

Supporting Information

Highly Stereoselective Cyclopropanation of Various Olefins with Diazosulfones Catalyzed by Ru(II)-Pheox Complexes

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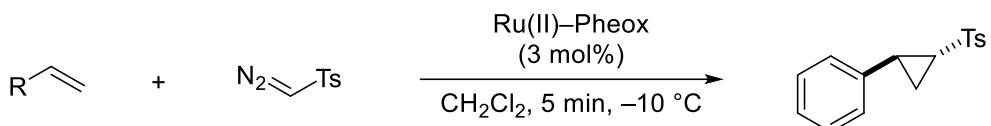
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General methods: All non-aqueous reactions were carried out in glassware under argon atmosphere and stirred via magnetic stir-plates. Thin-layer chromatography analyses were performed using Merck pre-coated silica gel plates with 254 indicator. Visualization was accomplished by UV light (254 nm), potassium permanganate, phosphomolybdic acid, or anisaldehyde. Flash column chromatography was performed using silica gel 60 (mesh 40-100) supplied by Kanto Chemical Co., Inc. ^1H and $^{13}\text{CNMR}$ spectra were recorded on a JEOLJNM-ECS400 (400 MHz ^1H , 100 MHz ^{13}C) or a JEOL JNM-ECX500 (500 MHz ^1H , 126 MHz ^{13}C). Chemical shift values (δ) are reported in ppm (tetramethylsilane δ 0.00 ppm for ^1H ; residual chloroform δ 77.0 ppm for ^{13}C). Optical rotations were measured on a JASCO P-1030 digital polarimeter. DART mass (positive mode) analyses were performed using a JEOL the Accu TOF TLC JMS-T100TD. Analytical HPLC was performed on a JASCO PU1586 with a UV-1575 UV/Vis detector using a chiral column.

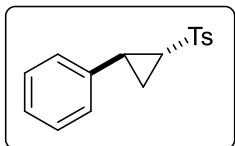
1. General procedure for catalytic asymmetric cyclopropanation of olefins with diazosulfones.



The solution of diazosulfones (0.2 mmol) in CH₂Cl₂ (2.0 mL) was slowly added to a mixture of Ru(II)-Pheox catalyst (3.8 mg, 0.006 mmol) and olefins (1.0 mmol) in CH₂Cl₂ (2.0 mL) under argon atmosphere at room temperature. After the addition completed, the reaction mixture was then stirred for 5 min at -10 °C. The progress of the reaction was monitored by TLC. Upon completion, solvent was removed and the residue was purified by column chromatography to give desired product. The *trans/cis* ratio was determined from the crude ¹H NMR spectra, and the ee value was determined by chiral HPLC analysis.

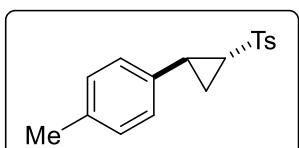
2. Analytical data of asymmetric cyclopropanation reaction products.

1-methyl-4-((1*R*,2*S*)-2-phenylcyclopropyl)sulfonyl)benzene (**3a**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between styrene (104.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methyl-4-((1*R*,2*S*)-2-phenylcyclopropyl)sulfonyl)benzene **3a** (80% yield, 43.5 mg, 0.16 mmol), 96% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.81 (d, *J* = 8.41 Hz, 2H), 7.35 (d, *J* = 8.41 Hz, 2H), 7.30-7.15 (m, 3H), 7.02 (d, *J* = 7.26 Hz, 2H), 2.87 (ddd, *J* = 4.20, 6.12, 10.13 Hz, 1H), 2.65 (ddd, *J* = 4.78, 4.78, 8.22 Hz, 1H), 2.44 (s, 3H), 1.87 (ddd, *J* = 5.59, 5.59, 9.94 Hz, 1H), 1.45 (ddd, *J* = 6.12, 6.12, 8.41 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 144.4, 137.5, 137.5, 129.9, 128.6, 127.5, 127.0, 126.5, 41.9, 23.7, 21.6, 13.8; [α]²¹_D = -58.0 (c = 1.0, CHCl₃); For C₁₆H₁₆O₂S [M+NH₄]⁺ Calcd: 290.12147, Found: 290.12143; The enantiomeric ratio of **3a** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 42.9 min and minor isomer 40.5 min.

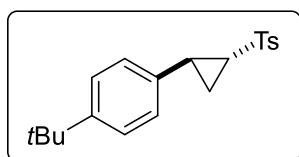
1-methyl-4-((2-(*p*-tolyl)cyclopropyl)sulfonyl)benzene (**3b**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-methyl styrene (118.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methyl-4-((2-(*p*-tolyl)cyclopropyl)sulfonyl)benzene **3b** (91% yield, 52.2 mg, 0.18 mmol), 93% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.81 (d, *J* = 8.41 Hz, 2H), 7.35 (d, *J* = 8.03 Hz, 2H), 7.05 (d, *J* = 7.26 Hz, 2H), 6.91 (d, *J* = 8.03 Hz, 2H), 2.83 (ddd, *J* = 4.30, 6.22, 10.22 Hz, 1H), 2.61 (ddd, *J* = 4.97, 4.97, 7.64 Hz, 1H), 2.44 (s, 3H), 2.28 (s, 3H), 1.85 (ddd, *J* = 5.30, 5.30, 9.94 Hz, 1H),

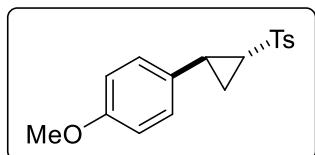
1.42 (ddd, 5.73, 6.50, 8.41 Hz, 1H); ^{13}C NMR (126 MHz, CDCl_3): δ 144.3, 137.6, 136.7, 134.4, 129.9, 129.2, 127.5, 126.4, 41.8, 23.4, 21.6, 21.9, 13.7; $[\alpha]^{21}_{\text{D}} = -48.1$ ($c = 1.0, \text{CHCl}_3$); For $\text{C}_{17}\text{H}_{18}\text{O}_2\text{S} [\text{M}+\text{H}]^+$ Calcd: 287.11057, Found: 287.11058; The enantiomeric ratio of **3b** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 18.1 min and minor isomer 20.2 min.

1-(tert-butyl)-4-(2-tosylcyclopropyl)benzene (**3c**)



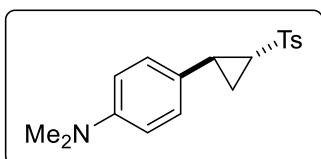
This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-*t*butyl styrene (160.3 mg, 1.0 mmol) and TsCHN_2 (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-(tert-butyl)-4-(2-tosylcyclopropyl)benzene **3c** (89% yield, 58.2 mg, 0.18 mmol), 92% ee. ^1H NMR (500 MHz, CDCl_3): δ 7.81 (d, $J = 6.50$ Hz, 2H), 7.35 (d, $J = 8.03$ Hz, 2H), 7.27 (ddd, $J = 2.1, 2.1, 8.41$ Hz, 2H), 6.95 (ddd, $J = 1.91, 1.91, 8.41$ Hz, 2H), 2.84 (ddd, $J = 4.21, 6.31, 10.13$ Hz, 1H), 2.64 (ddd, $J = 4.59, 5.35, 8.41$ Hz, 1H), 2.44 (s, 3H), 1.86 (ddd, $J = 5.59, 5.59, 9.56$ Hz, 1H), 1.44 (ddd, $J = 5.64, 6.69, 8.22$ Hz, 1H), 1.27 (s, 9H); ^{13}C NMR (126 MHz, CDCl_3): δ 150.1, 144.3, 137.6, 134.4, 129.9, 127.6, 126.2, 125.5, 41.7, 34.4, 31.2, 23.3, 21.6, 13.7; $[\alpha]^{24}_{\text{D}} = -51.5$ ($c = 1.0, \text{CHCl}_3$); For $\text{C}_{20}\text{H}_{24}\text{O}_2\text{S} [\text{M}+\text{H}]^+$ Calcd: 329.15752, Found: 329.15750; The enantiomeric ratio of **3c** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 10.7 min and minor isomer 9.37 min.

1-methoxy-4-(2-tosylcyclopropyl)benzene (**3d**)



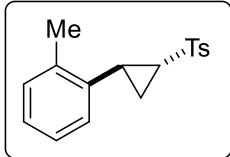
This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-methoxy styrene (134.2 mg, 1.0 mmol) and TsCHN_2 (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methoxy-4-(2-tosylcyclopropyl)benzene **3d** (96% yield, 58.1 mg, 0.19 mmol), 95% ee. ^1H NMR (500 MHz, CDCl_3): δ 7.81 (d, $J = 8.41$ Hz, 2H), 7.36 (d, $J = 8.03$ Hz, 2H), 6.94 (ddd, $J = 2.39, 2.39, 9.08$ Hz, 2H), 6.78 (ddd, $J = 2.48, 2.49, 8.79$ Hz, 2H), 3.75 (s, 3H), 2.83 (ddd, $J = 4.30, 6.22, 10.22$ Hz, 1H), 4.97 (ddd, $J = 4.97, 4.97, 7.84$ Hz, 1H), 2.44 (s, 3H), 1.83 (ddd, $J = 5.45, 5.45, 9.94$ Hz, 1H), 1.40 (ddd, $J = 5.73, 6.50, 8.41$ Hz, 1H); ^{13}C NMR (126 MHz, CDCl_3): δ 158.6, 144.3, 137.6, 129.9, 129.4, 127.7, 127.5, 114.0, 55.2, 41.7, 23.1, 21.6, 13.6; $[\alpha]^{24}_{\text{D}} = -53.5$ ($c = 1.0, \text{CHCl}_3$); For $\text{C}_{17}\text{H}_{18}\text{O}_3\text{S} [\text{M}+\text{NH}_4]^+$ Calcd: 320.13204, Found: 320.13203; The enantiomeric ratio of **3d** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 25.2 min and minor isomer 29.9 min.

N,N-dimethyl-4-(2-tosylcyclopropyl)aniline (3e)



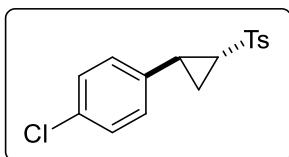
This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-N,N-dimethylamino styrene (147.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give N,N-dimethyl-4-(2-tosylcyclopropyl)aniline **3e** (88% yield, 55.7 mg, 0.18 mmol), 93% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.81 (d, *J* = 8.03 Hz, 2H), 7.34 (d, *J* = 8.41 Hz, 2H), 6.88 (d, *J* = 8.79 Hz, 2H), 6.60 (d, *J* = 8.79 Hz, 2H), 2.88 (s, 6H), 2.79 (ddd, *J* = 4.21, 6.12, 9.94 Hz, 1H), 2.55 (ddd, *J* = 4.78, 4.78, 8.03 Hz, 1H), 2.44 (s, 3H), 1.81 (ddd, *J* = 5.07, 5.07, 9.56 Hz, 1H), 1.39 (ddd, *J* = 6.12, 6.12, 7.64 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 149.7, 144.2, 137.8, 129.8, 127.5, 127.4, 124.9, 112.5, 41.5, 40.5, 23.3, 21.6, 13.3; [α]_D²⁴ = -66.9 (c = 1.0, CHCl₃); For C₁₈H₂₁NO₂S [M+H]⁺ Calcd: 316.13712, Found: 316.13710; The enantiomeric ratio of **3e** was determined by HPLC (Hexane : IPA = 4 : 1, 2.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 19.7 min and minor isomer 28.3 min.

1-methyl-2-(2-tosylcyclopropyl)benzene (3f)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between 2-methyl styrene (118.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methyl-2-(2-tosylcyclopropyl)benzene **3f** (90% yield, 51.7 mg, 0.18 mmol), 76% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.82 (d, *J* = 8.41 Hz, 2H), 8.03 (d, *J* = 8.03 Hz, 2H), 7.13 (d, *J* = 4.20 Hz, 2H), 7.10-7.04 (m, 1H), 6.84 (d, *J* = 7.26 Hz, 1H), 2.90 (ddd, *J* = 4.44, 6.31, 10.13 Hz, 1H), 2.61 (ddd, *J* = 4.97, 4.97, 8.41 Hz, 1H), 2.45 (s, 3H), 2.34 (s, 3H), 1.81 (ddd, *J* = 5.07, 5.07, 9.75 Hz, 1H), 1.42 (ddd, *J* = 5.54, 6.79, 8.12 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 144.4, 138.0, 137.5, 135.3, 130.1, 129.9, 127.6, 127.2, 125.9, 125.8, 41.1, 21.9, 21.6, 12.8; [α]_D²¹ = -26.4 (c = 1.0, CHCl₃); For C₁₇H₁₈O₂S [M+1]⁺ Calcd: 287.11057, Found: 287.11055; The enantiomeric ratio of **3f** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALPAK AD-H column (0.46 cm x 25 cm): major isomer 14.1 min and minor isomer 15.6 min.

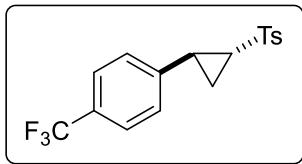
1-chloro-4-(2-tosylcyclopropyl)benzene (3g)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-chloro styrene (138.6 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-chloro-4-(2-tosylcyclopropyl)benzene **3g** (72% yield, 44.3 mg, 0.14 mmol), 94% ee.

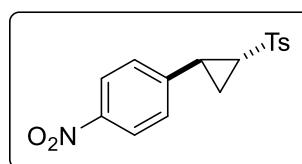
¹H NMR (500 MHz, CDCl₃): δ 7.80 (d, *J* = 8.41 Hz, 2H), 7.36 (d, *J* = 8.41, 2H), 7.21 (ddd, *J* = 2.10, 2.10, 8.41 Hz, 2H), 6.95 (ddd, *J* = 2.29, 2.30, 8.60 Hz, 2H) 2.84 (ddd, *J* = 4.30, 6.22, 10.22 Hz, 1H), 2.61 (ddd, *J* = 4.78, 4.78, 8.03 Hz, 1H), 2.45 (s, 3H), 1.87 (ddd, *J* = 5.54, 5.54, 9.94 Hz, 1H), 1.42 (ddd, *J* = 6.17, 6.31, 8.41 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 144.6, 137.4, 136.0, 132.9, 129.9, 128.7, 127.9, 127.5, 41.9, 23.0, 21.6, 13.9; [α]²⁴_D = -50.8 (c = 1.0, CHCl₃); For C₁₆H₁₅ClO₂S [M+NH₄]⁺ Calcd: 324.08250, Found: 324.088251; The enantiomeric ratio of **3g** was determined by HPLC (Hexane : IPA = 4 : 1, 0.5 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 49.1 min and minor isomer 45.4 min.

1-methyl-4-((2-(4-(trifluoromethyl)phenyl)cyclopropyl)sulfonyl)benzene (**3h**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-trifluoromethyl styrene (172.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methyl-4-((2-(4-(trifluoromethyl)phenyl)cyclopropyl)sulfonyl)benzene **3h** (62% yield, 44.3 mg, 0.14 mmol), 93% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.81 (d, *J* = 6.5 Hz, 2H), 7.51 (d, *J* = 8.03 Hz, 2H), 7.37 (d, *J* = 8.03 Hz, 2H), 7.14 (d, *J* = 8.41 Hz, 2H), 2.92 (ddd, *J* = 4.40, 6.12, 10.13 Hz, 1H), 2.69 (ddd, *J* = 4.49, 5.45, 8.50 Hz, 1H), 2.46 (s, 3H), 1.93 (ddd, *J* = 5.64, 5.64, 9.56 Hz, 1H), 1.49 (ddd, *J* = 6.12, 6.12, 8.60 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 144.7, 141.7, 137.2, 130.0, 129.7, 129.5, 129.2, 129.0, 127.6, 127.2, 126.9, 125.6, 125.6, 125.6, 125.0, 122.9, 120.7, 42.2, 23.3, 21.6, 14.2; [α]²³_D = -41.2 (c = 1.0, CHCl₃); For C₁₇H₁₅F₃O₂S [M+H]⁺ Calcd: 341.08231, Found: 341.08233; The enantiomeric ratio of **3h** was determined by HPLC (Hexane : IPA = 4 : 1, 0.5 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 27.5 min and minor isomer 25.9 min.

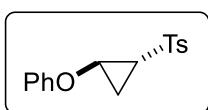
1-methyl-4-((2-(4-nitrophenyl)cyclopropyl)sulfonyl)benzene (**3i**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between 4-nitro styrene (149.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with CH₂Cl₂ as an eluent to give 1-methyl-4-((2-(4-nitrophenyl)cyclopropyl)sulfonyl)benzene **3i** (43% yield, 34.8 mg, 0.13 mmol), 91% ee. ¹H NMR (500 MHz, CDCl₃): δ 8.12 (d, *J* = 8.79 Hz, 2H), 7.81 (d, *J* = 8.41 Hz, 2H), 7.38 (d, *J* = 8.41 Hz, 2H), 7.18 (d, *J* = 8.79 Hz, 2H), 2.96 (ddd, *J* = 4.16, 6.12, 9.94 Hz, 1H), 2.74 (ddd, *J* = 4.59, 5.35, 8.41 Hz, 1H), 2.46 (s, 3H), 1.97 (ddd, *J* = 5.64, 5.64, 9.56 Hz, 1H), 1.52 (ddd, *J* = 6.12, 6.12, 8.41 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 147.0, 145.3, 144.9, 137.1, 130.1, 127.7, 127.3, 123.9, 42.6, 29.7, 21.6, 14.8; [α]²⁰_D = -41.7 (c = 1.0, CHCl₃); For C₁₆H₁₅NO₂S [M+NH₄]⁺

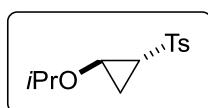
Calcd:335.10655, Found: 335.10655; The enantiomeric ratio of **3i** was determined by HPLC (Hexane : IPA = 1 : 1, 0.5 mL/min) using a CHIRALPAK IC column (0.46 cm x 25 cm): major isomer 37.6 min and minor isomer 46.8 min.

