

Supporting Information

Ag(I)-catalyzed three-components radical cascade synthesis of 3-organoselenyl chromones from 2-methoxyaryl alkynones, Se powder and organic boronic acids under aerobic conditions

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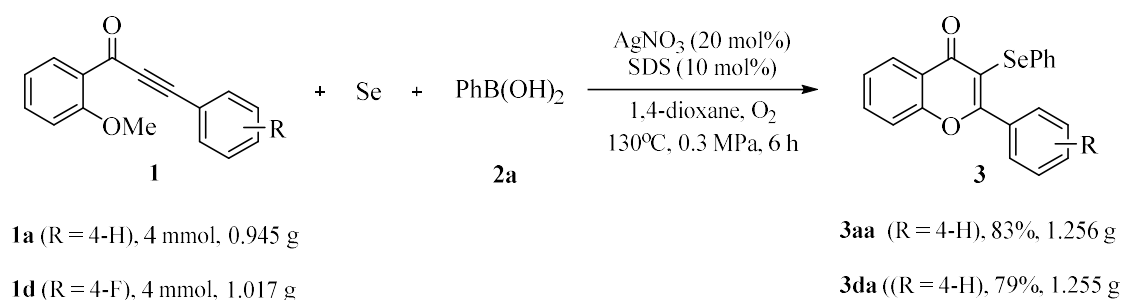
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1. General remarks

The ^1H , ^{13}C , ^{77}Se and ^{19}F NMR analyses were performed on a Bruker AVANCE III 500 MHz or 400 MHz spectrometer in deuterated solvents. ^1H , and ^{13}C NMR spectra were recorded with tetramethylsilane (TMS) as internal standard. The ^{77}Se NMR spectra were recorded with diphenyl diselenide ($\delta = 461$ ppm) as external standard. The ^{19}F NMR spectra were recorded with CFCl_3 ($\delta = 0$ ppm) as external standard. Low-resolution mass analyses were performed on a Thermo Scientific TRACE ISQ GC-MS instrument in EI mode (70 eV). High resolution mass analyses of new products **3ag**, **3ah**, **3aj**, **3ak**, **3ap**, **3ea**, **3fa**, **3ga** and **3oa** were performed on an Agilent 6545 LC/Q-TOF mass spectrometer in positive ESI mode. Melting points (uncorrected) were determined on a BUCHI M-565 apparatus. Gas chromatography (GC) analyses were performed on a Shimadzu GC-2010 Plus instrument with FID detector using a Shimadzu SH-Rtx-5 capillary column (30 m x 0.32 mm (i.d.), 0.25 μm).

Reagents and solvents were purchased as reagent grade and were directly used without further purification. The reactants 2-methoxyaryl alkynones **1** were prepared according to literature methods.^[1,2] Flash column chromatography were performed on silica gel (200-300 mesh) with petroleum ether/ethyl acetate as eluent.

2. Syntheses of 3-organoselenyl chromone **3aa** and **3da** on a gram scale

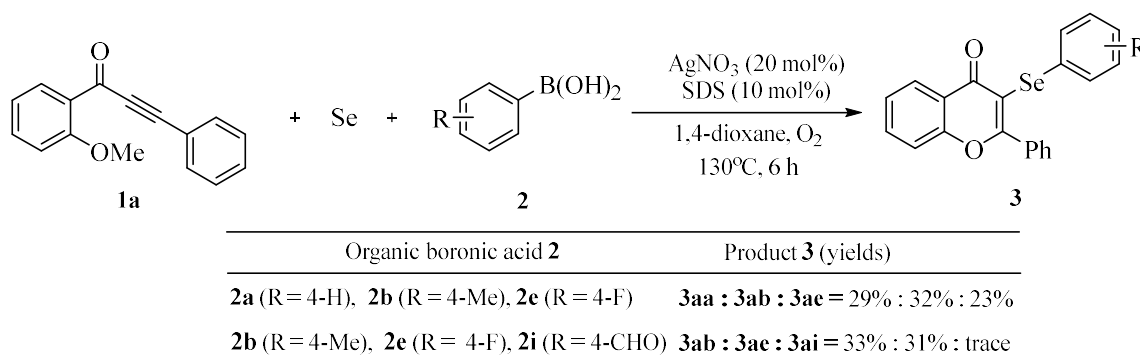


To a 110 mL of Teflon-lined stainless steel autoclave was added 1-(2-methoxy)phenyl-3-phenylprop-2-yn-1-one **1a** (4 mmol), Se powder (4.8 mmol), phenyl boronic acids **2a** (4.8 mmol), AgNO_3 (0.8 mmol), SDS (0.4 mmol) and 1,4-dioxane (14 mL). The autoclave was then carefully closed, charged

with O₂ to 0.3 MPa and put into a preheated 130 °C oil bath for 6 h under stirring condition. After completing reaction, the autoclave was cooled to room temperature and carefully depressurized. The crude reaction mixture in the autoclave was poured into saturated ammonia water (100 mL) and extracted with CH₂Cl₂ (3×100 mL). The extractions were combined, dried over anhydrous Na₂SO₄, filtrated and removed the solvent under reduced pressure. The residual was purified by flash chromatography on silica to afford 1.256 g of 2-phenyl-3-phenylselanyl-4*H*-chromen-4-one **3aa** in 83% yield.

After the reactant **1a** was changed with 1-(2-methoxy)phenyl-3-(4-fluoro)phenylprop-2-yn-1-one (**1d**) and through the same reaction procedure, 1.255 g of 2-(4-fluoro)phenyl-3-phenylselanyl-4*H*-chromen-4-one **3da** was isolated in 79% yield.

3. Combinatorial syntheses of 3-organoselenyl chromones



To a 30 mL of Teflon-lined stainless steel autoclave was added 1-(2-methoxy)phenyl-3-phenylprop-2-yn-1-one **1a** (0.6 mmol), Se powder (0.72 mmol), phenylboronic acid **2a** (0.24 mmol), 4-methylphenyl boronic acid **2b** (0.24 mmol), 4-fluorophenyl boronic acid **2e** (0.24 mmol), AgNO₃ (0.12 mmol), SDS (0.06 mmol) and 1,4-dioxane (2 mL). The autoclave was then carefully closed, charged with O₂ and put into a preheated 130 °C oil bath for 6 h under stirring condition. After completing reaction, the autoclave was cooled to room temperature and carefully depressurized. The crude reaction mixture in the autoclave was poured into saturated ammonia water (10 mL) and

extracted with CH₂Cl₂ (2×10 mL). The extractions were combined, dried over anhydrous Na₂SO₄, filtrated and removed the solvent under reduced pressure. The residual was purified by flash chromatography on silica to afford 2-phenyl-3-phenylselanyl-4*H*-chromen-4-one **3aa**, 2-phenyl-3-(4-methyl)phenylselanyl-4*H*-chromen-4-one **3ab**, and 2-phenyl-3-(4-fluoro)phenylselanyl-4*H*-chromen-4-one **3ae** in 29%, 32% and 23% yields, respectively.

After the set of boronic acids **2a**, **2b** and **2e** was changed with equimole of 4-methylphenyl boronic acid **2b**, 4-fluorophenyl boronic acid **2e** and 4-formylphenyl boronic acid **2i** and through the same reaction procedure, 2-phenyl-3-(4-methyl)phenylselanyl-4*H*-chromen-4-one **3ab** and 2-phenyl-3-(4-fluoro)phenylselanyl-4*H*-chromen-4-one **3ae** were isolated in 33% and 31%, respectively. Only a trace amount of 3-(4-formyl)phenylselanyl-2-phenyl-4*H*-chromen-4-one **3ai** was observed in the reaction mixture.

4. Mechanism studies

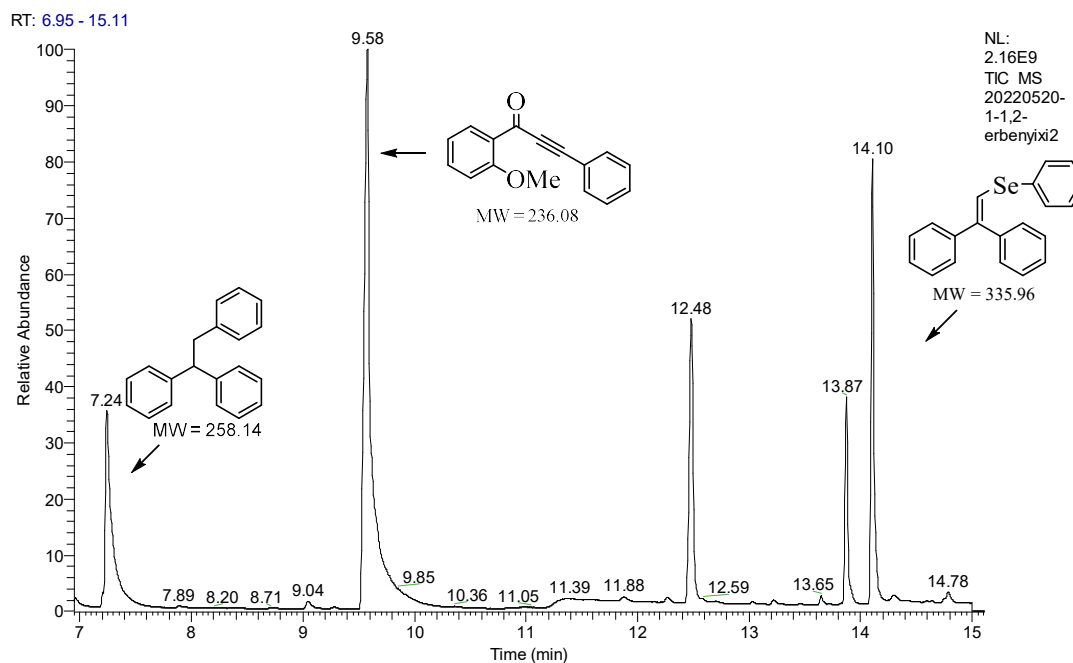


Figure S1 GC chromatogram of the reaction mixture of 1-(2-methoxy)phenyl-3-phenylprop-2-yn-1-one (**1a**), Se powder and phenyl boronic acid (**1b**) in the presence of 1,1-diphenylethylene

20220520-1-1,2-erbenyxi2 #676 RT: 7.30 AV: 1 NL: 3.50E7
T: {0.0} + c EI Full ms [50.00-500.00]

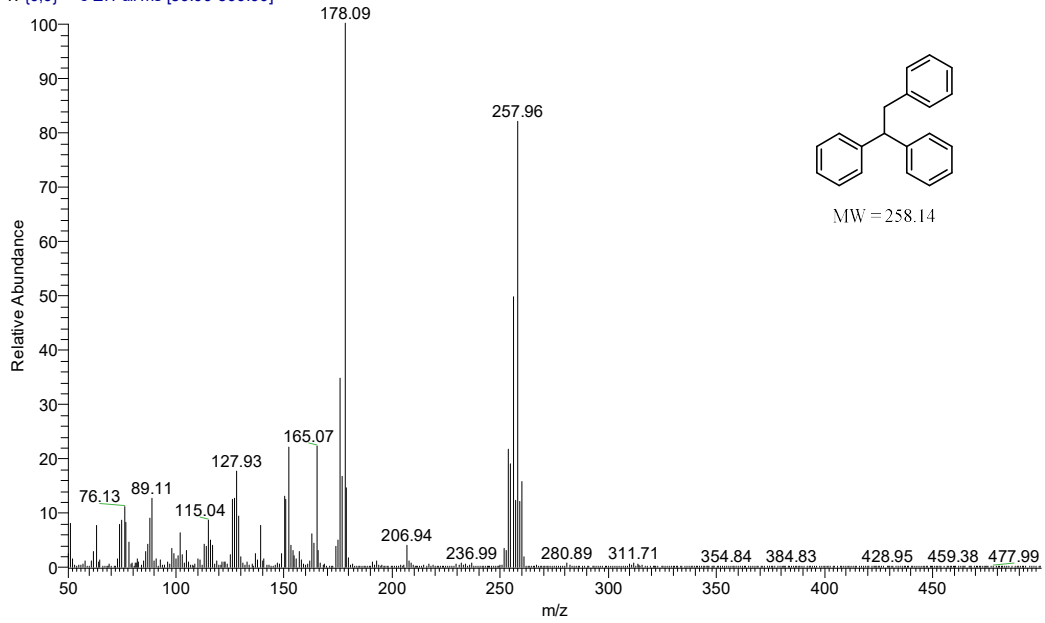


Figure S2 MS spectrum of the peak at 7.24 min

20220520-1-1,2-erbenyxi2 #2680 RT: 14.11 AV: 1 NL: 2.57E8
T: {0.0} + c EI Full ms [50.00-500.00]

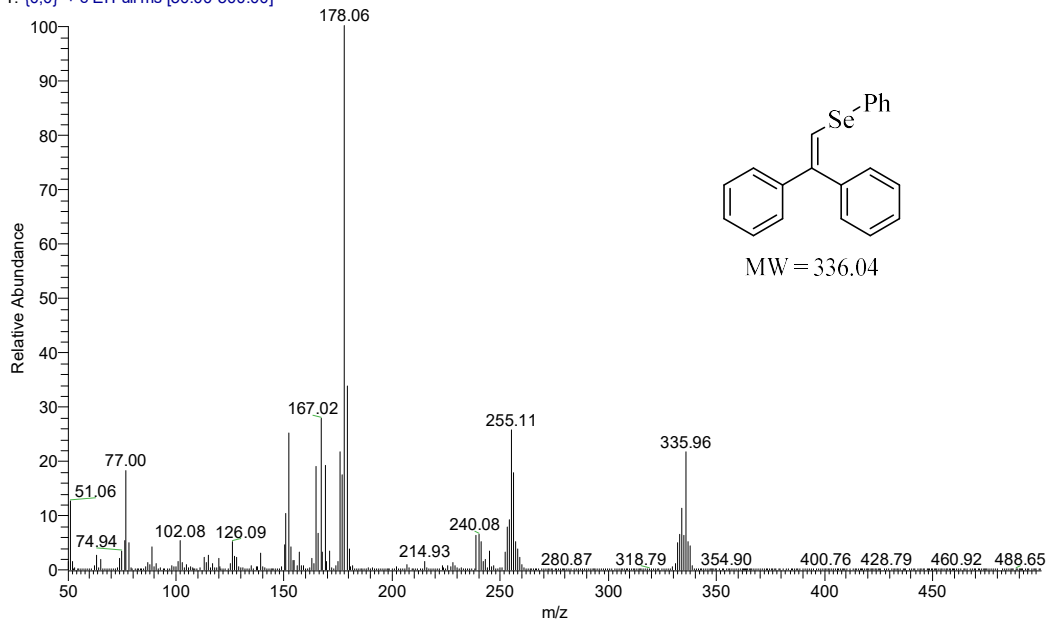


Figure S3 MS spectrum of the peak at 14.10 min

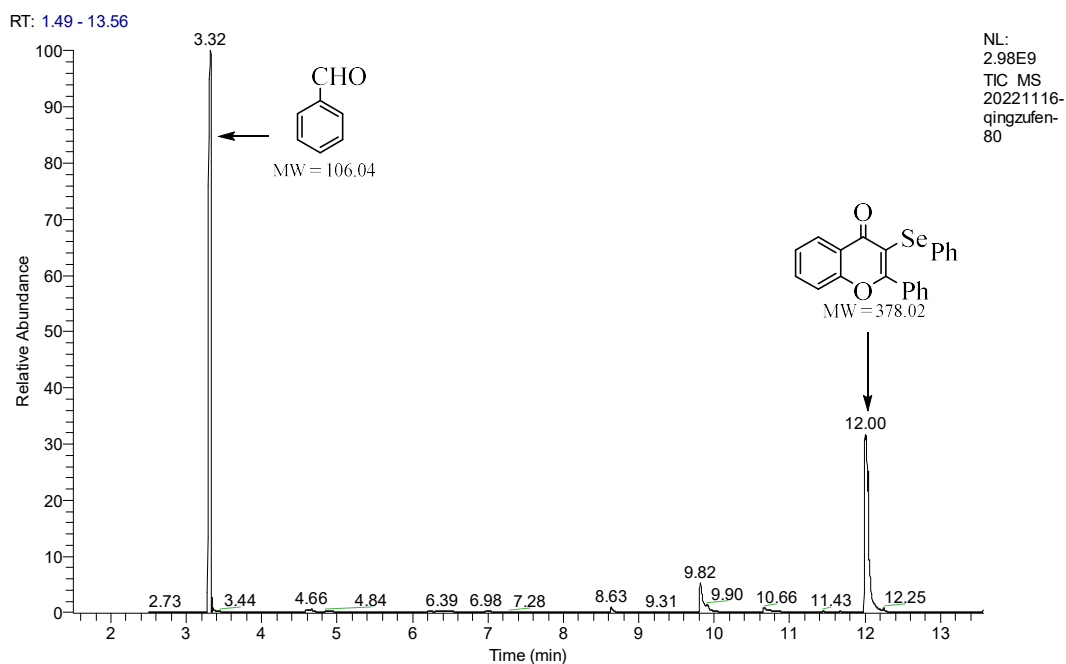


Figure S4 GC chromatogram of the reaction mixture of 1-(2-benzyloxy)phenyl-3-phenylprop-2-yn-1-one (**1a'**), Se powder and phenyl boronic acid (**1b**)

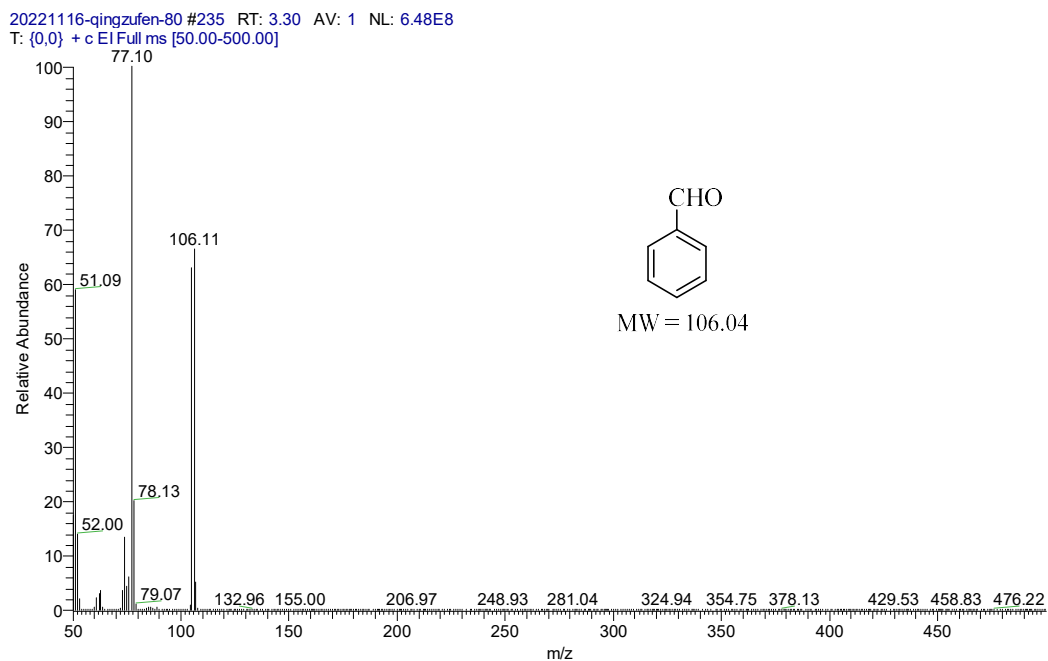
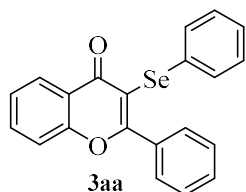


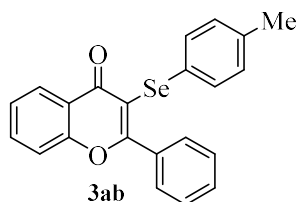
Figure S5 MS spectrum of the peak at 3.32 min

5. Characterization data for all synthesized 3-organoselenyl chromones

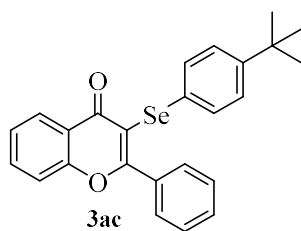
Note: The synthesized 3-organoselenyl chromones including **3ag**, **3ah**, **3aj**, **3ak**, **3ap**, **3ea**, **3fa**, **3ga** and **3oa** in this paper are new compounds.



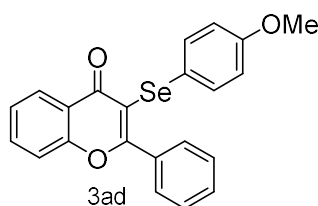
2-Phenyl-3-phenylselenanyl-4H-chromen-4-one (3aa) (CAS No.: 1332697-92-3): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 89% (202 mg); Yellow solid; m.p. 130-132 °C (lit.^[3] m.p.: 130-131 °C); ¹H NMR (CDCl₃, 400 MHz): δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.70-7.66 (m, 3H), 7.51-7.40 (m, 5H), 7.36-7.32 (m, 2H), 7.17-7.12 (m, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 175.99, 167.83, 156.00, 134.20, 134.04, 131.40, 131.04, 130.80, 129.29, 129.10, 128.04, 126.77, 126.70, 125.65, 122.43, 117.96, 114.12 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 304.56 ppm. GC-MS (EI) m/z: 378 (M⁺, 60%), 376 (34), 178 (100).



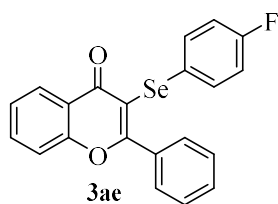
2-Phenyl-3-(p-tolyl)selenanyl-4H-chromen-4-one (3ab) (CAS No.: 1332697-96-7): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 90% (212 mg); Yellow solid; m.p. 104-106 °C (lit.^[4] m.p.: 104-106 °C). ¹H NMR (CDCl₃, 400 MHz): δ 8.26 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.71-7.63 (m, 3H), 7.53-7.39 (m, 5H), 7.28-7.25 (m, 2H), 6.98 (d, *J* = 8.0 Hz, 2H), 2.25 (s, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 176.04, 167.54, 155.98, 136.80, 134.29, 133.96, 131.62, 130.74, 129.89, 129.36, 128.01, 127.49, 126.69, 125.57, 122.47, 117.92, 114.50 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 296.89 ppm. GC-MS (EI) m/z: 392 (M⁺, 57%), 390 (30), 105 (100).



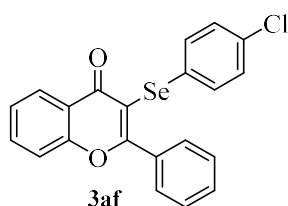
3-(4-tert-Butyl)phenylselanyl-2-phenyl-4H-chromen-4-one (3ac) (CAS No.: 2794102-70-6): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 93% (241 mg); Yellow solid; m.p. 122-124 °C. ¹H NMR (CDCl₃, 500 MHz): δ 8.24 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.67-7.63 (m, 3H), 7.48-7.37 (m, 5H), 7.26-7.23 (m, 2H), 7.14 (dt, *J* = 8.5, 2.4 Hz, 2H), 1.22 (s, 9H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.97, 167.35, 155.86, 149.80, 134.13, 133.80, 131.17, 130.51, 129.21, 127.84, 127.36, 126.56, 126.01, 125.42, 122.28, 117.77, 114.37, 34.30, 31.12 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 294.21 ppm. GC-MS (EI) m/z: 434 (M⁺, 26%), 432 (12), 207 (100).



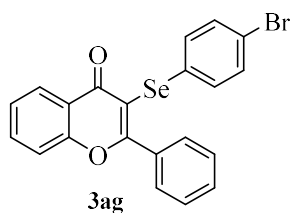
3-(4-Methoxyphenyl)selanyl-2-phenyl-4H-chromen-4-one (3ad) (CAS No.: 2794102-72-8): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 71% (174 mg); Yellow oil. ¹H NMR (CDCl₃, 500 MHz): δ 8.24 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.68-7.62 (m, 3H), 7.52-7.37 (m, 5H), 7.32 (dt, *J* = 8.9, 3 Hz, 2H), 6.69 (dt, *J* = 3.9, 3.1 Hz, 2H), 3.70 (s, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 176.15, 167.11, 159.21, 155.94, 134.41, 134.31, 133.89, 130.66, 129.39, 128.01, 126.62, 125.49, 122.48, 121.02, 117.90, 115.29, 114.71, 55.22 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 290.28 ppm. GC-MS (EI) m/z: 408 (M⁺, 21%), 406 (11), 165 (100).



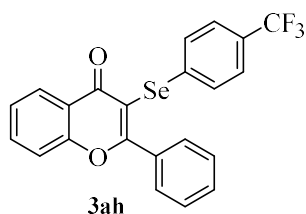
3-(4-Fluorophenyl)selanyl-2-phenyl-4H-chromen-4-one (3ae) (CAS No.: 1332697-93-4): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 91% (216 mg); Yellow solid; m.p. 138-139 °C (lit.^[3] m.p.: 138-139 °C). ¹H NMR (CDCl₃, 400 MHz): δ 8.24 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.70-7.64 (m, 3H), 7.53-7.40 (m, 5H), 7.32 (dd, *J* = 8.5, 5.5 Hz, 2H), 6.86-6.80 (m, 2H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.97, 167.46, 162.19 (d, *J*_{CF} = 245.0 Hz), 155.96, 134.11, 134.05, 134.06, 134.03, 133.96, 128.68 (d, *J*_{CF} = 150.0 Hz), 126.61, 125.66, 125.53 (d, *J*_{CF} = 2.5 Hz), 122.40, 117.95, 116.14 (d, *J*_{CF} = 21.3 Hz), 114.71 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 299.48 (d, *J* = 3.8 Hz) ppm; ¹⁹F NMR (CDCl₃, 376.3 MHz) δ -104.93 ppm. GC-MS (EI) m/z: 396 (M⁺, 24%), 394 (12), 105 (100).



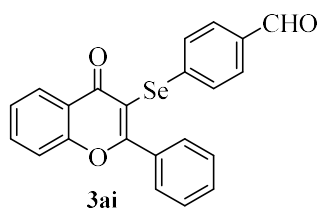
3-(4-Chlorophenyl)selanyl-2-phenyl-4H-chromen-4-one (3af) (CAS No.: 1332697-94-5): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 70% (173 mg); Yellow solid; m.p. 180-182 °C (lit.^[3] m.p.: 180-181 °C). ¹H NMR (CDCl₃, 400 MHz): δ 8.17 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.64-7.56 (m, 3H), 7.46-7.34 (m, 5H), 7.17 (dt, *J* = 8.5, 2.7 Hz, 2H), 7.02 (dt, *J* = 8.5, 2.7 Hz, 2H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 174.84, 166.81, 154.94, 133.10, 132.99, 131.92, 131.49, 129.89, 128.40, 128.19, 128.14, 127.07, 125.66, 124.72, 121.32, 116.93, 11.95 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 304.67 ppm. GC-MS (EI) m/z: 412 (M⁺, 14%), 414 (M+2, 6), 410 (6), 105 (100).



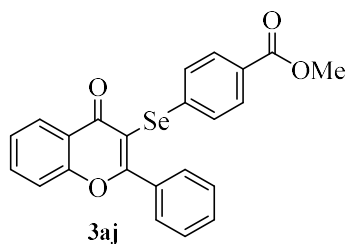
3-(4-Bromophenyl)selanyl-2-phenyl-4H-chromen-4-one (3ag): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 65% (178 mg); Yellow solid; m.p. 177-180 °C. ¹H NMR (CDCl₃, 400 MHz): δ 8.16 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.64-7.55 (m, 3H), 7.45-7.34 (m, 5H), 7.17 (dt, *J* = 8.6, 2.6 Hz, 2H), 7.10 (dt, *J* = 8.6, 2.4 Hz, 2H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 174.80, 166.87, 154.93, 133.11, 132.97, 131.65, 131.05, 129.91, 129.16, 128.18, 127.07, 125.65, 124.73, 121.31, 119.92, 116.93, 112.79 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 305.24 ppm. HRMS (+ESI) *m/z*: [M + H⁺] calculated for C₂₁H₁₄BrO₂Se⁺ 456.9337, found 456.9340.



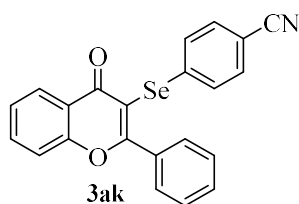
2-Phenyl-3-(4-(trifluoromethyl)phenyl)selanyl-4H-chromen-4-one (3ah): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 79% (210 mg); Yellow solid; m.p. 195-198 °C. ¹H NMR (CDCl₃, 500 MHz): δ 8.26 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.74-7.66 (m, 3H), 7.53-7.44 (m, 5H), 7.39 (s, 4H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.66, 168.40, 156.02, 136.73, 134.27, 133.89, 131.06, 130.08, 129.14, 128.60 (q, *J*_{CF} = 32.5 Hz), 128.15, 126.71, 125.89, 125.80 (q, *J*_{CF} = 3.8 Hz), 124.10 (q, *J*_{CF} = 270.0 Hz), 122.32, 118.01, 113.02 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 316.54 ppm; ¹⁹F NMR (376.3 MHz, CDCl₃) δ -62.55 ppm. HRMS (+ESI) *m/z*: [M + H⁺] calculated for C₂₂H₁₄F₃O₂Se⁺ 447.0106, found 447.0110.



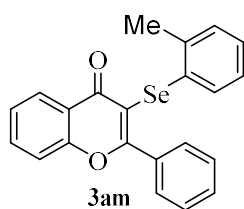
3-(4-Formylphenyl)selanyl-2-phenyl-4H-chromen-4-one (3ai) (CAS No.: 2794102-65-9): Flash column chromatography eluent (petroleum ether/ethyl acetate = 10:1); Yield: 70% (171 mg); Yellow solid; m.p. 169-172 °C. ¹H NMR (CDCl₃, 400 MHz): δ 9.88 (s, 1H), 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.77-7.73 (m, 1H), 7.69-7.64 (m, 4H), 7.54 (d, *J* = 8.2 Hz, 1H), 7.52-7.40 (m, 6H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 191.46, 175.59, 168.71, 156.04, 141.35, 134.41, 134.38, 133.82, 131.19, 130.16, 129.38, 129.12, 128.20, 126.79, 126.00, 122.30, 118.05, 112.47 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 325.52 ppm. GC-MS (EI) *m/z*: 406 (M⁺, 56%), 404 (30), 105 (100).



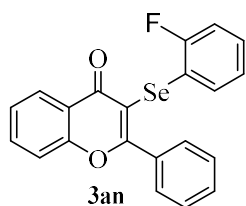
3-((4-Methoxycarbonyl)phenyl)selanyl-2-phenyl-4H-chromen-4-one (3aj): Flash column chromatography eluent (petroleum ether/ethyl acetate = 5:1); Yield: 61% (159 mg); Yellow solid; m.p. 168-171 °C. ¹H NMR (CDCl₃, 500 MHz): δ 8.20 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.77 (dt, *J* = 8.5, 2.1 Hz, 2H), 7.68-7.64 (m, 3H), 7.47 (d, *J* = 7.6 Hz, 1H), 7.45-4.37 (m, 4H), 7.30 (dt, *J* = 8.5, 2.2 Hz, 2H), 3.80 (s, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.27, 168.14, 166.37, 155.67, 138.49, 133.97, 133.58, 130.75, 129.76, 128.96, 128.90, 128.85, 127.81, 127.73, 126.32, 125.56, 121.98, 117.73, 112.51, 51.72 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 318.14 ppm. HRMS (+ESI) *m/z*: [M + H⁺] calculated for C₂₃H₁₇O₄Se⁺ 437.0287, found 437.0290.



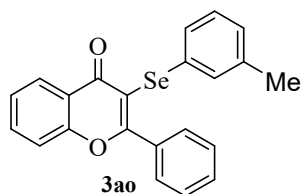
3-(4-Cyanophenyl)selenanyl-2-phenyl-4H-chromen-4-one (3ak): Flash column chromatography eluent (petroleum ether/ethyl acetate = 5:1); Yield: 52% (125 mg); Yellow solid; m.p. 178-181 °C. ¹H NMR (CDCl₃, 500 MHz): δ 8.25 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.76-7.73 (m, 1H), 7.67-7.65 (m, 2H), 7.55-7.44 (m, 5H), 7.41 (dt, *J* = 8.6, 1.7 Hz, 2H), 7.35 (dt, *J* = 8.6, 1.7 Hz, 2H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.39, 168.64, 155.93, 139.18, 134.35, 133.63, 132.26, 131.16, 129.74, 129.02, 128.15, 126.63, 125.97, 122.17, 118.68, 117.97, 112.34, 109.65 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 328.60 ppm. HRMS (+ESI) *m/z*: [M + H⁺] calculated for C₂₂H₁₄NO₂Se⁺ 404.0184, found 404.0186.



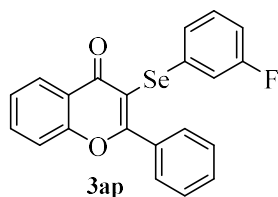
2-Phenyl-3-(o-tolyl)selenanyl-4H-chromen-4-one (3am) (CAS No.: 1332697-97-8): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 76% (179 mg); Yellow oil. ¹H NMR (CDCl₃, 400 MHz): δ 8.28 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.73-7.66 (m, 3H), 7.52-7.41 (m, 5H), 7.15 (d, *J* = 7.3 Hz, 1H), 7.10-7.04 (m, 2H), 6.98-6.94 (m, 1H), 2.32 (s, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 176.04, 168.01, 156.04, 137.73, 134.17, 134.08, 132.30, 130.84, 130.08, 129.97, 129.17, 128.04, 126.77, 126.65, 126.58, 125.70, 122.33, 117.98, 113.43, 21.81 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 270.62 ppm. GC-MS (EI) *m/z*: 392 (M⁺, 4%), 390 (2), 91 (100).



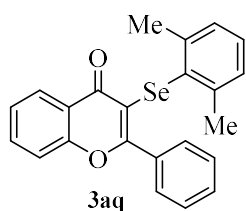
3-(2-Fluorophenyl)selanyl-2-phenyl-4H-chromen-4-one (3an) (CAS No.: 2794102-62-6): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 68% (162 mg); Yellow oil. ^1H NMR (CDCl_3 , 500 MHz): δ 8.24 (dd, $J = 8.0, 1.7$ Hz, 1H), 7.70-7.66 (m, 3H), 7.50-7.46 (m, 2H), 7.45-7.40 (m, 3H), 7.25-7.22 (m, 1H), 7.14-7.09 (m, 1H), 6.94-6.90 (m, 2H) ppm; ^{13}C NMR (CDCl_3 , 125 MHz): δ 175.77, 167.66, 160.79 (d, $J_{\text{CF}} = 241.3$ Hz), 156.00, 134.13, 133.91, 132.30 (d, $J_{\text{CF}} = 2.5$ Hz), 130.91, 129.15, 128.58 (d, $J_{\text{CF}} = 7.5$ Hz), 128.10, 126.60, 125.73, 124.79 (d, $J_{\text{CF}} = 2.5$ Hz), 122.20, 117.98, 117.97 (d, $J_{\text{CF}} = 22.5$ Hz), 115.37 (d, $J_{\text{CF}} = 22.5$ Hz), 112.31 ppm; ^{77}Se NMR (CDCl_3 , 95.5 MHz): δ 250.21 (d, $J = 16.2$ Hz) ppm; ^{19}F NMR (CDCl_3 , 376.3 MHz) δ -114.60 ppm. GC-MS (EI) m/z : 396 (M^+ , 18%), 394 (10), 196 (100).



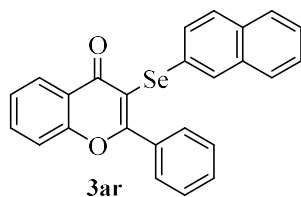
2-Phenyl-3-(m-tolyl)selanyl-4H-chromen-4-one (3ao) (CAS No.: 2794102-68-2): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 74% (174 mg); Yellow oil. ^1H NMR (CDCl_3 , 500 MHz): δ 8.27 (dd, $J = 8.0, 1.7$ Hz, 1H), 7.71-7.66 (m, 3H), 7.51-7.40 (m, 5H), 7.15-7.12 (m, 2H), 7.04 (t, $J = 7.6$ Hz, 1H), 6.95 (d, $J = 8.0$ Hz, 1H), 2.23 (s, 3H) ppm; ^{13}C NMR (CDCl_3 , 125 MHz): δ 176.02, 167.64, 156.00, 138.76, 134.22, 134.00, 131.71, 131.10, 130.73, 129.31, 128.91, 128.08, 128.01, 127.70, 126.72, 125.61, 122.43, 117.96, 114.22, 22.72 ppm; ^{77}Se NMR (CDCl_3 , 95.5 MHz): δ 302.91 ppm. GC-MS (EI) m/z : 392 (M^+ , 50%), 390 (26), 165 (100).



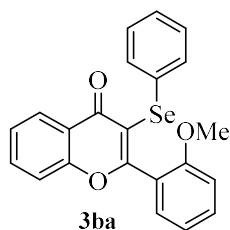
3-(3-Fluorophenyl)selanyl-2-phenyl-4H-chromen-4-one (3ap): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 51% (121 mg); Yellow oil. ^1H NMR (CDCl_3 , 500 MHz): δ 8.24 (dd, $J = 8.0, 1.7$ Hz, 1H), 7.69-7.65 (m, 3H), 7.50-7.39 (m, 5H), 7.12-7.07 (m, 2H), 7.02-6.99 (m, 1H), 6.84-6.78 (m, 1H) ppm; ^{13}C NMR (CDCl_3 , 125 MHz): δ 175.73, 168.16, 162.72 (d, $J_{\text{CF}} = 247.5$ Hz), 155.98, 134.21, 133.96, 133.33 (d, $J_{\text{CF}} = 7.5$ Hz), 130.99, 130.31 (d, $J_{\text{CF}} = 7.5$ Hz), 129.23, 128.12, 126.64, 126.18 (d, $J_{\text{CF}} = 2.5$ Hz), 125.80, 122.34, 118.02, 117.44 (d, $J_{\text{CF}} = 22.5$ Hz), 113.68 (d, $J_{\text{CF}} = 21.3$ Hz), 113.49 ppm; ^{77}Se NMR (CDCl_3 , 95.5 MHz): δ 315.62 ppm; ^{19}F NMR (CDCl_3 , 376.3 MHz) δ -111.70 ppm. HRMS (+ESI) m/z : $[\text{M} + \text{H}^+]$ calculated for $\text{C}_{21}\text{H}_{14}\text{FO}_2\text{Se}^+$ 397.0138, found 397.0139.



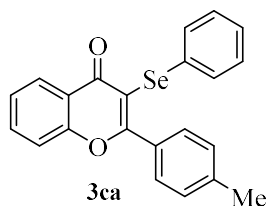
3-(2,6-Dimethylphenyl)selanyl-2-phenyl-4H-chromen-4-one (3aq) (CAS No.: 2794102-74-0): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 86% (209 mg); Yellow solid; m.p. 149-153 °C. ^1H NMR (CDCl_3 , 500 MHz): δ 8.21 (dd, $J = 8.1, 1.7$ Hz, 1H), 7.65-7.62 (m, 1H), 7.56-7.53 (m, 2H), 7.48-7.36 (m, 5H), 7.00-6.97 (m, 1H), 6.90 (d, $J = 7.5$ Hz, 2H), 2.35 (s, 6H) ppm; ^{13}C NMR (CDCl_3 , 125 MHz): δ 179.95, 164.47, 155.87, 142.26, 133.94, 133.68, 131.30, 130.49, 128.85, 128.04, 127.92, 127.59, 126.50, 125.30, 121.93, 117.82, 115.52, 24.17 ppm; ^{77}Se NMR (CDCl_3 , 95.5 MHz): δ 217.88 ppm. GC-MS (EI) m/z : 406 (M^+ , 2%), 404 (1), 105 (100).



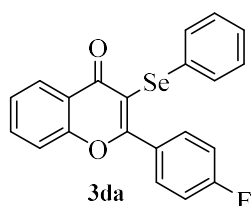
3-(Naphthalen-2-yl)selanyl-2-phenyl-4H-chromen-4-one (3ar) (CAS No.: 2890224-90-3): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 87% (223 mg); Yellow solid; m.p. 109-112 °C (lit.^[6] m.p.: 94-95 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.29 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.79 (d, *J* = 7.8 Hz, 1H), 7.75-7.62 (m, 6H), 7.50 (d, *J* = 8.5 Hz, 1H), 7.48-7.38 (m, 7H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 180.85, 172.66, 160.81, 138.93, 138.82, 138.69, 136.97, 135.58, 134.57, 134.06, 133.63, 133.55, 133.28, 132.80, 132.49, 132.07, 131.53, 131.07, 130.61, 130.45, 127.23, 122.74, 118.91 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 307.64 ppm. GC-MS (EI) m/z: 428 (M⁺, 26%), 426 (13), 105 (100).



