Supporting Information

Observation of Solvent Enantio-Isotope Effect in Asymmetric Ring-Opening of Cyclic Diaryliodoniums with Selenocyanate

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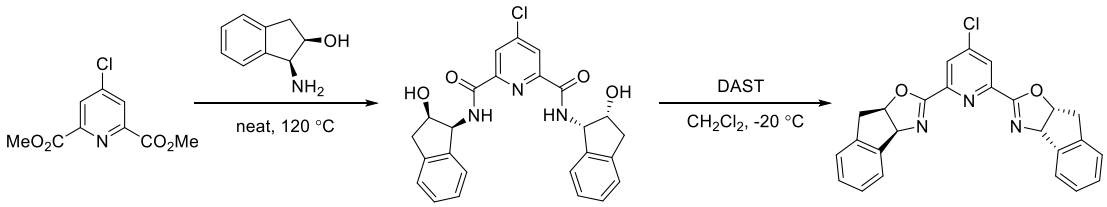
1. General Information and Materials

All reactions were carried out under a nitrogen atmosphere, unless the reaction procedure states otherwise. ^{1}H and ^{13}C NMR spectra were recorded on Bruker AC-400 FT spectrometer and Bruker AC-500 FT spectrometer using solvent residue as an internal reference (7.26 and 77.00 ppm for $CDCl_3$, 2.50 and 39.00 ppm for DMSO-d_6, respectively). Chemical shifts (δ) are reported in ppm, and coupling constants (*J*) are in Hertz (Hz). The following abbreviations explained the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. High resolution mass spectra (HRMS (ESI)) was recorded on a high-resolution mass spectrometer with a Q-TOF analyzer (Waters XEVO-G2 Q-TOF). Single crystal data were collected at 100 K on a Rigaku Oxford Diffraction Supernova Dual Source, Cu at Zero equipped with an AtlasS2 CCD using Cu Kα radiation. Reaction heats were measured using Omnical SuperCRC. Reaction heats were normalized to 100% conversion, and the sensible heat of dosing has been removed unless otherwise stated. All reagents were used as received from commercial sources and used without further purification. Flash column chromatography was performed using 200-300 mesh silica gel as the stationary phase. Room temperature refers 25°C-30°C.

2. Synthesis of Chiral Ligands

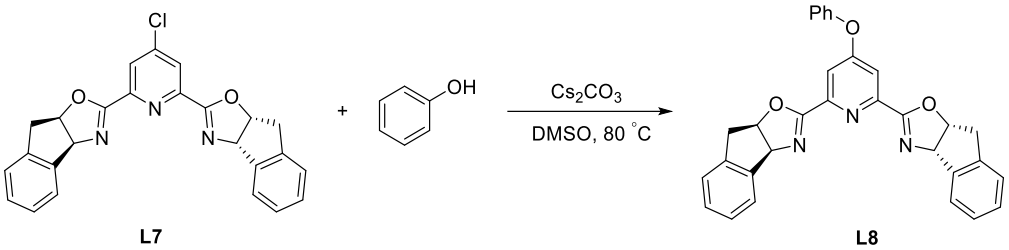
General Procedure for the Synthesis of Chiral Ligands (L7-L11)[1-4]

Synthesis of bisoxazoline L7[1]



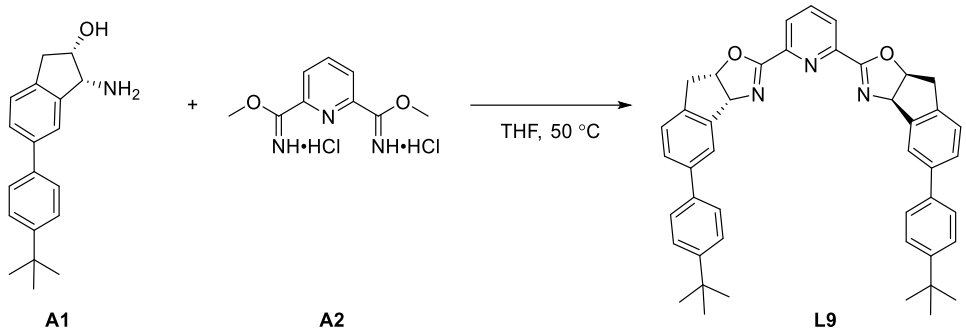
A mixture of dimethyl 4-chloropyridine-2,6-dicarboxylate (459 mg, 2.0 mmol) and (1*S*,2*R*)-aminoindanol (895 mg, 6.0 mmol, 3.0 equiv) was stirred at 120 °C for 16 h. The solid obtained was dissolved in hot CH_2Cl_2 (25 mL) and it was subjected to column chromatography using CH_2Cl_2/EtOAc (20/1, v/v) as the elution to afford **I** in 99% yield. To a flame-fried 50 mL Schlenk tube was added **I** (463 mg, 1.0 mmol), followed by the addition of 20 mL of CH_2Cl_2. The resulting solution was cooled to -20 °C and was charged with DAST (diethylaminosulfur trifluoride) (396 uL, 3.0 mmol). The reaction was allowed to proceed at -20 °C for 24 h and then was quenched with aqueous NH_4OH, diluted with H_2O. The aqueous layer was extracted with CH_2Cl_2 (20 mL×3), the combined organic phase was dried with Na_2SO_4, filtrated, and then filtrate was concentrated under reduced pressure. The residue was subjected to column chromatography using CH_2Cl_2/EtOAc (5/1, v/v) as the eluent to afford **L7** as a white solid (319 mg, 74% yield). $[\alpha]_D^{20}$ = -115.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 8.11 (s, 2H), 7.79 – 7.46 (m, 2H), 7.44 – 7.10 (m, 6H), 5.79 (d, *J* = 8.0 Hz, 2H), 5.70 – 5.45 (m, 2H), 3.57 – 3.41 (m, 4H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 162.0, 148.0, 145.3, 141.1, 139.7, 128.7, 127.5, 126.1, 125.6, 125.3, 84.6, 76.9, 39.6. **HRMS (ESI)** m/z: calcd. for $C_{25}H_{19}ClN_3O_2$ $[M+H]^+$: 428.1160; Found: 428.1172.

Synthesis of bisoxazoline L8[2]



To a flame-dried round-bottom flask under nitrogen was added **L7** (85.6 mg, 0.20 mmol, 1.0 equiv), phenol (22.6 mg, 0.24 mmol, 1.2 equiv), Cs_2CO_3 (130 mg, 0.40 mmol, 2.0 equiv) and dry dimethyl sulfoxide (2.0 mL). The mixture was stirred at 80 ºC for 12 h before it was cooled to room temparature. The crude reaction mixture was quenched with H_2O (5.0 mL). The aqueous layer was extracted with EtOAc (5.0 mL×3), the combined organic phase was dried with Na_2SO_4, filtrated, and then the filtrate was concentrated under reduced pressure. The residue was subjected to column chromatography using CH_2Cl_2/EtOAc (5/1, v/v) as the eluent to afford **L8** as a white solid (63.0 mg, 65% yield). $[\alpha]_D^{20}$ = -25.6 (c 0.50, CH_2Cl_2). **^{1}H NMR (600 MHz, $CDCl_3$)** δ 7.62 (s, 2H), 7.56 – 7.50 (m, 2H), 7.41 (t, *J* = 8.4 Hz, 2H), 7.26 – 7.21 (m, 7H), 7.04 (d, *J* = 7.8 Hz, 2H), 5.74 (d, *J* = 7.8 Hz, 2H), 5.65 – 5.47 (m, 2H), 3.59 – 3.36 (m, 4H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 165.5, 162.6, 153.6, 148.8, 141.3, 139.9, 130.4, 128.6, 127.4, 125.7, 125.6, 125.3, 120.6, 114.3, 84.3, 39.6. **HRMS (ESI)** m/z: calcd. for $C_{31}H_{24}N_3O_3$ $[M+H]^+$: 486.1812; Found: 486.1819.

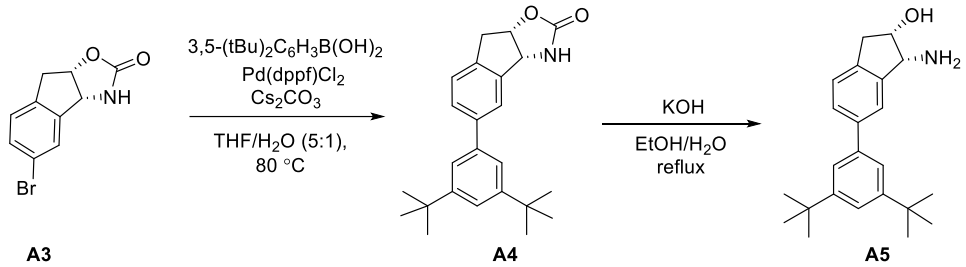
Synthesis of bisoxazoline L9[3]



To a flame-dried round-bottom flask under nitrogen was added **A1** (168.8 mg, 0.60 mmol, 3.0 equiv), **A2** (53.0 mg, 0.20 mmol, 1.0 equiv), and dry THF (5.0 mL). The mixture was stirred at 50 ºC for 20 h before it was cooled to room temperature. The crude reaction mixture was filtrated through a pad of celite and concentrated under vacuum. The residue was subjected to column chromatography on silica gel using CH_2Cl_2/EtOAc (5/1, v/v) as the eluent to afford **L9** as a white solid (53.7 mg, 41% yield). $[\alpha]_D^{20}$ = +52.2 (c 0.25, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.12 (d, *J* = 8.0 Hz, 2H), 7.79 (d, *J* = 2.0 Hz, 3H), 7.56 (d, *J* = 8.5 Hz, 4H), 7.50 (dd, *J* = 8.0, 2.0 Hz, 2H), 7.46 (d, *J* = 8.5 Hz, 4H), 7.30 (d, *J* = 8.0 Hz, 2H), 5.83 (d, *J* = 8.0 Hz, 2H), 5.68 – 5.61 (m, 2H), 3.52 (d, *J* = 4.0 Hz, 4H), 1.37 (s, 18H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 162.8, 150.1, 146.9, 142.0, 140.5, 138.7,

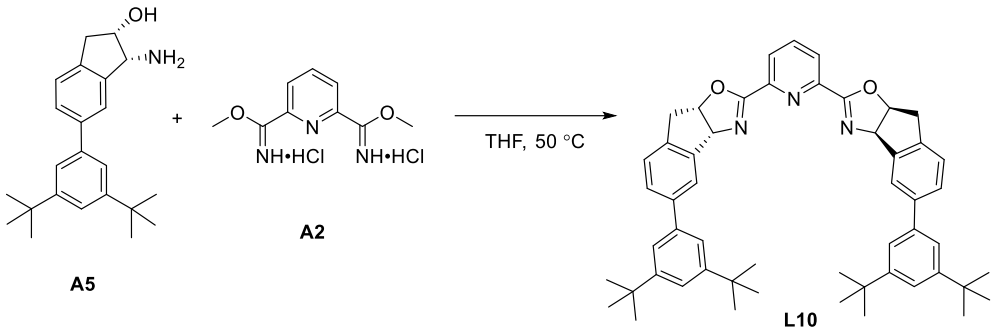
138.0, 137.2, 127.6, 126.7, 126.0, 125.7, 125.5, 124.1, 84.5, 39.4, 34.5, 31.3. **HRMS (ESI)** m/z: calcd. for $C_{45}H_{44}N_3O_2$ $[M+H]^+$: 658.3428; Found: 658.3442.

Synthesis of bisoxazoline L10



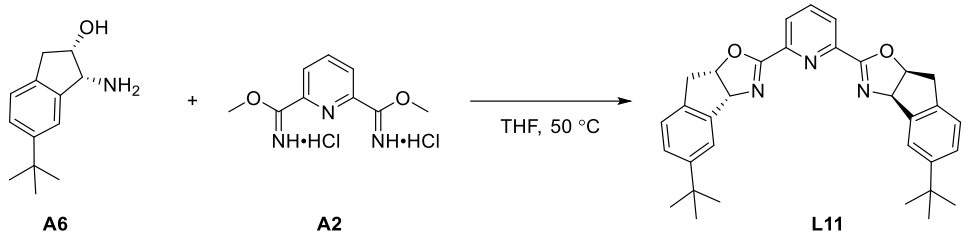
A reported procedure was followed with some modifications.[3-4] To a nitrogen-filled round-bottom flask were added **A3** (254.1 mg, 1.0 mmol, 1.0 equiv), $Pd(dppf)Cl_2$ (21.9 mg, 0.03 mmol, 3.0 mol%), Cs_2CO_3 (651.6 mg, 2.0 mmol, 2.0 equiv.) and (3,5-di-*tert*-butylphenyl)boronic acid (280.9 mg, 1.2 mmol, 1.2 equiv) in THF (5.0 mL) and H_2O (1.0 mL). The mixture was heated to 80 °C and stirred for 12 h before it was cooled to room temperature. The reaction mixture was quenched with water (5 mL), extracted with EtOAc (10 mL×3). The combined organic layers were washed with brine, dried over Na_2SO_4, and filtered. The solvent was removed under reduced pressure, and the residue was purified by silica gel column chromatography (CH_2Cl_2/EtOAc = 5/1) to afford compound **A4** as a white solid (253.4 mg, 70% yield). $[\alpha]_D^{20}$ = +21.0 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.43 (t, *J* = 2.0 Hz, 1H), 7.39 – 7.33 (m, 2H), 7.31 – 7.24 (m, 1H), 7.22 (d, *J* = 2.0 Hz, 2H), 6.61 (s, 1H), 5.50 – 5.35 (m, 1H), 5.24 (d, *J* = 7.5 Hz, 1H), 3.54 – 3.20 (m, 2H), 1.36 (s, 18H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 159.6, 150.8, 141.0, 140.7, 139.3, 137.6, 129.9, 128.5, 123.3, 122.7, 121.3, 80.3, 61.3, 38.9, 34.9, 31.5. **HRMS (ESI)** m/z: calcd. for $C_{24}H_{30}NO_2$ $[M+H]^+$: 364.2271; Found: 364.2219.

A 50-mL round bottom flask equipped with a condenser was charged with compound **A4** (253.4 mg, 0.70 mmol, 1.0 equiv.), KOH (117.8 mg, 3.6 mmol, 3.6 equiv.), EtOH (10 mL) and water (10 mL). The mixture was stirred at 100 °C for 6 h. After being cooled to room temperature, the mixture was extracted with EtOAc (3 x 5 mL) and the organic phase was extracted with aqueous HCl (2 M, 5 mL). The aqueous phase was brought to pH 14 by adding solid NaOH and was extracted again with EtOAc (5 mL×3). The combined EtOAc layers were dried over $MgSO_4$ and concentrated to obtain the title compound **A5** as a colorless solid without further purification (270.0 mg, 80 % yield). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.34 (s, 2H), 7.98 (s, 1H), 7.48 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.40 (d, *J* = 1.5 Hz, 2H), 7.35 (t, *J* = 1.5 Hz, 1H), 7.13 (d, *J* = 8.0 Hz, 1H), 5.50 (s, 1H), 4.75 (d, *J* = 6.0 Hz, 1H), 4.68 – 4.47 (m, 1H), 3.29 – 2.70 (m, 2H), 1.30 (s, 18H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 151.1, 141.9, 139.8, 139.5, 136.2, 129.1, 125.5, 125.2, 121.6, 121.4, 71.2, 57.5, 38.1, 34.9, 31.5, 31.4. $[\alpha]_D^{20}$ = -19.7 (c 0.50, CH_2Cl_2). **HRMS (ESI)** m/z: calcd. for $C_{23}H_{32}NO$ $[M+H]^+$: 338.2478; Found: 338.2480.



To a flame-dried round-bottom flask under argon was added **A5** (253.1 mg, 0.7 mmol, 2.8 equiv.), **A2** (66.3 mg, 0.25 mmol, 1.0 equiv.), and dry THF (5.0 mL). The mixture was stirred at 50 °C for 20 h before it was cooled to room temperature. The crude reaction mixture was filtrated with a pad of celite and concentrated under vacuum. The residue was subjected to column chromatography using CH_2Cl_2/EtOAc (5/1, v/v) as the eluent to afford **L10** (74.1 mg, 38% yield). $[\alpha]_D^{20}$ = +230.4 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.14 (dd, *J* = 8.0, 2.0 Hz, 2H), 7.83 – 7.79 (m, 2H), 7.55 – 7.50 (m, 3H), 7.46 – 7.42 (m, 6H), 7.33 (dd, *J* = 8.0, 2.0 Hz, 2H), 5.86 (dd, *J* = 8.0, 2.5 Hz, 2H), 5.67 (dt, *J* = 7.0, 3.5 Hz, 2H), 3.56 – 3.49 (m, 4H), 1.41 – 1.38 (m, 36H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 162.9, 151.0, 147.0, 141.9, 140.3, 138.7, 137.2, 128.0, 126.0, 125.5, 124.5, 121.7, 121.3, 84.5, 39.4, 34.9, 31.5. **HRMS (ESI)** m/z: calcd. for $C_{53}H_{60}N_3O_2$ $[M+H]^+$: 770.4680; Found: 770.4670.

Synthesis of bisoxazoline L11[3]



To a flame-dried round-bottom flask under argon was added **A6** (126.7 mg, 0.6 mmol, 3.0 equiv.), **A2** (53.0 mg, 0.2 mmol, 1.0 equiv.), and dry THF (5 mL). The mixture was stirred at 50 °C for 20 h before it was cooled to room temperature. The crude reaction mixture was filtrated with a pad of celite and concentrated under vacuum. The residue was subjected to column chromatography using CH_2Cl_2/EtOAc (5/1, v/v) as the elution to afford **L11** as a white solid (58.5 mg, 58% yield). $[\alpha]_D^{20}$ = +45.1 (c 0.25, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.10 (d, *J* = 8.0 Hz, 2H), 7.84 – 7.75 (m, 2H), 7.59 (d, *J* = 2.0 Hz, 2H), 7.39 – 7.28 (m, 2H), 7.18 (d, *J* = 8.0 Hz, 2H), 5.76 (d, *J* = 8.0 Hz, 2H), 5.65 – 5.56 (m, 2H), 3.50 – 3.38 (m, 4H), 1.33 (s, 18H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 162.7, 150.7, 147.1, 141.3, 137.0, 136.9, 126.1, 126.0, 124.8, 122.3, 84.5, 39.4, 34.7, 31.5. **HRMS (ESI)** m/z: calcd. for $C_{33}H_{36}N_3O_2$ $[M+H]^+$: 506.2802; Found: 506.2805.

3. Copper-catalyzed asymmetric coupling between cyclic diaryliodonium and KSeCN

General procedure for Cu-catalyzed coupling of cyclic iodonium, and potassium

selenocyanate in CH_2Cl_2/D_2O (General Procedure A)

Under nitrogen atmosphere, a Schlenk tube containing a stirring bar was charged with CuI (1.9 mg, 0.01 mmol), **L11** (10.1 mg, 0.02 mmol), and cyclic diaryliodonium salt **1** (0.20 mmol, 1.0 equiv.), in anhydrous dichloromethane (5.0 mL), the resulting solution was stirred for 30 min. A solution of potassium selenocyanate (0.40 mmol, 2.0 equiv.) in deuterium oxide (1.0 mL) was added. The reaction mixture was stirred at room temperature for 12 h. The reaction mixture was directly extracted with CH_2Cl_2, and the combined organic phase was dried with Na_2SO_4. The solid was filtered, and the filtrate was concentrated under reduced pressure. The residue was subjected to column chromatography using PE/EtOAc (50/1, v/v) as the eluent to afford product **3**.

General procedure for Cu-catalyzed coupling of cyclic iodonium, and potassium selenocyanate in CH_2Cl_2/H_2O (General Procedure A')

Under nitrogen atmosphere, a Schlenk tube containing a stirring bar was charged with CuI (1.0 mg, 0.005 mmol), **L11** (5.0 mg, 0.01 mmol), and cyclic diaryliodonium salt **1** (0.10 mmol, 1.0 equiv.), in anhydrous dichloromethane (2.5 mL), the resulting solution was stirred for 30 min. A solution of potassium selenocyanate (0.20 mmol, 2.0 equiv.) in water (0.5 mL) was added. The reaction mixture was stirred at room temperature for 12 h. The reaction mixture was directly extracted with CH_2Cl_2, and the combined organic phase was dried with Na_2SO_4. The solid was filtered, and the filtrate was concentrated under reduced pressure. The residue was subjected to column chromatography using PE/EtOAc (50/1, v/v) as the eluent to afford product **3**.

3a was prepared following the **General Procedure A**

The reaction of **1a** (91.2 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3a** as a pale-yellow solid (68.0 mg, 91%, 94% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.5:99.5, flow: 1.0 mL/min, λ = 254 nm, t_r = 8.937 min (major), 11.521 min (minor). $[\alpha]_D^{20}$ = -14.2 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.82 (d, *J* = 8.0 Hz, 1H), 7.73 (d, *J* = 7.5 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 1H), 7.35 – 7.29 (m, 2H), 7.06 (t, *J* = 8.0 Hz, 1H), 2.07 (s, 3H), 1.99 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 142.6, 141.8, 138.3, 137.8, 137.3, 130.63, 130.60, 130.5, 129.9, 127.9, 124.8, 101.8, 100.7, 21.2, 19.6. **HRMS (ESI)**

m/z: calcd. for $C_{15}H_{12}IN^{80}SeNa$ $[M+Na]^+$: 435.9072; Found: 435.9071.

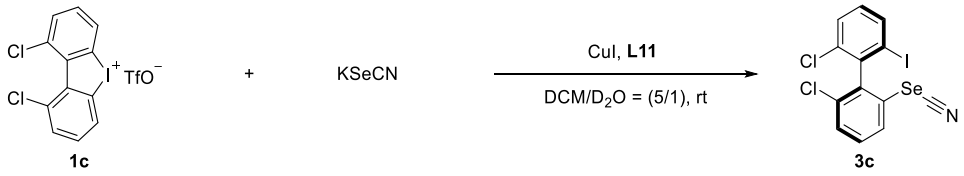
3a was prepared following the **General Procedure A'**

The reaction of **1a** (45.6 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and water (0.5 mL) at room temperature for 12 h afforded **3a** as a pale-yellow solid (37.2 mg, 90%, 92% ee) (eluent for column chromatography PE/EtOAc = 50:1).

1b 3b

3b was prepared following the **General Procedure A**

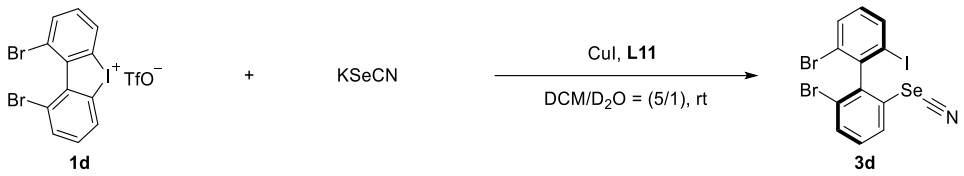
The reaction of **1b** (48.4 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and deuterium oxide (0.5 mL) at room temperature for 12 h afforded **3b** as a pale-yellow solid (43.8 mg, 99%, 88% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.2:99.8, flow: 1.0 mL/min, λ = 230 nm, t_r = 9.936 min (minor), 11.408 min (major). $[\alpha]_D^{20}$ = -1.4 (c 0.50, CH_2Cl_2). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.85 – 7.79 (m, 1H), 7.78 – 7.70 (m, 1H), 7.43 (t, *J* = 7.6 Hz, 1H), 7.40 – 7.36 (m, 2H), 7.13 (t, *J* = 7.6 Hz, 1H), 2.41 – 2.17 (m, 4H), 1.16 (t, *J* = 7.6 Hz, 3H), 1.12 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 144.4, 143.5, 141.9, 141.2, 137.3, 130.8, 130.1, 128.4, 128.2, 127.6, 125.5, 102.1, 101.6, 27.3, 25.9, 14.2, 13.8. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{17}IN^{80}Se$ $[M+H]^+$: 441.9565; Found: 441.9571.



1c 3c

3c was prepared following the **General Procedure A**

The reaction of **1c** (99.4 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3c** as a white solid (87.9 mg, 97%, 96% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 1:99, flow: 0.4 mL/min, λ = 230 nm, t_r = 72.797 min (major), 75.472 min (minor). $[\alpha]_D^{20}$ = -11.1 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.91 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.83 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.55 (td, *J* = 8.0, 6.5, 1.0 Hz, 2H), 7.44 (t, *J* = 8.0 Hz, 1H), 7.14 (t, *J* = 8.0 Hz, 1H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 140.7, 139.8, 138.1, 135.1, 134.0, 132.0, 131.3, 130.1, 129.9, 129.7, 126.3, 100.7, 100.2. **HRMS (ESI)** m/z: calcd. for $C_{13}H_6Cl_2IN^{80}SeNa$ $[M+Na]^+$: 475.7979; Found: 475.7971.



3d was prepared following the **General Procedure A**

The reaction of **1d** (117.2 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3d** a white solid (86.7 mg, 80%, 90% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 1.5:98.5, flow: 0.4 mL/min, λ = 230 nm, t_r = 78.143 min (major), 81.087 min (minor). $[\alpha]_D^{20}$ = -6.3 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.95 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.87 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.74 (dd, *J* = 3.5, 1.0 Hz, 1H), 7.72 (dd, *J* = 3.5, 1.0 Hz, 1H), 7.35 (t, *J* = 8.0 Hz, 1H), 7.04 (t, *J* = 8.0 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 143.9, 142.9, 138.9, 133.27, 133.25, 132.3, 131.6, 130.1, 126.3, 125.0, 123.4, 101.1, 99.9. **HRMS (ESI)** m/z: calcd. for $C_{13}H_6Br_2IN^{80}SeNa$ $[M+Na]^+$: 563.6969; Found: 563.6975.

3e was prepared following the **General Procedure A**

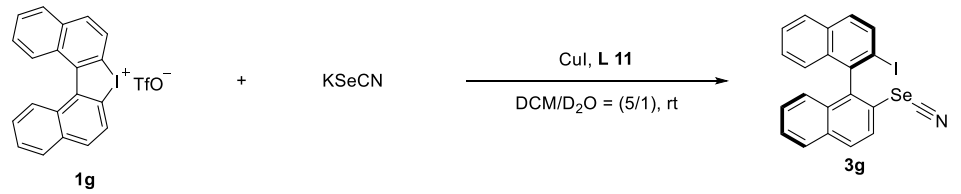
The reaction of **1e** (153.7 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3e** as a white solid (138.4 mg, 96%, 96% ee) (eluent for column chromatography PE/EtOAc = 10:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 30:70, flow: 0.8 mL/min, λ = 230 nm, t_r = 17.498 min (minor), 21.854 min (major). $[\alpha]_D^{20}$ = -47.5 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.82 – 7.75 (m, 2H), 7.51 – 7.44 (m, 4H), 7.42 – 7.37 (m, 2H), 7.22 (d, *J* = 8.0 Hz, 2H), 7.20 – 7.14 (m, 4H), 7.08 (t, *J* = 8.0 Hz, 2H), 2.43 (s, 3H), 2.40 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 147.9, 147.0, 145.8, 145.4, 137.8, 133.53, 133.45, 132.9, 132.4, 131.5, 131.4, 131.2, 129.81, 129.79, 129.7, 128.0, 127.92, 127.86, 122.4, 122.1, 103.1, 101.6, 21.72, 21.68. **HRMS (ESI)** m/z: calcd. for $C_{27}H_{20}INO_6S_2{}^{80}SeNa$ $[M+Na]^+$: 747.8834; Found: 747.8845.

3e was prepared following the **General Procedure A'**

The reaction of **1e** (72.4 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and water (0.5 mL) at room temperature for 12 h afforded **3e** as a white solid (66.0 mg, 91%, 88% ee) (eluent for column chromatography PE/EtOAc = 10:1).

3f was prepared following the **General Procedure A**

The reaction of **1f** (66.8 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and deuterium oxide (0.5 mL) at room temperature for 12 h afforded **3f** a white solid (55.4 mg, 89%, 97% ee) (eluent for column chromatography PE/EtOAc = 10:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 25:75, flow: 0.4 mL/min, λ = 230 nm, t_r = 20.400 min (minor), 24.224 min (major). $[\alpha]_D^{20}$ = -45.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.89 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.86 – 7.81 (m, 4H), 7.78 (dd, *J* = 6.0, 3.0 Hz, 1H), 7.59 – 7.53 (m, 2H), 7.49 – 7.43 (m, 2H), 7.43 – 7.37 (m, 4H), 7.33 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.20 (t, *J* = 8.0 Hz, 1H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 164.5, 163.6, 149.12, 149.06, 136.8, 133.9, 133.72, 133.71, 133.4, 131.6, 131.0, 130.1, 130.0, 129.8, 128.7, 128.53, 128.52, 128.3, 126.3, 123.8, 122.9, 102.0, 100.4. **HRMS (ESI)** m/z: calcd. for $C_{27}H_{16}INO_4{}^{80}SeNa$ $[M+Na]^+$: 647.9181; Found: 647.9185.

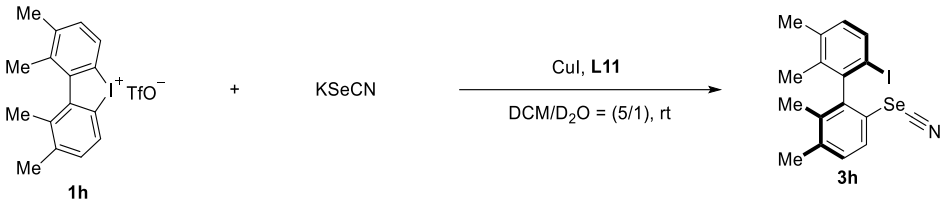


3g was prepared following the **General Procedure A**

The reaction of **1g** (52.8 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and deuterium oxide (0.5 mL) at room temperature for 12 h afforded **3g** as a white solid (47.8 mg, 99%, 98% ee) (eluent for column chromatography PE/EtOAc = 20:1). **HPLC conditions**: Chiralpak OD-H, isopropanol/hexane = 5:95, flow: 1.0 mL/min, λ = 254 nm, t_r = 13.436 min (major), 17.715 min (minor). $[\alpha]_D^{20}$ = -34.6 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.06 (dd, *J* = 8.5, 3.0 Hz, 2H), 8.02 (d, *J* = 8.5 Hz, 1H), 8.00 (d, *J* = 8.5 Hz, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 7.76 (d, *J* = 8.5 Hz, 1H), 7.59 – 7.51 (m, 2H), 7.37 (ddd, *J* = 8.0, 7.0, 1.0 Hz, 1H), 7.32 (ddd, *J* = 8.0, 7.0, 1.0 Hz, 1H), 7.06 (t, *J* = 9.0 Hz, 2H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 140.0, 139.2, 135.67, 133.1, 133.0, 132.7, 132.4, 130.9, 130.7, 128.5, 128.4, 128.1, 127.9, 127.13, 127.10, 126.9, 125.9, 125.2, 123.5, 101.7, 100.2. **HRMS (ESI)** m/z: calcd. for $C_{21}H_{12}IN^{80}SeNa$ $[M+Na]^+$: 507.9072; Found: 507.9054.

3g was prepared following the **General Procedure A'**

The reaction of **1g** (52.8 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and water (0.5 mL) at room temperature for 12 h afforded **3g** as a white solid (43.3 mg, 89%, 94% ee) (eluent for column chromatography PE/EtOAc = 20:1).

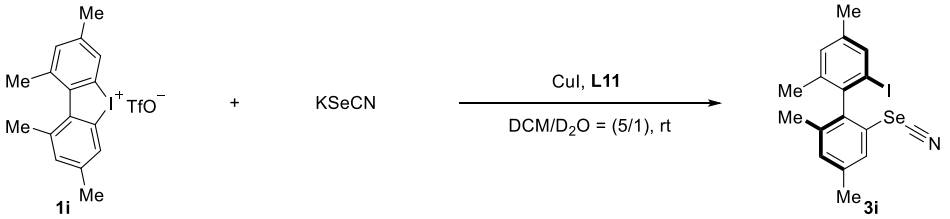


3h was prepared following the **General Procedure A**

The reaction of **1h** (96.9 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3h** as a white solid (79.1 mg, 90%, 94% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.5:99.5, flow: 1.0 mL/min, λ = 230 nm, t_r = 8.402 min (major), 9.129 min (minor). $[\alpha]_D^{20}$ = -21.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.70 (d, *J* = 8.0 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 7.25 (d, *J* = 8.0 Hz, 1H), 6.96 (d, *J* = 8.0 Hz, 1H), 2.35 (s, 3H), 2.30 (s, 3H), 1.97 (s, 3H), 1.87 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 143.4, 142.3, 138.0, 137.9, 137.1, 136.6, 136.5, 132.0, 131.2, 127.7, 121.7, 102.3, 97.4, 20.4, 20.3, 17.8, 16.3. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{16}IN^{80}SeNa$ $[M+Na]^+$: 463.9385; Found: 463.9383.

3h was prepared following the **General Procedure A'**

The reaction of **1h** (48.4 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and water (0.5 mL) at room temperature for 12 h afforded **3h** as a white solid (41.0 mg, 93%, 86% ee) (eluent for column chromatography PE/EtOAc = 50:1).

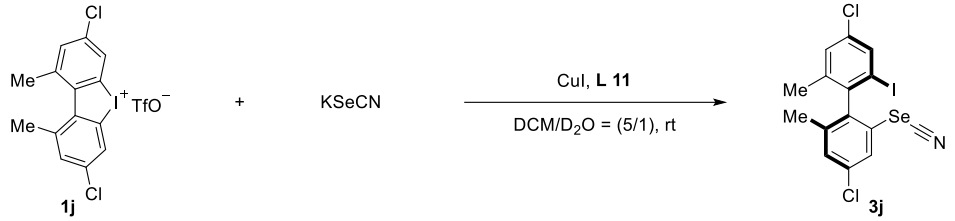


3i was prepared following the **General Procedure A**

The reaction of **1i** (96.8 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3i** as a white solid (74.5 mg, 85%, 90% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.5:99.5, flow: 1.0 mL/min, λ = 230 nm, t_r = 6.547 min (minor), 8.493 min (major). $[\alpha]_D^{20}$ = -17.0 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.66 – 7.62 (m, 1H), 7.53 – 7.49 (m, 1H), 7.15 – 7.02 (m, 2H), 2.41 (s, 3H), 2.33 (s, 3H), 2.02 (s, 3H), 1.93 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 140.7, 140.0, 139.5, 138.8, 138.1, 137.7, 137.6, 131.5, 131.3, 128.0, 124.8, 102.3, 101.1, 21.3, 21.2, 20.7, 19.6. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{17}IN^{80}Se$ $[M+H]^+$: 441.9565; Found: 441.9565.

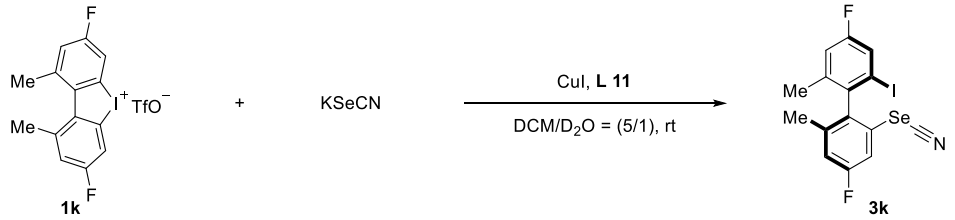
3i was prepared following the **General Procedure A'**

The reaction of **1i** (48.4 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and water (0.5 mL) at room temperature for 12 h afforded **3i** as a white solid (39.5 mg, 90%, 86% ee) (eluent for column chromatography PE/EtOAc = 50:1).



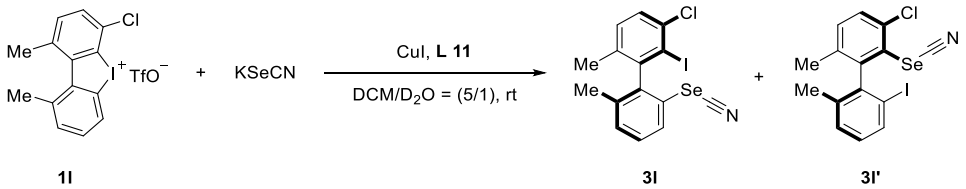
3j was prepared following the **General Procedure A**

The reaction of **1j** (52.5 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L11** (5.0 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv) in anhydrous dichloromethane (2.5 mL) and deuterium oxide (0.5 mL) at room temperature for 12 h afforded **3j** as a white solid (40.1 mg, 83%, 96% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.5:99.5, flow: 1.0 mL/min, λ = 230 nm, t_r = 8.696 min (minor), 16.332 min (major). $[\alpha]_D^{20}$ = -14.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.83 (d, *J* = 2.0 Hz, 1H), 7.72 (d, *J* = 2.0 Hz, 1H), 7.36 – 7.31 (m, 2H), 2.05 (s, 3H), 1.96 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 139.9, 139.6, 139.43, 139.36, 136.9, 135.84, 135.81, 130.9, 130.8, 127.7, 126.2, 100.8, 100.6, 21.2, 19.6. **HRMS (ESI)** m/z: calcd. for $C_{15}H_{11}Cl_2IN^{80}Se$ $[M+H]^+$: 481.8473; Found: 481.8496.



3k was prepared following the **General Procedure A**

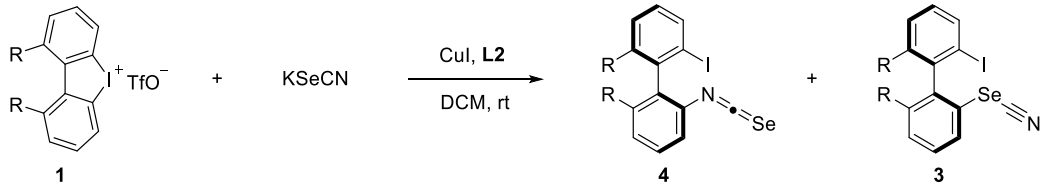
The reaction of **1k** (98.2 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3k** as a white solid (73.5 mg, 82%, 92% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.5:99.5, flow: 1.0 mL/min, λ = 254 nm, t_r = 10.303 min (minor), 14.402 min (major). $[\alpha]_D^{20}$ = -8.1 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.56 (dd, *J* = 7.5, 2.5 Hz, 1H), 7.48 (dd, *J* = 8.0, 2.5 Hz, 1H), 7.06 (ddd, *J* = 13.5, 9.0, 2.5 Hz, 2H), 2.07 (s, 3H), 1.97 (s, 3H). **^{19}F NMR (471 MHz, $CDCl_3$)** δ -110.13, -110.43. **^{13}C NMR (126 MHz, $CDCl_3$)** δ 162.8 (d, *J* = 253.1 Hz), 162.2 (d, *J* = 254.8 Hz), 140.5 (d, *J* = 8.3 Hz), 140.3 (d, *J* = 8.2 Hz), 137.3 (d, *J* = 3.5 Hz), 136.9 (d, *J* = 3.3 Hz), 126.8 (d, *J* = 8.7 Hz), 124.64(d, *J* = 23.7 Hz), 117.9 (d, *J* = 20.9 Hz), 117.5 (d, *J* = 21.2 Hz), 114.9 (d, *J* = 25.5 Hz), 101.0, 100. 8 (d, *J* = 8.5 Hz) 21.52, 21.51, 19.83, 19.82. **HRMS (ESI)** m/z: calcd. for $C_{15}H_{11}F_2IN^{80}Se$ $[M+H]^+$: 449.9064; Found: 449.9066.



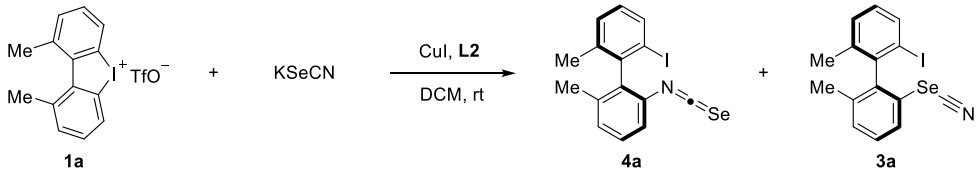
3l and **3l'** was prepared following the **General Procedure A**

The reaction of **1l** (98.1 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L11** (10.1 mg, 0.01 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv) in anhydrous dichloromethane (5.0 mL) and deuterium oxide (1.0 mL) at room temperature for 12 h afforded **3l** and **3l'** as a pale-yellow solid (78.2 mg, 88%, 1:5 dr) (eluent for column chromatography PE/EtOAc = 50:1). A small amount of pure compound can be obtained by re-crystallization from CH_2Cl_2. Date for major isomer: **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.77 – 7.72 (m, 1H), 7.45 (d, *J* = 8.0 Hz, 1H), 7.37 (t, *J* = 7.5 Hz, 1H), 7.35 – 7.32 (m, 1H), 7.27 (d, *J* = 7.5 Hz, 1H), 2.04 (s, 3H), 1.97 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 144.7, 143.4, 137.6, 137.5, 136.2, 131.7, 130.8, 130.1, 129.5, 128.6, 124.3, 104.9, 101.5, 20.9, 19.6. **HRMS (ESI)** m/z: calcd. for $C_{15}H_{11}ClIN^{80}SeNa$ $[M+Na]^+$: 469.8682; Found: 469.8676.

General procedure for Cu-catalyzed coupling of cyclic dianyliodonium, and potassium selenocyanate in CH_2Cl_2 (General Procedure B)

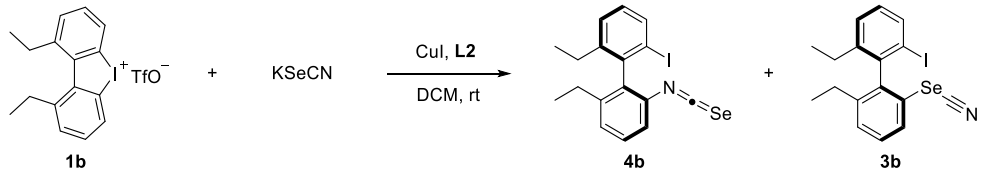


Under nitrogen atmosphere, a Schlenk tube containing a stirring bar was charged with CuI (1.9 mg, 0.01 mmol), **L2** (7.2 mg, 0.02 mmol), and cyclic diaryliodonium salt **1** (0.20 mmol, 1.0 equiv), in anhydrous dichloromethane (5.0 mL), the resulting solution was stirred for 30 min. Potassium selenocyanate **2** (0.40 mmol, 2.0 equiv) was added and the resulting mixture was stirred at room temperature for 12 h. After completing the consumption of starting materials, the mixture was filtered through a plug of celite with ethyl acetate. The filtrate was concentrated under reduced pressure, and the residue was purified by column chromatography on silica gel to deliver the corresponding products **4** and **3**.



4a was prepared following the **General Procedure A**

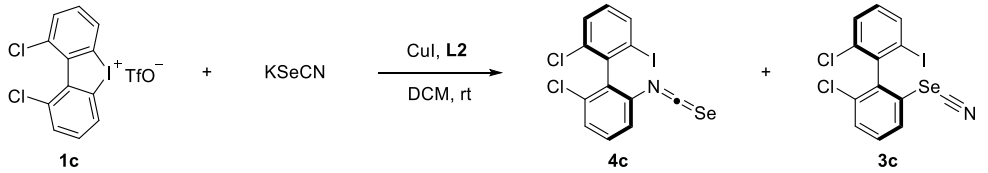
The reaction of **1a** (91.2 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L2** (7.2 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv), in dry CH_2Cl_2 (5.0 mL) at room temperature for 12 h afforded **4a** as a white solid (45.3 mg, 55%, 94% ee) and **3a** as a pale-yellow solid (30.0 mg, 36%) (eluent for column chromatography PE/EtOAc = 100:1). Analytic Data for **4a**: **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.1:99.9, flow: 0.4 mL/min, λ = 230 nm, t_r = 18.366 min (minor), 19.937 min (major). $[\alpha]_D^{20}$ = +35.8 (c 0.125, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.81 (d, *J* = 8.0 Hz, 1H), 7.35 – 7.26 (m, 3H), 7.19 (dd, *J* = 7.5, 2.0 Hz, 1H), 7.05 (t, *J* = 7.5 Hz, 1H), 2.02 (d, *J* = 5.0 Hz, 6H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 141.8, 140.9, 138.0, 137.9, 136.9, 130.2, 130.1, 129.9, 128.7, 123.1, 100.4, 21.2, 19.8. **HRMS (ESI)** m/z: calcd. for $C_{15}H_{13}IN^{80}Se$ $[M+H]^+$: 413.9252; Found: 413.9268.



1b **4b** **3b**

4b was prepared following the **General Procedure B**

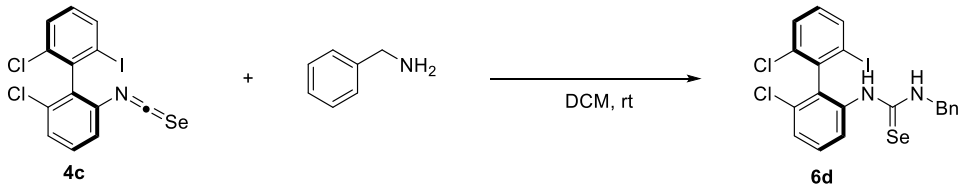
The reaction of **1b** (48.4 mg, 0.10 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L2** (7.2 mg, 0.02 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv), in dry CH_2Cl_2 (2.5 mL) at room temperature for 12 h afforded **3b** as a pale-yellow solid (18.0 mg, 41%, 80% ee) and **3b** as a pale-yellow solid (19.8 mg, 45%) (eluent for column chromatography PE/EtOAc = 100:1). Analytic Data for **4b**: **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.1:99.9, flow: 0.4 mL/min, λ = 230 nm, t_r = 22.661 min (minor), 23.639 min (major). $[\alpha]_D^{20}$ = +11.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (600 MHz, $CDCl_3$)** δ 7.83 (d, *J* = 7.8 Hz, 1H), 7.41 – 7.32 (m, 3H), 7.20 (d, *J* = 7.2 Hz, 1H), 7.11 (t, *J* = 7.8 Hz, 1H), 2.37 – 2.22 (m, 4H), 1.14 (t, *J* = 7.8 Hz, 3H), 1.08 (t, *J* = 7.8 Hz, 3H). **^{13}C NMR (151 MHz, $CDCl_3$)** δ 144.2, 143.5, 141.3, 140.0, 136.9, 131.6, 130.3, 129.4, 128.9, 128.4, 127.8, 123.0, 101.4, 27.6, 26.1, 14.5, 13.9. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{16}IN^{80}SeNa$ $[M+Na]^+$: 463.9385; Found: 463.9346.



1c **4c** **3c**

4c was prepared following the **General Procedure B**

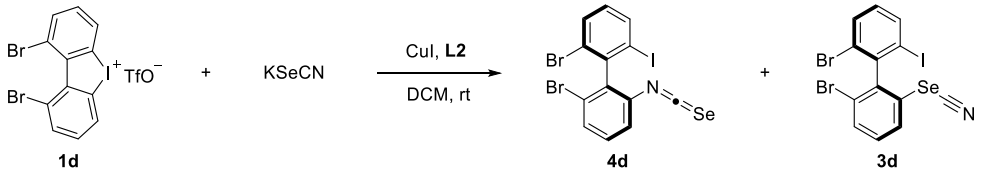
The reaction of **1c** (99.4 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L2** (7.2 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv), in dry CH_2Cl_2 (5.0 mL) at room temperature for 12 h afforded **4c** as a white solid (45.4 mg, 50%, 96% ee) and **3c** as a white solid (33.6 mg, 37%) (eluent for column chromatography PE/EtOAc = 100:1). There is no separation of **4c** for HPLC on various chiral columns. The ee value of compound **4c** was determined by transferring **4c** to its corresponding selenourea (see below). Analytic Data for **4c**: $[\alpha]_D^{20}$ = +9.5 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.90 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.54 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.49 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.39 (t, *J* = 8.0 Hz, 1H), 7.28 (d, *J* = 1.0 Hz, 1H), 7.12 (t, *J* = 8.0 Hz, 1H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 139.6, 138.8, 137.7, 134.8, 134.1, 131.6, 130.2, 129.6, 129.0, 123.9, 100.2. **HRMS (ESI)** m/z: calcd. for $C_{13}H_6Cl_2IN^{80}SeNa$ $[M+Na]^+$: 475.7979; Found: 475.7971.



4c **6d**

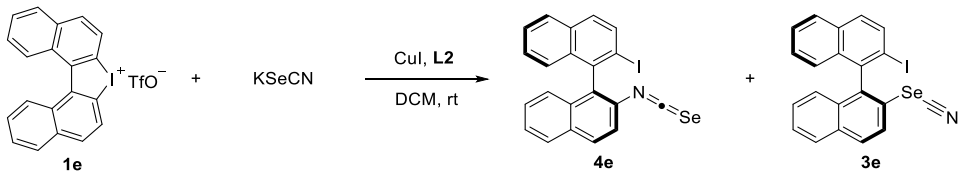
Under nitrogen atmosphere, a Schlenk tube containing a stirring bar was charged with **4c** (11.4 mg, 0.025 mmol) in anhydrous CH_2Cl_2 (1.0 mL) followed by the addition of benzylamine (0.050 mmol, 2.0 equiv). The solution was stirred at room temperature for 2 h. After completing the

consumption of starting materials, the solution was concentrated under reduced pressure, and the residue was purified by column chromatography on silica gel to deliver the corresponding product **6d** as a white solid (9.4 mg, 67%, 96% ee) (eluent for column chromatography PE/EtOAc = 5:1). Analytic Data for **6d**: **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 25:75, flow: 1.0 mL/min, λ = 254 nm, t_r = 8.491 min (major), 9.314 min (minor). $[\alpha]_D^{20}$ = +15.2 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.87 (d, *J* = 8.0 Hz, 1H), 7.51 (dd, *J* = 8.0, 2.5 Hz, 2H), 7.43 (t, *J* = 7.9 Hz, 2H), 7.37 – 7.23 (m, 6H), 7.11 (t, *J* = 8.0 Hz, 1H), 6.49 (s, 1H), 4.90 (s, 2H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 138.8, 138.4, 138.1, 136.3, 133.2, 131.6, 130.9, 129.9, 129.5, 128.8, 128.0, 127.9, 125.2, 99.8, 52.6. **HRMS (ESI)** m/z: calcd. for $C_{20}H_{16}Cl_2IN_2{}^{80}Se$ $[M+H]^+$: 560.8895; Found: 560.8886.



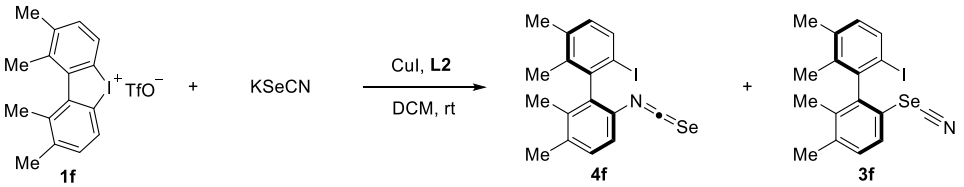
4d was prepared following the **General Procedure B**

The reaction of **1d** (117.2 mg, 0.20 mmol, 1.0 equiv), CuI (1.9 mg, 0.01 mmol) and **L2** (7.2 mg, 0.02 mmol), potassium selenocyanate (57.6 mg, 0.40 mmol, 2.0 equiv), in dry CH_2Cl_2 (5.0 mL) at room temperature for 12 h afforded **4d** as a white solid (47.6 mg, 44%, 98% ee) and **3d** as a white solid (50.8 mg, 47%) (eluent for column chromatography PE/EtOAc = 100:1). Analytic Data for **4d**: **HPLC conditions**: Chiralpak AD-3, isopropanol/hexane = 0.5:99.5, flow: 0.5 mL/min, λ = 230 nm, t_r = 18.336 min (major), 19.908 min (minor). $[\alpha]_D^{20}$ = -9.7 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.94 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.72 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.67 (dd, *J* = 6.5, 3.0 Hz, 1H), 7.35 – 7.26 (m, 2H), 7.03 (t, *J* = 8.0 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 142.0, 138.4, 132.8, 132.1, 131.8, 130.4, 124.5, 124.4, 123.4, 99.8. **HRMS (ESI)** m/z: calcd. for $C_{13}H_7Br_2IN^{80}Se$ $[M+H]^+$: 541.7150; Found: 541.7184.



4e was prepared following the **General Procedure B**

The reaction of **1e** (52.8 mg, 0.10 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L2** (3.6 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv), in dry CH_2Cl_2 (2.5 mL) at room temperature for 12 h afforded **4e** as a white solid (25.0 mg, 52%, 99% ee) and **3e** as a white solid (16.3 mg, 34%) (eluent for column chromatography PE/EtOAc = 100:1). Analytic Data for **4e**: **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 1:99, flow: 1.0 mL/min, λ = 254 nm, t_r = 8.954 min (major), 11.419 min (minor). $[\alpha]_D^{20}$ = -7.9 (c 0.50, CH_2Cl_2). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 8.07 (d, *J* = 8.8 Hz, 1H), 8.01 (d, *J* = 8.8 Hz, 1H), 7.95 (dd, *J* = 8.0, 5.2 Hz, 2H), 7.76 (d, *J* = 8.4 Hz, 1H), 7.58 – 7.46 (m, 3H), 7.41 – 7.33 (m, 1H), 7.33 – 7.25 (m, 1H), 7.15 (d, *J* = 8.4, 1H), 7.05 (d, *J* = 8.4, 1H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 138.4, 138.1, 135.5, 133.4, 132.8, 132.3, 132.1, 130.4, 130.0, 128.5, 128.3, 127.9, 127.5, 127.2, 126.7, 125.90, 125.87, 123.1, 99.8. **HRMS (ESI)** m/z: calcd. for $C_{21}H_{13}IN^{80}Se$ $[M+H]^+$: 485.9252; Found: 485.9272.

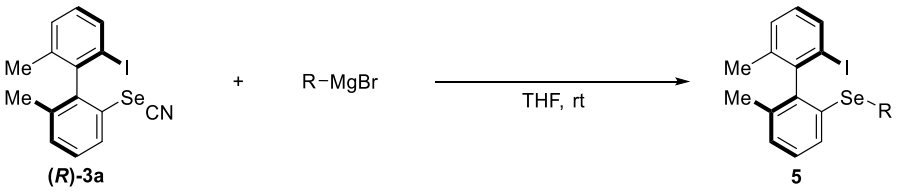


4f was prepared following the **General Procedure B**

The reaction of **1f** (48.4 mg, 0.1 mmol, 1.0 equiv), CuI (1.0 mg, 0.005 mmol) and **L2** (3.6 mg, 0.01 mmol), potassium selenocyanate (28.8 mg, 0.20 mmol, 2.0 equiv), in dry CH_2Cl_2 (2.5 mL) at room temperature for 12 h afforded **4f** as a white solid (23.1 mg, 48%, 98% ee) and **3f** as a white solid (21.2 mg, 44%) (eluent for column chromatography PE/EtOAc = 100:1). Analytic Data for **4f**: **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.1:99.9, flow: 0.4 mL/min, λ = 230 nm, t_r = 18.992 min (minor), 19.910 min (major). $[\alpha]_D^{20}$ = -15.2 (c 0.50, CH_2Cl_2). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.70 (d, *J* = 8.0 Hz, 1H), 7.18 (d, *J* = 8.0 Hz, 1H), 7.10 (d, *J* = 8.0 Hz, 1H), 6.94 (d, *J* = 8.0 Hz, 1H), 2.34 (s, 3H), 2.30 (s, 3H), 1.93 (s, 3H), 1.91 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 142.4, 141.0, 137.6, 137.5, 136.7, 136.4, 136.2, 131.5, 129.8, 122.6, 97.0, 20.6, 20.4, 17.8, 16.5. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{17}IN^{80}Se$ $[M+H]^+$: 441.9565; Found: 441.9579.

4. Synthetic applications

General procedure of selenocyanate with Grignard reagent (General Procedure C)

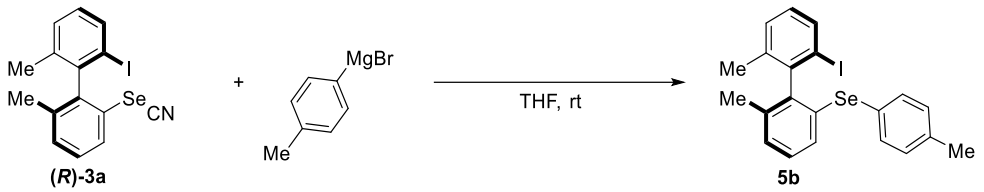


Under nitrogen atmosphere, a Schlenk tube containing a stirring bar was charged with **3a** (41.2 mg, 0.10 mmol) in anhydrous tetrahydrofuran (2.0 mL), Grignard reagent (0.20 mmol, 2.0 equiv) was added and the resulting mixture was stirred at room temperature for 2 h. After completing the consumption of starting materials, the mixture was filtered through a plug of celite with ethyl acetate. The filtrate was concentrated under reduced pressure, and the residue was purified by column chromatography on silica gel to deliver the corresponding product **5**.

5a was prepared following the **General Procedure C**

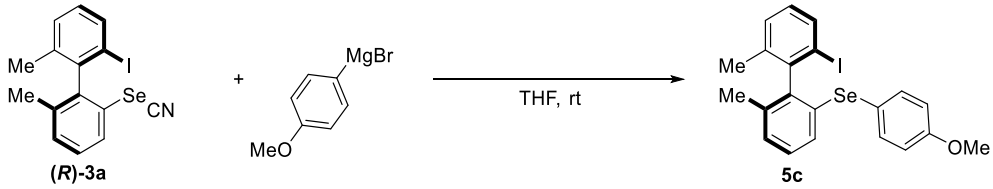
The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and phenylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5a** as a pale-yellow solid (45.8 mg, 99%, 90% ee) (eluent for column chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane =0.5:99.5, flow: 0.6

mL/min, λ = 254 nm, t_r = 10.457 min (major), 11.240 min (minor). $[\alpha]_D^{20}$ = -23.3 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.84 (d, *J* = 8.0 Hz, 1H), 7.69 – 7.58 (m, 2H), 7.40 – 7.27 (m, 4H), 7.17 – 7.08 (m, 2H), 7.02 (t, *J* = 8.0 Hz, 1H), 6.96 (dd, *J* = 7.5, 1.5 Hz, 1H), 2.10 (s, 3H), 1.97 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 144.0, 143.1, 138.2, 136.9, 136.4, 135.80, 135.75, 134.3, 130.1, 129.5, 129.4, 129.2, 128.5, 128.2, 127.9, 127.8, 101.3, 21.4, 19.9. **HRMS (ESI)** m/z: calcd. for $C_{20}H_{17}I^{80}SeNa$ $[M+Na]^+$: 486.9432; Found: 486.9448.



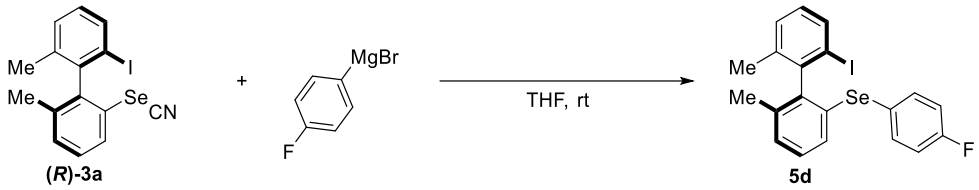
5b was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and *p*-tolylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5b** as a pale-yellow solid (41.5 mg, 87%, 90% ee) (eluent for column chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.5:99.5, flow: 0.6 mL/min, λ = 230 nm, t_r = 31.937 min (major), 44.652 min (minor). $[\alpha]_D^{20}$ = -17.3 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.83 (d, *J* = 8.0 Hz, 1H), 7.58 – 7.43 (m, 2H), 7.29 (dt, *J* = 7.5, 1.0 Hz, 1H), 7.19 – 7.09 (m, 2H), 7.11 – 7.04 (m, 2H), 7.02 (t, *J* = 7.5 Hz, 1H), 6.89 (dd, *J* = 7.0, 2.0 Hz, 1H), 2.36 (s, 3H), 2.11 (s, 3H), 1.96 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 144.0, 142.7, 138.4, 138.2, 136.9, 136.24, 136.18, 134.9, 130.3, 130.1, 129.5, 128.4, 127.6, 127.2, 125.2, 101.3, 21.4, 21.3, 19.9. **HRMS (ESI)** m/z: calcd. for $C_{21}H_{20}I^{80}Se$ $[M+H]^+$: 478.9769; Found: 478.9759.



5c was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and *p*-methoxyphenylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5c** as a pale-yellow solid (44.4 mg, 90%, 90% ee) (eluent for column chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.5:99.5, flow: 0.6 mL/min, λ = 230 nm, t_r = 18.457 min (major), 22.670 min (minor). $[\alpha]_D^{20}$ = -14.6 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.02 – 7.73 (m, 1H), 7.58 – 7.52 (m, 2H), 7.33 – 7.28 (m, 1H), 7.13 – 7.05 (m, 2H), 7.02 (t, *J* = 8.0 Hz, 1H), 6.96 – 6.66 (m, 2H), 6.85 – 6.81 (m, 1H), 3.83 (s, 3H), 2.12 (s, 3H), 1.96 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 160.1, 143.9, 142.3, 138.21, 138.15, 136.9, 136.2, 135.3, 130.1, 129.5, 128.4, 127.4, 126.7, 118.8, 115.1, 101.4, 55.3, 21.4, 19.8. **HRMS (ESI)** m/z: calcd. for $C_{21}H_{19}OI^{80}SeNa$ $[M+ Na]^+$: 516.9538; Found: 516.9579.

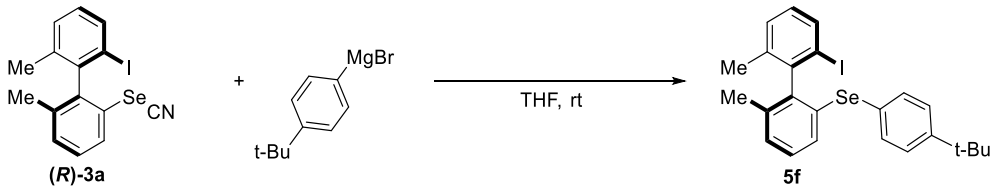


5d was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and 4-fluorophenylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5d** as a pale-yellow solid (46.9 mg, 98%, 90% ee) (eluent for column chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.5:99.5, flow: 0.6 mL/min, λ = 254 nm, t_r = 11.127 min (major), 12.479 min (minor). $[\alpha]_D^{20}$ = -15.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.83 (d, *J* = 8.0 Hz, 1H), 7.66 – 7.51 (m, 2H), 7.30 (d, *J* = 7.4 Hz, 1H), 7.17 – 7.06 (m, 2H), 7.06 – 6.99 (m, 3H), 6.88 (dd, *J* = 7.5, 1.5 Hz, 1H), 2.09 (s, 3H), 1.97 (s, 3H). **^{19}F NMR (471 MHz, $CDCl_3$)** δ -112.80. **^{13}C NMR (126 MHz, $CDCl_3$)** δ 163.0 (d, *J* = 248.8 Hz), 143.8, 142.8, 138.2, 138.1, 136.9, 136.5, 134.3, 130.1, 129.5, 128.5, 127.9, 127.3, 123.62, 123.60, 116.7, 116.6, 101.3, 21.4, 19.9. **HRMS (ESI)** m/z: calcd. for $C_{20}H_{16}IF^{80}SeNa$ $[M+Na]^+$: 504.9338; Found: 504.9318.

5e was prepared following the **General Procedure C**

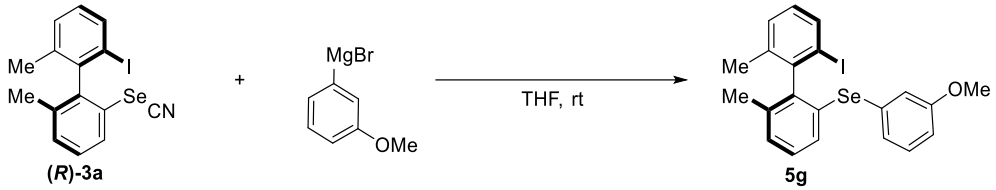
The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and *p*-chlorophenylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5e** as a pale-yellow solid (46.8 mg, 95%, 90% ee) (eluent for column chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.5:99.5, flow: 0.6 mL/min, λ = 254 nm, t_r = 10.660 min (major), 13.282 min (minor). $[\alpha]_D^{20}$ = -19.2 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.80 (d, *J* = 8.0 Hz, 1H), 7.52 – 7.44 (m, 2H), 7.28 – 7.20 (m, 3H), 7.14 – 7.06 (m, 2H), 6.99 (t, *J* = 8.0 Hz, 1H), 6.92 (dd, *J* = 7.5, 1.5 Hz, 1H), 2.05 (s, 3H), 1.94 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 143.9, 143.2, 138.1, 137.0, 136.90, 136.89, 136.6, 134.5, 133.8, 130.1, 129.6, 129.5, 128.6, 128.2, 127.9, 127.5, 101.3, 21.4, 19.9. **HRMS (ESI)** m/z: calcd. for $C_{20}H_{16}ICl^{80}SeNa$ $[M+Na]^+$: 520.9043; Found: 520.9055.



