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ELECTRONIC SUPPORTING INFORMATION

Access towards enantiopure α,α-difluoromethyl alcohols by means of sulfoxides as traceless chiral auxiliaries

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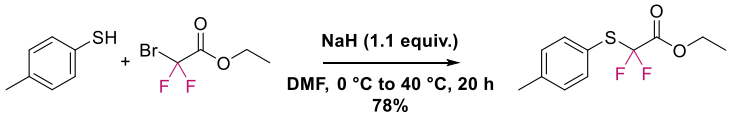
Table of contents

1. General experimental methods and equipment

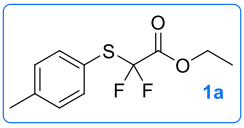
Starting materials, if commercially available, were purchased from standard suppliers (Sigma-Aldrich, Fluorochem, ABCR, Acros, Alfa Aesar or Apollo scientific) and used as such, provided that adequate checks by NMR analysis had confirmed the claimed purity. When needed, solvents were purified and dried following standard procedures. THF was dried by distillation over sodium/benzophenone prior to use. Toluene, when used anhydrous, was either dried over 4 Å molecular sieves previously activated overnight at 300 °C under vacuum or dried by distillation over sodium. Anhydrous DMF purchased from Sigma Aldrich was used as received. Air- and moisture- sensitive materials were stored and handled under an atmosphere of argon. Reactions were carried out under an atmosphere of argon when needed. Reactions were monitored by using thin-layer chromatography with precoated silica on aluminum foils (0.25 mm, Merck silica-gel (60-F_{254})). Flash column chromatography was performed on VWR silica gel (40–63 µm) using the indicated solvents, the solvent systems being indicated in v/v. Butyllithium (1.6 M in hexanes, Aldrich) was used as a solution in hexanes and its concentration was determined following the Wittig-Harborth double titration method ((total base) - (residual base after reaction with 1,2-dibromoethane)).[1] Spectroscopic NMR and MS data were obtained using chromatographically homogeneous samples. ^{1}H NMR (400 or 500 MHz), ^{19}F NMR (376 or 472 MHz) and ^{13}C NMR (101 or 126 MHz) spectra were recorded in $CDCl_3$ on Bruker Avance III HD 400 and 500 MHz instruments respectively. Chemical shifts are reported in parts per million (ppm) and are referred to partially deuterated chloroform ($\delta[^{1}H]$ = 7.26 ppm and $\delta[^{13}C]$ = 77.16 ppm). Multiplicities were abbreviated as br s (broad singlet), s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), td (triplet of doublets), dd (doublet of doublets). Coupling constants *J* were given in Hz. Spectra were processed with the program NMR notebook (Version 2.80, NMRtec). IR spectra were recorded on a Perkin Elmer's Spectrum one™, the frequencies being reported in cm^{-1}. Chiral HPLC analyses were performed on a Shimadzu Prominence chromatograph. High-resolution mass spectra (HRMS) were recorded with a TOF mass analyser under ESI in positive ionization mode detection by the analytical facility at the Université de Strasbourg. The X-ray crystallographic structure analysis was performed by the radiocrystallographic facility at the Université de Strasbourg. The analysis was carried out on a Nonius Kappa-CCD diffractometer equipped with an Oxford Cryosystem liquid N_2 device, using Mo-Kα radiation (λ = 0.71073 Å).

2. Synthesis of racemic aryl α,α-difluoromethyl sulfoxides 3a and 3b

a. Ethyl 2,2-difluoro-2-(*p*-tolylthio)acetate 1a



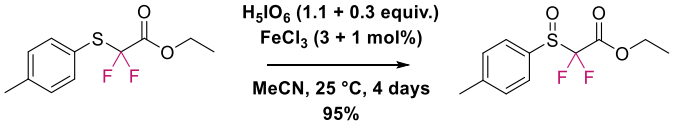
A solution of *p*-toluenethiol (1 equiv., 5 g, 39.5 mmol) dissolved in anhydrous DMF (15 mL) was cannulated dropwise onto a suspension of sodium hydride (60% dispersion in mineral oil; 1.1 equiv., 1.74 g, 43.4 mmol) in anhydrous DMF (15 mL) at 0 °C under an atmosphere of argon. Ethyl bromodifluoroacetate (1 equiv., 5.22 mL, 39.5 mmol) was then syringed dropwise into the previous solution. The reaction mixture was stirred at 40 °C for 20 hours, then cooled to 0 °C and quenched with water. The aqueous phase was extracted three times with CH_2Cl_2. The combined organic layers were washed with large amounts of water and with a saturated solution of NaCl. The resulting organic phase was dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel with cyclohexane/AcOEt (100/0 to 95/5). Ethyl 2,2-difluoro-2-(*p*-tolylthio)acetate **1a** (7.55 g, 78%) was obtained as a light yellow oil.



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.50 (d, J = 8.2 Hz, 2H), 7.20 (d, J = 8.2 Hz, 2H), 4.26 (q, J = 7.2 Hz, 2H), 2.38 (s, 3 H), 1.27 (t, J = 7.2 Hz, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –82.6 (s, 2F). These data are consistent with those already reported in the literature.[2]

b. Ethyl 2,2-difluoro-2-(*p*-tolylsulfinyl)acetate 2a

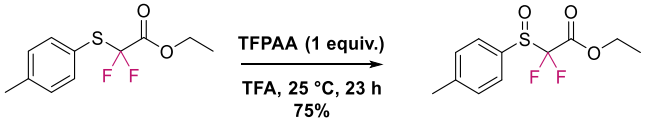
α. Periodic acid and iron (III) chloride



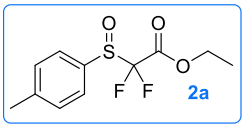
Ethyl 2,2-difluoro-2-(*p*-tolylthio)acetate **1a** (1 equiv., 12 g, 48.7 mmol) and $FeCl_3$ (3 mol%, 244 mg, 1.46 mmol) were dissolved in 75 mL of acetonitrile. After 10 minutes of stirring, periodic acid (1.1 equiv., 12.3 g, 53.6 mmol) was added to the mixture which was mechanically stirred at 25 °C. After 3 days (*ca.* 80% conversion, determined by ^{1}H and ^{19}F NMR analysis) were added more periodic acid (0.3 equiv.) and $FeCl_3$ (1 mol%). After 4 days of stirring, the reaction was slowly quenched with a saturated solution of $Na_2S_2O_3$ and extracted three times with CH_2Cl_2. The combined organic layers were washed with water and with a saturated solution of NaCl, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The crude product was purified by chromatography on

demetalated silica gel with cyclohexane/AcOEt (100/0 to 80/20). Ethyl 2,2-difluoro-2-(*p*-tolylsulfinyl)acetate **2a** (12.1 g, 95%) was obtained as a yellow oil.

β. Hydrogen peroxide and trifluoroacetic acid



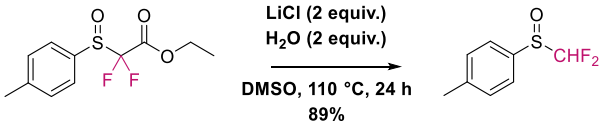
To a solution of trifluoroperoxyacetic acid (TFPAA) at 0 °C (1 equiv., prepared by mixing 415 µL of H_2O_2, 30% w/w in water, with 1.36 mL of trifluoroacetic acid, TFA, at 0 °C) was added dropwise ethyl 2,2-difluoro-2-(*p*-tolylthio)acetate **1a** (1 equiv., 1 g, 4.06 mmol) dissolved in 6.5 mL of TFA. The solution was warmed to 25 °C and stirred at this temperature for 23 hours. The reaction mixture was carefully poured onto a saturated solution of $NaHCO_3$. The aqueous phase was extracted three times with AcOEt. The combined organic phases were washed with water and with a saturated solution of NaCl, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The crude product was purified by chromatography on demetalated silica gel with cyclohexane/AcOEt (100/0 to 80/20). Ethyl 2,2-difluoro-2-(*p*-tolylsulfinyl)acetate **2a** (800 mg, 75%) was obtained as a yellow oil.



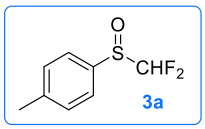
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.61 (d, J = 8.2 Hz, 2H), 7.38 (d, J = 8.2 Hz, 2H), 4.26 (qd, J = 7.2 Hz, 1.7 Hz, 2H), 2.44 (s, 3H), 1.27 (t, J = 7.2 Hz, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) −110.6 (AB system, J_{AB} = 228.0 Hz, $\Delta\nu_{AB}$ = 722.5 Hz, 2F). These data are consistent with those already reported in the literature.[2]

c. *α,α*-Difluoromethyl *p*-tolyl sulfoxide 3a

Thermal conditions

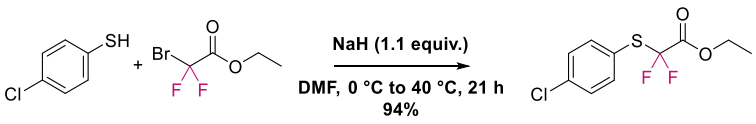


Ethyl 2,2-difluoro-2-(*p*-tolylsulfinyl)acetate **2a** (1 equiv., 3 g, 10.9 mmol) was dissolved in 85 mL of DMSO. LiCl (2 equiv., 931 mg, 21.8 mmol) and H_2O (2 equiv., 391 µL, 21.8 mmol) were then introduced. The reaction mixture was stirred at 110 °C for 24 hours. The mixture was cooled to room temperature and then poured onto cold water. The aqueous layer was saturated with NaCl and then extracted three times with AcOEt. The combined organic layers were washed with water and with a saturated solution of NaCl, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel with cyclohexane/AcOEt (100/0 to 80/20). *α,α*-Difluoromethyl *p*-tolyl sulfoxide **3a** (1.83 g, 89%) was obtained as a white solid.

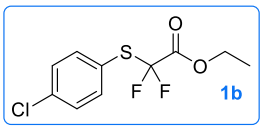


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.61 (d, J = 8.1 Hz, 2H), 7.39 (d, J = 8.1 Hz, 2H), 6.01 (t, J = 55.5 Hz, 1H), 2.44 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –119.5 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 261.6 Hz, $J_{AX} = J_{BX} = J_{H\text{-}F}$ = 55.2 Hz, $\Delta\nu_{AB}$ = 72.3 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 133.6 (t, J = 2.9 Hz), 130.5, 125.6, 121.1 (t, J = 289.4 Hz), 21.7. **IR ν (cm^{-1})** 3039, 1598, 1495, 1293, 1105, 1080, 1068, 1034, 1019, 969, 952, 808, 709, 694.

d. Ethyl 2-(4-chlorophenylthio)-2,2-difluoroacetate 1b



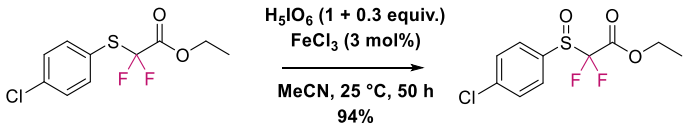
A solution of 4-chlorothiophenol (1 equiv., 12 g, 81.3 mmol) dissolved in anhydrous DMF (35 mL) was cannulated dropwise onto a suspension of sodium hydride (60% dispersion in mineral oil; 1.1 equiv., 3.58 g, 89.5 mmol) in anhydrous DMF (30 mL) at 0 °C under argon. Ethyl bromodifluoroacetate (1 equiv., 10.8 mL, 81.32 mmol) was then syringed dropwise into the previous solution. The reaction mixture was heated at 40 °C for 21 hours, then cooled to 0 °C, quenched with water and extracted three times with CH_2Cl_2. The combined organic layers were washed with large amounts of water and a saturated solution of NaCl. The resulting organic phase was dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel with cyclohexane/AcOEt (100/0 to 90/10). Ethyl 2-(4-chlorophenylthio)-2,2-difluoroacetate (20.4 g, 94%) **1b** was obtained as a light-yellow oil.



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.55 (d, J = 8.4 Hz, 2H), 7.38 (d, J = 8.5 Hz, 2H), 4.29 (q, J = 7.2 Hz, 2H), 1.29 (t, J = 7.2 Hz, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –82.1 (s, 2F). These data are consistent with those already reported in the literature.[2]

e. Ethyl 2-(4-chlorophenylsulfinyl)-2,2-difluoroacetate 2b

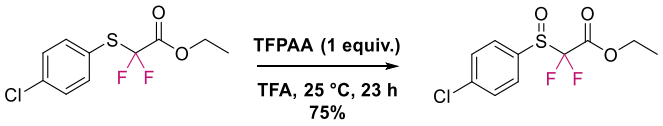
α. Periodic acid and iron (III) chloride



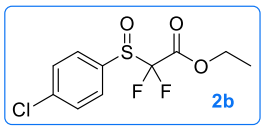
Ethyl 2-(4-chlorophenylthio)-2,2-difluoroacetate **1b** (1 equiv., 5 g, 18.7 mmol) and $FeCl_3$ (3 mol%, 94.1 mg, 562 µmol) were dissolved in 50 mL of acetonitrile. After 10 minutes of stirring, periodic acid (1 equiv., 4.32 g, 18.7 mmol) was added to the mixture which was mechanically stirred at 25 °C. After 24 h (*ca.* 80% conversion), 39 h (*ca.* 87% conversion) and 48 h (*ca.* 92% conversion), were added each time 0.1 equiv. of oxidizing agent (total = 0.3 equiv. of H_5IO_6). After 50 hours of stirring, the reaction

was slowly quenched with a saturated solution of $Na_2S_2O_3$. The aqueous phase was extracted several times with CH_2Cl_2. The combined organic layers were washed with water and with a saturated solution of NaCl, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The crude product was purified by chromatography on demetalated silica gel with cyclohexane/AcOEt (100/0 to 90/10). Ethyl 2-(4-chlorophenylsulfinyl)-2,2-difluoroacetate **2b** (4.97 g, 94%) was obtained as a yellow oil.

β. Hydrogen peroxide and trifluoroacetic acid



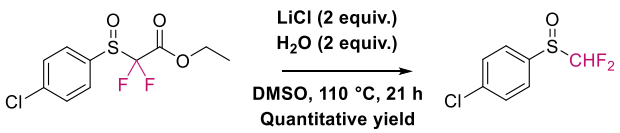
To a solution of trifluoroperoxyacetic acid (TFPAA) at 0 °C (1 equiv., prepared by mixing 383 µL of H_2O_2, 30% w/w in water, with 1.25 mL of trifluoroacetic acid, TFA, at 0 °C) was added dropwise ethyl 2-(4-chlorophenylthio)-2,2-difluoroacetate **1b** (1 equiv., 1 g, 3.75 mmol) dissolved in 6 mL of TFA. The solution was warmed to 25 °C and stirred at this temperature for 23 hours. The reaction mixture was carefully poured onto a saturated solution of $NaHCO_3$. The aqueous phase was extracted three times with AcOEt. The combined organic phases were washed with water and with a saturated solution of NaCl, dried over anhydrous sodium sulfate and concentrated under reduced pressure. The crude product was purified by chromatography on demetalated silica gel with cyclohexane/AcOEt (100/0 to 80/20). Ethyl 2-(4-chlorophenylsulfinyl)-2,2-difluoroacetate **2b** (800 mg, 75%) was obtained as a yellow oil.



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.67 (d, J = 8.4 Hz, 2H), 7.57 (d, J = 8.5 Hz, 2H), 4.30 (q, J = 7.1 Hz, 2H), 1.30 (t, J = 7.2 Hz, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) −110.0 (AB system, J_{AB} = 228.0 Hz, $\Delta\nu_{AB}$ = 994.3 Hz, 2F). These data are consistent with those already reported in the literature.[2]

f. 1-Chloro-4-((difluoromethyl)sulfinyl)benzene 3b

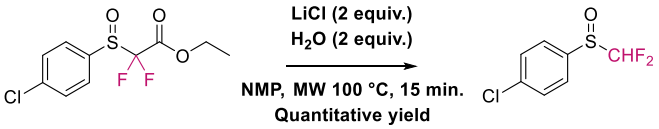
α. Thermal conditions



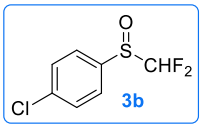
Ethyl 2-(4-chlorophenylsulfinyl)-2,2-difluoroacetate **2b** (1 equiv., 100 mg, 354 µmol) was dissolved in 3 mL of DMSO. LiCl (2 equiv., 30.3 mg, 707 µmol) and H_2O (2 equiv., 12.7 µL, 707 µmol) were then introduced. The reaction mixture was stirred at 110 °C for 21 hours, cooled to room temperature and then poured onto ice-cold water. The aqueous layer was saturated with NaCl and then extracted three

times with AcOEt. The combined organic layers were washed with water, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel with cyclohexane/AcOEt (90/10 to 70/30). 1-Chloro-4-((difluoromethyl)sulfinyl)benzene **3b** (75 mg, quantitative yield) was obtained as a white solid.

β. Microwave conditions



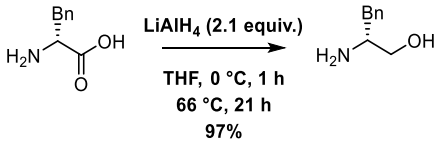
To a suspension of LiCl (2 equiv., 15.1 mg, 354 µmol) and ethyl 2-(4-chlorophenylsulfinyl)-2,2-difluoroacetate **2b** (1 equiv., 50 mg, 177 µmol) in 3 mL of *N*-methylpyrrolidine (NMP) was added H_2O (2 equiv., 6.37 mL, 354 µmol). The reaction mixture was heated to 100 °C under microwave irradiation for 15 minutes. The dark brown reaction mixture was cooled to room temperature. An aqueous solution of 1M HCl was added to the mixture. The aqueous layer was extracted three times with AcOEt. The combined organic layers were washed three times with ice-cold water and with a cold saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel with cyclohexane/AcOEt (100/0 to 70/30). 1-Chloro-4-((difluoromethyl)sulfinyl)benzene **3b** (38 mg, quantitative yield) was obtained as a white solid.



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.67 (d, J = 8.5 Hz, 2H), 7.58 (d, J = 8.5 Hz, 2H), 6.19 (t, J = 55.2 Hz, 1H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –119.3 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 262.3 Hz, $J_{AX} = J_{BX} = J_{H\text{-}F}$ = 55.2 Hz, $\Delta\nu_{AB}$ = 256.7 Hz, 2F). These data are consistent with those already reported in the literature.[4]

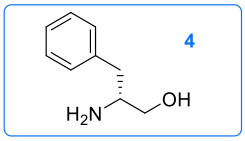
3. Synthesis of enantiopure *α,α*-difluoromethyl *p*-tolyl sulfoxide (*S*)-3a

a. (+)-Phenylalaninol 4



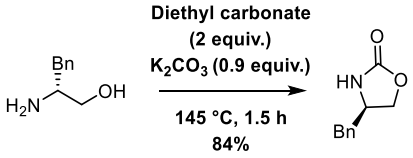
Following a reported procedure,[5] to a slurry of $LiAlH_4$ (2.1 equiv., 1.7 g, 44.7 mmol) in 60 mL of freshly distilled THF at 0 °C was added D-phenylalanine (1 equiv., 3.55 g, 21.3 mmol) under an atmosphere of argon. The slurry was stirred for 1 h at 0 °C and then heated under reflux for 21 h. The reaction mixture was cooled to 0 °C. 25 mL of an aqueous solution of NaOH 1M were added dropwise over 2 h. The slurry was filtered. The cake was washed several times with AcOEt. The organic layer was washed with a saturated solution of NaCl, dried over anhydrous sodium sulfate and concentrated under reduced

pressure. The D(+)-phenylalaninol **4** (3.13 g, 97%) was obtained after crystallisation in Et_2O as a white solid.

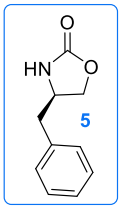


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.33-7.29 (m, 2H), 7.26-7.18 (m, 3H), 3.64 (dd, *J* = 3.8 Hz, 10.6 Hz, 1H), 3.38 (dd, *J* = 7.2 Hz, 10.6 Hz, 1H), 3.16-3.09 (m, 1H), 2.80 (dd, *J* = 5.1 Hz, 13.4 Hz, 1H), 2.53 (dd, *J* = 8.7 Hz, 13.4 Hz, 1H), 2.30-1.70 (br s, 3H). These data are consistent with those already reported in the literature.[5]

b. (*R*)-4-Benzyl-2-oxazolidinone 5

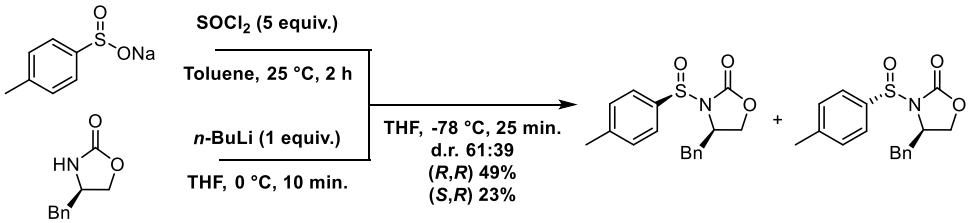


Following a reported procedure,[6] D(+)-phenylalaninol **4** (1 equiv., 1 g, 6.61 mmol) and dried K_2CO_3 (0.9 equiv., 823 mg, 5.95 mmol) were put in presence of freshly distilled diethyl carbonate (2 equiv., 1.62 mL, 13.2 mmol). The slurry was heated to 145 °C and EtOH was removed by distillation until elution ceased. The reaction mixture was cooled to room temperature and the remaining volatiles were removed under reduced pressure. CH_2Cl_2 was added to the resulting oil. The organic phase was washed with water, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel with cyclohexane/AcOEt (100/0 to 50/50). (*R*)-4-Benzyl-2-oxazolidinone **5** (986 mg, 84%) was obtained as an orange solid.



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.33 (t, *J* = 7.1 Hz, 2H), 7.26 (t, *J* = 5.4 Hz, 1H), 7.17 (d, *J* = 7.2 Hz, 2H), 5.58 (br s, 1H), 4.44 (t, *J* = 8.3 Hz, 1H), 4.16-4.04 (m, 2H), 2.87 (d, *J* = 6.8 Hz, 2H). These data are consistent with those already reported in the literature.[6]

c. (*R*)-4-benzyl-3-((*R*)-*p*-tolylsulfinyl) oxazolidin-2-one, (*R*,*R*)-6, and (*R*)-4-benzyl-3-((*S*)-*p*-tolylsulfinyl) oxazolidin-2-one, (*R*,*S*)-6

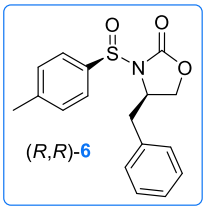


Preliminary synthesis of p-tolylsulfinyl chloride

$SOCl_2$ (5 equiv., 1.57 mL, 21.4 mmol) was diluted in 9 mL of freshly distilled toluene under argon. The solution was cooled to 0 °C. Sodium *p*-tolylsulfinate (1 equiv., 762 mg, 4.28 mmol) was slowly added to the previous solution. The reaction mixture was warmed to room temperature (25 °C) and it was stirred for 2 h. The remaining $SOCl_2$ was distilled (azeotrope with toluene) followed by removal of the residual solvent under reduced pressure, to afford *p*-tolylsulfinyl chloride.

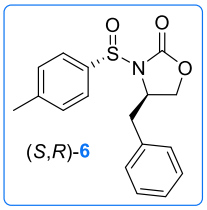
Procedure

To a solution of (*R*)-4-benzyl-2-oxazolidinone **5** (1 equiv., 500 mg, 2.85 mmol) in 6 mL of freshly distilled THF under an atmosphere of argon at 0 °C was added dropwise *n*-BuLi (1.1 equiv., 1.58 M in hexanes, 1.99 mL, 3.14 mmol) over a 5 to 10 minute-period. The resultant suspension was stirred at this temperature for 10 minutes and then cooled to -78 °C. It was stirred 10 minutes at this temperature. The freshly prepared *p*-tolylsulfinyl chloride (1.5 equiv., 747 mg, 4.28 mmol) dissolved in 4 mL of freshly distilled THF was then added as a slurry to the previous mixture. The reaction mixture was stirred at -78 °C for 25 minutes. It was quenched with a saturated solution of NH_4Cl and diluted with AcOEt. The aqueous phase was extracted three times with AcOEt. The combined organic layers were washed with a saturated solution of $NaHCO_3$ and with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. An NMR analysis of the crude mixture revealed total conversion with a ratio (*R*,*R*):(*R*,*S*) of 61:39. The crude product was purified by chromatography on demetalated silica gel with cyclohexane/AcOEt (100/0 to 80/20). The (*R*)-4-benzyl-3-((*R*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R*,*R*)-6** (426 mg, 48%) was obtained as a white solid and (*R*)-4-benzyl-3-((*S*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R*,*S*)-6** (209 mg, 23%) was obtained as an orange oil. It is also possible to crystallise (*R*)-4-benzyl-3-((*R*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R*,*R*)-6** from Et_2O from the crude mixture.



(*R*)-4-Benzyl-3-((*R*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R*,*R*)-6**

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.71 (d, *J* = 8.3 Hz, 2H), 7.48 (d, *J* = 8.0 Hz, 2H), 7.29-7.18 (m, 3H), 6.98-6.91 (m, 2H), 4.07 (dd, *J* = 3.8 Hz, 9.0 Hz, 1H), 3.97 (t, *J* = 8.0 Hz, 1H), 3.76-3.68 (m, 1H), 3.37 (dd, *J* = 3.5 Hz, 13.8 Hz, 1H), 2.90 (dd, *J* = 10.4 Hz, 13.9 Hz, 1H), 2.51 (s, 3H). These data are consistent with those already reported in the literature.[7]

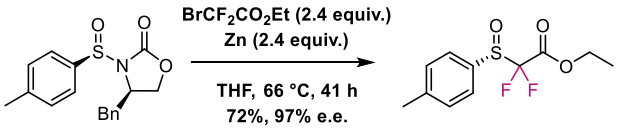


(*R*)-4-Benzyl-3-((*S*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R*,*S*)-6**

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.76 (d, *J* = 8.3 Hz, 2H), 7.41 (d, *J* = 8.0 Hz, 2H), 7.28-7.17 (m, 3H), 6.98-6.92 (m, 2H), 4.59-4.48 (m, 1H), 4.16 (t, *J* = 8.8 Hz, 1H), 4.08 (dd, *J* = 4.7 Hz, 8.9 Hz, 1H), 2.43 (s, 3H), 2.20-2.14 (m, 2H). These data are consistent with those already reported in the literature.[7]

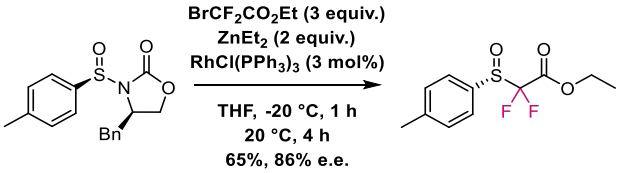
d. Ethyl (*S*)-2,2-difluoro-2-(*p*-tolylsulfinyl)acetate (*S*)-2a

α. Reformatsky-type reaction



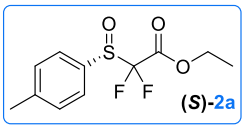
To a suspension of freshly activated Zn (Zn was activated with an aqueous solution of 4M HCl then washed several times with water and acetone and finally put under vacuum at 120 °C overnight; 2.4 equiv., 34.8 mg, 533 µmol) in 3 mL of freshly distilled THF was added one drop of ethyl bromodifluoroacetate. The mixture was stirred at 66 °C. A solution of (*R*)-4-benzyl-3-((*R*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R,R*)-6** (1 equiv., 70 mg, 222 µmol) and ethyl bromodifluoroacetate (2.4 equiv., 70.4 mL, 533 µmol) in 3 mL of freshly distilled THF was then added dropwise to the previous mixture. The reaction mixture was stirred at 66 °C for 41 hours, then cooled to room temperature and quenched with an aqueous solution of $KHSO_4$. The mixture was stirred for 30 minutes at 25 °C. It was then filtered through Celite® and washed carefully with diethyl ether. To the filtrate was added a saturated solution of NaCl. The filtrate was extracted three times with Et_2O. The combined organic layers were dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on demetalated silica gel in cyclohexane/AcOEt (100/0 to 90/10). Ethyl (*S*)-2,2-difluoro-2-(*p*-tolylsulfinyl)acetate **(*S*)-2a** (42 mg, 0.16 mmol, 72%, 97% e.e.) was obtained as a light yellow oil. The enantiomeric excess of the product was determined by chiral HPLC using a Chiracel IC column (*n*-hexane/*i*-PrOH = 80/20, flow rate: 0.5 mL/min, λ = 206 nm, τ = 23.9 min and 31.3 min).

β. Honda-Reformatsky-type reaction



(*R*)-4-Benzyl-3-((*R*)-*p*-tolylsulfinyl)oxazolidin-2-one **(*R,R*)-6** (1 equiv., 70 mg, 222 µmol) and $RhCl(PPh_3)_3$ (3 mol%, 6.16 mg, 6.7 µmol) were dissolved in 6 mL of freshly distilled THF. The mixture was cooled to -20 °C. Ethyl bromodifluoroacetate (3 equiv., 88 µL, 670 µmol) was added to the mixture followed by dropwise addition of diethylzinc (2 equiv., 1 M in hexanes, 444 µL, 444 µmol). The mixture was stirred at -20 °C for 1 h. Stirring was continued at 20 °C for 4 h. The reaction mixture was quenched with a saturated solution of NH_4Cl. The aqueous phase was extracted three times with AcOEt and the combined organic layers were washed with a saturated solution of NaCl, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by chromatography

on demetalated silica gel using cyclohexane/AcOEt (100/0 to 90/10). Ethyl (*S*)-2,2-difluoro-2-(*p*-tolylsulfinyl)acetate **(*S*)-2a** (38 mg, 145 µmol, 65%, 86% e.e.) was obtained as a transparent oil. The enantiomeric excess of the product was determined by chiral HPLC using a Chiracel IC column (*n*-hexane/*i*-PrOH = 80/20, flow rate: 0.5 mL/min, λ = 206 nm, τ = 24.0 min and 31.6 min).

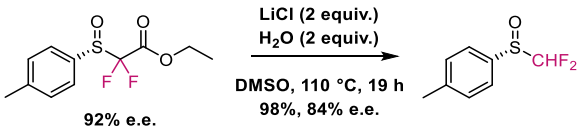


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.61 (d, J = 8.0 Hz, 2H), 7.38 (d, J = 8.2 Hz, 2H), 4.26 (qd, J = 7.2 Hz, 1.7 Hz, 2H), 2.44 (s, 3H), 1.27 (t, J = 7.2 Hz, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) −110.6 (AB system, J_{AB} = 227.0 Hz, $\Delta\nu_{AB}$ = 727.0 Hz, 2F). These data are consistent with those already reported in the literature.[2]

e. (*S*)-α,α-Difluoromethyl *p*-tolyl sulfoxide (*S*)-3a

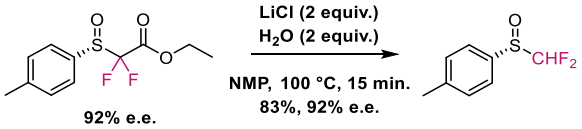
The enantioenriched ethyl (*S*)-2,2-difluoro-2-(*p*-tolylsulfinyl)acetate **(*S*)-2a** (92% e.e.) was decarboxylated under Krapcho's conditions previously optimized for the synthesis of the corresponding racemic compound **2a** (see § **1.f.**).

α. Thermal conditions

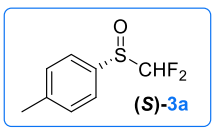


Under thermal conditions, after 19 h of stirring at 110 °C, (*S*)-α,α-difluoromethyl *p*-tolyl sulfoxide **(*S*)-3a** (107 mg, 98%, 84% e.e.) was obtained as a white solid. The enantiomeric excess of the product was determined by chiral HPLC using a Chiracel IC column (*n*-hexane/*i*-PrOH = 80:20, flow rate: 0.5 mL/min, λ = 205 nm, τ = 17.2 min and 23.2 min).

β. Microwave conditions



Under microwave conditions, after 15 minutes of stirring at 100 °C, (*S*)-α,α-difluoromethyl *p*-tolyl sulfoxide **(*S*)-3a** (69 mg, 83%, 92% e.e.) was obtained as a white solid. The enantiomeric excess of the product was determined by chiral HPLC using a Chiracel IC column (*n*-hexane/*i*-PrOH = 80/20, flow rate: 0.5 mL/min, λ = 205 nm, τ = 17.1 min and 23.0 min).

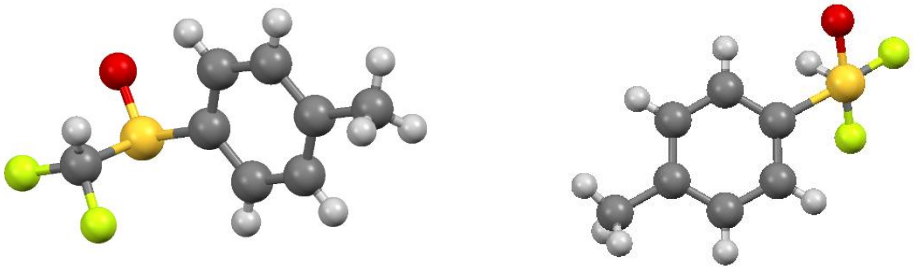


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.62 (d, J = 8.1 Hz, 2H), 7.40 (d, J = 8.0 Hz, 2H), 6.00 (t, J = 55.5 Hz, 1H), 2.46 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) −119.4 (d, 2F, J = 55.9 Hz). These data are consistent with those already reported in the literature.[3]

γ. Crystallographic structure of (*S*)-*α*,*α*-difluoromethyl *p*-tolyl sulfoxide (*S*)-3a

It should be noted that (*S*)-enantioenriched *α*,*α*-difluoromethyl *p*-tolyl sulfoxide **3a** can be further enantioenriched by crystallisation from Et_2O to obtain **(*S*)-3a** with > 97% e.e.. It was possible to get suitable crystals for a crystallographic analysis that confirmed the (*S*) configuration of the sulfur atom.

The crystals were placed in oil, and a single crystal was selected, mounted on a glass fibre and placed in a low-temperature N_2 stream. X-ray diffraction data collection was carried out on a Nonius Kappa-CCD diffractometer equipped with an Oxford Cryosystem liquid N_2 device, using Mo-Kα radiation (λ = 0.71073 Å). The crystal-detector distance was 36 mm. The cell parameters were determined (Denzo software)[8] from reflections taken from one set of 10 frames (1.0° steps in phi angle), each at 20 s exposure. The structure was solved by Direct methods using the program SHELXS-2014. The refinement and all further calculations were carried out using SHELXL-2014.[9] The H-atoms were included in calculated positions and treated as riding atoms using SHELXL default parameters. The non-H atoms were refined anisotropically, using weighted full-matrix least-squares on F^2.



*X-Ray analysis of (S)-α,α-difluoromethyl p-tolyl sulfoxide **(S)-3a***

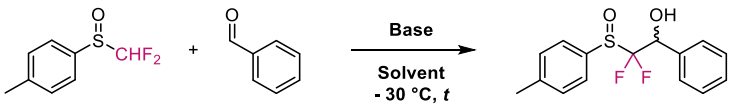
Formule	$C_8H_8F_2OS$	Cell volume	834.253 $Å^3$
M	190.20	Z, Calculated density	4, 1.514 Mg/m^3
Temperature	173 (2)	F(000)	392
Wavelength	0.71073	Crystal size	0.340 x 0.180 x 0.120 mm
Crystalline structure	Orthorhombic	Theta range for data collection	2.511 to 27.475
Space group	$P\ 2_1\ 2_1\ 2_1$		

a	4.91110 (10) Å	Z	0
b	8.9793 (2) Å	Z'	0
c	18.9180 (4) Å	Configuration	*S*
α	90 °	Flack parameter	- 0.01 (3)
β	90 °	R1	0.0308
γ	90 °	wR2	0.0769

Crystallographic data

4. Details concerning the synthesis of *α,α*-difluoro-*β*-hydroxy sulfoxides 7a-n

a. Determination of the best reaction conditions – Detailed general procedures



Entry	Base	Solvent	Time	d.r[a]
1	*t*-BuOK[b]	THF	40 min	40:60
2		DMF	2 h	53:47
3	P$_4$*t*-Bu[c]	THF	2 h	84:16
4		DMF	2 h	55:45 to 99:1
5	P$_4$*t*-Bu[d]	THF	2 h	99:1

[a] Diastereomeric ratios were determined by ^{19}F NMR and confirmed by reversed-phase HPLC – [b] **Procedure A**: potassium *tert*-butoxide was solubilized in the solvent of the reaction – [c] **Procedure B**: P$_4$*t*-Bu was used as a commercially available solution in hexane – [d] **Procedure C**: P$_4$*t*-Bu was added as a solution in freshly distilled THF.

α. Procedure A

In a vial under argon were dissolved *α,α*-difluoromethyl *p*-tolyl sulfoxide **3a** (1 equiv., 15 mg, 78.9 µmol) and benzaldehyde (1 equiv., 8.13 µL, 78.9 µmol) in 1 mL of the appropriate anhydrous solvent. The mixture was stirred at -30 °C for 10 minutes. Potassium *tert*-butoxide (2 equiv., 17.7 mg, 158 µmol) previously put in suspension or solubilised in 1.5 mL of the same anhydrous solvent was added dropwise to the previous solution. The reaction mixture was stirred at -30 °C for 40 minutes up to

2 hours, then quenched with water at this temperature. The aqueous layer was extracted three times with Et_2O. The combined organic layers were washed with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The diastereomeric ratio was determined by ^{19}F NMR and confirmed by reverse-phase HPLC. The crude product was purified by chromatography on silica gel using cyclohexane/AcOEt (100/0 to 80/20) to obtain 2,2-difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol **7a** as an oil.

β. Procedure B

In a vial under argon were dissolved *α*,*α*-difluoromethyl *p*-tolyl sulfoxide **3a** (1 equiv., 15 mg, 78.9 µmol) and benzaldehyde (1 equiv., 8.13 µL, 78.9 µmol) in 1 mL of the appropriate anhydrous solvent. P_4*t*-Bu (0.8 M solution in hexane, 2 equiv., 0.197 mL, 0.158 mmol) was added dropwise to this solution cooled to -30 °C. The reaction mixture was stirred at -30 °C for 2 hours, then quenched with water at this temperature. The aqueous layer was extracted three times with Et_2O. The combined organic layers were washed with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The diastereomeric ratio was determined by ^{19}F NMR and confirmed by reverse-phase HPLC. The crude product was purified by chromatography on silica gel using cyclohexane/AcOEt (100/0 to 80/20) to obtain 2,2-difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol **7a** as an oil.

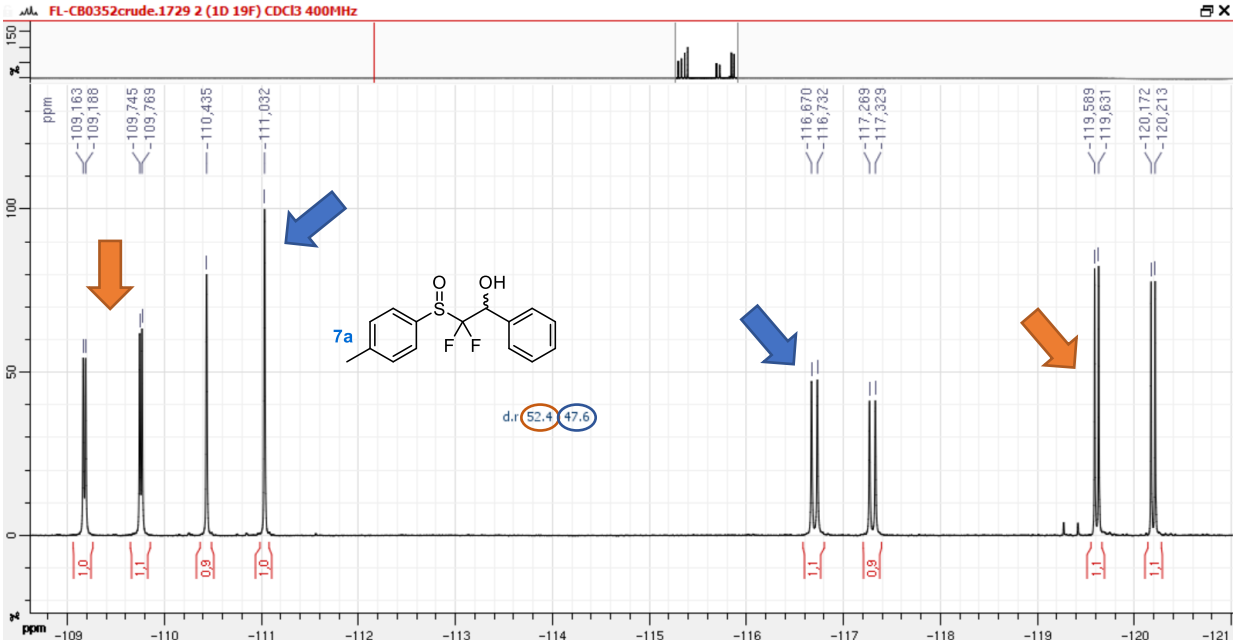
γ. Procedure C

Hexane was removed under vacuum from 197 µL of the commercially available solution of P_4*t*-Bu (0.8 M in hexane, 2 equiv., 197 µL, 158 µmol). The solid obtained was dissolved in 0.7 mL of freshly distilled THF previously cooled to -30 °C. To a solution of *α*,*α*-difluoromethyl *p*-tolyl sulfoxide **3a** (1 equiv., 15 mg, 78.9 µmol) and benzaldehyde (1 equiv., 8.13 µL, 78.9 µmol) dissolved in 1.8 mL of freshly distilled THF at -30 °C was added dropwise the previous solution of P_4*t*-Bu in THF. The reaction mixture was stirred at -30 °C for 2 hours, then quenched with water at this temperature. The aqueous layer was extracted three times with Et_2O. The combined organic layers were washed with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The diastereomeric ratio was determined by ^{19}F NMR and confirmed by reverse-phase HPLC. The crude product was purified by chromatography on silica gel using cyclohexane/AcOEt (100/0 to 80/20) to obtain 2,2-difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol **7a** as an oil.

b. Determination of the diastereomeric ratios by ^{19}F NMR and reverse-phase HPLC

To confirm the accuracy of the diastereomeric ratio measured by ^{19}F NMR, the ratio was compared with a determination by reverse-phase HPLC. See below one example (**Table 1**, Entry 2 of the corpus).

^{19}F NMR analysis – d.r. = 52.4 (diastereomer 1) : 47.6 (diastereomer 2)

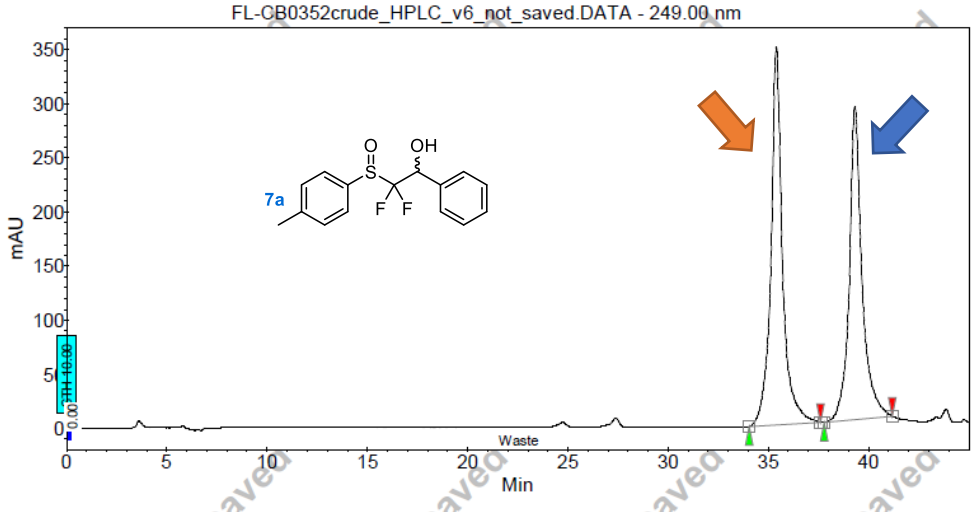


Reverse-phase HPLC analysis – d.r. = 52.35 (diastereomer 1) : 47.65 (diastereomer 2)

Chromatogram :
FL-CB0352crude_HPLC_v6_channel4

System : HPLC-1-PROSTAR
Method : NOT DEFINED
User : User1

Acquired : 7/24/2017 10:41:51 AM
Processed : 7/24/2017 4:51:14 PM
Printed : 7/24/2017 4:51:47 PM



Peak results :

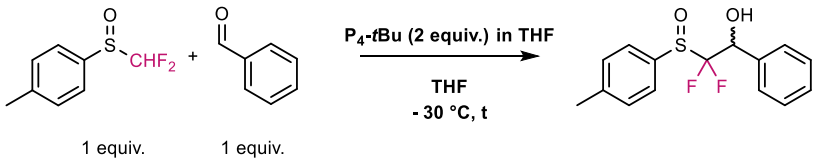
Index	Name	Time [Min]	Quantity [% Area]	Height [mAU]	Area [mAU.Min]	Area % [%]
1	UNKNOWN	35.38	52.35	349.6	234.8	52.350
2	UNKNOWN	39.32	47.65	289.4	213.7	47.650
Total			100.00	639.1	448.5	100.000

Using ^{19}F NMR, we could measure a d.r. of **52.4:47.6** while using reverse-phase HPLC we measured a d.r. of **52.35:47.65**. Both results being identical within experimental error, it was decided to use ^{19}F NMR to determine the diastereomeric ratios on each crude mixture.

c. Mechanistic hypothesis

α. Evolution of the diastereomeric ratio over time

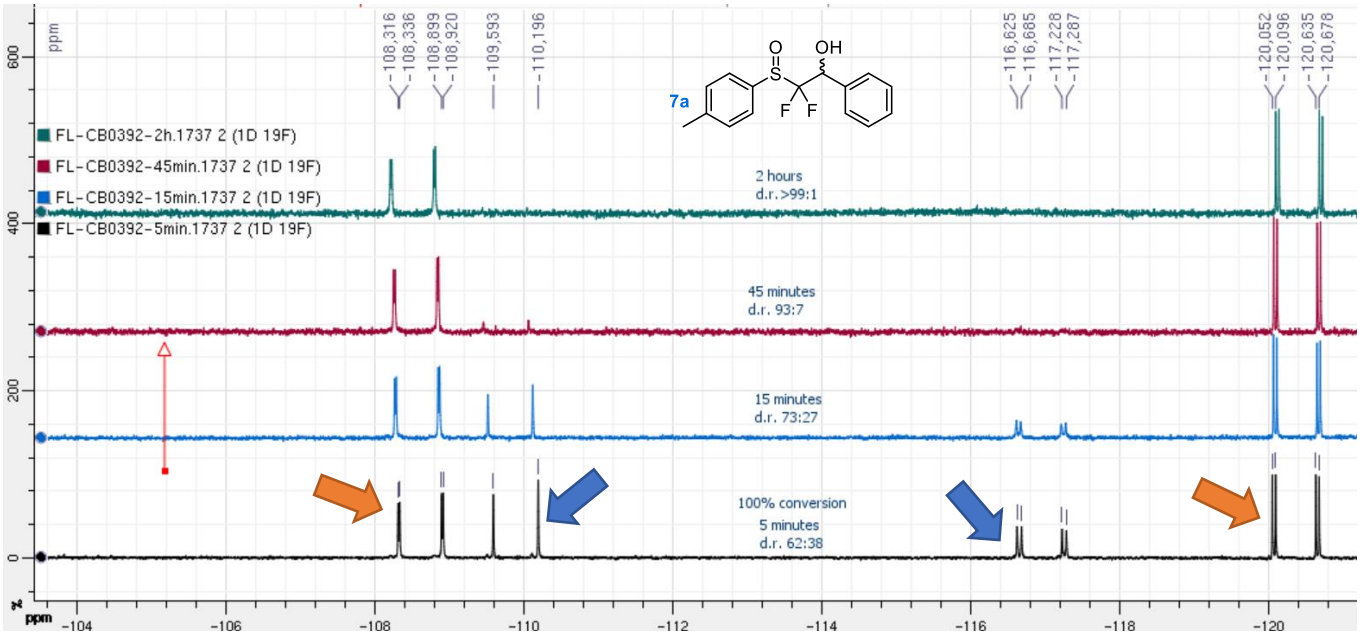
The diastereomeric excess of the reaction mixture (comprising 1 equiv. of benzaldehyde, 1 equiv. of sulfoxide and 2 equiv. of P_4*t*-Bu at -30 °C) increases over time. Hereafter are presented the procedure that has been employed, the ^{19}F NMR analysis performed and the graphics showing this evolution over time for the conditions cited above.