1-methyl-4-((2-phenoxy)cyclopropyl)sulfonyl)benzene (**3j**)



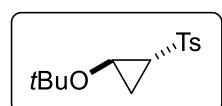
This compound was prepared according to the general procedure for asymmetric cyclopropanation between phenyl vinyl ether (96.1 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methyl-4-((2-phenoxy)cyclopropyl)sulfonyl)benzene **3j** (89% yield, 51.4 mg, 0.18 mmol), 98% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.81 (d, *J* = 8.03 Hz, 2H), 7.38 (d, *J* = 7.64 Hz, 2H), 7.21 (dddd, *J* = 2.1, 2.1, 7.45, 8.60 Hz, 2H), 6.98 (ddt, *J* = 1.15, 1.15, 7.45 Hz, 1H), 6.91 (dd, *J* = 1.15, 8.79 Hz, 2H), 4.32 (ddd, *J* = 2.29, 4.20, 7.26 Hz, 1H), 2.72 (ddd, *J* = 2.20, 6.22, 9.65 Hz, 1H), 2.47 (s, 3H), 1.81 (ddd, *J* = 6.69, 6.80, 6.88, 1H), 1.58 (ddd, *J* = 4.11, 6.79, 9.65 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 157.2, 144.8, 137.1, 130.0, 129.5, 127.7, 122.0, 114.8, 54.5, 39.5, 21.6, 14.0; [α]²³_D = +94.9 (c = 1.0, CHCl₃); For C₁₆H₁₆O₃S [M+H]⁺ Calcd: 289.08984, Found: 289.08987; The enantiomeric ratio of **3j** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 17.2 min and minor isomer 20.0 min.

1-((2-isopropoxycyclopropyl)sulfonyl)-4-methylbenzene (**3k**)



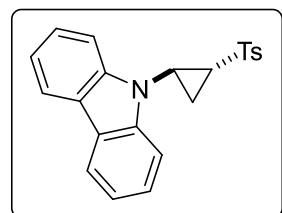
This compound was prepared according to the general procedure for asymmetric cyclopropanation between *i*propyl vinyl ether (96.1 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-((2-isopropoxycyclopropyl)sulfonyl)-4-methylbenzene **3k** (98% yield, 49.7 mg, 0.18 mmol), 98% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.77 (d, *J* = 8.41 Hz, 2H), 7.36 (d, *J* = 8.03 Hz, 2H), 3.89 (ddd, *J* = 2.49, 4.59, 7.26 Hz, 1H), 3.63 (sept, *J* = 6.12 Hz, 1H), 2.50 (ddd, *J* = 2.29, 6.12, 9.56 Hz, 1H), 2.45 (s, 3H), 1.56 (ddd, *J* = 6.75, 6.88, 7.26 Hz, 1H), 1.37 (ddd, *J* = 4.30, 6.60, 9.65 Hz, 1H), 1.14 (d, *J* = 6.12 Hz, 3H), 1.08 (d, *J* = 6.12 Hz, 3H); ¹³C NMR (126 MHz, CDCl₃): δ 144.4, 137.5, 129.8, 127.5, 73.3, 55.7, 39.5, 21.9, 21.7, 21.6, 13.9; [α]²²_D = +14.0 (c = 1.0, CHCl₃); For C₁₃H₁₈O₃S [M+NH₄]⁺ Calcd: 272.13204, Found: 272.13205.; The enantiomeric ratio of **3k** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALPAK IF-3 column (0.46 cm x 25 cm): major isomer 26.4 min and minor isomer 23.8 min.

1-((1R,2R)-2-(tert-butoxy)cyclopropyl)sulfonyl)-4-methylbenzene (**3l**)



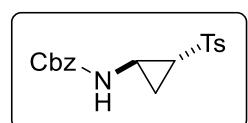
This compound was prepared according to the general procedure for asymmetric cyclopropanation between *t*butyl vinyl ether (100.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-((1R,2R)-2-(tert-butoxy)cyclopropyl)sulfonyl)-4-methylbenzene **3l** (98% yield, 53.2 mg, 0.20 mmol), 99% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.77 (d, *J* = 8.41 Hz, 2H), 7.35 (d, *J* = 8.03 Hz, 2H), 3.88 (ddd, *J* = 2.39, 4.30, 7.55 Hz, 1H), 2.47 (ddd, *J* = 2.29, 6.12, 9.56 Hz, 1H), 2.45 (s, 3H), 1.50 (ddd, *J* = 6.41, 6.41, 7.64 Hz, 1H), 1.28 (ddd, *J* = 4.40, 6.50, 9.36 Hz, 1H), 1.19 (s, 9H); ¹³C NMR (126 MHz, CDCl₃): δ 144.3, 137.6, 129.8, 127.5, 76.0, 51.1, 39.9, 27.6, 21.5, 13.2; [α]²³_D = -6.75 (c = 1.0, CHCl₃); For C₁₄H₂₀O₃S [M+H]⁺ Calcd: 269.12114, Found: 269.12113; The enantiomeric ratio of **3l** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 8.1 min and minor isomer 7.2 min.

9-(2-tosylcyclopropyl)-9H-carbazole (**3m**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between 9-vinylcarbazole (193.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 9-(2-tosylcyclopropyl)-9H-carbazolee **3m** (86% yield, 62.7 mg, 0.17 mmol), 95% ee. ¹H NMR (500 MHz, CDCl₃): δ 8.01 (d, *J* = 8.01 Hz, 2H), 7.96-7.91 (m, 2H), 7.46 (d, *J* = 8.41 Hz, 2H), 7.37-7.31 (m, 2H), 7.28 (d, *J* = 8.41 Hz, 2H), 7.25-7.19 (m, 2H), 4.04 (ddd, *J* = 3.06, 4.59, 7.64 Hz, 1H), 3.03 (ddd, *J* = 3.06, 6.12, 9.17 Hz, 1H), 2.52 (s, 3H), 2.62 (ddd, *J* = , 6.02, 6.02, 7.62 Hz, 1H), 1.85 (ddd, *J* = 4.88, 6.02, 9.27 Hz, 1H); ¹³C NMR (126 MHz, CDCl₃): δ 145.3, 140.4, 136.7, 130.3, 128.2, 126.0, 123.2, 120.3, 119.9, 109.6, 40.4, 30.4, 21.7, 14.8; [α]²¹_D = -124.4 (c = 1.0); For C₂₂H₁₉NO₂S [M+H]⁺ Calcd: 362.12147, Found: 362.12148; The enantiomeric ratio of **3m** was determined by HPLC (Hexane : IPA = 5 : 1, 1.0 mL/min) using a CHIRALPAK IC column (0.46 cm x 25 cm): major isomer 26.7 min and minor isomer 22.4 min.

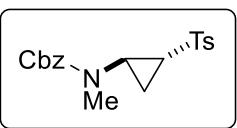
benzyl (2-tosylcyclopropyl)carbamate (**3n**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between benzyl vinylcarbamate (177.2 mg, 1.0 mmol) and TsCHN₂ (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 9-(2-tosylcyclopropyl)-9H-carbazolee **3n** (86% yield, 62.7 mg, 0.17 mmol), *trans/cis* = 90:10, 95% *trans* ee, 89% *cis* ee. ¹H NMR (500 MHz, CDCl₃) (*trans* isomer): δ 7.80 (brs, 2H), 7.53-7.10 (m, 7H), 5.15

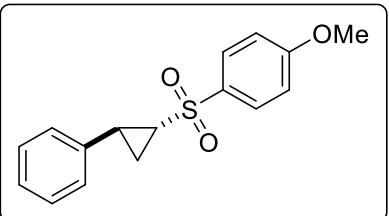
(brs, 1H), 5.02 (s, 2H), 3.38 (brs, 1H), 2.58 (brs, 1H), 2.43 (s, 3H), 1.74 (ddd, $J = 5.92, 6.02, 8.41$ Hz, 1H), 1.33 (brs, 1H). ^1H NMR (500 MHz, CDCl_3) (*cis* isomer): δ 7.72 (d, $J = 8.03$ Hz, 2H), 7.44–7.28 (m, 5H), 7.23 (d, $J = 8.03$ Hz, 2H), 5.73 (d, $J = 8.41$ Hz, 1H), 5.13 (d, $J = 12.23$ Hz, 1H), 5.09 (d, $J = 12.23$ Hz, 1H), 3.59 (ddd, $J = 7.45, 7.45, 14.33$ Hz, 1H), 2.57 (ddd, $J = 6.69, 6.69, 9.17$ Hz, 1H), 2.42 (s, 3H), 1.70 (ddd, $J = 6.50, 6.50, 6.50$ Hz, 1H), 1.51 (ddd, $J = 7.26, 7.84, 8.03$ Hz, 1H); ^{13}C NMR (126 MHz, CDCl_3) (*trans* isomer): δ 156.0, 144.6, 136.9, 135.9, 129.8, 128.4, 128.2, 128.0, 127.8, 67.0, 40.0, 30.5, 21.6, 13.1. ^{13}C NMR (126 MHz, CDCl_3) (*cis* isomer): δ 156.2, 144.7, 137.3, 136.2, 129.9, 128.6, 128.2, 128.2, 127.3, 67.0, 36.7, 31.8, 21.6, 10.8; (*trans* isomer) $[\alpha]^{23}\text{D} = -9.65$ ($c = 1.0$), (*cis* isomer) $[\alpha]^{24}\text{D} = +34.9$ ($c = 0.35$); For $\text{C}_{18}\text{H}_{19}\text{NO}_4\text{S}$ [$\text{M}+\text{NH}_4$]⁺ Calcd: 363.13785, (*trans* isomer) Found: 363.13791, (*cis* isomer) Found: 363.13777; The enantiomeric ratio of **3n** (*trans* isomer)) was determined by HPLC (Hexane : IPA = 4 : 1, 2.0 mL/min) using a CHIRALPAK IC column (0.46 cm x 25 cm): major isomer 27.4 min and minor isomer 36.0 min. The enantiomeric ratio of **3n** (*cis* isomer)) was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALPAK IA column (0.46 cm x 25 cm): major isomer 17.3 min and minor

benzyl methyl(2-tosylcyclopropyl)carbamate (3o)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between benzyl methyl(vinyl)carbamate (191.2 mg, 1.0 mmol) and TsCHN_2 (39.2 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give benzyl methyl(2-tosylcyclopropyl)carbamate **3o** (71% yield, 51.2 mg, 0.14 mmol), 98% ee. ^1H NMR (500 MHz, CDCl_3): δ 7.79 (d, $J = 8.03$ Hz, 2H), 7.45–7.15 (m, 7H), 4.96 (s, 2H), 3.33 (ddd, $J = 3.16, 5.07, 8.12$ Hz, 1H), 2.74 (s, 3H), 2.65 (ddd, $J = 3.06, 6.12, 9.17$ Hz, 1H), 2.42 (s, 3H), 1.82 (ddd, $J = 6.31, 6.31, 8.03$ Hz, 1H), 1.49 (brs, 1H); ^{13}C NMR (126 MHz, CDCl_3): δ 156.3, 144.6, 136.9, 136.3, 129.8, 128.4, 128.0, 127.8, 127.7, 67.1, 40.7, 36.7, 34.5, 21.5, 14.9; $[\alpha]^{30}\text{D} = -33.2$ ($c = 0.35$); For $\text{C}_{19}\text{H}_{21}\text{NO}_4\text{S}$ [$\text{M}+\text{H}$]⁺ Calcd: 360.12695, Found: 360.12692; The enantiomeric ratio of **3o** was determined by HPLC (Hexane : IPA = 1 : 1, 2.0 mL/min) using a CHIRALPAK IC column (0.46 cm x 25 cm): major isomer 13.4 min and minor isomer 16.2 min.

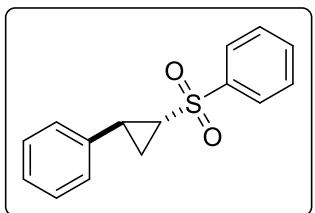
1-methoxy-4-((2-phenylcyclopropyl)sulfonyl)benzene (3p)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between styrene (104.2 mg, 1.0 mmol) and 1-((diazomethyl)sulfonyl)-4-methoxybenzene (42.4 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-methoxy-4-((2-phenylcyclopropyl)sulfonyl)benzene **3p** (87%

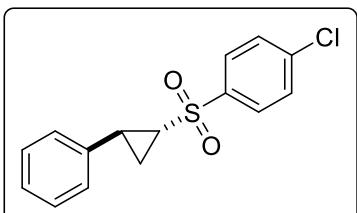
yield, 50.2 mg, 0.17 mmol), 95% ee. ^1H NMR (500 MHz, CDCl_3): δ 7.86 (d, $J = 8.79$ Hz, 2H), 7.24 (dd, $J = 7.07, 7.07$ Hz, 2H), 7.22-7.17 (m, 1H), 7.05-6.99 (m, 4H), 3.87 (s, 3H), 2.85 (ddd, $J = 4.30, 6.02, 10.03$ Hz, 1H), 2.64 (ddd, $J = 4.49, 4.49, 8.50$, 1H), 1.86 (ddd, $J = 5.26, 5.26, 10.03$ Hz, 1H), 1.45 (ddd, $J = 6.12, 6.12, 8.41$ Hz, 1H); ^{13}C NMR (126 MHz, CDCl_3): δ 163.5, 137.5, 132.1, 129.7, 128.6, 127.0, 126.5, 114.5, 55.6, 42.1, 23.7, 13.8; $[\alpha]^{30}_{\text{D}} = -46.9$ ($c = 1.0$); For $\text{C}_{16}\text{H}_{16}\text{O}_3\text{S} [\text{M}+\text{H}]^+$ Calcd: 289.08984, Found: 289.08981; The enantiomeric ratio of **3p** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALPAK IC column (0.46 cm x 25 cm): major isomer 35.4 min and minor isomer 39.5 min.

(*(2-phenylcyclopropyl)sulfonyl*)benzene (**3q**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between styrene (104.2 mg, 1.0 mmol) and ((diazomethyl)sulfonyl)benzene (36.4 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give (*(2-phenylcyclopropyl)sulfonyl*)benzene **3q** (72% yield, 37.7 mg, 0.15 mmol), 95% ee. ^1H NMR (500 MHz, CDCl_3): δ 7.97-7.91 (m, 2H), 7.68-7.62 (m, 1H), 7.60-7.53 (m, 2H), 7.27-7.16 (m, 3H), 7.05-6.97 (m, 2H), 2.89 (ddd, $J = 4.21, 6.12, 9.94$ Hz, 1H), 2.66 (ddd, $J = 4.97, 4.97, 8.41$ Hz, 1H), 1.89 (ddd, $J = 5.54, 5.54, 9.94$ Hz, 1H), 1.48 (ddd, $J = 5.73, 6.50, 8.41$ Hz, 1H); ^{13}C NMR (126 MHz, CDCl_3): δ 140.5, 137.3, 133.5, 129.3, 128.6, 127.5, 127.1, 126.6, 41.7, 23.7, 12.8; $[\alpha]^{30}_{\text{D}} = -63.0$ ($c = 1.0$); For $\text{C}_{15}\text{H}_{14}\text{O}_2\text{S} [\text{M}+\text{H}]^+$ Calcd: 259.07927, Found: 259.07929; The enantiomeric ratio of **3q** was determined by HPLC (Hexane : IPA = 4 : 1, 1.0 mL/min) using a CHIRALCEL OJ-H column (0.46 cm x 25 cm): major isomer 23.8 min and minor isomer 28.0 min.

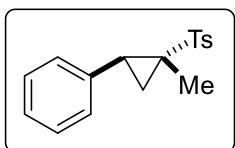
1-chloro-4-((2-phenylcyclopropyl)sulfonyl)benzene (**3r**)



This compound was prepared according to the general procedure for asymmetric cyclopropanation between styrene (104.2 mg, 1.0 mmol) and 1-chloro-4-((diazomethyl)sulfonyl)benzene (43.3 mg, 0.2 mmol). The resulting mixture was purified by silica gel column chromatography with Hexane/EtOAc as an eluent to give 1-chloro-4-((2-phenylcyclopropyl)sulfonyl)benzene **3r** (67% yield, 39.0 mg, 0.13 mmol), 90% ee. ^1H NMR (500 MHz, CDCl_3): δ 7.93-7.83 (m, 2H), 7.59-7.49 (m, 2H), 7.31-7.16 (m, 3H), 7.02 (d, $J = 6.88$ Hz, 2H), 2.89 (ddd, $J = 4.21, 6.12, 10.13$ Hz, 1H), 2.65 (ddd, $J = 4.97, 4.97, 8.22$ Hz, 1H), 1.88 (ddd, $J = 5.54, 5.54, 9.56$ Hz, 1H); ^{13}C NMR (126 MHz, CDCl_3): δ 140.2, 138.9, 137.1, 129.6, 129.0, 128.7, 127.2, 126.5, 41.7, 23.8, 13.9; $[\alpha]^{25}_{\text{D}} = -48.0$ ($c = 1.0$); For $\text{C}_{15}\text{H}_{13}\text{ClO}_2\text{S} [\text{M}+\text{NH}_4]^+$ Calcd: 310.06685, Found: 310.06688; The enantiomeric ratio of **3r** was determined by HPLC (Hexane : IPA

= 4 : 1, 1.0 mL/min) using a CHIRALPAK IB column (0.46 cm x 25 cm): major isomer 16.0 min and minor isomer 17.2 min.

