Supporting Information

Supported Manganese Catalysts Achieve Highly Efficient C-H Bond Oxidation and Olefin Epoxidation

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1. General information

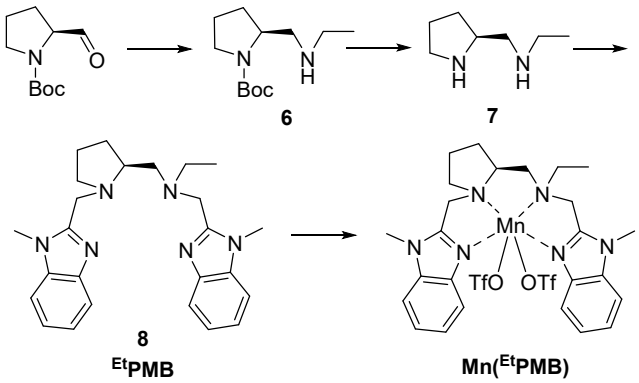
Commercial reagents were used without further purification, and solvents were dried before use. Melting points were recorded with a micro melting point apparatus and uncorrected. The ^{1}H NMR spectra were recorded at 400 MHz. The ^{13}C NMR spectra were recorded at 100 MHz. Chemical shifts were expressed in parts per million (δ) downfield from the internal standard tetramethylsilane, and were reported as s (singlet), d (doublet), t (triplet), dd (doublet of doublet), dt (doublet of triplet), td (triplet of doublet), m (multiplet), br s (broad singlet), etc. The coupling constants *J* were given in Hz. HRMS spectra were recorded on an Agilent 1200HPLC-6210TOFMS using ESI as an ion source. The conversion of starting materials was monitored by thin layer chromatography (TLC) using silica gel plates (silica gel 60 F254 0.25 mm), and components were visualized by observation under UV light (254 and 365 nm). Optical rotations were determined using an AUTOPOL V polarimeter. HPLC analyses were performed on Agilent 1100 and Waters e2695 equipped with OD-H, AD-H, IA-H, IC-H, and OJ-H.

The morphology of samples was observed through a field emission scanning electron microscope (FE-SEM, HITACHI Regulus 8100) at an acceleration voltage of 10 kV. The related elemental distribution was analyzed with energy-dispersive X-ray spectroscopy (EDS, Oxford Ultim Max 65). Transmission electron microscope (TEM) images were performed using a Tecnai G2 F30 S-Twin and Energy spectrum model: Xplore 80. Nitrogen sorption isotherms at the temperature of liquid nitrogen were performed on a Micromeritics system, and the samples were degassed for 10 h at 393 K before the measurements. The specific surface areas were calculated from the adsorption data using Brunauer–Emmett–Teller (BET) methods. The total pore volume at P/Po = 0.995. The pore size distribution curves were obtained from the desorption branches using the nonlocal density functional

theory (NLDFT) method. Thermogravimetric analysis (TGA) was carried out using a thermal analyzer (METTLER TOLEDO TGA/DSC 3+), the sample was heated at the rate of 10 $k \cdot min^{-1}$ from room temperature up to 1073 K under a nitrogen atmosphere.

2. Synthesis and characterization of the catalysts.

2.1 The procedure for the synthesis of Mn(^{Et}PMB)



(1) The synthesis of **6**.

A 50 mL reactor was added **Ethylamine** (90 mg, 2.0 mmol), **N-(*tert*-butoxycarbonyl)-*L*-prolinal** (398 mg, 2.0 mmol), and DCM (10 mL). The mixture was stirred at 40℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated to dryness under reduced pressure. Then dissolved in MeOH (20 mL) and $NaBH_4$ (189 mg, 5.0 mmol) was slowly added at 0℃. The mixture was extracted with DCM (50 mL×3) after 8 hours of reaction. The combined organic phase was dried with anhydrous Na_2SO_4, and concentrated to dryness under reduced pressure to obtain a yellow liquid **6** (416 mg, 1.85 mmol) in 91% yield.

(2) The synthesis of **7**.

A 50 mL reactor was added **6** (416 mg, 1.8 mmol) and DCM (20 mL), then TFA (4.15 g, 36.4 mmol) was slowly added at 25℃ and stirred for 12 hours. The mixture was concentrated under reduced pressure to remove residual acid and obtained a yellow crude **7** (211 mg, 1.65 mmol) in 90% yield.

(3) The synthesis of **8**.

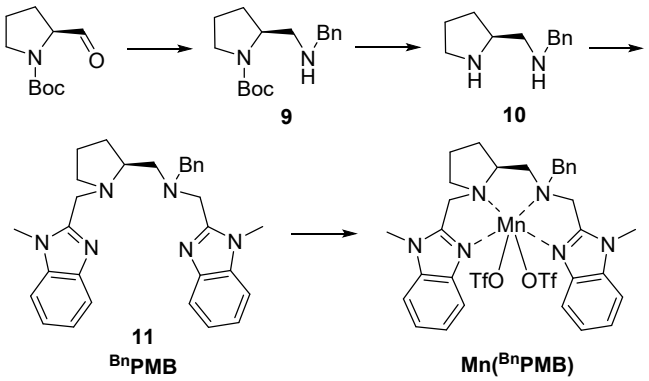
A 100 mL reactor was added **7** (211 mg, 1.65 mmol), **2-(Chloromethyl)-1-methyl-1*H*-benzimidazole** (743 mg, 4.1 mmol), K_2CO_3 (682 mg, 4.9 mmol), and MeCN (30 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column

chromatography (PE: EA = 1: 1, v/v), then after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **8** (480 mg, 1.15 mmol) in 70% yield.

(4) The synthesis of **Mn(^{Et}PMB)**.

8 (480 mg, 1.15 mmol) and $Mn(OTf)_2$ (447 mg, 1.27 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under a vacuum to obtain a light yellow solid **Mn(^{Et}PMB)** (860 mg, 1.12 mmol) in 97% yield.

2.2 The procedure for the synthesis of Mn(^{Bn}PMB)



(1) The synthesis of **9**.

A 50 mL reactor was added **Benzylamine** (214 mg, 2.0 mmol), **N-(*tert*-butoxycarbonyl)-*L*-prolinal** (398 mg, 2.0 mmol), and DCM (10 mL). The mixture was stirred at 40℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated to dryness under reduced pressure. Then dissolved in MeOH (20 mL) and $NaBH_4$ (189 mg, 5.0 mmol) was slowly added at 0℃. The mixture was extracted with DCM (50 mL×3) after 8 hours of reaction. The combined organic phase was dried with anhydrous Na_2SO_4, and concentrated to dryness under reduced pressure to obtain a yellow liquid **9** (523 mg, 1.8 mmol) in 90% yield.

(2) The synthesis of **10**.

A 50 mL reactor was added **9** (523 mg, 1.8 mmol) and DCM (20 mL), then TFA (4.11 g, 36.0 mmol) was slowly added at 25℃ and stirred for 12 hours. The mixture was concentrated under reduced pressure to remove residual acid and obtained a yellow crude **10** (312 mg, 1.64 mmol) in 91% yield.

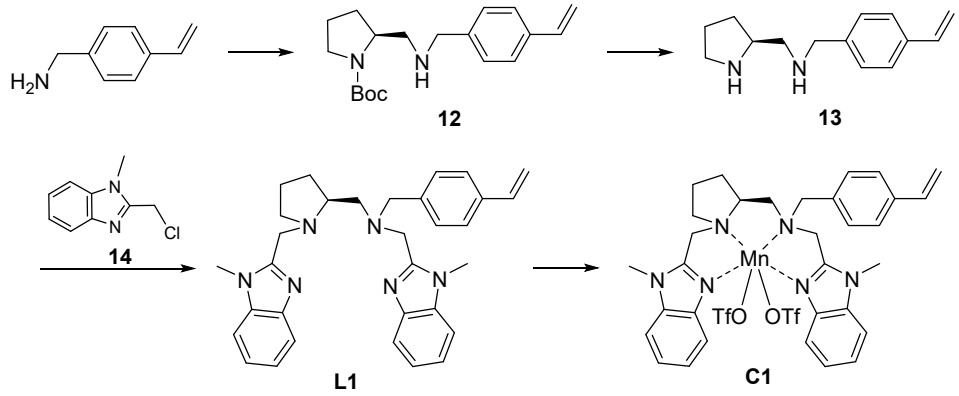
(3) The synthesis of **11**.

A 100 mL reactor was added **10** (312 mg, 1.64 mmol), **2-(Chloromethyl)-1-methyl-1*H*-benzimidazole** (740 mg, 4.1 mmol), K_2CO_3 (680 mg, 4.9 mmol), and MeCN (30 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v), then after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **11** (510 mg, 1.07 mmol) in 65% yield.

(4) The synthesis of **Mn(^{Bn}PMB)**.

11 (510 mg, 1.07 mmol) and $Mn(OTf)_2$ (414 mg, 1.17 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under a vacuum to obtain a light yellow solid **Mn(^{Bn}PMB)** (859 mg, 1.03 mmol) in 97% yield.

2.3 The procedure for the synthesis of C1



(1) The synthesis of **12**.

A 100 mL reactor was added **(4-vinylbenzyl) Amine** (595 mg, 5.0 mmol), ***N*-(*tert*-butoxycarbonyl)-*L*-prolinal** (996 mg, 5.0 mmol), and DCM (10 mL). The mixture was stirred at 40℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated to dryness under reduced pressure. Then dissolved in MeOH (20 mL) and $NaBH_4$ (908 mg, 24.0 mmol) was slowly added at 0℃. The mixture was extracted with DCM (50 mL×3) after 8 hours of reaction. The combined organic phase was dried with anhydrous Na_2SO_4, and concentrated to dryness under reduced pressure to obtain a yellow liquid **12** (1.45 g, 4.6 mmol) in 92% yield.

(2) The synthesis of **13**.

A 100 mL reactor was added **12** (1.0 g, 3.2 mmol) and DCM (20 mL), then TFA (7.21 g, 63.2 mmol) was slowly added at 25℃ and stirred for 12 hours. The mixture was concentrated under reduced pressure to remove residual acid and obtained a yellow crude **13** (608 mg, 2.8 mmol) in 88% yield.

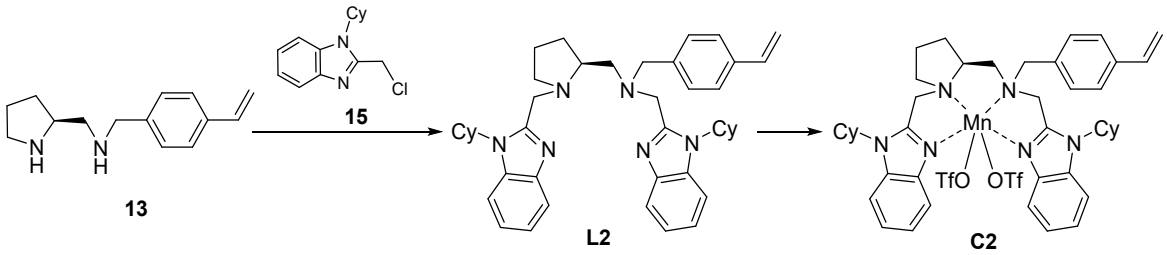
(3) The synthesis of **L1**.

A 100 mL reactor was added **13** (216 mg, 1.0 mmol), **14** (451 mg, 2.5 mmol), K_2CO_3 (415 mg, 3.0 mmol), and MeCN (20 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v), then after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **L1** (318 mg, 0.63 mmol) in 63% yield.

(4) The synthesis of **C1**.

L1 (318 mg, 0.63 mmol) and $Mn(OTf)_2$ (245 mg, 0.69 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under vacuum to obtain a light yellow solid **C1** (525 mg, 0.61 mmol) in 97% yield.

2.4 The procedure for the synthesis of C2



(1) The synthesis of **L2**.

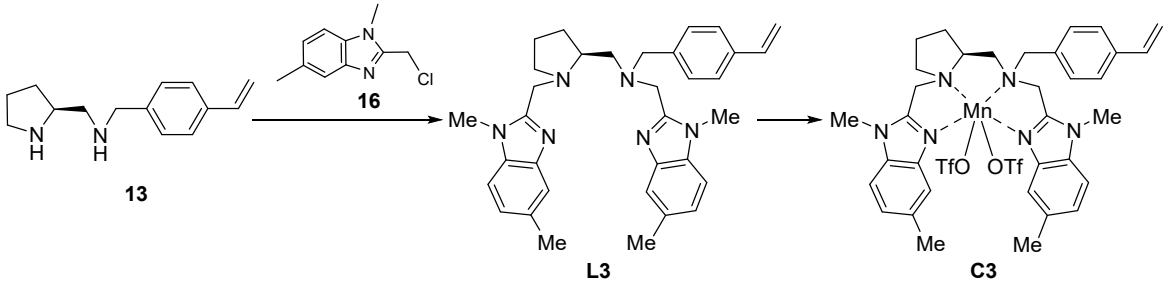
A 100 mL reactor was added **13** (216 mg, 1.0 mmol), **15** (622 mg, 2.5 mmol), K_2CO_3 (415 mg, 3.0 mmol), and MeCN (20 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v), then

after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **L2** (306 mg, 0.48 mmol) in 48% yield.

(2) The synthesis of **C2**.

L2 (306 mg, 0.48 mmol) and $Mn(OTf)_2$ (185 mg, 0.53 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under vacuum to obtain a light yellow solid **C2** (456 mg, 0.46 mmol) in 96% yield.

2.5 The procedure for the synthesis of C3



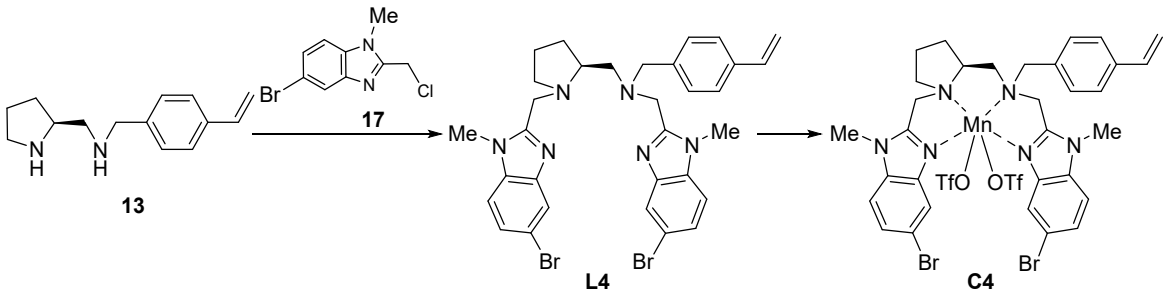
(1) The synthesis of **L3**.

A 100 mL reactor was added **13** (216 mg, 1.0 mmol), **16** (487 mg, 2.5 mmol), K_2CO_3 (415 mg, 3.0 mmol), and MeCN (20 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v), then after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **L3** (239 mg, 0.45 mmol) in 45% yield.

(2) The synthesis of **C3**.

L3 (239 mg, 0.45 mmol) and $Mn(OTf)_2$ (174 mg, 0.49 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under vacuum to obtain a light yellow solid **C3** (385 mg, 0.43 mmol) in 97% yield.

2.6 The procedure for the synthesis of C4



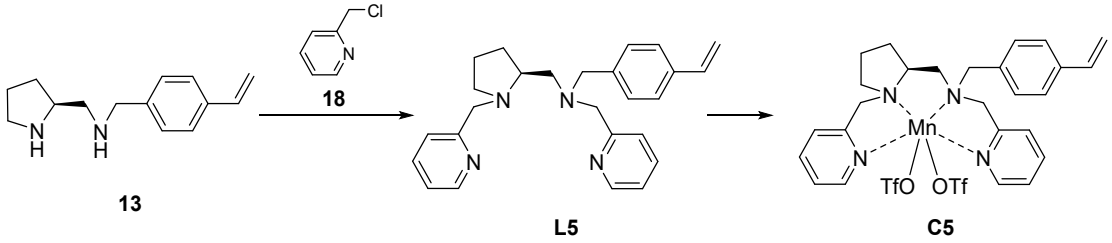
(1) The synthesis of **L4**.

A 100 mL reactor was added **13** (216 mg, 1.0 mmol), **17** (649 mg, 2.5 mmol), K_2CO_3 (415 mg, 3.0 mmol), and MeCN (20 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v), then after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **L4** (216 mg, 0.33 mmol) in 33% yield.

(2) The synthesis of **C4**.

L4 (216 mg, 0.33 mmol) and $Mn(OTf)_2$ (127 mg, 0.36 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under vacuum to obtain a light yellow solid **C4** (315 mg, 0.31 mmol) in 95% yield.

2.7 The procedure for the synthesis of C5



(1) The synthesis of **L5**.

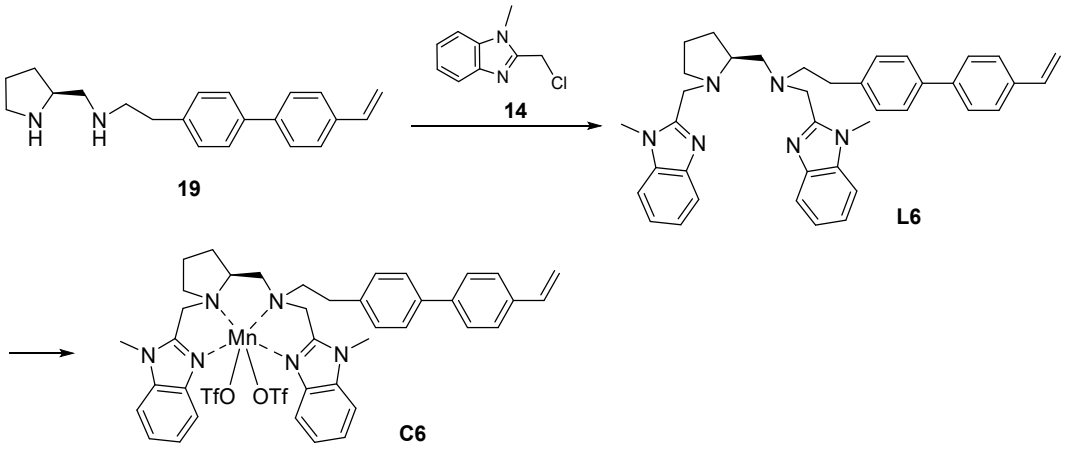
A 100 mL reactor was added **13** (216 mg, 1.0 mmol), **18** (319 mg, 2.5 mmol), K_2CO_3 (415 mg, 3.0 mmol), and MeCN (20 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under

decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v) to obtain a yellow solid **L5** (251 mg, 0.63 mmol) in 63% yield.

(2) The synthesis of **C5**.

L5 (251 mg, 0.63 mmol) and $Mn(OTf)_2$ (245 mg, 0.69 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under vacuum to obtain a light yellow solid **C5** (455 mg, 0.61 mmol) in 96% yield.

2.8 The procedure for the synthesis of C6



(1) The synthesis of **L6**.

A 100 mL reactor was added **19** (306 mg, 1.0 mmol), **14** (451 mg, 2.5 mmol), K_2CO_3 (415 mg, 3.0 mmol), and MeCN (20 mL). The mixture was stirred at 60℃ for 8 hours with a nitrogen atmosphere. Upon completion, the reaction mixture was concentrated under decompression and purified by silica gel column chromatography (PE: EA = 1: 1, v/v), then after recrystallization (PE: EA = 5: 1, v/v) to obtain a yellow solid **L6** (244 mg, 0.41 mmol) in 41% yield.

(2) The synthesis of **C6**.

L6 (244 mg, 0.41 mmol) and $Mn(OTf)_2$ (159 mg, 0.45 mmol) were dissolved in MeCN (30 mL) at room temperature, then the mixture was stirred at 60℃ for 6 hours in a nitrogen atmosphere. After drying under a vacuum, the result solids were washed thoroughly with PE three times. Then dried under vacuum to obtain a light yellow solid **C6** (373 mg, 0.39 mmol) in 96% yield.

2.9 The procedure for the synthesis of supported Mn catalysts

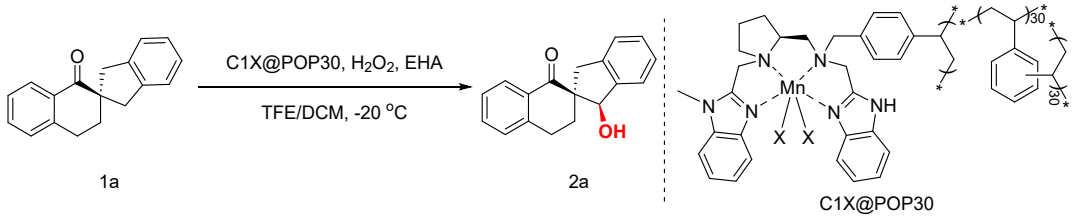
The synthesis of C1@POP10: C1 (86 mg, 0.1 mmol), DVB (130 mg, 1 mmol), and AIBN (30 mg, 0.18 mmol) were dissolved in THF (10 mL) in a Schlenk reactor. The mixture was stirred at 100℃ for 24 hours. When the reaction was completed, the solution was filtered and washed with THF and EtOAc three times respectively. Then dried at 70℃ for 24 hours to obtain a yellow solid.

The synthesis **C1@POP30**, **C1@POP60**, **C2@POP30**, **C3@POP30**, **C4@POP30**, **C5@POP30**, **C6@POP30**: Supported Mn catalysts were synthesized by the same method. The difference is in the ratio of manganese complexes to DVB. Then supported Mn catalysts indicated as **C1@POP30** (**C1** : DVB = 1 : 30), **C1@POP60** (**C1** : DVB = 1 : 60), **C2@POP30** (**C2** : DVB = 1 : 30), **C3@POP30** (**C3** : DVB = 1 : 30), **C4@POP30** (**C4** : DVB = 1 : 30), **C5@POP30** (**C5** : DVB = 1 : 30), **C5@POP30** (**C5** : DVB = 1 : 30).

3. Optimization of the hydroxylation reaction

3.1 Evaluation of axial ligand

Table S1 Evaluation of axial ligand



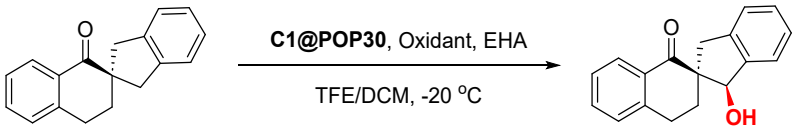
Entry	X	Cat.(mol%)	Yield(%)[b]	*ee* (%)[c]	dr[d]
1	OAc	2	57	83.1	>95:5
2	OTf	2	61	93.3	>95:5
3	Cl	2	40	75.3	87:13
4	Br	2	52	80.7	>95:5
5	NO_3	2	54	83.4	>95:5
6	ClO_4	2	50	89.8	>95:5
7	OTf	1.5	60	93.2	>95:5
8	**OTf**	**1.0**	**60**	**93.3**	>95:5
9	OTf	0.5	56	93.1	>95:5

10	OTf	0.2	37	87.6	90:10

[a]**1a** (0.5 mmol), C1X@POP30, and EHA (9 equiv.) were added to in 2 mL of solvent (TFE/DCM = 5:1), then H_2O_2 (1.1 equiv. aqueous solution was diluted in 0.5 mL TFE) was added to the solution dropwise at -20℃, using a syringe pump over 2.5 h and stirred for another 0.5 h. [b]Isolated yields. [c]Determined by chiral HPLC analysis. [d]Determined by ^{1}HNMR.

3.2 Evaluation of oxidant

Table S2 Evaluation of Oxidant[a]



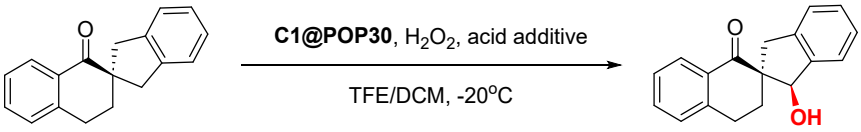
1a **2a**

Entry	Oxidant	Usage(equiv.)	Yield(%)[c]	*ee* (%)[d]	dr[e]
1	H_2O_2	1	57	93.3	>95:5
2[b]	m-CPBA	1	46	83.0	90:10
3	TBHP	1	52	91.8	>95:5
4[b]	PhIO	1	49	89.9	>95:5
5	**H_2O_2**	**1.1**	**60**	**93.3**	>95:5
6	H_2O_2	1.2	55	93.3	>95:5

[a]**1a** (0.5 mmol), **C1@POP30** (1 mol%), and EHA (9 equiv.) were added to 2 mL of solvent (TFE/DCM = 5:1), then oxidant (aqueous solution was diluted in 0.5 mL TFE) was added to the solution dropwise at -20℃, using a syringe pump over 2.5 h and stirred for another 0.5 h. [b]Oxidant was multiple small additions at -20℃ over 2.5 h and stirred for another 0.5 h. [c] Isolated yields. [d] Determined by chiral HPLC analysis. [e]Determined by ^{1}HNMR.

3.3 Evaluation of acid additive

Table S3 Evaluation of acid additive[a]



1a **2a**

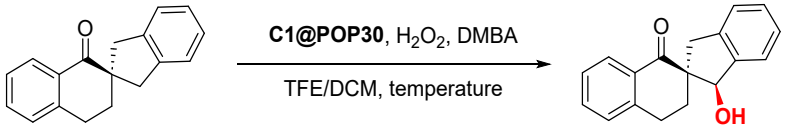
Entry	Acid	Usage(equiv.	Yield(%)[b]	*ee* (%)[c]	dr[e]
1	EHA (2-Ethylhexanoic acid)	9	60	93.3	>95:5
2	MVA (4-Methylvaleric acid)	9	45	78.5	91:9
3	PBA (4-Phenylbutyric acid)	9	32	81.0	>95:5
4	EBA (2-Ethylbutyric acid)	9	47	88.9	>95:5
5	DMBA (2,2-Dimethylbutyric acid)	9	60	94.7	>95:5
6	PA (Pivalic acid)	9	53	89.5	>95:5

7	BA (Butyric Acid)	9	45	77.3	87:13
8	AA (Acetic acid)	9	45	77.1	85:15
9	DMBA (2,2-Dimethylbutyric acid)	7	61	94.8	>95:5
10	**DMBA (2,2-Dimethylbutyric acid)**	**6**	**60**	**94.7**	**>95:5**
11	DMBA (2,2-Dimethylbutyric acid)	5	55	91.3	>95:5

[a]**1a** (0.5 mmol), **C1@POP30** (1 mol%), and acid were added to 2 mL of solvent (TFE/DMC = 5:1), then H_2O_2 (1.1 equiv. 50% aqueous solution diluted in 0.5 mL TFE) was added to the solution dropwise at -20℃, using a syringe pump over 2.5 h and stirred for another 0.5 h. [b] Isolated yields. [c] Determined by chiral HPLC analysis. [e]Determined by ^{1}HNMR.

3.4 Evaluation of temperature

Table S4 Optimization of Mn-catalyzed asymmetric hydroxylation[a]



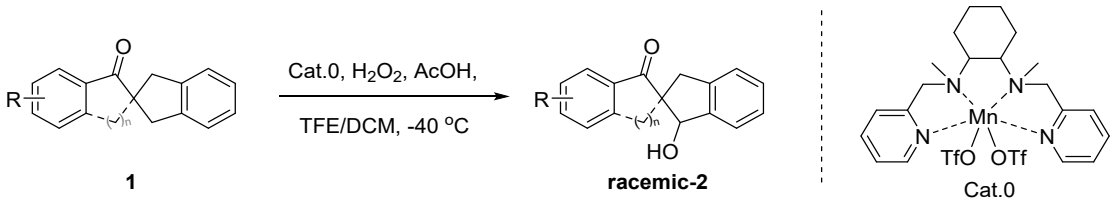
1a **2a**

Entry	Temperature(°C)	Yield(%)[b]	*ee* (%)[c]	dr[e]
1	0	55	80.5	>95:5
2	-10	57	89.1	>95:5
3	-20	61	94.8	>95:5
4	-30	61	97.1	>95:5
5	**-40**	**64**	**99.1**	>95:5

[a] **1a** (0.5 mmol), **C1@POP30** (1 mol%), and DMBA (6 equiv.) were added to 2 mL of solvent (TFE/DMC = 5:1), then H_2O_2 (1.1 equiv. 50% aqueous solution diluted in 0.5 mL TFE) was added to the solution dropwise using a syringe pump over 1.5 h and stirred for another 0.5 h. [b]Isolated yields. [c]Determined by chiral HPLC analysis. [e]Determined by ^{1}HNMR.

4. General procedure for reactions and recycling studies.

4.1 General procedure for racemic hydroxylation

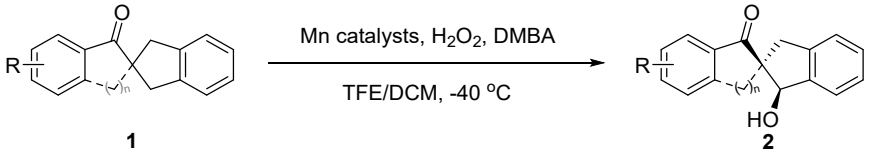


1 **racemic-2** Cat.0

Substrate **1** was synthesized by reference.[1] Substrate **1** (0.5 mmol), Cat.0 (1 mol%), AcOH (2.5 mmol, 5 equiv.), and mixed solvent (1 mL) were added in a Schlenk reactor at -40℃. Then oxidant solution (0.25 mmol, 0.5 equiv., 50% H_2O_2 in the 1.0 mL solution) was added

via a syringe pump over 1.5 hours with stirring. Then another Cat.0 (1 mol%) and AcOH (2.5 mmol, 5 equiv.) in the 1 mL solvent were added to the above mixture, and another oxidant solution (0.25 mmol, 0.5 equiv., 50% H_2O_2 in the 1.0 mL solution) was added via a syringe pump over 1.5 hours. The reaction was monitored by TLC. Upon completion, the mixture was quenched with a saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layers were washed twice with saturated aqueous $NaHCO_3$, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column chromatography to afford the racemic hydroxylation product. (The solvent was mixed with TFE/DCM=5:1)

4.2 General procedure for asymmetric hydroxylation



1 **2**

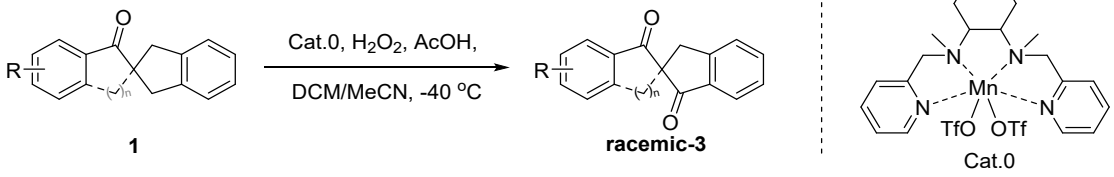
Substrate **1** (0.5 mmol), Mn catalyst (1 mol%), DMBA (3 mmol, 6 equiv.), and mixed solvent (2 mL) were added in a Schlenk reactor at -40℃. Then oxidant solution (0.55 mmol, 1.1 equiv., 50% H_2O_2 in the 0.5 mL solution) was added via a syringe pump over 2.5 hours and stirred for another 0.5 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with a saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layers were washed twice with saturated aqueous $NaHCO_3$, dried over anhydrous Na_2SO_4, concentrated under reduced pressure, and purified by silica gel column chromatography to afford the target product. (The solvent was mixed with TFE/DCM=5:1, X-ray-quality crystals were grown by slow diffusion of PE into DCM solutions)

Table S5. Crystallographic data and refinements for product 2a.

Empirical formula	$C_{18}H_{16}O_2$
Formula weight	264.31
Temperature/K	150.00
Crystal system	orthorhombic
Space group	$P2_12_12_1$
a/Å	5.9260(3)
b/Å	11.6332(6)
c/Å	19.3715(10)

α/°	90
β/°	90
γ/°	90
Volume/Å^3	1335.44(12)
ρ_{calc}g/cm^3	1.315
μ/mm^{-1}	0.427
F(000)	560.0
Crystal size/mm^3	0.4 × 0.4 × 0.2
Radiation	GaKα (λ = 1.34138)
2Θ range for data collection/°	7.712 to 126.85
Index ranges	-7 ≤ h ≤ 7, -15 ≤ k ≤ 15, -25 ≤ l ≤ 24
Reflections collected	13849
Independent reflections	3273 [R_{int} = 0.0463, R_{sigma} = 0.0299]
Data/restraints/parameters	3273/0/182
Goodness-of-fit on F^2	1.052
Final R indexes [I>=2σ (I)]	R_1 = 0.0308, wR_2 = 0.0796
Final R indexes [all data]	R_1 = 0.0320, wR_2 = 0.0801
Largest diff. peak/hole / e Å^{-3}	0.18/-0.17
Flack parameter	-0.03(9)

4.3 General procedure for racemic ketonization

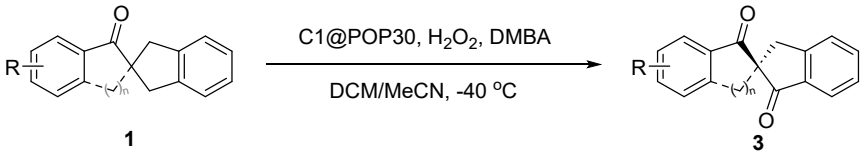


1 **racemic-3** Cat.0

Substrate **1** (0.5 mmol), Cat.0 (1 mol%), AcOH (5.0 mmol, 10 equiv.), and MeCN/DCM (5:1, 2 mL) were added in a Schlenk reactor at -40℃. Then oxidant solution (1.5 mmol, 3.0 equiv., 50% H_2O_2 in the 1.0 mL MeCN) was added via a syringe pump over 3 hours with stirring. The reaction was monitored by TLC. Upon completion, the mixture was quenched with a saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layers were washed twice with saturated aqueous $NaHCO_3$, dried over anhydrous Na_2SO_4, concentrated under reduced pressure, and purified by silica gel column

chromatography to afford the racemic oxidation product.

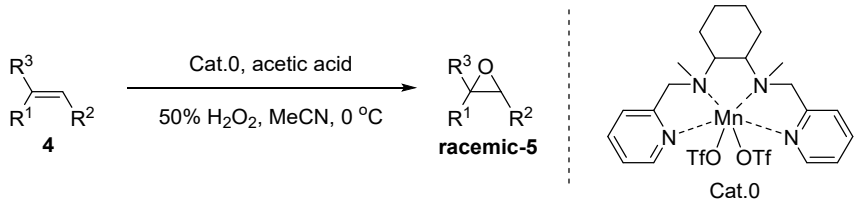
4.4 General procedure for asymmetric ketonization



1 **3**

Substrate **1** (0.5 mmol), Mn catalyst (1 mol%), DMBA (3 mmol, 6 equiv.), and MeCN/DCM (5:1, 2 mL) were added in a Schlenk reactor at -40℃. Then oxidant solution (0.55 mmol, 1.1 equiv., 50% H_2O_2 in the 0.5 mL MeCN) was added via a syringe pump over 2.5 hours and stirred for another 0.5 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with a saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layers were washed twice with saturated aqueous $NaHCO_3$, dried over anhydrous Na_2SO_4, concentrated under reduced pressure, and then purified by silica gel column chromatography to afford the target products.

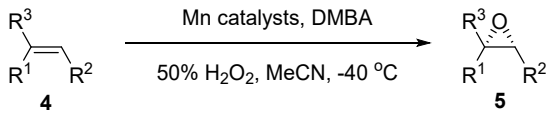
4.5 General procedure for racemic epoxidation



4 **racemic-5**

Substrate **4** was synthesized by reference.[2-5] Substrate **4** (0.5 mmol), Mn catalyst (2 mol%), acetic acid (5 mmol, 10 equiv.), and MeCN (2 mL) were added in a Schlenk reactor at 0℃. Then 50% H_2O_2 (1.5 mmol, 3 equiv.) was added via a syringe pump over 2 hours and stirred another 2 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with a saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layers were washed twice with saturated aqueous $NaHCO_3$, dried over anhydrous Na_2SO_4, and concentrated under reduced pressure to afford the racemic epoxides.

4.6 General procedure for asymmetric epoxidation



4 **5**

Substrate **4** (0.25 mmol), Mn catalysts (1 mol%), DMBA (1.25 mmol, 5 equiv.), and MeCN (1 mL) were added in a Schlenk reactor at -40℃. Then H_2O_2 (0.375 mmol, 1.5 equiv., 50%

aqueous solution diluted in 0.5 mL MeCN) was added via a syringe pump over 1.5 hours and stirred another 0.5 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with a saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layers were washed twice with saturated aqueous $NaHCO_3$, dried over anhydrous Na_2SO_4, concentrated under reduced pressure, and then purified by silica gel column chromatography to afford the target products.

4.7 Recycling studies

Chalcone (208 mg, 1 mmol), **C1@POP30** (1 mol%) and DMBA (581 mg, 5 mmol) were added to 2 mL MeCN and cooled down to -40 ℃. Then, H_2O_2 (81.6 mg, 1.2 mmol, 50% aqueous solution diluted in 0.5 mL MeCN) was added via a syringe pump over 2 hours and stirred another 2 h. After the reaction, the catalyst was separated through centrifugation, and the catalyst was washed with EA, dried and reused in next run. In the 5^{th} cycle, yield was decreased obviously. We surmised that it may be metal loss, so recovered catalyst re-coordination and re-introduced into the reaction after centrifugation and dying. The results are shown in Table S6. Additionally, TEM images indicate that both the freshly prepared and recycled **C1@POP30** exhibit similar morphologies (Fig. S5, S6). This suggests that the catalyst demonstrates significant stability in the oxidation reaction.

Table S6. Cycle results.

Cycle	Yield(%)	*ee*(%)
1	96	99.3
2	95	99.2
3	93	99.2
4	91	99.3
5	87	99.1
6	95	99.2

4.8 Continuous flow

Grind **C1@POP30** (238 mg) and silica gel (2.0 g) until mixed thoroughly, then fill to the bed-type continuous flow column. Purge the continuous flow system with argon for 30 minutes, and pump MeCN to the continuous flow system to exhaust at 16 μL/min for 30 minutes with syringe pumps. Prepare a solution of chalcone (2.08 g, 10 mmol), DMBA

(5.81 g, 50 mmol) diluted in MeCN to 36 mL, and a solution of 50%H_2O_2 (816 mg, 12 mmol) diluted in MeCN to 18 mL. Inject the two solutions into the continuous flow system at a flow rate of 40 μL/min and 20 μL/min respectively at -40℃. At the same time, the sampling test is at the planned time. The effluent was poured into the saturated Na_2SO_3 aqueous solution and then extracted with DCM. The combined organic layer was dried with anhydrous Na_2SO_4, concentrated under reduced pressure, and purified by flash column chromatography over silica gel to get asymmetric epoxidation products (2.06 g, 99% conv., 92% yield, 98.9% ee.).

5. Characterization

5.1 The swelling ratio (SR) of C1@POP10, 30 and 60

The swelling ratio (SR) of the samples was determined gravimetrically by immersing a pre-weighed (Wd) dried sample in 3.5 mL of MeCN for 1 h. The samples were centrifuged (16000 r/min) to remove the solvent and weighed (Ws). The SR of the samples is calculated as follows[6, 7]:

$$\mathrm{SR}\ (\%) = \frac{\mathrm{Ws} - \mathrm{Wd}}{\mathrm{Wd}} \times 100$$

Table S7. Swelling ratio (SR) of catalysis 10, 30, and 60.

catalysis	Wd (mg)	Ws (mg)	SR (%)
C1@POP10	50	167	234
C1@POP30	50	187	274
C1@POP60	50	197	294

5.2 The XPS results

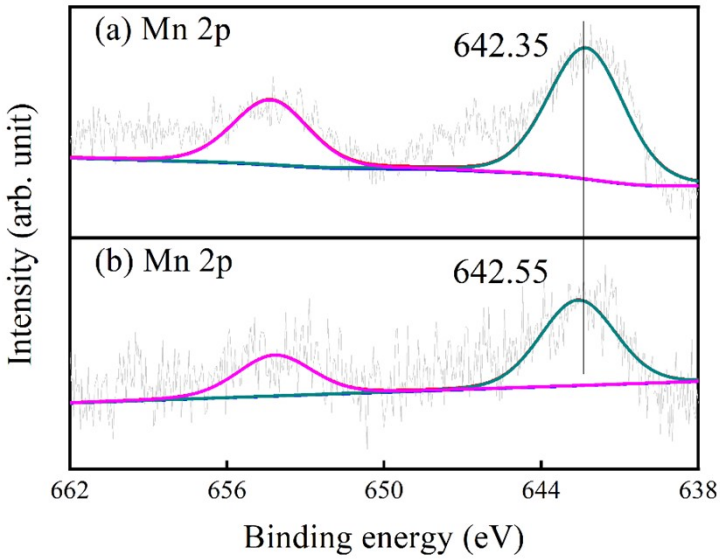


Figure S1. XPS of Mn 2p. (a) C1@POP30. (b) C1.

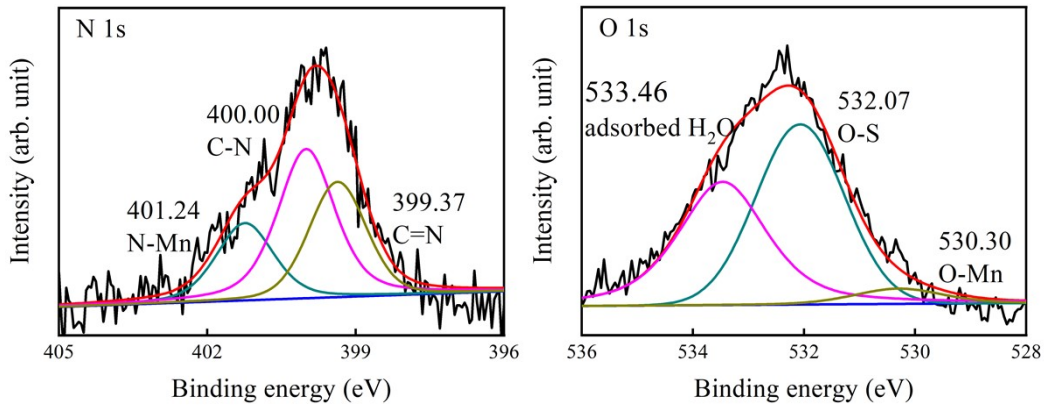


Figure S2. XPS of C1@POP30. (a) N 1s. (b) O 1s.

5.3 N2 sorption isotherm and Pore size distribution

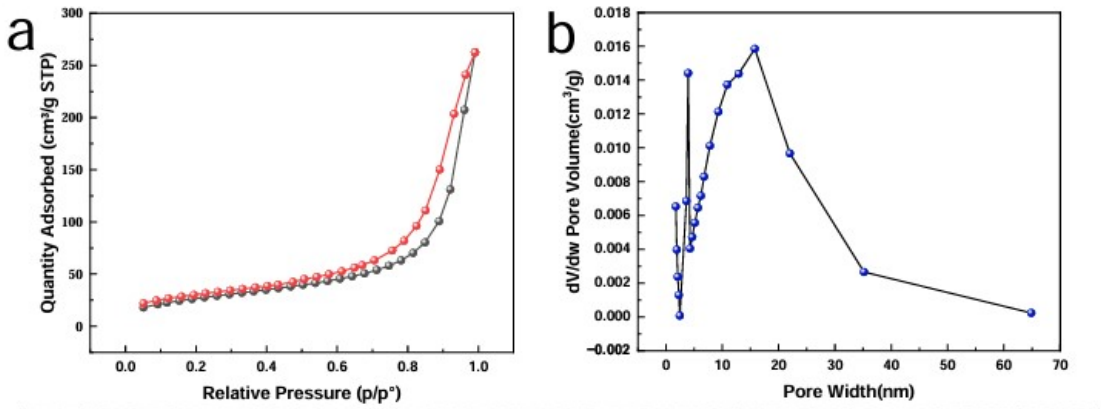


Figure S3. a) N_2 sorption isotherm. b) Pore size distribution

5.4 TGA results

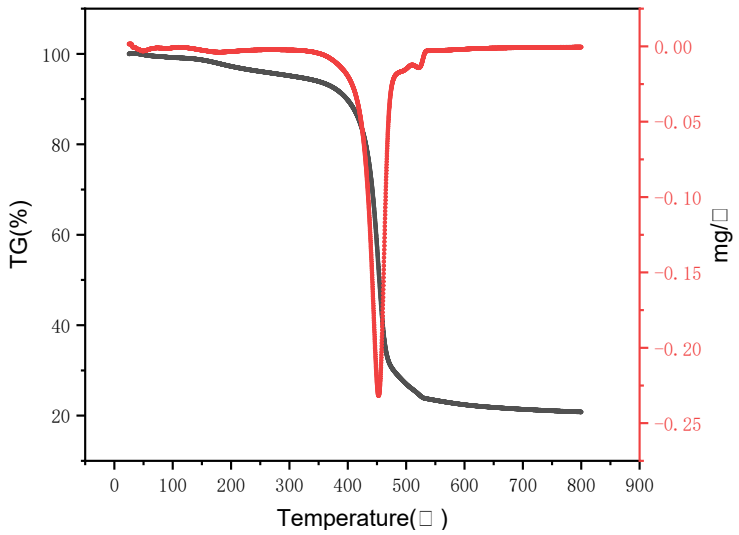


Figure S4. TGA of C1@POP30.

5.5 Transmission electron microscope (TEM)

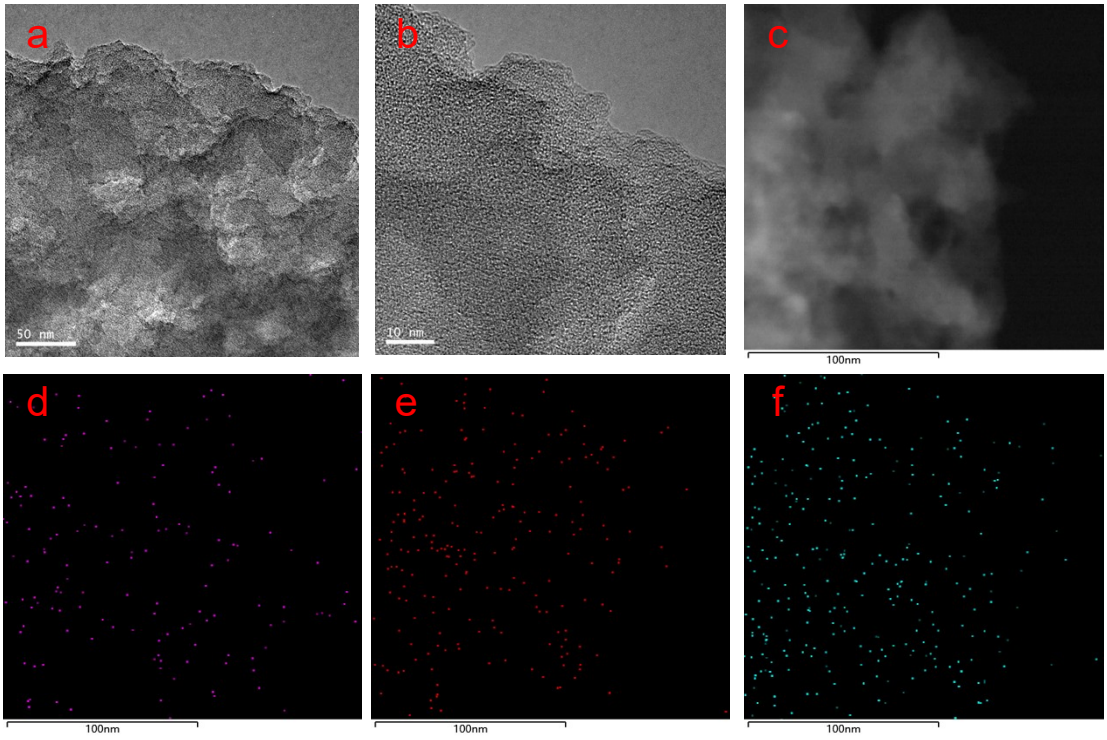


Figure S5. Transmission electron microscope (TEM) fresh. (a) C1@POP30, scale bar 50 nm, (b) 10 nm, (c) Transmission electron microscope (TEM) image and energy-dispersive X-ray spectroscopy (EDS) mapping of composition elements: (d) Mn, (e)

N, (f) O (scale bar 100 nm).

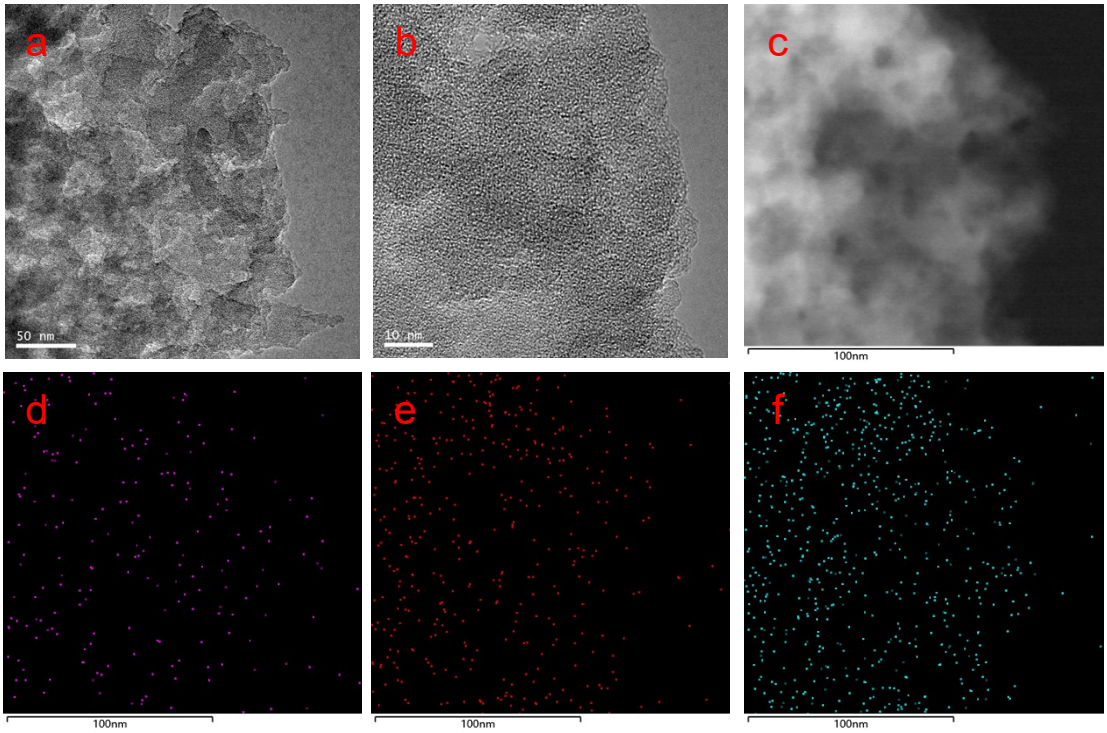
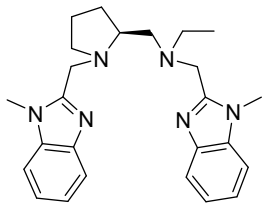


Figure S6. Transmission electron microscope (TEM) (a) used C1@POP30, scale bar 50 nm, (b) 10 nm, (c) Transmission electron microscope (TEM) image and energy-dispersive X-ray spectroscopy (EDS) mapping of composition elements: (d) Mn, (e) N, (f) O (scale bar 100 nm).

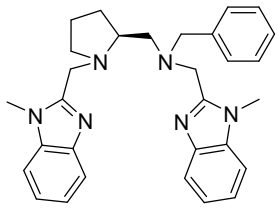
6. Spectra data

(*S*)-*N*-((1-methyl-1*H*-benzo[*d*]imidazol-2-yl)methyl)-*N*-((1-((1-methyl-1*H*-benzo[*d*]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)ethanamine (^{Et}PMB):



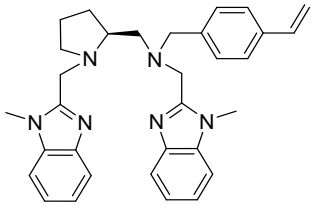
Yellow solid; m.p.= 79.1-80.7 ℃;^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.76 – 7.67 (m, 2H), 7.33 – 7.18 (m, 6H), 4.22 (d, *J* = 13.2 Hz, 1H), 3.86 (d, *J* = 13.2 Hz, 1H), 3.83 (s, 3H), 3.74 (d, *J* = 13.6 Hz, 1H), 3.70 – 3.52 (m, 4H), 2.74 (ddd, *J* = 9.2, 6.8, 2.4 Hz, 1H), 2.67 – 2.51 (m, 4H), 2.42 (dd, *J* = 12.8, 8.0 Hz, 1H), 2.30 (td, *J* = 9.2, 7.2 Hz, 1H), 1.98 – 1.86 (m, 1H), 1.67 – 1.50 (m, 2H), 1.50 – 1.36 (m, 1H), 1.06 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 152.37, 152.16, 142.14, 142.10, 136.26, 136.17, 122.55, 122.39, 121.91, 121.80, 119.49, 119.44, 109.09, 62.30, 58.84, 54.94, 52.39, 52.27, 48.84, 30.42, 30.07, 29.87, 22.52, 11.55; HRMS-ESI (m/z): calcd for $C_{25}H_{33}N_6$ $[M + H]^+$: 417.2761, found: 417.2765.

(*S*)-*N*-benzyl-1-(1-methyl-1*H*-benzo[*d*]imidazol-2-yl)-*N*-((1-((1-methyl-1*H*-benzo[*d*]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)methanamine (^{Bn}PMB):



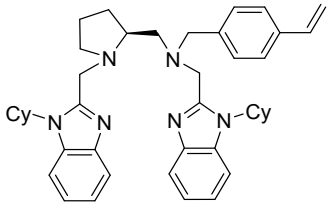
Yellow solid; m.p.= 83.5-85.1 ℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.70 (tdd, *J* = 8.8, 3.6, 2.4 Hz, 2H), 7.35 – 7.29 (m, 4H), 7.25 – 7.18 (m, 7H), 4.20 (dd, *J* = 13.2, 1.2 Hz, 1H), 3.75 (qd, *J* = 13.2, 1.2 Hz, 2H), 3.65 – 3.57 (m, 3H), 3.56 (s, 3H), 3.46 (s, 3H), 2.76 – 2.65 (m, 3H), 2.56 – 2.46 (m, 1H), 2.27 (td, *J* = 9.2, 7.2 Hz, 1H), 2.01 – 1.92 (m, 1H), 1.63 – 1.53 (m, 1H), 1.53 – 1.35 (m, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 152.29, 151.75, 142.19, 142.15, 138.41, 136.20, 129.60, 128.35, 127.46, 122.60, 122.36, 121.95, 121.78, 119.53, 119.46, 109.10, 109.08, 62.38, 60.19, 59.41, 54.78, 52.35, 52.09, 30.50, 29.92, 29.71, 22.36; HRMS-ESI (m/z): calcd for $C_{30}H_{35}N_6$ $[M + H]^+$: 479.2918, found: 479.2922.

(*S*)-1-(1-methyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((1-methyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L1):



Yellow solid; m.p.= 84.2-85.9 ℃;^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.72 – 7.67 (m, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.26 – 7.20 (m, 8H), 6.68 (dd, *J* = 17.6, 3.2 Hz, 1H), 5.72 (dd, *J* = 17.6, 1.2 Hz, 1H), 5.23 (dd, *J* = 11.2, 1.2 Hz, 1H), 4.20 (d, *J* = 13.6 Hz, 1H), 3.79 (d, *J* = 13.6 Hz, 1H), 3.71 (d, *J* = 13.6 Hz, 1H), 3.67 – 3.56 (m, 5H), 3.55 – 3.52 (m, 1H), 3.48 (s, 3H), 2.77 – 2.64 (m, 3H), 2.50 (dd, *J* = 12.4, 7.2 Hz, 1H), 2.28 (td, *J* = 9.2, 7.2 Hz, 2H), 2.02 – 1.91 (m, 1H), 1.67 – 1.46 (m, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 152.27, 151.72, 142.17, 142.12, 137.98, 136.80, 136.42, 136.20, 129.77, 126.17, 122.63, 122.38, 121.97, 121.80, 119.53, 119.46, 113.87, 109.12, 109.10, 62.33, 59.85, 59.38, 54.82, 52.38, 52.10, 30.49, 30.00, 29.72, 22.37; HRMS-ESI (m/z): calcd for $C_{32}H_{37}N_6$ $[M + H]^+$: 505.3074, found: 505.3073.

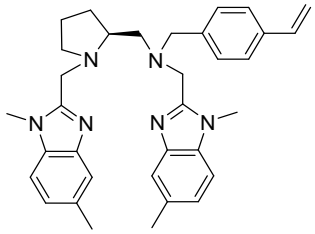
(*S*)-1-(1-cyclohexyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((1-cyclohexyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L2):



Yellow solid; m.p.= 89.7-90.9 ℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.71 – 7.67 (m, 2H), 7.59 – 7.48 (m, 2H), 7.38 (d, *J* = 8.4 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.21 – 7.15 (m, 4H), 6.70 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.73 (d, *J* = 17.6 Hz, 1H), 5.23 (d, *J* = 10.8 Hz, 1H), 4.43 (tdt, *J* = 12.0, 7.6, 4.0 Hz, 2H), 4.11 (d, *J* = 13.2 Hz, 1H), 3.94 (d, *J* = 13.2 Hz, 1H), 3.80 (d, *J* = 13.2 Hz, 1H), 3.69 (d, *J* = 13.2 Hz, 1H), 3.59 (d, *J* = 13.2 Hz, 1H), 3.44 (d, *J* = 13.2 Hz, 1H), 2.79 – 2.67 (m, 2H), 2.67 – 2.48 (m, 2H), 2.37 – 2.19 (m, 2H), 2.17 – 2.00 (m, 3H), 1.98 – 1.84 (m, 5H), 1.81 – 1.72 (m, 3H), 1.56 – 1.47 (m, 1H), 1.36 – 1.20 (m, 5H), 1.17 – 1.05 (m, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 151.77, 150.90, 143.08, 142.94, 138.05,

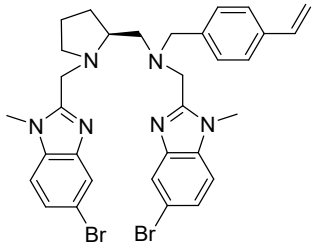
136.86, 136.44, 134.11, 134.09, 129.60, 126.33, 122.04, 121.83, 121.45, 121.27, 119.96, 119.84, 113.80, 112.43, 112.27, 62.22, 59.93, 59.21, 56.16, 55.62, 54.34, 52.85, 52.48, 31.40, 31.34, 31.31, 31.10, 30.76, 26.20, 25.95, 25.83, 25.76, 25.47, 25.40, 22.59; HRMS-ESI (m/z): calcd for $C_{42}H_{53}N_6$ $[M + H]^+$: 641.4326, found: 641.4325.

(*S*)-1-(1,5-dimethyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((1,5-dimethyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L3):



Yellow solid; m.p.= 84.7-86.1 ℃;^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.47 (d, *J* = 7.2 Hz, 2H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.28 – 7.23 (m, 2H), 7.14 – 7.02 (m, 4H), 6.68 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.72 (d, *J* = 17.6 Hz, 1H), 5.23 (d, *J* = 10.8 Hz, 1H), 4.17 (d, *J* = 13.2 Hz, 1H), 3.77 (d, *J* = 13.2 Hz, 1H), 3.71 (d, *J* = 3.6 Hz, 1H), 3.62 (d, *J* = 4.4 Hz, 1H), 3.59 – 3.57 (m, 4H), 3.54 (d, *J* = 4.0 Hz, 1H), 3.48 (s, 3H), 2.74 – 2.54 (m, 5H), 2.46 (s, 6H), 2.34 – 2.13 (m, 4H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 152.19, 151.62, 142.45, 142.40, 138.06, 136.78, 136.45, 134.34, 134.33, 131.56, 131.38, 129.74, 126.14, 124.06, 123.82, 119.28, 119.23, 113.79, 108.62, 108.59, 62.35, 59.86, 59.36, 54.76, 52.32, 52.16, 30.49, 30.00, 29.76, 22.40, 21.52; HRMS-ESI (m/z): calcd for $C_{34}H_{41}N_6$ $[M + H]^+$: 533.3387, found: 533.3387.

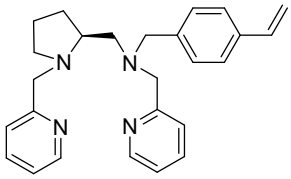
(*S*)-1-(5-bromo-1-methyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((5-bromo-1-methyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L4):



Yellow solid; m.p.= 85.3-87.2 ℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.82 – 7.80 (m, 2H), 7.38 – 7.27 (m, 4H), 7.25 – 7.18 (m, 2H), 7.12 – 7.08 (m, 1H), 7.06 – 7.02 (m, 1H), 6.68

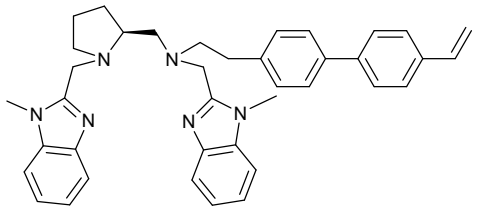
(ddd, *J* = 18.0, 11.2, 2.8 Hz, 1H), 5.72 (d, *J* = 17.6 Hz, 1H), 5.23 (d, *J* = 11.2 Hz, 1H), 4.18 – 4.10 (m, 1H), 3.81 – 3.72 (m, 1H), 3.71 – 3.58 (m, 3H), 3.53 – 3.48 (m, 7H), 2.70 (t, *J* = 8.4 Hz, 2H), 2.63 – 2.54 (m, 2H), 2.50 – 2.45 (m, 1H), 2.32 – 2.22 (m, 1H), 2.11 – 1.87 (m, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 153.35, 152.87, 143.37, 137.72, 136.92, 136.35, 135.14, 135.08, 129.73, 126.18, 125.66, 125.46, 122.31, 122.23, 114.96, 114.83, 113.96, 110.35, 110.32, 62.33, 59.88, 59.37, 54.83, 52.21, 51.83, 30.43, 30.11, 29.97, 22.43; HRMS-ESI (m/z): calcd for $C_{32}H_{35}Br_2N_6$ [M + H]$^+$: 661.1284, found: 661.1283.

(*S*)-1-(pyridin-2-yl)-*N*-((1-(pyridin-2-ylmethyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L5):



Yellow solid; m.p.= 74.0-76.1 ℃;^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.52 – 8.48 (m, 2H), 7.64 – 7.56 (m, 2H), 7.55 – 7.49 (m, 1H), 7.39 – 7.24 (m, 5H), 7.16 – 7.06 (m, 2H), 6.68 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.71 (d, *J* = 17.6 Hz, 1H), 5.20 (d, *J* = 11.2 Hz, 1H), 4.37 – 4.10 (m, 1H), 3.82 – 3.68 (m, 2H), 3.68 – 3.39 (m, 3H), 2.82 – 2.37 (m, 3H), 2.25 – 2.14 (m, 1H), 2.10 – 1.83 (m, 2H), 1.76 – 1.50 (m, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 160.22, 148.92, 148.78, 139.04, 136.66, 136.37, 136.35, 136.32, 129.19, 126.09, 123.07, 123.00, 121.89, 121.79, 113.35, 62.35, 61.30, 61.16, 59.44, 59.02, 54.87, 30.11, 22.57; HRMS-ESI (m/z): calcd for $C_{26}H_{31}N_4$ [M + H]$^+$: 399.2543, found: 399.2540.

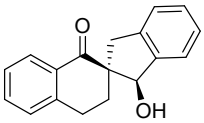
(*S*)-N-((1-methyl-1H-benzo[d]imidazol-2-yl)methyl)-N-((1-((1-methyl-1H-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-2-(4'-vinyl-[1,1'-biphenyl]-4-yl)ethan-1-amine (L6):

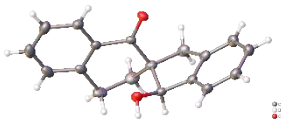


Yellow solid; m.p.= 135.5-137.9 ℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.74 – 7.68 (m, 1H), 7.39 – 7.32 (m, 4H), 7.31 (s, 1H), 7.25 – 7.20 (m, 3H), 6.71 (dd, *J* = 17.6, 11.2 Hz,

1H), 5.75 (d, *J* = 17.6 Hz, 0H), 5.26 (d, *J* = 10.8 Hz, 0H), 4.62 (s, 1H), 4.24 (d, *J* = 13.2 Hz, 1H), 3.83 – 3.71 (m, 1H), 3.69 (d, *J* = 13.6 Hz, 1H), 3.65 (d, *J* = 13.6 Hz, 1H), 3.61 (s, 3H), 3.56 (d, *J* = 13.2 Hz, 1H), 3.51 (s, 3H), 2.77 – 2.66 (m, 3H), 2.53 (dd, *J* = 12.8, 7.2 Hz, 1H), 2.35 – 2.24 (m, 1H), 2.02 – 1.94 (m, 1H), 1.63 – 1.56 (m, 1H), 1.54 – 1.47 (m, 1H), 1.45 – 1.38 (m, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 152.19, 151.71, 141.82, 141.70, 137.96, 137.49, 136.81, 136.42, 136.07, 136.02, 129.77, 128.75, 128.60, 128.42, 126.18, 122.74, 122.52, 122.11, 121.98, 119.42, 119.33, 113.88, 109.16, 62.32, 59.85, 59.39, 54.76, 52.03, 51.91, 46.30, 30.48, 30.03, 29.76, 22.38; HRMS-ESI (m/z): calcd for $C_{32}H_{37}N_6$ $[M + H]^+$: 595.3544, found: 595.3540.

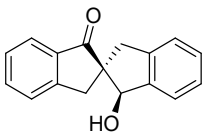
(1*R*,2*S*)-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2a)：





White solid; m.p.= 129.1-130.7 ℃;[8] 64% yield, 99.1% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 8.0 Hz, 1H), 7.54 – 7.41 (m, 2H), 7.33 – 7.24 (m, 4H), 7.15 (d, *J* = 7.2 Hz, 1H), 5.13 (d, *J* = 8.4 Hz, 1H), 3.47 (d, *J* = 16.0 Hz, 1H), 3.40 (s, 1H), 3.15 (t, *J* = 6.0 Hz, 2H), 2.96 (d, *J* = 16.4 Hz, 1H), 2.56 (dt, *J* = 13.6, 7.2 Hz, 1H), 2.23 (dt, *J* = 13.6, 5.2 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.90, 144.42, 143.28, 138.68, 133.74, 131.72, 128.72, 128.33, 128.01, 127.40, 126.87, 124.83, 123.75, 82.79, 58.06, 39.30, 33.24, 26.50; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 11.225 min, *t* (minor) = 15.045 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{17}O_2$ $[M + H]^+$: 265.1223, found: 265.1224.

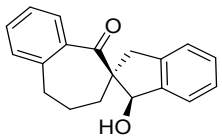
(1'*R*,2*R*)-1'-hydroxy-1',3'-dihydro-2,2'-spirobi[inden]-1(3*H*)-one (2b)：



White solid; m.p.= 127.4-128.8 ℃; 42% yield, 99.0% *ee*, 10:1 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.81 (d, *J* = 7.6 Hz, 1H), 7.63 (td, *J* = 7.6, 1.2 Hz, 1H), 7.48 – 7.38 (m, 3H),

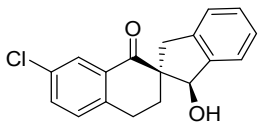
7.34 – 7.27 (m, 3H), 5.03 (d, *J* = 5.2 Hz, 1H), 3.62 (d, *J* = 15.6 Hz, 1H), 3.29 (d, *J* = 16.8 Hz, 2H), 3.10 (d, *J* = 17.2 Hz, 1H), 2.89 (d, *J* = 15.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 208.36, 152.86, 143.38, 141.66, 136.46, 135.32, 128.90, 127.85, 127.43, 126.49, 125.02, 124.83, 124.37, 83.50, 77.39, 77.07, 76.76, 60.37, 41.54, 41.52; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254nm, t (major) = 13.826 min, t (minor) = 21.649 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{15}O_2$ [M + H]$^+$: 251.1067, found: 251.1069.

(1'*R*,6*S*)-1'-hydroxy-1',3',8,9-tetrahydrospiro[benzo[7]annulene-6,2'-inden]-5(7*H*)-one (2c)：



White solid; m.p.= 129.9-131.4 ℃; 38% yield, 46.6% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.46 – 7.34 (m, 2H), 7.31 – 7.20 (m, 4H), 7.18 – 7.14 (m, 2H), 5.03 (d, *J* = 8.4 Hz, 1H), 3.50 (d, *J* = 9.2 Hz, 1H), 3.41 (d, *J* = 16.4 Hz, 1H), 3.04 – 2.94 (m, 1H), 2.92 – 2.80 (m, 2H), 2.18 – 2.07 (m, 1H), 2.06 – 1.97 (m, 2H), 1.98 – 1.88 (m, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 213.80, 143.56, 140.91, 140.02, 137.83, 131.18, 128.85, 128.53, 127.49, 127.28, 126.74, 124.84, 124.63, 83.04, 62.55, 40.77, 34.63, 33.41, 23.93; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 11.670 min, *t* (minor) = 18.850 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{19}O_2$ [M + H]$^+$: 279.1380, found: 279.1379.

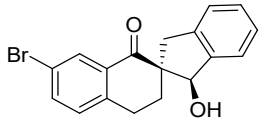
(1*R*,2*S*)-7'-chloro-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2d)：



White solid; m.p.= 139.5-140.8 ℃; 59% yield, 98.0% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 2.4 Hz, 1H), 7.49 – 7.39 (m, 2H), 7.34 – 7.19 (m, 3H), 7.16 (d, *J* = 7.2 Hz, 1H), 5.14 (d, *J* = 11.2 Hz, 1H), 3.48 (d, *J* = 16.0 Hz, 1H), 3.27 – 3.00 (m, 3H), 2.93 (d, *J* = 16.4 Hz, 1H), 2.52 (ddd, *J* = 14.0, 8.8, 5.6 Hz, 1H), 2.36 – 2.10 (m, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.47, 143.97, 141.43, 138.60, 133.58, 133.09, 133.02,

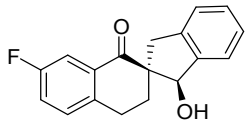
130.27, 128.50, 127.68, 127.49, 124.86, 123.81, 82.53, 57.99, 39.28, 33.02, 25.92; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 12.906 min, *t* (minor) = 13.992 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{16}ClO_2$ [M + H]$^+$: 299.0833, found: 299.0830.

(1*R*,2*S*)-7'-bromo-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2e)：



White solid; m.p.= 178.4-179.3 ℃;[8] 66% yield, 97.7% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 2.0 Hz, 1H), 7.59 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.42 (d, *J* = 6.8 Hz, 1H), 7.33 – 7.20 (m, 2H), 7.16 (d, *J* = 8.0 Hz, 2H), 5.13 (d, *J* = 10.4 Hz, 1H), 3.48 (d, *J* = 16.4 Hz, 1H), 3.25 – 2.98 (m, 3H), 2.91 (d, *J* = 16.4 Hz, 1H), 2.50 (ddd, *J* = 13.6, 8.8, 5.2 Hz, 1H), 2.23 (dt, *J* = 13.6, 5.2 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.33, 143.92, 141.94, 138.68, 136.40, 133.32, 130.72, 130.56, 128.51, 127.48, 124.86, 123.85, 120.87, 82.47, 57.98, 39.31, 32.96, 25.98; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 10.969 min, *t* (minor) = 15.069 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{16}BrO_2$ [M + H]$^+$: 343.0328, found: 343.0330.

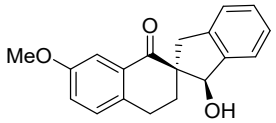
(1*R*,2*S*)-7'-fluoro-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2f)：



White solid; m.p.= 152.3-154.2 ℃; 65% yield, 99.2% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.65 (dd, *J* = 9.2, 2.8 Hz, 1H), 7.43 (d, *J* = 7.2 Hz, 1H), 7.36 – 7.13 (m, 5H), 5.15 (d, *J* = 11.2 Hz, 1H), 3.49 (d, *J* = 16.0 Hz, 1H), 3.25 – 3.00 (m, 3H), 2.94 (d, *J* = 16.0 Hz, 1H), 2.52 (ddd, *J* = 13.6, 8.4, 5.2 Hz, 1H), 2.24 (dt, *J* = 13.6, 5.2 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.65, 199.64, 162.91, 160.46, 144.03, 138.97, 138.94, 138.66, 133.37, 133.31, 130.57, 130.50, 128.48, 127.47, 127.42, 124.86, 123.80, 123.77, 121.22, 121.00, 113.88, 113.66, 82.53, 57.91, 39.27, 33.26, 25.78; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min,

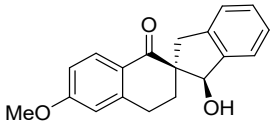
wavelength = 254nm, *t* (major) = 11.369 min, *t* (minor) = 13.156 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{16}FO_2$ [M + H]$^+$: 283.1129, found: 283.1134.

(1*R*,2*S*)-1-hydroxy-7'-methoxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2g)：



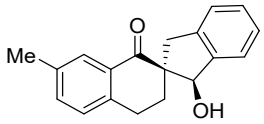
White solid; m.p.= 118.5-119.1 ℃;[8] 69% yield, 99.1% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.48 (d, *J* = 2.4 Hz, 1H), 7.45 (d, *J* = 7.2 Hz, 1H), 7.33 – 7.20 (m, 2H), 7.17 (t, *J* = 8.4 Hz, 2H), 7.09 (dd, *J* = 8.4, 2.8 Hz, 1H), 5.12 (d, *J* = 10.0 Hz, 1H), 3.80 (s, 3H), 3.47 (d, *J* = 16.0 Hz, 1H), 3.34 (s, 1H), 3.08 (t, *J* = 5.6 Hz, 2H), 2.96 (d, *J* = 16.0 Hz, 1H), 2.53 (dt, *J* = 14.0, 7.2 Hz, 1H), 2.22 (dt, *J* = 13.2, 5.2 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.85, 158.50, 144.41, 138.69, 135.84, 132.43, 129.93, 128.32, 127.38, 124.83, 123.72, 122.27, 109.75, 82.66, 58.00, 55.44, 39.25, 33.42, 25.68; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 24.059 min, *t* (minor) = 21.024 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{19}O_3$ [M + H]$^+$: 295.1329, found: 295.1332.

(1*R*,2*S*)-1-hydroxy-6'-methoxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2h)：



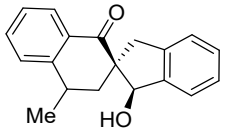
White solid; m.p.= 125.7-128.1℃; 65% yield, 99.1% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.97 (d, *J* = 8.8 Hz, 1H), 7.44 (d, *J* = 7.4 Hz, 1H), 7.31 – 7.20 (m, 2H), 7.14 (d, *J* = 7.2 Hz, 1H), 6.83 (dd, *J* = 8.8, 2.8 Hz, 1H), 6.71 (d, *J* = 2.4 Hz, 1H), 5.10 (d, *J* = 10.0 Hz, 1H), 3.86 (s, 3H), 3.57 – 3.50 (m, 1H), 3.44 (d, *J* = 16.0 Hz, 1H), 3.12 – 3.08 (m, 2H), 2.96 (d, *J* = 16.4 Hz, 1H), 2.61 – 2.48 (m, 1H), 2.19 (dt, *J* = 13.6, 5.2 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.81, 163.92, 145.83, 144.62, 138.77, 130.51, 128.23, 127.32, 125.20, 124.77, 123.70, 113.51, 112.42, 82.94, 57.62, 55.50, 39.56, 33.43, 26.93; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 20.135 min, *t* (minor) = 28.245 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{19}O_3$ [M + H]$^+$: 295.1329, found: 295.1333.

(1*R*,2*S*)-1-hydroxy-7'-methyl-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2i)：



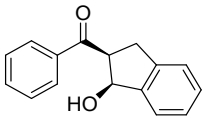
White solid; m.p.= 137.8-139.4 ℃; 67% yield, 99.0% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.80 (s, 1H), 7.45 (d, *J* = 7.2 Hz, 1H), 7.36 – 7.20 (m, 3H), 7.15 (t, *J* = 7.6 Hz, 2H), 5.11 (d, *J* = 10.4 Hz, 1H), 3.46 (d, *J* = 16.4 Hz, 1H), 3.39 (d, *J* = 10.8 Hz, 1H), 3.16 – 3.06 (m, 2H), 2.96 (d, *J* = 16.0 Hz, 1H), 2.63 – 2.46 (m, 1H), 2.35 (s, 3H), 2.21 (dt, *J* = 13.6, 4.8 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 201.22, 144.43, 140.35, 138.71, 136.53, 134.77, 131.45, 128.64, 128.29, 128.06, 127.36, 124.81, 123.75, 82.74, 58.01, 39.28, 33.32, 26.07, 20.98; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 11.932 min, *t* (minor) = 14.825 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{19}O_2$ [M + H]$^+$: 279.1380, found: 279.1387.

(1*R*,2*S*)-1-hydroxy-4'-methyl-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2j)：



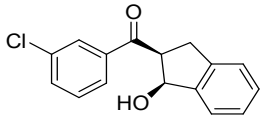
White solid; m.p.= 140.7-142.4 ℃; 52% yield, 99.0% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 (dd, *J* = 7.6, 1.2 Hz, 1H), 7.56 (td, *J* = 7.6, 1.6 Hz, 1H), 7.44 – 7.23 (m, 6H), 5.27 (d, *J* = 9.6 Hz, 1H), 3.92 (d, *J* = 16.4 Hz, 1H), 3.64 – 3.21 (m, 1H), 2.67 (d, *J* = 16.4 Hz, 1H), 2.33 – 2.20 (m, 2H), 2.05 (dd, *J* = 14.0, 10.4 Hz, 1H), 1.43 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.08, 147.65, 142.44, 141.58, 133.70, 132.17, 128.98, 127.79, 127.25, 126.91, 126.68, 125.02, 124.93, 81.22, 58.29, 42.40, 41.34, 29.46, 21.23; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min, wavelength = 254nm, *t* (major) = 14.341 min, *t* (minor) = 17.683 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{19}O_2$ [M + H]$^+$: 279.1380, found: 279.1383.

((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(phenyl)methanone (2k)：



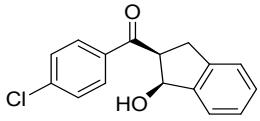
White solid; m.p.= 105.3-106.7 ℃;[8] 66% yield, 98.0% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 (d, *J* = 7.2 Hz, 2H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.51 (t, *J* = 7.6 Hz, 2H), 7.44 (d, *J* = 6.8 Hz, 1H), 7.31 – 7.28 (m, 3H), 5.50 (t, *J* = 6.0 Hz, 1H), 4.34 (q, *J* = 7.2 Hz, 1H), 3.60 (dd, *J* = 16.0, 7.6 Hz, 1H), 3.24 – 2.97 (m, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.64, 143.36, 141.67, 136.90, 133.41, 128.98, 128.83, 128.38, 127.30, 125.00, 124.66, 77.26, 51.33, 33.31; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 29.460 min, *t* (minor) = 35.160 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_2$ [M + H]$^+$: 239.1067, found: 239.1074.

(3-chlorophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2m)：



White solid; m.p.= 142.3-144.5 ℃; 63% yield, 95.6% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.99 (d, *J* = 2.4 Hz, 1H), 7.91 (d, *J* = 7.6 Hz, 1H), 7.57 (dd, *J* = 8.0, 2.4 Hz, 1H), 7.51 – 7.39 (m, 2H), 7.33 – 7.22 (m, 3H), 5.49 (d, *J* = 6.0 Hz, 1H), 4.30 (q, *J* = 7.2 Hz, 1H), 3.63 (dd, *J* = 16.4, 7.6 Hz, 1H), 3.11 (ddd, *J* = 16.4, 8.4 Hz, 1H), 2.73 (s, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 198.96, 142.99, 141.55, 138.54, 135.16, 133.24, 130.14, 129.17, 128.46, 127.38, 126.39, 125.06, 124.67, 77.27, 51.73, 32.88; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 21.710 min, *t* (minor) = 24.695 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{14}ClO_2$ [M + H]$^+$: 273.0677, found: 273.0684.

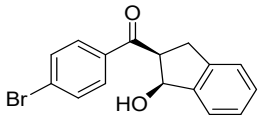
(4-chlorophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2n)：



White solid; m.p.= 161.0-161.9 ℃;[8] 65% yield, 98.1% *ee*, 14:1 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 – 7.92 (m, 2H), 7.52 – 7.46 (m, 2H), 7.43 (d, *J* = 7.6 Hz, 1H), 7.33 – 7.27 (m, 3H), 5.49 (d, *J* = 6.4 Hz, 1H), 4.30 (q, *J* = 7.6, 1H), 3.61 (dd, *J* = 16.0, 7.2 Hz, 1H), 3.12 (dd, *J* = 16.4, 8.4 Hz, 1H), 2.80 (s, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.16,

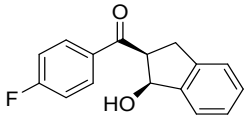
143.10, 141.53, 139.83, 135.25, 129.75, 129.14, 129.12, 129.06, 128.71, 127.38, 125.04, 124.64, 77.29, 51.45, 33.07; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 22.000 min, *t* (minor) = 24.061 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{14}ClO_2$ $[M + H]^+$: 273.0677, found: 273.0681.

(4-bromophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2o)：



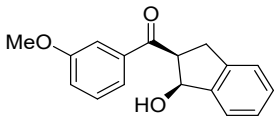
White solid; m.p.= 141.7-142.9 ℃;[8] 66% yield, 98.1% *ee*, 5:1 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 8.0 Hz, 2H), 7.68 – 7.62 (m, 2H), 7.44 – 7.40 (m, 1H), 7.32 – 7.24 (m, 3H), 5.49 (t, *J* = 6.4 Hz, 1H), 4.29 (td, *J* = 8.0, 6.4 Hz, 1H), 3.61 (dd, *J* = 16.0, 7.2 Hz, 1H), 3.12 (dd, *J* = 16.4, 8.4 Hz, 1H), 2.80 (d, *J* = 7.6 Hz, 1H);^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.33, 143.07, 141.53, 135.67, 132.14, 129.84, 129.14, 128.55, 127.38, 125.04, 124.64, 77.28, 51.47, 33.02; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 23.600 min, *t* (minor) = 25.364 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{14}BrO_2$ $[M + H]^+$: 317.0172, found: 317.0177.

(4-fluorophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1H-inden-2-yl)methanone (2p)：



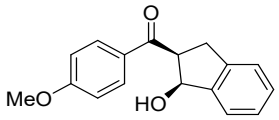
White solid; m.p.= 105.9-106.8 ℃;[8] 57% yield, 96.6% *ee*, 5:1 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.16 – 8.08 (m, 2H), 7.49 (dd, *J* = 7.6, 2.0 Hz, 1H), 7.38 – 7.28 (m, 3H), 7.27 – 7.20 (m, 2H), 5.55 (dd, *J* = 8.0, 6.0 Hz, 1H), 4.36 (td, *J* = 8.0, 6.0 Hz, 1H), 3.66 (dd, *J* = 16.4, 7.6 Hz, 1H), 3.18 (dd, *J* = 16.4, 8.4 Hz, 1H), 3.07 – 2.83 (m, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 198.86, 167.19, 164.65, 143.17, 141.53, 133.32, 133.29, 131.05, 130.96, 129.09, 127.36, 125.02, 124.63, 116.06, 115.84, 77.30, 51.29, 33.22; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 85:15, flow rate=0.8 mL/min, wavelength = 254 nm, *t* (major) = 19.379 min, *t* (minor) = 21.443 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{14}FO_2$ $[M + H]^+$: 257.0972, found: 257.0970.

((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(3-methoxyphenyl)methanone (2q)：



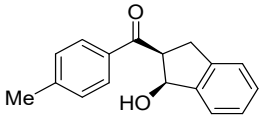
White solid; m.p.= 103.7-104.7 ℃;[8] 71% yield, 98.0% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.64 – 7.61 (m, 1H), 7.55 (dd, *J* = 2.4, 1.6 Hz, 1H), 7.46 – 7.37 (m, 2H), 7.32 – 7.24 (m, 3H), 7.18 – 7.10 (m, 1H), 5.48 (d, *J* = 6.0 Hz, 1H), 4.31 (td, *J* = 8.0, 6.4 Hz, 1H), 3.85 (s, 3H), 3.61 (dd, *J* = 16.4, 8.0 Hz, 1H), 3.14 (td, *J* = 16.0, 8.4 Hz, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.33, 160.00, 143.29, 141.71, 138.26, 129.79, 128.99, 127.28, 125.00, 124.67, 120.93, 119.84, 112.73, 77.33, 55.48, 51.54, 33.24; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 25.665 min, *t* (minor) = 19.359 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{17}O_3$ [M + H]$^+$: 269.1172, found: 269.1176.

((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(4-methoxyphenyl)methanone (2r)：



White solid; m.p.= 153.3-154.7 ℃;[8] 70% yield, 98.4% *ee*, >95:5 dr; H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 7.99 (m, 2H), 7.47 – 7.42 (m, 1H), 7.29 – 7.27 (m, 3H), 7.02 – 6.94 (m, 2H), 5.48 (d, *J* = 6.0 Hz, 1H), 4.29 (ddd, *J* = 8.4, 7.6, 6.0 Hz, 1H), 3.89 (s, 3H), 3.56 (dd, *J* = 16.4, 7.6 Hz, 1H), 3.35 (s, 1H), 3.15 (dd, *J* = 16.0, 8.4 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.46, 144.34, 143.49, 141.67, 134.36, 129.52, 128.90, 128.52, 127.26, 124.96, 124.63, 77.27, 51.01, 33.55, 21.72; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 22.620 min, *t* (minor) = 25.238 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{17}O_3$ [M + H]$^+$: 269.1172, found: 269.1170.

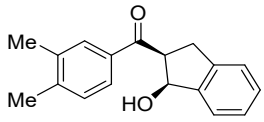
((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(*p*-tolyl)methanone (2s)：



White solid; m.p.= 120.6-121.9 ℃;[8] 74% yield, 98.1% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.49 – 7.39 (m, 1H), 7.33 – 7.26 (m, 5H), 5.49 (d, *J* = 6.4 Hz, 1H), 4.31 (td, *J* = 8.0, 6.0 Hz, 1H), 3.58 (dd, *J* = 16.0, 7.6 Hz, 1H), 3.22 (s, 1H), 3.14 (dd, *J* = 16.0, 8.4 Hz, 1H), 2.44 (s, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.46,

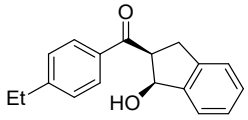
144.34, 143.49, 141.67, 134.36, 129.52, 128.90, 128.52, 127.26, 124.96, 124.63, 77.27, 51.01, 33.55, 21.72; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 20.769 min, *t* (minor) = 22.726 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{17}O_2$ [M + H]$^+$: 253.1223, found: 253.1227.

(3,4-dimethylphenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2t)：



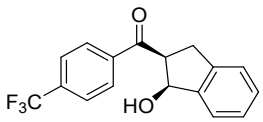
White solid; m.p.= 106.1-107.0 ℃;[8] 68% yield, 96.5% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.81 (s, 1H), 7.77 (dd, *J* = 7.6, 2.0 Hz, 1H), 7.48 – 7.42 (m, 1H), 7.36 – 7.22 (m, 4H), 5.48 (d, *J* = 4.0 Hz, 1H), 4.32 (td, *J* = 8.0, 6.0 Hz, 1H), 3.57 (dd, *J* = 16.4, 7.6 Hz, 1H), 3.34 – 3.02 (m, 2H), 2.35 (s, 6H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.78, 143.54, 143.12, 141.72, 137.22, 134.75, 130.04, 129.52, 128.87, 127.24, 126.13, 124.96, 124.62, 77.28, 50.94, 33.65, 20.10, 19.89; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 25.815 min, *t* (minor) = 24.217 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{19}O_2$ [M + H]$^+$: 267.1380, found: 267.1380.

(4-ethylphenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2u)：



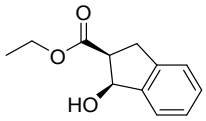
White solid; m.p.= 94.3-95.2 ℃;[8] 57% yield, 97.3% *ee*, >95:5 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.03 – 7.93 (m, 2H), 7.49 – 7.39 (m, 1H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.33 – 7.23 (m, 3H), 5.48 (d, *J* = 6.0 Hz, 1H), 4.46 – 4.16 (m, 1H), 3.58 (dd, *J* = 16.4, 7.6 Hz, 1H), 3.23 (s, 1H), 3.14 (ddd, *J* = 16.4, 8.4, 2.8 Hz, 1H), 2.75 (q, *J* = 7.6 Hz, 2H), 1.30 (t, *J* = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 200.43, 150.46, 143.51, 141.71, 134.58, 128.89, 128.64, 128.35, 127.25, 124.97, 124.65, 77.27, 51.06, 33.52, 29.02, 15.21; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 80:20, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 18.938 min, *t* (minor) = 21.016 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{19}O_2$ [M + H]$^+$: 267.1380, found: 267.1385.

((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(4-(trifluoromethyl)phenyl)methanone (2v)：



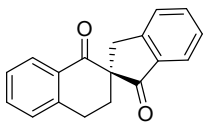
White solid; m.p.= 188.5-189.4 ℃;[8] 64% yield, 92.5% *ee*, 4:1 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.13 (d, *J* = 8.0 Hz, 2H), 7.78 (d, *J* = 8.4 Hz, 2H), 7.42 (d, *J* = 7.2 Hz, 1H), 7.34 – 7.27 (m, 3H), 5.52 (dd, *J* = 8.0, 6.4 Hz, 1H), 4.36 (td, *J* = 8.0, 6.4 Hz, 1H), 3.67 (dd, *J* = 16.4, 7.6 Hz, 1H), 3.13 (dd, *J* = 16.4, 8.4 Hz, 1H), 2.58 (d, *J* = 8.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 199.19, 142.85, 141.55, 139.77, 134.69, 134.37, 129.29, 128.61, 127.44, 125.93, 125.90, 125.86, 125.82, 125.11, 124.67, 77.26, 52.06, 32.66; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 92:8, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 15.646 min, *t* (minor) = 19.006 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{14}FO_2$ $[M + H]^+$: 307.0940, found: 307.0938.

Ethyl (1S,2S)-1-hydroxy-2,3-dihydro-1H-indene-2-carboxylate (2w)：



Colorless oil; 34% yield, 78.5% *ee*, 94:6 dr; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.47 – 7.40 (m, 1H), 7.32 – 7.22 (m, 3H), 5.34 (d, *J* = 5.6 Hz, 1H), 4.24 (q, *J* = 7.2 Hz, 2H), 3.50 – 3.32 (m, 2H), 3.10 (dd, *J* = 14.8, 7.2 Hz, 1H), 2.91 (s, 1H), 1.32 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 173.11, 142.68, 141.83, 129.08, 127.21, 125.02, 124.90, 75.85, 60.94, 49.47, 32.89, 14.27; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 85:15, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 13.066 min, *t* (minor) = 15.404 min]; HRMS-ESI (m/z): calcd for $C_{12}H_{15}O_3$ $[M + H]^+$: 207.1016, found: 207.1012.

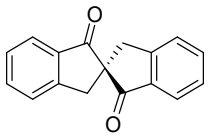
(*S*)-3',4'-dihydro-1'*H*-spiro[indene-2,2'-naphthalene]-1,1'(3*H*)-dione (3a)：



White solid; m.p.= 110.5-111.3 ℃;[9] 85% yield, 97.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.05 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.77 (d, *J* = 7.6 Hz, 1H), 7.64 (td, *J* = 7.6, 1.2 Hz, 1H), 7.58 – 7.47 (m, 2H), 7.42 (t, *J* = 7.6 Hz, 1H), 7.38 – 7.29 (m, 2H), 3.86 (d, *J* =

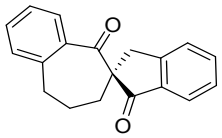
17.2 Hz, 1H), 3.51 (ddd, *J* = 17.2, 8.8, 4.8 Hz, 1H), 3.15 – 2.95 (m, 2H), 2.57 (ddd, *J* = 14.0, 6.8, 5.2 Hz, 1H), 2.33 (ddd, *J* = 13.6, 8.8, 4.8 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 204.11, 196.41, 152.93, 144.29, 135.26, 135.21, 133.86, 131.47, 128.83, 128.17, 127.83, 126.81, 126.48, 124.68, 61.10, 38.01, 32.20, 25.50; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 16.618 min, *t* (minor) = 22.762 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{15}O_2$ [M + H]$^+$: 263.1067, found: 263.1064.

(*R*)-2,2'-spirobi[indene]-1,1'(3*H*,3'*H*)-dione (3b)：



White solid; m.p.= 171.4-172.3 ℃;[10] 71% yield, 96.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.76 (d, *J* = 7.6 Hz, 2H), 7.65 (td, *J* = 7.6, 1.2 Hz, 2H), 7.56 (dt, *J* = 7.6, 1.2 Hz, 2H), 7.46 – 7.37 (m, 2kH), 3.73 (d, *J* = 17.2 Hz, 2H), 3.19 (d, *J* = 16.8Hz, 2H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 202.72, 153.86, 135.47, 135.30, 127.82, 126.38, 124.93, 65.35, 38.09; Determined by HPLC analysis [Daicel chiralpak IC, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 19.288 min, *t* (minor) = 34.535 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{13}O_2$ [M + H]$^+$: 249.0910, found: 249.0906.

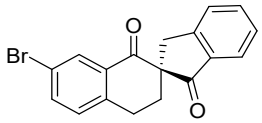
(*S*)-8,9-dihydrospiro[benzo[7]annulene-6,2'-indene]-1',5(3'*H*,7*H*)-dione (3c)：



White solid; m.p.= 157.1-159.4 ℃;79% yield, 45.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.78 (d, *J* = 8.0 Hz, 1H), 7.64 (t, *J* = 7.6 Hz, 1H), 7.52 (d, *J* = 7.6 Hz, 1H), 7.43 (p, *J* = 7.2 Hz, 3H), 7.34 (t, *J* = 7.6 Hz, 1H), 7.18 (d, *J* = 7.6 Hz, 1H), 3.64 (d, *J* = 16.8 Hz, 1H), 3.22 (d, *J* = 16.8 Hz, 1H), 3.02 – 2.90 (m, 1H), 2.90 – 2.74 (m, 1H), 2.53 – 2.25 (m, 1H), 2.10 – 1.93 (m, 2H), 1.79 (dt, *J* = 14.8, 4.4 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 209.77, 204.97, 153.49, 140.14, 137.43, 135.22, 134.92, 132.03, 128.41, 127.81, 127.54, 127.15, 126.50, 124.91, 64.41, 36.66, 31.42, 30.04, 22.44; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254

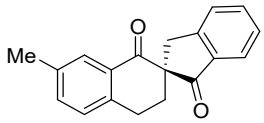
nm, *t* (major) = 21.517 min, *t* (minor) = 26.959 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{17}O_2$ $[M + H]^+$: 277.1223, found: 277.1228.

