# Supporting Information

# Asymmetric Counter-Anion-Directed Aminomethylation: Synthesis of Chiral β-Amino Acids via Trapping of an Enol Intermediate

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## 1. General information & materials

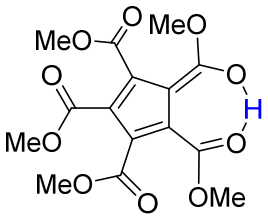
**General:** All $^{1}H$ NMR (400 MHz) and $^{13}C$ NMR (100 MHz) and $^{19}F$ NMR (376 MHz) spectra were recorded on Brucker spectrometers in $CDCl_3$. $^{1}H$ NMR and $^{13}C$ NMR spectra were recorded in $CDCl_3$ on a 400 MHz spectrometer; chemical shifts were reported in ppm with the solvent signal as reference, and coupling constants (*J*) were given in Hertz. The peak information was described as: s =singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. High-resolution mass spectrometry (HRMS) were recorded on a commercial apparatus (ESI or CI Source). Enantioselectivities were determined with HPLC using Chiralpak IA, IC, ID and AD-H columns. The racemic standards used in HPLC studies were prepared according to the general procedure using racemic BINOL-derived phosphoric acid catalyst *rac*-**PPA**.

**Materials:** Solvent $CHCl_3$ was distilled over calcium hydride. α-aminomethyl ether **3** were prepared according to the literature method.[1] Chiral BINOL-derived phosphoric acids (**5a-5f**) were prepared according to the literature procedures.[2] 4 Å molecular sieve was dried in a Muffle furnace at 250 ℃ over 5 h. All reactions were carried out under nitrogen atmosphere in a well-dried glassware.

# 2. Experimental procedures

## 2.1 Synthesis of organocatalysts 6

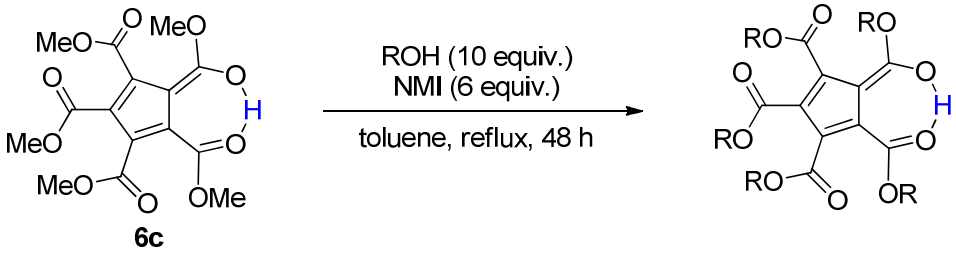
**Pentakis(methoxycarbonyl)cyclopentadiene (6c):**



**6c**

Cyclopentadiene acid **6c** was prepared according to the reported procedure to produce.[3]

**General procedure for the Synthesis of chiral PCCPs (6a, 6b, 6d, and 6e):**[4]




**6c**

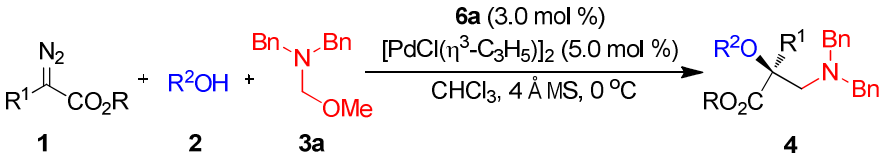
According to the reported method by Lambert, cyclopentadiene **6c** (1.0 equiv), chiral alcohol (10 equiv), and 1-methylimidazole (6.0 equiv) were dissolved in toluene. The reaction solution was refluxing for 48 h at 125 ºC, then cooled to room temperature, and concentrated *in vacuo*. The residue was purified by silica gel column chromatography (MeOH/DCM=1/50-1/20). The purified product was subsequently washed with 6 M HCl (3 x), dried with anhydrous sodium sulfate, and concentrated *in vacuo* after filtration to yield a brown solid product **6**. The characterization data of these catalysts are identical to those earlier reported.[4]

## 2.2 General procedure for optimization of conditions of three-component reaction

To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added metal catalyst (5 mol %), chiral Brønsted acid, and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, benzyl alcohol **2a** (32.4 mg, 0.3 mmol, 1.5 eq) and α-aminomethyl ether **3a** (48.2 mg, 0.2 mmol, 1.0 eq) in corresponding solvent (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (52.8 mg, 0.3 mmol, 1.5 eq) in 1.5 mL of same solvent was added to the

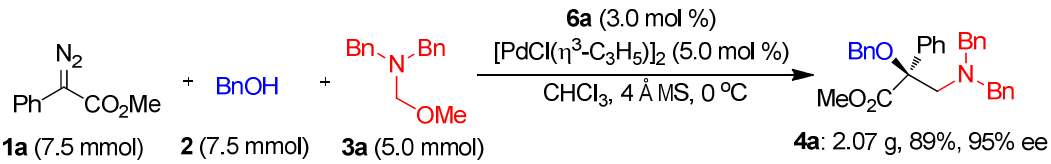
above reaction mixture for 2 h *via* a syringe pump at indicate temperature. After completion of the addition, stirring was continued at indicate temperature until the diazo compound was consumed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give the product **4a**.

## 2.3 General procedure for the enantioselective three-component reaction




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %), chiral PCCP **6a** (5.9 mg, 3.0 mol %), and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, benzyl alcohol **2** (0.3 mmol, 1.5 eq) and α-aminomethyl ether **3a** (48.2 mg, 0.2 mmol, 1.0 eq) in $CHCl_3$ (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1** (0.3 mmol, 1.5 eq) in 1.5 mL of $CHCl_3$ was added to the above reaction mixture for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound was consumed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give the products **4** in high yields.

## 2.4 Procedure for the gram scale three-component reaction

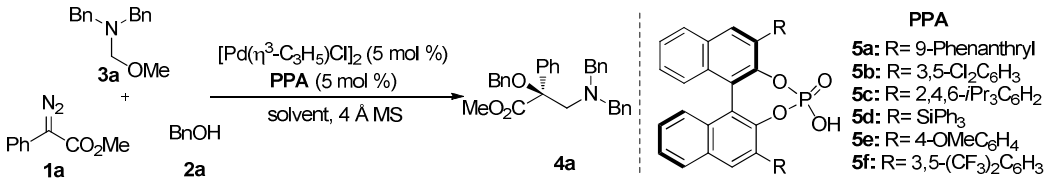



To a 25 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (90 mg, 5.0 mol %), chiral PCCP **6a** (146 mg, 3.0 mol %), and 4 Å molecular sieve (300 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen

(3 cycles). Then, benzyl alcohol **2a** (810 mg, 7.5 mmol, 1.5 eq) and α-aminomethyl ether **3a** (1.22 g, 5.0 mmol, 1.0 eq) in $CHCl_3$ (10 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (1.32 g, 7.5 mmol, 1.5 eq) in 5 mL of $CHCl_3$ was added to the above reaction mixture for 2 h via a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ for 10 h. Upon completion (monitored by TLC), the solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give 2.07 g pure product **4a** (89% yield, 95% ee).

# 3. Complete data for optimization of the reaction conditions

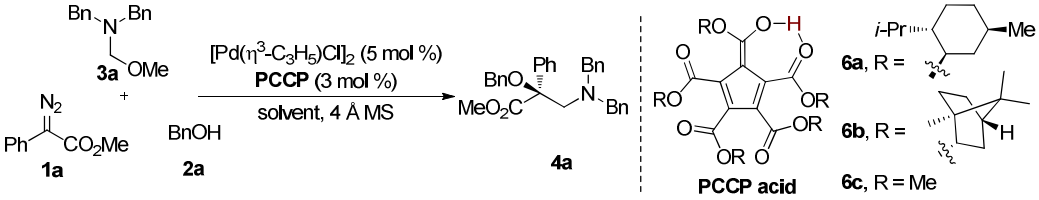
## Table S1. Preliminary Optimization of Three-component Reaction with PPA[a]




| entry | solvent | T/℃ | **PPA** | yield [b] (%) | ee [c] (%) |
|---|---|---|---|---|---|
| 1 | DCM | 25 | **5a** | 90 | 0 |
| 2 | DCM | 25 | **5b** | 87 | 5 |
| 3 | DCM | 25 | **5c** | 92 | 37 |
| 4 | DCM | 25 | **5d** | 90 | 31 |
| 5 | DCM | 25 | **5e** | 93 | 0 |
| 6 | DCM | 25 | **5f** | 87 | 12 |
| 7 | DCM | 0 | **5a** | 93 | 0 |
| 8 | DCM | 0 | **5b** | 89 | 5 |
| 9 | DCM | 0 | **5c** | 95 | 51 |
| 10 | DCM | 0 | **5d** | 92 | 27 |
| 11 | DCM | 0 | **5e** | 90 | 0 |
| 12 | DCM | 0 | **5f** | 89 | 15 |
| 13 | DCM | -20 | **5c** | 87 | 48 |
| 14 | DCM | -20 | **5d** | 89 | 27 |
| 15[d] | DCM | 0 | **5c** | 88 | 51 |
| 16[e] | DCM | 0 | **5c** | 68 | 53 |
| 17 | THF | 0 | **5c** | < 20 | - |
| 18 | toluene | 0 | **5c** | 72 | 47 |
| 19 | EA | 0 | **5c** | 50 | 60 |
| 20 | $CHCl_3$ | 0 | **5c** | 89 | 53 |

[a]Unless otherwise indicated, all reactions were conducted on a 0.2 mmol scale for **3**, **1**:**2**:**3** = 1.5:1.5:1 [b]Isolated yields. [c]Determined by HPLC analysis of the major product using a chiral stationary phase. [d]10 mol % **5c** was used. [e]20 mol % **5a** was used.

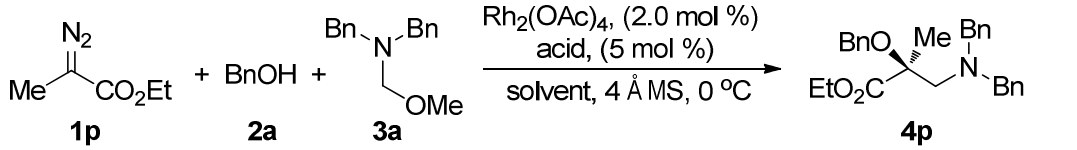
## Table S2. Optimization of Three-component Reaction with PCCP[a]



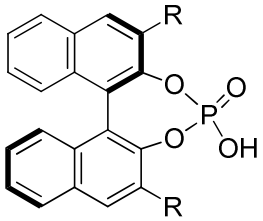

| entry | solvent | T/℃ | PCCP | yield [b] (%) | ee [c] (%) |
|---|---|---|---|---|---|
| 1 | DCM | 25 | **6c** | 92 | - |
| 2 | DCM | 25 | **6a** | 90 | 85 |
| 3 | DCM | 25 | **6b** | 89 | 80 |
| 4 | DCM | 0 | **6a** | 90 | 88 |
| 5 | DCM | 0 | **6b** | 88 | 84 |
| 6 | DCM | -20 | **6a** | 75 | 90 |
| 7 | DCM | -20 | **6b** | 75 | 86 |
| 8 | $CHCl_3$ | 0 | **6a** | 92 | 96 |
| 9 | toluene | 0 | **6a** | 78 | 88 |
| 10 | EA | 0 | **6a** | 50 | 80 |
| 11 | DCE | 0 | **6a** | 90 | 93 |
| 12 | THF | 0 | **6a** | < 20 | - |
| 13[d] | $CHCl_3$ | 0 | **6a** | 91 | 94 |
| 14[e] | $CHCl_3$ | 0 | **6a** | 75 | 93 |
| 15[f] | $CHCl_3$ | 0 | **6a** | 40 | 93 |
| 16[g] | $CHCl_3$ | 0 | **6a** | 90 | 96 |

[a]Unless otherwise indicated, all reactions were conducted on a 0.2 mmol scale for **3**, **1**:**2**:**3** = 1.5:1.5:1. [b]Isolated yield. [c]Determined by HPLC analysis of the major product using a chiral stationary phase. [d]5.0 mol % **6a** was used. [e]1.0 mol % **6a** was used. [f]0.5 mol % **6a** was used. [g]The reaction was catalyzed by $Rh_2(OAc)_4$ instead of the Pd-catalyst.

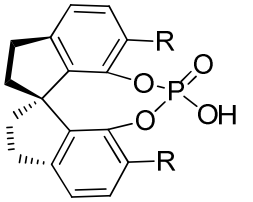
**Table S3. Condition Optimization of Three-Component Reaction with Alkyl Diazo Compound 1p[a]**



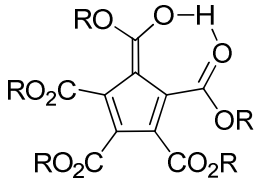

**1p** **2a** **3a** **4p**

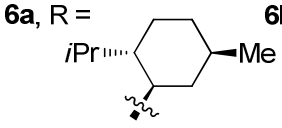


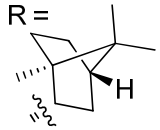
**5a:** R= 9-Phenanthryl
**5b:** R= 3,5-$Cl_2C_6H_3$
**5c:** R= 2,4,6-*i*$Pr_3C_6H_2$
**5d:** R= $SiPh_3$
**5e:** R= 4-$OMeC_6H_4$
**5f:** R= 3,5-$(CF_3)_2C_6H_3$

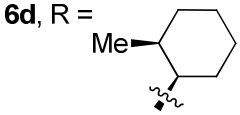


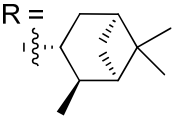
**5g:** R= 9-Phenanthryl
**5h:** R= 2,4,6-*i*$Pr_3C_6H_2$
**5i:** R= 2,4,6-$Me_3C_6H_2$
**5j:** R= $SiPh_3$
**5k:** R= 2-Naphtyl
**5l:** R= 3,5-$(CF_3)_2C_6H_3$





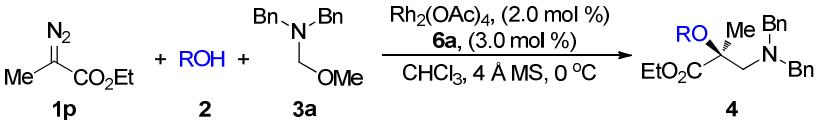




| entry | solvent | acid | yield (%)[b] | ee (%)[c] |
|---|---|---|---|---|
| 1 | $CHCl_3$ | **5a** | 86 | 0 |
| 2 | $CHCl_3$ | **5b** | 79 | 0 |
| 3 | $CHCl_3$ | **5c** | 82 | 16 |
| 4 | $CHCl_3$ | **5d** | 80 | 10 |
| 5 | $CHCl_3$ | **5e** | 74 | 0 |
| 6 | $CHCl_3$ | **5f** | 83 | 5 |
| 7 | $CHCl_3$ | **5g** | 76 | 64 |
| 8 | $CHCl_3$ | **5h** | 81 | 60 |
| 9 | $CHCl_3$ | **5i** | 85 | 43 |
| 10 | $CHCl_3$ | **5j** | 92 | 29 |
| 11 | $CHCl_3$ | **5k** | 80 | 51 |
| 12 | $CHCl_3$ | **5l** | 89 | 43 |
| 13 | $CHCl_3$ | **6a** | 85 | 80 |
| 14[d] | $CHCl_3$ | **6a** | 23 | 81 |
| 15 | $CHCl_3$ | **6b** | 81 | 76 |
| 16 | $CHCl_3$ | *ent*-**6a** | 82 | -80 |
| 17 | $CHCl_3$ | **6d** | 78 | 64 |

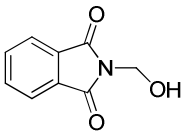
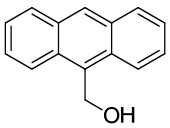
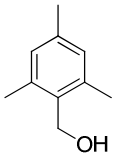
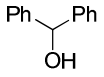
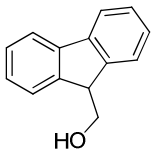
| | | | | |
|---|---|---|---|---|
| 18 | $CHCl_3$ | **6e** | 70 | 52 |
| 19 | DCM | **6a** | 88 | 63 |
| 20 | THF | **6a** | < 10 | - |
| 21 | toluene | **6a** | 42 | 47 |
| 22 | EA | **6a** | 27 | 57 |

[a]Unless otherwise indicated, all reactions were conducted in 0.2 mmol scale for **3a**, **1n**:**2a**:**3a** = 1.5:1.5:1. [b]Isolated yields. [c]Determined by HPLC analysis using a chiral stationary phase. [d]The reaction was catalyzed by$[PdCl(\eta^3\text{-}C_3H_5)]_2$ instead of $Rh_2(OAc)_4$.

**Table S4. Investigation the Reaction of Alkyl Diazo Compound 1p with a Variety of Alcohols 2.[a]**

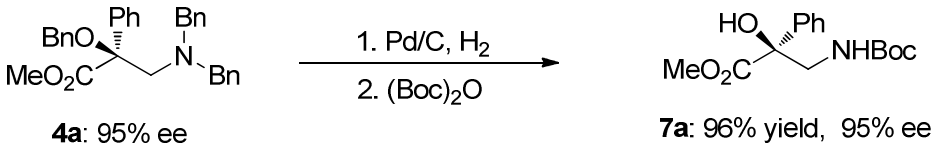



**1p** **2** **3a** **4**

| entry | ROH | yield (%)[b] | *ee* (%)[c] |
|---|---|---|---|
| 1 | EtOH | 83 | 40 |
| 2 |  | 76 | 52 |
| 3 |  | 87 | 75 |
| 4 |  | 85 | 67 |
| 5 |  | 89 | 85 |
| 6 |  | 90 | 90 |

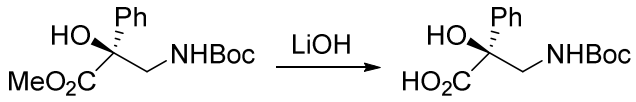
[a]Unless otherwise indicated, all reactions were conducted in 0.2 mmol scale for **3a**, **1n**:**2**:**3a** = 1.5:1.5:1. [b]Isolated yields. [c]Determined by HPLC analysis using a chiral stationary phase.

## 4. Product derivatizations



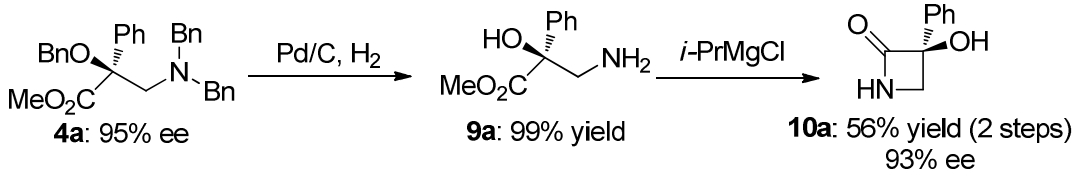

**4a**: 95% ee　　**7a**: 96% yield, 95% ee

***Synthesis of 7a*:** To a 50-mL hydrogenation reactor containing a magnetic stirring bar, **4a** (930 mg, 2.0 mmol) in 25 mL of MeOH, was added wet 10% Pd/C (200 mg, 20 %). The heterogeneous mixture was placed under 40-60 psi $H_2$ atmosphere and stirred overnight at room temperature. After the hydrogenolysis was complete, as indicated by LC-MS analysis, the reaction mixture was diluted with 25 mL of DCM. DIPEA (387 mg, 3 mmol, 1.5 eq) and $Boc_2O$ (654 mg, 2.4 mmol, 1.2 eq) were added in sequence at room temperature. The mixture was stirred at room temperature overnight and then filtered through a pad of Celite to remove Pd/C, and the solid was washed with MeOH. The combined filtrate was concentrated under vacuum, and the residue was purified by silica chromatography column (eluent: EtOAc/light petroleum ether = 1/10~1/5) to give 566 mg **7a** (96% yield and 95% ee).



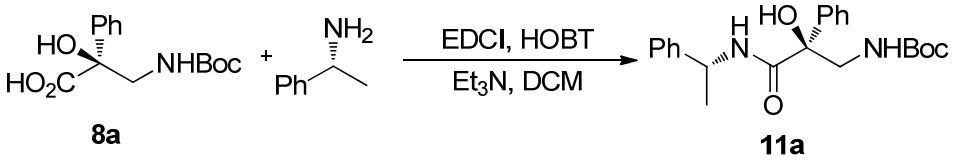

**7a**: 96% yield, 95% ee　　**8a**: 99% yield, 95% ee

***Synthesis of 8a*:** To a 50-mL oven-dried flask containing a magnetic stirring bar, *N*-Boc-α-hydroxyl-β-amino acid ester **7a** (590 mg, 2.0 mmol), THF (20 mL), $H_2O$ (10 mL), and LiOH (3.0 mmol, 1.5 eq) were added in sequence at room temperature. The reaction mixture was then stirred at room temperature for 24 hours. After completion of the reaction, as indicated by LC-MS analysis, the reaction mixture was acidified to pH = 3 with 1N HCl aqueous solution and extracted with $CH_2Cl_2$ (3 ×100 mL). The combined $CH_2Cl_2$ layers was washed with brine and dried over anhydrous $Na_2SO_4$. The solvent was evaporated under vacuum after filtration to afford 560 mg pure *N*-Boc-α-hydroxyl-β-amino acid **8a** (99% yield and 95% ee).




***Synthesis of 9a*:** To a 50-mL hydrogenation reactor containing a magnetic stirring bar, **4a** (465 mg, 1.0 mmol) in 15 mL of MeOH, was added wet 10% Pd/C (100 mg, 20 %). The heterogeneous mixture was placed under 40-60 psi $H_2$ atmosphere and stirred overnight at room temperature. After the hydrogenolysis was complete, as indicated by LC-MS analysis. The mixture was filtered through a pad of Celite to remove Pd/C, and the solid was washed with MeOH. The combined filtrate was concentrated under vacuum to give crude product α-hydroxyl-β-amino acid ester **9a**.

***Synthesis of 10a*:** To a 50-mL oven-dried flask containing a magnetic stirring bar, the above obtained **9a** (195 mg, 1.0 mmol) in anhydrous THF (5.0 mL), was added *i*PrMgCl (2.5 mL, 2.0 M in THF, 5.0 mmol) drop wisely *via* a syringe at 0 ℃. The resulting reaction mixture was stirred at room temperature overnight. Upon completion (monitored by LC-MS), the reaction was quenched with $NH_4Cl$ aq. (20 mL) and extracted with ethyl acetate (50 mL). The organic phase was washed with brine and dried over anhydrous $Na_2SO_4$. The solvent was removed in vacuo after filtration and the residue was purified by flash chromatography (eluent: EtOAc/light petroleum ether = 1/10~1/2) to give 91 mg **10a** as a white powder (56% yield over 2 steps from **4a**, 93% ee).

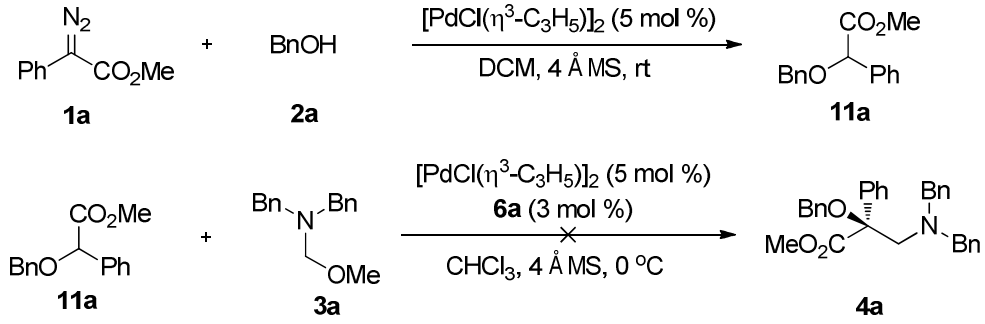



***Synthesis of 11a*:** To a 50-mL oven-dried flask containing a magnetic stirring bar, *N*-Boc-α-hydroxyl-β-amino acid **8a** (281 mg, 1.0 mmol) in DCM (15 mL), was added HOBT (200 mg, 1.5 mmol) and EDCI (290 mg, 1.5 mmol) in sequence under a nitrogen atmosphere at room temperature. The mixture was stirred for 10 minutes at room temperature and cooled down to 0 °C. (*R*)-1-phenylethylamine (0.15 mL, 1.2 mmol) and $Et_3N$ (0.6 mL) were added to the above reaction mixture in sequence. The mixture was stirred for 24 h at room temperature. After completion of the reaction, as indicated by LC-MS analysis, diluted with DCM (25 mL), washed with 1N HCl aqueous solution (4 × 20 mL) and $NaHCO_3$ saturated solution in sequence. The organic phase was

dried over anhydrous $Na_2SO_4$, the solvent was evaporated under vacuum after filtration to give crude product **11a** as a white solid (256 mg, 67% yield) with dr >19:1, which indicates that no racemization was occurred during the hydrolysis of **7a** to produce **8a** under the reaction conditions.

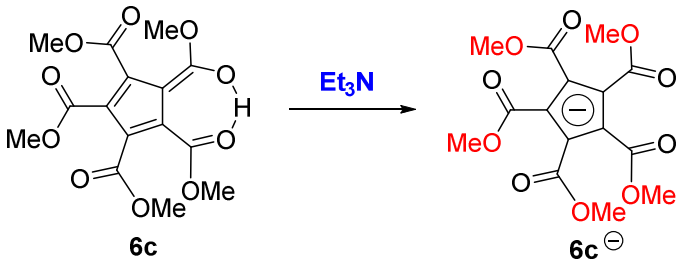
## 5. Control experiments

**Control reaction with insertion product 11a**




Control experiment with the O-H insertion product **11a** and **3a** was conducted under the standard condition, in which no three-component product was observed. These results exclude the possibility that the product is generated from the O-H insertion product **11a**.

**Proton NMR observation of the formation of V-6c$^-$**




To a NMR tube, **6c** (15 mg) in $CDCl_3$ (0.5 ml) was added, and the sample was subjected to $^1H$ NMR analysis. $Et_3N$ (10 mg) was then added to the above NMR tube, mixed uniformity, and followed by $^1H$ NMR analysis. After the addition of $Et_3N$ into **6c**, three singlet peaks were observed around 3.64 ppm, and the acidic H signal at 20.08 ppm was disappear (see Figure S1).

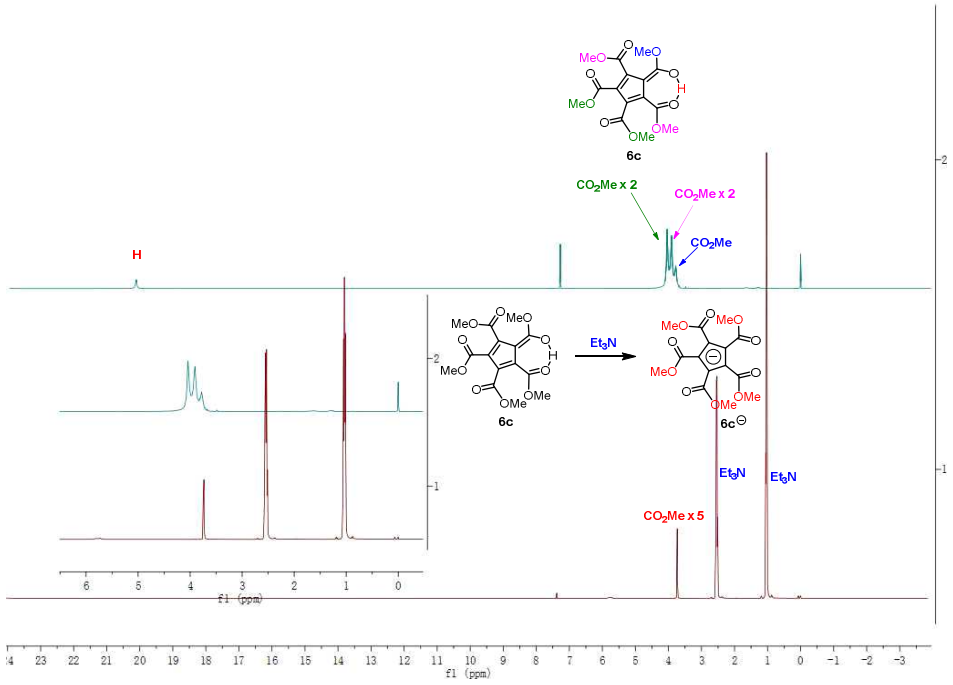
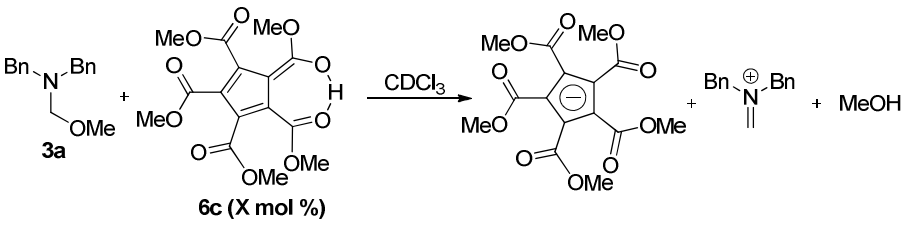



**Figure S1.** $^{1}$H NMR comparison of **6c** and its conjugate base.

**Proton NMR observation of the formation of methylene iminium ion intermediate**




To six NMR tubes, each was added **3a** (24 mg), and followed by adding variety amount of **6c:** (1.8 mg, 5 mol %), (7.5 mg, 20 mol %), (17.5 mg, 50 mol %), (28.5 mg, 80 mol %), (35.6 mg, 100 mol %), and (42.7 mg, 120 mol %) in $CDCl_3$ (0.5 ml) respectively. The above mixtures were shocking for 5 min followed by subjected to $^{1}$H NMR analysis.

With the addition of **6c** into **3a**, **6c** was convert into its conjugate base and MeOH was formed at same time, which indicates that the ion pair was generated from **3a** *via* desorption of MeOH (see Figure S2 for details). Furthermore, the methylene iminium ion intermediate was also detected by HR-MS of the mixture of **3a** and **6c** (see Figure S3).

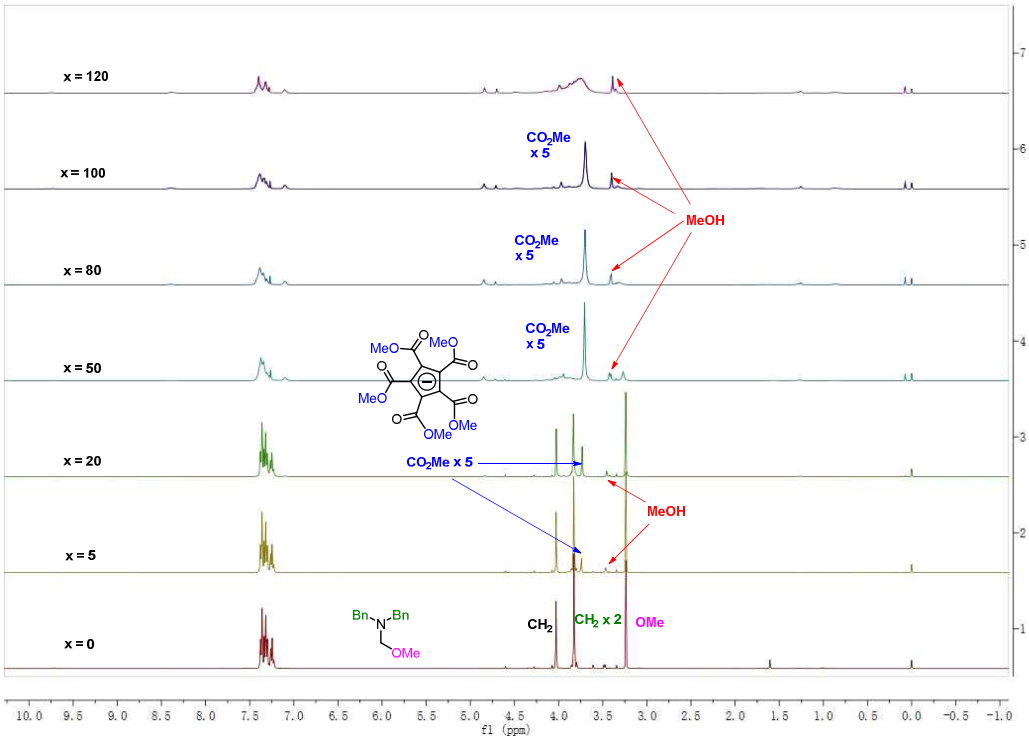
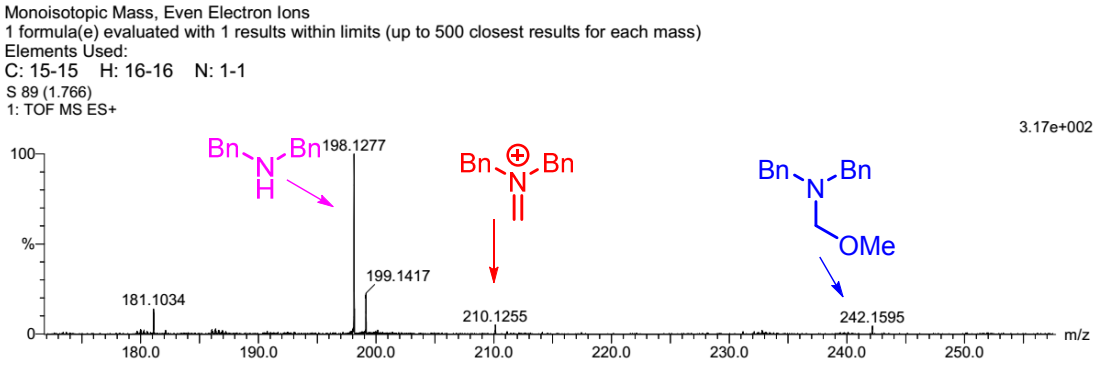


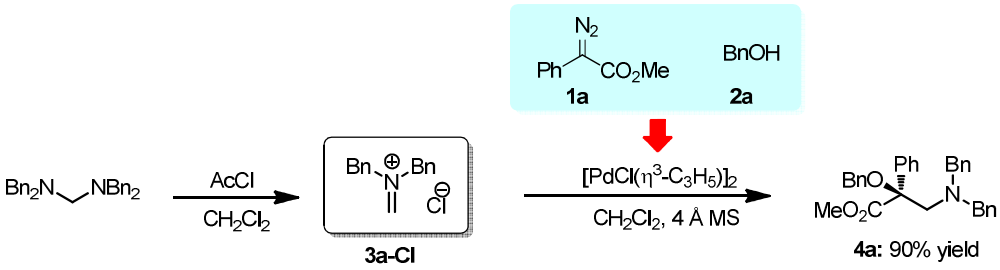

**Figure S2.** $^{1}$H NMR monitoring of the reaction mixture of **3a** with different amount of **6c**.




| | | | | | |
|---|---|---|---|---|---|
| Minimum: | | | | -1.5 | |
| Maximum: | | 500.0 | 1000.0 | 500.0 | |
| Mass | Calc. Mass | mDa | PPM | DBE | Formula |
| 210.1277 | 210.1283 | -0.6 | -2.9 | 8.5 | C15 H16 N |

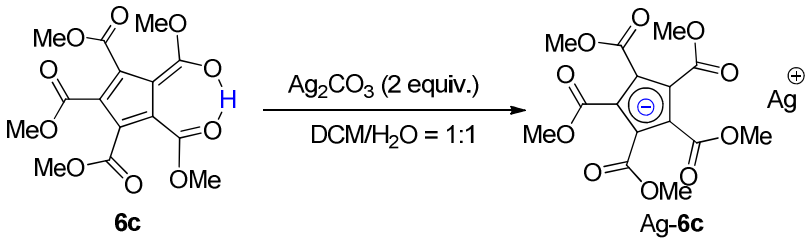
**Figure S3.** HR-MS spectrum for the reaction mixture of **3a** with **6c**.

## Control reaction with iminium ion intermediate 3a-Cl



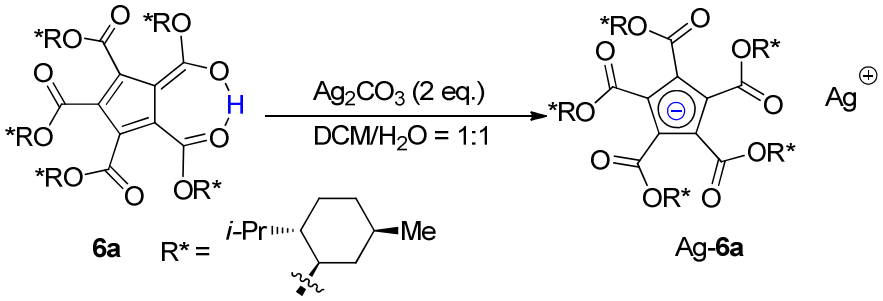

To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, *N, N, N', N'*-tetrabenzylmethanediamine (81 mg, 0.2 mmol), 4 Å molecular sieve (100 mg) in $CH_2Cl_2$ (2.0 mL), was added acetyl chloride (16 mg, 0.2 mmol) slowly at 0 °C. After stirring at room temperature for 1 h, $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %) in $CH_2Cl_2$ (0.5 mL) was added to the above reaction tube *via* syringe. Then, the solution of the diazo compound **1a** (53 mg, 0.3 mmol, 1.5 eq) and benzyl alcohol **2a** (32 mg, 0.3 mmol, 1.5 eq) in $CH_2Cl_2$ (1.0 mL) was added to the reaction mixture for 1 h *via* a syringe pump at room temperature. After completion of the addition, stirring was continued at room temperature until the diazo compound decomposed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give 83 mg products **4a** (90% yield).

## Chiral anion metathesis reaction



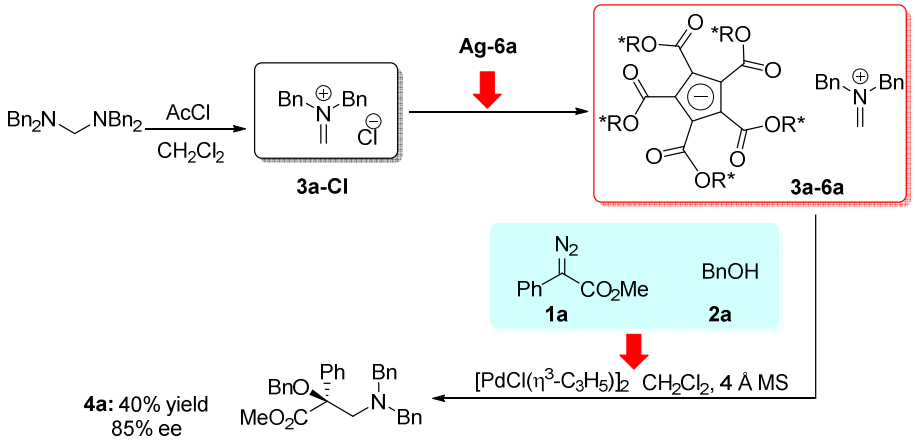

***Synthesis of Ag-6c:*** To a 25 mL oven-dried flask containing a magnetic stirring bar, PCCP (**6c**) (178 mg, 0.5 mmol, 1.0 eq.) in 20 mL mixed solvent ($CH_2Cl_2/H_2O$ = 1:1) in dark, was added $Ag_2CO_3$ (276 mg, 2.0 eq.) in one portion under vigorous stirring at room temperature, and the reaction mixture was stirred overnight under these conditions. The reaction mixture was filtered and the filtrate was diluted with $CH_2Cl_2/H_2O$ (20 mL). The aqueous layer was separated, and

washed with $CH_2Cl_2$. The aqueous layer concentrated under reduced pressure to give 180 mg desired silver salt Ag-**6c** as a gray solid. $^1$H NMR (400 MHz, $CD_3OD$) 3.75 (s, 15H). $^{13}$C NMR (100 MHz, $CD_3OD$) δ 169.7, 118.2, 52.1. Single crystal X-ray diffraction data for Ag-**6c** was attached below.




***Synthesis of Ag-6a:*** To a 25 mL oven-dried flask containing a magnetic stirring bar, PCCP (**6a**) (200 mg, 0.2 mmol, 1.0 eq.) in 20 mL solution ($CH_2Cl_2/H_2O$ = 1:1) in dark, was added $Ag_2CO_3$ (113 mg, 2.0 eq.) in one portion under vigorous stirring at room temperature, and the reaction mixture was stirred overnight under these conditions. The reaction mixture was filtered and the filtrate was diluted with $CH_2Cl_2/H_2O$ (20 mL). The organic layer was separated, and washed with $H_2O$. The aqueous layer concentrated under reduced pressure to give 156 mg desired silver salt Ag-**6a** as a black solid. $^1$H NMR (400 MHz, $CDCl_3$) δ 4.89 – 4.62 (m, 5H), 2.14 – 0.71 (m, 90H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 169.4, 116. 8, 74.7, 46.7, 40.0, 34.3, 31.6, 25.2, 23.1, 22.2, 21.2, 16.5.

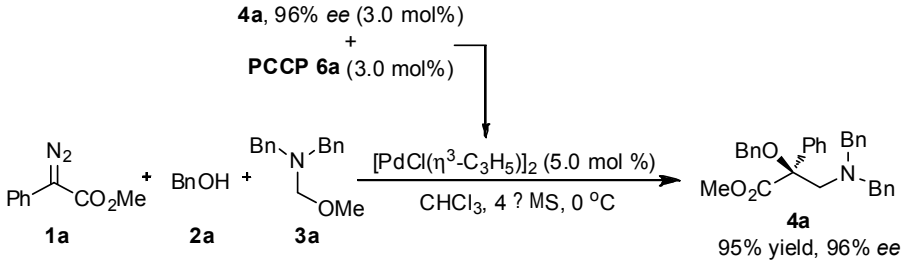
## Control reaction with iminium ion intermediate 3a-6a




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, *N, N, N', N'*-tetrabenzylmethanediamine (81 mg, 0.2 mmol), 4 Å molecular sieve (100 mg) in $CH_2Cl_2$ (2.0

mL), was added acetyl chloride (16 mg, 0.2 mmol) slowly at 0 °C. After stirring at room temperature for 1 h, the solution of Ag-**6a** (264 mg, 0.24 mmol, 1.2 eq) in $CH_2Cl_2$ (0.5 mL) was added to the reaction mixture and stirred for 4 h at room temperature in dark. Then $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %) in $CH_2Cl_2$ (0.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (53 mg, 0.3 mmol, 1.5 eq) and benzyl alcohol **2a** (32 mg, 0.3 mmol, 1.5 eq) in $CH_2Cl_2$ (1.0 mL) was added to the reaction mixture for 1 h *via* a syringe pump at room temperature. After completion of the addition, stirring was continued at room temperature until the diazo compound decomposed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give 37 mg products **4a** in 40% yield with 85% *ee*.

## Control reaction with a combination of 4a (96% ee) and PCCP 6a as co-catalyst




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %) and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). The premixed complex (see Figure S4): **4a** (2.8 mg, 3.0 mol %, 96% *ee*) and chiral PCCP **6a** (5.9 mg, 3.0 mol %) in $CHCl_3$ (1.0 ml) was added and the mixture was stirred for 10 min. Then, benzyl alcohol **2a** (32 mg, 0.3 mmol) and α-aminomethyl ether **3a** (48.8 mg, 0.2 mmol) in $CHCl_3$ (1.0 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (52.5 mg, 0.3 mmol) in 1.5 mL of $CHCl_3$ was added to the suspension for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound decomposed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give 88 mg pure product 4a in 95% yield with 96% *ee*.

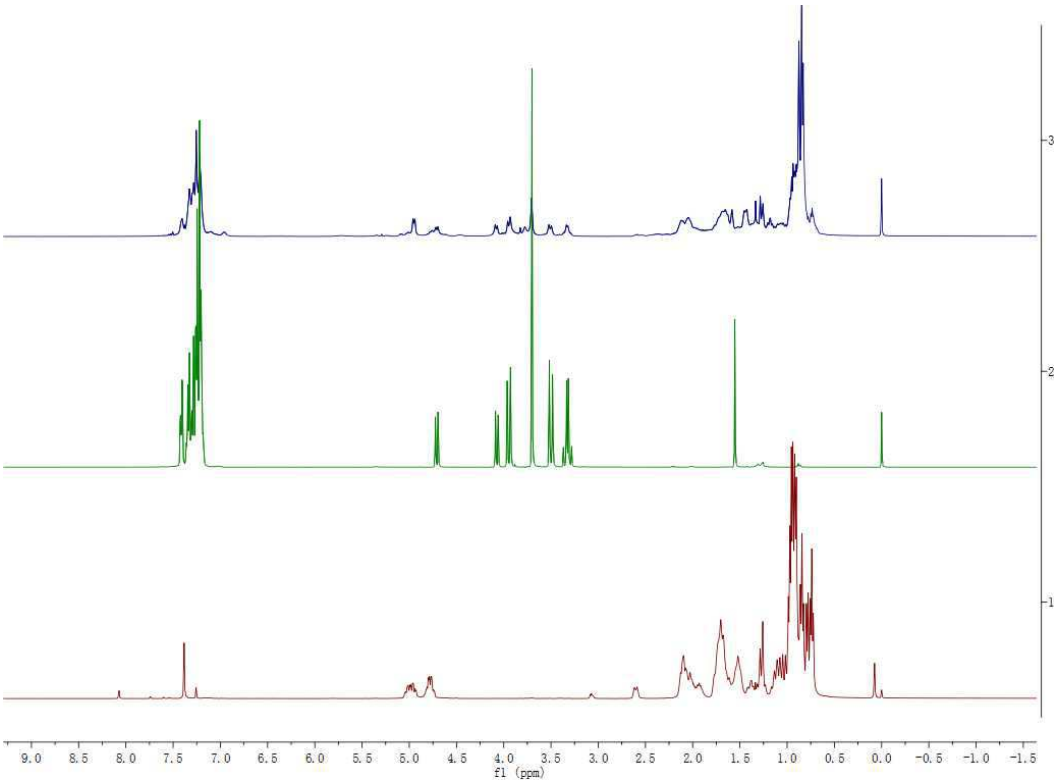
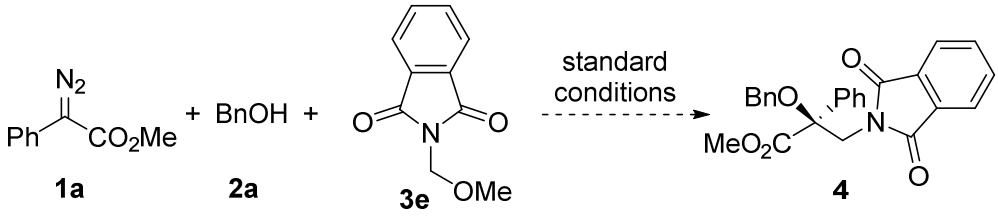



**Figure S4.** Proton NMR of a combination of chiral **4a** (96% *ee*) with **PCCP 6a**.

**Reaction with phthalimide substituted methyl amino 3e**




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %), chiral PCCP **6a** (5.9 mg, 3.0 mol %), and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, benzyl alcohol **2a** (32.4 mg, 0.3 mmol) and α-aminomethyl ether **3e** (38.2 mg, 0.2 mmol) in $CHCl_3$ (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (52.8 mg, 0.3 mmol) in 1.5 mL of $CHCl_3$ was added to the suspension for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound decomposed completely. The solvent was evaporated under vacuum after filtering through Celite and the residue was recorded with $^1H$ NMR spectra in $CDCl_3$ (see

Figure S5). Most of the material **3e** remained intact according to these spectra.

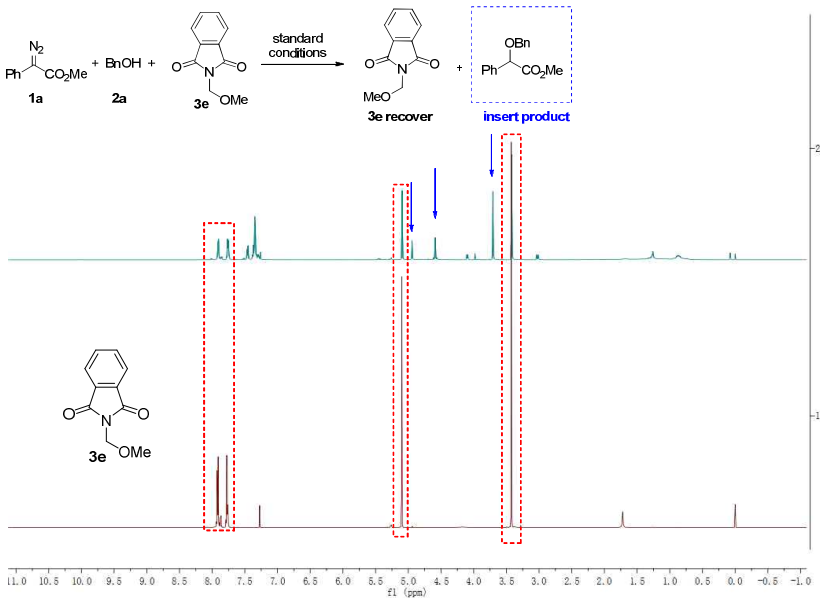
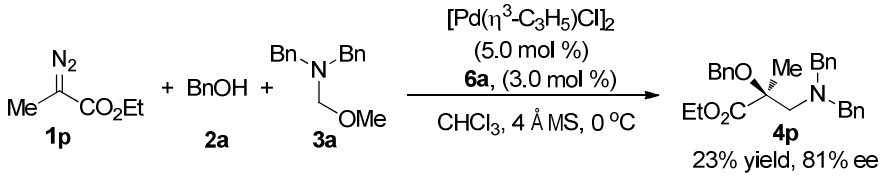



**Figure S5.** Proton NMR of crude reaction mixture of **1a**, **2a**, and **3e** under the standard conditions.

## Pd-Catalyzed reaction of α-alkyl diazoacetate 1p




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$, chiral PCCP **6a** (5.9 mg, 3.0 mol %), and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, benzyl alcohol **2a** (32.4 mg, 0.3 mmol) and α-aminomethyl ether **3a** (48.8 mg, 0.2 mmol) in $CHCl_3$ (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1p** (38.4 mg, 0.3 mmol) in 1.5 mL of $CHCl_3$ was added to the suspension for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound decomposed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was recorded with $^1H$ NMR spectra in $CDCl_3$ (see Figure S6) and purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give **4p** in 23% yield with 81% ee (combined with oxidation product and β-*H* shift product).

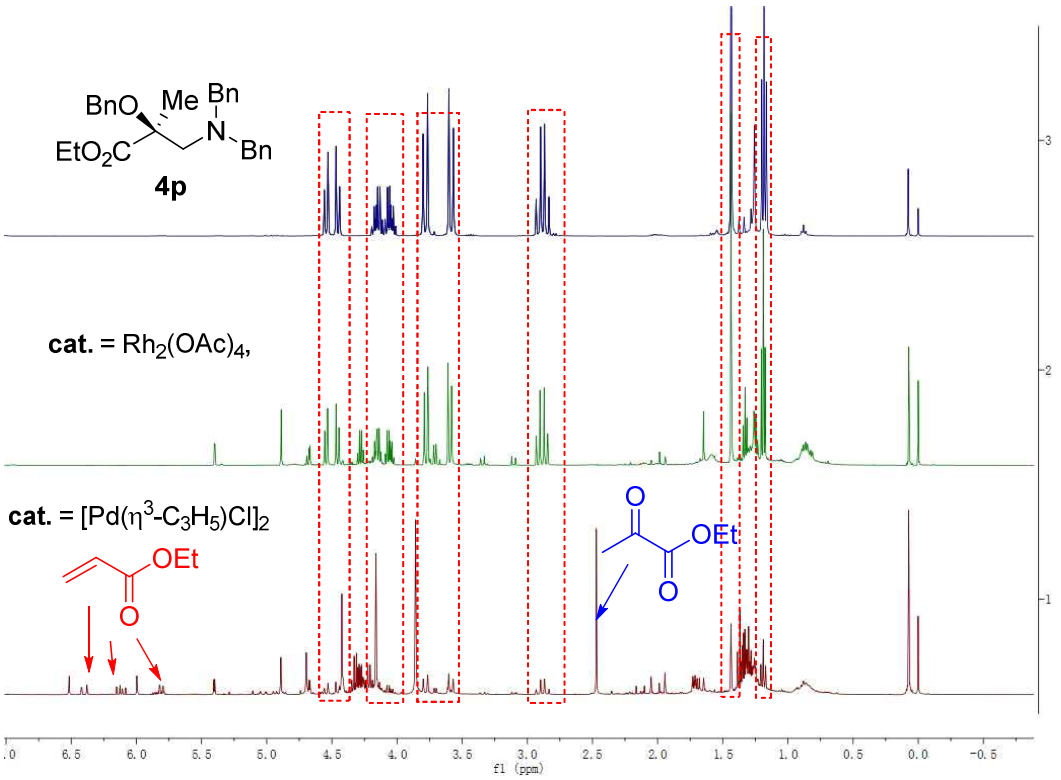
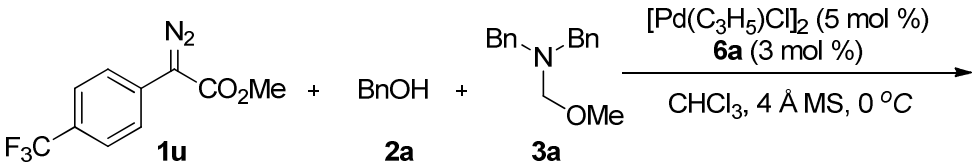



**Figure S6.** Proton NMR of the crude reaction mixture of **1p** with **2a** and **3a** in the presence of Pd-catalyst.

## Catalytic reaction of α-aryl diazoacetate 1u




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %), chiral PCCP **6a** (5.9 mg, 3.0 mol %), and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, benzyl alcohol **2a** (32.4 mg, 0.3 mmol) and α-aminomethyl ether **3a** (48.8 mg, 0.2 mmol) in $CHCl_3$ (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1u** (0.3 mmol, 73.2 mg) in 1.5 mL of $CHCl_3$ was added to the suspension for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound decomposed completely. The solvent was evaporated under vacuum

after filtering through Celite and the residue was recorded with $^1$H NMR spectra in $CDCl_3$. (see Figure S7). Only O-H insertion product of **1u** with **2a** was observed according to these spectra.

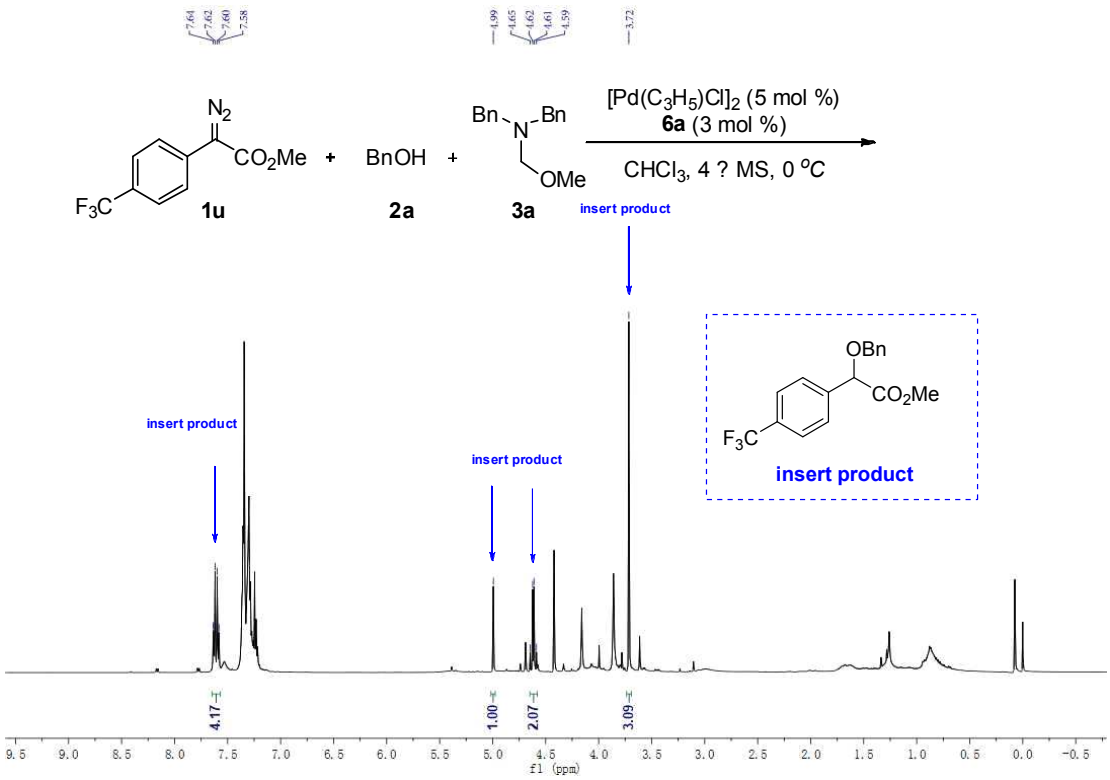
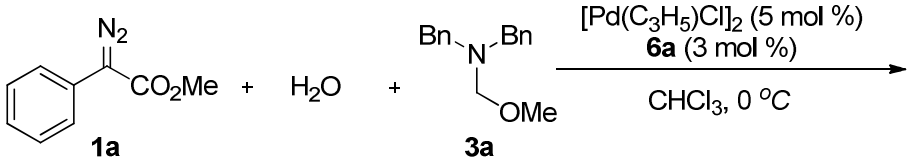



**Figure S7.** Proton NMR of crude reaction mixture of **1u**, **2a**, and **3a** under the standard conditions.

## Control experiment of model reaction with water instead of alcohol




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %) and chiral PCCP **6a** (5.9 mg, 3.0 mol %). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, $H_2O$ (5.4 mg, 0.3 mmol) and α-aminomethyl ether **3a** (48.8 mg, 0.2 mmol) in $CHCl_3$ (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (52.8 mg, 0.3 mmol) in 1.5 mL of $CHCl_3$ was added to the suspension for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound decomposed completely.

The solvent was evaporated under vacuum after filtering through Celite and the residue was recorded with $^1$H NMR spectra in $CDCl_3$ (see Figure S8). And only oxidation product and O-H insertion product were observed according to these spectra.

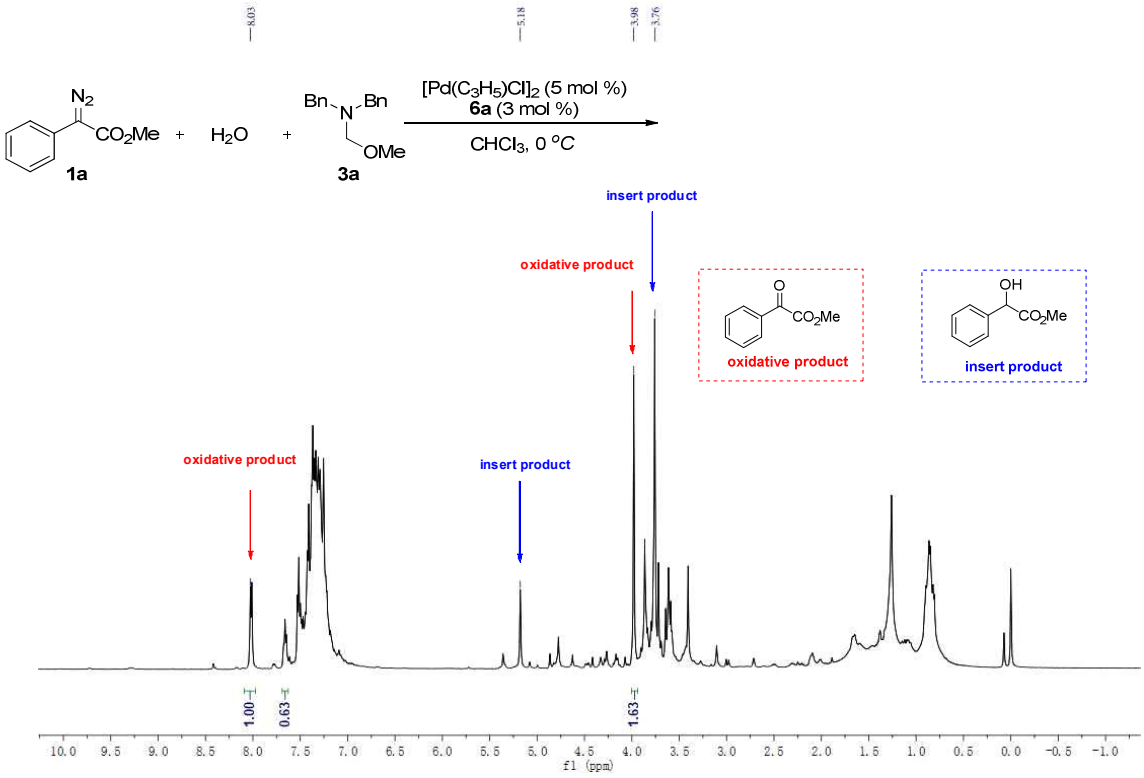
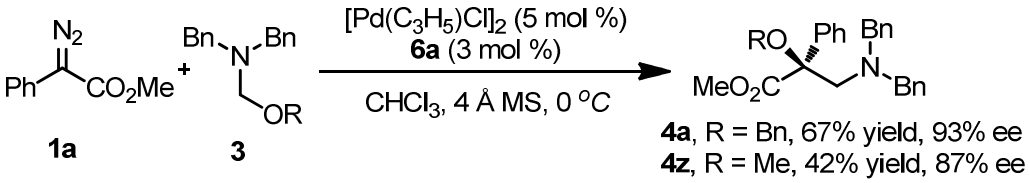



**Figure S8.** Proton NMR of crude reaction mixture of **1a**, $H_2O$, and **3a** under the standard conditions.

## Control experiment in the absence of alcohol under standard conditions




To a 10 mL oven-dried Schlenk reaction tube equipped with a magnetic stir bar, was added $[PdCl(\eta^3\text{-}C_3H_5)]_2$ (3.7 mg, 5.0 mol %), chiral PCCP **6a** (5.9 mg, 3.0 mol %), and 4 Å molecular sieve (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Then, α-aminomethyl ether **3** (0.2 mmol, 1.0 eq) in $CHCl_3$ (1.5 mL) was added to the above reaction tube *via* syringe. The solution of the diazo compound **1a** (52.8 mg, 0.3 mmol) in

1.5 mL of $CHCl_3$ was added to the suspension for 2 h *via* a syringe pump at 0 ℃. After completion of the addition, stirring was continued at 0 ℃ until the diazo compound decomposed completely. The solvent was evaporated under vacuum after filtering through Celite. The residue was purified by column chromatography on silica gel (eluent: EtOAc/light petroleum ether = 1/100~1/10) to give the corresponding products **4a** or **4z** in moderate to high yields with high enantioselectivity. For the proton NMR of crude reaction mixture of **1a** and **3a** in the absence of alcohol **2a** under the standard conditions, see Figure S9.

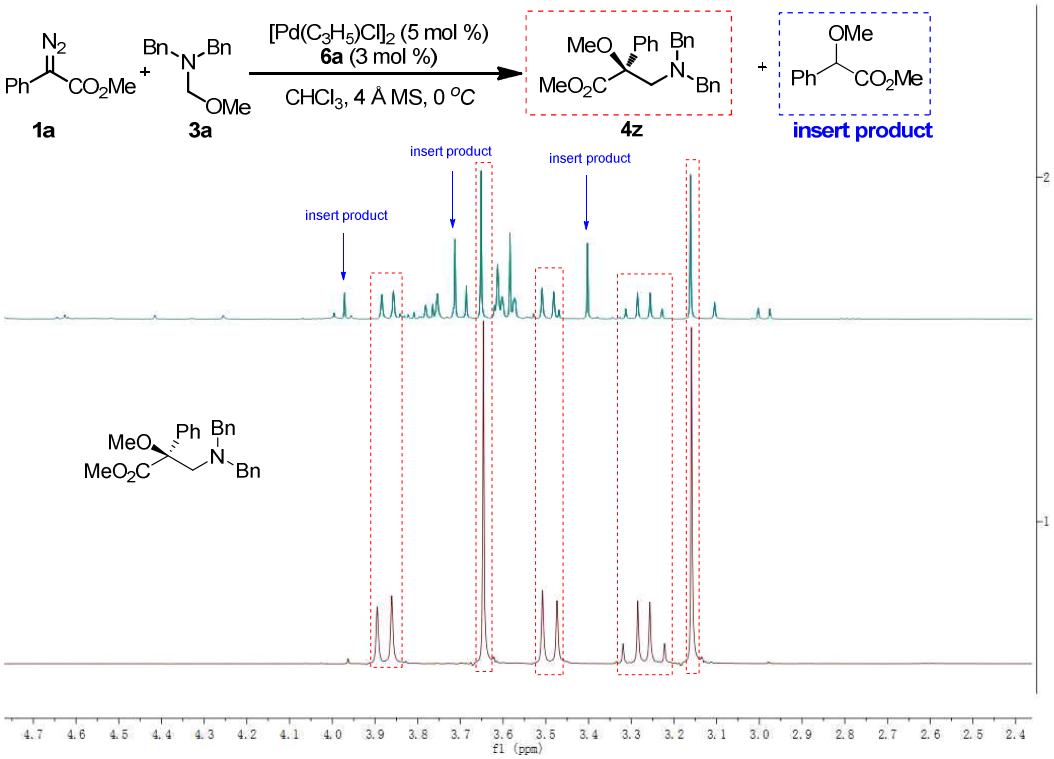



**Figure S9.** Proton NMR of crude reaction mixture of model reaction in the absence of alcohol under the standard conditions.

## 6. Computational details

All calculations were carried out using the Gaussian 09 program.[5] The hybrid density functional M06-2X[6] was used in combination with the standard 6-31G(d) basis set for C, H, N, O and Cl, and the Lanl (Los Alamos National Laboratory) basis sets,[7] also known as LanL2DZ (Lanl-2-double zeta)[8] for Pd. All structures were fully optimized in chloroform solvent (ε = 4.7113) using the SMD method of Truhlar and Cramer.[9] Vibrational analyses at the same level of theory were performed to confirm each stationary point to be either a local minimum or a transition state (TS), and to obtain thermal correction.[10] The connection of each TS to its corresponding reactant and product was confirmed by IRC (intrinsic reaction coordinate) calculations.[11] To consider solvent effect, single-point energy calculations for key transition states were performed in dichloromethane (ε = 8.93). All discussed energies are relative Gibbs free energies in solvent (ΔG) at 273 K unless specified.

Free energy profiles for the formation of enolate **III** and enol **IV** from ylide **II**. To form enolate **III**, **II** has to overcome a free energy barrier of 14.6 kcal/mol through **TS1** and is endothermic with 5.4 kcal/mol; while to form enol **IV**, **II** only need to overcome a free energy barrier of 9.3 kcal/mol through **TS2** and is exothermic with 8.4 kcal/mol. Thus, enol **IV** is more likely to be the reactive intermediate participating in the next step (Figure S10).

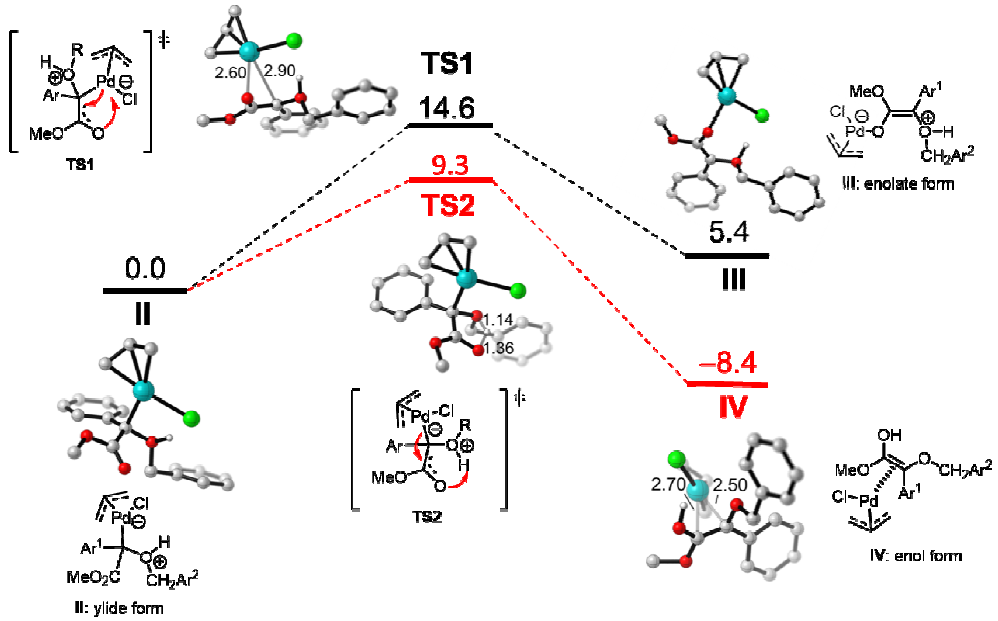
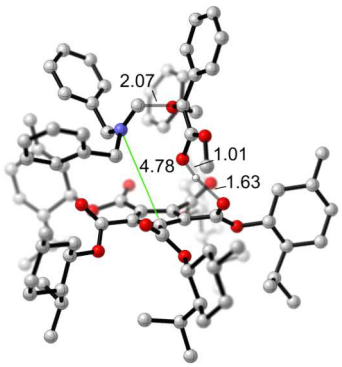
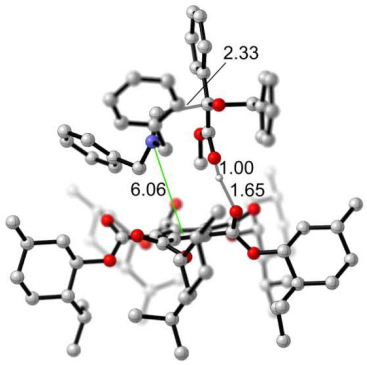



**Figure S10** Free energy profiles for the formation of intermediates **III** and **IV** from intermediate **II**.




**TS3-Si**

$\Delta\Delta G^{\ddagger}$ =0 kcal/mol




**TS3-Re**

$CHCl_3$: $\Delta\Delta G^{\ddagger}$ = 2.9 (exp. 2.1) kcal/mol

$CH_2Cl_2$: $\Delta\Delta G^{\ddagger}$ = 2.5 (exp. 1.6) kcal/mol

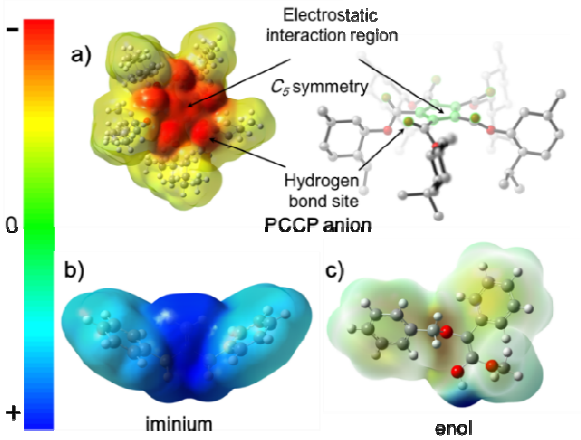



**Figure S11.** DFT-calculated electrostatic potential map. (a) DFT-calculated electrostatic potential map and three-dimensional structure, with C5 symmetry of the PCCP anion, the negative charges are mainly located at the center 5-membered ring and the carbonyl groups, thus this region may electrostatically interact with the positive iminium and the carbonyl groups may form hydrogen bond with the enol. (b) DFT-calculated electrostatic potential map of the iminium, the positive charges are mainly around the *N*-atom, which may interact with the electrostatic region of the PCCP anion. (c) DFT-calculated electrostatic potential map of the enol, the electrostatic potential near the hydroxyl hydrogen is positive, in favor of the formation of hydrogen bond with one of the carbonyl groups in the PCCP anion.

