# *Electronic Supplementary Information*

## Catalytic Asymmetric 1,4-Type Friedel-Crafts (Hetero)Arylation of 1-Azadienes: Highly Enantioselective Synthesis of Chiral Hetero-Triarylmethanes

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## Table of Contents

# 1 General Information

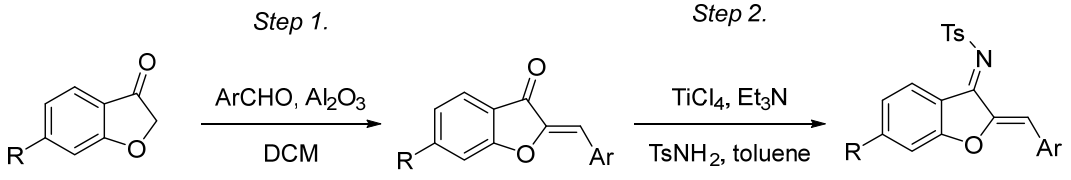
Unless otherwise specified, all reactions were carried out under argon atmosphere in anhydrous conditions. All the solvents were purified according to the standard procedures. All chemicals which are commercially available were used without further purification unless otherwise noted. Thin-layer chromatography (TLC) was performed on silica gel plates (60F-254) using UV-light (254 and 365nm).

$^{1}$H-NMR and $^{13}$C-NMR spectra were recorded at 400 MHz or 600 MHz spectrophotometer. Chemical shifts ($\delta$) are expressed in ppm, and $J$ values are given in Hz. NMR multiplicities are abbreviated as follows: s = singlet, br = broad signal, d = doublet, t = triplet, q = quartet, m = multiple, dd = doublet of doublet. Values of enantiomeric excess was determined by chiral HPLC (Aglient 1260 Infinity) with *n*-hexane and *i*-propanol as eluents. High resolution mass spectrometry (HRMS) was were recorded on an ESI-ion trap Mass spectrometer (Agilent 1100 series LC/MSD, SL model). Optical rotations were measured on a Jasco P-2000 polarimeter. All chemicals and solvents were used as received without further purification unless otherwise stated. Column chromatography was performed on silica gel (200–300 mesh).

# 2 General Procedure for the Preparation of Substrates

## 2.1 General Procedure for the Synthesis of Azadienes

According to the known procedures,[1] benzofuran-fused 1-azadienes **1a-1l** were synthesized. According to the known procedures, [1b,2] benzofuran-fused enones **ia-il** were synthesized.



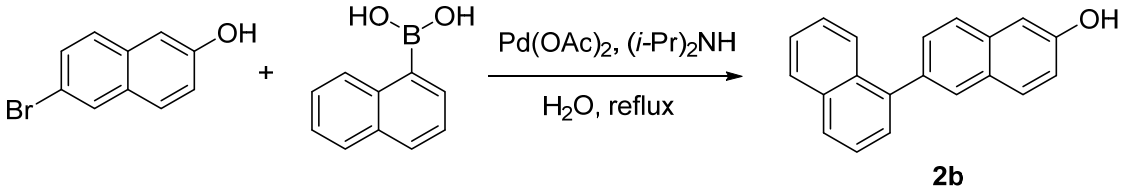

**iia-iil** **ia-il** **1a-1l**

**Step 1**: Aluminium oxide (13.0g, activated, basic) was added to a solution of ketones **ii** (4 mmol) and aldehydes (8 mmol) in dichloromethane (30 mL). The mixture was violently stirred at room temperature under argon atmosphere. The progress of the reaction was monitored by TLC analysis. The suspension was filtered off, and the residue was washed with dichloromethane. Combined and concentrated the filtrates. The residue was purified by flash chromatography on silica gel to give enones **i**.

**Step 2**: 4-Methylbenzenesulfonamide (513 mg, 3.00 mmol) and heterocyclic enones **I** (3.00 mmol) were added in a round bottom flask in toluene (40 mL) and cooled to 0 °C. Then, $Et_3N$ (0.84 mL, 6.0 mmol) and $TiCl_4$ (1.0 M in Toluene, 3.0 mL, 3.0 mmol) were successively added. The reaction mixture was heated to reflux for overnight. The solution was then cooled to room temperature, quenched with water (100 mL) and extracted with DCM (3 × 30 mL). The combined organic phase was dried over $Na_2SO_4$ and concentrated. The residue was purified by flash chromatography on silica gel to afford benzofuran-fused 1-azadienes **1**.

## 2.2 General Procedure for the Synthesis of *β*-Naphthol Derivatives

According to the known literature procedures,[3] (6-naphthyl)-*β*-naphthols **2b** was synthesized. All the others *β*-naphthols were obtained from the commercially available.




**2b**

To a mixture of 6-bromonaphthalen-2-ol (1.1 g, 5 mmol, 1 eq.), 1-naphthylboronic acid (7.5 mmol, 1.5 eq.) and $Pd(OAc)_2$ (45 mg, 0.2 mmol, 0.04 eq.) in water (10 mL) was added diisopropylamine (1 mL). After heat to reflux for 10

hours, the mixture was then filtered and washed with ethyl acetate (3 × 10 mL), The aqueous layer was extracted with ethyl acetate. The organic layer was washed with brine, dried over $Na_2SO_4$, filtered and then concentrated. The residue was purified by silica gel column chromatograph (ethyl acetate/petroleum ether = 1/20, v/v) to afford the product **2b.**

## 2.3 All Substrates for the Asymmetric Friedel-Crafts Reactions

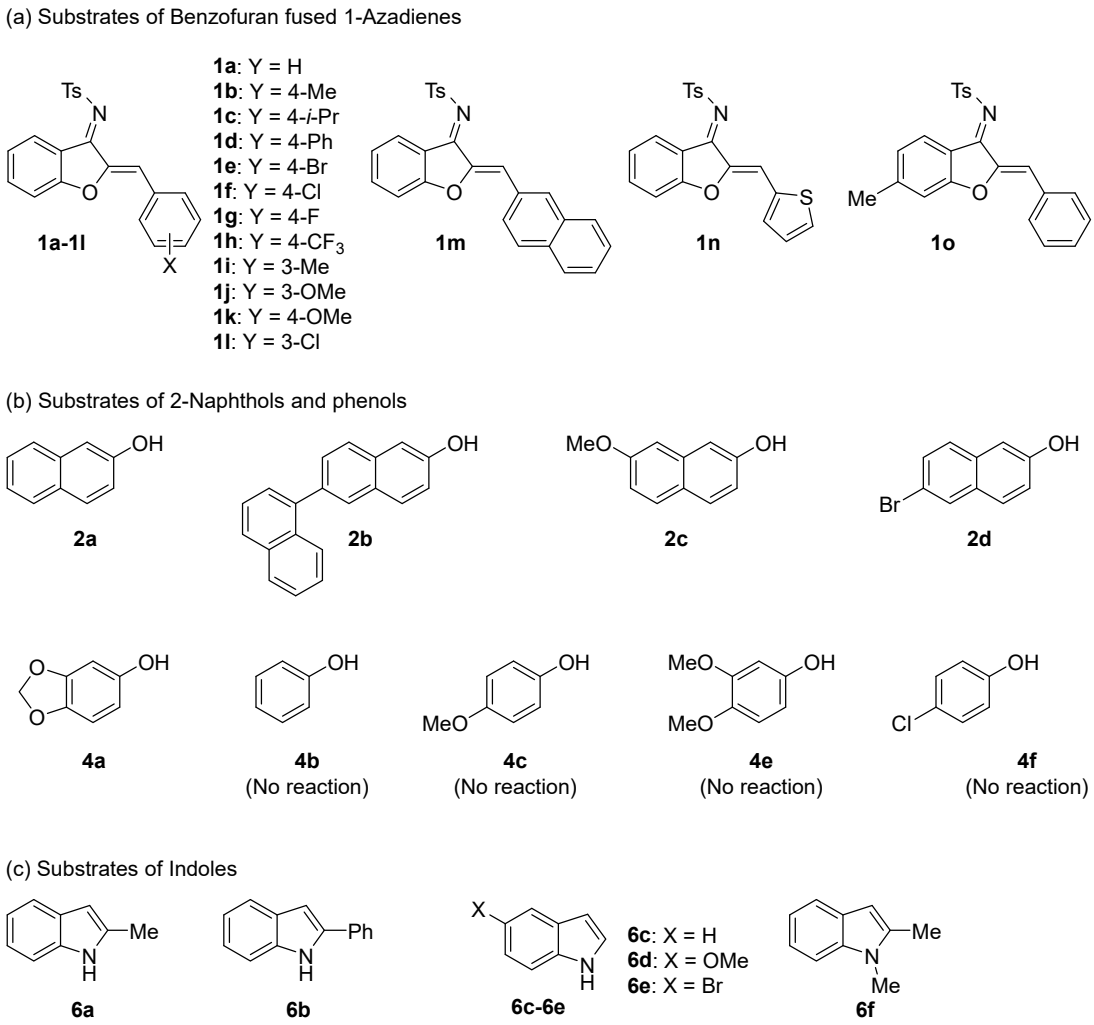
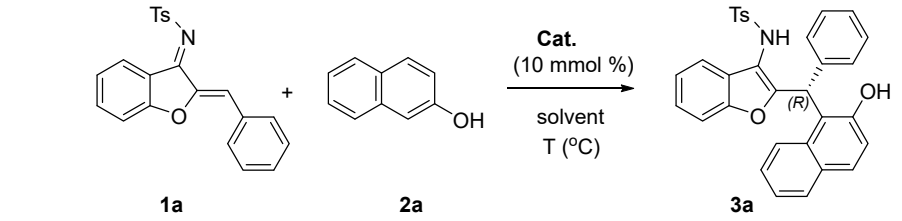


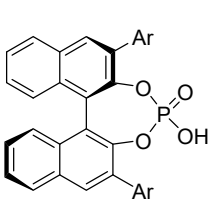

**Figure S1**. All the substrates employed in the asymmetric F-C reactions

# 3 Optimization of Asymmetric Catalytic Reactions

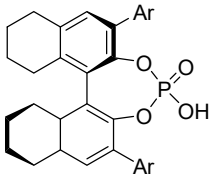
## 3.1 Asymmetric Friedel-Crafts Arylation of Azadienes and *β*-Naphthol



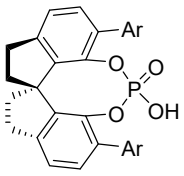

**1a** **2a** **3a**



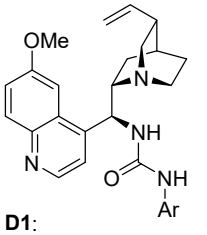
**A1**:
Ar = 2,4,6-($^i$Pr)$_3$-C$_6$H$_2$



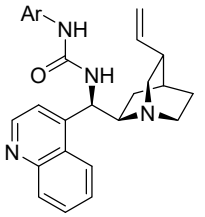
**B1**:
Ar = 2,4,6-($^i$Pr)$_3$-C$_6$H$_2$



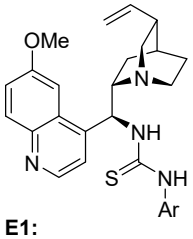
**C1**:
Ar = 2,4,6-Me$_3$-C$_6$H$_2$



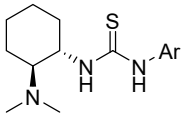
**D1**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



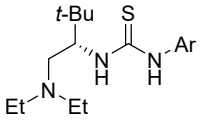
**D2**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



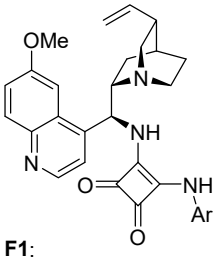
**E1:**
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



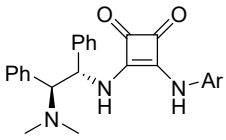
**E2:**
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



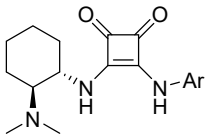
**E3:**
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



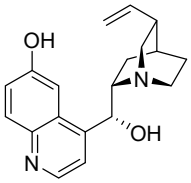
**F1**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$
**F2**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$CH$_2$
**F3**:
Ar= C$_6$H$_5$CH$_2$



**F4**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



**F5**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$



**G**

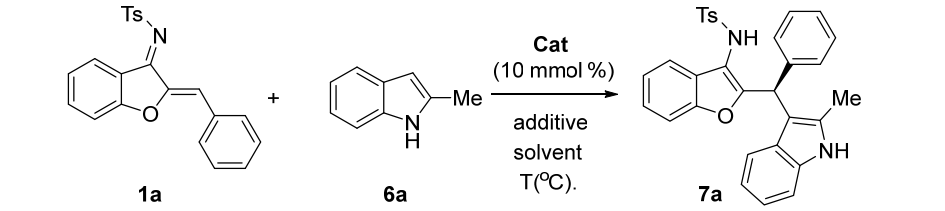
**Table S1**. Optimization of Friedel-Crafts Arylation of Azadienes **1a** and *β*-Naphthol **2a** [a]

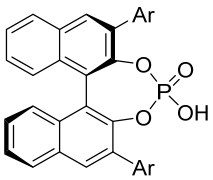
| Entry | **Cat** | Solvent | T (°C) | *t* (h) | Yield (%)[b] | Ee (%)[c] |
|---|---|---|---|---|---|---|
| 1 | **A1** | toluene | 20 | 6 | 61 | 3 (*R*) |
| 2 | **B1** | toluene | 20 | 48 | 48 | 3 (*S*) |
| 3 | **C1** | toluene | 20 | 24 | 45 | 52 (*S*) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | **D1** | toluene | 20 | 18 | 93 | 85 (*R*) |
| 5 | **D2** | toluene | 20 | 18 | 88 | 85 (*S*) |
| 6 | **E1** | toluene | 20 | 18 | 88 | 85 (*R*) |
| 7 | **E2** | toluene | 20 | 24 | 76 | 70 (*R*) |
| 8 | **E3** | toluene | 20 | 24 | 71 | 38 (*R*) |
| 9 | **F1** | toluene | 20 | 4 | 88 | 80 (*R*) |
| 10 | **F2** | toluene | 20 | 48 | 87 | 75 (*R*) |
| 11 | **F3** | toluene | 20 | 24 | 77 | 41 (*S*) |
| 12 | **F4** | toluene | 20 | 48 | trace | / |
| 13 | **F5** | toluene | 20 | 18 | 89 | 72 (*R*) |
| 14 | **G** | toluene | 20 | 6 | 67 | 21 (*R*) |
| 15 | **D1** | MeOH | 20 | 72 | 60 | 0 |
| 16 | **D1** | THF | 20 | 48 | 36 | 17 (*R*) |
| 17 | **D1** | MeCN | 20 | 48 | 16 | 65 (*R*) |
| 18 | **D1** | $Et_2O$ | 20 | 48 | 48 | 71 (*R*) |
| 19 | **D1** | $CH_2Cl_2$ | 20 | 12 | 97 | 87 (*R*) |
| 20 | **D1** | $(CH_2Cl)_2$ | 20 | 12 | 79 | 86 (*R*) |
| 21 | **D1** | $CHCl_3$ | 20 | 18 | 84 | 87 (*R*) |
| 22 | **D1** | $PhCF_3$ | 20 | 18 | 85 | 87 (*R*) |
| 23 | **D1** | toluene | -40 | 30 | 95 | 93 (*R*) |
| 24 | **D1** | toluene | -30 | 21 | 89 | 92 (*R*) |
| 25 | **D1** | toluene | -20 | 20 | 90 | 90 (*R*) |
| 26 | **D1** | $CH_2Cl_2$ | -40 | 48 | 68 | 42 (*R*) |
| 27 | **D1** | $CH_2Cl_2$ | -30 | 21 | 80 | 79 (*R*) |
| 28 | **D1** | $CH_2Cl_2$ | -20 | 20 | 80 | 82 (*R*) |
| 30 | **D1** | $CH_2Cl_2$ | 40 | 12 | 86 | 86 (*R*) |

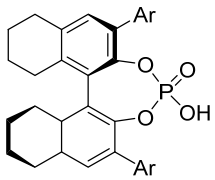
[a]Unless otherwise specified, the reaction was conducted with **1a** (0.1 mmol), **2a** (0.12 mmol), catalyst (10 mmol %) in the indicated solvent (2 mL). [b]Yield of isolated product. [c]Determined by HPLC.

### 3.2 Asymmetric Friedel-Crafts Heteroarylation of Azadienes and 2-Me Substituted Indoles

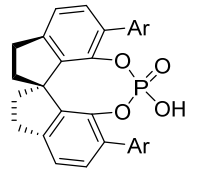


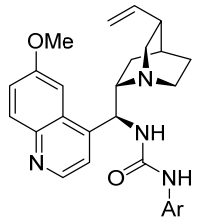

**A1**:
Ar = 2,4,6-($^i$Pr)$_3$-C$_6$H$_2$
**A2**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$
**A3**:
Ar = 2-naphthyl
**A4**:
Ar = 1-naphthyl
**A5**:
Ar = 9-anthryl
**A6**:
Ar = 4-MeO-C$_6$H$_4$




**B1**:
Ar = 2,4,6-($^i$Pr)$_3$-C$_6$H$_2$
**B2**:
Ar = 2,4,6-Me$_3$-C$_6$H$_2$
**B3**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$
**B4**:
Ar = 2-naphthyl
**B5**:
Ar = 1-naphthyl




**C1**:
Ar = 2,4,6-Me$_3$-C$_6$H$_2$
**C2**:
Ar = 2-naphthyl
**C3**:
Ar = 1-naphthyl
**C4**:
Ar = 9-anthryl




**D1**:
Ar = 3,5-(CF$_3$)$_2$-C$_6$H$_3$

**Table S2**. Optimization of Friedel-Crafts Heteroarylation of Azadienes **1a** and 2-Me substituted indole **6a** [a]

| Entry | **Cat** | additive | Solvent | T (°C) | *t* | Yield (%)[b] | ee (%)[c] |
|---|---|---|---|---|---|---|---|
| 1 | **D1** | / | toluene | 20 | 24 h | 45 | 40 (*S*) |
| 2 | **A1** | / | toluene | 20 | 2 h | 94 | 53 (*S*) |
| 3 | **A2** | / | toluene | 20 | 10 min | 96 | 32 (*S*) |
| 4 | **A3** | / | toluene | 20 | 2 h | 96 | 3 (*R*) |
| 5 | **A4** | / | toluene | 20 | 10 min | 97 | 13 (*R*) |
| 6 | **A5** | / | toluene | 20 | 10 min | 98 | 3 (*S*) |
| 7 | **A6** | / | toluene | 20 | 10 min | 93 | 20 (*R*) |
| 8 | **B1** | / | toluene | 20 | 1 h | 98 | 73 (*S*) |
| 9 | **B2** | / | toluene | 20 | 10 min | 96 | 53 (*S*) |
| 10 | **B3** | / | toluene | 20 | 10 min | 96 | 43 (*S*) |
| 11 | **B4** | / | toluene | 20 | 10 min | 97 | 40 (*R*) |
| 12 | **B5** | / | toluene | 20 | 10 min | 94 | 5 (*R*) |
| 13 | **C1** | / | toluene | 20 | 2 h | 98 | 31 (*R*) |
| 14 | **C2** | / | toluene | 20 | 1 h | 97 | 55 (*S*) |
| 15 | **C3** | / | toluene | 20 | 30 min | 94 | 13 (*S*) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16 | **C4** | / | toluene | 20 | 30 min | 98 | 17 (*S*) |
| 19 | **B1** | / | toluene | 20 | 10 min | 93 | 7 (*S*) |
| 20 | **B1** | / | toluene | 20 | 1 h | 98 | 73 (*S*) |
| 21 | **B1** | / | $CH_2Cl_2$ | 20 | 1 h | 97 | 77 (*S*) |
| 22 | **B1** | / | THF | 20 | 24 h | trace | / |
| 23 | **B1** | / | MeCN | 20 | 2 h | 85 | 73 (*S*) |
| 24 | **B1** | / | $CH_2Cl_2$ | 20 | 1 h | 98 | 84 (*S*) |
| 25 | **B1** | 4Å MS | $CH_2Cl_2$ | 20 | 1 h | 98 | 87 (*S*) |
| 26 | **B1** | 3Å MS | $CH_2Cl_2$ | 20 | 1 h | 98 | 88 (*S*) |
| 27 | **B1** | 3Å MS | $CH_2Cl_2$ | 0 | 2 h | 98 | 90 (*S*) |
| 28 | **B1** | 3Å MS | $CH_2Cl_2$ | -10 | 10 h | 98 | 92 (*S*) |

[a]Unless otherwise specified, the reaction of **1a** (0.1 mmol) and **6a** (0.12 mmol) was conducted in the presence of catalyst (10 mmol %) and indicated additive (50 mg) in the indicated solvent (1 mL). [b]Yield of isolated product. [c]Determined by HPLC.

### 3.3 Effect of Catalyst Loading

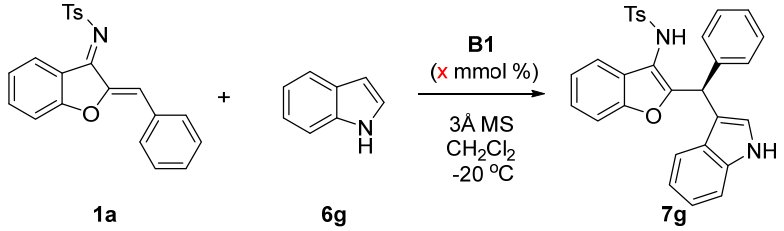
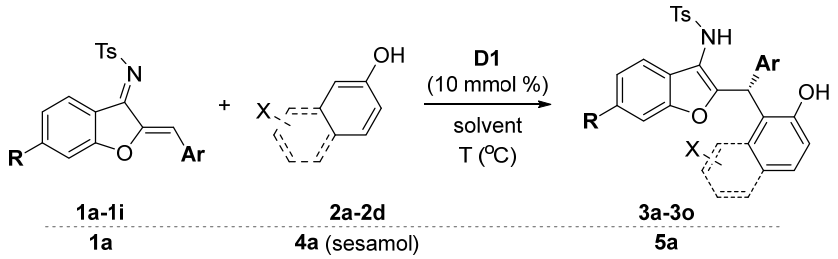



**Table S3.** Investigation of Catalyst loading for the Friedel-Crafts Reaction of **1a** with indole **6g**[a]

| Entry | **B1** (x mmol %) | *t* (h) | Yield (%) [b] | ee (%) [c] |
|---|---|---|---|---|
| **1** | 10 | 10 | 98 | 96 (*S*) |
| **2** | 5 | 20 | 95 | 95 (*S*) |
| **3** | 2.5 | 24 | 90 | 95 (*S*) |
| **4** | 1.0 | 46 | 87 | 94 (*S*) |

[a]Unless otherwise specified, the reaction was conducted with **1a** (0.1 mmol), **6a** (0.12 mmol), **B1** (x mmol %) and 3Å MS (50 mg) in $CH_2Cl_2$ (1 mL). [b]Yield of isolated product. [c]Determined by HPLC. Time space yield refer to the amount of product /catalyst loading/reaction time

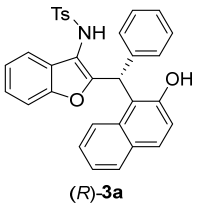
## 4 General Procedure for the Asymmetric Friedel-Crafts Arylation




**General Procedure A:** Under argon atmosphere, 1-azadienes **1** (0.1 mmol), *β*-naphthols **2** (0.12 mmol), the chiral urea catalyst **D1** (10 mmol %) was dissolved in toluene (2 mL). The reaction mixture was allowed to stir at -40 °C for 16 ~ 48 h. Then the reacting mixture was directly purified by silica gel chromatography with the elution of ethyl acetate/petroleum ether = 1/5 to 1/3, affording the desired products **3**.

**General Procedure B:** Under argon atmosphere, 1-azadienes **1** (0.1 mmol), *β*-naphthols **2** or sesamol **4a** (0.12 mmol) and the chiral urea catalyst **D1** (10 mmol %) was dissolved in $CH_2Cl_2$ (2 mL). The reaction mixture was allowed to stir at 30 °C for 12 ~ 48 h. Then the reacting mixture was directly purified by silica gel chromatography with the elution of ethyl acetate/petroleum ether = 1/5 to 1/3, affording the desired products **3** or **5a**.

**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(phenyl)methyl)benzofuran-3-yl)-4-methyl-benzenesulfonamide.**

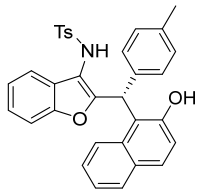



(*R*)-**3a**

Following the *General Procedure A*, (*R*)-**3a** was obtained as white solid (30 h, 47.6 mg, 95% yield, 94% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -8.4 (*c* 1.0, $CHCl_3$); m.p. 216-217 °C; **HRMS (ESI-TOF)** calcd for $C_{32}H_{24}NO_4S$ $[M - H]^-$ : 518.1432, found: 518.1434; **$^1$H NMR**

(400 MHz, acetone-$d^6$, ppm): $\delta$ 9.40 (s, 1H), 8.06 (s,1H) 7.76 (dd, 1H, $J$ = 3.5, 6.3 Hz), 7.65-7.58 (m, 2H), 7.49 (d, 2H, $J$ = 8.4 Hz), 7.45-7.38 (m, 1H), 7.24-7.17 (m, 2H), 7.11-7.03 (m, 7H), 6.95 (d, 2H, $J$ = 8.1 Hz), 6.66-6.64 (m, 2H), 6.31 (s, 1H), 2.01 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 154.0, 153.4, 152.6, 143.8, 139.8, 136.4, 132.7, 129.9, 129.6, 128.4, 127.9, 127.6, 127,1, 126.1, 125.94, 125.86, 125.4, 124.4, 122.9, 122.8, 120.1, 118.1, 117.7, 115.8, 111.1, 37.7, 20.6; **HPLC analysis**: Daicel CHIRALCEL OD-H, *n*-hexane/*i*-PrOH = 85/15, flow rate = 1.0 mL/min, λ = 230 nm, retention time: $t_R$ = 5.4 min (major), $t_R$ = 6.3 min (minor).

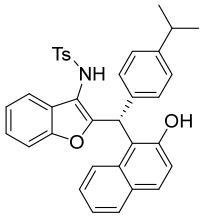
**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(*p*-tolyl)methyl)benzofuran-3-yl)-4-methyl-benzenesulfonamide.**




(*R*)-**3b**

Following the *General Procedure B,* (*R*)-**3b** was obtained as white solid (24 h, 50.5 mg, 90% yield, 96% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -12.2 (*c* 1.0, $CHCl_3$); m.p. 206-207 °C; **HRMS (ESI-TOF)** calcd for $C_{33}H_{26}NO_4S$ $[M - H]^-$ : 532.1588, found: 532.1589; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 7.97-7.88 (m, 1H)，7.76-7.70 (m, 2H), 7.66-7.58 (m, 3H), 7.40-7.29 (m, 2H), 7.26-7.17 (m, 4H), 7.09 (d, 2H, $J$ = 7.6 Hz), 6.98 (d, 2H, $J$ = 8.0 Hz), 6.66 (d, 2H, $J$ = 7.9 Hz), 6.39 (s, 1H), 2.29 (s, 3H), 2.15 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 154.2, 153.4, 152.6, 143.7, 136.7, 136.2, 135.2, 132.7, 129.9, 129.6, 129.5, 128.6, 128.4, 127.2, 126.1, 125.9, 125.4, 124.3, 122.8, 122.7, 120.1, 118.3, 117.7, 115.7, 111.1, 37.3, 20.5, 20.1； **HPLC analysis**: Daicel CHIRALPAK IA, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 9.7 min (minor), $t_R$ = 13.5 min (major).

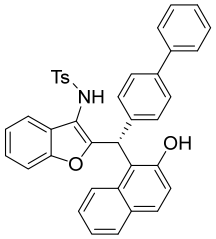
**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(4-isopropylphenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**




(*R*)-**3c**

Following the *General Procedure A*, (*R*)-**3c** was obtained as white solid (16 h, 39.4 mg, 72% yield, 99% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -8.5 (*c* 1.0, $CHCl_3$); m.p. 203-204 °C; **HRMS (ESI-TOF**) calcd for $C_{35}H_{30}NO_4S$ $[M - H]^-$ : 560.1901, found: 560.1904; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.50 (br, 1H), 8.20 (br, 1H), 7.98-7.89 (m, 1H), 7.74 (d, 2H, *J* = 8.66 Hz), 7.64 (d, 2H, *J* = 8.2 Hz), 7.58 (d, 1H , *J* = 7.2 Hz), 7.37 (d, 1H, *J* = 8.1 Hz), 7.32 (d, 1H, *J* = 8.9 Hz) 7.27-7.16 (m, 4H), 7.13 (d, 2H, *J* = 8.2 Hz), 7.07 (d, 2H, *J* = 8.18 Hz), 6.71 (d, 2H, *J* = 7.9 Hz), 6.39 (s, 1H), $\delta$ 2.19 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 154.3, 153.3, 152.5, 146.3, 143.7, 136.9, 136.4, 132.7, 129.9, 129.6, 129.5, 128.4, 127.7, 127.2, 126.1, 125.9, 125.4, 124.3, 122.9, 120.1, 118.3, 117.8, 115.8, 111.1, 37.4, 33.5, 23.5, 23.4, 20.6; **HPLC analysis**: Daicel CHIRALPAK AD-H, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 5.6 min (minor), $t_R$ = 6.5 min (major).

**(*R*)-*N*-(2-([1,1'-biphenyl]-4-yl(2-hydroxynaphthalen-1-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

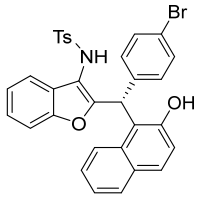



(*R*)-**3d**

Following the *General Procedure A*, (*R*)-**3d** was obtained as white solid (16 h, 59.6 mg, 94% yield, 98% ee) after flash chromatography (elution gradient: ethyl

acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -6.0 (*c* 1.0, $CHCl_3$); m.p. 181-183 ºC; **HRMS (ESI-TOF)** calcd for $C_{38}H_{28}NO_4S$ $[M - H]^-$ : 594.1745, found: 594.1748; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.54 (br, 1H), 8.20 (br, 1H), 7.93-7.88 (m, 1H), 7.77-7.72 (m, 2H), 7.63 (d, 4H, *J* = 8.1 Hz), 7.58 (dd, 1H, *J* = 1.1, 7.7 Hz), 7.36 (d, 1H, *J* = 7.92 Hz), 7.33 (d, 1H, *J* = 8.9 Hz), 7.25-7.16 (m, 7H), 7.10 (d, 2H, *J* = 8.1 Hz), 6.83-6.77 (m, 2H), 6.45 (s, 1H), 2.16 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 154.0, 153.4, 152.6, 143.8, 139.8 136.3, 132.7, 129.9, 129.6, 128.4, 127.9, 127.6, 127.2, 126.1, 125.94, 125.86, 125.4, 124.4, 122.9, 122.8, 120.1, 118.1, 117.7, 115.8, 111.1, 37.7, 20.6; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 7.3 min (minor), $t_R$ = 8.4 min (major).

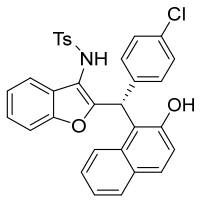
**(*R*)-*N*-(2-((4-bromophenyl)(2-hydroxynaphthalen-1-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**




(*R*)-**3e**

Following the *General Procedure B,* (*R*)-**3e** was obtained as white solid (12 h, 47.6 mg, 80% yield, 91% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -6.2 (*c* 1.0, $CHCl_3$); m.p. 207-209 ºC; **HRMS (ESI-TOF)** calcd for $C_{32}H_{23}BrNO_4S$ $[M - H]^-$ : 596.0537, found: 596.0535; **$^1$H NMR** (600 MHz, acetone-$d^6$, ppm): $\delta$ 9.58 (br, 1H), 8.21 (br, 1H), 7.87 (d, 1H, *J* = 8.7 Hz), 7.77-7.73 (m, 2H), 7.64 (d, 2H, *J* = 8.4 Hz), 7.57 (d, 1H, *J* = 7.6 Hz), 7.36-7.35 (m, 3H), 7.32 (d, 1H, *J* = 9.1 Hz), 7.25-7.18 (m, 4H), 7.11 (d, 2H, *J* = 8.4 Hz), 6.73 (d, 2H, *J* = 8.0 Hz), 6.41 (s, 1H), 2.19 (s, 3H); **$^{13}$C NMR** (150 MHz, acetone-$d^6$, ppm): $\delta$ 153.4, 152.7, 143.8, 139.5, 136.4, 132.5, 131.0, 129.9, 129.8, 129.7, 129.6, 128.5, 127.2, 126.0, 125.7, 125.6, 124.5, 123.0, 120.2, 119.4, 117.7, 117.6, 116.0, 111.2, 37.4, 20.6; **HPLC analysis:** Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 5.9 min (minor), $t_R$ = 6.6 min (major).

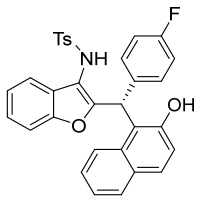
**(*R*)-*N*-(2-((4-chlorophenyl)(2-hydroxynaphthalen-1-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**




(*R*)-**3f**

Following the *General Procedure B*, (*R*)-**3f** was obtained as white solid (12 h, 46.9 mg, 88% yield, 90% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -11.5 (*c* 1.0, $CHCl_3$); m.p. 204-206 °C; **HRMS (ESI-TOF)** calcd for $C_{32}H_{23}ClNO_4S$ $[M - H]^-$ : 552.1042 , found: 552.1041; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.62 (br, 1H), 8.22 (br, 1H), 7.91-7.83 (m, 1H), 7.80-7.72 (m, 2H), 7.64 (d, 2H, *J* = 8.4 Hz), 7.60-7.51 (m, 1H), 7.37 (d, 1H, *J* = 7.9 Hz), 7.33 (d, 1H, *J* = 8.6 Hz), 7.28-7.17 (m, 6H), 7.12 (d, 2H, *J* = 8.1 Hz), 6.80 (d, 2H, *J* = 8.1 Hz), 6.43 (s, 1H), 2.19 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 153.6, 153.4, 152.7, 143.8, 140.0, 136.4, 132.5, 129.9, 129.8, 129.6, 129.3, 128.5, 128.0, 127.2, 126.0, 125.7, 125.6, 125.5, 123.0, 120.1, 117.7, 117.6, 116.0, 37.3, 20.5; **HPLC analysis:** Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ =5.7 min (minor), $t_R$ = 6.5 min (major).

**(*R*)-*N*-(2-((4-fluorophenyl)(2-hydroxynaphthalen-1-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

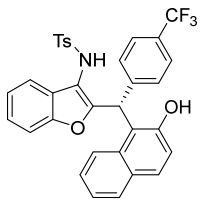



(*R*)-**3g**

Following the *General Procedure B,* (*R*)-**3g** was obtained as white solid (24 h, 50.4 mg, 94% yield, 89% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5; $[\alpha]_D^{20}$ = -10.6 (*c* 1.0, $CHCl_3$); m.p. 166-168 °C; **HRMS (ESI-TOF)** calcd for $C_{32}H_{23}FNO_4S$ $[M - H]^-$ : 536.1330 , found: 536.1339; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.42 (br, 1H), 8.06 (br, 1H), 7.78-7.71 (m, 1H),

7.63-7.56 (m, 2H), 7.49 (d, 2H, $J$ = 8.3 Hz), 7.44-7.40 (m, 1H), 7.21 (d, 1H, $J$ = 8.3 Hz), 7.18 (d, 2H, $J$ = 8.8 Hz), 7.11-7.01 (m, 4H), 6.96 (d, 2H, $J$ = 8.0 Hz), 6.81 (t, 2H, $J$ = 8.8 Hz), 6.71-6.64 (m, 2H), 6.29 (s, 1H), 2.03 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 162.4, 160.0, 153.9, 153.4, 152.6, 143.7, 136.5, 135.9 (d, $^4J_{CF}$ = 3.3 Hz), 131.2 (d, $^1J_{CF}$ = 272.8 Hz), 129.7, 129.6, 129.4 (d, $^3J_{CF}$ = 8.4 Hz), 128.5, 126.1, 127.2, 125.6, 124.5, 123.0, 122.8, 120.1, 117.9, 117.8, 115.8, 114.6 (d, $^2J_{CF}$ = 21.4 Hz), 111.2, 37.2, 20.5; **$^{19}$F NMR** (376 MHz, acetone-$d^6$, ppm): $\delta$ -118.6 (s); **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 6.0 min (minor), $t_R$ = 6.8 min (major).

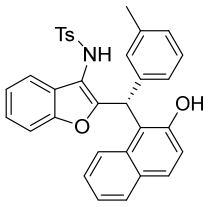
**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(4-(trifluoromethyl)phenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**



(*R*)-**3h**

Following the *General Procedure A*, (*R*)-**3h** was obtained as white solid (24 h, 57.0 mg, 96% yield 93% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -8.3 (*c* 1.0, $CHCl_3$); m.p. 157-159 °C; **HRMS (ESI-TOF)** calcd for $C_{33}H_{23}F_3NO_4S$ $[M - H]^-$: 586.1305, found: 586.1305; **$^1$H NMR** (600 MHz, acetone-$d^6$, ppm): $\delta$ 9.52 (br, 1H), 8.16 (br, 1H), 7.70 (d, 1H, $J$ = 8.3 Hz), 7.65-7.60 (m, 2H), 7.52 (d, 2H, $J$ = 8.2 Hz), 7.43-7.39 (m, 3H), 7.24 (d, 1H, $J$ = 8.2 Hz), 7.21 (d, 1H, $J$ = 8.9 Hz), 7.12-7.04 (m, 4H), 6.97 (d, 2H, $J$ = 8.2 Hz), 6.89 (d, 2H, $J$ = 8.2 Hz), 6.40 (s, 1H), 2.00 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 153.4, 153.3, 152.8, 144.9, 143.7, 136.5, 132.44, 130.0 129.8, 129.6, 128.6, 128.3, 127.2, 126.0, 125.8, 125.4, 124.9, 124.86, 124.82 (q, $J_{CF}$ = 4.1 Hz), 124.6, 123.0 ,122.9, 120.1, 117.8, 117.3, 116.2, 111.2, 37.8, 20.4; **$^{19}$F NMR** (376 MHz, acetone-$d^6$, ppm): $\delta$ -62.7 (s); **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate =1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 4.9 min (minor), $t_R$ = 5.4 min (major).

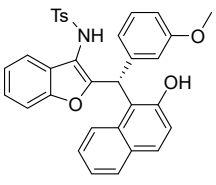
**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(m-tolyl)methyl)benzofuran-3-yl)-4-methyl Benzenesulfonamide.**




(*R*)-**3i**

Following the *General Procedure B,* (*R*)-**3i** was obtained as white solid (24 h, 48.2 mg, 90% yield, 87% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -7.3 (*c* 1.0, $CHCl_3$); m.p. 203-205 °C; **HRMS (ESI-TOF)** calcd for $C_{33}H_{26}NO_4S$ $[M - H]^-$ : 532.1588 , found: 532.1587; **$^1$H NMR** (600 MHz, acetone-$d^6$, ppm): $\delta$ 9.30 (br, 1H), 8.01 (br, 1H), 7.83-7.75 (m, 1H), 7.61-7.56 (m, 2H), 7.50 (d, 2H, *J* = 8.0 Hz), 7.46 (d, 1H, *J* = 7.6 Hz), 7.20 (d, 1H, *J* = 8.0 Hz), 7.18 (d, 2H, *J* = 8.8 Hz), 7.11-7.03 (m, 4H), 6.95 (d, 2H, *J* = 8.0 Hz), 6.90 (t, 1H, *J* = 7.6 Hz), 6.85 (d, 1H, *J* = 7.6 Hz), 6.58-6.40 (m, 2H), 6.26 (s, 1H), 2.06 (s, H), 2.01 (s, 3H); **$^{13}$C NMR** (150 MHz, acetone-$d^6$, ppm): $\delta$ 154.1, 153.4, 152.5, 143.6, 139.8, 137.2, 136.5, 132.8, 129.9, 129.5, 129.5, 128.3, 128.2, 127.8, 127.2, 126.7, 126.2, 125.9, 125.4, 124.8, 124.3, 122.9, 122.8, 120.2, 118.3, 117.7, 115.8, 111.1, 37.7, 20.7, 20.5; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 8.1 min (minor), $t_R$ = 10.0 min (major).

**(*R*)-N-(2-((2-hydroxynaphthalen-1-yl)(3-methoxyphenyl)methyl)benzofuran-3-yl-4-methylbenzenesulfonamide.**

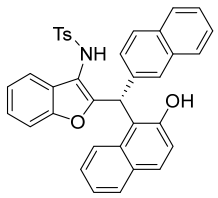



(*R*)-**3j**

Following the *General Procedure B,* (*R*)-**3j** was obtained as white solid (12 h, 53.8 mg, 98% yield, 88% ee) after flash chromatography (elution gradient: ethyl

acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -8.2 (*c* 1.0, $CHCl_3$); m.p. 120-122 °C; **HRMS (ESI-TOF)** calcd for $C_{33}H_{26}NO_5S$ $[M - H]^-$ : 548.1537, found: 548.1539; **$^1$H NMR** (600 MHz, acetone-$d^6$, ppm): $\delta$ 9.30 (br, 1H), 8.02 (br 1H), 7.85-7.79 (m, 1H), 7.61-7.57 (m, 2H), 7.49 (d, 2H, *J* = 8.4 Hz), 7.46-7.42 (m, 1H), 7.22 (d, 1H, *J* = 8.4 Hz), 7.18 (d, 2H, *J* = 8.8 Hz), 7.11-7.04 (m, 4H), 6.95 (t, 3H, *J* = 8.0 Hz), 6.62 (dd, 1H, *J* = 2.4, 8.0 Hz), 6.29 (s, 1H), 6.25 (dd, 1H, *J* = 2.4, 7.6 Hz), 6.22 (s, 1H), 3.52 (s, 3H), 2.03 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 159.6, 153.9, 152.5, 143.7, 141.4, 136.4, 132.8, 129.9, 129.5, 128.9, 128.3, 127.2, 126.1, 25.8, 125.5, 124.4, 122.9, 122.8, 120.14, 120.07, 118.2, 117.7, 115.8, 114.3, 111.1, 110.6, 54.4, 37.7, 20.5; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 7.2 min (minor), $t_R$ = 8.2 min (major).

**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(naphthalen-2-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

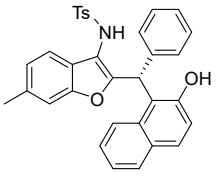


(*R*)-**3k**

Following the *General Procedure A*, (*R*)-**3k** was obtained as white solid (36 h, 52.8 mg, 87% yield, 94% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -4.5 (*c* 1.0, $CHCl_3$); m.p. 198-200 °C; **HRMS (ESI-TOF)** calcd for $C_{36}H_{26}NO_4S$ $[M - H]^-$ : 568.1588, found: 568.1587; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.70 (br, 1H), 8.24 (br, 1H), 7.94 (d, 1H, *J* = 8.6 Hz), 7.88-7.83 (m, 1H), 7.78 (d, 1H, *J* = 9.0 Hz), 7.75 (d, 2H, *J* = 8.6 Hz), 7.72-7.60 (m, 4H), 7.51-7.44 (m, 2H), 7.43-7.34 (m,2H), 7.31-7.22 (m, 3H), 7.21-7.10 (m, 2H), 6.93 (d, 2H, *J* = 7.9 Hz), 6.88 (dd, 1H, *J* = 1.4, 8.6 Hz), 6.55 (s, 1H), 1.62 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 153.8, 153.6, 152.6, 143.7, 137.6, 136.0, 133.3, 132.8, 132.16, 129.9, 129.7, 129.4, 128.4, 127.8, 127.4, 127.7, 126.04, 126.02, 125.8, 125.5, 124.4, 123.0, 122.8, 120.3, 118.0, 117.6, 115.9, 111.3, 37.8, 19.9; HPLC

analysis: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 8.2 min (minor), $t_R$ = 9.1 min (major).