5f was prepared following the **General Procedure C**

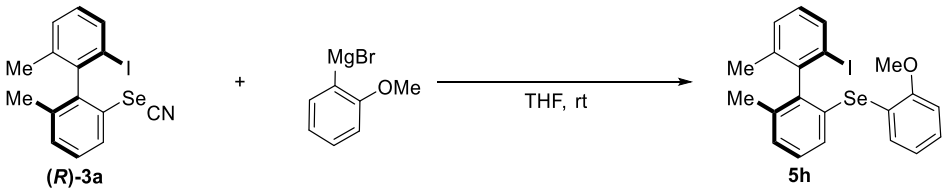
The reaction of **3a** (90% ee, 41.2 mg, 0.1 mmol, 1.0 equiv) and *p*-tertbutylphenylmagnesium bromide (1.0 mol/L in THF, 0.2 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5f** as a pale-yellow solid (41.5 mg, 80%, 90% ee) (eluent for column

chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.3:99.7, flow: 0.4 mL/min, λ = 230 nm, t_r = 24.145 min (major), 31.098 min (minor). $[\alpha]_D^{20}$ = -14.9 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.84 (d, *J* = 8.0 Hz, 1H), 7.59 – 7.50 (m, 2H), 7.39 – 7.31 (m, 2H), 7.33 – 7.27 (m, 1H), 7.15 – 7.07 (m, 2H), 7.03 (t, *J* = 8.0 Hz, 1H), 7.00 – 6.95 (m, 1H), 2.11 (s, 3H), 1.97 (s, 3H), 1.34 (s, 9H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 151.5, 144.0, 142.9, 138.2, 136.9, 136.2, 135.7, 134.6, 130.0, 129.4, 128.4, 127.7, 127.6, 126.5, 125.5, 101.4, 34.6, 31.2, 21.4, 19.9. **HRMS (ESI)** m/z: calcd. for $C_{24}H_{26}I^{80}Se$ $[M+H]^+$: 521.0239; Found: 521.0250.



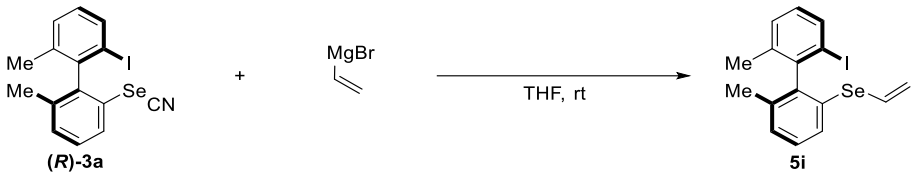
5g was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and *m*-methoxyphenylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5g** as a pale-yellow solid (47.3 mg, 96%, 90% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.5:99.5, flow: 0.6 mL/min, λ = 254 nm, t_r = 13.721 min (major), 15.710 min (minor). $[\alpha]_D^{20}$ = +34.0 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.80 (d, *J* = 8.0 Hz, 1H), 7.26 (d, *J* = 7.5 Hz, 1H), 7.23 – 7.10 (m, 3H), 7.12 – 7.02 (m, 2H), 7.04 – 6.90 (m, 2H), 6.88 – 6.82 (m, 1H), 3.74 (s, 3H), 2.07 (s, 3H), 1.94 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 159.8, 144.0, 143.1, 138.1, 136.8, 136.3, 134.0, 130.11, 130.06, 130.0, 129.4, 128.5, 128.1, 128.0, 127.8, 120.6, 114.2, 101.3, 55.3, 21.4, 19.9. **HRMS (ESI)** m/z: calcd. for $C_{21}H_{19}OI^{80}SeNa$ $[M+Na]^+$: 516.9538; Found: 516.9519.



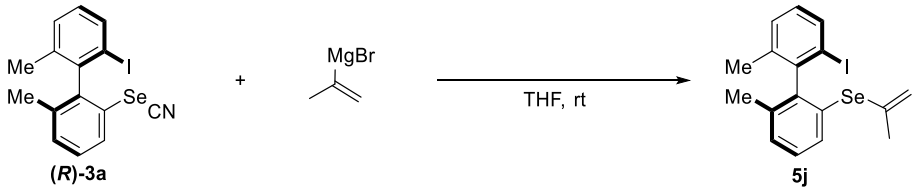
5h was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and *o*-methoxyphenylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5h** as a pale-yellow solid (44.4 mg, 90%, 90% ee) (eluent for column chromatography PE/EtOAc = 50:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 0.5:99.5, flow: 1.0 mL/min, λ = 230 nm, t_r = 7.480 min (minor), 8.326 min (major). $[\alpha]_D^{20}$ = -23.7 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, Chloroform-*d*)** δ 7.81 (d, *J* = 8.0 Hz, 1H), 7.51 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.35 – 7.23 (m, 2H), 7.15 (dd, *J* = 8.0, 6.5 Hz, 1H), 7.11 (d, *J* = 7.5 Hz, 1H), 7.07 (dd, *J* = 8.0, 1.5 Hz, 1H), 6.99 (t, *J* = 7.5 Hz, 1H), 6.89 – 6.79 (m, 2H), 3.78 (s, 3H), 2.11 (s, 3H), 1.98 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 158.6, 144.4, 144.2, 138.1, 136.8, 136.4, 135.5, 132.5, 130.0, 129.4, 129.3, 129.1, 128.3, 128.2, 121.4, 119.2, 110.7, 101.3, 55.8, 21.4, 20.0. **HRMS (ESI)** m/z: calcd. for $C_{21}H_{20}OI^{80}Se$ $[M+H]^+$: 494.9719; Found: 494.9741.



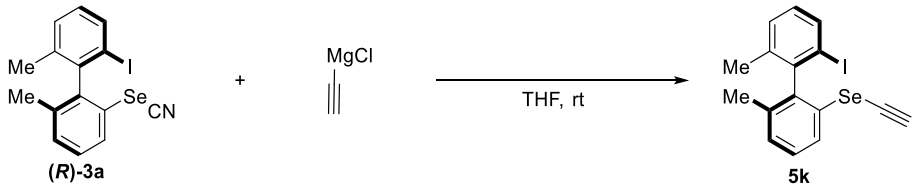
5i was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and vinylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5i** as a pale-yellow solid (37.2 mg, 90%, 90% ee) (eluent for column chromatography PE). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.2:99.8, flow: 0.6 mL/min, λ = 254 nm, t_r = 12.130 min (major), 13.377 min (minor). $[\alpha]_D^{20}$ = -39.3 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.81 (d, *J* = 8.0 Hz, 1H), 7.39 (d, *J* = 8.0 Hz, 1H), 7.34 – 7.25 (m, 2H), 7.21 (d, *J* = 7.5 Hz, 1H), 7.02 (t, *J* = 8.0 Hz, 1H), 6.88 (dd, *J* = 17.0, 9.5 Hz, 1H), 5.85 (d, *J* = 9.5 Hz, 1H), 5.71 (d, *J* = 17.0 Hz, 1H), 2.06 (s, 3H), 1.98 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 144.1, 143.8, 138.0, 136.8, 136.6, 131.9, 130.0, 129.4, 128.5, 128.4, 127.9, 126.6, 122.0, 101.2, 21.4, 20.0. **HRMS (ESI)** m/z: calcd. for $C_{16}H_{16}I^{80}Se$ $[M+H]^+$: 414.9456; Found: 414.9451.



5j was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and prop-1-ea-2-ylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5j** as a pale-yellow solid (29.0 mg, 68%, 90% ee) (eluent for column chromatography PE). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0:100, flow: 0.4 mL/min, λ = 230 nm, t_r = 22.831 min (major), 24.599 min (minor). $[\alpha]_D^{20}$ = -21.9 (c 2.00, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.82 – 7.77 (m, 1H), 7.38 (dd, *J* = 7.5, 1.5 Hz, 1H), 7.29 – 7.21 (m, 2H), 7.21 – 7.16 (m, 1H), 6.99 (t, *J* = 7.5 Hz, 1H), 5.62 (d, *J* = 1.5 Hz, 1H), 5.45 (d, *J* = 1.0 Hz, 1H), 2.15 (t, *J* = 1.0 Hz, 3H), 2.05 (s, 3H), 1.96 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 144.50, 144.47, 137.9, 136.7, 136.6, 135.9, 131.3, 129.9, 129.30, 129.26, 128.4, 128.3, 122.8, 101.2, 26.1, 21.4, 20.1. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{18}I^{80}Se$ $[M+H]^+$: 428.9613; Found: 428.9620.



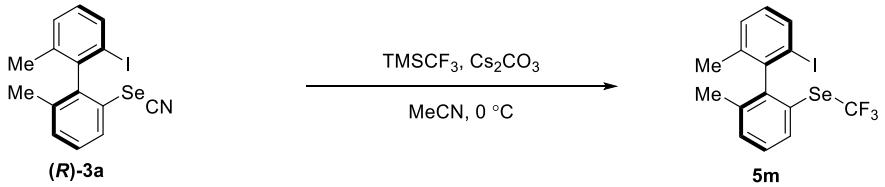
5k was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and ethynylmagnesium chloride (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5k** as a colorless oil (26.7 mg, 65%, 90% ee) (eluent for column chromatography PE). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.2:99.8, flow: 0.6 mL/min, λ = 230 nm,

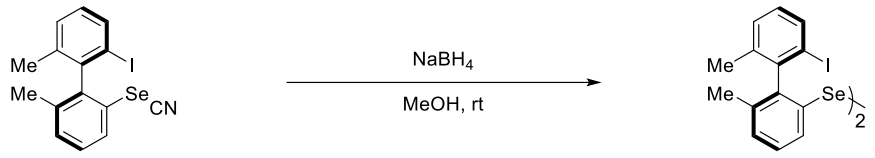
t_r = 25.834 min (major), 30.195 min (minor). $[\alpha]_D^{20}$ = -21.5 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.84 – 7.79 (m, 1H), 7.79 – 7.75 (m, 1H), 7.32 (t, *J* = 8.0 Hz, 1H), 7.29 (dt, *J* = 7.5, 1.0 Hz, 1H), 7.21 (dt, *J* = 7.5, 1.0 Hz, 1H), 7.03 (t, *J* = 8.0 Hz, 1H), 3.25 (s, 1H), 2.07 (s, 3H), 1.97 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 142.2, 141.5, 138.4, 137.2, 136.6, 130.3, 130.1, 129.1, 128.9, 128.6, 125.8, 100.9, 92.8, 64.9, 21.2, 19.5. **HRMS (ESI)** m/z: calcd. for $C_{16}H_{14}I^{80}Se$ $[M+H]^+$: 412.9300; Found: 412.9294.

5l was prepared following the **General Procedure C**

The reaction of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and cydopropylmagnesium bromide (1.0 mol/L in THF, 0.20 mL, 2.0 equiv) in anhydrous tetrahydrofuran (2.0 mL) at room temperature for 2 h afforded **5l** as a colorless oil (41.2 mg, 96%, 90% ee) (eluent for column chromatography PE). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.5:99.5, flow: 0.6 mL/min, λ = 254 nm, t_r = 9.721 min (minor), 10.297 min (major). $[\alpha]_D^{20}$ = -31.6 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.83 – 7.72 (m, 1H), 7.60 (d, *J* = 7.5 Hz, 1H), 7.32 – 7.20 (m, 2H), 7.13 (dd, *J* = 7.5, 1.0 Hz, 1H), 6.99 (t, *J* = 8.0 Hz, 1H), 2.27 – 2.10 (m, 1H), 2.04 (s, 3H), 1.94 (s, 3H), 1.17 – 1.07 (m, 2H), 0.74 – 0.58 (m, 2H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 143.8, 142.5, 138.2, 136.9, 136.1, 134.3, 130.1, 129.5, 128.4, 127.1, 125.9, 101.3, 21.3, 19.8, 7.9, 7.7, 5.3. **HRMS (ESI)** m/z: calcd. for $C_{17}H_{18}I^{80}Se$ $[M+H]^+$: 428.9613; Found: 428.9623.

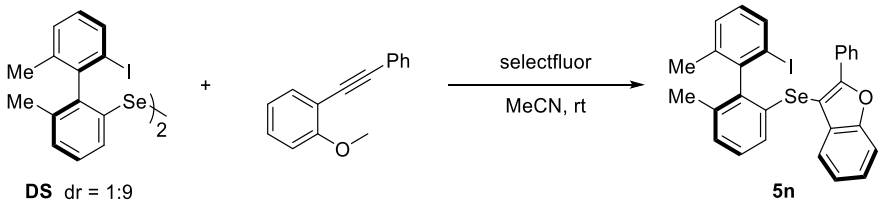


A reported procedure was followed with some modifications.[5] In a 25 mL round-bottom flask, a mixture of **3a** (90% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and Cs_2CO_3 (130.3 mg, 0.40 mmol, 4.0 equiv) was dissolved in CH_3CN (2.0 ml) and cooled to 0 °C. Then $TMSCF_3$ (56.9 mg, 0.40 mmol, 4.0 equiv) was added at once via syringe and the mixture was then stirred at ambient temperature for 2 h. The resulting mixture was filtered through a short pad of celite and extracted with CH_2Cl_2 (3×5.0 mL). The resulting organic solution was washed with water (10 mL) and brine (10 mL). The organic layer was dried over anhydrous $MgSO_4$, filtered and concentrated. The residue was purified by column chromatography to give the corresponding products **5m** a colorless oil (30.2 mg, 66%, 88% ee) (eluent for column chromatography PE). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0:100, flow: 0.6 mL/min, λ = 254 nm, t_r = 10.606 min (major), 11.678 min (minor). $[\alpha]_D^{20}$ = -45.3 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.78 (d, *J* = 8.0 Hz, 1H), 7.74 – 7.69 (m, 1H), 7.38 – 7.33 (m, 2H), 7.30 – 7.25 (m, 1H), 7.02 (t, *J* = 8.0 Hz, 1H), 2.02 (s, 3H), 1.99 (s, 3H). **^{19}F NMR (471 MHz, $CDCl_3$)** δ -34.06. **^{13}C NMR (126 MHz, $CDCl_3$)** δ 146.5, 144.0, 137.8, 137.5, 136.6, 132.7, 131.3, 130.1, 129.7, 128.9, 125.4, 122.6 (q, *J* = 333.4 Hz) 101.2, 21.1, 20.3. **HRMS (ESI)** m/z: calcd. for $C_{15}H_{13}F_3I^{80}Se$ $[M+H]^+$: 456.9174; Found: 456.9172.



(*R*)-3a　　**DS** dr = 1:9

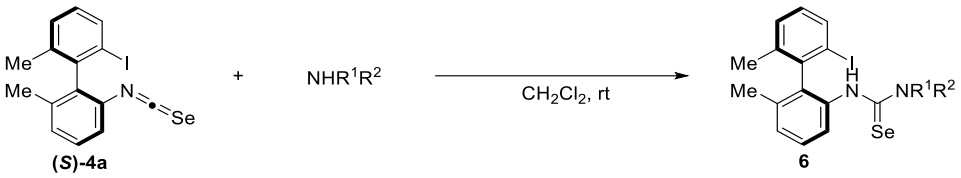
A reported procedure was followed with some modifications.[6] To a solution of **3a** (90% ee, 206.1 mg, 0.50 mmol, 1.0 equiv) in MeOH (5.0 mL) was added $NaBH_4$ (37.8 mg, 1.0 mmol, 2.0 equiv) at 0 °C. After the mixture had stirred at 0 °C for 30 min, water (10 mL) was added in one portion. Subsequently, the mixture was stirred at room temperature for 2 h under air; a white solid formed. **DS** as a pale-yellow solid (143.0 mg, 93%, dr = 1:9) was collected by filtration and no further purification was carried out. $[\alpha]_D^{20}$ = -24.1 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.84 (d, *J* = 8.0 Hz, 1H), 7.64 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 7.18 – 7.12 (m, 2H), 7.03 (t, *J* = 7.5 Hz, 1H), 2.06 (s, 3H), 1.96 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 143.1, 142.12, 142.08, 138.54, 138.51, 137.12, 137.09, 136.12, 136.06, 130.29, 130.26, 129.97, 129.91, 129.85, 128.86, 128.82, 128.33, 128.30, 127.01, 126.98, 101.55, 101.51, 21.44, 21.40, 19.38, 19.36. **HRMS (ESI)** m/z: calcd. for $C_{28}H_{25}I^{80}Se_2$ $[M+H]^+$: 774.8371; Found: 774.8372.



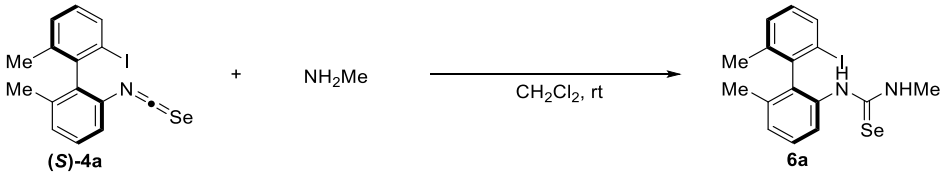
DS dr = 1:9　　**5n**

A reported procedure was followed with some modifications.[7] **DS** (38.6 mg, 0.05 mmol, 1.0 equiv) was added to a round bottom flask followed by addition of dry MeCN (1.0 mL). To this solution, selectfluor (35.4 mg, 0.10 mmol, 2.0 equiv) was added under N_2 atmosphere. After 5 min a solution of 1-methoxy-2-phenylethynyl-benzene (20.8 mg, 0.10 mmol 2.0 equiv) in dry MeCN (1.0 mL) was added to the reaction mixture. The reaction mixture was stirred at room temperature for 12 h. After reaction completion EtOAc (5 mL) and distilled water (5 mL) were added and the aquous layer was washed with EtOAc (3×5 mL), the combined organic phase was dried with Na_2SO_4, filtrated, and then filtrate was concentrated under reduced pressure. The residue was subjected to column chromatography using PE/EtOAc (50/1, v/v) as the eluent to afford **5n** as a pale-yellow solid (45.8 mg, 67%, 86% ee) (eluent for column chromatography PE/EtOAc = 100:1). **HPLC conditions**: Chiralpak OD-3, isopropanol/hexane = 0.3:99.7, flow: 0.6 mL/min, λ = 254 nm, t_r = 14.579 min (minor), 16.911 min (major). $[\alpha]_D^{20}$ = -28.4 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.24 – 8.16 (m, 2H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.62 – 7.55 (m, 2H), 7.46 – 7.34 (m, 5H), 7.29 – 7.20 (m, 1H), 7.11 (d, *J* = 7.5 Hz, 1H), 7.06 (t, *J* = 7.5 Hz, 1H), 7.00 (t, *J* = 7.5 Hz, 1H), 6.81 (d, *J* = 8.0 Hz, 1H), 2.26 (s, 3H), 2.01 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 158.0, 154.2, 143.2, 141.9, 138.5, 137.2, 136.6, 132.5, 132.1, 130.4, 129.9, 129.8, 129.2, 128.7, 128.4, 127.9, 127.4, 125.2, 124.7, 123.4, 121.3, 111.1, 101.5, 98.7, 21.4, 19.6. **HRMS (ESI)** m/z: calcd. for $C_{28}H_{21}IO^{80}SeNa$ $[M+Na]^+$: 602.9695; Found: 602.9678.

General reaction of isoselenate with amines (General Procedure D)

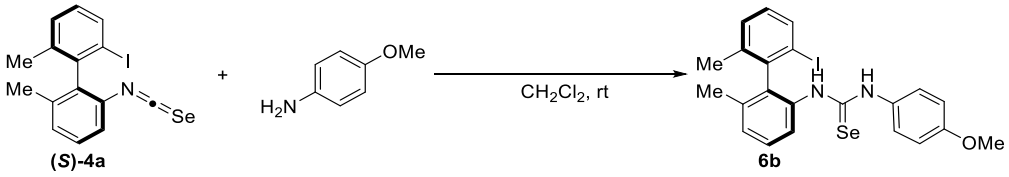


Under nitrogen atmosphere, a Schlenk tube containing a stirring bar was charged with **4a** (94% ee, 41.2 mg, 0.10 mmol) in anhydrous CH_2Cl_2 (2.0 mL) followed by the addition of amines (0.20 mmol, 2.0 equiv). The solution was stirred at room temperature for 2 h. After completing the consumption of starting materials, the solution was concentrated under reduced pressure, and the residue was purified by column chromatography on silica gel to deliver the corresponding product **6**.



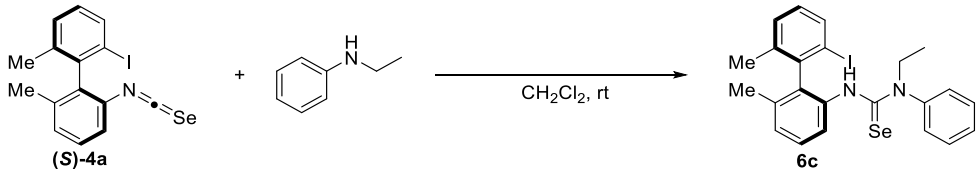
6a was prepared following the **General Procedure D**

The reaction of **4a** (94% ee, 41.2 mg, 0.10 mmol, 1.0 equiv), methylamine (40 % in H_2O) (15.5 uL, 0.20 mmol, 2.0 equiv) in anhydrous CH_2Cl_2 (2.0 mL) at room temperature for 2 h afforded **6a** as a white solid (36.1 mg, 82%, 94% ee) (eluent for column chromatography PE/EtOAc = 5:1). **HPLC conditions**: Chiralpak ID, isopropanol/hexane = 20:80, flow: 1.0 mL/min, λ = 254 nm, t_r = 7.443 min (major), 8.828 min (minor). $[\alpha]_D^{20}$ = +15.1 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.78 (d, *J* = 8.0 Hz, 1H), 7.38 (t, *J* = 8.0 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 2H), 7.22 (d, *J* = 8.0 Hz, 2H), 7.01 (t, *J* = 8.0 Hz, 1H), 6.53 (s, 1H), 3.17 (d, *J* = 4.5 Hz, 3H), 1.99 (s, 3H), 1.97 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 180.1, 140.3, 139.9, 140.0, 137.3, 137.2, 133.3, 130.6, 130.1, 129.6, 129.2, 123.1, 100.3, 34.9, 21.3, 19.8. **HRMS (ESI)** m/z: calcd. for $C_{16}H_{18}IN_2{}^{80}Se$ $[M+H]^+$: 444.9674; Found: 444.9669.



6b was prepared following the **General Procedure D**

The reaction of **4a** (94% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and 4-methoxyaniline (24.6 mg, 0.20 mmol, 2.0 equiv) in anhydrous CH_2Cl_2 (2.0 mL) at room temperature for 2 h afforded **6b** as a white solid (52.3 mg, 80%, 94% ee) (eluent for column chromatography PE/EtOAc = 20:1). **HPLC conditions**: Chiralpak AD-H, isopropanol/hexane = 10:90, flow: 1.0 mL/min, λ = 254 nm, t_r = 16.087 min (major), 17.424 min (minor). $[\alpha]_D^{20}$ = +18.8 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 8.07 (s, 1H), 8.00 (s, 1H), 7.60 (d, *J* = 8.0 Hz, 1H), 7.31 (t, *J* = 8.0 Hz, 1H), 7.20 (d, *J* = 7.5 Hz, 1H), 7.17 – 7.09 (m, 2H), 6.92 (t, *J* = 7.5 Hz, 1H), 6.70 (d, *J* = 8.0 Hz, 2H), 6.64 (s, 2H), 3.76 (s, 3H), 2.01 (s, 3H), 1.85 (s, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 159.1, 141.2, 136.8, 130.6, 129.7, 128.5, 128.0, 127.4, 125.0, 124.6, 115.3, 114.2, 100.6, 55.5, 21.8, 19.5. **HRMS (ESI)** m/z: calcd. for $C_{22}H_{22}IN_2O{}^{80}Se$ $[M+H]^+$: 536.9937; Found: 536.9946.



6c was prepared following the **General Procedure D**

The reaction of **4a** (94% ee, 41.2 mg, 0.10 mmol, 1.0 equiv) and N-ethylaniline (24.2 mg, 0.20 mmol, 2.0 equiv) at room temperature for 2 h afforded **6c** as a white solid (53.7 mg, 95%, 94% ee) (eluent for column chromatography PE/EtOAc = 20:1). **HPLC conditions**: Chiralpak ID, isopropanol/hexane = 7:93, flow: 1.0 mL/min, λ = 254 nm, t_r = 9.582 min (minor), 10.353 min (major). $[\alpha]_D^{20}$ = +58.6 (c 0.50, CH_2Cl_2). **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.85 (d, *J* = 8.0 Hz, 1H), 7.53 (d, *J* = 8.0 Hz, 1H), 7.35 – 7.19 (m, 6H), 7.08 (d, *J* = 7.5 Hz, 1H), 6.94 (t, *J* = 7.5 Hz, 1H), 6.54 (s, 1H), 6.45 (s, 1H), 4.49 – 3.87 (m, 2H), 2.04 (s, 3H), 1.80 (s, 3H), 1.08 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR (126 MHz, $CDCl_3$)** δ 179.0, 141.8, 139.7, 139.5, 138.5, 136.7, 136.6, 135.8, 130.7, 130.4, 129.2, 128.9, 127.9, 127.4, 126.5, 100.6, 52.3, 22.0, 19.4, 12.9. **HRMS (ESI)** m/z: calcd. for $C_{23}H_{24}IN_2{}^{80}Se$ $[M+H]^+$: 535.0144; Found: 535.0156.

5. Kinetic Studies

General Procedure for Reactions in Omnical Heat Flow Calorimeter

Heat flow calorimetric data were acquired on Omnical Super CRC, which allows continuous monitoring of the instantaneous heat flow around the reaction vessel. In the absence of side reactions, the isothermal reaction heat flow, **q**, is proportional to the reaction rate, **r**, where $\mathbf{\Delta H_{rxn}}$ is the heat of the reaction and **V** is the volume.

$$\mathrm{q} = \Delta \mathrm{H}_{rxn} \cdot \mathrm{V} \cdot \mathrm{r}$$

The enthalpy change of the reaction, $\mathbf{\Delta H_{rxn}}$, can be calculated by the integration of the total heat flow curve over time and divide the integral sum by the mole (**n**) amount of the limiting reagent consumed.

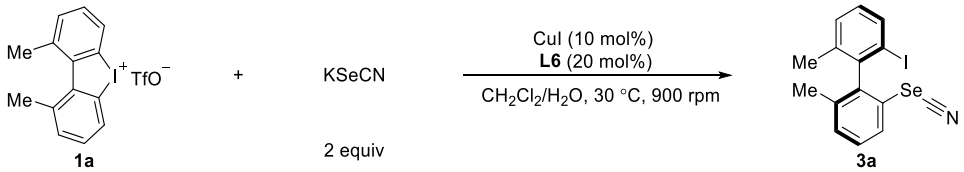
$$\Delta \mathrm{H}_{rxn} = \frac{\int_{t=0}^{t=\infty} \mathrm{q} \cdot \mathrm{dt}}{n}$$

The observed heat profile can also be used to determine the fraction conversion by calculation of the fractional area under the temporal heat flow curve where the numerator denotes the area under the heat flow curve to time (**t**) and the denominator denotes the total area under the heat flow curve.

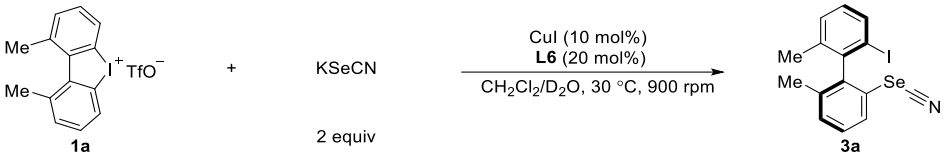
$$\text{Fraction Conversion (FC)} = \frac{\int_{\mathrm{t=0}}^{\mathrm{t}} \mathrm{q} \cdot \mathrm{dt}}{\int_{\mathrm{t=0}}^{\mathrm{t=\infty}} \mathrm{q} \cdot \mathrm{dt}}$$

Unless otherwise indicated, all reactions were carried out in a 15 mL septum-capped vial equipped with a magnetic stir bar. The stir rate of the calorimeter was set at 900 rpm (rotations per minute) and the reaction mixture was allowed to equilibrate inside of the calorimeter at 30 ºC for 60 minutes prior to the initiation of the reaction by injection of potassium selenocyanate in H_2O or D_2O or the copper iodide and **L6** catalyst. All liquid reagents were performed using plastic syringes.

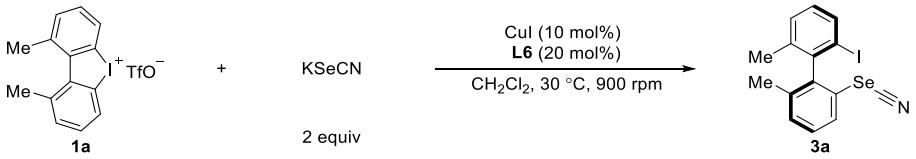
(1) H_2O or D_2O effect on the reaction rate



A 15 mL septum-capped vial equipped with a magnetic stir bar was charged with CuI (1.0 mg, 0.005 mmol), **L6** (5.0 mg, 0.01 mmol), cyclic diaryliodonium salt **1a (**45.6 mg, 0.10 mmol, 1.0 equiv). 2.5 mL of dry CH_2Cl_2 was added to the vial, and it was placed into the calorimeter and allowed to thermally equilibrate to 30 ºC for ~60 minutes. While this vial was equilibrating, potassium selenocyanate (0.20 mmol, 2.0 equiv) dissolved in water (0.5 mL) was added, and the solution was drawn into a 1 mL plastic syringe; the needle was capped with a small piece of Teflon, and placed into the thermostated syringe block. After the system reached thermal equilibrium, the reaction was initiated by the injection of the KSeCN solution.



A 15 mL septum-capped vial equipped with a magnetic stir bar was charged with CuI (1.0 mg, 0.005 mmol), **L6** (5.0 mg, 0.01 mmol), cyclic diaryliodonium salt **1a (**45.6 mg, 0.10 mmol, 1.0 equiv). 2.5 mL of dry CH_2Cl_2 was added to the vial, and it was placed into the calorimeter and allowed to thermally equilibrate to 30 ºC for ~60 minutes. While this vial was equilibrating, potassium selenocyanate (0.20 mmol, 2.0 equiv) dissolved in deuterium oxide (0.5 mL) was added, and the solution was drawn into a 1 mL plastic syringe; the needle was capped with a small piece of Teflon, and placed into the thermostated syringe block. After the system reached thermal equilibrium, the reaction was initiated by the injection of the KSeCN solution.



A 15 mL septum-capped vial equipped with a magnetic stir bar was charged with CuI (1.0 mg, 0.005 mmol), **L6** (5.0 mg, 0.01 mmol), cyclic diaryliodonium salt **1a (**45.6 mg, 0.10 mmol, 1.0 equiv) and potassium selenocyanate (0.20 mmol, 2.0 equiv). It was placed into the calorimeter and allowed to thermally equilibrate to 30 ºC for ~60 minutes. While this vial was equilibrating, 2.5 mL of dry CH_2Cl_2 was drawn into a 2.5 mL plastic syringe; the needle was capped with a small piece of Teflon, and placed into the thermostated syringe block. After the system reached thermal equilibrium, the reaction was initiated by the injection of the CH_2Cl_2 solution.

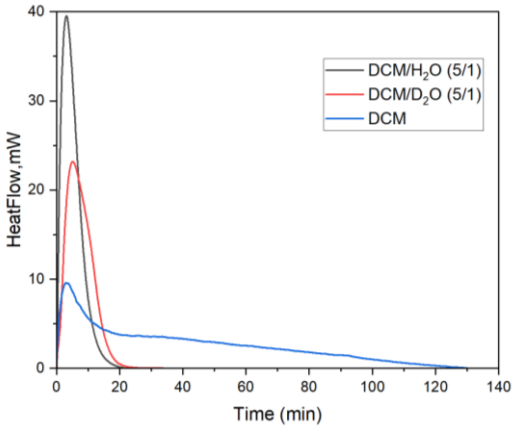


Figure S1. Heat Flow vs time at different solvent

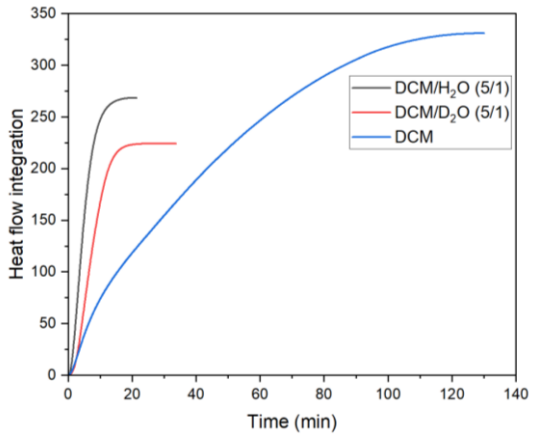


Figure S2. Heat Flow integration vs time at different solvent

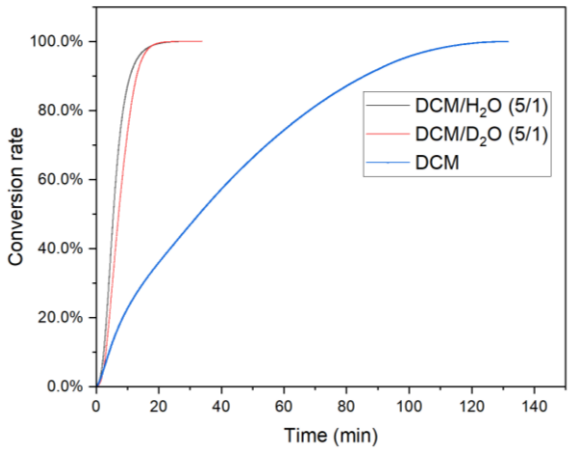
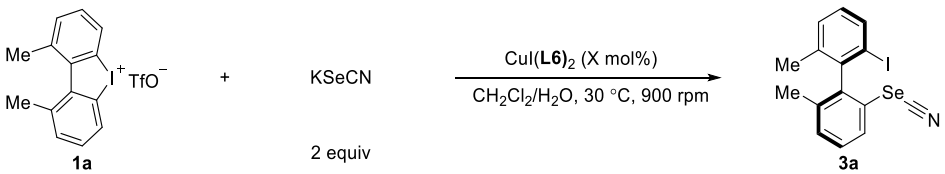


Figure S3. Conversion rate vs time at different solvent

(2) The effect of the concentration of CuI(L6)$_2$.



A 15 mL septum-capped vial equipped with a magnetic stir bar was charged with CuI(**L6**)$_2$ (X mol%), cyclic diaryliodonium salt **1a** (45.6 mg, 0.1 mmol, 1.0 equiv). 2.5 mL of dry CH_2Cl_2 was added to the vial, and it was placed into the calorimeter and allowed to thermally equilibrate to 30 ºC for ~60 minutes. While this vial was equilibrating, potassium selenocyanate (0.20 mmol, 2.0 equiv) dissolved in water (0.5 mL) was added, and the solution was drawn into a 1 mL plastic syringe; the needle was capped with a small piece of Teflon, and placed into the thermostated syringe block. After the system reached thermal equilibrium, the reaction was initiated by the injection of the KSeCN solution.

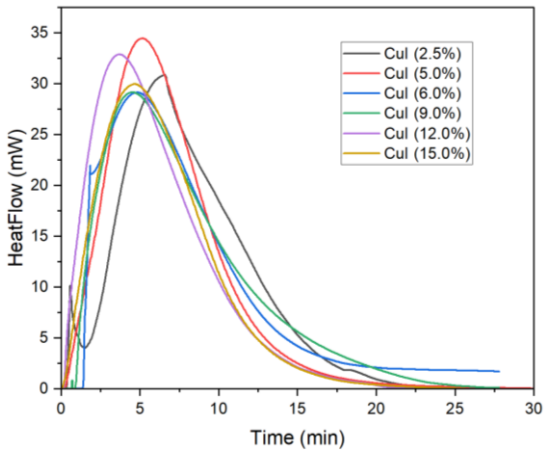


Figure S4. Heat Flow vs time at different concentrations of CuI(**L6**)$_2$

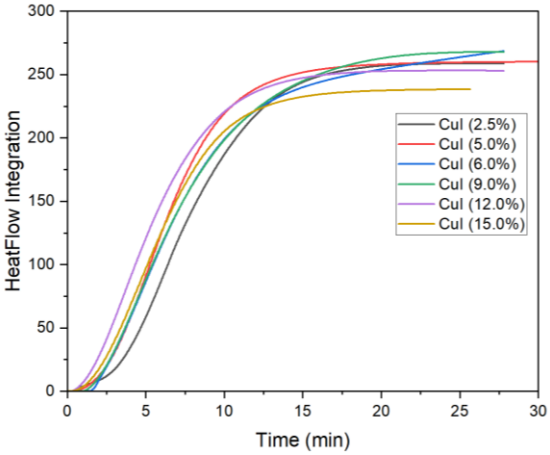


Figure S5. Heat Flow Integration vs time at different concentrations of CuI(**L6**)$_2$

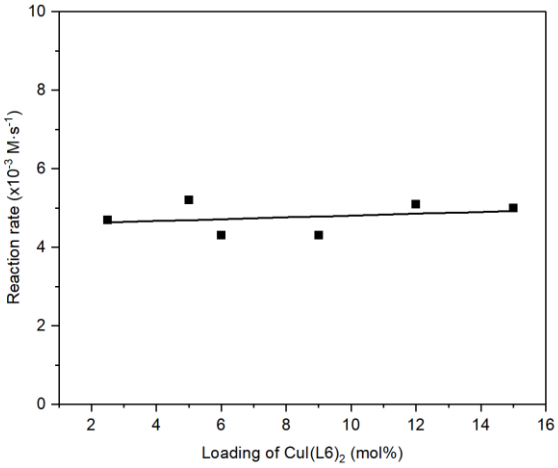
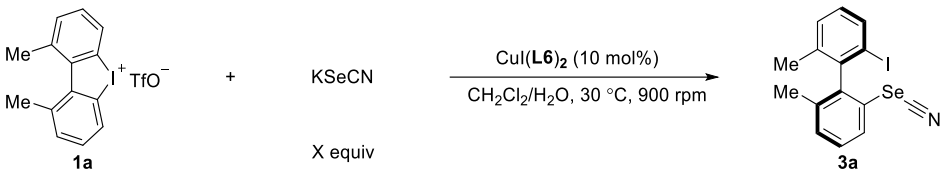


Figure S6. Reaction rate of different concentrations of CuI(**L6**)$_2$

(3) The effect of the concentration of KSeCN.



A 15 mL septum-capped vial equipped with a magnetic stir bar was charged with CuI(**L6**)$_2$ (10 mol%), cyclic diaryliodonium salt **1a** (45.6 mg, 0.1 mmol, 1.0 equiv). 2.5 mL of dry CH_2Cl_2 was added to the vial, and it was placed into the calorimeter and allowed to thermally equilibrate to 30 ºC for ~60 minutes. While this vial was equilibrating, potassium selenocyanate (x equiv) dissolved in water (0.1 mL) was added, and the solution was drawn into a 1 mL plastic syringe; the needle was capped with a small piece of Teflon, and placed into the thermostated syringe block. After the system reached thermal equilibrium, the reaction was initiated by the injection of the KSeCN solution.

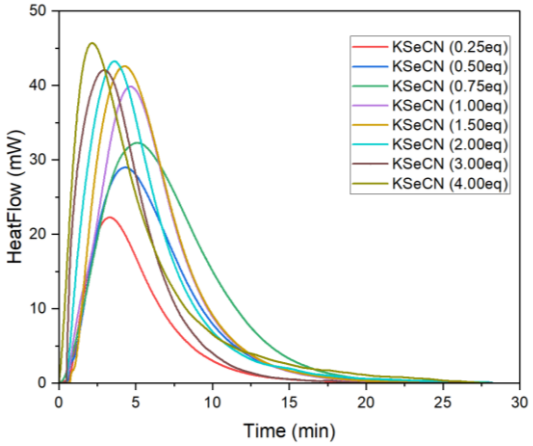


Figure S7. Heat Flow vs time at different concentrations of KSeCN

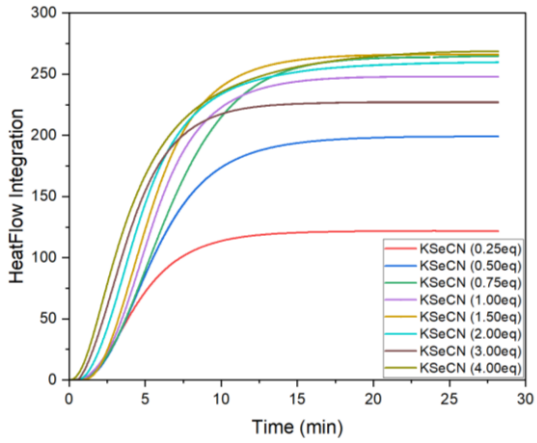


Figure S8. Heat Flow Integration vs time at different concentrations of KSeCN

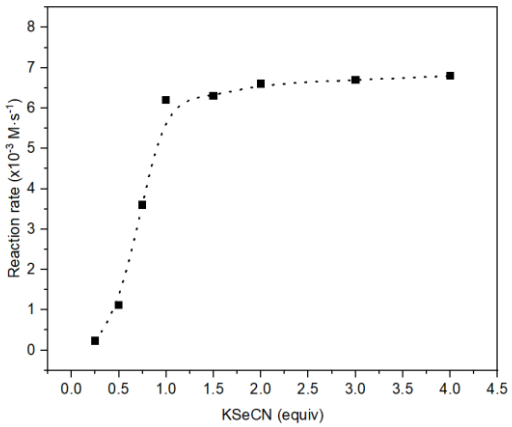


Figure S9. Reaction rate of different concentrations of KSeCN

6. Crystal structures and structure refinement

X-ray Structure of **3g**

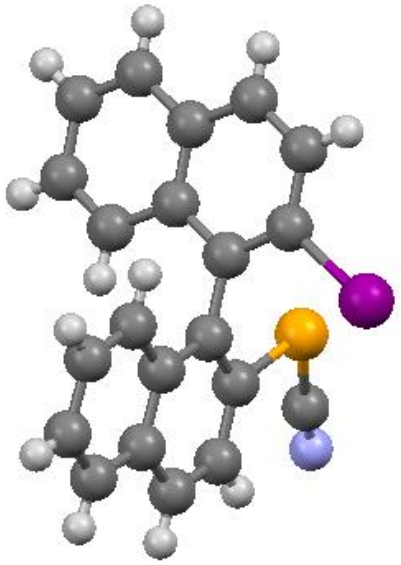


Table S1 Crystal data and structure refinement for 3g.

Identification code	6-20-2 (**3g**)
Empirical formula	$C_{21}H_{12}INSe$
Formula weight	484.18
Temperature/K	292.96(13)
Crystal system	tetragonal
Space group	$P4_1$
a/Å	10.94350(10)
b/Å	10.94350(10)
c/Å	14.74820(10)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	1766.25(3)
Z	4
ρ_{calc}g/cm^3	1.821
μ/mm^{-1}	16.593
F(000)	928.0
Crystal size/mm^3	0.15 × 0.13 × 0.12
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	8.08 to 146.798
Index ranges	$-9 \le h \le 13$, $-13 \le k \le 13$, $-18 \le l \le 18$
Reflections collected	13914
Independent reflections	3436 [R_{int} = 0.0435, R_{sigma} = 0.0314]

Data/restraints/parameters	3436/1/218
Goodness-of-fit on F^2	1.027
Final R indexes [I>=2σ (I)]	R_1 = 0.0373, wR_2 = 0.0962
Final R indexes [all data]	R_1 = 0.0379, wR_2 = 0.0969
Largest diff. peak/hole / e $Å^{-3}$	0.53/-0.32
Flack/Hooft parameter	-0.005(6)/-0.021(3)

X-ray Structure of **6b**

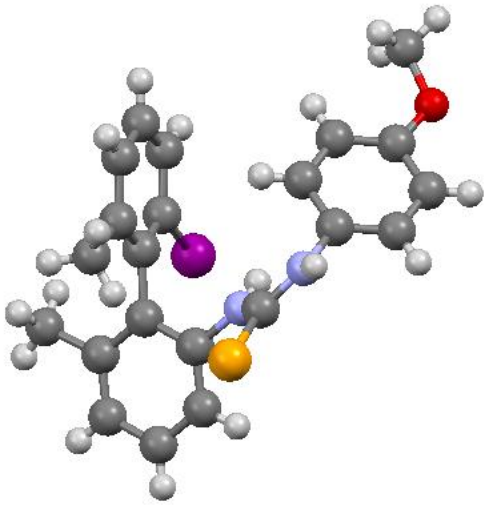


Table S2 Crystal data and structure refinement for 6b.

Identification code	6-98-1 (**6b**)
Empirical formula	$C_{22}H_{21}IN_2OSe$
Formula weight	535.27
Temperature/K	293.3(5)
Crystal system	triclinic
Space group	P1
a/Å	9.3735(5)
b/Å	11.1993(6)
c/Å	11.3482(5)
α/°	63.903(5)
β/°	80.905(4)
γ/°	86.542(4)
Volume/$Å^3$	1056.34(10)
Z	2
$\rho_{calc}g/cm^3$	1.683
μ/mm^{-1}	13.981
F(000)	524.0
Crystal size/mm^3	0.13 × 0.11 × 0.08
Radiation	Cu Kα (λ = 1.54184)

2Θ range for data collection/°	8.772 to 146.49
Index ranges	$-11 \leq h \leq 11$, $-13 \leq k \leq 13$, $-14 \leq l \leq 12$
Reflections collected	14604
Independent reflections	6247 [R_{int} = 0.1189, R_{sigma} = 0.0745]
Data/restraints/parameters	6247/413/493
Goodness-of-fit on F^2	1.049
Final R indexes [I>=2σ (I)]	R_1 = 0.0917, wR_2 = 0.2514
Final R indexes [all data]	R_1 = 0.1086, wR_2 = 0.2709
Largest diff. peak/hole / e $Å^{-3}$	1.09/-0.92
Flack/Hooft parameter	0.007(14)/0.092(5)

7. References

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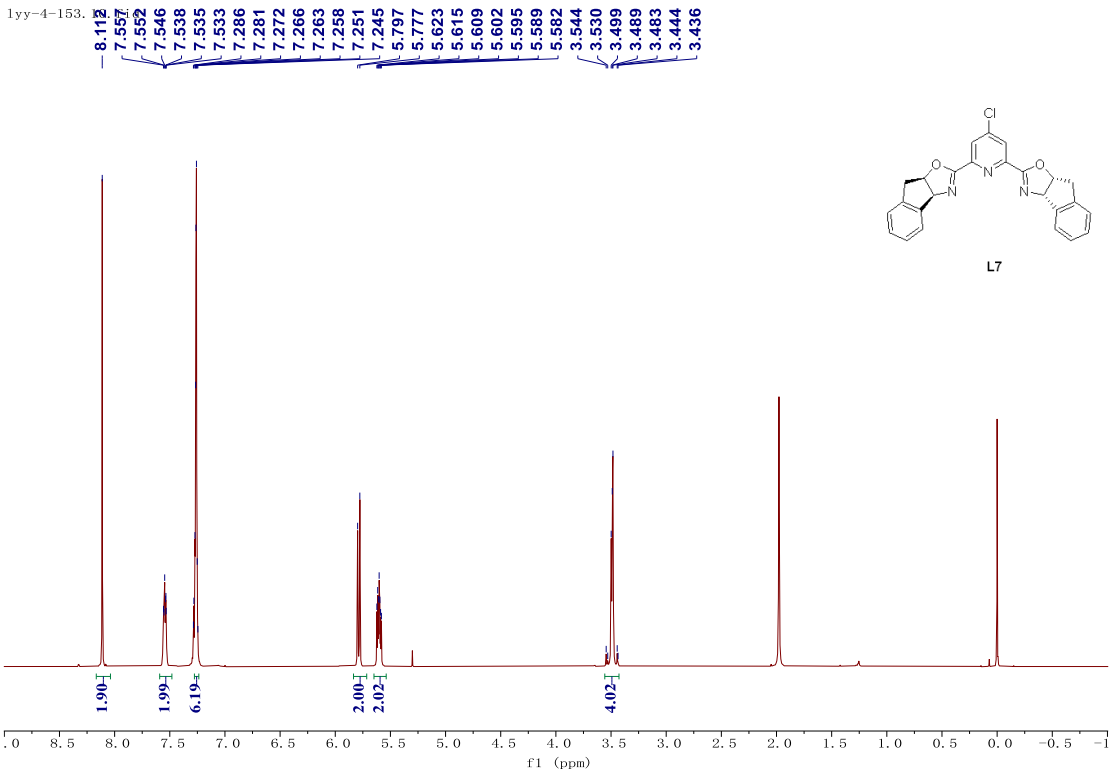
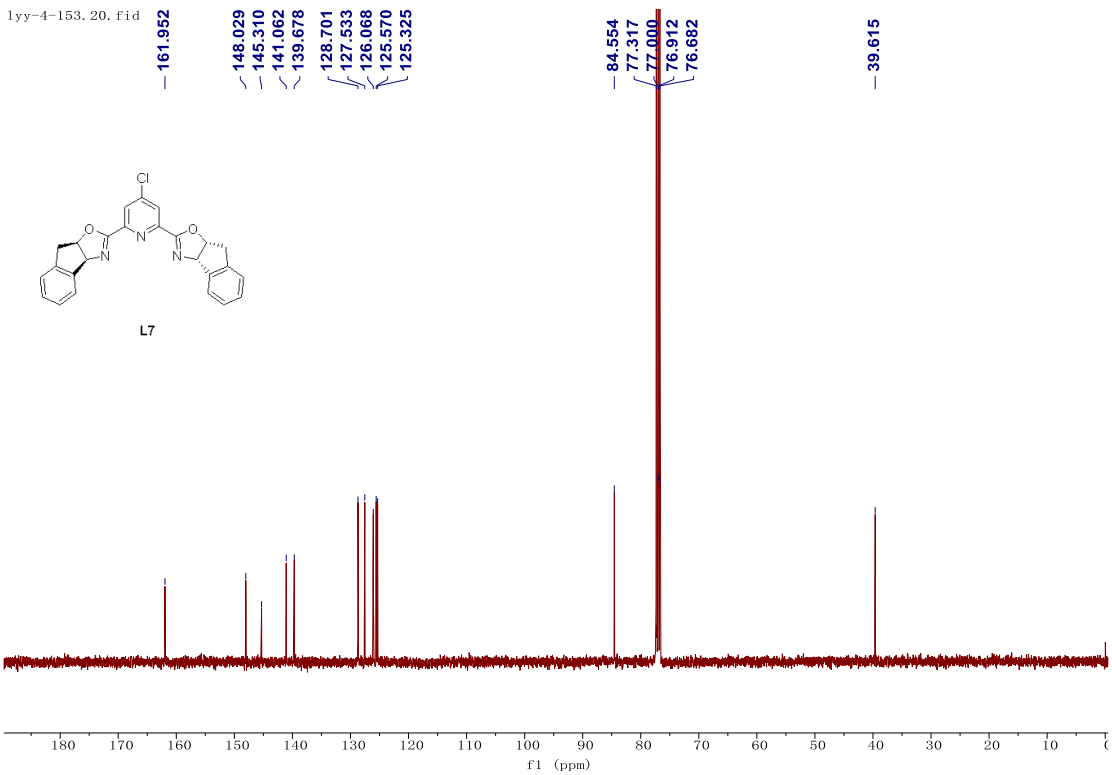
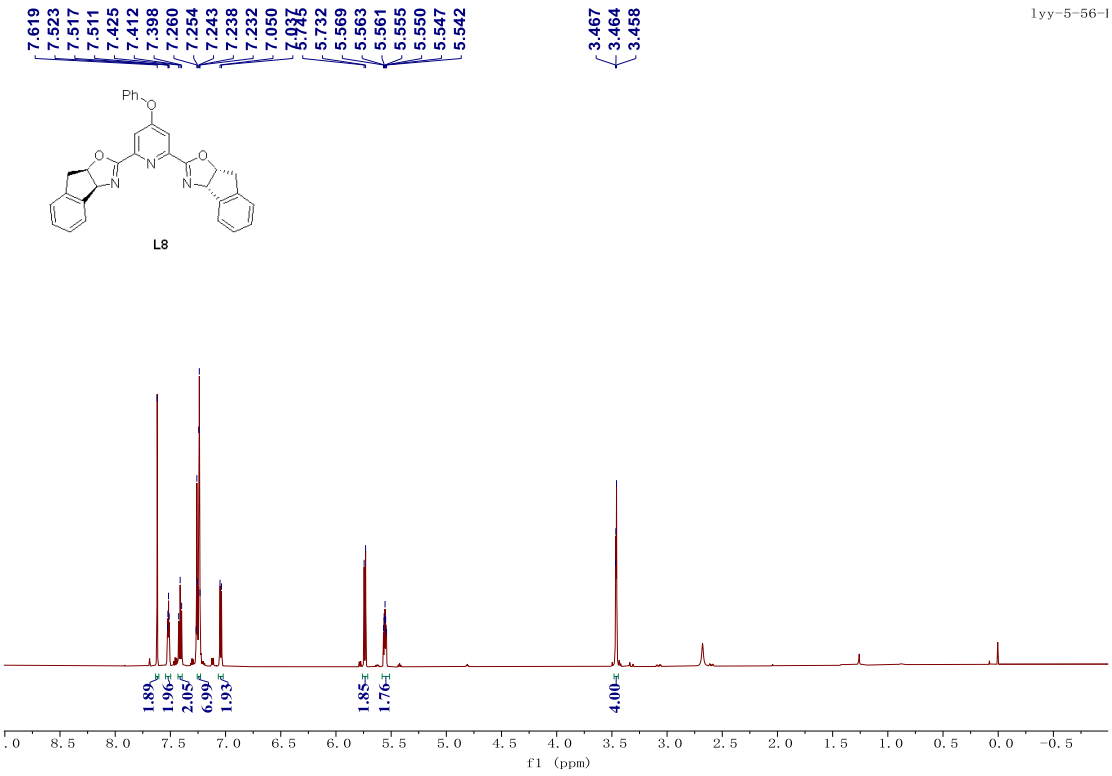
8. Copies of NMR spectra