## Molecular Geometries and Energies

M06-2X (SMD, $CHCl_3$) Cartesian coordinates and energies in Hartree

**II**

Number of imaginary freguencies: 0

| | | | |
|---|---|---|---|
| C | -0.570488000 | 2.010523000 | -1.044904000 |
| C | 0.343603000 | 1.733474000 | -0.011707000 |
| C | 1.188786000 | 2.773529000 | 0.408127000 |
| C | 1.118391000 | 4.032041000 | -0.185366000 |

| | | | |
|---|---|---|---|
| C | 0.204645000 | 4.295268000 | -1.201868000 |
| C | -0.640440000 | 3.272197000 | -1.626350000 |
| H | -1.230697000 | 1.225080000 | -1.400026000 |
| H | 1.908860000 | 2.600547000 | 1.197466000 |
| H | 1.785386000 | 4.815990000 | 0.162223000 |
| H | 0.153199000 | 5.279168000 | -1.657524000 |
| H | -1.359300000 | 3.450439000 | -2.421138000 |
| C | 0.387726000 | 0.350197000 | 0.554304000 |
| O | -0.953243000 | -0.231405000 | 0.430943000 |
| C | -2.045970000 | 0.128831000 | 1.360141000 |
| H | -1.915104000 | -0.476793000 | 2.255355000 |
| H | -1.877879000 | 1.183926000 | 1.582909000 |
| C | -3.346064000 | -0.113003000 | 0.659747000 |
| C | -3.976421000 | 0.920960000 | -0.037083000 |
| C | -3.919775000 | -1.386600000 | 0.676639000 |
| C | -5.172240000 | 0.684036000 | -0.708185000 |
| H | -3.526736000 | 1.911047000 | -0.048189000 |
| C | -5.111971000 | -1.625511000 | -0.001560000 |
| H | -3.429588000 | -2.189521000 | 1.222273000 |
| C | -5.739016000 | -0.589797000 | -0.691680000 |
| H | -5.662665000 | 1.491775000 | -1.242608000 |
| H | -5.553103000 | -2.617227000 | 0.012949000 |
| H | -6.671556000 | -0.774678000 | -1.216419000 |
| C | 0.896584000 | 0.040673000 | 1.910029000 |
| O | 0.378398000 | -0.755494000 | 2.671597000 |
| H | -0.881368000 | -1.238280000 | 0.203107000 |
| O | 2.059119000 | 0.655673000 | 2.193688000 |
| C | 2.667940000 | 0.269071000 | 3.428202000 |
| H | 3.579067000 | 0.861649000 | 3.503314000 |
| H | 2.005644000 | 0.481604000 | 4.270003000 |
| H | 2.909144000 | -0.796678000 | 3.416758000 |
| Pd | 1.635797000 | -1.005376000 | -0.665112000 |
| Cl | -0.174389000 | -2.784945000 | -0.534566000 |
| C | 3.384582000 | 0.161835000 | -0.759828000 |
| H | 3.899342000 | -0.151545000 | 0.148144000 |
| H | 3.259697000 | 1.234116000 | -0.884289000 |
| C | 3.414943000 | -0.672191000 | -1.910062000 |
| H | 3.196392000 | -0.242175000 | -2.885170000 |
| C | 3.319946000 | -2.049566000 | -1.733112000 |
| H | 3.102137000 | -2.696296000 | -2.577015000 |
| H | 3.724320000 | -2.526778000 | -0.842087000 |

Total Energy ($CHCl_3$): -1548.737496

Thermal correction to Gibbs Free Energy (273 K): 0.311316

**III**

Number of imaginary freguencies: 0

| | | | |
|---|---|---|---|
| C | 0.303514000 | 2.301710000 | -1.074994000 |
| C | 0.734137000 | 1.849939000 | 0.183002000 |
| C | 1.692681000 | 2.604610000 | 0.875455000 |
| C | 2.223700000 | 3.759069000 | 0.305349000 |
| C | 1.804409000 | 4.190617000 | -0.951319000 |
| C | 0.834813000 | 3.458377000 | -1.635046000 |
| H | -0.451059000 | 1.730981000 | -1.608899000 |
| H | 2.022435000 | 2.293128000 | 1.858833000 |
| H | 2.965632000 | 4.329888000 | 0.856441000 |
| H | 2.221296000 | 5.092523000 | -1.388894000 |
| H | 0.489566000 | 3.787922000 | -2.610689000 |
| C | 0.134230000 | 0.598095000 | 0.701934000 |
| O | -1.114522000 | 0.258274000 | 0.201449000 |
| C | -2.177457000 | 1.003050000 | 0.796761000 |
| H | -2.143066000 | 0.864324000 | 1.887378000 |
| H | -2.045099000 | 2.073457000 | 0.590299000 |
| C | -3.489500000 | 0.513729000 | 0.240203000 |
| C | -3.600011000 | -0.751333000 | -0.339298000 |
| C | -4.620268000 | 1.328915000 | 0.331029000 |
| C | -4.832238000 | -1.192843000 | -0.819554000 |
| H | -2.718767000 | -1.382110000 | -0.420555000 |
| C | -5.850874000 | 0.883049000 | -0.142219000 |
| H | -4.534685000 | 2.318824000 | 0.773830000 |
| C | -5.959254000 | -0.380546000 | -0.721643000 |
| H | -4.908043000 | -2.176730000 | -1.273343000 |
| H | -6.723521000 | 1.525152000 | -0.066648000 |
| H | -6.917327000 | -0.727755000 | -1.096960000 |
| C | 0.527410000 | -0.133590000 | 1.800159000 |
| O | -0.190741000 | -1.149145000 | 2.280462000 |
| H | -0.677025000 | -1.576938000 | 1.535389000 |
| O | 1.618222000 | 0.167510000 | 2.503262000 |
| C | 2.296926000 | -0.937664000 | 3.119349000 |
| H | 3.245067000 | -0.533538000 | 3.472147000 |
| H | 1.718853000 | -1.330636000 | 3.956618000 |
| H | 2.473533000 | -1.730182000 | 2.384015000 |
| Pd | 1.456828000 | -1.116223000 | -0.542263000 |
| Cl | -0.260001000 | -2.882181000 | -0.269995000 |
| C | 3.314911000 | -0.032154000 | -0.827926000 |
| H | 3.880262000 | -0.467186000 | -0.004128000 |
| H | 3.265913000 | 1.052465000 | -0.863086000 |
| C | 3.056541000 | -0.781148000 | -1.984820000 |
| H | 2.732026000 | -0.279583000 | -2.893437000 |

| | | | |
|---|---|---|---|
| C | 2.816775000 | -2.160548000 | -1.814667000 |
| H | 2.373389000 | -2.736739000 | -2.620735000 |
| H | 3.370168000 | -2.725061000 | -1.065499000 |

Total Energy ($CHCl_3$): -1548.750782

Thermal correction to Gibbs Free Energy (273 K) : 0.311197

**IV**

Number of imaginary freguencies: 0

| | | | |
|---|---|---|---|
| C | -3.451634000 | -1.198072000 | 0.744980000 |
| C | -2.379545000 | -1.868909000 | 0.120542000 |
| C | -2.532960000 | -3.249405000 | -0.125814000 |
| C | -3.697649000 | -3.912967000 | 0.240790000 |
| C | -4.750447000 | -3.237021000 | 0.855551000 |
| C | -4.613422000 | -1.873317000 | 1.102164000 |
| H | -3.364960000 | -0.139089000 | 0.965205000 |
| H | -1.735662000 | -3.798740000 | -0.609136000 |
| H | -3.781688000 | -4.977044000 | 0.036701000 |
| H | -5.657452000 | -3.762906000 | 1.136781000 |
| H | -5.416840000 | -1.323389000 | 1.584730000 |
| C | -1.185997000 | -1.133494000 | -0.254274000 |
| O | -1.297549000 | 0.285929000 | -0.065024000 |
| C | -1.532321000 | 1.091870000 | -1.284491000 |
| H | -0.671451000 | 0.930326000 | -1.934204000 |
| H | -2.433321000 | 0.652616000 | -1.714851000 |
| C | -1.713056000 | 2.521148000 | -0.883771000 |
| C | -2.957684000 | 2.971308000 | -0.435610000 |
| C | -0.630455000 | 3.402081000 | -0.921474000 |
| C | -3.118806000 | 4.292579000 | -0.031135000 |
| H | -3.798985000 | 2.282681000 | -0.411680000 |
| C | -0.791366000 | 4.724849000 | -0.517762000 |
| H | 0.337737000 | 3.046163000 | -1.265732000 |
| C | -2.034857000 | 5.169034000 | -0.072696000 |
| H | -4.087869000 | 4.639976000 | 0.313325000 |
| H | 0.051921000 | 5.407606000 | -0.549659000 |
| H | -2.160508000 | 6.201027000 | 0.240876000 |
| C | 0.027717000 | -1.498082000 | -0.805577000 |
| O | 0.927141000 | -0.666916000 | -1.157144000 |
| H | -0.512486000 | 0.649235000 | 0.516582000 |
| O | 0.228029000 | -2.826231000 | -0.984971000 |
| C | 1.532053000 | -3.211190000 | -1.403244000 |
| H | 1.482800000 | -4.288582000 | -1.563849000 |
| H | 1.817011000 | -2.707068000 | -2.329464000 |
| H | 2.267947000 | -2.989134000 | -0.622829000 |
| Pd | 2.525524000 | -0.087466000 | 0.228652000 |

| | | | |
|---|---|---|---|
| Cl | 0.845284000 | 1.077951000 | 1.684552000 |
| C | 4.288255000 | -0.706326000 | -0.843848000 |
| H | 4.438457000 | 0.186073000 | -1.449705000 |
| H | 4.256919000 | -1.650446000 | -1.379124000 |
| C | 4.584055000 | -0.687501000 | 0.529193000 |
| H | 4.701212000 | -1.620264000 | 1.075707000 |
| C | 4.307092000 | 0.509195000 | 1.221748000 |
| H | 4.286415000 | 0.510604000 | 2.307409000 |
| H | 4.482061000 | 1.471685000 | 0.743050000 |

Total Energy ($CHCl_3$): -1548.728098

Thermal correction to Gibbs Free Energy (273 K) : 0.310532

**TS1**

Number of imaginary freguencies: 1

| | | | |
|---|---|---|---|
| C | 0.645241000 | 2.057619000 | -1.439726000 |
| C | 0.755109000 | 1.776969000 | -0.067550000 |
| C | 1.322167000 | 2.742395000 | 0.771951000 |
| C | 1.786677000 | 3.947742000 | 0.246858000 |
| C | 1.666494000 | 4.221300000 | -1.112201000 |
| C | 1.083779000 | 3.271720000 | -1.953173000 |
| H | 0.220555000 | 1.305327000 | -2.101505000 |
| H | 1.412412000 | 2.550443000 | 1.835694000 |
| H | 2.233253000 | 4.680667000 | 0.912356000 |
| H | 2.023116000 | 5.164052000 | -1.515214000 |
| H | 0.984230000 | 3.472202000 | -3.015808000 |
| C | 0.303798000 | 0.454400000 | 0.426983000 |
| O | -1.064893000 | 0.079214000 | 0.004216000 |
| C | -2.085079000 | 1.118136000 | 0.082434000 |
| H | -2.018803000 | 1.605216000 | 1.062085000 |
| H | -1.846704000 | 1.849347000 | -0.691986000 |
| C | -3.430973000 | 0.482505000 | -0.143550000 |
| C | -4.574108000 | 1.188727000 | 0.239505000 |
| C | -3.560354000 | -0.765931000 | -0.754489000 |
| C | -5.837439000 | 0.655926000 | 0.006406000 |
| H | -4.472582000 | 2.157619000 | 0.722595000 |
| C | -4.829203000 | -1.300376000 | -0.975900000 |
| H | -2.675670000 | -1.326758000 | -1.043996000 |
| C | -5.967528000 | -0.592038000 | -0.602329000 |
| H | -6.720688000 | 1.211581000 | 0.306573000 |
| H | -4.922468000 | -2.275422000 | -1.444273000 |
| H | -6.953395000 | -1.011532000 | -0.778446000 |
| C | 0.282866000 | 0.032137000 | 1.816686000 |
| O | -0.695358000 | -0.670980000 | 2.171287000 |

| | | | |
|---|---|---|---|
| H | -1.224683000 | -0.581931000 | 0.923993000 |
| O | 1.291628000 | 0.310610000 | 2.612758000 |
| C | 1.268488000 | -0.327480000 | 3.903389000 |
| H | 2.168833000 | 0.016340000 | 4.408703000 |
| H | 0.377599000 | -0.025990000 | 4.456331000 |
| H | 1.285068000 | -1.411966000 | 3.780539000 |
| Pd | 1.616800000 | -1.153719000 | -0.416929000 |
| Cl | -0.145779000 | -2.889225000 | -0.339303000 |
| C | 3.464661000 | -0.076134000 | -0.456871000 |
| H | 3.864776000 | -0.330478000 | 0.524291000 |
| H | 3.433083000 | 0.983047000 | -0.697457000 |
| C | 3.512339000 | -1.024469000 | -1.503965000 |
| H | 3.401513000 | -0.688466000 | -2.532939000 |
| C | 3.290346000 | -2.370027000 | -1.192853000 |
| H | 3.085830000 | -3.085787000 | -1.982410000 |
| H | 3.615456000 | -2.779098000 | -0.237944000 |

Total Energy ($CHCl_3$): -1548.719084
Thermal correction to Gibbs Free Energy (273 K) : 0.307637

**TS2**

Number of imaginary freguencies: 1

| | | | |
|---|---|---|---|
| C | -0.737838000 | 2.761788000 | -0.915709000 |
| C | 0.297929000 | 2.271853000 | -0.090969000 |
| C | 1.409127000 | 3.117994000 | 0.118735000 |
| C | 1.464012000 | 4.380986000 | -0.458397000 |
| C | 0.428865000 | 4.854392000 | -1.263366000 |
| C | -0.669541000 | 4.028106000 | -1.486278000 |
| H | -1.599501000 | 2.135326000 | -1.121833000 |
| H | 2.229165000 | 2.781994000 | 0.739806000 |
| H | 2.334752000 | 5.004269000 | -0.272094000 |
| H | 0.479917000 | 5.842533000 | -1.709496000 |
| H | -1.487958000 | 4.367616000 | -2.115484000 |
| C | 0.200197000 | 0.941592000 | 0.483552000 |
| O | -1.058136000 | 0.298741000 | 0.205318000 |
| C | -2.071482000 | 0.322572000 | 1.286768000 |
| H | -1.680886000 | -0.301745000 | 2.091484000 |
| H | -2.104817000 | 1.370664000 | 1.586571000 |
| C | -3.370479000 | -0.166929000 | 0.730924000 |
| C | -4.236267000 | 0.721903000 | 0.087708000 |
| C | -3.709402000 | -1.518779000 | 0.823127000 |
| C | -5.431072000 | 0.262923000 | -0.457591000 |
| H | -3.973104000 | 1.775215000 | 0.024269000 |
| C | -4.904397000 | -1.978378000 | 0.276104000 |

| | | | |
|---|---|---|---|
| H | -3.032634000 | -2.208261000 | 1.321324000 |
| C | -5.764224000 | -1.087888000 | -0.363778000 |
| H | -6.103346000 | 0.957134000 | -0.952219000 |
| H | -5.163765000 | -3.029870000 | 0.349477000 |
| H | -6.697258000 | -1.446266000 | -0.788280000 |
| C | 0.921340000 | 0.287226000 | 1.503547000 |
| O | 0.660070000 | -0.865723000 | 1.918951000 |
| H | -0.961696000 | -0.648605000 | -0.209659000 |
| O | 1.972779000 | 0.983275000 | 2.008358000 |
| C | 2.732774000 | 0.301782000 | 3.002620000 |
| H | 3.571828000 | 0.959745000 | 3.231237000 |
| H | 2.134781000 | 0.132923000 | 3.901425000 |
| H | 3.097790000 | -0.660696000 | 2.634764000 |
| Pd | 1.689307000 | -1.379582000 | -0.409232000 |
| Cl | -0.567604000 | -2.254602000 | -1.031114000 |
| C | 3.760071000 | -0.895652000 | -0.120754000 |
| H | 4.038555000 | -1.672890000 | 0.589289000 |
| H | 3.974361000 | 0.130883000 | 0.165233000 |
| C | 3.556005000 | -1.221057000 | -1.471790000 |
| H | 3.557099000 | -0.450351000 | -2.237943000 |
| C | 2.955933000 | -2.476474000 | -1.711358000 |
| H | 2.533362000 | -2.696624000 | -2.687116000 |
| H | 3.207491000 | -3.332113000 | -1.086749000 |

Total Energy ($CHCl_3$): -1548.714344
Thermal correction to Gibbs Free Energy (273 K): 0.311461

**TS3-Si**

Number of imaginary freguencies: 1

| | | | |
|---|---|---|---|
| O | -2.976291000 | -2.093238000 | -0.189983000 |
| O | -2.436899000 | 1.262976000 | 1.921545000 |
| O | 0.836382000 | 3.008800000 | 1.015398000 |
| O | 2.866745000 | 0.643062000 | -1.201182000 |
| O | 0.072124000 | -2.652237000 | -2.320827000 |
| O | -2.716988000 | -1.825402000 | -2.413427000 |
| O | -3.904652000 | 0.675859000 | 0.323417000 |
| O | -1.268241000 | 3.516275000 | 0.387903000 |
| O | 1.829870000 | 2.566604000 | -1.744475000 |
| O | 1.550132000 | -1.101719000 | -3.019755000 |
| C | -1.431136000 | -0.475071000 | -1.002582000 |
| C | -1.614417000 | 0.659771000 | -0.200344000 |
| C | -0.433359000 | 1.435362000 | -0.253899000 |
| C | 0.478939000 | 0.778306000 | -1.088250000 |
| C | -0.134210000 | -0.416570000 | -1.550736000 |

| | | | |
|---|---|---|---|
| C | -2.434452000 | -1.554507000 | -1.135554000 |
| C | -3.653272000 | -2.888252000 | -2.668456000 |
| H | -4.382300000 | -2.901629000 | -1.851042000 |
| C | -2.920517000 | -4.221333000 | -2.704614000 |
| H | -2.138771000 | -4.174232000 | -3.475844000 |
| H | -2.419160000 | -4.382558000 | -1.743052000 |
| C | -3.890557000 | -5.366899000 | -3.008962000 |
| H | -4.621236000 | -5.417884000 | -2.187217000 |
| C | -4.657424000 | -5.069084000 | -4.301591000 |
| H | -3.946773000 | -5.085077000 | -5.141338000 |
| H | -5.389873000 | -5.863115000 | -4.492539000 |
| C | -5.357012000 | -3.705834000 | -4.265877000 |
| H | -6.137012000 | -3.715947000 | -3.490866000 |
| H | -5.861907000 | -3.529906000 | -5.221353000 |
| C | -4.362631000 | -2.569958000 | -3.981839000 |
| H | -3.602256000 | -2.591220000 | -4.778818000 |
| C | -4.976730000 | -1.151701000 | -3.981159000 |
| H | -4.130684000 | -0.454045000 | -3.981435000 |
| C | -5.794930000 | -0.888536000 | -5.246211000 |
| H | -6.041447000 | 0.175377000 | -5.328128000 |
| H | -6.739347000 | -1.444819000 | -5.237862000 |
| H | -5.242449000 | -1.175175000 | -6.148848000 |
| C | -3.154584000 | -6.701187000 | -3.083658000 |
| H | -3.846117000 | -7.527969000 | -3.280462000 |
| H | -2.627896000 | -6.914636000 | -2.147027000 |
| H | -2.410840000 | -6.685892000 | -3.889765000 |
| C | -5.806226000 | -0.846799000 | -2.730283000 |
| H | -5.185685000 | -0.827045000 | -1.827001000 |
| H | -6.606896000 | -1.582253000 | -2.581103000 |
| H | -6.278246000 | 0.138480000 | -2.824154000 |
| C | -2.679281000 | 0.892894000 | 0.764179000 |
| C | -4.994119000 | 0.793185000 | 1.268914000 |
| H | -4.765733000 | 1.633059000 | 1.934150000 |
| C | -5.117275000 | -0.484837000 | 2.086301000 |
| H | -4.175837000 | -0.677211000 | 2.614220000 |
| H | -5.288429000 | -1.326873000 | 1.402021000 |
| C | -6.277832000 | -0.368963000 | 3.081086000 |
| H | -6.046125000 | 0.455535000 | 3.772806000 |
| C | -7.567547000 | -0.007577000 | 2.337054000 |
| H | -8.385561000 | 0.126579000 | 3.055049000 |
| H | -7.846973000 | -0.853167000 | 1.691286000 |
| C | -7.412702000 | 1.249138000 | 1.473887000 |
| H | -7.231193000 | 2.118955000 | 2.121320000 |
| H | -8.347812000 | 1.440899000 | 0.938242000 |

| | | | |
|---|---|---|---|
| C | -6.258687000 | 1.098161000 | 0.471419000 |
| H | -6.479614000 | 0.213117000 | -0.145870000 |
| C | -6.070219000 | 2.285160000 | -0.497908000 |
| H | -5.358170000 | 1.943685000 | -1.259862000 |
| C | -5.461589000 | 3.525552000 | 0.162057000 |
| H | -4.438125000 | 3.340431000 | 0.507609000 |
| H | -6.057950000 | 3.867598000 | 1.016975000 |
| H | -5.416955000 | 4.349052000 | -0.559684000 |
| C | -7.376176000 | 2.639727000 | -1.210883000 |
| H | -7.182648000 | 3.311614000 | -2.053691000 |
| H | -8.076766000 | 3.148502000 | -0.538700000 |
| H | -7.876738000 | 1.745649000 | -1.601629000 |
| C | -6.436614000 | -1.651915000 | 3.891118000 |
| H | -7.249619000 | -1.563208000 | 4.619988000 |
| H | -5.518229000 | -1.894257000 | 4.436671000 |
| H | -6.666665000 | -2.497283000 | 3.231655000 |
| C | -0.199605000 | 2.705465000 | 0.450933000 |
| C | -1.125029000 | 4.844160000 | 0.925228000 |
| H | -0.085622000 | 5.156307000 | 0.771595000 |
| C | -1.427965000 | 4.859314000 | 2.416673000 |
| H | -0.726569000 | 4.193305000 | 2.932244000 |
| H | -2.443632000 | 4.470487000 | 2.580122000 |
| C | -1.312304000 | 6.278679000 | 2.983251000 |
| H | -0.267629000 | 6.602266000 | 2.860020000 |
| C | -2.197180000 | 7.237419000 | 2.181171000 |
| H | -3.250478000 | 6.967424000 | 2.349844000 |
| H | -2.069410000 | 8.260475000 | 2.555066000 |
| C | -1.902468000 | 7.183444000 | 0.678700000 |
| H | -0.881650000 | 7.546091000 | 0.491117000 |
| H | -2.581585000 | 7.860219000 | 0.150588000 |
| C | -2.056361000 | 5.757281000 | 0.130439000 |
| H | -3.089238000 | 5.438511000 | 0.343114000 |
| C | -1.844416000 | 5.616601000 | -1.393942000 |
| H | -2.206846000 | 4.616438000 | -1.661095000 |
| C | -2.675300000 | 6.635305000 | -2.175680000 |
| H | -2.684830000 | 6.383336000 | -3.241258000 |
| H | -2.265416000 | 7.647508000 | -2.081264000 |
| H | -3.715045000 | 6.659763000 | -1.827835000 |
| C | -0.372209000 | 5.686584000 | -1.812092000 |
| H | -0.291805000 | 5.685653000 | -2.905198000 |
| H | 0.196271000 | 4.824015000 | -1.445197000 |
| H | 0.112747000 | 6.600875000 | -1.446861000 |
| C | -1.655642000 | 6.304950000 | 4.469486000 |
| H | -1.005649000 | 5.632429000 | 5.040751000 |

| | | | |
|---|---|---|---|
| H | -2.692647000 | 5.986997000 | 4.631706000 |
| H | -1.545194000 | 7.312156000 | 4.885449000 |
| C | 1.842728000 | 1.282443000 | -1.350842000 |
| C | 3.107577000 | 3.227451000 | -1.836258000 |
| H | 3.851371000 | 2.477299000 | -2.125558000 |
| C | 3.484143000 | 3.811296000 | -0.483172000 |
| H | 3.448673000 | 3.029016000 | 0.282010000 |
| H | 2.738208000 | 4.567168000 | -0.199075000 |
| C | 4.875257000 | 4.443462000 | -0.552889000 |
| H | 5.589128000 | 3.648799000 | -0.822092000 |
| C | 4.898838000 | 5.500290000 | -1.663300000 |
| H | 4.238810000 | 6.329005000 | -1.366056000 |
| H | 5.907679000 | 5.919663000 | -1.761977000 |
| C | 4.426619000 | 4.947679000 | -3.014347000 |
| H | 5.149785000 | 4.202730000 | -3.375562000 |
| H | 4.410930000 | 5.757106000 | -3.751738000 |
| C | 3.033013000 | 4.304567000 | -2.914756000 |
| H | 2.339213000 | 5.083194000 | -2.559727000 |
| C | 2.466118000 | 3.768732000 | -4.245907000 |
| H | 1.418018000 | 3.511956000 | -4.046697000 |
| C | 3.155854000 | 2.492673000 | -4.737021000 |
| H | 2.998415000 | 1.652763000 | -4.050184000 |
| H | 4.236320000 | 2.636059000 | -4.863620000 |
| H | 2.747103000 | 2.200993000 | -5.710991000 |
| C | 5.287390000 | 5.020334000 | 0.797545000 |
| H | 6.303497000 | 5.429174000 | 0.763488000 |
| H | 5.256473000 | 4.251845000 | 1.578971000 |
| H | 4.608728000 | 5.829593000 | 1.094446000 |
| C | 2.482868000 | 4.840068000 | -5.337467000 |
| H | 2.068897000 | 5.789345000 | -4.976778000 |
| H | 1.886612000 | 4.519933000 | -6.198409000 |
| H | 3.500516000 | 5.031944000 | -5.696437000 |
| C | 0.474056000 | -1.501426000 | -2.322237000 |
| C | 2.448538000 | -2.131506000 | -3.471398000 |
| H | 1.853154000 | -2.982130000 | -3.820173000 |
| C | 3.327495000 | -2.573694000 | -2.305451000 |
| H | 2.692754000 | -2.969976000 | -1.500934000 |
| H | 3.847100000 | -1.690279000 | -1.908715000 |
| C | 4.348210000 | -3.625710000 | -2.746958000 |
| H | 3.793525000 | -4.511404000 | -3.093310000 |
| C | 5.162053000 | -3.087887000 | -3.927456000 |
| H | 5.862687000 | -3.855508000 | -4.278923000 |
| H | 5.769300000 | -2.240360000 | -3.575682000 |
| C | 4.271010000 | -2.622081000 | -5.082930000 |

| | | | |
|---|---|---|---|
| H | 3.735652000 | -3.487992000 | -5.497605000 |
| H | 4.895639000 | -2.220773000 | -5.887914000 |
| C | 3.259364000 | -1.558583000 | -4.629431000 |
| H | 3.833102000 | -0.705794000 | -4.230302000 |
| C | 2.358753000 | -1.007975000 | -5.756663000 |
| H | 1.814998000 | -0.159296000 | -5.323630000 |
| C | 3.189718000 | -0.480311000 | -6.927937000 |
| H | 2.567649000 | 0.113666000 | -7.606385000 |
| H | 3.621502000 | -1.299765000 | -7.514355000 |
| H | 4.014055000 | 0.155791000 | -6.583360000 |
| C | 5.244642000 | -4.038198000 | -1.583424000 |
| H | 5.964552000 | -4.806409000 | -1.888429000 |
| H | 4.654526000 | -4.435433000 | -0.749998000 |
| H | 5.810766000 | -3.175537000 | -1.211210000 |
| C | 1.312949000 | -2.010647000 | -6.252047000 |
| H | 0.591384000 | -2.270091000 | -5.470034000 |
| H | 1.776907000 | -2.937469000 | -6.610436000 |
| H | 0.748734000 | -1.582754000 | -7.088107000 |
| C | 0.861792000 | -3.595967000 | 5.482862000 |
| C | 0.479022000 | -2.246119000 | 5.399541000 |
| C | 0.249804000 | -1.545961000 | 6.595179000 |
| C | 0.383726000 | -2.187544000 | 7.823674000 |
| C | 0.751915000 | -3.528785000 | 7.893900000 |
| C | 0.992431000 | -4.228799000 | 6.714464000 |
| H | 1.056477000 | -4.145441000 | 4.566656000 |
| H | -0.044300000 | -0.505217000 | 6.576798000 |
| H | 0.193606000 | -1.627956000 | 8.734949000 |
| H | 0.851793000 | -4.021594000 | 8.856079000 |
| H | 1.285010000 | -5.274115000 | 6.748995000 |
| C | 0.413519000 | -1.657126000 | 4.037489000 |
| O | 0.393864000 | -2.568173000 | 2.993342000 |
| C | -0.899235000 | -3.112473000 | 2.673034000 |
| H | -1.493697000 | -2.350139000 | 2.154399000 |
| H | -1.409861000 | -3.410114000 | 3.597381000 |
| C | -0.641834000 | -4.294336000 | 1.782595000 |
| C | -0.507362000 | -5.575966000 | 2.320318000 |
| C | -0.400467000 | -4.091987000 | 0.421951000 |
| C | -0.135296000 | -6.645252000 | 1.507265000 |
| H | -0.692204000 | -5.734272000 | 3.380763000 |
| C | -0.021627000 | -5.157332000 | -0.392488000 |
| H | -0.495582000 | -3.096378000 | -0.003638000 |
| C | 0.112737000 | -6.435145000 | 0.151030000 |
| H | -0.036607000 | -7.640020000 | 1.931970000 |
| H | 0.169812000 | -4.975048000 | -1.445791000 |

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|---|---|---|---|
| H | 0.408533000 | -7.267130000 | -0.481665000 |
| C | -0.111827000 | -0.395117000 | 3.716646000 |
| O | -0.279885000 | -0.105911000 | 2.457558000 |
| H | -0.988059000 | 0.595395000 | 2.279403000 |
| O | -0.275051000 | 0.521500000 | 4.648740000 |
| C | -0.512917000 | 1.888997000 | 4.256215000 |
| H | -1.567167000 | 2.020295000 | 4.008674000 |
| H | 0.121127000 | 2.159670000 | 3.406818000 |
| H | -0.251804000 | 2.486382000 | 5.128631000 |
| C | 6.214964000 | 1.823433000 | 3.595112000 |
| C | 4.858289000 | 1.515080000 | 3.527764000 |
| C | 4.264258000 | 1.171499000 | 2.310074000 |
| C | 5.052458000 | 1.146191000 | 1.153914000 |
| C | 6.411909000 | 1.450556000 | 1.221333000 |
| C | 6.995900000 | 1.787811000 | 2.440908000 |
| H | 6.661505000 | 2.093941000 | 4.547345000 |
| H | 4.251335000 | 1.549427000 | 4.430103000 |
| H | 4.593409000 | 0.902521000 | 0.198251000 |
| H | 7.012993000 | 1.428459000 | 0.316800000 |
| H | 8.053409000 | 2.029372000 | 2.491337000 |
| C | 2.801559000 | 0.777371000 | 2.267642000 |
| H | 2.336819000 | 1.032190000 | 1.312608000 |
| H | 2.247518000 | 1.299683000 | 3.052877000 |
| N | 2.648800000 | -0.669442000 | 2.493881000 |
| C | 2.749576000 | -1.562672000 | 1.320918000 |
| H | 1.740240000 | -1.859670000 | 1.019663000 |
| H | 3.173028000 | -0.964551000 | 0.509680000 |
| C | 3.611683000 | -2.772171000 | 1.596871000 |
| C | 4.987339000 | -2.616987000 | 1.800141000 |
| C | 3.053050000 | -4.049788000 | 1.663266000 |
| C | 5.791157000 | -3.723404000 | 2.056170000 |
| H | 5.425979000 | -1.621783000 | 1.752377000 |
| C | 3.858400000 | -5.160169000 | 1.921235000 |
| H | 1.984027000 | -4.172232000 | 1.513900000 |
| C | 5.227392000 | -4.999070000 | 2.116534000 |
| H | 6.859048000 | -3.592927000 | 2.205149000 |
| H | 3.409842000 | -6.148364000 | 1.966512000 |
| H | 5.855569000 | -5.862341000 | 2.315856000 |
| C | 2.388348000 | -1.137381000 | 3.703323000 |
| H | 2.613156000 | -2.187440000 | 3.880271000 |
| H | 2.521569000 | -0.453895000 | 4.540055000 |

Total Energy ($CHCl_3$): -4575.098028

Total Energy (DCM): -4575.102125

Thermal correction to Gibbs Free Energy (273 K) : 1.933803

**TS3-Re**

Number of imaginary freguencies: 1

symmetry c1

| | | | |
|---|---|---|---|
| O | 3.700868000 | 0.088573000 | -2.623240000 |
| O | 1.464575000 | 3.267133000 | -1.228810000 |
| O | -1.245576000 | 2.024921000 | 0.601720000 |
| O | -0.608779000 | -2.144617000 | 1.679264000 |
| O | 2.435146000 | -3.143273000 | -0.800815000 |
| O | 4.589874000 | -1.193080000 | -0.993562000 |
| O | 3.618846000 | 2.604301000 | -1.097752000 |
| O | 0.485479000 | 3.027282000 | 1.600670000 |
| O | -0.681449000 | -0.100155000 | 2.644168000 |
| O | 2.094585000 | -3.057683000 | 1.425146000 |
| C | 2.556248000 | -0.123776000 | -0.549186000 |
| C | 1.967663000 | 1.139929000 | -0.322692000 |
| C | 0.902468000 | 0.969042000 | 0.574152000 |
| C | 0.823949000 | -0.396723000 | 0.911577000 |
| C | 1.856172000 | -1.071316000 | 0.210815000 |
| C | 3.649156000 | -0.384311000 | -1.506017000 |
| C | 5.665670000 | -1.574622000 | -1.867868000 |
| H | 5.876218000 | -0.729198000 | -2.532630000 |
| C | 5.256486000 | -2.778060000 | -2.706719000 |
| H | 4.994012000 | -3.605839000 | -2.033388000 |
| H | 4.358353000 | -2.529835000 | -3.284280000 |
| C | 6.398425000 | -3.199107000 | -3.637344000 |
| H | 6.594779000 | -2.363322000 | -4.326178000 |
| C | 7.671568000 | -3.444737000 | -2.821333000 |
| H | 7.510222000 | -4.323965000 | -2.179860000 |
| H | 8.502431000 | -3.691731000 | -3.493715000 |
| C | 8.044619000 | -2.247367000 | -1.940874000 |
| H | 8.305192000 | -1.391065000 | -2.579528000 |
| H | 8.937391000 | -2.490049000 | -1.355310000 |
| C | 6.891030000 | -1.860382000 | -1.003082000 |
| H | 6.661080000 | -2.744753000 | -0.387251000 |
| C | 7.202639000 | -0.702819000 | -0.029091000 |
| H | 6.378366000 | -0.684565000 | 0.694428000 |
| C | 8.497025000 | -0.952170000 | 0.746911000 |
| H | 8.589639000 | -0.243772000 | 1.576873000 |
| H | 9.379197000 | -0.826439000 | 0.108598000 |
| H | 8.527266000 | -1.965400000 | 1.165185000 |
| C | 6.016300000 | -4.425977000 | -4.460044000 |
| H | 6.821952000 | -4.711989000 | -5.145324000 |

| | | | |
|---|---|---|---|
| H | 5.115394000 | -4.240936000 | -5.054879000 |
| H | 5.814644000 | -5.281035000 | -3.803385000 |
| C | 7.238062000 | 0.670416000 | -0.706079000 |
| H | 6.254477000 | 0.956951000 | -1.095586000 |
| H | 7.958317000 | 0.698096000 | -1.533091000 |
| H | 7.539083000 | 1.436642000 | 0.017501000 |
| C | 2.301047000 | 2.429099000 | -0.935503000 |
| C | 4.053897000 | 3.823835000 | -1.726879000 |
| H | 3.280857000 | 4.582117000 | -1.565248000 |
| C | 4.222901000 | 3.592213000 | -3.221969000 |
| H | 3.268096000 | 3.257820000 | -3.645987000 |
| H | 4.949523000 | 2.782189000 | -3.376931000 |
| C | 4.705074000 | 4.870393000 | -3.916233000 |
| H | 3.925507000 | 5.637204000 | -3.788361000 |
| C | 5.980522000 | 5.381198000 | -3.238265000 |
| H | 6.294805000 | 6.324482000 | -3.701630000 |
| H | 6.787193000 | 4.655031000 | -3.418704000 |
| C | 5.806966000 | 5.568680000 | -1.727411000 |
| H | 5.070930000 | 6.363585000 | -1.539453000 |
| H | 6.753733000 | 5.903163000 | -1.290984000 |
| C | 5.348528000 | 4.268315000 | -1.050366000 |
| H | 6.112735000 | 3.503469000 | -1.262471000 |
| C | 5.205320000 | 4.348250000 | 0.486188000 |
| H | 5.081658000 | 3.314991000 | 0.833765000 |
| C | 3.969911000 | 5.129201000 | 0.947146000 |
| H | 3.039964000 | 4.620458000 | 0.668711000 |
| H | 3.946479000 | 6.142421000 | 0.526541000 |
| H | 3.974724000 | 5.226822000 | 2.038875000 |
| C | 6.468139000 | 4.910285000 | 1.141302000 |
| H | 6.439318000 | 4.755005000 | 2.224969000 |
| H | 6.566348000 | 5.987854000 | 0.966763000 |
| H | 7.372647000 | 4.423985000 | 0.756929000 |
| C | 4.918245000 | 4.640545000 | -5.409248000 |
| H | 5.240322000 | 5.559941000 | -5.910485000 |
| H | 3.998992000 | 4.294744000 | -5.894071000 |
| H | 5.690348000 | 3.879695000 | -5.575400000 |
| C | -0.059729000 | 2.033466000 | 0.921374000 |
| C | -0.315911000 | 4.204276000 | 1.879537000 |
| H | -1.338698000 | 3.874806000 | 2.095952000 |
| C | -0.292983000 | 5.103040000 | 0.647233000 |
| H | -0.772459000 | 4.583232000 | -0.189367000 |
| H | 0.755958000 | 5.259782000 | 0.361081000 |
| C | -0.954393000 | 6.459227000 | 0.905215000 |
| H | -2.012368000 | 6.287423000 | 1.156788000 |

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|---|---|---|---|
| C | -0.289362000 | 7.126382000 | 2.111768000 |
| H | 0.762768000 | 7.334907000 | 1.866404000 |
| H | -0.767511000 | 8.091407000 | 2.318925000 |
| C | -0.365855000 | 6.225639000 | 3.344218000 |
| H | -1.424127000 | 6.070946000 | 3.593819000 |
| H | 0.093221000 | 6.716892000 | 4.209880000 |
| C | 0.306694000 | 4.865160000 | 3.108858000 |
| H | 1.360830000 | 5.051326000 | 2.850386000 |
| C | 0.284214000 | 3.944498000 | 4.351222000 |
| H | 0.518468000 | 2.930001000 | 4.001468000 |
| C | 1.369744000 | 4.348953000 | 5.349882000 |
| H | 1.374168000 | 3.677022000 | 6.215301000 |
| H | 1.208923000 | 5.367087000 | 5.724330000 |
| H | 2.363552000 | 4.310545000 | 4.891019000 |
| C | -1.080434000 | 3.902277000 | 5.045582000 |
| H | -1.084762000 | 3.138384000 | 5.830904000 |
| H | -1.895167000 | 3.667642000 | 4.349798000 |
| H | -1.313509000 | 4.860369000 | 5.523991000 |
| C | -0.887469000 | 7.341110000 | -0.337646000 |
| H | -1.372090000 | 6.860710000 | -1.194399000 |
| H | 0.155567000 | 7.540239000 | -0.611867000 |
| H | -1.379755000 | 8.304657000 | -0.166217000 |
| C | -0.203725000 | -0.998930000 | 1.757748000 |
| C | -1.804791000 | -0.467466000 | 3.458130000 |
| H | -1.934475000 | -1.552762000 | 3.399855000 |
| C | -3.047542000 | 0.225842000 | 2.912867000 |
| H | -3.205605000 | -0.075020000 | 1.867218000 |
| H | -2.871685000 | 1.311110000 | 2.904141000 |
| C | -4.274837000 | -0.094066000 | 3.771625000 |
| H | -4.446860000 | -1.181288000 | 3.728743000 |
| C | -3.988799000 | 0.277706000 | 5.230673000 |
| H | -3.875308000 | 1.370547000 | 5.294933000 |
| H | -4.848828000 | 0.011187000 | 5.856867000 |
| C | -2.718852000 | -0.391180000 | 5.765166000 |
| H | -2.866446000 | -1.479995000 | 5.792258000 |
| H | -2.542639000 | -0.068954000 | 6.796732000 |
| C | -1.497450000 | -0.056986000 | 4.897435000 |
| H | -1.384051000 | 1.038798000 | 4.895092000 |
| C | -0.161078000 | -0.642550000 | 5.402198000 |
| H | 0.619920000 | -0.213166000 | 4.762131000 |
| C | -0.068718000 | -2.165547000 | 5.272886000 |
| H | -0.115399000 | -2.491824000 | 4.228172000 |
| H | -0.871038000 | -2.668057000 | 5.826853000 |
| H | 0.883862000 | -2.518101000 | 5.684365000 |

| | | | |
|---|---|---|---|
| C | -5.519661000 | 0.616683000 | 3.249207000 |
| H | -6.395426000 | 0.391235000 | 3.868008000 |
| H | -5.753479000 | 0.321320000 | 2.219913000 |
| H | -5.369563000 | 1.703888000 | 3.261321000 |
| C | 0.132251000 | -0.209122000 | 6.839389000 |
| H | 0.000116000 | 0.872042000 | 6.968687000 |
| H | 1.164822000 | -0.453678000 | 7.109980000 |
| H | -0.523415000 | -0.716559000 | 7.556254000 |
| C | 2.150312000 | -2.515982000 | 0.201478000 |
| C | 2.266169000 | -4.482344000 | 1.513225000 |
| H | 2.984785000 | -4.786236000 | 0.744187000 |
| C | 0.939541000 | -5.184375000 | 1.256974000 |
| H | 0.565309000 | -4.903399000 | 0.264964000 |
| H | 0.204688000 | -4.834604000 | 1.995299000 |
| C | 1.107259000 | -6.703058000 | 1.360137000 |
| H | 1.814407000 | -7.017518000 | 0.577252000 |
| C | 1.717134000 | -7.066124000 | 2.717934000 |
| H | 1.884468000 | -8.148777000 | 2.775217000 |
| H | 0.990310000 | -6.815380000 | 3.505009000 |
| C | 3.025955000 | -6.316341000 | 2.991621000 |
| H | 3.789712000 | -6.640033000 | 2.269979000 |
| H | 3.396468000 | -6.583031000 | 3.986862000 |
| C | 2.835444000 | -4.795092000 | 2.894129000 |
| H | 2.071719000 | -4.512624000 | 3.636176000 |
| C | 4.096819000 | -3.957899000 | 3.203519000 |
| H | 3.755434000 | -2.919562000 | 3.295248000 |
| C | 4.728079000 | -4.356852000 | 4.537995000 |
| H | 5.482396000 | -3.622136000 | 4.839018000 |
| H | 5.226116000 | -5.331064000 | 4.472882000 |
| H | 3.977615000 | -4.413424000 | 5.335576000 |
| C | -0.219737000 | -7.418438000 | 1.127863000 |
| H | -0.098534000 | -8.506787000 | 1.163565000 |
| H | -0.643661000 | -7.154630000 | 0.152711000 |
| H | -0.948479000 | -7.135638000 | 1.897390000 |
| C | 5.141193000 | -3.990503000 | 2.083465000 |
| H | 4.766980000 | -3.524267000 | 1.165001000 |
| H | 5.452941000 | -5.015348000 | 1.846843000 |
| H | 6.036329000 | -3.436776000 | 2.389416000 |
| C | -5.671748000 | 0.158920000 | -4.813514000 |
| C | -4.336858000 | 0.271065000 | -4.382437000 |
| C | -3.318118000 | 0.125737000 | -5.341684000 |
| C | -3.635367000 | -0.106647000 | -6.676387000 |
| C | -4.961486000 | -0.204964000 | -7.092496000 |
| C | -5.978008000 | -0.071294000 | -6.150303000 |

| | | | |
|---|---|---|---|
| H | -6.469930000 | 0.250067000 | -4.083223000 |
| H | -2.278458000 | 0.201609000 | -5.052491000 |
| H | -2.831005000 | -0.209890000 | -7.398986000 |
| H | -5.198374000 | -0.385268000 | -8.136487000 |
| H | -7.018140000 | -0.149559000 | -6.453472000 |
| C | -4.112481000 | 0.479712000 | -2.941761000 |
| O | -5.235688000 | 0.772012000 | -2.179714000 |
| C | -5.541969000 | 2.174862000 | -2.130664000 |
| H | -4.676705000 | 2.716642000 | -1.730702000 |
| H | -5.751385000 | 2.538718000 | -3.144255000 |
| C | -6.737358000 | 2.320945000 | -1.233844000 |
| C | -8.029225000 | 2.302277000 | -1.762012000 |
| C | -6.563986000 | 2.353464000 | 0.152398000 |
| C | -9.136930000 | 2.312913000 | -0.915999000 |
| H | -8.166275000 | 2.274343000 | -2.840524000 |
| C | -7.668981000 | 2.364150000 | 1.000274000 |
| H | -5.555376000 | 2.360118000 | 0.562533000 |
| C | -8.956950000 | 2.339971000 | 0.465877000 |
| H | -10.138794000 | 2.299581000 | -1.334734000 |
| H | -7.527129000 | 2.389253000 | 2.076857000 |
| H | -9.818829000 | 2.346097000 | 1.126311000 |
| C | -2.906620000 | 0.641148000 | -2.282710000 |
| O | -2.943497000 | 0.878502000 | -0.985168000 |
| H | -2.108448000 | 1.200733000 | -0.535119000 |
| O | -1.761370000 | 0.463000000 | -2.923889000 |
| C | -0.520556000 | 0.637964000 | -2.220827000 |
| H | -0.477799000 | -0.012549000 | -1.343083000 |
| H | 0.256734000 | 0.351445000 | -2.927902000 |
| H | -0.390045000 | 1.685147000 | -1.933056000 |
| C | 0.005339000 | -4.068476000 | -2.495001000 |
| C | -0.651327000 | -3.112076000 | -1.719215000 |
| C | -1.973454000 | -3.310151000 | -1.326665000 |
| C | -2.638063000 | -4.478342000 | -1.717468000 |
| C | -1.987949000 | -5.428379000 | -2.496705000 |
| C | -0.662601000 | -5.224233000 | -2.886890000 |
| H | 1.041251000 | -3.904053000 | -2.771588000 |
| H | -0.119110000 | -2.218337000 | -1.401573000 |
| H | -3.671618000 | -4.637453000 | -1.416906000 |
| H | -2.512168000 | -6.330882000 | -2.796645000 |
| H | -0.154592000 | -5.968370000 | -3.492892000 |
| C | -2.661283000 | -2.296622000 | -0.445561000 |
| H | -2.821031000 | -2.707039000 | 0.554616000 |
| H | -2.041079000 | -1.403598000 | -0.324660000 |
| N | -3.992124000 | -1.887869000 | -0.949115000 |

| | | | |
|---|---|---|---|
| C | -5.008996000 | -1.465037000 | 0.047623000 |
| H | -5.051589000 | -0.372660000 | 0.038367000 |
| H | -4.638071000 | -1.791972000 | 1.022693000 |
| C | -6.364733000 | -2.064556000 | -0.234028000 |
| C | -6.551813000 | -3.446803000 | -0.126719000 |
| C | -7.437291000 | -1.252084000 | -0.601032000 |
| C | -7.796922000 | -4.008489000 | -0.386079000 |
| H | -5.718272000 | -4.080571000 | 0.169827000 |
| C | -8.687953000 | -1.815357000 | -0.855851000 |
| H | -7.290051000 | -0.178961000 | -0.688851000 |
| C | -8.868268000 | -3.191357000 | -0.751354000 |
| H | -7.936187000 | -5.081672000 | -0.298052000 |
| H | -9.517664000 | -1.173891000 | -1.137904000 |
| H | -9.841021000 | -3.630583000 | -0.951089000 |
| C | -4.224610000 | -1.732770000 | -2.219593000 |
| H | -5.249193000 | -1.554527000 | -2.532780000 |
| H | -3.493280000 | -2.093379000 | -2.936875000 |

Total Energy ($CHCl_3$): -4575.089533

Total Energy (DCM): -4575.094281

Thermal correction to Gibbs Free Energy (273 K) : 1.929899

## 7. References:


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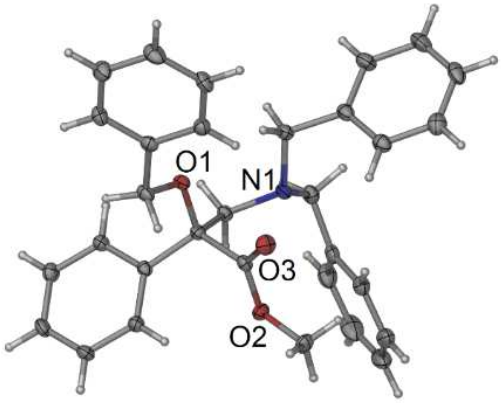
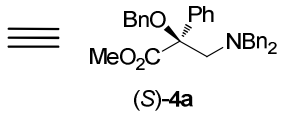
# 8. Single crystal X-ray diffraction data

## Single crystal X-ray diffraction data of (*S*)-4a (CDCC NO.: 1849954)




(*S*)-4a

Bond precision: C-C = 0.0019 A Wavelength=1.54184

Cell: a=9.6616(1) b=11.6145(1) c=11.4666(1)
alpha=90 beta=96.814(1) gamma=90

Temperature: 293 K

| | Calculated | Reported |
|---|---|---|
| Volume | 1277.63(2) | 1277.63(2) |
| Space group | P 21 | P2(1) |
| Hall group | P 2yb | ? |
| Moiety formula | C31 H31 N O3 | ? |
| Sum formula | C31 H31 N O3 | C31 H31 N O3 |
| Mr | 465.57 | 465.57 |
| Dx,g cm-3 | 1.210 | 1.210 |
| Z | 2 | 2 |
| Mu (mm-1) | 0.609 | 0.609 |
| F000 | 496.0 | 496.0 |
| F000' | 497.41 | |
| h,k,lmax | 11,14,13 | 11,14,13 |
| Nref | 4846[ 2550] | 4833 |
| Tmin,Tmax | 0.823,0.875 | 0.829,0.878 |
| Tmin' | 0.823 | |

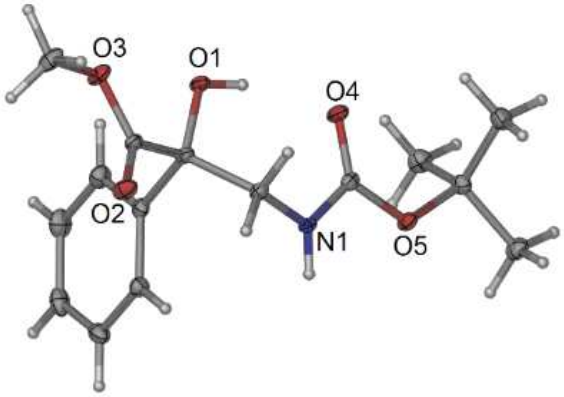
Correction method= # Reported T Limits: Tmin=0.829 Tmax=0.878
AbsCorr = MULTI-SCAN

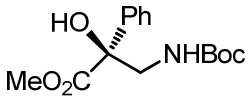
Data completeness= 1.90/1.00 Theta(max)= 69.990

R(reflections)= 0.0273( 4811) wR2(reflections)= 0.0714( 4833)

S = 1.033 Npar= 317

## Single crystal X-ray diffraction data of (*S*)-7a (CDCC NO.: 1849960)




(*S*)-7a

Bond precision: C-C = 0.0019 A Wavelength=1.54184

Cell: a=5.9401(1) b=10.6560(1) c=23.6934(2)
alpha=90 beta=90 gamma=90

Temperature: 100 K

| | Calculated | Reported |
|---|---|---|
| Volume | 1499.74(3) | 1499.74(3) |
| Space group | P 21 21 21 | P2(1)2(1)2( |
| Hall group | P 2ac 2ab | ? |
| Moiety formula | C15 H21 N O5 | ? |
| Sum formula | C15 H21 N O5 | C15 H21 N O5 |
| Mr | 295.33 | 295.33 |
| Dx,g cm-3 | 1.308 | 1.308 |
| Z | 4 | 4 |
| Mu (mm-1) | 0.815 | 0.815 |
| F000 | 632.0 | 632.0 |
| F000' | 634.11 | |
| h,k,lmax | 7,13,29 | 7,13,29 |
| Nref | 3081[ 1808] | 3062 |
| Tmin,Tmax | 0.710,0.809 | 0.696,0.816 |
| Tmin' | 0.644 | |

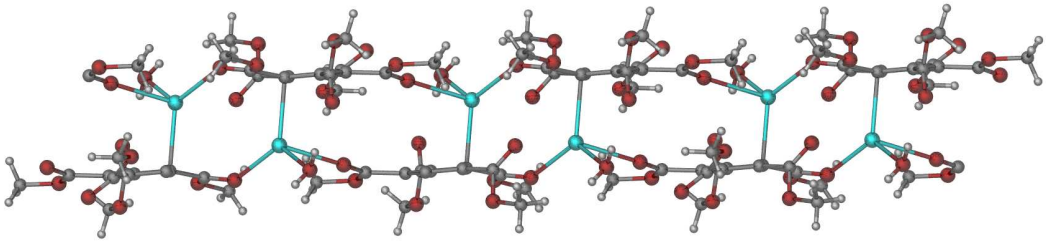
Correction method= # Reported T Limits: Tmin=0.696 Tmax=0.816
AbsCorr = MULTI-SCAN

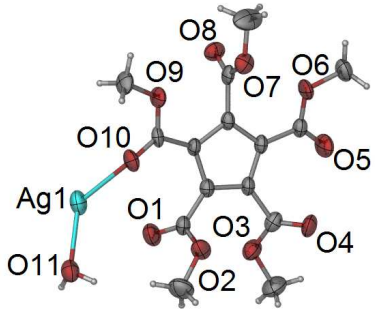
Data completeness= 1.69/0.99 Theta(max)= 74.720

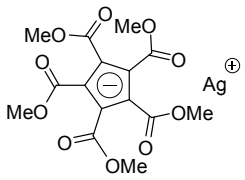
R(reflections)= 0.0318( 3039) wR2(reflections)= 0.0860( 3062)

S = 1.089 Npar= 190

## Single crystal X-ray diffraction data of Ag-6c (CDCC NO.: 1849959)






**Ag-6c**

| | | | |
|---|---|---|---|
| Bond precision: | C-C = 0.0075 A | | Wavelength=1.54184 |
| Cell: | a=8.8042(3) | b=10.5315(4) | c=10.8818(4) |
| | alpha=107.990(4) | beta=100.432(3) | gamma=104.927(4) |
| Temperature: 293 K | | | |

| | Calculated | Reported |
|---|---|---|
| Volume | 889.20(7) | 889.19(6) |
| Space group | P -1 | P -1 |
| Hall group | -P 1 | -P 1 |
| Moiety formula | C15 H17 Ag O11 | C15 H17 Ag O11 |
| Sum formula | C15 H17 Ag O11 | C15 H17 Ag O11 |
| Mr | 481.16 | 481.15 |
| Dx, g cm-3 | 1.797 | 1.797 |
| Z | 2 | 2 |
| Mu (mm-1) | 9.650 | 9.650 |
| F000 | 484.0 | 484.0 |
| F000' | 485.94 | |
| h, k, lmax | 10, 12, 12 | 10, 12, 12 |
| Nref | 3177 | 3144 |
| Tmin, Tmax | 0.061, 0.176 | 0.234, 1.000 |
| Tmin' | 0.006 | |

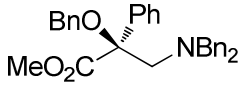
Correction method= # Reported T Limits: Tmin=0.234 Tmax=1.000 AbsCorr = MULTI-SCAN

Data completeness= 0.990 Theta(max)= 67.079

R(reflections)= 0.0691( 2822) wR2(reflections)= 0.1836( 3144)

S = 1.015 Npar= 251

# 9. Analytical data of products




(*S*)-**4a**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-phenylpropanoate**

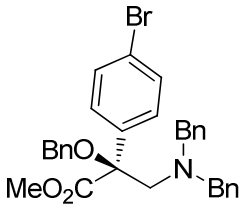
(*S*)-**4a**: 92% yield, 96% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.46 – 7.16 (m, 20H), 4.71 (d, *J* = 11.2 Hz, 1H), 4.07 (d, *J* = 11.2 Hz, 1H), 3.95 (d, *J* = 13.7 Hz, 2H), 3.70 (s, 3H), 3.50 (d, *J* = 13.7 Hz, 2H), 3.35 (d, *J* = 13.8 Hz, 1H), 3.30 (d, *J* = 13.8 Hz, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.4, 139.3, 138.7, 138.5, 129.4, 128.3, 128.2, 128.2, 128.0, 127.5, 127.2, 127.1, 126.7, 87.8, 67.6, 61.0, 58.7, 51.9.

**HRMS-ESI:** calcd. for $C_{31}H_{32}NO_3$ $[M + H]^+$: 466.2382 found: 466.2385

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 10.16 min, $t_{minor}$ = 11.00 min.




(*S*)-**4b**

**(*S*)-Methyl 2-(benzyloxy)-2-(4-bromophenyl)-3-(dibenzylamino) propanoate**

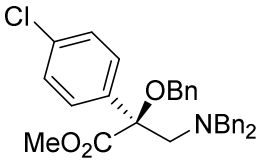
(*S*)-**4b**: 89% yield, 92% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.47 – 7.41 (m, 2H), 7.32 – 7.15 (m, 17H), 4.69 (d, *J* = 11.1 Hz, 1H), 4.11 (d, *J* = 11.1 Hz, 1H), 3.84 (d, *J* = 13.7 Hz, 2H), 3.68 (s, 3H), 3.53 (d, *J* = 13.7 Hz, 2H), 3.33 – 3.21 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 171.9, 139.1, 138.4, 137.7, 131.4, 129.3, 128.9, 128.3, 128.1, 127.5, 127.4, 126.7, 122.2, 87.3, 67.7, 60.6, 58.8, 52.1.

**HRMS-ESI:** calcd. for $C_{31}H_{31}BrNO_3$ $[M + H]^+$: 544.1487 found: 544.1492

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 12.88 min, $t_{minor}$ = 15.20 min.




(*S*)-**4c**

**(*S*)-Methyl 2-(benzyloxy)-2-(4-chlorophenyl)-3-(dibenzylamino) propanoate**

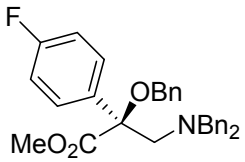
(*S*)-**4c**: 91% yield, 94% ee.

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.32 (m, 2H), 7.32 – 7.12 (m, 17H), 4.69 (d, *J* = 11.1 Hz, 1H), 4.12 (d, *J* = 11.1 Hz, 1H), 3.86 (d, *J* = 13.7 Hz, 2H), 3.69 (s, 3H), 3.54 (d, *J* = 13.6 Hz, 2H), 3.33 – 3.22 (m, 2H).

$^{13}$C NMR (100 MHz, $CDCl_3$) δ 172.0, 139.1, 138.4, 137.1, 134.0, 129.3, 128.6, 128.4, 128.3, 128.1, 127.4, 127.4, 126.8, 87.2, 67.7, 60.6, 58.8, 52.1.

**HRMS-ESI:** calcd. for $C_{31}H_{31}ClNO_3$ $[M + H]^+$: 500.1992 found: 500.2004

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 12.18 min, $t_{minor}$ = 13.89 min.




(*S*)-**4d**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(4-fluorophenyl) propanoate**

(*S*)-**4d**: 78% yield, 90% ee.

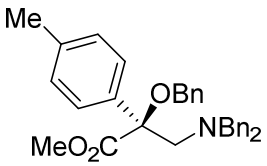
**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.39 (M, 2H), 7.33 – 7.11 (m, 15H), 7.06 – 6.95 (m, 2H), 4.69 (d, *J* = 11.2 Hz, 1H), 4.09 (d, *J* = 11.2 Hz, 1H), 3.87 (d, *J* = 13.7 Hz, 2H), 3.69 (s, 3H), 3.53 (d, *J* = 13.7 Hz, 2H), 3.28 (M, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.2, 162.4 (d, *J* = 247.2 Hz), 139.2, 138.5, 134.4 (d, *J* = 3.0 Hz), 129.3, 128.9 (d, *J* = 8.1 Hz), 128.2, 128.1, 127.4, 127.4, 126.8, 115.2 (d, *J* = 21.3 Hz), 87.2, 67.6, 60.8, 58.8, 52.0.

**$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -113.96.

**HRMS-ESI:** calcd. for $C_{31}H_{31}FNO_3$ $[M + H]^+$: 484.2288 found: 484.2296

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 12.13 min, $t_{minor}$ = 13.79 min.




(*S*)-**4e**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(*p*-tolyl) propanoate**

(*S*)-**4e**: 96% yield, 93% ee.

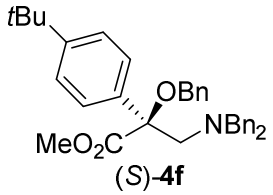
**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.32 – 7.16 (m, 17H), 7.14 (d, *J* = 8.1 Hz, 2H), 4.69 (d, *J* = 11.2 Hz, 1H), 4.06 (d, *J* = 11.2 Hz, 1H), 3.99 (d, *J* = 13.7 Hz, 2H), 3.68 (s, 3H), 3.47 (d, *J* = 13.7 Hz, 2H), 3.36 – 3.25 (m, 2H), 2.34 (s, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.5, 139.4, 138.9, 138.0, 135.5, 129.4, 129.0, 128.1, 128.0, 127.5, 127.1, 126.7, 87.7, 67.5, 61.3, 58.8, 51.8, 21.1.

**HRMS-ESI:** calcd. for $C_{32}H_{34}NO_3$ $[M + H]^+$: 480.2539 found: 480.2528

**HPLC:** (Chiral IC, λ= 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.20 min,

$t_{minor}$ = 5.33 min.




(*S*)-**4f**

**(*S*)-Methyl 2-(benzyloxy)-2-(4-(*tert*-butyl)phenyl)-3-(dibenzylamino) propanoate**

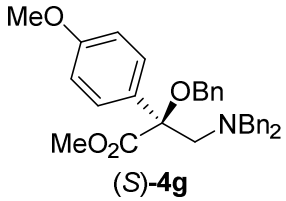
(*S*)-**4f**: 96% yield, 94% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.37 – 7.15 (m, 19H), 4.71 (d, *J* = 11.3 Hz, 1H), 4.08 (d, *J* = 11.3 Hz, 1H), 3.99 (d, *J* = 13.8 Hz, 2H), 3.69 (s, 3H), 3.50 (d, *J* = 13.8 Hz, 2H), 3.35 (d, *J* = 13.8 Hz, 1H), 3.29 (d, *J* = 13.8 Hz, 1H), 1.31 (s, 9H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.6, 151.1, 139.4, 139.0, 135.4, 129.4, 128.1, 128.0, 127.5, 127.1, 126.9, 126.7, 125.2, 87.8, 67.6, 61.3, 58.7, 51.8, 34.6, 31.4.

**HRMS-ESI:** calcd. for $C_{35}H_{40}NO_3$ $[M + H]^+$: 522.3008 found:522.3016

**HPLC:** (Chiral IC, λ= 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 5.67 min, $t_{minor}$ = 4.76 min.




(*S*)-**4g**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(4-methoxyphenyl) propanoate**

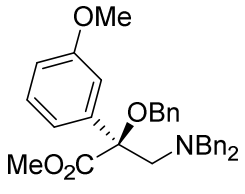
(*S*)-**4g**: 95% yield, 95% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.40 – 7.30 (m, 2H), 7.30 – 7.11 (m, 15H), 6.86 (d, *J* = 8.9 Hz, 1H), 4.69 (d, *J* = 11.2 Hz, 1H), 4.06 (d, *J* = 11.2 Hz, 1H), 3.98 (d, *J* = 13.7 Hz, 2H), 3.80 (s, 3H), 3.69 (s, 3H), 3.48 (d, *J* = 13.8 Hz, 2H), 3.37 – 3.23 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.5, 159.3, 139.3, 138.9, 130.6, 129.4, 128.5, 128.1, 128.0, 127.5, 127.1, 126.7, 113.6, 87.5, 67.5, 61.3, 58.7, 55.3, 51.8.

**HRMS-ESI:** calcd. for $C_{32}H_{34}NO_4$ $[M + H]^+$: 496.2488 found: 496.2502

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 9.14 min, $t_{minor}$ = 10.10 min.




(*S*)-**4h**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(3-methoxyphenyl)propanoate**

(*S*)-**4h**: 95% yield, 90% ee.

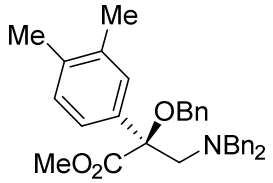
**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.37 – 7.14 (m, 16H), 7.06 – 6.94 (m, 2H), 6.85 (M, 1H), 4.72 (d, *J* =

11.3 Hz, 1H), 4.11 (d, *J* = 11.3 Hz, 1H), 3.95 (d, *J* = 13.8 Hz, 2H), 3.74 (s, 3H), 3.70 (s, 3H), 3.50 (d, *J* = 13.8 Hz, 2H), 3.31 (s, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 159.5, 140.0, 139.3, 138.8, 129.3, 129.3, 128.4, 128.0, 127.4, 127.2, 126.7, 119.5, 113.4, 113.2, 87.8, 67.6, 61.1, 58.7, 55.2, 51.9.

**HRMS-ESI:** calcd. for $C_{32}H_{34}NO_4$ $[M + H]^+$: 496.2488 found: 496.2465

**HPLC:** (Chiral IC, λ= 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 14.53 min, $t_{minor}$ = 11.21 min.




(*S*)-**4i**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(3,4-dimethylphenyl) propanoate**

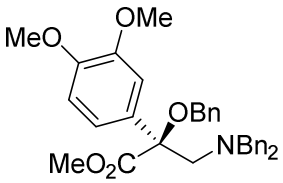
(*S*)-**4i**: 95% yield, 95% ee.

**$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.37 – 7.03 (m, 18H), 4.69 (d, *J* = 11.2 Hz, 1H), 4.06 (d, *J* = 11.2 Hz, 1H), 4.00 (d, *J* = 13.7 Hz, 2H), 3.69 (s, 3H), 3.47 (d, *J* = 13.7 Hz, 2H), 3.32 (t, *J* = 8.3 Hz, 2H), 2.25 (s, 3H), 2.24 (s, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.6, 139.4, 139.0, 136.7, 136.5, 135.8, 129.5, 129.4, 128.4, 128.1, 128.0, 127.5, 127.1, 126.7, 124.1, 87.8, 67.5, 61.3, 58.8, 51.7, 20.0, 19.5.

**HRMS-ESI:** calcd. for $C_{33}H_{36}NO_3$ $[M + H]^+$: 494.2695 found: 494.2671

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.55 min, $t_{minor}$ = 5.46 min.




(*S*)-**4j**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(3,4-dimethoxyphenyl)propanoate**

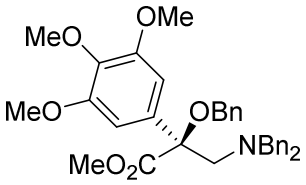
(*S*)-**4j**: 95% yield, 90% ee.

**$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.34 – 7.17 (m, 15H), 7.01 – 6.87 (m, 2H), 6.80 (d, *J* = 8.4 Hz, 1H), 4.72 (d, *J* = 11.4 Hz, 1H), 4.11 (d, *J* = 11.4 Hz, 1H), 3.96 (d, *J* = 13.7 Hz, 2H), 3.88 (s, 3H), 3.75 (s, 3H), 3.71 (s, 3H), 3.50 (d, *J* = 13.7 Hz, 2H), 3.34 – 3.22 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.4, 148.8, 148.7, 139.3, 138.9, 131.0, 129.3, 128.2, 128.0, 127.4, 127.2, 126.7, 119.6, 110.5, 110.3, 87.7, 67.6, 61.4, 58.8, 55.9, 55.8, 51.9.

**HRMS-ESI:** calcd. for $C_{33}H_{36}NO_5$ $[M + H]^+$: 526.2593 found: 526.2605

**HPLC:** (Chiral OD-H, λ= 254 nm, hexane/2-propanol = 10/1, Flow rate = 1.0 mL/min), $t_{major}$ = 9.13 min, $t_{minor}$ = 8.57 min.




(*S*)-**4k**

**(*S*)-Methyl 2-(benzyloxy)-3-(dibenzylamino)-2-(3,4,5-trimethoxyphenyl) propanoate**

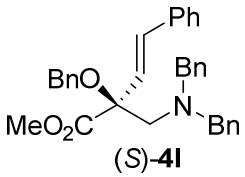
(*S*)-**4k**: 90% yield, 90% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.39 – 7.14 (m, 15H), 6.64 (s, 2H), 4.75 (d, *J* = 11.5 Hz, 1H), 4.20 (d, *J* = 11.5 Hz, 1H), 3.93 – 3.80 (m, 5H), 3.72 (s, 9H), 3.57 (d, *J* = 13.7 Hz, 2H), 3.35 – 3.19 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 152.9, 139.3, 138.8, 137.7, 134.0, 129.2, 128.2, 128.0, 127.3, 126.8, 104.3, 87.9, 67.7, 61.2, 60.9, 58.8, 56.0, 51.9.

**HRMS-ESI:** calcd. for $C_{34}H_{38}NO_6$ $[M + H]^+$: 556.2699 found: 556.2662

**HPLC:** (Chiral IC, λ= 254 nm, hexane/2-propanol = 95/5, Flow rate = 1.0 mL/min), $t_{major}$ = 19.11 min, $t_{minor}$ = 13.30 min.