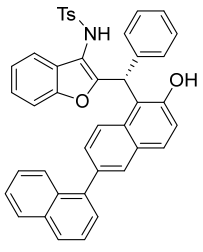
**(*R*)-*N*-(2-((2-hydroxynaphthalen-1-yl)(phenyl)methyl)-6-methylbenzofuran-3-yl)-4-methylbenzenesulfonamide.**




(*R*)-**3l**

Following the *General Procedure A*, (*R*)-**3l** was obtained as white solid (36h, 43.6 mg, 82% yield, 91% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/10; $[\alpha]_D^{20}$ = -6.5 (*c* 1.0, $CHCl_3$); m.p. 202-203 °C; **HRMS (ESI-TOF)** calcd for $C_{33}H_{26}NO_4S$ $[M - H]^-$ : 532.1588, found: 532.1587; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.42 (br, 1H), 8.03 (br, 1H), 7.81-7.72 (m,1H), 7.66-7.56 (m, 2H), 7.49 (d, 2H, *J* = 8.4 Hz), 7.2 (d, 1H, *J* = 8.1 Hz), 7.20 (d, 1H, *J* = 8.9 Hz), 7.11-7.00 (m, 6H), 6.96 (d, 2H, *J* = 8.1 Hz), 6.90 (d, 1H, *J* = 8.1 Hz), 6.70-6.56 (m, 2H), 6.28 (s, 1H), 2.24 (s, 1H), 2.02 (s, 1H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 153.8, 152.5, 143.7, 139.9, 136.3, 134.6, 132.7, 129.9, 129.6, 129.5, 128.3, 127.9, 127.6, 127.1, 126.0, 125.9, 125.3, 124.2, 123.5, 122.7, 119.7, 118.3, 117.7, 115.8, 111.3, 37.5, 20.59, 20.56; **HPLC analysis**: Daicel CHIRALPAK OD-H, *n*-hexane/*i*-PrOH = 96/4, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 11.4 min (minor), $t_R$ = 13.2 min (major).

**(*R*)-*N*-(2-((6'-hydroxy-[1,2'-binaphthalen]-5'-yl)(phenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

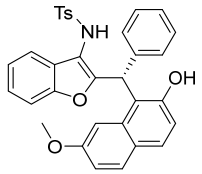



(*R*)-**3m**

Following the *General Procedure A*, (*R*)-**3m** was obtained as white solid (20 h, 63.2

mg, 92% yield, 95% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -11.3 (*c* 1.0, $CHCl_3$); m.p. 219-220 °C; **HRMS (ESI-TOF)** calcd for $C_{42}H_{30}NO_4S$ $[M - H]^-$ : 644.1901 , found: 644.1898. **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.60 (s, 1H), 8.26 (s, 1H), 8.07 (d, 1H, *J* = 8.9 Hz), 7.94 (dd, 2H, *J* = 8.1, 19.9 Hz), 7.89-7.80 (m, 3H), 7.67 (d, 2H, *J* = 8.4 Hz), 7.62-7.48 (m, 3H), 7.47-7.35 (m, 5H), 7.87-7.16 (m, 5H), 7.13 (d, 2H, *J* = 8.1 Hz), 6.95-6.85 (m, 3H), 6,53 (s, 1H), 2.18 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 154.1, 153.4, 152.9, 143.8, 139.8, 136.5, 135.0, 134.0, 131.9, 131.6, 129.9, 129.6, 129.2, 128.3, 128.0, 127.7, 127.6, 127.2, 127.1, 126.1, 126.15, 126.09, 125.8, 125.7, 125.6, 125.5, 124.4, 122.9, 120.1, 118.3, 118.2, 115.8, 111.2, 37.9, 20.6; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 7.0 min (minor), $t_R$ = 7.9 min (major).

**(*R*)-*N*-(2-((2-hydroxy-7-methoxynaphthalen-1-yl)(phenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

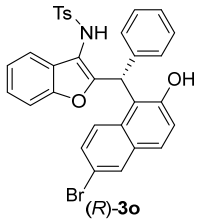



(*R*)-**3n**

Following the *General Procedure A*, (*R*)-**3n** was obtained as white solid (40 h, 53.6 mg, 90% yield, 91% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -18.6 (*c* 1.0, $CHCl_3$); m.p. 201-203 °C; **HRMS (ESI-TOF)** calcd for $C_{33}H_{27}NO_5S$ $[M - H]^-$ : 548.1537, found: 548.1538; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.43 (br, 1H), 8.03 (br, 1H), 7.52-7.44 (m, 5H), 7.26 (d, 1H, *J* = 7.9 Hz), 7.14 (s, 1H), 7.11-7.01 (m, 6H), 6.93 (d, 2H, *J* = 8.1 Hz), 6.72-6.64 (m, 3H), 6.27 (s, 1H), 3.38 (s, 3H), 1.97 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 157.3, 154.1, 153.4, 153.1, 143.8, 139.8, 136.1, 134.0, 129.6, 129.2, 127.9, 127.6, 127.1, 126.0, 125.8, 125.1, 124,4, 123.0, 120.1, 117.6, 115.9, 115.4, 114.9, 111.2, 105.3, 54.3, 37.5, 20.5; **HPLC analysis**: Daicel CHIRALPAK AD-H, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time:

$t_R$ = 9.8 min (minor), $t_R$ = 11.3 min (major).

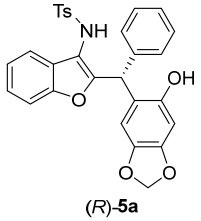
**(*R*)-*N*-(2-((6-bromo-2-hydroxynaphthalen-1-yl)(phenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**



(*R*)-**3o**

Following the *General Procedure A*, (*R*)-**3o** was obtained as white solid (41 h, 57.2 mg, 91% yield, 91% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/5); $[\alpha]_D^{20}$ = -1.6 (*c* 1.0, $CHCl_3$); m.p. 206-208 °C; **HRMS (ESI-TOF)** calcd for $C_{32}H_{23}BrNO_4S$ $[M - H]^-$: 596.1537, found: 596.157; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.73 (br, 1H), 8.22 (br, 1H), 7.97 (d, 1H, *J* = 2.2 Hz), 7.85 (d, 1H, *J* = 9.3 Hz), 7.76 (d, 1H, *J* = 8.9 Hz), 7.65 (d, 2H, *J* = 8.3 Hz), 7.55 (dd, 1H, *J* = 0.6, 7.5 Hz), 7.40 (d, 2H, *J* = 8.9 Hz), 7.32 (dd, 1H, *J* = 2.2, 9.3 Hz), 7.28-7.24 (m, 1H), 7.22-7.18 (m, 4H), 7.12 (d, 2H, *J* = 8.1 Hz), 6.81-6.79 (m, 2H), 6.50 (s, 1H), 2.18 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 153.8, 153.4, 153.2, 143.7, 140.0, 136.5, 131.3, 131.1, 130.2, 130.0, 128.8, 128.3, 128.1, 127.6, 127.2, 126.08, 126.05, 124.5, 122.9, 120.1, 119.0, 118.6, 116.0, 116.0, 111.2, 37.6, 20.6; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 6.0 min (minor), $t_R$ = 6.7 min (major).

**(*R*)-*N*-(2-((5-hydroxybenzo[*d*][1,3]dioxol-4-yl)(phenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

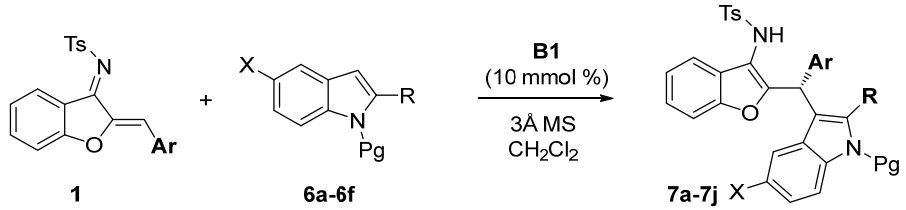


(*R*)-**5a**

Following the *General Procedure B,* (*R*)-**5a** was obtained as white solid (24 h, 42.6 mg, 82% yield, 84% ee) after flash chromatography (elution gradient: ethyl

acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -13.9 (*c* 1.0, $CHCl_3$); m.p. 198-200 °C; **HRMS (ESI-TOF)** calcd for $C_{29}H_{22}NO_6S$ $[M - H]^-$ : 512.1173 , found: 512.1174; **$^1$H NMR** (600 MHz, acetone-$d^6$, ppm): $\delta$ 8.29 (br, 1H), 8.23 (br, 1H), 7.44 (d, 2H, *J* = 8.3 Hz), 7.32-7.28 (m, 2H), 7.13-7.07 (m, 2H), 7.05-7.01 (m, 2H), 6.97 (d, 2H, *J* = 8.0 Hz), 6.93 (d, 2H, *J* = 7.4 Hz), 6.42 (s, 1H), 6.33 (s, 1H), 5.80 (s, 1H), 5.74-5.73 (m, 2H), 2.13 (s, 3H); **$^{13}$C NMR** (150 MHz, acetone-$d^6$, ppm): $\delta$ 154.7, 153.5, 149.0, 146.7, 143.4, 140.8, 137.0, 129.4, 128.5, 127.9, 127.2, 126.3, 126.2, 124.3, 122.8, 120.1, 119.3, 114.4, 111.1, 108.7, 101.0, 97.6, 39.8, 20.6; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 11.6 min (minor), $t_R$ =14.5 min (major).

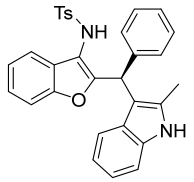
## 5 General Procedure for the Asymmetric Friedel-Crafts Heteroarylation




**7a-7i**: Pg = H, (-10 to -60 °C, 10-64 h)
**7j**: Pg = Me, R = Me, X = H, (20 °C, 64 h)

**General Procedure C:** Under argon atmosphere, 1-azadienes **1** (0.1 mmol), indole derivatives **6** (0.12 mmol), the chiral phosphoric acid **B1** (10 mmol %) and 3Å MS (50 mg) were added in the solution of $CH_2Cl_2$ (1 mL). The reaction mixture was allowed to stir at the indicated temperature for 10 ~ 64 h. Then, the reacting mixture was directly purified by silica gel chromatography with the elution of ethyl acetate/petroleum ether = 1/4 to 1/3, affording the desired products **7**.

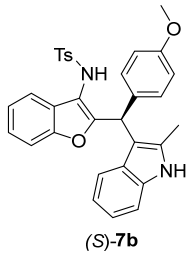
**(*S*)-4-methyl-*N*-(2-((2-methyl-1H-indol-3-yl)(phenyl)methyl)benzofuran-3-yl)ben zenesulfonamide.**




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

Following the *General Procedure C,* (*S*)-**7a** was obtained as yellow solid (-10 ºC, 10 h, 49.6 mg, 98% yield, 92% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/3); $[\alpha]_D^{20}$ = -5.7 (*c* 1.0, $CHCl_3$); m.p. 108-110 ºC; **HRMS (ESI-TOF)** calcd for $C_{31}H_{26}NaN_2O_3S$ $[M + Na]^+$ : 529.1556 , found: 529.1556; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.85 (br, 1H), 8.51 (br, 1H), 7.54 (d, 2H, *J* = 8.1 Hz), 7.22 (d, 2H, *J* = 8.3 Hz), 7.17 (d, 2H, *J* = 8.1 Hz), 7.13-7.06 (m, 4H), 7.04-6.96 (m, 6H), 6.94-6.90 (m, 1H), 6.85-6.81 (m, 1H), 6.72-6.68 (m, 1H), 5.94 (s, 1H), 2.17 (s, 3H), 2.16 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 156.6, 152.9, 143.5, 141.2, 137.9, 135.7, 133.1, 129.4, 128.3, 128.1, 127.9, 127.3, 126.3, 126.1, 124.1, 122.7, 120.3, 119.4, 119.3, 118.6, 113.9, 111.1, 110.3, 109.8, 38.3, 20.5, 11.4; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 6.3 min (majorr), $t_R$ =7.9 min (minor).

**(*S*)-*N*-(2-((4-methoxyphenyl)(2-methyl-1H-indol-3-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**

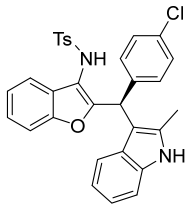



(*S*)-**7b**

Following the *General Procedure C,* (*S*)-**7b** was obtained as yellow solid (-10 ºC, 10 h, 52.5 mg, 98% yield, 93% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/3); $[\alpha]_D^{20}$ = -9.2 (*c* 1.0, $CHCl_3$); m.p. 141-143 ºC; **HRMS (ESI-TOF)** calcd for $C_{32}H_{28}NaN_2O_4S$ $[M + Na]^+$ : 559.1662 , found: 559.1662; **$^1$H**

**NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.85 (br, 1H), 8.52 (s, 1H), 7.53 (d, 2H, $J$ = 8.3 Hz), 7.23-7.20 (m, 2H), 7.12 (d, 1H, $J$ = 8.0 Hz), 7.03-6.98 (m, 5H), 6.92-6.89 (m, 1H), 6.85-6.81 (m, 1H), 6.73-6.69 (m, 1H), 6.63-6.56 (m, 3H), 5.92 (s, 1H), 3.53 (s, 3H), 2.16 (s, 6H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 159.7, 156.6, 152.9, 143.5, 142.8, 137.9, 135.7, 133.1, 129.4, 128.8, 128.1, 127.2, 126.3, 124.1, 122.7, 120.7, 120.3, 119.4, 119.3, 118.6, 114.9, 113.9, 111.1, 110.9, 110.3, 109.7, 54.4, 38.3, 20.5, 11.4; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 7.3 min (major), $t_R$ =8.7 min (minor).

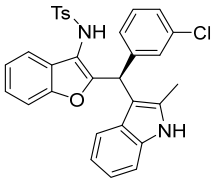
**(*S*)-*N*-(2-((4-chlorophenyl)(2-methyl-1H-indol-3-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**




(*S*)-**7c**

Following the *General Procedure C,* (*S*)-**7c** was obtained as yellow solid (-10 °C, 10 h, 52.8 mg, 98% yield, 90% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/3); $[\alpha]_D^{20}$ = -4.6 (*c* 1.0, $CHCl_3$); m.p. 120-122 °C; **HRMS (ESI-TOF)** calcd for $C_{31}H_{25}ClNaN_2O_3S$ $[M + Na]^+$ : 563.1167 , found: 563.1164; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.88 (br, 1H), 8.57 (s, 1H), 7.53 (d, 2H, $J$ = 8.4 Hz), 7.21 (d, 1H, $J$ = 8.2 Hz), 7.16-7.11 (m, 4H), 7.05-6.99 (m, 4H), 6.96 (d, 2H, $J$ = 8.4 Hz), 6.93-6.89 (m, 1H), 6.85-6.81 (m, 1H), 6.73-6.69 (m, 1H), 5.93 (s, 1H), 2.16 (s, 3H), 2.15 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 156.0, 153.0, 143.6, 140.2, 137.8, 135.7, 133.2, 131.5, 130.0, 129.5, 128.0, 127.9, 127.3, 126.2, 124.3, 122.8, 120.5, 119.4, 119.1, 118.8, 114.1, 111.2, 110.4, 109.4, 37.8, 20.6, 11.4; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 5.4 min (major), $t_R$ = 6.4 min (minor).

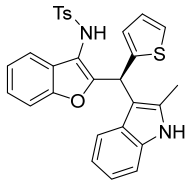
**(*S*)-*N*-(2-((3-chlorophenyl)(2-methyl-1H-indol-3-yl)methyl)benzofuran-3-yl)-4-methylbenzenesulfonamide.**




(*S*)-**7d**

Following the *General Procedure C,* (*S*)-**7d** was obtained as yellow solid (-10 ºC, 10 h, 53.4 mg, 98% yield, 95% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/3); $[\alpha]_D^{20}$ = -15.1 (*c* 1.0, $CHCl_3$); m.p. 145-147 ºC; **HRMS (ESI-TOF)** calcd for $C_{31}H_{25}ClNaN_2O_3S$ $[M + Na]^+$ : 563.1167 , found: 563.1166; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.92 (br, 1H), 8.61 (s, 1H), 7.55 (d, 2H, *J* = 8.1 Hz), 7.24 (d, 1H, *J* = 8.1 Hz), 7.18-7.07 (m, 4H), 7.05-7.01 (m, 4H), 6.96-6.91 (m, 3H), 6.86-6.83 (m, 1H), 6.74-6.71 (m, 1H), 5.94 (s, 1H), 2.18 (s, 3H), 2.15 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 155.7, 153.0, 143.8, 143.6, 137.8, 135.7, 133.4, 133.3, 129.6, 129.5, 128.2, 127.8, 126.9, 126.3, 126.2, 124.3, 122.8, 120.5, 119.5, 119.1, 118.8, 114.3, 111.2, 110.5, 109.1, 38.1, 20.6, 11.4; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 5.4 min (major), $t_R$ = 6.6 min (minor).

**(*S*)-4-methyl-*N*-(2-((2-methyl-1H-indol-3-yl)(thiophen-2-yl)methyl)benzofuran-3-yl)benzenesulfonamide.**

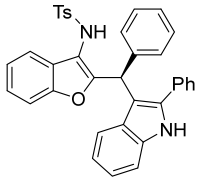



(*S*)-**7e**

Following the *General Procedure C,* (*S*)-**7e** was obtained as yellow solid (-60 ºC, 20 h, 45.3 mg, 88% yield, 92% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/3); $[\alpha]_D^{20}$ = +6.0 (*c* 1.0, $CHCl_3$); m.p. 128-130 ºC; **HRMS (ESI-TOF)** calcd for $C_{29}H_{24}NaN_2O_3S_2$ $[M + Na]^+$ : 535.1121 , found: 535.1118; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.89 (br, 1H), 8.52 (s, 1H), 7.53 (d, 2H, *J* = 8.3

Hz), 7.39 (d, 1H, *J* = 8.0 Hz), 7.26 (d, 1H, *J* = 8.1 Hz), 7.13-7.11 (m, 2H), 7.07-7.03 (m, 3H), 6.95-6.94 (m, 1H), 6.92-6.88 (m, 1H), 6.86-6.83 (m, 1H), 6.77-6.74 (m, 2H), 6.59-6.56 (m, 1H), 6.14 (s, 1H), 2.26 (s, 3H), 2.17 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 156.0, 152.9, 145.3, 143.6, 137.8, 135.6, 133.0, 129.5, 127.7, 127.2, 126.2, 126.1, 125.4, 124.3, 124.2, 122.7, 120.4, 119.33, 119.30, 118.7, 113.4, 111.2, 110.3, 110.2; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 6.7 min (major), $t_R$ = 8.3 min (minor).

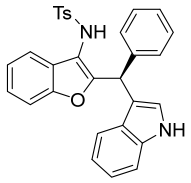
**(*S*)-4-methyl-*N*-(2-(phenyl(2-phenyl-1H-indol-3-yl)methyl)benzofuran-3-yl)-benzenesulfonamide.**




(*S*)-**7f**

Following the *General Procedure C,* (*R*)-**7f** was obtained as yellow solid (-40 ºC, 64 h, 51.1 mg, 90% yield, 89% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = +13.5 (*c* 1.0, $CHCl_3$); m.p. 126-128 ºC; **HRMS (ESI-TOF)** calcd for $C_{29}H_{24}NaN_2O_3S_2$ $[M + Na]^+$ : 591.1713 , found: 591.1709; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 10.31 (br, 1H) $\delta$ 8.11 (s, 1H), 7.53-7.51 (m, 2H), 7.41-7.37 (m, 3H), 7.35-7.32 (m, 3H), 7.27-7.21 (m, 2H), 7.06-7.03 (m, 5H), 7.00-6.98 (m, 2H), 6.94-6.91 (m, 2H), 6.86-6.95 (m, 2H), 6.76-6.93 (m, 1H), 5.84 (s, 1H), 2.17 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 156.5, 152.9, 143.5, 141.2, 137.6, 136.8, 136.7, 132.8, 129.5, 128.7, 128.3, 128.1, 127.9, 127.8, 127.3, 126.3, 126.2, 124.2, 122.7, 121.6, 121.1, 119.4, 119.2, 114.1, 111.2, 111.1, 110.8, 38.8, 20.6; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 6.7 min (major), $t_R$ = 8.0 min (minor).

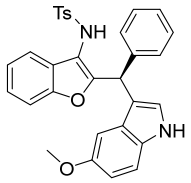
**(*S*)-*N*-(2-((1H-indol-3-yl)(phenyl)methyl)benzofuran-3-yl)-4-methylbenzenesulf-onamide.**




(*S*)-**7g**

Following the *General Procedure C,* (*S*)-**7g**[4] was obtained as pink solid (-20 ºC, 12 h, 48.7 mg, 99% yield, 96% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -11.1 (*c* 1.0, $CHCl_3$); $[\alpha]_D^{20}$ = +13.5 (*c* 1.0, ethyl acetate); m.p. 109-111 ºC; **HRMS (ESI-TOF)** calcd for $C_{30}H_{24}KN_2O_3S$ $[M + K]^+$ : 531.1139 , found: 512.1133; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.98 (br, 1H), 8.68 (s, 1H), 7.47 (d, 2H, *J* = 8.2 Hz), 7.30- 7.24 (m, 3H), 7.08-7.00 (m, 8H), 6.94 (t, 1H, *J* = 7.5 Hz), 6.89(d, 2H, *J* = 8.0 Hz), 6.82 (d, 1H, *J* = 1.9 Hz), 6.77 (t, 1H, *J* = 7.5 Hz), 5.73 (s, 1H), 2.03 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 155.4, 153.3, 143.5, 141.1, 137.4, 136.8, 129.4, 128.5, 128.0, 127.2, 126.8, 126.4, 124.2, 123.7, 122.7, 121.4, 120.1, 119.2, 118.7, 114.9, 113.5, 111.4, 111.1, 39.2, 20.5; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 15.6 min (major), $t_R$ = 17.9 min (minor).

**(*S*)-*N*-(2-((5-methoxy-1H-indol-3-yl)(phenyl)methyl)benzofuran-3-yl)-4-methyl-benzenesulfonamide.**

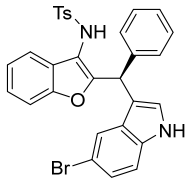



(*S*)-**7h**

Following the *General Procedure C,* (*S*)-**7h** was obtained as white solid (-20 ºC, 12 h, 51.4 mg, 98% yield, 93% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -7.9 (*c* 1.0, $CHCl_3$); m.p. 127-129 ºC; **HRMS (ESI-TOF)** calcd for $C_{31}H_{26}N_2NaO_4S$ $[M + Na]^+$ : 545.1505 , found: 545.1506; **$^1$H**

**NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 9.81 (br, 1H), 8.62 (s, 1H), 7.47 (d, 2H, $J$ = 8.3 Hz), 7.24-7.21 (m, 2H), 7.16-7.03 (m, 7H), 6.99-6.95 (m, 1H), 6.89 (d, 2H, $J$ = 8.1 Hz), 6.78 (d, 1H, $J$ = 2.4 Hz), 6.62-6.59 (m, 2H), 5,71 (s, 1H), 3.50 (s, 3H), 2.03 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 155.7, 153.8, 153.3, 143.5, 141.1, 137.5, 131.9, 129.4, 128.6, 128.0, 127.2, 126.4, 124.4, 124.2, 122.7, 119.9, 114.6, 113.6, 112.0, 111.4, 111.1, 101.3, 54.9, 39.2, 20.5; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 85/15, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 14.6 min (major), $t_R$ = 16.6 min (minor).

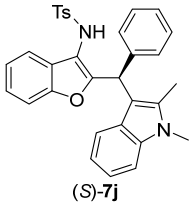
**(*S*)-*N*-(2-((5-bromo-1H-indol-3-yl)(phenyl)methyl)benzofuran-3-yl)-4-methyl-benzenesulfonamide.**



(*S*)-**7i**

Following the *General Procedure C,* (*S*)-**7i** was obtained as yellow solid (12 h, 54.7 mg, 96% yield, 94% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/4); $[\alpha]_D^{20}$ = -13.3 (*c* 1.0, $CHCl_3$); m.p. 137-139 °C; **HRMS (ESI-TOF)** calcd for $C_{30}H_{23}BrN_2NaO_3S$ $[M + Na]^+$ : 593.0503 , found: 593.0508; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 10.18 (br, 1H), 8.68 (s, 1H), 7.46 (d, 2H, $J$ = 7.9 Hz), 7.29-7.22 (m, 4H), 7.08-7.04 (m, 7H), 7.01-6.97 (m, 1H), 6.01-6.85 (m, 3H), 5.71 (s, 1H), 2.00 (s, H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 155.0, 153.3, 143.5, 140.8, 137.4, 135.4, 129.3, 128.6, 128.4, 128.2, 127.2, 126.7, 126.4, 125.5, 124.3, 124.1, 122.8, 121.6, 120.1, 114.7, 113.7, 113.3, 111.8, 111.1, 39.0, 20.5; **HPLC analysis**: Daicel CHIRALPAK IA, *n*-hexane/*i*-PrOH = 80/20, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 8.1 min (major), $t_R$ = 9.8 min (minor).

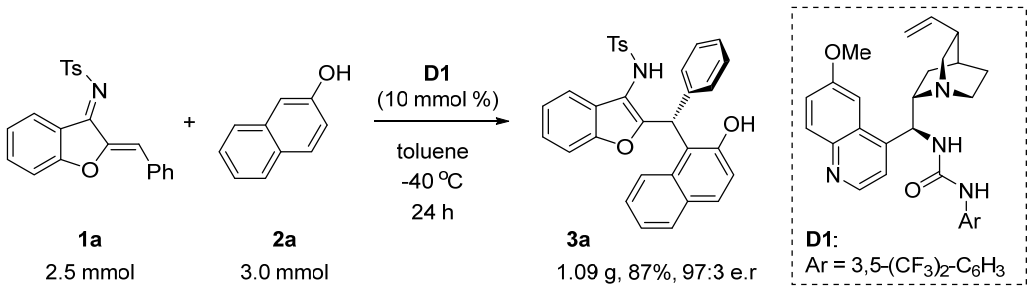
**(*S*)-*N*-(2-((1,2-dimethyl-1H-indol-3-yl)(phenyl)methyl)benzofuran-3-yl)-4-meth-ylbenzenesulfonamide**




(*S*)-**7j**

Following the *General Procedure C,* (*S*)-**7j** was obtained as white solid (64 h, 44.2 mg, 85% yield, 29% ee) after flash chromatography (elution gradient: ethyl acetate/petroleum ether = 1/3); $[\alpha]_D^{20}$ = -8.3 (*c* 1.0, $CHCl_3$); m.p. 126-128 °C; **HRMS (ESI-TOF)** calcd for $C_{32}H_{26}NaN_2O_3S$ $[M + Na]^+$ : 543.1748 , found: 543.1750; **$^1$H NMR** (400 MHz, acetone-$d^6$, ppm): $\delta$ 8.45 (s, 1H), 7.53 (d, 2H, *J* = 8.13 Hz), 7.20 (t, 2H, *J* = 7.2 Hz), 7.12 (d, 1H, *J* = 8.3 Hz), 7.07-7.00 (m, 6H), 6.95 (d, 3H, *J* = 8.0 Hz), 6.88 (t, 2H, *J* = 7.2 Hz), 6.71 (t, 2H, *J* = 7.4 Hz), 6.00 (s, 1H), 3.50 (s, 3H), 2.20 (s, 3H), 2.14 (s, 3H); **$^{13}$C NMR** (100 MHz, acetone-$d^6$, ppm): $\delta$ 156.8, 152.9, 143.5, 141.2, 138.0, 136.9, 134.6, 129.5, 128.2, 127.9, 127.3, 127.2, 126.3, 126.1, 124.1, 122.7, 120.3, 119.5, 119.3, 118.6, 114.0, 111.1, 109.7, 108.7, 38.5, 28.9, 20.6, 10.0; **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 85/15, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 10.9 min (minor), $t_R$ = 12.3 min (major).

## 6 General Procedure for the Gram-Scale Syntheses



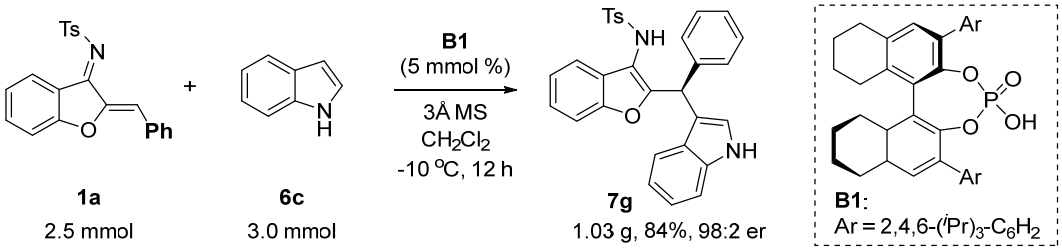

**1a** 2.5 mmol

**2a** 3.0 mmol

**3a** 1.09 g, 87%, 97:3 e.r

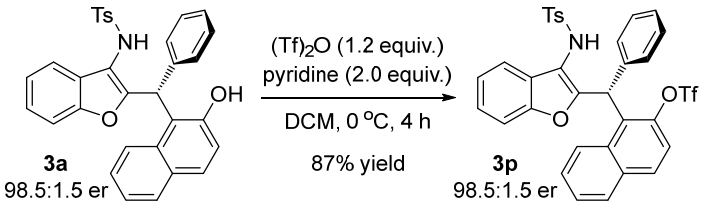
**General Procedure for the Gram-Scale Synthesis of 3a:** Under argon atmosphere, 1-azadienes **1a** (0.938 g, 2.5 mmol), *β*-naphthol **2a** (0.433 g, 3.0 mmol) and the chiral urea catalyst **D1** (144.5 mg, 10 mmol %) was dissolved in toluene (50 mL) at -40 °C. The reaction mixture was allowed to stir at -40 °C for 24 h. Then, the reacting mixture was concentrated, and the residues were purified by silica gel chromatography (ethyl

acetate/petroleum ether =1/5) to yield the desired product **3a** (1.09 g) in 87% yield and 97:3 er. **HPLC analysis**: Daicel CHIRALCEL OD-H, *n*-hexane/*i*-PrOH = 85/15, flow rate = 1.0 mL/min, λ = 230 nm, retention time: $t_R$ = 5.3 min (major), $t_R$ = 6.3 min (minor).




**General Procedure for the Gram-Scale Synthesis of 7g:** Under argon atmosphere, the solution of *α,β*-unsaturated imine **1a** (0.938 g, 2.5 mmol) and indole derivatives **6c** (0.351 g, 3.0 mmol) in $CH_2Cl_2$ (50 mL)was added 3Å MS (1.25 g) and chiral phosphoric acid **B1** (95.5 mg, 5 mmol %). The reaction mixture was allowed to stir at -10 °C for 12 h. Then, the reacting mixture was concentrated, and the residues were purified by silica gel chromatography (ethyl acetate/petroleum ether =1/3) to yield the desired product **7g** (1.03 g) in 84% yield and 98:2 er. **HPLC analysis**: Daicel CHIRALPAK IC, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 15.5 min (major), $t_R$ =17.7 min (minor).

## 7 General Procedure of the Protection for 3a




Under argon atmosphere, Trifluoromethanesulfonic anhydride (0.12 mmol) was added to solution of **3a** (0.1 mmol, 98.5:1.5 er, after once recrystallization from the gram-scale synthesis) and pyridine (0.2 mmol) in DCE (2 mL) at ice bath. When the reaction finish, the rsolution was then quenched with 10% HCl and extracted with

DCE. The combined organic phases were dried over $Na_2SO_4$ and concentrated. The residue was purified by flash chromatography on silica gel with the elution of DCM:petroleum ether = 1:1 to afford **3p** as white solid (4 h, 74.8 mg, 87% yield, 97% ee)**.**

**(*R*)-1-((3-((4-methylphenyl)sulfonamido)benzofuran-2-yl)(phenyl)methyl)naphthalen-2-yl trifluoromethanesulfonate (3p):** $[\alpha]_D^{20}$ = -12.6 (*c* 1.0, $CHCl_3$); m.p. 232-234 °C; **HRMS (ESI-TOF)** calcd for $C_{32}H_{23}F_3NO_6S_2$ $[M - H]^-$ : 650.0997, found: 650.0836; **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): $\delta$ 8.12 (d, 1H, *J* = 8.8 Hz), 7.86 (d, 1H, *J* = 9.2 Hz) 7.82 (d, 1H, *J* = 8.2 Hz), 7.65 (d, 2H, *J* = 8.2 Hz), 7.50-7.36 (m, 4H), 7.29-7.13 (m, 6H), 6.98 (d, 2H, *J* = 7.9 Hz), 6.78 (d, 2H, *J* = 7.2 Hz), 6.45 (s, 1H), 6.31 (s, 1H), 2.21 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): $\delta$ 153.4, 152.2, 146.4, 143.8, 139.0, 136.1, 133.3, 131.0, 129.5, 128.6, 128.3, 128.1, 127.6, 127.5, 127.4, 126.9, 126.7, 126.6, 125.8, 124.9, 123.4, 120.1, 118.1, 116.9, 115.7, 111.7, 39.5, 21.5, **$^{19}$F NMR** (376 MHz, $CDCl_3$, ppm): -73.4, **HPLC analysis**: Daicel CHIRALCEL AD-H, *n*-hexane/*i*-PrOH = 90/10, flow rate = 1.0 mL/min, λ = 254 nm, retention time: $t_R$ = 30.8 min (major), $t_R$ = 27.6 min (minor).

## 8 Assignment of Absolute Configuration for Products

**Experimental:** Single crystals of $C_{32}H_{25}NO_4S$ (**3a**) were obtained from *n*-Hexanes and DCM. A suitable crystal was selected and measured on a diffractometer. The crystal was kept at 298(2) K during data collection.

**Crystal Data** for $C_{32}H_{25}NO_4S$ (**3a**) (*M* = 519.59 g/mol): orthorhombic, space group $P2_12_12_1$ (no. 19), *a* = 9.778(7) Å, *b* = 15.230(11) Å, *c* = 17.325(12) Å, *V* = 2580(3) Å$^3$, *Z* = 4, *T* = 298(2) K, μ(MoKα) = 0.165 mm$^{-1}$, *Dcalc* = 1.338 g/cm$^3$, 14848 reflections measured (3.56° ≤ 2Θ ≤ 50.298°), 4625 unique ($R_{int}$ = 0.0511, $R_{sigma}$ = 0.0546) which were used in all calculations. The final $R_1$ was 0.0432 (I > 2σ(I)) and $wR_2$ was 0.1137 (all data).

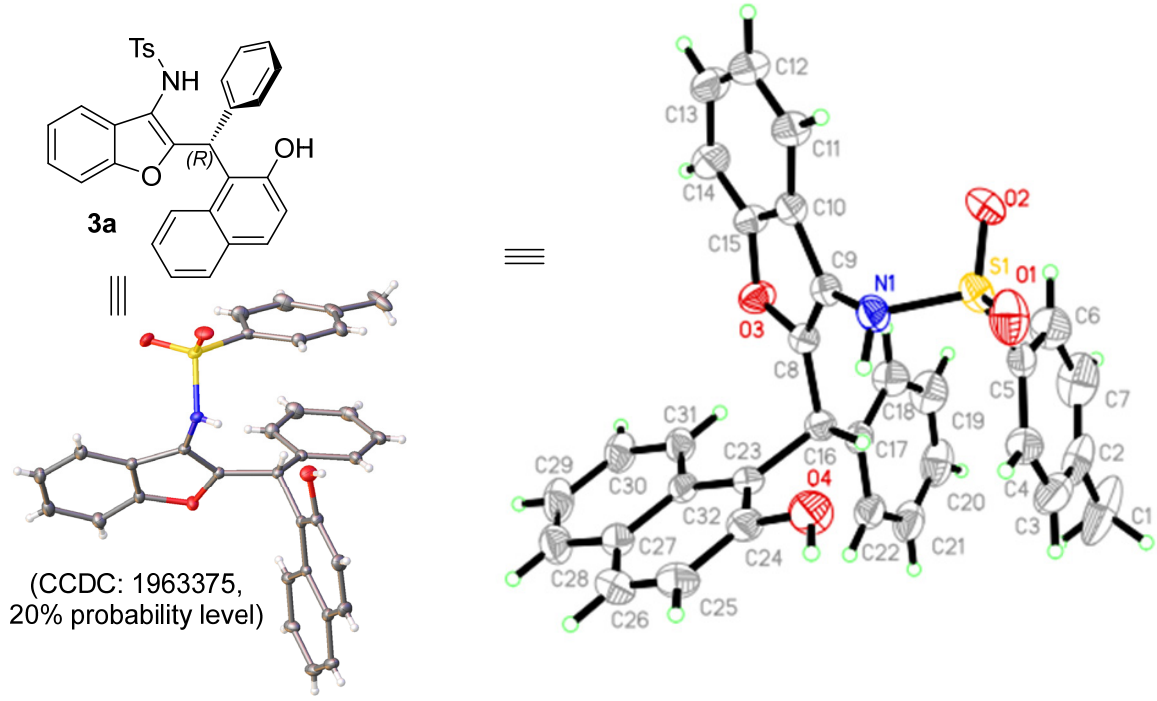



**Figure S2.** View of **3a**.

**Table S4.** Crystal data and structure refinement for **3a.**

| | |
|---|---|
| Identification code | **3a** |
| Empirical formula | $C_{32}H_{25}NO_4S$ |
| Formula weight | 519.59 |
| Temperature/K | 298(2) |
| Crystal system | orthorhombic |
| Space group | $P2_12_12_1$ |
| a/Å | 9.778(7) |
| b/Å | 15.230(11) |
| c/Å | 17.325(12) |
| α/° | 90 |
| β/° | 90 |
| γ/° | 90 |
| Volume/Å$^3$ | 2580(3) |
| Z | 4 |

| | |
|---|---|
| ρ calcg/$cm^3$ | 1.338 |
| μ/$mm^{-1}$ | 0.165 |
| F(000) | 1088.0 |
| Crystal size/$mm^3$ | 0.350 × 0.310 × 0.250 |
| Radiation | MoKα (λ = 0.71073) |
| 2Θ range for data collection/° | 3.56 to 50.298 |
| Index ranges | -10 ≤ h ≤ 11, -18 ≤ k ≤ 18, -20 ≤ l ≤ 17 |
| Reflections collected | 14848 |
| Independent reflections | 4625 [$R_{int}$ = 0.0511, $R_{sigma}$ = 0.0546] |
| Data/restraints/parameters | 4625/0/346 |
| Goodness-of-fit on $F^2$ | 0.976 |
| Final R indexes [I>=2 σ (I)] | $R_1$ = 0.0432, $wR_2$ = 0.0956 |
| Final R indexes [all data] | $R_1$ = 0.0735, $wR_2$ = 0.1137 |
| Largest diff. peak/hole / e $Å^{-3}$ | 0.14/-0.22 |
| **Flack parameter** | **0.02(12)** |

# 9 References

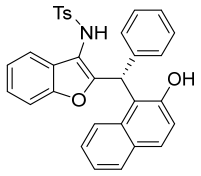

[1] (a) Z. Shi, Q. Tong, W. W. Y. Leong, and G. Zhong, *Chem.-Eur. J.* 2012, **18**, 9802-9806; (b) Y.-G. Zhou, Z. Gu, J.-J. Xie, and G.-F. Jiang, *Asian J. Org. Chem.* 2018, **7**, 1561-1564.

[2] M. Wang, Z.-Q. Rong, and Y. Zhao, *Chem. Comm.* 2014, **50**, 15309-15312.

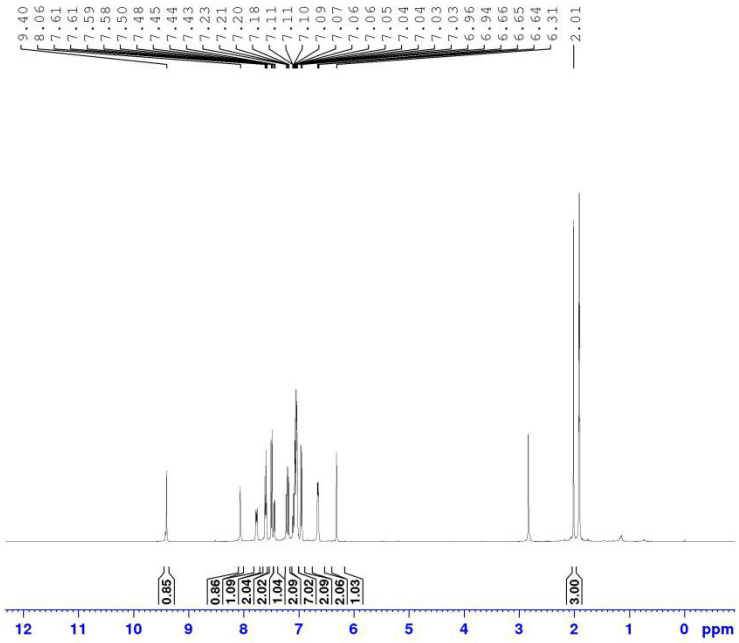
[3] Q. Yin, S. G. Wang, X. W. Liang, D. W. Gao, J. Zheng and S-L. You, *Chem. Sci.*, 2015, **6**, 4179-4183.

[4] H.-P. Xie, B. Wu, X.-W. Wang and Y.-G. Zhou, *Chin. J. Catal.* **2019**, 40, 1566-1575.

