Supporting Information

Electrocatalytic three-component cyclization reaction: synthesis of selenium-containing cyclopentenes *via* intermolecular selective [3+2] annulation of terminal alkynes, unsaturated propionates, and diselenides

Zu-Yu Mo,‡ Yi Zhang,‡ Xin-Yu Tang, Lei Gao, Ying-Ming Pan, Mu-Xue He,* and Xian-Li Ma*

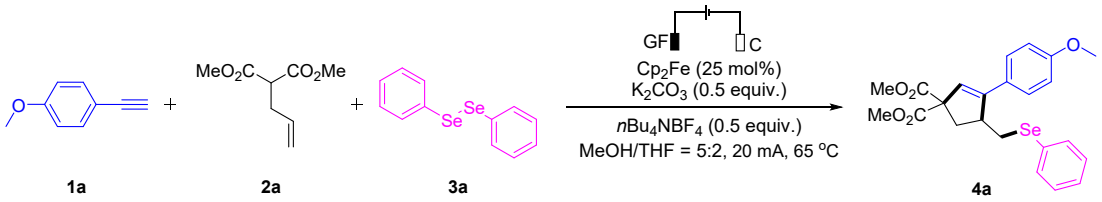
Guangxi Key Laboratory of Drug Discovery and Optimization, Guangxi Engineering Research Center for Pharmaceutical Molecular Screening and Druggability Evaluation, Key Laboratory of Medical and Translational Medicine, School of Pharmacy, Guilin Medical University, Guilin 541199, People's Republic of China
E-mail: mxl78@glmc.edu.cn; hemuxue@126.com; mozuyu90@163.com
‡These authors contributed equally to this work.

Table of Contents

1. General information

Without special instructions, all reagents and solvents were commercially available and were not further purified. Column chromatography was carried out using silica gel (200-300 mesh). NMR spectroscopy was performed on Bruker AV-400 instruments. Chemical shifts for ^{1}H NMR spectra are reported as δ in units of parts per million (ppm) downfield from TMS (δ 0.00) and relative to the signal of chloroform-*d* (δ 7.26, singlet) and dimethyl sulfoxide-d_6 (δ 2.50, quintet). The abbreviations used to explain the multiplicities were as follows: s, singlet; d, doublet; t, triplet; q, quartet; dd, doublet-doublet; m, multiplet and *J*, coupling constant in Hz. ^{13}C NMR spectra are reported as δ in units of parts per million (ppm) downfield from TMS (δ 0.00) and relative to the signal of chloroform-*d* (δ 77.16, triplet) and dimethyl sulfoxide-d_6 (δ 39.52, septet). The HRMS spectrum was measured by micromass QTOF2 Quadrupole/Time of Flight Tandem mass spectrometer with electron spray ionization. Cyclic voltammograms were recorded on a CHI 660E potentiostat.

2. Procedures for the electrolysis



A 10 ml three-necked round-bottomed flask was charged with **1a** (0.3 mmol, 1.0 equiv.), **2a** (0.6 mmol, 2 equiv.), **3a** (0.225 mmol, 0.75 equiv.), Cp_2Fe (0.075 mmol, 25 mol%), K_2CO_3 (0.15 mmol, 0.5 equiv.) and *n*Bu_4NBF_4 (0.15 mmol, 0.5 equiv.). The flask was equipped with a graphite felt (10 mm x 10 mm x 5 mm) anode and a carbon rod (Φ 6 mm) cathode. MeOH (5 mL) and THF (2 mL) was added under air atmosphere. Electrolysis was carried out at 65 °C (oil bath temperature), which using a constant current of 20 mA until the substrate was completely consumed (monitored by TLC, about 4 hours). After the reaction was completed, the solvent was concentrated under reduced pressure. Purification with silica gel column chromatography using ethyl acetate/n-hexane to afford the desired product **4a**. The pictures of reaction set-up were shown in Figure S1.

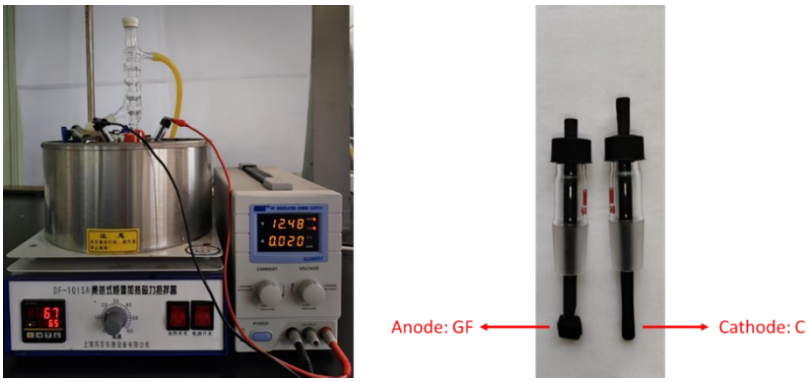
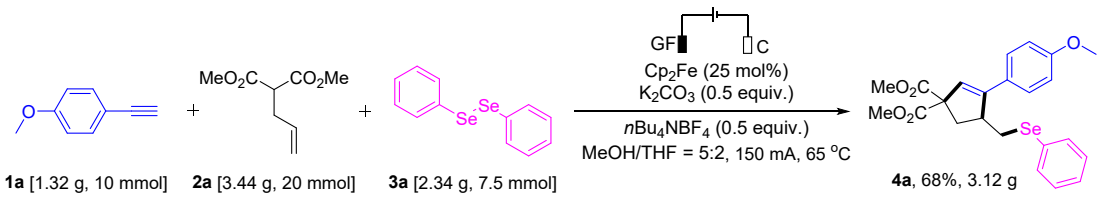


Figure S1. Electrolysis setup (undivided cell)

3. Procedures for the scale up electrolysis



1a [1.32 g, 10 mmol] **2a** [3.44 g, 20 mmol] **3a** [2.34 g, 7.5 mmol] **4a**, 68%, 3.12 g

A single-chamber electrolytic cell was charged with 1-ethynyl-4-methoxybenzene **1a** (10 mmol, 1.32 g), dimethyl 2-allylmalonate **2a** (20 mmol, 3.44 g), 1,2-diphenyldiselane **3a** (7.5 mmol, 2.34 g), Cp_2Fe (2.5 mmol, 0.47 g), K_2CO_3 (5 mmol, 0.69 g) and nBu$_4$NBF$_4$ (5 mmol, 1.65 g). The flask was equipped with a graphite felt (15 mm x 30 mm x 5 mm) anode and a carbon rod (Φ 10 mm) cathode. MeOH (50 mL) and THF (20 mL) was added under air atmosphere. Electrolysis was carried out at 65 °C (oil bath temperature), which using a constant current of 150 mA until the substrate was completely consumed (monitored by TLC, about 13 hours). After the reaction was completed, the solvent was concentrated under reduced pressure. Purification with silica gel column chromatography using ethyl acetate/ n-hexane to afford the desired product **4a**. The yield of **4a** was 68% (3.12 g). The picture of reaction set-up was shown in Figure S2.

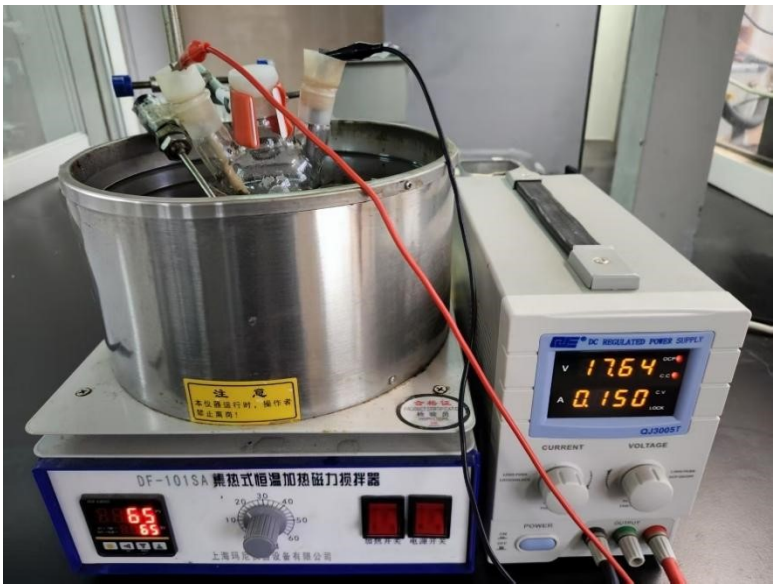
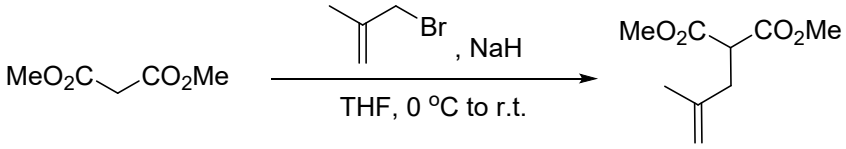
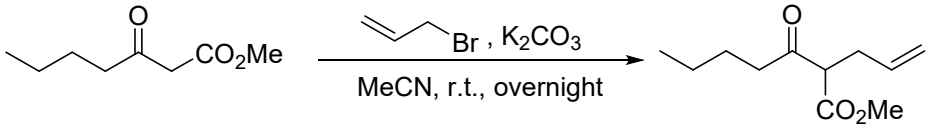


Figure S2. Scale up electrolysis setup (undivided cell)

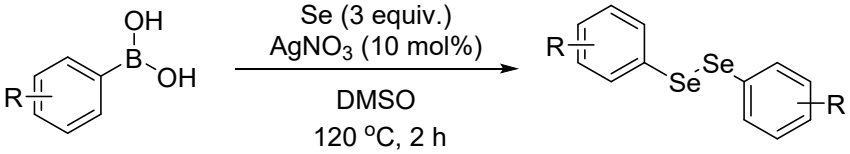
4. Procedure for the synthesis of dimethyl 2-(2-methylallyl)malonate, methyl 2-allyl-3-oxoheptanoate and diaryl diselenides



According to a modified literature procedure[1], NaH (1.1 equiv., 60% oil dispersion) was slowly added to a solution of malonate (1.0 equiv.) and 3-brompropene (1.1 equiv.) in THF (0.5 M) at 0 °C. After being stirred at room temperature for 6 hours, the reaction mixture was quenched with saturated NH_4Cl aq., extracted with EtOAc, dried over Na_2SO_4 and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel to give the desired product dimethyl 2-(2-methylallyl)malonate.



To a 250 mL round bottom flask containing K_2CO_3 (5.53 g, 40 mmol, 2.0 equiv.) and CH_3CN (40 mL) was added methyl 3-oxoheptanoate (3.18 mL, 20 mmol, 1.0 equiv.) and allyl bromide (1.9 mL, 22 mmol, 1.1 equiv.). The reaction mixture was stirred at room temperature for overnight. To quench the reaction, hydrochloric acid (10%) was added to the flask slowly until the pH reached 6-7. The reaction mixture was further diluted with 50 mL water and was extracted with EtOAc (3×50 mL). The combined organic layer was washed with brine and dried over anhydrous sodium sulfate. After filtration, the solvent was evaporated under reduced pressure, and the residue was purified by column chromatography (silica gel, eluted by a mixture of EtOAc and n-hexane) to afford compound methyl 2-allyl-3-oxoheptanoate[2].



The reaction was carried out in a Schlenk tube equipped with magnetic stir bar and charged with arylboronic acid (1 equiv.), selenium (3 equiv.), $AgNO_3$ (10 mol%), and DMSO (2.0 mL). The mixture was stirred in a heating mantle preheated to 120 °C for 2 h. The reaction progress was monitored by TLC. After cooling to room temperature, the reaction mixture was diluted with H_2O (10 mL) and extracted with EtOAc (3×10 mL). The combined organic phase was washed with water and brine (30 mL), dried over anhydrous Na_2SO_4. Evaporation of the solvent under reduced pressure and purification of the residue by silica gel column chromatography petroleum ether as the eluent furnished the desired product diaryl diselenides, as yellow solids[3].

References:

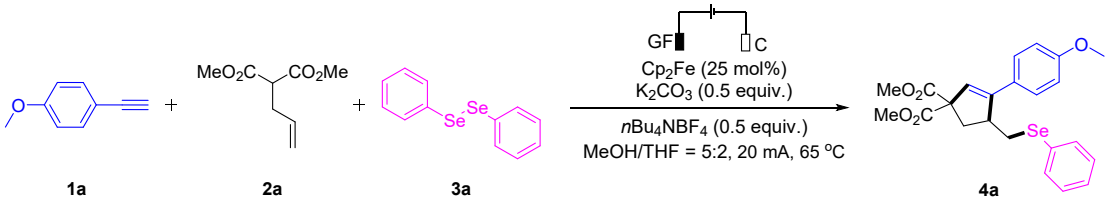
[1] *J. Am. Chem. Soc.* **2023**, *145*, 15735-15741.

[2] *Angew. Chem. Int. Ed.* **2020**, *59*, 13552-13556.

[3] *Chem. Commun.* **2023**, *59*, 8719-8722.

5. Additional optimization of reaction conditions

Table S1. Optimization of the reaction conditions.[a]



1a 2a 3a 4a

Entry	Variation from standard conditions	Yield[b]
1	Cp_2Fe (5 mol %)	37
2	Cp_2Fe (10 mol %)	68
3	Cp_2Fe (20 mol %)	85
4	Cs_2CO_3 instead of K_2CO_3	77
5	Na_2CO_3 instead of K_2CO_3	88
6	DBU insead of K_2CO_3	90
7	K_2CO_3 (20 mol%)	63
8	K_2CO_3 (1 equiv.)	65
9	nBu$_4$NPF$_6$ instead of nBu$_4$NBF$_4$	59
10	nBu$_4$NBr instead of nBu$_4$NBF$_4$	60
11	nBu$_4$NBF$_4$ (1.0 equiv.)	62
12	nBu$_4$NBF$_4$ (2.0 equiv.)	55
13	MeCN as solvent	0
14	MeOH as solvent	69
15	r.t.	37
16	Constant current: 15 mA	90
17	**3a** (1.0 equiv.)	72

[a]Reaction conditions: GF (10 mm × 10 mm × 5 mm) anode, carbon rod (Φ 6 mm) cathode, constant current = 20 mA, undivided cell, **1a** (0.3 mmol, 1.0 equiv.), **2a** (0.6 mmol, 2.0 equiv.), **3a** (0.225 mmol, 0.75 equiv.), Cp_2Fe (0.075 mmol, 25 mol%), K_2CO_3 (0.15 mmol, 0.5 equiv.), nBu$_4$NBF$_4$ (0.15 mmol, 0.5 equiv.), MeOH/THF (5.0 mL/2.0 mL), 65 °C, 4 h. [b]Isolated yields.