(*S*)-**4l**

**(*S, E*)-Methyl 2-(benzyloxy)-2-((dibenzylamino)methyl)-4-phenylbut-3-enoate**

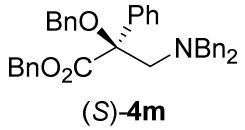
(*S, E*)-**4l**: 88% yield, 72% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.44 – 7.23 (m, 20H), 6.72 (d, *J* = 16.5 Hz, 1H), 6.52 (d, *J* = 16.5 Hz, 1H), 4.77 (d, *J* = 11.3 Hz, 1H), 4.56 (d, *J* = 11.3 Hz, 1H), 4.02 (d, *J* = 13.7 Hz, 2H), 3.74 (s, 3H), 3.55 (d, *J* = 13.7 Hz, 2H), 3.15 (d, *J* = 13.7 Hz, 1H), 3.04 (d, *J* = 13.6 Hz, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.1, 139.5, 138.9, 136.3, 132.3, 129.3, 128.6, 128.3, 128.1, 128.0, 127.6, 127.3, 126.9, 126.8, 126.7, 86.5, 67.8, 62.8, 59.1, 52.1.

**HRMS-ESI:** calcd. for $C_{33}H_{34}NO_3$ $[M + H]^+$: 492.2533 found: 492.2534

**HPLC:** (Chiral OD-H, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.84 min, $t_{minor}$ = 8.28 min.




(*S*)-**4m**

**(*S*)-Benzyl 2-(benzyloxy)-3-(dibenzylamino)-2-phenylpropanoate**

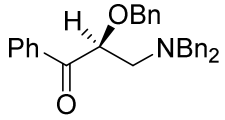
(*S*)-**4m**: 78% yield, 94% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.44 – 7.37 (m, 2H), 7.36 – 7.10 (m, 24H), 5.34 (d, *J* = 12.2 Hz, 1H), 5.08 (d, *J* = 12.3 Hz, 1H), 4.68 (d, *J* = 11.1 Hz, 1H), 4.08 (d, *J* = 11.1 Hz, 1H), 3.85 (d, *J* = 13.8 Hz, 2H), 3.54 (d, *J* = 13.8 Hz, 2H), 3.43 – 3.31 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 171.8, 139.1, 138.7, 138.4, 135.5, 129.3, 128.5, 128.5, 128.3, 128.1, 128.1, 128.0, 127.4, 127.2, 126.7, 87.7, 67.6, 66.9, 61.0, 58.3.

**HRMS-ESI:** calcd. for $C_{37}H_{36}NO_3$ $[M + H]^+$: 542.2695 found: 542.2700

**HPLC:** (Chiral OD-H, $\lambda$ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 29.66 min, $t_{minor}$ = 25.47 min.




(*S*)-**4n**

**(*S*)-2-(Benzyloxy)-3-(dibenzylamino)-1-phenylpropan-1-one**

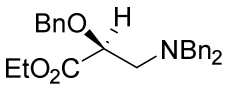
(*S*)-**4n**: 90% yield, 87% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 7.5 Hz, 2H), 7.52 – 7.44 (m, 1H), 7.35 – 7.24 (m, 7H), 7.25 – 7.14 (m, 10H), 4.88 (dd, *J* = 6.9, 4.7 Hz, 1H), 4.65 (d, *J* = 11.6 Hz, 1H), 4.38 (d, *J* = 11.6 Hz, 1H), 3.70 (d, *J* = 13.6 Hz, 2H), 3.60 (d, *J* = 13.6 Hz, 2H), 3.05 – 2.90 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 199.3, 139.4, 137.6, 135.3, 133.2, 129.0, 128.6, 128.5, 128.5, 128.3, 128.2, 127.9, 126.9, 82.0, 72.2, 59.0, 55.8.

**HRMS-ESI:** calcd. for $C_{30}H_{30}NO_2$ $[M + H]^+$: 436.2277 found: 436.2271

**HPLC:** (Chiral OD-H, $\lambda$ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 5.70 min, $t_{minor}$ = 5.25 min.




(*S*)-**4o**

**(*S*)-Ethyl 2-(benzyloxy)-3-(dibenzylamino) propanoate**

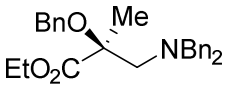
(*S*)-**4o**: 78% yield, 59% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.46 – 7.12 (m, 15H), 4.66 (d, *J* = 11.6 Hz, 1H), 4.39 (d, *J* = 11.6 Hz, 1H), 4.20 – 4.04 (m, 3H), 3.69 (d, *J* = 13.7 Hz, 2H), 3.58 (d, *J* = 13.7 Hz, 2H), 2.90 (d, *J* = 5.6 Hz, 2H), 1.19 (t, *J* = 7.1 Hz, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 171.7, 139.3, 137.5, 129.0, 128.4, 128.2, 128.1, 127.9, 127.0, 78.1, 72.5, 60.8, 58.8, 55.6, 14.2.

**HRMS-ESI:** calcd. for $C_{26}H_{30}NO_3$ $[M + H]^+$: 404.2226 found: 404.2252

**HPLC:** (Chiral OD-H, $\lambda$ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 22.07 min, $t_{minor}$ = 33.06 min.




(*S*)-**4p**

**(*S*)-Ethyl 2-(benzyloxy)-3-(dibenzylamino)-2-methylpropanoate**

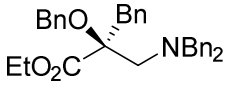
(*S*)-**4p**: 85% yield, 80% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.40 – 7.02 (m, 15H), 4.47 (d, *J* = 11.0 Hz, 1H), 4.38 (d, *J* = 11.0 Hz, 1H), 4.15 – 3.90 (m, 2H), 3.71 (d, *J* = 13.7 Hz, 2H), 3.51 (d, *J* = 13.7 Hz, 2H), 2.84 (d, *J* = 13.7 Hz, 1H), 2.77 (d, *J* = 13.7 Hz, 1H), 1.36 (s, 3H), 1.11 (t, *J* = 7.1 Hz, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 173.5, 139.6, 138.8, 129.2, 128.2, 128.1, 127.6, 127.4, 126.8, 82.8, 67.1, 61.3, 60.9, 59.4, 19.9, 14.2.

**HRMS-ESI:** calcd. for $C_{27}H_{32}NO_3$ $[M + H]^+$: 418.2382 found: 418.2336

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 5.80 min, $t_{minor}$ = 5.12 min.




(*S*)-**4q**

**(*S*)-Ethyl 2-benzyl-2-(benzyloxy)-3-(dibenzylamino) propanoate**

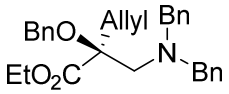
(*S*)-**4q**: 90% yield, 55% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.39 – 7.18 (m, 20H), 4.77 (d, *J* = 10.9 Hz, 1H), 4.63 (d, *J* = 11.0 Hz, 1H), 4.18 – 3.94 (m, 2H), 3.75 (d, *J* = 13.6 Hz, 2H), 3.56 (d, *J* = 13.7 Hz, 2H), 3.37 – 3.19 (m, 2H), 3.00 (d, *J* = 14.0 Hz, 1H), 2.90 (d, *J* = 14.1 Hz, 1H), 1.10 (t, *J* = 7.1 Hz, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.6, 139.3, 138.5, 136.4, 130.4, 129.3, 128.2, 128.2, 128.1, 127.6, 127.4, 126.9, 126.6, 85.7, 66.9, 61.0, 58.7, 57.6, 39.5, 14.1.

**HRMS-ESI:** calcd. for $C_{33}H_{36}NO_3$ $[M + H]^+$: 494.2695 found: 494.2671

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 5.38 min, $t_{minor}$ = 4.99 min.




(*S*)-**4r**

**(*S*)-Ethyl 2-(benzyloxy)-2-((dibenzylamino)methyl)pent-4-enoate**

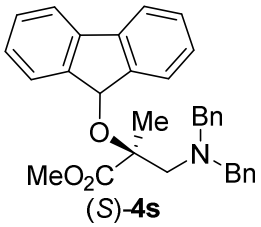
(*S*)-**4r**: 76% yield, 72% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.40 – 7.34 (m, 2H), 7.31 – 7.25 (m, 9H), 7.26 – 7.18 (m, 4H), 5.77 – 5.63 (m, 1H), 5.16 – 5.00 (m, 2H), 4.62 (d, *J* = 10.6 Hz, 1H), 4.50 (d, *J* = 10.6 Hz, 1H), 4.25 – 4.12 (m, 1H), 4.11 – 3.99 (m, 1H), 3.84 (d, *J* = 13.8 Hz, 2H), 3.48 (d, *J* = 13.8 Hz, 2H), 2.98 (d, *J* = 14.0 Hz, 1H), 2.94 (d, *J* = 14.0 Hz, 1H), 2.82 (dd, *J* = 15.2, 6.4 Hz, 1H), 2.68 (dd, *J* = 15.2, 7.7 Hz, 1H), 1.19 (t, *J* = 7.1 Hz, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.6, 139.4, 138.4, 132.6, 129.2, 128.2, 128.1, 127.7, 127.4, 126.8, 118.4, 84.2, 66.6, 60.9, 58.9, 58.4, 37.5, 14.2.

**HRMS-ESI:** calcd. for $C_{29}H_{34}NO_3$ $[M + H]^+$: 444.2533 found: 444.2535

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.02 min, $t_{minor}$ = 5.54 min.



(*S*)-**4s**

**(*S*)-Methyl 2-((9H-fluoren-9-yl)oxy)-3-(dibenzylamino)-2-methylpropanoate**

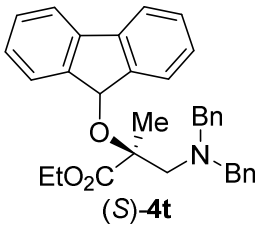
(*S*)-**4s**: 89% yield, 90% ee.

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 8.01 (d, *J* = 7.5 Hz, 1H), 7.62 – 7.45 (m, 3H), 7.30 (dd, *J* = 15.9, 6.0 Hz, 10H), 7.23 – 7.11 (m, 4H), 5.63 (s, 1H), 3.83 (d, *J* = 13.7 Hz, 2H), 3.65 (s, 3H), 3.44 (d, *J* = 13.7 Hz, 2H), 2.99 (d, *J* = 13.7 Hz, 1H), 2.87 (d, *J* = 13.6 Hz, 1H), 1.74 (s, 3H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 174.1, 144.9, 144.5, 140.9, 139.8, 139.6, 129.2, 128.7, 128.7, 128.1, 127.7, 127.3, 126.9, 126.8, 125.7, 119.9, 119.4, 83.6, 78.5, 62.0, 59.5, 52.0, 23.2.

**HRMS-ESI:** calcd. for $C_{32}H_{32}NO_3$ $[M + H]^+$: 477.2377 found: 477.2386

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 8.10 min, $t_{minor}$ = 7.31 min.



(*S*)-**4t**

**(*S*)-Ethyl 2-((9H-fluoren-9-yl)oxy)-3-(dibenzylamino)-2-methylpropanoate**

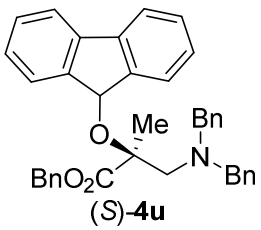
(*S*)-**4t**: 90% yield, 90% ee.

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 8.06 (d, *J* = 7.5 Hz, 1H), 7.68 – 7.53 (m, 3H), 7.39 – 7.30 (m, 10H), 7.28 – 7.22 (m, 3H), 7.20 (t, *J* = 7.5 Hz, 1H), 5.69 (s, 1H), 4.35 – 4.26 (m, 1H), 4.17 – 4.01 (m, 1H), 3.86 (d, *J* = 13.8 Hz, 2H), 3.53 (d, *J* = 13.8 Hz, 2H), 3.04 (d, *J* = 13.7 Hz, 1H), 2.94 (d, *J* = 13.6 Hz, 1H), 1.81 (s, 3H), 1.23 (t, *J* = 7.1 Hz, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 173.7, 144.9, 144.6, 140.8, 139.8, 139.5, 129.2, 128.7, 128.6, 128.1, 127.6, 127.3, 126.9, 126.8, 125.7, 119.8, 119.3, 83.5, 78.4, 62.0, 61.2, 59.3, 23.2, 14.1.

**HRMS-ESI:** calcd. for $C_{33}H_{34}NO_3$ $[M + H]^+$: 492.2533 found: 492.2531

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 7.54 min, $t_{minor}$ = 6.60 min.



(*S*)-**4u**

**(*S*)-Benzyl 2-((9H-fluoren-9-yl)oxy)-3-(dibenzylamino)-2-methylpropanoate**

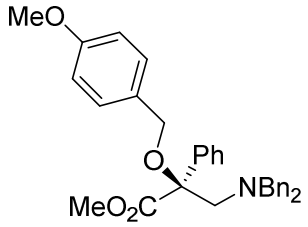
(*S*)-**4u**: 83% yield, 92% ee.

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.98 (d, *J* = 7.6 Hz, 1H), 7.63 – 7.44 (m, 3H), 7.32 – 7.21 (m, 15H), 7.20 – 7.14 (m, 3H), 7.10 (t, *J* = 7.5 Hz, 1H), 5.63 (s, 1H), 5.28 (d, *J* = 12.4 Hz, 1H), 4.99 (d, *J* = 12.4 Hz, 1H), 3.77 (d, *J* = 13.8 Hz, 2H), 3.48 (d, *J* = 13.8 Hz, 2H), 3.01 (d, *J* = 13.7 Hz, 1H), 2.92 (d, *J* = 13.7 Hz, 1H), 1.77 (s, 3H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 173.6, 144.9, 144.6, 140.9, 139.8, 139.5, 135.7, 129.3, 128.8, 128.7, 128.6, 128.4, 128.3, 128.2, 127.7, 127.4, 127.0, 126.9, 125.7, 119.9, 119.4, 83.7, 78.6, 66.9, 62.1, 59.3, 23.2.

**HRMS-ESI:** calcd. for $C_{38}H_{36}NO_3$ $[M + H]^+$: 554.2690 found: 554.2698

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 9.45 min, $t_{minor}$ = 8.53 min.




(*S*)-**4v**

**(*S*)-Methyl 3-(dibenzylamino)-2-((4-methoxybenzyl)oxy)-2-phenylpropanoate**

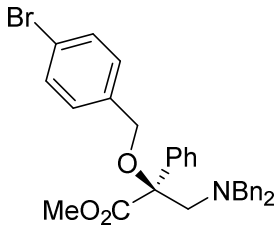
(*S*)-**4v**: 89% yield, 94% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.44 – 7.37 (m, 2H), 7.36 – 7.29 (m, 3H), 7.27 – 7.14 (m, 13H), 6.80 – 6.73 (m, 2H), 4.63 (d, *J* = 10.6 Hz, 1H), 3.99 (d, *J* = 10.6 Hz, 1H), 3.93 (d, *J* = 13.7 Hz, 2H), 3.73 (s, 3H), 3.69 (s, 3H), 3.49 (d, *J* = 13.7 Hz, 2H), 3.33 (d, *J* = 13.8 Hz, 1H), 3.28 (d, *J* = 13.8 Hz, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.4, 158.9, 139.3, 138.6, 131.0, 129.4, 129.1, 128.3, 128.2, 128.1, 127.2, 126.8, 113.6, 87.7, 67.3, 61.0, 58.8, 55.3, 51.9.

**HRMS-ESI:** calcd. for $C_{32}H_{34}NO_4$ $[M + H]^+$: 496.2488 found: 496.2509

**HPLC:** (Chiral ID, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 20.57 min, $t_{minor}$ = 18.01 min.




(*S*)-**4w**

**(*S*)-Methyl 2-((4-bromobenzyl)oxy)-3-(dibenzylamino)-2-phenylpropanoate**

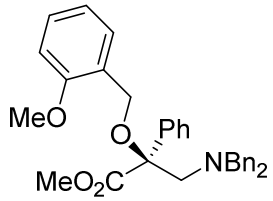
(*S*)-**4w**: 78% yield, 93% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.41 – 7.30 (m, 7H), 7.30 – 7.18 (m, 10H), 7.18 – 7.07 (m, 2H), 4.63 (d, *J* = 11.4 Hz, 1H), 4.05 – 3.88 (m, 3H), 3.69 (s, 3H), 3.48 (d, *J* = 13.8 Hz, 2H), 3.36 – 3.27 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 139.2, 138.2, 137.8, 131.2, 129.3, 129.2, 128.4, 128.3, 128.1, 127.1, 126.8, 121.0, 88.0, 67.0, 61.3, 58.8, 51.9.

**HRMS-ESI:** calcd. for $C_{31}H_{31}BrNO_3$ $[M + H]^+$: 544.1487 found: 544.1473

**HPLC:** (Chiral ID, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 17.62 min, $t_{minor}$ = 15.86 min.




(*S*)-**4x**

**(*S*)-Methyl 3-(dibenzylamino)-2-((2-methoxybenzyl)oxy)-2-phenylpropanoate**

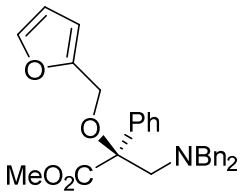
(*S*)-**4x**: 91% yield, 93% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.59 – 7.48 (m, 1H), 7.48 – 7.38 (m, 2H), 7.35 – 7.13 (m, 14H), 6.88 (d, *J* = 7.3 Hz, 1H), 6.75 (d, *J* = 8.1 Hz, 1H), 4.72 (d, *J* = 12.3 Hz, 1H), 4.25 (d, *J* = 12.3 Hz, 1H), 3.89 (d, *J* = 13.7 Hz, 2H), 3.67 (s, 1H), 3.66 (s, 1H), 3.56 (d, *J* = 13.8 Hz, 2H), 3.44 – 3.26 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.4, 156.5, 139.4, 138.7, 129.3, 128.3, 128.2, 128.0, 128.0, 127.3, 127.1, 126.7, 120.4, 109.8, 87.5, 62.3, 60.2, 58.7, 55.1, 51.9.

**HRMS-ESI:** calcd. for $C_{32}H_{34}NO_4$ $[M + H]^+$: 496.2488 found: 496.2521

**HPLC:** (Chiral ID, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 19.28 min, $t_{minor}$ = 17.74 min.




(*S*)-**4y**

**(*S*)-Methyl 3-(dibenzylamino)-2-(furan-2-ylmethoxy)-2-phenylpropanoate**

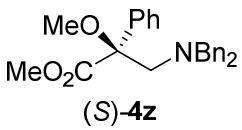
(*S*)-**4y**: 90% yield, 87% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.54 – 7.39 (m, 2H), 7.33 (dd, *J* = 8.4, 4.6 Hz, 4H), 7.30 – 7.10 (m, 10H), 6.21 (d, *J* = 33.8 Hz, 2H), 4.66 (d, *J* = 11.9 Hz, 1H), 4.09 (d, *J* = 11.9 Hz, 1H), 3.91 (d, *J* = 13.5 Hz, 2H), 3.70 (s, 3H), 3.50 (d, *J* = 13.6 Hz, 2H), 3.28 (M, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.2, 152.2, 142.3, 139.3, 138.1, 129.4, 128.4, 128.3, 128.1, 127.3, 126.8, 110.2, 108.4, 87.8, 61.1, 60.2, 58.7, 51.9.

**HRMS-ESI:** calcd. for $C_{29}H_{29}NO_4$ $[M + H]^+$: 456.2175 found: 456.2172

**HPLC:** (Chiral ID, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 7.45 min, $t_{minor}$ = 6.51 min.




(*S*)-**4z**

**(*S*)-Methyl 3-(dibenzylamino)-2-methoxy-2-phenylpropanoate**

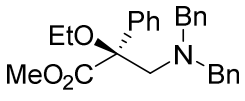
(*S*)-**4z**: 92% yield, 87% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.48 – 6.97 (m, 15H), 3.80 (d, *J* = 13.6 Hz, 2H), 3.57 (s, 3H), 3.41 (d, *J* = 13.7 Hz, 2H), 3.22 (d, *J* = 13.8 Hz, 1H), 3.16 (d, *J* = 13.8 Hz, 1H), 3.08 (s, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 139.3, 138.4, 129.3, 128.3, 128.1, 128.1, 127.0, 126.8, 87.2, 58.8, 58.5, 52.7, 52.0.

**HRMS-ESI:** calcd. for $C_{25}H_{28}NO_3$ $[M + H]^+$: 390.2070 found: 390.2085

**HPLC:** (Chiral ID, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 16.42 min, $t_{minor}$ = 13.57 min.




(*S*)-**4A**

**(*S*)-Methyl 3-(dibenzylamino)-2-ethoxy-2-phenylpropanoate**

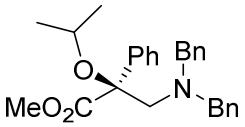
(*S*)-**4A**: 90% yield, 96% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.38 – 7.16 (m, 15H), 3.86 (d, *J* = 13.7 Hz, 2H), 3.65 (s, 3H), 3.60 – 3.46 (m, 3H), 3.26 (d, *J* = 13.8 Hz, 1H), 3.21 (d, *J* = 13.8 Hz, 1H), 3.17 – 3.06 (m, 1H), 1.15 (t, *J* = 7.0 Hz, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 171.5, 138.3, 137.9, 128.3, 127.1, 127.0, 126.8, 125.8, 125.7, 86.1, 76.3, 76.0, 75.7, 59.7, 58.7, 57.7, 50.8, 14.5.

**HRMS-ESI:** calcd. for $C_{26}H_{30}NO_3$ $[M + H]^+$: 404.2220 found: 404.2226

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 11.86 min, $t_{minor}$ = 9.48 min.




(*S*)-**4B**

**(*S*)-Methyl 3-(dibenzylamino)-2-isopropoxy-2-phenylpropanoate**

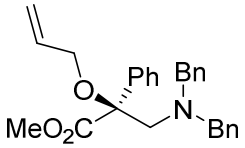
(*S*)-**4B**: 88% yield, 90% ee.

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.26 – 7.10 (m, 15H), 3.94 (d, *J* = 13.6 Hz, 2H), 3.77 – 3.69 (m, 1H), 3.55 (d, *J* = 1.0 Hz, 3H), 3.35 (d, *J* = 13.6 Hz, 2H), 3.30 (d, *J* = 13.4 Hz, 1H), 3.13 (d, *J* = 13.3 Hz, 1H), 1.18 (d, *J* = 5.9 Hz, 3H), 0.50 (d, *J* = 5.8 Hz, 3H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 173.2, 139.7, 139.4, 129.5, 128.1, 128.0, 128.0, 127.7, 126.7, 87.6, 68.8, 61.0, 58.8, 51.5, 24.3, 23.5.

**HRMS-ESI:** calcd. for $C_{27}H_{32}NO_3$ $[M + H]^+$: 418.2377 found: 418.2371

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 8.91 min, $t_{minor}$ = 6.77 min.




(*S*)-**4C**

**(*S*)-Methyl 2-(allyloxy)-3-(dibenzylamino)-2-phenylpropanoate**

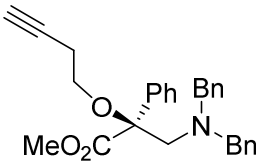
(*S*)-**4C**: 85% yield, 89% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.46 – 7.21 (m, 15H), 6.00 – 5.85 (m, 1H), 5.26 (dd, *J* = 17.2, 1.7 Hz, 1H), 5.10 (dd, *J* = 10.5, 1.6 Hz, 1H), 4.21 – 4.10 (m, 1H), 3.97 (d, *J* = 13.7 Hz, 2H), 3.73 (s, 3H), 3.69 – 3.61 (m, 1H), 3.56 (d, *J* = 13.7 Hz, 2H), 3.34 (d, *J* = 13.8 Hz, 1H), 3.30 (d, *J* = 13.8 Hz, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 139.3, 138.5, 135.1, 129.4, 128.3, 128.1, 128.1, 127.0, 126.8, 115.8, 87.6, 66.7, 60.6, 58.7, 51.9.

**HRMS-ESI:** calcd. for $C_{27}H_{30}NO_3$ $[M + H]^+$: 416.2220 found: 416.2217

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 5.88 min, $t_{minor}$ = 4.87 min.




(*S*)-**4D**

**(*S*)-Methyl 2-(but-3-yn-1-yloxy)-3-(dibenzylamino)-2-phenylpropanoate**

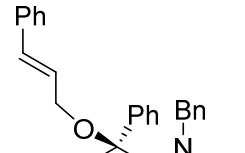
(*S*)-**4D**: 82% yield, 83% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.45 – 7.26 (m, 15H), 4.01 (d, *J* = 13.7 Hz, 2H), 3.80 – 3.68 (m, 4H), 3.58 (d, *J* = 13.7 Hz, 2H), 3.34 (d, *J* = 13.8 Hz, 1H), 3.30 – 3.19 (m, 2H), 2.58 – 2.40 (m, 2H), 1.90 (t, *J* = 2.5 Hz, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.2, 139.3, 138.2, 129.4, 128.3, 128.2, 128.1, 127.1, 126.8, 87.9, 81.4, 69.2, 63.7, 60.9, 58.8, 51.8, 20.2.

**HRMS-ESI:** calcd. for $C_{28}H_{30}NO_3$ $[M + H]^+$: 428.2220 found: 428.2217

**HPLC:** (Chiral OD-H, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.19 min, $t_{minor}$ = 6.89 min.




(*S*)-**4E**

**(*S*)-Methyl 2-(cinnamyloxy)-3-(dibenzylamino)-2-phenylpropanoate**

(*S*)-**4E**: 90% yield, 87% ee.

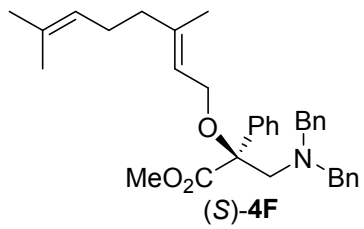
**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.43 – 7.38 (m, 2H), 7.37 – 7.30 (m, 3H), 7.30 – 7.16 (m, 15H), 6.50 (d, *J* = 15.9 Hz, 1H), 6.23 (dt, *J* = 15.9, 5.7 Hz, 1H), 4.28 – 4.19 (m, 1H), 3.95 (d, *J* = 13.7 Hz, 2H), 3.81 – 3.73 (m, 1H), 3.70 (s, 3H), 3.52 (d, *J* = 13.7 Hz, 2H), 3.32 (d, *J* = 14.0 Hz, 1H), 3.28 (d, *J* = 13.9 Hz,

1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 139.3, 138.5, 137.0, 131.2, 129.3, 128.4, 128.3, 128.1, 128.1, 127.4, 127.1, 126.7, 126.5, 126.4, 87.6, 66.4, 60.8, 58.8, 51.9.

**HRMS-ESI:** calcd. for $C_{33}H_{34}NO_3$ $[M + H]^+$: 492.2533 found: 492.2535

**HPLC:** (Chiral IE, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 8.48 min, $t_{minor}$ = 9.70 min.




(*S*)-**4F**

**(*S, E*)-Methyl 3-(dibenzylamino)-2-((3,7-dimethylocta-2,6-dien-1-yl)oxy)-2-phenylpropanoate**

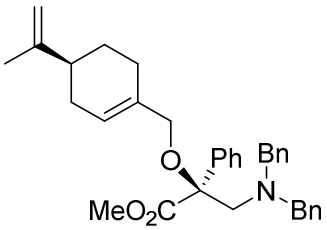
(*S, E*)-**4F**: 90% yield, 90% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.48 (d, *J* = 7.0 Hz, 2H), 7.44 – 7.26 (m, 13H), 5.44 (t, *J* = 6.4 Hz, 1H), 5.15 (t, *J* = 6.6 Hz, 1H), 4.21 (dd, *J* = 11.0, 6.4 Hz, 1H), 3.97 (d, *J* = 13.7 Hz, 2H), 3.76 (s, 3H), 3.72 (dd, *J* = 10.6, 3.7 Hz, 1H), 3.62 (d, *J* = 13.7 Hz, 2H), 3.38 (d, *J* = 13.8 Hz, 1H), 3.33 (d, *J* = 13.8 Hz, 1H), 2.18 – 2.08 (m, 2H), 2.09 – 2.00 (m, 2H), 1.73 (s, 3H), 1.65 (s, 3H), 1.60 (s, 3H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.5, 139.4, 139.0, 138.9, 131.5, 129.4, 128.2, 128.1, 127.9, 127.1, 126.7, 124.1, 121.3, 87.2, 62.4, 60.3, 58.8, 51.8, 39.6, 26.5, 25.7, 17.7, 16.5.

**HRMS-ESI:** calcd. for $C_{34}H_{42}NO_3$ $[M + H]^+$: 512.3159 found: 512.3150

**HPLC:** (Chiral IC, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.20 min, $t_{minor}$ = 5.38 min.




**4G**

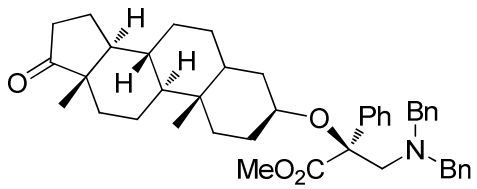
**(*S*)-Methyl 3-(dibenzylamino)-2-phenyl-2-(((S)-4-(prop-1-en-2-yl)cyclohex-1-en-1-yl)methoxy)propanoate**

(*S, S*)-**4G**: 90% yield, *dr* > 95:5

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.30 – 7.26 (m, 2H), 7.25 – 7.20 (m, 3H), 7.20 – 7.16 (m, 4H), 7.14 – 7.10 (m, 6H), 5.54 (s, 1H), 4.58 (d, *J* = 7.9 Hz, 2H), 3.91 (d, *J* = 10.7 Hz, 1H), 3.80 (d, *J* = 13.7 Hz, 2H), 3.58 (s, 3H), 3.44 (d, *J* = 13.7 Hz, 2H), 3.35 (d, *J* = 10.8 Hz, 1H), 3.23 (d, *J* = 13.8 Hz, 1H), 3.16 (d, *J* = 13.8 Hz, 1H), 2.07 – 1.89 (m, 4H), 1.80 (t, *J* = 13.8 Hz, 1H), 1.70 – 1.63 (m, 1H), 1.61 (s, 3H), 1.38 – 1.26 (m, 1H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 171.3, 149.0, 138.3, 137.6, 133.7, 128.3, 127.1, 127.0, 126.9, 126.0, 125.7, 122.0, 107.4, 86.1, 68.6, 59.3, 57.6, 50.7, 40.0, 29.4, 26.4, 25.6, 19.7.

**HRMS-ESI:** calcd. for $C_{34}H_{40}NO_3$ $[M + H]^+$: 510.3003 found: 510.3001



**4H**

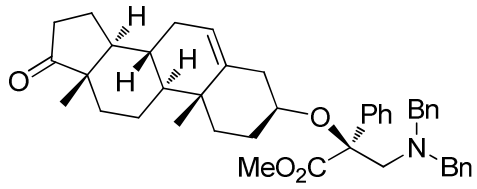
**(S)-Methyl**
**3-(dibenzylamino)-2-(((3S,5S,8R,9S,10S,13S,14S)-10,13-dimethyl-17-oxohexadecahydro-1H-cyclopenta[a]phenanthren-3-yl) oxy)-2-phenylpropanoate**

**4H**: 95% yield, *dr* > 95:5

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.36 – 7.26 (m, 8H), 7.26 – 7.17 (m, 8H), 3.99 (d, *J* = 13.6 Hz, 2H), 3.61 (s, 3H), 3.49 – 3.33 (m, 4H), 3.20 (d, *J* = 13.4 Hz, 1H), 2.45 – 2.34 (m, 1H), 2.18 – 2.07 (m, 1H), 2.07 – 1.96 (m, 1H), 1.90 – 1.81 (m, 1H), 1.77 – 1.71 (m, 1H), 1.62 – 1.54 (m, 2H), 1.49 – 1.39 (m, 3H), 1.20 – 1.12 (m, 2H), 1.10 – 0.99 (m, 2H), 0.94 – 0.77 (m, 7H), 0.76 – 0.67 (m, 4H), 0.58 – 0.48 (m, 2H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 221.5, 173.1, 140.0, 139.4, 129.5, 128.1, 128.0, 127.5, 126.7, 87.1, 75.3, 60.8, 58.9, 54.5, 51.6, 51.4, 47.8, 44.9, 37.3, 36.3, 35.9, 35.5, 35.0, 31.6, 30.8, 29.7, 28.5, 21.8, 20.4, 13.8, 12.2.

**HRMS-ESI:** calcd. for $C_{43}H_{54}NO_4$ $[M + H]^+$: 648.4047 found: 648.4045



**4I**

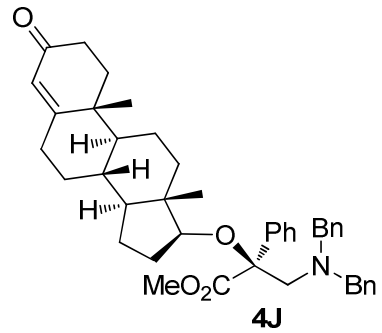
**(*S*)-Methyl**
**3-(dibenzylamino)-2-(((3S,8R,9S,10R,13S,14S)-10,13-dimethyl-17-oxo-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a]phenanthren-3-yl)oxy)-2-phenylpropanoate**

**4I**: 93% yield, *dr* > 95:5

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.37 – 7.28 (m, 6H), 7.28 – 7.26 (m, 2H), 7.26 – 7.17 (m, 7H), 4.80 – 4.68 (m, 1H), 4.07 (d, *J* = 13.6 Hz, 2H), 3.62 (s, 3H), 3.44 – 3.33 (m, 4H), 3.23 (d, *J* = 13.3 Hz, 1H), 2.46 – 2.38 (m, 1H), 2.25 – 2.15 (m, 1H), 2.11 – 2.00 (m, 1H), 1.96 – 1.72 (m, 5H), 1.55 – 1.38 (m, 5H), 1.24 – 1.15 (m, 2H), 1.13 – 1.05 (m, 1H), 1.04 – 0.96 (m, 1H), 0.92 – 0.79 (m, 8H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 221.3, 173.0, 141.7, 139.9, 139.4, 129.5, 128.2, 128.1, 128.0, 127.6, 126.7, 120.1, 87.6, 75.9, 60.8, 58.9, 51.8, 51.6, 50.3, 47.6, 40.6, 37.6, 36.6, 35.9, 31.5, 31.4, 30.8, 30.0, 21.9, 20.3, 19.3, 13.5.

**HRMS-ESI:** calcd. for $C_{43}H_{52}NO_4$ $[M + H]^+$: 646.3891 found: 646.3888




**4J**

**(*S*)-Methyl**

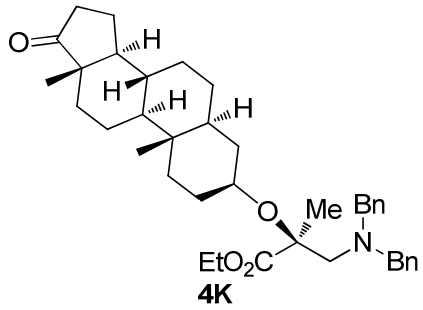
**3-(dibenzylamino)-2-(((8R,9S,10R,13S,14S,17S)-10,13-dimethyl-3-oxo-2,3,6,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[a]phenanthren-17-yl) oxy)-2-phenylpropanoate**

**4J**: 92% yield, *dr* > 95:5

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.34 – 7.29 (m, 3H), 7.30 – 7.24 (m, 7H), 7.21 – 7.16 (m, 5H), 5.68 (s, 1H), 3.92 (d, *J* = 13.7 Hz, 2H), 3.60 (s, 3H), 3.48 (s, 1H), 3.46 – 3.36 (m, 3H), 3.19 (d, *J* = 13.4 Hz, 1H), 2.42 – 2.25 (m, 3H), 2.24 – 2.13 (m, 2H), 1.96 – 1.88 (m, 1H), 1.86 – 1.71 (m, 2H), 1.62 – 1.41 (m, 4H), 1.25 – 1.15 (m, 2H), 1.13 – 1.05 (m, 4H), 0.94 – 0.81 (m, 2H), 0.77 – 0.64 (m, 5H), 0.29 – 0.17 (m, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 199.6, 173.1, 171.5, 139.9, 139.3, 129.4, 128.2, 128.0, 127.8, 126.7, 123.7, 87.7, 84.7, 61.1, 58.7, 53.7, 51.6, 50.0, 42.8, 38.6, 35.7, 35.6, 35.5, 34.0, 32.8, 31.5, 30.0, 23.6, 20.6, 17.4, 12.1.

**HRMS-ESI:** calcd. for $C_{43}H_{52}NO_4$ $[M + H]^+$: 646.3891 found: 646.3876




**4K**

**(*S*)-Ethyl**

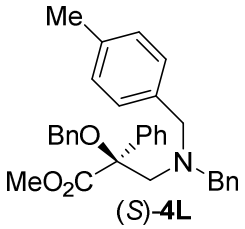
**3-(dibenzylamino)-2-(((3S,5S,8R,9S,10S,13S,14S)-10,13-dimethyl-17-oxohexadecahydro-1H-cyclopenta[a]phenanthren-3-yl)oxy)-2-methylpropanoate**

**4K**: 96% yield, *dr* > 95:5

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.34 – 7.26 (m, 8H), 7.25 – 7.18 (m, 2H), 4.14 – 3.98 (m, 2H), 3.75 (d, *J* = 13.7 Hz, 2H), 3.56 (d, *J* = 13.7 Hz, 2H), 3.39 – 3.26 (m, 1H), 2.78 (d, *J* = 13.5 Hz, 1H), 2.72 (d, *J* = 13.5 Hz, 1H), 2.47 – 2.36 (m, 1H), 2.10 – 1.85 (m, 3H), 1.81 – 1.73 (m, 2H), 1.71 – 1.57 (m, 3H), 1.51 – 1.42 (m, 3H), 1.38 – 1.32 (m, 4H), 1.27 – 1.22 (m, 4H), 1.18 (t, *J* = 7.0 Hz, 3H), 1.10 – 1.01 (m, 1H), 0.97 – 0.87 (m, 2H), 0.83 (s, 3H), 0.78 (s, 3H), 0.63 (t, *J* = 10.9 Hz, 1H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 221.5, 174.2, 139.7, 129.2, 128.1, 126.8, 82.5, 74.9, 62.0, 60.7, 59.3, 54.6, 51.4, 47.8, 45.2, 37.8, 37.4, 35.9, 35.6, 35.0, 31.6, 31.0, 29.5, 28.6, 21.8, 21.0, 20.4, 14.1, 13.8, 12.3.

**HRMS-ESI:** calcd. for $C_{39}H_{54}NO_4$ $[M + H]^+$: 600.4047 found: 600.4041




(*S*)-**4L**

**(*S*)-Methyl 3-(benzyl(4-methylbenzyl)amino)-2-(benzyloxy)-2-phenylpropanoate**

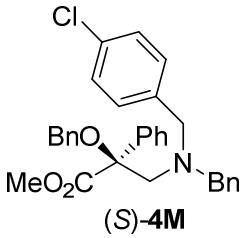
(*S*)-**4L**: 95% yield, 90% ee.

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.41 (d, *J* = 7.5 Hz, 2H), 7.36 – 7.27 (m, 5H), 7.26 – 7.16 (m, 8H), 7.10 (d, *J* = 7.6 Hz, 2H), 7.06 (d, *J* = 7.7 Hz, 2H), 4.71 (d, *J* = 11.2 Hz, 1H), 4.07 (d, *J* = 11.2 Hz, 1H), 3.93 (d, *J* = 13.7 Hz, 1H), 3.88 (d, *J* = 13.7 Hz, 1H), 3.70 (s, 3H), 3.50 (d, *J* = 5.5 Hz, 1H), 3.47 (d, *J* = 5.4 Hz, 1H), 3.34 (d, *J* = 13.9 Hz, 1H), 3.29 (d, *J* = 13.8 Hz, 1H), 2.30 (s, 3H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 172.4, 139.4, 138.8, 138.6, 136.2, 136.1, 129.4, 128.8, 128.3, 128.2, 128.1, 127.5, 127.2, 127.2, 126.7, 87.8, 67.6, 60.9, 58.6, 58.3, 51.9, 21.2.

**HRMS-ESI:** calcd. for $C_{32}H_{34}NO_3$ $[M + H]^+$: 480.2533 found: 480.2532

**HPLC:** (Chiral IA, λ = 254 nm, hexane/2-propanol = 300/1, Flow rate = 1.0 mL/min), $t_{major}$ = 6.76 min, $t_{minor}$ = 5.36 min.




(*S*)-**4M**

**(*S*)-Methyl 3-(benzyl(4-chlorobenzyl)amino)-2-(benzyloxy)-2-phenylpropanoate**

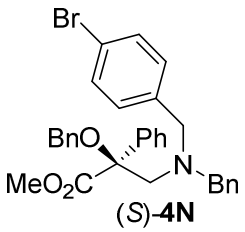
(*S*)-**4M**: 92% yield, 94% ee.

**$^1$H NMR** (500 MHz, $CDCl_3$) δ 7.40 (d, *J* = 7.3 Hz, 2H), 7.37 – 7.31 (m, 3H), 7.30 – 7.19 (m, 10H), 7.17 (d, *J* = 7.5 Hz, 2H), 7.13 (d, *J* = 7.9 Hz, 2H), 4.70 (d, *J* = 11.1 Hz, 1H), 4.07 (d, *J* = 11.1 Hz, 1H), 3.93 (d, *J* = 13.8 Hz, 1H), 3.88 (d, *J* = 13.7 Hz, 1H), 3.70 (s, 3H), 3.49 (d, *J* = 7.6 Hz, 1H), 3.46 (d, *J* = 7.7 Hz, 1H), 3.33 (d, *J* = 13.9 Hz, 1H), 3.28 (d, *J* = 13.8 Hz, 1H).

**$^{13}$C NMR** (125 MHz, $CDCl_3$) δ 172.3, 138.9, 138.7, 138.3, 137.9, 132.4, 130.6, 129.3, 128.4, 128.3, 128.2, 128.2, 128.1, 127.5, 127.3, 127.1, 126.9, 87.8, 67.7, 61.0, 58.8, 58.1, 52.6, 51.9.

**HRMS-ESI:** calcd. for $C_{31}H_{31}ClNO_3$ $[M + H]^+$: 500.1987 found: 500.1983

**HPLC:** (Chiral IA, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 9.74 min, $t_{minor}$ = 8.73 min.




(*S*)-**4N**

**(*S*)-Methyl 3-(benzyl(4-bromobenzyl)amino)-2-(benzyloxy)-2-phenylpropanoate**

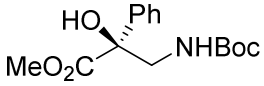
(*S*)-**4N**: 92% yield, 92% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.42 – 7.30 (m, 7H), 7.29 – 7.15 (m, 10H), 7.08 (d, *J* = 8.3 Hz, 2H), 4.70 (d, *J* = 11.1 Hz, 1H), 4.07 (d, *J* = 11.1 Hz, 1H), 3.92 (d, *J* = 14.0 Hz, 1H), 3.88 (d, *J* = 13.9 Hz, 1H), 3.70 (s, 3H), 3.49 (d, *J* = 10.5 Hz, 1H), 3.45 (d, *J* = 10.6 Hz, 1H), 3.33 (d, *J* = 13.8 Hz, 1H), 3.28 (d, *J* = 13.8 Hz, 1H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 172.3, 138.9, 138.7, 138.5, 138.3, 131.1, 131.0, 129.3, 128.4, 128.3, 128.2, 128.1, 127.5, 127.3, 127.1, 126.9, 120.5, 87.8, 67.7, 61.0, 58.9, 58.1, 51.9.

**HRMS-ESI:** calcd. for $C_{31}H_{31}BrNO_3$ $[M + H]^+$: 544.1482 found: 544.1479

**HPLC:** (Chiral IA, λ = 254 nm, hexane/2-propanol = 100/1, Flow rate = 1.0 mL/min), $t_{major}$ = 15.39 min, $t_{minor}$ = 14.24 min.




(*S*)-**7a**

**(*S*)-Methyl 3-((*tert*-butoxycarbonyl)amino)-2-hydroxy-2-phenylpropanoate**

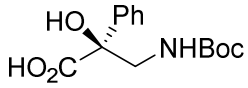
(*S*)-**7a**: 96% yield, 95% ee.

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.70 – 7.52 (m, 2H), 7.47 – 7.29 (m, 3H), 5.03 (s, 1H), 4.32 (s, 1H), 4.12 (d, *J* = 13.7 Hz, 1H), 3.79 (s, 3H), 3.46 (d, *J* = 13.9 Hz, 1H), 1.42 (s, 9H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 174.2, 156.3, 139.0, 128.4, 128.3, 125.6, 79.9, 78.9, 53.4, 48.6, 28.3.

**HRMS-ESI:** calcd. for $C_{15}H_{21}NO_5Na$ $[M + Na]^+$: 318.1317 found: 318.1317

**HPLC:** (Chiral OD-H, λ= 210 nm, hexane/2-propanol = 50/1, Flow rate = 1.0 mL/min), $t_{major}$ = 20.03 min, $t_{minor}$ = 22.11 min.




(*S*)-**8a**

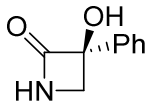
**(*S*)-3-((*tert*-butoxycarbonyl) amino)-2-hydroxy-2-phenylpropanoic acid**

(*S*)-**8a**: 99% yield, 95% ee

**$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.68 (M, 2H), 7.35 (M, 3H), 5.26 (s, 1H), 4.06 – 3.76 (m, 1H), 3.73 – 3.34 (m, 1H), 1.43 (s, 9H).

**$^{13}$C NMR** (100 MHz, $CDCl_3$) δ 174.3, 159.1, 138.0, 128.5, 125.5, 81.6, 80.8, 49.8, 28.2.

**HRMS-ESI:** calcd. for $C_{14}H_{19}NO_5Na$ $[M + Na]^+$: 304.1161 found: 304.1146.




(*S*)-**10a**

**(*S*)-3-hydroxy-3-phenylazetidin-2-one**

(*S*)-**10a**: 56% yield, 93% ee.

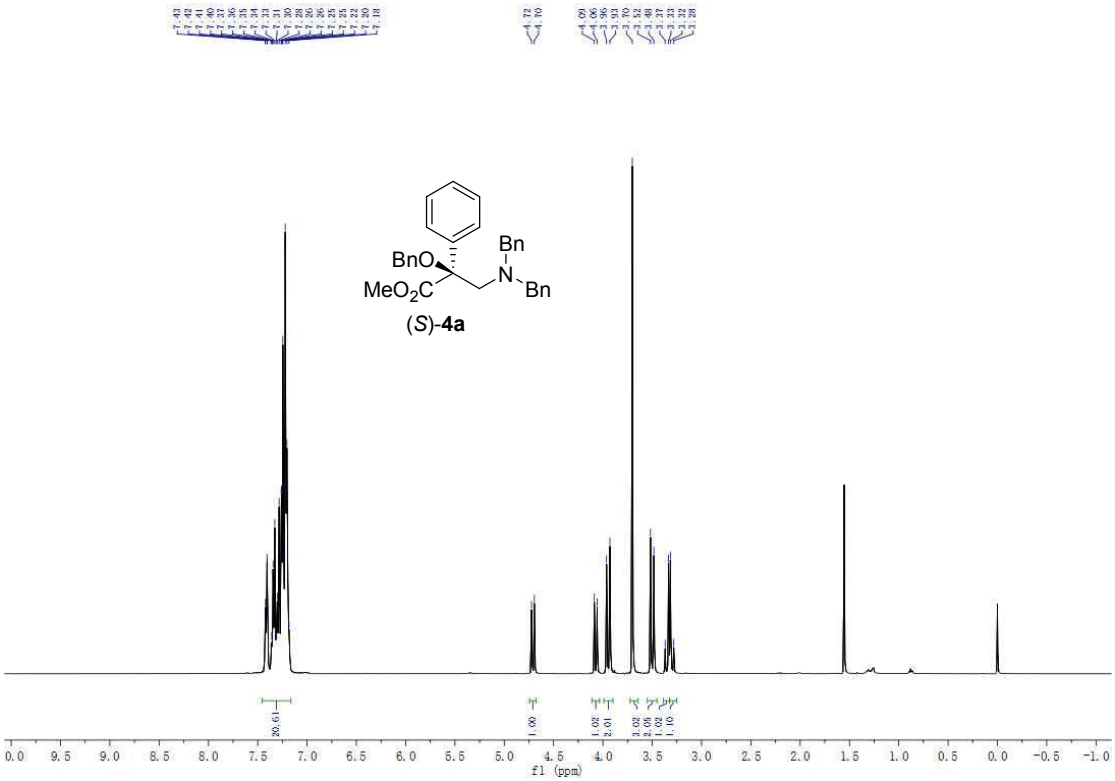
**$^1$H NMR** (400 MHz, Acetone) δ 7.47 – 7.41 (m, 2H), 7.29 – 7.14 (m, 4H), 5.55 (s, 1H), 3.43 (s, 2H).

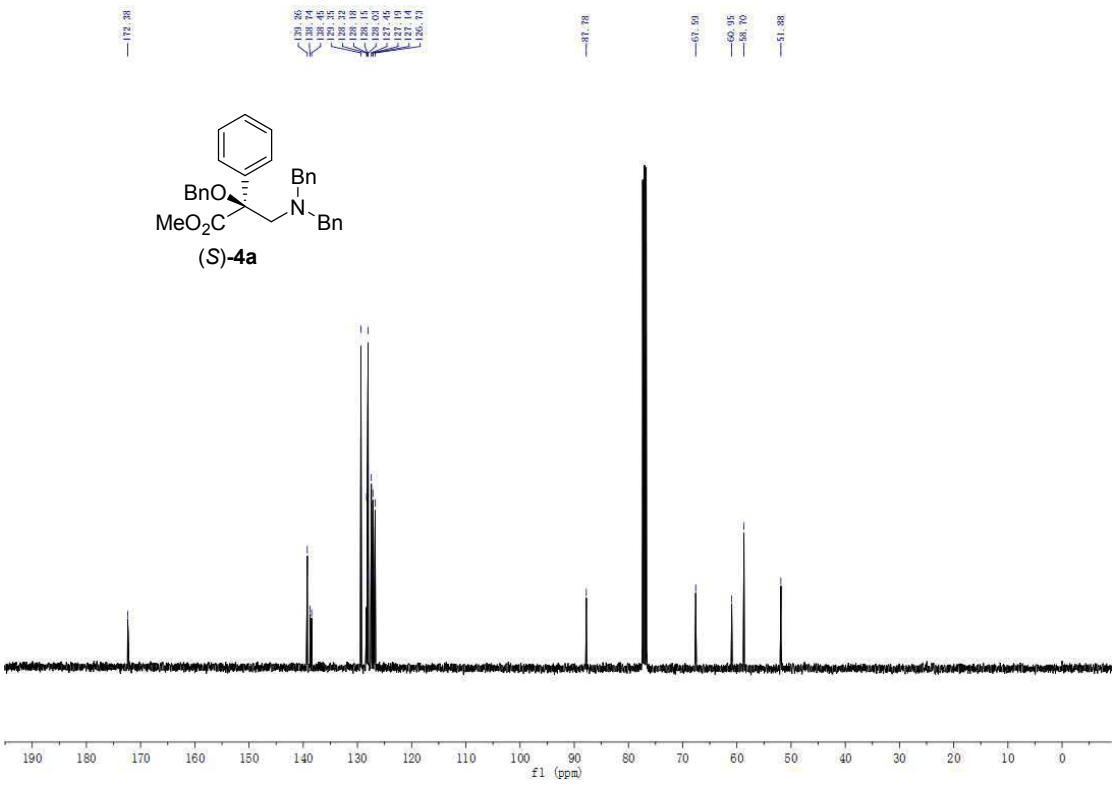
**$^{13}$C NMR** (100 MHz, Acetone) δ 170.9, 140.9, 129.1, 128.6, 126.3, 88.5, 54.4.

**HPLC:** (Chiral OD-H, λ= 210 nm, hexane/2-propanol = 10/1, Flow rate = 1.0 mL/min), $t_{major}$ = 14.50 min, $t_{minor}$ = 13.06 min.

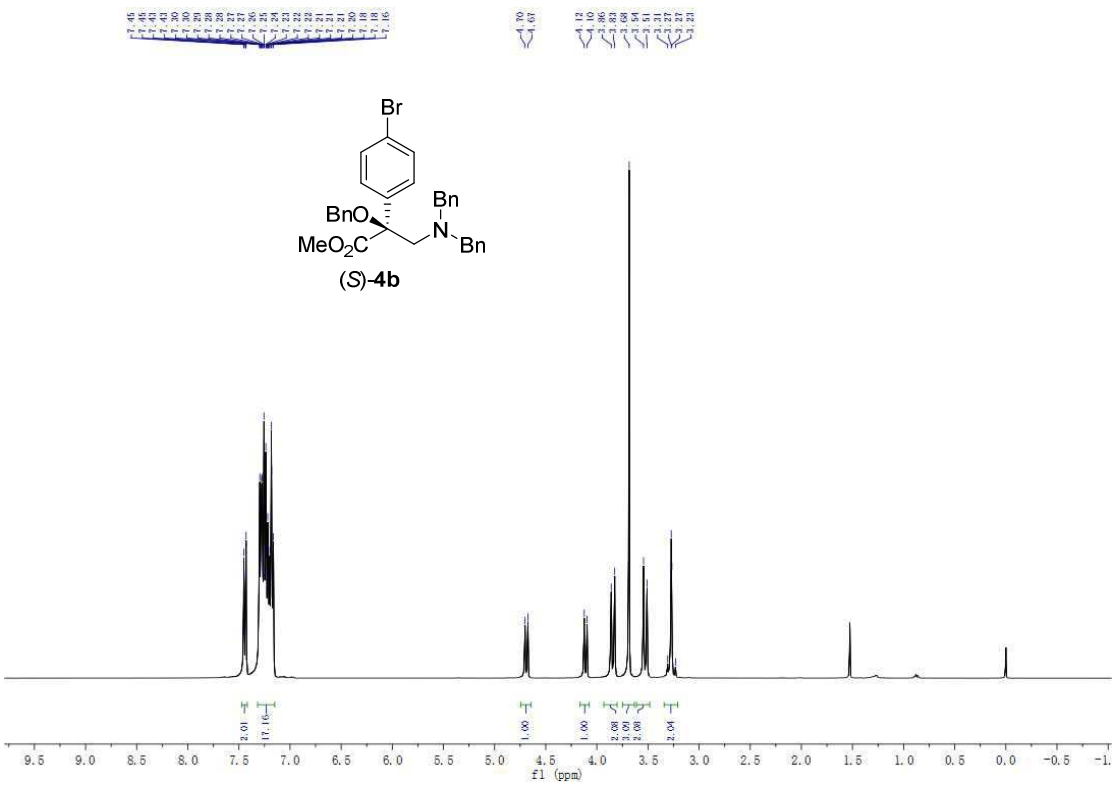
# 10. NMR spectra of products

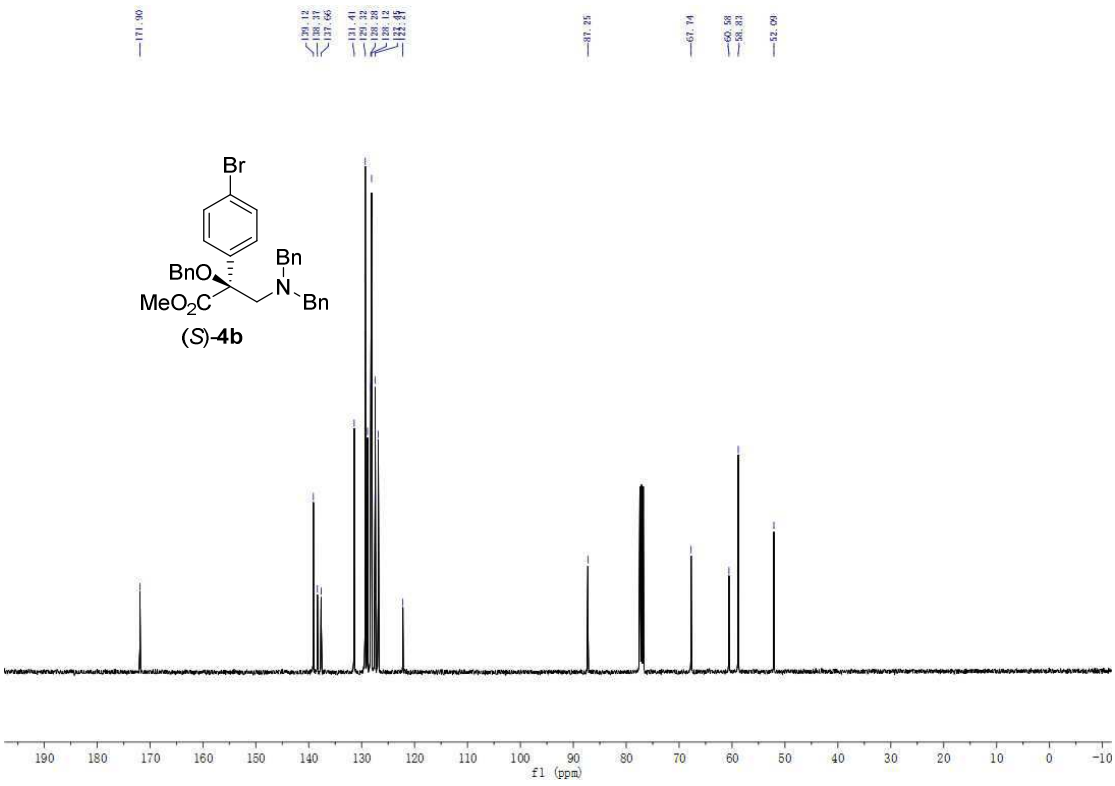
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4a**



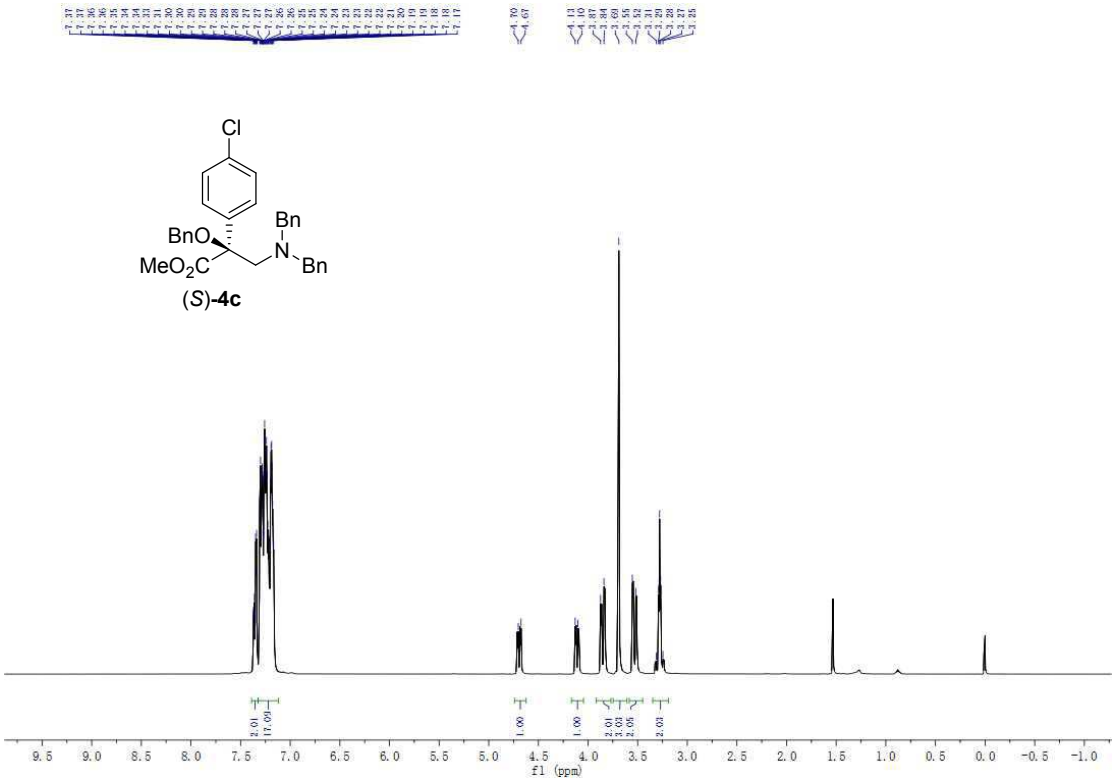



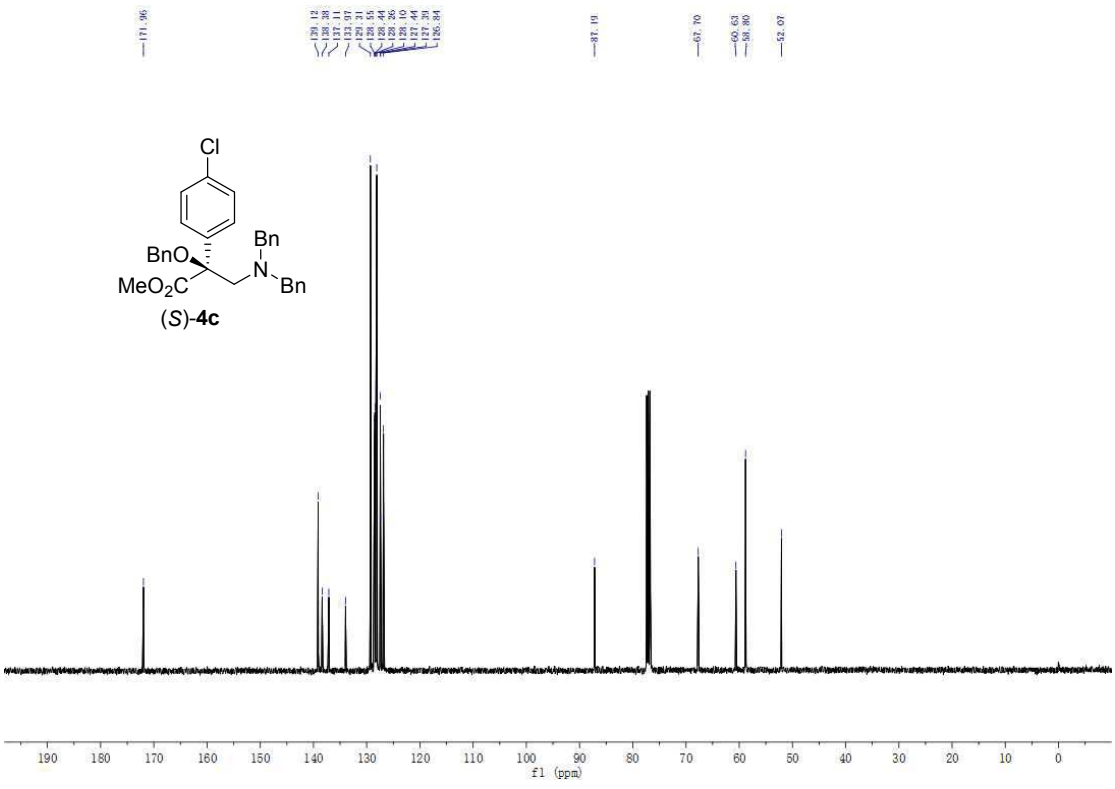
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4b**



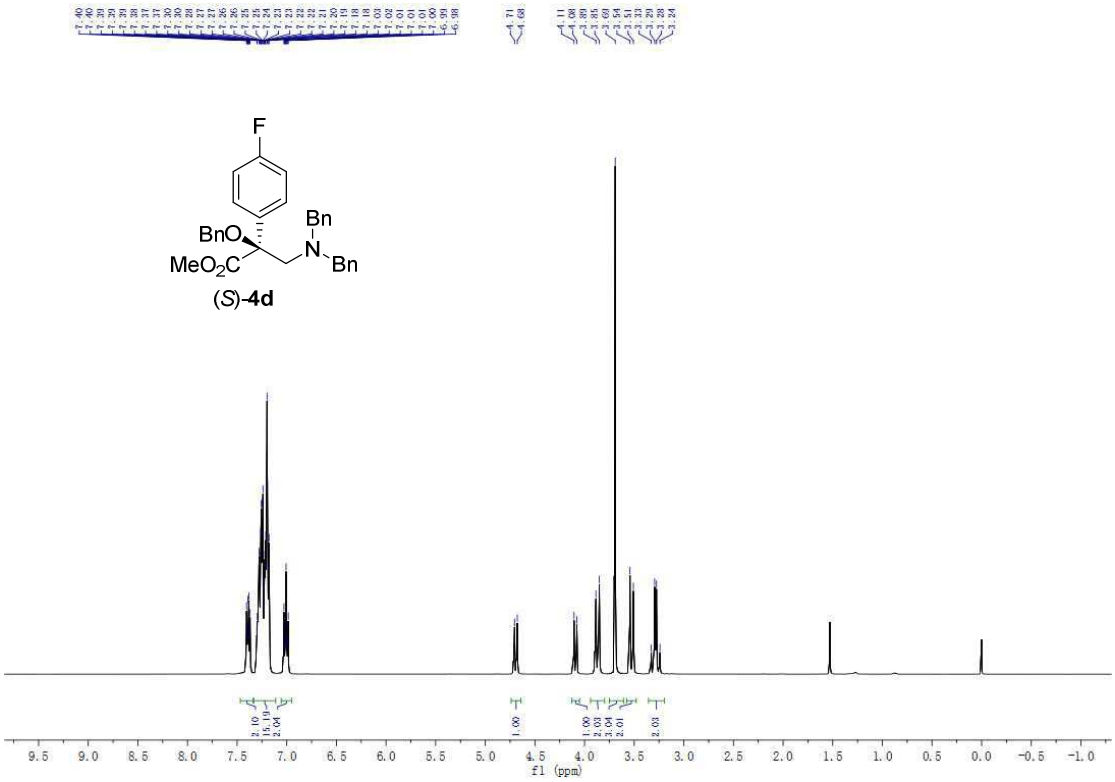



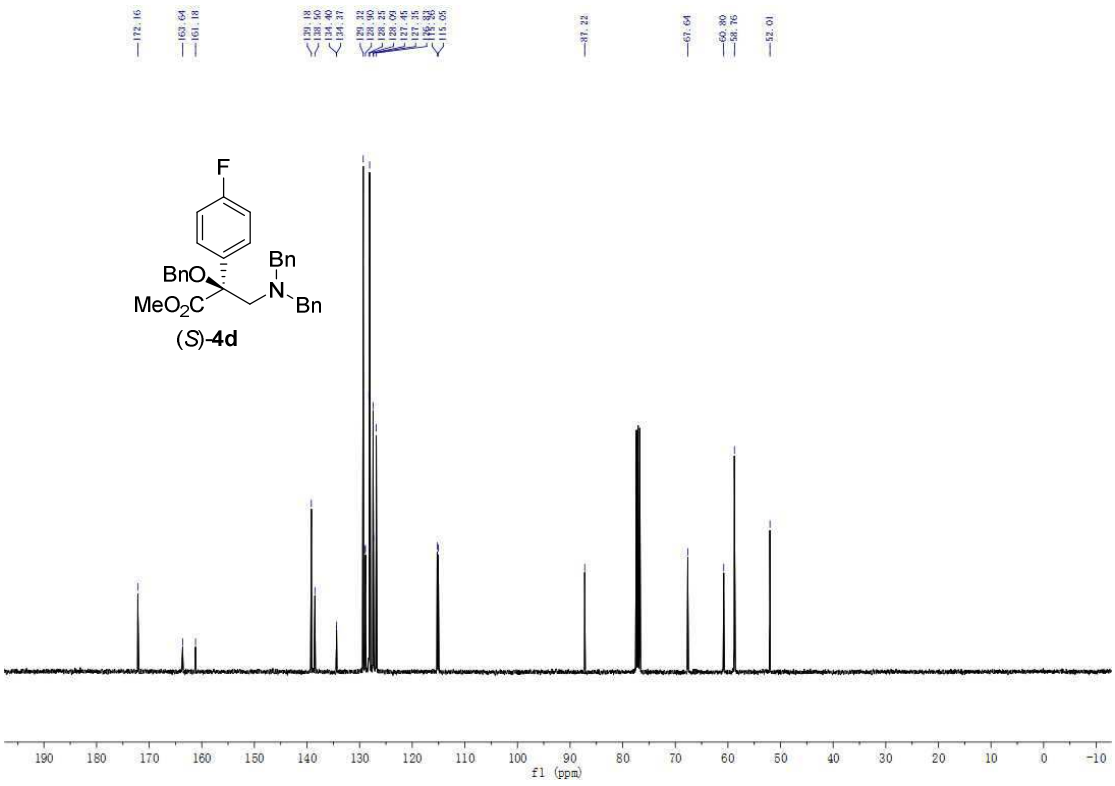
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4c**