(*S*)-7'-bromo-3',4'-dihydro-1'*H*-spiro[indene-2,2'-naphthalene]-1,1'(3*H*)-dione (3e):



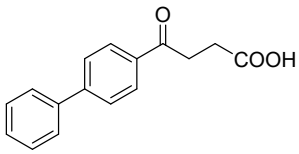
White solid; m.p.= 139.7-142.1 ℃; 84% yield, 95.1% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.12 (d, *J* = 2.4 Hz, 1H), 7.73 (d, *J* = 7.6 Hz, 1H), 7.66 – 7.57 (m, 2H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.39 (t, *J* = 7.6 Hz, 1H), 7.18 (d, *J* = 8.0 Hz, 1H), 3.86 (d, *J* = 16.8 Hz, 1H), 3.45 (ddd, *J* = 17.2, 9.6, 5.2 Hz, 1H), 3.00 (d, *J* = 16.8 Hz, 1H), 2.92 (dt, *J* = 17.2, 5.6 Hz, 1H), 2.50 (dt, *J* = 13.6, 5.6 Hz, 1H), 2.31 (ddd, *J* = 14.4, 9.6, 5.2 Hz, 1H); ^{13} C NMR (100 MHz, Chloroform-*d*) δ 203.46, 195.03, 152.84, 143.07, 136.55, 135.39, 134.88, 132.93, 130.84, 130.68, 127.93, 126.51, 124.75, 120.75, 60.85, 37.88, 32.07, 25.01; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 28.432 min, *t* (minor) = 40.066 min]; HRMS-ESI (m/z): calcd for $C_{18}H_{14}BrO_2$ $[M + H]^+$: 341.0172, found: 341.0177.

(*S*)-7'-methyl-3',4'-dihydro-1'*H*-spiro[indene-2,2'-naphthalene]-1,1'(3*H*)-dione (3i):



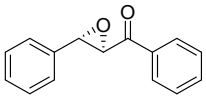
White solid; m.p.= 117.3-119.4 ℃;87% yield, 97.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.83 (d, *J* = 2.0 Hz, 1H), 7.74 (d, *J* = 7.6 Hz, 1H), 7.61 (td, *J* = 7.2, 1.2 Hz, 1H), 7.48 (d, *J* = 7.6 Hz, 1H), 7.39 (t, *J* = 7.6 Hz, 1H), 7.33 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.18 (d, *J* = 8.0 Hz, 1H), 3.81 (d, *J* = 17.2 Hz, 1H), 3.41 (ddd, *J* = 17.2, 8.8, 4.8 Hz, 1H), 3.03 (d, *J* = 17.2 Hz, 1H), 2.95 (ddd, *J* = 16.8, 6.8, 4.8 Hz, 1H), 2.52 (ddd, *J* = 13.6, 6.8, 4.8 Hz, 1H), 2.36 (s, 3H), 2.27 (ddd, *J* = 13.6, 8.8, 4.8 Hz, 1H); ^{13} C NMR (100 MHz, Chloroform-*d*) δ 204.23, 196.67, 152.96, 141.41, 136.46, 135.30, 135.17, 134.89, 131.25, 128.75, 128.18, 127.79, 126.49, 124.64, 61.12, 37.98, 32.35, 25.12, 20.98; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 15.386 min, *t* (minor) = 24.238 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{17}O_2$ $[M + H]^+$: 277.1223, found: 277.1225.

4-([1,1'-biphenyl]-4-yl)-4-oxobutanoic acid (3x):



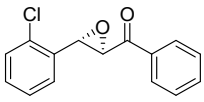
White solid; m.p.= 185.1-187.2 ℃;[11] 74% yield; ^{1}H NMR (400 MHz, DMSO-d_6) δ 12.18 (s, 1H), 8.07 (d, *J* = 8.4 Hz, 2H), 7.84 (d, *J* = 8.4 Hz, 2H), 7.78 – 7.73 (m, 2H), 7.55 – 7.48 (m, 2H), 7.47 – 7.41 (m, 1H), 3.29 (t, *J* = 6.0 Hz, 2H), 2.62 (dd, *J* = 6.8, 5.6 Hz, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 198.51, 174.32, 145.01, 139.37, 135.72, 129.58, 129.06, 128.86, 127.46, 127.38, 33.60, 28.36; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M + H]^+$: 255.1016, found: 255.1020.

(2*R*,3*S*)-3-Phenyloxiran-2-yl)-phenylmethanone (5aa):



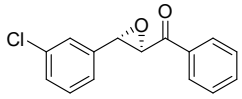
White solid; m.p.= 78.2-82.9 ℃;[12] 96% yield, 99.3% *ee;* ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.13 – 7.75 (m, 2H), 7.65 – 7.60 (m, 1H), 7.49 (dd, *J* = 8.4, 7.2 Hz, 2H), 7.45 – 7.35 (m, 5H), 4.30 (d, *J* = 2.0 Hz, 1H), 4.08 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 193.12, 135.49, 134.04, 129.10, 128.92, 128.81, 128.39, 125.82, 61.05, 59.43; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 15.366min, *t* (minor) = 13.802min]; HRMS-ESI (m/z): calcd for $C_{15}H_{13}O_2$ $[M + H]^+$: 225.0910, found: 225.0911.

(2*R*,3*S*)-3-(2-Chlorophenyl)oxiran-2-yl)-phenylmethanone (5ab):



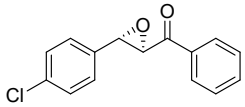
Colorless oil; 94% yield, 98.1% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 (dd, *J* = 7.6, 1.2 Hz, 2H), 7.66 – 7.60 (m, 1H), 7.51 (t, *J* = 7.6 Hz, 2H), 7.40 (m, 2H), 7.36 – 7.31 (m, 2H), 4.41 (d, *J* = 1.6 Hz, 1H), 4.17 (d, *J* = 2.0 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.81, 135.37, 134.10, 133.80, 133.33, 129.79, 129.36, 128.90, 128.43, 127.29, 126.15, 60.07, 57.19; Determined by HPLC analysis [Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 95:5, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 23.604 min, *t* (minor) = 25.076 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}ClO_2$ $[M + H]^+$: 259.0520, found: 259.0519.

(2*R*,3*S*)-3-(3-Chlorophenyl)oxiran-2-yl)-phenylmethanone (5ac):



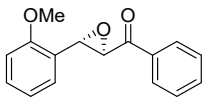
White solid; m.p.= 68.9-74.1 ℃;[12] 95% yield, 99.4% ee; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.00 (d, *J* = 7.6 Hz, 2H), 7.63 (t, *J* = 7.2 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 1H), 7.31 (d, *J* = 8.0 Hz, 1H), 4.25 (s, 1H), 4.06 (s, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.76, 135.38, 134.99, 134.15, 134.06, 129.06, 128.96, 128.38, 127.15, 60.96, 58.72; Determined by HPLC analysis [Daicel chiralpak OD-H, 25 °C, hexane/ isopropanol 98:2, flow rate=0.8 mL/min, wavelength = 254 nm, *t* (major) = 27.918 min, *t* (minor) = 25.883 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}ClO_2$ [M + H]$^+$: 259.0520, found: 259.0520.

(2*R*,3*S*)-3-(4-Chlorophenyl)oxiran-2-yl)-phenylmethanone (5ad):



White solid; m.p.= 113.3-115.7 ℃;[12] 96% yield, 99.2% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 – 7.97 (m, 2H), 7.65 – 7.60 (m, 1H), 7.53 – 7.44 (m, 2H), 7.41 – 7.35 (m, 2H), 7.34 – 7.28 (m, 2H), 4.25 (d, *J* = 2.0 Hz, 1H), 4.06 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.75, 135.38, 134.97, 134.14, 134.07, 129.05, 128.96, 128.37, 127.15, 60.94, 58.71; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 13.716 min, *t* (minor) = 12.597min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}ClO_2$ [M + H]$^+$: 259.0520, found: 259.0519.

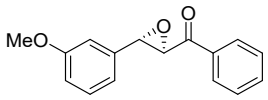
(2*R*,3*S*)-3-(2-Methoxyphenyl)oxiran-2-yl)-phenylmethanone (5ae):



Colorless oil; 80% yield, 99.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.10 – 7.94 (m, 2H), 7.68 – 7.56 (m, 1H), 7.49 (t, *J* = 8.0 Hz, 2H), 7.33 (ddd, *J* = 16.0, 8.0 1.6 Hz, 2H), 7.00 (t, *J* = 7.6 Hz, 1H), 6.92 (d, *J* = 8.4 Hz, 1H), 4.39 (d, *J* = 1.6 Hz, 1H), 4.19 (d, *J* = 2.0 Hz, 1H), 3.84 (s, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 193.69, 158.22, 135.70, 133.79, 129.69, 128.76, 128.42, 125.55, 124.26, 120.81, 110.33, 60.50, 55.77, 55.38. Determined

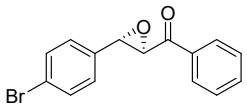
by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 93:7, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 18.616 min, *t* (minor) = 16.328 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M + H]^+$: 255.1016, found: 255.1016.

(2*R*,3*S*)-3-(3-Methoxyphenyl)oxiran-2-yl)-phenylmethanone (5af):



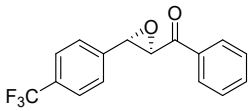
Colorless oil; 88% yield, 93.1% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.03 – 7.99 (m, 2H), 7.65 – 7.60 (m, 1H), 7.52 – 7.47 (m, 2H), 7.32 (t, *J* = 8.0 Hz, 1H), 6.97 (dt, *J* = 7.6, 1.2 Hz, 1H), 6.94 – 6.89 (m, 2H), 4.28 (d, *J* = 2.0 Hz, 1H), 4.06 (d, *J* = 2.0 Hz, 1H), 3.83 (s, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 193.05, 160.08, 137.16, 135.47, 134.05, 129.92, 128.92, 128.39, 118.24, 114.78, 110.85, 60.97, 59.34, 55.36; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 93:7, flow rate=1 mL/min, wavelength = 254 n *t* (major) = 21.998 min, *t* (minor) = 23.609 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M + H]^+$: 255.1016, found: 255.1016.

(2*R*,3*S*)-3-(4-Bromophenyl)oxiran-2-yl)-(phenyl)methanone (5ag):



White solid; m.p.= 90.3-92.7 ℃;[12] 96% yield, 99.3% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 (d, *J* = 7.6 Hz, 2H), 7.65 (t, *J* = 7.2 Hz, 1H), 7.58 – 7.48 (m, 4H), 7.31 – 7.23 (m, 2H), 4.27 (s, 1H), 4.07 (s, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.72, 135.37, 134.61, 134.16, 132.00, 128.97, 128.38, 127.45, 123.10, 60.91, 58.77; Determined by HPLC analysis [Daicel chiralpak OD-H, 25 °C, hexane/ isopropanol 92:8, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 17.376 min, *t* (minor) = 15.541 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}BrO_2$ $[M + H]^+$: 303.0015, found: 303.0016.

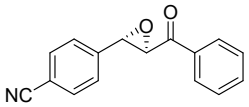
(2*R*,3*S*)-3-(4-Trifluorophenyl)oxiran-2-yl)-phenylmethanone (5ah):



White solid; m.p.= 107.2-110.2 ℃;[12] 97% yield, 99.1% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.01 (d, *J* = 7.6 Hz, 2H), 7.66 (m, 3H), 7.57 – 7.45 (m, 4H), 4.28 (s, 1H), 4.15 (s, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.48, 139.60, 135.31, 134.25, 131.38, 131.05,

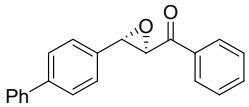
129.00, 128.40, 126.13, 125.88, 125.84, 125.80, 125.77, 125.25, 122.54, 60.91, 58.48; Determined by HPLC analysis [Daicel chiralpak OD-H, 25 °C, hexane/ isopropanol 92:8, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 15.051 min, *t* (minor) = 13.435 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{12}F_3O_2$[M + H] $^+$: 293.0784, found: 293.0784.

4-((2*S*,3*R*)-3-benzoyloxiran-2-yl)benzonitrile (5ai):



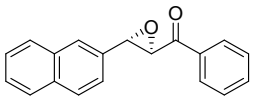
White solid; m.p.= 93.5-97.2 ℃;[13] 95% yield, 91.6% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 – 7.95 (m, 2H), 7.73 – 7.62 (m, 3H), 7.55 – 7.46 (m, 4H), 4.25 (d, *J* = 1.6 Hz, 1H), 4.15 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.20, 140.88, 135.24, 134.34, 132.64, 129.03, 128.49, 128.42, 126.48, 118.34, 112.89, 60.86, 58.24; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 21.439 min, *t* (minor) = 19.222 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{12}NO_2$[M + H] $^+$: 250.0863, found: 250.0863.

[(2*R*,3*S*)-3-[1,1'-biphenyl]-4-yloxiranyl]phenylmethanone (5aj):



White solid; m.p.= 127.2-132.5 ℃; 95% yield, 98.3% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.07 – 8.01 (m, 2H), 7.66 – 7.59 (m, 5H), 7.53 – 7.44 (m, 6H), 7.41 – 7.36 (m, 1H), 4.36 (d, *J* = 1.6 Hz, 1H), 4.14 (d, *J* = 1.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 193.07, 142.13, 140.42, 135.51, 134.47, 134.06, 128.94, 128.91, 128.41, 127.68, 127.56, 127.14, 126.31, 61.09, 59.32； Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 23.449 min, *t* (minor) = 24.980 min]; HRMS-ESI (m/z): calcd for $C_{21}H_{17}O_2$ [M+H]$^+$: 301.1223, found 301.1220.

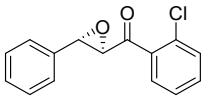
[(2*R*,3*S*)-3-(2-Naphthalenyl)-2-oxiranyl]phenylmethanone (5ak):



White solid; m.p.= 82.5-84.3 ℃;[13] 70% yield, 96.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 7.99 (m, 2H), 7.90 – 7.85 (m, 4H), 7.66 – 7.59 (m, 1H), 7.55 – 7.46 (m, 4H), 7.43

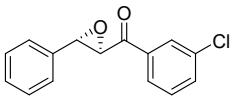
(dd, *J* = 8.4, 1.6 Hz, 1H), 4.40 (d, *J* = 1.6 Hz, 1H), 4.25 (d, *J* = 1.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 193.04, 134.02, 132.91, 128.92, 128.82, 128.38, 127.92, 127.87, 126.71, 126.63, 125.88, 122.46, 61.22, 59.67; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 22.504 min, *t* (minor) = 18.546 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{15}O_2$ $[M+H]^+$: 275.1067, found 275.1066.

(2-Chlorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5al):



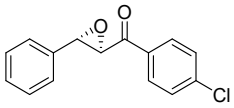
Colorless oil; 85% yield, 96.6% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.47 – 7.40 (m, 2H), 7.38 – 7.33 (m, 6H), 4.15 (d, *J* = 2.0 Hz, 1H), 4.09 (d, *J* = 1.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 196.32, 136.52, 135.28, 133.13, 132.19, 130.49, 130.17, 129.09, 128.74, 127.23, 125.87, 62.94, 60.47; Determined by HPLC analysis [Daicel chiralpak OJ-H, 25 °C, hexane/ isopropanol 98:2, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 35.370 min, *t* (minor) = 27.406 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}ClO_2$ $[M+H]^+$: 259.0520, found 259.0522.

(3-Chlorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5am):



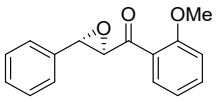
White solid; m.p.= 90.7-92.8 ℃;[14] 90% yield, 93.0% *ee*； ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.99 (t, *J* = 2.0 Hz, 1H), 7.89 (dt, *J* = 8.0, 1.6 Hz, 1H), 7.59 (m, 1H), 7.48 – 7.34 (m, 6H), 4.24 (d, *J* = 2.0 Hz, 1H), 4.08 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.14, 136.88, 135.31, 135.17, 133.96, 130.26, 129.23, 128.86, 128.42, 126.54, 125.83, 61.04, 59.55; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 13.657 min, *t* (minor) = 15.185 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}ClO_2$ $[M+H]^+$: 259.0520, found 259.0520.

(4-Chlorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5an):



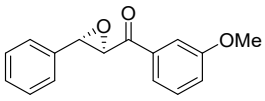
White solid; m.p.= 92.5-94.7 ℃;[15] 87% yield, 92.8% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.99 – 7.94 (m, 2H), 7.49 – 7.45 (m, 2H), 7.43 – 7.34 (m, 5H), 4.23 (d, *J* = 2.0 Hz, 1H), 4.08 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 192.08, 140.65, 135.26, 133.71, 129.83, 129.28, 129.19, 128.85, 125.80, 61.10, 59.41; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 20.777 min, *t* (minor) = 17.564 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}ClO_2$ $[M+H]^+$: 259.0520, found 259.0520.

(2-Methoxyphenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5ao):



Yellow oil; 90% yield, 98.9% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.83 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.52 (ddd, *J* = 8.8, 7.6, 2.0 Hz, 1H), 7.44 – 7.31 (m, 5H), 7.05 (td, *J* = 7.6, 0.8 Hz, 1H), 6.93 (dd, *J* = 8.4, 0.8 Hz, 1H), 4.31 (d, *J* = 2.0 Hz, 1H), 4.01 (d, *J* = 2.0 Hz, 1H), 3.60 (s, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 194.88, 159.58, 136.50, 134.90, 130.72, 128.70, 128.57, 125.98, 125.79, 121.04, 111.56, 64.56, 59.83, 55.60; Determined by HPLC analysis [Daicel chiralpak OJ-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 34.107 min, *t* (minor) = 31.814 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M+H]^+$: 255.1016, found 255.1015.

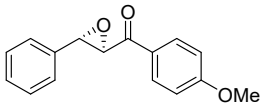
(3-Methoxyphenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5ap):



Yellow oil; 94% yield, 99.0% *ee*； ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.60-7.57 (m, 1H), 7.53 (dd, *J* = 2.8, 1.6 Hz, 1H), 7.43-7.35 (m, 6H), 7.16 (ddd, *J* = 8.0, 2.4, 0.8 Hz, 1H), 4.28 (d, *J* = 2.0 Hz, 1H), 4.08 (d, *J* = 2.0 Hz, 1H), 3.85 (s, 3H); ^{13}C NMR (10 MHz, Chloroform-*d*) δ 192.92, 160.02, 136.77, 135.48, 129.91, 129.09, 128.80, 125.82, 121.03, 120.64, 112.42, 61.06, 59.49, 55.54; Determined by HPLC analysis [Daicel chiralpak OJ-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 29.026 min, *t*

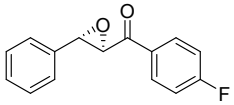
(minor) = 26.457 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M+H]^+$: 255.1016, found 255.1015.

(4-Methoxyphenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5aq):



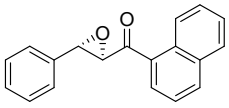
White solid; m.p.= 68.2-71.0 ℃;[15] 93% yield, 98.2% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 7.92 (m, 2H), 7.38 (d, *J* = 4.8 Hz, 5H), 7.01 – 6.91 (m, 2H), 4.25 (s, 1H), 4.06 (s, 1H), 3.87 (s, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 191.37, 164.26, 135.71, 130.79, 129.00, 128.77, 128.60, 125.82, 114.13, 60.88, 59.21, 55.59; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 92:8, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 57.452 min, *t* (minor) = 50.788 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M+H]^+$: 255.1016, found 255.1015.

(4-Fluorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5ar):



White solid; m.p.= 93.9-96.1 ℃;[13] 88% yield, 98,2% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.06 (dd, *J* = 8.4, 5.2 Hz, 2H), 7.44 – 7.33 (m, 5H), 7.16 (t, *J* = 8.4 Hz, 2H), 4.24 (s, 1H), 4.07 (s, 1H);^{13}C NMR (100 MHz, Chloroform-*d*) δ 191.63, 167.54, 164.99 (d, *J* = 255 Hz), 135.33, 131.91, 131.88 (d, *J* = 3 Hz), 131.25, 131.15 (d, *J* = 10 Hz), 129.17, 128.84, 125.81, 116.27, 116.05 (d, *J* = 22 Hz), 61.08, 59.34; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 92:8, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 17.036 min, *t* (minor) = 20.576 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{12}FO_2$ $[M+H]^+$: 243.0816, found 243.0816.

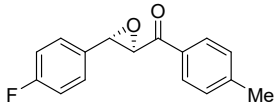
(Naphthalen-1-yl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5as):



White solid; m.p.= 120.1-121.8 ℃;[15] 80% yield, 94.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.67 (dd, *J* = 8.4, 1.2 Hz, 1H), 8.05 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.98 (dd, *J* = 7.2, 1.2 Hz, 1H), 7.91 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.64 (ddd, *J* = 8.4, 6.8, 1.6 Hz, 1H), 7.58 (ddd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 7.51 (dd, *J* = 8.4, 7.2 Hz, 1H), 7.47 – 7.36 (m, 5H), 4.26 (d, *J* = 1.6 Hz,

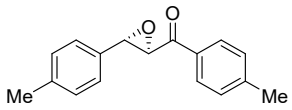
1H), 4.15 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 196.26, 135.45, 133.92, 133.82, 133.01, 130.29, 129.10, 128.89, 128.80, 128.59, 128.49, 126.84, 125.87, 125.51, 124.35, 62.66, 59.70; Determined by HPLC analysis [Daicel chiralpak IA-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 20.242 min, *t* (minor) = 17.410 min]; HRMS-ESI (m/z): calcd for $C_{19}H_{15}O_2$ $[M+H]^+$: 275.1067, found 275.1067.

[(2*R*,3*S*)-3-(4-Fluorophenyl)-2-oxiranyl](4-methylphenyl)methanone (5at):



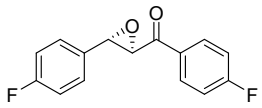
White solid; m.p.= 77.8-82.6 ℃; 93% yield, 98.6% ee; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.0 Hz, 2H), 7.41 – 7.21 (m, 4H), 7.09 (t, *J* = 8.0 Hz, 2H), 4.24 (s, 1H), 4.06 (s, 1H), 2.43 (s, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.41, 164.40, 161.94 (d, *J* = 246 Hz), 145.21, 133.00, 131.42, 131.39 (d, *J* = 3 Hz), 129.62, 128.49, 127.63, 127.55 (d, *J* = 5 Hz), 115.97, 115.75 (d, *J* = 22 Hz), 60.88, 58.73, 21.82; Determined by HPLC analysis [Daicel chiralpak OD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 34.340 min, *t* (minor) = 29.951 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{14}FO_2$ $[M+H]^+$: 257.0972, found 257.0971.

(2*R*,3*S*)-4-Methylphenyl-3-(4-methylphenyl)-2-oxiran-methanone (5au):



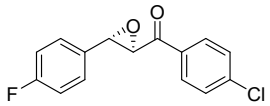
White solid; m.p.= 103.0-105.8 ℃;[12] 90% yield, 98.6% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.31 – 7.23 (m, 4H), 7.20 (d, *J* = 8.0 Hz, 2H), 4.26 (d, *J* = 2.0 Hz, 1H), 4.02 (d, *J* = 1.6 Hz, 1H), 2.41 (s, 3H), 2.37 (s, 3H).^{13}C NMR (100 MHz, Chloroform-*d*) δ 192.74, 145.02, 139.00, 133.11, 132.63, 129.56, 129.46, 128.48, 125.80, 60.99, 59.39, 21.79, 21.28; Determined by HPLC analysis [Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 34.340 min, *t* (minor) = 29.951 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{17}O_2$ $[M+H]^+$: 253.1223, found 253.1222.

(4-Fluorophenyl) ((2*R*,3*S*)-3-(4-fluorophenyl)-oxiran-2-yl)-methanone (5av):



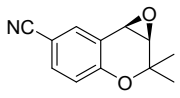
White solid; m.p.= 81.5-83.7 ℃;[13] 95% yield, 99.2% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.11 – 8.03 (m, 2H), 7.38 – 7.31 (m, 2H), 7.22 – 7.13 (m, 2H), 7.13 – 7.05 (m, 2H), 4.20 (d, *J* = 2.0 Hz, 1H), 4.06 (d, *J* = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 191.42, 166.30 (d, *J* = 256 Hz), 163.23 (d, *J* = 247 Hz), 131.85 (d, *J* = 3 Hz), 131.20 (d, *J* = 9 Hz), 131.12 (d, *J* = 4 Hz), 127.58 (d, *J* = 9 Hz), 116.18 (d, *J* = 20 Hz), 115.91 (d, *J* = 21 Hz), 61.02, 58.70; Determined by HPLC analysis [Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 18.494 min, *t* (minor) = 20.132 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{11}F_2O_2$ $[M+H]^+$: 261.0722, found 261.0722.

(4-Chlorophenyl) ((2*R*,3*S*)-3-(4-fluorophenyl)-oxiran-2-yl)-methanone (5aw):



White solid; m.p.= 112.6-115.7 ℃; 91% yield, 99.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.01 – 7.92 (m, 2H), 7.51 – 7.43 (m, 2H), 7.38 – 7.30 (m, 2H), 7.10 (t, *J* = 8.4 Hz, 2H), 4.19 (d, *J* = 2.0 Hz, 1H), 4.06 (d, *J* = 1.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 191.88, 163.25 (d, *J* = 246 Hz), 140.72, 133.66, 131.04 (d, *J* = 3 Hz), 129.82, 129.30, 127.59 (d, *J* = 9 Hz), 115.93 (d, *J* = 26 Hz), 61.04, 58.78; Determined by HPLC analysis [Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 18.629 min, *t* (minor) = 21.850 min]; HRMS-ESI (m/z): calcd for $C_{15}H_{11}ClFO_2$ $[M+H]^+$: 277.0426, found 277.0427.

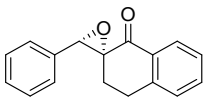
(1a*R*,7b*R*)-2,2-dimethyl-1a,7b-dihydro-2*H*-oxireno[2,3-*c*]chromene-6-carbonitrile (5ax):



White solid; m.p.= 143.8-146.4 ℃;[16] 95% yield, 91.4% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.61 (m, 1H), 7.55 – 7.45 (m, 1H), 6.90 – 6.78 (m, 1H), 3.90 (dd, *J* = 4.4, 2.4 Hz, 1H), 3.53 (dd, *J* = 4.4, 2.4 Hz, 1H), 1.60 – 1.55 (m, 3H), 1.30 – 1.22 (m, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 156.51, 134.41, 133.83, 121.16, 119.04, 118.77,

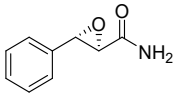
104.25, 74.70, 62.31, 49.88, 25.50, 23.02. Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 99:1, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 13.337 min, *t* (minor) = 16.282 min]; HRMS-ESI (m/z): calcd for $C_{12}H_{11}NO_2$ $[M+H]^+$: 201.0790, found 201.0790.

(2*R*,3′*S*)-3′-Phenyl-3,4-dihydro-1*H*-spiro[naphthalene-2,2′-oxiran]-1-one (5ay):



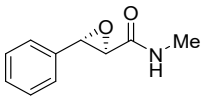
White solid; m.p.= 104.1-107.0 ℃; 80% yield, 89.0% *ee*;[17] ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.12 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.52 (td, *J* = 7.6, 1.6 Hz, 1H), 7.42 – 7.33 (m, 6H), 7.22 (d, *J* = 7.6 Hz, 1H), 4.36 (s, 1H), 2.91 – 2.70 (m, 2H), 2.54 – 2.33 (m, 1H), 1.86 (dt, *J* = 13.6, 4.4 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 193.62, 143.38, 134.26, 134.16, 132.71, 128.77, 128.39, 128.35, 127.67, 127.02, 126.66, 64.34, 64.11, 27.35, 25.35; Determined by HPLC analysis [Daicel chiralpak AD-H, 25 °C, hexane/ isopropanol 90:10, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 15.607 min, *t* (minor) = 19.754 min]; HRMS-ESI (m/z): calcd for $C_{17}H_{15}O_2$ $[M+H]^+$: 251.1067, found 251.1067.

(2*R*,3*S*)-3-Phenyloxirane-2-carboxamide (5ba):



White solid; m.p.= 68.8-70.7 ℃; 94% yield, 93.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.42-7.36 (m, 3H), 7.33 – 7.27 (m, 2H), 6.22 (s, 1H), 5.65 (s, 1H), 3.99 (d, *J* = 2.0 Hz, 1H), 3.53 (d, *J* = 2.0 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 170.06, 134.76, 129.14, 128.71, 125.80, 58.96, 58.62; Determined by HPLC analysis[Daicel chiralpak OJ-H, 25 °C, hexane/ isopropanol 95:5, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 25.630 min, *t* (minor) = 23.086 min]; HRMS-ESI (m/z): calcd for $C_9H_{10}NO_2$ $[M+H]^+$: 164.0706, found 164.0706.

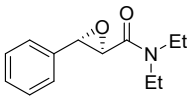
(2*R*,3*S*)-*N*-Methyl-3-phenyloxirane-2-carboxamide (5bb):



White solid; m.p.= 72.5-75.5 ℃; 90% yield, 91.8% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 (dd, *J* = 4.8, 1.6 Hz, 3H), 7.29-7.26 (m, 2H), 6.31 (s, 1H), 3.90 (d, *J* = 2.0 Hz, 1H),

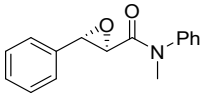
3.55 (d, *J* = 2.0 Hz, 1H), 2.89 (d, *J* = 5.2 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 168.06, 134.92, 129.04, 128.66, 125.78, 59.11, 59.03, 25.62; Determined by HPLC analysis[Daicel chiralpak OJ-H, 25 °C, hexane/ isopropanol 95:5, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 31.043 min, *t* (minor) = 22.543 min]; HRMS-ESI (m/z): calcd for $C_{10}H_{12}NO_2$ $[M+H]^+$: 178.0863, found 178.0863.

(2*R*,3*S*)-*N, N*-Diethyl-3-phenyloxirane-2-carboxamide (5bc):



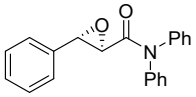
White solid; m.p.= 77.8-80.2 ℃; 92% yield, 94.5% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.49 – 7.30 (m, 5H), 4.09 (d, *J* = 2.0 Hz, 1H), 3.58 (d, *J* = 1.6 Hz, 1H), 3.49 – 3.39 (m, 4H), 1.19 (dt, *J* = 16.8, 6.4 Hz, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 165.71, 135.83, 128.73, 128.67, 125.72, 57.64, 57.22, 41.53, 40.94, 14.95, 13.01; Determined by HPLC analysis[Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 36.214 min, *t* (minor) = 28.099 min]; HRMS-ESI (m/z): calcd for $C_{13}H_{18}NO_2$ $[M+H]^+$: 220.1332, found 220.1334.

(2*R*,3*S*)-*N*-Methyl-*N*-phenyl-3-diphenyloxirane-2-carboxamide (5bd):



White solid; m.p.= 83.3-86.7 ℃; 94% yield, 96.5% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 – 7.32 (m, 2H), 7.31 – 7.27 (m, 4H), 7.25 – 7.21 (m, 2H), 7.16 – 7.11 (m, 2H), 4.16 (d, *J* = 2.0 Hz, 1H), 3.38 (s, 3H), 3.24 (d, *J* = 1.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 166.56, 142.14, 135.41, 129.89, 128.60, 128.48, 128.15, 126.85, 125.74, 58.24, 56.75, 37.75; Determined by HPLC analysis[Daicel chiralpak OD-H, 25 °C, hexane/ isopropanol 92:8, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 25.063 min, *t* (minor) = 29.935 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{16}NO_2$ $[M+H]^+$: 254.1176, found 254.1176.

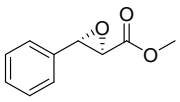
(2*R*,3*S*)-*N, N,* 3-triphenyloxirane-2-carboxamide (5be):



White solid; m.p.= 107.1-111.2 ℃; 93% yield, 94.8% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 – 7.26 (m, 13H), 7.18 (m, 2H), 4.22 (d, *J* = 2.0 Hz, 1H), 3.35 (d, *J* = 2.0 Hz, 1H). ^{13}C

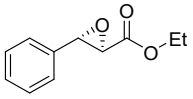
NMR (100 MHz, Chloroform-*d*) δ 166.53, 135.22, 128.75, 128.55, 125.80, 58.71, 57.77; Determined by HPLC analysis[Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 70:30, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 38.222 min, *t* (minor) = 61.380 min]; HRMS-ESI (m/z): calcd for $C_{21}H_{18}NO_2$ $[M+H]^+$: 316.1332, found 316.1332.

(2*R*,3*S*)-Methyl-3-phenyloxirane-2-carboxylate (5ca):



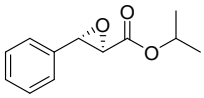
White solid; m.p.= 87.5-90.3 ℃; 87% yield, 89.0% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.38 - 7.34 (m, 3H), 7.29 - 7.27 (m, 2H), 4.10 (d, *J* = 1.6 Hz, 1H), 3.82 (s, 3H), 3.52 (d, *J* = 1.6 Hz, 1H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 168.66, 134.91, 129.05, 128.70, 125.83, 58.00, 56.66, 52.63; Determined by HPLC analysis[Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 93:7, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 17.445 min, *t* (minor) = 15.414 min]; HRMS-ESI (m/z): calcd for $C_{10}H_{11}O_3$ $[M+H]^+$: 179.0703, found 179.0703.

(2*R*,3*S*)-Ethyl-3-phenyloxirane-2-carboxylate (5cb):



Colorless oil; 93% yield, 91.6% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.38 – 7.34 (m, 3H), 7.30 (dd, *J* = 7.6, 2.4 Hz, 2H), 4.34 – 4.23 (m, 2H), 4.11 (d, *J* = 2.0 Hz, 1H), 3.52 (d, *J* = 2.0 Hz, 1H)1.33 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 168.22, 135.02, 128.99, 128.66, 125.85, 61.78, 57.92, 56.79, 14.13; Determined by HPLC analysis[Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 93:7, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 16.888 min, *t* (minor) = 14.547 min]; HRMS-ESI (m/z): calcd for $C_{11}H_{13}O_3$ $[M+H]^+$: 193.0859, found 193.0859.

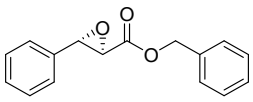
Isopropyl (2*R*,3*S*)-3-phenyloxirane-2-carboxylate (5cc):



Corlorless oil; 88% yield, 90.1% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.41 – 7.31 (m, 3H), 7.35 – 7.25 (m, 2H), 5.19 – 5.10 (m, 1H), 4.07 (d, *J* = 2.0 Hz, 1H), 3.48 (d, *J* = 2.0 Hz, 1H), 1.31 (dd, *J* = 7.6, 6.4 Hz, 6H).^{13}C NMR (100 MHz, Chloroform-*d*) δ 167.74, 135.11,

128.98, 128.66, 125.88, 69.61, 57.85, 56.99, 21.81, 21.73; Determined by HPLC analysis [Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 93:7, flow rate=1 mL/min, wavelength = 254 nm, *t* (major) = 14.038 min, *t* (minor) = 12.055 min]; HRMS-ESI (m/z): calcd for $C_{12}H_{15}O_3$ $[M+H]^+$: 207.1016, found 207.1015.

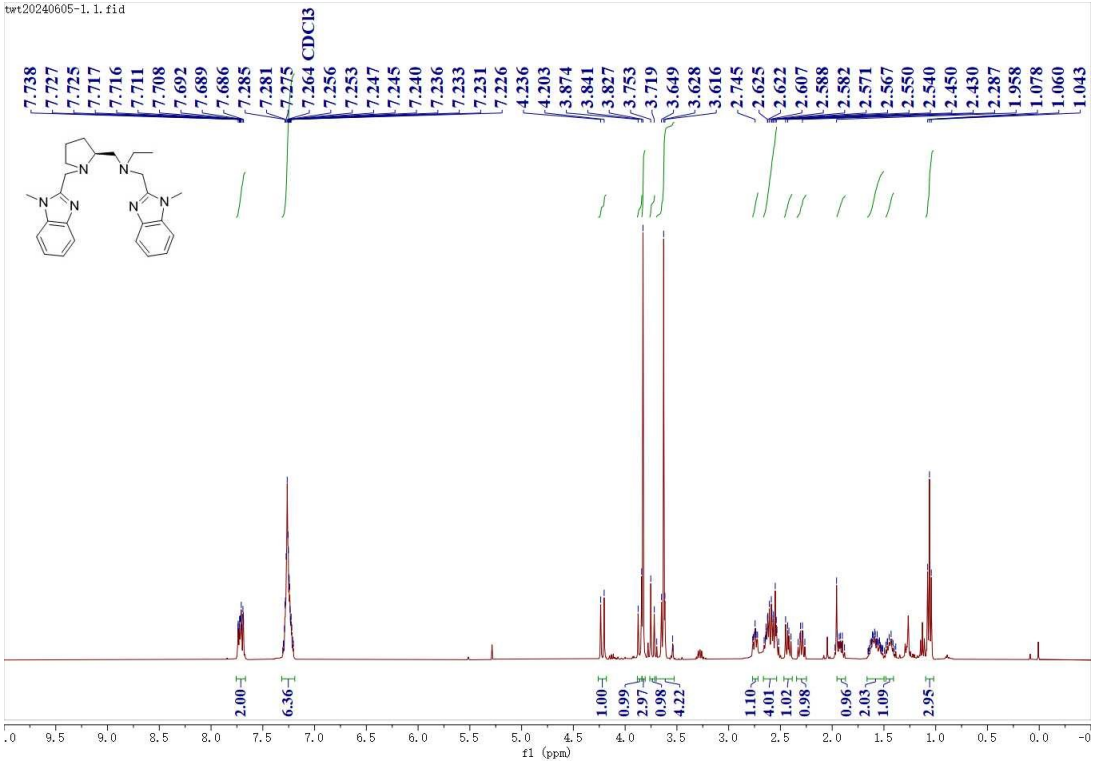
Benzyl (2*R*,3*S*)-3-phenyloxirane-2-carboxylate (5cd):



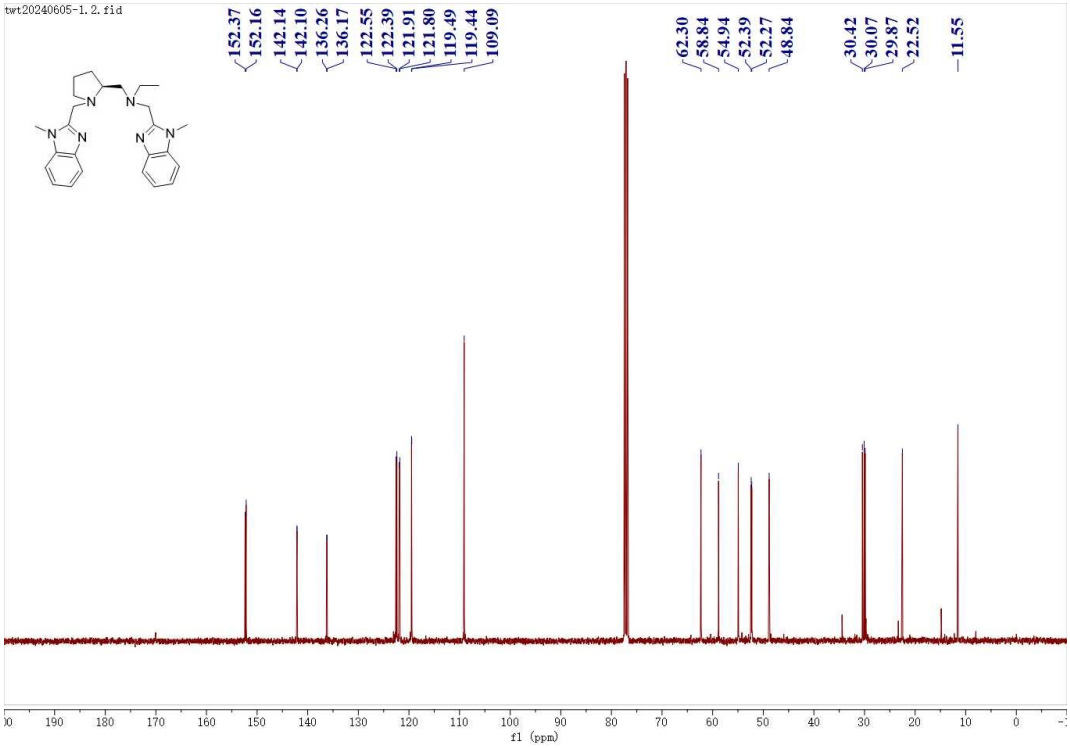
White solid; m.p.= 103.1-106.0 ℃; 90% yield, 89.9% *ee*; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.44 – 7.34 (m, 8H), 7.31 – 7.28 (m, 2H), 5.27 (q, *J* = 12.4 Hz, 2H), 4.13 (d, *J* = 1.6 Hz, 1H), 3.57 (d, *J* = 2.0 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 168.12, 135.02, 134.89, 129.07, 128.73, 128.70, 128.68, 128.55, 125.88, 67.48, 58.08, 56.78; Determined by HPLC analysis [Daicel chiralpak IC-H, 25 °C, hexane/ isopropanol 85:15, flow rate=1 mL/min, wavelength = 220 nm, *t* (major) = 11.436 min, *t* (minor) = 10.641 min]; HRMS-ESI (m/z): calcd for $C_{16}H_{15}O_3$ $[M+H]^+$: 255.1016, found 255.1018.

7. NMR Spectra and HPLC chromatograms

(*S*)-*N*-((1-methyl-1*H*-benzo[*d*]imidazol-2-yl)methyl)-*N*-((1-((1-methyl-1*H*-benzo[*d*]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)ethanamine (^{Et}PMB)

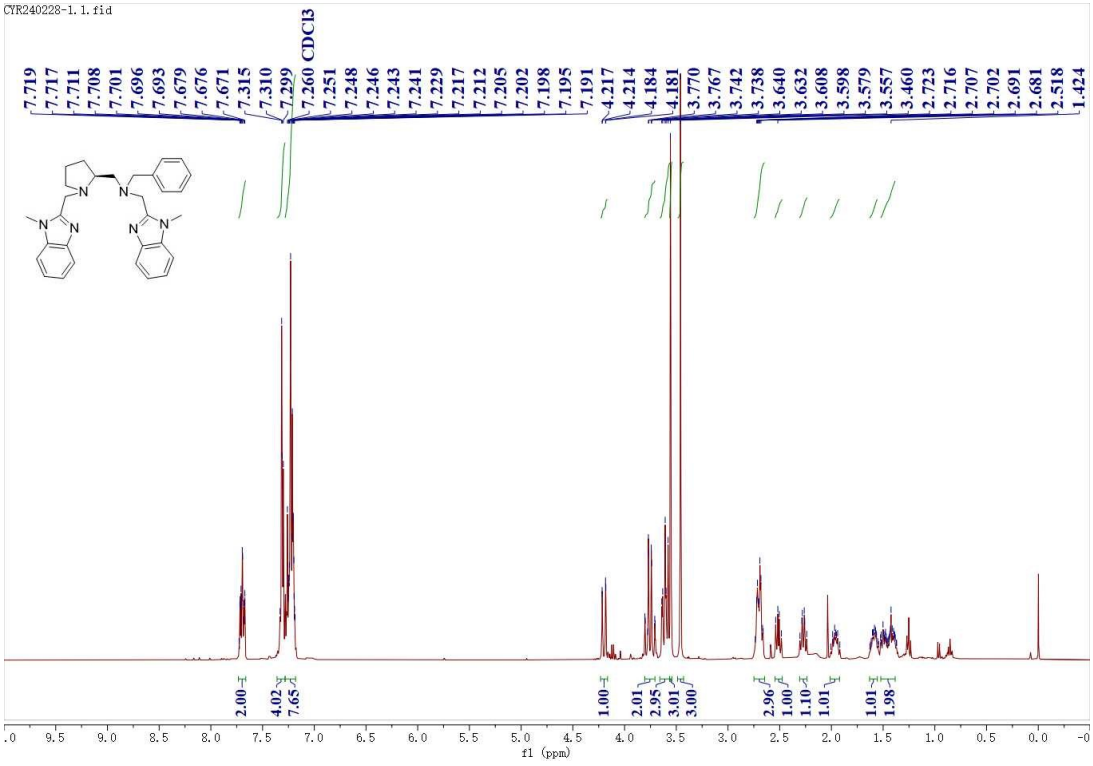


^{1}H NMR (400 MHz) in $CDCl_3$

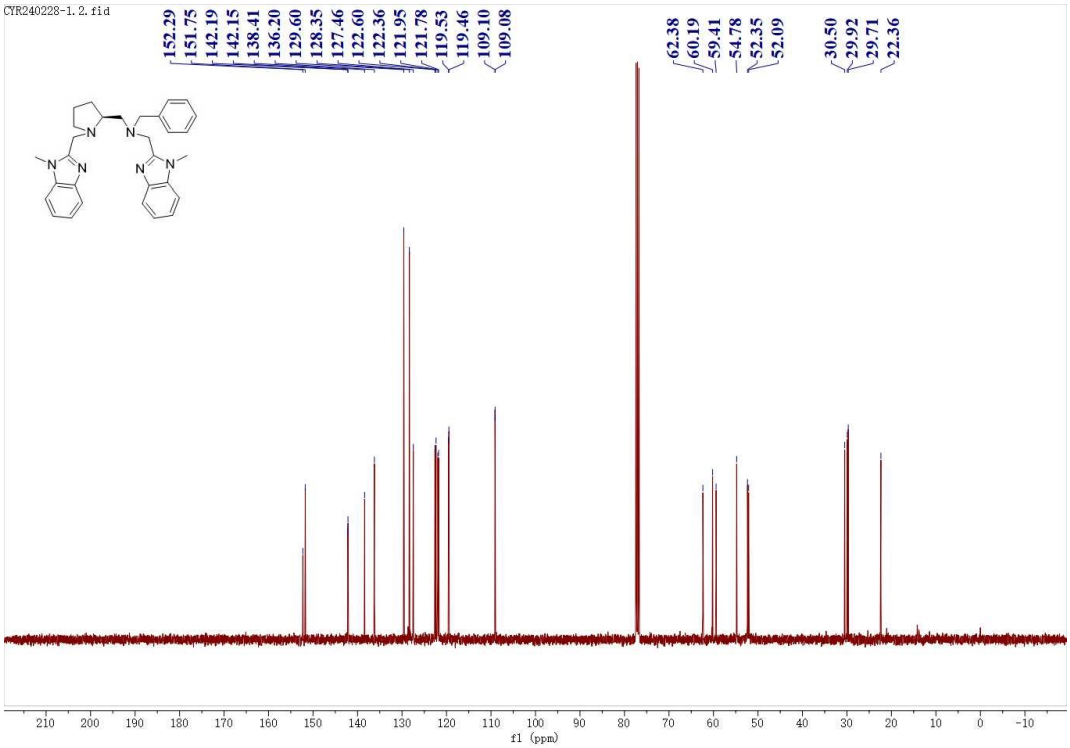


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-*N*-benzyl-1-(1-methyl-1*H*-benzo[*d*]imidazol-2-yl)-*N*-((1-((1-methyl-1*H*-benzo[*d*]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)methanamine (^{Bn}PMB)

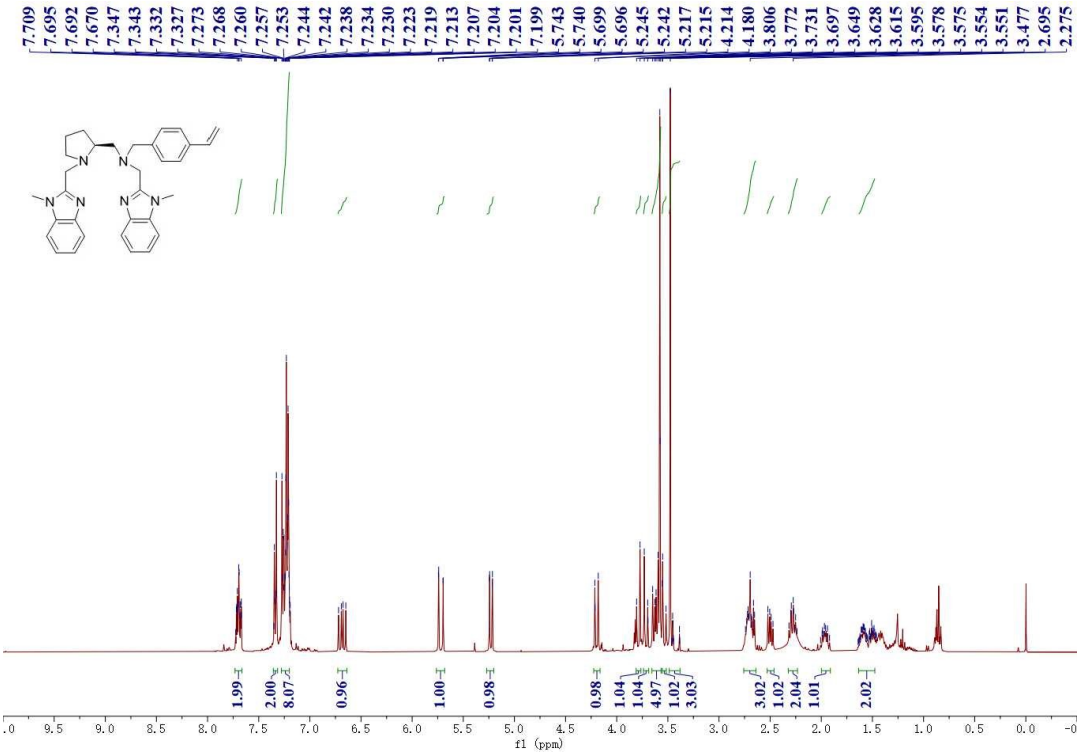


^{1}H NMR (400 MHz) in $CDCl_3$

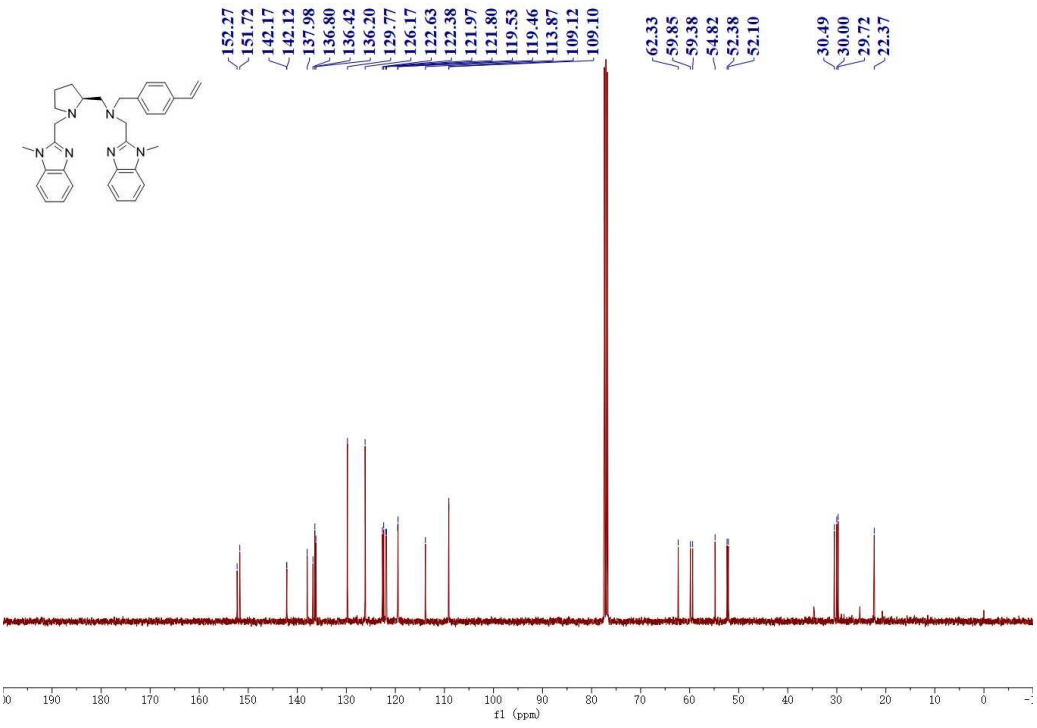


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-1-(1-methyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((1-methyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L1)

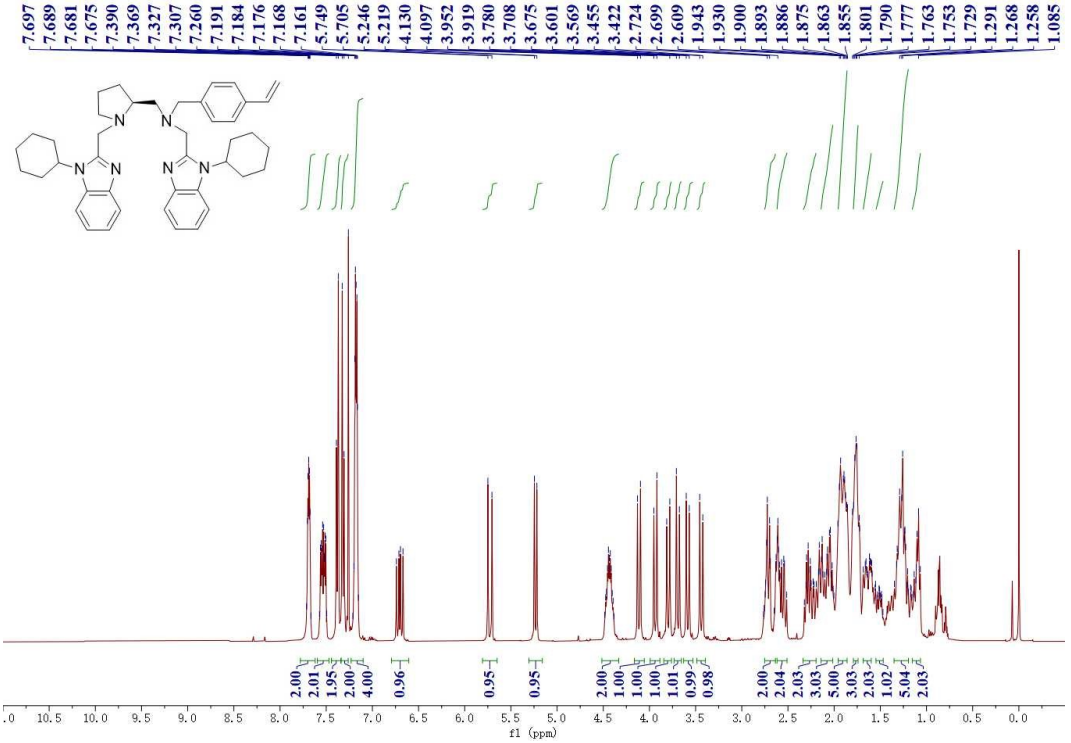


^{1}H NMR (400 MHz) in $CDCl_3$

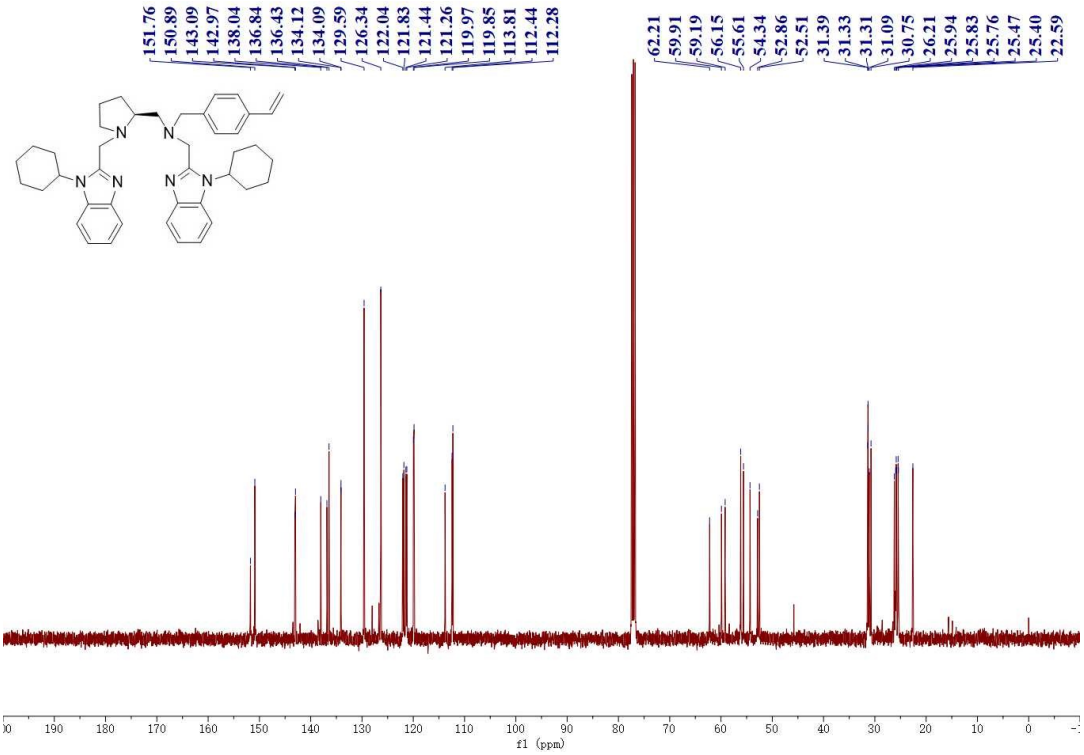


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-1-(1-cyclohexyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((1-cyclohexyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L2)

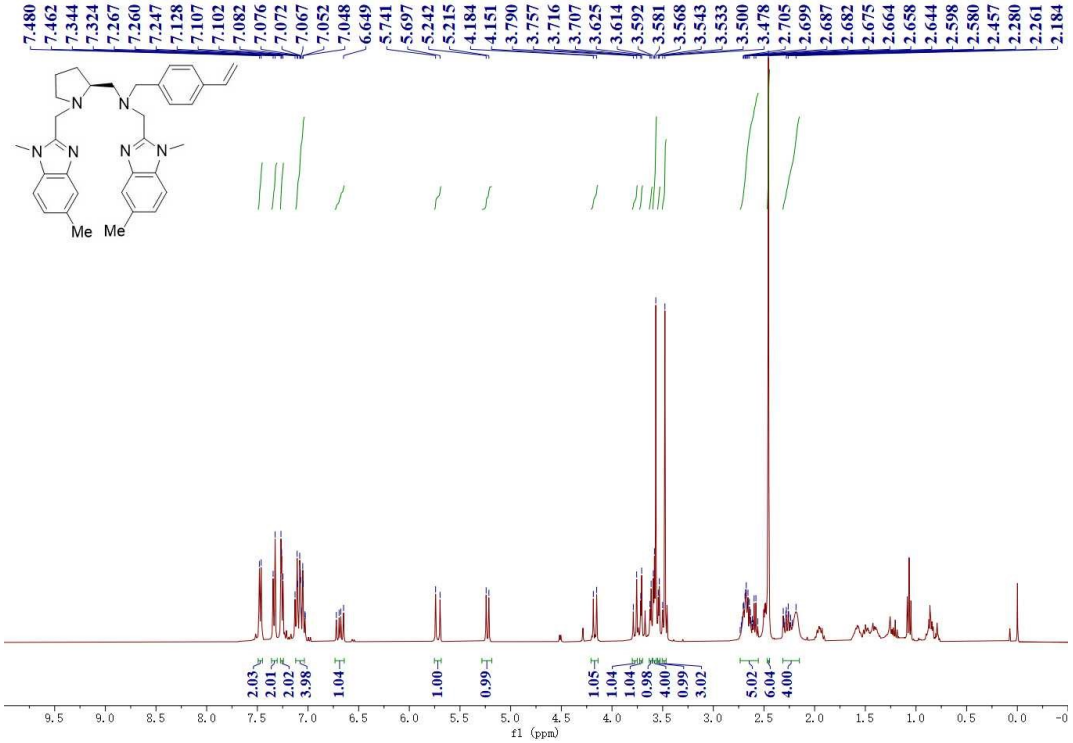


^{1}H NMR (400 MHz) in $CDCl_3$

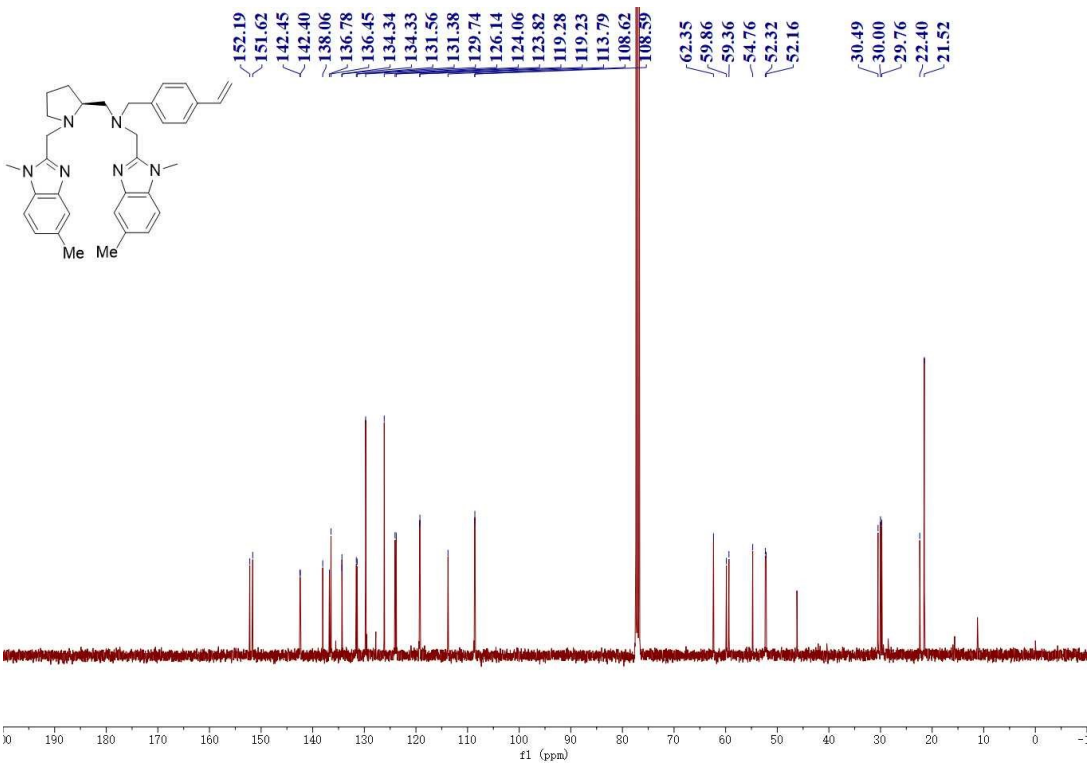


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-1-(1,5-dimethyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((1,5-dimethyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L3)

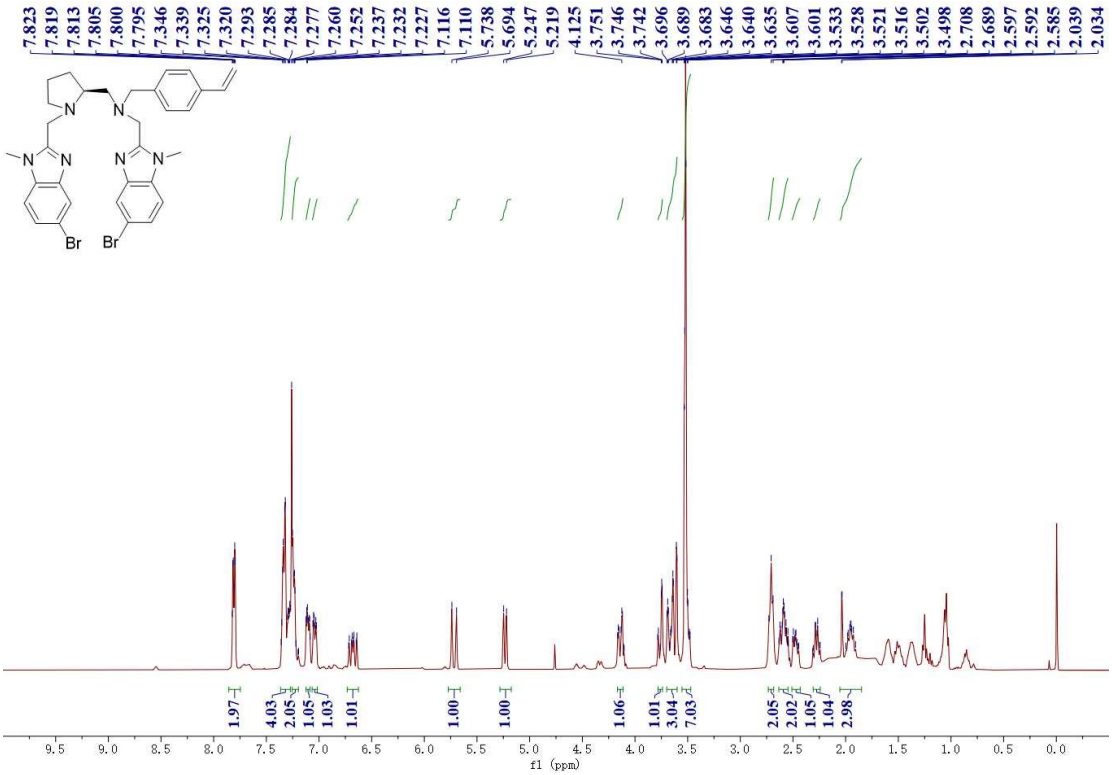


^{1}H NMR (400 MHz) in $CDCl_3$

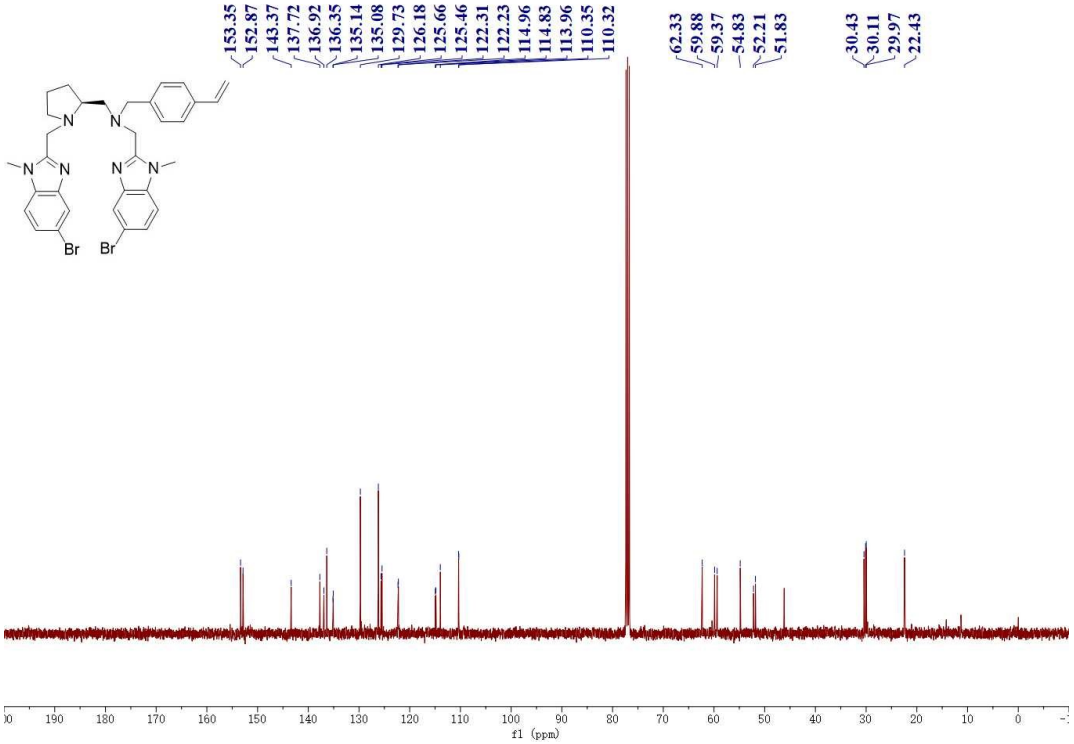


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-1-(5-bromo-1-methyl-1*H*-benzo[d]imidazol-2-yl)-*N*-((1-((5-bromo-1-methyl-1*H*-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L4)

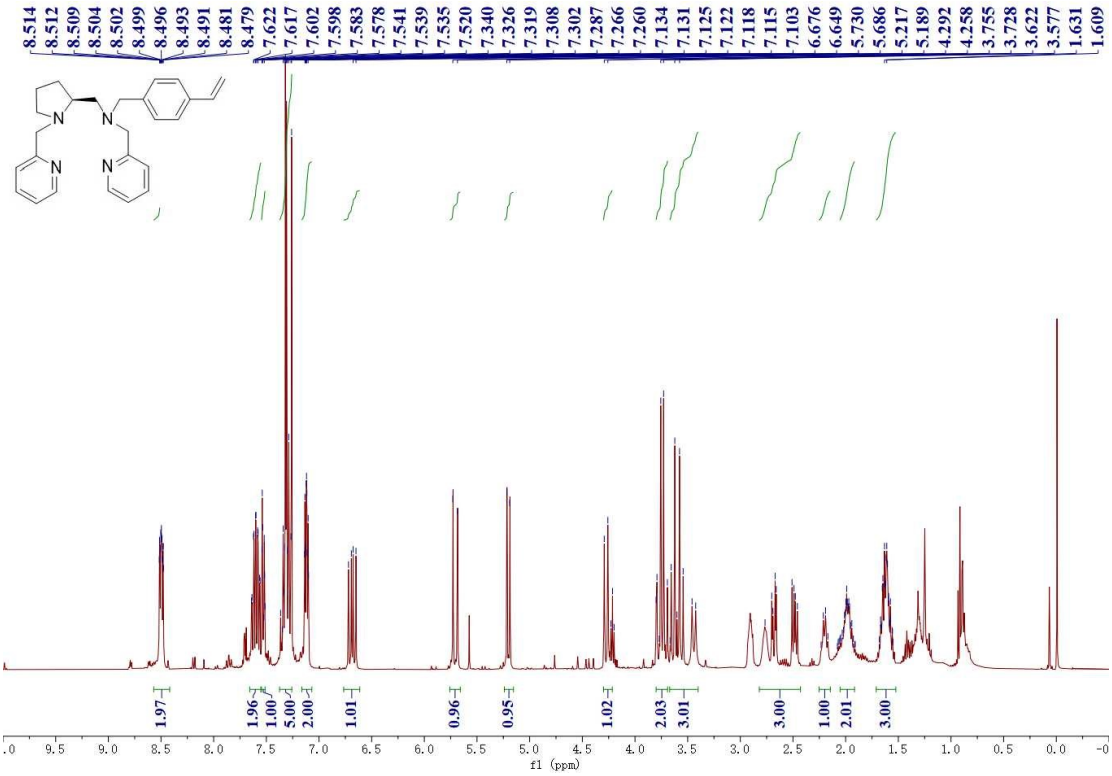


^{1}H NMR (400 MHz) in $CDCl_3$

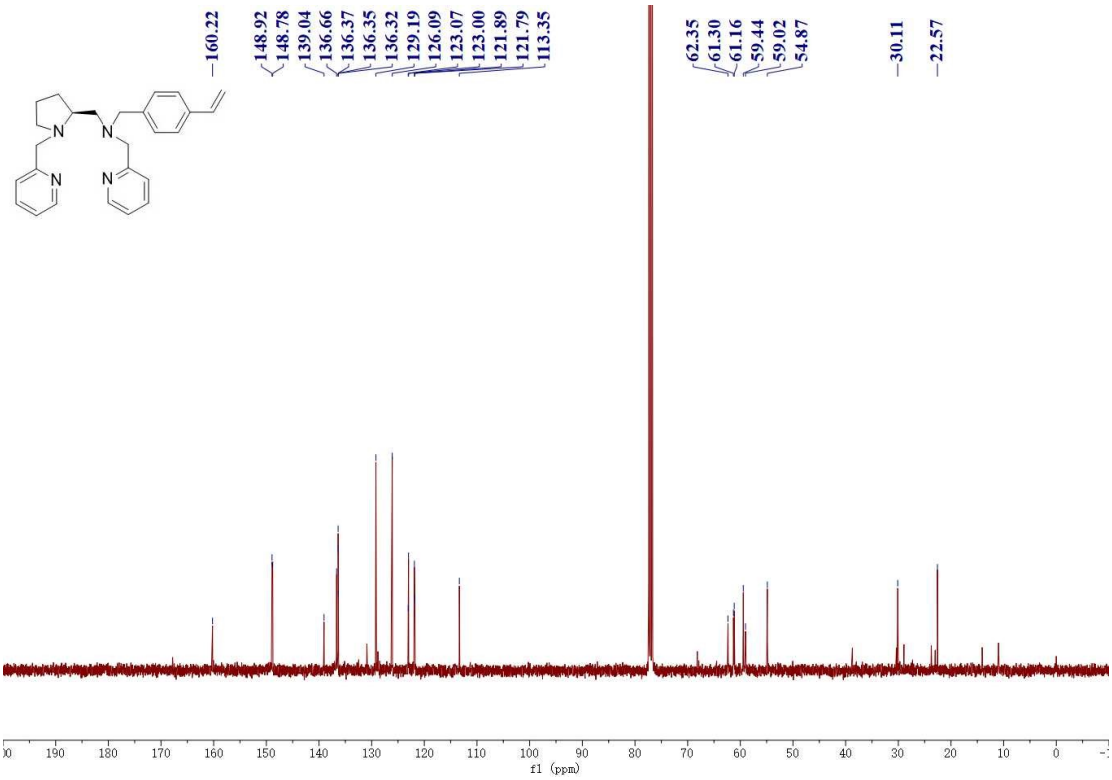


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-1-(pyridin-2-yl)-*N*-((1-(pyridin-2-ylmethyl)pyrrolidin-2-yl)methyl)-*N*-(4-vinylbenzyl)methanamine (L5)

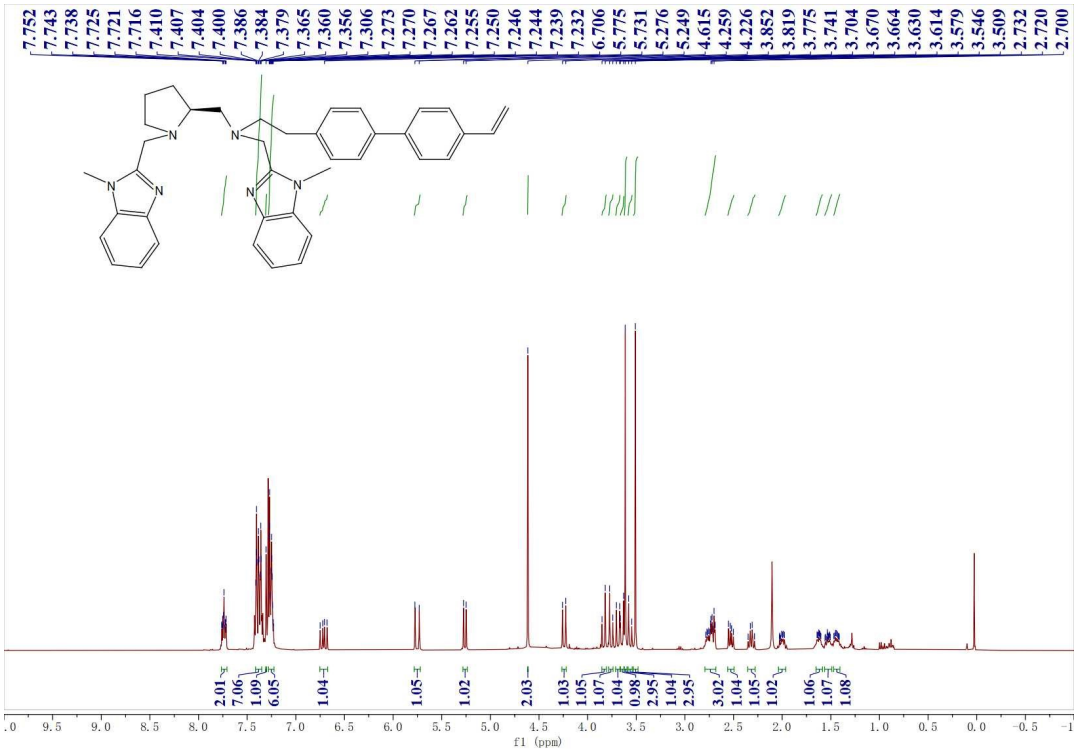


^{1}H NMR (400 MHz) in $CDCl_3$

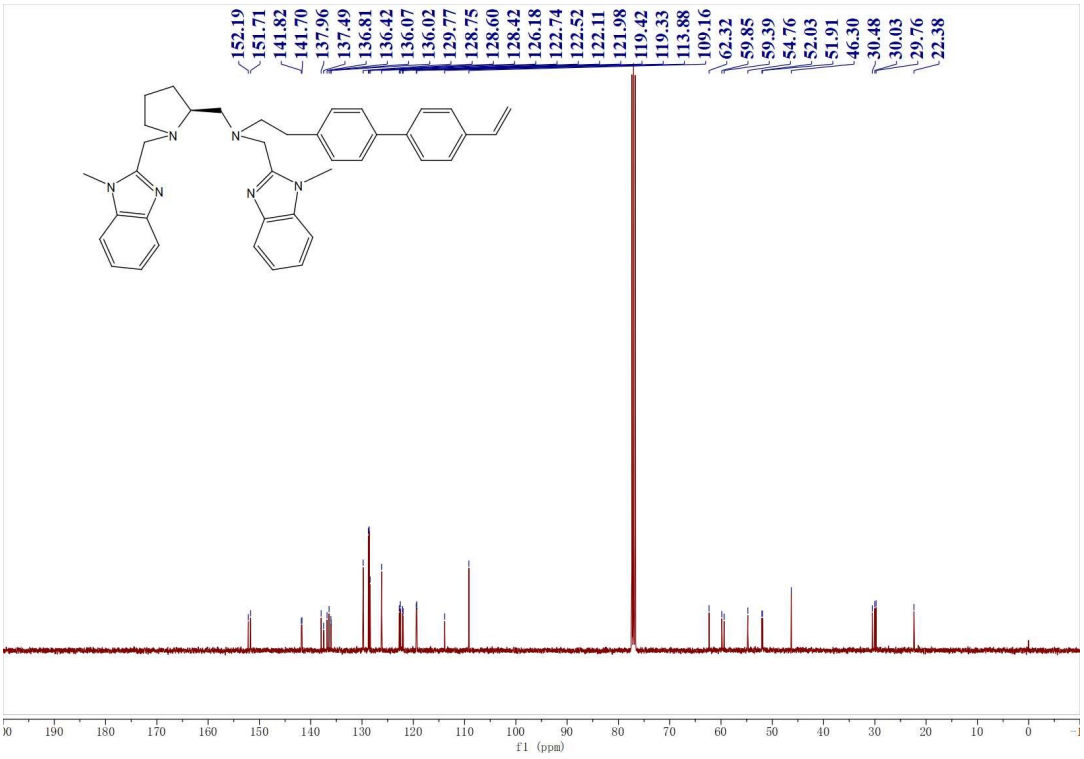


^{13}C NMR (100 MHz) in $CDCl_3$

(*S*)-N-((1-methyl-1H-benzo[d]imidazol-2-yl)methyl)-N-((1-((1-methyl-1H-benzo[d]imidazol-2-yl)methyl)pyrrolidin-2-yl)methyl)-2-(4'-vinyl-[1,1'-biphenyl]-4-yl)ethan-1-amine (L6)

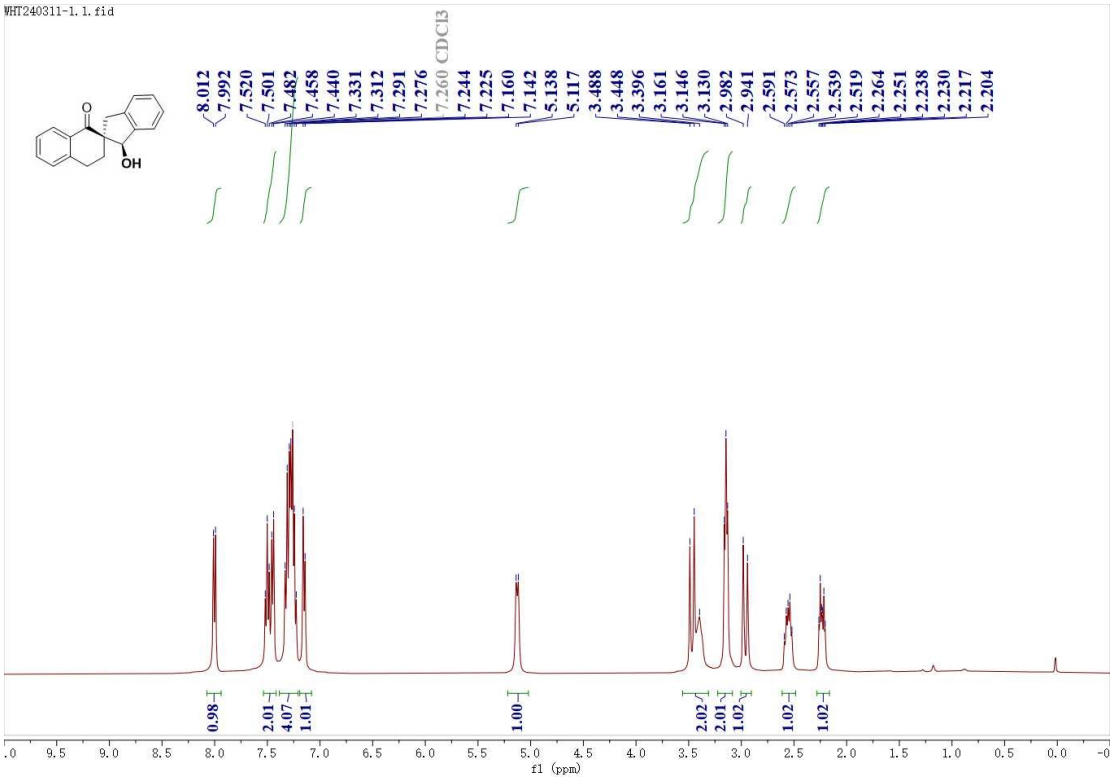


^{1}H NMR (400 MHz) in $CDCl_3$

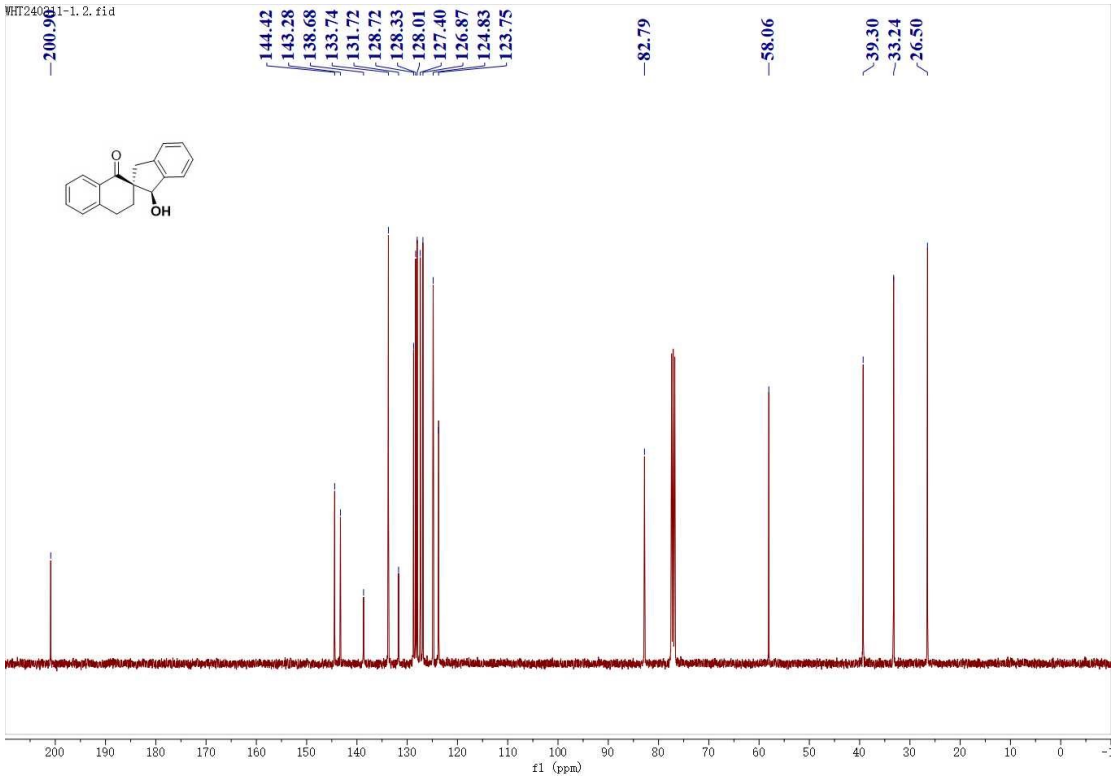


^{13}C NMR (100 MHz) in $CDCl_3$

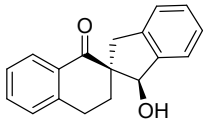
(1*R*,2*S*)-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2a)

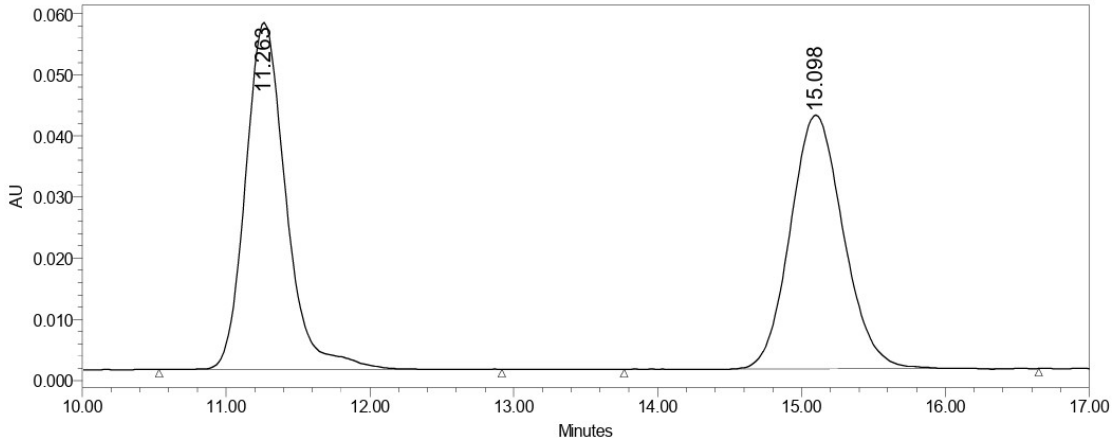


^{1}H NMR (400 MHz) in $CDCl_3$

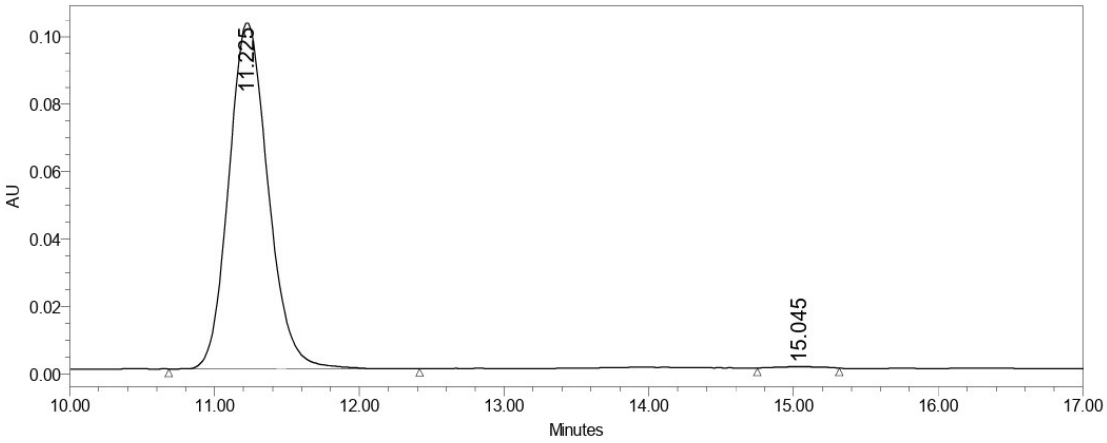


^{13}C NMR (100 MHz) in $CDCl_3$



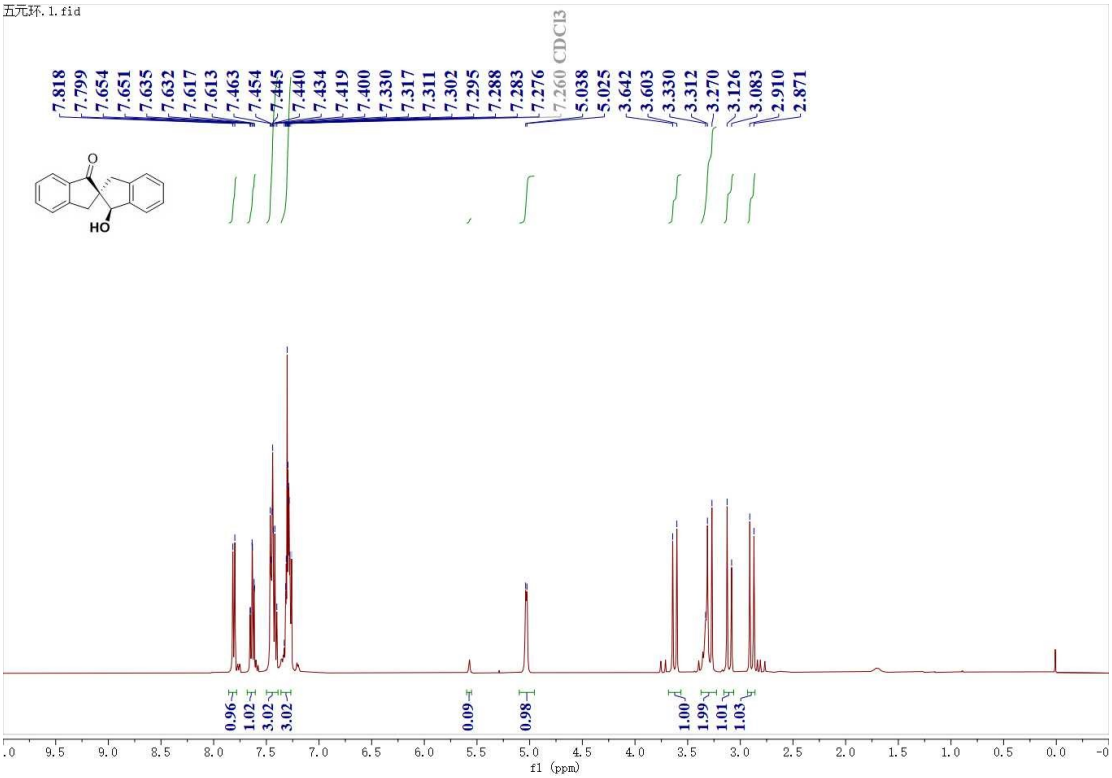


Peak#	Ret. Time	Area	Height	Area %
1	11.263	1108640	56767	50.92
2	15.098	1068591	41525	49.08

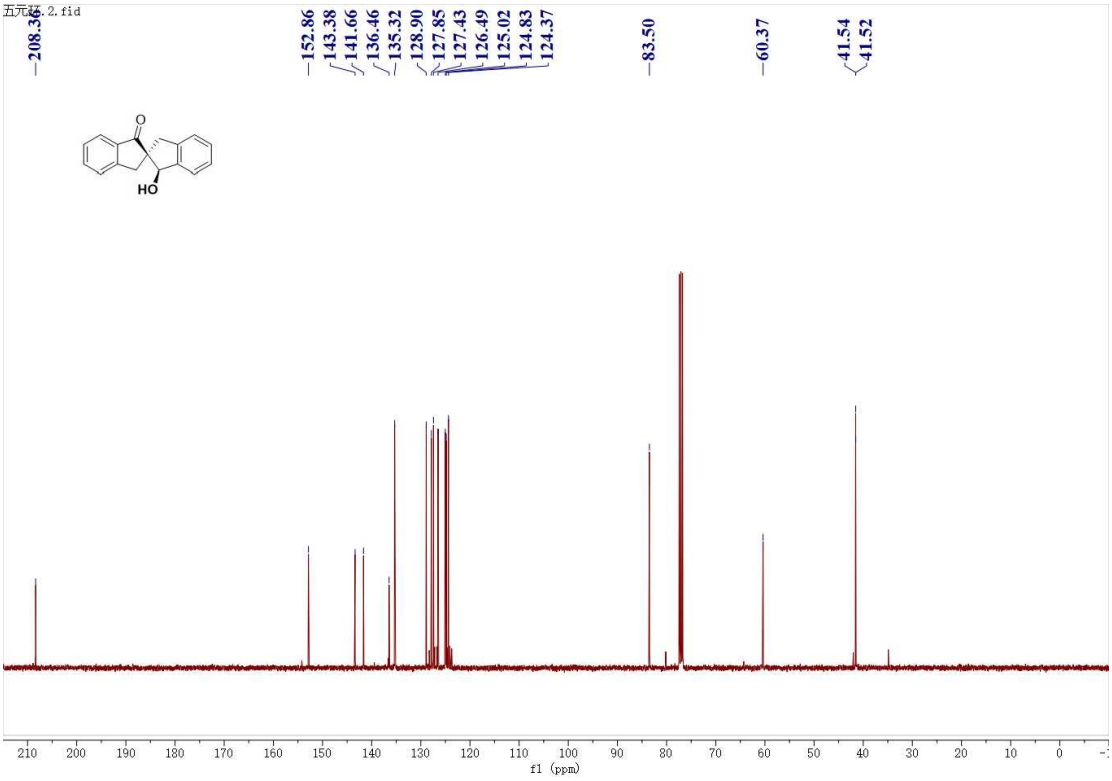


Peak#	Ret. Time	Area	Height	Area %
1	11.225	1936354	102702	99.57
2	15.045	8434	424	0.43

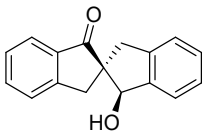
(1'*R*,2*R*)-1'-hydroxy-1',3'-dihydro-2,2'-spirobi[inden]-1(3*H*)-one (2b)