6. Control experiments

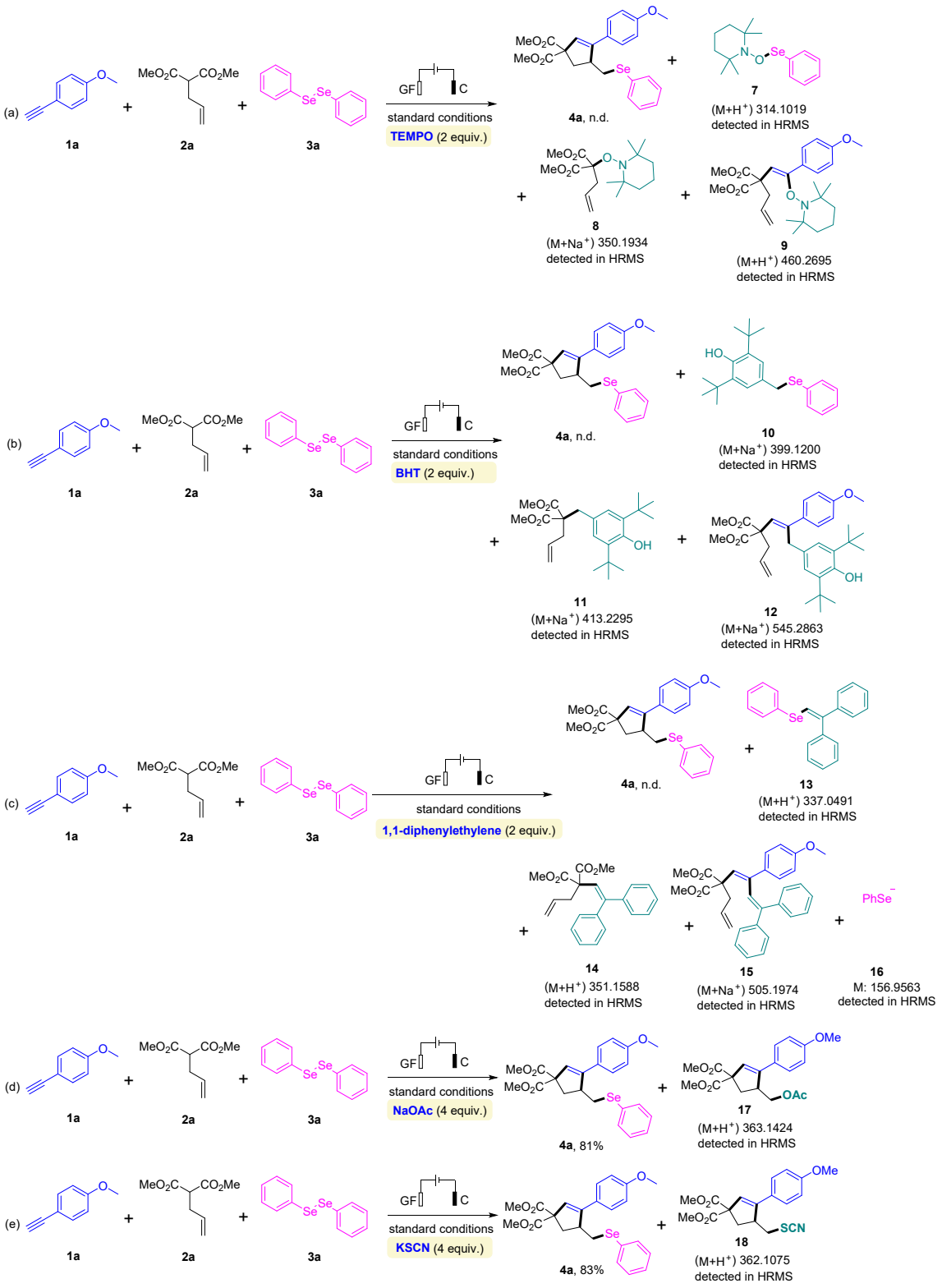


Figure S3. Control experiment

7. The HRMS spectra of compounds 7-16

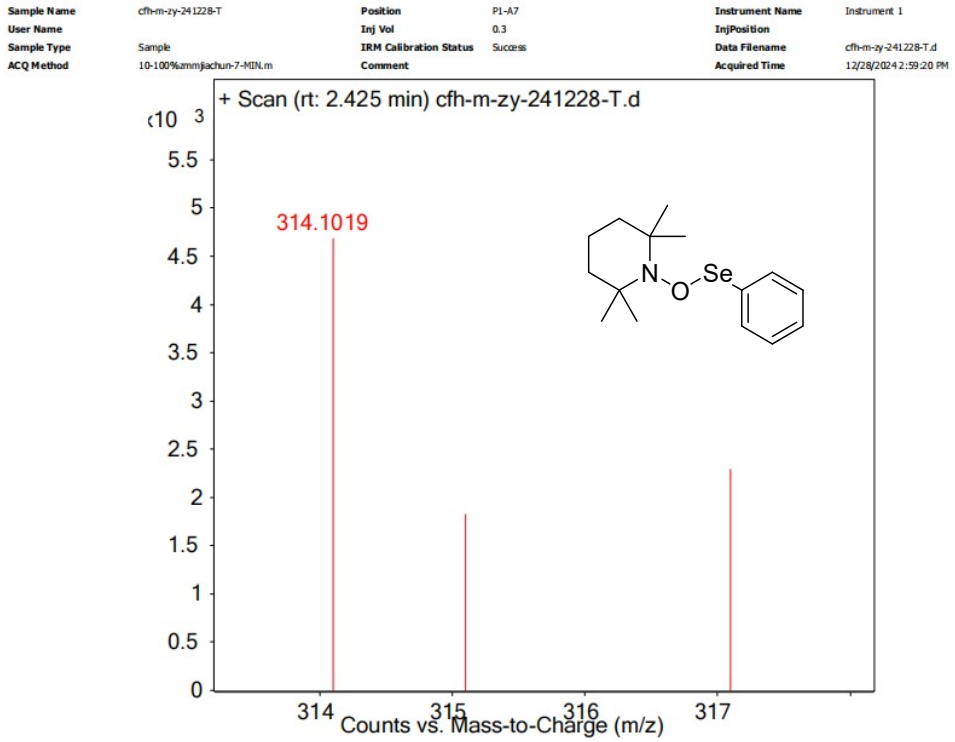


Figure S4. HRMS of compound **7**: calculated for $C_{15}H_{24}NOSe^+$ $[M+H]^+$: 314.1018, found 314.1019 (m/z) [ESI].

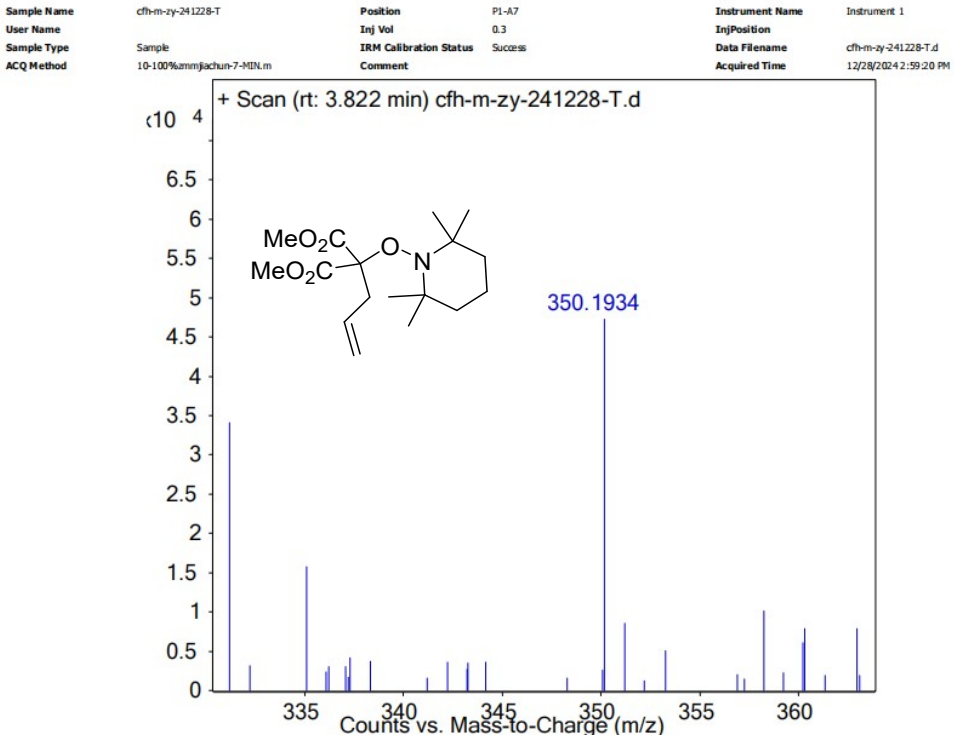


Figure S5. HRMS of compound **8**: calculated for $C_{17}H_{29}NO_5Na^+$ $[M+Na]^+$: 350.1938, found 350.1934 (m/z) [ESI].

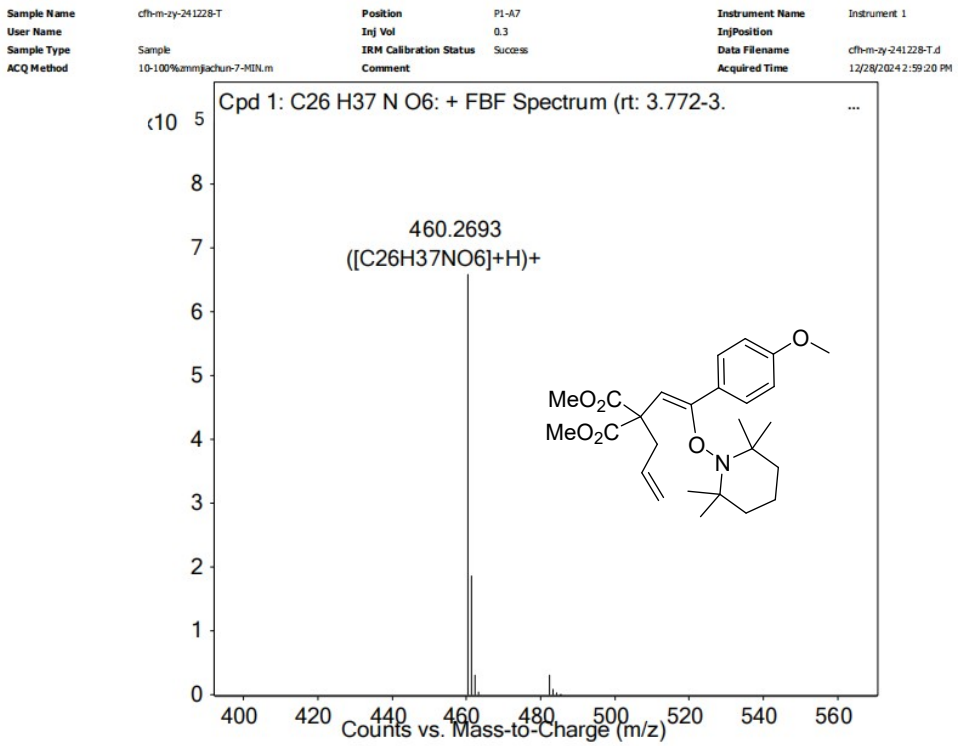


Figure S6. HRMS of compound **9**: calculated for $C_{26}H_{38}NO_6^+$ $[M+H]^+$: 460.2694, found 460.2693 (m/z) [ESI].

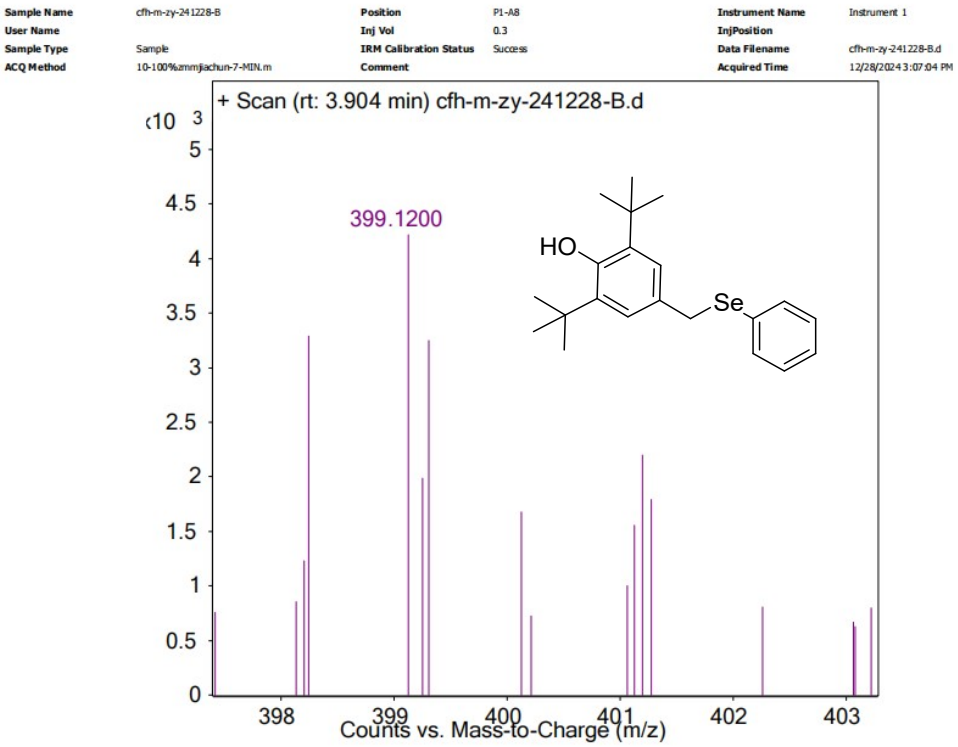


Figure S7. HRMS of compound **10**: calculated for $C_{21}H_{28}OSeNa^+$ $[M+Na]^+$: 399.1197, found 399.1200 (m/z) [ESI].