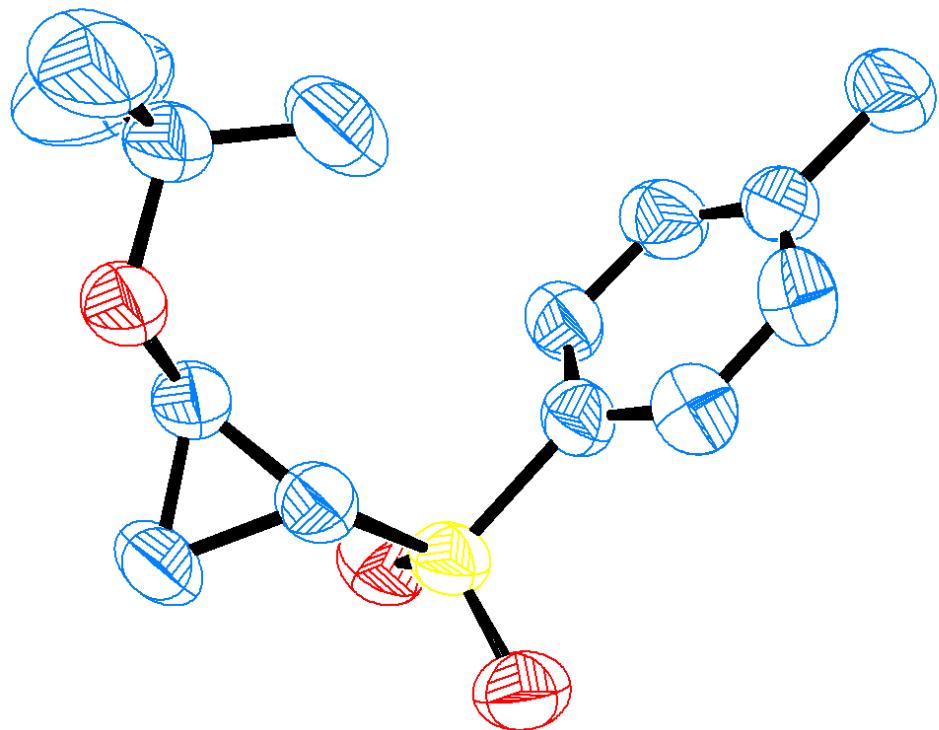
1-methyl-4-((1-methyl-2-phenylcyclopropyl)sulfonyl)benzene (7)



To solution of **3a** (108.9 mg, 0.4 mmol) in dry THF (2 mL) was added dropwise butyllithium (1.6 M in hexane, 0.5 mL,) at -78 °C under Ar, and stirring was continued for 30 min at -78 °C after which MeI (123.6 mg, 0.8 mmol) was added dropwise to the solution. The resultant solution was stirred at -78 °C for 30 min and then allowed to warm to room temperature over a period of 1 h before being treated with saturated aqueous NH₄Cl. The aqueous layer was extracted with ethyl acetate, and the combined organic layer was washed with brine, dried over with Na₂SO₄ and concentrated *in vacuo*. The residue was purified by column chromatography to give desired product. The *trans/cis* ratio was determined from the crude ¹H NMR spectra, and the ee value was determined by chiral HPLC analysis. **7** (80% yield, 101.9 mg, 0.36 mmol), 94% ee. ¹H NMR (500 MHz, CDCl₃): δ 7.82 (d, *J* = 8.41 Hz, 2H), 7.39 (d, *J* = 8.41 Hz, 2H), 7.30-7.19 (m, 3H), 7.05 (d, *J* = 7.26 Hz, 2H), 3.21 (dd, *J* = 7.07, 9.75 Hz, 1H), 2.48 (s, 3H), 2.02 (dd, *J* = 5.54, 9.75 Hz, 1H), 1.27 (dd, *J* = 5.73, 6.88 Hz, 1H), 1.01 (s, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 144.4, 135.2, 135.0, 129.7, 128.8, 128.8, 128.3, 127.1, 42.8, 27.5, 21.6, 16.2, 13.6; [α]²⁷_D = -39.8 (c = 1.0, CHCl₃); For C₁₇H₁₈O₂S [M+H]⁺ Calcd: 287.11057, Found: 287.11055; The enantiomeric ratio of **7** was determined by HPLC (Hexane : IPA = 3 : 1, 1.0 mL/min) using a CHIRALPAK ID column (0.46 cm x 25 cm): major isomer 11.3 min and minor isomer 12.2 min.

3. X-ray Crystal structure.

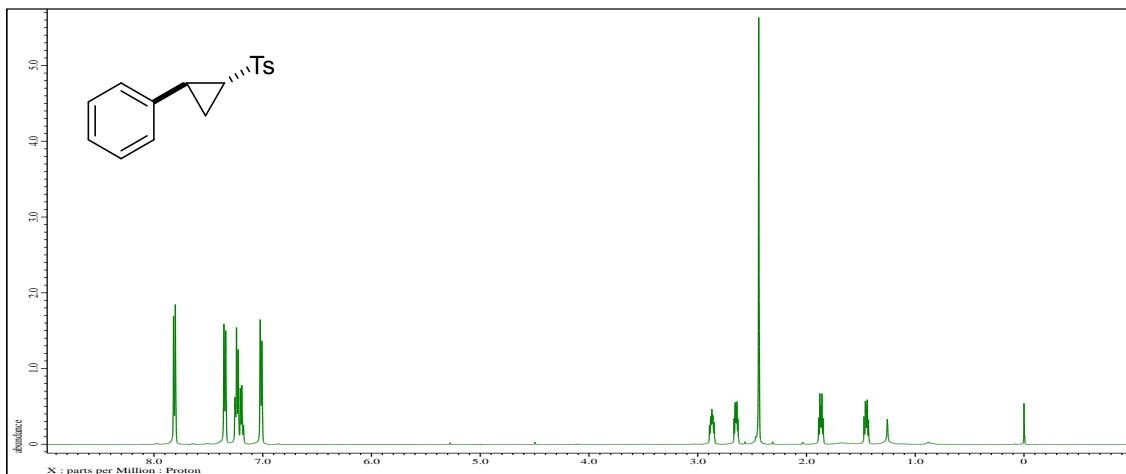
1-(((1*R*,2*R*)-2-(tert-butoxy)cyclopropyl)sulfonyl)-4-methylbenzene (3l)



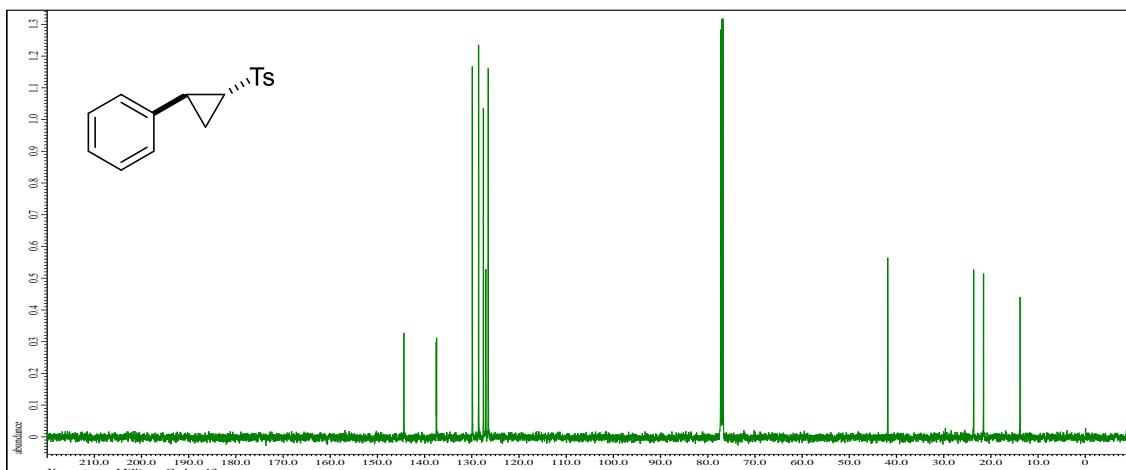
Empirical formula	$C_{14} H_{20} O_3 S$		
Formula weight	268.36		
Temperature	296(2) K		
Wavelength	0.71069 Å		
Crystal system	Monoclinic		
Space group	$C2$		
Unit cell dimensions	$a = 16.720(7)$ Å	$\alpha = 90^\circ$	
	$b = 9.987(4)$ Å	$\beta = 90.306(9)^\circ$	
	$c = 8.832(4)$ Å	$\gamma = 90^\circ$	
Volume	1474.7(10) Å ³		
Z	4		
Density (calculated)	1.209 Mg/m ³		
Absorption coefficient	0.218 mm ⁻¹		
$F(000)$	576		
Crystal size	0.60 x 0.20 x 0.10 mm ³		
Theta range for data collection	2.31 to 28.46°		
Index ranges	-21≤ h ≤22, -13≤ k ≤12, -11≤ l ≤11		
Reflections collected	13131		
Independent reflections	3152 [$R(\text{int}) = 0.0326$]		
Completeness to theta = 28.46°	94.7 %		
Max. and min. transmission	0.9732 and 0.9154		
Refinement method	Full-matrix least-squares on F^2		
Data / restraints / parameters	3152 / 1 / 167		
Goodness-of-fit on F^2	1.031		
Final R indices [$I > 2\sigma(I)$]	$R1 = 0.0467, wR2 = 0.1275$		
R indices (all data)	$R1 = 0.0581, wR2 = 0.1375$		
Absolute structure parameter	0.02(10)		
Largest diff. peak and hole	0.307 and -0.222 e Å ⁻³		

4. NMR and HPLC spectral data.

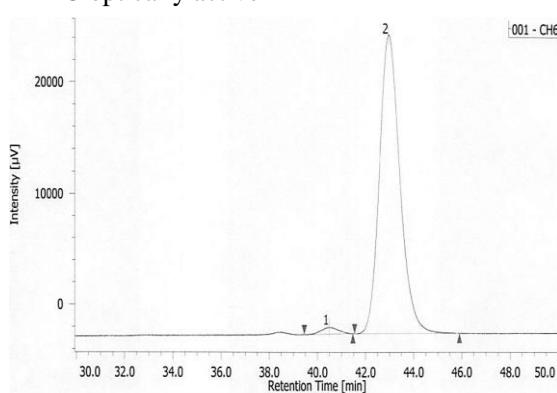
¹H NMR



¹³C NMR

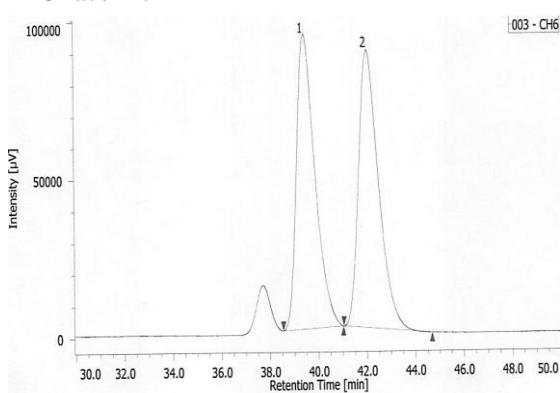


HPLC optically active



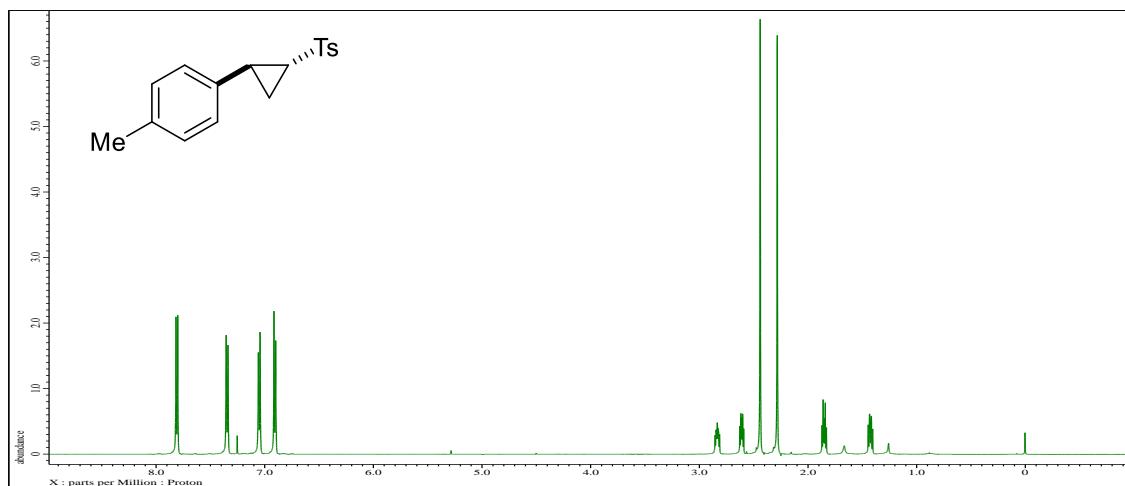
No.	tR [min]	Area	Area%
1	40.492	29502	1.819
2	42.945	1592806	98.181