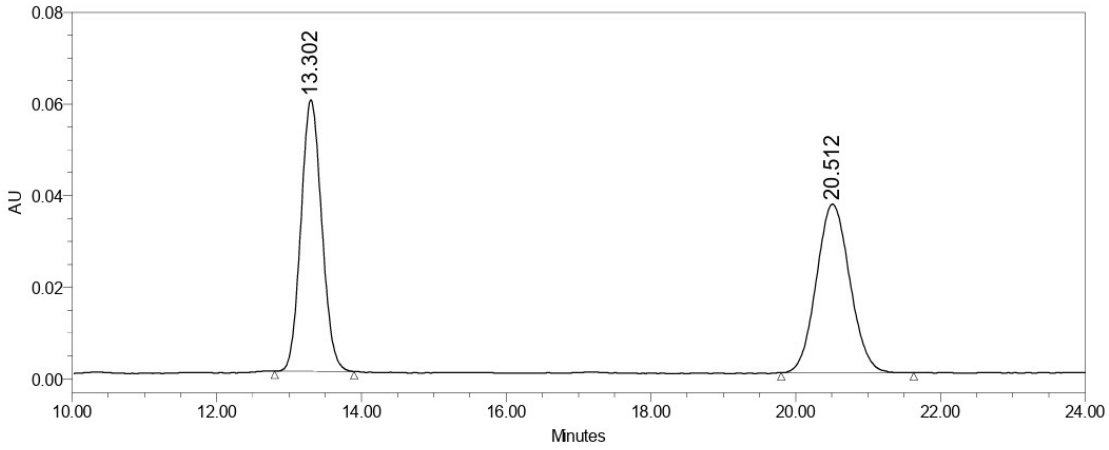


^{1}H NMR (400 MHz) in $CDCl_3$

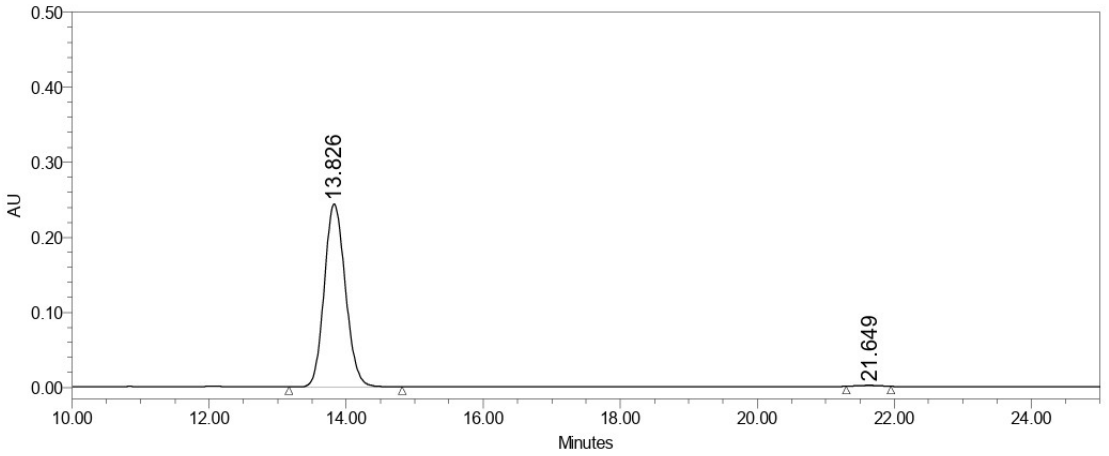


^{13}C NMR (100 MHz) in $CDCl_3$



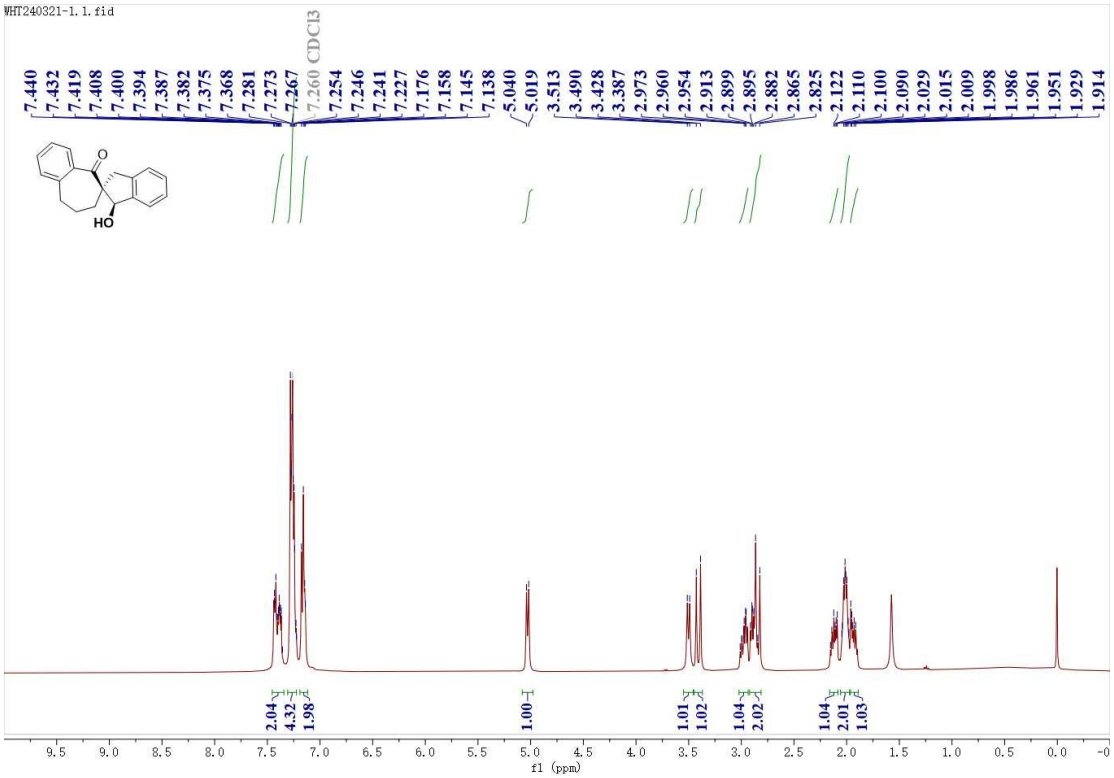


Peak#	Ret. Time	Area	Height	Area %
1	13.302	1181498	59308	50.00
2	20.512	1181607	36825	50.00

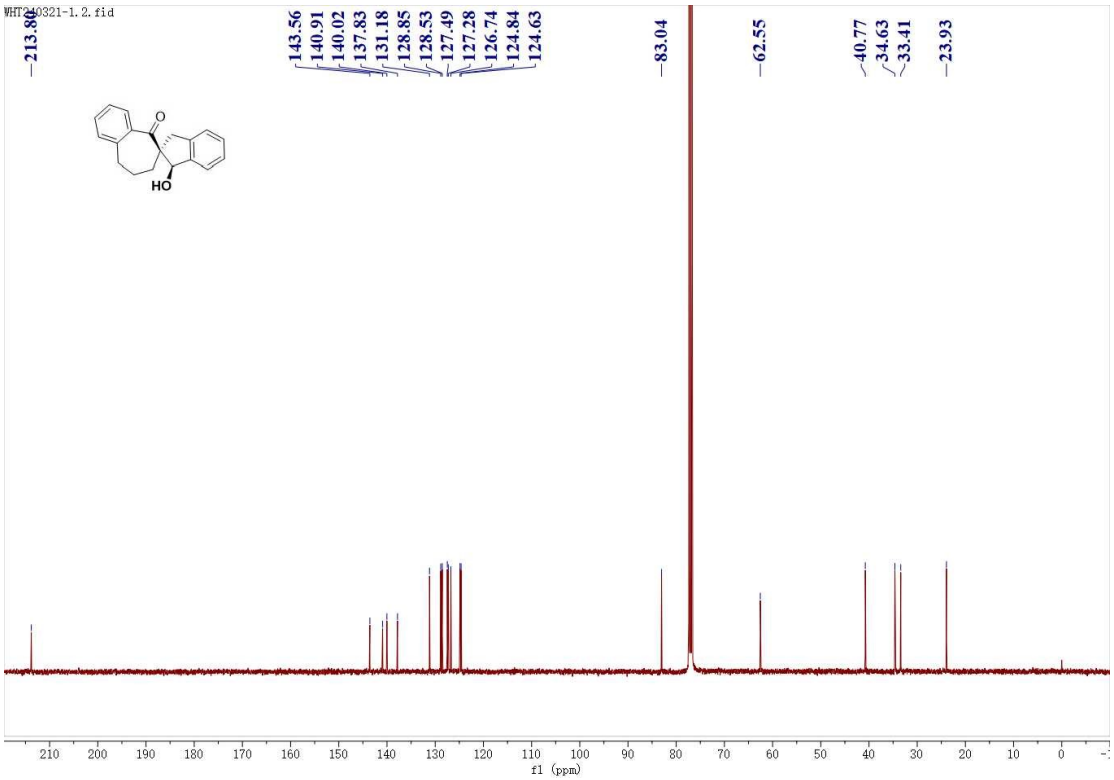


Peak#	Ret. Time	Area	Height	Area %
1	13.826	5195818	243725	99.49
2	21.649	26450	1155	0.51

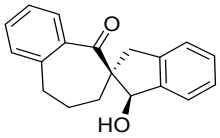
(1'*R*,6*S*)-1'-hydroxy-1',3',8,9-tetrahydrospiro[benzo[7]annulene-6,2'-inden]-5(7*H*)-one (2c)

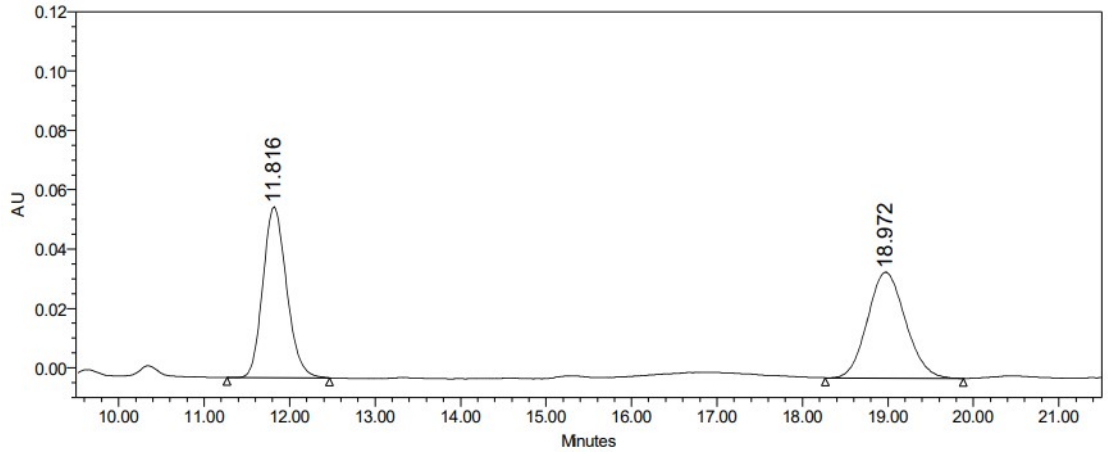


^{1}H NMR (400 MHz) in $CDCl_3$

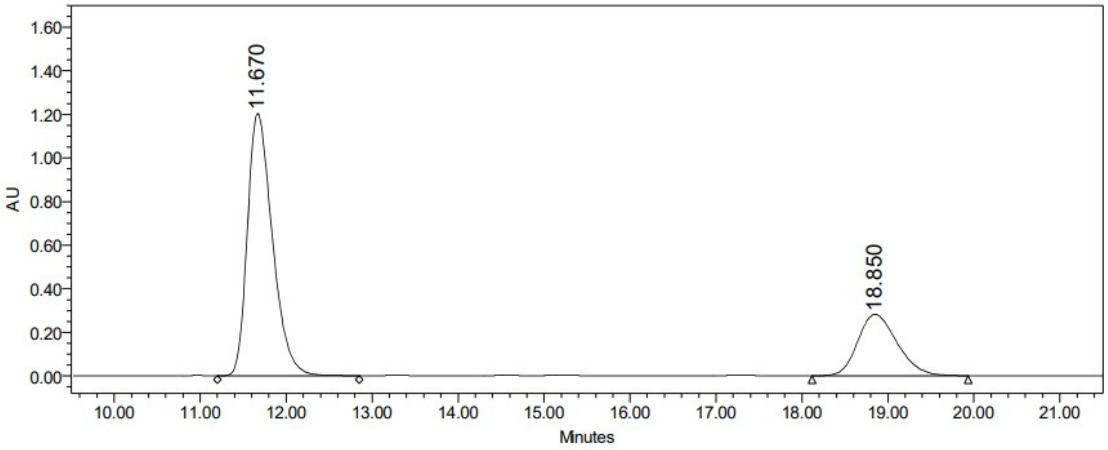


^{13}C NMR (100 MHz) in $CDCl_3$



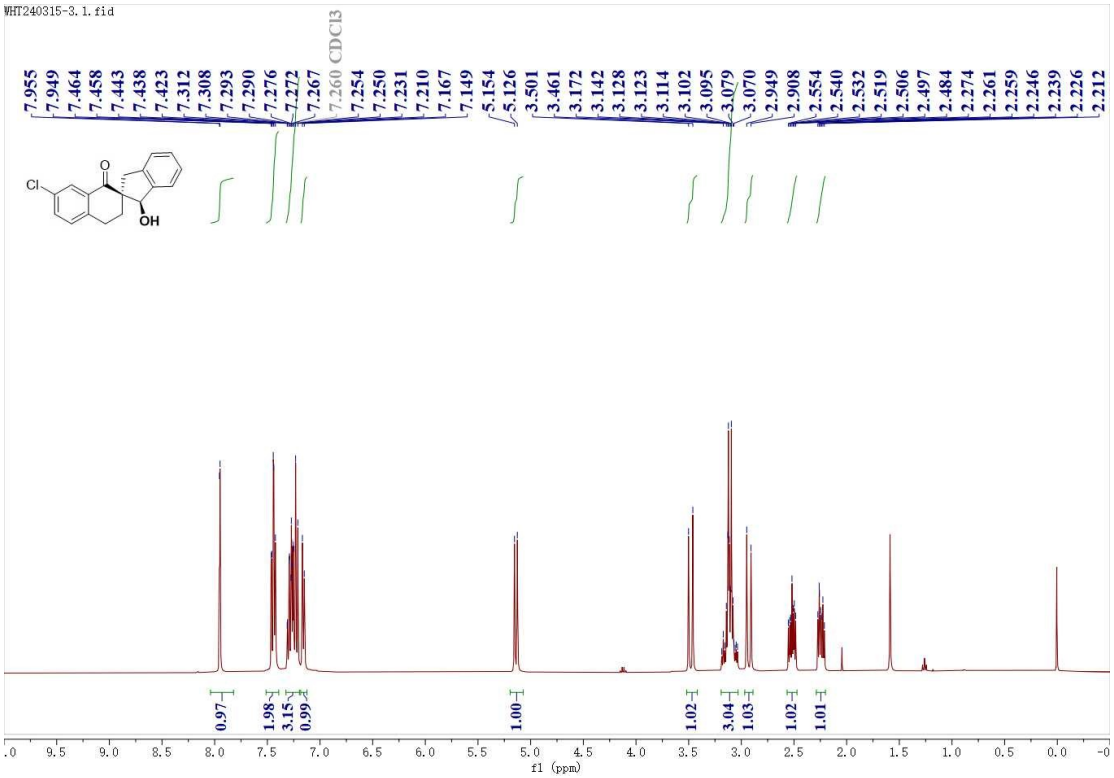


Peak#	Ret. Time	Area	Height	Area %
1	11.816	1108642	57513	50.18
2	18.972	1100790	35655	49.82

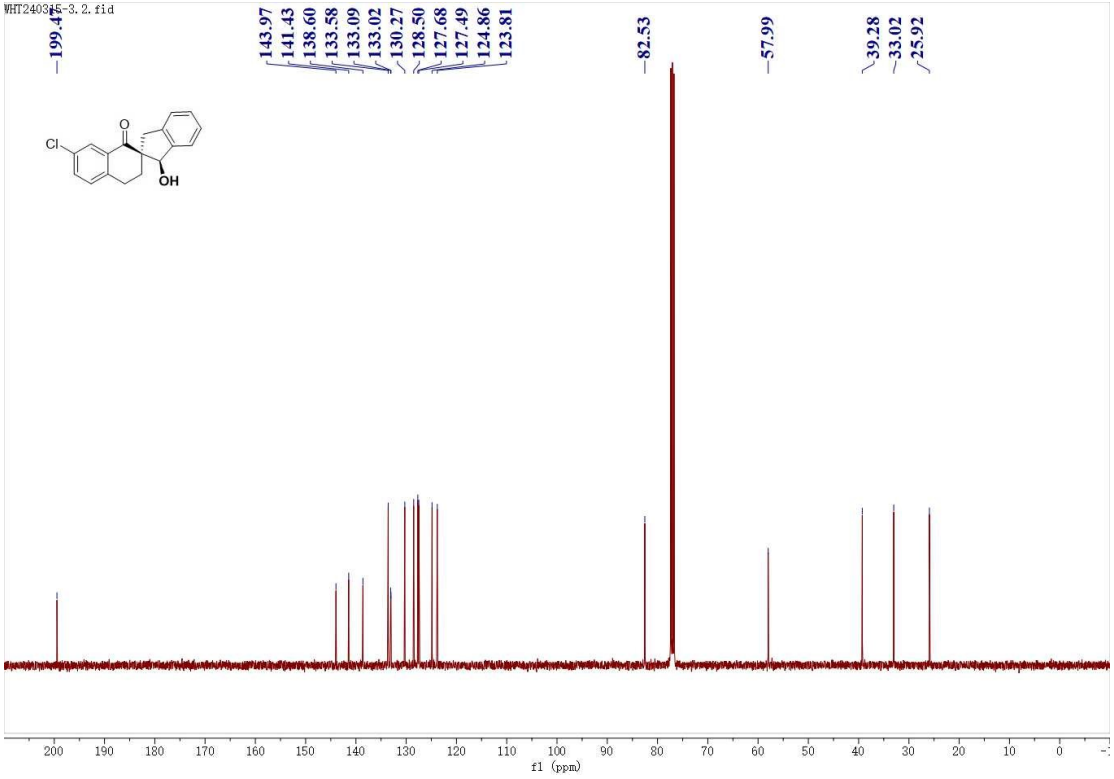


Peak#	Ret. Time	Area	Height	Area %
1	11.670	24316324	1202750	73.18
2	18.850	8912917	281267	26.82

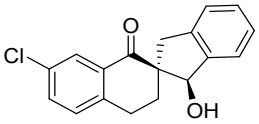
(1*R*,2*S*)-7'-chloro-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2d)

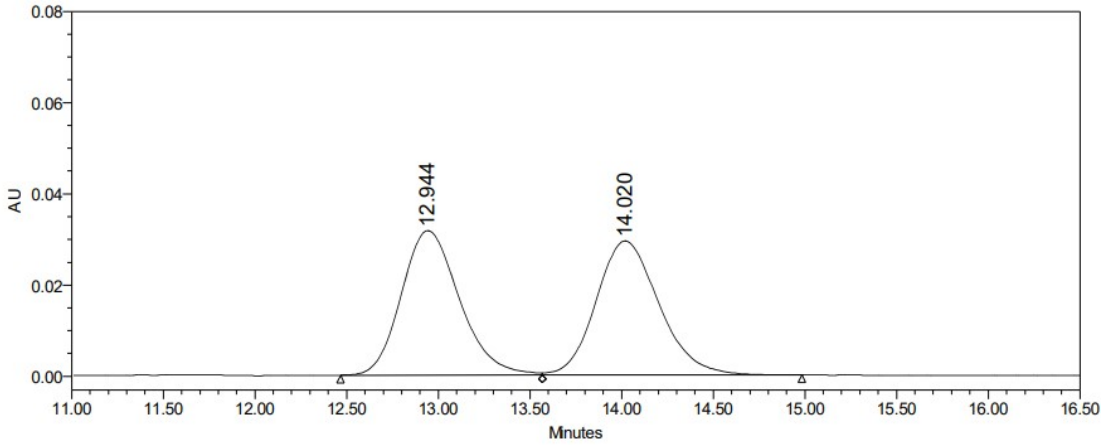


^{1}H NMR (400 MHz) in $CDCl_3$

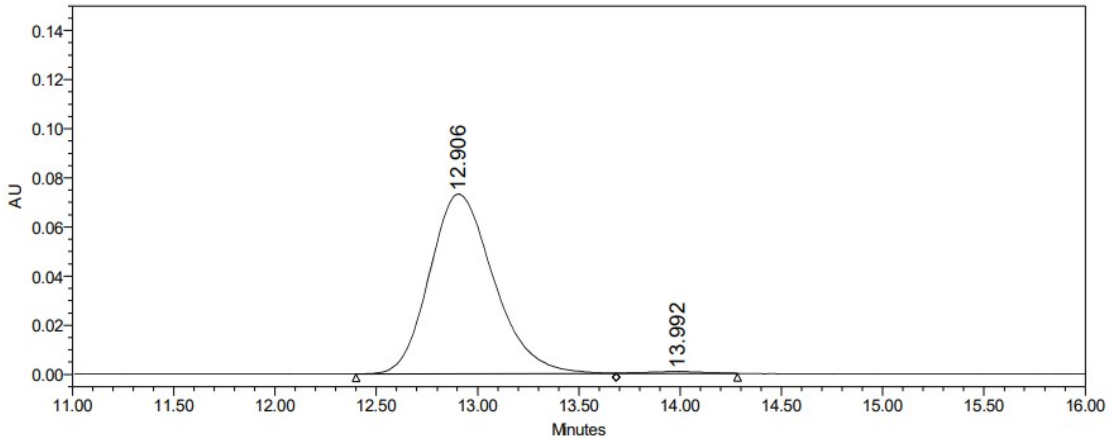


^{13}C NMR (100 MHz) in $CDCl_3$



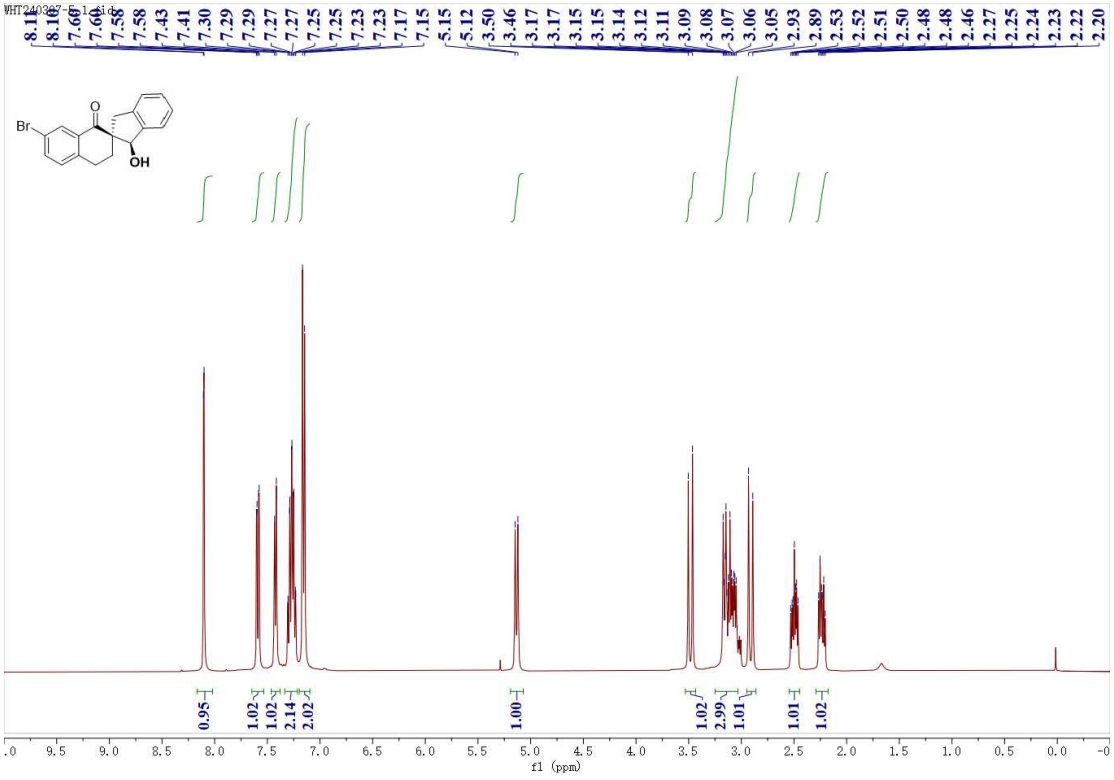


Peak#	Ret. Time	Area	Height	Area %
1	12.944	700441	31740	50.02
2	14.020	699894	29408	49.98

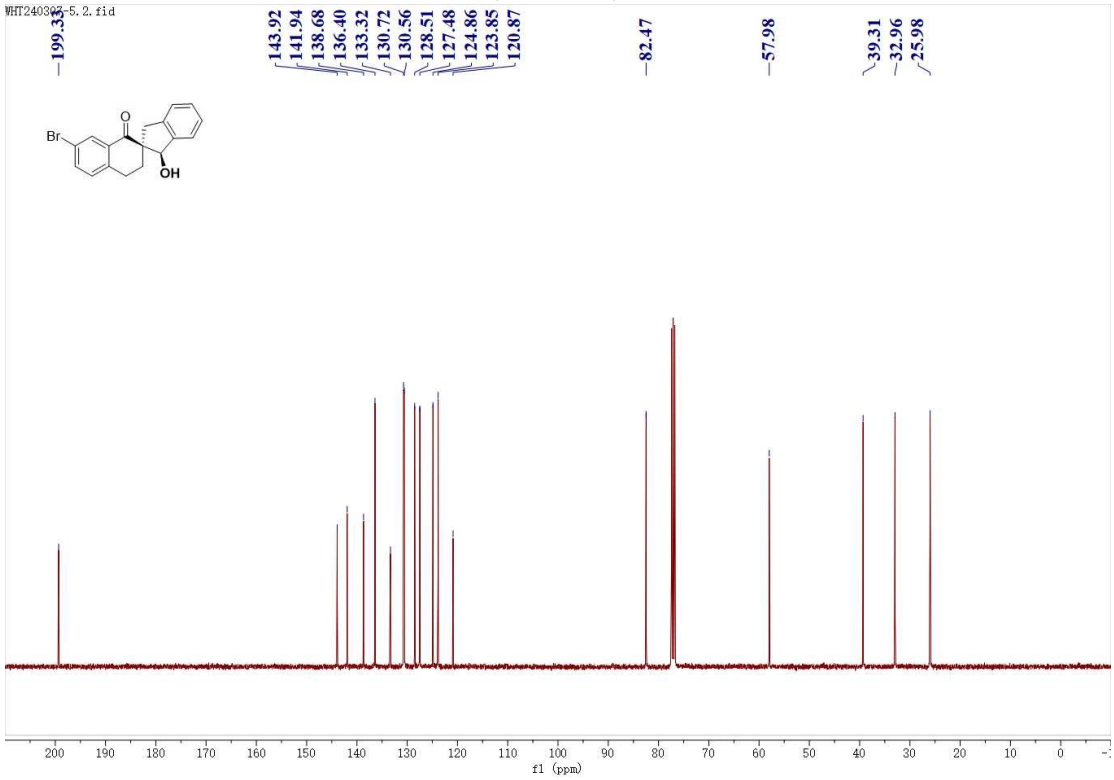


Peak#	Ret. Time	Area	Height	Area %
1	12.906	1614743	73179	99.02
2	13.992	16038	759	0.98

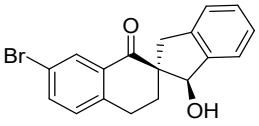
(1*R*,2*S*)-7'-bromo-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2e).

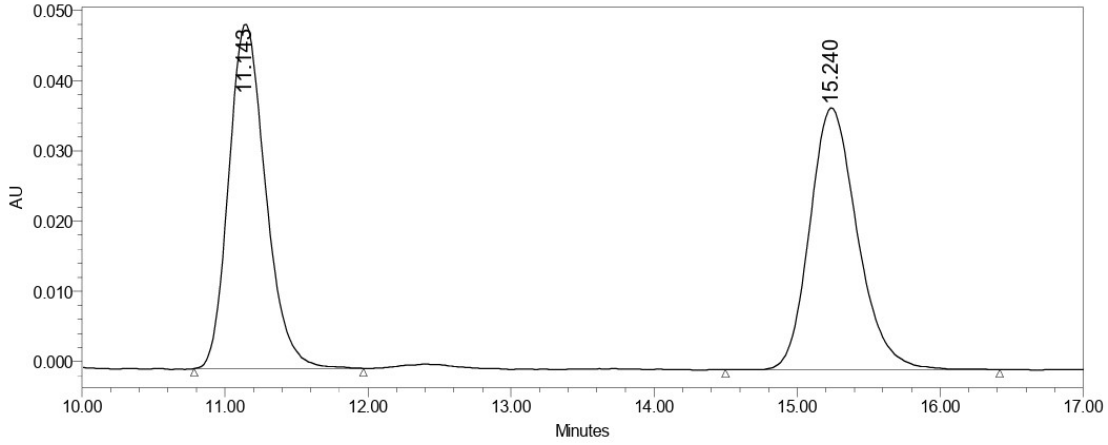


^{1}H NMR (400 MHz) in $CDCl_3$

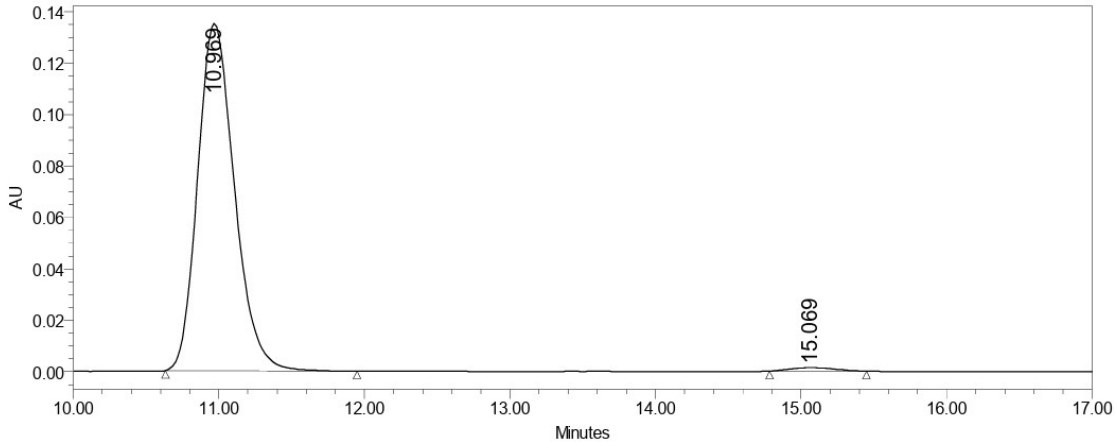


^{13}C NMR (100 MHz) in $CDCl_3$



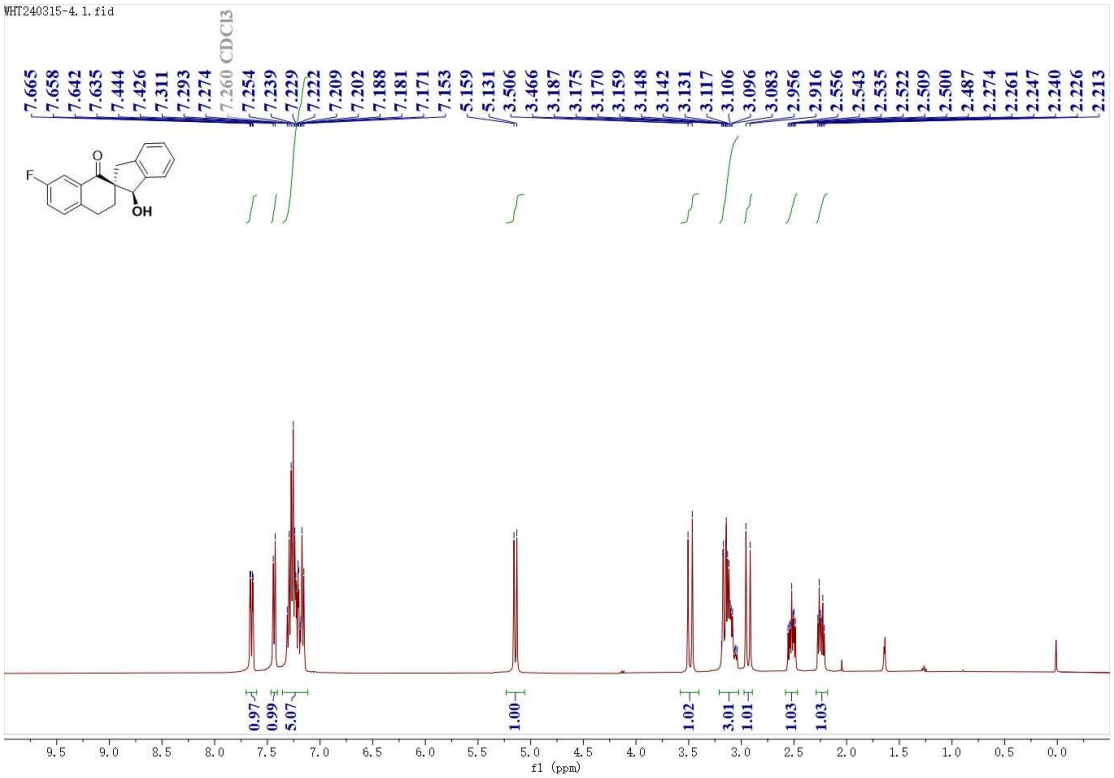


Peak#	Ret. Time	Area	Height	Area %
1	11.143	875696	49040	50.42
2	15.240	860987	37290	49.58

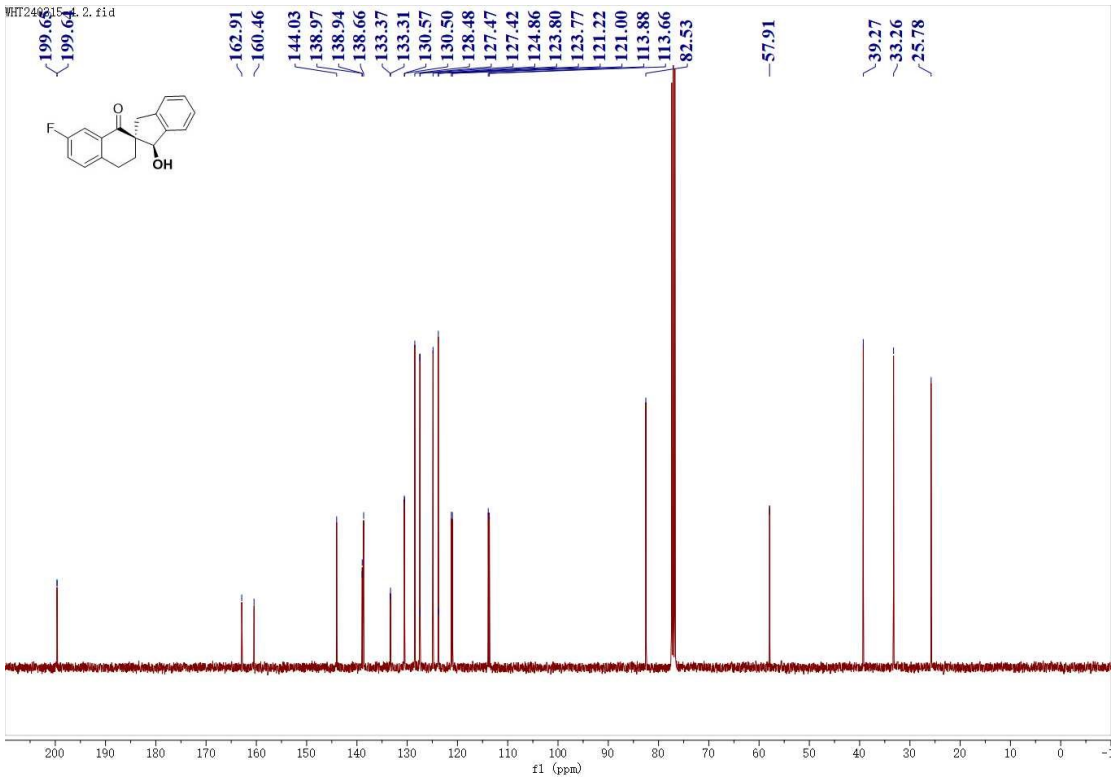


Peak#	Ret. Time	Area	Height	Area %
1	10.969	2370918	134983	98.86
2	15.069	27413	1361	1.14

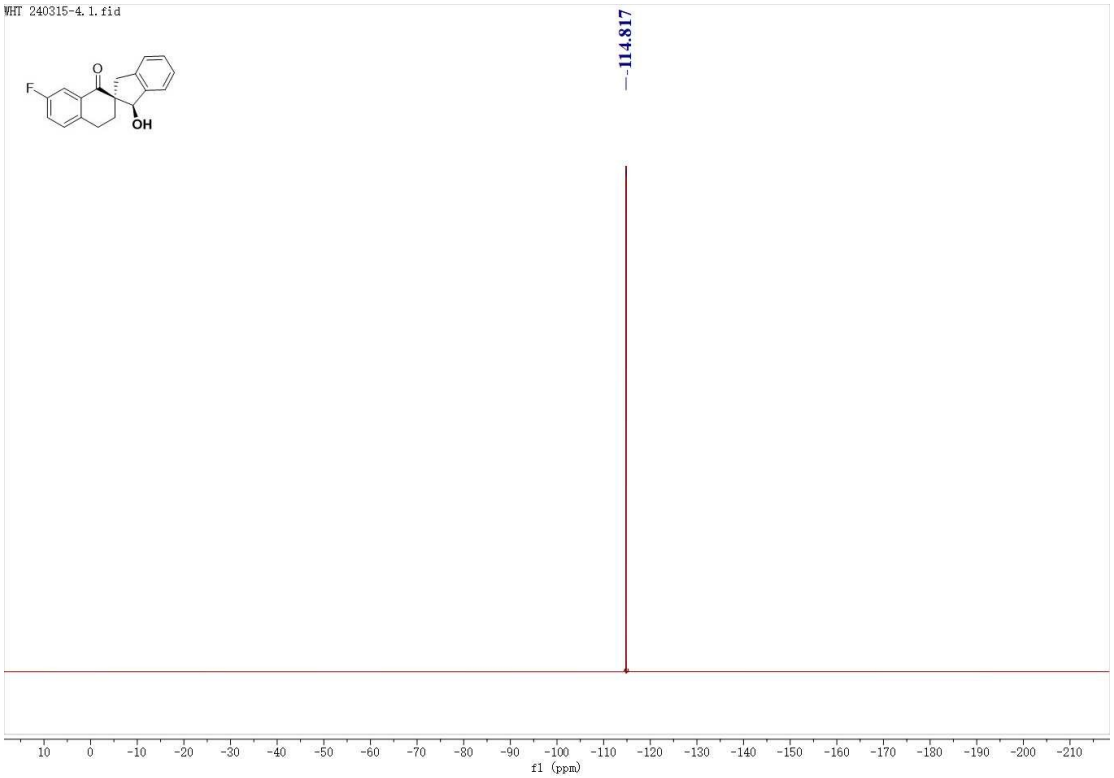
(1*R*,2*S*)-7'-fluoro-1-hydroxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2f)



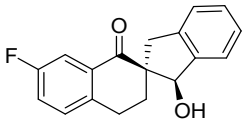
^{1}H NMR (400 MHz) in $CDCl_3$

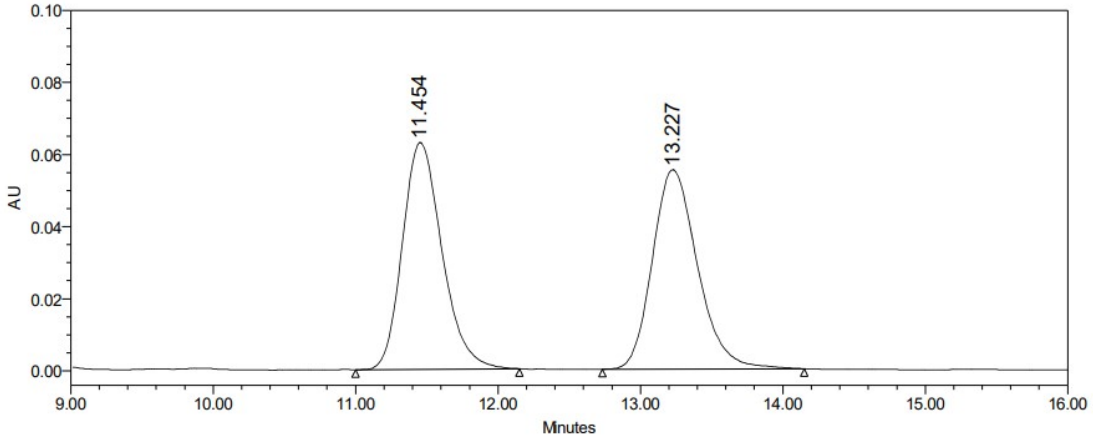


^{13}C NMR (100 MHz) in $CDCl_3$

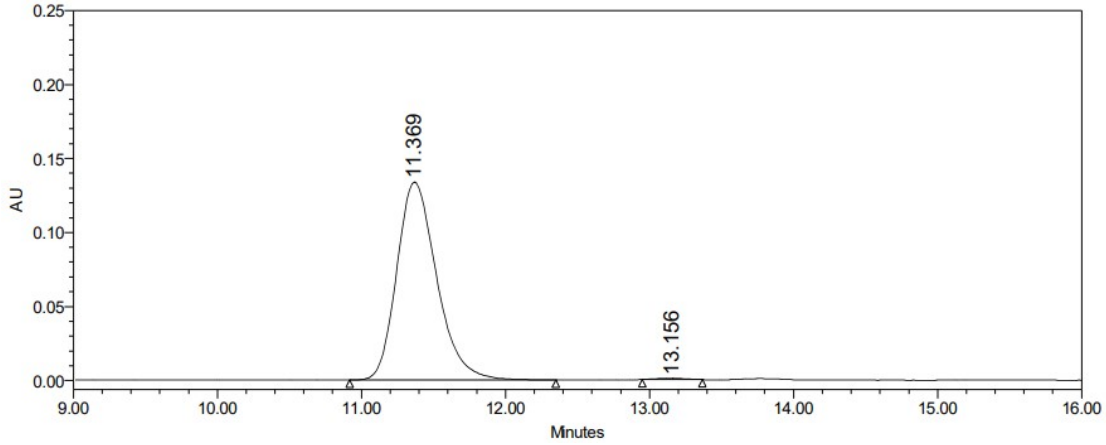


^{19}F NMR (376 MHz) in $CDCl_3$



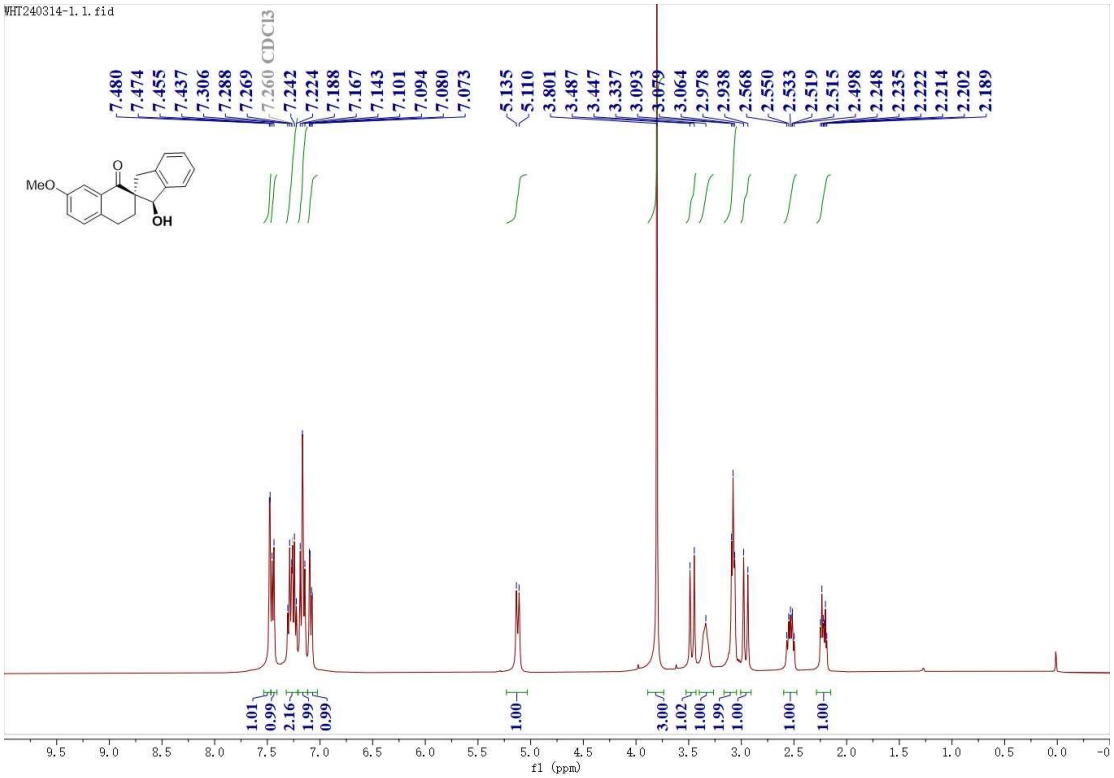


Peak#	Ret. Time	Area	Height	Area %
1	11.454	1214571	62959	49.92
2	13.227	1218493	55386	50.08

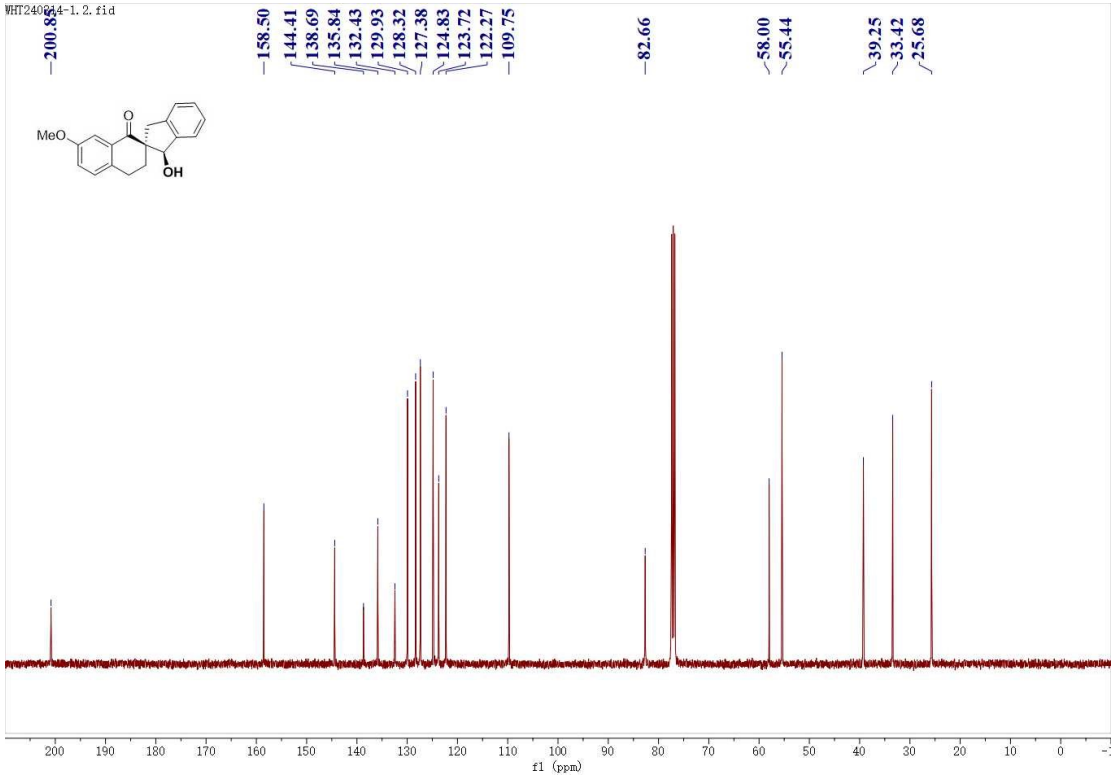


Peak#	Ret. Time	Area	Height	Area %
1	11.369	2571277	133702	99.60
2	13.156	10300	689	0.40

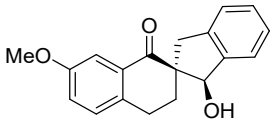
(1*R*,2*S*)-1-hydroxy-7'-methoxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2g)

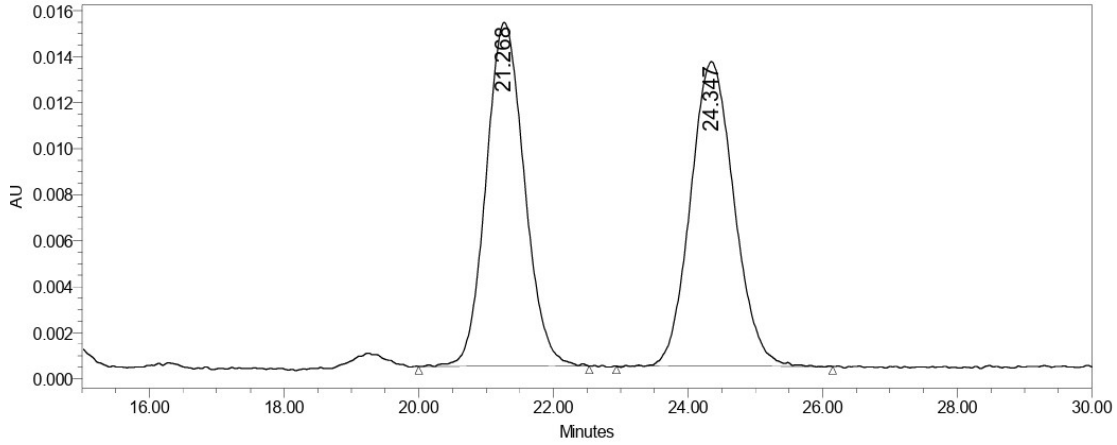


^{1}H NMR (400 MHz) in $CDCl_3$

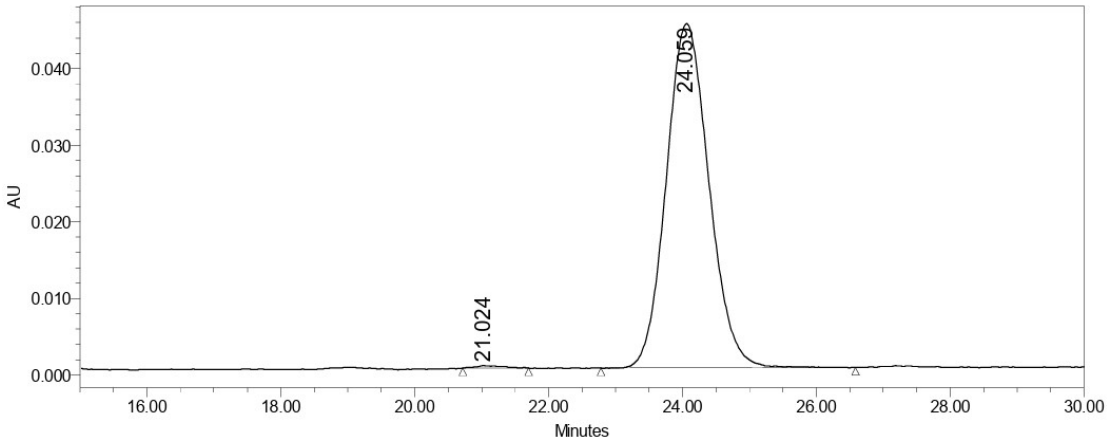


^{13}C NMR (100 MHz) in $CDCl_3$



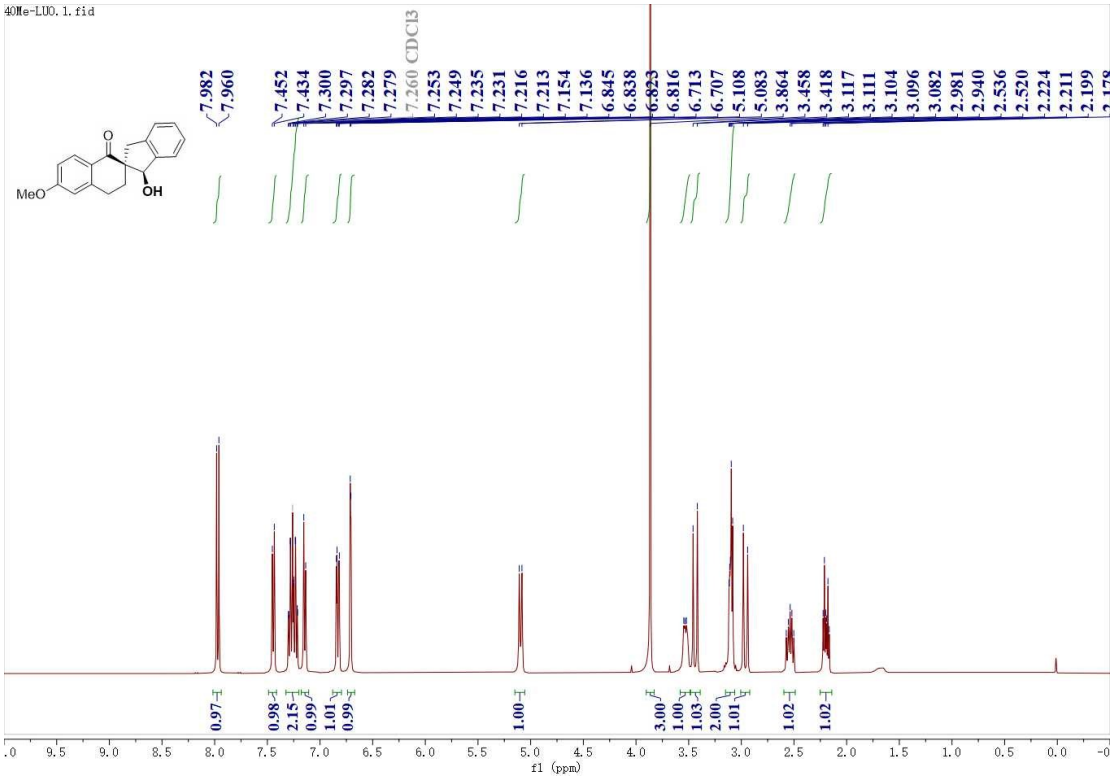


Peak#	Ret. Time	Area	Height	Area %
1	21.268	590825	14946	49.76
2	24.347	596602	13237	50.24

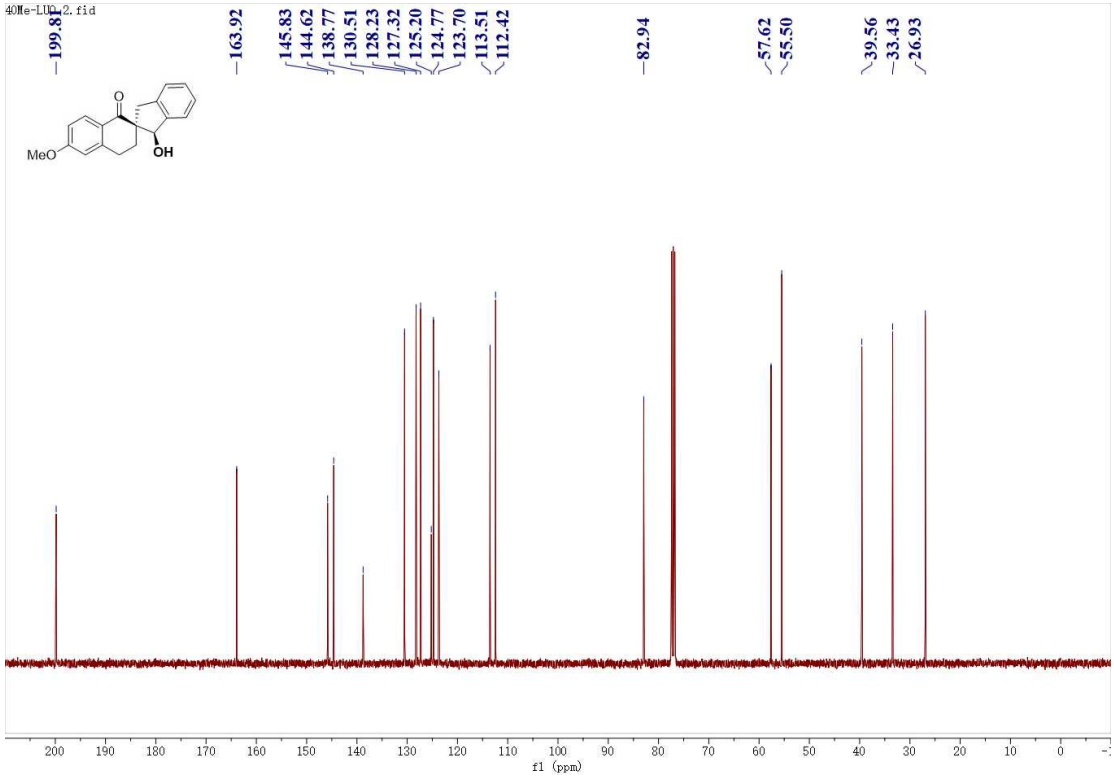


Peak#	Ret. Time	Area	Height	Area %
1	21.024	9366	338	0.47
2	24.059	1990530	44964	99.53

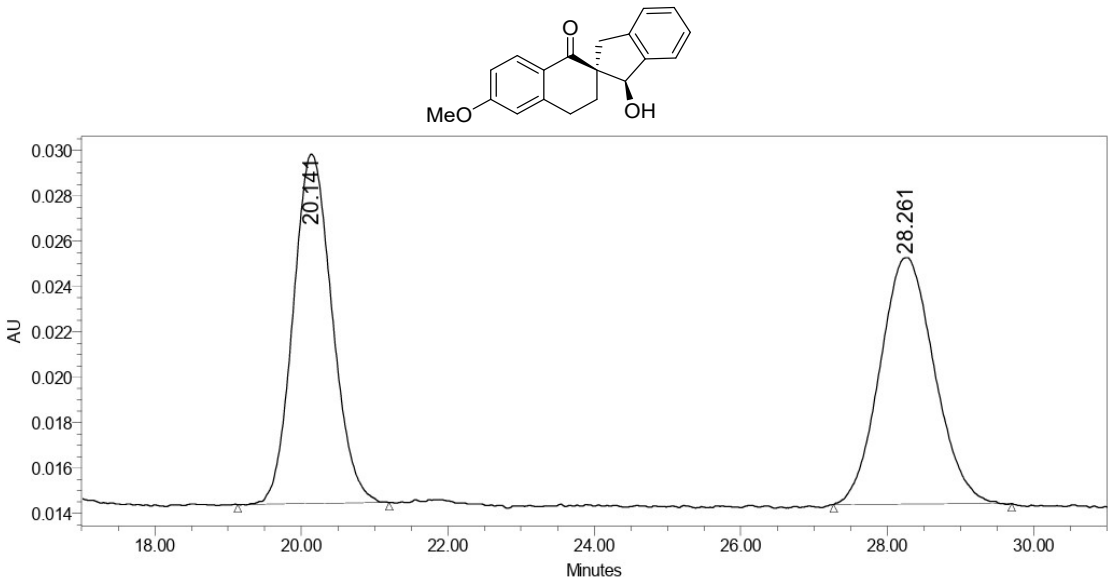
(1*R*,2*S*)-1-hydroxy-6'-methoxy-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2h)



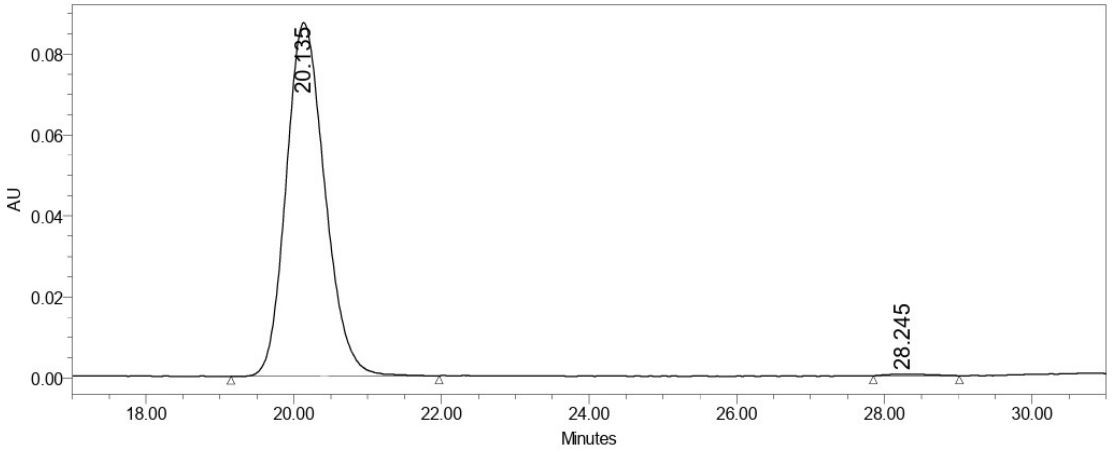
^{1}H NMR (400 MHz) in $CDCl_3$



^{13}C NMR (100 MHz) in $CDCl_3$

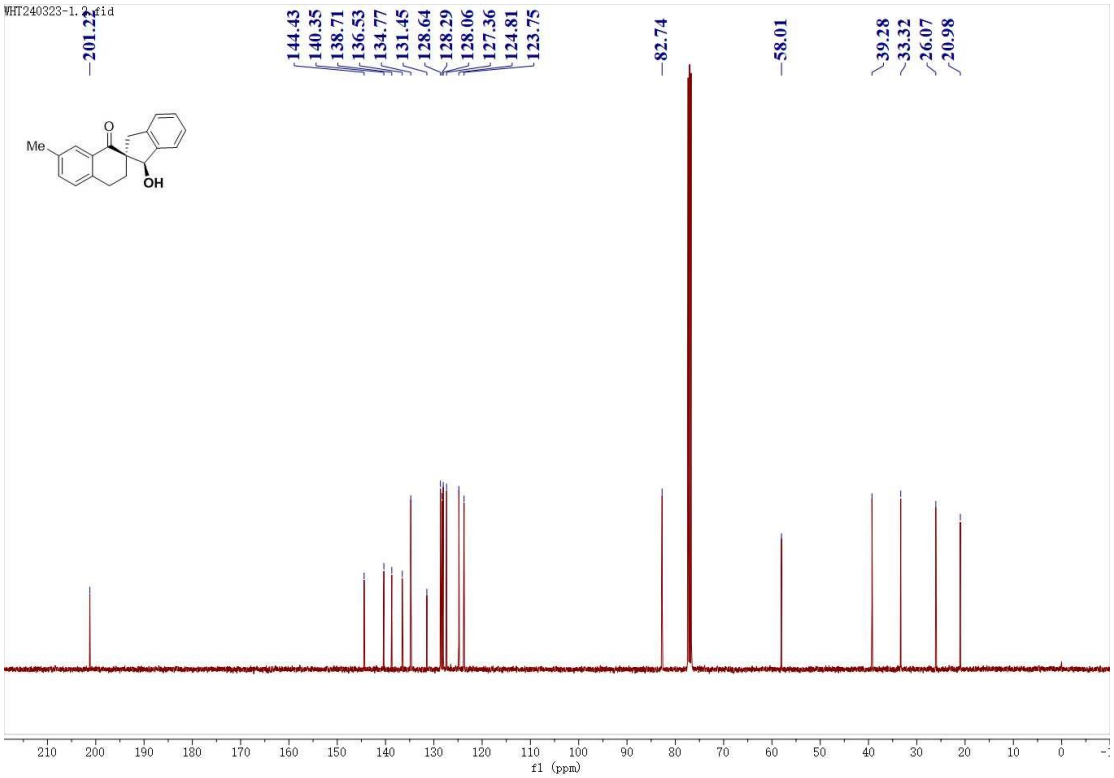


Peak#	Ret. Time	Area	Height	Area %
1	20.141	570390	15417	50.37
2	28.261	561987	10870	49.63

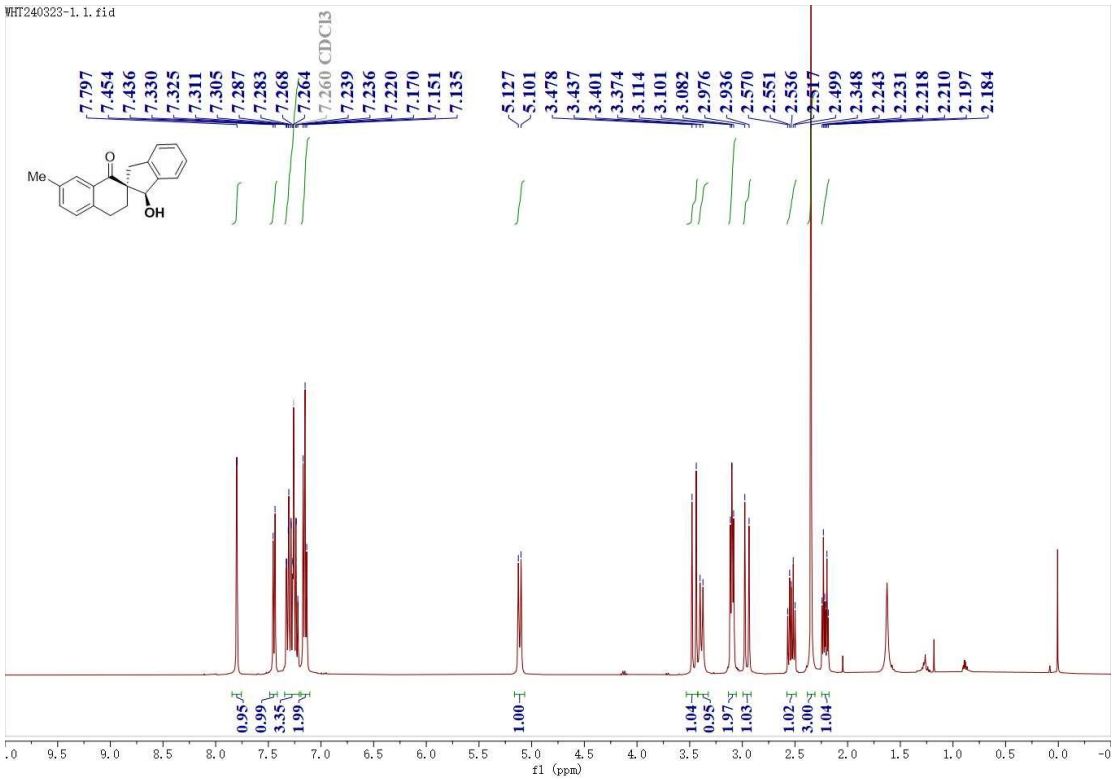


Peak#	Ret. Time	Area	Height	Area %
1	20.135	3172803	87274	99.54
2	28.245	14708	397	0.46

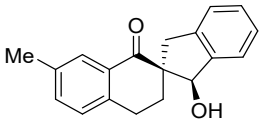
(1*R*,2*S*)-1-hydroxy-7'-methyl-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2i)

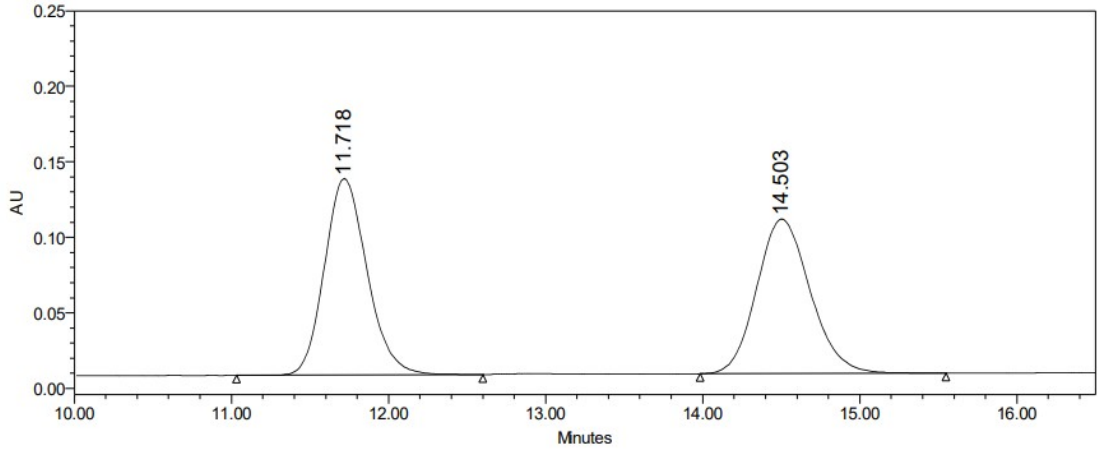


^{1}H NMR (400 MHz) in $CDCl_3$

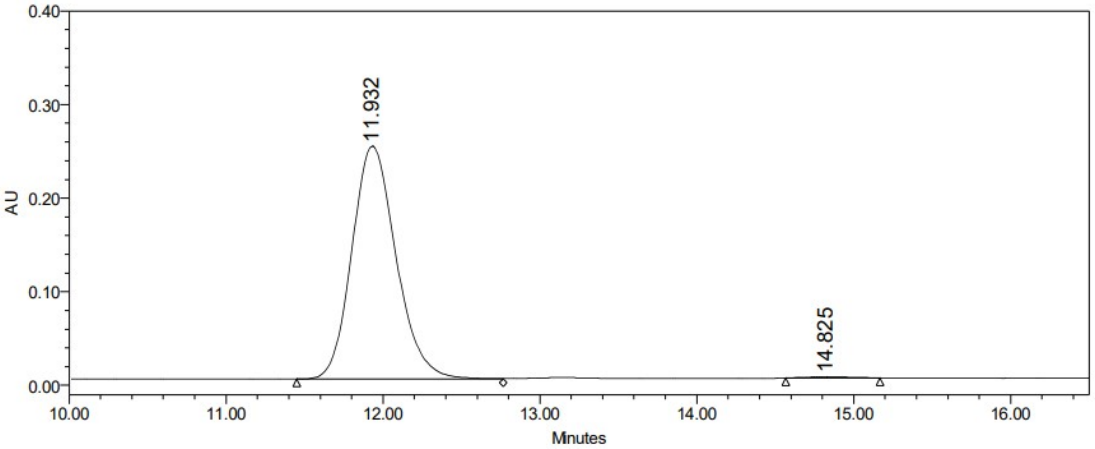


^{13}C NMR (100 MHz) in $CDCl_3$



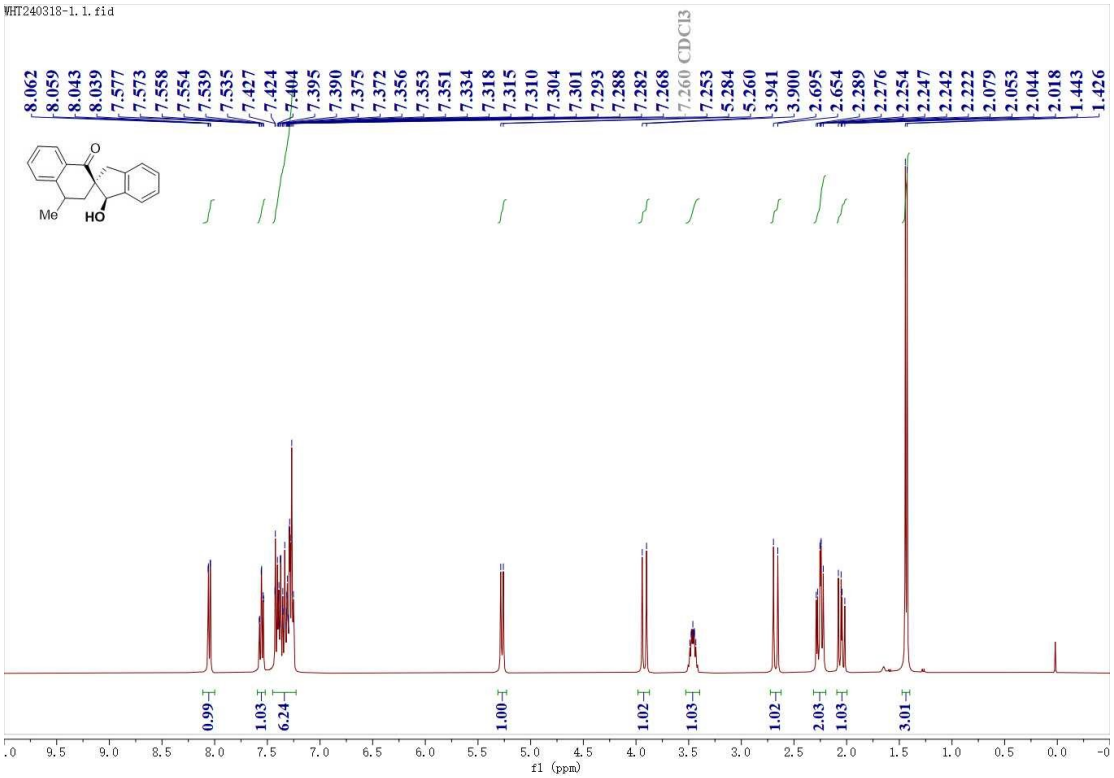


Peak#	Ret. Time	Area	Height	Area %
1	11.718	2446791	129974	50.28
2	14.503	2419134	102320	49.72

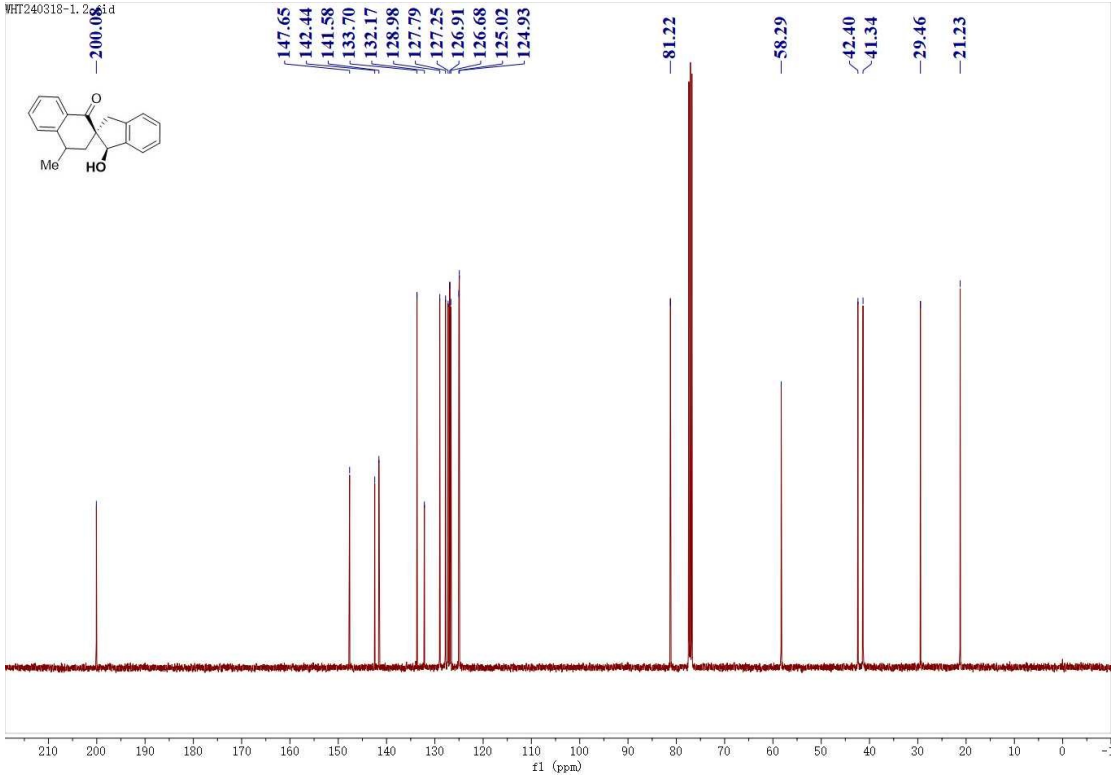


Peak#	Ret. Time	Area	Height	Area %
1	11.932	4868865	249073	99.51
2	14.825	23746	1249	0.49

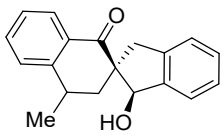
(1*R*,2*S*)-1-hydroxy-4'-methyl-1,3,3',4'-tetrahydro-1'*H*-spiro[indene-2,2'-naphthalen]-1'-one (2j)

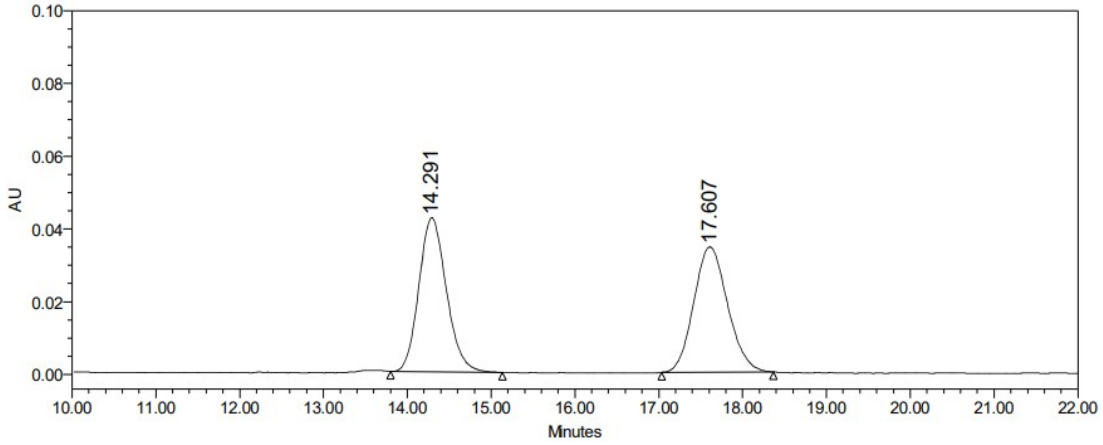


^{1}H NMR (400 MHz) in $CDCl_3$

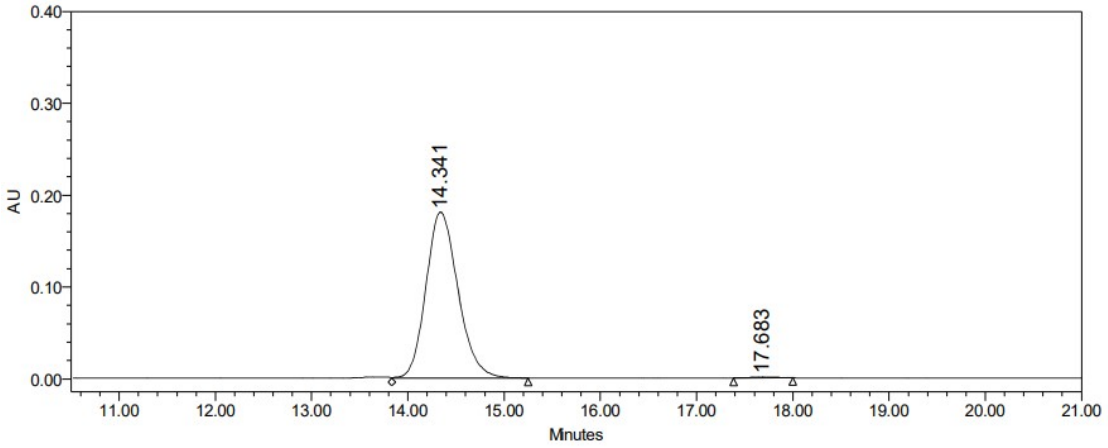


^{13}C NMR (100 MHz) in $CDCl_3$



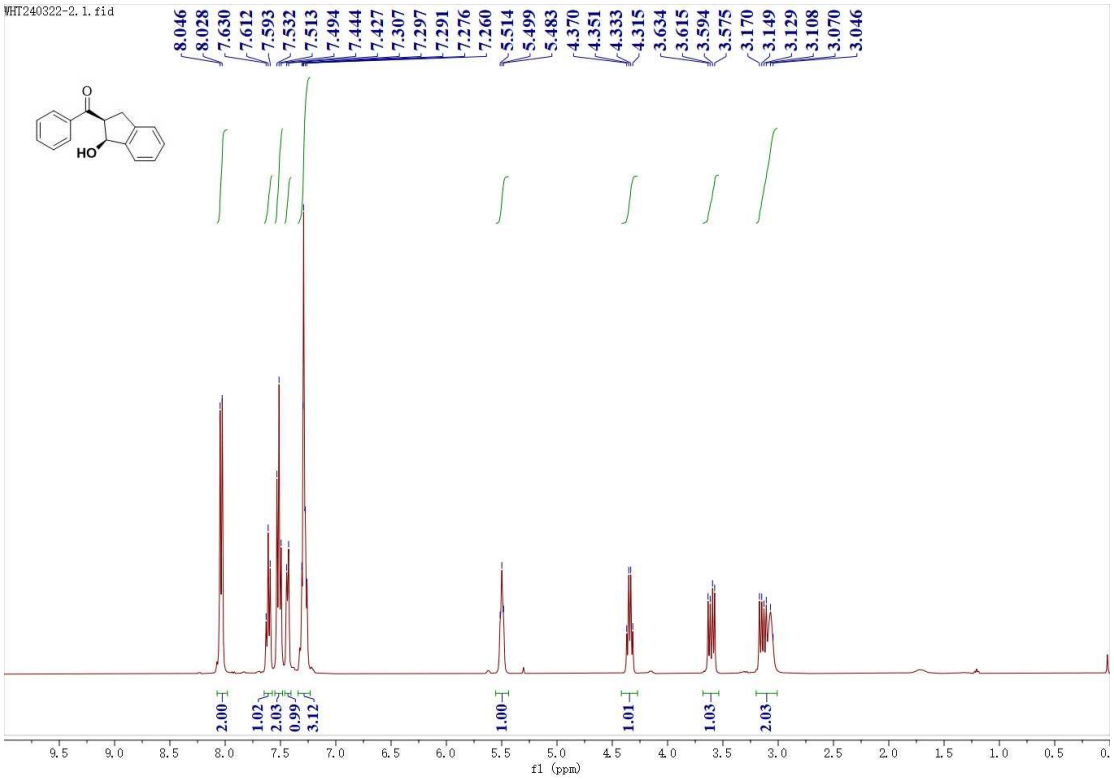


Peak#	Ret. Time	Area	Height	Area %
1	14.291	965448	42306	49.97
2	17.607	966704	34449	50.03

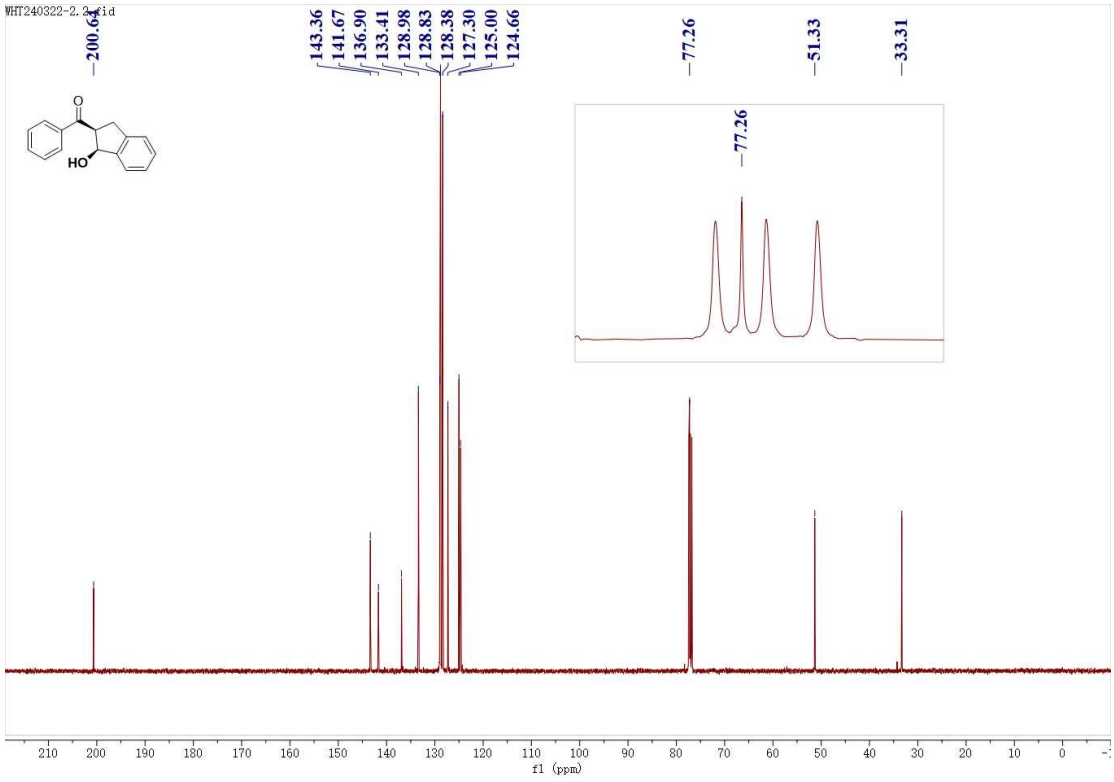


Peak#	Ret. Time	Area	Height	Area %
1	14.341	4185287	180792	99.50
2	17.683	20864	982	0.50

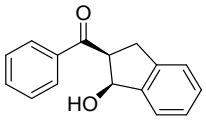
((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(phenyl)methanone (2k)

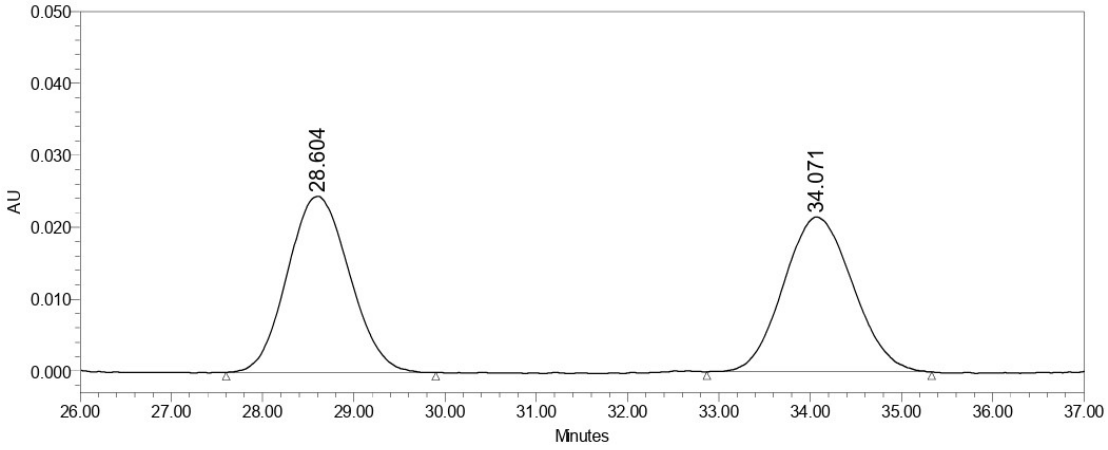


^{1}H NMR (400 MHz) in $CDCl_3$

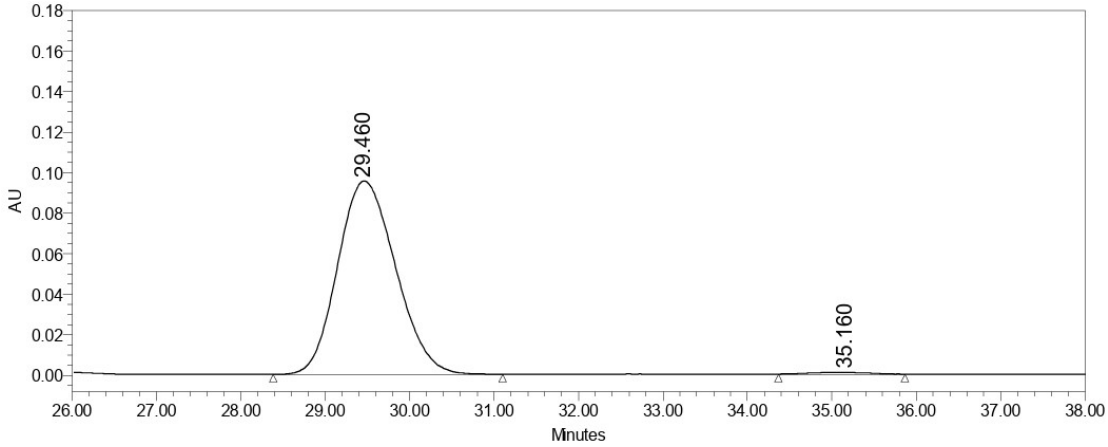


^{13}C NMR (100 MHz) in $CDCl_3$



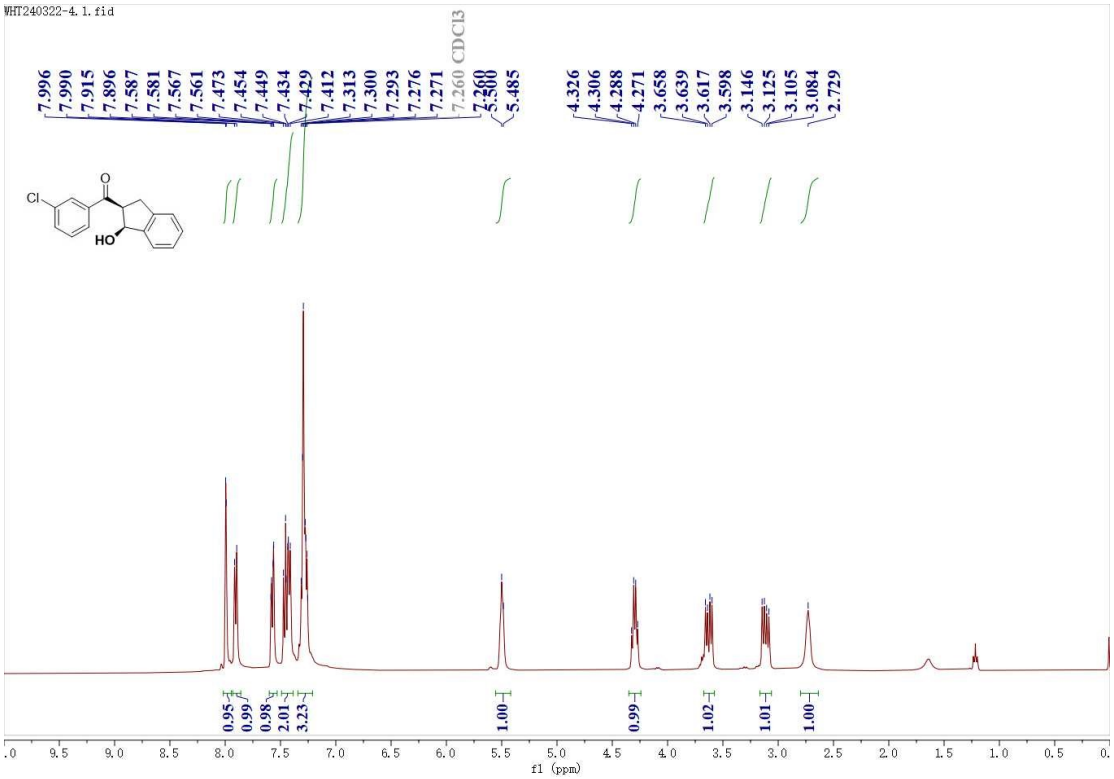


Peak#	Ret. Time	Area	Height	Area %
1	28.604	1156051	24502	50.47
2	34.071	1134526	21530	49.53

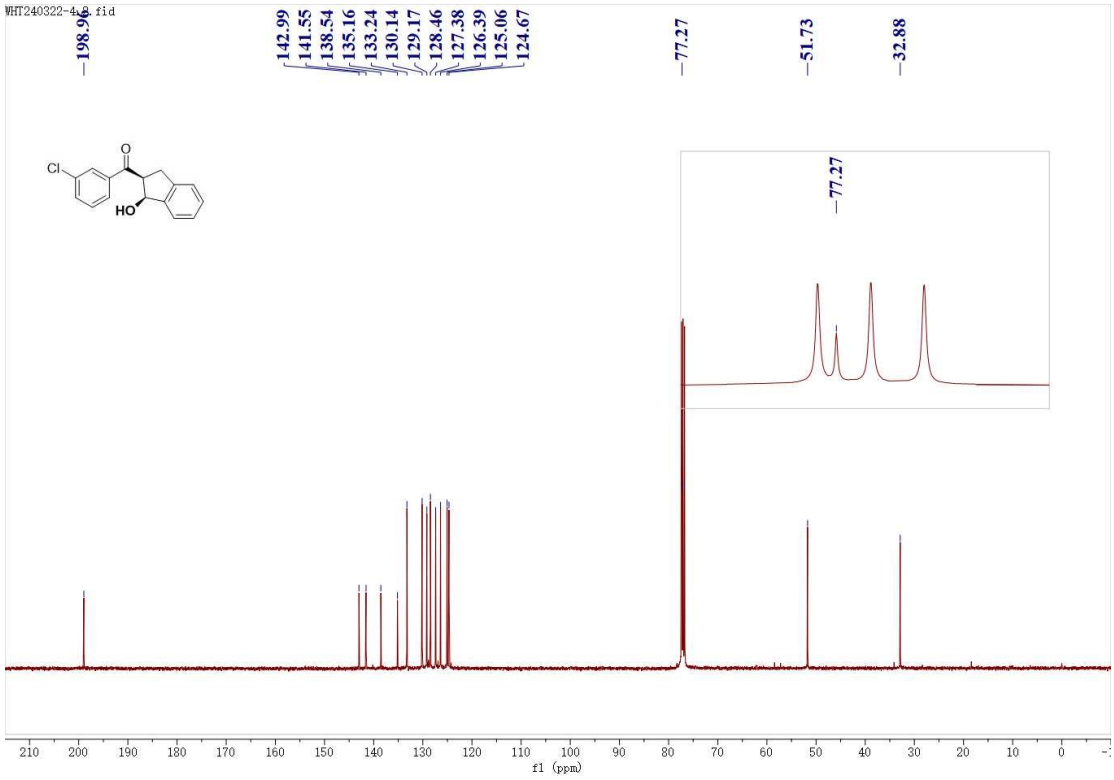


Peak#	Ret. Time	Area	Height	Area %
1	29.460	4547788	95335	99.00
2	35.160	45729	970	1.00

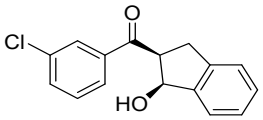
(3-chlorophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2m)