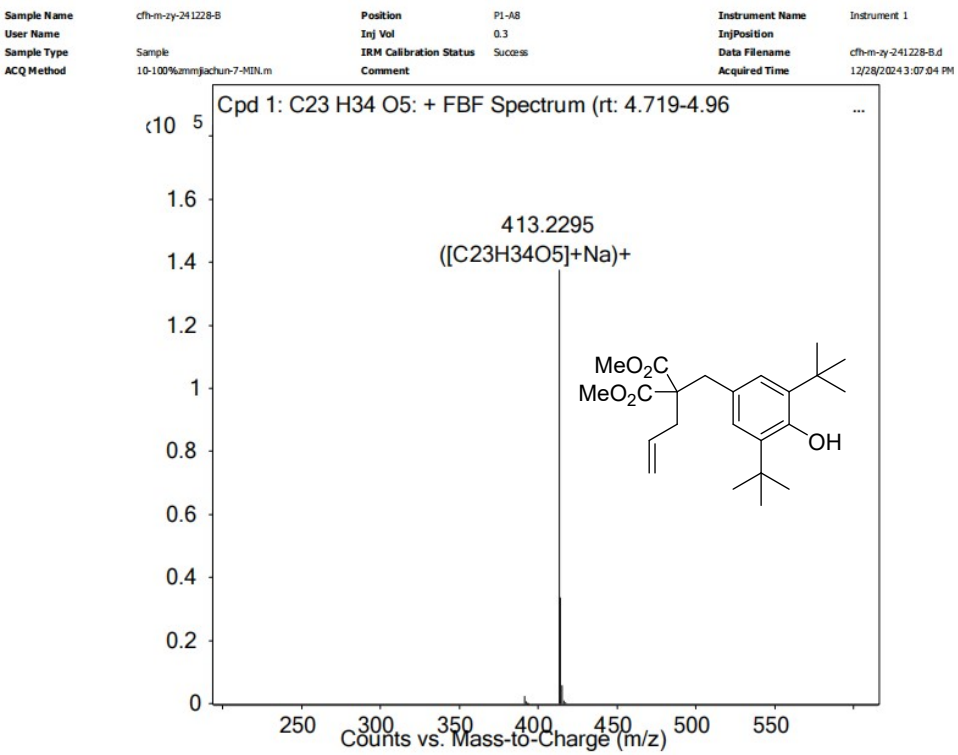


Figure S8. HRMS of compound **11**: calculated for $C_{23}H_{34}O_5Na^+$ $[M+Na]^+$: 413.2298, found 413.2295 (m/z) [ESI].

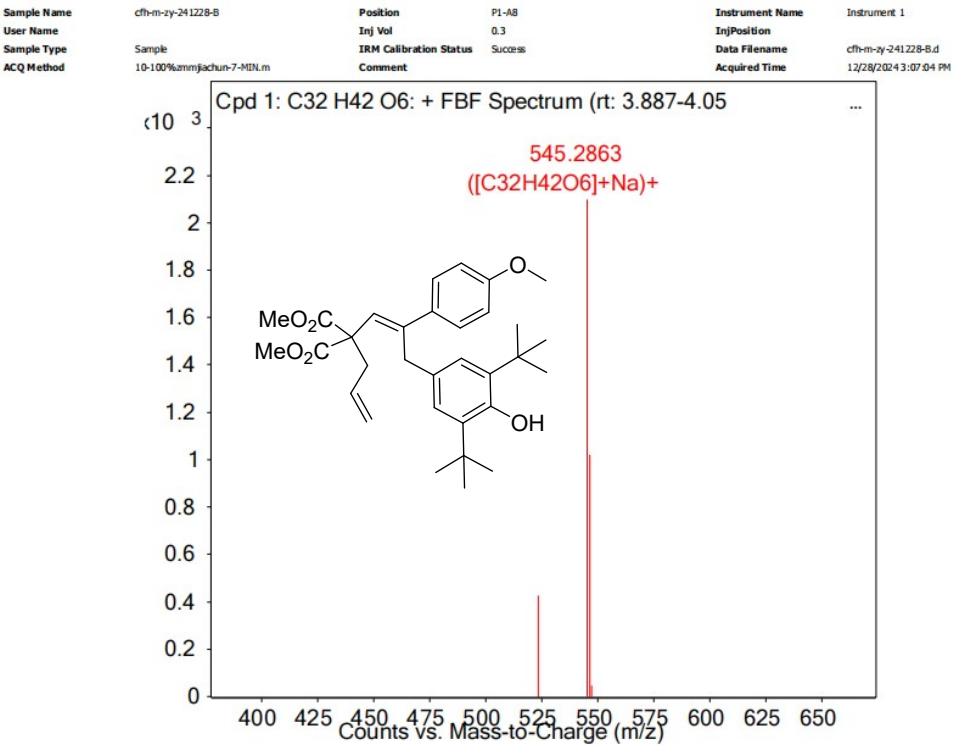


Figure S9. HRMS of compound **12**: calculated for $C_{32}H_{42}O_6Na^+$ $[M+Na]^+$: 545.2873, found 545.2863 (m/z) [ESI].

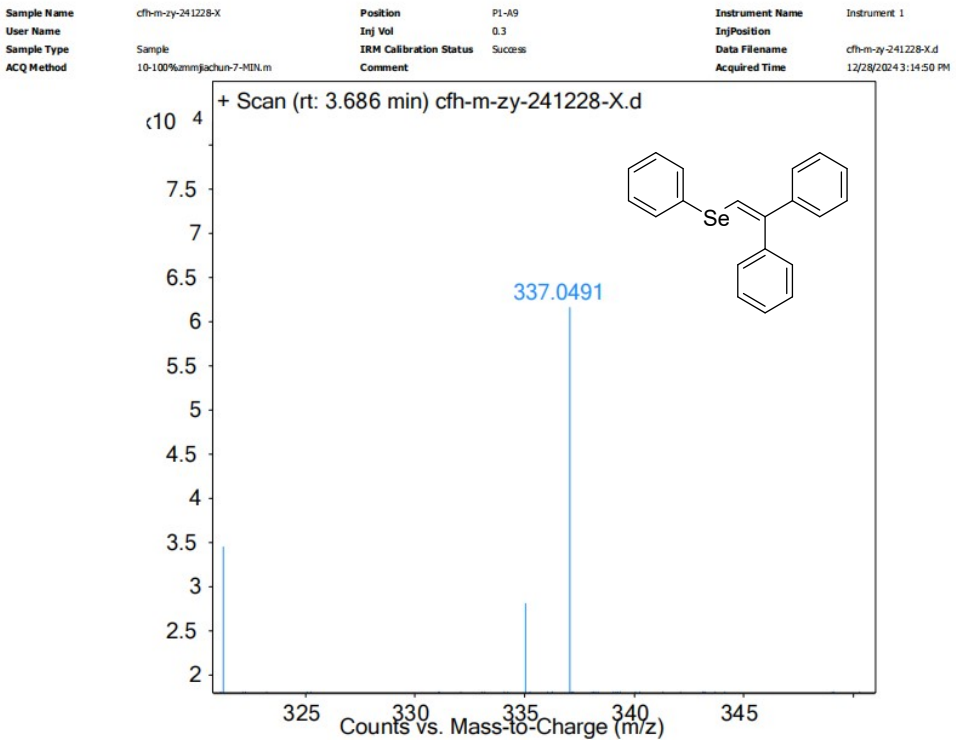


Figure S10. HRMS of Compound **13**: calculated for $C_{20}H_{17}Se^{+}$ $[M+H]^{+}$: 337.0490, found 337.0491 (m/z) [ESI].

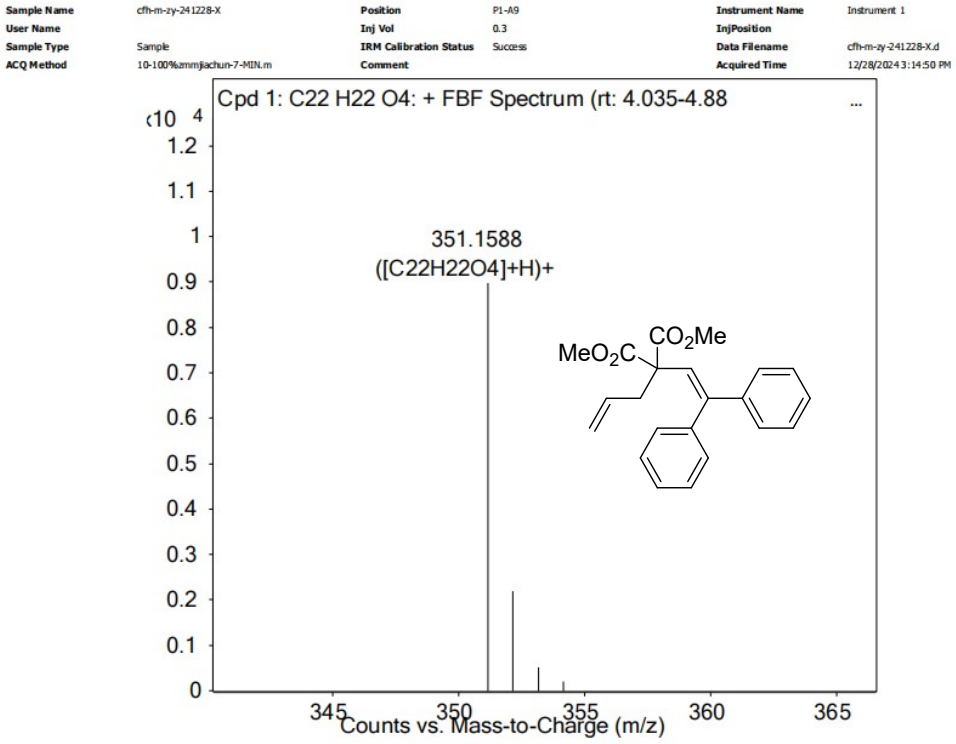


Figure S11. HRMS of compound **14**: calculated for $C_{22}H_{23}O_4^{+}$ $[M+H]^{+}$: 351.1591, found 351.1588 (m/z) [ESI].

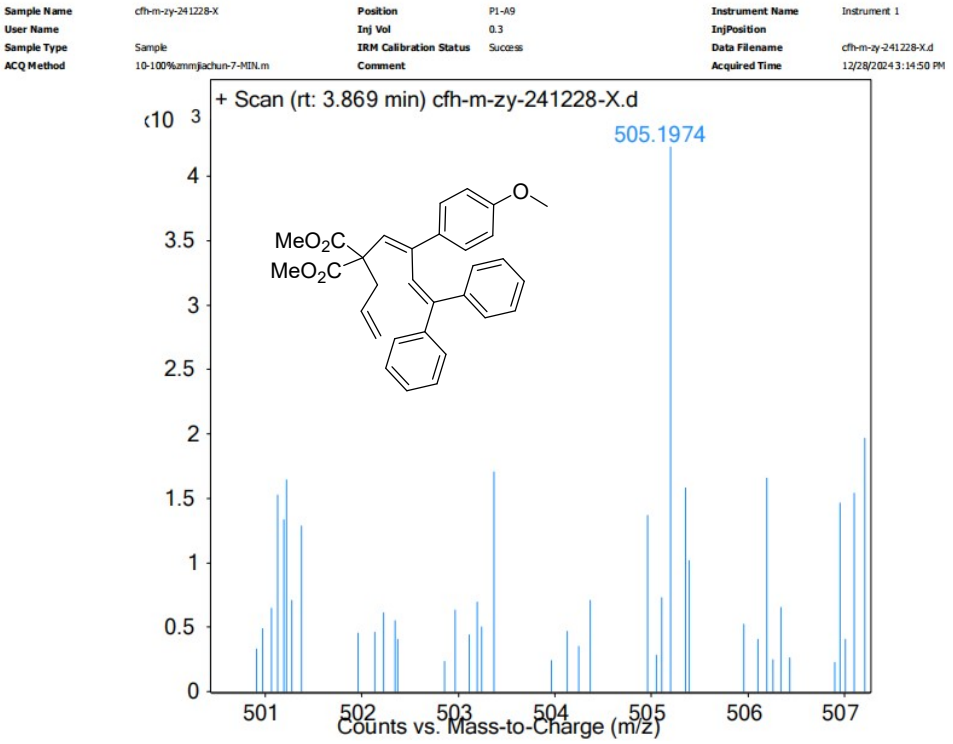


Figure S12. HRMS of compound **15**: calculated for $C_{31}H_{30}O_5Na^+$ $[M+Na]^+$: 505.1985, found 505.1974 (m/z) [ESI].

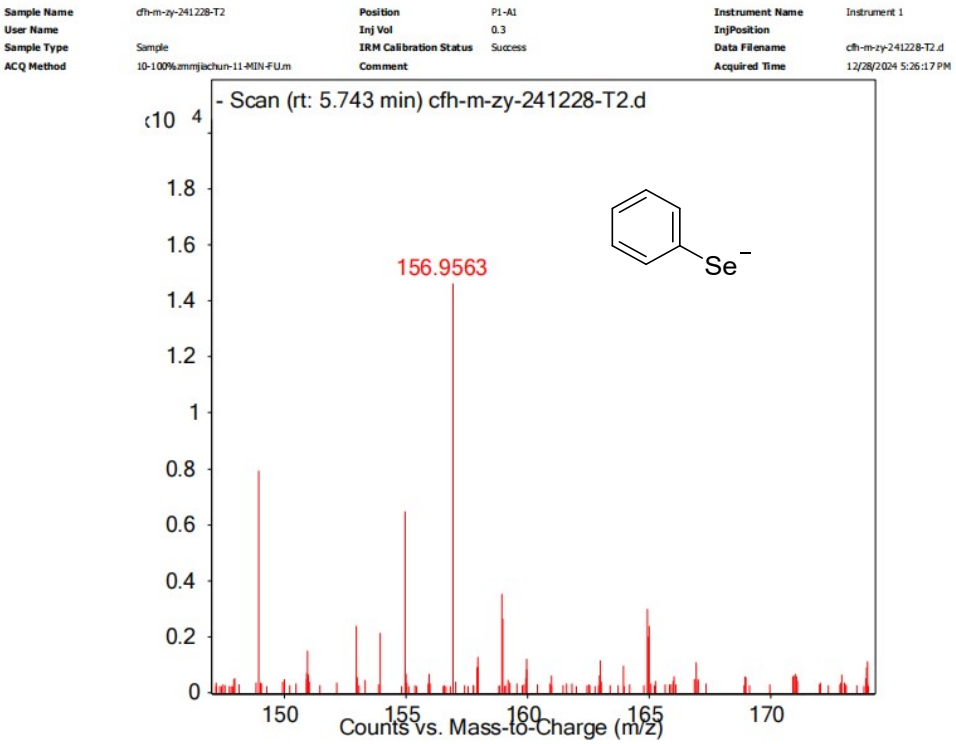


Figure S13. HRMS of Selenium anion **16**: calculated for $C_6H_5Se^-$ [M]: 156.9562, found 156.9563 (m/z) [ESI].