Procedure E

Hexane was removed under vacuum from 197 µL of the commercially available solution of P_4*t*-Bu (0.8 M in hexane, 2 equiv., 197 µL, 158 µmol). The solid obtained was dissolved in 0.7 mL of freshly distilled THF previously cooled to -30 °C. To a solution of *α*,*α*-difluoromethyl *p*-tolyl sulfoxide **3a** (1 equiv., 15 mg, 78.9 µmol) and benzaldehyde (1 equiv., 8.13 µL, 78.9 µmol) dissolved in 1.8 mL of freshly distilled THF at -30 °C was added dropwise the previously prepared solution of P_4*t*-Bu in THF. 0.4 mL of the reaction mixture were collected after 5 min, 15 min, 45 min and 2 h. These samples were each time immediately quenched by syringing them into 2 mL of water. The aqueous phases were extracted with Et_2O three times. The combined organic layers were washed with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The diastereomeric ratio was determined by ^{19}F NMR.

^{19}F NMR of the reaction mixture sampled after 5, 15, 45 and 120 minutes

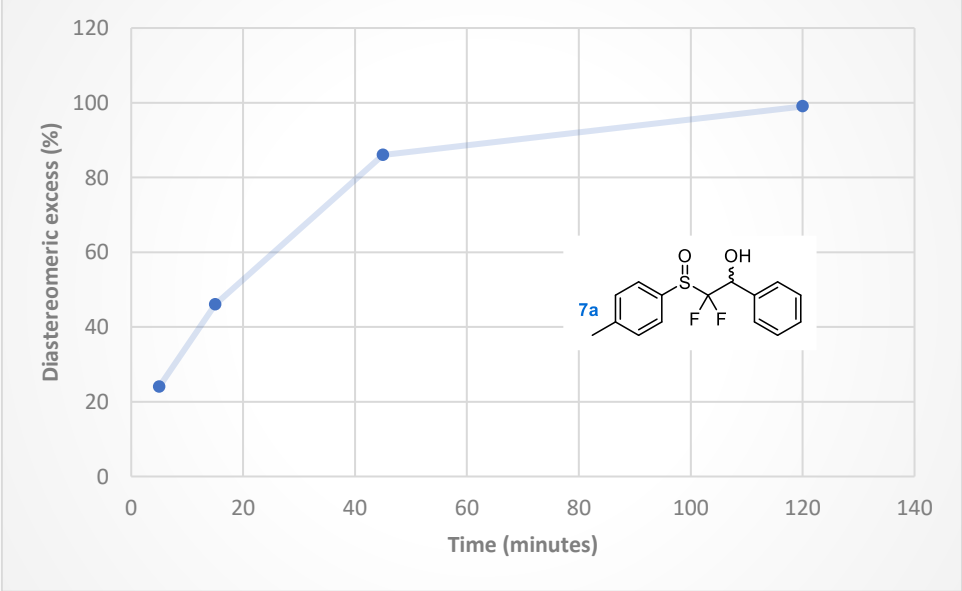


Evolution of the diastereomeric excess over time for two equivalents of P$_4$*t*-Bu – Data

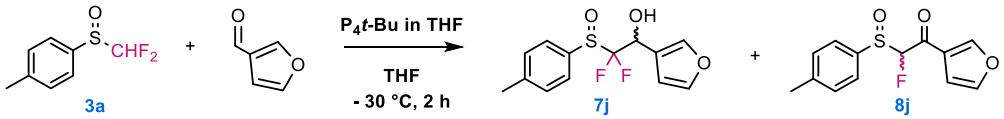
Time (min)	Diastereomer 1[a]	Diastereomer 2[a]	Diastereomeric excess (%)
5	62	38	24
15	73	27	46
45	93	7	86
120	99,5	0,5	99

[a] The percentage of each diastereomer was determined via quantitative ^{19}F NMR integration

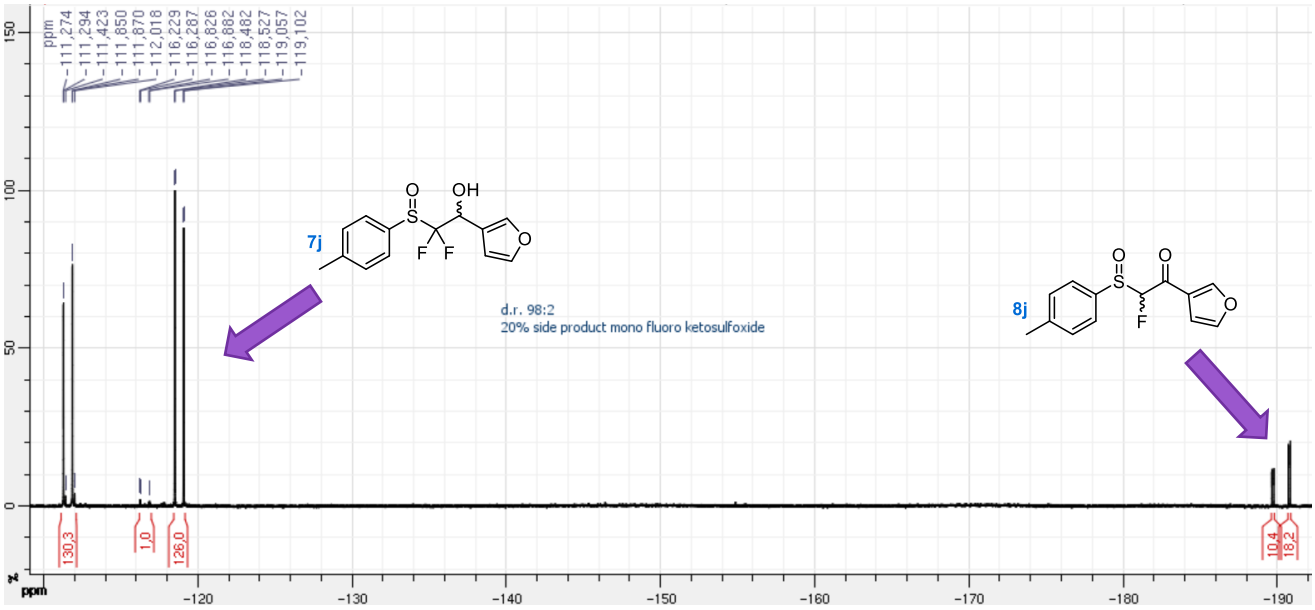
Evolution of the diastereomeric excess over time for two equivalents of P$_4$*t*-Bu – Graphic



β. Presence of *α*-fluoro-*β*-ketosulfoxide in the crude mixtures

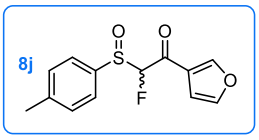


Here is one example of the ^{19}F NMR of a crude mixture showing the presence of the corresponding *α*-fluoro-*β*-ketosulfoxide as side product of the reaction. The presence of this side product correlates the assumed mechanism (cf. **Scheme 3** of the manuscript).



^{19}F NMR spectra of the crude mixture

Two diastereomers



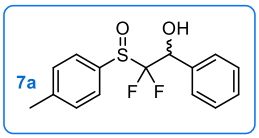
^1H NMR (400 MHz, $CDCl_3$) *δ* (ppm) 8.22 (d, *J* = 2.8 Hz, 1H), 7.93 (d, *J* = 2.9 Hz, 0.9H), 7.54 (d, *J* = 8.2 Hz, 2H), 7.48 (d, *J* = 8.1 Hz, 1.8H), 7.44 (t, *J* = 1.6 Hz, 1H), 7.37 (t, *J* = 1.5 Hz, 0.9H), 7.35 (d, *J* = 8.1 Hz, 2H), 7.28 (d, *J* = 8.1 Hz, 1.8H), 6.81 (d, *J* = 1.6 Hz, 1H), 6.72 (d, *J* = 1.7 Hz, 0.9H), 5.87 (d, *J* = 50.5 Hz, 0.9H), 5.63 (d, *J* = 48.5 Hz, 1H), 2.43 (s, 3H), 2.39 (s, 2.7H). **^{19}F NMR (376 MHz, $CDCl_3$)** *δ* (ppm) –189.6 (dd, *J* = 3.4 Hz, 50.4 Hz, 1F) and –190.7 (dd, *J* = 2.7 Hz, 48.4 Hz, 1F). **IR *ν* (cm^{-1})** 2926, 2874, 1725, 1669, 1596, 1558, 1514, 1493, 1456, 1382, 1288, 1161, 1143, 1119, 1080, 1057, 1016, 943, 873, 811, 745, 703. **HRMS (ESI positive)** calcd for $C_{13}H_{11}FNaO_3S$: 289.0305, found: 289.0294.

5. Synthesis of *α,α*-difluoro-*β*-hydroxy sulfoxides 7a-n

a. 2,2-Difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol 7a

Crude mixture – Diastereomeric ratio = 99:1 (**^{19}F NMR)**

One diastereomer (major one with procedure C)

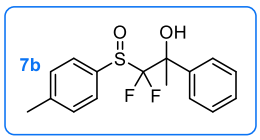


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.63 (d, J = 7.9 Hz, 2H), 7.54-7.48 (m, 2H), 7.43-7.34 (m, 5H), 5.37 (dd, J = 8.3 Hz, 16.4 Hz, 1H), 3.54 (s, 1H), 2.45 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –114.5 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 219.3 Hz, $J_{AX} = J_{H\text{-}F}$ = 8.2 Hz, $J_{BX} = J_{H\text{-}F}$ = 16.3 Hz, $\Delta\nu_{AB}$ = 4311 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.8, 134.2, 132.8, 130.1, 129.6, 128.7, 128.2, 126.5, 123.4 (dd, J = 292.9 Hz, 311.5 Hz), 73.7 (t, J = 21.8 Hz), 21.8. **IR *ν* (cm^{-1})** 3265, 1595, 1493, 1456, 1205, 1106, 1085, 1067, 1033, 1013, 975, 812, 726, 697. **HRMS (ESI positive)** calcd for $C_{15}H_{14}F_2NaO_2S$: 319.0575, found: 319.0588.

b. 2,2-Difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol 7b

Crude mixture – Diastereomeric ratio = 56:44 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 55:45 (**^{19}F NMR)**

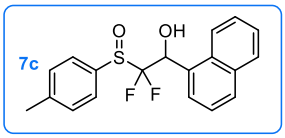


^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.60 (d, J = 7.8 Hz, 1.6H), 7.58 (m 3.6H), 7.54 (d, J = 8.1 Hz, 2.0H), 7.51-7.39 (m, 2.8H), 7.38-7.31 (m, 6.2H), 4.77 (br s, 0.7H), 4.35 (br s, 1H), 2.44 (s, 2.5H), 2.42 (s, 3H), 2.08 (s, 3H), 1.74 (s, 2.5H). **^{19}F NMR (472 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –110.5 (AB system, $J_{AB} = J_{F\text{-}F}$ = 221.1 Hz, $\Delta\nu_{AB}$ = 5729 Hz, 1F); *diastereomer 2*, δ (ppm) –112.5 (AB system, $J_{AB} = J_{F\text{-}F}$ = 219.3 Hz, $\Delta\nu_{AB}$ = 6289 Hz, 0.7F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 143.8, 140.4, 139.0, 132.4, 132.3, 130.0, 130.0, 128.7, 128.7, 128.5, 128.2, 126.9, 126.8, 126.7, 126.4, 78.9 (t, J = 21.3 Hz), 77.9 (dd, J = 40.9 Hz, 20.4 Hz), 25.3, 24.3, 21.8, 21.7. **IR *ν* (cm^{-1})** 3350, 2922, 2852, 1597, 1494, 1449, 1379, 1123, 1082, 1066, 1042, 1016, 969, 810, 761, 699. **HRMS (ESI positive)** calcd for $C_{16}H_{17}F_2O_2S$: 311.0912, found: 311.0895.

c. 2,2-Difluoro-1-(naphthalen-1-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7c

Crude mixture – Diastereomeric ratio = 56:44 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 34:66 (**^{19}F NMR)**



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.06 (d, J = 8.1 Hz, 0.5H), 7.93-7.83 (m, 4.5H), 7.79 (d, J = 7.7 Hz, 1H), 7.70-7.62 (m, 3H), 7.57-5.41 (m, 4.5H), 7.40-7.34 (m, 3H), 6.34 (dd, J = 1.8 Hz, 22.6 Hz, 1H) 6.26 (dd, J = 5.1 Hz, 17.9 Hz,

0.5H), 4.47-4.39 (br s, 1H), 3.89-3.82 (br s, 0.5H), 2.44 (s, 4.5H). **^{19}F NMR (376 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –112.4 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 221.4 Hz, $J_{AX} = J_{H\text{-}F}$ = 5.4 Hz, $J_{BX} = J_{H\text{-}F}$ = 17.7 Hz, $\Delta\nu_{AB}$ = 5292 Hz, 0.34F).; *diastereomer 2*, δ (ppm) −112.9 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 226.2 Hz, $J_{BX} = J_{H\text{-}F}$ = 21.8 Hz, $\Delta\nu_{AB}$ = 2931 Hz, 0.66F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 143.7, 133.8, 133.6, 132.9, 132.9, 132.7, 131.5, 131.1, 130.6, 130.3, 130.2, 130.1, 129.9, 129.0, 129.0, 128.9, 127.1, 126.8, 126.8, 126.6, 126.5, 126.4, 125.9, 125.8, 125.4, 123.3, 123.1, 69.7 (dd, *J* = 20.4 Hz, 23.6 Hz), 66.9 (dd, *J* = 19.5 Hz, 28.6 Hz), 21.8, 21.7.

One diastereomer (major one with procedure C)

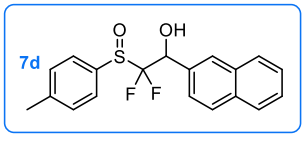
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.06 (d, *J* = 8.3 Hz, 1H), 7.92-7.82 (m, 3H), 7.68 (d, *J* = 8.1 Hz, 2H), 7.58-7.48 (m, 3H), 7.39 (d, *J* = 8.1 Hz, 2H), 6.28 (ddd, *J* = 3.5 Hz, 5.0 Hz, 18.5 Hz, 1H), 3.60 (d, *J* = 3.5 Hz, 1H), 2.46 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –112.3 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 221.2 Hz, $J_{AX} = J_{H\text{-}F}$ = 4.8 Hz, $J_{BX} = J_{H\text{-}F}$ = 18.4 Hz, $\Delta\nu_{AB}$ = 5566 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 133.8, 133.0, 132.6, 131.5, 130.3, 130.2, 129.0, 127.1, 126.8, 126.4, 125.9, 125.4, 123.3 (d, *J* = 1.8 Hz), 69.7 (dd, *J* = 21.3 Hz, 23.8 Hz), 21.8.

IR *v* (cm^{-1}) 3307, 2925, 1597, 1514, 1493, 1398, 1192, 1087, 1041, 1015, 967, 789, 772, 739. **HRMS (ESI positive)** calcd for $C_{19}H_{17}F_2O_2S$: 347.0912, found: 347.0889.

d. 2,2-Difluoro-1-(naphthalen-2-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7d

Crude mixture – Diastereomeric ratio = 73:27 (**^{19}F NMR**)

Two diastereomers – Diastereomeric ratio = 70:30 (**^{19}F NMR**)



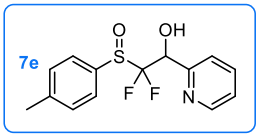
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 8.00 (s, 0.7H), 7.94 (s, 0.3H), 7.90-7.81 (m, 3H), 7.67-7.59 (m, 2.7H), 7.57-7.47 (m, 2.3H), 7.4-7.34 (m, 2H), 5.63-5.50 (m, 1H), 4.33-4.15 (br s, 0.4H), 3.79-3.58 (br s, 0.8H), 2.44 (s, 3H). **^{19}F NMR (472 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –114.5 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 218.5 Hz, $J_{AX} = J_{H\text{-}F}$ = 8.7 Hz, $J_{BX} = J_{H\text{-}F}$ = 14.7 Hz, $\Delta\nu_{AB}$ = 4735 Hz, 0.7F). *diastereomer 2*, δ (ppm) –113.5 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 225.4 Hz, $J_{BX} = J_{H\text{-}F}$ = 21.7 Hz, $\Delta\nu_{AB}$ = 2483 Hz, 0.3F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 143.8, 133.9, 133.8, 133.1, 133.1, 132.7, 132.7, 132.0, 131.6, 131.1, 130.2, 130.1, 128.5, 128.5, 128.4, 128.3, 128.1, 127.9, 127.8, 127.8, 126.9,

126.8, 126.6, 126.5, 126.5, 125.1, 125.0, 73.9 (t, *J* = 21.8 Hz), 71.7 (dd, *J* = 20.4 Hz, 28.6 Hz), 21.8, 21.8. **IR *v* (cm^{-1})** 3320, 2958, 2924, 2869, 1724, 1597, 1380, 1272,1193, 1107, 1085, 1041, 1015, 976, 951, 900, 863, 795, 749. **IR *v* (cm^{-1})** 2957, 2925, 2856, 2872, 1726, 1596, 1491, 1463, 1380, 1274, 1142, 1122, 1075, 1040, 967, 810, 743, 703. **HRMS (ESI positive)** calcd for $C_{19}H_{16}F_2NaO_2S$: 369.0731, found: 369.0 718.

e. 2,2-Difluoro-1-(pyridin-2-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7e

Crude mixture – Diastereomeric ratio = 88:12 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 90:10 (**^{19}F NMR)**



^{1}H NMR (400 MHz, CDCl$_3$) *δ* (ppm) 8.60 (br s, 1H), 7.81-7.72 (m, 2.7H), 7.65 (d, *J* = 7.8 Hz, 0.3H), 7.44-7.34 (m, 4H), 5.48 (d, *J* = 24.0 Hz, 0.1H), 4.92 (d, *J* = 15.0 Hz, 0.9H), 2.45 (s, 2.7H), 2.43 (s, 0.3H). **^{19}F NMR (376 MHz, CDCl$_3$)** *diastereomer 1*, *δ* (ppm) –114.8 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 220.0 Hz, J_{BX} = $J_{H\text{-}F}$ = 15.7 Hz, $\Delta\nu_{AB}$ = 2776 Hz, 0.9F); *diastereomer 2*, *δ* (ppm) –117.4 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 220.7 Hz, J_{AX} = $J_{H\text{-}F}$ = 2.0 Hz, J_{BX} = $J_{H\text{-}F}$ = 23.8 Hz, $\Delta\nu_{AB}$ = 1145 Hz, 0.1F).

One diastereomer (major one with procedure C)

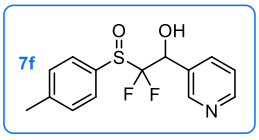
^{13}C NMR (126 MHz, CDCl$_3$) *δ* (ppm) 151.5, 148.2, 143.5, 137.7, 134.0, 130.1, 127.7 (dd, *J* = 299.7 Hz, 309.3 Hz), 126.7, 124.5, 123.0, 70.9 (t, *J* = 25.0 Hz), 21.8.

HRMS (ESI positive) calcd for $C_{14}H_{14}F_2NO_2S$: 298.0708, found: 298.0699.

f. 2,2-Difluoro-1-(pyridin-3-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7f

Crude mixture – Diastereomeric ratio = 69:31 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 70:30 (**^{19}F NMR)**



^{1}H NMR (400 MHz, CDCl$_3$) *δ* (ppm) 8.67-8.47 (m, 2H), 7.94-7.84 (m, 1H), 7.67-7.60 (m, 2H), 7.42-7.28 (m, 3H), 5.45 (d, *J* = 22.6 Hz, 0.3H), 5.34 (dd, *J* = 7.5 Hz, 16.8 Hz, 0.7H), 2.44 (s, 3H). **^{19}F NMR (376 MHz, CDCl$_3$)** *diastereomer 1*, *δ* (ppm) –113.9 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 221.4 Hz, J_{AX} = $J_{H\text{-}F}$ = 7.5 Hz, J_{BX} = $J_{H\text{-}F}$ = 16.3 Hz, $\Delta\nu_{AB}$ = 4311 Hz, 0.7F); *diastereomer 2*, *δ* (ppm) –114.3 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 226.8 Hz, J_{BX} = $J_{H\text{-}F}$ = 22.5 Hz, $\Delta\nu_{AB}$ = 2403 Hz, 0.3F). **^{13}C NMR (126 MHz, CDCl$_3$)** *δ* (ppm) 150.1, 149.9, 149.0, 148.8, 144.1, 143.9, 136.5, 136.3, 132.5 (d, *J* = 3.2 Hz), 132.1 (d, *J* = 3.6 Hz), 131.1, 131.0, 130.2, 129.0,

126.5, 126.4, 123.8, 123.7, 122.9 (dd, *J* = 292.0 Hz, 311.5 Hz), 71.9 (t, *J* = 22.7 Hz), 69.0 (dd, *J* = 19.5 Hz, 29.5 Hz), 21.8, 21.8.

One diastereomer (minor one with procedure C)

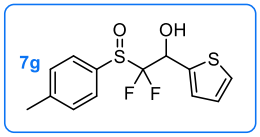
^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 8.60 (s, 1H), 8.57 (d, *J* = 4.0 Hz, 1H), 7.86 (d, *J* = 7.9 Hz, 1H), 7.64 (d, *J* = 8.1 Hz, 2H), 7.39 (d, *J* = 8.1 Hz, 2H), 7.32 (dd, *J* = 7.9 Hz, 4.9 Hz, 1H), 5.45 (dd, *J* = 1.1 Hz, 22.7 Hz, 1H), 2.45 (s, 3H). **^{19}F NMR (472 MHz, $CDCl_3$)** δ (ppm) –113.8 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 227.1 Hz, $J_{BX} = J_{H\text{-}F}$ = 23.4 Hz, $\Delta\nu_{AB}$ = 3303 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 150.2, 149.1, 143.9, 136.0, 132.0 (d, *J* = 2.3 Hz), 131.1, 130.2, 126.5, 124.2 (dd, *J* = 297.5 Hz, 305.2 Hz), 123.6, 69.0 (dd, *J* = 20.0 Hz, 29.1 Hz), 21.8.

IR *ν* (cm^{-1}) 3059, 1597, 1493, 1429, 1186, 1110, 1086, 1057, 1043, 1033, 1016, 983, 810, 764, 710. **HRMS (ESI positive)** calcd for $C_{14}H_{14}F_2NO_2S$: 298.0708, found: 298.0720.

g. 2,2-Difluoro-1-(thiophen-2-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7g

Crude mixture – Diastereomeric ratio = 70:30 (**^{19}F NMR**)

Two diastereomers – Diastereomeric ratio = 60:40 (**^{19}F NMR**)

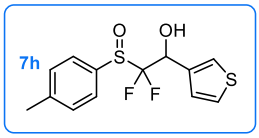


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.63 (d, *J* = 7.7 Hz, 2H), 7.43-7.34 (m, 3H), 7.25 (d, *J* = 3.3 Hz, 0.6H), 7.14 (d, *J* = 3.1 Hz, 0.4H), 7.05 (dd, *J* = 3.5 Hz, 4.9 Hz, 0.6H), 7.02 (dd, *J* = 5.0 Hz, 3.5 Hz, 0.4H), 5.73-5.59 (m, 1H), 4.86-4.62 (br s, 0.4H), 3.98-3.70 (br s, 0.6H), 2.45 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –114.8 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 218.0 Hz, $J_{AX} = J_{H\text{-}F}$ = 8.9 Hz, $J_{BX} = J_{H\text{-}F}$ = 14.3 Hz, $\Delta\nu_{AB}$ = 3787 Hz, 0.6F); *diastereomer 2*, δ (ppm) –114.0 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 222.1 Hz, $J_{BX} = J_{H\text{-}F}$ = 15.7 Hz, $\Delta\nu_{AB}$ = 2026 Hz, 0.4F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 143.8, 137.2, 136.4 (d, *J* = 2.1 Hz), 132.6 (d, *J* = 3.6 Hz), 132.2 (d, *J* = 3.2 Hz), 130.2, 130.2, 128.3, 127.6, 127.4, 127.2, 127.0, 127.0, 126.5, 126.5, 123.4 (dd, *J* = 297.0 Hz, 305.2 Hz), 122.9 (dd, *J* = 293.8 Hz, 311.5 Hz), 70.2 (t, *J* = 22.7 Hz), 68.4 (dd, *J* = 20.4 Hz, 29.5 Hz), 21.8, 21.7. **IR *ν* (cm^{-1})** 3295, 2923, 1596, 1493,1435, 1198, 1179, 1113, 1085, 1041, 1015, 965, 856, 810, 785, 705. **HRMS (ESI positive)** calcd for $C_{13}H_{12}F_2O_2S_2$: 325.0139, found: 325.0148.

h. 2,2-Difluoro-1-(thiophen-3-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7h

Crude mixture – Diastereomeric ratio = 55:45 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 54:46 (**^{19}F NMR)**

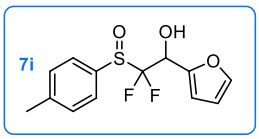


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.66-7.58 (m, 2H), 7.51 (d, J = 2.4 Hz, 0.56H), 7.44 (d, J = 2.8 Hz, 0.44H), 7.40-7.30 (m, 3H), 7.22 (d, J = 4.9 Hz, 0.56H), 7.15 (d, J = 5.0 Hz, 0.44H), 5.56-5.42 (m, 1H), 4.34 (d, J = 5.7 Hz, 0.44H), 3.58 (d, J = 3.9 Hz, 0.56H), 2.44 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –114.6 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 218.7 Hz, J_{AX} = $J_{H\text{-}F}$ = 9.5 Hz, J_{BX} = $J_{H\text{-}F}$ = 15.0 Hz, $\Delta\nu_{AB}$ = 3640 Hz, 0.54F); *diastereomer 2*, δ (ppm) –113.7 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 224.8 Hz, J_{BX} = $J_{H\text{-}F}$ = 21.1 Hz, $\Delta\nu_{AB}$ = 1925 Hz, 0.46F); **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.8, 143.7, 135.7, 135.1 (d, J = 1.8 Hz), 132.8 (d, J = 3.6 Hz), 132.4 (d, J = 1.8 Hz), 131.1, 130.1, 129.0, 126.7, 126.6, 126.5, 126.4, 126.4, 125.6, 125.0, 123.3 (dd, J = 292.9 Hz, 310.6 Hz), 70.2 (t, J = 22.7 Hz), 68.5 (dd, J = 20.9 Hz, 29.1 Hz), 21.8, 21.8. **IR ν (cm^{-1})** 3325, 2958, 2924, 2872, 1722, 1596, 1493, 1414, 1401, 1279, 1195, 1111, 1085, 1043, 1015, 986, 930, 836, 810,766, 703. **HRMS (ESI positive)** calcd for $C_{13}H_{12}F_2NaO_2S_2$: 325.0139, found: 325.0126.

i. 2,2-Difluoro-1-(furan-2-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7i

Crude mixture – Diastereomeric ratio = 57:43 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 56:44 (**^{19}F NMR)**



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.68-7.60 (m, 2H), 7.47 (d, J = 1.1 Hz, 0.56H), 7.44 (d, J = 1.0 Hz, 0.44H), 7.38 (d, J = 7.8 Hz, 2H), 6.58 (d, J = 3.3 Hz, 0.56H), 6.53 (d, J = 3.2 Hz, 0.44H), 6.42 (dd, J = 1.7 Hz, 3.2 Hz, 0.56H), 6.40 (dd, J = 1.7 Hz, 3.3 Hz, 0.44H), 5.43 (d, J = 21.2 Hz, 0.44H), 5.30 (dd, J = 10.3 Hz, 14.2 Hz, 0.56H), 4.32 (s, 0.44H), 3.56 (s, 0.56H), 2.44 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –114.5 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 219.3 Hz, J_{AX} = $J_{H\text{-}F}$ = 10.2 Hz, J_{BX} = $J_{H\text{-}F}$ = 14.3 Hz, $\Delta\nu_{AB}$ = 3009 Hz, 0.56F); *diastereomer 2*, δ (ppm) –113.9 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 224.1 Hz, J_{BX} = $J_{H\text{-}F}$ = 21.1 Hz, $\Delta\nu_{AB}$ = 1381 Hz, 0.44F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 148.0, 147.5, 147.5, 143.9, 143.8, 143.7, 132.8 (d, J = 2.7 Hz), 132.1 (d, J = 3.2 Hz), 130.1, 130.1, 126.6, 126.5, 123.6 (dd, J = 297.0 Hz, 307.5 Hz), 123.5 (dd, J = 294.7 Hz, 308.4 Hz), 111.2, 110.9, 110.9, 110.7, 67.6 (t, J = 23.2 Hz), 66.2 (dd, J = 20.9 Hz, 30.0 Hz), 21.8, 21.8.

One diastereomer (minor one with procedure C)

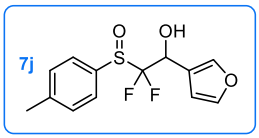
^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.62 (d, J = 6.7 Hz, 2H), 7.42 (d, J = 1.2 Hz, 1H), 7.36 (d, J = 6.4 Hz, 2H), 6.53 (d, J = 3.1 Hz, 1H), 6.37 (m, 1H), 5.51 (d, J = 19.5 Hz, 1H), 5.22 (m, 1H), 2.43 (s, 3H). **^{19}F NMR (472 MHz, $CDCl_3$)** δ (ppm) –114.0 (AB system, J_{AB} = $J_{F\text{-}F}$ = 221.1 Hz, $\Delta\nu_{AB}$ = 1461 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 148.3, 143.7, 143.6, 132.3, 130.0, 126.7, 110.7, 110.5, 65.4 (dd, J = 20.4 Hz, 29.1 Hz), 21.7.

IR ν (cm^{-1}) 3296, 2925, 1597, 1495, 1196, 1147, 1115, 1085, 1047, 1014, 987, 936, 926, 795, 809, 745. **HRMS (ESI positive)** calcd for $C_{13}H_{13}F_2O_3S$: 287.0548, found: 287.0560.

j. 2,2-Difluoro-1-(furan-3-yl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7j

Crude mixture – Diastereomeric ratio = 98:2 (**^{19}F NMR**)

One diastereomer (major one with procedure C)

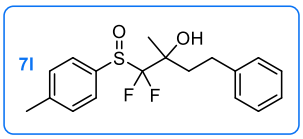


^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.66-7.60 (m, 3H), 7.45 (t, J = 1.7 Hz, 1H), 7.38 (d, J = 8.1 Hz, 2H), 6.54 (s, 1H), 5.35 (dd, J = 9.5 Hz, 15.5 Hz, 1H), 3.30-3.10 (br s, 1H), 2.45 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –114.9 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 219.3 Hz, J_{AX} = $J_{H\text{-}F}$ = 9.5 Hz, J_{BX} = $J_{H\text{-}F}$ = 15.0 Hz, $\Delta\nu_{AB}$ = 3627 Hz, 0.98F); [*diastereomer 2* (minor one with procedure C) δ (ppm) –114.0 (ABX system, J_{AB} = $J_{F\text{-}F}$ = 224.8 Hz, J_{BX} = $J_{H\text{-}F}$ = 20.4 Hz, $\Delta\nu_{AB}$ = 1921 Hz, 0.02F)]. **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.8, 142.1, 132.6, 132.6, 130.0, 126.4, 123.4 (dd, J = 293.4 Hz, 310.2 Hz), 119.4 (d, J = 2.7 Hz), 109.3, 67.1 (t, J = 23.2 Hz), 21.7. **IR ν (cm^{-1})** 3324, 2926, 1761, 1730, 1596, 1494, 1454, 1286, 1196, 1161, 1112, 1085, 1042, 1016, 980, 953, 875, 811, 790. **HRMS (ESI positive)** calcd for $C_{13}H_{13}F_2O_3S$: 287.0548, found: 287.0558.

k. 1,1-Difluoro-2-methyl-4-phenyl-1-(*p*-tolylsulfinyl)butan-2-ol 7l

Crude mixture – Diastereomeric ratio = 60:40 (**^{19}F NMR**)

First diastereomer (major one with procedure C)



^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.64 (d, J = 7.9 Hz, 2H), 7.69 (d, J = 8.1 Hz, 2H), 7.31-7.25 (m, 2H), 7.23-7.16 (m, 3H), 2.87-2.73 (m, 2H), 2.46 (s, 3H), 2.18 (td, J = 5.0 Hz, 14 Hz, 1H), 1.98 (td, J = 5.5 Hz, 13.4 Hz, 1H), 1.71 (s, 3H). **^{19}F NMR (472 MHz, $CDCl_3$)** δ (ppm) –113.3 (AB system, J_{AB} = $J_{F\text{-}F}$ = 220.0 Hz, $\Delta\nu_{AB}$ = 6205 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.8, 141.8, 132.5

(d, *J* = 3.6 Hz), 130.1, 128.6, 128.6, 126.8, 126.1, 123.8 (dd, *J* = 295.6 Hz, 318.8 Hz), 76.7 (unknown), 37.8, 29.1, 22.4, 21.8.

Second diastereomer (minor one with procedure C)

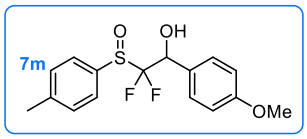
^{1}H NMR (500 MHz, $CDCl_3$) δ (ppm) 7.63 (d, *J* = 7.9 Hz, 2H), 7.39 (d, *J* = 8.1 Hz, 2H), 7.35-7.29 (m, 2H), 7.26-7.19 (m, 3H), 2.93 (td, *J* = 4.8 Hz, 13.0 Hz, 1H), 2.80 (td, *J* = 5.5 Hz, 12.2 Hz, 1H), 2.46 (s, 3H), 2.31 (td, *J* = 4.8 Hz, 13.3 Hz, 1H), 2.20 (tdd, *J* = 2.1 Hz, 5.4 Hz, 12.2 Hz, 1H), 1.50 (s, 3H). **^{19}F NMR (472 MHz, $CDCl_3$)** δ (ppm) –112.9 (AB system, $J_{AB} = J_{F\text{-}F}$ = 222.8 Hz, $\Delta\nu_{AB}$ = 5686 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 143.9, 141.5, 132.4 (d, *J* = 4.1 Hz), 130.0, 128.7, 128.6, 126.8, 126.3, 39.4, 29.2, 22.9, 21.8.

IR *ν* (cm^{-1}) 3369, 2924, 1724, 1598, 1495, 1455, 1379, 1288, 1211, 1180, 1110, 1083, 1065, 1045, 1016, 985, 944, 809, 749, 701. **HRMS (ESI positive)** calcd for $C_{18}H_{20}F_2NaO_2S$: 361.1044, found: 361.1047.

l. 2,2-Difluoro-1-(4-methoxyphenyl)-2-(*p*-tolylsulfinyl)ethan-1-ol 7m

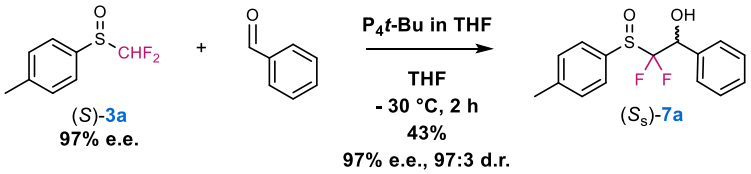
Crude mixture – Diastereomeric ratio = 79:21 (**^{19}F NMR)**

Two diastereomers – Diastereomeric ratio = 79:21 (**^{19}F NMR)**



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.66-7.58 (m, 2H), 7.48-7.34 (m, 4H), 6.96-6.86 (m, 2H), 5.38-5.25 (m, 1H), 3.82 (s, 2.3H), 3.80 (s, 0.7H), 2.44 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** *diastereomer 1*, δ (ppm) –114.9 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 218.0 Hz, $J_{AX} = J_{H\text{-}F}$ = 8.9 Hz, $J_{BX} = J_{H\text{-}F}$ = 15.7 Hz, $\Delta\nu_{AB}$ = 3905 Hz, 0.79F); *diastereomer 2*, δ (ppm) –113.8 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 226.2 Hz, $J_{BX} = J_{H\text{-}F}$ = 21.8 Hz, $\Delta\nu_{AB}$ = 2625 Hz, 0.21F).**^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 160.6, 160.4, 143.7, 143.6, 132.9 (dd, *J* = 2.3 Hz), 130.1, 129.6, 129.3, 126.6, 126.5, 126.4, 126.3 (d, *J* = 1.8 Hz), 123.6 (dd, *J* = 292.0 Hz, 309.7 Hz), 114.1, 114.0, 73.3 (t, *J* = 21.8 Hz), 71.0 (dd, *J* = 20.0 Hz, 29.1 Hz), 55.4, 55.4, 21.8, 21.7. **IR *ν* (cm^{-1})** 3325, 2925, 1611, 1498, 1589, 1513, 1463, 1443, 1305, 1249, 1175, 1105, 1085, 1032, 1016, 974, 841, 810, 789, 750, 703. **HRMS (ESI positive)** calcd for $C_{16}H_{16}F_2NaO_3S$: 349.0680, found: 349.0676.

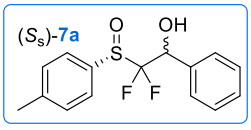
6. Access to highly enantioenriched 2,2-difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol (S_S)-7a



Hexane was removed under vacuum from 197 µL of the commercially available solution of P$_4$*t*-Bu (0.8 M in hexane, 2 equiv., 197 µL, 158 µmol). The solid obtained was dissolved in 0.7 mL of freshly distilled THF previously cooled to -30 °C. To a solution of sulfoxide **(*S*)-3a** (1 equiv., 15 mg, 78.9 µmol) and benzaldehyde (1 equiv., 8.13 µL, 78.9 µmol) dissolved in 1.8 mL of freshly distilled THF at -30 °C was added dropwise the previous solution of P$_4$*t*-Bu in THF. The reaction mixture was stirred at -30 °C for 2 hours, then quenched with water at this temperature. The aqueous layer was extracted three times with Et$_2$O. The combined organic layers were washed with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The diastereomeric ratio was determined by ^{19}F NMR. The crude product was purified by chromatography on silica gel using cyclohexane/AcOEt (100/0 to 80/20) to obtain 2,2-difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol **(*S*$_S$)-7a** (10 mg, 33.7 µmol, 43%, 97% e.e., 97:3 d.r.) as an oil. The enantiomeric excess of the product was determined by chiral HPLC using a Chiracel IC column (*n*-hexane/*i*-PrOH = 80/20, flow rate: 0.5 mL/min, λ = 210 nm, τ = 10.1 min, 11.1 min, 21.2 min and 25.1 min).

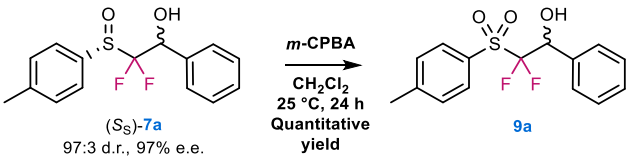
Crude mixture – Diastereomeric ratio = 97:3 (**^{19}F NMR)**

One diastereomer (major one with procedure C)

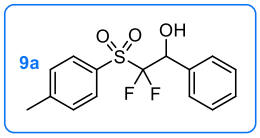


^{1}H NMR (400 MHz, CDCl$_3$) δ (ppm) 7.63 (d, J = 7.9 Hz, 2H), 7.54-7.48 (m, 2H), 7.43-7.35 (m, 5H), 5.39 (dd, J = 8.4 Hz, 16.6 Hz, 1H), 3.47 (s, 1H), 2.45 (s, 3H). **^{19}F NMR (376 MHz, CDCl$_3$)** δ (ppm) –114.4 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 219.3 Hz, $J_{AX} = J_{H\text{-}F}$ = 7.5 Hz, $J_{BX} = J_{H\text{-}F}$ = 17.0 Hz, $\Delta\nu_{AB}$ = 4447 Hz, 0.97F); [*diastereomer 2* (minor one with procedure C) δ (ppm) –113.4 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 227.5 Hz, $J_{BX} = J_{H\text{-}F}$ = 23.2 Hz, $\Delta\nu_{AB}$ = 2664 Hz, 0.03F)].

7. Access to highly enantioenriched 2,2-difluoro-1-phenyl-2-tosylethan-1-ol 9a



To a solution of 2,2-difluoro-1-phenyl-2-(*p*-tolylsulfinyl)ethan-1-ol **(S_S)-7a** (1 equiv., 3.3 mg, 11.1 µmol) in 0.2 mL of anhydrous CH_2Cl_2 was added *m*-CPBA (78% of active oxygen, 1.5 equiv., 3.74 mg, 16.7 µmol) at 25 °C. The solution was stirred at this temperature for 24 hours. The reaction was quenched with a saturated solution of $Na_2S_2O_3$. The aqueous phase was extracted three times with CH_2Cl_2. The combined organic phases were washed with a saturated solution of $NaHCO_3$ and with a saturated solution of NaCl, dried over anhydrous sodium sulfate, filtered and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel using cyclohexane/AcOEt (100/0 to 80/20) to obtain 2,2-difluoro-1-phenyl-2-tosylethan-1-ol **9a** (3.5 mg, 11.1 µmol, quantitative yield) as a white solid.



^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) 7.88 (d, J = 8.3 Hz, 2H), 7.51-7.45 (m, 2H), 7.41 (d, J = 8.1 Hz, 2H), 7.40-7.36 (m, 3H), 5.56 (dd, J = 21.3 Hz, 2.1 Hz, 1H), 3.44-3.17 (br s, 1H), 2.48 (s, 3H). **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) –111.9 (ABX system, $J_{AB} = J_{F\text{-}F}$ = 237.1 Hz, $J_{BX} = J_{H\text{-}F}$ = 21.1 Hz, $\Delta\nu_{AB}$ = 5850 Hz, 2F). **^{13}C NMR (126 MHz, $CDCl_3$)** δ (ppm) 147.4, 133.8, 130.9, 130.3, 129.7, 129.7, 128.7, 128.3, 120.2 (dd, J = 288.8 Hz, 298.4 Hz), 71.5 (dd, J = 20.0 Hz, 26.3 Hz), 22.1. **IR ν (cm^{-1})** 3501, 3067, 2925, 1595, 1494, 1456, 1336, 1307, 1196, 1152, 1111, 1090, 1065, 996, 814, 736, 699. **HRMS (ESI positive)** calcd for $C_{15}H_{14}F_2K0_3S$: 351.0263, found: 351.0271.