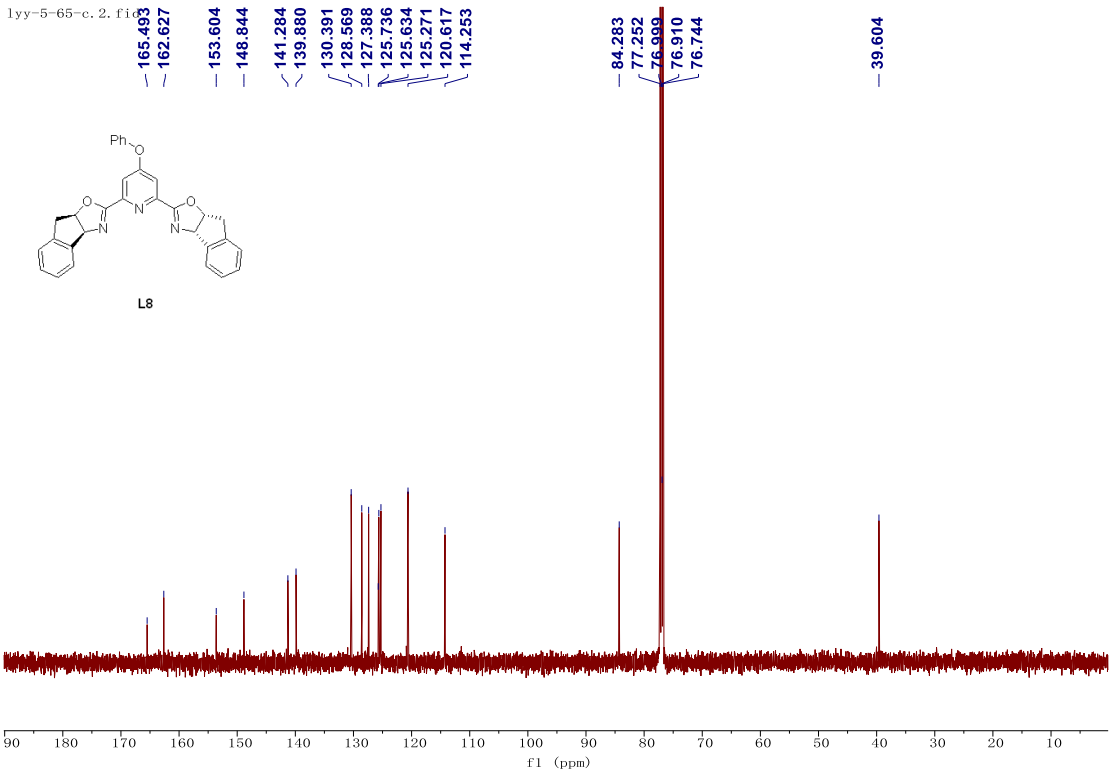
^{1}H NMR spectra of **L7**



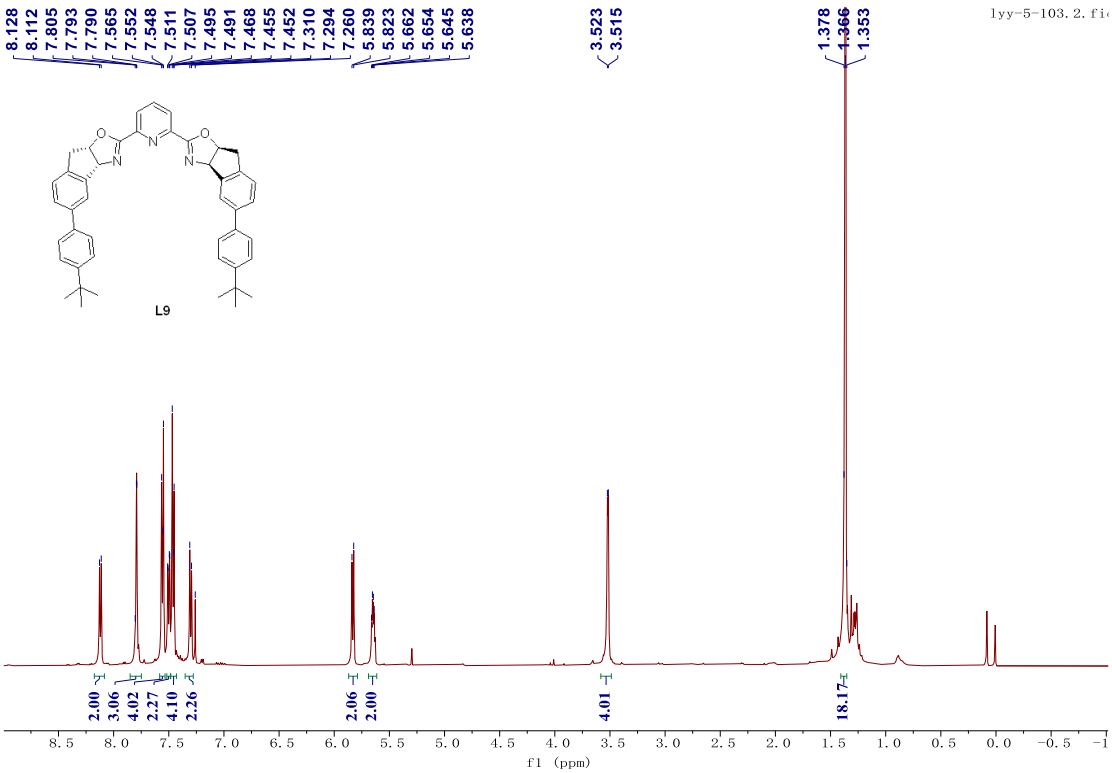
^{13}C NMR spectra of **L7**



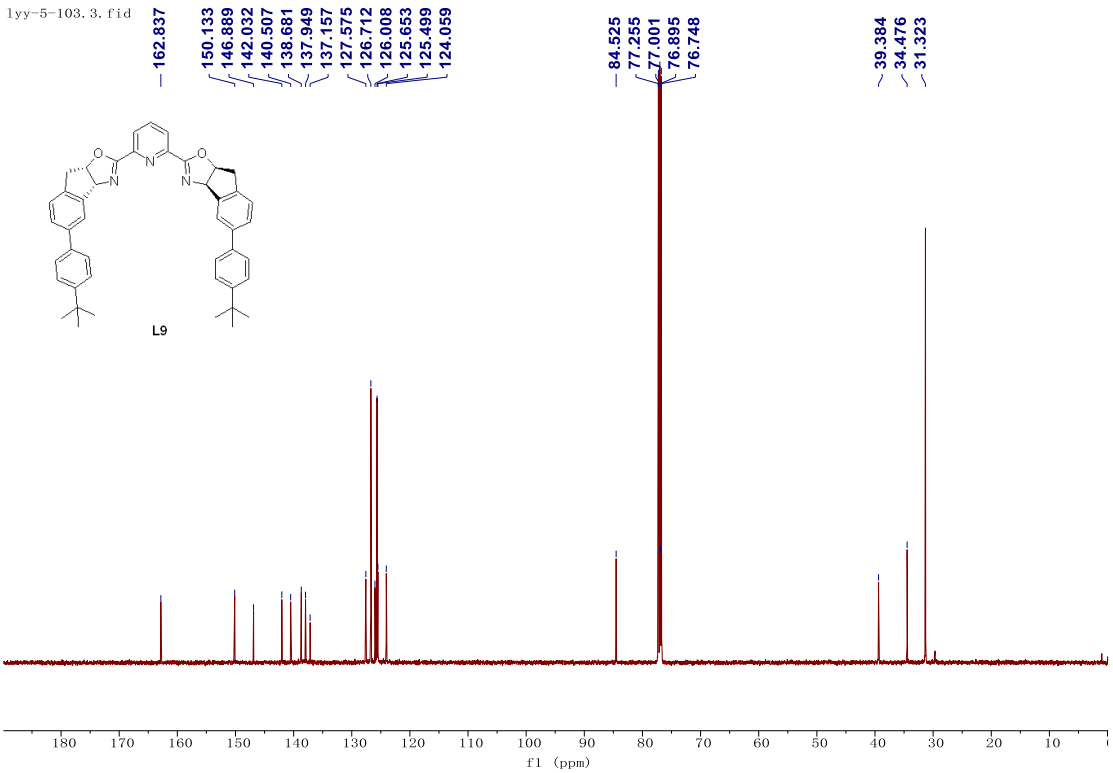
^{1}H NMR spectra of **L8**



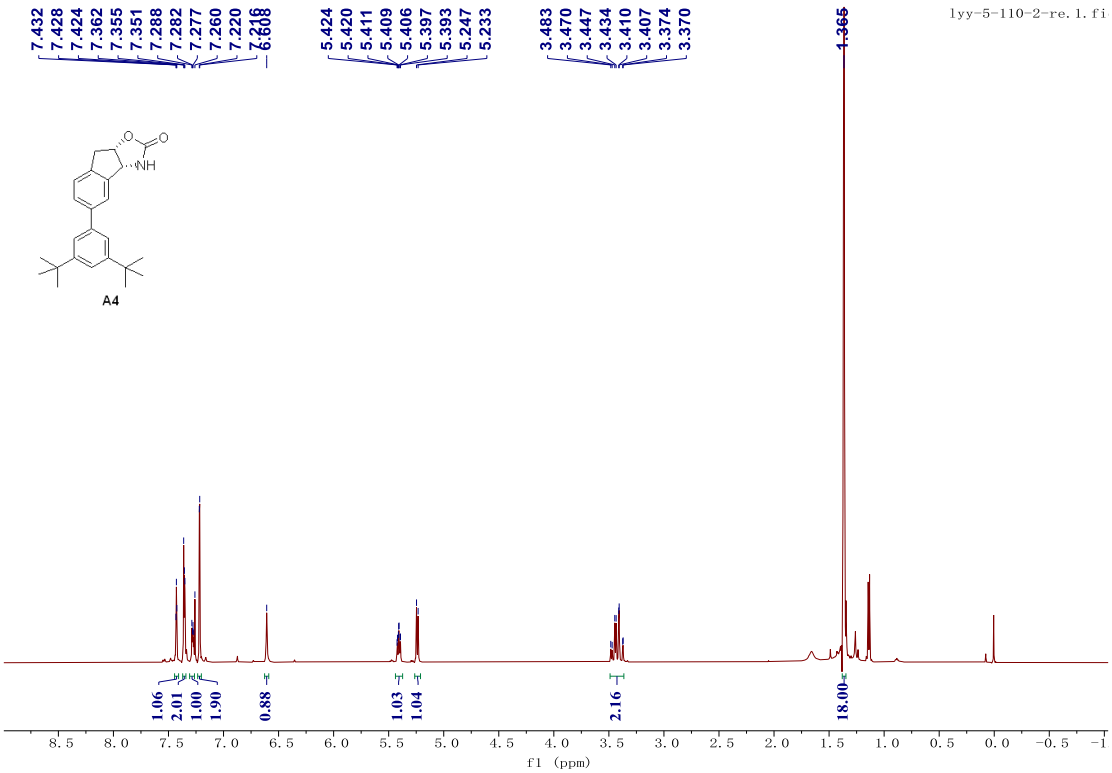
^{13}C NMR spectra of **L8**



^{1}H NMR spectra of **L9**



^{13}C NMR spectra of **L9**



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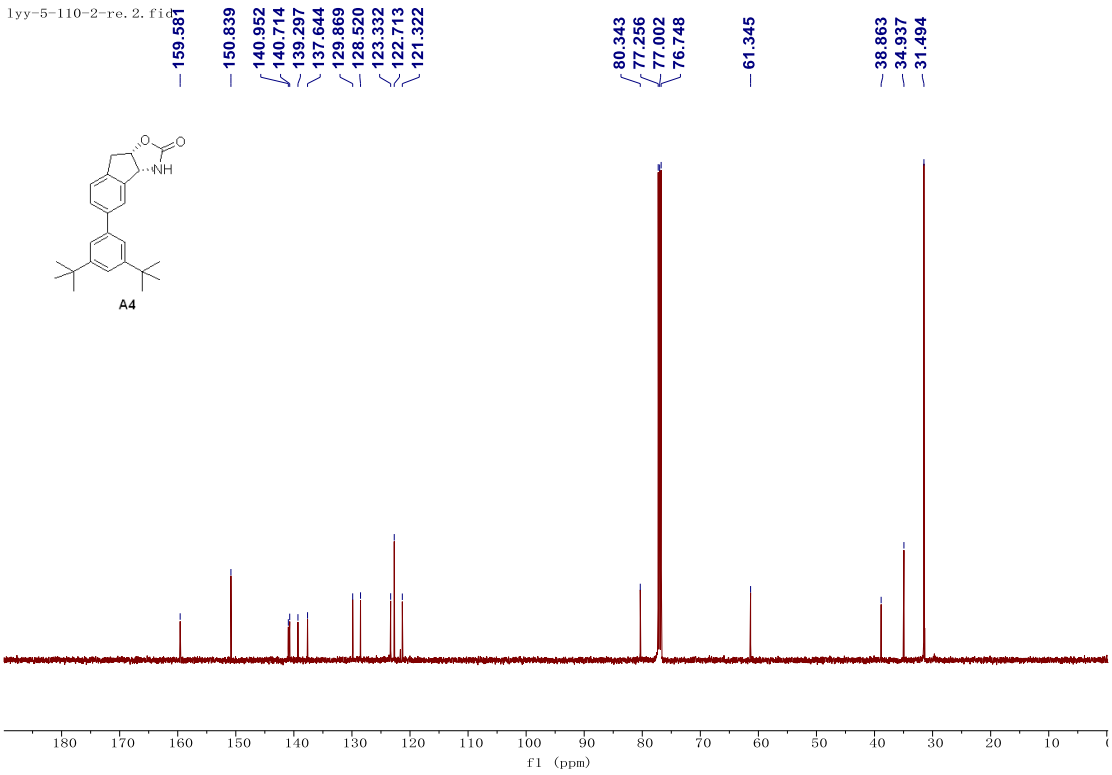
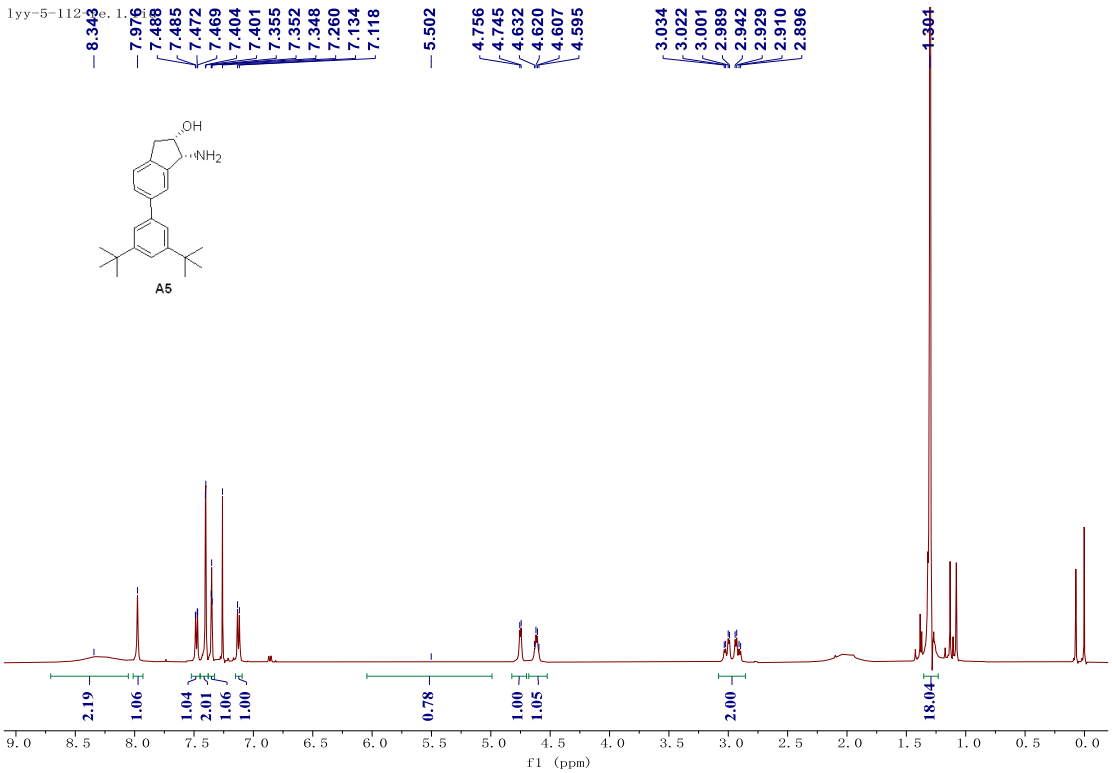
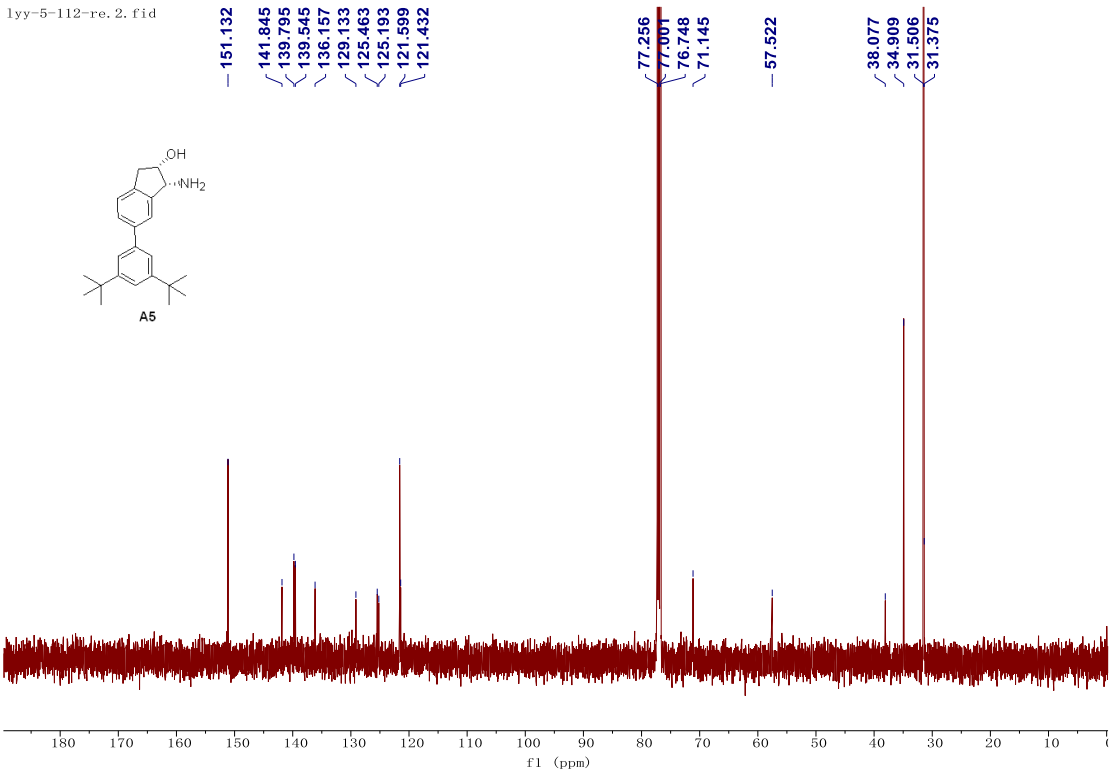