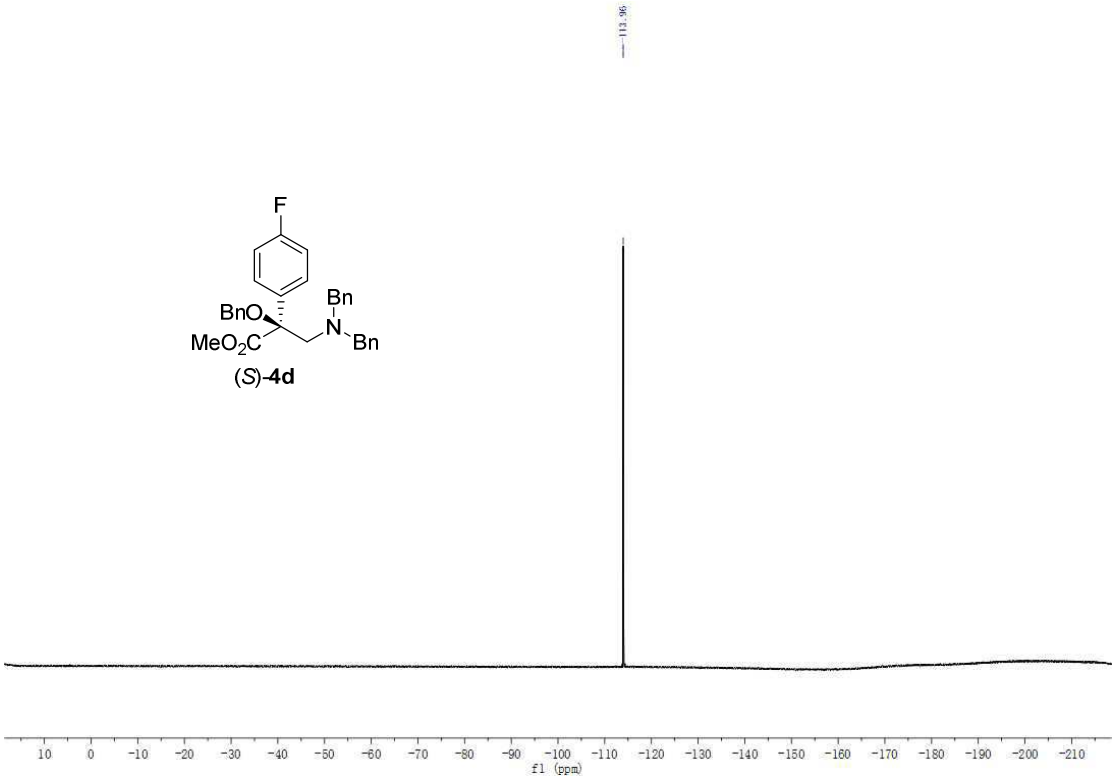



**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4d**

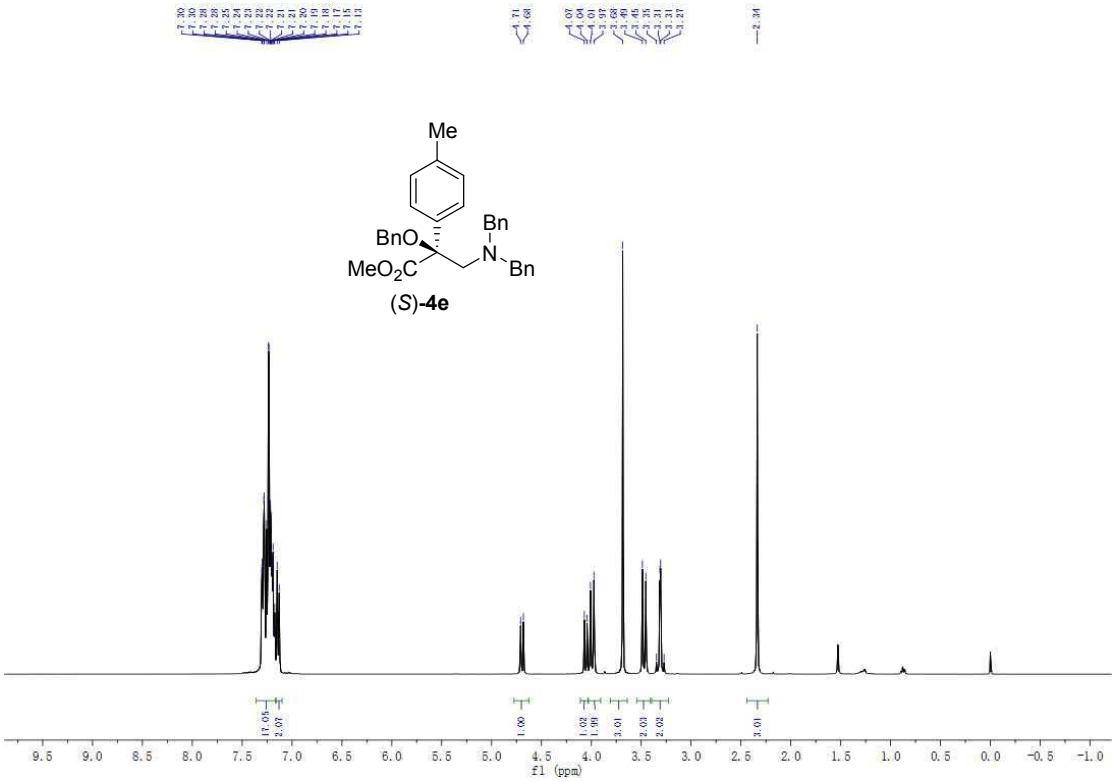


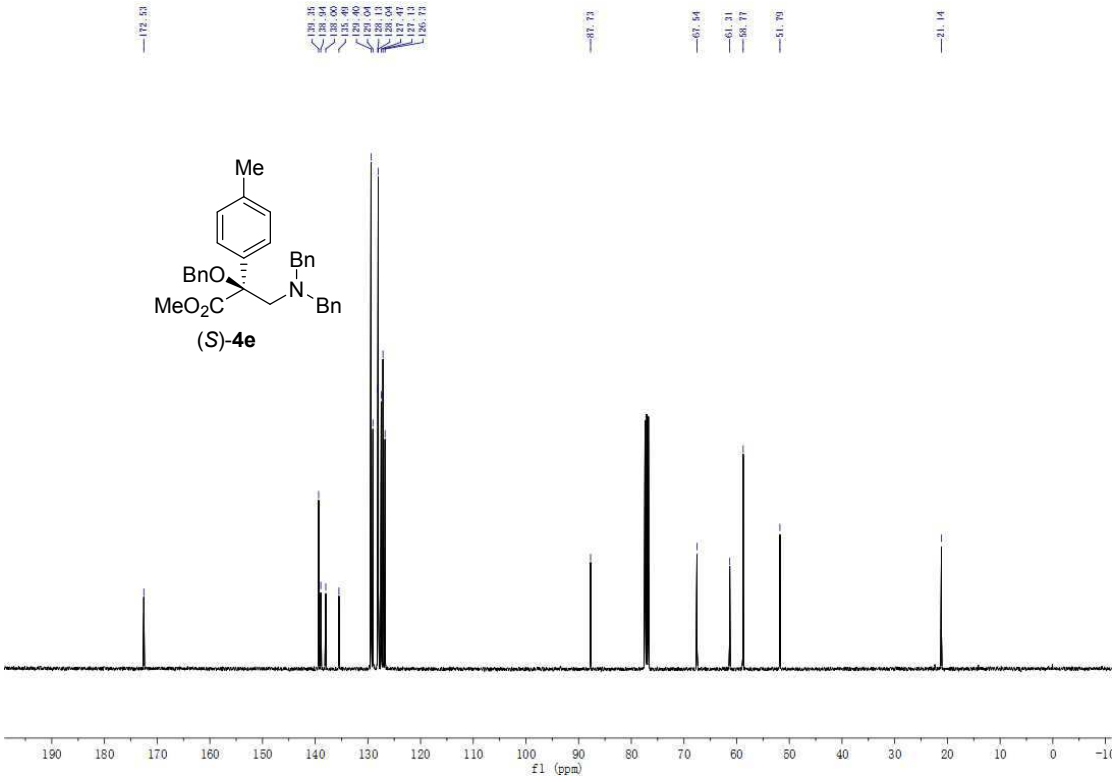



**$^{19}$F NMR (376 MHz, $CDCl_3$) spectra for (*S*)-4d**

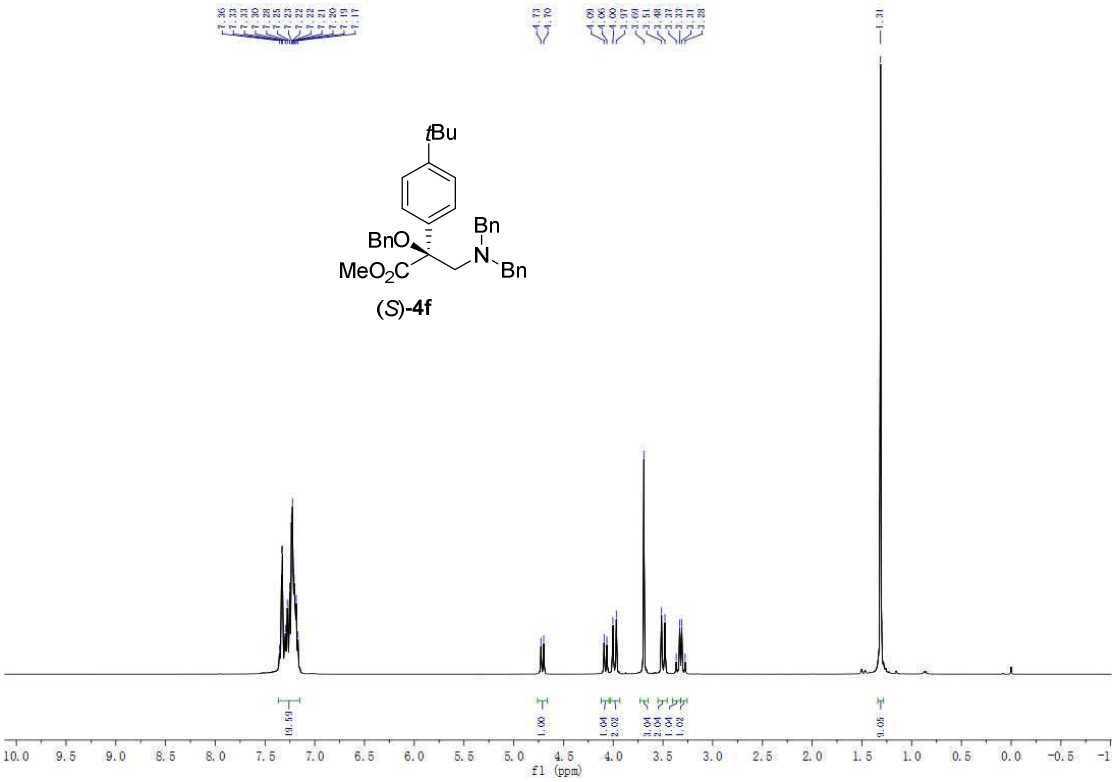


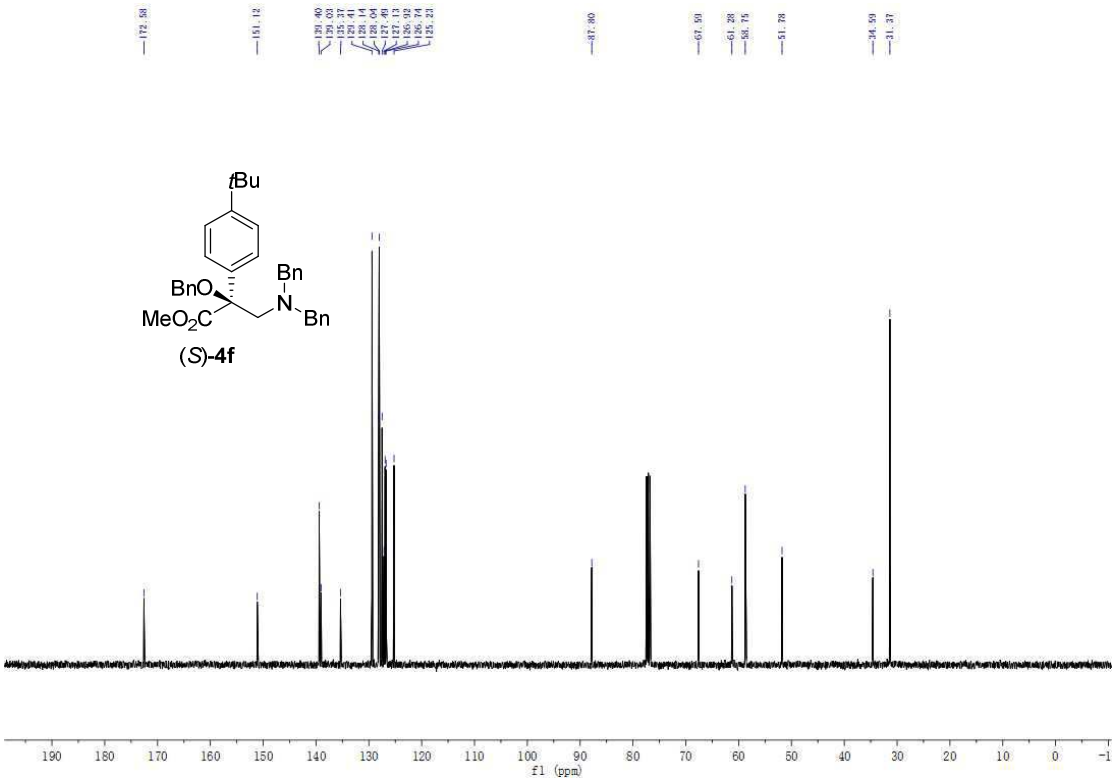
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4e**



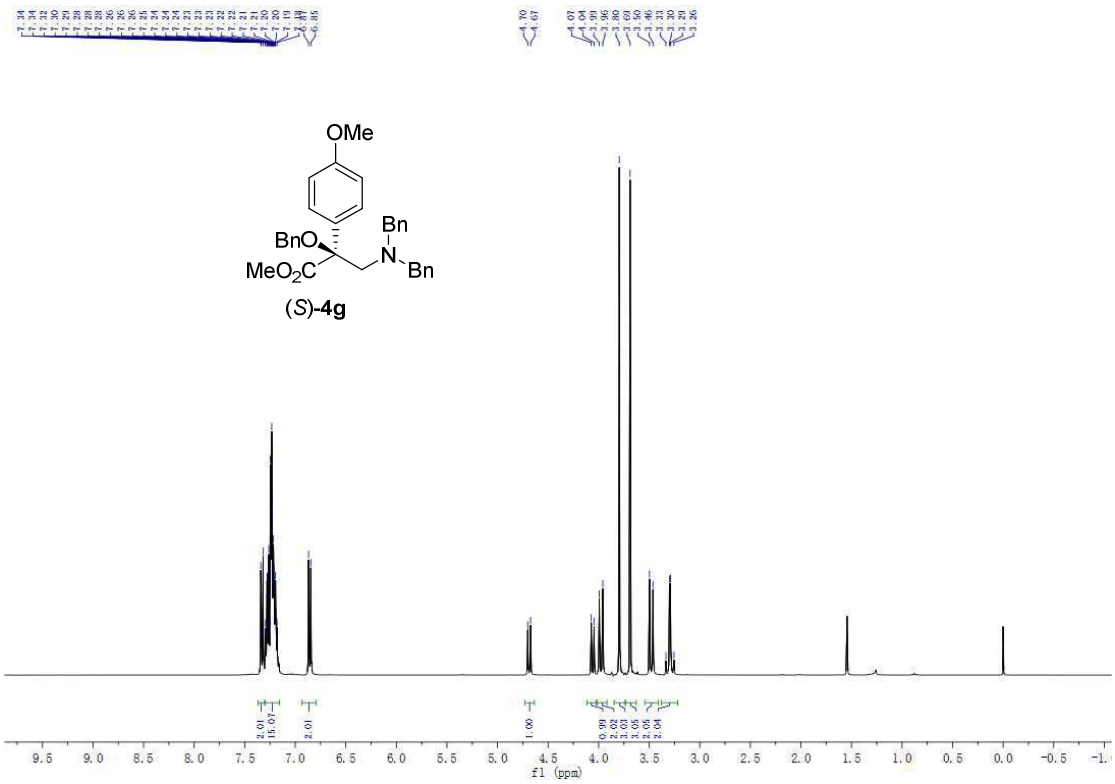



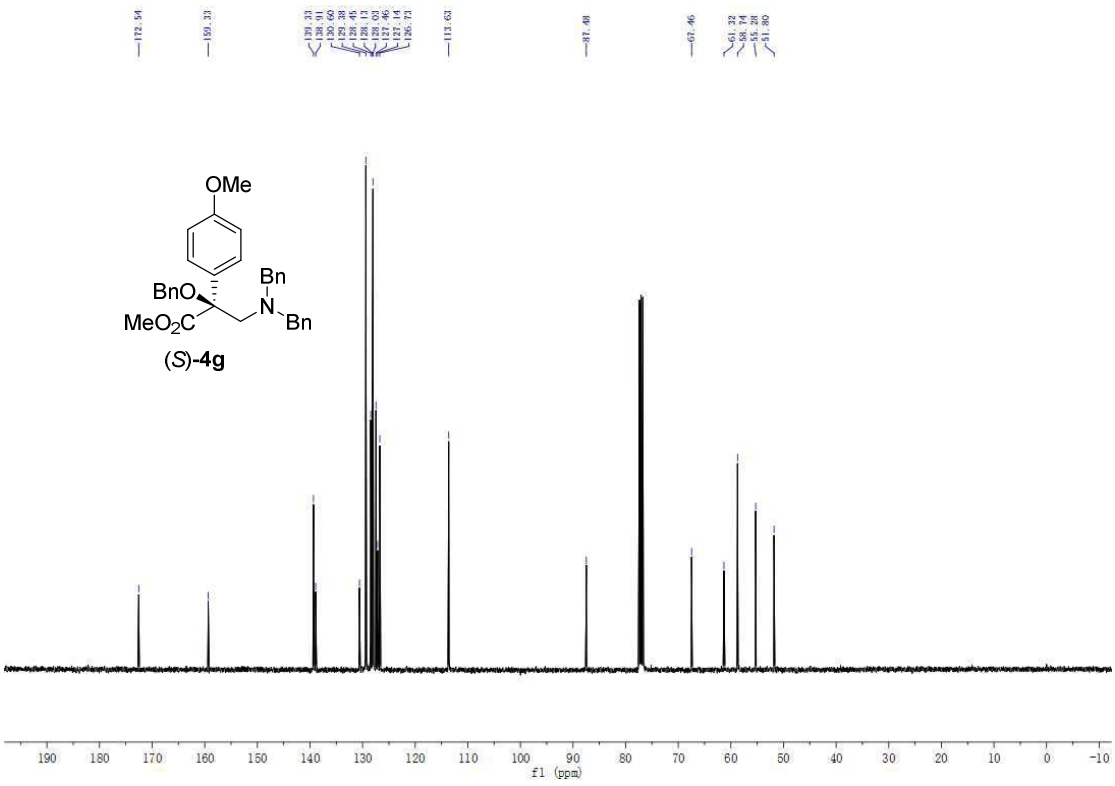
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4f**



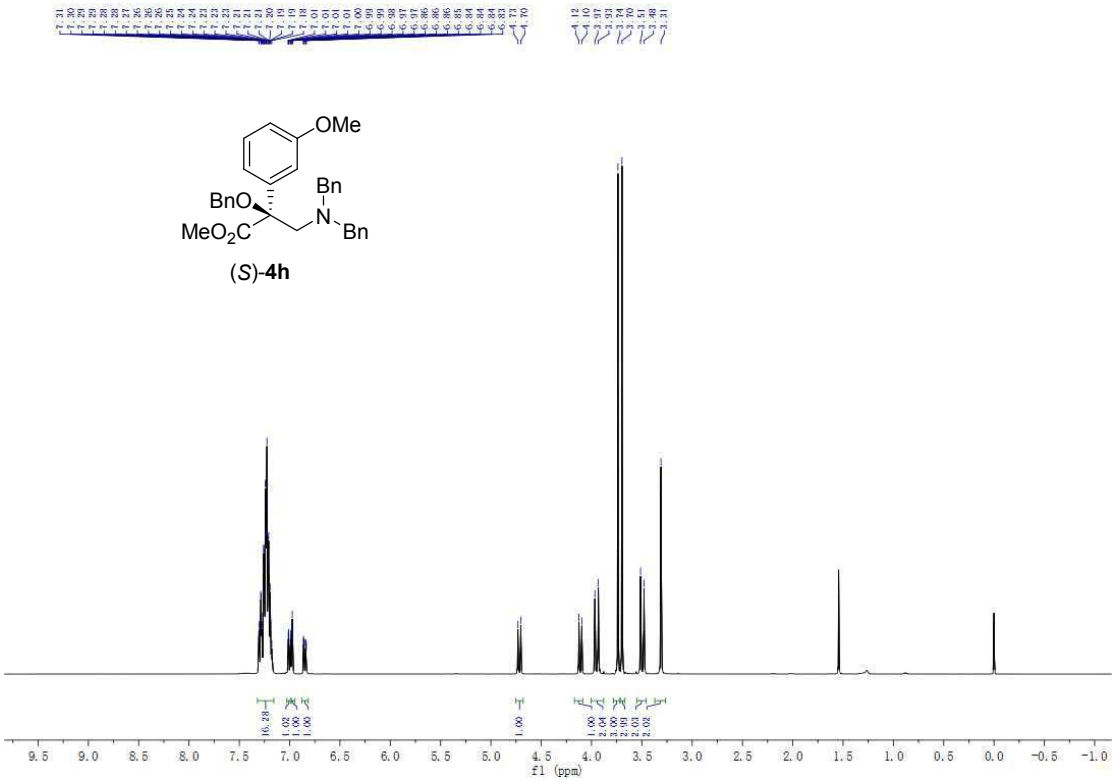



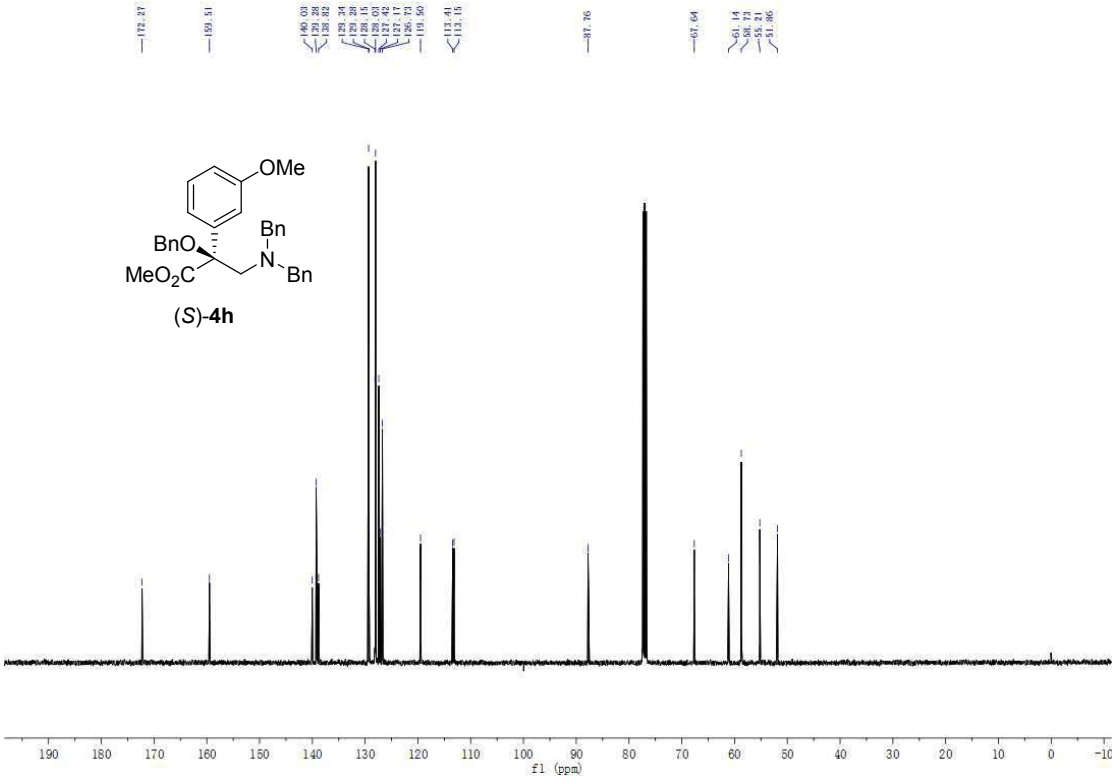
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4g**



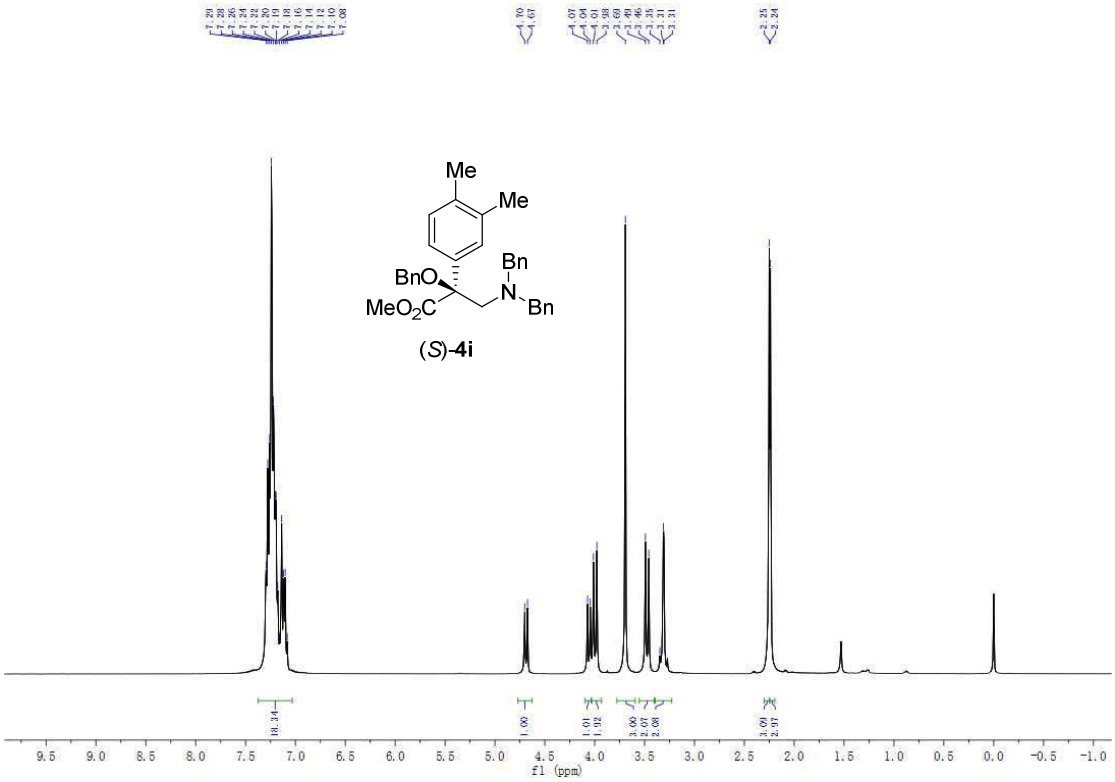



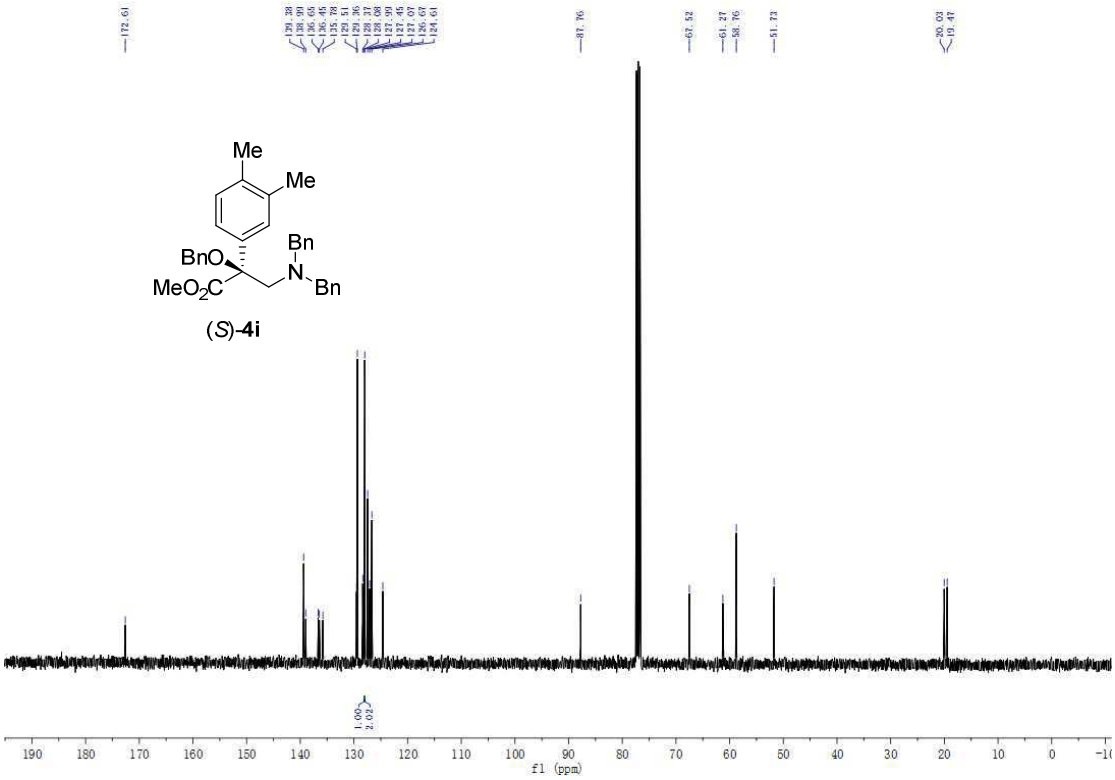
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4h**



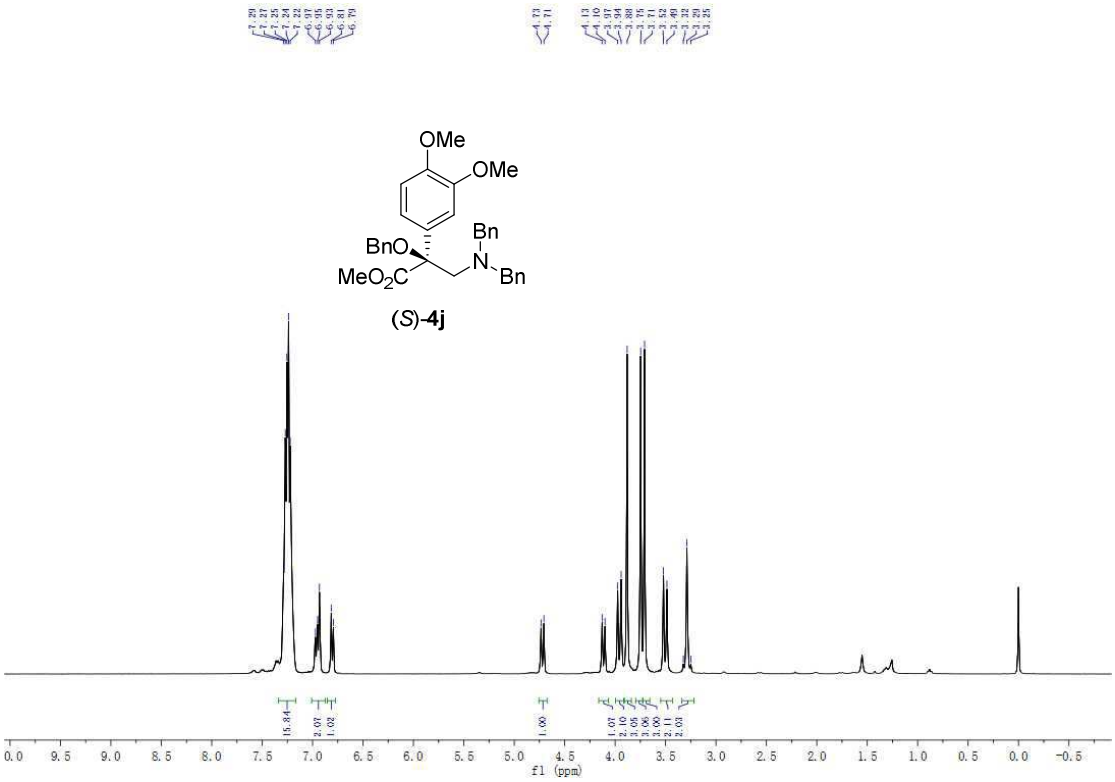



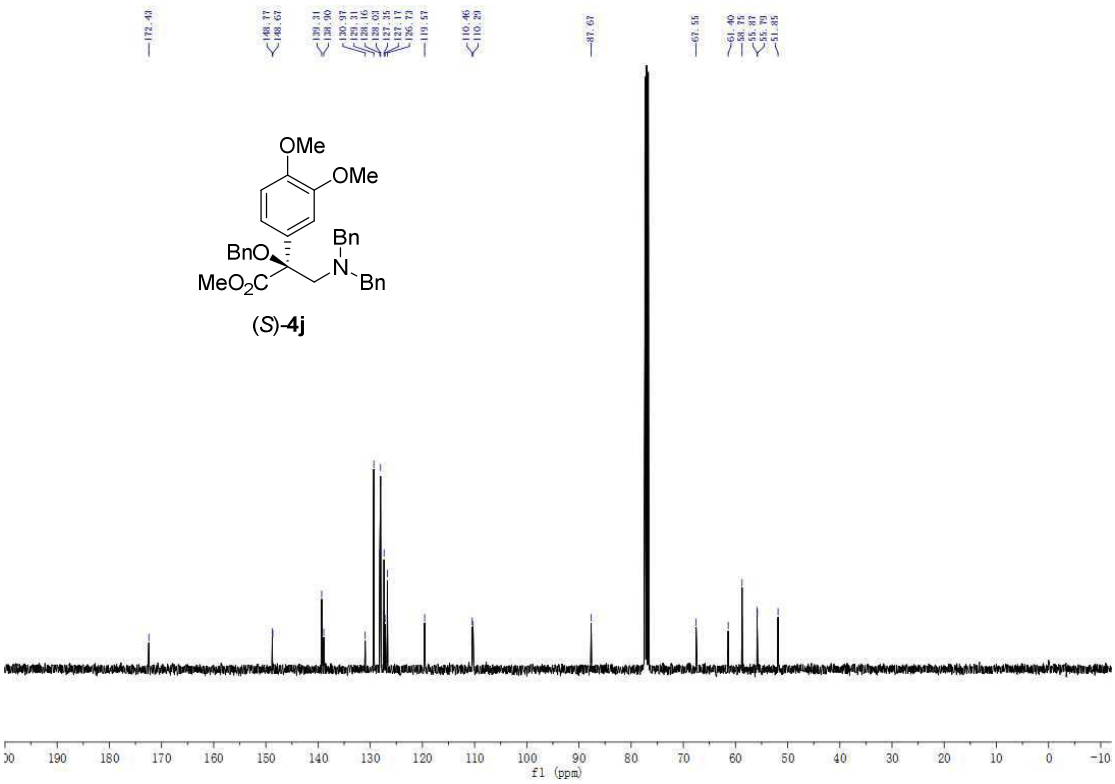
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4i**



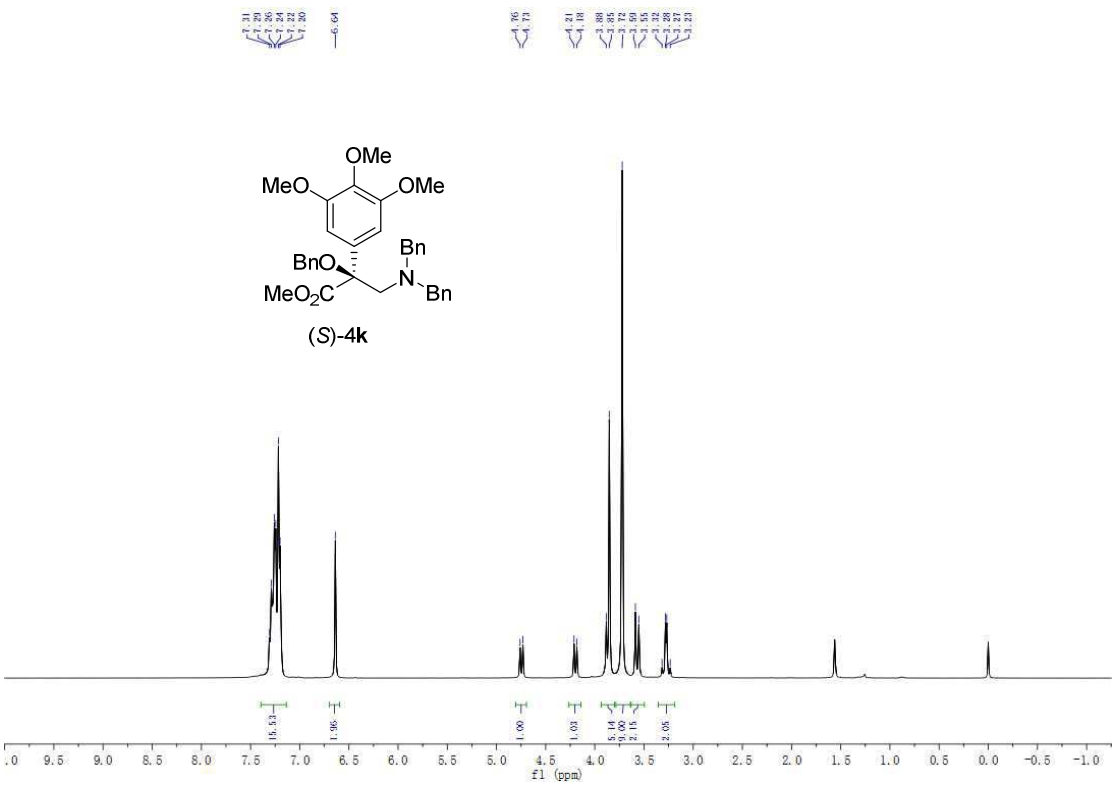



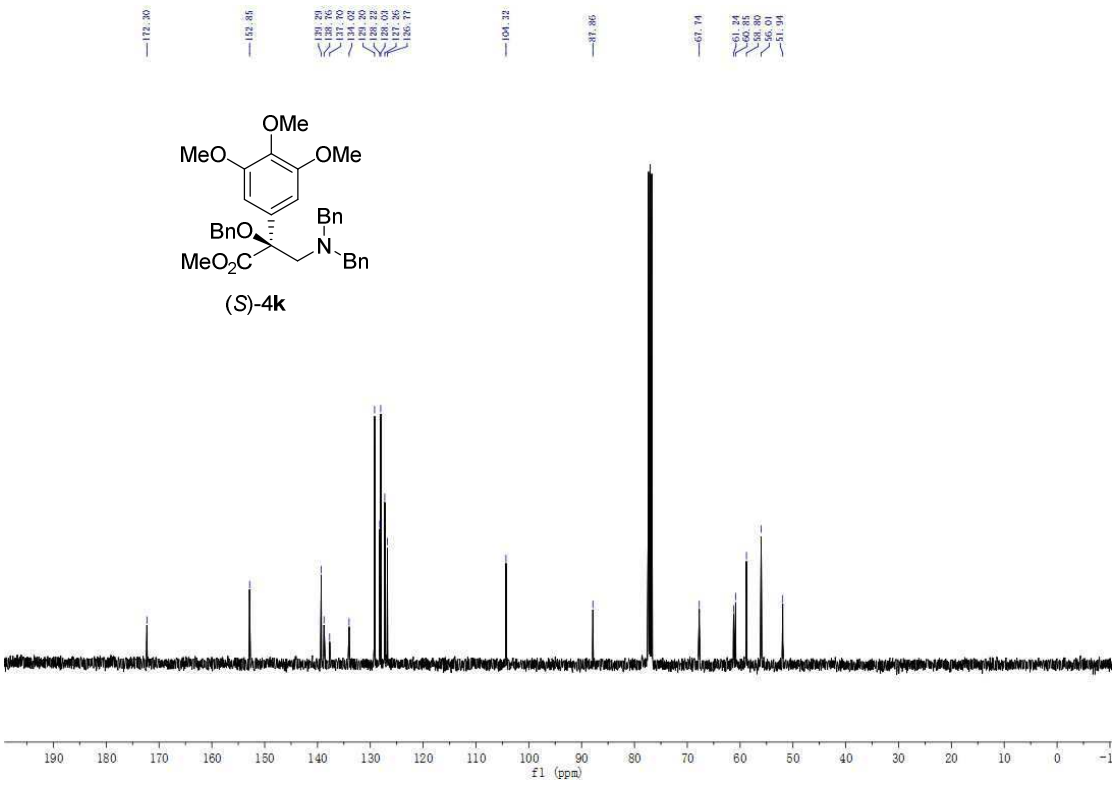
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4j**



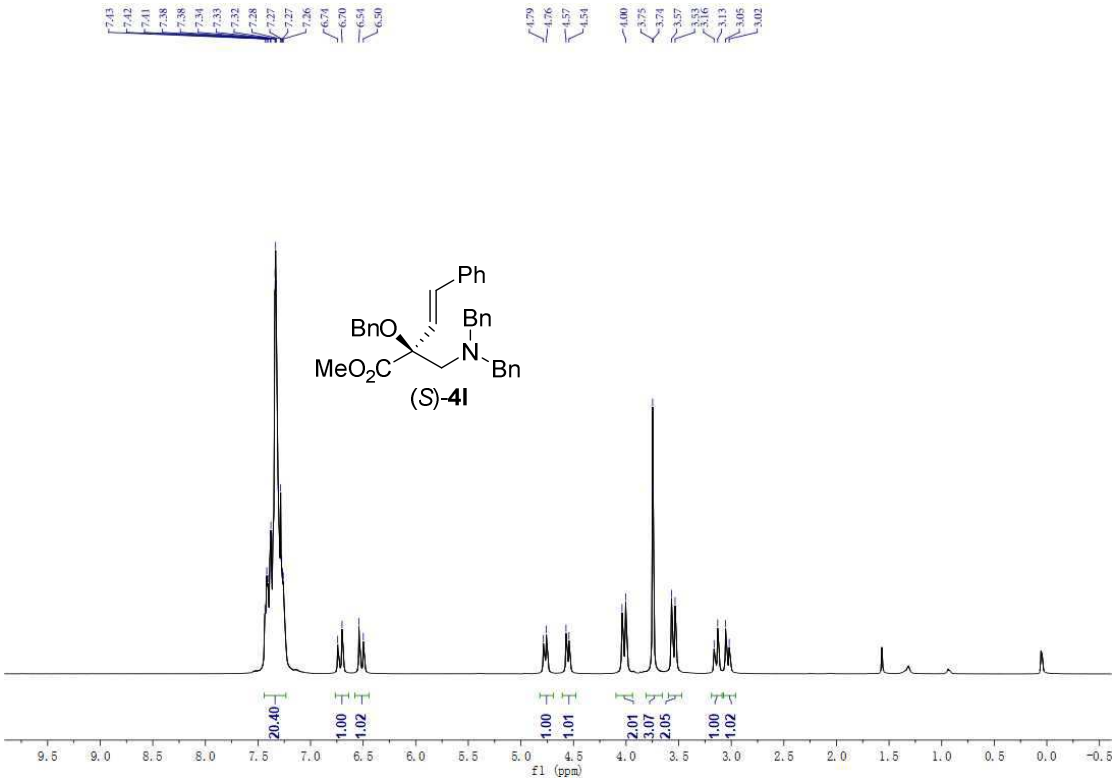



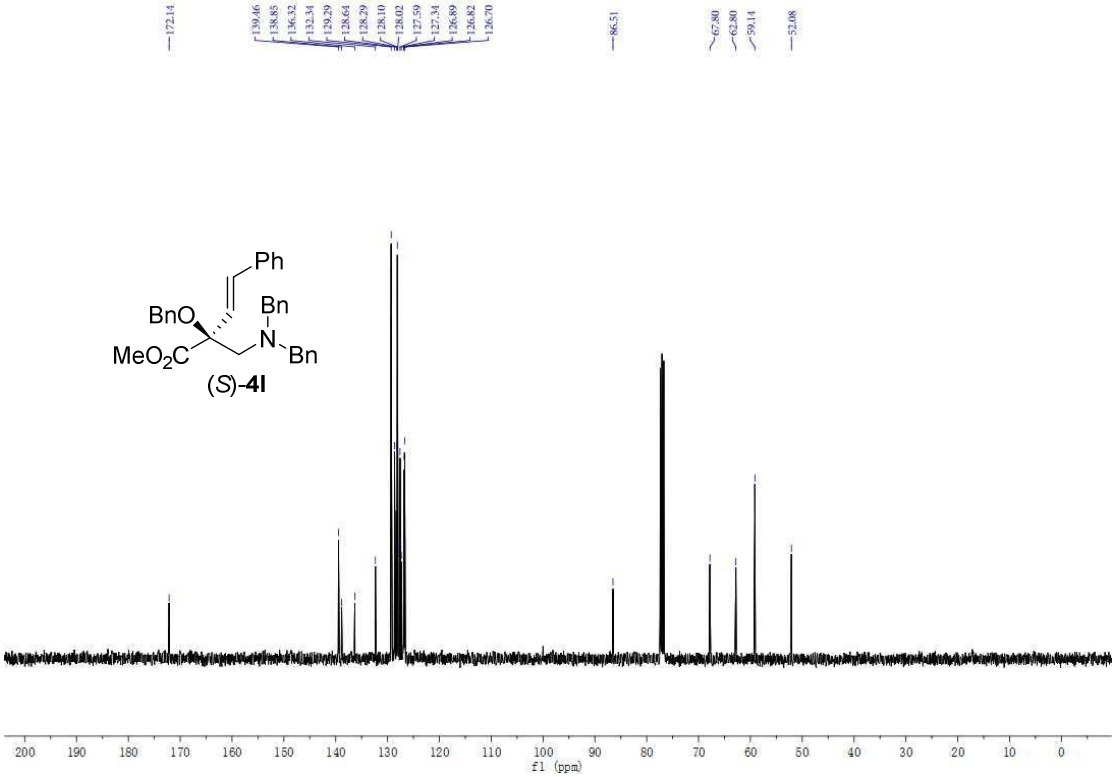
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4k**



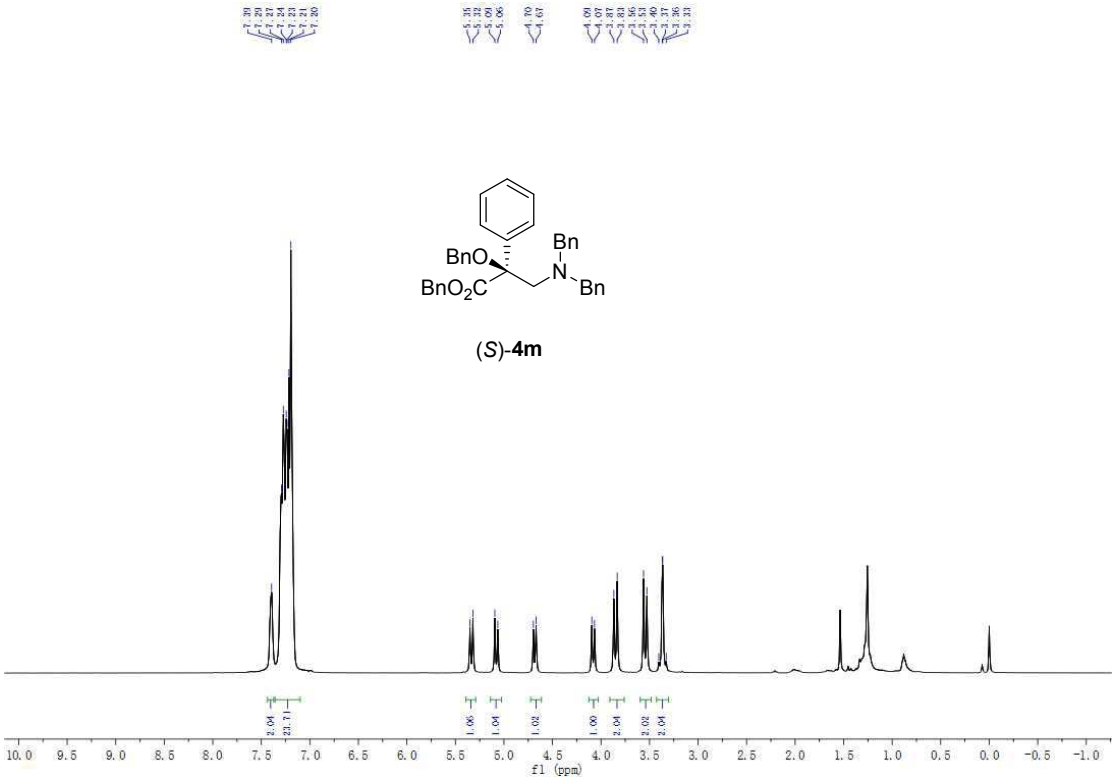



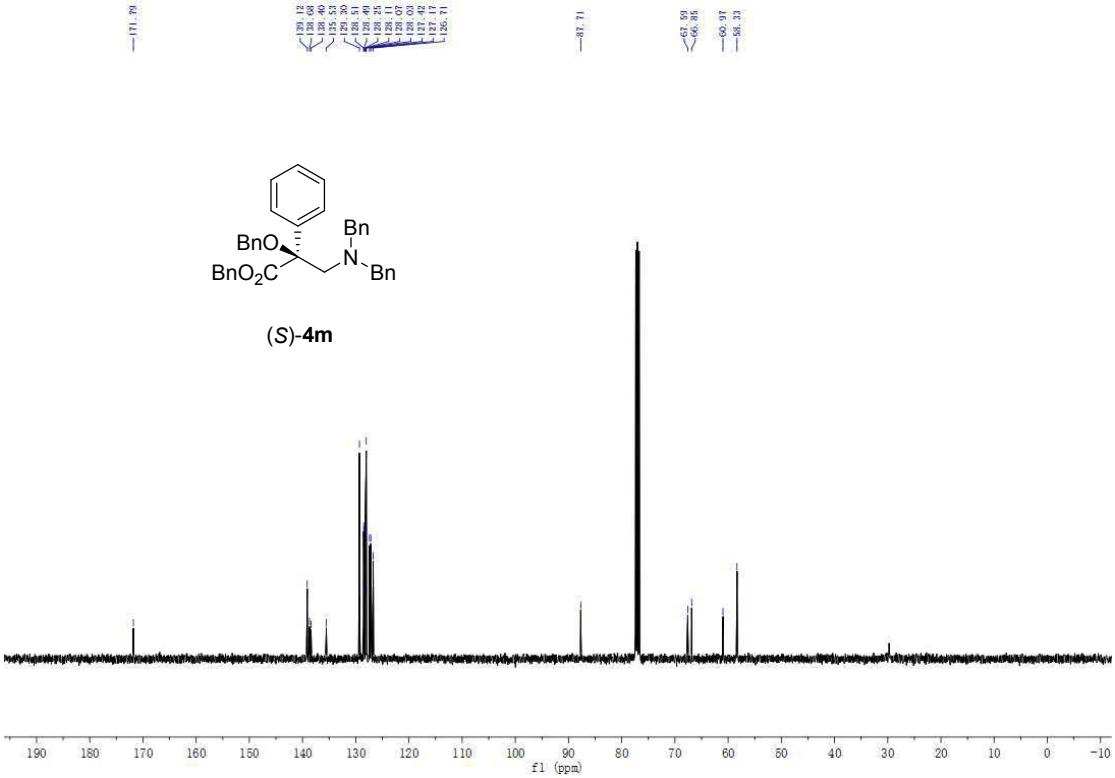
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4l**



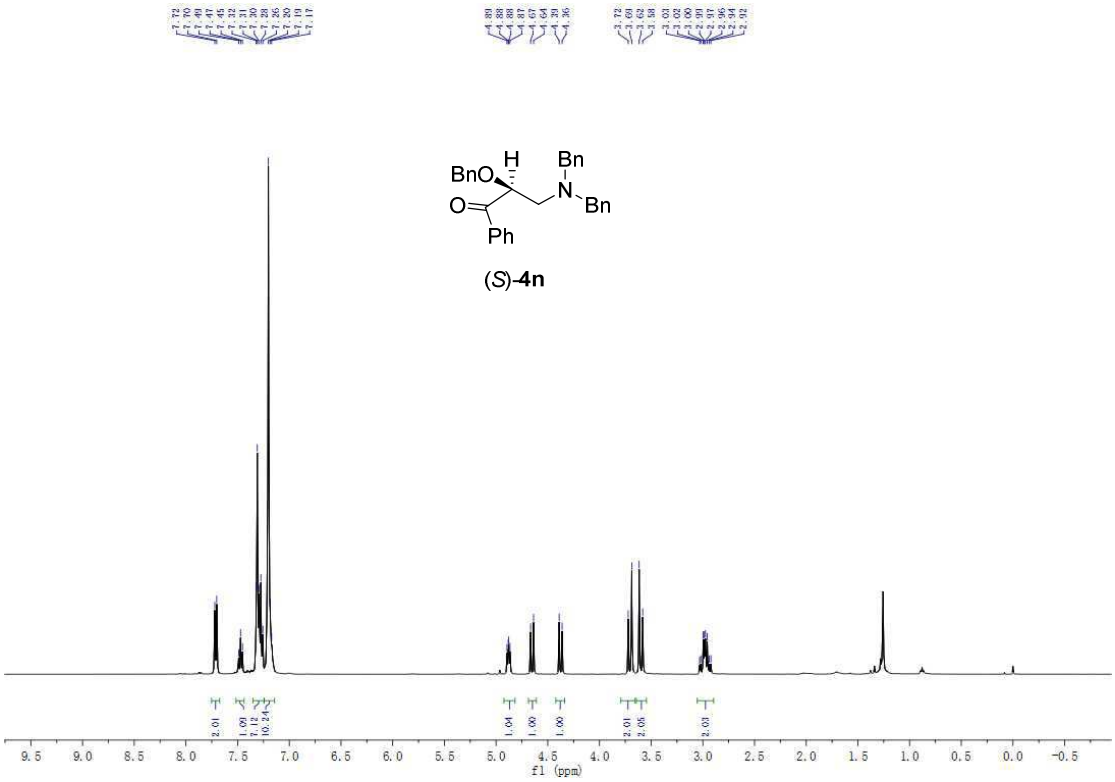



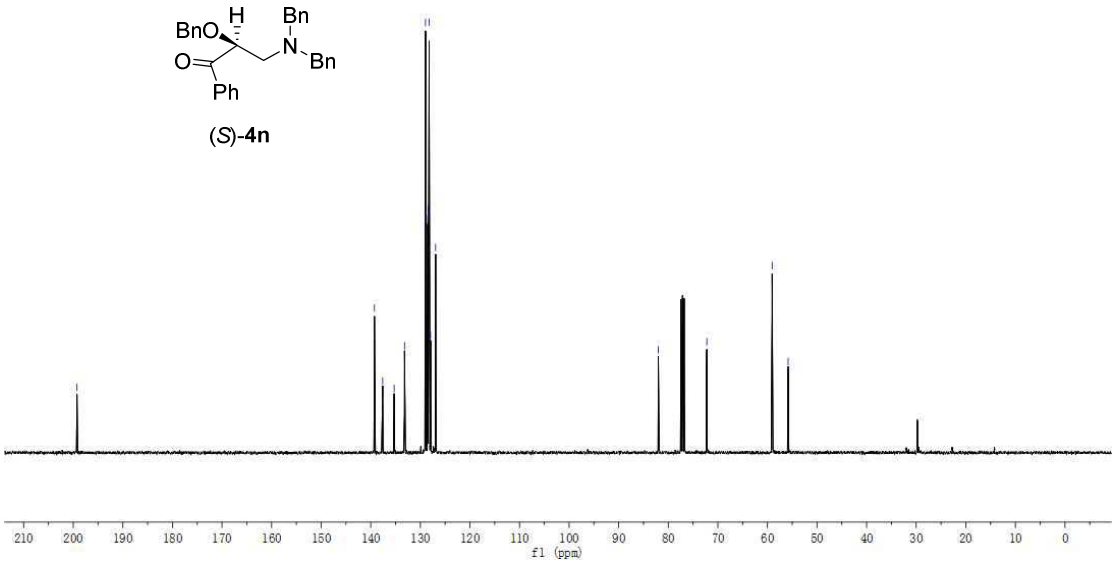
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4m**



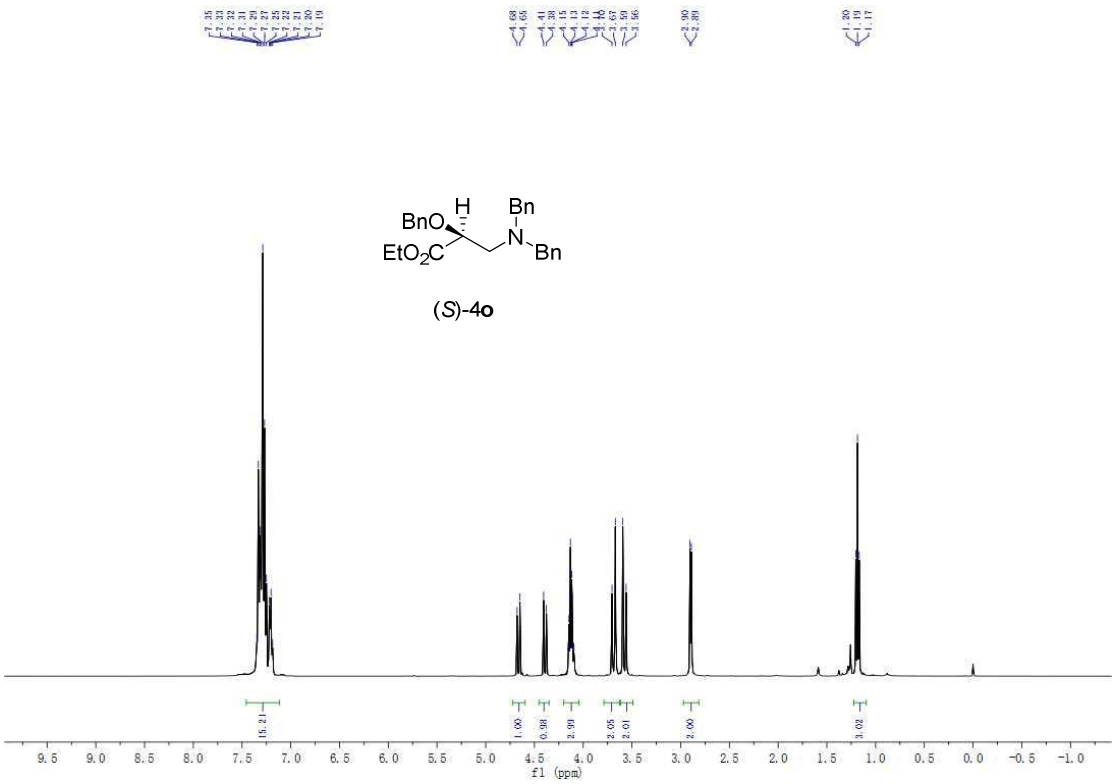



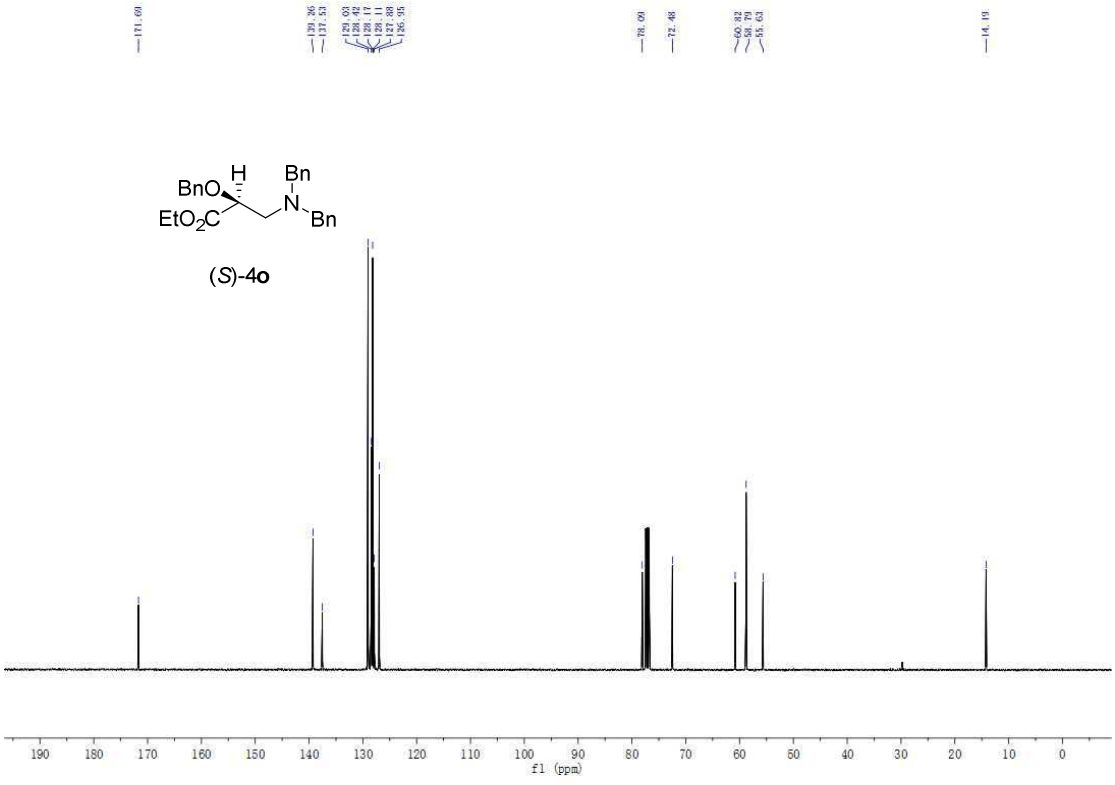
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4n**



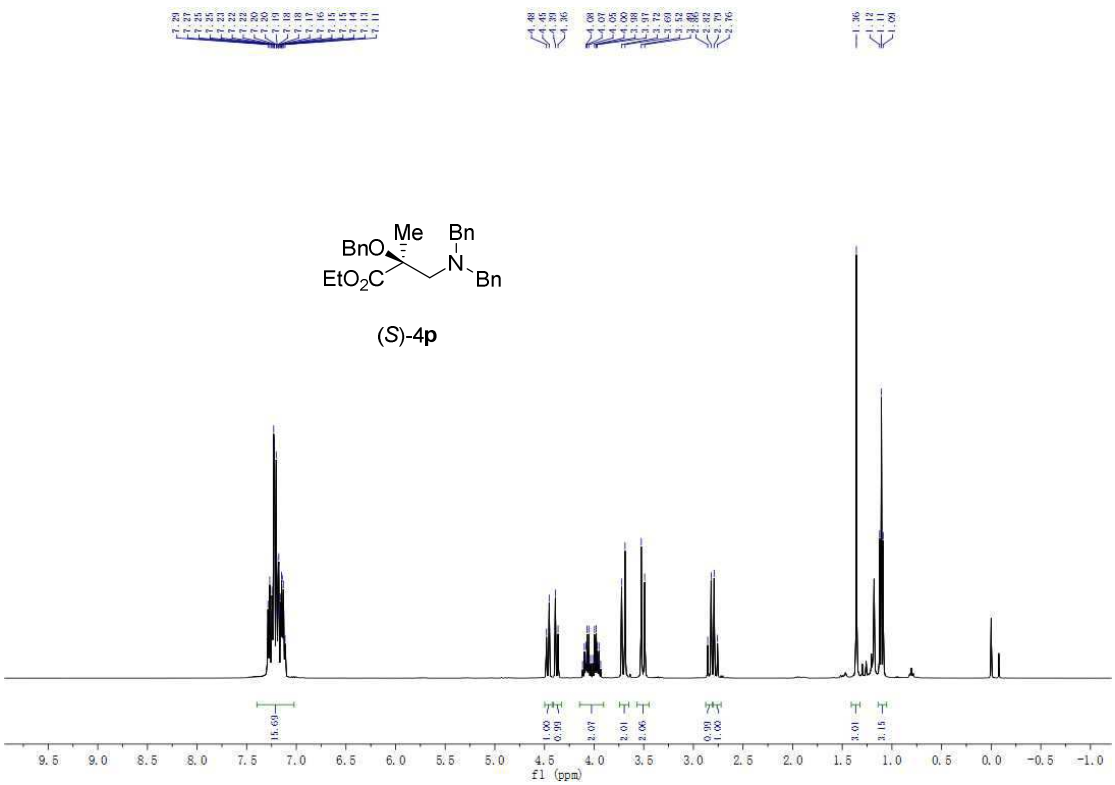



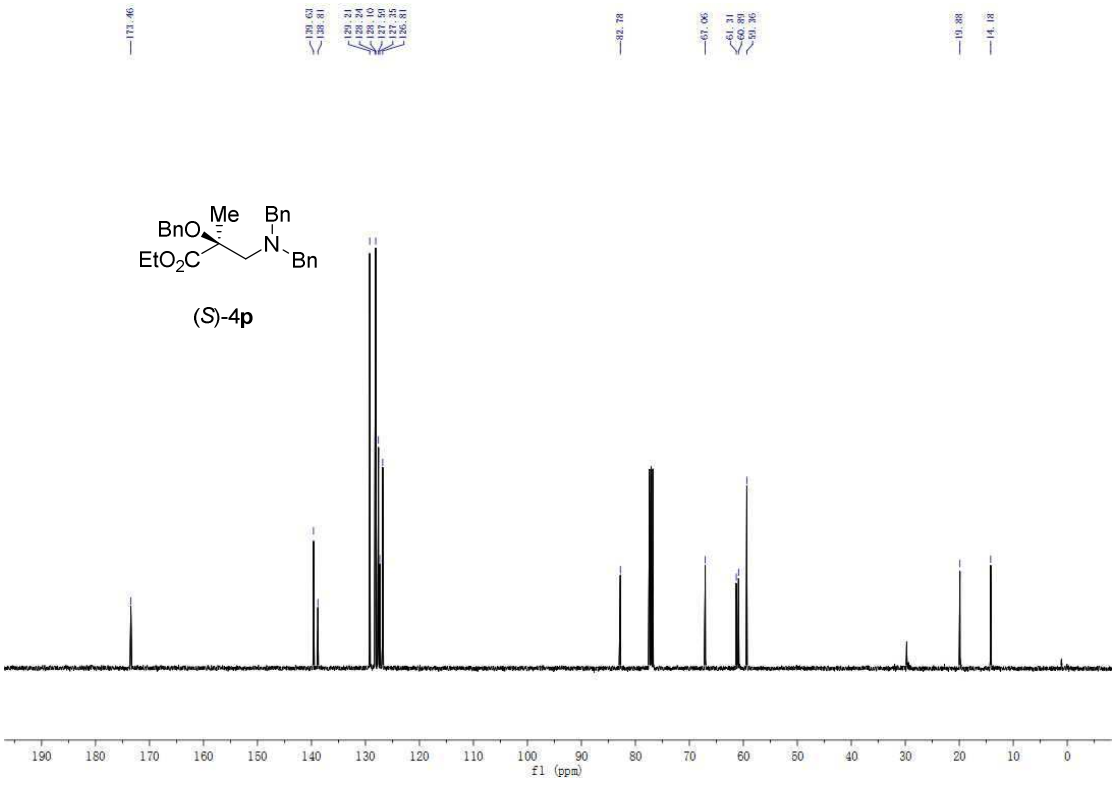
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4o**



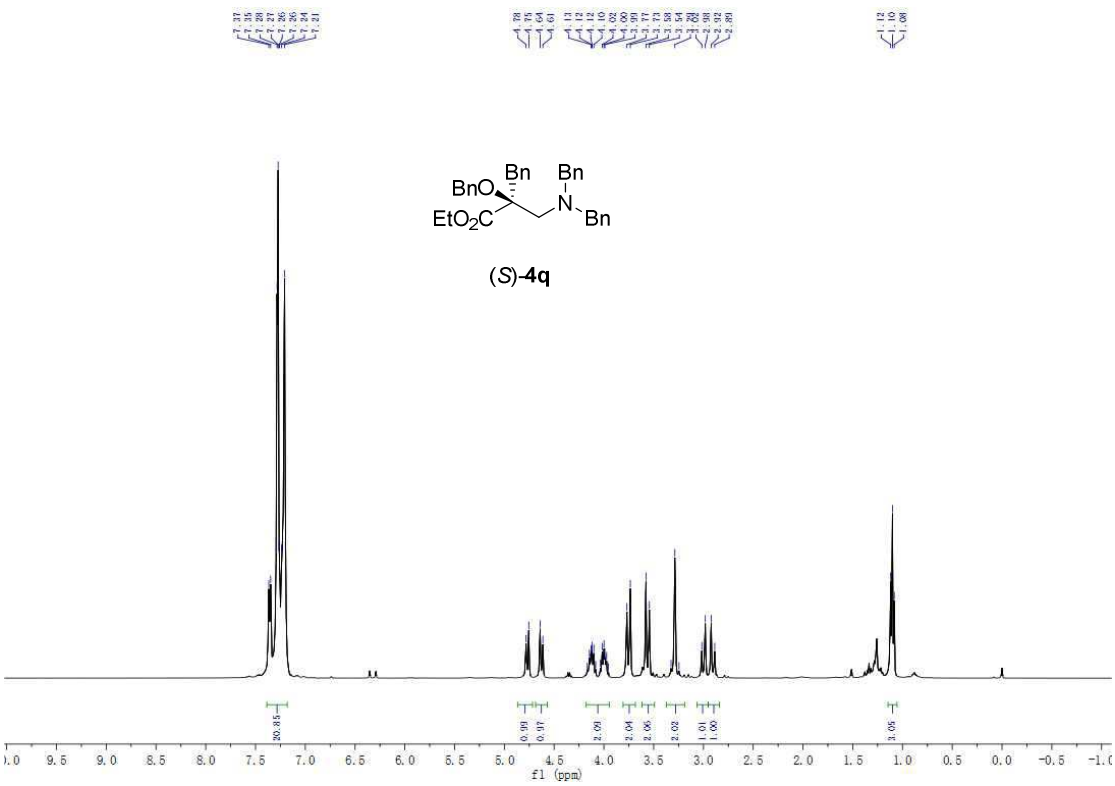



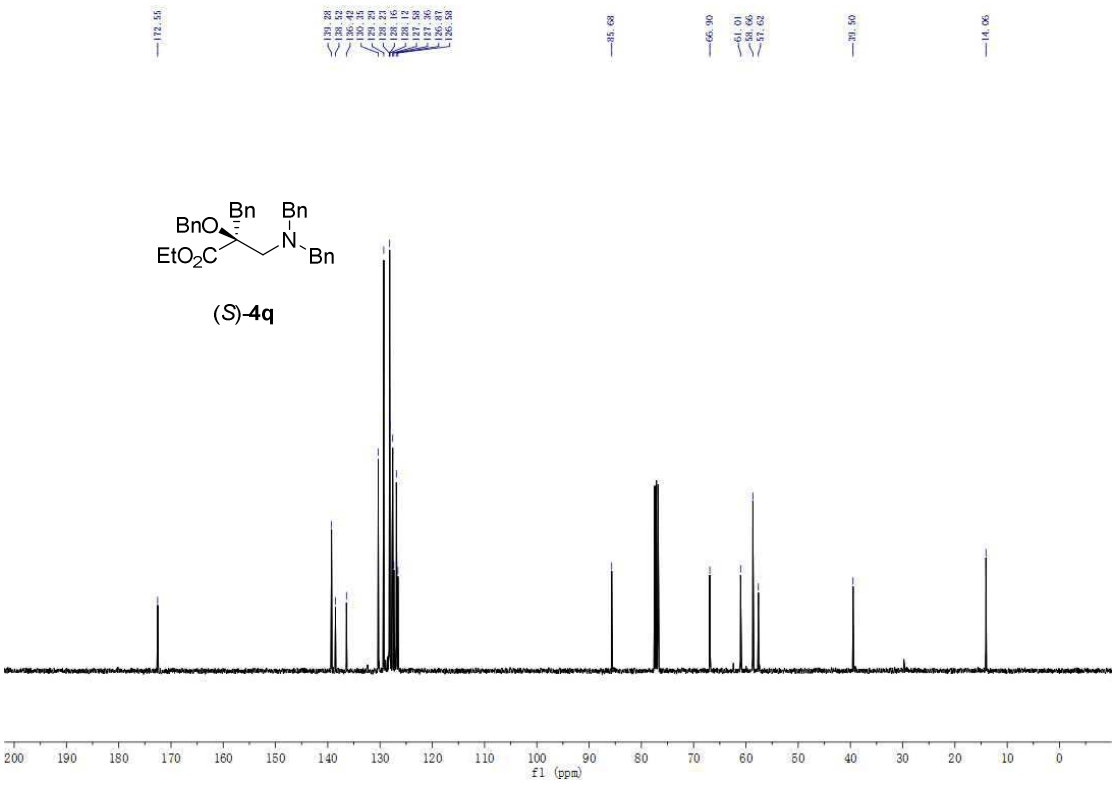
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4p**



