



Supporting Information

for

Synthesis of chiral cyclohexane-linked bisimidazolines

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Analytical data and copies of ^1H and ^{13}C NMR spectra of compounds 2 and 4, copies of HRMS spectra of unknown compounds 4 and 5

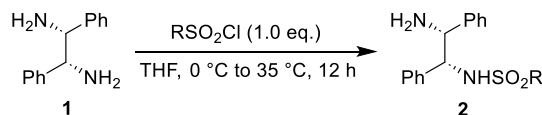
Table of contents

1. General information	S2
2. General procedure for the synthesis of <i>N</i> -[(1 <i>R</i> ,2 <i>R</i>)-2-amino-1,2-diphenylethyl]-sulfonamides 2	S2
3 General procedure for the synthesis of (1 <i>S</i> ,2 <i>S</i>)- <i>N</i> ¹ , <i>N</i> ² -bis((1 <i>R</i> ,2 <i>R</i>)-2-(sulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamides 4	S4
4. General procedure for the synthesis of (1 <i>S</i> ,2 <i>S</i>)-1,2-bis((4 <i>R</i> ,5 <i>R</i>)-1-(sulfonyl)-4,5-diphenyl-4,5-dihydro-1 <i>H</i> -imidazol-2-yl)cyclohexanes 5	S7
5. References	S10
6. Copies of ¹ H and ¹³ C NMR spectra of compounds 2 and 4 and HRMS spectra of products 4 and 5	S11

1. General information

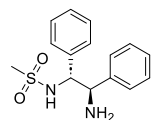
Unless otherwise noted, all materials were purchased from commercial suppliers. THF was refluxed over sodium with benzophenone as an indicator and freshly distilled prior to use. DCM (dichloromethane) was refluxed over CaH_2 and freshly distilled prior to use. Column chromatography was performed on silica gel (normal phase, 200–300 mesh) from Anhui Liangchen Silicon Material Co., Ltd. Petroleum ether (PE, 60–90 °C fraction) and ethyl acetate (EA) were used as eluent. Reactions were monitored by thin-layer chromatography (TLC) on GF254 silica gel plates (0.2 mm) from Anhui Liangchen Silicon Material Co., Ltd. The plates were visualized by UV light. ^1H NMR (400 MHz) and ^{13}C NMR (101 MHz) spectra were recorded on a Bruker 400 NMR spectrometer (Billerica, MA, USA), usually with TMS as an internal standard for ^1H NMR and the middle peak of CDCl_3 as an internal standard (77.16) for ^{13}C NMR in CDCl_3 solution or with DMSO as an internal standard (2.50) for ^1H NMR and the middle peak of $\text{DMSO}-d_6$ as an internal standard (39.5) for ^{13}C NMR in $\text{DMSO}-d_6$ solution. The chemical shifts (δ) were reported in parts per million (ppm) relative to tetramethylsilane (TMS). Melting points were obtained on a melting point apparatus. HRMS measurements were carried out on an LC/MSD TOF mass spectrometer. Specific rotations were measured on an Anton Paar MCP500 polarimeter (Singapore) and reported as follows: $[\alpha]_D^{25}$ (c : g/100 mL, in solvent). The enantiomeric excesses were determined using chiral HPLC analysis using an Agilent 1260 LC instrument (Santa Clara, CA, USA) with a Daicel Chiralcel AD-H column (Hyderabad, India) with a mixture of isopropyl alcohol and hexane as eluents.

2. General procedure for the synthesis of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]sulfonamides **2**



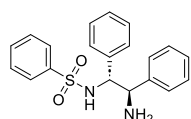
(1*R*,2*R*)-1,2-Diphenylethane-1,2-diamine (**1**, 1.06 g, 5 mmol) and Et_3N (1.4 mL, 10 mmol) were dissolved in anhydrous THF (20 mL) at 0 °C. After 10 min, a solution of sulfonyl chloride (5 mmol) in anhydrous THF (10 mL) was added dropwise under stirring. The reaction temperature was allowed to warm to 35 °C. The reaction mixture was stirred for 12 h. After concentration under reduced pressure, the residue was subjected to silica gel column chromatography with DCM/MeOH 20:1(v/v) as eluent to afford colorless crystals **2**.

N-[(1*R*,2*R*)-2-Amino-1,2-diphenylethyl]methanesulfonamide (**2a**)¹



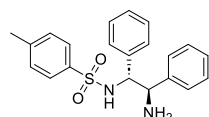
Colorless crystals, 0.88 g, yield: 67%, M.p. 109.7–110.6 °C; R_f = 0.28 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = +8.50$ (c = 2.0, CHCl_3). ^1H NMR (400 MHz, CDCl_3) δ : 7.37–7.29 (m, 8H, ArH), 7.29–7.22 (m, 2H, ArH), 4.56 (d, J = 5.1 Hz, 1H, CH), 4.28 (d, J = 5.1 Hz, 1H, CH), 2.26 (s, 3H, CH_3). ^{13}C NMR (101 MHz, CDCl_3) δ : 142.0, 139.8, 128.80, 128.75, 127.98, 127.94, 127.0, 126.8, 63.6, 60.3, 40.8.

***N*-[(1*R*,2*R*)-2-Amino-1,2-diphenylethyl]benzenesulfonamide (2b)²**



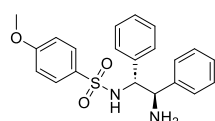
Colorless crystals, 1.30 g, yield: 74%, M.p. 139.7–142.0 °C; R_f = 0.30 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = -8.50$ ($c = 2.0$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.47–7.41 (m, 2H, ArH), 7.34 (t, $J = 7.4$ Hz, 1H, ArH), 7.22–7.08 (m, 12H, ArH), 4.41 (d, $J = 5.3$ Hz, 1H, CH), 4.13 (d, $J = 5.3$ Hz, 1H, CH). **¹³C NMR** (101 MHz, CDCl₃) δ : 141.5, 140.3, 139.2, 132.0, 128.63, 128.57, 128.4, 127.7, 127.6, 127.1, 126.9, 126.6, 63.4, 60.6.

***(1R,2R)*-*N*-*p*-Toluenesulfonyl-1,2-diphenylethylenediamine (2c)¹**



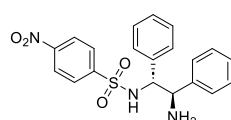
Colorless crystals, 1.12 g, yield: 61%, M.p. 122.4–124.1 °C; R_f = 0.33 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = -25.250$ ($c = 2.0$, CHCl₃); Lit.³ $[\alpha]_D^{25} = -17.4$ ($c = 1.3$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.31 (d, $J = 8.3$ Hz, 2H, ArH), 7.20–7.04 (m, 10H, ArH), 6.96 (d, $J = 8.0$ Hz, 2H, ArH), 4.39 (d, $J = 5.5$ Hz, 1H, CH), 4.15 (d, $J = 5.5$ Hz, 1H, CH), 2.31 (s, 3H, CH₃). **¹³C NMR** (101 MHz, CDCl₃) δ : 142.6, 141.4, 139.3, 137.3, 129.2, 128.5, 128.3, 127.6, 127.5, 127.2, 127.0, 126.7, 63.4, 60.6, 21.5.

***N*-[(1*R*,2*R*)-2-Amino-1,2-diphenylethyl]-4-methoxybenzenesulfonamide (2d)¹**



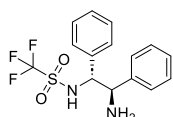
Colorless crystals, 1.20 g, yield: 64%, M.p. 127.5–131.4 °C; R_f = 0.17 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = -22.65$ ($c = 2.0$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.40–7.31 (m, 2H, ArH), 7.23–7.07 (m, 10H, ArH), 6.68–6.60 (m, 2H, ArH), 4.36 (d, $J = 5.4$ Hz, 1H, CH), 4.12 (d, $J = 5.4$ Hz, 1H, CH), 3.79 (s, 3H, CH₃). **¹³C NMR** (101 MHz, CDCl₃) δ : 162.4, 141.6, 139.4, 132.0, 129.1, 128.6, 128.4, 127.7, 127.5, 127.2, 126.7, 113.8, 63.3, 60.7, 55.6.

***N*-[(1*R*,2*R*)-2-Amino-1,2-diphenylethyl]-4-nitrobenzenesulfonamide (2e)⁴**

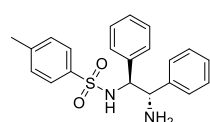


Colorless crystals, 1.43 g, yield: 72%, M.p. 196.7–198.1 °C; R_f = 0.30 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = -7.65$ ($c = 2.0$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.96 (d, $J = 8.9$ Hz, 2H, ArH), 7.53 (d, $J = 8.8$ Hz, 2H, ArH), 7.24–7.18 (m, 5H, ArH), 7.18–7.11 (m, 5H, ArH), 4.49 (d, $J = 4.5$ Hz, 1H, CH), 4.22 (d, $J = 4.5$ Hz, 1H, CH). **¹³C NMR** (101 MHz, DMSO-*d*₆) δ : 148.7, 146.8, 142.4, 139.5, 127.7, 127.6, 127.5, 127.3, 126.58, 126.55, 123.8, 65.0, 60.4.

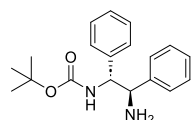
***N*-[(1*R*,2*R*)-2-Amino-1,2-diphenylethyl]-1,1,1-trifluoromethanesulfonamide (2f)⁵**



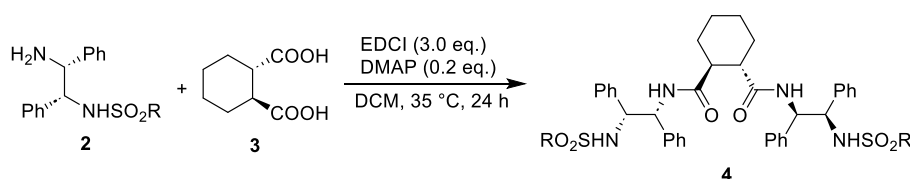
Colorless crystals, 1.15 g, yield: 61%, M.p. 147.5–148.3 °C; R_f = 0.35 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = -3.95$ ($c = 2.0$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.44–7.30 (m, 10H, ArH), 4.71 (d, $J = 3.3$ Hz, 1H, CH), 4.40 (d, $J = 3.3$ Hz, 1H, CH). **¹³C NMR** (101 MHz, CDCl₃) δ : 140.4, 139.3, 129.0, 128.9, 128.4, 128.3, 126.5, 126.2, 64.3, 60.3. **¹⁹F NMR** (376 MHz, CDCl₃) δ : -77.87.

(1*S*,2*S*)-*N*-*p*-Toluenesulfonyl-1,2-diphenylethylenediamine (2g)⁶

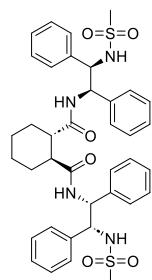
Colorless crystals, 1.12 g, yield: 61%, M.p. 122.3–124.2 °C; R_f = 0.33 (DCM/MeOH 40:1, v/v), $[\alpha]_D^{25} = +26.90$ ($c = 2.0$, CHCl₃); Lit.⁷ $[\alpha]_D^{22} = +30.0$ ($c = 1.0$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.31 (d, $J = 8.3$ Hz, 2H, ArH), 7.21–7.06 (m, 10H, ArH), 6.97 (d, $J = 8.0$ Hz, 2H, ArH), 4.37 (d, $J = 5.3$ Hz, 1H, CH), 4.12 (d, $J = 5.3$ Hz, 1H, CH), 2.31 (s, 3H, CH₃); **¹³C NMR** (101 MHz, CDCl₃) δ : 142.6, 141.6, 139.4, 137.3, 129.2, 128.5, 128.4, 127.54, 127.47, 127.1, 127.0, 126.7, 63.3, 60.6, 21.5.

1,1-Dimethylethyl *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]carbamate (2h)⁸

Yellow crystals, 2.17 g, yield: 70%, M.p. 106.4–107.7 °C; R_f = 0.50 (DCM/MeOH 20:1, v/v), $[\alpha]_D^{25} = +13.30$ ($c = 2.0$, CHCl₃); Lit.⁹ $[\alpha]_D^{22} = +29.15$ ($c = 0.5$, CHCl₃). **¹H NMR** (400 MHz, CDCl₃) δ : 7.43–7.18 (m, 10H, ArH), 5.84 (d, $J = 8.5$ Hz, 1H, NH), 4.89 (s, 1H, CH), 4.37 (d, $J = 4.1$ Hz, 1H, CH), 1.36 (s, 9H, 3CH₃); **¹³C NMR** (101 MHz, CDCl₃) δ : 155.8, 142.4, 141.1, 128.6, 128.5, 127.5, 127.3, 126.9, 126.6, 79.4, 60.1, 28.4.

3 General procedure for the synthesis of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(sulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamides 4

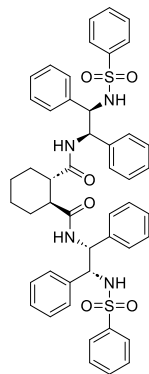
(*S,S*)-Cyclohexane-1,2-dicarboxylic acid (**3**, 120 mg, 0.7 mmol), EDCI (403 mg, 2.1 mmol), and DMAP (17 mg, 0.14 mmol) were dissolved in anhydrous DCM (5 mL). The mixture was stirred at 25 °C for 50 min. A solution of product **2** (1.4 mmol) in dry DCM (5 mL) was added dropwise at the same temperature. The reaction temperature was allowed to warm to 35 °C. The reaction mixture was stirred for 24 h. Colorless precipitates appeared. Petroleum ether (10 mL) was added to assist formation of precipitates. After filtration, the precipitates were washed with petroleum ether and recrystallized from methanol to give colorless crystals **4**.

(1*S*,2*S*)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(methylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4a)

Colorless crystals, 336 mg, yield: 38%, M.p. 283.5–285.2 °C; R_f = 0.25 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25} = -13.55$ ($c = 2.0$, DMSO). **¹H NMR** (400 MHz, DMSO-*d*₆) δ : 7.92 (d, $J = 9.7$ Hz, 2H, 2NH), 7.64 (d, $J = 9.9$ Hz, 2H, 2NH), 7.38 (d, $J = 7.2$ Hz, 4H, ArH), 7.28 (t, $J = 7.5$ Hz, 4H, ArH), 7.24–7.15 (m, 6H, ArH), 7.05–6.95 (m, 6H, ArH), 5.20 (dd, $J = 9.6, 4.7$ Hz, 2H, 2CH), 4.78 (dd, $J = 10.1, 4.8$ Hz, 2H, 2CH), 2.37–2.30 (m, 2H, 2CH), 2.07 (s, 6H, 2CH₃), 1.62 (d, $J = 8.5$ Hz, 2H in CH₂), 1.53 (d, $J = 12.6$ Hz, 2H in CH₂), 1.20–1.09 (m, 2H, CH₂), 1.05–0.90 (m, 2H, CH₂). **¹³C NMR** (101 MHz, DMSO-*d*₆) δ : 173.8, 140.3, 139.8, 127.8, 127.7, 127.03, 126.98, 126.7,

62.0, 56.3, 45.6, 40.8, 29.3, 25.1. **HRMS (ESI):** m/z calcd for $C_{38}H_{45}N_4O_6S_2^+$ $[M+H]^+$: 717.2775, found: 717.2778.

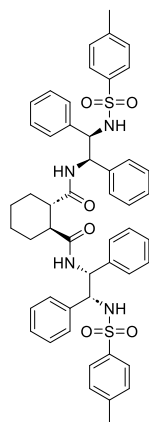
(1S,2S)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(phenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4b)



Colorless crystals, 434 mg, yield: 71%, M.p. 256.5–259.3 °C; R_f = 0.25 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25}$ = –30.80 (c = 2.0, DMSO). **¹H NMR** (400 MHz, DMSO- d_6) δ : 7.51–7.42 (m, 4H, 4NH), 7.34 (d, J = 7.5 Hz, 2H, ArH), 7.18 (t, J = 7.9 Hz, 4H, ArH), 7.15–7.00 (m, 6H, ArH), 7.02–6.94 (m, 2H, ArH), 6.91 (t, J = 7.3 Hz, 4H, ArH), 6.88–6.81 (m, 4H, ArH), 6.77 (d, J = 7.8 Hz, 2H, ArH), 6.73–6.66 (m, 4H, ArH), 6.34 (d, J = 7.6 Hz, 2H, ArH), 4.95 (dd, J = 10.0, 7.7 Hz, 2H, 2CH), 4.59 (dd, J = 10.0, 7.7 Hz, 2H, 2CH), 2.58–2.51 (m, 2H in CH₂), 2.09–1.97 (m, 4H, CH₂CH₂), 1.84 (d, J = 9.0 Hz, 2H, CH₂), 1.45–1.38 (m, 2H, CH₂). **¹³C NMR** (101 MHz, DMSO- d_6) δ : 173.8, 141.2, 139.2, 139.0, 131.6, 128.5, 127.5, 127.3, 127.0, 126.8, 126.6, 126.4,

125.9, 61.8, 56.68, 54.98, 45.6, 29.3, 25.1. **HRMS (ESI):** m/z calcd for $C_{48}H_{49}N_4O_6S_2^+$ $[M+H]^+$: 841.3088, found: 841.3098.

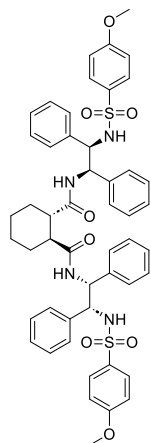
(1S,2S)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4c)



Colorless crystals, 245 mg, yield: 73%, M.p. 251.3–252.7 °C; R_f = 0.23 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25}$ = –35.20 (c = 2.0, DMSO). **¹H NMR** (400 MHz, DMSO- d_6) δ : 7.36 (d, J = 8.3 Hz, 4H, 4NH), 7.04 (d, J = 7.1 Hz, 6H, ArH), 7.00–6.96 (m, 6H, ArH), 6.92 (t, J = 7.5 Hz, 4H, ArH), 6.87–6.81 (m, 4H, ArH), 6.76 (d, J = 7.8 Hz, 2H, ArH), 6.73–6.67 (m, 4H, ArH), 6.25 (d, J = 7.7 Hz, 2H, ArH), 4.94 (dd, J = 9.9, 7.8 Hz, 2H, 2CH), 4.56 (dd, J = 9.9, 7.6 Hz, 2H, 2CH), 2.53 (d, J = 9.9 Hz, 2H, 2CH), 2.28 (s, 6H, 2CH₃), 2.02 (d, J = 12.7 Hz, 2H in 2CH₂), 1.81 (d, J = 8.7 Hz, 2H in 2CH₂), 1.54 (m, 2H, CH₂), 1.39–1.28 (m, 2H, CH₂). **¹³C NMR** (101 MHz, DMSO- d_6) δ : 173.7, 141.7, 139.3, 139.2, 138.3, 128.9, 127.5, 127.3, 127.0, 126.7, 126.5, 126.3, 126.0, 61.7, 56.6, 45.5, 29.3, 25.1, 20.8. **HRMS (ESI):** m/z calcd for $C_{50}H_{53}N_4O_6S_2^+$

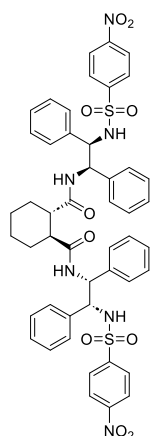
$[M+H]^+$: 869.3401, found: 869.3409.

(1*S*,2*S*)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(4-methoxyphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4d)



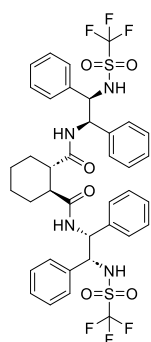
Colorless crystals, 511 mg, yield: 87%, M.p. 256.3–258.7 °C; *R*_f = 0.20 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25} = -13.05$ (*c* = 2.0, DMSO). ¹H NMR (400 MHz, DMSO-*d*₆) δ : 7.88 (t, *J* = 11.0 Hz, 1H, 4H, 4NH), 7.18 (d, *J* = 8.5 Hz, 4H, ArH), 7.12–7.05 (m, 14H, ArH), 7.04 (d, *J* = 8.1 Hz, 2H, ArH), 6.87 (t, *J* = 7.5 Hz, 4H, ArH), 6.68 (d, *J* = 8.5 Hz, 4H, ArH), 5.05 (dd, *J* = 9.8, 4.9 Hz, 2H, CH), 4.74 (dd, *J* = 10.0, 4.8 Hz, 2H, 2CH), 3.72 (s, 6H, 2CH₃), 2.29 (s, 2H, 2CH), 1.61 (s, 2H in CH₂), 1.53 (d, *J* = 13.4 Hz, 2H in CH₂), 1.10 (s, 2H in CH₂), 0.92 (d, *J* = 12.6 Hz, 2H in CH₂). ¹³C NMR (101 MHz, DMSO-*d*₆) δ : 173.7, 161.5, 139.2, 132.9, 128.1, 127.5, 127.3, 127.0, 126.7, 126.5, 126.3, 113.6, 61.6, 56.7, 55.5, 45.5, 29.2, 25.1. HRMS (ESI): *m/z* calcd for C₅₀H₅₃N₄O₈S₂⁺ [*M*+*H*]⁺: 901.3300, found: 901.3299.

(1*S*,2*S*)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(4-nitrophenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4e)



Colorless crystals, 112 mg, yield: 52%, M.p. >300 °C; *R*_f = 0.20 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25} = -13.70$ (*c* = 1.0, DMSO). ¹H NMR (400 MHz, DMSO-*d*₆) δ : 8.47 (d, *J* = 10.0 Hz, 2H, 2NH), 8.01–7.96 (m, 4H, ArH), 7.93 (d, *J* = 9.8 Hz, 2H, 2NH), 7.53–7.47 (m, 4H, ArH), 7.12–6.95 (m, 14H, ArH), 6.91–6.78 (m, 6H, ArH), 5.08 (dd, *J* = 9.7, 5.4 Hz, 2H, 2CH), 4.77 (dd, *J* = 10.0, 5.4 Hz, 2H, CH), 2.35–2.25 (m, 2H, CH), 1.69–1.57 (m, 4H, CH₂CH₂), 1.17–1.07 (m, 2H, CH₂), 1.03–0.97 (m, 2H, CH₂). ¹³C NMR (101 MHz, DMSO-*d*₆) δ : 173.7, 148.7, 146.5, 139.0, 138.7, 127.6, 127.49, 127.45, 127.1, 126.8, 126.7, 126.4, 123.8, 62.2, 56.3, 45.6, 29.3, 25.1. HRMS (ESI): *m/z* calcd for C₄₈H₄₇N₆O₁₀S₂⁺ [*M*+*H*]⁺: 931.2790, found: 931.2781.