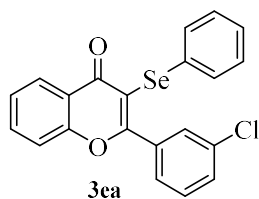
2-(2-Methoxy)phenyl-3-phenylselanyl-4H-chromen-4-one (3ba) (CAS No.: 1332698-04-0): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 75% (183 mg); Yellow oil. ¹H NMR (CDCl₃, 400 MHz): δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.68-7.63 (m, 1H), 7.49-7.32 (m, 6H), 7.16-7.11 (m, 3H), 7.05 (td, *J* = 7.5, 1.0 Hz, 1H), 6.96 (d, *J* = 8.5 Hz, 1H), 3.71 (s, 3.71 Hz, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 175.65, 166.28, 156.83, 156.42, 133.84, 132.06, 131.38, 131.19, 129.89, 128.86, 126.66, 126.62, 125.47, 123.76, 122.73, 120.27, 118.11, 116.51, 111.10, 55.43 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 308.26 ppm. GC-MS (EI) m/z: 408 (M⁺, 20%), 406 (10), 77 (100).



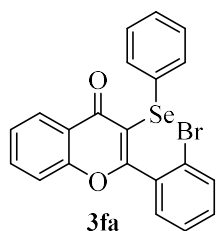
3-Phenylselanyl-2-p-tolyl-4H-chromen-4-one (3ca) (CAS No.: 1332698-00-6): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 90% (211 mg); Yellow solid; m.p. 108-111 °C (lit.^[3] m.p.: 99-100 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.26 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.67-7.64 (m, 1H), 7.61 (dt, *J* = 8.2, 2.1 Hz, 2H), 7.47 (dd, *J* = 8.5, 1.0 Hz, 1H), 7.41-7.34 (m, 3H), 7.25 (d, *J* = 7.6 Hz, 2H), 7.19-7.12 (m, 3H), 2.42 (s, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.99, 168.10, 155.97, 141.31, 133.99, 131.60, 131.37, 130.82, 129.33, 129.10, 128.73, 126.69, 126.66, 125.58, 122.41, 117.95, 113.58, 21.62 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 304.50 ppm. GC-MS (EI) m/z: 392 (M⁺, 21%), 390 (11), 119 (100).



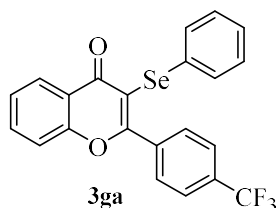
2-(4-Fluoro)phenyl-3-phenylselanyl-4H-chromen-4-one (3da) (CAS No.: 1332698-06-2): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 84% (200 mg); Yellow solid; m.p. 112-114 °C (lit.^[3] m.p.: 112-113 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.25 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.71-7.66 (m, 3H), 7.47 (dd, *J* = 8.5, 1.0 Hz, 1H), 7.43-7.39 (m, 1H), 7.33-7.28 (m, 2H), 7.16-7.08 (m, 5H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.93, 166.58, 163.96 (d, *J*_{CF} = 250 Hz), 155.89, 134.10, 131.64, 131.57, 131.24, 131.01, 130.27 (d, *J*_{CF} = 3.8 Hz), 129.15, 126.78 (d, *J*_{CF} = 21.3 Hz), 125.72, 122.33, 117.90, 115.20 (d, *J*_{CF} = 22.5 Hz), 114.26 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 305.23 ppm; ¹⁹F NMR (CDCl₃, 376.3 MHz) δ -108.10 ppm. GC-MS (EI) m/z: 396 (M⁺, 26%), 394 (16), 77 (100).



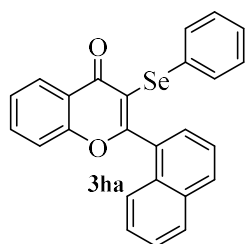
2-(3-Chloro)phenyl-3-phenylselanyl-4H-chromen-4-one (3ea): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 70% (173 mg); Yellow oil. ^1H NMR (CDCl_3 , 400 MHz): δ 8.26 (dd, $J = 8.0, 1.6$ Hz, 1H), 7.72-7.68 (m, 1H), 7.62 (t, $J = 1.9$ Hz, 1H), 7.55 (dt, $J = 7.7, 1.4$ Hz, 1H), 7.49-7.42 (m, 3H), 7.37-7.30 (m, 3H), 7.18-7.12 (m, 3H) ppm; ^{13}C NMR (CDCl_3 , 100 MHz): δ 175.96, 165.78, 155.92, 135.67, 134.21, 134.04, 131.50, 130.97, 130.73, 129.37, 129.24, 129.18, 127.57, 127.07, 126.76, 125.84, 122.34, 117.95, 115.02 ppm; ^{77}Se NMR (CDCl_3 , 95.5 MHz): δ 305.94 ppm. HRMS (+ESI) m/z : $[\text{M} + \text{H}^+]$ calculated for $\text{C}_{21}\text{H}_{14}\text{ClO}_2\text{Se}^+$ 412.9842, found 412.9839.



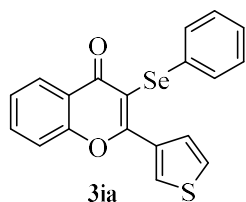
2-(2-Bromo)phenyl-3-phenylselanyl-4H-chromen-4-one (3fa): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 83% (227 mg); Yellow oil. ^1H NMR (CDCl_3 , 400 MHz): δ 8.28 (dd, $J = 8.0, 1.7$ Hz, 1H), 7.70-7.62 (m, 2H), 7.47-7.31 (m, 7H), 7.17-7.11 (m, 3H) ppm; ^{13}C NMR (CDCl_3 , 100 MHz): δ 175.74, 166.79, 156.18, 135.58, 134.21, 132.91, 132.10, 131.62, 130.74, 130.33, 129.05, 127.19, 127.15, 126.67, 125.81, 122.75, 122.44, 118.12, 116.31 ppm; ^{77}Se NMR (CDCl_3 , 95.5 MHz): δ 303.88 ppm. HRMS (ESI $^+$) m/z : $[\text{M} + \text{H}^+]$ calculated for $\text{C}_{21}\text{H}_{14}\text{BrO}_2\text{Se}^+$ 456.9337, found 456.9340.



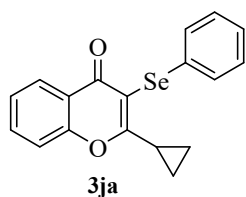
3-Phenylselanyl-2-(4-trifluoromethyl)phenyl-4H-chromen-4-one (3ga): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 63% (168 mg); Yellow solid; m.p. 138-142 °C. ¹H NMR (CDCl₃, 400 MHz): δ 8.25 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.77-7.66 (m, 5H), 7.48-7.41 (m, 2H), 7.30-7.25 (m, 2H), 7.15-7.09 (m, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 175.84, 165.80, 155.97, 137.45, 134.31, 132.28 (q, *J*_{CF} = 32.0 Hz), 131.34, 130.92, 129.75, 129.22, 127.06, 126.73, 125.93, 125.06 (q, *J*_{CF} = 3.9 Hz), 122.34, 117.98, 115.25 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 305.87 ppm; ¹⁹F NMR (CDCl₃, 376.3 MHz) δ -305.87 ppm. HRMS (+ESI) *m/z*: [M + H⁺] calculated for C₂₂H₁₄F₃O₂Se⁺ 447.0106, found 447.0108.



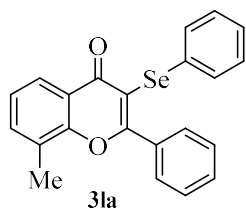
2-(Naphthalen-1-yl)-3-phenylselanyl-4H-chromen-4-one (3ha) (CAS No.: 1332698-07-3): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 73% (187 mg); Yellow solid; m.p. 103-105°C (lit.^[3] m.p.: 103-105 °C). ¹H NMR (CDCl₃, 400 MHz): δ 8.32 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.95 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.88 (d, *J* = 8.2 Hz, 1H), 7.67-7.62 (m, 2H), 7.53-7.38 (m, 6H), 7.22-7.19 (m, 2H), 7.05-7.97 (m, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 175.87, 167.48, 156.33, 134.14, 133.31, 132.27, 131.84, 130.80, 130.52, 130.48, 128.86, 128.62, 127.65, 127.21, 127.02, 126.77, 126.51, 125.78, 124.83, 124.78, 122.79, 118.14, 117.39 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 309.21 ppm. GC-MS (EI) *m/z*: 428 (M⁺, 23%), 426 (11), 77 (100).



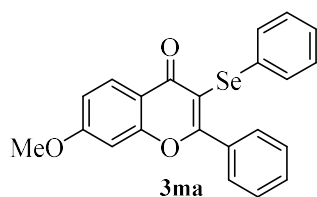
3-Phenylselanyl-2-(thiophen-3-yl)-4H-chromen-4-one (3ia) (CAS No.: 2489435-17-6): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 81% (186 mg); Yellow solid; m.p. 118-121 °C (lit.^[4] m.p.: 103-105 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.22 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.18 (dd, *J* = 3.1, 1.4 Hz, 1H), 7.72 (dd, *J* = 5.1, 1.3 Hz, 1H), 7.68-7.64 (m, 1H), 7.47 (d, *J* = 8.5 Hz, 1 H), 7.41-7.31 (m, 4H), 7.18-7.11 (m, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 176.05, 162.62, 155.67, 134.58, 134.03, 131.41, 130.96, 130.35, 129.25, 128.48, 126.70, 126.68, 125.59, 125.33, 122.25, 117.79, 112.61 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 296.72 ppm. GC-MS (EI) m/z: 384 (M⁺, 19%), 382 (10), 184 (100).



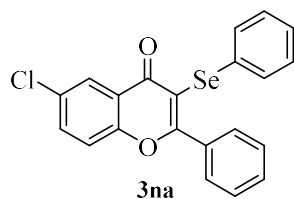
2-Cyclopropyl-3-phenylselanyl-4H-chromen-4-one (3ja) (CAS No.: 2489435-16-5): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 57% (117 mg); Yellow solid; m.p. 105-108 °C (lit.^[4] m.p.: 104-106 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.17 (dd, *J* = 8.0, 1.8 Hz, 1H), 7.59-7.56 (m, 1H), 7.44-7.42 (m, 2H), 7.34-7.27 (m, 2H), 7.19-7.12 (m, 3H), 3.05-2.99 (m, 1H), 1.28 (dt, *J* = 7.7, 4.5 Hz, 2H), 1.08 (dt, *J* = 11.2, 4.1 Hz, 2H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 174.80, 172.77, 155.04, 133.52, 131.36, 130.58, 129.12, 126.61, 126.58, 125.30, 122.61, 117.27, 112.54, 16.12, 10.06 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 264.32 ppm. GC-MS (EI) m/z: 342 (M⁺, 28%), 340 (14), 327 (100).



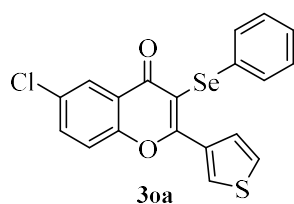
8-Methyl-2-phenyl-3-phenylselanyl-4H-chromen-4-one (3la) (CAS No.: 2489435-19-8): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 69% (162 mg); Yellow solid; m.p. 126-128 °C (lit.^[4] m.p.: 126-128 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.11 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.75-7.73 (m, 2H), 7.52-7.44 (m, 4H), 7.36-7.29 (m, 3H), 7.17-7.11 (m, 3H), 2.48 (s, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 176.34, 167.35, 154.48, 134.92, 134.31, 131.51, 130.89, 130.81, 129.40, 129.10, 128.07, 127.44, 126.70, 125.22, 124.26, 122.31, 113.80, 15.69 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 303.08 ppm. GC-MS (EI) *m/z*: 392 (M⁺, 13%), 390 (6), 105 (100).



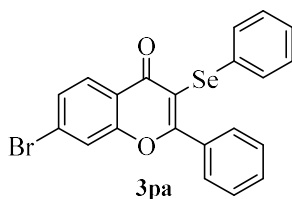
7-Methoxy-2-phenyl-3-phenylselanyl-4H-chromen-4-one (3ma) (CAS No.: 2794102-84-2): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 62% (152 mg); Yellow oil. ¹H NMR (CDCl₃, 500 MHz): δ 8.16 (d, *J* = 8.9 Hz, 1H), 7.67-7.65 (m, 2H), 7.50-7.41 (m, 3H), 7.34-7.29 (m, 2H), 7.16-7.11 (m, 3H), 6.99 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.87 (d, *J* = 2.4 Hz, 1H), 3.88 (s, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.28, 167.44, 164.34, 157.72, 134.24, 131.56, 130.88, 130.67, 129.23, 129.06, 128.14, 128.00, 126.65, 116.31, 114.99, 114.00, 100.07, 55.91 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 301.65 ppm. GC-MS (EI) *m/z*: 408 (M⁺, 17%), 406 (8), 178 (100).



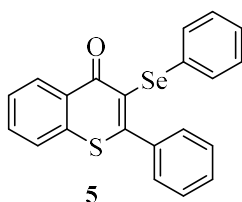
6-Chloro-2-phenyl-3-phenylselanyl-4H-chromen-4-one (3na) (CAS No.: 1332698-13-1): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 62% (154 mg); Yellow solid; m.p. 128-130 °C (lit.^[4] m.p.: 128-130 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.20 (d, *J* = 2.6 Hz, 1H), 7.68-7.66 (m, 2H), 7.61 (dd, *J* = 9.0, 2.7 Hz, 1H), 7.52-7.49 (m, 1H), 7.47-7.43 (m, 3H), 7.33-7.29 (m, 2H), 7.16-7.12 (m, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 174.94, 167.81, 154.32, 134.19, 133.84, 131.46, 131.27, 131.00, 130.98, 129.29, 129.12, 128.08, 126.96, 126.02, 123.29, 119.75, 114.30 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 307.59 ppm. GC-MS (EI) m/z: 412 (M⁺, 20%), 414 (M+2, 6), 410 (10), 178 (100).



6-Chloro-3-phenylselanyl-2-(thiophen-3-yl)-4H-chromen-4-one (3oa): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 54% (136 mg); Yellow solid; m.p. 156-159 °C. ¹H NMR (CDCl₃, 400 MHz): δ 8.19 (dd, *J* = 3.0, 1.3 Hz, 1H), 8.17 (d, *J* = 2.6 Hz, 1H), 7.71 (dd, *J* = 5.1, 1.3 Hz, 1H), 7.61 (dd, *J* = 8.9, 2.6 Hz, 1H), 7.45 (d, *J* = 8.9 Hz, 1H), 7.38-7.32 (m, 3H), 7.20-7.12 (m, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 175.06, 162.67, 154.01, 134.24, 134.23, 131.42, 131.33, 131.29, 131.02, 130.54, 130.48, 130.41, 129.31, 128.41, 126.90, 126.06, 125.49, 123.11, 119.59, 112.68 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 298.97 ppm. HRMS (+ESI) m/z: [M + H⁺] calculated for C₁₉H₁₂ClO₂SSe⁺ 418.9407, found 418.9410.



7-Bromo-2-phenyl-3-phenylselanyl-4H-chromen-4-one (3pa) (CAS No.: 2489435-22-3): Flash column chromatography eluent (petroleum ether/ethyl acetate = 15:1); Yield: 61% (167 mg); Yellow solid; m.p. 84-86 °C (lit.^[5] m.p.: 84-85 °C). ¹H NMR (CDCl₃, 500 MHz): δ 8.10 (d, *J* = 8.6 Hz, 1H), 7.69-7.35 (m, 3H), 7.54 (dd, *J* = 8.5, 1.8 Hz, 1H), 7.52-7.49 (m, 1H), 7.46-7.43 (m, 2H), 7.33-7.28 (m, 2H), 7.17-7.12 (m, 3H) ppm; ¹³C NMR (CDCl₃, 125 MHz): δ 175.46, 167.66, 156.01, 133.76, 131.24, 130.99, 129.29, 129.26, 129.11, 128.26, 128.15, 128.09, 126.95, 121.23, 121.08, 114.63 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 307.59 ppm. GC-MS (EI) *m/z*: 456 (M⁺, 12%), 458 (M+2, 9), 454 (6), 105 (100).



2-Phenyl-3-phenylselanyl-4H-thiophene-4-one (5) (CAS No.: 2552737-73-0): Flash column chromatography eluent (petroleum ether/ethyl acetate = 20:1); Yield: 29% (69 mg); Yellow solid; m.p. 118-120 °C (lit.^[6] m.p.: 112-113 °C). ¹H NMR (CDCl₃, 400 MHz): δ (dd, *J* = 8.6, 1.6 Hz, 1H), 7.62-7.51 (m, 3H), 7.41-7.30 (m, 5H), 7.24-7.18 (m, 2H), 7.12-7.04 (m, 3H) ppm; ¹³C NMR (CDCl₃, 100 MHz): δ 178.13, 156.08, 138.11, 137.21, 132.01, 131.99, 131.73, 129.79, 129.71, 129.67, 128.90, 128.54, 128.36, 128.14, 126.70, 125.61 ppm; ⁷⁷Se NMR (CDCl₃, 95.5 MHz): δ 360.33 ppm. GC-MS (EI) *m/z*: 394 (M⁺, 40%), 392 (22), 178 (100).

6. References:

1. W. Yin, H. He, Y. Zhang, D. Luo and H. He, *Synthesis* 2014, **46**, 2617-2621.
2. C. Zhou, A. Dubrovsky and R. Larock, *J. Org. Chem.* 2006, **71**, 1626-1632.
3. G. Zeni, B. Godoi and C. A. Bruning, *Adv. Synth. Catal.* 2011, **353**, 2042-2050.
4. Y. F. Du, K. Zhao, Z. K. Ai, J. X. Xiao and Y. D. Li, *Org. Chem. Front.* 2020, **7**, 3935-3940.
5. H. B. Zhang, E. Tang, J. R. Lai, F. D. Yin and Q. S. Guo, *Org. Biomol. Chem.* 2022, **20**, 5104-5114.
6. R. F. Schumacher, B. Godoi, T. Barcellos, T. Anjos and E. L. Gutterres, *New J. Chem.* 2023, **47**, 1076-1080.

6. ^1H , ^{13}C , ^{77}Se and ^{19}F NMR spectra of products

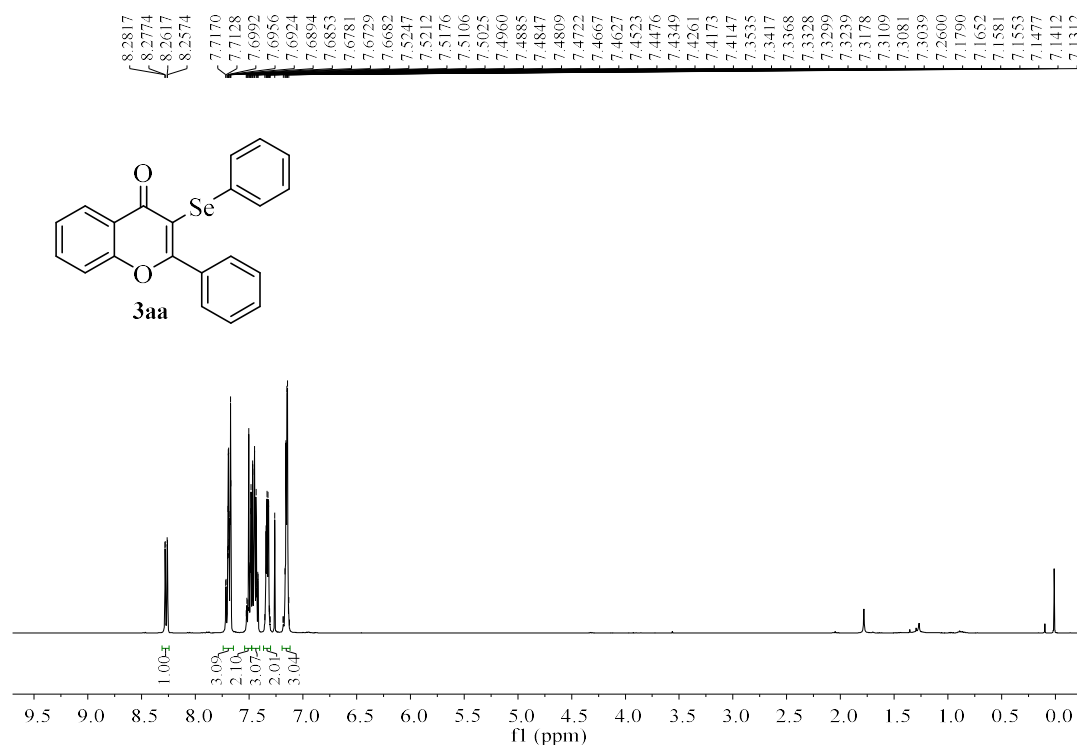


Figure S6 ^1H NMR (400 MHz) spectrum of **3aa** in CDCl_3

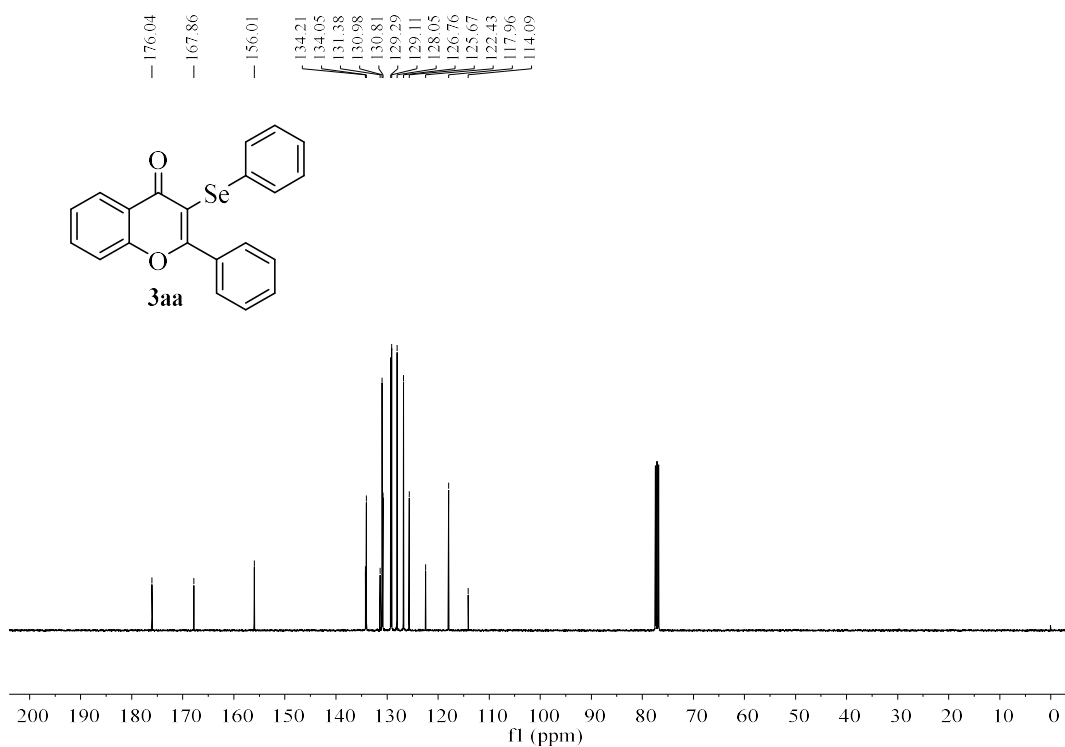


Figure S7 ^{13}C NMR (100 MHz) spectrum of **3aa** in CDCl_3

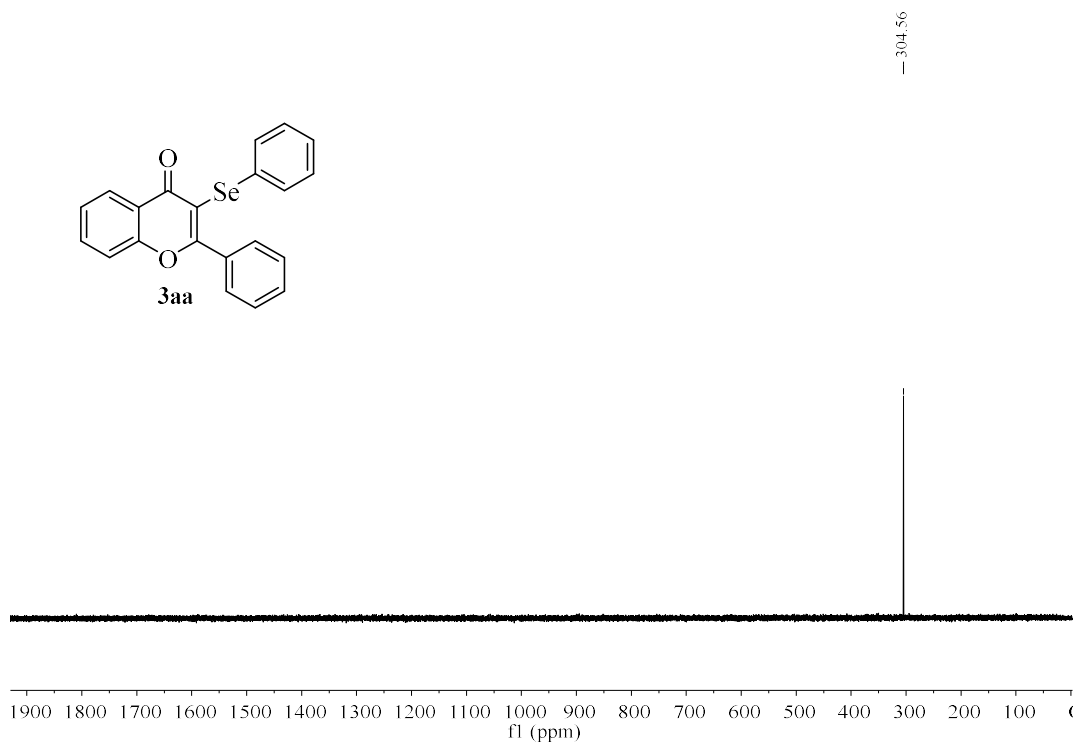


Figure S8 ^{77}Se NMR (95.5 MHz) spectrum of **3aa** in CDCl_3

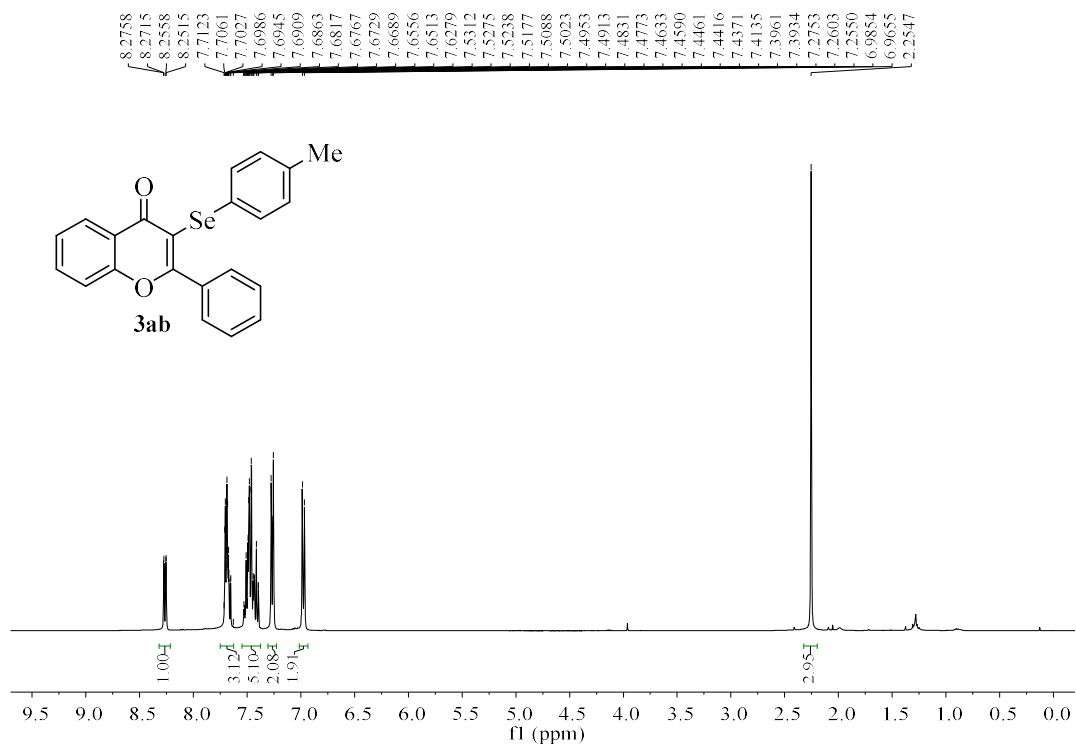


Figure S9 ^1H NMR (400 MHz) spectrum of **3ab** in CDCl_3

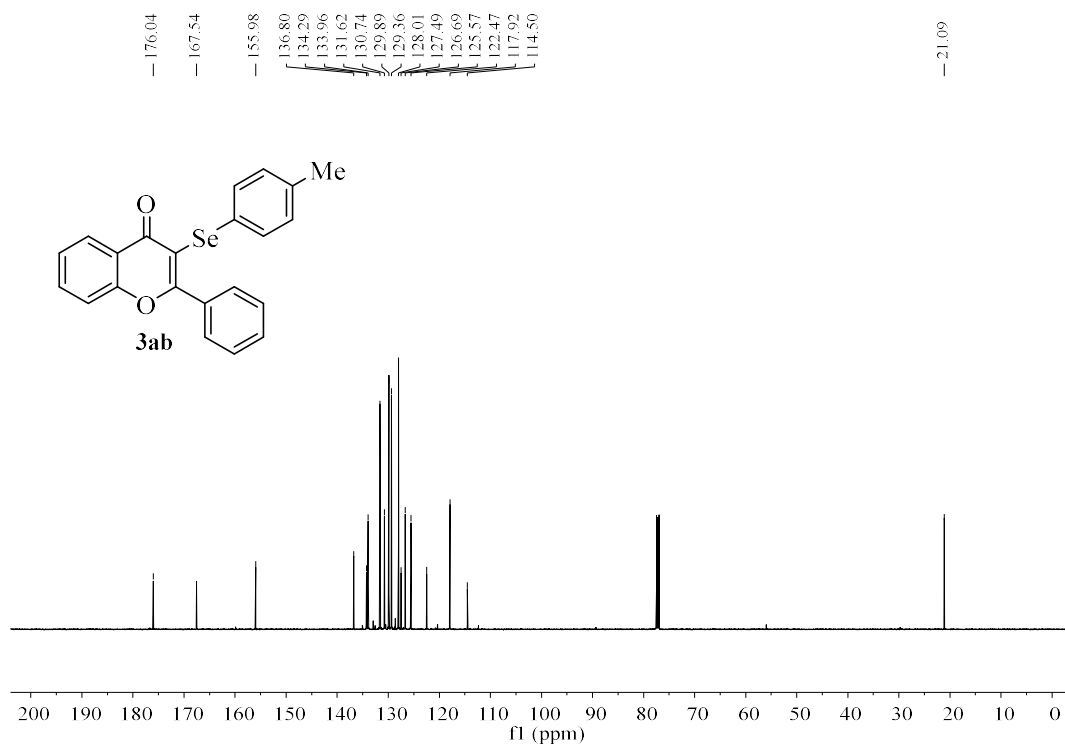


Figure S10 ¹³C NMR (125 MHz) spectrum of **3ab** in CDCl₃

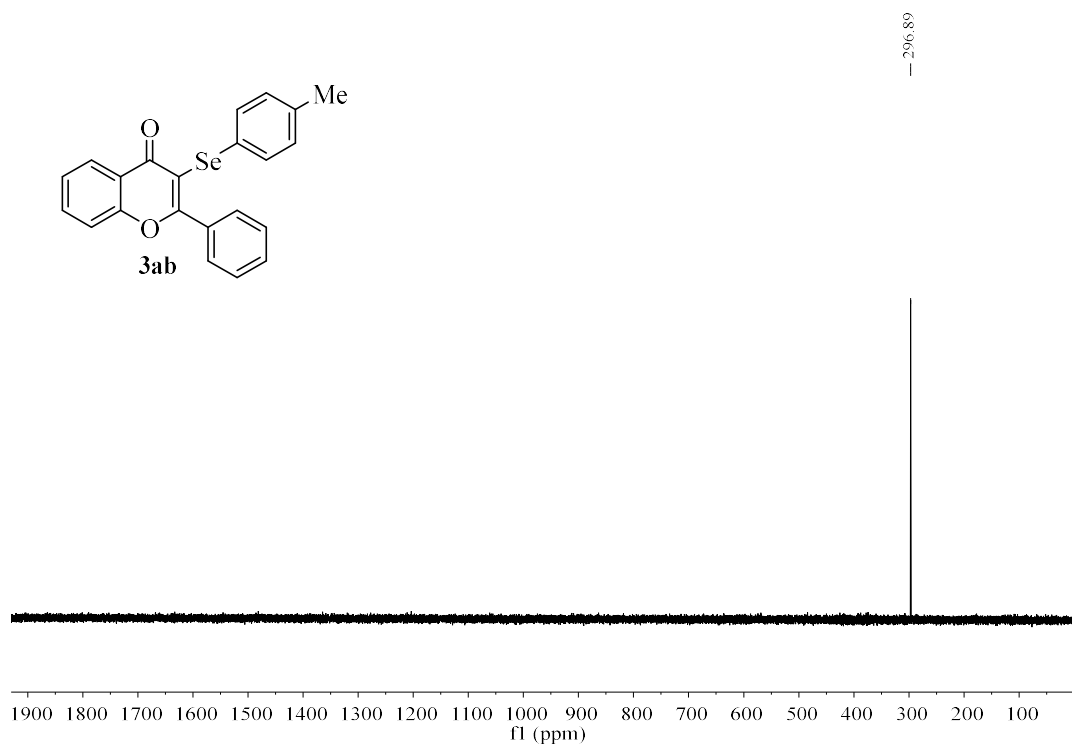
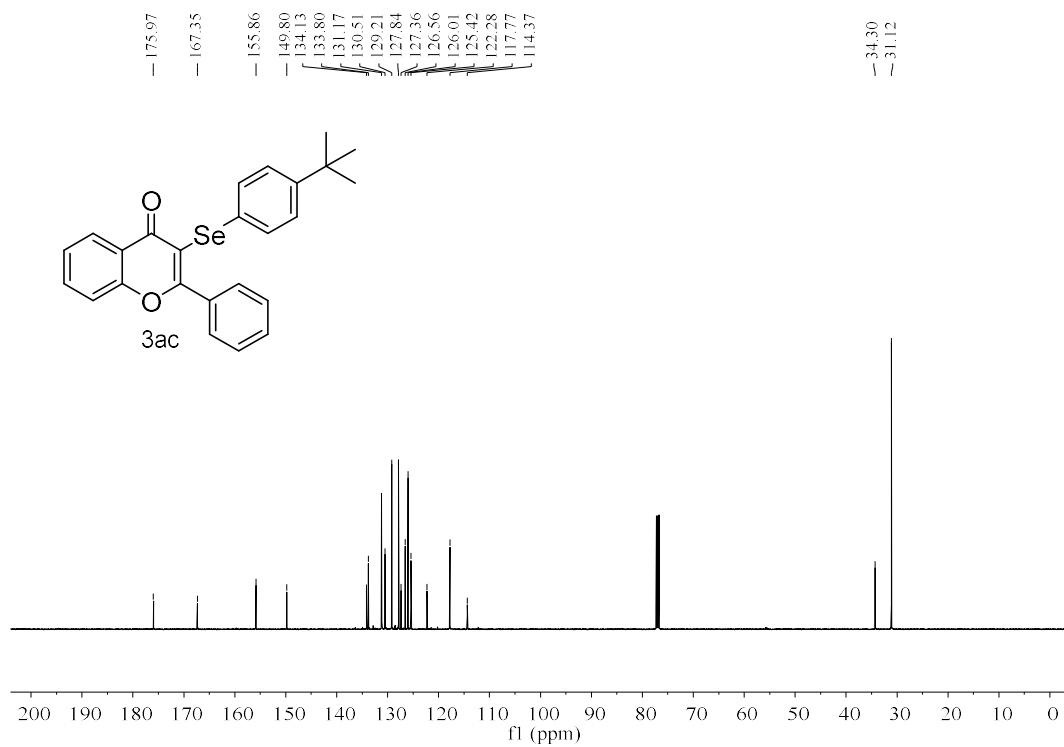
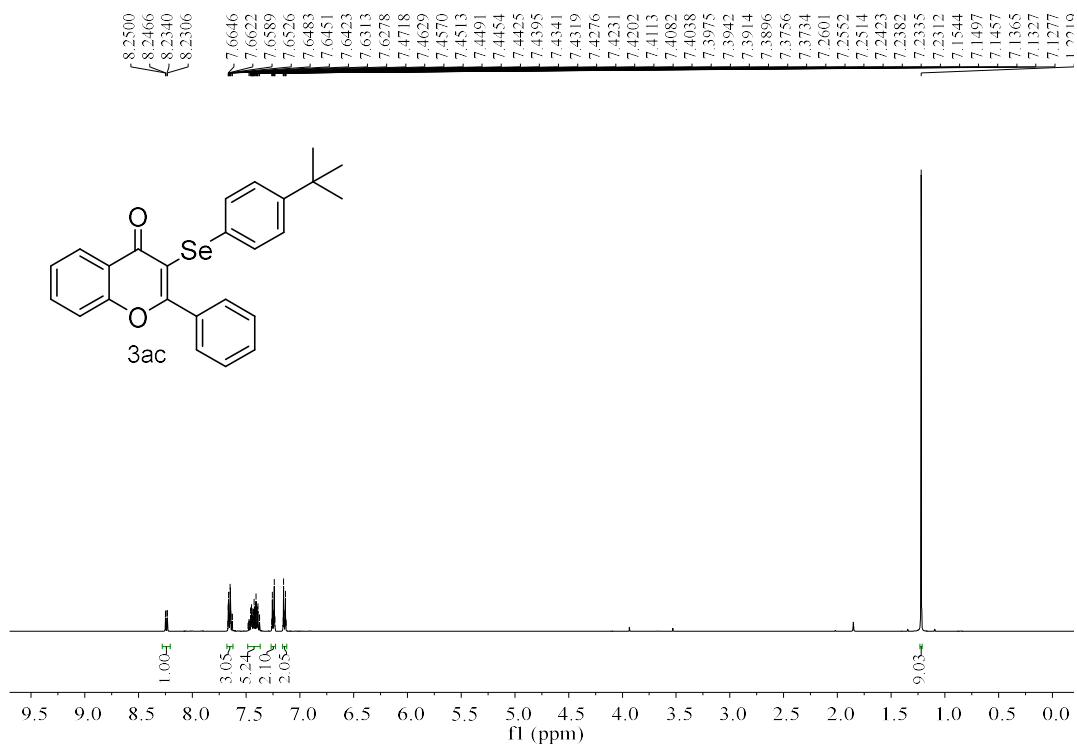