8. Bibliographic references

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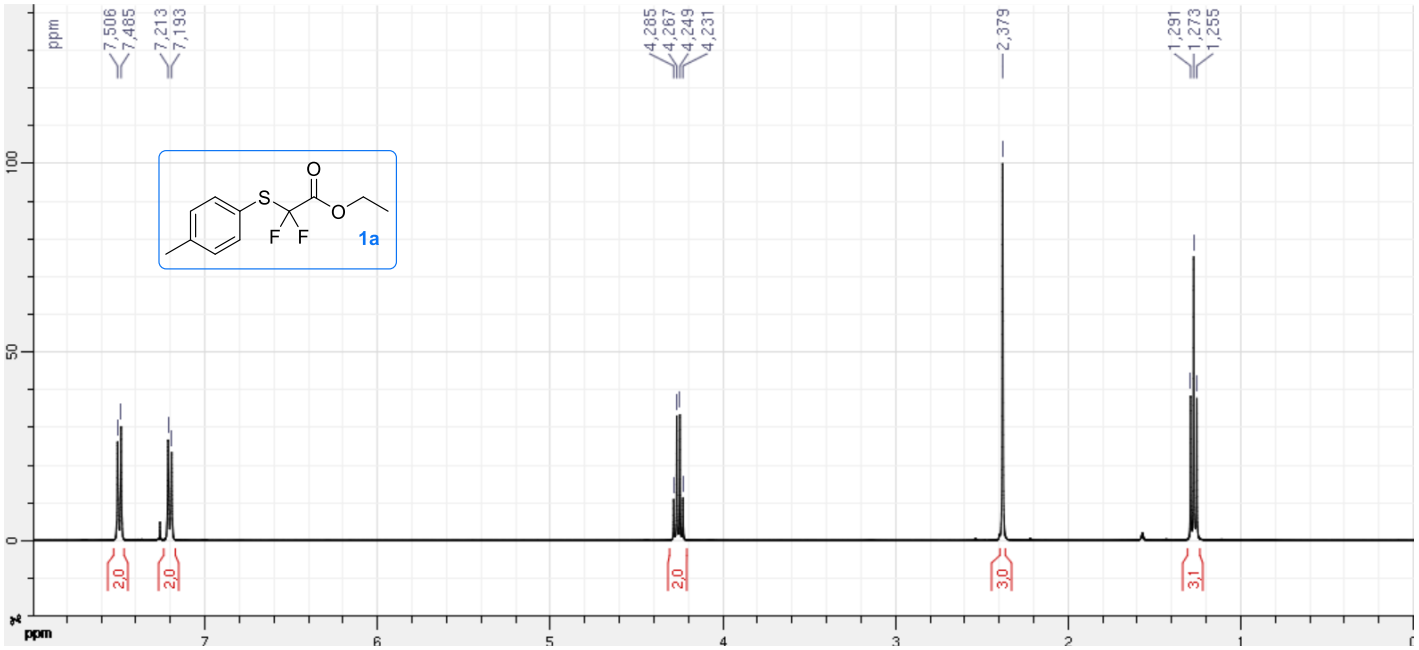
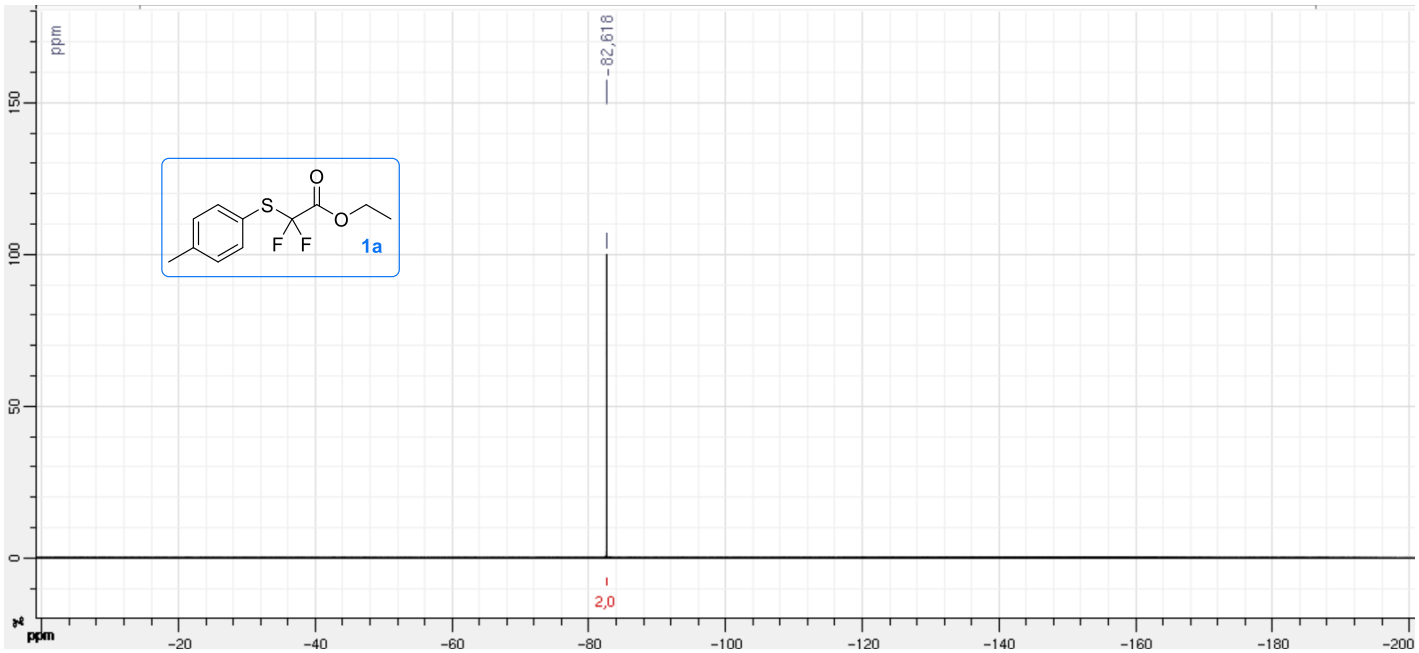
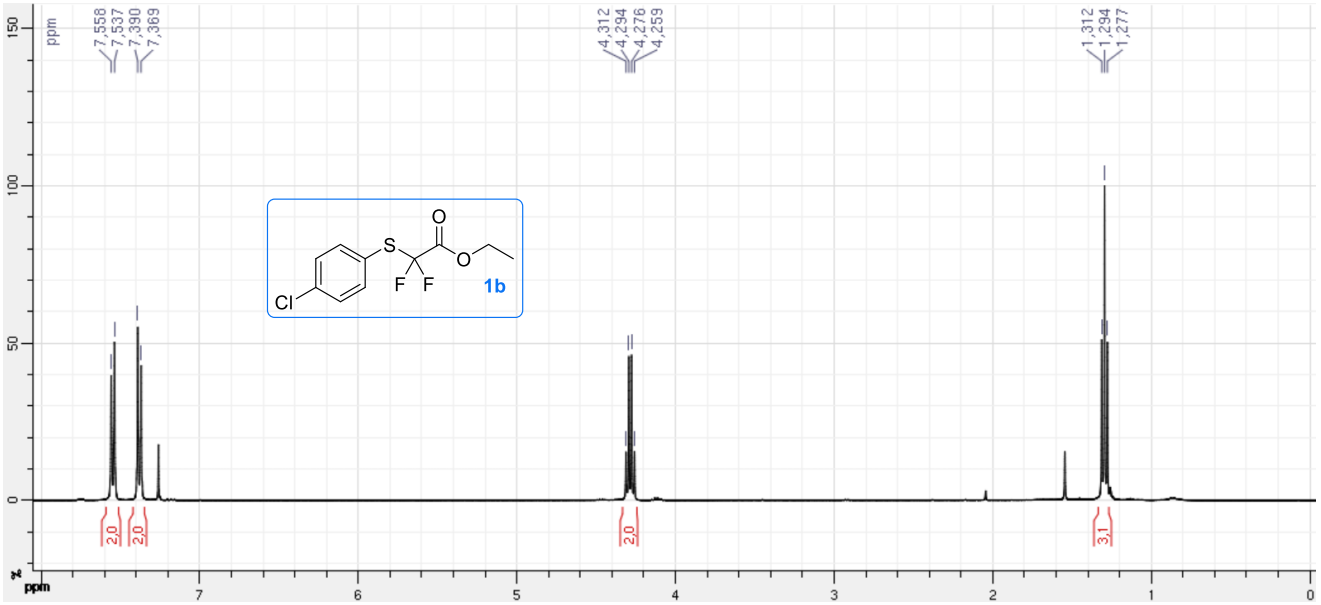
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **1a**



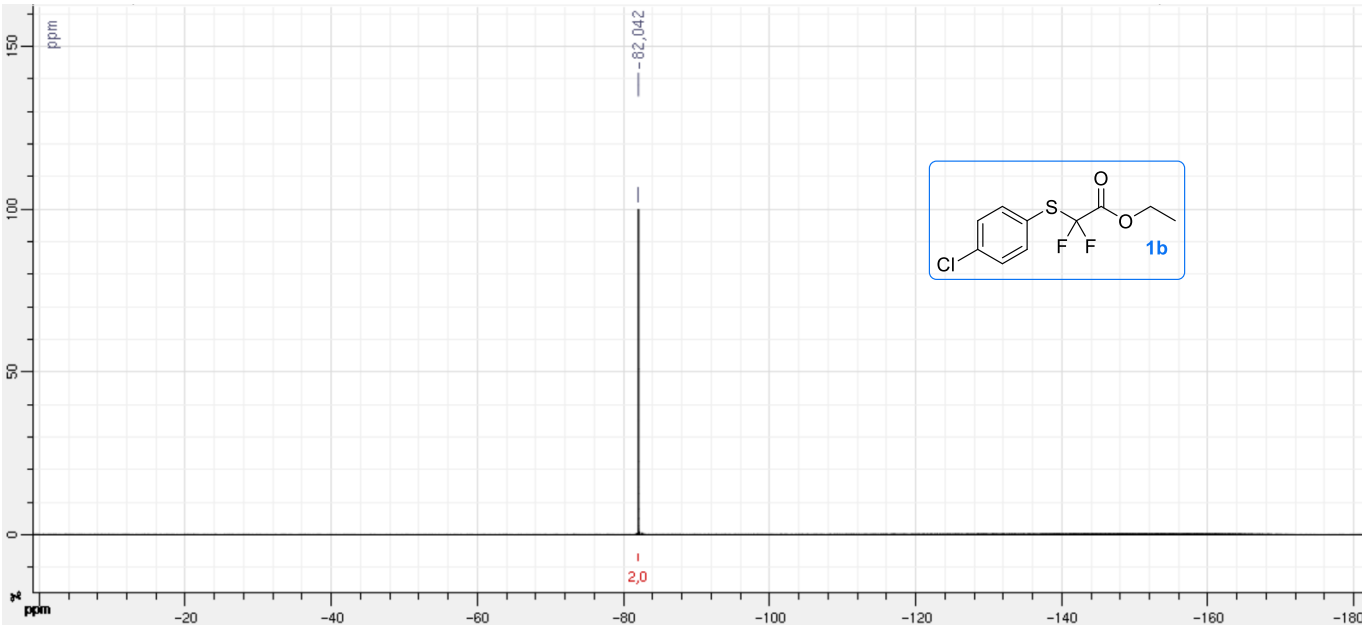
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **1a**



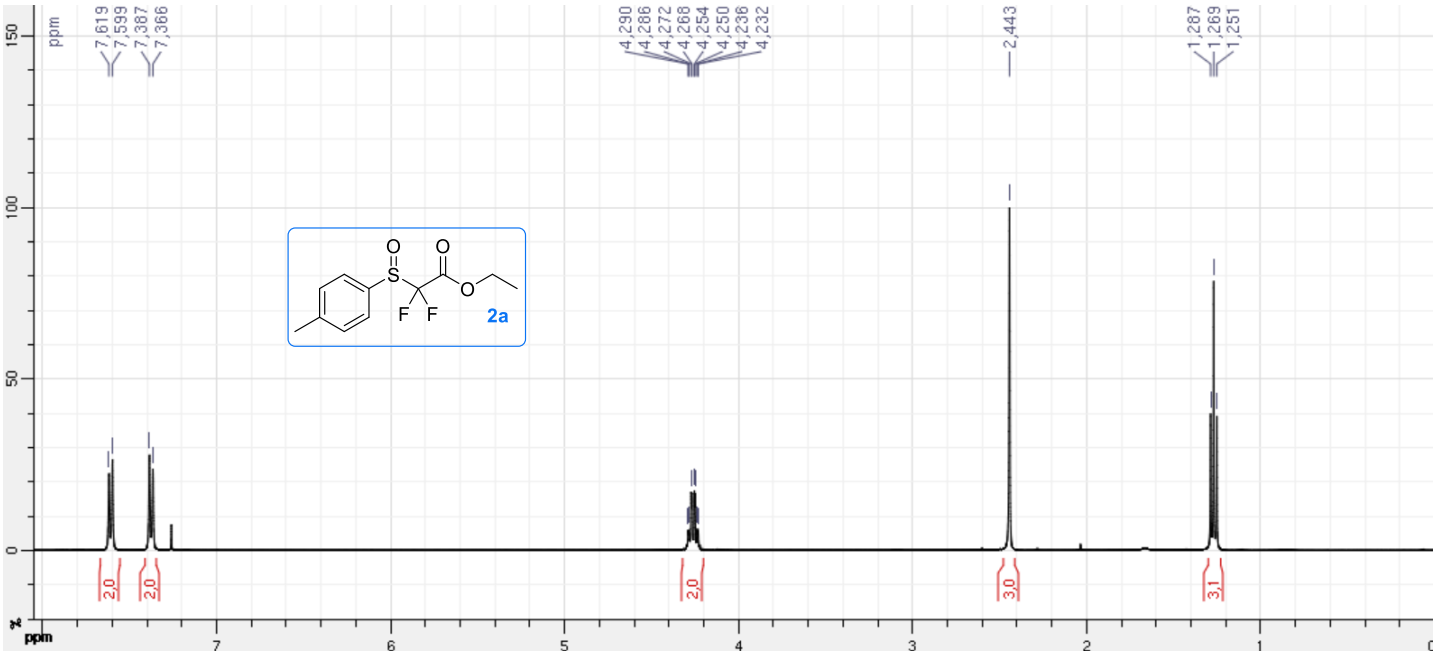
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **1b**



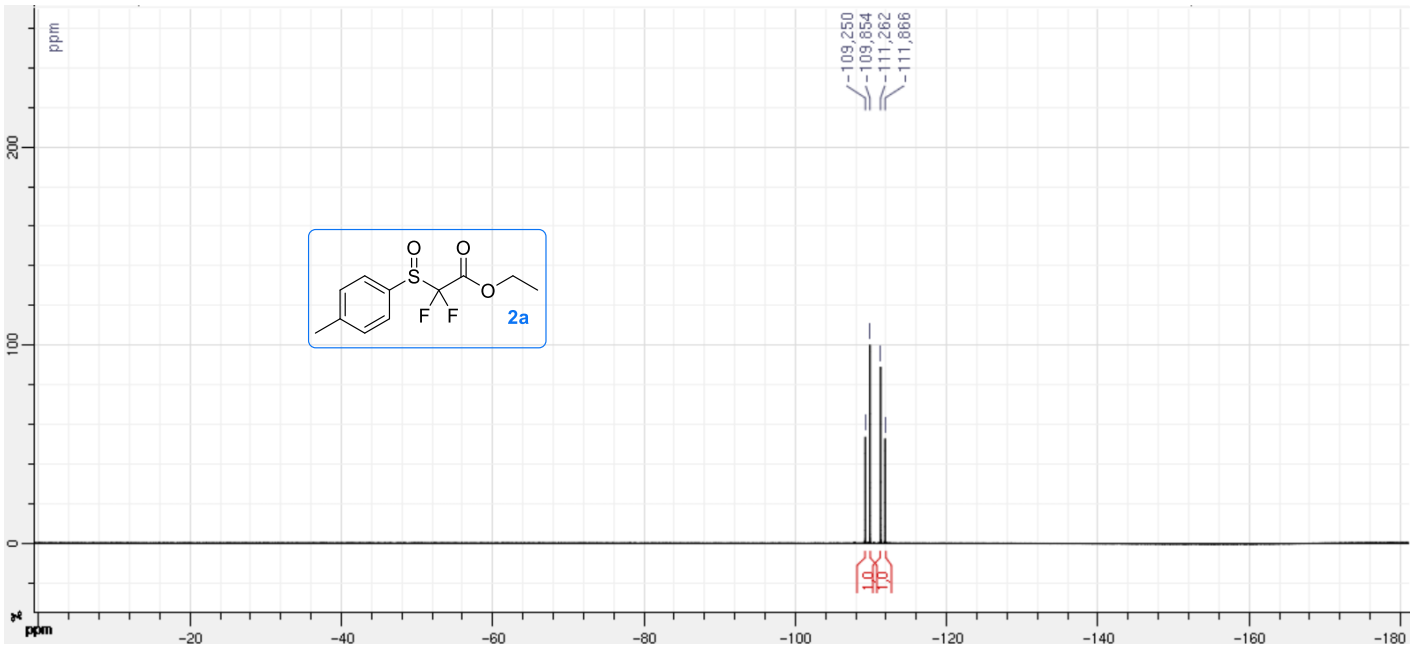
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **1b**



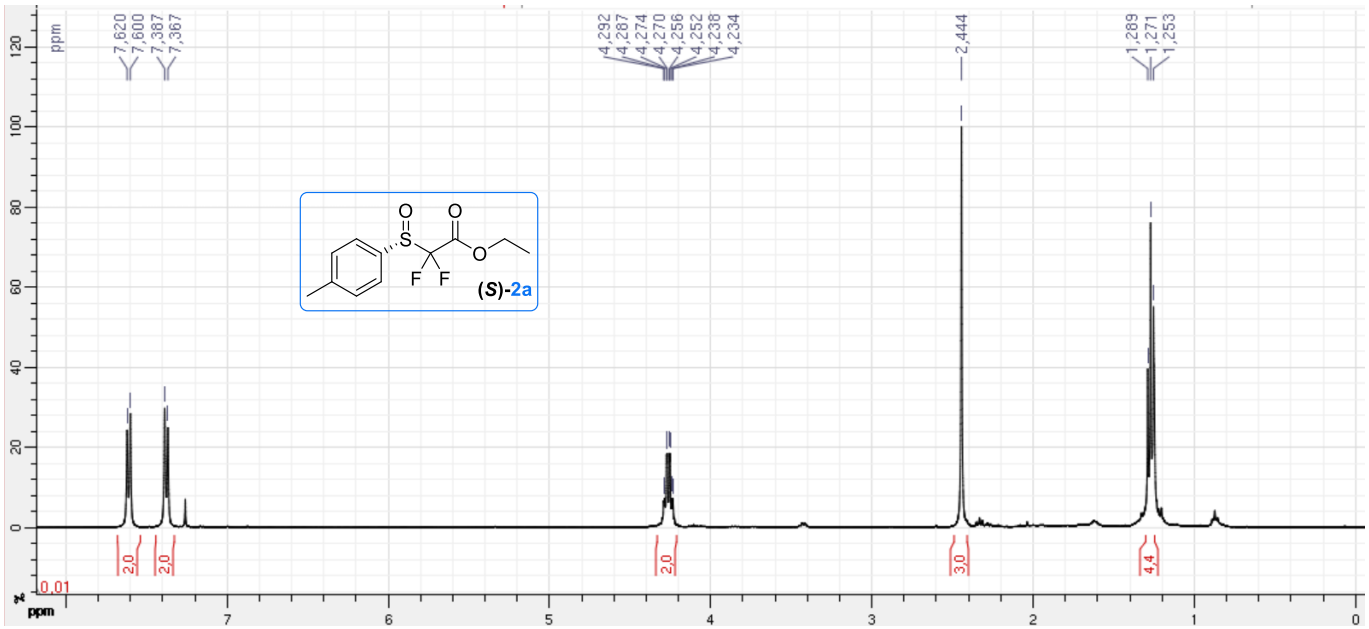
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **2a**



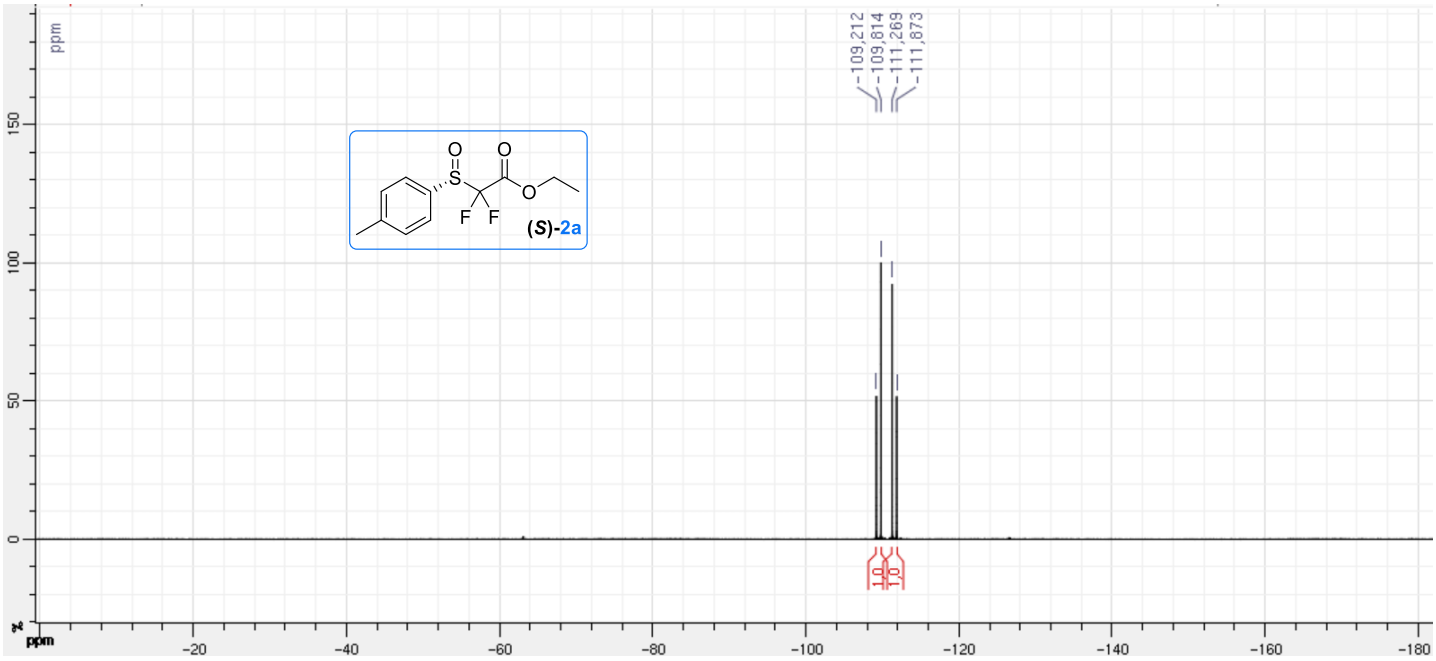
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **2a**



^{1}H NMR (400 MHz, $CDCl_3$) – Purified (*S*)-**2a**



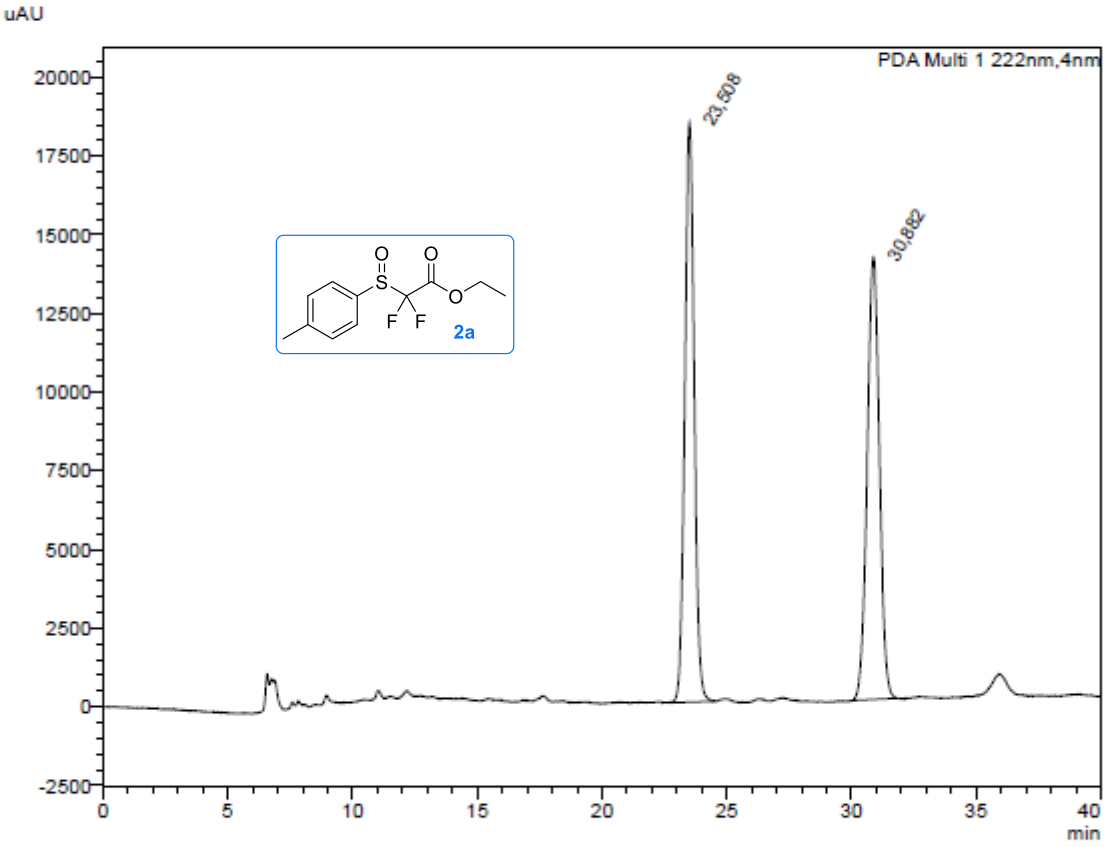
^{19}F NMR (376 MHz, $CDCl_3$) – Purified (*S*)-**2a**



Chiral HPLC – Reference racemic 2a

Sample Name : CB74A-rac01
Data Filename : CB74A-rac01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2016-04-21.lcb
Vial # : 1-1
Injection Volume : 1 uL
Date Acquired : 21/04/2016 11:37:55 Acquired by : User-Adv
IC hex/iproh 80/20 0.5ml

<PDA Chromatogram>



<PDA Chromatogram>

Peak Table

PDA Ch1 222nm

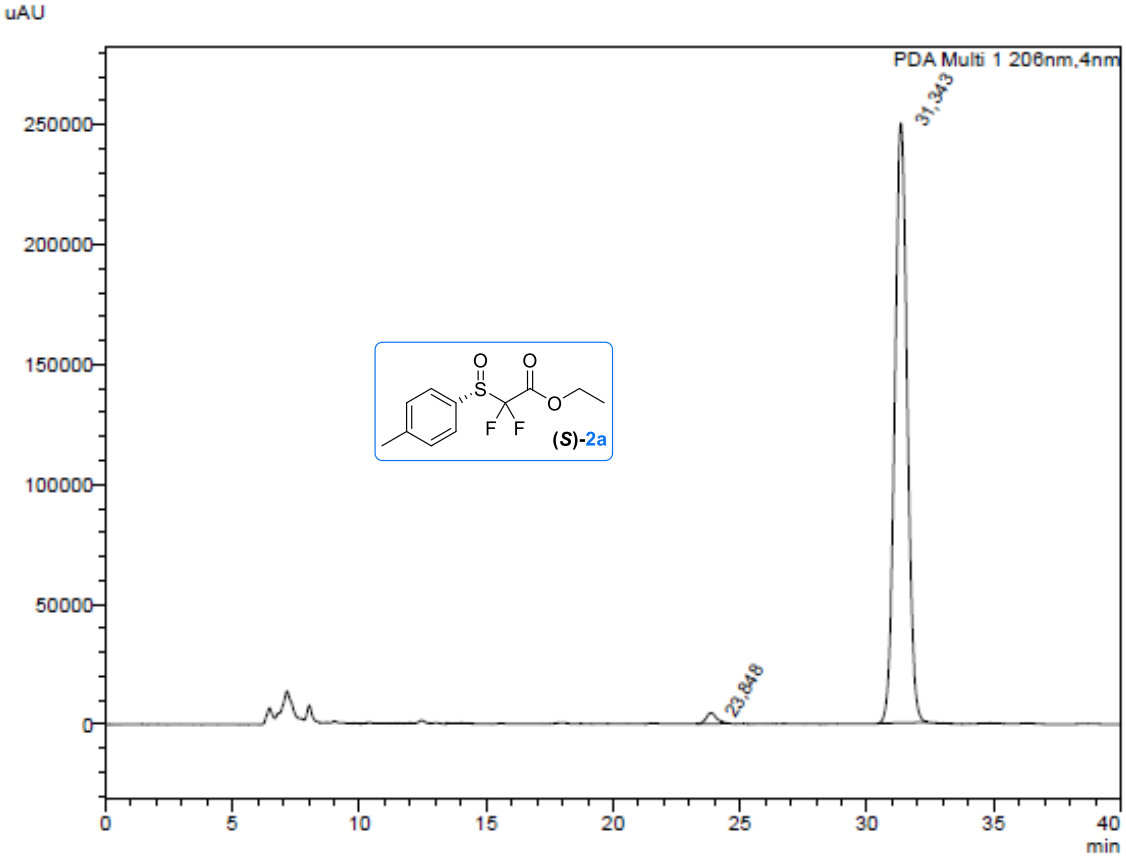
Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	23,508	483860	18423	50,255	--	--	204/223/261/484/655
2	30,882	478954	14059	49,745	0,314	9,235	204/223/260/488
Total		962813	32481	100,000			

Chiral HPLC – Reformatsky-type reaction

<Sample Information>

Sample Name : CB120B-en01
Data Filename : CB120B-en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2016-05-09.lcb
Vial # : 1-2
Injection Volume : 1 uL
Date Acquired : 09/05/2016 13:03:43 Acquired by : User-Adv
IC hex/iproh 80/20 0.5ml

<PDA Chromatogram>



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Peak Table

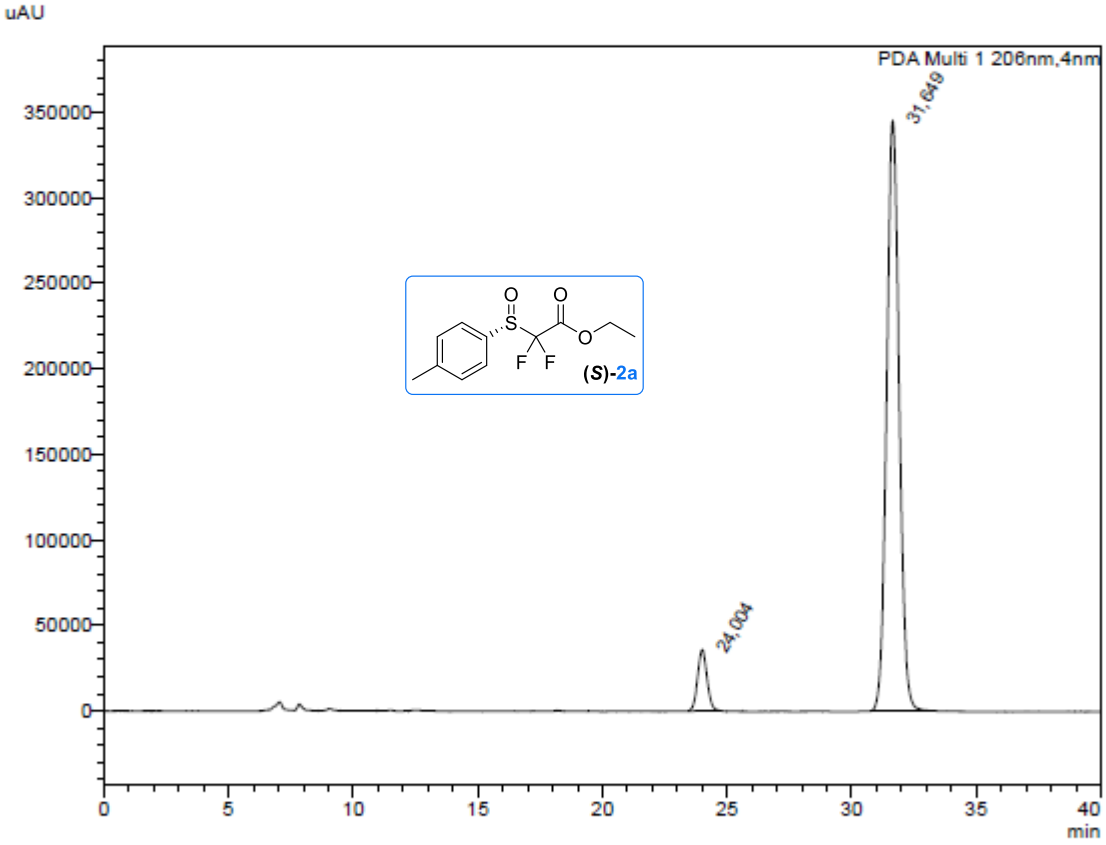
PDA Ch1 206nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	23.848	129888	4488	1.496	--	--	204/223/262/485/584
2	31.343	8549634	250054	98.504	0.314	9.161	204/224/261/485/584
Total		8679522	254542	100.000			

Chiral HPLC – Honda-Reformatsky-type reaction

Sample Name : CB119B-en01
Data Filename : CB119B-en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2016-05-09.lcb
Vial # : 1-1
Injection Volume : 1 uL
Date Acquired : 09/05/2016 12:04:23 Acquired by : User-Adv
IC hex/iproh 80/20 0.5ml

<PDA Chromatogram>



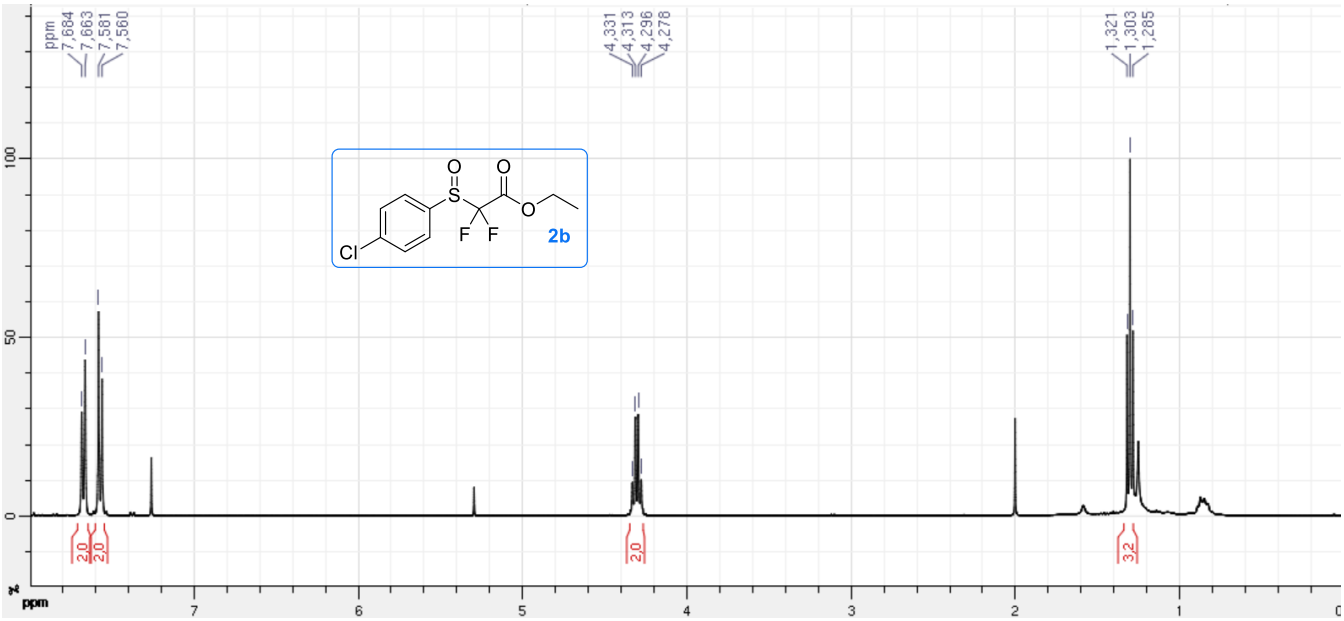
<PDA Chromatogram>

Peak Table

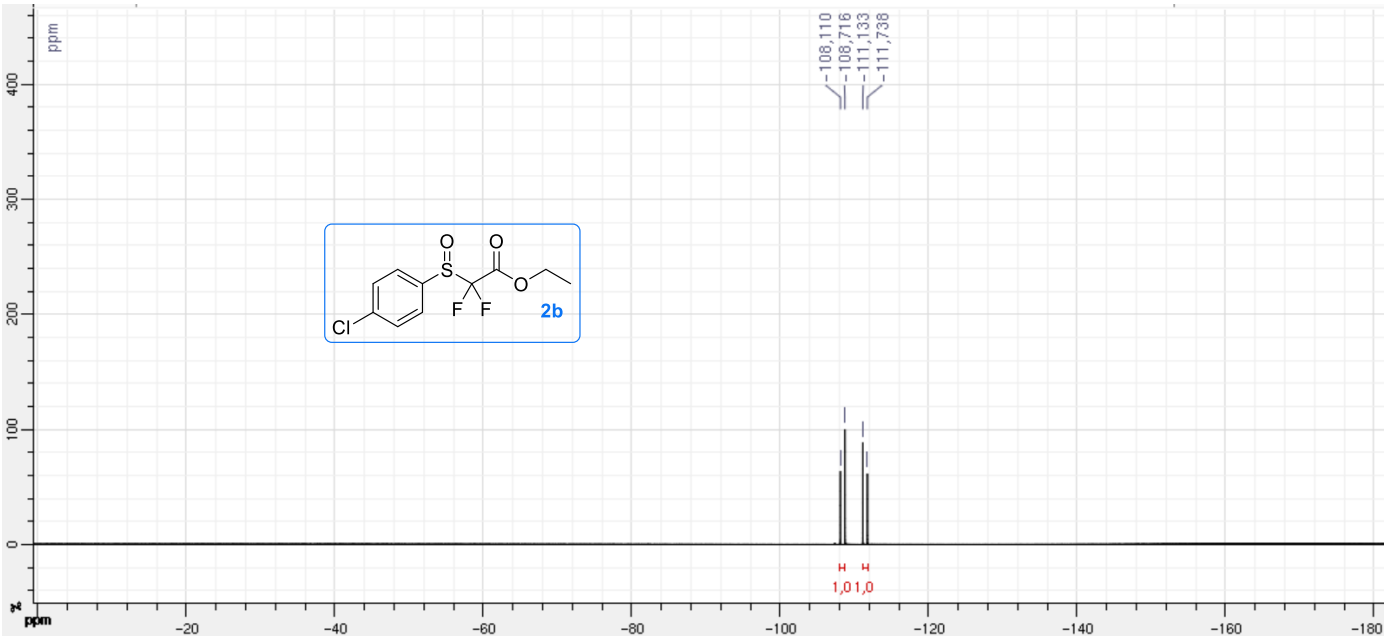
PDA Ch1 206nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	24.004	934156	35713	7.210	--	--	204/224/261/655/525
2	31.649	12022572	344511	92.790	0.318	9.453	204/224/261/525/569
Total		12956728	380224	100.000			

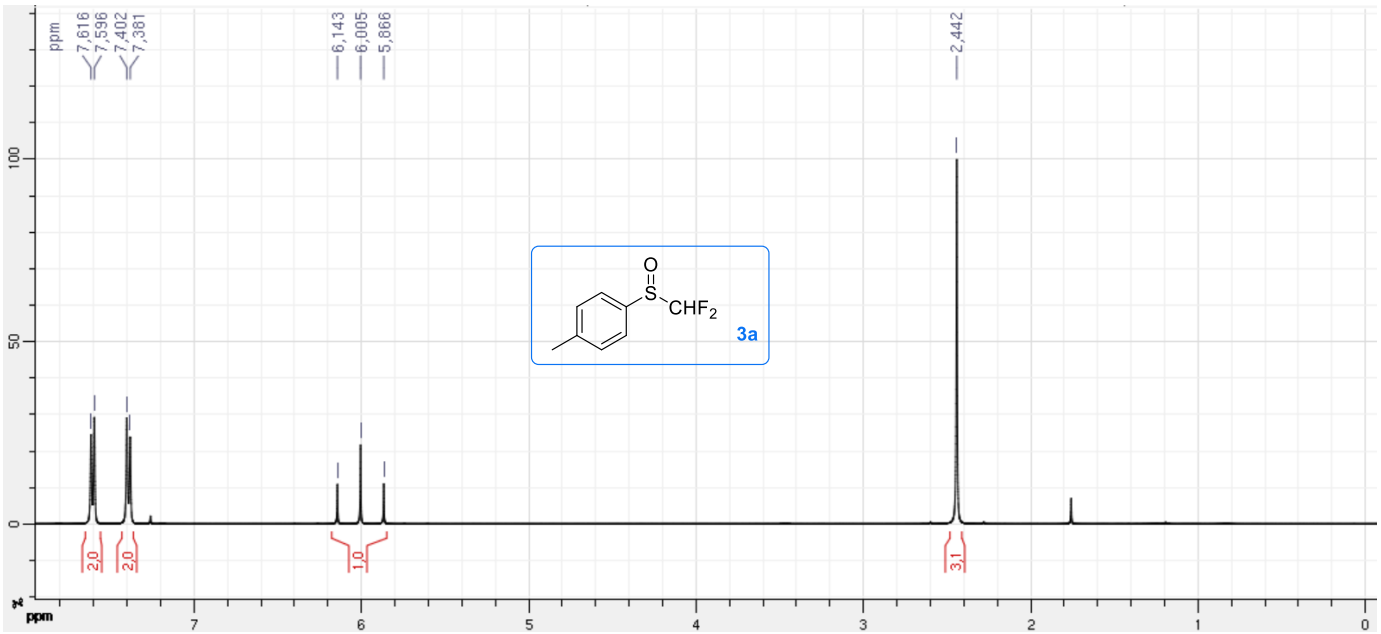
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **2b**



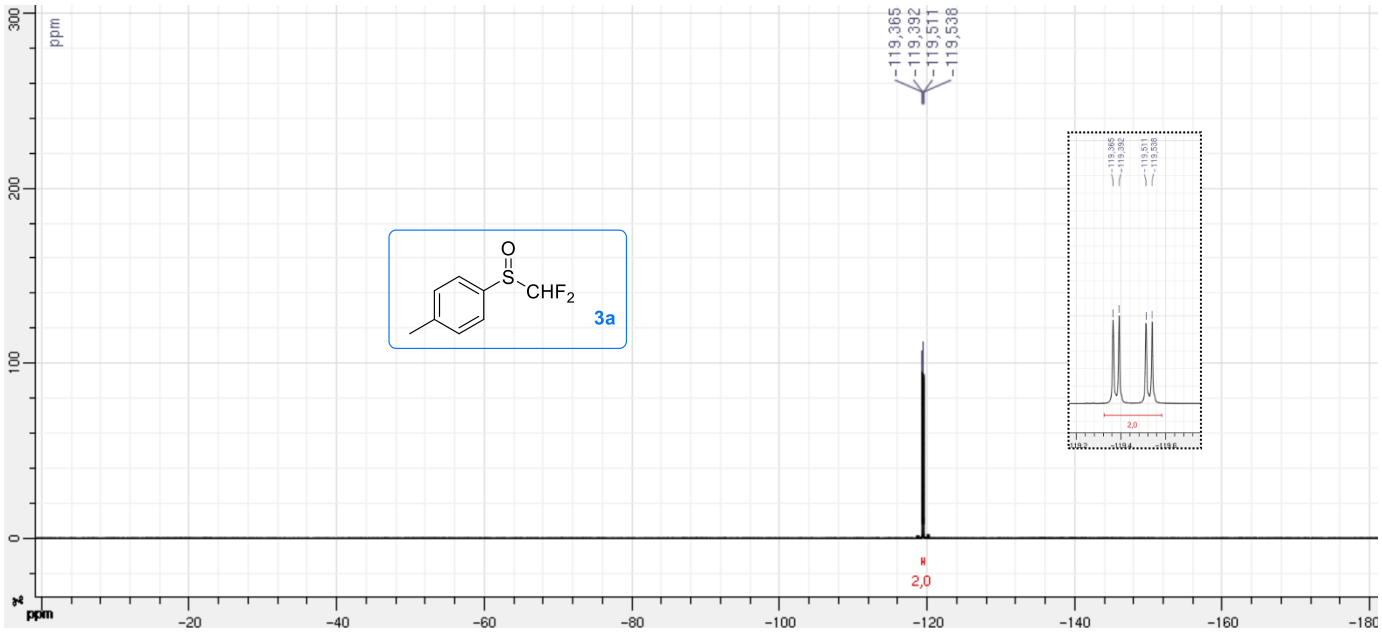
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **2b**



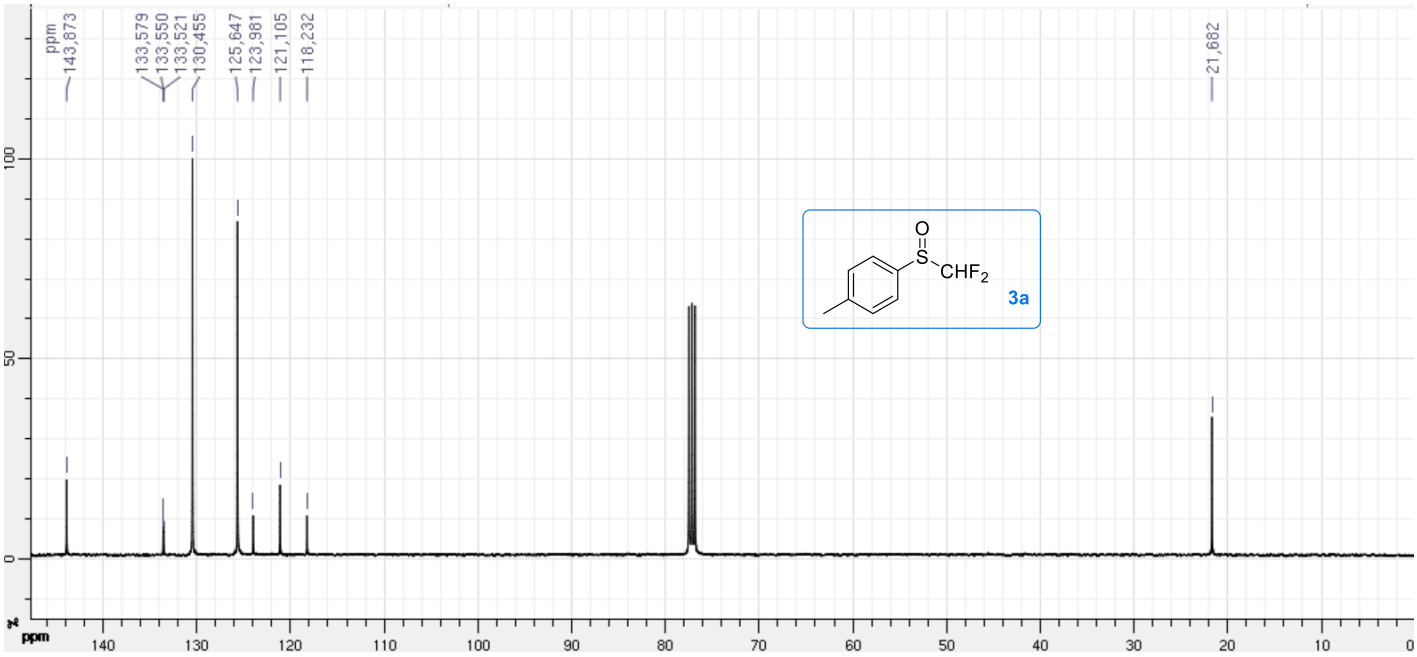
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **3a**