# 10 Copies of NMR and HPLC Spectrums




(*R*)-**3a**

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EXPNO                  223
PROCNO                   1

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PULPROG           zg30
TD               65536
SOLVENT         Acetone
NS                     8
DS                     0
SWH             8012.820 Hz
FIDRES             0.122266 Hz
AQ              4.0894465 sec
RG                 52.37
DW                 62.400 usec
DE                  6.50 usec
TE                295.1 K
D1              1.00000000 sec
TD0                    1

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NUC1                  1H
P1                 10.75 usec
PLW1          17.50000000 W

F2 - Processing parameters
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WDW                   EM
SSB       0
LB                  0.30 Hz
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PC                  1.00
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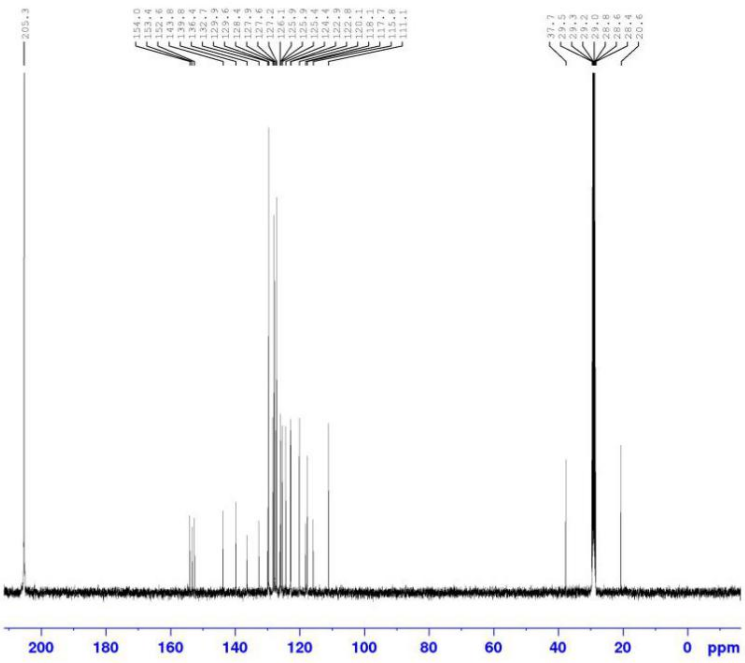


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PROCNO                   1

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RG                 185.85
DW                 19.800 usec
DE                  6.50 usec
TE                295.9 K
D1              2.00000000 sec
D11             0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1          100.6283629 MHz
NUC1                  13C
P1                 10.50 usec
PLW1          74.00000000 W

======== CHANNEL f2 ========
SFO2          400.1516006 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2              90.00 usec
PLW2          17.50000000 W
PLW12          0.26142001 W
PLW13          0.13149001 W

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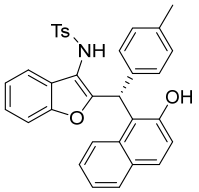
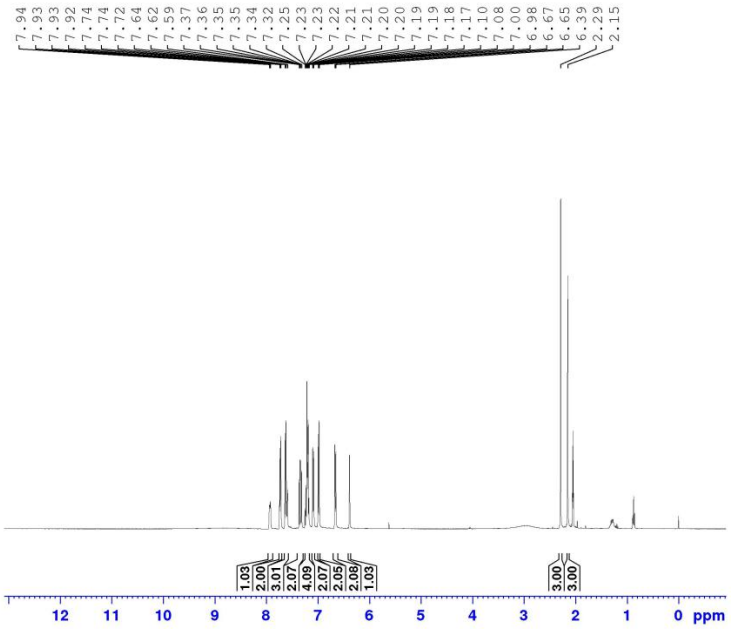



(*R*)-**3b**

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PROCNO                   1

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TD                   65536
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DS                       0
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FIDRES             0.122266 Hz
AQ                 4.0894465 sec
RG                    55.34
DW                    62.400 usec
DE                     6.50 usec
TE                   293.3 K
D1                 1.00000000 sec
TD0                      1

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NUC1                     1H
P1                    10.75 usec
PLW1            17.50000000 W

F2 - Processing parameters
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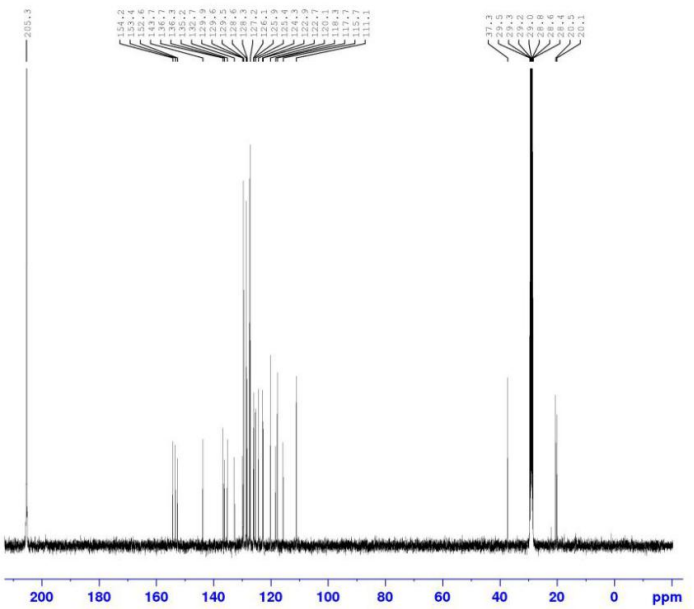
SF               400.1500068 MHz
WDW                     EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



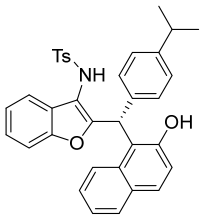

```
Current Data Parameters
NAME                  R-11
EXPNO                  149
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190306
Time                  9.22
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG             zgpg30
TD                   65536
SOLVENT           Acetone
NS                     483
DS                       0
SWH               25252.525 Hz
FIDRES             0.385323 Hz
AQ                 1.2976128 sec
RG                   195.85
DW                    19.800 usec
DE                     6.50 usec
TE                   293.3 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                      1

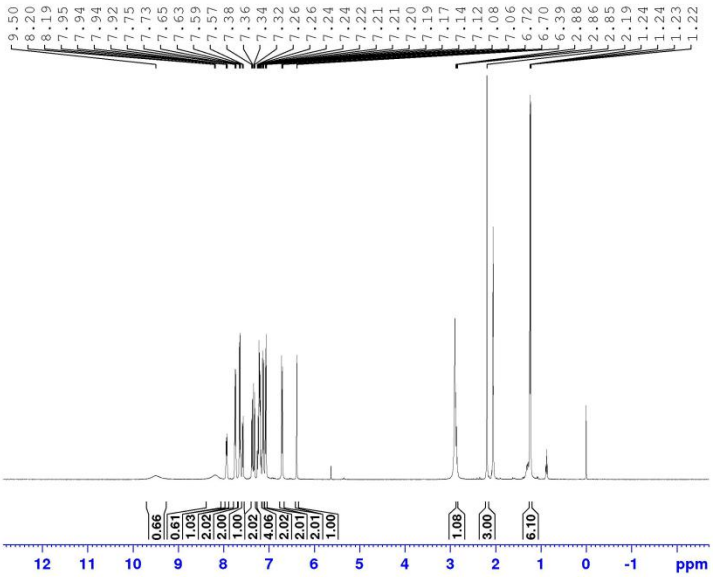
======== CHANNEL f1 ========
SFO1             100.6283629 MHz
NUC1                    13C
P1                    10.50 usec
PLW1            74.00000000 W

======== CHANNEL f2 ========
SFO2             400.1516006 MHz
NUC2                     1H
CPDPRG[2           waltz16
PCPD2                 90.00 usec
PLW2            17.50000000 W
PLW12            0.26142001 W
PLW13            0.13149001 W

F2 - Processing parameters
SI                   32768
SF               100.6177980 MHz
WDW                     EM
SSB          0
LB                     1.00 Hz
GB           0
PC                     1.40
```




(*R*)-**3c**

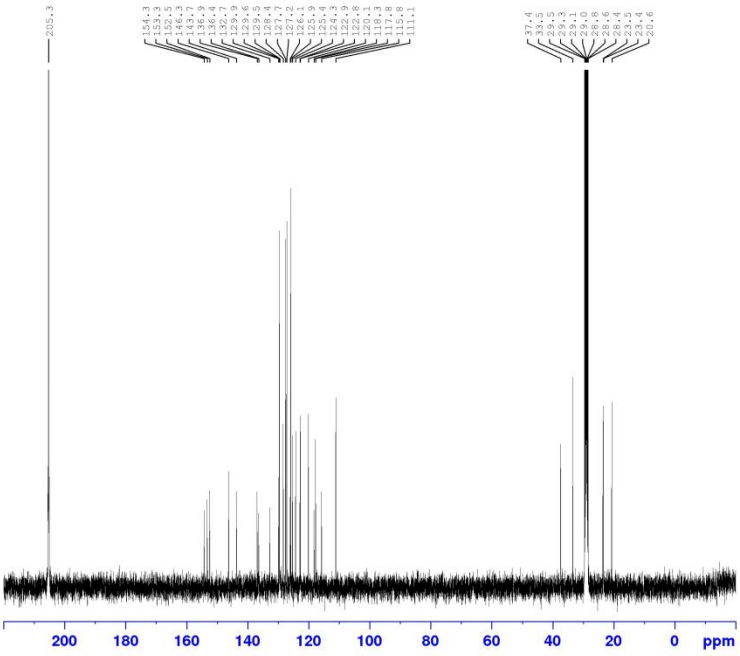



```
Current Data Parameters
NAME                  R-8
EXPNO                 169
PROCNO                  1

F2 - Acquisition Parameters
Date_              20190315
Time                 13.20
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT           Acetone
NS                      8
DS                      0
SWH               8012.820 Hz
FIDRES            0.122266 Hz
AQ                4.0894465 sec
RG                   87.16
DW                 62.400 usec
DE                  6.50 usec
TE                 292.7 K
D1                1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.1522008 MHz
NUC1                    1H
P1                  10.75 usec
PLW1          17.50000000 W

F2 - Processing parameters
SI                  65536
SF            400.1500055 MHz
WDW                    EM
SSB       0
LB                   0.30 Hz
GB        0
PC                   1.00
```



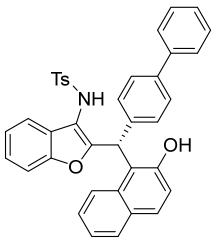

```
Current Data Parameters
NAME                  R-8
EXPNO                 170
PROCNO                  1

F2 - Acquisition Parameters
Date_              20190315
Time                 13.49
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG           zgpg30
TD                  65536
SOLVENT           Acetone
NS                    512
DS                      0
SWH              25252.525 Hz
FIDRES            0.385323 Hz
AQ                1.2976128 sec
RG                   195.85
DW                 19.800 usec
DE                  6.50 usec
TE                 293.0 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                     1

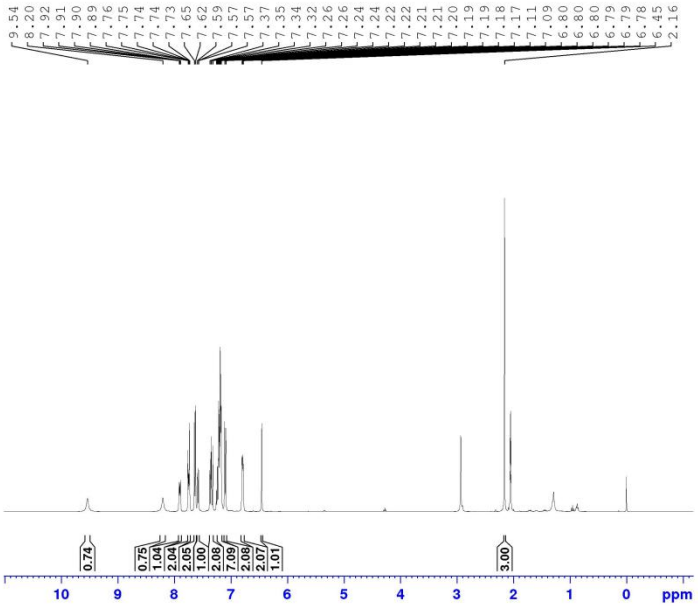
======== CHANNEL f1 ========
SFO1          100.6283629 MHz
NUC1                    13C
P1                  10.50 usec
PLW1          74.00000000 W

======== CHANNEL f2 ========
SFO2          400.1516006 MHz
NUC2                    1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2          17.50000000 W
PLW12          0.26142001 W
PLW13          0.13149001 W

F2 - Processing parameters
SI                  32768
SF            100.6177980 MHz
WDW                    EM
SSB       0
LB                   1.00 Hz
GB        0
PC                   1.40
```




(*R*)-**3d**

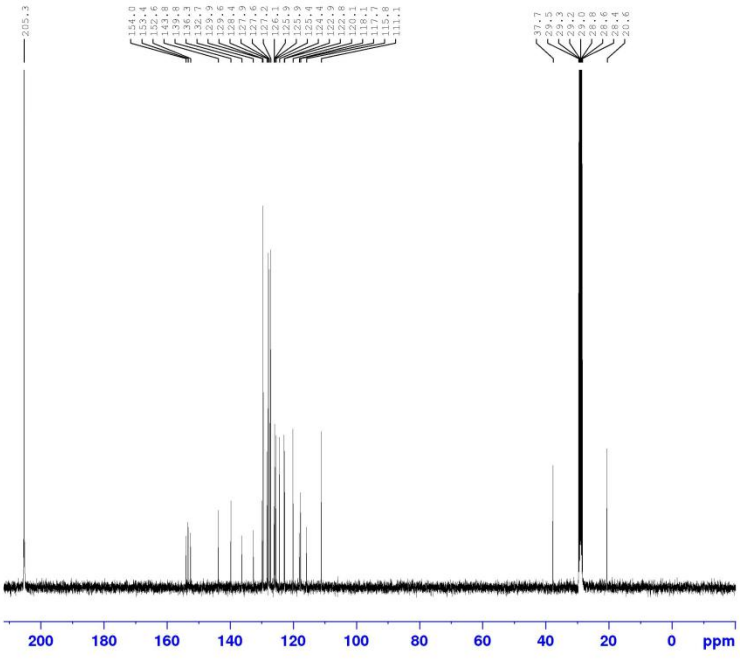



```
Current Data Parameters
NAME                  R-7
EXPNO                 175
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190317
Time                1.33
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG            zg30
TD                65536
SOLVENT         Acetone
NS                      8
DS                      0
SWH             8012.820 Hz
FIDRES          0.122266 Hz
AQ              4.0894465 sec
RG                 71.53
DW                62.400 usec
DE                 6.50 usec
TE                292.6 K
D1              1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.1522008 MHz
NUC1                   1H
P1                  10.75 usec
PLW1          17.50000000 W

F2 - Processing parameters
SI                    65536
SF            400.1500083 MHz
WDW                     EM
SSB       0
LB                   0.30 Hz
GB        0
PC                    1.00
```



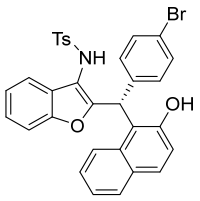

```
Current Data Parameters
NAME                  R-7
EXPNO                 175
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190317
Time                2.03
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT         Acetone
NS                    512
DS                      0
SWH            25252.525 Hz
FIDRES          0.385323 Hz
AQ              1.2976128 sec
RG                 195.85
DW                19.800 usec
DE                 6.50 usec
TE                293.1 K
D1              2.00000000 sec
D11             0.03000000 sec
TD0                     1

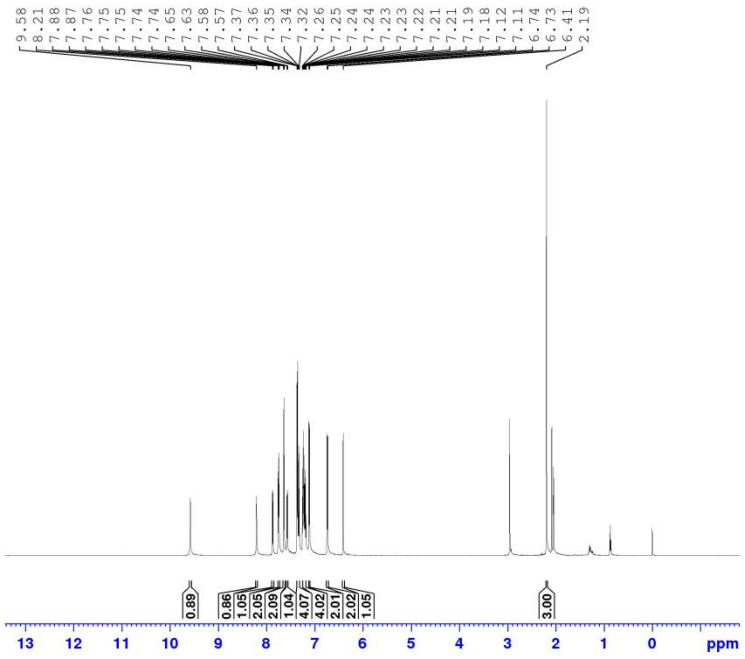
======== CHANNEL f1 ========
SFO1          100.6283629 MHz
NUC1                  13C
P1                  10.50 usec
PLW1          74.00000000 W

======== CHANNEL f2 ========
SFO2          400.1516006 MHz
NUC2                   1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2          17.50000000 W
PLW12          0.26142001 W
PLW13          0.13149001 W

F2 - Processing parameters
SI                    32768
SF            100.6177980 MHz
WDW                     EM
SSB       0
LB                   1.00 Hz
GB        0
PC                    1.40
```



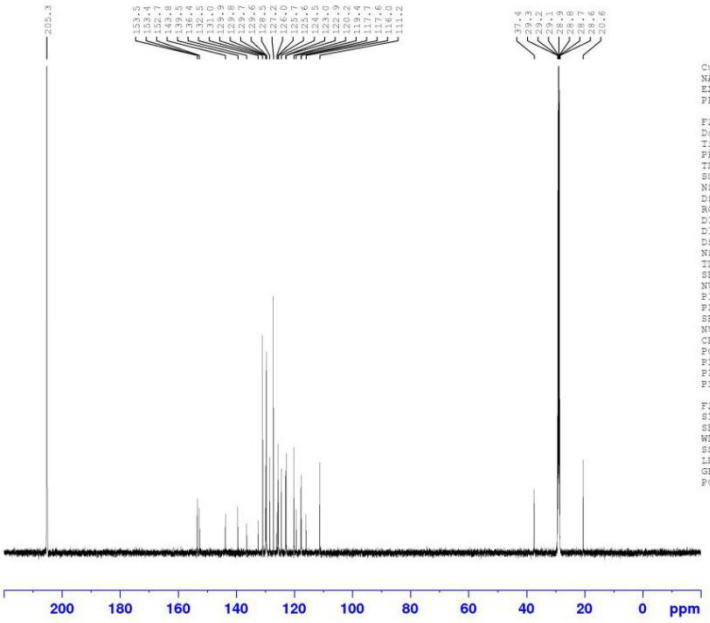

(*R*)-**3e**




```
Current Data Parameters
NAME                  R-1
EXPNO                  10
PROCNO                  1

F2 - Acquisition Parameters
Date_            20190301
Time                17.06 h
PROBHD    Z114607_0222 (
TD                   65536
SOLVENT            Acetone
NS                       3
DS                       2
RG                   61.75
D1             1.00000000 sec
DS                       2
NS                       3
TD0                      1
SFO1         600.1737060 MHz
NUC1                    1H
P1                  10.00 usec
PLW1         26.09399986 W

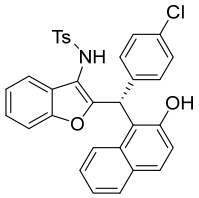
F2 - Processing parameters
SI                   65536
SF            600.1700115 MHz
WDW                     EM
SSB       0
LB                   0.30 Hz
GB        0
PC                   1.00
```



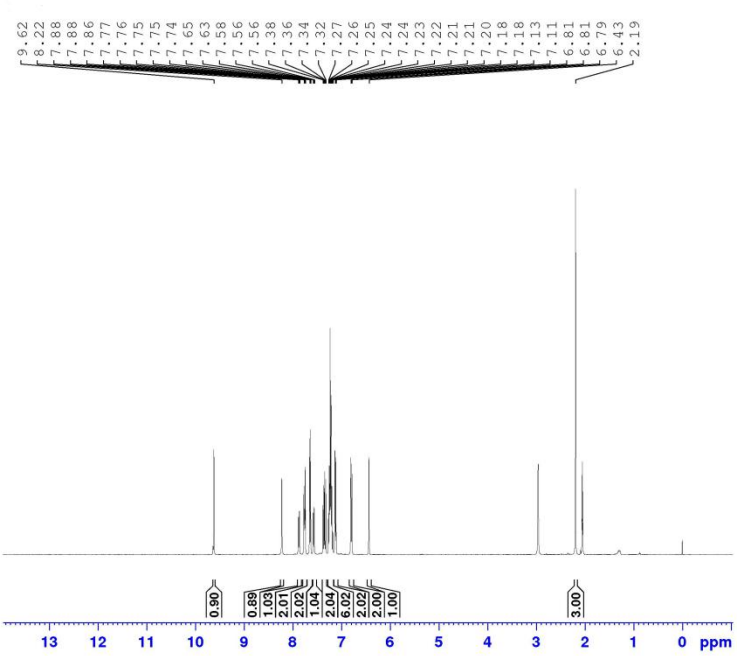

```
Current Data Parameters
NAME                  R-1
EXPNO                  11
PROCNO                  1

F2 - Acquisition Parameters
Date_            20190301
Time                17.08 h
PROBHD    Z114607_0222 (
TD                   65536
SOLVENT            Acetone
NS                     241
DS                       4
RG                  188.35
D1             2.00000000 sec
D11            0.03000000 sec
DS                       4
NS                     241
TD0                      1
SFO1        150.9279578 MHz
NUC1                   13C
P1                  12.00 usec
PLW1         97.67099762 W
SFO2         600.1724007 MHz
NUC2                    1H
CPDPRG[2          waltz16
PCPD2               80.00 usec
PLW2         26.09399986 W
PLW12         0.40399119 W
PLW13         0.20248041 W

F2 - Processing parameters
SI                   32768
SF           150.9128665 MHz
WDW                     EM
SSB       0
LB                   1.00 Hz
GB        0
PC                   1.40
```




(*R*)-**3f**

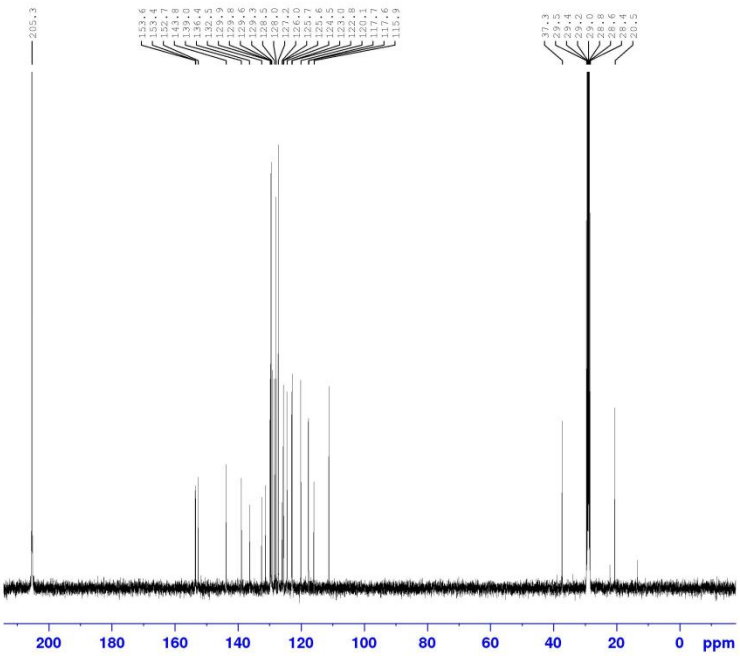



```
Current Data Parameters
NAME                  R-12
EXPNO                  187
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190328
Time                 11.38
INSTRUM              spect
PROBHD   5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT           Acetone
NS                        8
DS                        0
SWH               8012.820 Hz
FIDRES               0.122266 Hz
AQ                4.0894465 sec
RG                     63.8
DW                   62.400 usec
DE                    6.50 usec
TE                   294.3 K
D1                1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1            400.1522008 MHz
NUC1                    1H
P1                   10.75 usec
PLW1           17.50000000 W

F2 - Processing parameters
SI                    65536
SF              400.1500065 MHz
WDW                     EM
SSB          0
LB                    0.30 Hz
GB           0
PC                    1.00
```



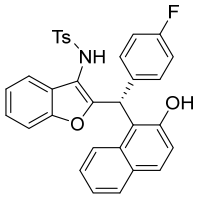

```
Current Data Parameters
NAME                  R-12
EXPNO                  184
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190325
Time                 23.06
INSTRUM              spect
PROBHD   5 mm PABBO BB/
PULPROG           zgpg30
TD                  65536
SOLVENT           Acetone
NS                      425
DS                        0
SWH              25252.525 Hz
FIDRES               0.385323 Hz
AQ                1.2976128 sec
RG                    195.88
DW                   19.800 usec
DE                    6.50 usec
TE                   294.1 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                       1

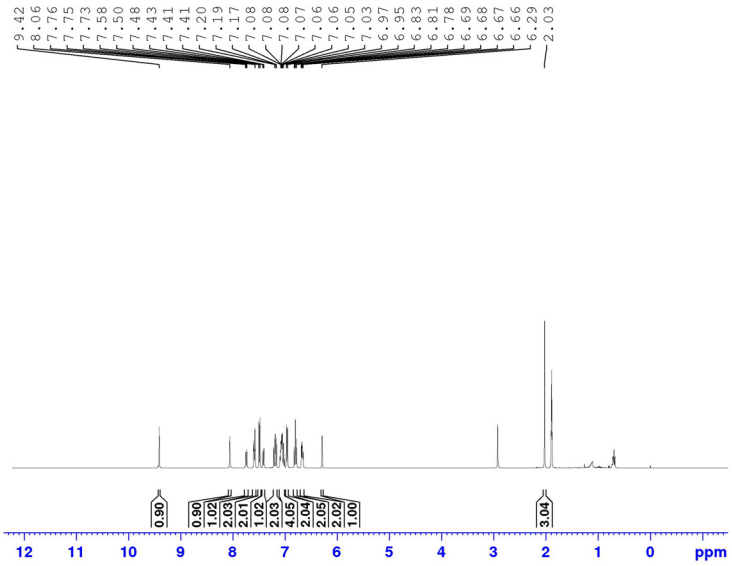
======== CHANNEL f1 ========
SFO1            100.6283629 MHz
NUC1                    13C
P1                   10.50 usec
PLW1           74.00000000 W

======== CHANNEL f2 ========
SFO2            400.1516006 MHz
NUC2                    1H
CPDPRG[2             waltz16
PCPD2                90.00 usec
PLW2           17.50000000 W
PLW12           0.26142001 W
PLW13           0.13149001 W

F2 - Processing parameters
SI                    32768
SF              100.6177980 MHz
WDW                     EM
SSB          0
LB                    1.00 Hz
GB           0
PC                    1.40
```



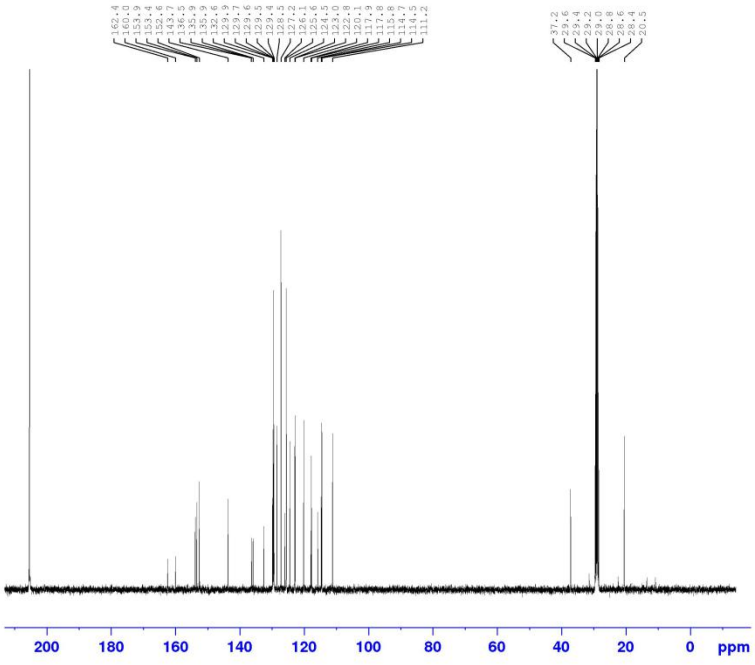

(*R*)-**3g**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      47
PROCNO                      1

F2 - Acquisition Parameters
Date_               20191103
Time                   17.06 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                           8
DS                           0
SWH                 5555.556 Hz
FIDRES                0.169542 Hz
AQ                    5.8982401 sec
RG                       58.8235
DW                       90.000 usec
DE                        9.42 usec
TE                       296.3 K
D1                    1.00000000 sec
TD0                          1
SFO1               400.1321847 MHz
NUC1                        1H
P0                        3.58 usec
P1                       10.75 usec
PLW1               16.71999931 W

F2 - Processing parameters
SI                       65536
SF                 400.1300688 MHz
WDW                         EM
SSB          0
LB                        0.30 Hz
GB           0
PC                        1.00
```

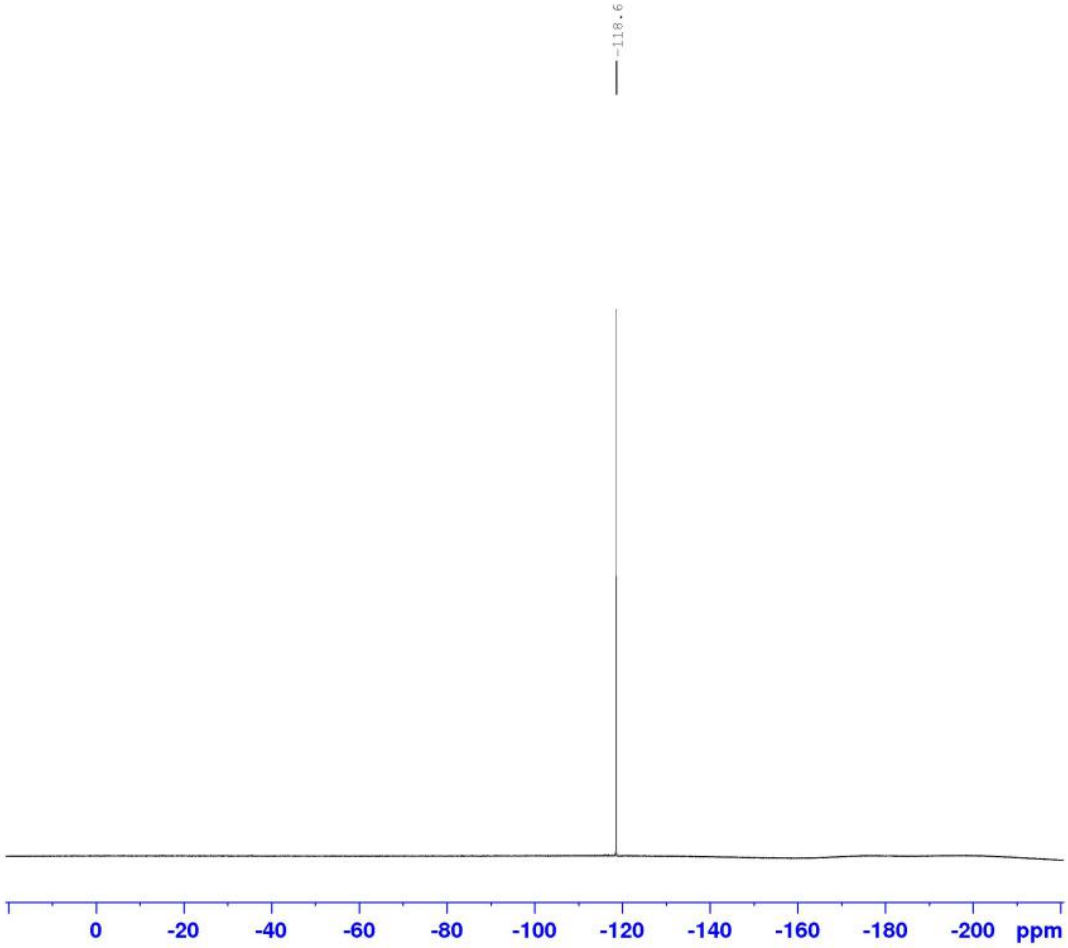



```
Current Data Parameters
NAME                  new nmr
EXPNO                      48
PROCNO                      1

F2 - Acquisition Parameters
Date_               20191103
Time                   17.13 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG                zgpg30
TD                     65536
SOLVENT              Acetone
NS                         125
DS                           0
SWH                25000.000 Hz
FIDRES                0.762939 Hz
AQ                    1.3107200 sec
RG                         101
DW                       20.000 usec
DE                        6.50 usec
TE                       296.3 K
D1                    2.00000000 sec
D11                   0.03000000 sec
TD0                          1
SFO1               100.6238359 MHz
NUC1                        13C
P0                        3.33 usec
P1                       10.00 usec
PLW1               75.41799927 W
SFO2               400.1316005 MHz
NUC2                        1H
CPDPRG[2             waltz65
PCPD2                    80.00 usec
PLW2               16.71999931 W
PLW12               0.37619999 W
PLW13               0.18892001 W

F2 - Processing parameters
SI                       32768
SF                 100.6127685 MHz
WDW                         EM
SSB          0
LB                        1.00 Hz
GB           0
PC                        1.40
```

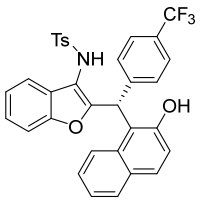
p-F



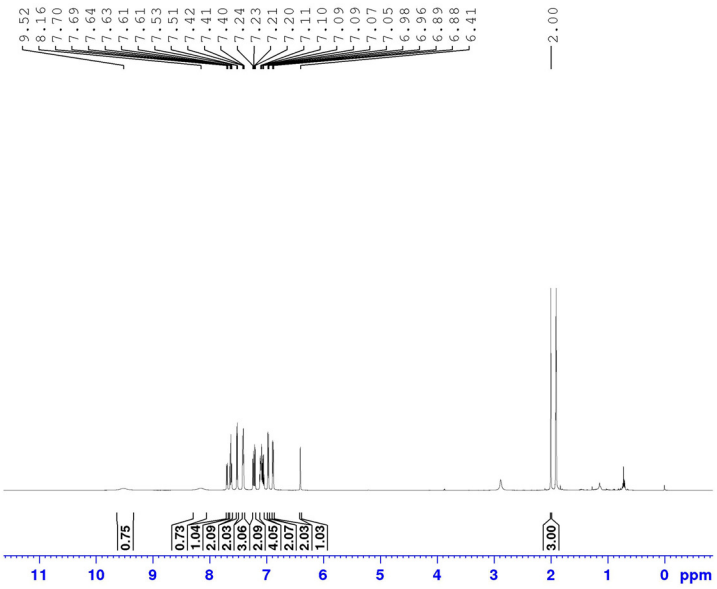

```
Current Data Parameters
NAME                  new nmr
EXPNO                      50
PROCNO                      1

F2 - Acquisition Parameters
Date_                20191103
Time                   17.19 h
INSTRUM                Avance
PROBHD   Z116098_0861 (
PULPROG                    zg
TD                     131072
SOLVENT               Acetone
NS                          16
DS                           4
SWH                  90909.094 Hz
FIDRES                1.387163 Hz
AQ                    0.7208960 sec
RG                         101
DW                       5.500 usec
DE                       6.50 usec
TE                       296.5 K
D1                  1.00000000 sec
TD0                          1
SFO1               376.4607164 MHz
NUC1                        19F
P1                       18.00 usec
PLW1               16.38400078 W

F2 - Processing parameters
SI                         65536
SF                 376.4983662 MHz
WDW                           EM
SSB       0
LB                       0.30 Hz
GB        0
PC                       1.00
```



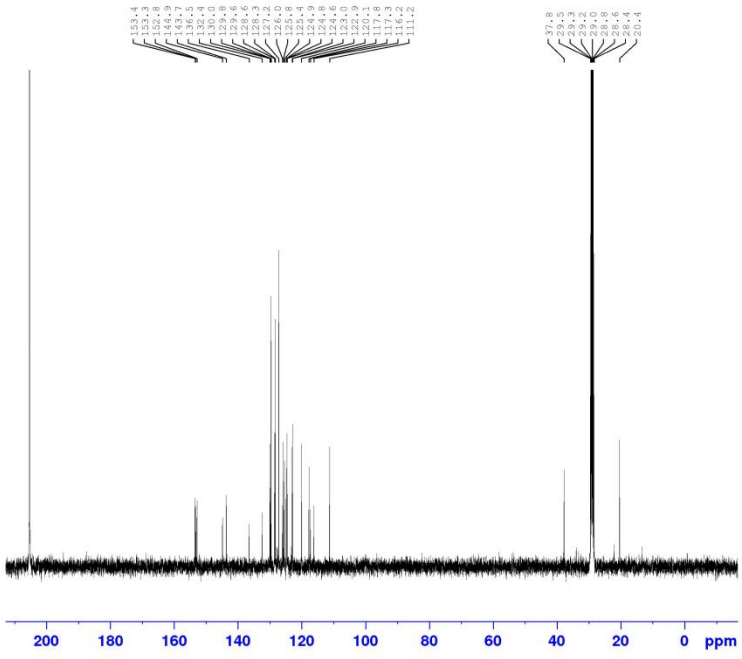

(*R*)-**3h**




```
Current Data Parameters
NAME      Dec11-2019-wangchengjie
EXPNO                 100
PROCNO                  1

F2 - Acquisition Parameters
Date_           20191211
Time              12.17 h
PROBHD    Z114607_0222 (
TD                65536
SOLVENT           Acetone
NS                   16
DS                    2
RG                30.88
D1             1.00000000 sec
DS                    2
NS                   16
TD0                   1
SFO1         600.1737060 MHz
NUC1                 1H
P1                10.00 usec
PLW1         26.09399986 W

F2 - Processing parameters
SI                65536
SF           600.1700974 MHz
WDW                  EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```



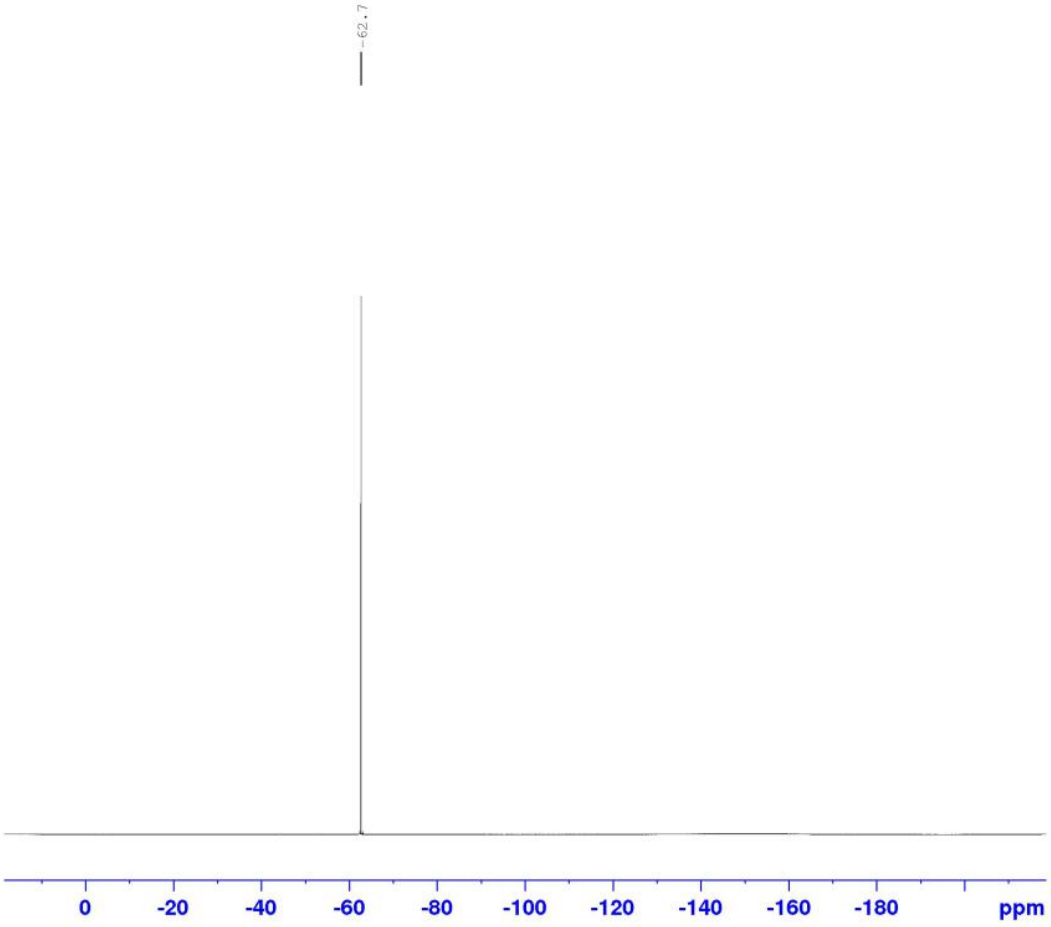

```
Current Data Parameters
NAME              old nmr
EXPNO                 158
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190310
Time              10.23
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG          zgpg30
TD                65536
SOLVENT           Acetone
NS                  194
DS                    0
SWH           25252.525 Hz
FIDRES        0.385323 Hz
AQ            1.2976128 sec
RG                195.85
DW               19.800 usec
DE                6.50 usec
TE                292.3 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         100.6283629 MHz
NUC1                13C
P1               10.50 usec
PLW1         74.00000000 W

======== CHANNEL f2 ========
SFO2         400.1516006 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         17.50000000 W
PLW12         0.26142001 W
PLW13         0.13149001 W

F2 - Processing parameters
SI                32768
SF           100.6177980 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```

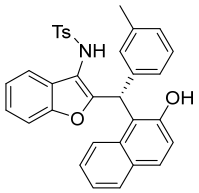



```
Current Data Parameters
NAME                  old nmr
EXPNO                     159
PROCNO                      1

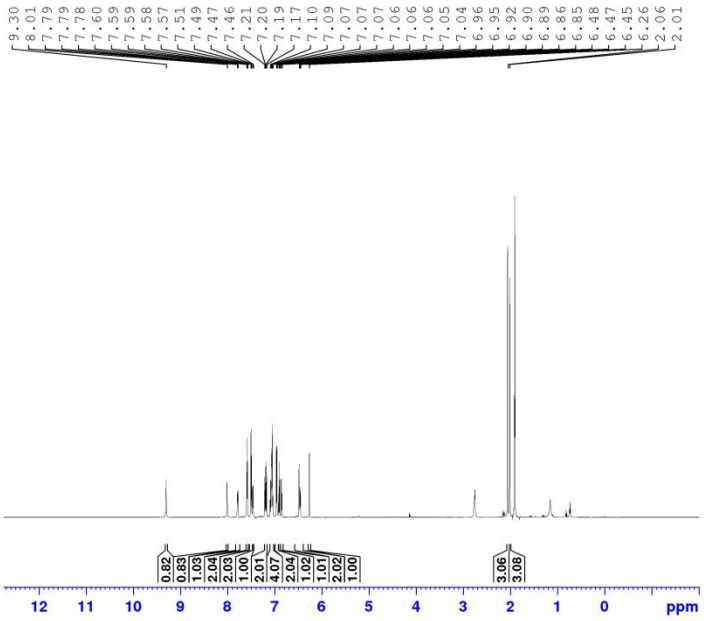
F2 - Acquisition Parameters
Date_               20190310
Time                   10.34
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG              zgflqn
TD                   131072
SOLVENT              Acetone
NS                        16
DS                         4
SWH                89285.711 Hz
FIDRES              0.681196 Hz
AQ                 0.7340032 sec
RG                    195.85
DW                     5.600 usec
DE                     6.50 usec
TE                     292.6 K
D1                1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
SFO1             376.4795333 MHz
NUC1                     19F
P1                     14.00 usec
PLW1            24.85000038 W

F2 - Processing parameters
SI                     65536
SF               376.5171850 MHz
WDW                       EM
SSB          0
LB                      0.30 Hz
GB           0
PC                      1.00
```



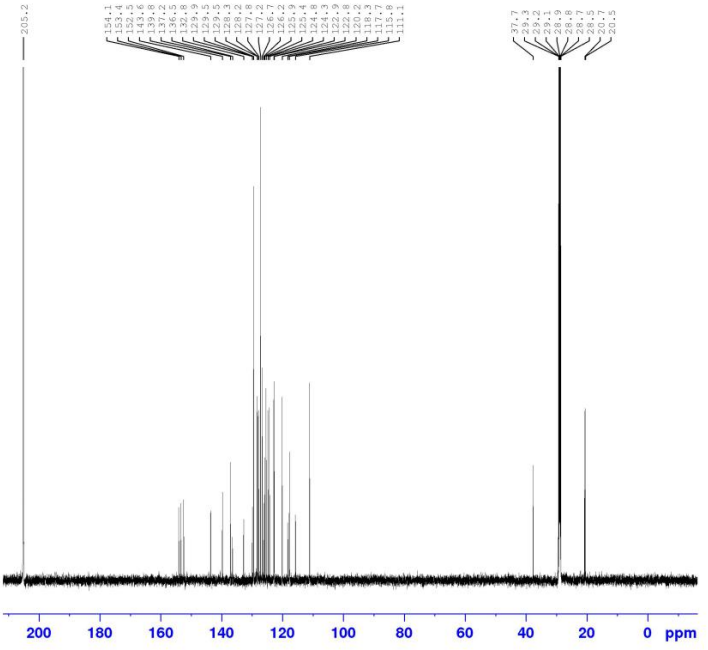

(*R*)-**3i**