Figure S11 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ab** in CDCl₃



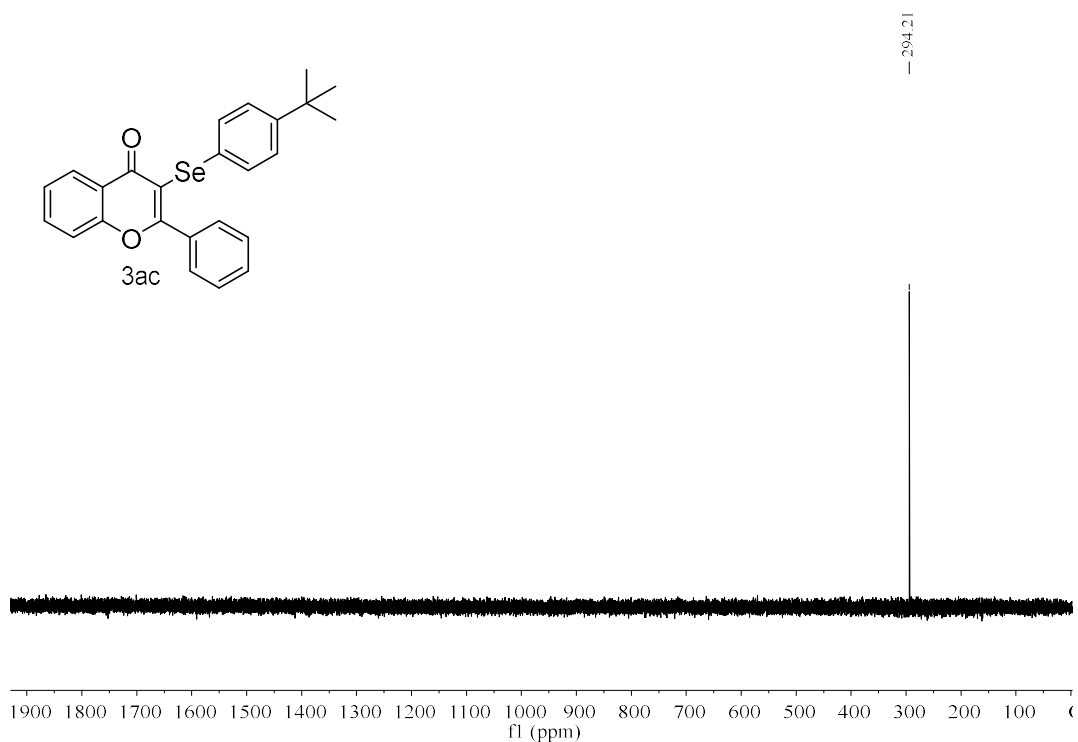


Figure S14 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ac** in CDCl₃

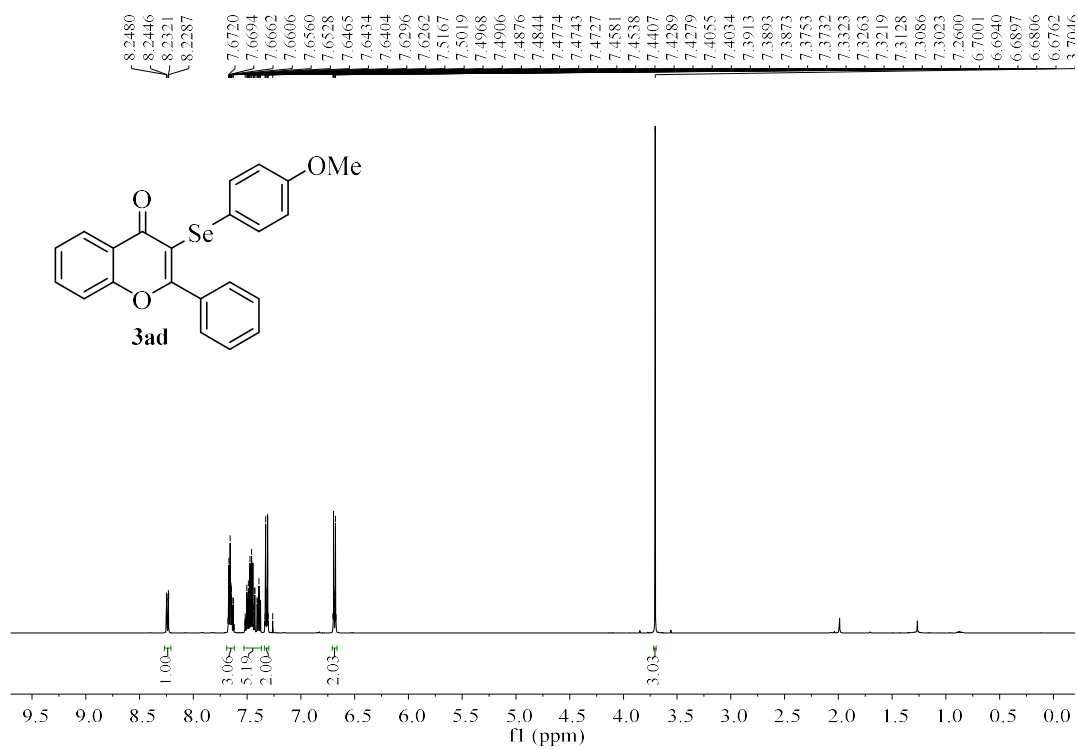


Figure S15 ¹H NMR (500 MHz) spectrum of **3ad** in CDCl₃

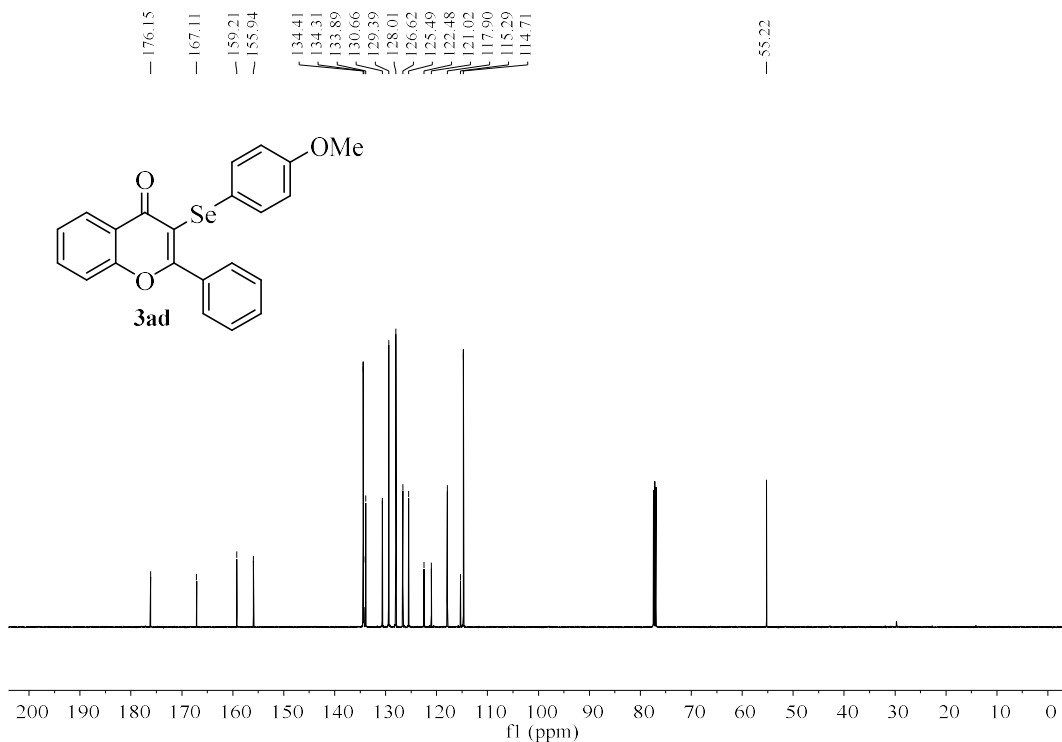


Figure S16 ^{13}C NMR (125 MHz) spectrum of **3ad** in CDCl_3

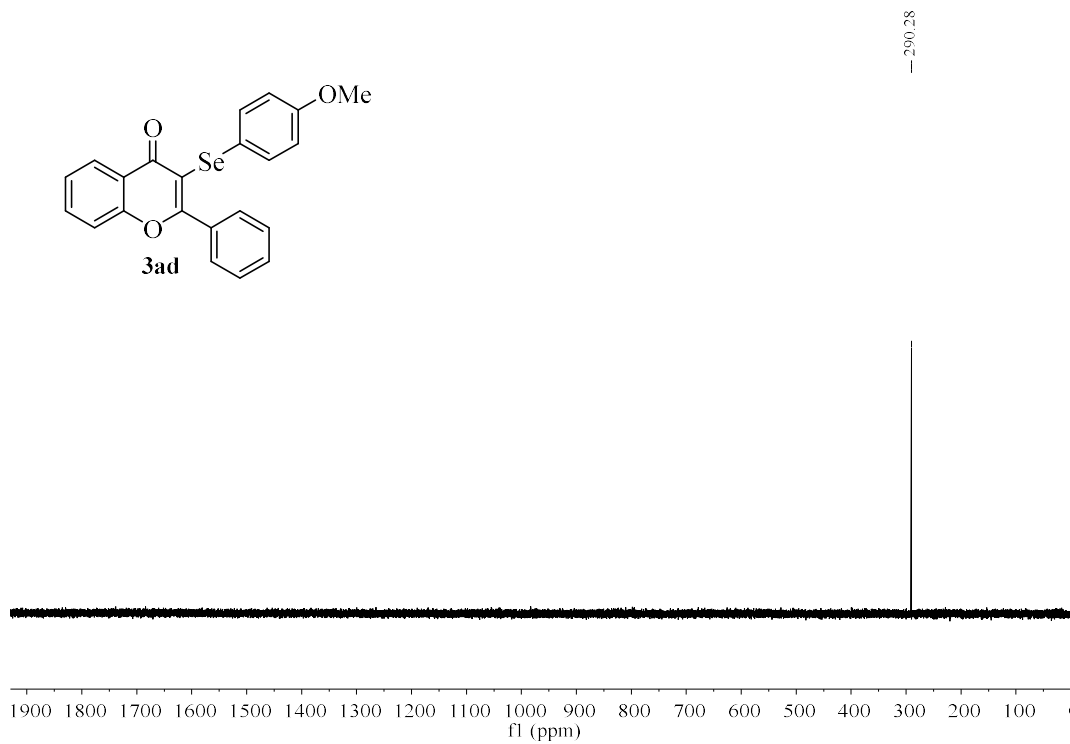


Figure S17 ^{77}Se NMR (95.5 MHz) spectrum of **3ad** in CDCl_3

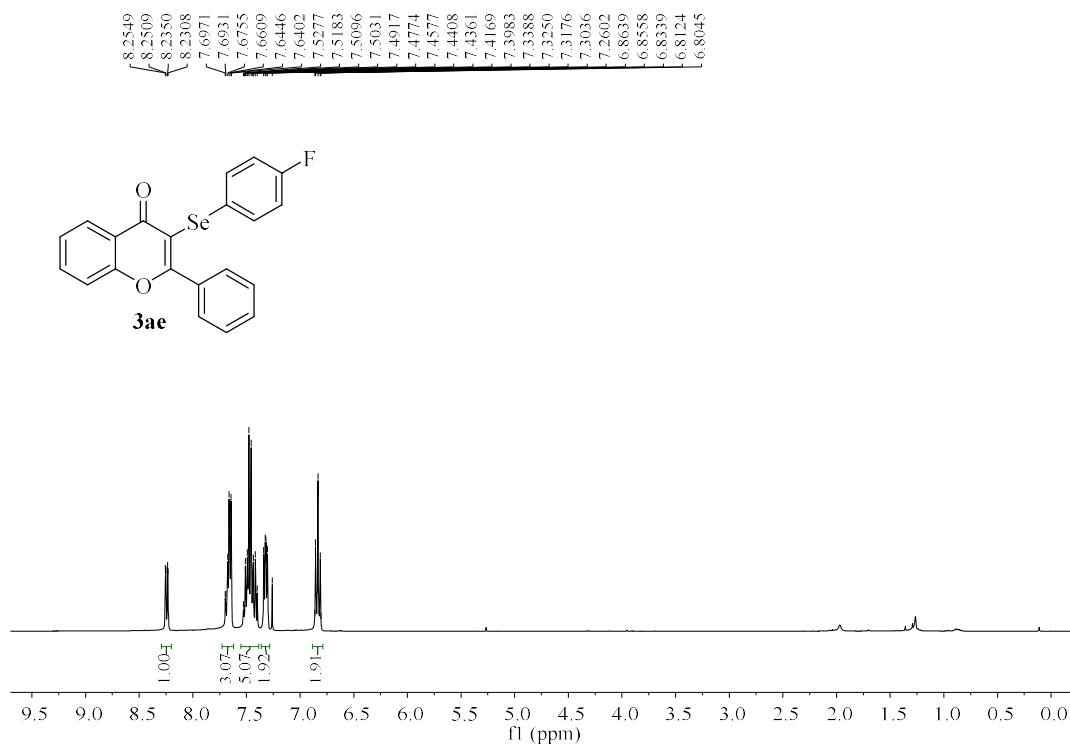


Figure S18 ^1H NMR (400 MHz) spectrum of **3ae** in CDCl_3

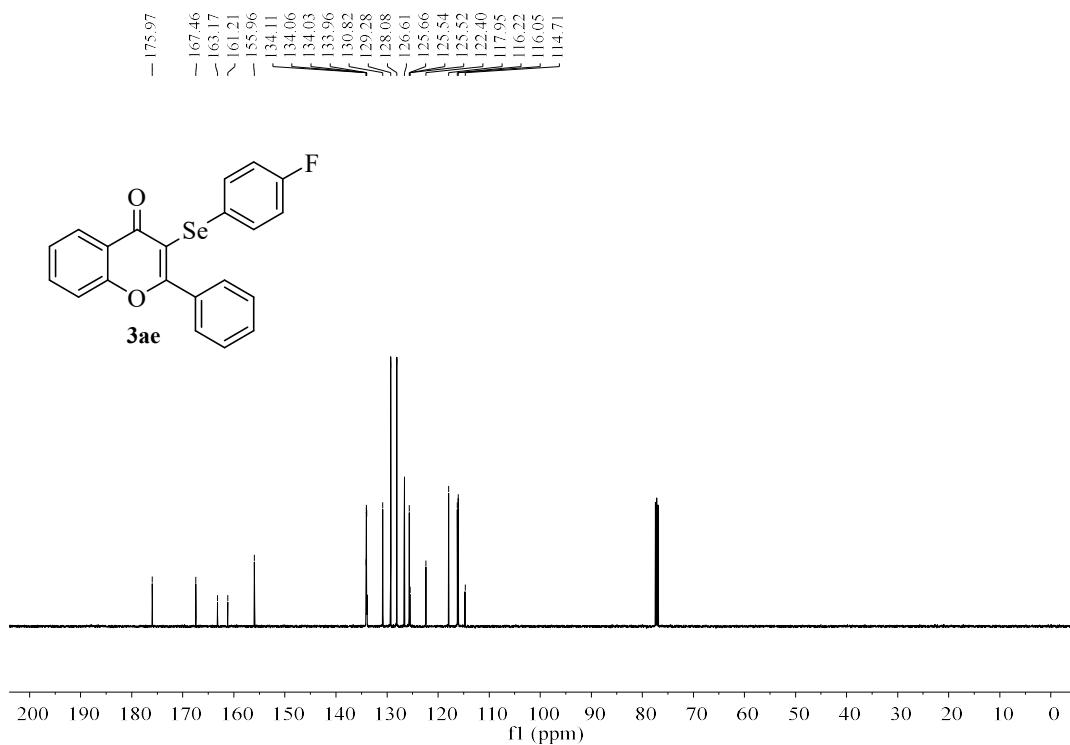


Figure S19 ^{13}C NMR (125 MHz) spectrum of **3ae** in CDCl_3

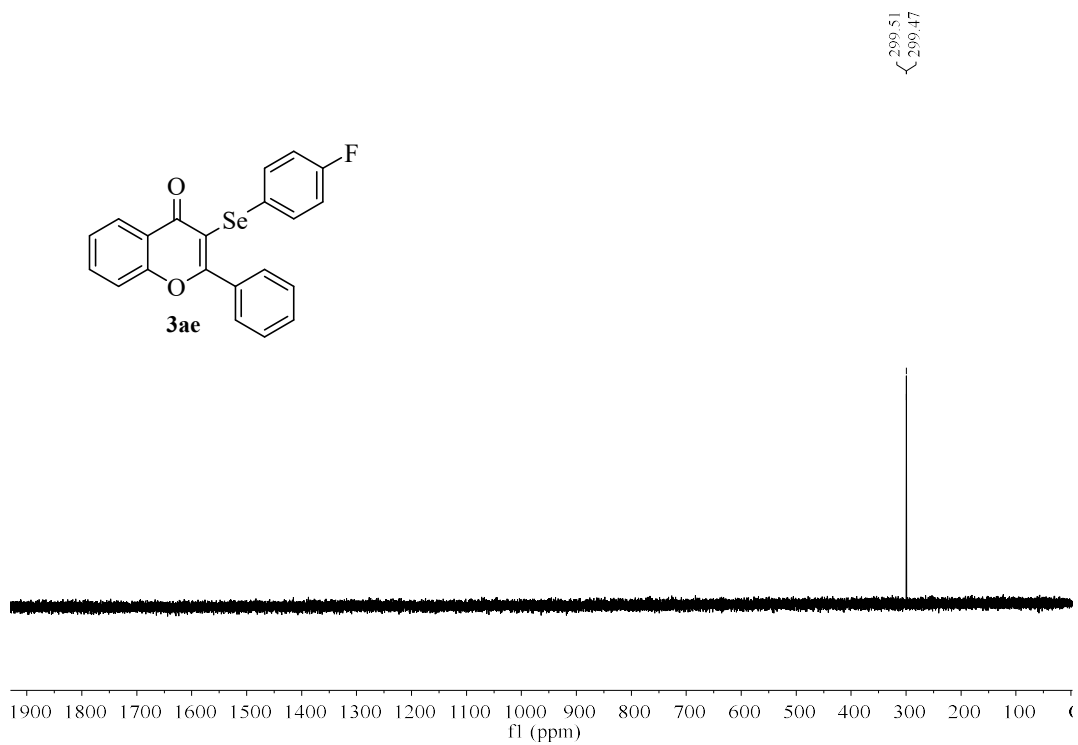


Figure S20 ^{77}Se NMR (95.5 MHz) spectrum of **3ae** in CDCl_3

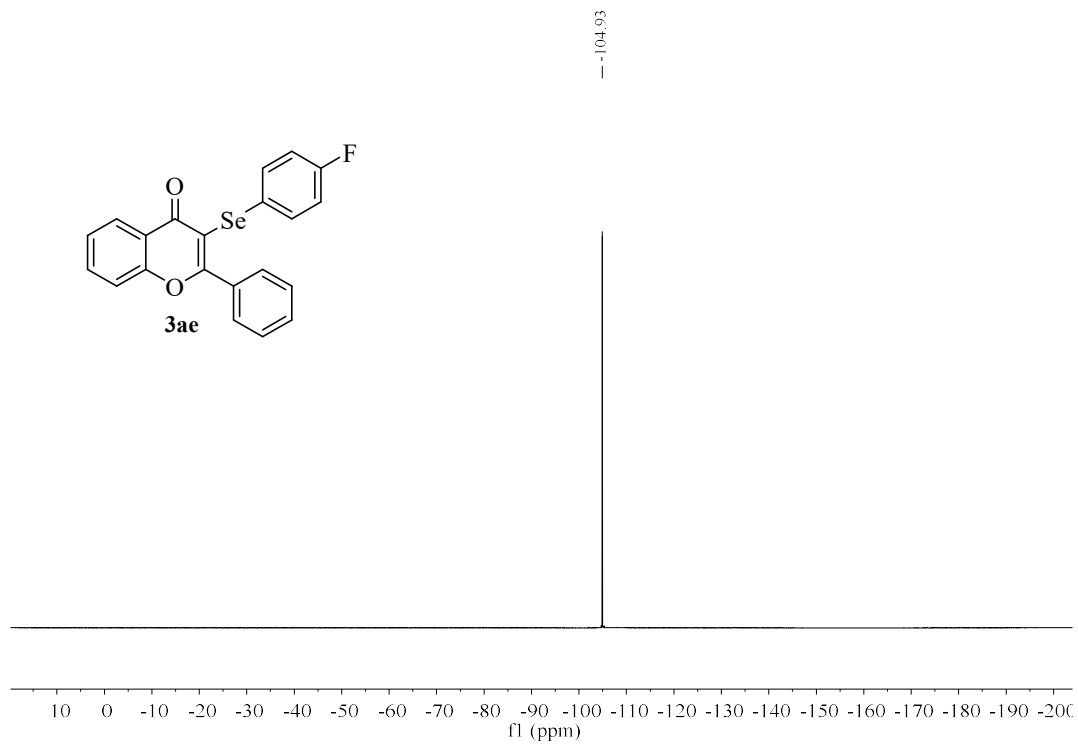


Figure S21 ^{19}F NMR (376.3 MHz) spectrum of **3ae** in CDCl_3

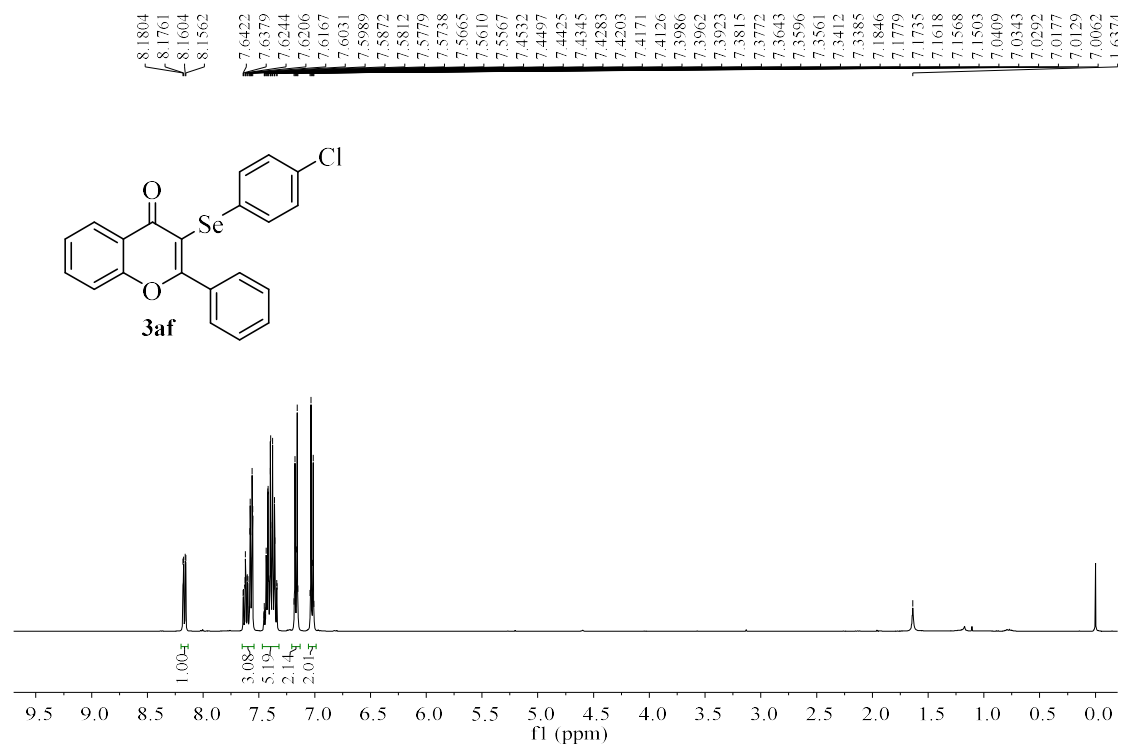


Figure S22 ¹H NMR (400 MHz) spectrum of **3af** in CDCl₃

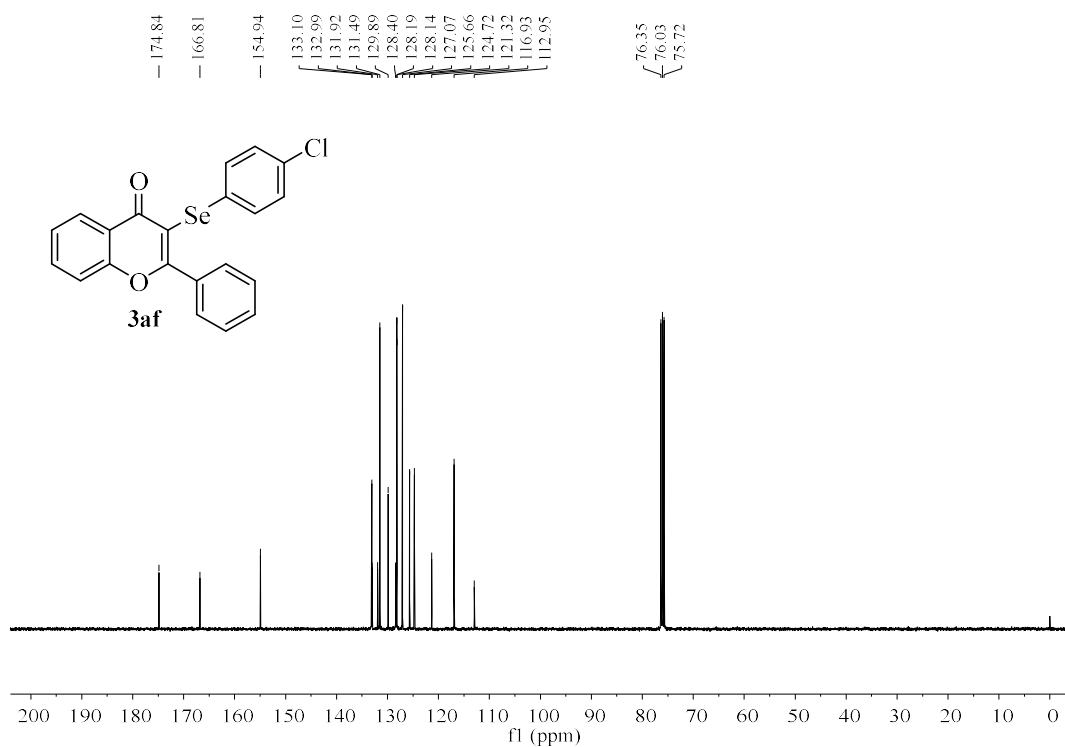


Figure S23 ¹³C NMR (100 MHz) spectrum of **3af** in CDCl₃

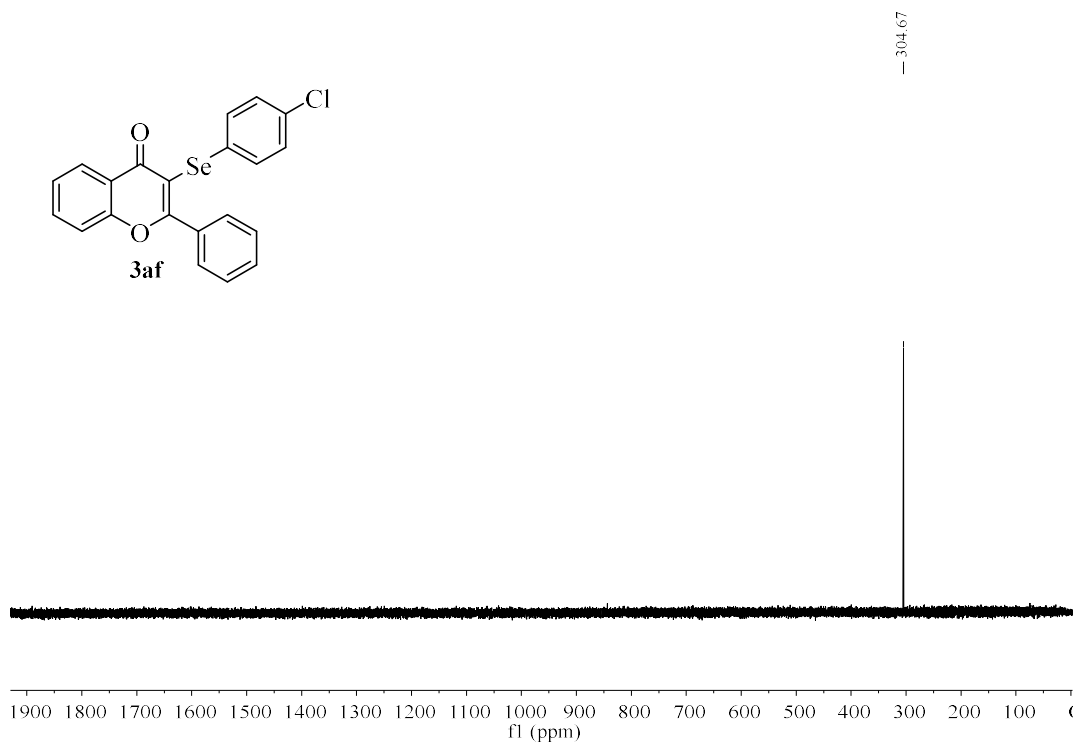


Figure S24 ^{77}Se NMR (95.5 MHz) spectrum of **3af** in CDCl_3

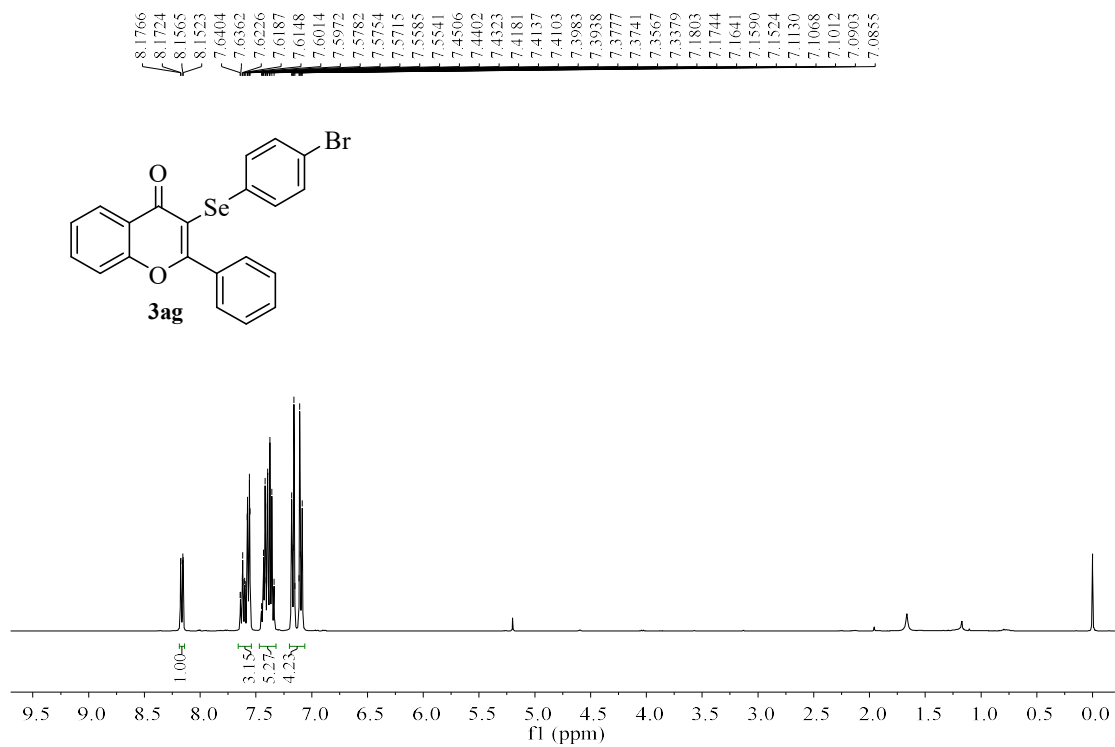


Figure S25 ^1H NMR (400 MHz) spectrum of **3ag** in CDCl_3

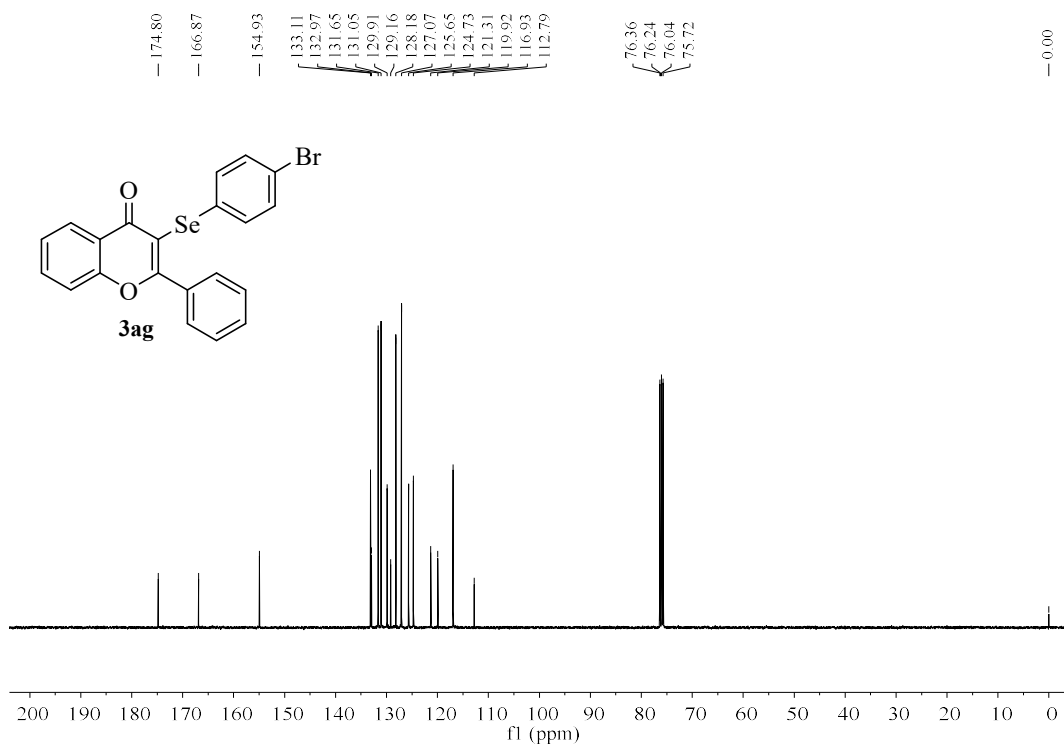


Figure S26 ¹³C NMR (100 MHz) spectrum of **3ag** in CDCl₃

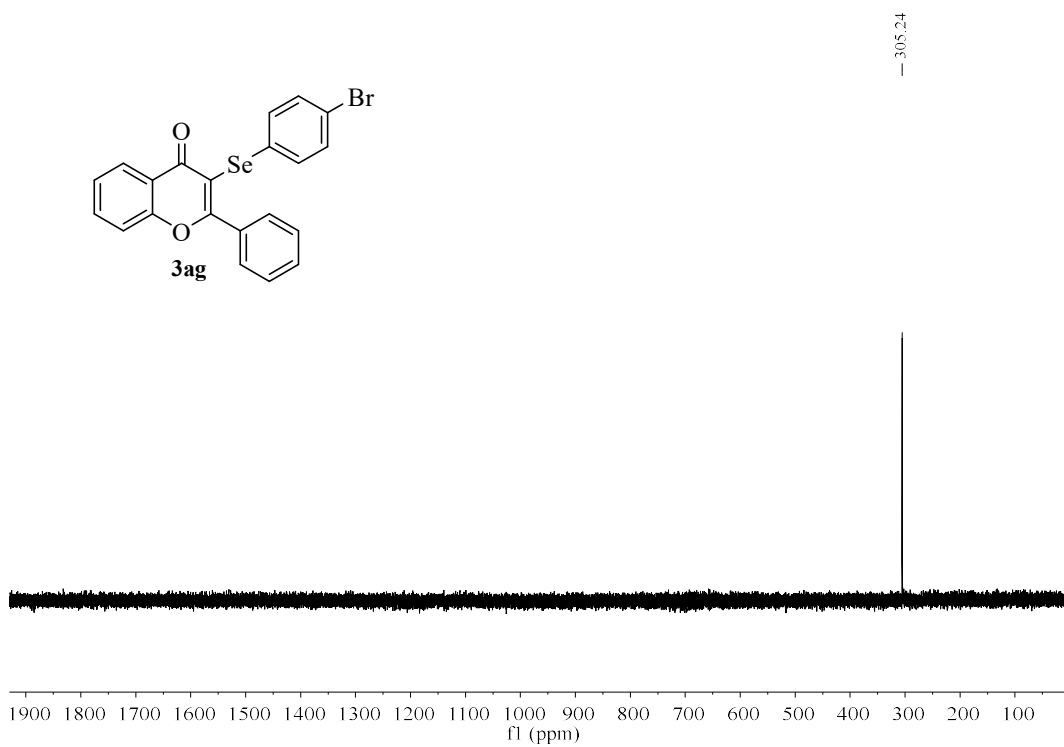


Figure S27 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ag** in CDCl₃

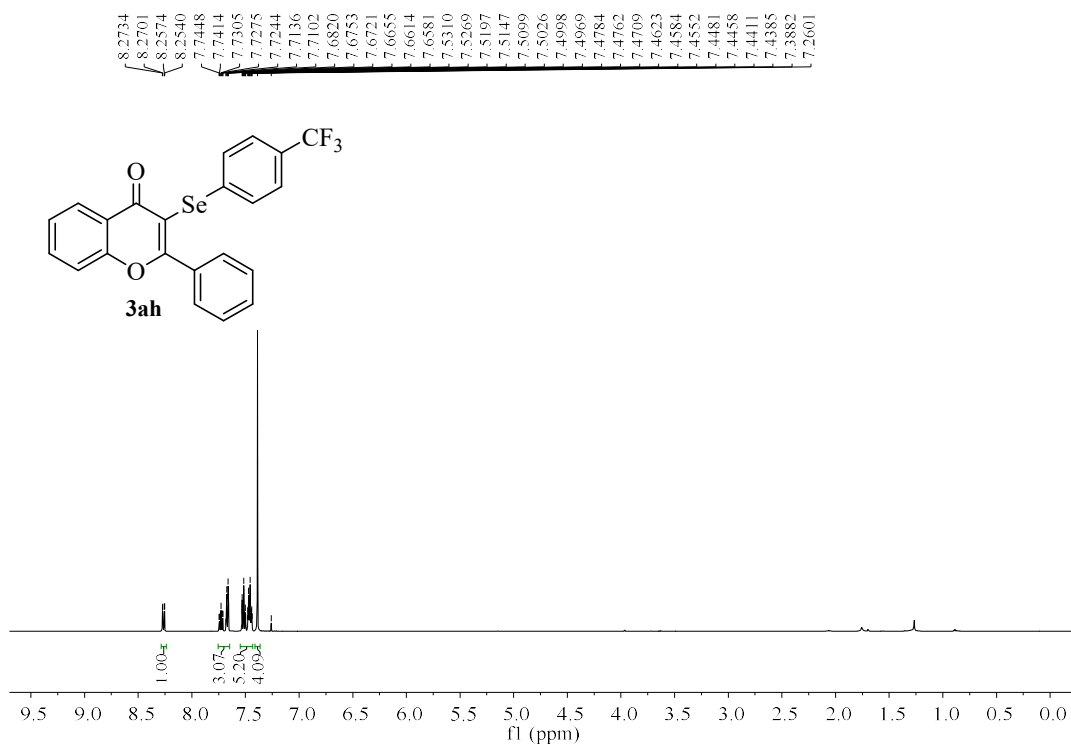


Figure S28 ¹H NMR (500 MHz) spectrum of **3ah** in CDCl₃