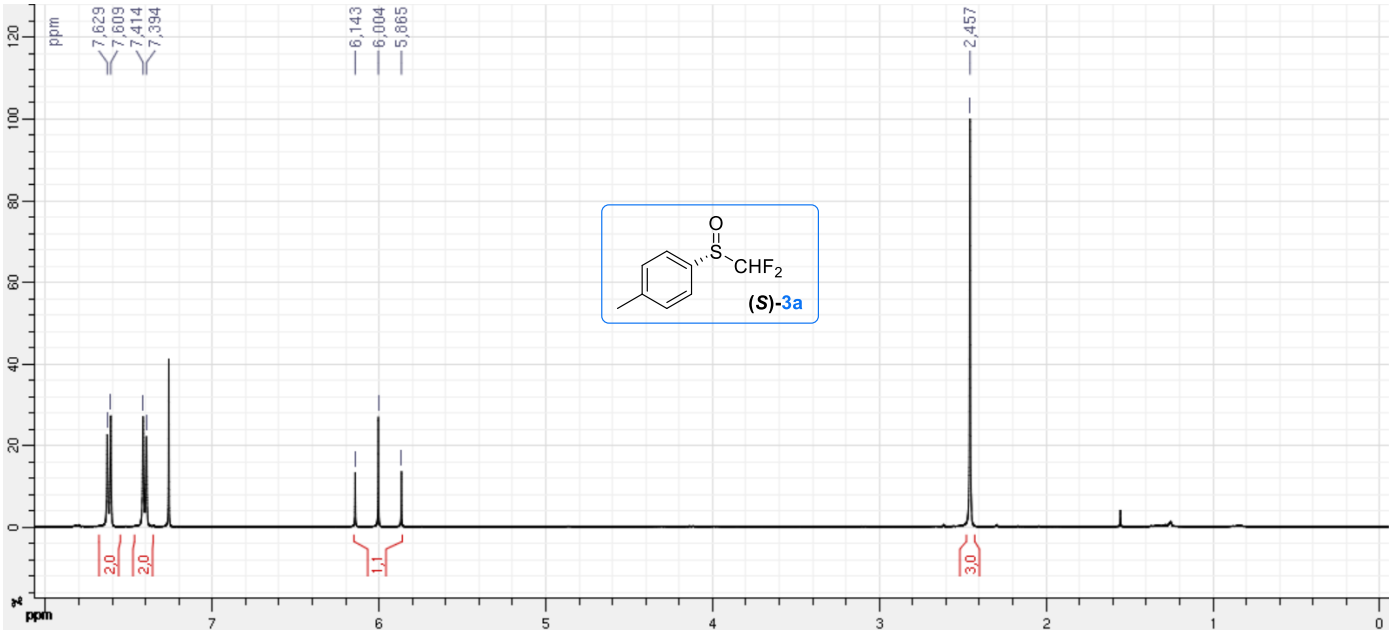
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **3a**



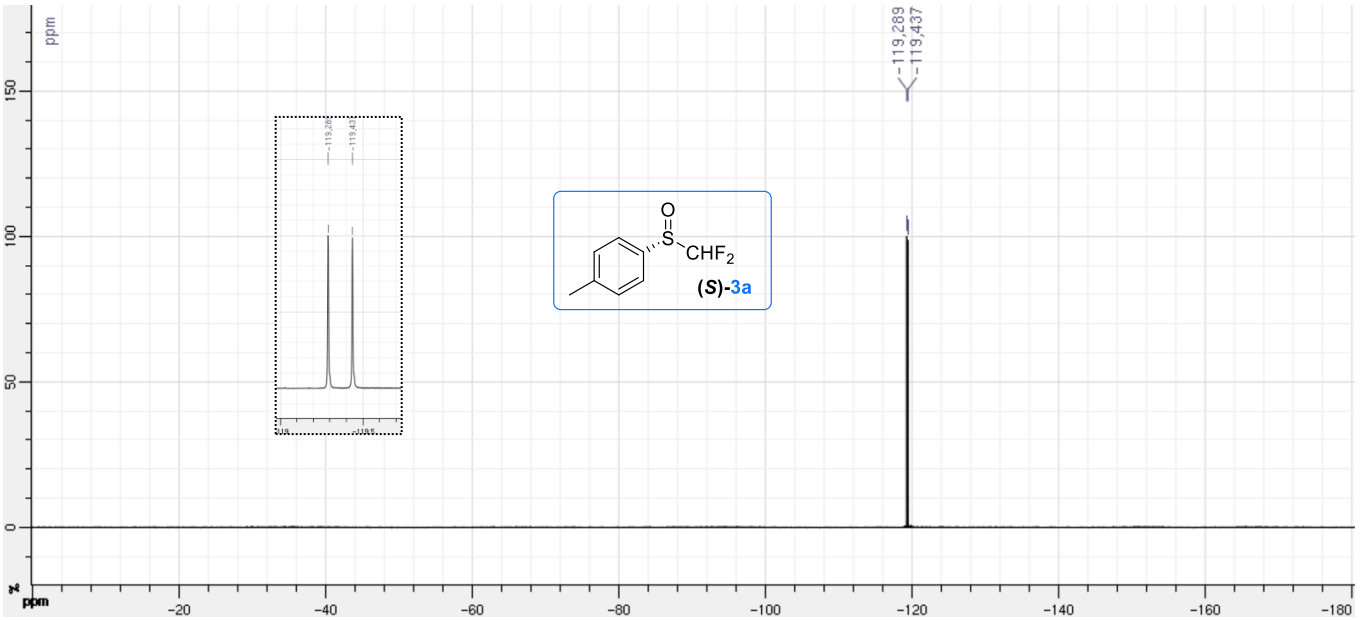
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **3a**



^{1}H NMR (400 MHz, $CDCl_3$) – Purified (*S*)-**3a**



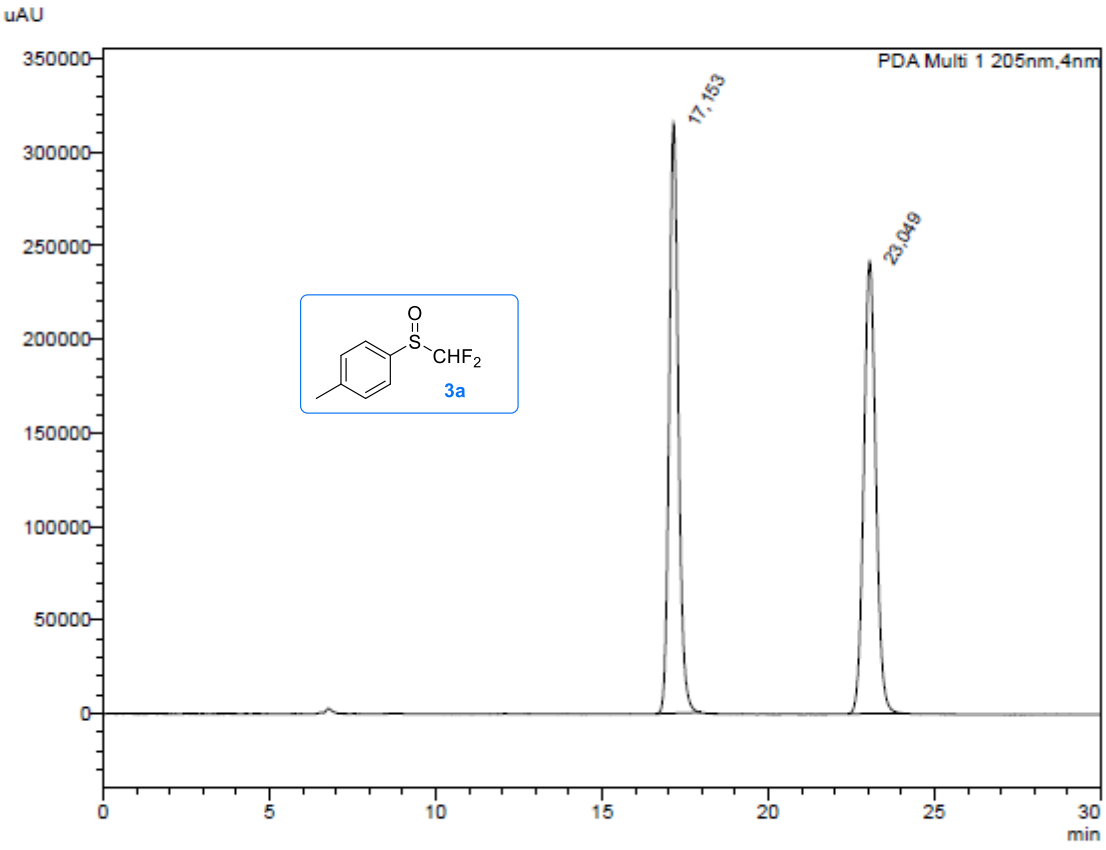
^{19}F NMR (376 MHz, $CDCl_3$) – Purified (*S*)-**3a**



Chiral HPLC – Reference racemic 3a

Sample Name : CB129-rac06
Data Filename : CB129-rac06_06.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2016-06-08.lcb
Vial # : 1-2
Injection Volume : 1 uL
Date Acquired : 09/06/2016 01:29:29 Acquired by : User-Adv
IC hex/iproh 80/20 0.5ml

<PDA Chromatogram>



<PDA Chromatogram>

Peak Table

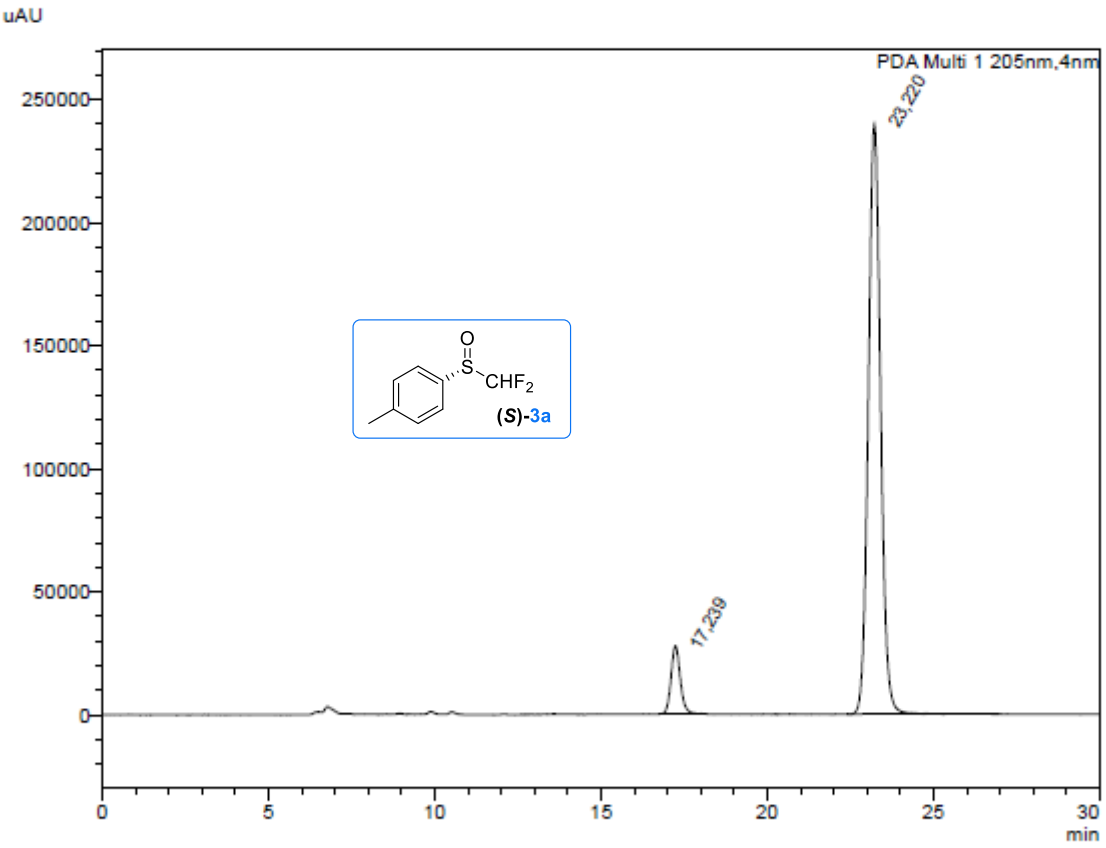
PDA Ch1 205nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	17.153	6086440	315063	49.930	--	--	204/220/247/658/476
2	23.049	6103421	241640	50.070	0.344	10.061	204/220/247/325/486
Total		12189861	556703	100.000			

Chiral HPLC – Krapcho decarboxylation under thermal conditions – (*S*)-3a

Sample Name : CB138CR-en01
Data Filename : CB138CR-en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2016-06-09.lcb
Vial # : 1-3
Injection Volume : 1 uL
Date Acquired : 09/06/2016 09:38:37 Acquired by : User-Adv
IC hex/iproh 80/20 0.5ml

<PDA Chromatogram>



<PDA Chromatogram>

Peak Table

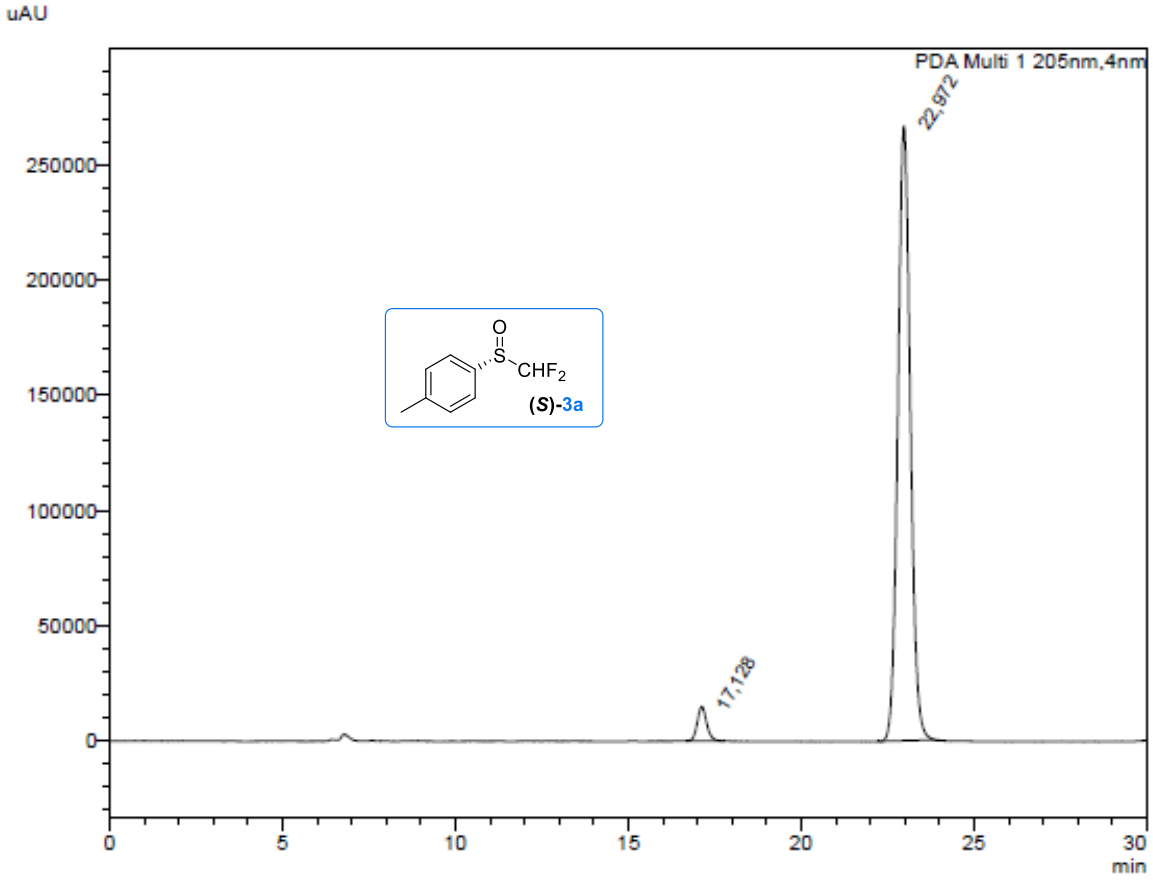
PDA Ch1 205nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	17.239	531921	27600	7.999	-	-	204/220/247/485/426
2	23.220	6117985	239627	92.001	0.347	10.170	204/220/247/655/485
Total		6649906	267227	100.000			

Chiral HPLC – Krapcho decarboxylation under microwave conditions – (*S*)-3a

Sample Name : CB139A-en01
Data Filename : CB139A-en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2016-06-09.lcb
Vial # : 1-4
Injection Volume : 1 uL
Date Acquired : 09/06/2016 11:44:30 Acquired by : User-Adv
IC hex/iproh 80/20 0.5ml

<PDA Chromatogram>



<PDA Chromatogram>

Peak Table

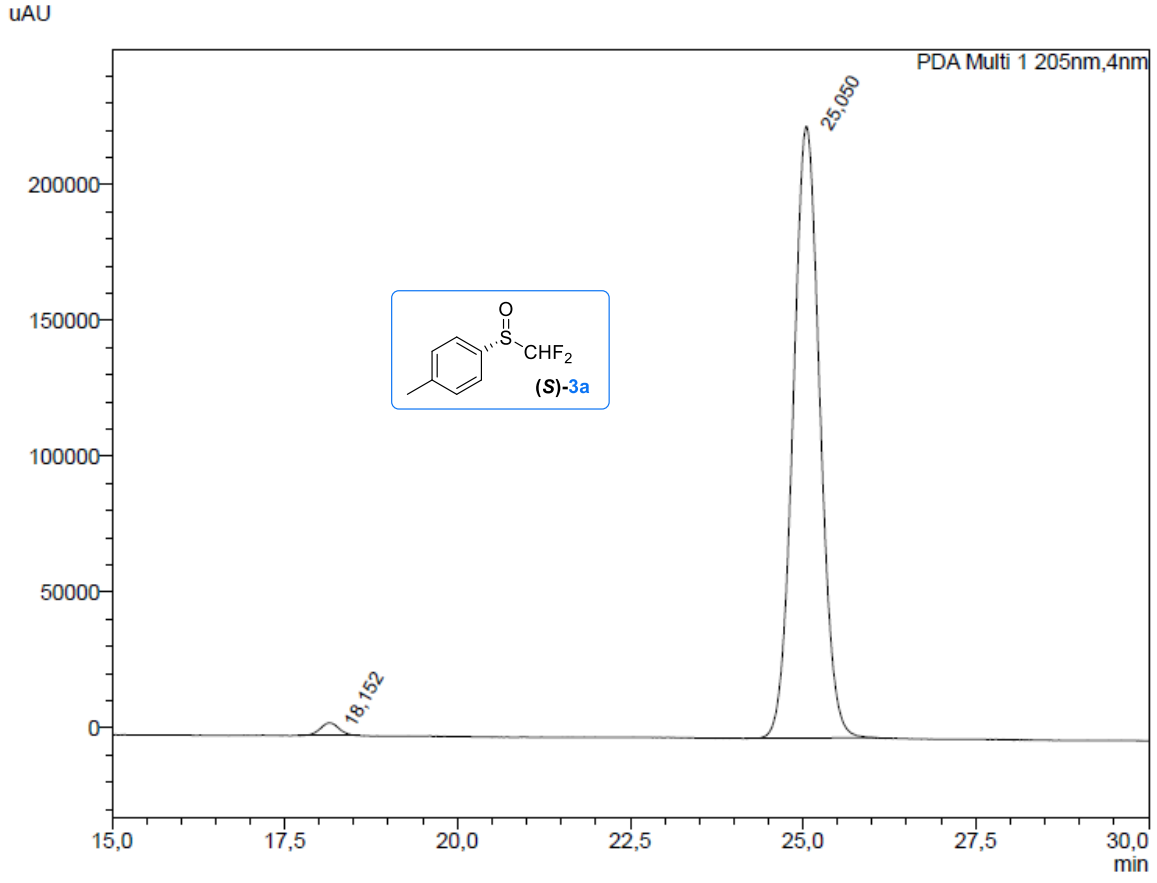
PDA Ch1 205nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	17,128	282820	14890	4,049	-	-	204/220/247/656/488
2	22,972	6701865	266397	95,951	0,341	10,052	204/220/247/485/566
Total		6984684	281287	100,000			

Chiral HPLC – (*S*)-3a crystallised in Et_2O

Sample Name : CB227-cryst-blanc-en01
Data Filename : CB227-cryst-blanc-en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2017-11-16.lcb
Vial # : 1-2
Injection Volume : 1 uL
Date Acquired : 16/11/2017 15:48:49 Acquired by : User-Adv
IC Hex/IPA 80/20 0.5 ml/mi

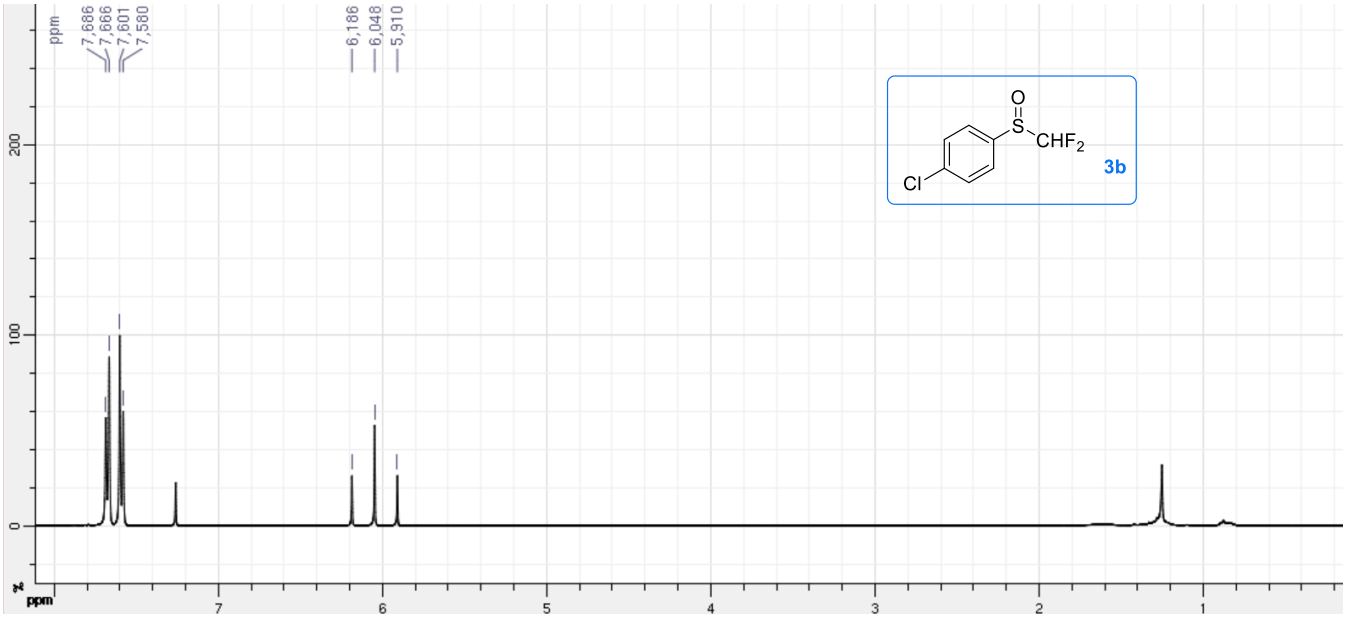
<PDA Chromatogram>



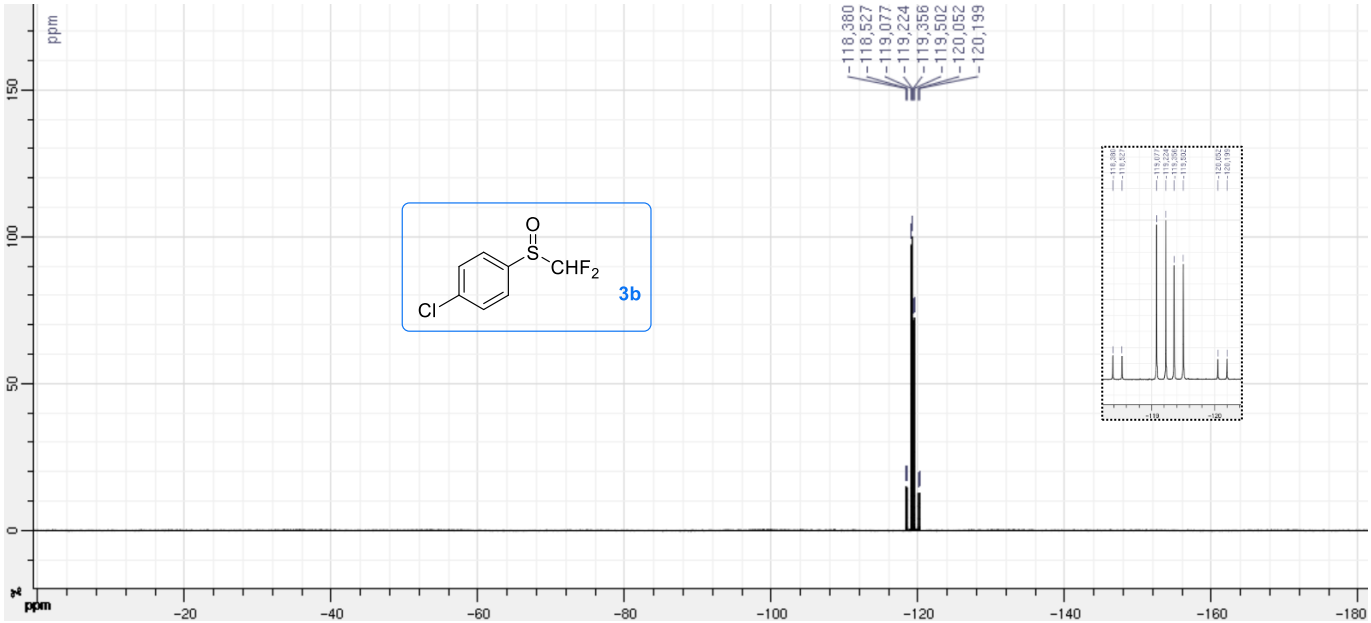
PDA Ch1 205nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	18,152	88753	4679	1,442	--	--	222/254/655/485/377
2	25,050	6065132	225213	98,558	0,380	11,250	204/220/247/658/394
Total		6153885	229892	100,000			

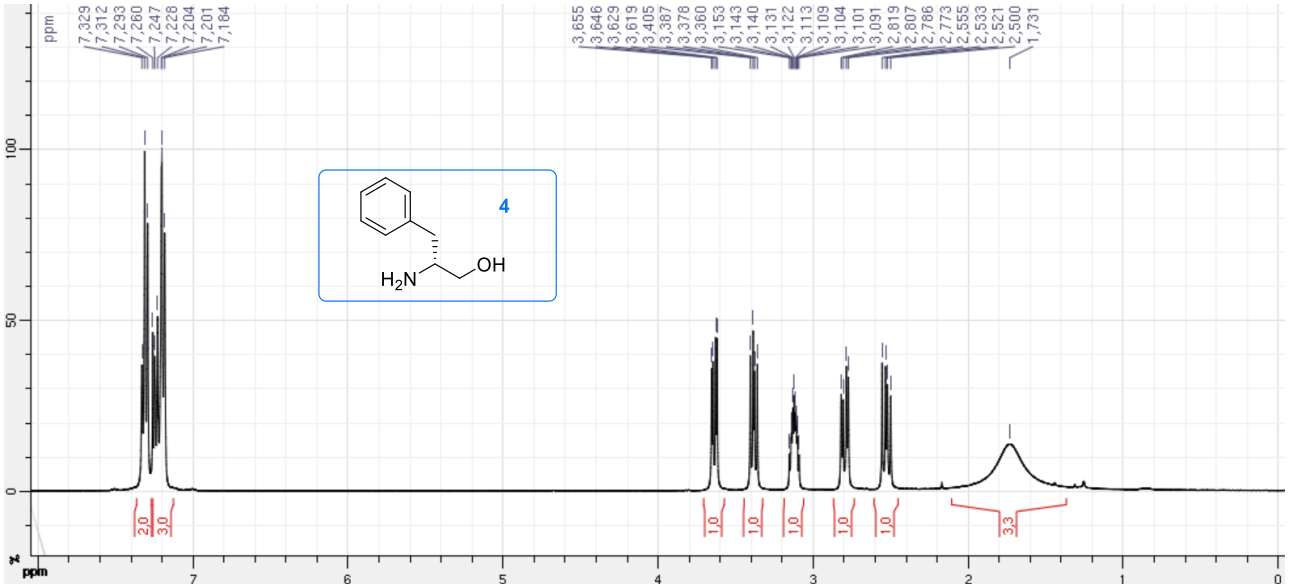
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **3b**



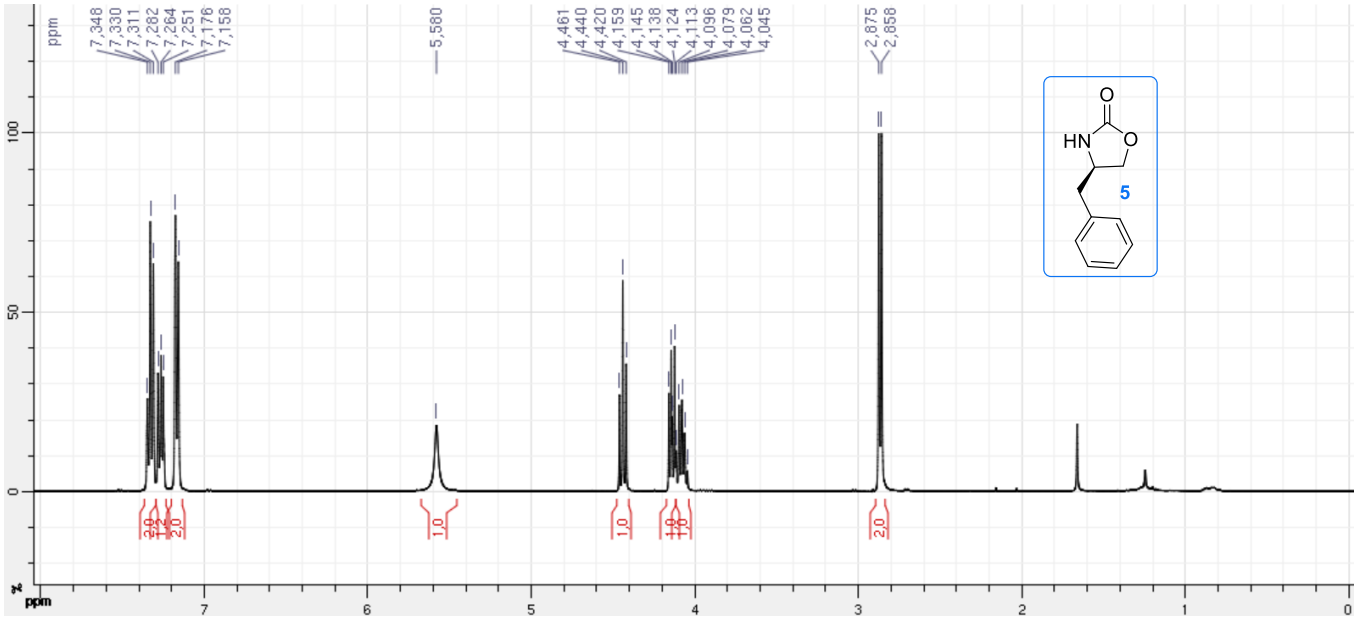
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **3b**



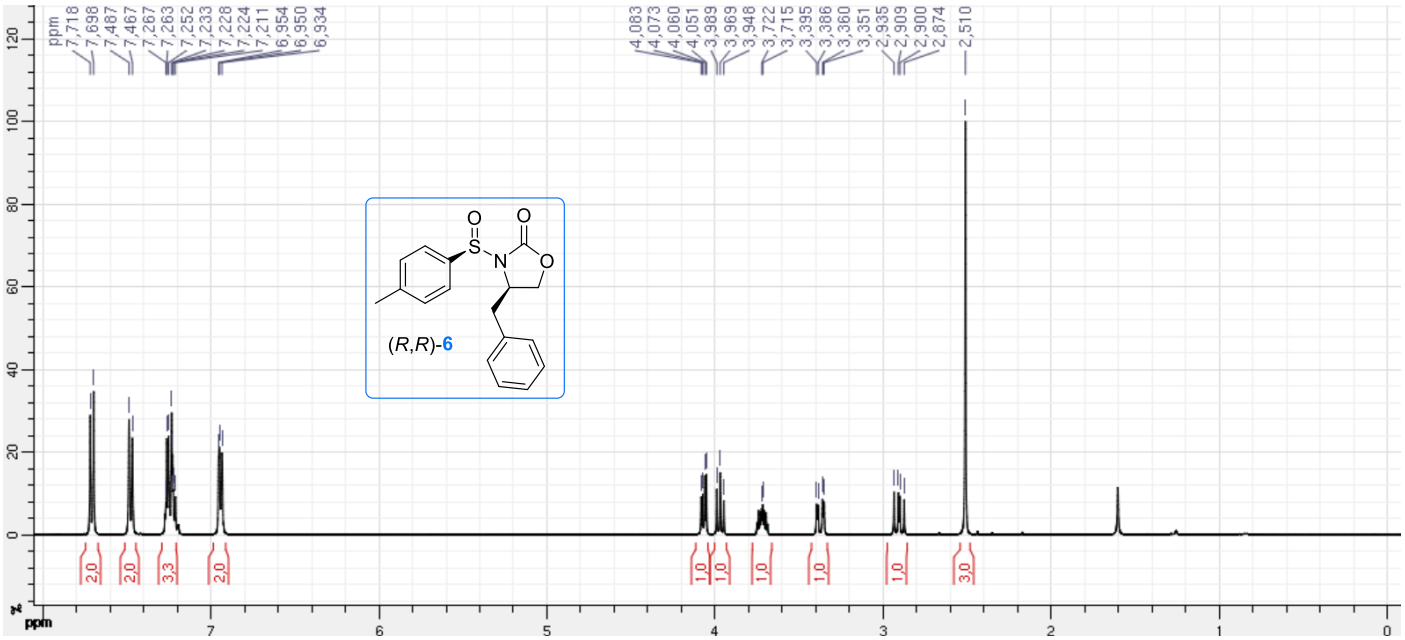
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **4**



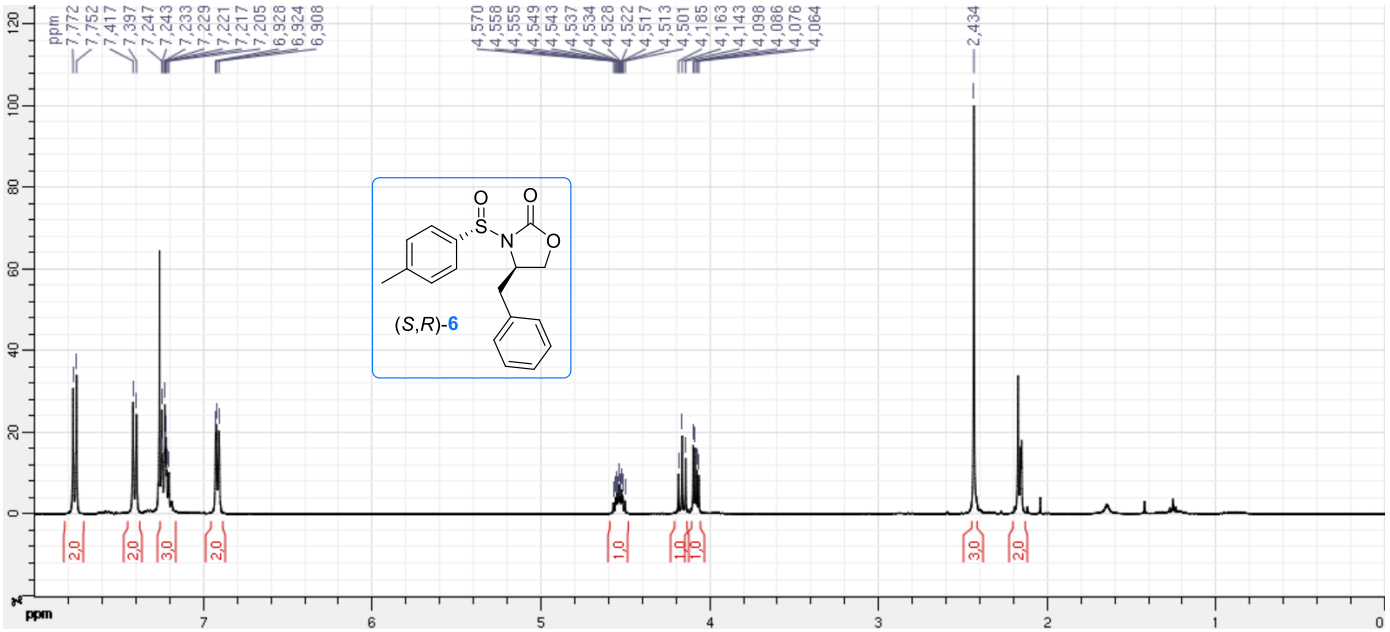
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **5**



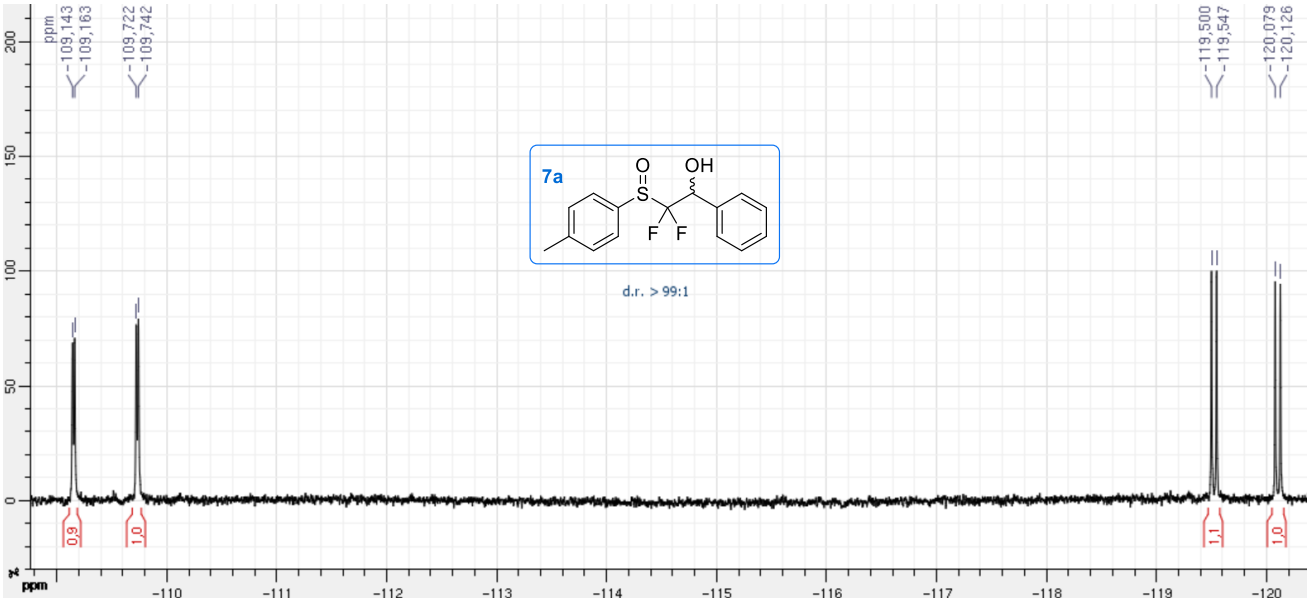
^{1}H NMR (400 MHz, $CDCl_3$) – Purified (*R*,*R*)-**6**



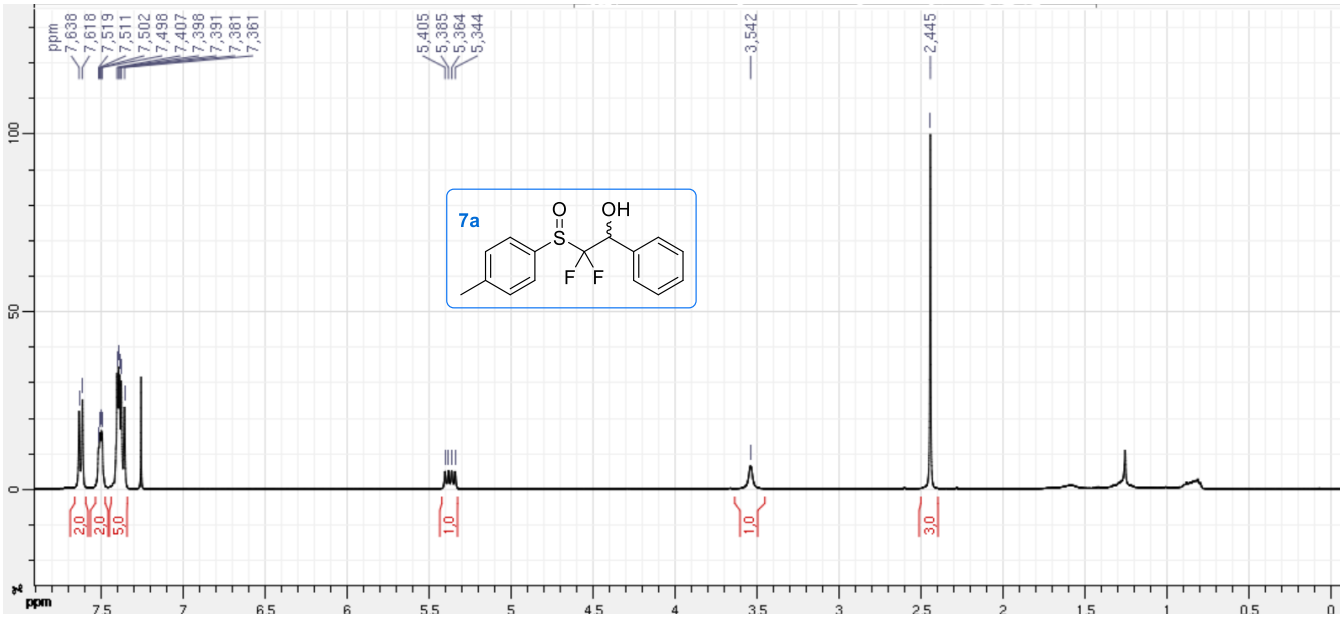
^{1}H NMR (400 MHz, $CDCl_3$) – Purified (*S*,*R*)-**6**



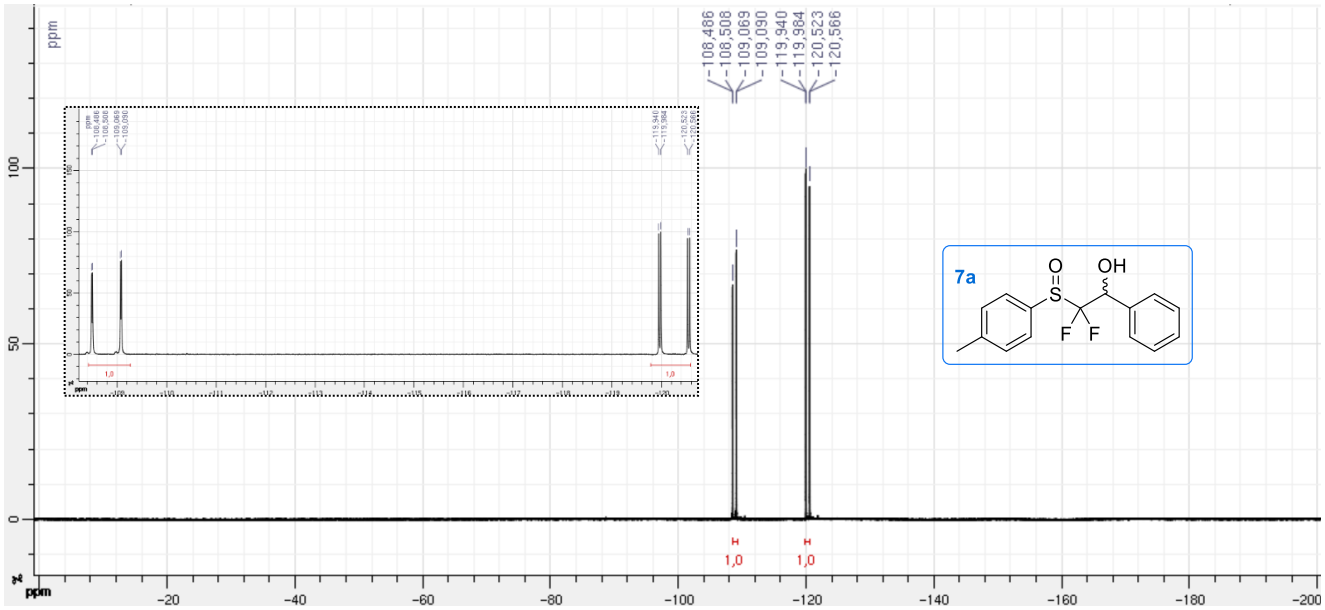
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7a**