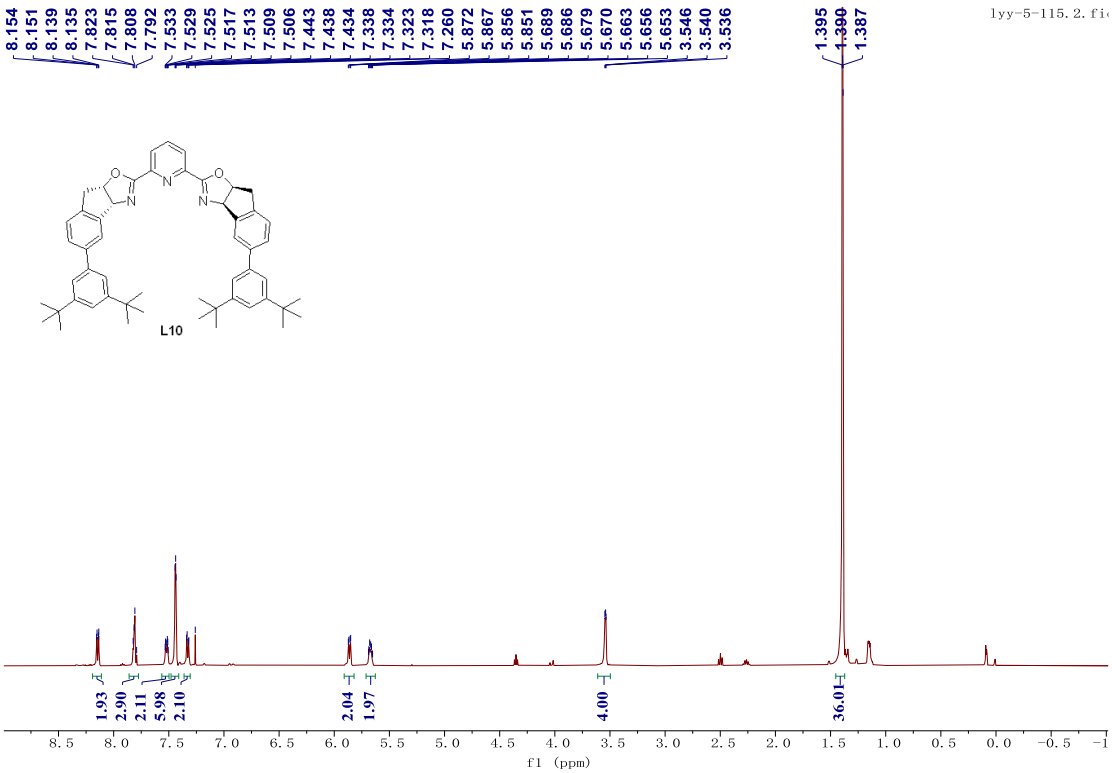
^{13}C NMR spectra of **A4**



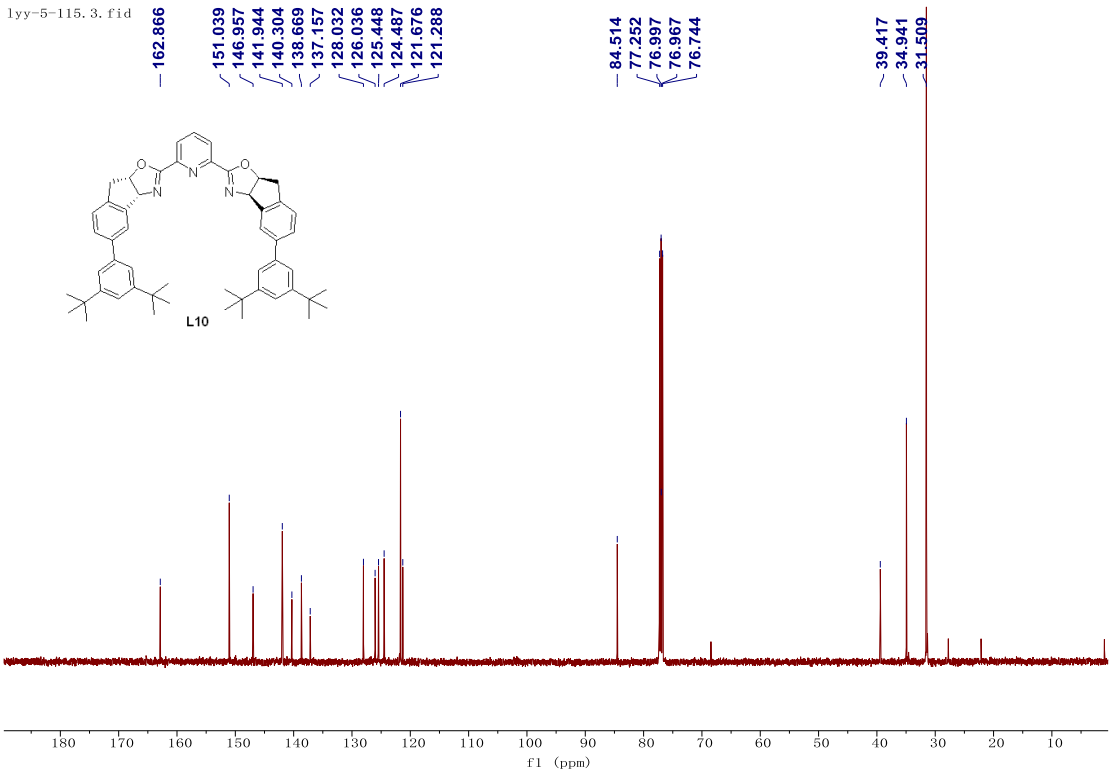
^{1}H NMR spectra of **A5**



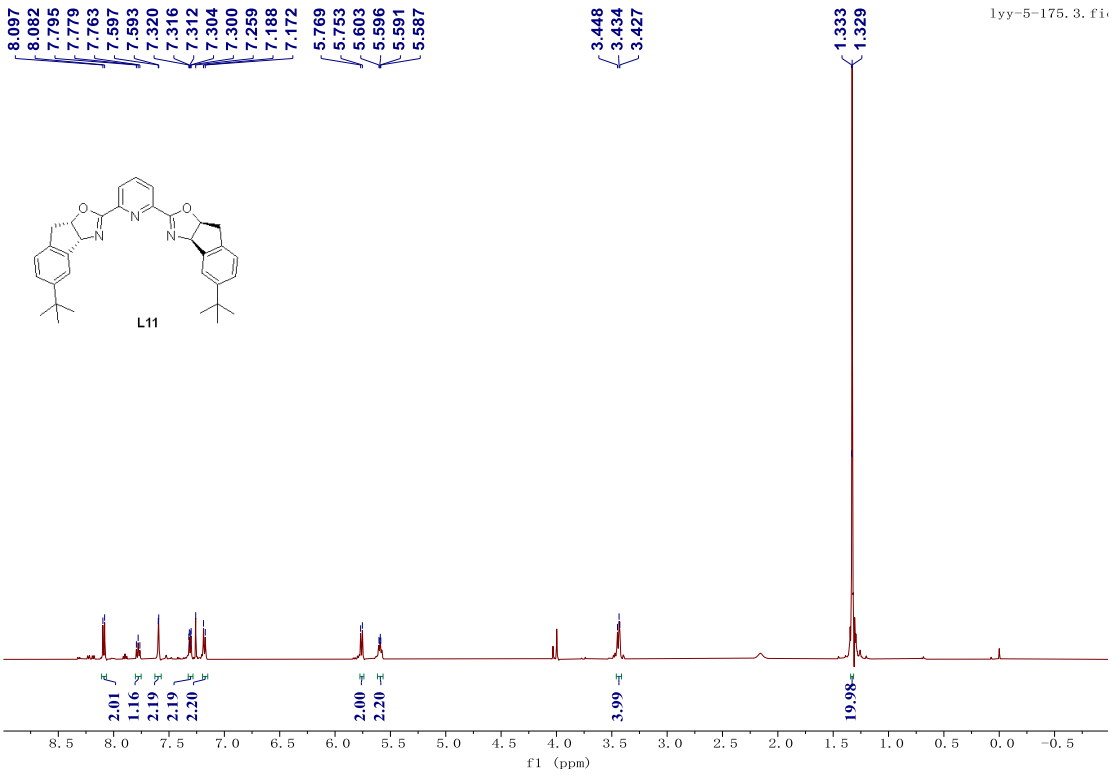
^{13}C NMR spectra of **A5**



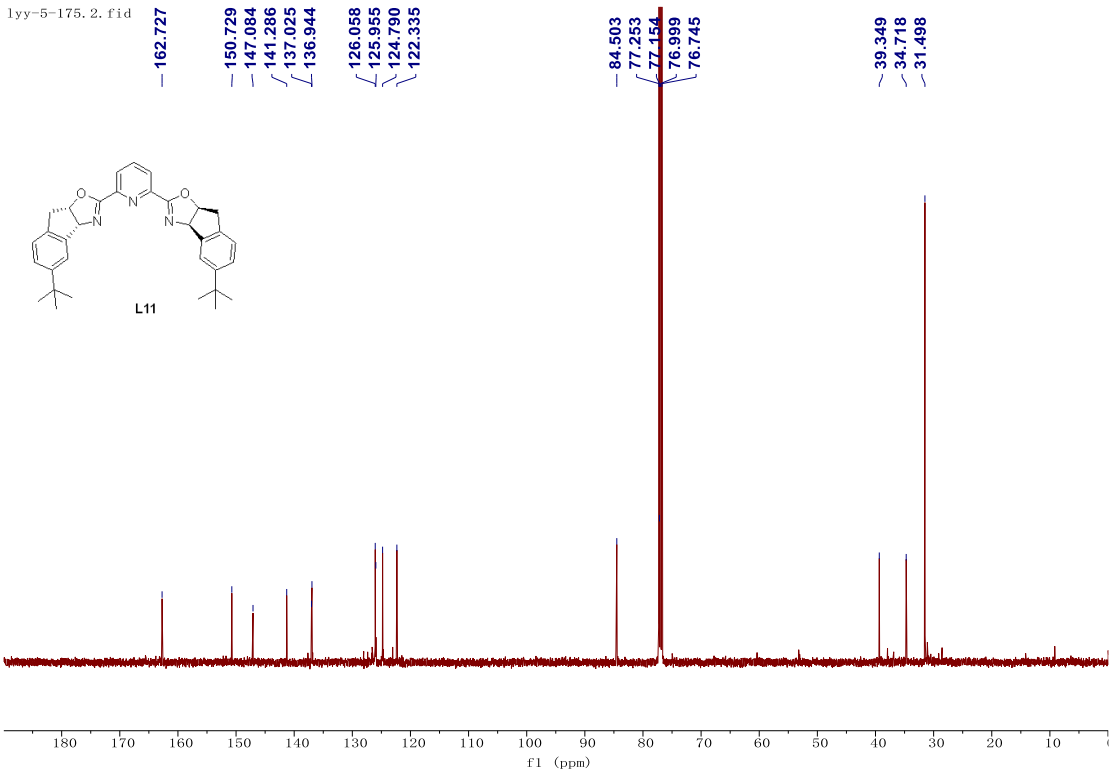
^{1}H NMR spectra of **L10**



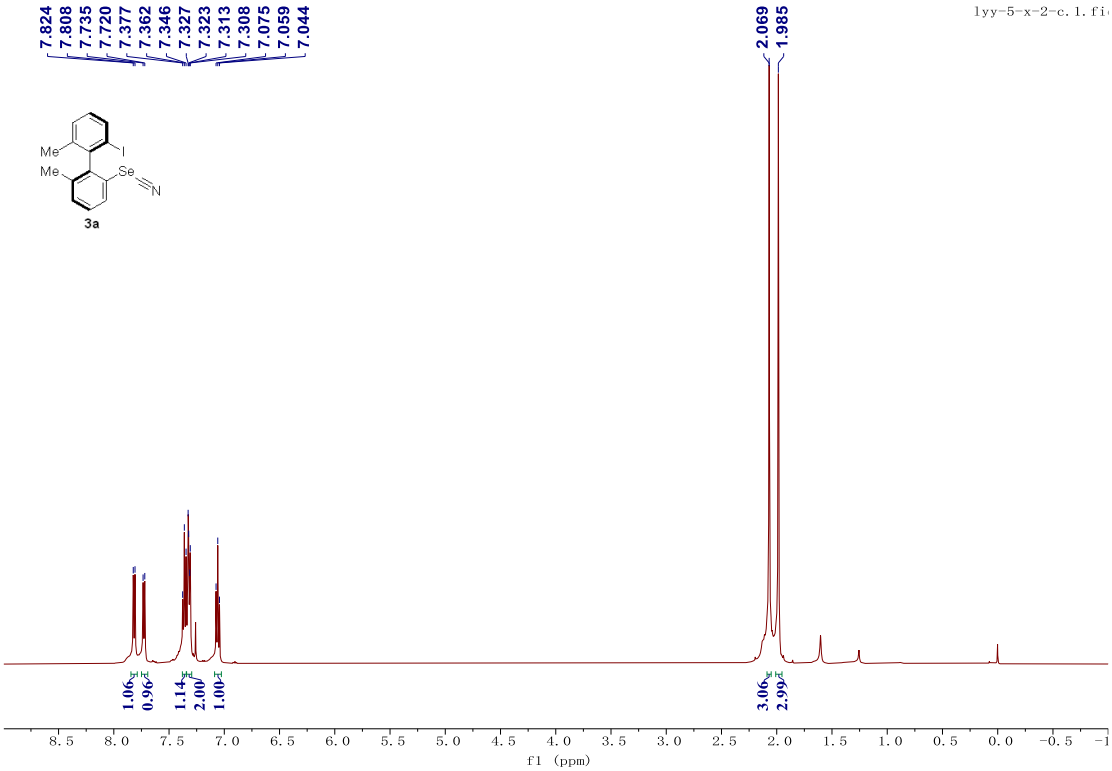
/^{13}C NMR spectra of **L10**



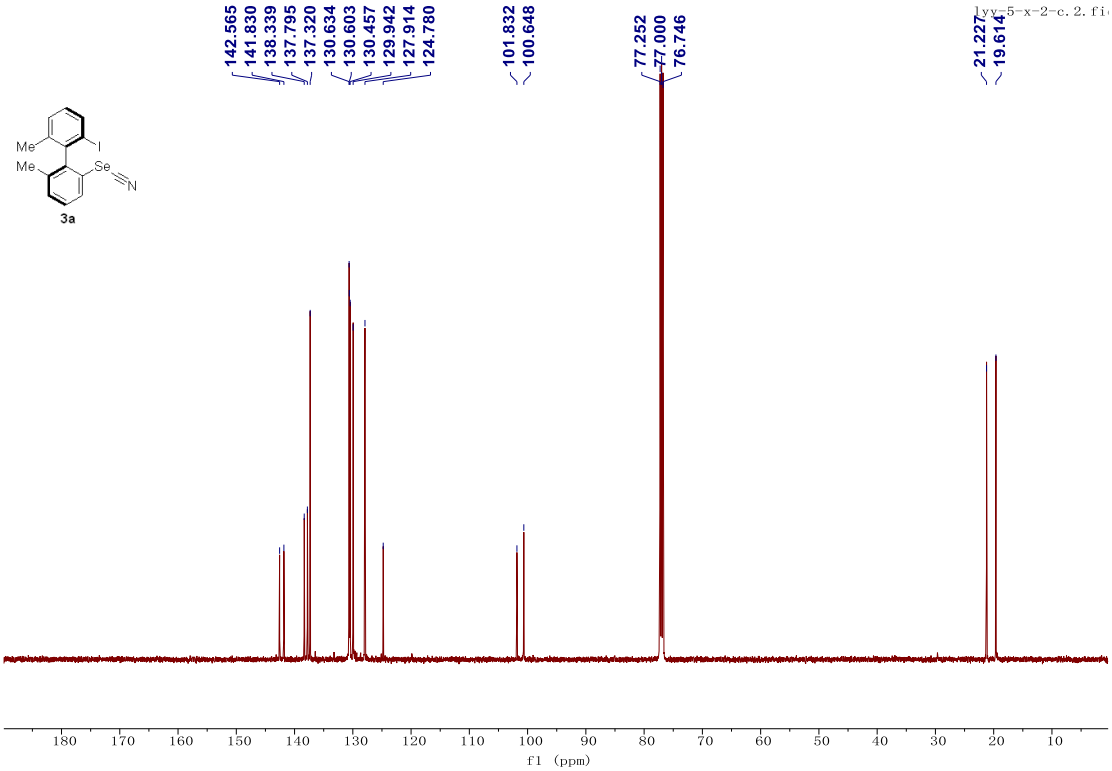
^{1}H NMR spectra of **L11**



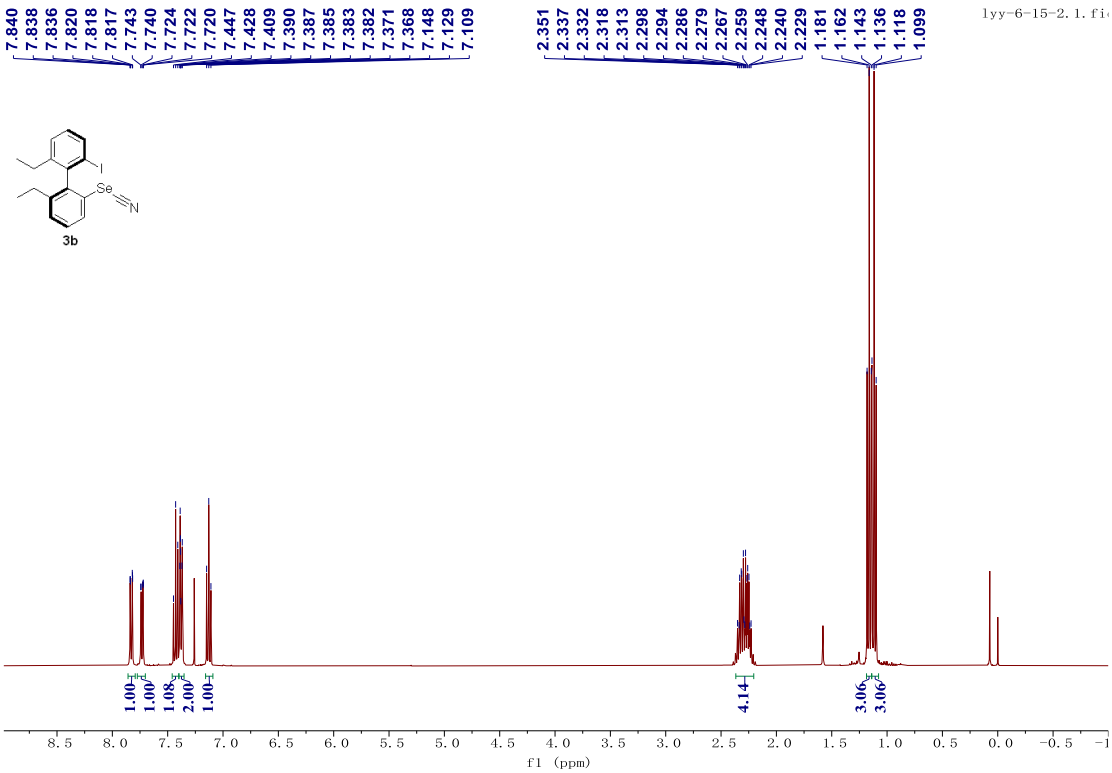
^{13}C NMR spectra of **L11**



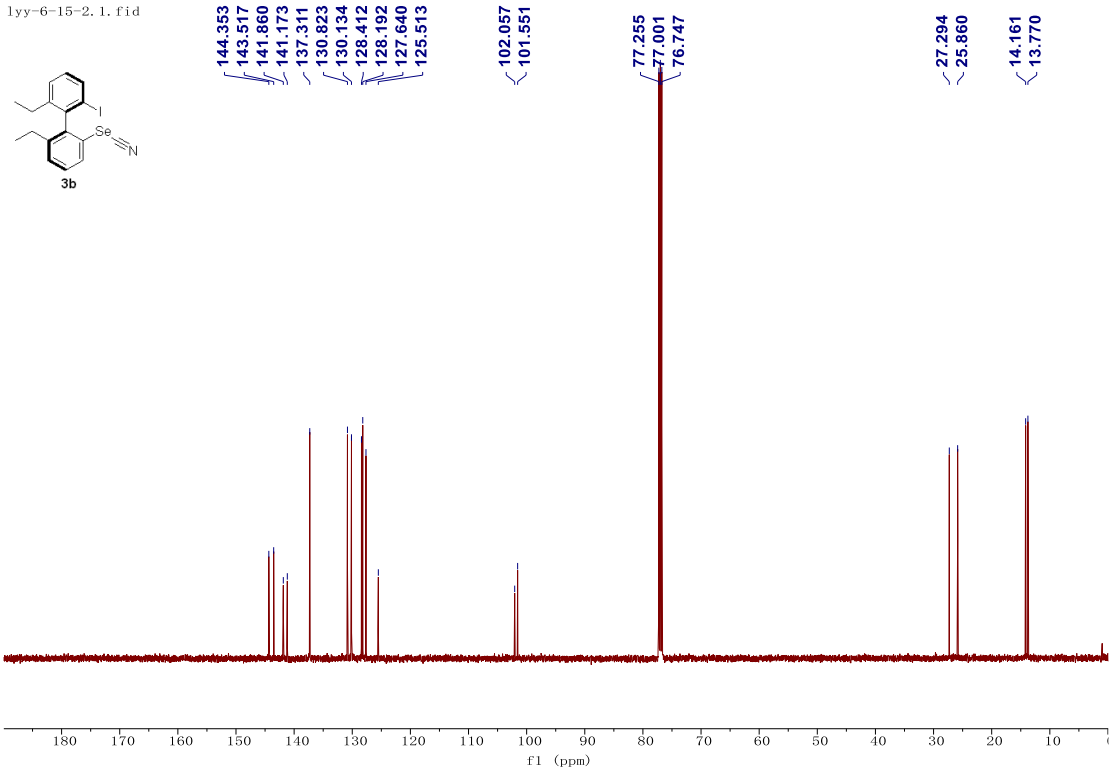
^{1}H NMR spectra of **3a**



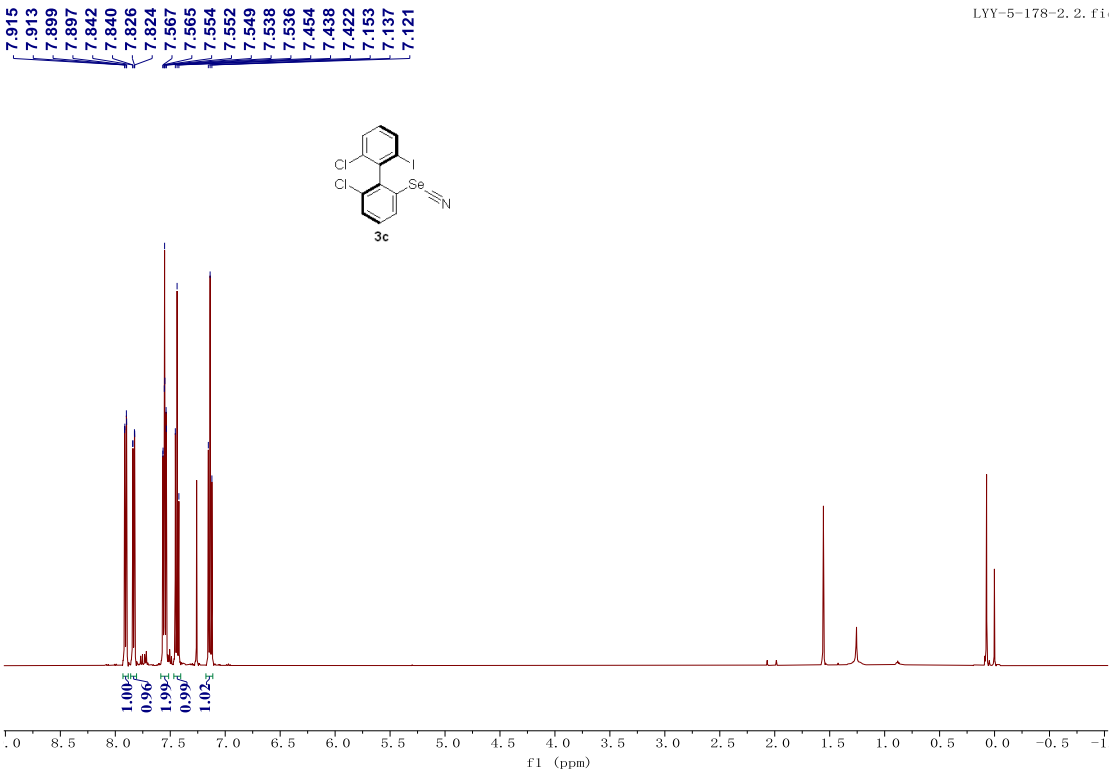
^{13}C NMR spectra of **3a**



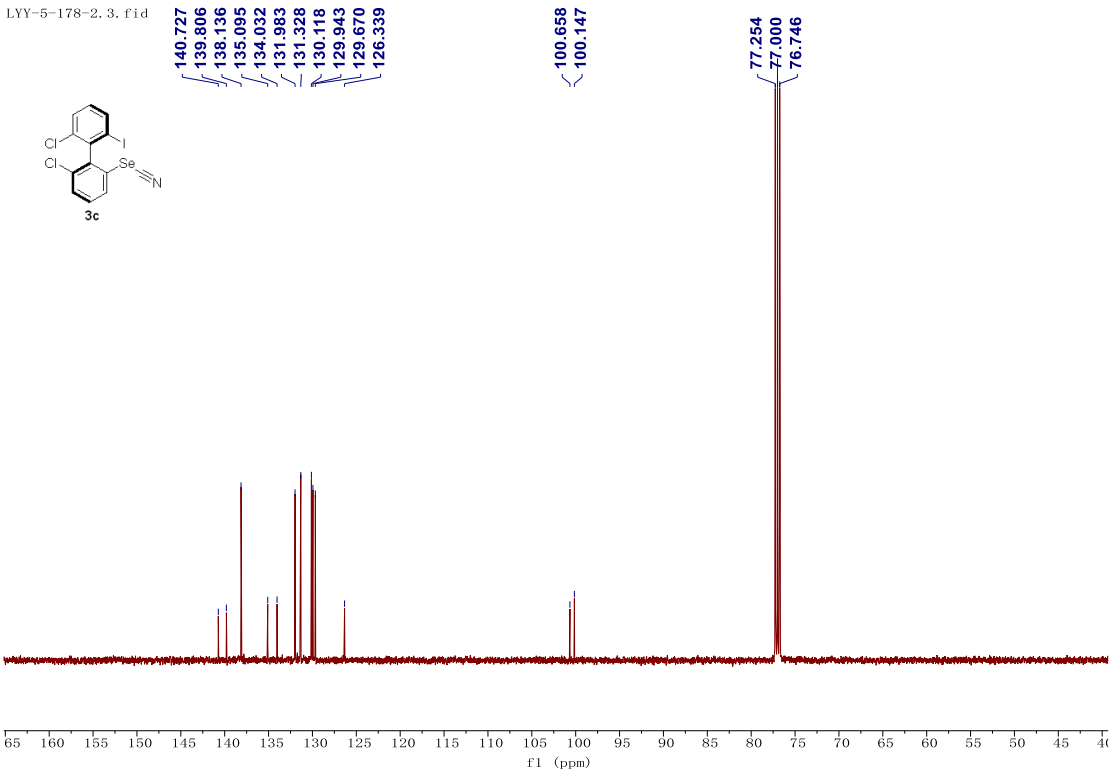
^{1}H NMR spectra of **3b**



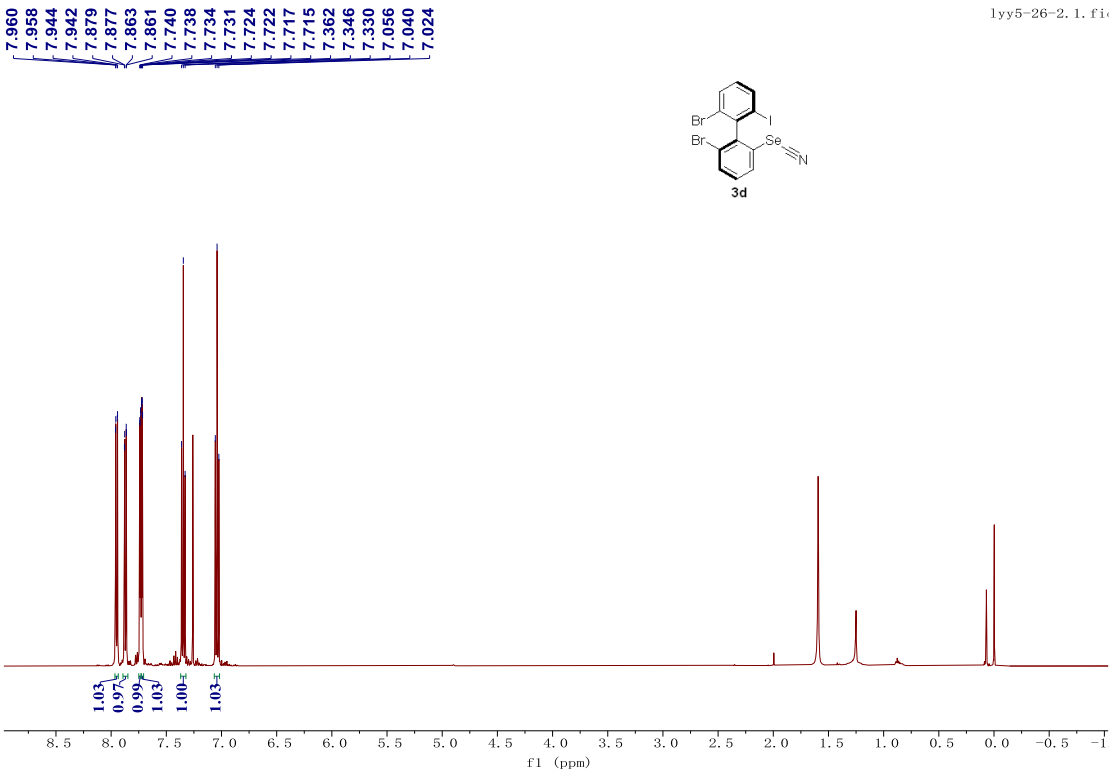
^{13}C NMR spectra of **3b**



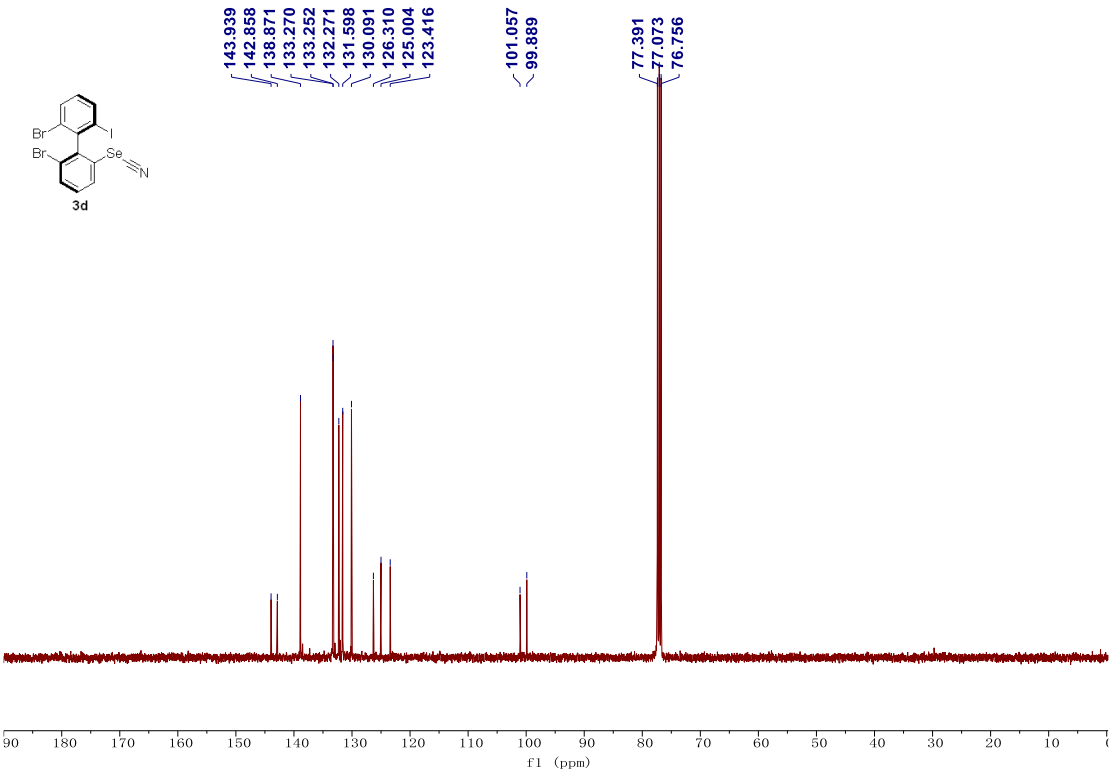
^{1}H NMR spectra of **3c**



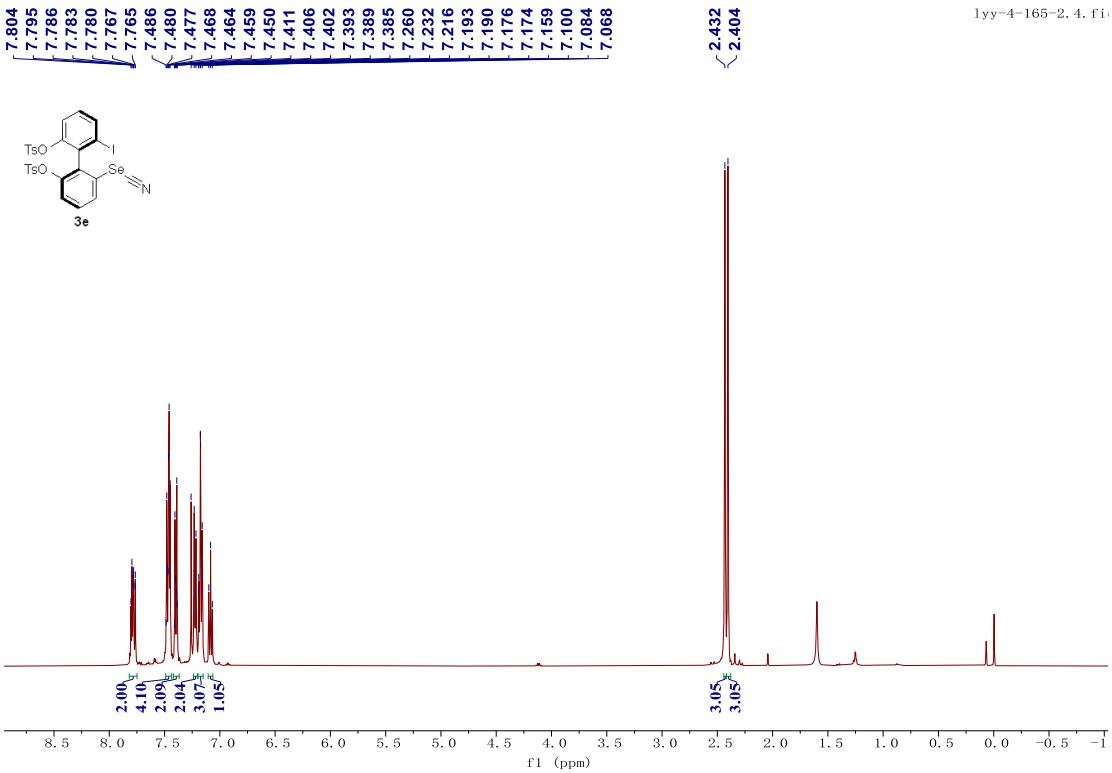
^{13}C NMR spectra of **3c**



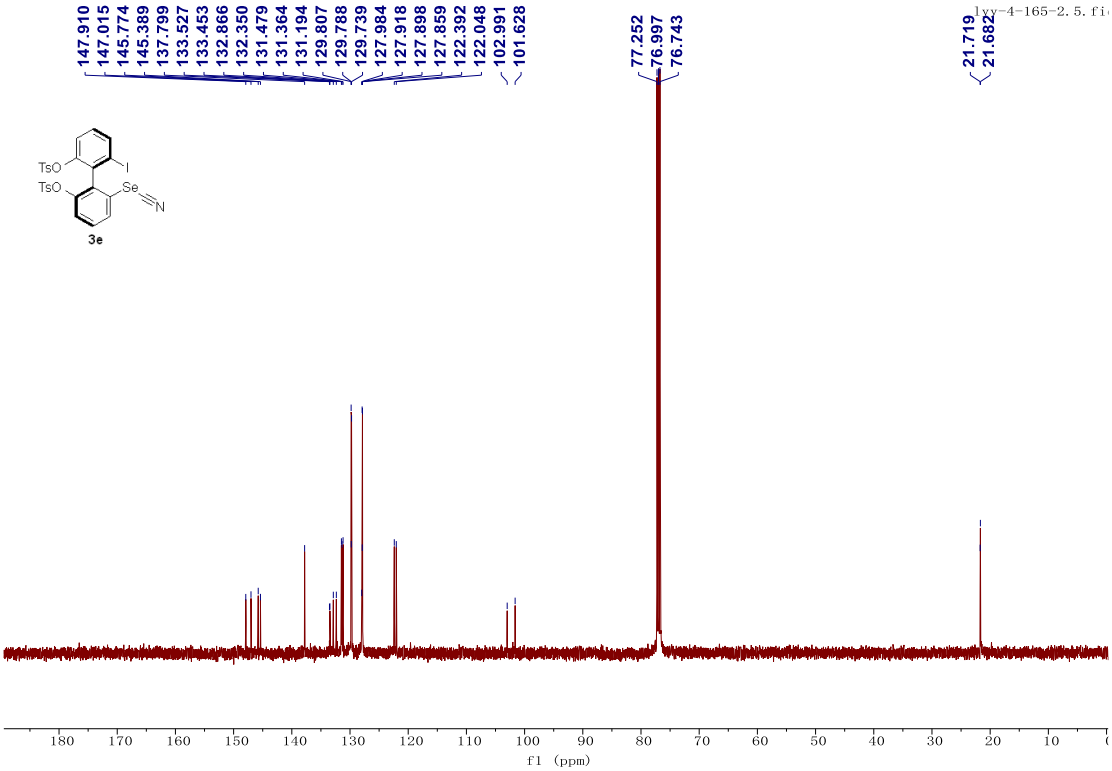
^{1}H NMR spectra of **3d**



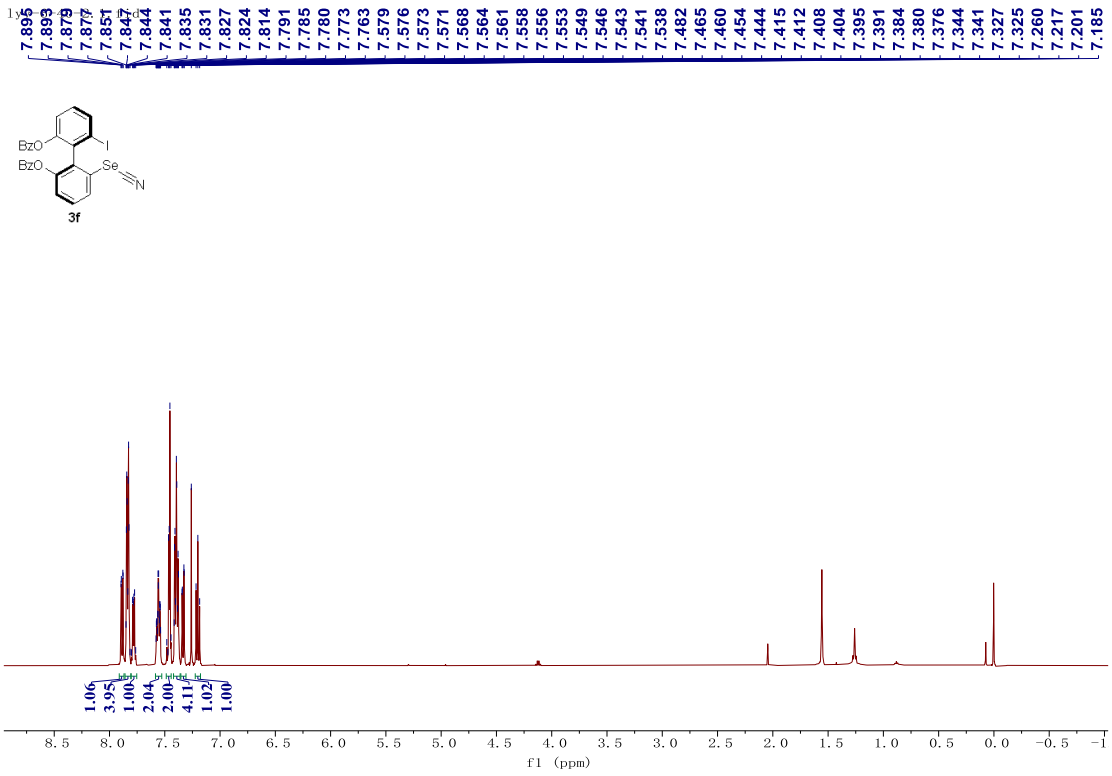
^{13}C NMR spectra of **3d**



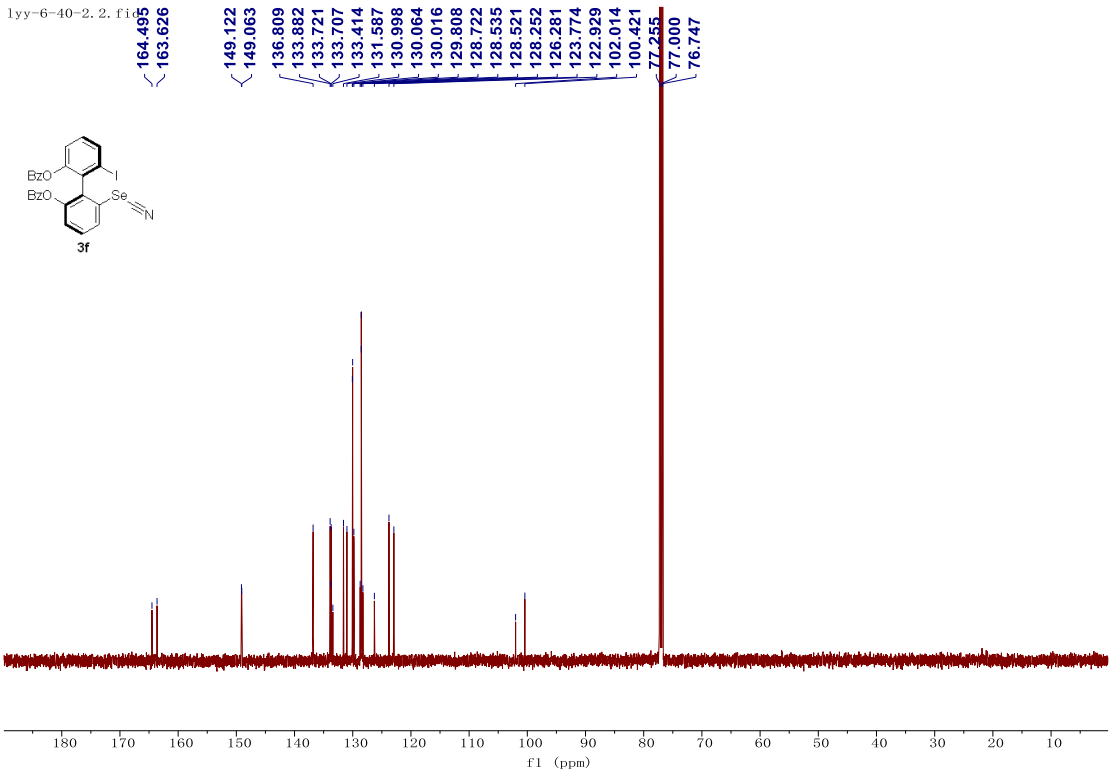
^{1}H NMR spectra of **3e**



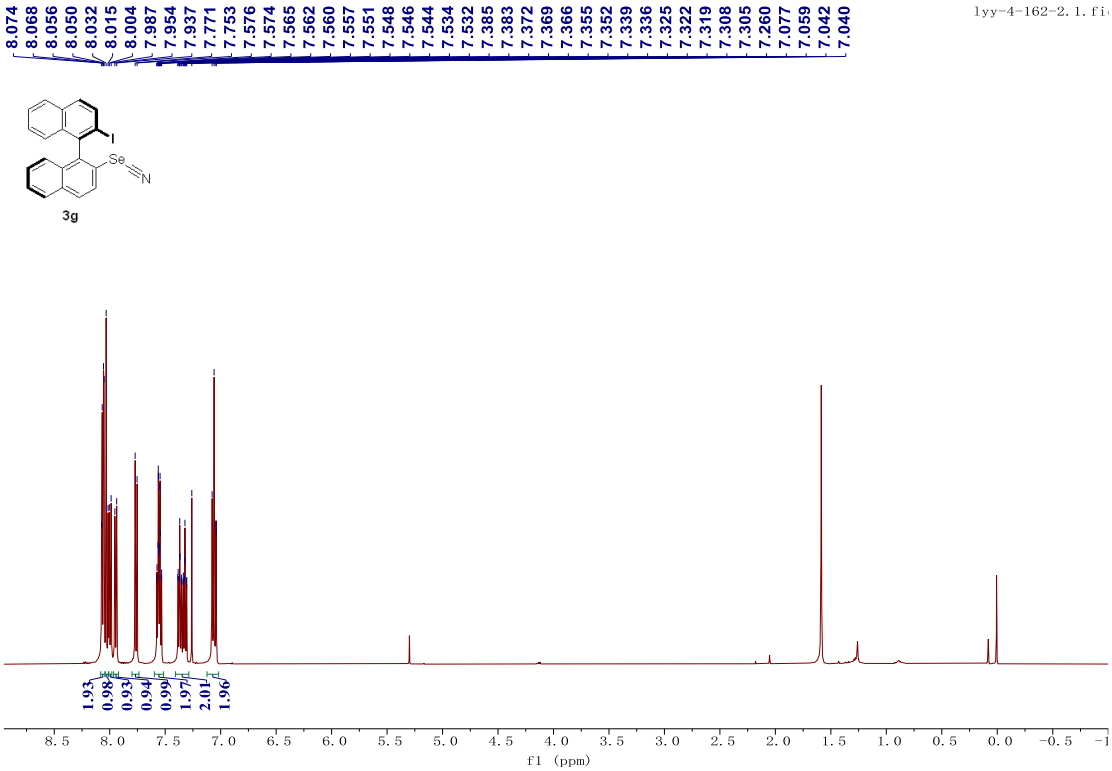
^{13}C NMR spectra of **3e**



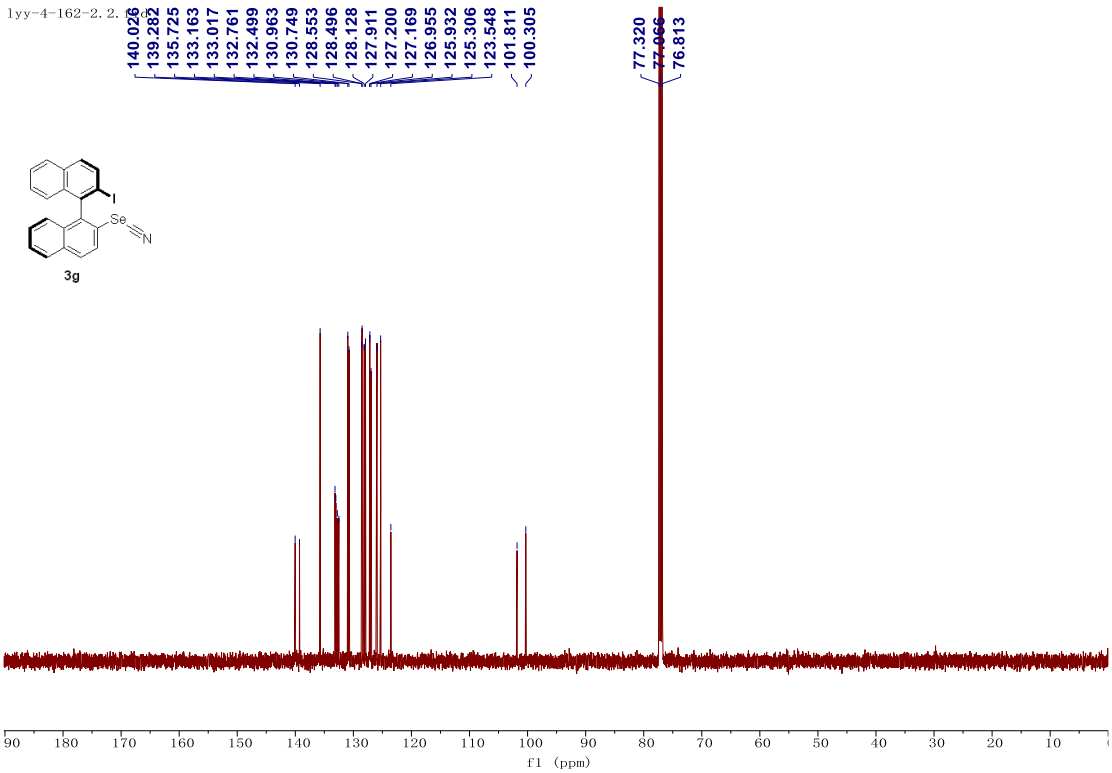
^{1}H NMR spectra of **3f**



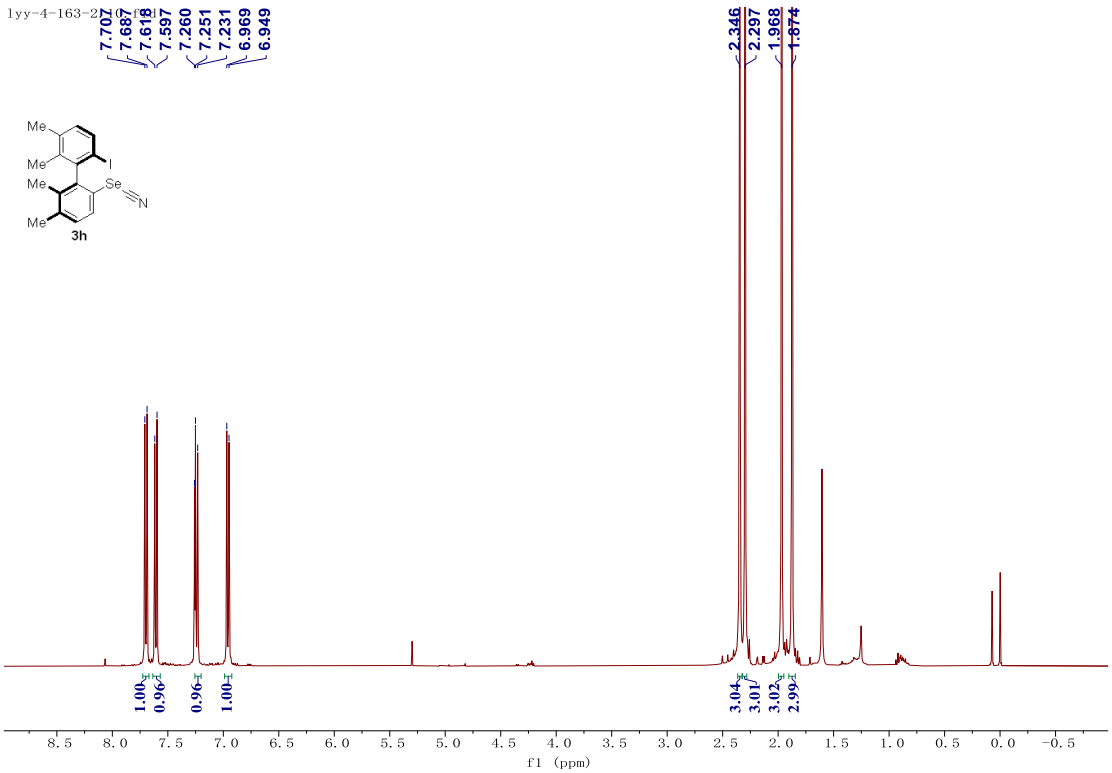
^{13}C NMR spectra of **3f**



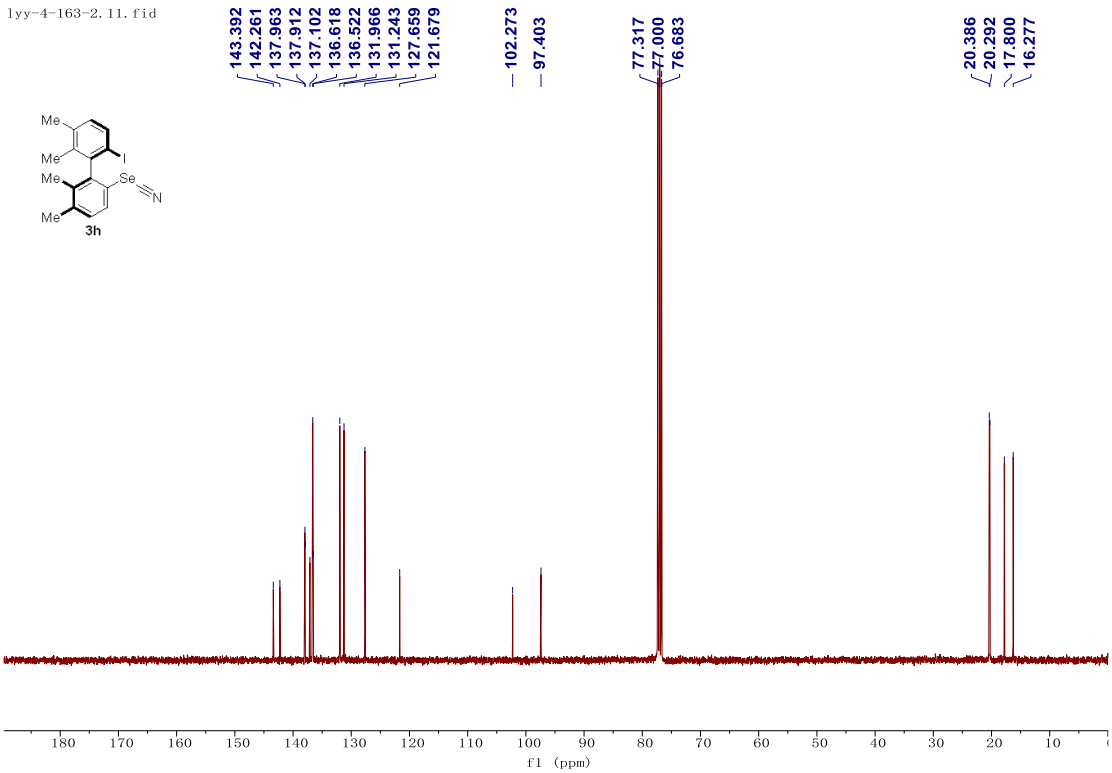
^{1}H NMR spectra of **3g**



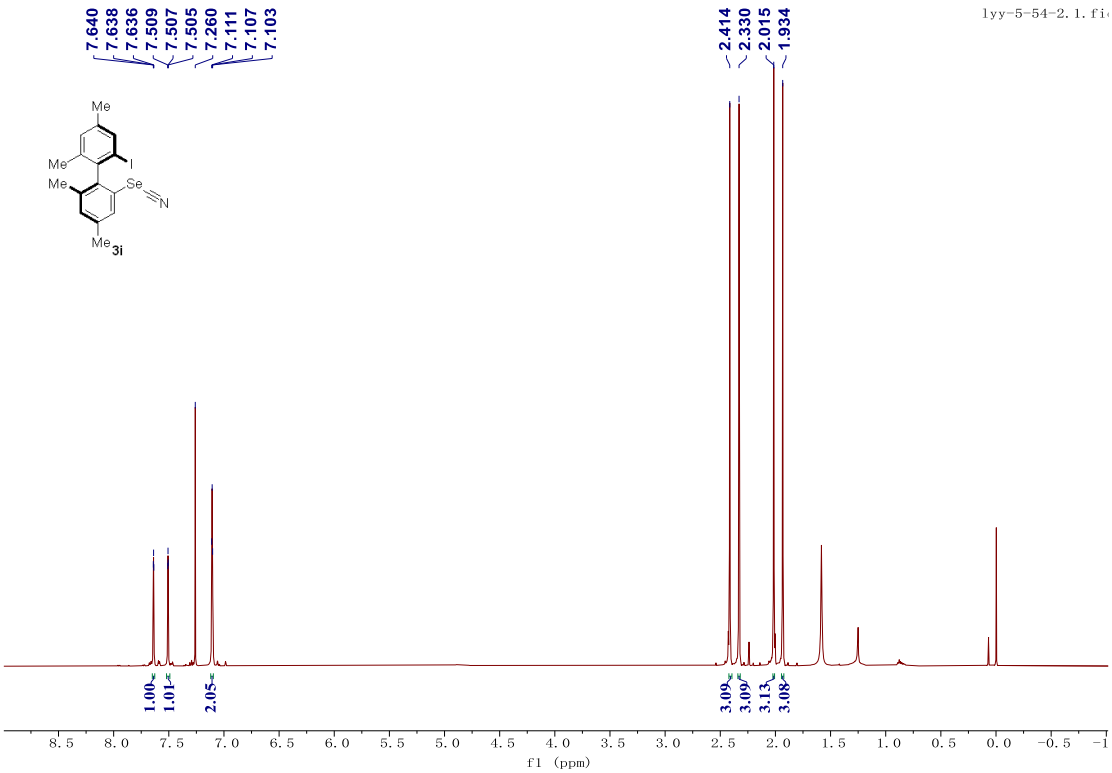
^{13}C NMR spectra of **3g**



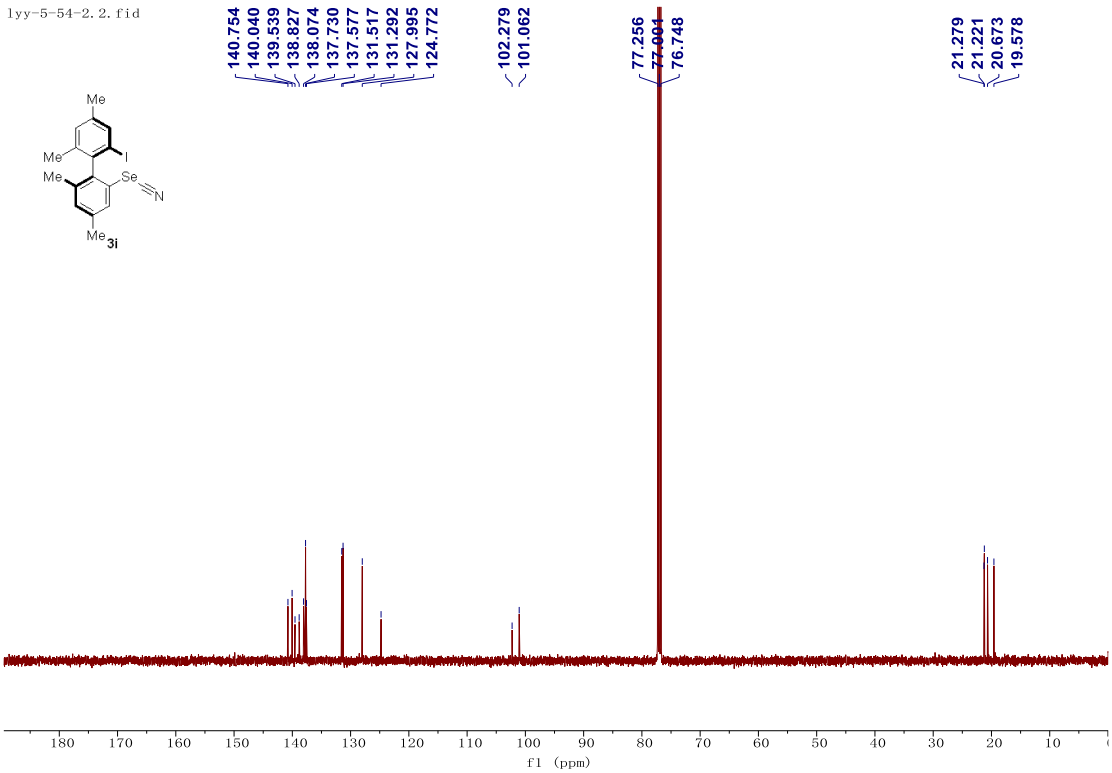
^{1}H NMR spectra of **3h**



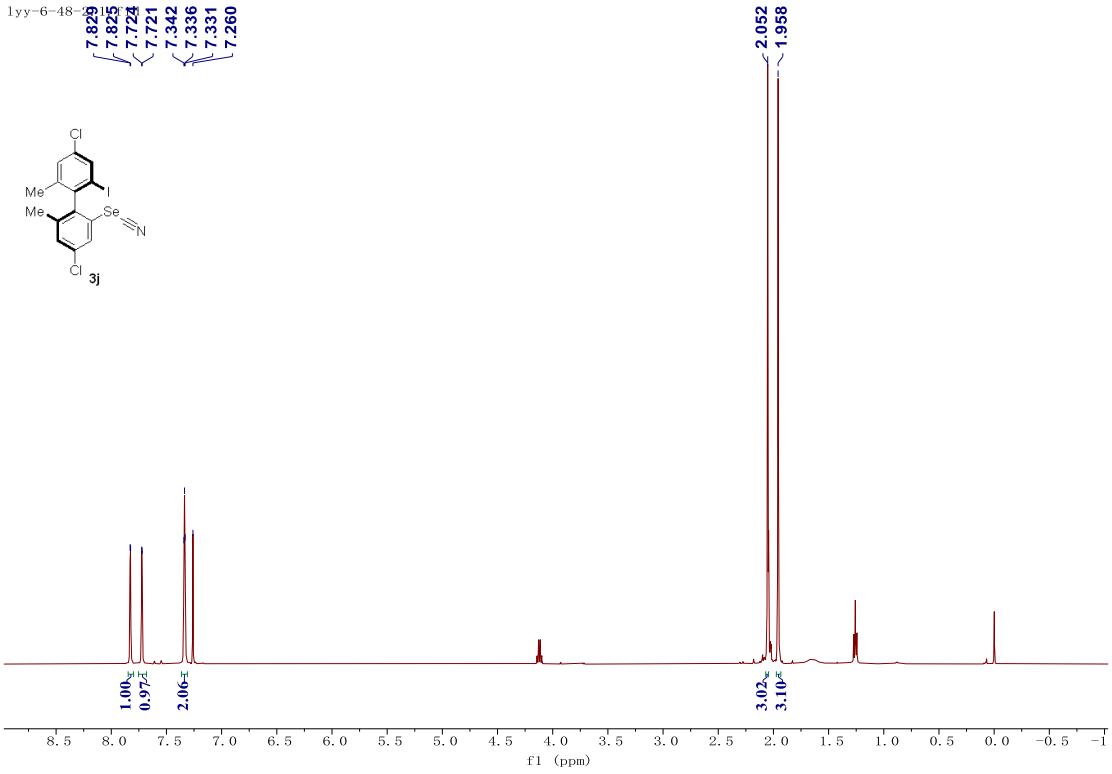
^{13}C NMR spectra of **3h**



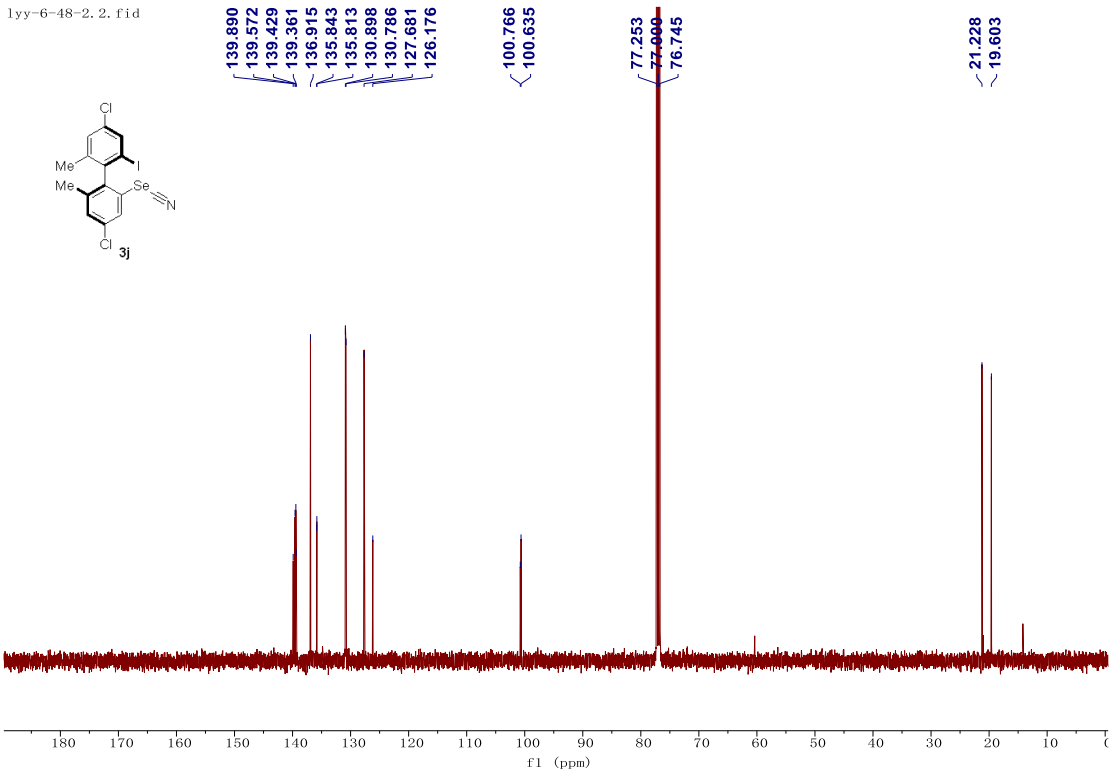
^{1}H NMR spectra of **3i**



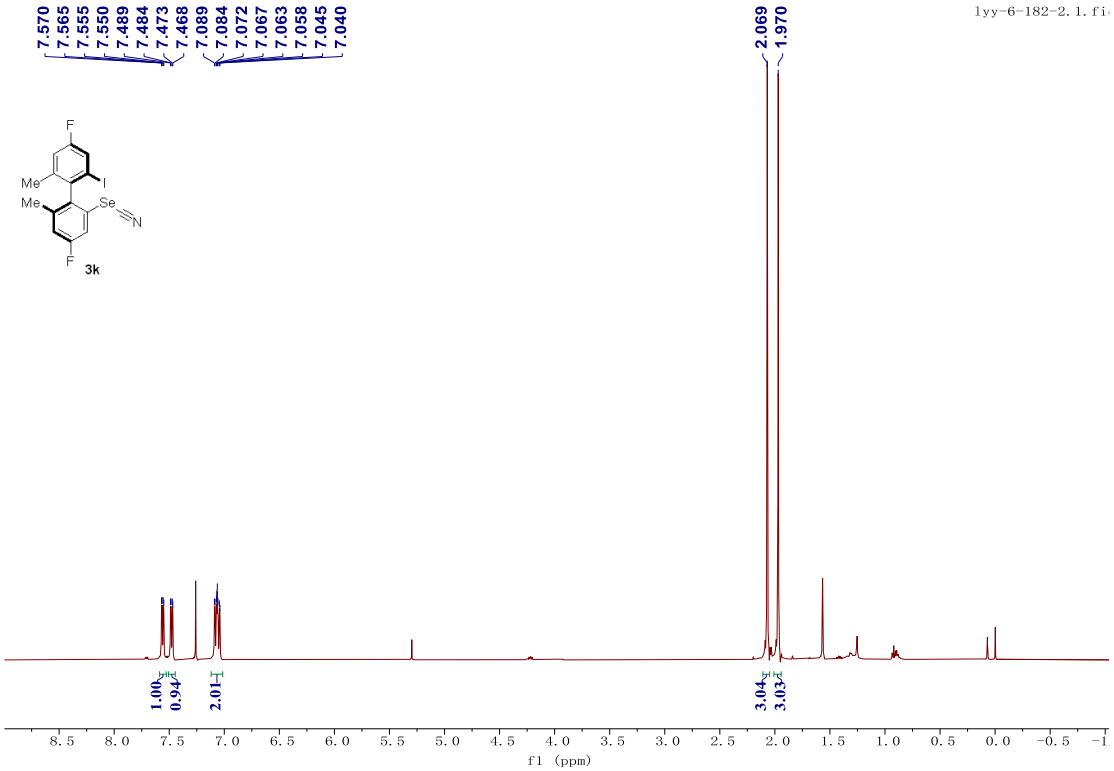
^{13}C NMR spectra of **3i**



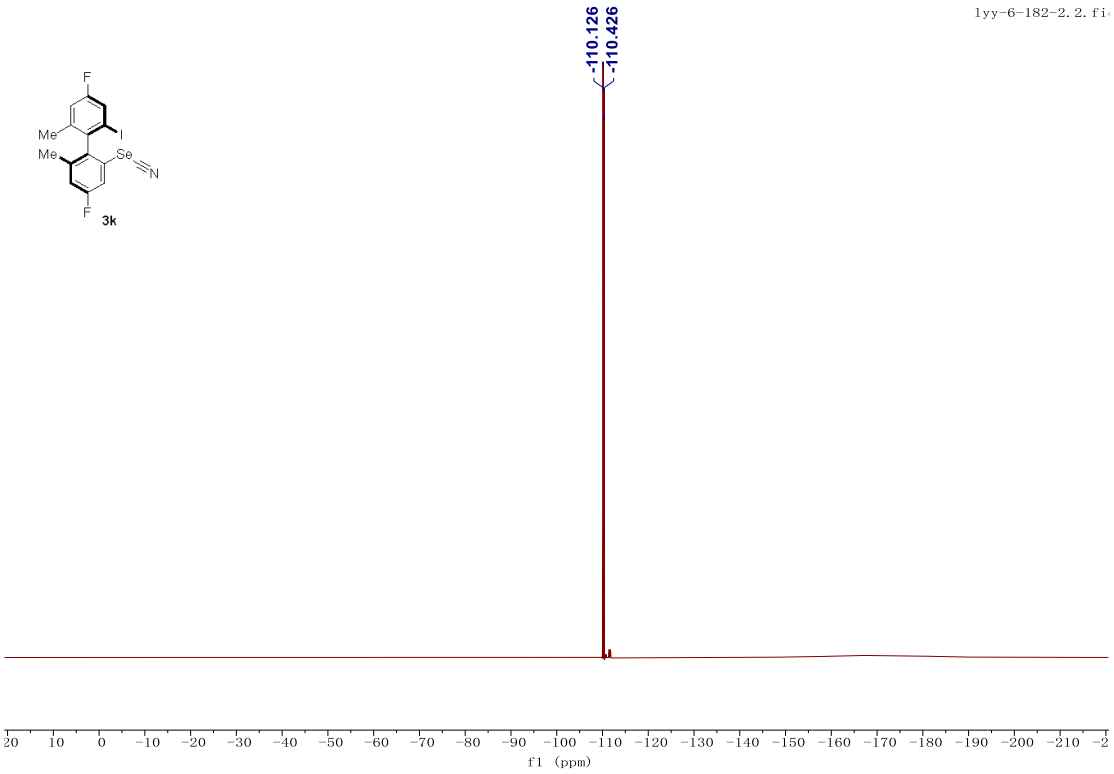
^{1}H NMR spectra of **3j**



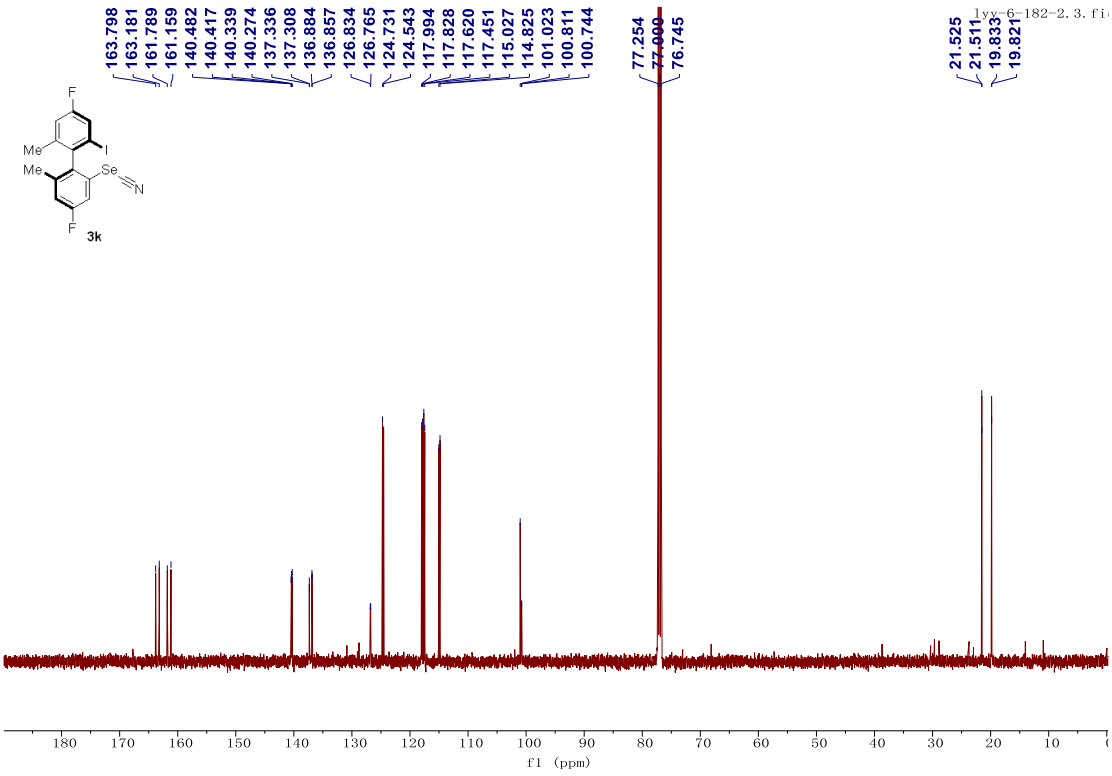
^{13}C NMR spectra of **3j**



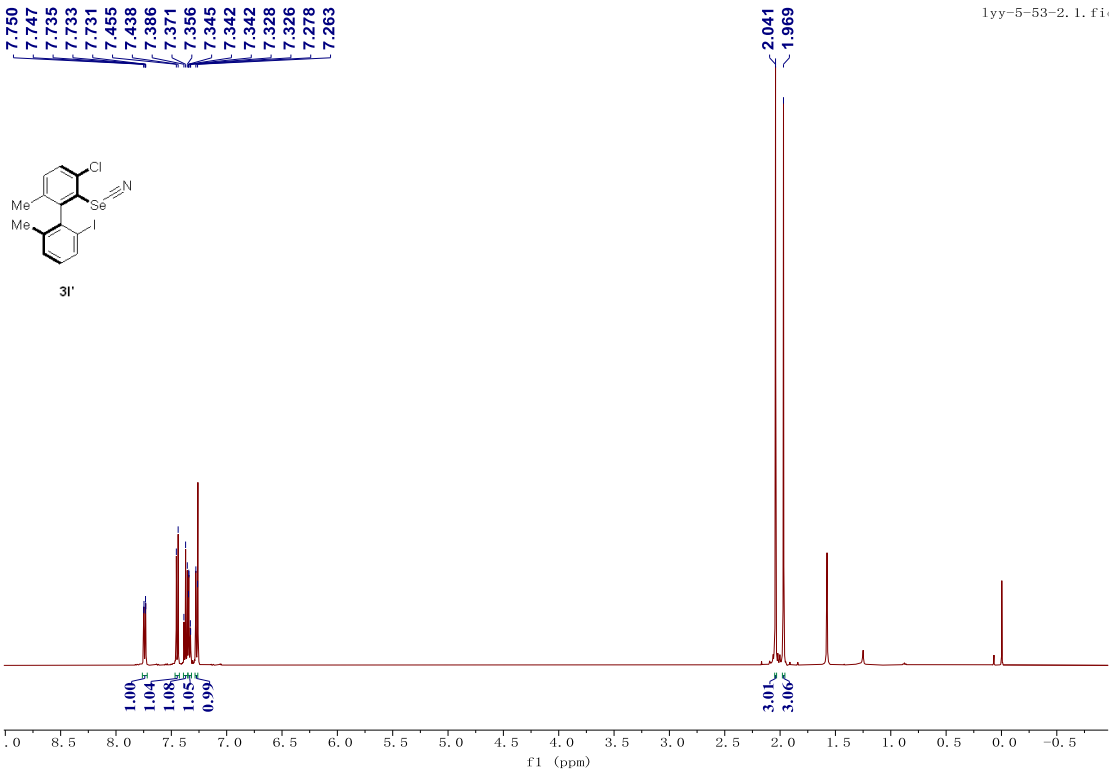
^{1}H NMR spectra of **3k**



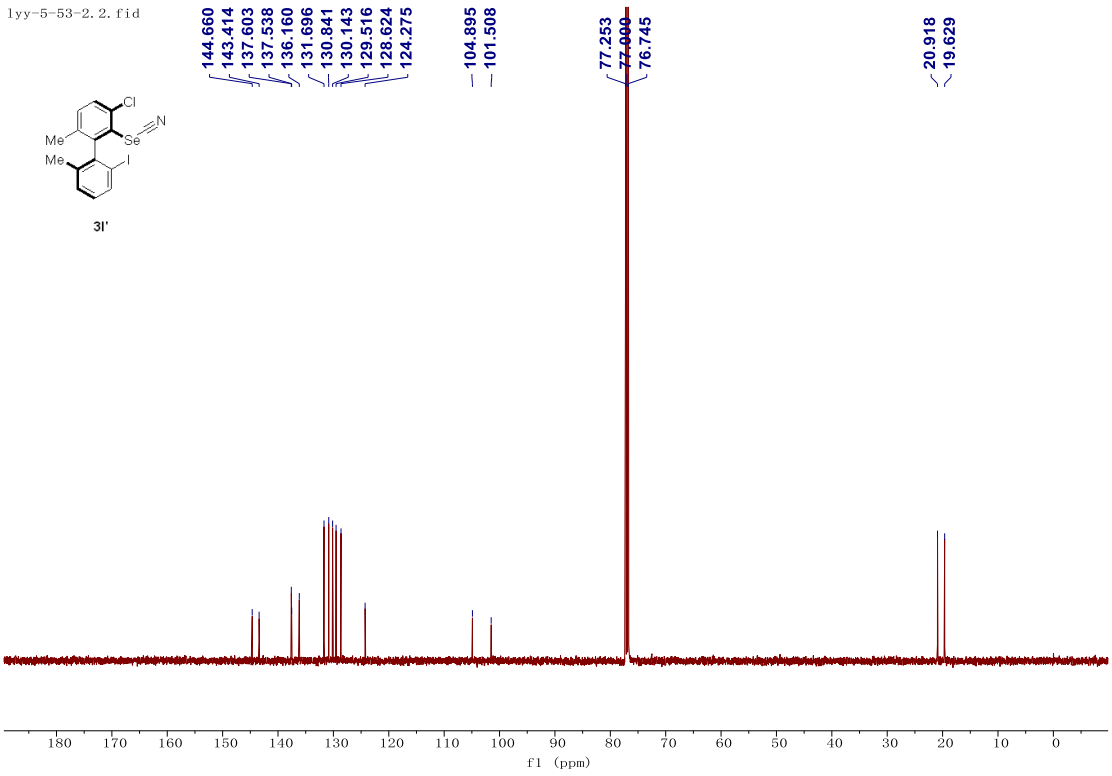
^{19}F NMR spectra of **3k**



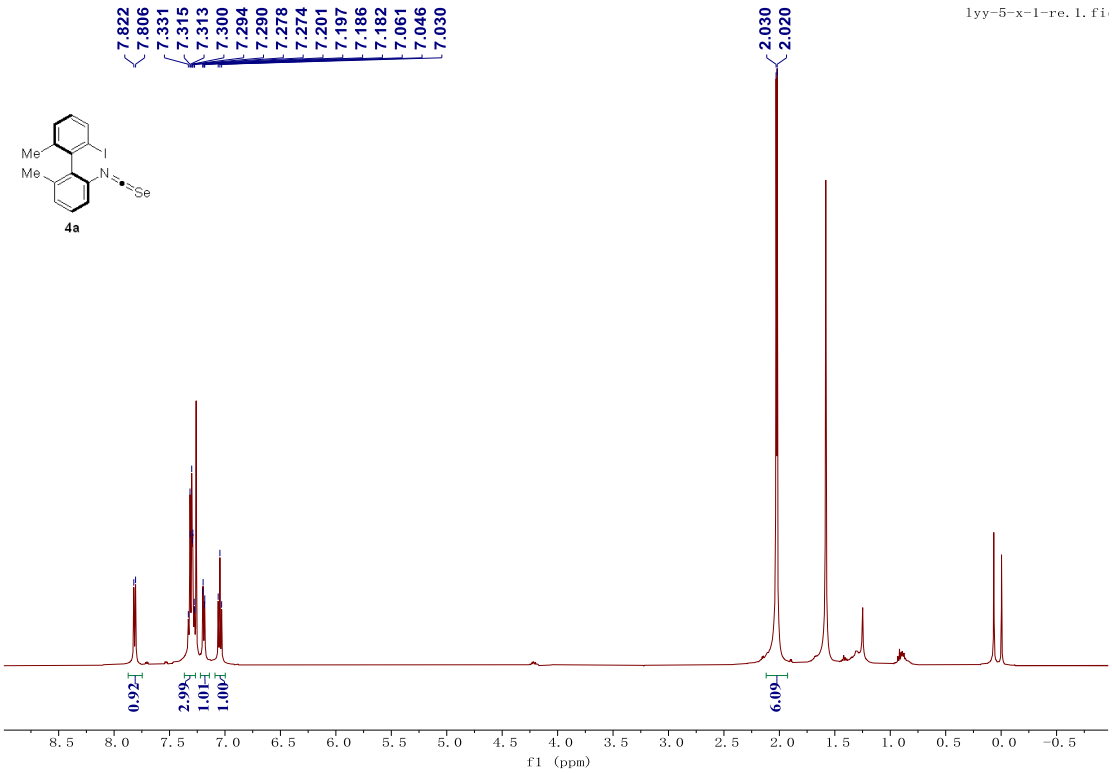
^{13}C NMR spectra of **3k**



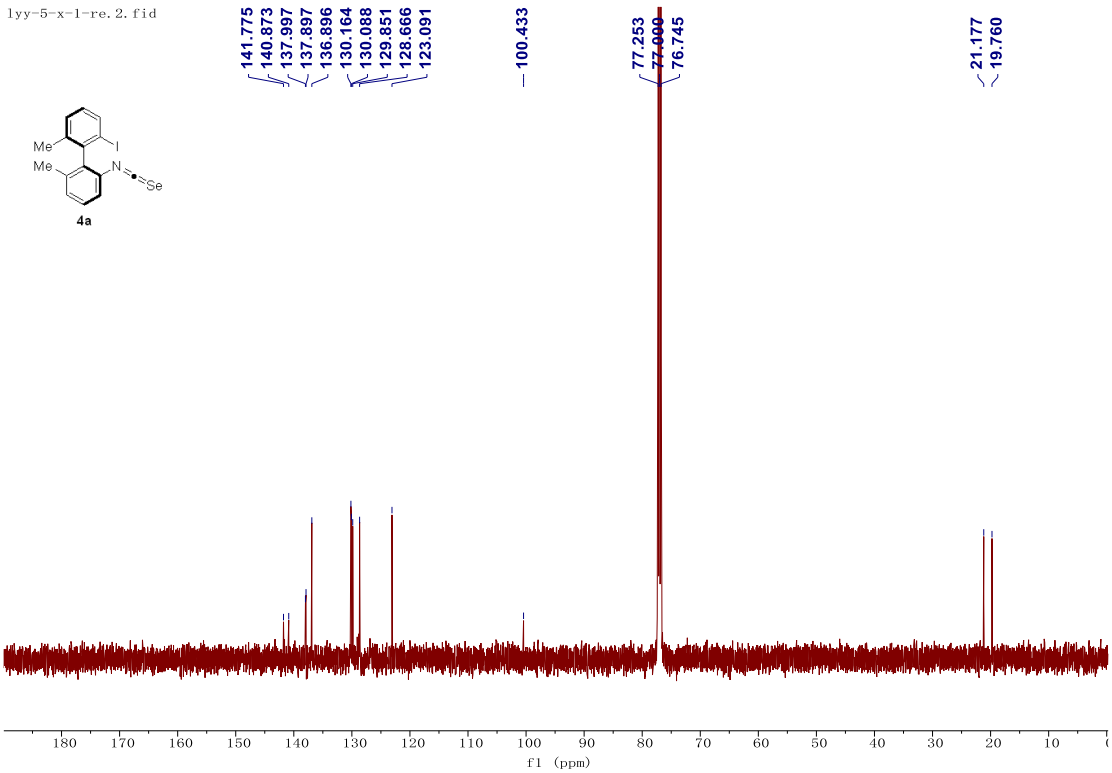
^{1}H NMR spectra of **3l'**



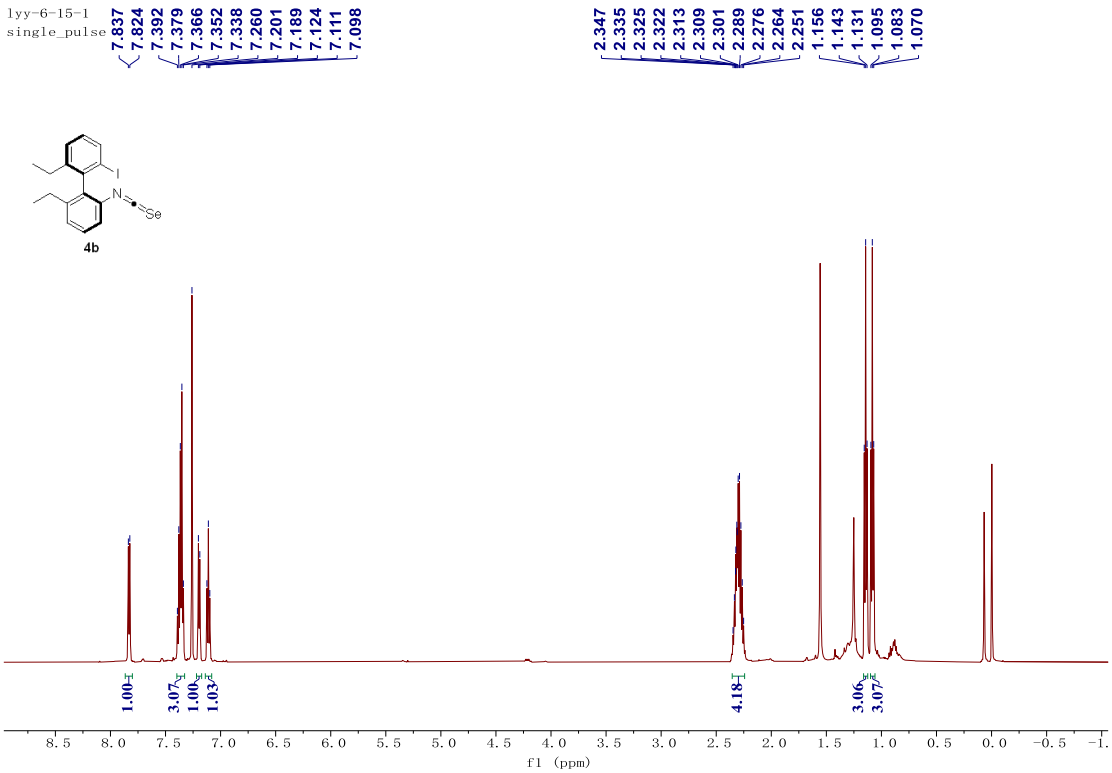
^{13}C NMR spectra of **3l'**



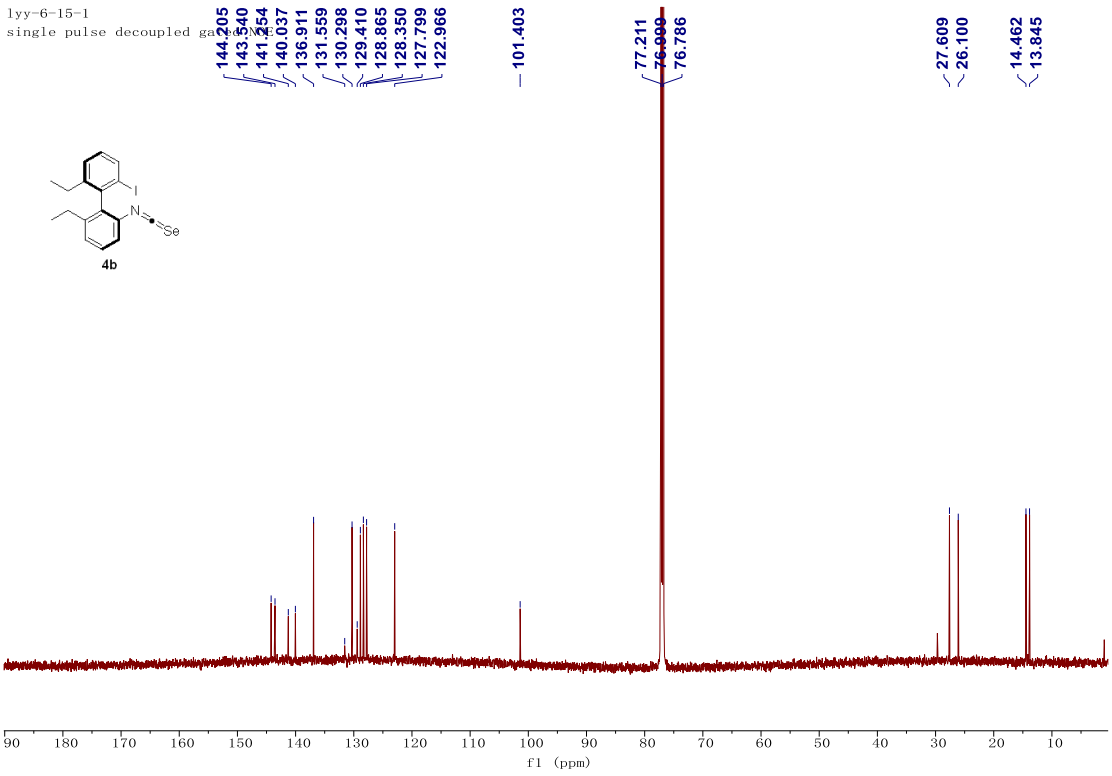
^{1}H NMR spectra of **4a**



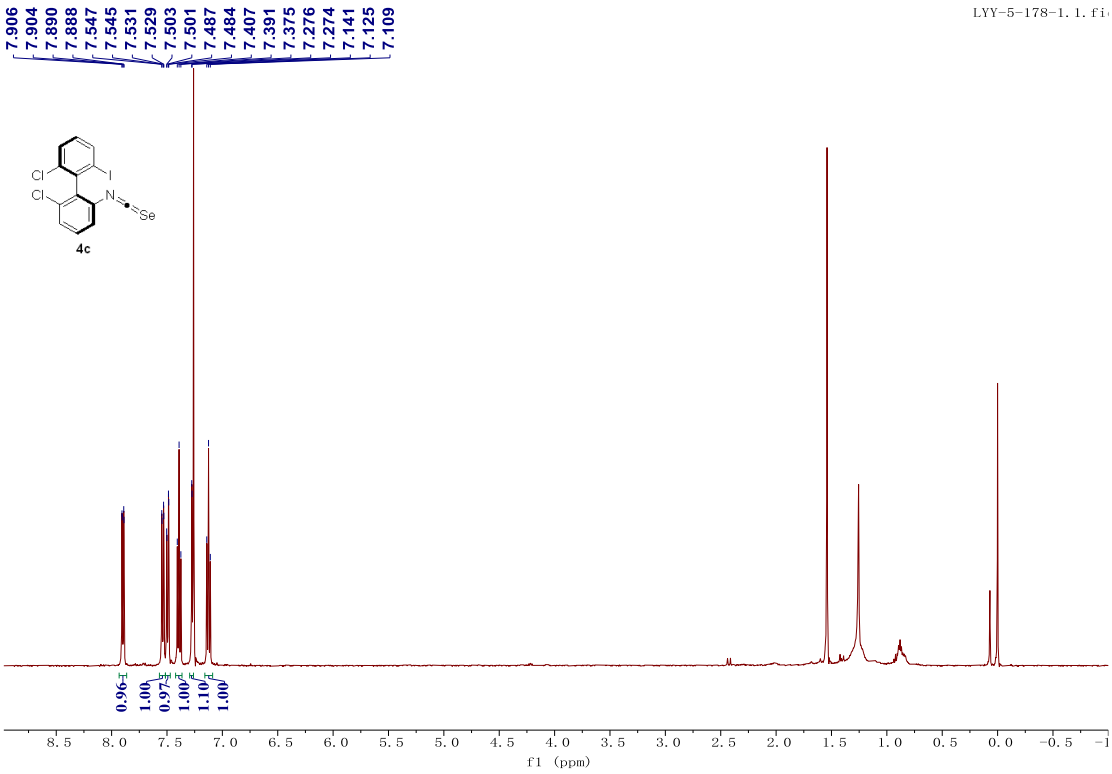
^{13}C NMR spectra of **4a**



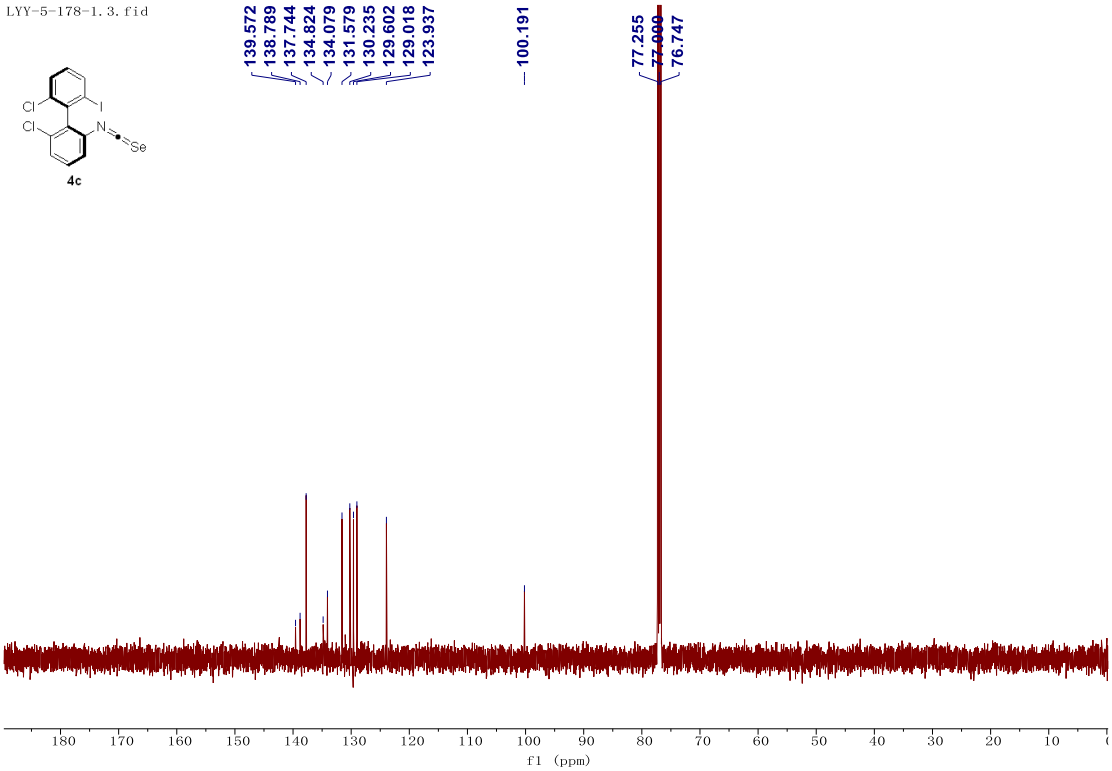
^{1}H NMR spectra of **4b**



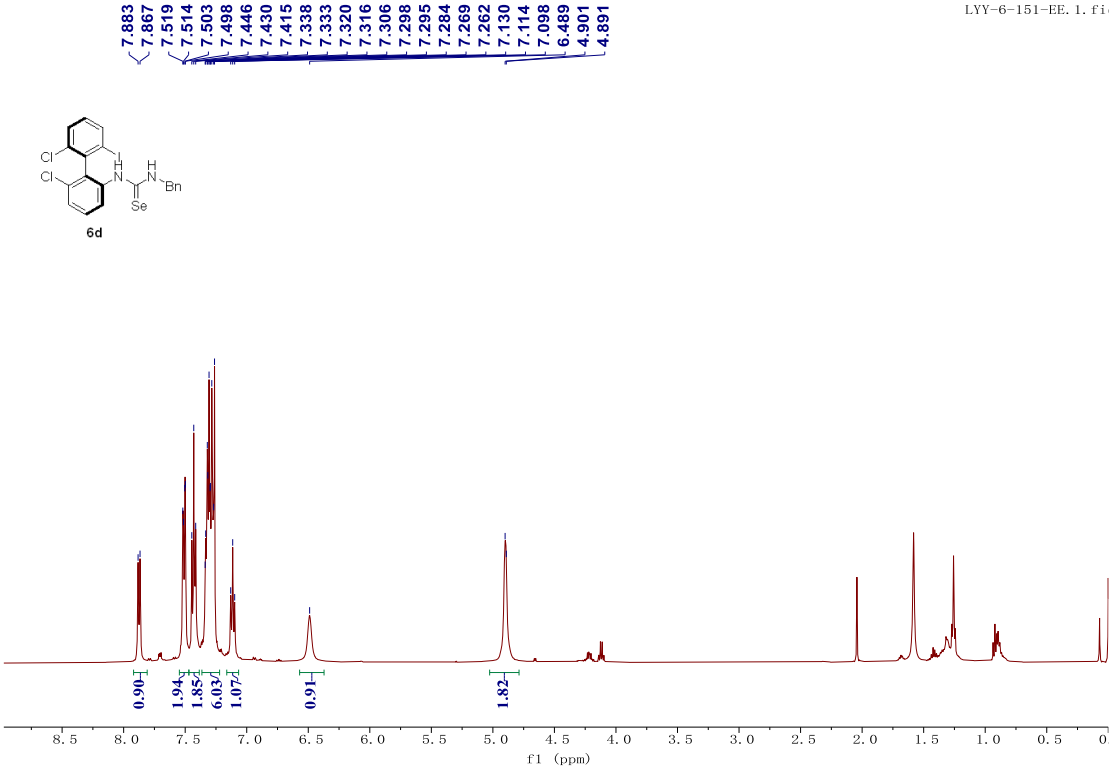
^{13}C NMR spectra of **4b**



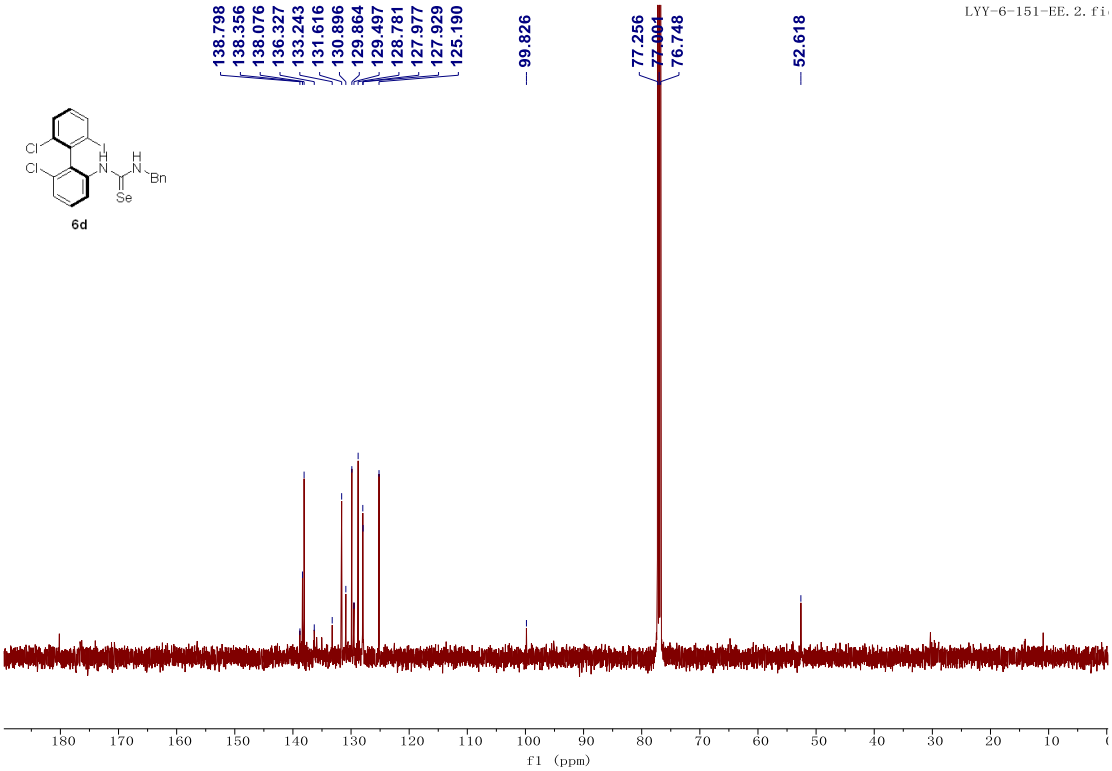
^{1}H NMR spectra of **4c**



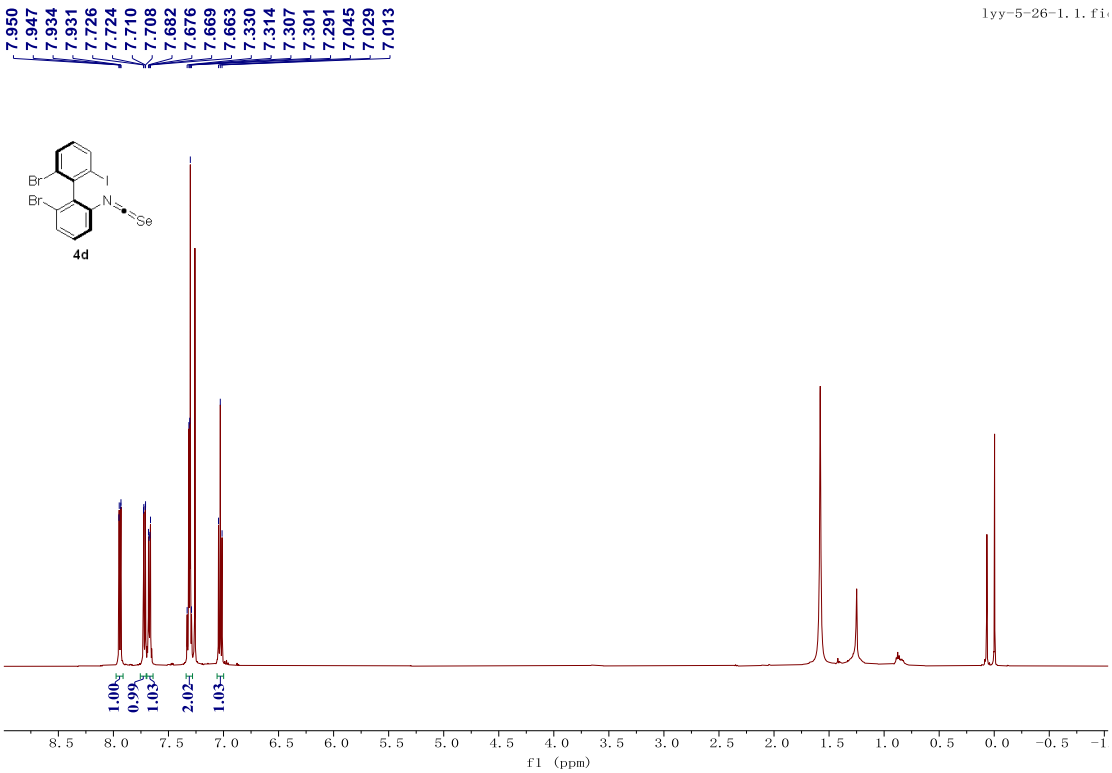
^{13}C NMR spectra of **4c**



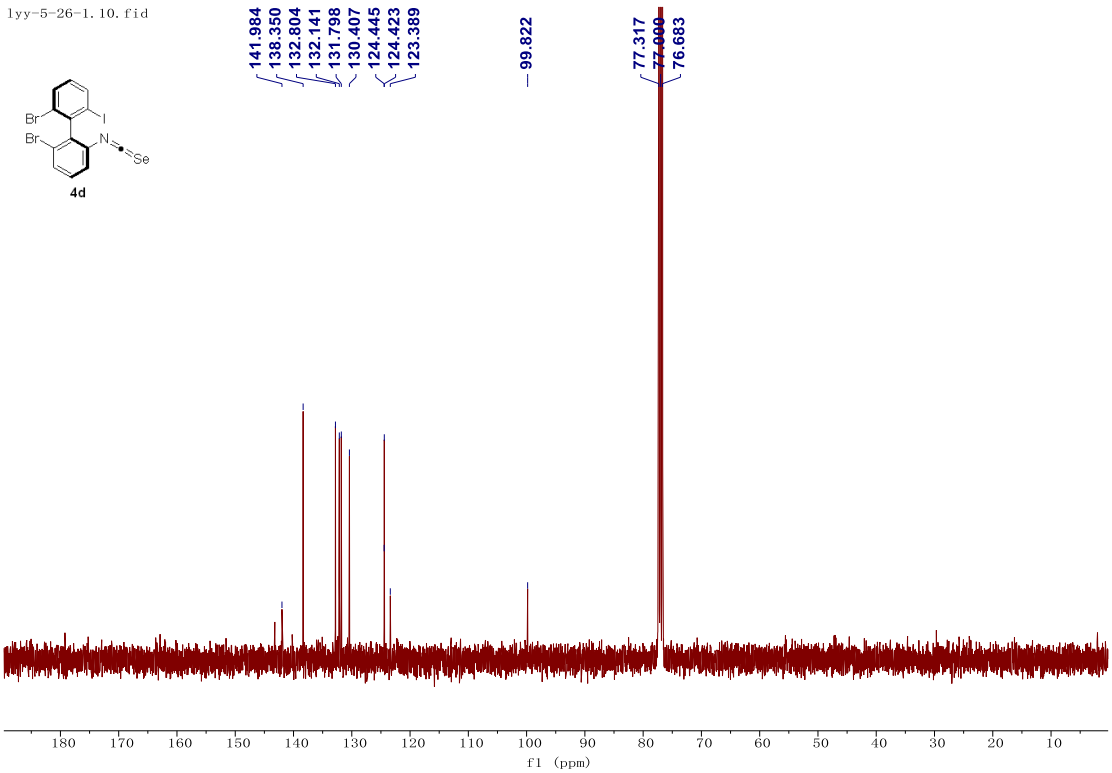
^{1}H NMR spectra of **6d**



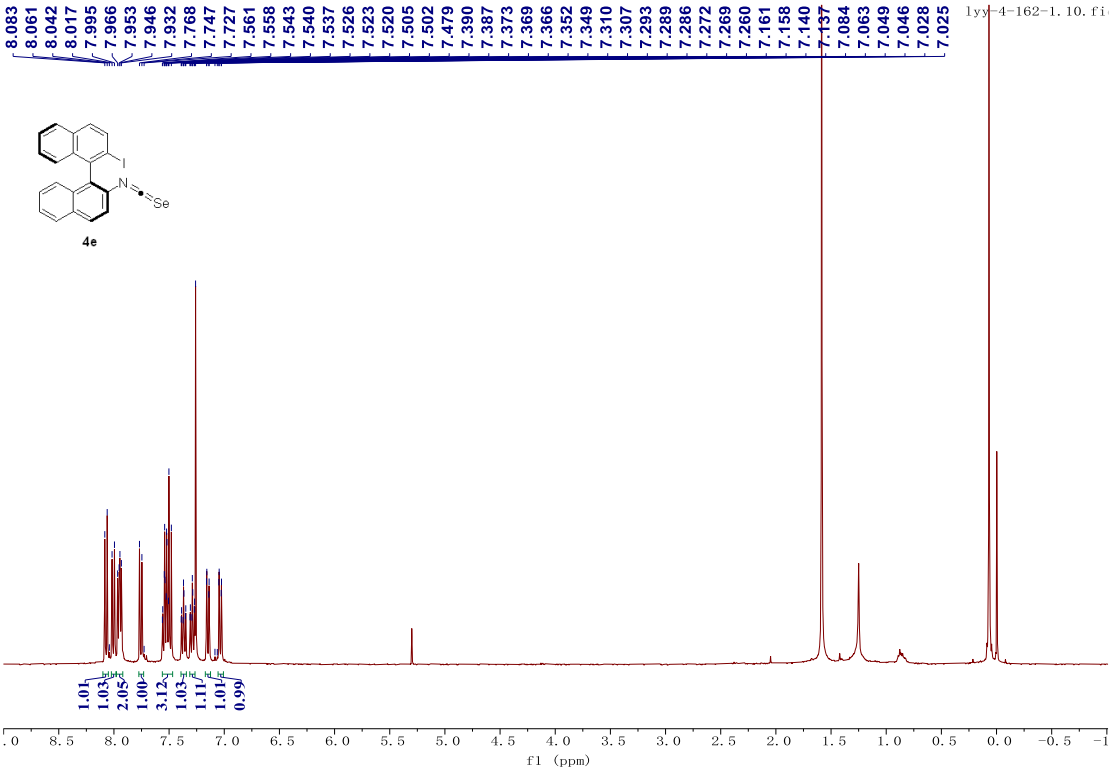
^{13}C NMR spectra of **6d**



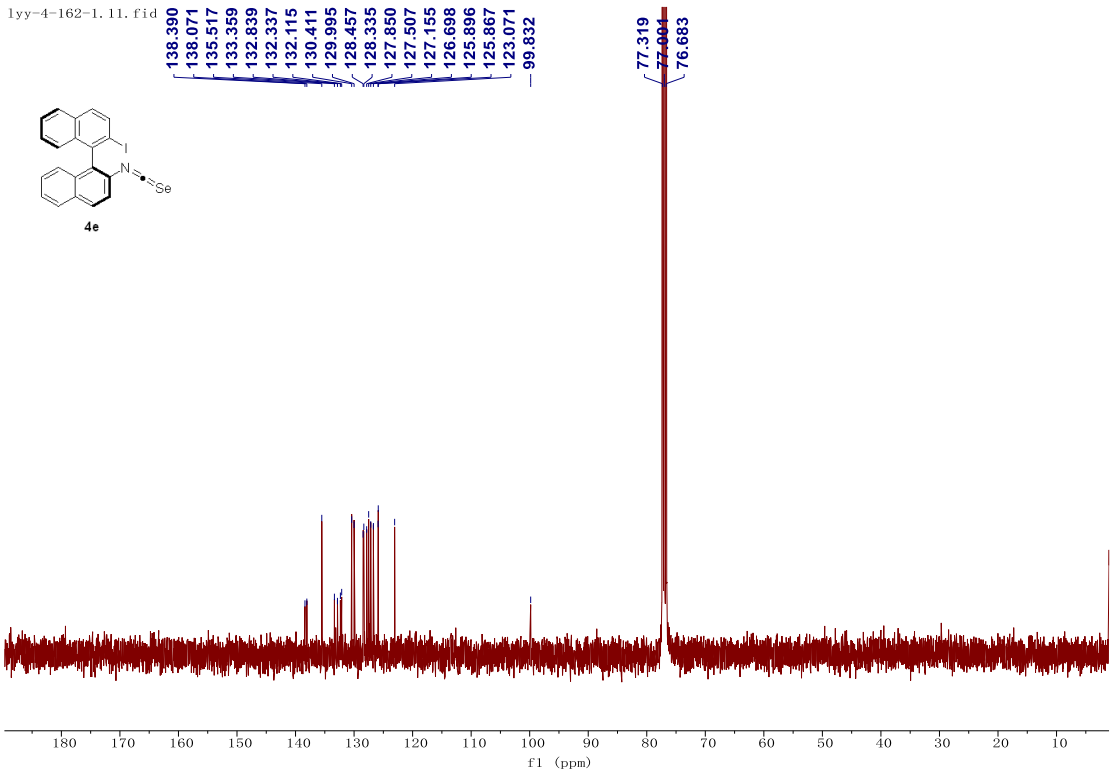
^{1}H NMR spectra of **4d**



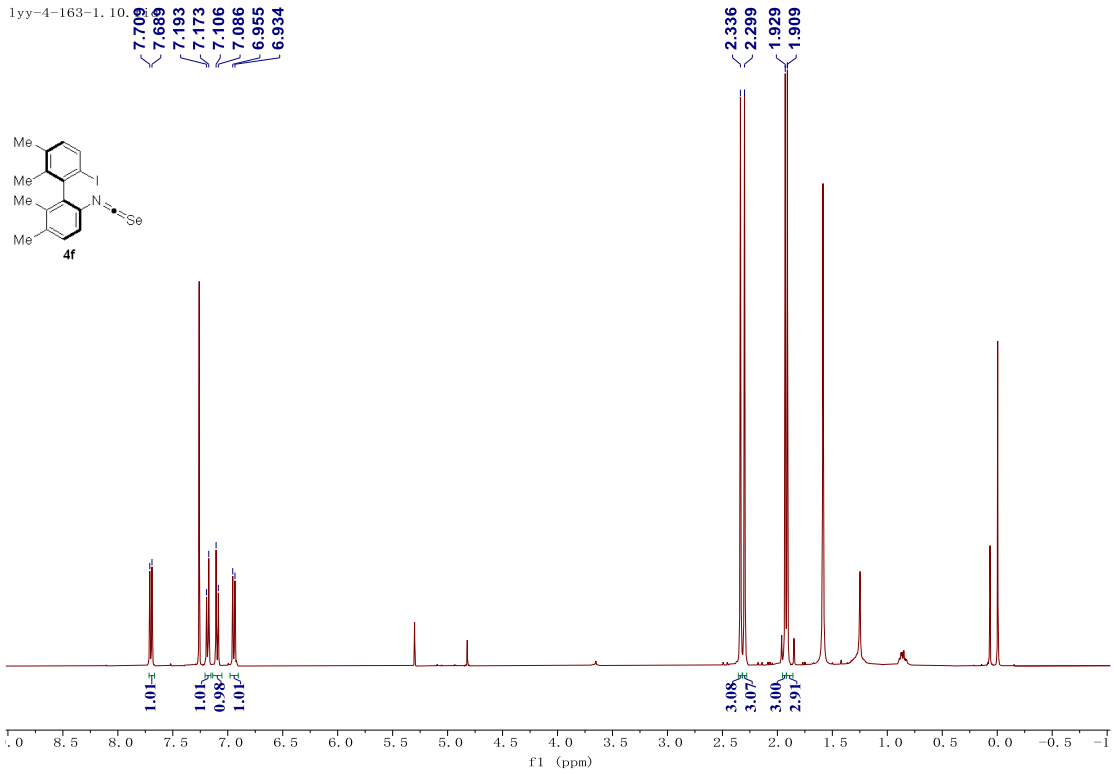
^{13}C NMR spectra of **4d**



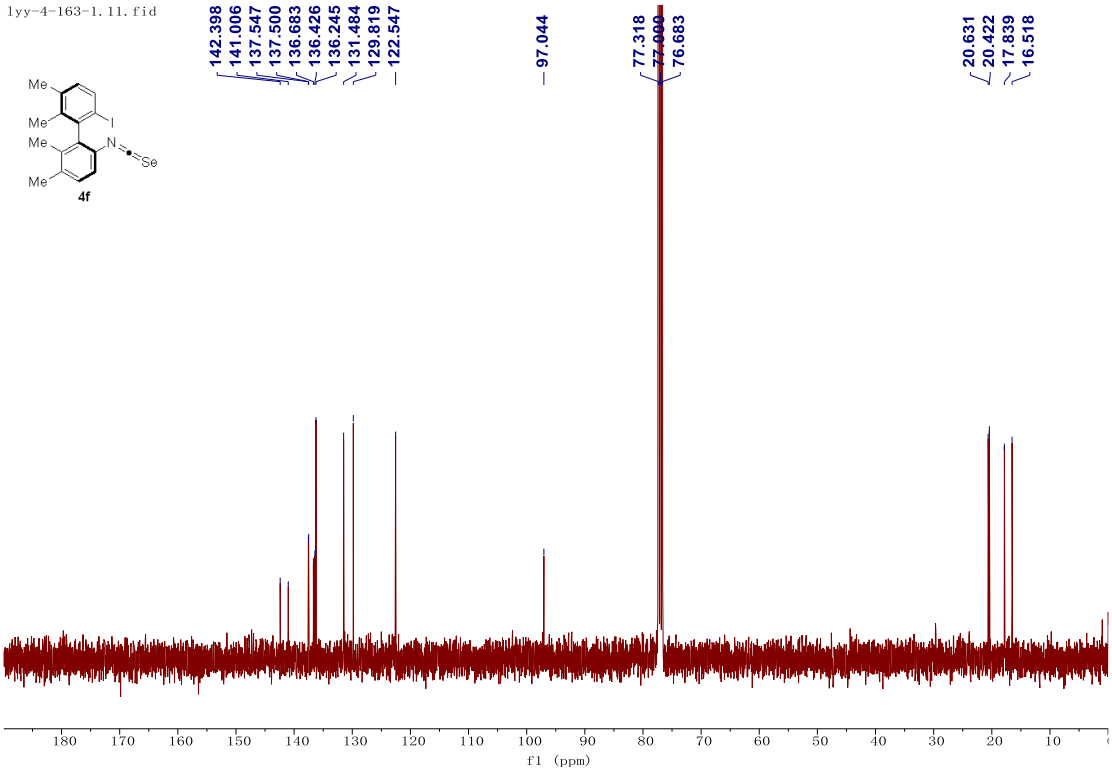