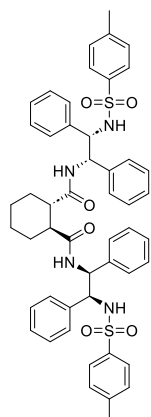
(1*S*,2*S*)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(trifluoromethylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4f)



Colorless crystals, 294 mg, yield: 32%, M.p. 262.5–264.3 °C; *R*_f = 0.23 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25} = -32.90$ (*c* = 1.0, DMSO). ¹H NMR (400 MHz, DMSO-*d*₆) δ : 9.73 (d, *J* = 9.6 Hz, 2H, 2NH), 7.96 (d, *J* = 9.8 Hz, 2H, 2NH), 7.32 (d, *J* = 7.1 Hz, 4H, ArH), 7.26 (t, *J* = 7.4 Hz, 4H, ArH), 7.20 (d, *J* = 7.0 Hz, 2H, ArH), 7.18–7.12 (m, 4H, ArH), 7.06–6.99 (m, 6H, ArH), 5.20 (dd, *J* = 9.8, 5.6 Hz, 2H, 2CH), 4.86 (dd, *J* = 9.7, 5.6 Hz, 2H, 2CH), 2.37–2.30 (m, 2H, 2CH), 1.70–1.56 (m, 4H, 2CH₂), 1.20–0.96 (m, 4H, 2CH₂). ¹³C NMR (101 MHz, DMSO-*d*₆) δ : 173.6, 138.4, 127.9, 127.6, 127.4, 127.0, 126.83, 126.75, 63.4, 56.7, 45.6, 29.2, 25.0. ¹⁹F

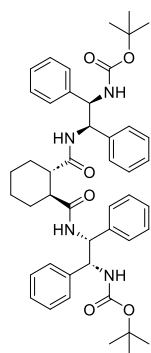
NMR (376 MHz, DMSO-*d*₆) δ : -77.97. HRMS (ESI): *m/z* calcd for C₃₈H₃₉F₆N₄O₆S₂⁺ [*M*+*H*]⁺: 825.2210, found: 825.2209.

(1*S*,2*S*)-*N*¹,*N*²-Bis((1*S*,2*S*)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4g)



Colorless crystals, 235 mg, yield: 70%, M.p. 251.2–252.7 °C; R_f = 0.23 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25}$ = –21.45 (c = 2.0, DMSO). ¹H NMR (400 MHz, DMSO-*d*₆) δ : 8.06–8.01 (m, 2H, 2NH), 7.96 (d, J = 8.5 Hz, 2H, 2NH), 7.25–7.17 (m, 4H, ArH), 7.16–6.94 (m, 24H, ArH), 5.02 (dd, J = 8.4, 6.4 Hz, 2H, 2CH), 4.66–4.58 (d, J = 5.1 Hz, 2H, 2CH), 2.52–2.43 (m, 2H, 2CH), 2.26 (s, 6H, CH₃), 1.83–1.73 (m, 2H in 2CH₂), 1.71–1.58 (m, 2H in 2CH₂), 1.22–1.05 (m, 4H, 2CH₂). ¹³C NMR (101 MHz, DMSO-*d*₆) δ : 173.9, 141.7, 140.4, 138.9, 138.3, 128.9, 127.6, 127.5, 127.4, 127.0, 126.6, 126.5, 126.1, 61.9, 57.6, 44.8, 29.5, 25.1, 20.9. HRMS (ESI): m/z calcd for C₅₀H₅₃N₄O₆S₂⁺ [M+H]⁺: 869.3401, found: 869.3409.

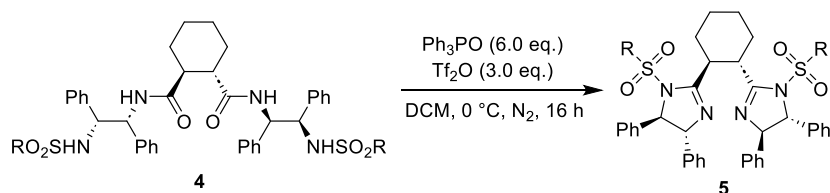
(1*S*,2*S*)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(*t*-butyloxy carbonyl)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4h)



Colorless crystals, 760 mg, yield: 65%, M.p. 256.5–259.2 °C. R_f = 0.32 (DCM/MeOH 20:1, v/v). $[\alpha]_D^{25}$ = –27.42 (c = 2.0, DMSO). ¹H NMR (400 MHz, DMSO-*d*₆) δ : 8.03 (d, J = 9.7 Hz, 2H, 2NH), 7.31–7.20 (m, 10H, 2H in 2NH & 8H in ArH), 7.19–7.13 (m, 6H, ArH), 7.01–6.90 (m, 6H, ArH), 5.23 (dd, J = 9.8, 4.7 Hz, 2H, 2CH), 5.11 (dd, J = 9.9, 4.6 Hz, 2H, 2CH), 2.29 (d, J = 10.2 Hz, 2H, 2CH), 1.59–1.52 (m, 2H, CH₂), 1.36 (d, J = 12.8 Hz, 2H, CH₂), 1.22 (s, 18H, 6CH₃), 1.05–1.01 (m, 2H, CH₂), 0.90–0.78 (m, 2H, CH₂). ¹³C NMR (101 MHz, DMSO-*d*₆) δ : 173.9, 155.0, 141.1, 139.8, 127.7, 127.4, 126.8, 126.7, 126.5, 126.2, 77.9, 57.8, 55.8, 45.5,

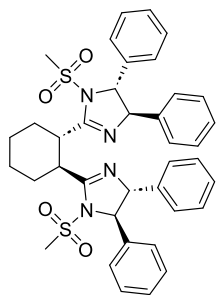
29.3, 28.1, 27.6, 25.1. HRMS (ESI): m/z calcd for C₄₆H₅₇N₄O₆⁺ [M+H]⁺: 761.4273, found: 761.4276.

4. General procedure for the synthesis of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-(sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexanes 5



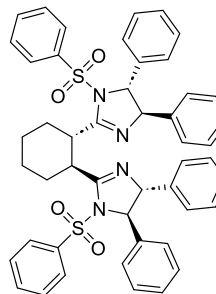
Triphenylphosphine oxide (1.67 g, 6 mmol) and triflic anhydride (0.5 mL, 3 mmol) were dissolved in dry DCM (0.5 mmol/mL) at 0 °C. The mixture was stirred at the same temperature for 30 min. The above prepared cyclohexane-1,2-dicarboxamide (1 mmol) was added portionwise. The resulting mixture was allowed to warm to room temperature and stirred at room temperature for 16 h. After addition of saturated aqueous sodium bicarbonate, the organic phase was separated and the aqueous phase was extracted with DCM (10 mL $\times$ 2). The combined organic phase was dried over sodium sulfate. After removal of the solvent, the residue was subjected to silica gel column chromatography with petroleum ether/EtOAc 10:1 (v/v) as eluent to afford colorless crystals 5.

(1*S*,2*S*)-1,2-Bis((4*R*,5*R*)-1-(methylsulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5a)



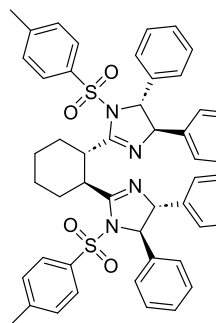
Colorless crystals, 350 mg, yield: 51%, M.p. 186.2–189.4 °C; R_f = 0.15 (PE/EA 10:1, v/v). $[\alpha]_D^{25} = +133.15$ ($c = 2.0$, CHCl_3). $^1\text{H NMR}$ (400 MHz, CDCl_3) δ : 7.37 (dd, $J = 8.1, 6.5$ Hz, 4H, ArH), 7.33–7.27 (m, 5H, ArH), 7.27–7.22 (m, 7H, ArH), 7.21–7.16 (m, 4H, ArH), 4.88 (s, 4H, 4CH), 3.87–3.61 (m, 2H, 2CH), 2.87 (s, 6H, 2CH₃), 2.73–2.65 (m, 2H, 2H in 2CH₂), 1.98–1.92 (m, 2H, 2H in 2CH₂), 1.61–1.53 (m, 4H, 2CH₂). $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ : 163.6, 142.6, 140.6, 129.2, 128.9, 128.3, 128.2, 126.9, 126.3, 78.4, 71.3, 40.9, 39.6, 33.0, 25.8. **HRMS (ESI)**: m/z calcd for $\text{C}_{38}\text{H}_{41}\text{N}_4\text{O}_4\text{S}_2^+$ $[\text{M}+\text{H}]^+$: 681.2564, found: 681.2565.

(1*S*,2*S*)-1,2-Bis((4*R*,5*R*)-4,5-diphenyl-1-(phenylsulfonyl)-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5b)



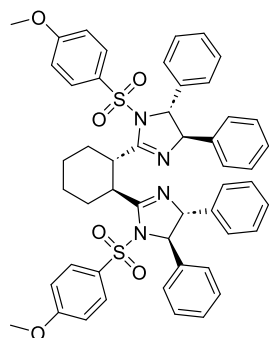
Colorless crystals, 458 mg, yield: 57%, M.p. 267.9–269.3 °C; R_f = 0.25 (PE/EA 10:1, v/v). $[\alpha]_D^{25} = -19.60$ ($c = 2.0$, CHCl_3). $^1\text{H NMR}$ (400 MHz, CDCl_3) δ : 7.94–7.87 (m, 4H, ArH), 7.42–7.36 (m, 4H, ArH), 7.35–7.29 (m, 2H, ArH), 7.24–7.21 (m, 2H, ArH), 7.21–7.17 (m, 4H, ArH), 7.09 (tt, $J = 7.5, 1.2$ Hz, 2H, ArH), 7.01 (t, $J = 7.7$ Hz, 4H, ArH), 6.63–6.51 (m, 4H, ArH), 6.49–6.38 (m, 4H, ArH), 4.84 (d, $J = 6.2$ Hz, 2H, 2CH), 4.24 (d, $J = 6.2$ Hz, 2H, 2CH), 4.21–4.14 (m, 2H, 2CH), 3.04–2.90 (m, 2H, 2H in 2CH₂), 2.10–1.94 (m, 2H, 2H in 2CH₂), 1.64 (m, 4H, 2CH₂). $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ : 164.1, 142.8, 141.8, 136.6, 133.0, 129.1, 128.9, 128.6, 128.1, 127.6, 127.3, 126.2, 80.2, 71.4, 41.6, 34.7, 26.1. **HRMS (ESI)**: m/z calcd for $\text{C}_{48}\text{H}_{45}\text{N}_4\text{O}_4\text{S}_2^+$ $[\text{M}+\text{H}]^+$: 805.2877, found: 805.2874.

(1*S*,2*S*)-1,2-Bis((4*R*,5*R*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5c)



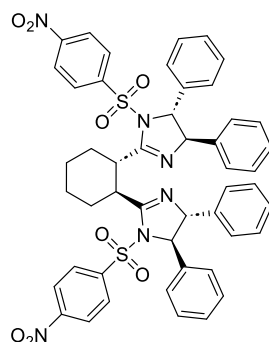
Colorless crystals, 300 mg, yield: 36%, M.p. 273.6–274.5 °C; R_f = 0.25 (PE/EA 10:1, v/v). $[\alpha]_D^{25} = -78.22$ ($c = 0.9$, CHCl_3). $^1\text{H NMR}$ (400 MHz, CDCl_3) δ : 7.82 (d, $J = 8.3$ Hz, 4H, ArH), 7.42–7.35 (m, 4H, ArH), 7.35–7.24 (m, 4H, ArH), 7.21–7.15 (m, 4H, ArH), 7.01 (d, $J = 7.7$ Hz, 2H, ArH), 6.99 (d, $J = 7.7$ Hz, 2H, ArH), 6.38 (d, $J = 8.0$ Hz, 4H, ArH), 6.31 (d, $J = 8.0$ Hz, 4H, ArH), 4.83 (d, $J = 6.1$ Hz, 2H, 2CH), 4.17 (d, $J = 6.1$ Hz, 4H, 4CH), 3.08–2.56 (m, 2H, 2H in 2CH₂), 2.04 (s, 6H, 2CH₃), 2.02 (s, 2H, 2H in 2CH₂), 1.73–1.58 (m, 4H, 4H in 2CH₂). $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ : 164.4, 143.9, 143.0, 142.1, 133.4, 129.6, 129.1, 128.9, 128.7, 128.0, 127.6, 127.5, 126.1, 80.3, 71.4, 41.6, 34.9, 26.1, 21.4. **HRMS (ESI)**: m/z calcd for $\text{C}_{50}\text{H}_{49}\text{N}_4\text{O}_4\text{S}_2^+$ $[\text{M}+\text{H}]^+$: 833.3190, found: 833.3192.

(1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-methoxyphenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5d)



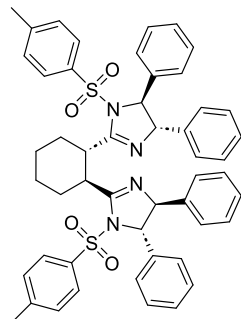
Colorless crystals, 606 mg, yield: 70%, M.p. 214.5–216.7 °C; R_f = 0.13 (PE/EA 10:1, v/v). $[\alpha]_D^{25} = -115.45$ ($c = 2.0$, CHCl_3). $^1\text{H NMR}$ (400 MHz, CDCl_3) δ : 7.88–7.80 (m, 4H, ArH), 7.38 (dd, $J = 8.1, 6.4$ Hz, 4H, ArH), 7.34–7.29 (m, 2H, ArH), 7.24–7.17 (m, 6H, ArH), 6.99 (t, $J = 7.7$ Hz, 4H, ArH), 6.57–6.50 (m, 4H, ArH), 6.16–6.08 (m, 4H, ArH), 4.87 (d, $J = 6.2$ Hz, 2H, 2CH), 4.21 (d, $J = 6.2$ Hz, 2H, 2CH), 4.18–4.14 (m, 2H, 2CH), 3.51 (s, 6H, 2CH₃), 3.03–2.93 (m, 2H, 2H in 2CH₂), 2.00 (s, 2H, 2H in 2CH₂), 1.72–1.60 (m, 4H, 2CH₂). $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ : 164.5, 163.3, 142.9, 141.9, 130.8, 129.0, 128.9, 128.5, 128.0, 127.6, 127.1, 126.3, 114.2, 80.0, 71.5, 55.7, 41.7, 34.7, 26.1. **HRMS (ESI)**: m/z calcd for $\text{C}_{50}\text{H}_{49}\text{N}_4\text{O}_6\text{S}_2^+$ $[\text{M}+\text{H}]^+$: 865.3088, found: 865.3088.

(1*S*,2*S*)-1,2-Bis((4*R*,5*R*)-1-((4-nitrophenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5e)



Colorless crystals, 268 mg, yield: 30%, M.p. 279.2–283.8 °C; R_f = 0.30 (PE/EA 10:1, v/v). $[\alpha]_D^{25} = -80.00$ ($c = 1.1$, CHCl_3). $^1\text{H NMR}$ (400 MHz, CDCl_3) δ : 8.10–8.02 (m, 4H, ArH), 7.46–7.34 (m, 10H, ArH), 7.29–7.23 (m, 2H, ArH), 7.21–7.17 (m, 4H, ArH), 7.01 (t, $J = 7.7$ Hz, 4H, ArH), 6.54–6.47 (m, 4H, ArH), 4.91 (d, $J = 6.3$ Hz, 2H, 2CH), 4.28 (d, $J = 6.3$ Hz, 2H, 2CH), 4.16–4.09 (m, 2H, 2CH), 2.97–2.85 (m, 2H, 2H in 2CH₂), 2.11–1.98 (m, 2H, 2H in 2CH₂), 1.73–1.59 (m, 4H, 2CH₂). $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ : 163.5, 150.4, 142.2, 141.8, 140.6, 129.9, 129.3, 128.7, 128.5, 126.6, 126.2, 124.1, 79.8, 71.7, 41.7, 34.5, 26.0. **HRMS (ESI)**: m/z calcd for $\text{C}_{48}\text{H}_{43}\text{N}_6\text{O}_8\text{S}_2^+$ $[\text{M}+\text{H}]^+$: 895.2578, found: 895.2576.

(1*S*,2*S*)-1,2-Bis((4*S*,5*S*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5g)



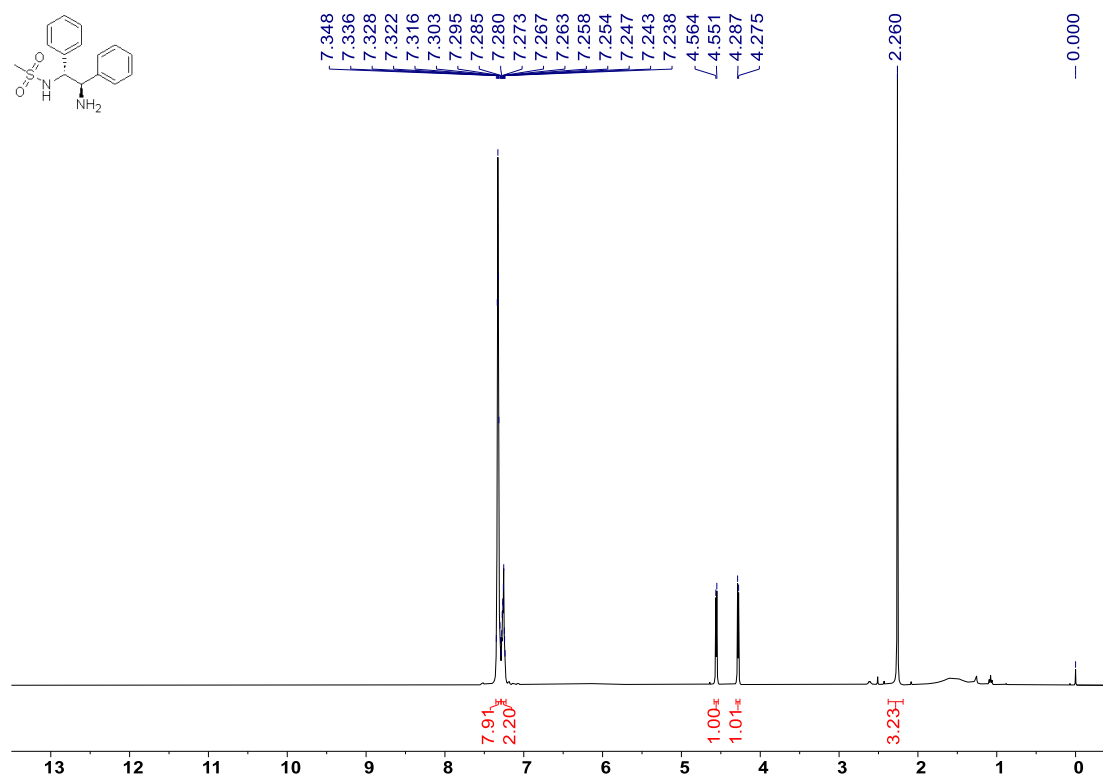
Colorless crystals, 258 mg, yield: 36%, M.p. 273.6–274.3 °C; R_f = 0.25 (PE/EA 10:1, v/v). $[\alpha]_D^{25} = -51.33$ ($c = 2.0$, CHCl_3). $^1\text{H NMR}$ (400 MHz, CDCl_3) δ : 7.82 (d, $J = 8.0$ Hz, 4H, ArH), 7.46–7.23 (m, 8H, ArH), 7.19 (d, $J = 7.3$ Hz, 4H, ArH), 7.00 (t, $J = 7.6$ Hz, 4H, ArH), 6.38 (d, $J = 7.5$ Hz, 4H, ArH), 6.31 (d, $J = 7.9$ Hz, 4H, ArH), 4.82 (d, $J = 6.1$ Hz, 2H, 2CH), 4.17 (d, $J = 6.2$ Hz, 4H in 4CH), 3.03 (s, 2H in 2CH₂), 2.04 (s, 8H, 6H in 2CH₃ & 2H in 2CH), 1.64 (s, 4H in 2CH₂). $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ : 164.3, 143.9, 143.0, 142.1, 133.4, 129.6, 129.1, 128.9, 128.7, 128.0, 127.6, 127.5, 126.1, 80.3, 71.4, 41.6, 34.8, 26.1, 21.4. **HRMS (ESI)**: m/z calcd for $\text{C}_{50}\text{H}_{49}\text{N}_4\text{O}_4\text{S}_2^+$ $[\text{M}+\text{H}]^+$: 833.3190, found: 833.3192.

5. References

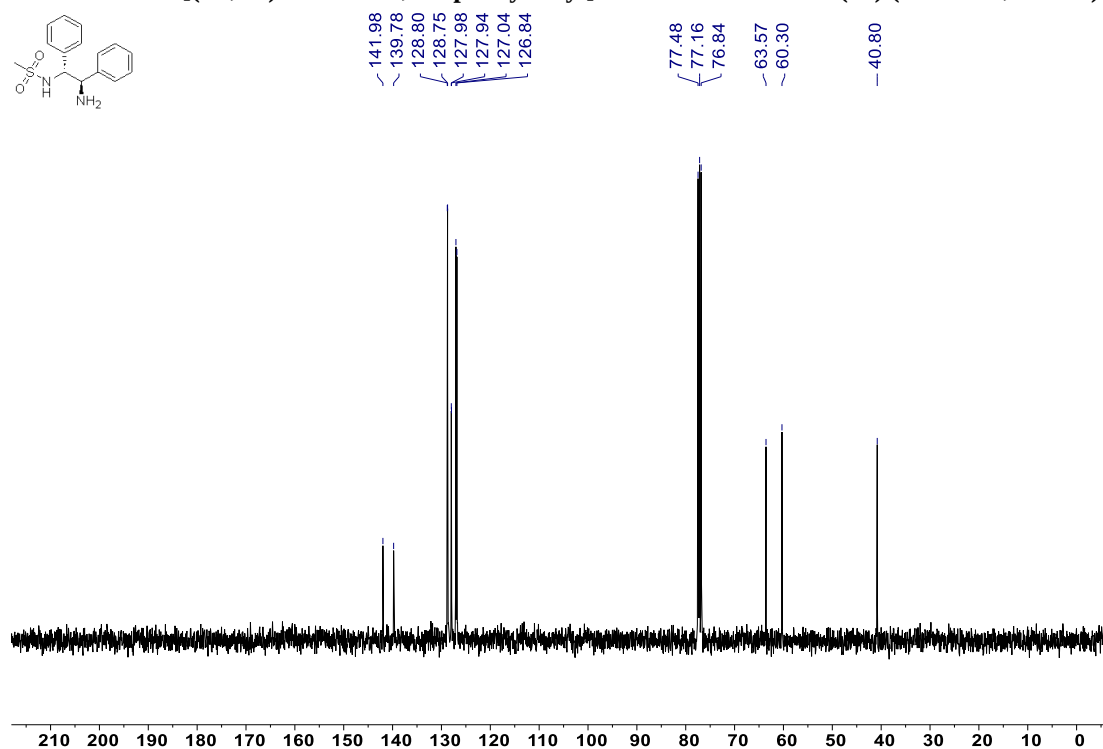
- (1) Yu, F.; Sun, X.; Jin, Z.; Wen, S.; Liang, X.; Ye, J. *Chem. Commun.*, **2010**, 46, 4589–4591.
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- (9) Kochetkov, S. V.; Kucherenko, A. S.; Zlotin, S. G. *Org. Biomol. Chem.* **2018**, 16, 6423–6429.