HPLC racemic

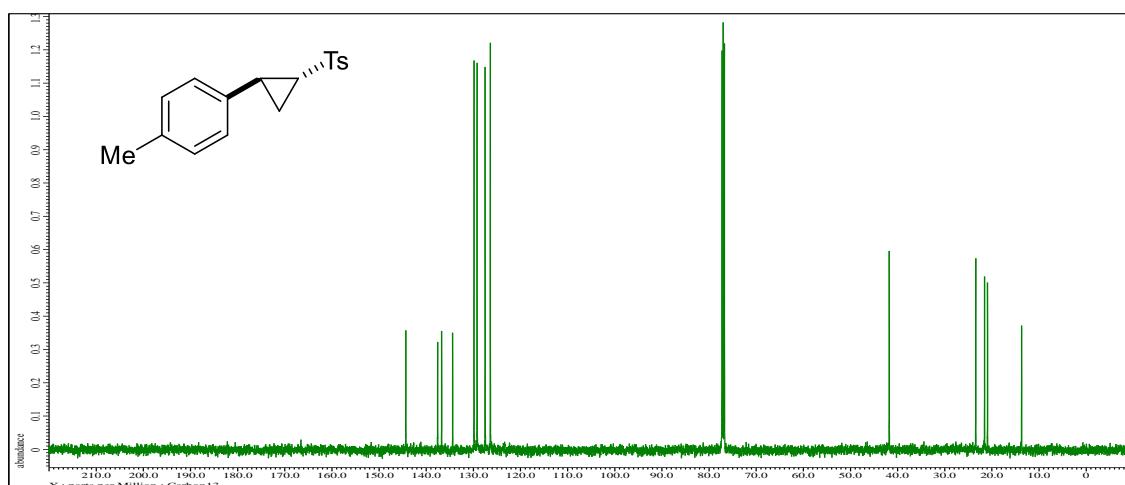


No.	tR [min]	Area	Area%
1	39.425	4924223	49.497
2	42.018	5024278	50.503

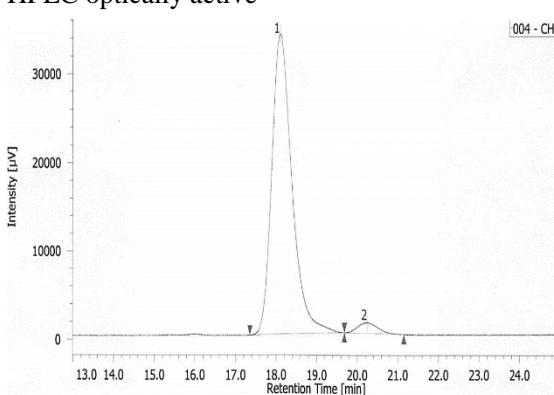
¹H NMR



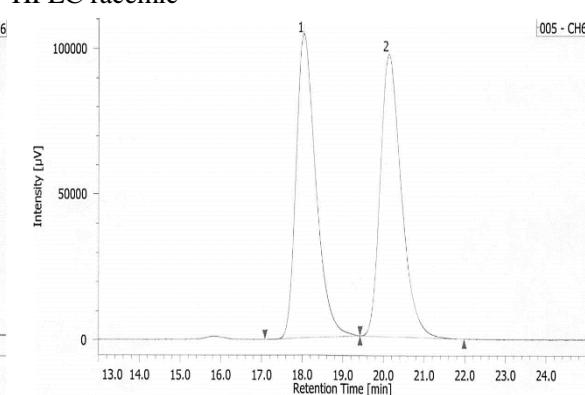
¹³C NMR



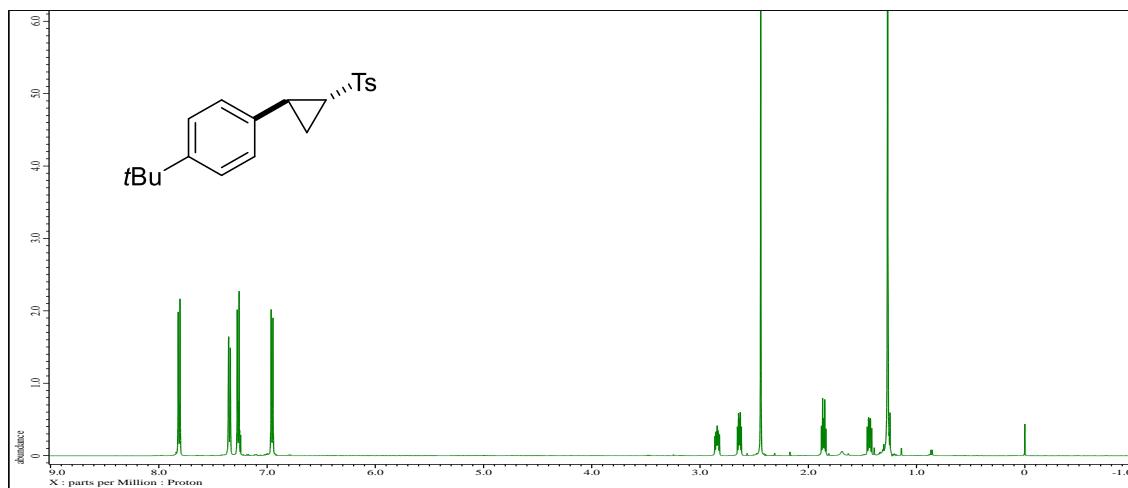
HPLC optically active



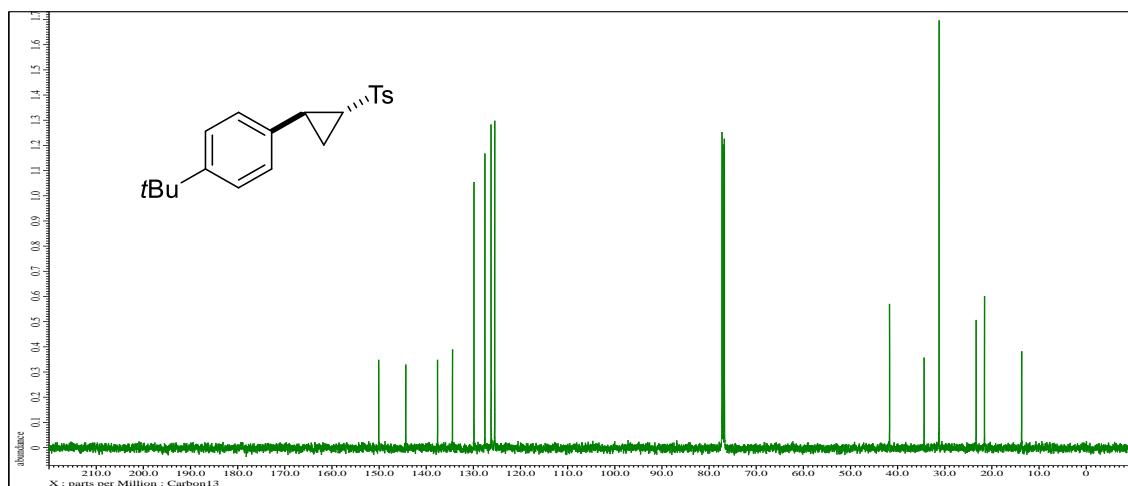
HPLC racemic



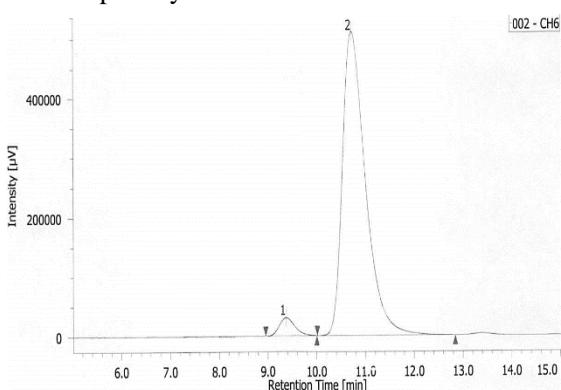
¹H NMR



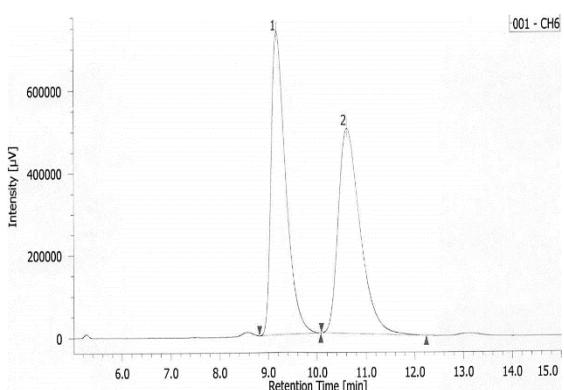
¹³C NMR



HPLC optically active



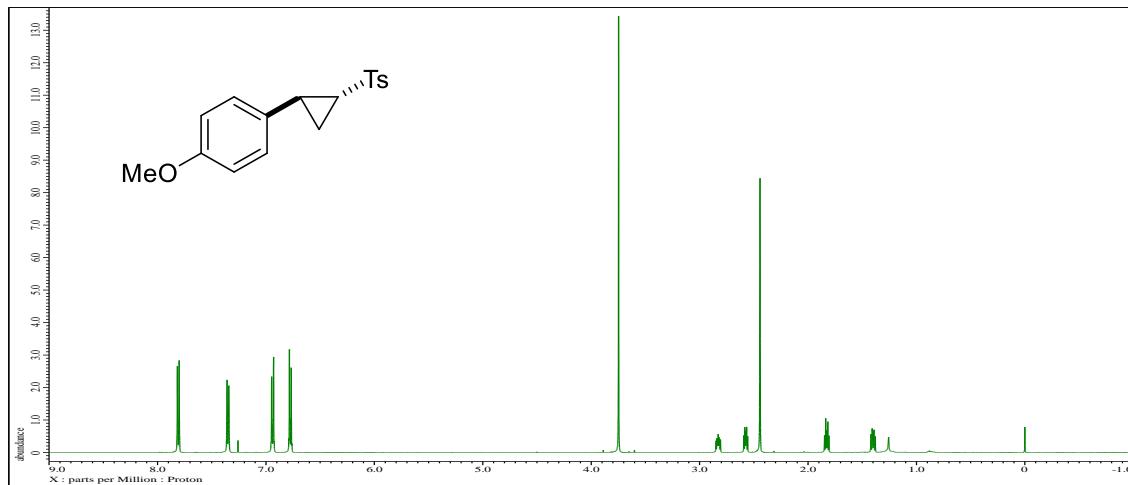
HPLC racemic



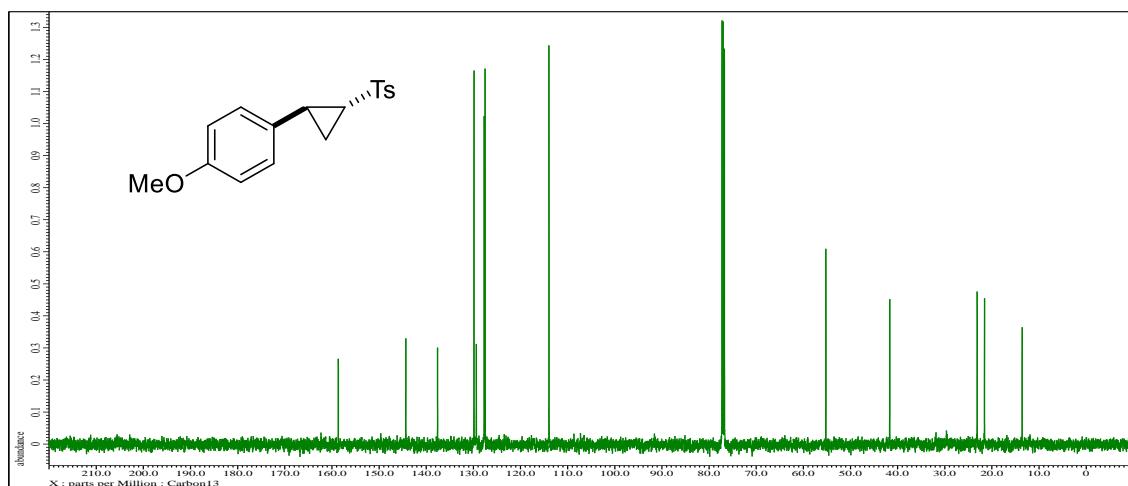
No.	tR [min]	Area	Area%
1	9.370	669649	3.854
2	10.720	16705930	96.146

No.	tR [min]	Area	Area%
1	9.173	15183984	49.574
2	10.613	15444694	50.426

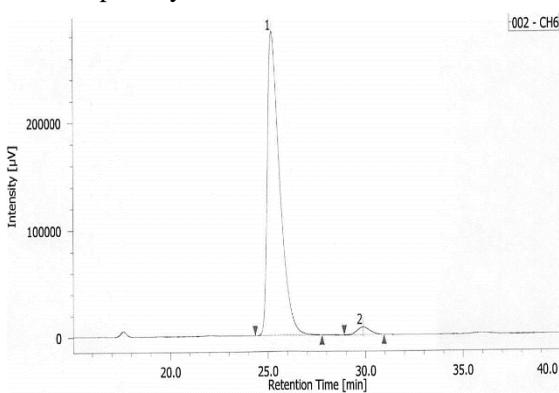
¹H NMR



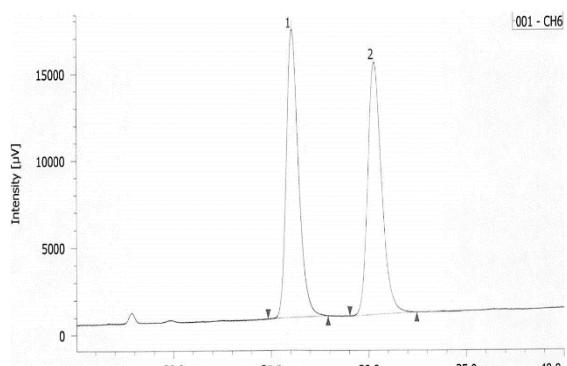
¹³C NMR



HPLC optically active



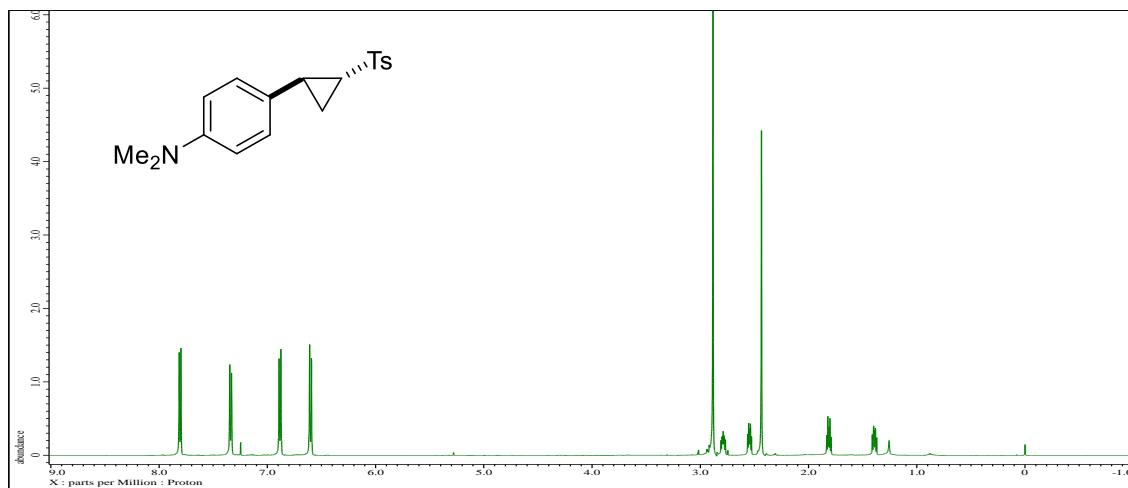
HPLC racemic



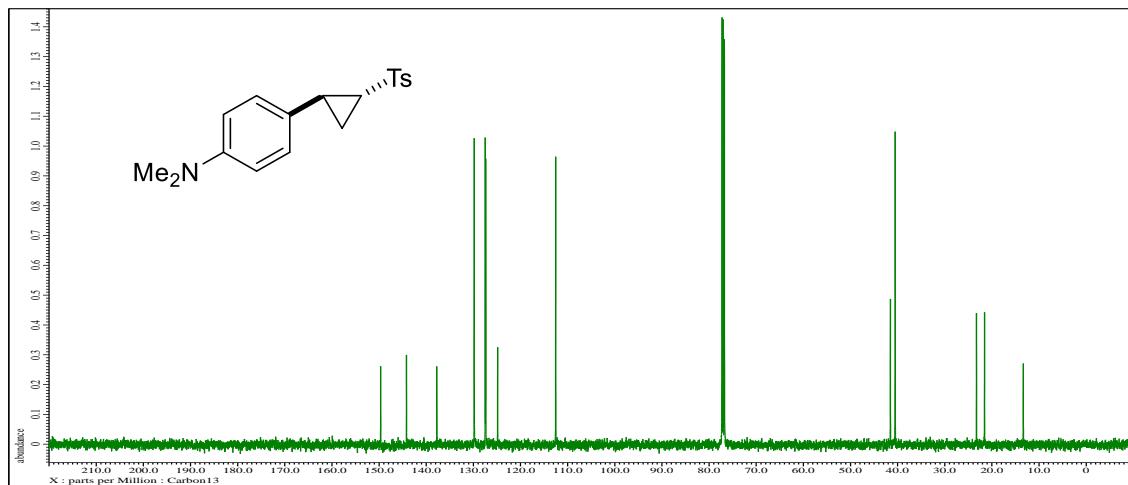
No.	tR [min]	Area	Area%
1	25.215	12298810	97.334
2	29.855	336804	2.666