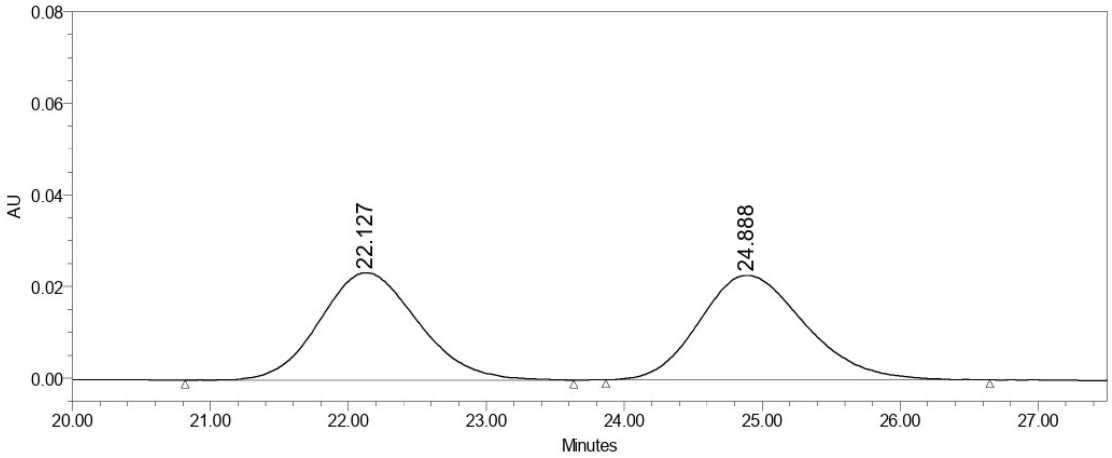


^{1}H NMR (400 MHz) in $CDCl_3$

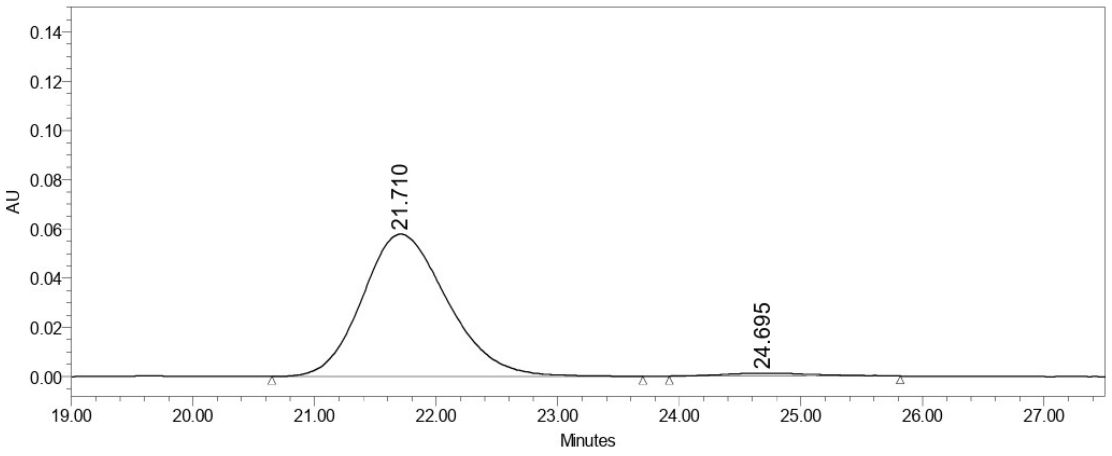


^{13}C NMR (100 MHz) in $CDCl_3$



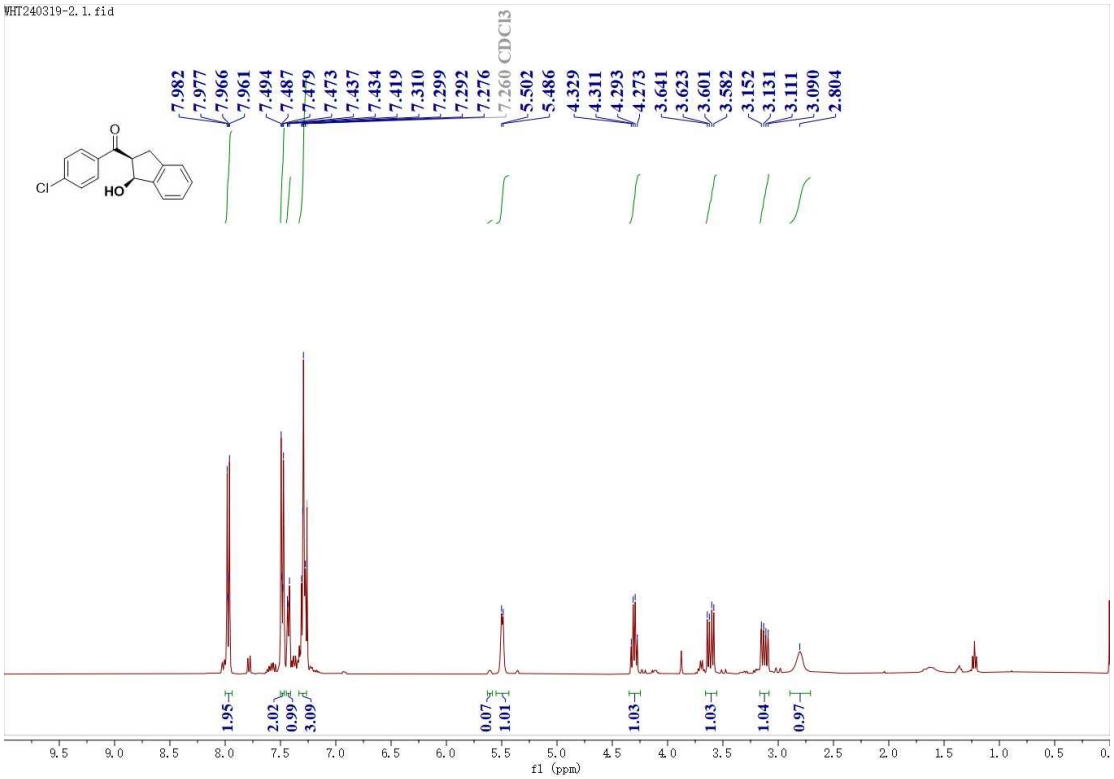


Peak#	Ret. Time	Area	Height	Area %
1	22.127	1167907	23440	48.98
2	24.888	1216688	22855	51.02

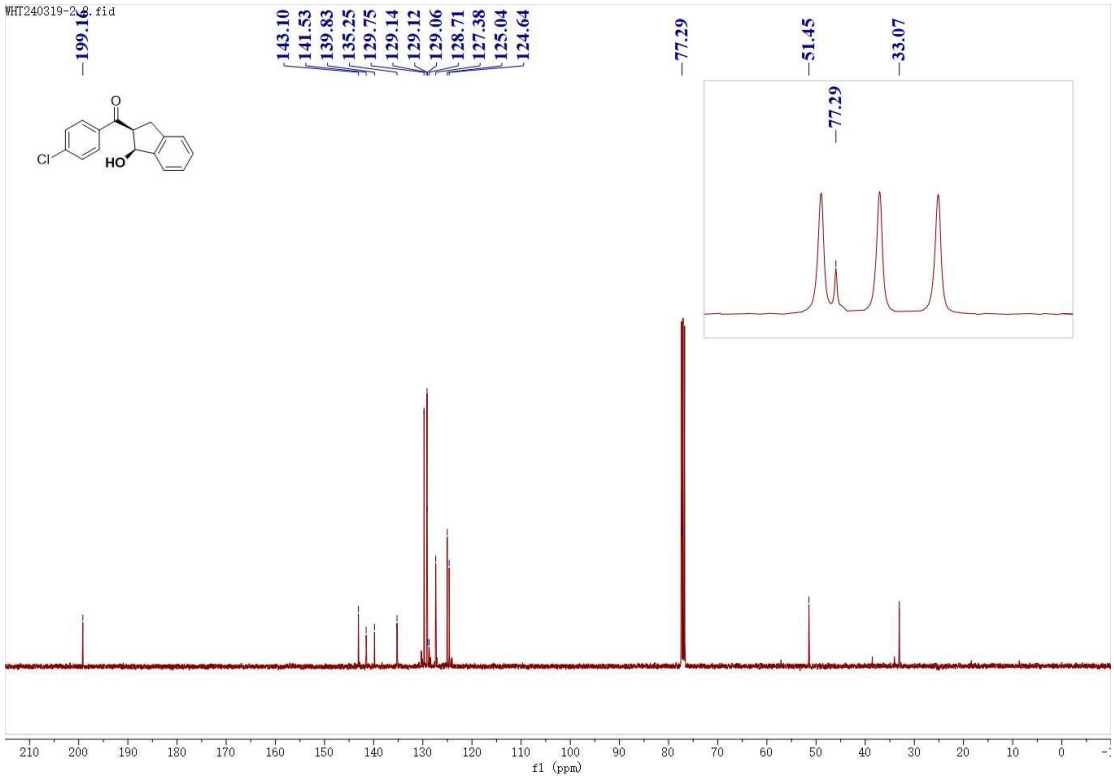


Peak#	Ret. Time	Area	Height	Area %
1	21.710	2815824	57869	97.79
2	24.695	63702	1202	2.21

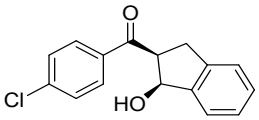
(4-chlorophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2n)

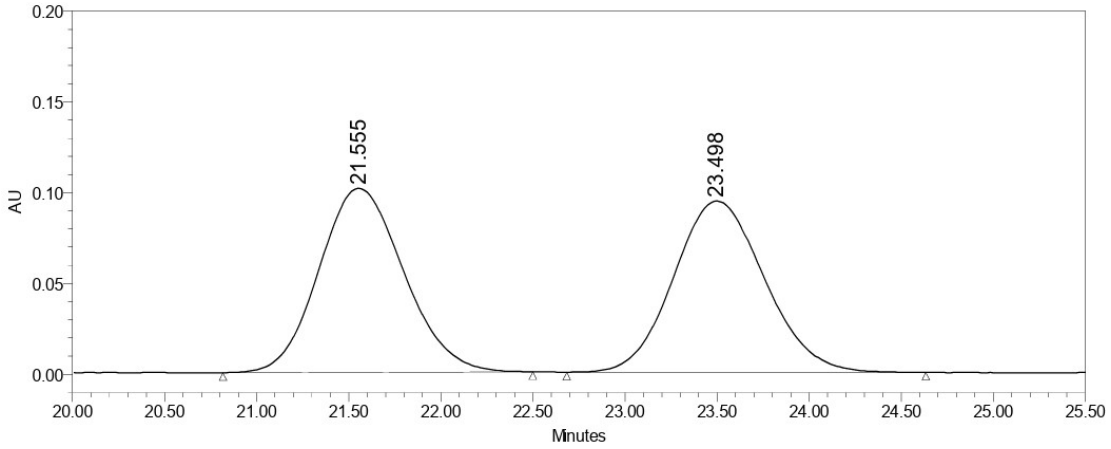


^{1}H NMR (400 MHz) in $CDCl_3$

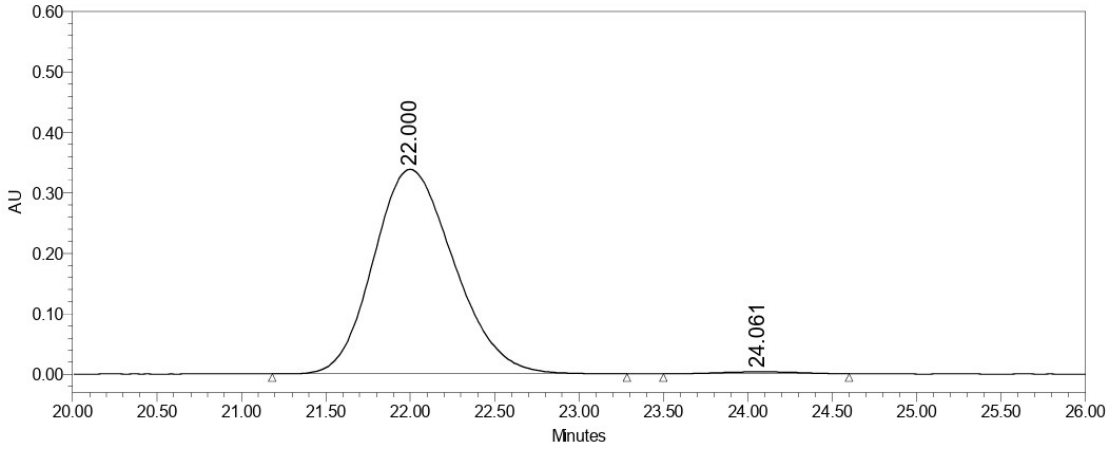


^{13}C NMR (100 MHz) in $CDCl_3$



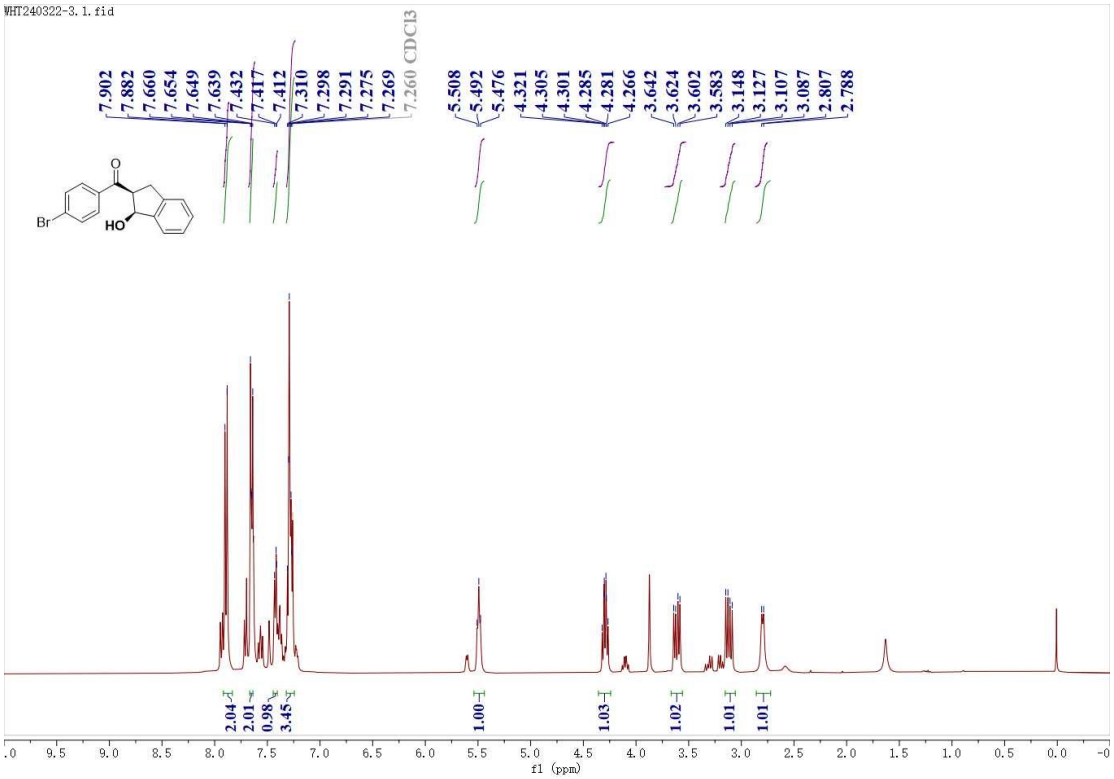


Peak#	Ret. Time	Area	Height	Area %
1	21.555	3245621	101426	50.06
2	23.498	3237860	94355	49.94

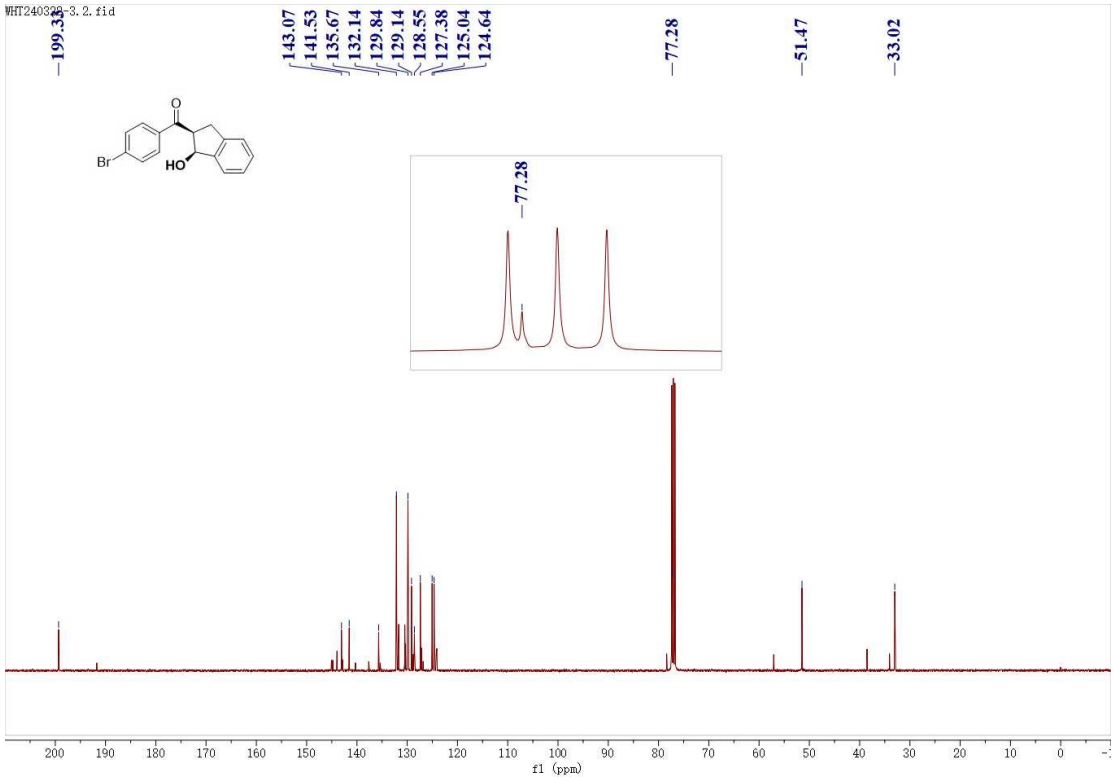


Peak#	Ret. Time	Area	Height	Area %
1	22.000	11217542	338116	99.04
2	24.061	109256	3387	0.96

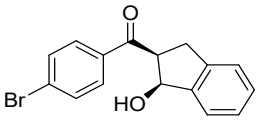
(4-bromophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2o)

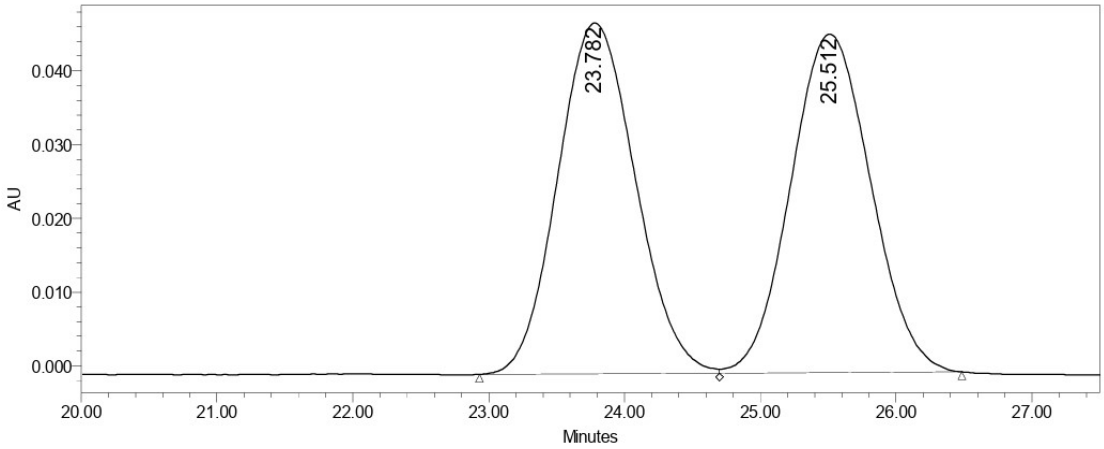


^{1}H NMR (400 MHz) in $CDCl_3$

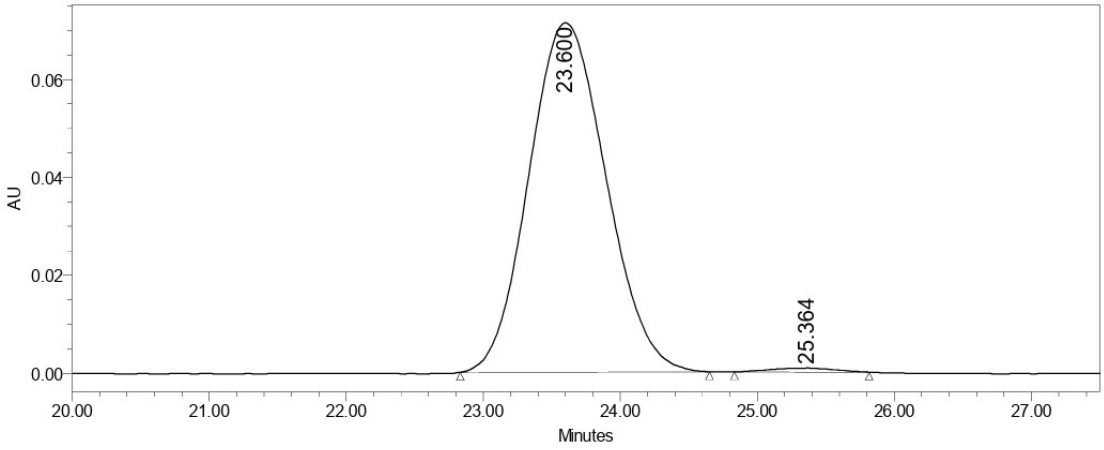


^{13}C NMR (100 MHz) in $CDCl_3$



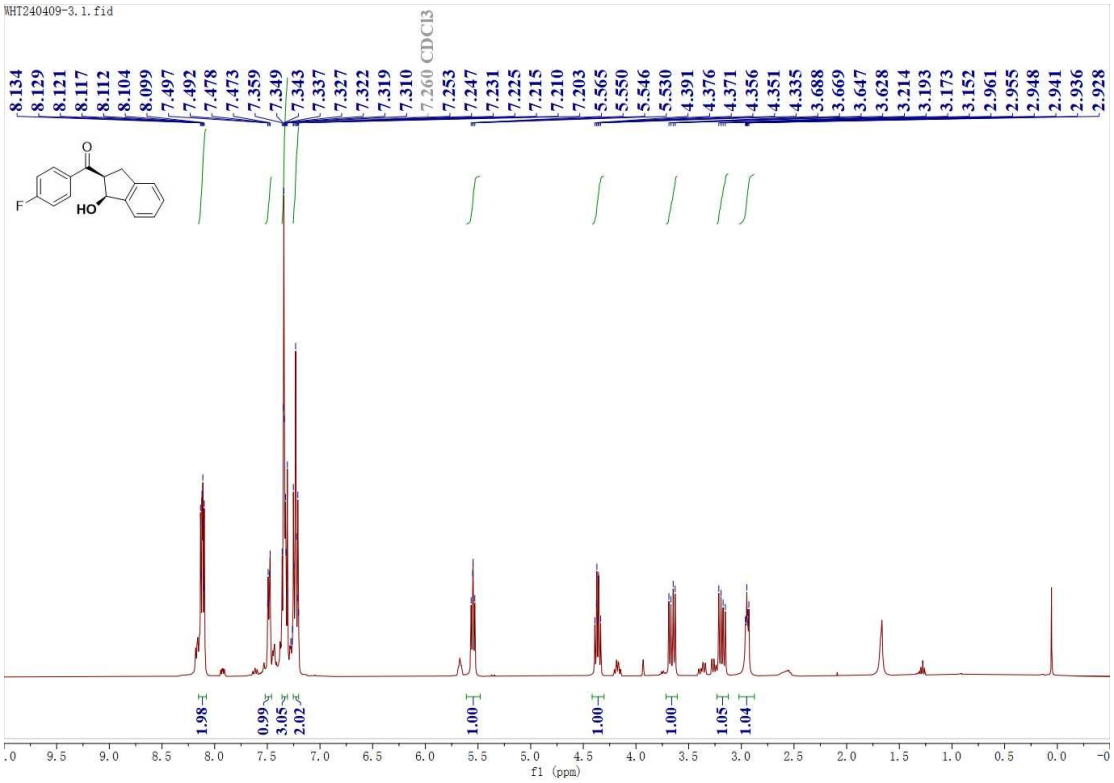


Peak#	Ret. Time	Area	Height	Area %
1	23.782	1888358	47544	50.11
2	25.512	1880022	45903	49.89

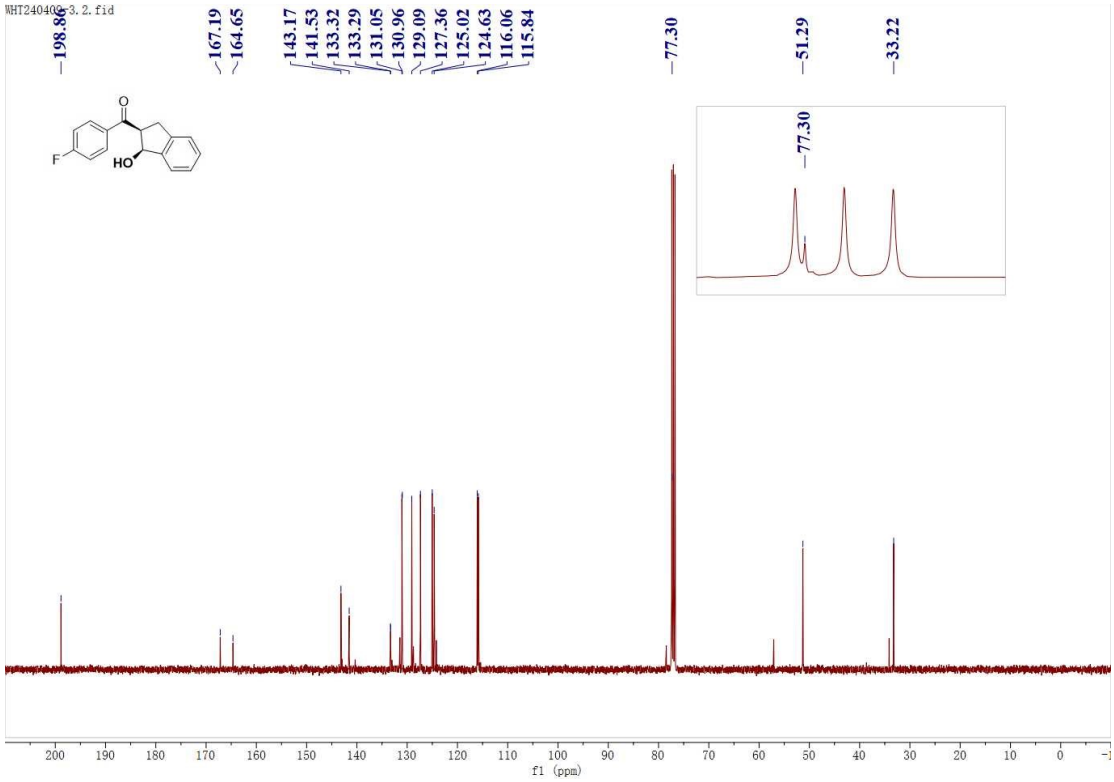


Peak#	Ret. Time	Area	Height	Area %
1	23.600	2793433	71376	99.04
2	25.364	27173	846	0.96

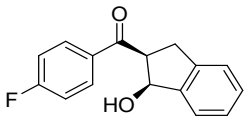
(4-fluorophenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1H-inden-2-yl)methanone (2p)

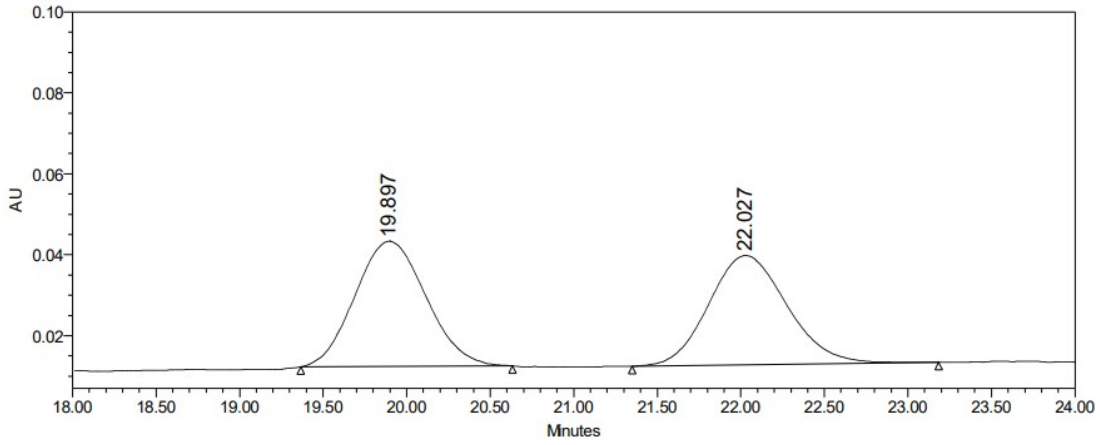


^{1}H NMR (400 MHz) in $CDCl_3$

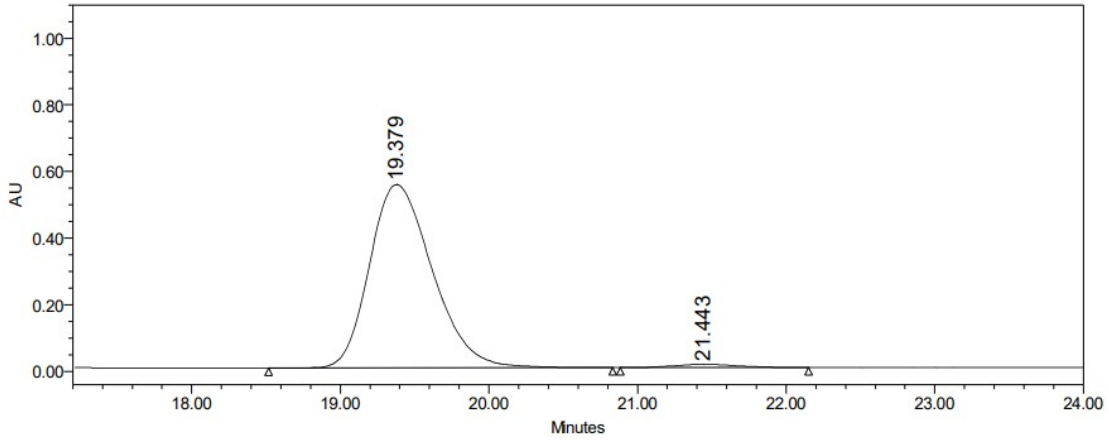


^{13}C NMR (100 MHz) in $CDCl_3$



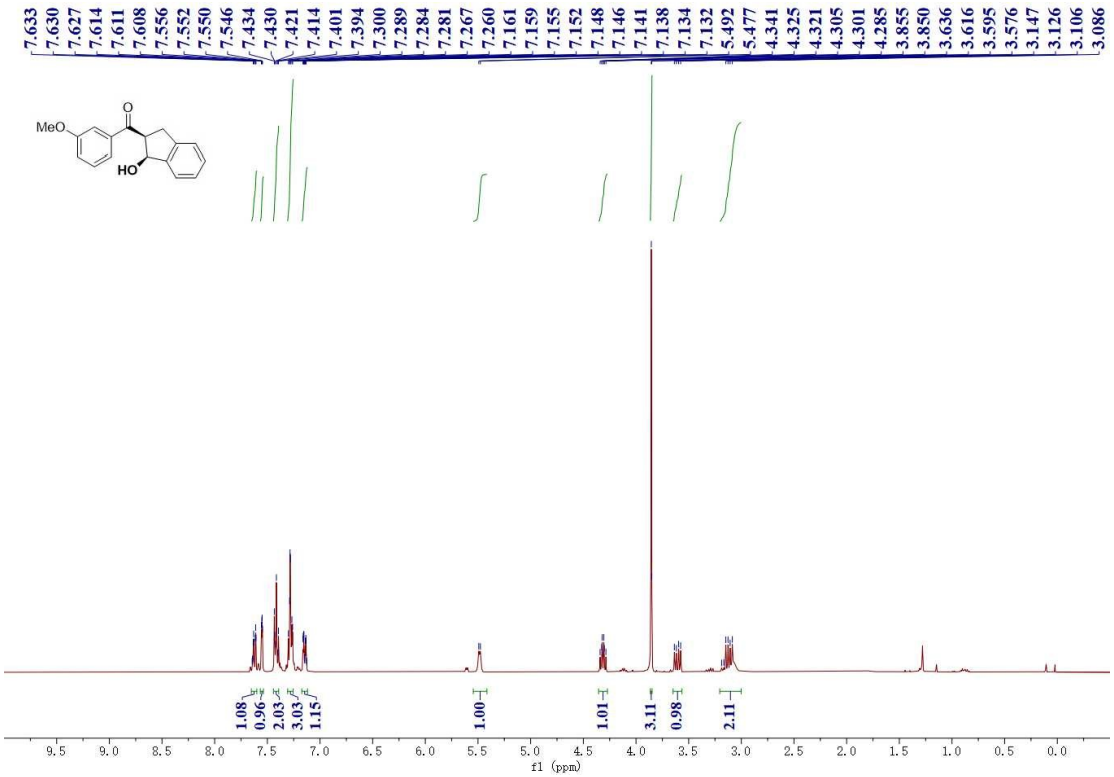


Peak#	Ret. Time	Area	Height	Area %
1	19.897	914248	30967	50.89
2	22.027	882358	27048	49.11

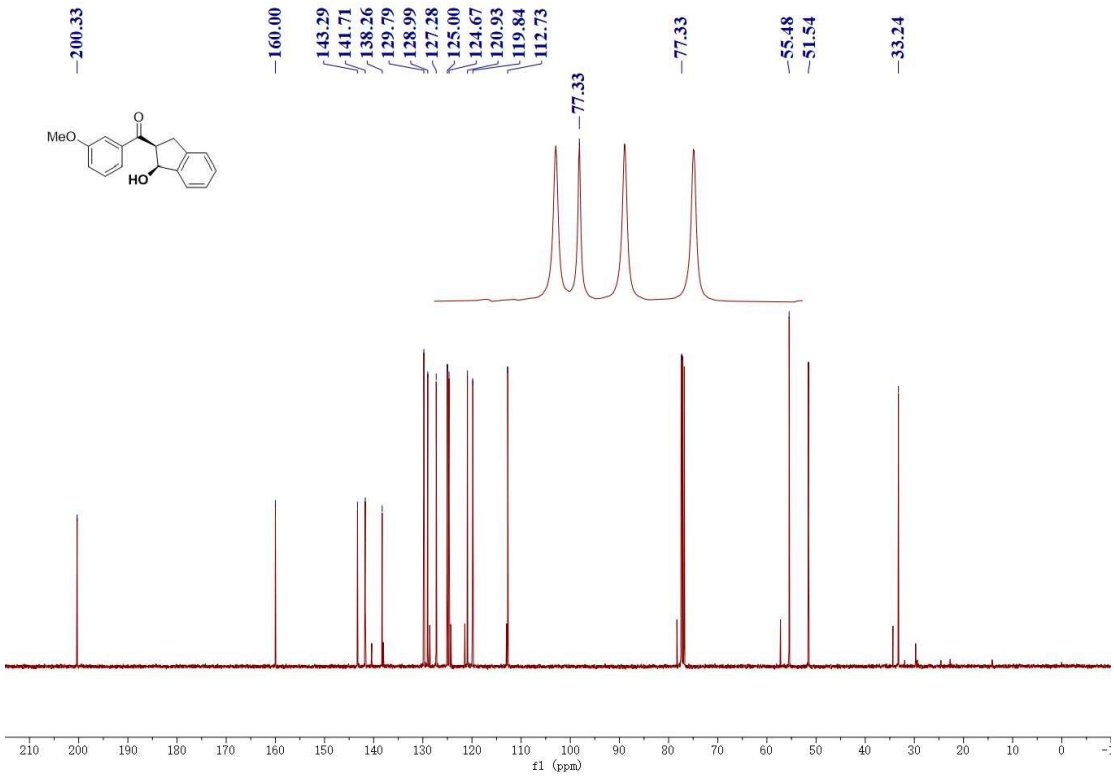


Peak#	Ret. Time	Area	Height	Area %
1	19.379	16163800	550357	98.29
2	21.443	281440	9277	1.71

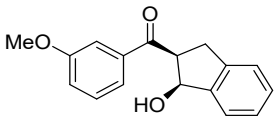
((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(3-methoxyphenyl)methanone (2q)

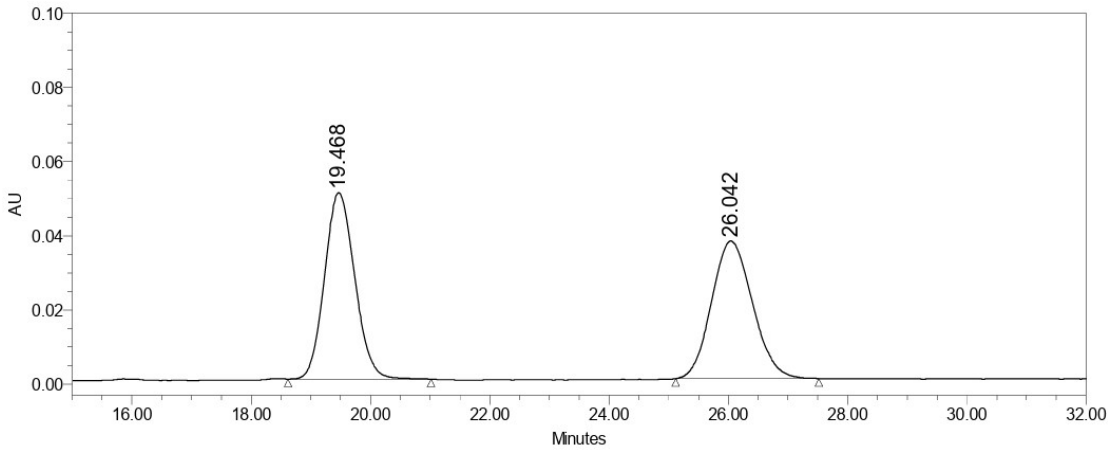


^{1}H NMR (400 MHz) in $CDCl_3$

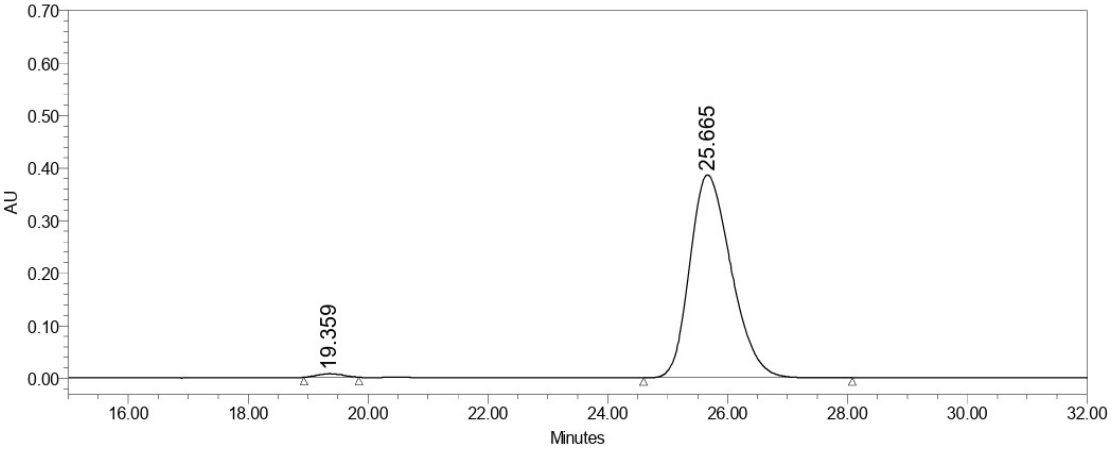


^{13}C NMR (100 MHz) in $CDCl_3$



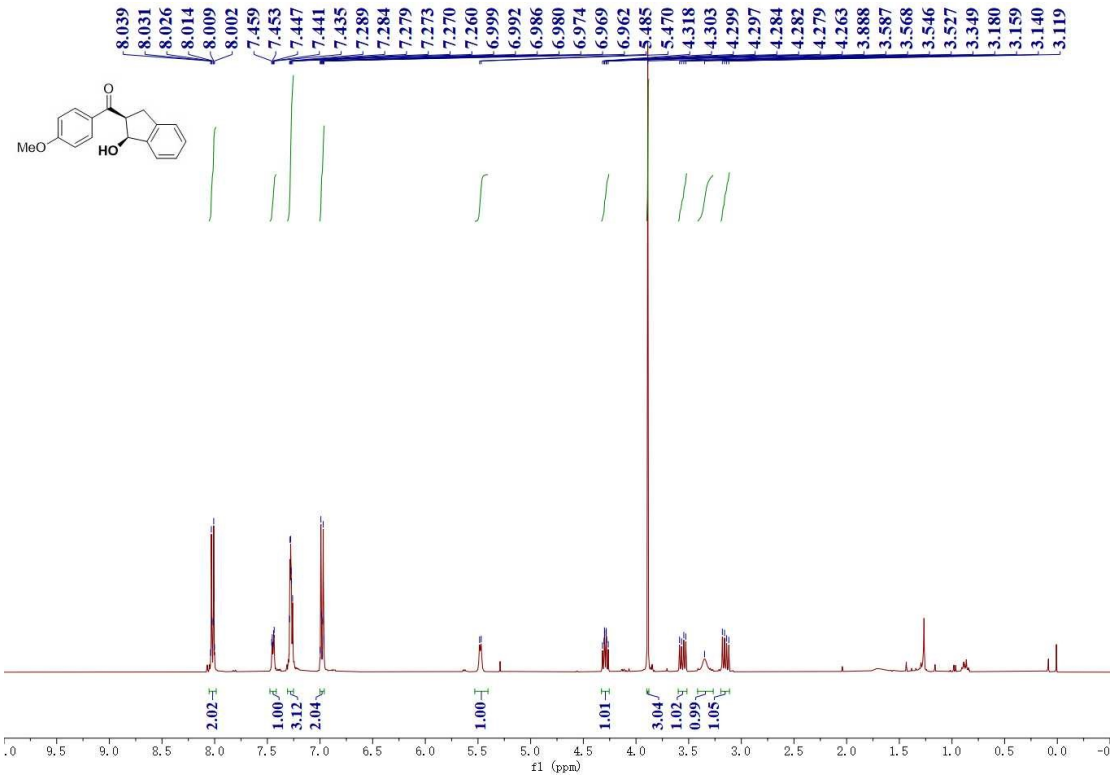


Peak#	Ret. Time	Area	Height	Area %
1	19.468	1773845	50277	50.08
2	26.042	1768528	37126	49.92

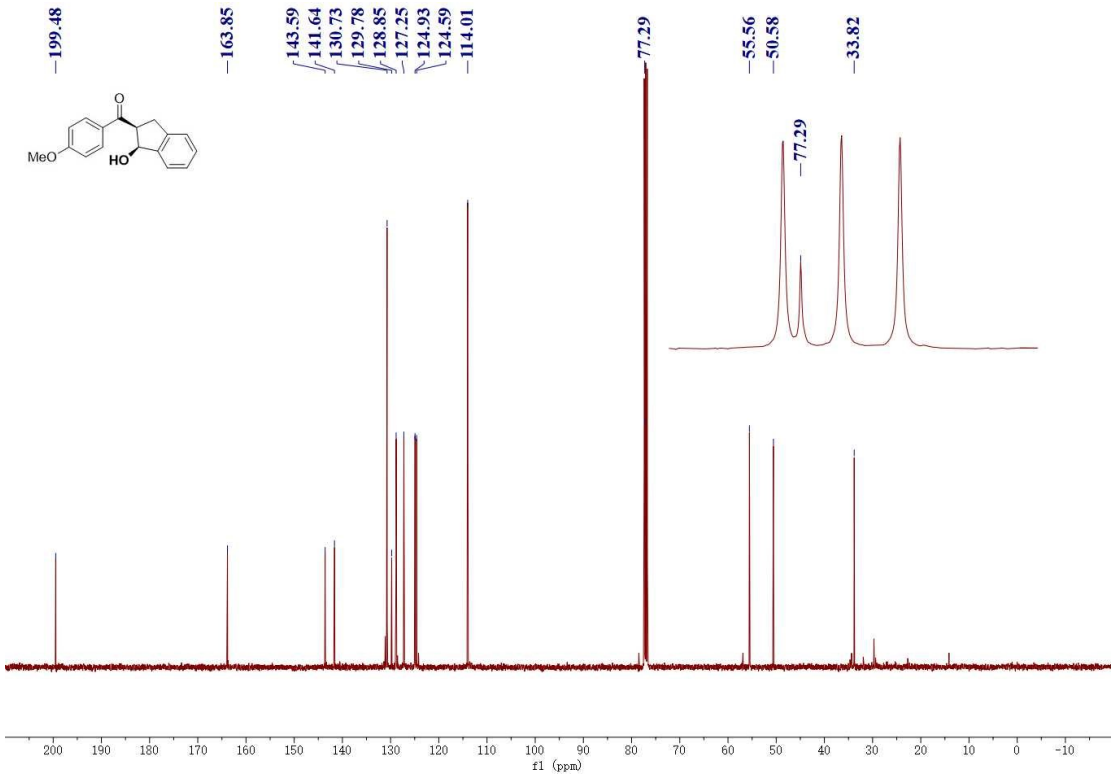


Peak#	Ret. Time	Area	Height	Area %
1	19.359	190856	6520	1.02
2	25.665	18522483	386271	98.98

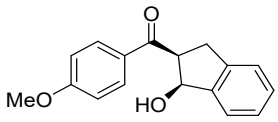
((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(4-methoxyphenyl)methanone (2r)

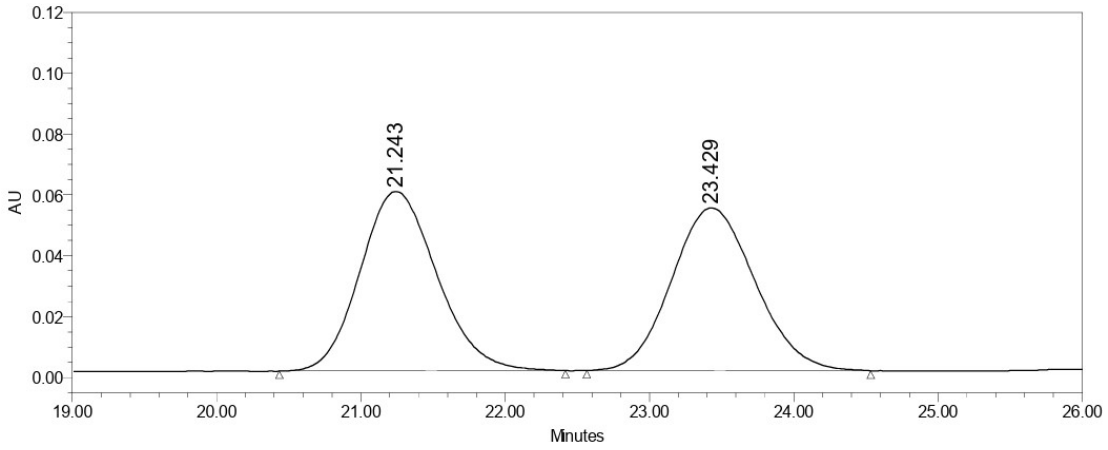


^{1}H NMR (400 MHz) in $CDCl_3$

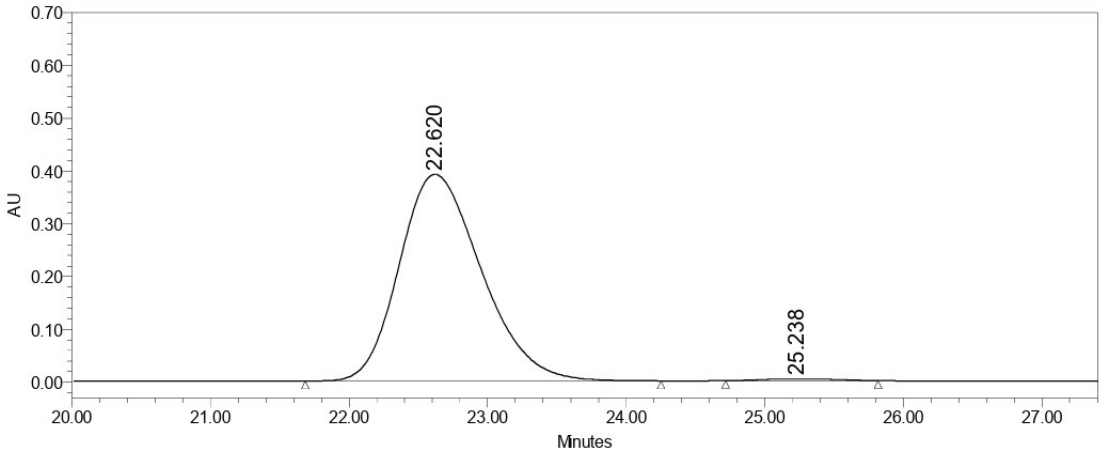


^{13}C NMR (100 MHz) in $CDCl_3$



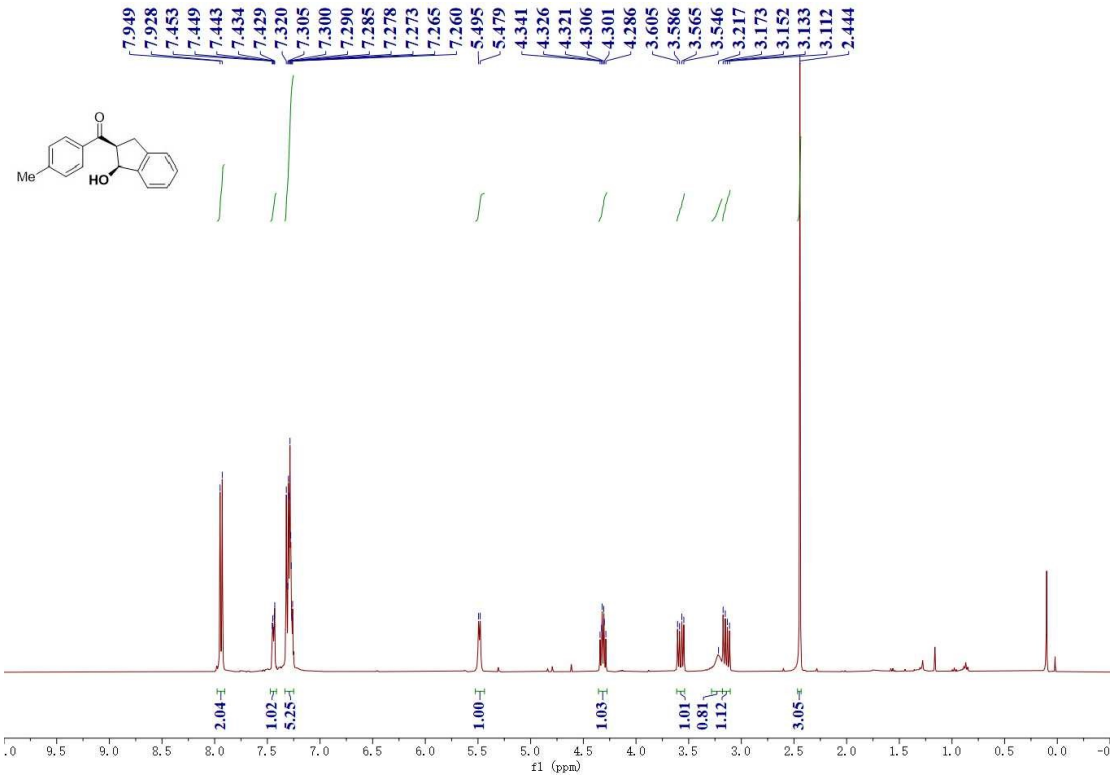


Peak#	Ret. Time	Area	Height	Area %
1	21.243	2182173	59020	50.34
2	23.429	2152457	53513	49.66

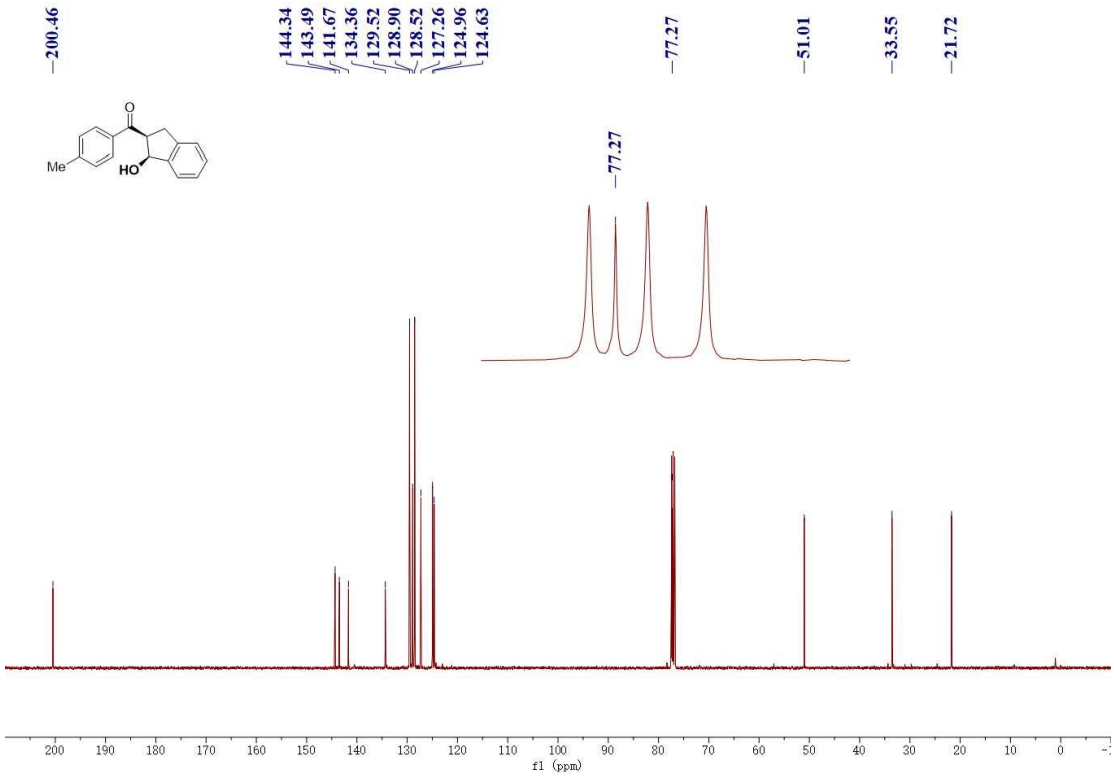


Peak#	Ret. Time	Area	Height	Area %
1	22.620	16139196	391512	99.18
2	25.238	132716	3644	0.82

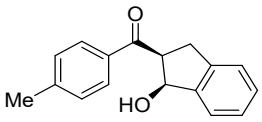
((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(*p*-tolyl)methanone (2s)

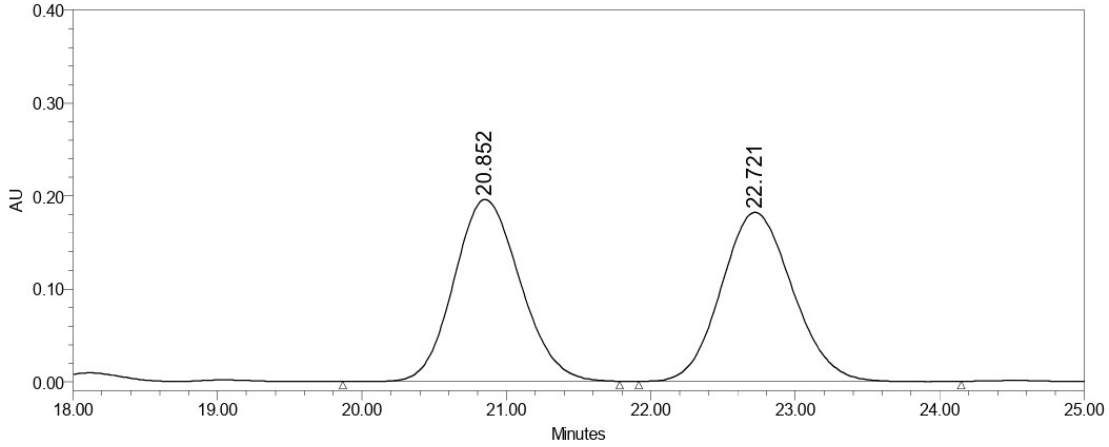


^{1}H NMR (400 MHz) in $CDCl_3$

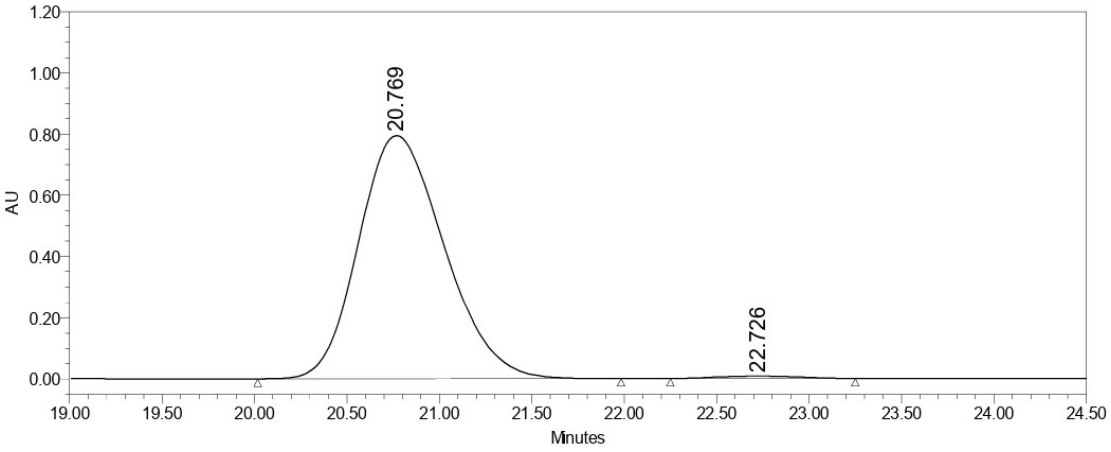


^{13}C NMR (100 MHz) in $CDCl_3$



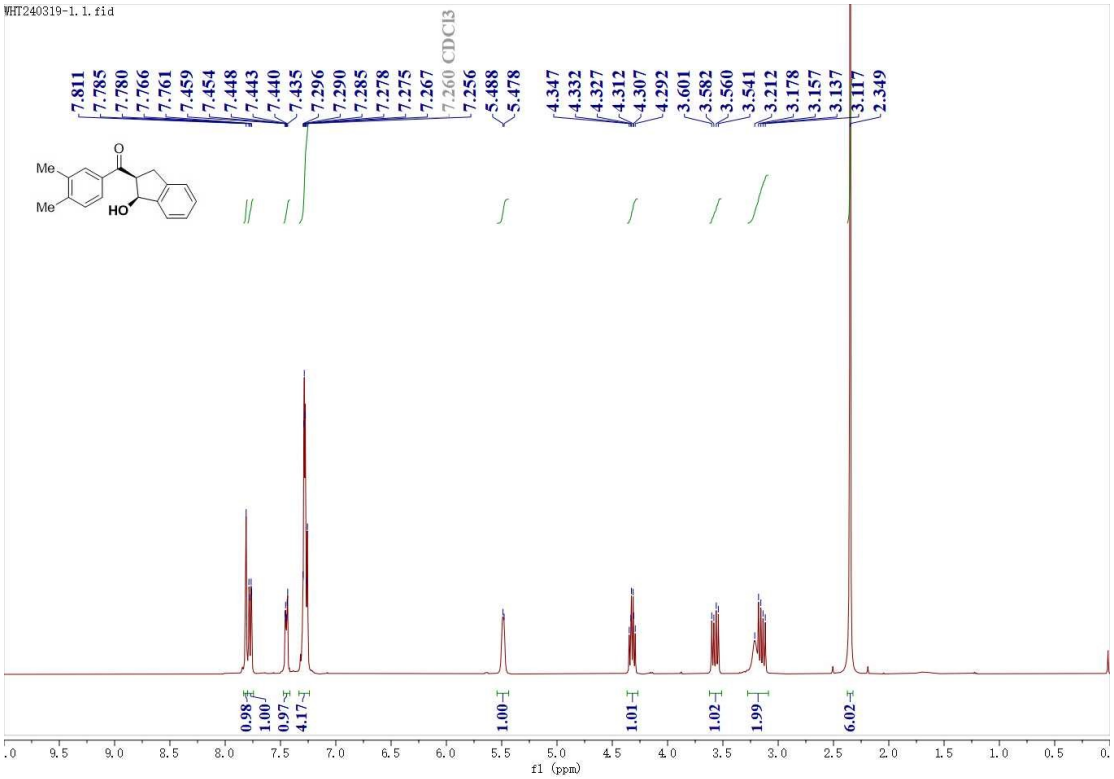


Peak#	Ret. Time	Area	Height	Area %
1	20.852	6216774	195701	50.01
2	22.721	6213411	181787	49.99

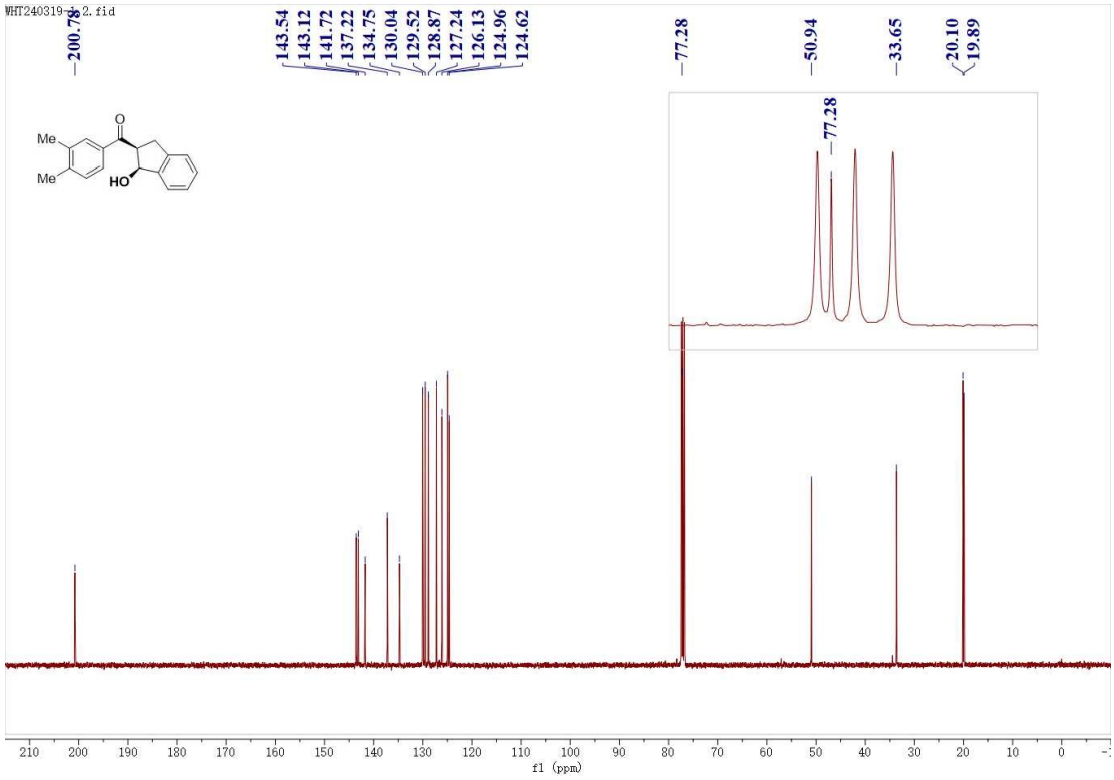


Peak#	Ret. Time	Area	Height	Area %
1	20.769	25577552	795071	99.05
2	22.726	245449	8023	0.95

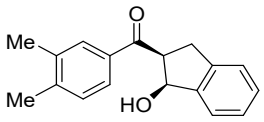
(3,4-dimethylphenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2t)

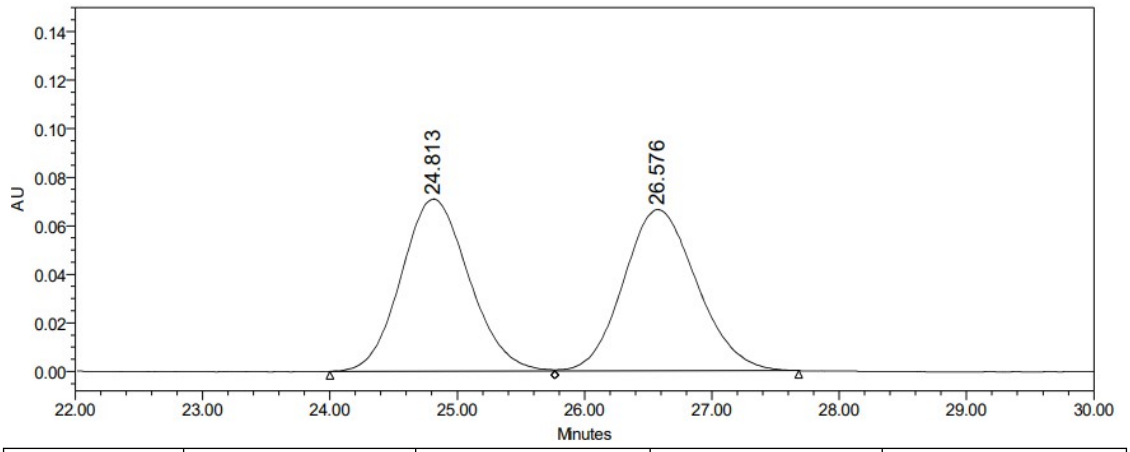


^{1}H NMR (400 MHz) in $CDCl_3$

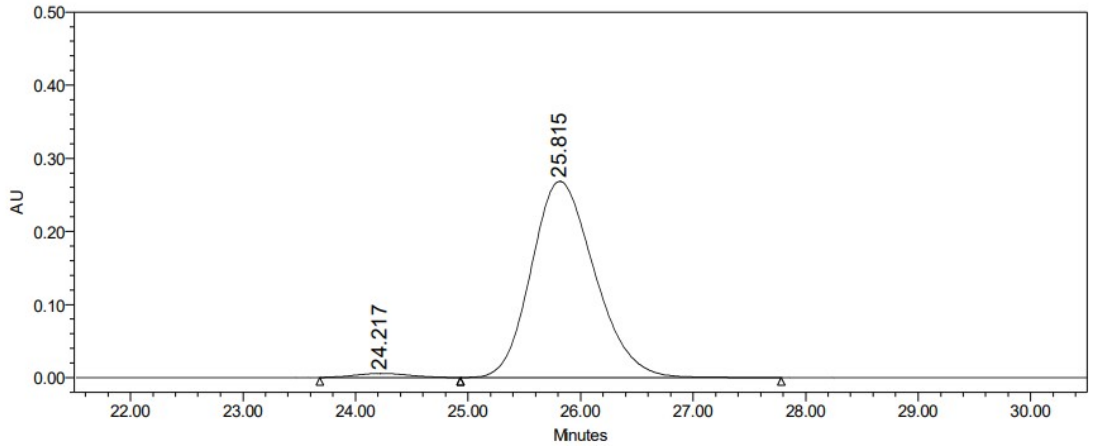


^{13}C NMR (100 MHz) in $CDCl_3$



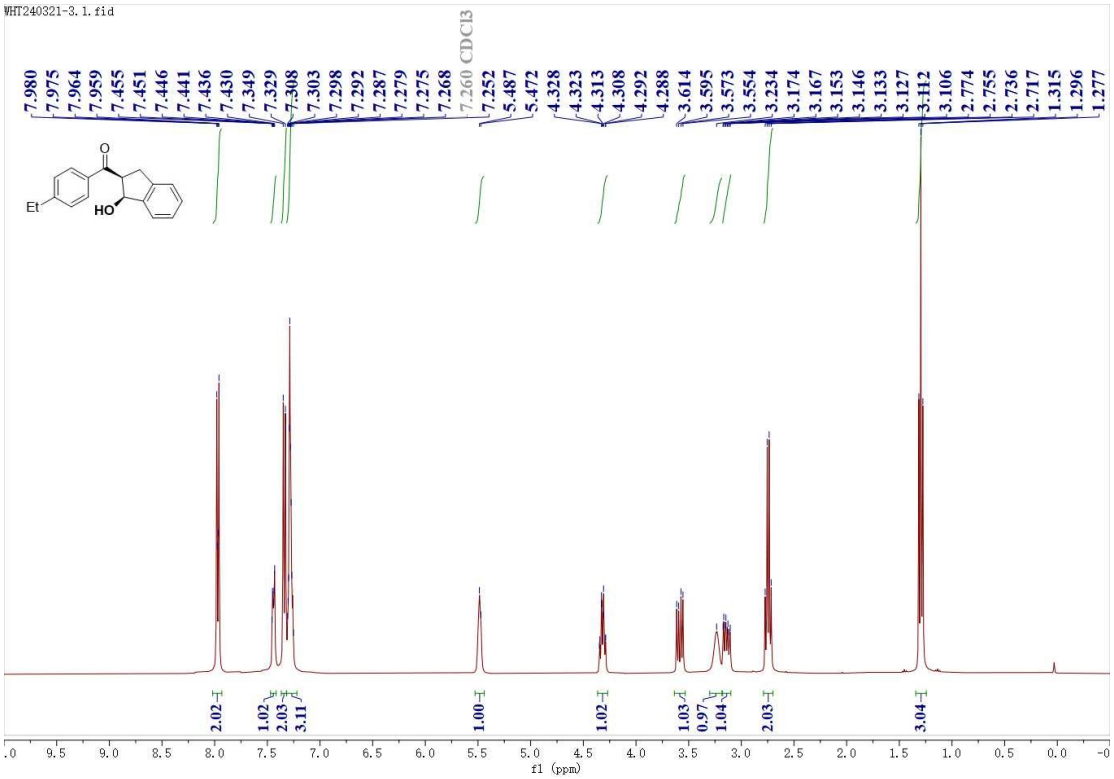


Peak#	Ret. Time	Area	Height	Area %
1	24.813	2629277	70914	49.64
2	26.576	2667016	66555	50.36

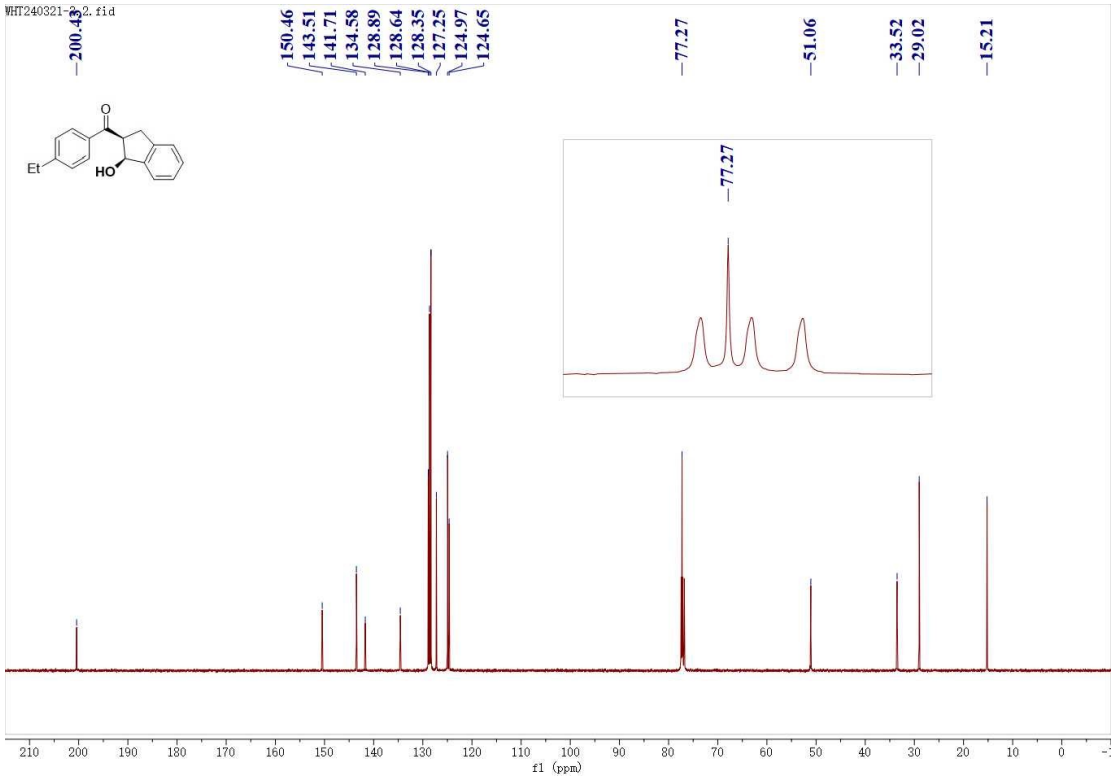


Peak#	Ret. Time	Area	Height	Area %
1	24.217	187268	5619	1.75
2	25.815	10503717	268596	98.25

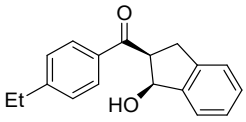
(4-ethylphenyl)((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)methanone (2u)

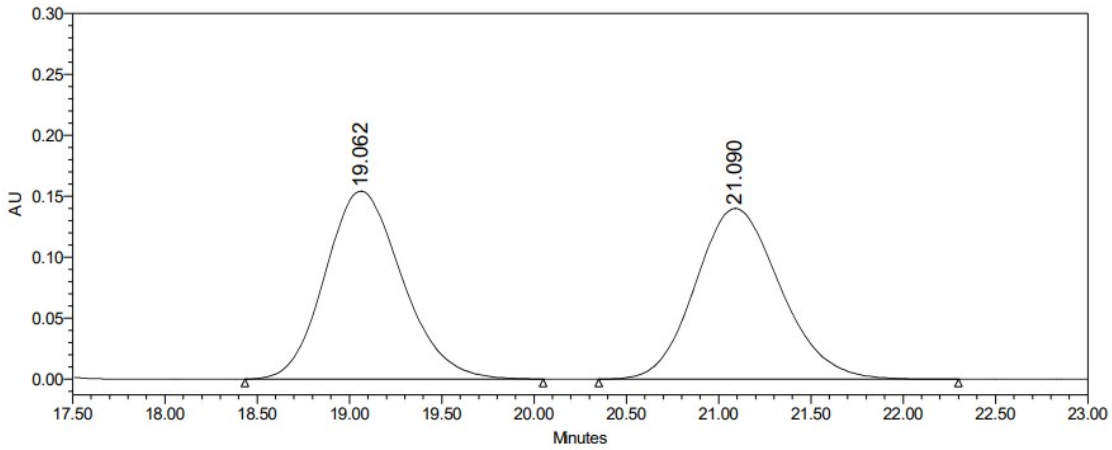


^{1}H NMR (400 MHz) in $CDCl_3$

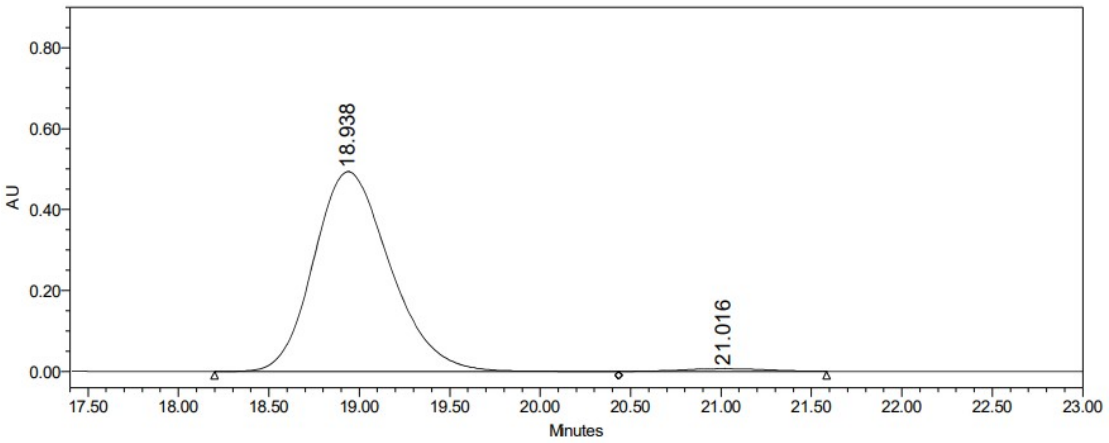


^{13}C NMR (100 MHz) in $CDCl_3$



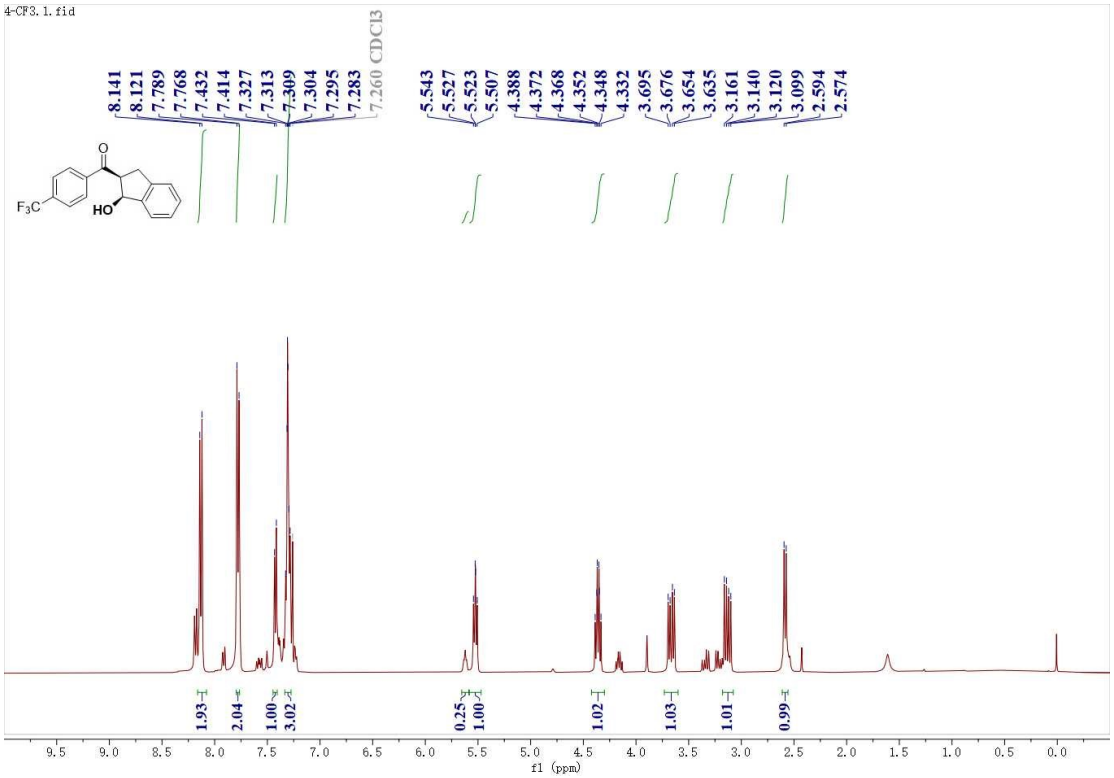


Peak#	Ret. Time	Area	Height	Area %
1	19.062	4485162	154187	50.00
2	21.090	4484806	140144	50.00

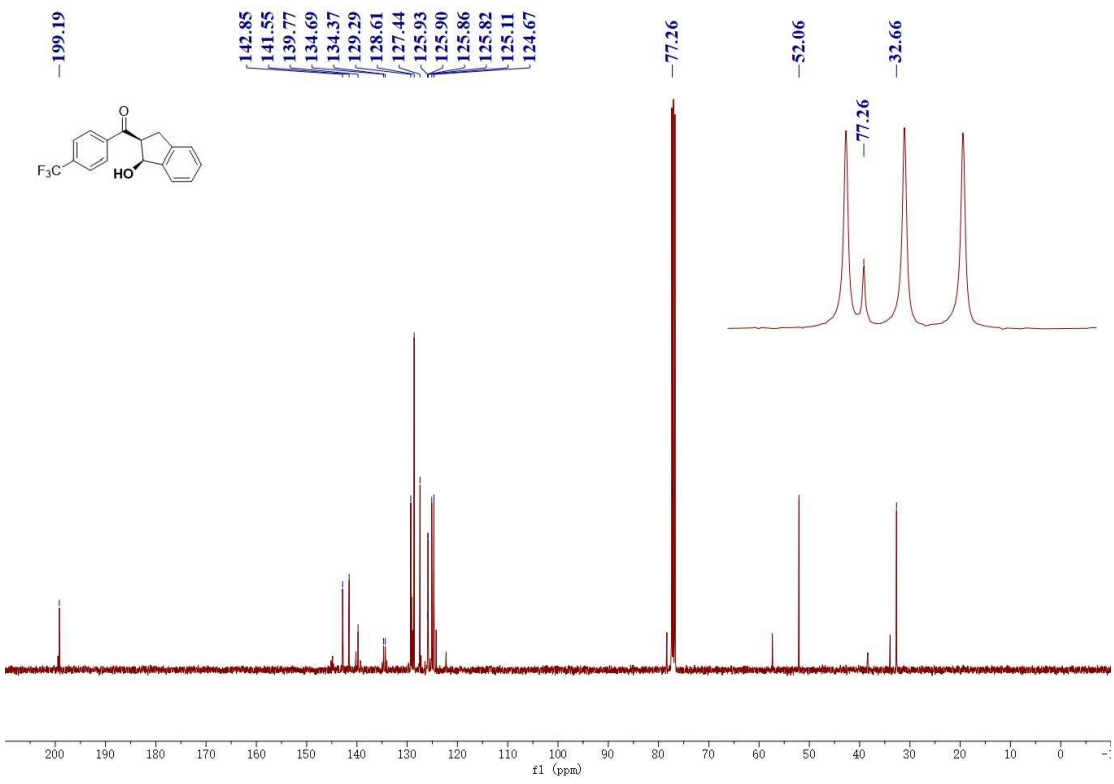


Peak#	Ret. Time	Area	Height	Area %
1	18.938	14466332	494214	98.64
2	21.016	199913	6668	1.36

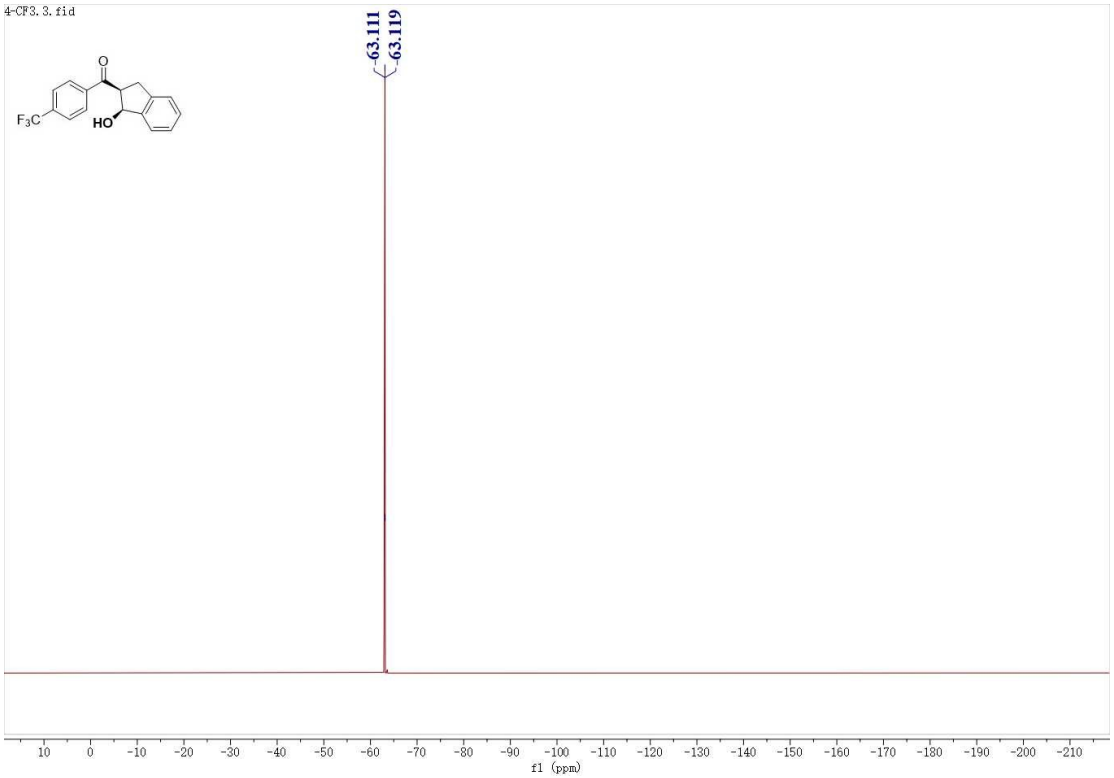
((1*S*,2*S*)-1-hydroxy-2,3-dihydro-1*H*-inden-2-yl)(4-(trifluoromethyl)phenyl)methanone (2v)



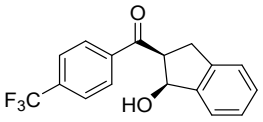
^{1}H NMR (400 MHz) in $CDCl_3$

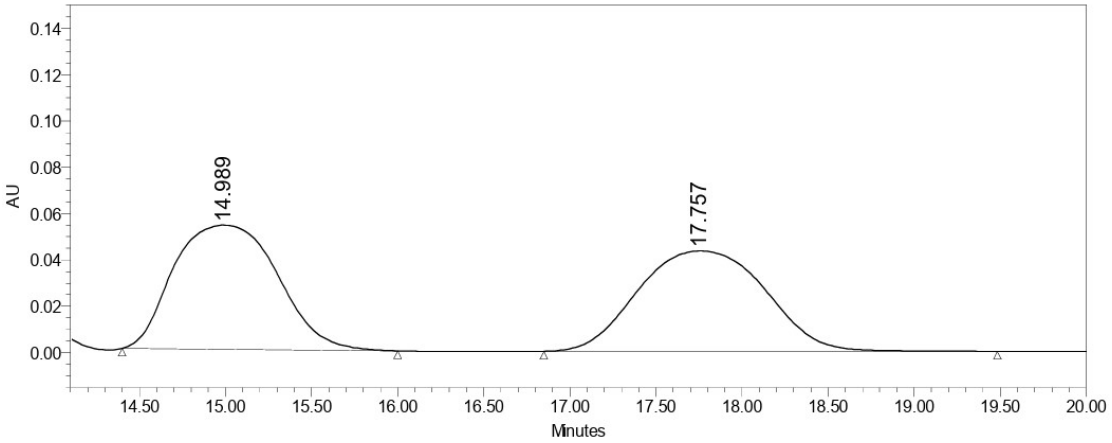


^{13}C NMR (100 MHz) in $CDCl_3$

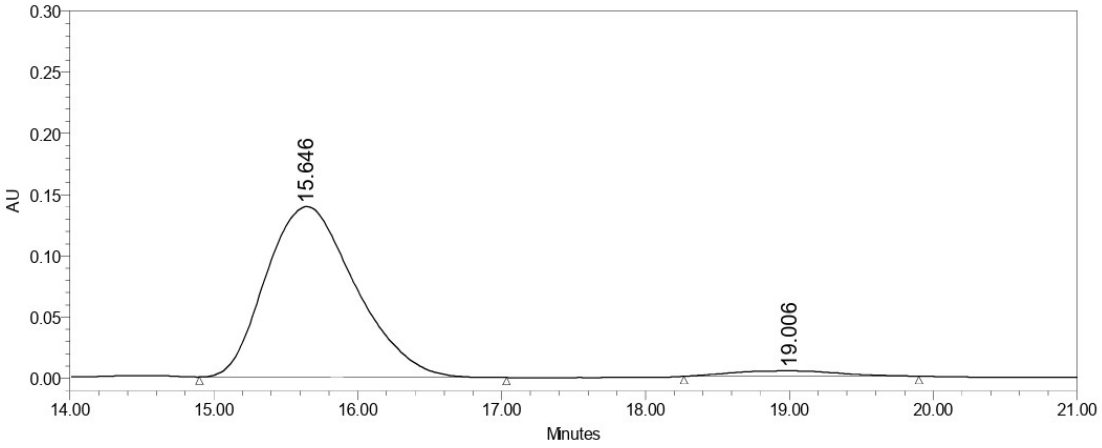


^{19}F NMR (376 MHz) in $CDCl_3$



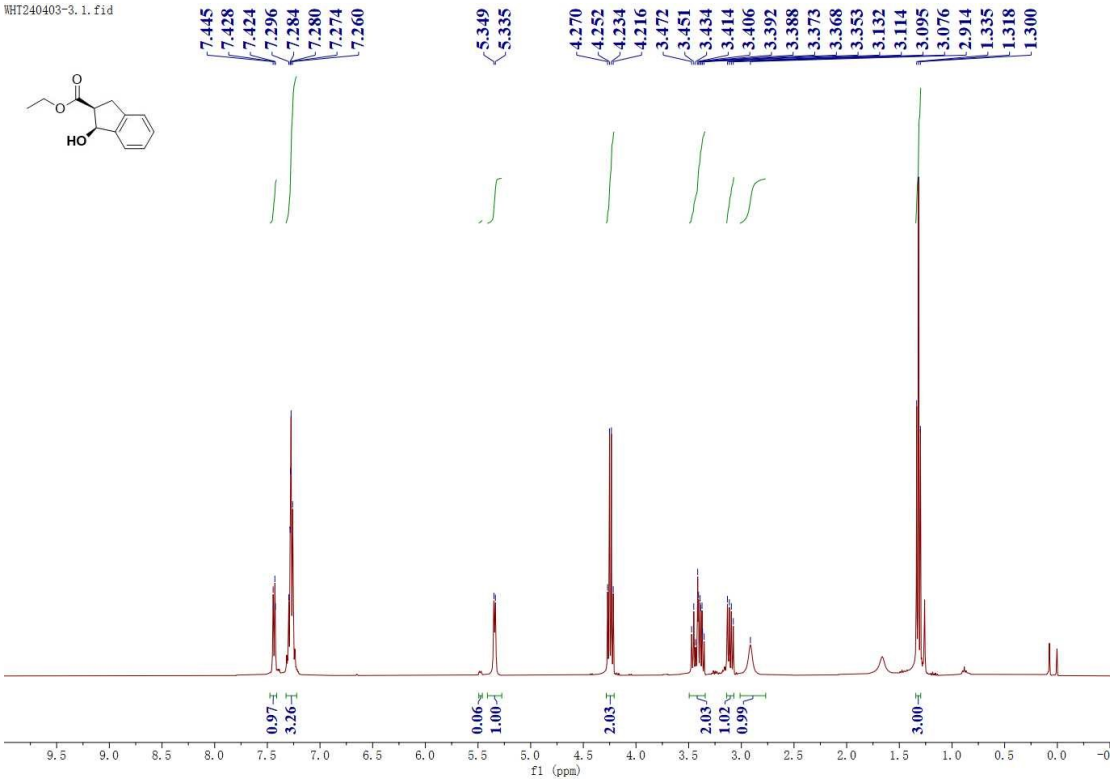


Peak#	Ret. Time	Area	Height	Area %
1	14.989	2255408	53644	50.19
2	17.757	2238683	43395	49.81

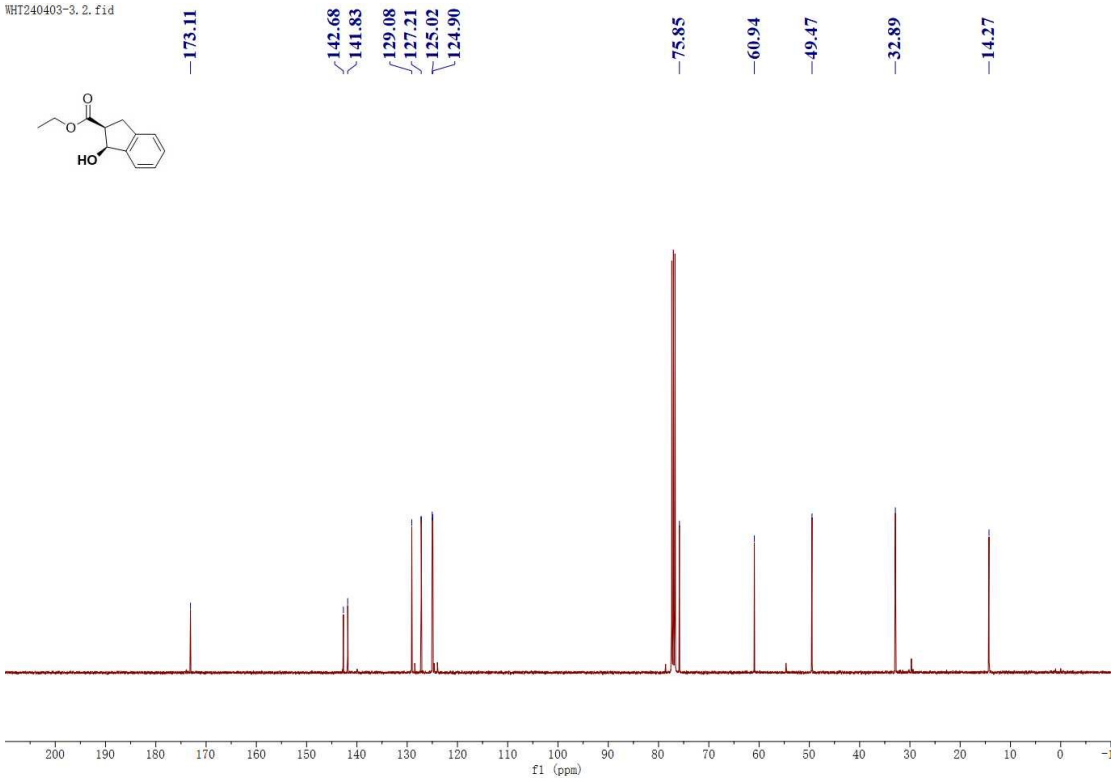


Peak#	Ret. Time	Area	Height	Area %
1	15.646	6028494	139327	96.23
2	19.006	235906	4496	3.77

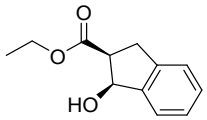
Ethyl (1S,2S)-1-hydroxy-2,3-dihydro-1H-indene-2-carboxylate (2w)