6. Copies of ^1H and ^{13}C NMR spectra of compounds 2 and 4 and HRMS spectra of products 4 and 5

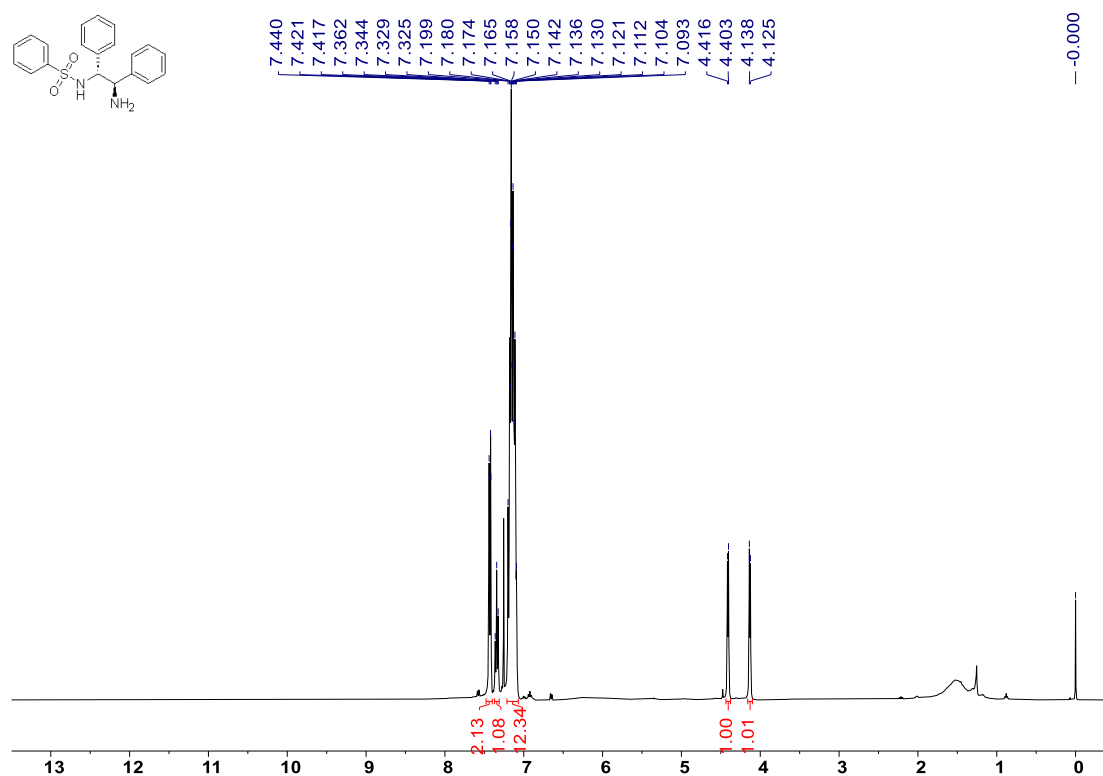
^1H NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]methanesulfonamide (2a) (400 MHz, CDCl_3)



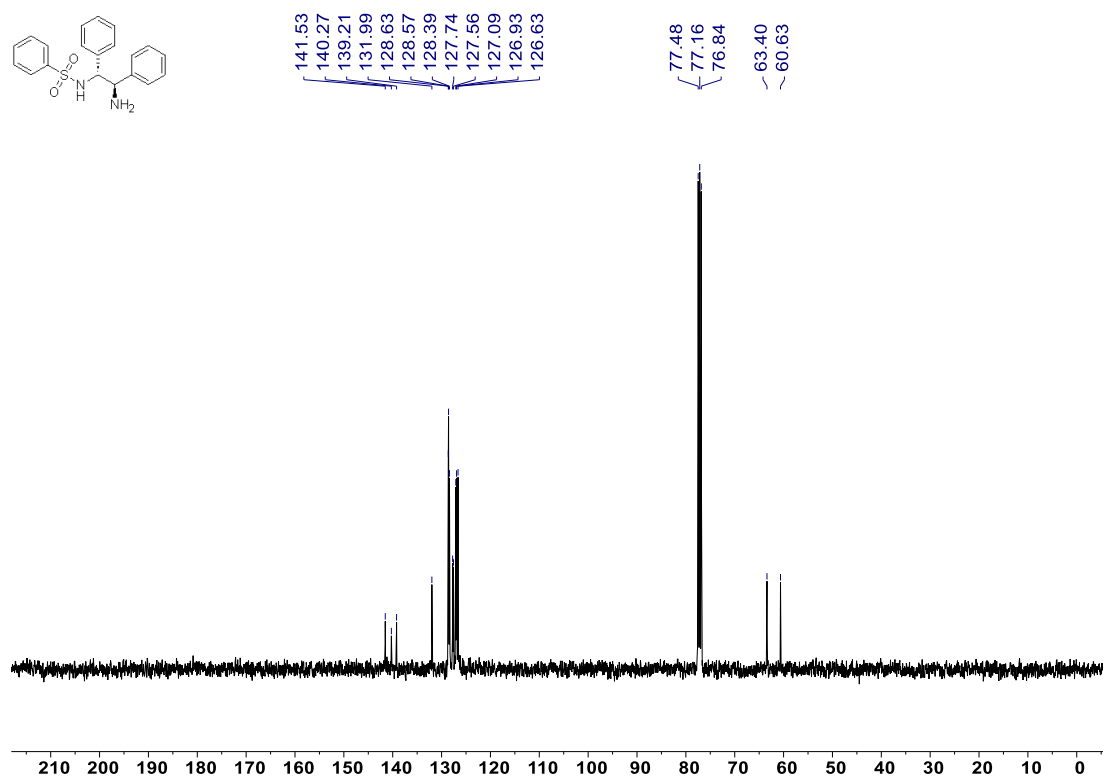
^{13}C NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]methanesulfonamide (2a) (101 MHz, CDCl_3)



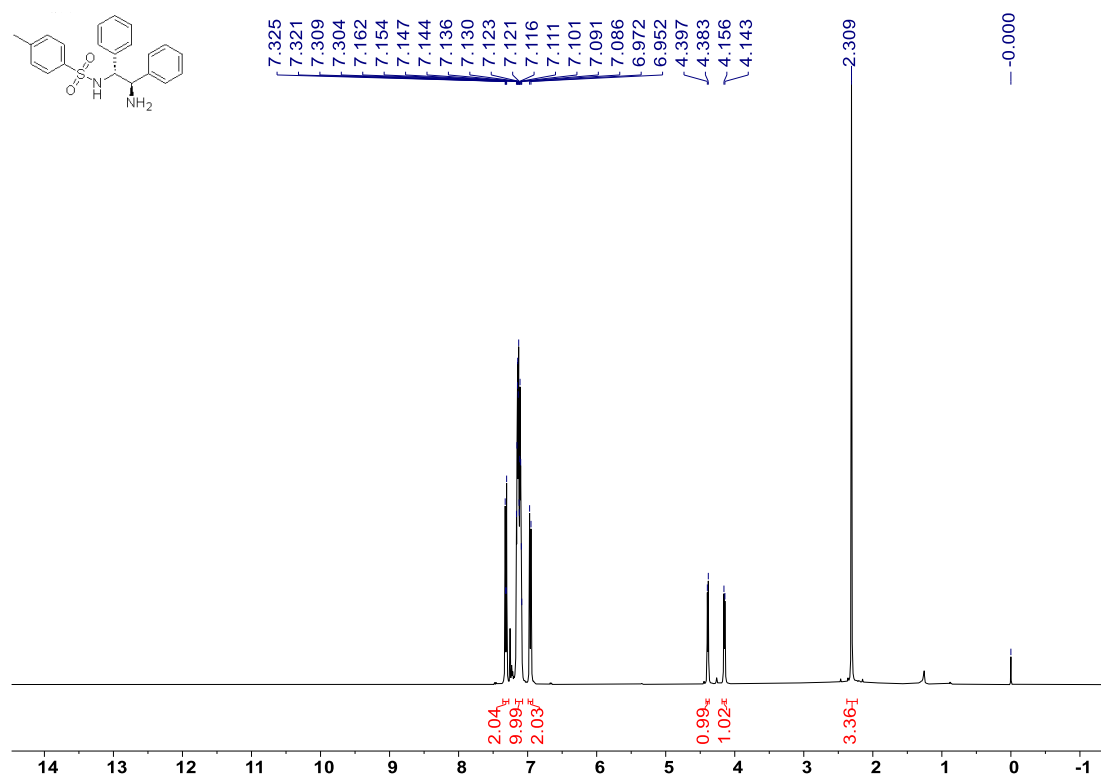
¹H NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]benzenesulfonamide (2b) (400 MHz, CDCl₃)



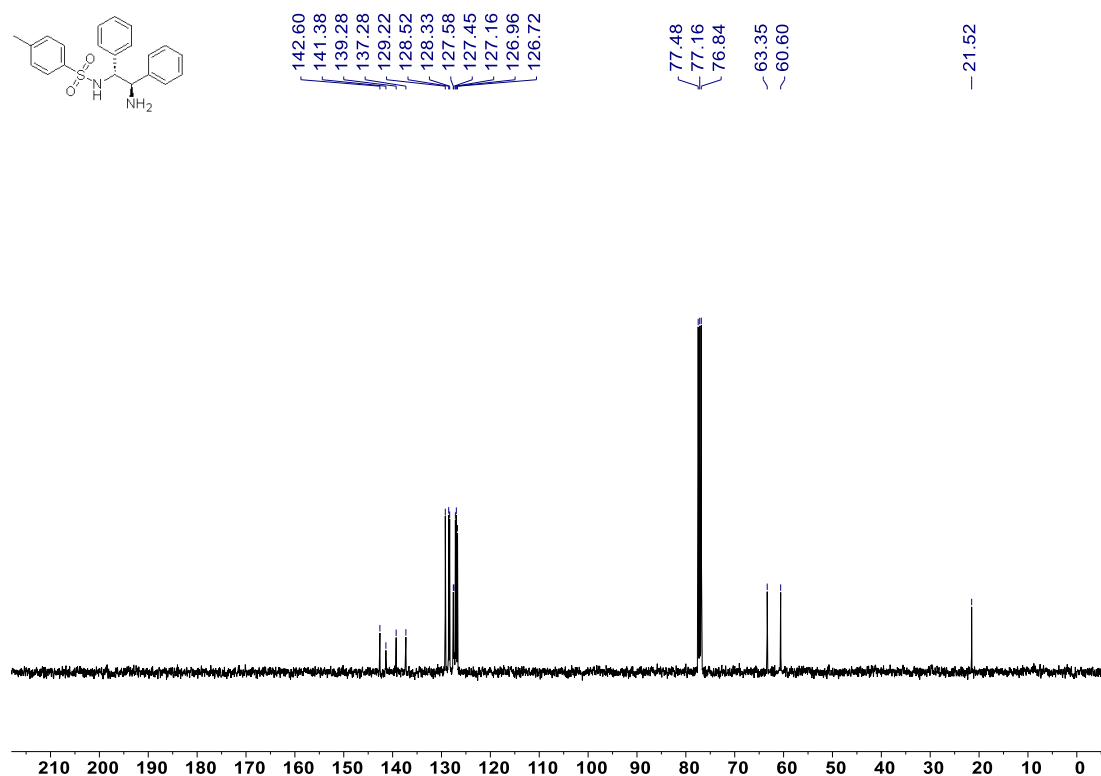
¹³C NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]benzenesulfonamide (2b) (101 MHz, CDCl₃)



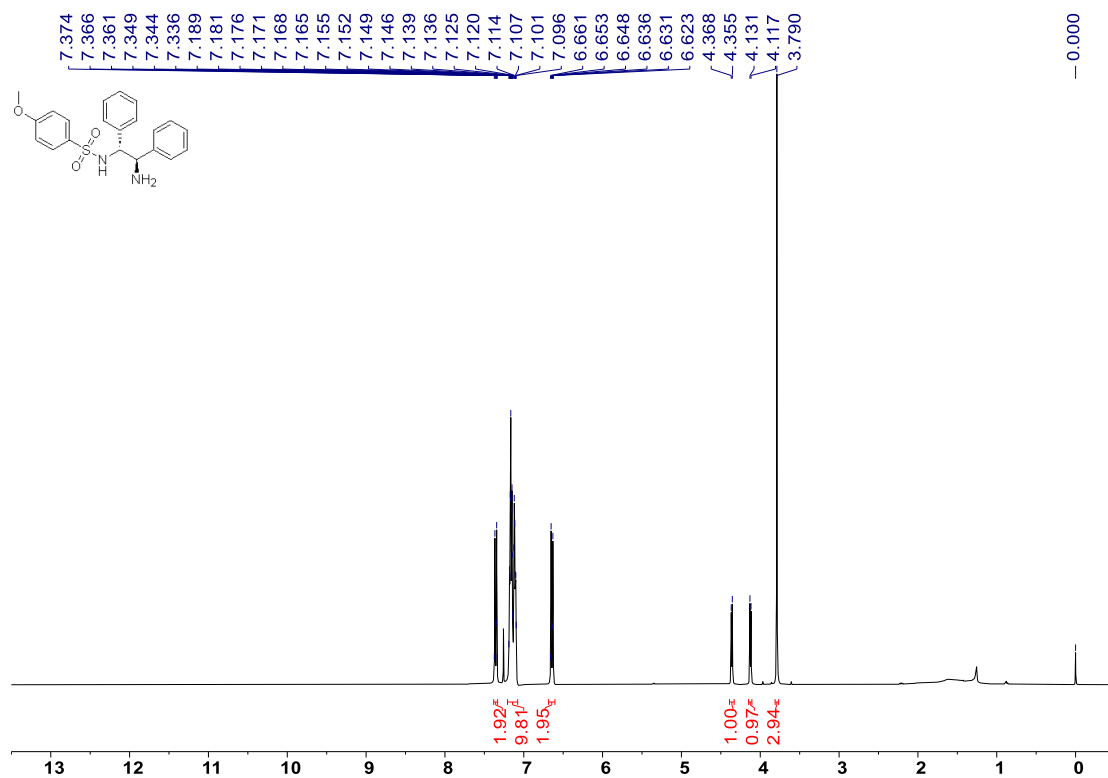
¹H NMR of (1*R*,2*R*)-*N*-*p*-toluenesulfonyl-1,2-diphenylethylenediamine (2c) (400 MHz, CDCl₃)



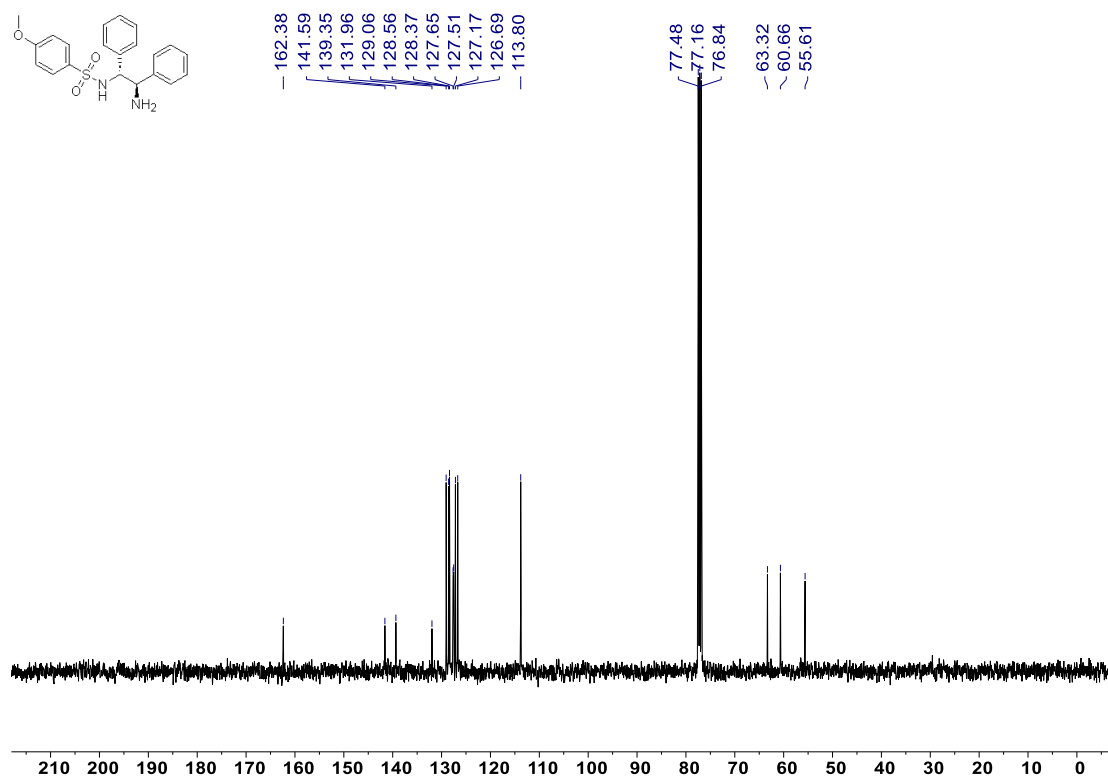
¹³C NMR of (1*R*,2*R*)-*N*-*p*-toluenesulfonyl-1,2-diphenylethylenediamine (2c) (101 MHz, CDCl₃)



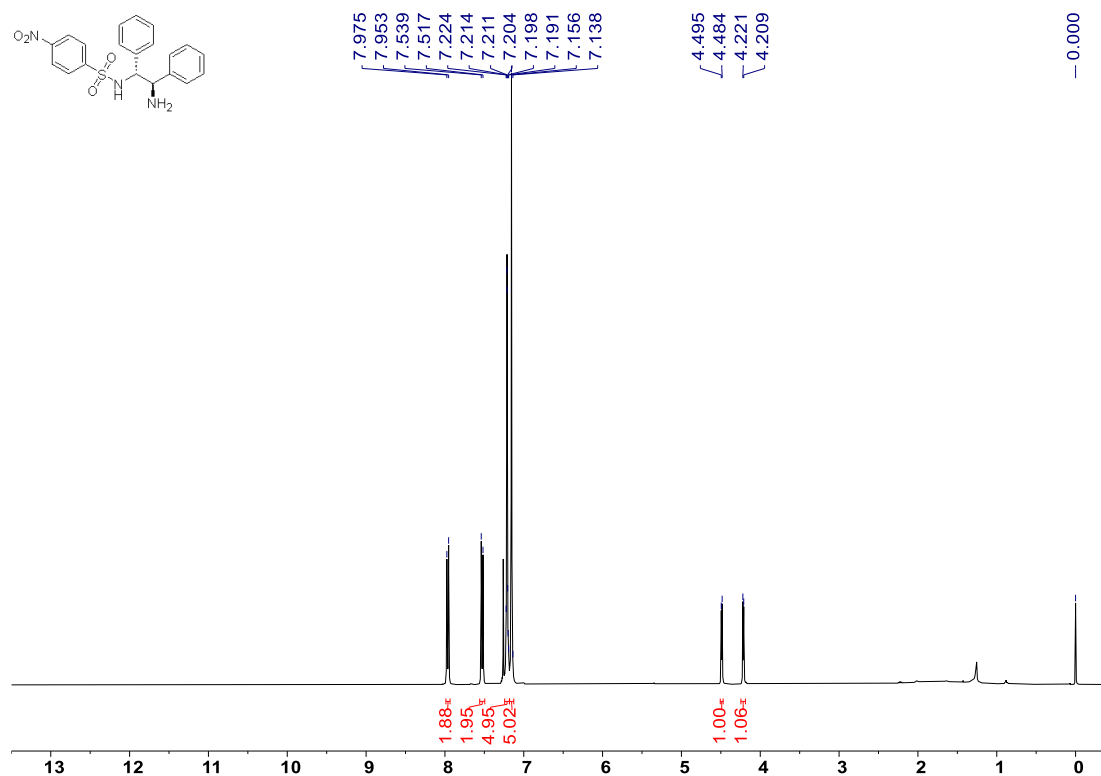
¹H NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-4-methoxybenzenesulfonamide (2d) (400 MHz, CDCl₃)



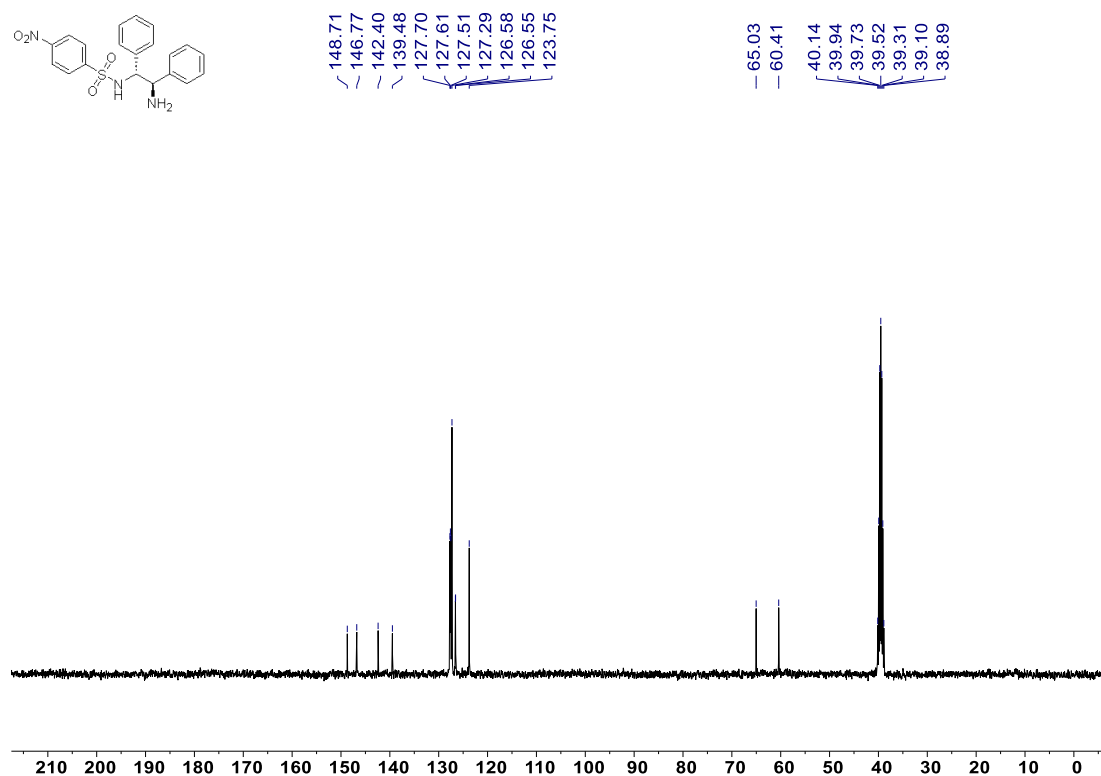
¹³C NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-4-methoxybenzenesulfonamide (2d) (101 MHz, CDCl₃)



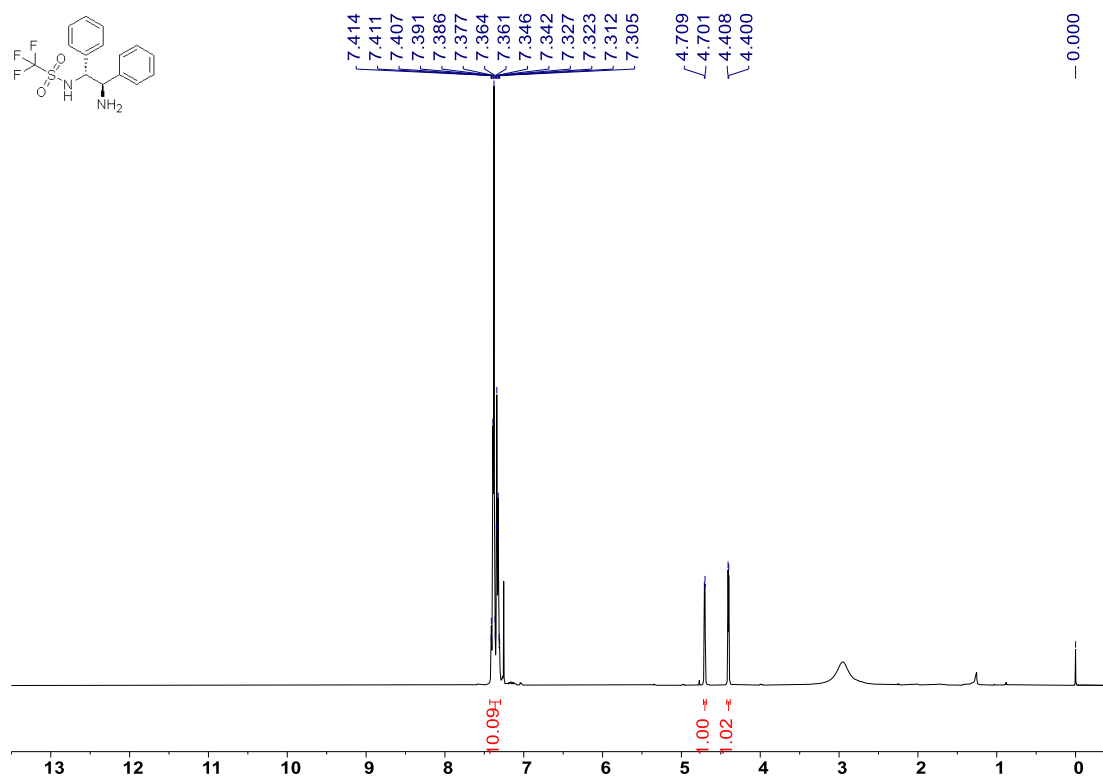
¹H NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-4-nitrobenzenesulfonamide (2e) (400 MHz, CDCl₃)