^{1}H NMR spectra of **4e**



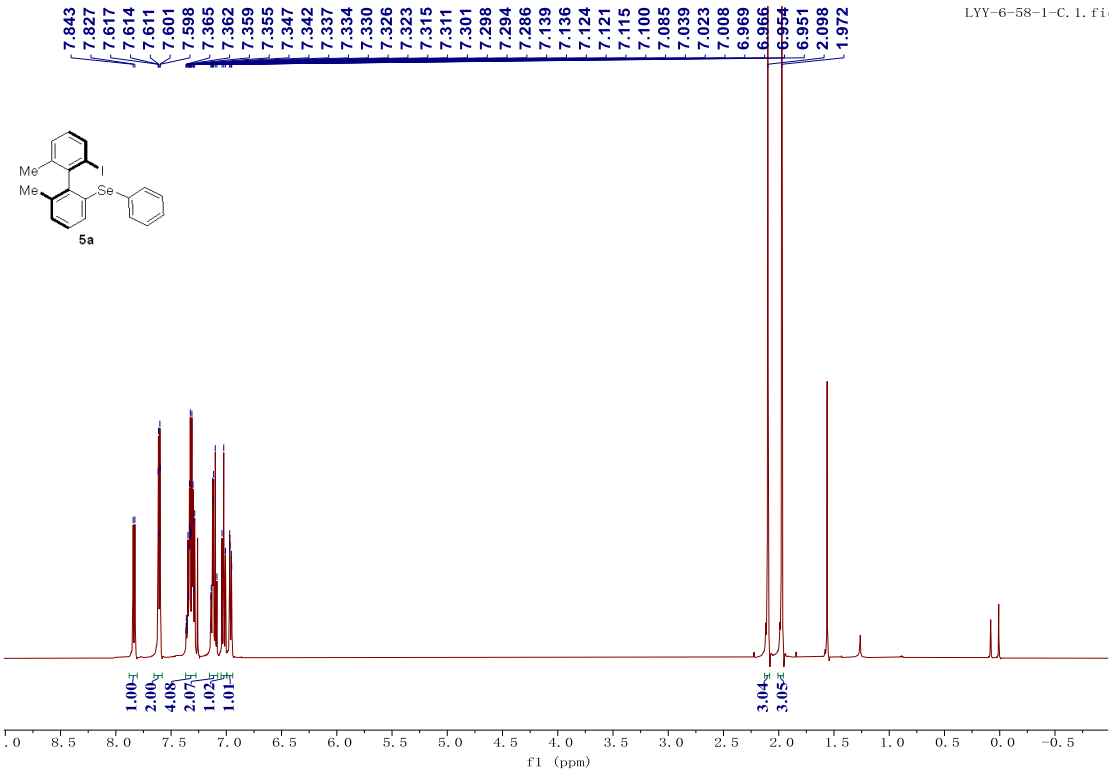
^{13}C NMR spectra of **4e**



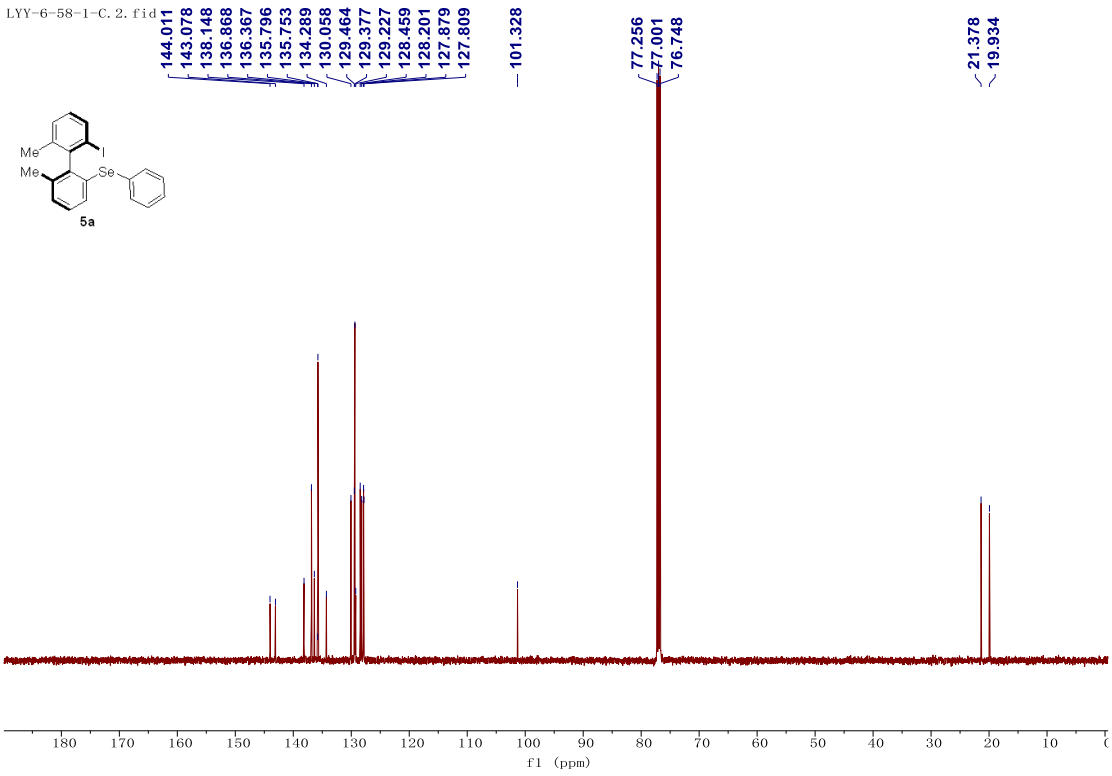
^{1}H NMR spectra of **4f**



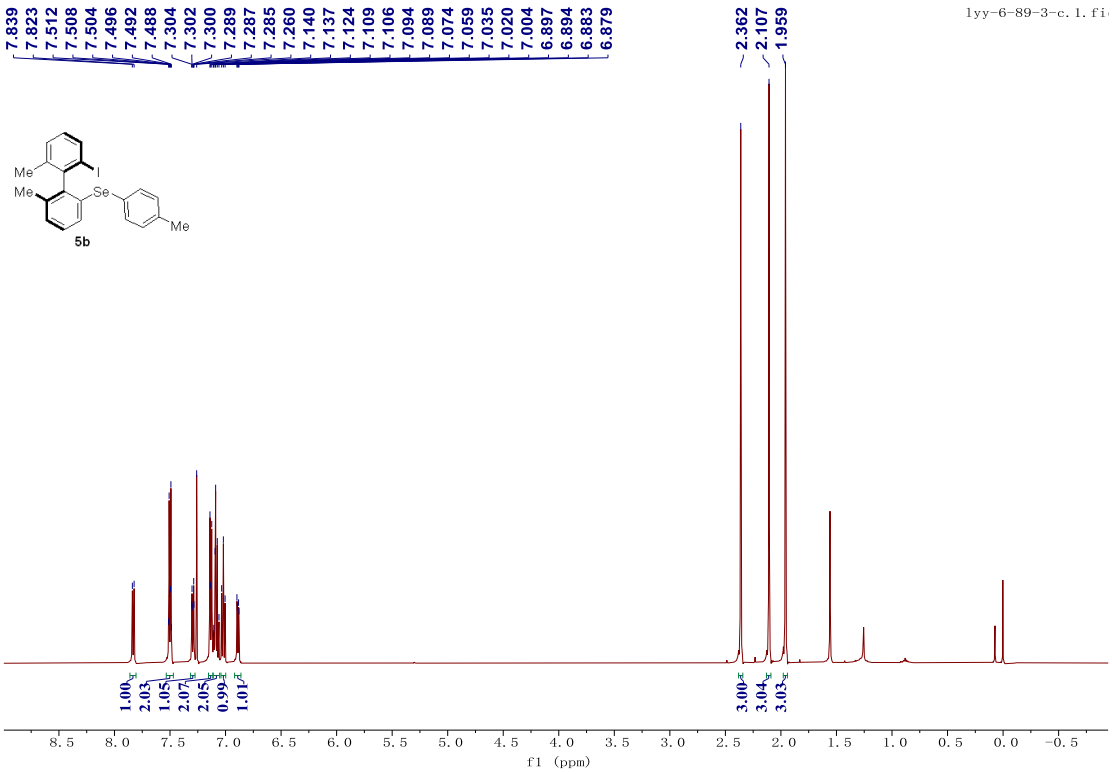
^{13}C NMR spectra of **4f**



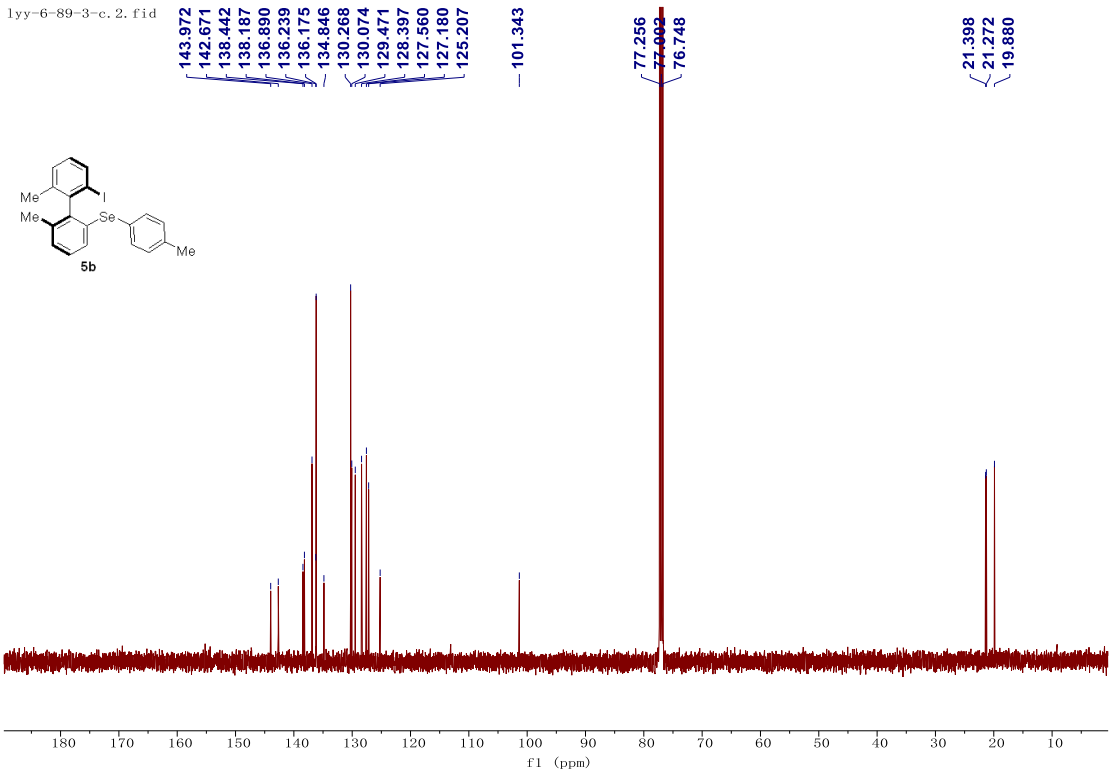
^{1}H NMR spectra of **5a**



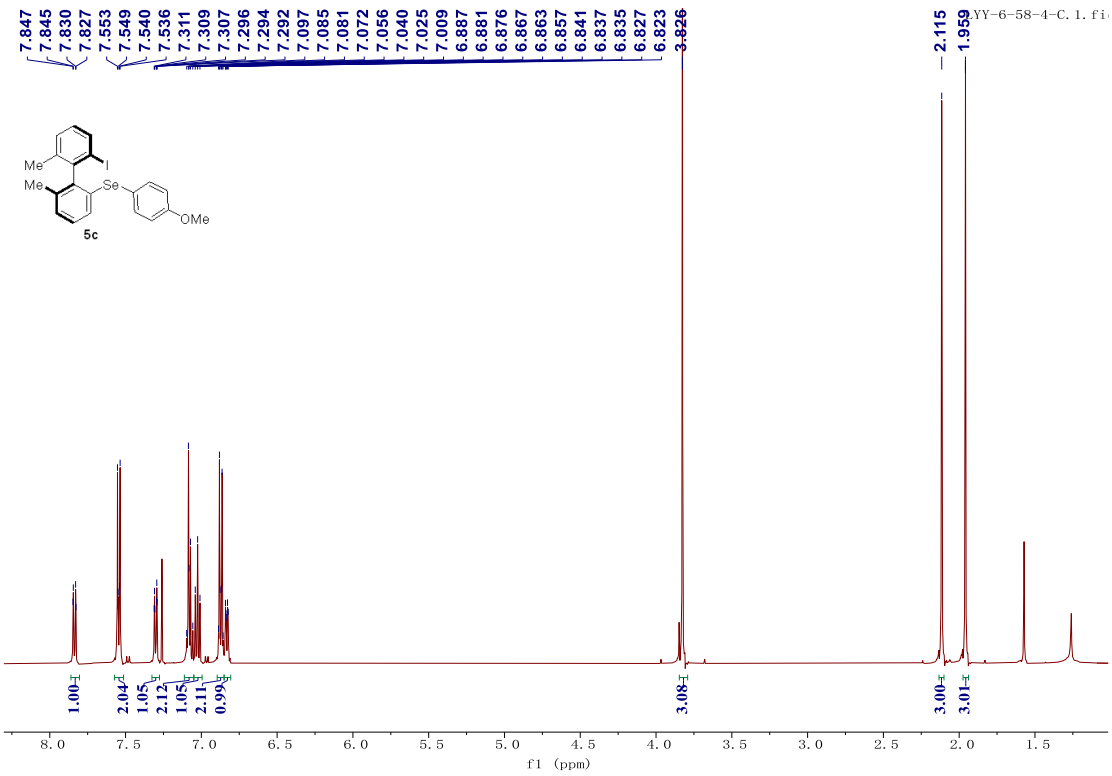
^{13}C NMR spectra of **5a**



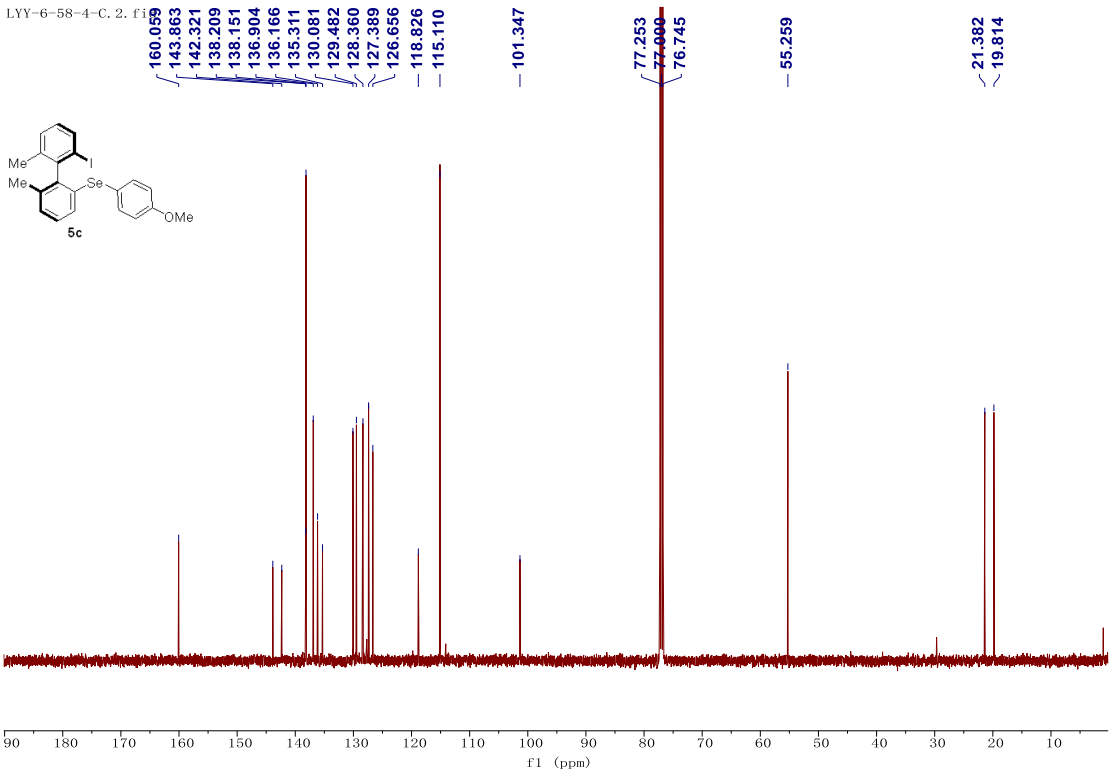
^{1}H NMR spectra of **5b**



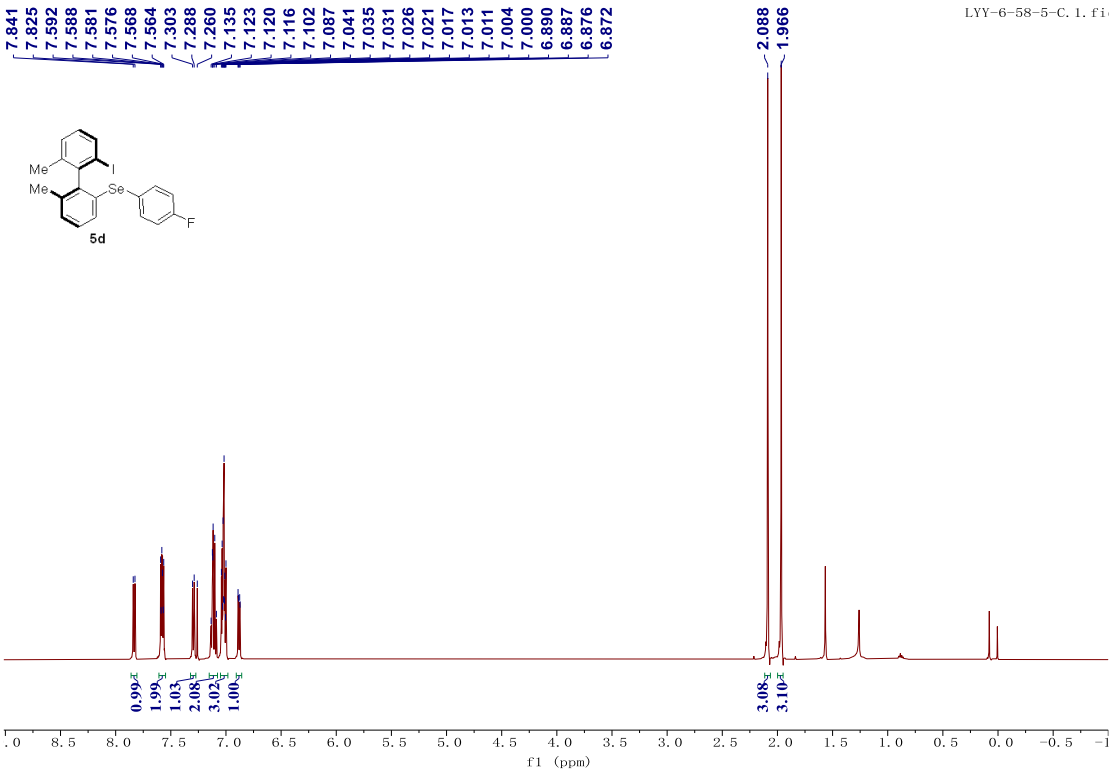
^{13}C NMR spectra of **5b**



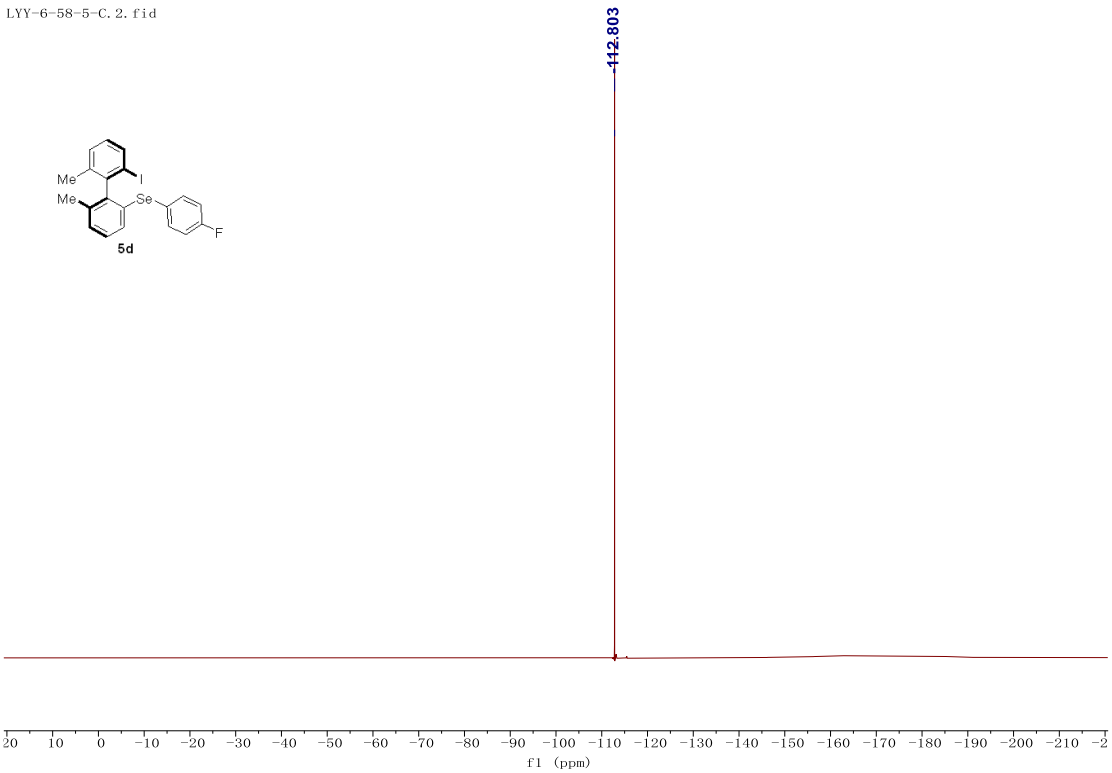
^{1}H NMR spectra of **5c**



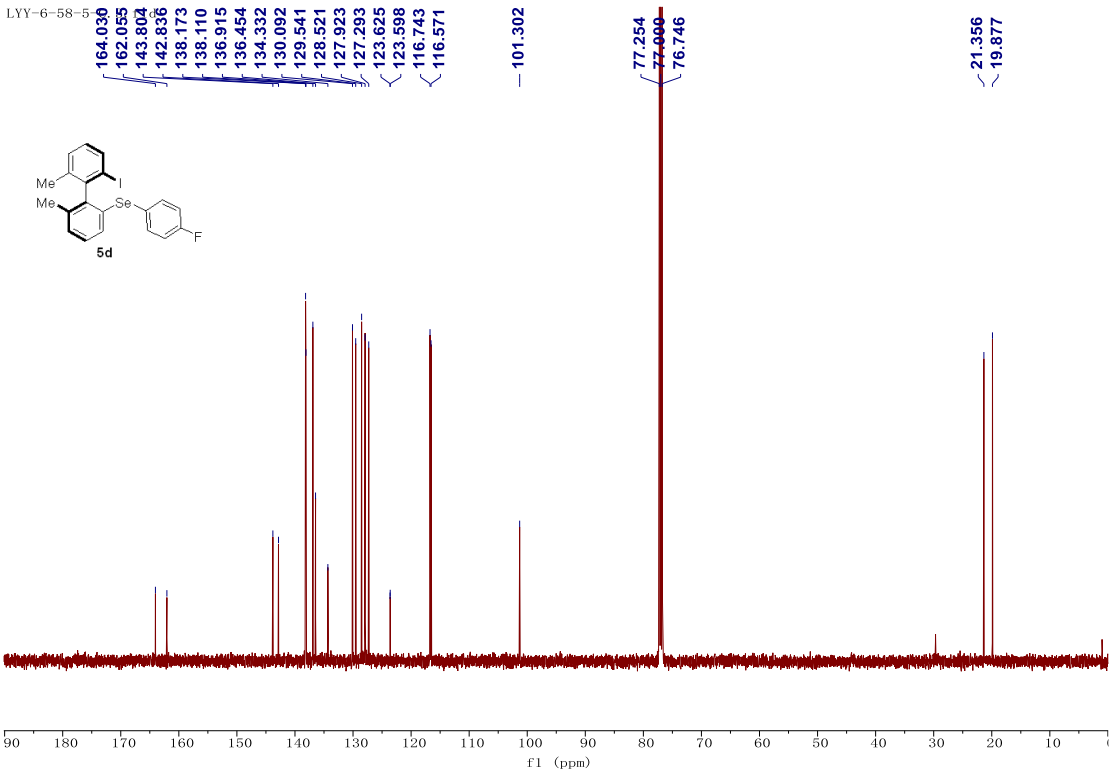
^{13}C NMR spectra of **5c**



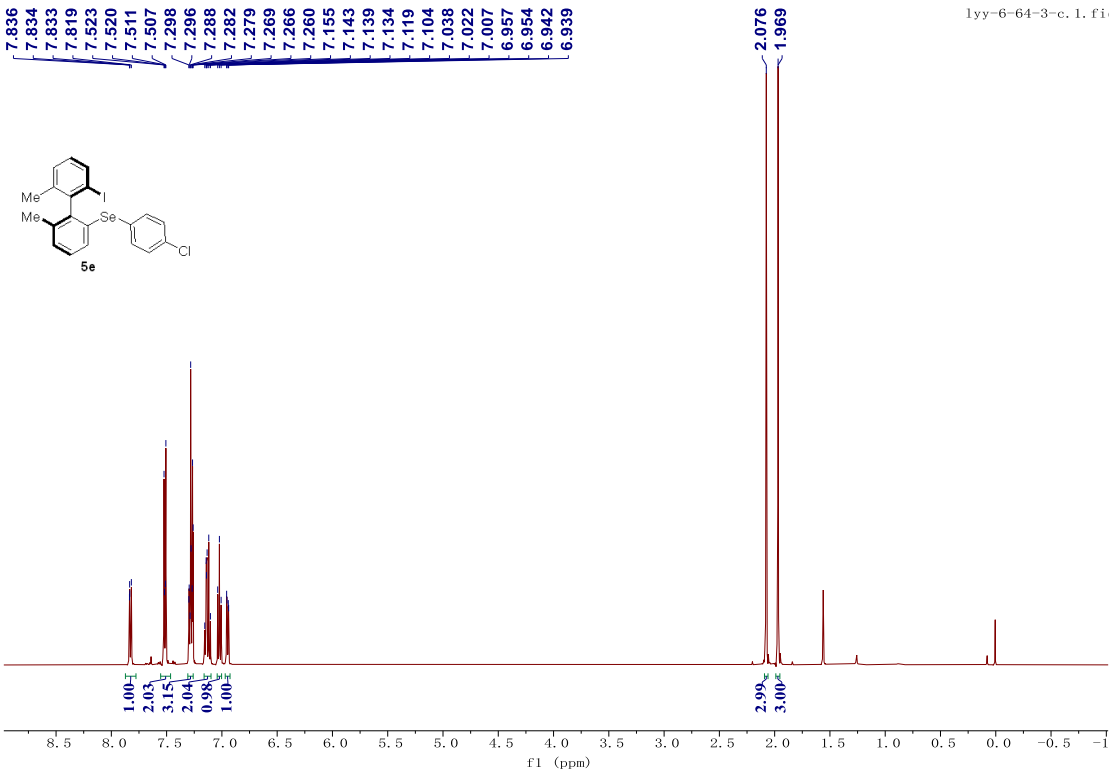
^{1}H NMR spectra of **5d**



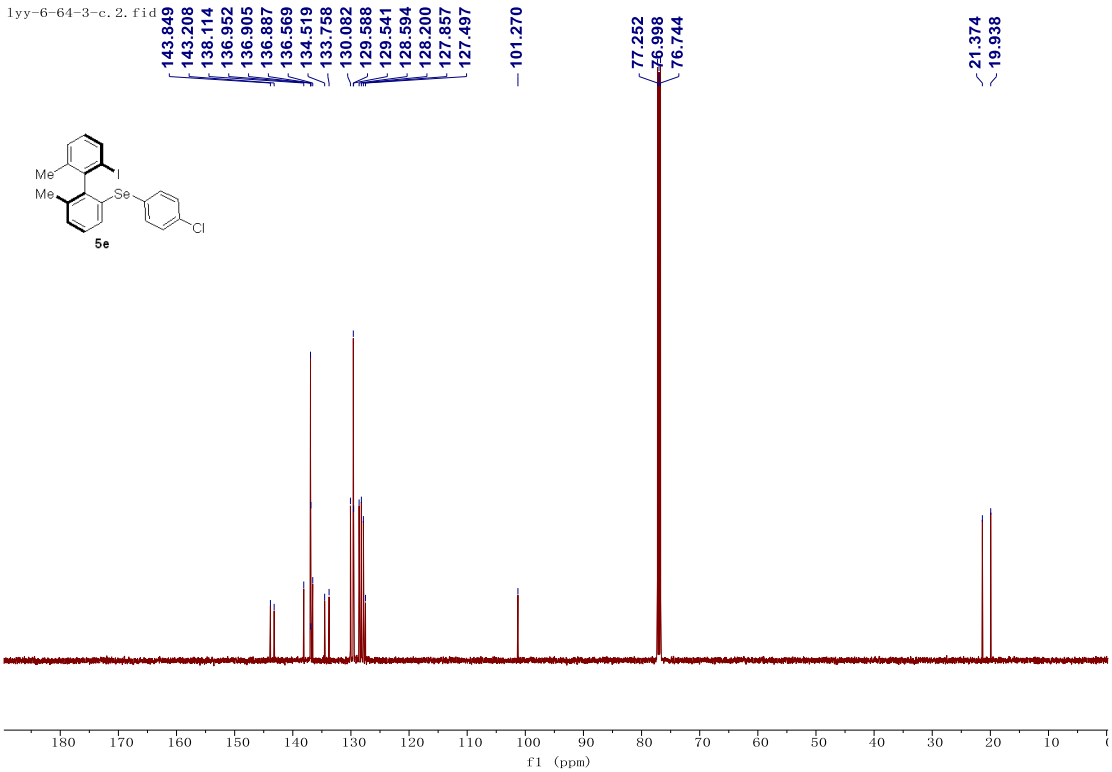
^{19}F NMR spectra of **5d**



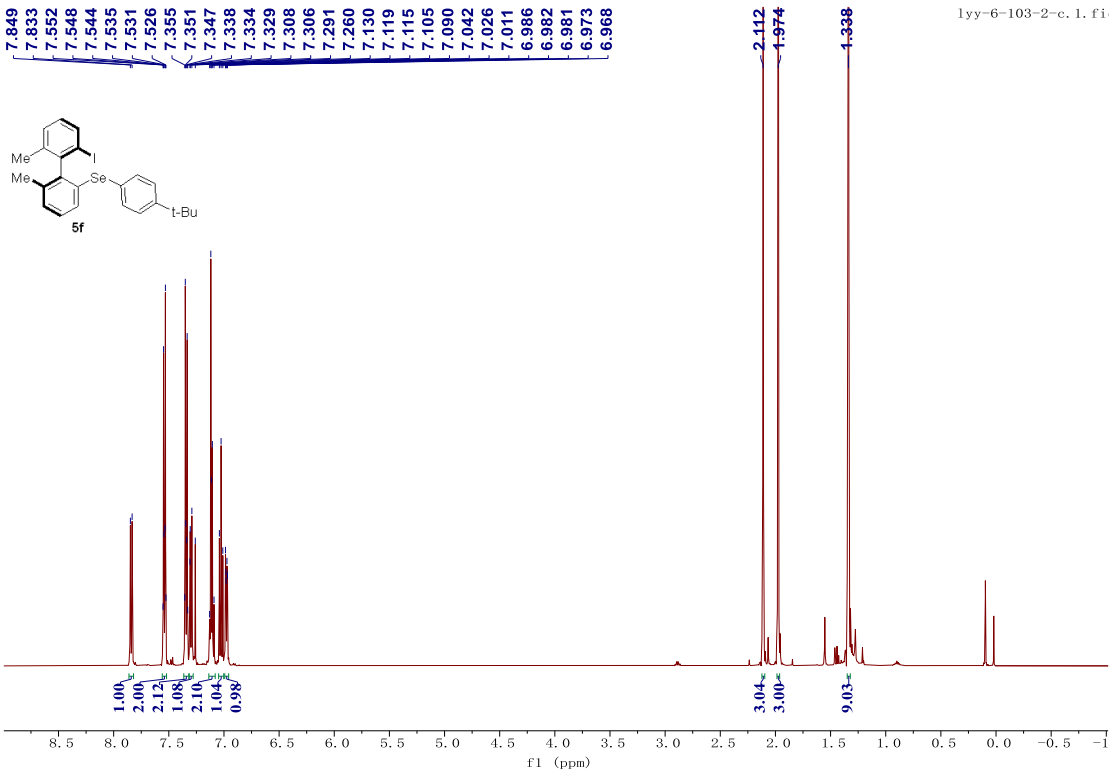
^{13}C NMR spectra of **5d**



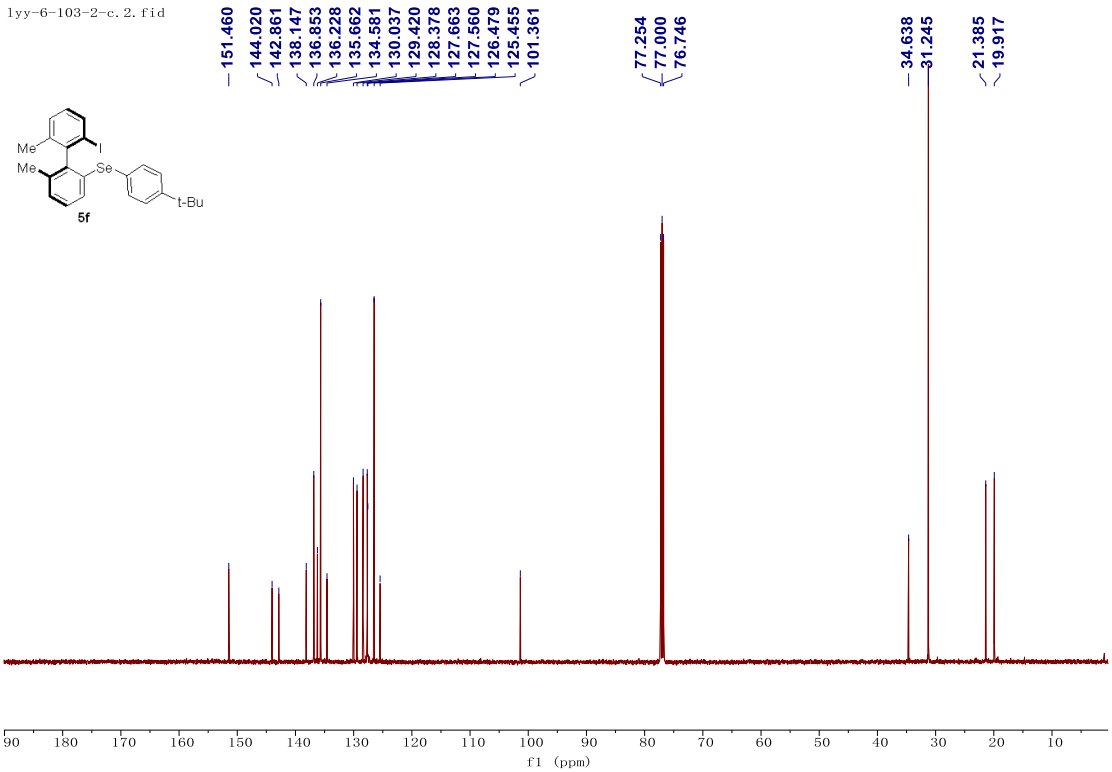
^{1}H NMR spectra of **5e**



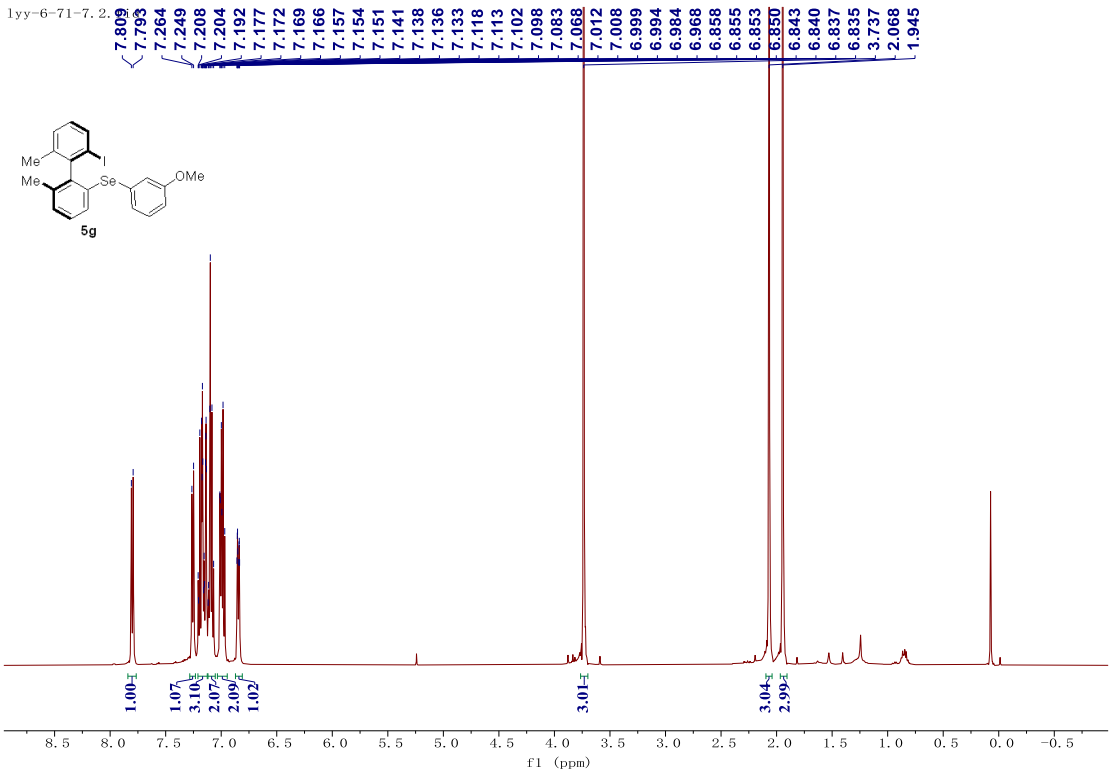
^{13}C NMR spectra of **5e**



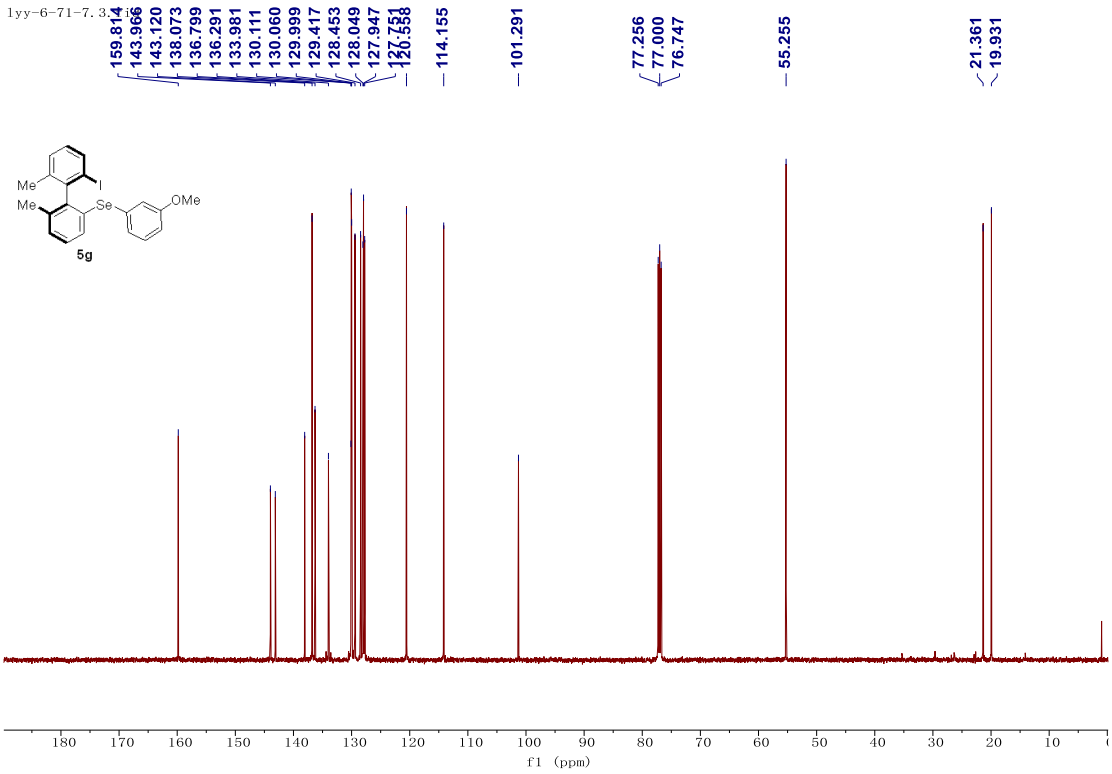
^{1}H NMR spectra of **5f**



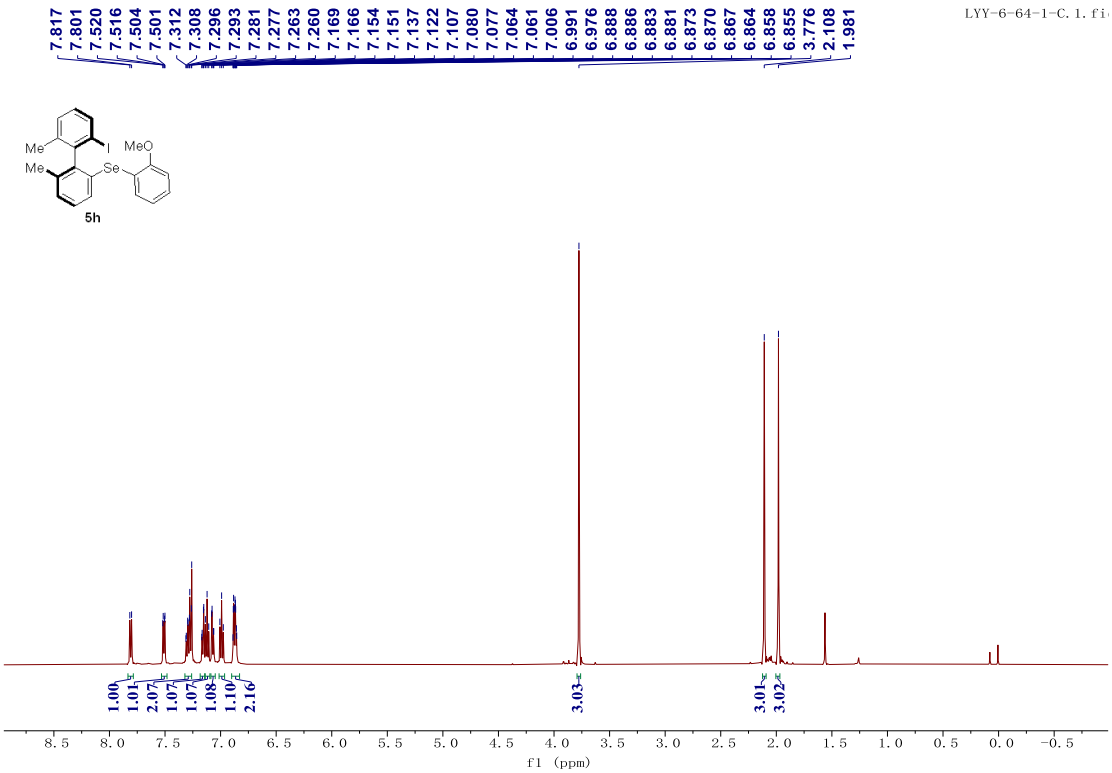
^{13}C NMR spectra of **5f**



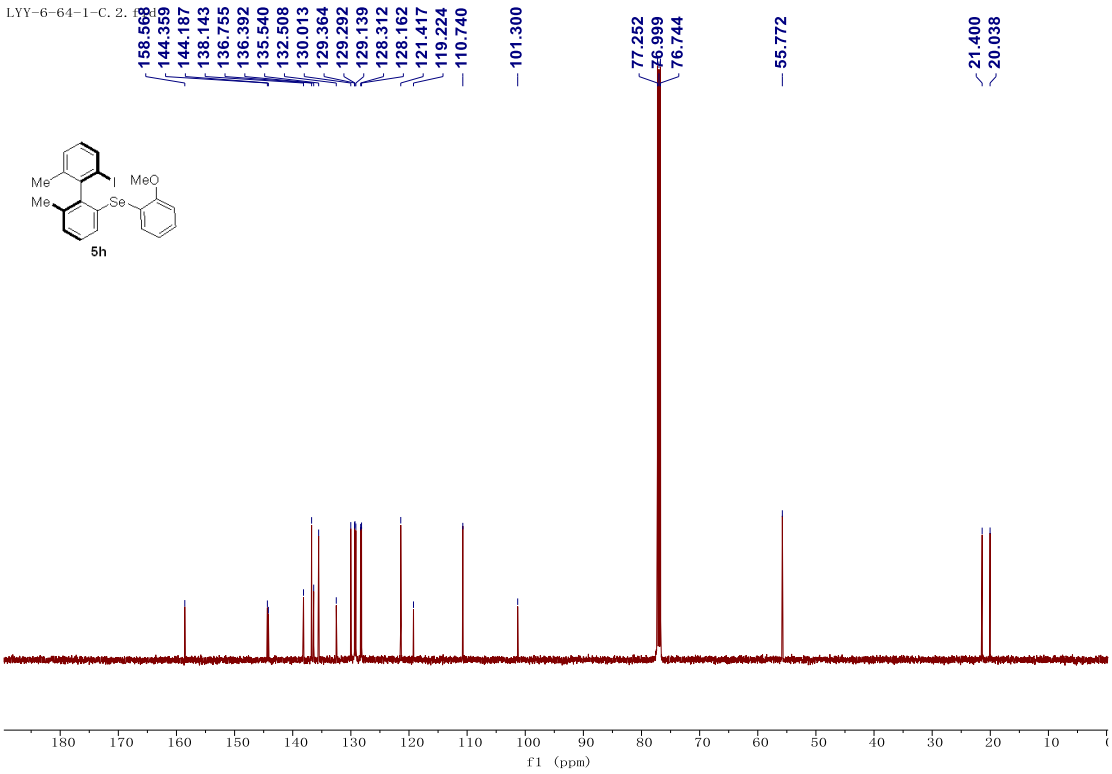
^{1}H NMR spectra of **5g**



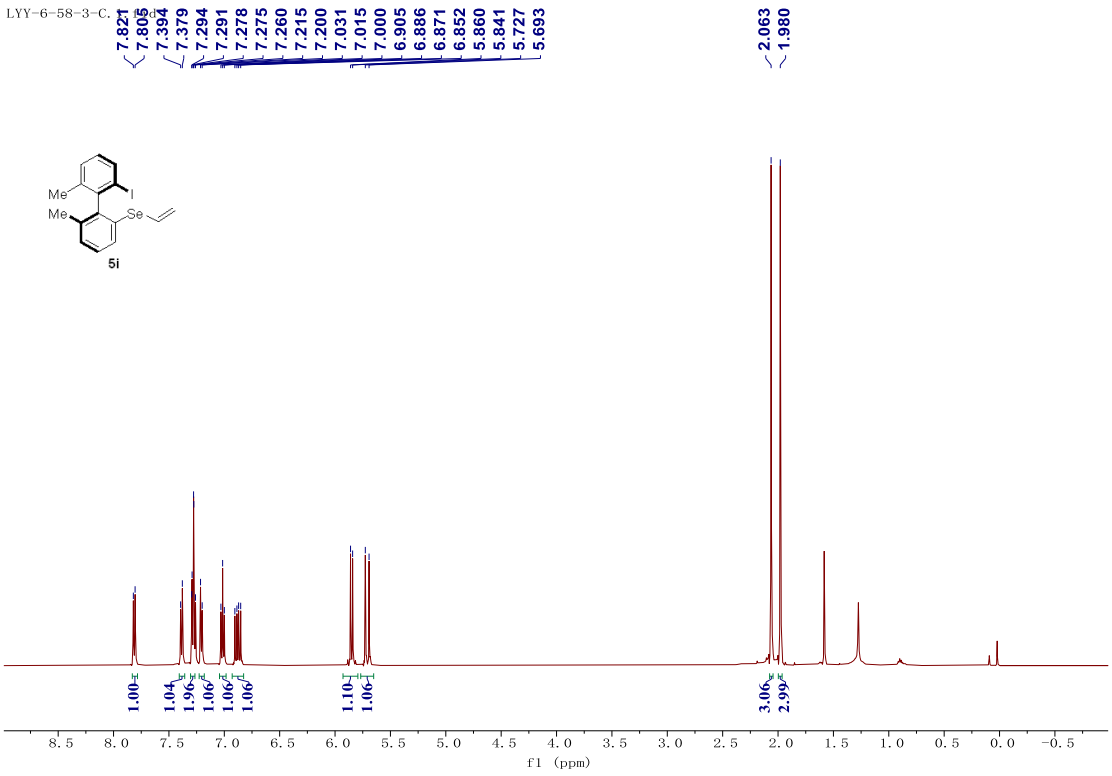
^{13}C NMR spectra of **5g**



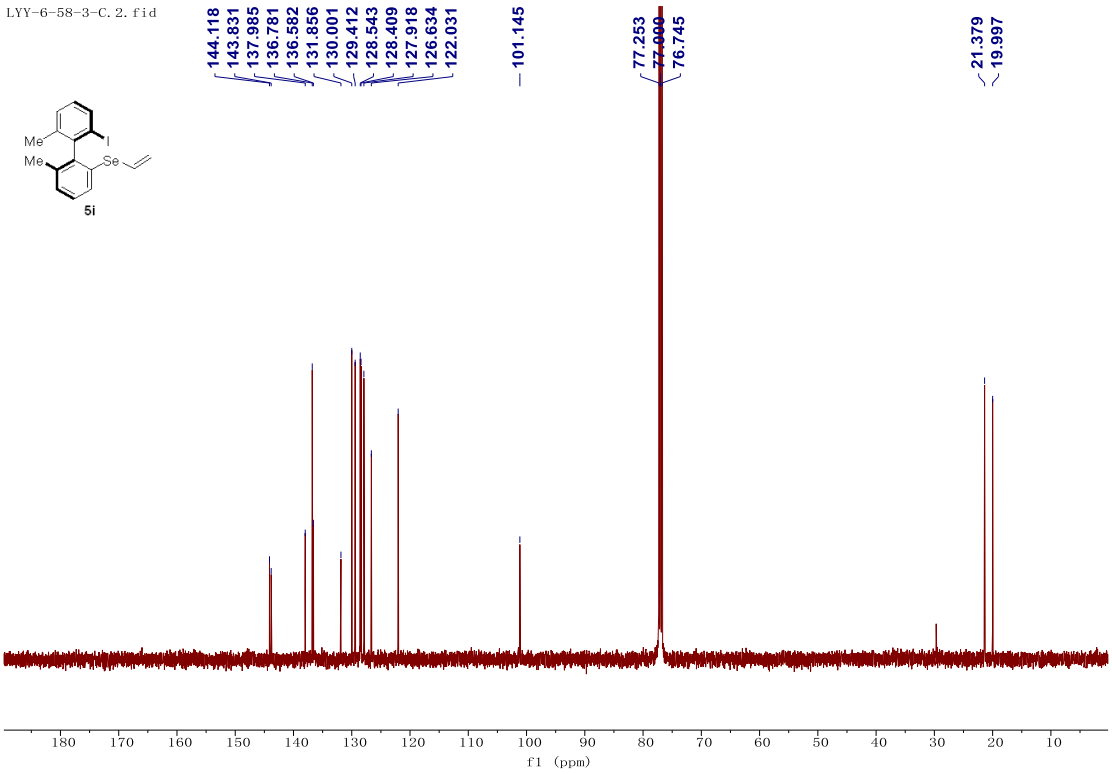
^{1}H NMR spectra of **5h**



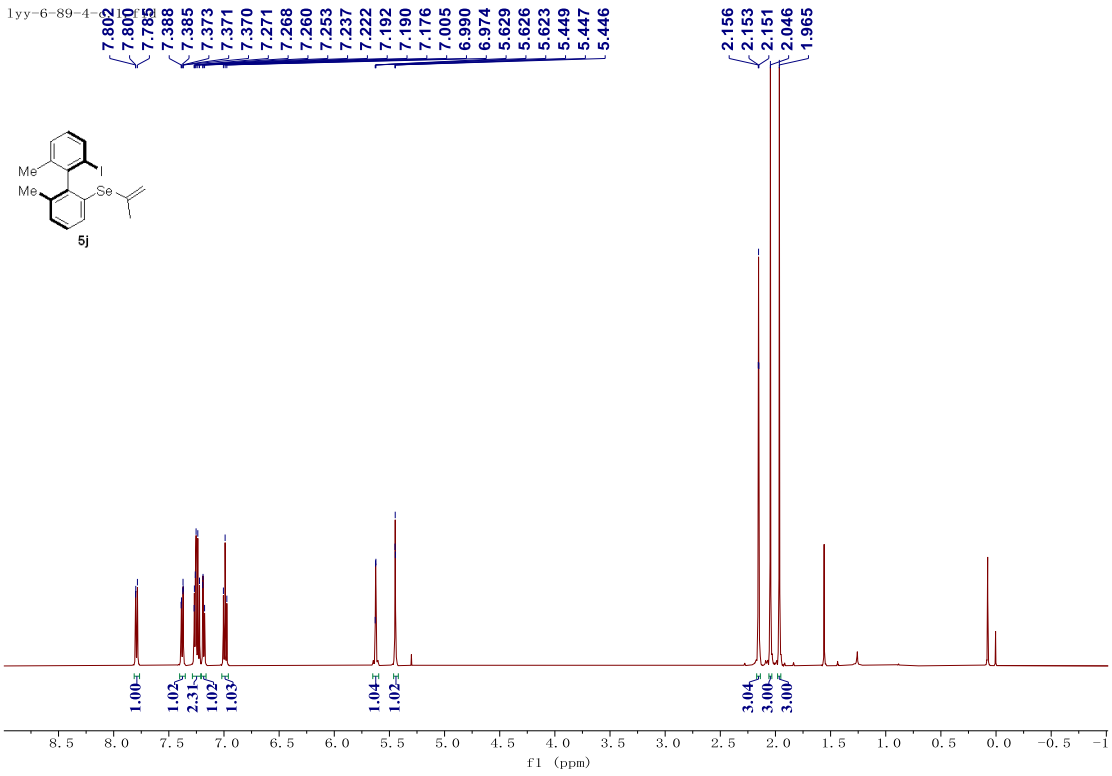
^{13}C NMR spectra of **5h**



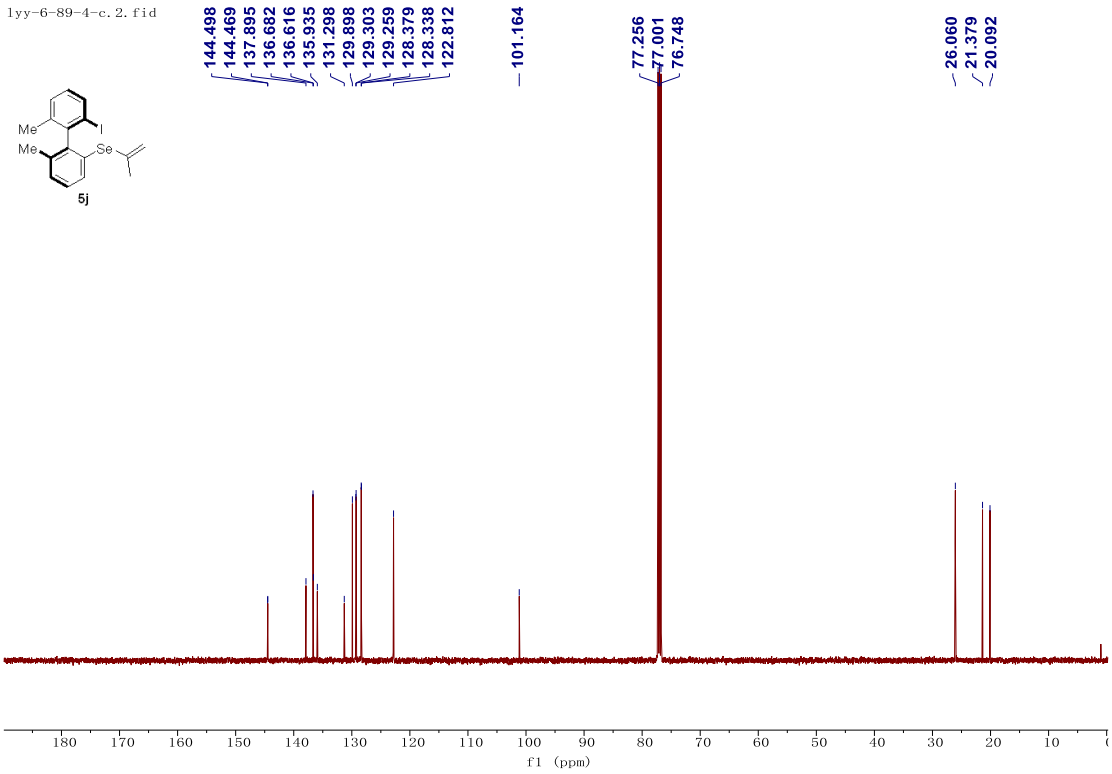
^{1}H NMR spectra of **5i**



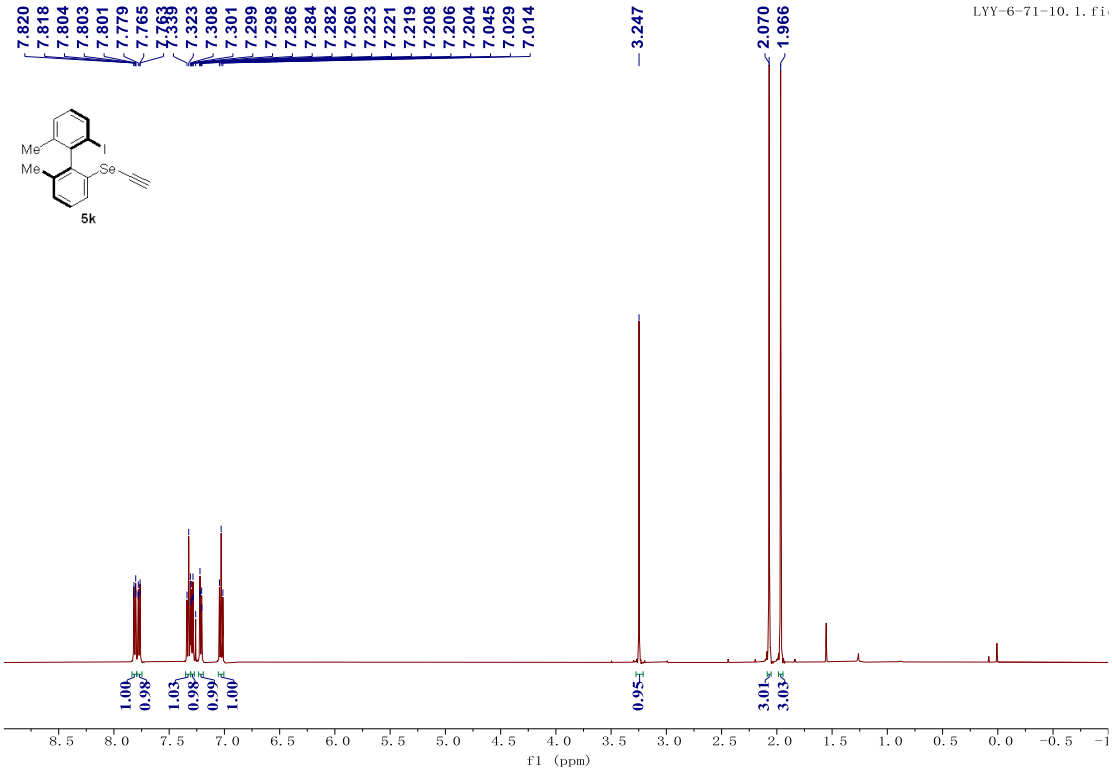
^{13}C NMR spectra of **5i**



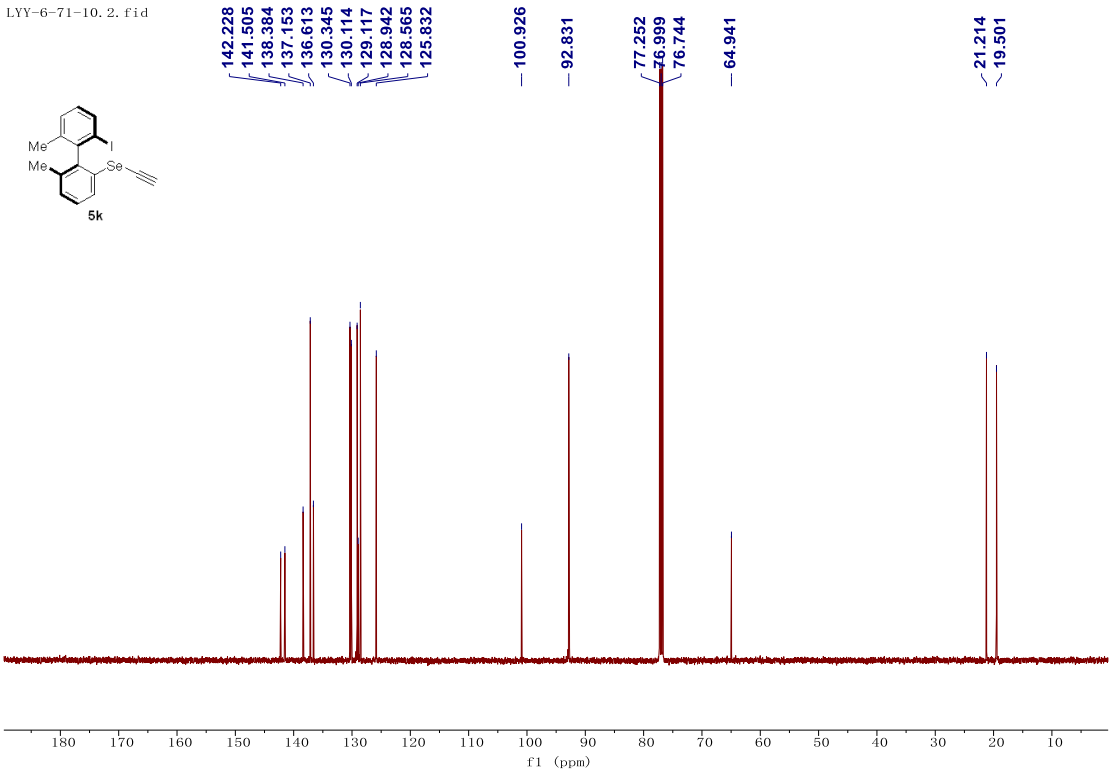
^{1}H NMR spectra of **5j**



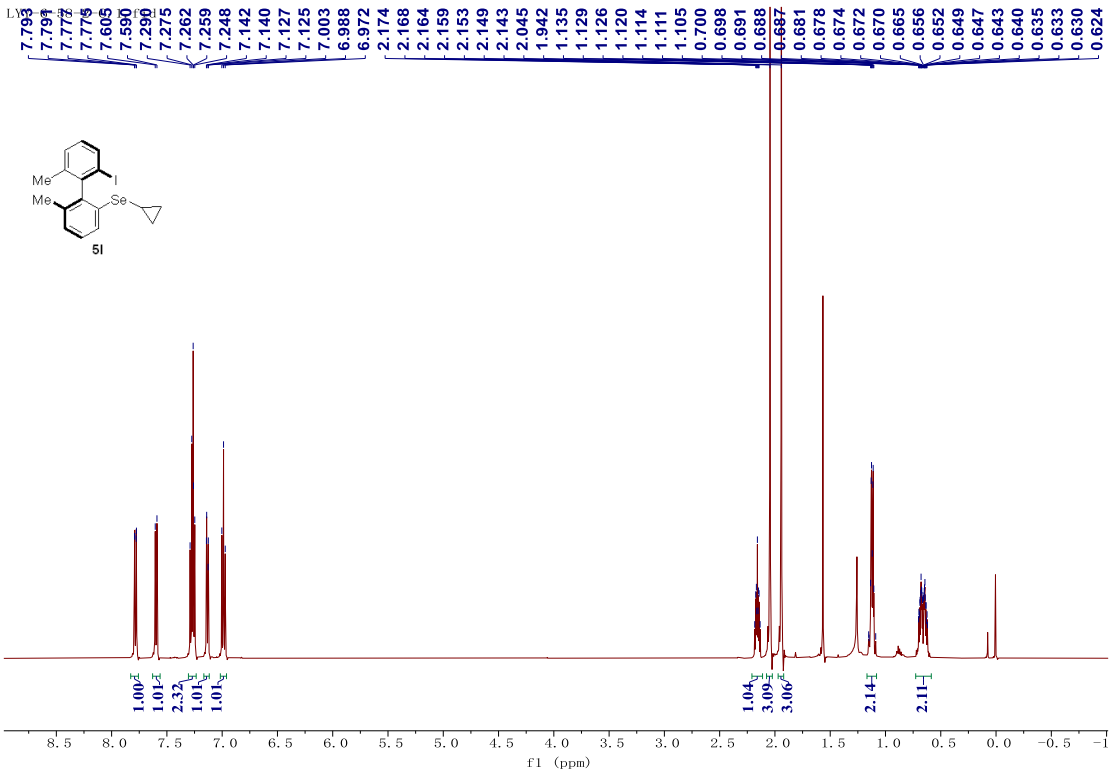
^{13}C NMR spectra of **5j**



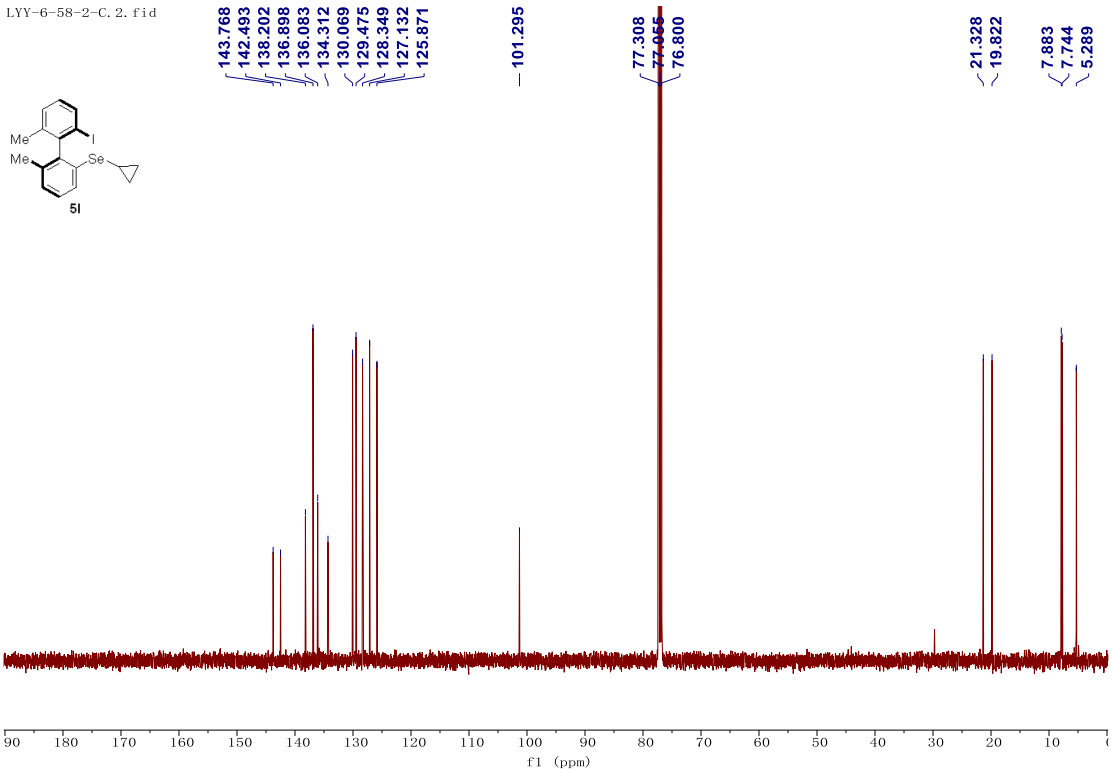
^{1}H NMR spectra of **5k**



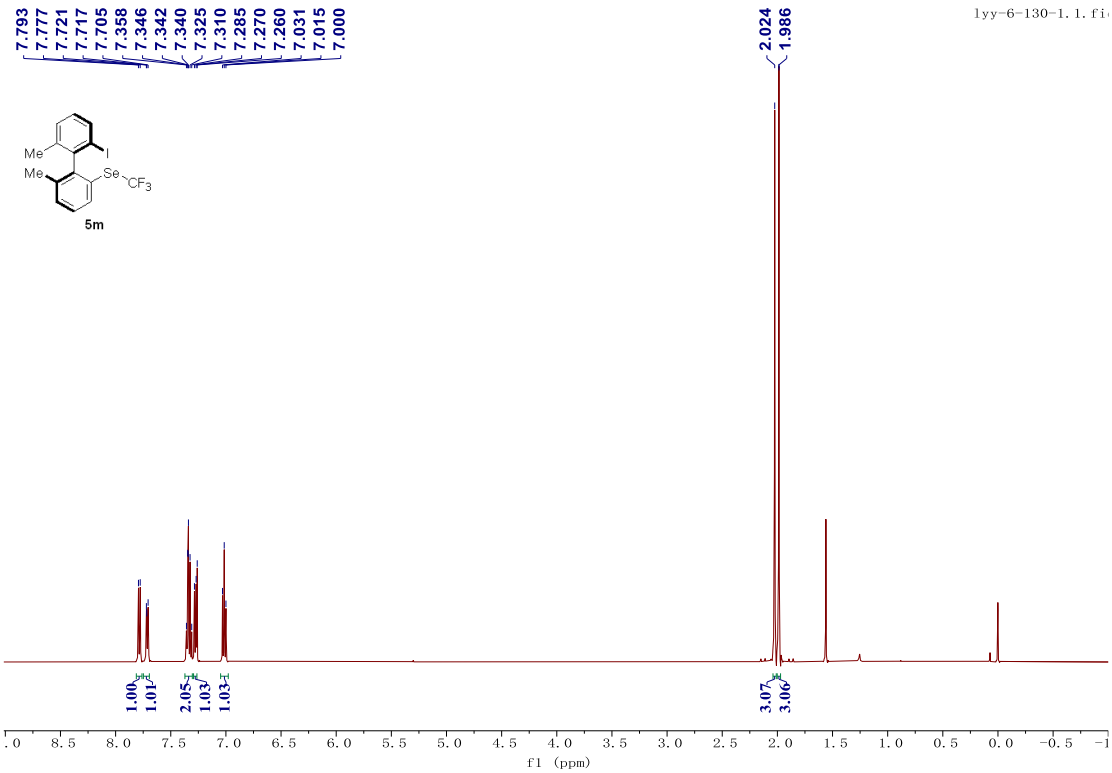
^{13}C NMR spectra of **5k**



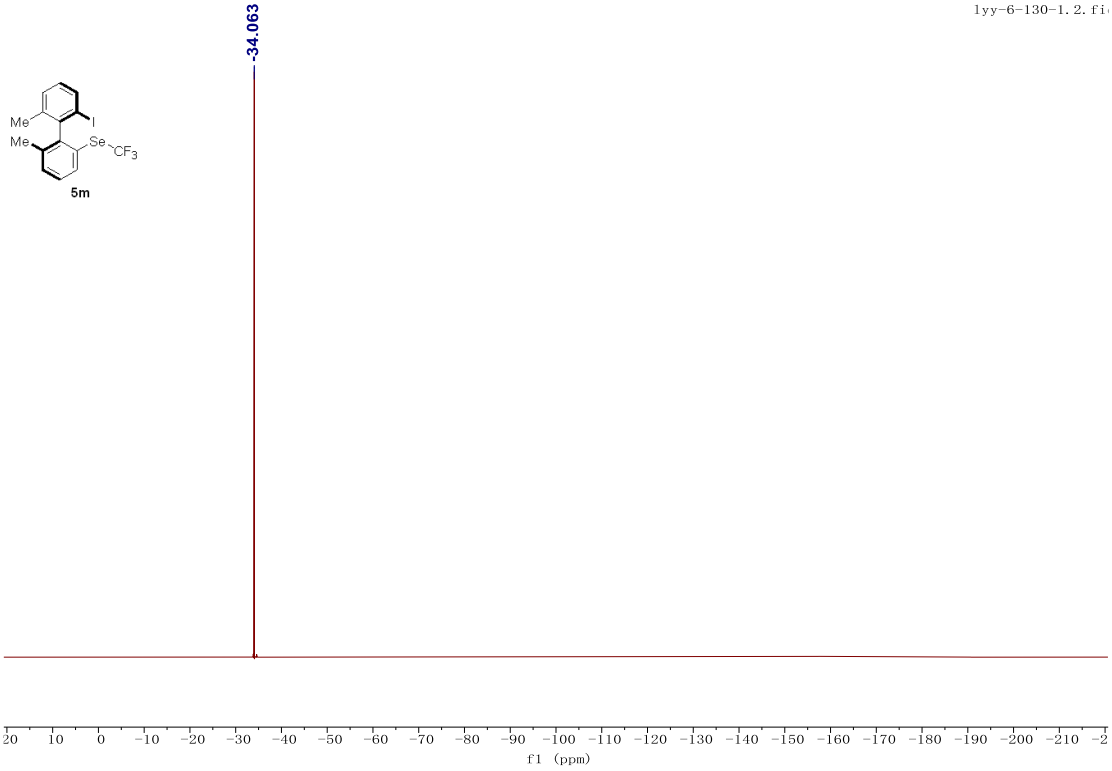
^{1}H NMR spectra of **5l**



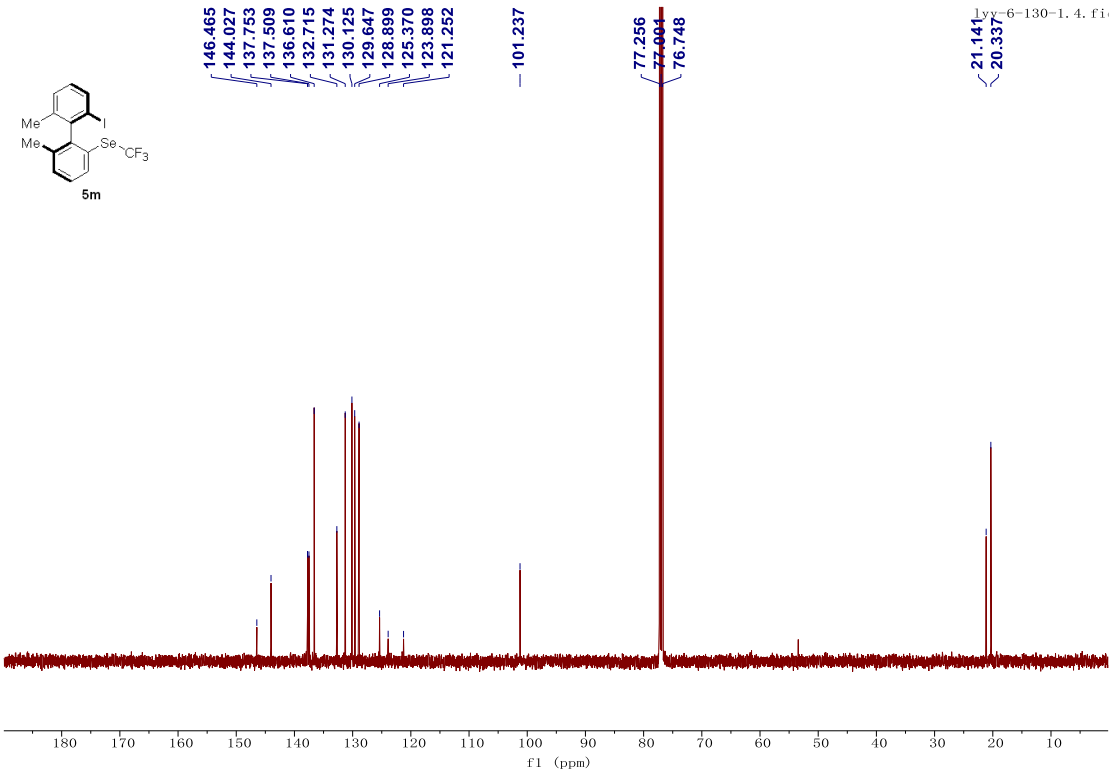
^{13}C NMR spectra of **5l**



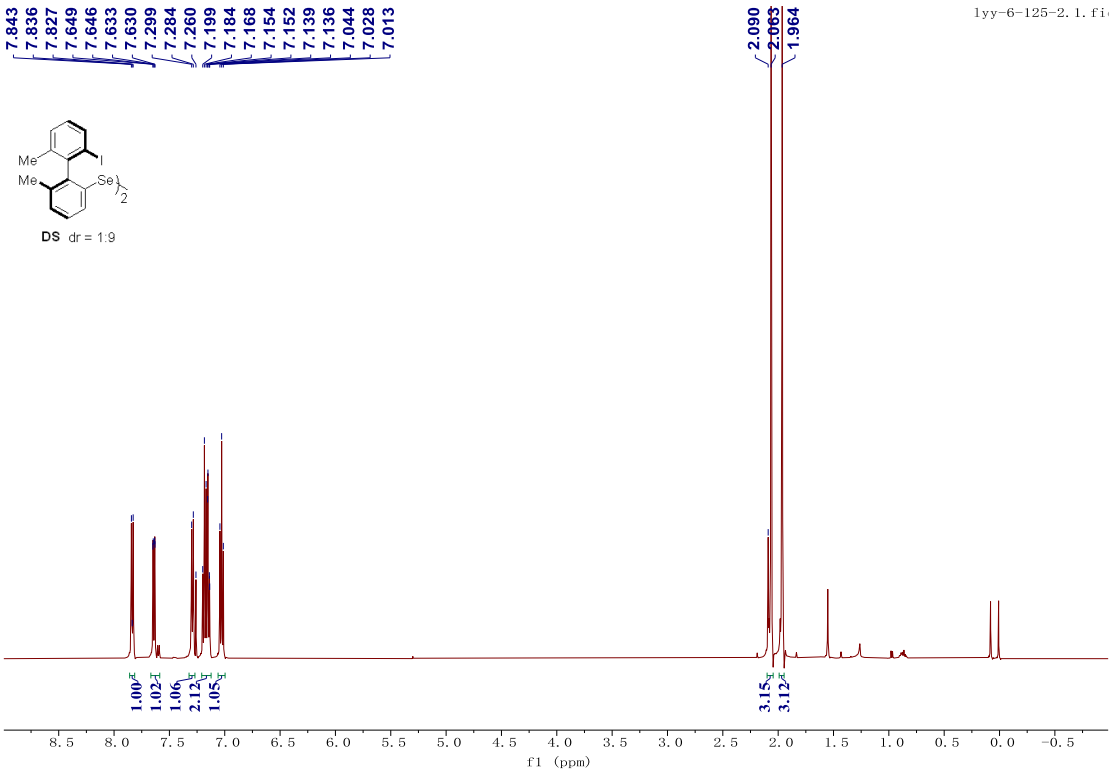
^{1}H NMR spectra of **5m**



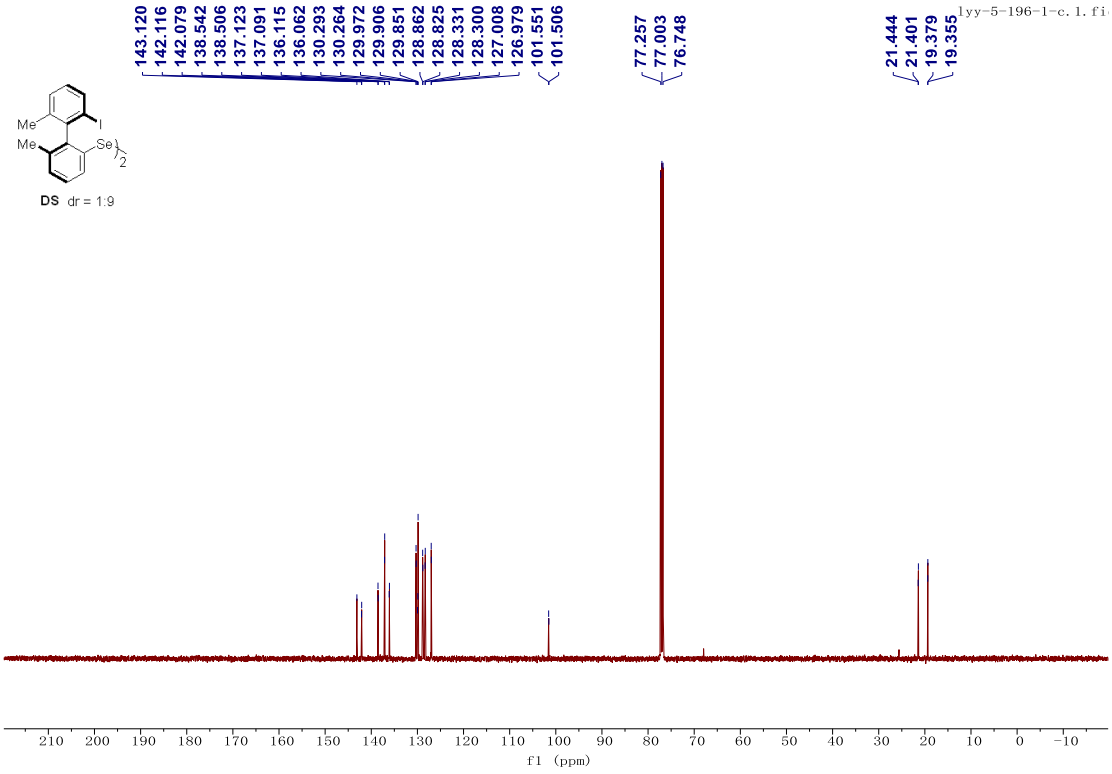
^{19}F NMR spectra of **5m**



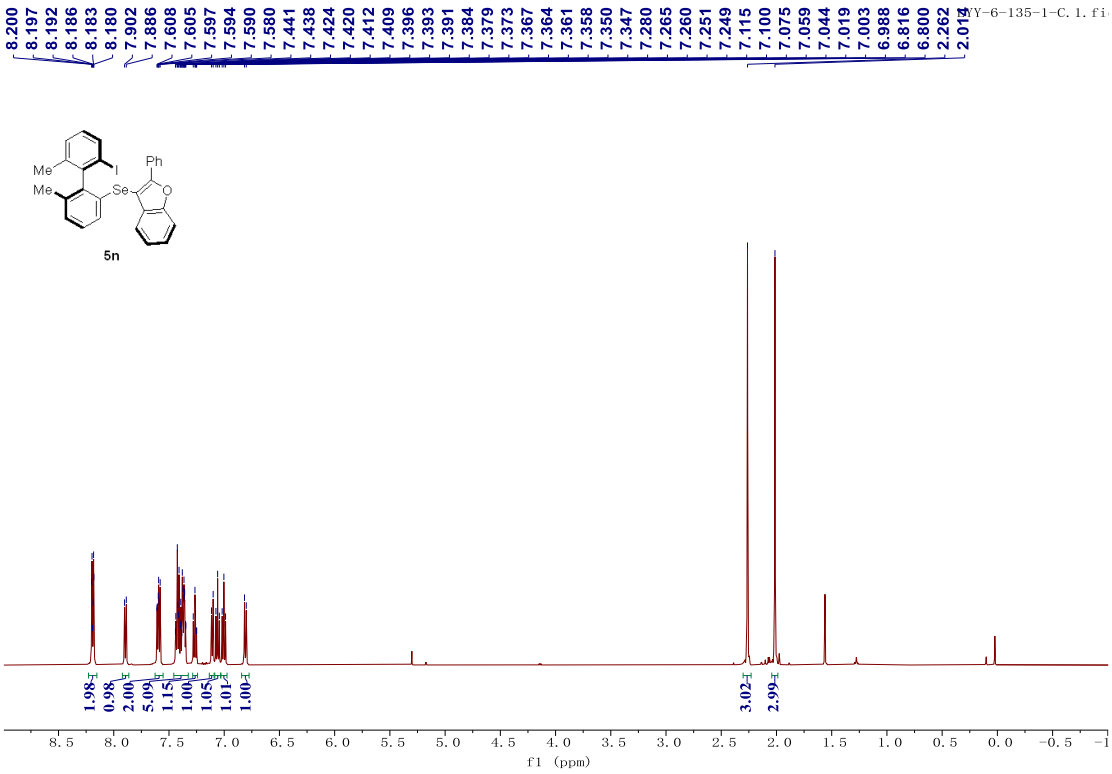
^{13}C NMR spectra of **5m**



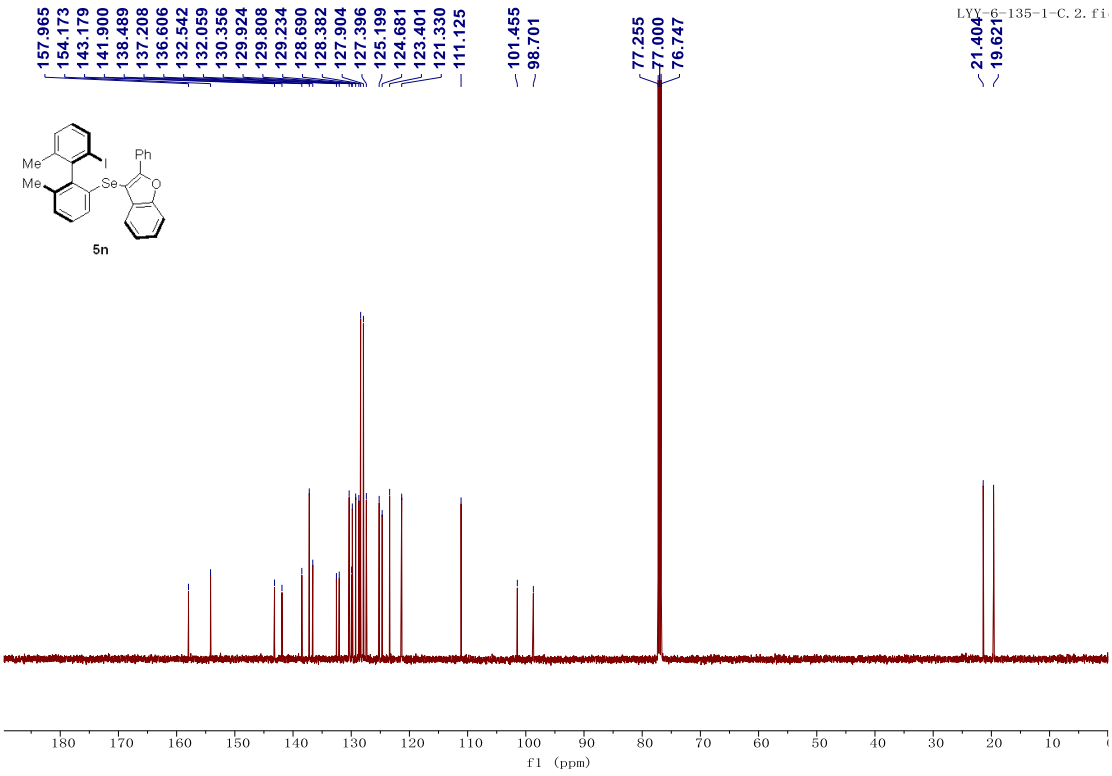
^{1}H NMR spectra of **DS**



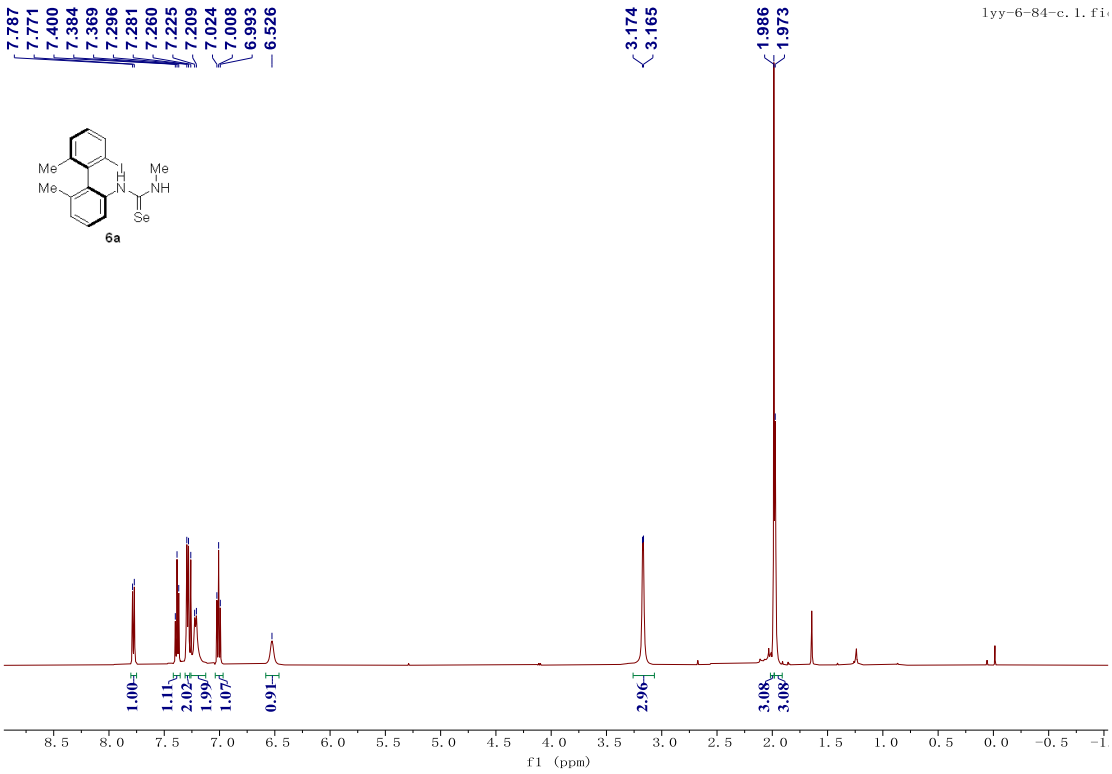
^{13}C NMR spectra of **DS**



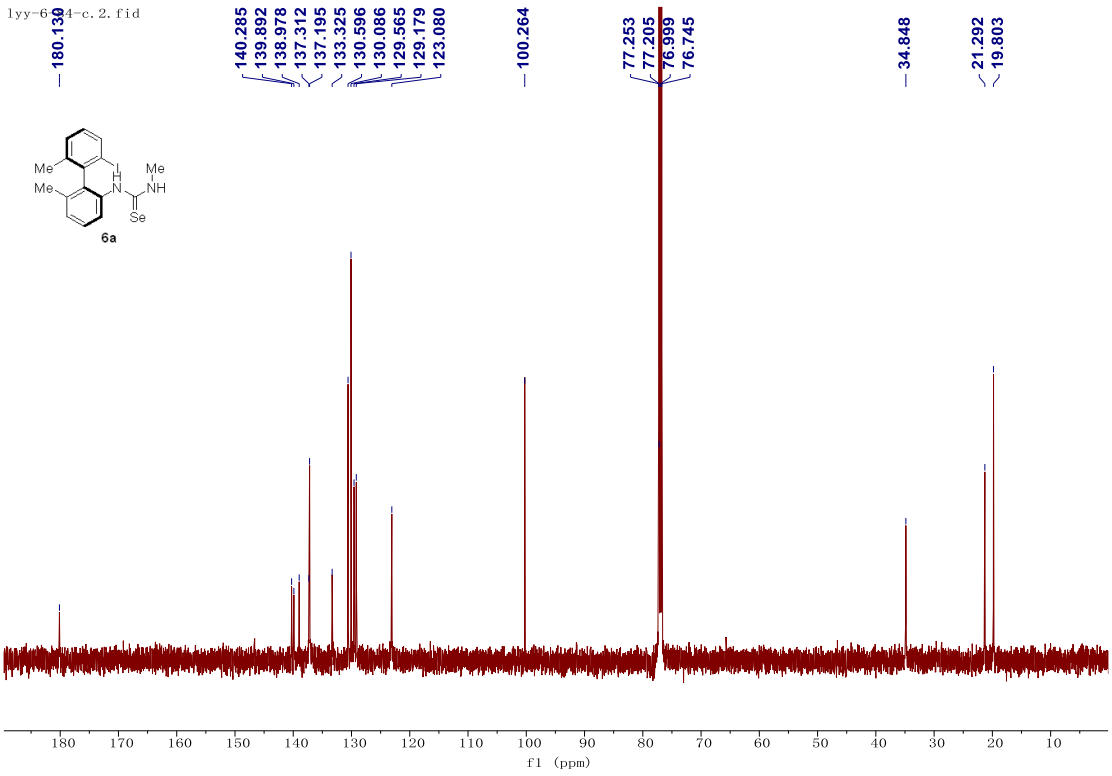
^{1}H NMR spectra of **5n**



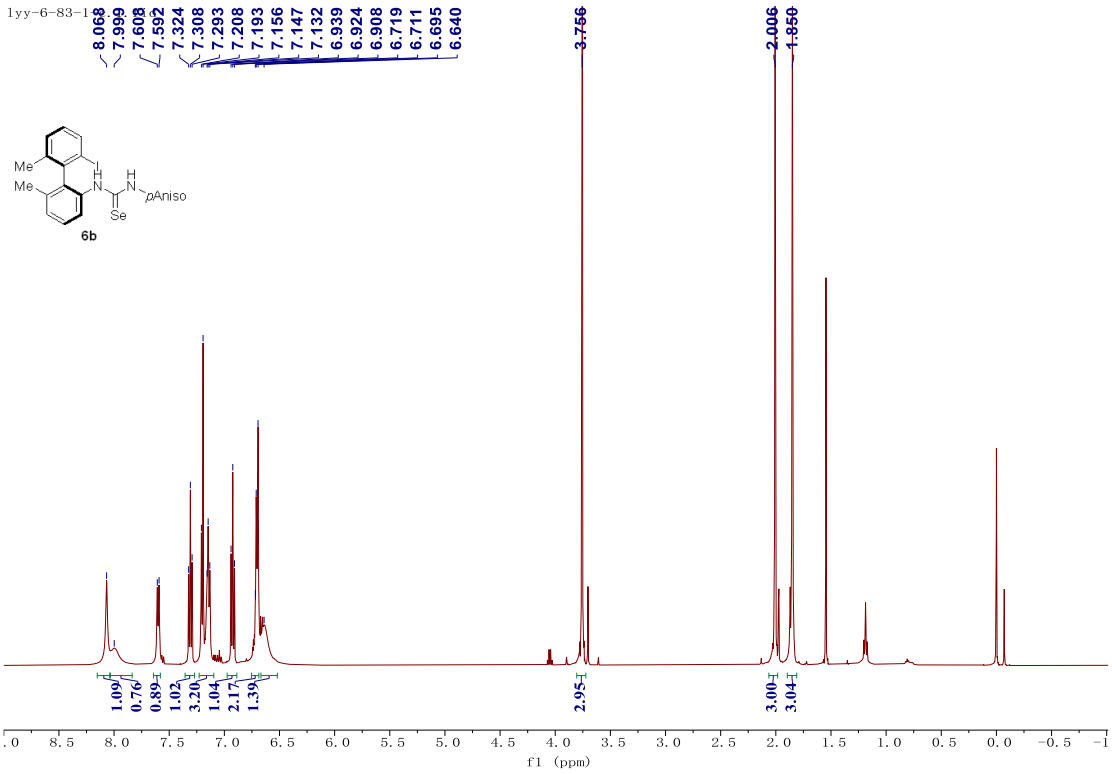
^{13}C NMR spectra of **5n**



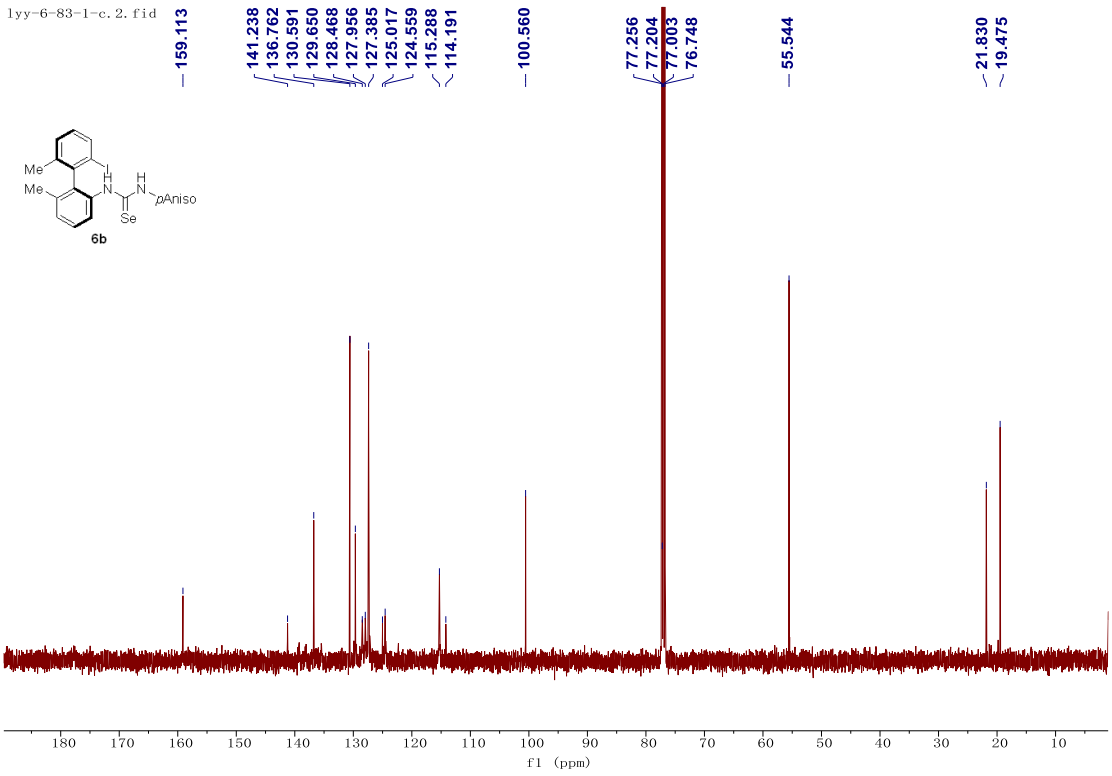
^{1}H NMR spectra of **6a**



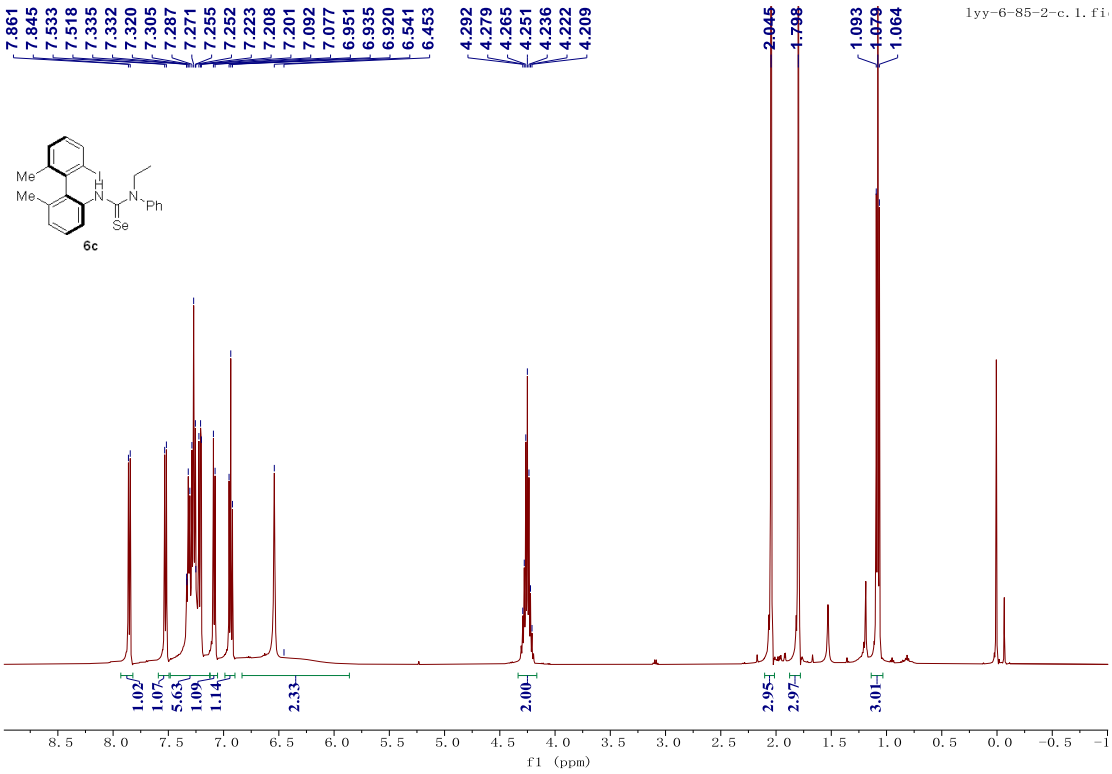
^{13}C NMR spectra of **6a**



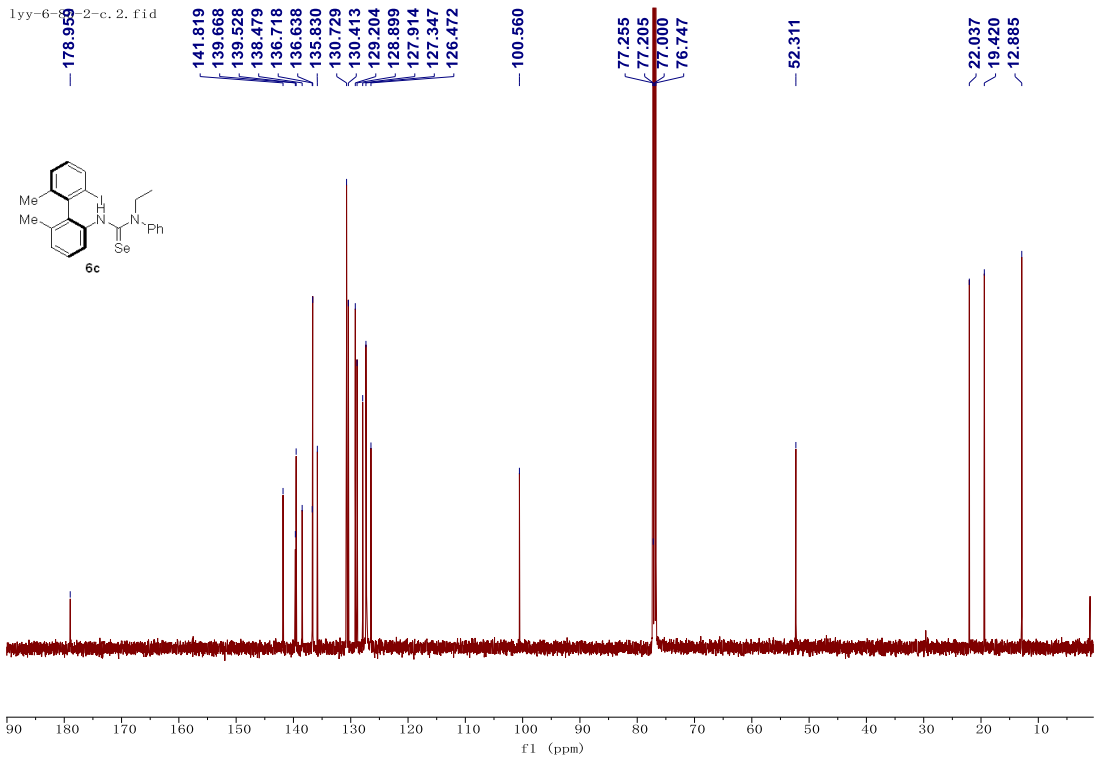
^{1}H NMR spectra of **6b**



^{13}C NMR spectra of **6b**

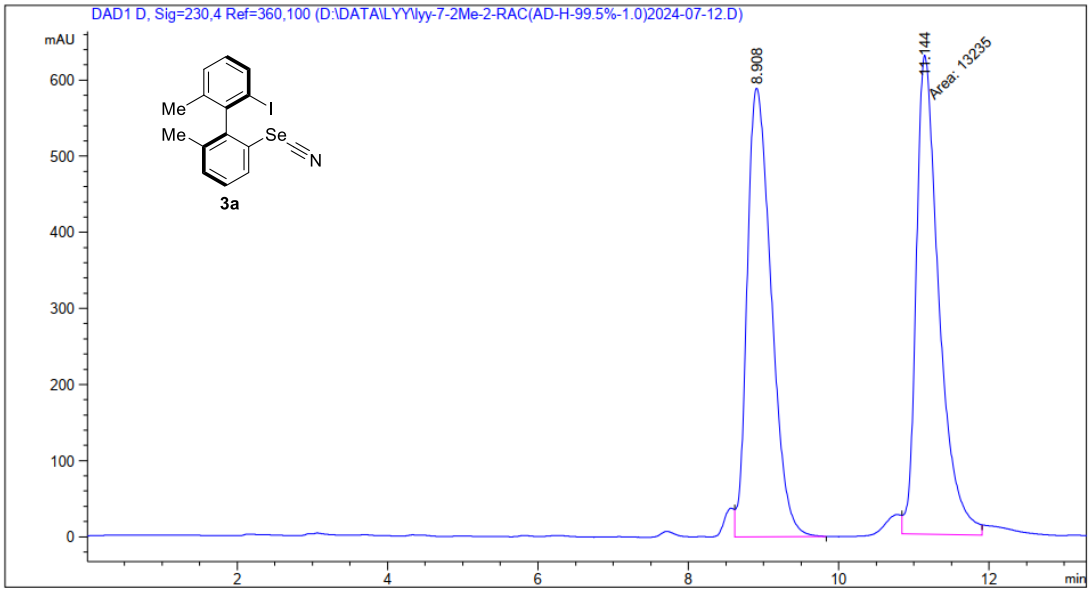


^{1}H NMR spectra of **6c**



^{13}C NMR spectra of **6c**

9. Copies of HPLC traces

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----|-------|----|-------|----------|----------|--------|
   1   8.908 VB    0.3556 1.31113e4   589.24768  49.7652