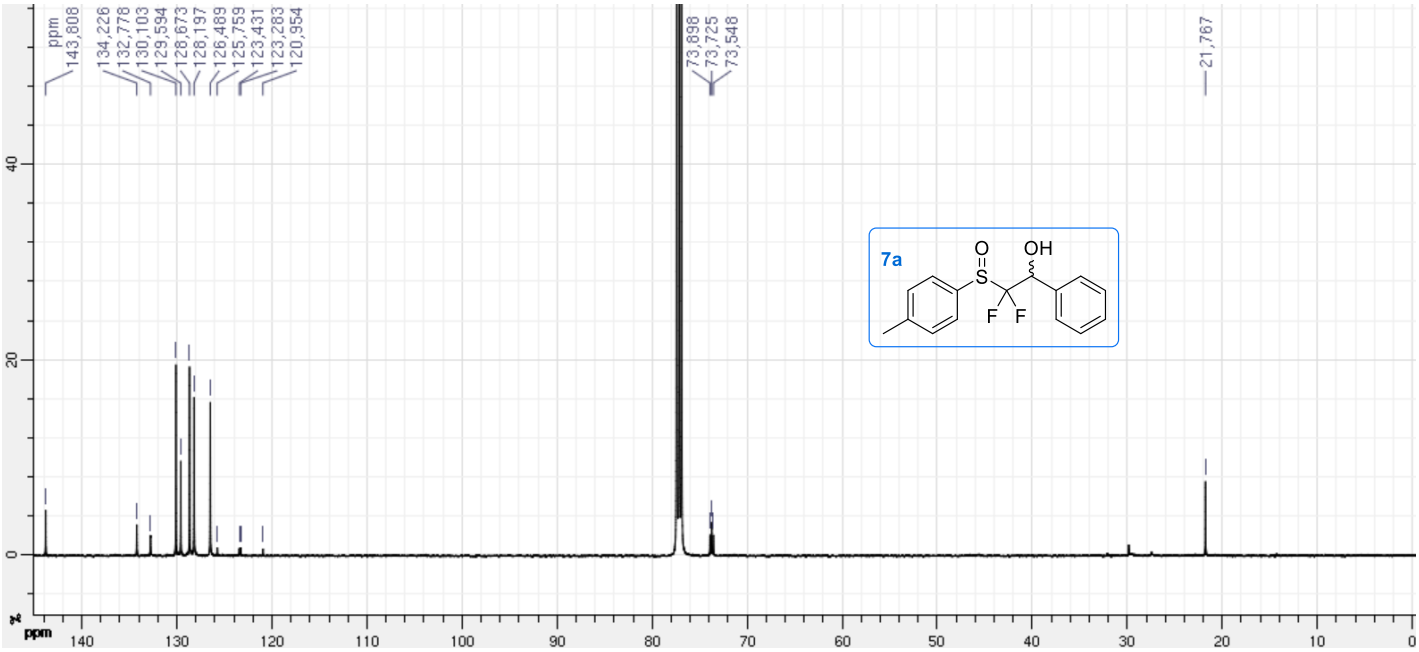
^{1}H NMR (400 MHz, $CDCl_3$) – One diastereomer – Purified **7a**



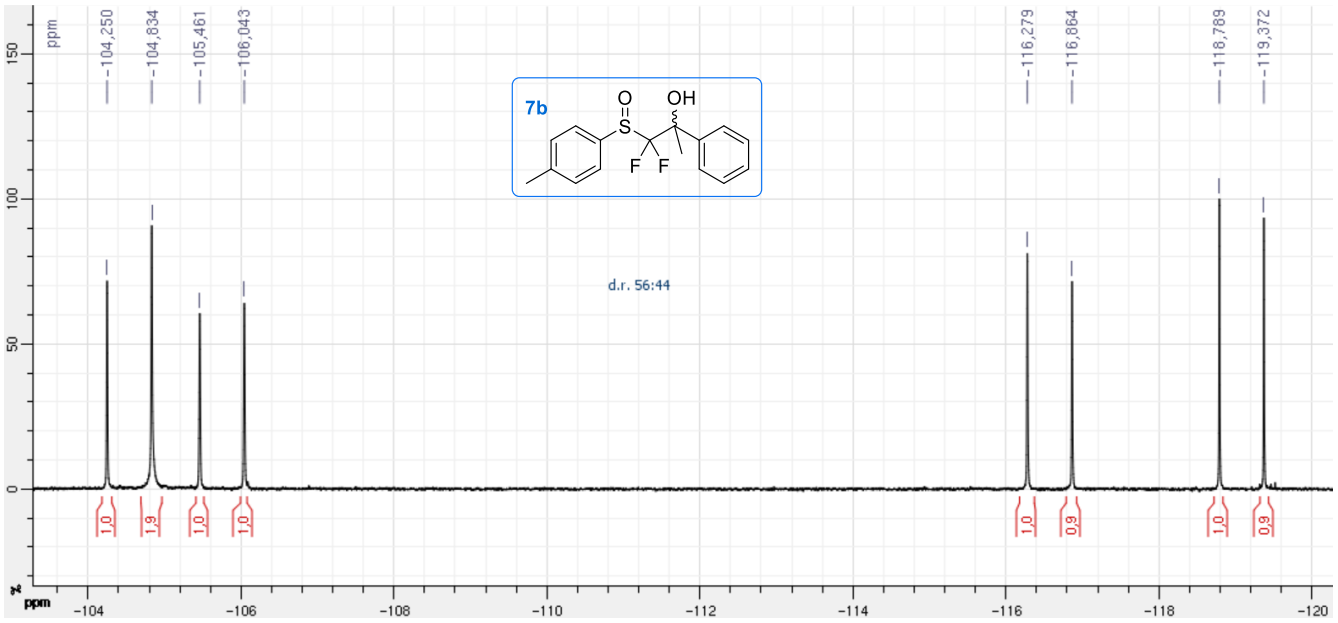
^{19}F NMR (376 MHz, $CDCl_3$) – One diastereomer – Purified **7a**



^{13}C NMR (126 MHz, $CDCl_3$) – One diastereomer – Purified **7a**

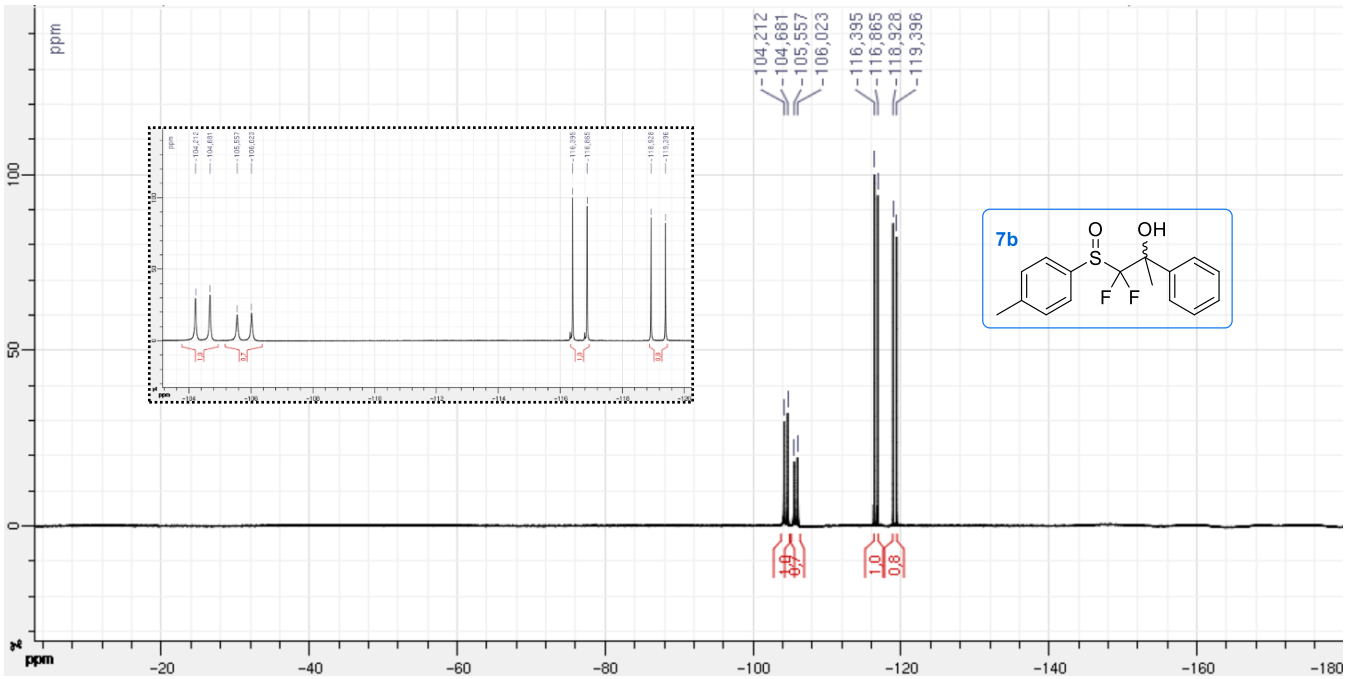


^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7b**

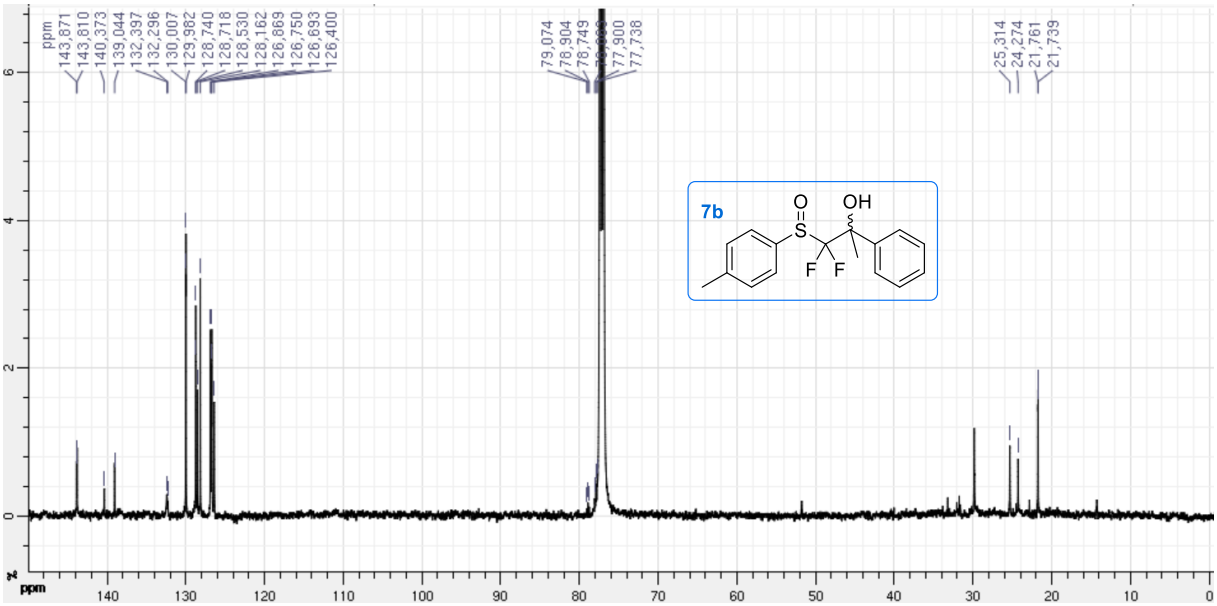


^{1}H NMR (500 MHz, $CDCl_3$) – Purified **7b**

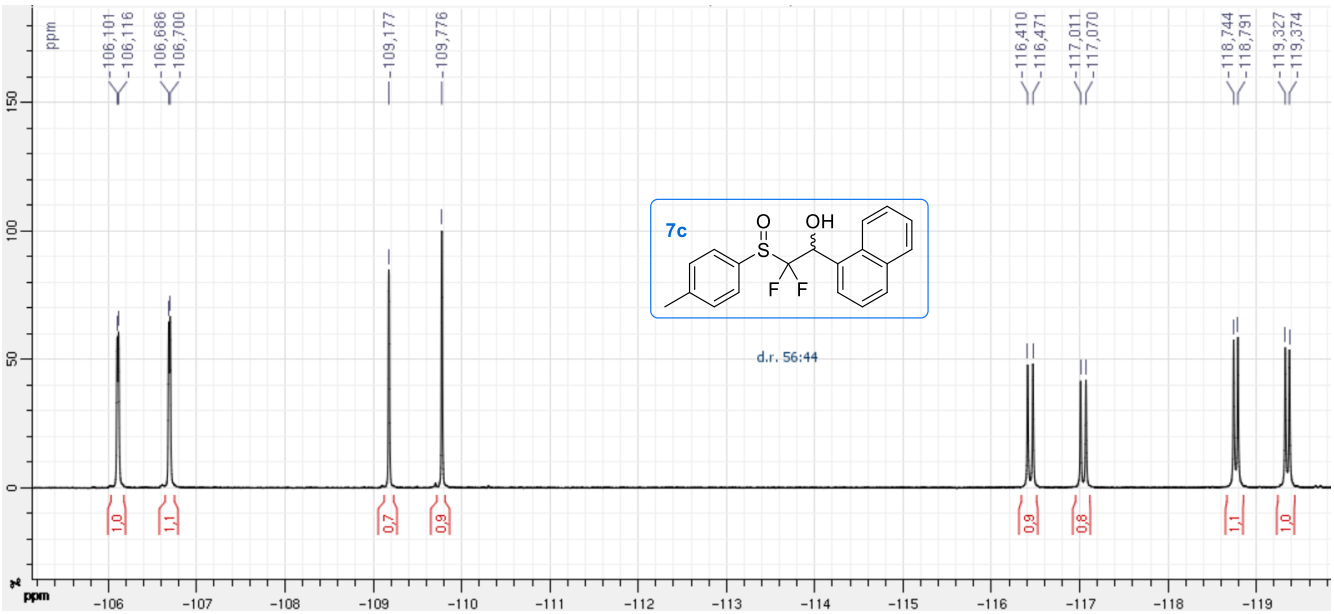
^{19}F NMR (472 MHz, $CDCl_3$) – Purified **7b**



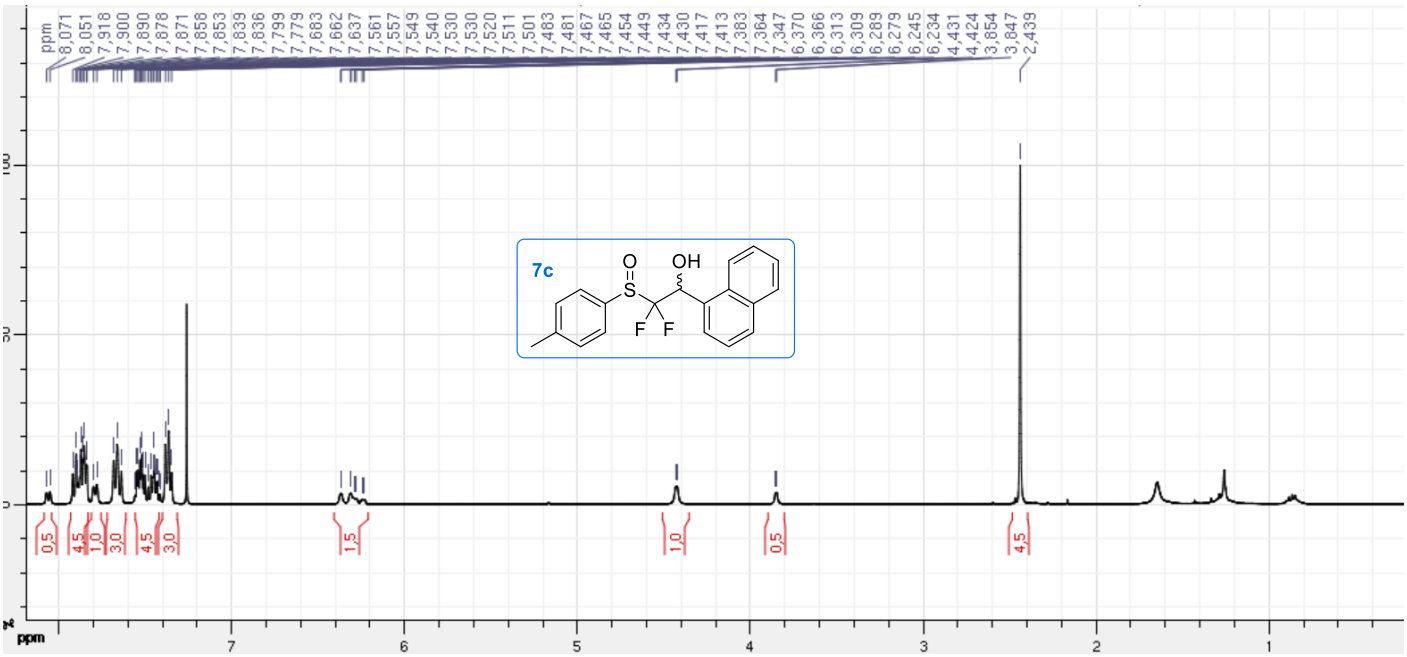
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7b**



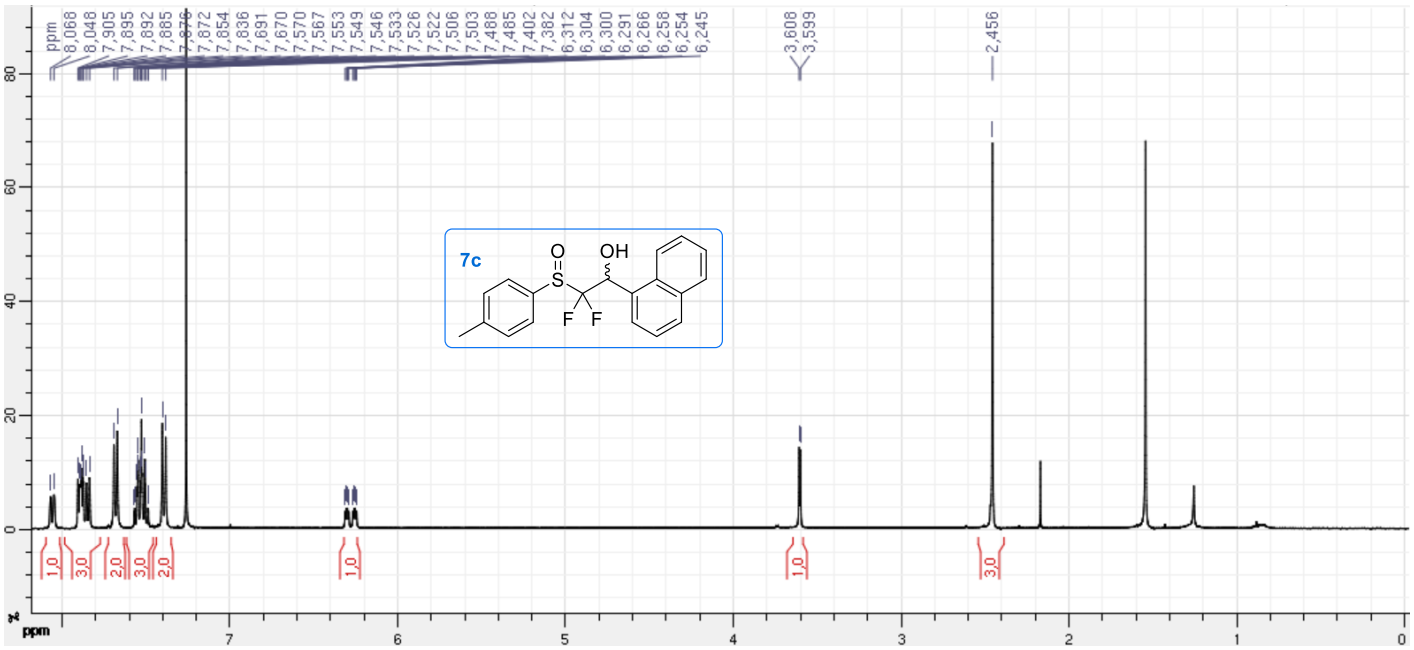
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7c**



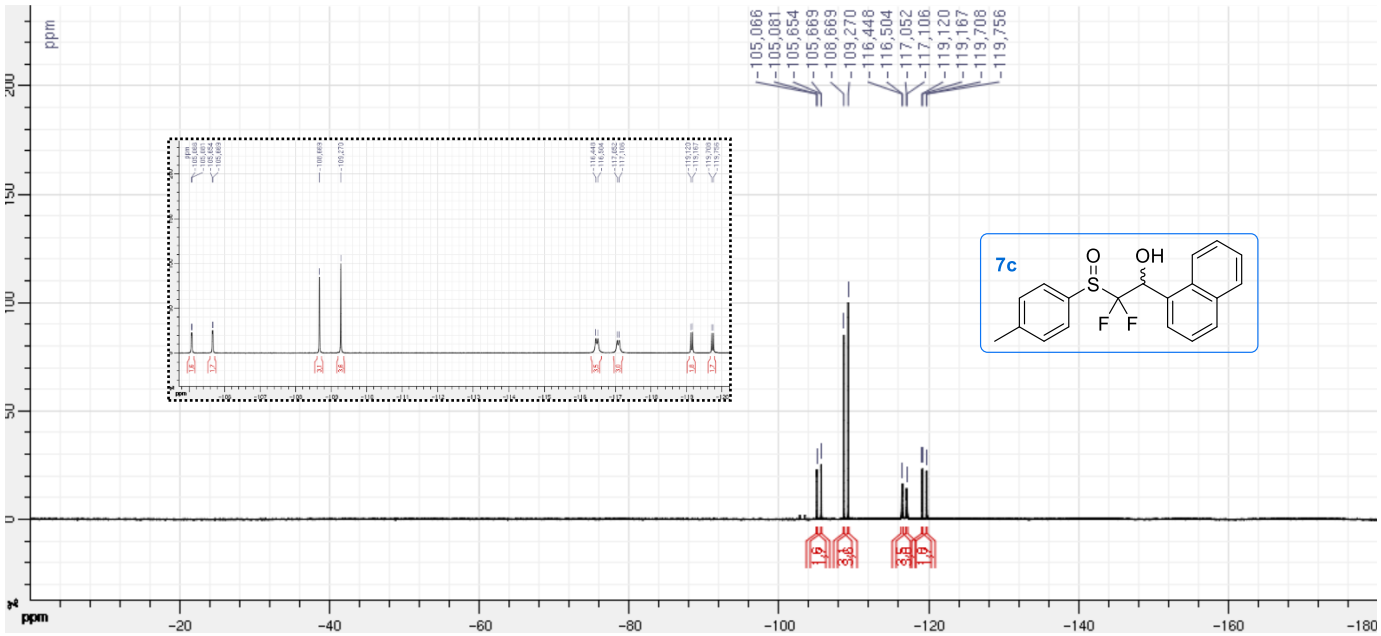
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7c**



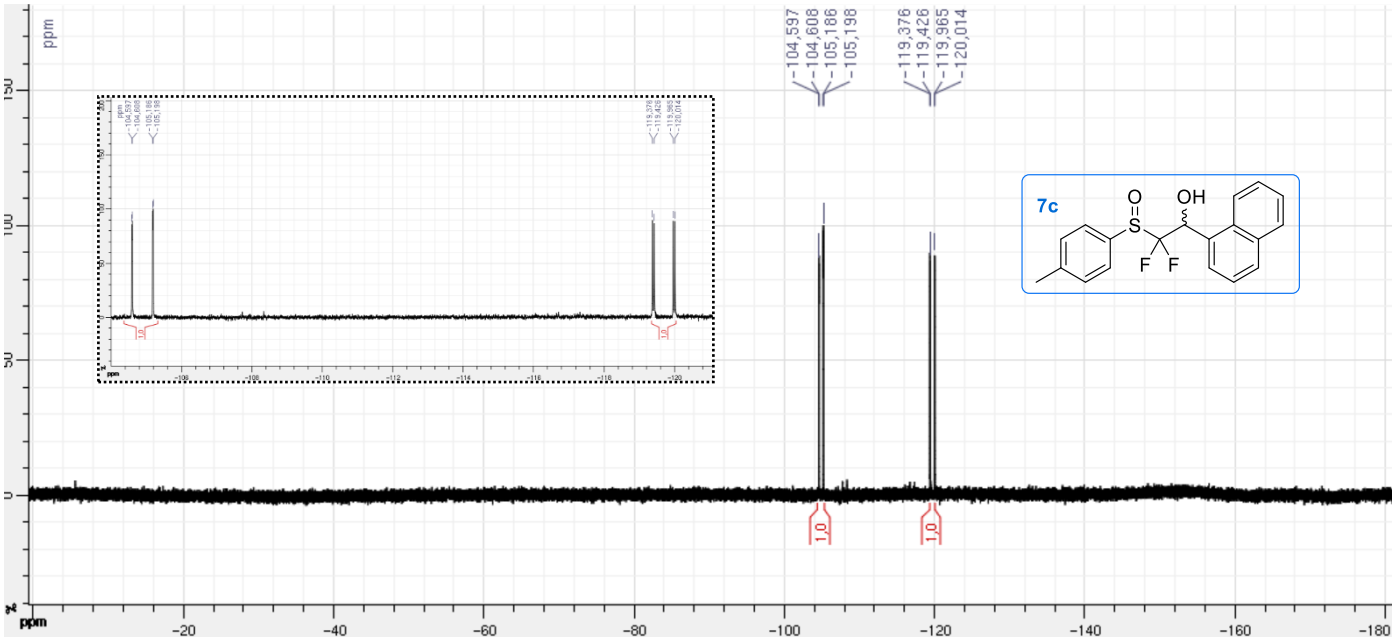
^{1}H NMR (400 MHz, $CDCl_3$) – One diastereomer – Purified **7c**



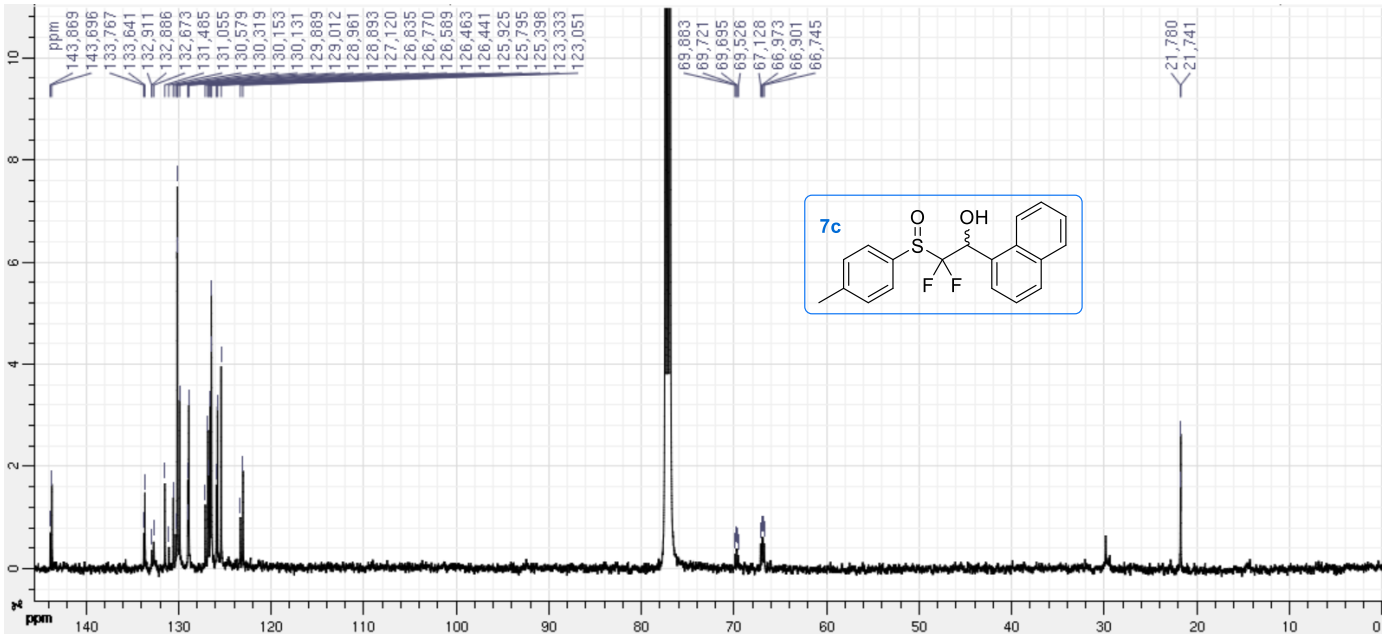
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7c**



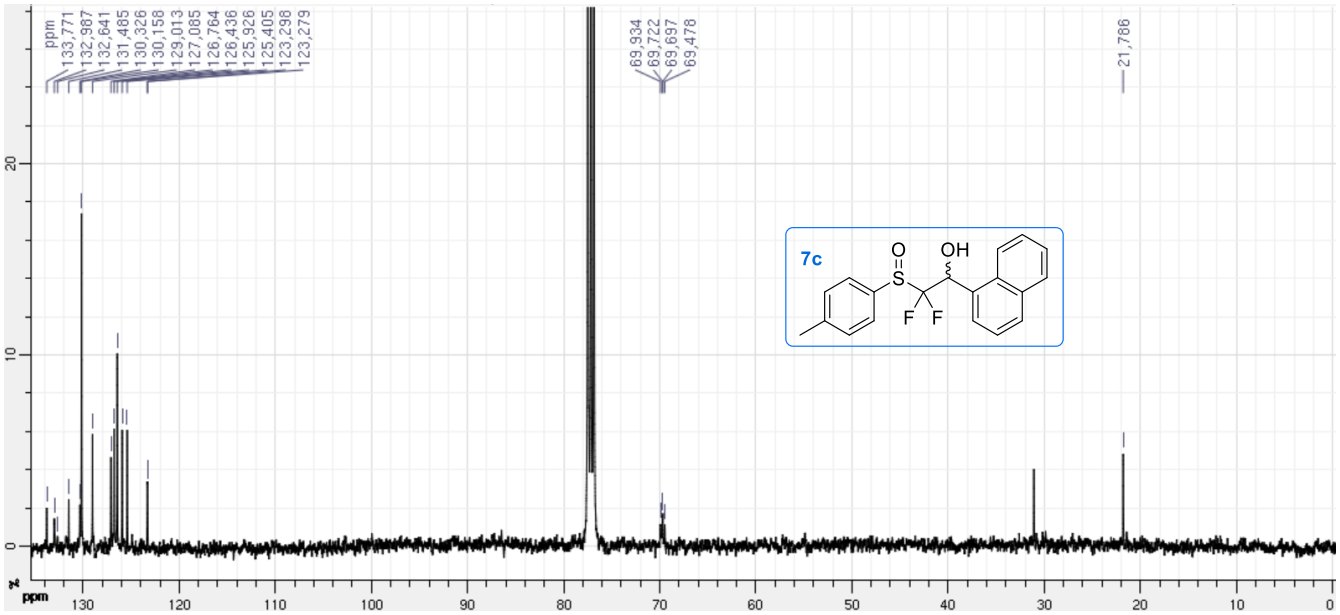
^{19}F NMR (376 MHz, $CDCl_3$) – One diastereomer – Purified **7c**



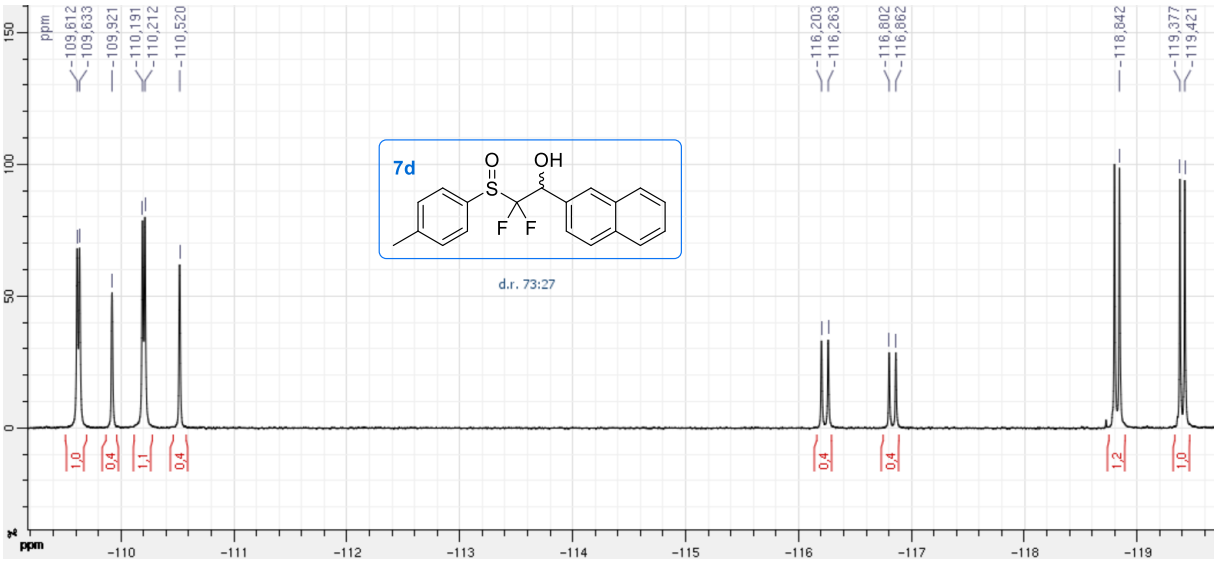
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7c**



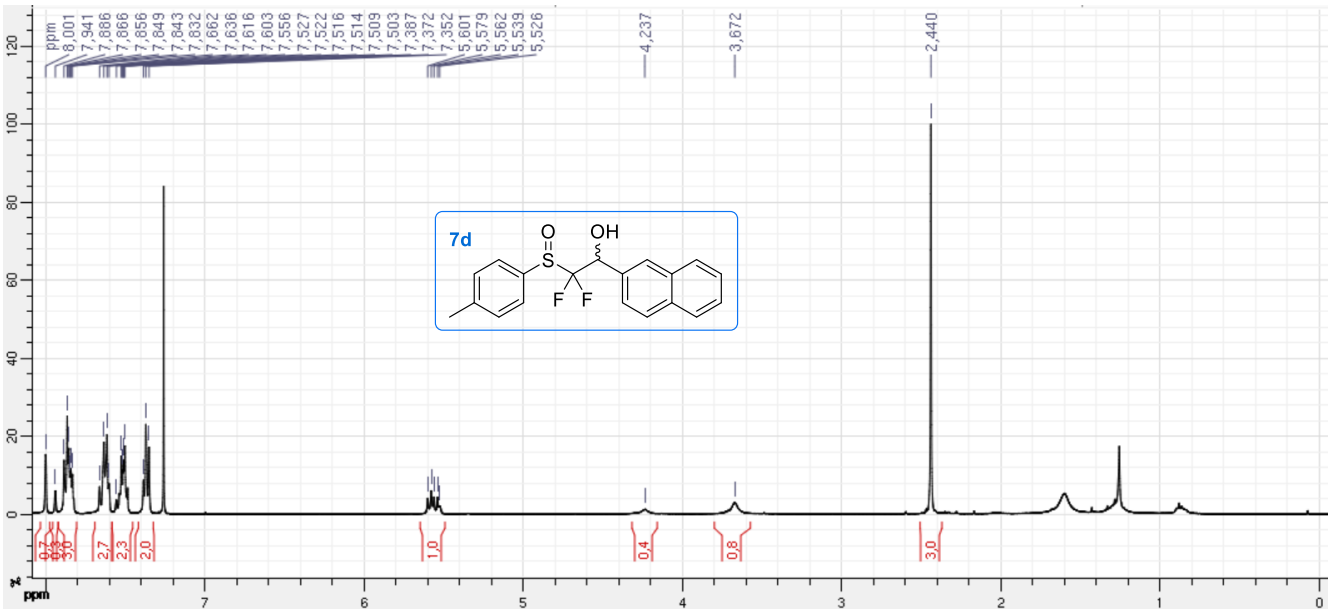
^{13}C NMR (126 MHz, $CDCl_3$) – One diastereomer – Purified **7c**



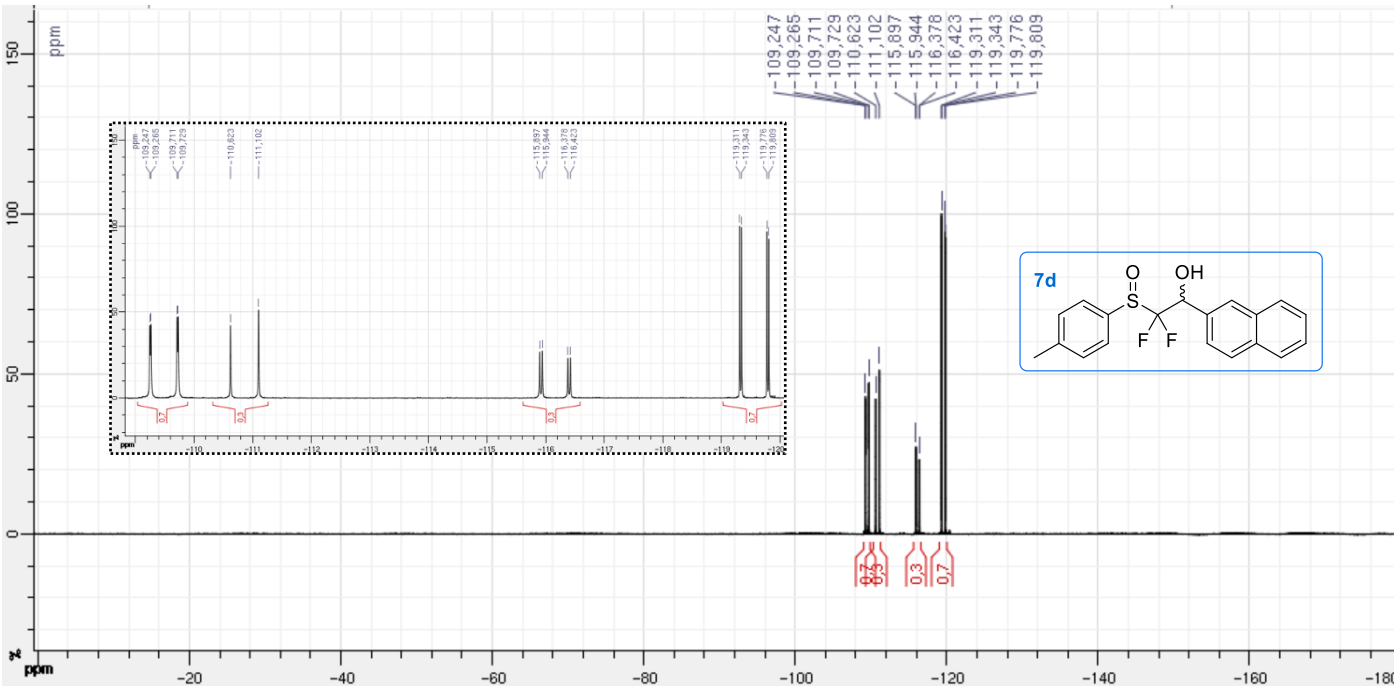
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7d**



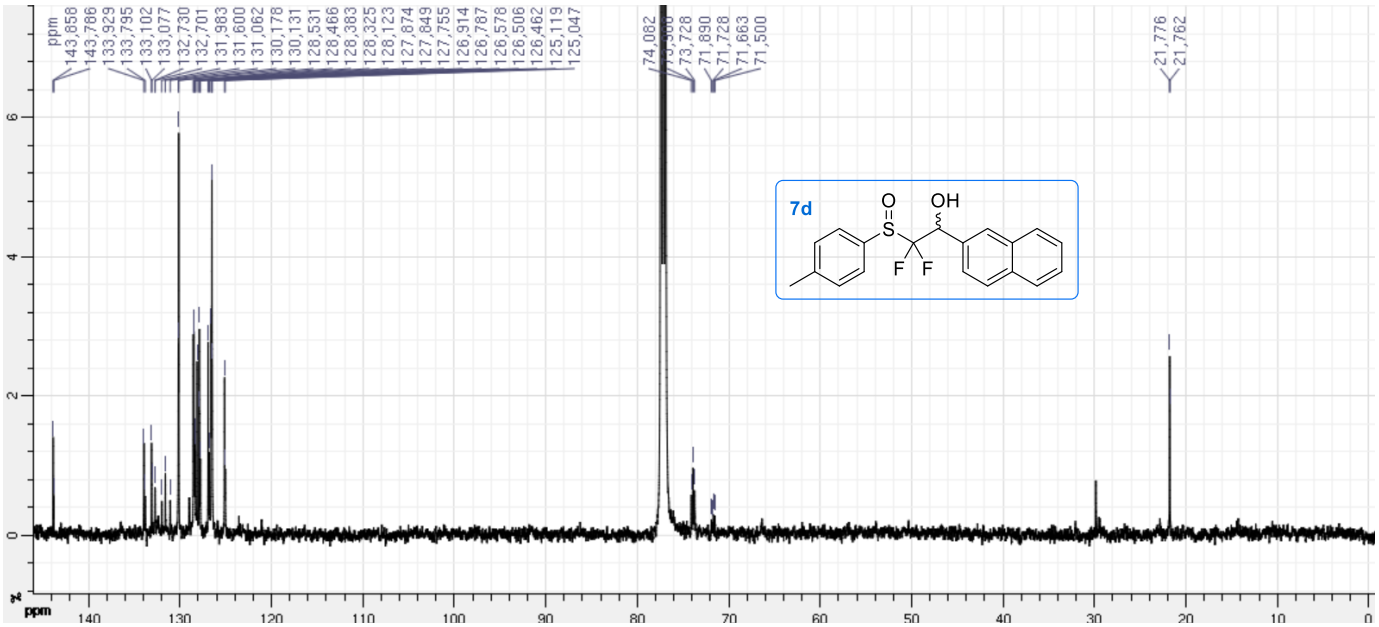
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7d**