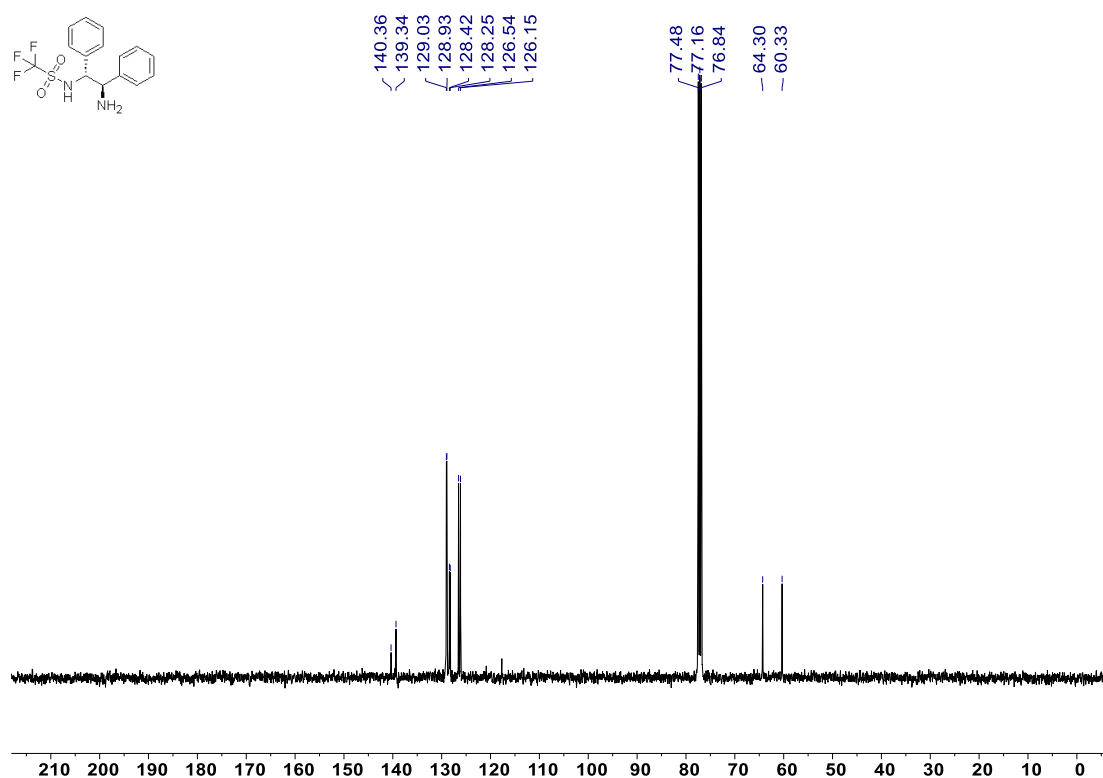
¹³C NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-4-nitrobenzenesulfonamide (2e) (101 MHz, DMSO-*d*₆)



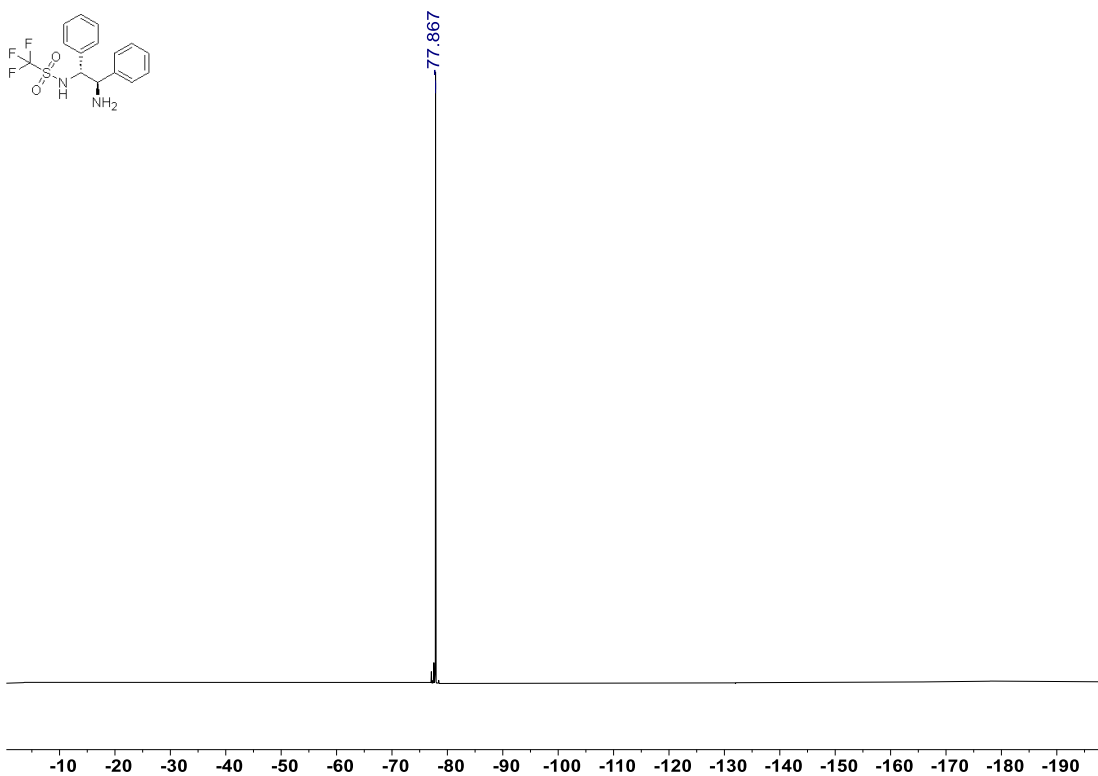
¹H NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-1,1,1-trifluoromethanesulfonamide (2f) (400 MHz, CDCl₃)



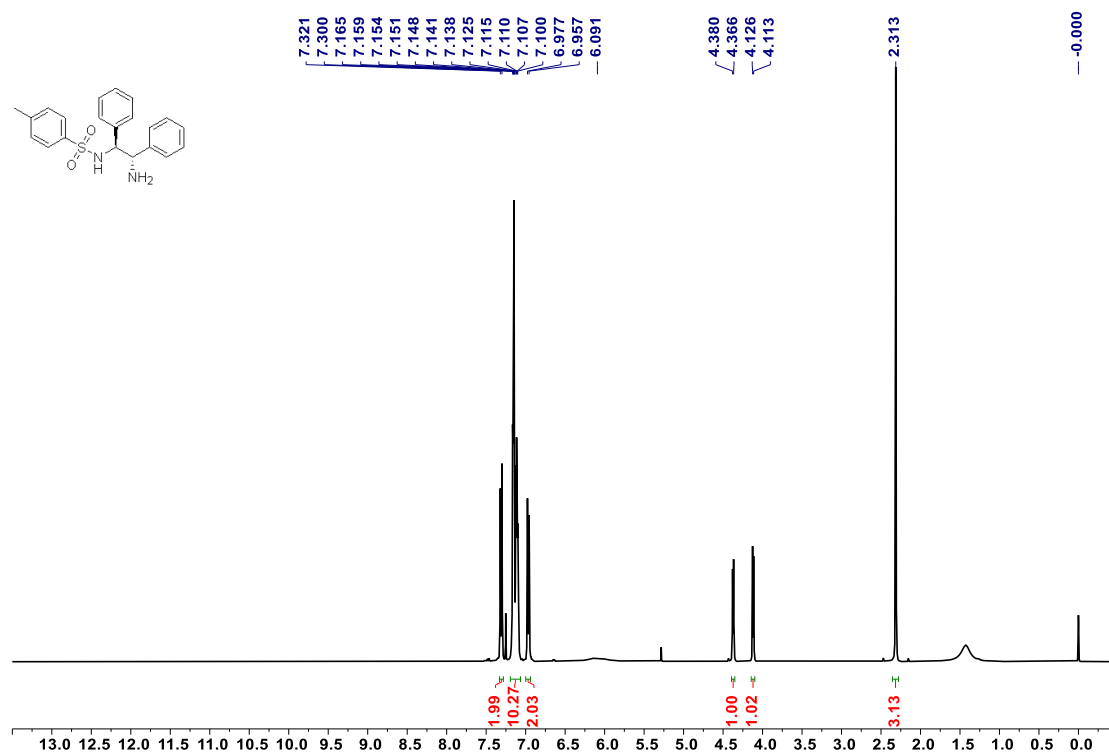
¹³C NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-1,1,1-trifluoromethanesulfonamide (2f) (101 MHz, CDCl₃)



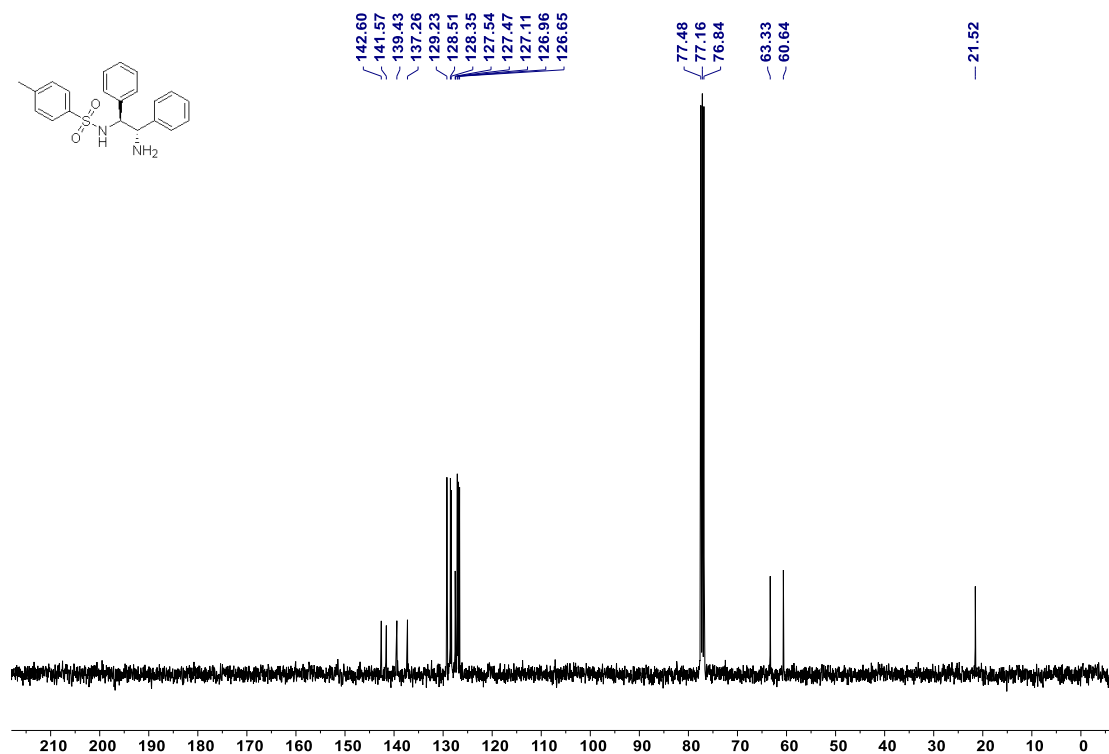
^{19}F NMR of *N*-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]-1,1,1-trifluoromethanesulfonamide (2f) (376 MHz, CDCl_3)



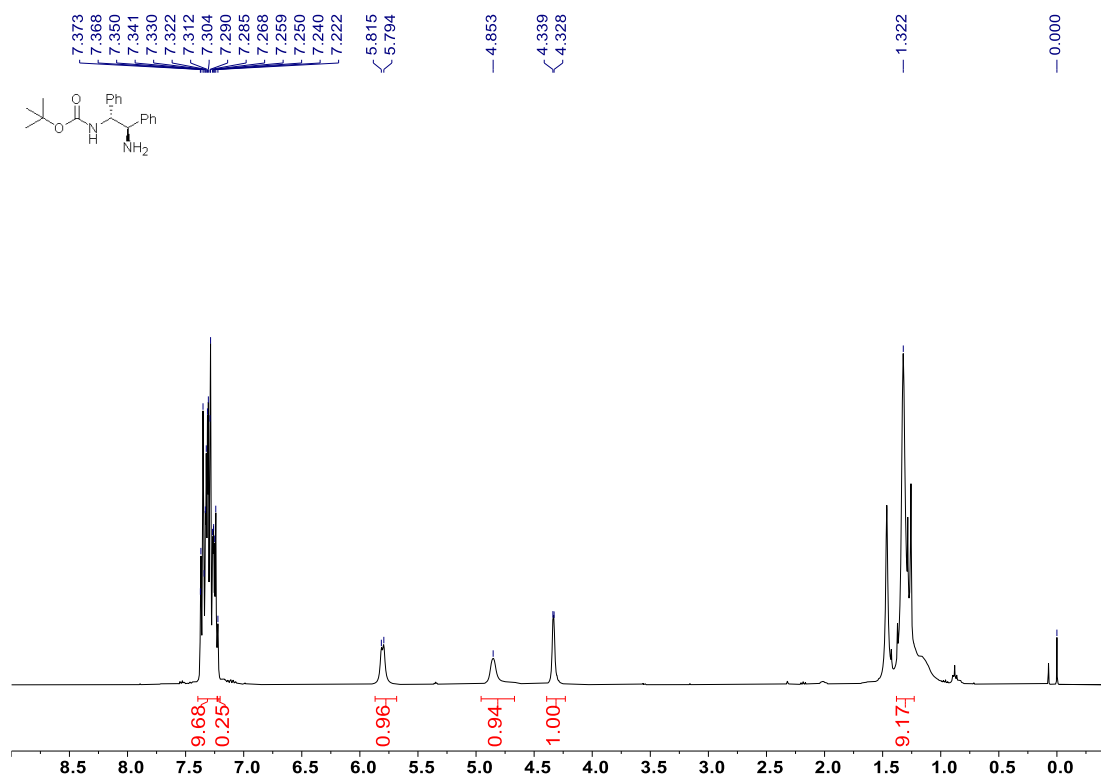
¹H NMR of (1*S*,2*S*)-*N*-*p*-toluenesulfonyl-1,2-diphenylethylenediamine (2g) (400 MHz, CDCl₃)



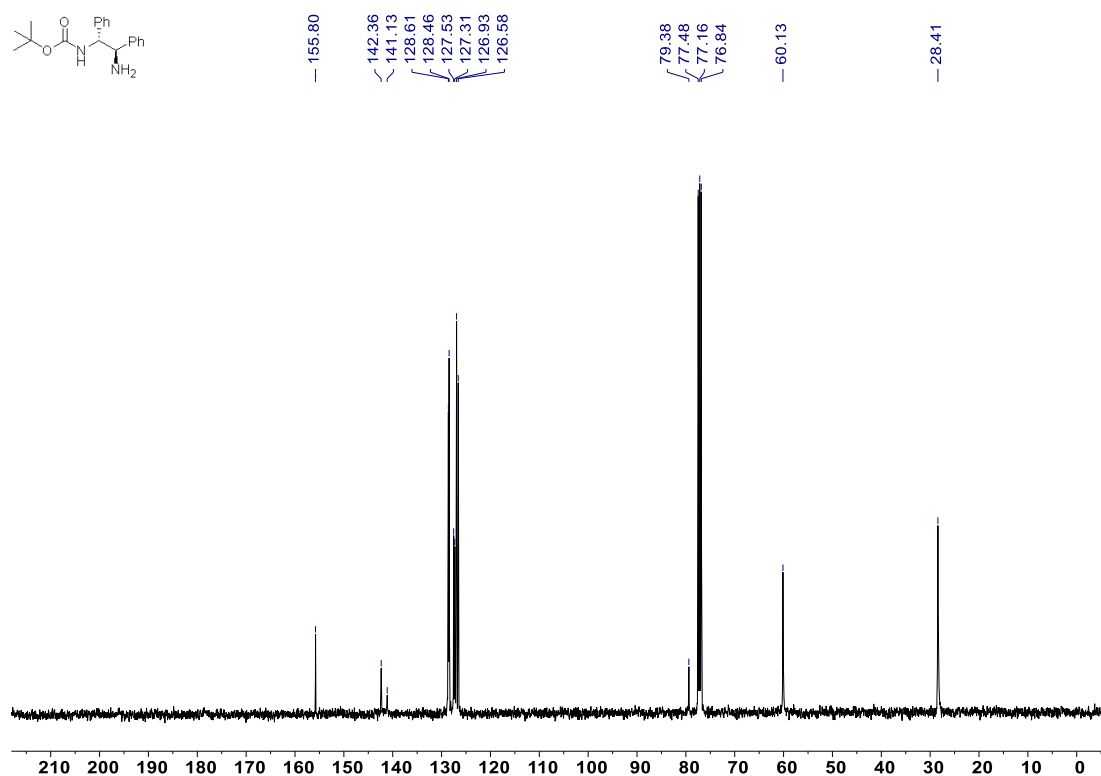
¹³C NMR of (1*S*,2*S*)-*N*-*p*-toluenesulfonyl-1,2-diphenylethylenediamine (2g) (101 MHz, CDCl₃)



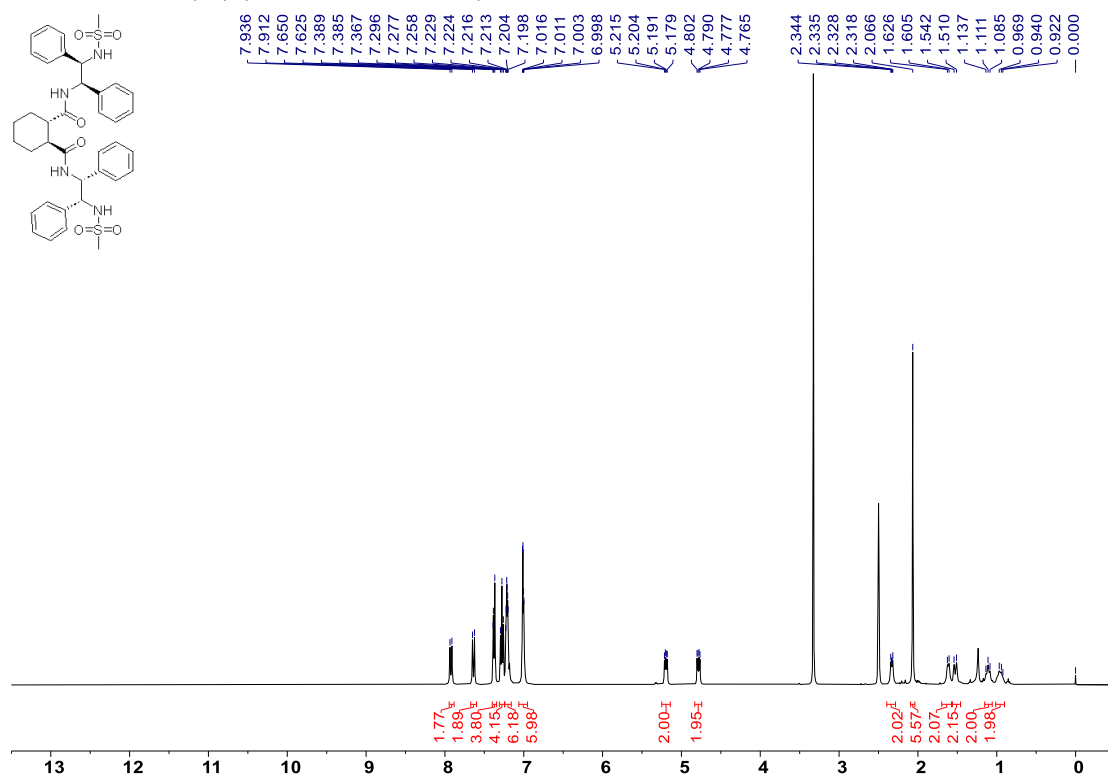
¹H NMR of 1,1-dimethylethyl N-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]carbamate (2h) (400 MHz, CDCl₃)



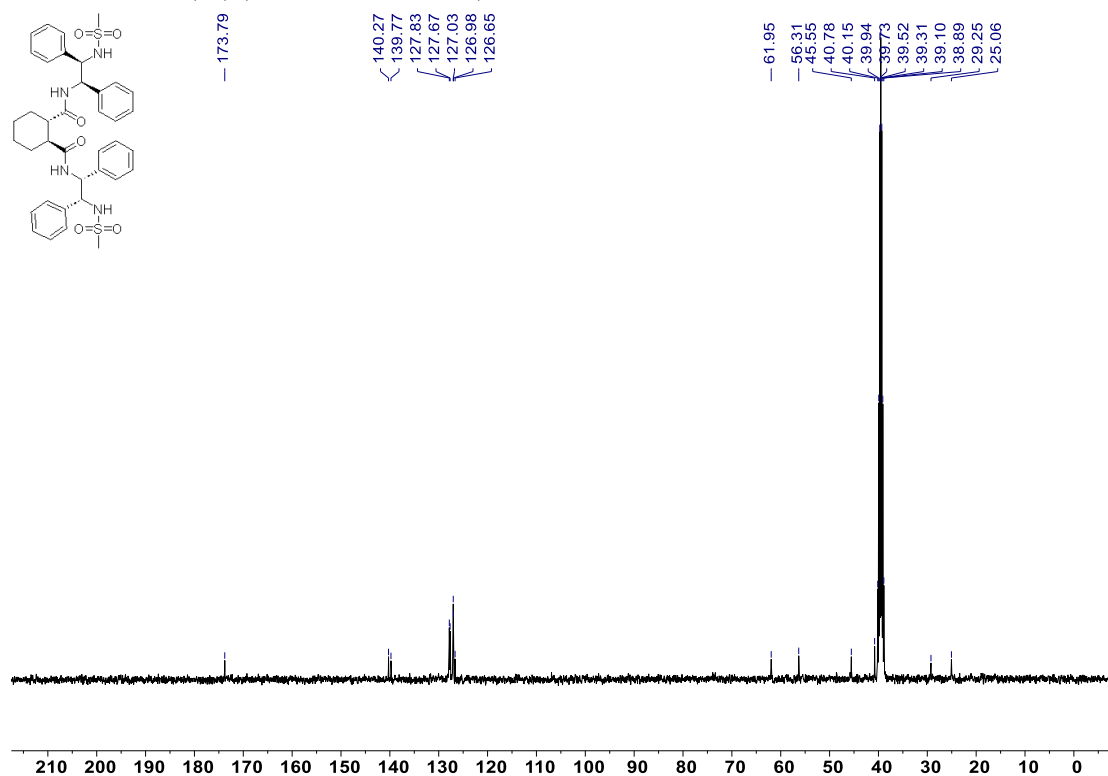
¹³C NMR of 1,1-dimethylethyl N-[(1*R*,2*R*)-2-amino-1,2-diphenylethyl]carbamate (2h) (101 MHz, CDCl₃)