No.	tR [min]	Area	Area%
1	26.057	712285	40.911
2	30.275	714820	50.089

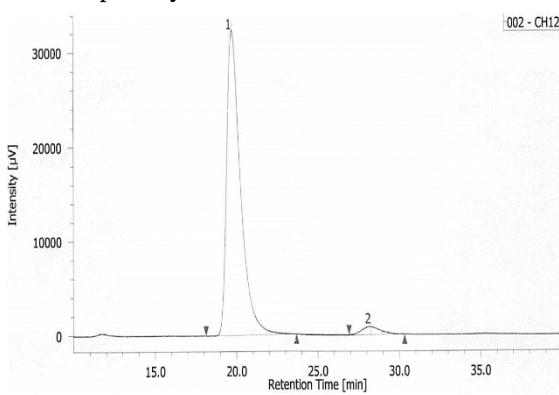
¹H NMR



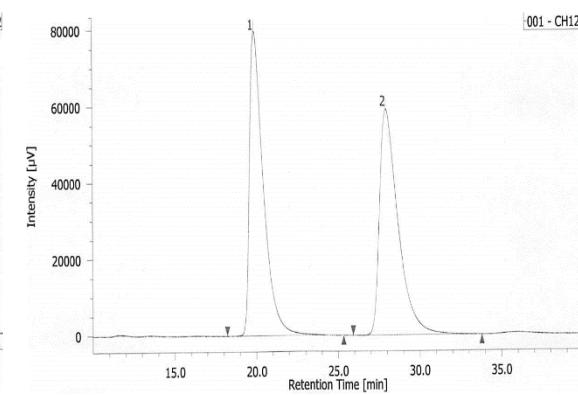
¹³C NMR



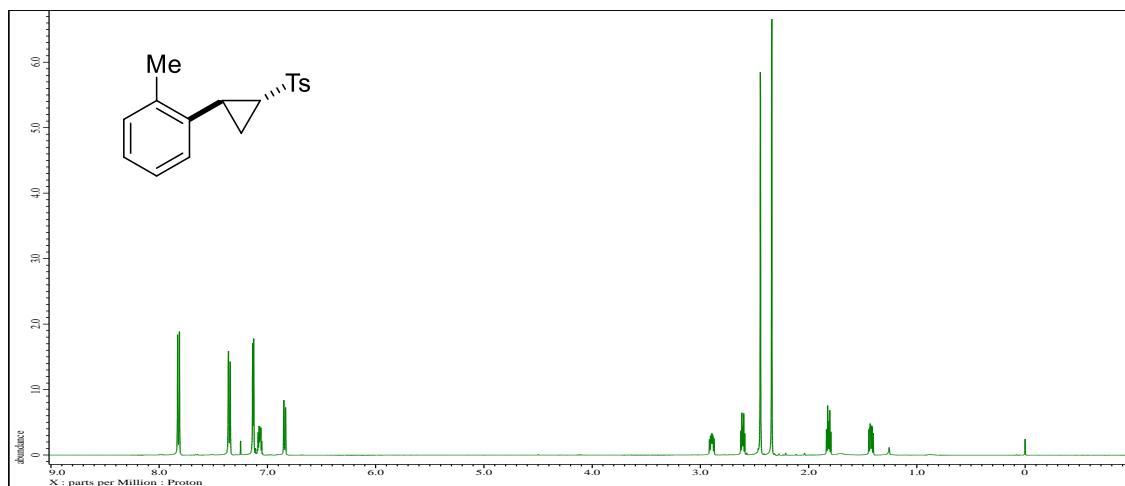
HPLC optically active



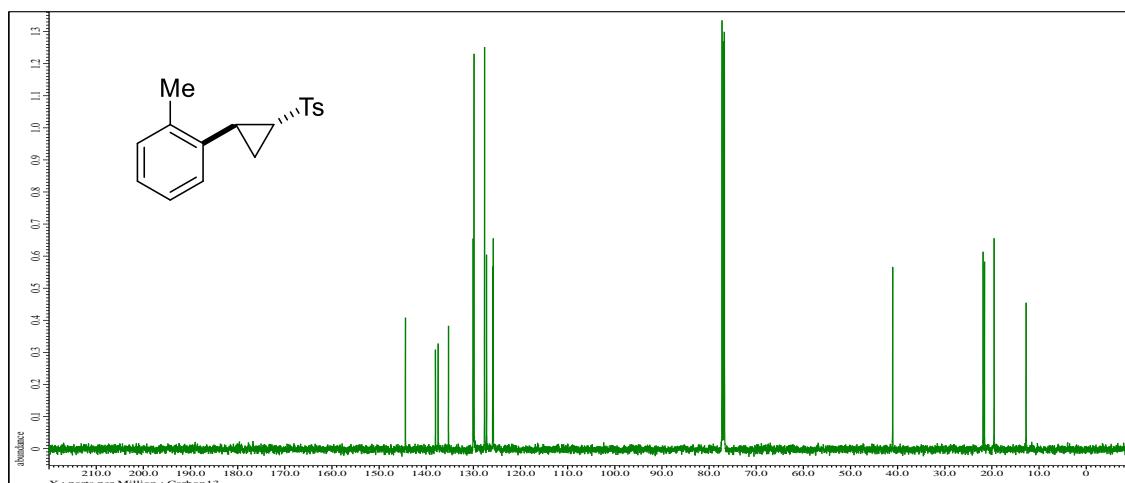
HPLC racemic



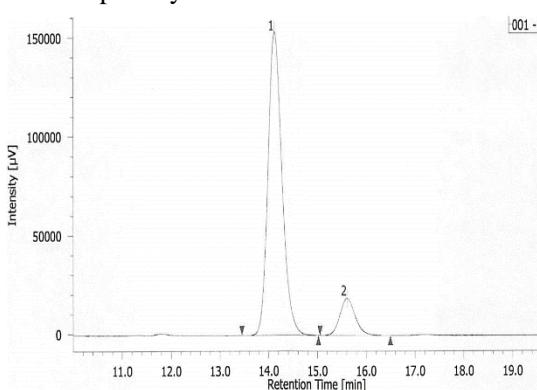
¹H NMR



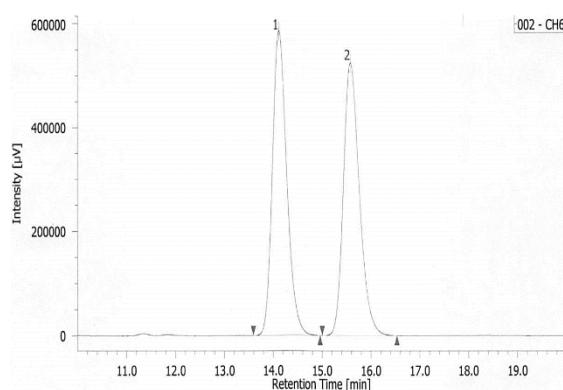
¹³C NMR



HPLC optically active



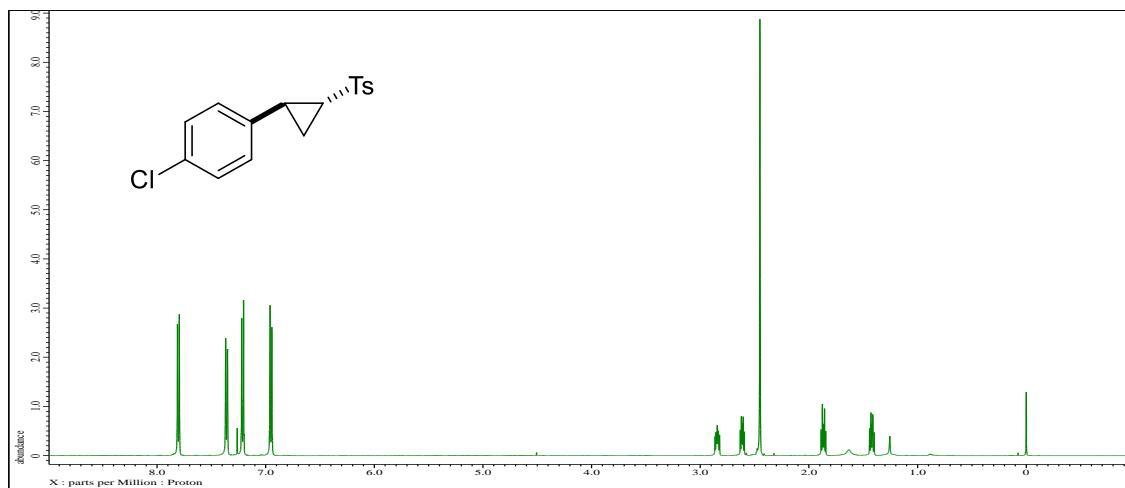
HPLC racemic



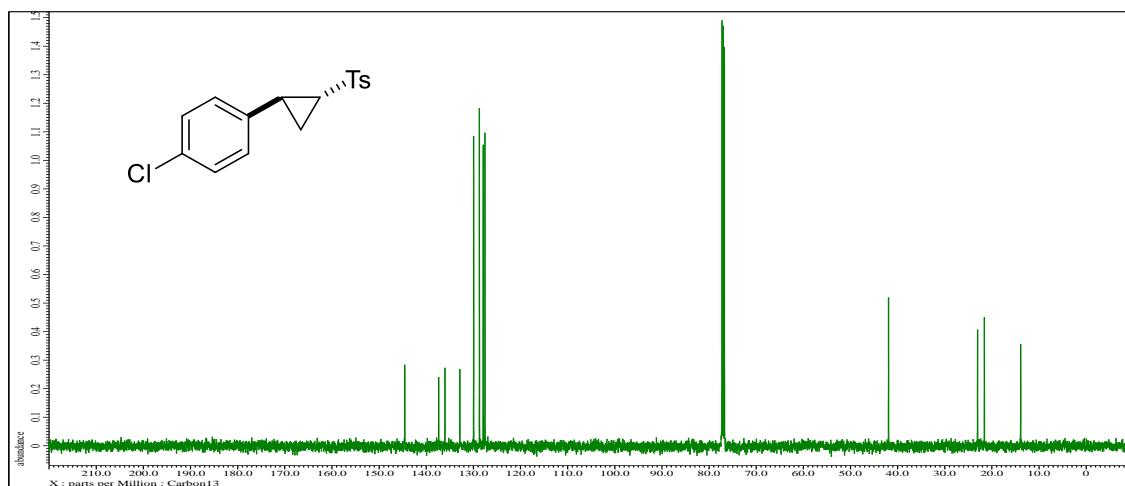
No.	tR [min]	Area	Area%
1	14.123	3036867	88.140
2	15.605	408647	11.860

No.	tR [min]	Area	Area%
1	14.110	11860317	50.008
2	15.573	11856321	49.992

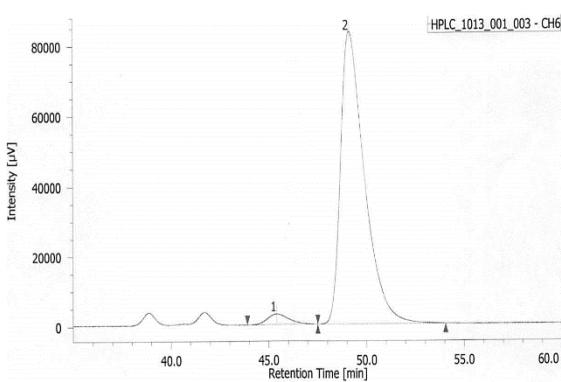
¹H NMR



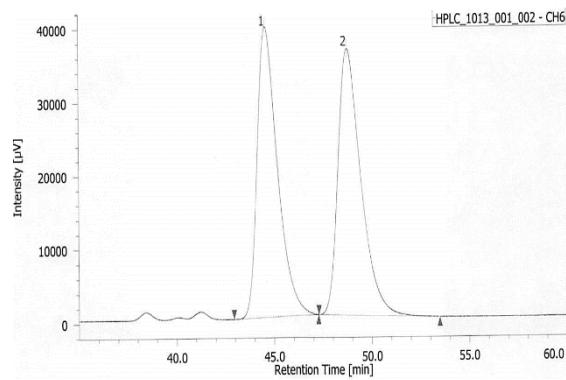
¹³C NMR



HPLC optically active



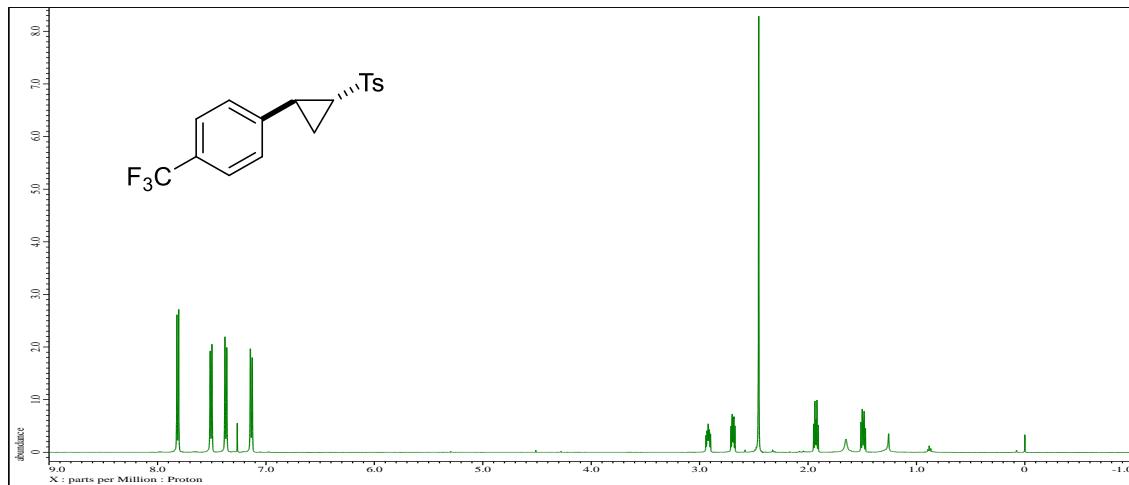
HPLC racemic



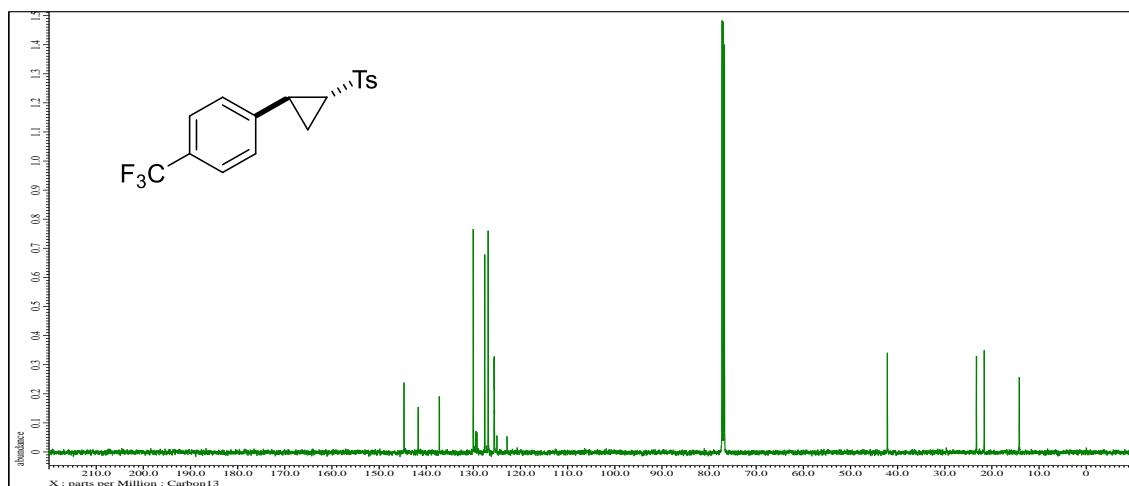
No.	tR [min]	Area	Area%
1	45.403	227559	3.129
2	49.135	7044982	96.871

No.	tR [min]	Area	Area%
1	44.565	2859823	49.403
2	48.752	2928917	50.597

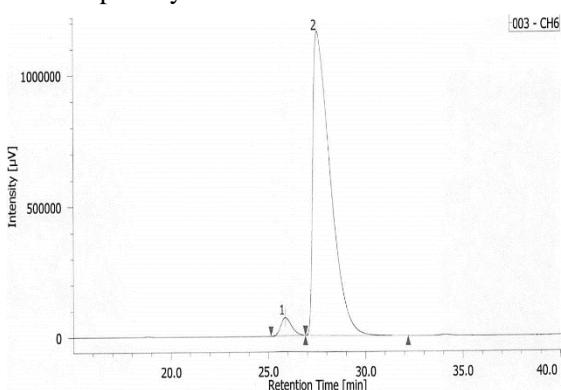
¹H NMR



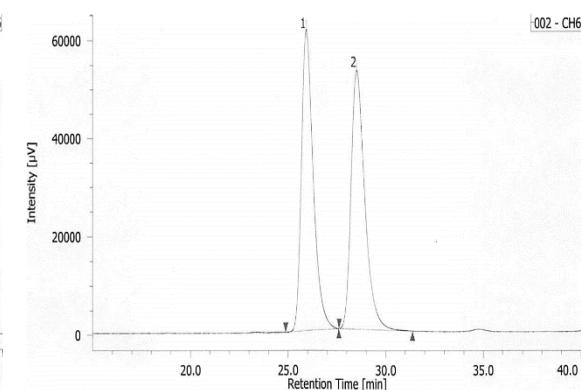
¹³C NMR



HPLC optically active



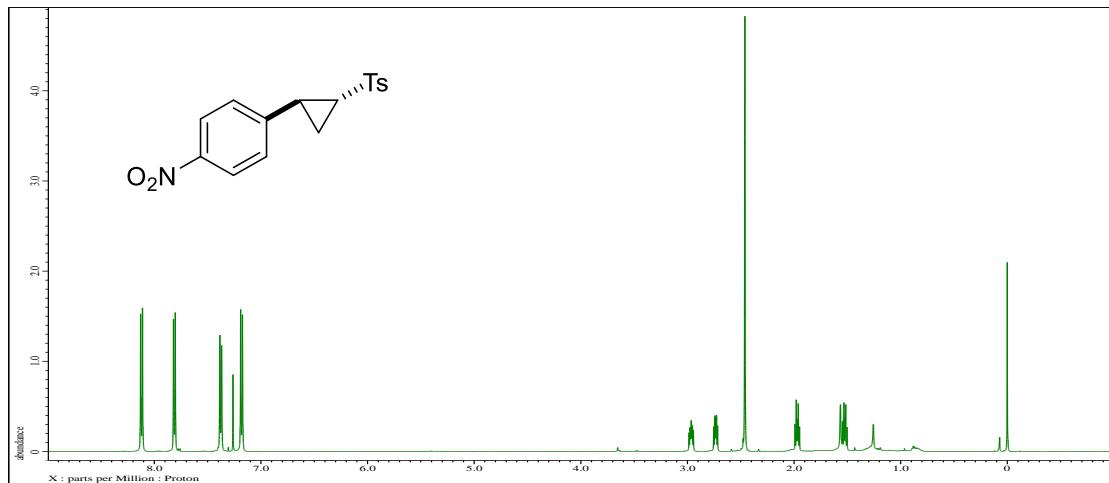
HPLC racemic



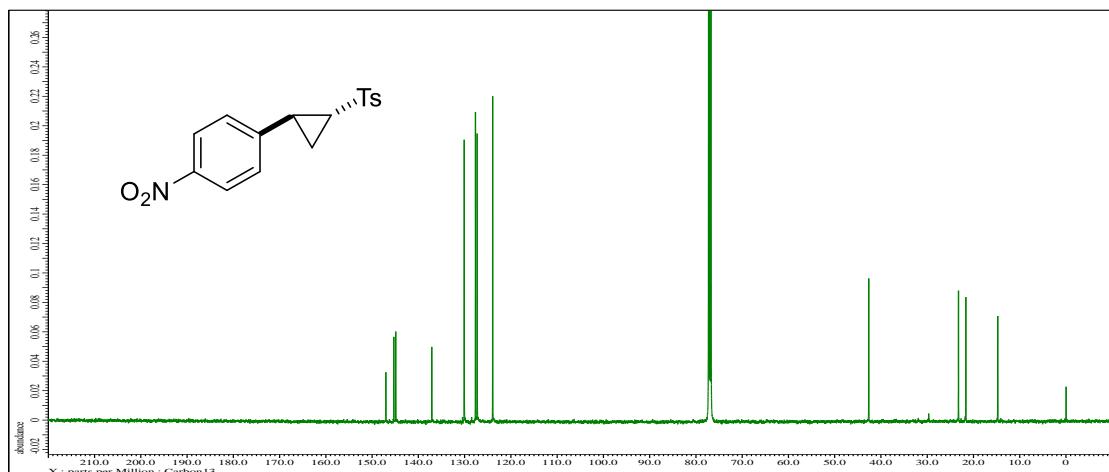
No.	tR [min]	Area	Area%
1	25.867	2657821	3.522
2	27.517	72814565	96.478