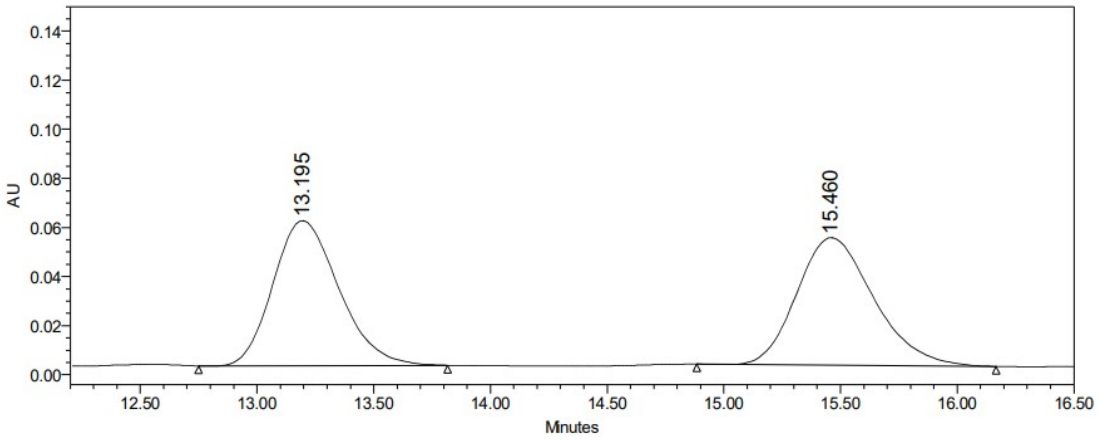


^{1}H NMR (400 MHz) in $CDCl_3$

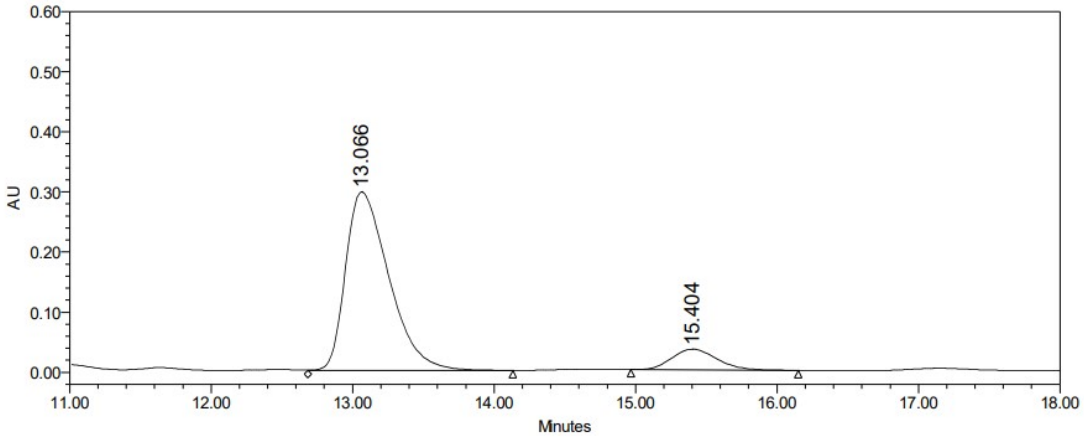


^{13}C NMR (100 MHz) in $CDCl_3$



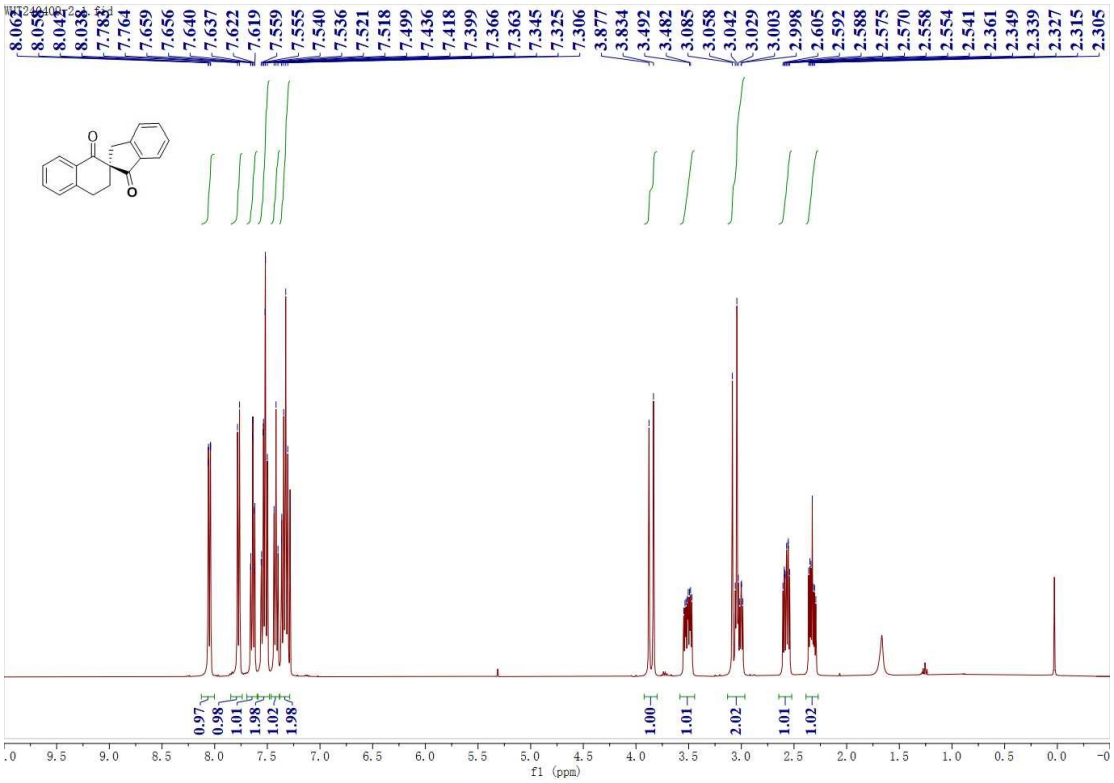


Peak#	Ret. Time	Area	Height	Area %
1	13.195	1159820	59104	49.33
2	15.460	1191128	51971	50.67

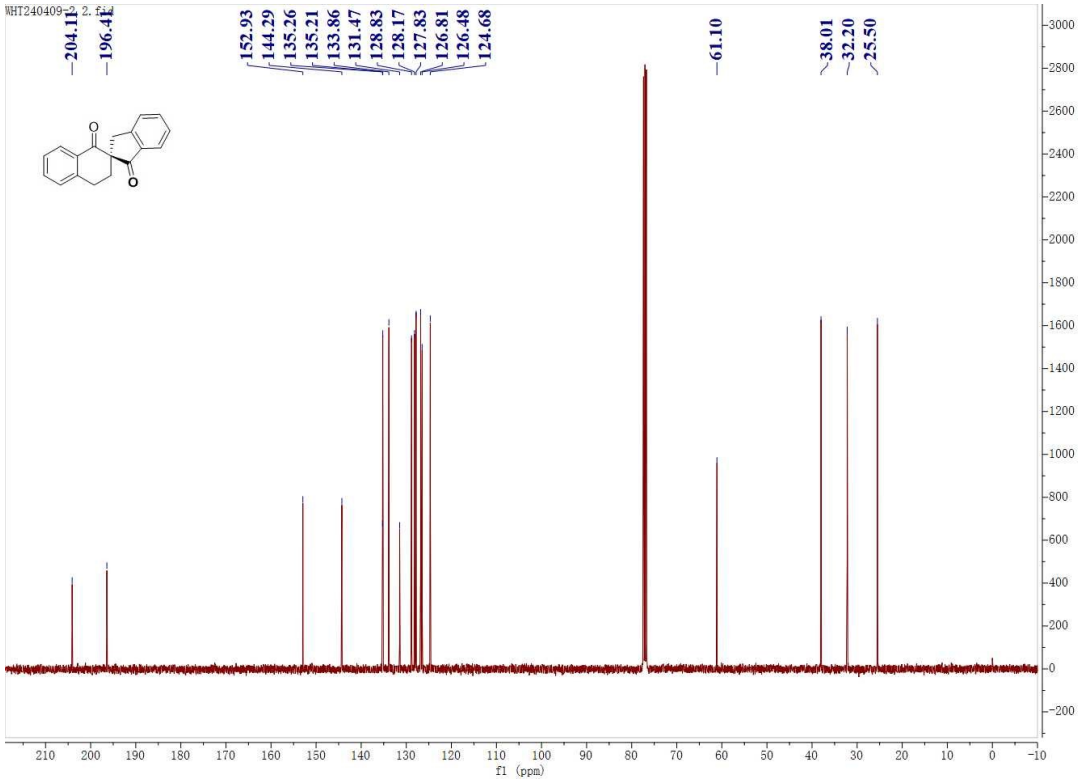


Peak#	Ret. Time	Area	Height	Area %
1	13.066	6289424	297251	89.24
2	15.404	758472	34350	10.76

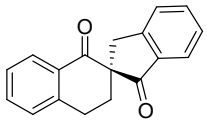
(*S*)-3',4'-dihydro-1'*H*-spiro[indene-2,2'-naphthalene]-1,1'(3*H*)-dione (3a)

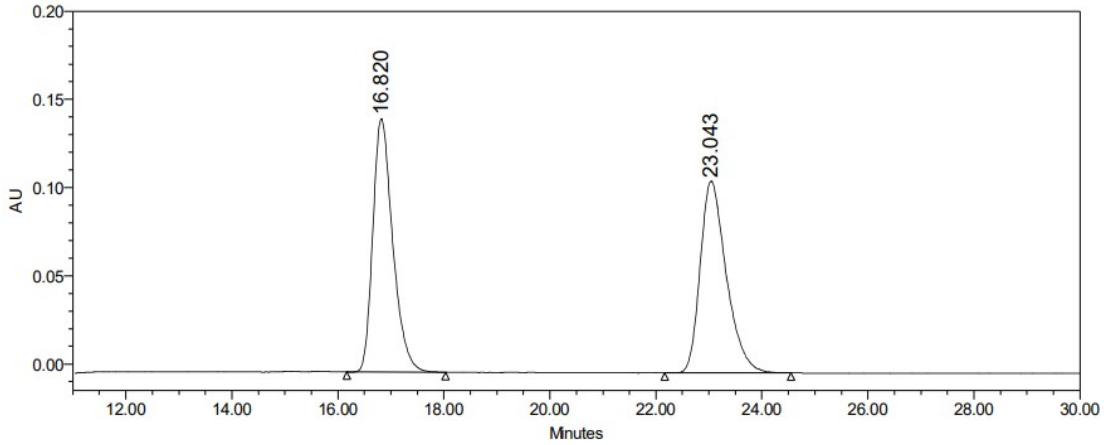


^{1}H NMR (400 MHz) in $CDCl_3$

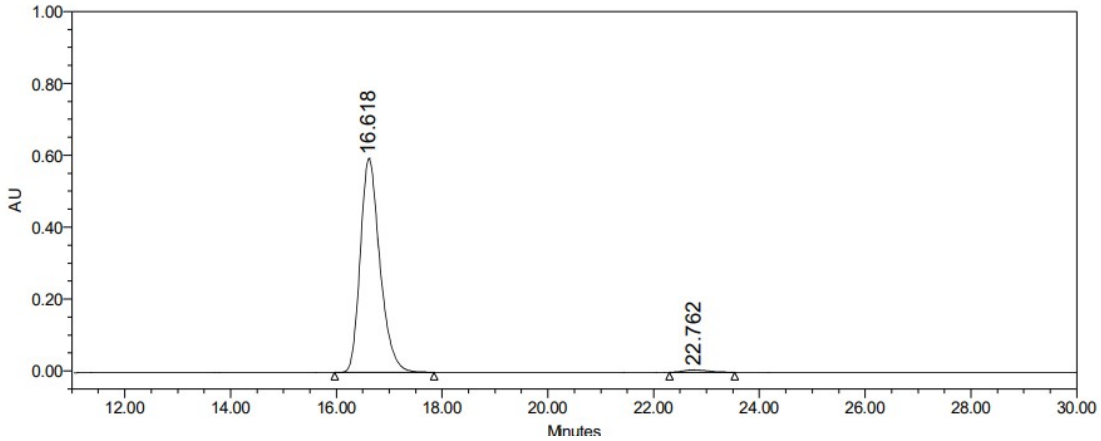


^{13}C NMR (100 MHz) in $CDCl_3$



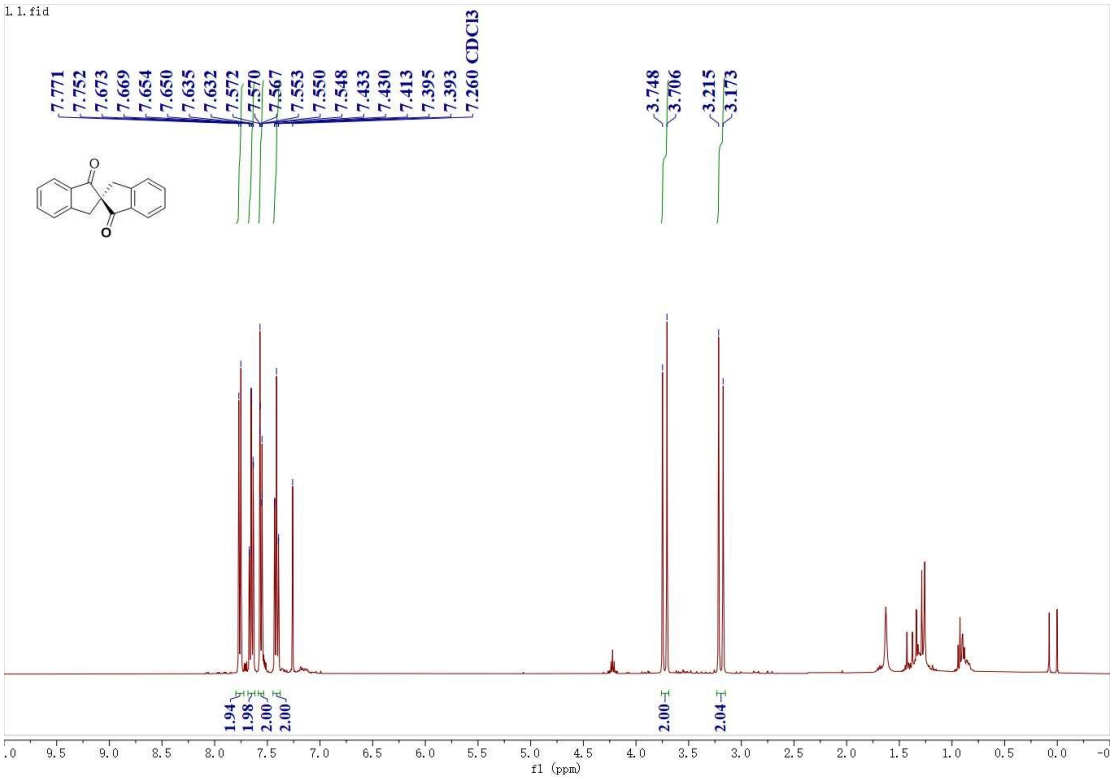


Peak#	Ret. Time	Area	Height	Area %
1	16.820	3755239	143754	50.22
2	23.043	3721825	108708	49.78

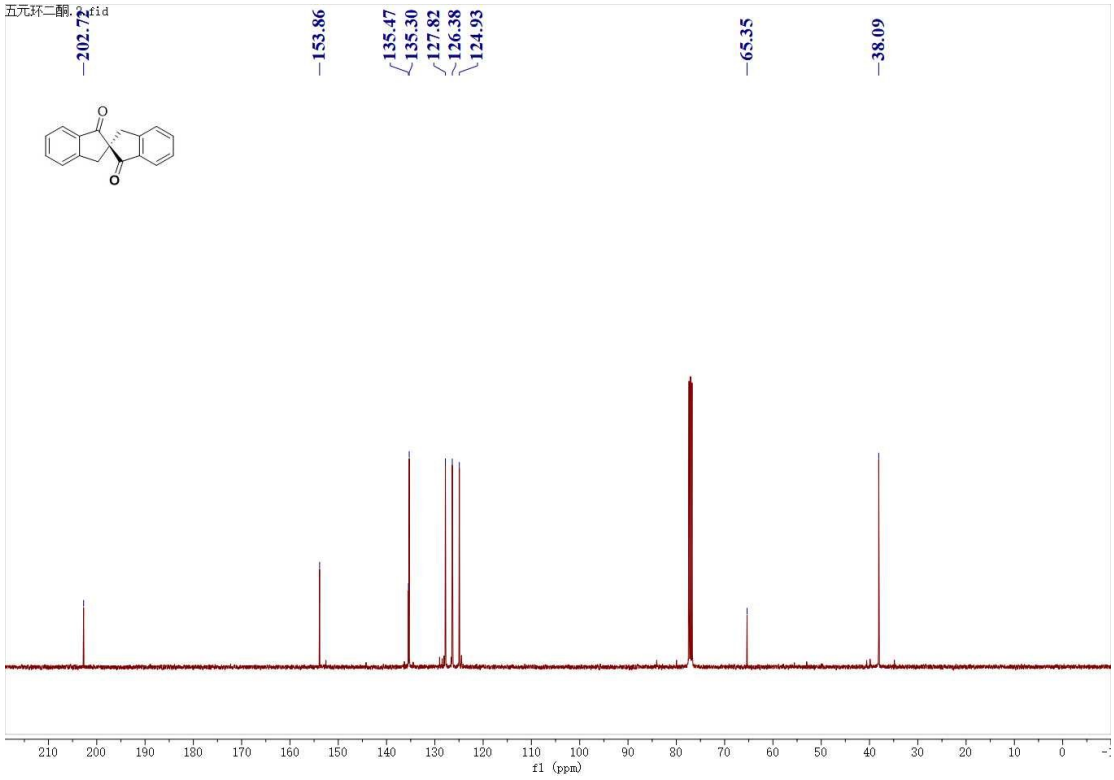


Peak#	Ret. Time	Area	Height	Area %
1	16.618	15298690	594956	98.50
2	22.762	232611	7344	1.50

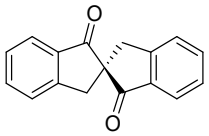
(*R*)-2,2'-spirobi[indene]-1,1'(3*H*,3'*H*)-dione (3b)

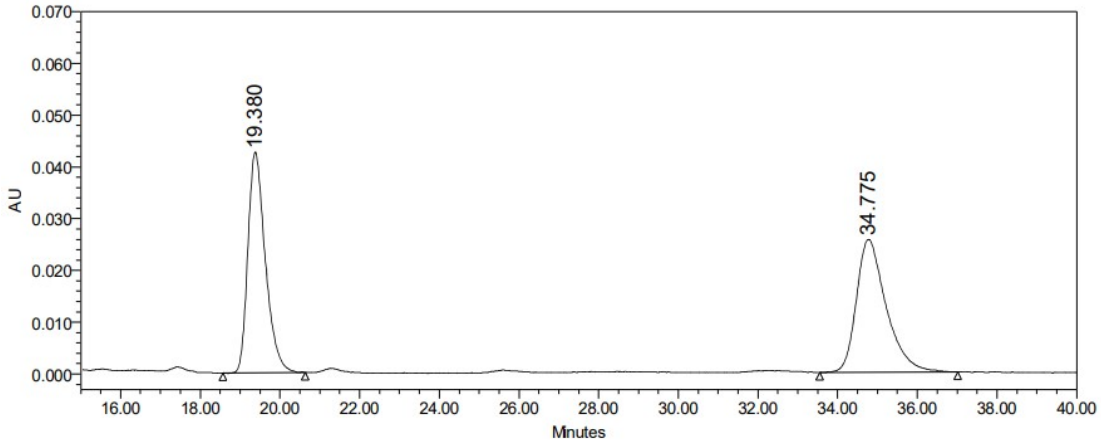


^{1}H NMR (400 MHz) in $CDCl_3$

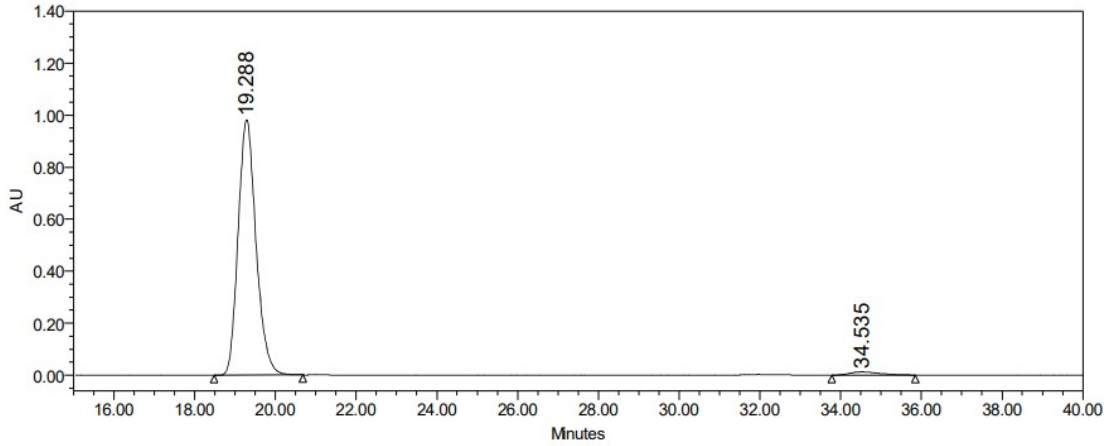


^{13}C NMR (100 MHz) in $CDCl_3$



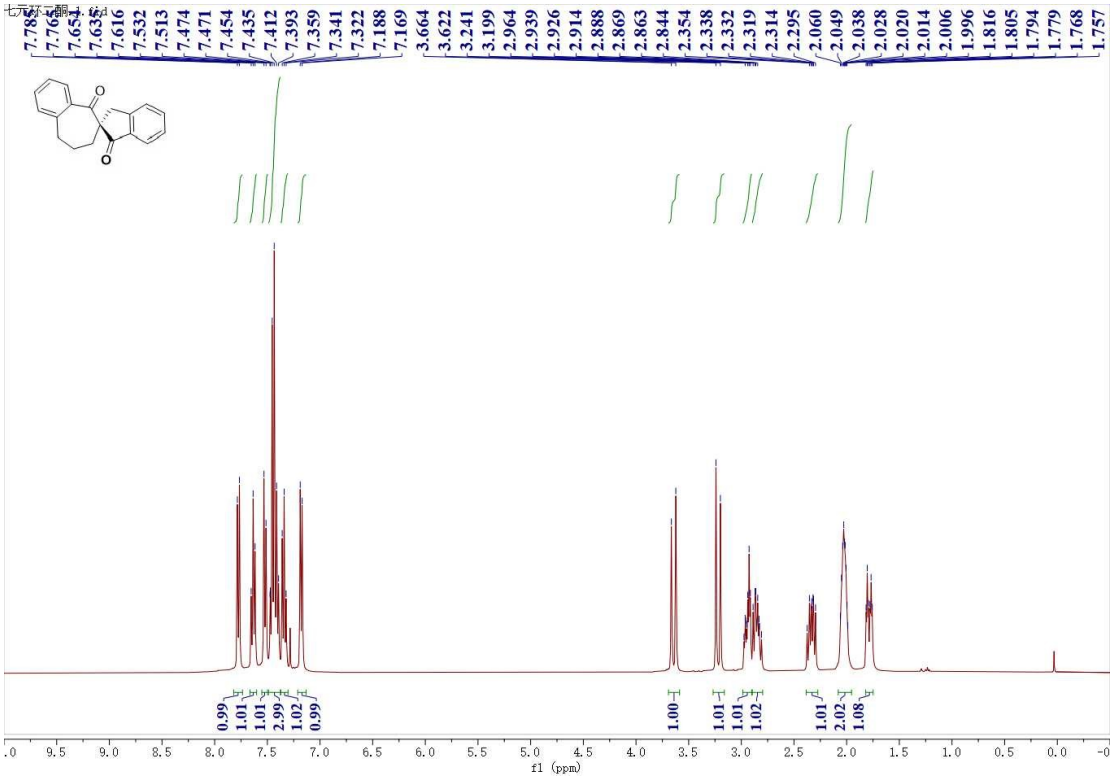


Peak#	Ret. Time	Area	Height	Area %
1	19.380	1293352	42571	49.31
2	34.775	1329435	25645	50.69

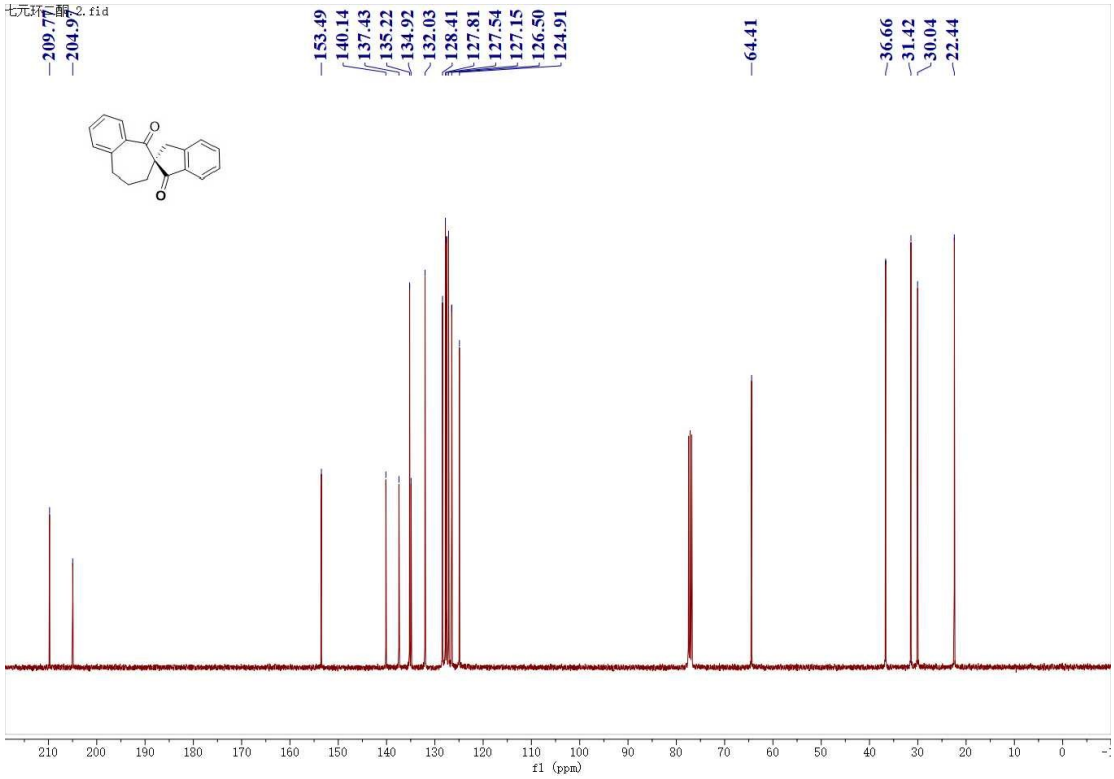


Peak#	Ret. Time	Area	Height	Area %
1	19.288	30256087	980828	97.98
2	34.535	622649	12439	2.02

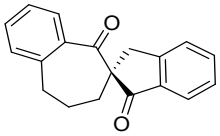
(*S*)-8,9-dihydrospiro[benzo[7]annulene-6,2'-indene]-1',5(3'*H*,7*H*)-dione (3c)

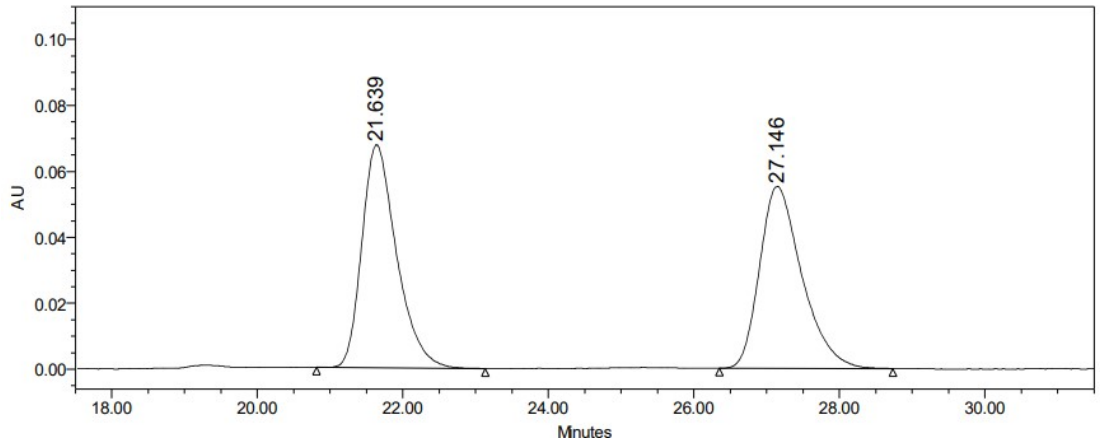


^{1}H NMR (400 MHz) in $CDCl_3$

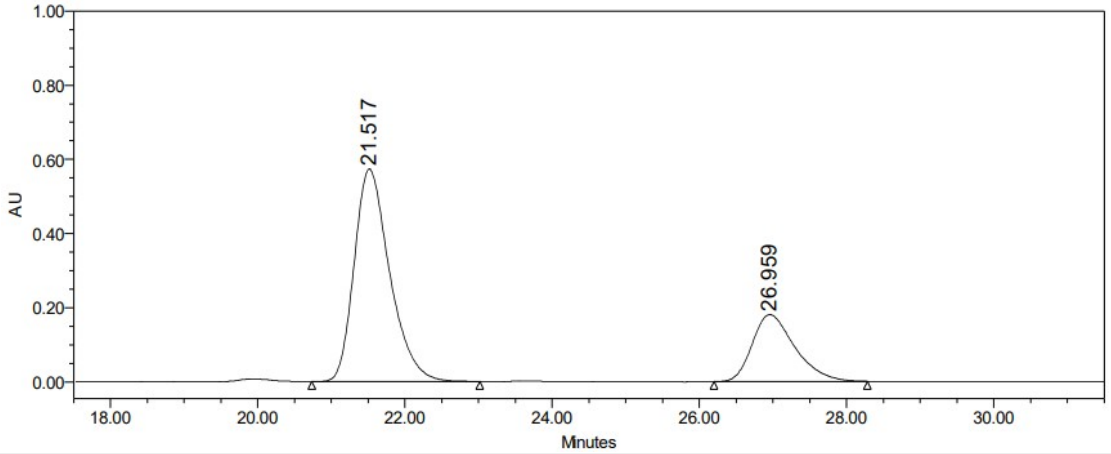


^{13}C NMR (100 MHz) in $CDCl_3$



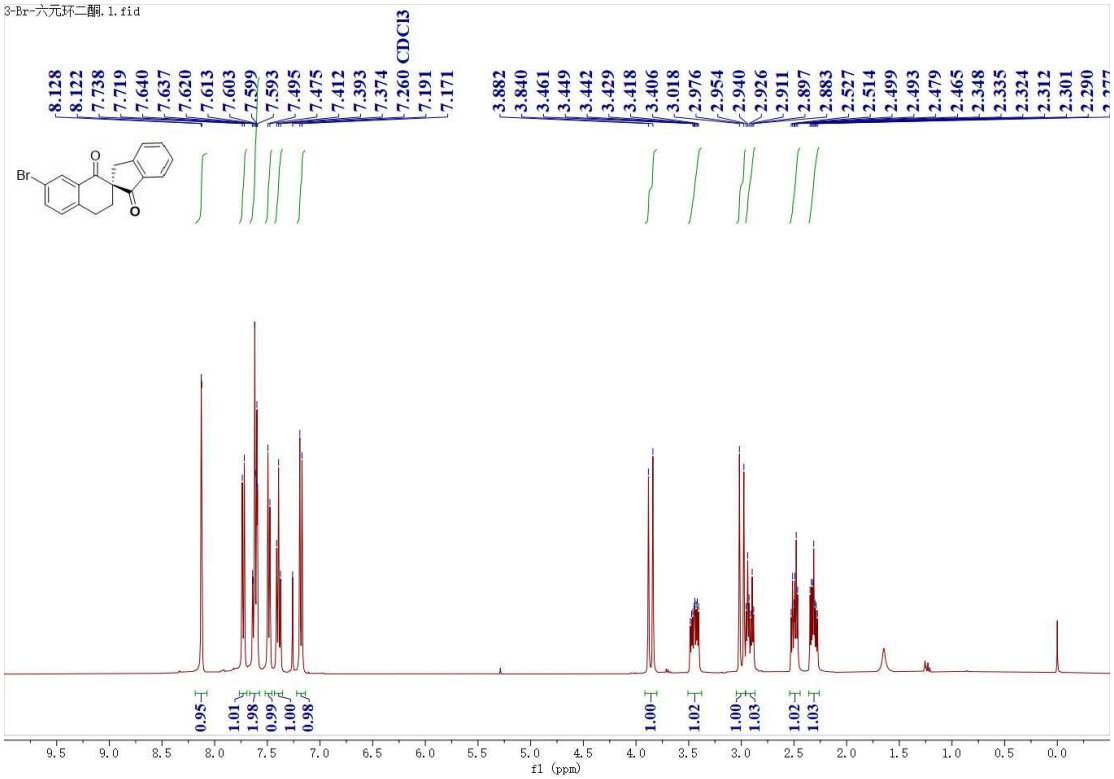


Peak#	Ret. Time	Area	Height	Area %
1	21.639	2249244	67653	50.20
2	27.146	2230998	55186	49.80

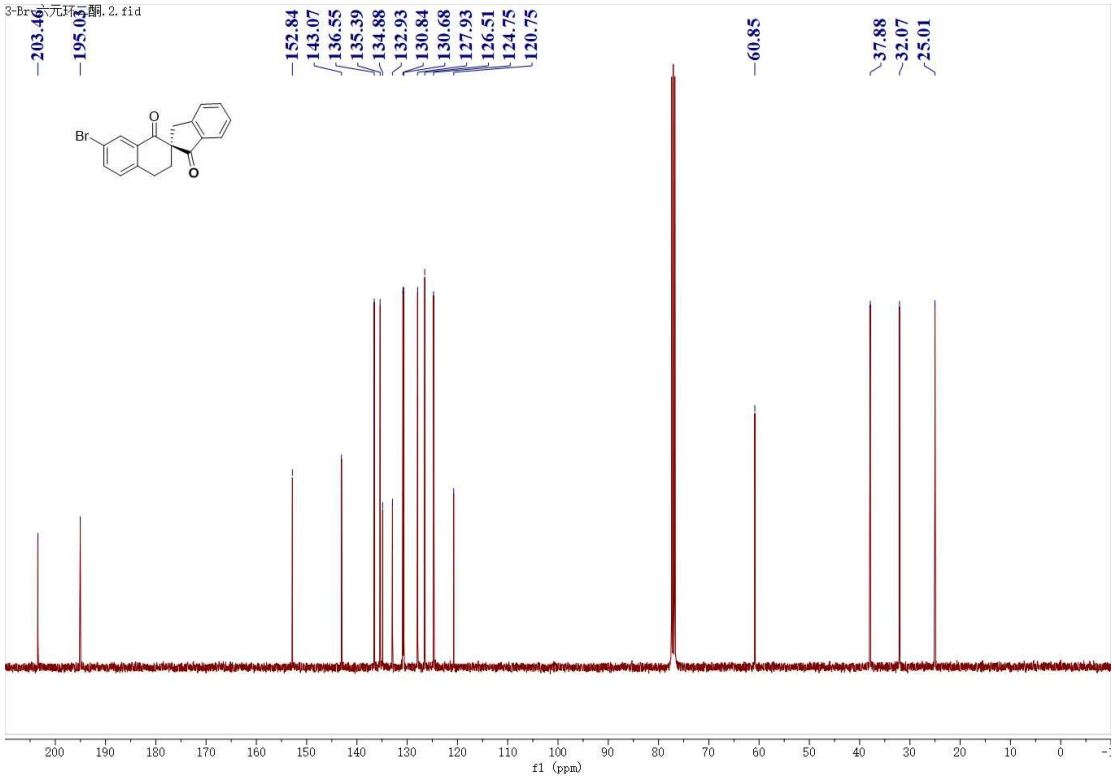


Peak#	Ret. Time	Area	Height	Area %
1	21.517	19199228	573218	72.50
2	26.959	7283031	180796	27.50

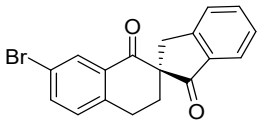
(*S*)-7'-bromo-3',4'-dihydro-1'*H*-spiro[indene-2,2'-naphthalene]-1,1'(3*H*)-dione (3e)

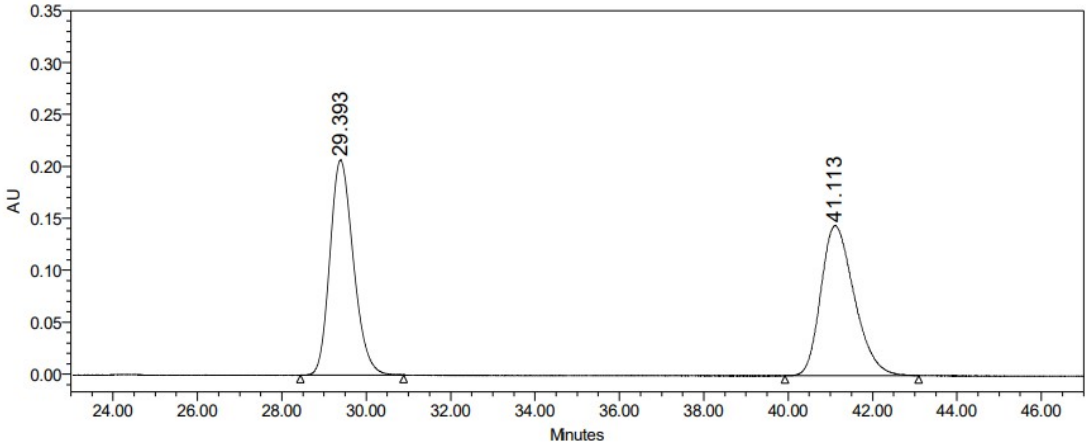


^{1}H NMR (400 MHz) in $CDCl_3$

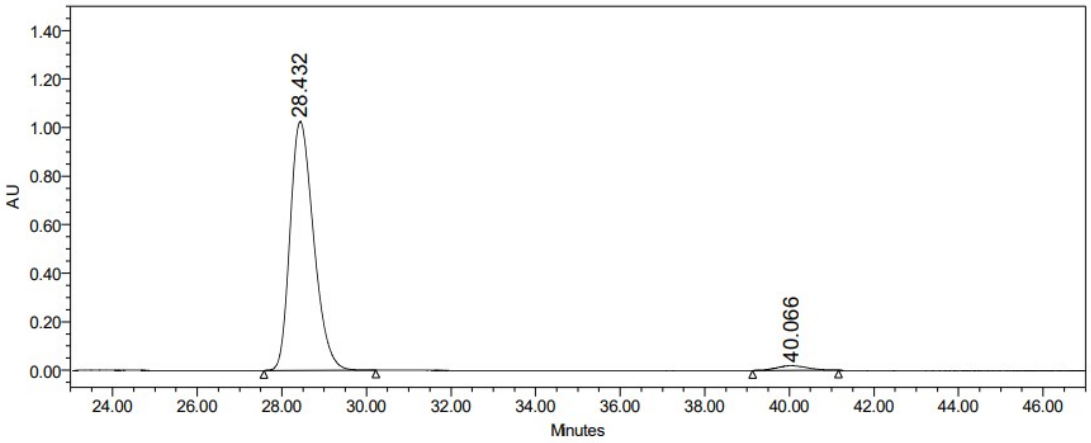


^{13}C NMR (100 MHz) in $CDCl_3$



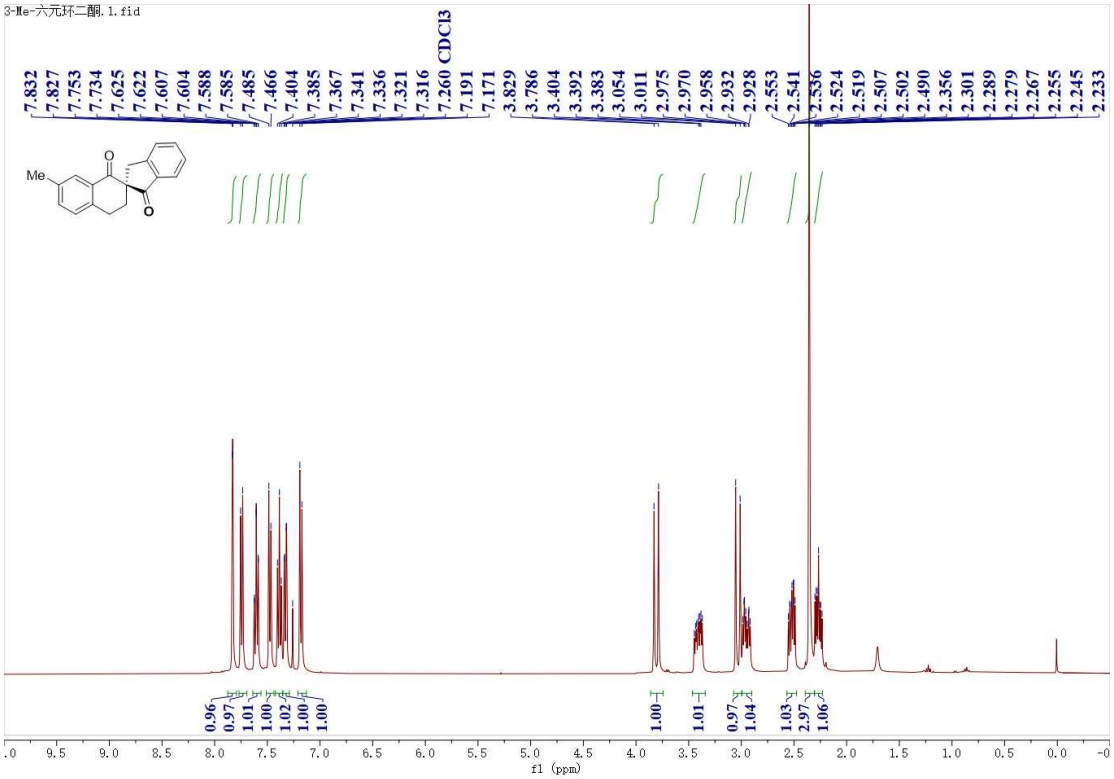


Peak#	Ret. Time	Area	Height	Area %
1	29.393	8017831	206935	50.29
2	41.113	7925878	144434	49.71

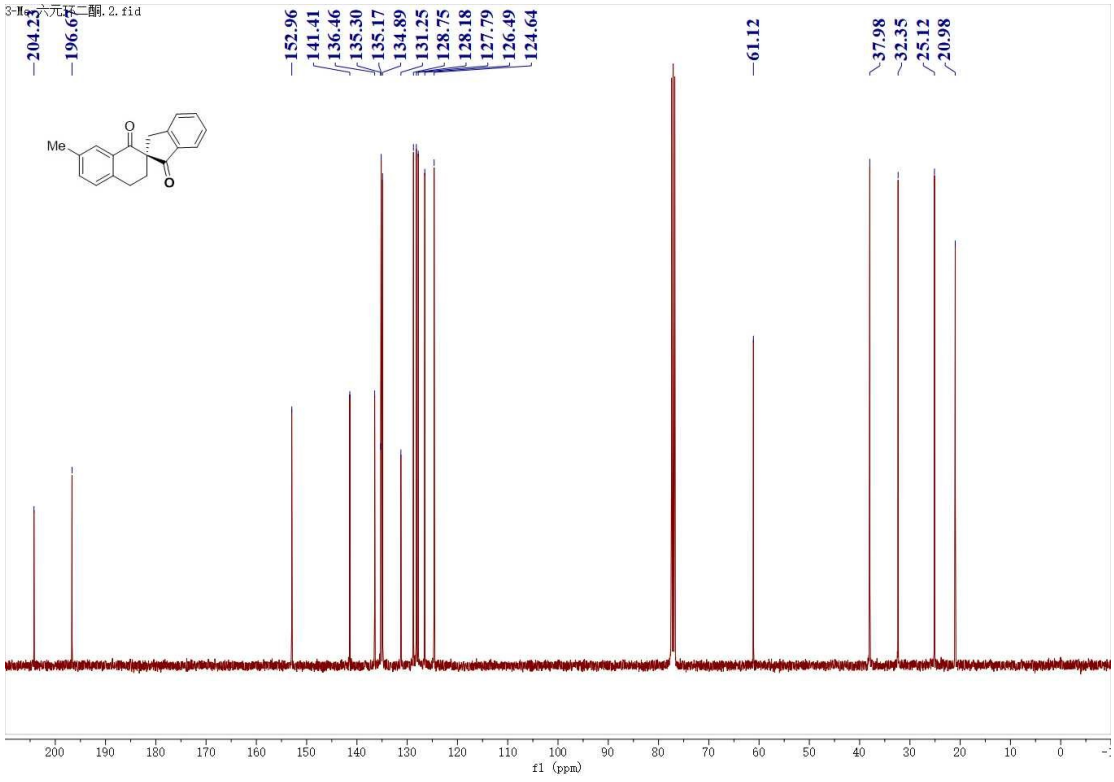


Peak#	Ret. Time	Area	Height	Area %
1	28.432	39727238	1026115	97.55
2	40.066	997617	19437	2.45

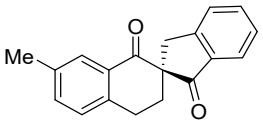
(*S*)-7'-methyl-3',4'-dihydro-1'*H*-spiro[indene-2,2'-naphthalene]-1,1'(3*H*)-dione (3i)

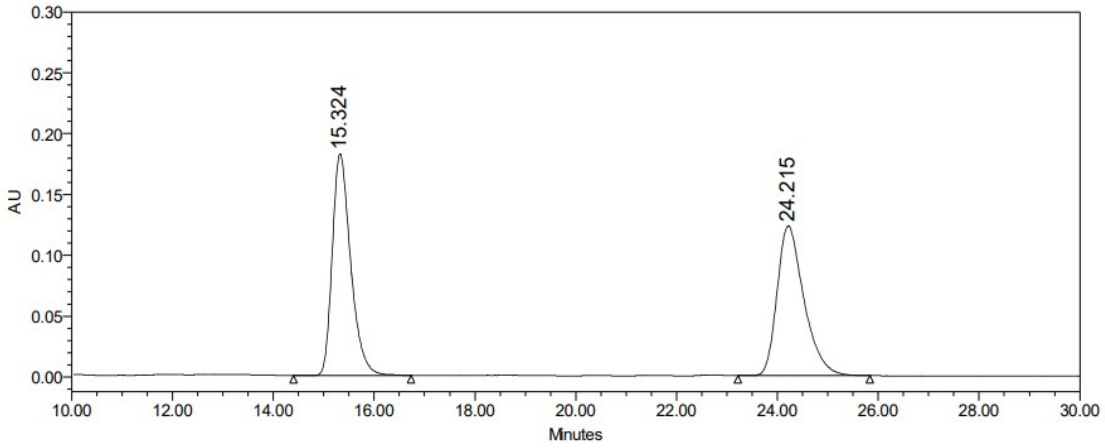


^{1}H NMR (400 MHz) in $CDCl_3$

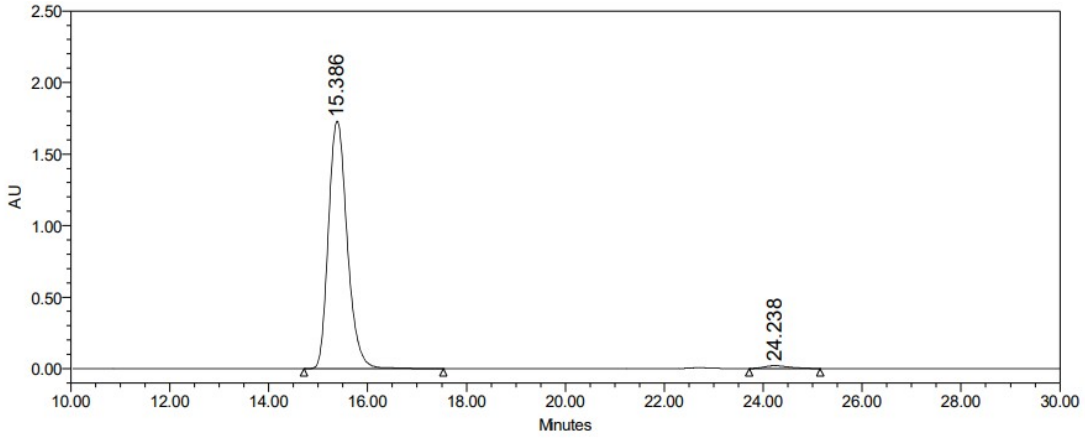


^{13}C NMR (100 MHz) in $CDCl_3$



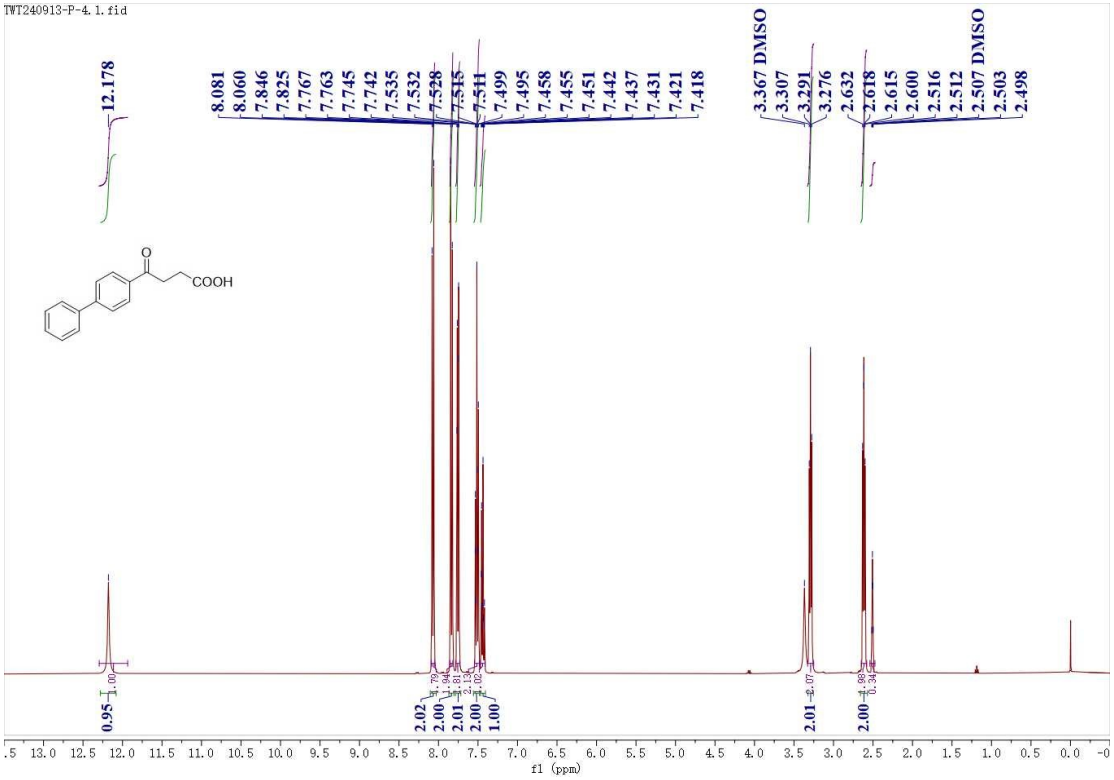


Peak#	Ret. Time	Area	Height	Area %
1	15.324	4622452	182259	50.43
2	24.215	4543721	123015	49.57

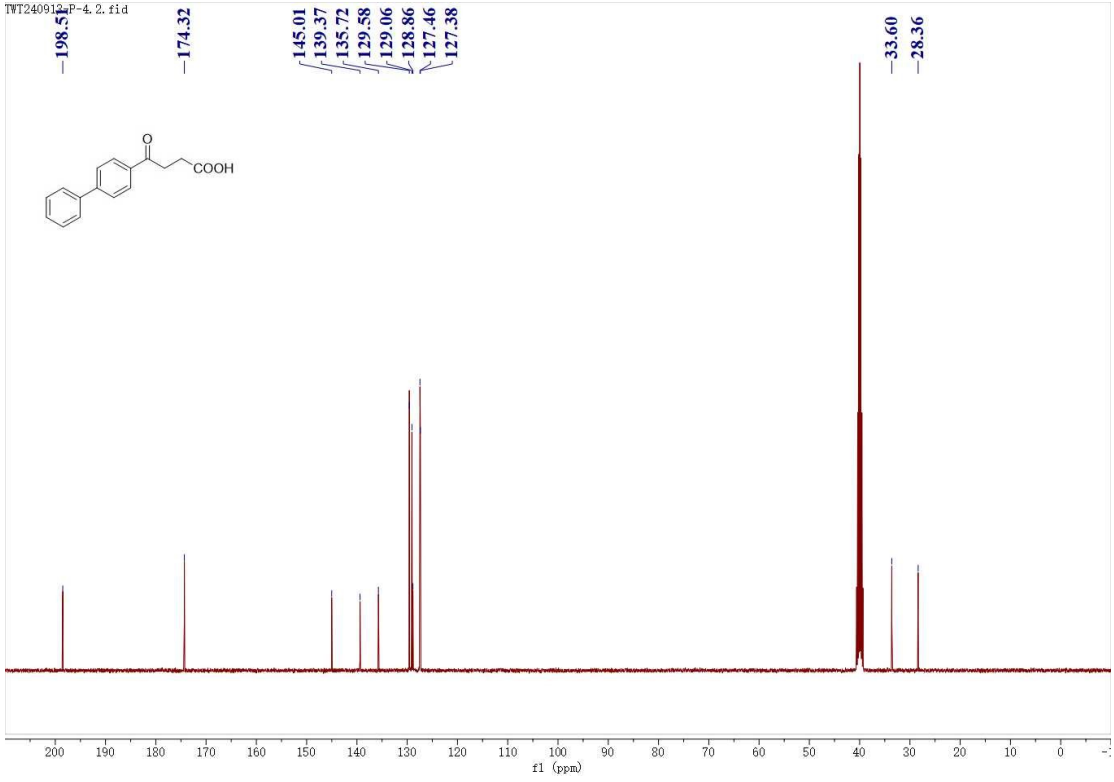


Peak#	Ret. Time	Area	Height	Area %
1	15.386	45587219	1728741	98.49
2	24.238	698525	20120	1.51

4-([1,1'-biphenyl]-4-yl)-4-oxobutanoic acid (3x):

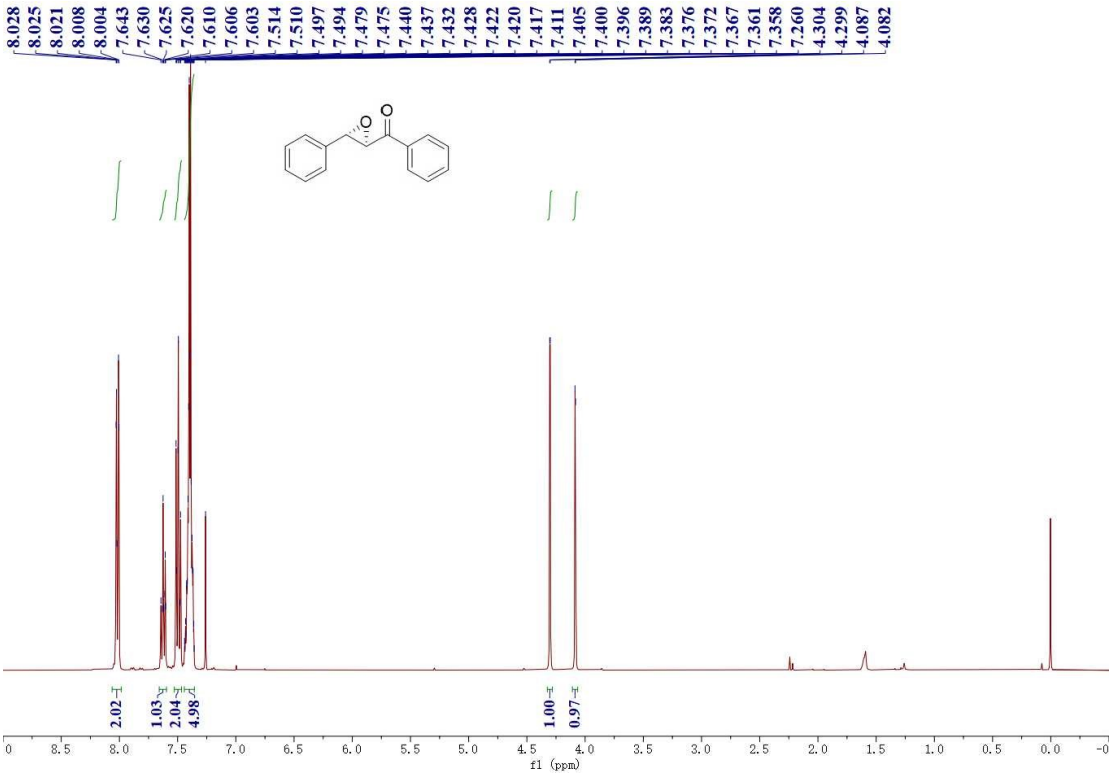


^{1}H NMR (400 MHz) in DMSO-d_6

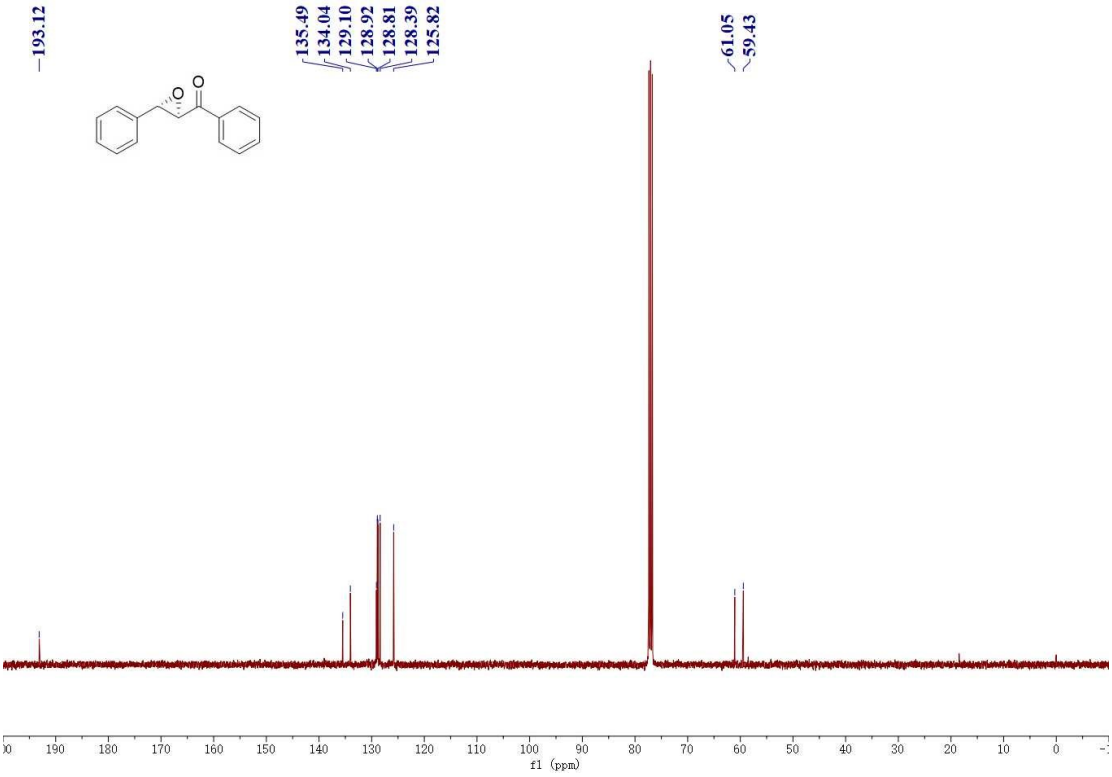


^{13}C NMR (100 MHz) in DMSO-d_6

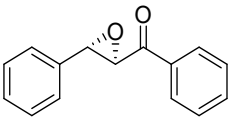
(2*R*,3*S*)-3-Phenyloxiran-2-yl)-phenylmethanone (5aa)

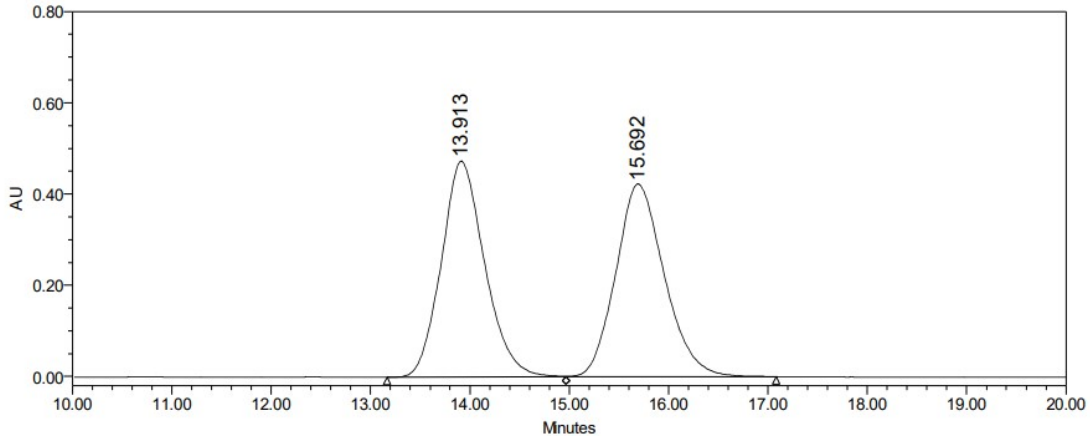


^{1}H NMR (400 MHz) in $CDCl_3$

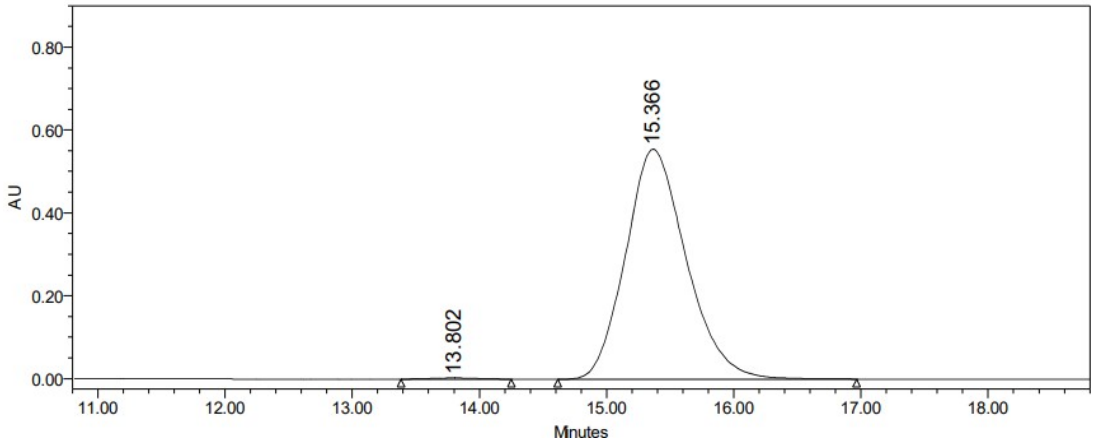


^{13}C NMR (100 MHz) in $CDCl_3$



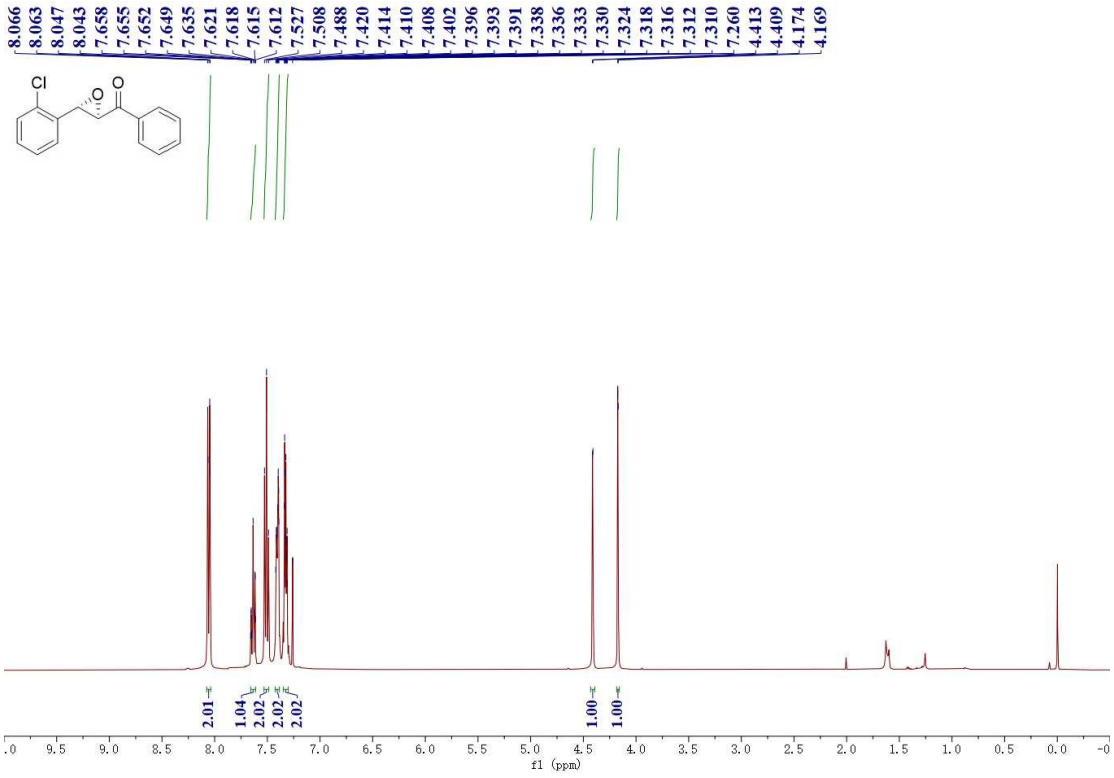


Peak#	Ret. Time	Area	Height	Area %
1	13.913	14348095	473114	49.96
2	15.692	14370696	422730	50.04

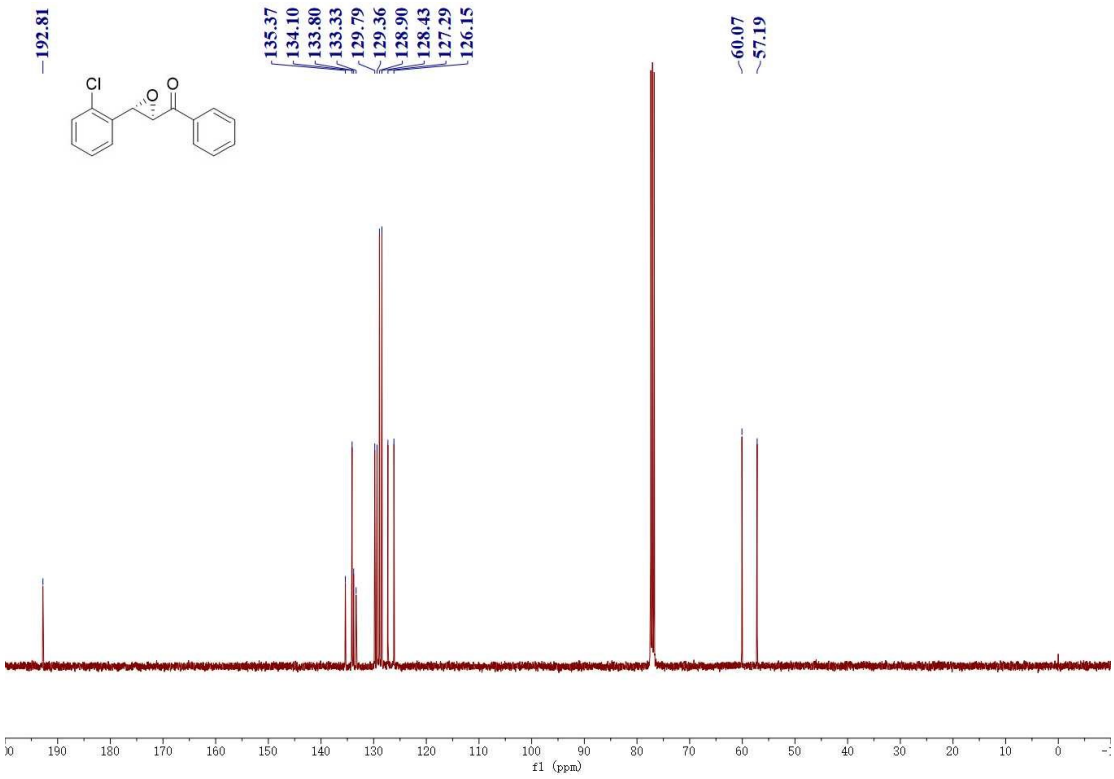


Peak#	Ret. Time	Area	Height	Area %
1	13.802	69123	2658	0.37
2	15.366	18382481	555452	99.63

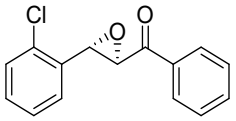
(2*R*,3*S*)-3-(2-Chlorophenyl)oxiran-2-yl)-phenylmethanone (5ab)

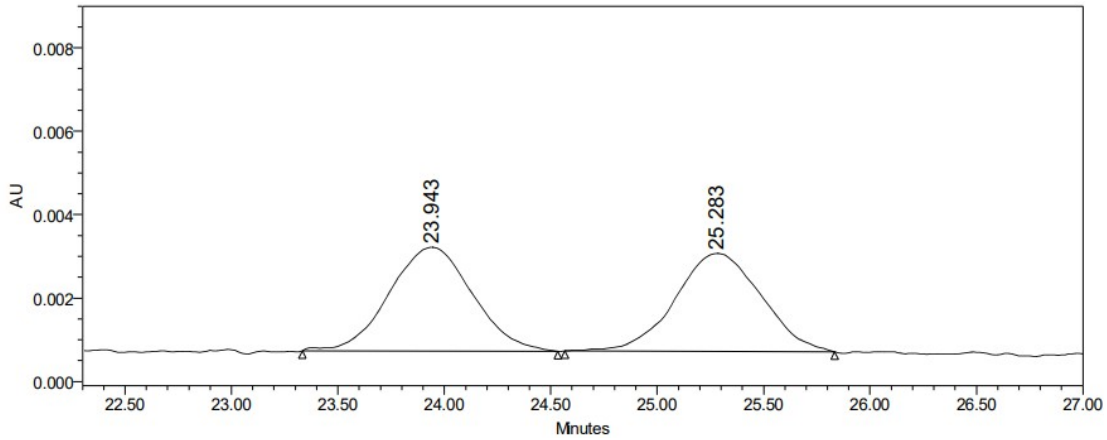


^{1}H NMR (400 MHz) in $CDCl_3$

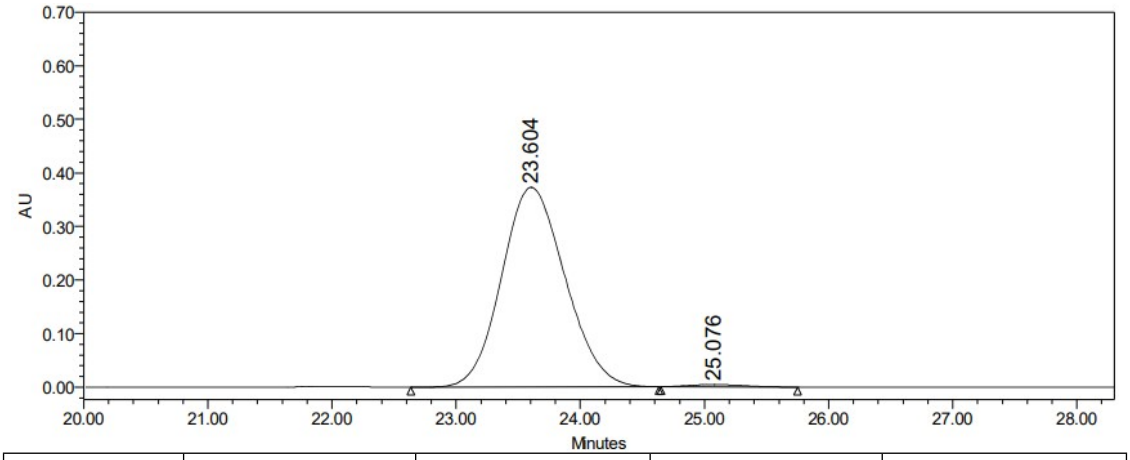


^{13}C NMR (100 MHz) in $CDCl_3$



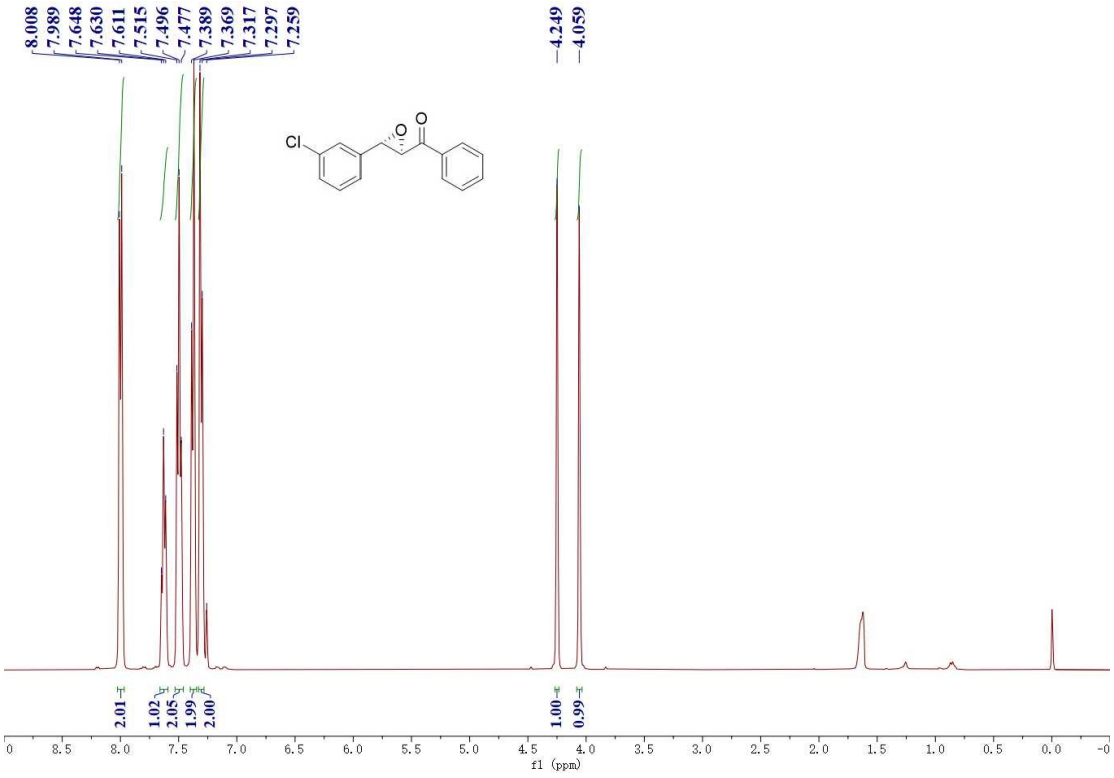


Peak#	Ret. Time	Area	Height	Area %
1	23.943	67515	2488	50.47
2	25.283	66262	2353	49.53

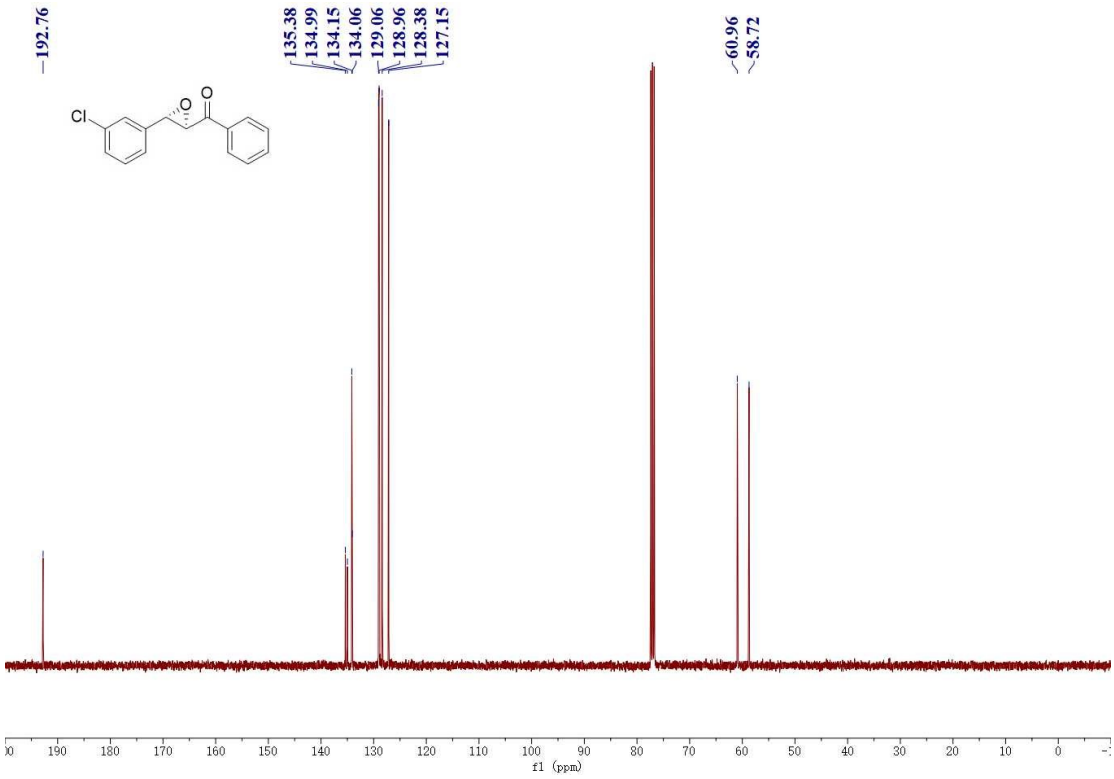


Peak#	Ret. Time	Area	Height	Area %
1	23.604	13273266	372543	99.04
2	25.076	129173	4473	0.96

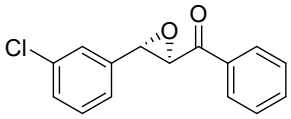
(2*R*,3*S*)-3-(3-Chlorophenyl)oxiran-2-yl)-phenylmethanone (5ac)

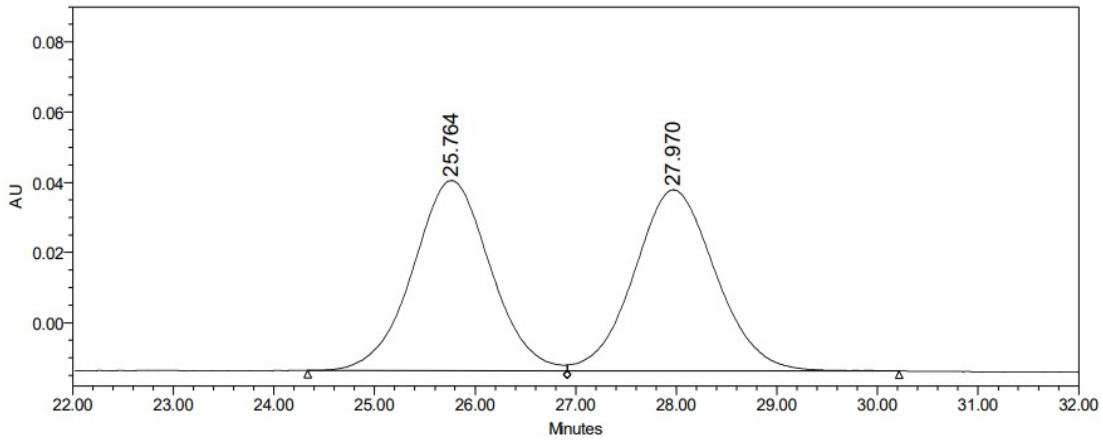


^{1}H NMR (400 MHz) in $CDCl_3$

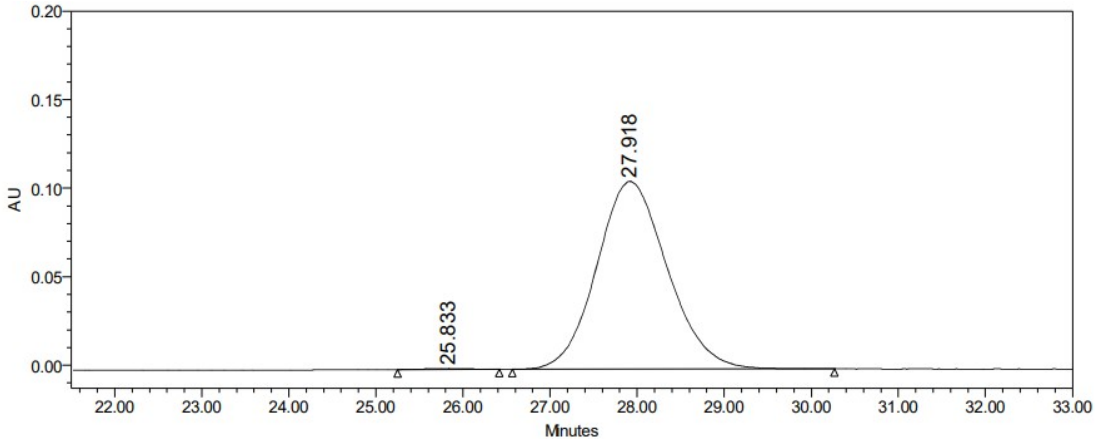


^{13}C NMR (100 MHz) in $CDCl_3$



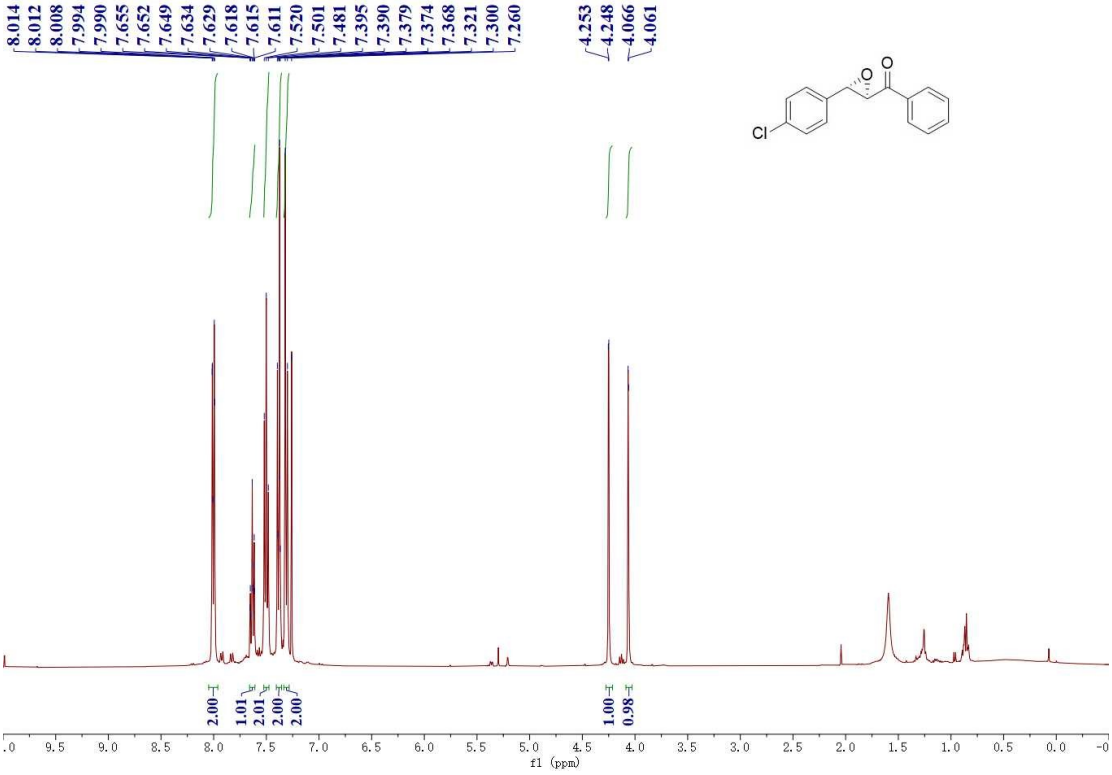


Peak#	Ret. Time	Area	Height	Area %
1	25.764	2903398	54204	49.98
2	27.970	2905483	51573	50.02

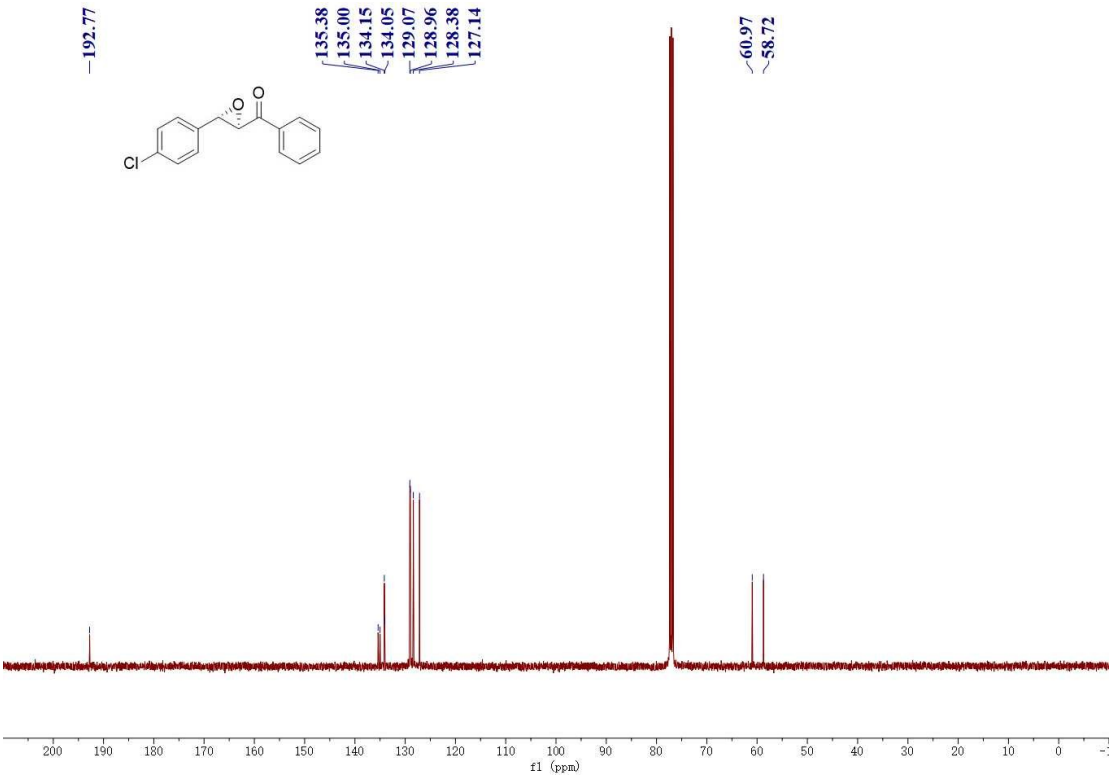


Peak#	Ret. Time	Area	Height	Area %
1	25.833	19090	482	0.32
2	27.918	5987208	106033	99.68

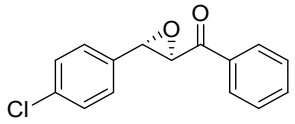
(2*R*,3*S*)-3-(4-Chlorophenyl)oxiran-2-yl)-phenylmethanone (5ad)

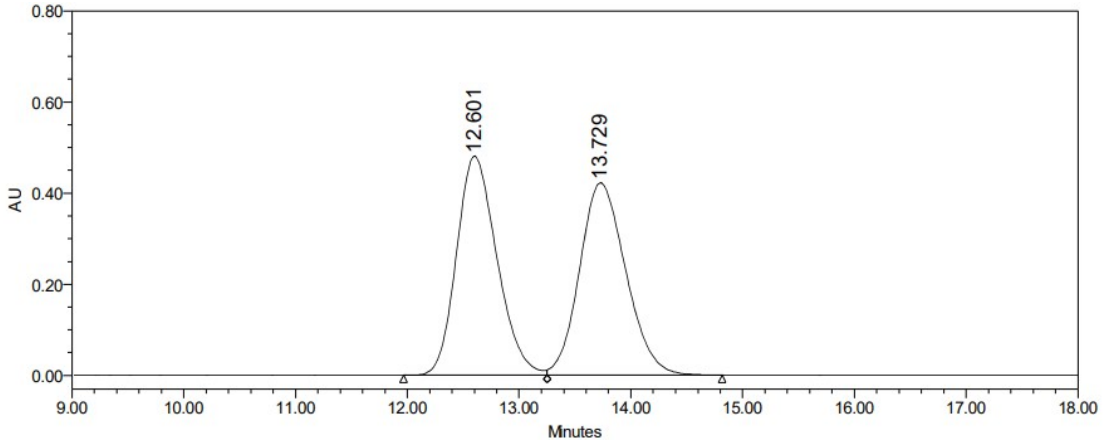


^{1}H NMR (400 MHz) in $CDCl_3$

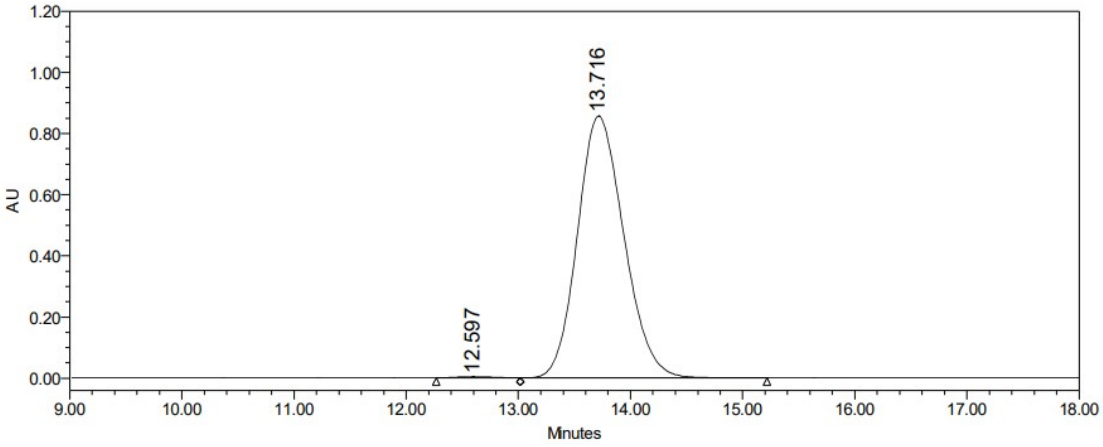


^{13}C NMR (100 MHz) in $CDCl_3$



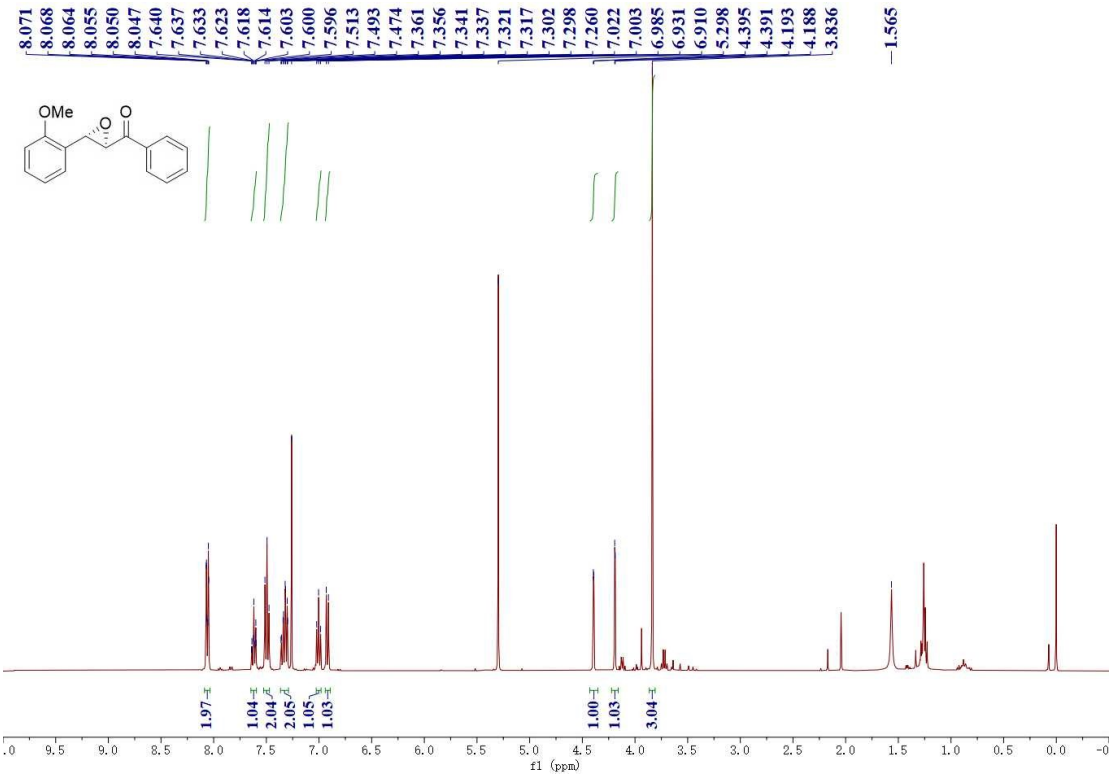


Peak#	Ret. Time	Area	Height	Area %
1	12.601	12056921	480523	49.93
2	13.729	12092617	422049	50.07

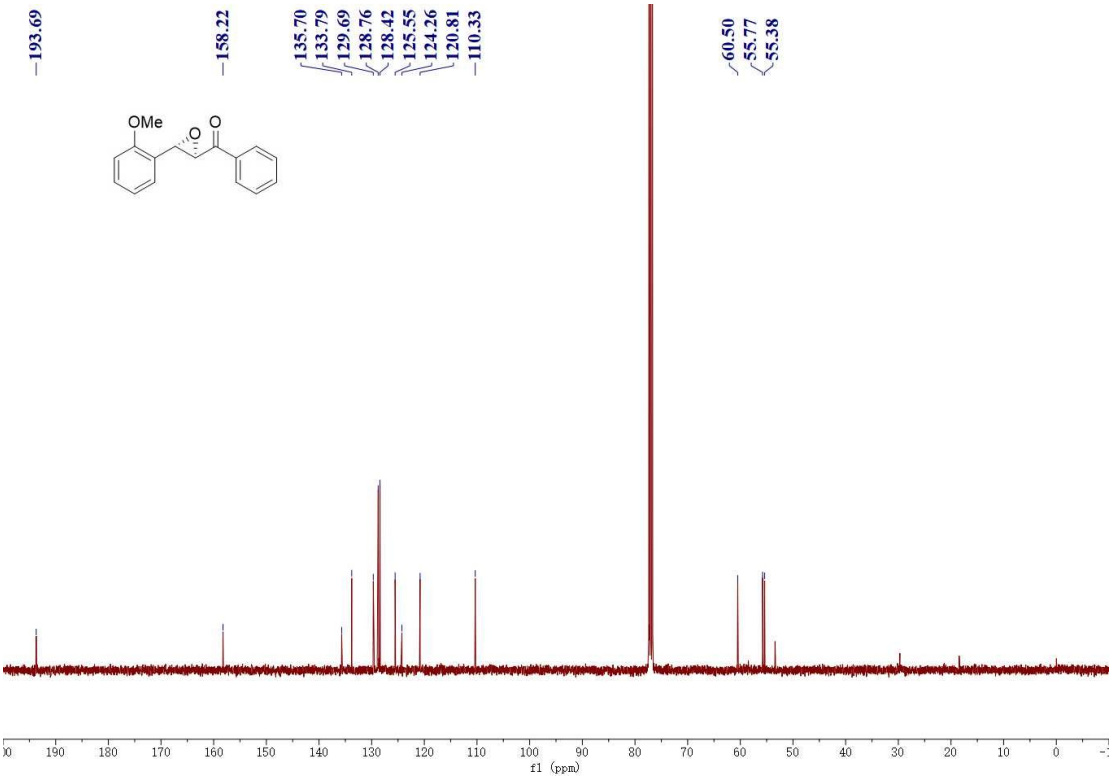


Peak#	Ret. Time	Area	Height	Area %
1	12.597	95209	4182	0.38
2	13.716	24641026	857298	99.62