^1H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(methylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4a) (400 MHz, DMSO-*d*₆)



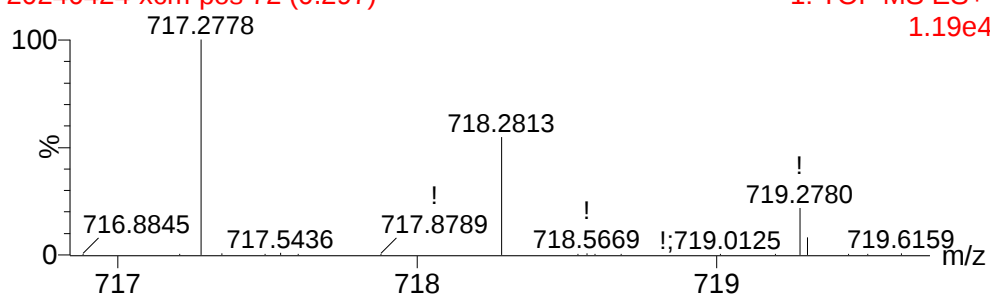
^{13}C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(methylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4a) (101 MHz, DMSO-*d*₆)



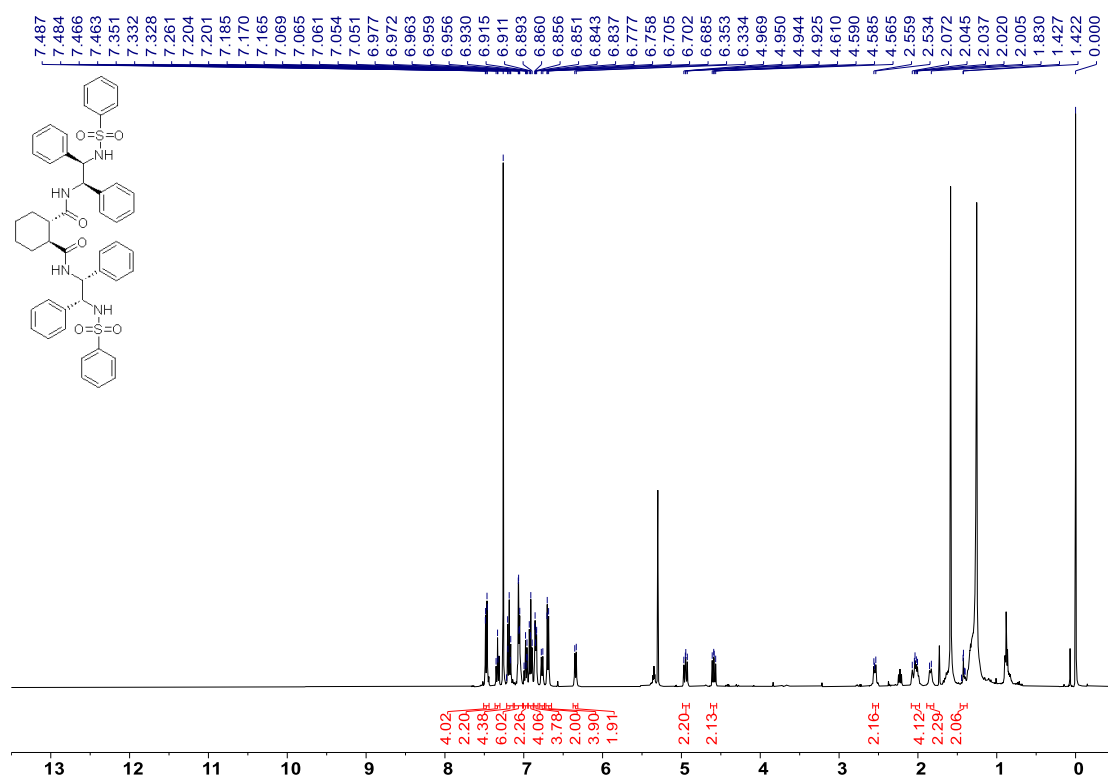
HRMS (ESI) of (1S,2S)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(methylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4a)

20240424-xcm-pos 72 (0.297)

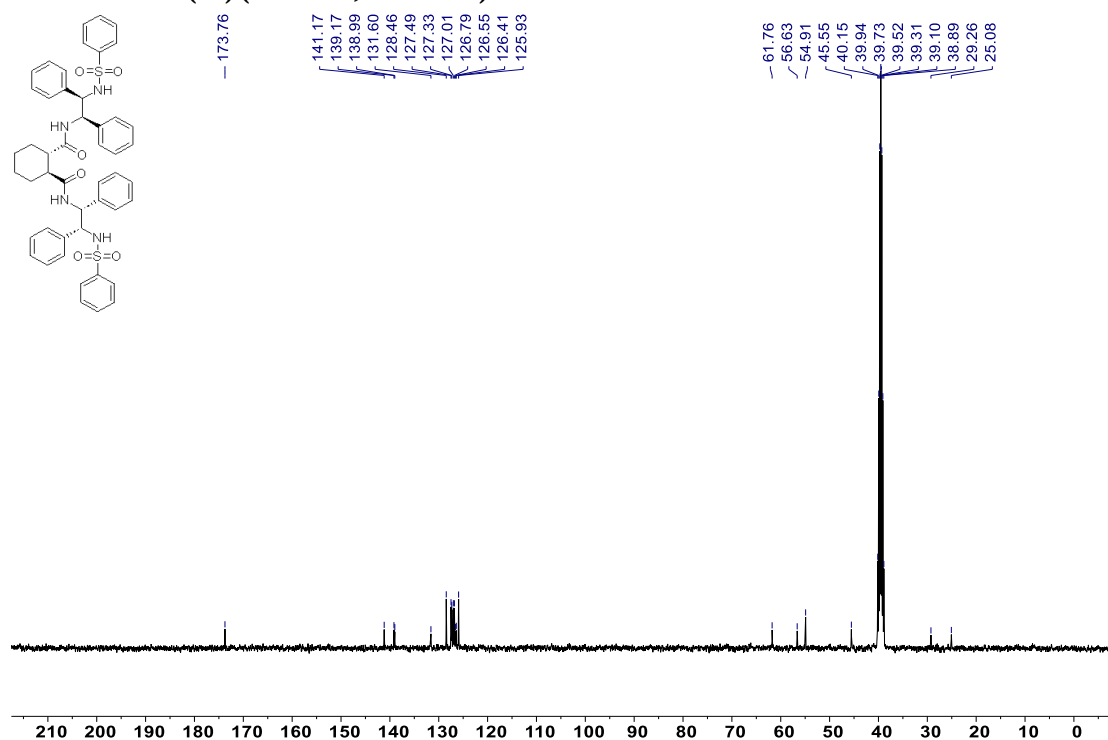
1: TOF MS ES+
1.19e4



¹H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(phenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4b) (400 MHz, DMSO-*d*₆)



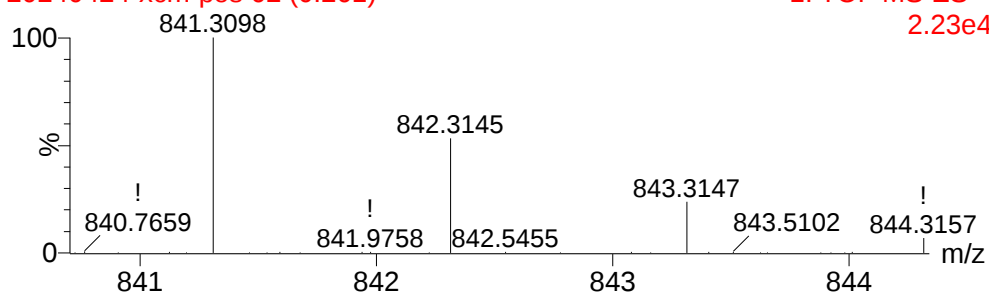
¹³C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(phenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4b) (101 MHz, DMSO-*d*₆)



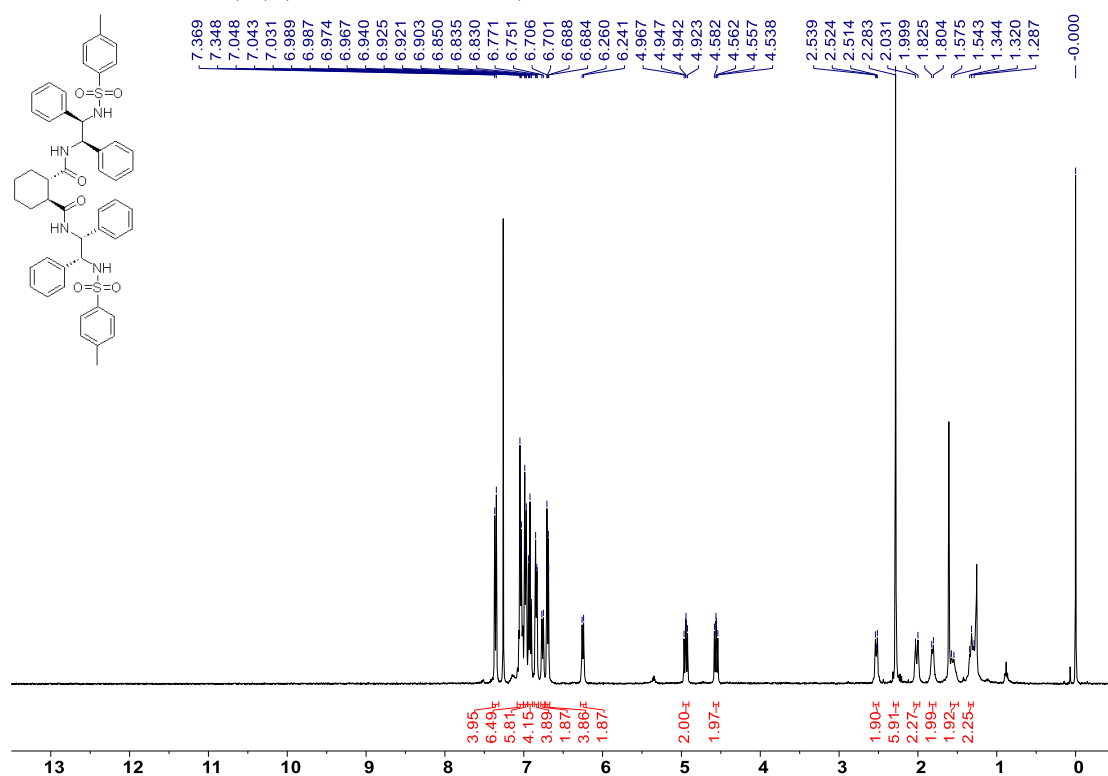
HRMS (ESI) of (1S,2S)-*N*¹,*N*²-Bis((1*R*,2*R*)-2-(phenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4b)

20240424-xcm-pos 62 (0.261)

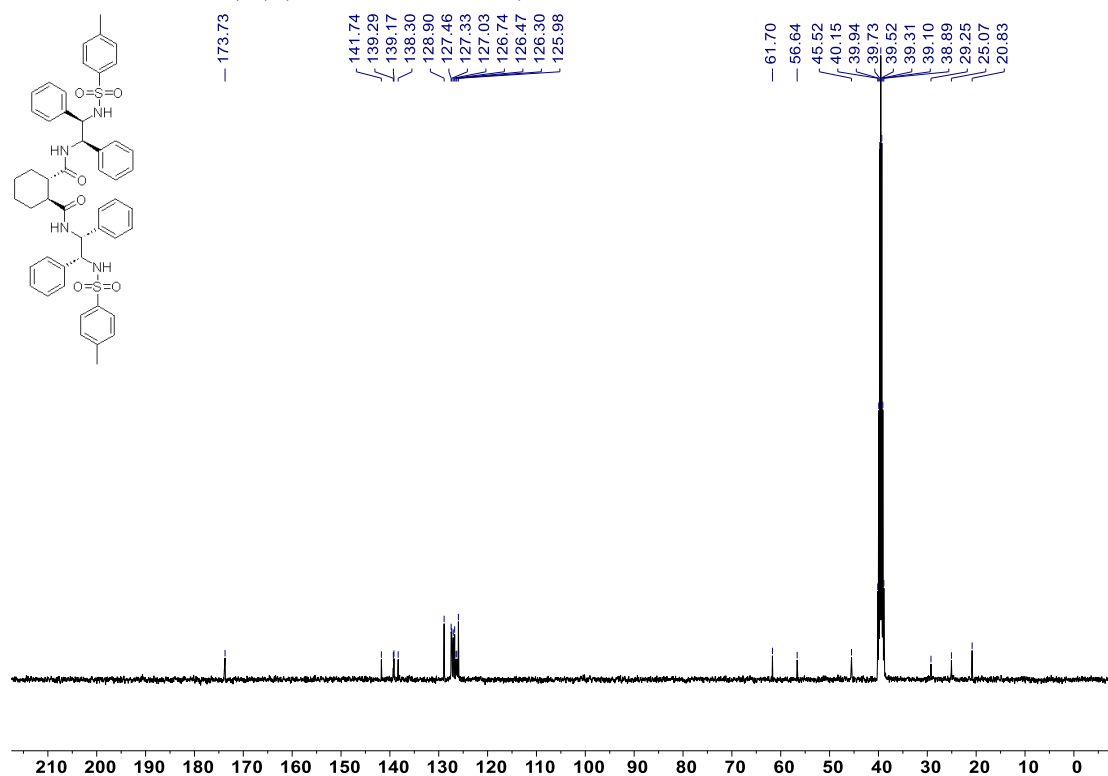
1: TOF MS ES+
2.23e4



¹H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4c) (400 MHz, DMSO-*d*₆)



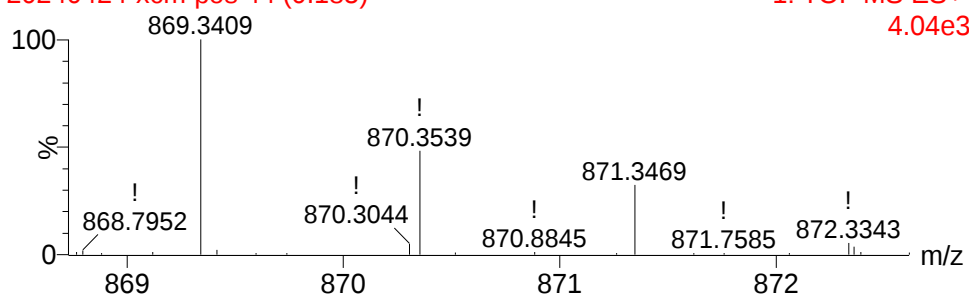
¹³C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4c) (101 MHz, DMSO-*d*₆)



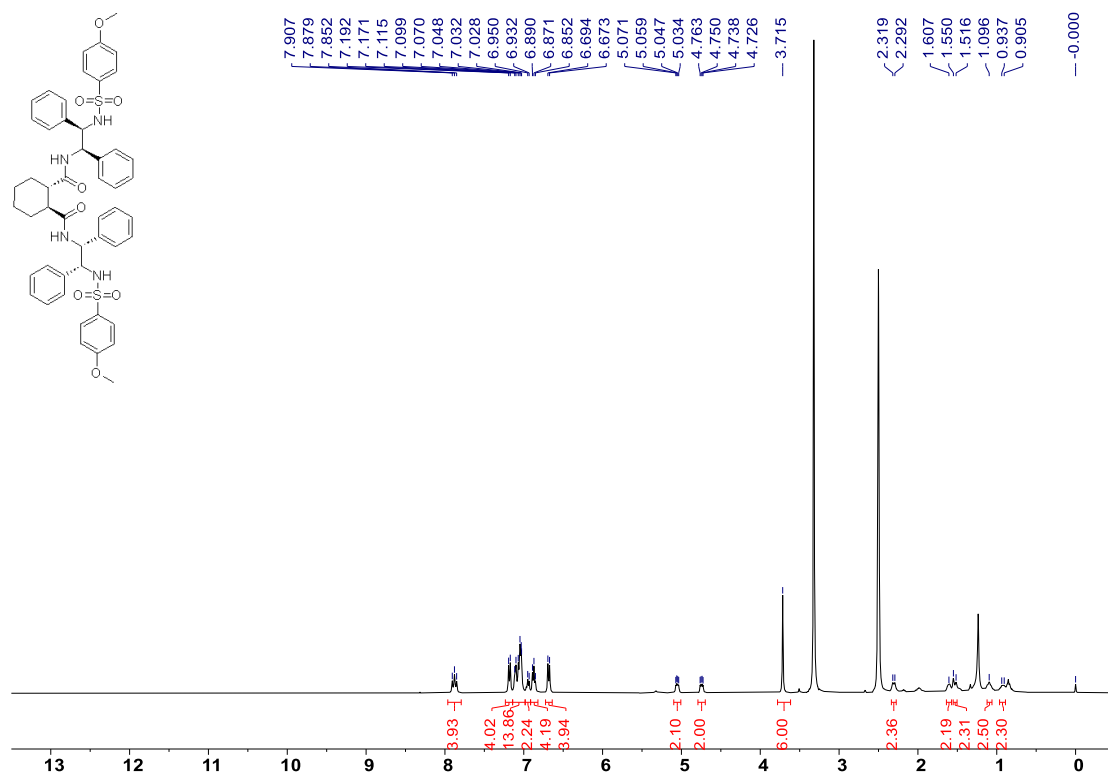
HRMS (ESI) of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4c)

20240424-xcm-pos 44 (0.185)

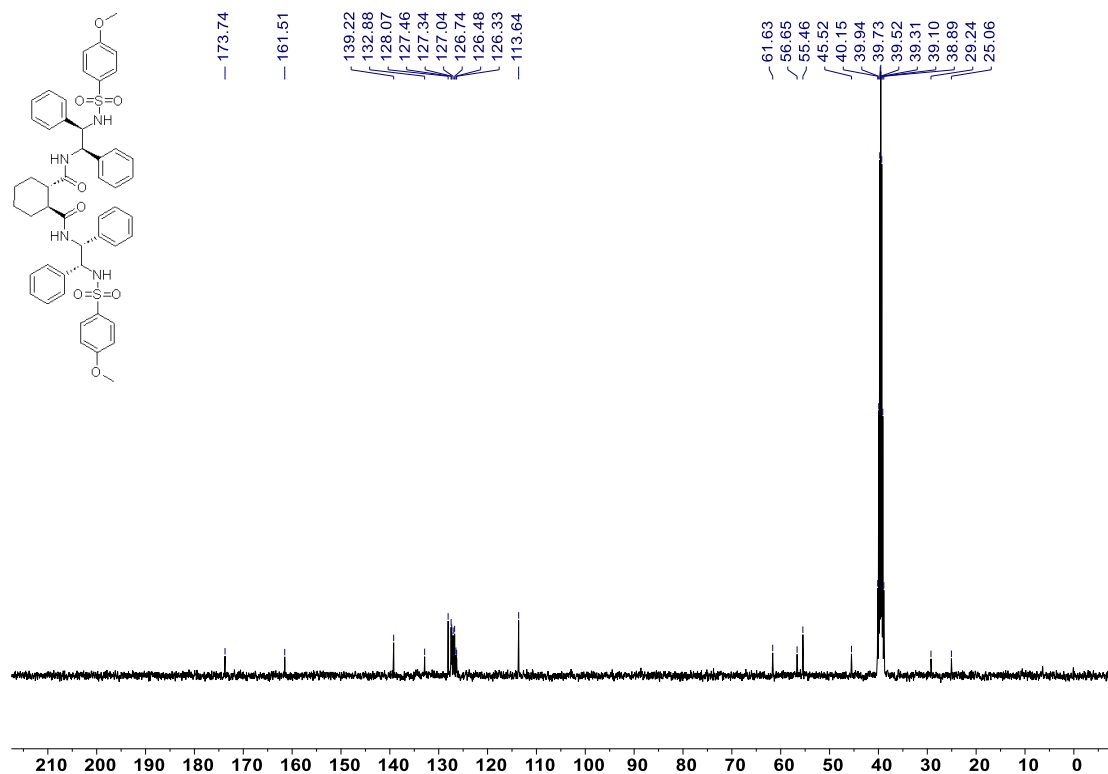
1: TOF MS ES+
4.04e3



¹H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-methoxyphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4d) (400 MHz, DMSO-*d*₆)



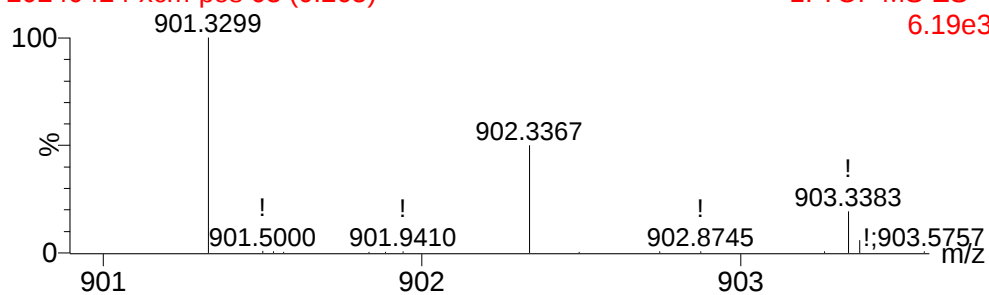
¹³C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-methoxyphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4d) (101 MHz, DMSO-*d*₆)



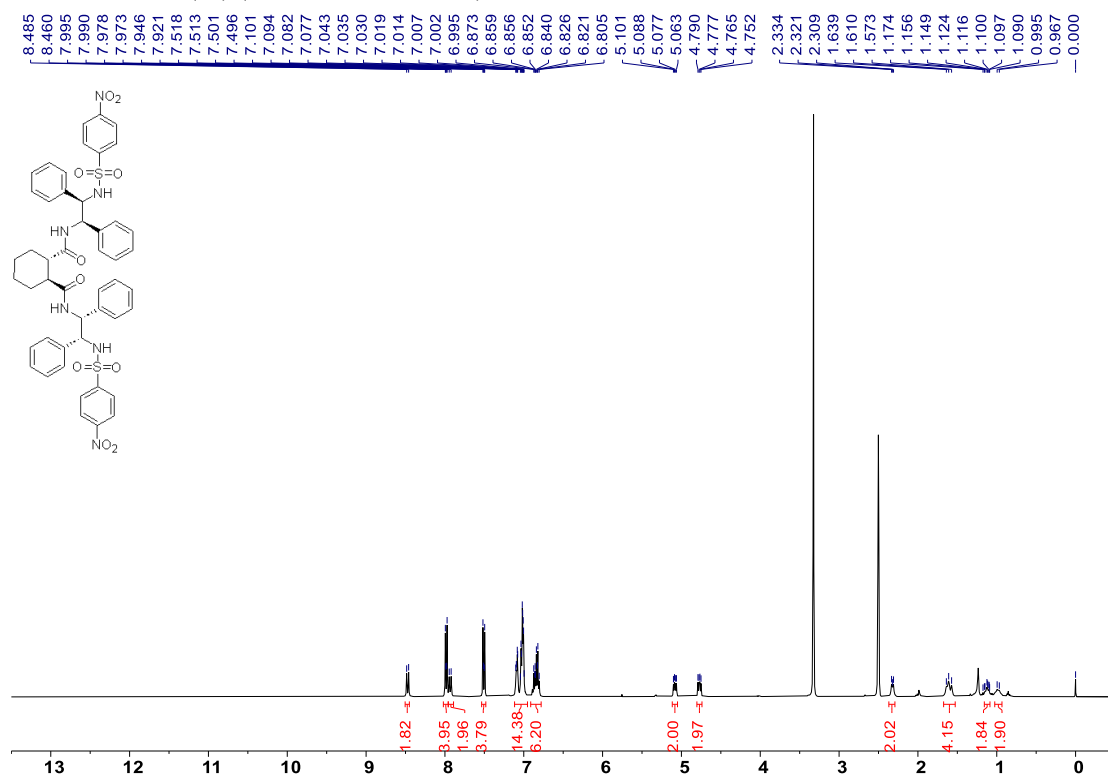
HRMS (ESI) of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-methoxyphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4d)