^{19}F NMR (472 MHz, $CDCl_3$) – Purified **7d**

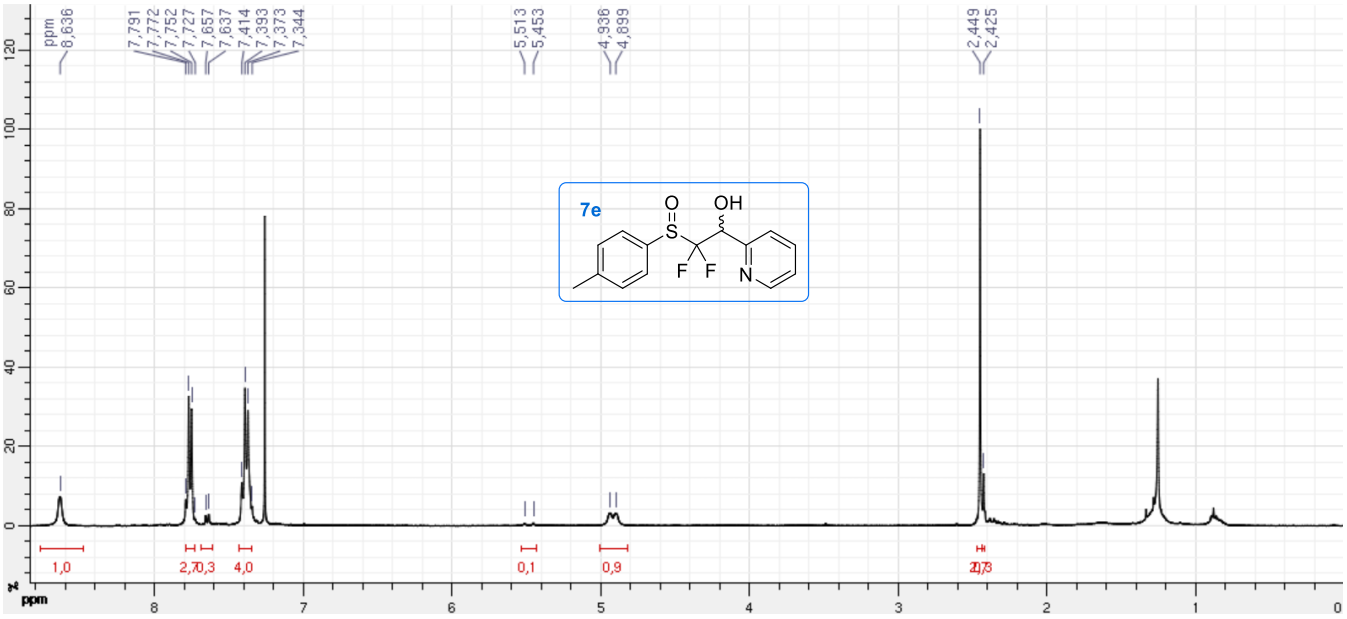


^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7d**

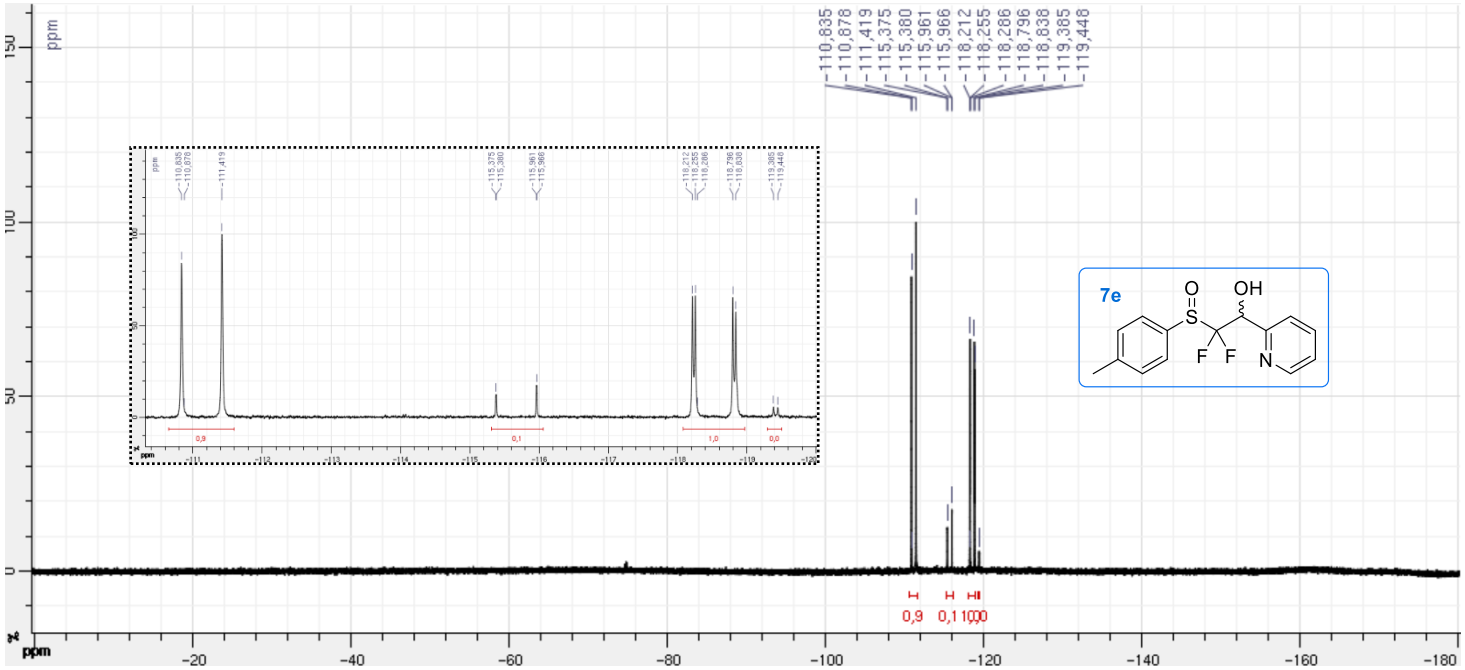


^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7e**

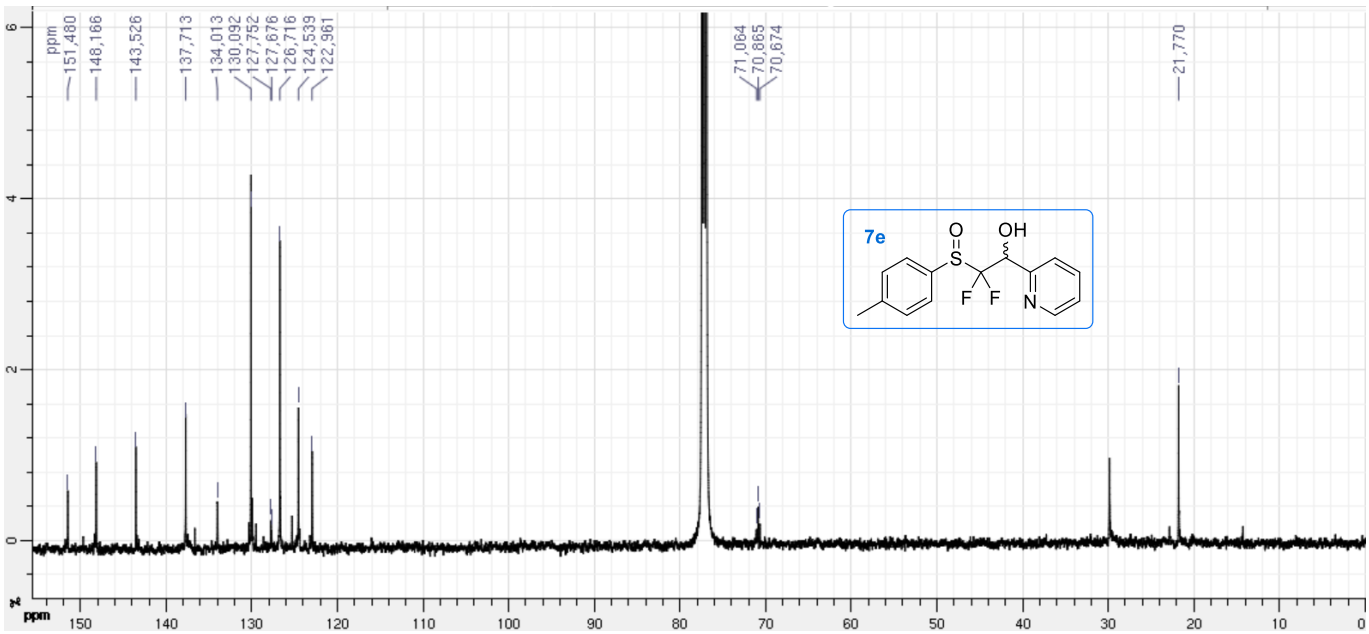
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7e**



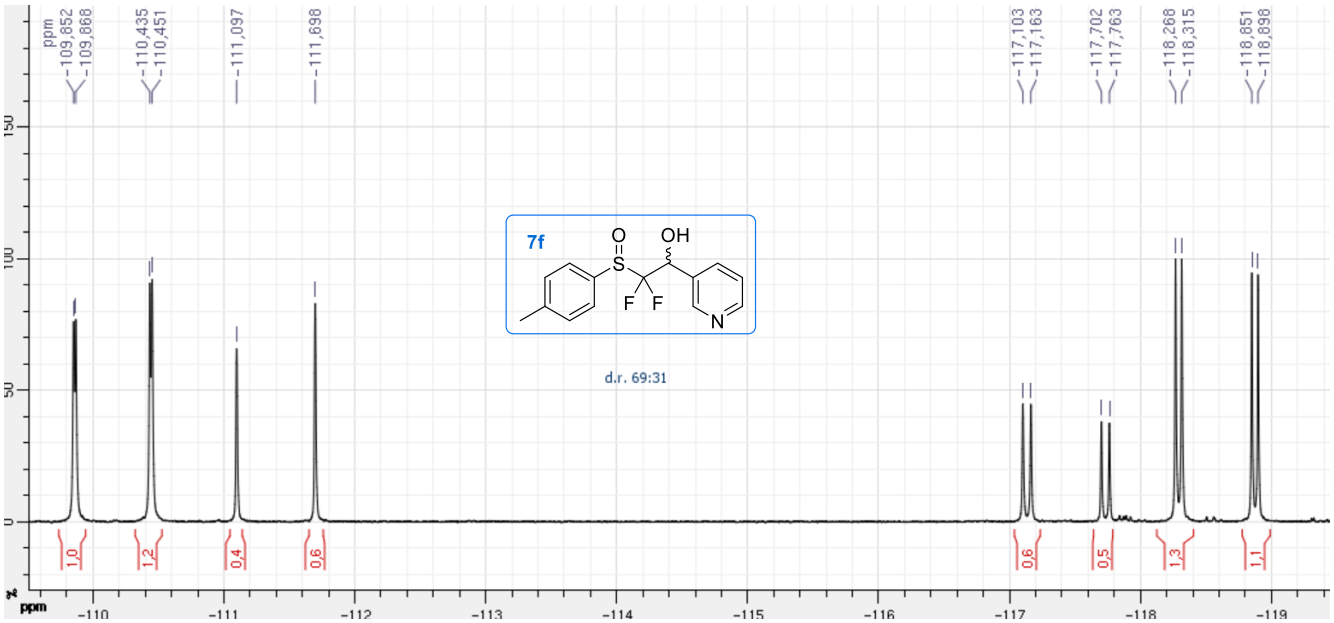
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7e**



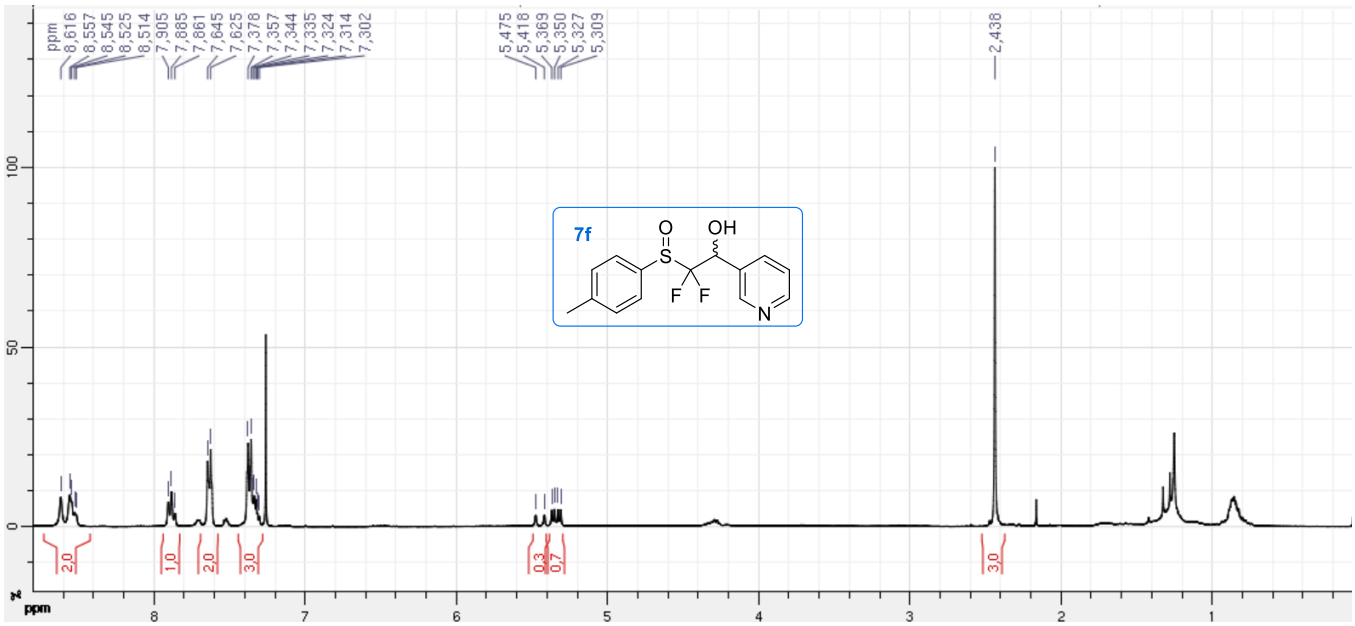
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7e**



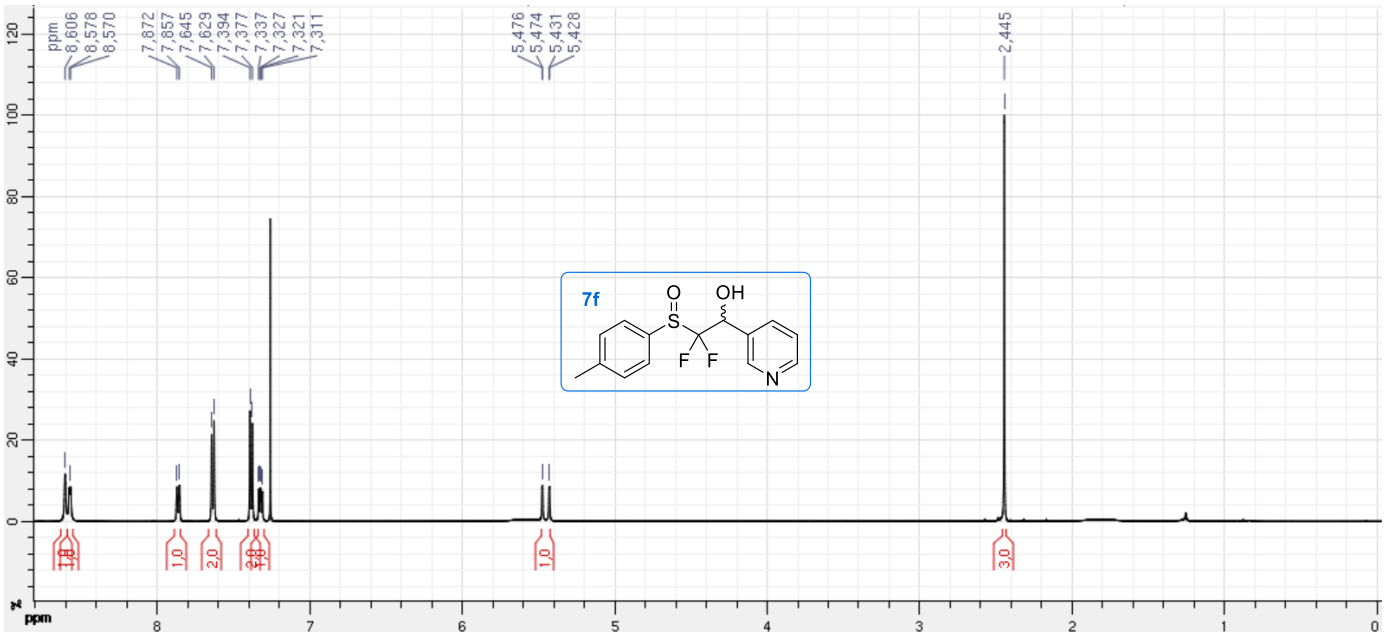
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7f**



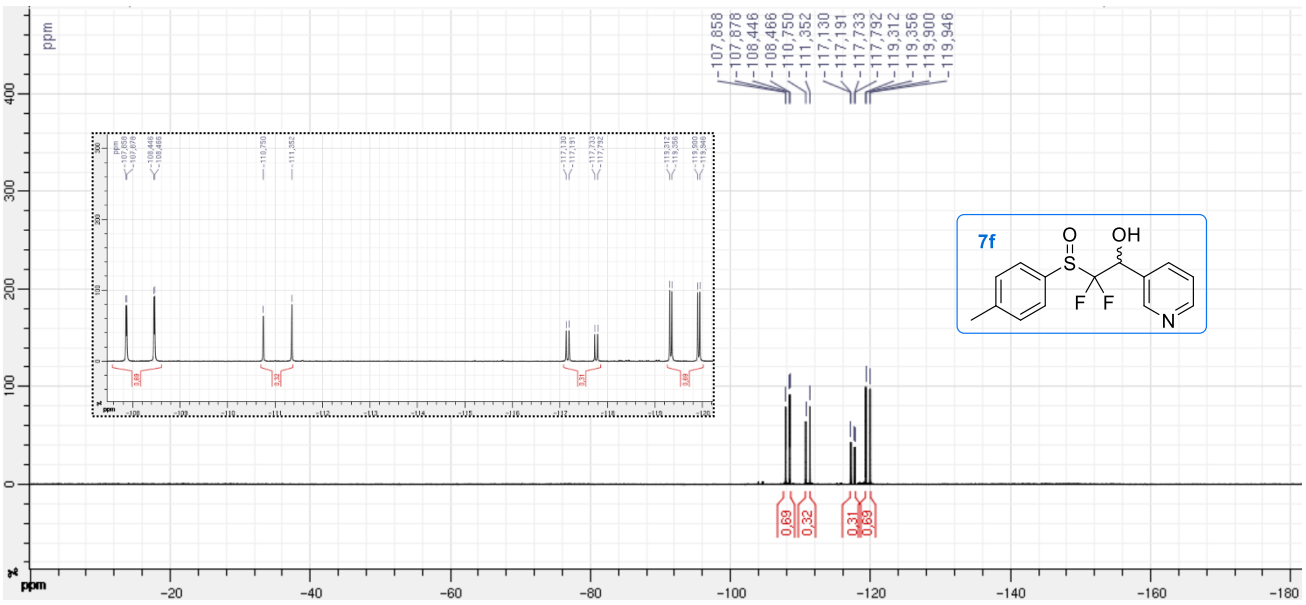
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7f**



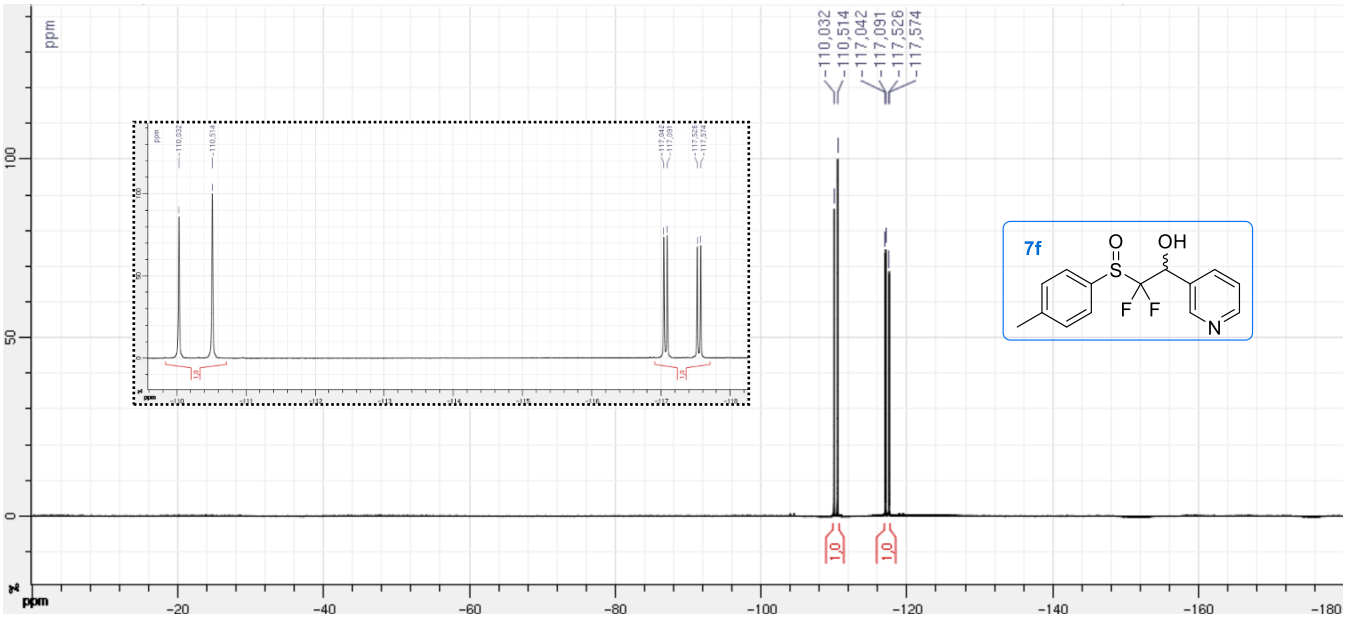
^{1}H NMR (500 MHz, $CDCl_3$) – One diastereomer – Purified **7f**



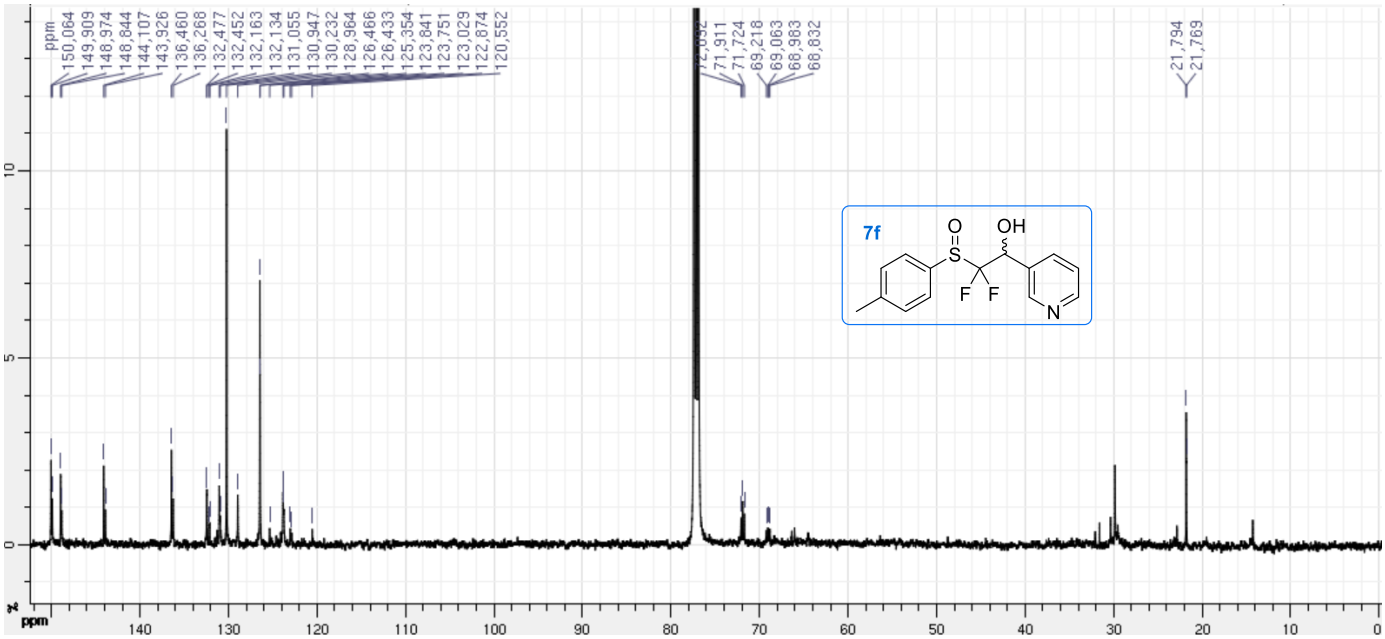
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7f**



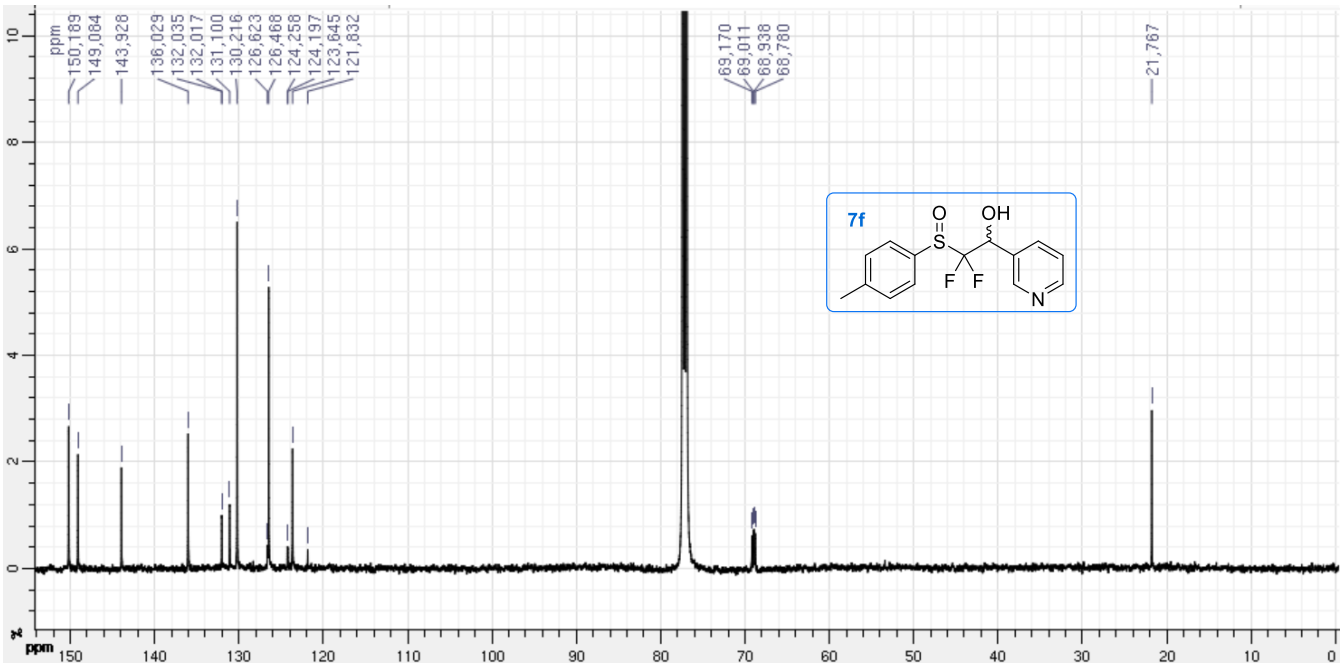
^{19}F NMR (472 MHz, $CDCl_3$) – One diastereomer – Purified **7f**



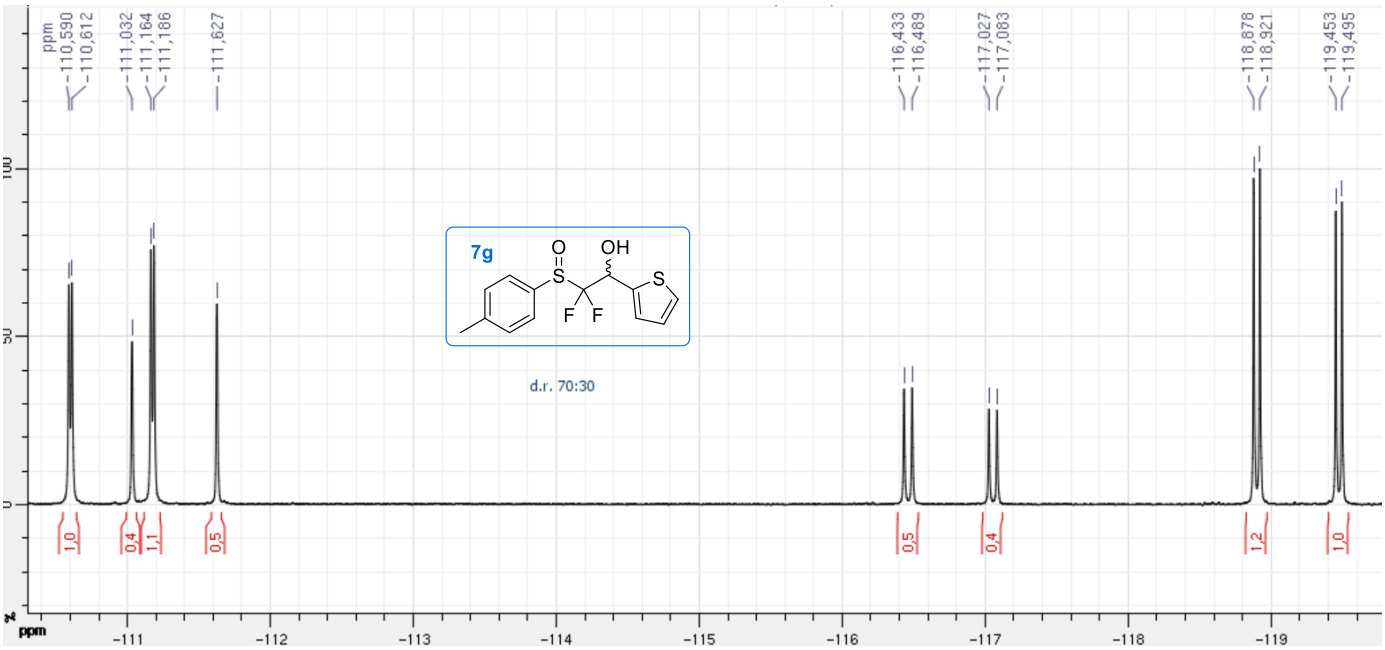
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7f**



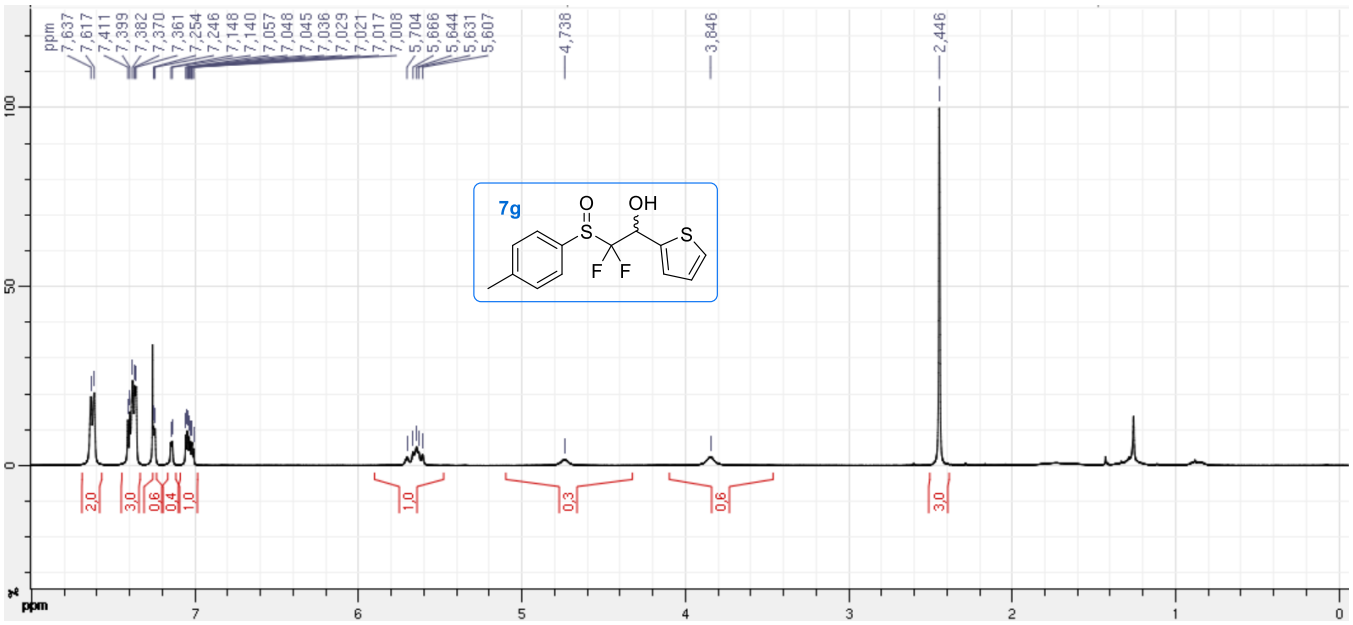
^{13}C NMR (126 MHz, $CDCl_3$) – One diastereomer – Purified **7f**



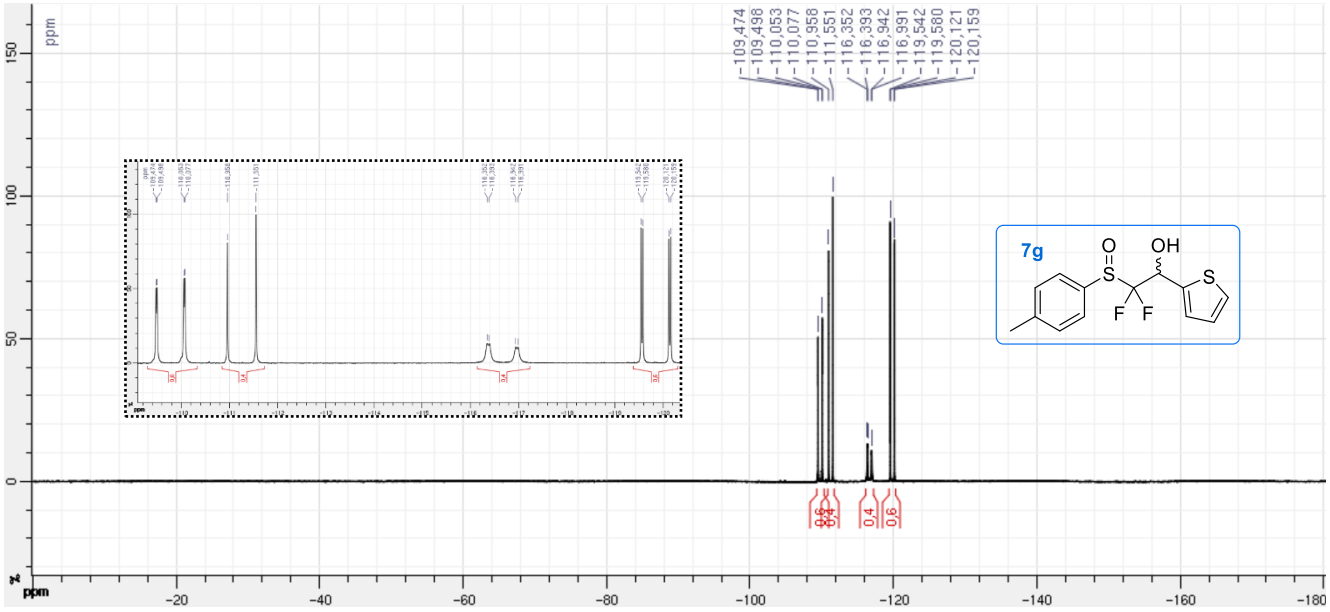
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7g**



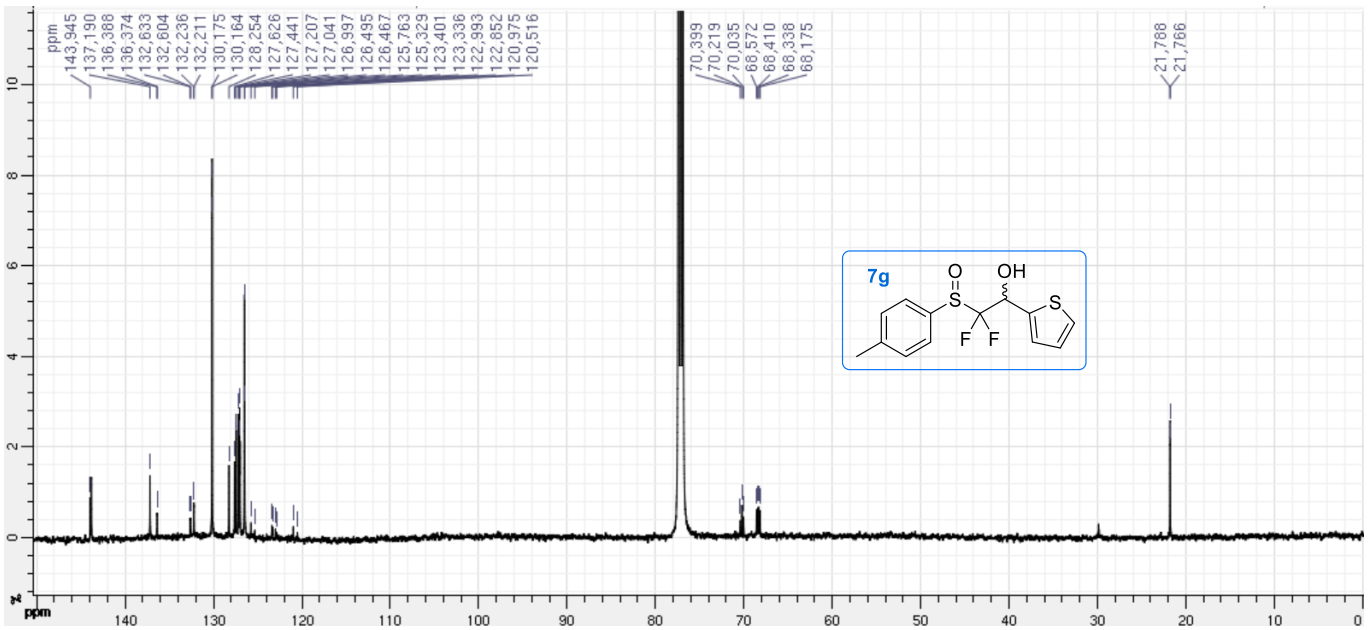
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7g**



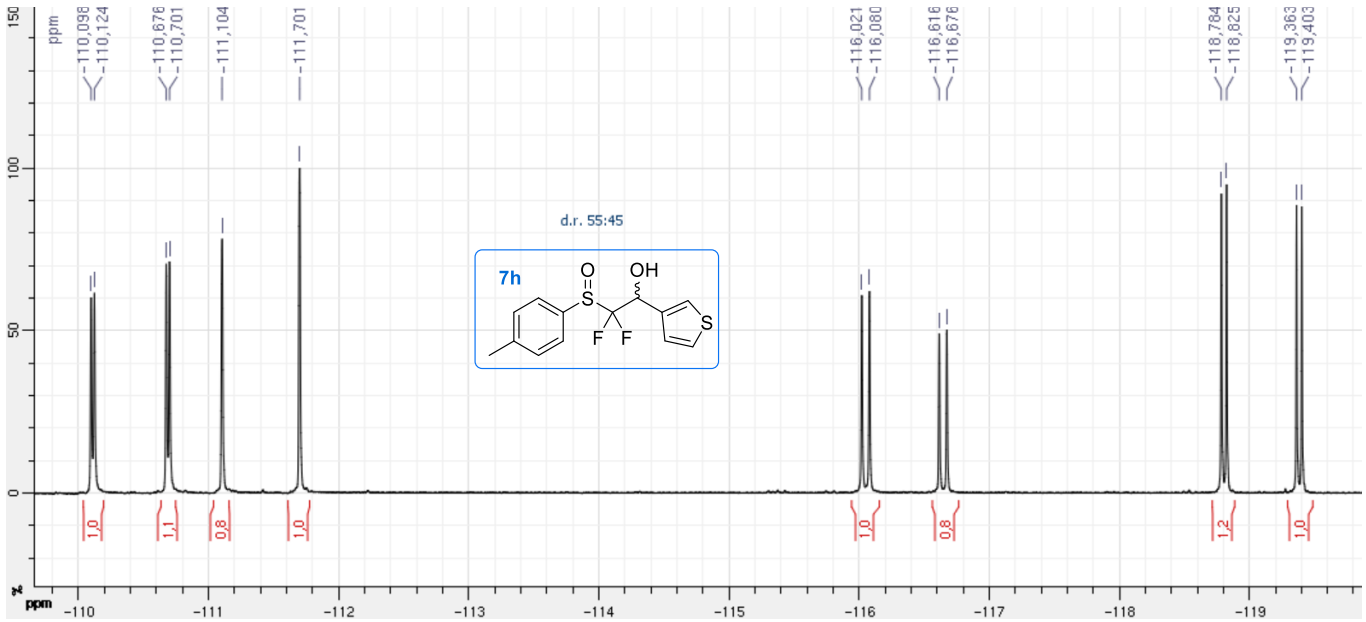
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7g**



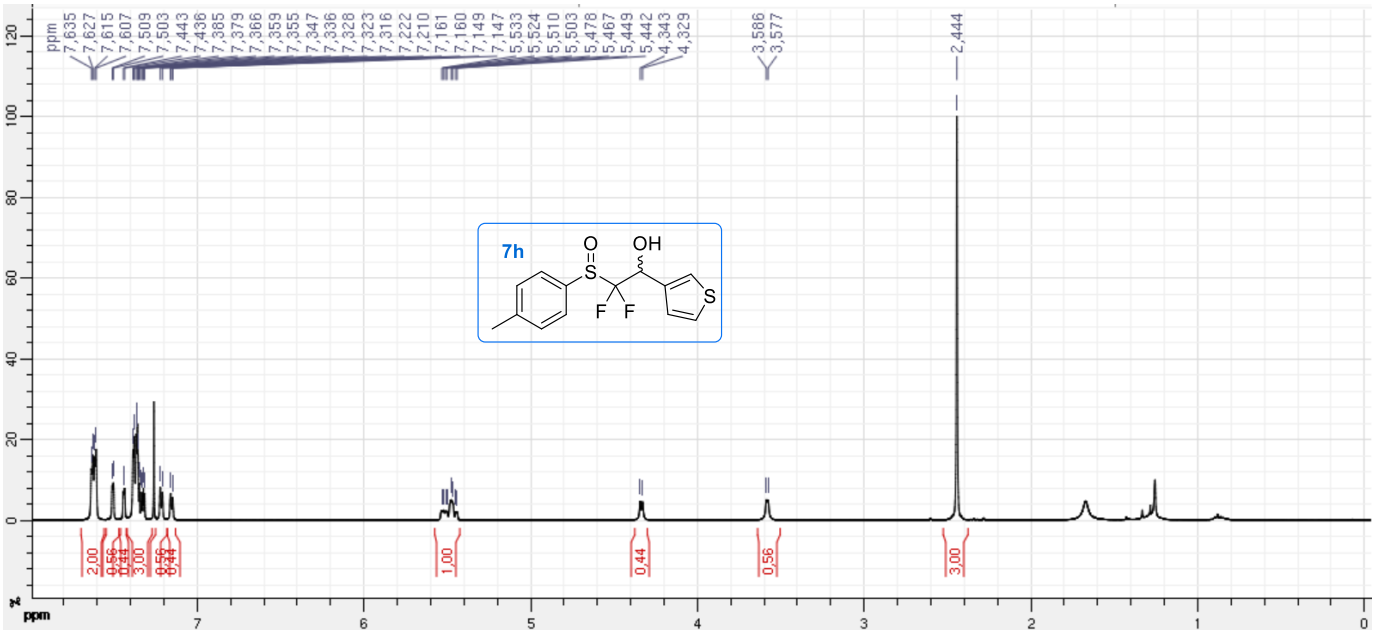
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7g**



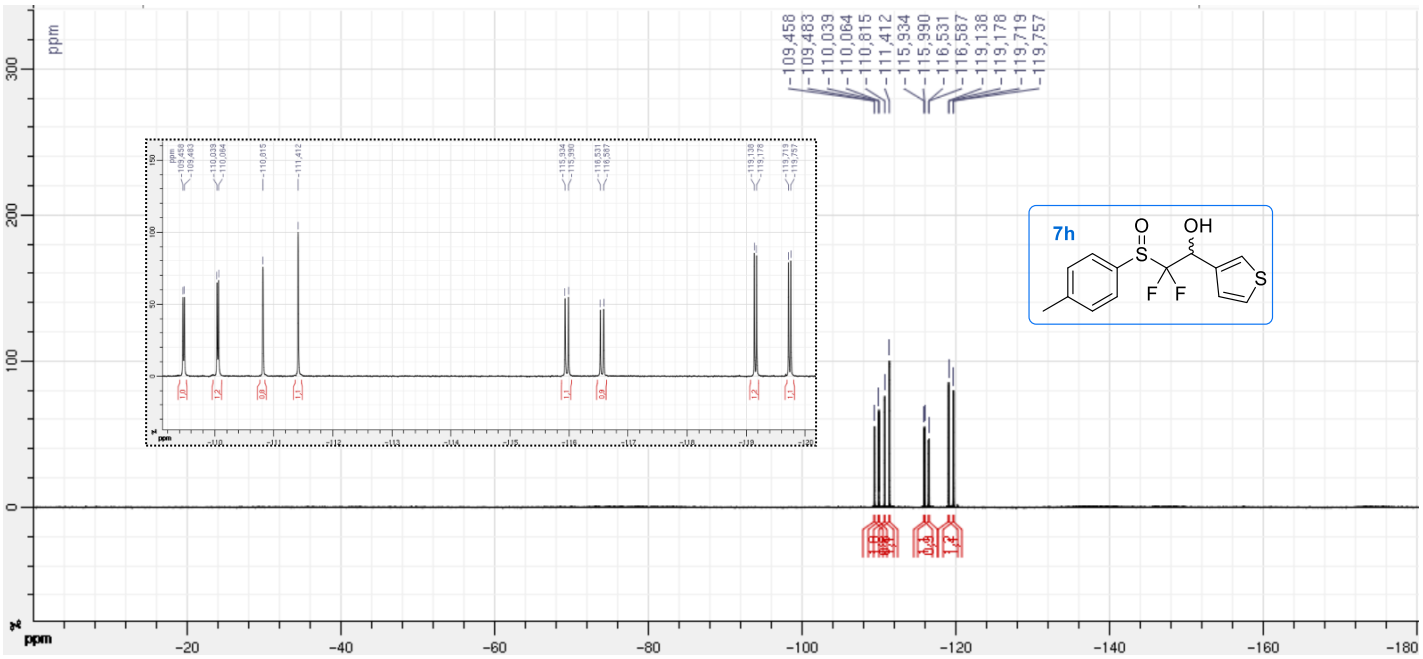
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7h**



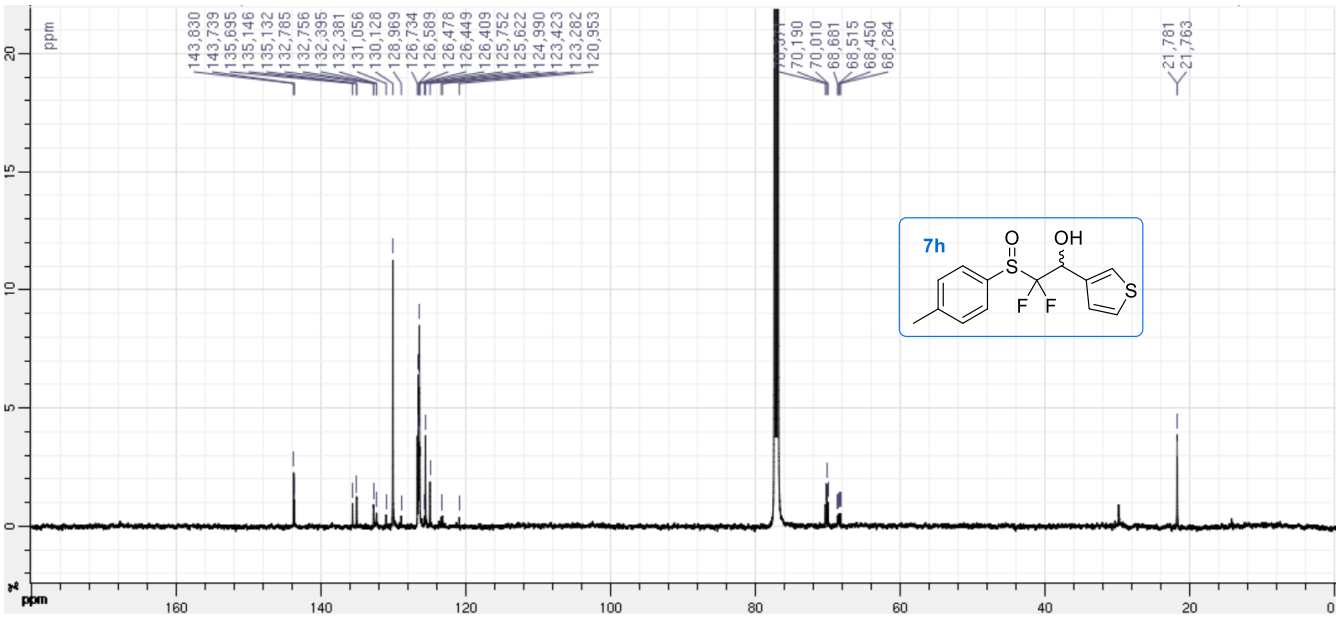
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7h**