```
Current Data Parameters
NAME                  R-19
EXPNO                   60
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190411
Time                 21.53 h
PROBHD    Z114607_0222 (
TD                    65536
SOLVENT             Acetone
NS                        2
DS                        2
RG                    53.41
D1              1.00000000 sec
DS                        2
NS                        2
TD0                       1
SFO1           600.1737060 MHz
NUC1                    1H
P1                   10.00 usec
PLW1           26.09399986 W

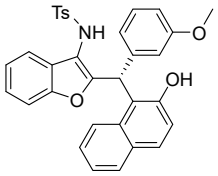
F2 - Processing parameters
SI                    65536
SF             600.1700980 MHz
WDW                     EM
SSB          0
LB                    0.30 Hz
GB           0
PC                    1.00
```



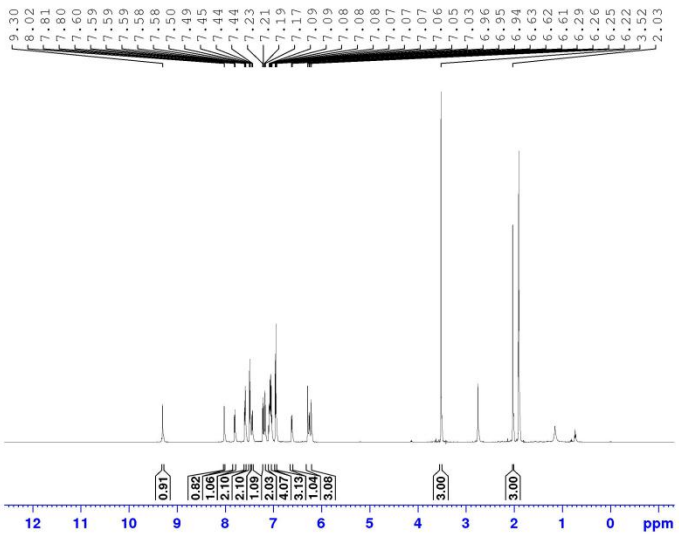

```
Current Data Parameters
NAME                  R-19
EXPNO                   61
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190411
Time                 22.08 h
PROBHD    Z114607_0222 (
TD                    65536
SOLVENT             Acetone
NS                      280
DS                        4
RG                   188.35
D1              2.00000000 sec
D11             0.03000000 sec
DS                        4
NS                      280
TD0                       1
SFO1           150.9279578 MHz
NUC1                    13C
P1                   12.00 usec
PLW1           97.67099762 W
SFO2           600.1724007 MHz
NUC2                    1H
CPDPRG[2            waltz16
PCPD2                80.00 usec
PLW2           26.09399986 W
PLW12           0.40399119 W
PLW13           0.20248041 W

F2 - Processing parameters
SI                    32768
SF             150.9128665 MHz
WDW                     EM
SSB          0
LB                    1.00 Hz
GB           0
PC                    1.40
```



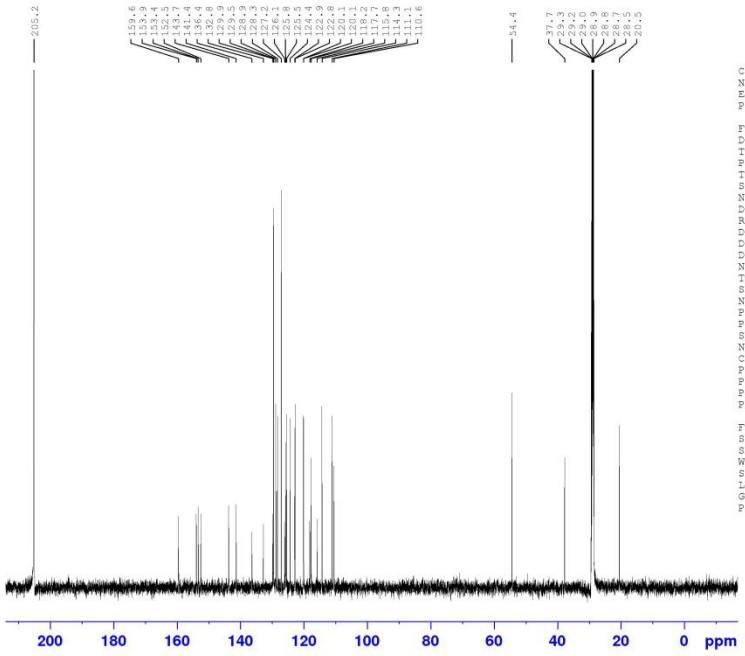

(*R*)-**3j**




```
Current Data Parameters
NAME                  R-18
EXPNO                   40
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190411
Time                21.17 h
PROBHD    Z114607_0222 (
TD                   65536
SOLVENT            Acetone
NS                       2
DS                       2
RG                   53.41
D1              1.00000000 sec
DS                       2
NS                       2
TD0                      1
SFO1           600.1737060 MHz
NUC1                    1H
P1                   10.00 usec
PLW1           26.09399986 W

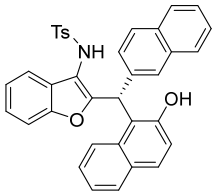
F2 - Processing parameters
SI                   65536
SF             600.1700971 MHz
WDW                     EM
SSB          0
LB                    0.30 Hz
GB           0
PC                    1.00
```



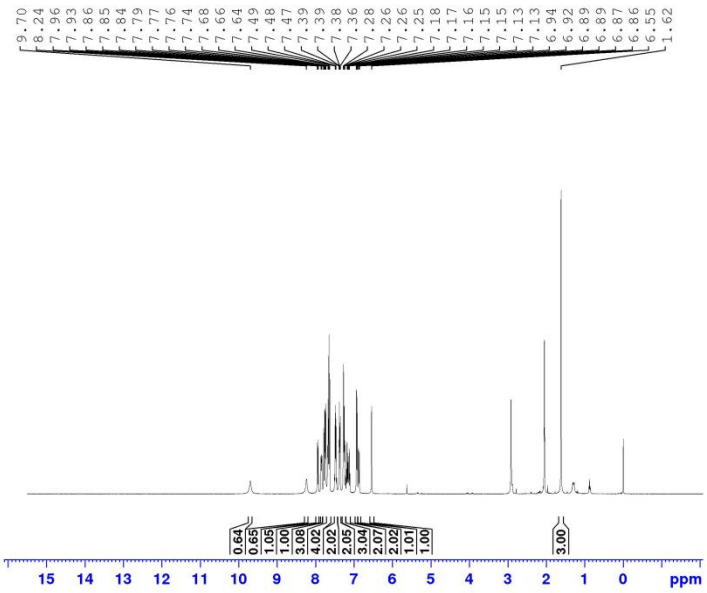

```
Current Data Parameters
NAME                  R-18
EXPNO                   41
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190411
Time                21.23 h
PROBHD    Z114607_0222 (
TD                   65536
SOLVENT            Acetone
NS                     253
DS                       4
RG                   188.35
D1              2.00000000 sec
D11             0.03000000 sec
DS                       4
NS                     253
TD0                      1
SFO1           150.9279578 MHz
NUC1                    13C
P1                   12.00 usec
PLW1           97.67099762 W
SFO2           600.1724007 MHz
NUC2                    1H
CPDPRG[2          waltz16
PCPD2                80.00 usec
PLW2           26.09399986 W
PLW12           0.40399119 W
PLW13           0.20248041 W

F2 - Processing parameters
SI                   32768
SF             150.9128665 MHz
WDW                     EM
SSB          0
LB                    2.00 Hz
GB           0
PC                    1.40
```




(*R*)-**3k**

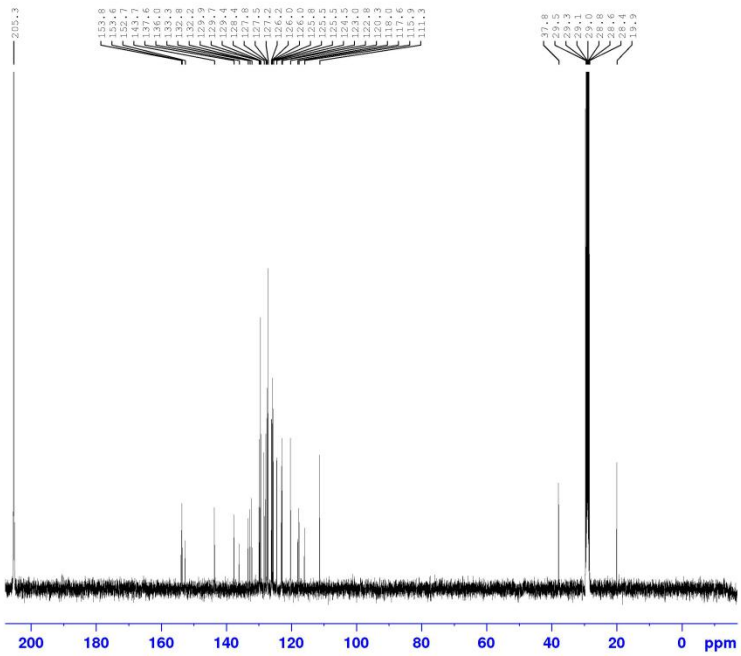



```
Current Data Parameters
NAME                  R-9
EXPNO                 165
PROCNO                  1

F2 - Acquisition Parameters
Date_              20190313
Time                15.22
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG             zg30
TD                 65536
SOLVENT          Acetone
NS                      8
DS                      0
SWH              8012.820 Hz
FIDRES           0.122266 Hz
AQ               4.0894465 sec
RG                  78.11
DW                62.400 usec
DE                 6.50 usec
TE                292.3 K
D1             1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.1522008 MHz
NUC1                    1H
P1                 10.75 usec
PLW1          17.50000000 W

F2 - Processing parameters
SI                  65536
SF            400.1500061 MHz
WDW                    EM
SSB       0
LB                  0.30 Hz
GB        0
PC                  1.00
```



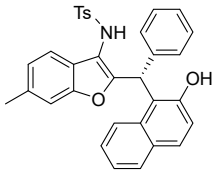

```
Current Data Parameters
NAME                  R-9
EXPNO                 166
PROCNO                  1

F2 - Acquisition Parameters
Date_              20190313
Time                15.40
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG           zgpg30
TD                 65536
SOLVENT          Acetone
NS                    512
DS                      0
SWH             25252.525 Hz
FIDRES           0.385323 Hz
AQ               1.2976128 sec
RG                 195.85
DW                19.800 usec
DE                 6.50 usec
TE                292.8 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                     1

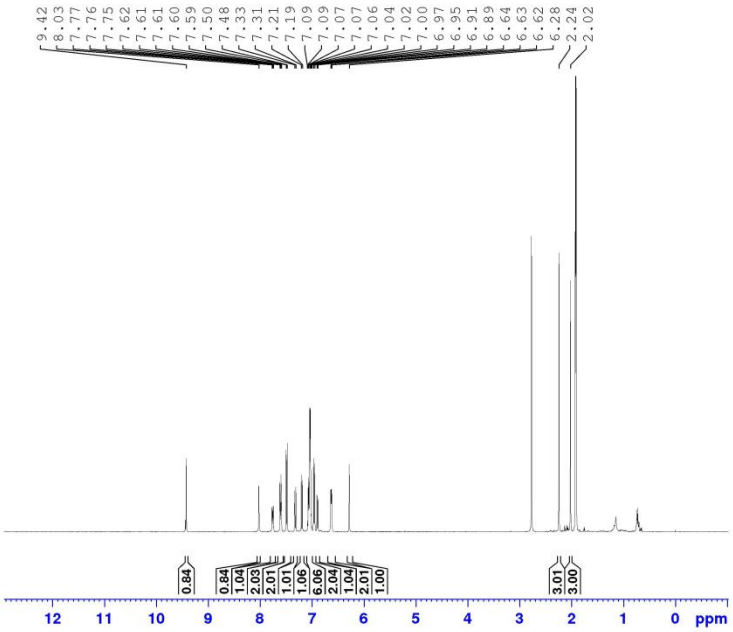
======== CHANNEL f1 ========
SFO1          100.6283629 MHz
NUC1                    13C
P1                 10.50 usec
PLW1          74.00000000 W

======== CHANNEL f2 ========
SFO2          400.1516006 MHz
NUC2                    1H
CPDPRG[2          waltz16
PCPD2              90.00 usec
PLW2          17.50000000 W
PLW12          0.26142001 W
PLW13          0.13149001 W

F2 - Processing parameters
SI                  32768
SF            100.6177980 MHz
WDW                    EM
SSB       0
LB                  1.00 Hz
GB        0
PC                  1.40
```




(*R*)-**3l**

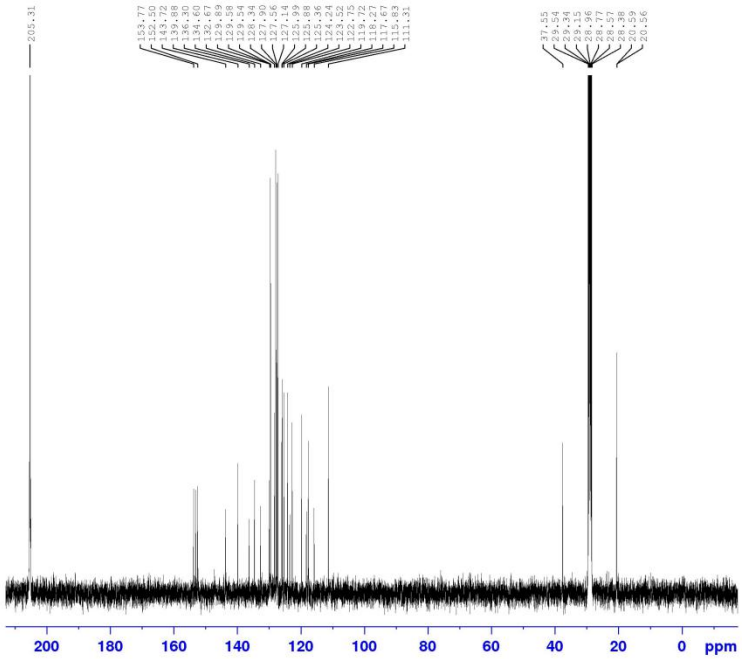



```
Current Data Parameters
NAME                  R-24
EXPNO                  194
PROCNO                   1

F2 - Acquisition Parameters
Date_            20190402
Time                 8.34
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT           Acetone
NS                      8
DS                      0
SWH               8012.820 Hz
FIDRES               0.122266 Hz
AQ                4.0894465 sec
RG                    71.53
DW                  62.400 usec
DE                   6.50 usec
TE                  293.1 K
D1             1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1            400.1522008 MHz
NUC1                    1H
P1                   10.75 usec
PLW1           17.50000000 W

F2 - Processing parameters
SI                    65536
SF              400.1500603 MHz
WDW                     EM
SSB       0
LB                    0.30 Hz
GB        0
PC                    1.00
```



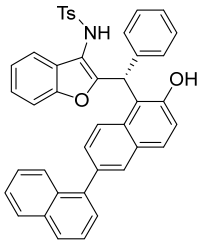

```
Current Data Parameters
NAME                  R-24
EXPNO                  195
PROCNO                   1

F2 - Acquisition Parameters
Date_            20190402
Time                 8.41
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG           zgpg30
TD                  65536
SOLVENT           Acetone
NS                    512
DS                      0
SWH              25252.525 Hz
FIDRES               0.385323 Hz
AQ                1.2976128 sec
RG                   195.88
DW                  19.800 usec
DE                   6.50 usec
TE                  293.4 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                      1

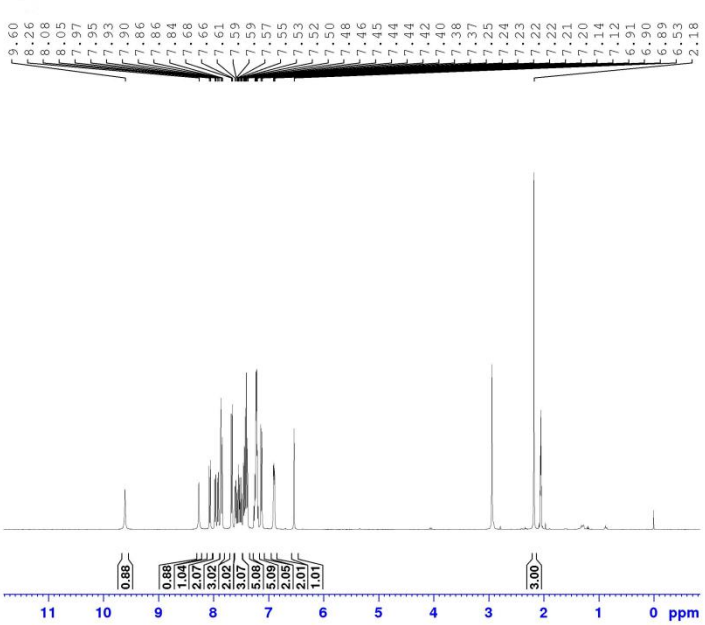
======== CHANNEL f1 ========
SFO1            100.6283629 MHz
NUC1                    13C
P1                   10.50 usec
PLW1           74.00000000 W

======== CHANNEL f2 ========
SFO2            400.1516006 MHz
NUC2                    1H
CPDPRG[2             waltz16
PCPD2                90.00 usec
PLW2           17.50000000 W
PLW12           0.26142001 W
PLW13           0.13149001 W

F2 - Processing parameters
SI                    32768
SF              100.6177980 MHz
WDW                     EM
SSB       0
LB                    1.00 Hz
GB        0
PC                    1.40
```




(*R*)-**3m**

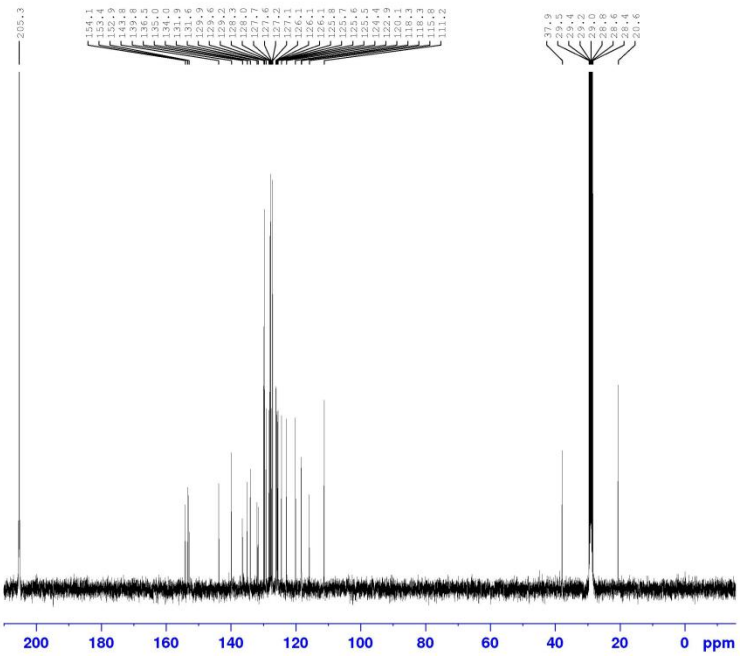



```
Current Data Parameters
NAME                  R-16
EXPNO                  188
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190329
Time                 18.02
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG              zg30
TD                  65536
SOLVENT           Acetone
NS                       8
DS                       0
SWH               8012.820 Hz
FIDRES               0.122266 Hz
AQ                4.0894465 sec
RG                    63.8
DW                   62.400 usec
DE                    6.50 usec
TE                  293.7 K
D1                1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1            400.1522008 MHz
NUC1                    1H
P1                   10.75 usec
PLW1            17.50000000 W

F2 - Processing parameters
SI                      65536
SF              400.1500064 MHz
WDW                     EM
SSB          0
LB                    0.30 Hz
GB           0
PC                    1.00
```



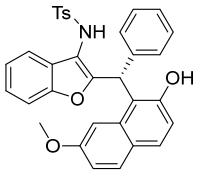

```
Current Data Parameters
NAME                  R-16
EXPNO                  189
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190329
Time                 18.05
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG            zgpg30
TD                  65536
SOLVENT           Acetone
NS                     340
DS                       0
SWH              25252.525 Hz
FIDRES               0.385323 Hz
AQ                1.2976128 sec
RG                   195.85
DW                   19.800 usec
DE                    6.50 usec
TE                  293.7 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                      1

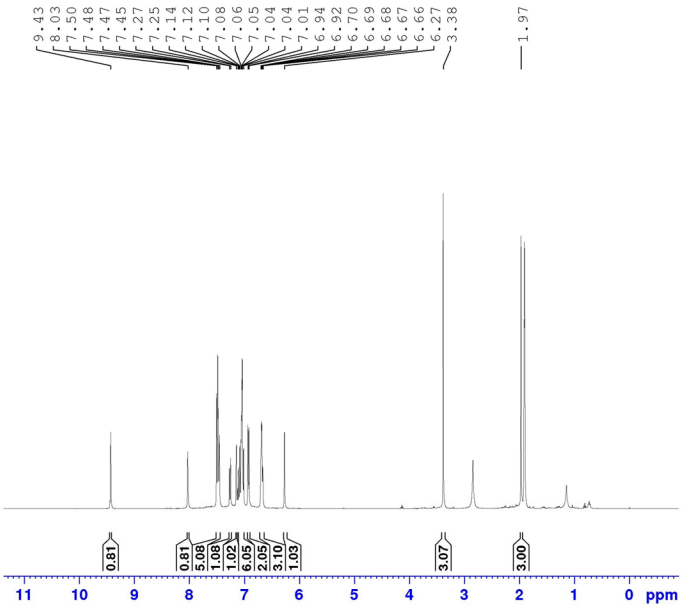
======== CHANNEL f1 ========
SFO1            100.6283629 MHz
NUC1                    13C
P1                   10.50 usec
PLW1            74.00000000 W

======== CHANNEL f2 ========
SFO2            400.1516006 MHz
NUC2                    1H
CPDPRG[2             waltz16
PCPD2                90.00 usec
PLW2            17.50000000 W
PLW12            0.26142001 W
PLW13            0.13149001 W

F2 - Processing parameters
SI                      32768
SF              100.6177980 MHz
WDW                     EM
SSB          0
LB                    1.00 Hz
GB           0
PC                    1.40
```




(*R*)-**3n**

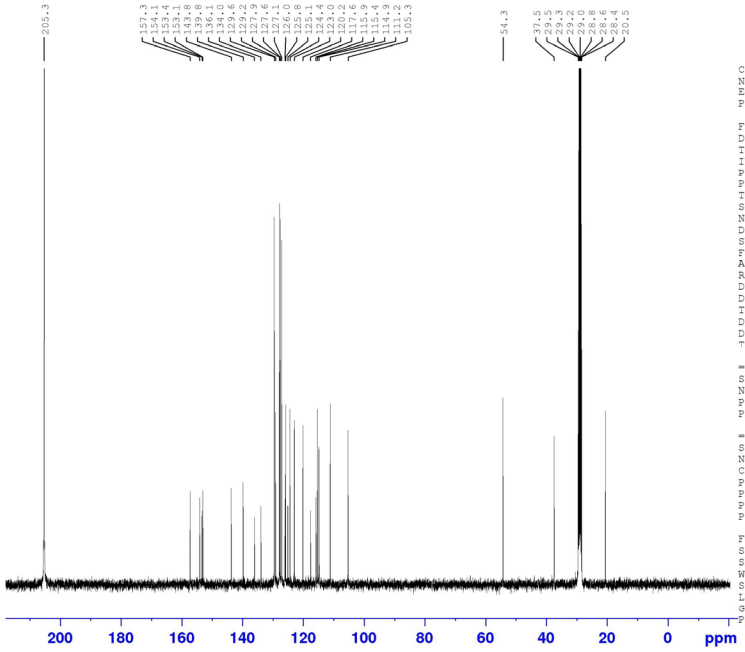



```
Current Data Parameters
NAME                  R-4
EXPNO                 250
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190510
Time              19.08
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG           zg30
TD               65536
SOLVENT         Acetone
NS                    8
DS                    0
SWH            8012.820 Hz
FIDRES         0.122266 Hz
AQ             4.0894465 sec
RG                31.56
DW               62.400 usec
DE                6.50 usec
TE               296.5 K
D1            1.00000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1          400.1522008 MHz
NUC1                  1H
P1                10.75 usec
PLW1         17.50000000 W

F2 - Processing parameters
SI                65536
SF            400.1500643 MHz
WDW                  EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```



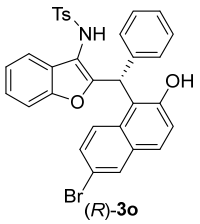

```
Current Data Parameters
NAME                  R-4
EXPNO                 251
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190510
Time              19.22
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG         zgpg30
TD               65536
SOLVENT         Acetone
NS                  512
DS                    0
SWH           25252.525 Hz
FIDRES         0.385323 Hz
AQ             1.2976128 sec
RG                195.85
DW               19.800 usec
DE                6.50 usec
TE               297.0 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                   1

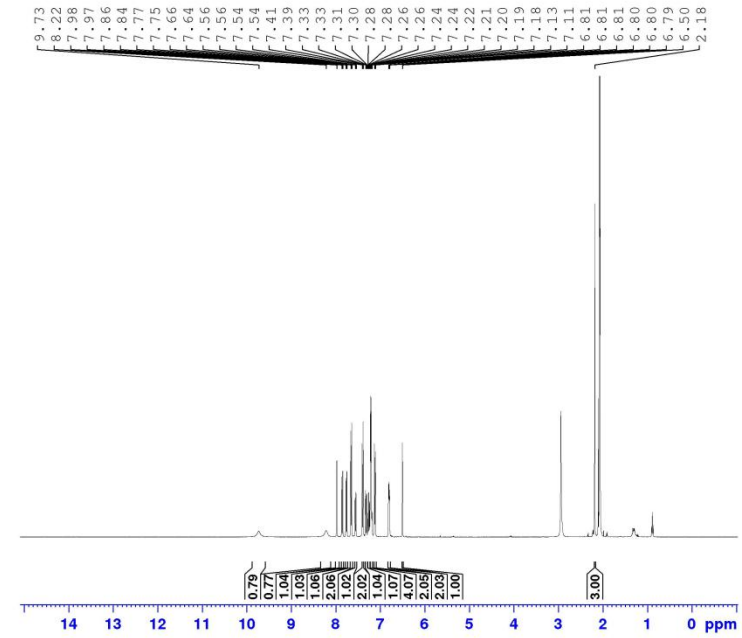
======== CHANNEL f1 ========
SFO1          100.6283629 MHz
NUC1                  13C
P1                10.50 usec
PLW1         74.00000000 W

======== CHANNEL f2 ========
SFO2          400.1516006 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2         17.50000000 W
PLW12         0.26142001 W
PLW13         0.13149001 W

F2 - Processing parameters
SI                32768
SF            100.6177980 MHz
WDW                  EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```




(*R*)-**3o**

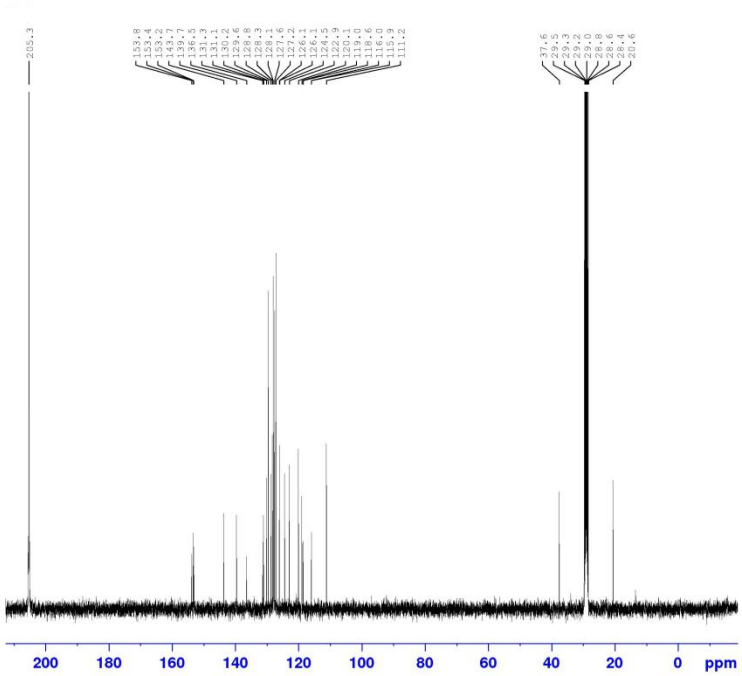



```
Current Data Parameters
NAME                  R-5
EXPNO                 204
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190406
Time              16.05
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG           zg30
TD               65536
SOLVENT         Acetone
NS                    8
DS                    0
SWH            8012.820 Hz
FIDRES         0.122266 Hz
AQ             4.0894465 sec
RG                71.53
DW                62.400 usec
DE                 6.50 usec
TE               293.2 K
D1            1.00000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1         400.1522008 MHz
NUC1               1H
P1                10.75 usec
PLW1        17.50000000 W

F2 - Processing parameters
SI                65536
SF           400.1500000 MHz
WDW                EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```



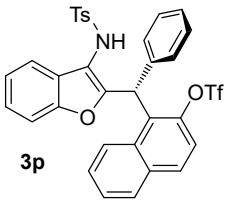

```
Current Data Parameters
NAME                  R-5
EXPNO                 205
PROCNO                  1

F2 - Acquisition Parameters
Date_           20190406
Time              16.35
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG         zgpg30
TD               65536
SOLVENT         Acetone
NS                  512
DS                    0
SWH           25252.525 Hz
FIDRES         0.385323 Hz
AQ             1.2976128 sec
RG                195.85
DW                19.800 usec
DE                 6.50 usec
TE               293.6 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                   1

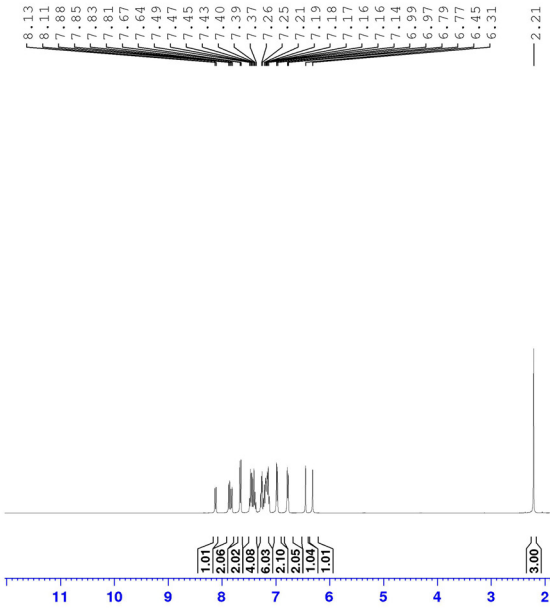
======== CHANNEL f1 ========
SFO1         100.6283629 MHz
NUC1               13C
P1                10.50 usec
PLW1        74.00000000 W

======== CHANNEL f2 ========
SFO2         400.1516006 MHz
NUC2               1H
CPDPRG[2         waltz16
PCPD2             90.00 usec
PLW2        17.50000000 W
PLW12        0.26142001 W
PLW13        0.13149001 W

F2 - Processing parameters
SI                32768
SF           100.6177980 MHz
WDW                EM
SSB       0
LB                1.00 Hz
GB        0
PC                1.40
```




**3p**

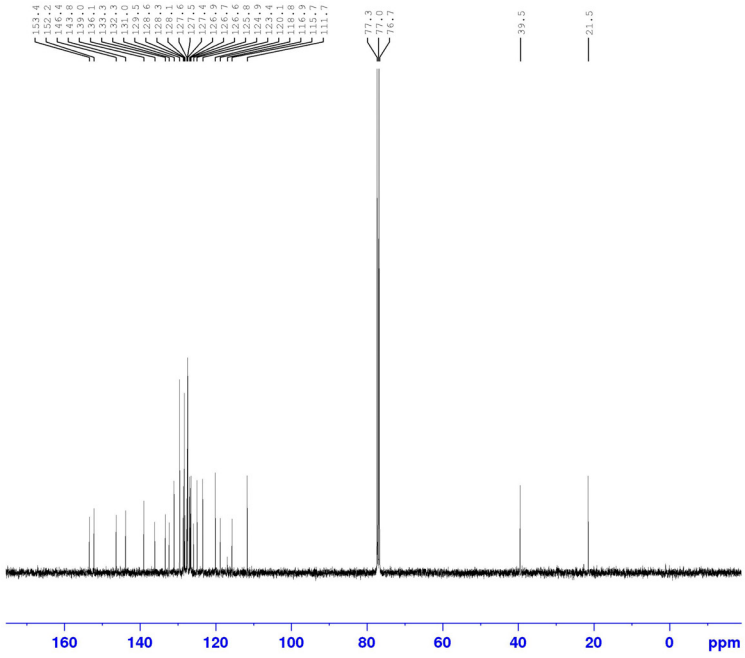



```
Current Data Parameters
NAME                  old nmr
EXPNO                     260
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190517
Time                    5.23
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT               CDCl3
NS                        8
DS                        0
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894465 sec
RG                     78.11
DW                  62.400 usec
DE                   6.50 usec
TE                   297.3 K
D1                 1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1            400.1522008 MHz
NUC1                       1H
P1                     10.75 usec
PLW1           17.50000000 W

F2 - Processing parameters
SI                        65536
SF              400.1500128 MHz
WDW                         EM
SSB                         0
LB                       0.30 Hz
GB                          0
PC                       1.00
```



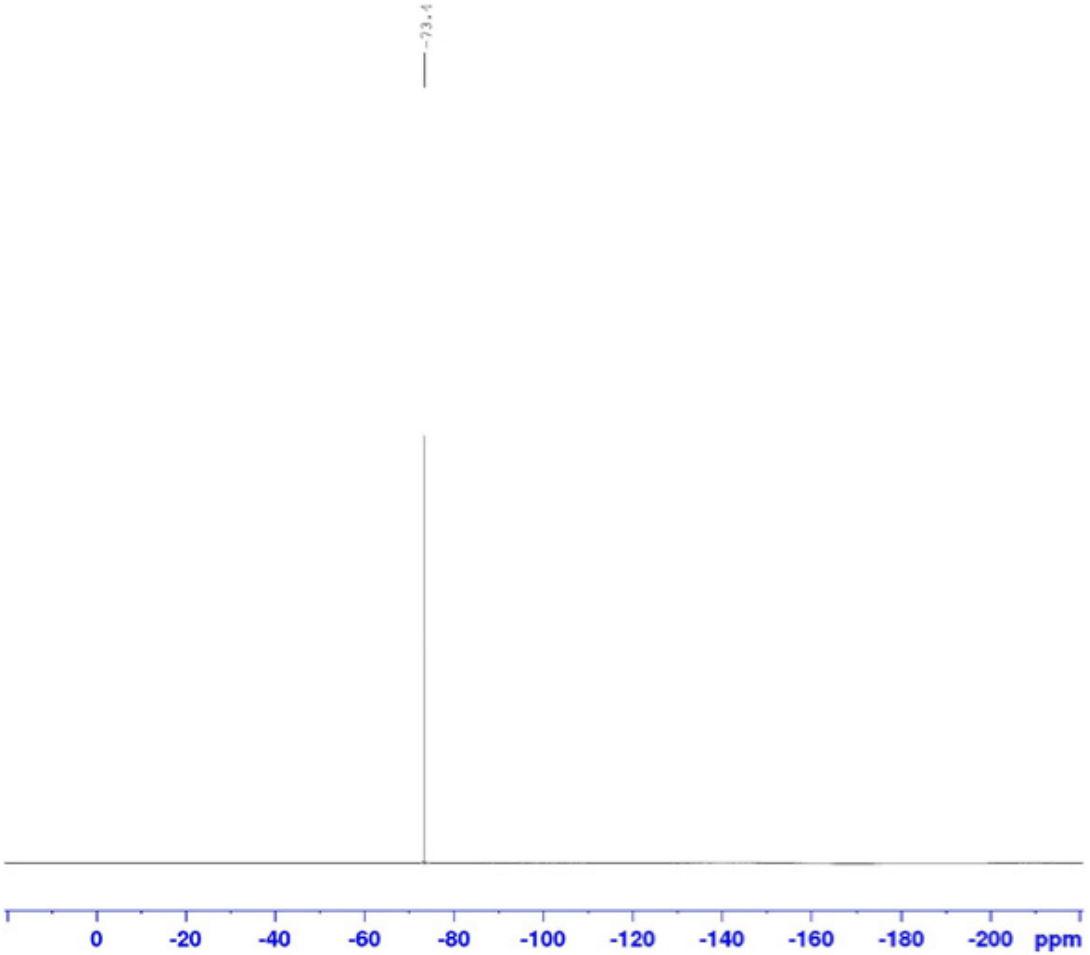

```
Current Data Parameters
NAME                  old nmr
EXPNO                     261
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190517
Time                    5.53
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG              zgpg30
TD                    65536
SOLVENT               CDCl3
NS                      512
DS                        0
SWH               25252.525 Hz
FIDRES             0.385323 Hz
AQ                 1.2976128 sec
RG                    195.85
DW                  19.800 usec
DE                   6.50 usec
TE                   297.6 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1            100.6283629 MHz
NUC1                      13C
P1                     10.50 usec
PLW1           74.00000000 W

======== CHANNEL f2 ========
SFO2            400.1516006 MHz
NUC2                       1H
CPDPRG[2              waltz16
PCPD2                  90.00 usec
PLW2           17.50000000 W
PLW12           0.26142001 W
PLW13           0.13149001 W

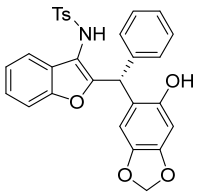
F2 - Processing parameters
SI                        32768
SF              100.6177980 MHz
WDW                         EM
SSB                         0
LB                       1.00 Hz
GB                          0
PC                       1.40
```



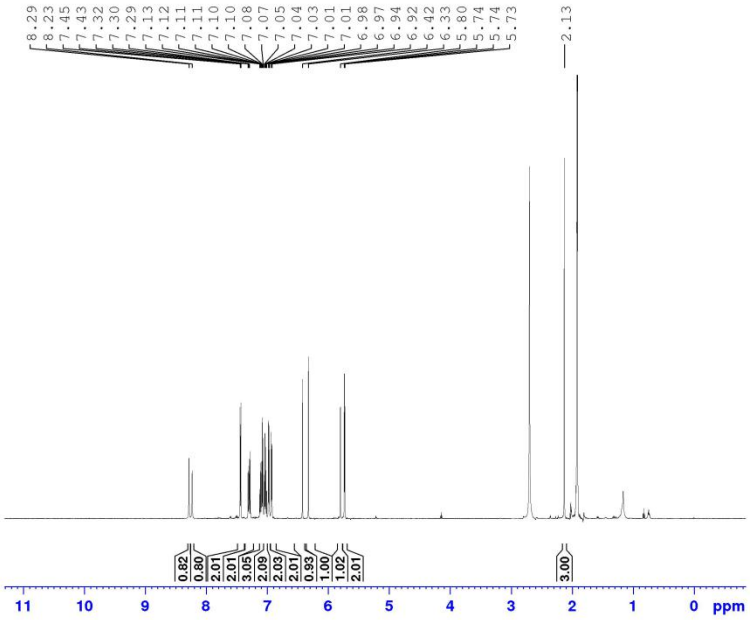

```
Current Data Parameters
NAME                 new nmr
EXPNO                     33
PROCNO                     1

F2 - Acquisition Parameters
Date_              20191214
Time                   1.14 h
INSTRUM              Avance
PROBHD    5116098_0861 (
PULPROG                   zg
TD                    131072
SOLVENT                CDCL3
NS                        16
DS                         4
SWH                93909.094 Hz
FIDRES              1.387163 Hz
AQ                  0.7208960 sec
RG                      101
DW                    5.500 usec
DE                    6.50 usec
TE                    294.3 K
D1                 1.00000000 sec
TD0                        1
SFO1              376.4607164 MHz
NUC1                     19F
P1                    18.00 usec
PLW1              16.38400078 W

F2 - Processing parameters
SI                        65536
SF                376.4983662 MHz
WDW                        EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



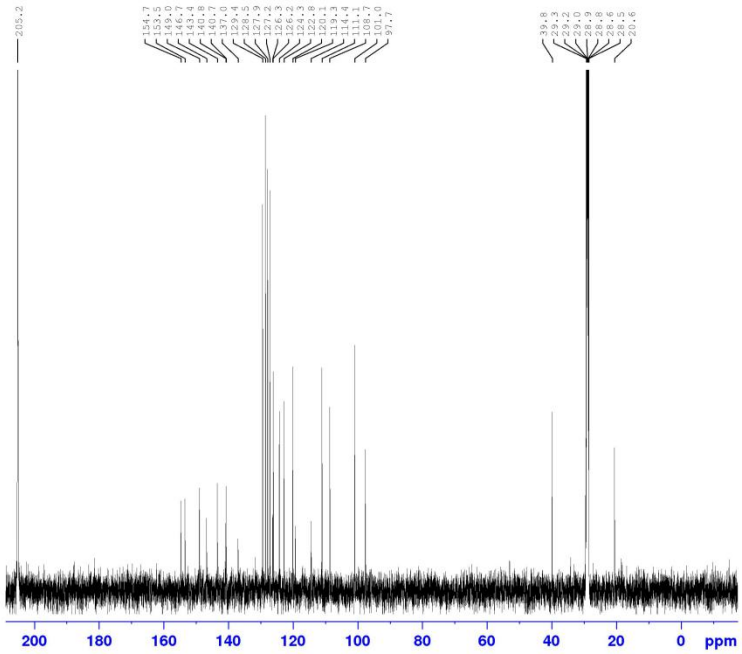

(*R*)-**5a**




```
Current Data Parameters
NAME                  R-22
EXPNO                   50
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190411
Time                 21.35 h
PROBHD    Z114607_0222 (
TD                    65536
SOLVENT             Acetone
NS                        3
DS                        2
RG                    84.87
D1              1.00000000 sec
DS                        2
NS                        3
TD0                       1
SFO1          600.1737060 MHz
NUC1                    1H
P1                   10.00 usec
PLW1          26.09399986 W

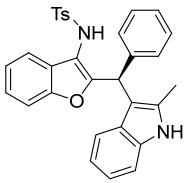
F2 - Processing parameters
SI                    65536
SF            600.1700912 MHz
WDW                     EM
SSB       0
LB                    0.30 Hz
GB        0
PC                    1.00
```



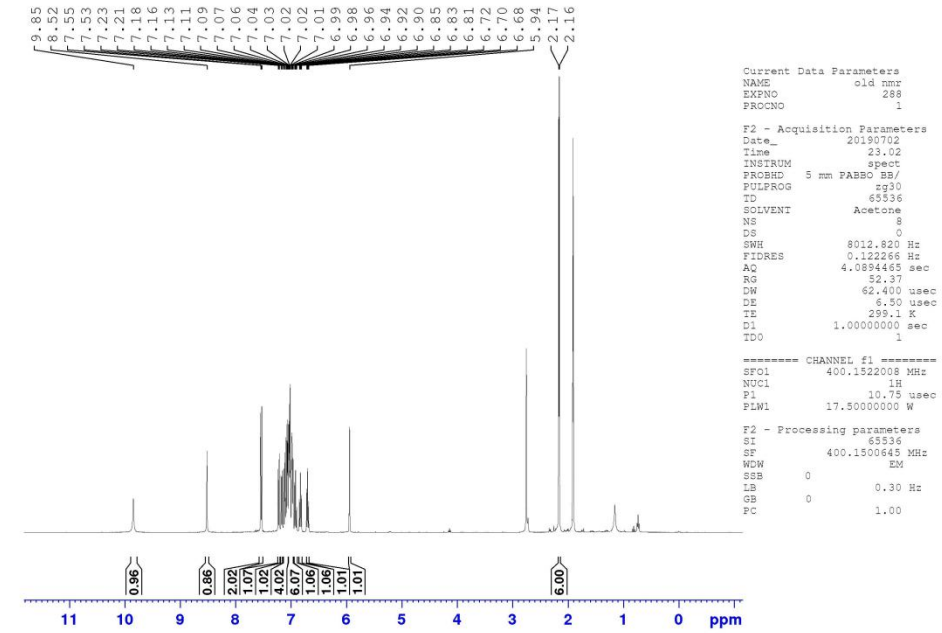