No.	tR [min]	Area	Area%
1	25.927	2561752	49.904
2	28.510	2571569	50.096

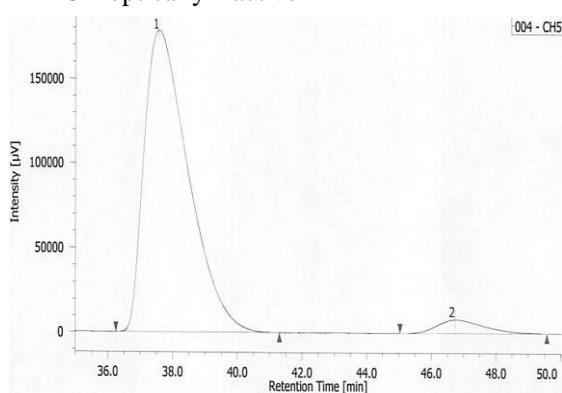
¹H NMR



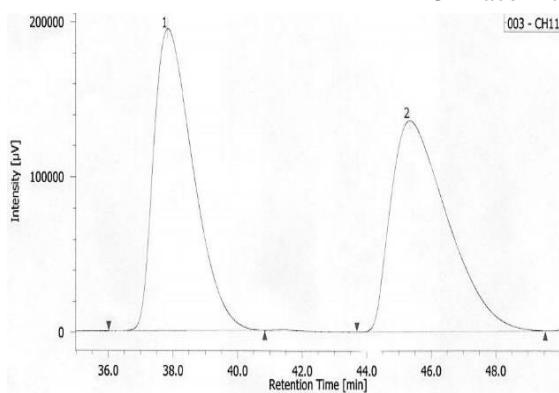
¹³C NMR



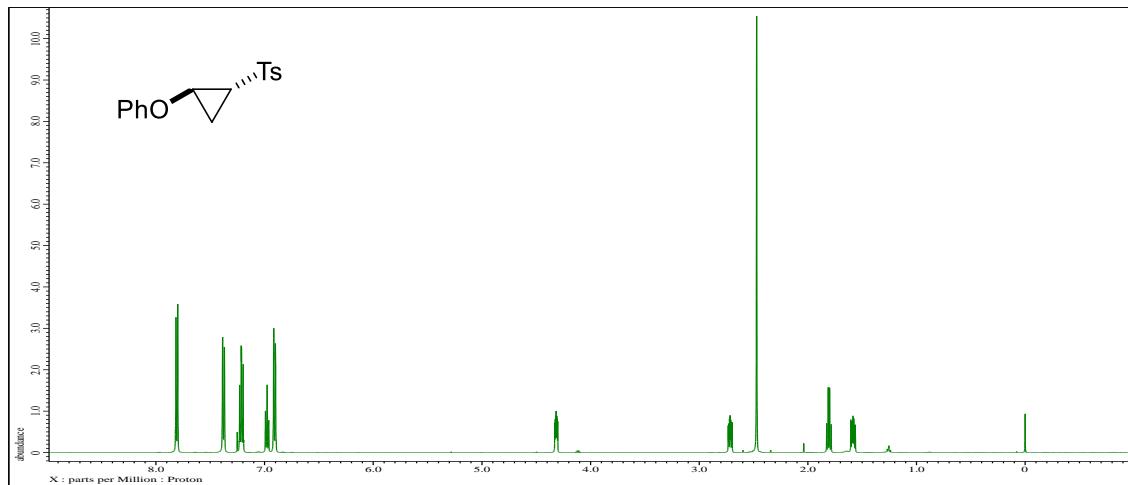
HPLC optically active



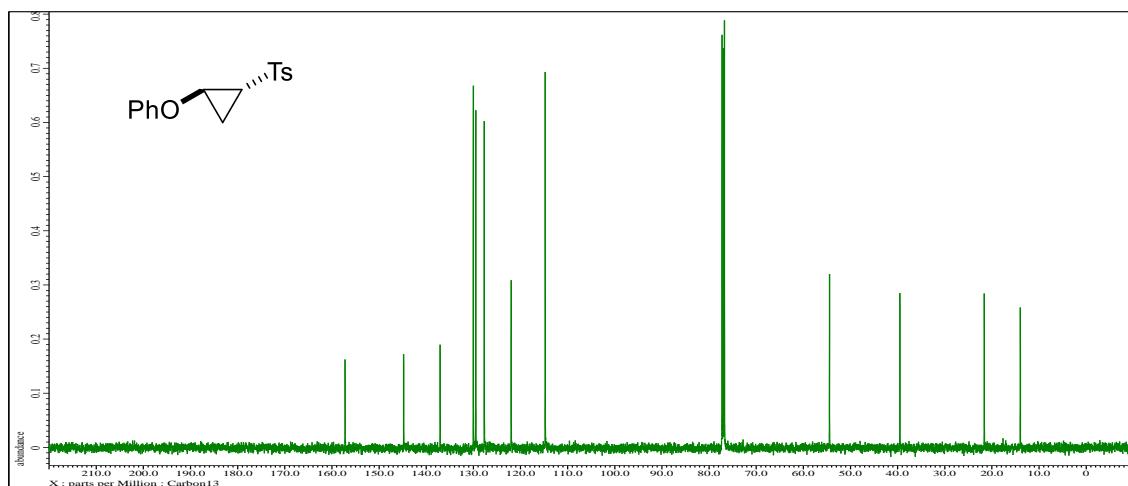
HPLC racemic



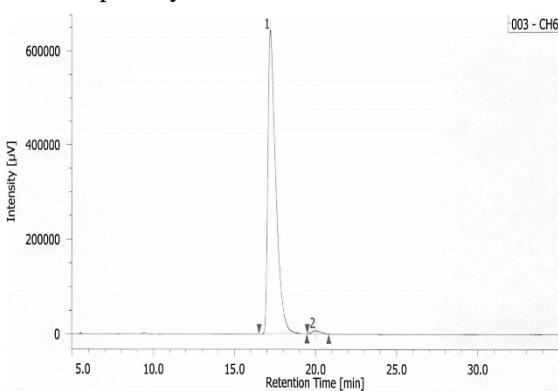
¹H NMR



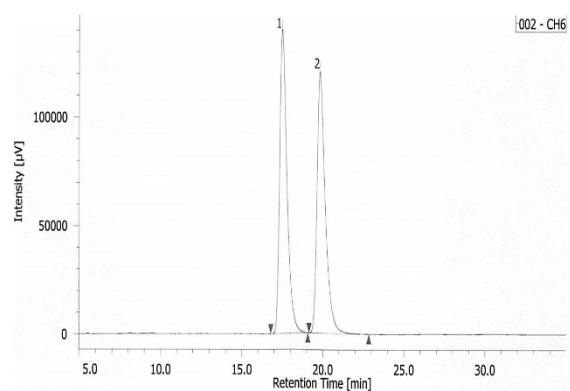
¹³C NMR



HPLC optically active



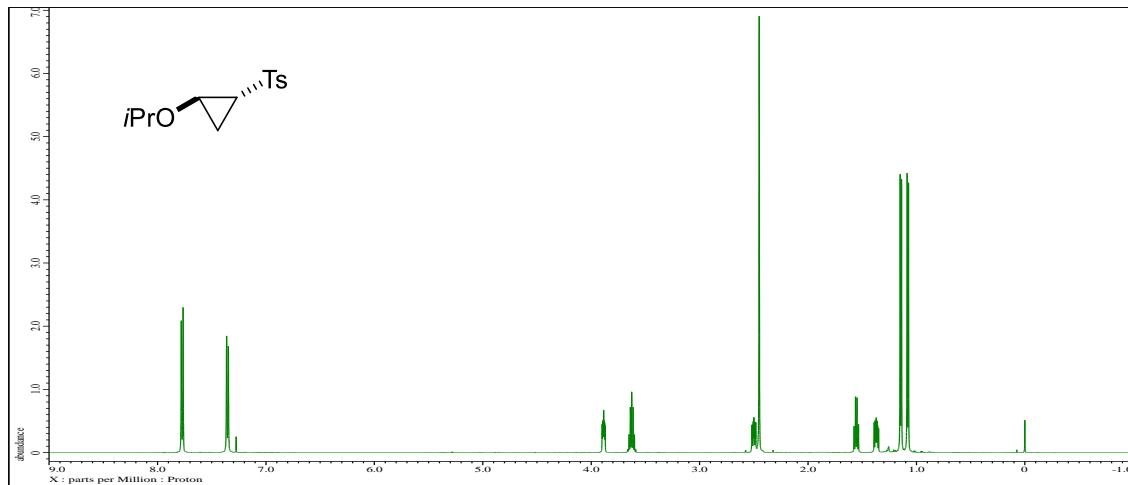
HPLC racemic



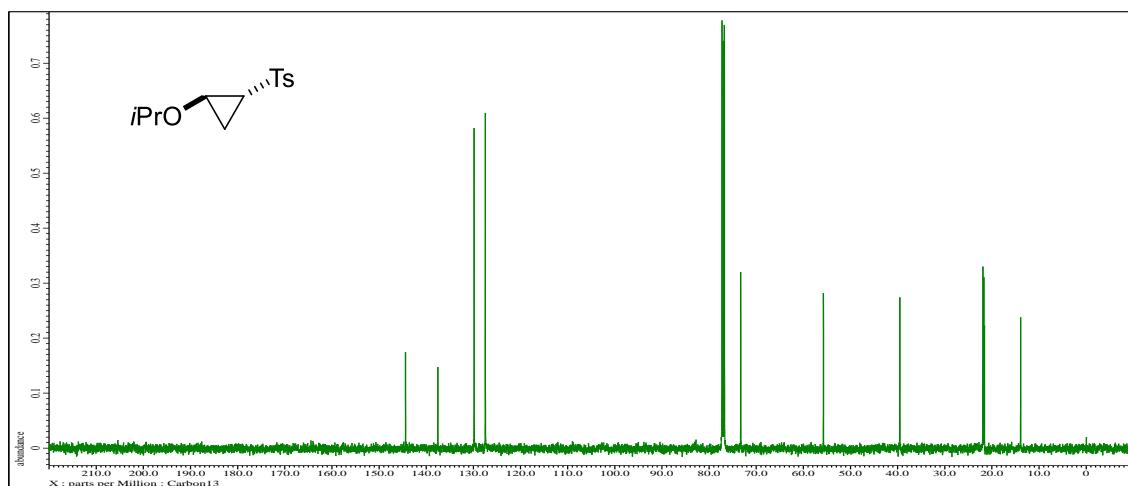
No.	tR [min]	Area	Area%
1	17.182	21521622	98.885
2	20.007	242610	1.115

No.	tR [min]	Area	Area%
1	17.478	4352020	50.151
2	19.800	4325764	49.849

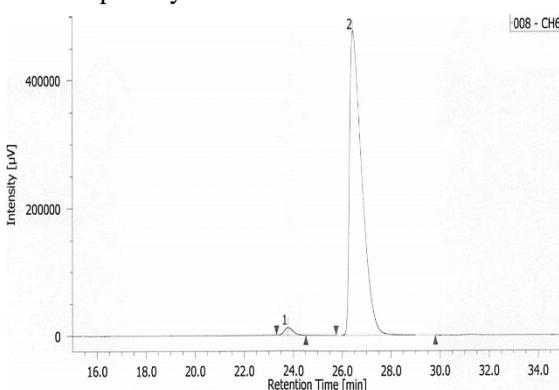
¹H NMR



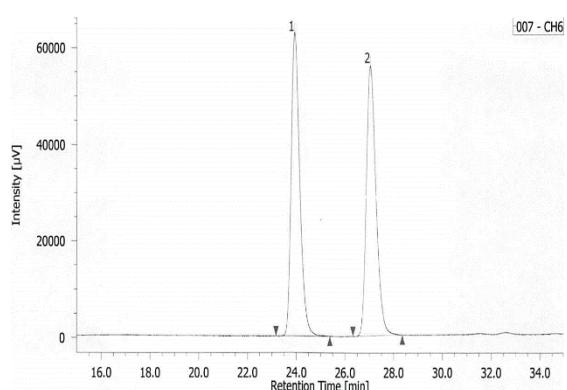
¹³C NMR



HPLC optically active



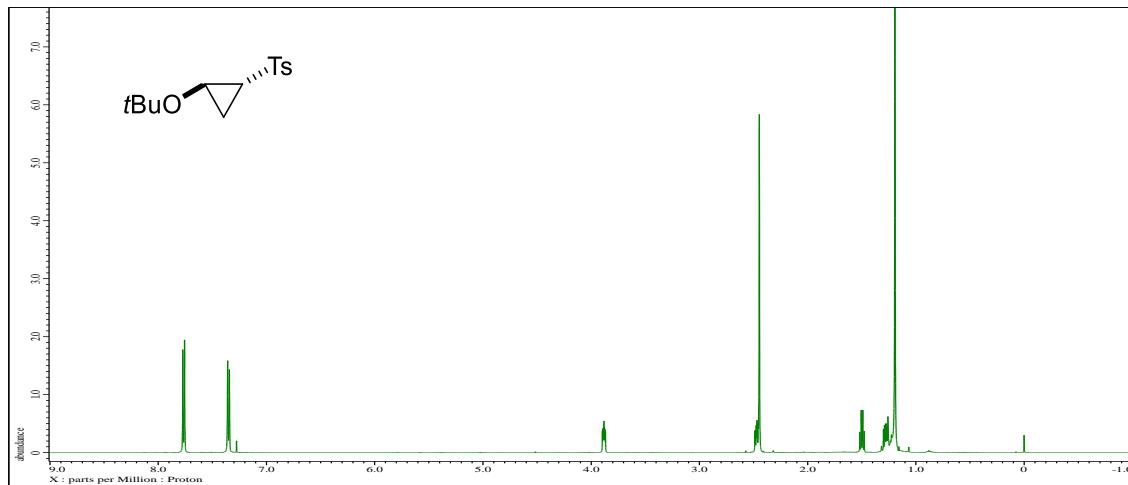
HPLC racemic



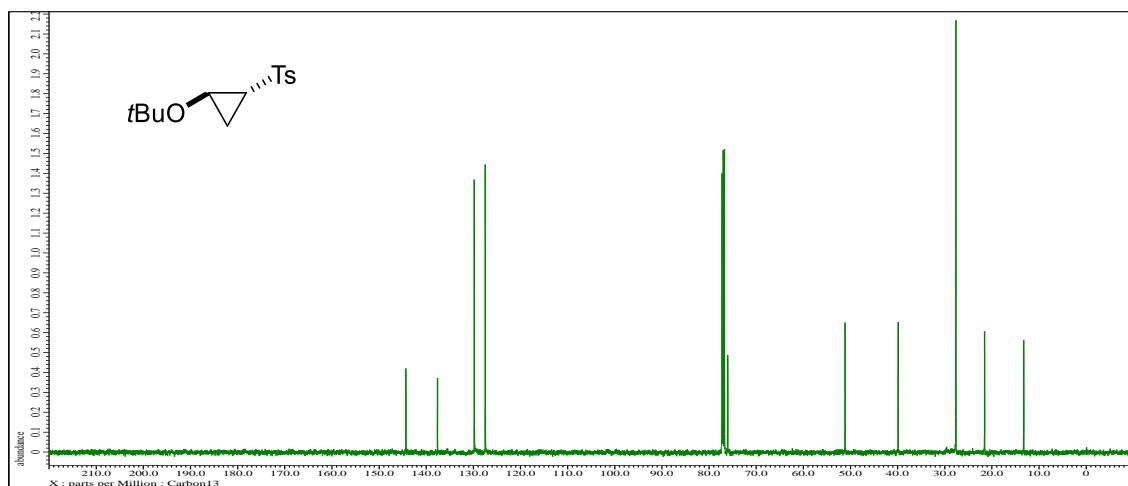
No.	tR [min]	Area	Area%
1	23.780	292538	1.747
2	26.438	16450904	98.253

No.	tR [min]	Area	Area%
1	23.917	1537136	49.986
2	27.025	1537982	50.014

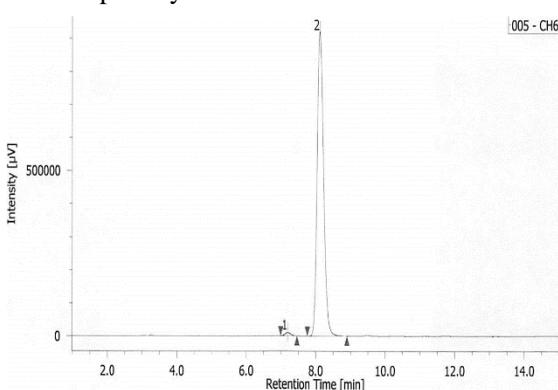
¹H NMR



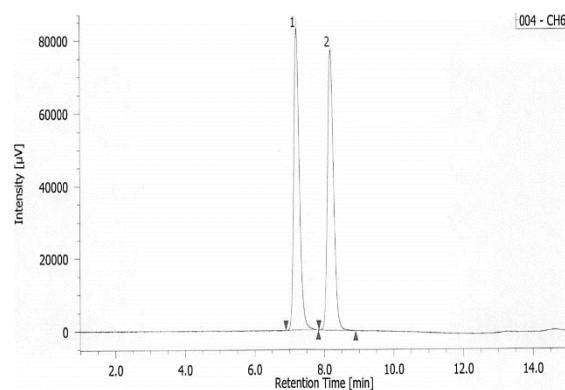
¹³C NMR



HPLC optically active



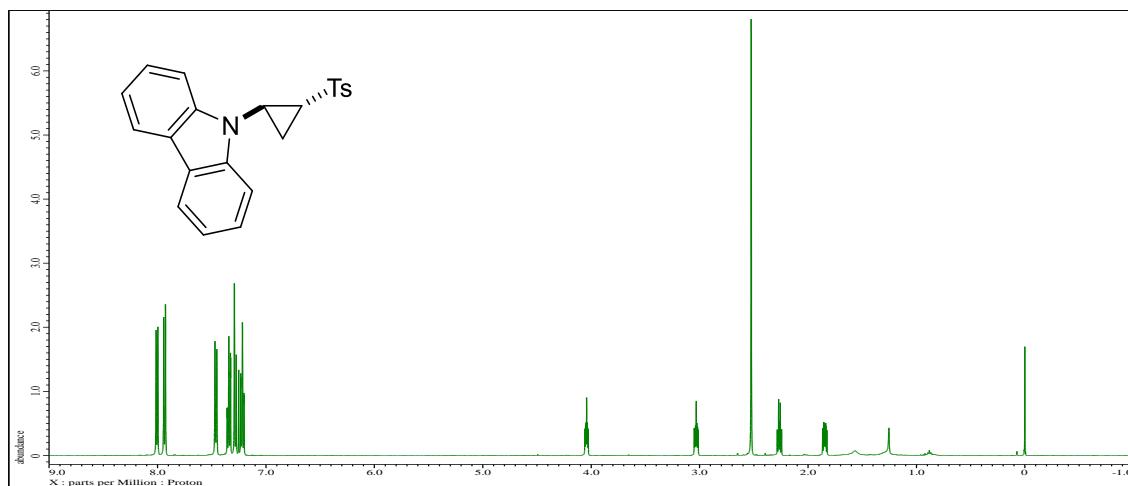
HPLC racemic



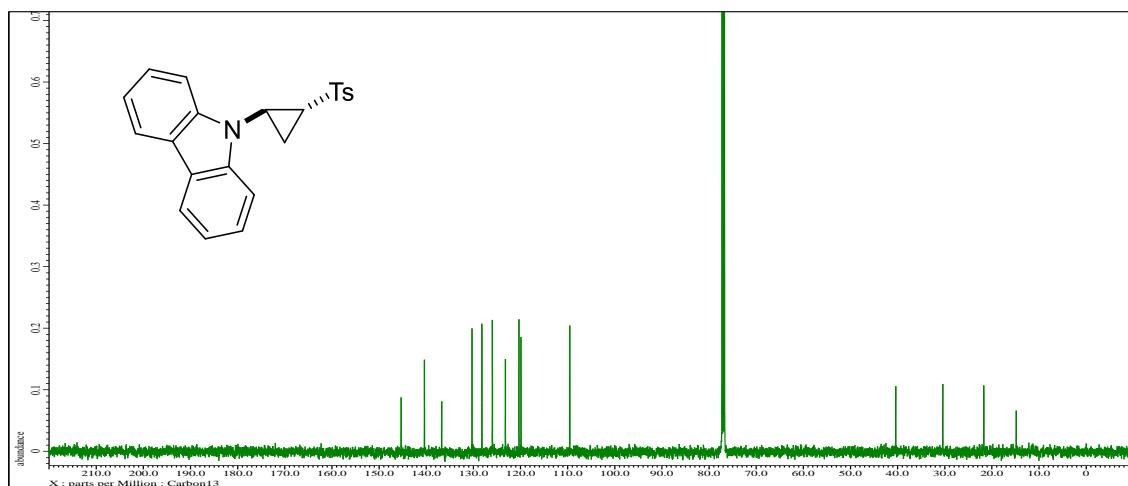
No.	tR [min]	Area	Area%
1	7.190	106575	0.894
2	8.108	11810689	99.106