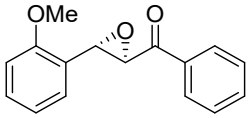
(2*R*,3*S*)-3-(2-Methoxyphenyl)oxiran-2-yl)-phenylmethanone (5ae)

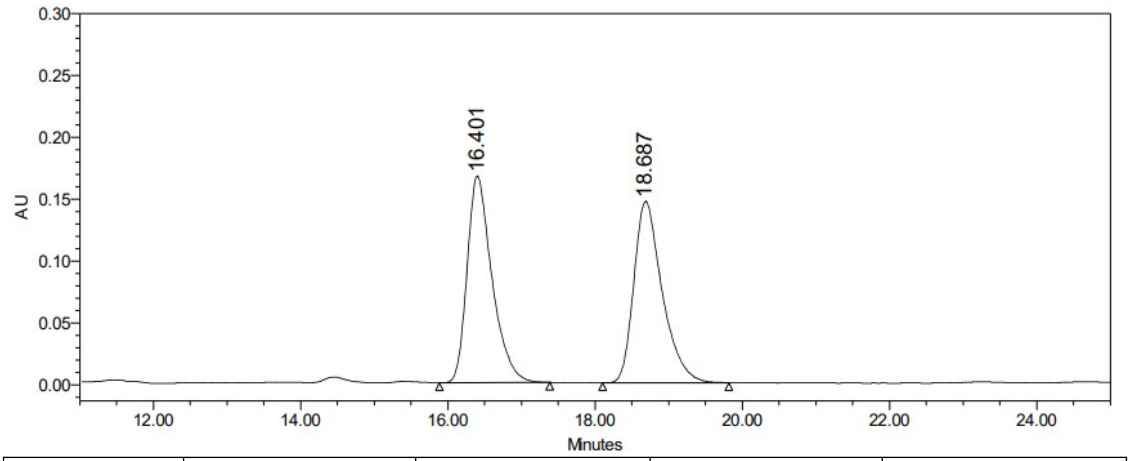


^{1}H NMR (400 MHz) in $CDCl_3$

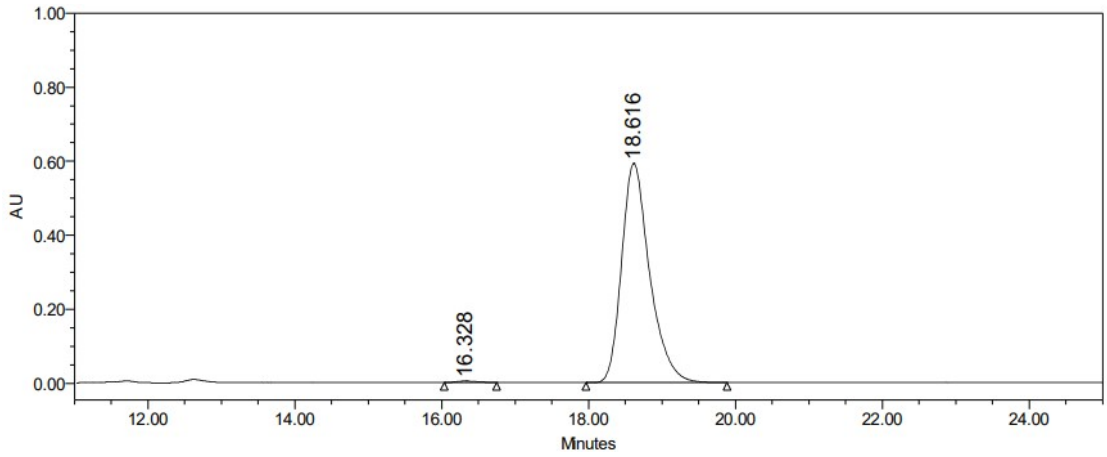


^{13}C NMR (100 MHz) in $CDCl_3$





Peak#	Ret. Time	Area	Height	Area %
1	16.401	3933425	167078	50.01
2	18.687	3931301	146710	49.99



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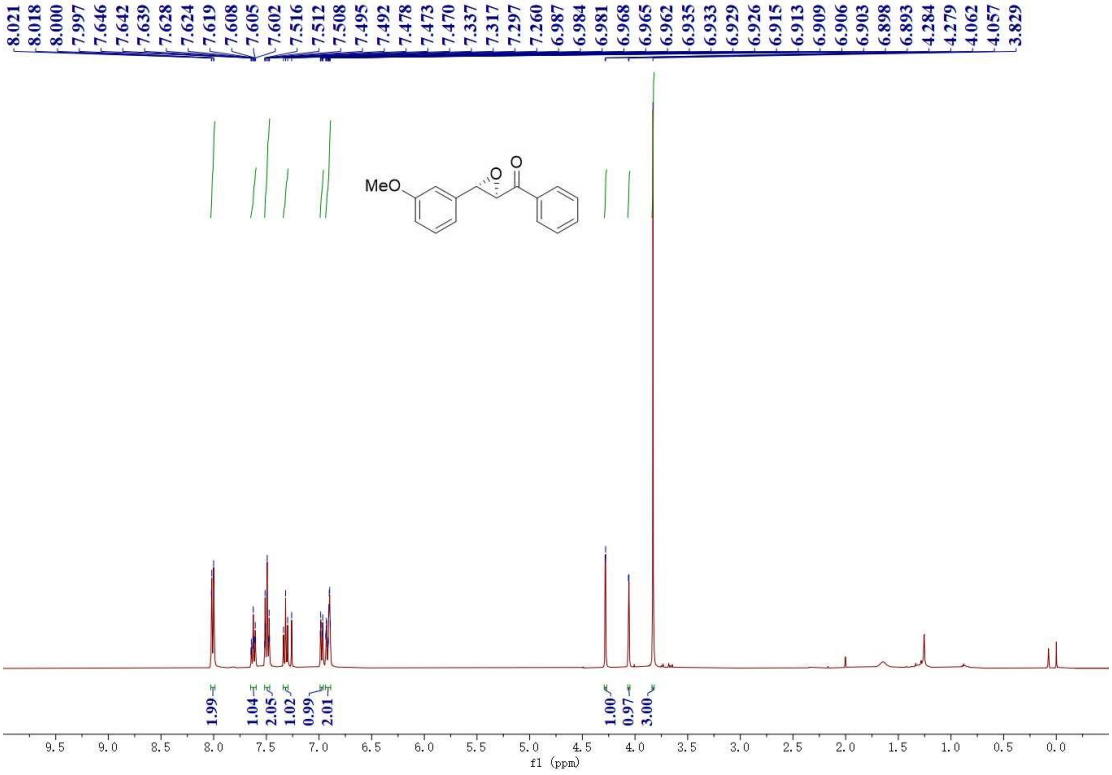
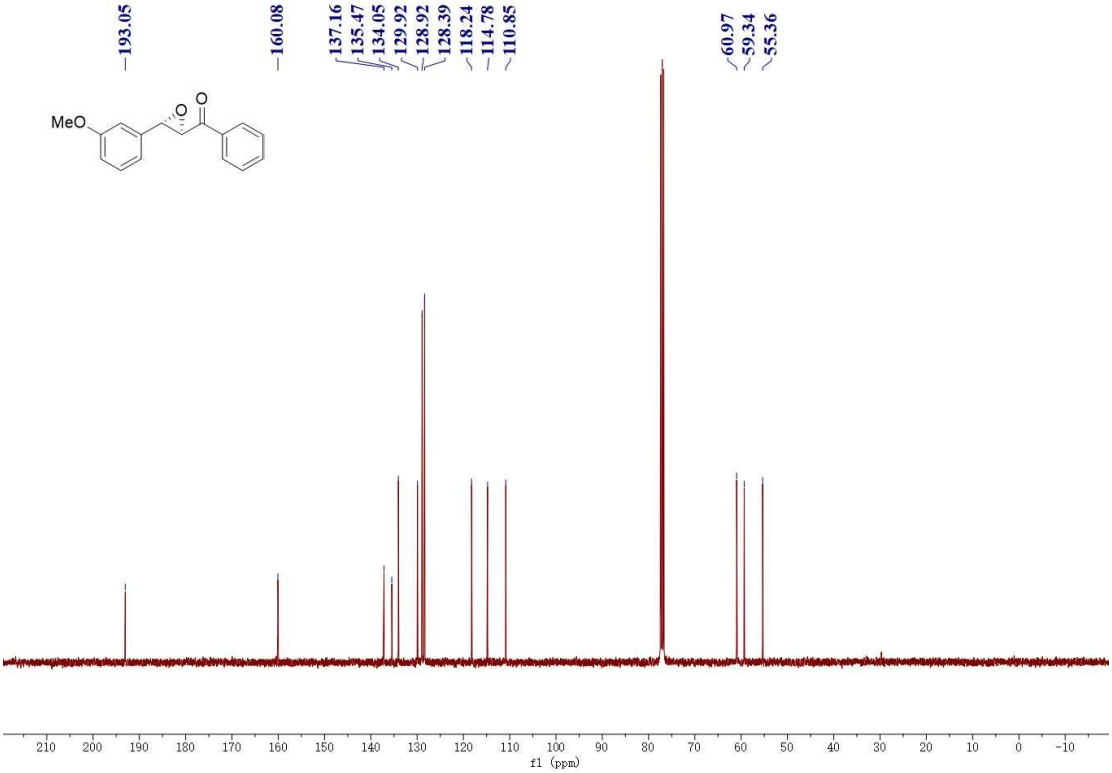
Peak#	Ret. Time	Area	Height	Area %
1	16.328	82605	4011	0.52
2	18.616	15695772	592933	99.48

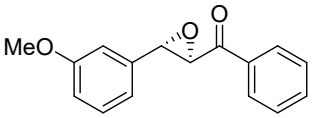
(2*R*,3*S*)-3-(3-Methoxyphenyl)oxiran-2-yl)-phenylmethanone (5af)

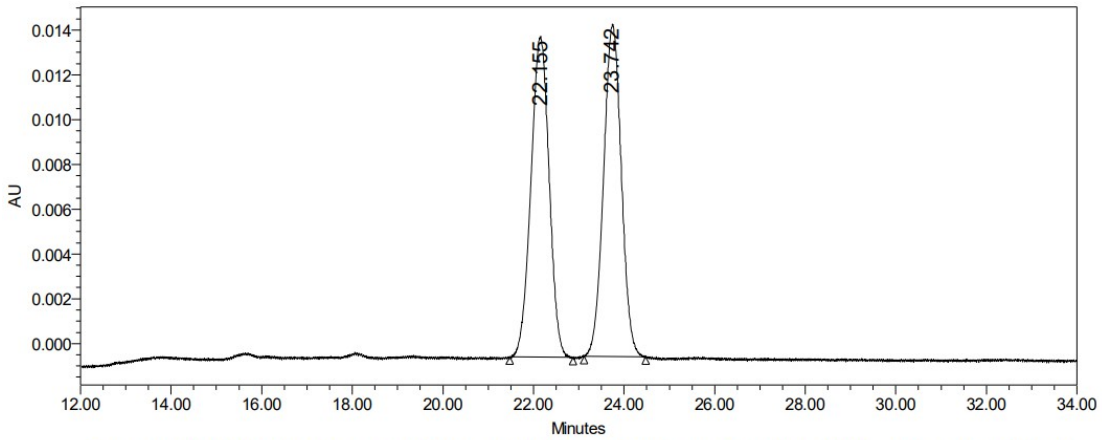


^{1}H NMR (400 MHz) in $CDCl_3$

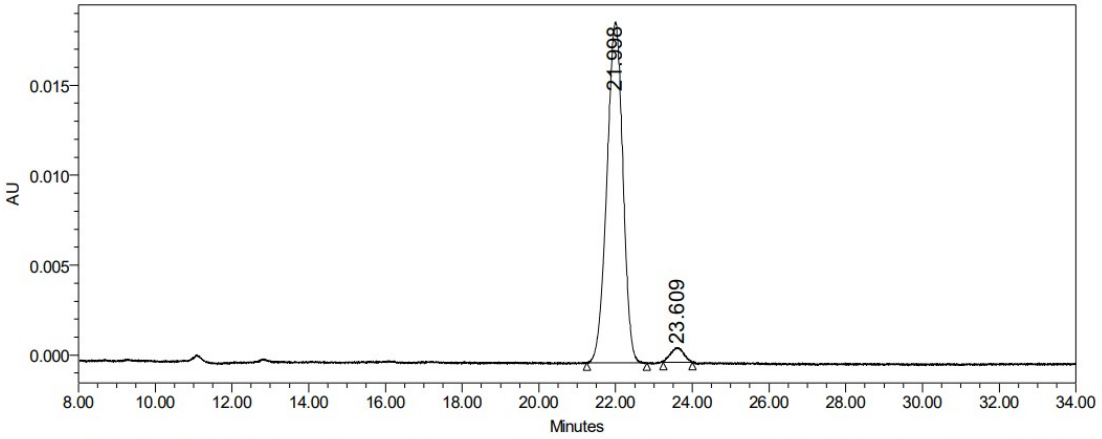


^{13}C NMR (100 MHz) in $CDCl_3$



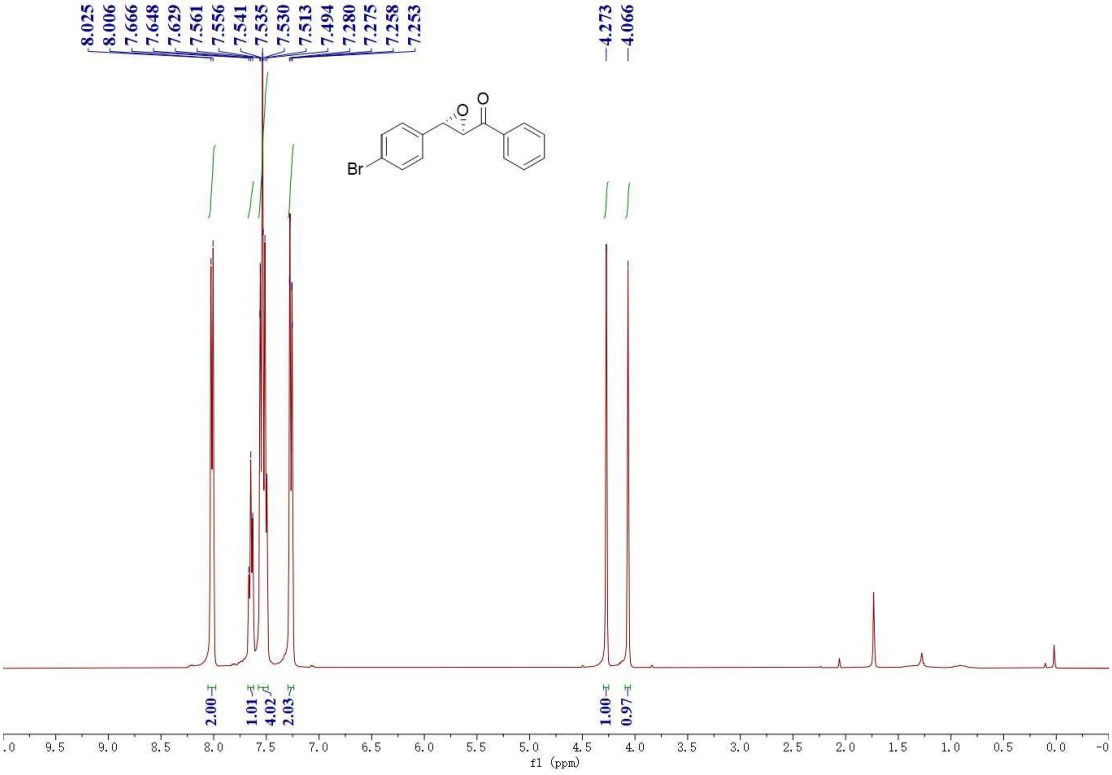


Peak#	Ret. Time	Area	Height	Area %
1	22.155	400266	14317	49.67
2	23.742	405640	14832	50.33

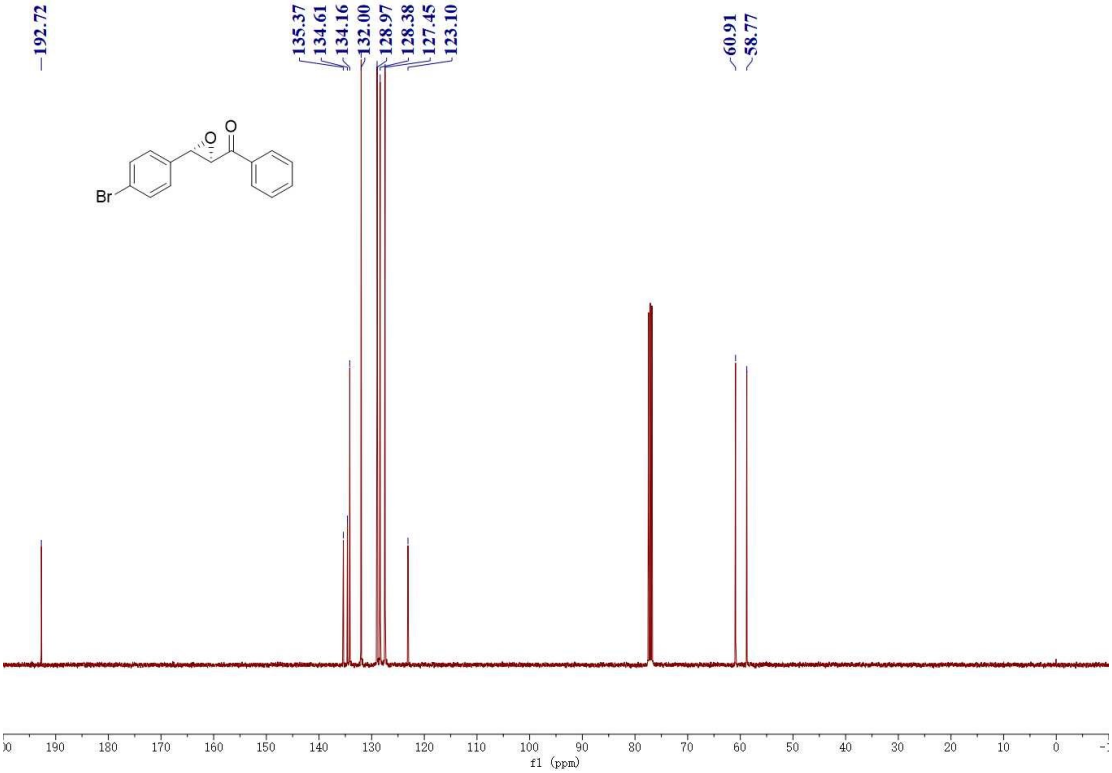


Peak#	Ret. Time	Area	Height	Area %
1	21.998	554854	18940	96.53
2	23.609	19959	830	3.47

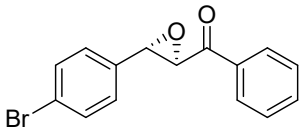
(2*R*,3*S*)-3-(4-Bromophenyl)oxiran-2-yl)-(phenyl)methanone (5ag)

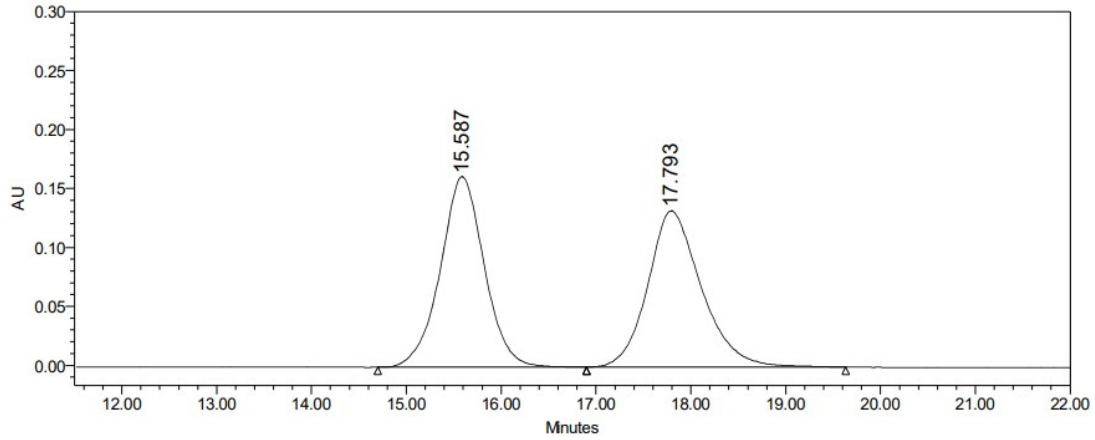


^{1}H NMR (400 MHz) in $CDCl_3$

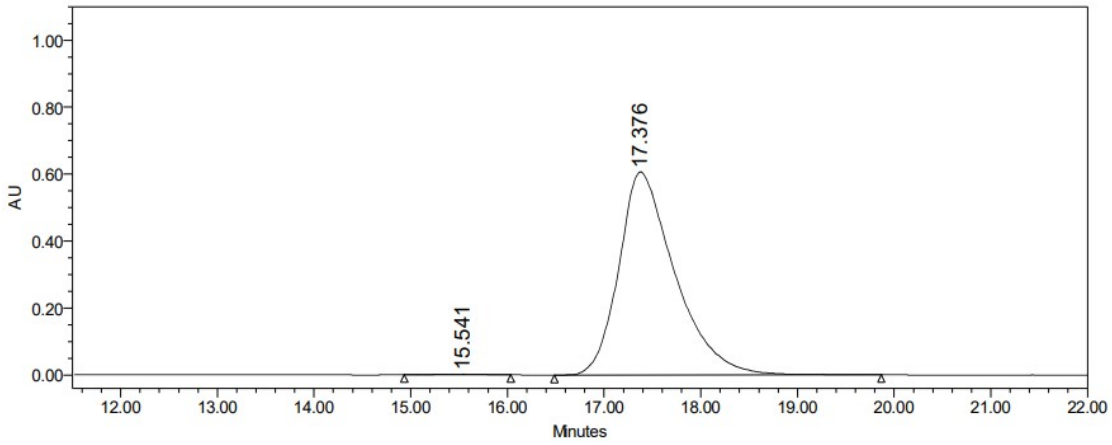


^{13}C NMR (100 MHz) in $CDCl_3$



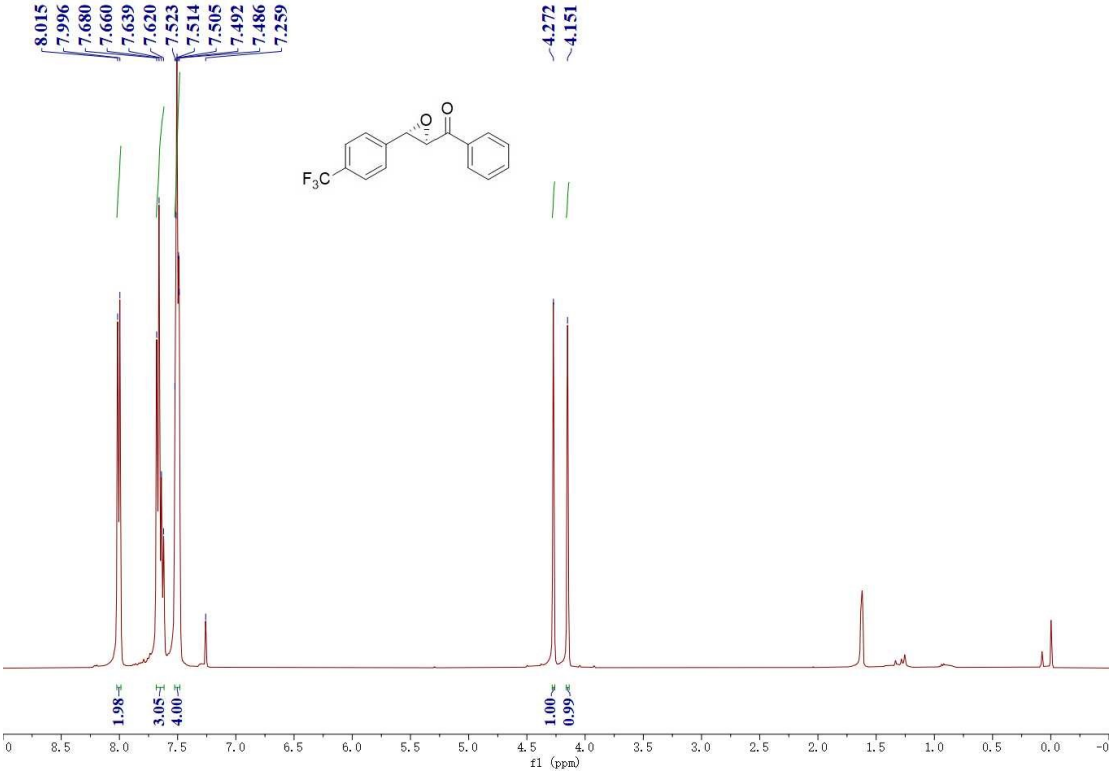


Peak#	Ret. Time	Area	Height	Area %
1	15.587	5204493	161591	50.04
2	17.793	5195729	132336	49.96

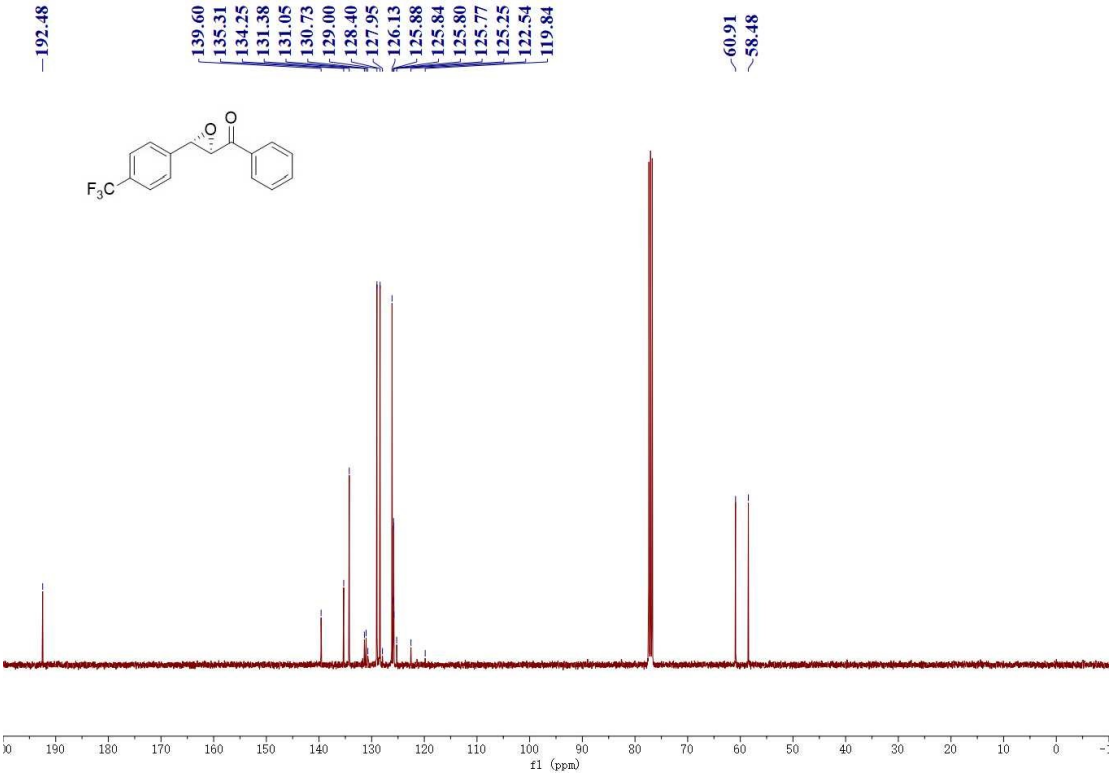


Peak#	Ret. Time	Area	Height	Area %
1	15.541	88962	2874	0.36
2	17.376	24475306	606293	99.64

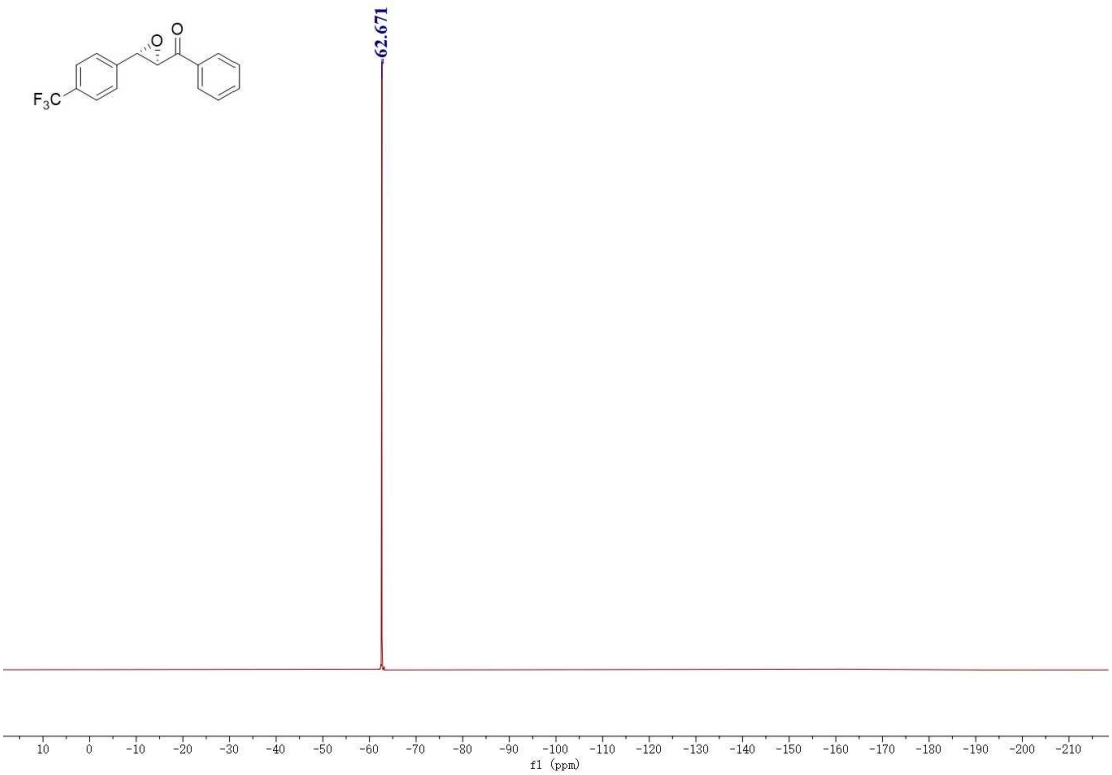
(2*R*,3*S*)-3-(4-Trifluorophenyl)oxiran-2-yl)-phenylmethanone (5ah)



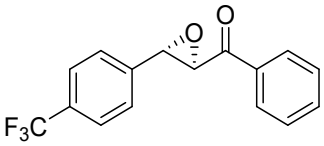
^{1}H NMR (400 MHz) in $CDCl_3$

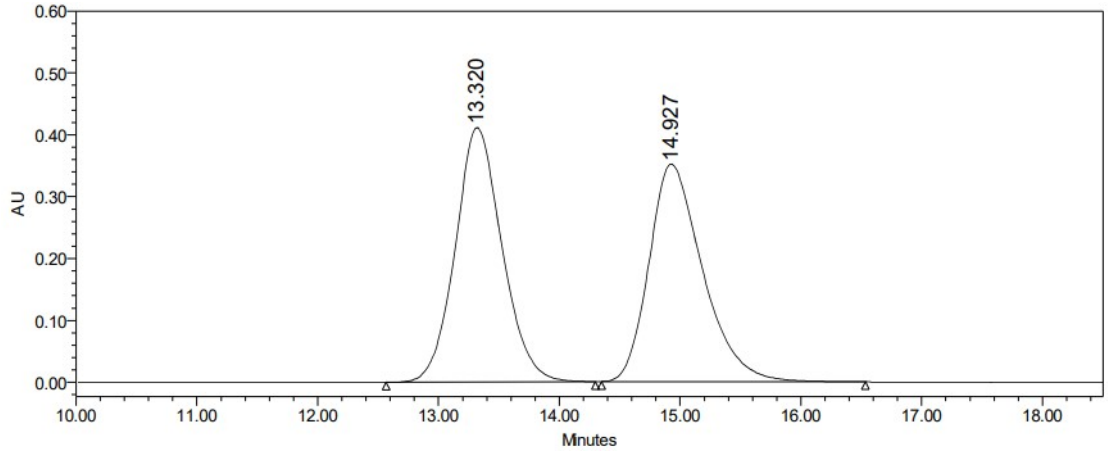


^{13}C NMR (100 MHz) in $CDCl_3$

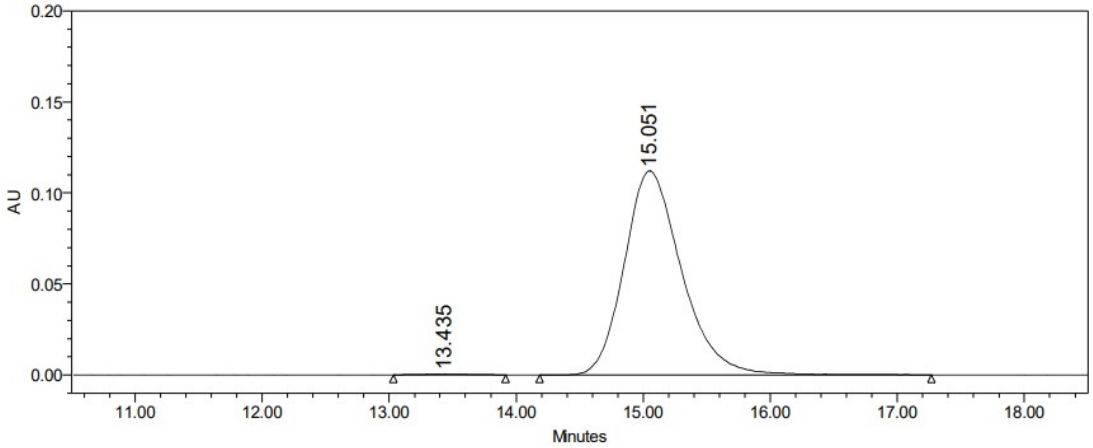


^{19}F NMR (376 MHz) in $CDCl_3$



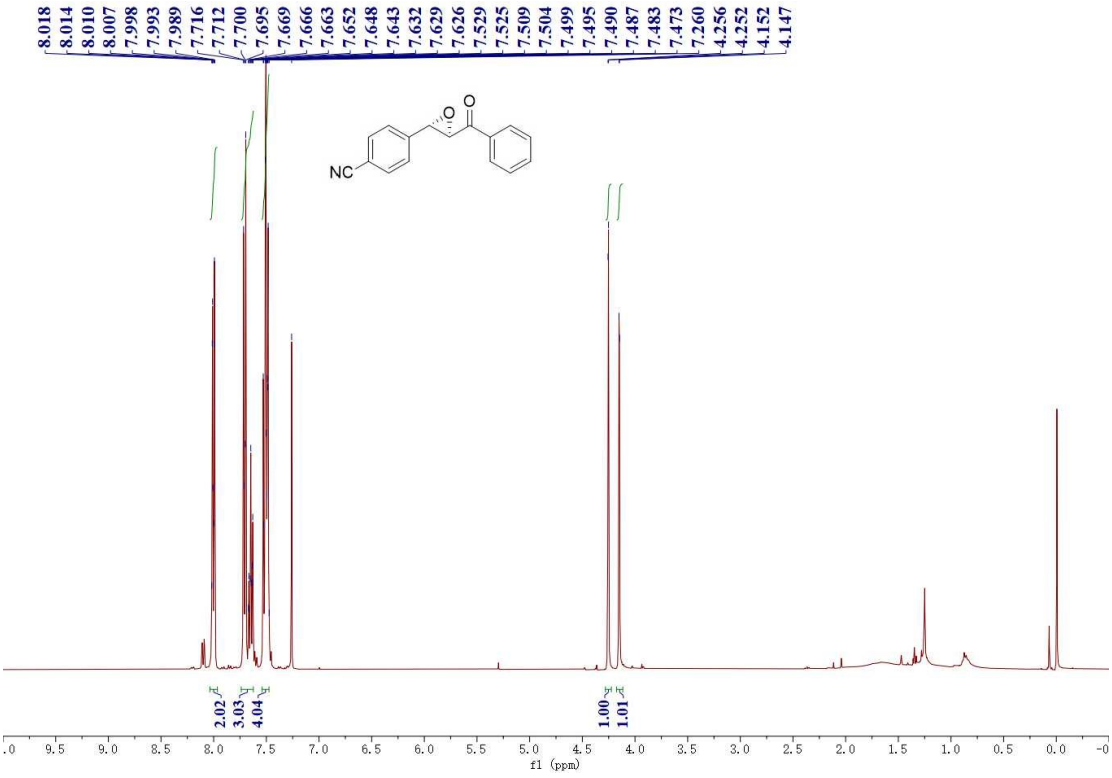


Peak#	Ret. Time	Area	Height	Area %
1	13.320	110626629	411452	50.52
2	14.927	10834014	351612	49.48

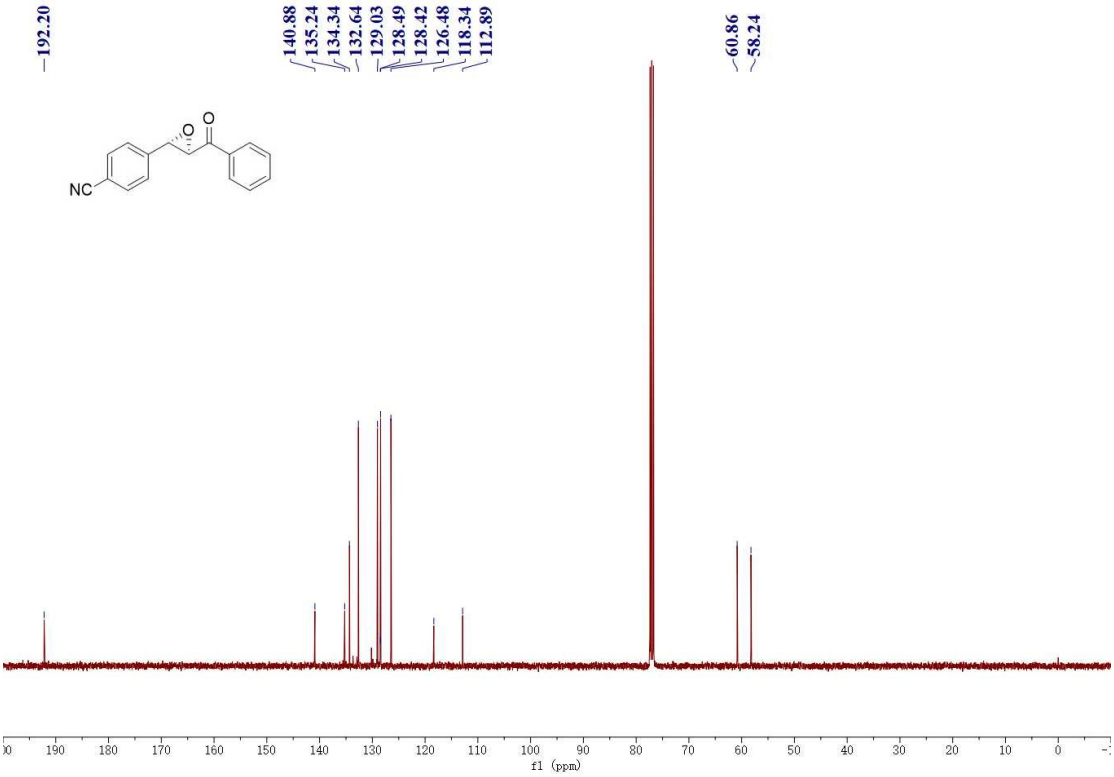


Peak#	Ret. Time	Area	Height	Area %
1	13.435	15556	584	0.44
2	15.051	3520639	112207	99.56

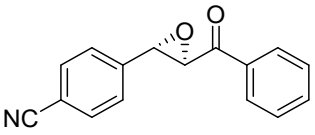
4-((2*S*,3*R*)-3-benzoyloxiran-2-yl)benzonitrile (5ai)

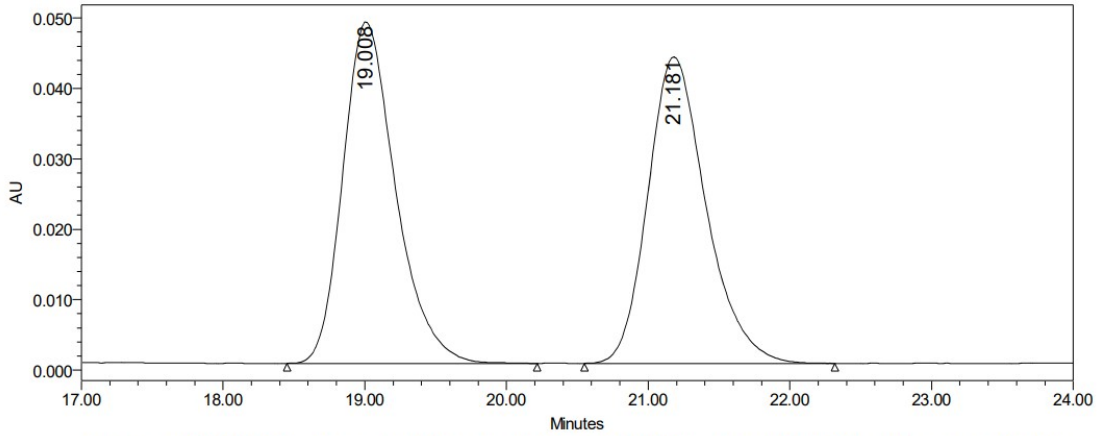


^{1}H NMR (400 MHz) in $CDCl_3$

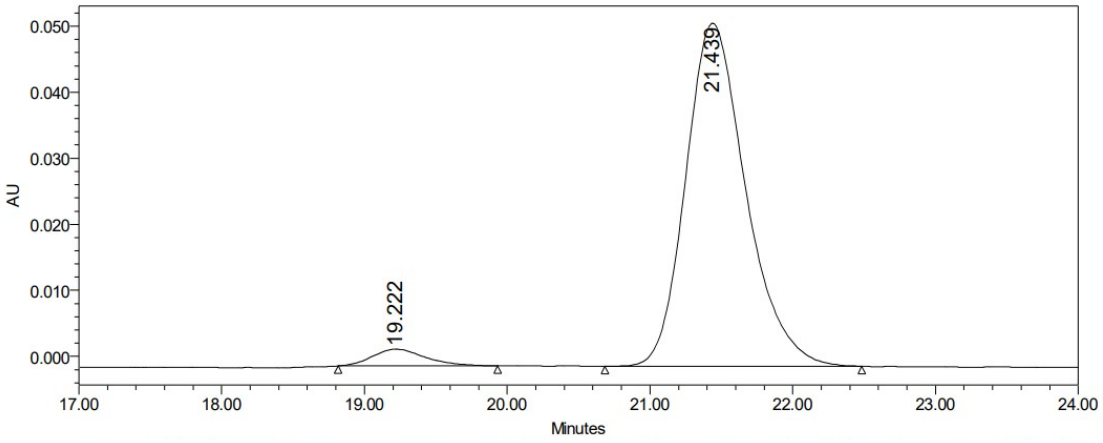


^{13}C NMR (100 MHz) in $CDCl_3$



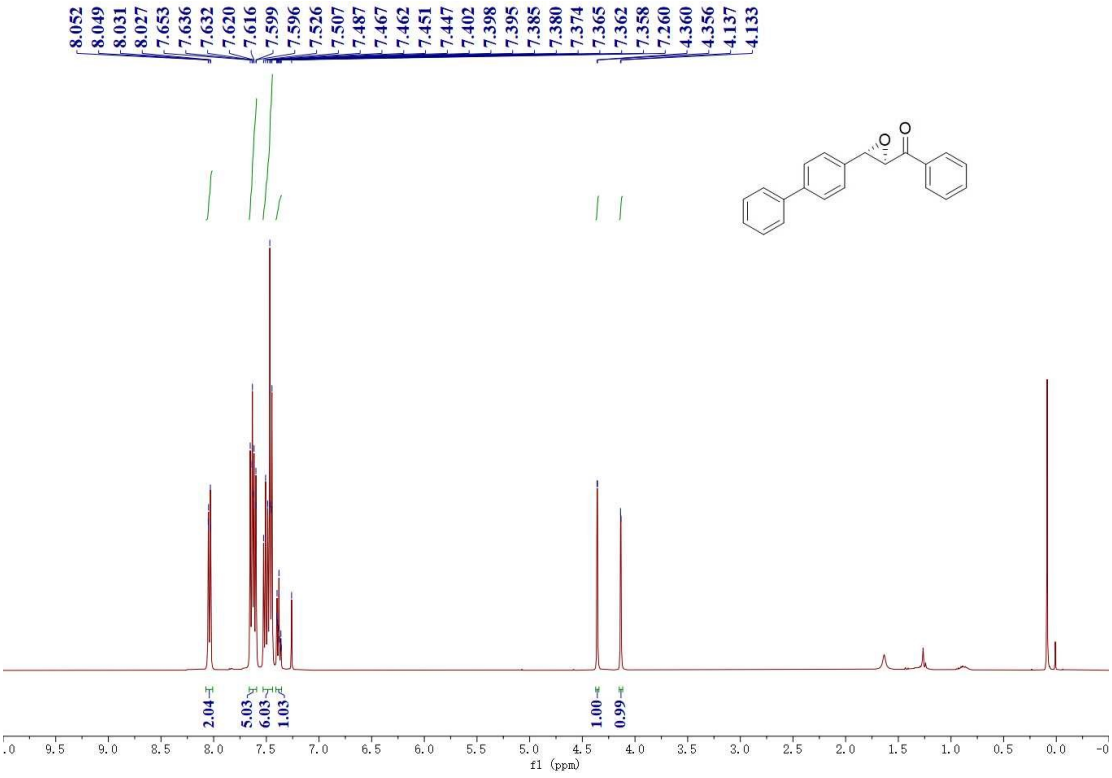


Peak#	Ret. Time	Area	Height	Area %
1	19.008	1256910	48528	50.27
2	21.181	1243613	43525	49.73

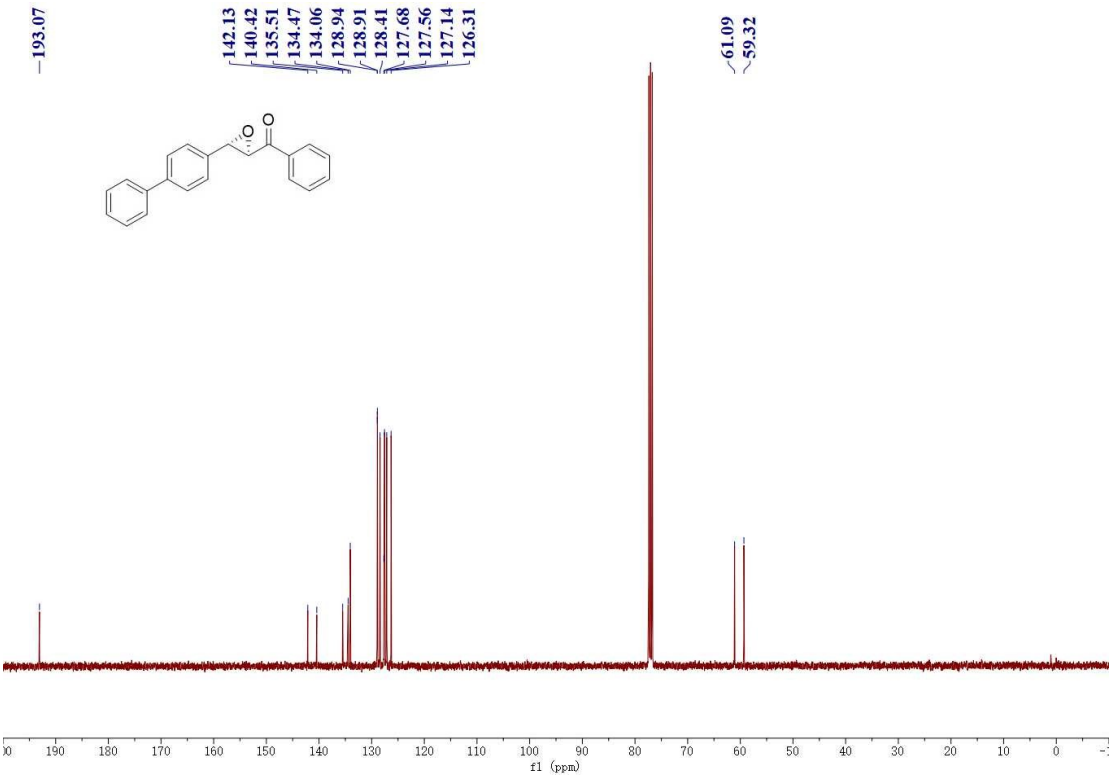


Peak#	Ret. Time	Area	Height	Area %
1	19.222	66413	2540	4.20
2	21.439	1515154	51946	95.80

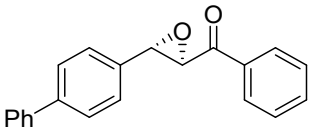
[(2*R*,3*S*)-3-[1,1'-biphenyl]-4-yloxiranyl]phenylmethanone (5aj)

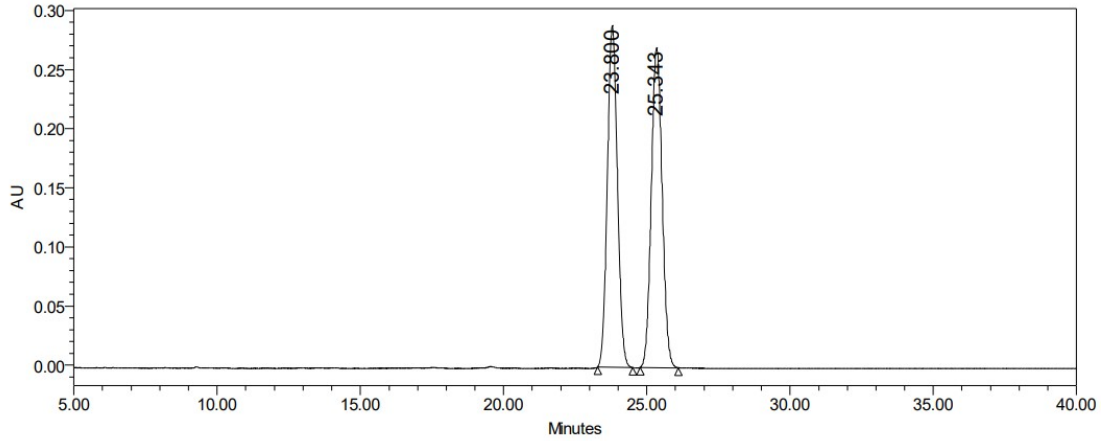


^{1}H NMR (400 MHz) in $CDCl_3$

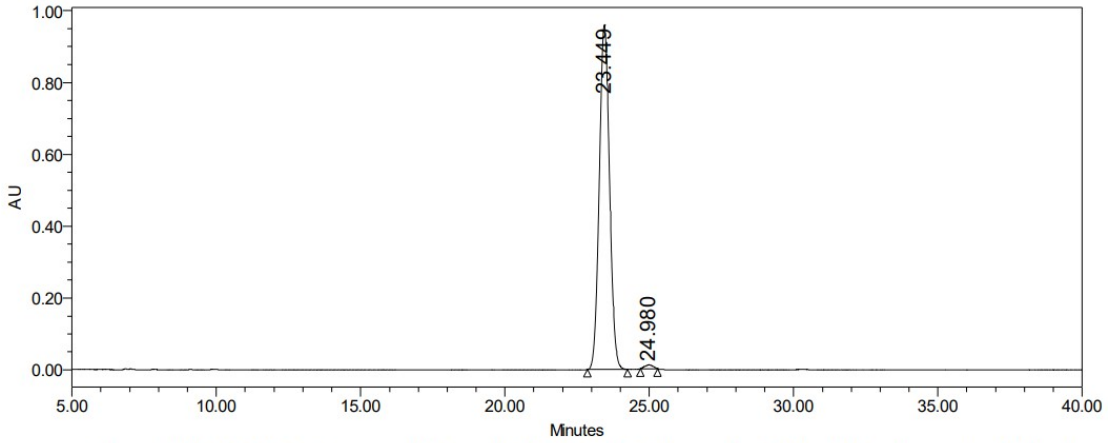


^{13}C NMR (100 MHz) in $CDCl_3$



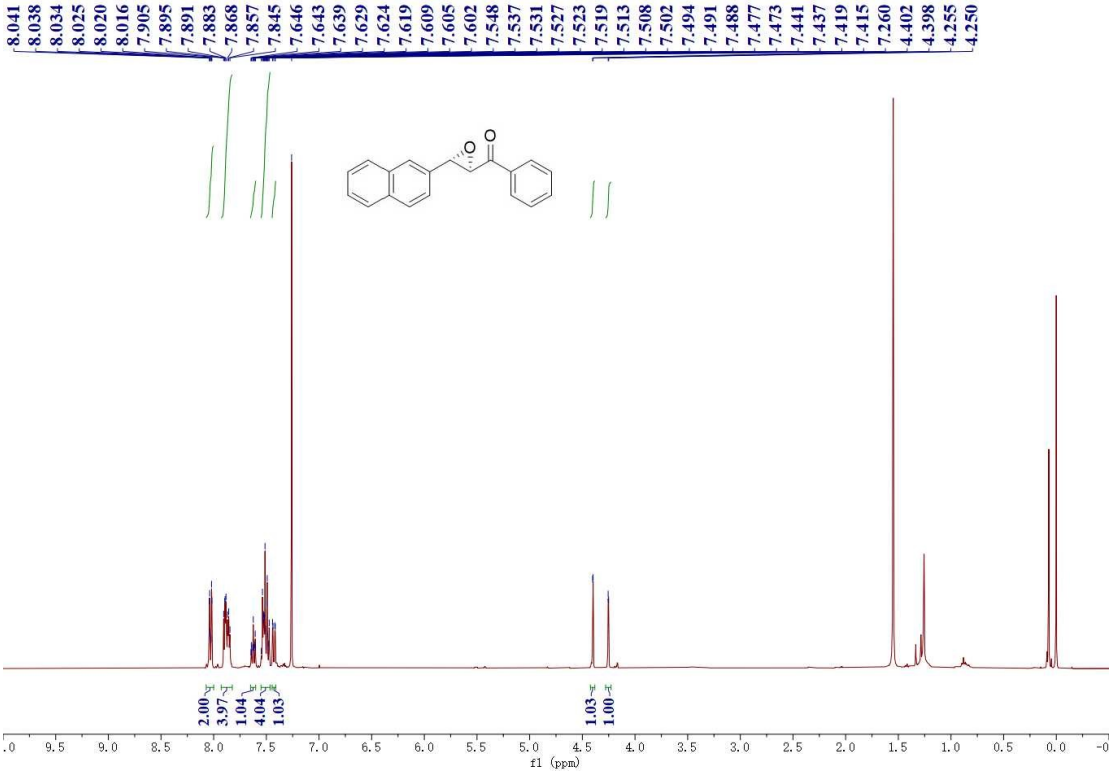


Peak#	Ret. Time	Area	Height	Area %
1	23.800	7056340	288759	49.95
2	25.343	7069831	270545	50.05

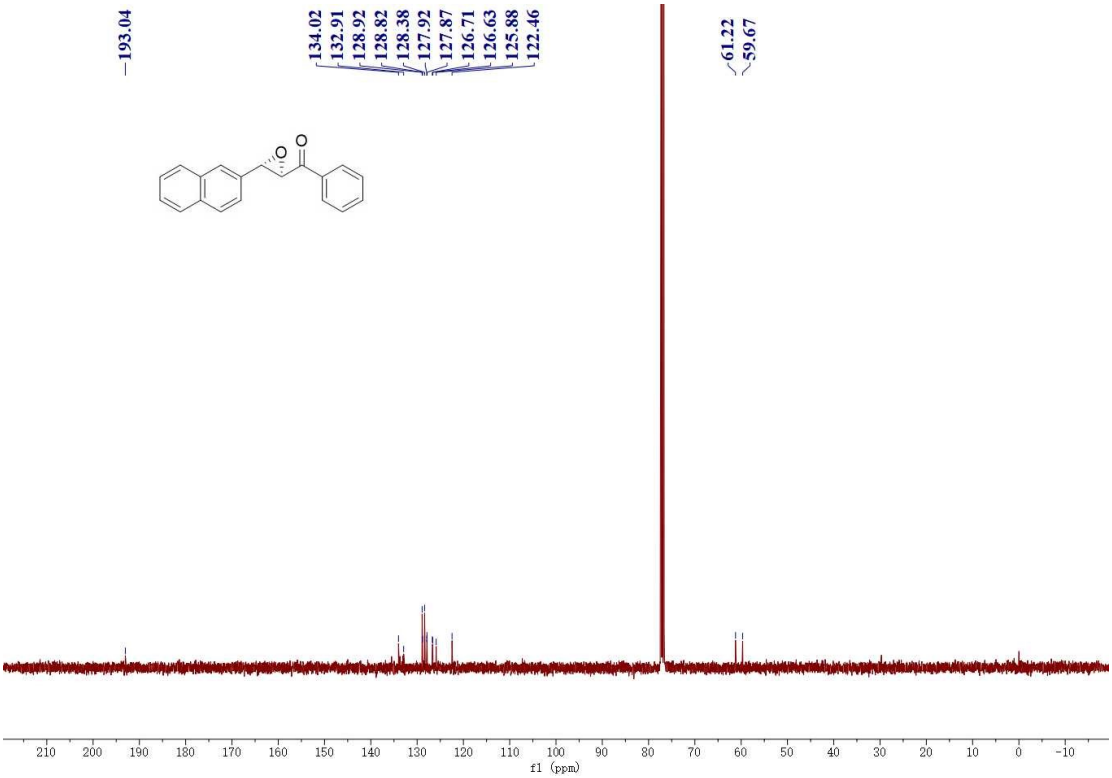


Peak#	Ret. Time	Area	Height	Area %
1	23.449	23588054	959447	99.16
2	24.980	200896	9991	0.84

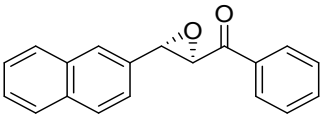
[(2*R*,3*S*)-3-(2-Naphthalenyl)-2-oxiranyl]phenylmethanone (5ak)

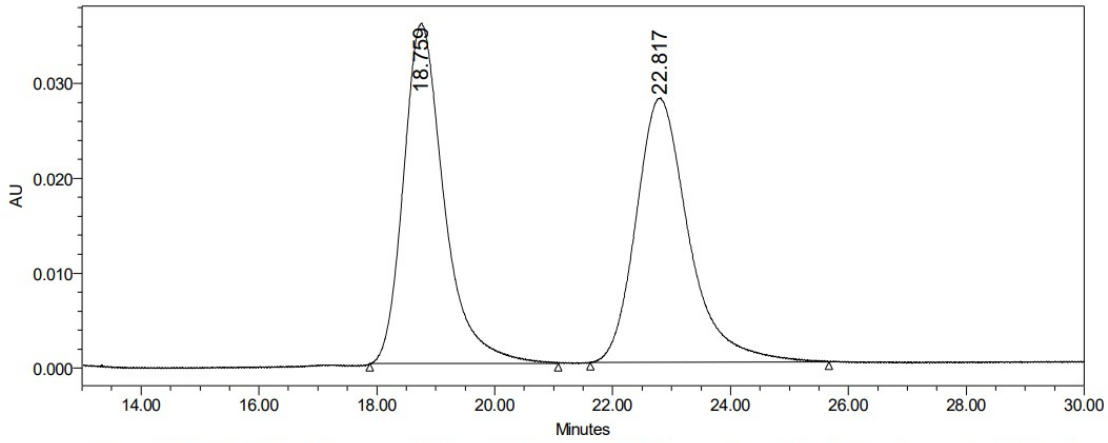


^{1}H NMR (400 MHz) in $CDCl_3$

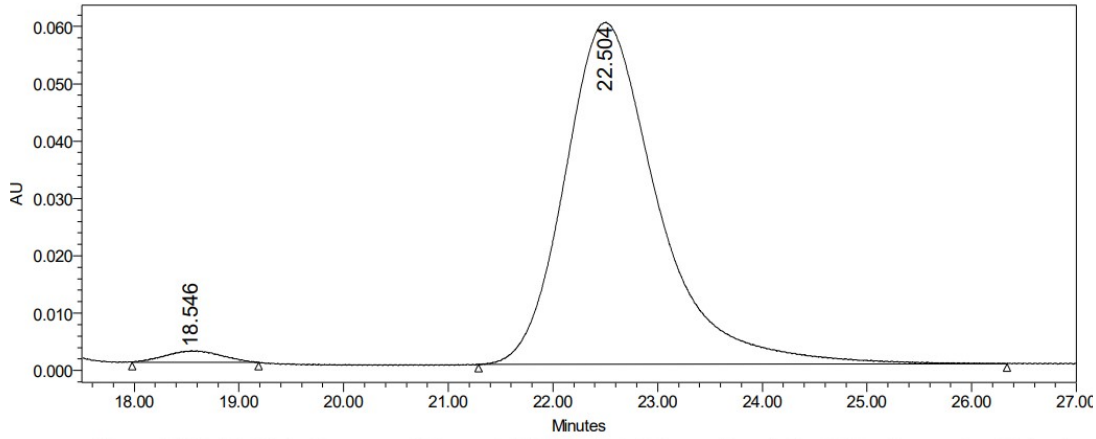


^{13}C NMR (100 MHz) in $CDCl_3$



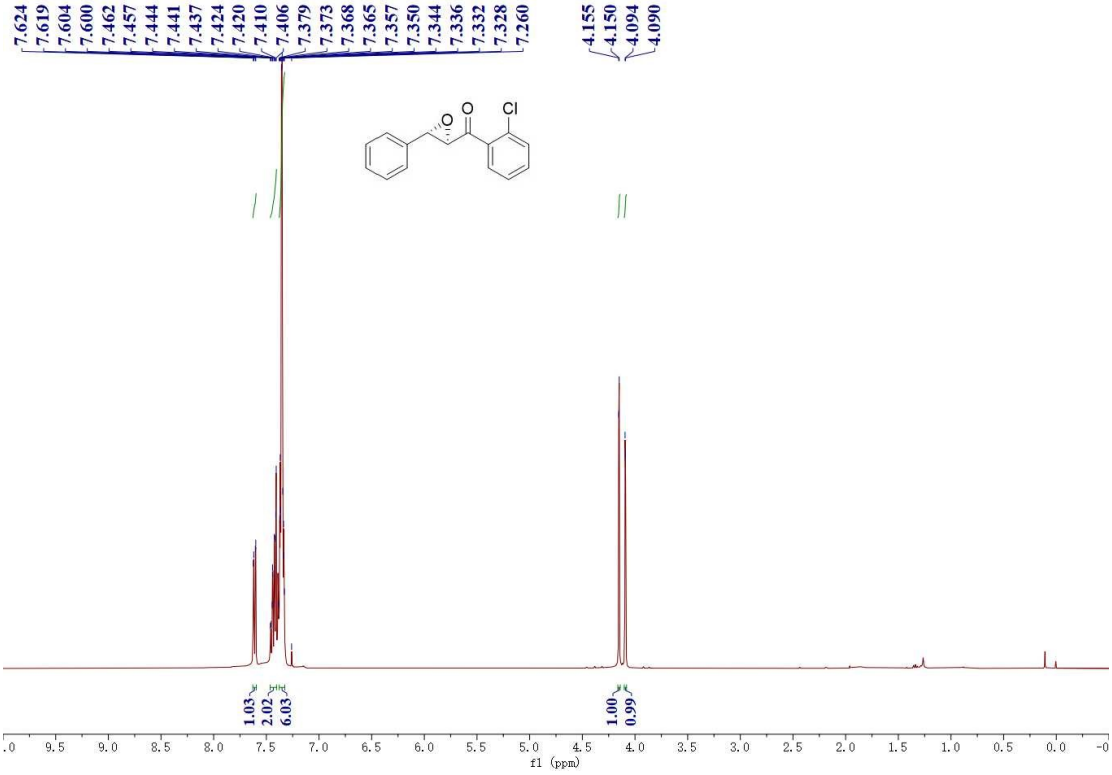


Peak#	Ret. Time	Area	Height	Area %
1	18.759	1718208	35857	49.97
2	22.817	1720065	27832	50.03

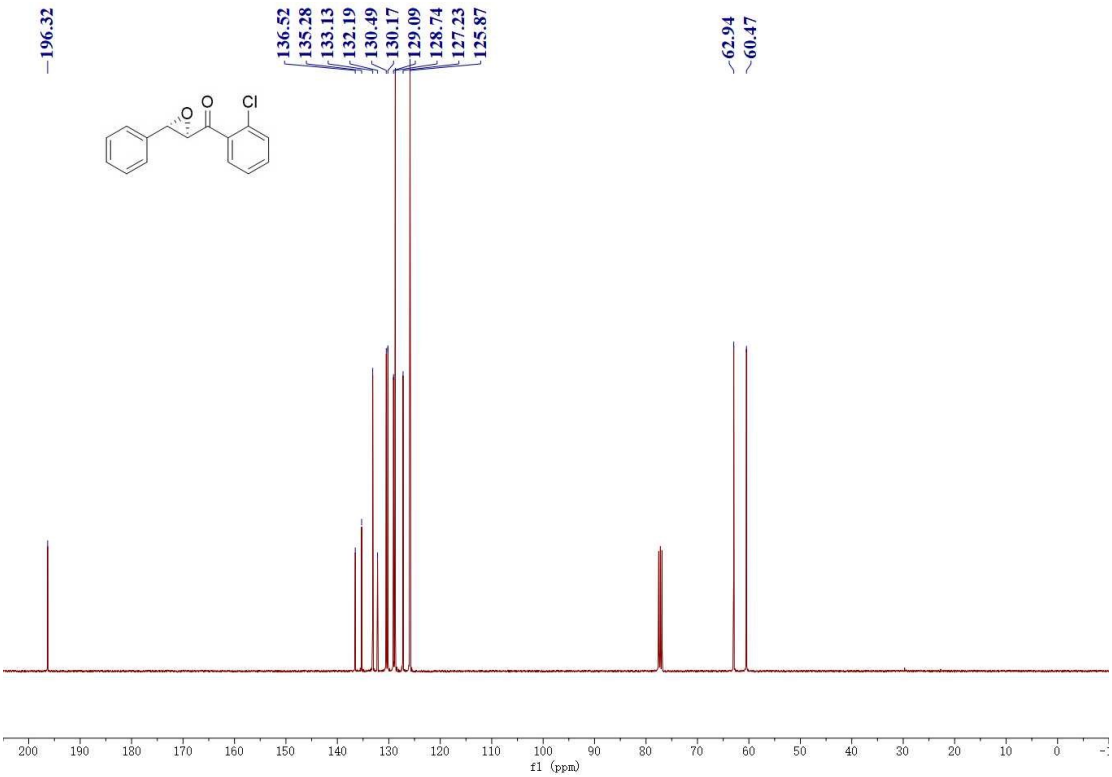


Peak#	Ret. Time	Area	Height	Area %
1	18.546	73569	2015	1.98
2	22.504	3637709	59469	98.02

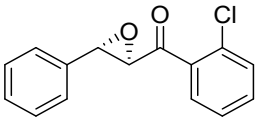
(2-Chlorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5al)

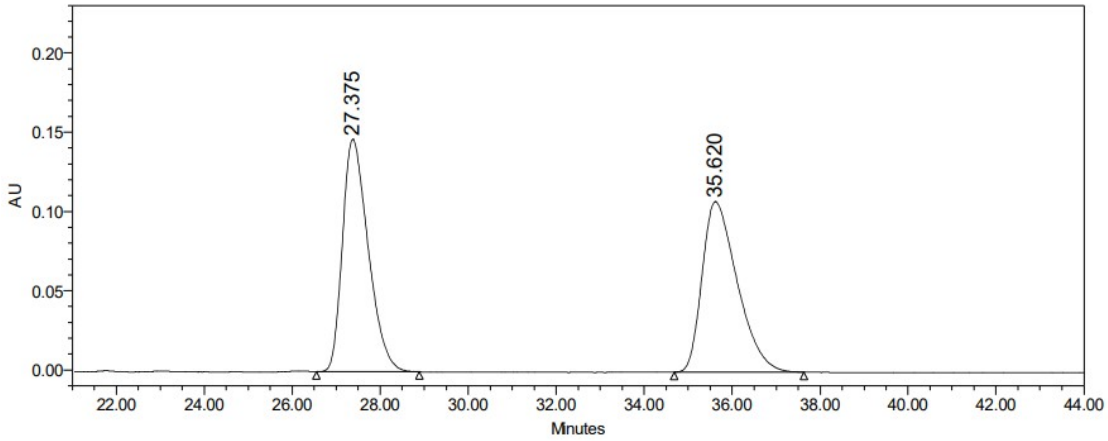


^{1}H NMR (400 MHz) in $CDCl_3$

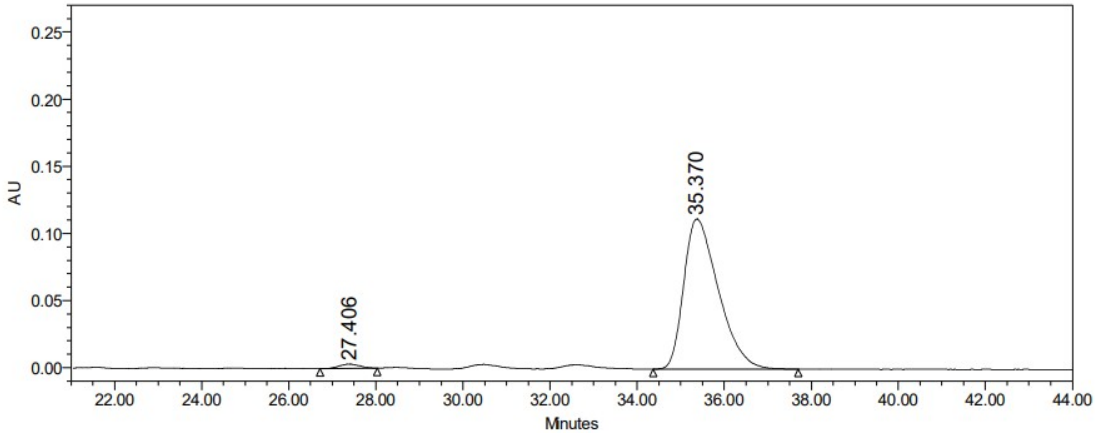


^{13}C NMR (100 MHz) in $CDCl_3$



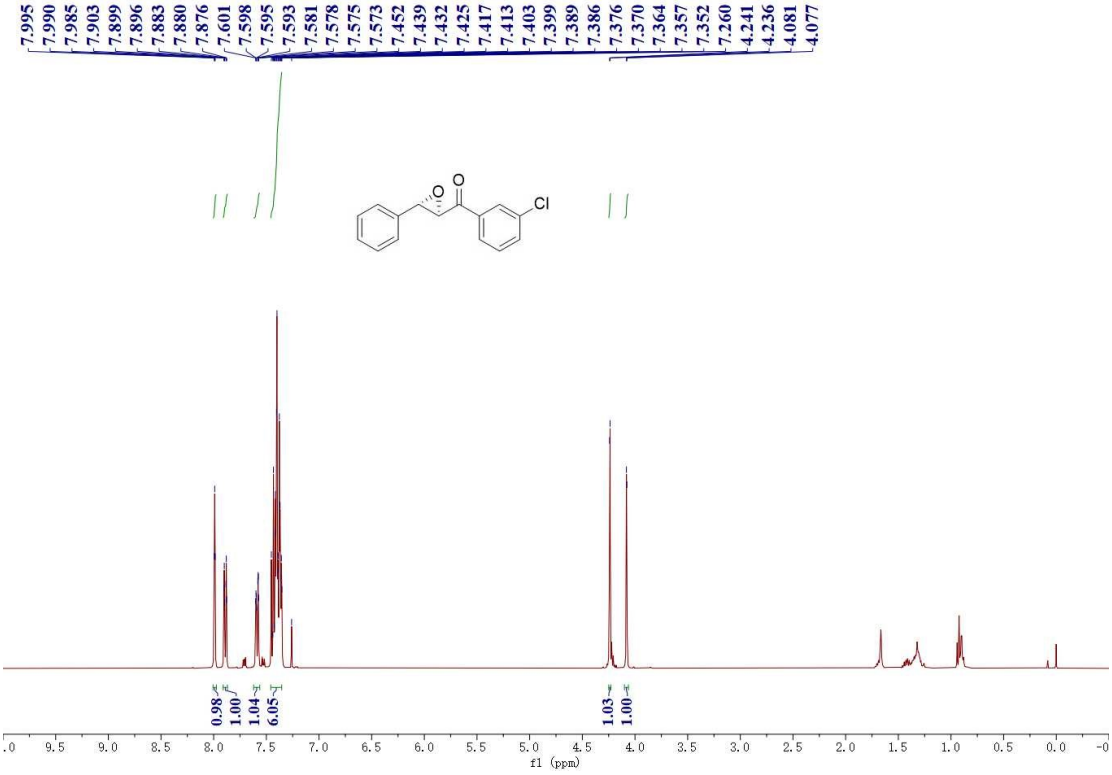


Peak#	Ret. Time	Area	Height	Area %
1	27.375	5966421	146786	49.96
2	35.620	5976451	107585	50.04

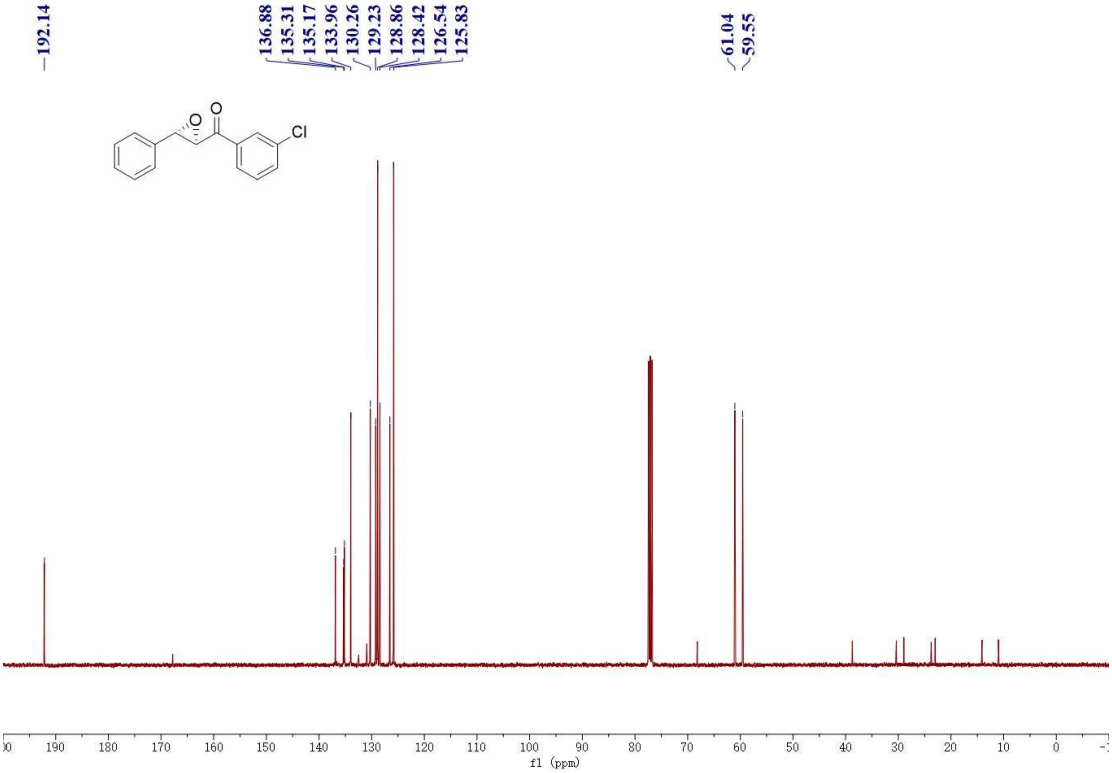


Peak#	Ret. Time	Area	Height	Area %
1	27.406	106924	3174	1.70
2	35.370	6178553	111802	98.30

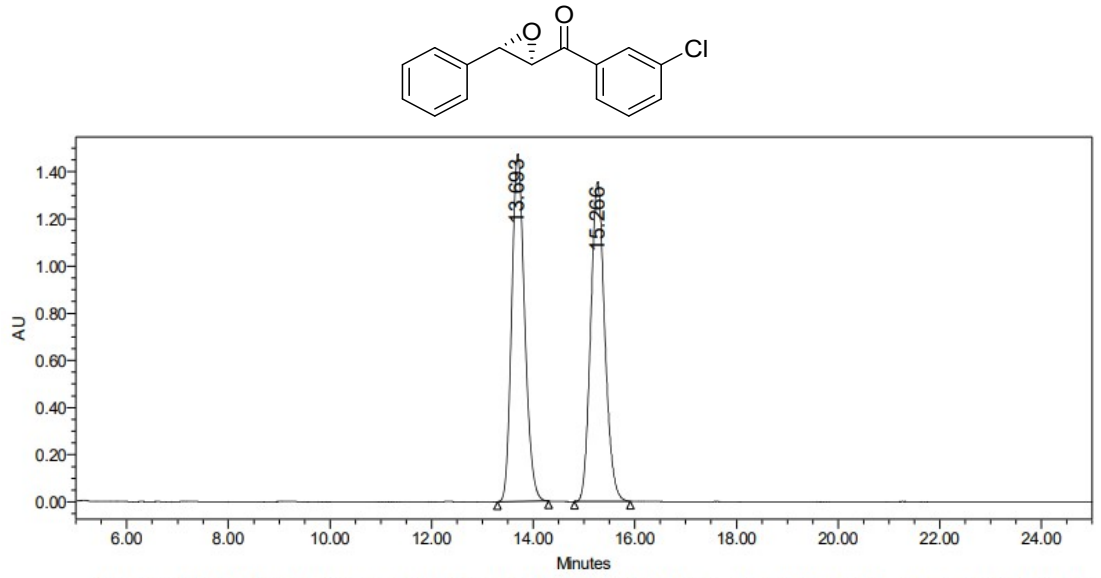
(3-Chlorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5am)



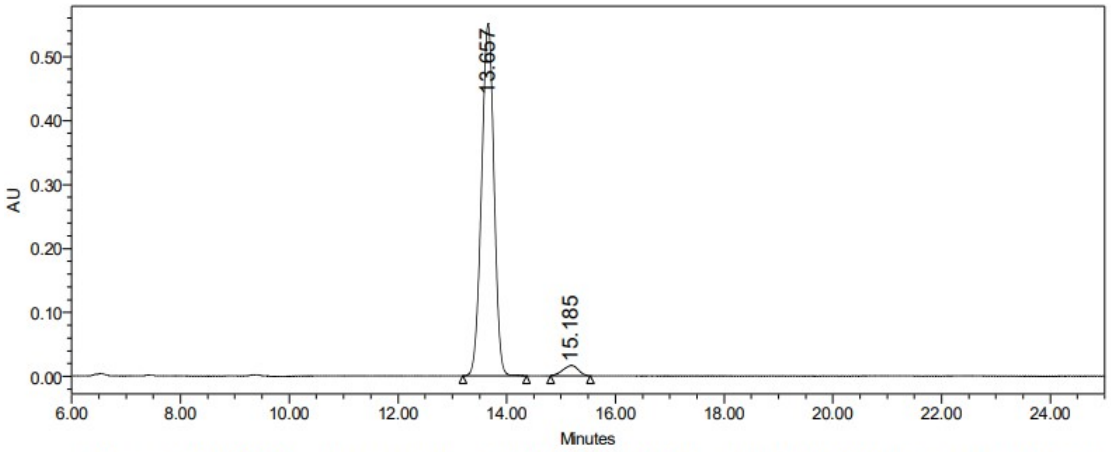
^{1}H NMR (400 MHz) in $CDCl_3$



^{13}C NMR (100 MHz) in $CDCl_3$

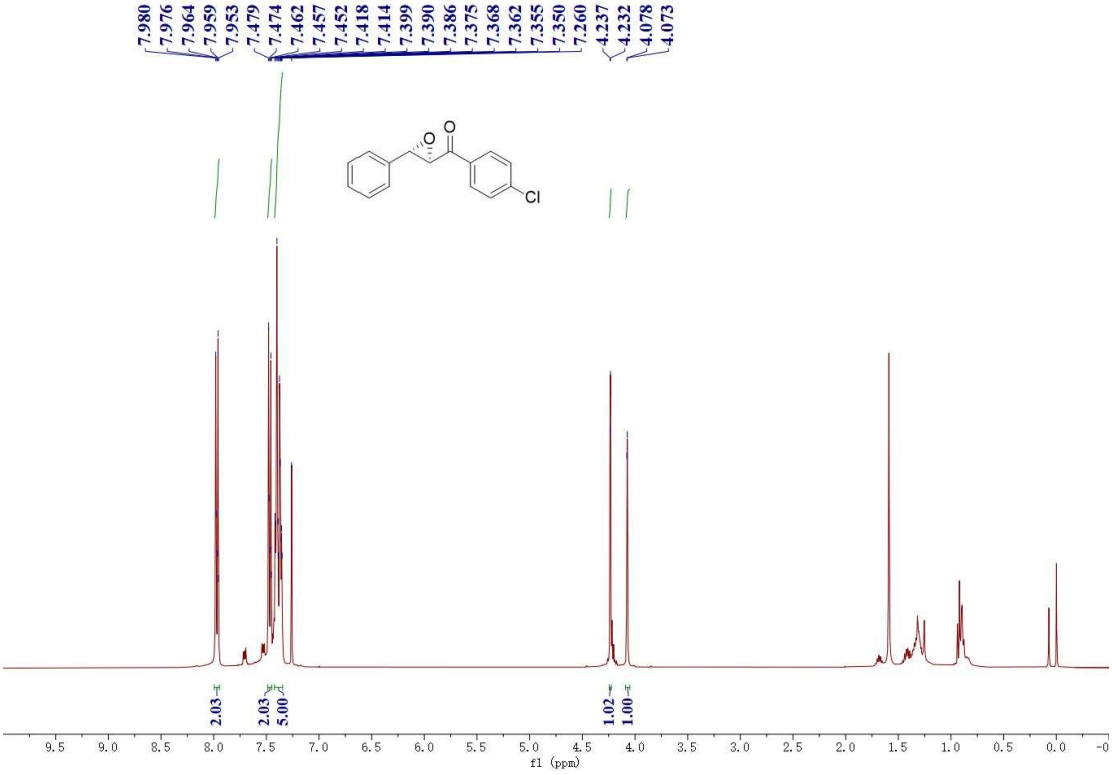


Peak#	Ret. Time	Area	Height	Area %
1	13.693	26088281	1471709	49.93
2	15.266	26163229	1354360	50.07

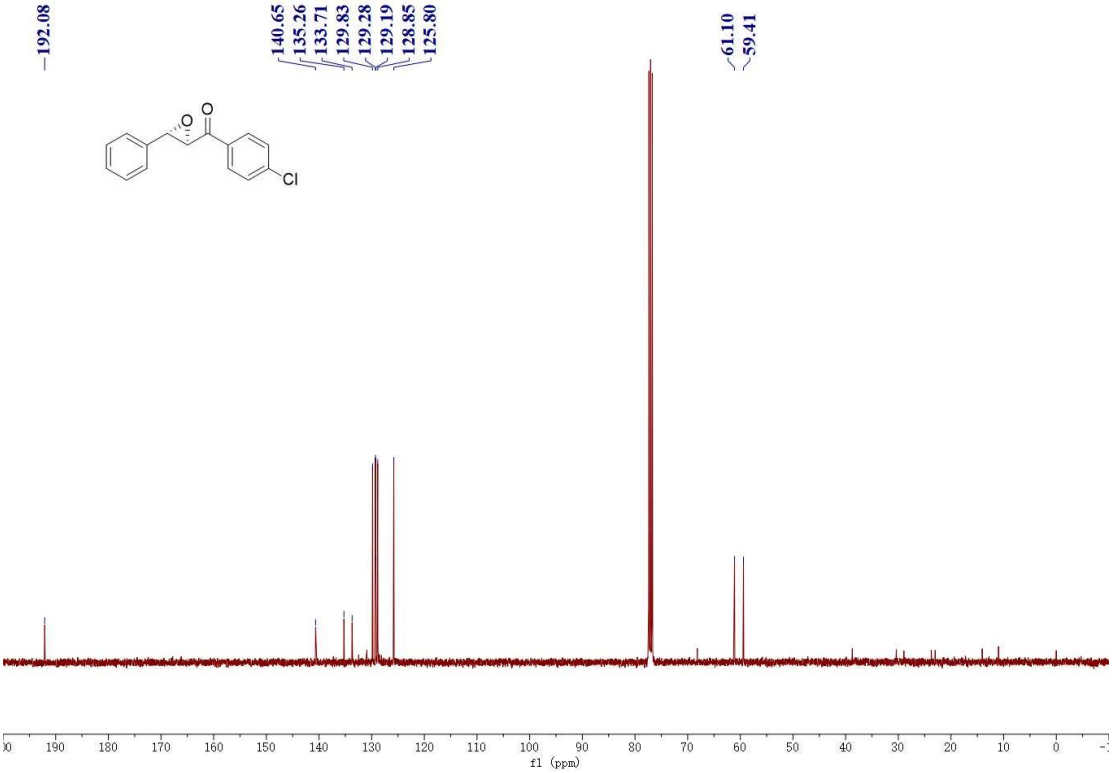


Peak#	Ret. Time	Area	Height	Area %
1	13.657	8755432	550062	96.51
2	15.185	316484	16121	3.49

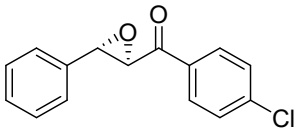
(4-Chlorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5an)

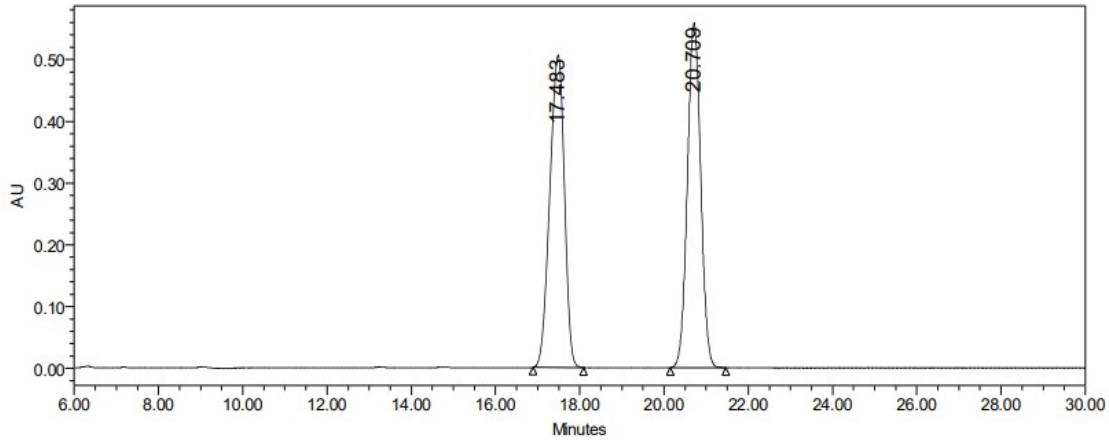


^{1}H NMR (400 MHz) in $CDCl_3$

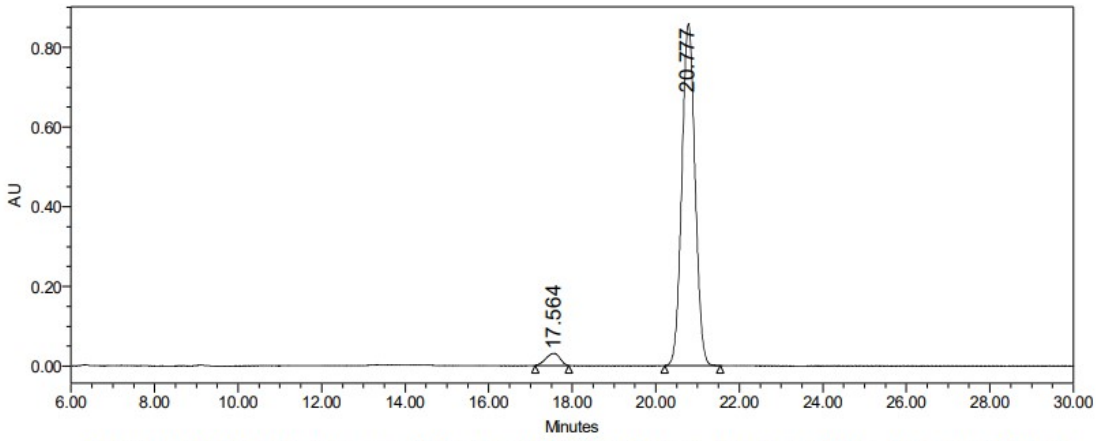


^{13}C NMR (100 MHz) in $CDCl_3$



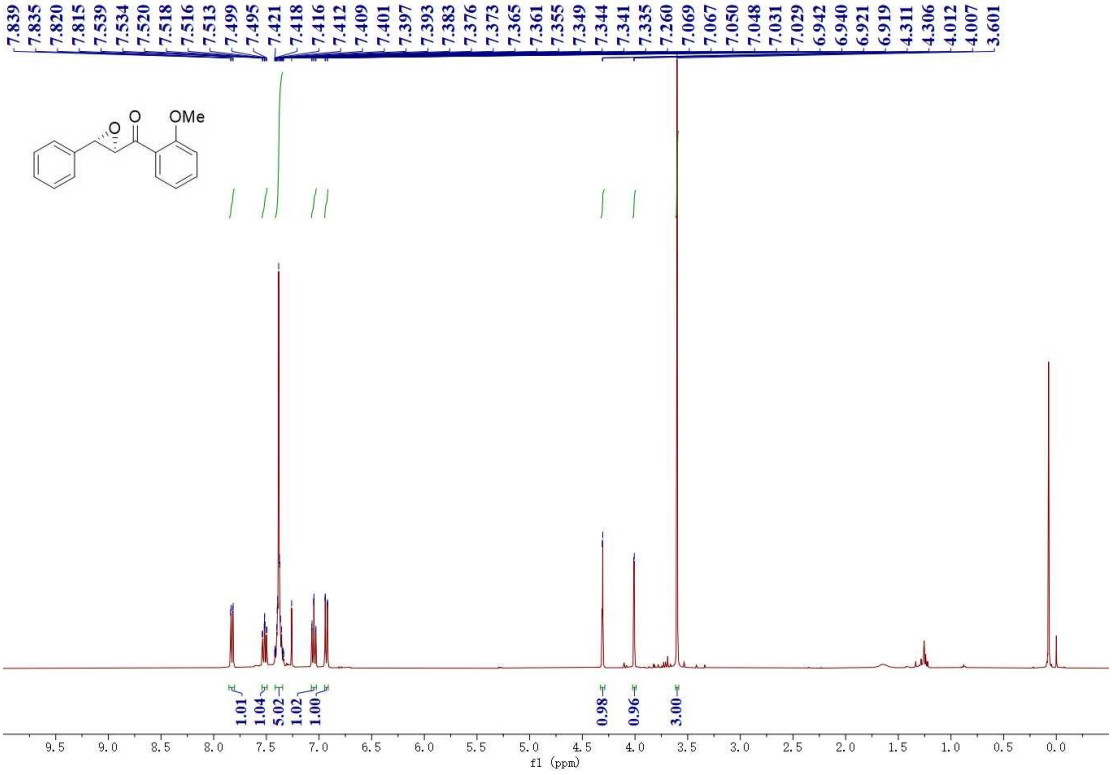


Peak#	Ret. Time	Area	Height	Area %
1	17.483	12192605	505478	50.00
2	20.709	12190640	557701	50.00

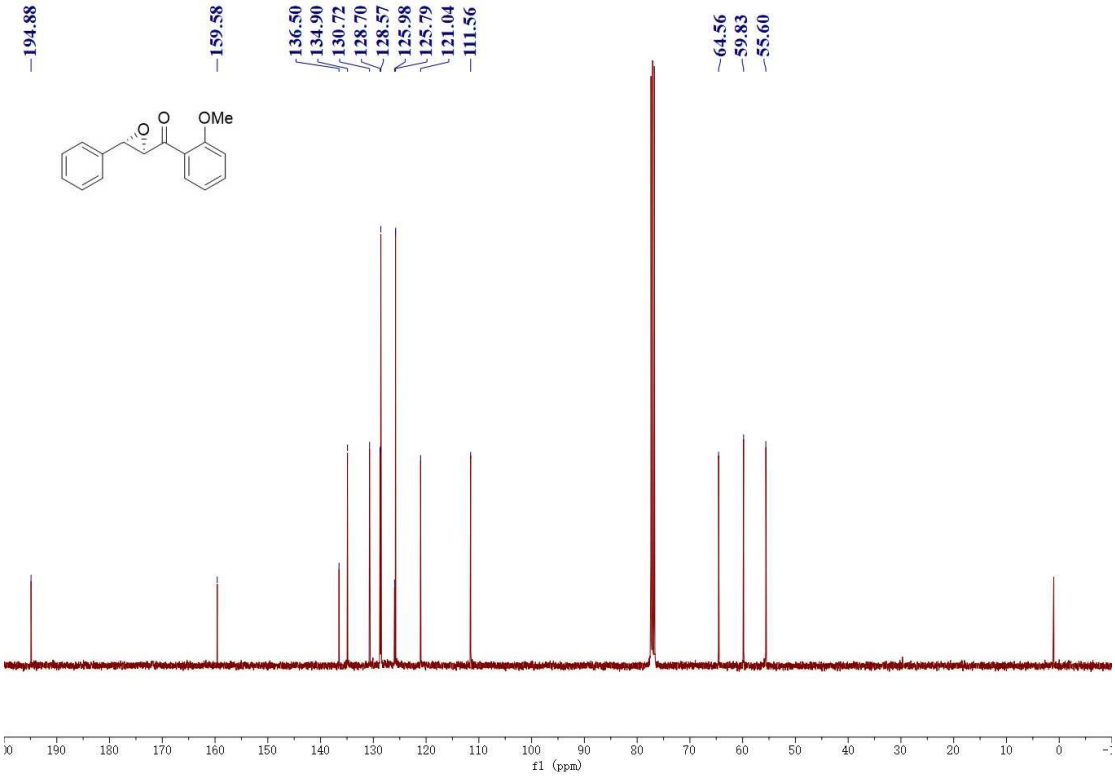


Peak#	Ret. Time	Area	Height	Area %
1	17.564	705905	30506	3.61
2	20.777	18821973	857370	96.39