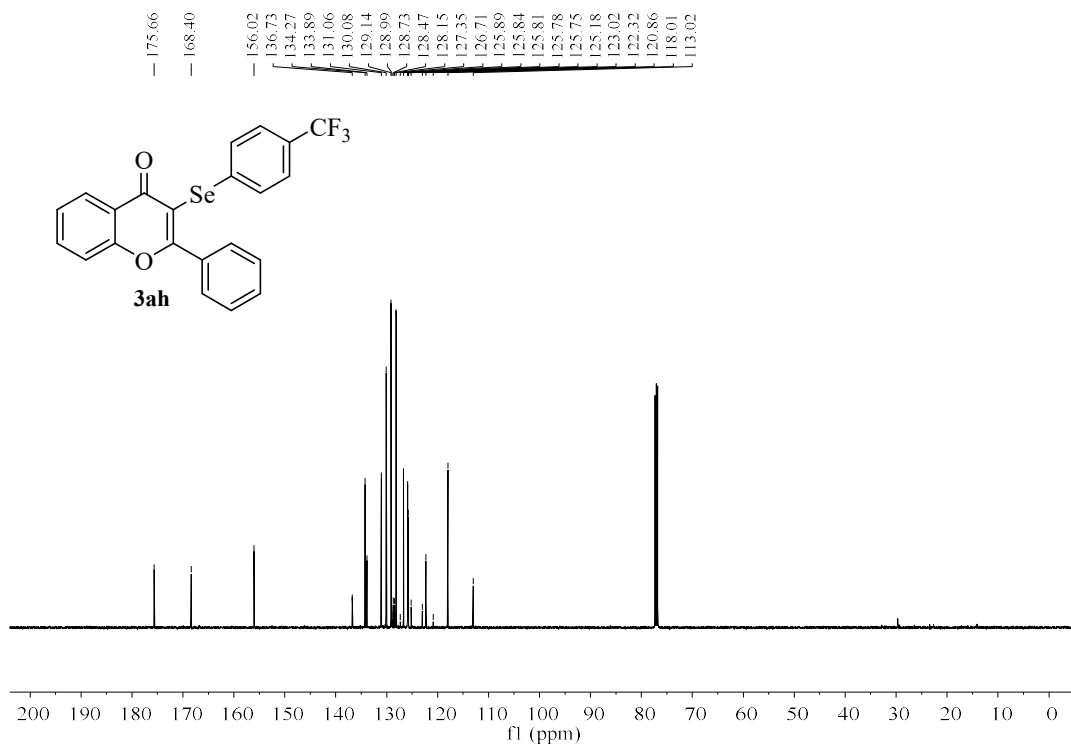


Figure S29 ¹³C NMR (125 MHz) spectrum of **3ah** in CDCl₃

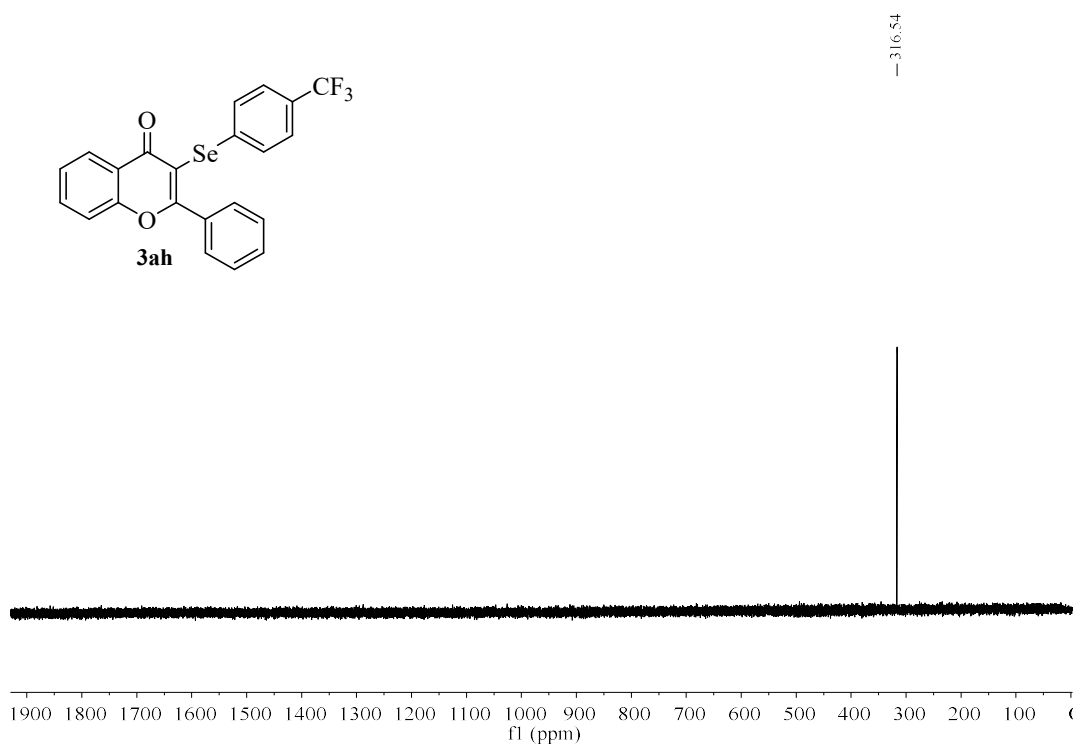


Figure S30 ^{77}Se NMR (95.5 MHz) spectrum of **3ah** in CDCl_3

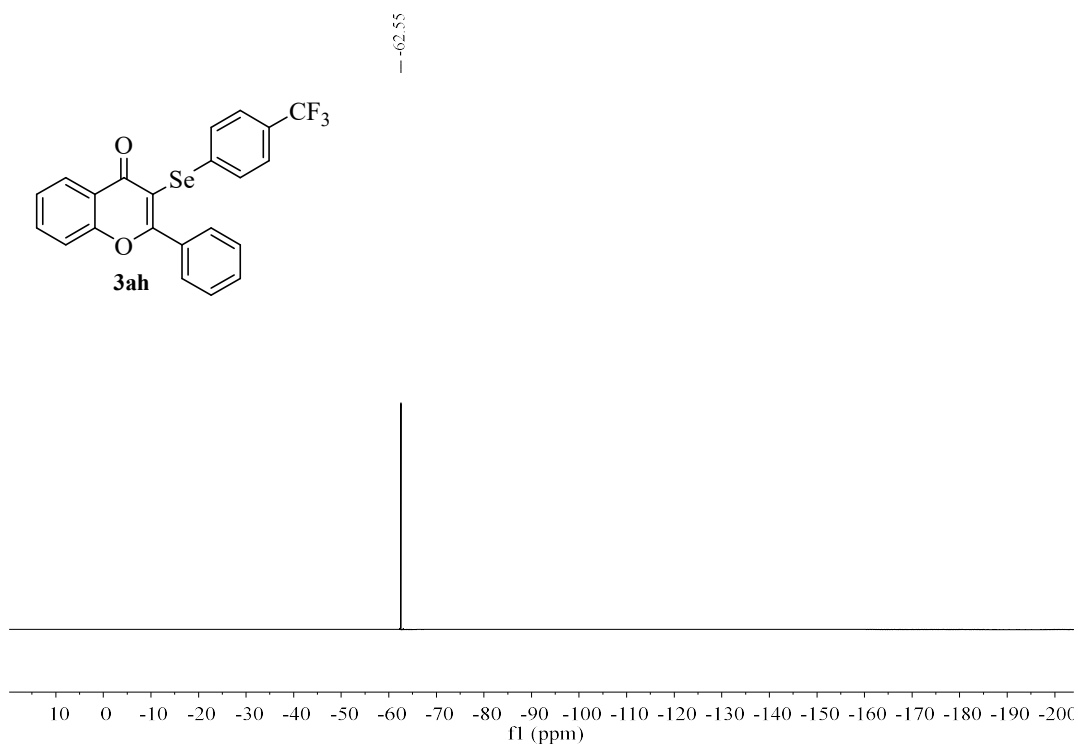


Figure S31 ^{19}F NMR (376.3 MHz) spectrum of **3ah** in CDCl_3

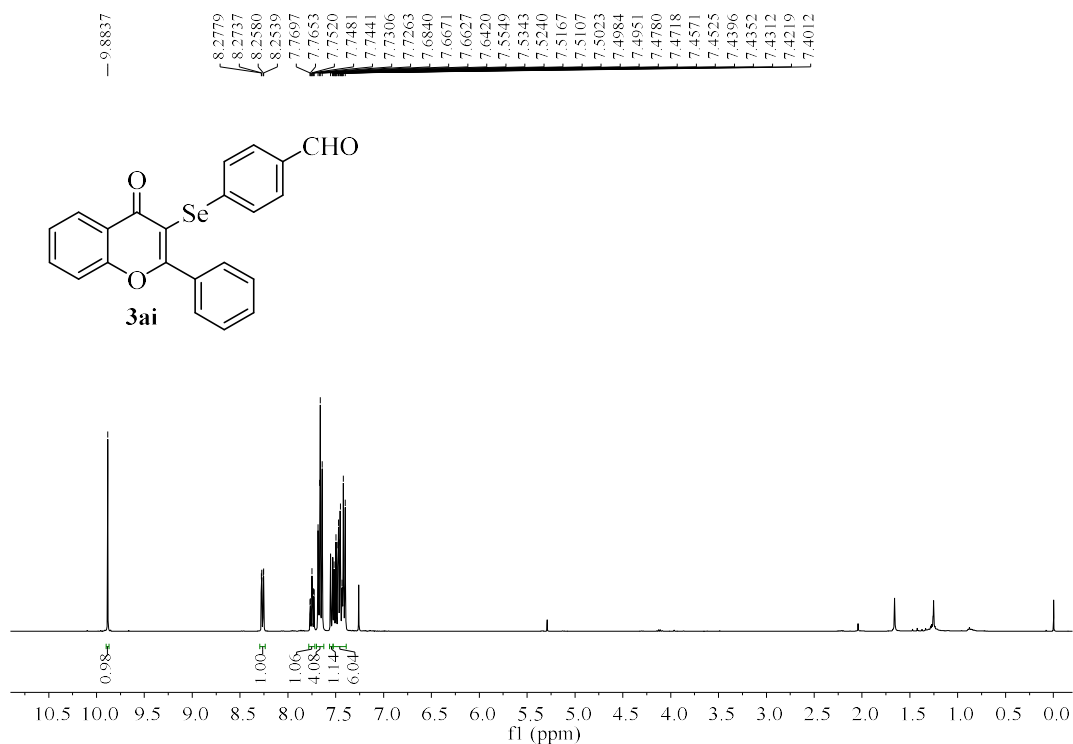


Figure S32 ¹H NMR (400 MHz) spectrum of **3ai** in CDCl₃

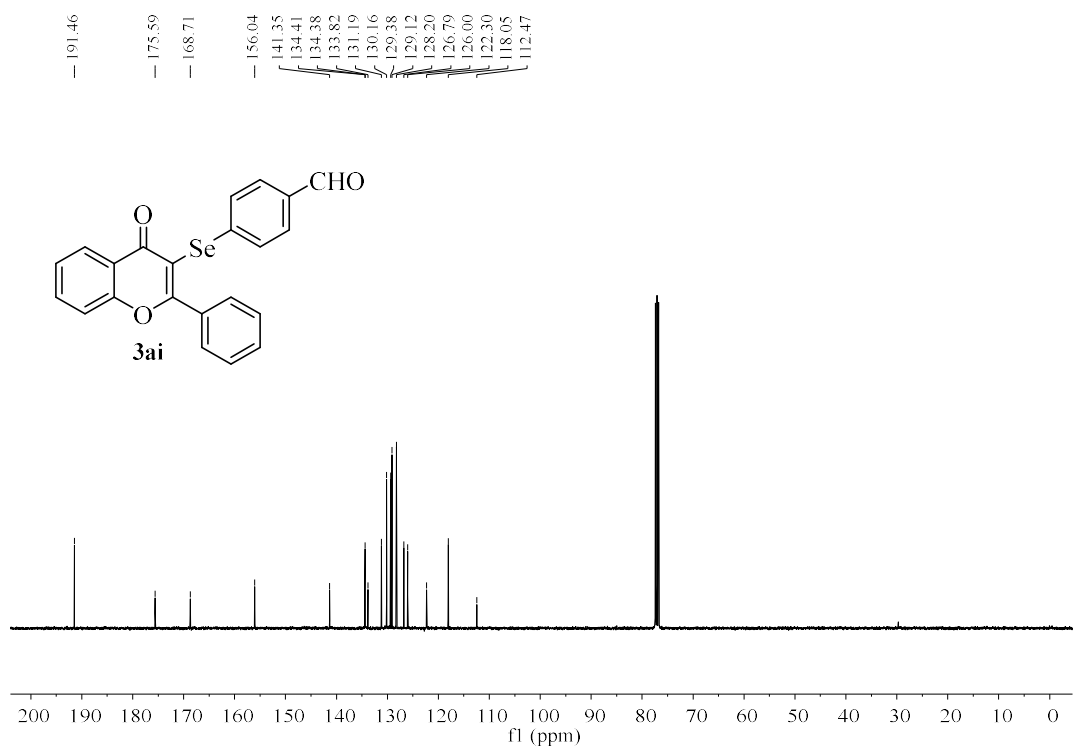


Figure S33 ¹³C NMR (100 MHz) spectrum of **3ai** in CDCl₃

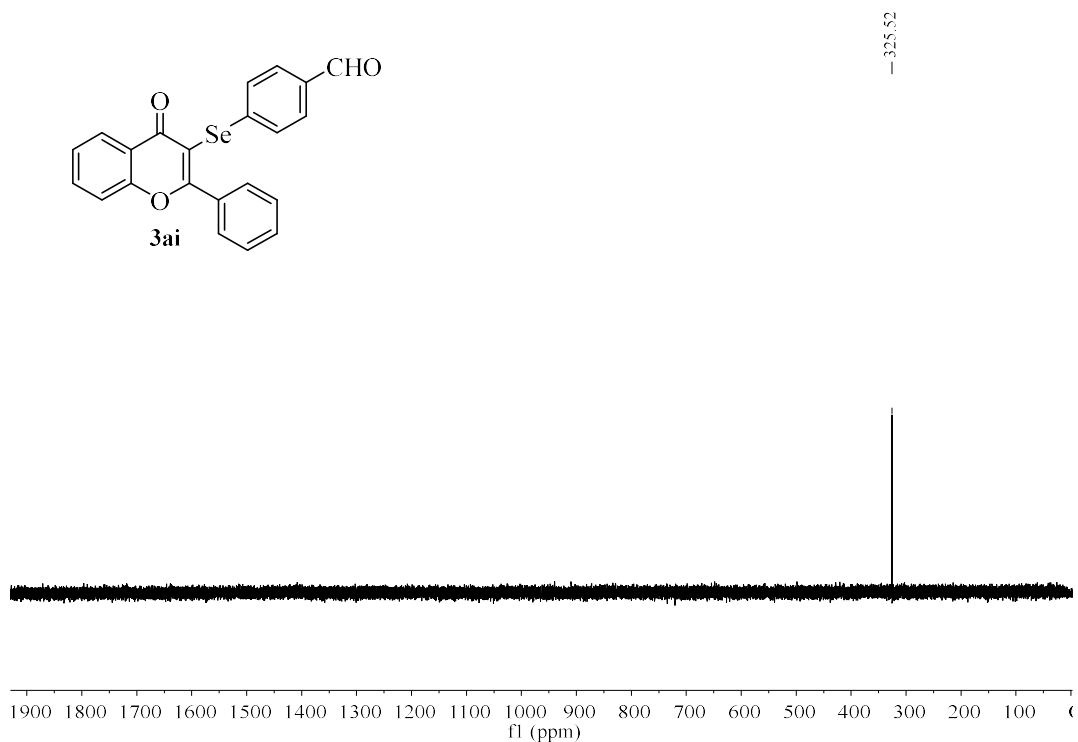


Figure S34 ^{77}Se NMR (95.5 MHz) spectrum of **3ai** in CDCl_3

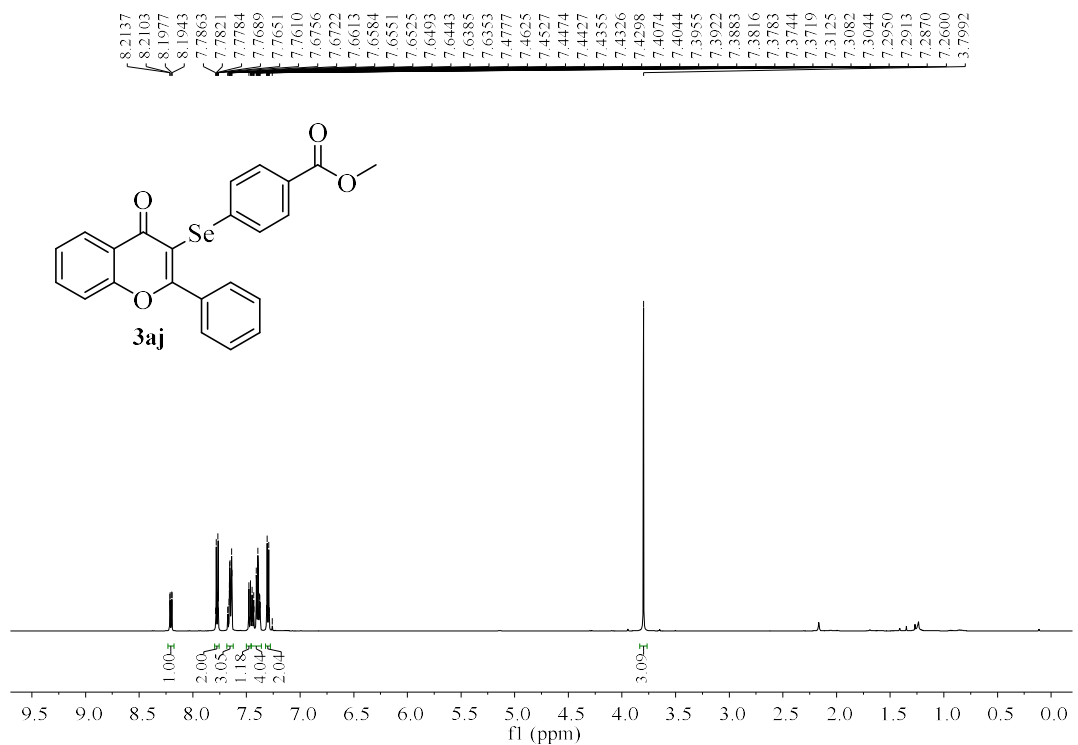


Figure S35 ^1H NMR (500 MHz) spectrum of **3aj** in CDCl_3

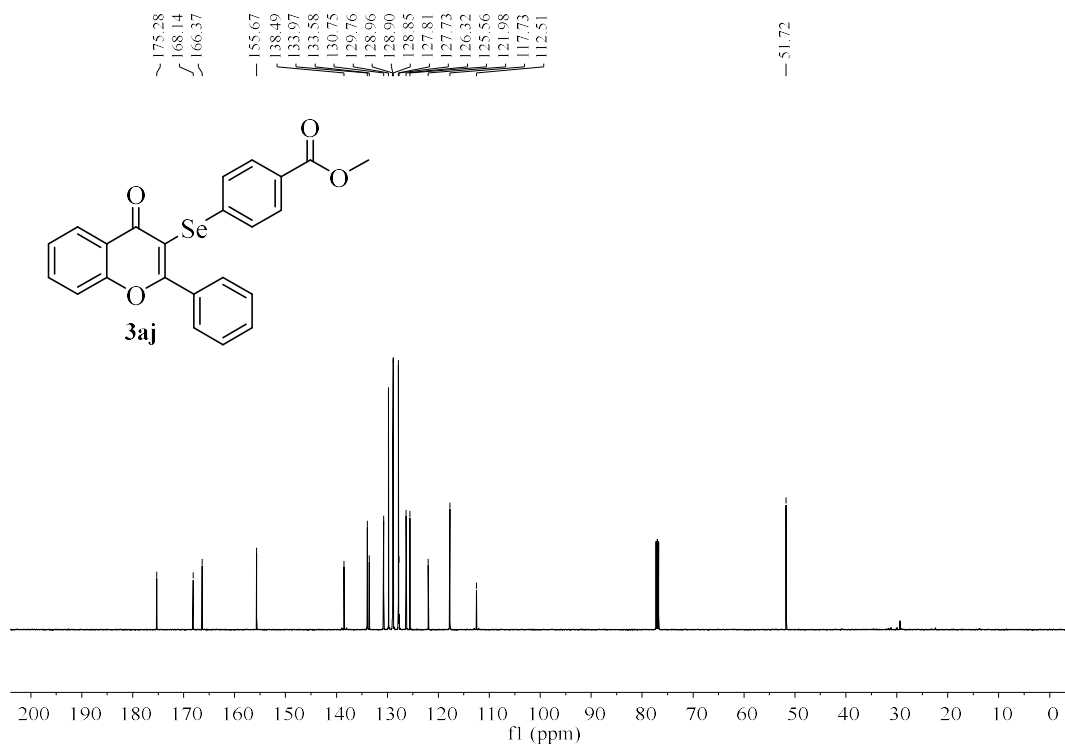


Figure S36 ¹³C NMR (125 MHz) spectrum of **3aj** in CDCl₃

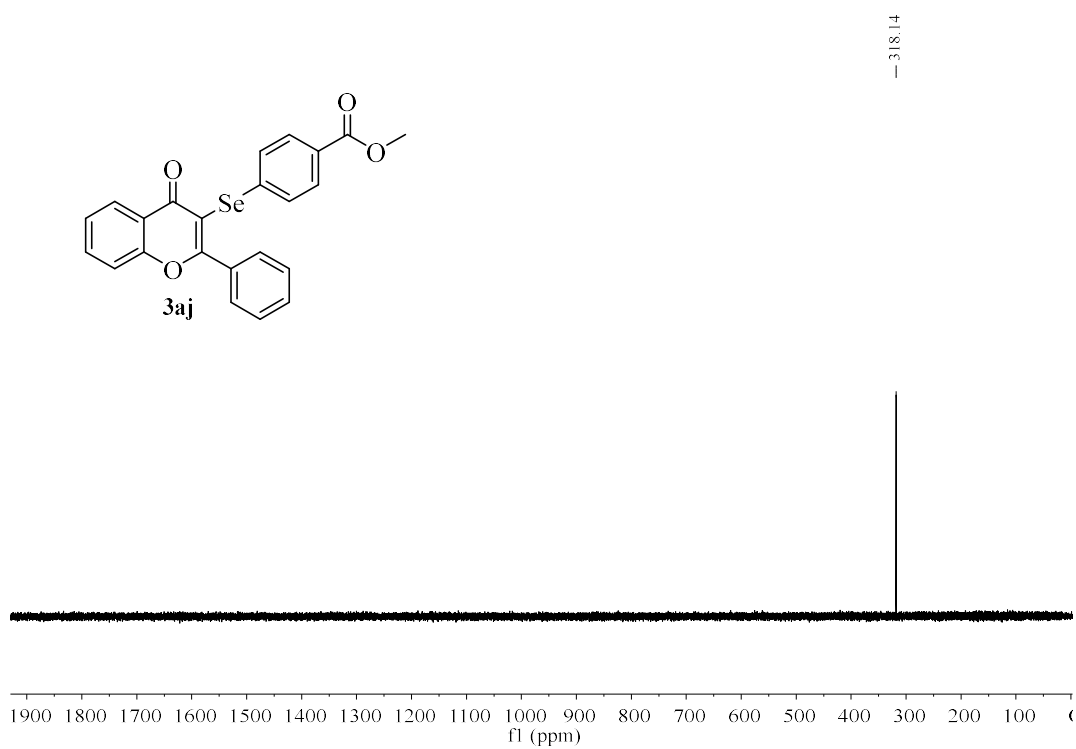


Figure S37 ⁷⁷Se NMR (95.5 MHz) spectrum of **3aj** in CDCl₃

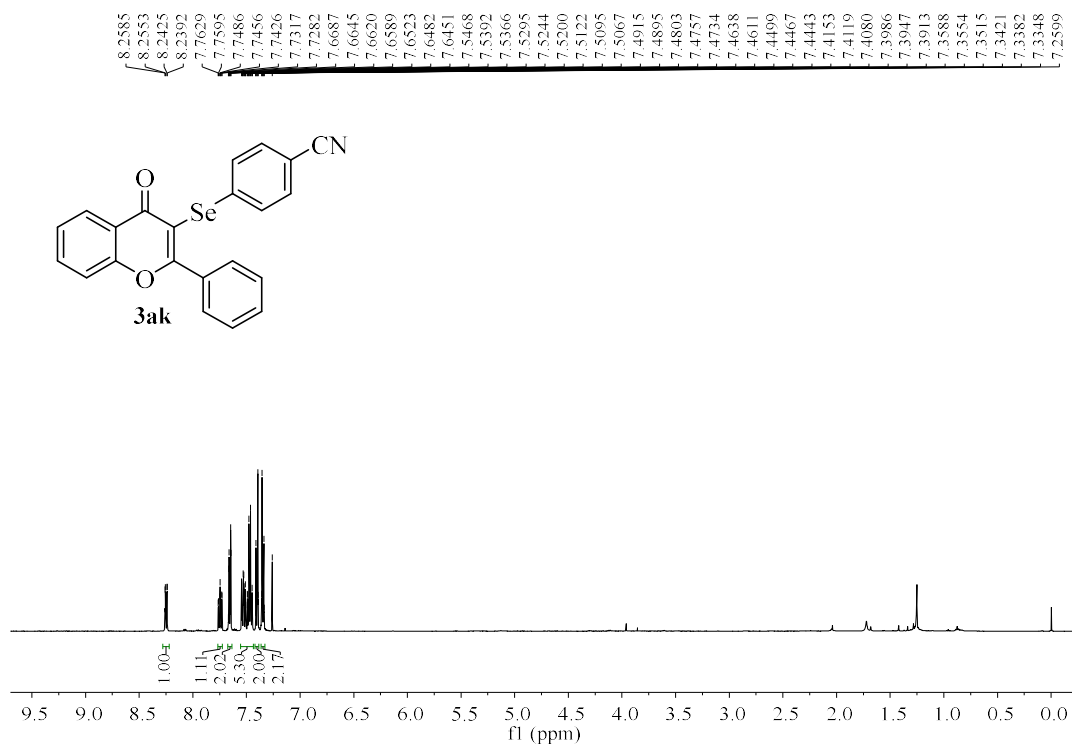


Figure S38 ¹H NMR (500 MHz) spectrum of **3ak** in CDCl₃

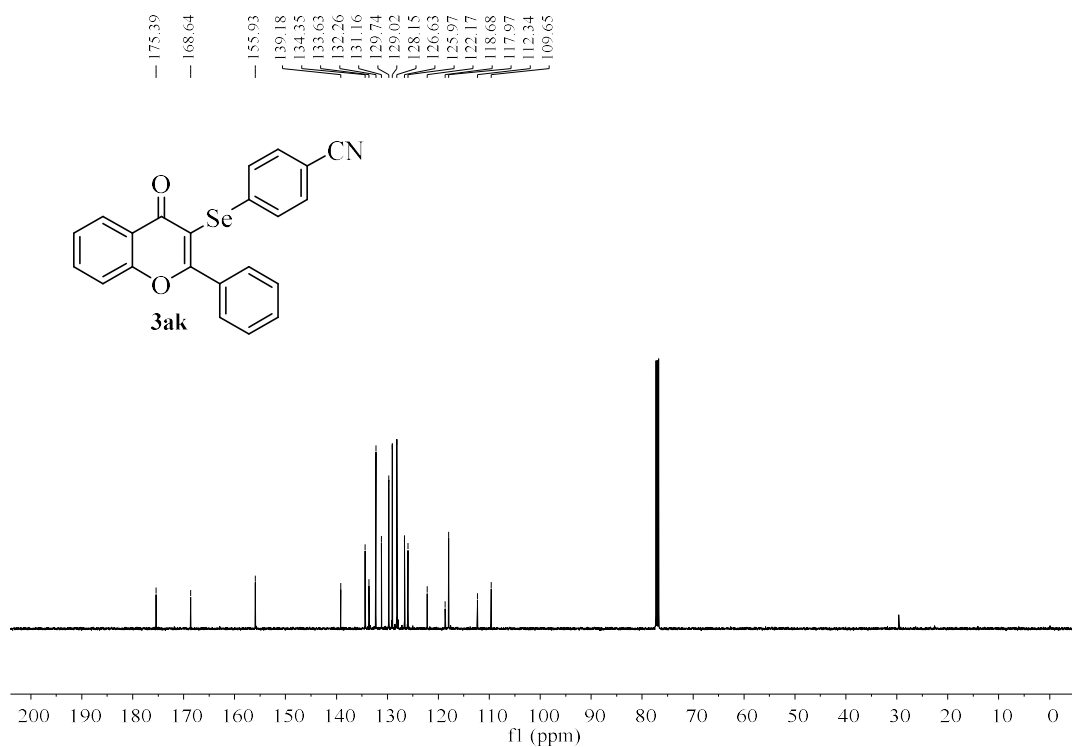


Figure S39 ¹³C NMR (125 MHz) spectrum of **3ak** in CDCl₃

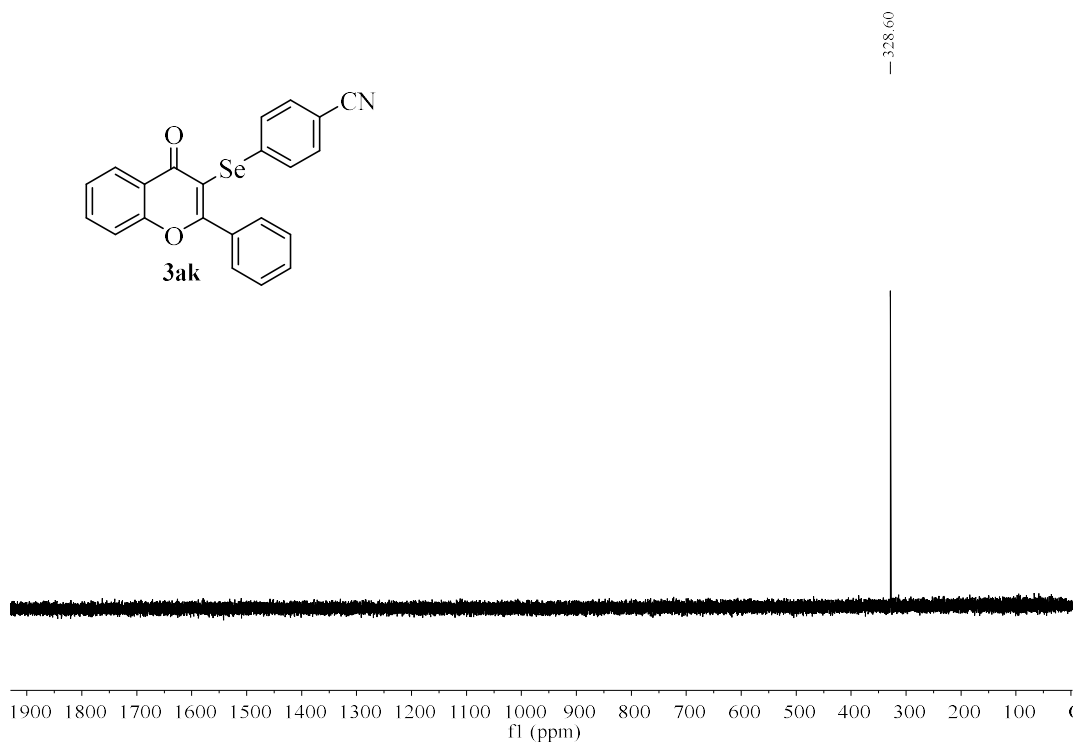


Figure S40 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ak** in CDCl₃

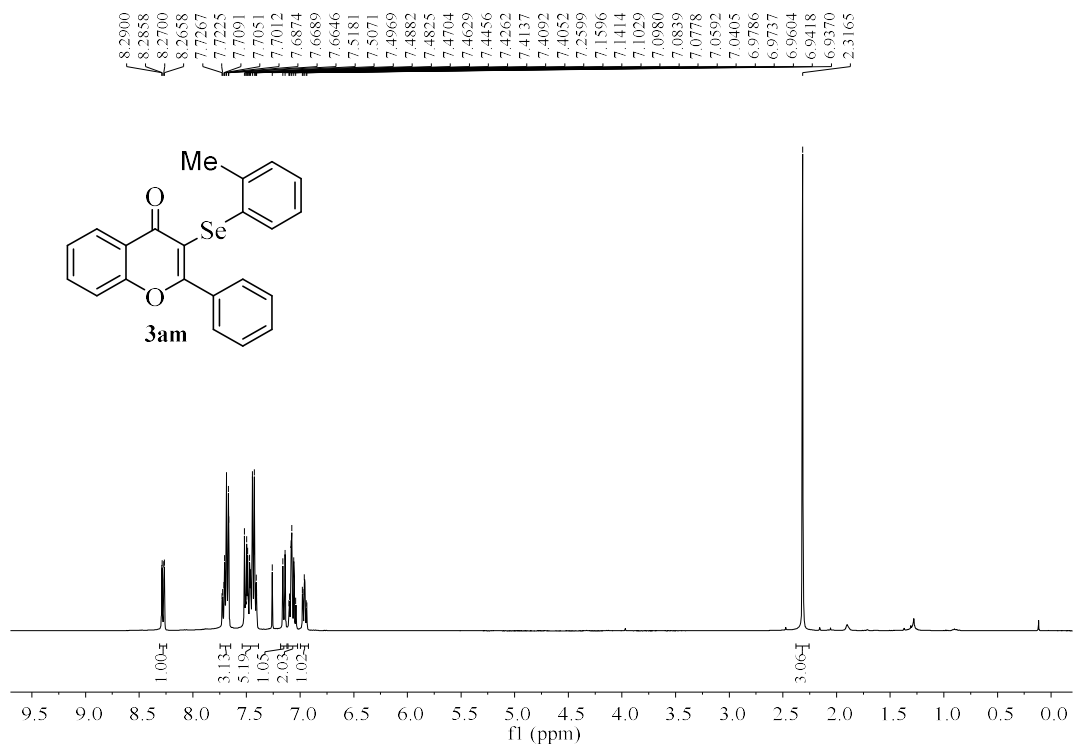


Figure S41 ¹H NMR (400 MHz) spectrum of **3am** in CDCl₃

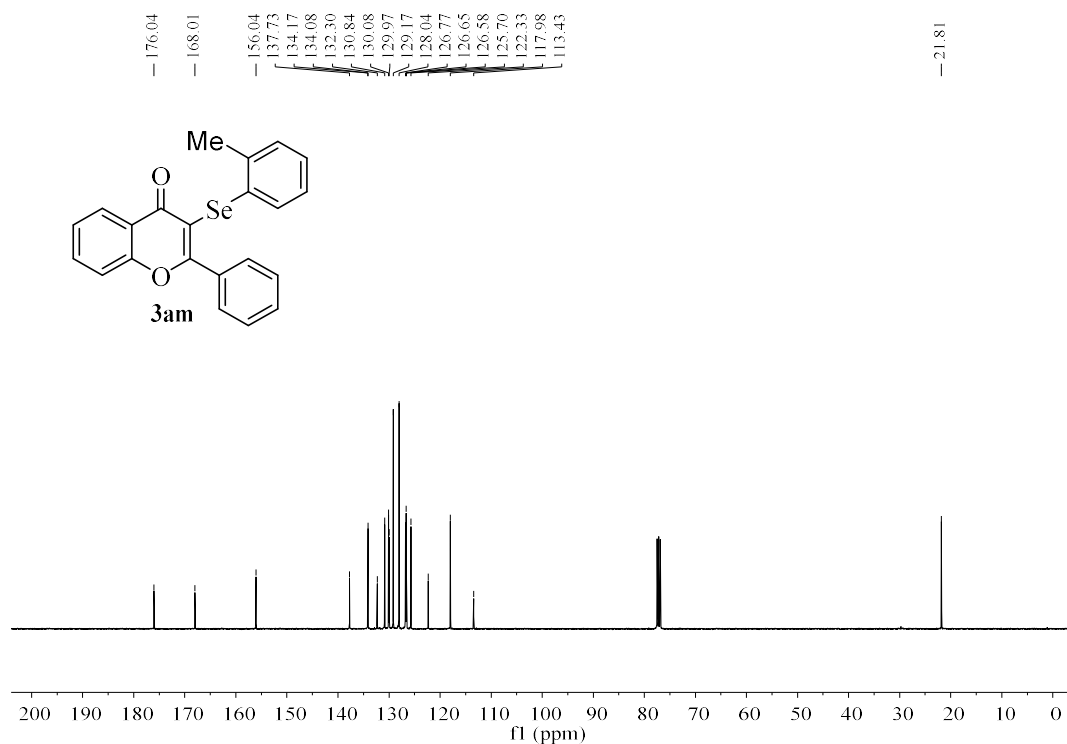


Figure S42 ^{13}C NMR (100 MHz) spectrum of **3am** in CDCl_3

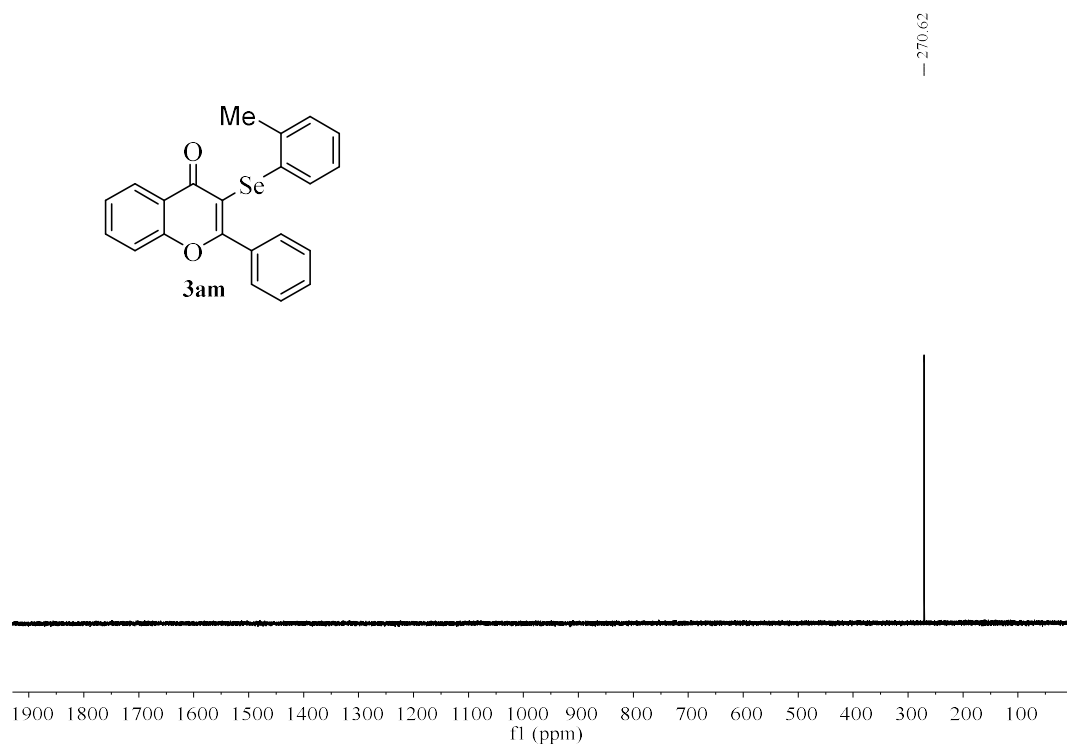


Figure S43 ^{77}Se NMR (95.5 MHz) spectrum of **3am** in CDCl_3

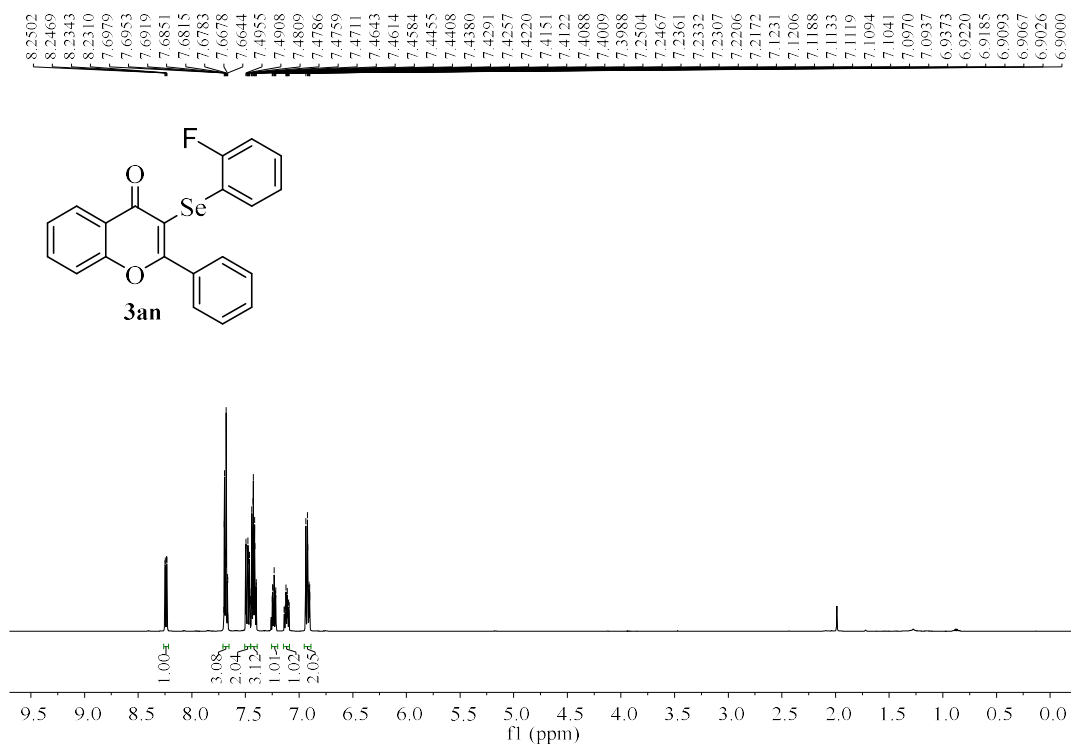


Figure S44 ^1H NMR (500 MHz) spectrum of **3an** in CDCl_3