```
Current Data Parameters
NAME                  R-22
EXPNO                   51
PROCNO                   1

F2 - Acquisition Parameters
Date_              20190411
Time                 21.49 h
PROBHD    Z114607_0222 (
TD                    65536
SOLVENT             Acetone
NS                      256
DS                        4
RG                   188.35
D1              2.00000000 sec
D11             0.03000000 sec
DS                        4
NS                      256
TD0                       1
SFO1          150.9279578 MHz
NUC1                   13C
P1                   12.00 usec
PLW1          97.67099762 W
SFO2          600.1724007 MHz
NUC2                    1H
CPDPRG[2          waltz16
PCPD2                80.00 usec
PLW2          26.09399986 W
PLW12          0.40399119 W
PLW13          0.20248041 W

F2 - Processing parameters
SI                    32768
SF            150.9128665 MHz
WDW                     EM
SSB       0
LB                    2.00 Hz
GB        0
PC                    1.40
```




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

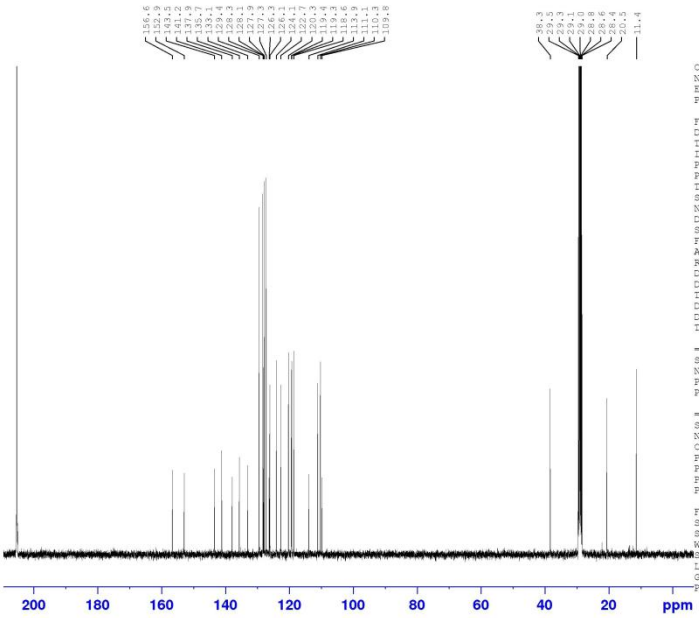



```
Current Data Parameters
NAME                  old nmr
EXPNO                     288
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190702
Time                   23.02
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT             Acetone
NS                          8
DS                          0
SWH                8012.820 Hz
FIDRES            0.122266 Hz
AQ                4.0894465 sec
RG                     52.37
DW                   62.400 usec
DE                    6.50 usec
TE                   299.1 K
D1                1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1            400.1522008 MHz
NUC1                      1H
P1                     10.75 usec
PLW1            17.50000000 W

F2 - Processing parameters
SI                      65536
SF              400.1500645 MHz
WDW                        EM
SSB                         0
LB                      0.30 Hz
GB                          0
PC                      1.00
```



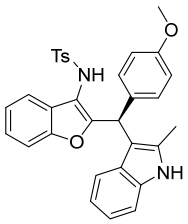

```
Current Data Parameters
NAME                  old nmr
EXPNO                     289
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190702
Time                   23.37
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG              zgpg30
TD                    65536
SOLVENT             Acetone
NS                        600
DS                          0
SWH               25252.525 Hz
FIDRES            0.385323 Hz
AQ                1.2976128 sec
RG                     195.85
DW                   19.800 usec
DE                    6.50 usec
TE                   299.6 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                         1

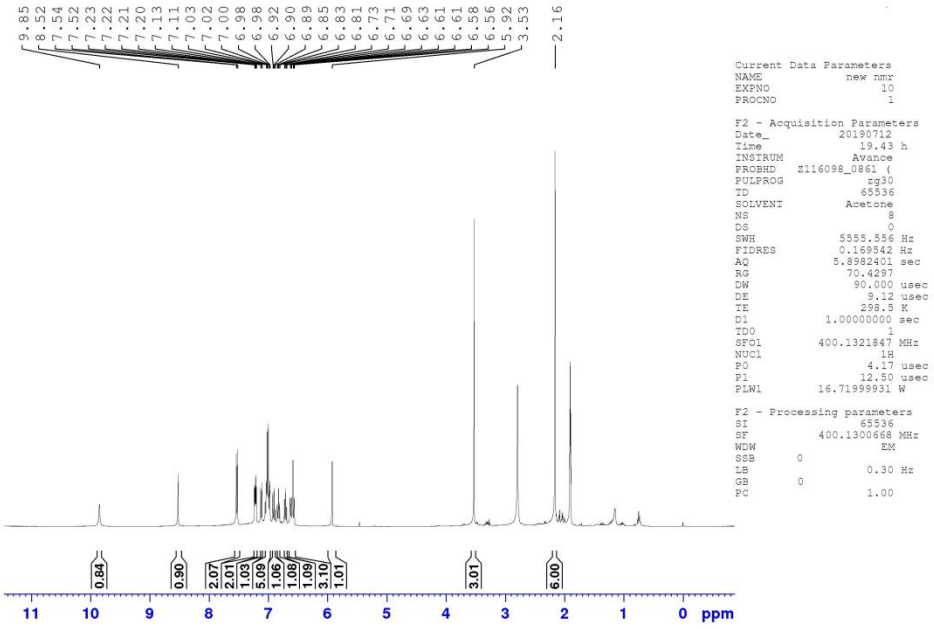
======== CHANNEL f1 ========
SFO1            100.6283629 MHz
NUC1                      13C
P1                    10.50 usec
PLW1            74.00000000 W

======== CHANNEL f2 ========
SFO2            400.1516006 MHz
NUC2                      1H
CPDPRG[2            waltz16
PCPD2                 90.00 usec
PLW2            17.50000000 W
PLW12            0.26142001 W
PLW13            0.13149001 W

F2 - Processing parameters
SI                      32768
SF              100.6177980 MHz
WDW                        EM
SSB                         0
LB                      1.00 Hz
GB                          0
PC                      1.40
```



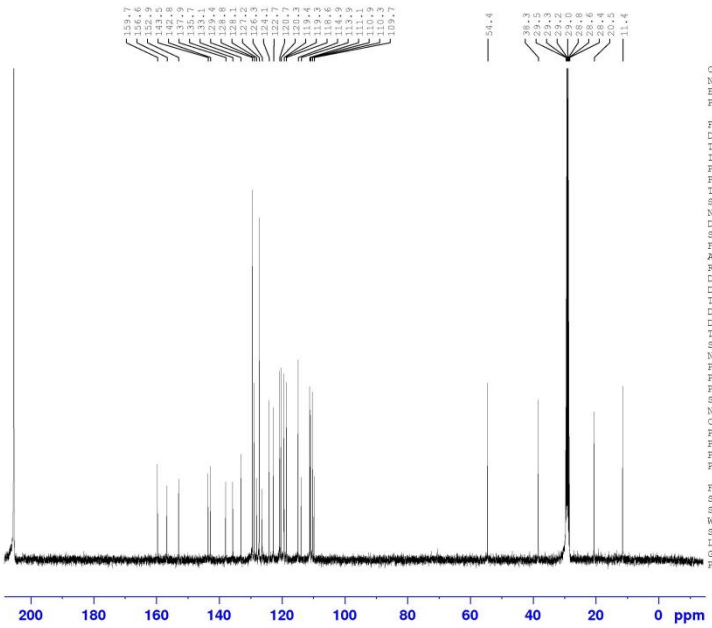

(*S*)-**7b**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      10
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190712
Time                  19.43 h
INSTRUM               Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                           8
DS                           0
SWH                5555.556 Hz
FIDRES            0.169542 Hz
AQ                 5.8982401 sec
RG                   70.4297
DW                   90.000 usec
DE                    9.12 usec
TE                   298.5 K
D1                1.00000000 sec
TD0                          1
SFO1           400.1321847 MHz
NUC1                      1H
P0                    4.17 usec
P1                   12.50 usec
PLW1           16.71999931 W

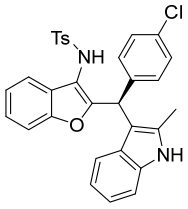
F2 - Processing parameters
SI                     65536
SF              400.1300668 MHz
WDW                       EM
SSB          0
LB                    0.30 Hz
GB           0
PC                    1.00
```



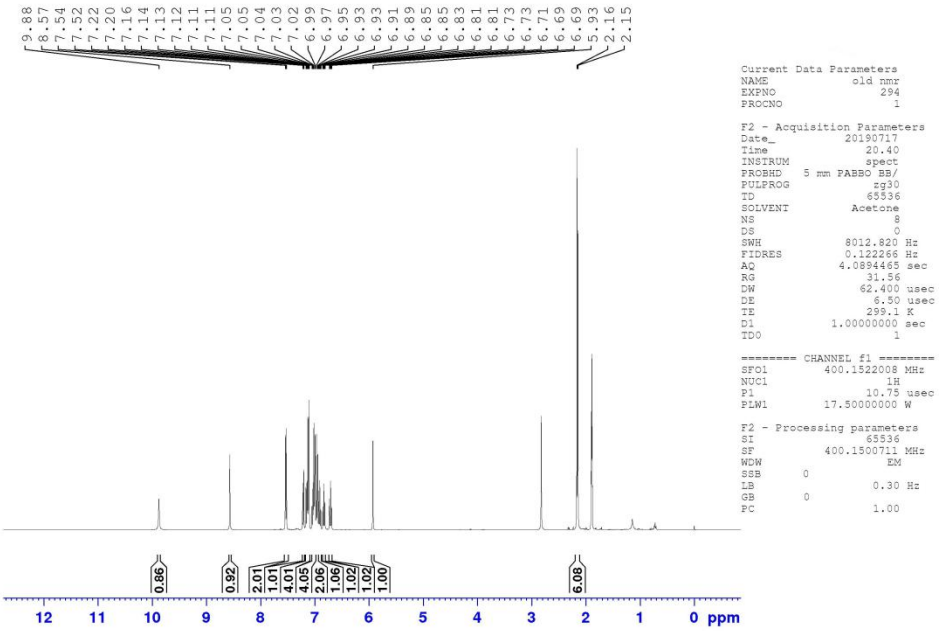

```
Current Data Parameters
NAME                  new nmr
EXPNO                      11
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190712
Time                  20.02 h
INSTRUM               Avance
PROBHD    Z116098_0861 (
PULPROG              zgpg30
TD                     65536
SOLVENT              Acetone
NS                         321
DS                           0
SWH               25000.000 Hz
FIDRES            0.762939 Hz
AQ                 1.3107200 sec
RG                       101
DW                  20.000 usec
DE                    6.50 usec
TE                   299.1 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                          1
SFO1           100.6238359 MHz
NUC1                      13C
P0                    4.00 usec
P1                   12.00 usec
PLW1           75.41799927 W
SFO2           400.1316005 MHz
NUC2                      1H
CPDPRG[2          waltz65
PCPD2                80.00 usec
PLW2           16.71999931 W
PLW12           0.34549999 W
PLW13           0.17351000 W

F2 - Processing parameters
SI                     32768
SF             100.6127685 MHz
WDW                       EM
SSB          0
LB                    1.00 Hz
GB           0
PC                    1.40
```




(*S*)-**7c**

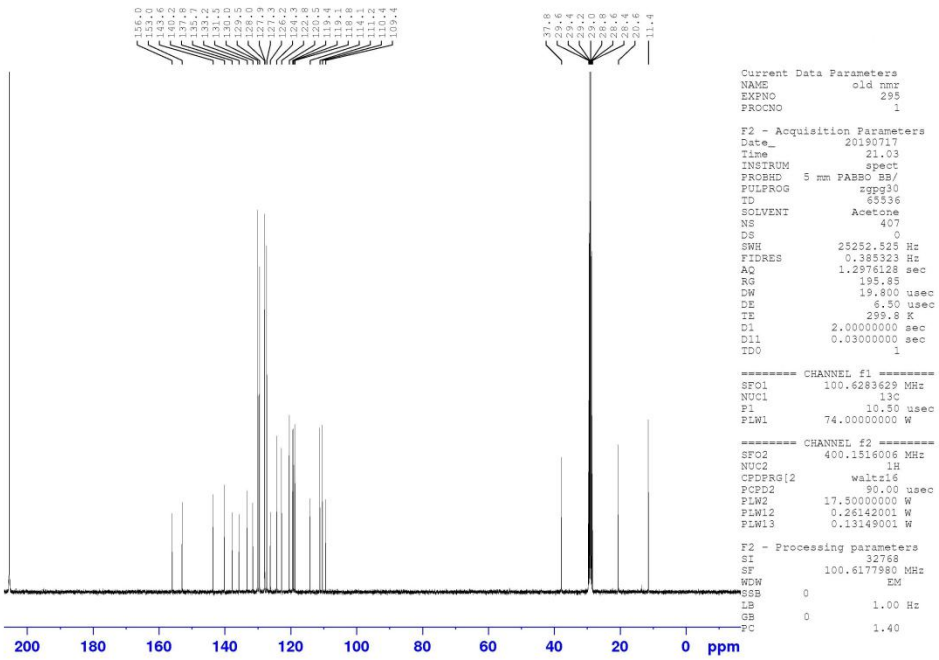



```
Current Data Parameters
NAME                  old nmr
EXPNO                     294
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                   20.40
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG                zg30
TD                    65536
SOLVENT             Acetone
NS                          8
DS                          0
SWH                8012.820 Hz
FIDRES             0.122266 Hz
AQ                 4.0894465 sec
RG                     31.56
DW                   62.400 usec
DE                    6.50 usec
TE                   299.1 K
D1                1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
SFO1            400.1522008 MHz
NUC1                       1H
P1                      10.75 usec
PLW1             17.50000000 W

F2 - Processing parameters
SI                        65536
SF              400.1500711 MHz
WDW                        EM
SSB          0
LB                      0.30 Hz
GB           0
PC                      1.00
```



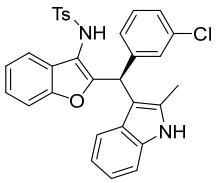

```
Current Data Parameters
NAME                  old nmr
EXPNO                     295
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                   21.03
INSTRUM                spect
PROBHD    5 mm PABBO BB/
PULPROG             zgpg30
TD                    65536
SOLVENT             Acetone
NS                        407
DS                          0
SWH               25252.525 Hz
FIDRES             0.385323 Hz
AQ                 1.2976128 sec
RG                    195.85
DW                   19.800 usec
DE                    6.50 usec
TE                   299.8 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                         1

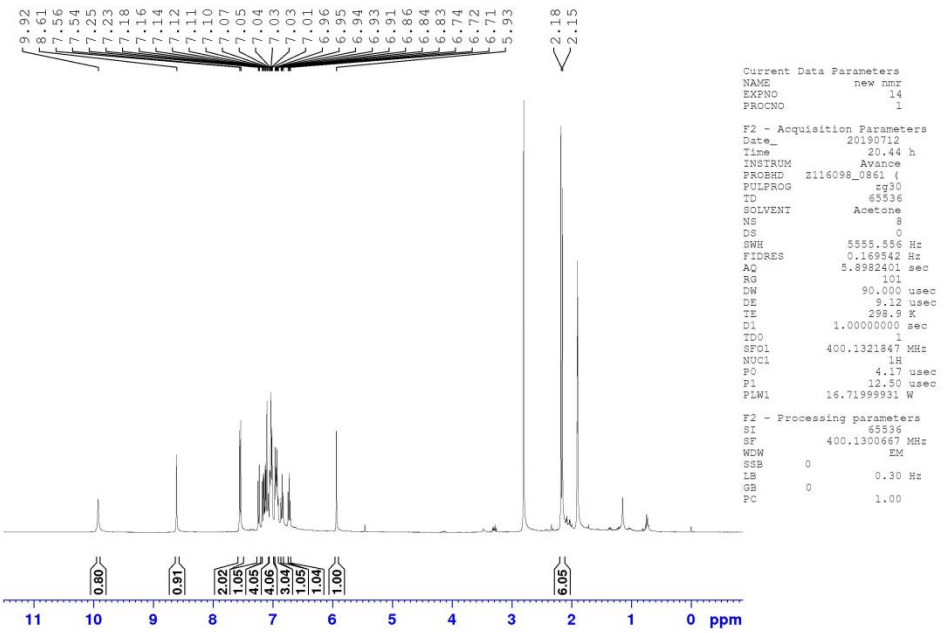
======== CHANNEL f1 ========
SFO1            100.6283629 MHz
NUC1                       13C
P1                      10.50 usec
PLW1             74.00000000 W

======== CHANNEL f2 ========
SFO2            400.1516006 MHz
NUC2                       1H
CPDPRG[2             waltz16
PCPD2                  90.00 usec
PLW2             17.50000000 W
PLW12             0.26142001 W
PLW13             0.13149001 W

F2 - Processing parameters
SI                        32768
SF              100.6177980 MHz
WDW                        EM
SSB          0
LB                      1.00 Hz
GB           0
PC                      1.40
```



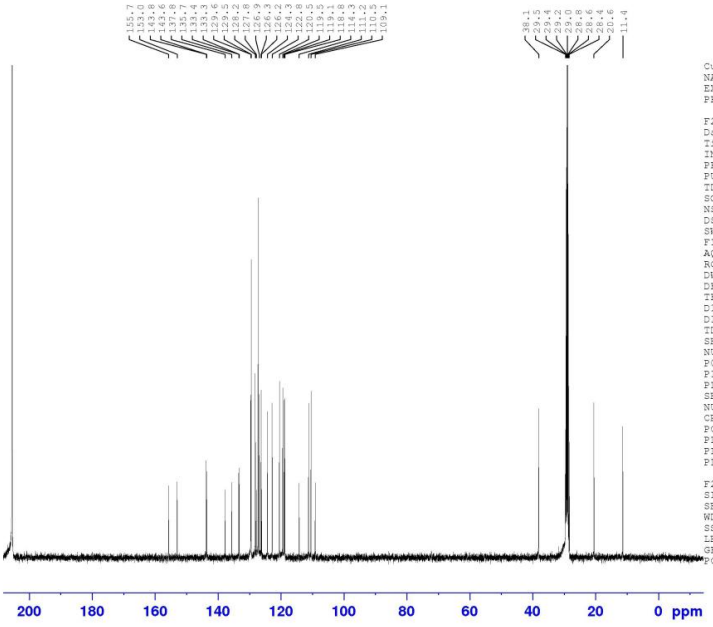

(*S*)-**7d**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      14
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190712
Time                   20.44 h
INSTRUM               Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT             Acetone
NS                         8
DS                         0
SWH                 5555.556 Hz
FIDRES              0.169542 Hz
AQ                  5.8982401 sec
RG                       101
DW                    90.000 usec
DE                     9.12 usec
TE                    298.9 K
D1                  1.00000000 sec
TD0                        1
SFO1             400.1321847 MHz
NUC1                      1H
P0                     4.17 usec
P1                    12.50 usec
PLW1            16.71999931 W

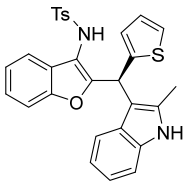
F2 - Processing parameters
SI                     65536
SF               400.1300667 MHz
WDW                       EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



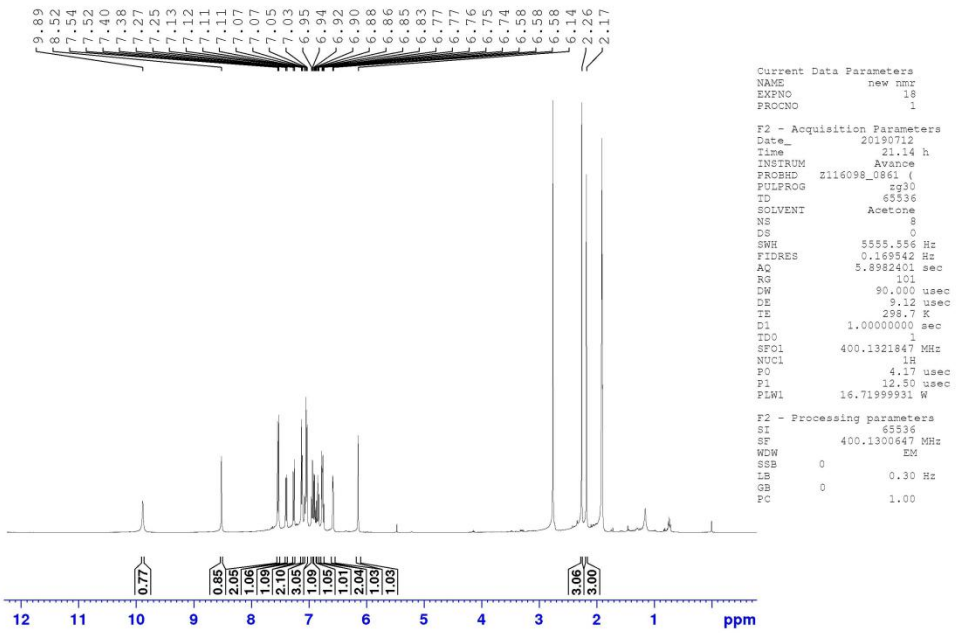

```
Current Data Parameters
NAME                  new nmr
EXPNO                      15
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190712
Time                   21.05 h
INSTRUM               Avance
PROBHD    Z116098_0861 (
PULPROG                zgpg30
TD                     65536
SOLVENT             Acetone
NS                       364
DS                         0
SWH                25000.000 Hz
FIDRES              0.762939 Hz
AQ                  1.3107200 sec
RG                    65.2085
DW                    20.000 usec
DE                     6.50 usec
TE                    299.3 K
D1                  2.00000000 sec
D11                 0.03000000 sec
TD0                        1
SFO1             100.6238359 MHz
NUC1                      13C
P0                     4.00 usec
P1                    12.00 usec
PLW1             75.41799927 W
SFO2             400.1316005 MHz
NUC2                      1H
CPDPRG[2              waltz65
PCPD2                 80.00 usec
PLW2             16.71999931 W
PLW12             0.34549999 W
PLW13             0.17351000 W

F2 - Processing parameters
SI                     32768
SF               100.6127685 MHz
WDW                       EM
SSB          0
LB                     1.00 Hz
GB           0
PC                     1.40
```



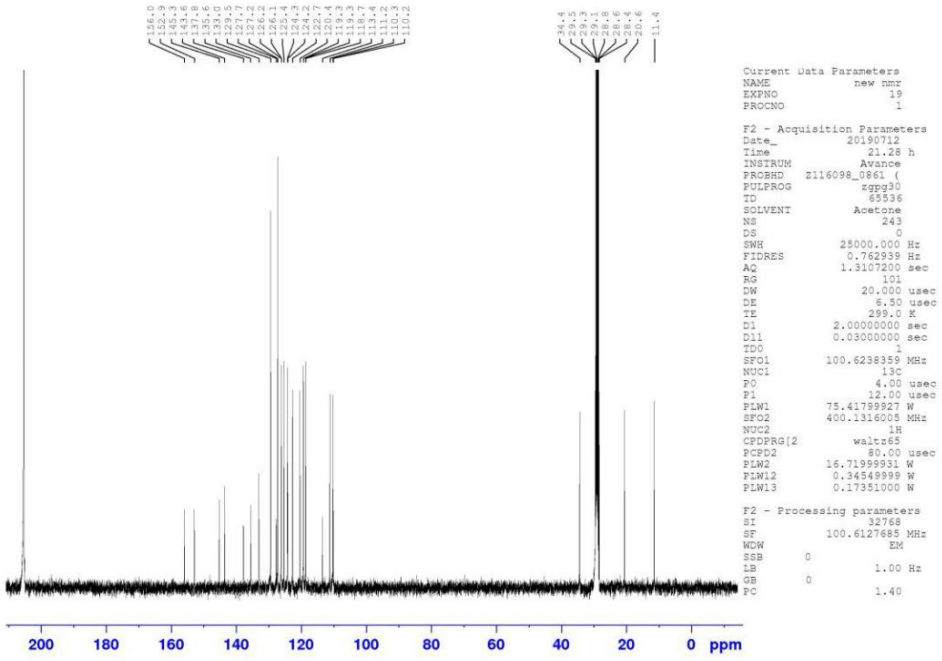

(*S*)-**7e**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      18
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190712
Time                   21.14 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                           8
DS                           0
SWH                 5555.556 Hz
FIDRES              0.169542 Hz
AQ                  5.8982401 sec
RG                         101
DW                    90.000 usec
DE                     9.12 usec
TE                     298.7 K
D1                1.00000000 sec
TD0                          1
SFO1             400.1321847 MHz
NUC1                       1H
P0                     4.17 usec
P1                    12.50 usec
PLW1             16.71999931 W

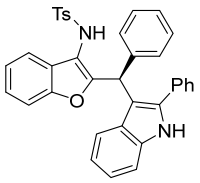
F2 - Processing parameters
SI                       65536
SF               400.1300647 MHz
WDW                         EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



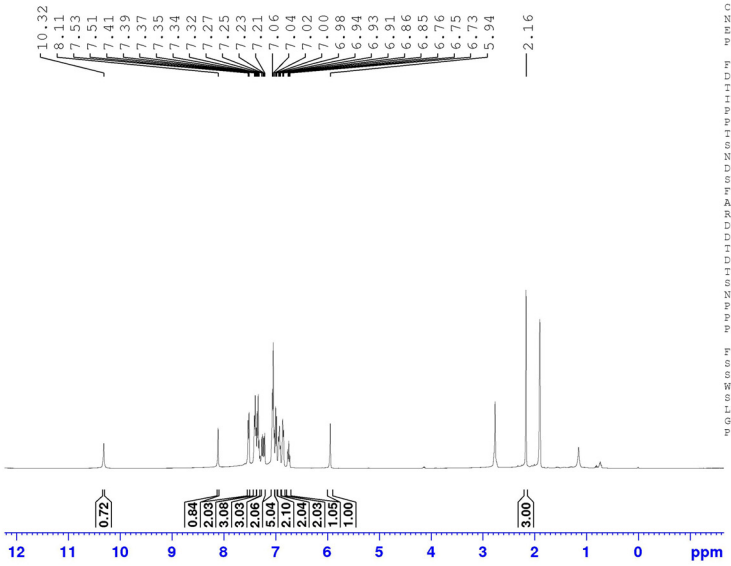

```
Current Data Parameters
NAME                  new nmr
EXPNO                      19
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190712
Time                   21.28 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG               zgpg30
TD                     65536
SOLVENT              Acetone
NS                         243
DS                           0
SWH                25000.000 Hz
FIDRES              0.762939 Hz
AQ                  1.3107200 sec
RG                         101
DW                    20.000 usec
DE                     6.50 usec
TE                     299.0 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                          1
SFO1             100.6238359 MHz
NUC1                       13C
P0                     4.00 usec
P1                    12.00 usec
PLW1             75.41799927 W
SFO2             400.1316005 MHz
NUC2                       1H
CPDPRG[2              waltz65
PCPD2                 80.00 usec
PLW2             16.71999931 W
PLW12             0.34549999 W
PLW13             0.17351000 W

F2 - Processing parameters
SI                       32768
SF               100.6127685 MHz
WDW                         EM
SSB          0
LB                     1.00 Hz
GB           0
PC                     1.40
```



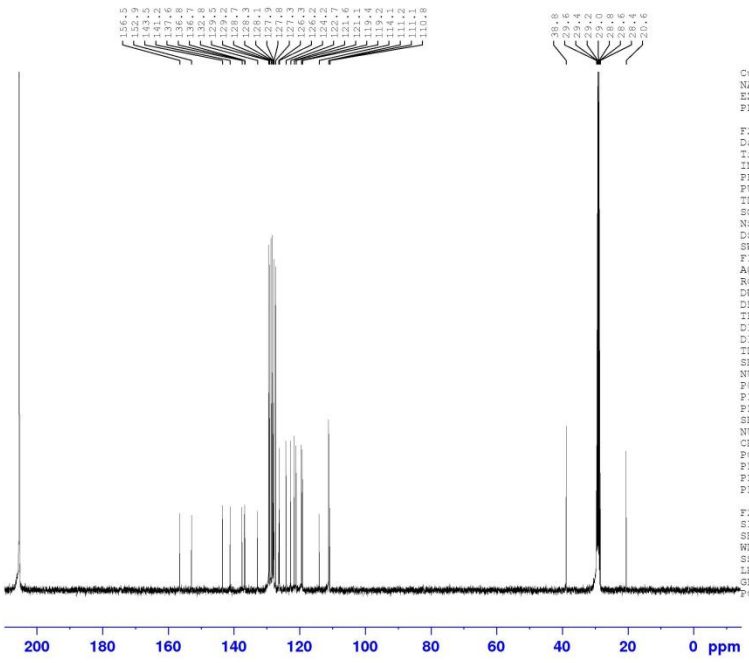

(*S*)-**7f**




```
Current Data Parameters
NAME                  new nmr
EXPNO                       6
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190702
Time                    2.36 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                          8
DS                          0
SWH                5555.556 Hz
FIDRES            0.169542 Hz
AQ                 5.8982401 sec
RG                        101
DW                   90.000 usec
DE                    9.12 usec
TE                    296.8 K
D1                 1.00000000 sec
TD0                         1
SFO1             400.1321847 MHz
NUC1                       1H
P0                    4.17 usec
P1                   12.50 usec
PLW1             16.71999931 W

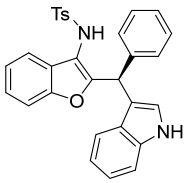
F2 - Processing parameters
SI                         65536
SF               400.1300678 MHz
WDW                          EM
SSB          0
LB                    0.30 Hz
GB           0
PC                    1.00
```



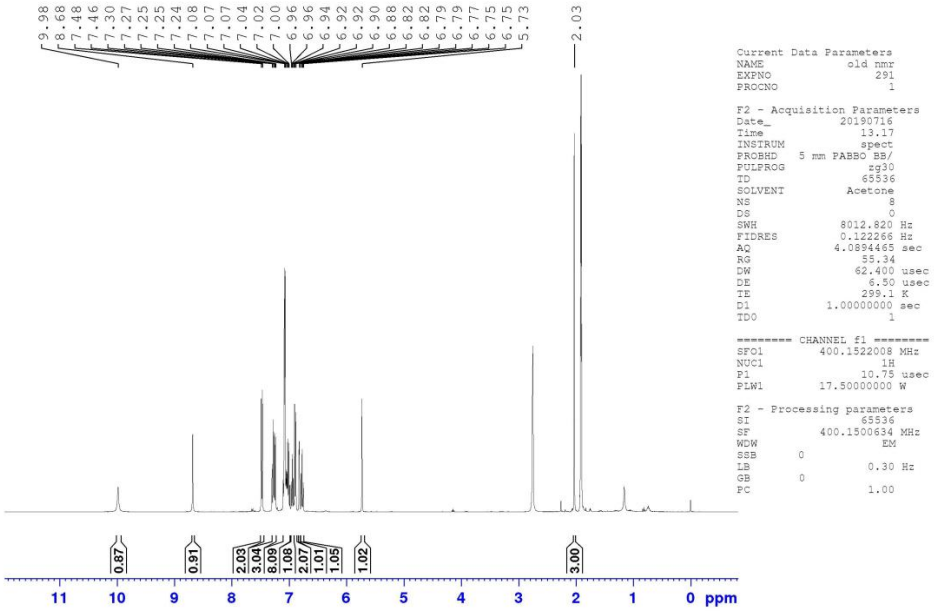

```
Current Data Parameters
NAME                  new nmr
EXPNO                       7
PROCNO                      1

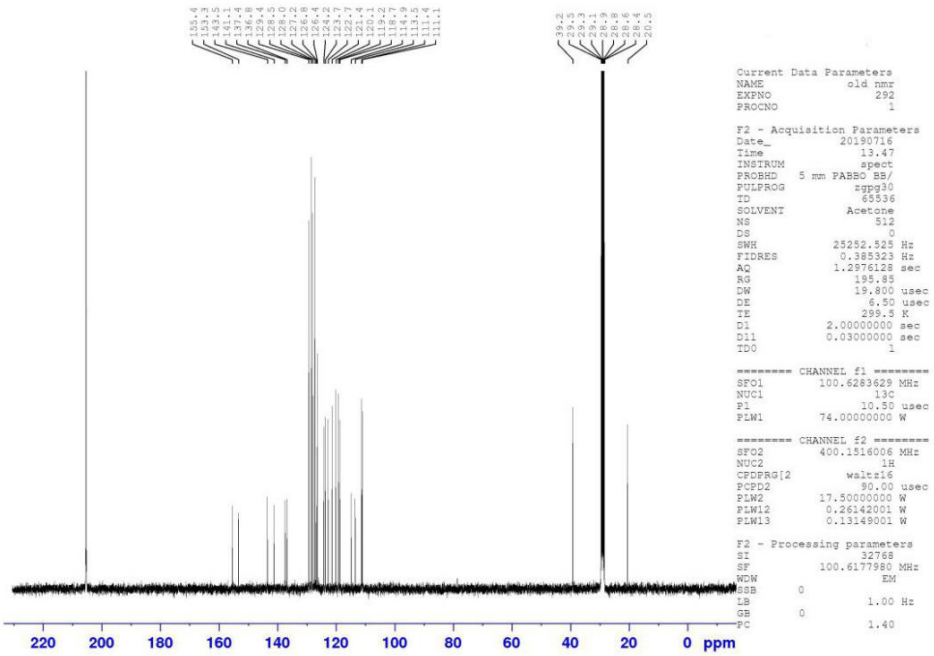
F2 - Acquisition Parameters
Date_               20190702
Time                    3.05 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG              zgpg30
TD                     65536
SOLVENT              Acetone
NS                         512
DS                          0
SWH               25000.000 Hz
FIDRES            0.762939 Hz
AQ                 1.3107200 sec
RG                        101
DW                   20.000 usec
DE                    6.50 usec
TE                    297.5 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                         1
SFO1             100.6238359 MHz
NUC1                       13C
P0                    4.00 usec
P1                   12.00 usec
PLW1             75.41799927 W
SFO2             400.1316005 MHz
NUC2                       1H
CPDPRG[2              waltz65
PCPD2                80.00 usec
PLW2             16.71999931 W
PLW12             0.34549999 W
PLW13             0.17351000 W

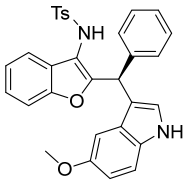
F2 - Processing parameters
SI                         32768
SF               100.6127685 MHz
WDW                          EM
SSB          0
LB                    1.00 Hz
GB           0
PC                    1.40
```


Ts
NH
O
NH

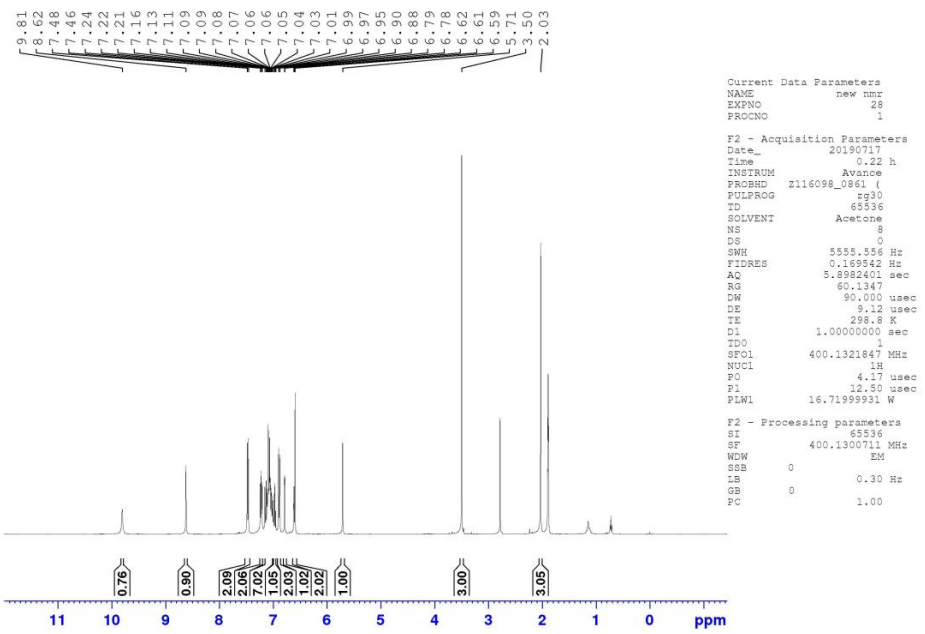
(*S*)-**7g**


9.98
8.68
7.48
7.46
7.30
7.27
7.25
7.25
7.24
7.08
7.07
7.07
7.04
7.02
7.00
6.96
6.96
6.94
6.92
6.92
6.90
6.88
6.82
6.82
6.79
6.79
6.77
6.75
6.75
5.73
2.03
0.87
0.91
2.03
3.04
8.09
1.08
2.07
1.01
1.05
1.02
3.00
11 10 9 8 7 6 5 4 3 2 1 0 ppm
Current Data Parameters
NAME old nmr
EXPNO 291
PROCNO 1
F2 - Acquisition Parameters
Date_ 20190716
Time 13.17
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zg30
TD 65536
SOLVENT Acetone
NS 8
DS 0
SWH 8012.820 Hz
FIDRES 0.122266 Hz
AQ 4.0894465 sec
RG 55.34
DW 62.400 usec
DE 6.50 usec
TE 299.1 K
D1 1.00000000 sec
TD0 1
======== CHANNEL f1 ========
SFO1 400.1522008 MHz
NUC1 1H
P1 10.75 usec
PLW1 17.50000000 W
F2 - Processing parameters
SI 65536
SF 400.1500634 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00


155.4
153.3
143.5
141.1
137.4
136.8
129.4
128.5
127.2
126.8
126.4
124.2
123.7
122.7
121.4
120.1
119.2
118.8
118.7
114.9
113.5
111.4
111.1
39.2
29.5
29.3
29.1
28.9
28.8
28.6
28.4
20.5
220 200 180 160 140 120 100 80 60 40 20 0 ppm
Current Data Parameters
NAME old nmr
EXPNO 292
PROCNO 1
F2 - Acquisition Parameters
Date_ 20190716
Time 13.47
INSTRUM spect
PROBHD 5 mm PABBO BB/
PULPROG zgpg30
TD 65536
SOLVENT Acetone
NS 512
DS 0
SWH 25252.525 Hz
FIDRES 0.385323 Hz
AQ 1.2976128 sec
RG 195.85
DW 19.800 usec
DE 6.50 usec
TE 299.5 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1
======== CHANNEL f1 ========
SFO1 100.6283629 MHz
NUC1 13C
P1 10.50 usec
PLW1 74.00000000 W
======== CHANNEL f2 ========
SFO2 400.1516006 MHz
NUC2 1H
CPDPRG[2 waltz16
PCPD2 90.00 usec
PLW2 17.50000000 W
PLW12 0.26142001 W
PLW13 0.13149001 W
F2 - Processing parameters
SI 32768
SF 100.6177980 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



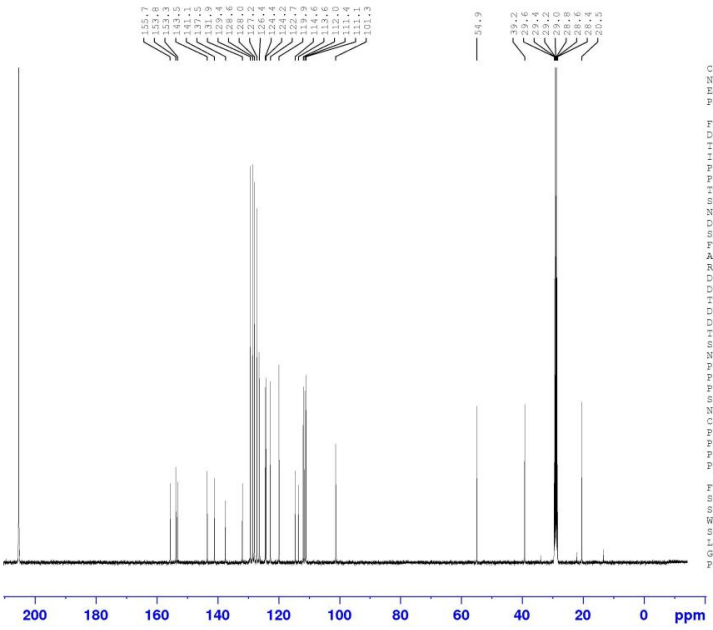

(*S*)-**7h**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      28
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                    0.22 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                         8
DS                         0
SWH                 5555.556 Hz
FIDRES              0.169542 Hz
AQ                  5.8982401 sec
RG                     60.1347
DW                    90.000 usec
DE                     9.12 usec
TE                     298.8 K
D1                1.00000000 sec
TD0                        1
SFO1             400.1321847 MHz
NUC1                       1H
P0                     4.17 usec
P1                    12.50 usec
PLW1             16.71999931 W

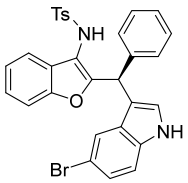
F2 - Processing parameters
SI                         65536
SF               400.1300711 MHz
WDW                        EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



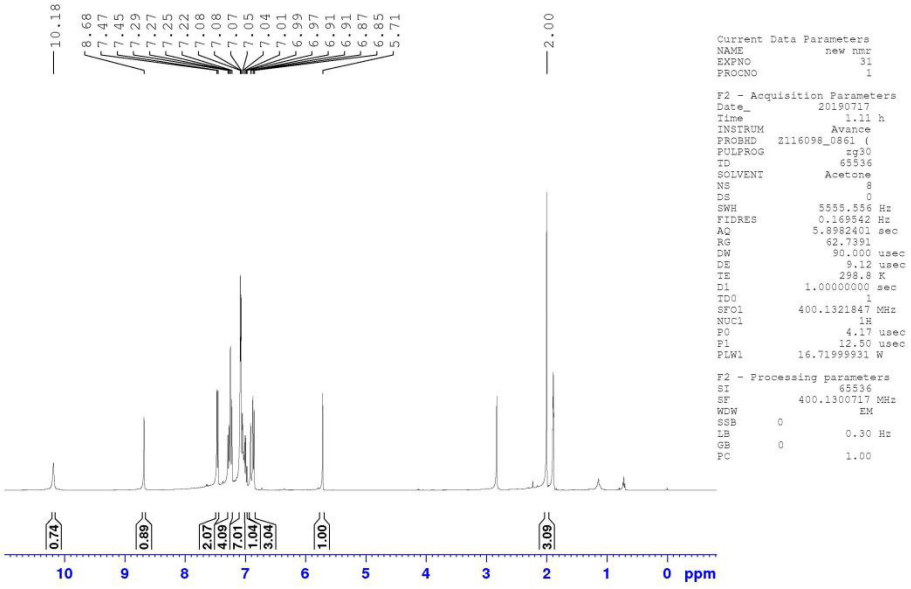

```
Current Data Parameters
NAME                  new nmr
EXPNO                      29
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                    0.52 h
INSTRUM                Avance
PROBHD    Z116098_0861 (
PULPROG                zgpg30
TD                     65536
SOLVENT              Acetone
NS                       512
DS                         0
SWH                25000.000 Hz
FIDRES              0.762939 Hz
AQ                  1.3107200 sec
RG                     67.8168
DW                    20.000 usec
DE                     6.50 usec
TE                     299.4 K
D1                2.00000000 sec
D11               0.03000000 sec
TD0                        1
SFO1             100.6238359 MHz
NUC1                       13C
P0                     4.00 usec
P1                    12.00 usec
PLW1             75.41799927 W
SFO2             400.1316005 MHz
NUC2                       1H
CPDPRG[2              waltz65
PCPD2                 80.00 usec
PLW2             16.71999931 W
PLW12             0.34549999 W
PLW13             0.17351000 W

F2 - Processing parameters
SI                         32768
SF               100.6127685 MHz
WDW                        EM
SSB          0
LB                     1.00 Hz
GB           0
PC                     1.40
```