20240424-xcm-pos 63 (0.265)

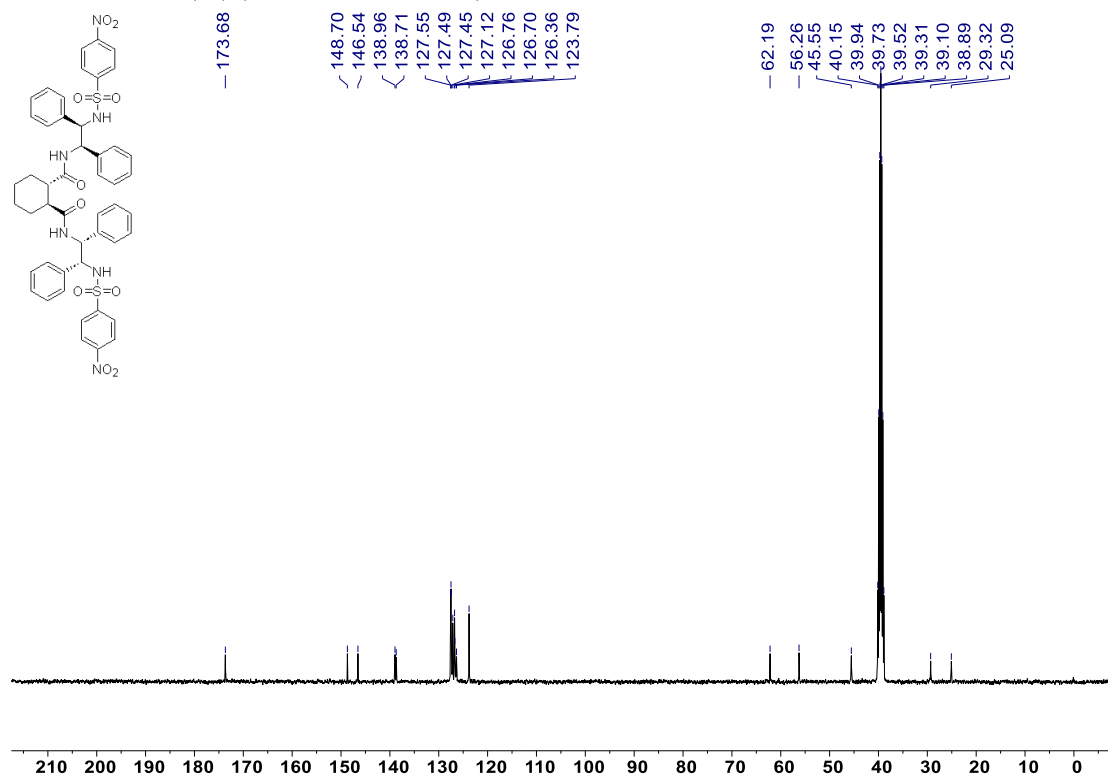
1: TOF MS ES+
6.19e3



^1H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-nitrophenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4e) (400 MHz, DMSO-*d*₆)



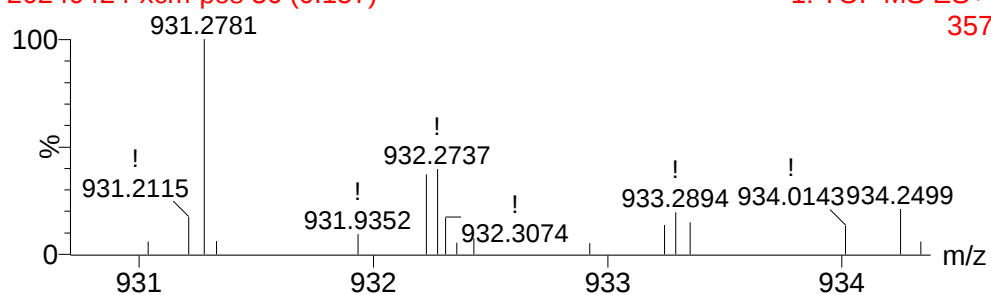
^{13}C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-nitrophenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4e) (101 MHz, DMSO-*d*₆)



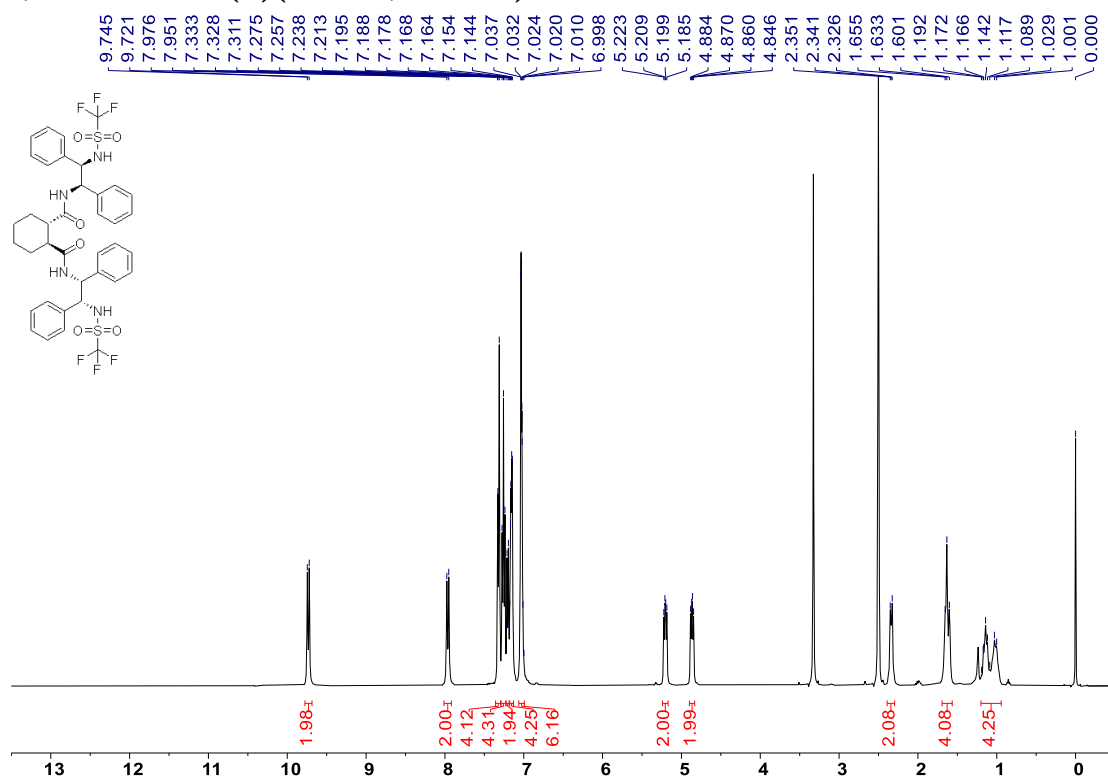
HRMS (ESI) of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(4-nitrophenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4e)

20240424-xcm-pos 36 (0.157)

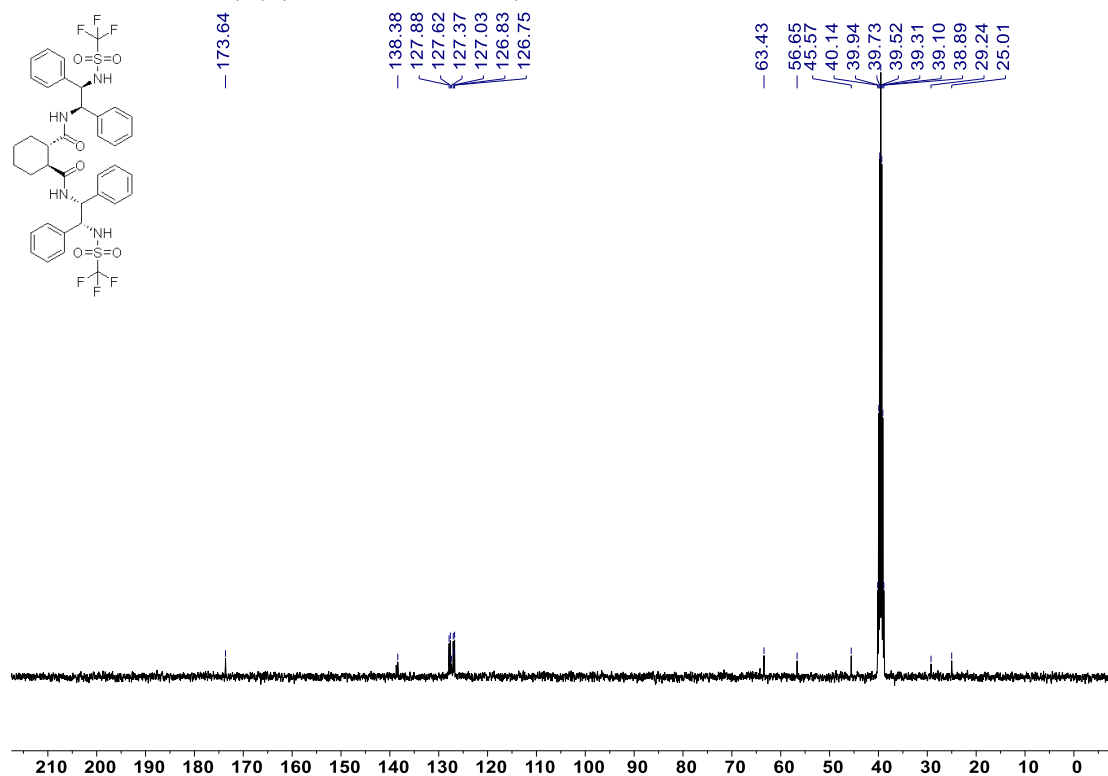
1: TOF MS ES+
357



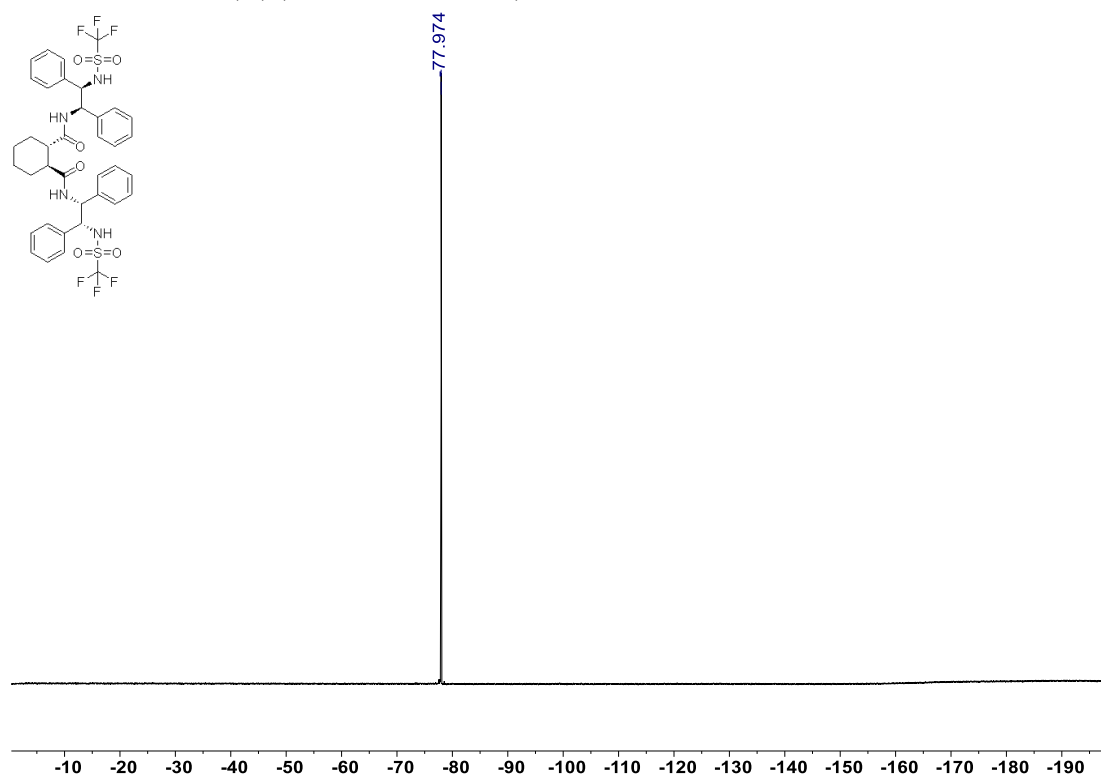
^1H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(trifluoromethylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4f) (400 MHz, DMSO-*d*₆)



^{13}C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(trifluoromethylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4f) (101 MHz, DMSO-*d*₆)



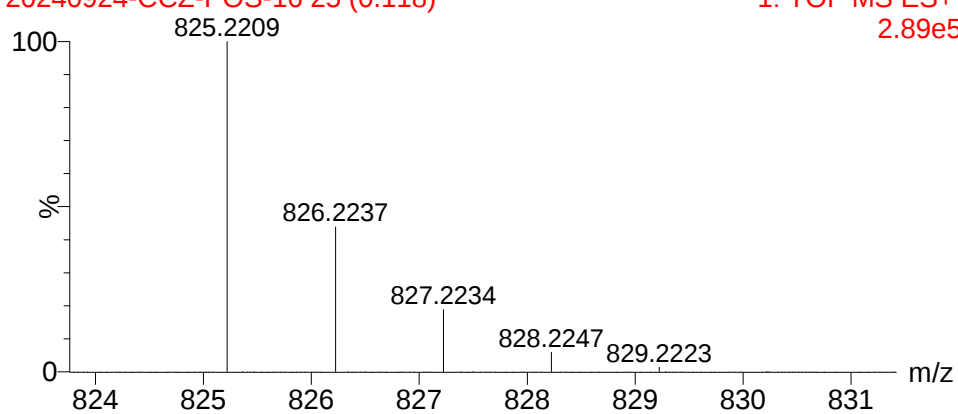
^{19}F NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(trifluoromethylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4f) (376 MHz, DMSO-*d*₆)



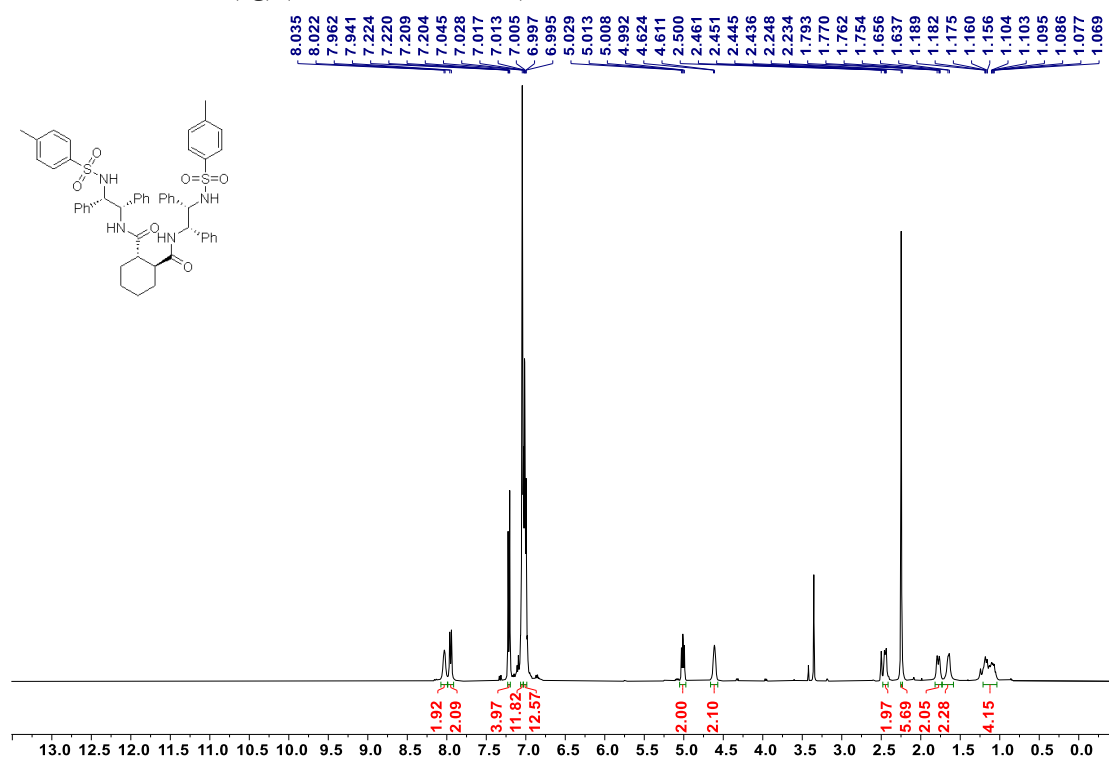
HRMS (ESI) of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(trifluoromethylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4f)

20240924-CCZ-POS-16 25 (0.118)

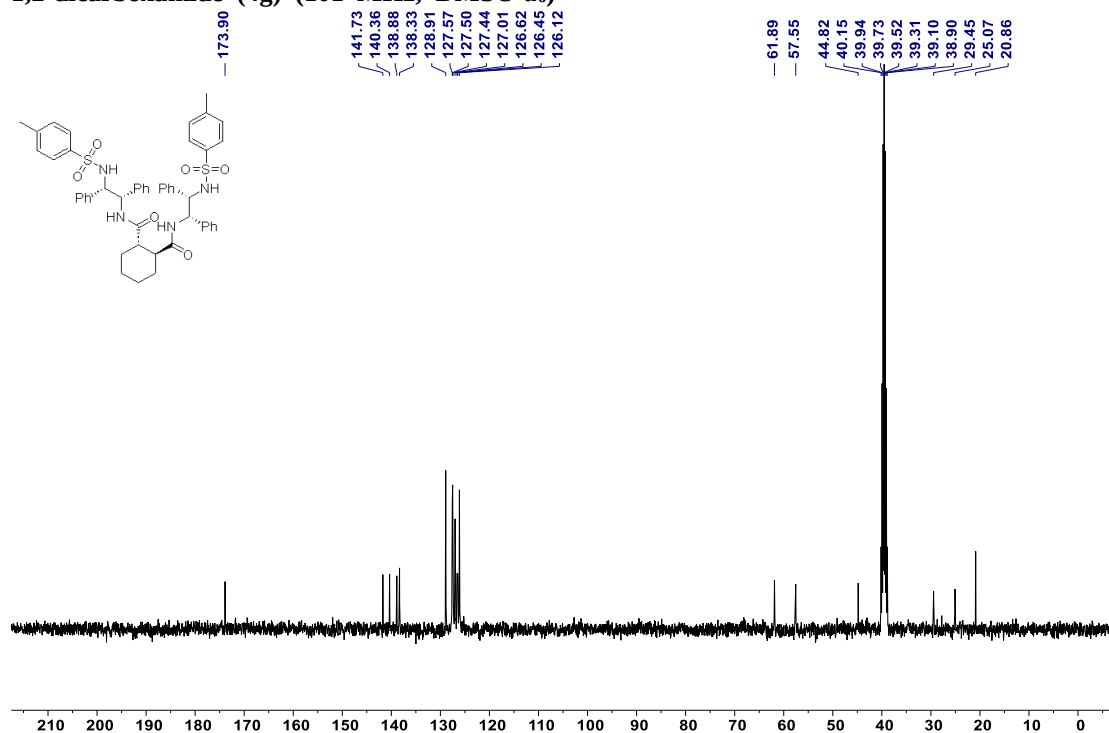
1: TOF MS ES+
2.89e5



¹H NMR of (1S,2S)-N¹,N²-bis((1S,2S)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4g) (400 MHz, DMSO-d₆)



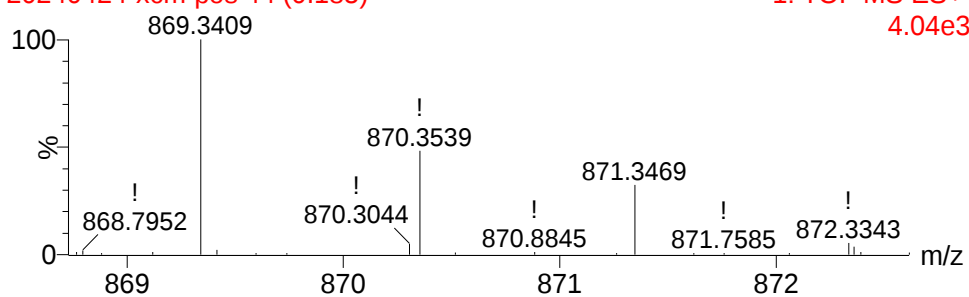
¹³C NMR of (1S,2S)-N¹,N²-bis((1S,2S)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4g) (101 MHz, DMSO-d₆)



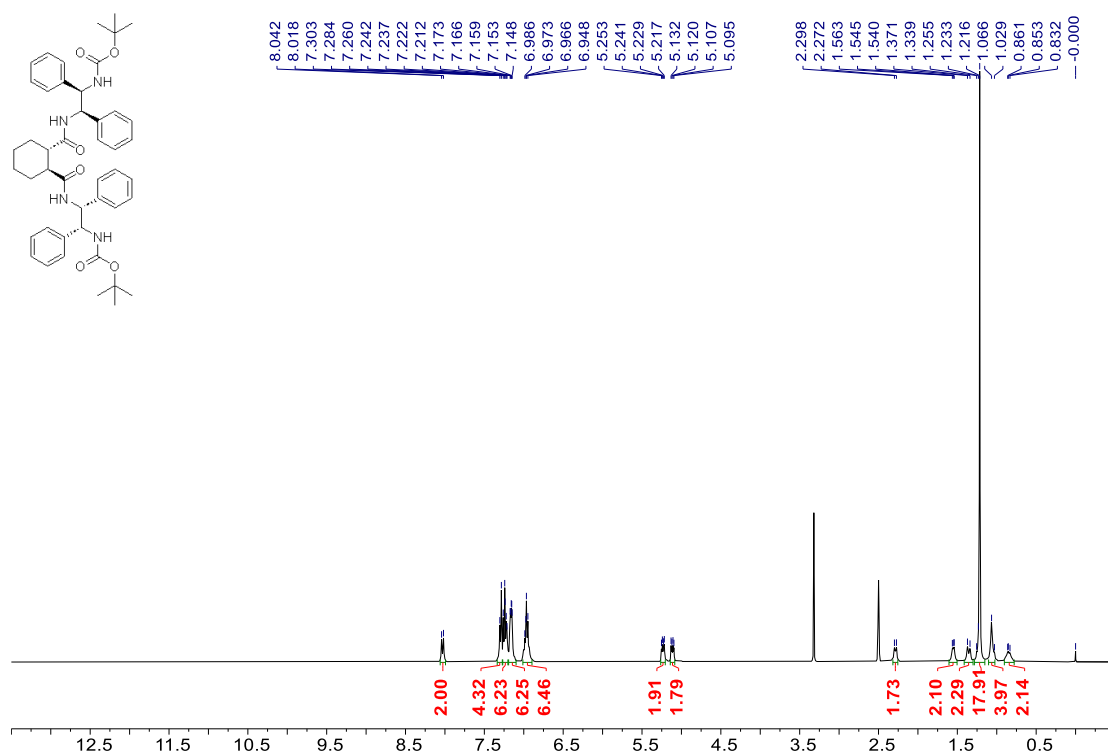
HRMS (ESI) of (1*S*,2*S*)-*N*¹,*N*²-bis((1*S*,2*S*)-2-(4-methylphenylsulfonamido)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4g)