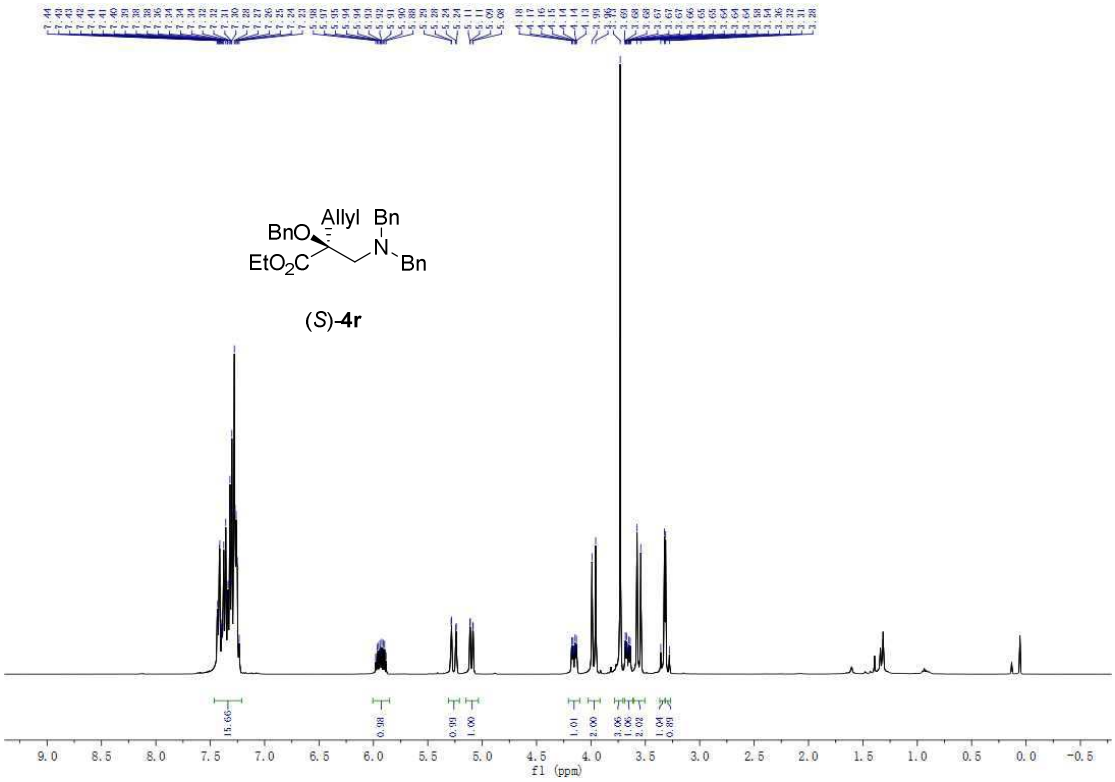



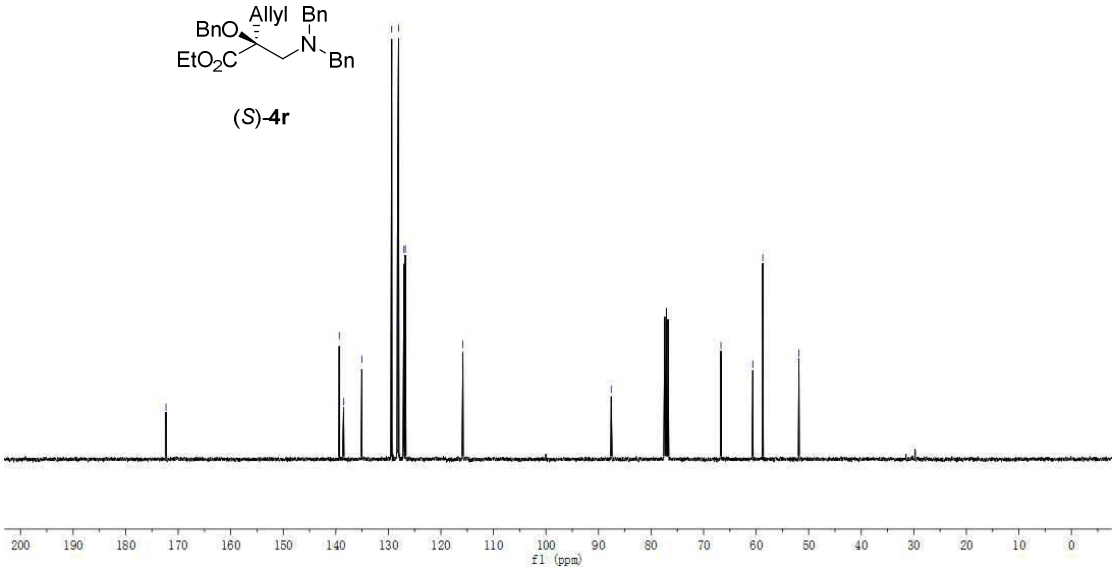
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4q**



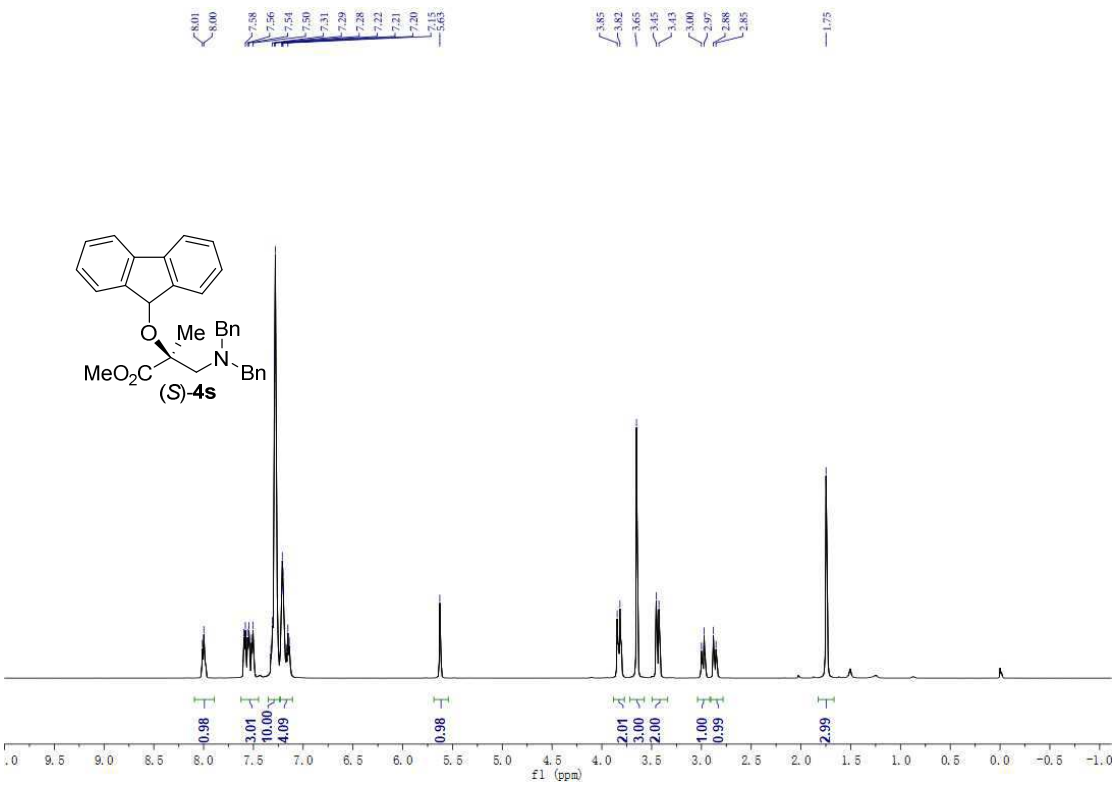



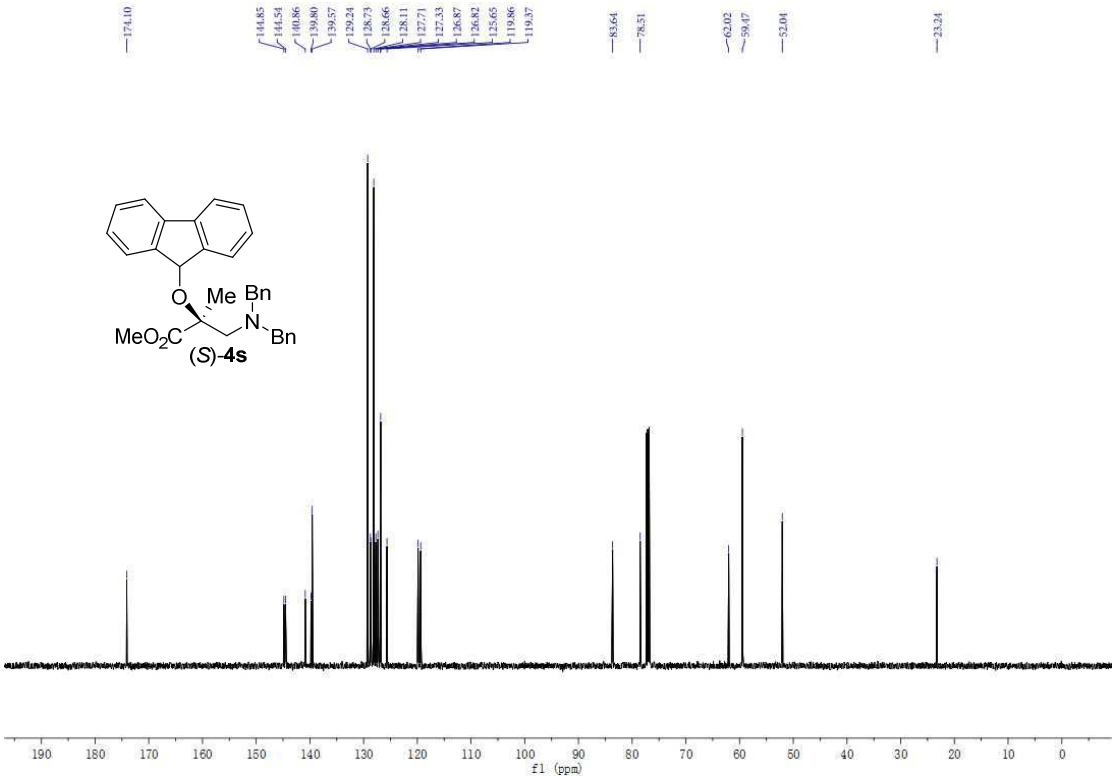
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4r**



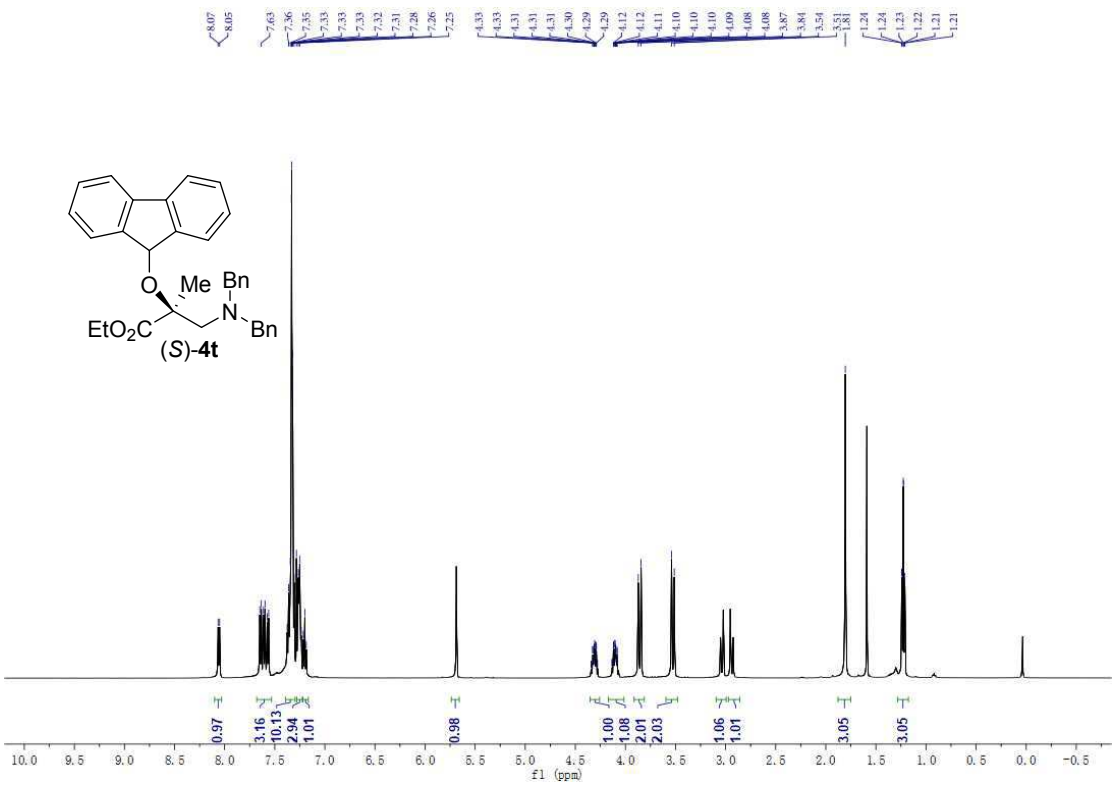



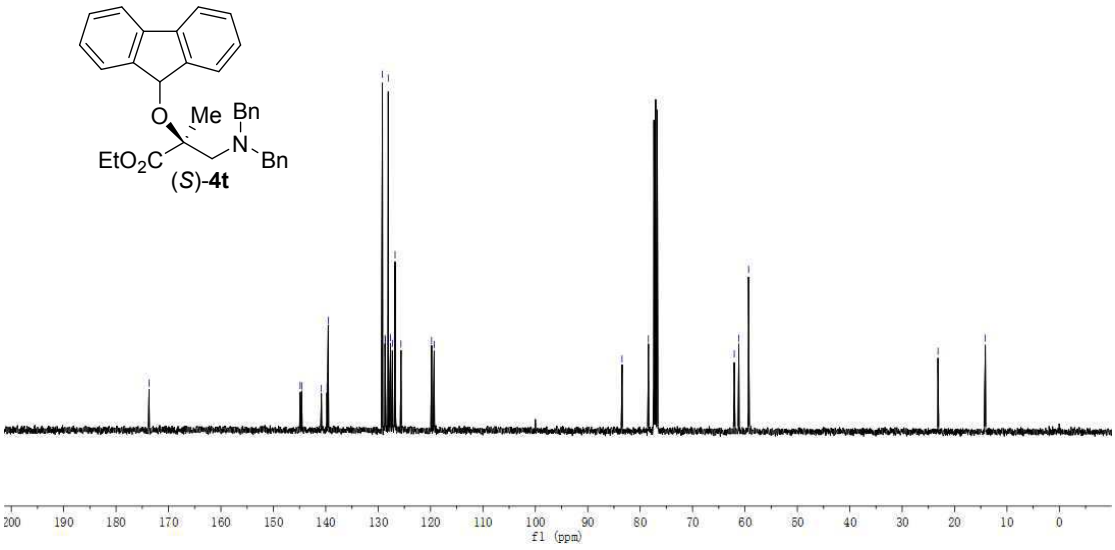
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for (*S*)-4s**



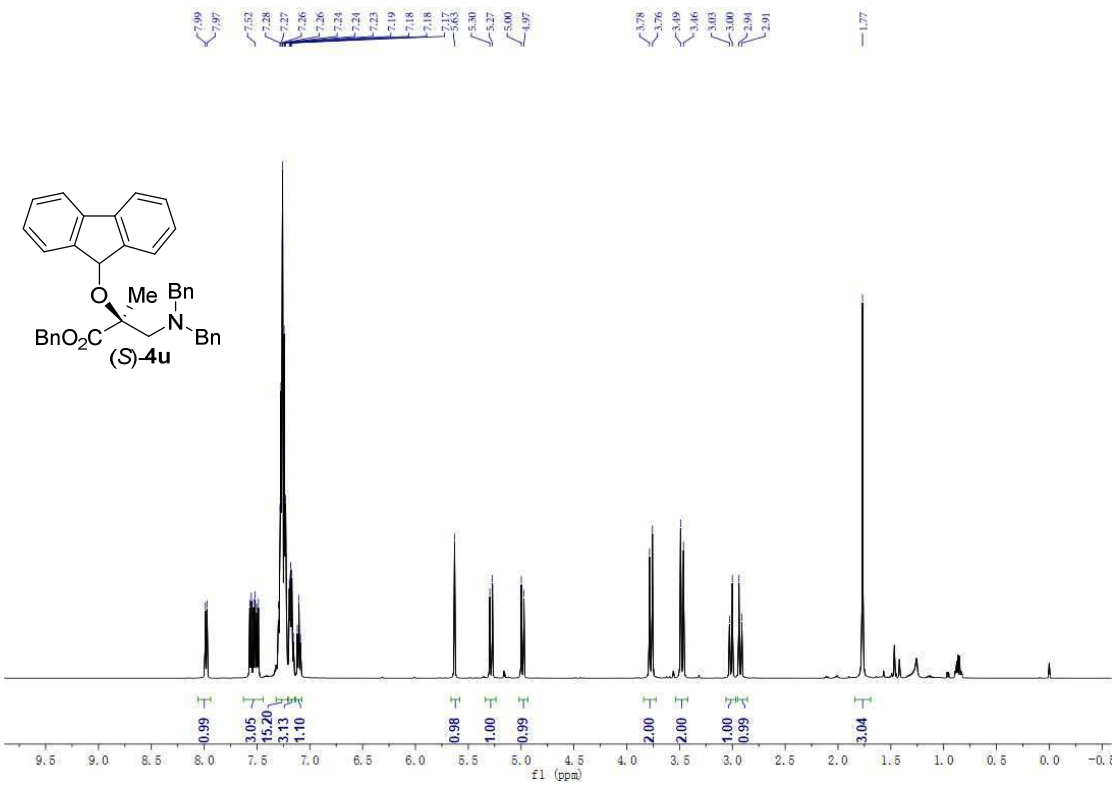



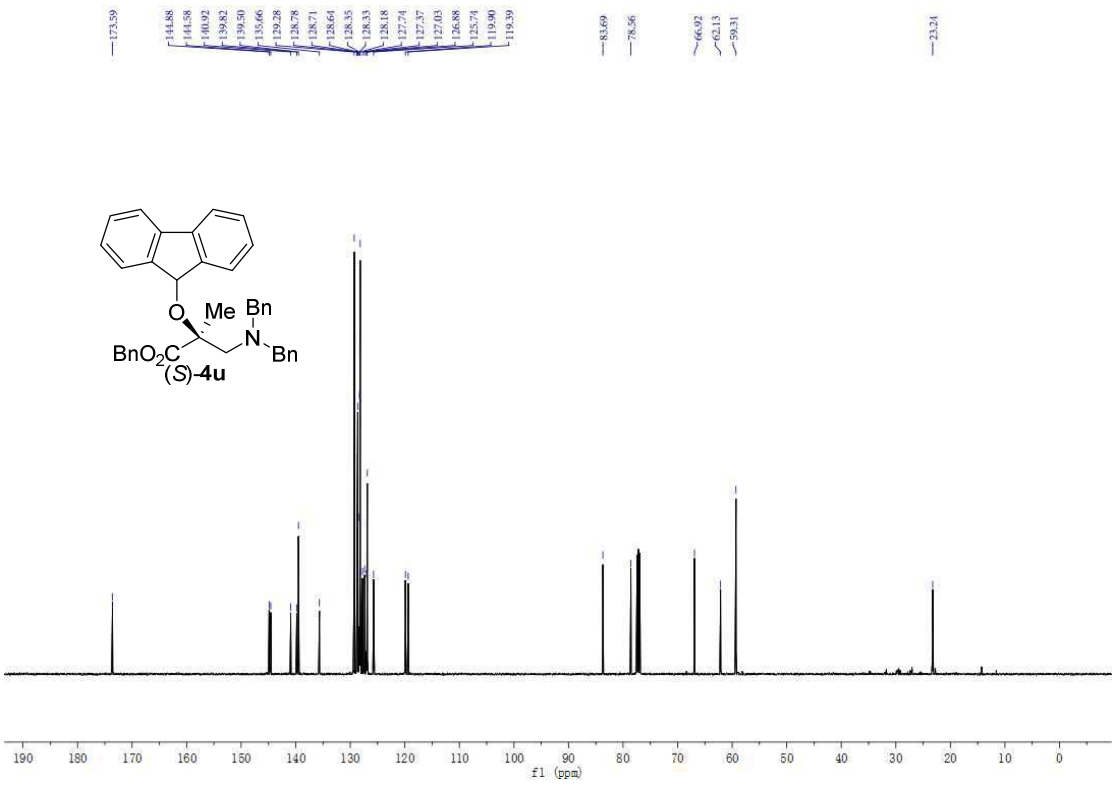
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4t**



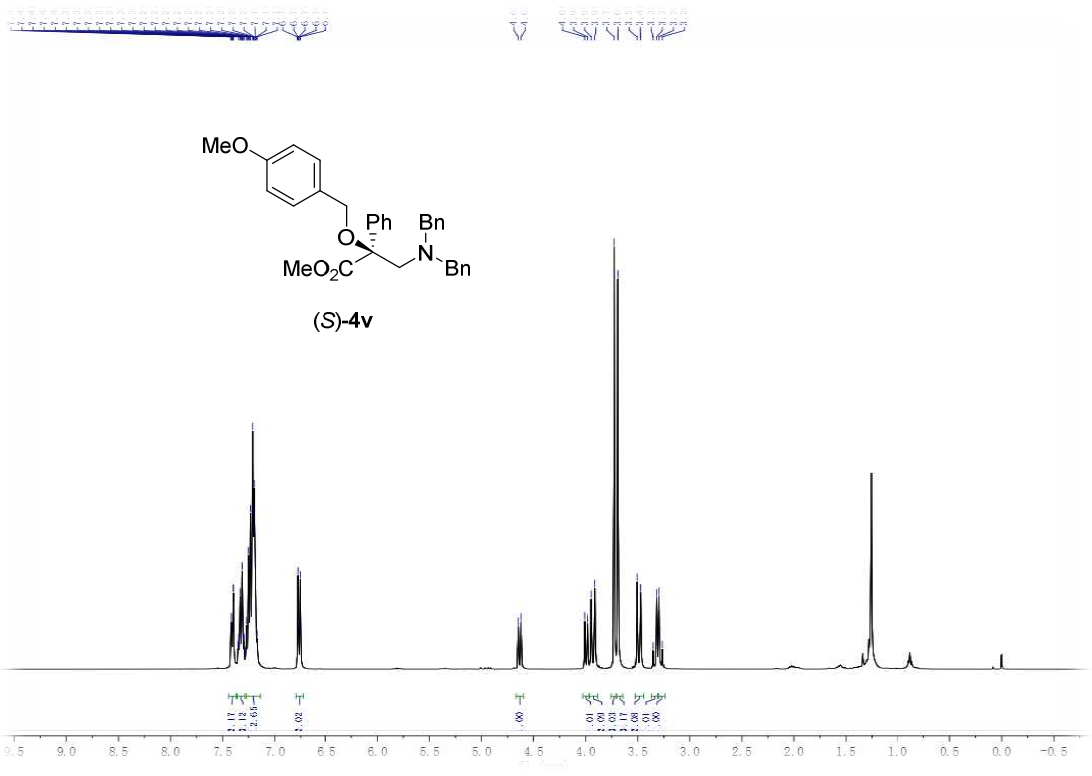



**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for (*S*)-4u**

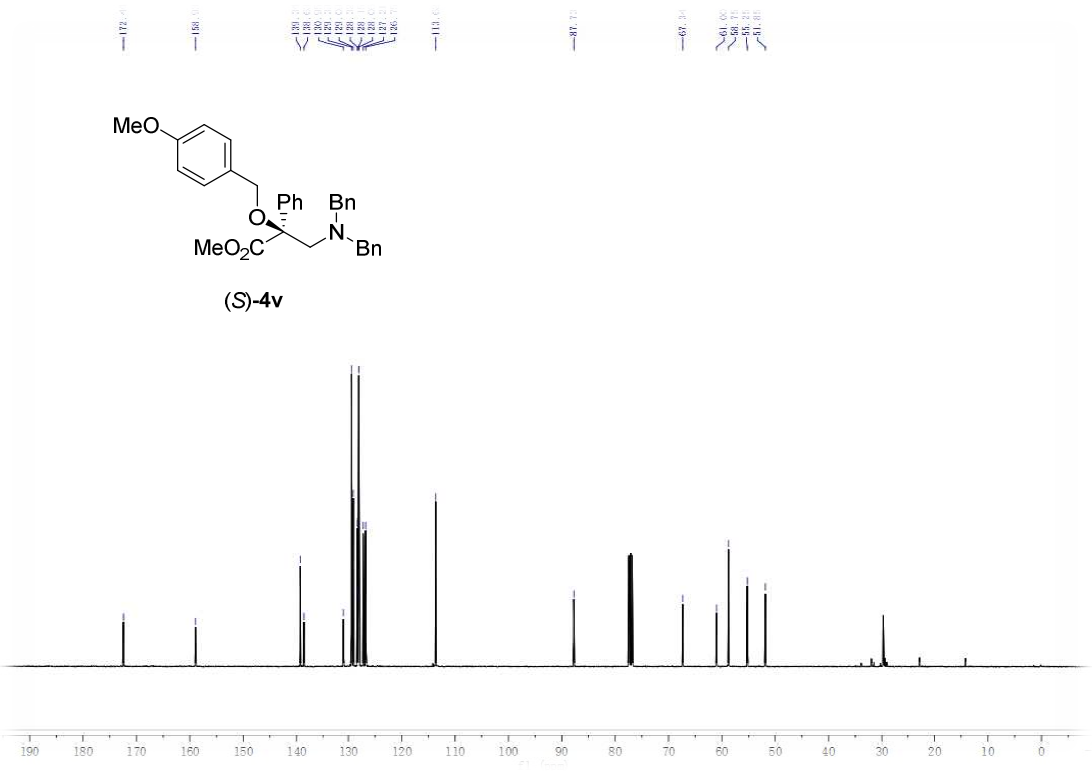


**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4v**

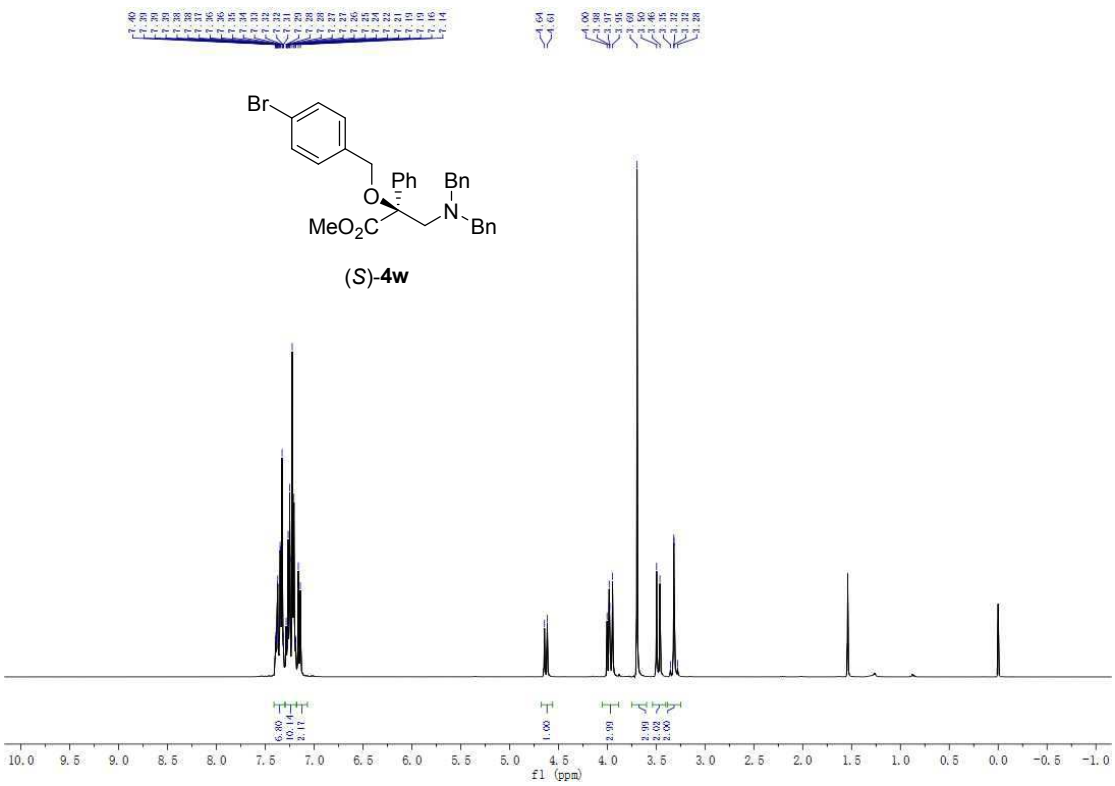


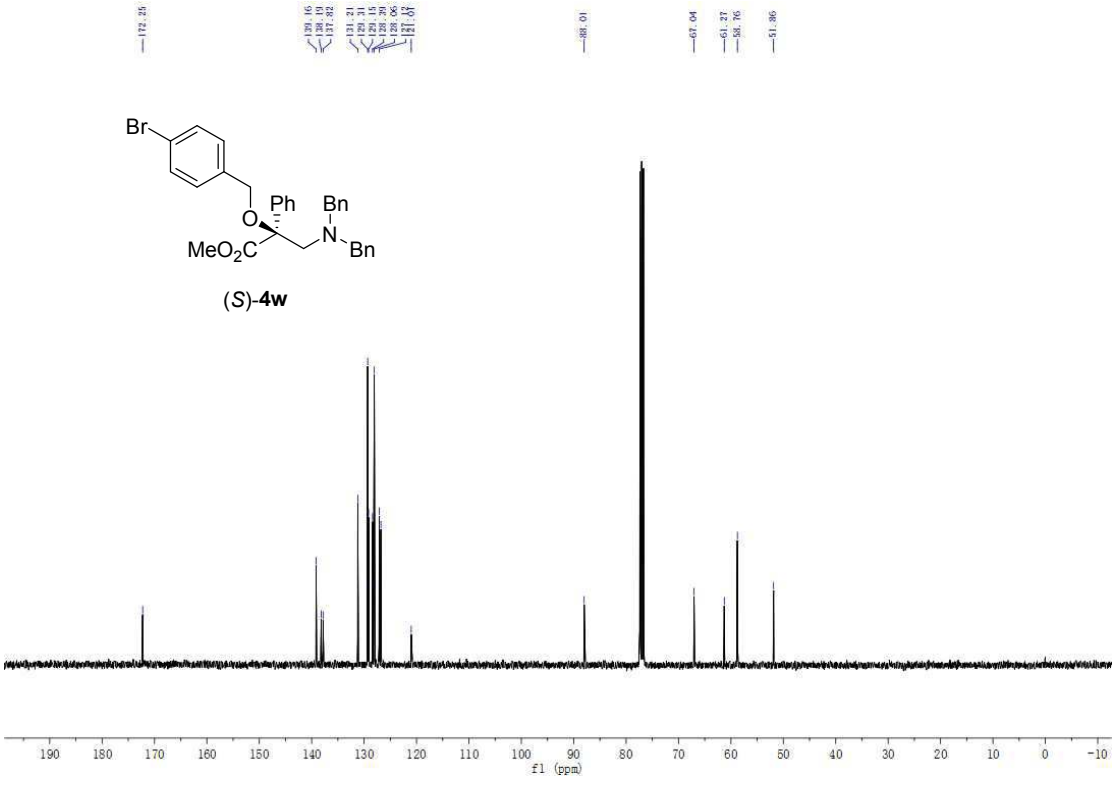

(*S*)-**4v**



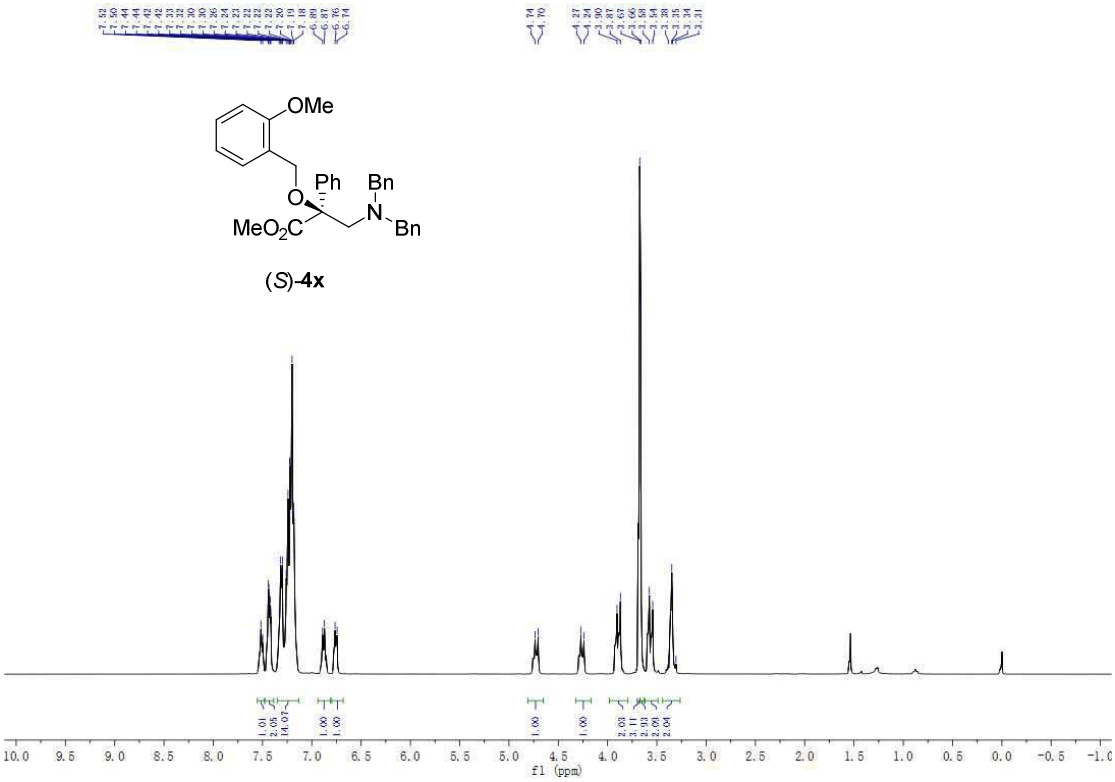

(*S*)-**4v**

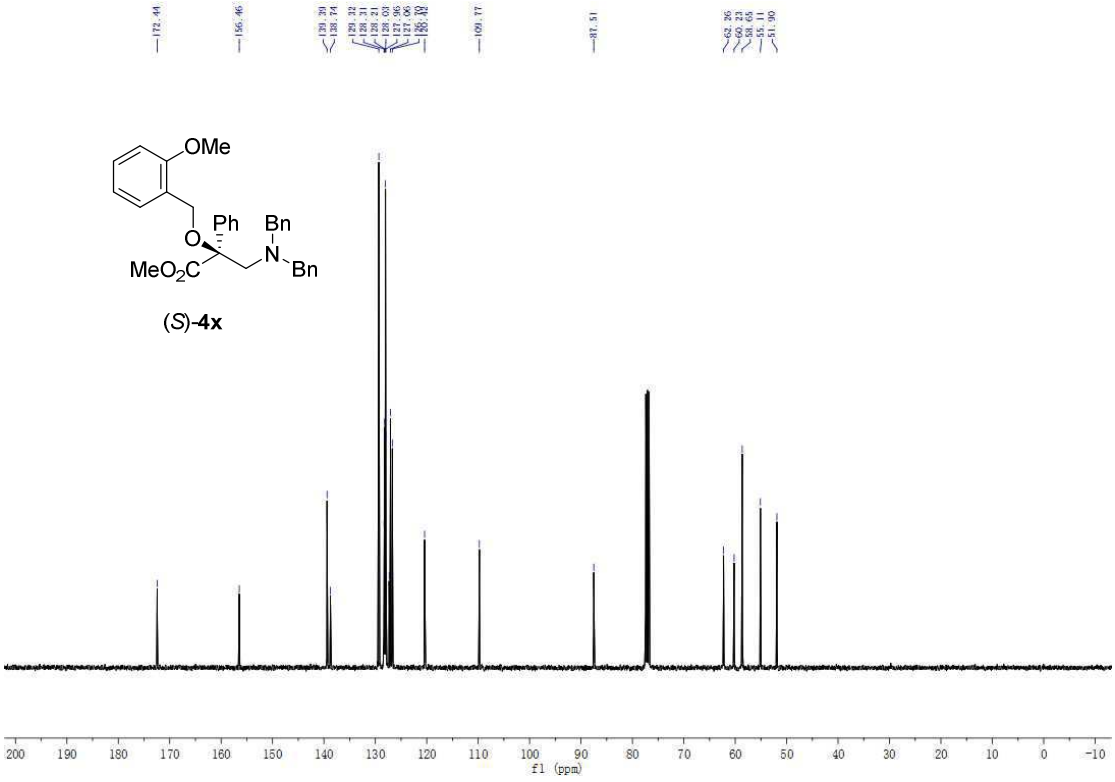
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4w**



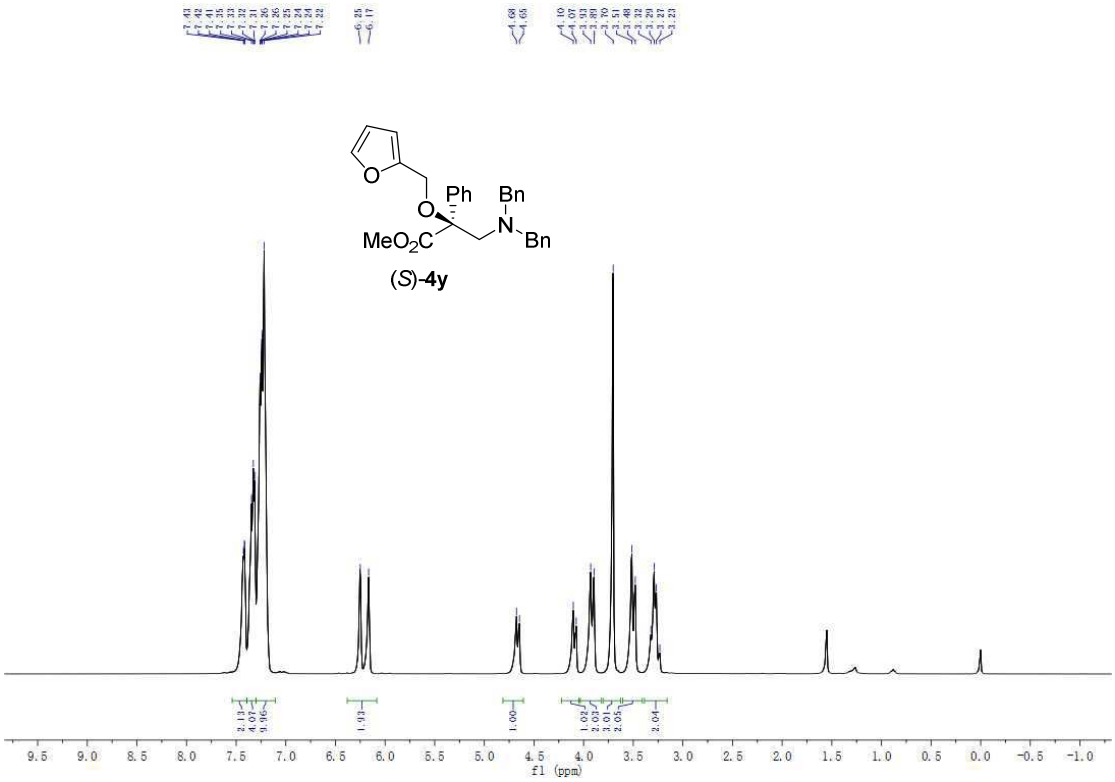



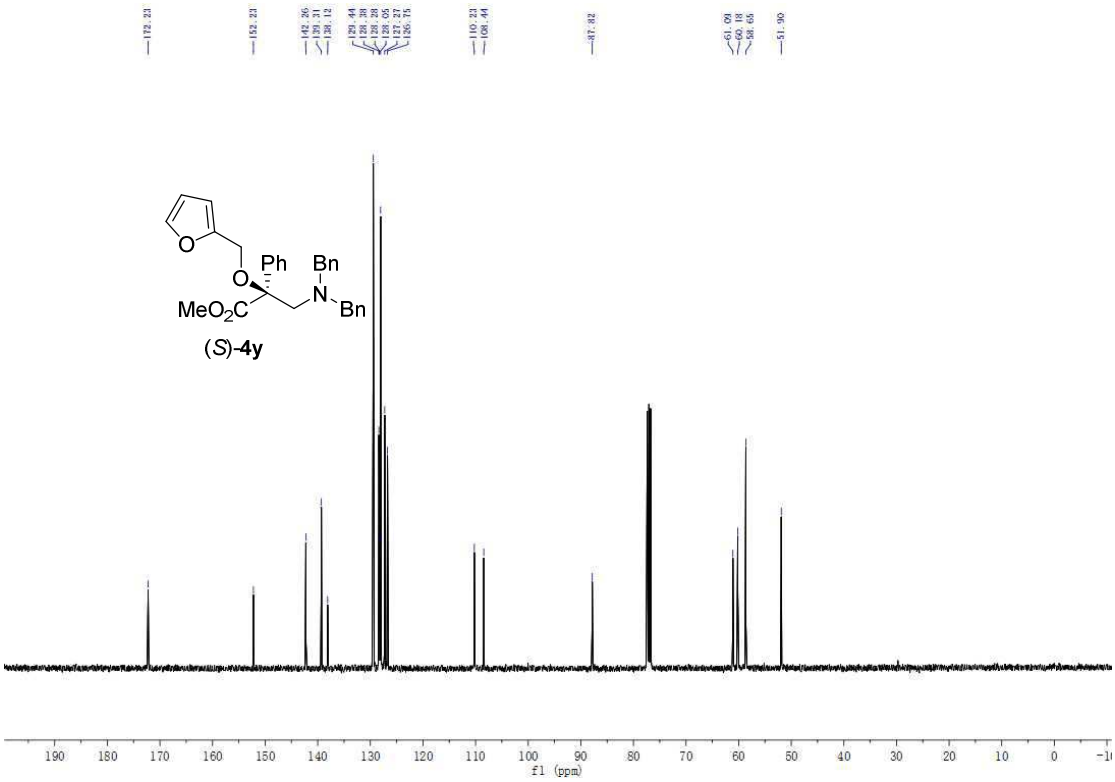
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4x**



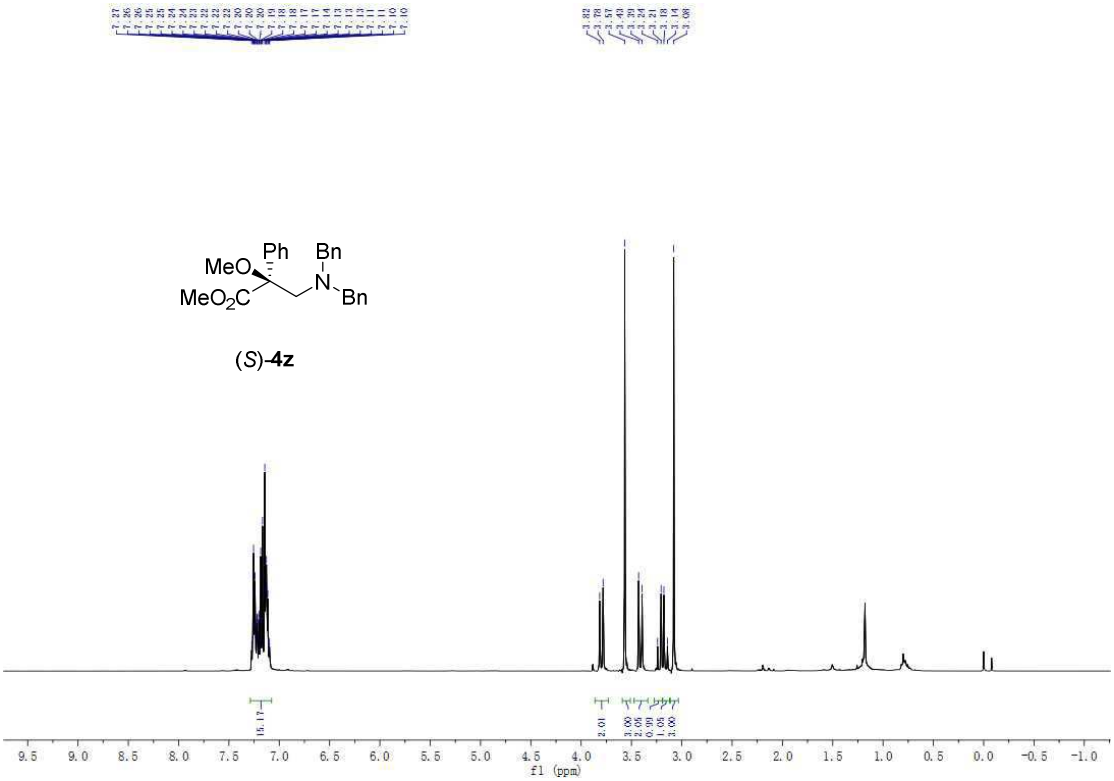



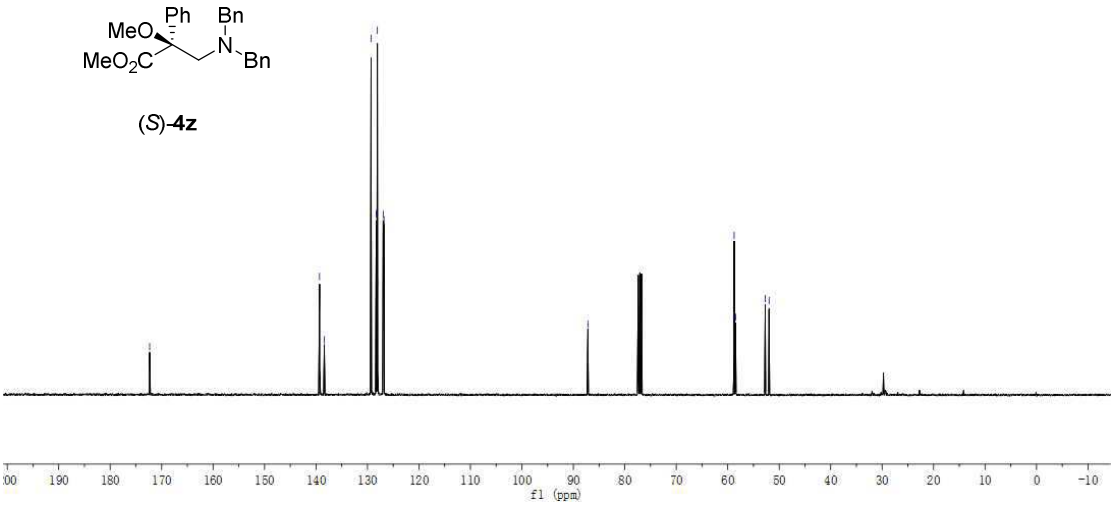
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4y**



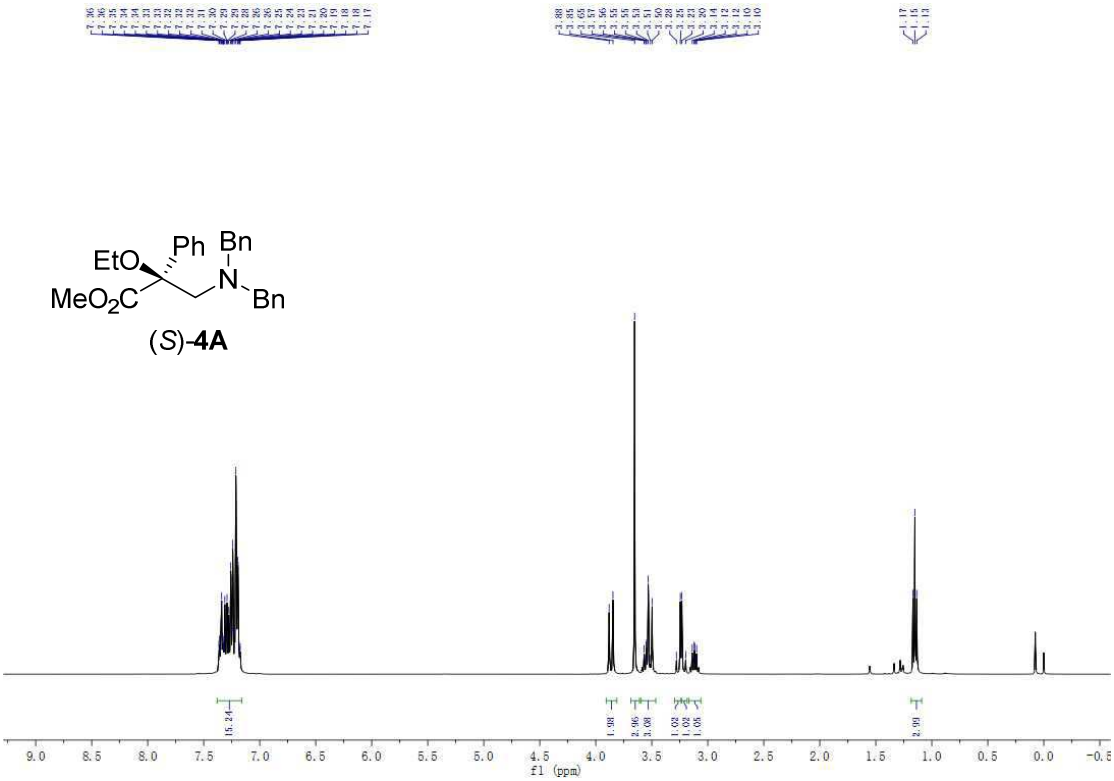



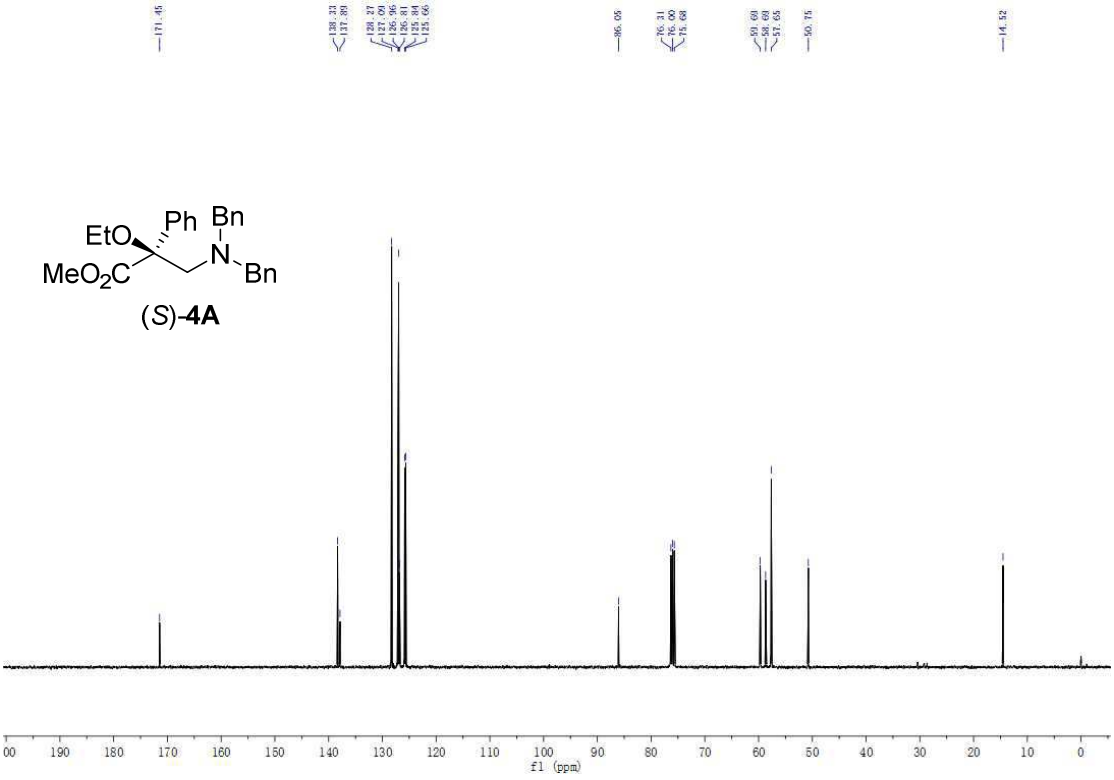
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4z**



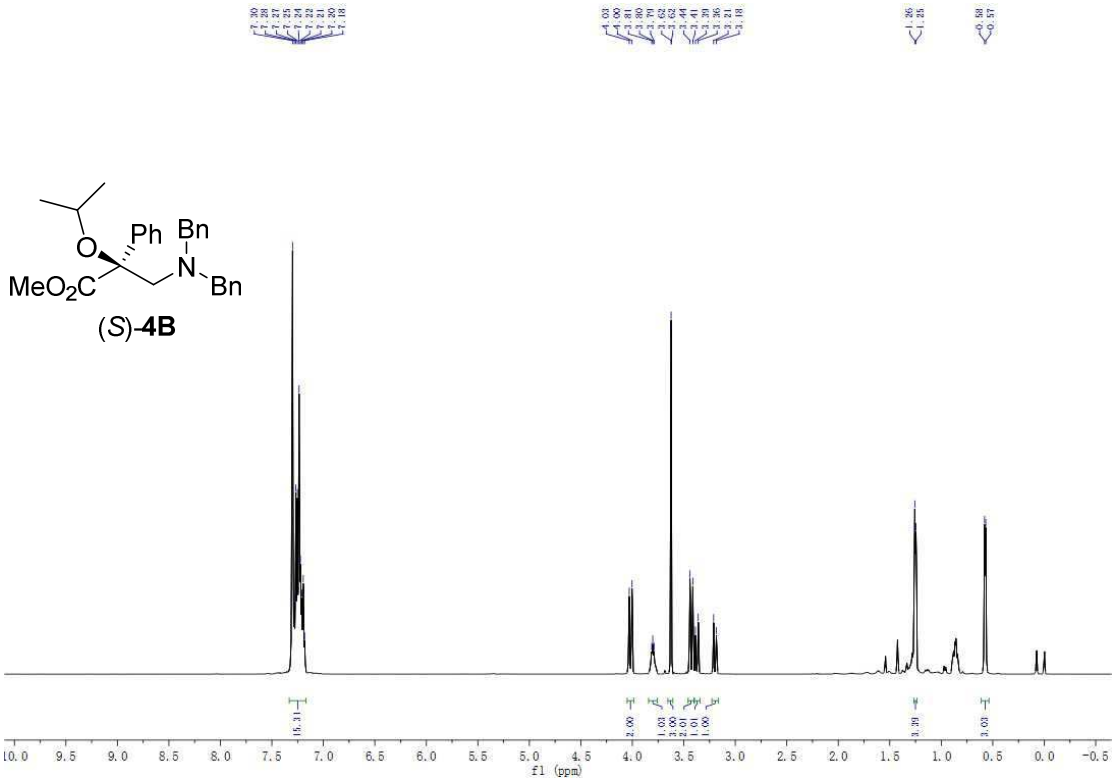



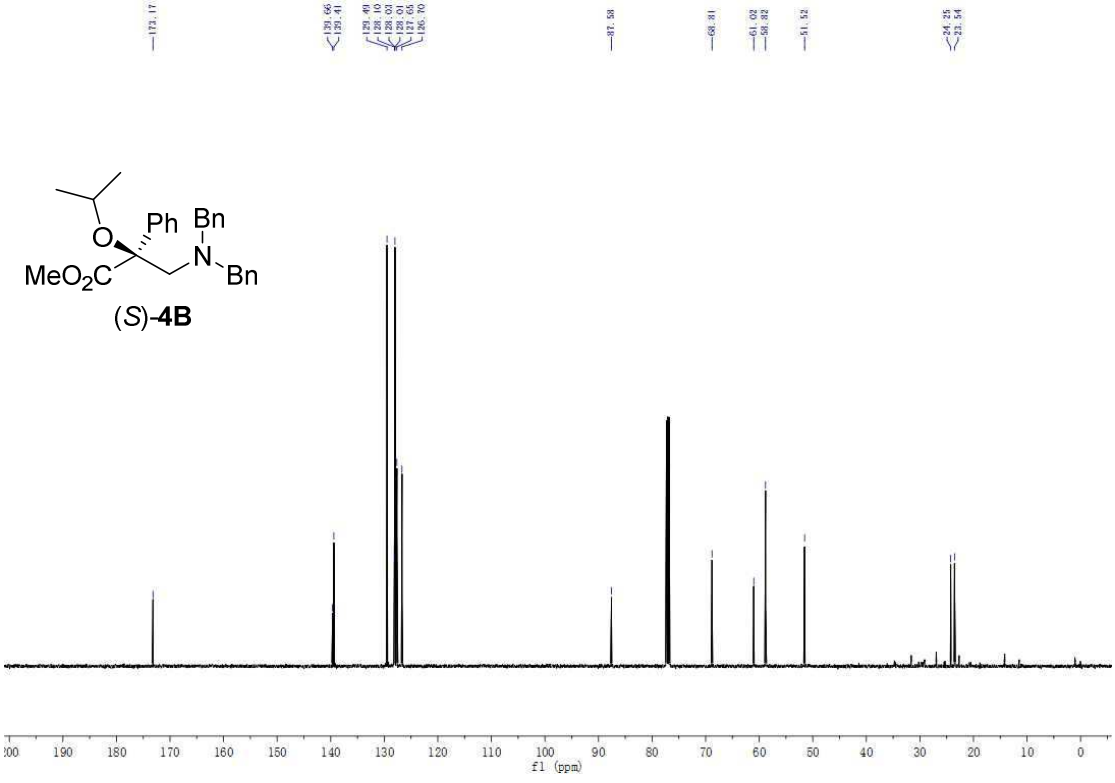
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4A**



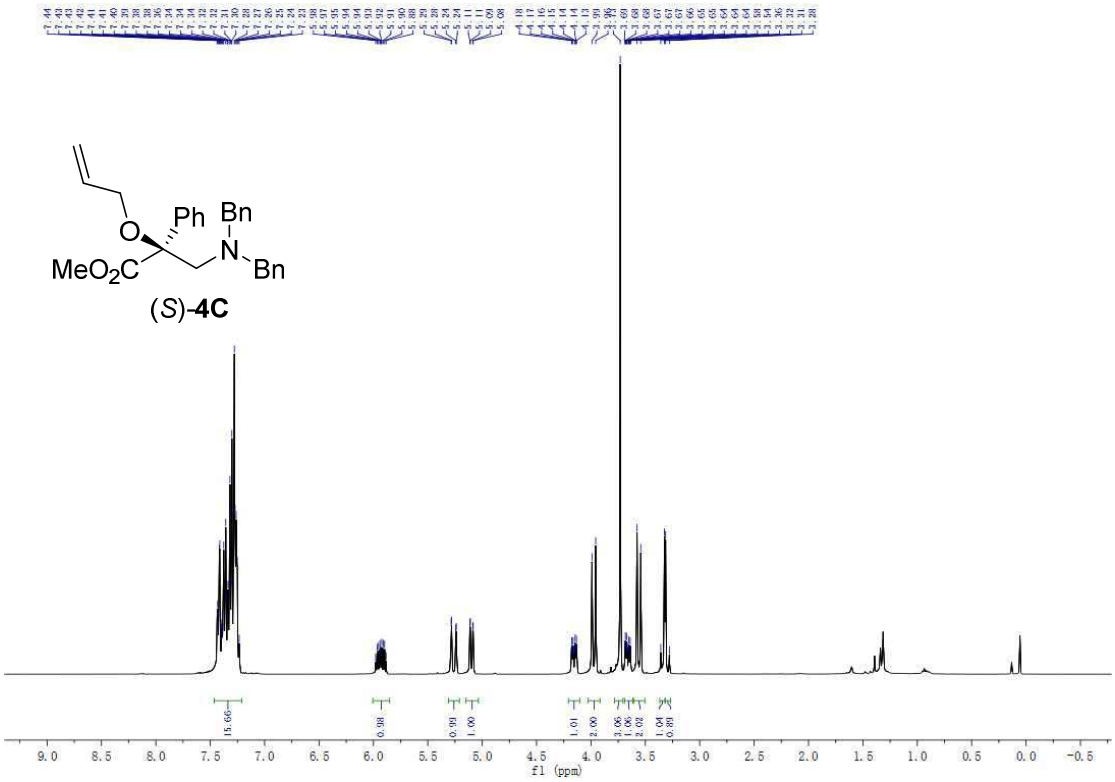



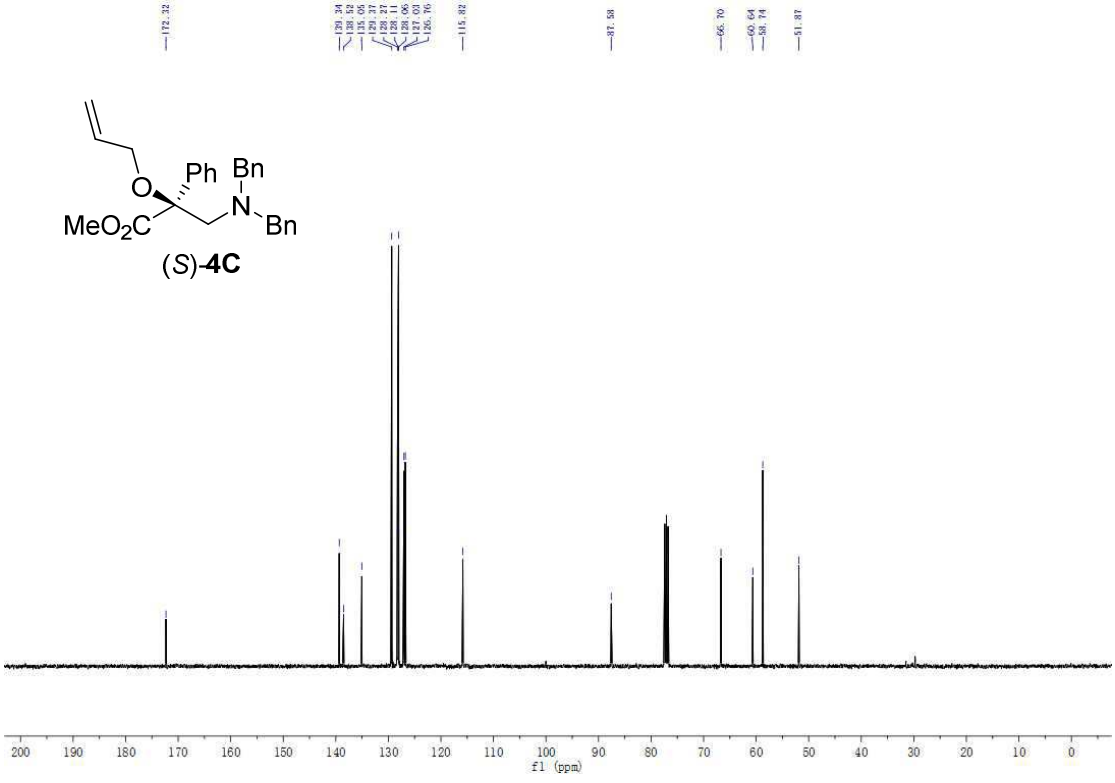
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for (*S*)-4B**



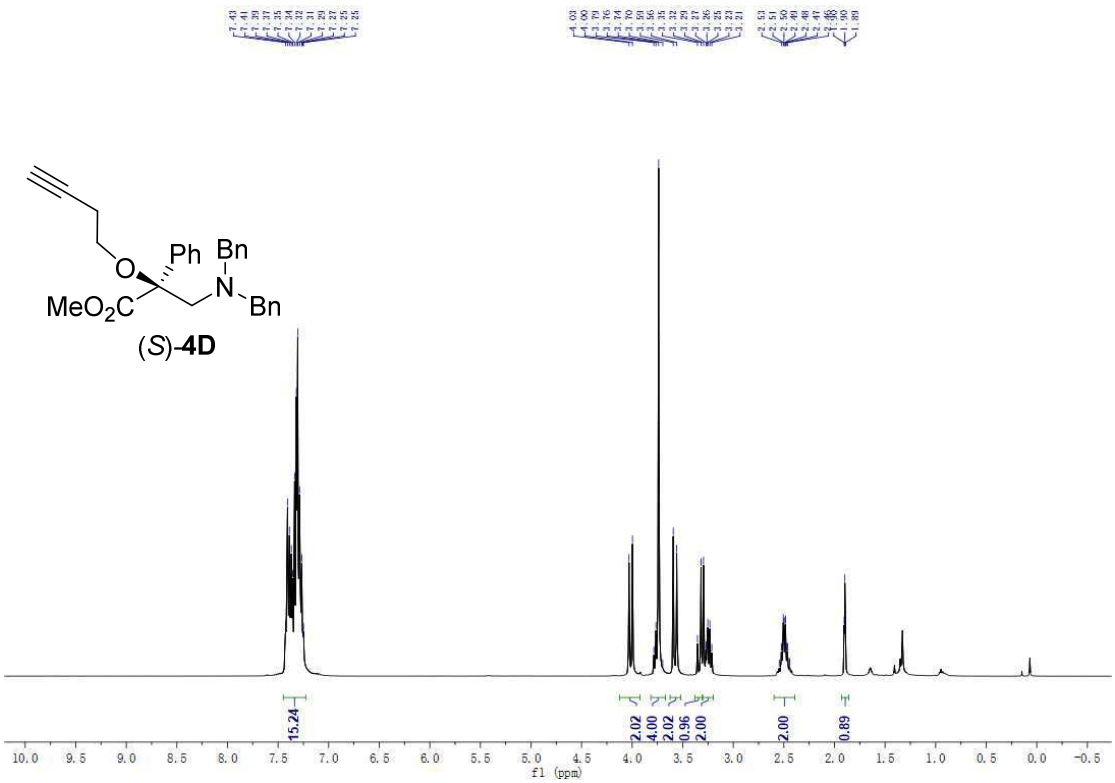



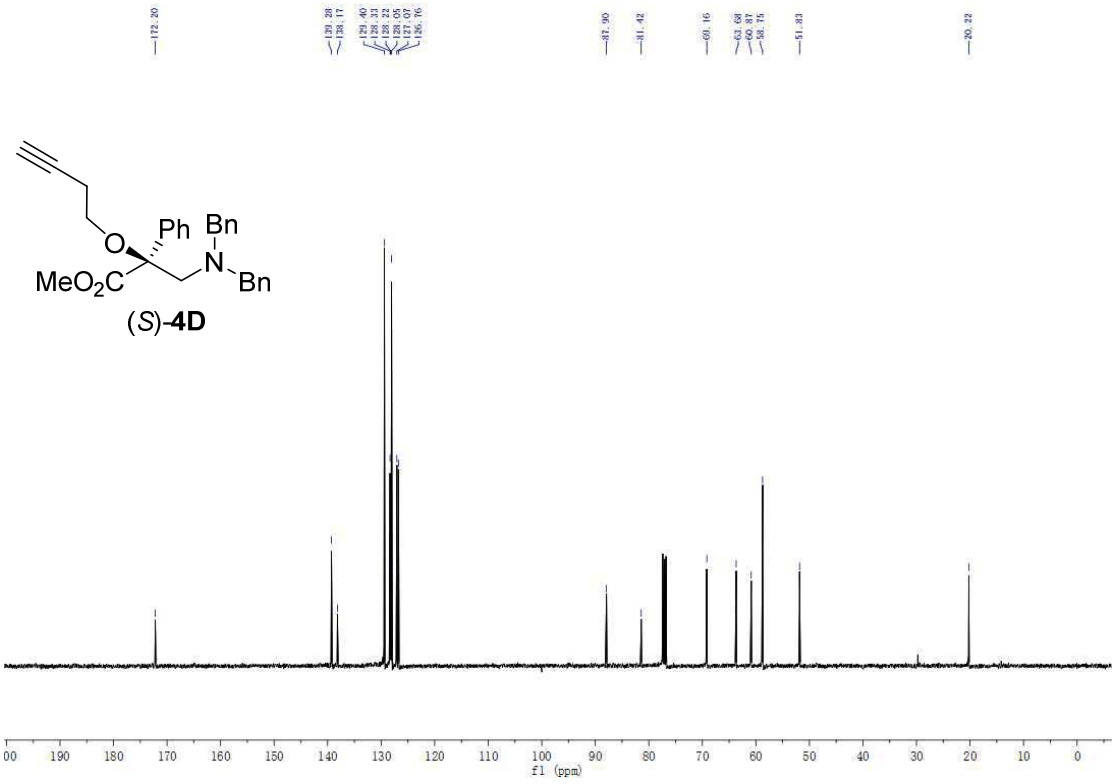
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4C**