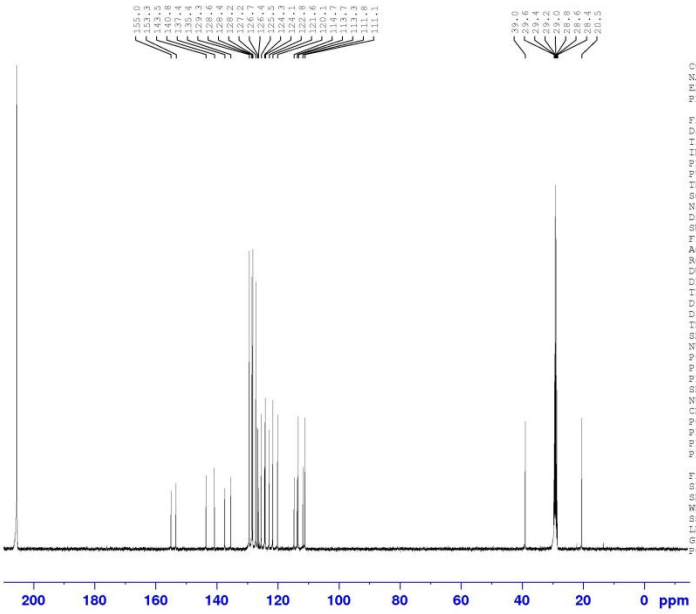

(*S*)-**7i**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      31
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                    1.11 h
INSTRUM                Avance
PROBHD   Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                           8
DS                           0
SWH                  5555.556 Hz
FIDRES               0.169542 Hz
AQ                   5.8982401 sec
RG                     62.7391
DW                      90.000 usec
DE                       9.12 usec
TE                      298.8 K
D1                   1.00000000 sec
TD0                          1
SFO1               400.1321847 MHz
NUC1                        1H
P0                       4.17 usec
P1                      12.50 usec
PLW1               16.71999931 W

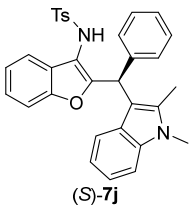
F2 - Processing parameters
SI                       65536
SF                 400.1300717 MHz
WDW                         EM
SSB                  0
LB                       0.30 Hz
GB                   0
PC                       1.00
```



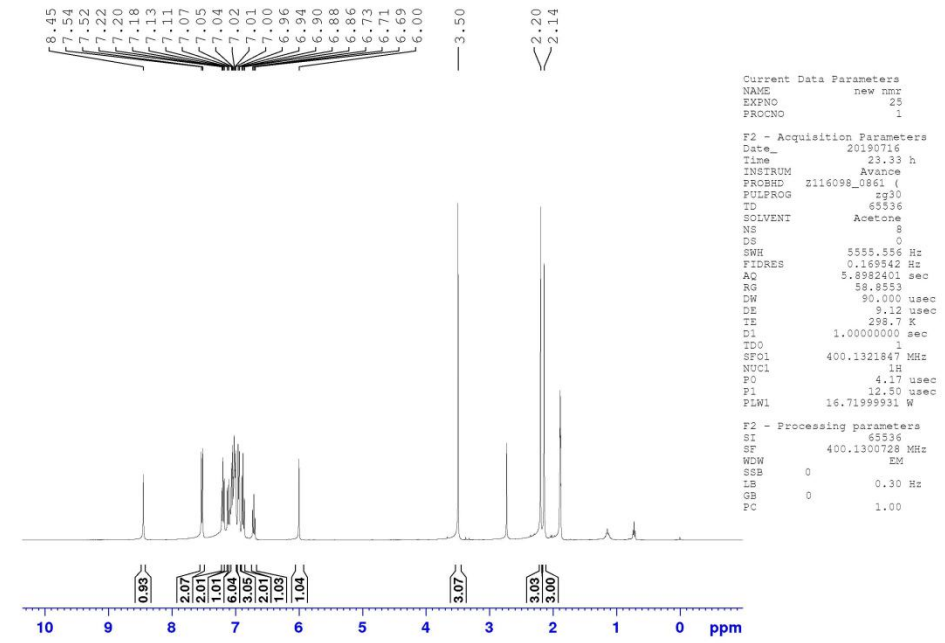

```
Current Data Parameters
NAME                  new nmr
EXPNO                      32
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                    1.41 h
INSTRUM                Avance
PROBHD   Z116098_0861 (
PULPROG              zgpg30
TD                     65536
SOLVENT              Acetone
NS                         512
DS                           0
SWH                 25000.000 Hz
FIDRES               0.762939 Hz
AQ                   1.3107200 sec
RG                     65.2085
DW                      20.000 usec
DE                       6.50 usec
TE                      299.4 K
D1                   2.00000000 sec
D11                  0.03000000 sec
TD0                          1
SFO1               100.6238359 MHz
NUC1                        13c
P0                       4.00 usec
P1                      12.00 usec
PLW1                75.41799927 W
SFO2               400.1316005 MHz
NUC2                        1H
CPDPRG[2                waltz65
PCPD2                   80.00 usec
PLW2                16.71999931 W
PLW12                0.34549999 W
PLW13                0.17351000 W

F2 - Processing parameters
SI                       32768
SF                 100.6127685 MHz
WDW                         EM
SSB                  0
LB                       1.00 Hz
GB                   0
PC                       1.40
```



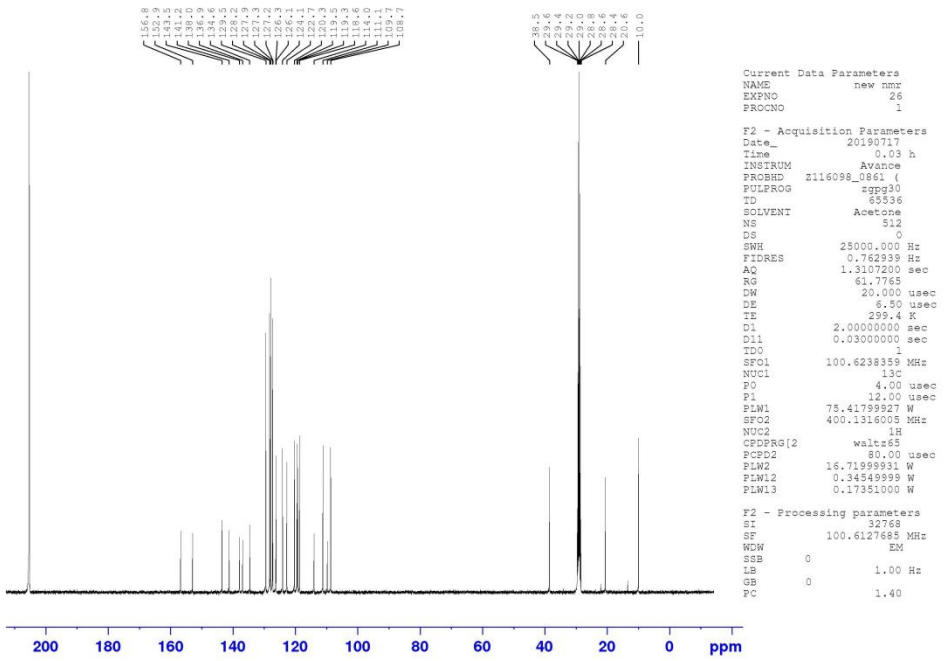

(*S*)-**7j**




```
Current Data Parameters
NAME                  new nmr
EXPNO                      25
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190716
Time                   23.33 h
INSTRUM               Avance
PROBHD    Z116098_0861 (
PULPROG                 zg30
TD                     65536
SOLVENT              Acetone
NS                           8
DS                           0
SWH                 5555.556 Hz
FIDRES              0.169542 Hz
AQ                  5.8982401 sec
RG                     58.8553
DW                    90.000 usec
DE                     9.12 usec
TE                     298.7 K
D1                  1.00000000 sec
TD0                          1
SFO1             400.1321847 MHz
NUC1                        1H
P0                     4.17 usec
P1                    12.50 usec
PLW1             16.71999931 W

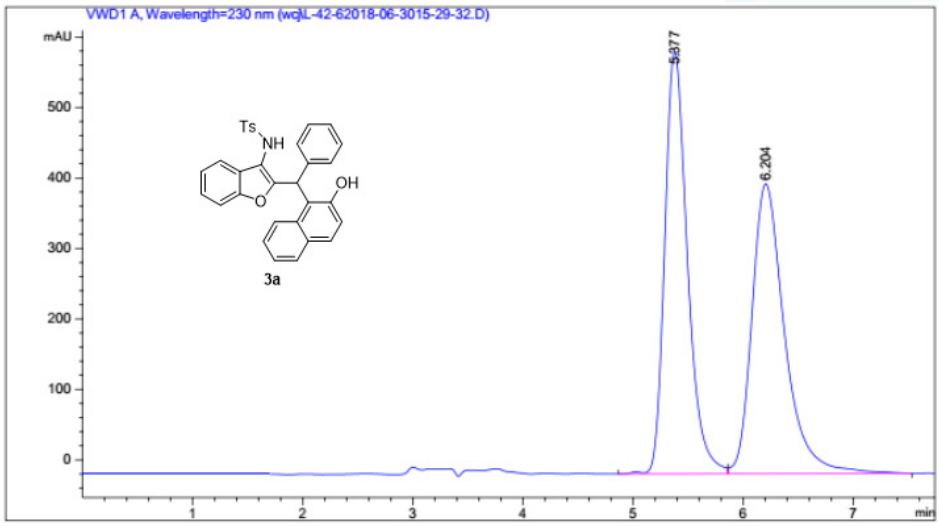
F2 - Processing parameters
SI                         65536
SF                  400.1300728 MHz
WDW                           EM
SSB          0
LB                     0.30 Hz
GB           0
PC                     1.00
```



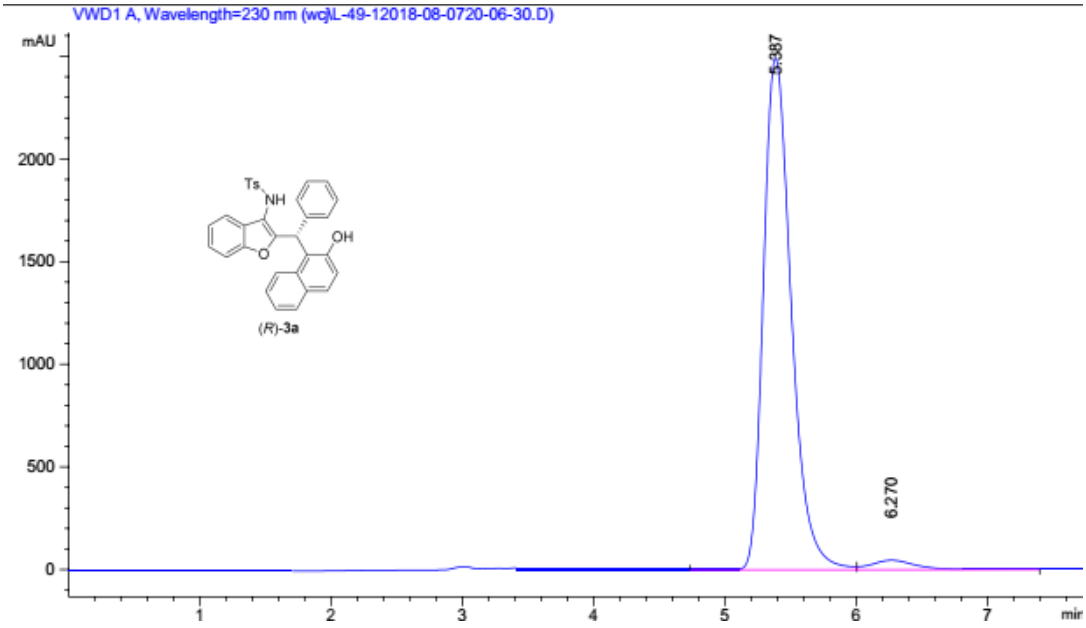

```
Current Data Parameters
NAME                  new nmr
EXPNO                      26
PROCNO                      1

F2 - Acquisition Parameters
Date_               20190717
Time                    0.03 h
INSTRUM               Avance
PROBHD    Z116098_0861 (
PULPROG                zgpg30
TD                     65536
SOLVENT              Acetone
NS                         512
DS                           0
SWH                25000.000 Hz
FIDRES              0.762939 Hz
AQ                  1.3107200 sec
RG                     61.7765
DW                    20.000 usec
DE                     6.50 usec
TE                     299.4 K
D1                  2.00000000 sec
D11                 0.03000000 sec
TD0                          1
SFO1             100.6238359 MHz
NUC1                       13C
P0                     4.00 usec
P1                    12.00 usec
PLW1             75.41799927 W
SFO2             400.1316005 MHz
NUC2                        1H
CPDPRG[2              waltz65
PCPD2                 80.00 usec
PLW2             16.71999931 W
PLW12             0.34549999 W
PLW13             0.17351000 W