20240424-xcm-pos 44 (0.185)

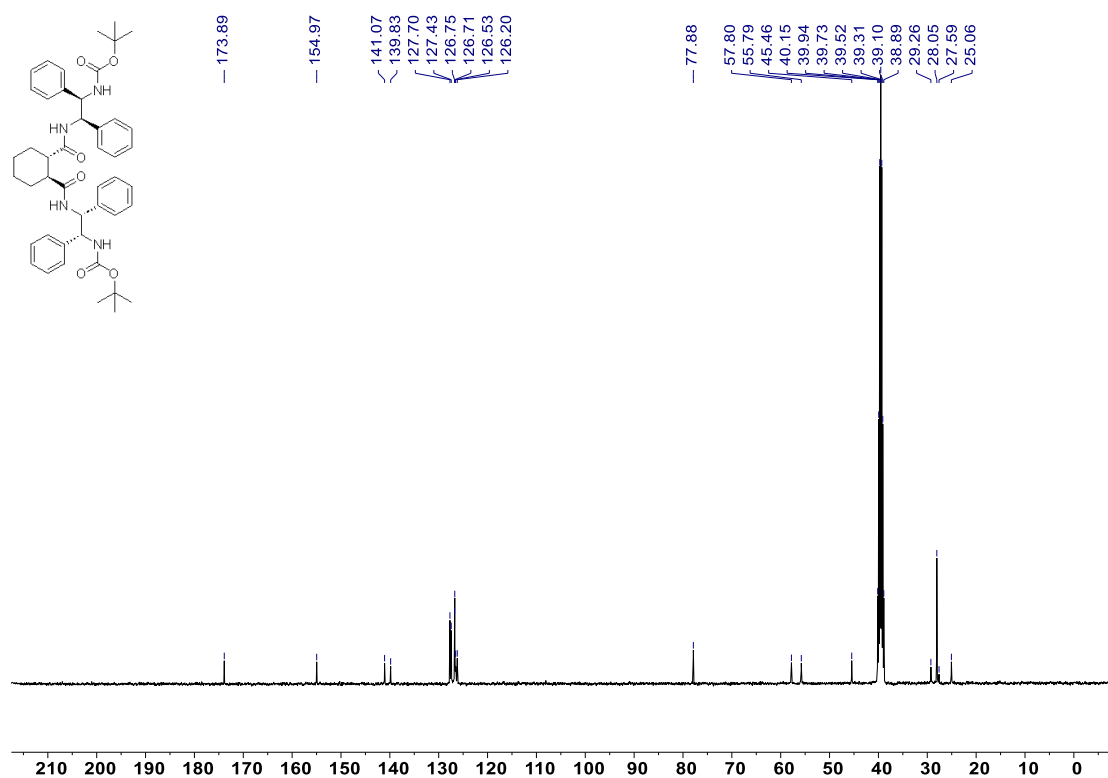
1: TOF MS ES+
4.04e3



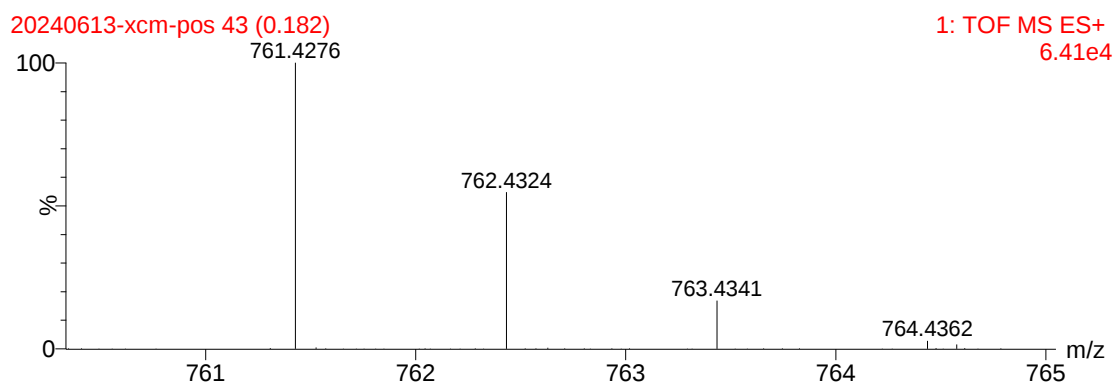
¹H NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(*tert*-butoxycarbonyl)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4h) (400 MHz, DMSO-*d*₆)



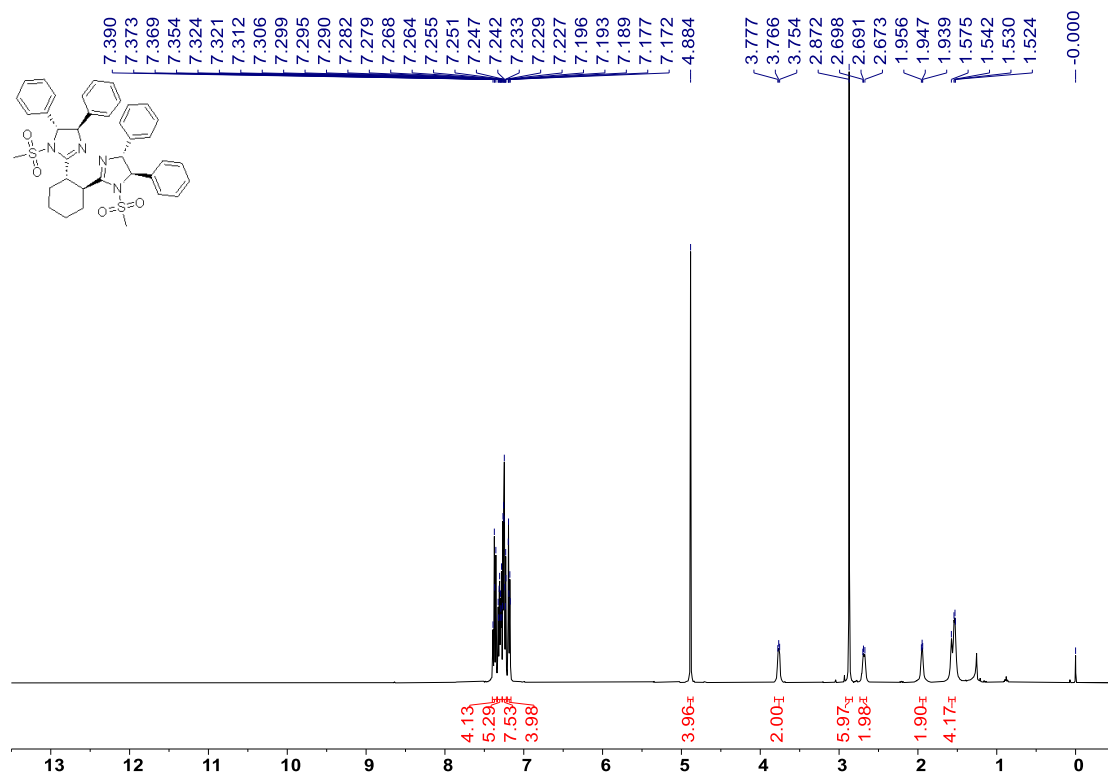
¹³C NMR of (1*S*,2*S*)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(*tert*-butoxycarbonyl)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4h) (101 MHz, DMSO-*d*₆)



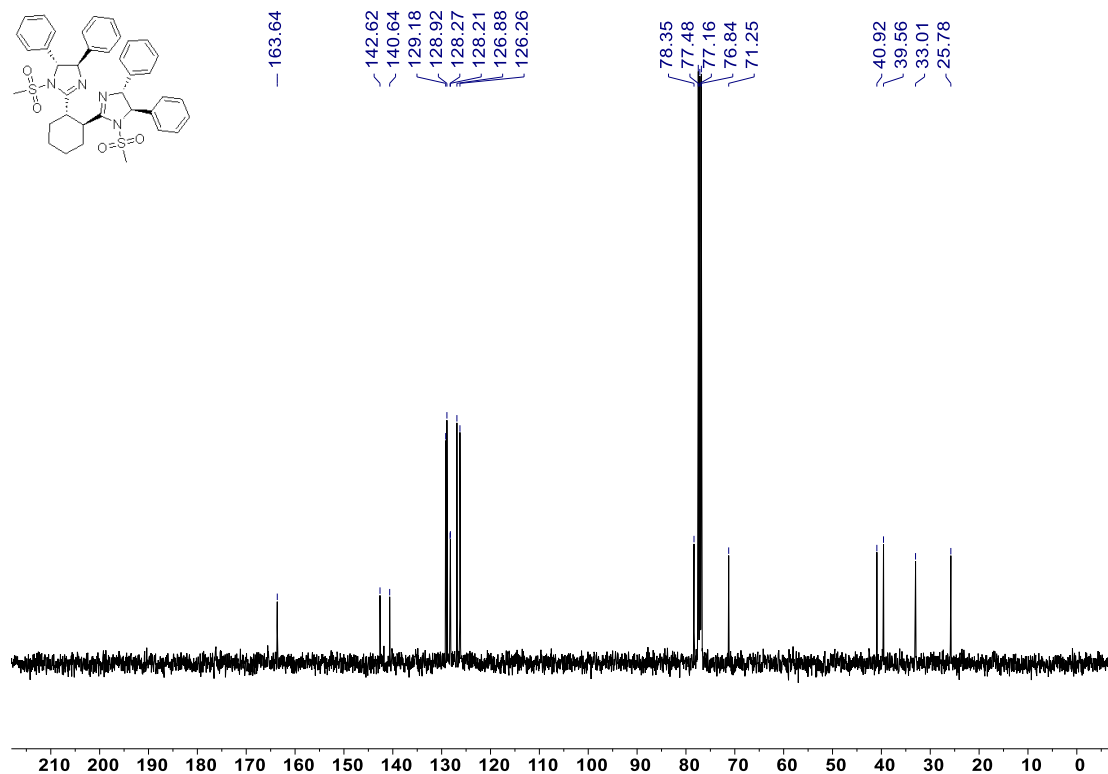
HRMS (ESI) of (1S,2S)-*N*¹,*N*²-bis((1*R*,2*R*)-2-(*tert*-butoxycarbonyl)-1,2-diphenylethyl)cyclohexane-1,2-dicarboxamide (4h)



¹H NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-(methylsulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5a) (400 MHz, CDCl₃)



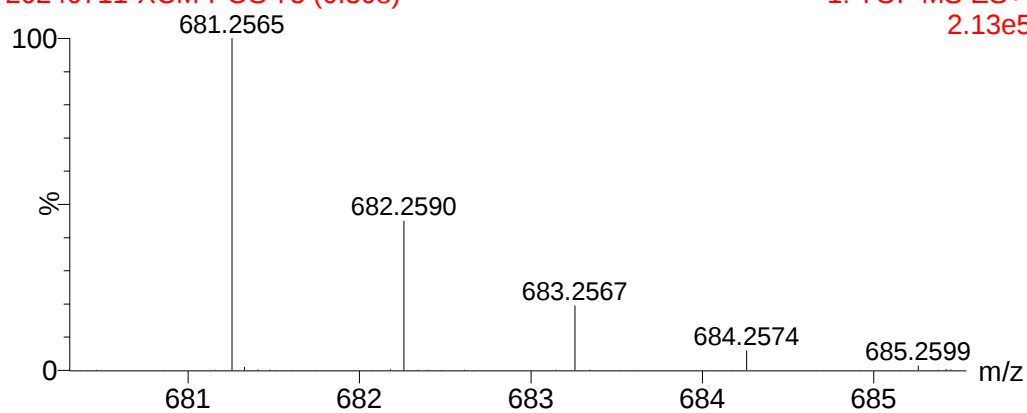
¹³C NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-(methylsulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5a) (101 MHz, CDCl₃)



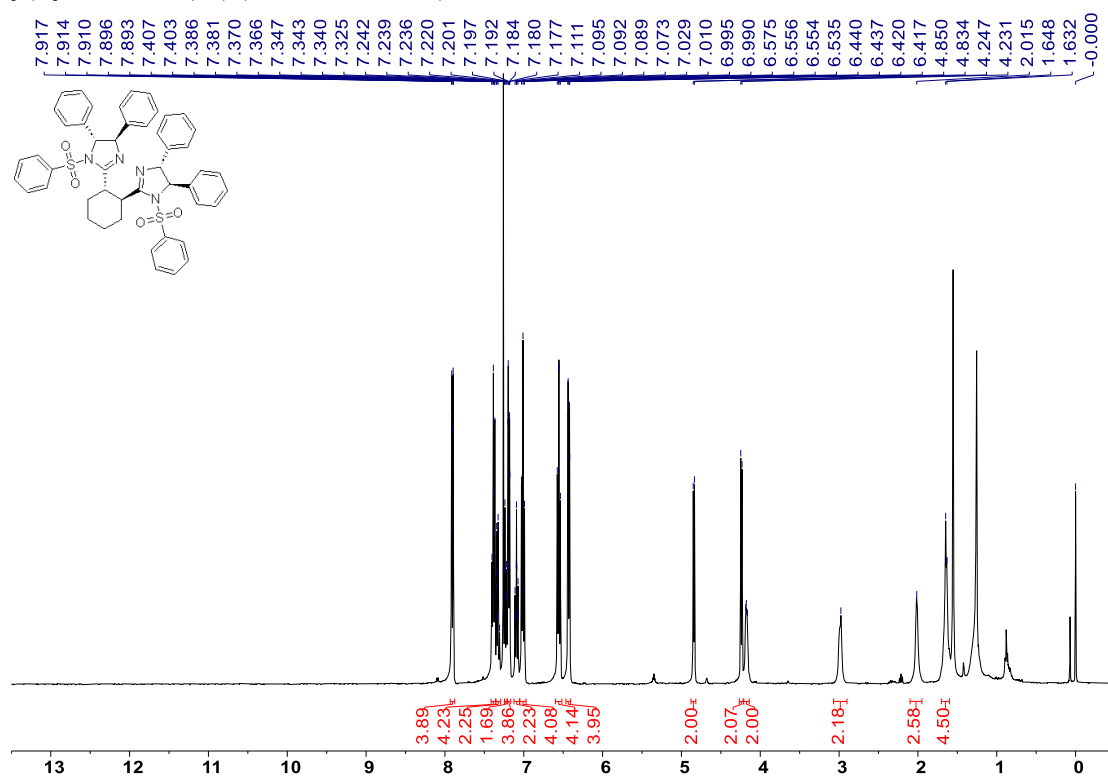
HRMS (ESI) of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-(methylsulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5a)

20240711-XCM-POS 75 (0.308)

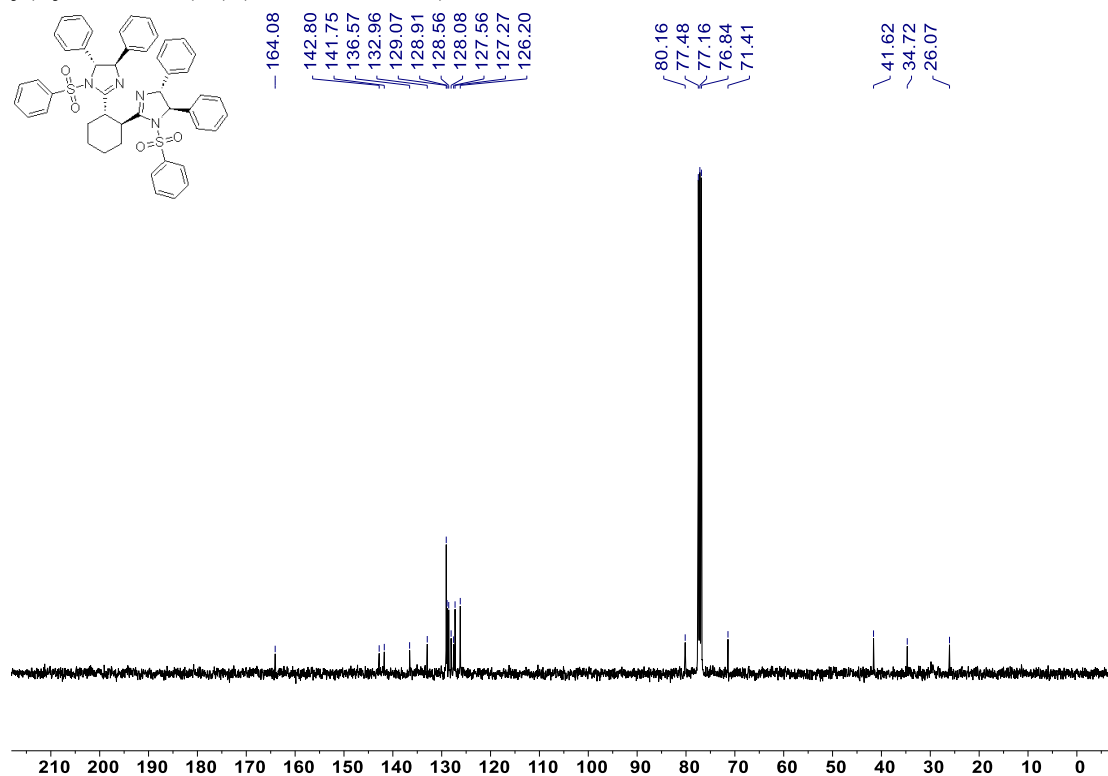
1: TOF MS ES+
2.13e5



¹H NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-4,5-diphenyl-1-(phenylsulfonyl)-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5b) (400 MHz, CDCl₃)



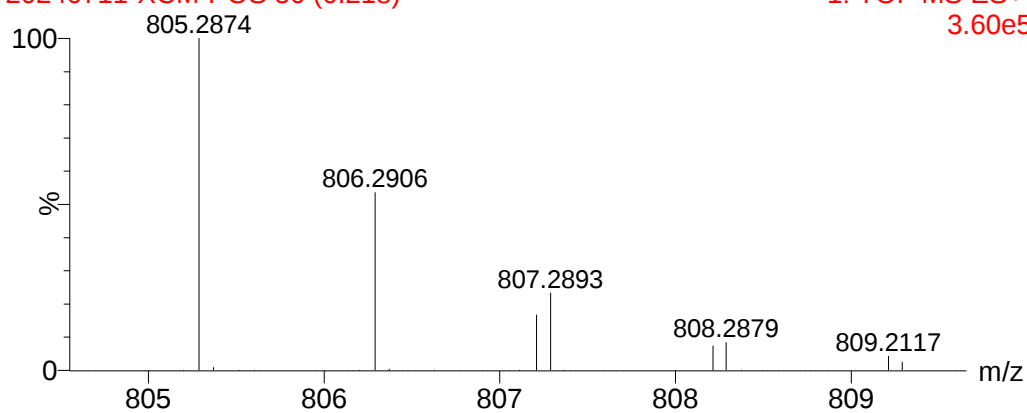
¹³C NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-4,5-diphenyl-1-(phenylsulfonyl)-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5b) (101 MHz, CDCl₃)



HRMS (ESI) of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-4,5-diphenyl-1-(phenylsulfonyl)-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5b)

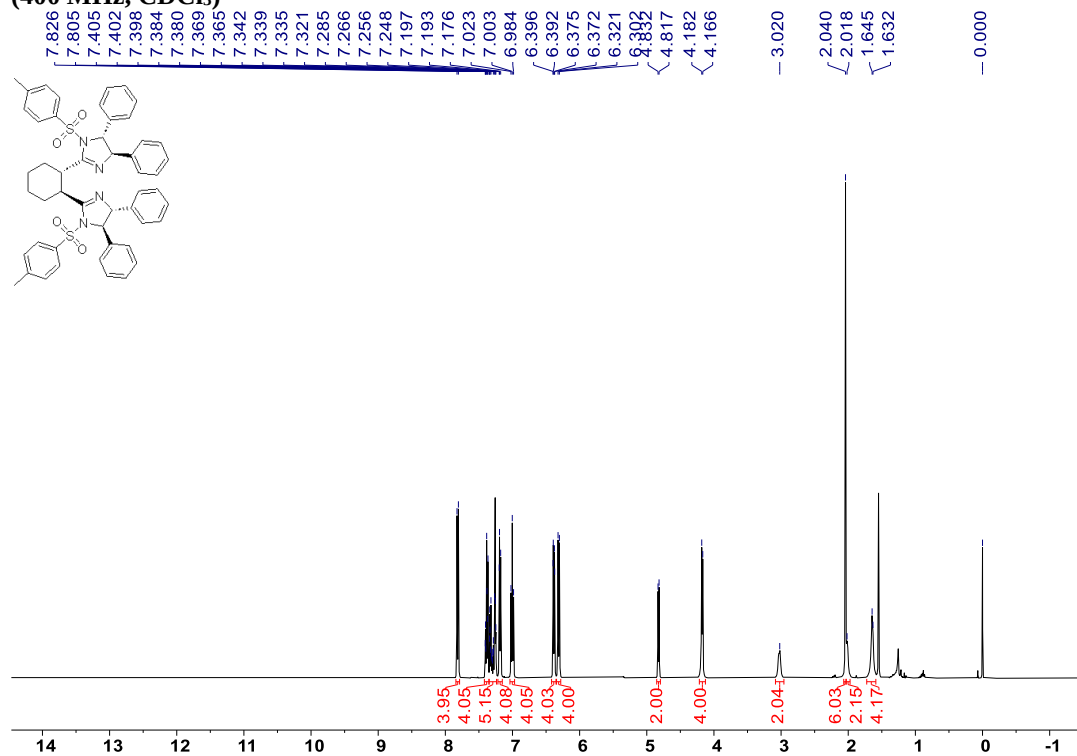
20240711-XCM-POS 50 (0.218)