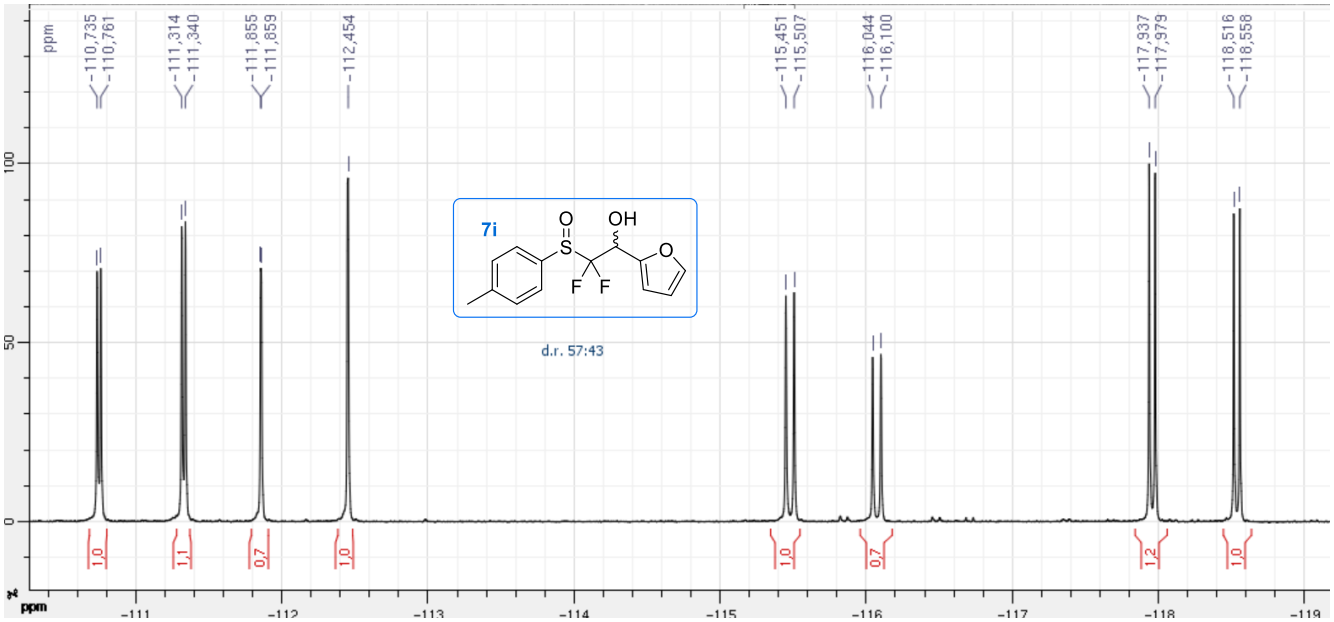
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7h**



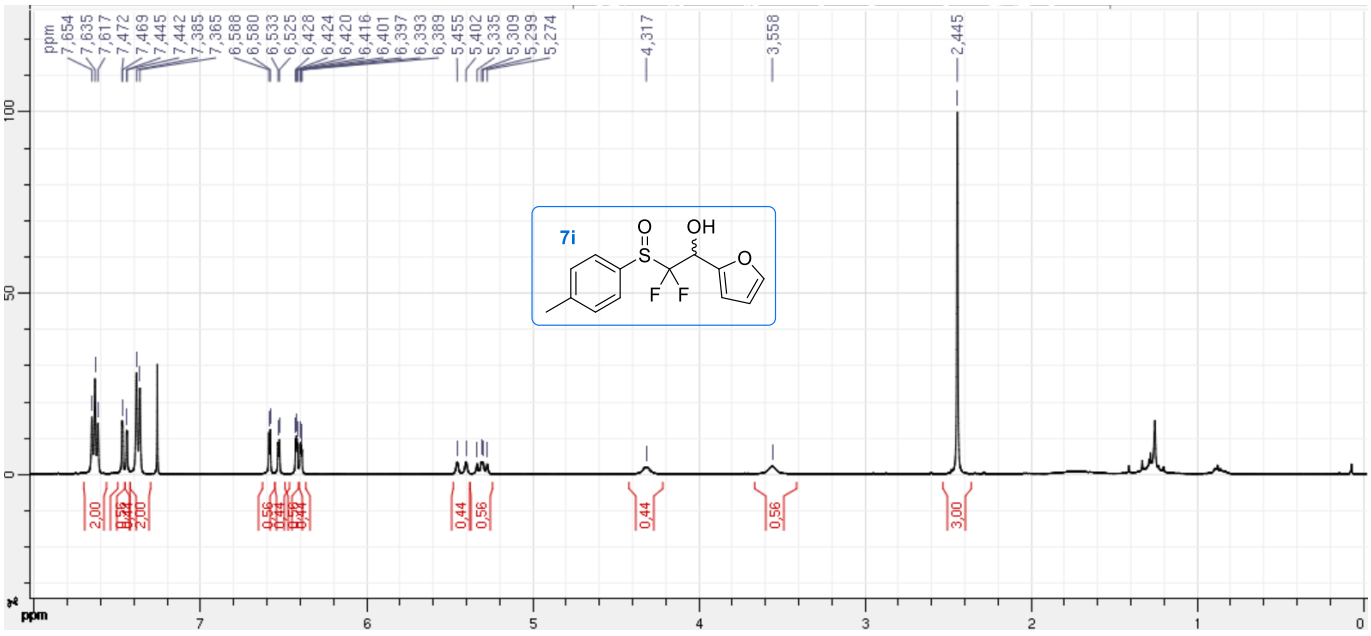
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7h**



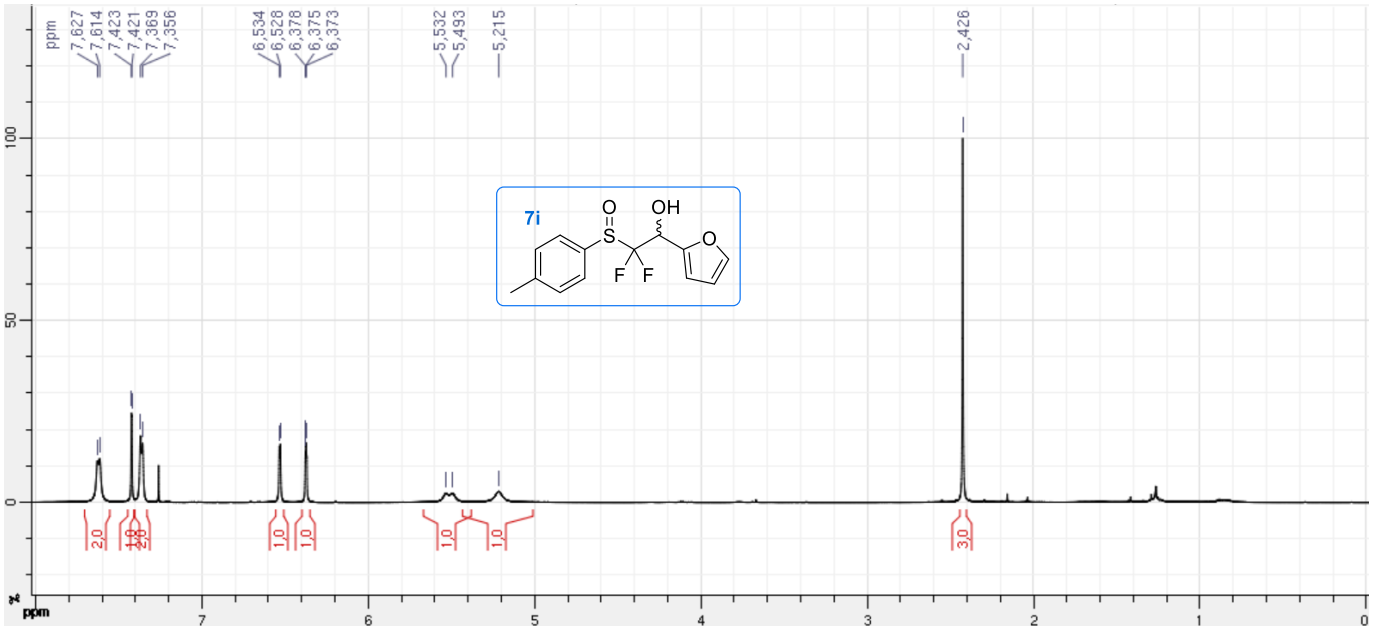
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7i**



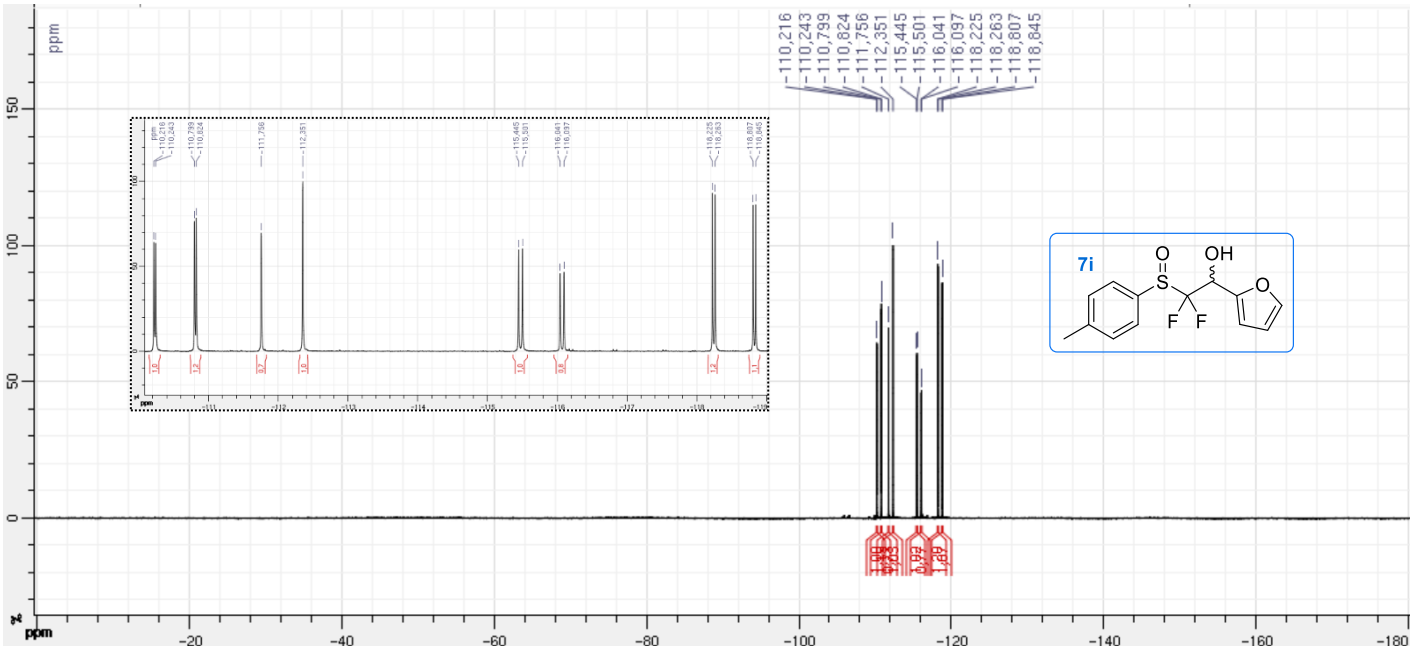
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7i**



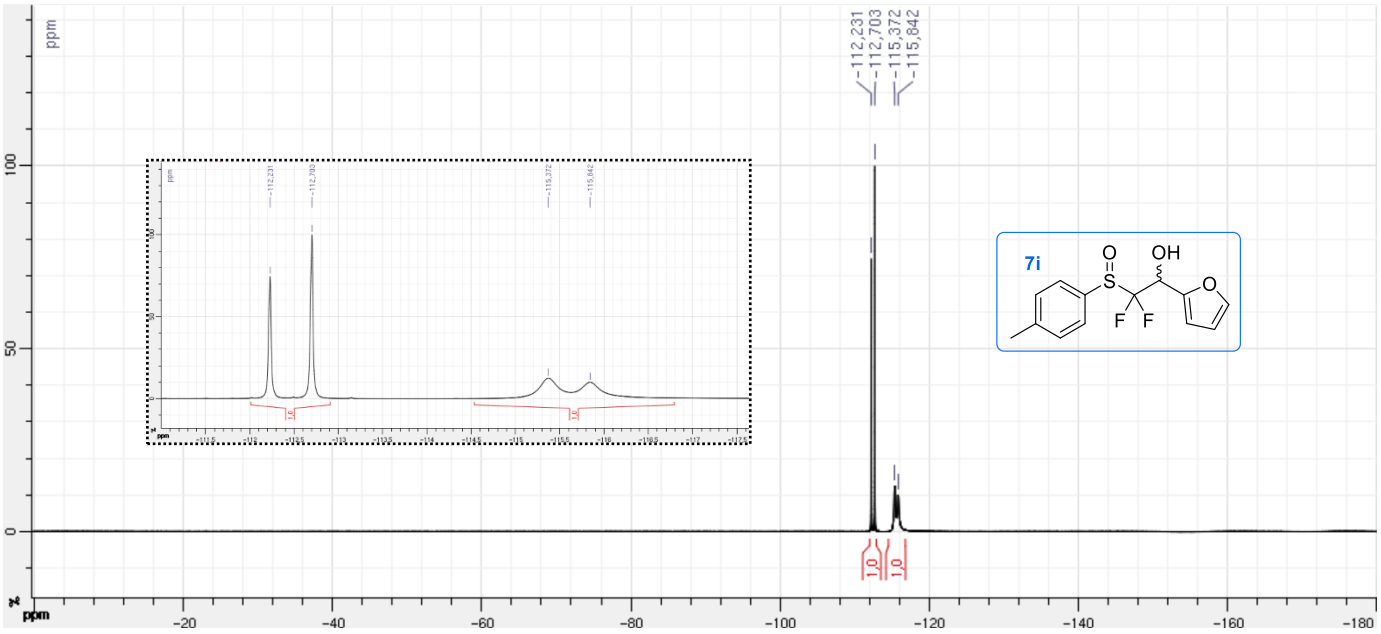
^{1}H NMR (500 MHz, $CDCl_3$) – One diastereomer – Purified **7i**



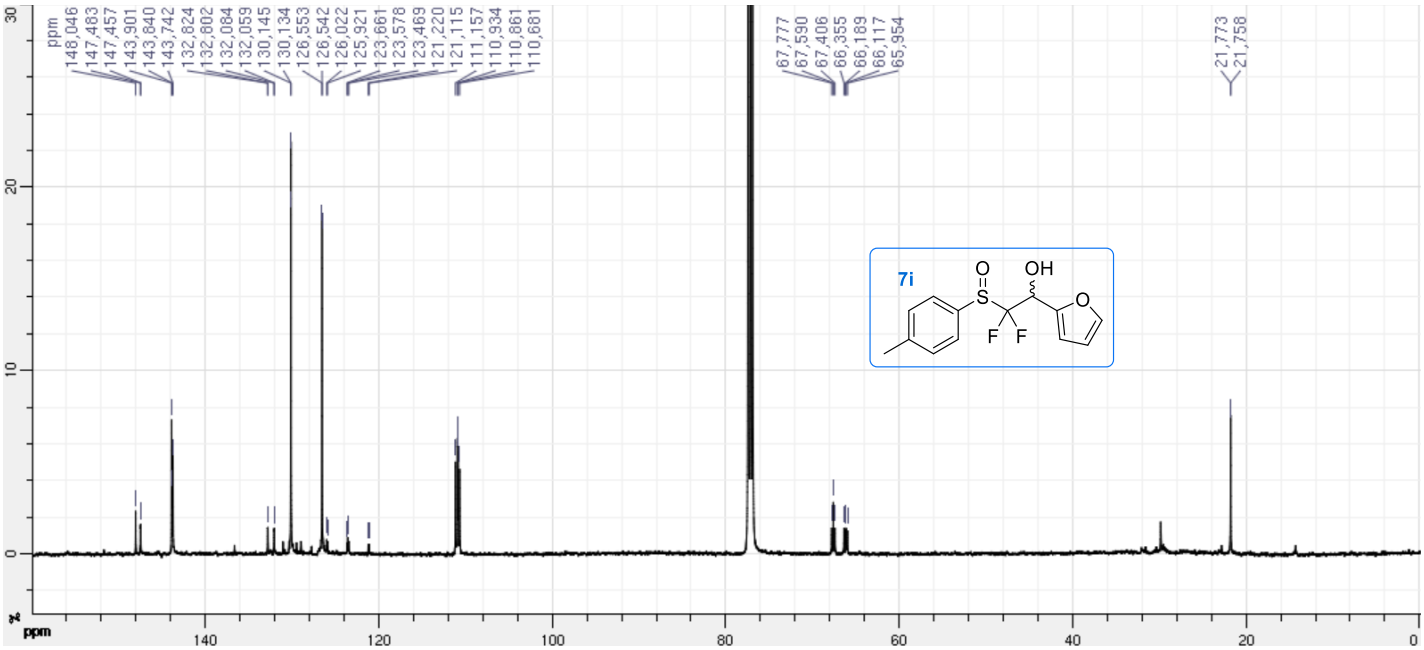
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7i**



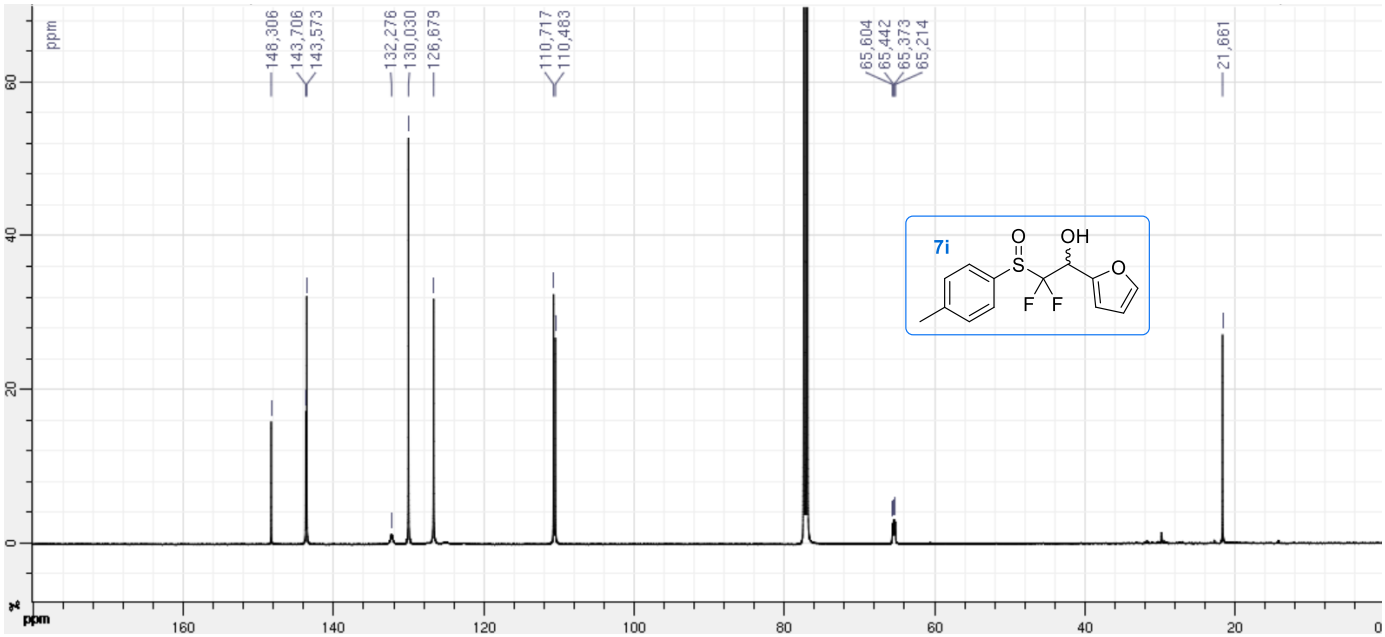
^{19}F NMR (472 MHz, $CDCl_3$) – One diastereomer – Purified **7i**



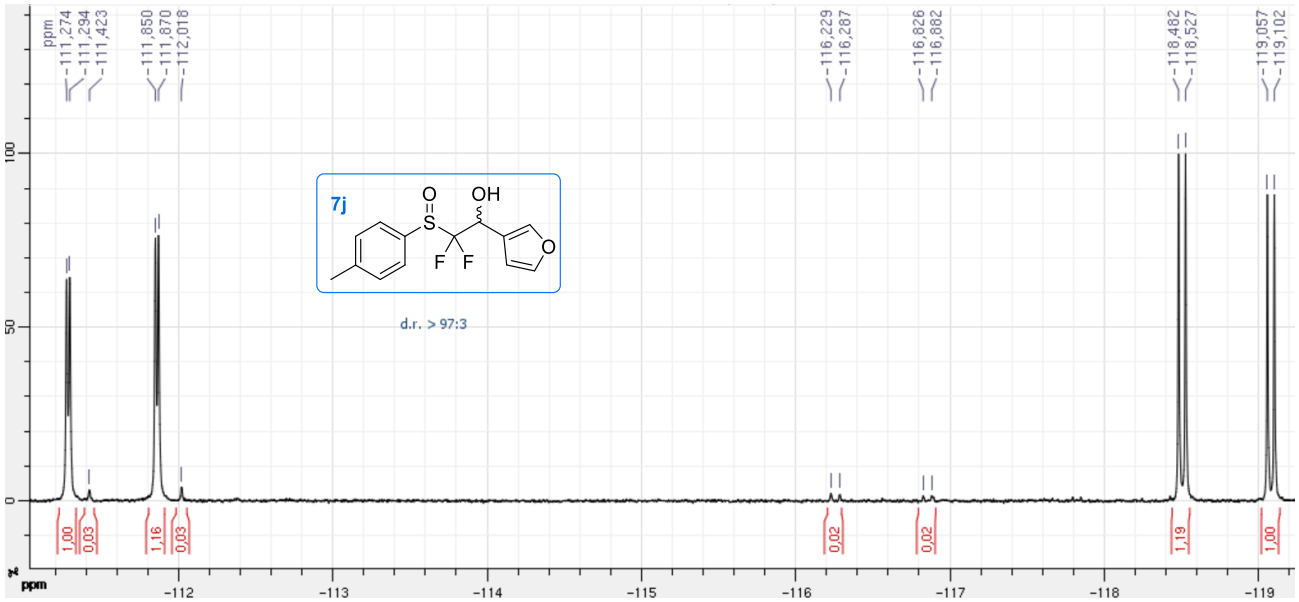
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7i**



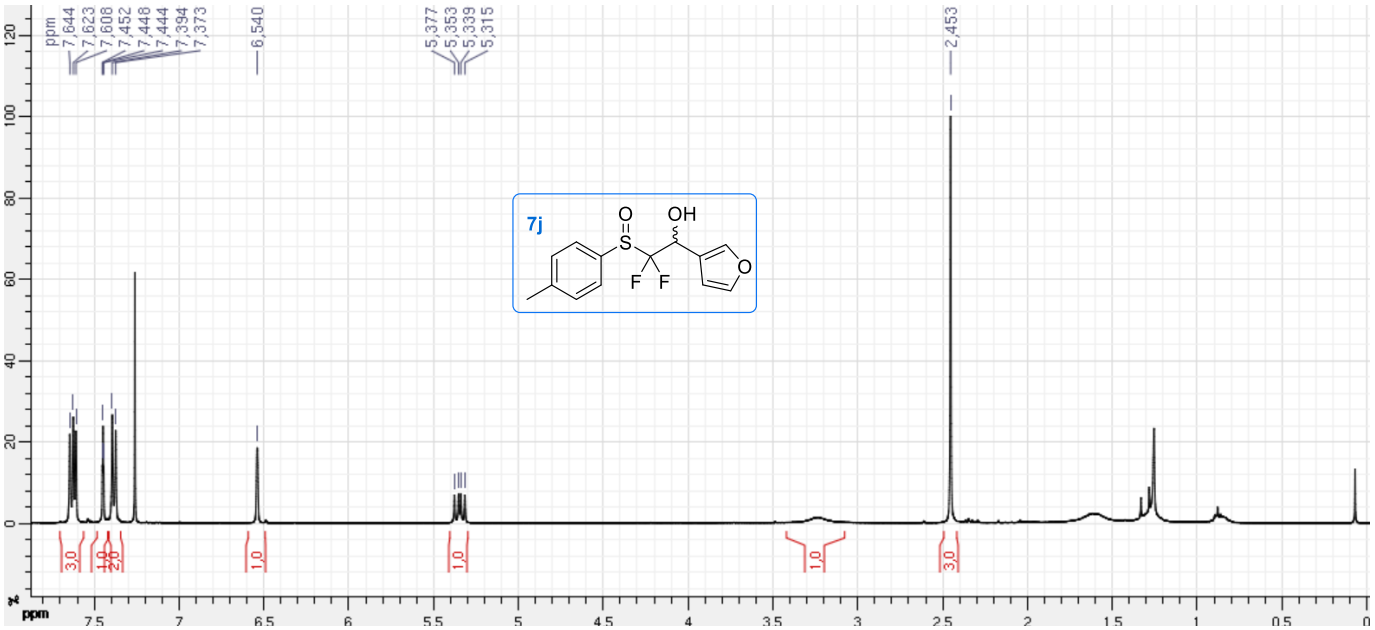
^{13}C NMR (126 MHz, $CDCl_3$) – One diastereomer – Purified **7i**



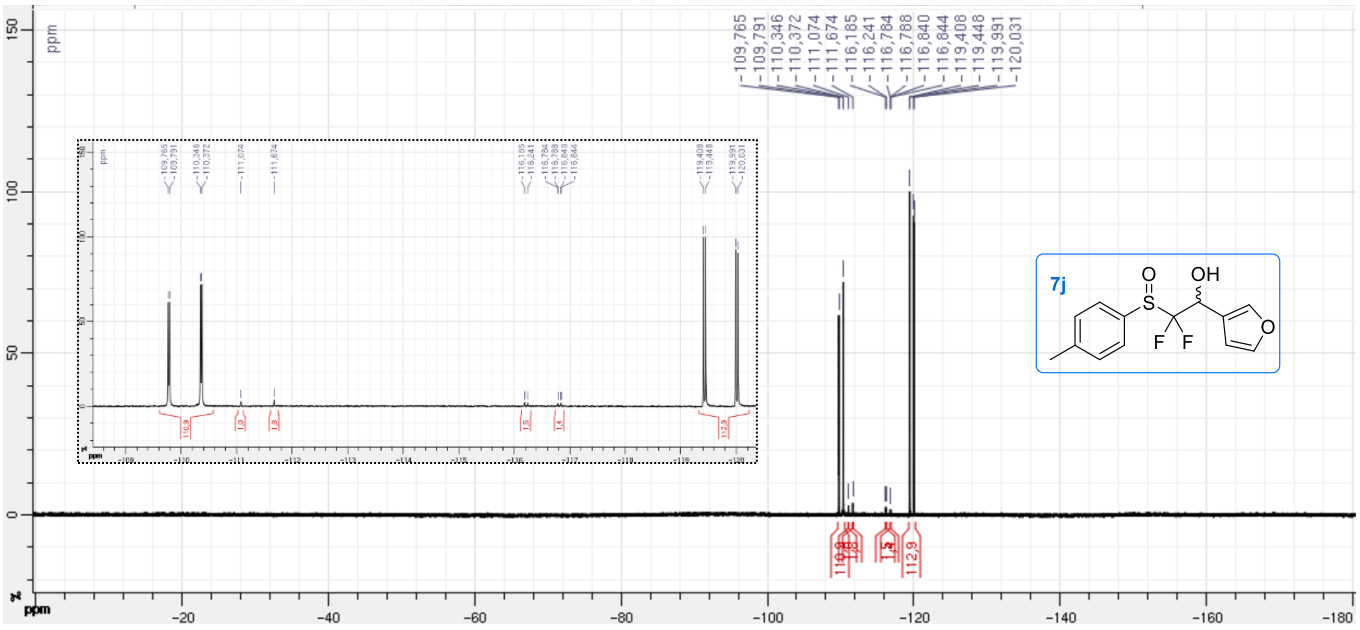
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7j**



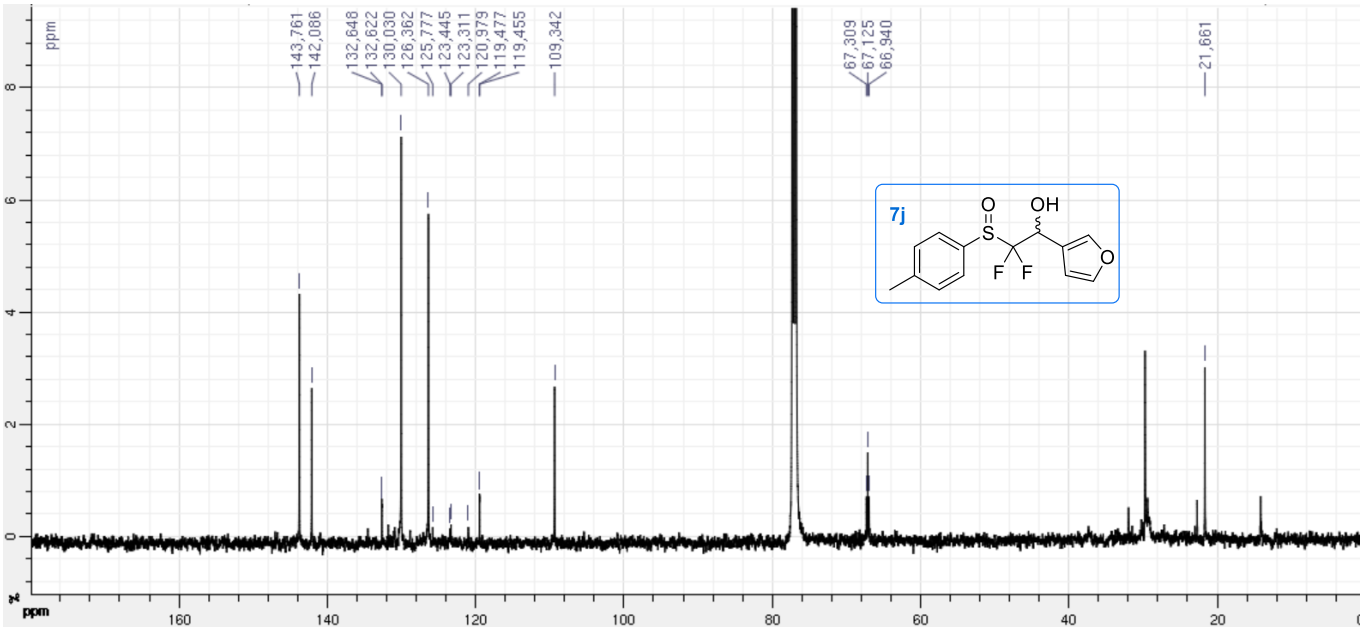
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7j**



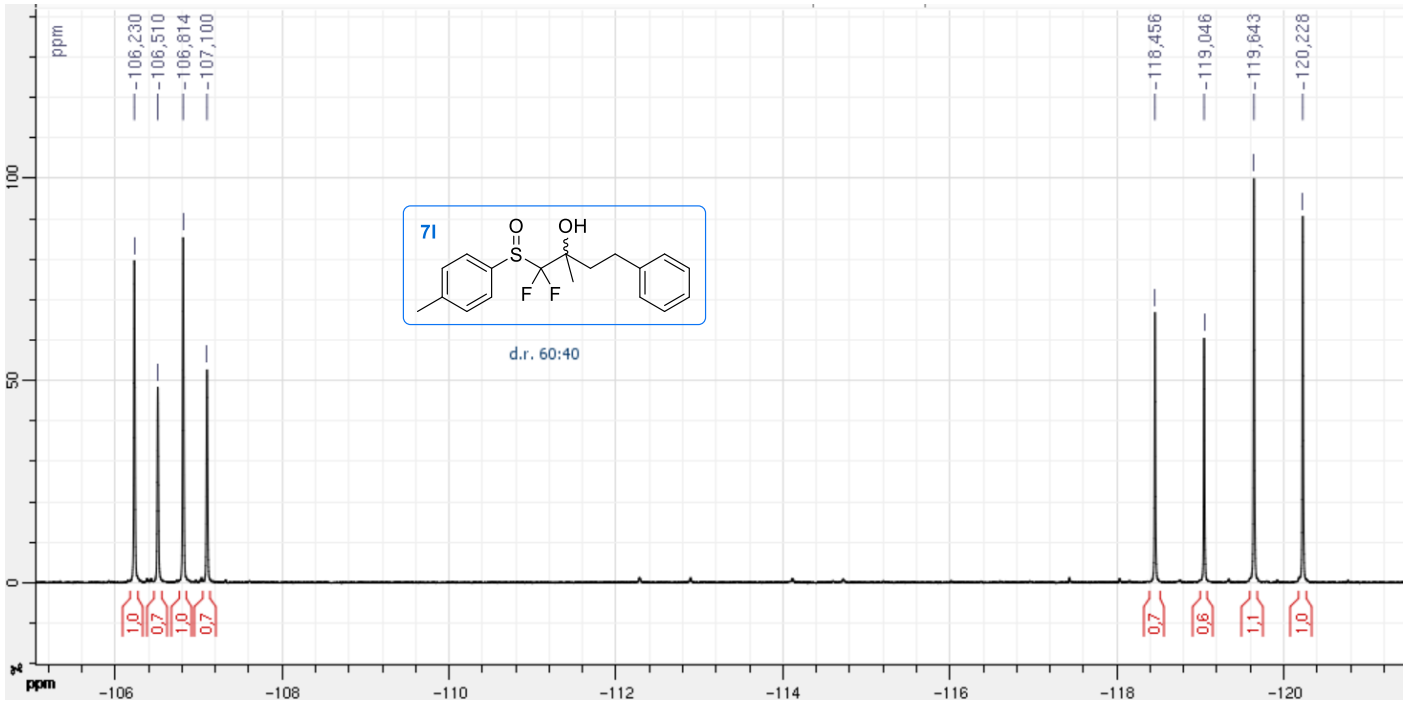
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7j**



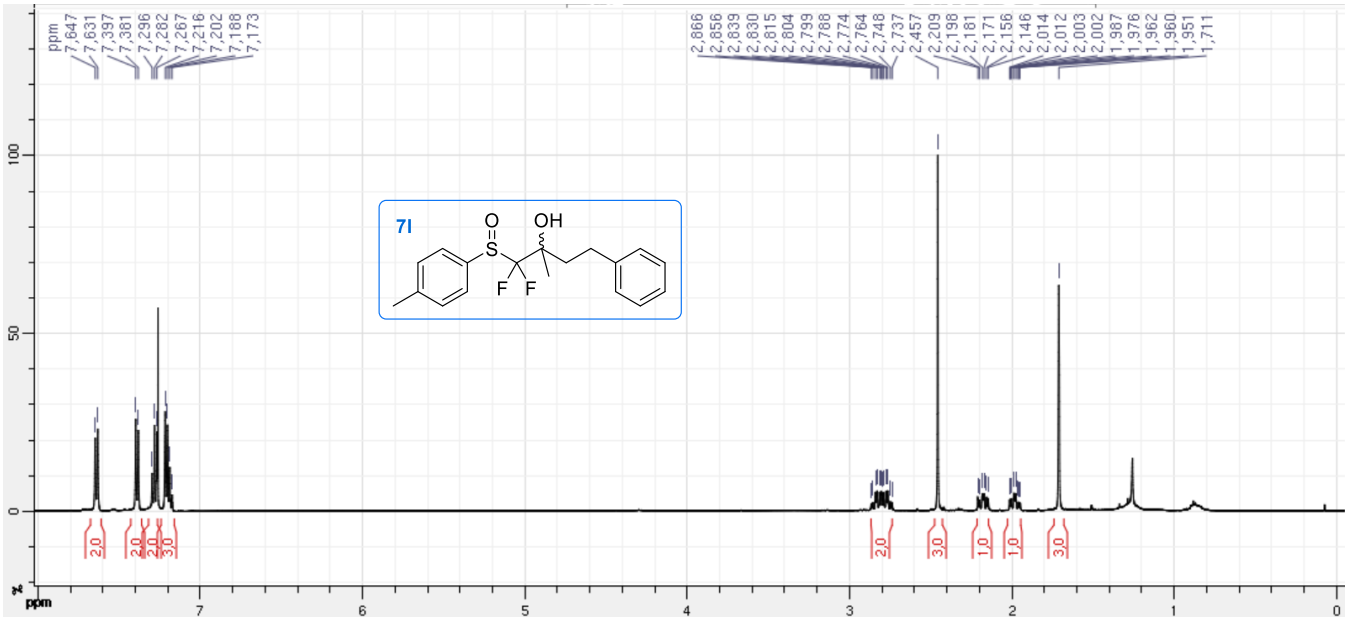
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7j**



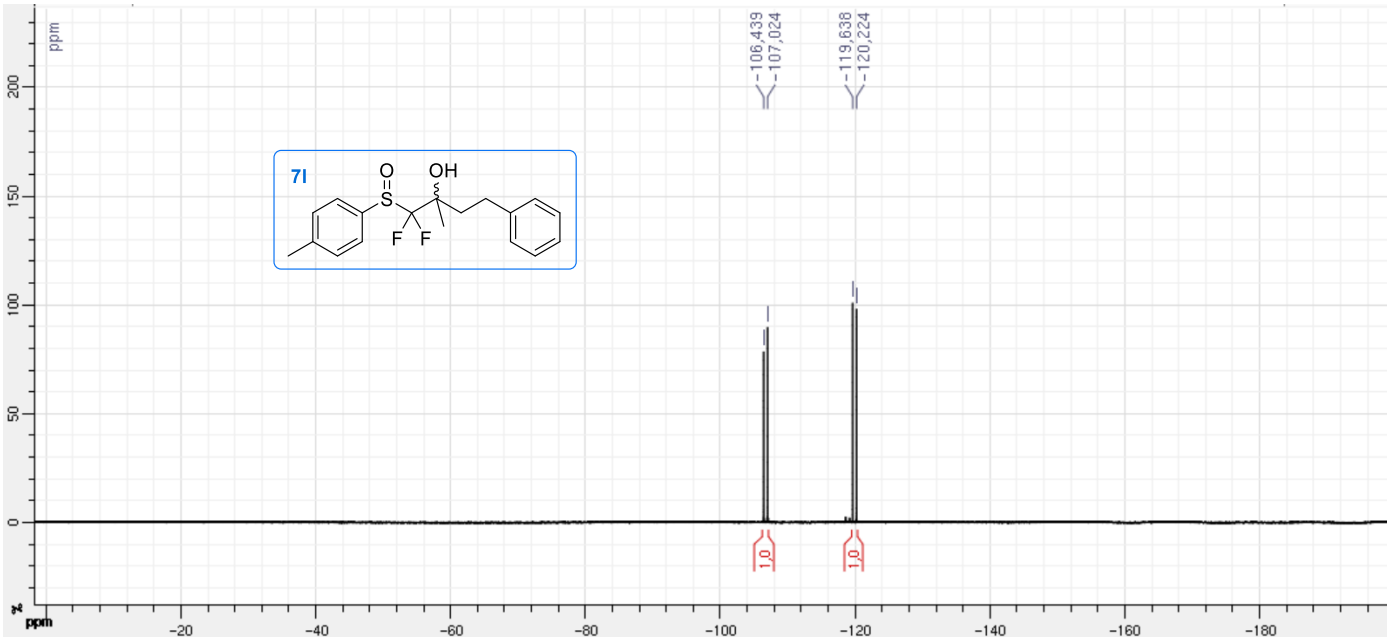
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7l**



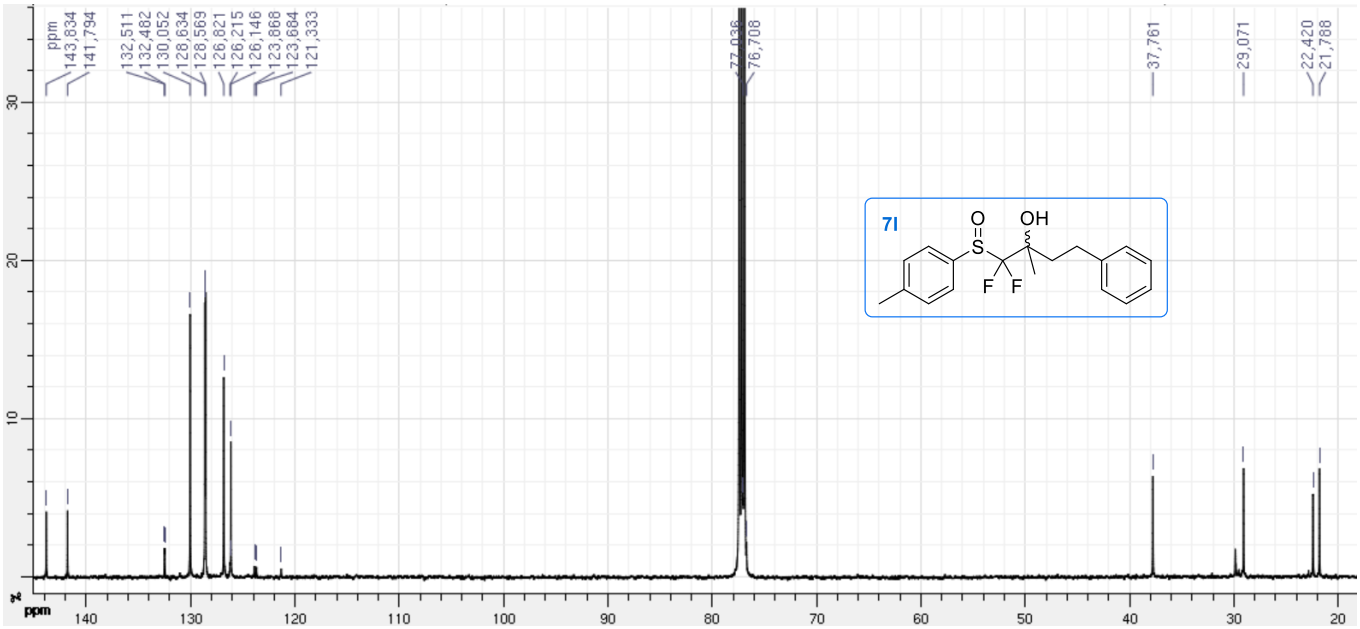
^{1}H NMR (500 MHz, $CDCl_3$) – First diastereomer – Purified **7l**



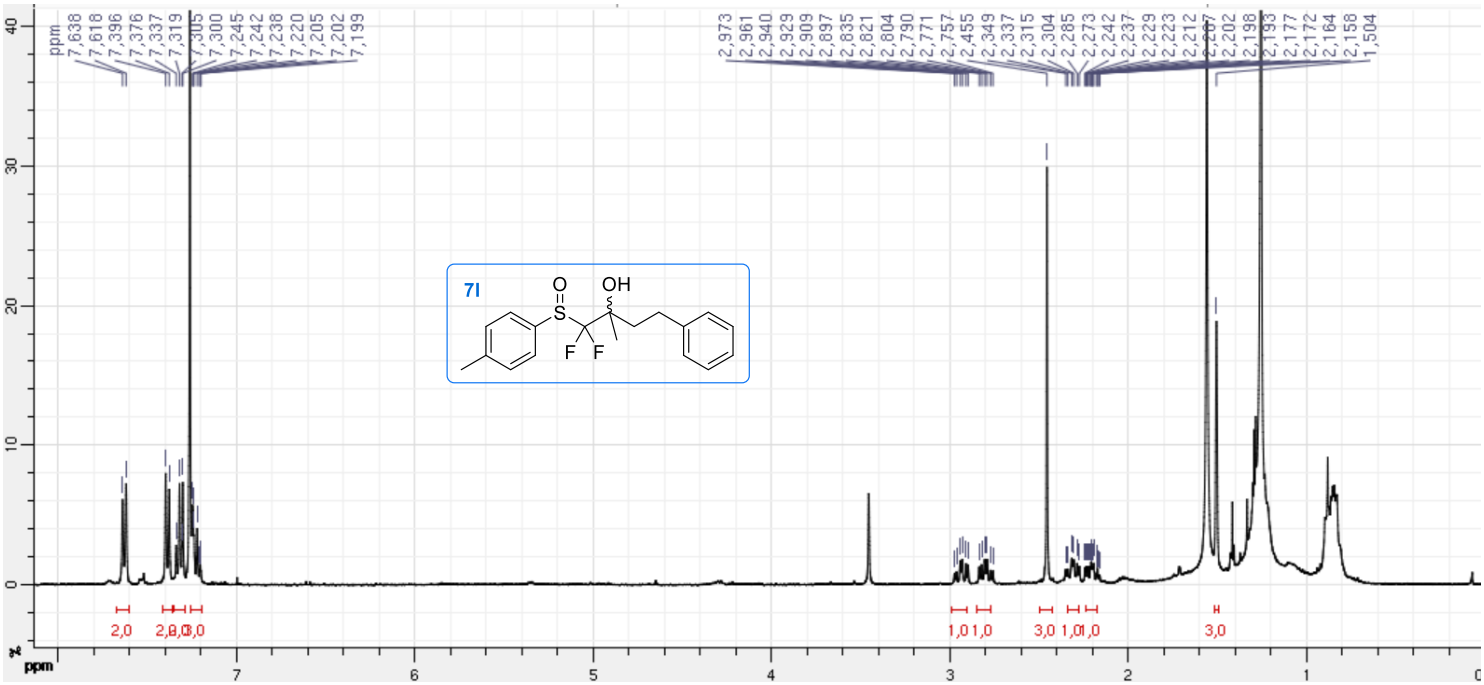
^{19}F NMR (472 MHz, $CDCl_3$) – First diastereomer – Purified **7l**