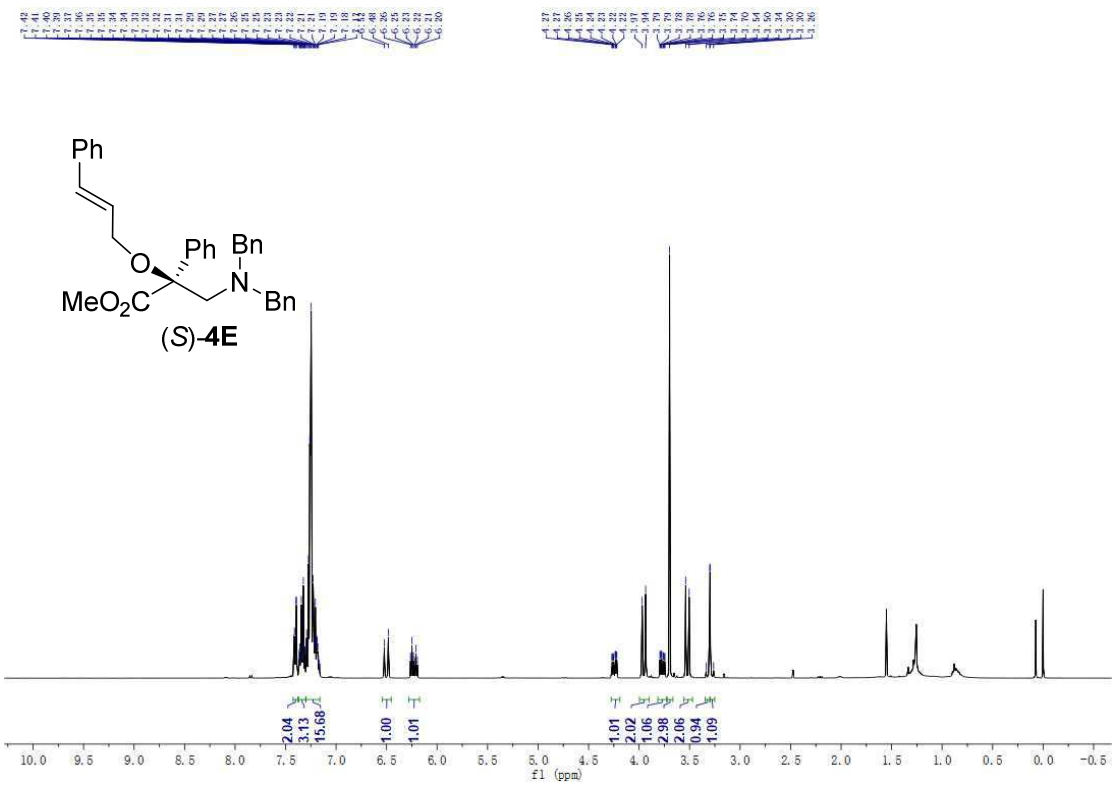



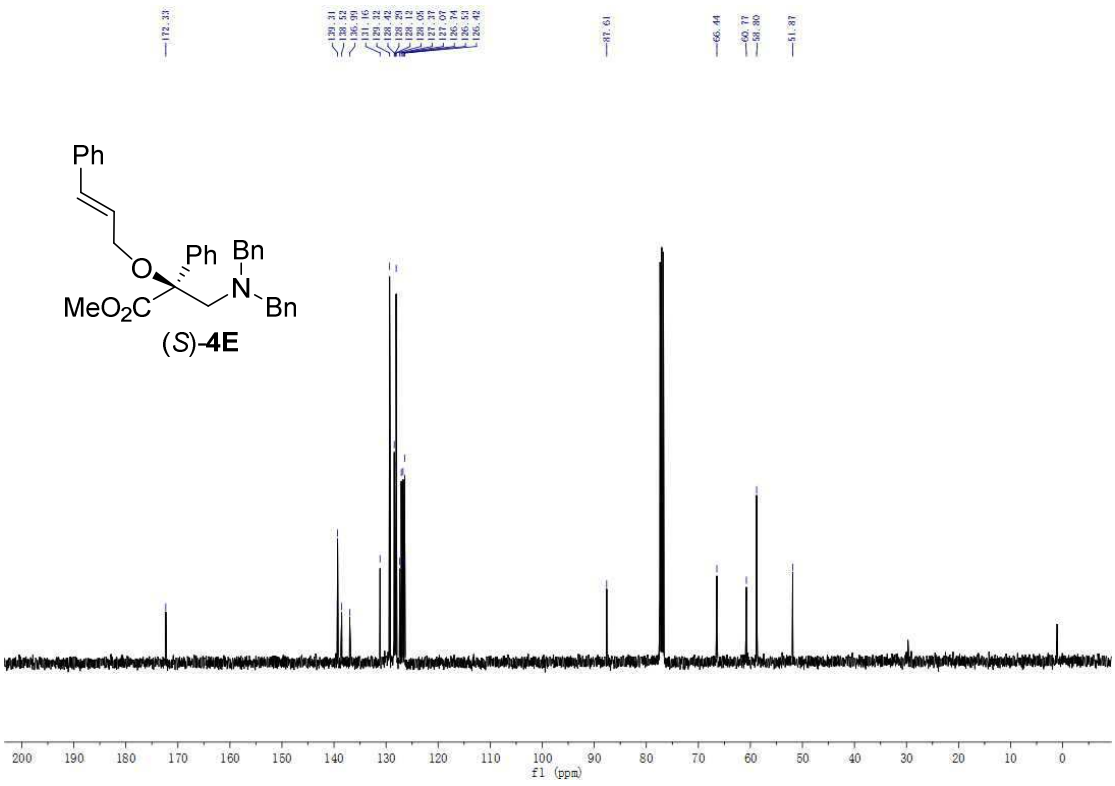
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4D**



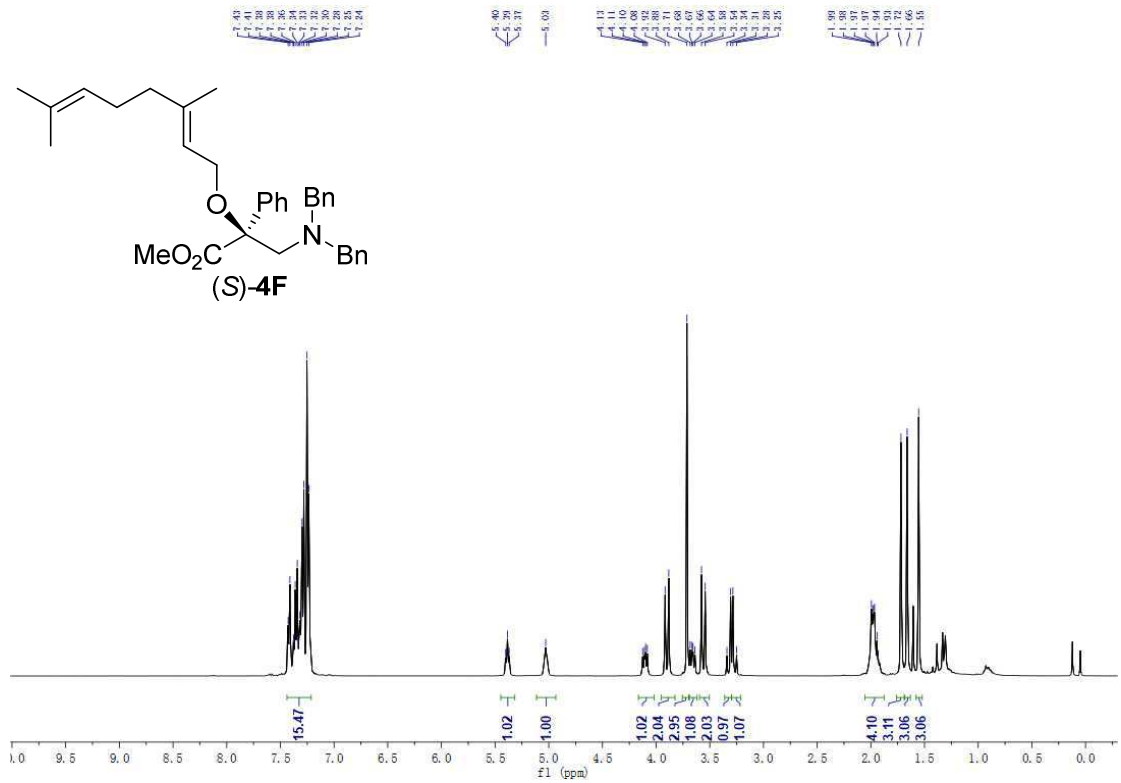



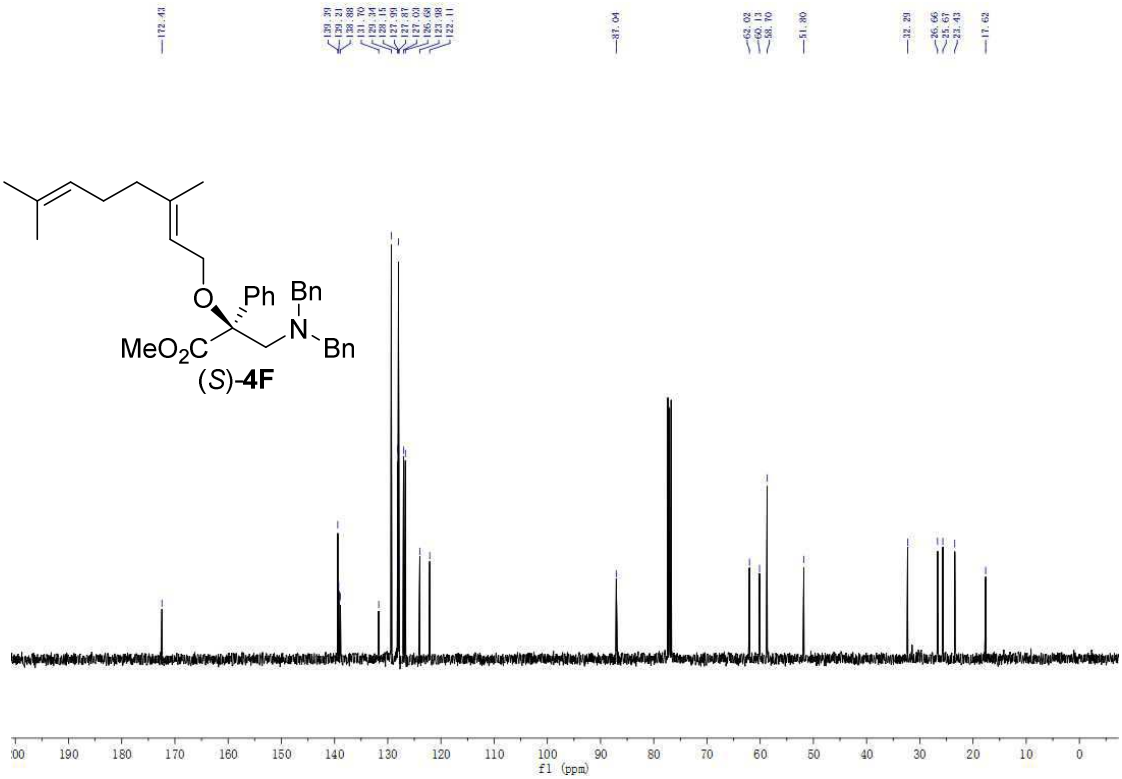
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4E**



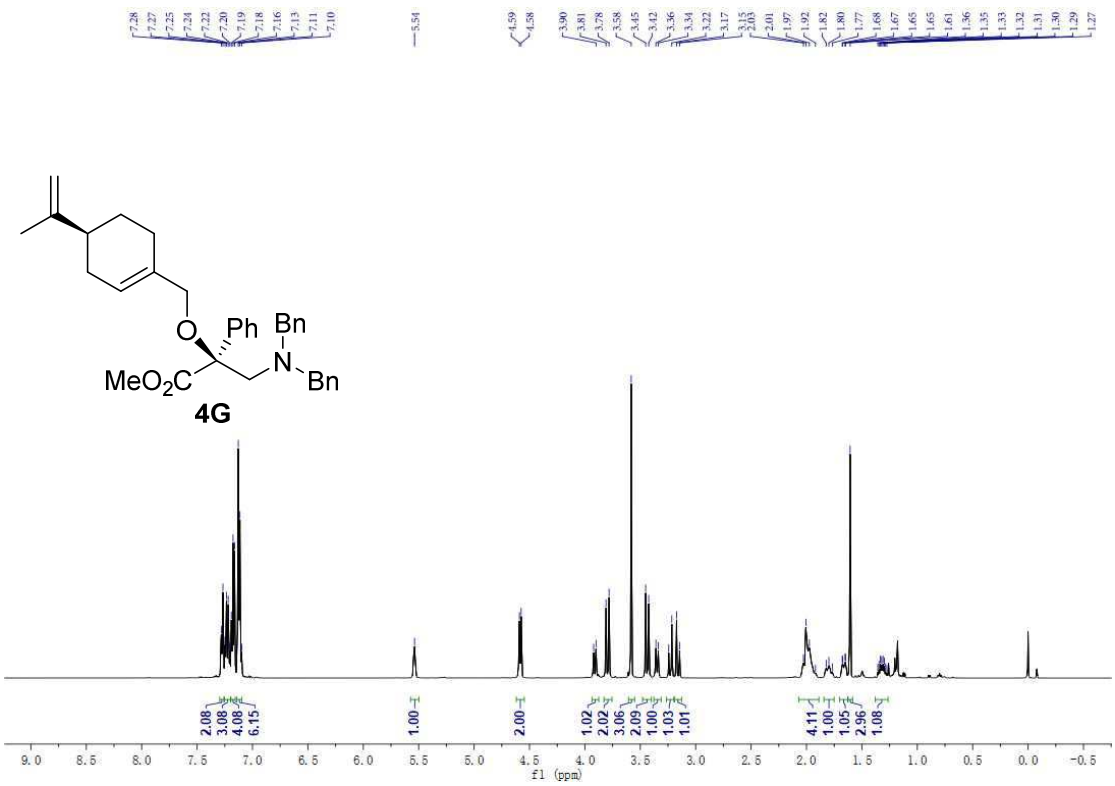



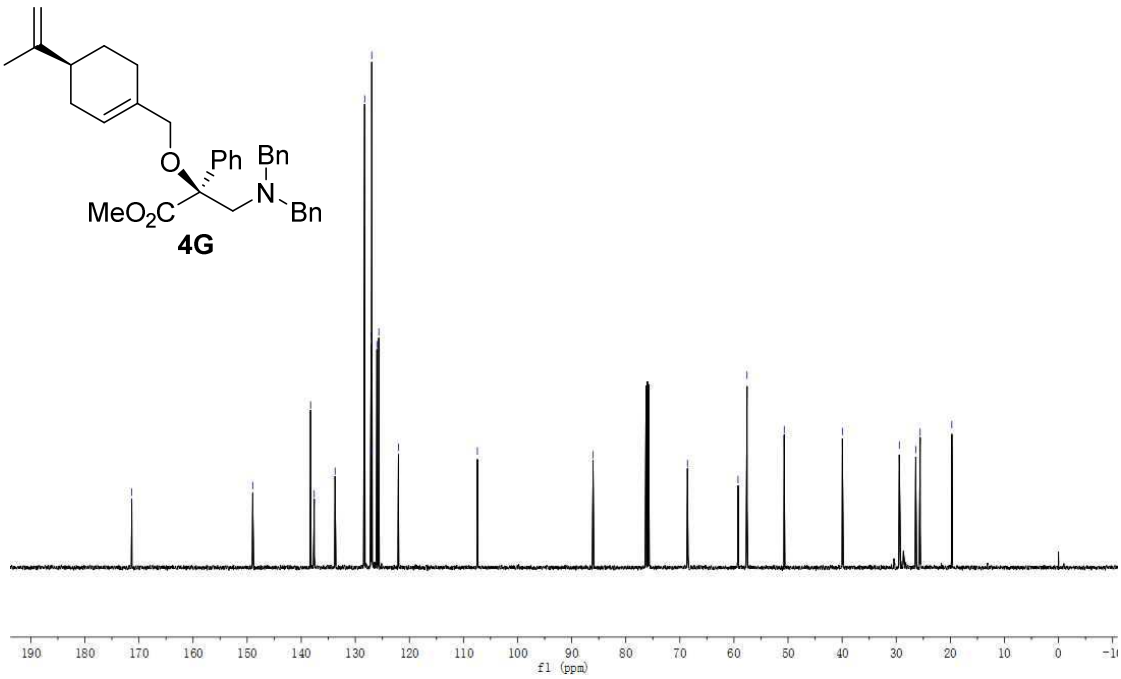
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4F**



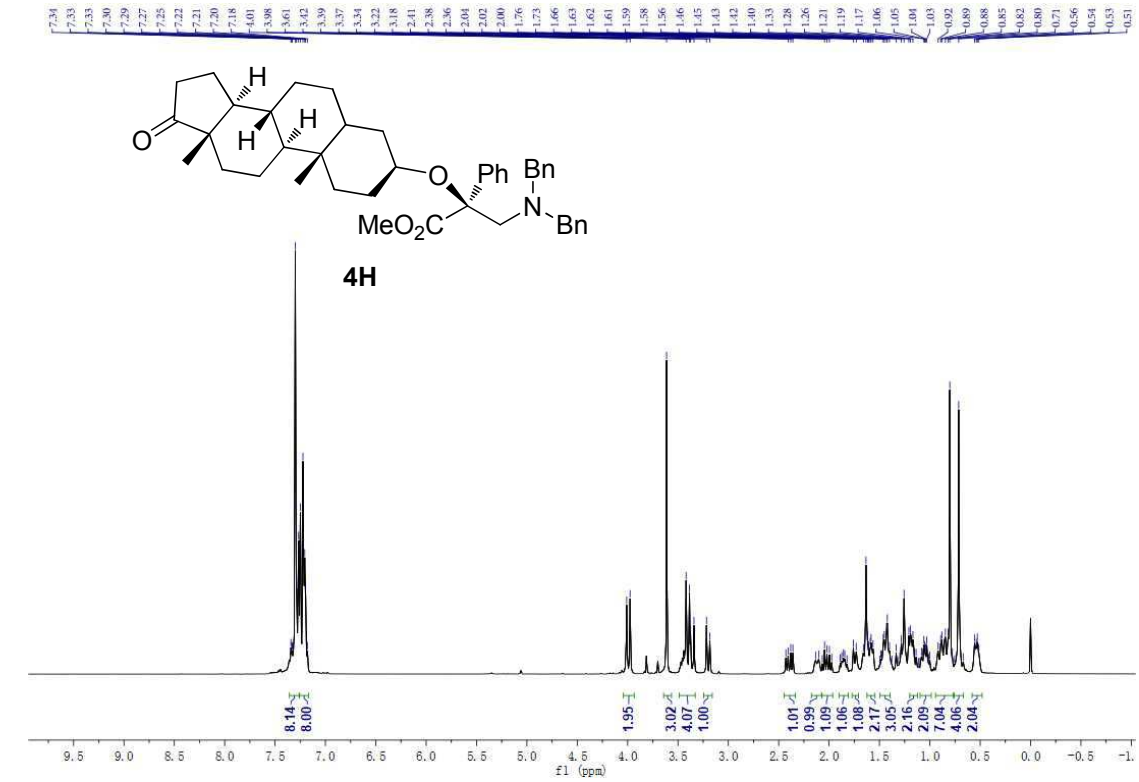



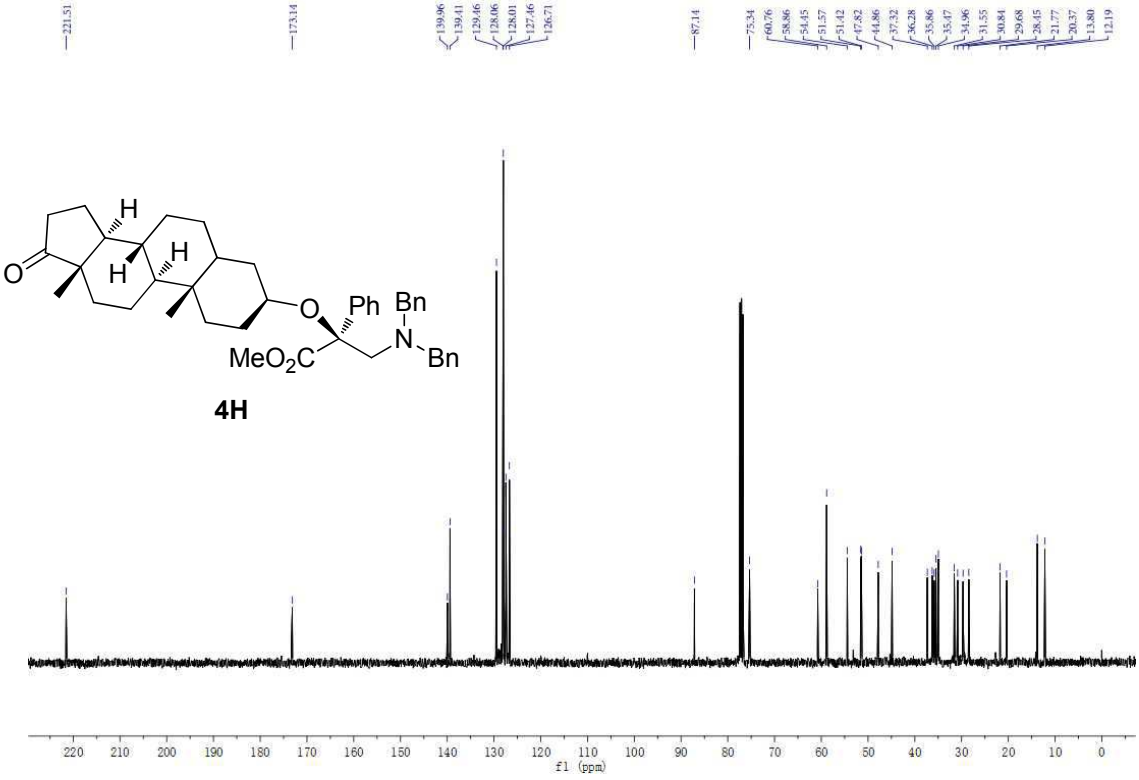
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for 4G**



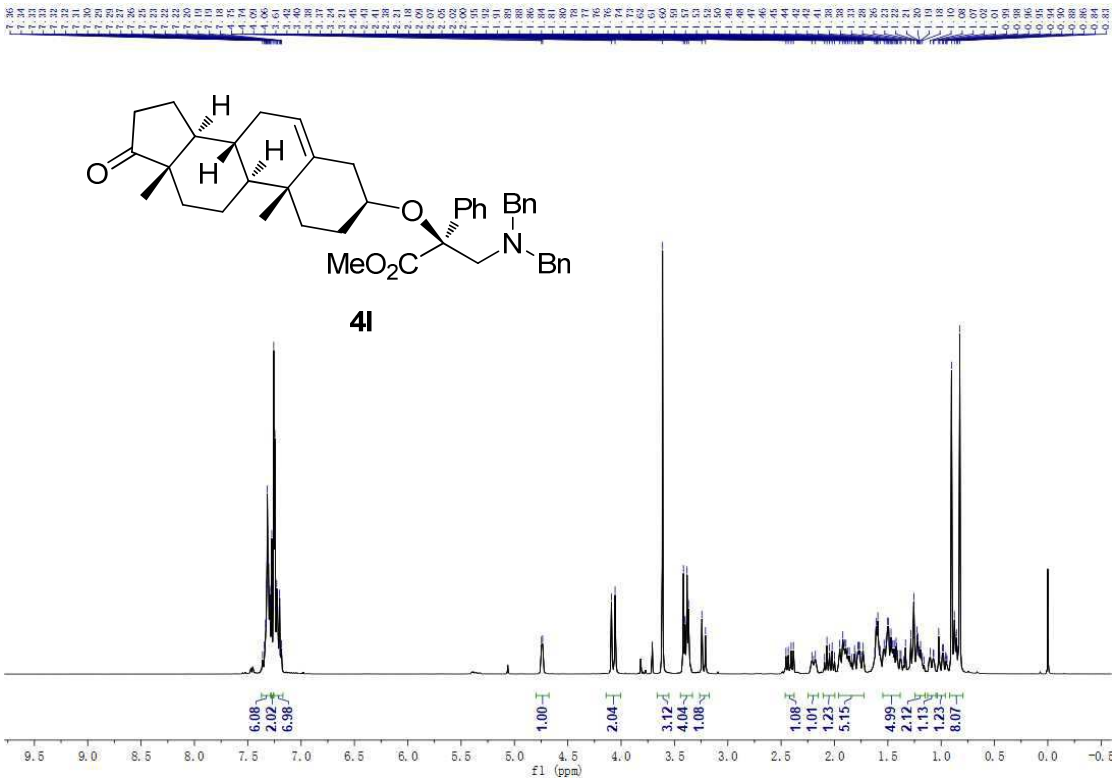



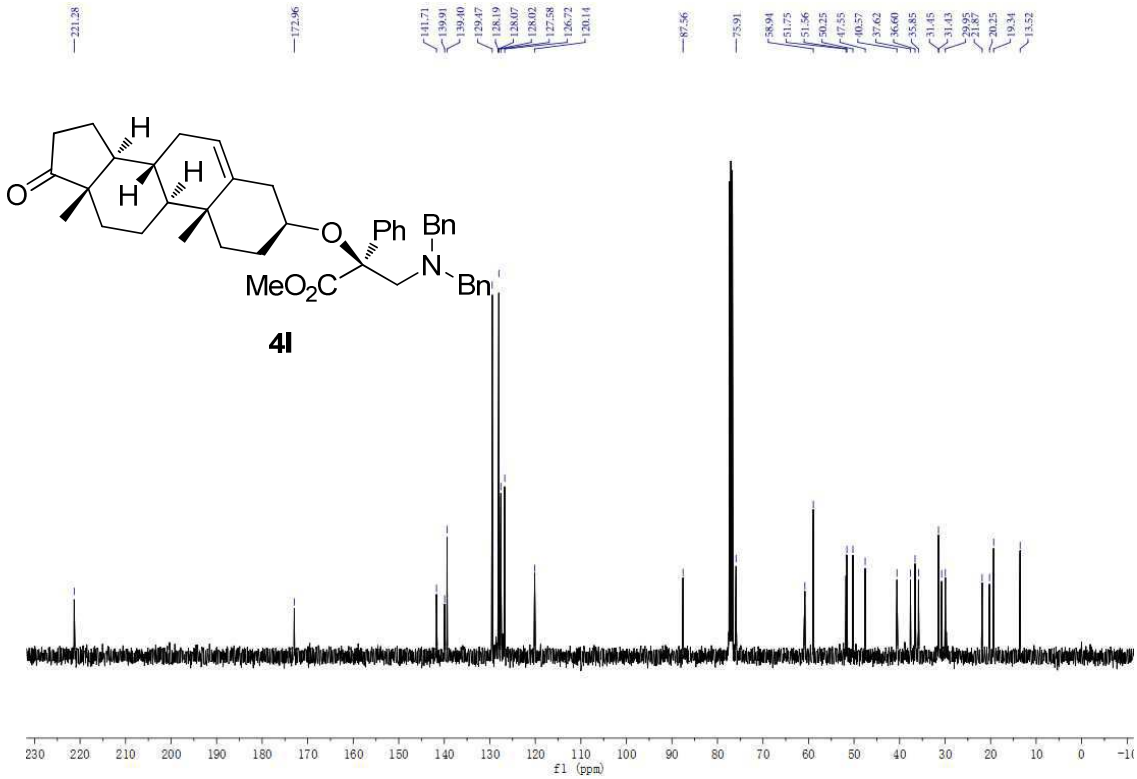
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for 4H**



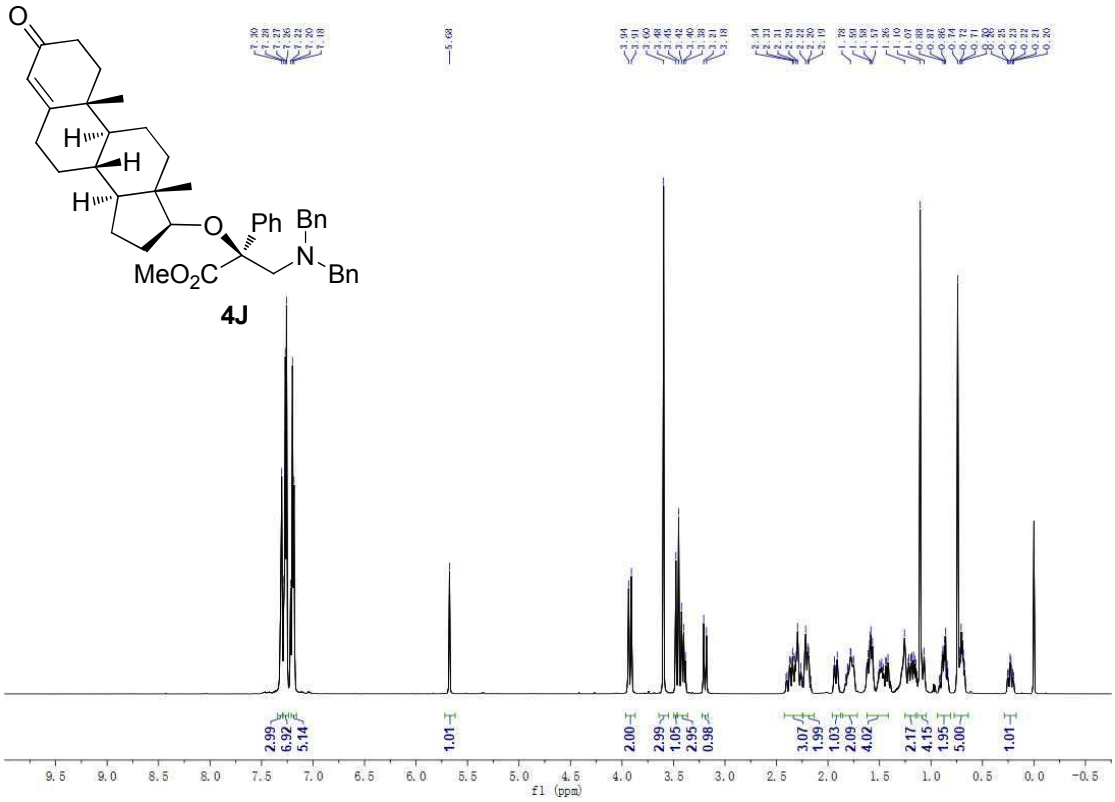



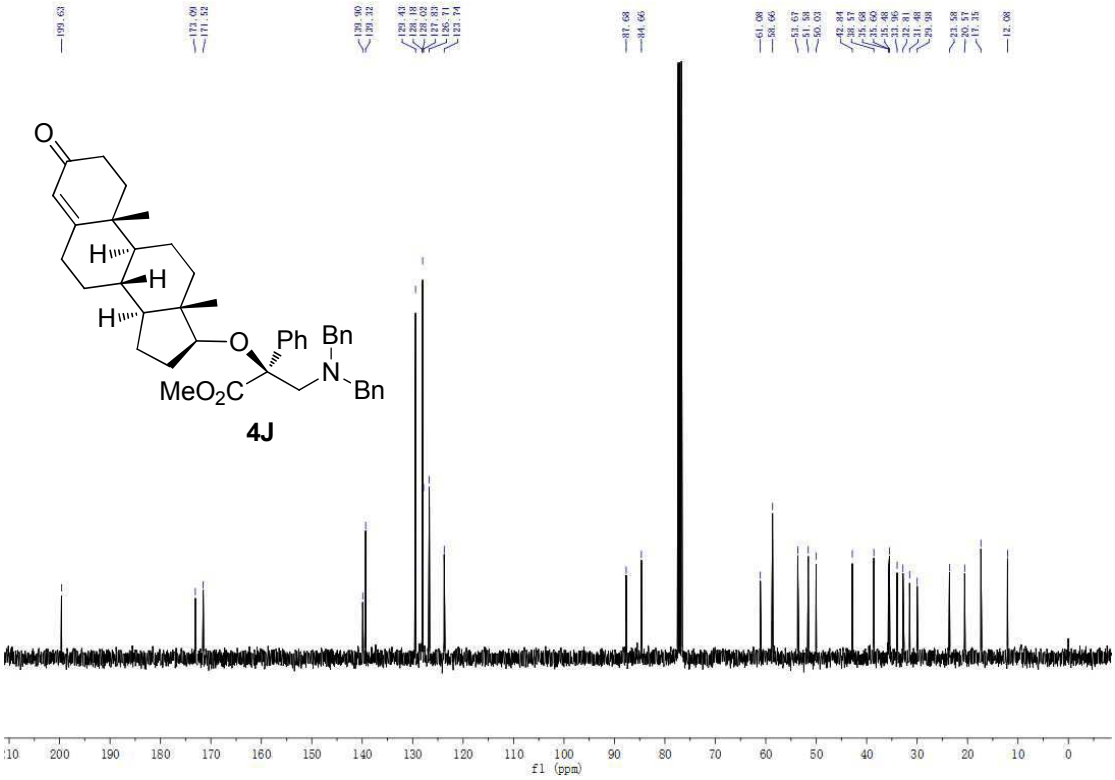
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for 4I**



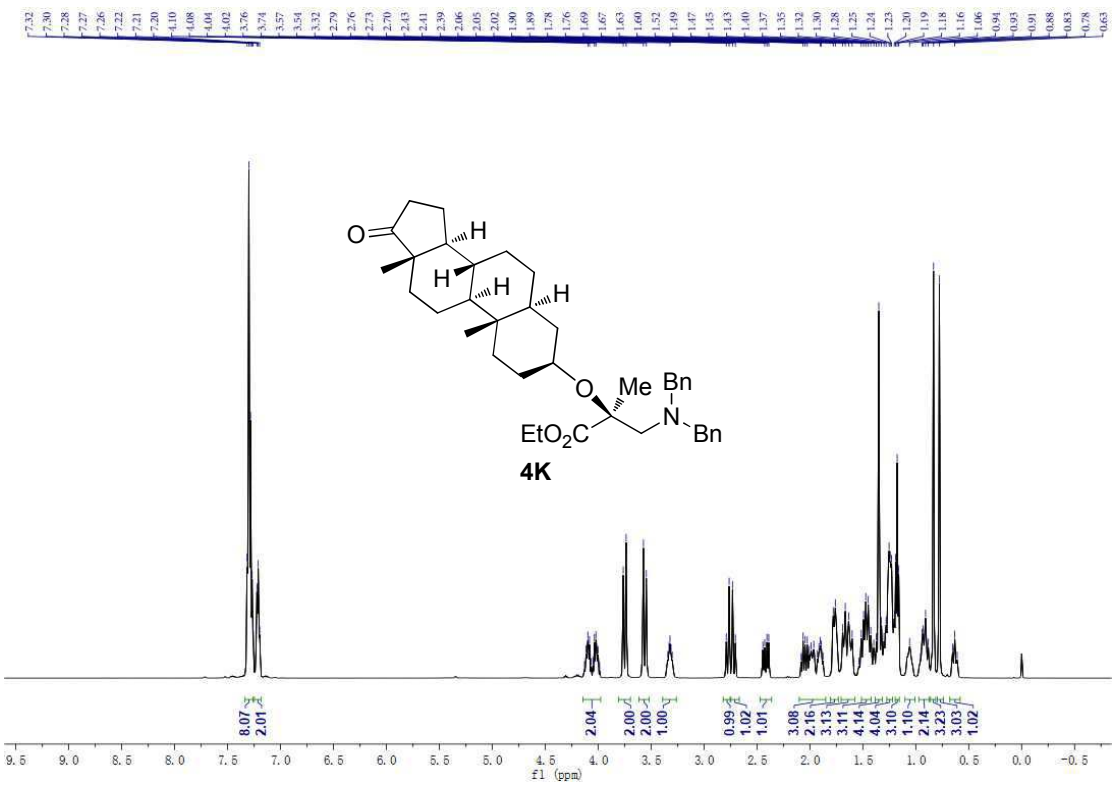



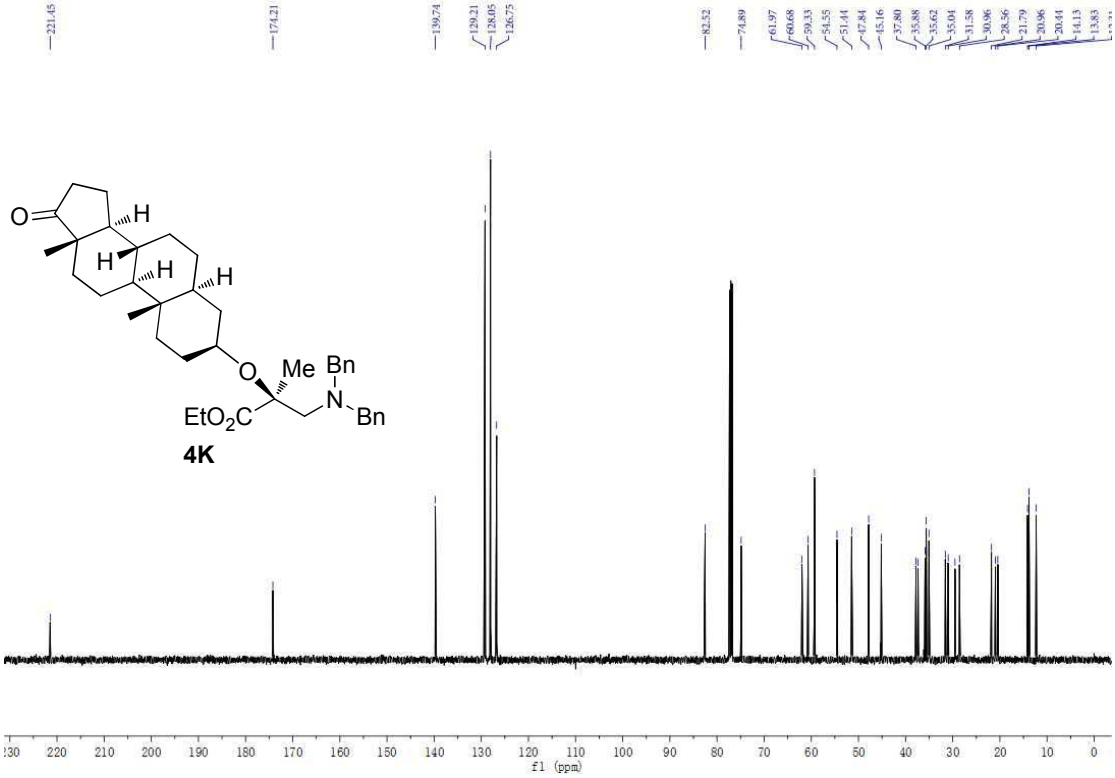
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for 4J**



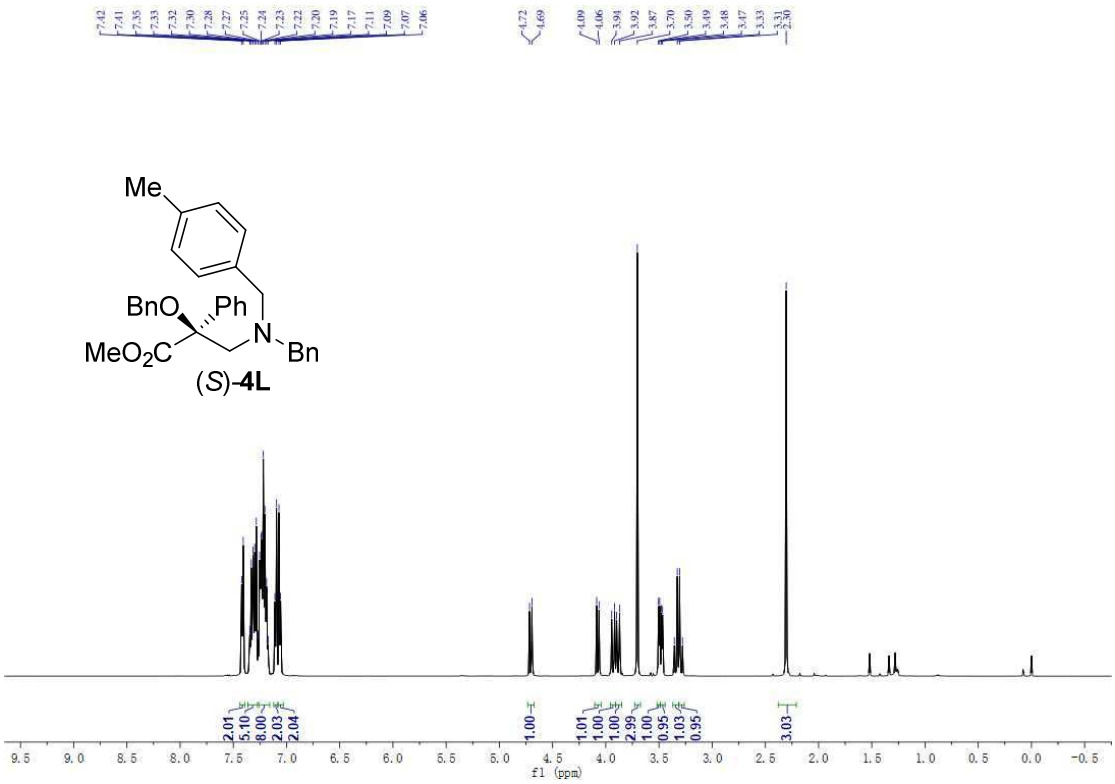



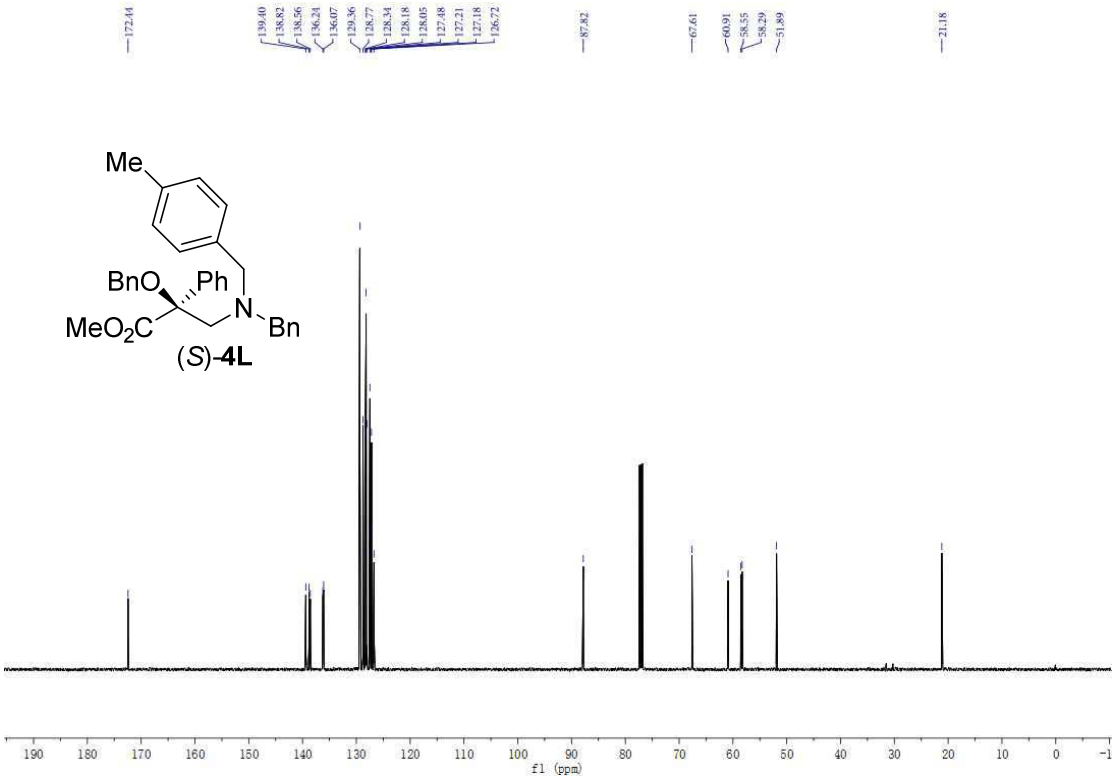
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for 4K**



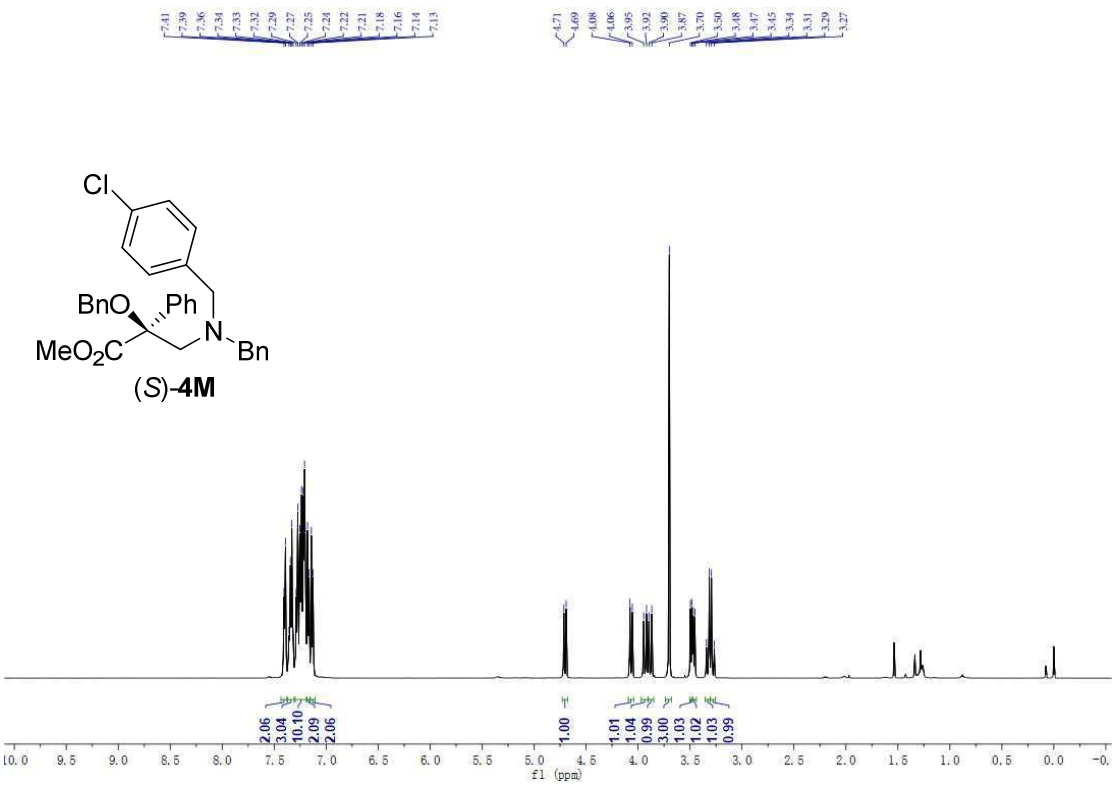



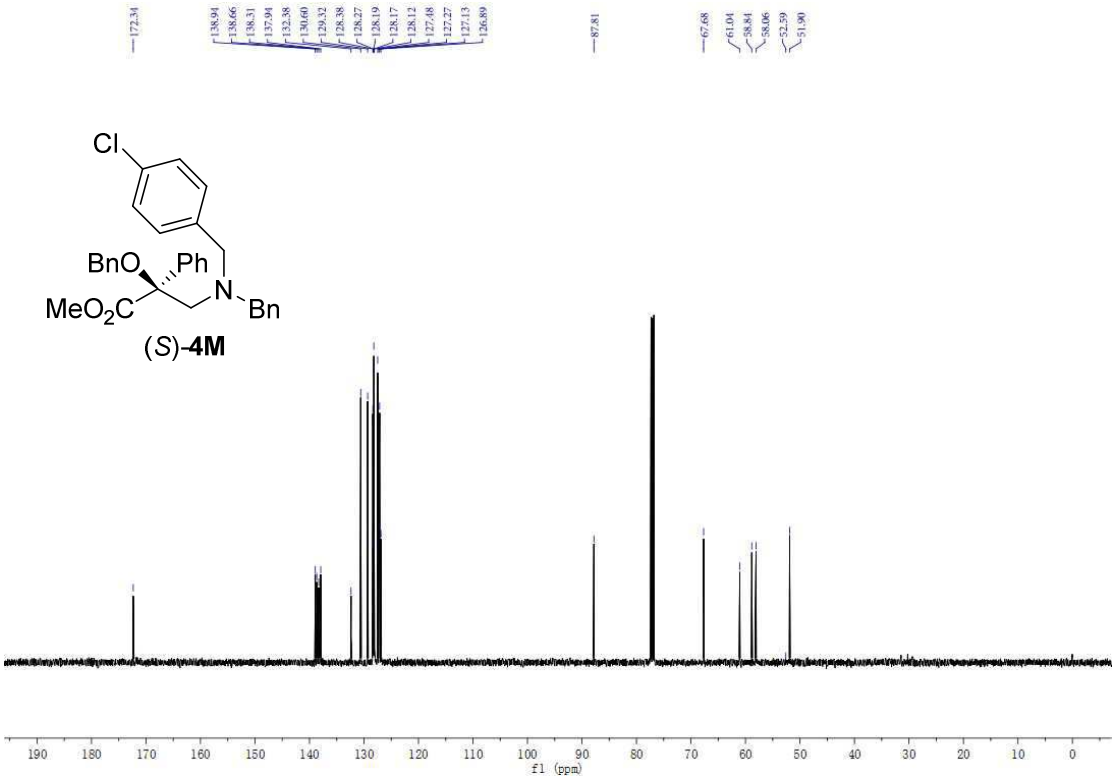
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for (*S*)-4L**



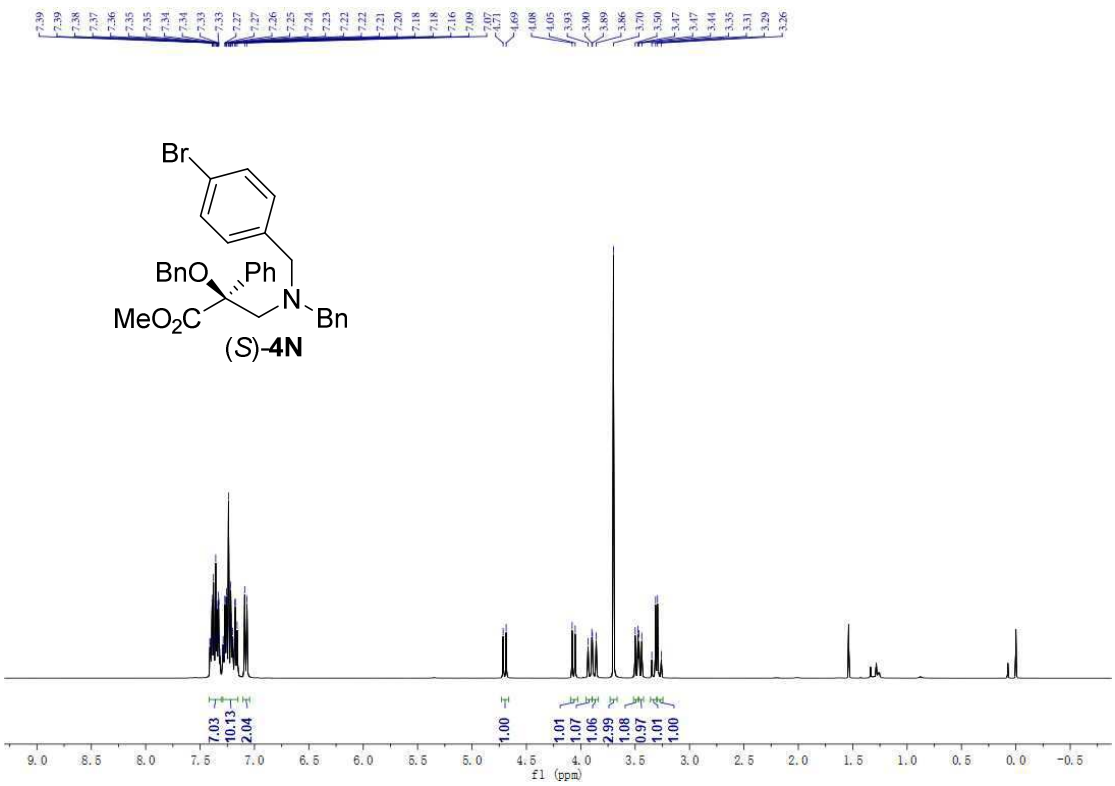



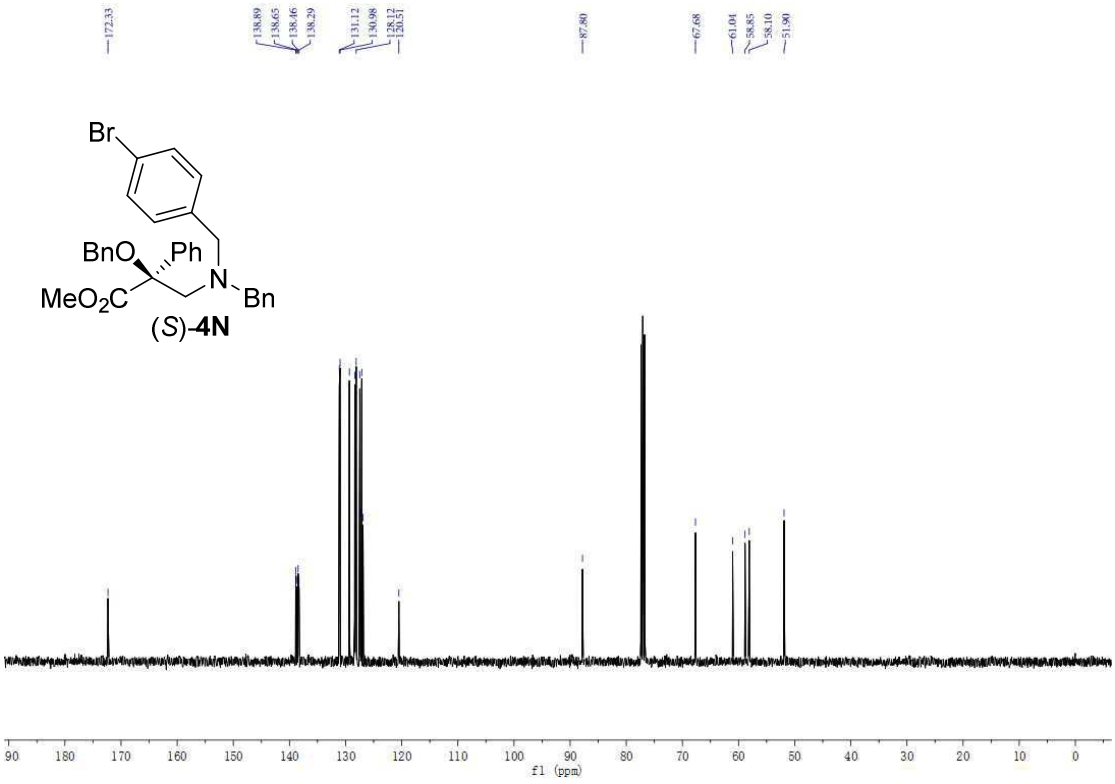
**$^{1}$H NMR (500 MHz, $CDCl_3$) and $^{13}$C NMR (500 MHz, $CDCl_3$) spectra for (*S*)-4M**



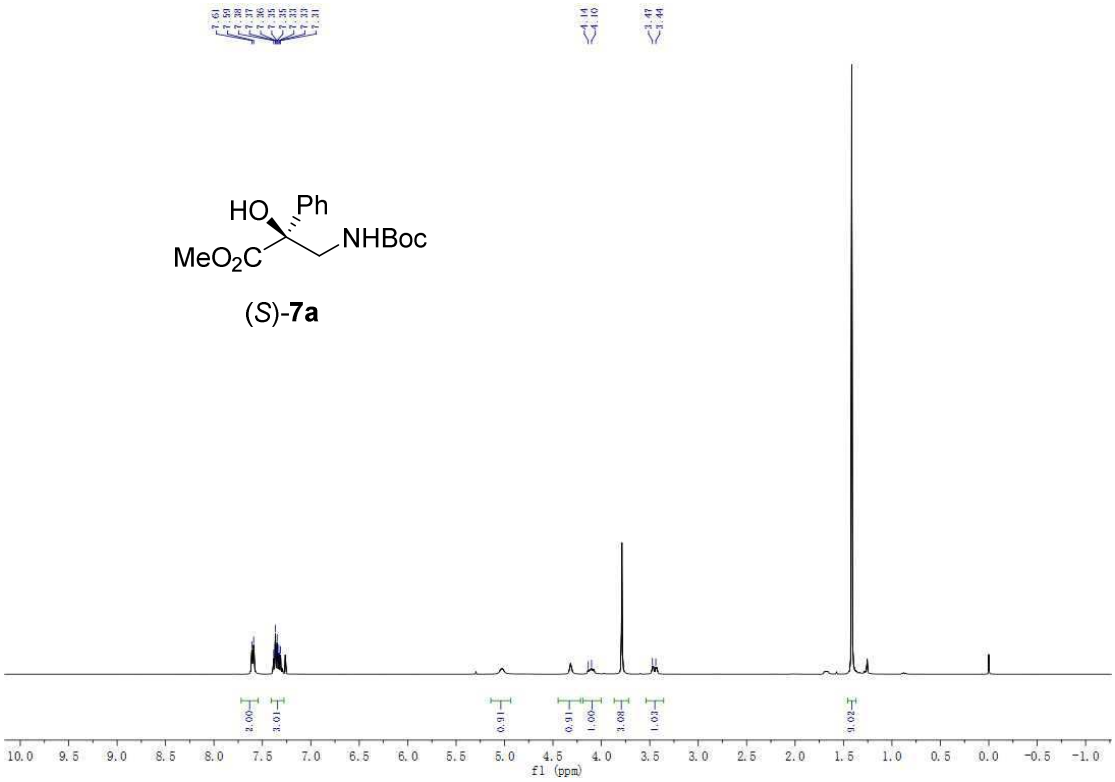



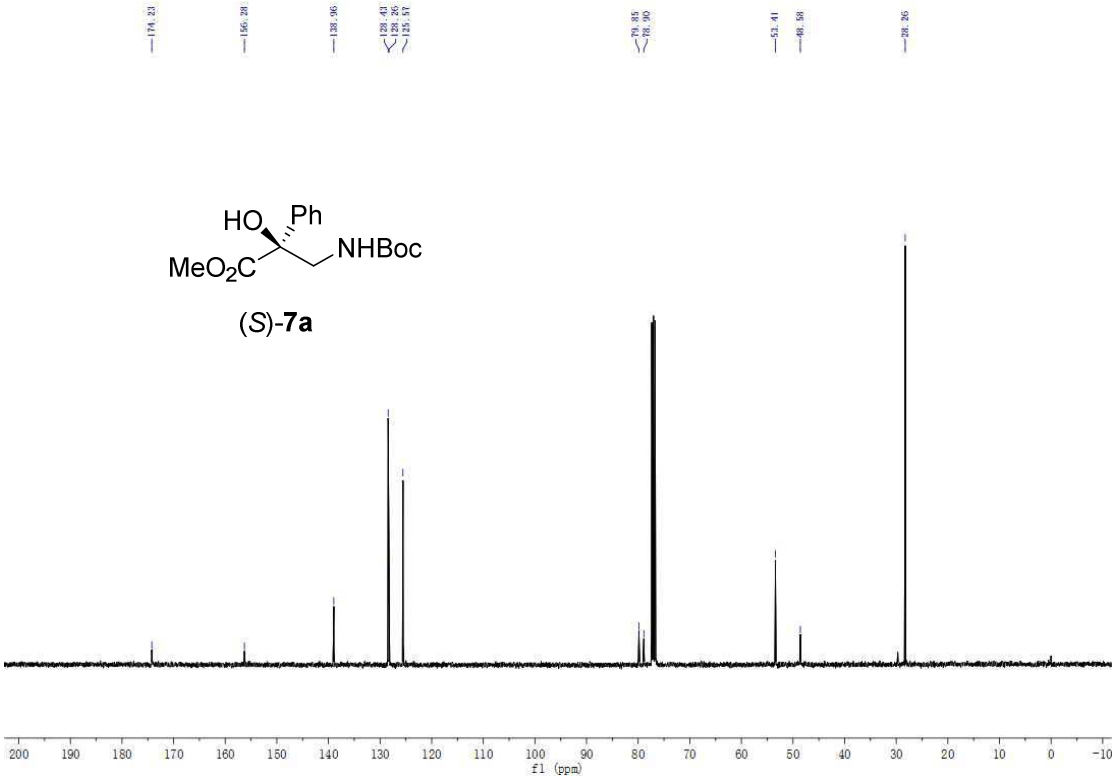
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-4N**



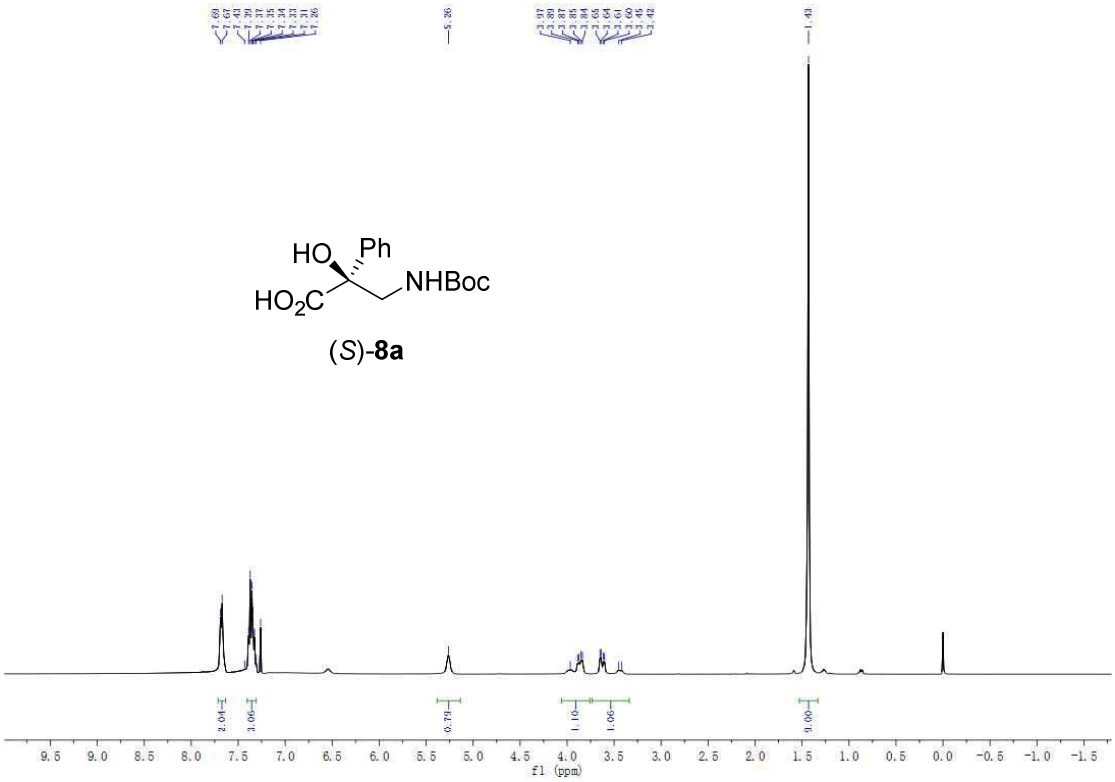



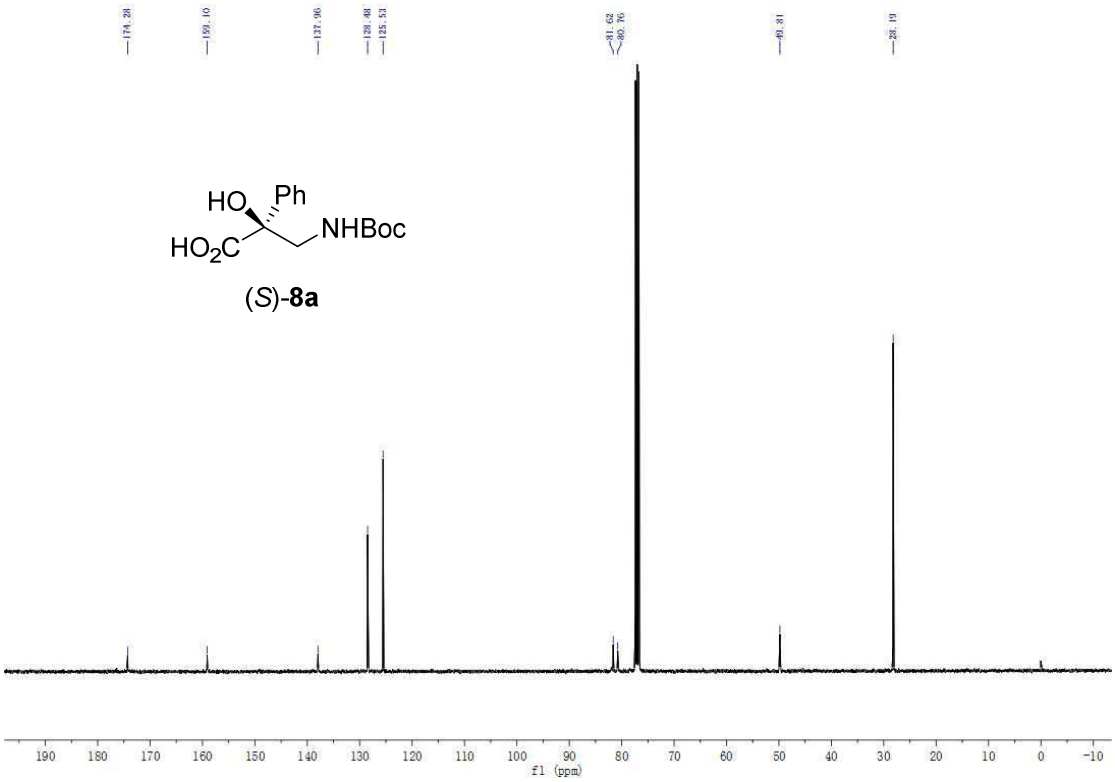
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-7a**



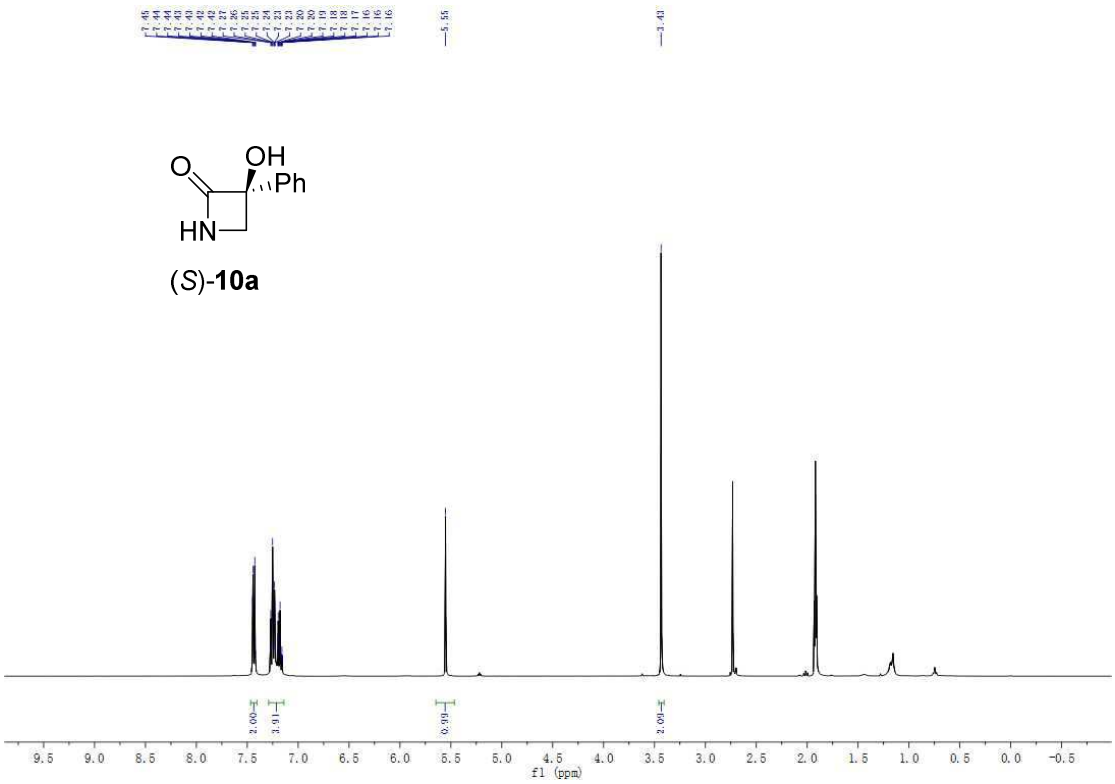



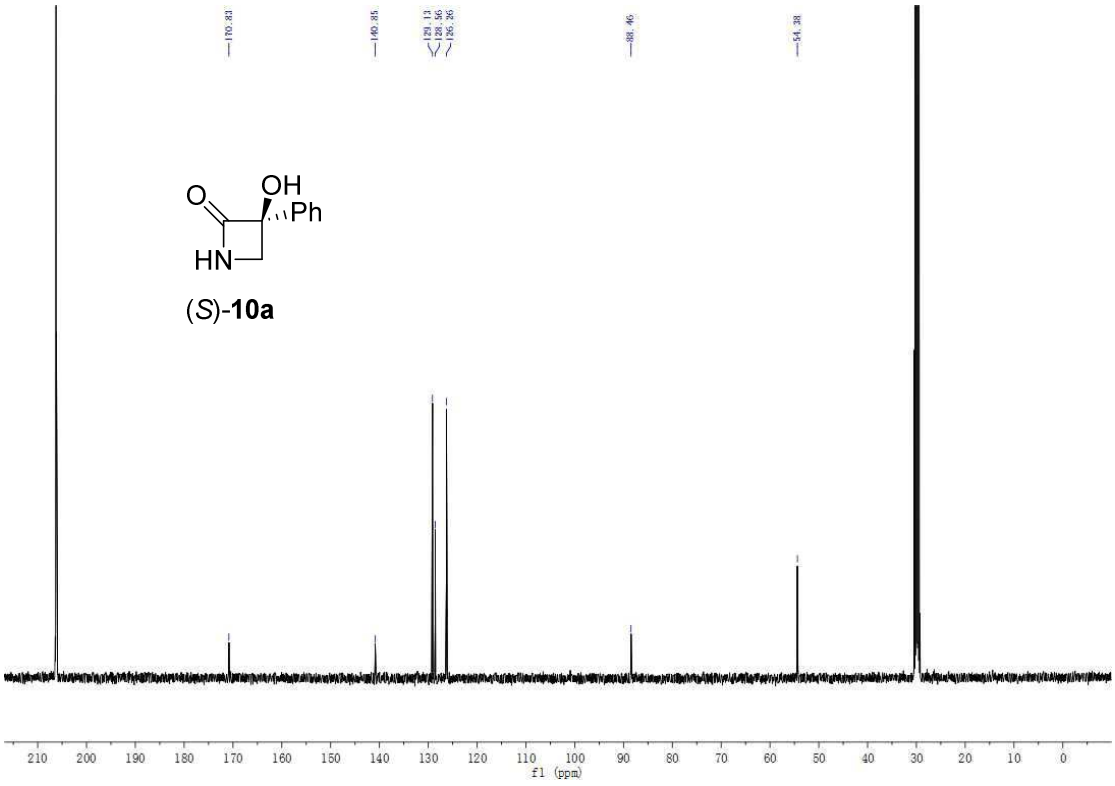
**$^{1}$H NMR (400 MHz, $CDCl_3$) and $^{13}$C NMR (100 MHz, $CDCl_3$) spectra for (*S*)-8a**