1: TOF MS ES+
3.60e5



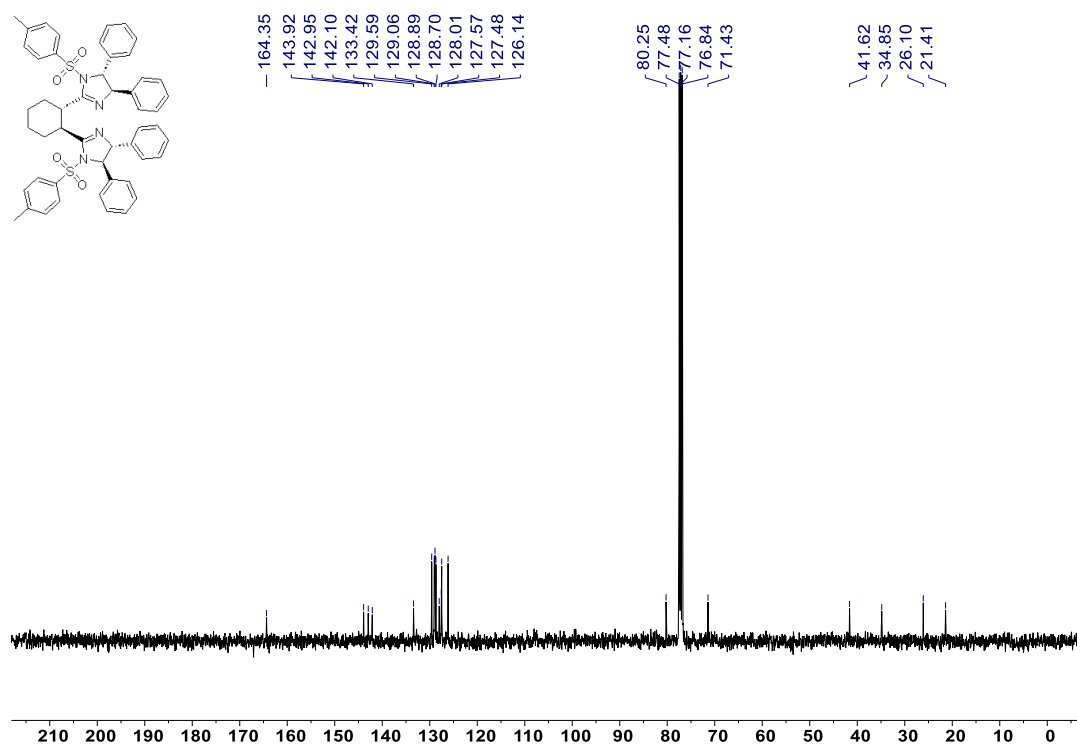
¹H NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5c)

(400 MHz, CDCl₃)



¹³C NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5c)

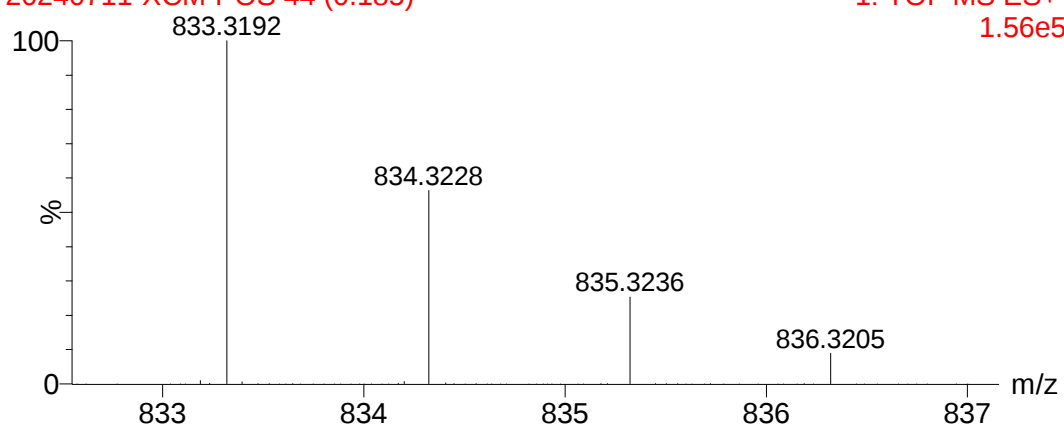
(101 MHz, CDCl₃)



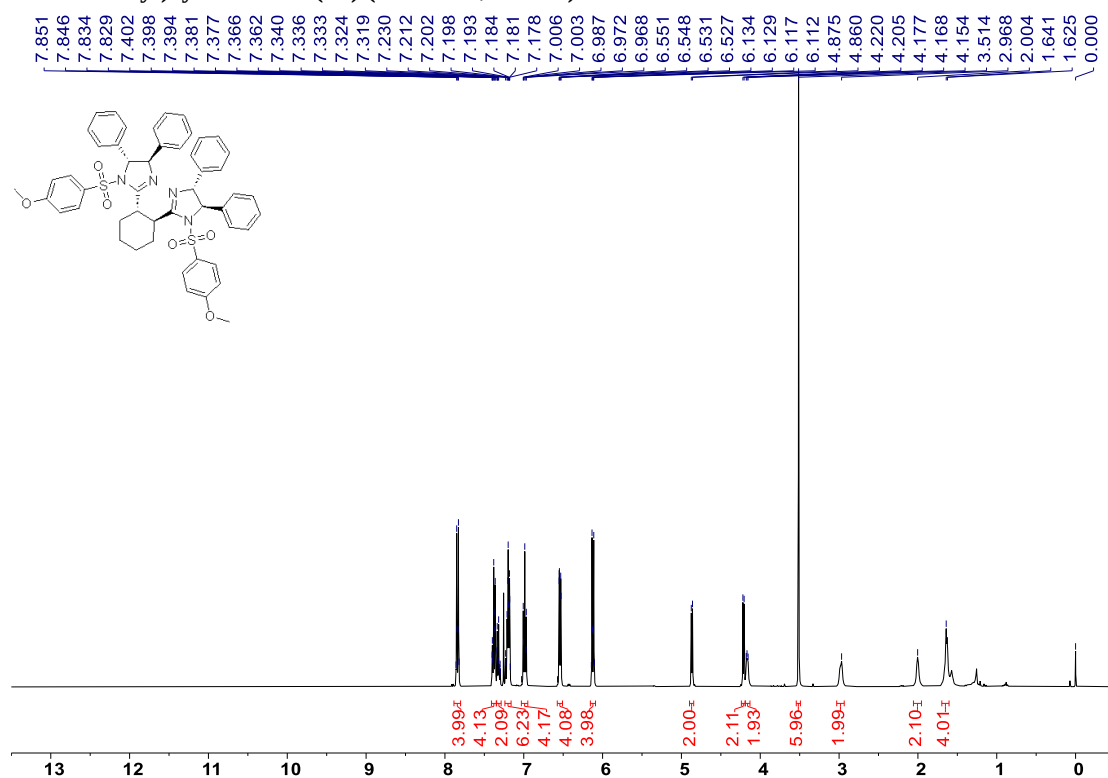
HRMS (ESI) of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane
(5c)

20240711-XCM-POS 44 (0.185)

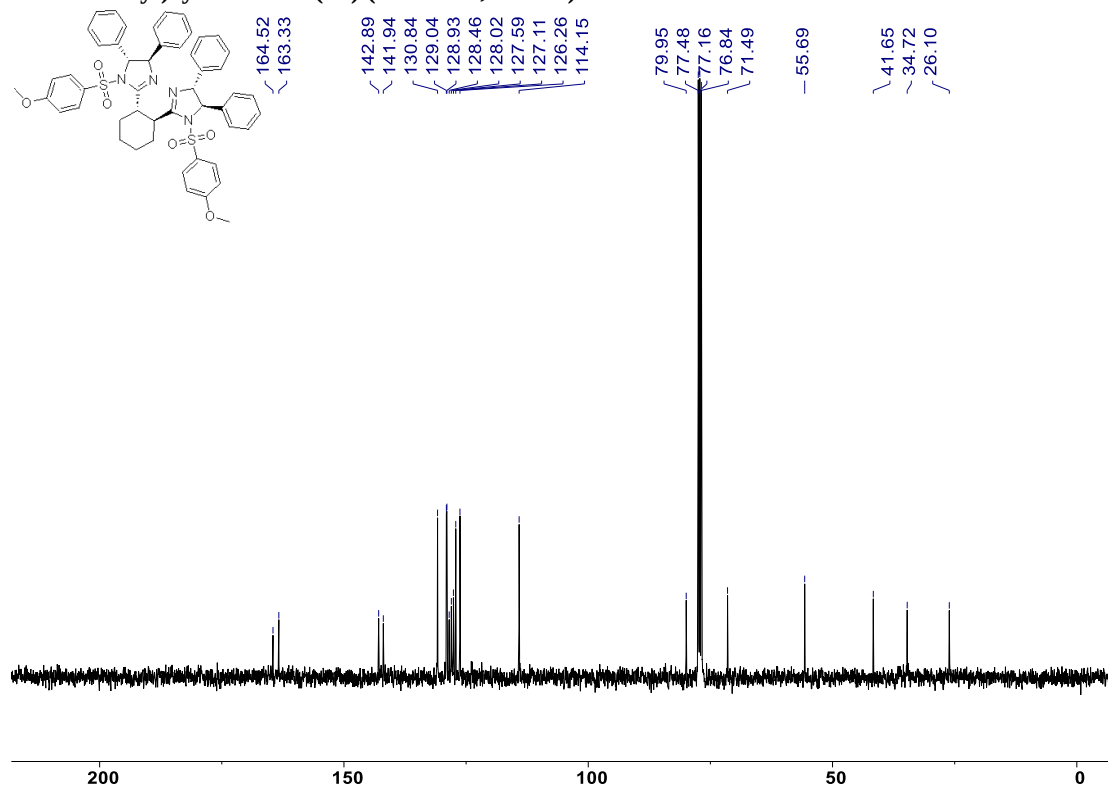
1: TOF MS ES+
1.56e5



¹H NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-methoxyphenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5d) (400 MHz, CDCl₃)



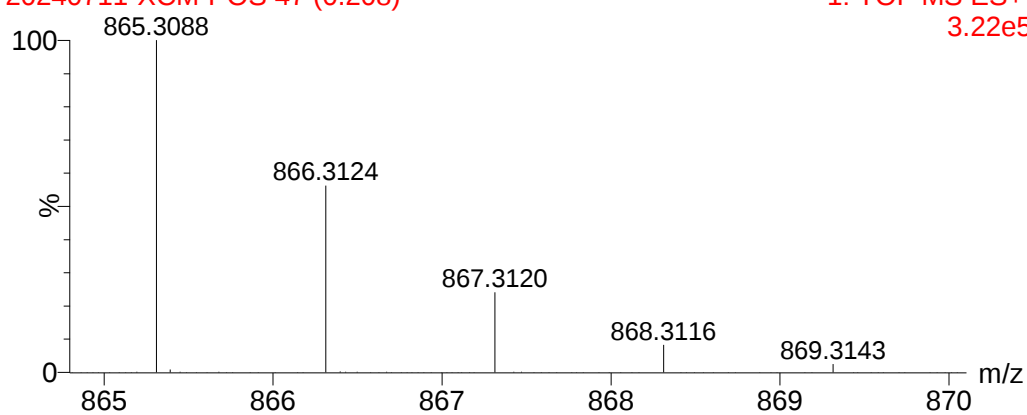
¹³C NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-methoxyphenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5d) (101 MHz, CDCl₃)



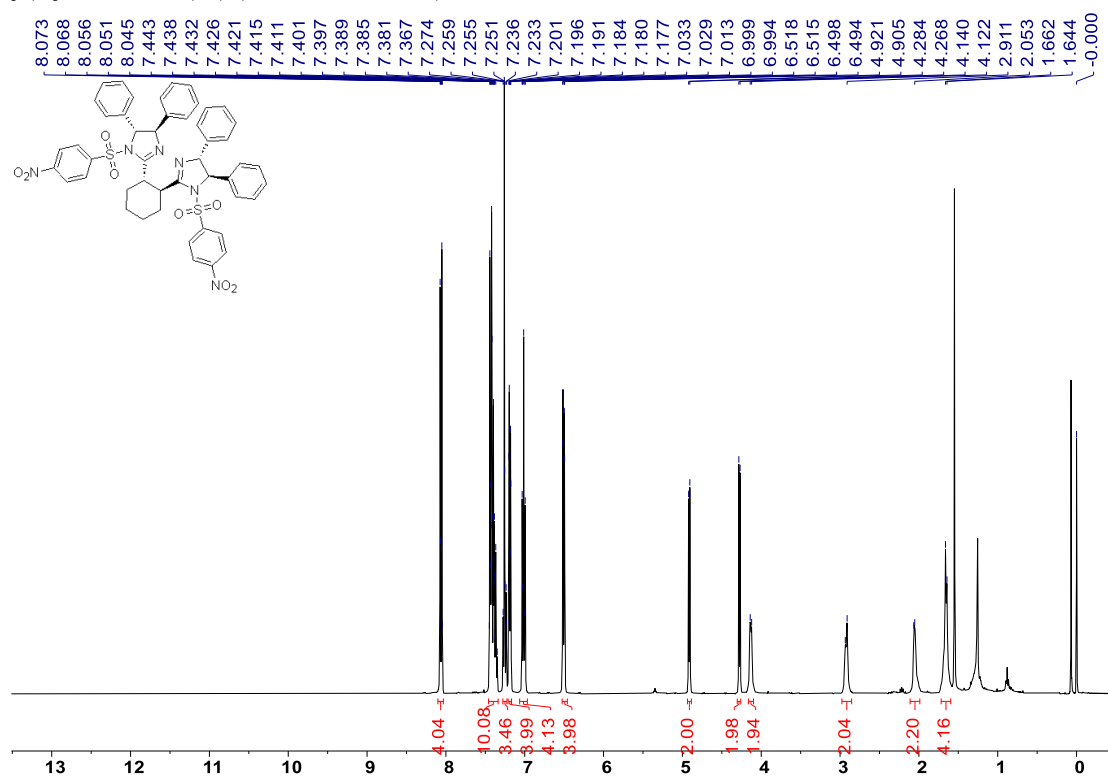
HRMS (ESI) of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-methoxyphenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5d)

20240711-XCM-POS 47 (0.208)

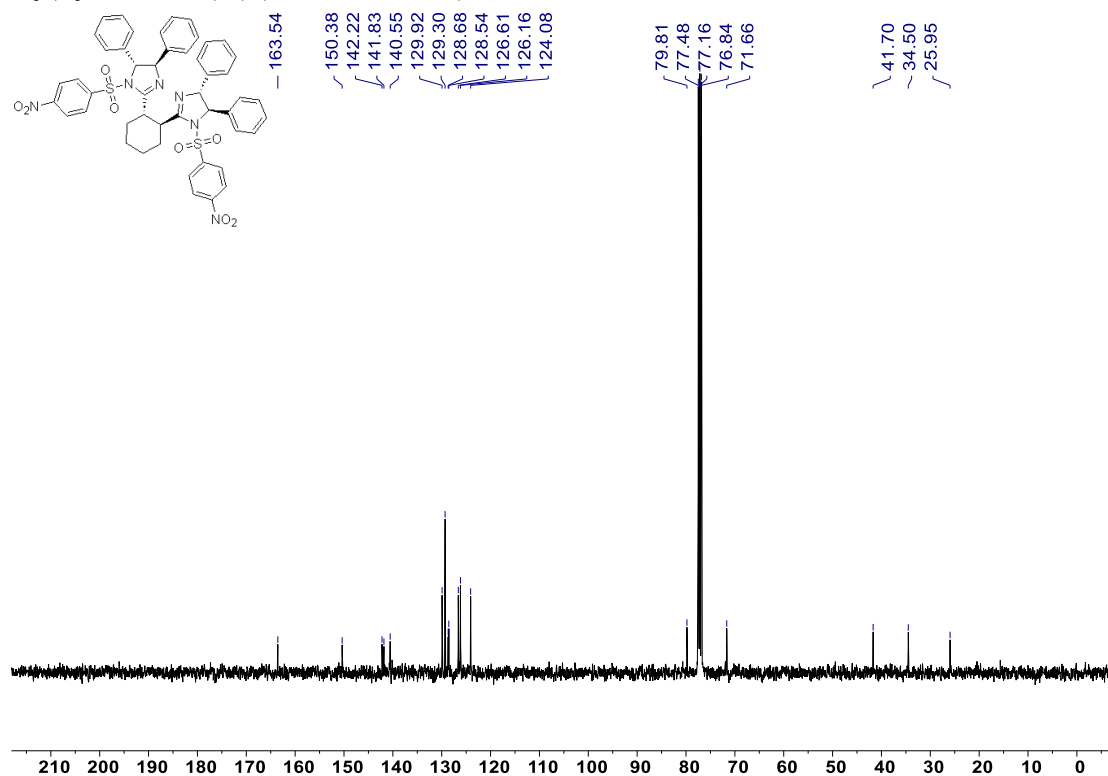
1: TOF MS ES+
3.22e5



¹H NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-nitrophenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5e) (400 MHz, CDCl₃)



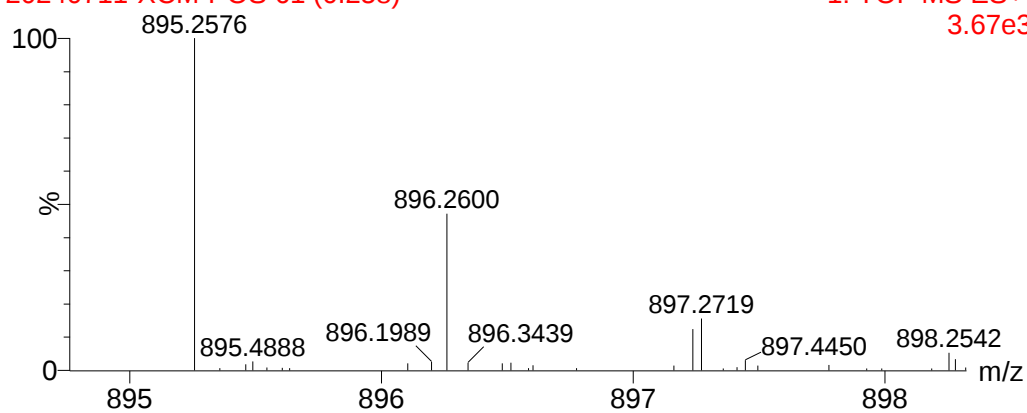
¹³C NMR of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-nitrophenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5e) (101 MHz, CDCl₃)



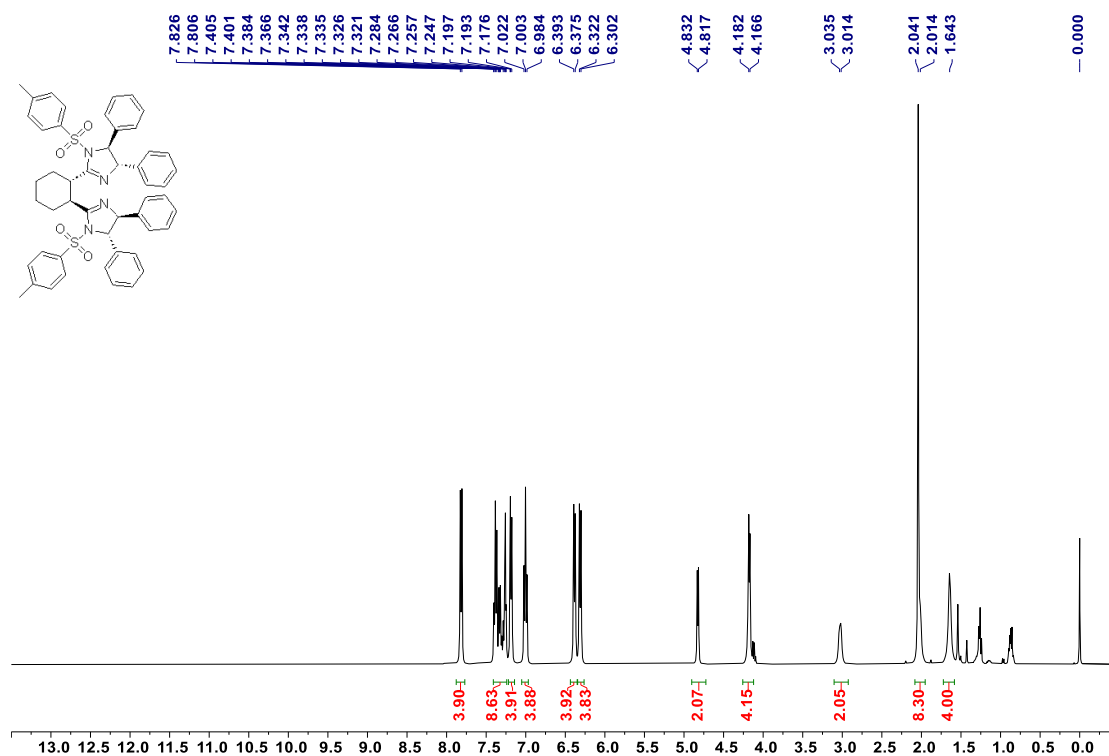
HRMS (ESI) of (1*S*,2*S*)-1,2-bis((4*R*,5*R*)-1-((4-nitrophenyl)sulfonyl)-4,5-diphenyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5e)

20240711-XCM-POS 61 (0.258)

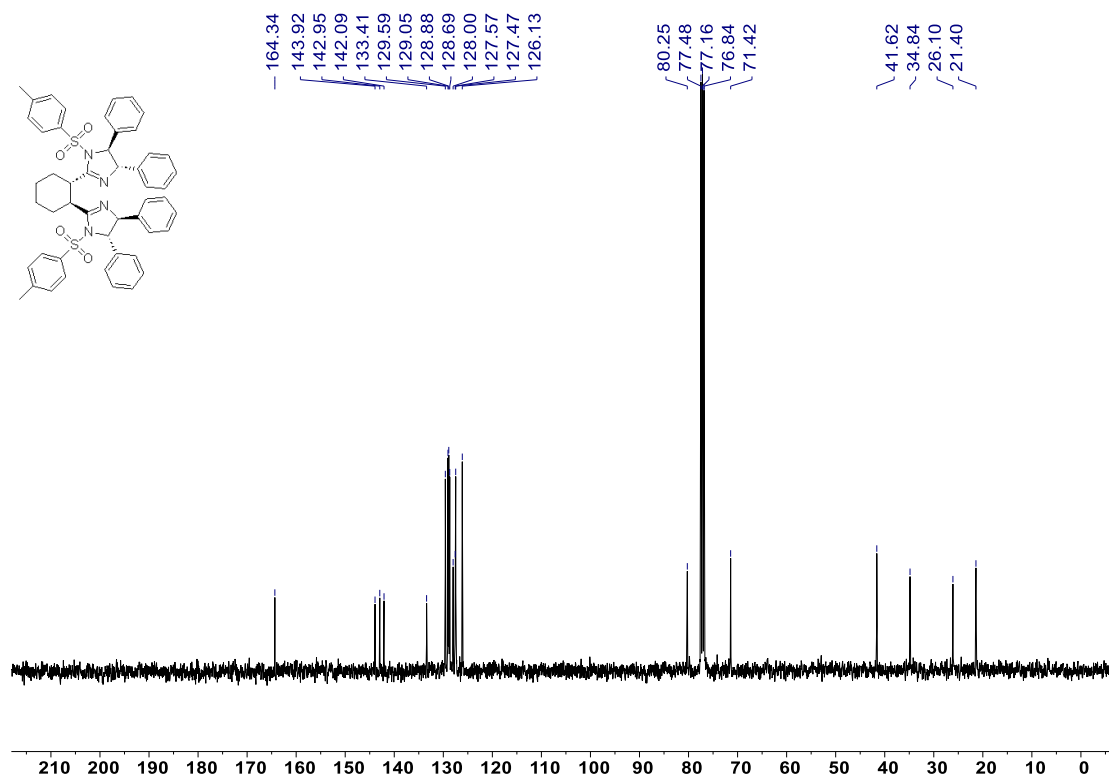
1: TOF MS ES+
3.67e3



^1H NMR of (1*S*,2*S*)-1,2-bis((4*S*,5*S*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5g)
(400 MHz, CDCl_3)



^{13}C NMR of (1*S*,2*S*)-1,2-bis((4*S*,5*S*)-4,5-diphenyl-1-tosyl-4,5-dihydro-1*H*-imidazol-2-yl)cyclohexane (5g)
(101 MHz, CDCl_3)



HRMS (ESI) of (1S,2S)-1,2-bis((4S,5S)-4,5-diphenyl-1-tosyl-4,5-dihydro-1H-imidazol-2-yl)cyclohexane
(5g)

20240711-XCM-POS 44 (0.185)

1: TOF MS ES+
1.56e5