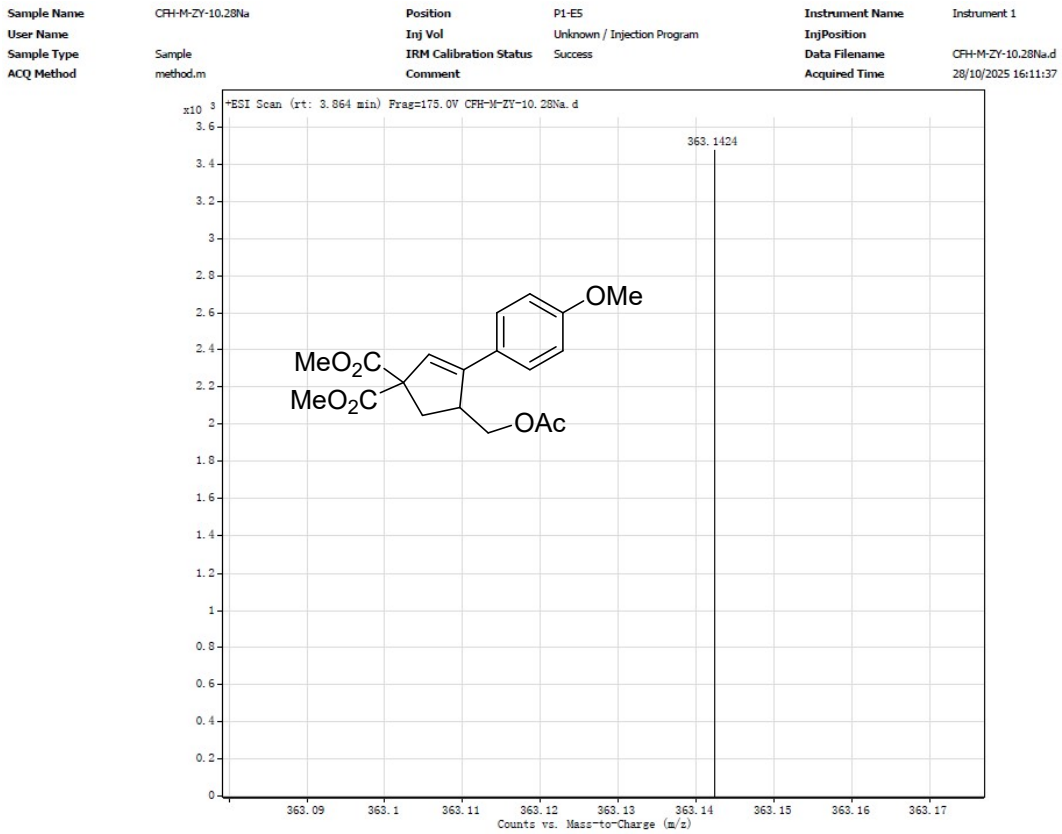


Figure S14. HRMS of compound **17**: calculated for $C_{19}H_{23}O_7^+$ $[M+H]^+$: 363.1438, found 363.1424 (m/z) [ESI].

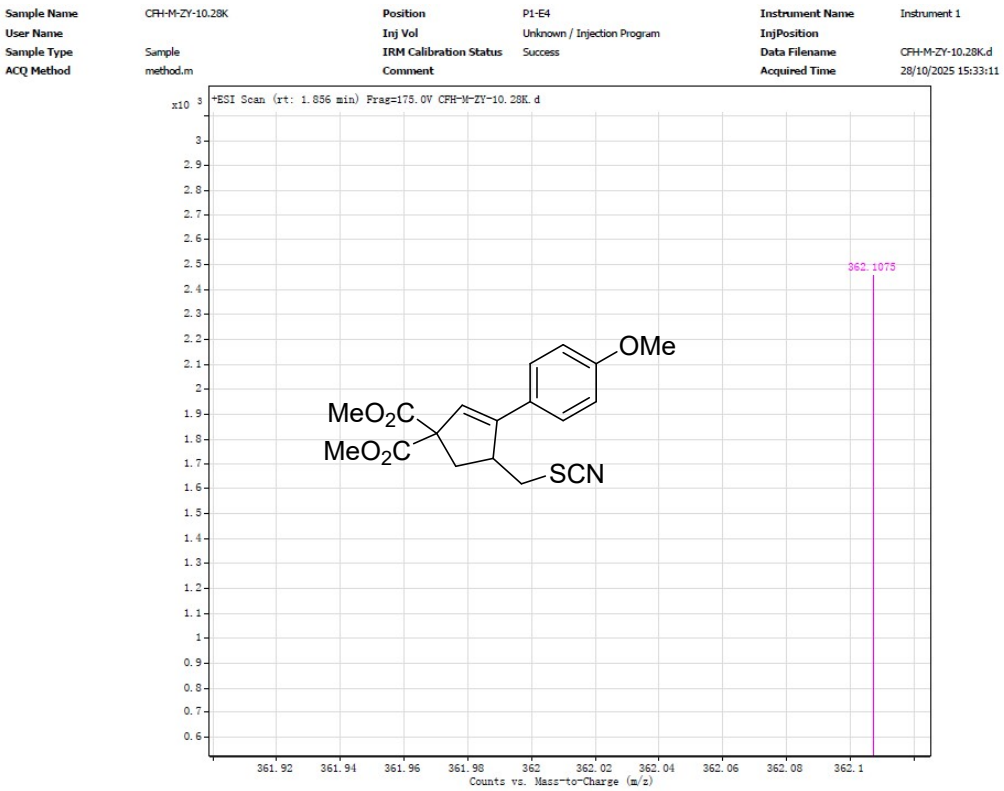


Figure S15. HRMS of compound **18**: calculated for $C_{18}H_{20}NO_5S^+$ $[M+H]^+$: 362.1057, found 362.1075 (m/z) [ESI].

8. Cyclic voltammetry studies

The manufacturer of the electrochemical workstation used in the cyclic voltammetry experiment is Shanghai Chenhua Instrument Co., Ltd, the instrument model is CHI660E. Cyclic voltammetry was performed in a three electrodes cell connected to a schlenk line at room temperature. The surface of the glassy carbon electrode was polished with Al_2O_3 powder, cleaned with distilled water, treated with ultrasound, and then rinsed with ethanol, dried, and set aside for use. The working electrode was a steady glassy carbon disk electrode, the counter electrode a platinum wire. The reference was a Ag/AgCl electrode submerged in saturated aqueous KCl solution, and separated from reaction by a salt bridge. The scan rate is 0.1 V/s.

Initially, we conducted cyclic voltammetry measurements for dimethyl 2-allylmalonate **2a**. The cyclic voltammetry analysis showed no detectable oxidation peak for **2a** within the potential range of 0-1.5 V (Figure S14, curve a). Subsequent investigation of the ferrocene redox behavior revealed a distinct oxidation peak at 0.55 V vs. Ag/AgCl (Figure S14, curve b). Comparative analysis demonstrated that the cyclic voltammogram remained essentially unchanged upon addition of **2a** (Figure S14, curve c). In contrast, significant enhancement of the oxidation current was observed when K_2CO_3 was introduced as a base (Figure S14, curve d), indicating the occurrence of single electron transfer between ferrocene and the conjugate base of **2a**. These experimental observations clearly demonstrate the critical role of base in facilitating the electrochemical oxidation of **2a**.

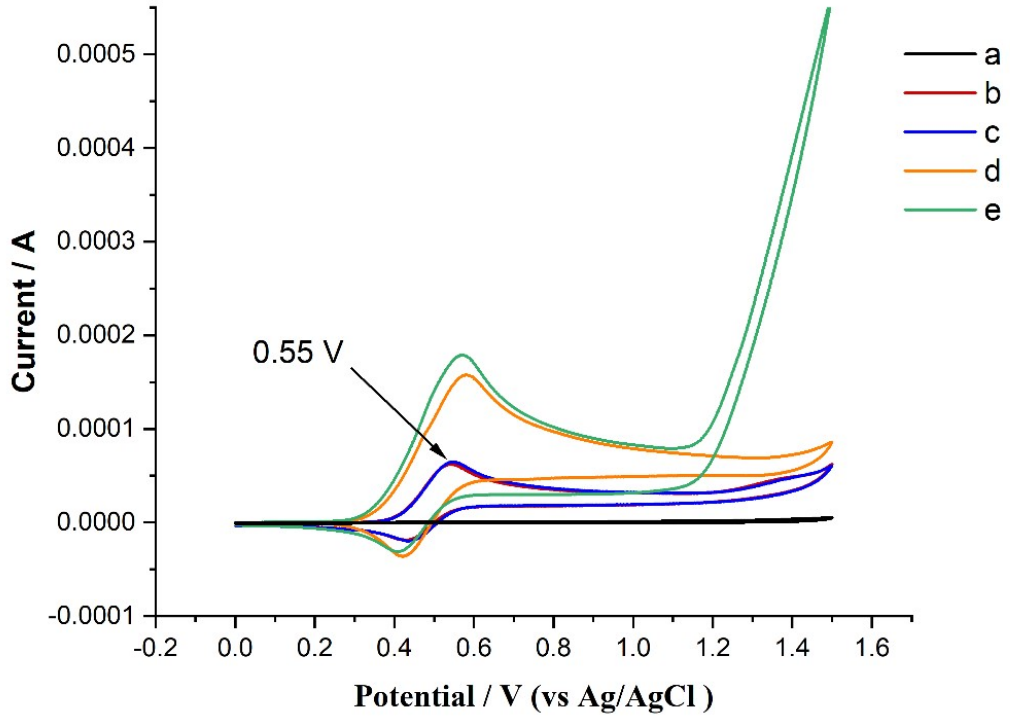


Figure S16. Cyclic voltammograms in an electrolyte solution of nBu$_4$NBF$_4$ (0.1 M) in MeOH/THF (5:2） using a glassy carbon disk working electrode (diameter, 3 mm), Pt disk and Ag/AgCl as counter and reference electrode at 100 mV/s scan rate: (a) **2a** (10 mM); (b) Cp_2Fe (3 mM); (c) Cp_2Fe (3 mM) + **2a** (10 mM); (d) Cp_2Fe (3 mM) + **2a** (10 mM) + K_2CO_3 (50 mM); (e)

1a (10 mM) + **2a** (10 mM) + **3a** (10 mM) + Cp_2Fe (3 mM) + K_2CO_3 (50 mM). Charting with IUPAC. Init E (V) = 0 V, Final E (V) = 0 V, High E (V) = 1.5 V.

Furthermore, we investigated the redox behavior of diphenyl diselenide **3a**. Cyclic voltammetry analysis revealed an oxidation peak at 1.66 V vs. Ag/AgCl (Figure S15), corresponding to the anodic oxidation of **3a** to generate selenium-centered radicals and selenonium cations. Additionally, the reduction potential of **3a** was examined, demonstrating the feasibility of diselenide reduction with a distinct reduction peak observed at -1.49 V vs. Ag/AgCl (Figure S16, red curve). These cyclic voltammetry results collectively demonstrate the dual electrochemical reactivity of **3a**, which can undergo both anodic oxidation and cathodic reduction under appropriate potential conditions.

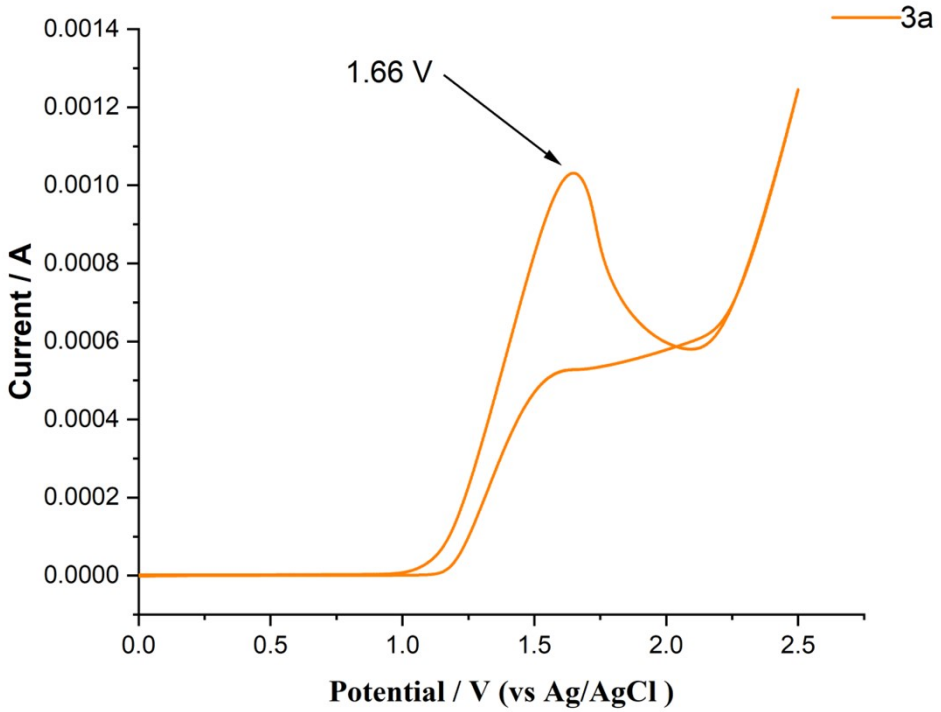


Figure S17. Cyclic voltammograms in an electrolyte solution of nBu$_4$NBF$_4$ (0.1 M) in MeOH/THF （5:2） using a glassy carbon disk working electrode (diameter, 3 mm), Pt disk and Ag/AgCl as counter and reference electrode at 100 mV/s scan rate: **3a** (10 mM). Charting with IUPAC. Init E (V) = 0 V, Final E (V) = 0 V, High E (V) = 2.5 V.