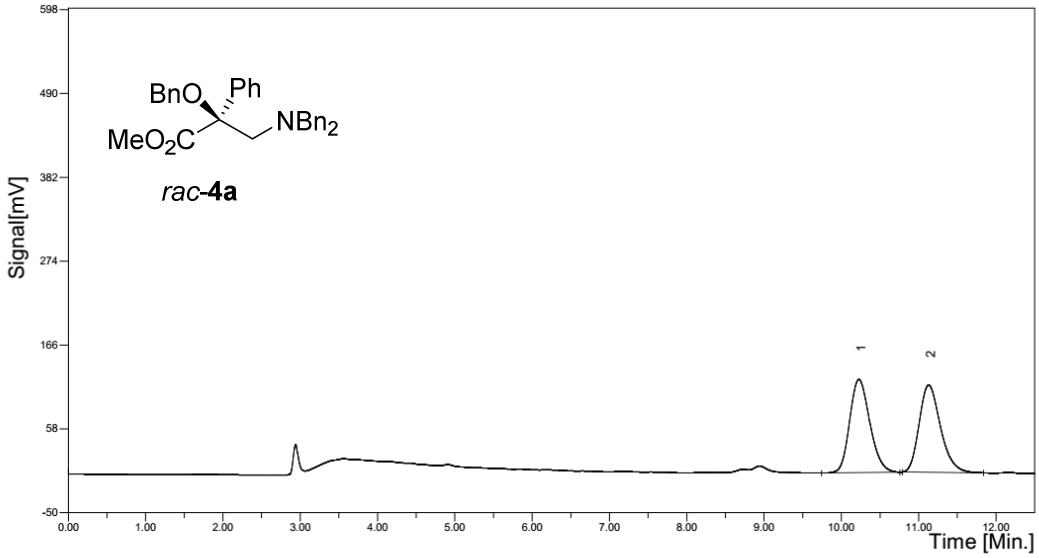



**$^{1}$H NMR (400 MHz, Acetone) and $^{13}$C NMR (100 MHz, Acetone) spectra for (*S*)-10a**



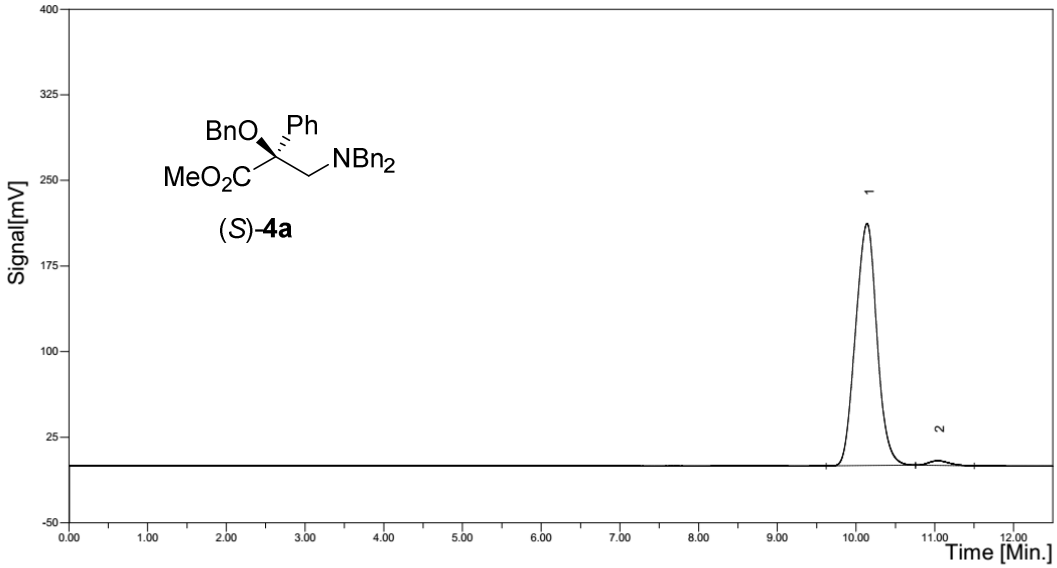



# 11. HPLC chromatograms of all products



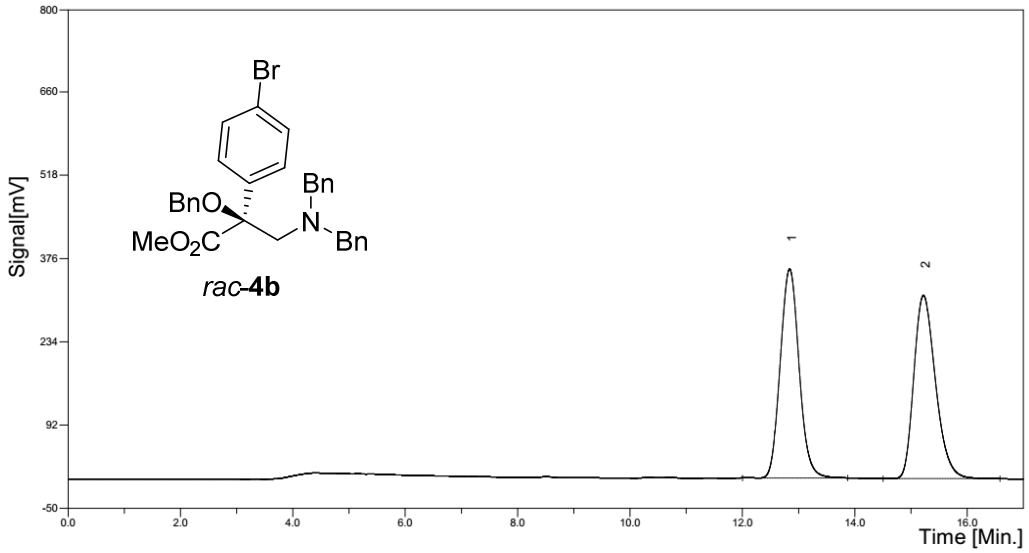

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 10.22667 | 119.97 | 2172.36 | 50.2096 | 0.0000 | 100.0000 |
| 2 | Unknown | 11.12917 | 112.32 | 2154.23 | 49.7904 | 0.0000 | 100.0000 |
| 合计 | | | 232.29 | 4326.59 | 100 | | |



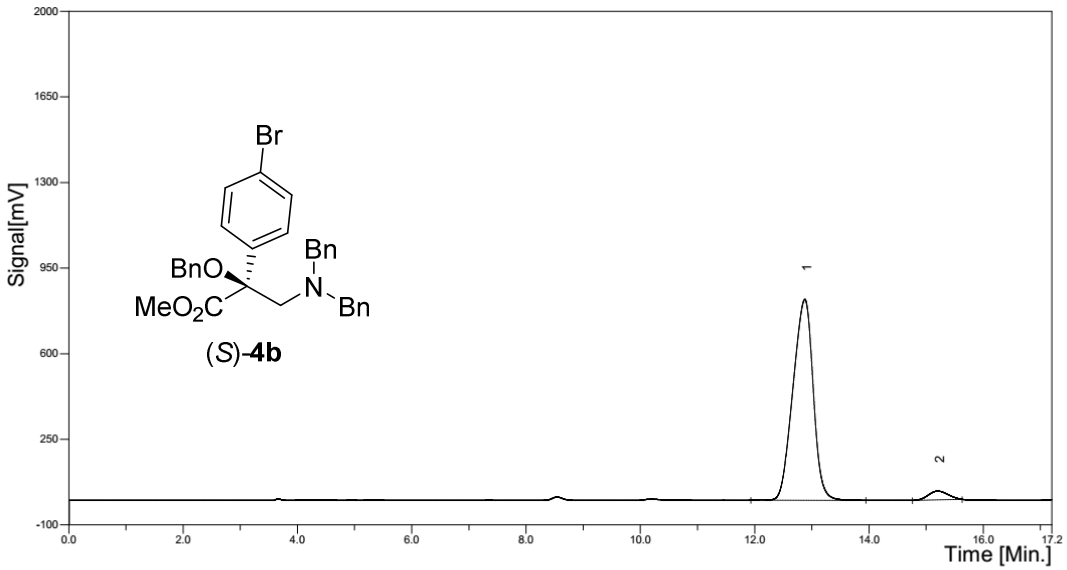

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 10.14000 | 212.03 | 4006.15 | 98.1924 | 0.0000 | 0.0000 |
| 2 | Unknown | 11.03667 | 4.09 | 73.75 | 1.8076 | 0.0000 | 100.0000 |
| 合计 | | | 216.12 | 4079.90 | 100 | | |



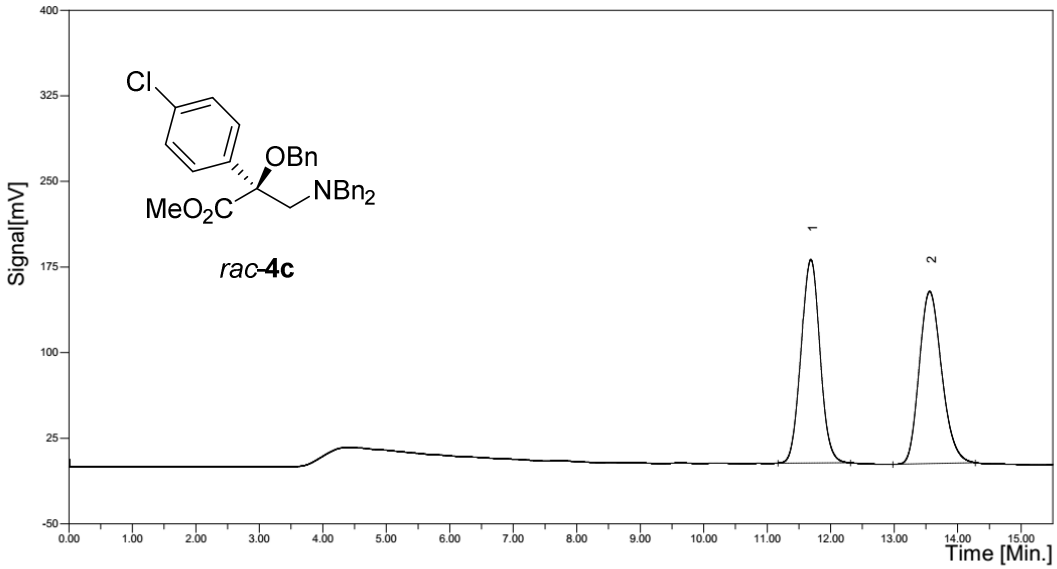

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.84083 | 356.12 | 8282.41 | 49.7692 | 0.0000 | 100.0000 |
| 2 | Unknown | 15.22167 | 312.30 | 8359.23 | 50.2308 | 0.0000 | 100.0000 |
| 合计 | | | 668.42 | 16641.63 | 100 | | |



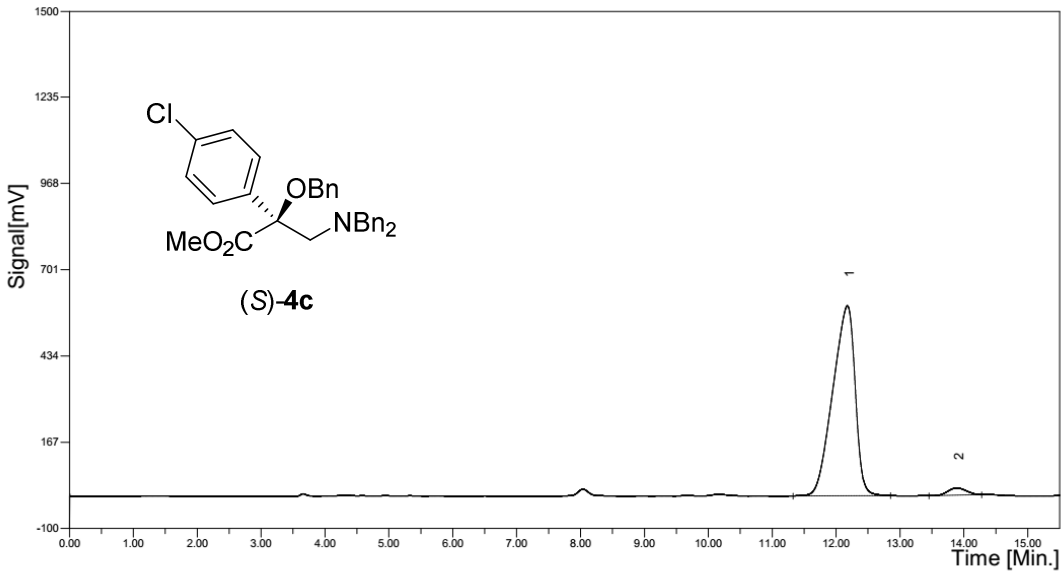

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.87667 | 821.01 | 20210.69 | 95.9467 | 0.0000 | 0.0000 |
| 2 | Unknown | 15.20333 | 35.84 | 853.80 | 4.0533 | 0.0000 | 100.0000 |
| 合计 | | | 856.85 | 21064.49 | 100 | | |



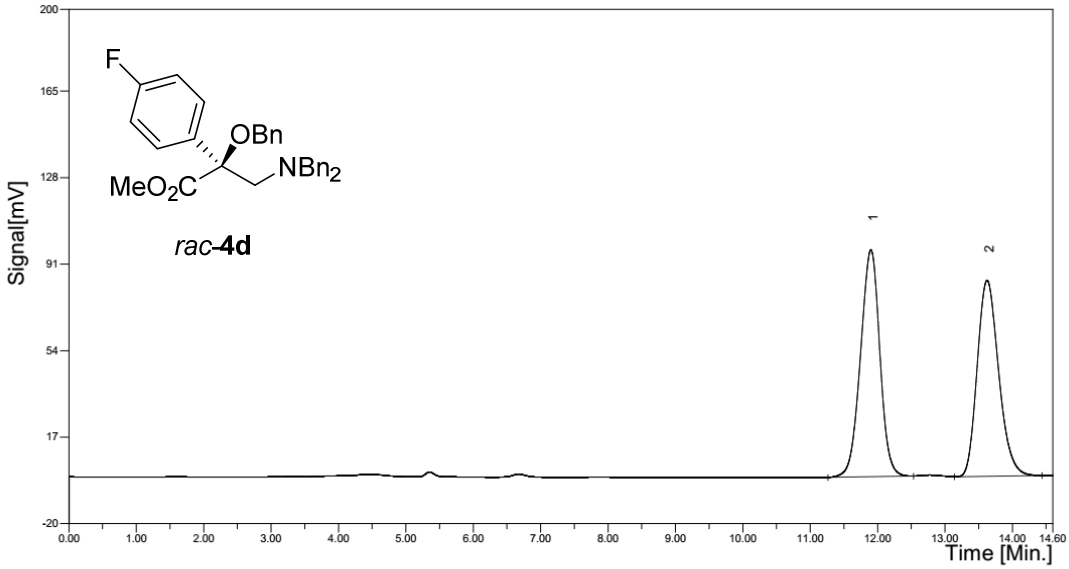

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV. sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 11.68667 | 178.26 | 3707.76 | 49.9500 | 0.0000 | 100.0000 |
| 2 | Unknown | 13.55833 | 150.84 | 3715.18 | 50.0500 | 0.0000 | 100.0000 |
| 合计 | | | 329.10 | 7422.95 | 100 | | |



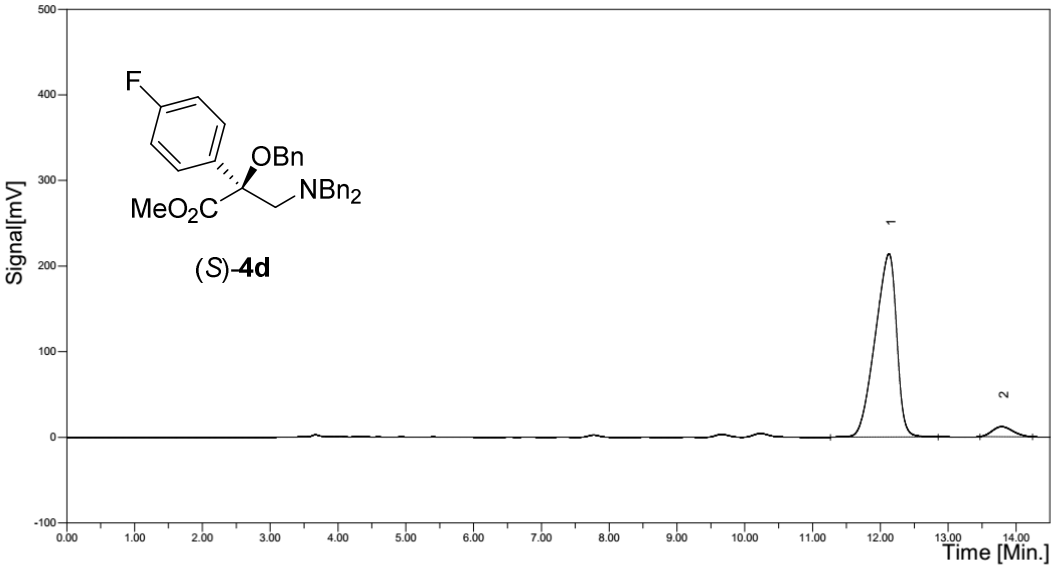

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV. sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.17583 | 587.58 | 14298.88 | 97.0413 | 0.0000 | 100.0000 |
| 2 | Unknown | 13.88833 | 22.09 | 435.96 | 2.9587 | 0.0000 | 100.0000 |
| 合计 | | | 609.67 | 14734.84 | 100 | | |



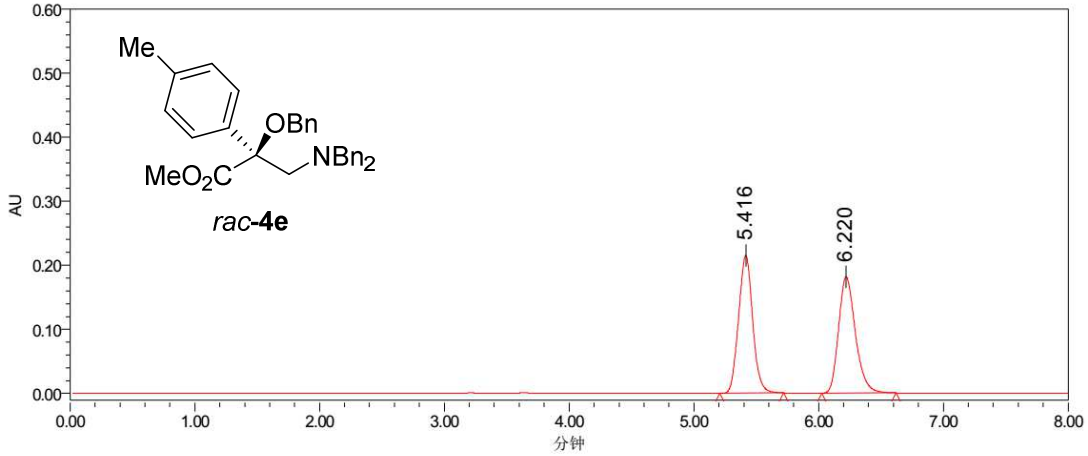

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 11.90083 | 97.03 | 1931.92 | 51.0697 | 0.0000 | 100.0000 |
| 2 | Unknown | 13.62417 | 83.80 | 1850.98 | 48.9303 | 0.0000 | 100.0000 |
| 合计 | | | 180.83 | 3782.90 | 100 | | |



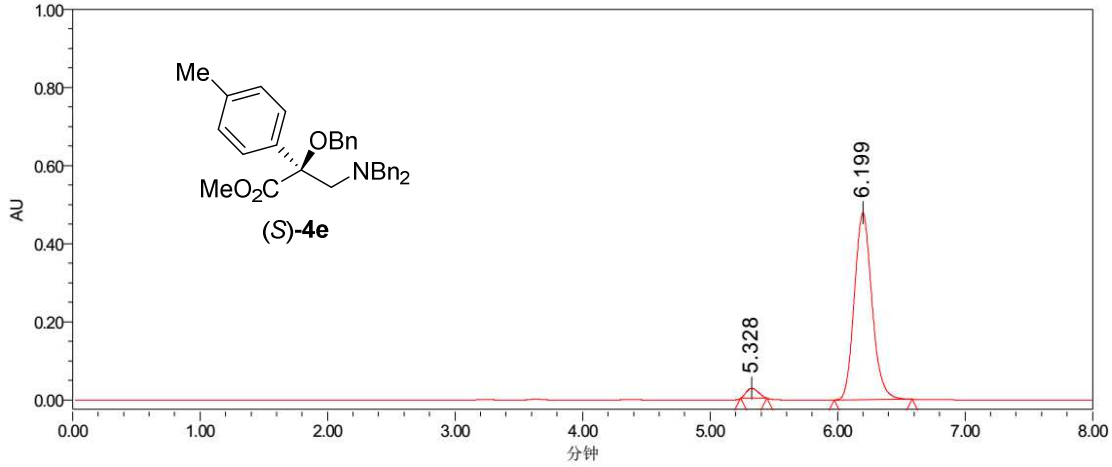

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.12583 | 214.15 | 4722.66 | 95.0297 | 0.0000 | 0.0000 |
| 2 | Unknown | 13.78750 | 11.68 | 247.01 | 4.9703 | 0.0000 | 100.0000 |
| 合计 | | | 225.83 | 4969.67 | 100 | | |



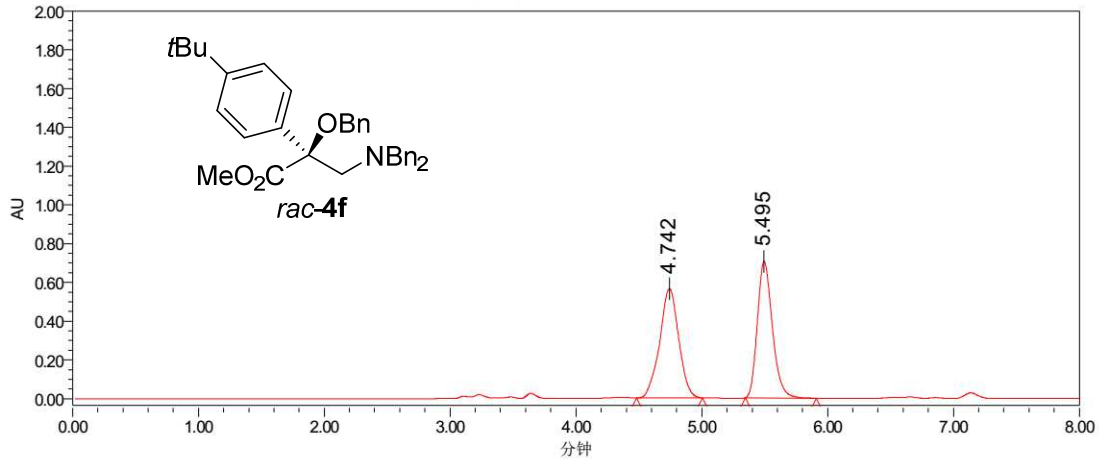

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.416 | 1688030 | 215164 | 49.86 |
| 2 | | 6.220 | 1697281 | 181639 | 50.14 |



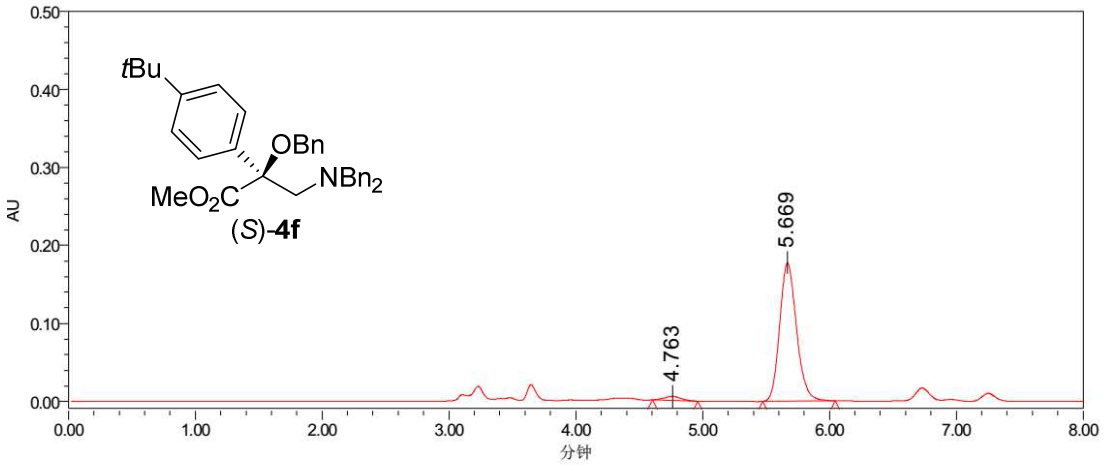

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.328 | 165007 | 25676 | 3.48 |
| 2 | | 6.199 | 4577282 | 478566 | 96.52 |



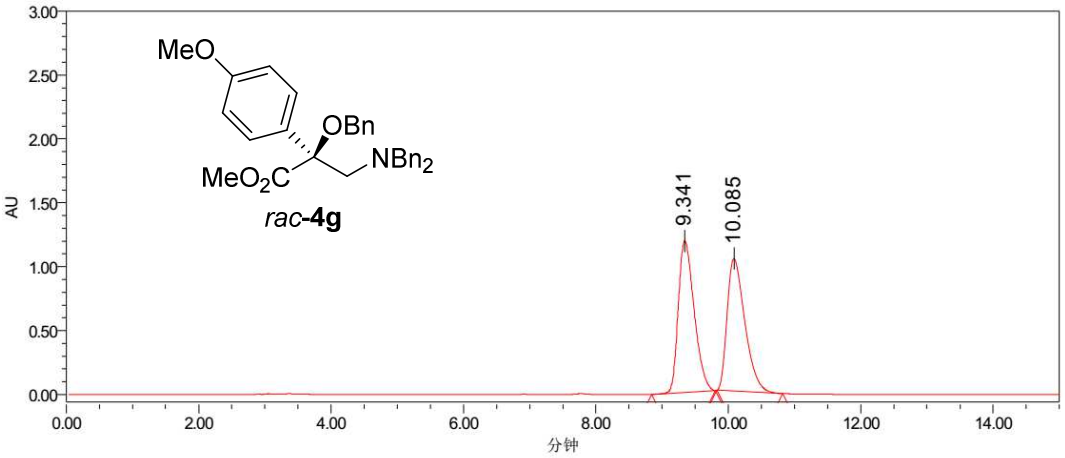

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 4.742 | 5924872 | 563820 | 50.28 |
| 2 | | 5.495 | 5859394 | 703783 | 49.72 |



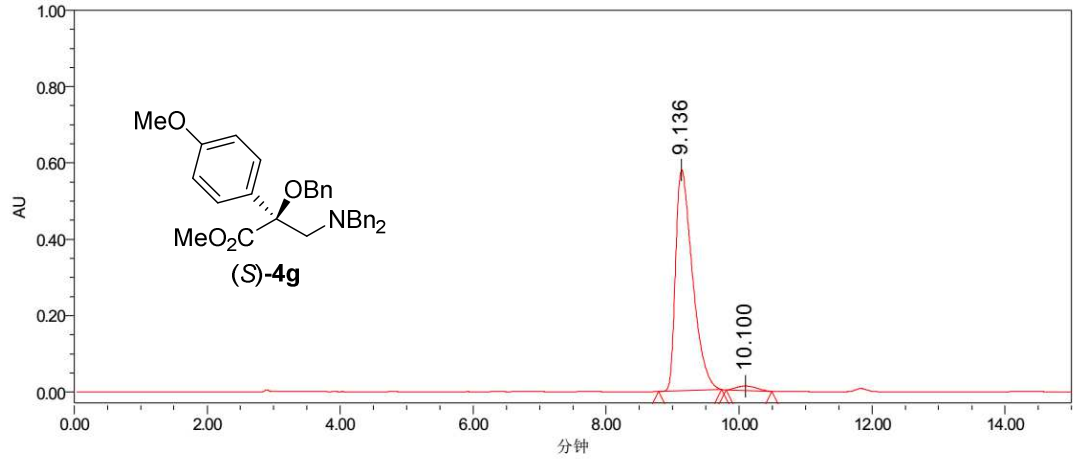

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 4.763 | 47260 | 5132 | 2.81 |
| 2 | | 5.669 | 1634568 | 177347 | 97.19 |



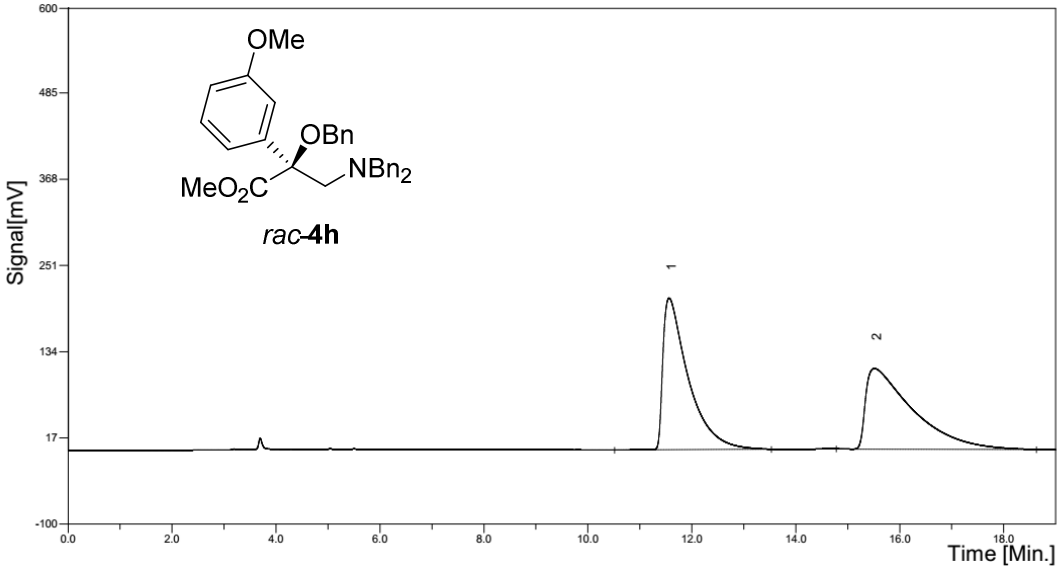

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 9.341 | 19631589 | 1186152 | 50.37 |
| 2 | | 10.085 | 19343266 | 1036473 | 49.63 |



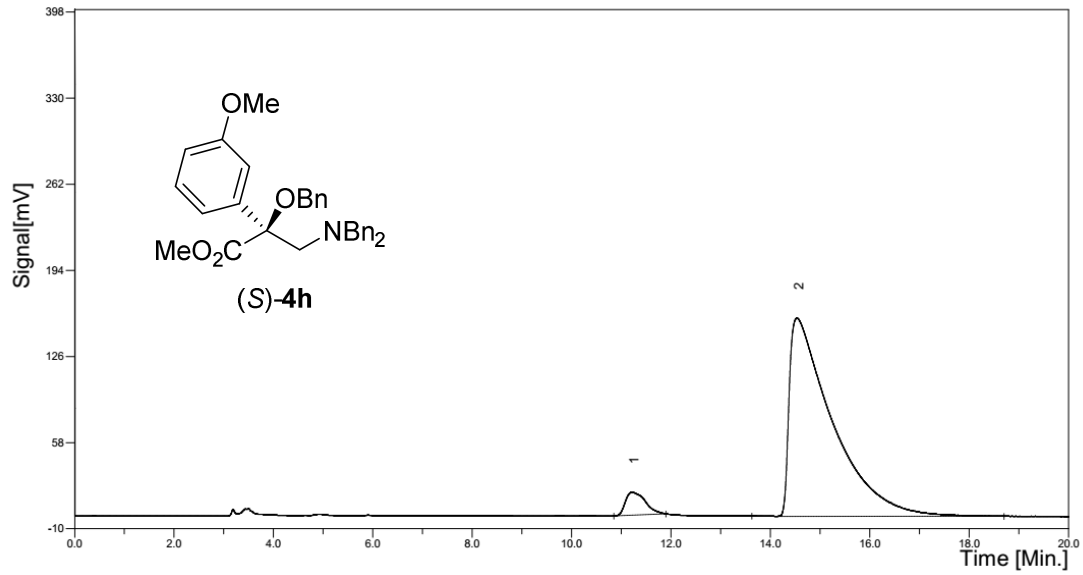

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 9.136 | 10149347 | 578997 | 97.61 |
| 2 | | 10.100 | 248743 | 11761 | 2.39 |



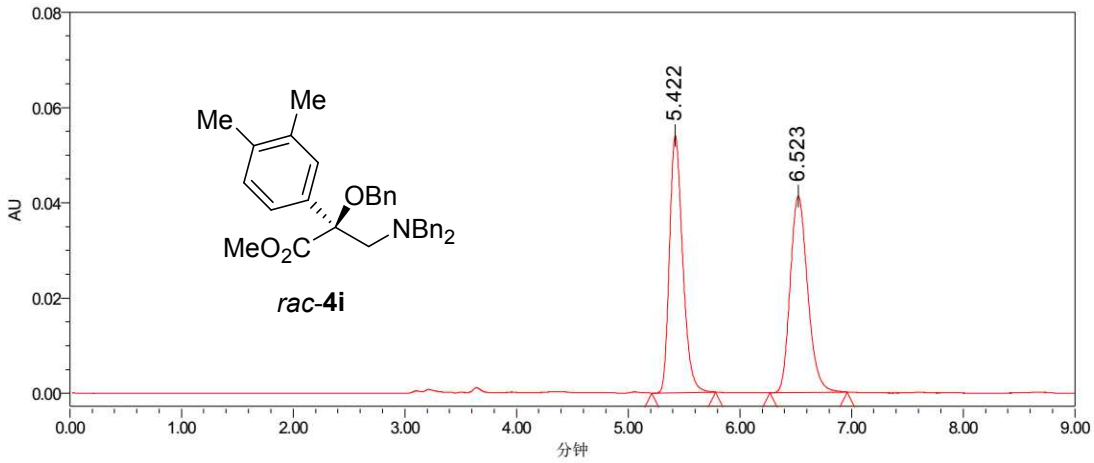

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 11.56333 | 205.73 | 6949.28 | 50.4434 | 0.0000 | 0.0000 |
| 2 | Unknown | 15.51417 | 109.15 | 6827.12 | 49.5566 | 0.0000 | 0.0000 |
| 合计 | | | 314.88 | 13776.41 | 100 | | |



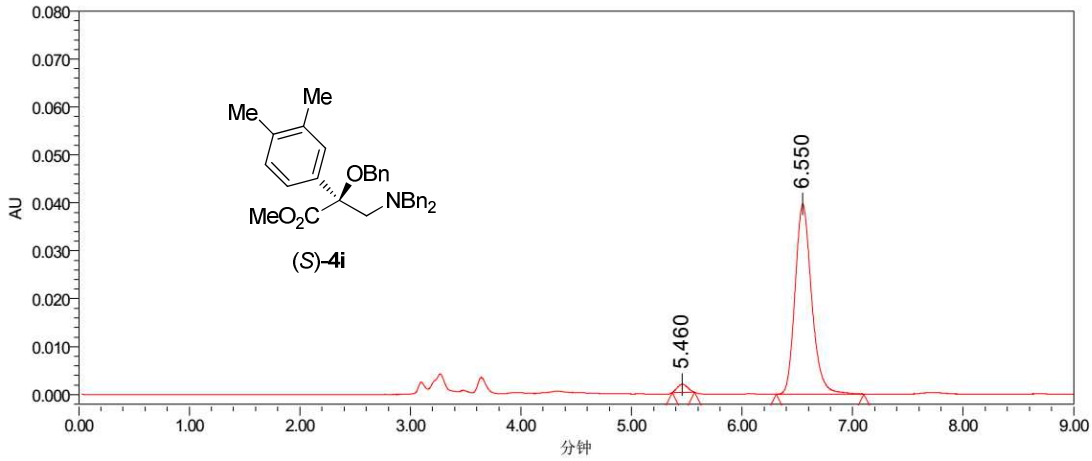

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 11.21333 | 18.17 | 502.19 | 5.1015 | 0.0000 | 100.0000 |
| 2 | Unknown | 14.53167 | 156.25 | 9341.70 | 94.8985 | 0.0000 | 0.0000 |
| 合计 | | | 174.42 | 9843.89 | 100 | | |



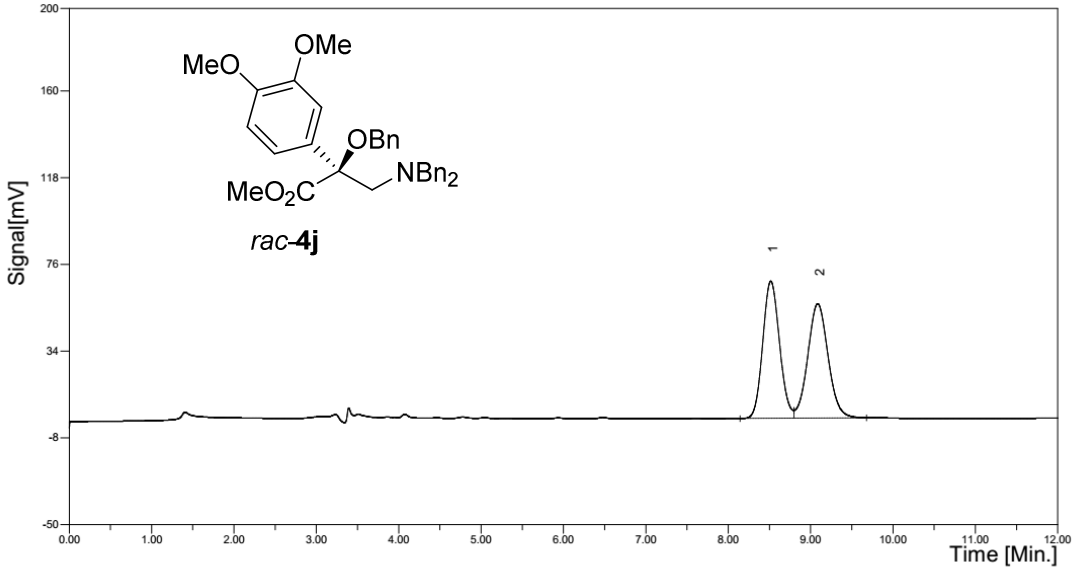

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.422 | 440391 | 53946 | 49.67 |
| 2 | | 6.523 | 446250 | 41229 | 50.33 |



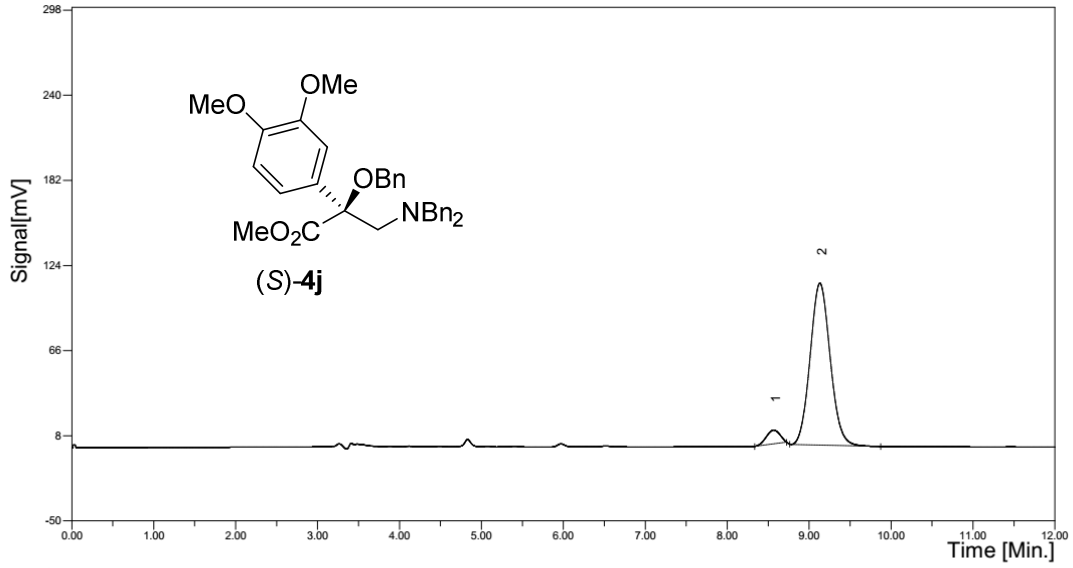

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.460 | 11353 | 1725 | 2.68 |
| 2 | | 6.550 | 411553 | 39699 | 97.32 |



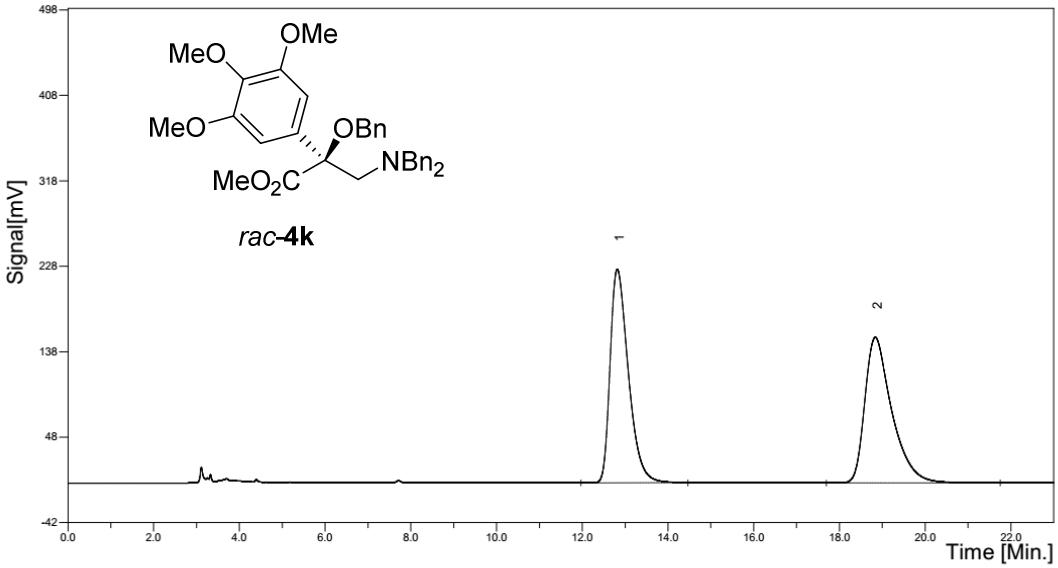

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|
| 1 | Unknown | 8.51667 | 66.40 | 939.53 | 0.0000 | 0.0000 |
| 2 | Unknown | 9.08667 | 55.38 | 949.10 | 0.0000 | 0.0000 |
| 合计 | | | 121.78 | 1888.63 | | |



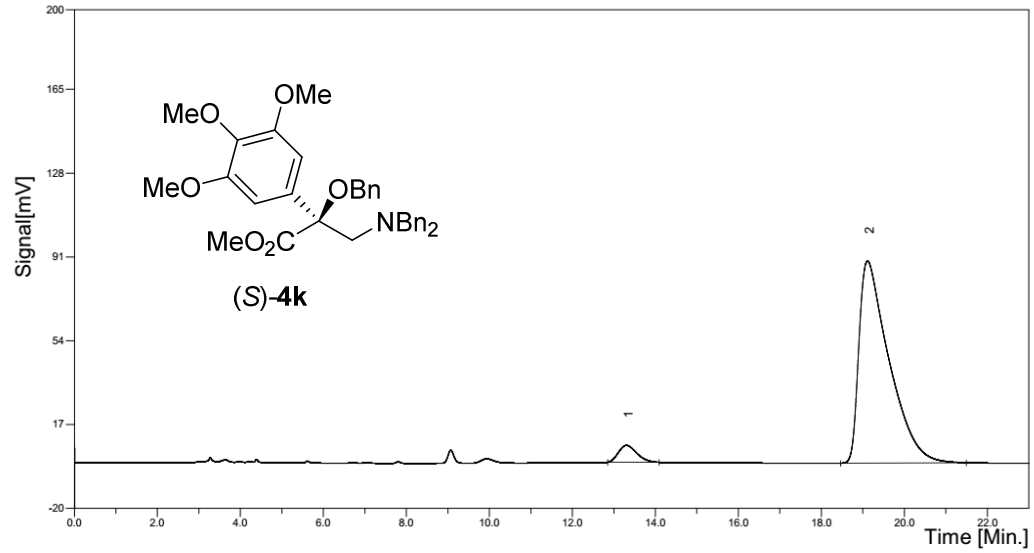

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 8.56667 | 9.39 | 108.32 | 5.4822 | 0.0000 | 100.0000 |
| 2 | Unknown | 9.13167 | 110.13 | 1867.51 | 94.5178 | 0.0000 | 100.0000 |
| 合计 | | | 119.51 | 1975.83 | 100 | | |



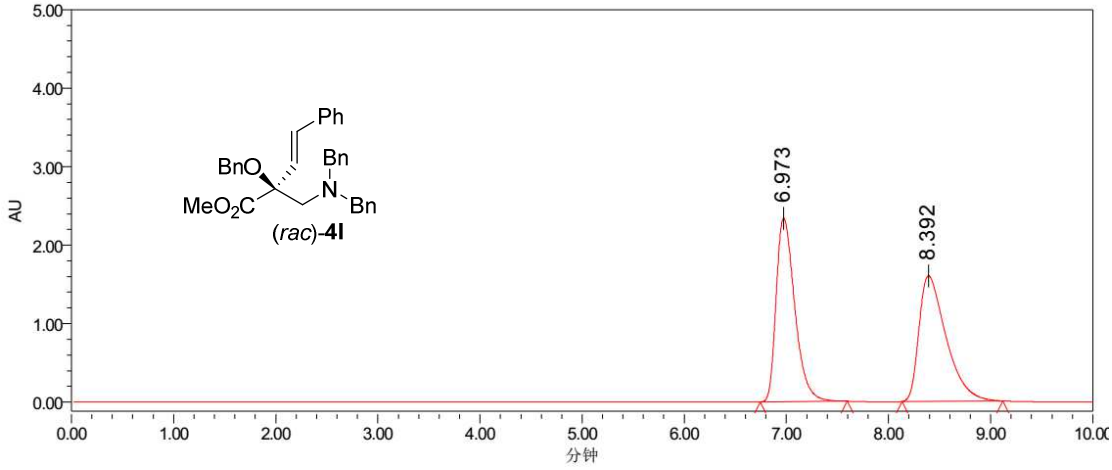

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.81667 | 224.72 | 6619.78 | 49.7033 | 0.0000 | 100.0000 |
| 2 | Unknown | 18.83667 | 153.29 | 6698.80 | 50.2967 | 0.0000 | 100.0000 |
| 合计 | | | 378.00 | 13318.58 | 100 | | |



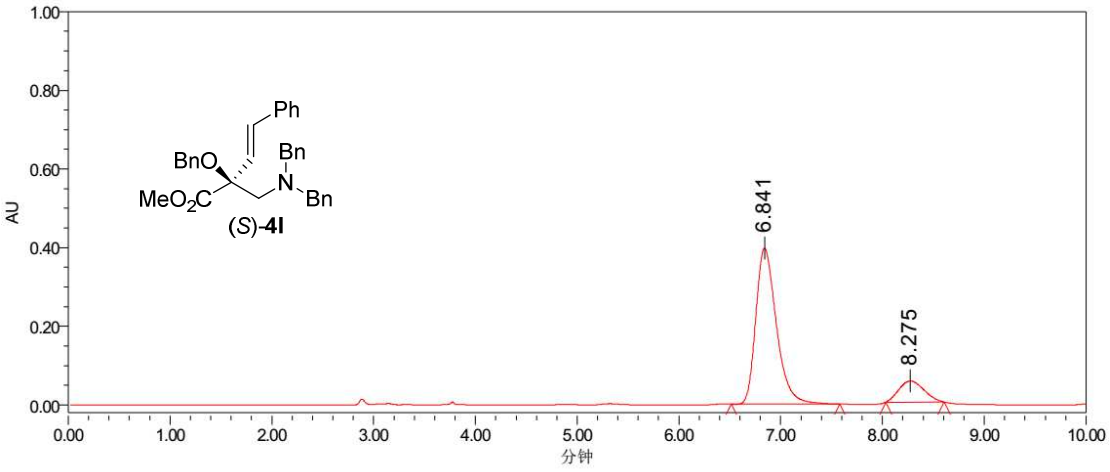

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 13.30250 | 7.48 | 229.76 | 4.8713 | 0.0000 | 0.0000 |
| 2 | Unknown | 19.11083 | 89.25 | 4486.81 | 95.1287 | 0.0000 | 0.0000 |
| 合计 | | | 96.73 | 4716.57 | 100 | | |



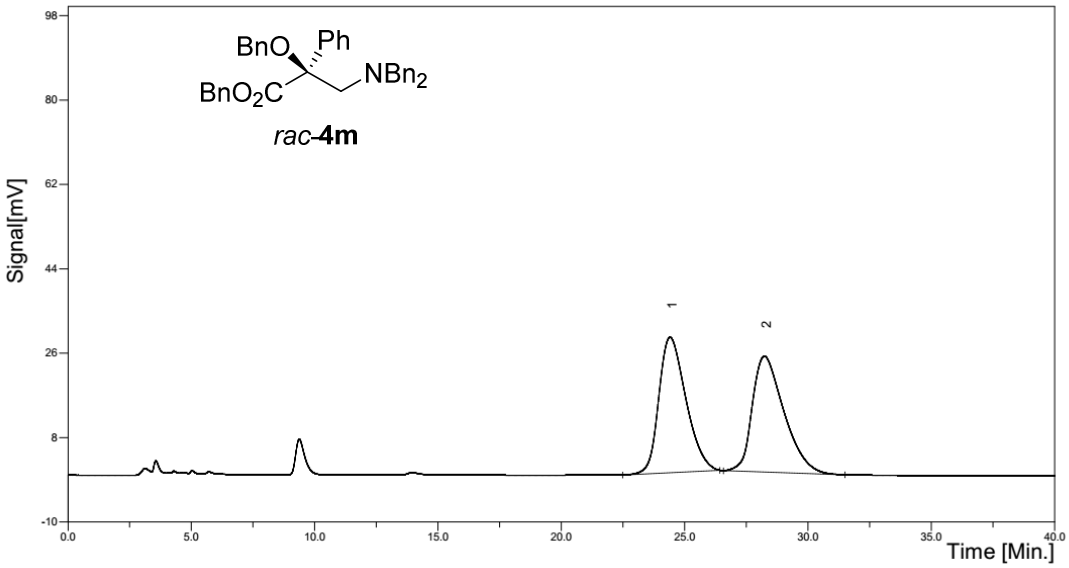

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.973 | 29661647 | 2338941 | 50.08 |
| 2 | | 8.392 | 29571682 | 1599249 | 49.92 |



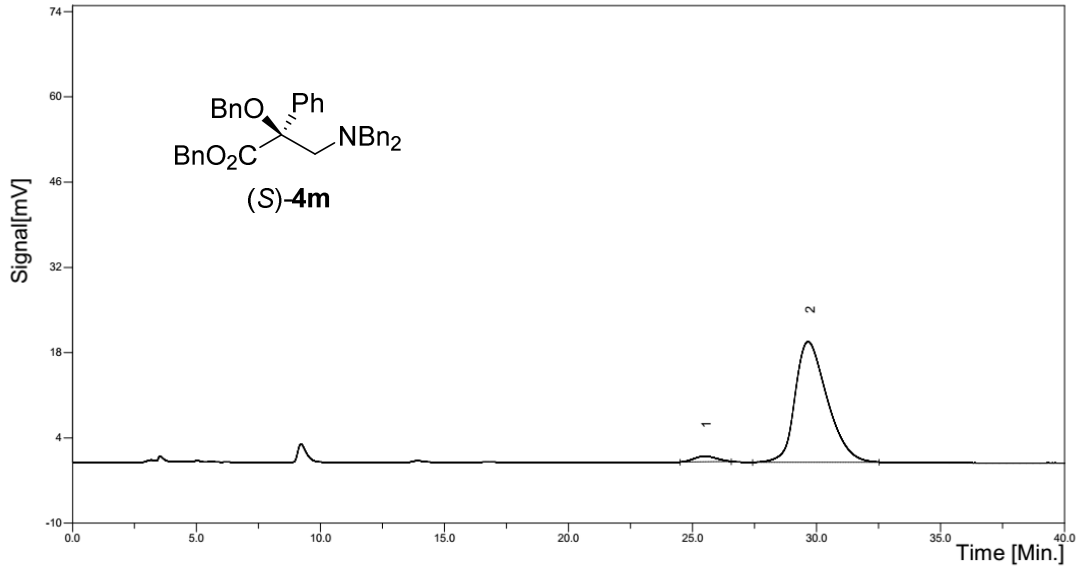

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.841 | 5572420 | 396472 | 85.82 |
| 2 | | 8.275 | 920872 | 53681 | 14.18 |



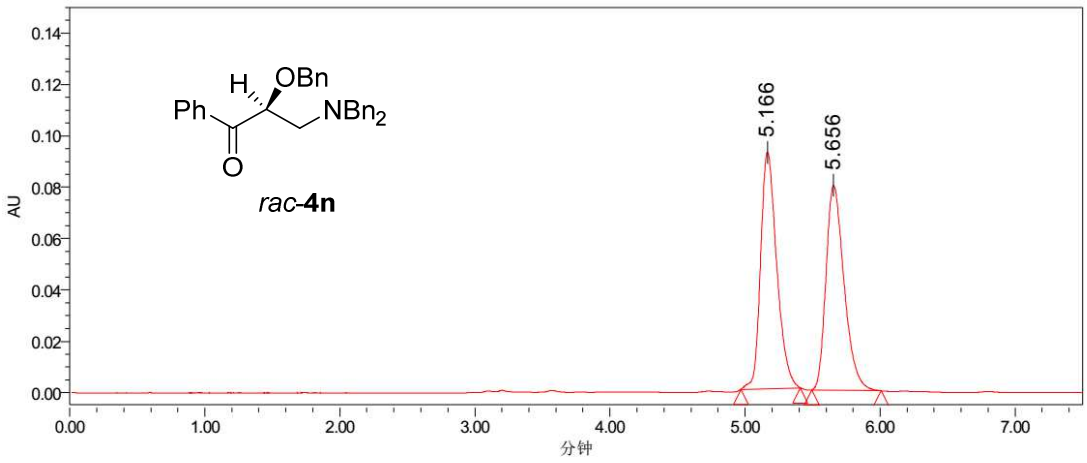

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 24.40000 | 28.89 | 2203.48 | 50.0298 | 0.0000 | 100.0000 |
| 2 | Unknown | 28.23000 | 24.70 | 2200.86 | 49.9702 | 0.0000 | 0.0000 |
| 合计 | | | 53.59 | 4404.34 | 100 | | |



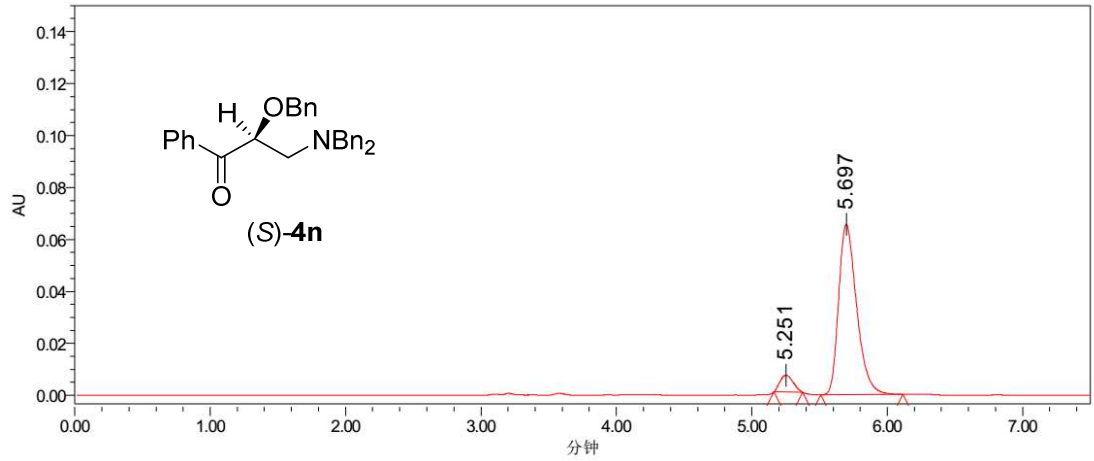

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 25.46750 | 0.91 | 57.19 | 3.1198 | 0.0000 | 100.0000 |
| 2 | Unknown | 29.65667 | 19.81 | 1775.92 | 96.8802 | 0.0000 | 0.0000 |
| 合计 | | | 20.72 | 1833.11 | 100 | | |



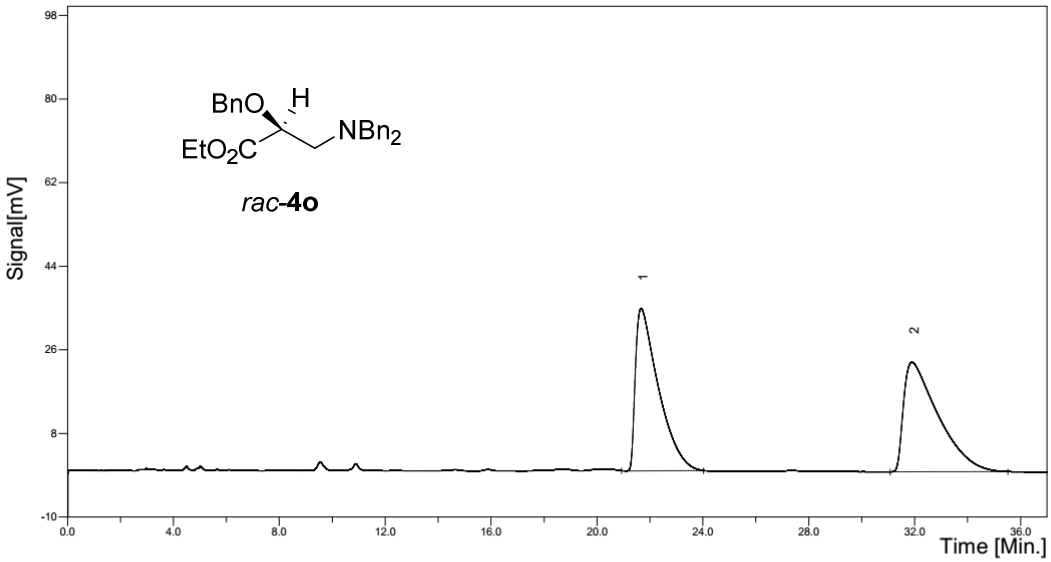

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.166 | 763976 | 92068 | 50.67 |
| 2 | | 5.656 | 743678 | 79702 | 49.33 |



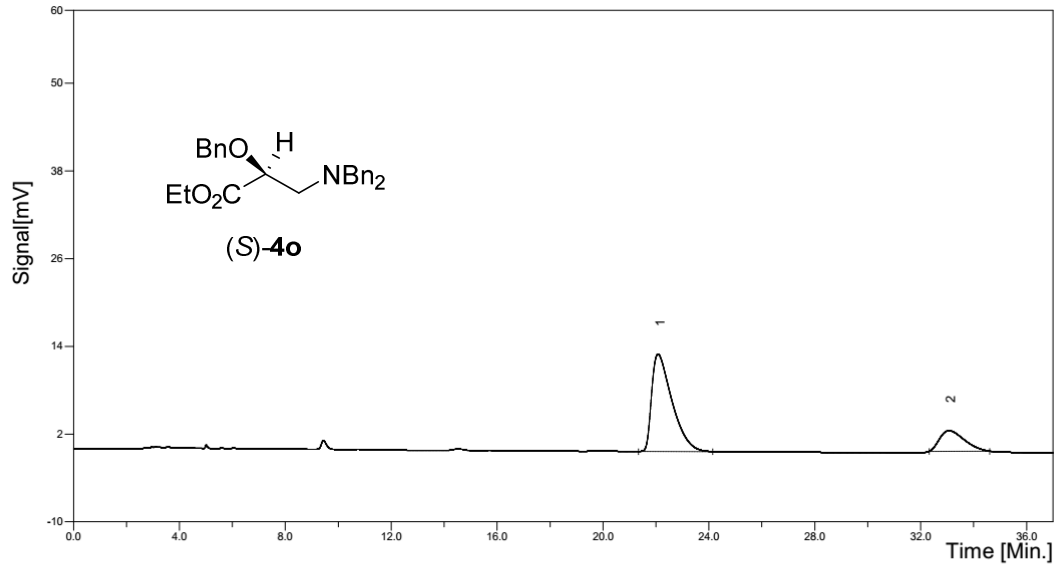

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.251 | 43918 | 6488 | 6.77 |
| 2 | | 5.697 | 604487 | 65535 | 93.23 |



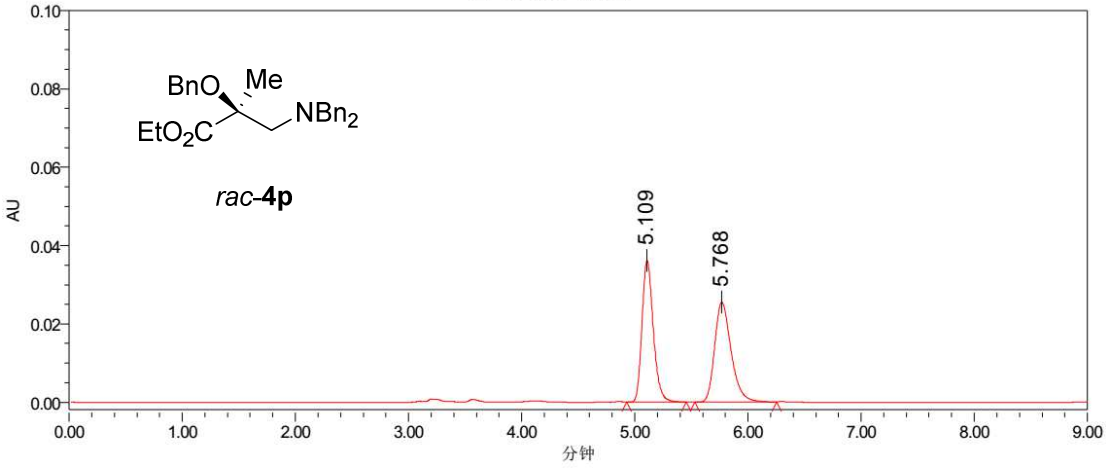

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 21.66500 | 34.94 | 2103.27 | 49.6371 | 0.0000 | 100.0000 |
| 2 | Unknown | 31.90000 | 23.57 | 2134.03 | 50.3629 | 0.0000 | 0.0000 |
| 合计 | | | 58.51 | 4237.31 | 100 | | |



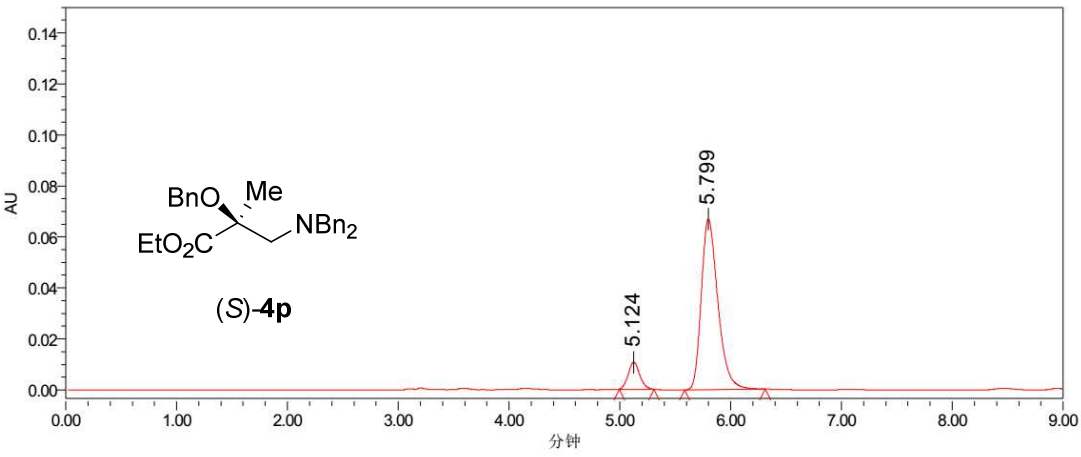

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 22.07333 | 13.33 | 707.63 | 79.4818 | 0.0000 | 100.0000 |
| 2 | Unknown | 33.06417 | 2.82 | 182.68 | 20.5182 | 0.0000 | 0.0000 |
| 合计 | | | 16.15 | 890.31 | 100 | | |



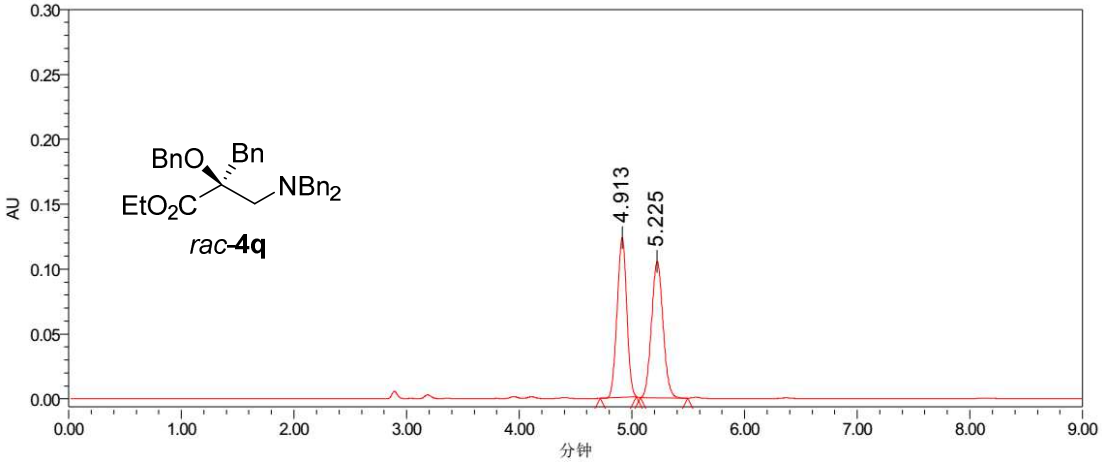

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.109 | 249637 | 36134 | 49.27 |
| 2 | | 5.768 | 257004 | 25497 | 50.73 |



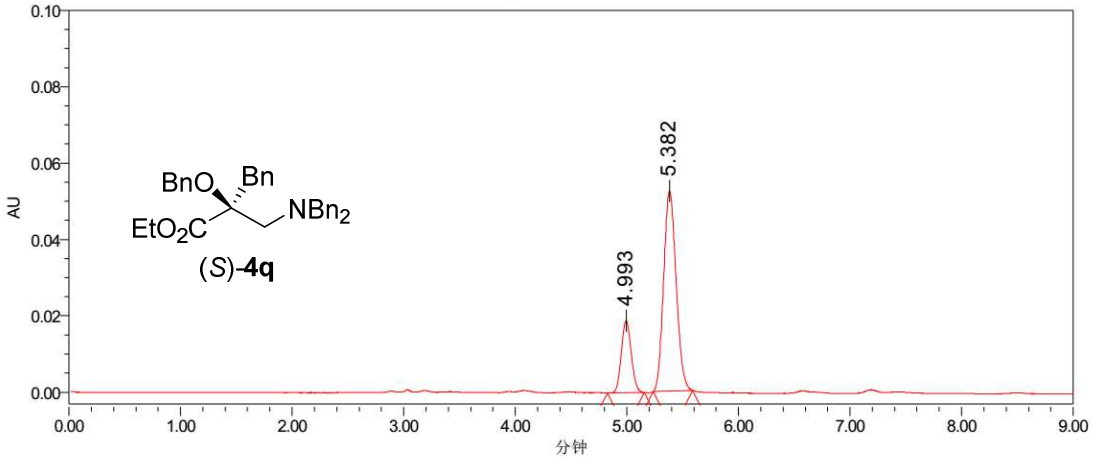

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.124 | 76880 | 10648 | 9.97 |
| 2 | | 5.799 | 694394 | 66863 | 90.03 |



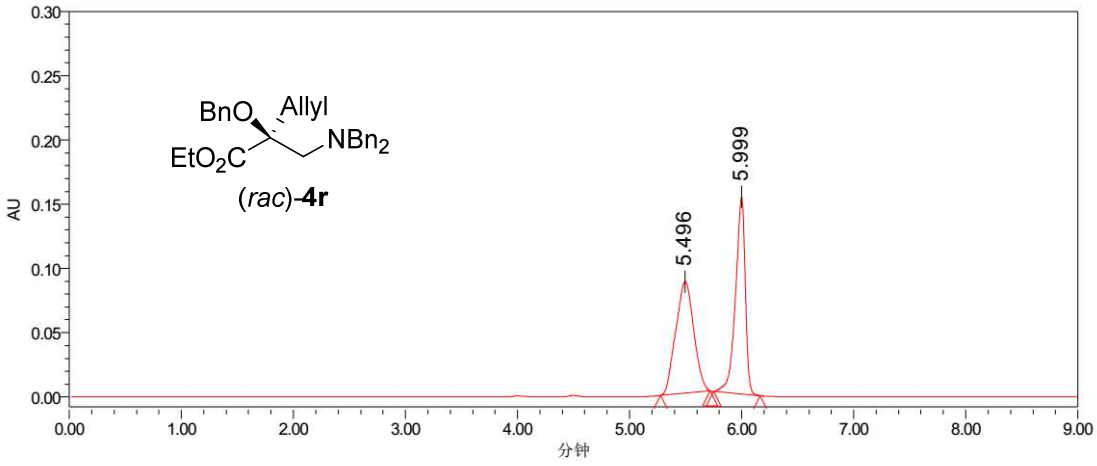

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 4.913 | 731623 | 122875 | 49.51 |
| 2 | | 5.225 | 746214 | 104925 | 50.49 |



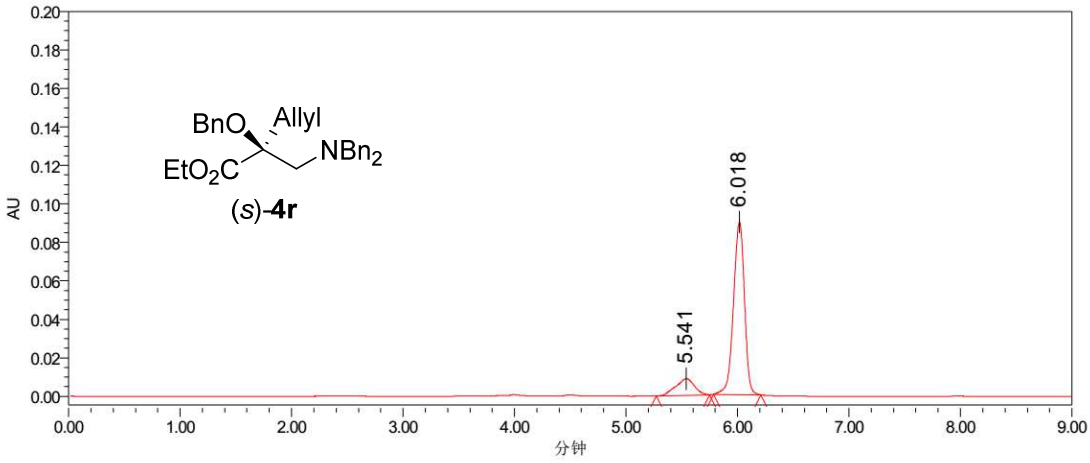

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 4.993 | 116861 | 18845 | 22.28 |
| 2 | | 5.382 | 407532 | 52356 | 77.72 |



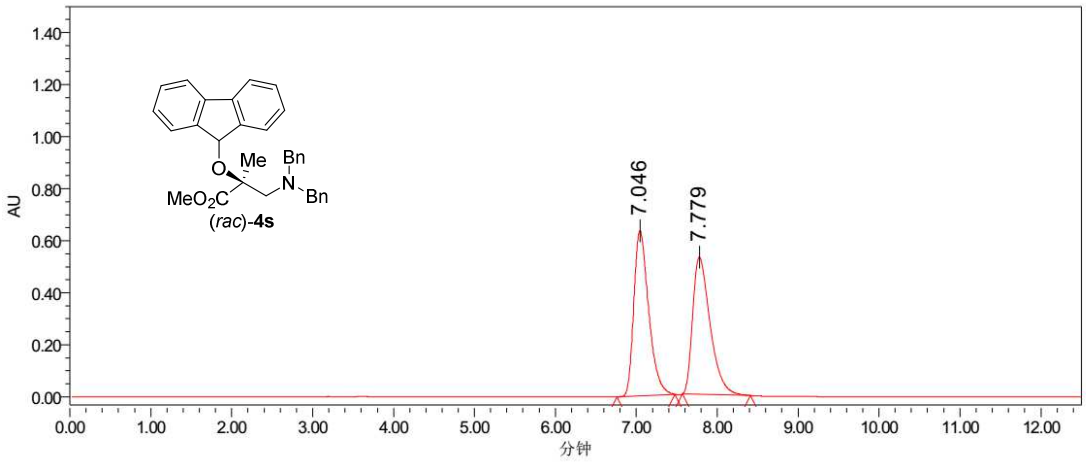

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.496 | 970733 | 86801 | 50.88 |
| 2 | | 5.999 | 937154 | 153470 | 49.12 |