No.	tR [min]	Area	Area%
1	7.203	920294	49.707
2	8.185	931148	50.293

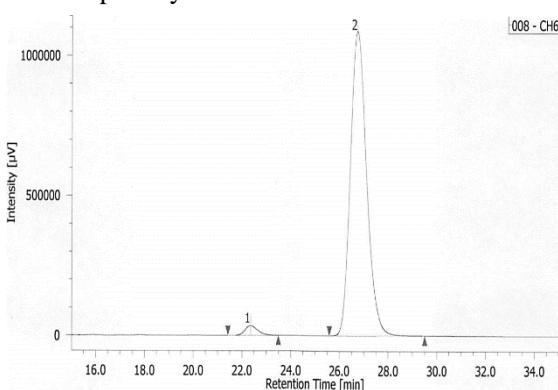
¹H NMR



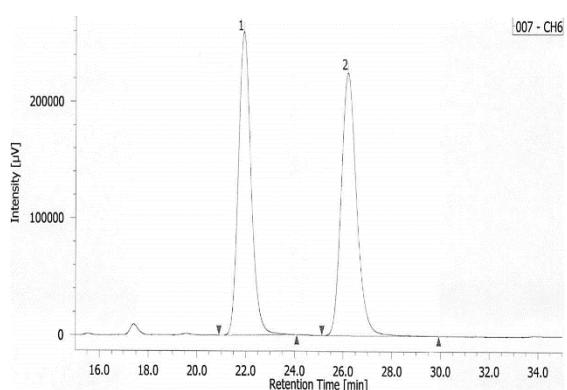
¹³C NMR



HPLC optically active



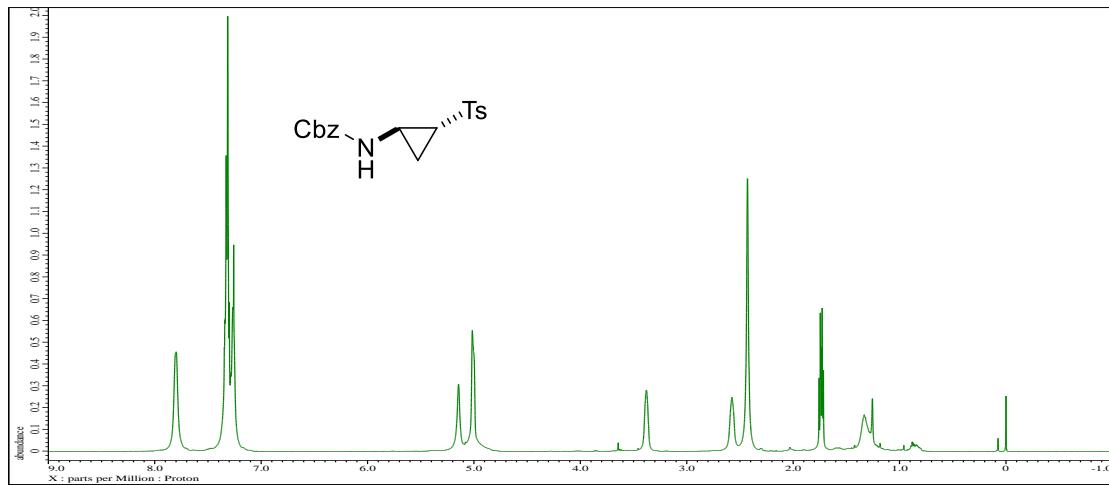
HPLC racemic



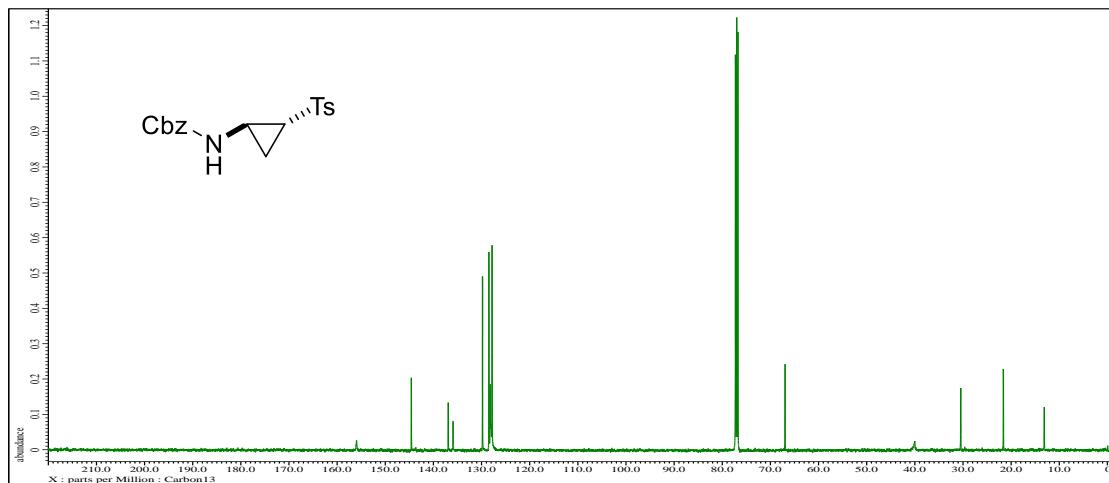
No.	tR [min]	Area	Area%
1	21.905	9458503	49.067
2	26.182	9818221	50.933

No.	tR [min]	Area	Area%
1	22.358	1309877	2.539
2	26.722	50281612	97.461

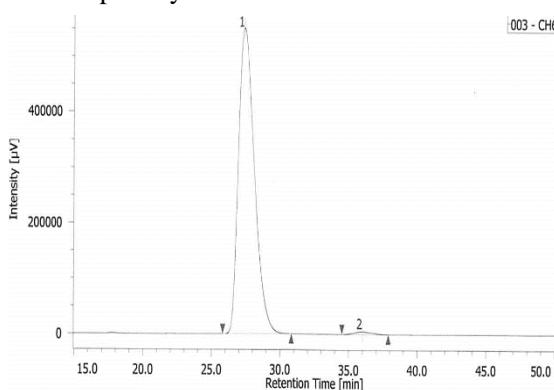
¹H NMR



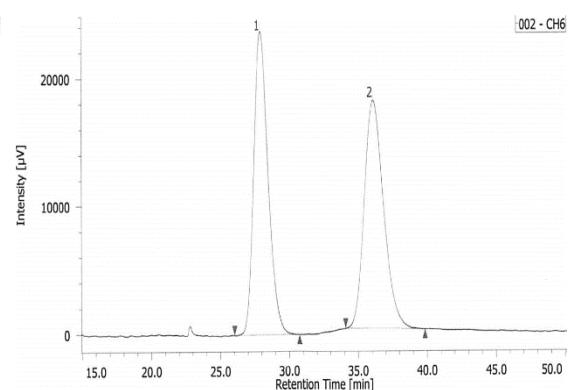
¹³C NMR



HPLC optically active



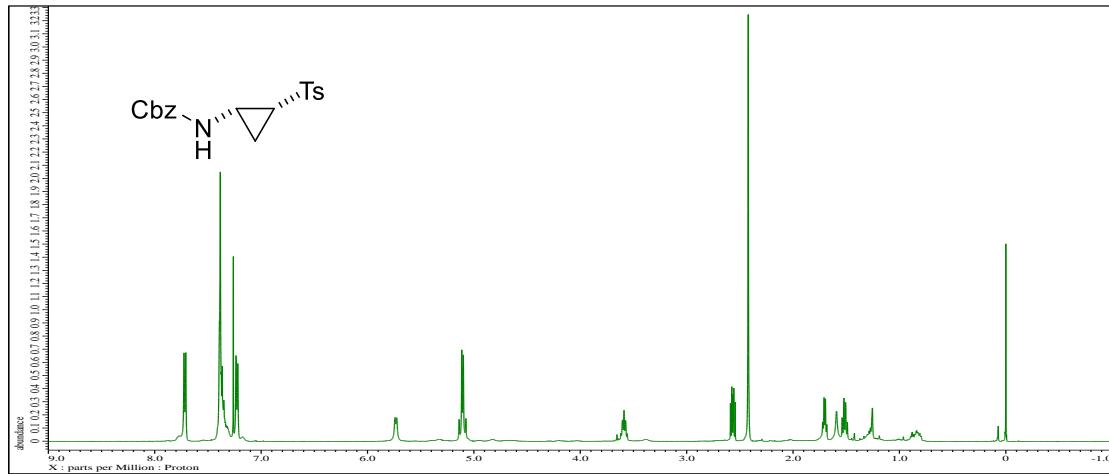
HPLC racemic



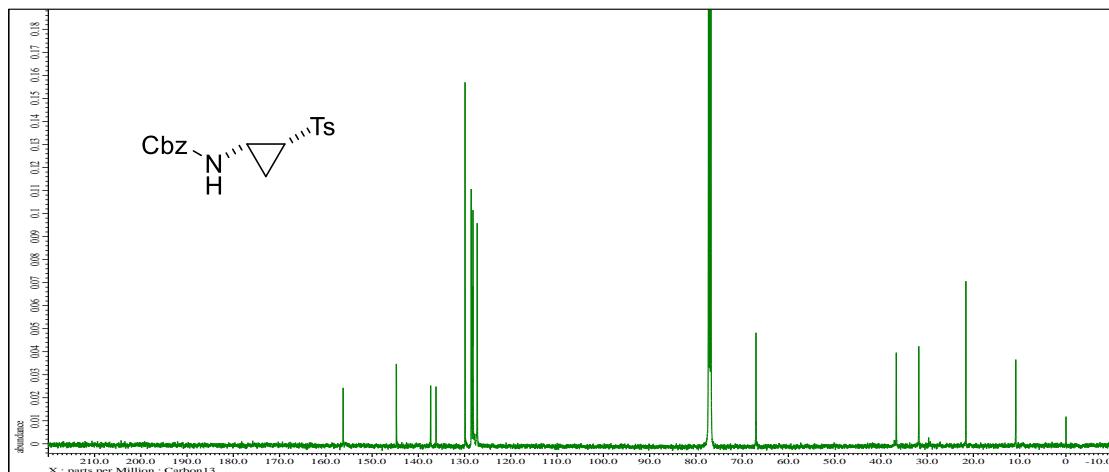
No.	tR [min]	Area	Area%
1	27.350	44955882	99.099
2	36.000	408554	0.901

No.	tR [min]	Area	Area%
1	27.900	1732348	49.794
2	36.062	1746656	50.206

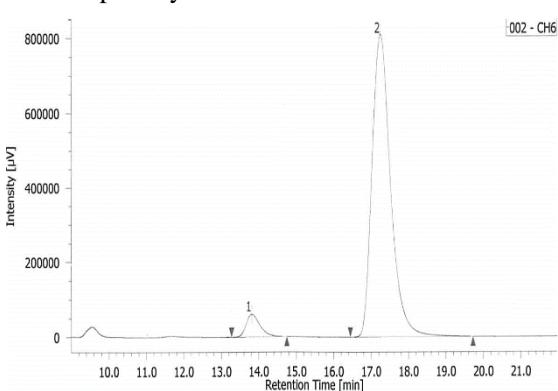
¹H NMR



¹³C NMR

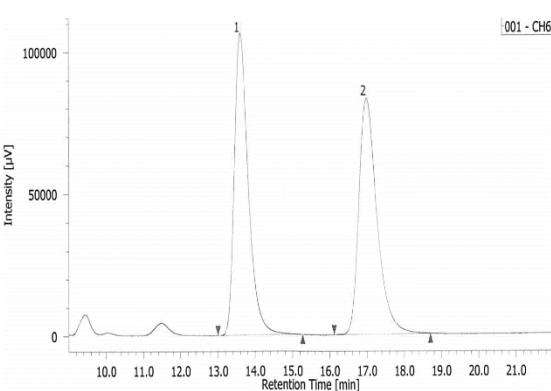


HPLC optically active



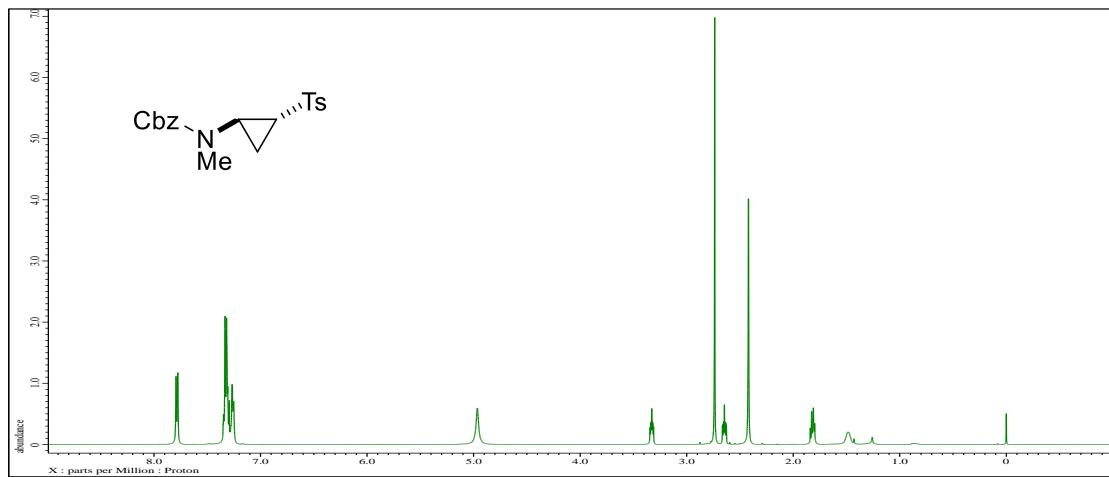
No.	tR [min]	Area	Area%
1	13.815	1585052	5.349
2	17.252	28049940	94.651

HPLC racemic

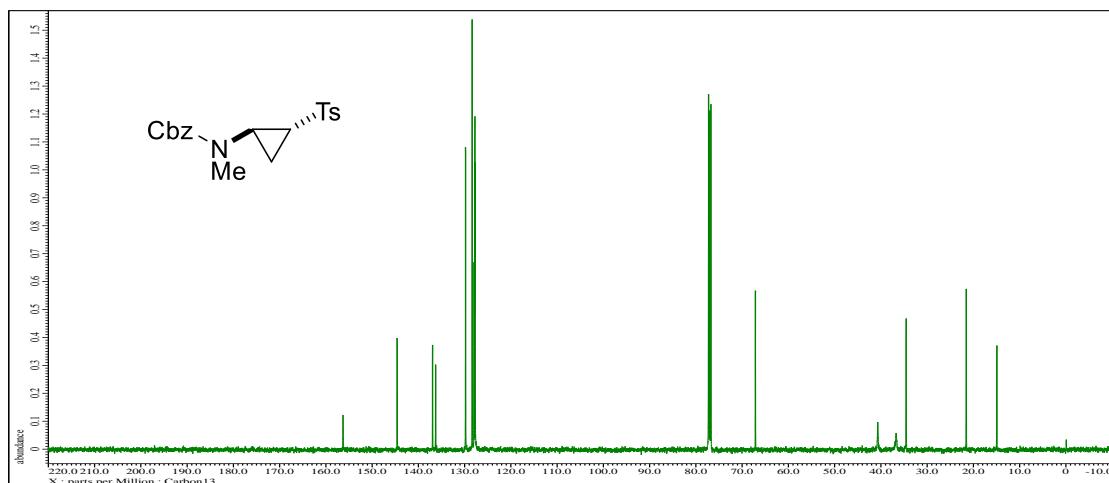


No.	tR [min]	Area	Area%
1	13.592	2794879	49.802
2	16.978	2817131	50.198

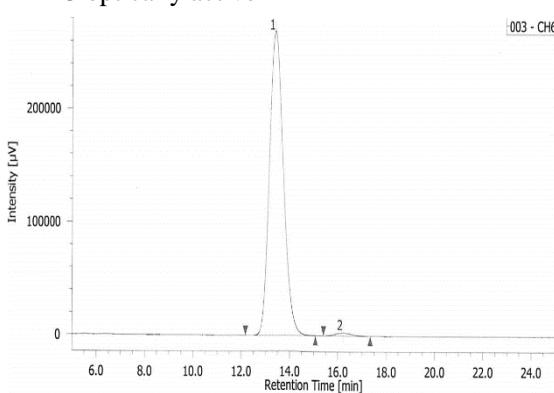
¹H NMR



¹³C NMR

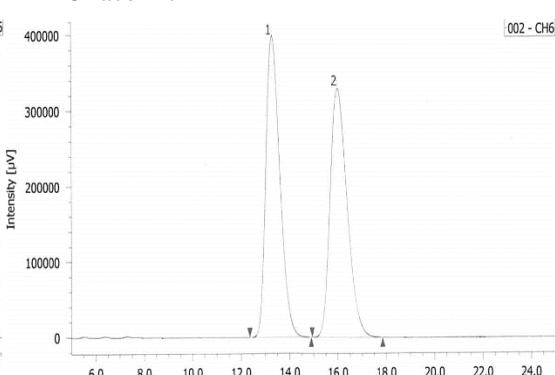


HPLC optically active



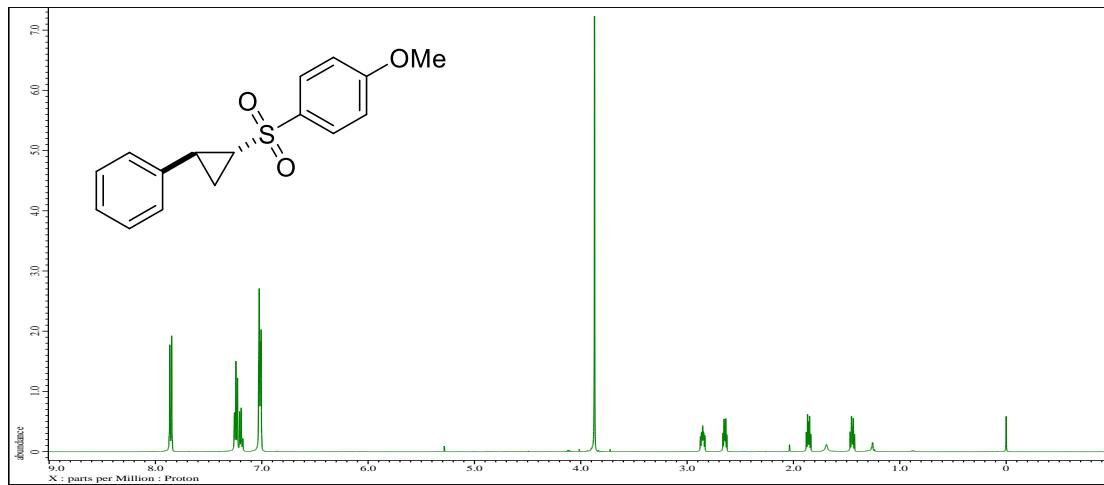
No.	tR [min]	Area	Area%
1	13.392	10738355	98.845
2	16.212	125463	1.155