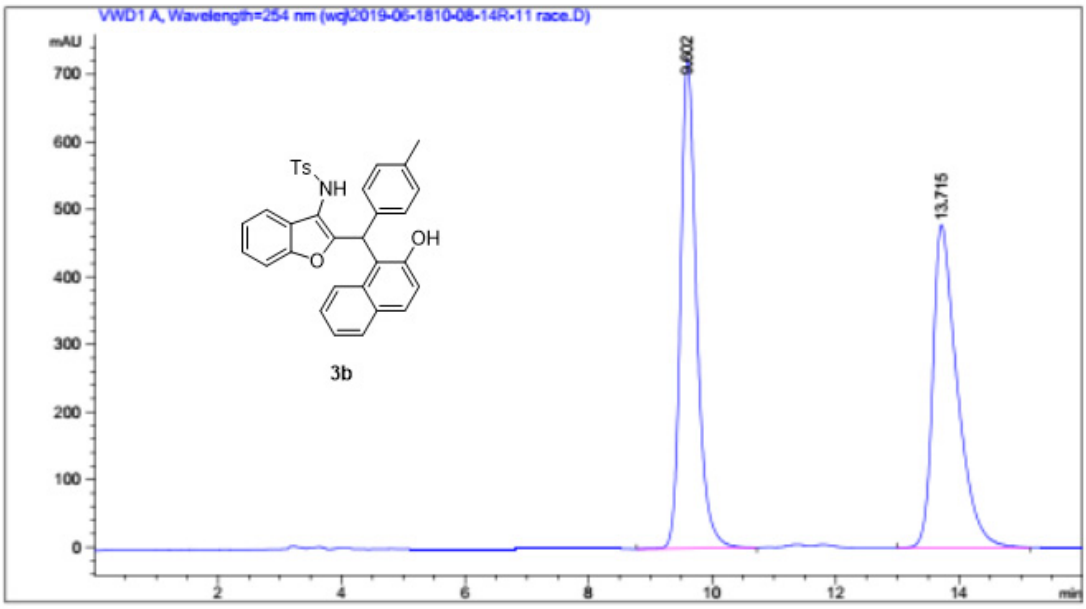
F2 - Processing parameters
SI                         32768
SF                  100.6127685 MHz
WDW                           EM
SSB          0
LB                     1.00 Hz
GB           0
PC                     1.40
```



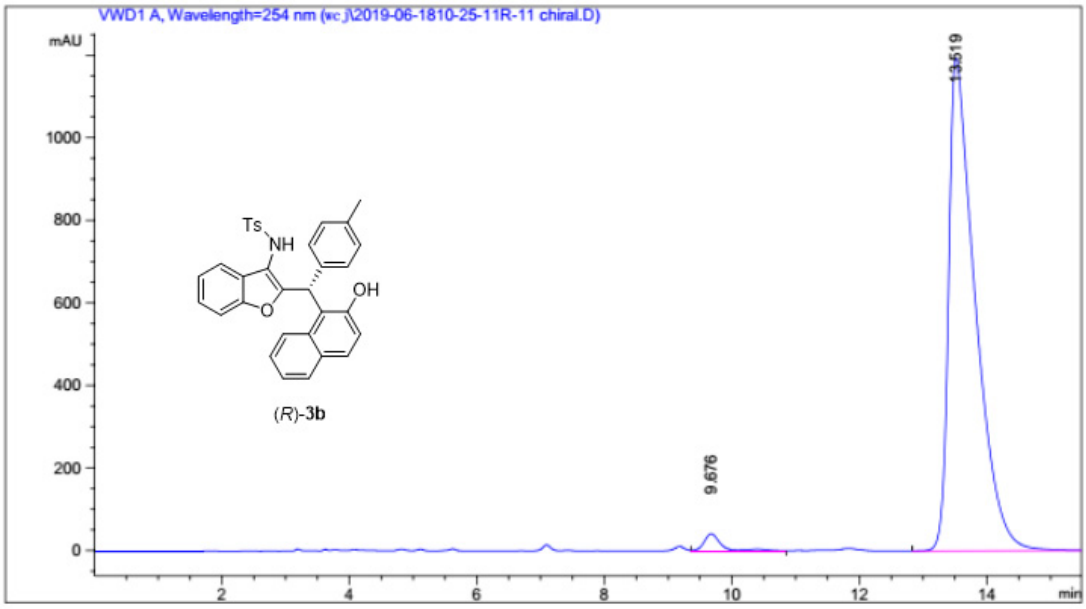

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.377 | VV R | 0.2171 | 8548.87402 | 599.38977 | 50.1947 |
| 2 | 6.204 | VB | 0.3126 | 8482.56738 | 411.24854 | 49.8053 |



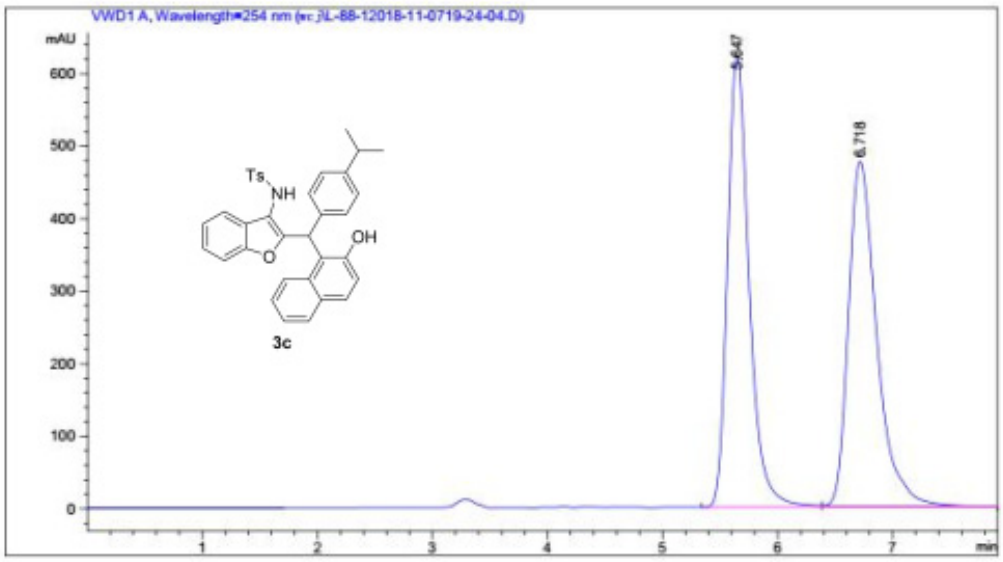

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.387 | MF | 0.2450 | 3.66390e4 | 2492.21802 | 96.9803 |
| 2 | 6.270 | FM | 0.4125 | 1140.85291 | 46.09628 | 3.0197 |



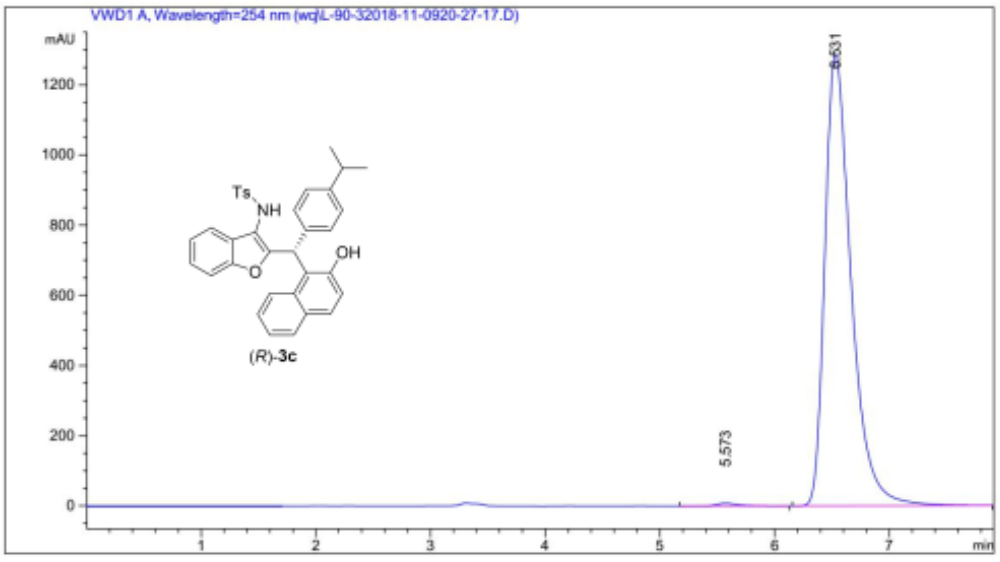

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 9.602 | BB | 0.2728 | 1.30948e4 | 724.80713 | 49.9604 |
| 2 | 13.715 | BB | 0.4010 | 1.31156e4 | 478.12552 | 50.0396 |



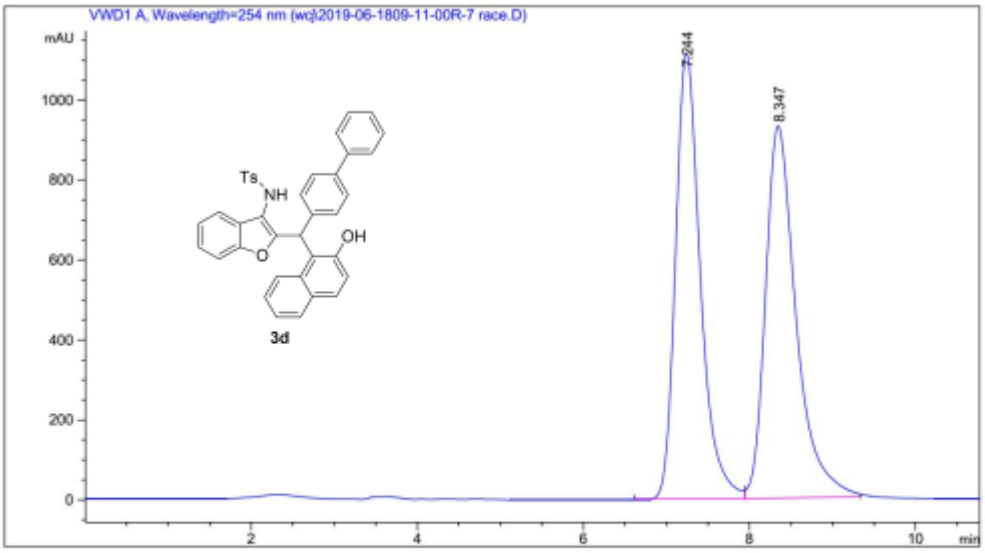

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 9.676 | VV R | 0.2506 | 775.81409 | 41.31821 | 2.2004 |
| 2 | 13.519 | BBA | 0.4081 | 3.44813e4 | 1193.33203 | 97.7996 |



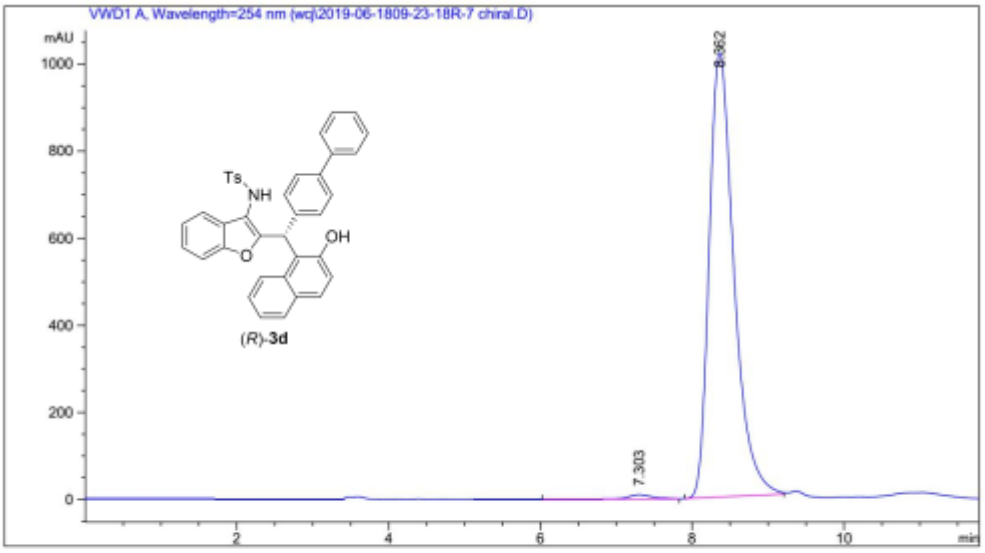

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.647 | BV | 0.1987 | 8107.05664 | 623.28149 | 49.8328 |
| 2 | 6.718 | VBA | 0.2611 | 8161.45068 | 475.91675 | 50.1672 |



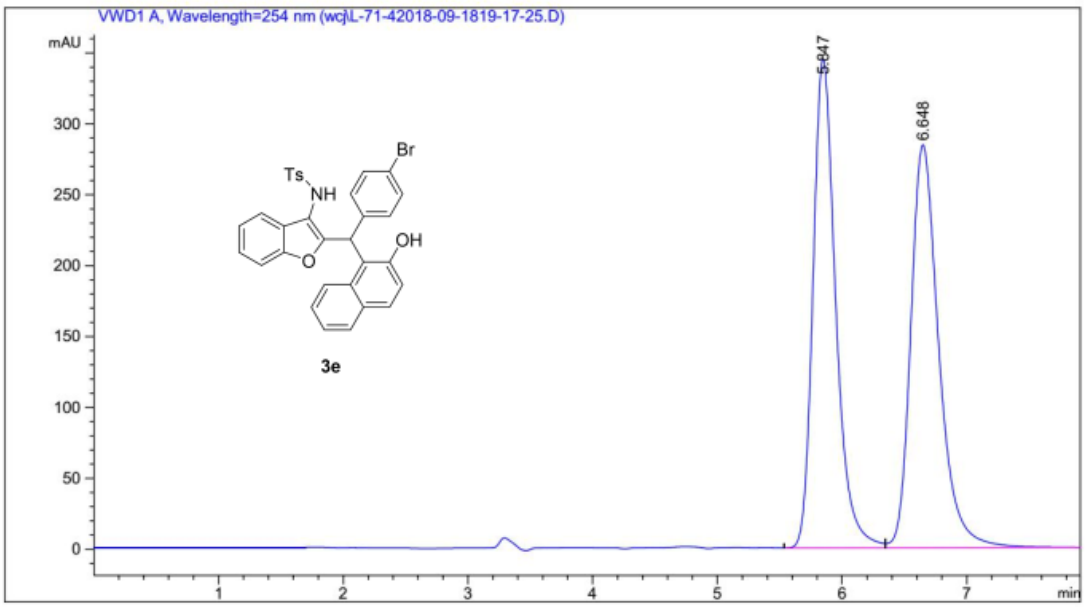

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.573 | VB R | 0.2059 | 108.33190 | 7.76075 | 0.5250 |
| 2 | 6.531 | BBA | 0.2431 | 2.05253e4 | 1286.77612 | 99.4750 |



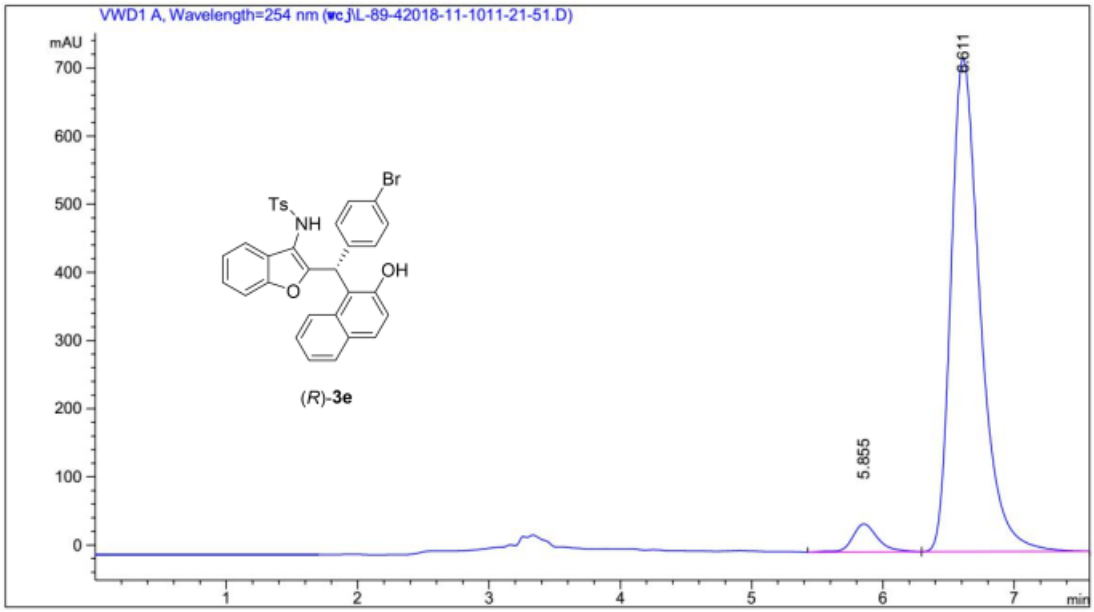

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.244 | MM | 0.3461 | 2.31615e4 | 1115.32312 | 49.2930 |
| 2 | 8.347 | MM | 0.4264 | 2.38259e4 | 931.28455 | 50.7070 |



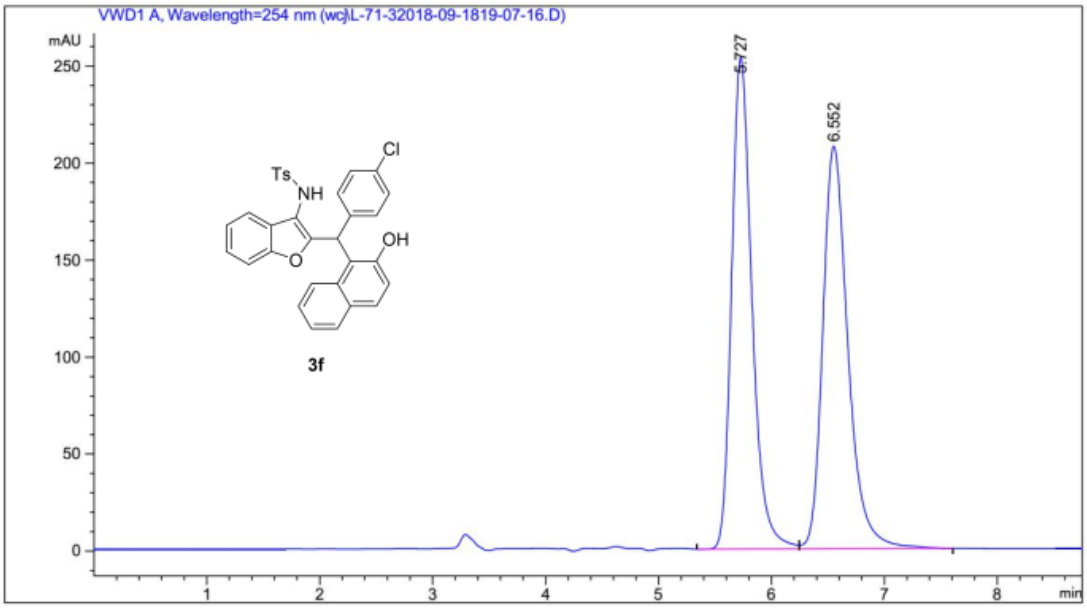

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.303 | VB R | 0.3325 | 215.65932 | 9.77252 | 0.9248 |
| 2 | 8.362 | MM | 0.3774 | 2.31031e4 | 1020.39819 | 99.0752 |



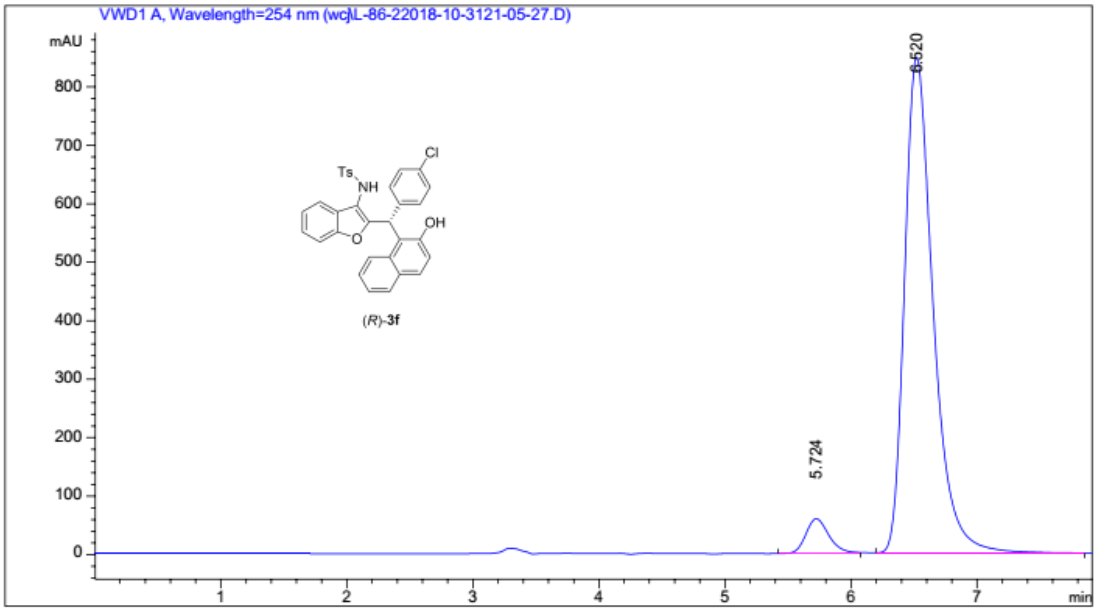

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.847 | BV | 0.1923 | 4352.83203 | 344.86273 | 49.5617 |
| 2 | 6.648 | VBA | 0.2369 | 4429.82275 | 284.14957 | 50.4383 |



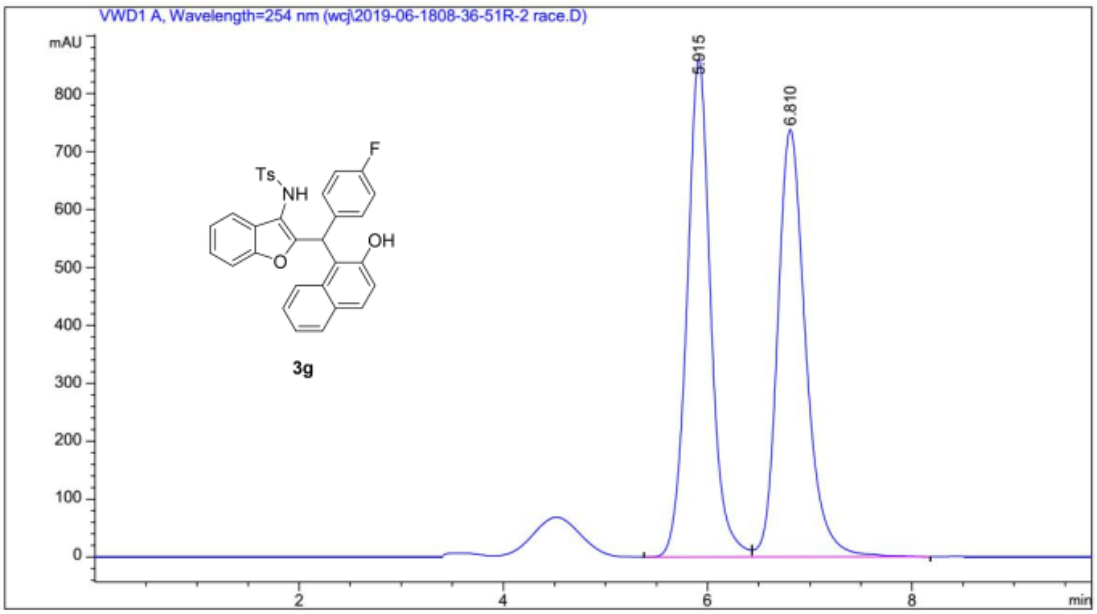

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.855 | BV | 0.2035 | 550.72144 | 41.06212 | 4.6848 |
| 2 | 6.611 | VBA | 0.2344 | 1.12047e4 | 724.74121 | 95.3152 |



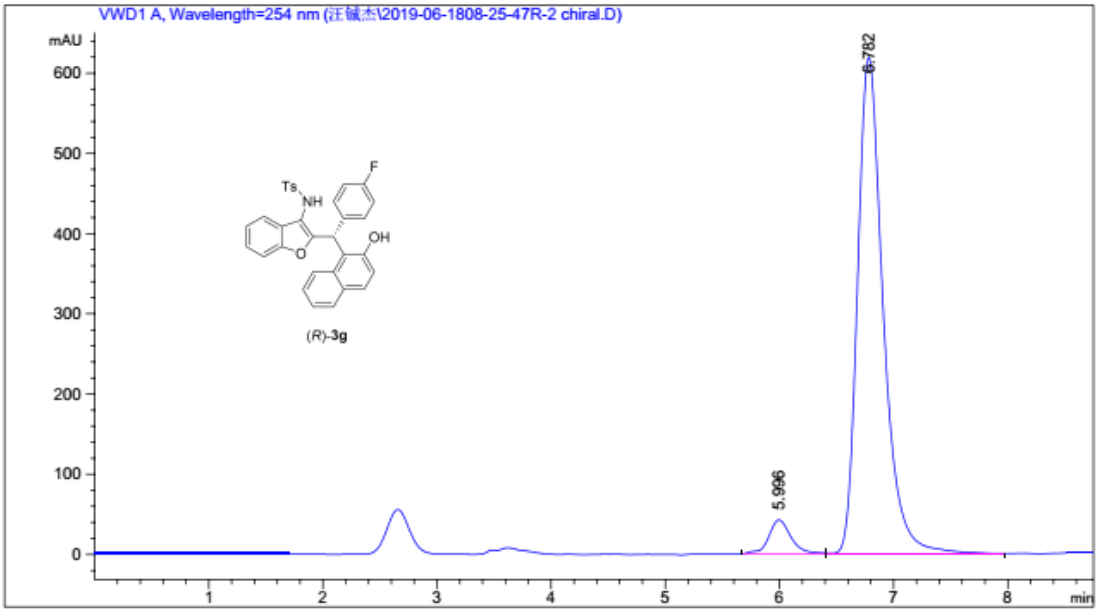

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.727 | BV | 0.1912 | 3174.87866 | 253.29189 | 49.6806 |
| 2 | 6.552 | VB | 0.2368 | 3215.69727 | 207.49826 | 50.3194 |



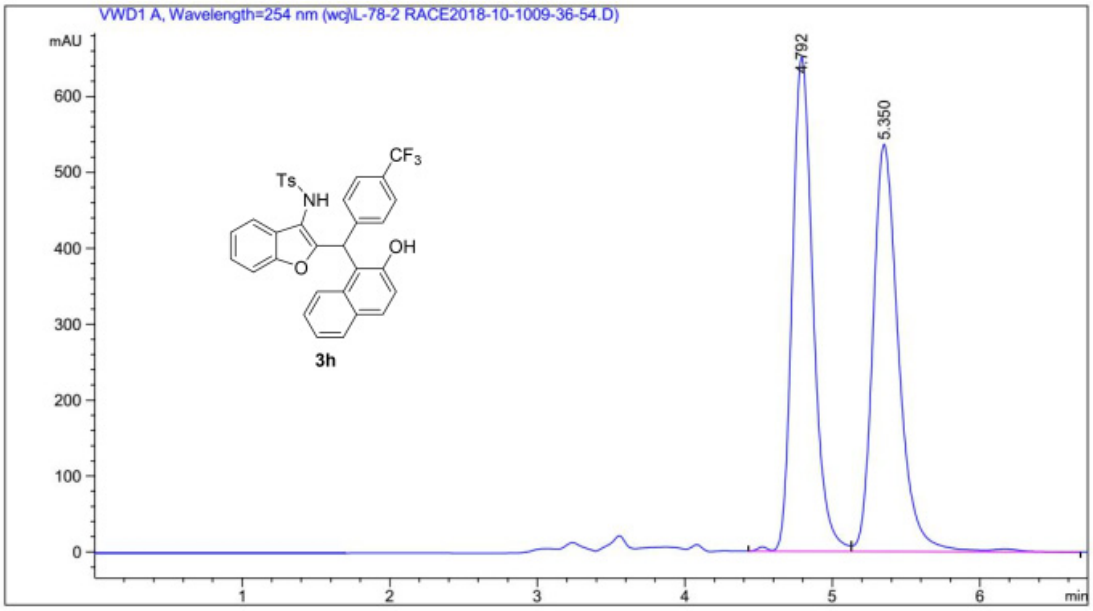

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.724 | MM | 0.2113 | 747.88257 | 59.00315 | 5.3033 |
| 2 | 6.520 | VB | 0.2387 | 1.33543e4 | 847.91431 | 94.6967 |



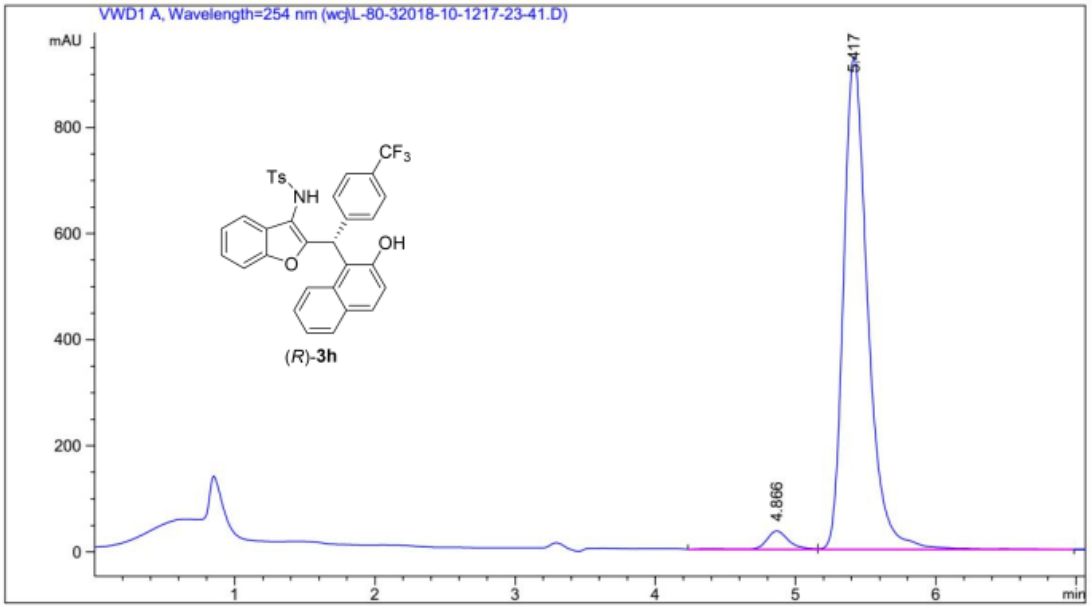

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.915 | BV | 0.2433 | 1.38740e4 | 859.62250 | 49.6817 |
| 2 | 6.810 | VB | 0.2902 | 1.40518e4 | 737.63416 | 50.3183 |



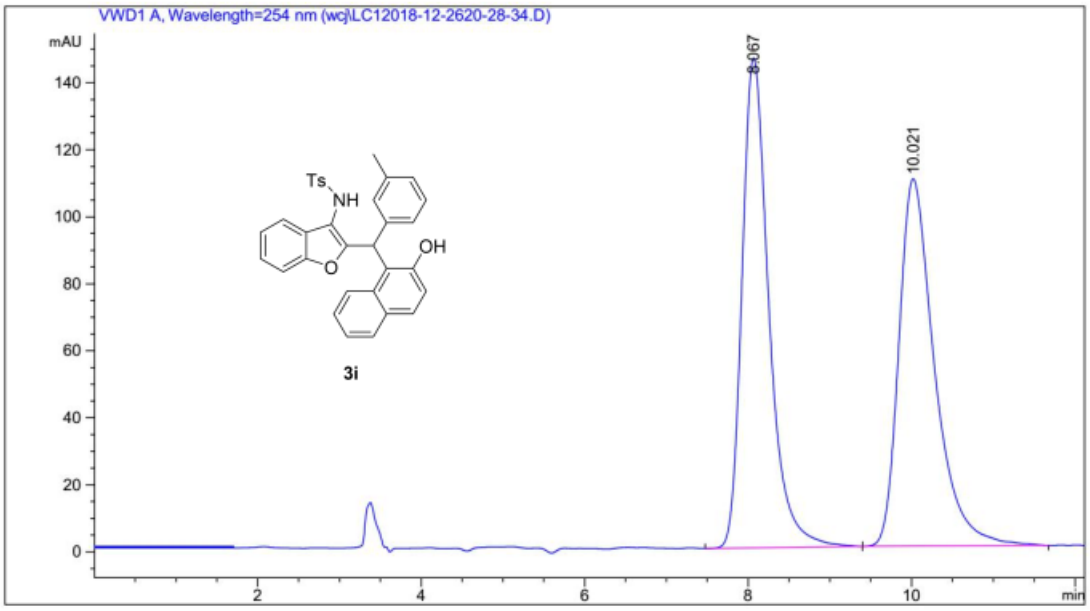

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.996 | MF | 0.2281 | 580.09808 | 42.38439 | 5.6575 |
| 2 | 6.782 | FM | 0.2604 | 9673.48340 | 619.15106 | 94.3425 |



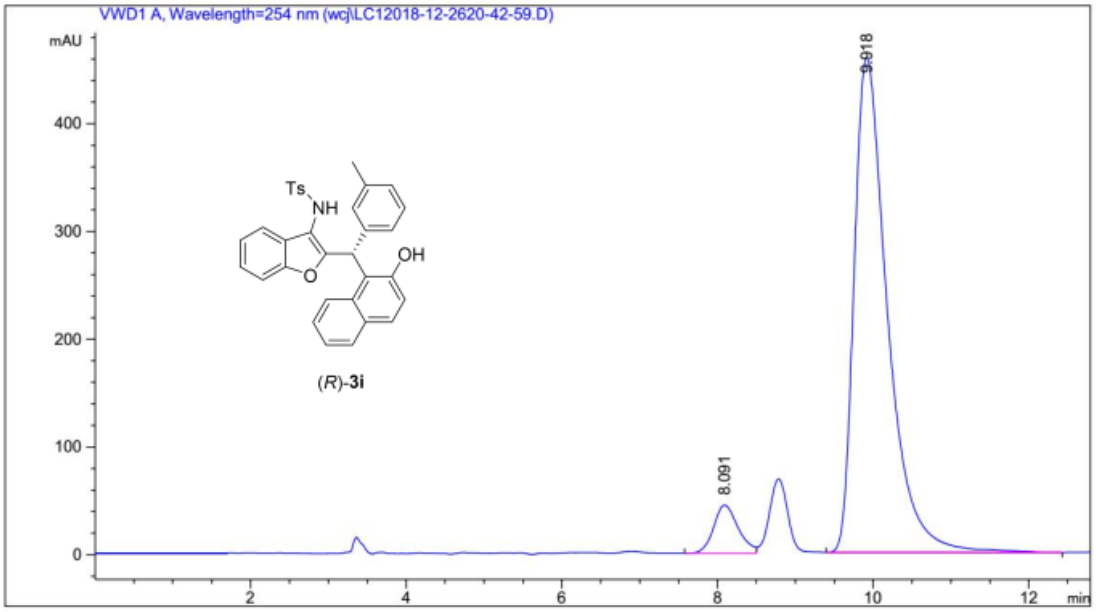

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 4.792 | VV R | 0.1499 | 6374.74219 | 650.36310 | 49.5533 |
| 2 | 5.350 | VV R | 0.1835 | 6489.68115 | 536.32739 | 50.4467 |



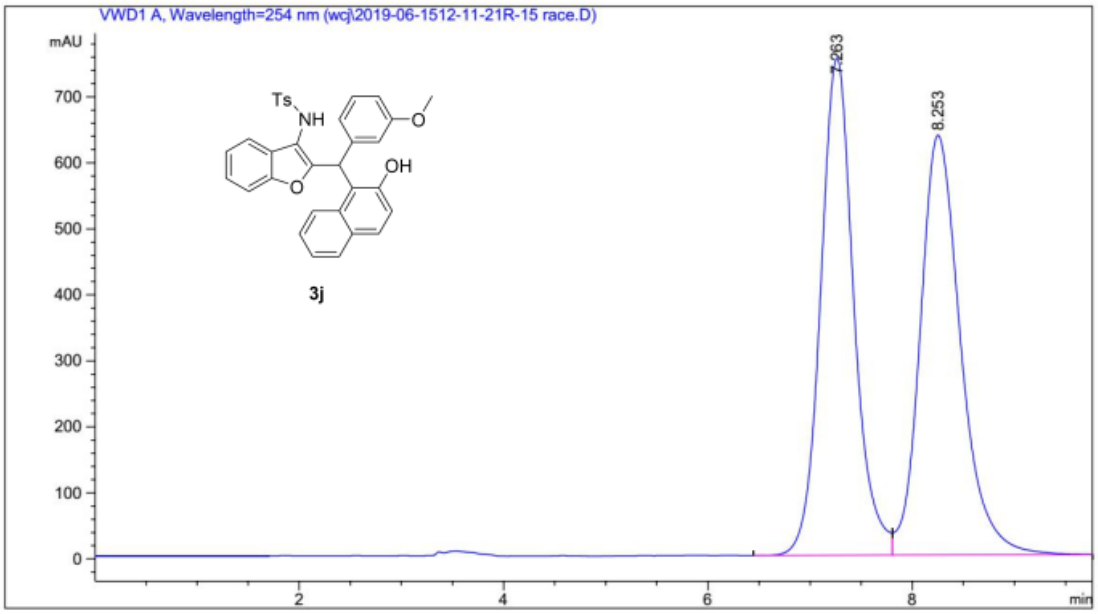

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 4.866 | VV R | 0.1709 | 392.83792 | 34.48727 | 3.4066 |
| 2 | 5.417 | VV R | 0.1831 | 1.11387e4 | 927.73663 | 96.5934 |



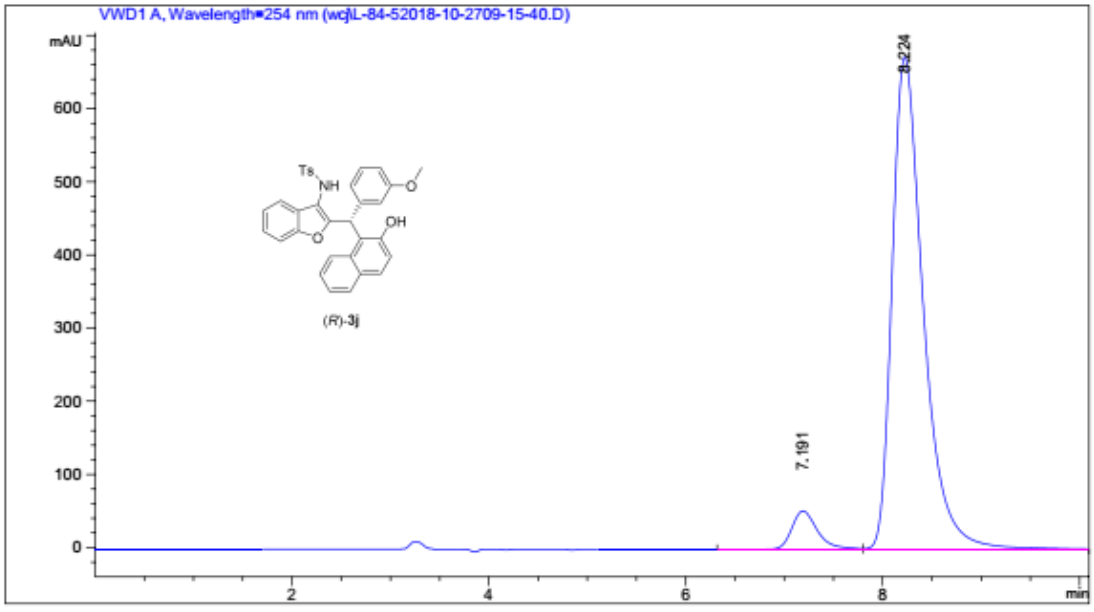

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 8.067 | BB | 0.3470 | 3333.49683 | 146.21475 | 50.1732 |
| 2 | 10.021 | BB | 0.4573 | 3310.47998 | 109.63569 | 49.8268 |



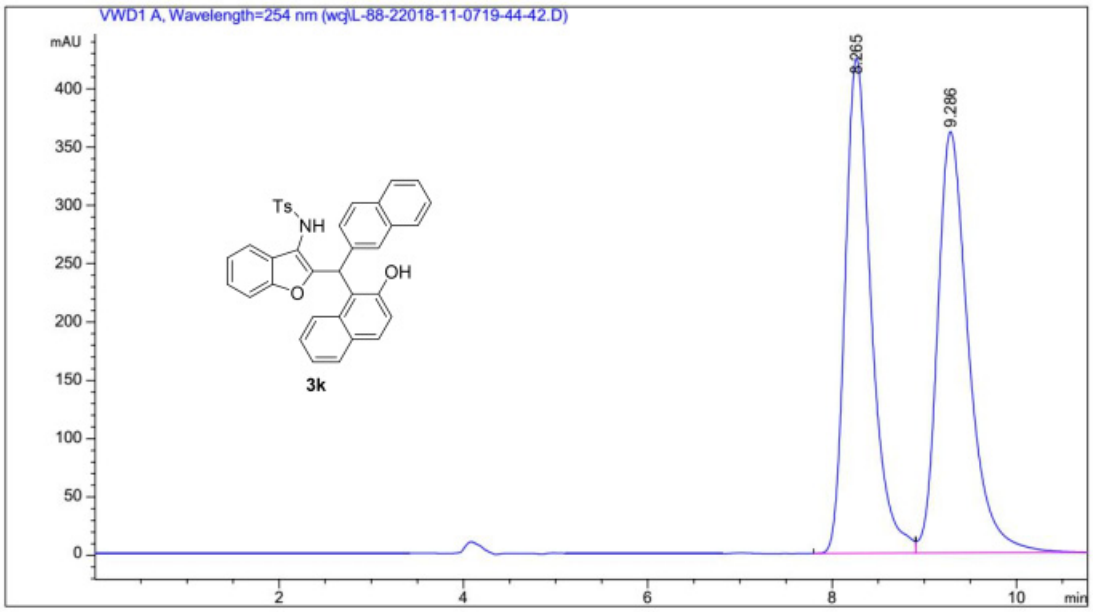

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 8.091 | BV | 0.3316 | 972.53229 | 44.56988 | 6.6211 |
| 2 | 9.918 | VB | 0.4490 | 1.37158e4 | 459.85532 | 93.3789 |



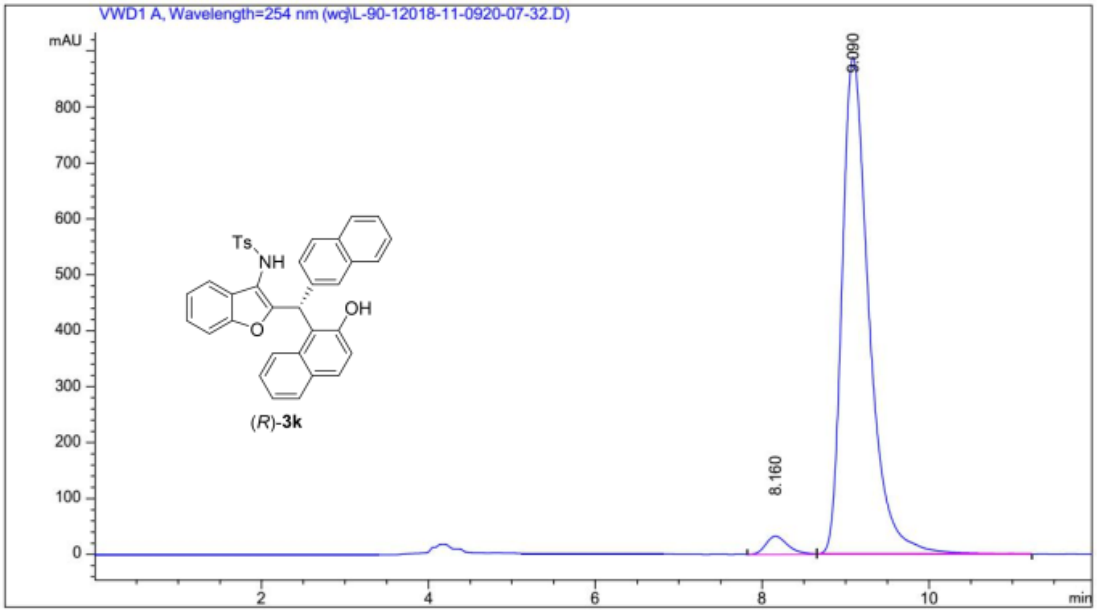

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.263 | BV | 0.3438 | 1.70328e4 | 753.18359 | 49.3209 |
| 2 | 8.253 | VBA | 0.4210 | 1.75019e4 | 636.09125 | 50.6791 |



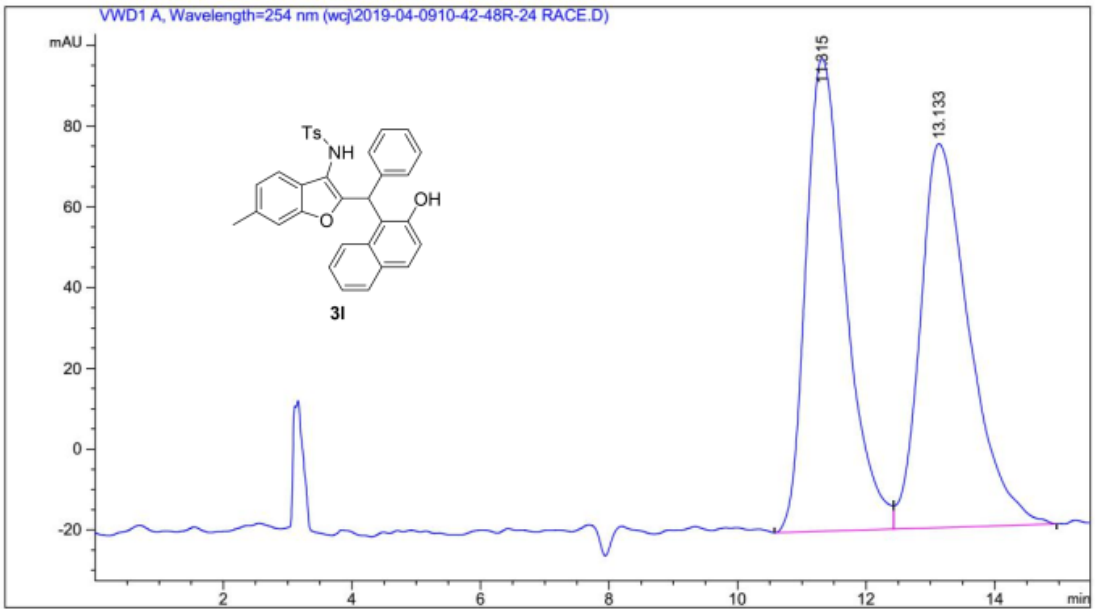

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.191 | VV R | 0.2764 | 949.98859 | 52.42862 | 6.0406 |
| 2 | 8.224 | VBA | 0.3343 | 1.47768e4 | 672.50623 | 93.9594 |



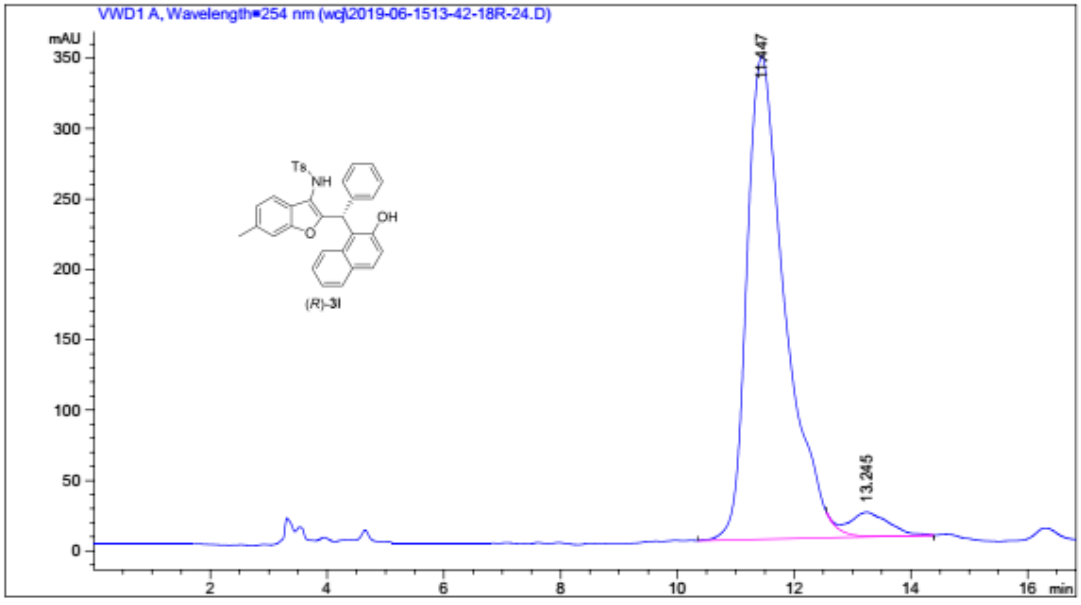

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 8.265 | BV | 0.2985 | 8306.07324 | 424.02887 | 49.6156 |
| 2 | 9.286 | VBA | 0.3556 | 8434.77051 | 360.94202 | 50.3844 |



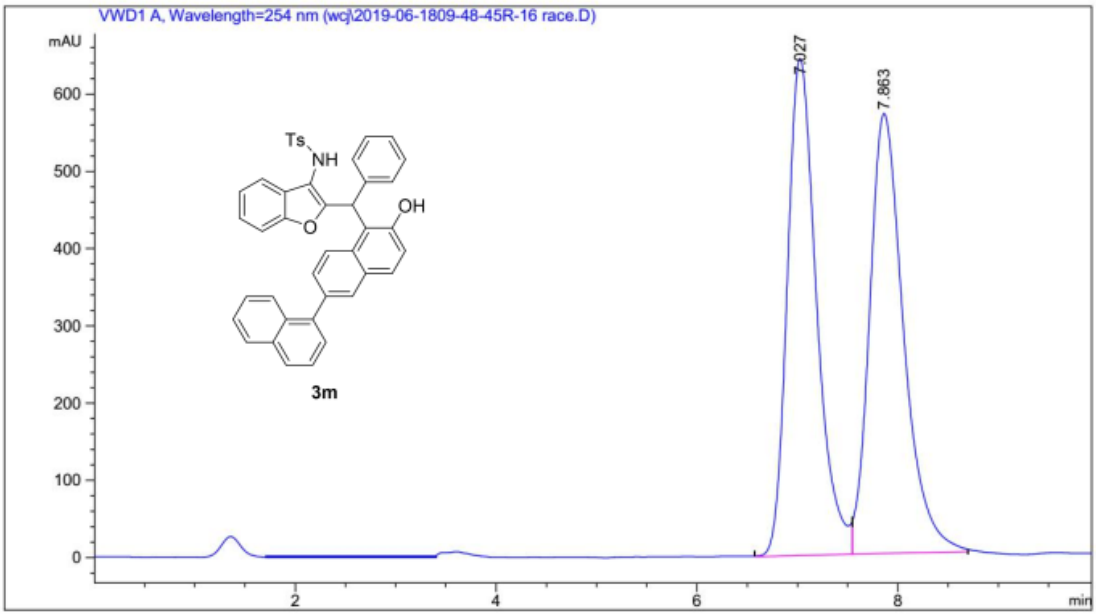

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 8.160 | BV | 0.2835 | 602.02930 | 32.58949 | 2.9316 |
| 2 | 9.090 | VV R | 0.3387 | 1.99342e4 | 888.67975 | 97.0684 |



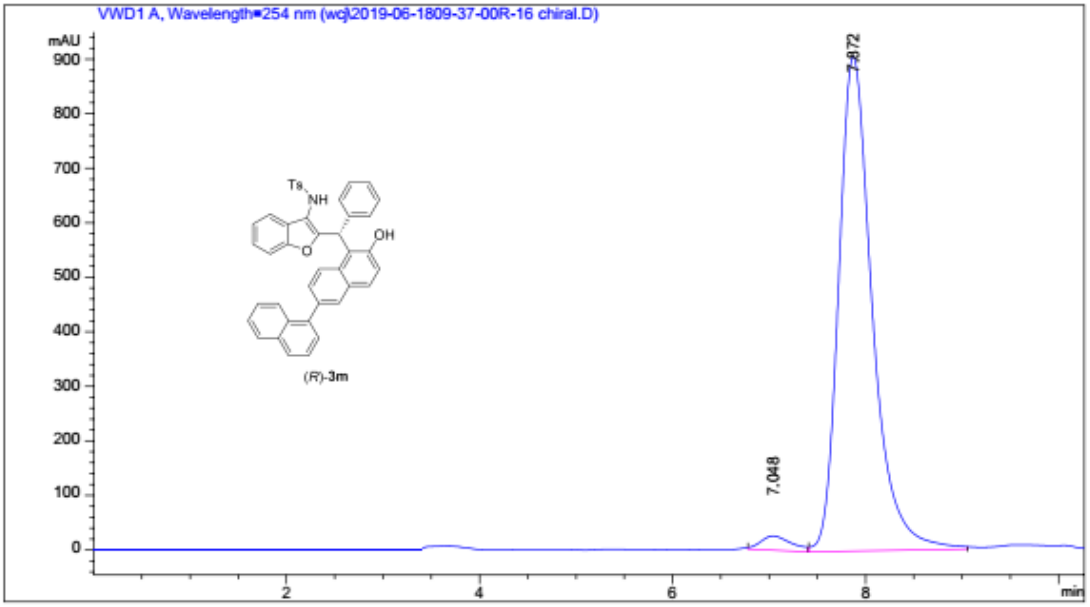

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 11.315 | BV | 0.6557 | 5034.02979 | 117.06155 | 50.0282 |
| 2 | 13.133 | VB | 0.7640 | 5028.34473 | 95.07822 | 49.9718 |



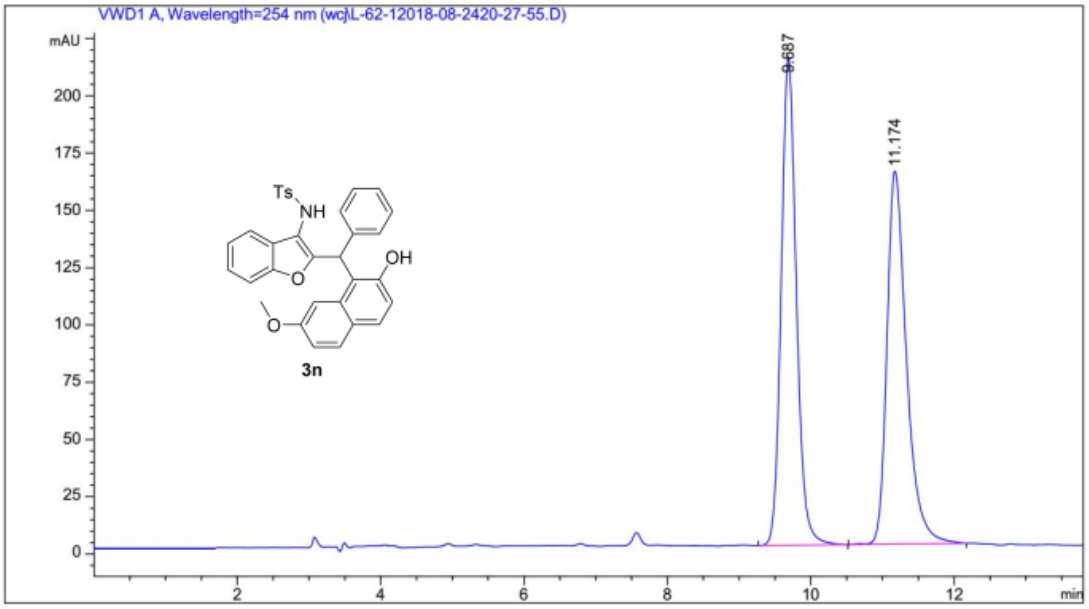

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 11.447 | BV R | 0.6918 | 1.56277e4 | 343.49097 | 95.2950 |
| 2 | 13.245 | VB E | 0.6290 | 771.58673 | 16.92014 | 4.7050 |



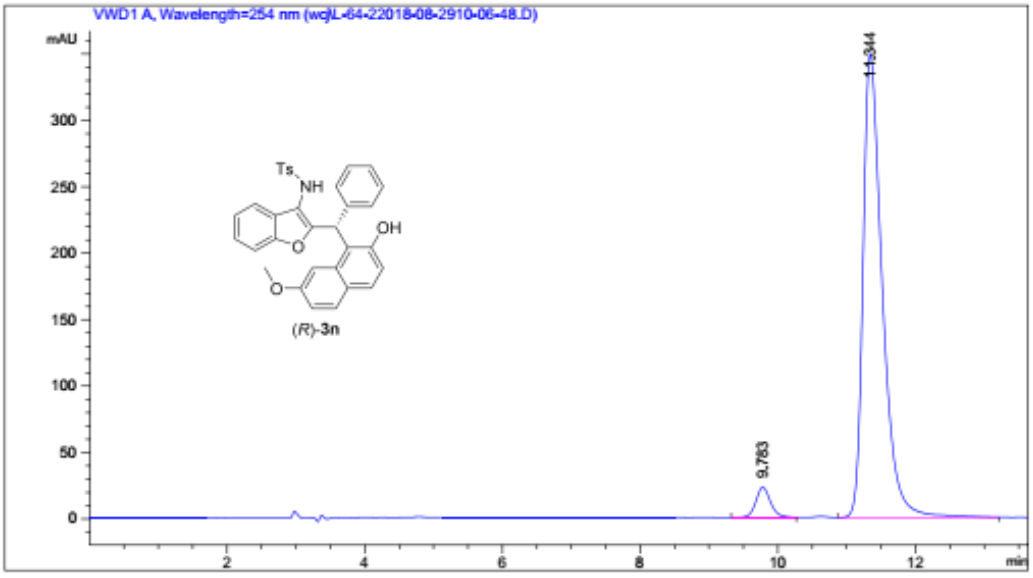

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.027 | MM | 0.3383 | 1.30573e4 | 643.25696 | 49.3267 |
| 2 | 7.863 | MM | 0.3926 | 1.34138e4 | 569.36920 | 50.6733 |



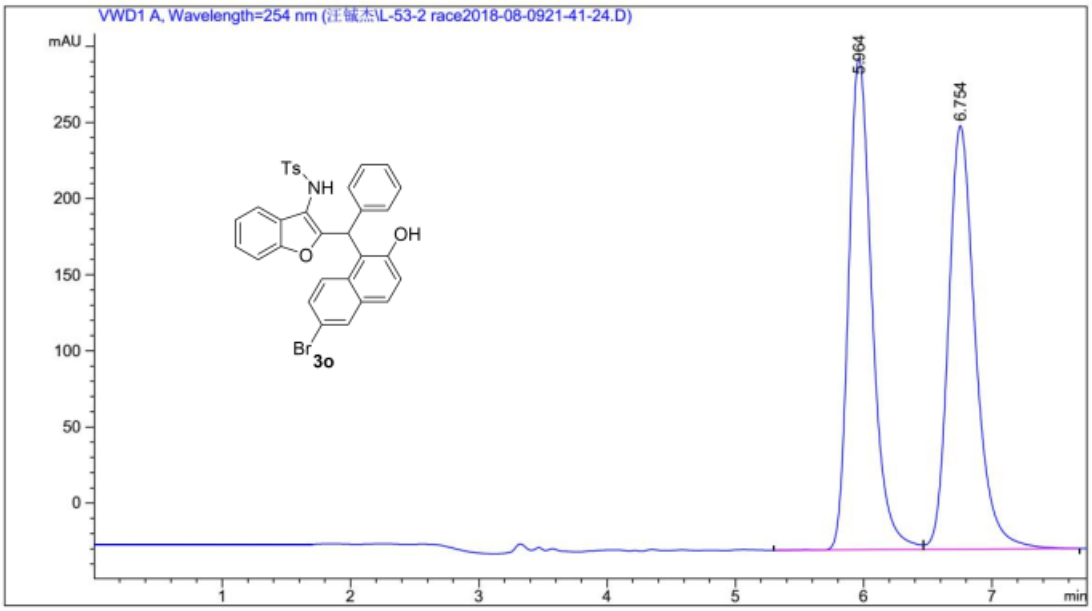

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.048 | MM | 0.3690 | 575.36865 | 25.98837 | 2.5573 |
| 2 | 7.872 | MM | 0.4031 | 2.19234e4 | 906.44177 | 97.4427 |



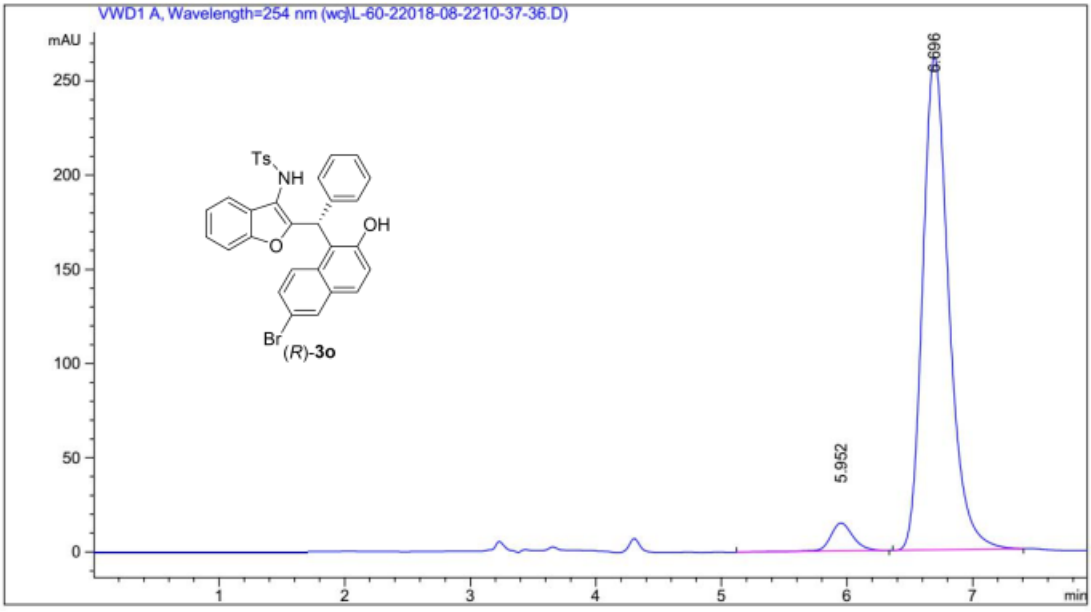