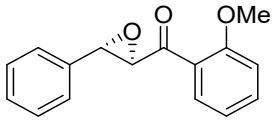
(2-Methoxyphenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5ao)

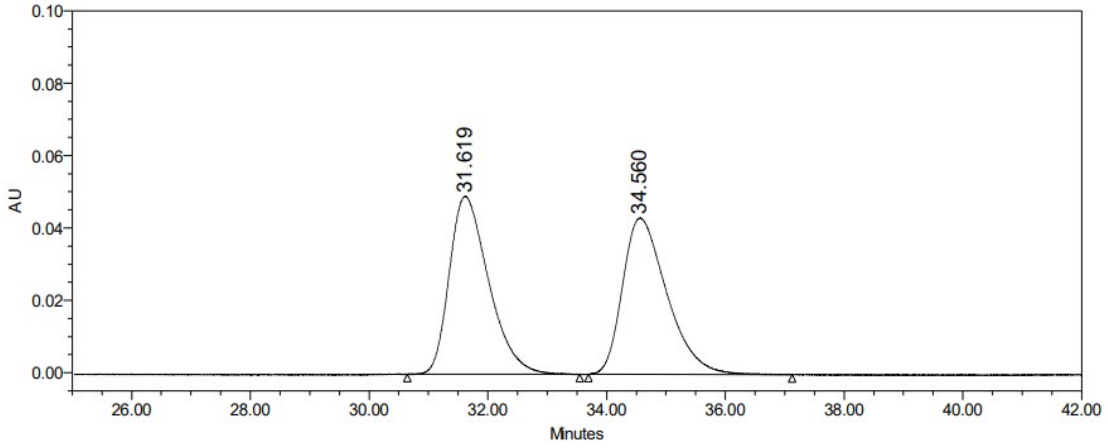


^{1}H NMR (400 MHz) in $CDCl_3$

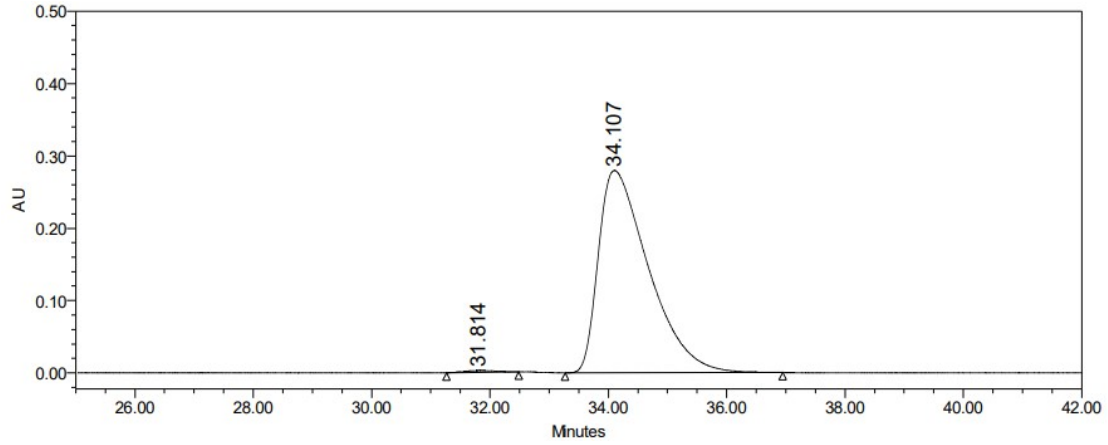


^{13}C NMR (100 MHz) in $CDCl_3$



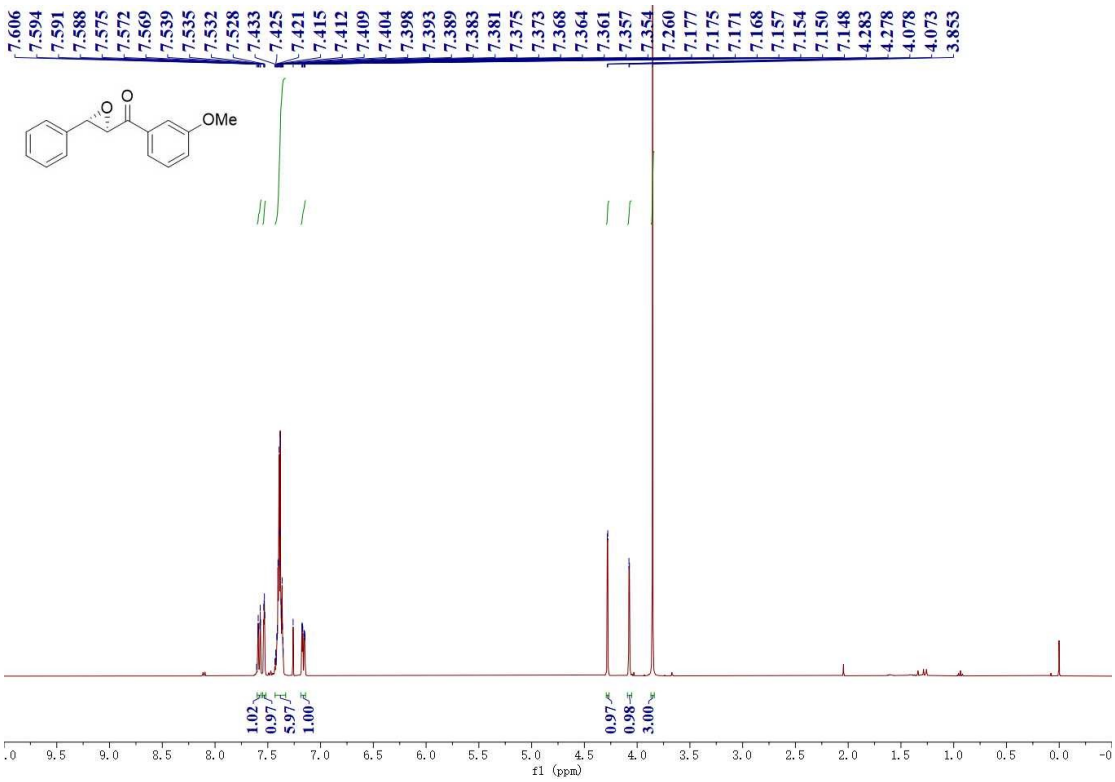


Peak#	Ret. Time	Area	Height	Area %
1	31.619	2265508	49197	50.32
2	34.560	2236720	43206	49.68

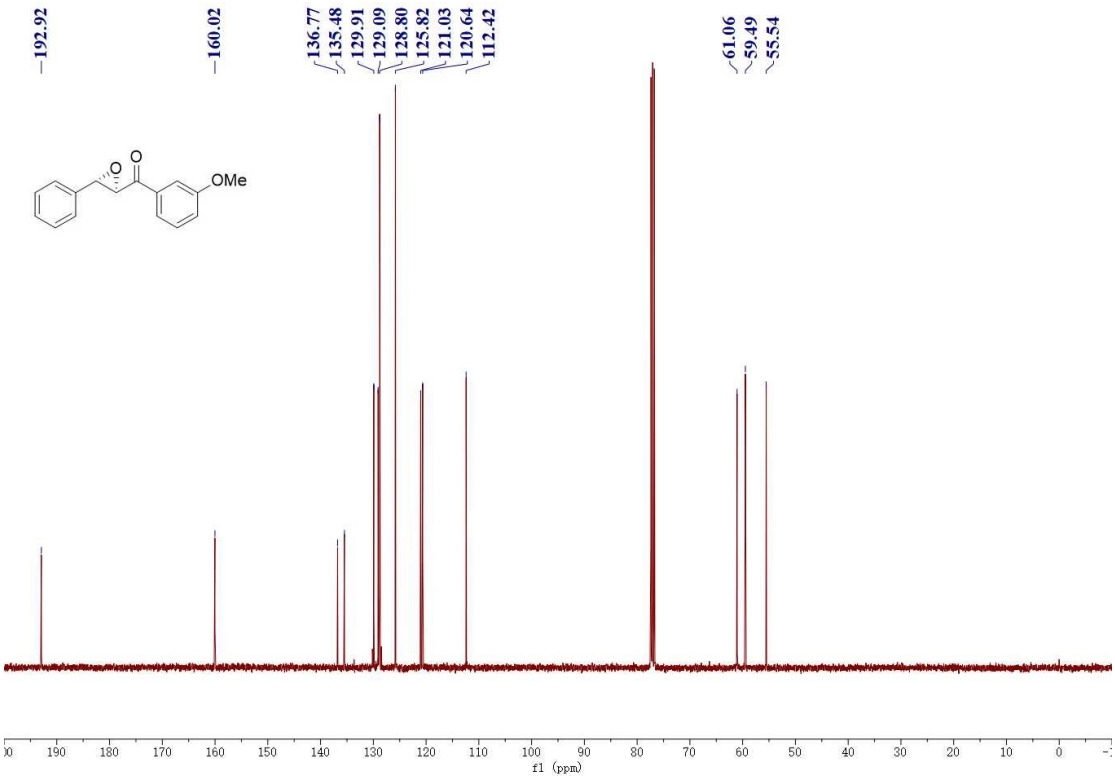


Peak#	Ret. Time	Area	Height	Area %
1	31.814	88294	2479	0.53
2	34.107	16490890	279617	99.47

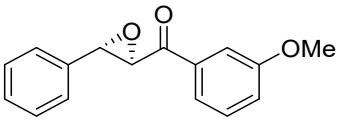
(3-Methoxyphenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5ap)

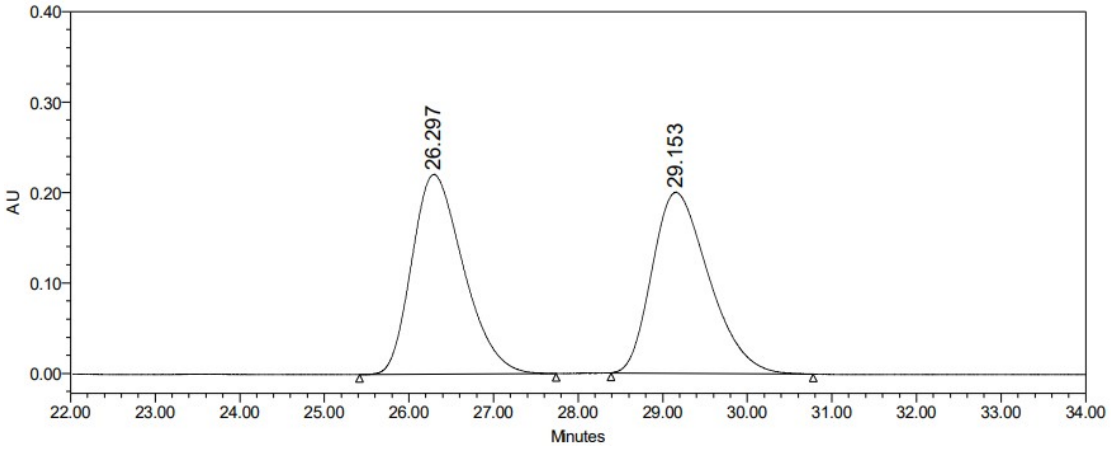


^{1}H NMR (400 MHz) in $CDCl_3$

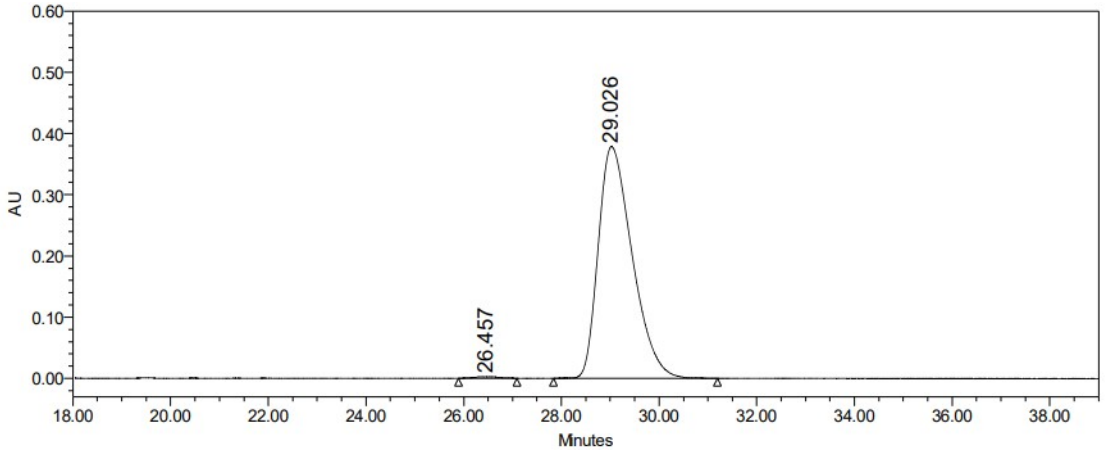


^{13}C NMR (100 MHz) in $CDCl_3$



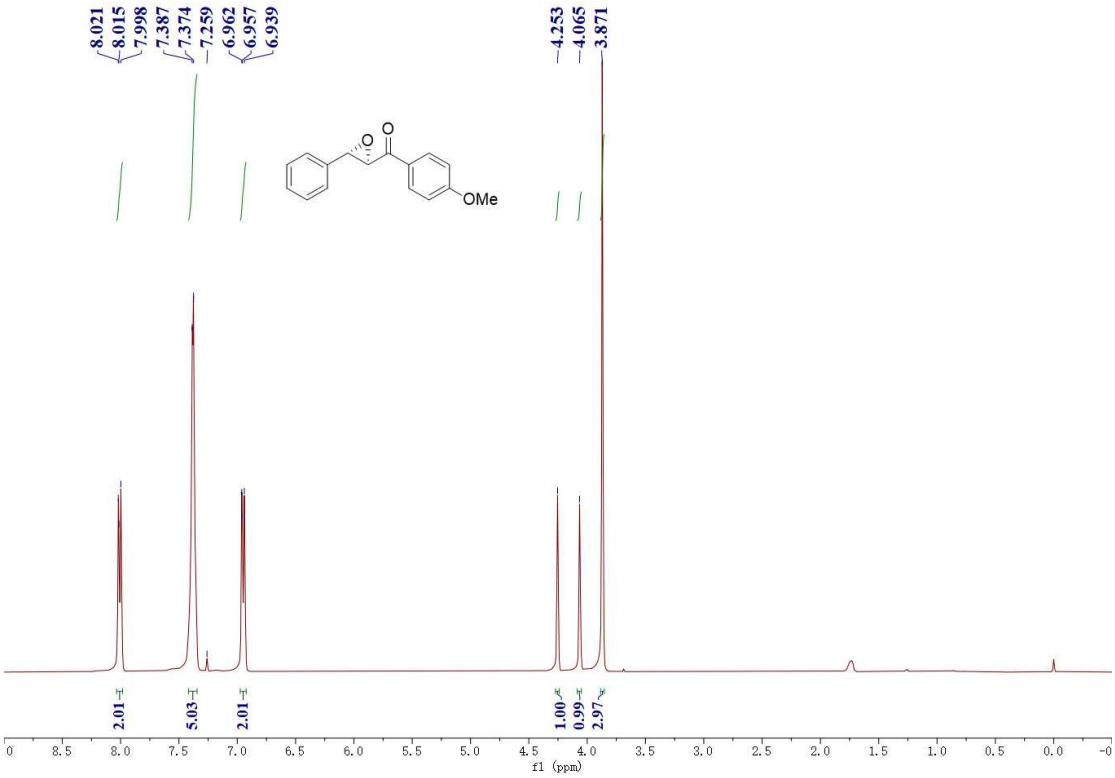


Peak#	Ret. Time	Area	Height	Area %
1	26.297	9348237	50.05	220714
2	29.153	9329495	49.95	200061

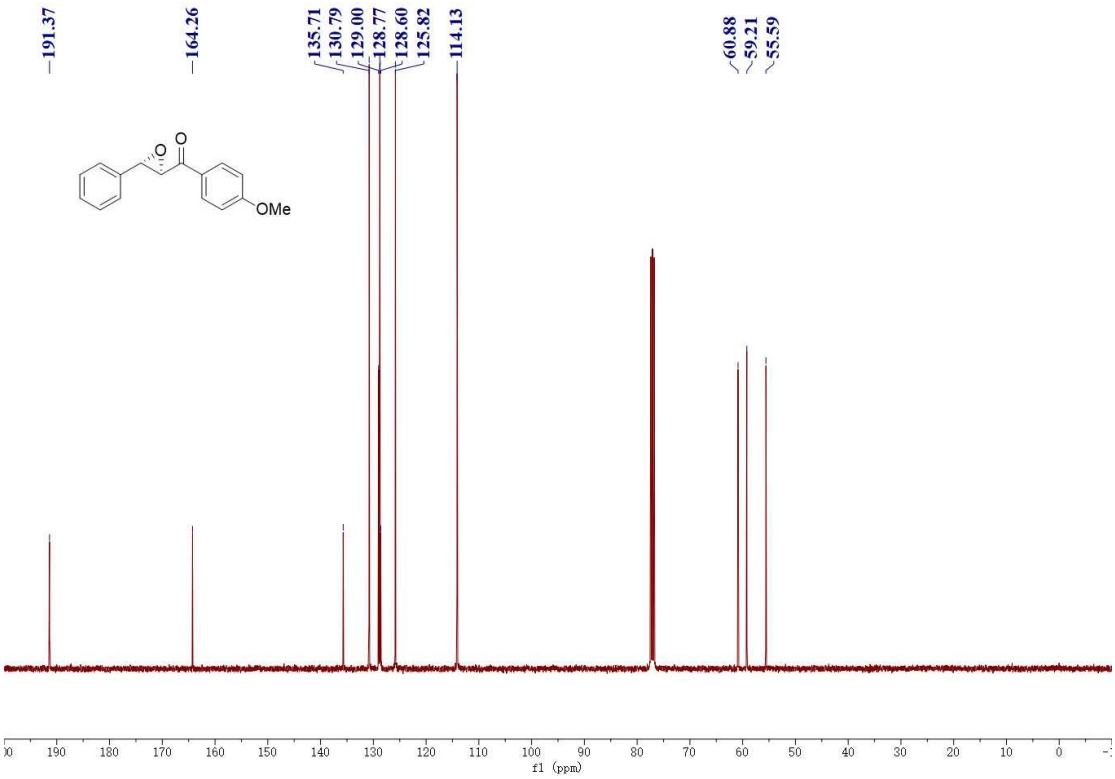


Peak#	Ret. Time	Area	Height	Area %
1	26.457	94824	2694	0.52
2	29.026	18271964	378644	99.48

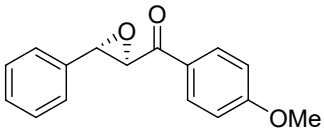
(4-Methoxyphenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5aq)

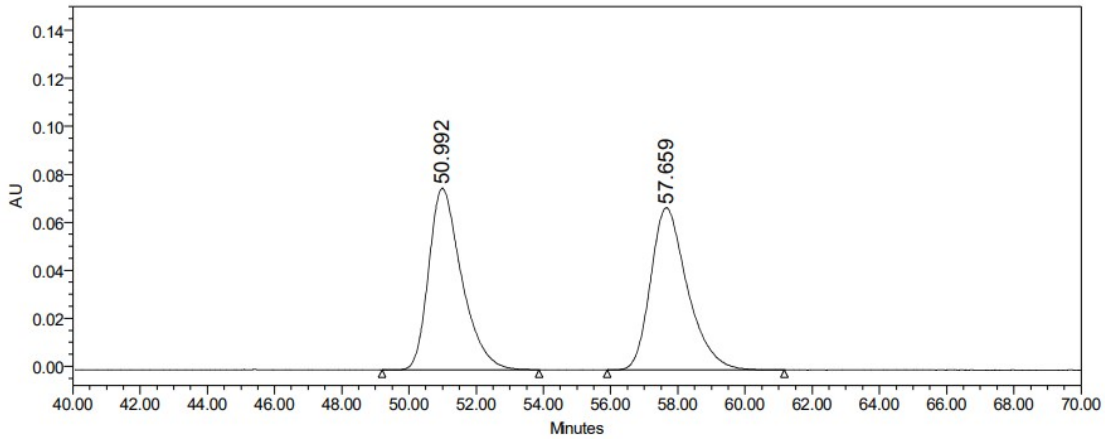


^{1}H NMR (400 MHz) in $CDCl_3$

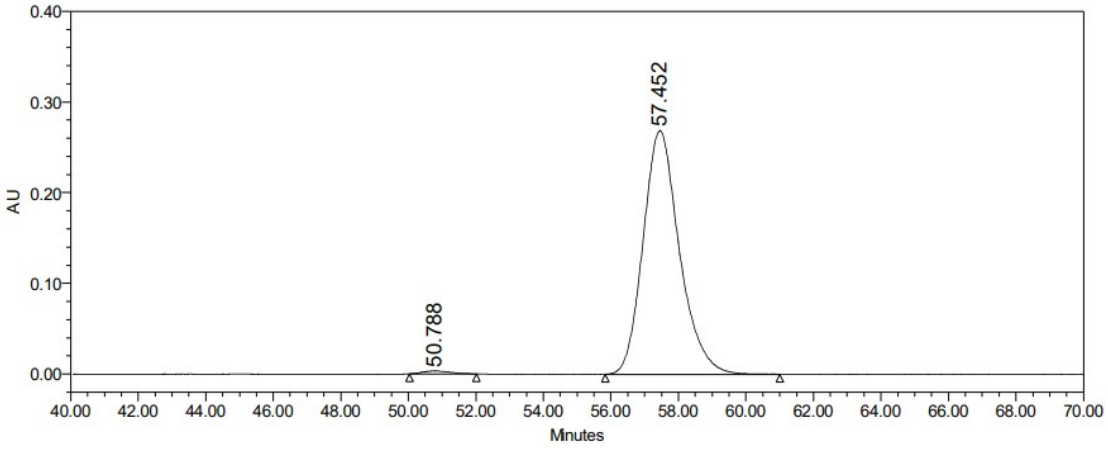


^{13}C NMR (100 MHz) in $CDCl_3$



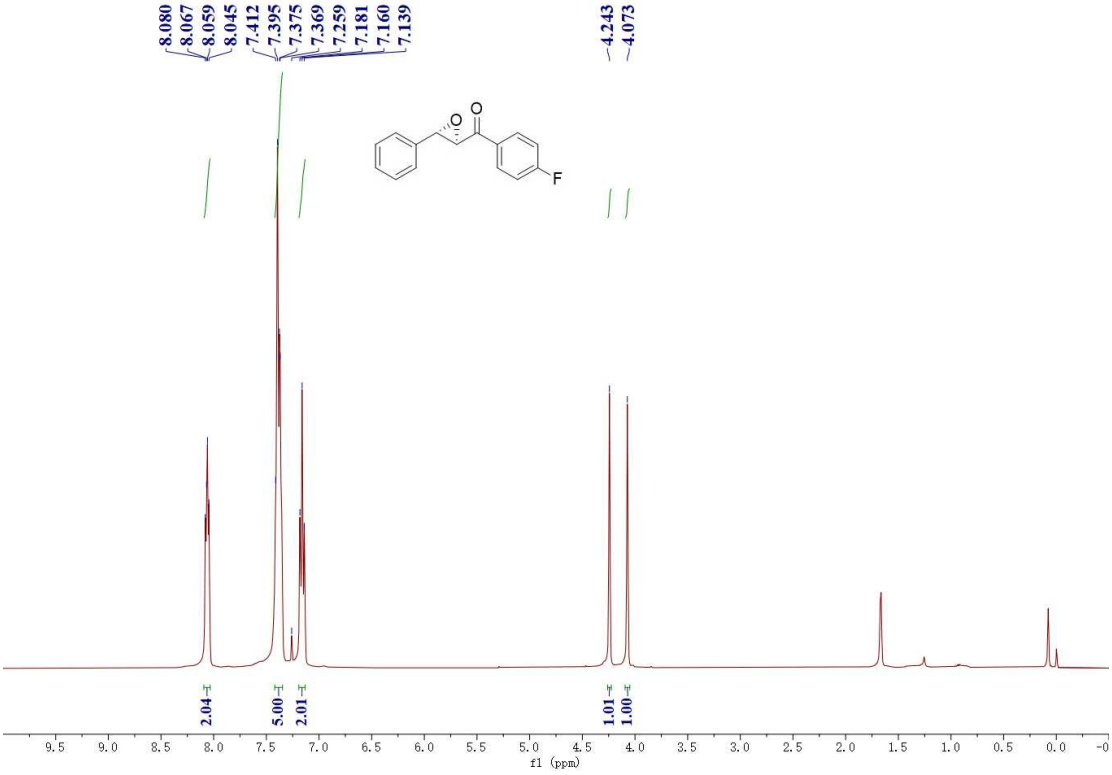


Peak#	Ret. Time	Area	Height	Area %
1	50.992	5146719	75599	49.96
2	57.659	5153946	67644	50.04

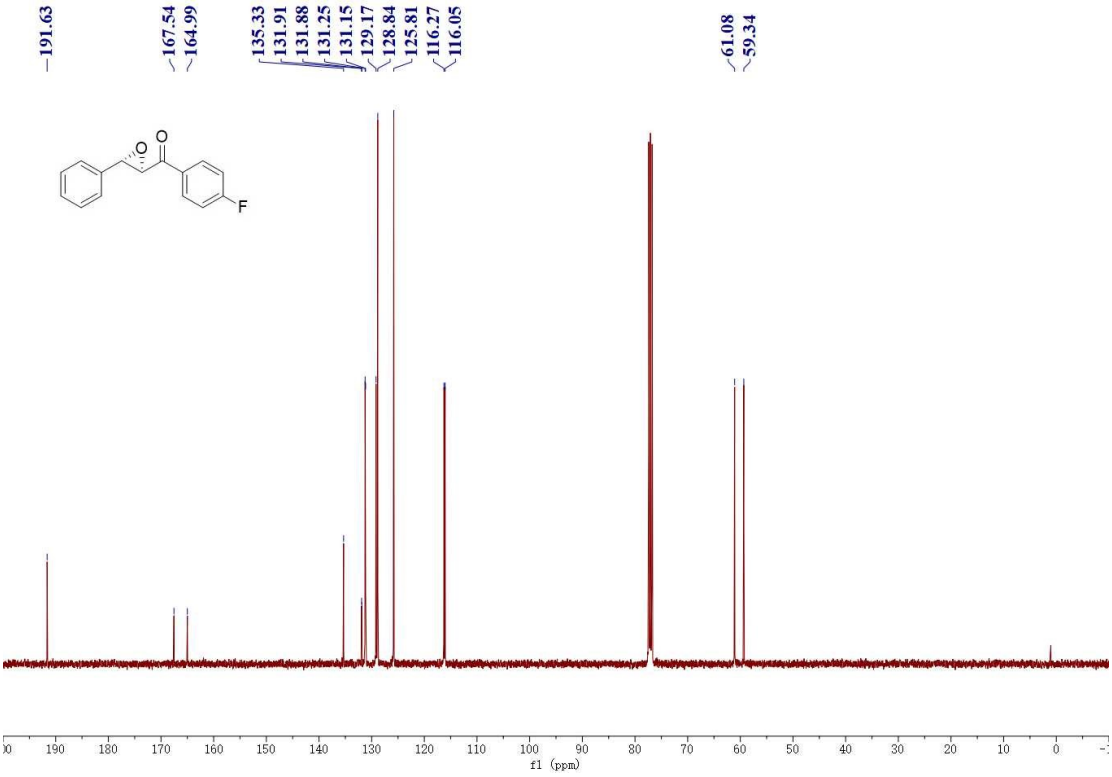


Peak#	Ret. Time	Area	Height	Area %
1	50.788	186736	3250	0.92
2	57.452	20068089	268565	99.08

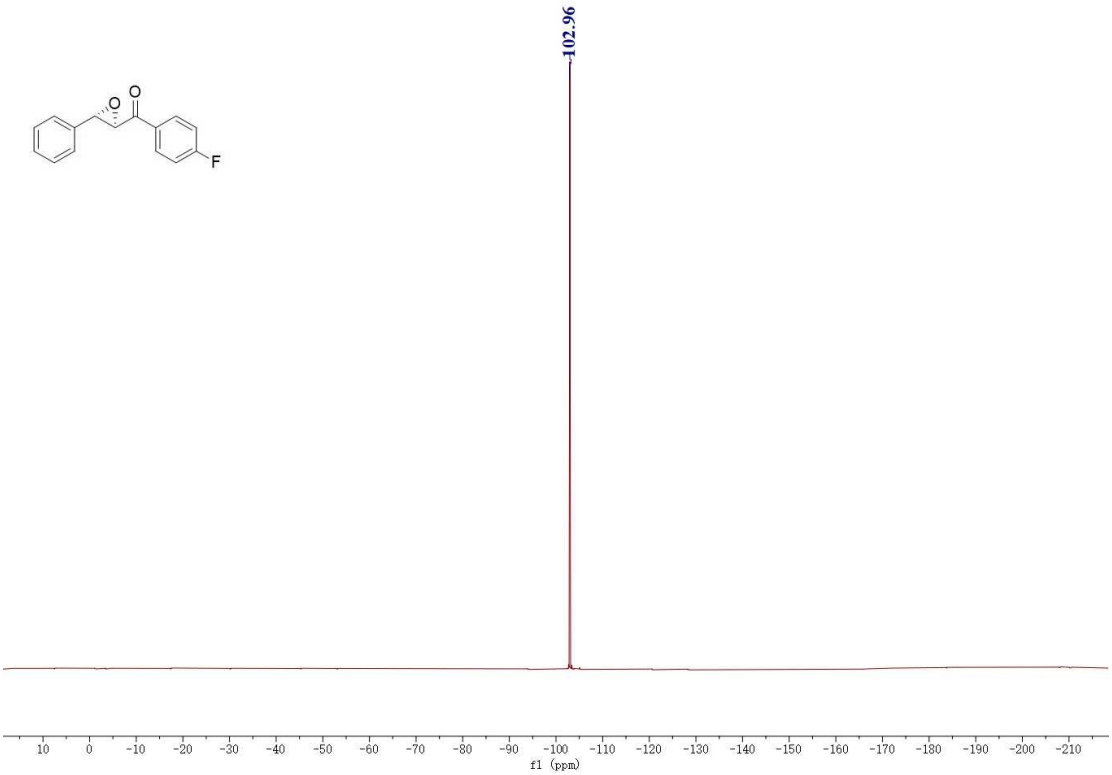
(4-Fluorophenyl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5ar)



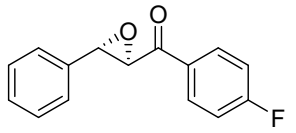
^{1}H NMR (400 MHz) in $CDCl_3$

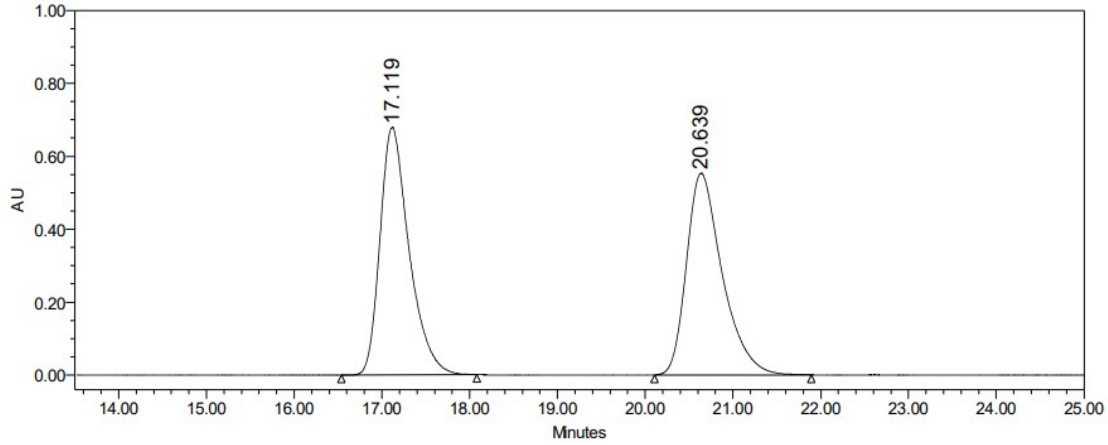


^{13}C NMR (100 MHz) in $CDCl_3$

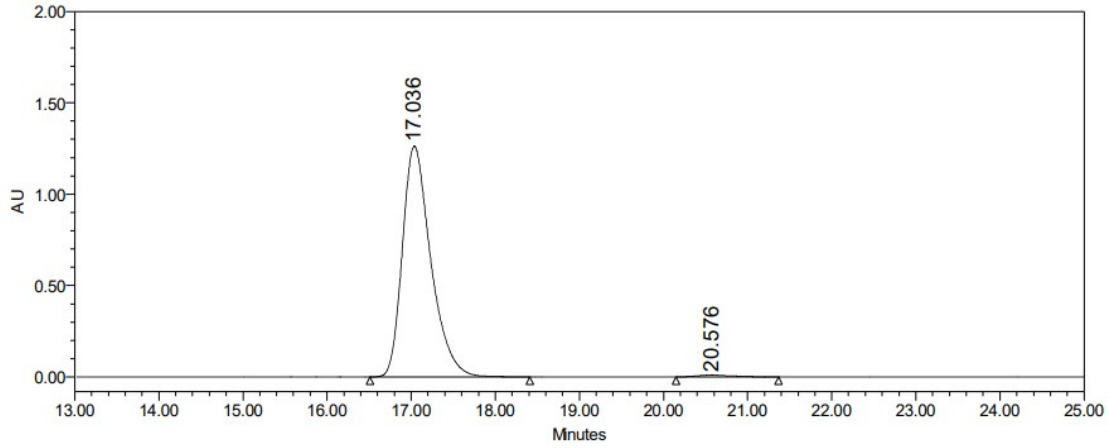


^{19}F NMR (376 MHz) in $CDCl_3$



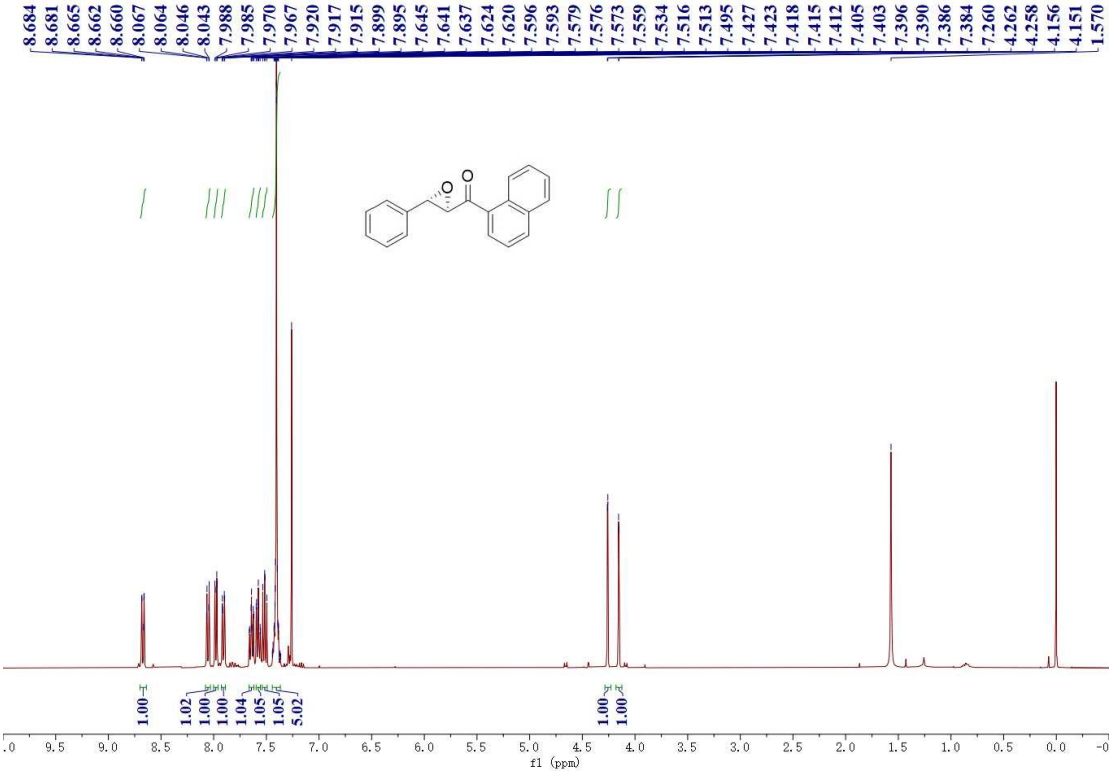


Peak#	Ret. Time	Area	Height	Area %
1	17.119	15657939	679182	50.02
2	20.639	15644117	553073	49.98

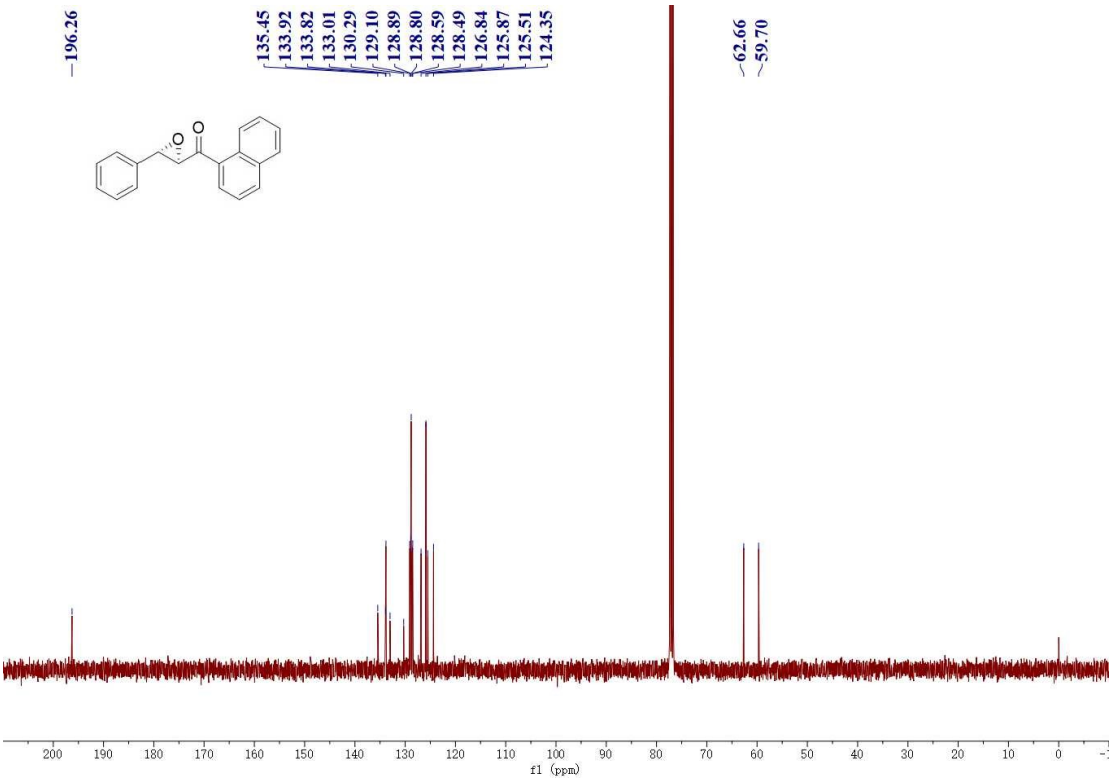


Peak#	Ret. Time	Area	Height	Area %
1	17.036	29631535	1263288	99.06
2	20.576	280874	10375	0.94

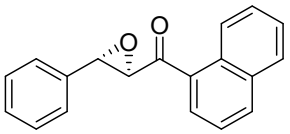
(Naphthalen-1-yl)((2*R*,3*S*)-3-phenyloxiran-2-yl)-methanone (5as)

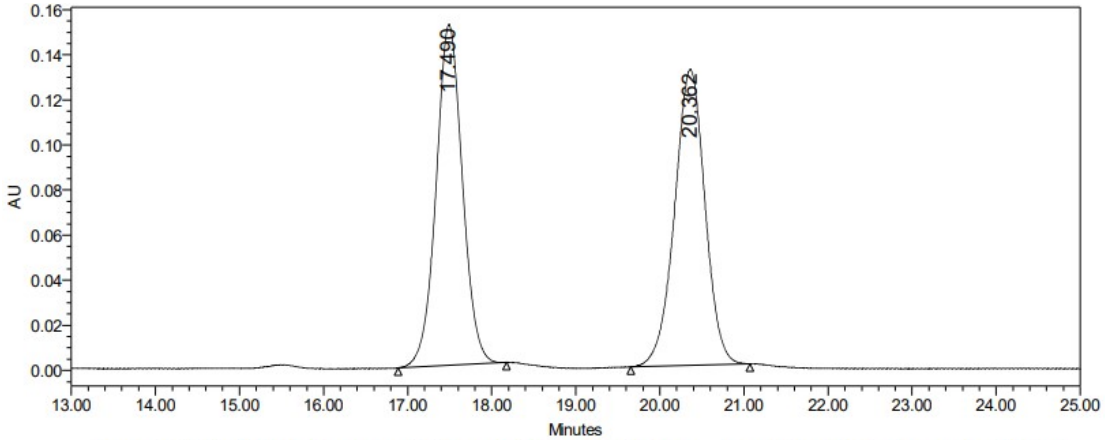


^{1}H NMR (400 MHz) in $CDCl_3$

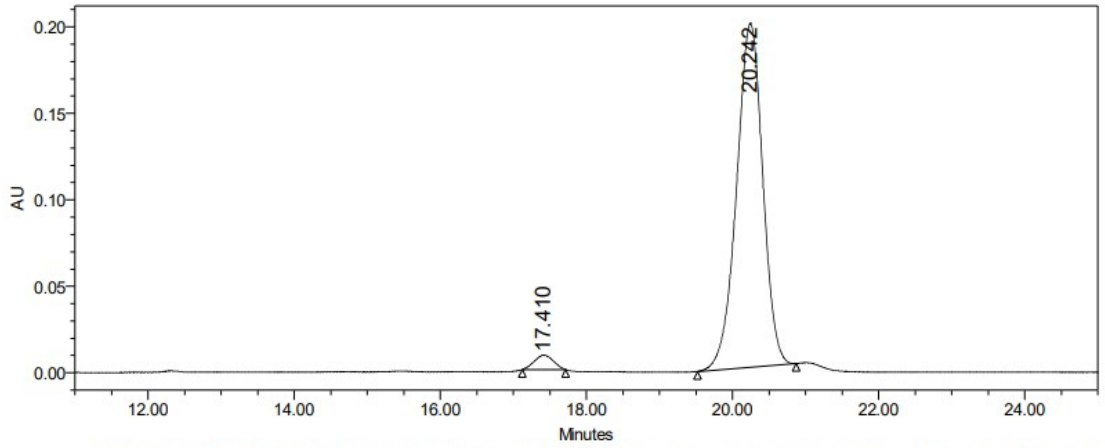


^{13}C NMR (100 MHz) in $CDCl_3$



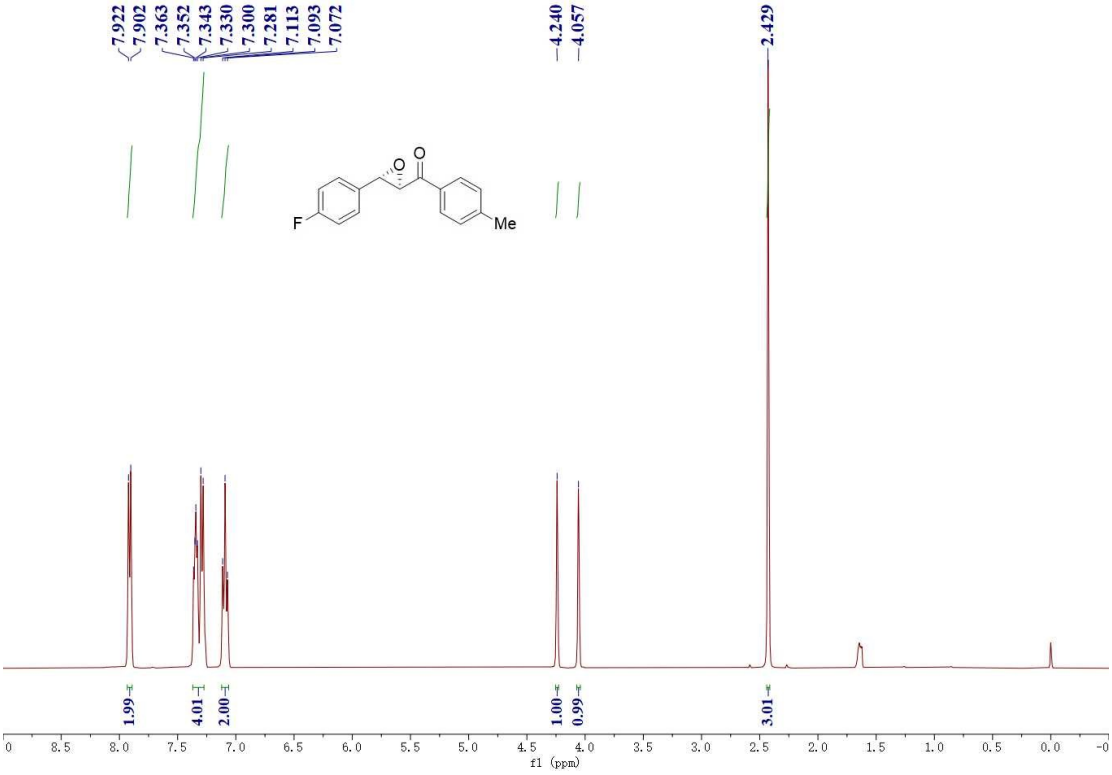


Peak#	Ret. Time	Area	Height	Area %
1	17.490	3295486	151149	50.00
2	20.362	3295110	131254	50.00

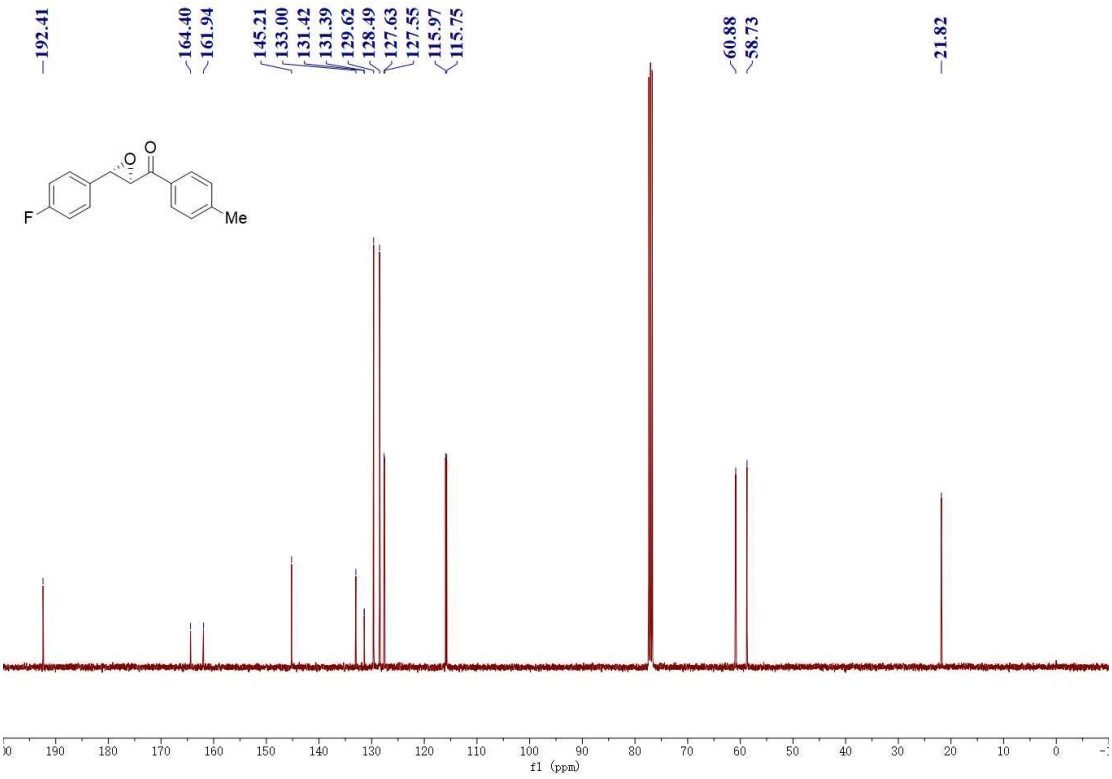


Peak#	Ret. Time	Area	Height	Area %
1	17.410	153210	8369	3.00
2	20.242	4945591	198765	97.00

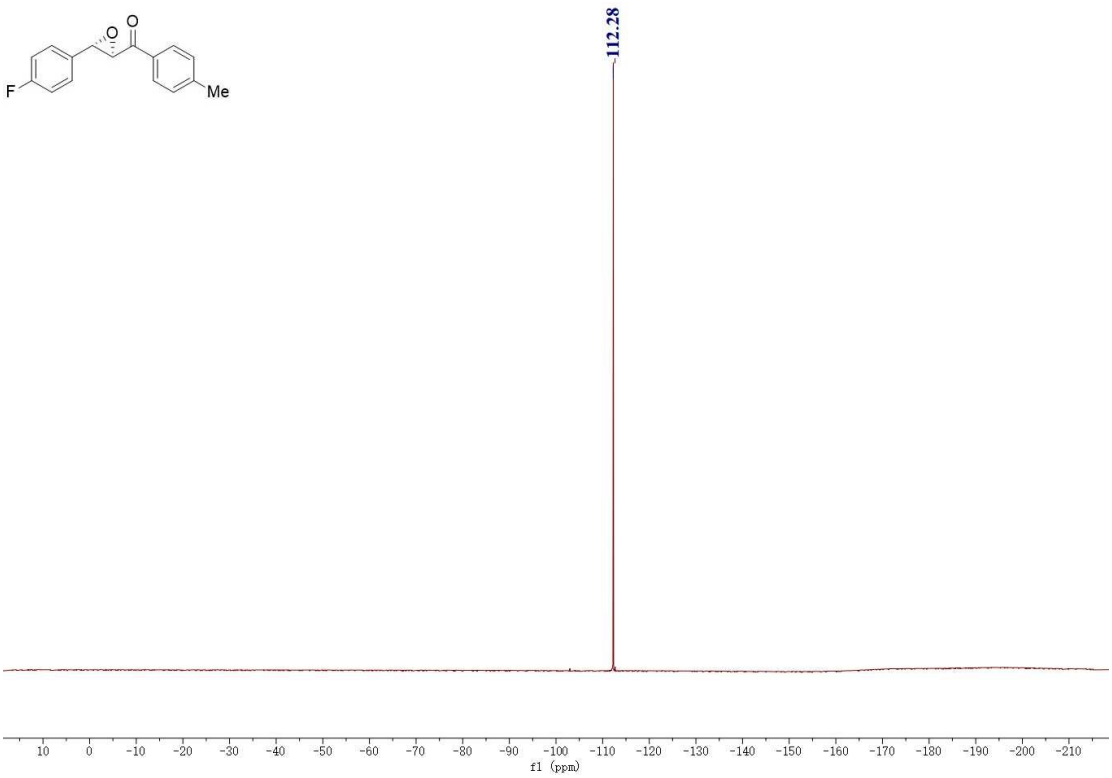
[(2*R*,3*S*)-3-(4-Fluorophenyl)-2-oxiranyl](4-methylphenyl)methanone (5at)



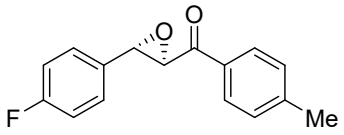
^{1}H NMR (400 MHz) in $CDCl_3$

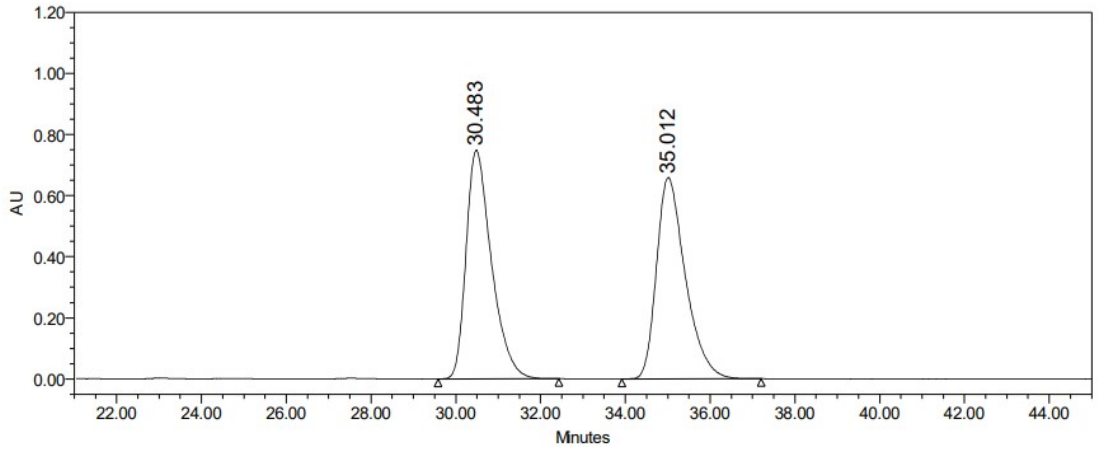


^{13}C NMR (100 MHz) in $CDCl_3$

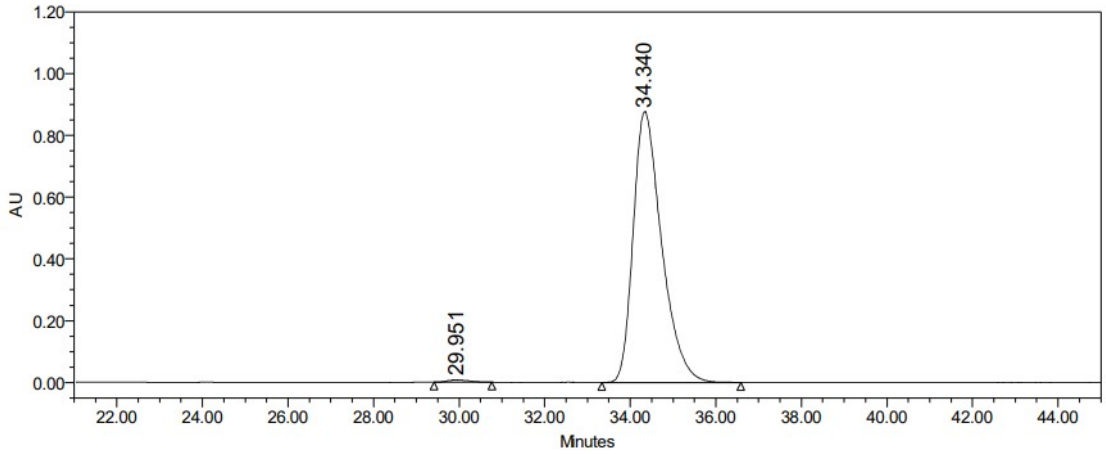


^{19}F NMR (376 MHz) in $CDCl_3$



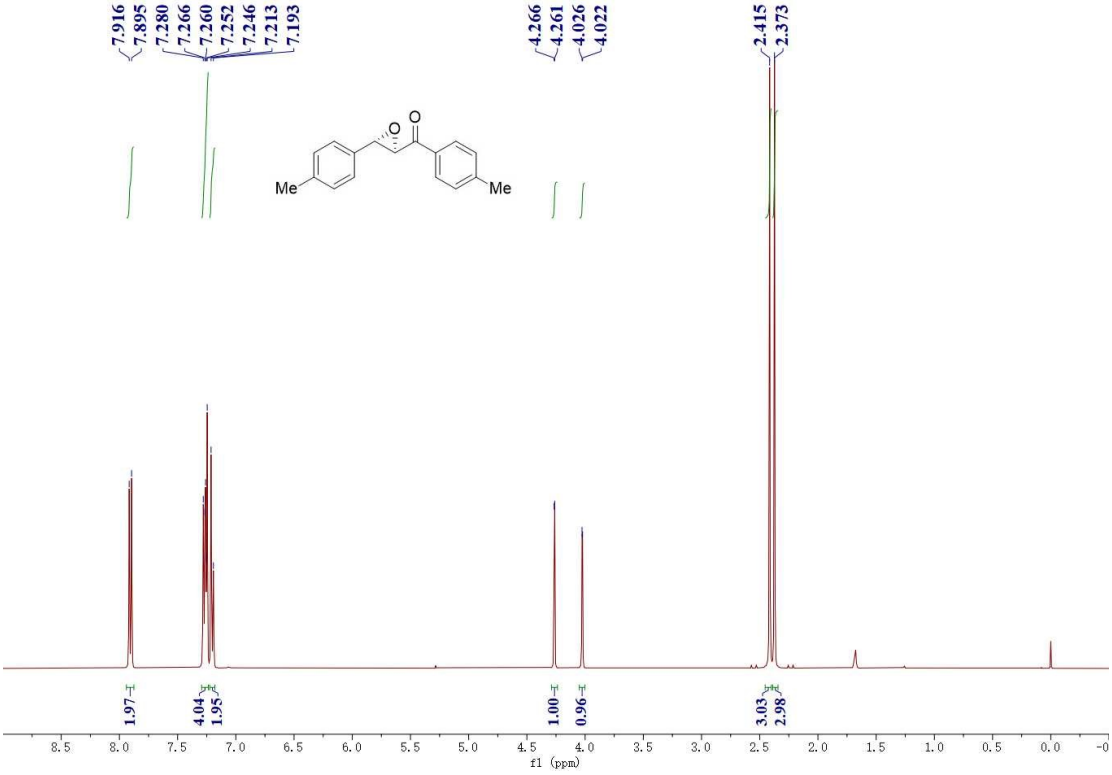


Peak#	Ret. Time	Area	Height	Area %
1	30.483	31176467	748664	50.00
2	35.012	31179047	659057	50.00

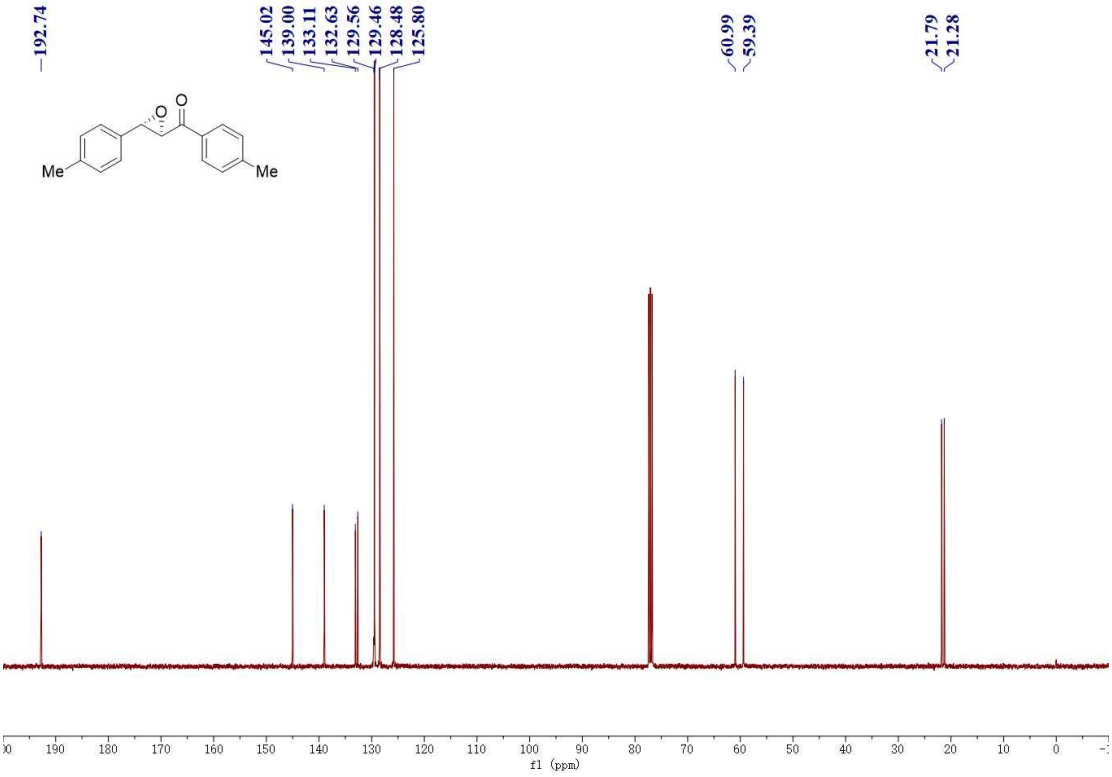


Peak#	Ret. Time	Area	Height	Area %
1	29.951	287319	7908	0.70
2	34.340	40608189	877623	99.30

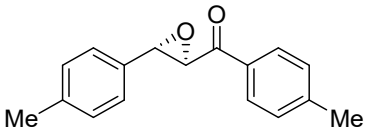
(2*R*,3*S*)-4-Methylphenyl-3-(4-methylphenyl)-2-oxiran-methanone (5au)

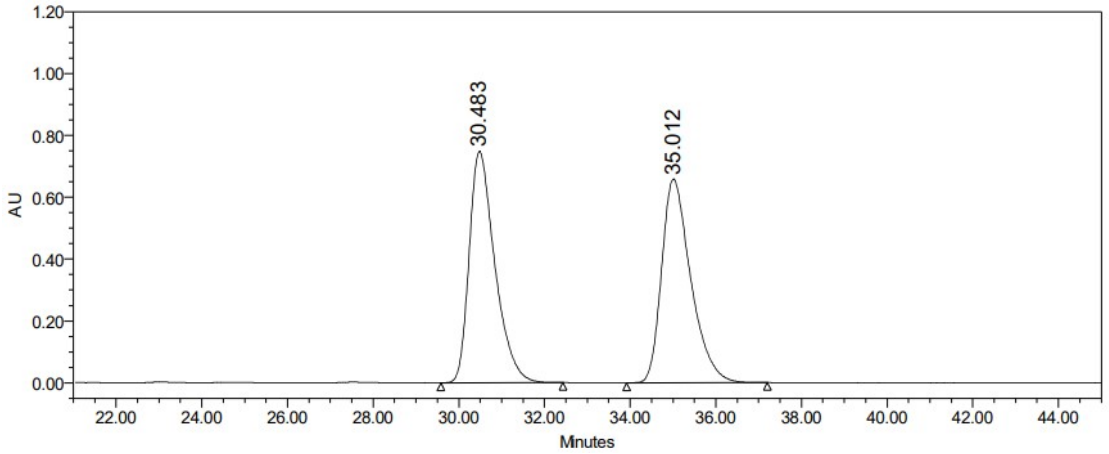


^{1}H NMR (400 MHz) in $CDCl_3$

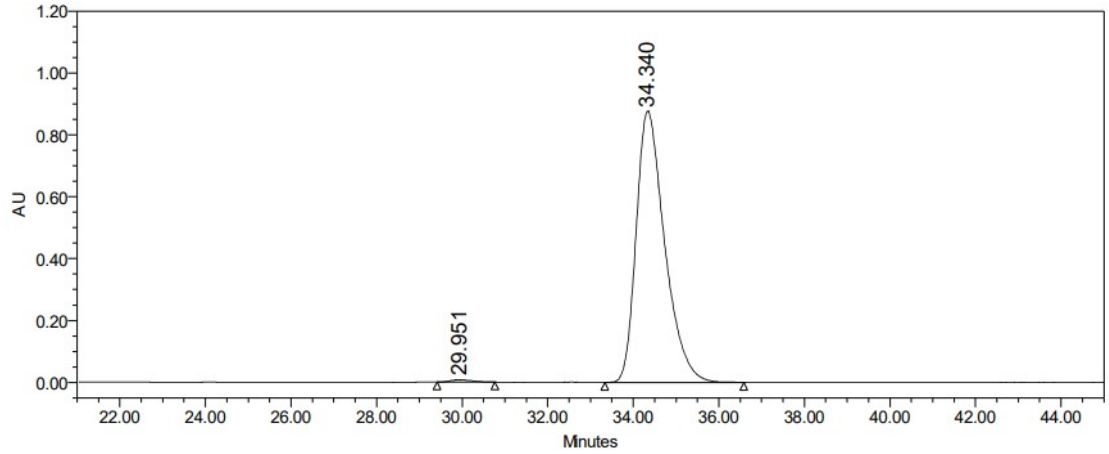


^{13}C NMR (100 MHz) in $CDCl_3$



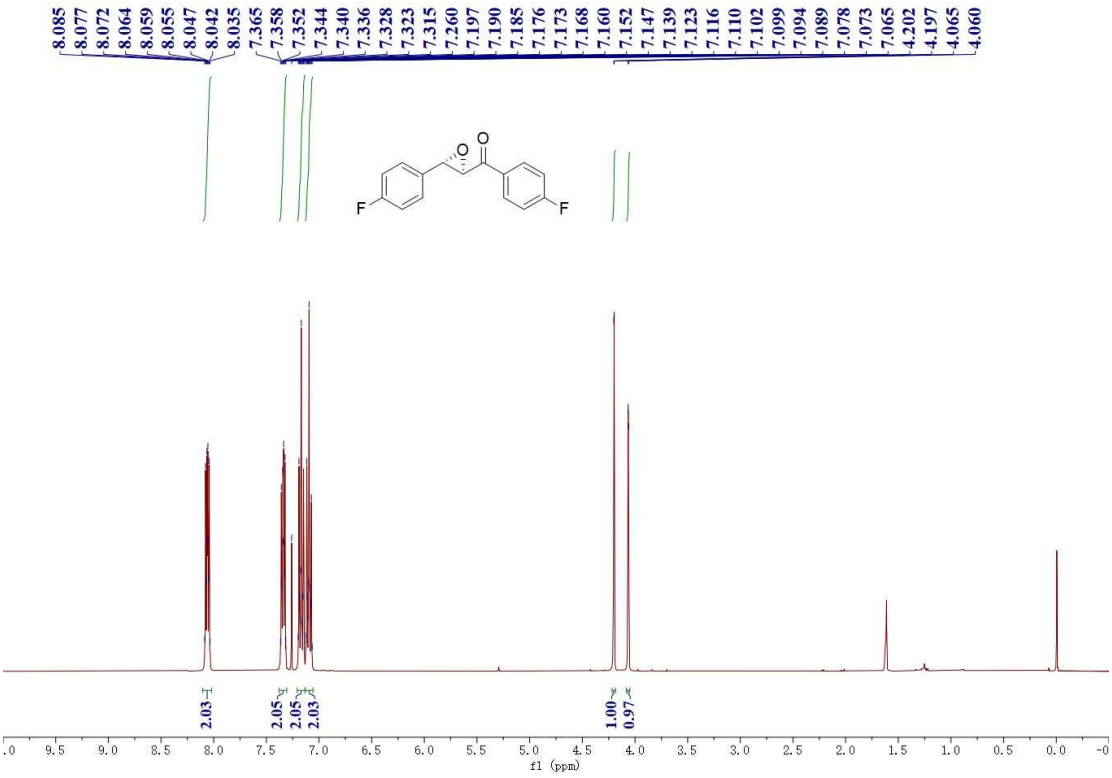


Peak#	Ret. Time	Area	Height	Area %
1	30.483	31176467	748664	50.00
2	35.012	31179047	659057	50.00

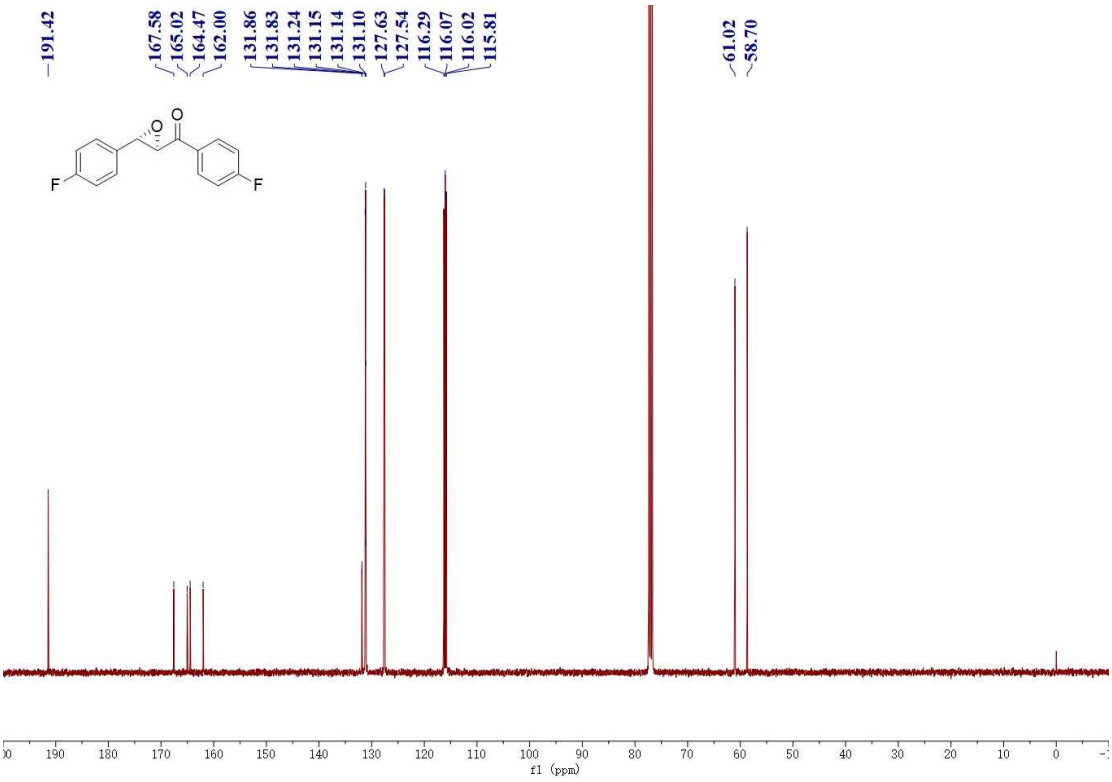


Peak#	Ret. Time	Area	Height	Area %
1	29.951	287319	7908	0.70
2	34.340	40608189	877623	99.30

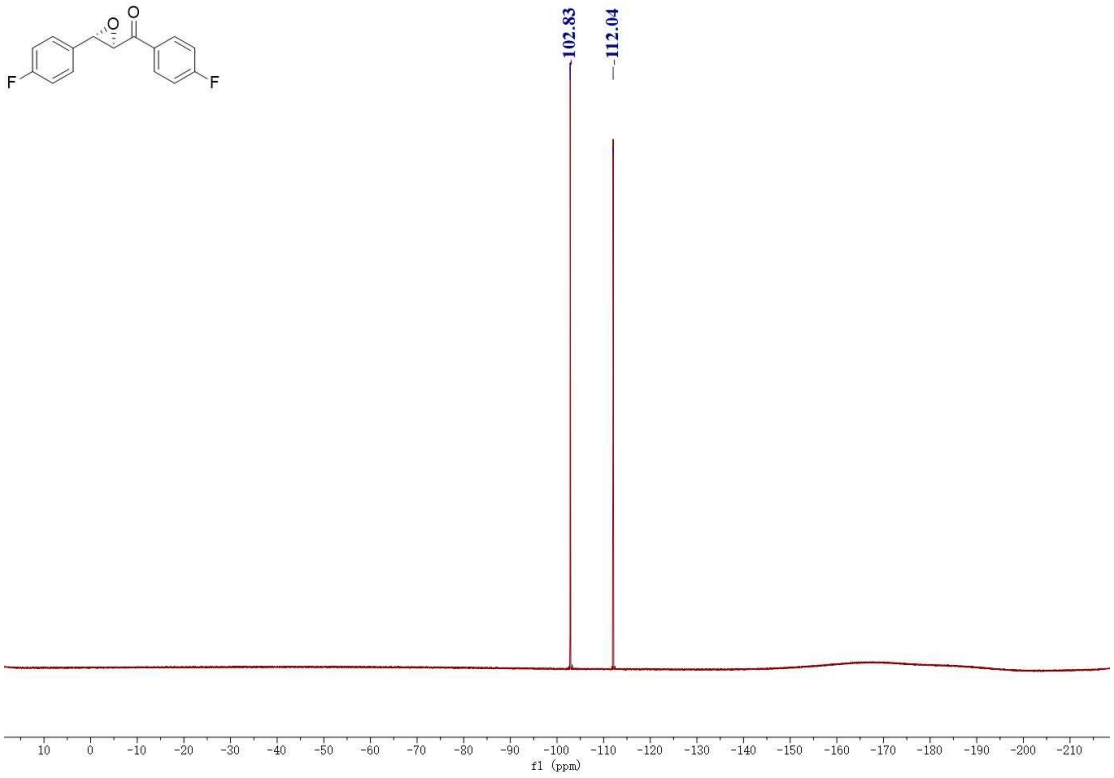
(4-Fluorophenyl) ((2*R*,3*S*)-3-(4-fluorophenyl)-oxiran-2-yl)-methanone (5av)



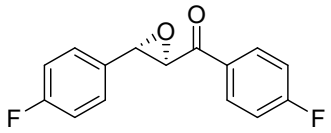
^{1}H NMR (400 MHz) in $CDCl_3$

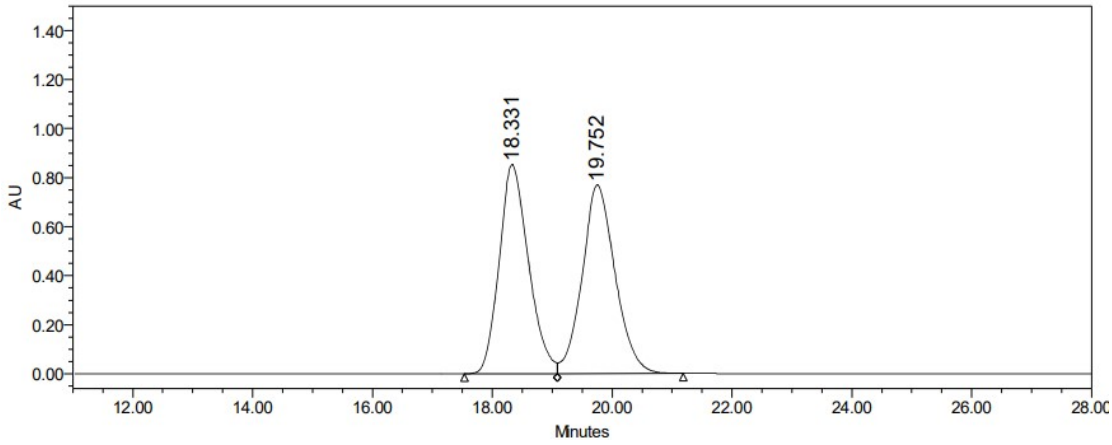


^{13}C NMR (100 MHz) in $CDCl_3$

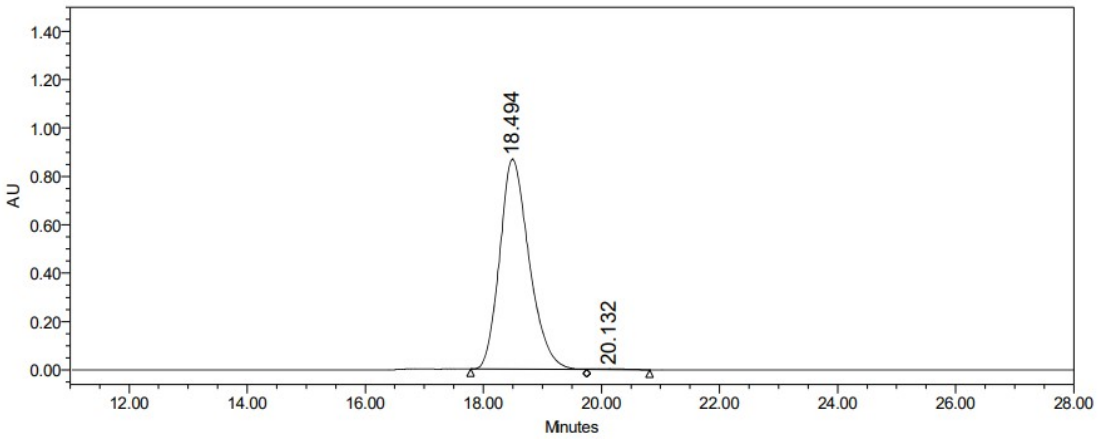


^{19}F NMR (376 MHz) in $CDCl_3$



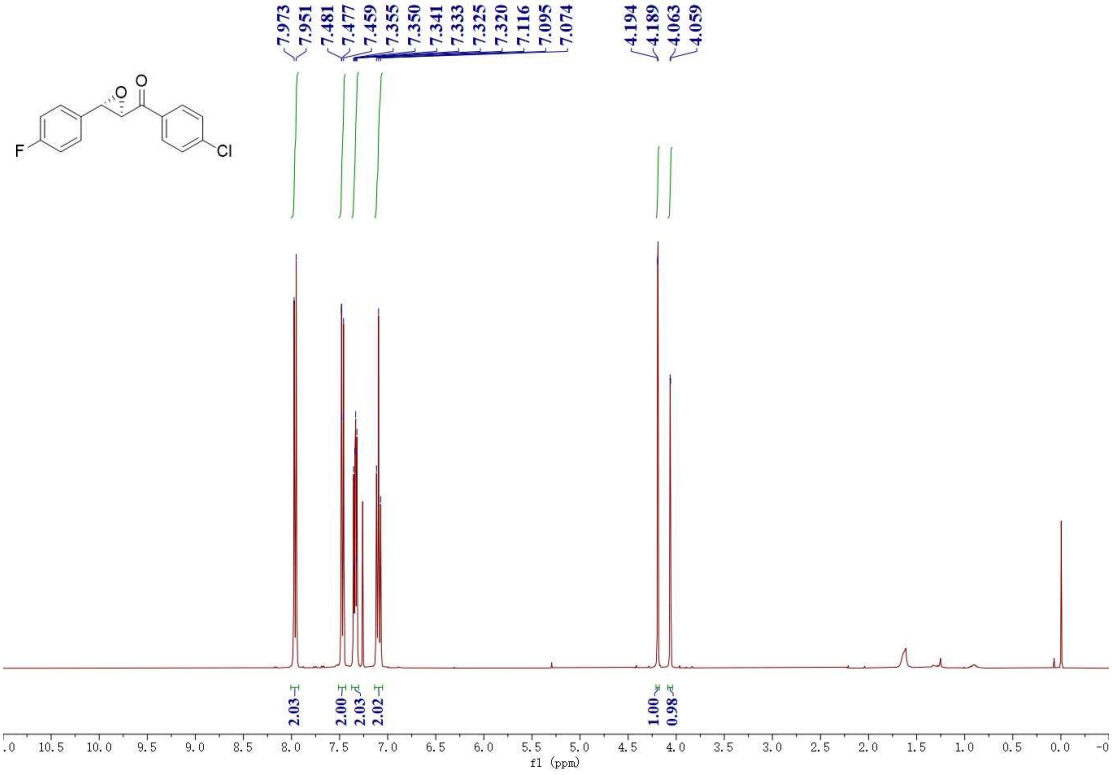


Peak#	Ret. Time	Area	Height	Area %
1	18.331	28963321	852589	49.65
2	19.752	29374319	768919	50.35

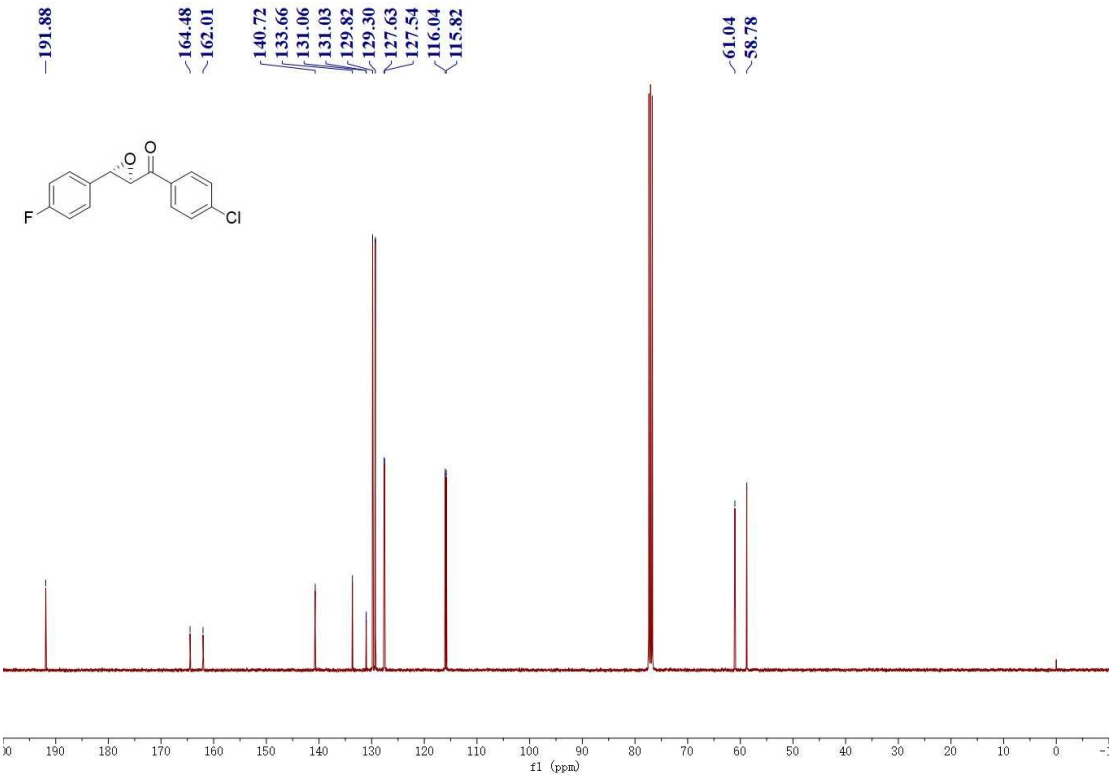


Peak#	Ret. Time	Area	Height	Area %
1	18.494	30179715	869597	99.59
2	20.132	122866	3568	0.41

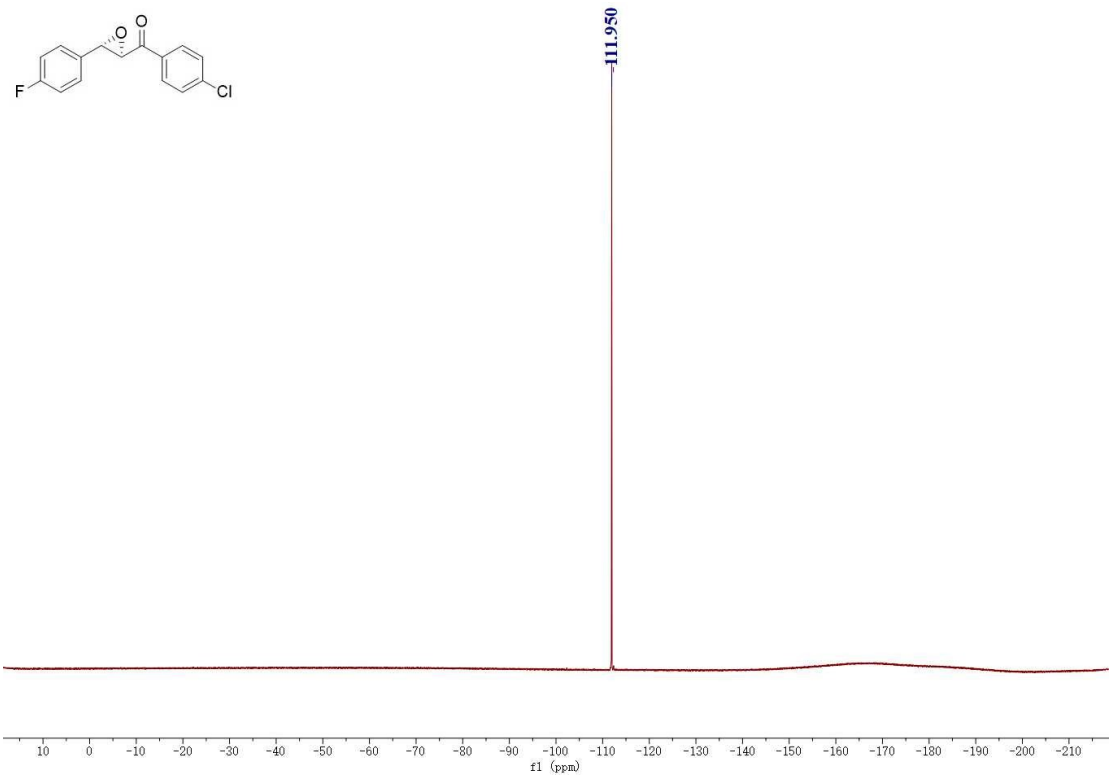
(4-Chlorophenyl) ((2*R*,3*S*)-3-(4-fluorophenyl)-oxiran-2-yl)-methanone (5aw)



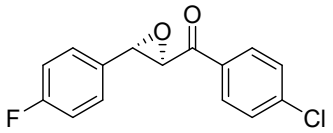
^{1}H NMR (400 MHz) in $CDCl_3$

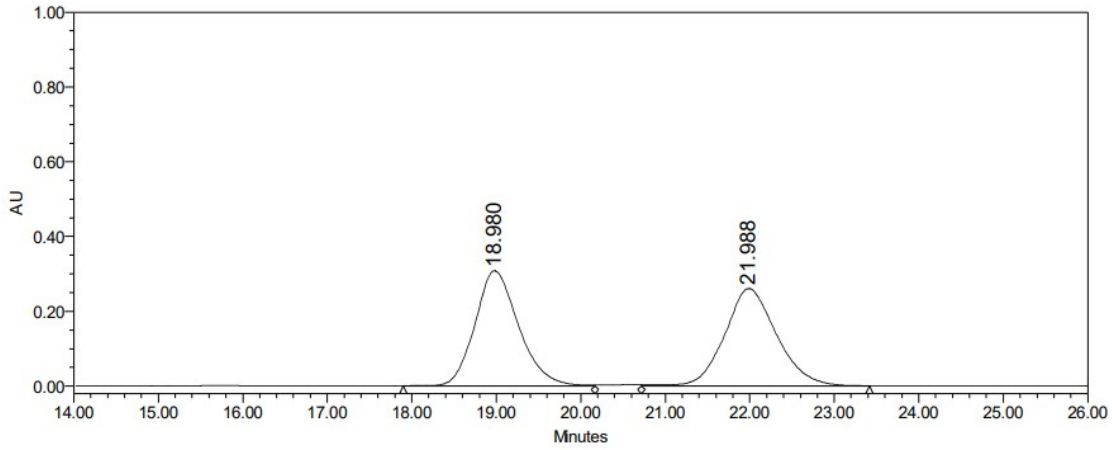


^{13}C NMR (100 MHz) in $CDCl_3$

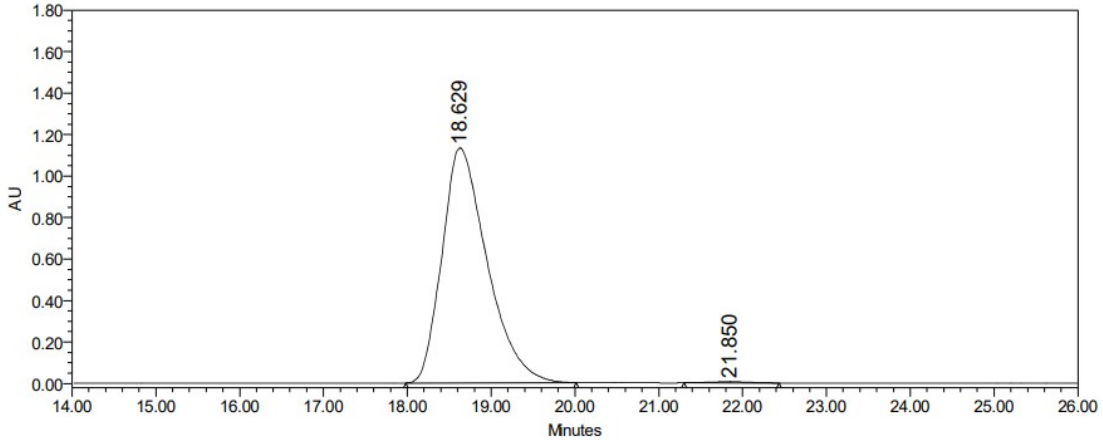


^{19}F NMR (376 MHz) in $CDCl_3$





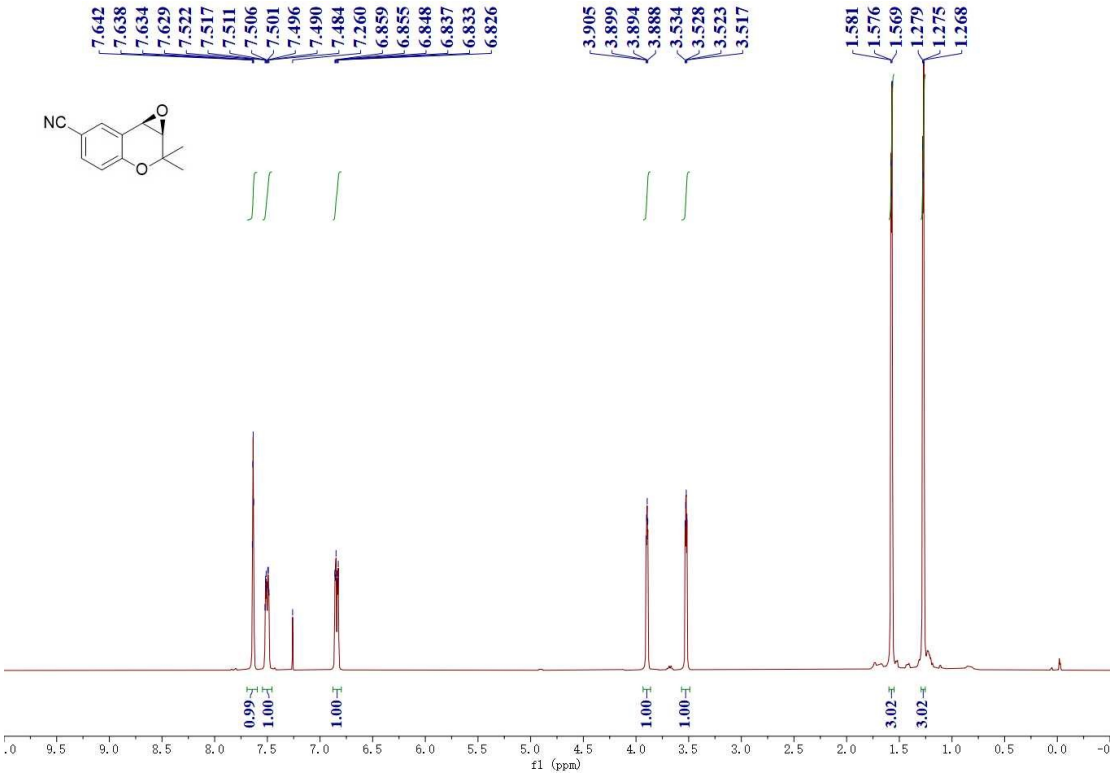
Peak#	Ret. Time	Area	Height	Area %
1	18.980	11070651	308443	49.79
2	21.988	11162758	260500	50.21



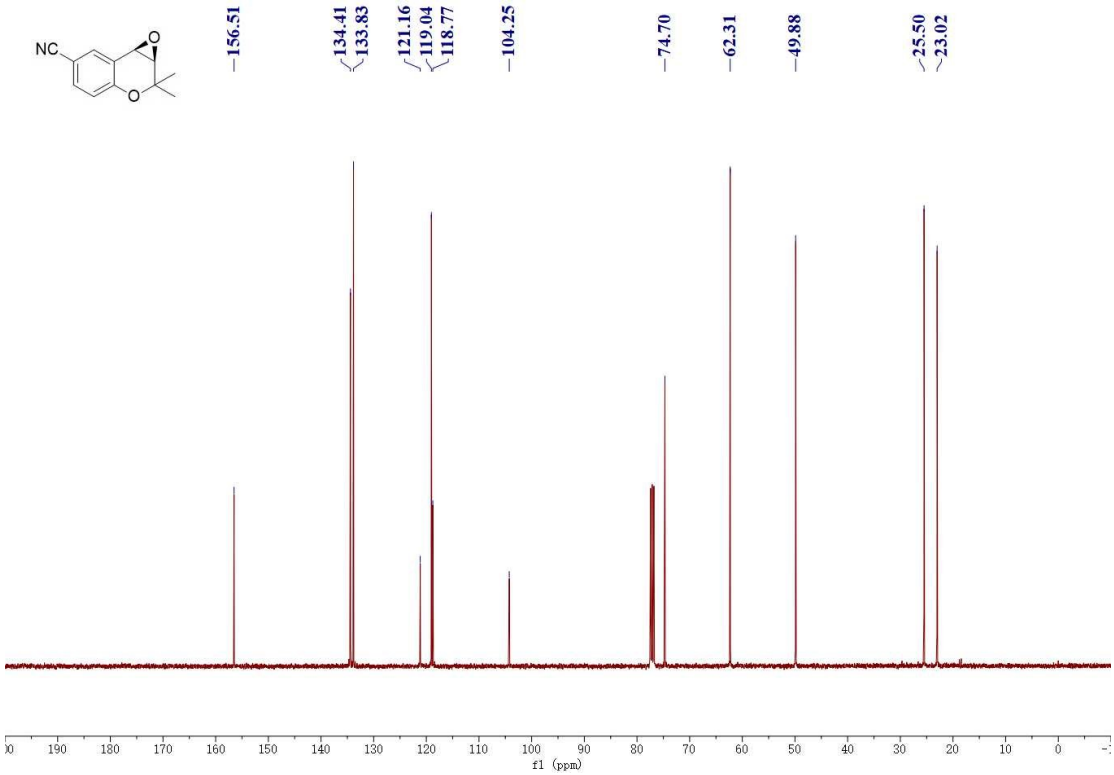
Peak#	Ret. Time	Area	Height	Area %
1	18.629	42303600	1133632	99.52
2	21.850	204637	5890	0.48

(1a*R*,7b*R*)-2,2-dimethyl-1a,7b-dihydro-2*H*-oxireno[2,3-*c*]chromene-6-carbonitrile

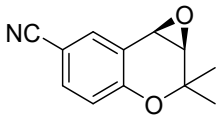
(5ax)