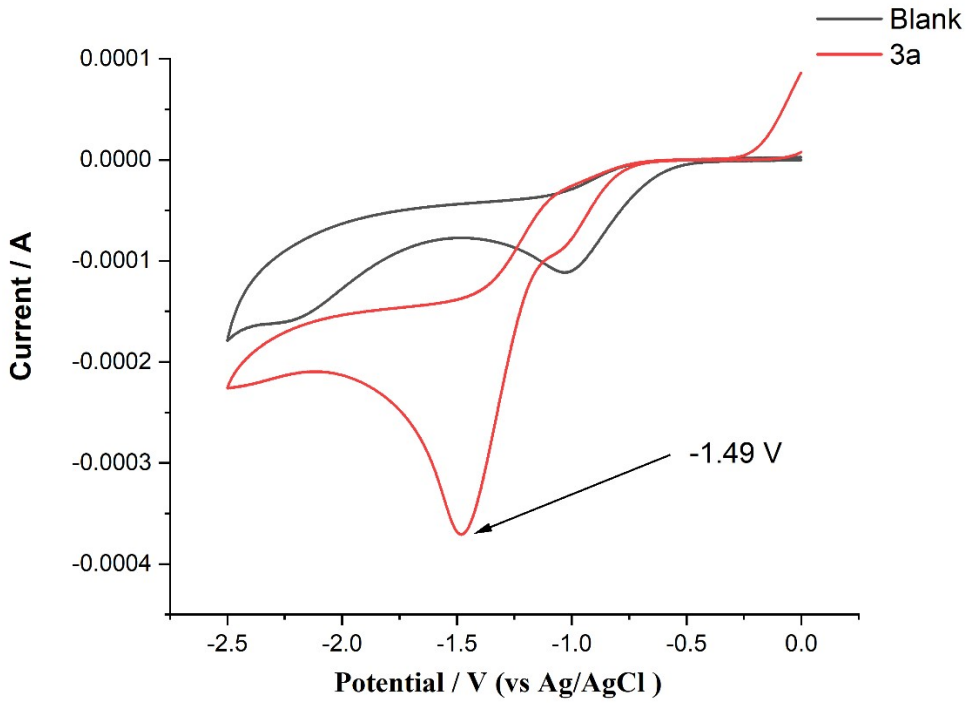
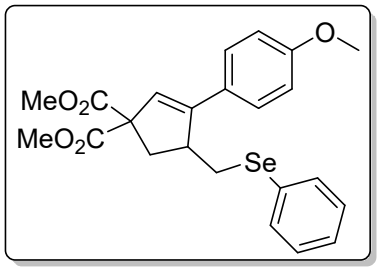
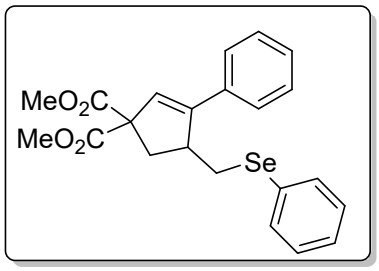


Figure S18. Cyclic voltammograms in an electrolyte solution of nBu$_4$NBF$_4$ (0.1 M) in MeOH/THF（5:2） using a glassy carbon disk working electrode (diameter, 3 mm), Pt disk and Ag/AgCl as counter and reference electrode at 100 mV/s scan rate: black line for blank, red line for **3a** (10 mM). Charting with IUPAC. Init E (V) = 0 V, Final E (V) = 0 V, Low E (V) = -2.5 V.

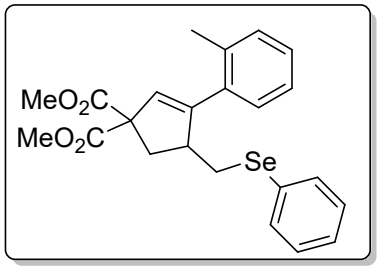
9. Characterization data for the electrolysis products



Dimethyl 3-(4-methoxyphenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4a). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 20:1) furnished the product (yield = 93%, 128.2 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 - 7.50 (m, 2H), 7.27 - 7.24 (m, 3H), 7.19 (d, *J* = 8.7 Hz, 2H), 6.81 (d, *J* = 8.8 Hz, 2H), 6.04 (d, *J* = 0.7 Hz, 1H), 3.78 (s, 3H), 3.76 (s, 3H), 3.72 (s, 3H), 3.53 - 3.48 (m, 1H), 3.23 (dd, *J* = 12.1, 2.4 Hz, 1H), 2.86 (dd, *J* = 14.1, 8.6 Hz, 1H), 2.77 - 2.65 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.70, 171.66, 159.64, 149.01, 133.62, 129.74, 129.04, 127.89, 127.22, 126.54, 122.25, 113.96, 65.25, 55.27, 52.88, 52.84, 45.20, 37.49, 32.90. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{24}O_5SeNa^+$ $[M+Na]^+$ 483.0681, found 483.0679.

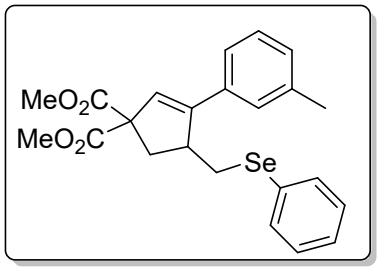


Dimethyl 3-phenyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4b). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 88%, 113.4 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.50 - 7.46 (m, 2H), 7.29 - 7.22 (m, 8H), 6.12 (d, *J* = 1.3 Hz, 1H), 3.74 (s, 3H), 3.70 (s, 3H), 3.56 - 3.51 (m, 1H), 3.21 (dd, *J* = 12.1, 2.6 Hz, 1H), 2.88 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.74 - 2.61 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.46, 171.39, 149.51, 133.96, 133.53, 129.62, 128.99, 128.54, 128.25, 127.18, 126.55, 124.23, 65.23, 52.86, 52.81, 45.08, 37.48, 32.72. **HRMS** (m/z) (ESI): calcd for $C_{22}H_{23}O_4Se^+$ $[M+H]^+$ 431.0756, found 431.0751.

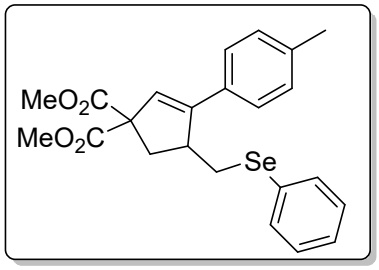


Dimethyl 4-((phenylselanyl)methyl)-3-(*o*-tolyl)cyclopent-2-ene-1,1-dicarboxylate (4c). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl

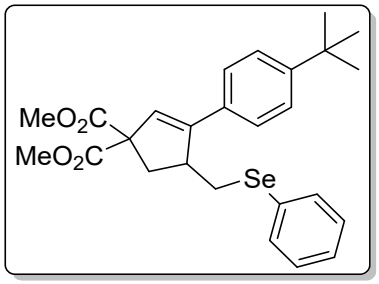
acetate = 35:1) furnished the product (yield = 85%, 113.1 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.40 (dd, *J* = 6.3, 2.9 Hz, 2H), 7.22 - 7.14 (m, 6H), 7.10 (d, *J* = 7.4 Hz, 1H), 5.88 (d, *J* = 1.3 Hz, 1H), 3.80 (s, 3H), 3.74 (s, 3H), 3.61 - 3.56 (m, 1H), 3.07 - 3.01 (m, 2H), 2.69 (t, *J* = 12.0 Hz, 1H), 2.46 (dd, *J* = 13.8, 5.8 Hz, 1H), 2.31 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.59, 171.11, 150.22, 135.80, 134.64, 132.69, 130.49, 129.84, 128.91, 128.23, 127.69, 127.25, 126.82, 125.56, 65.24, 52.72, 52.69, 47.48, 37.78, 32.09, 20.23. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{25}O_4Se^+$ $[M+H]^+$ 445.0913, found 445.0919.



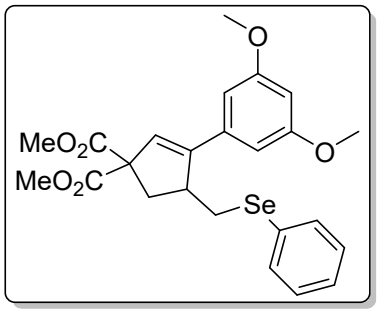
Dimethyl 4-((phenylselanyl)methyl)-3-(*m*-tolyl)cyclopent-2-ene-1,1-dicarboxylate (4d). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 81%, 107.7 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 - 7.50 (m, 2H), 7.27 - 7.24 (m, 3H), 7.18 (t, *J* = 7.8 Hz, 1H), 7.08 - 7.05 (m, 3H), 6.11 (d, *J* = 1.5 Hz, 1H), 3.77 (s, 3H), 3.71 (s, 3H), 3.55 - 3.50 (m, 1H), 3.23 (dd, *J* = 12.2, 2.7 Hz, 1H), 2.89 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.70 (dd, *J* = 12.2, 10.8 Hz, 1H), 2.64 (dd, *J* = 14.1, 3.8 Hz, 1H), 2.29 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.58, 171.49, 149.65, 138.13, 133.94, 133.62, 129.65, 129.07, 129.04, 128.47, 127.25, 127.21, 124.05, 123.69, 65.24, 52.90, 52.84, 45.14, 37.51, 32.84, 21.40. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{25}O_4Se^+$ $[M+H]^+$ 445.0913, found 445.0906.



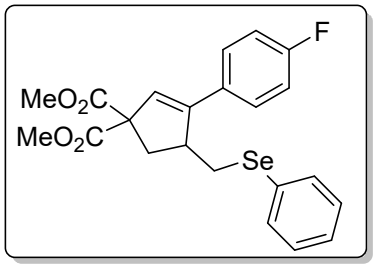
Dimethyl 4-((phenylselanyl)methyl)-3-(*p*-tolyl)cyclopent-2-ene-1,1-dicarboxylate (4e). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 86%, 114.4 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 - 7.48 (m, 2H), 7.27 - 7.23 (m, 3H), 7.15 (d, *J* = 8.2 Hz, 2H), 7.09 (d, *J* = 8.1 Hz, 2H), 6.08 (d, *J* = 1.2 Hz, 1H), 3.76 (s, 3H), 3.71 (s, 3H), 3.54 - 3.47 (m, 1H), 3.23 (dd, *J* = 12.1, 2.6 Hz, 1H), 2.87 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.74 - 2.68 (m, 1H), 2.64 (dd, *J* = 14.1, 3.8 Hz, 1H), 2.33 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.66, 171.59, 149.49, 138.23, 133.62, 131.17, 129.73, 129.30, 129.05, 127.22, 126.53, 123.34, 65.27, 52.92, 52.86, 45.14, 37.54, 32.88, 21.25. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{24}O_4SeNa^+$ $[M+Na]^+$ 467.0732, found 467.0729.



Dimethyl 3-(4-(*tert*-butyl)phenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4f). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 74%, 107.8 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.36 - 7.34 (m, 2H), 7.15 (d, *J* = 8.2 Hz, 2H), 7.09 - 7.05 (m, 5H), 5.95 (s, 1H), 3.60 (s, 3H), 3.55 (s, 3H), 3.39 (t, *J* = 9.1 Hz, 1H), 3.12 (dd, *J* = 12.0, 2.0 Hz, 1H), 2.73 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.58 (t, *J* = 11.4 Hz, 1H), 2.48 (dd, *J* = 14.1, 3.7 Hz, 1H), 1.15 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.58, 171.46, 151.37, 149.29, 133.53, 131.11, 129.73, 128.99, 127.15, 126.28, 125.47, 123.56, 65.22, 52.84, 52.78, 45.01, 37.54, 34.58, 32.87, 31.24. **HRMS** (m/z) (ESI): calcd for $C_{26}H_{31}O_4Se^+$ $[M+H]^+$ 487.1382, found 487.1380.

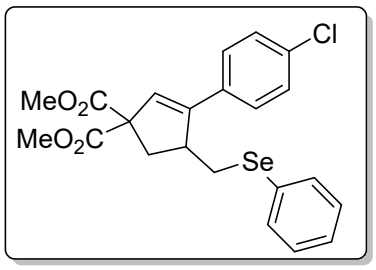


Dimethyl 3-(3,5-dimethoxyphenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4g). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 75%, 110.1 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.51 - 7.49 (m, 2H), 7.23 (t, *J* = 3.1 Hz, 3H), 6.42 (d, *J* = 2.3 Hz, 2H), 6.38 (t, *J* = 2.5 Hz, 1H), 6.12 (s, 1H), 3.76 (s, 3H), 3.71 (s, 9H), 3.53 - 3.47 (m, 1H), 3.25 (dd, *J* = 12.2, 2.5 Hz, 1H), 2.89 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.72 (t, *J* = 11.3 Hz, 1H), 2.63 (dd, *J* = 14.1, 3.9 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.38, 171.26, 160.80, 149.58, 135.97, 133.44, 129.54, 128.99, 127.10, 124.75, 104.53, 100.51, 65.09, 55.22, 52.83, 52.78, 45.17, 37.41, 32.67. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_6Se^+$ $[M+H]^+$ 491.0968, found 491.0977.

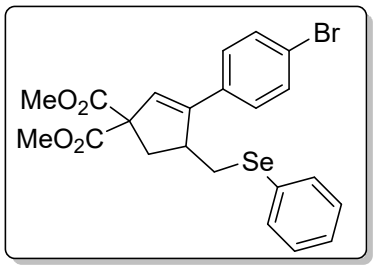


Dimethyl 3-(4-fluorophenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4h). Purification of the crude material by silica gel column chromatography (petroleum

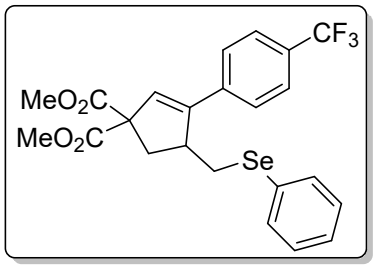
ether/ethyl acetate = 20:1) furnished the product (yield = 84%, 112.7 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.50 (dd, *J* = 6.5, 2.9 Hz, 2H), 7.27 - 7.24 (m, 3H), 7.19 (dd, *J* = 8.7, 5.4 Hz, 2H), 6.96 (t, *J* = 8.6 Hz, 2H), 6.08 (d, *J* = 0.7 Hz, 1H), 3.77 (s, 3H), 3.72 (s, 3H), 3.54 - 3.46 (m, 1H), 3.16 (dd, *J* = 12.2, 2.6 Hz, 1H), 2.88 (dd, *J* = 14.1, 8.6 Hz, 1H), 2.73 (dd, *J* = 12.0, 10.6 Hz, 1H), 2.65 (dd, *J* = 14.2, 3.8 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.43, 171.39, 162.55 (d, *J* = 248.2 Hz), 148.44, 133.70, 130.15 (d, *J* = 3.3 Hz), 129.55, 129.05, 128.31 (d, *J* = 8.1 Hz), 127.31, 124.13, 115.51 (d, *J* = 21.5 Hz), 65.27, 52.91, 52.88, 45.28, 37.46, 32.67. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -112.86. **HRMS** (m/z) (ESI): calcd for $C_{22}H_{22}FO_4Se^+$ $[M+H]^+$ 449.0662, found 449.0664.