   2  11.144 MM    0.3505 1.32350e4   629.34705  50.2348
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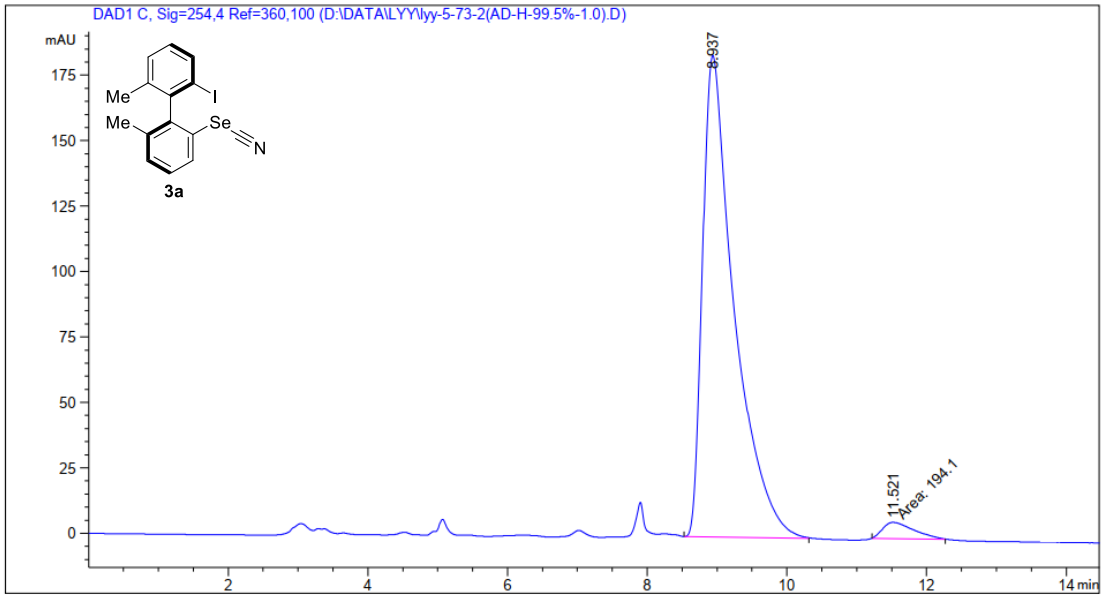
HPLC spectra of **3a-rac**

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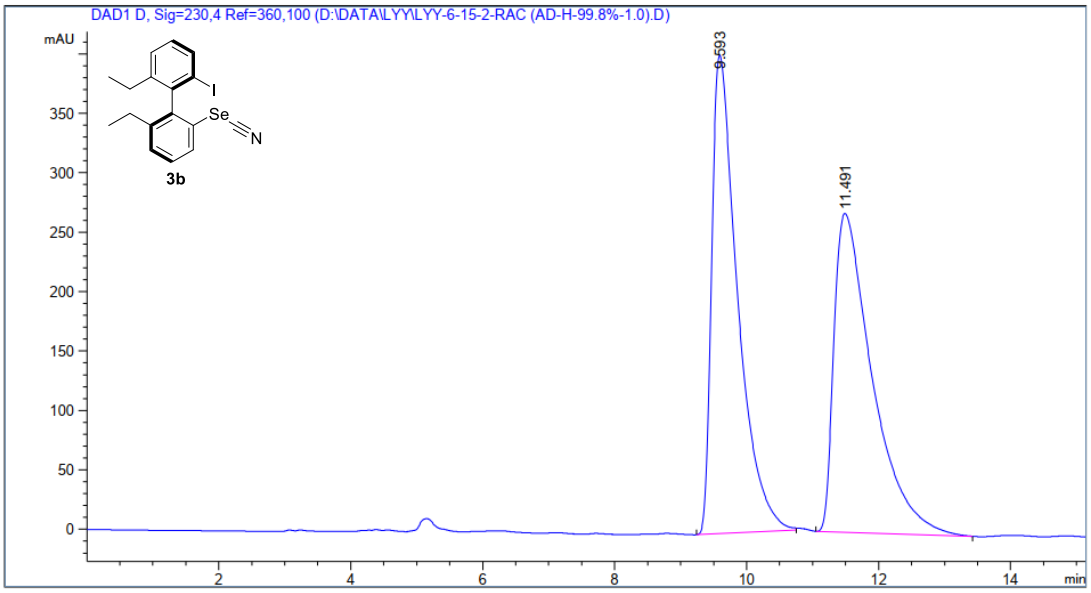
----|-------|----|-------|----------|----------|--------|
   1   8.937 BB    0.4496 5795.02832  183.93570  96.7591
   2  11.521 MM    0.5223  194.10034    6.19353   3.2409
```

HPLC spectra of **3a**

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Peak RetTime Type  Width     Area      Height     Area
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   1   9.593 BB    0.4020 1.09644e4   402.25760  50.3583
   2  11.491 BB    0.5938 1.08083e4   268.38559  49.6417
```
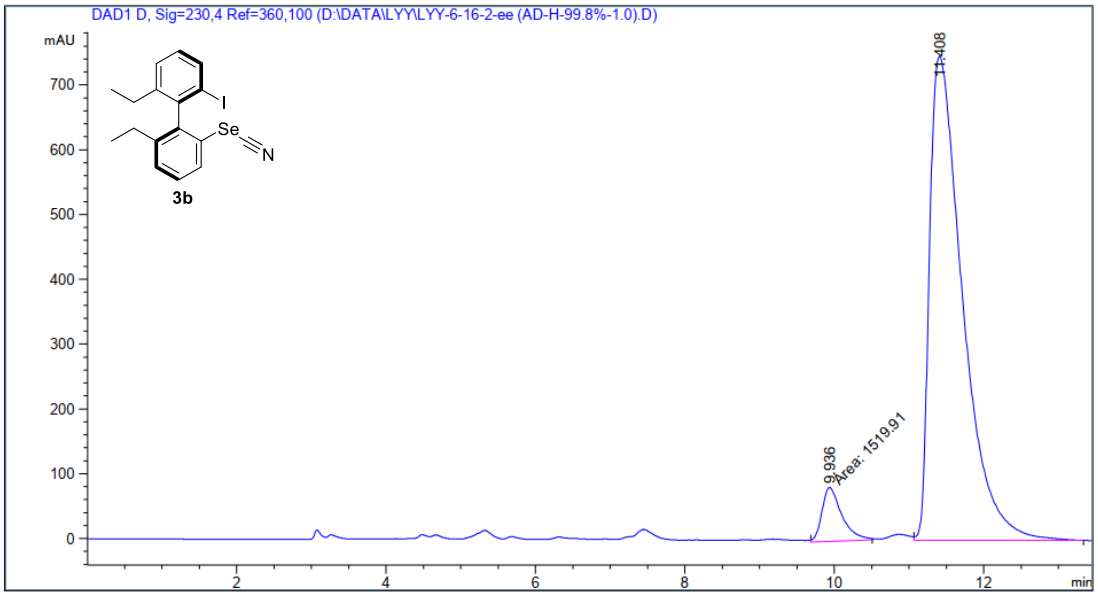

HPLC spectra of **3b-rac**

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   1   9.936 MM    0.3058 1519.90540   82.82503   6.2077
   2  11.408 VB    0.4683 2.29643e4   747.65234  93.7923
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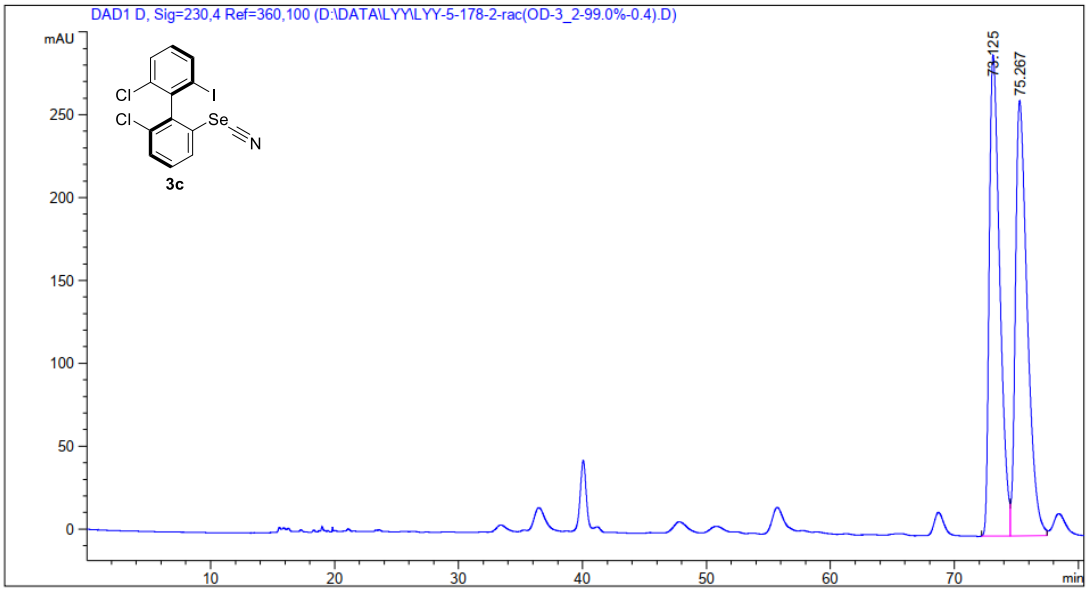
HPLC spectra of **3b**

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   1  73.125 BV    0.9020 1.71103e4   290.12817  49.5088
   2  75.267 VB    0.9957 1.74498e4   262.46454  50.4912
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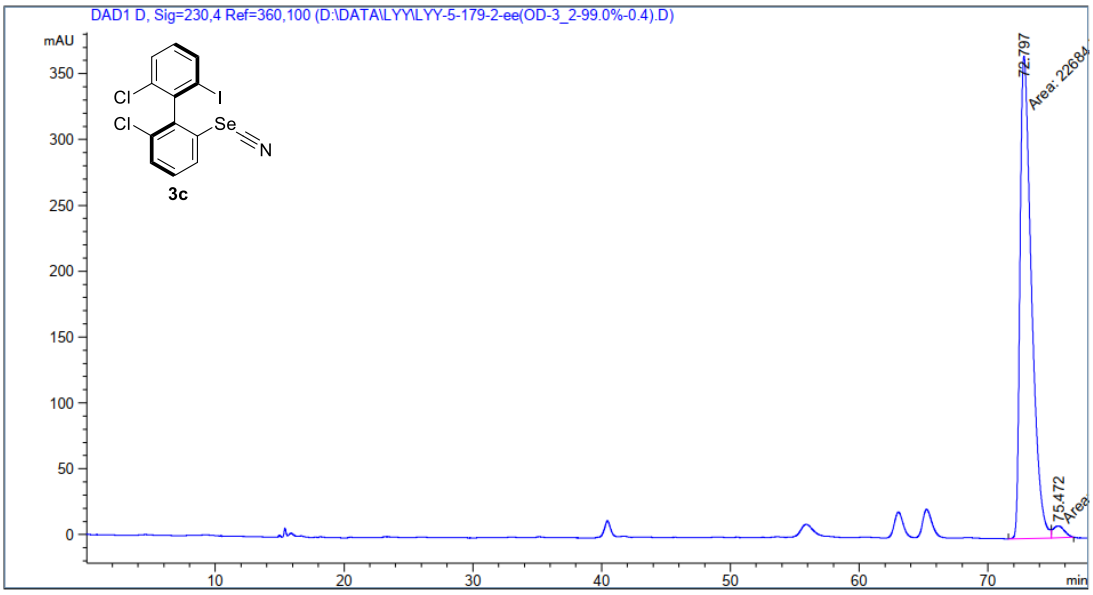
HPLC spectra of **3c-rac**

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   1  72.797 MF    1.0323 2.26845e4   366.22885  97.6540
   2  75.472 FM    1.0125  544.97473    8.97083   2.3460
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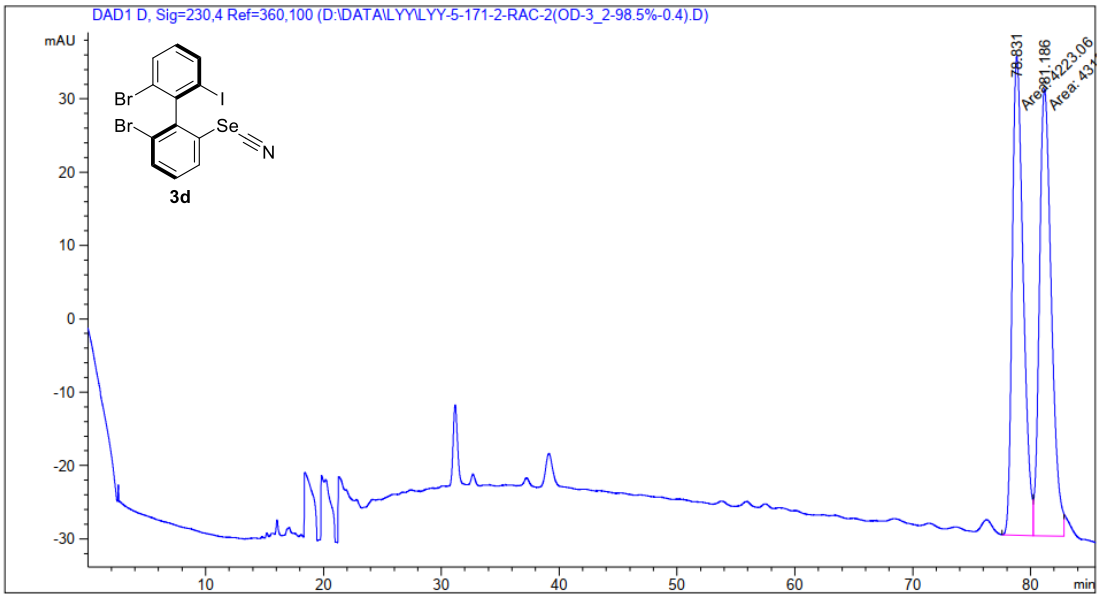
HPLC spectra of **3c**

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Peak RetTime Type  Width     Area      Height     Area
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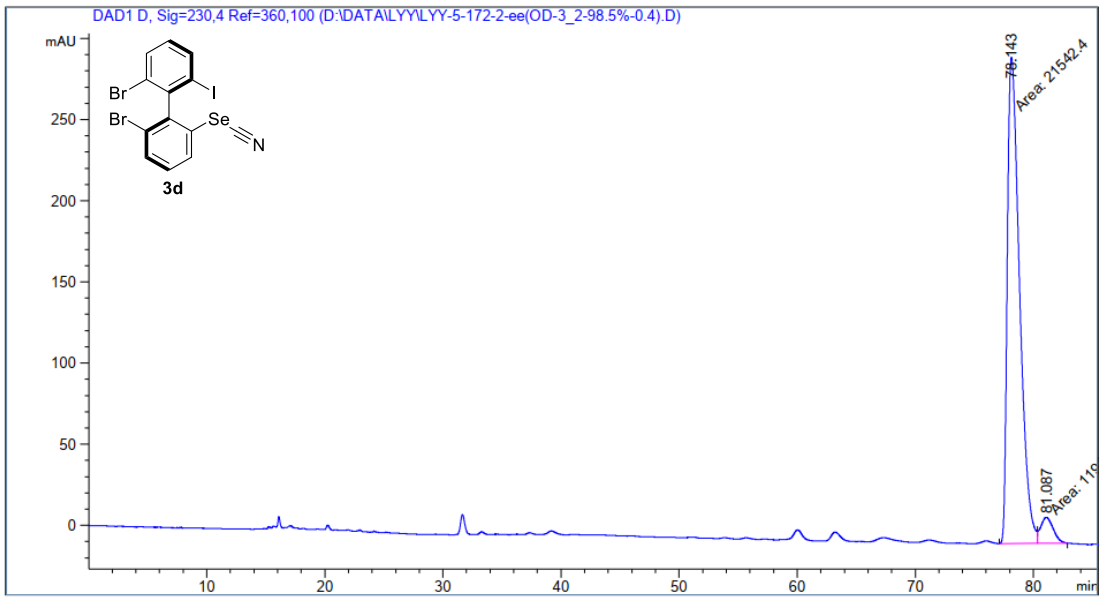
----|-------|----|-------|----------|----------|--------|
   1  78.831 MF    1.0782 4223.05664   65.27996  49.4567
   2  81.186 FM    1.1800 4315.84033   60.95868  50.5433
```

HPLC spectra of **3d-rac**

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----|-------|----|-------|----------|----------|--------|
   1  78.143 MF    1.1991 2.15424e4   299.41440  94.7505
   2  81.087 FM    1.2471 1193.51526   15.95043   5.2495
```
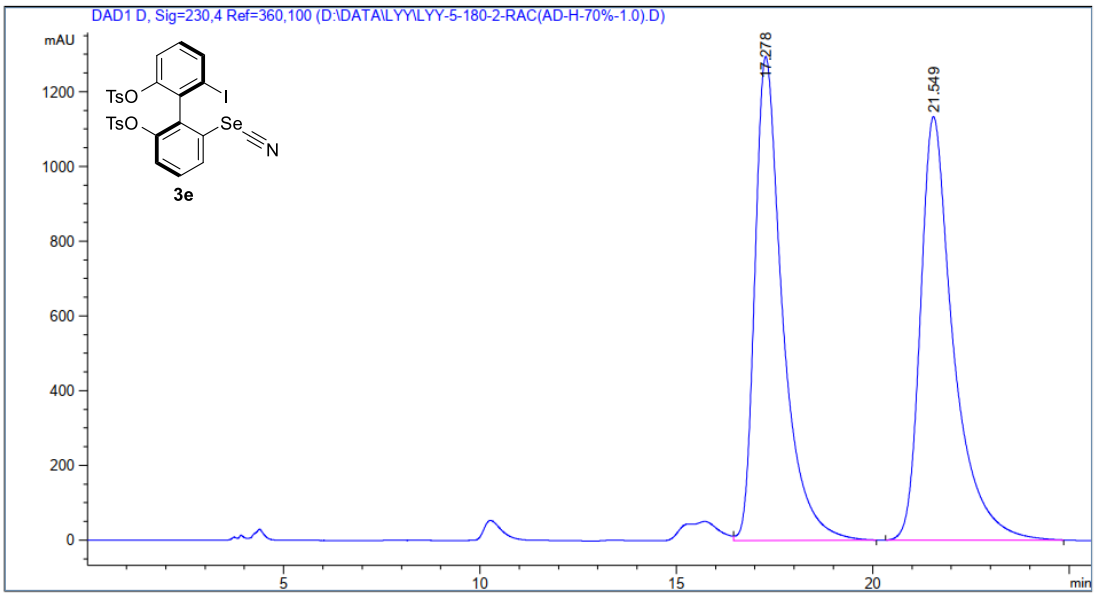

HPLC spectra of **3d**

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Peak RetTime Type  Width     Area      Height     Area
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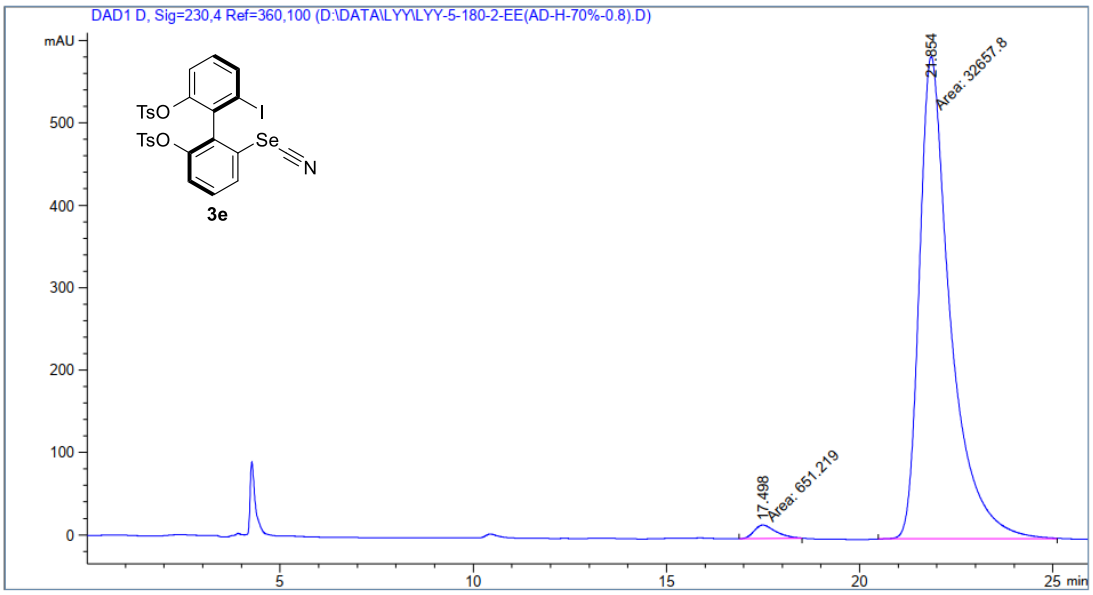
----|-------|----|-------|----------|----------|--------|
   1  17.278 VB    0.7278 6.34728e4  1295.07837  48.9807
   2  21.549 BB    0.8563 6.61145e4  1133.86572  51.0193
```

HPLC spectra of **3e-rac**

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----|-------|----|-------|----------|----------|--------|
   1  17.498 MM    0.6571  651.21869   16.51740   1.9551
   2  21.854 MM    0.9304 3.26578e4   585.03436  98.0449
```
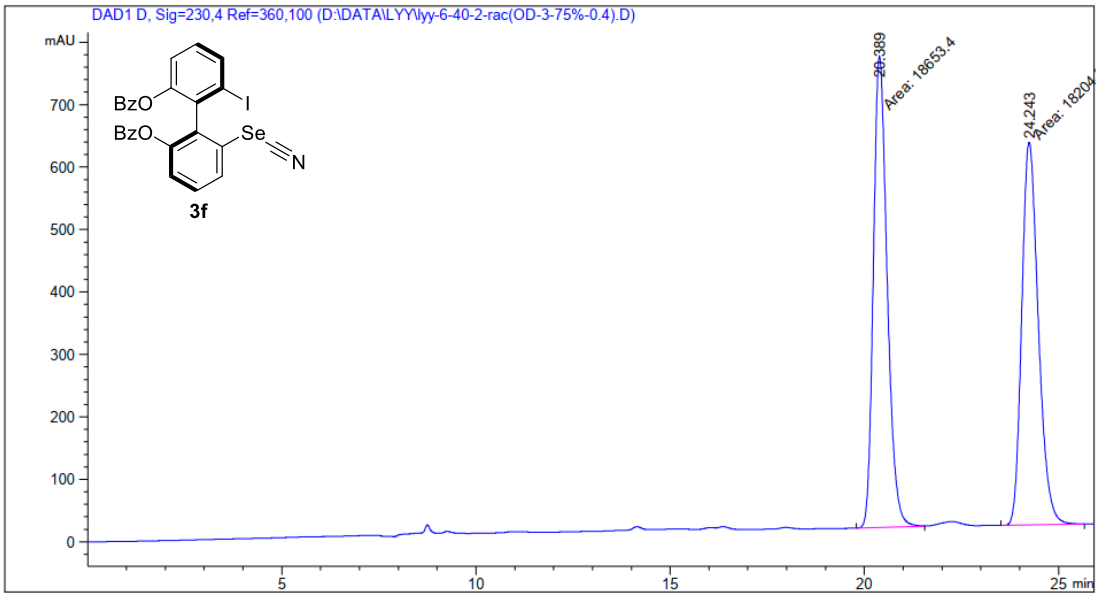