HPLC racemic

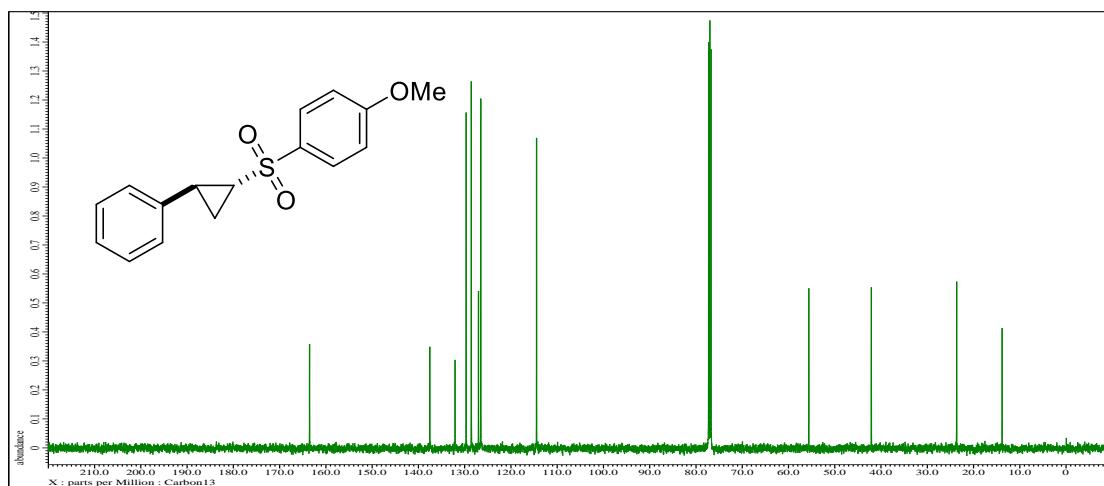


No.	tR [min]	Area	Area%
1	13.287	15944962	49.936
2	15.992	15985933	50.064

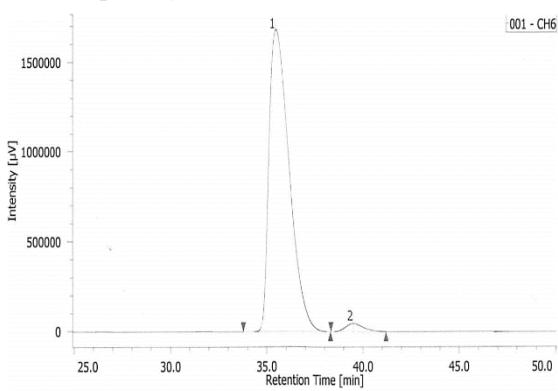
¹H NMR



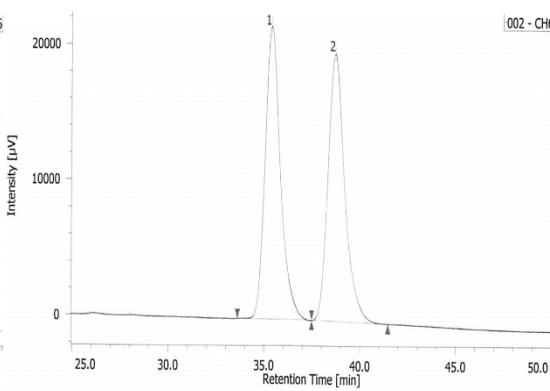
¹³C NMR



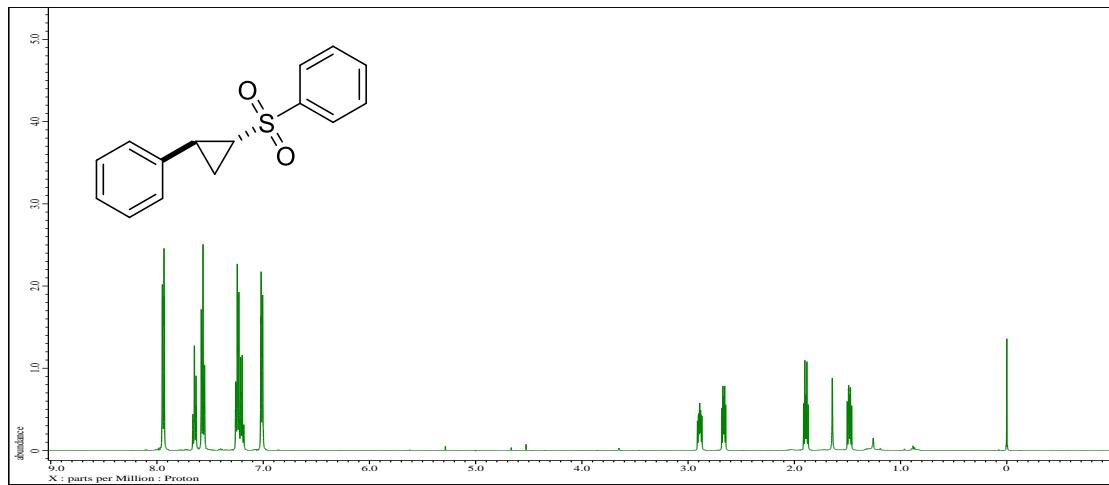
HPLC optically active



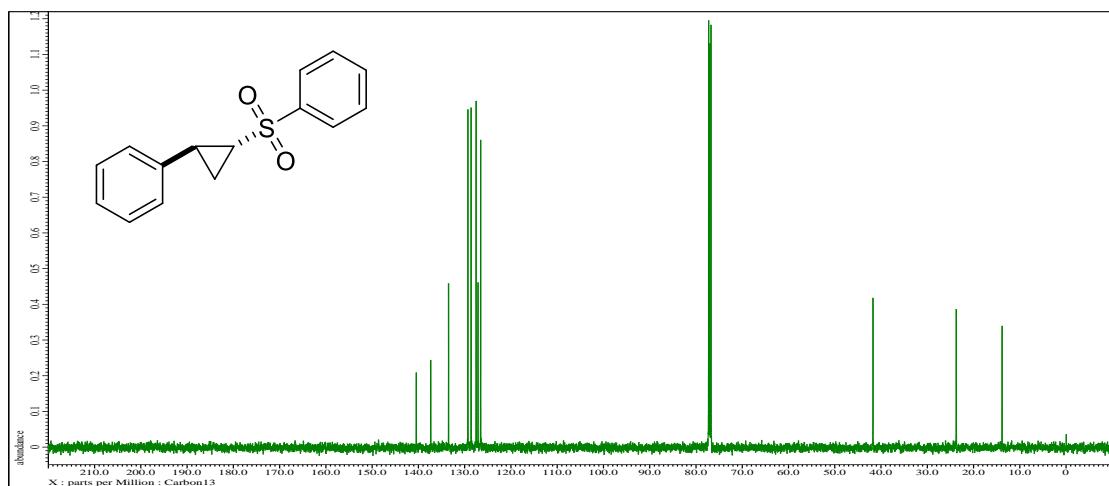
HPLC racemic



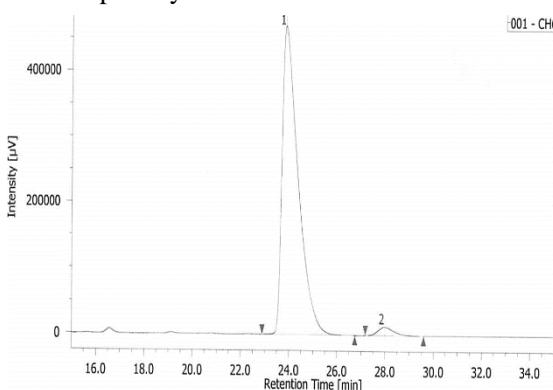
¹H NMR



¹³C NMR

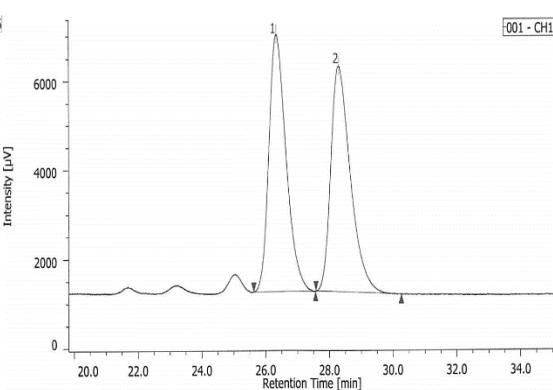


HPLC optically active



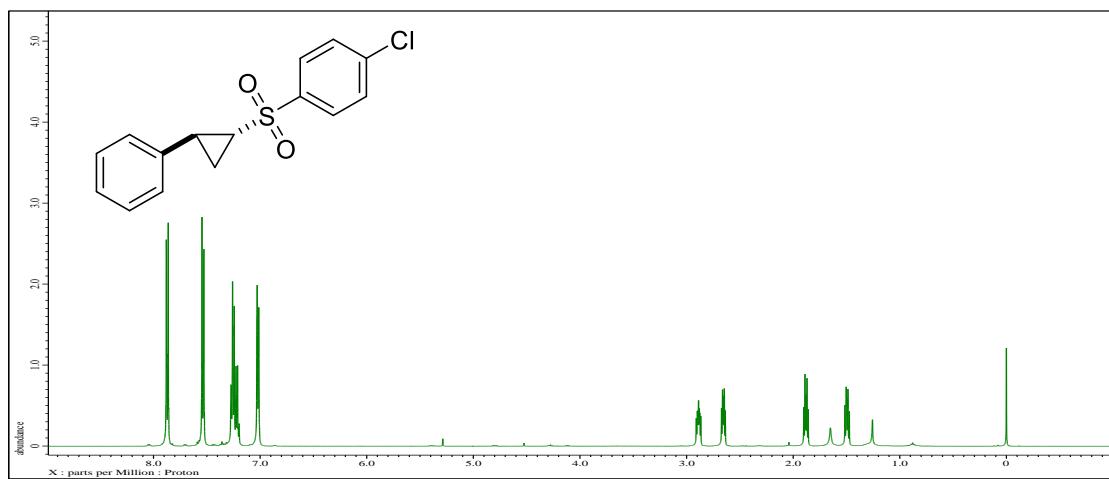
No.	tR [min]	Area	Area%
1	23.848	21601553	97.285
2	27.978	602815	2.715

HPLC racemic

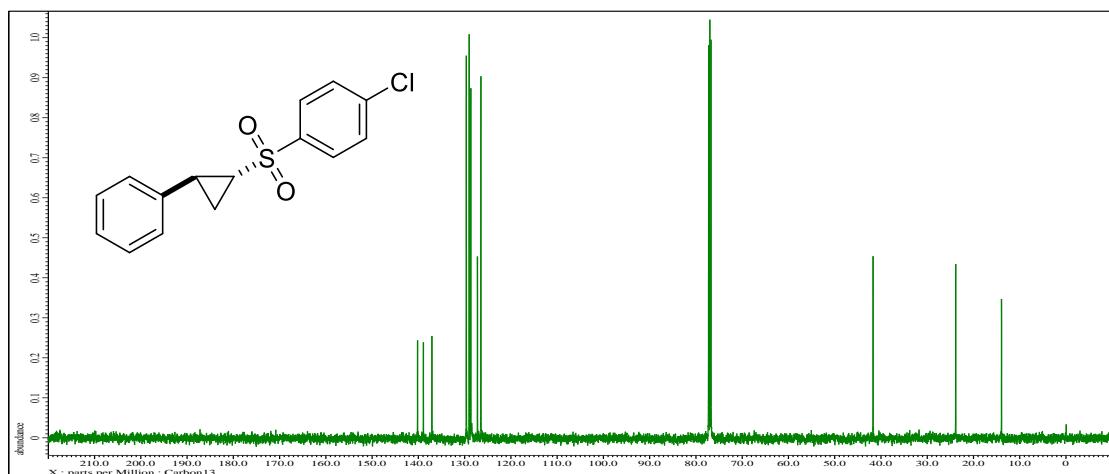


No.	tR [min]	Area	Area%
1	26.342	215525	50.008
2	28.308	215457	49.992

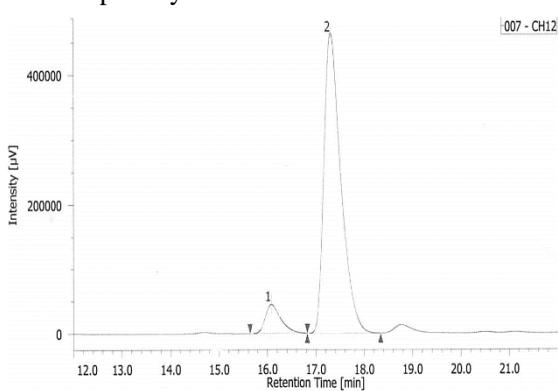
¹H NMR



¹³C NMR

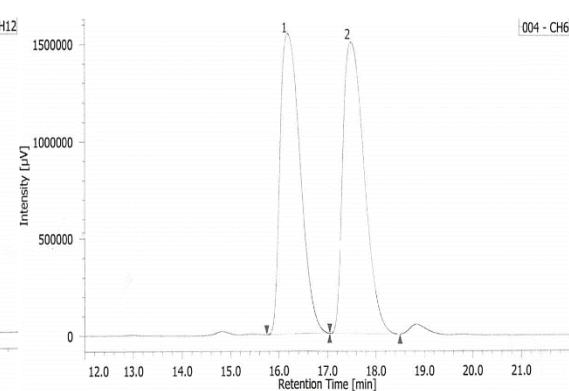


HPLC optically active



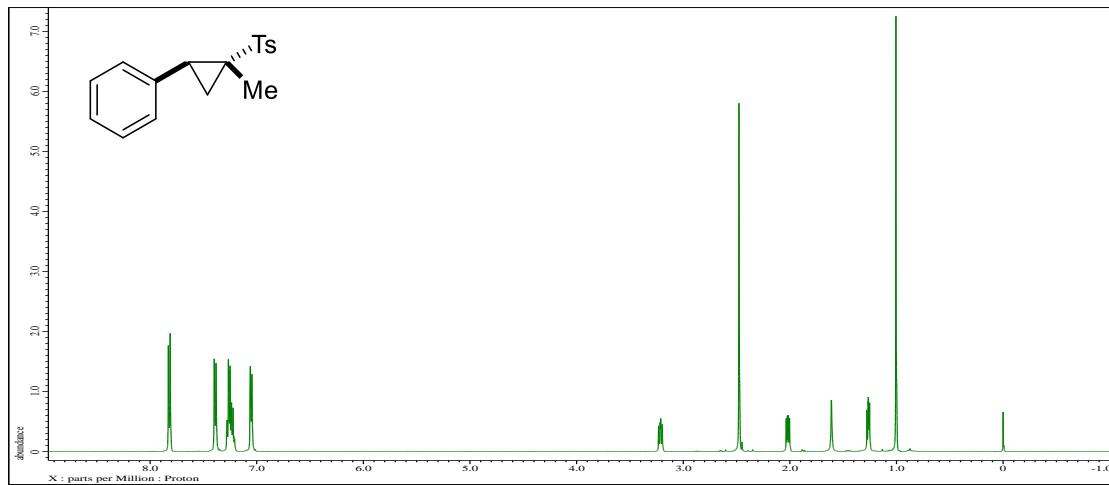
No.	tR [min]	Area	Area%
1	16.080	993879	8.055
2	17.305	11344869	91.945

HPLC racemic

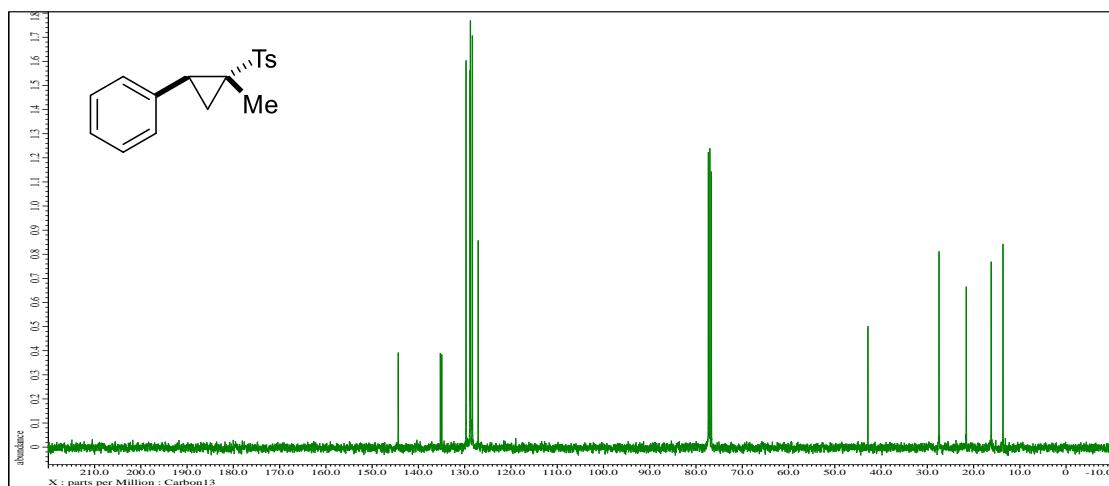


No.	tR [min]	Area	Area%
1	16.180	44503087	49.210
2	17.483	45931580	50.790

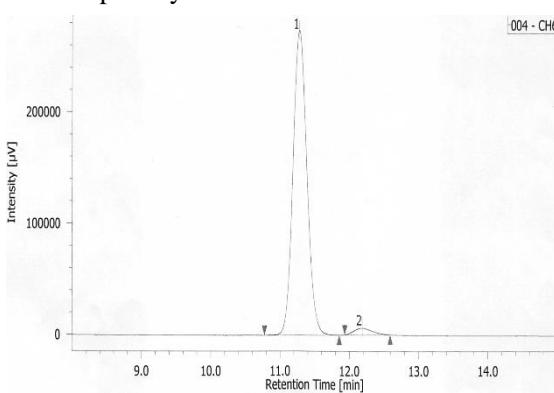
¹H NMR



¹³C NMR

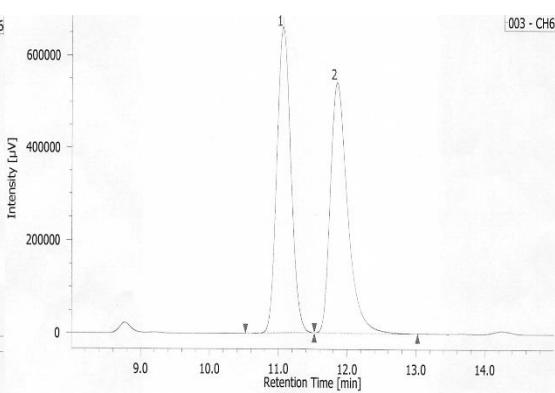


HPLC optically active



No.	tR [min]	Area	Area%
1	11.273	3808086	97.220
2	12.183	108893	2.780

HPLC racemic



No.	tR [min]	Area	Area%
1	11.058	9373152	49.875
2	11.845	9420305	50.125