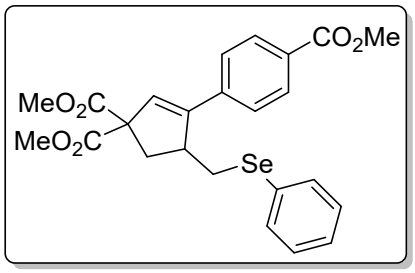
Dimethyl 3-(4-chlorophenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4i). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 20:1) furnished the product (yield = 56%, 77.9 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.48 (dd, *J* = 6.4, 3.1 Hz, 2H), 7.25 - 7.21 (m, 5H), 7.14 - 7.11 (m, 2H), 6.11 (d, *J* = 1.3 Hz, 1H), 3.76 (s, 3H), 3.71 (s, 3H), 3.51 - 3.44 (m, 1H), 3.13 (dd, *J* = 12.2, 2.6 Hz, 1H), 2.86 (dd, *J* = 14.1, 8.6 Hz, 1H), 2.71 (dd, *J* = 12.1, 10.6 Hz, 1H), 2.63 (dd, *J* = 14.2, 3.8 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.34, 171.31, 148.38, 134.02, 133.77, 132.49, 129.50, 129.08, 128.75, 127.89, 127.38, 124.91, 65.31, 52.98, 52.94, 45.17, 37.47, 32.66. **HRMS** (m/z) (ESI): calcd for $C_{22}H_{22}ClO_4Se^+$ $[M+H]^+$ 465.0367, found 465.0375.



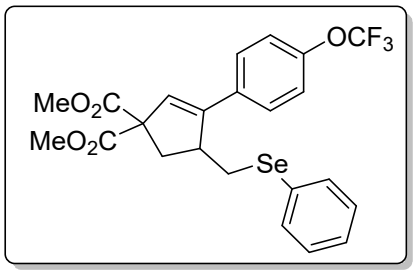
Dimethyl 3-(4-bromophenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4j). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 54%, 82.3 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 (dd, *J* = 6.4, 3.0 Hz, 2H), 7.42 (d, *J* = 8.5 Hz, 2H), 7.31 - 7.27 (m, 3H), 7.11 (d, *J* = 8.5 Hz, 2H), 6.15 (d, *J* = 1.0 Hz, 1H), 3.80 (s, 3H), 3.76 (s, 3H), 3.54 - 3.49 (m, 1H), 3.17 (dd, *J* = 12.2, 2.6 Hz, 1H), 2.91 (dd, *J* = 14.2, 8.6 Hz, 1H), 2.74 (dd, *J* = 12.1, 10.6 Hz, 1H), 2.66 (dd, *J* = 14.2, 3.8 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.36, 171.33, 148.51, 133.83, 132.99, 131.76, 129.52, 129.14, 128.22, 127.44, 125.06, 122.31, 65.37, 53.05, 53.01, 45.16, 37.53, 32.71. **HRMS** (m/z) (ESI): calcd for $C_{22}H_{22}BrO_4Se^+$ $[M+H]^+$ 508.9861, found 508.9863.



Dimethyl 4-((phenylselanyl)methyl)-3-(4-(trifluoromethyl)phenyl)cyclopent-2-ene-1,1-dicarboxylate (4k). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 35:1) furnished the product (yield = 68%, 101.5 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.57 - 7.51 (m, 4H), 7.35 - 7.27 (m, 5H), 6.26 (s, 1H), 3.82 (s, 3H), 3.77 (s, 3H), 3.60 (q, *J* = 8.4 Hz, 1H), 3.18 (dd, *J* = 12.2, 2.5 Hz, 1H), 2.95 (dd, *J* = 14.2, 8.6 Hz, 1H), 2.77 (dd, *J* = 12.1, 10.4 Hz, 1H), 2.69 (dd, *J* = 14.2, 3.9 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.26, 171.22, 148.33, 137.62, 133.87, 130.04 (q, *J* = 32.6 Hz), 129.39, 129.16, 127.52, 126.90, 126.76, 125.57 (q, *J* = 3.7 Hz), 124.05 (q, *J* = 271.9 Hz), 65.40, 53.11, 53.07, 45.14, 37.51, 32.58. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -62.60. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{22}F_3O_4Se^+$ $[M+H]^+$ 499.0630, found 499.0633.

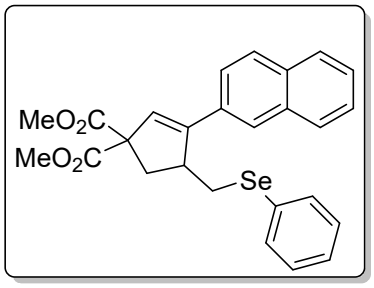


Dimethyl 3-(4-(methoxycarbonyl)phenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4l). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 35:1) furnished the product (yield = 41%, 60.0 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.51 - 7.48 (m, 2H), 7.29 - 7.25 (m, 5H), 6.22 (d, *J* = 1.1 Hz, 1H), 3.91 (s, 3H), 3.78 (s, 3H), 3.73 (s, 3H), 3.57 - 3.52 (m, 1H), 3.15 (dd, *J* = 12.2, 2.6 Hz, 1H), 2.89 (dd, *J* = 14.2, 8.6 Hz, 1H), 2.74 - 2.62 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.34, 171.30, 166.76, 148.80, 138.61, 133.91, 129.95, 129.78, 129.48, 129.20, 127.54, 126.68, 126.64, 65.49, 53.12, 53.08, 52.27, 45.24, 37.60, 32.72. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{24}O_6SeNa^+$ $[M+Na]^+$ 511.0630, found 511.0626.

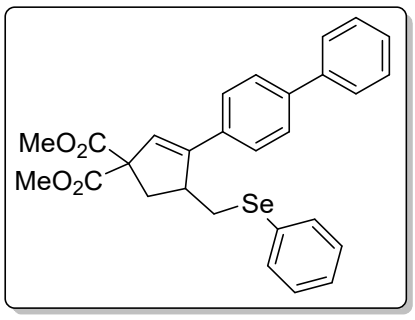


Dimethyl 4-((phenylselanyl)methyl)-3-(4-(trifluoromethoxy)phenyl)cyclopent-2-ene-1,1-dicarboxylate (4m). Purification of the crude material by silica gel column chromatography (petroleum

ether/ethyl acetate = 40:1) furnished the product (yield = 63%, 97.0 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.50 - 7.47 (m, 2H), 7.25 - 7.21 (m, 5H), 7.11 (d, *J* = 8.3 Hz, 2H), 6.13 (d, *J* = 1.3 Hz, 1H), 3.77 (s, 3H), 3.72 (s, 3H), 3.55 - 3.49 (m, 1H), 3.15 (dd, *J* = 12.2, 2.7 Hz, 1H), 2.89 (dd, *J* = 14.2, 8.6 Hz, 1H), 2.74 (dd, *J* = 12.2, 10.3 Hz, 1H), 2.64 (dd, *J* = 14.2, 3.9 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.36, 171.31, 148.96 (q, *J* = 1.7 Hz), 148.18, 133.83, 132.84, 129.51, 129.10, 128.04, 127.43, 125.38, 121.02, 120.46 (q, *J* = 257.4 Hz), 65.38, 52.97, 52.94, 45.27, 37.54, 32.67. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -57.79. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{21}F_3O_5SeNa^+$ $[M+Na]^+$ 537.0398, found 537.0401.

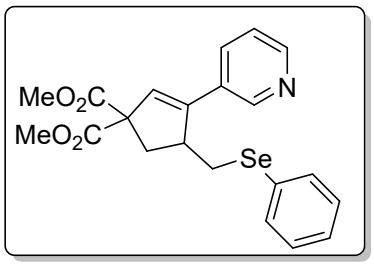


Dimethyl 3-(naphthalen-2-yl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4n). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 53%, 76.2 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.80 (dd, *J* = 11.9, 7.5 Hz, 2H), 7.71 (t, *J* = 4.0 Hz, 1H), 7.58 (dd, *J* = 7.7, 2.2 Hz, 3H), 7.53 - 7.46 (m, 3H), 7.33 - 7.28 (m, 3H), 6.31 (s, 1H), 3.83 (s, 3H), 3.77 (s, 3H), 3.69 (t, *J* = 9.5 Hz, 1H), 3.33 (dd, *J* = 12.3, 2.1 Hz, 1H), 2.97 (dd, *J* = 14.1, 8.6 Hz, 1H), 2.82 - 2.75 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.60, 171.55, 149.46, 133.89, 133.25, 133.12, 131.34, 129.62, 129.16, 128.29, 128.19, 127.65, 127.40, 126.41, 126.38, 125.58, 124.74, 124.67, 65.43, 53.02, 52.95, 45.28, 37.56, 32.99. **HRMS** (m/z) (ESI): calcd for $C_{26}H_{24}O_4SeNa^+$ $[M+Na]^+$ 503.0732, found 503.0736.

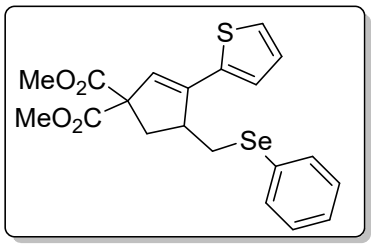


Dimethyl 3-([1,1'-biphenyl]-4-yl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (4o). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 49%, 74.3 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.48 (d, *J* = 7.7 Hz, 2H), 7.42 (d, *J* = 7.4 Hz, 4H), 7.33 (t, *J* = 7.6 Hz, 2H), 7.23 (dd, *J* = 13.8, 7.5 Hz, 3H), 7.17 - 7.13 (m, 3H), 6.08 (s, 1H), 3.68 (s, 3H), 3.63 (s, 3H), 3.51 - 3.44 (m, 1H), 3.17 (dd, *J* = 12.2, 2.7 Hz, 1H), 2.81 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.67 (t, *J* = 11.3 Hz, 1H), 2.57 (dd, *J* = 14.1, 3.8 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.59, 171.53, 149.19, 141.08, 140.45, 133.73, 133.00, 129.71, 129.11, 128.89, 127.58, 127.32, 127.28, 127.08, 127.01, 124.36, 65.39, 53.00, 52.95, 45.19, 37.60, 32.92. **HRMS** (m/z) (ESI): calcd for $C_{28}H_{27}O_4Se^+$

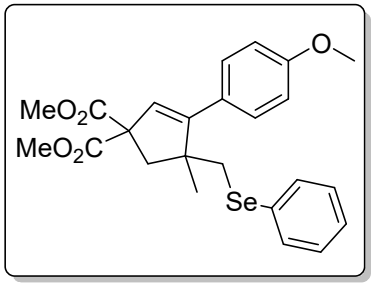
$[M+H]^+$ 507.1069, found 507.1064.



Dimethyl 4-((phenylselanyl)methyl)-3-(pyridin-3-yl)cyclopent-2-ene-1,1-dicarboxylate (4p). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 68%, 87.8 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.49 - 8.45 (m, 2H), 7.47 - 7.44 (m, 3H), 7.23 (q, *J* = 3.6 Hz, 3H), 7.17 (dd, *J* = 7.8, 4.9 Hz, 1H), 6.17 (s, 1H), 3.75 (s, 3H), 3.70 (s, 3H), 3.57 - 3.48 (m, 1H), 3.12 (dd, *J* = 12.3, 3.0 Hz, 1H), 2.87 (dd, *J* = 14.2, 8.5 Hz, 1H), 2.72 (dd, *J* = 12.3, 10.2 Hz, 1H), 2.63 (dd, *J* = 14.2, 3.9 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.15, 171.13, 149.17, 147.70, 146.49, 133.82, 133.73, 129.88, 129.27, 129.14, 127.46, 126.36, 123.43, 65.36, 53.04, 53.01, 44.93, 37.45, 32.40. **HRMS** (m/z) (ESI): calcd for $C_{21}H_{22}NO_4Se^+$ $[M+H]^+$ 432.0709, found 432.0714.

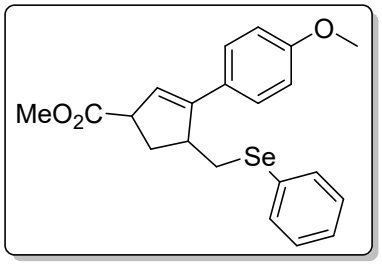


Dimethyl 4-((phenylselanyl)methyl)-3-(thiophen-2-yl)cyclopent-2-ene-1,1-dicarboxylate (4q). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 83%, 108.4 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.51 (dd, *J* = 6.4, 2.9 Hz, 2H), 7.24 - 7.21 (m, 3H), 7.17 (d, *J* = 5.0 Hz, 1H), 6.89 (dd, *J* = 4.9, 3.8 Hz, 1H), 6.78 (d, *J* = 3.5 Hz, 1H), 6.03 (s, 1H), 3.71 (s, 3H), 3.69 (s, 3H), 3.34 (dd, *J* = 12.4, 2.4 Hz, 2H), 2.82 - 2.68 (m, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.29, 171.27, 143.13, 137.57, 133.66, 129.50, 129.05, 127.41, 127.27, 125.68, 125.32, 123.19, 65.28, 52.92, 52.87, 46.42, 37.45, 32.90. **HRMS** (m/z) (ESI): calcd for $C_{20}H_{21}O_4SSe^+$ $[M+H]^+$ 437.0321, found 437.0321.

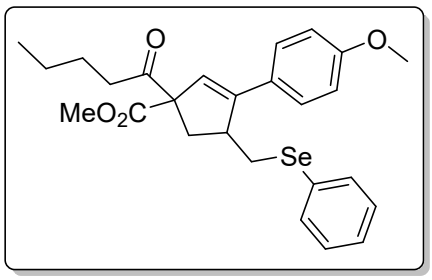


Dimethyl 3-(4-methoxyphenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (5a). Purification of the crude material by silica gel column chromatography (petroleum

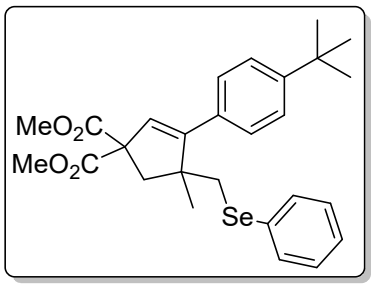
ether/ethyl acetate = 30:1) furnished the product (yield = 78%, 110.8 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.48 - 7.45 (m, 2H), 7.30 (d, *J* = 8.7 Hz, 2H), 7.23 - 7.19 (m, 3H), 6.85 (d, *J* = 8.6 Hz, 2H), 5.85 (s, 1H), 3.78 (s, 3H), 3.75 (s, 3H), 3.73 (s, 3H), 3.16 (s, 2H), 2.89 (d, *J* = 14.0 Hz, 1H), 2.59 (d, *J* = 14.0 Hz, 1H), 1.42 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.70, 171.61, 159.40, 153.44, 132.95, 131.21, 129.26, 129.05, 127.73, 126.86, 125.15, 113.69, 63.70, 55.28, 52.96, 52.86, 51.86, 45.17, 40.82, 27.35. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_5Se^+$ $[M+H]^+$ 475.1018, found 475.1019.