HPLC spectra of **3e**

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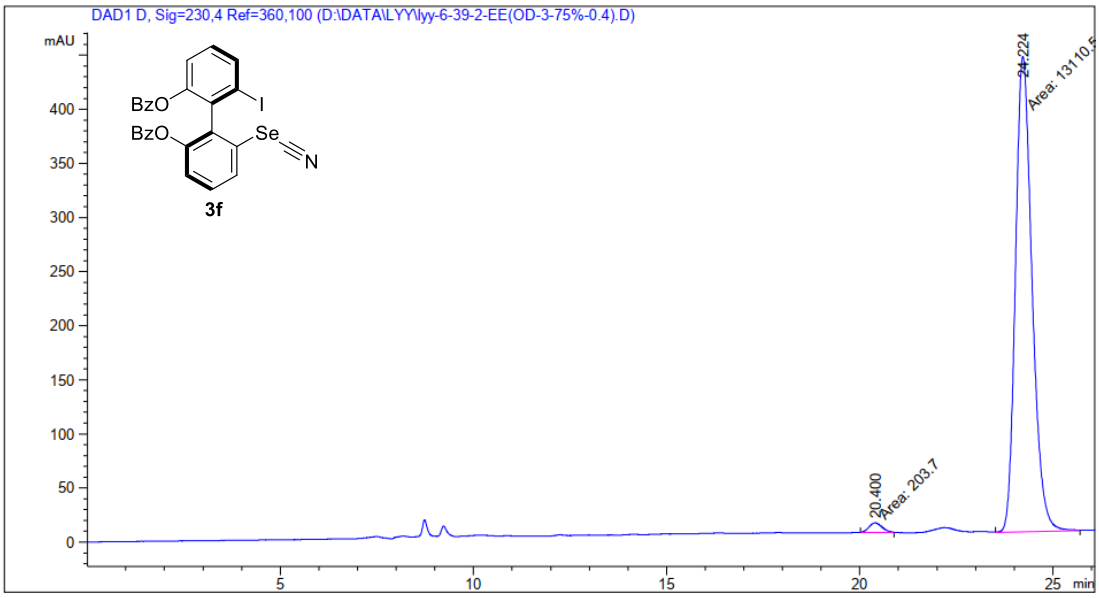
----|-------|----|-------|----------|----------|--------|
   1  20.389 MM    0.4120 1.86534e4   754.50677  50.6092
   2  24.243 MM    0.4947 1.82043e4   613.30682  49.3908
```

HPLC spectra of **3f-rac**

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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  20.400 MM    0.3832  203.70009    8.85909   1.5299
   2  24.224 MM    0.4975 1.31105e4   439.22388  98.4701
```
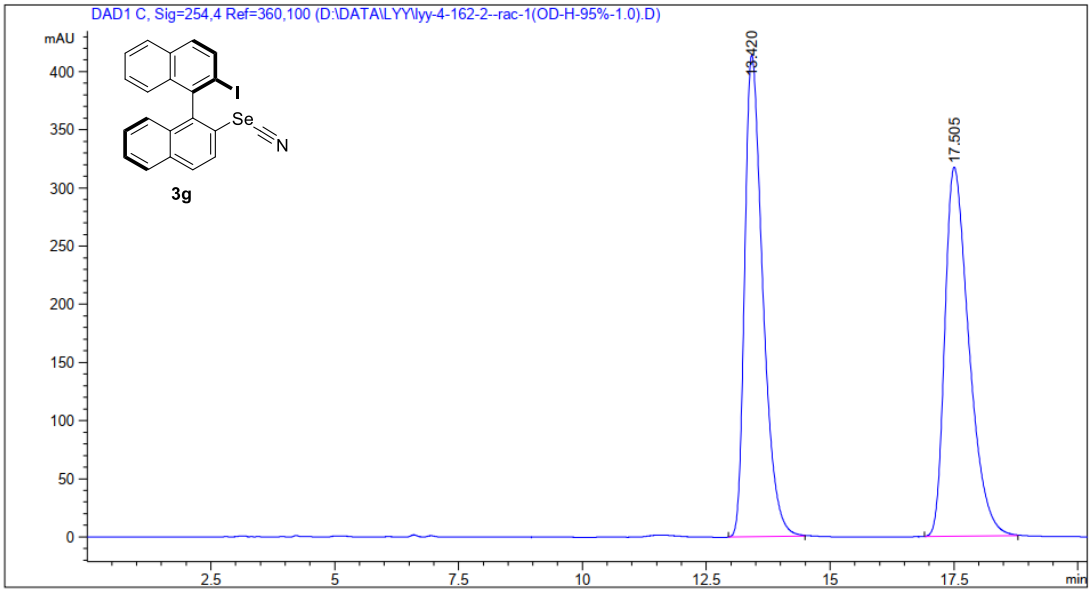

HPLC spectra of **3f**

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=====================================================================
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Peak RetTime Type  Width     Area      Height     Area
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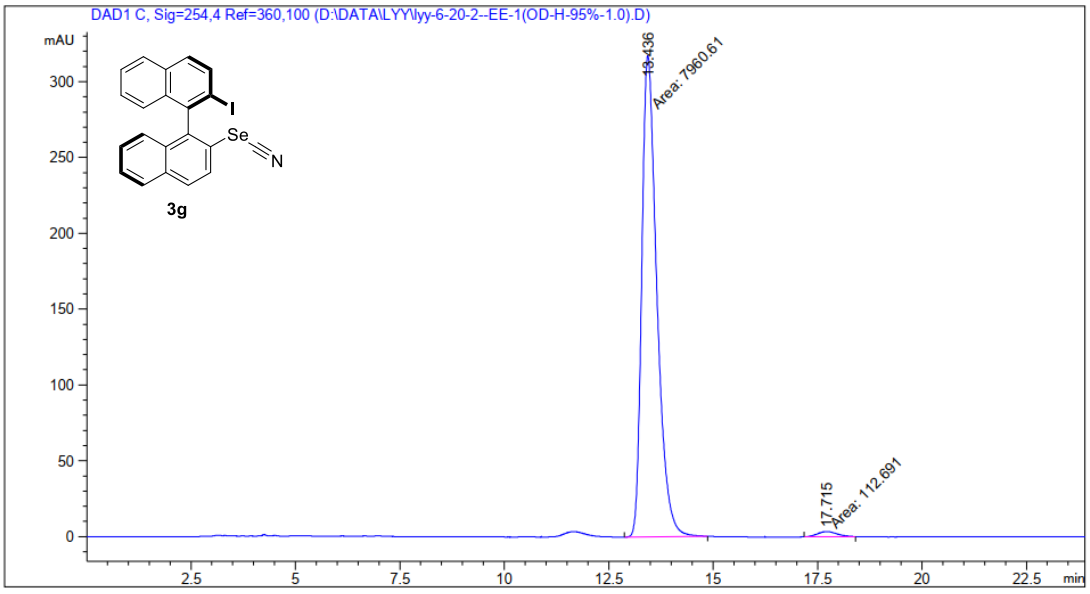
----|-------|----|-------|----------|----------|--------|
   1  13.420 BB    0.3865 1.05301e4   414.27277  49.4754
   2  17.505 BB    0.5152 1.07534e4   317.43173  50.5246
```

HPLC spectra of **3g-rac**

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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1  13.436 MM    0.4182 7960.60938  317.24777  98.6042
   2  17.715 MM    0.5431  112.69091    3.45821   1.3958
```
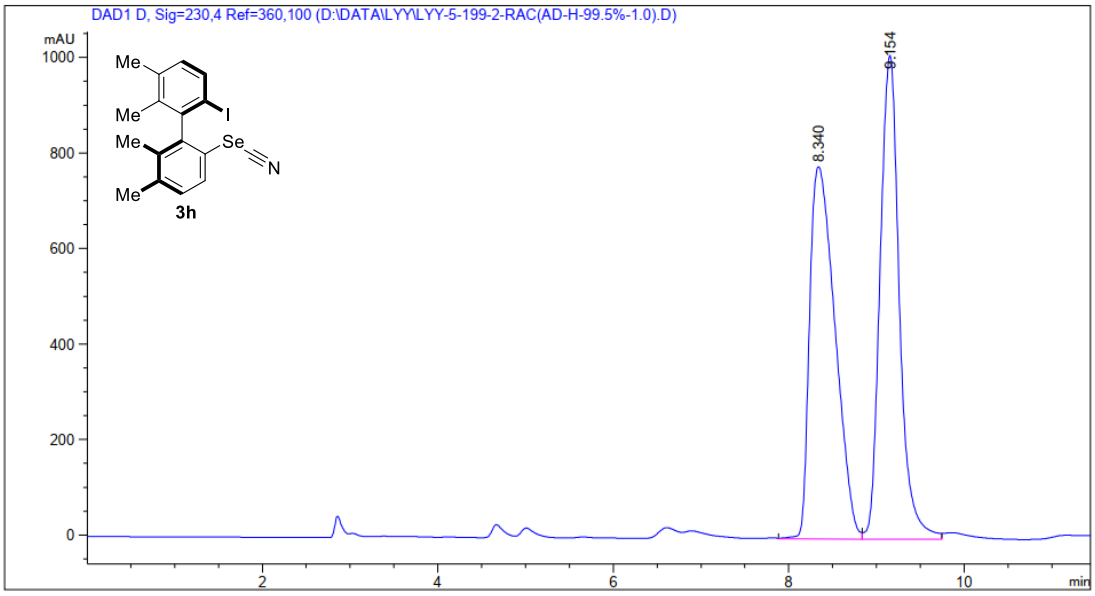

HPLC spectra of **3g**

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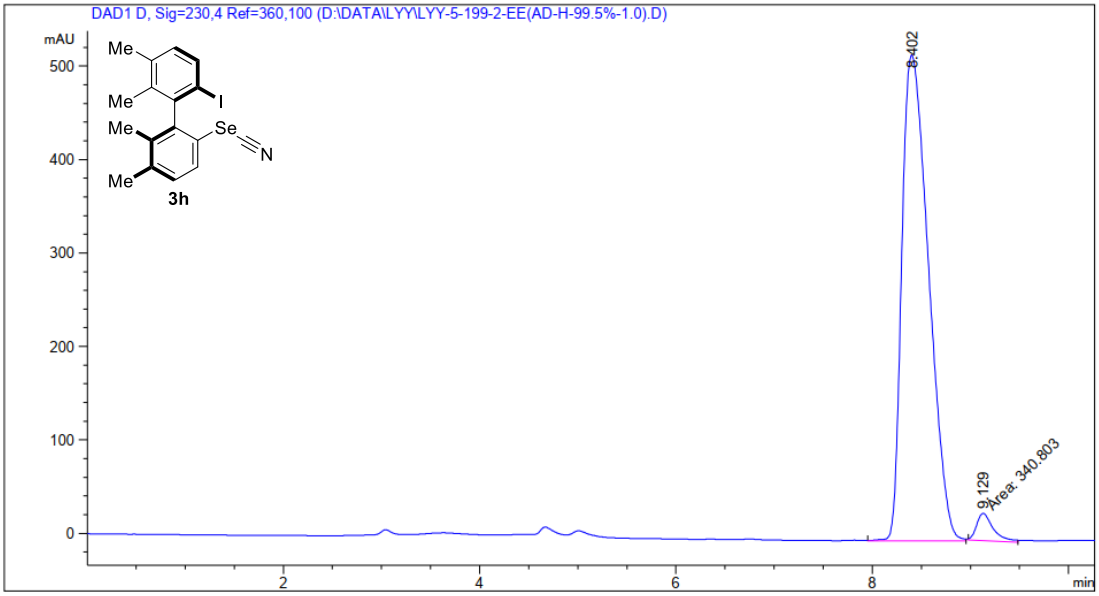
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.340 VV    0.3186 1.56762e4   779.72083  50.2815
   2   9.154 VV    0.2406 1.55007e4  1012.51062  49.7185
```

HPLC spectra of **3h-rac**

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Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1   8.402 VV    0.3021 9802.07520  519.60944  96.6400
   2   9.129 MM    0.1958  340.80350   29.01172   3.3600
```
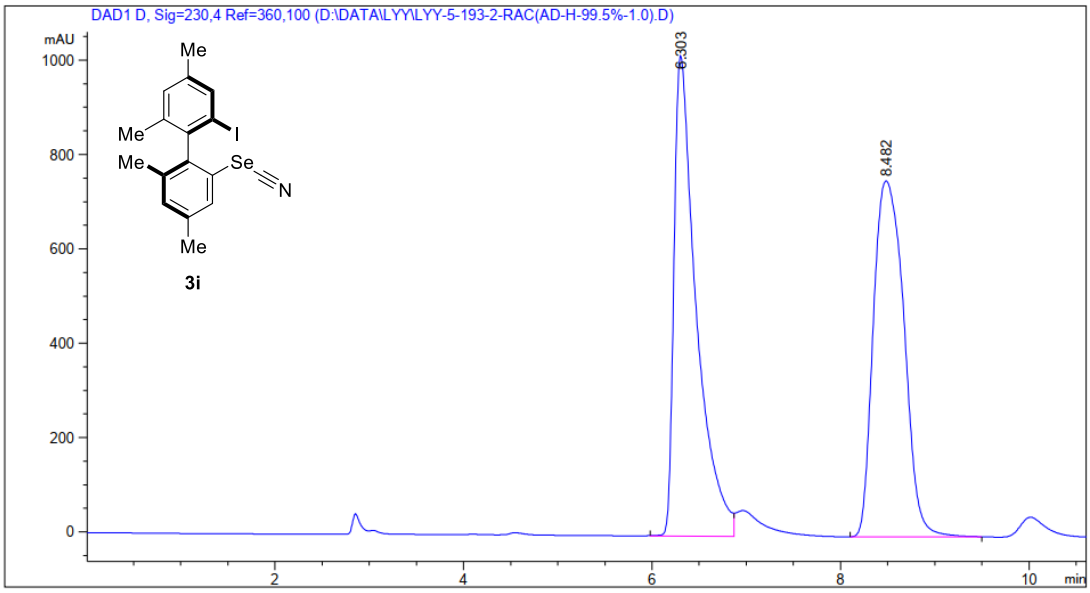

HPLC spectra of **3h**

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==================================================================
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Peak RetTime Type  Width     Area      Height     Area
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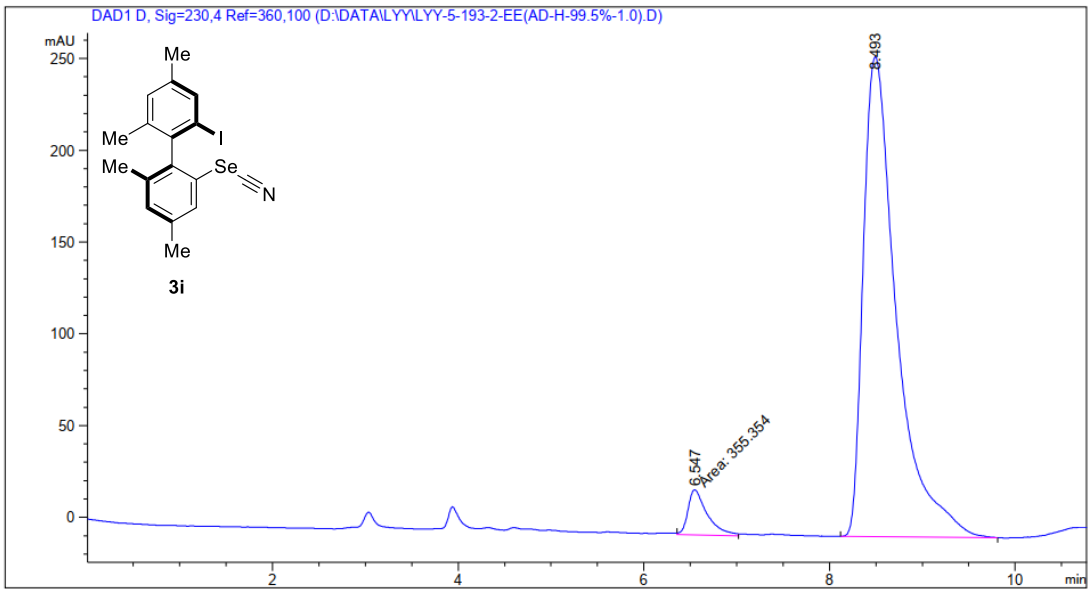
----|-------|----|-------|----------|----------|--------|
   1   6.303 BV    0.2351 1.66794e4  1018.47943  49.5195
   2   8.482 BB    0.3748 1.70031e4   754.79767  50.4805
```

HPLC spectra of **3i**

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==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   6.547 MM    0.2402  355.35434   24.65356   5.1917
   2   8.493 BB    0.3715 6489.24561  261.50790  94.8083
```
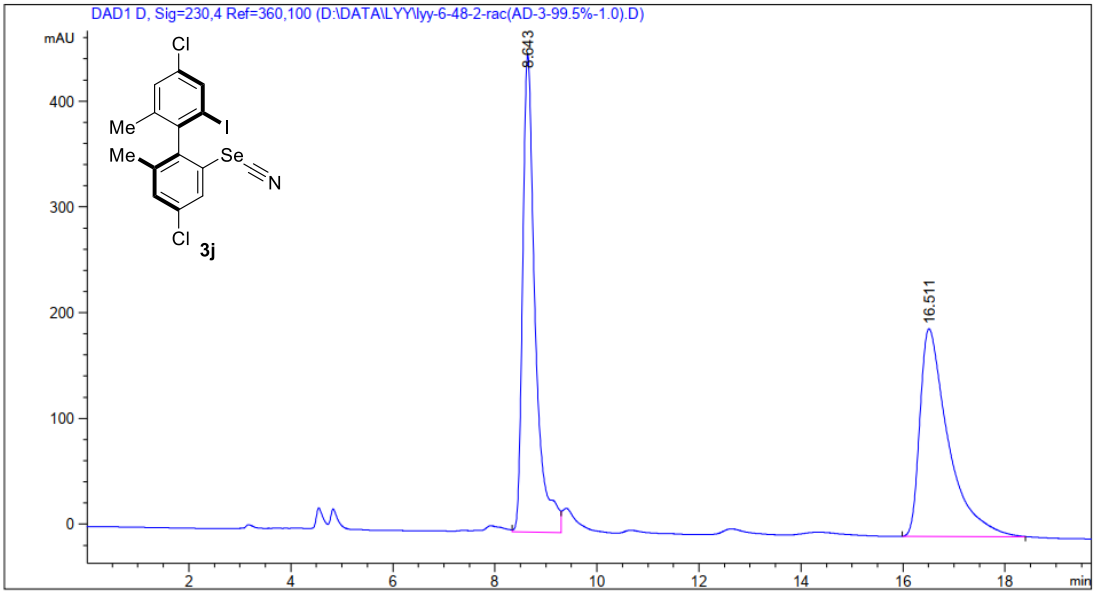

HPLC spectra of **3i**

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==================================================================================
                              Area Percent Report
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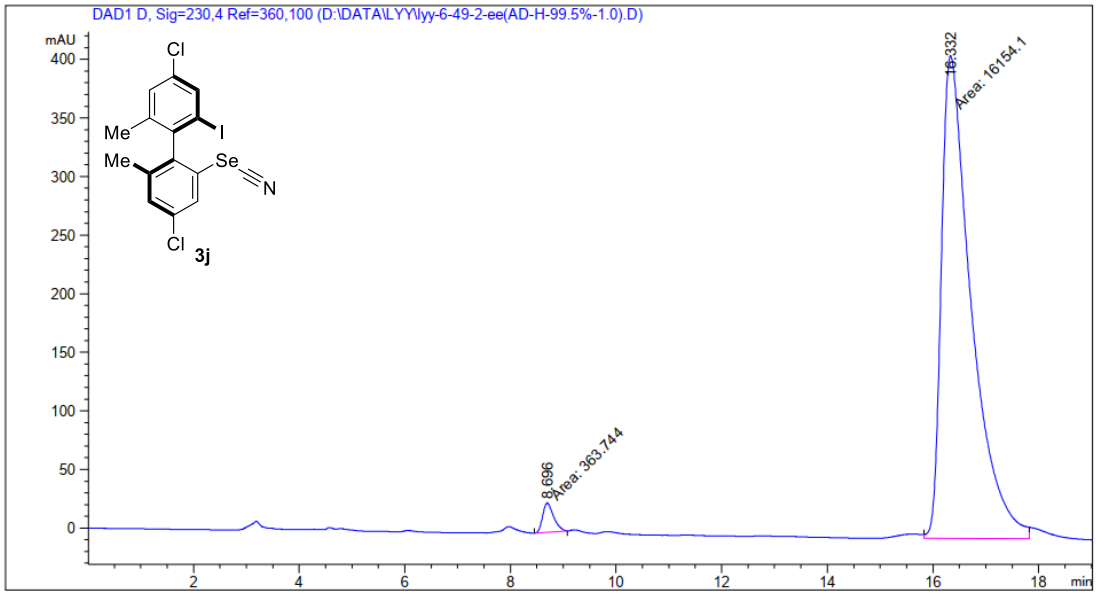
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.643 VV    0.2533 7712.78809  451.46548  50.3804
   2  16.511 BB    0.5648 7596.33154  196.60860  49.6196
```

HPLC spectra of **3j-rac**

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==================================================================================
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==================================================================================
Peak RetTime Type  Width     Area      Height     Area
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----|-------|----|-------|----------|----------|--------|
   1   8.696 MM    0.2421  363.74374   25.04235   2.2021
   2  16.332 MM    0.6537 1.61541e4   411.87308  97.7979
```
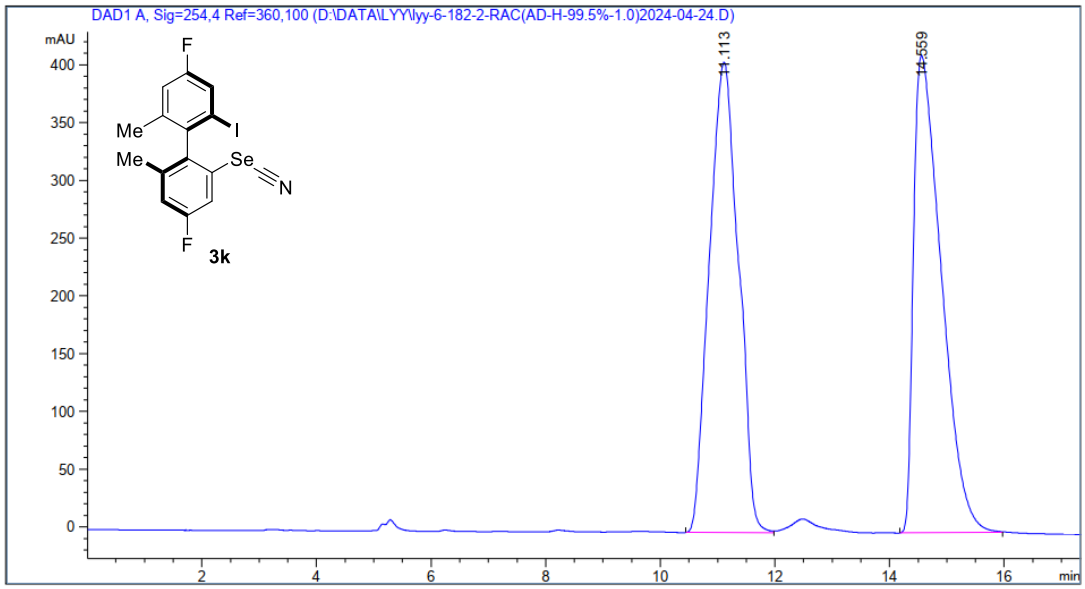

HPLC spectra of **3j**

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==================================================================================
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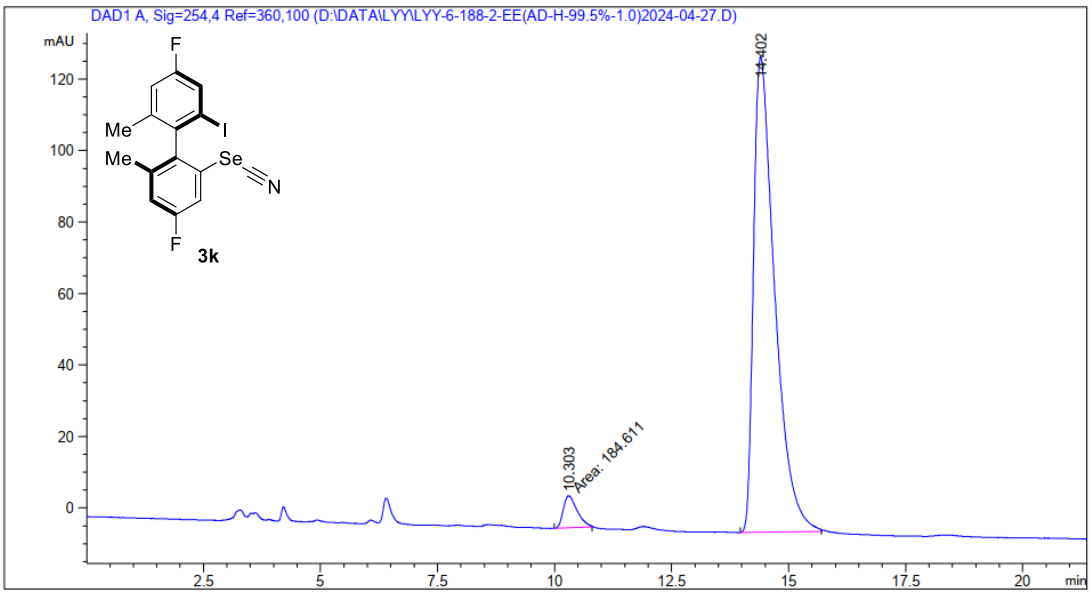
==================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.113 BV    0.5559 1.43760e4   407.20609  50.7841
   2  14.559 BB    0.5095 1.39321e4   413.08557  49.2159
```

HPLC spectra of **3k-rac**

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==================================================================================
                                Area Percent Report
==================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.303 MM    0.3428  184.61133    8.97687   4.2234
   2  14.402 BB    0.4692 4186.54736  132.99893  95.7766
```
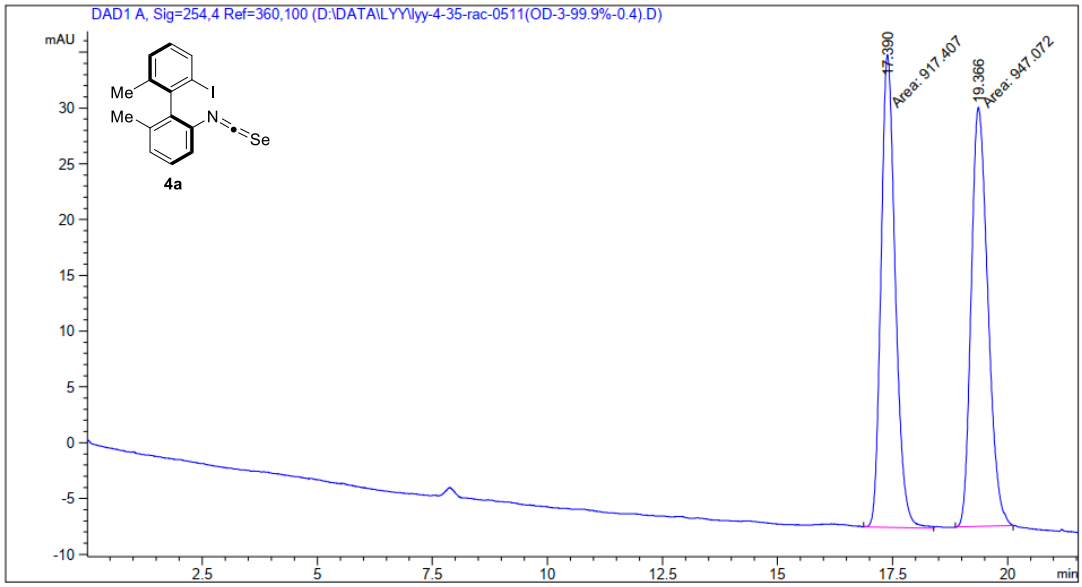
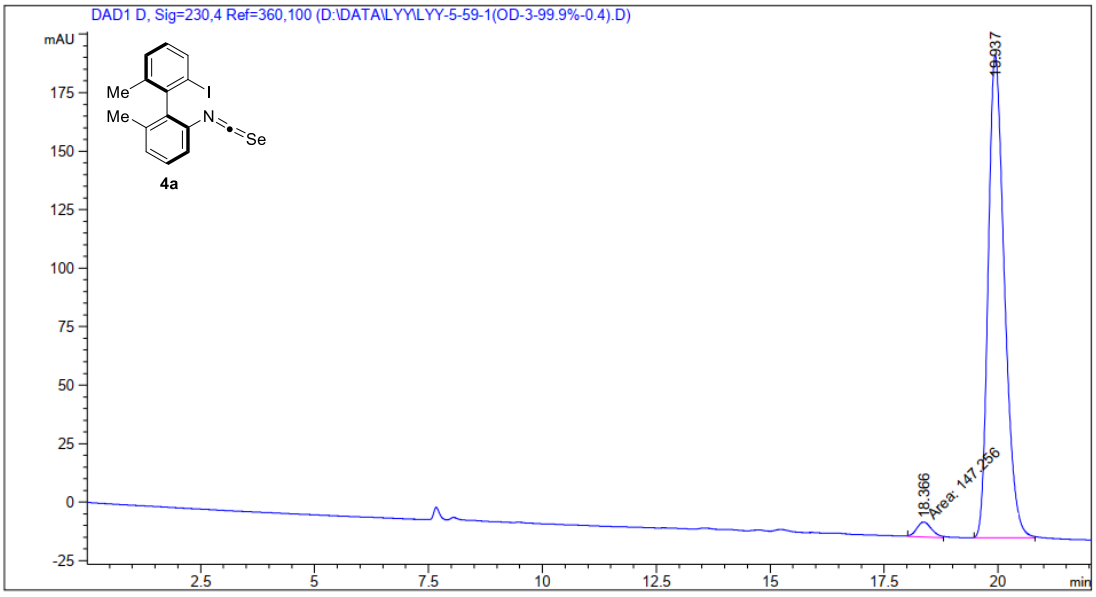

HPLC spectra of **3k**



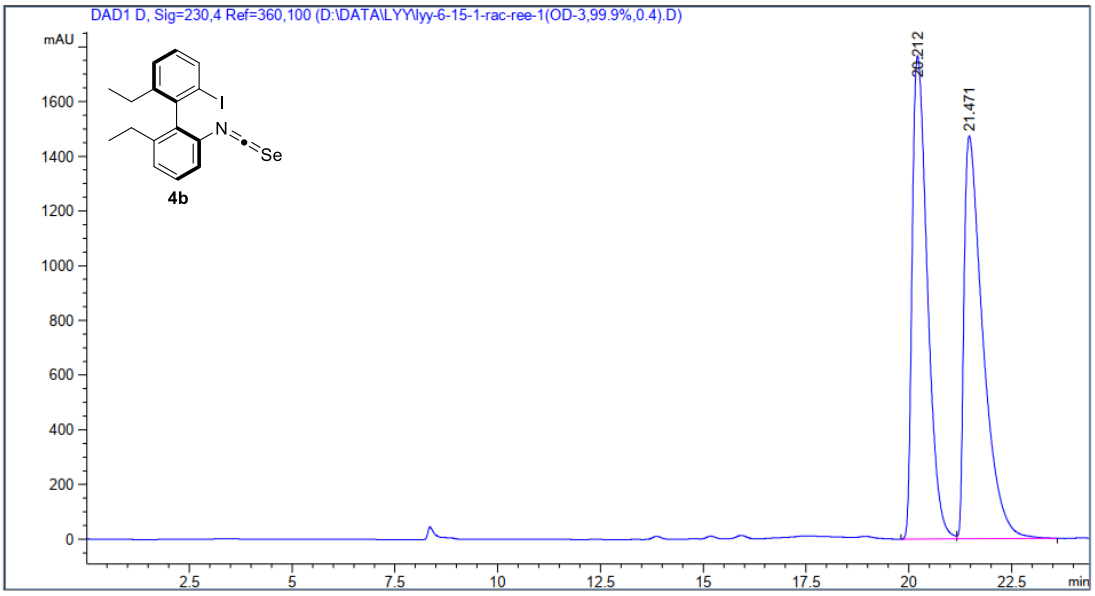

```
=====================================================================
                    Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  17.390 MM    0.3611  917.40729   42.34734  49.2045
   2  19.366 MM    0.4202  947.07172   37.56086  50.7955
```

HPLC spectra of **4a-rac**



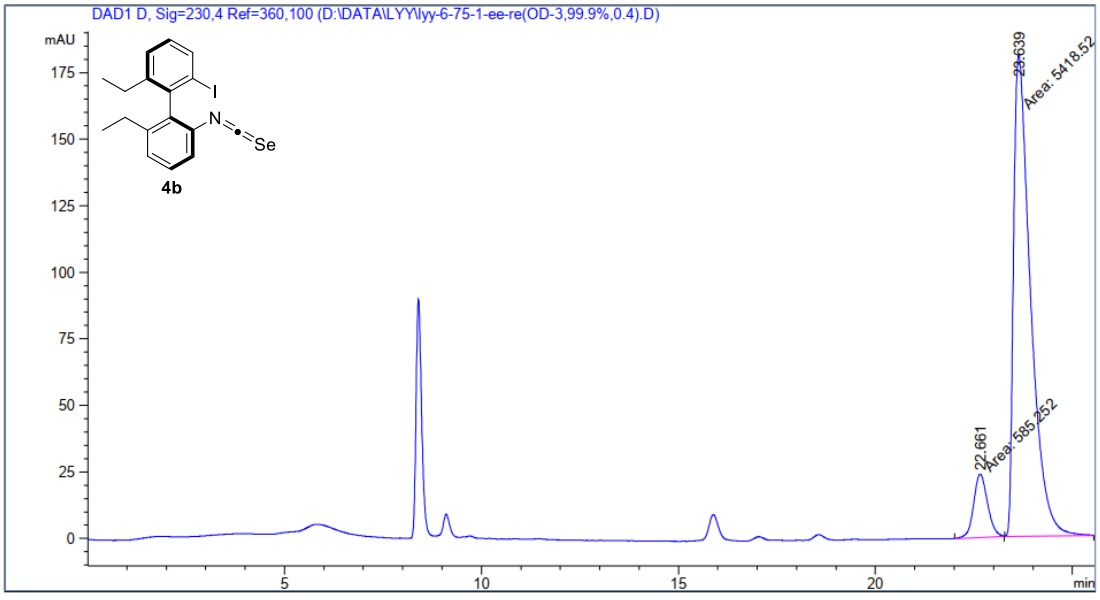

```
=====================================================================
                    Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  18.366 MM    0.3809  147.25562    6.44348   2.7956
   2  19.937 BB    0.3839 5120.20215  206.02350  97.2044
```

HPLC spectra of **4a**




```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  20.212 BV    0.3985 4.55149e4  1766.90076  49.0814
   2  21.471 VB    0.4799 4.72187e4  1473.26477  50.9186
```

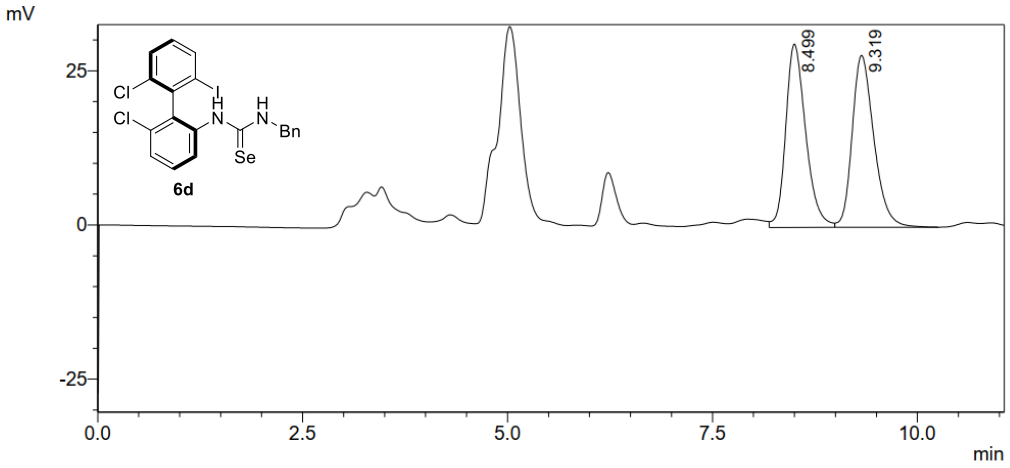
HPLC spectra of **4b-rac**




```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  22.661 MM    0.4099  585.25153   23.79885   9.7481
   2  23.639 MM    0.5000 5418.51611  180.60495  90.2519
```

HPLC spectra of **4b**

<Chromatogram>



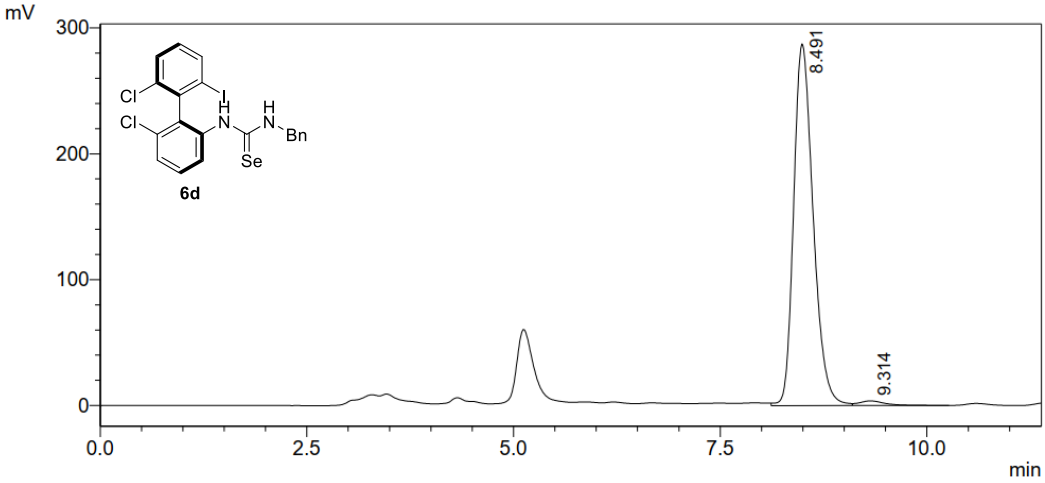
<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	8.499	505797	29721	49.516			
2	9.319	515685	27876	50.484		V	
Total		1021482	57597				

HPLC spectra of **6d-rac**

<Chromatogram>

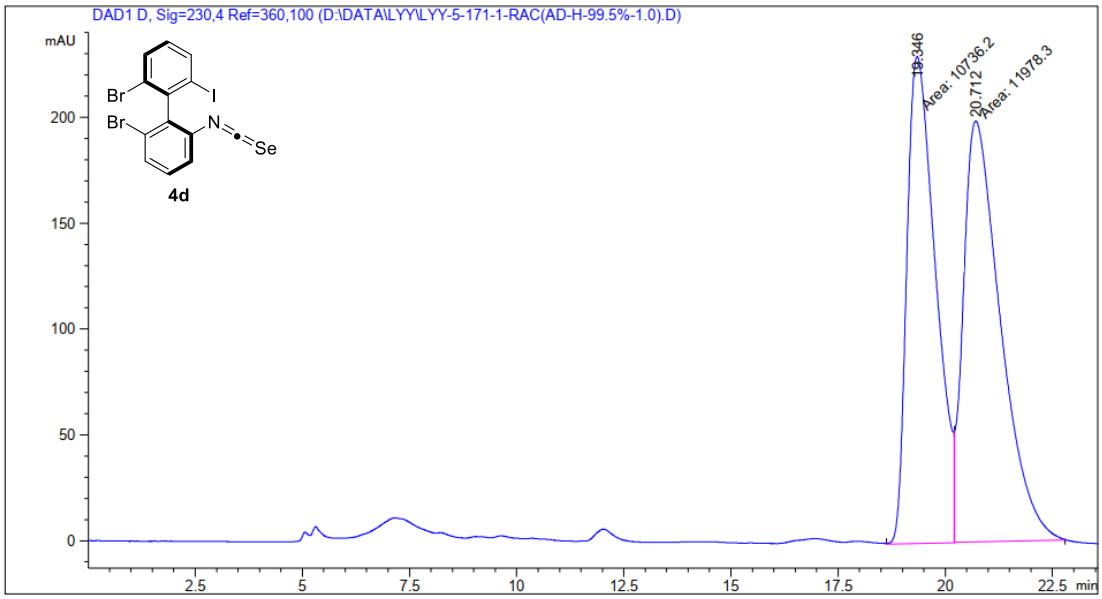


<Peak Table>

Detector A Channel 1 254nm

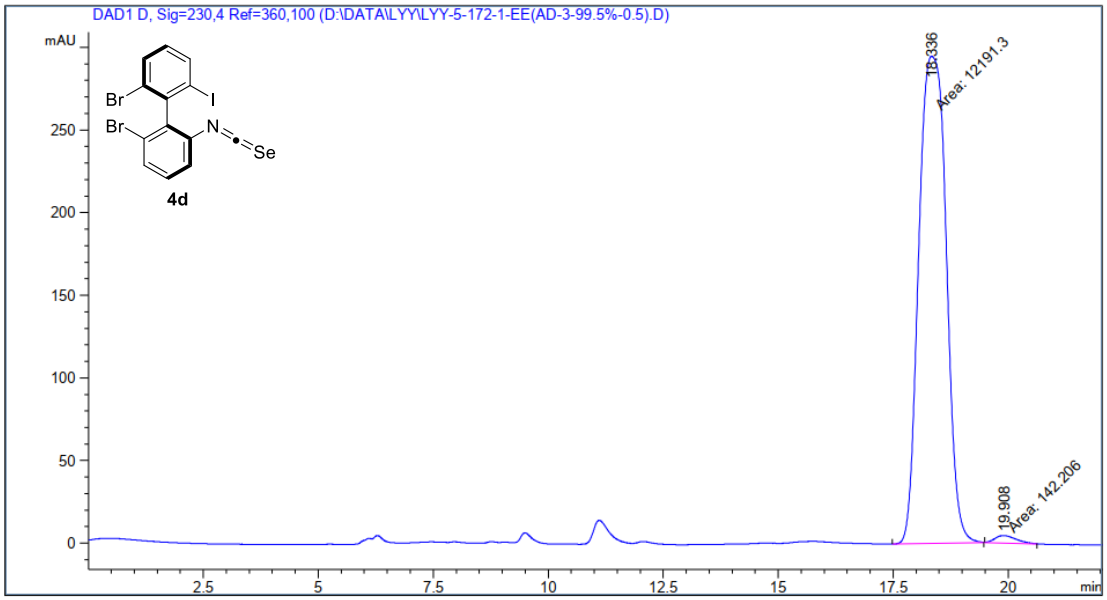
Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	8.491	4717647	287262	98.212			
2	9.314	85889	3733	1.788		SV	
Total		4803536	290995				

HPLC spectra of **6d**



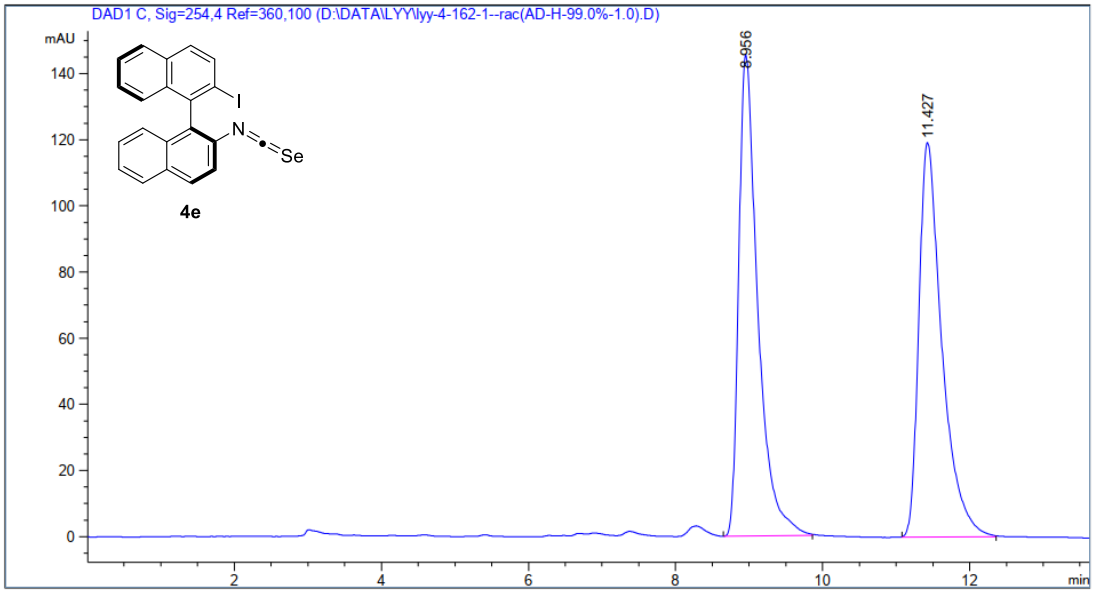

```
==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  19.346 MF    0.7780 1.07362e4   230.00362  47.2659
   2  20.712 FM    1.0037 1.19783e4   198.89357  52.7341
```

HPLC spectra of **4d-rac**



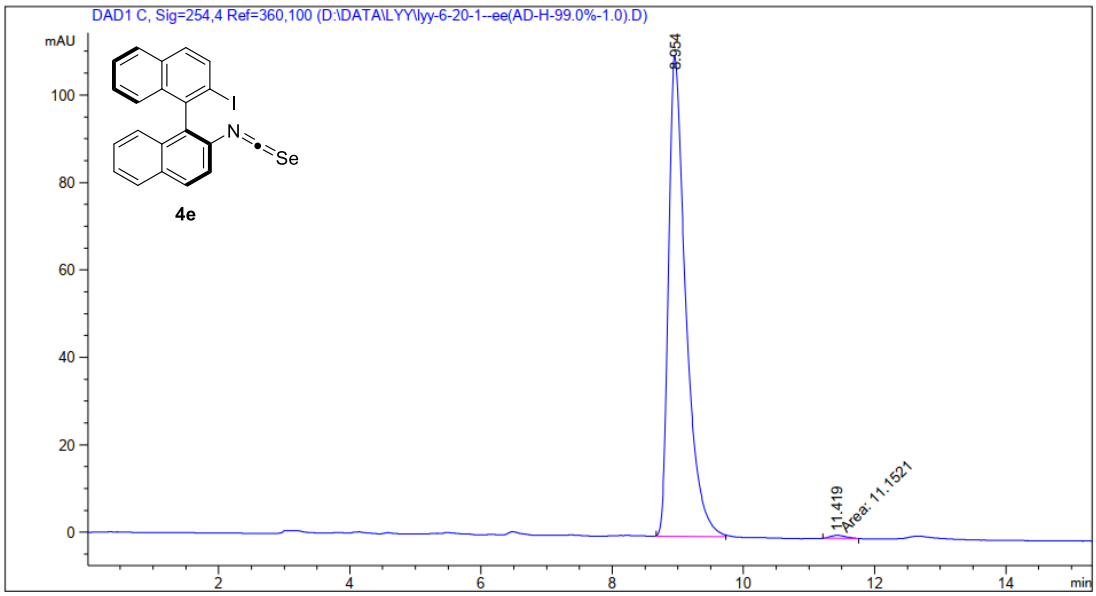

```
==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  18.336 MM    0.6895 1.21913e4   294.69824  98.8470
   2  19.908 MM    0.5276  142.20572    4.49226   1.1530
```

HPLC spectra of **4d**



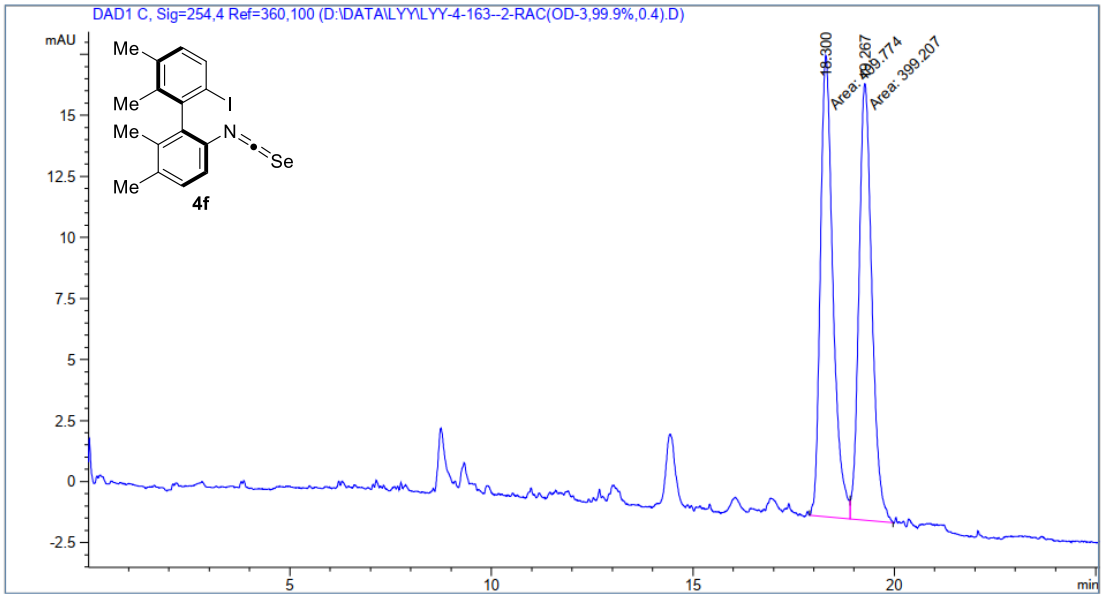

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.956 VB    0.2665 2625.16211  145.49535  50.2292
   2  11.427 BB    0.3224 2601.20264  119.27790  49.7708
```

HPLC spectra of **4e-rac**



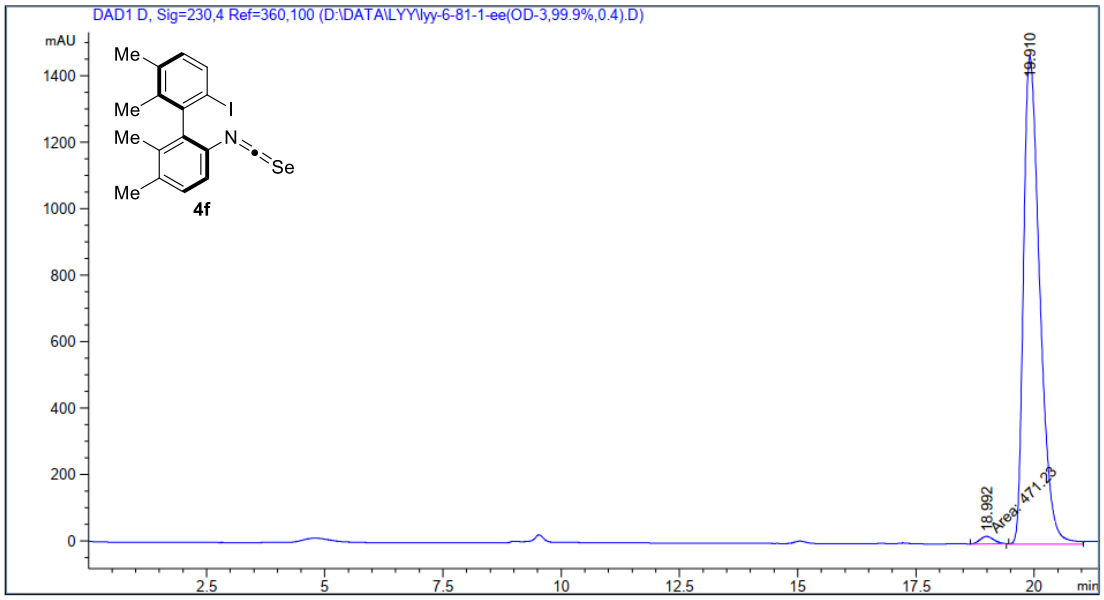

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   8.954 BB    0.2712 2004.41370  109.68398  99.4467
   2  11.419 MM    0.2738   11.15209 6.78901e-1   0.5533
```

HPLC spectra of **4e**



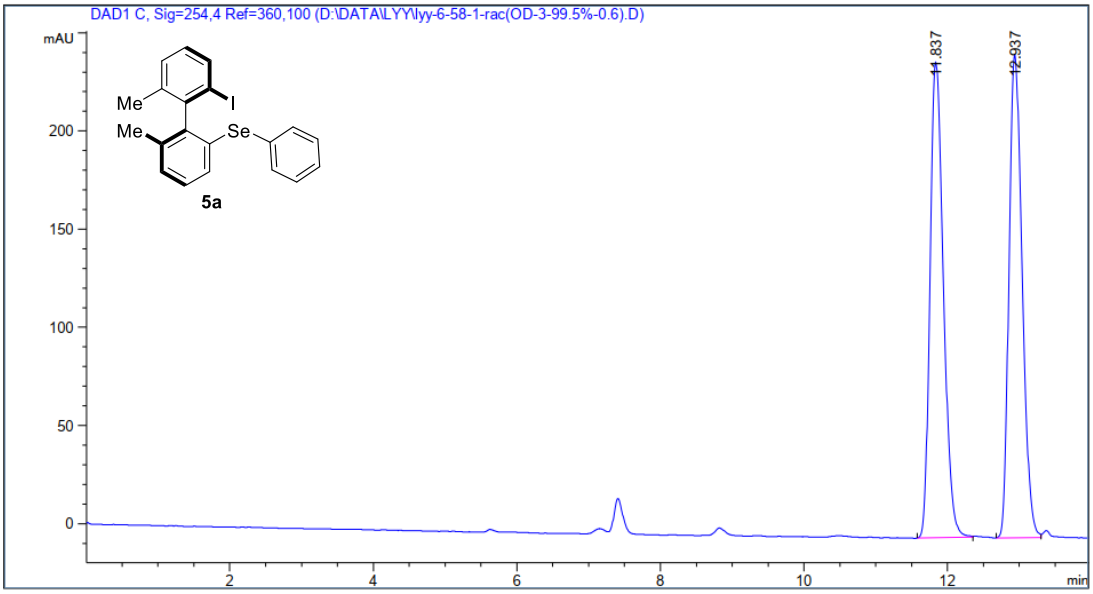

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  18.300 MF    0.3618  409.77390   18.87851  50.6531
   2  19.267 FM    0.3723  399.20679   17.87318  49.3469
```

HPLC spectra of **4f-rac**



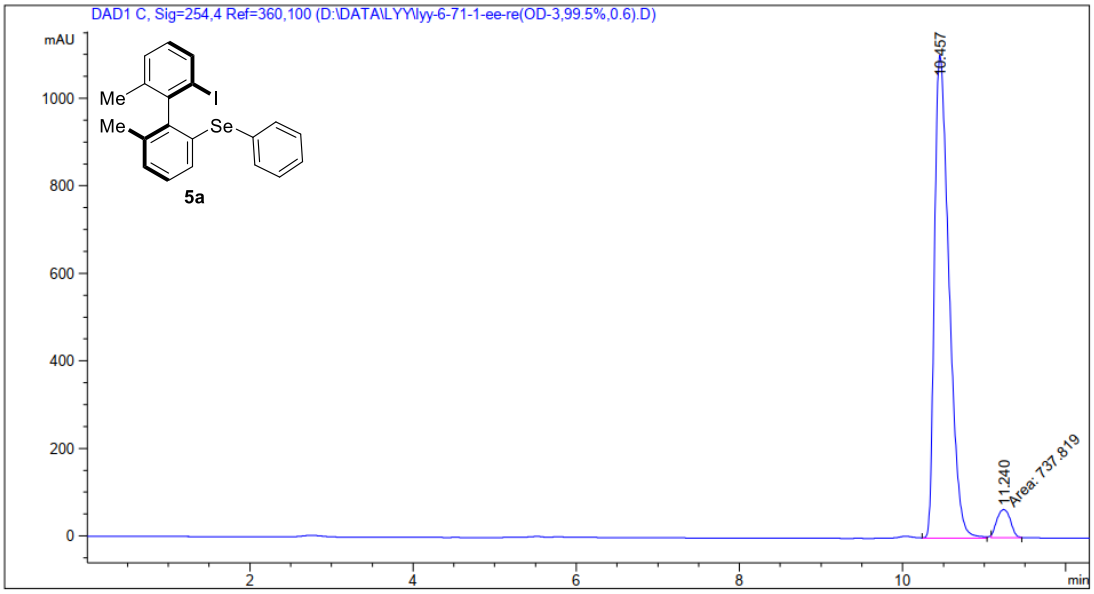

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  18.992 MM    0.3436  471.23044   22.86027   1.3243
   2  19.910 VV    0.3693 3.51120e4  1466.47217  98.6757
```

HPLC spectra of **4f**



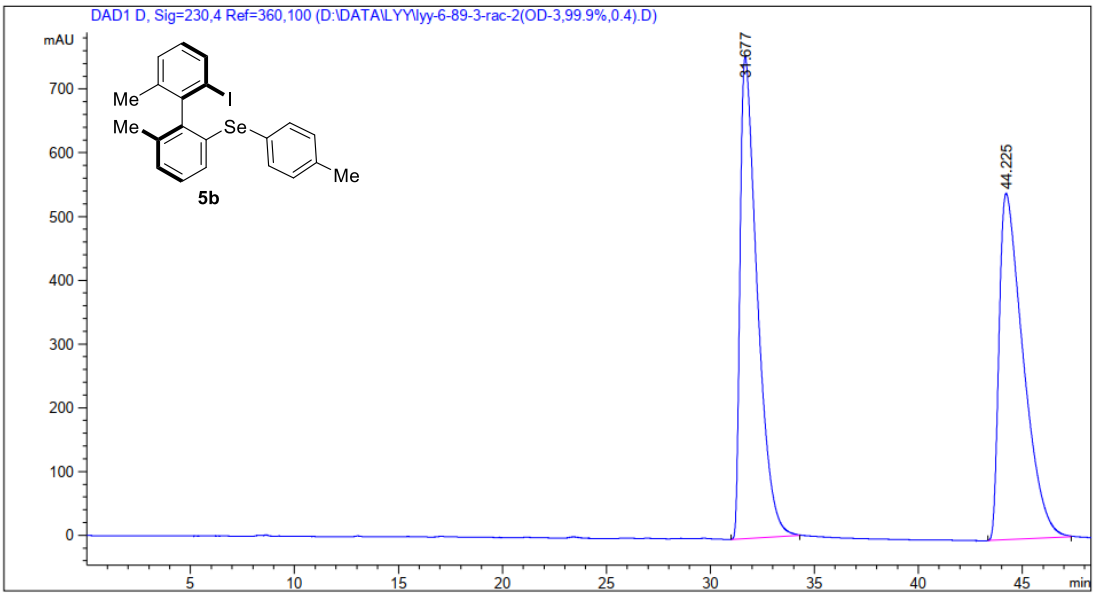

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.837 BB    0.1988 3131.15649  242.21458  50.0193
   2  12.937 BV    0.2004 3128.73560  245.94547  49.9807
```

HPLC spectra of **5a-rac**



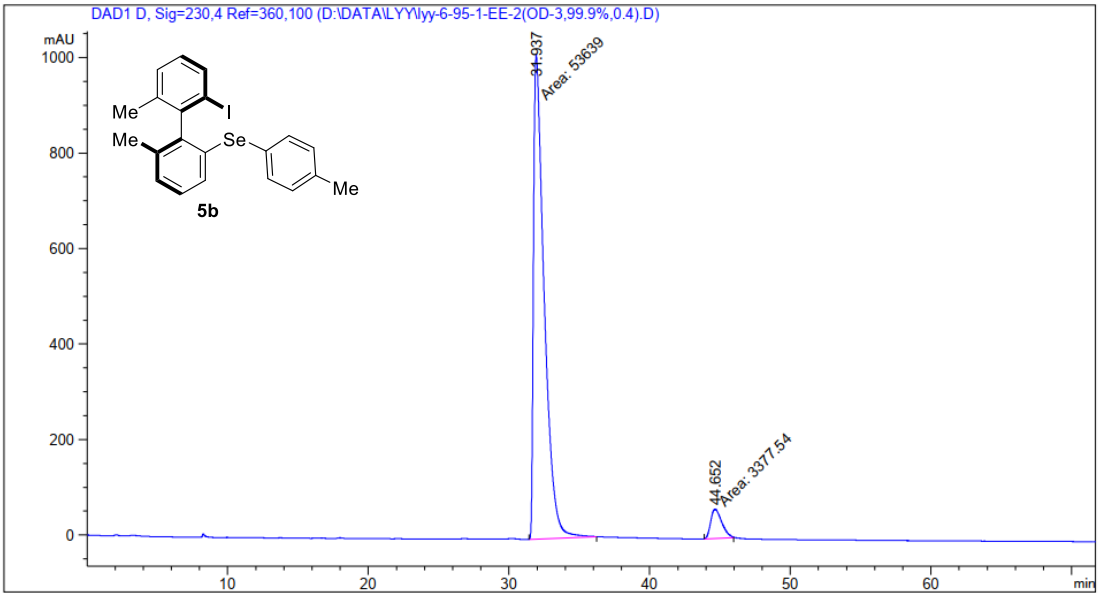

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.457 VV    0.1923 1.36449e4  1103.44958  94.8701
   2  11.240 MM    0.1927  737.81860   63.81617   5.1299
```

HPLC spectra of **5a**



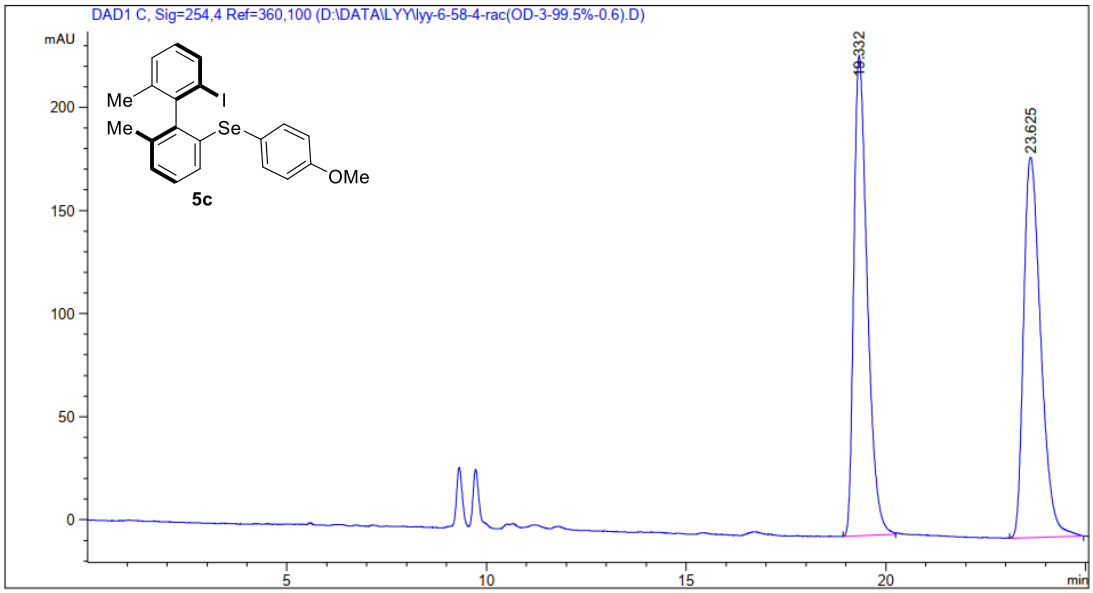

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]    [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  31.677 BB    0.8379 4.32930e4   756.21466  49.7937
   2  44.225 BB    1.1579 4.36518e4   542.99207  50.2063
```

HPLC spectra of **5b-rac**



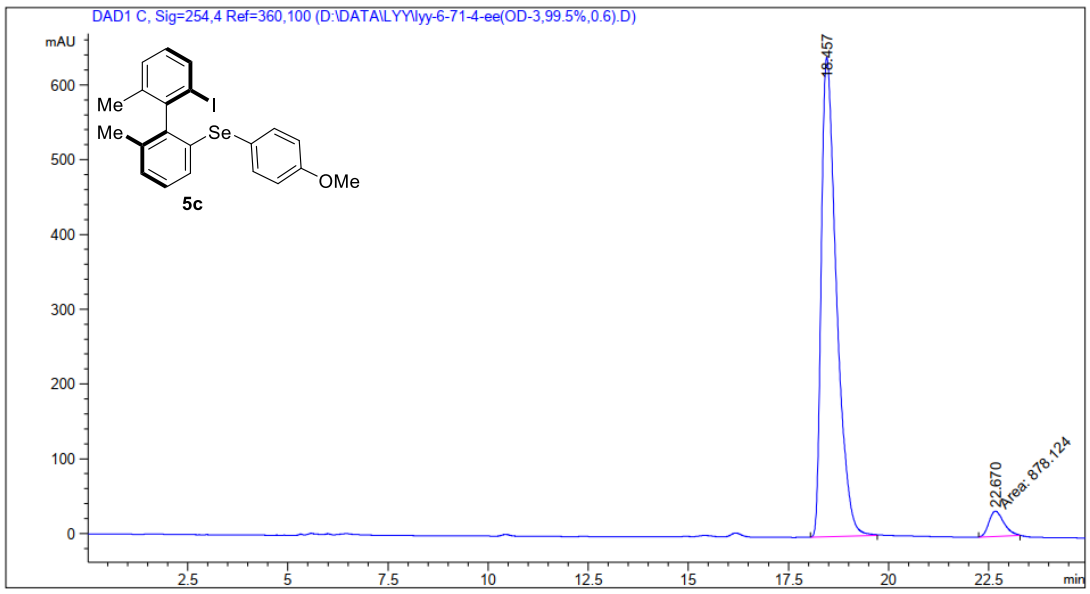

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]    [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  31.937 MM    0.8821 5.36390e4  1013.43005  94.0762
   2  44.652 MM    0.9174 3377.53638   61.35929   5.9238
```