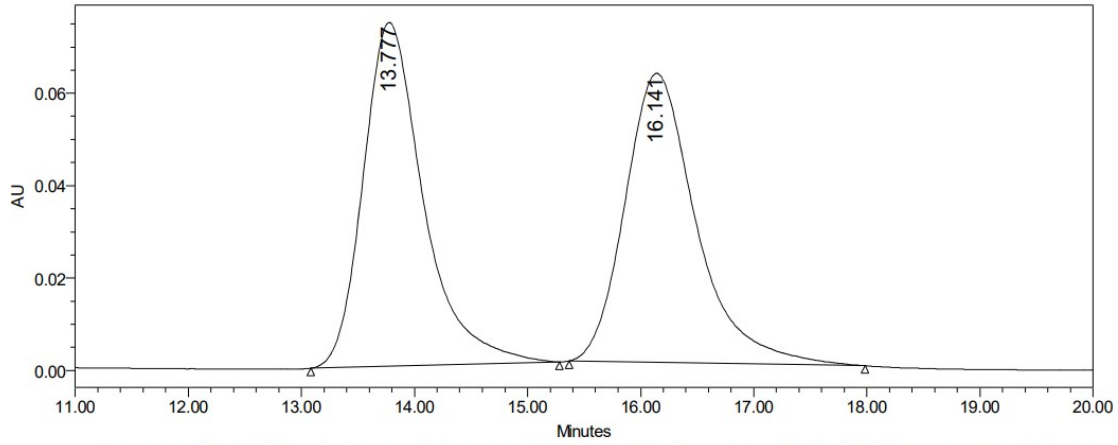


^{1}H NMR (400 MHz) in $CDCl_3$

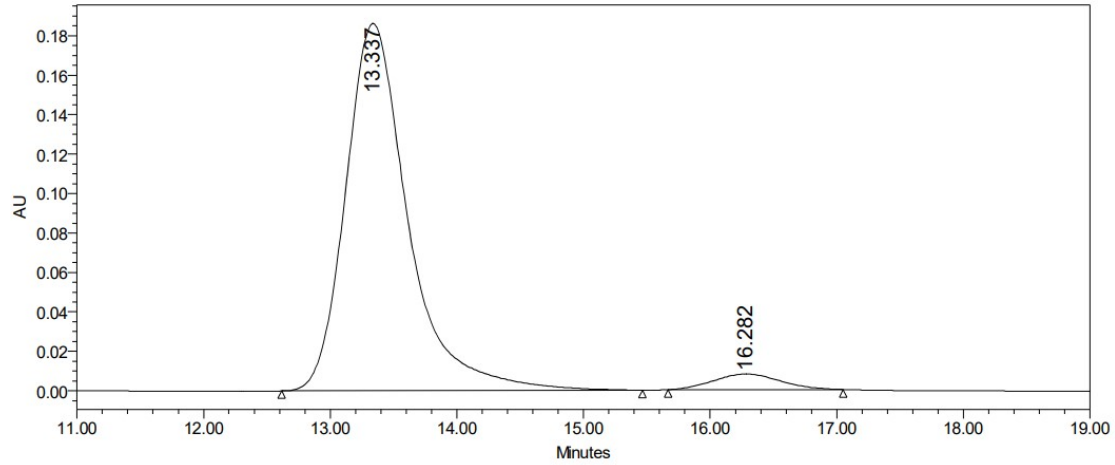


^{13}C NMR (100 MHz) in $CDCl_3$



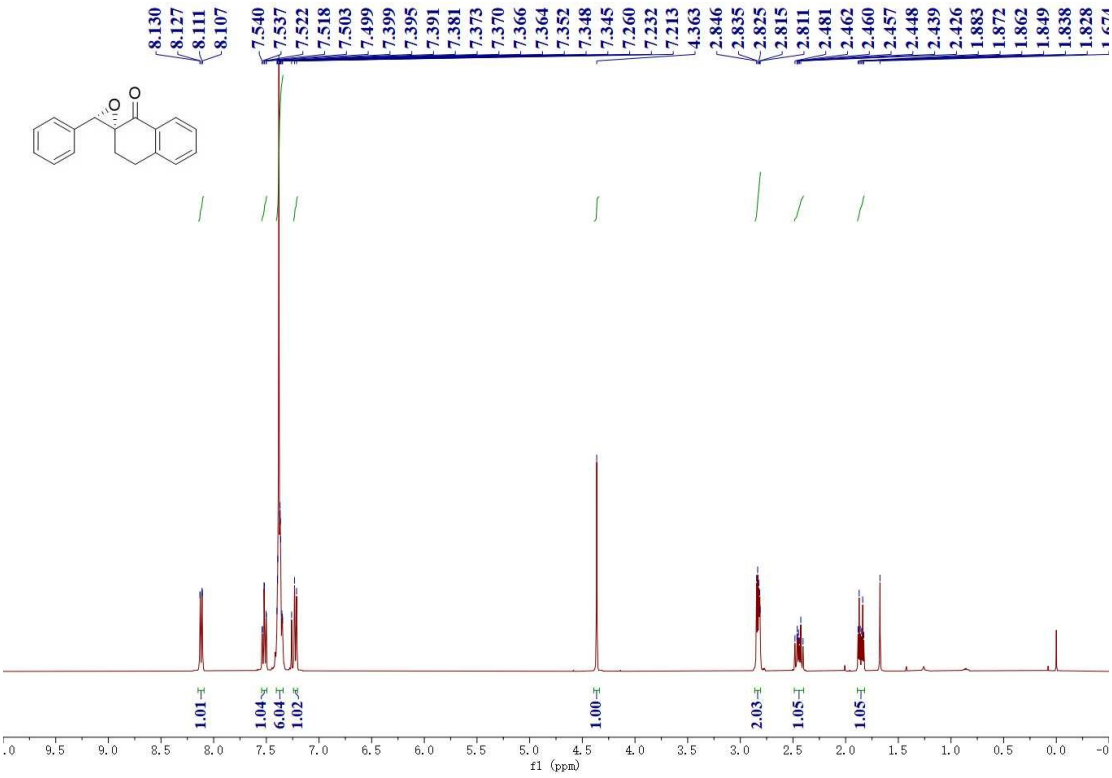


Peak#	Ret. Time	Area	Height	Area %
1	13.777	2751522	74399	50.13
2	16.141	2737293	62565	49.87

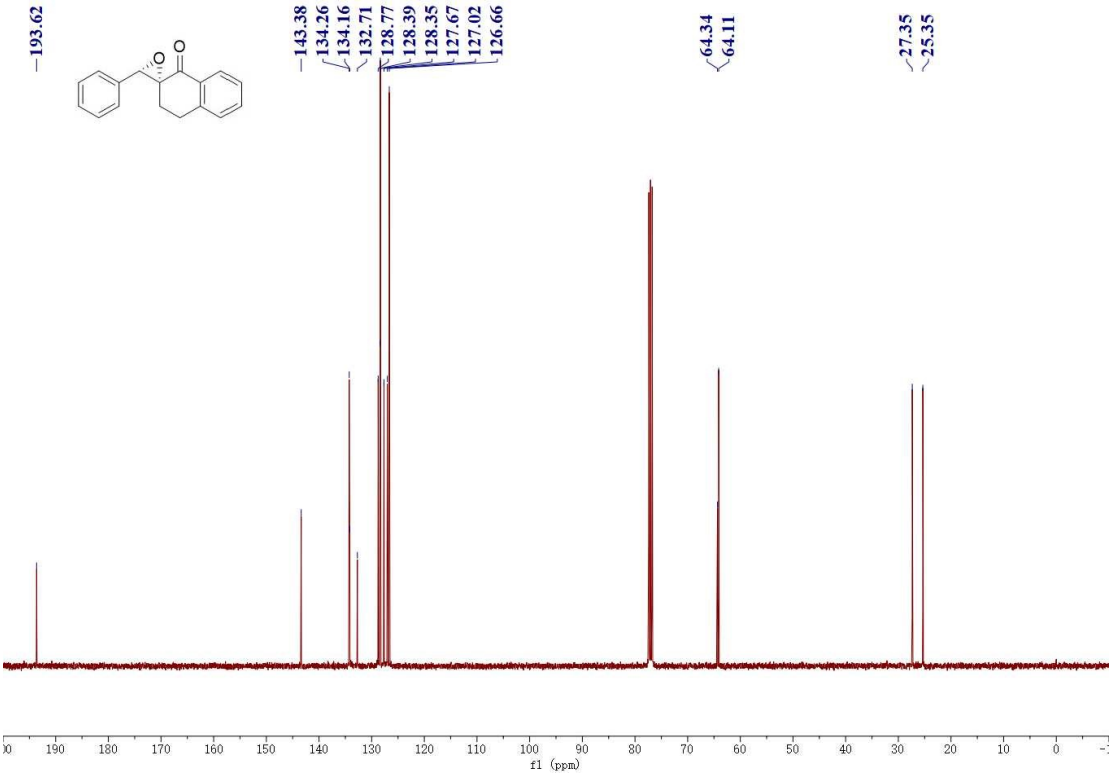


Peak#	Ret. Time	Area	Height	Area %
1	13.337	6376749	186278	95.68
2	16.282	288702	7853	4.32

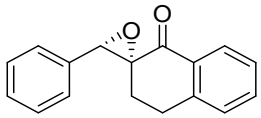
(2*R*,3′*S*)-3′-Phenyl-3,4-dihydro-1*H*-spiro[naphthalene-2,2′-oxiran]-1-one (5ay)

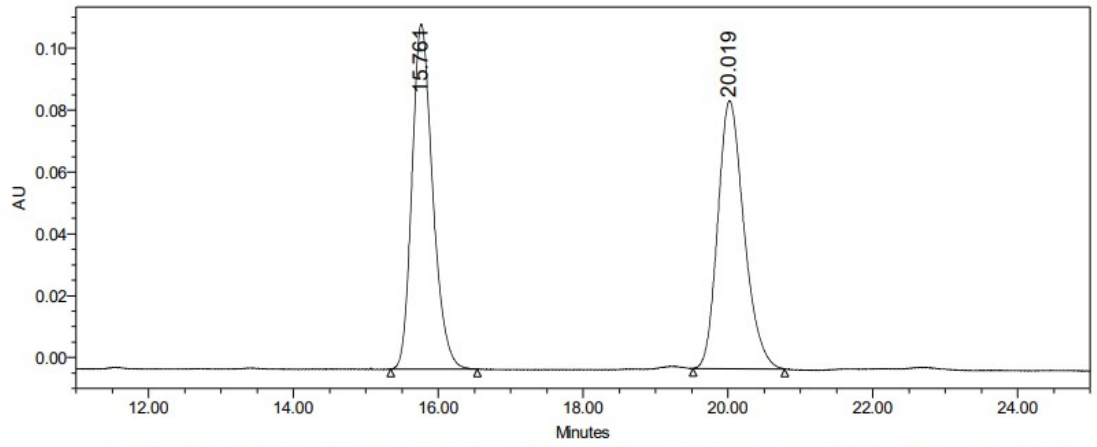


^{1}H NMR (400 MHz) in $CDCl_3$

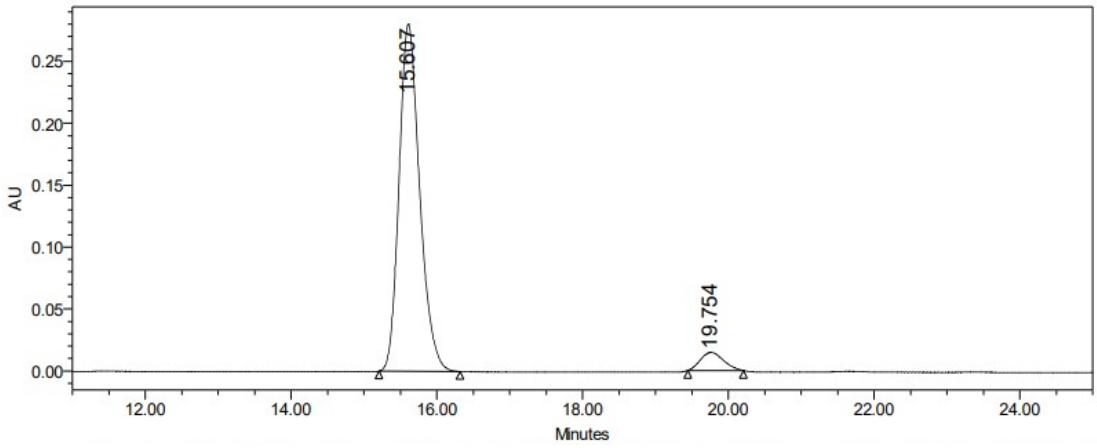


^{13}C NMR (100 MHz) in $CDCl_3$



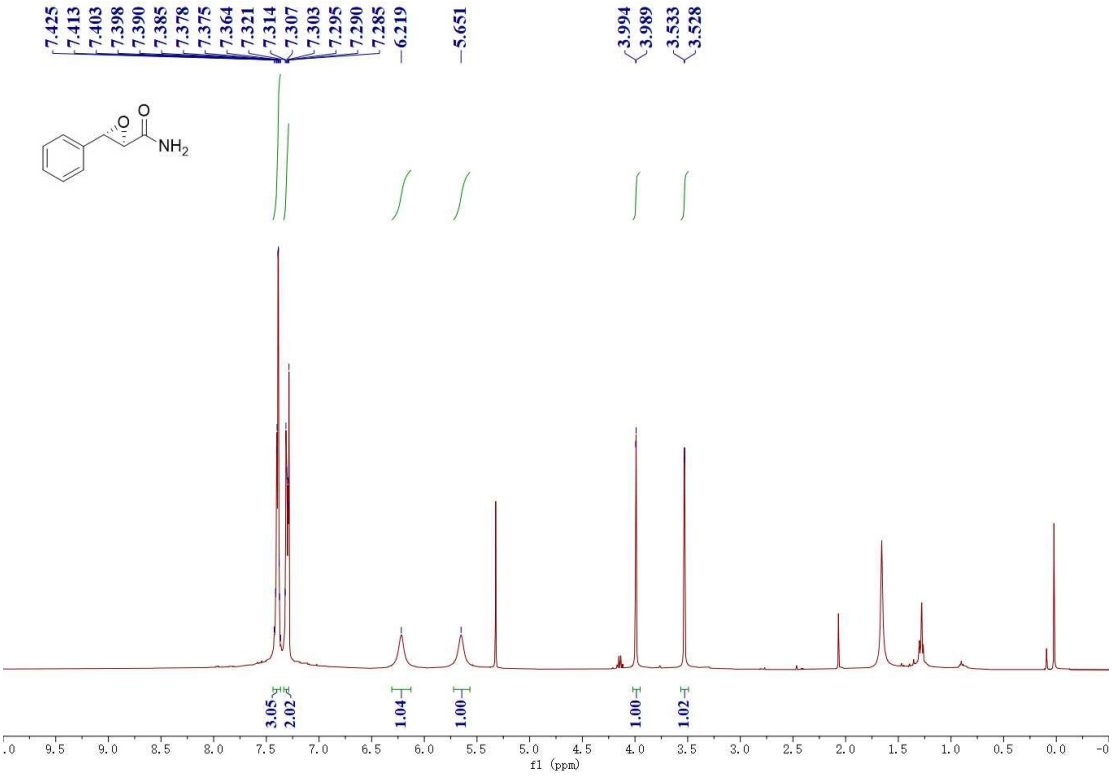


Peak#	Ret. Time	Area	Height	Area %
1	15.761	2218334	111500	50.42
2	20.019	2181639	86691	49.58

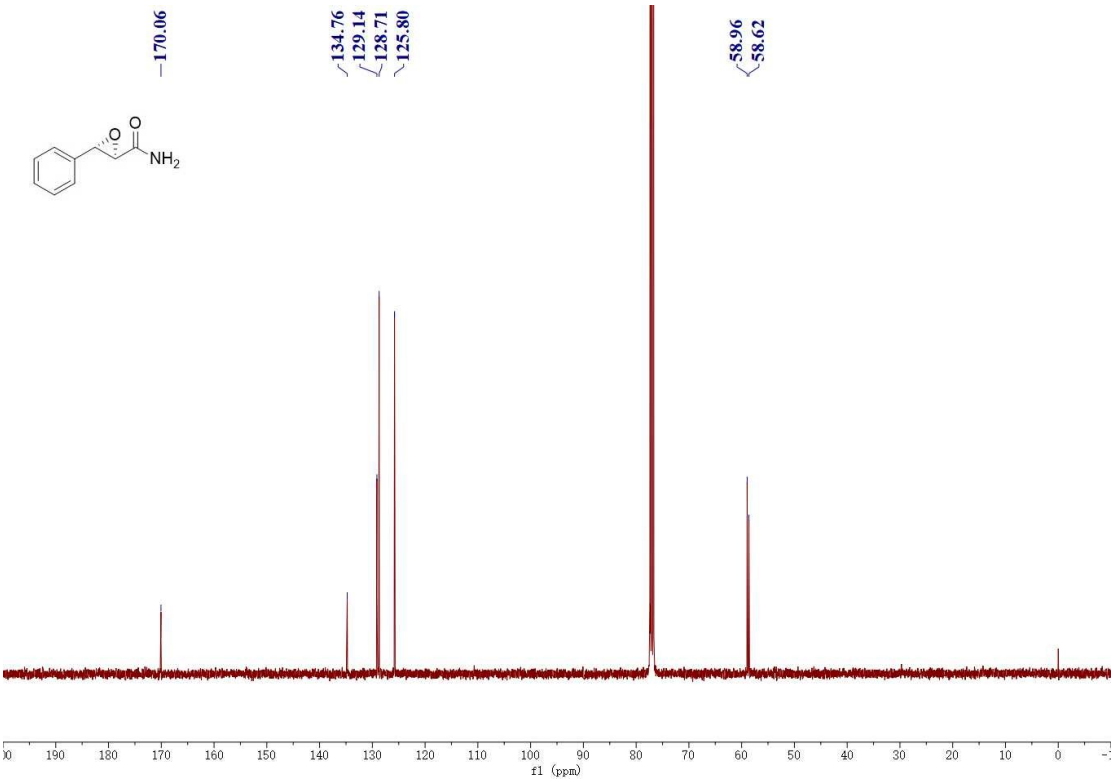


Peak#	Ret. Time	Area	Height	Area %
1	15.607	5515727	280293	94.48
2	19.754	322333	14651	5.52

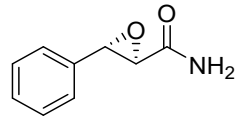
(2*R*,3*S*)-3-Phenyloxirane-2-carboxamide (5ba)

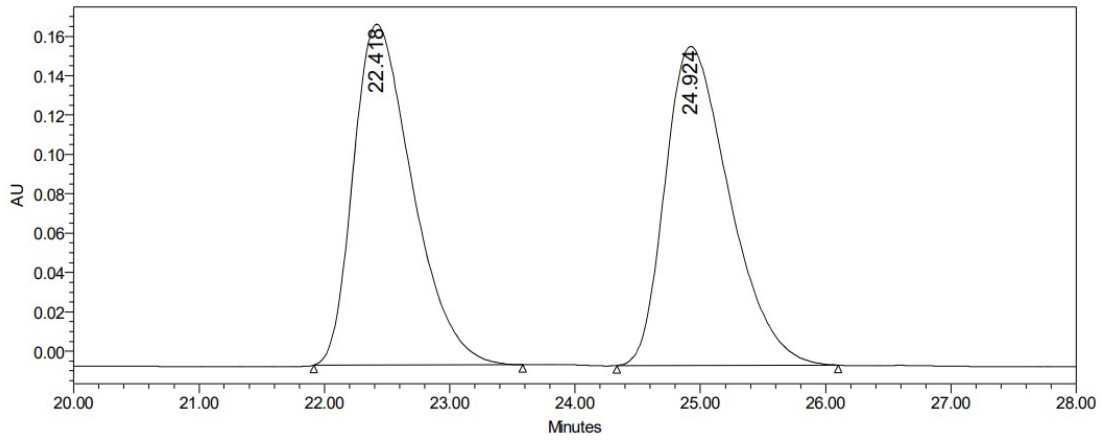


^{1}H NMR (400 MHz) in $CDCl_3$

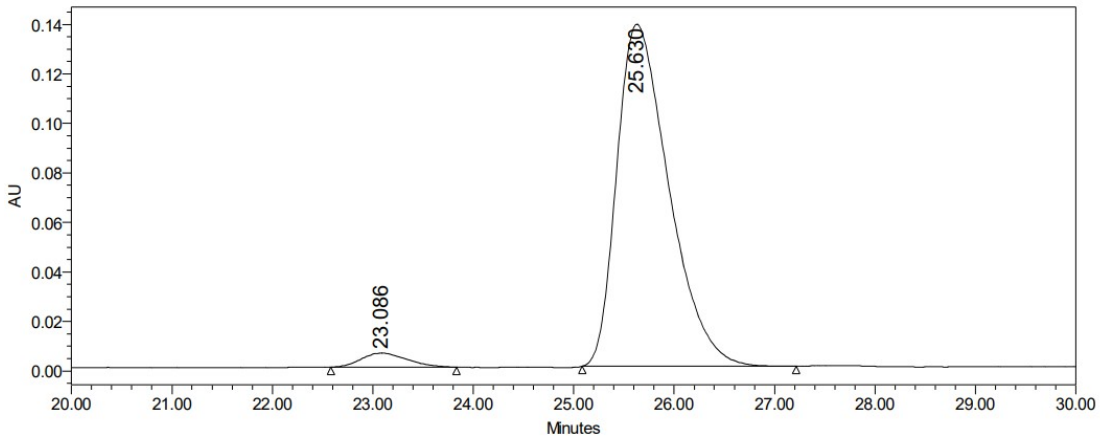


^{13}C NMR (100 MHz) in $CDCl_3$



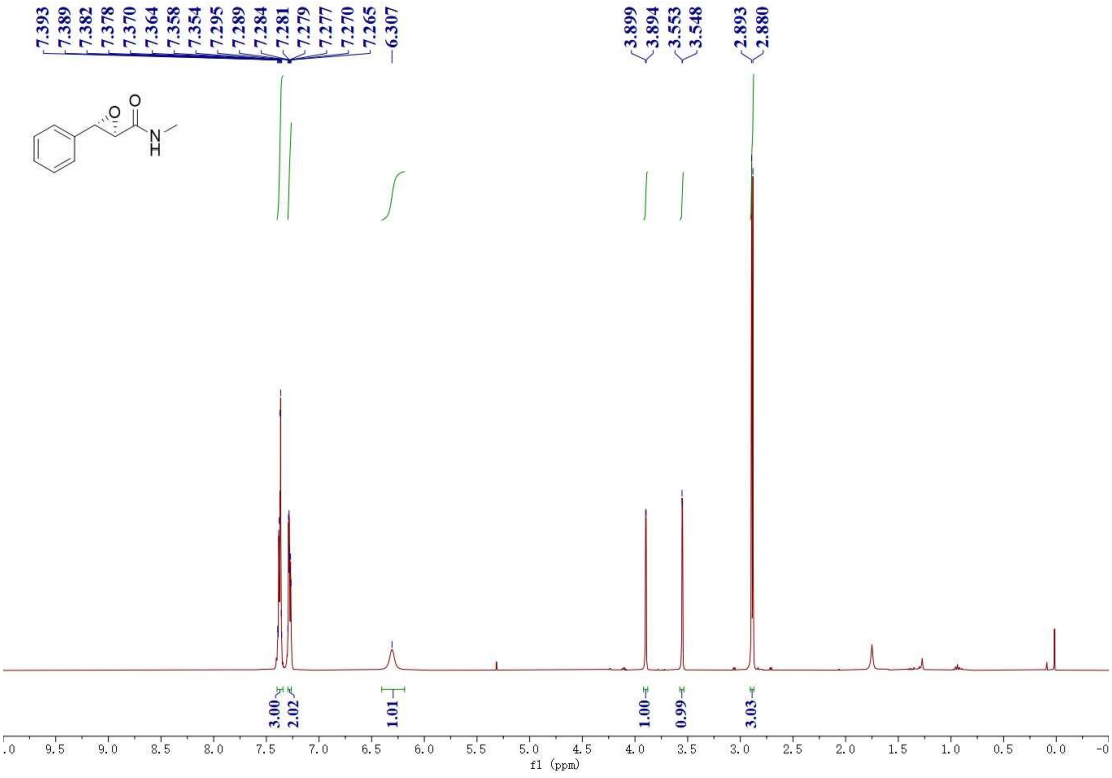


Peak#	Ret. Time	Area	Height	Area %
1	22.418	5671300	173138	49.50
2	24.924	5786372	162167	50.50

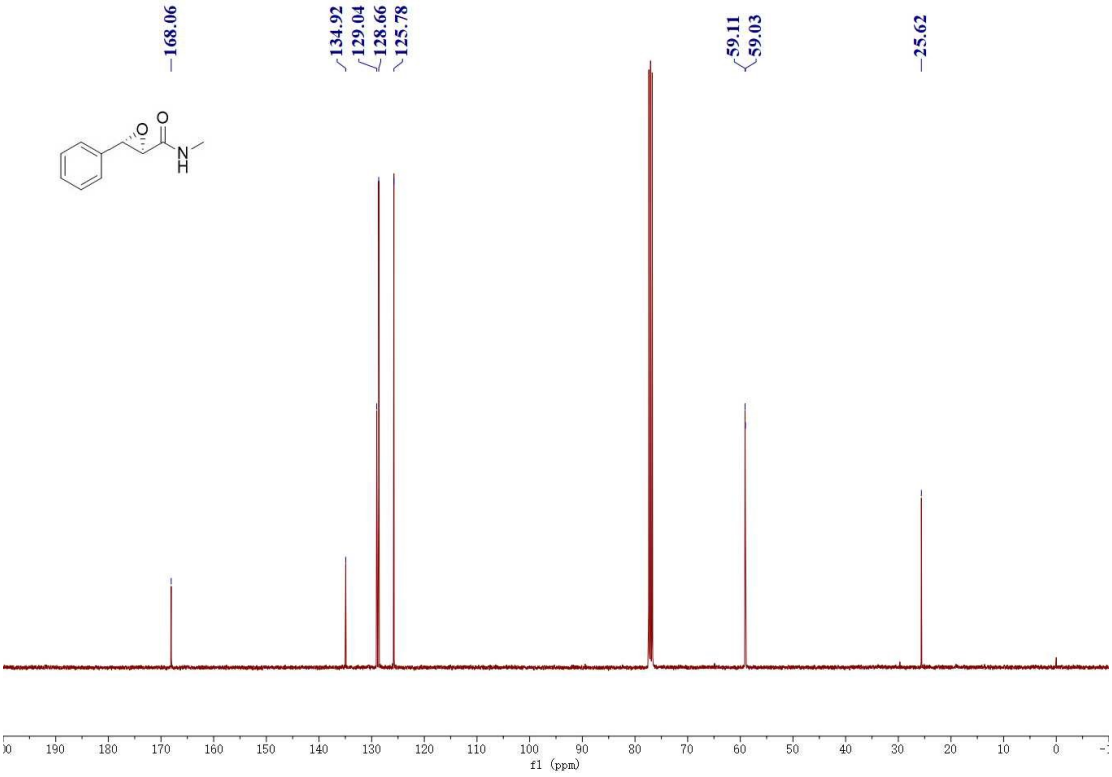


Peak#	Ret. Time	Area	Height	Area %
1	23.086	179194	5689	3.48
2	25.630	4974979	138138	96.52

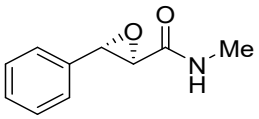
(2*R*,3*S*)-*N*-Methyl-3-phenyloxirane-2-carboxamide (5bb)

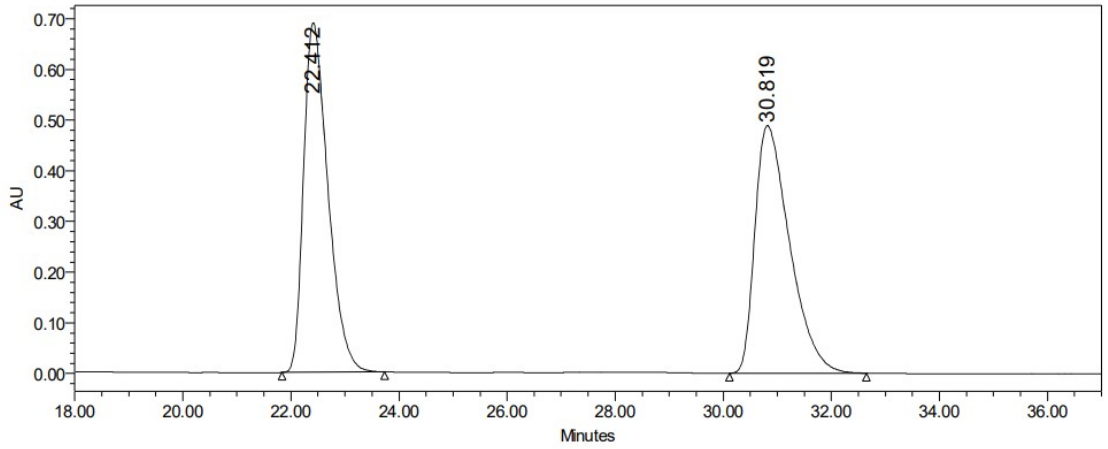


^{1}H NMR (400 MHz) in $CDCl_3$

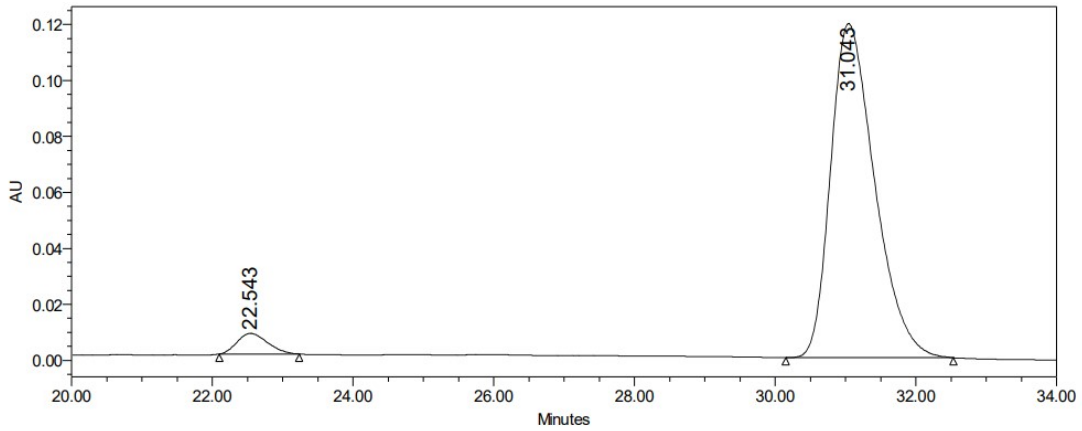


^{13}C NMR (100 MHz) in $CDCl_3$



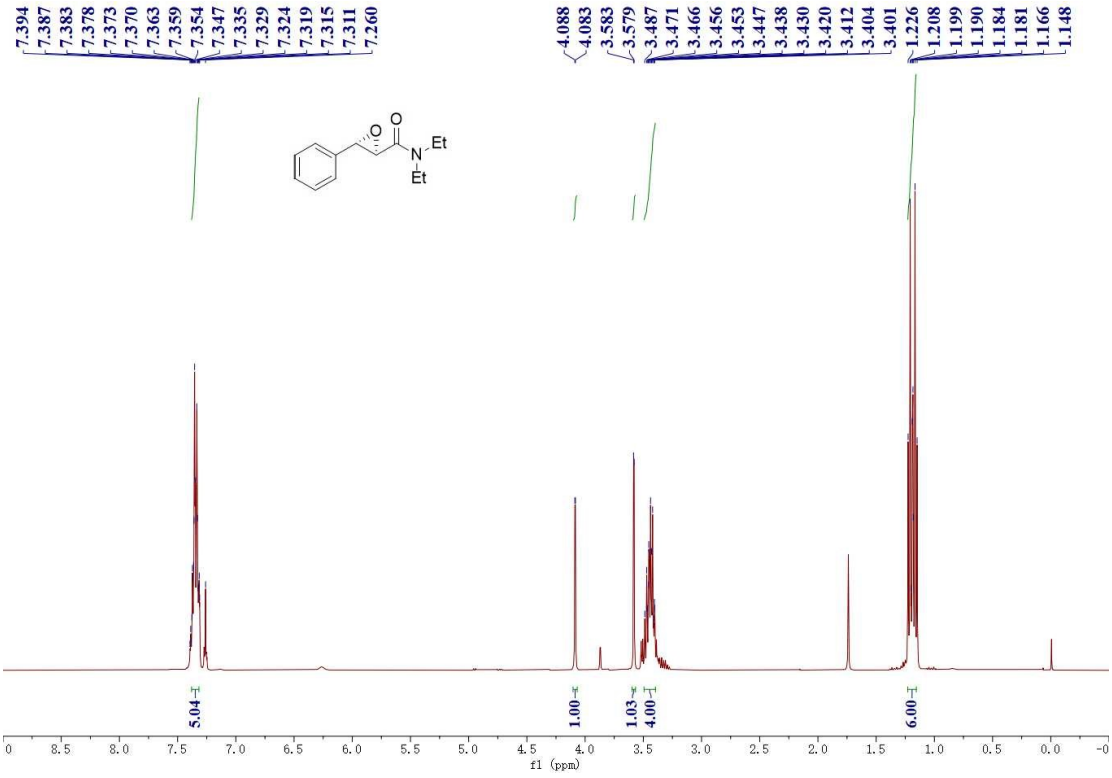


Peak#	Ret. Time	Area	Height	Area %
1	22.412	21570424	689205	49.74
2	30.819	21794536	488426	50.26

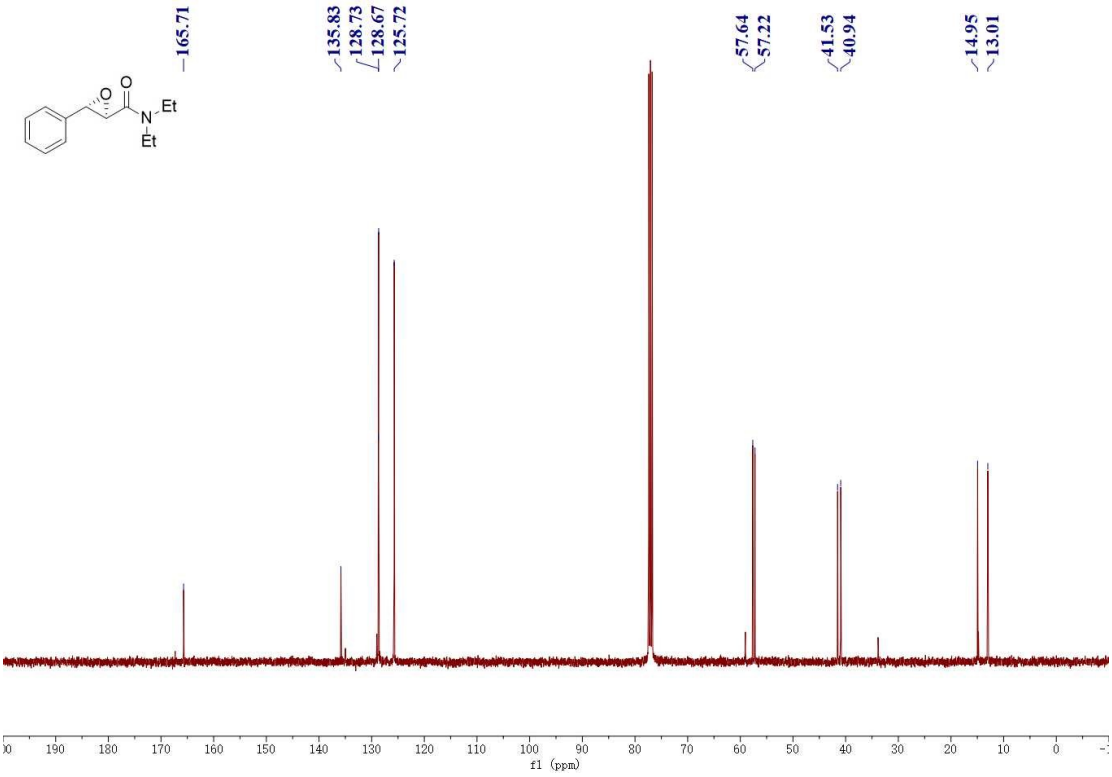


Peak#	Ret. Time	Area	Height	Area %
1	22.543	221321	7368	4.09
2	31.043	5192899	119351	95.91

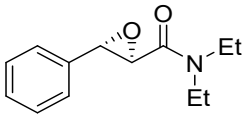
(2*R*,3*S*)-*N*, *N*-Diethyl-3-phenyloxirane-2-carboxamide (5bc)

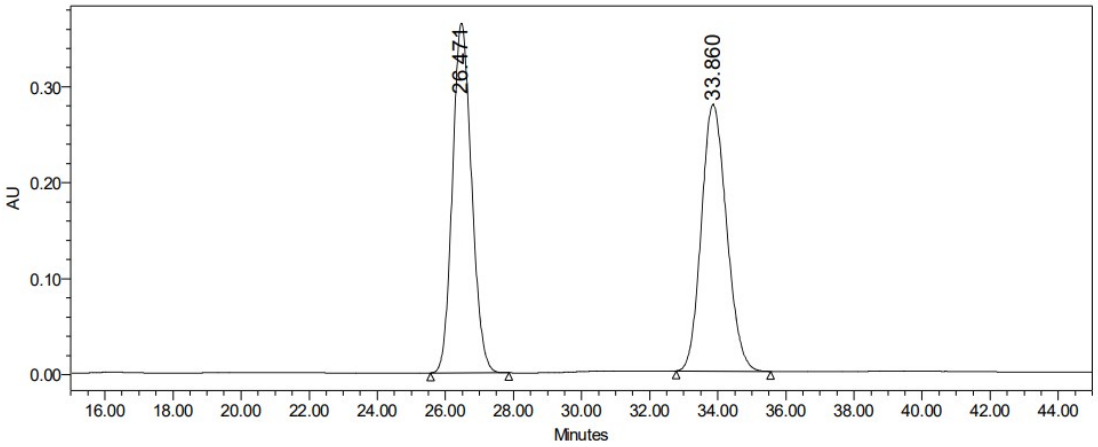


^{1}H NMR (400 MHz) in $CDCl_3$

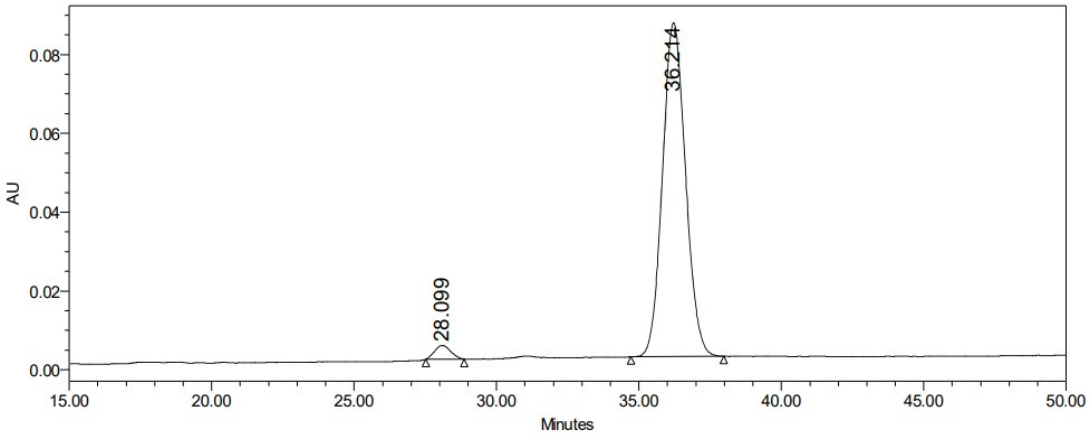


^{13}C NMR (100 MHz) in $CDCl_3$



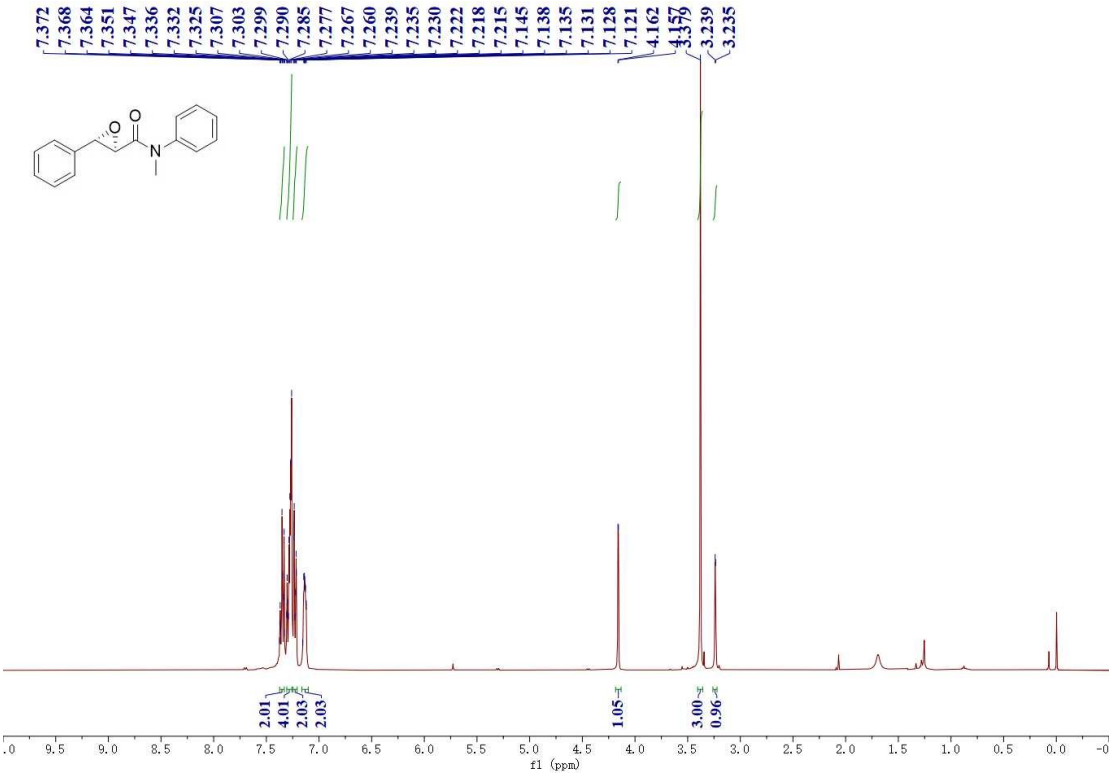


Peak#	Ret. Time	Area	Height	Area %
1	26.471	14232418	364220	49.87
2	33.860	14306793	278010	50.13

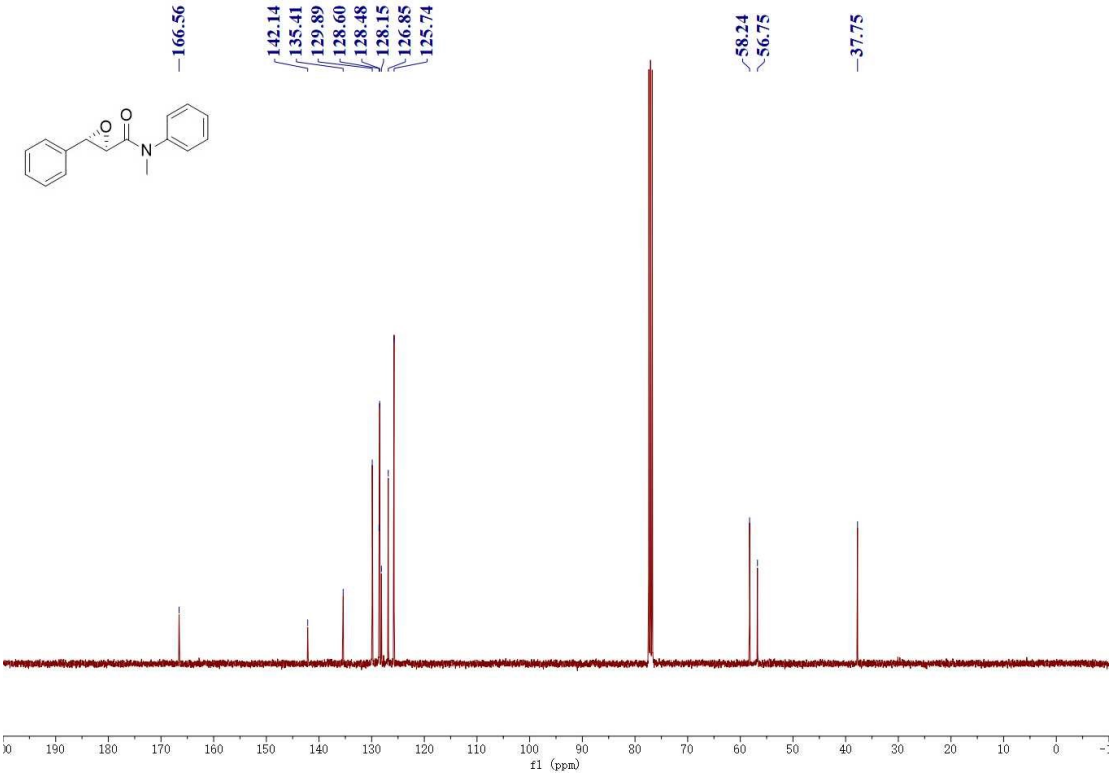


Peak#	Ret. Time	Area	Height	Area %
1	28.099	134417	3460	2.75
2	36.214	4759888	84681	97.25

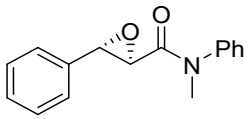
(2*R*,3*S*)-*N*-Methyl-*N*-phenyl-3-diphenyloxirane-2-carboxamide (5bd)

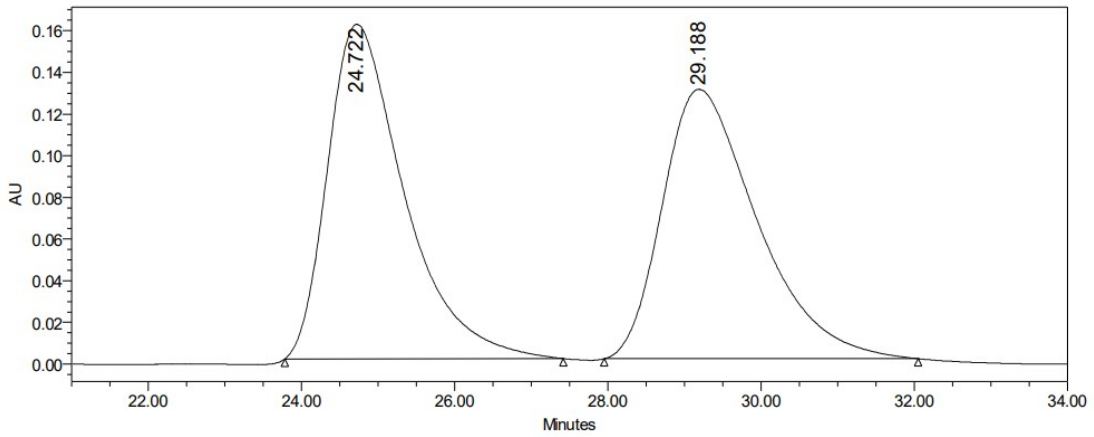


^{1}H NMR (400 MHz) in $CDCl_3$

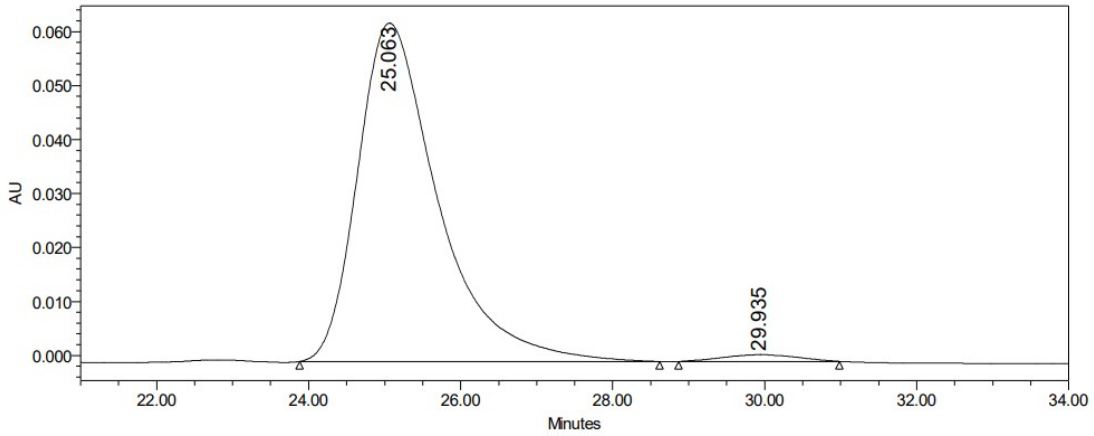


^{13}C NMR (100 MHz) in $CDCl_3$



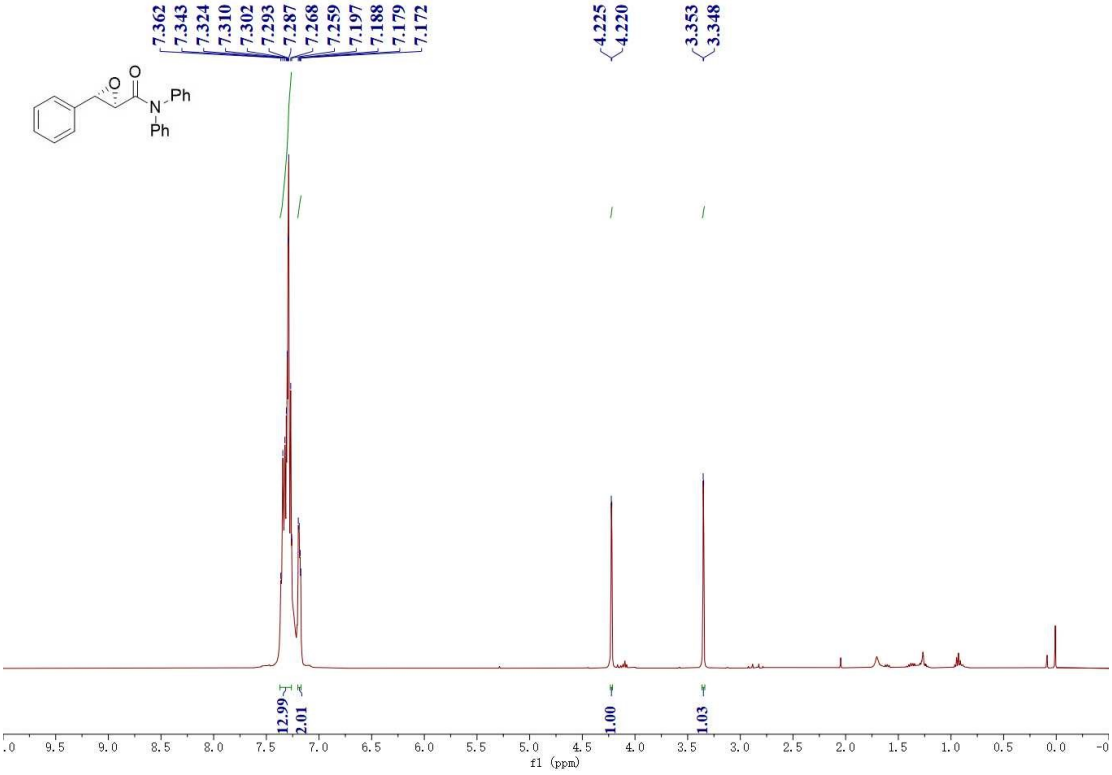


Peak#	Ret. Time	Area	Height	Area %
1	24.722	11165447	160505	50.11
2	29.188	11115124	129326	49.89

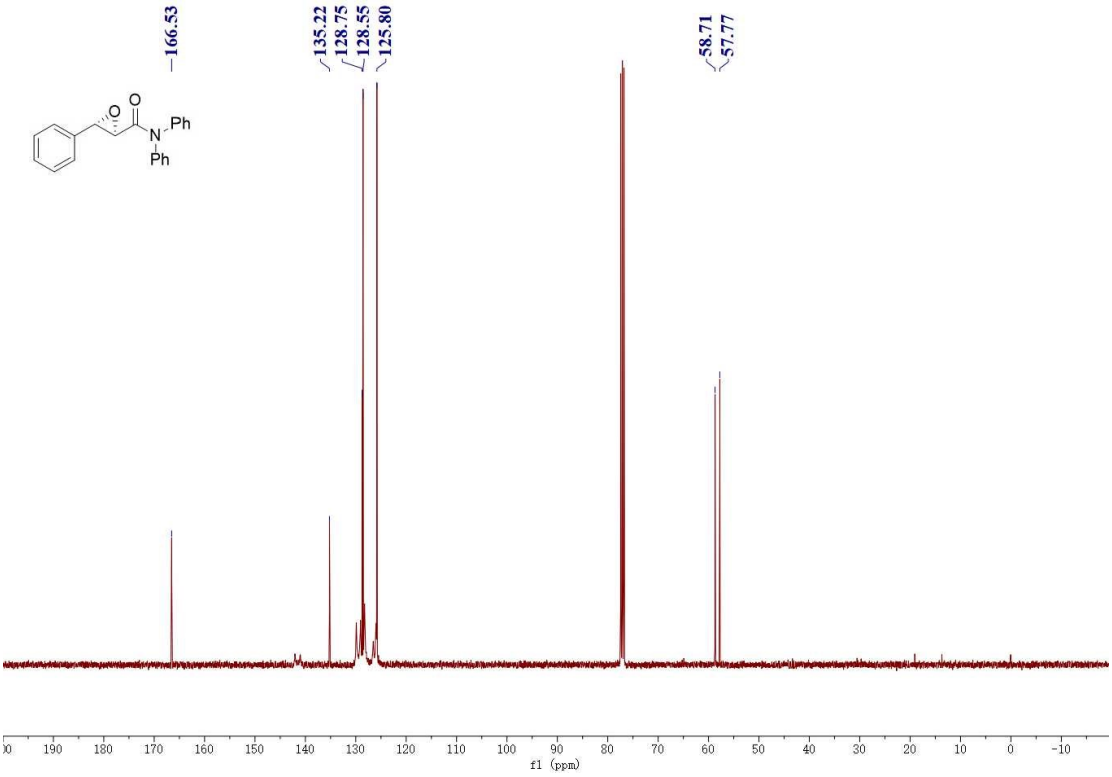


Peak#	Ret. Time	Area	Height	Area %
1	25.063	4601040	62703	98.23
2	29.935	82783	1227	1.77

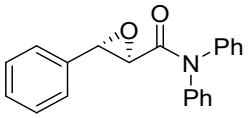
(2*R*,3*S*)-*N*, *N*, 3-triphenyloxirane-2-carboxamide (5be)

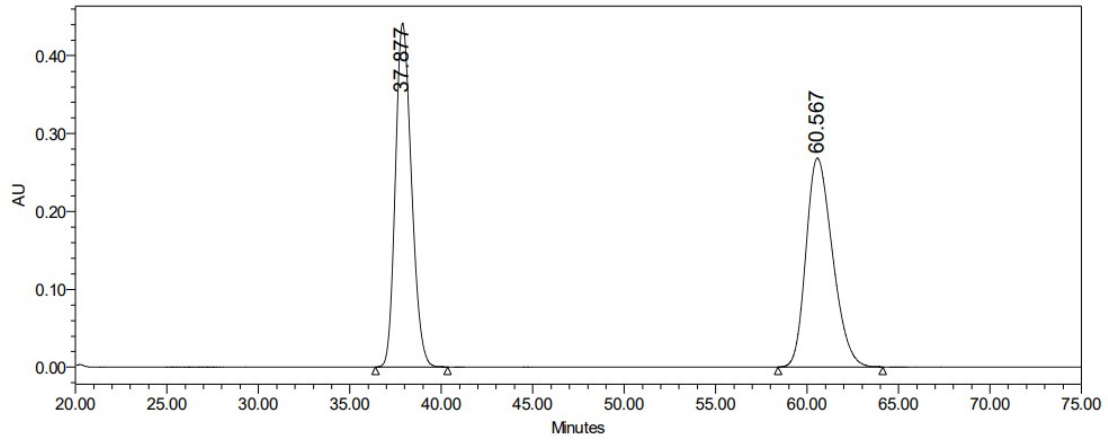


^{1}H NMR (400 MHz) in $CDCl_3$

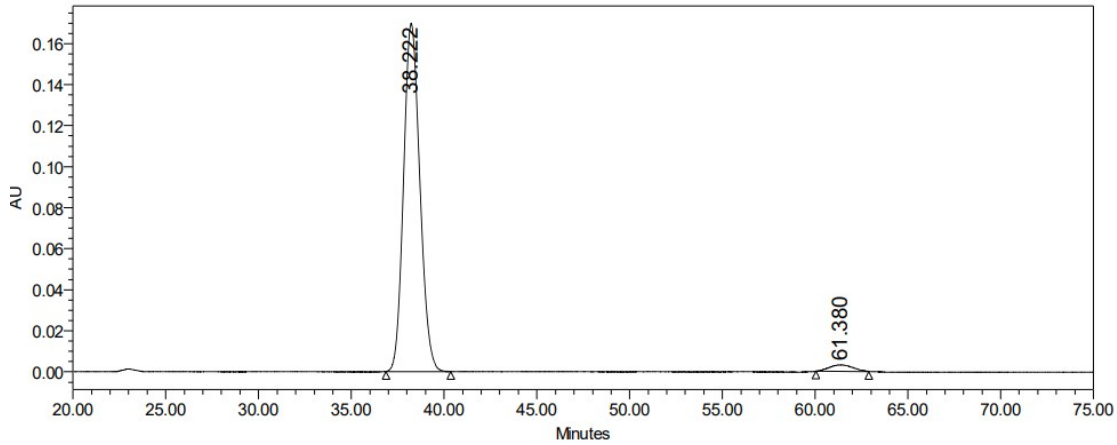


^{13}C NMR (100 MHz) in $CDCl_3$



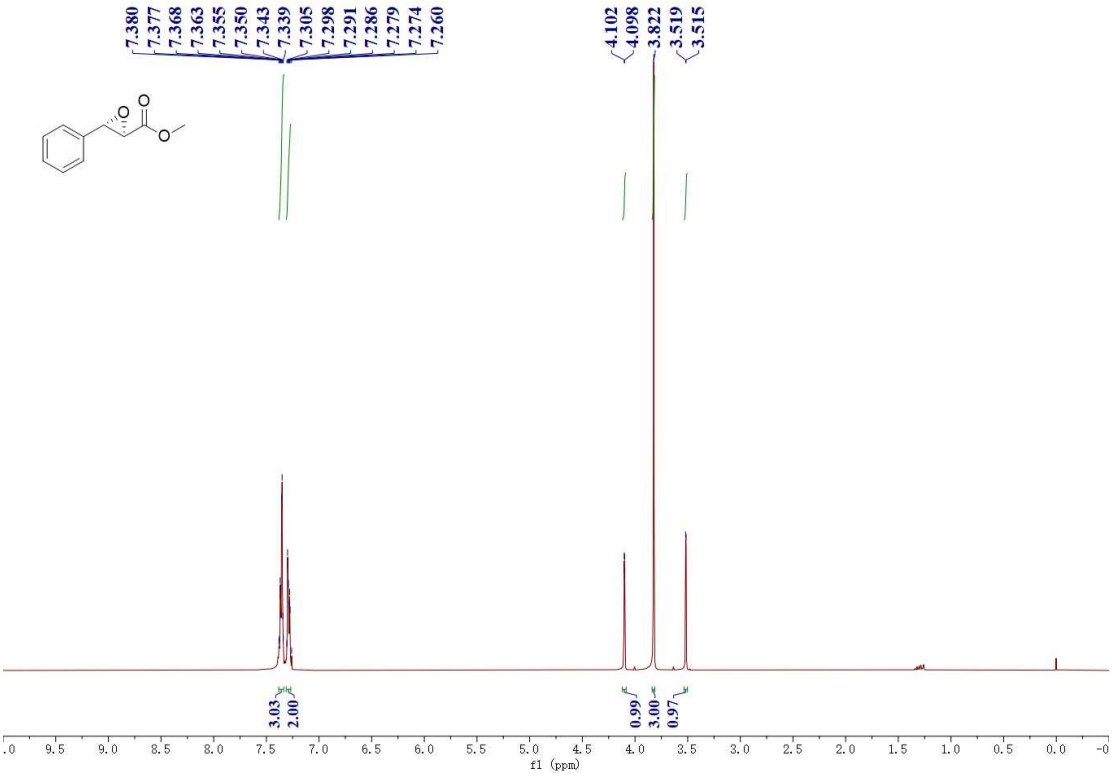


Peak#	Ret. Time	Area	Height	Area %
1	37.877	27031360	441241	49.95
2	60.567	27082481	268295	50.05

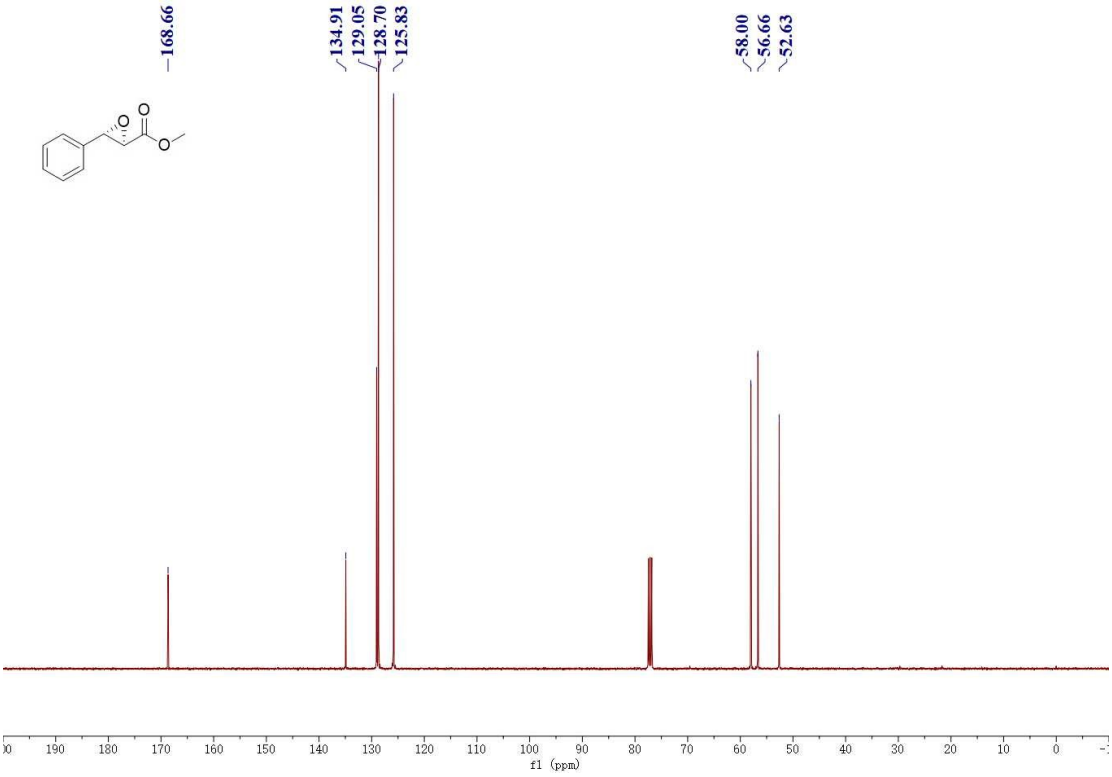


Peak#	Ret. Time	Area	Height	Area %
1	38.222	10359158	169693	97.40
2	61.380	276001	3182	2.60

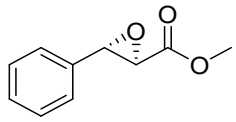
(2*R*,3*S*)-Methyl-3-phenyloxirane-2-carboxylate (5ca)

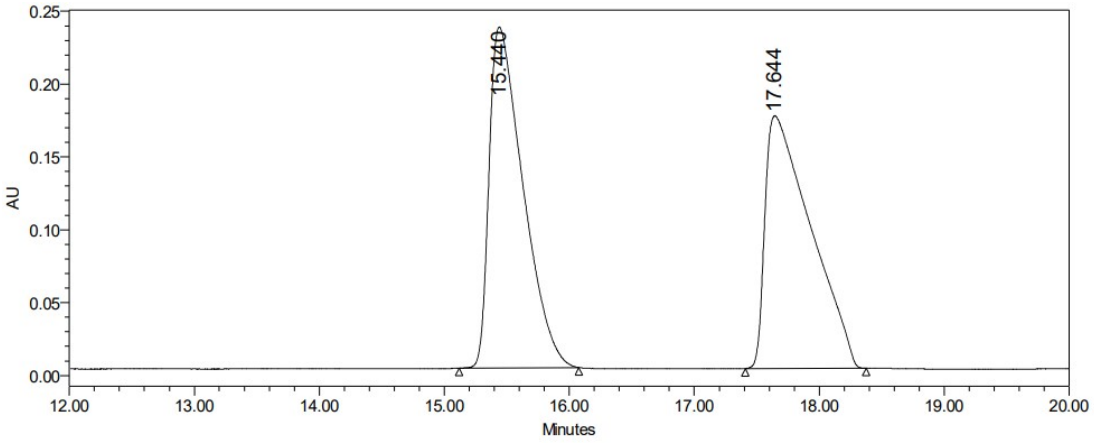


^{1}H NMR (400 MHz) in $CDCl_3$

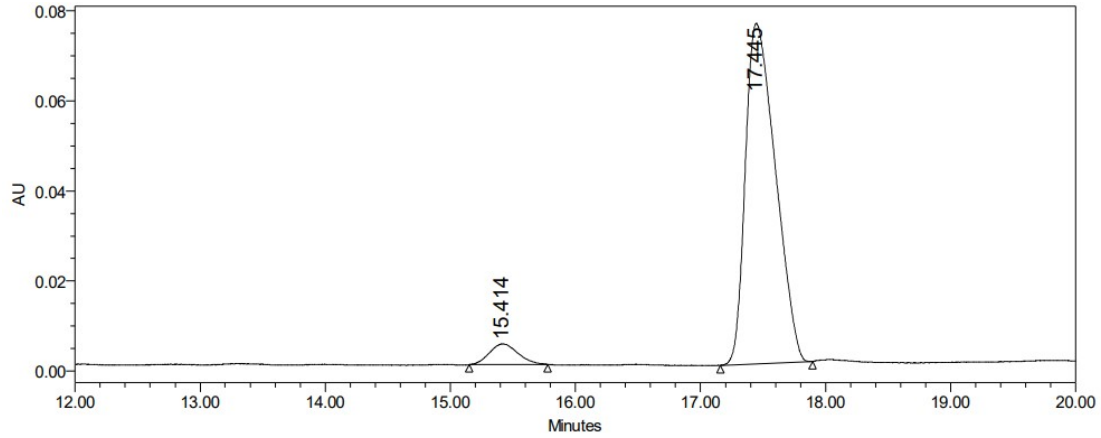


^{13}C NMR (100 MHz) in $CDCl_3$



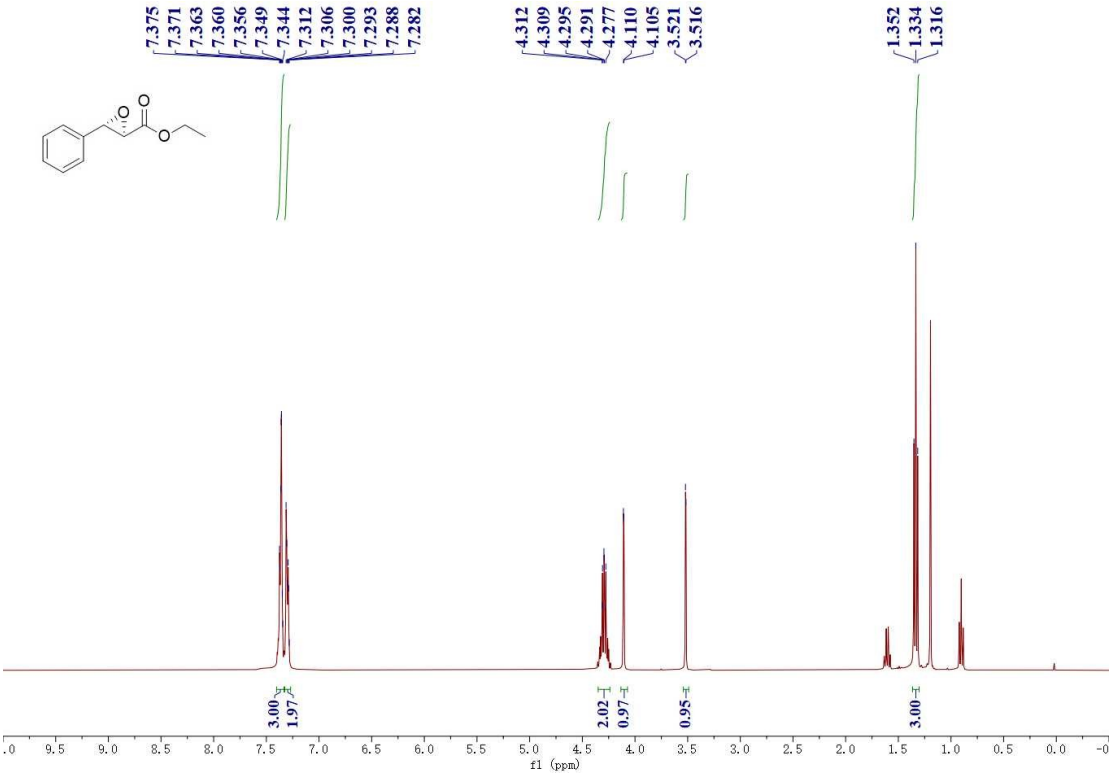


Peak#	Ret. Time	Area	Height	Area %
1	15.440	4404927	233877	49.90
2	17.644	4406656	173373	50.01

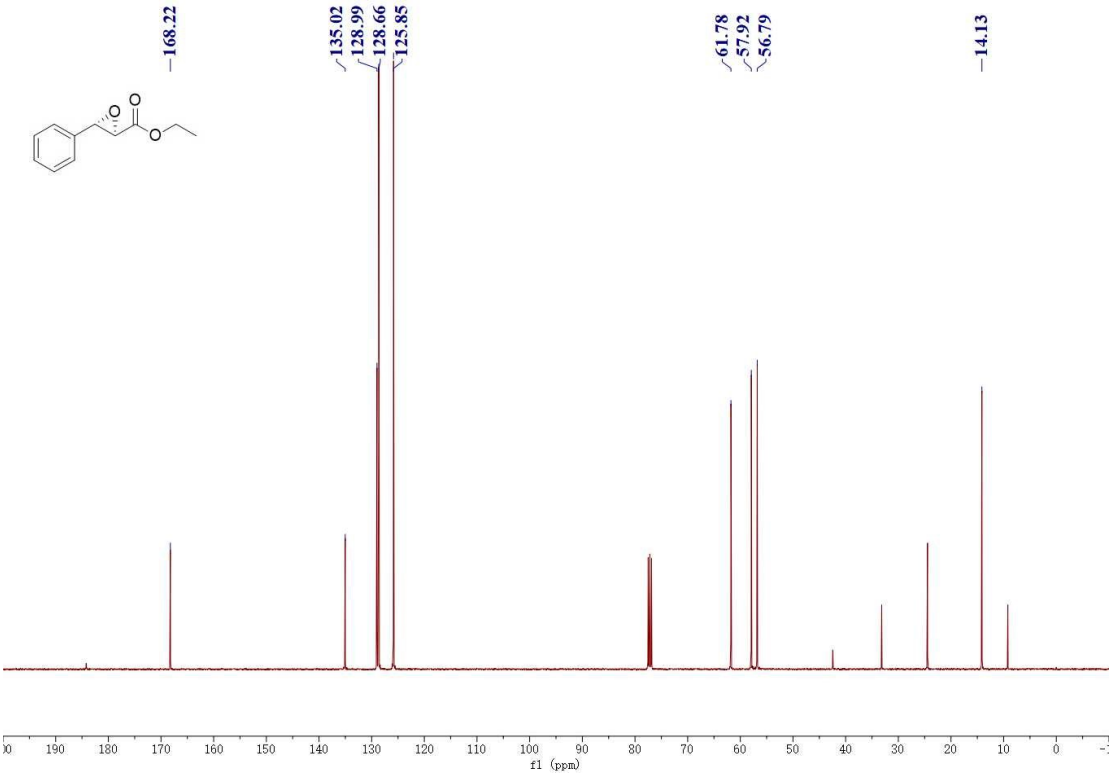


Peak#	Ret. Time	Area	Height	Area %
1	15.414	73278	4606	5.49
2	17.445	1262010	75571	94.51

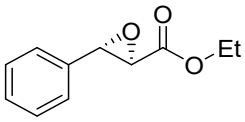
(2*R*,3*S*)-Ethyl-3-phenyloxirane-2-carboxylate (5cb)

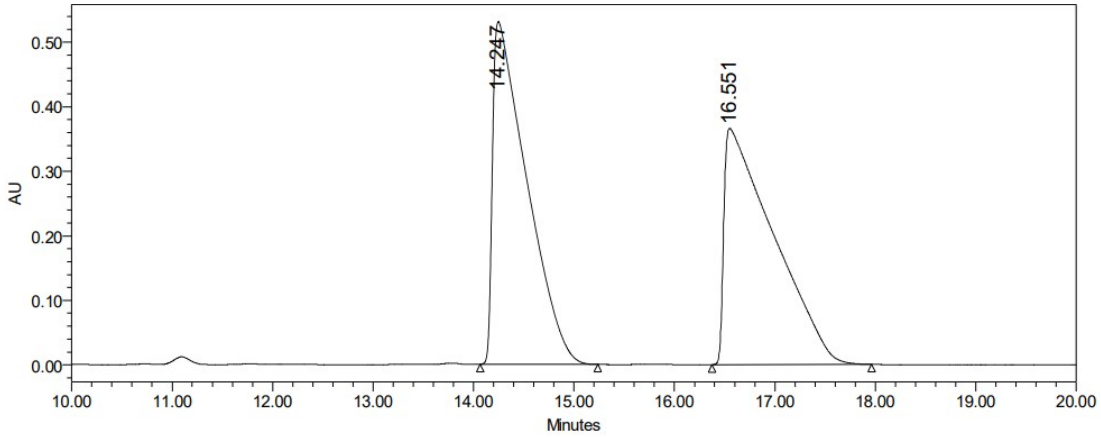


^{1}H NMR (400 MHz) in $CDCl_3$

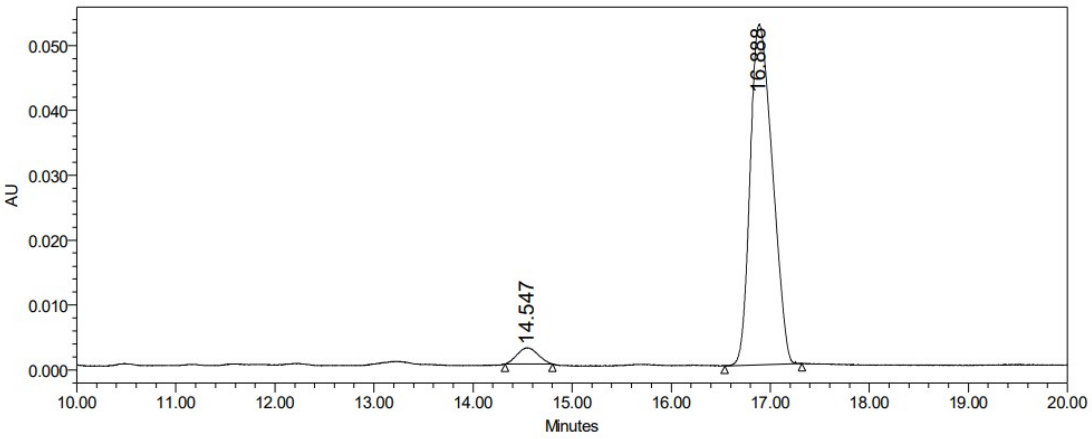


^{13}C NMR (100 MHz) in $CDCl_3$



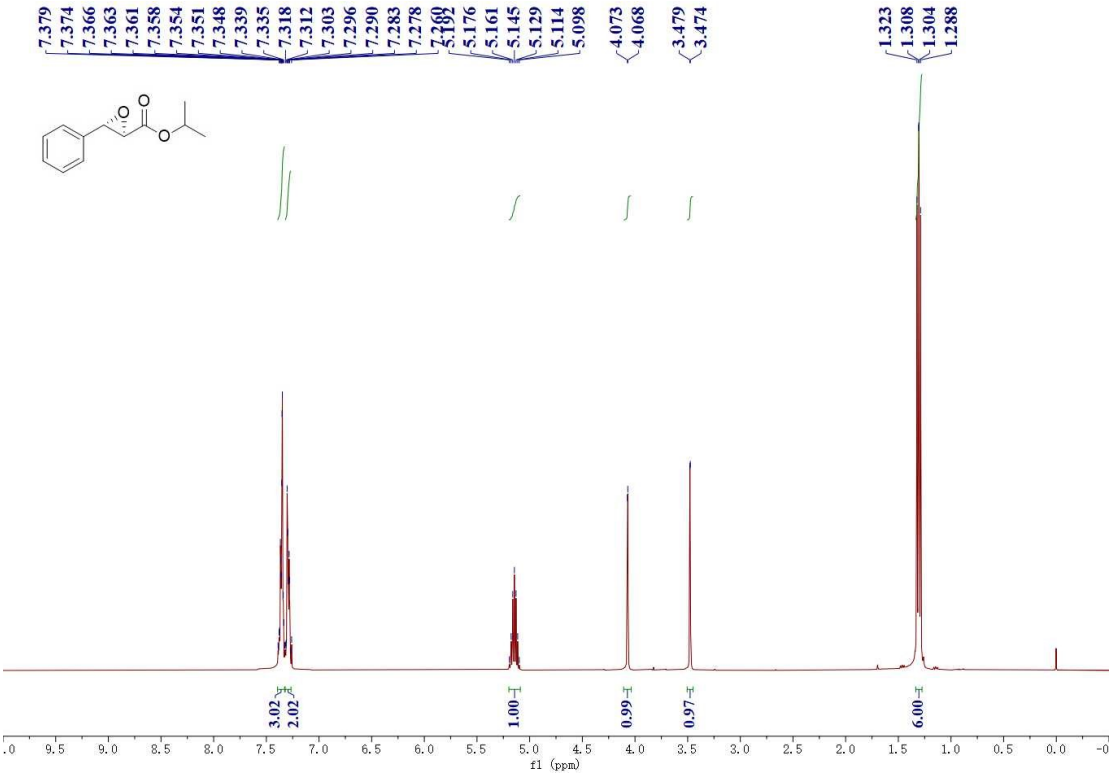


Peak#	Ret. Time	Area	Height	Area %
1	14.247	12525644	530781	49.94
2	16.551	12557618	366127	50.06

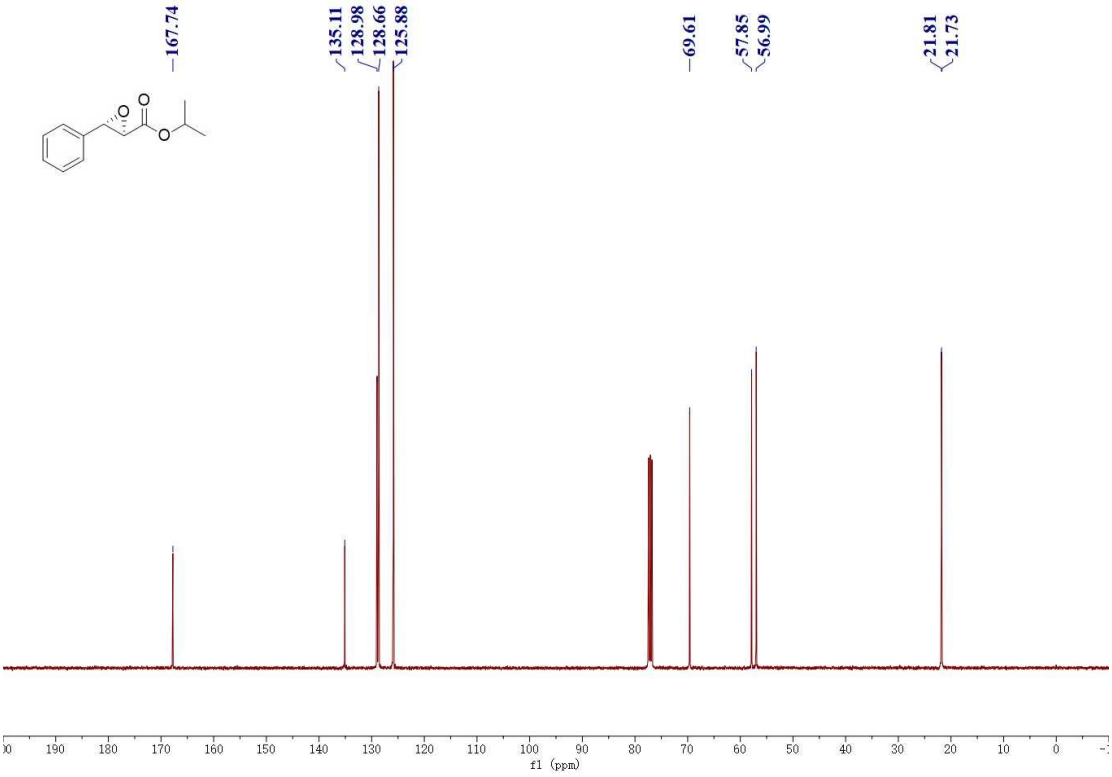


Peak#	Ret. Time	Area	Height	Area %
1	14.547	36152	2487	4.21
2	16.888	821565	52477	95.79

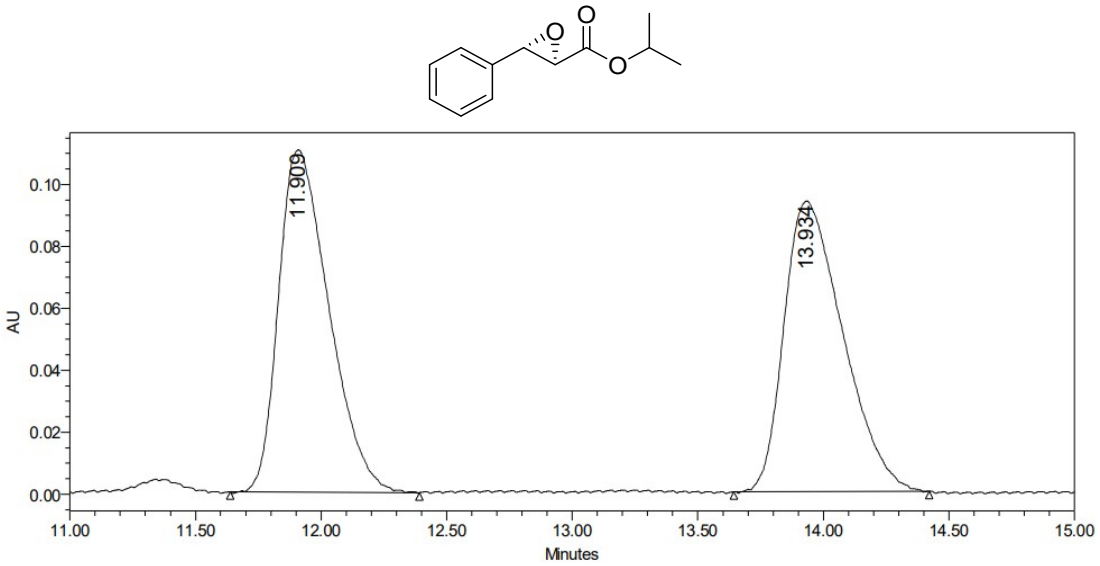
Isopropyl (2*R*,3*S*)-3-phenyloxirane-2-carboxylate (5cc)



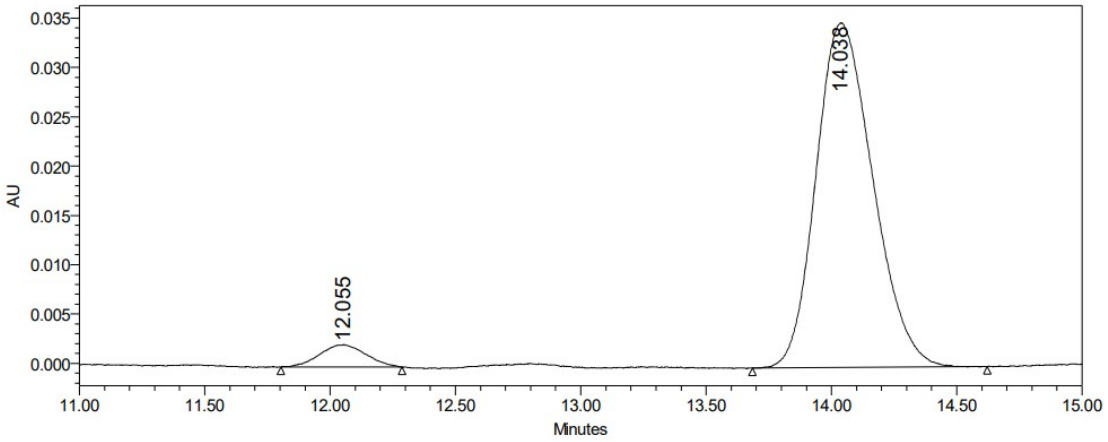
^{1}H NMR (400 MHz) in $CDCl_3$



^{13}C NMR (100 MHz) in $CDCl_3$

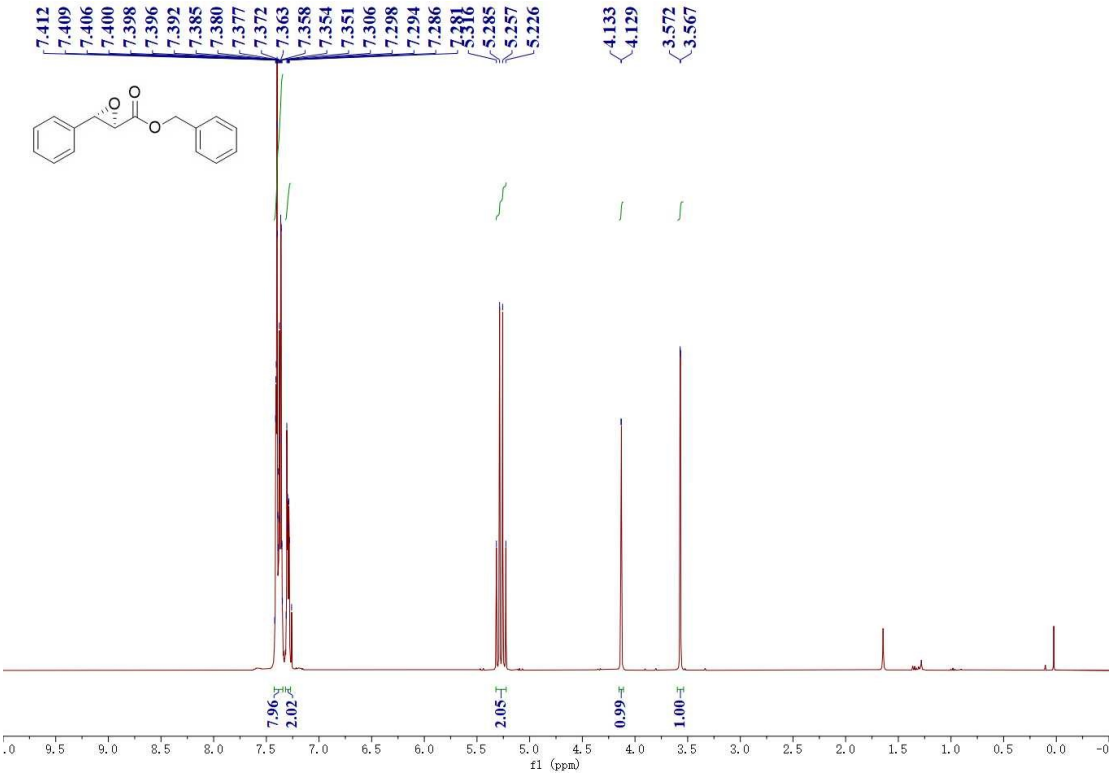


Peak#	Ret. Time	Area	Height	Area %
1	11.909	1542793	110512	50.19
2	13.934	1531341	93801	49.81

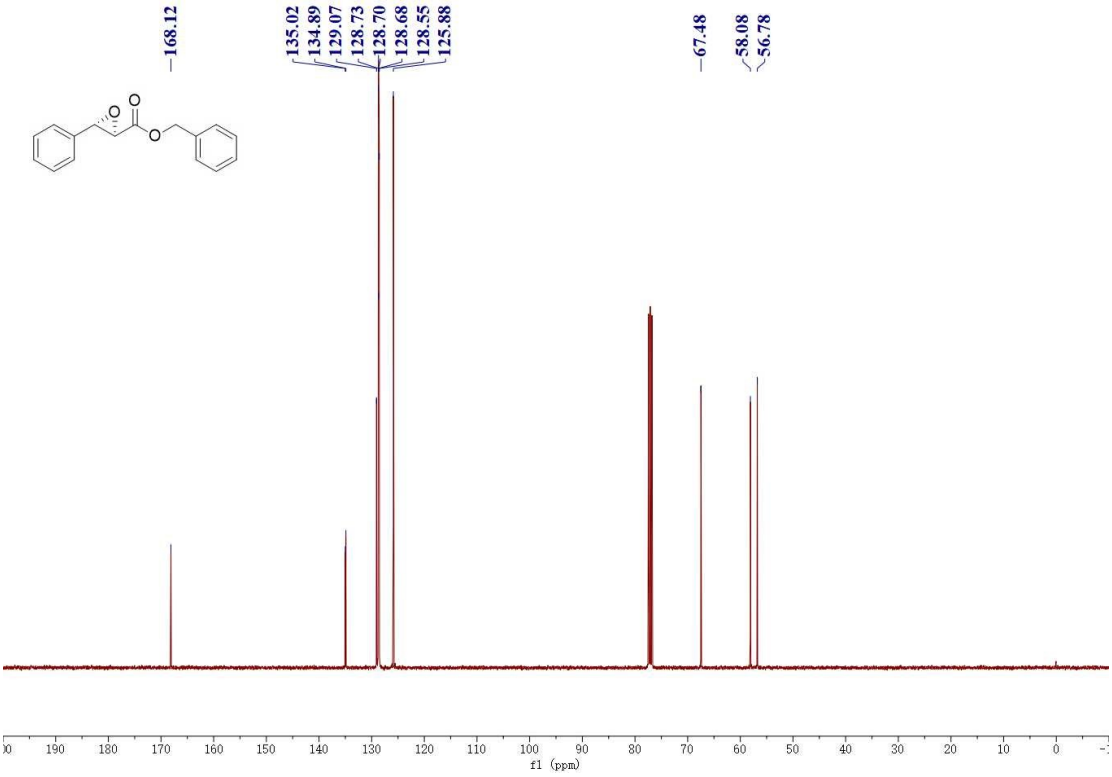


Peak#	Ret. Time	Area	Height	Area %
1	12.055	28822	2247	4.97
2	14.038	551516	34942	95.03

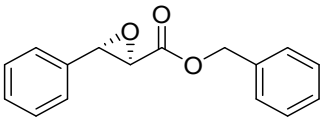
Benzyl (2*R*,3*S*)-3-phenyloxirane-2-carboxylate (5cd)

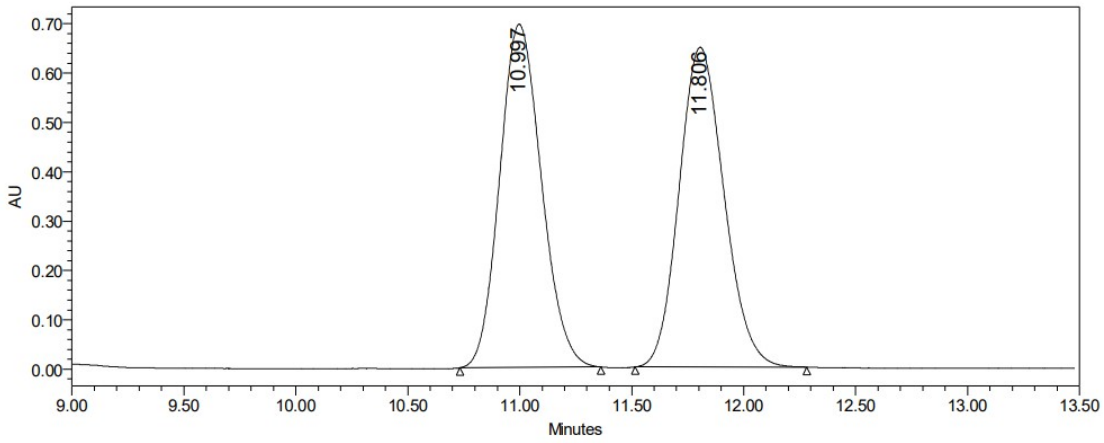


^{1}H NMR (400 MHz) in $CDCl_3$

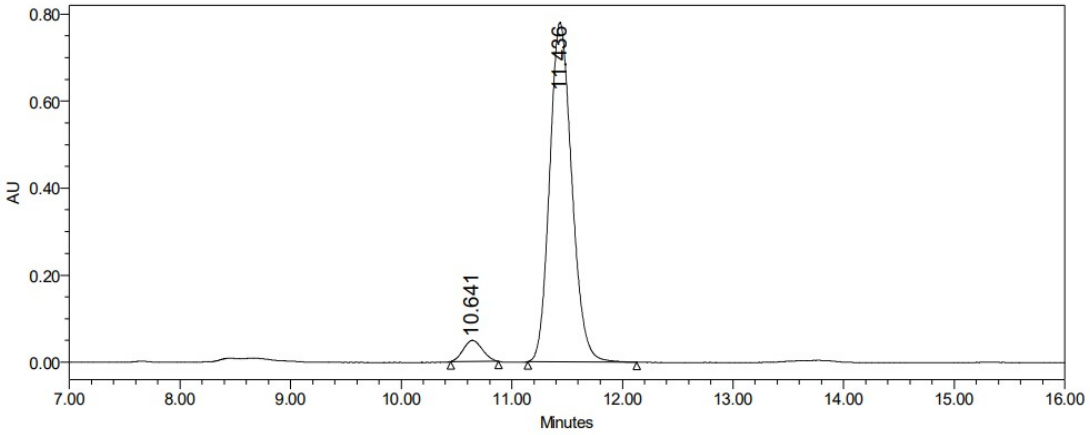


^{13}C NMR (100 MHz) in $CDCl_3$





Peak#	Ret. Time	Area	Height	Area %
1	10.997	9017255	695366	49.94
2	11.806	9037426	647792	50.06



Peak#	Ret. Time	Area	Height	Area %
1	10.641	578717	48306	5.06
2	11.436	10859766	780023	94.94

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