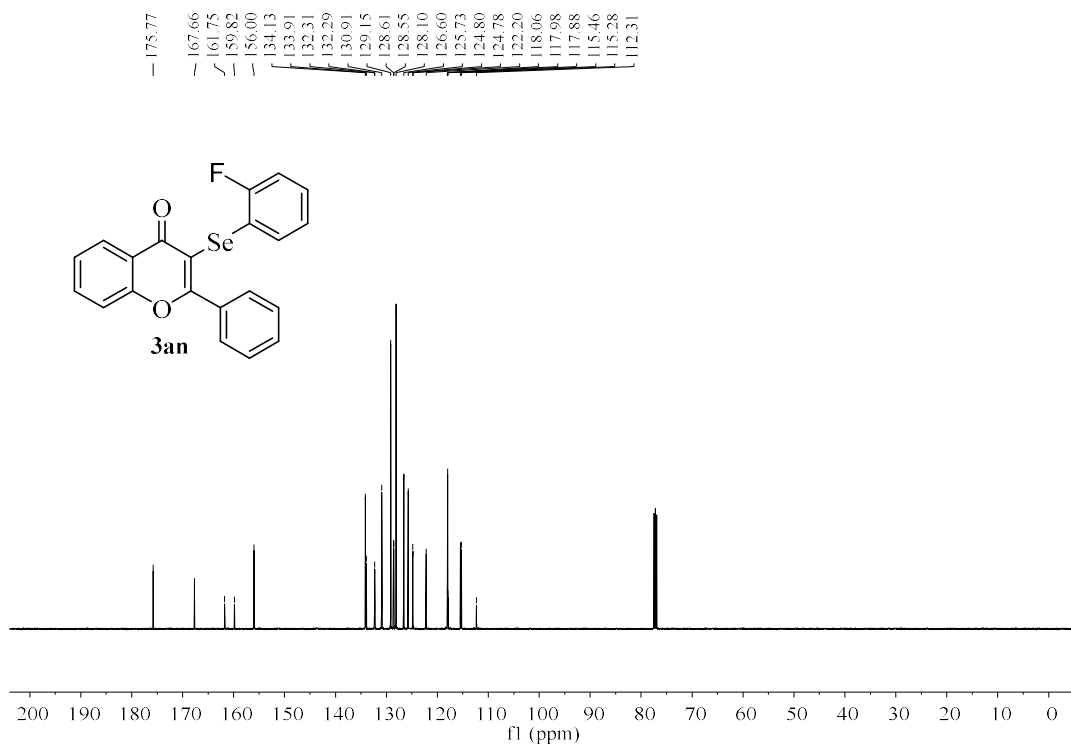


Figure S45 ^{13}C NMR (125 MHz) spectrum of **3an** in CDCl_3

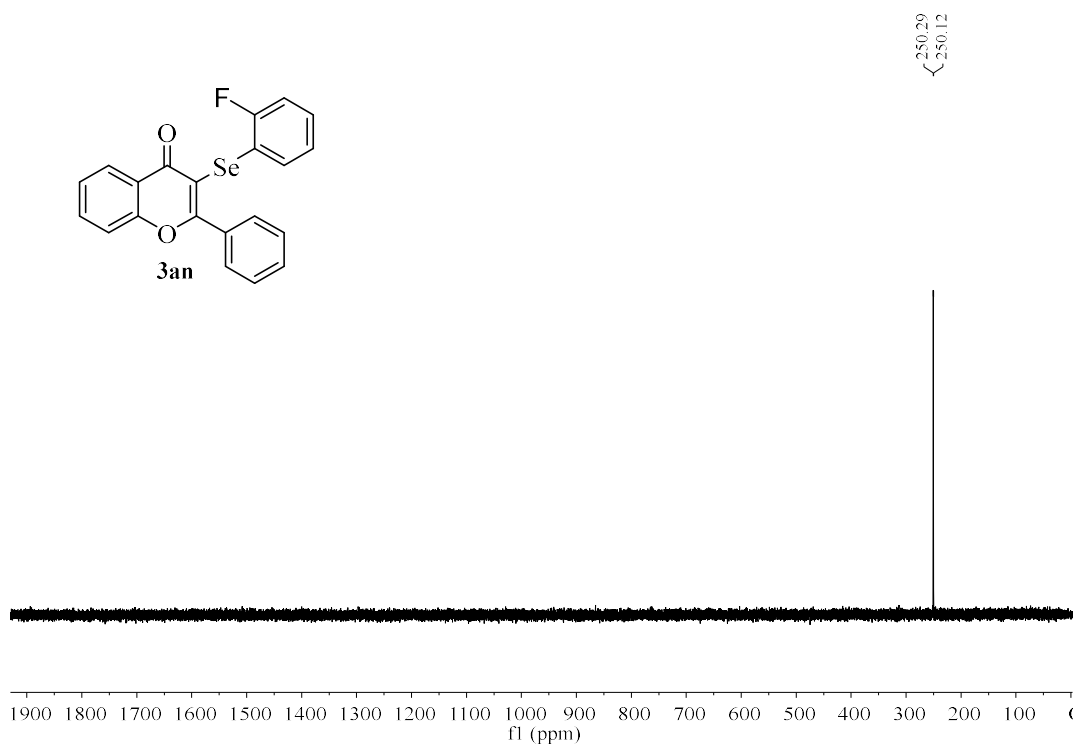


Figure S46 ⁷⁷Se NMR (95.5 MHz) spectrum of **3an** in CDCl₃

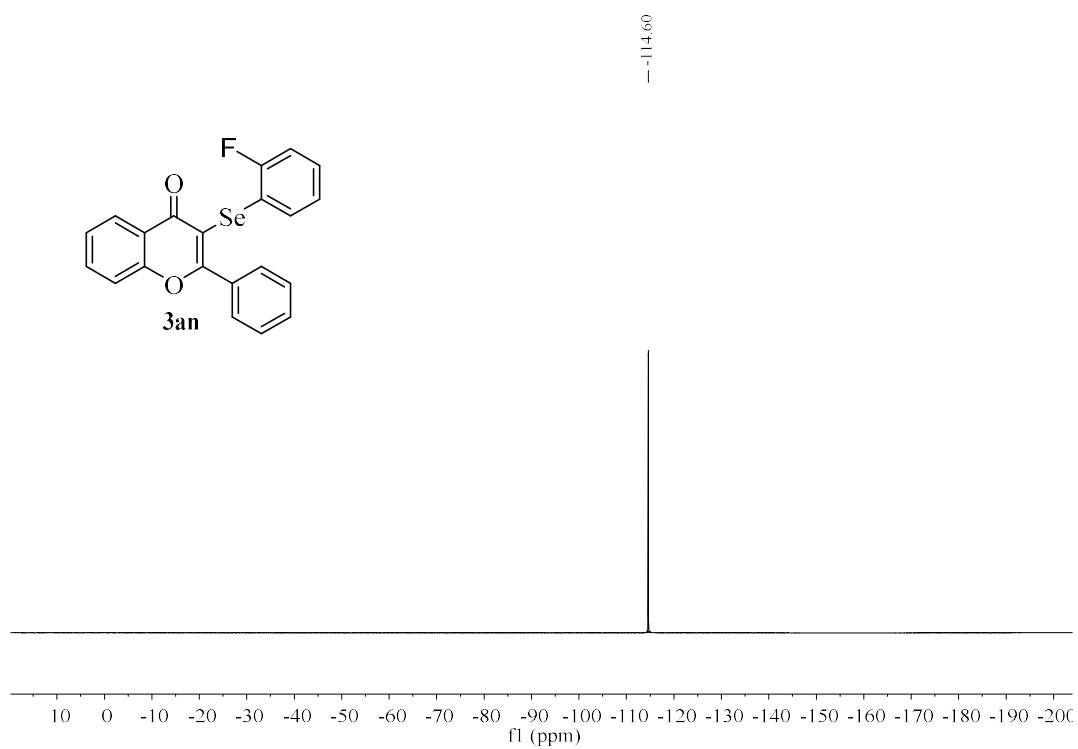


Figure S47 ¹⁹F NMR (376.3 MHz) spectrum of **3an** in CDCl₃

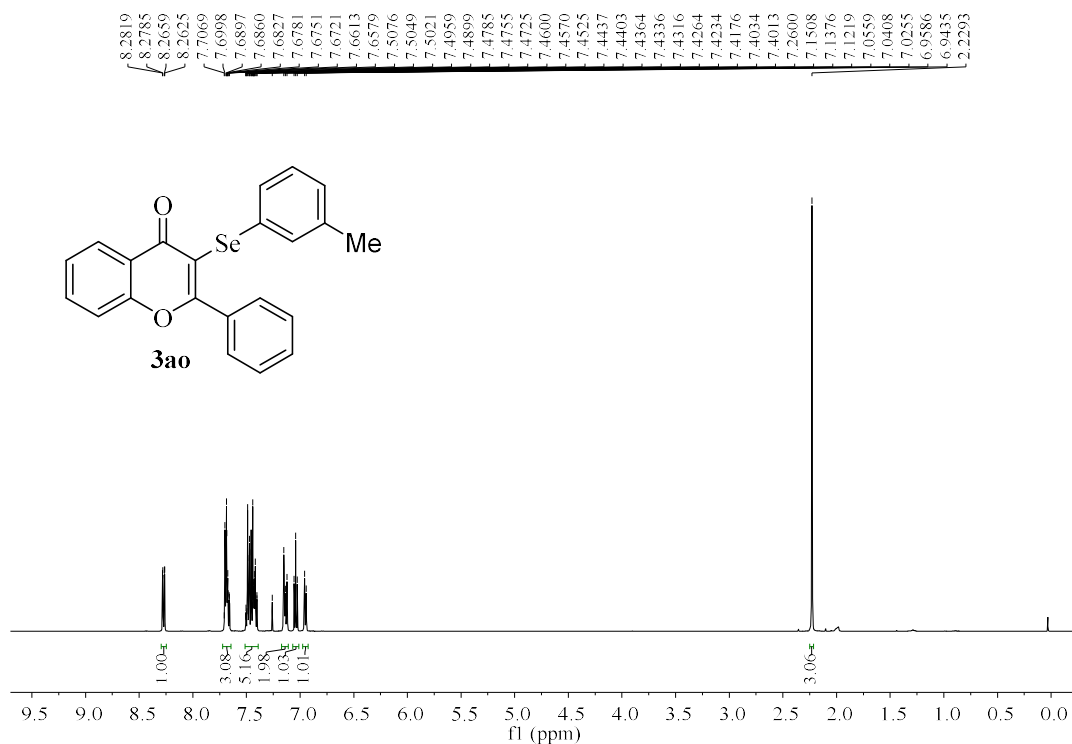


Figure S48 ¹H NMR (500 MHz) spectrum of **3ao** in CDCl₃

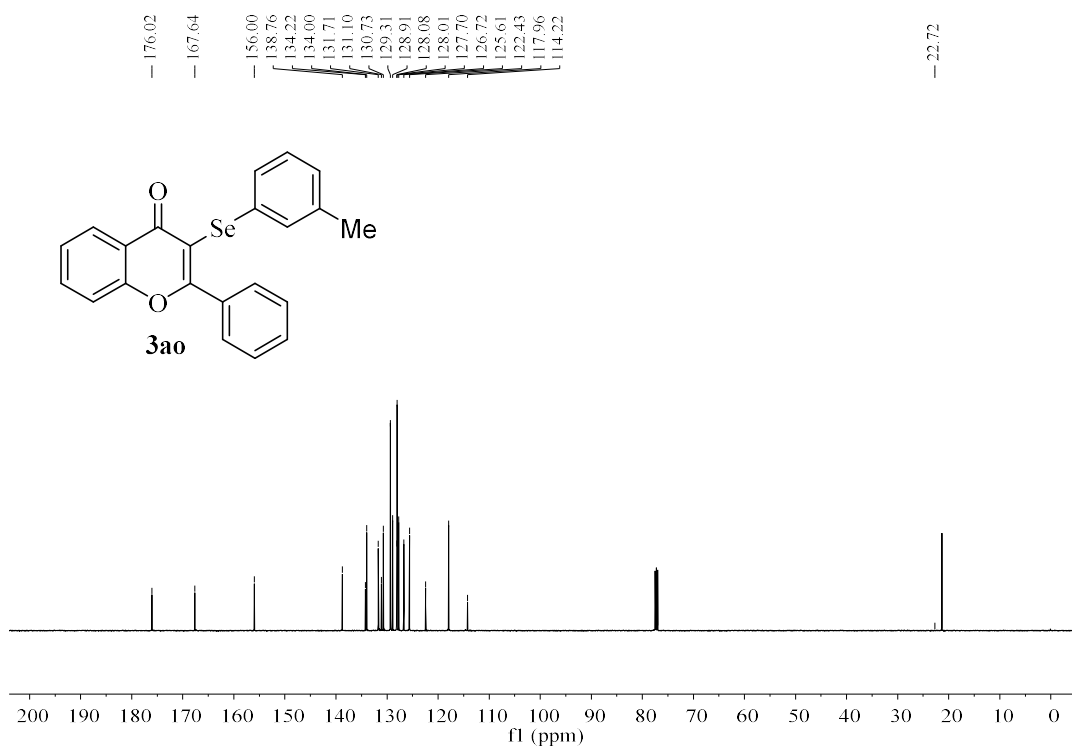


Figure S49 ¹³C NMR (125 MHz) spectrum of **3ao** in CDCl₃

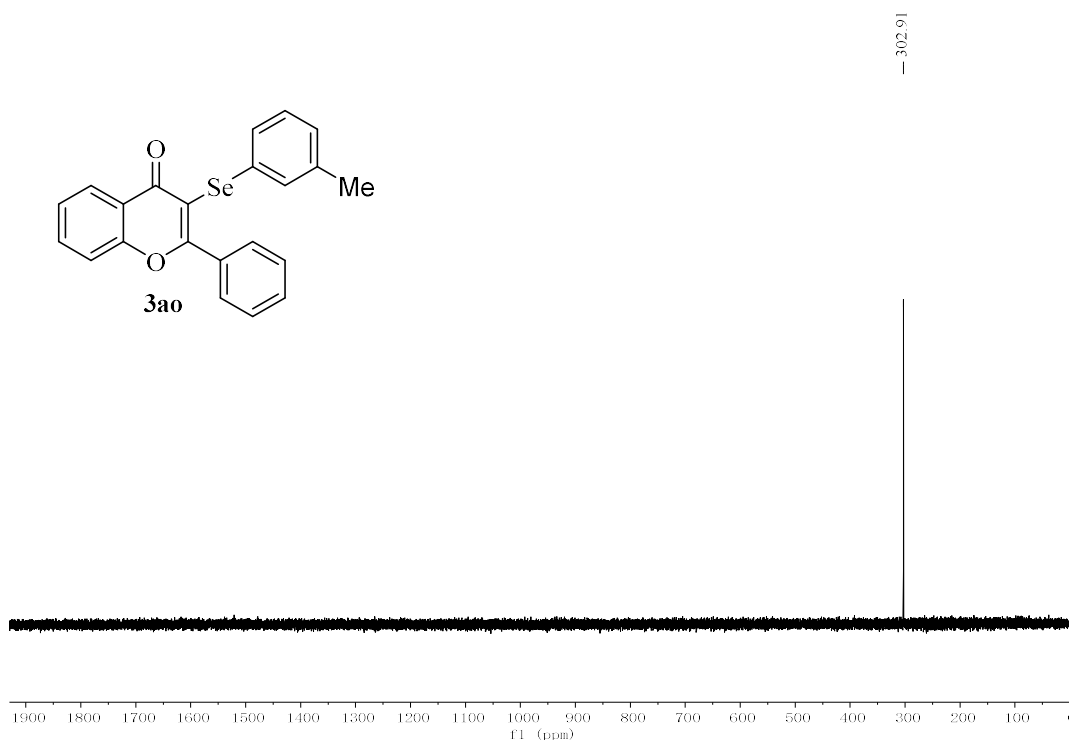


Figure S50 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ao** in CDCl₃

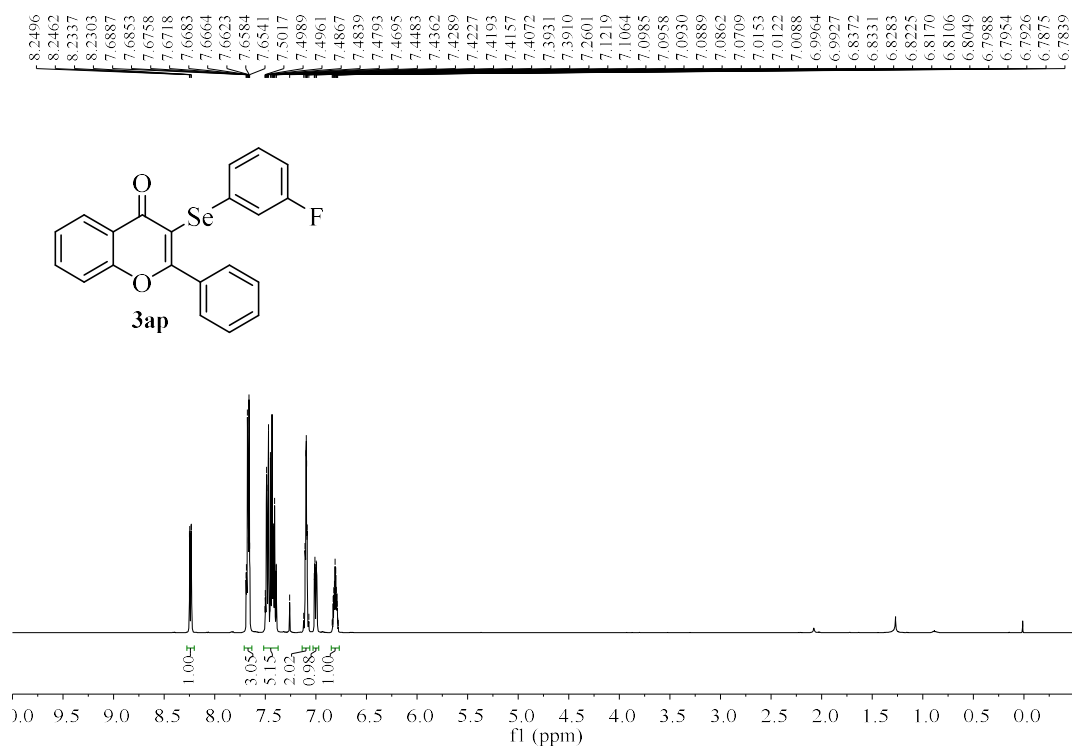


Figure S51 ¹H NMR (500 MHz) spectrum of **3ap** in CDCl₃

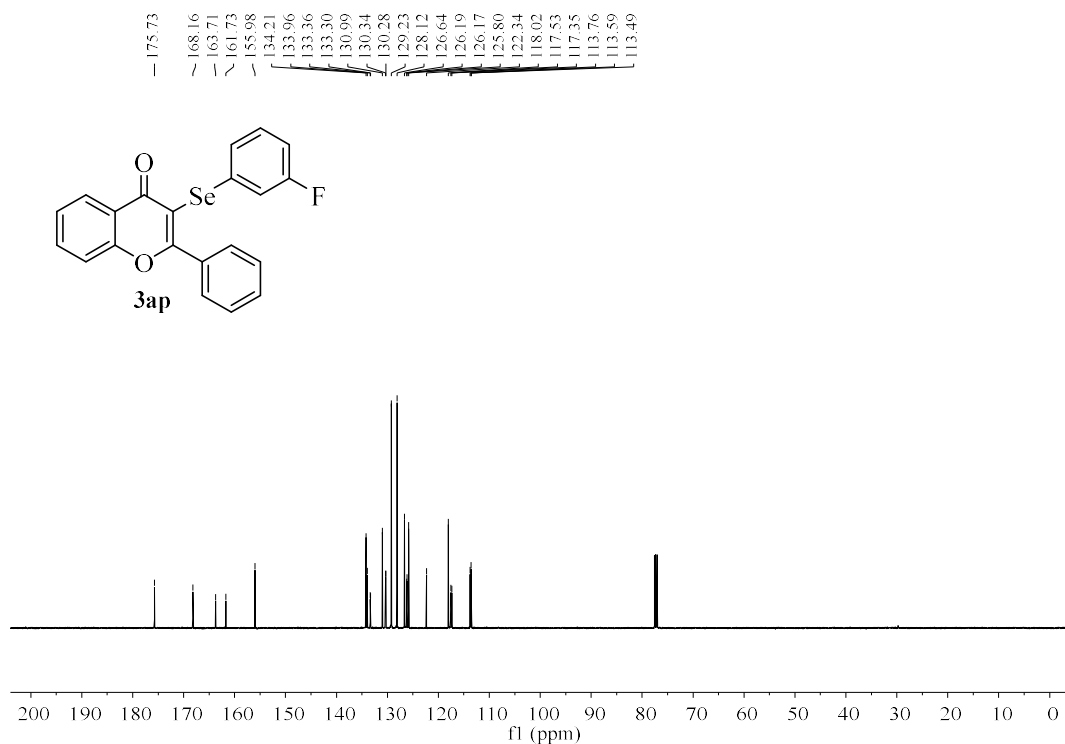


Figure S52 ^{13}C NMR (125 MHz) spectrum of **3ap** in CDCl_3

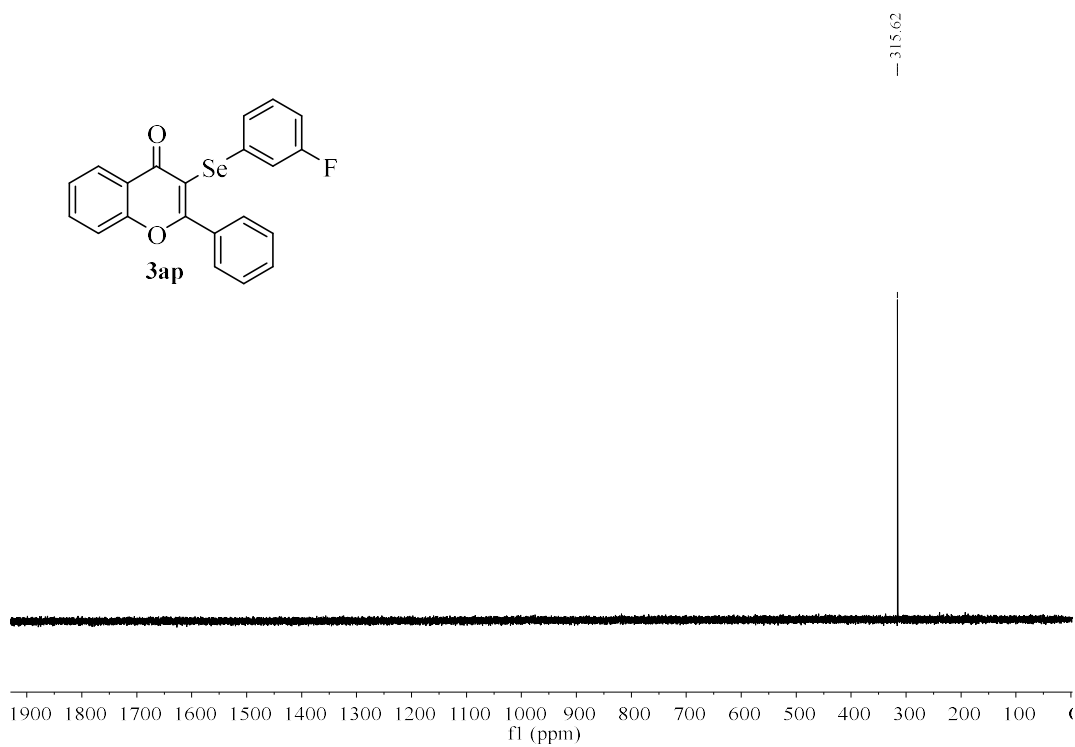


Figure S53 ^{77}Se NMR (95.5 MHz) spectrum of **3ap** in CDCl_3

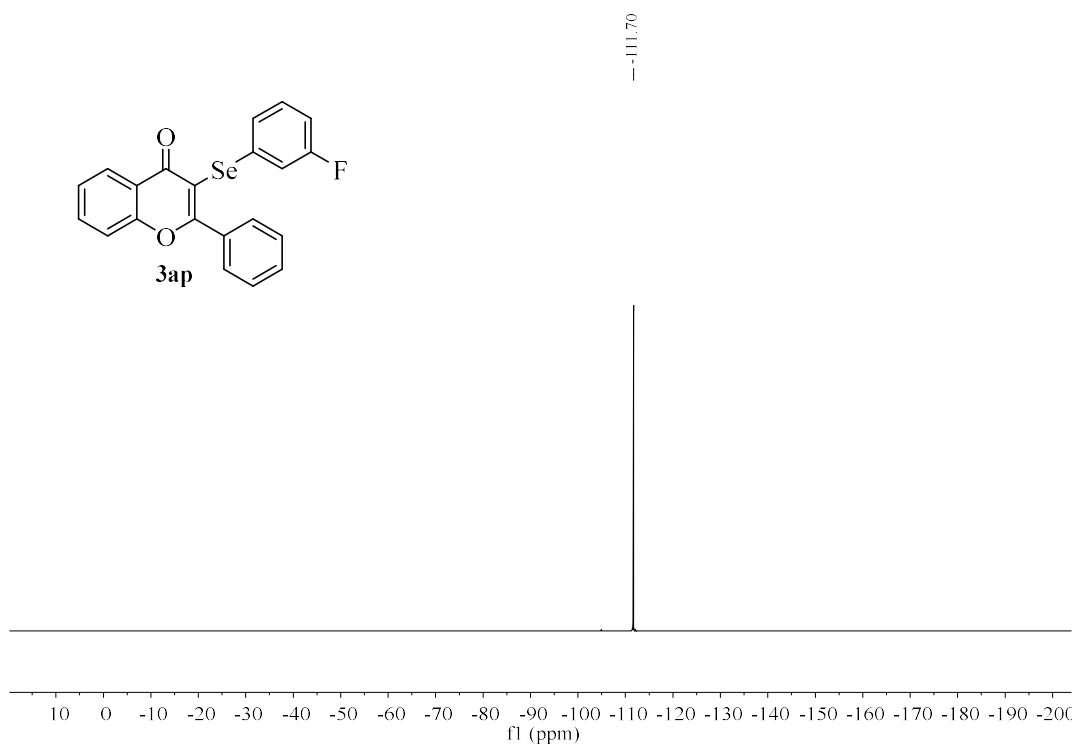


Figure S54 ^{19}F NMR (376.3 MHz) spectrum of **3ap** in CDCl_3

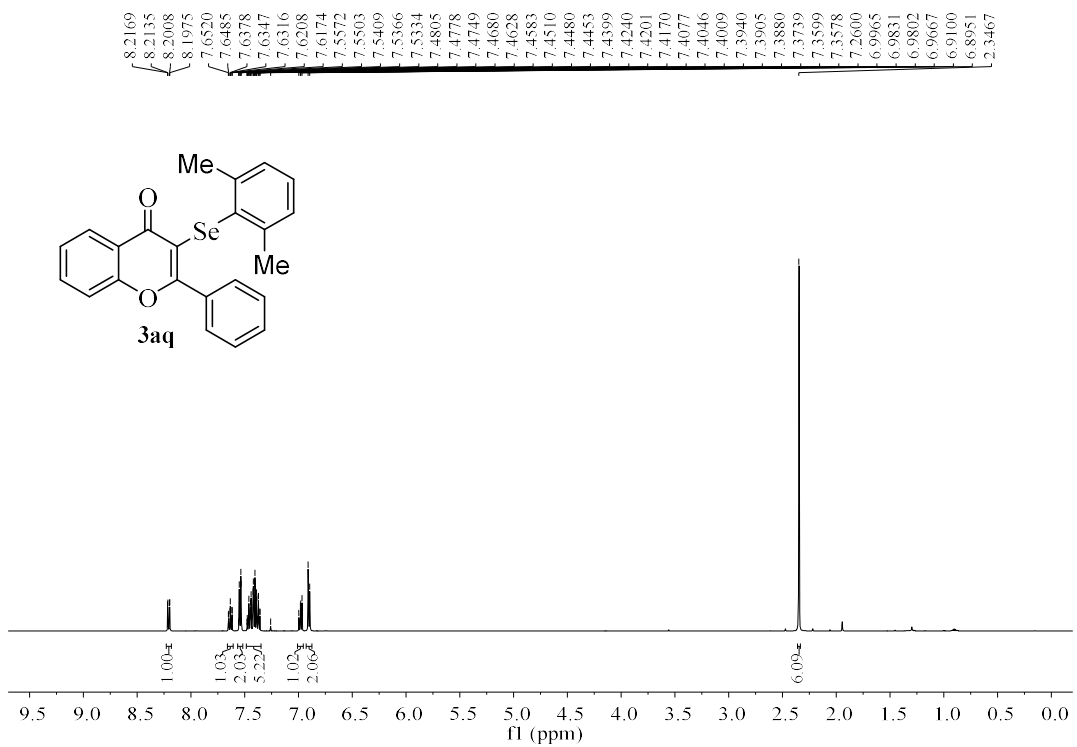


Figure S55 ^1H NMR (500 MHz) spectrum of **3aq** in CDCl_3

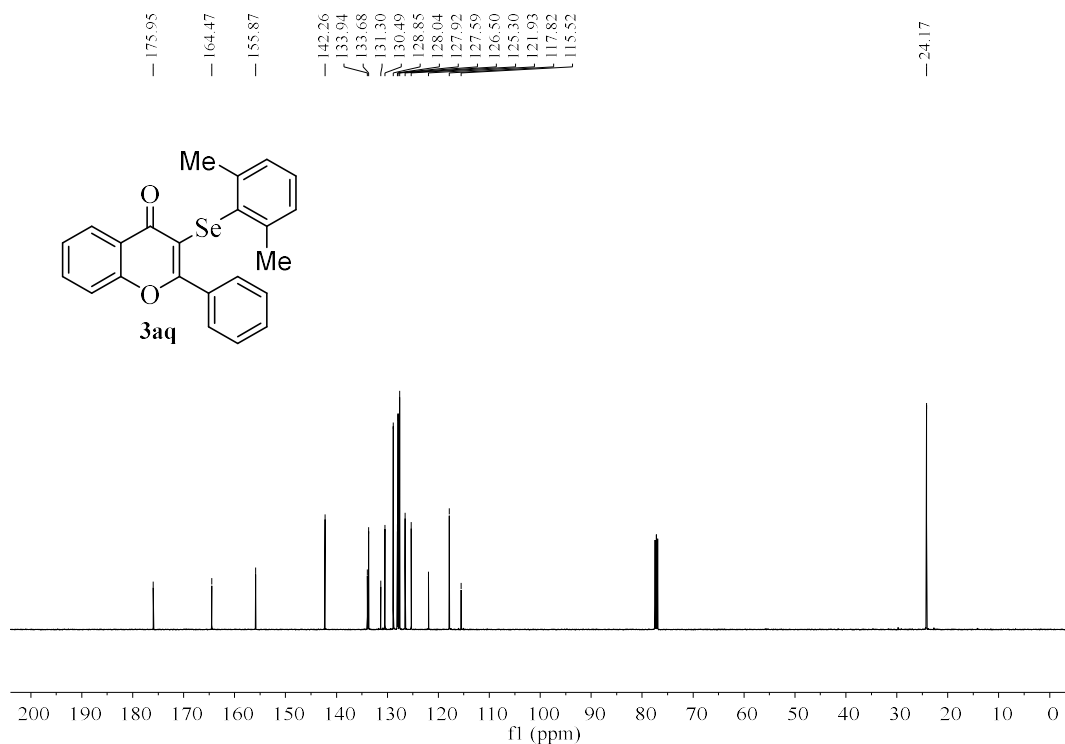


Figure S56 ^{13}C NMR (125 MHz) spectrum of **3aq** in CDCl_3

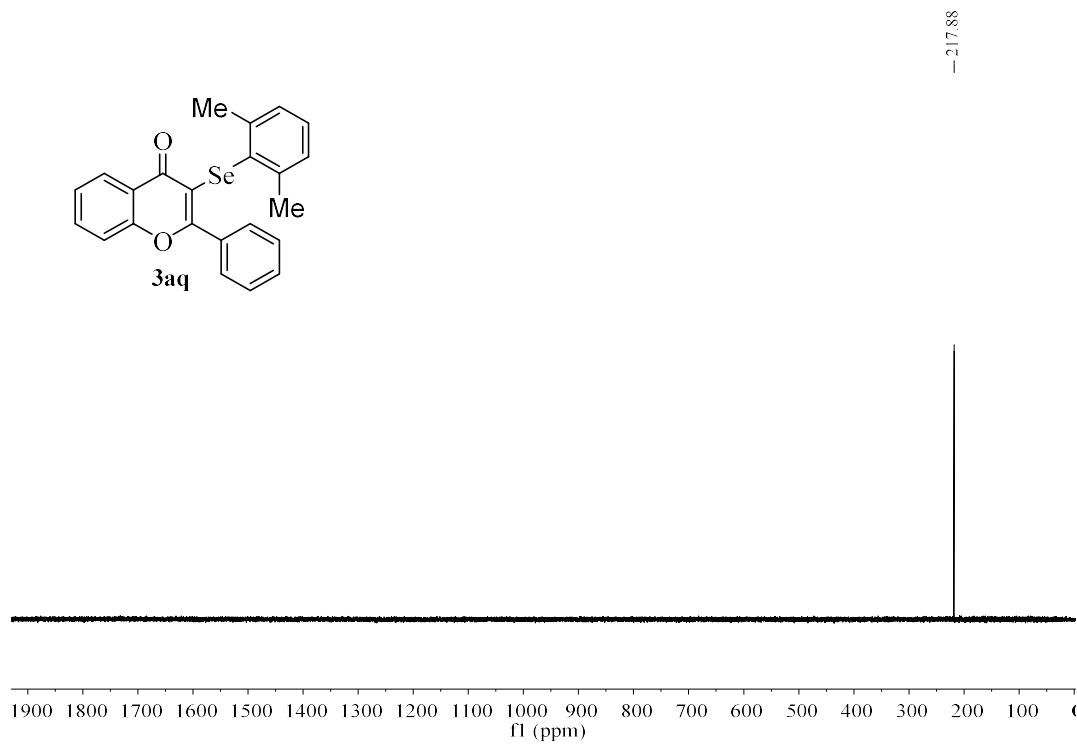


Figure S57 ^{77}Se NMR (95.5 MHz) spectrum of **3aq** in CDCl_3

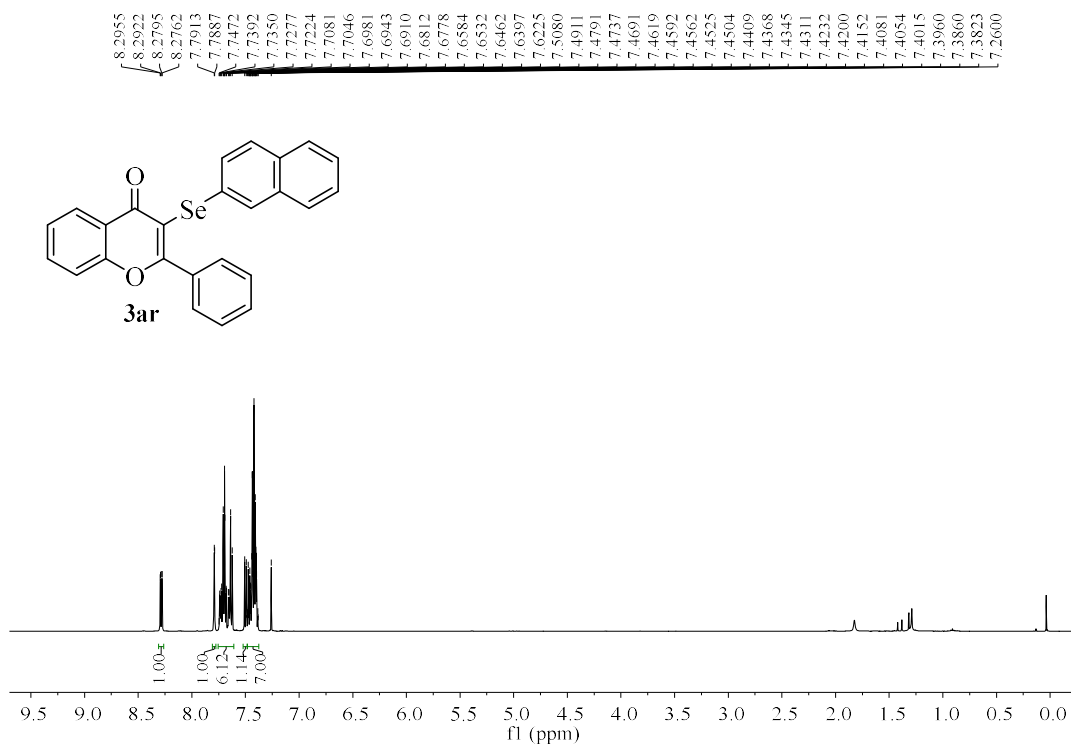


Figure S58 ^1H NMR (500 MHz) spectrum of **3ar** in CDCl_3

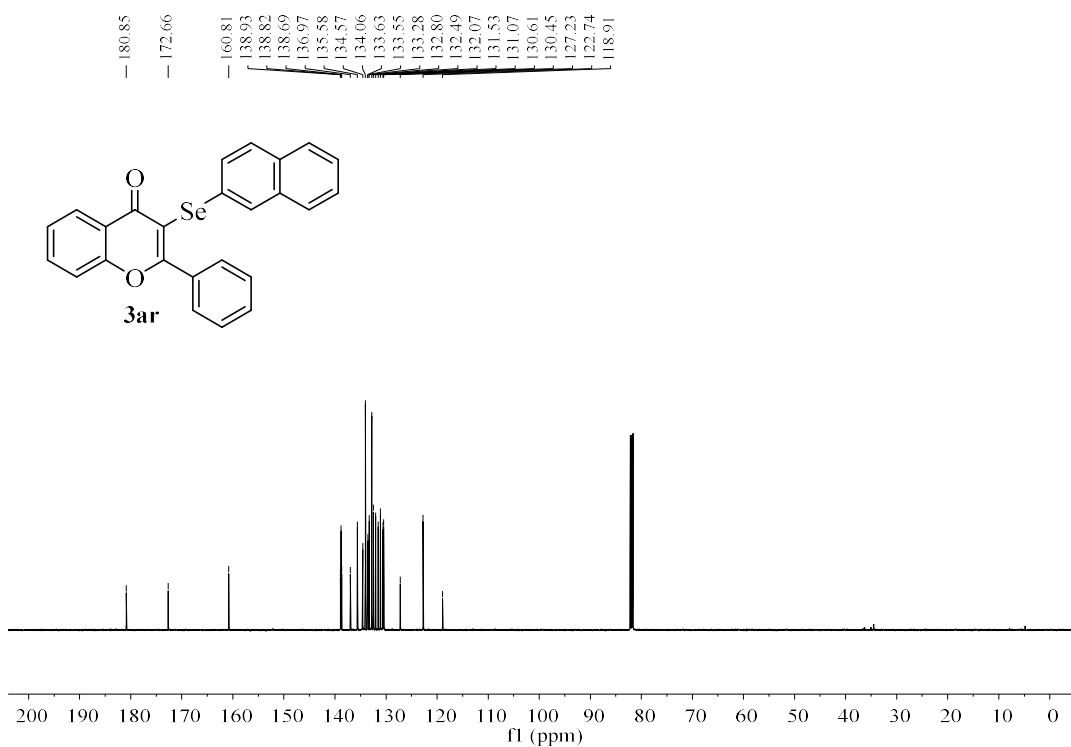


Figure S59 ^{13}C NMR (125 MHz) spectrum of **3ar** in CDCl_3

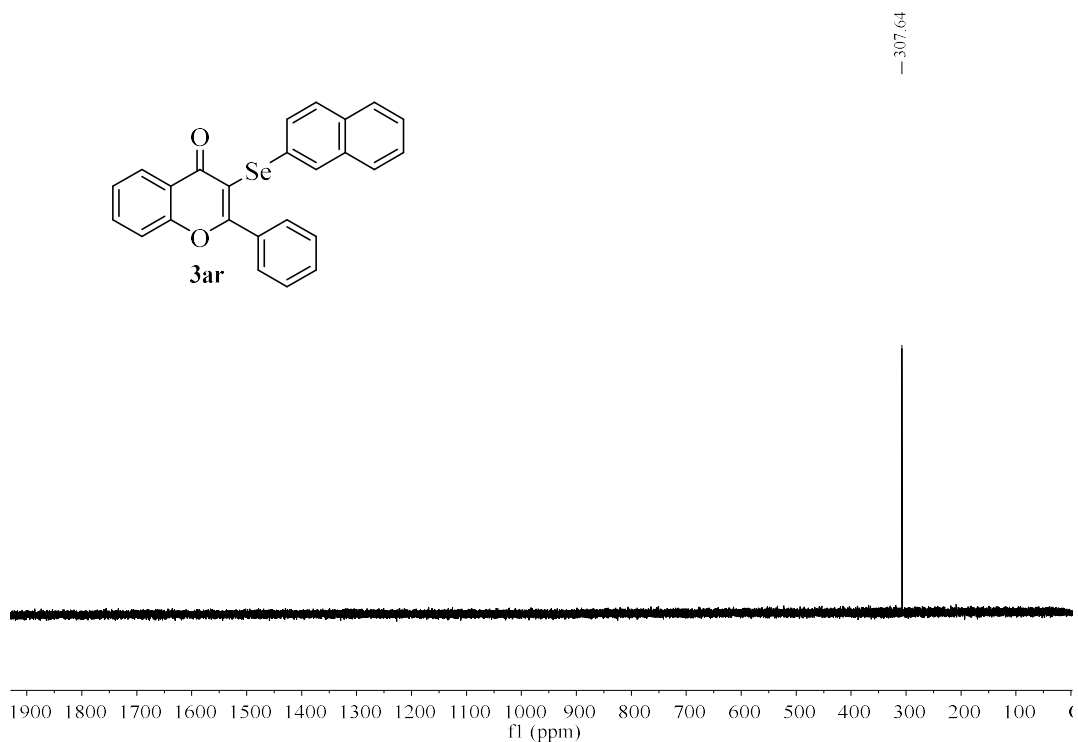