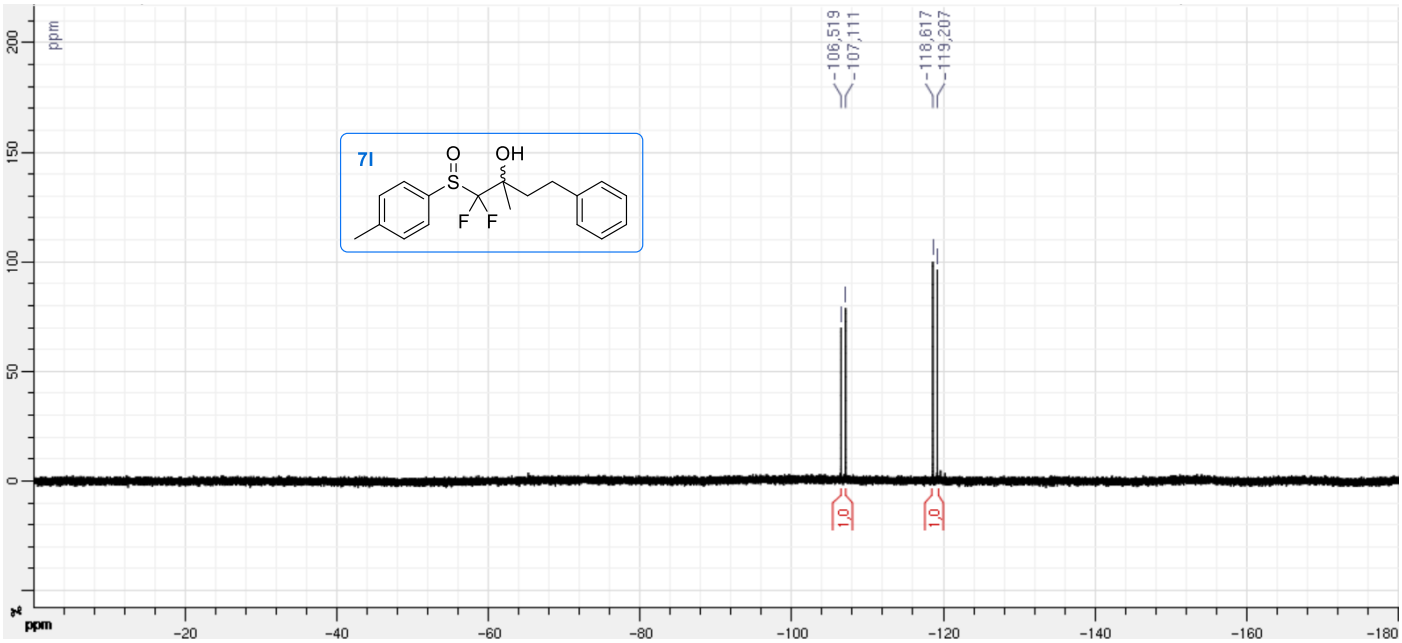
^{13}C NMR (126 MHz, $CDCl_3$) – First diastereomer – Purified **7l**



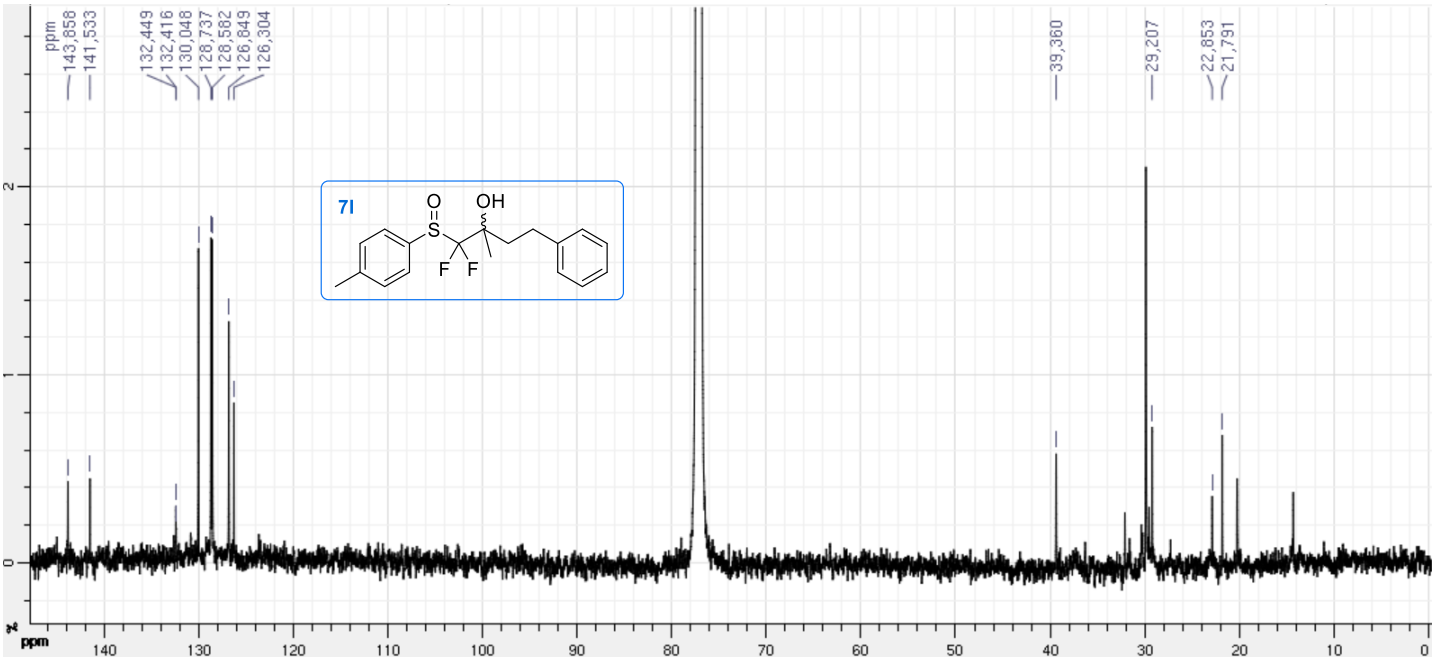
^{1}H NMR (500 MHz, $CDCl_3$) – Second diastereomer – Purified **7l**



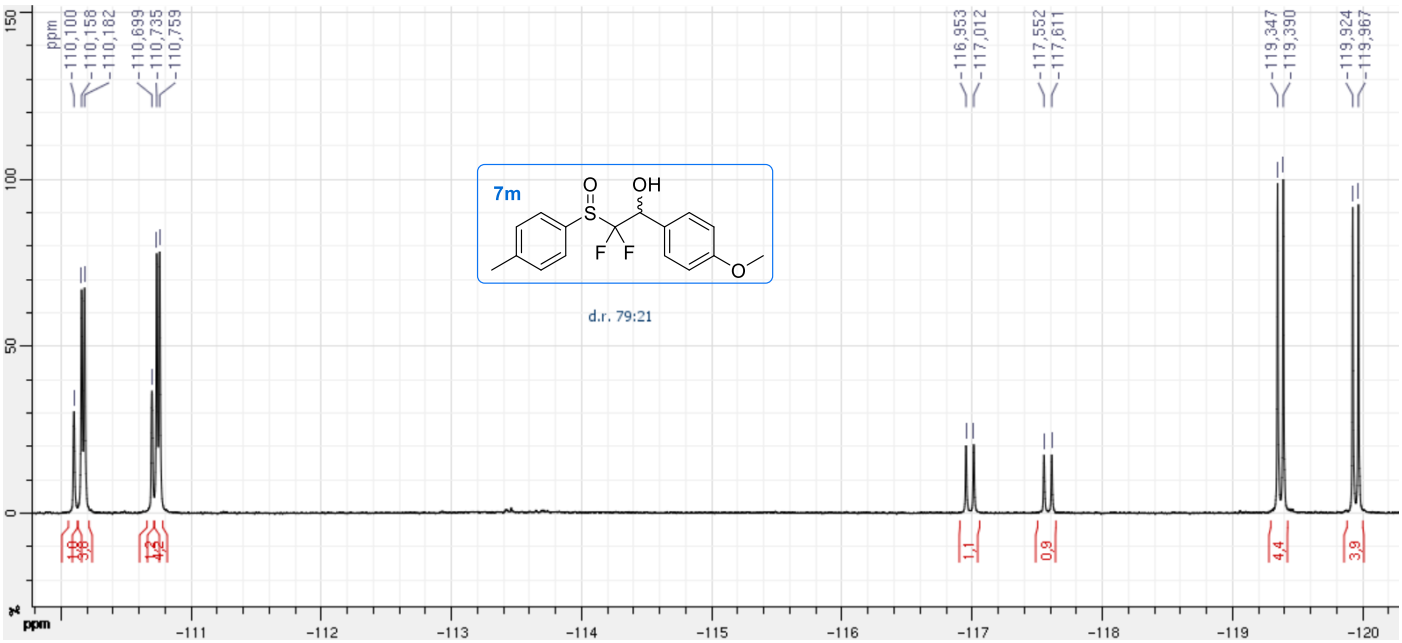
^{19}F NMR (472 MHz, $CDCl_3$) – Second diastereomer – Purified **7l**



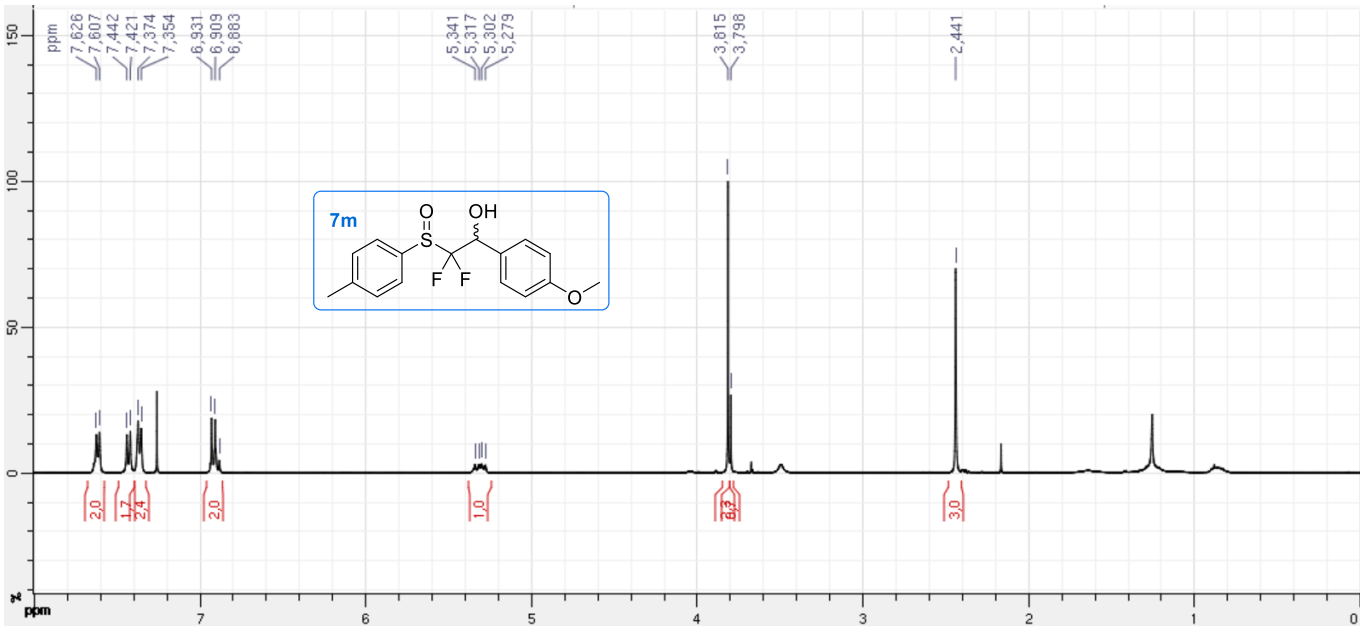
^{13}C NMR (126 MHz, $CDCl_3$) – Second diastereomer – Purified **7l**



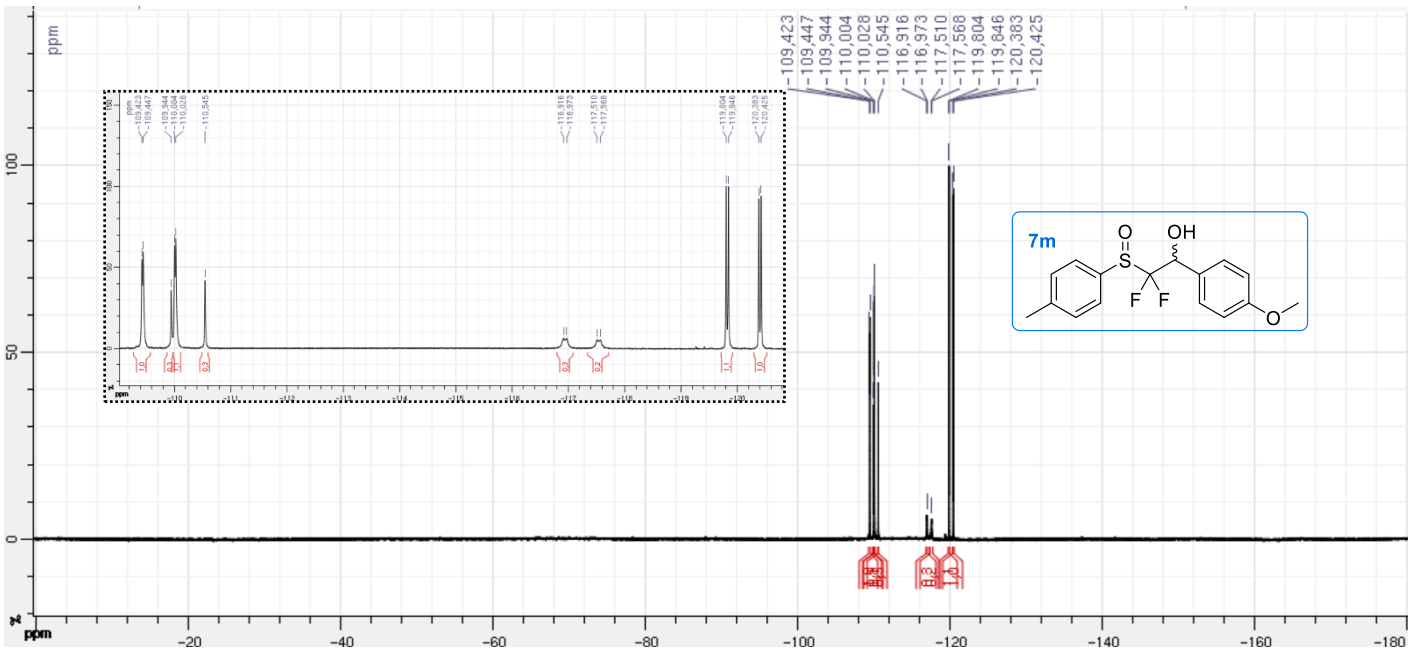
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of **7m**



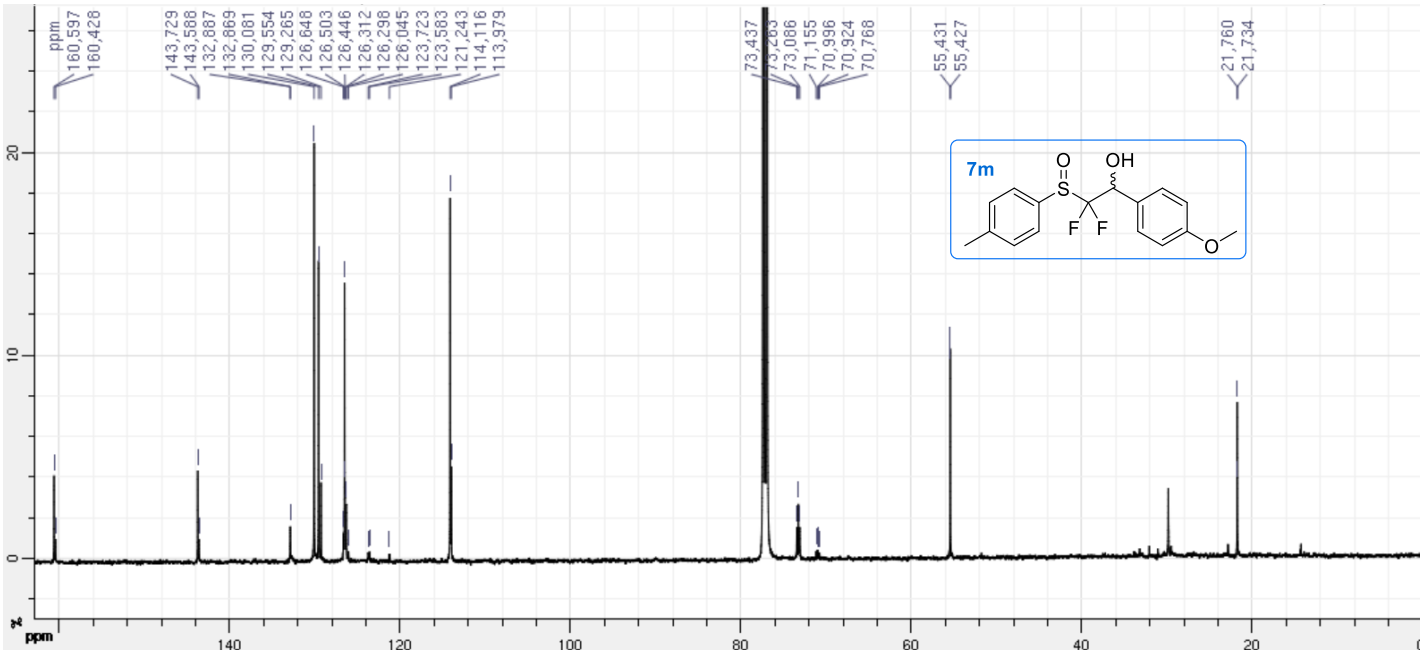
^{1}H NMR (400 MHz, $CDCl_3$) – Purified **7m**



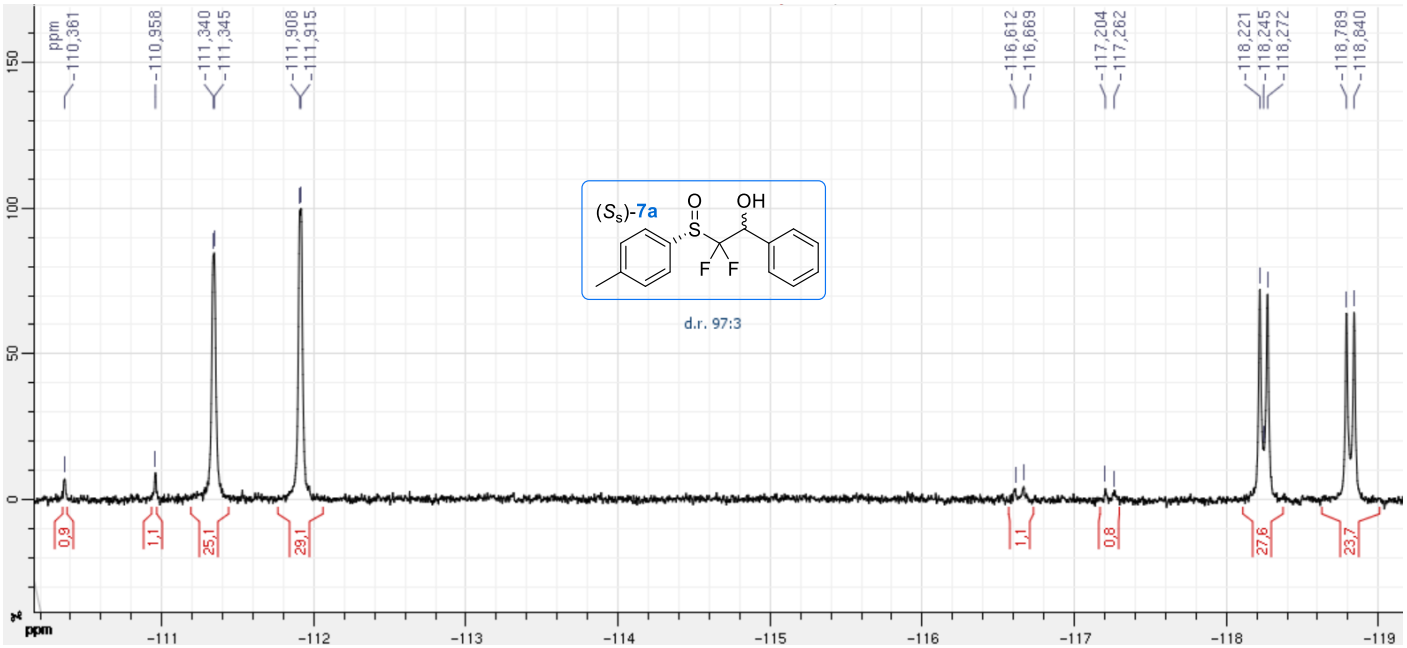
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **7m**



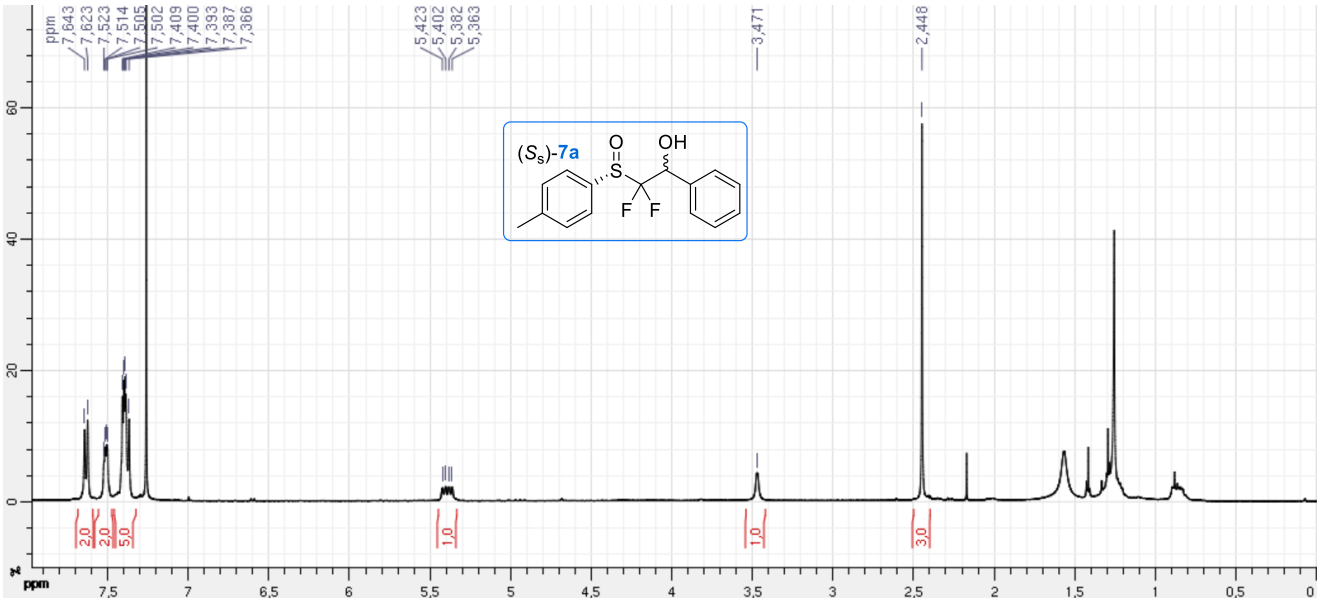
^{13}C NMR (126 MHz, $CDCl_3$) – Purified **7m**



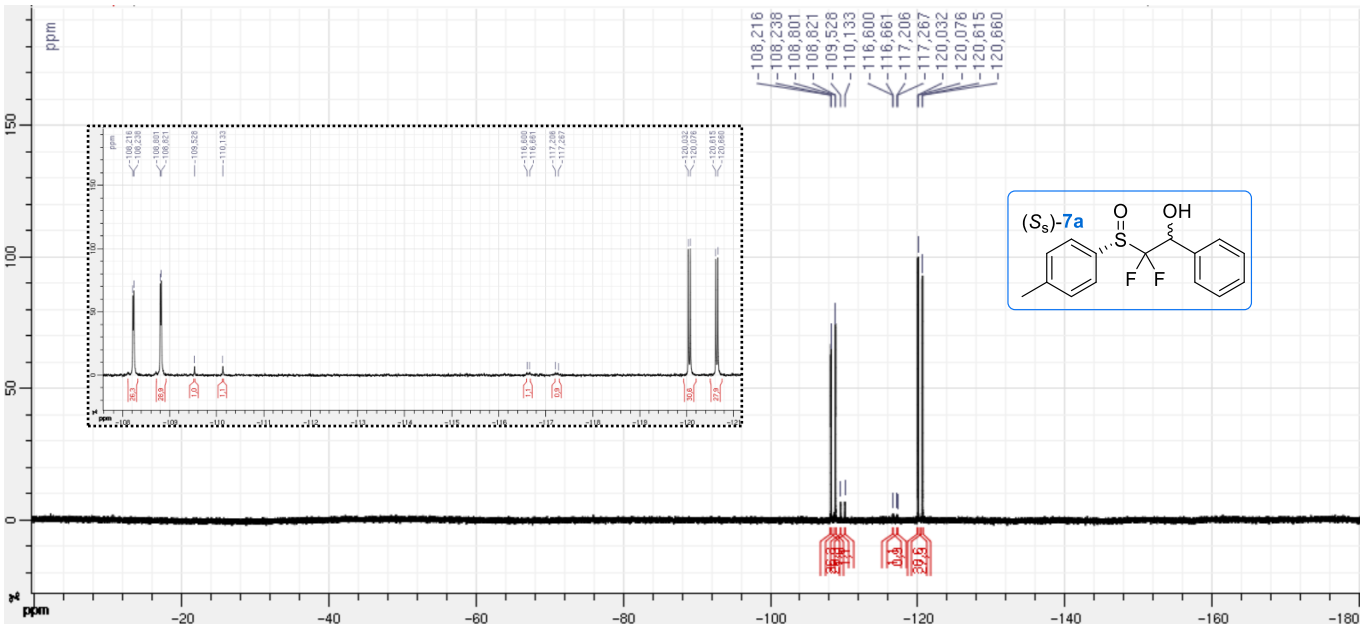
^{19}F NMR (376 MHz, $CDCl_3$) – Crude mixture of (S_S)-**7a**



^{1}H NMR (400 MHz, $CDCl_3$) – Purified (S_S)-**7a**



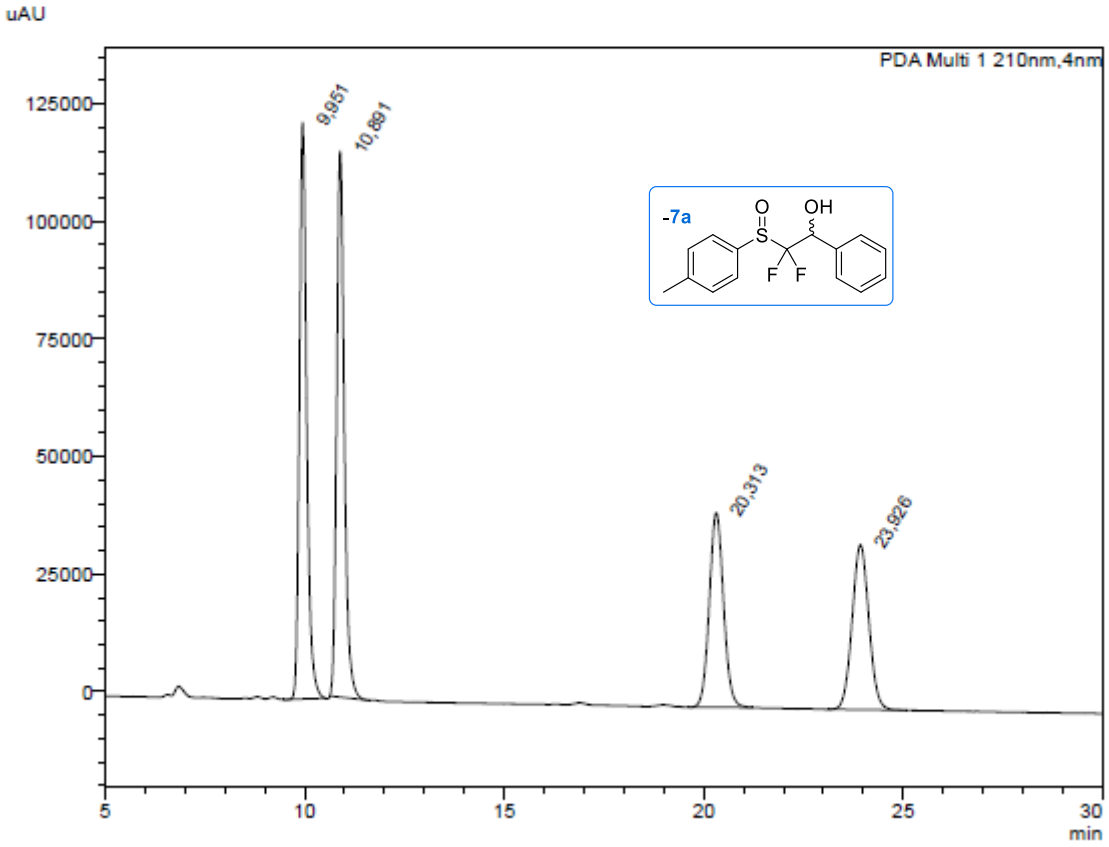
^{19}F NMR (376 MHz, $CDCl_3$) – Purified (S_S)-**7a**



Chiral HPLC – Racemic 7a – Two diastereomers

Sample Name : CB255A-drrac01
Data Filename : CB255A-drrac01_02.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2017-07-11.lcb
Vial # : 1-1
Injection Volume : 1 uL
Date Acquired : 11/07/2017 17:01:49 Acquired by : User-Adv
IC Hex/IPA 80/20 0.5ml/min

<PDA Chromatogram>



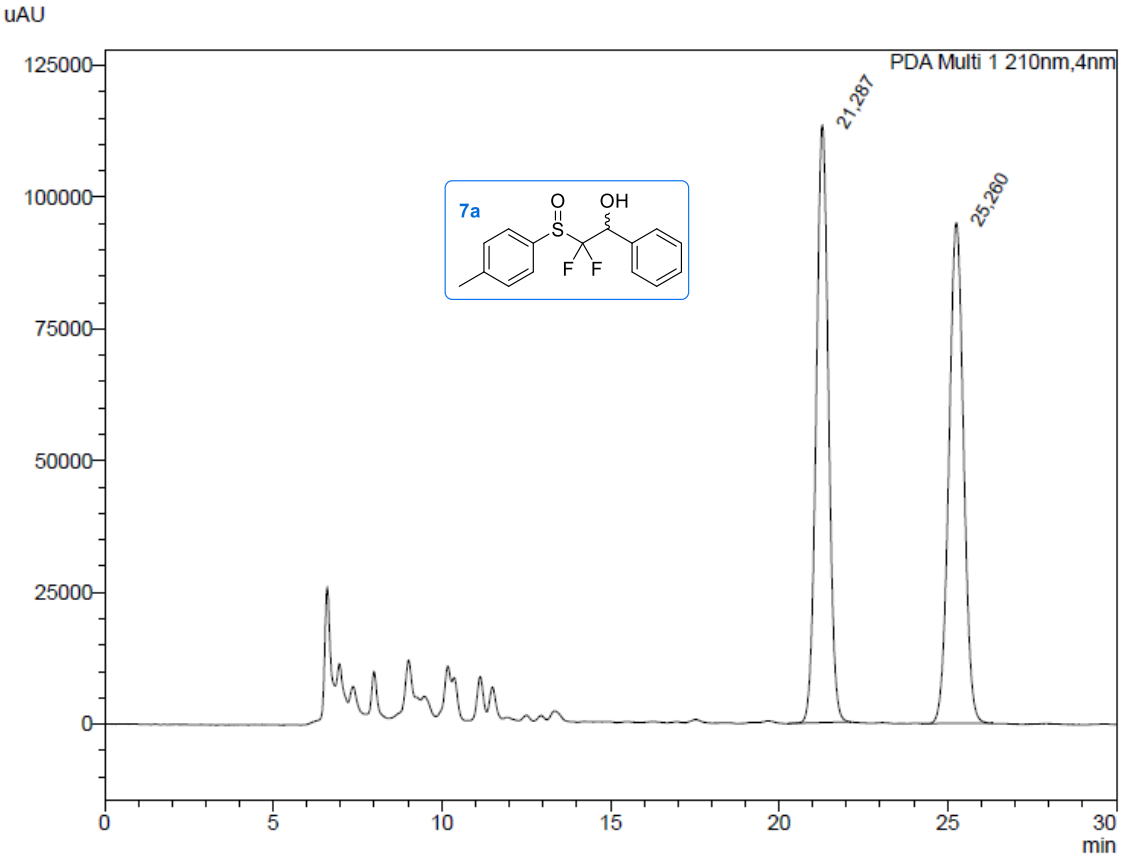
PDA Ch1 210nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	21.287	2857542	113392	49.898	--	--	205/251/485/441/602
2	25.260	2869276	95014	50.102	0.187	5.409	205/251/655/485/569
Total		5726818	208406	100.000			

Chiral HPLC – Diastereopure racemic 7a – One diastereomer

Sample Name : CB382A_en01
Data Filename : CB382A_en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2018-07-03.lcb
Vial # : 1-1
Injection Volume : 1 uL
Date Acquired : 03/07/2018 16:29:42 Acquired by : User-Adv
IC Hex/IPA 80/20 0.5 mL/min

<PDA Chromatogram>



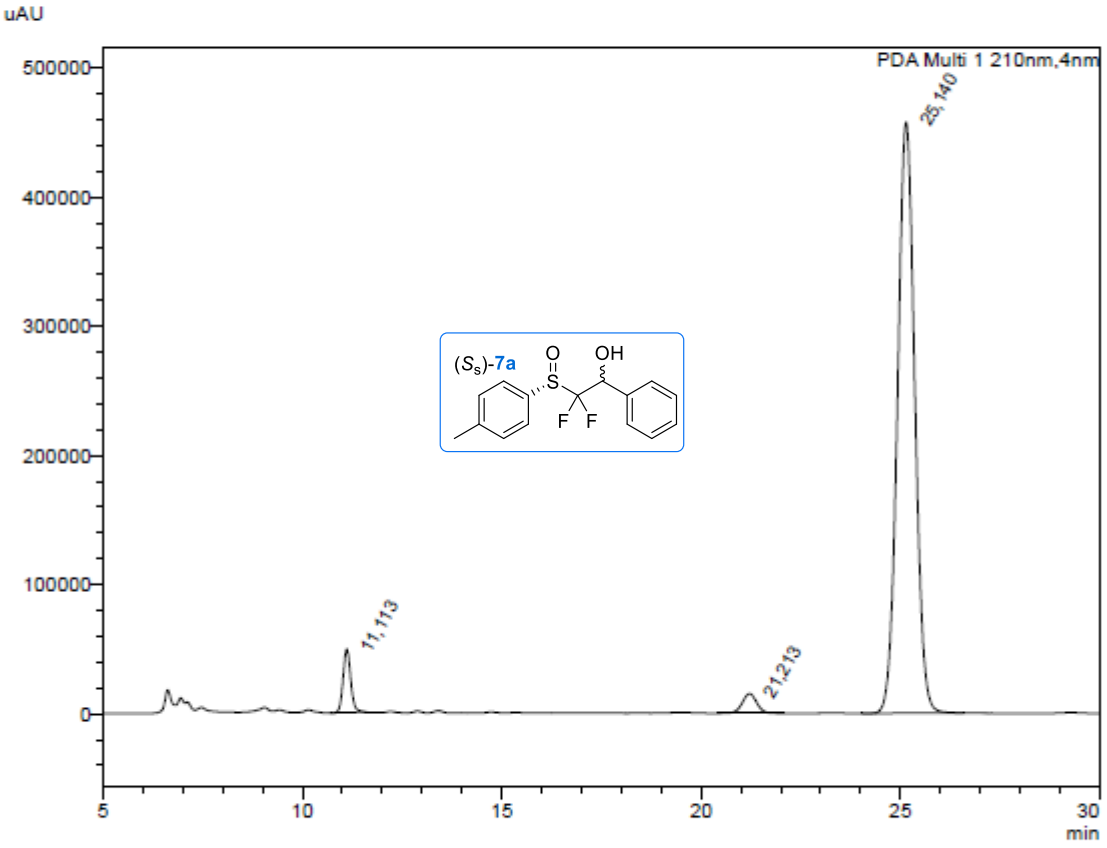
PDA Ch1 210nm

Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	21.287	2857542	113392	49.898	--	--	205/251/485/441/602
2	25.260	2869276	95014	50.102	0.187	5.409	205/251/655/485/569
Total		5726818	208406	100.000			

Chiral HPLC – Enantio- and diastereoenriched (S_S)-7a

Sample Name : CB603A_en01
Data Filename : CB603A_en01_01.lcd
Method Filename : Hex_IPA_8020_0-5ml.lcm
Batch Filename : 2018-07-03.lcb
Vial # : 1-2
Injection Volume : 1 uL
Date Acquired : 03/07/2018 18:45:56 Acquired by : User-Adv
IC Hex/IPA 80/20 0.5 mL/min

<PDA Chromatogram>



<PDA Chromatogram>

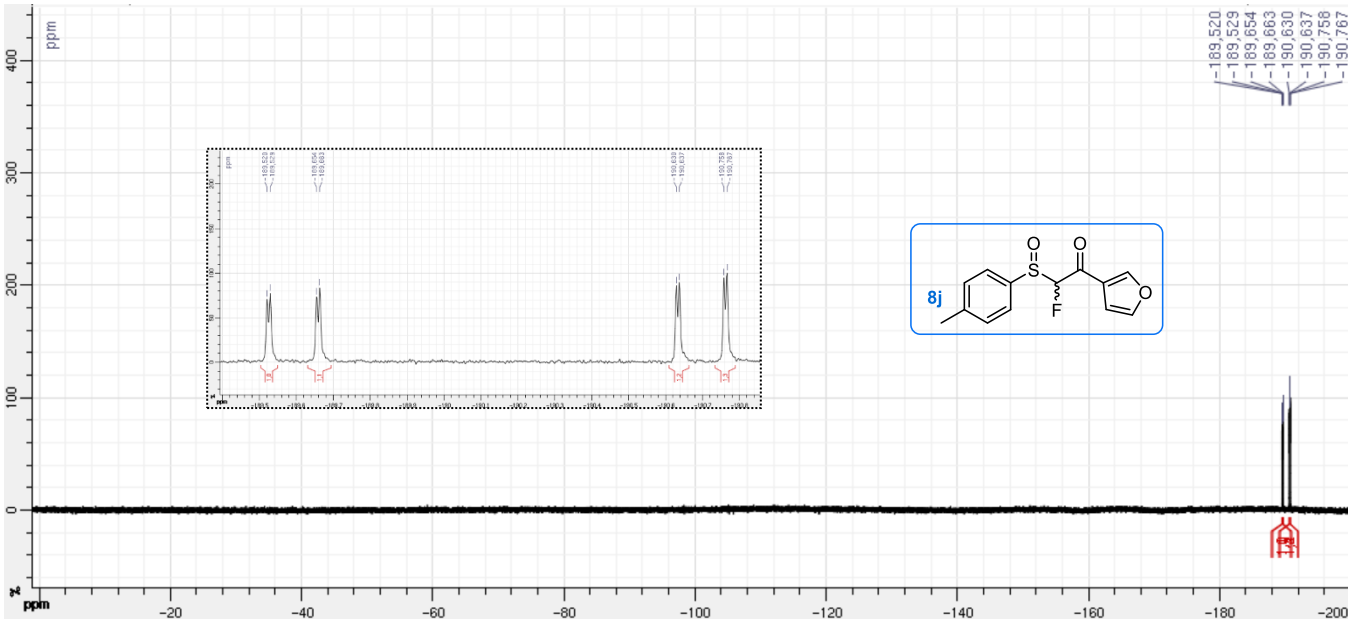
Peak Table

PDA Ch1 210nm

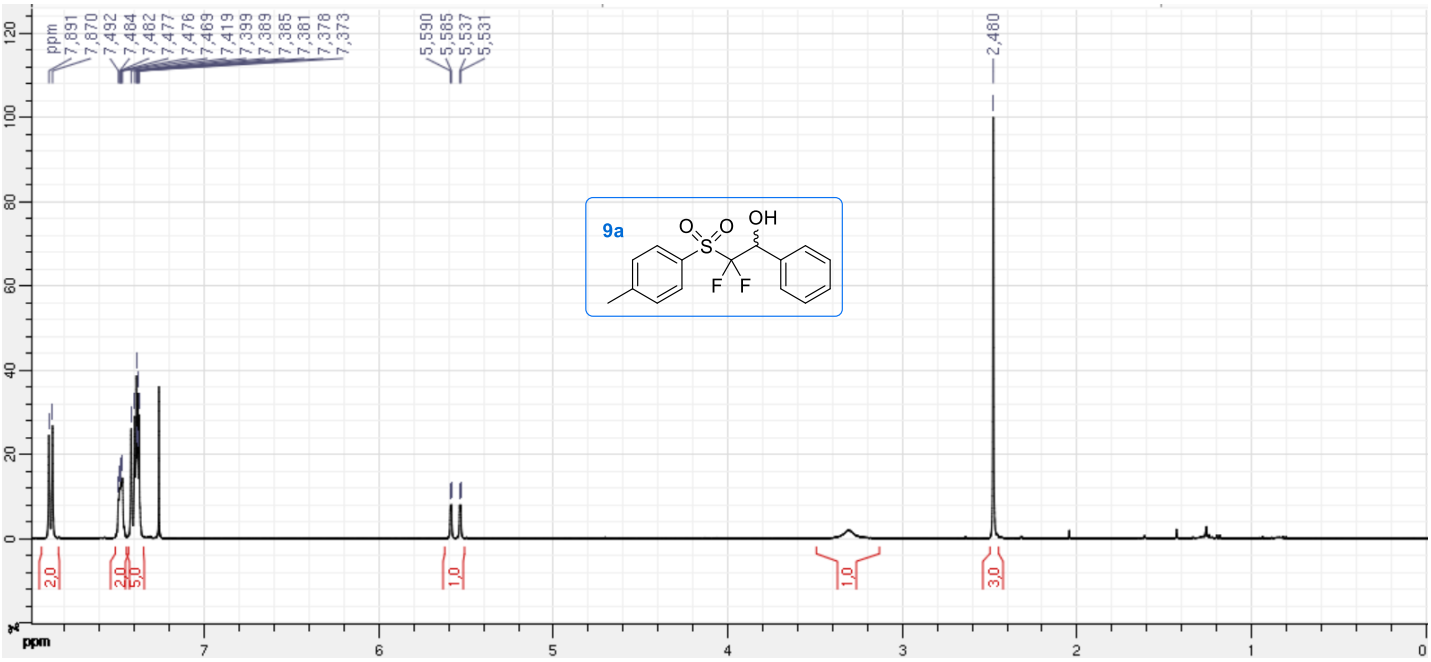
Peak#	Ret. Time	Area	Height	Area%	Capacity Factor(k')	Resolution(USP)	Lambda max
1	11.113	652167	49079	4.406	--	--	205/250/485/655/627
2	21.213	384533	15196	2.598	0.909	19.740	205/251/485
3	25.140	13765680	457437	92.996	1.262	5.361	205/251/630
Total		14802380	521712	100.000			

^{1}H NMR (400 MHz, $CDCl_3$) – Purified **8j**

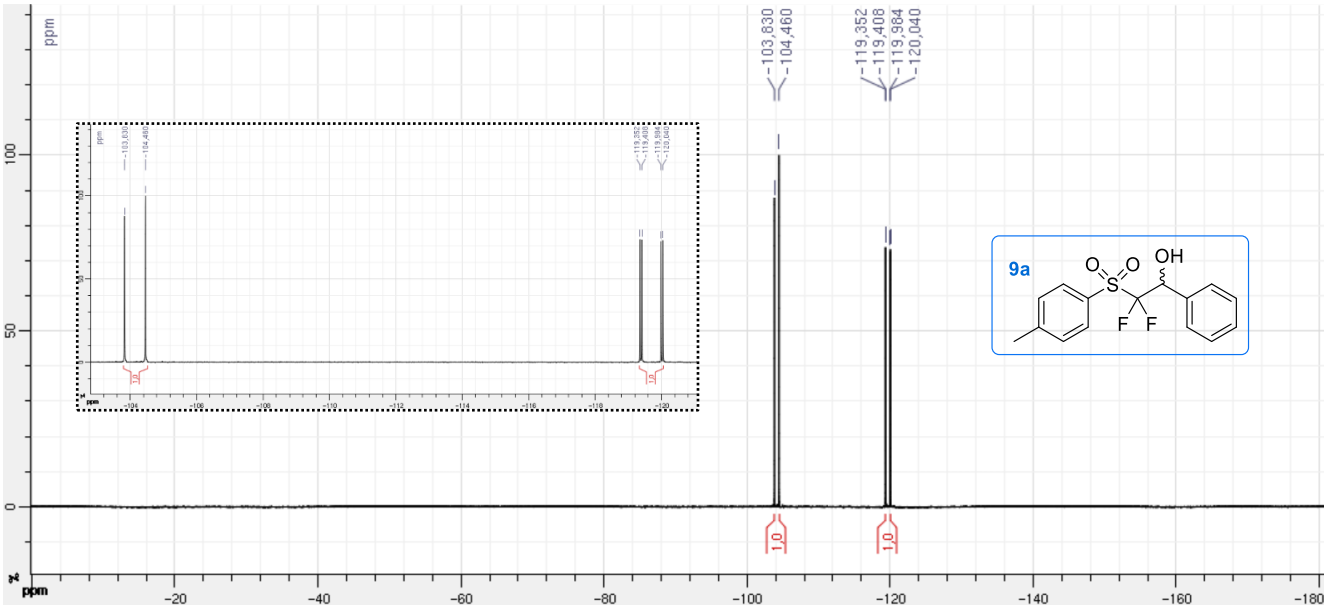
^{19}F NMR (376 MHz, $CDCl_3$) – Purified **8j**



^{1}H NMR (400 MHz, $CDCl_3$) – Purified **9a**



^{19}F NMR (376 MHz, $CDCl_3$) – Purified **9a**



^{13}C NMR (126 MHz, $CDCl_3$) – Purified **9a**