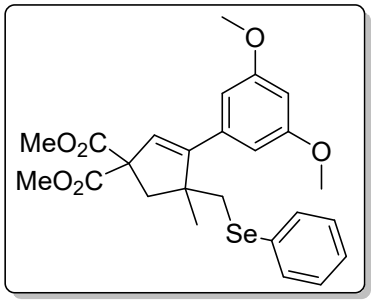
Methyl 3-(4-methoxyphenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1-carboxylate (5b). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 35:1) furnished the product (yield = 69%, 83.1 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.38 - 7.35 (m, 2H), 7.14 - 7.11 (m, 3H), 7.09 - 7.06 (m, 2H), 6.71 - 6.68 (m, 2H), 5.87 (d, *J* = 1.1 Hz, 1H), 3.72 - 3.69 (m, 1H), 3.68 (s, 3H), 3.58 (s, 3H), 3.42 - 3.41 (m, 1H), 3.06 (dd, *J* = 12.0, 2.8 Hz, 1H), 2.65 (dd, *J* = 12.0, 9.6 Hz, 1H), 2.42 - 2.36 (m, 1H), 2.22 - 2.17 (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.90, 159.32, 147.07, 133.26, 130.20, 129.07, 127.55, 127.18, 127.09, 122.83, 113.98, 55.32, 52.01, 49.39, 45.31, 33.45, 32.71. **HRMS** (m/z) (ESI): calcd for $C_{21}H_{22}O_3SeNa^+$ $[M+Na]^+$ 425.0626, found 425.0626.



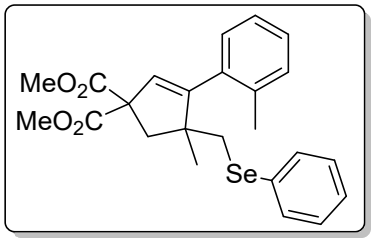
Methyl 3-(4-methoxyphenyl)-1-pentanoyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1-carboxylate (5c). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 40:1) furnished the product (yield = 56%, 81.6 mg, dr = 1:1) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.50 - 7.46 (m, 2H), 7.24 (q, *J* = 3.6 Hz, 3H), 7.16 (dd, *J* = 8.5, 0.9 Hz, 2H), 6.80 (d, *J* = 8.7 Hz, 2H), 6.03 (s, 1H), 3.79 (s, 3H), 3.74 (s, 1.5H), 3.69 (s, 1.5H), 3.21 - 3.13 (m, 1H), 2.78 - 2.44 (m, 5H), 1.59 - 1.50 (m, 2H), 1.34 - 1.20 (m, 3H), 0.91 - 0.83 (m, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 206.08, 172.46, 159.77, 149.41, 133.75, 129.90, 129.16, 127.96, 127.34, 126.88, 122.62, 114.12, 72.22, 55.43, 52.82, 45.29, 39.09, 36.31, 33.17, 26.02, 22.34, 14.02. **HRMS** (m/z) (ESI): calcd for $C_{26}H_{30}O_4SeNa^+$ $[M+Na]^+$ 509.1201, found 509.1199.



Dimethyl 3-(4-(*tert*-butyl)phenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (5d). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 40:1) furnished the product (yield = 61%, 91.4 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.51 - 7.49 (m, 2H), 7.39 - 7.33 (m, 4H), 7.23 - 7.21 (m, 3H), 5.94 (s, 1H), 3.77 (s, 3H), 3.75 (s, 3H), 3.26 - 3.19 (m, 2H), 2.94 (d, *J* = 14.0 Hz, 1H), 2.64 (d, *J* = 14.0 Hz, 1H), 1.48 (s, 3H), 1.36 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.40, 171.32, 153.50, 150.69, 132.87, 132.27, 131.05, 128.89, 127.58, 126.72, 125.58, 125.03, 63.64, 52.71, 52.61, 51.79, 45.12, 40.70, 34.39, 31.19, 27.25. **HRMS** (m/z) (ESI): calcd for $C_{27}H_{33}O_4Se^+$ $[M+H]^+$ 501.1539, found 501.1539.

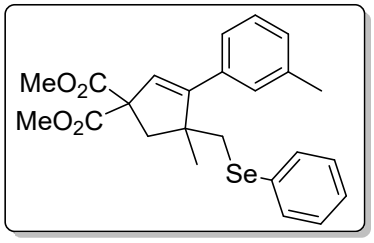


Dimethyl 3-(3,5-dimethoxyphenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (5e). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 55%, 83.1 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47 - 7.45 (m, 2H), 7.20 (d, *J* = 5.0 Hz, 3H), 6.48 (d, *J* = 1.6 Hz, 2H), 6.42 (t, *J* = 2.8 Hz, 1H), 5.86 (s, 1H), 3.76 (s, 9H), 3.73 (s, 3H), 3.14 (s, 2H), 2.86 (d, *J* = 14.1 Hz, 1H), 2.57 (d, *J* = 14.1 Hz, 1H), 1.39 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.52, 171.42, 160.52, 153.87, 137.38, 132.89, 131.20, 129.03, 126.85, 126.26, 106.51, 99.85, 63.83, 55.36, 52.94, 52.83, 52.10, 45.00, 40.70, 27.43. **HRMS** (m/z) (ESI): calcd for $C_{25}H_{29}O_6Se^+$ $[M+H]^+$ 505.1124, found 505.1127.

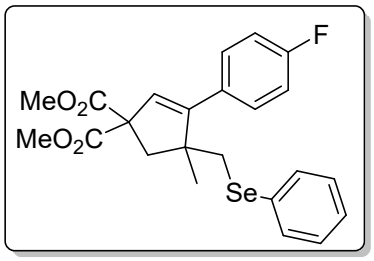


Dimethyl 4-methyl-4-((phenylselanyl)methyl)-3-(*o*-tolyl)cyclopent-2-ene-1,1-dicarboxylate (5f). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 61%, 83.7 mg) as yellow oil. **^{1}H NMR**

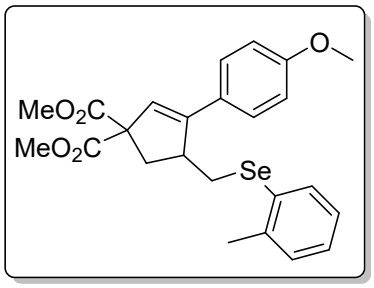
(400 MHz, $CDCl_3$) δ 7.45 (dd, *J* = 7.3, 2.1 Hz, 2H), 7.20 - 7.15 (m, 5H), 7.10 (dd, *J* = 3.8, 1.8 Hz, 2H), 5.63 (s, 1H), 3.73 (s, 3H), 3.68 (s, 3H), 3.10 (d, *J* = 11.4 Hz, 1H), 3.00 (d, *J* = 11.4 Hz, 1H), 2.84 (d, *J* = 14.2 Hz, 1H), 2.55 (d, *J* = 14.2 Hz, 1H), 2.29 (s, 3H), 1.24 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.74, 171.63, 152.65, 136.87, 134.72, 132.91, 131.22, 130.47, 129.10, 128.90, 127.64, 127.24, 126.89, 125.08, 64.26, 53.63, 52.91, 52.82, 44.27, 40.76, 26.45, 20.41. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_4Se^+$ $[M+H]^+$ 459.1069, found 459.1065.



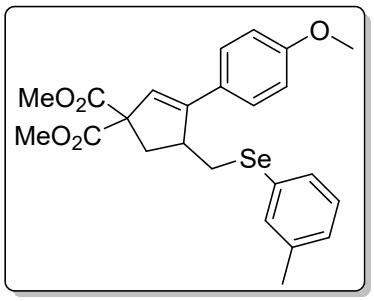
Dimethyl 4-methyl-4-((phenylselanyl)methyl)-3-(*m*-tolyl)cyclopent-2-ene-1,1-dicarboxylate (5g). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 35:1) furnished the product (yield = 63%, 86.5 mg) as yellow oil. **^{1}H NMR** (400 MHz, DMSO-d_6) δ 7.42 (d, *J* = 7.5 Hz, 2H), 7.27 - 7.20 (m, 4H), 7.15 (t, *J* = 9.1 Hz, 3H), 5.83 (s, 1H), 3.69 (s, 3H), 3.67 (s, 3H), 3.15 (dd, *J* = 13.9, 1.9 Hz, 2H), 2.74 (d, *J* = 13.9 Hz, 1H), 2.43 (d, *J* = 13.9 Hz, 1H), 2.29 (s, 3H), 1.33 (s, 3H). **^{13}C NMR** (100 MHz, DMSO-d_6) δ 170.95, 170.71, 152.90, 137.57, 134.60, 131.85, 130.73, 129.20, 128.68, 128.26, 128.24, 126.71, 125.54, 124.55, 63.16, 52.97, 52.80, 51.27, 44.75, 39.38, 27.08, 20.98. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_4Se^+$ $[M+H]^+$ 459.1069, found 459.1063.



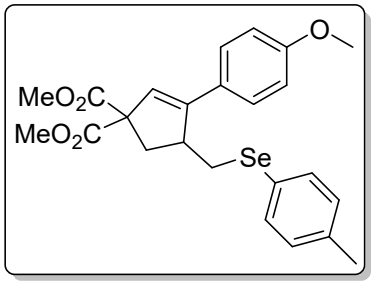
Dimethyl 3-(4-fluorophenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (5h). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 70%, 96.9 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.45 (dd, *J* = 6.5, 2.6 Hz, 2H), 7.31 (dd, *J* = 8.4, 5.5 Hz, 2H), 7.22 - 7.19 (m, 3H), 7.00 (t, *J* = 8.6 Hz, 2H), 5.86 (s, 1H), 3.76 (s, 3H), 3.74 (s, 3H), 3.11 (s, 2H), 2.89 (d, *J* = 14.1 Hz, 1H), 2.59 (d, *J* = 14.1 Hz, 1H), 1.39 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.41, 171.30, 162.50 (d, *J* = 247.3 Hz), 152.88, 132.93, 131.40 (d, *J* = 3.4 Hz), 130.95, 129.82 (d, *J* = 8.0 Hz), 129.03, 126.90, 126.46, 115.14 (d, *J* = 21.3 Hz), 63.75, 52.91, 52.80, 51.94, 44.92, 40.52, 27.28. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -113.91. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{23}FO_4SeNa^+$ $[M+Na]^+$ 485.0638, found 485.0638.



Dimethyl 3-(4-methoxyphenyl)-4-((*o*-tolylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (6b). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 83%, 117.9 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.46 (d, *J* = 7.6 Hz, 1H), 7.24 - 7.15 (m, 4H), 7.12 - 7.10 (m, 1H), 6.85 - 6.83 (m, 2H), 6.05 (d, *J* = 1.4 Hz, 1H), 3.79 (s, 3H), 3.77 (s, 3H), 3.74 (s, 3H), 3.52 - 3.47 (m, 1H), 3.19 (dd, *J* = 11.9, 2.6 Hz, 1H), 2.87 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.74 - 2.68 (m, 2H), 2.44 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.63, 171.57, 159.61, 149.04, 140.10, 133.12, 130.70, 129.92, 127.83, 127.19, 126.49, 126.36, 122.14, 113.92, 65.23, 55.19, 52.81, 52.76, 44.99, 37.55, 31.77, 22.52. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_5Se^+$ $[M+H]^+$ 475.1018, found 475.1024.

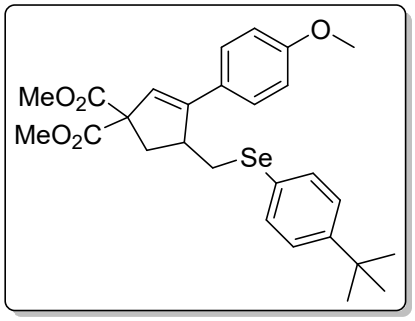


Dimethyl 3-(4-methoxyphenyl)-4-((*m*-tolylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (6c). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 89%, 126.4 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.32 (d, *J* = 10.8 Hz, 2H), 7.21 (d, *J* = 8.7 Hz, 2H), 7.15 (t, *J* = 7.5 Hz, 1H), 7.06 (d, *J* = 7.6 Hz, 1H), 6.82 (d, *J* = 8.7 Hz, 2H), 6.06 (s, 1H), 3.77 (d, *J* = 2.1 Hz, 6H), 3.72 (s, 3H), 3.53 - 3.48 (m, 1H), 3.24 (dd, *J* = 12.2, 2.6 Hz, 1H), 2.86 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.76 - 2.67 (m, 2H), 2.32 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.50, 171.49, 159.44, 148.82, 138.58, 133.79, 130.30, 129.31, 128.68, 127.84, 127.72, 126.31, 121.97, 113.75, 65.06, 55.03, 52.71, 52.66, 44.97, 37.27, 32.51, 21.11. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_5Se^+$ $[M+H]^+$ 475.1018, found 475.1013.

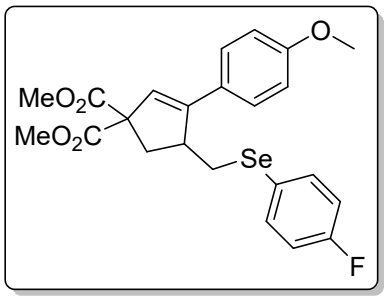


Dimethyl 3-(4-methoxyphenyl)-4-((*p*-tolylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate

(6d). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 79%, 112.2 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.0 Hz, 2H), 7.17 (d, *J* = 8.7 Hz, 2H), 7.08 (d, *J* = 7.8 Hz, 2H), 6.80 (d, *J* = 8.7 Hz, 2H), 6.00 (d, *J* = 1.5 Hz, 1H), 3.80 (s, 3H), 3.76 (s, 3H), 3.72 (s, 3H), 3.49 - 3.43 (m, 1H), 3.18 (dd, *J* = 12.1, 2.4 Hz, 1H), 2.84 (dd, *J* = 14.1, 8.5 Hz, 1H), 2.70 - 2.61 (m, 2H), 2.33 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.84, 171.80, 159.69, 149.15, 137.37, 134.15, 129.94, 127.99, 126.69, 125.86, 122.26, 114.00, 65.33, 55.38, 52.96, 52.92, 45.26, 37.58, 33.20, 21.22. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_5Se^+$ $[M+H]^+$ 475.1018, found 475.1021.