Figure S60 ^{77}Se NMR (95.5 MHz) spectrum of **3ar** in CDCl_3

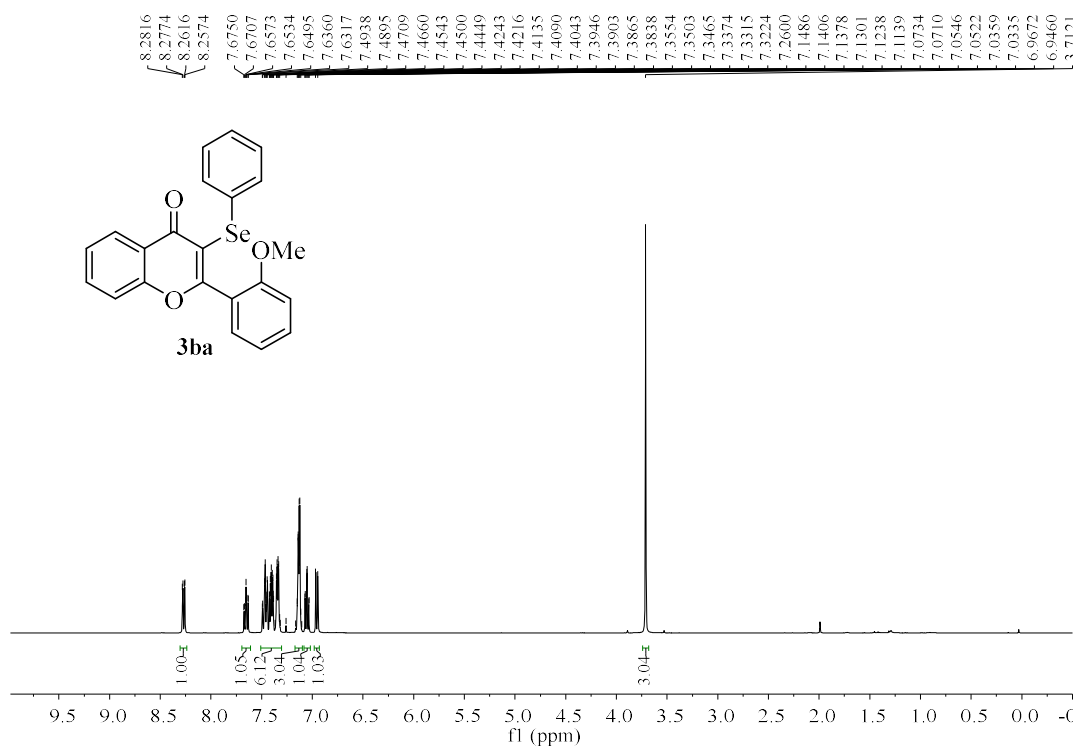


Figure S61 ^1H NMR (400 MHz) spectrum of **3ba** in CDCl_3

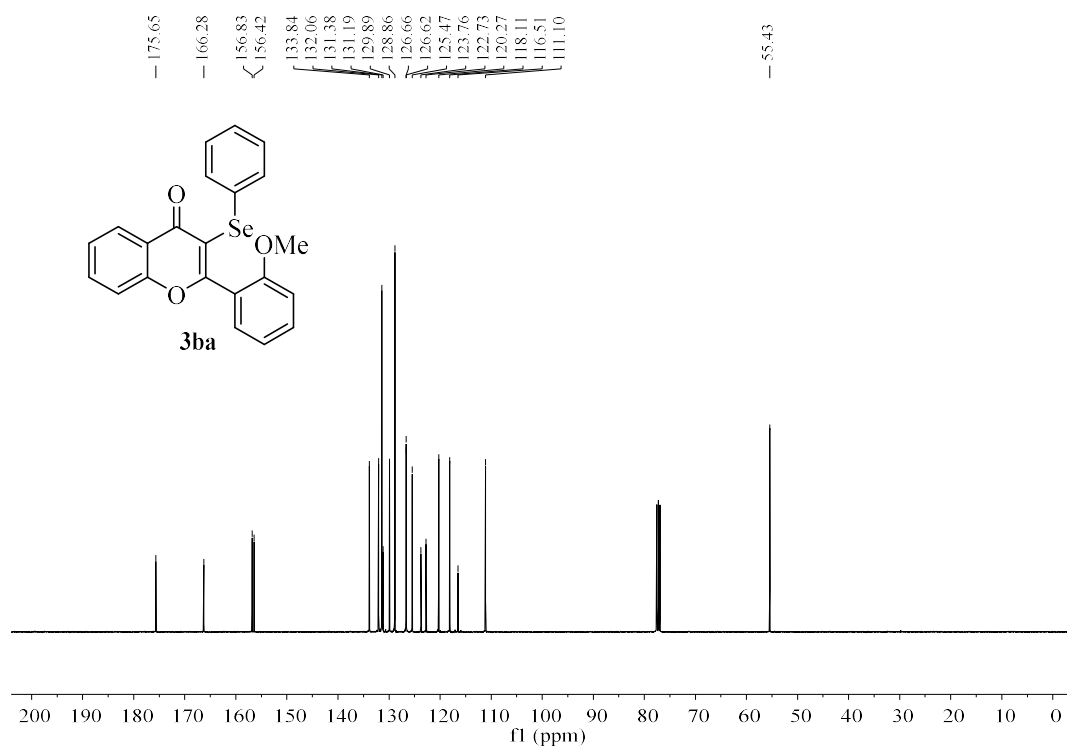


Figure S62 ¹³C NMR (100 MHz) spectrum of **3ba** in CDCl₃

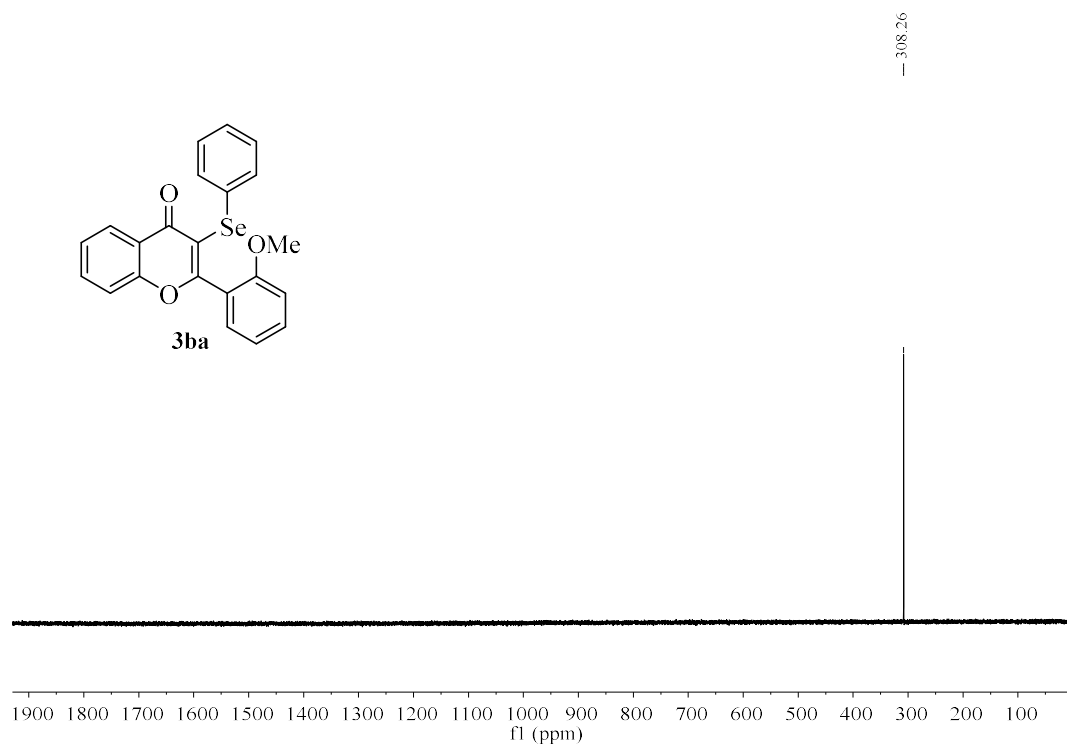


Figure S63 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ba** in CDCl₃

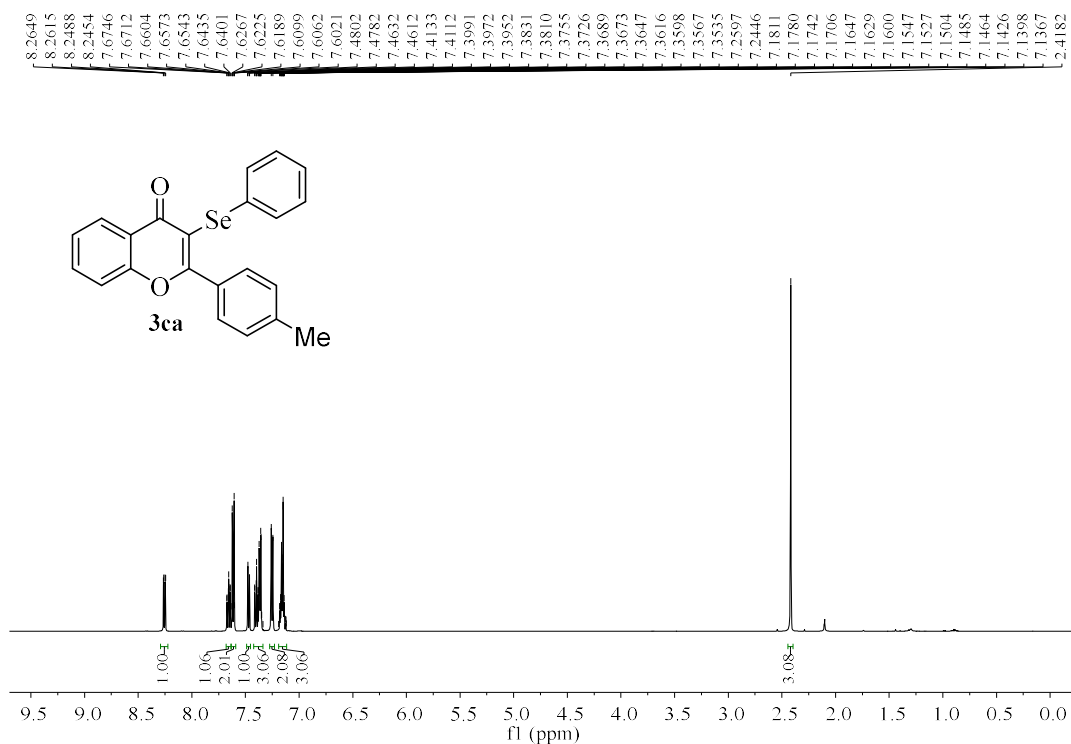


Figure S64 ^1H NMR (500 MHz) spectrum of **3ca** in CDCl_3

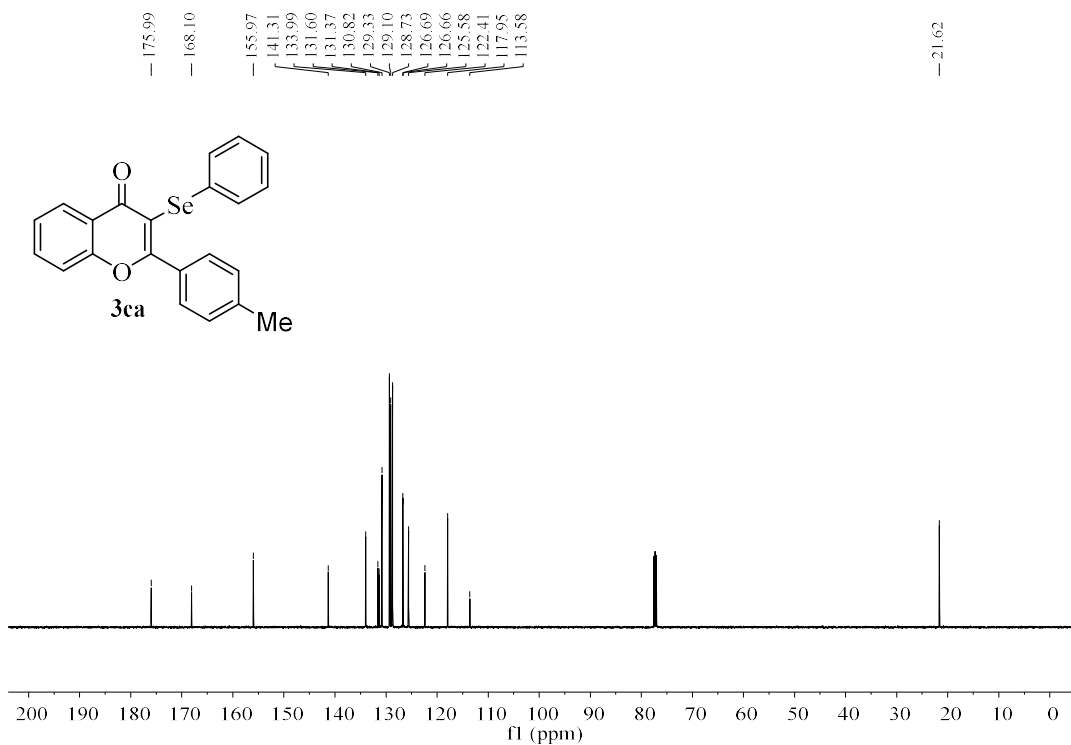


Figure S65 ^{13}C NMR (125 MHz) spectrum of **3ca** in CDCl_3

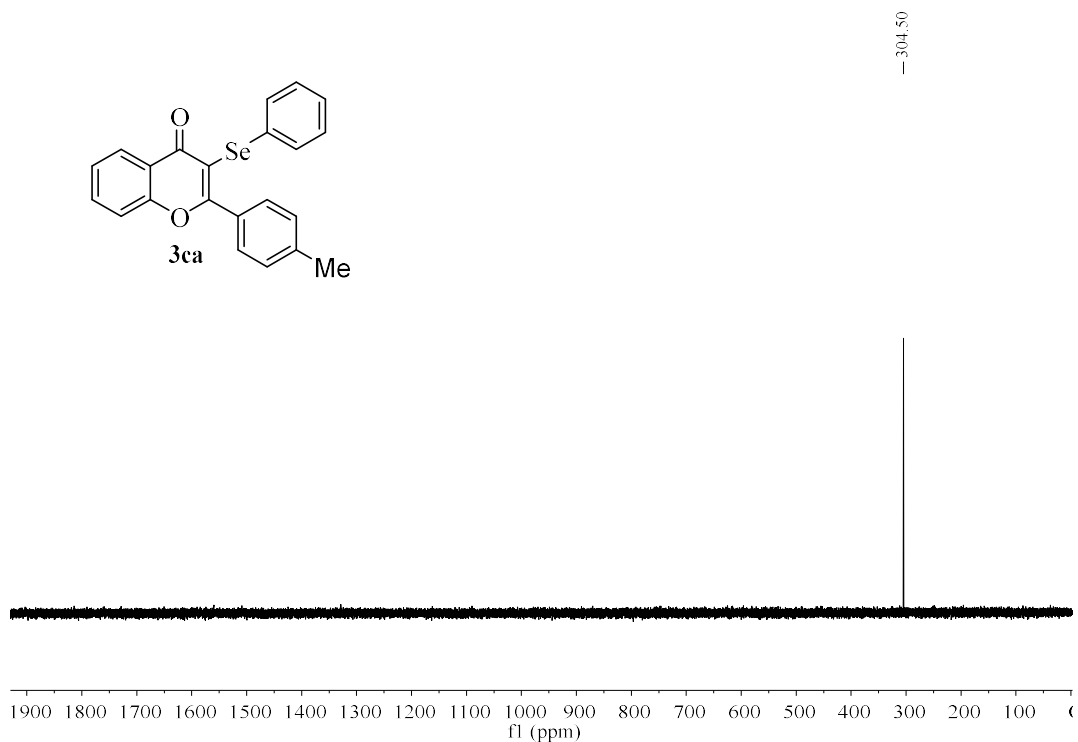


Figure S66 ^{77}Se NMR (95.5 MHz) spectrum of **3ca** in CDCl_3

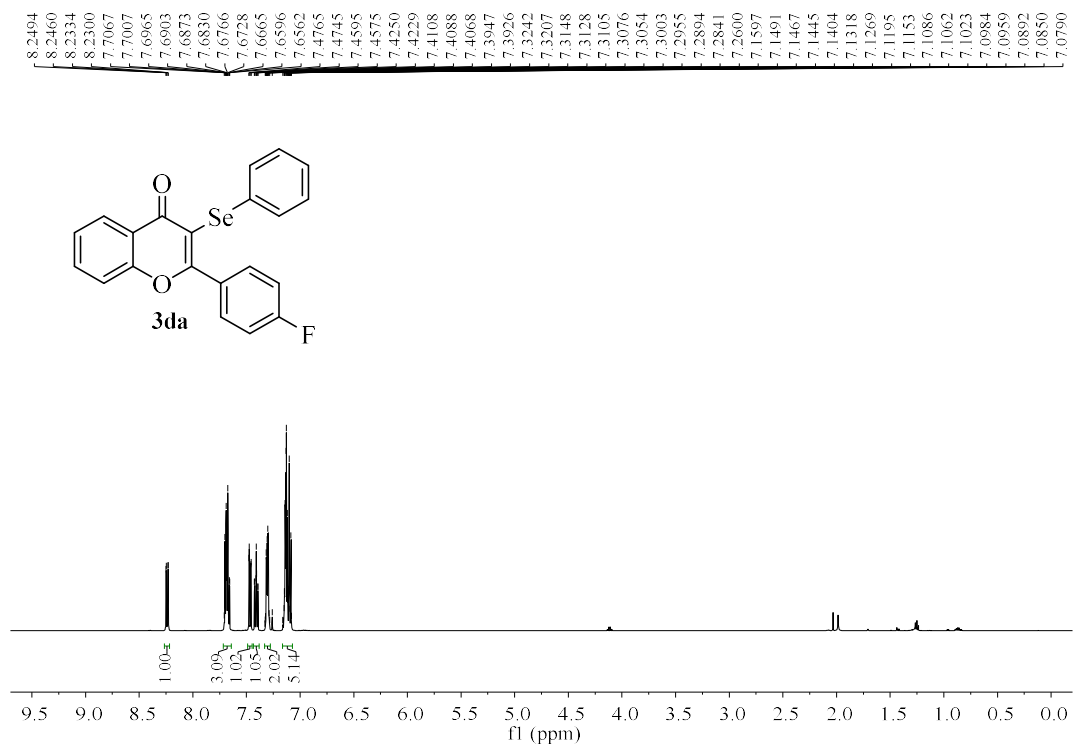


Figure S67 ^1H NMR (500 MHz) spectrum of **3da** in CDCl_3

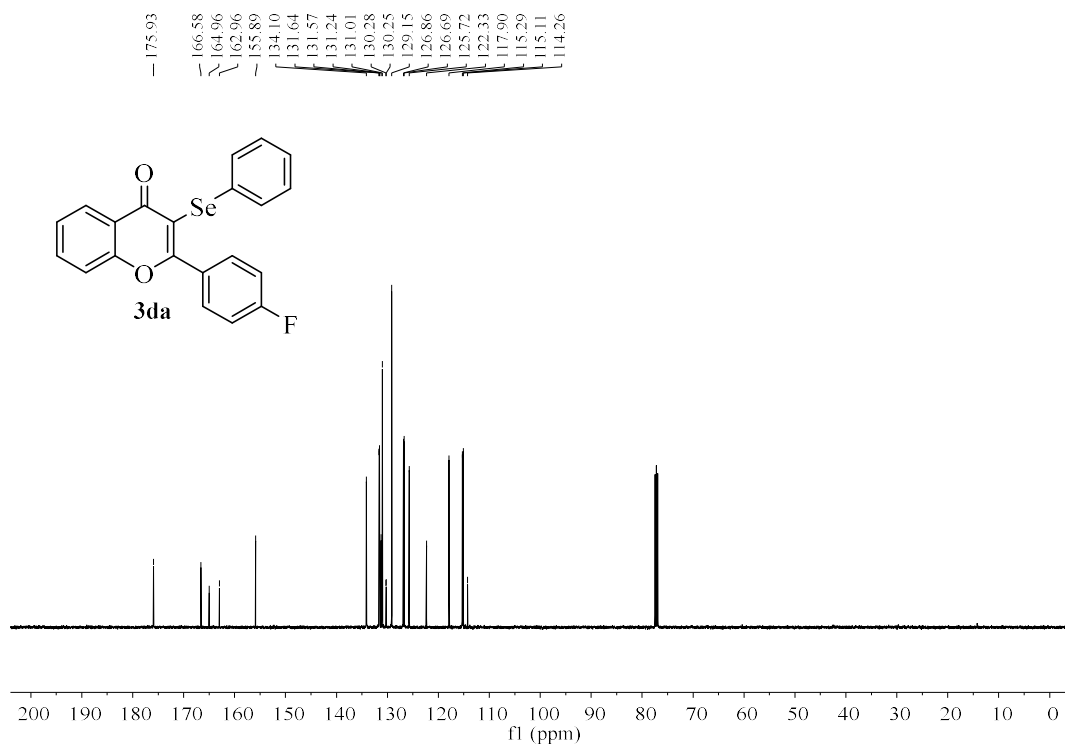


Figure S68 ¹³C NMR (125 MHz) spectrum of **3da** in CDCl₃

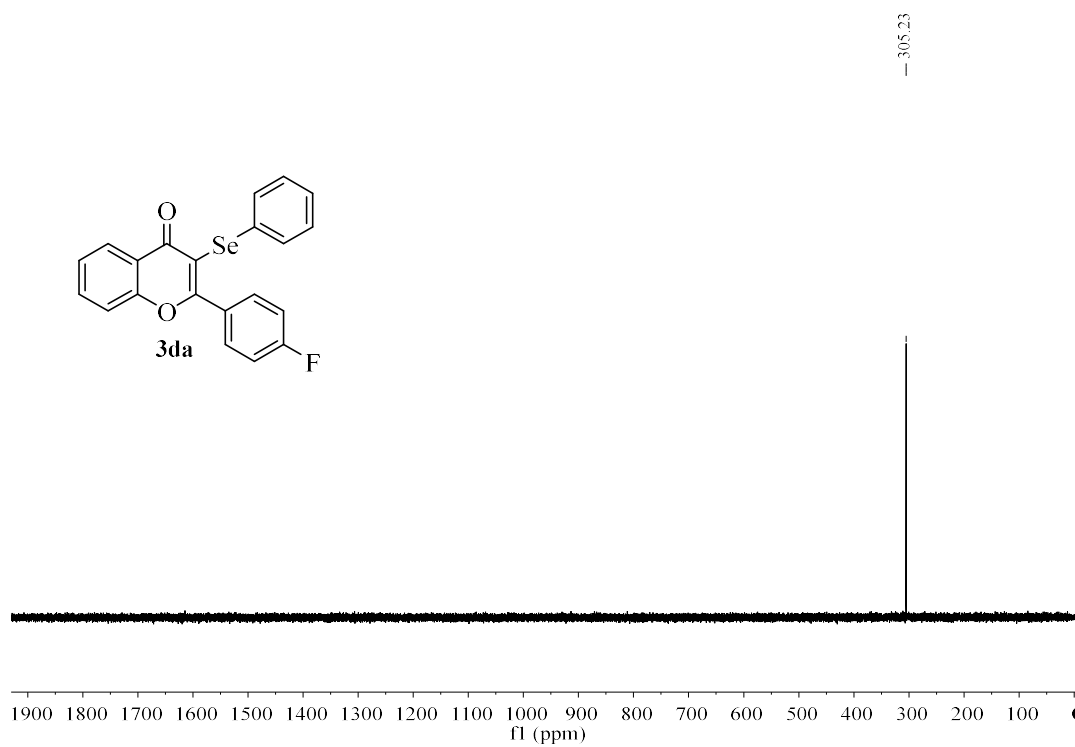


Figure S69 ⁷⁷Se NMR (95.5 MHz) spectrum of **3da** in CDCl₃



Figure S70 ^{19}F NMR (376.3 MHz) spectrum of **3da** in CDCl_3

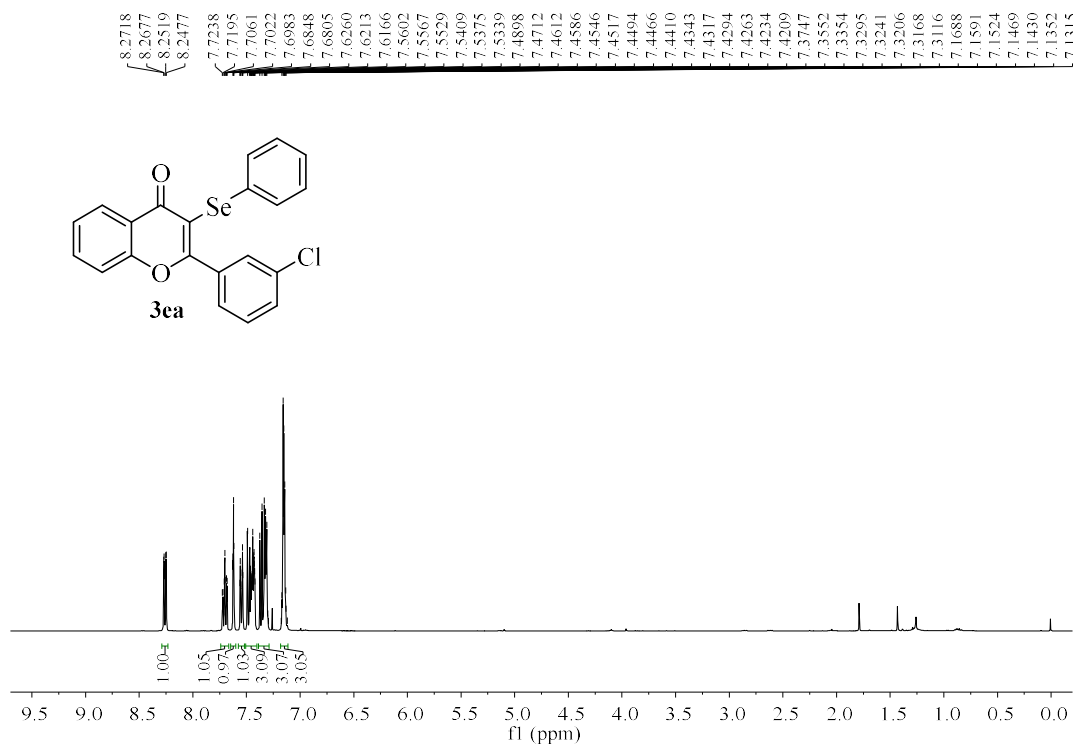


Figure S71 ^1H NMR (400 MHz) spectrum of **3ea** in CDCl_3

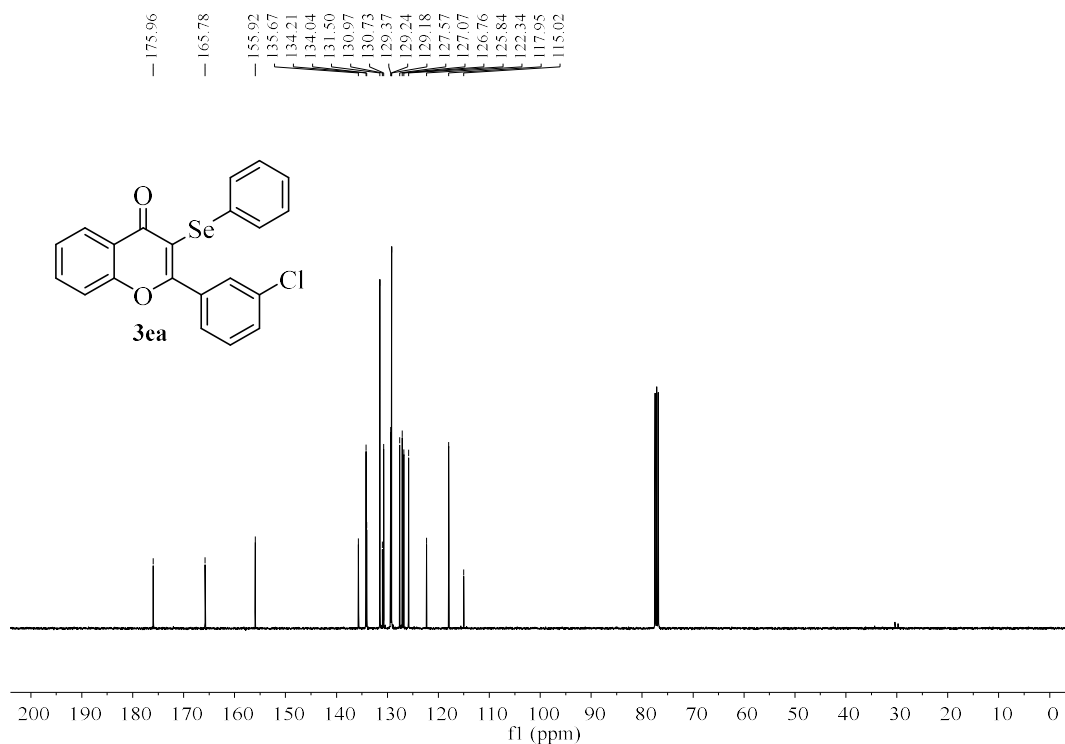


Figure S72 ¹³C NMR (100 MHz) spectrum of **3ea** in CDCl₃

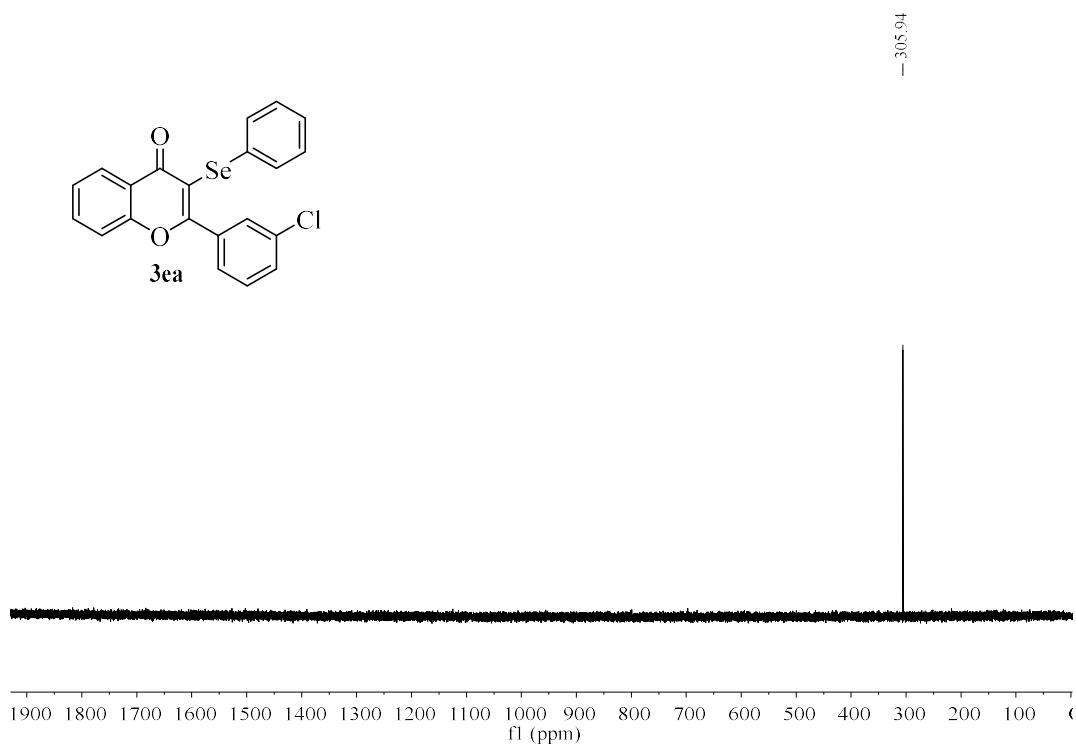


Figure S73 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ea** in CDCl₃

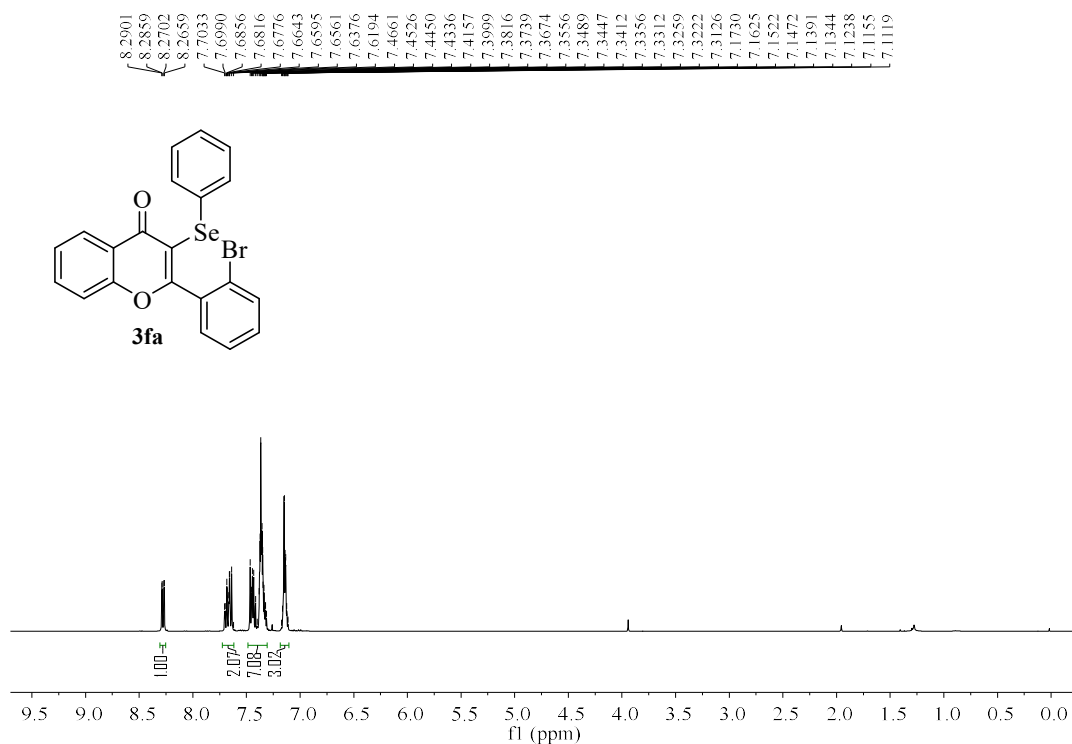


Figure S74 ^1H NMR (400 MHz) spectrum of **3fa** in CDCl_3

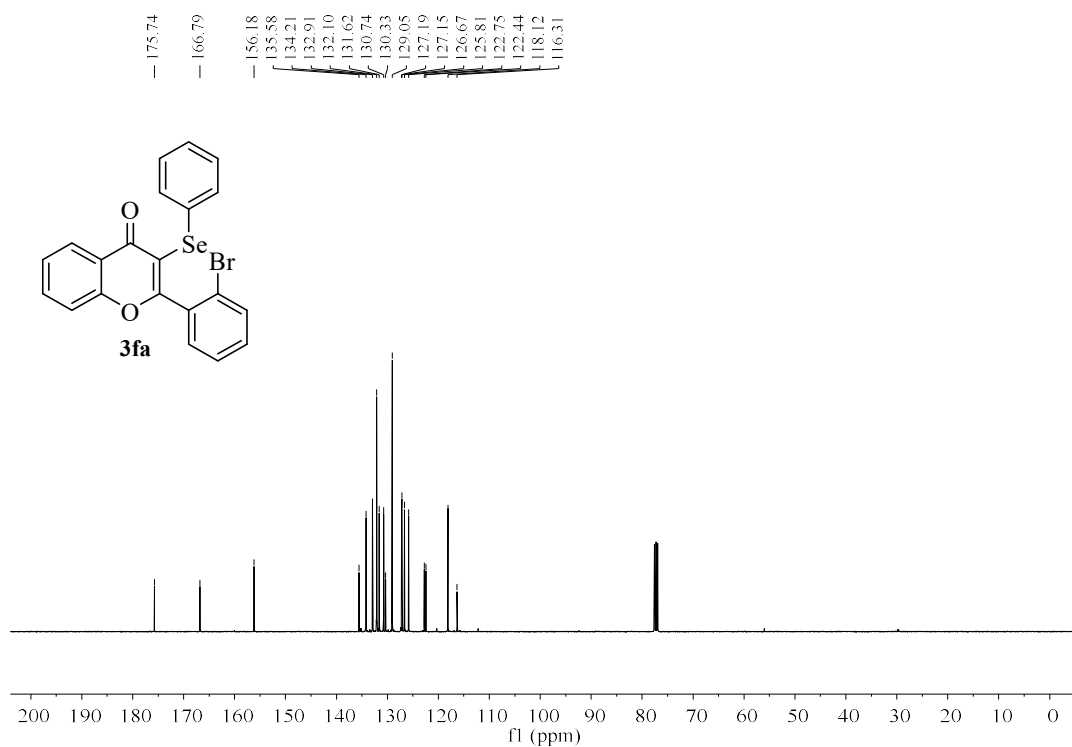


Figure S75 ^{13}C NMR (100 MHz) spectrum of **3fa** in CDCl_3

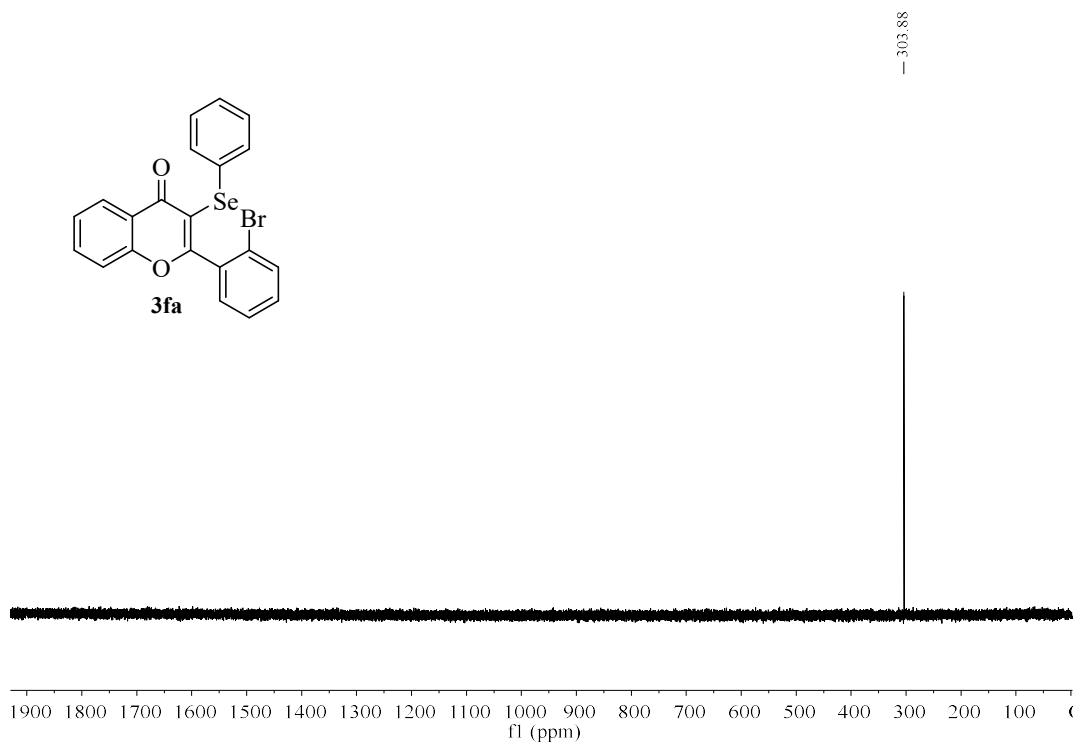