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 9.687 | BB | 0.2262 | 3124.36182 | 212.90576 | 50.4254 |
| 2 | 11.174 | VB R | 0.2852 | 3071.64966 | 162.75993 | 49.5746 |



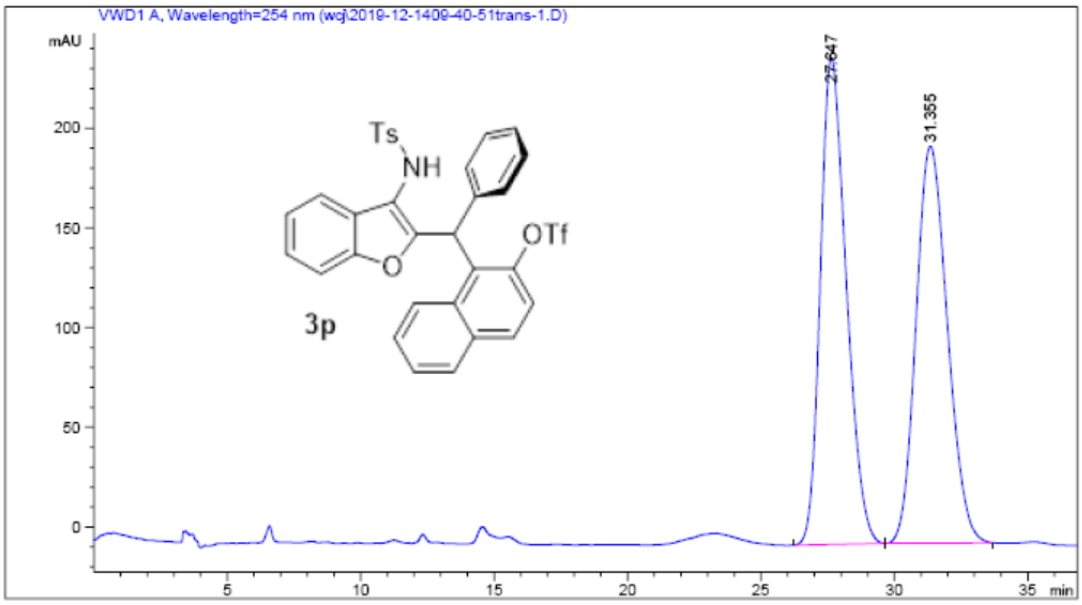

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 9.783 | BB | 0.2272 | 336.87836 | 22.69812 | 4.7451 |
| 2 | 11.344 | BB | 0.2891 | 6762.60303 | 348.89798 | 95.2549 |



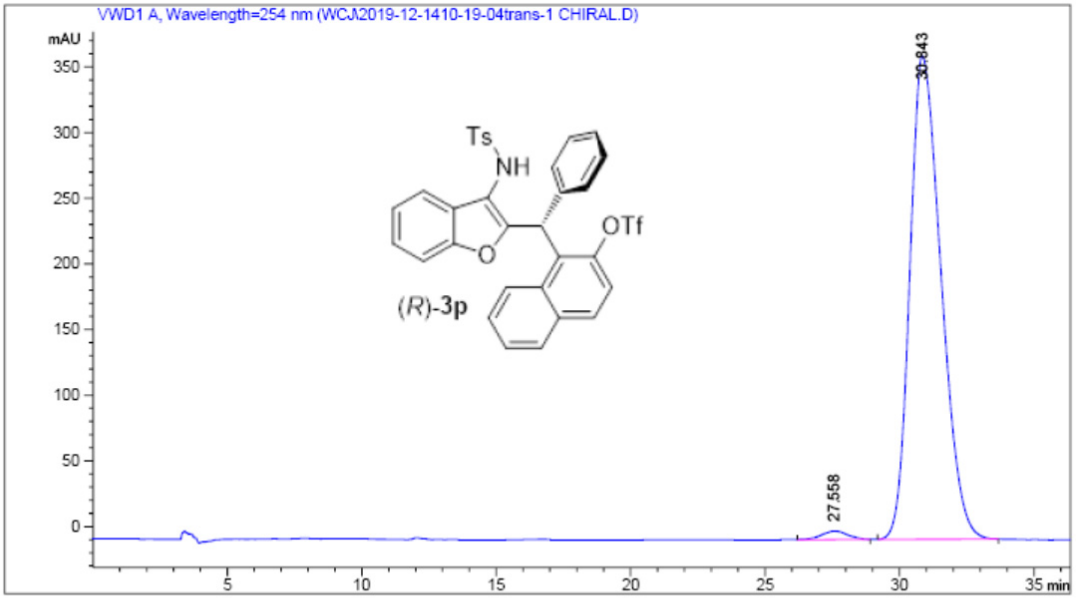

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.964 | VV R | 0.1943 | 4076.66528 | 322.79672 | 50.1429 |
| 2 | 6.754 | VB | 0.2211 | 4053.42212 | 278.07520 | 49.8571 |



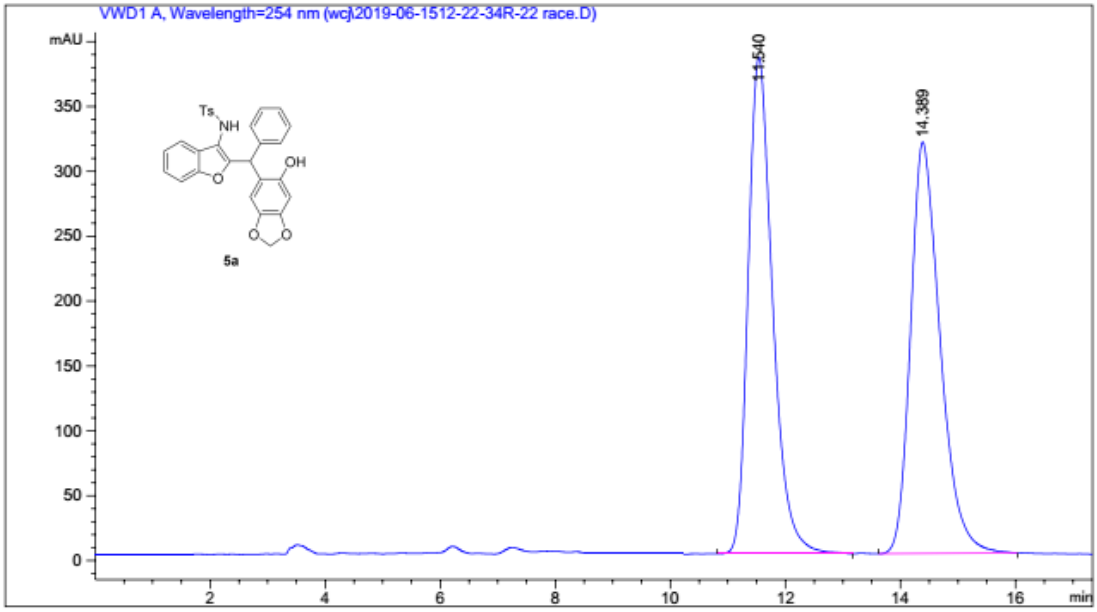

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.952 | BB | 0.1894 | 184.77423 | 14.82211 | 4.6596 |
| 2 | 6.696 | BB | 0.2215 | 3780.66724 | 261.69958 | 95.3404 |



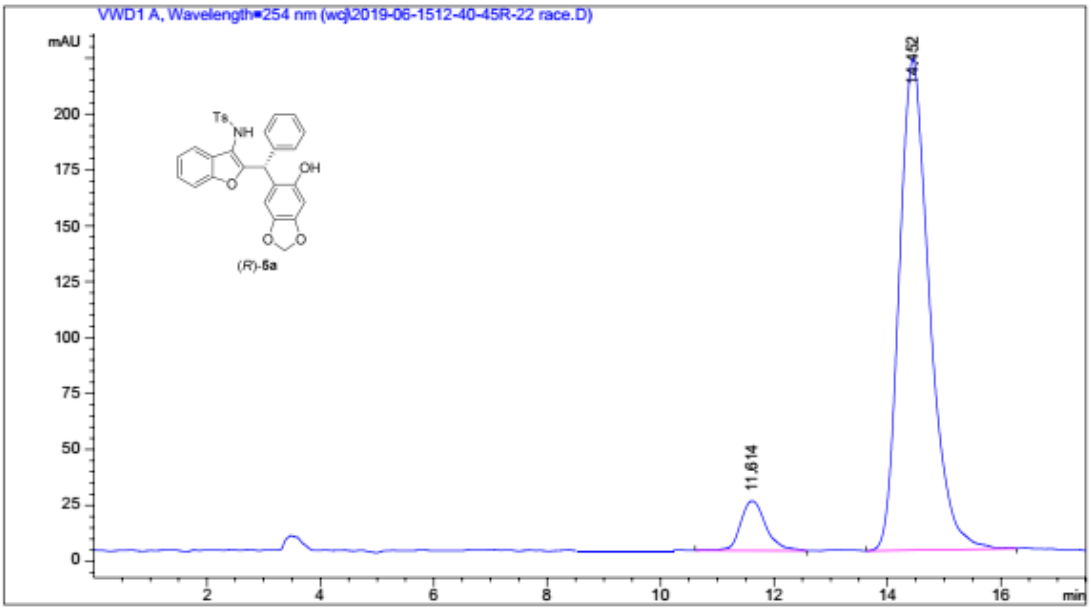

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 27.647 | BB | 1.0489 | 1.64291e4 | 244.21140 | 50.2642 |
| 2 | 31.355 | BB | 1.2485 | 1.62564e4 | 199.11592 | 49.7358 |



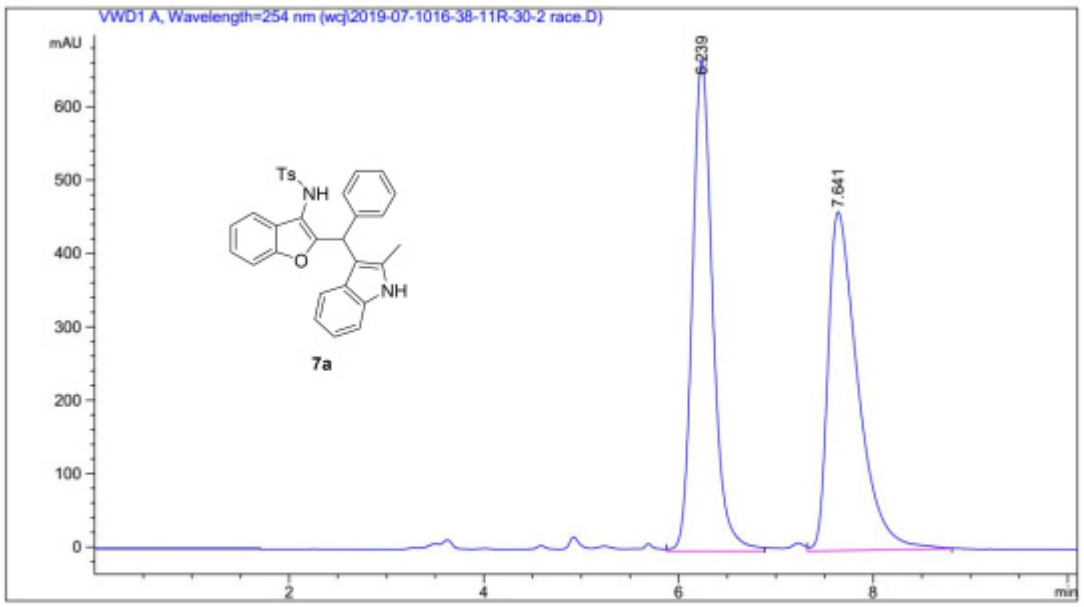

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 27.558 | BB | 0.8401 | 422.90979 | 6.39033 | 1.4067 |
| 2 | 30.843 | BB | 1.2498 | 2.96412e4 | 367.95706 | 98.5933 |



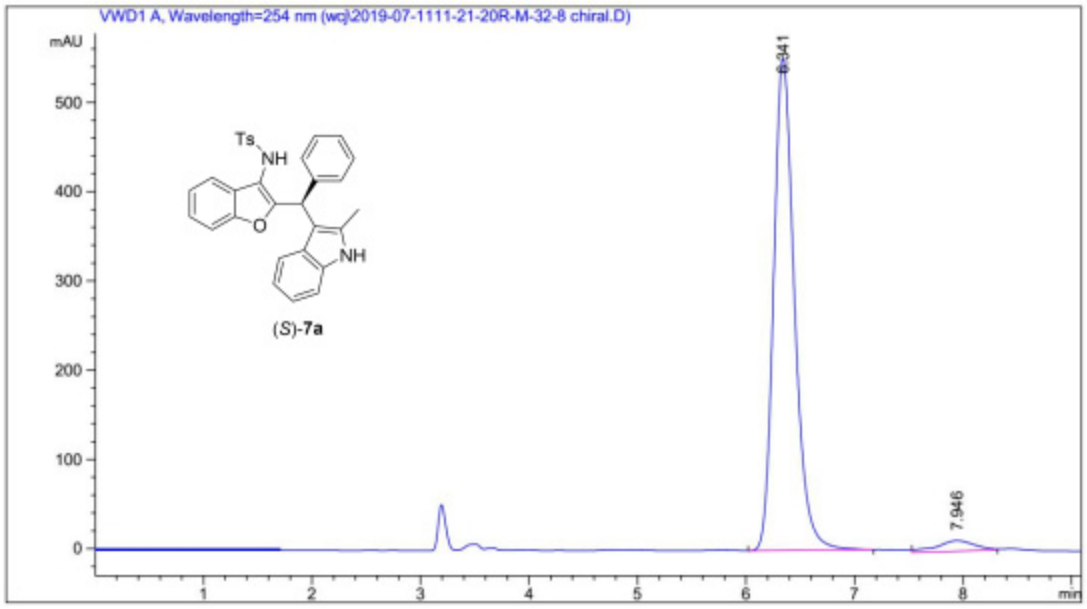

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 11.540 | BV | 0.4483 | 1.12946e4 | 382.74017 | 49.9625 |
| 2 | 14.389 | BB | 0.5572 | 1.13115e4 | 317.04361 | 50.0375 |



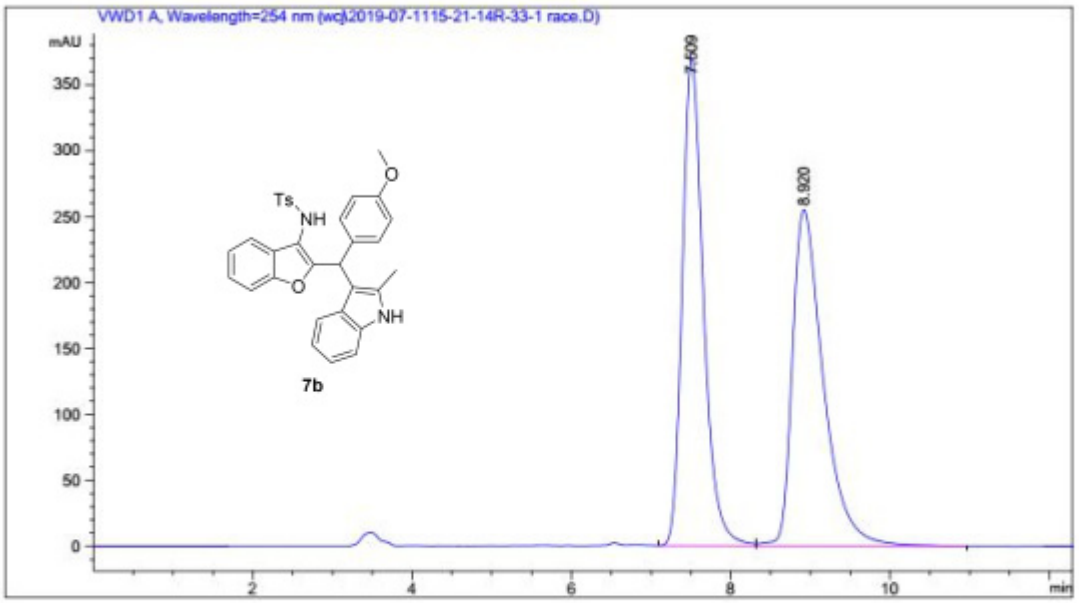

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 11.614 | BB | 0.4891 | 688.78833 | 22.19267 | 7.8097 |
| 2 | 14.452 | BV R | 0.5541 | 8130.89600 | 220.02017 | 92.1903 |



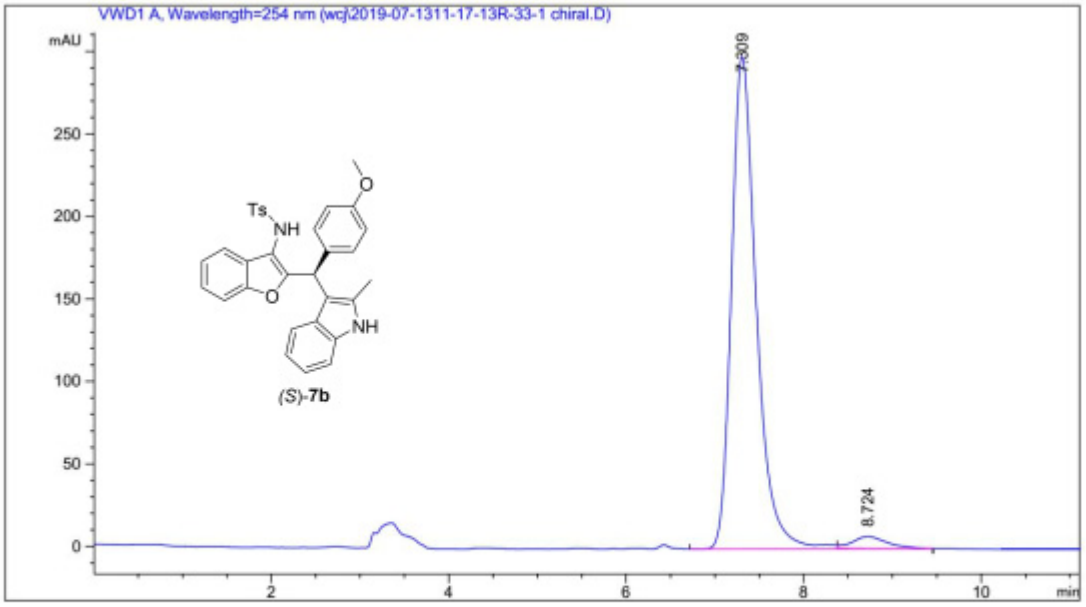

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 6.239 | MM | 0.2413 | 9704.95996 | 670.35870 | 49.7312 |
| 2 | 7.641 | MM | 0.3542 | 9809.86719 | 461.59543 | 50.2688 |



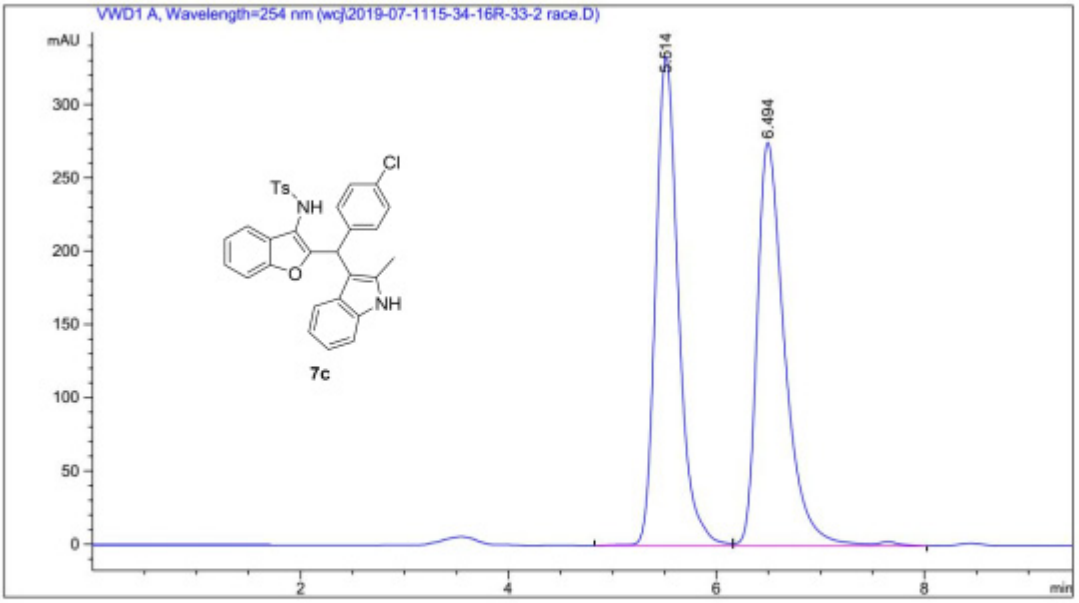

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 6.341 | BB | 0.2028 | 7320.74268 | 551.60553 | 96.1450 |
| 2 | 7.946 | MM | 0.4093 | 293.52786 | 11.95253 | 3.8550 |



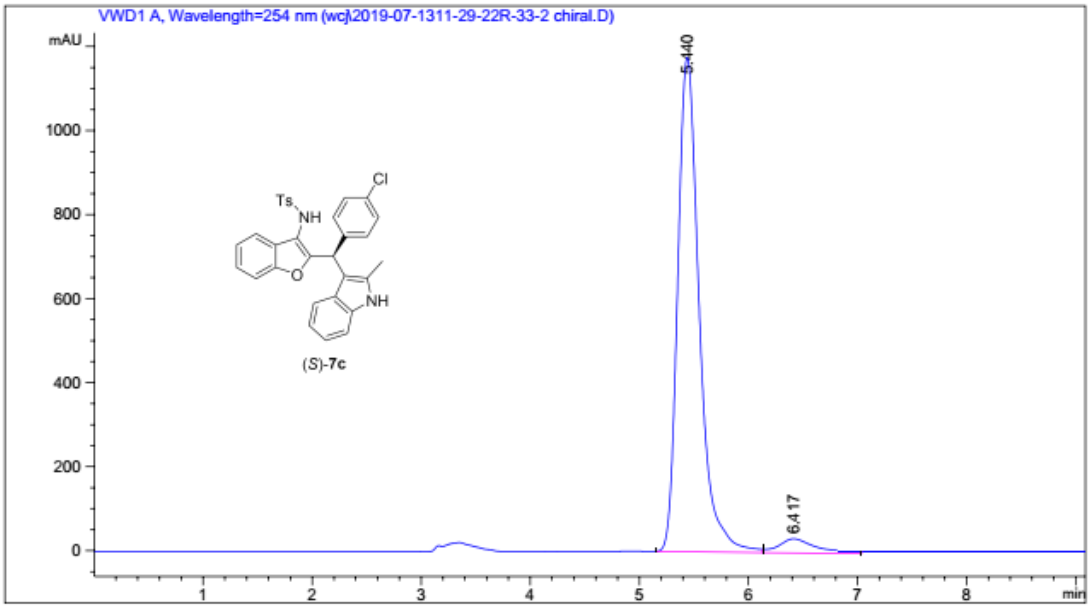

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.509 | BV | 0.2821 | 6821.78271 | 370.02179 | 49.7532 |
| 2 | 8.920 | VB | 0.4071 | 6889.47168 | 255.10687 | 50.2468 |



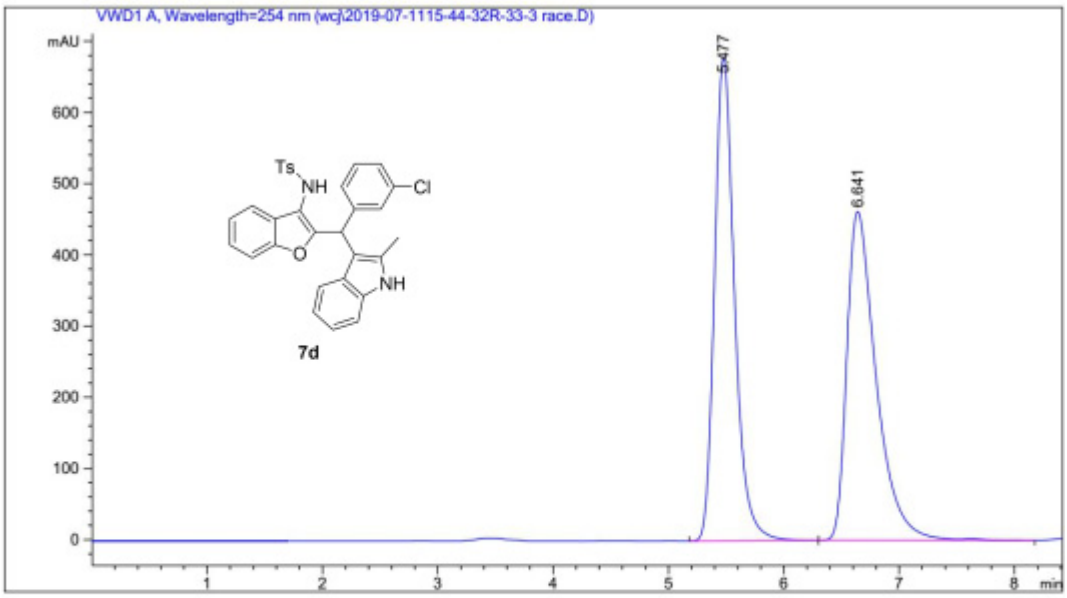

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 7.309 | BV R | 0.2932 | 5806.58008 | 298.16077 | 96.6673 |
| 2 | 8.724 | VB E | 0.3944 | 200.18649 | 7.29040 | 3.3327 |



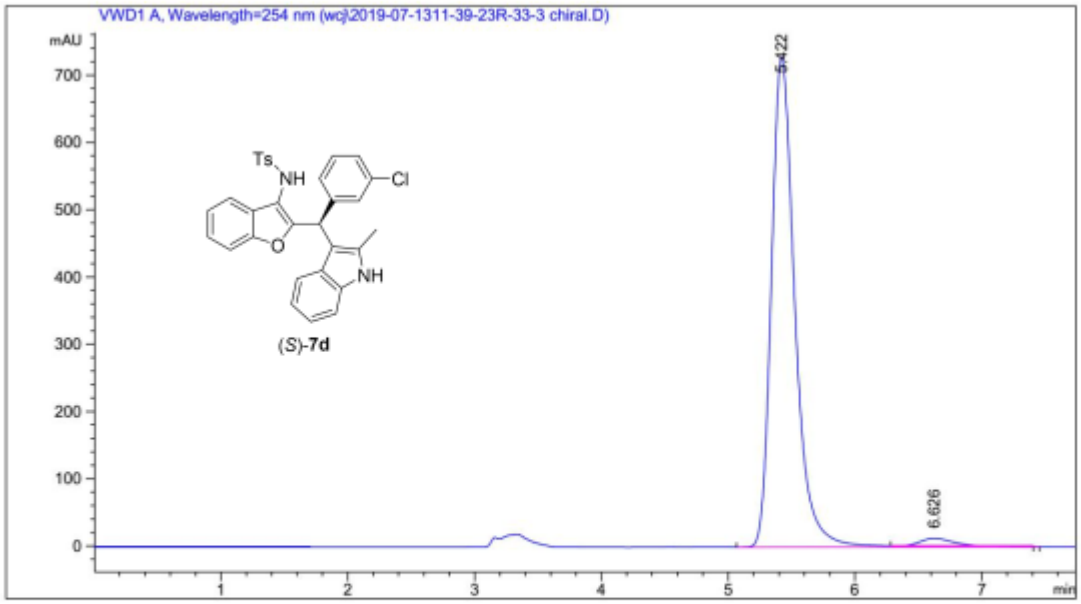

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.514 | BV | 0.2332 | 5065.26904 | 333.57312 | 49.8911 |
| 2 | 6.494 | VV R | 0.2776 | 5087.39014 | 275.04663 | 50.1089 |



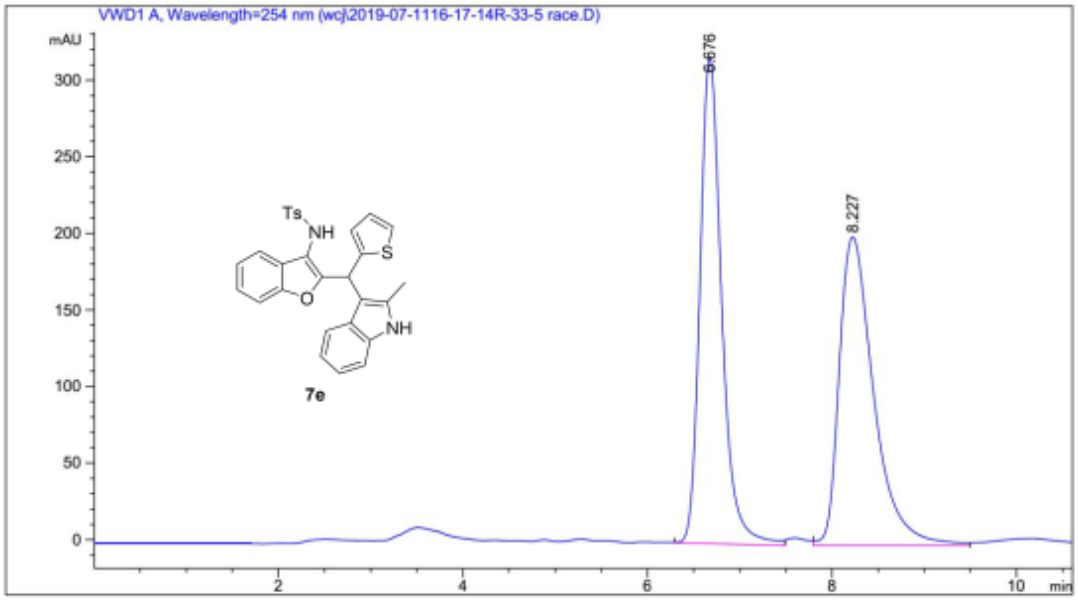

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.440 | MF | 0.2280 | 1.60986e4 | 1176.58972 | 95.0344 |
| 2 | 6.417 | FM | 0.4145 | 841.15784 | 33.81992 | 4.9656 |



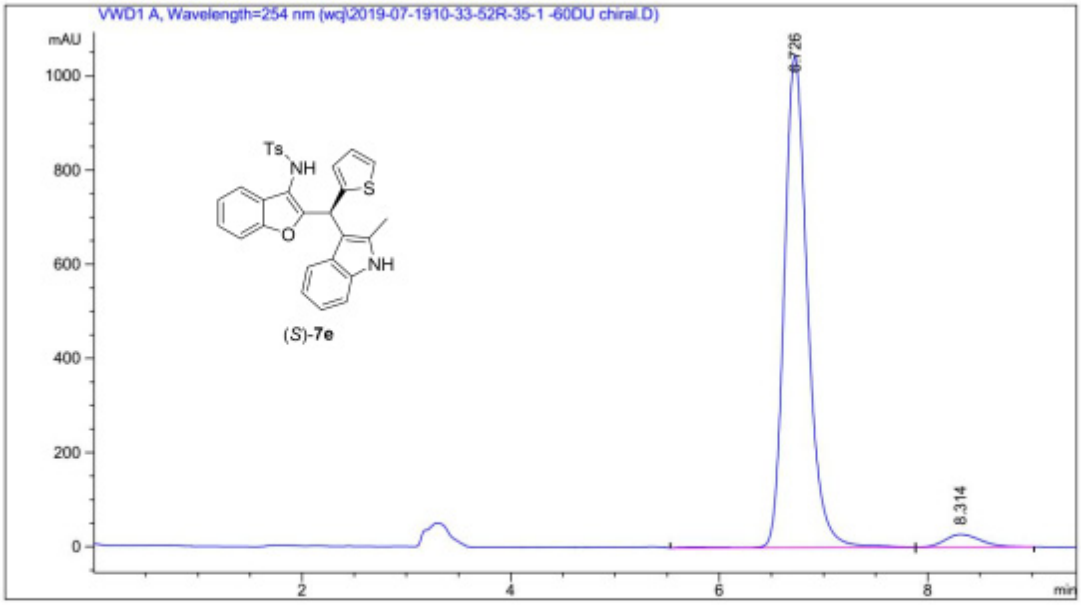

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.477 | BB | 0.1857 | 8178.25342 | 678.11737 | 50.0378 |
| 2 | 6.641 | BV R | 0.2639 | 8165.90039 | 461.36234 | 49.9622 |



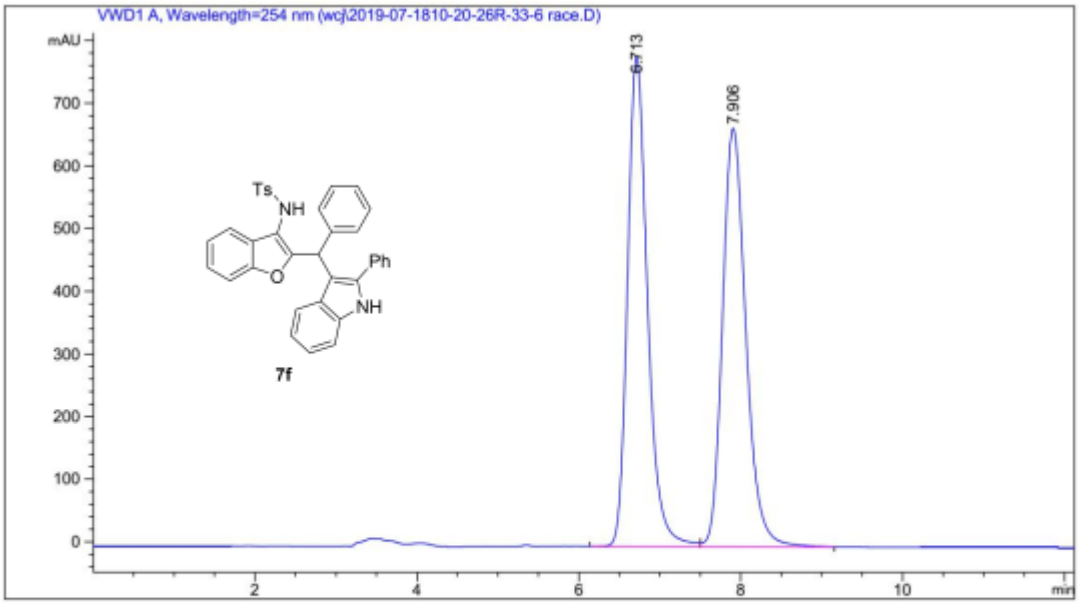

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 5.422 | BV R | 0.1963 | 9383.65430 | 728.41284 | 97.4556 |
| 2 | 6.626 | VB E | 0.2969 | 244.98700 | 12.32516 | 2.5444 |



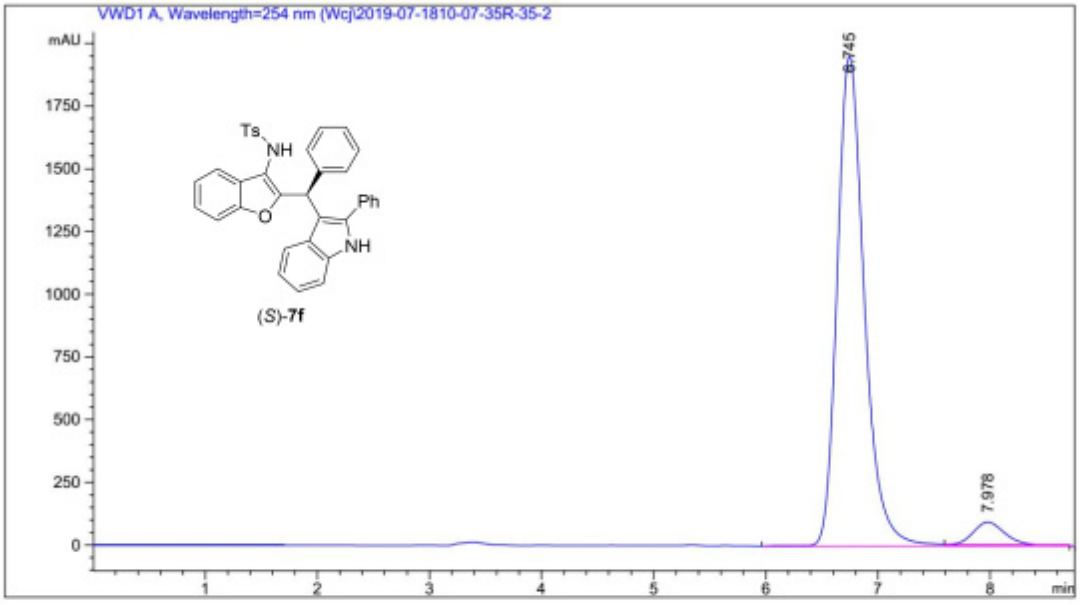

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 6.676 | MM | 0.2719 | 5184.96436 | 317.87924 | 49.7978 |
| 2 | 8.227 | MM | 0.4325 | 5227.07471 | 201.41629 | 50.2022 |



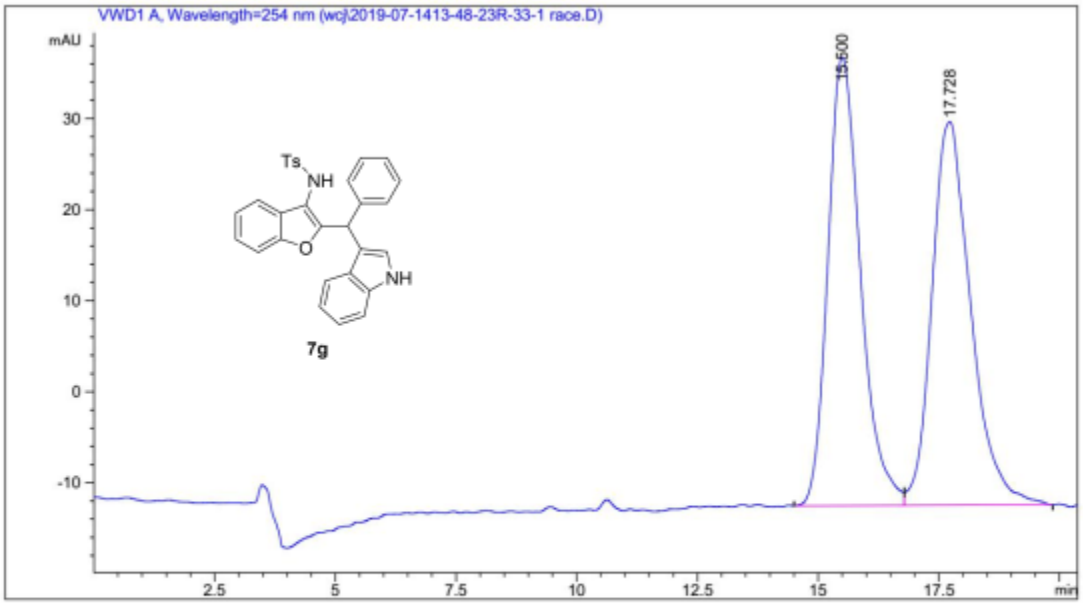

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 6.726 | VV R | 0.2372 | 1.61701e4 | 1043.44275 | 96.1546 |
| 2 | 8.314 | VB | 0.3779 | 646.66431 | 26.95582 | 3.8454 |



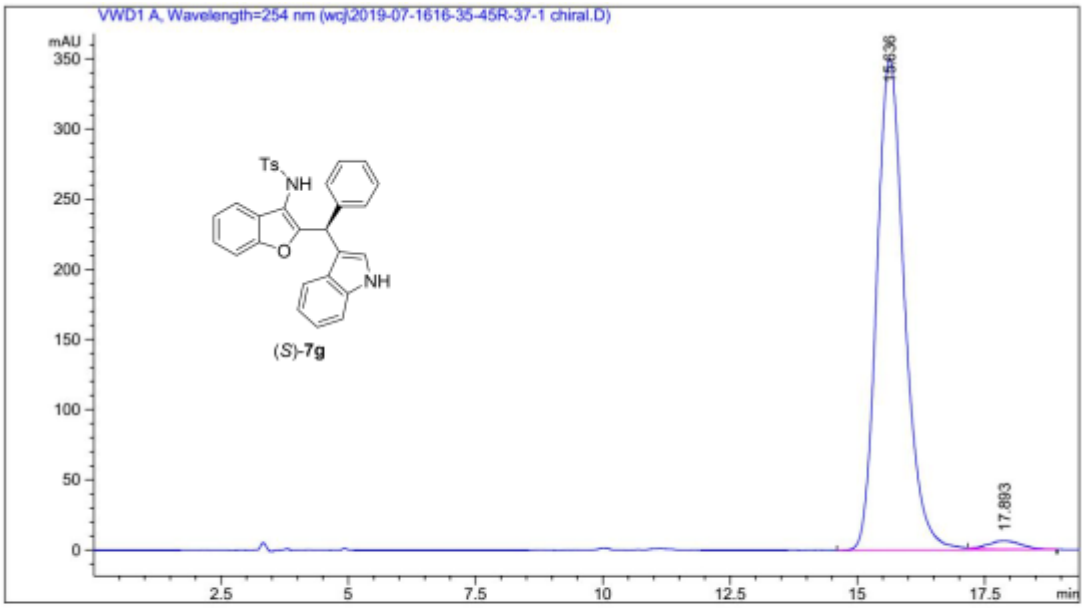

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 6.713 | BV | 0.2621 | 1.33808e4 | 780.28302 | 50.0201 |
| 2 | 7.906 | VB | 0.3088 | 1.33700e4 | 667.14227 | 49.9799 |



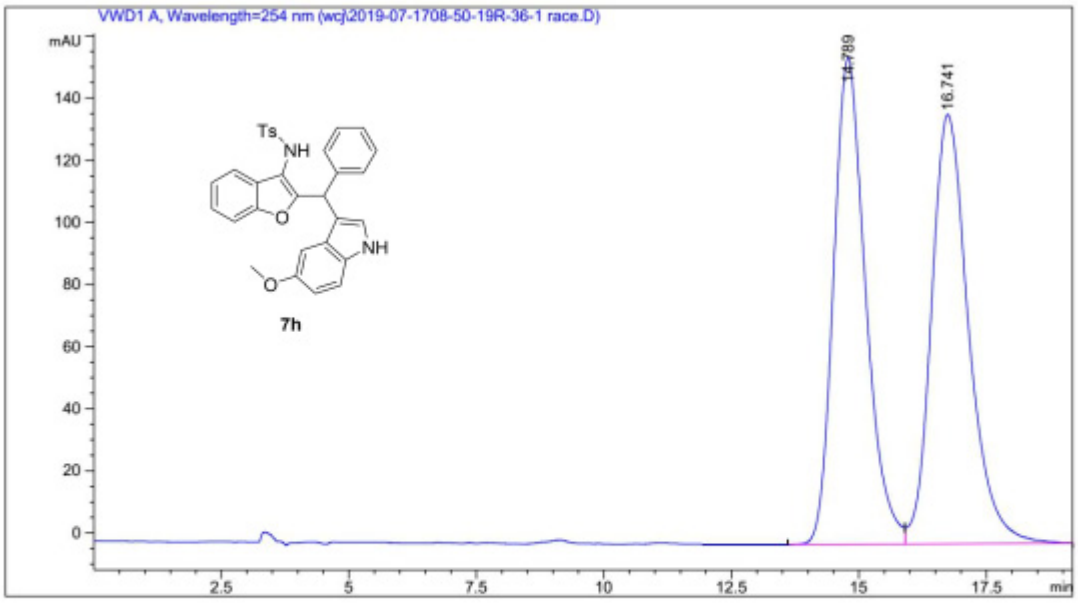

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 6.745 | VV R | 0.2576 | 3.29490e4 | 1951.76318 | 94.6657 |
| 2 | 7.978 | VBAE | 0.3065 | 1856.65039 | 92.36141 | 5.3343 |



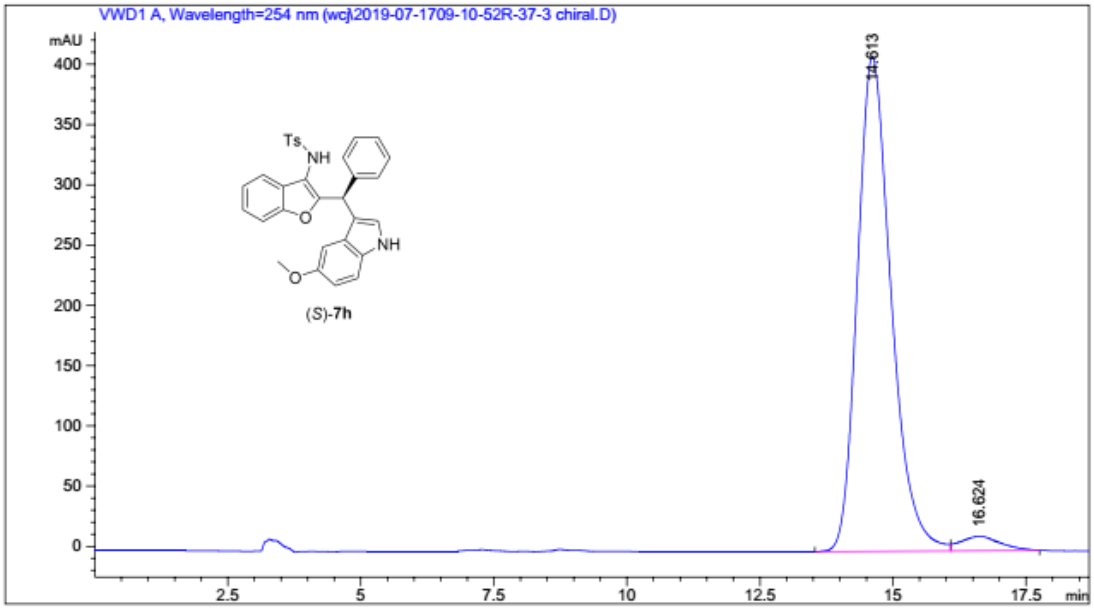

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 15.500 | BV | 0.7311 | 2313.56738 | 49.24519 | 49.5130 |
| 2 | 17.728 | VB | 0.8147 | 2359.07886 | 42.10588 | 50.4870 |



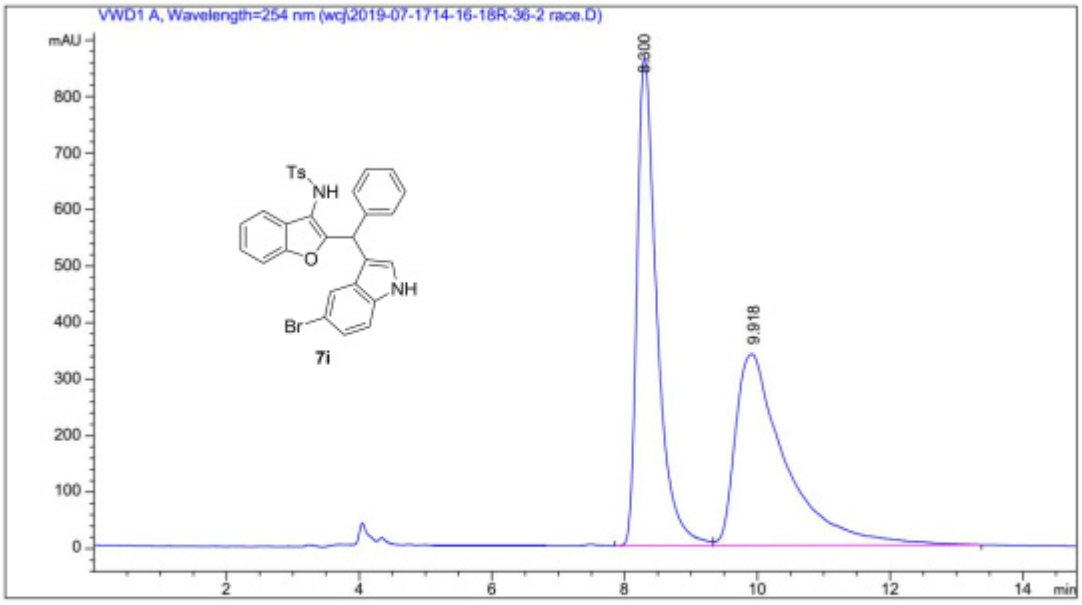

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 15.636 | BV R | 0.5882 | 1.32912e4 | 350.68134 | 97.9944 |
| 2 | 17.893 | VB E | 0.6373 | 272.02359 | 6.05303 | 2.0056 |



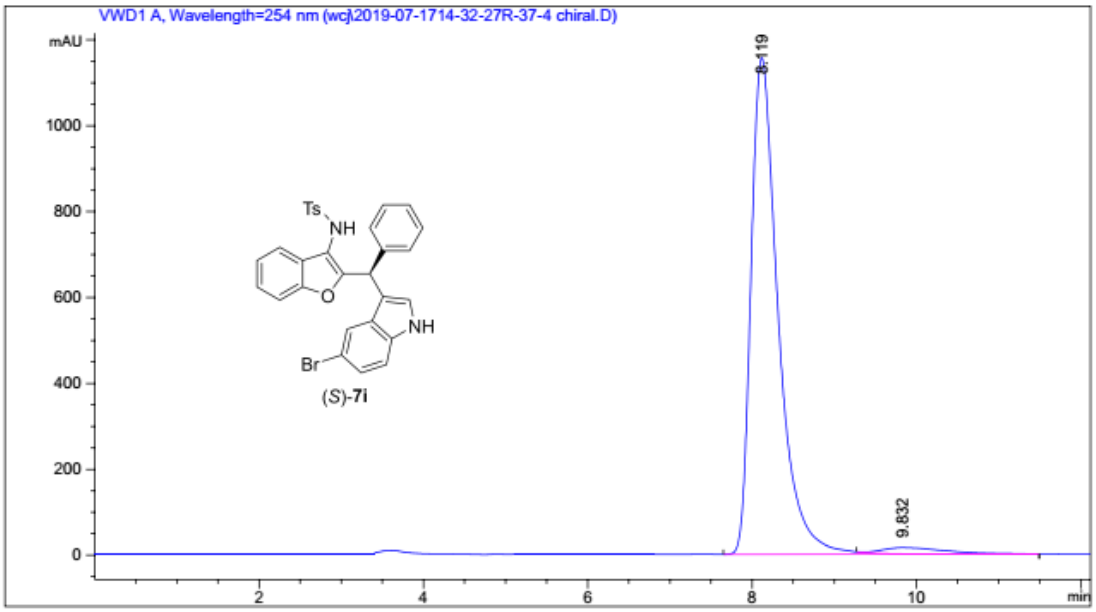

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 14.789 | BV | 0.6722 | 6832.19434 | 156.53864 | 49.3785 |
| 2 | 16.741 | VBA | 0.7705 | 7004.17188 | 138.15886 | 50.6215 |



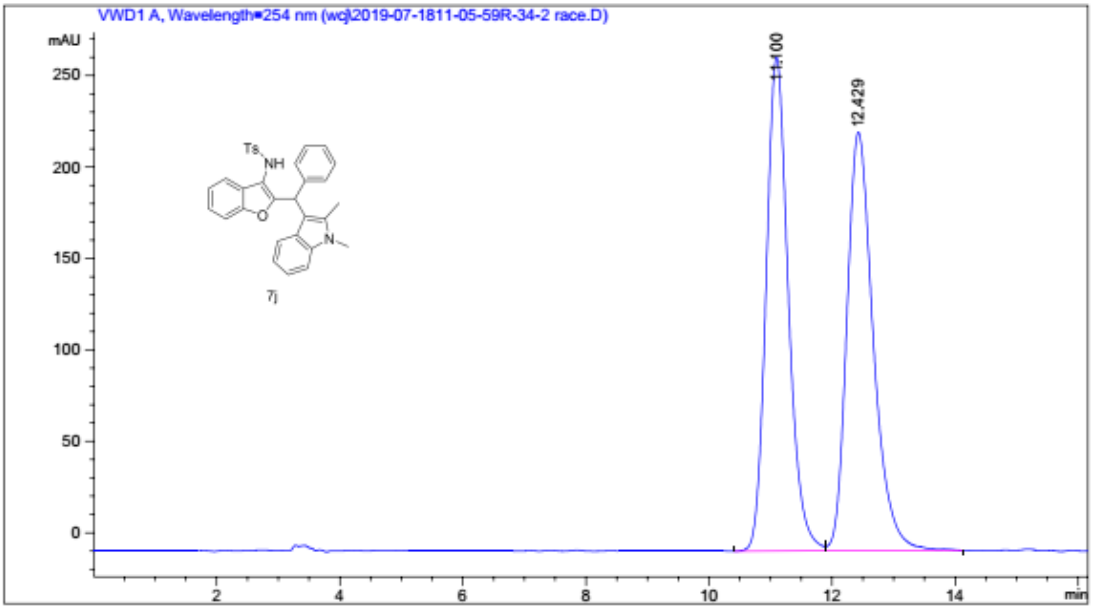

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 14.613 | MF | 0.7348 | 1.80885e4 | 410.30331 | 96.7242 |
| 2 | 16.624 | FM | 0.8748 | 612.60992 | 11.67148 | 3.2758 |



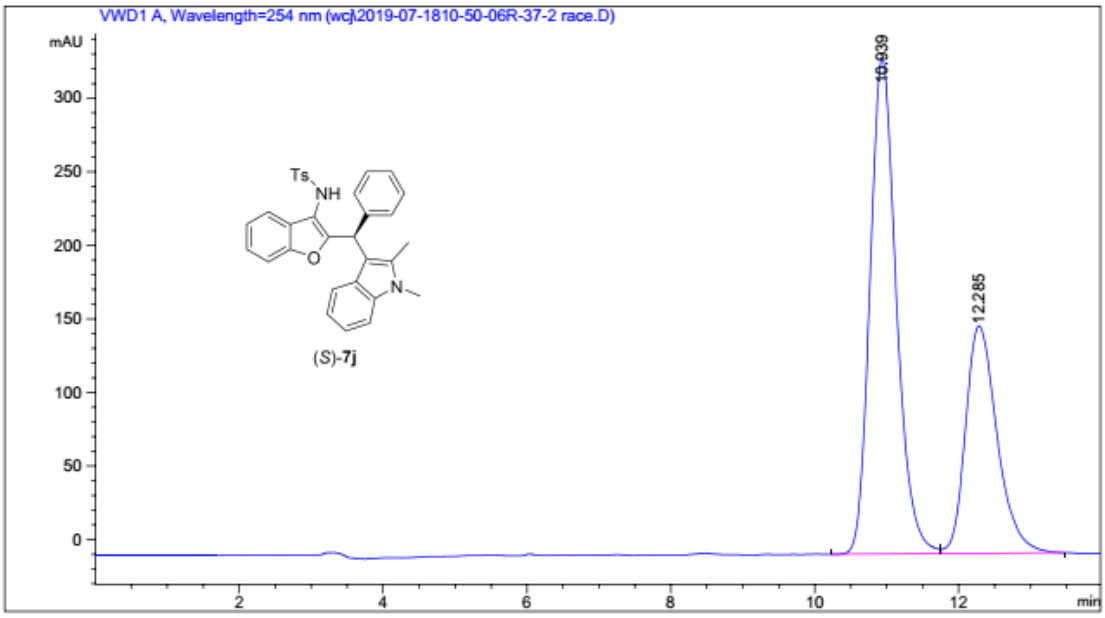

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 8.300 | BV | 0.3089 | 1.79915e4 | 864.28168 | 50.2686 |
| 2 | 9.918 | VB | 0.7464 | 1.77993e4 | 338.53836 | 49.7314 |




| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 8.119 | BV R | 0.3437 | 2.65153e4 | 1155.68701 | 97.1591 |
| 2 | 9.832 | VB E | 0.7333 | 775.31024 | 14.39605 | 2.8409 |




| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 11.100 | BV | 0.3854 | 6770.62402 | 270.15363 | 49.7913 |
| 2 | 12.429 | VV R | 0.4580 | 6827.37305 | 228.90221 | 50.2087 |




| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area % |
|---|---|---|---|---|---|---|
| 1 | 10.939 | BV | 0.3916 | 8563.68750 | 336.84872 | 64.5030 |
| 2 | 12.285 | VB | 0.4694 | 4712.72266 | 154.72401 | 35.4970 |