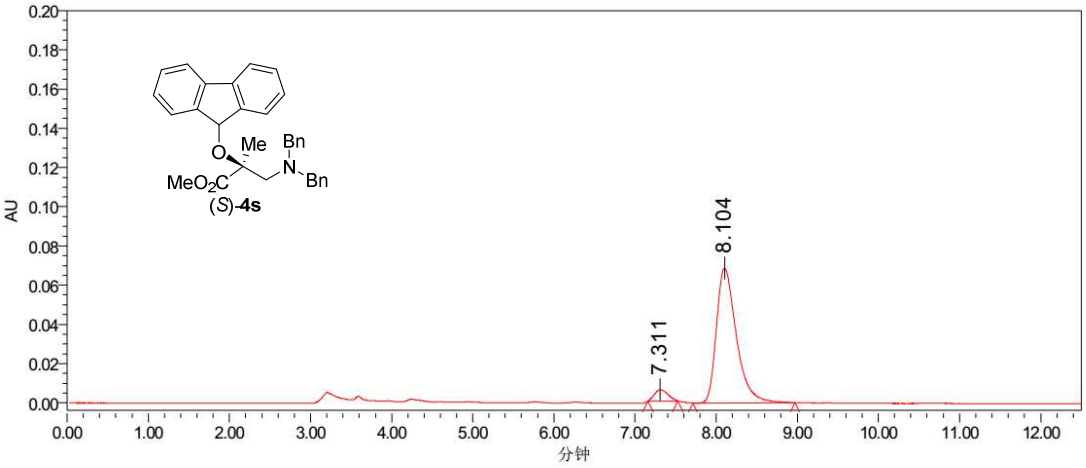

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.541 | 99282 | 8565 | 13.88 |
| 2 | | 6.018 | 616215 | 89690 | 86.12 |



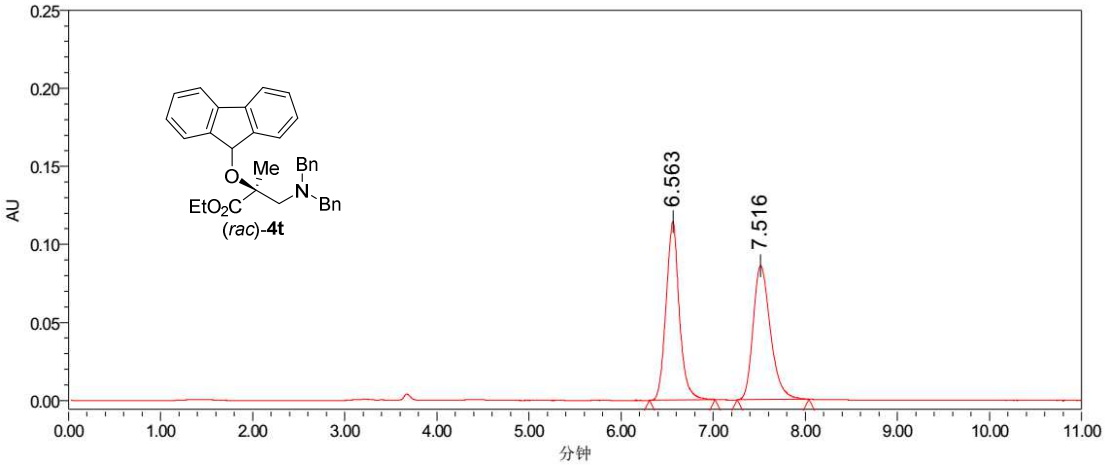

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 7.046 | 8039425 | 633970 | 50.21 |
| 2 | | 7.779 | 7971819 | 528079 | 49.79 |



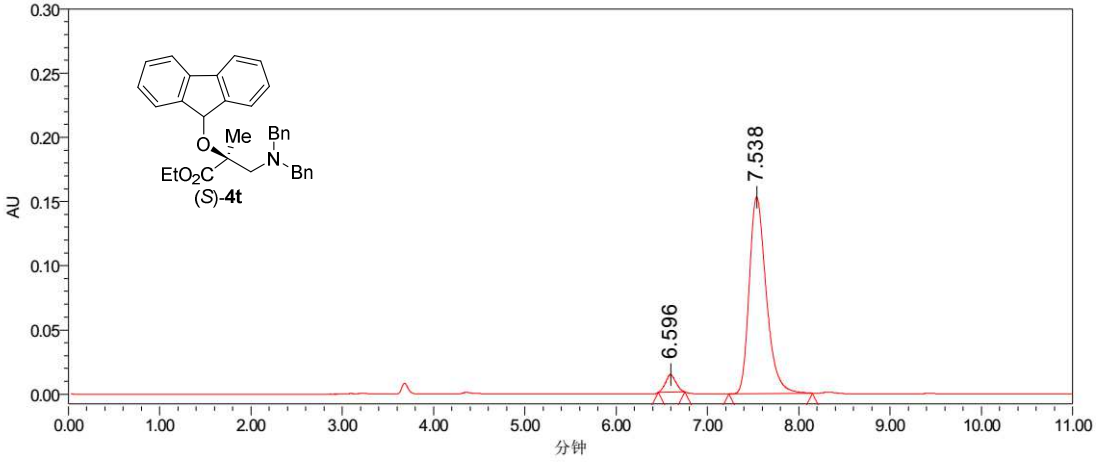

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 7.311 | 66116 | 5709 | 5.35 |
| 2 | | 8.104 | 1169262 | 68672 | 94.65 |



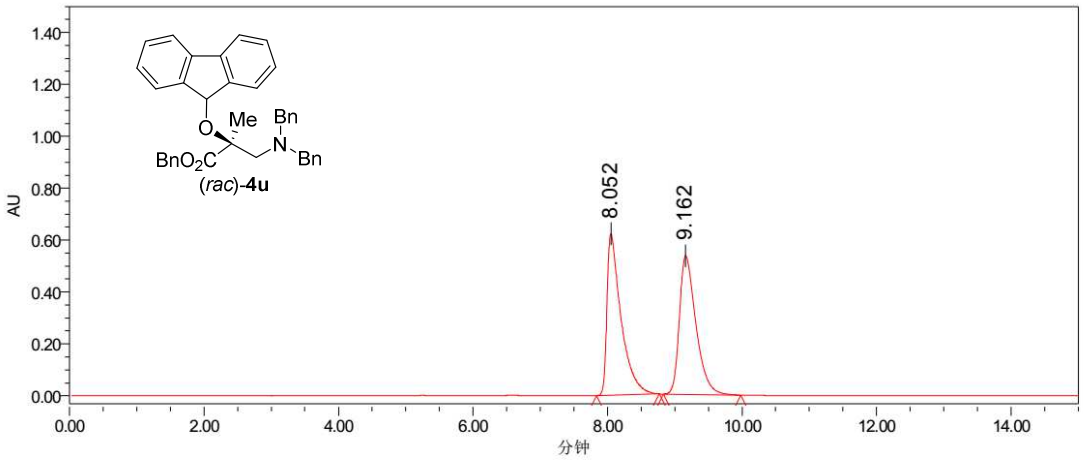

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.563 | 1139353 | 114262 | 50.28 |
| 2 | | 7.516 | 1126838 | 85876 | 49.72 |



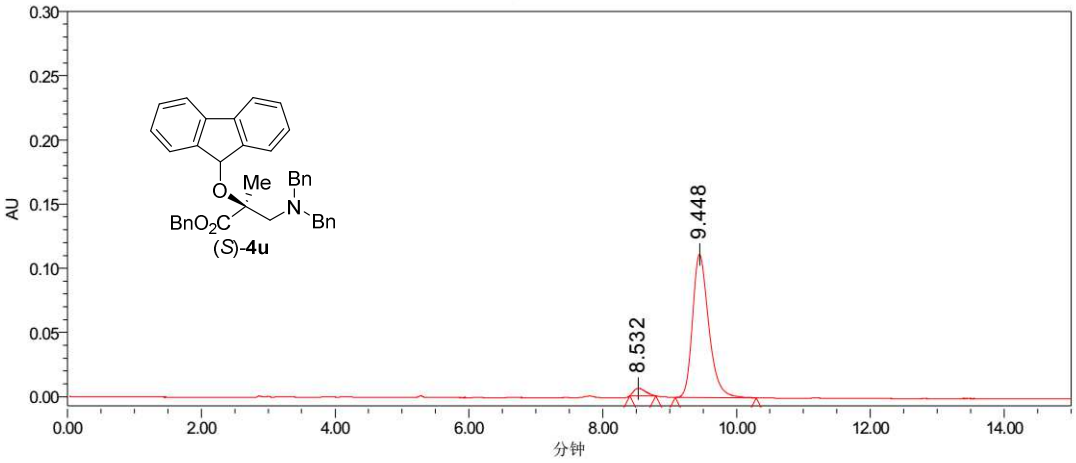

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.596 | 107159 | 13716 | 5.10 |
| 2 | | 7.538 | 1995297 | 153271 | 94.90 |



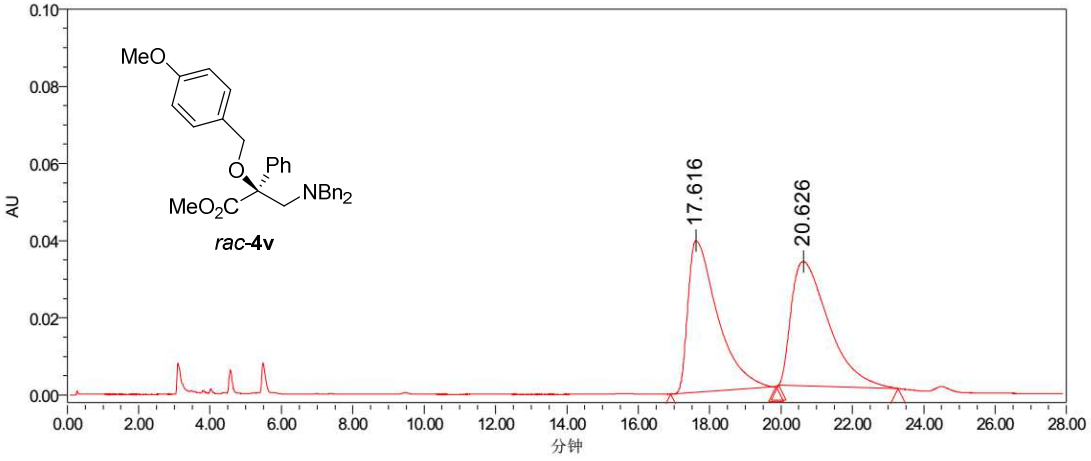

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 8.052 | 9024694 | 622113 | 49.66 |
| 2 | | 9.162 | 9150063 | 533984 | 50.34 |



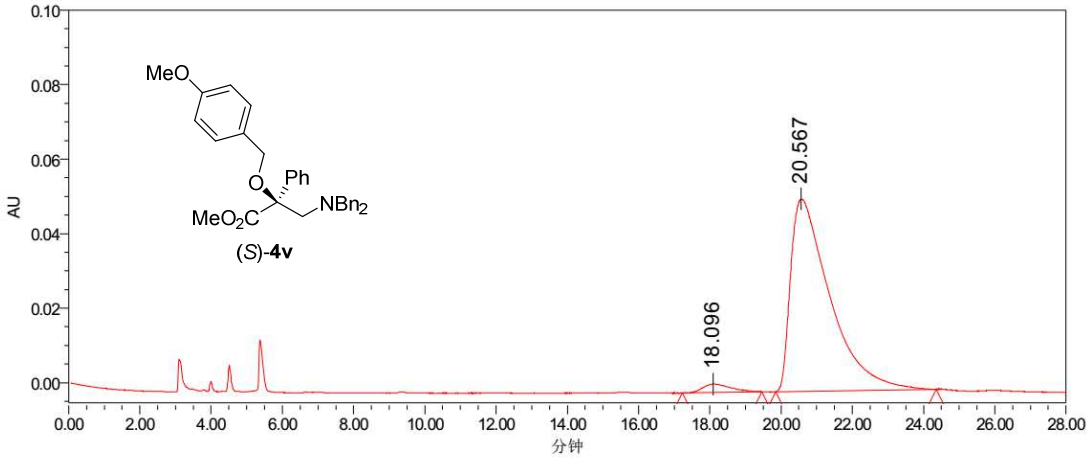

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 8.532 | 72398 | 5938 | 3.70 |
| 2 | | 9.448 | 1882951 | 111558 | 96.30 |



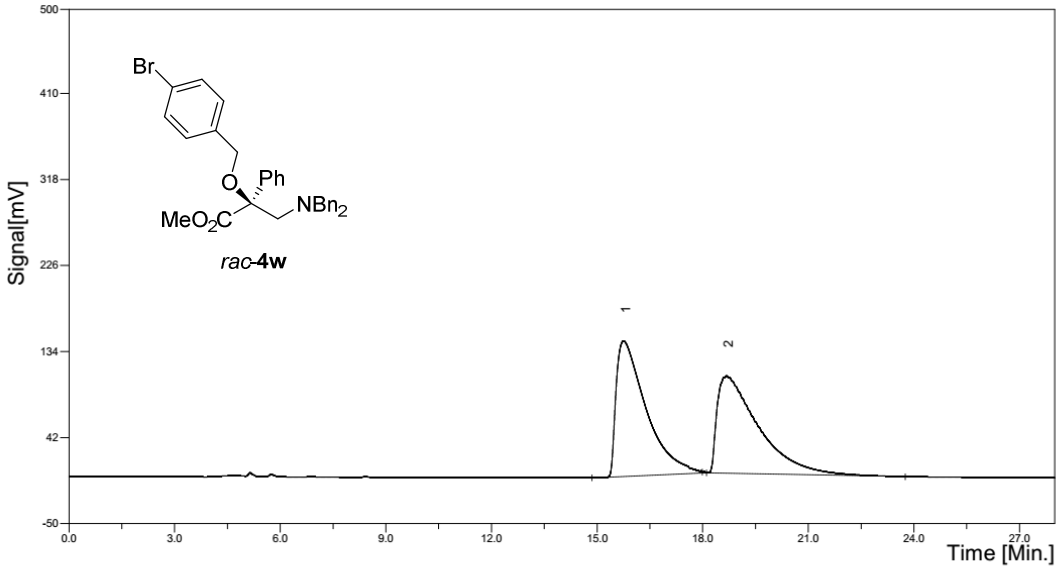

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 17.616 | 2272440 | 39329 | 49.30 |
| 2 | | 20.626 | 2337008 | 32174 | 50.70 |



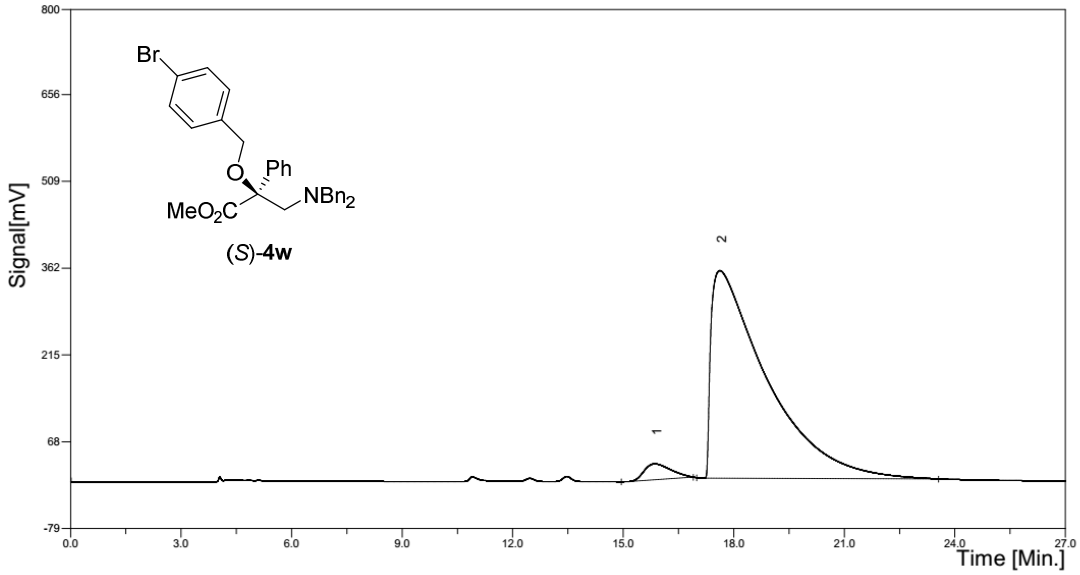

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 18.096 | 125604 | 2276 | 3.09 |
| 2 | | 20.567 | 3933964 | 51597 | 96.91 |



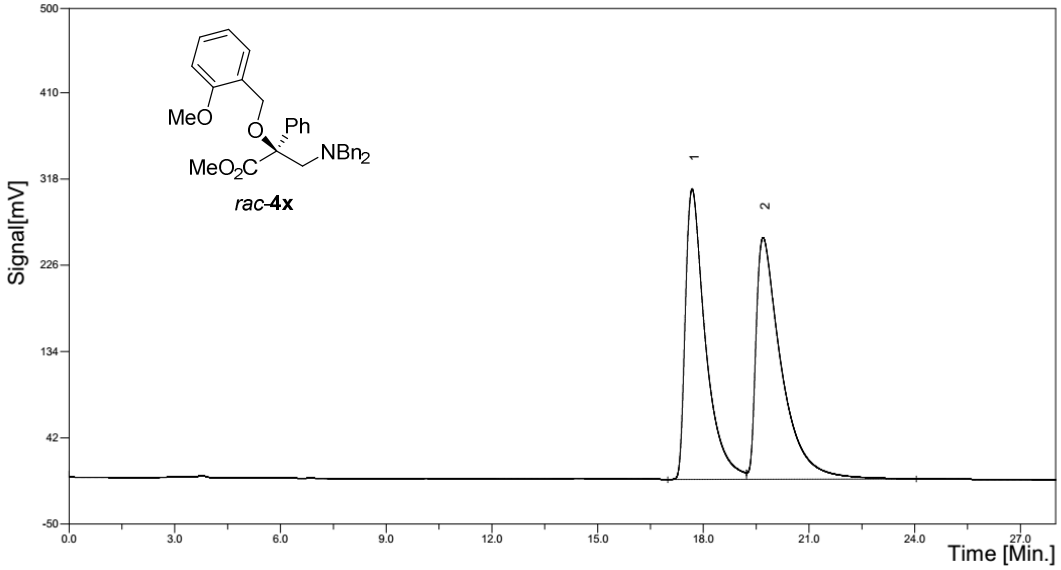

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 15.75167 | 144.63 | 8513.24 | 50.6523 | 0.0000 | 0.0000 |
| 2 | Unknown | 18.67167 | 103.32 | 8293.98 | 49.3477 | 0.0000 | 100.0000 |
| 合计 | | | 247.95 | 16807.22 | 100 | | |



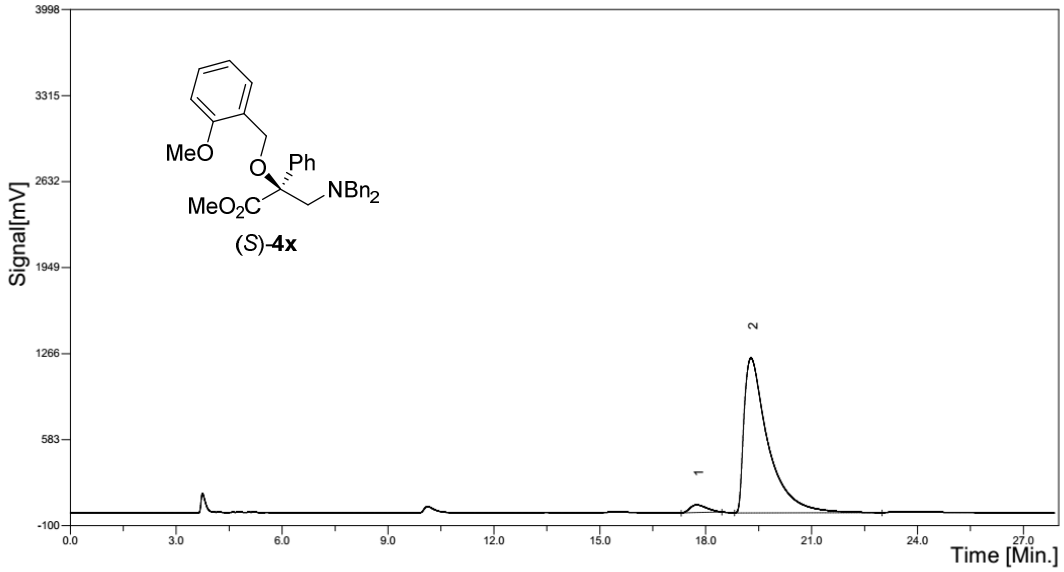

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 15.85500 | 26.62 | 1312.98 | 3.4402 | 0.0000 | 0.0000 |
| 2 | Unknown | 17.62167 | 350.81 | 36853.01 | 96.5598 | 0.0000 | 100.0000 |
| 合计 | | | 377.43 | 38165.99 | 100 | | |



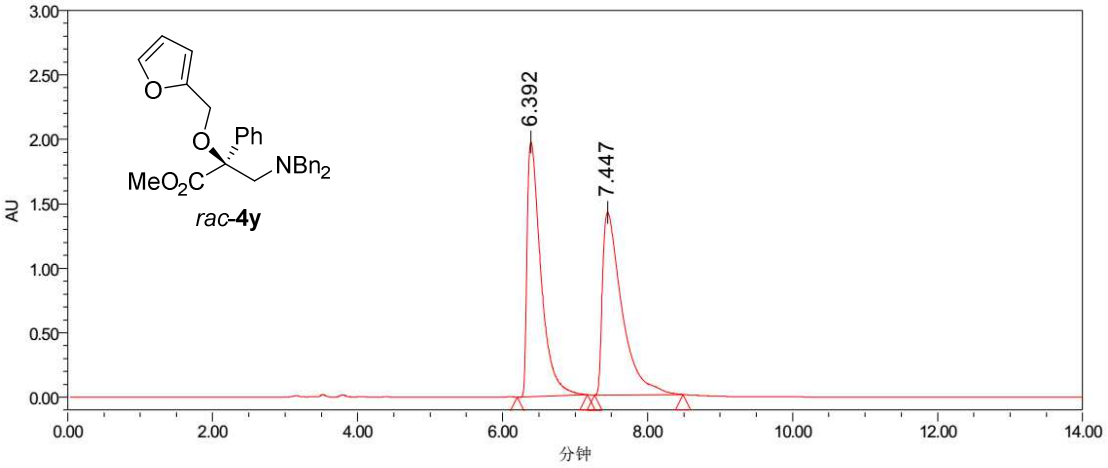

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 17.68083 | 309.85 | 12277.99 | 48.8586 | 0.0000 | 0.0000 |
| 2 | Unknown | 19.69583 | 257.77 | 12851.65 | 51.1414 | 0.0000 | 0.0000 |
| 合计 | | | 567.62 | 25129.65 | 100 | | |



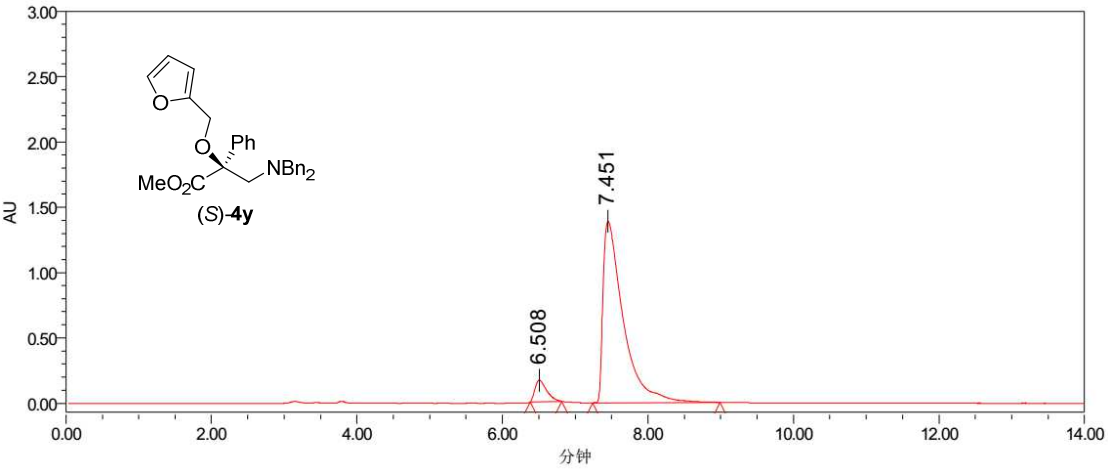

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 17.74333 | 61.17 | 2014.37 | 3.3531 | 0.0000 | 100.0000 |
| 2 | Unknown | 19.28167 | 1229.60 | 58060.26 | 96.6469 | 0.0000 | 0.0000 |
| 合计 | | | 1290.77 | 60074.62 | 100 | | |



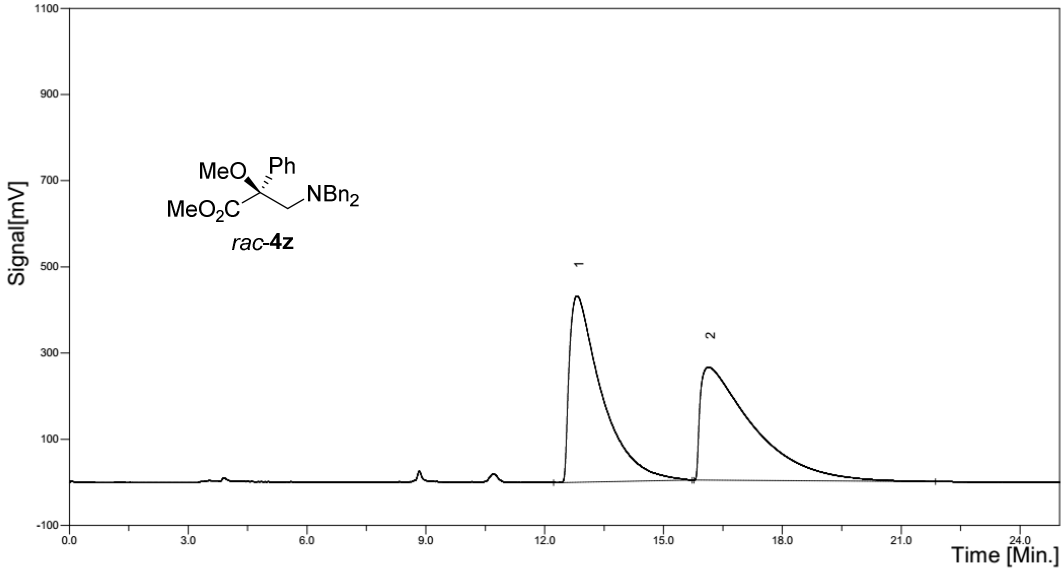

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.392 | 26239301 | 1974406 | 49.77 |
| 2 | | 7.447 | 26483219 | 1415552 | 50.23 |



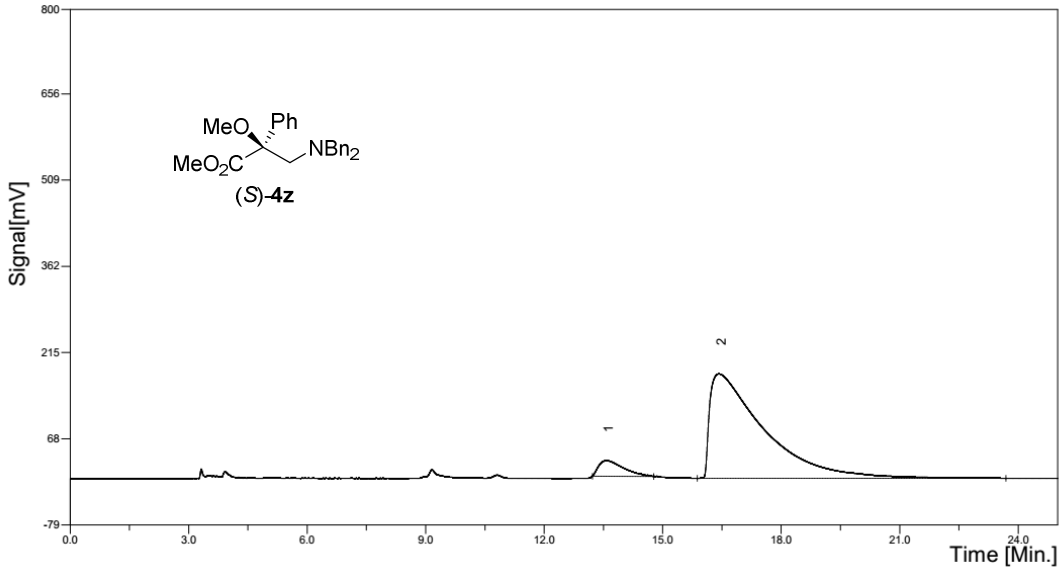

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.508 | 1821869 | 164656 | 6.35 |
| 2 | | 7.451 | 26848721 | 1390495 | 93.65 |



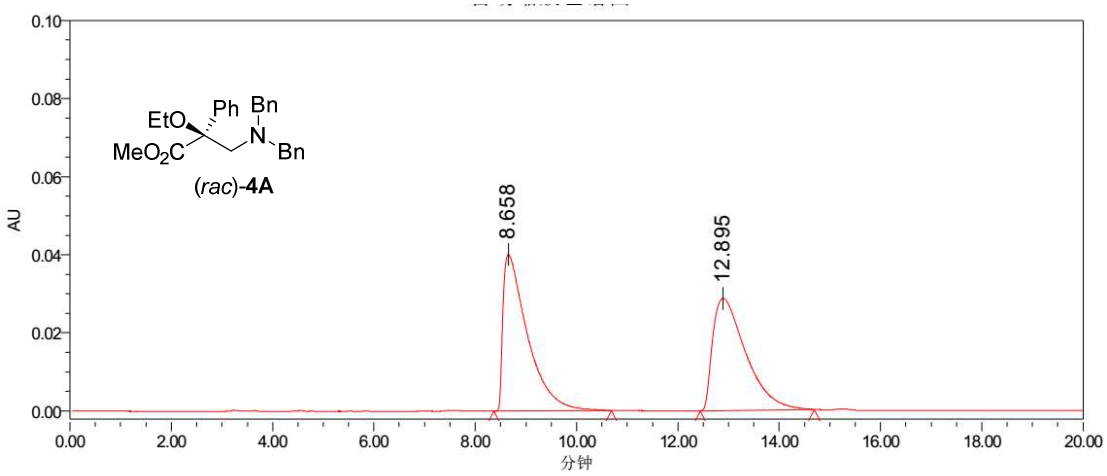

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV. sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.81583 | 431.46 | 24486.35 | 50.2916 | 0.0000 | 100.0000 |
| 2 | Unknown | 16.13250 | 262.09 | 24202.37 | 49.7084 | 0.0000 | 0.0000 |
| 合计 | | | 693.55 | 48688.72 | 100 | | |



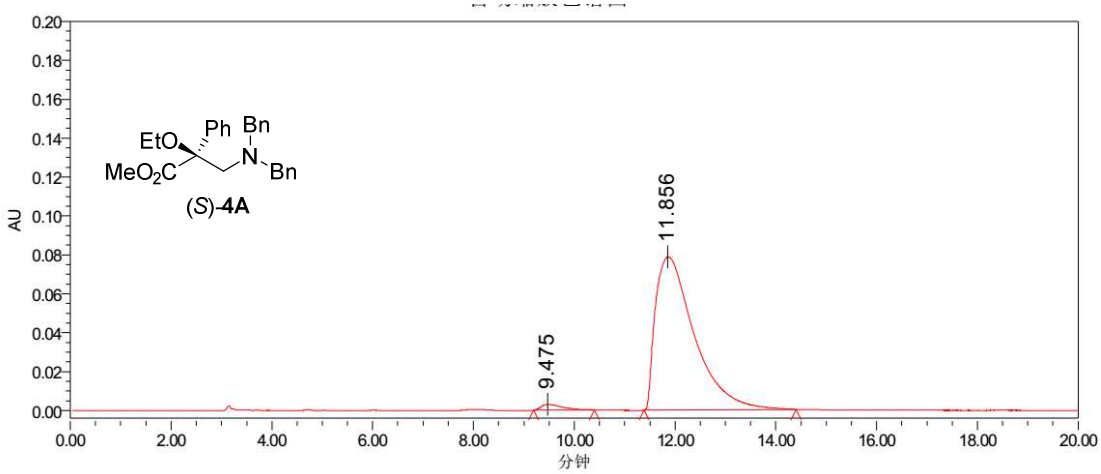

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV. sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 13.57250 | 26.40 | 1145.94 | 6.3414 | 0.0000 | 100.0000 |
| 2 | Unknown | 16.42333 | 177.90 | 16924.86 | 93.6586 | 0.0000 | 0.0000 |
| 合计 | | | 204.30 | 18070.80 | 100 | | |



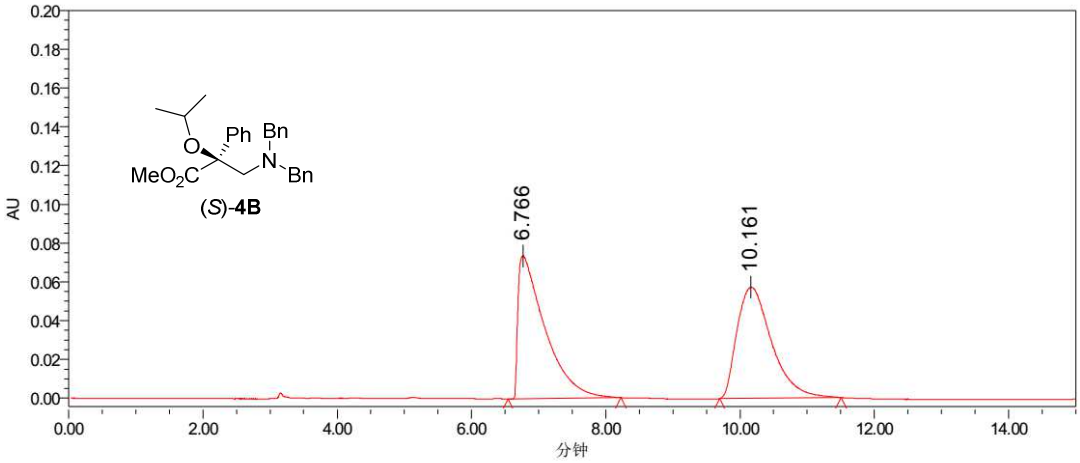

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 8.658 | 1341762 | 40044 | 50.66 |
| 2 | | 12.895 | 1306756 | 28754 | 49.34 |



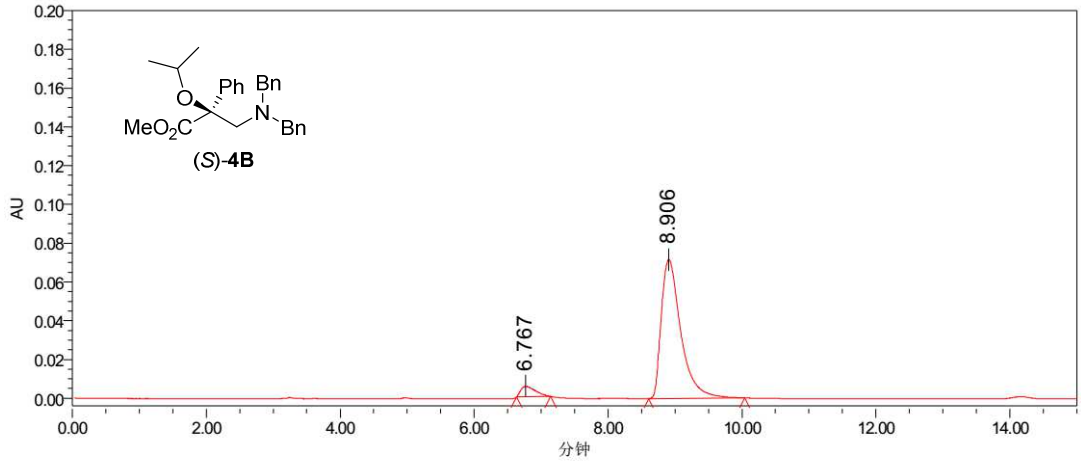

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 9.475 | 87246 | 2955 | 2.02 |
| 2 | | 11.856 | 4227744 | 78712 | 97.98 |



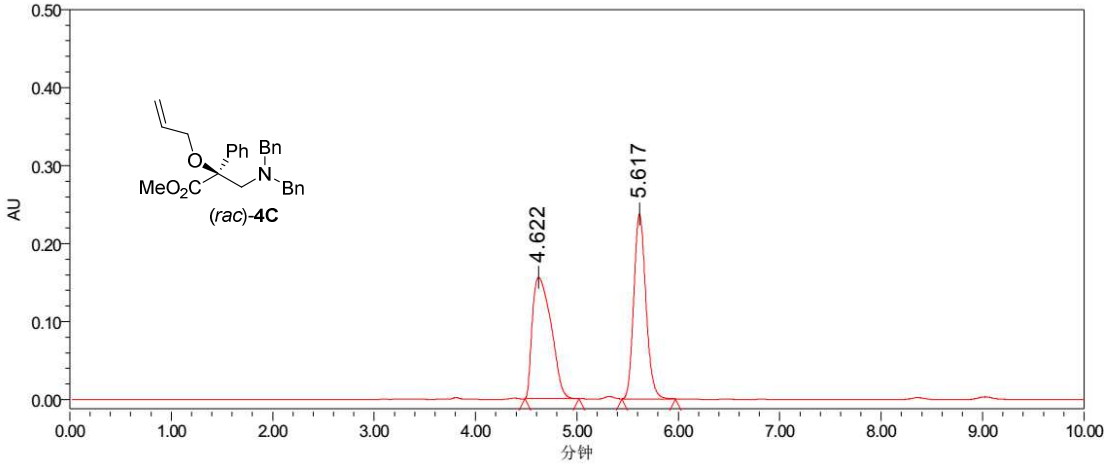

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.766 | 2045413 | 73676 | 50.01 |
| 2 | | 10.161 | 2044518 | 57341 | 49.99 |



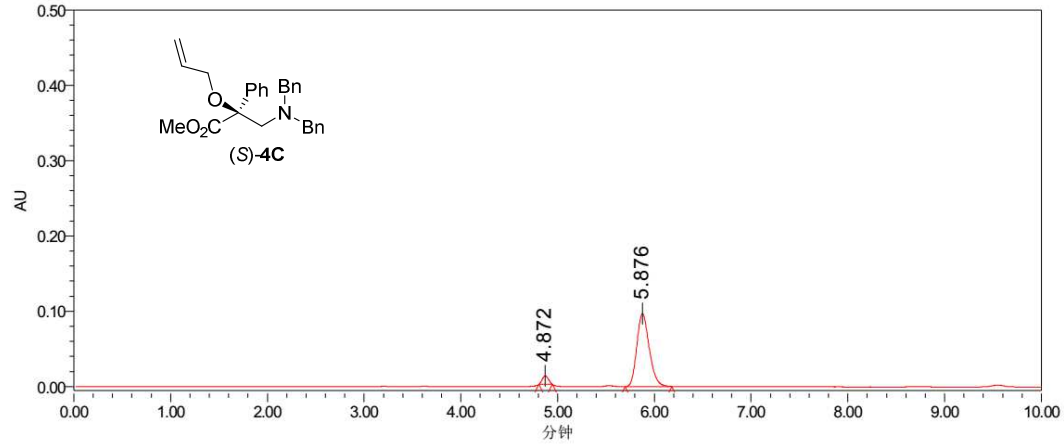

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.767 | 82747 | 5417 | 5.38 |
| 2 | | 8.906 | 1455310 | 71613 | 94.62 |



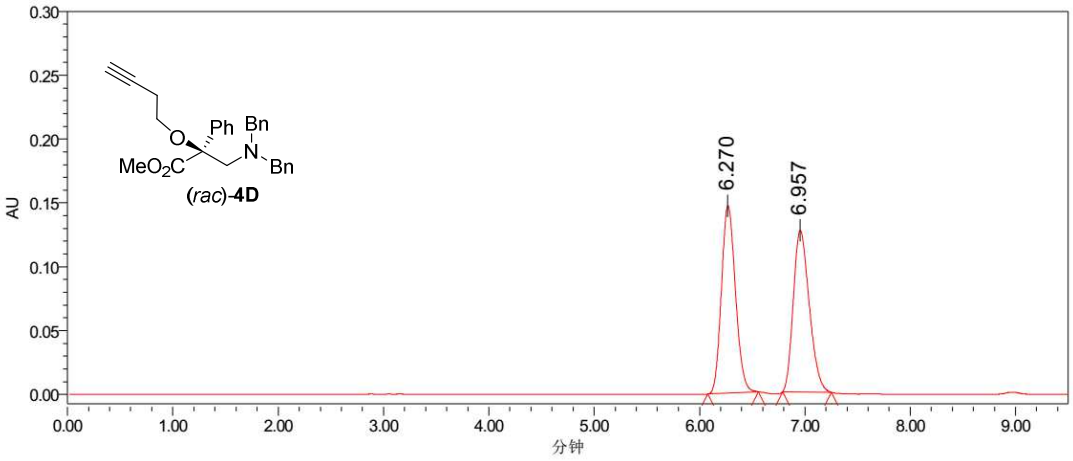

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 4.622 | 1989844 | 155313 | 50.34 |
| 2 | | 5.617 | 1963203 | 237146 | 49.66 |



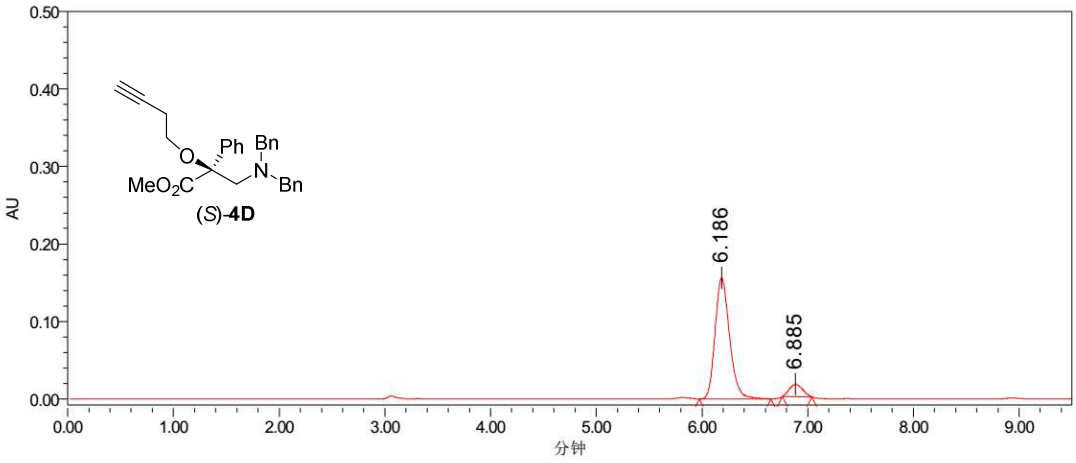

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 4.872 | 48270 | 10949 | 5.30 |
| 2 | | 5.876 | 862605 | 96656 | 94.70 |



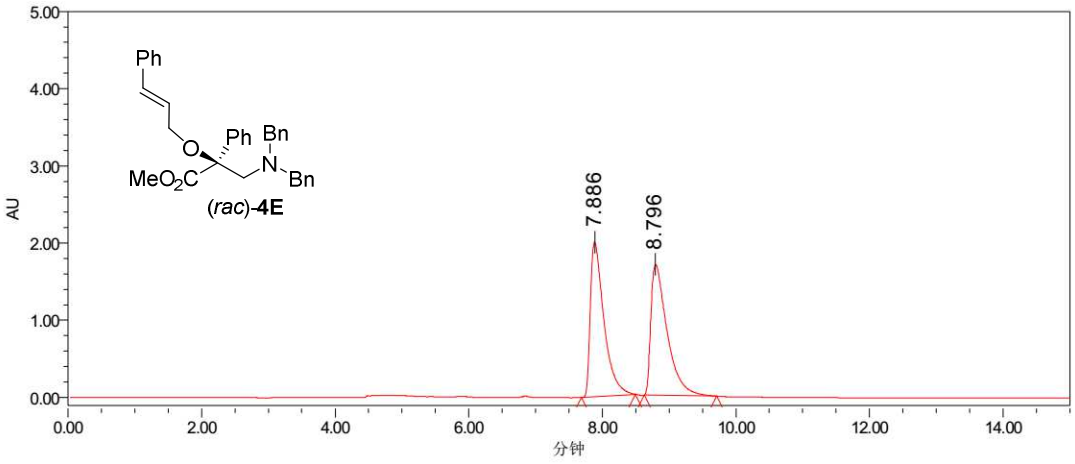

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.270 | 1356964 | 146851 | 50.34 |
| 2 | | 6.957 | 1338670 | 126470 | 49.66 |



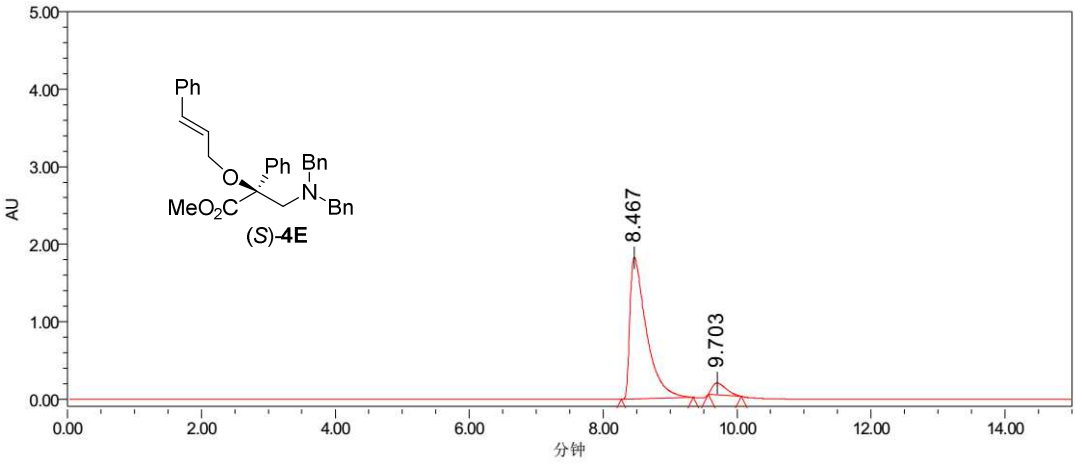

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 6.186 | 1479109 | 155766 | 91.32 |
| 2 | | 6.885 | 140612 | 15749 | 8.68 |



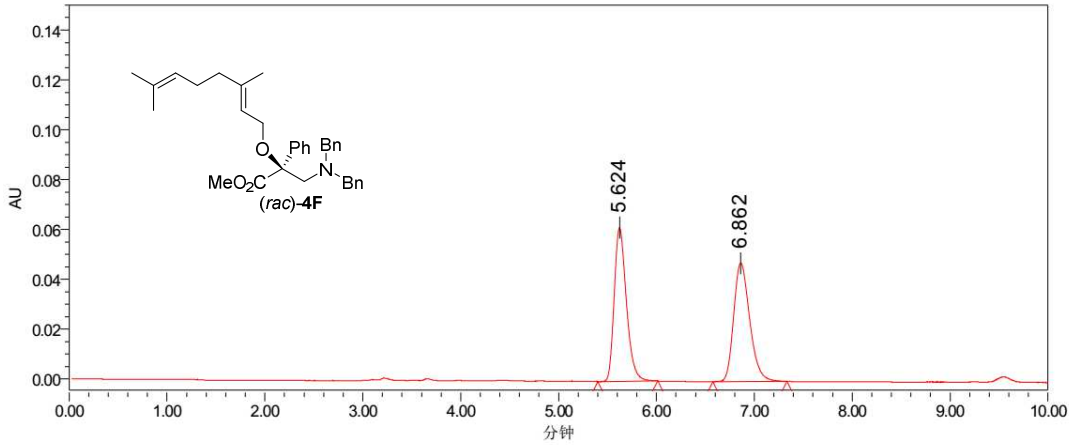

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 7.886 | 28359715 | 2000516 | 49.71 |
| 2 | | 8.796 | 28688847 | 1694636 | 50.29 |



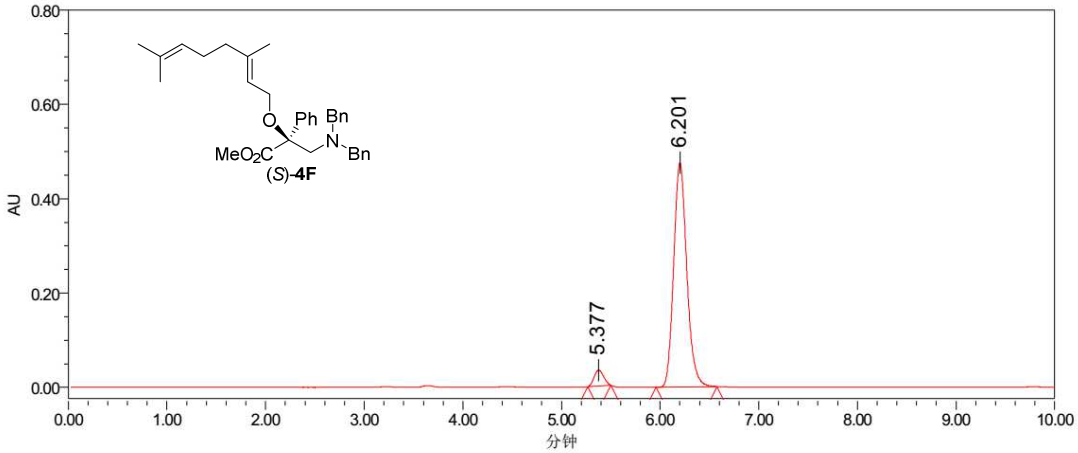

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 8.467 | 31043266 | 1822551 | 93.35 |
| 2 | | 9.703 | 2212610 | 153282 | 6.65 |



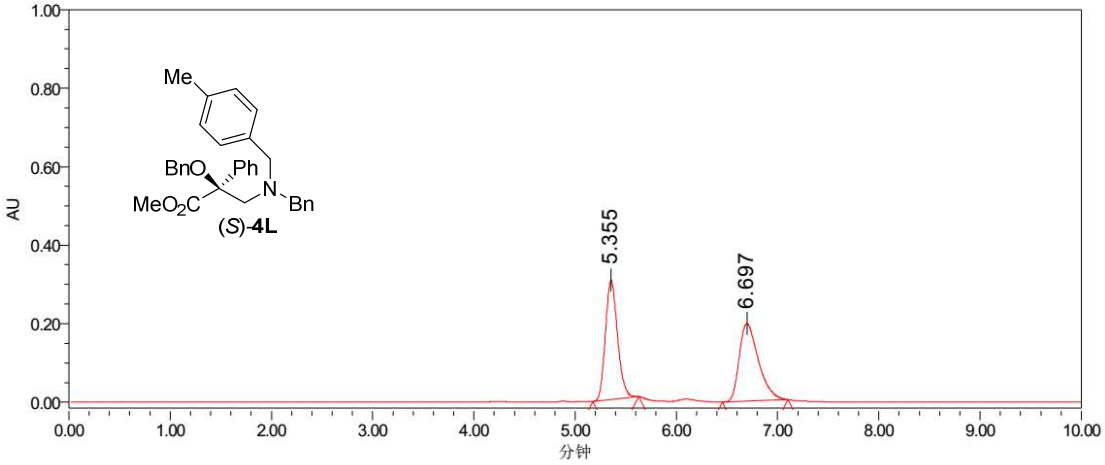

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.624 | 533772 | 61653 | 49.62 |
| 2 | | 6.862 | 541942 | 47517 | 50.38 |



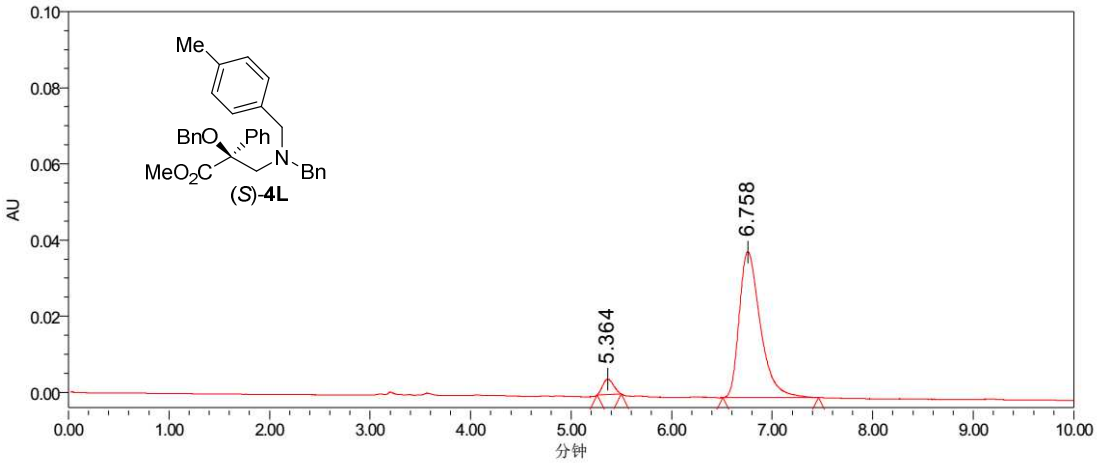

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.377 | 229125 | 33811 | 4.97 |
| 2 | | 6.201 | 4383111 | 475479 | 95.03 |



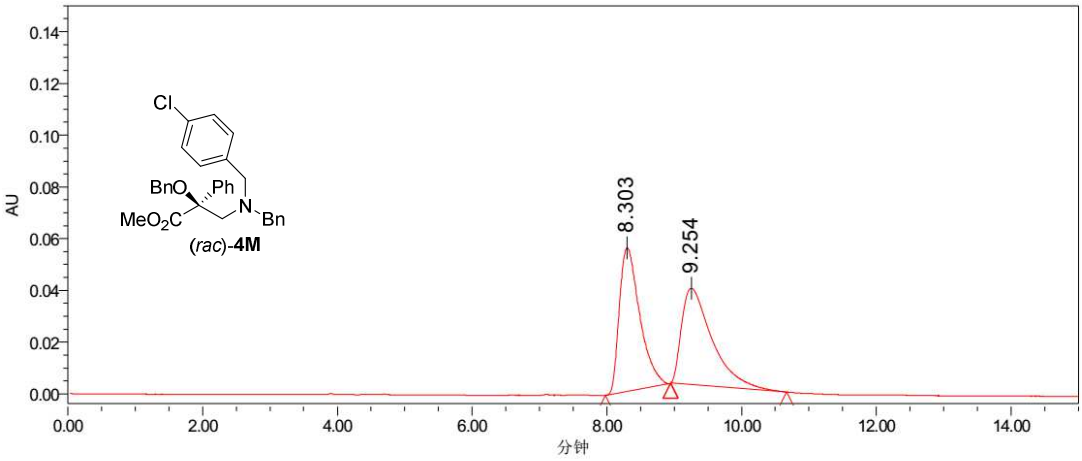

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.355 | 2535320 | 304883 | 49.35 |
| 2 | | 6.697 | 2602281 | 197658 | 50.65 |



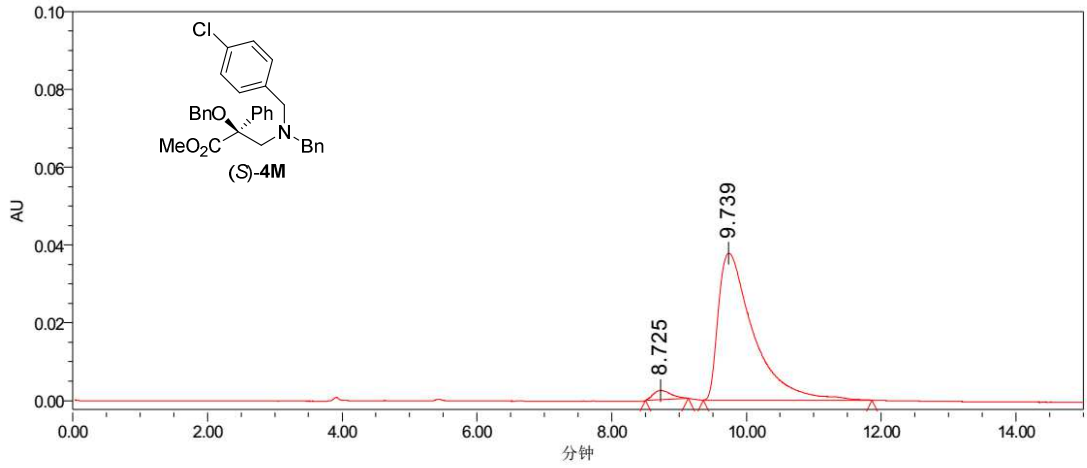

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 5.364 | 29798 | 4010 | 5.06 |
| 2 | | 6.758 | 558705 | 38278 | 94.94 |



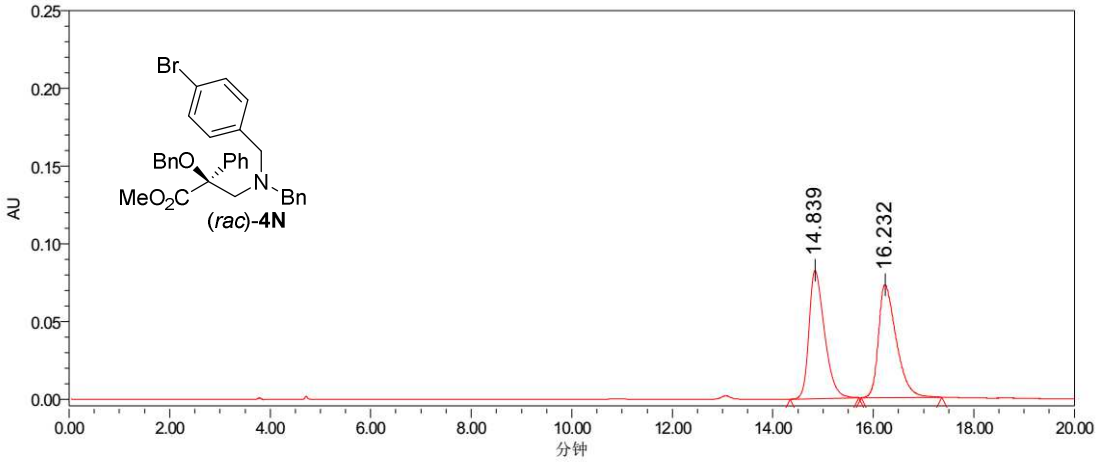

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 8.303 | 1164286 | 55477 | 49.73 |
| 2 | | 9.254 | 1177075 | 37231 | 50.27 |



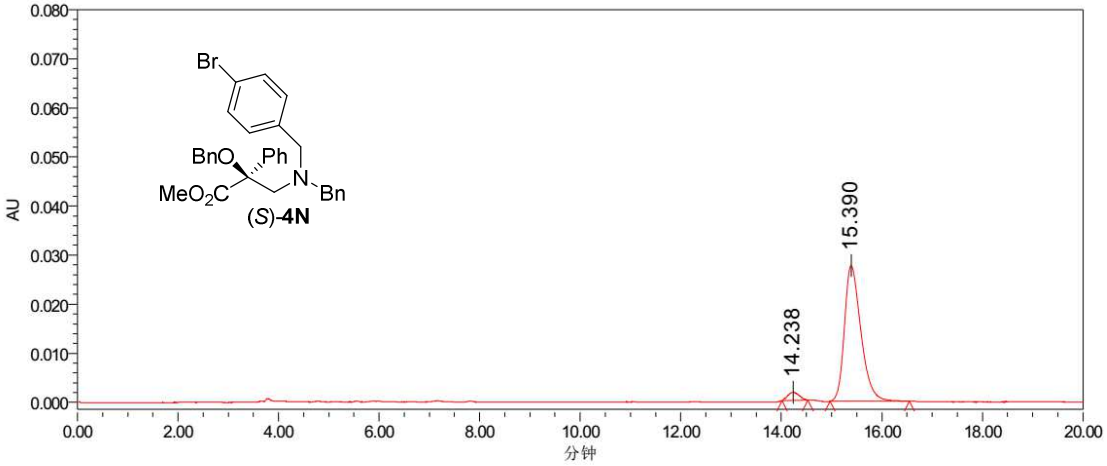

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 8.725 | 43725 | 2371 | 3.10 |
| 2 | | 9.739 | 1367537 | 37734 | 96.90 |



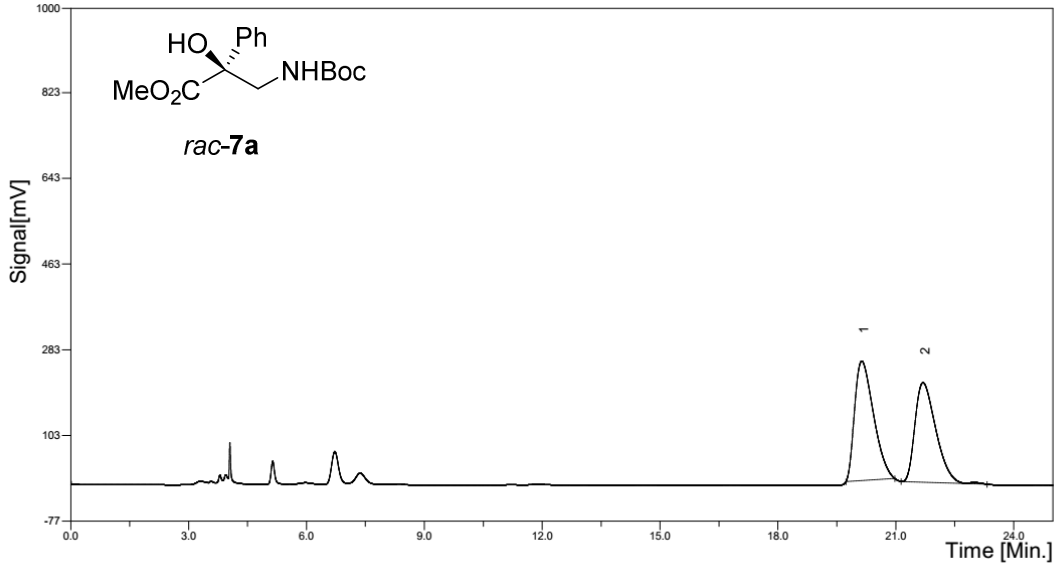

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 14.839 | 1769631 | 82452 | 49.91 |
| 2 | | 16.232 | 1776241 | 72513 | 50.09 |



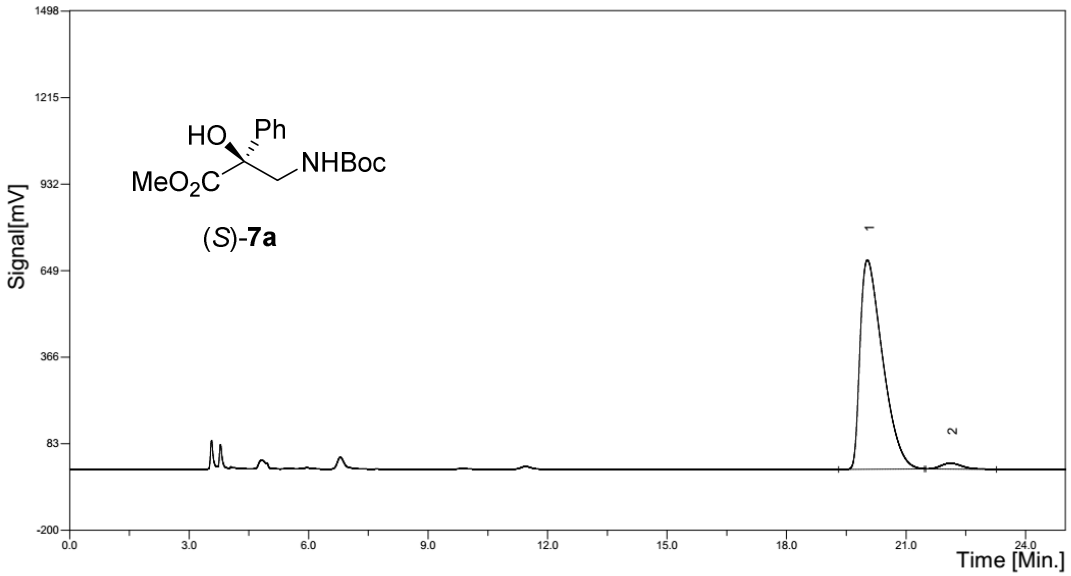

峰结果

| | 名称 | 保留时间 (分钟) | 面积 (微伏*秒) | 高度 (微伏) | % 面积 |
|---|---|---|---|---|---|
| 1 | | 14.238 | 25266 | 1627 | 3.88 |
| 2 | | 15.390 | 625431 | 27622 | 96.12 |



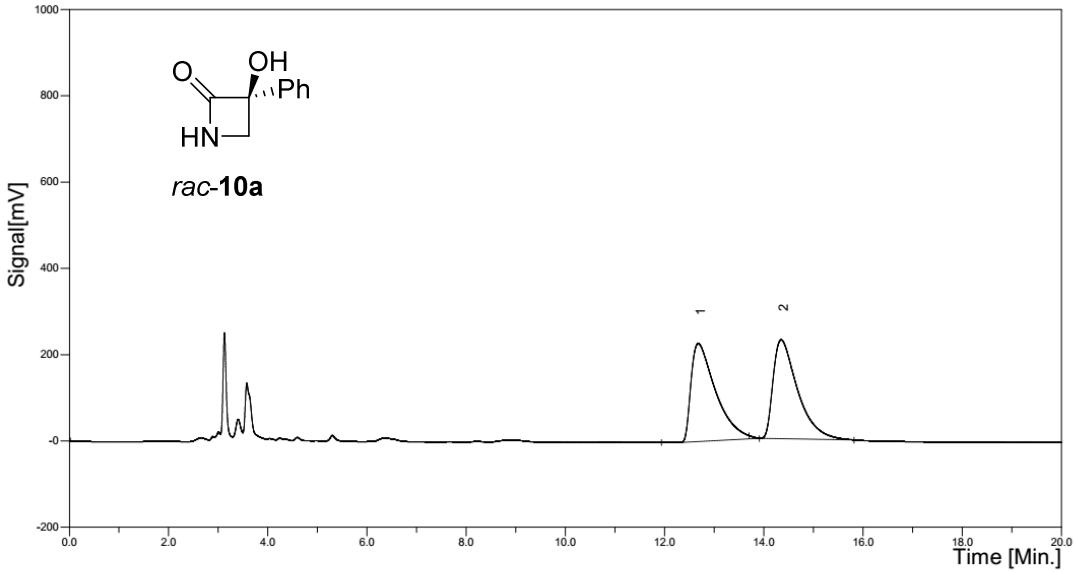

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV. sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 20.13250 | 251.05 | 8392.28 | 52.0810 | 0.0000 | 100.0000 |
| 2 | Unknown | 21.69250 | 209.11 | 7721.63 | 47.9190 | 0.0000 | 0.0000 |
| 合计 | | | 460.16 | 16113.91 | 100 | | |



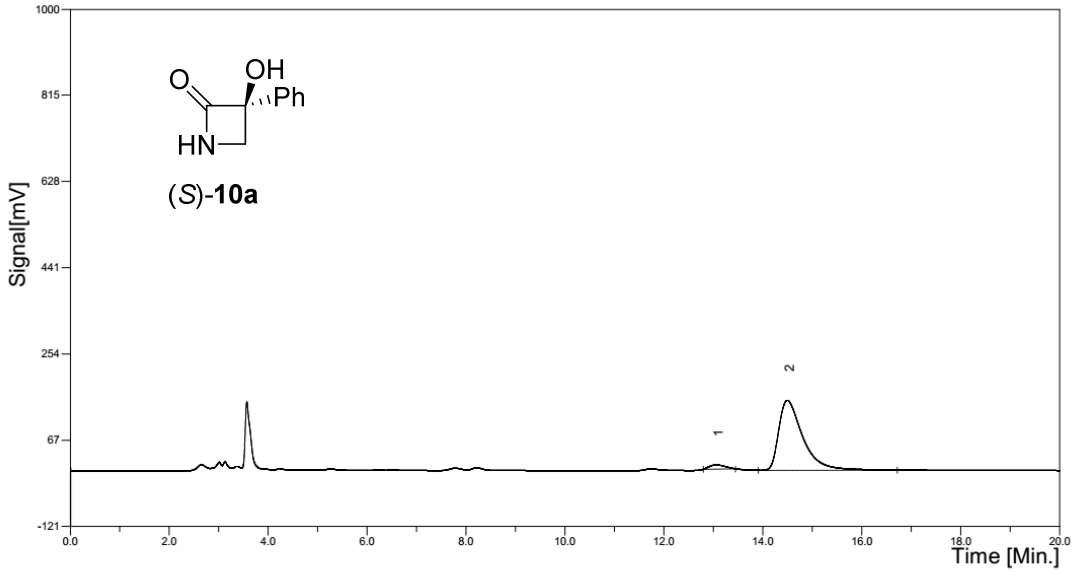

**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV. sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 20.02917 | 684.48 | 26799.18 | 97.5285 | 0.0000 | 100.0000 |
| 2 | Unknown | 22.10917 | 18.99 | 679.14 | 2.4715 | 0.0000 | 100.0000 |
| 合计 | | | 703.47 | 27478.31 | 100 | | |




**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 12.67750 | 225.64 | 7715.61 | 50.6635 | 0.0000 | 100.0000 |
| 2 | Unknown | 14.34750 | 225.09 | 7513.51 | 49.3365 | 0.0000 | 100.0000 |
| 合计 | | | 450.72 | 15229.12 | 100 | | |




**组分表**

| # | 组分名 | 保留时间(min) | 峰高(mV) | 峰面积(mV.sec) | 面积百分比(%) | 浓 度 | 样品含量(%) |
|---|---|---|---|---|---|---|---|
| 1 | Unknown | 13.05750 | 9.01 | 198.06 | 3.7507 | 0.0000 | 100.0000 |
| 2 | Unknown | 14.49500 | 151.42 | 5082.46 | 96.2493 | 0.0000 | 0.0000 |
| 合计 | | | 160.42 | 5280.51 | 100 | | |