Figure S76 ⁷⁷Se NMR (95.5 MHz) spectrum of **3fa** in CDCl₃

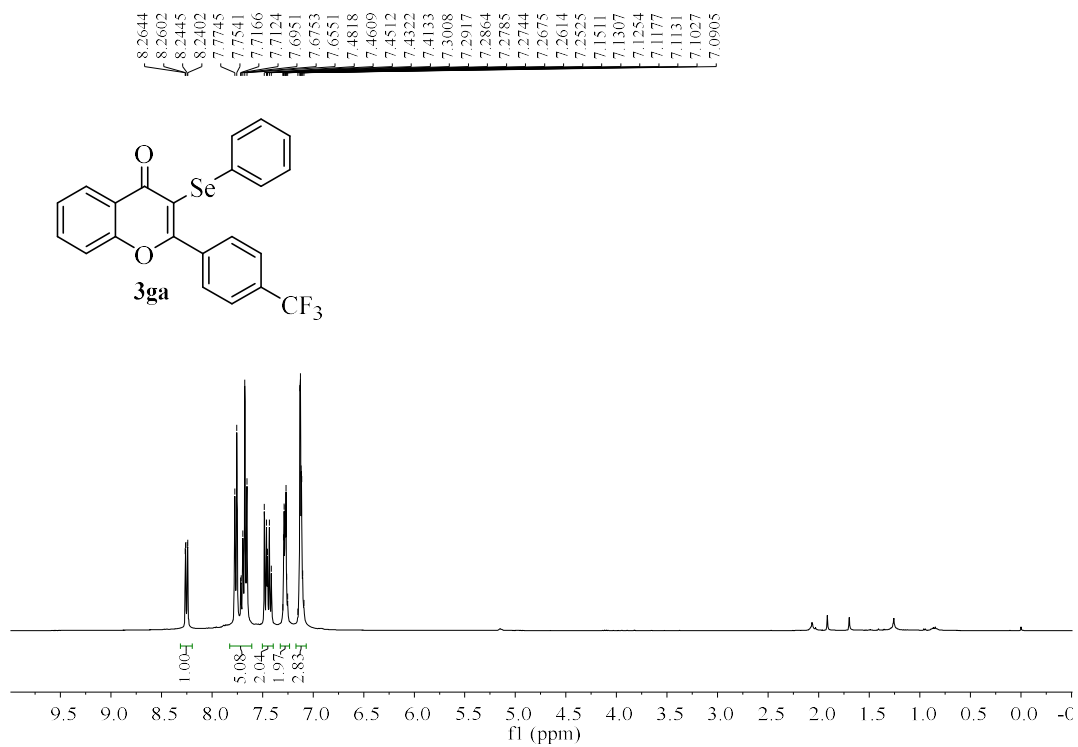


Figure S77 ¹H NMR (400 MHz) spectrum of **3ga** in CDCl₃

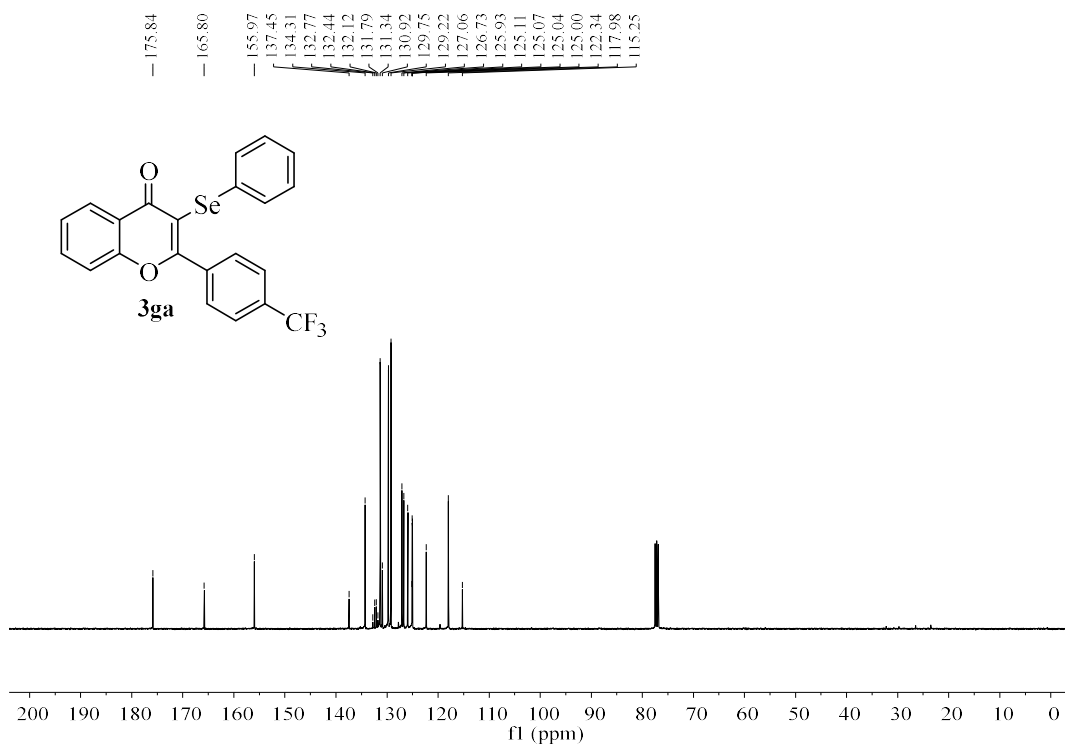


Figure S78 ¹³C NMR (100 MHz) spectrum of **3ga** in CDCl₃

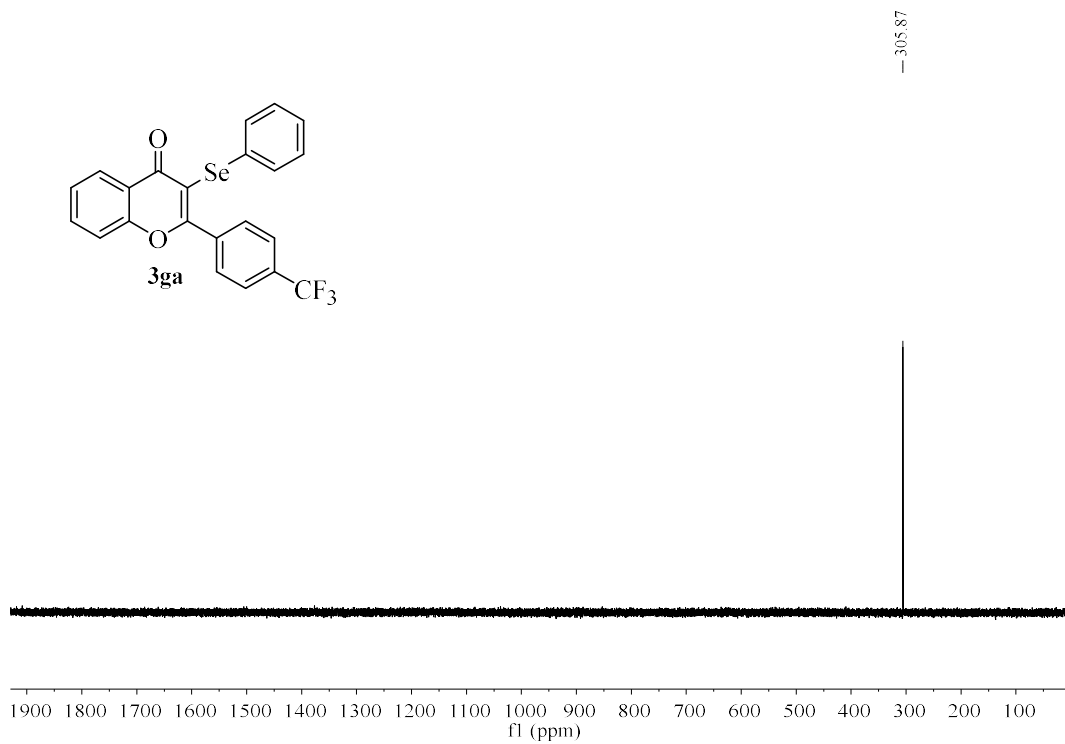


Figure S79 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ga** in CDCl₃

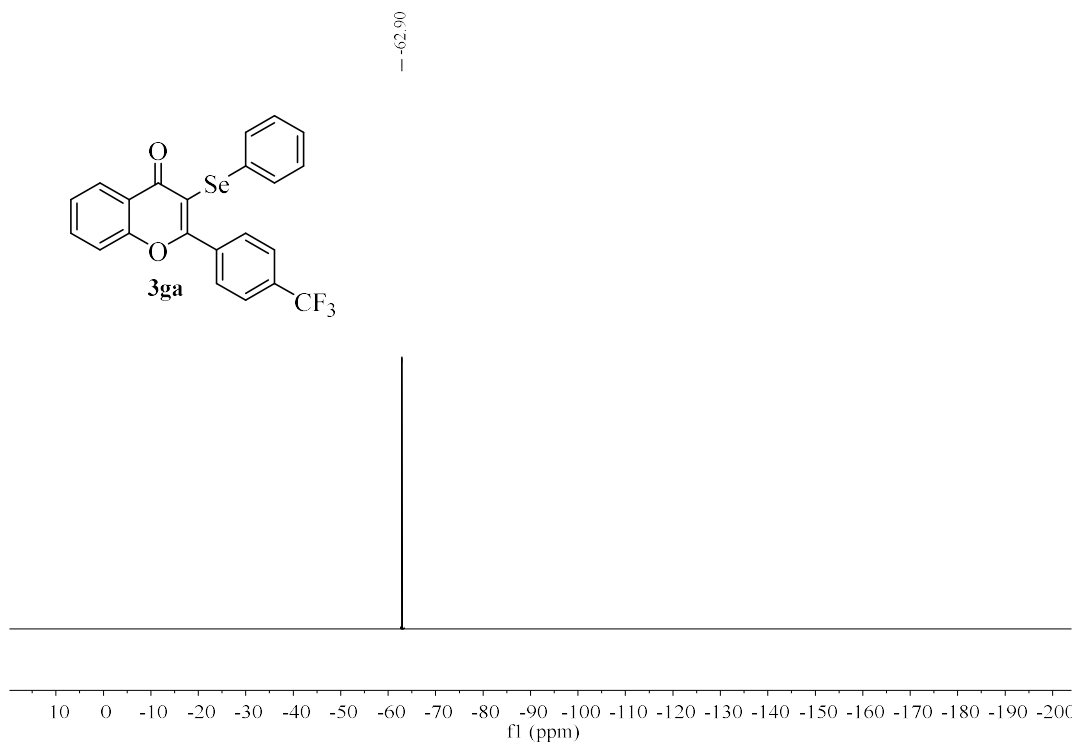


Figure S80 ^{19}F NMR (376.3 MHz) spectrum of **3ga** in CDCl_3

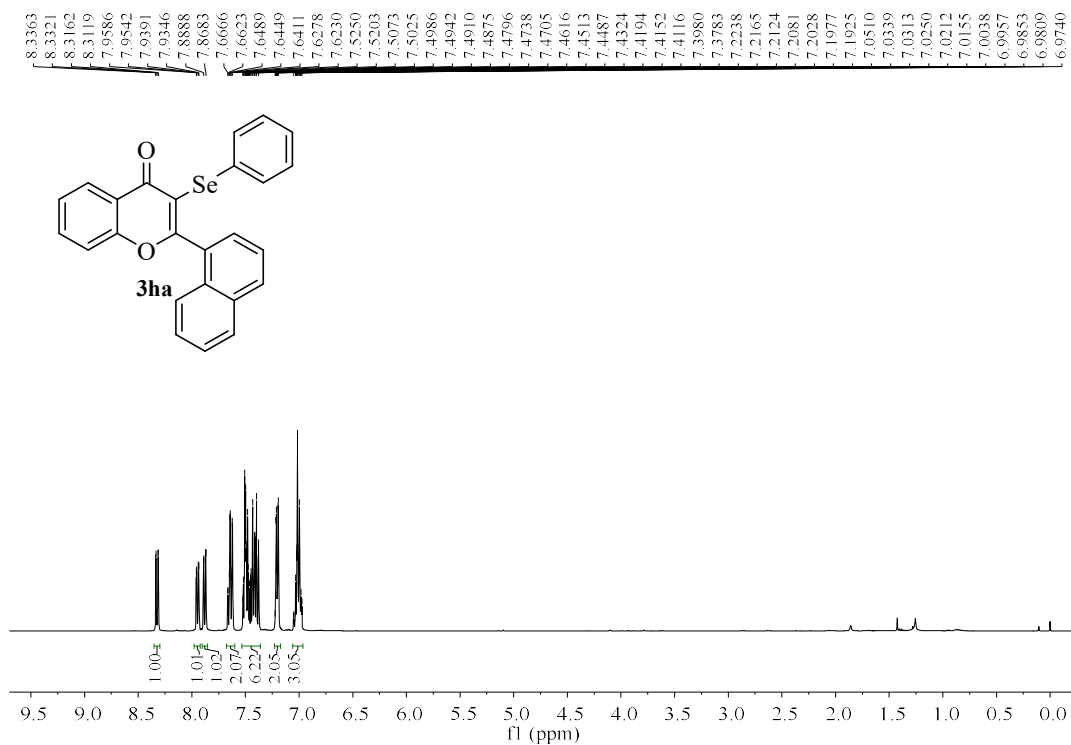


Figure S81 ^1H NMR (400 MHz) spectrum of **3ha** in CDCl_3

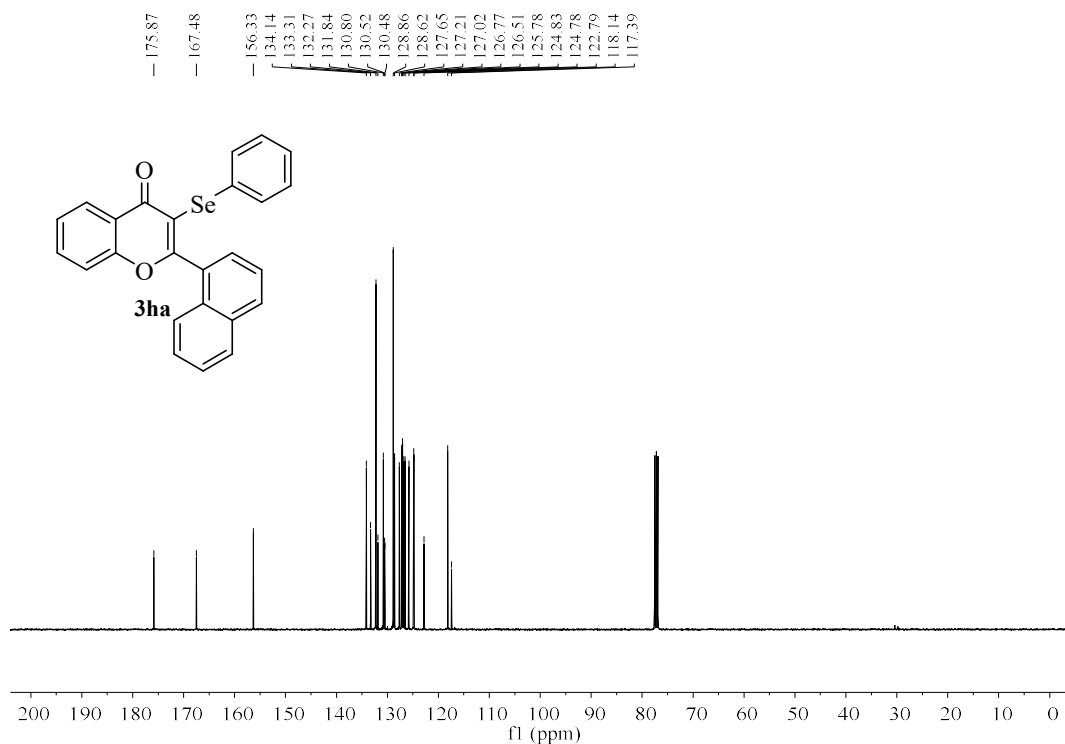


Figure S82 ¹³C NMR (100 MHz) spectrum of **3ha** in CDCl₃

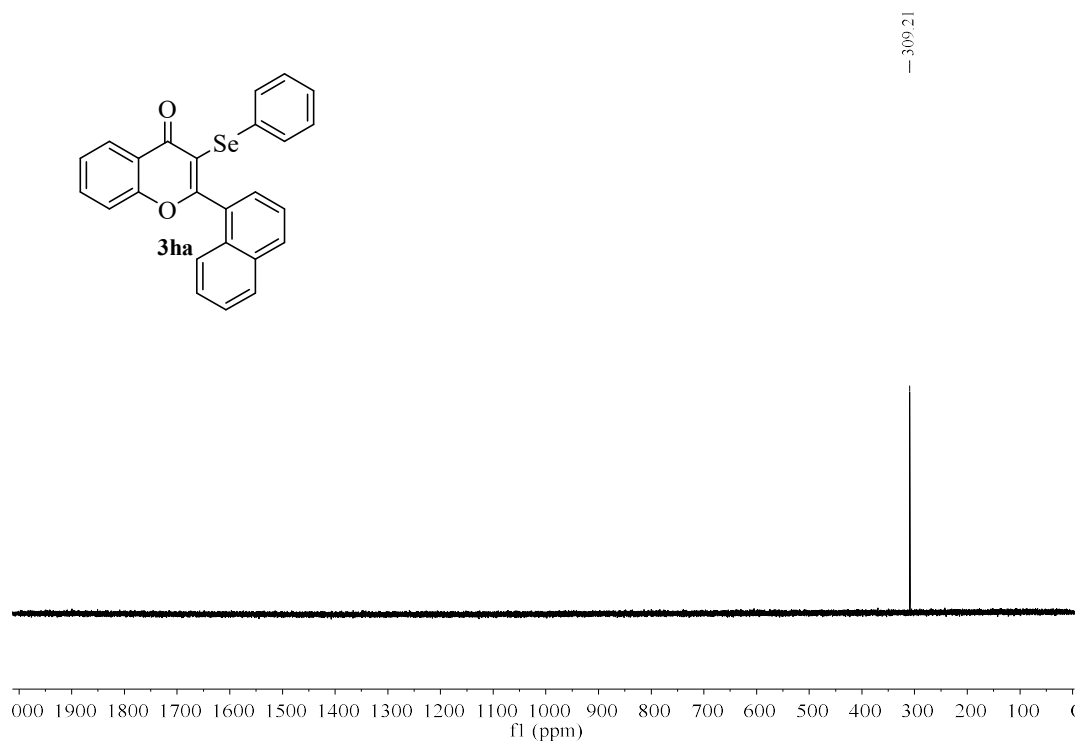


Figure S83 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ha** in CDCl₃

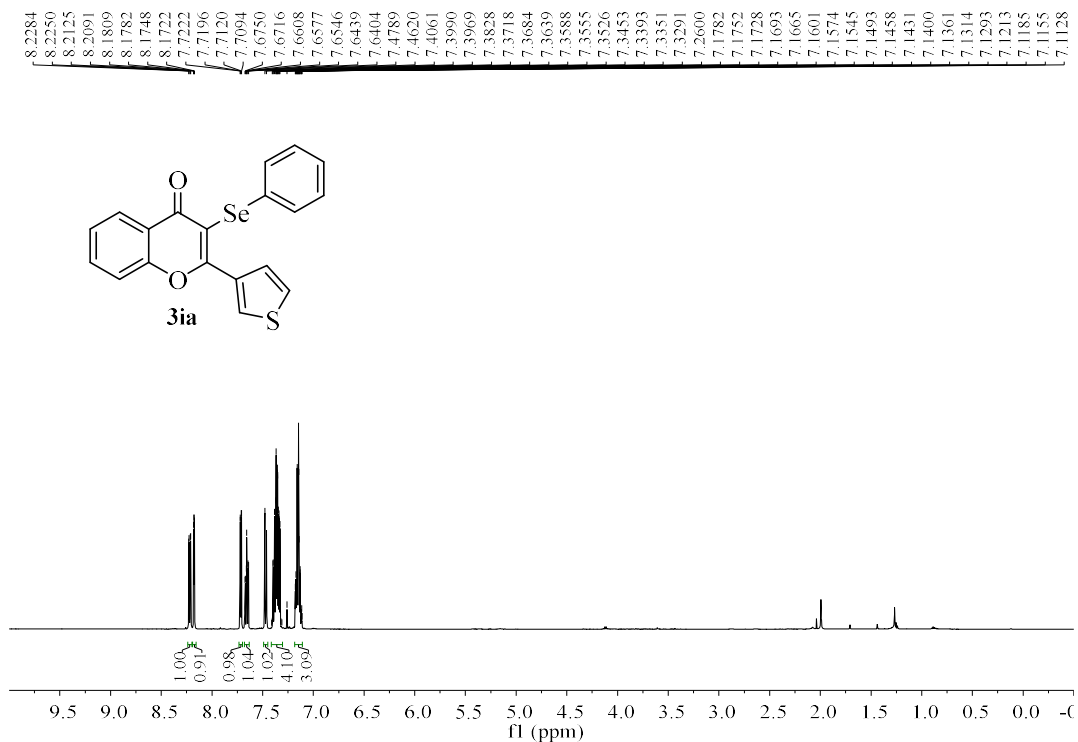


Figure S84 ^1H NMR (500 MHz) spectrum of **3ia** in CDCl_3

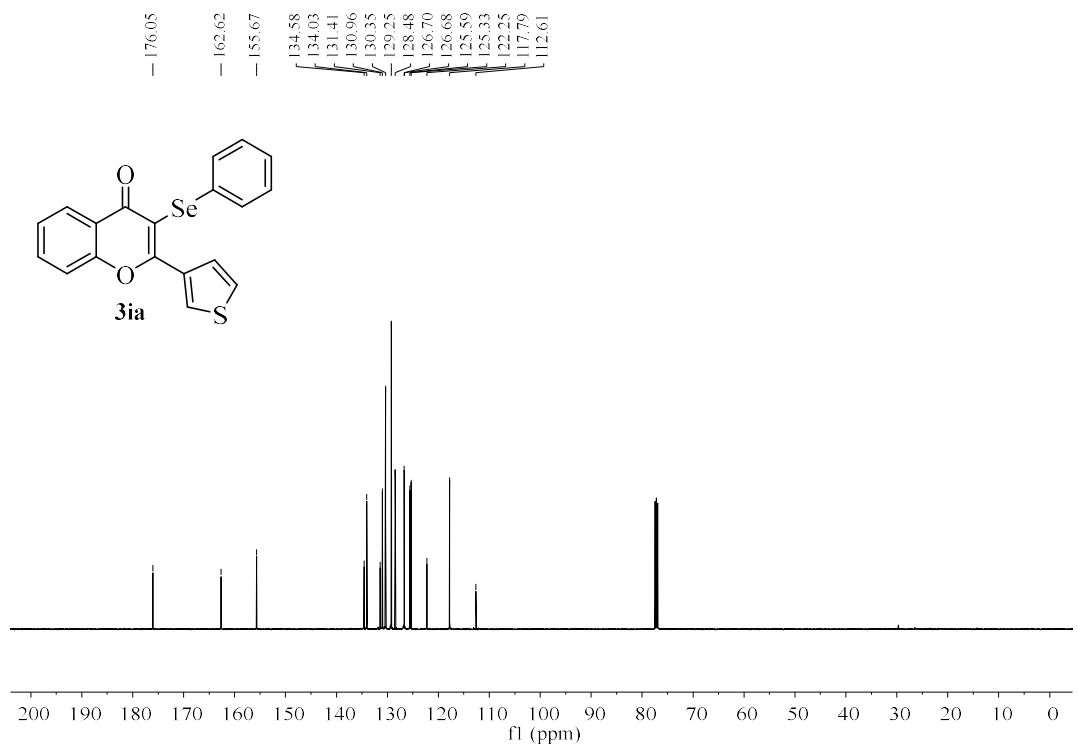


Figure S85 ^{13}C NMR (125 MHz) spectrum of **3ia** in CDCl_3

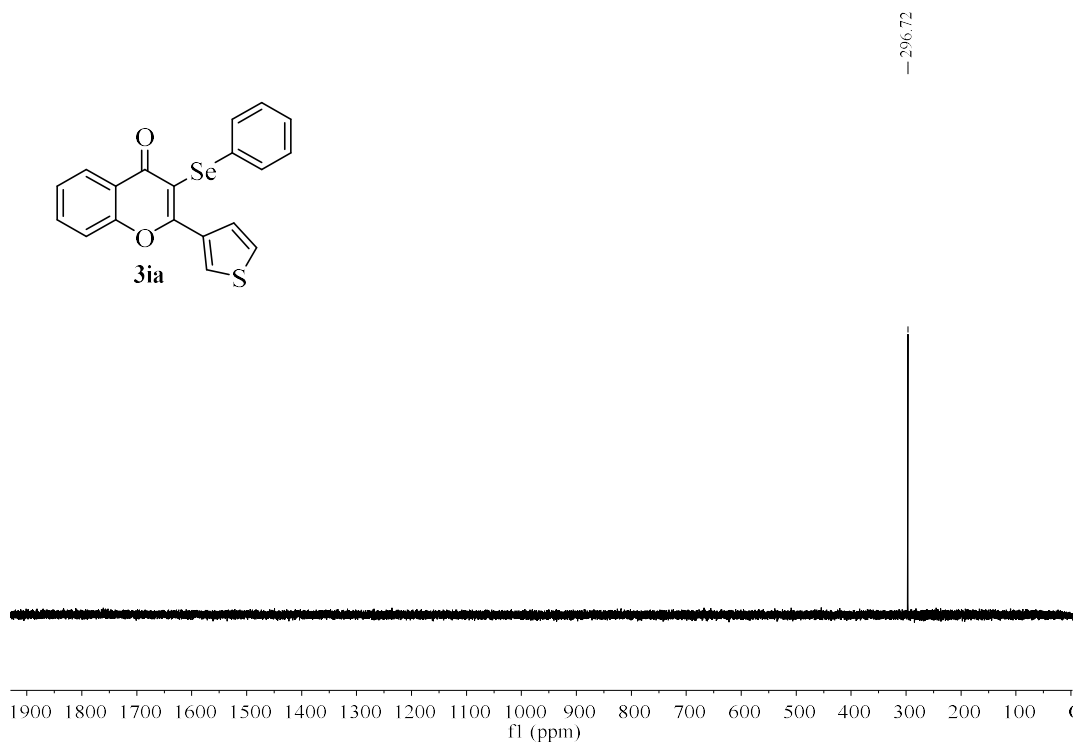


Figure S86 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ia** in CDCl₃

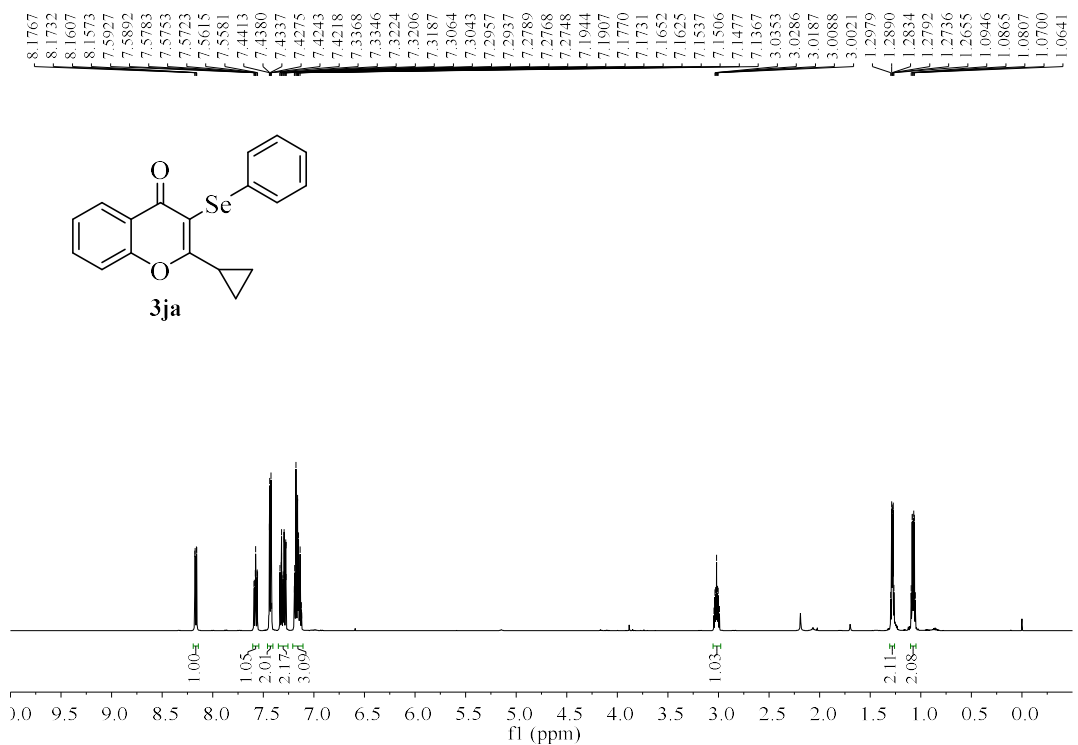


Figure S87 ¹H NMR (500 MHz) spectrum of **3ja** in CDCl₃

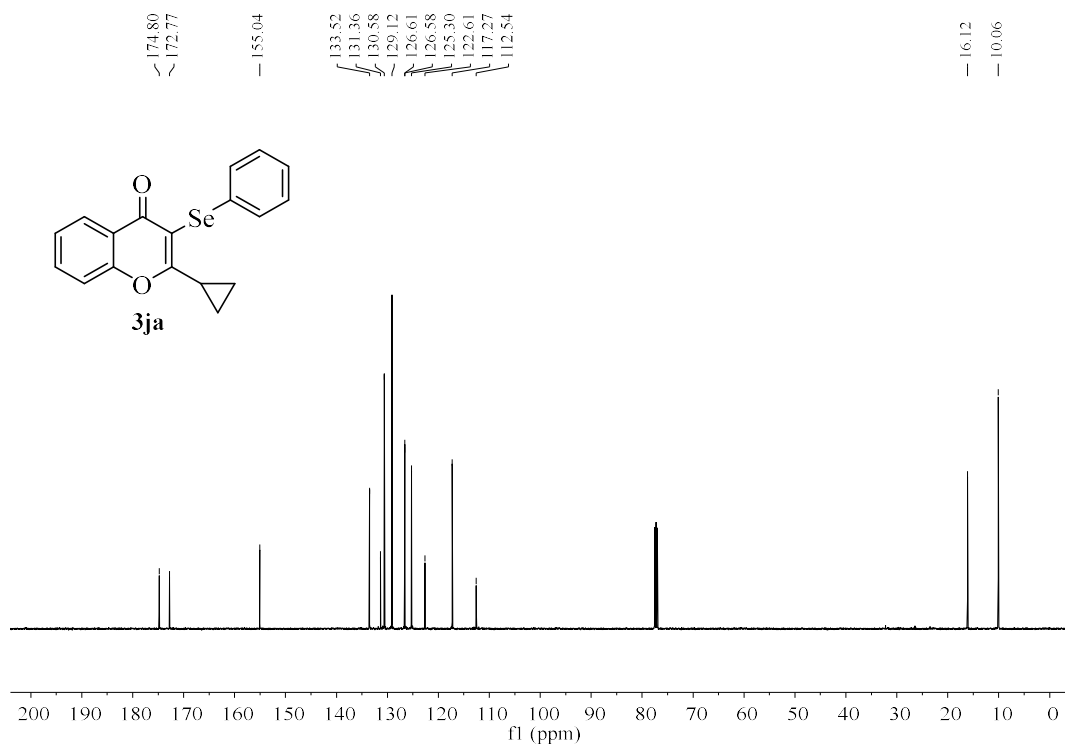


Figure S88 ¹³C NMR (125 MHz) spectrum of **3ja** in CDCl₃

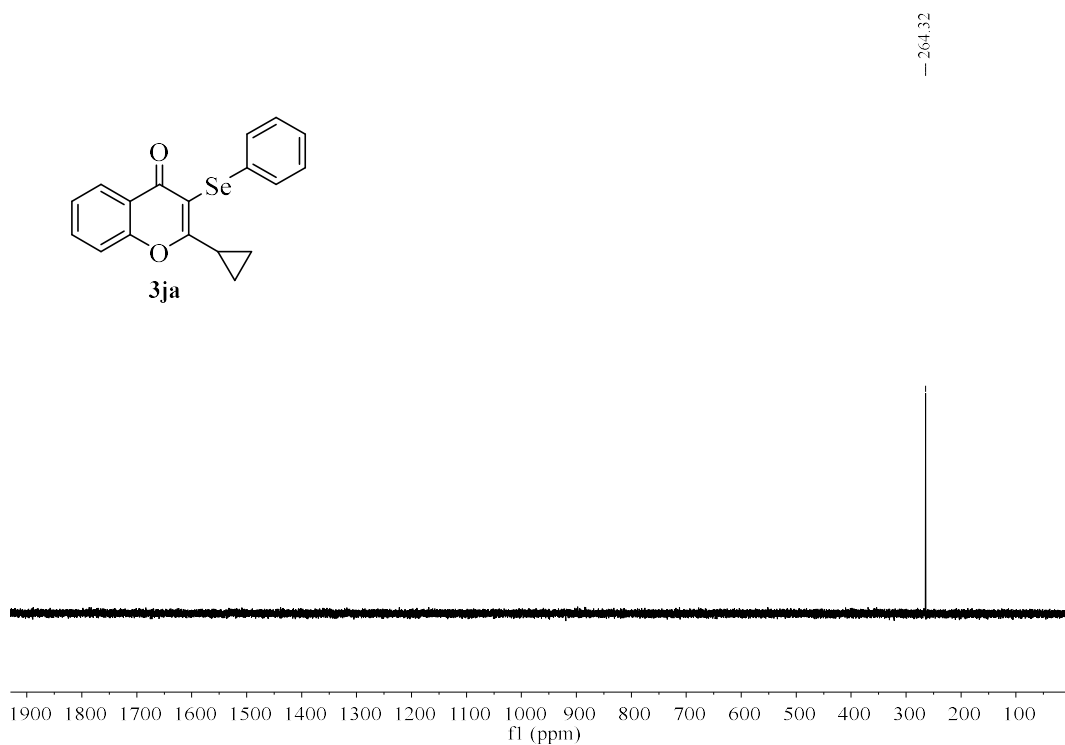


Figure S89 ⁷⁷Se NMR (95.5 MHz) spectrum of **3ja** in CDCl₃

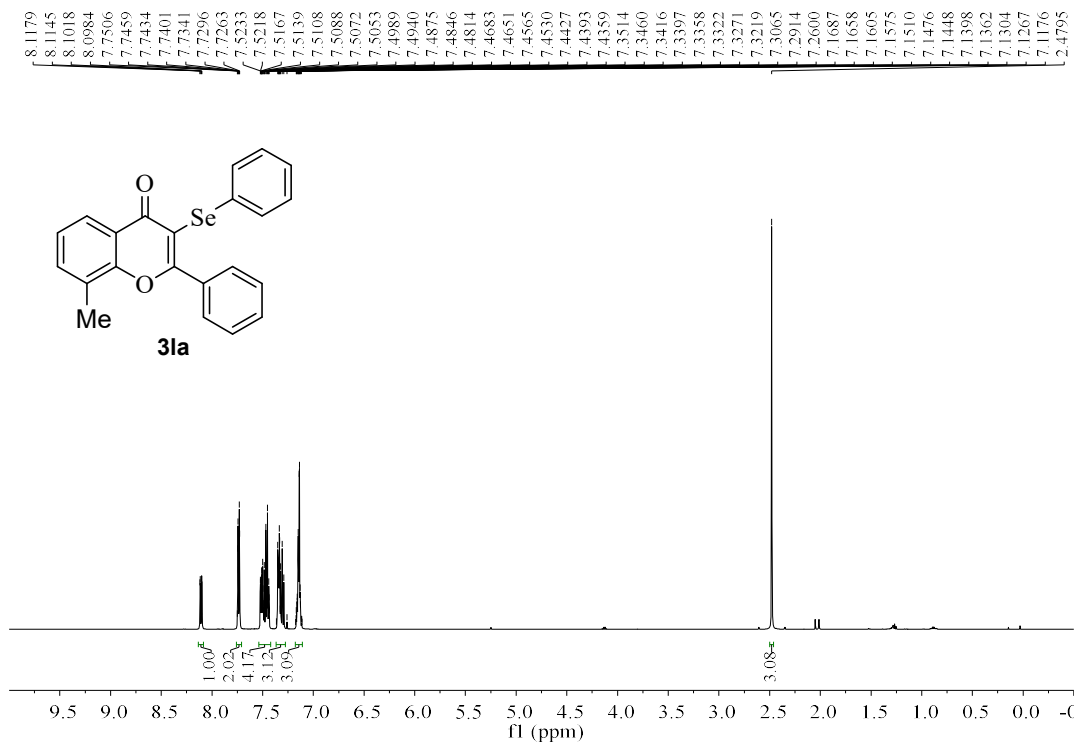


Figure S90 ¹H NMR (500 MHz) spectrum of **3la** in CDCl₃

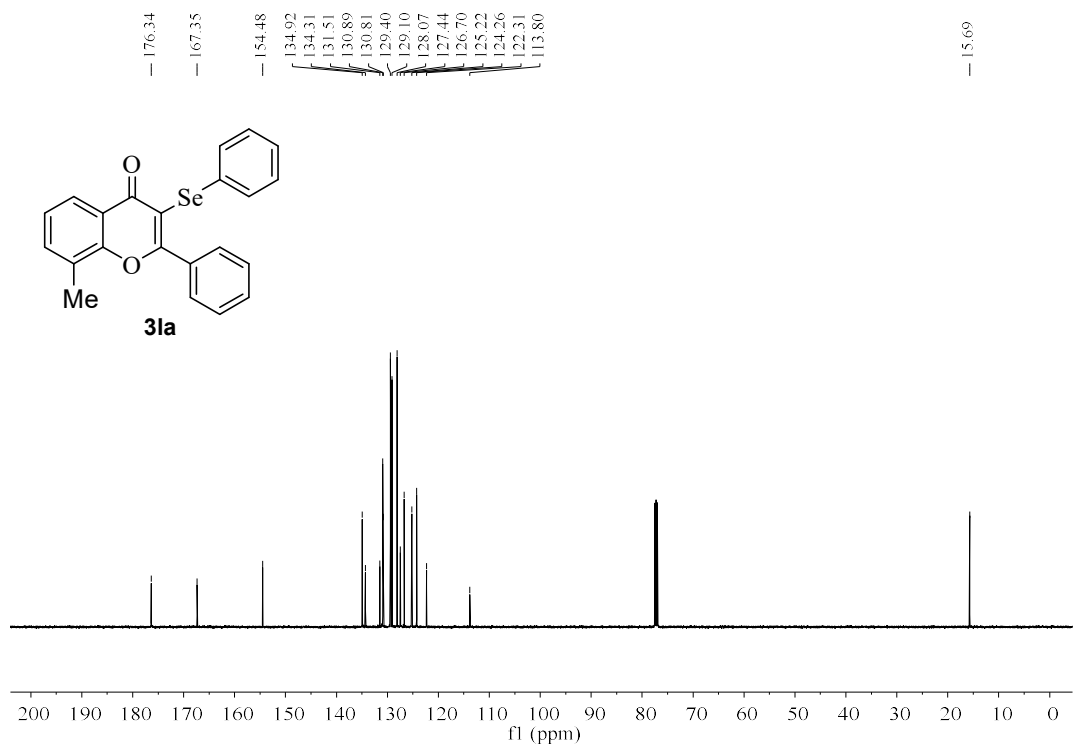


Figure S91 ¹³C NMR (125 MHz) spectrum of **3la** in CDCl₃