HPLC spectra of **5b**



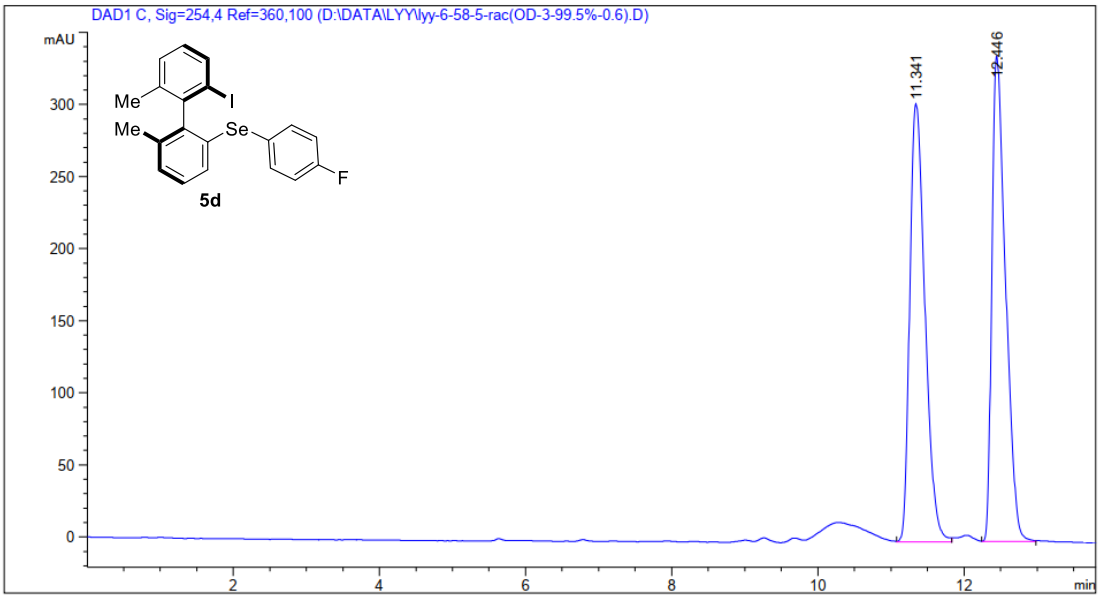

```
==================================================================
                    Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  19.332 BB    0.3568 5445.79492  232.92320  49.6245
   2  23.625 BB    0.4575 5528.20898  184.52164  50.3755
```

HPLC spectra of **5c-rac**



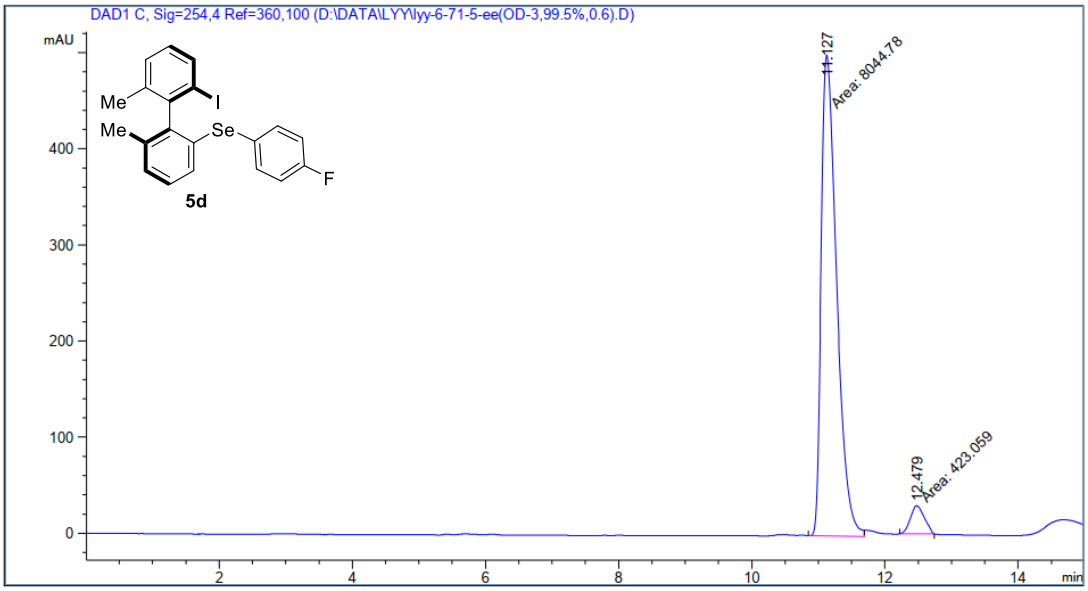

```
==================================================================
                    Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  18.457 BB    0.3993 1.68869e4   641.11707  95.0570
   2  22.670 MM    0.4326  878.12396   33.82783   4.9430
```

HPLC spectra of **5c**



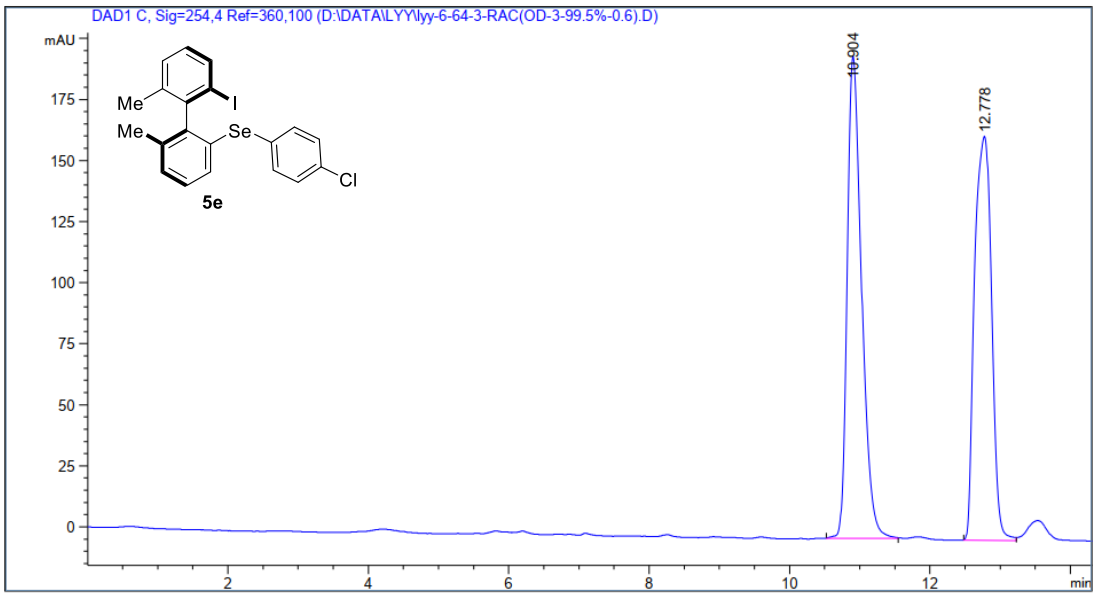

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.341 VB    0.2244 4385.31836  303.84277  50.0754
   2  12.446 VB    0.1934 4372.10742  336.99298  49.9246
```

HPLC spectra of **5d-rac**



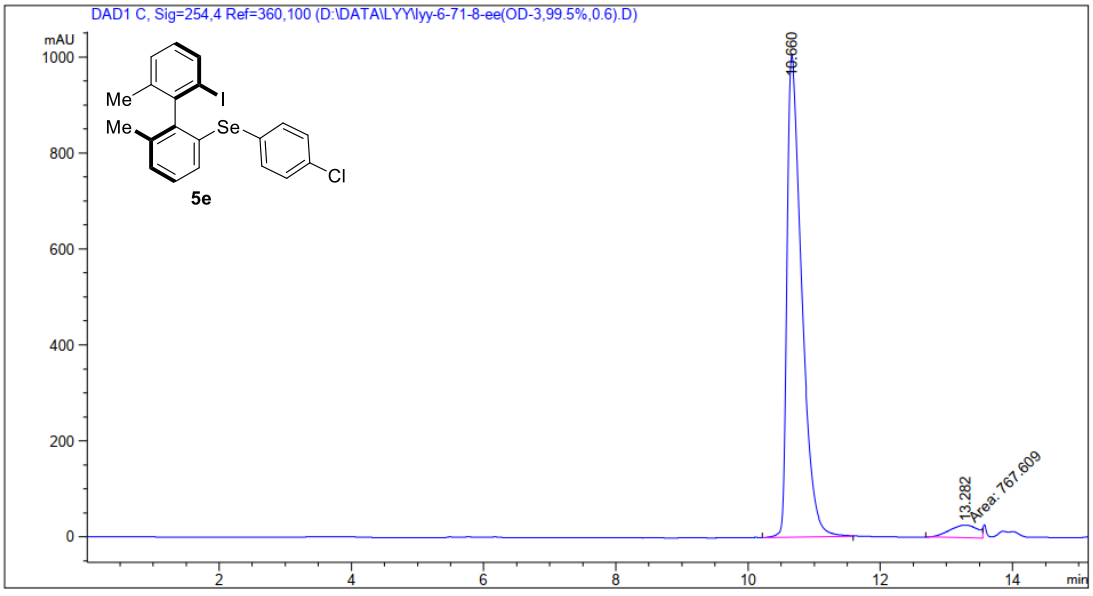

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.127 MM    0.2681 8044.78467  500.03421  95.0039
   2  12.479 MM    0.2424  423.05902   29.09138   4.9961
```

HPLC spectra of **5d**



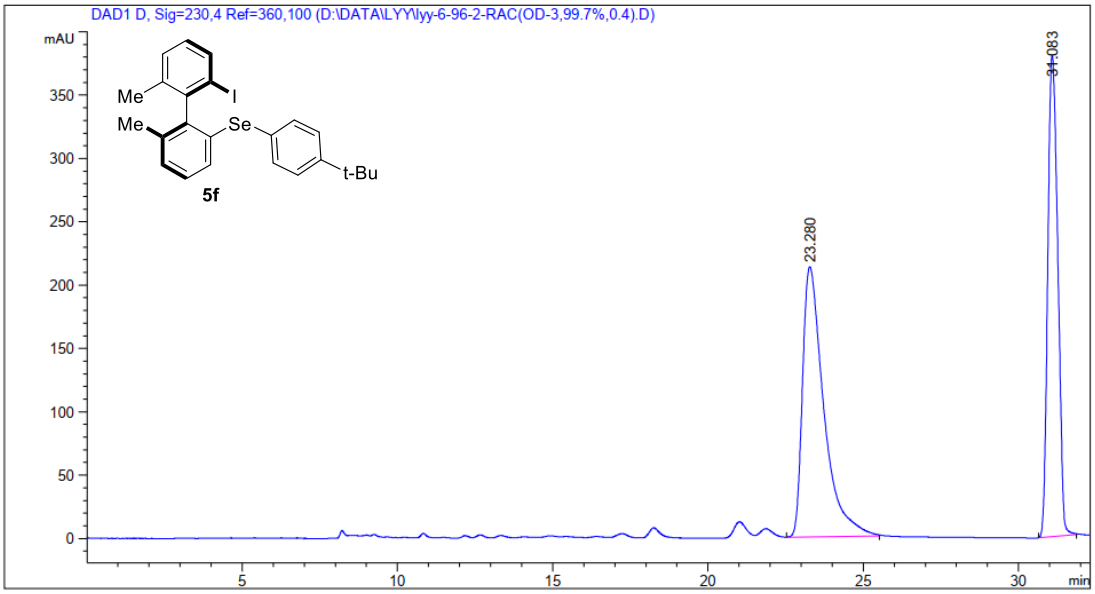

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.904 BB    0.2193 2827.78882  197.25467  50.4195
   2  12.778 BV    0.2802 2780.73462  165.32210  49.5805
```

HPLC spectra of **5e-rac**



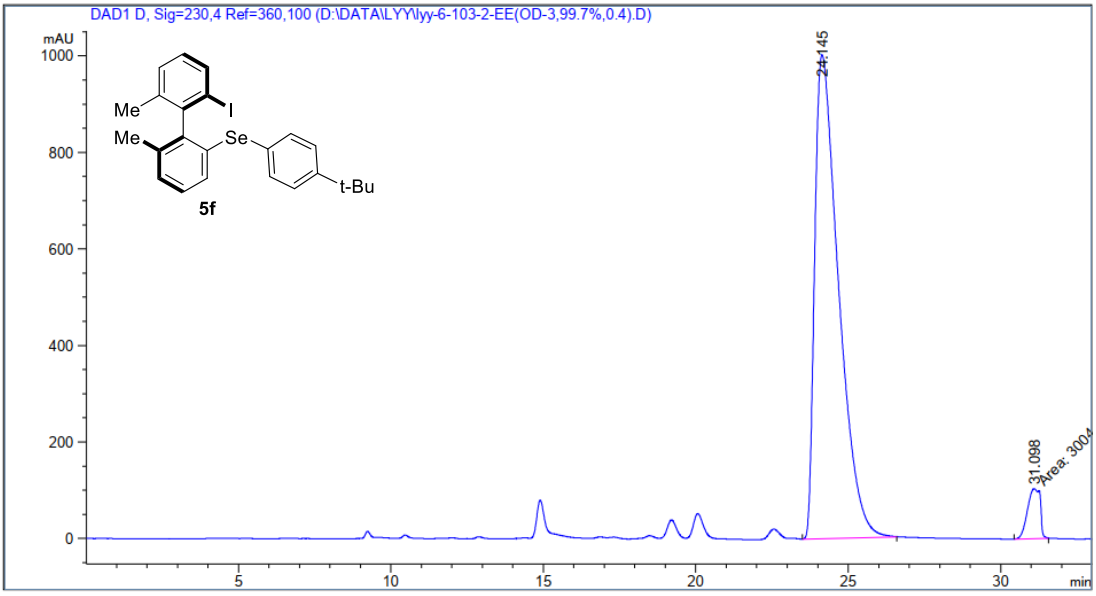

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.660 VB    0.2320 1.55022e4  1004.57373  95.2820
   2  13.282 MM    0.4874  767.60883   26.24605   4.7180
```

HPLC spectra of **5e**



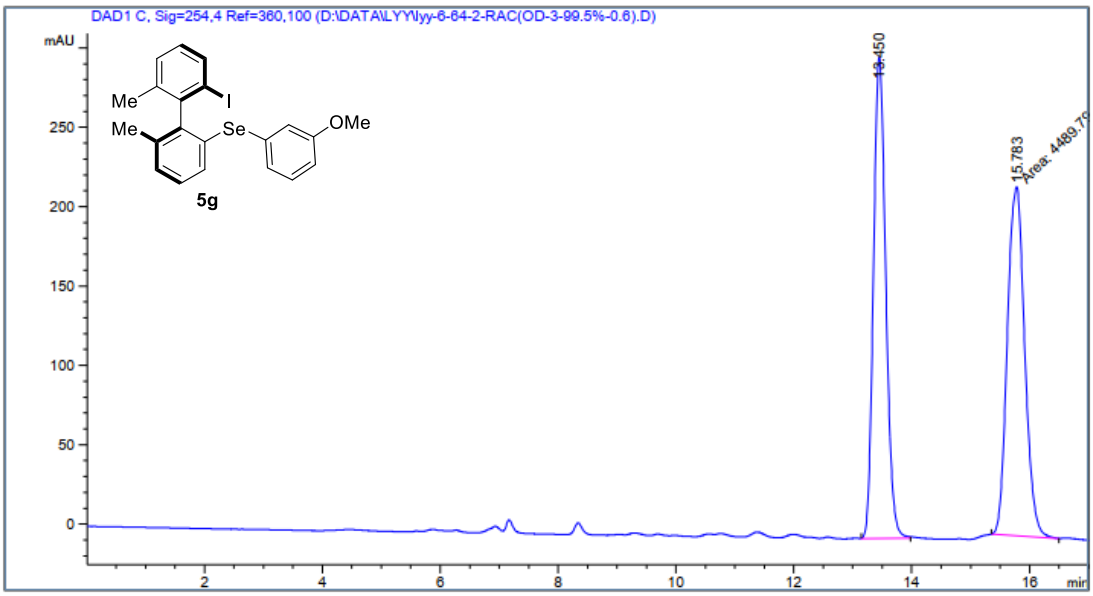

```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]    [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  23.280 VB    0.7063 1.01307e4   213.21255  54.3197
   2  31.083 BB    0.3635 8519.45313  380.03293  45.6803
```

HPLC spectra of **5f-rac**




```
==================================================================
                     Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]       [min]    [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  24.145 BB    0.8003 5.43259e4  1002.42822  94.7586
   2  31.098 MM    0.4844 3004.93970  103.38733   5.2414
```

HPLC spectra of **5f**



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Area Percent Report

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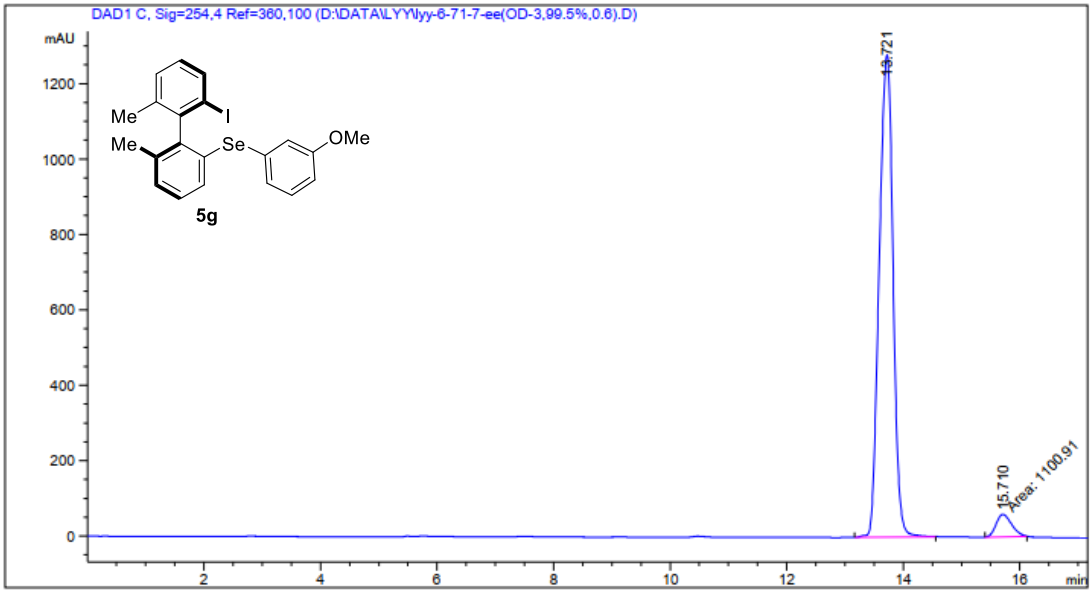
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.450	BB	0.2248	4388.46338	303.23022	49.4294
2	15.783	MM	0.3402	4489.78711	219.94670	50.5706

HPLC spectra of **5g-rac**



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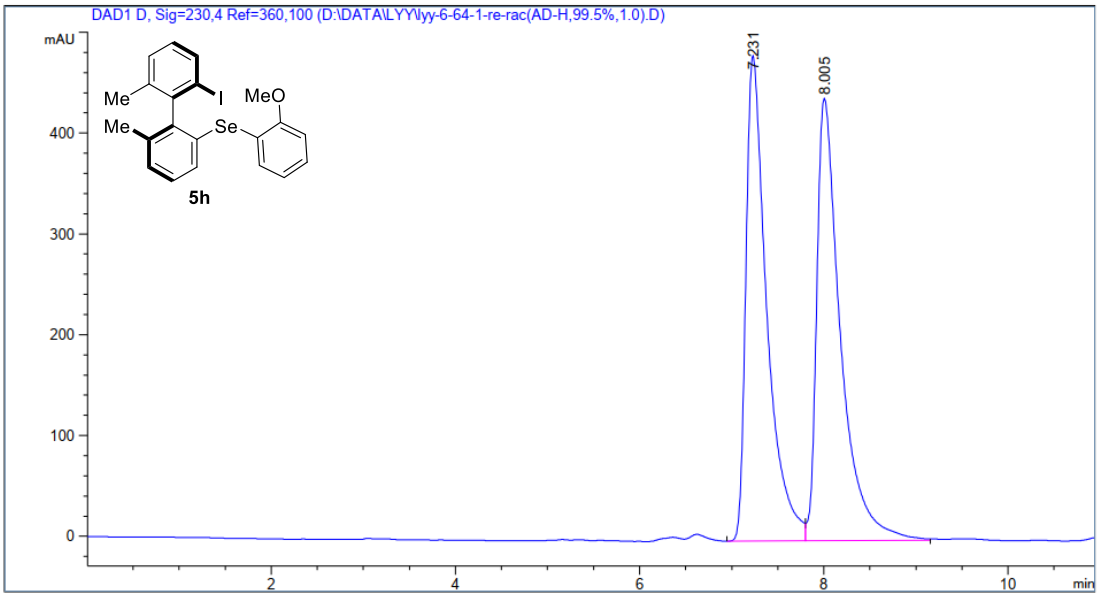
Area Percent Report

==========

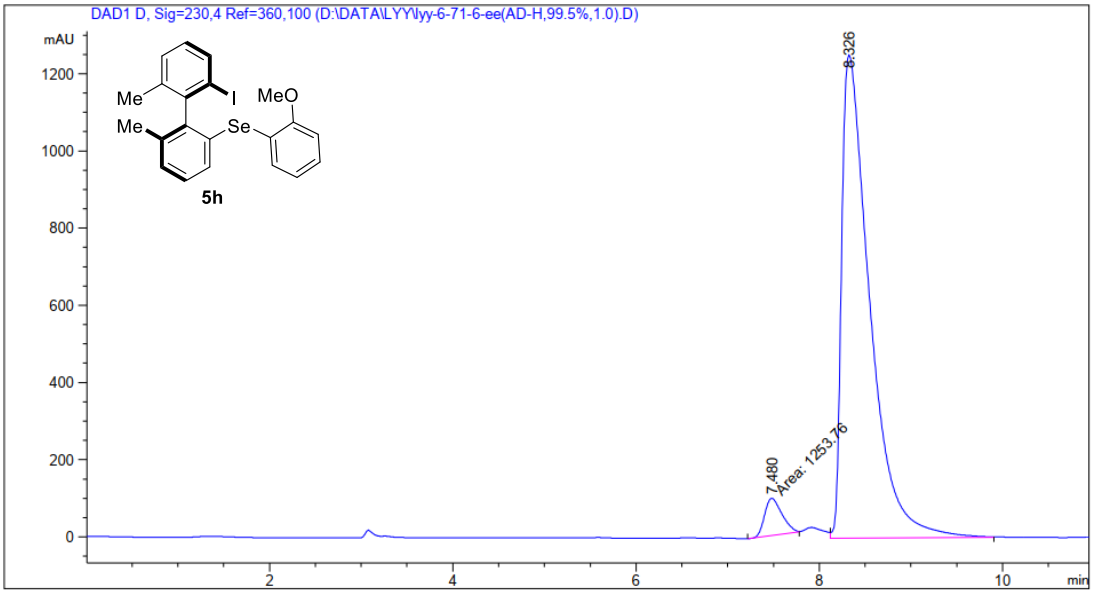
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.721	VB	0.2663	2.10780e4	1278.55042	95.0362
2	15.710	MM	0.3079	1100.91455	59.59592	4.9638

HPLC spectra of **5g**



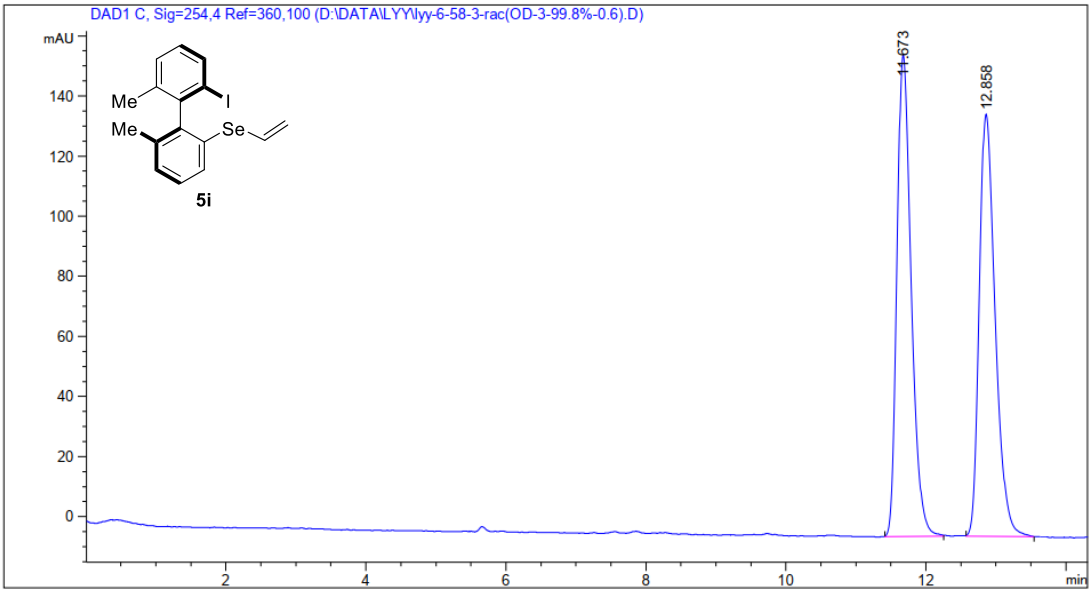

```
=====================================================================
                    Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   7.231 VV    0.2298 7583.20117  481.25137  49.0572
   2   8.005 VB    0.2634 7874.68604  438.66830  50.9428
```

HPLC spectra of **5h-rac**



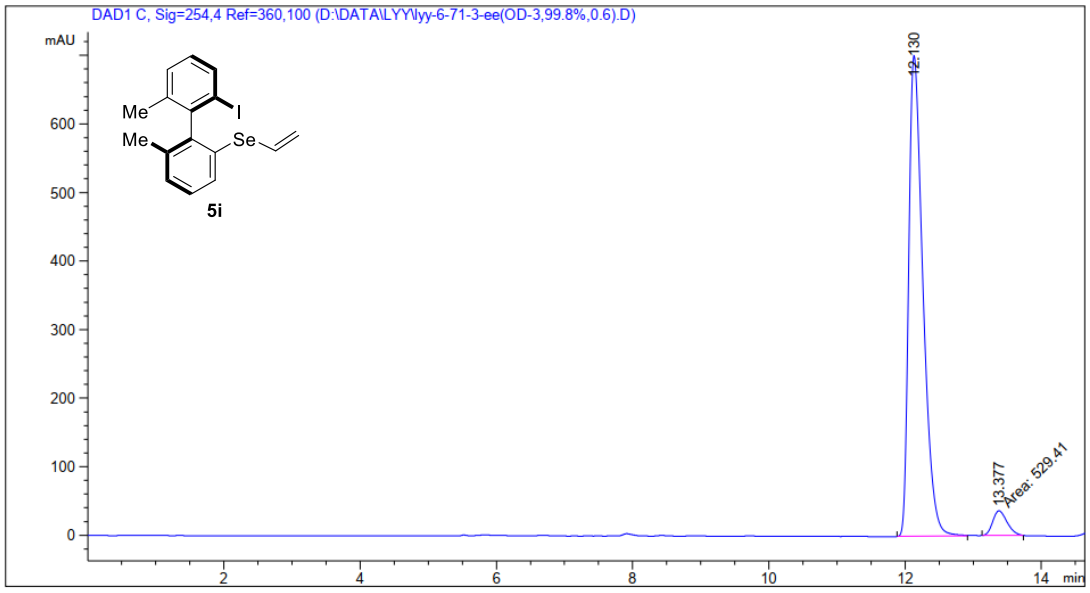

```
=====================================================================
                    Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   7.480 MM    0.2169 1253.75720   96.35194   4.5051
   2   8.326 VB    0.3178 2.65761e4  1251.01343  95.4949
```

HPLC spectra of **5h**



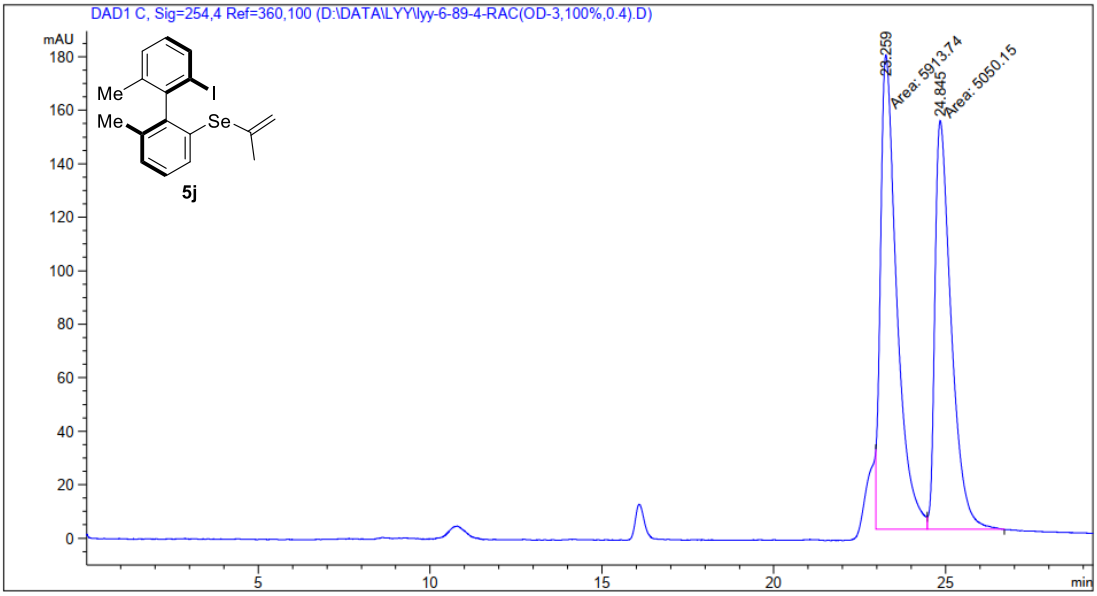

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  11.673 BB    0.2166 2261.01221  160.28281  50.5009
   2  12.858 BB    0.2422 2216.15869  140.33112  49.4991
```

HPLC spectra of **5i-rac**



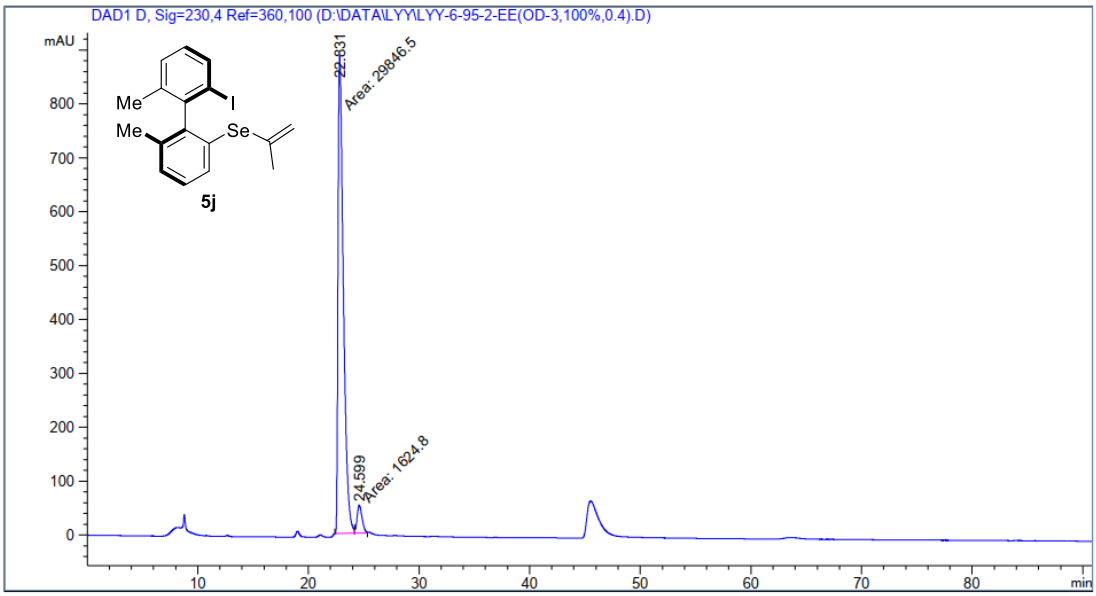

```
=====================================================================
                      Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  12.130 BB    0.2205 1.01287e4   701.26959  95.0328
   2  13.377 MM    0.2443  529.41034   36.11733   4.9672
```

HPLC spectra of **5i**



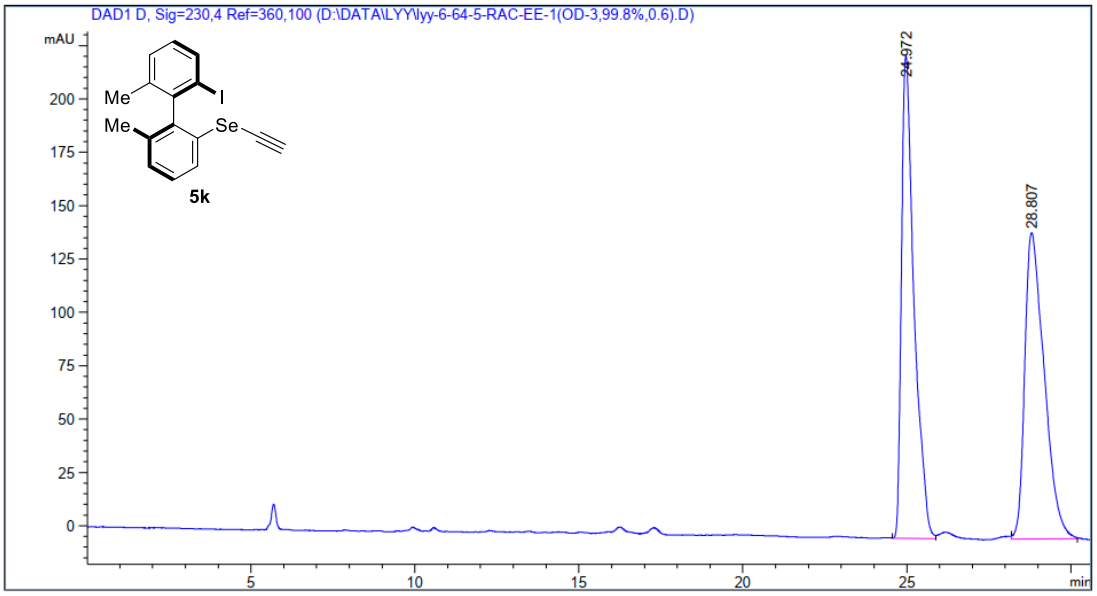

```
==================================================================================
                                Area Percent Report
==================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  23.259 MF    0.5558 5913.73730  177.34207  53.9383
   2  24.845 FM    0.5509 5050.14893  152.78676  46.0617
```

HPLC spectra of **5j-rac**



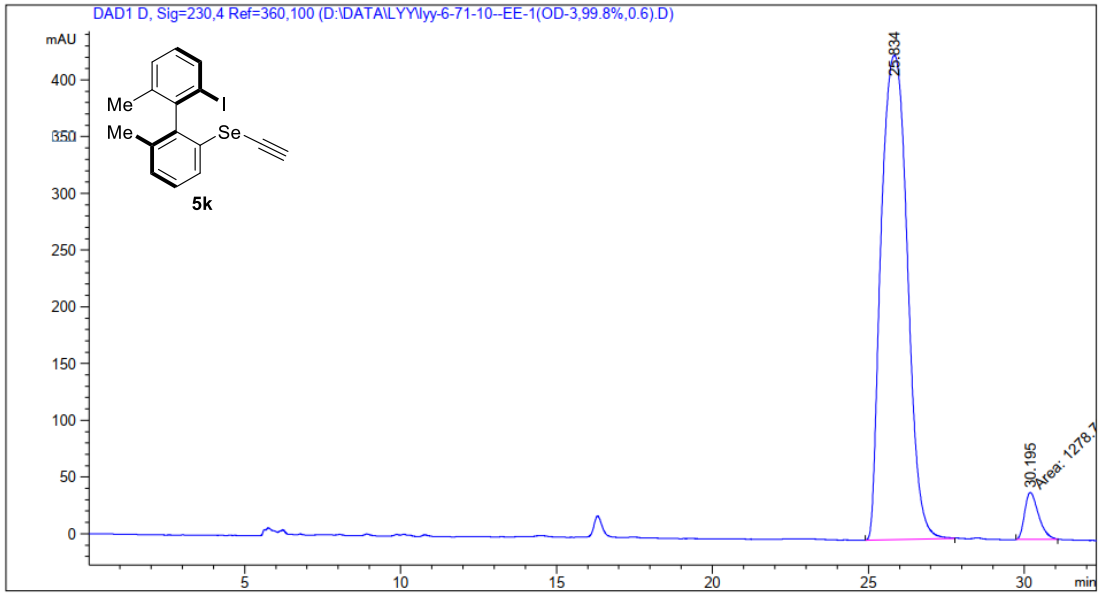

```
==================================================================================
                                Area Percent Report
==================================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  22.831 MF    0.5621 2.98465e4   884.89301  94.8372
   2  24.599 FM    0.5244 1624.79602   51.64217   5.1628
```

HPLC spectra of **5j**



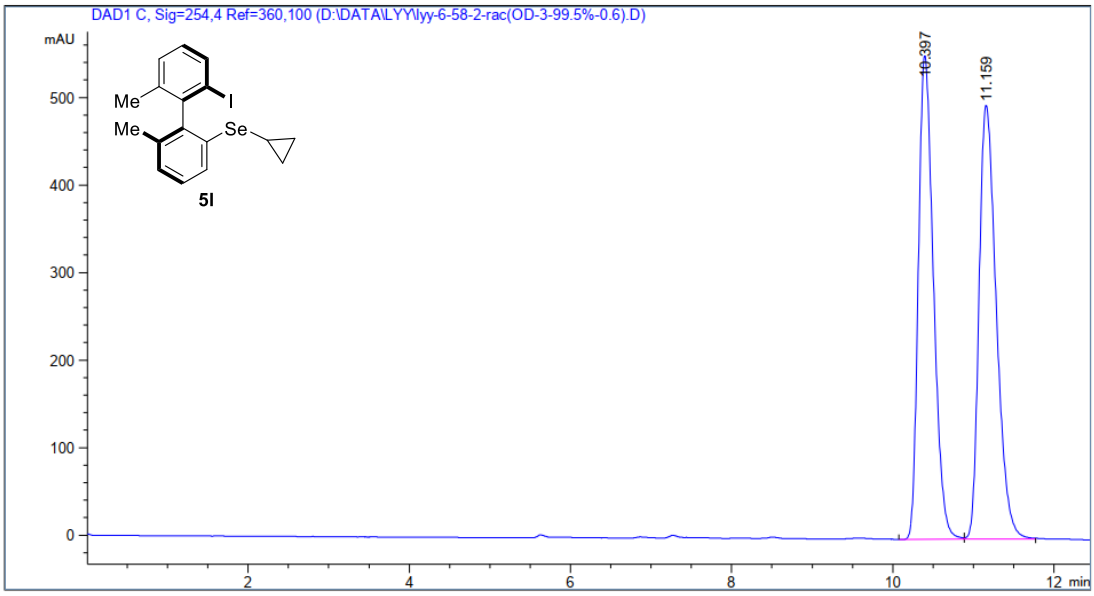

```
=====================================================================
                    Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  24.972 BB    0.3922 6012.13818  226.11945  50.3819
   2  28.807 BB    0.6036 5921.00293  143.42139  49.6181
```

HPLC spectra of **5k-rac**



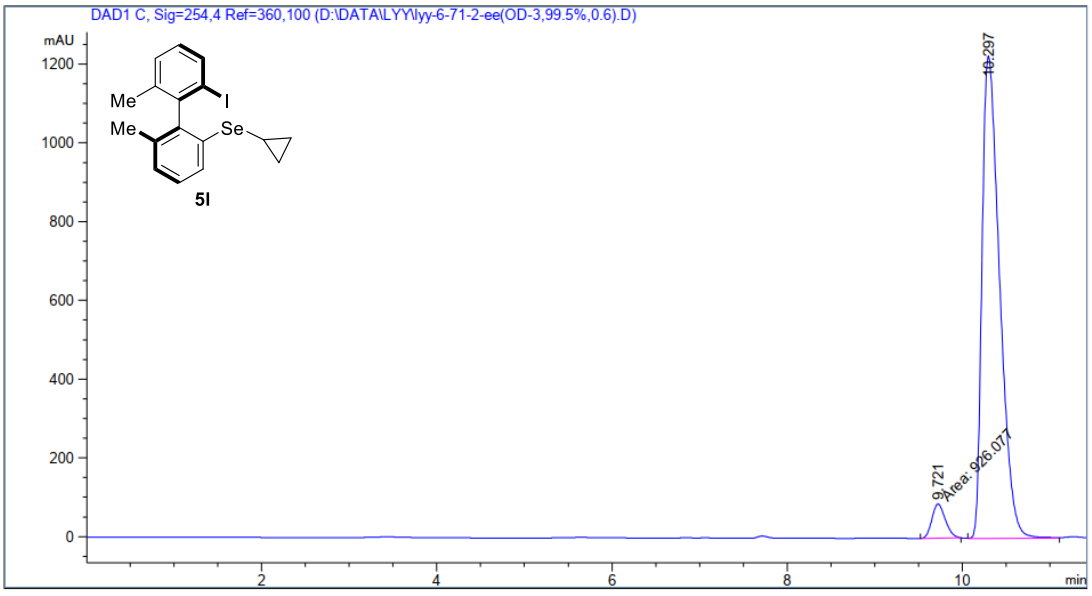

```
=====================================================================
                    Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  25.834 BB    0.9697 2.48714e4   426.90152  95.1099
   2  30.195 MM    0.5156 1278.76111   41.33352   4.8901
```

HPLC spectra of **5k**



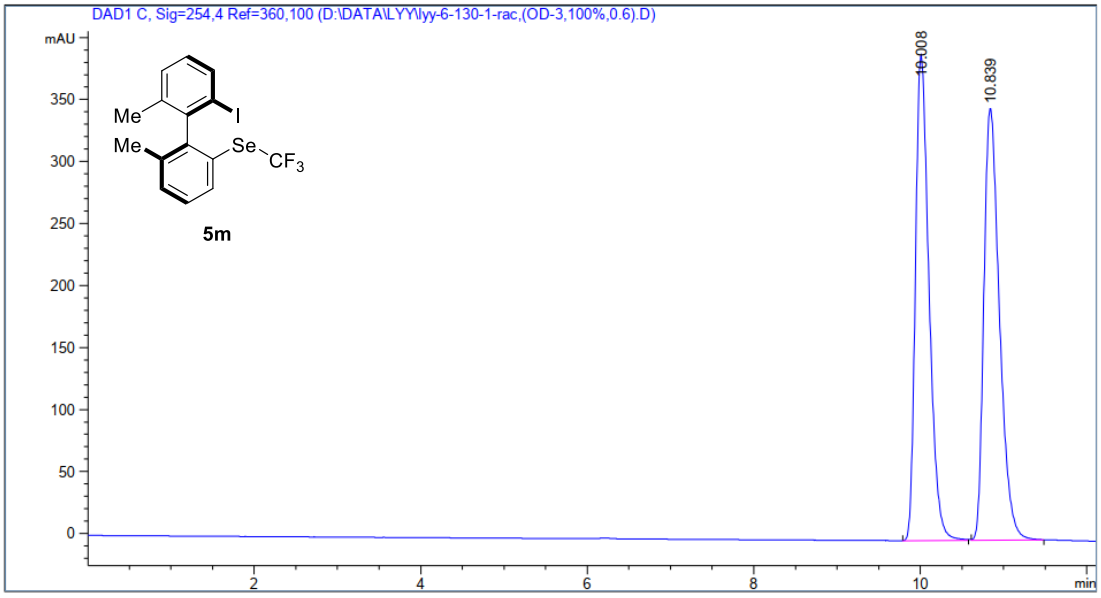

```
==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.397 VV    0.2010 7151.31152  552.51837  49.2268
   2  11.159 VB    0.2317 7375.94678  495.28275  50.7732
```

HPLC spectra of **5l**



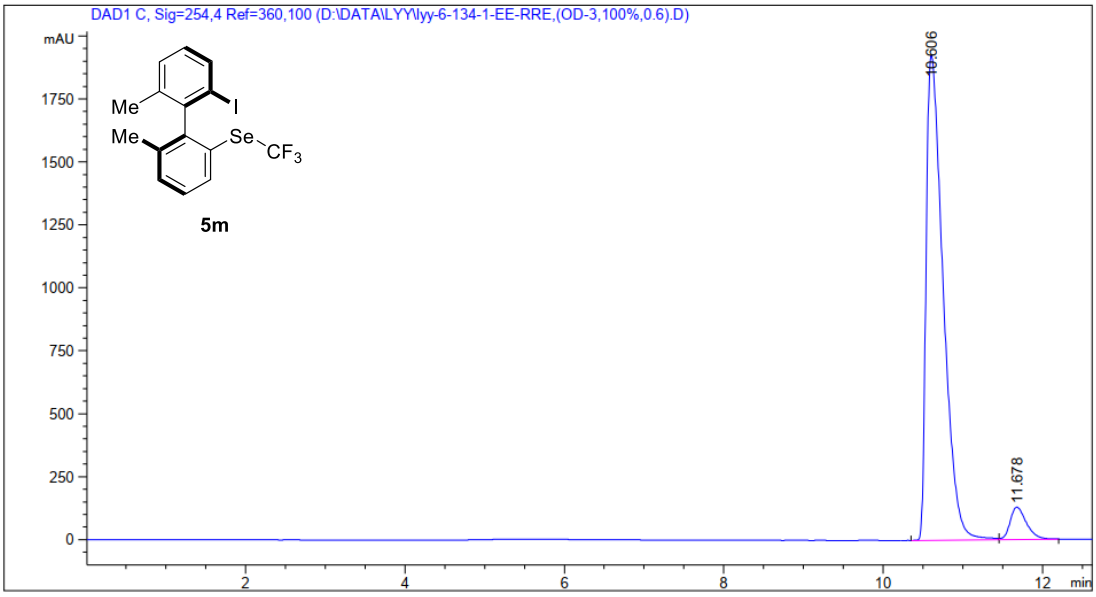

```
==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1   9.721 MM    0.1778  926.07727   86.79826   5.1350
   2  10.297 VB    0.2149 1.71087e4  1225.09619  94.8650
```

HPLC spectra of **5l**



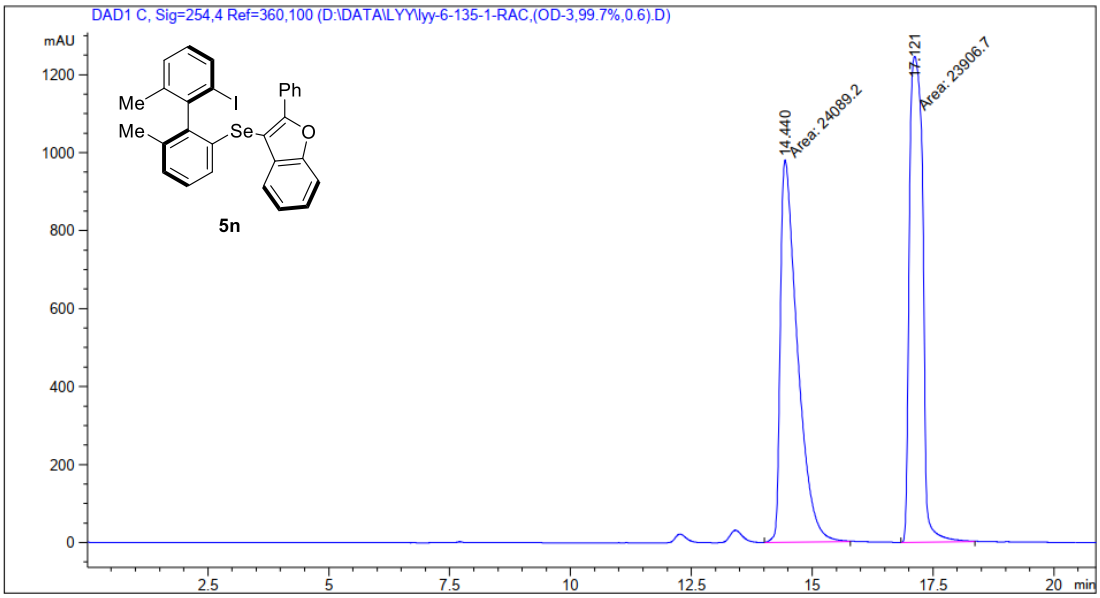

```
==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.008 BB    0.1741 4429.84863  391.35587  49.4391
   2  10.839 BB    0.1996 4530.36914  348.74747  50.5609
```

HPLC spectra of **5m-rac**



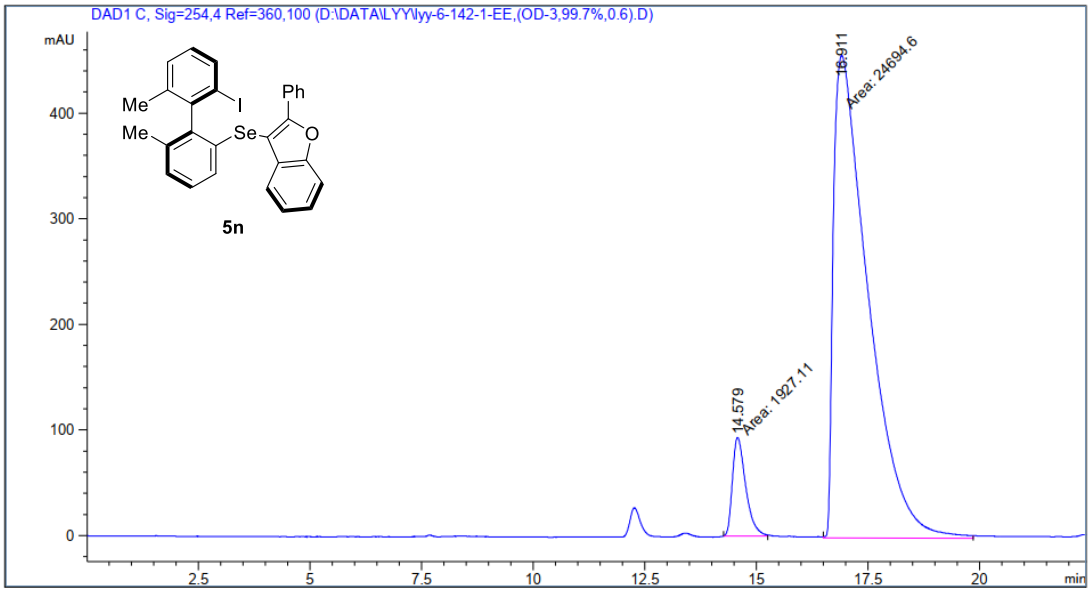

```
==================================================================
                      Area Percent Report
==================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  10.606 VV    0.2260 2.83852e4  1925.06250  93.9385
   2  11.678 VB    0.2163 1831.57947  128.45947   6.0615
```

HPLC spectra of **5m**




```
=====================================================================
                        Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  14.440 MM    0.4093 2.40892e4   980.92352  50.1900
   2  17.121 MM    0.3198 2.39067e4  1245.78992  49.8100
```

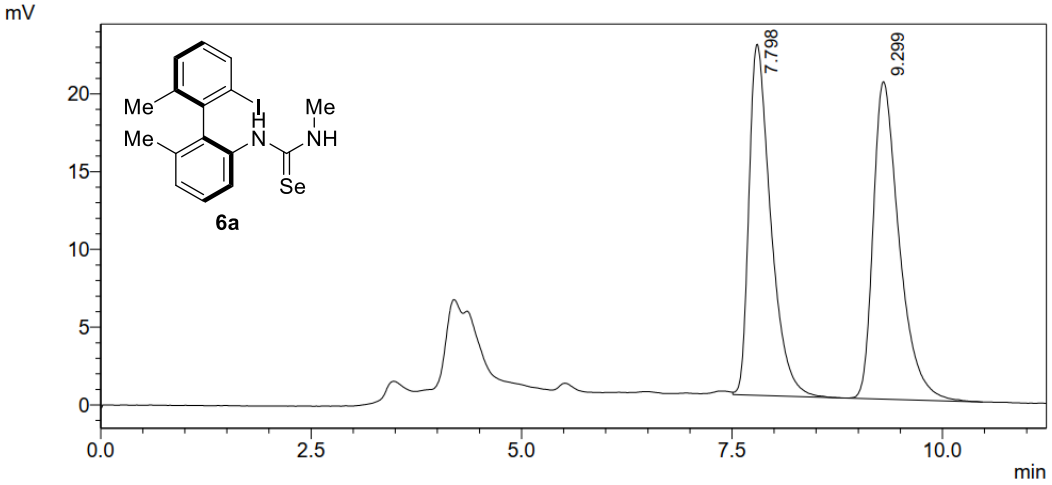
HPLC spectra of **5n-rac**




```
=====================================================================
                        Area Percent Report
=====================================================================
Peak RetTime Type  Width     Area      Height     Area
  #   [min]        [min]   [mAU*s]     [mAU]       %
----|-------|----|-------|----------|----------|--------|
   1  14.579 MM    0.3436 1927.10999   93.46421   7.2389
   2  16.911 MM    0.9012 2.46946e4   456.71765  92.7611
```

HPLC spectra of **5n**

<Chromatogram>



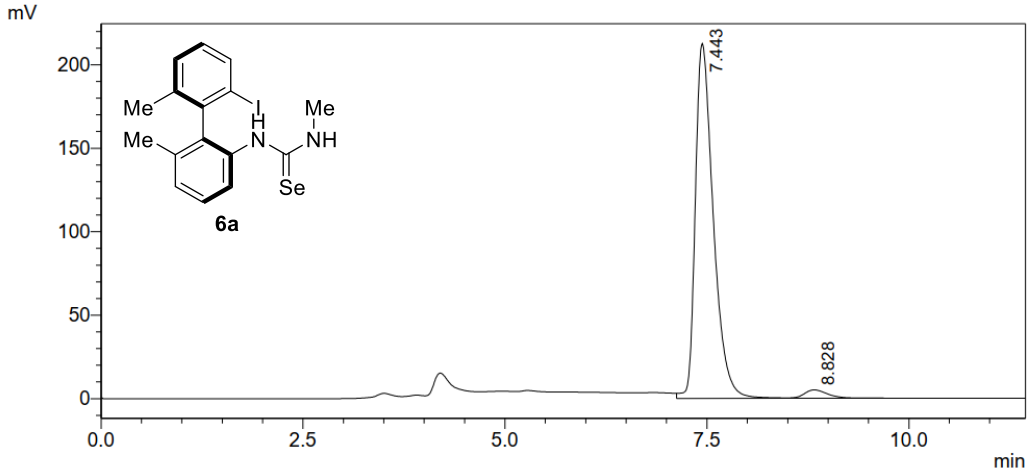
<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.798	406613	22569	48.036			
2	9.299	439857	20418	51.964			
Total		846470	42987				

HPLC spectra of **6a-rac**

<Chromatogram>



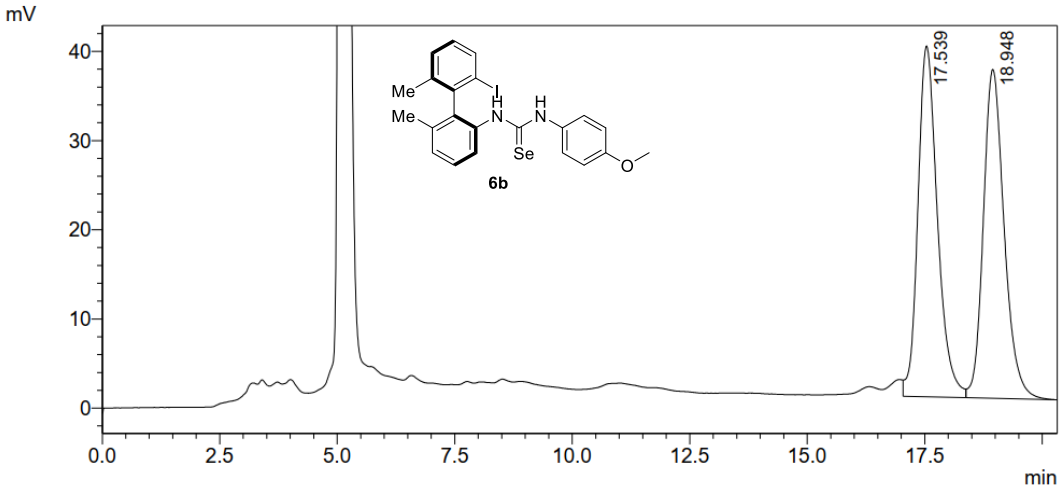
<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	7.443	3292517	212602	96.963			
2	8.828	103115	5067	3.037		V M	
Total		3395632	217670				

HPLC spectra of **6a**

<Chromatogram>



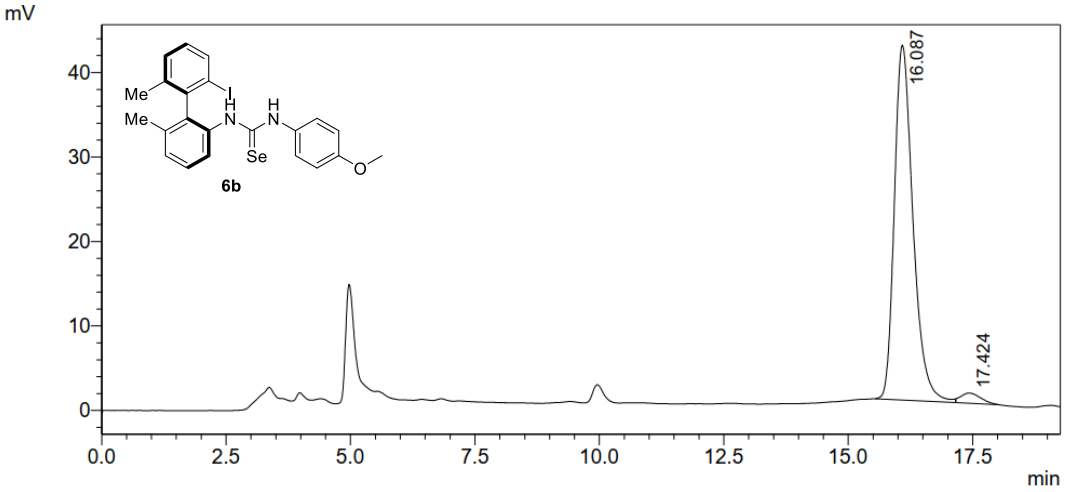
<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	17.539	1137788	39327	50.007			
2	18.948	1137472	36882	49.993		V	
Total		2275260	76209				

HPLC spectra of **6b-rac**

<Chromatogram>



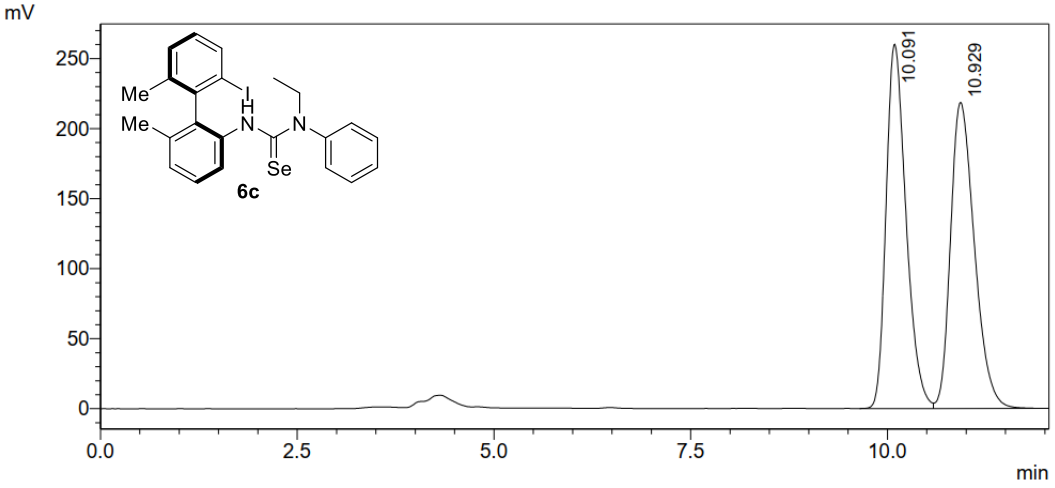
<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	16.087	1091861	41982	97.011		M	
2	17.424	33638	1196	2.989		V M	
Total		1125499	43178				

HPLC spectra of **6b**

<Chromatogram>



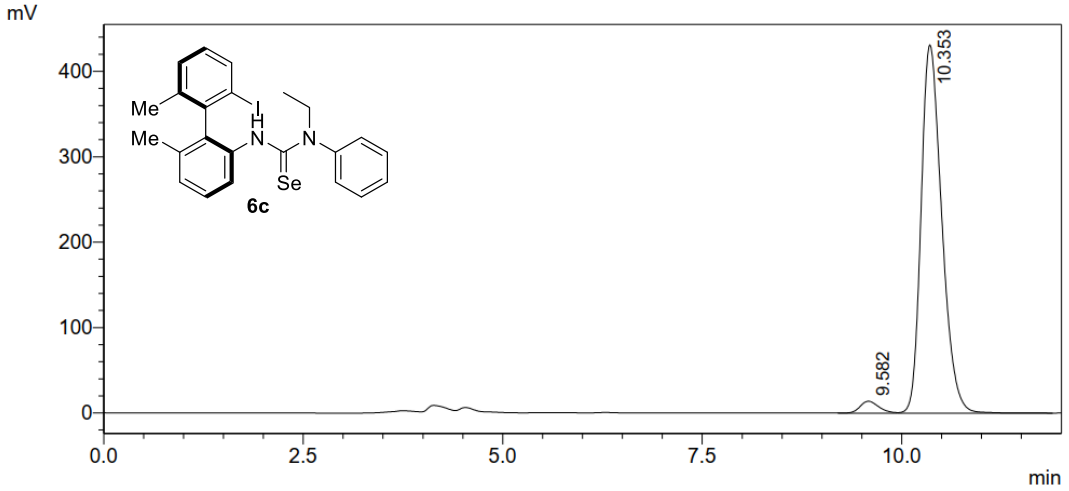
<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	10.091	4594223	260047	49.897		V	
2	10.929	4613185	218531	50.103		V	
Total		9207408	478578				

HPLC spectra of **6c-rac**

<Chromatogram>



<Peak Table>

Detector A Channel 1 254nm

Peak#	Ret. Time	Area	Height	Conc.	Unit	Mark	Name
1	9.582	227642	13948	2.844		V	
2	10.353	7777707	431030	97.156		SV	
Total		8005349	444978				

HPLC spectra of **6c**