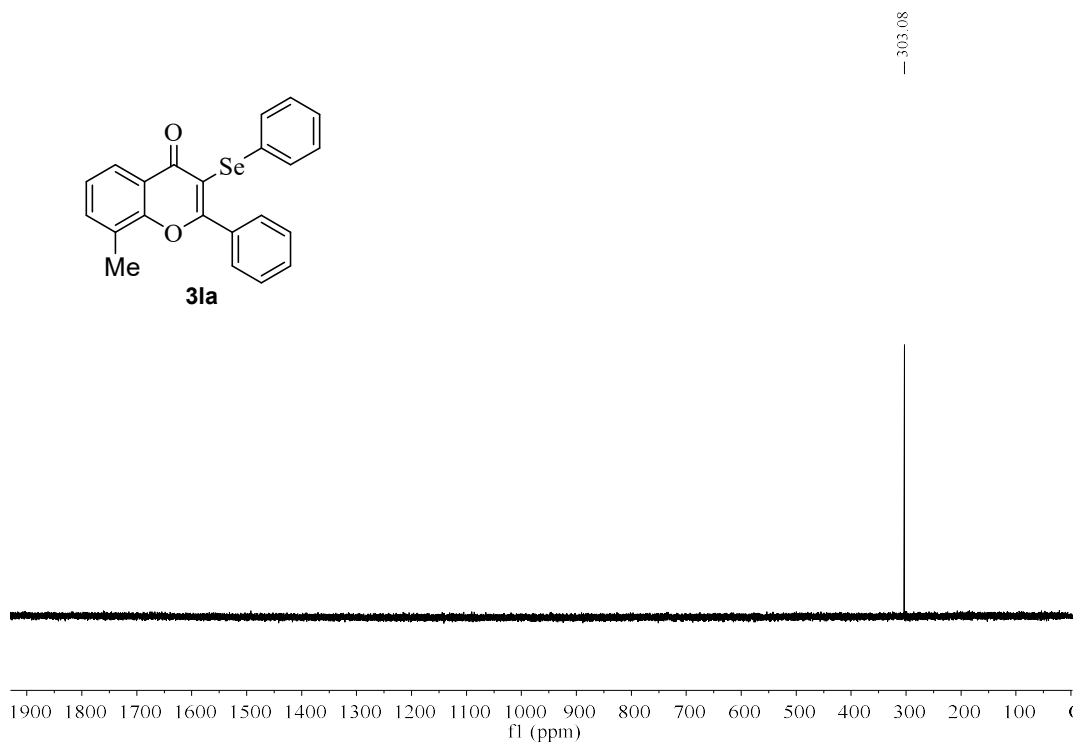


Figure S92 ⁷⁷Se NMR (95.5 MHz) spectrum of **3la** in CDCl₃

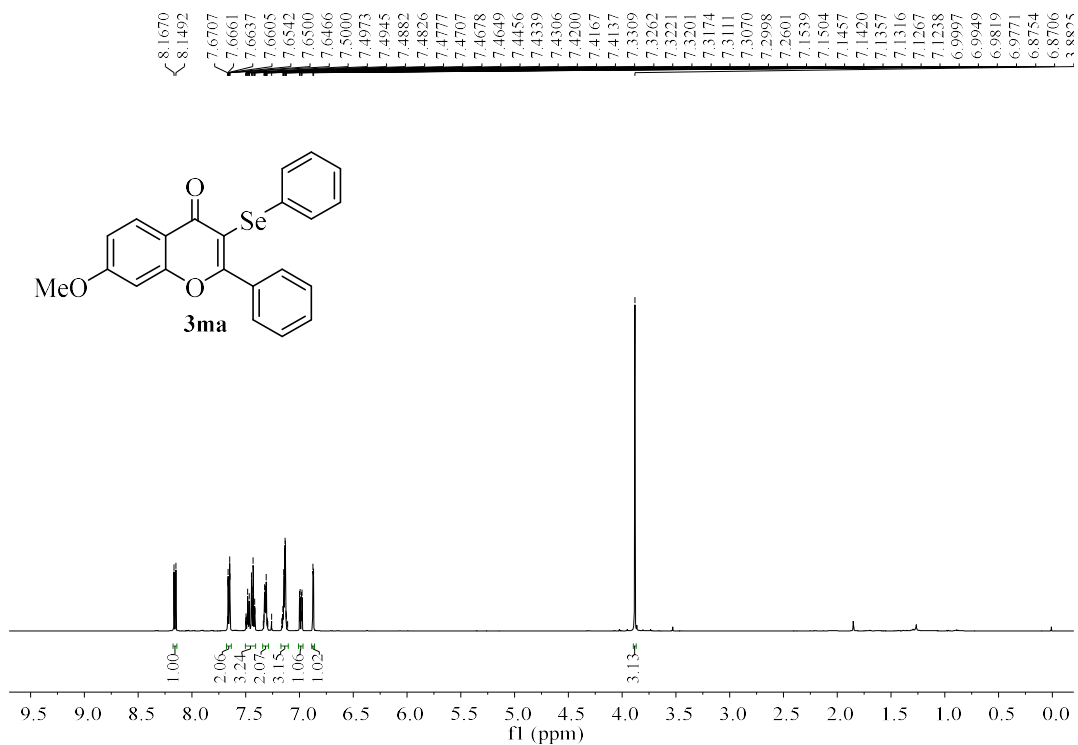


Figure S93 ¹H NMR (500 MHz) spectrum of **3ma** in CDCl₃

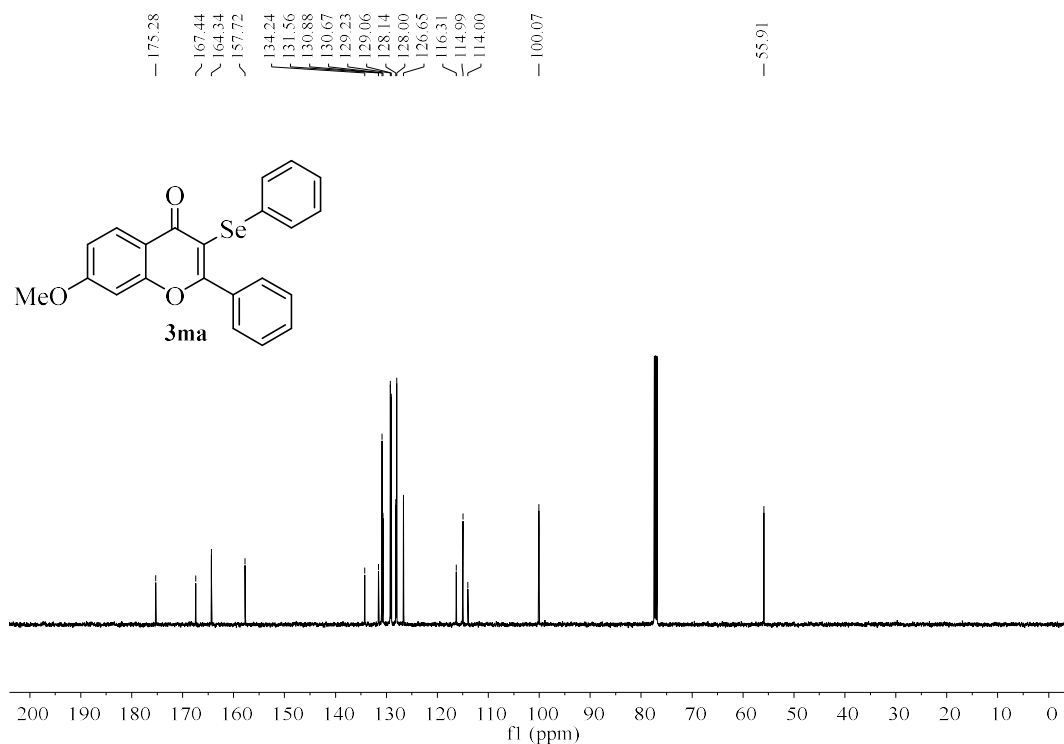


Figure S94 ^{13}C NMR (125 MHz) spectrum of **3ma** in CDCl_3

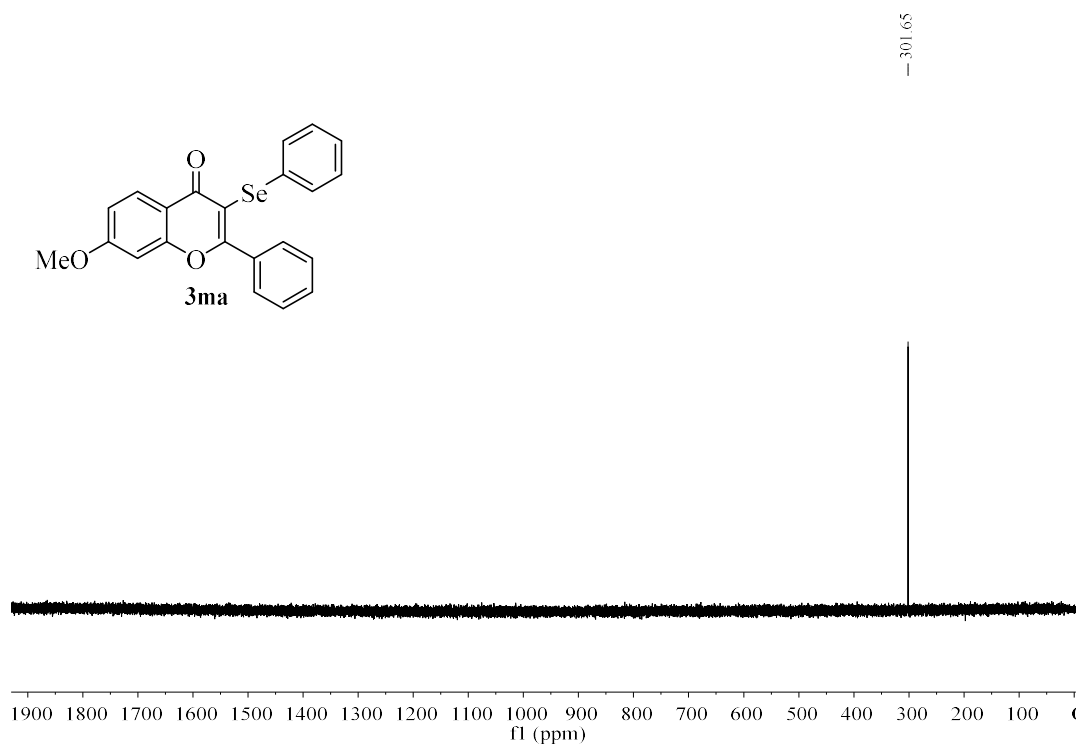


Figure S95 ^{77}Se NMR (95.5 MHz) spectrum of **3ma** in CDCl_3

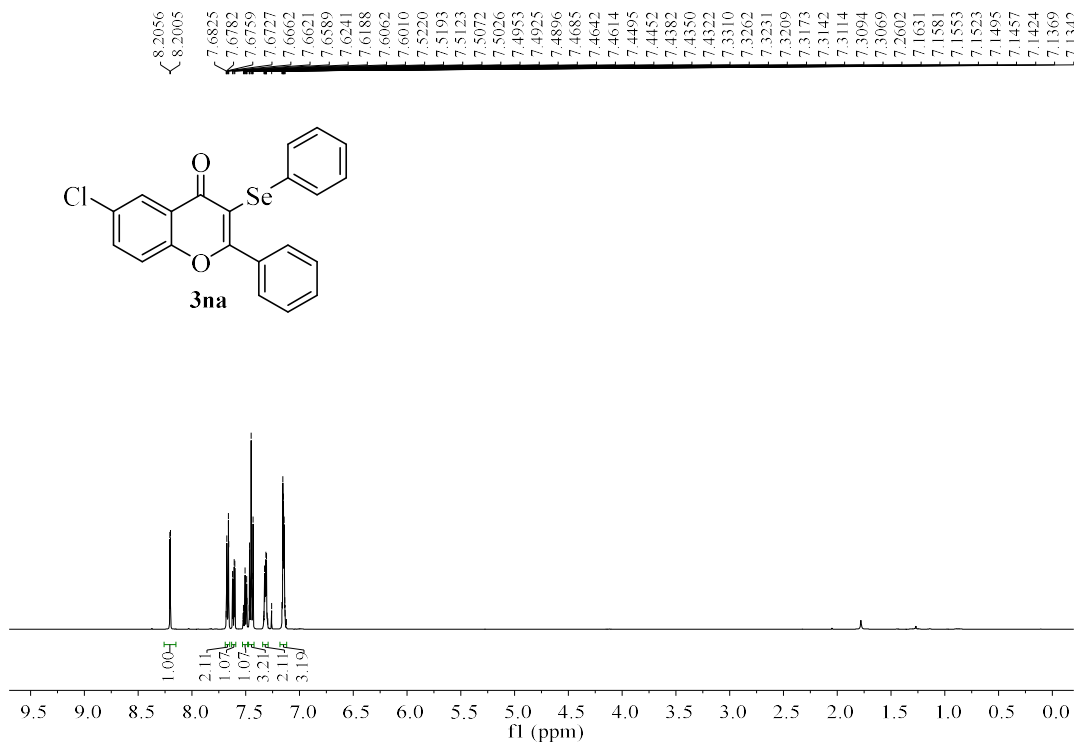


Figure S96 ^1H NMR (500 MHz) spectrum of **3na** in CDCl_3

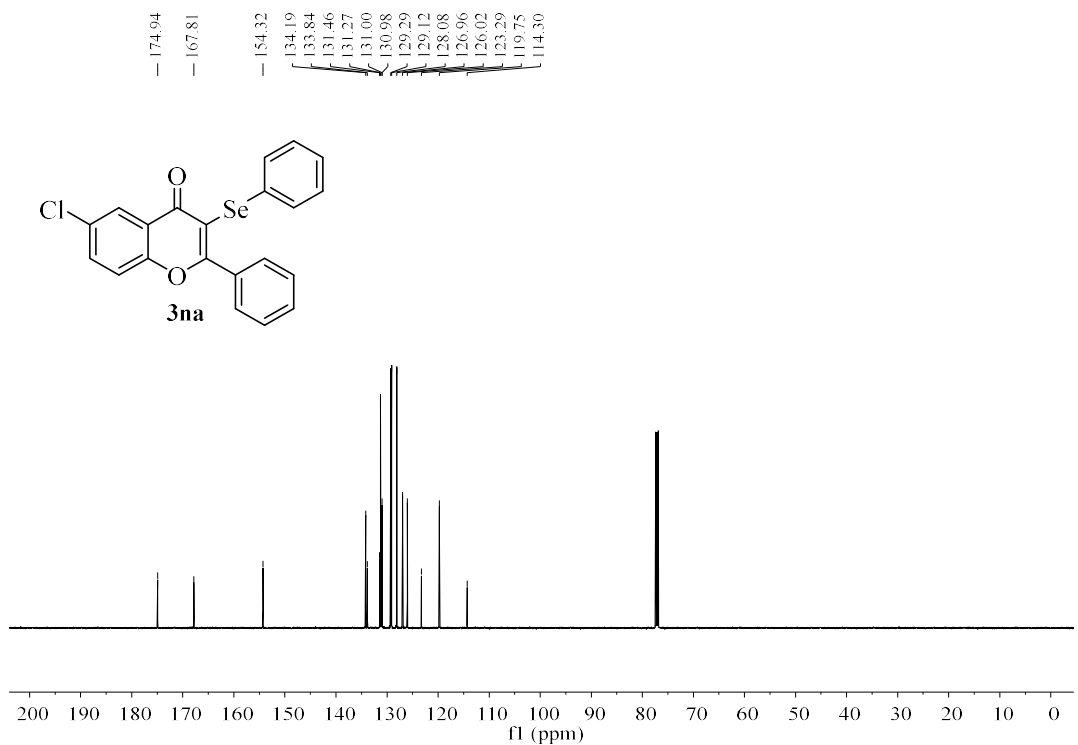


Figure S97 ^{13}C NMR (125 MHz) spectrum of **3na** in CDCl_3

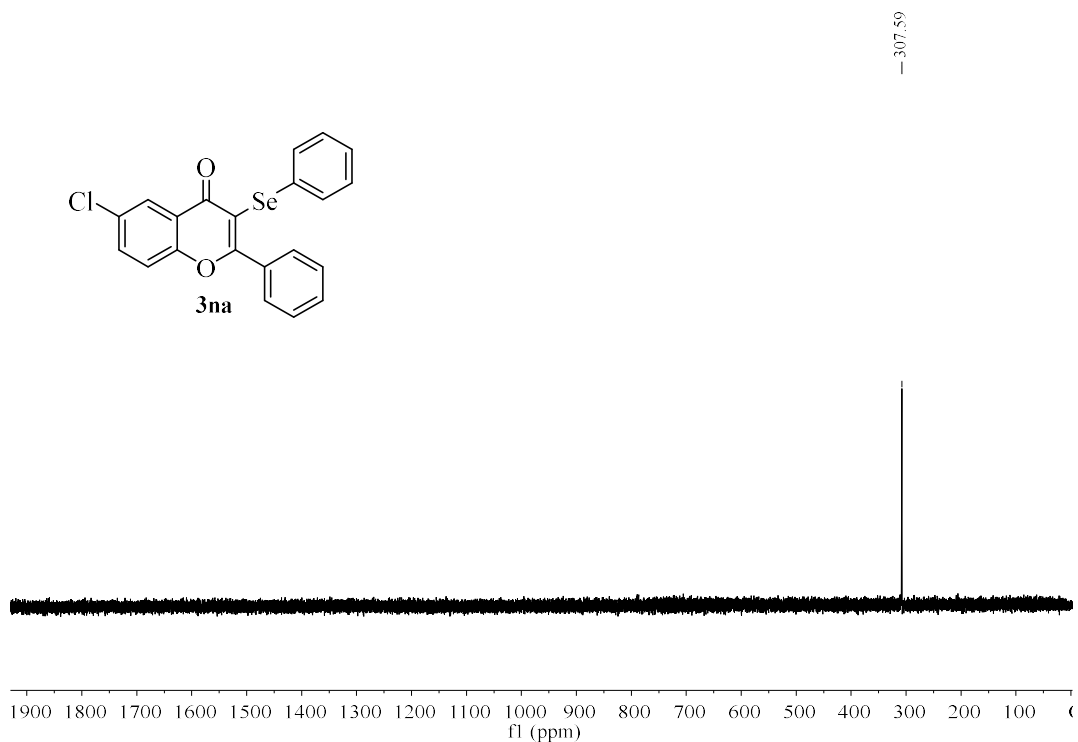


Figure S98 ⁷⁷Se NMR (95.5 MHz) spectrum of **3na** in CDCl₃

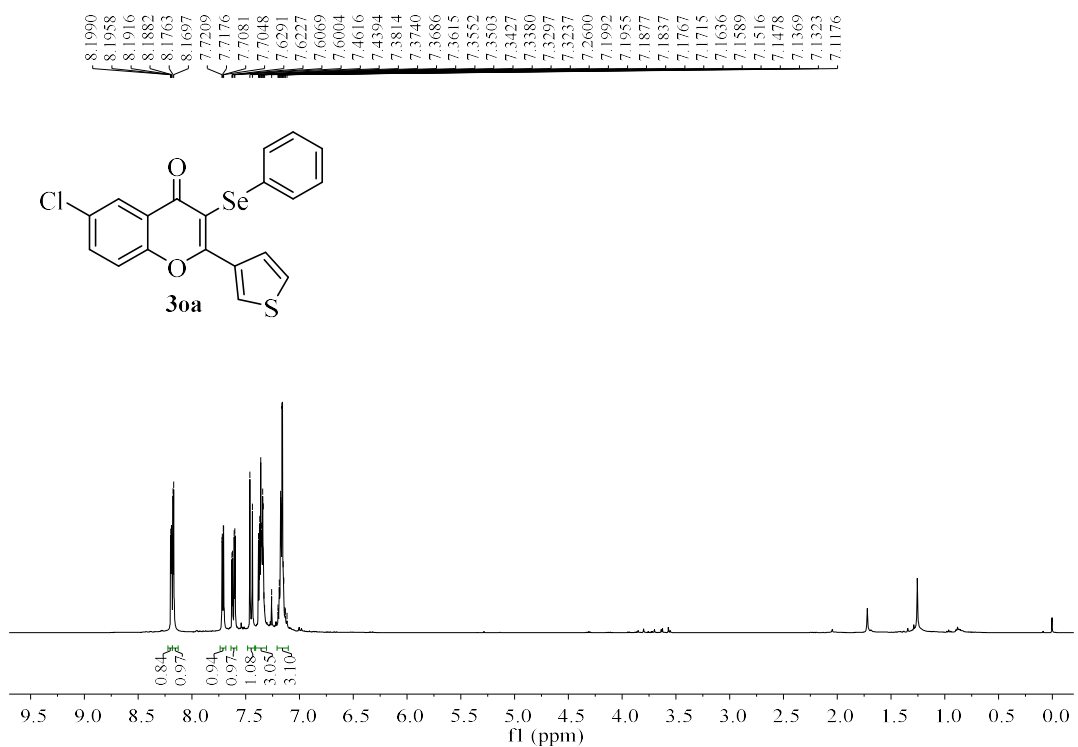


Figure S99 ¹H NMR (400 MHz) spectrum of **3oa** in CDCl₃

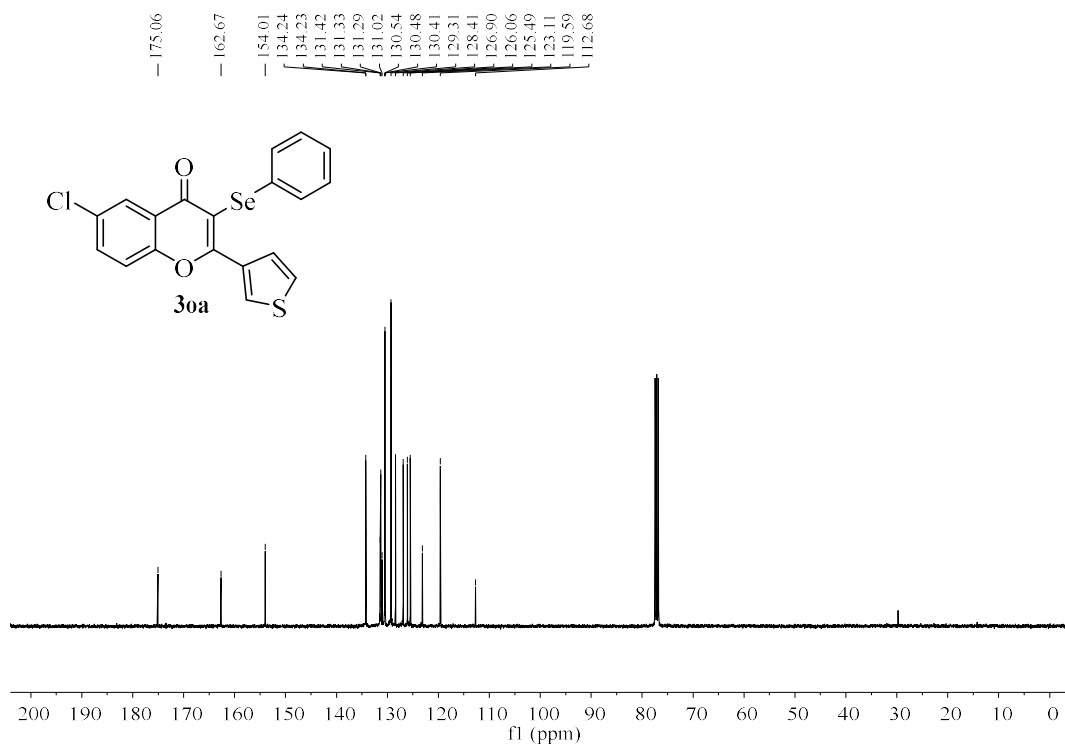


Figure S100 ^{13}C NMR (100 MHz) spectrum of **30a** in CDCl_3

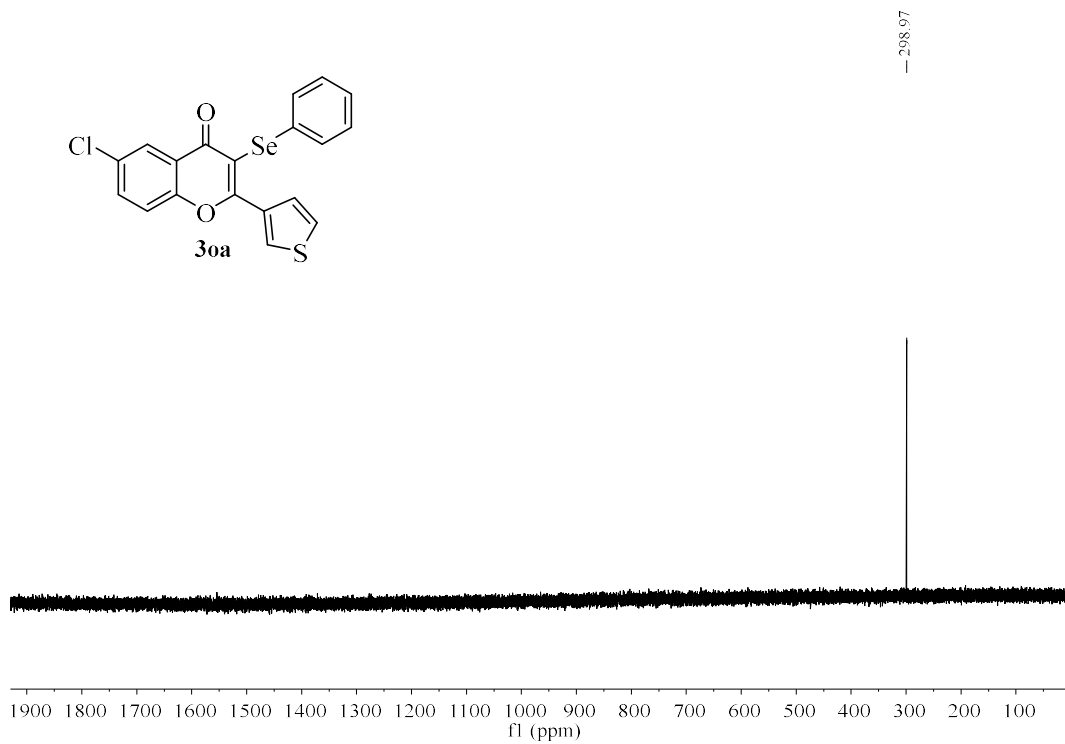


Figure S101 ^{77}Se NMR (95.5 MHz) spectrum of **30a** in CDCl_3

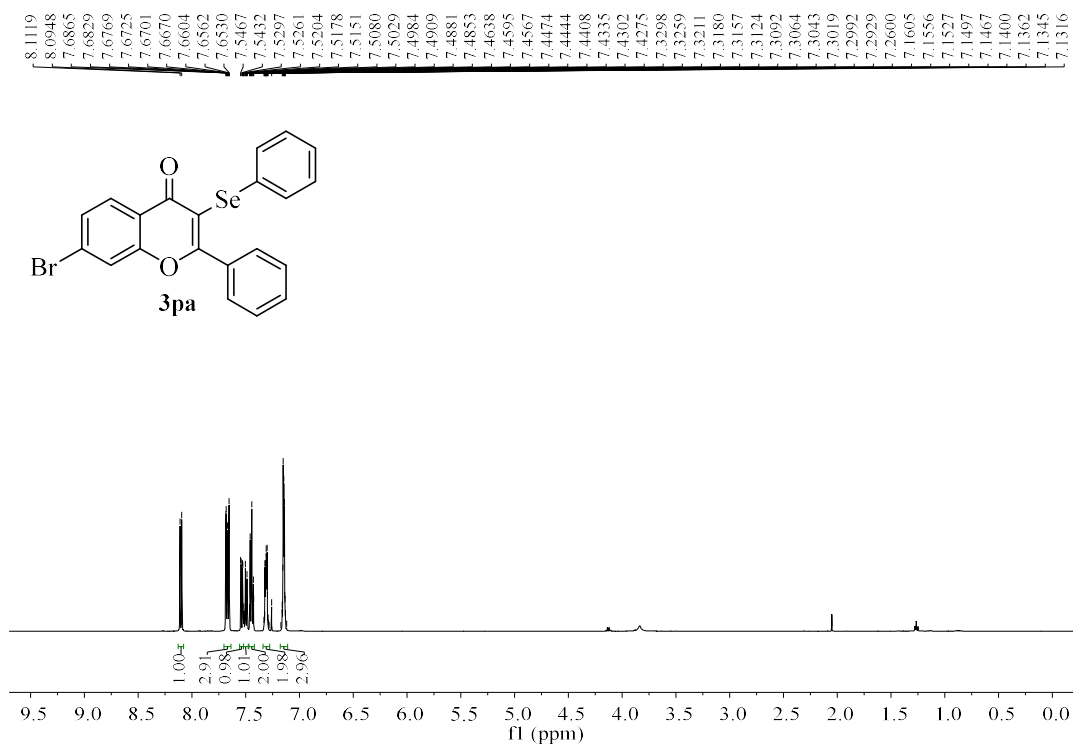


Figure S102 ^1H NMR (500 MHz) spectrum of **3pa** in CDCl_3

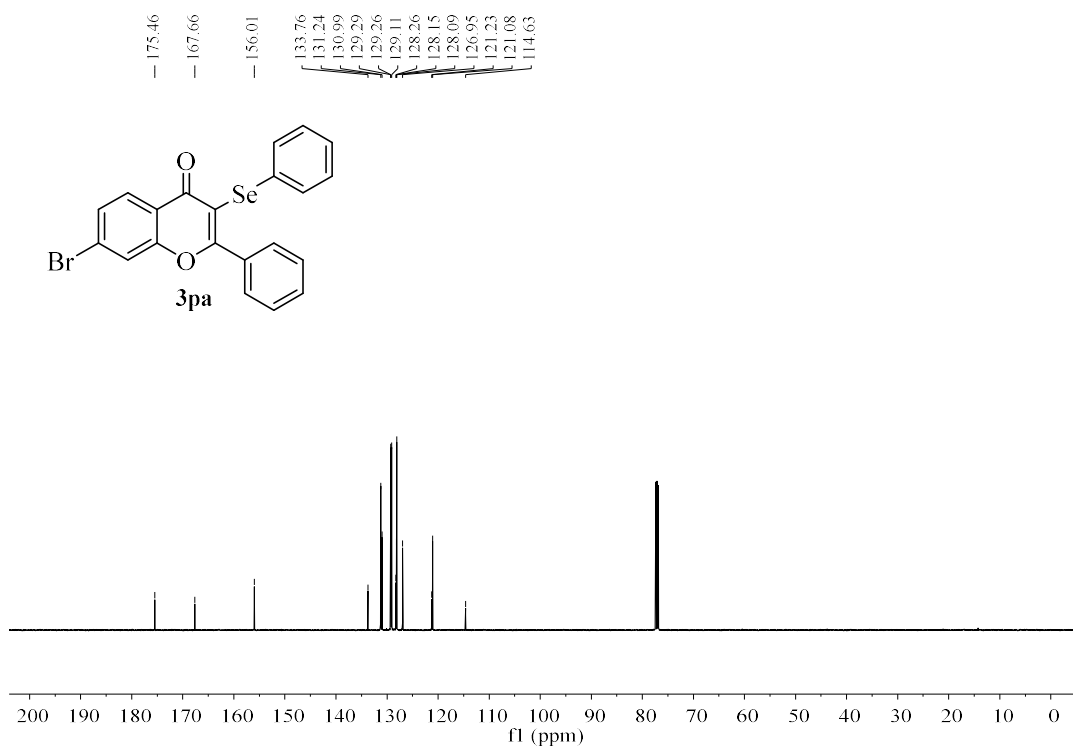


Figure S103 ^{13}C NMR (125 MHz) spectrum of **3pa** in CDCl_3

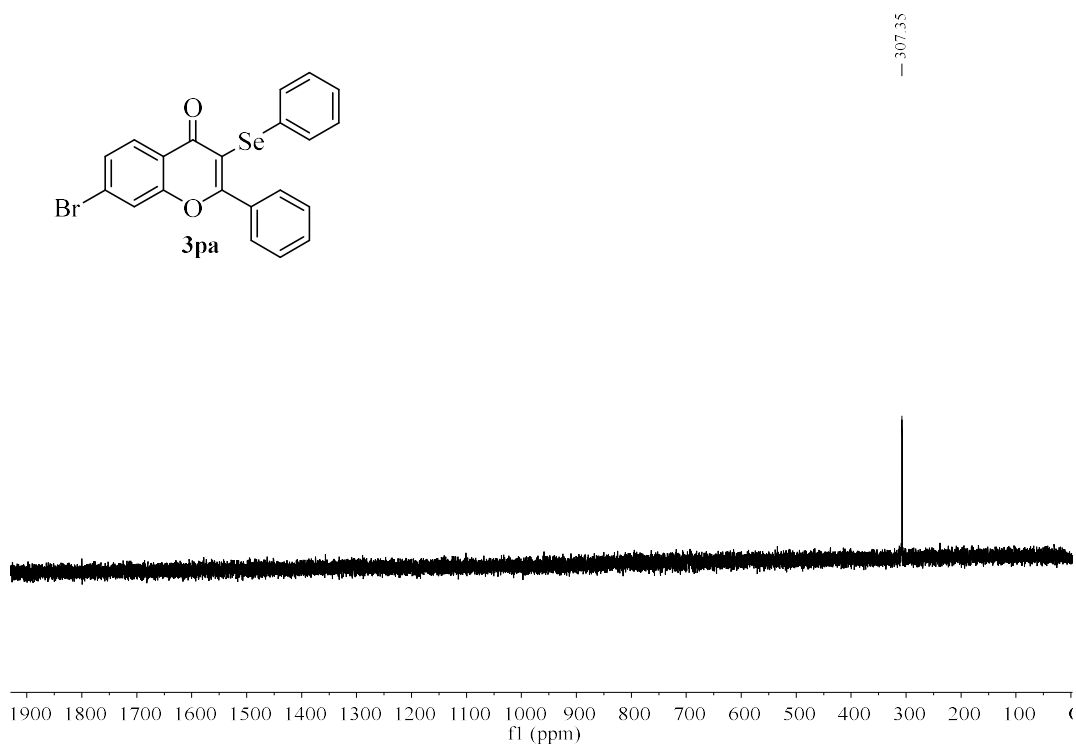


Figure S104 ^{77}Se NMR (95.5 MHz) spectrum of **3pa** in CDCl_3

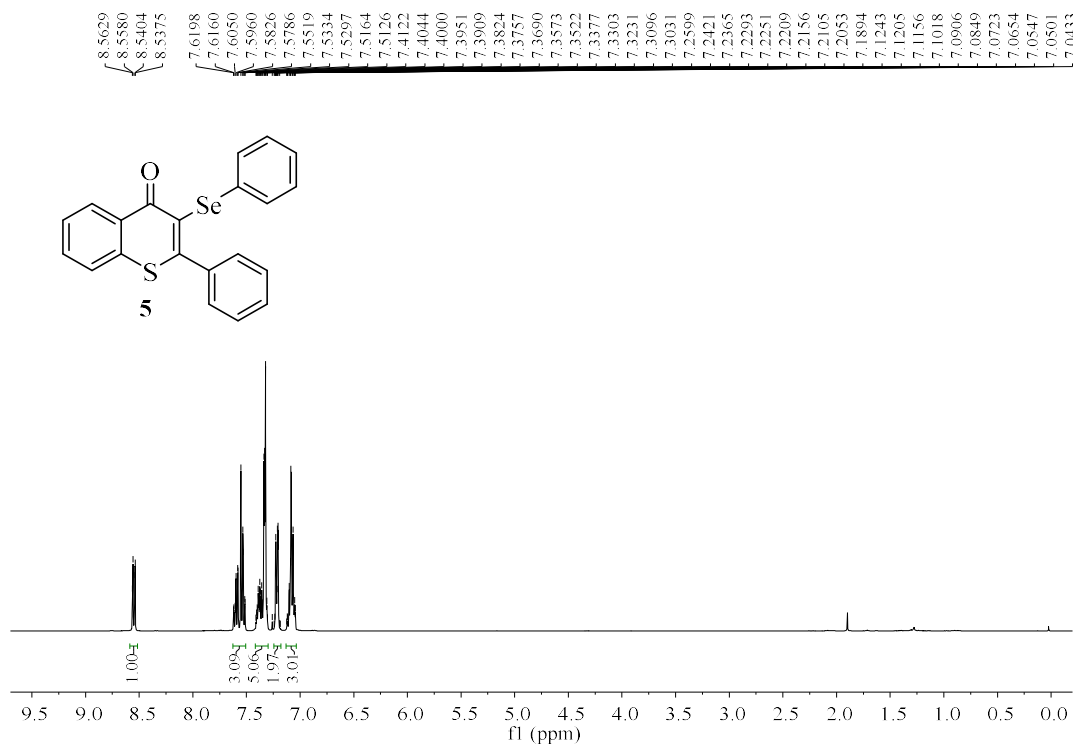


Figure S105 ^1H NMR (400 MHz) spectrum of **5** in CDCl_3

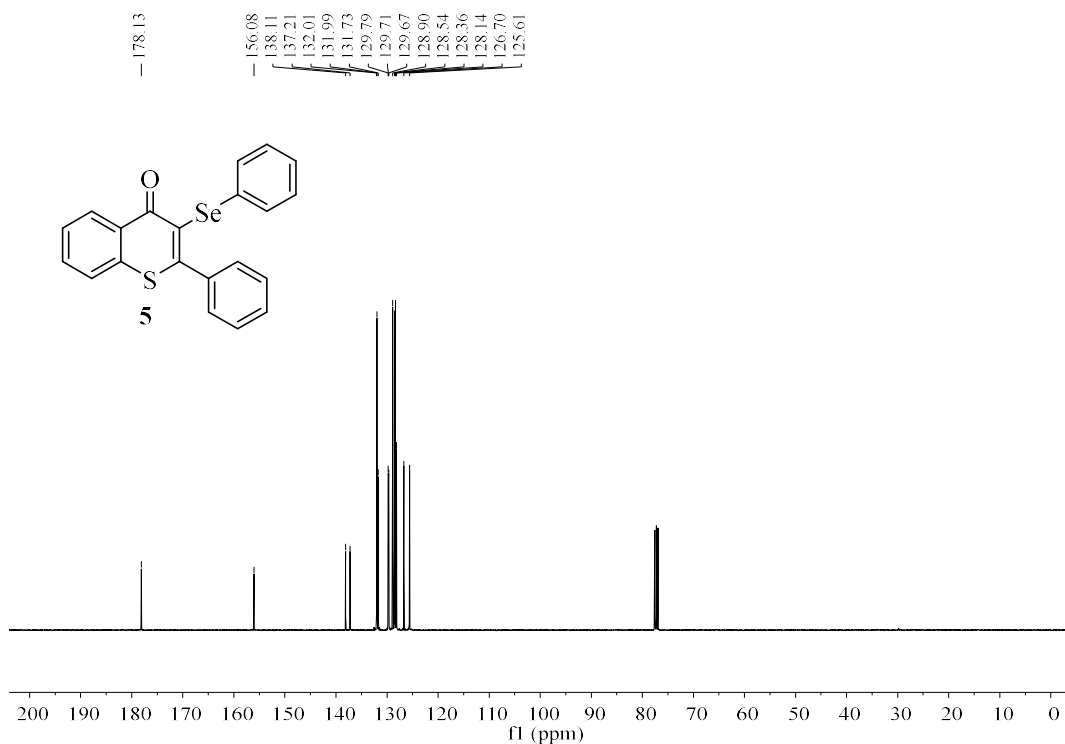


Figure S106 ^{13}C NMR (100 MHz) spectrum of **5** in CDCl_3

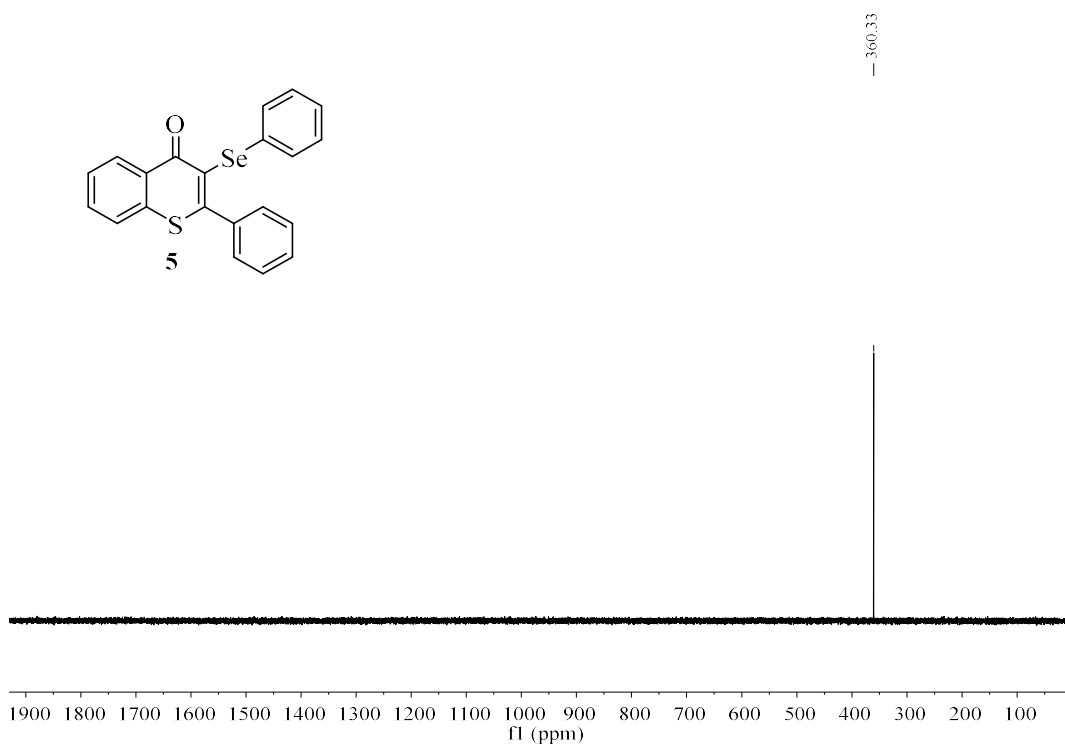


Figure S107 ^{77}Se NMR (95.5 MHz) spectrum of **5** in CDCl_3