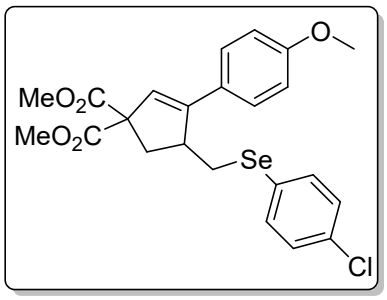


Dimethyl 4-(((4-(*tert*-butyl)phenyl)selanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate (6e). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 75%, 116.0 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.4 Hz, 2H), 7.16 (d, *J* = 8.8 Hz, 2H), 6.80 (d, *J* = 8.8 Hz, 2H), 6.02 (s, 1H), 3.79 (s, 3H), 3.77 (s, 3H), 3.73 (s, 3H), 3.54 - 3.47 (m, 1H), 3.19 (dd, *J* = 12.1, 2.3 Hz, 1H), 2.86 (dd, *J* = 14.1, 8.6 Hz, 1H), 2.73 - 2.64 (m, 2H), 1.32 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.76, 171.73, 159.62, 150.55, 149.05, 133.84, 127.92, 126.58, 126.13, 126.10, 122.16, 113.93, 65.29, 55.27, 52.89, 52.85, 45.22, 37.54, 34.58, 33.11, 31.32. **HRMS** (m/z) (ESI): calcd for $C_{27}H_{33}O_5Se^+$ $[M+H]^+$ 517.1488, found 517.1494.

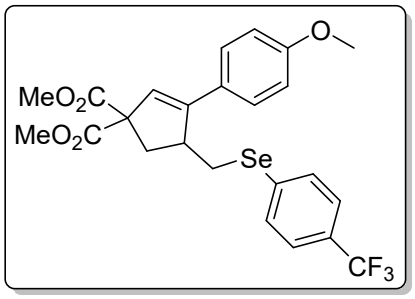


Dimethyl 4-(((4-fluorophenyl)selanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate (6f). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 78%, 111.7 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47 (dd, *J* = 8.2, 5.7 Hz, 2H), 7.14 (d, *J* = 8.6 Hz, 2H), 6.94 (t, *J* = 8.6 Hz, 2H), 6.79 (d, *J* = 8.6 Hz, 2H), 6.01 (s, 1H), 3.76 (s, 3H), 3.75 (s, 3H), 3.71 (s, 3H), 3.45 (t, *J* = 8.2 Hz, 1H), 3.14 (dd, *J* = 12.0, 2.3 Hz, 1H), 2.82 (dd, *J* = 14.1, 8.6 Hz, 1H), 2.71 (t, *J* = 10.7 Hz, 1H), 2.63 (dd, *J* = 14.1, 3.3 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.60, 171.57, 162.38 (d, *J* = 247.1 Hz), 159.55, 148.72, 136.10 (d, *J* = 7.9 Hz), 127.73, 126.33, 123.99 (d, *J* = 3.4 Hz), 122.19, 116.11 (d, *J* = 21.4 Hz), 113.86, 65.17, 55.17, 52.84, 52.80, 45.03, 37.28, 33.56. **^{19}F NMR** (376

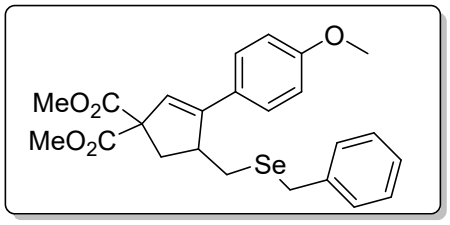
MHz, $CDCl_3$) δ -114.25. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{23}FO_5SeNa^+$ $[M+Na]^+$ 501.0587, found 501.0583.



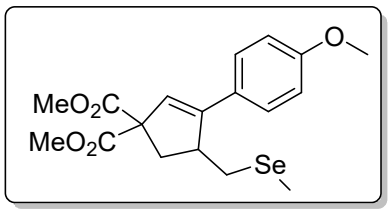
Dimethyl 4-(((4-chlorophenyl)selanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate (6g). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 85%, 125.9 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.39 (d, *J* = 8.4 Hz, 2H), 7.17 (d, *J* = 7.9 Hz, 4H), 6.80 (d, *J* = 8.7 Hz, 2H), 6.01 (s, 1H), 3.77 (s, 3H), 3.76 (s, 3H), 3.71 (s, 3H), 3.52 - 3.47 (m, 1H), 3.16 (dd, *J* = 12.1, 2.5 Hz, 1H), 2.86 - 2.74 (m, 2H), 2.62 (dd, *J* = 14.1, 3.5 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.56, 171.49, 159.61, 148.68, 134.81, 133.27, 129.05, 127.96, 127.74, 126.38, 122.40, 113.91, 65.22, 55.19, 52.82, 52.79, 45.09, 37.33, 33.16. **HRMS** (m/z) (ESI): calcd for $C_{23}H_{24}ClO_5Se^+$ $[M+H]^+$ 495.0472, found 495.0471.



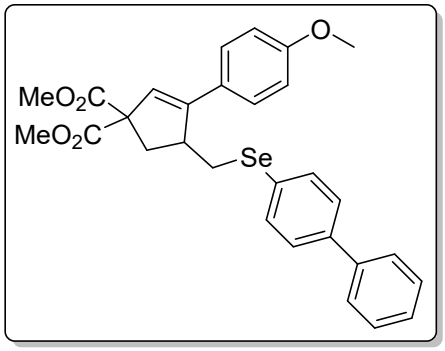
Dimethyl 3-(4-methoxyphenyl)-4-(((4-(trifluoromethyl)phenyl)selanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (6h). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 81%, 128.2 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.2 Hz, 2H), 7.42 (d, *J* = 8.3 Hz, 2H), 7.19 (d, *J* = 8.7 Hz, 2H), 6.80 (d, *J* = 8.7 Hz, 2H), 6.04 (s, 1H), 3.76 (s, 6H), 3.70 (s, 3H), 3.58 - 3.50 (m, 1H), 3.23 (dd, *J* = 12.0, 2.5 Hz, 1H), 2.91 - 2.82 (m, 2H), 2.62 (dd, *J* = 14.1, 3.5 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.50, 171.42, 159.62, 148.55, 135.57 (q, *J* = 1.9 Hz), 132.20, 128.56 (q, *J* = 32.6 Hz), 127.70, 126.27, 125.47 (q, *J* = 3.5 Hz), 124.08 (q, *J* = 271.9 Hz), 122.57, 113.89, 65.22, 55.05, 52.78, 52.75, 44.94, 37.27, 32.38. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -62.47. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{24}F_3O_5Se^+$ $[M+H]^+$ 529.0736, found 529.0728.



Dimethyl 4-((benzylselanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate (6i). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 60%, 85.2 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 4.4 Hz, 4H), 7.20 - 7.15 (m, 3H), 6.82 - 6.78 (m, 2H), 5.98 (d, *J* = 1.1 Hz, 1H), 3.76 (s, 3H), 3.72 (t, *J* = 4.4 Hz, 5H), 3.68 (s, 3H), 3.48 - 3.41 (m, 1H), 2.85 - 2.76 (m, 2H), 2.52 - 2.38 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.58, 171.54, 159.46, 149.03, 139.21, 128.85, 128.39, 127.87, 126.59, 126.53, 122.13, 113.83, 65.02, 55.17, 52.77, 45.14, 37.65, 28.43, 27.29. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{27}O_5Se^+$ $[M+H]^+$ 475.1018, found 475.1026.

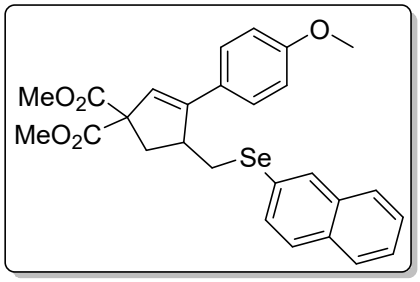


Dimethyl 3-(4-methoxyphenyl)-4-((methylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (6j). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 35:1) furnished the product (yield = 84%, 100.1 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.30 - 7.27 (m, 2H), 6.81 (d, *J* = 8.8 Hz, 2H), 5.97 (d, *J* = 1.5 Hz, 1H), 3.71 (s, 3H), 3.70 (s, 3H), 3.65 (s, 3H), 3.53 - 3.47 (m, 1H), 2.82 - 2.77 (m, 2H), 2.54 (dd, *J* = 14.0, 3.8 Hz, 1H), 2.39 (dd, *J* = 12.0, 10.6 Hz, 1H), 1.90 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.35, 171.31, 159.38, 148.83, 127.63, 126.42, 121.92, 113.73, 64.93, 54.93, 52.51, 45.13, 37.37, 29.85, 4.23. **HRMS** (m/z) (ESI): calcd for $C_{18}H_{22}O_5SeNa^+$ $[M+Na]^+$ 421.0524, found 421.0517.

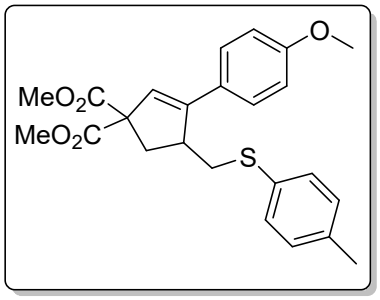


Dimethyl 4-(([1,1'-biphenyl]-4-ylselanyl)methyl)-3-(4-methoxyphenyl) cyclopent-2-ene- 1,1-dicarboxylate (6k). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 76%, 122.1 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.35 (d, *J* = 8.0 Hz, 4H), 7.25 (d, *J* = 8.1 Hz, 2H), 7.19 (t, *J* = 7.6 Hz, 2H), 7.10 (t, *J* = 7.3 Hz, 1H), 7.01 - 6.99 (m, 2H), 6.58 (d, *J* = 8.6 Hz, 2H), 5.89 (s, 1H), 3.55 (s, 3H), 3.49 (d, *J* = 4.1 Hz, 6H), 3.40 - 3.30 (m, 1H), 3.05 (dd, *J* = 12.8, 2.4 Hz, 1H), 2.73 - 2.60

(m, 2H), 2.54 (dd, *J* = 14.1, 3.2 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.39, 171.34, 159.36, 148.65, 139.97, 139.65, 133.57, 128.73, 128.64, 127.61, 127.34, 127.26, 126.61, 126.17, 122.01, 113.71, 65.04, 54.86, 52.61, 52.56, 44.94, 37.21, 32.71. **HRMS** (m/z) (ESI): calcd for $C_{29}H_{29}O_5Se^+$ $[M+H]^+$ 537.1175, found 537.1184.



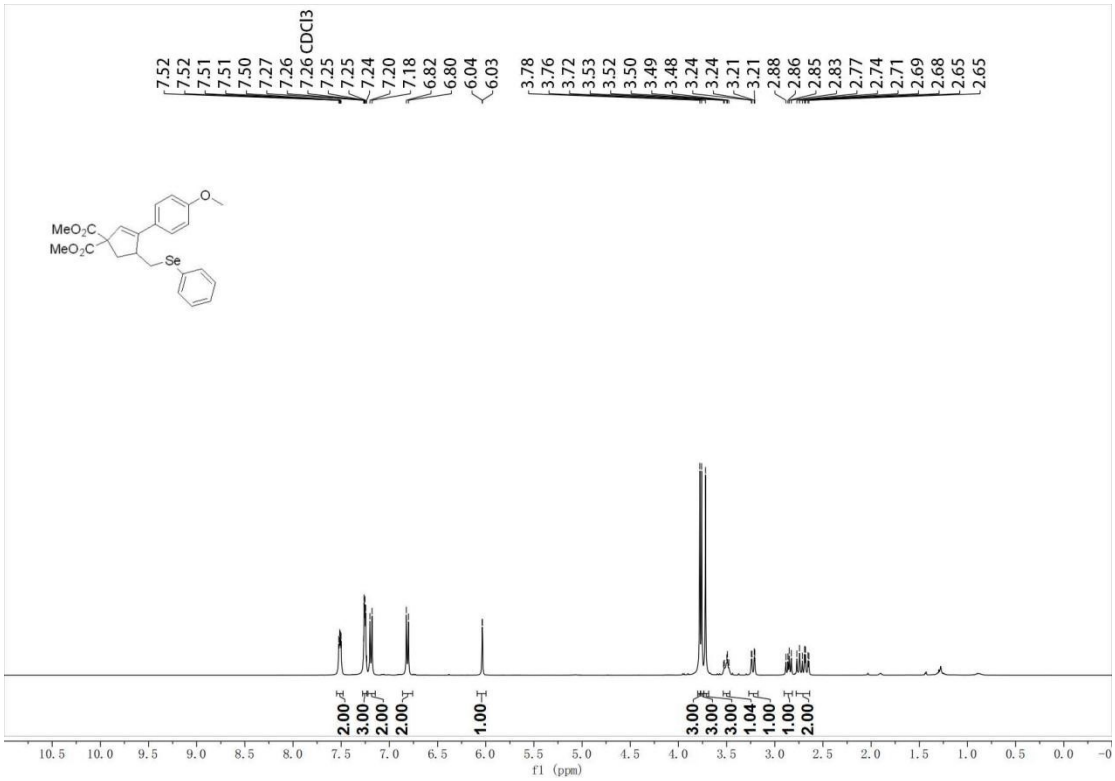
Dimethyl 3-(4-methoxyphenyl)-4-((naphthalen-2-ylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate (6l). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 30:1) furnished the product (yield = 71%, 108.5 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.99 (s, 1H), 7.80 (dd, *J* = 7.1, 2.2 Hz, 1H), 7.75 - 7.71 (m, 2H), 7.59 (dd, *J* = 8.5, 1.7 Hz, 1H), 7.51 - 7.44 (m, 2H), 7.18 (d, *J* = 8.8 Hz, 2H), 6.75 (d, *J* = 8.8 Hz, 2H), 6.10 (d, *J* = 1.0 Hz, 1H), 3.79 (s, 3H), 3.74 (d, *J* = 1.0 Hz, 6H), 3.59 - 3.52 (m, 1H), 3.36 (dd, *J* = 12.2, 2.4 Hz, 1H), 2.95 - 2.87 (m, 2H), 2.78 (dd, *J* = 14.1, 3.5 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.55, 171.50, 159.40, 148.77, 133.70, 132.10, 131.86, 130.63, 128.19, 127.69, 127.61, 127.11, 127.05, 126.33, 126.24, 125.91, 122.07, 113.73, 65.14, 55.00, 52.76, 52.70, 45.07, 37.30, 32.67. **HRMS** (m/z) (ESI): calcd for $C_{27}H_{27}O_5Se^+$ $[M+H]^+$ 511.1018, found 511.1028.



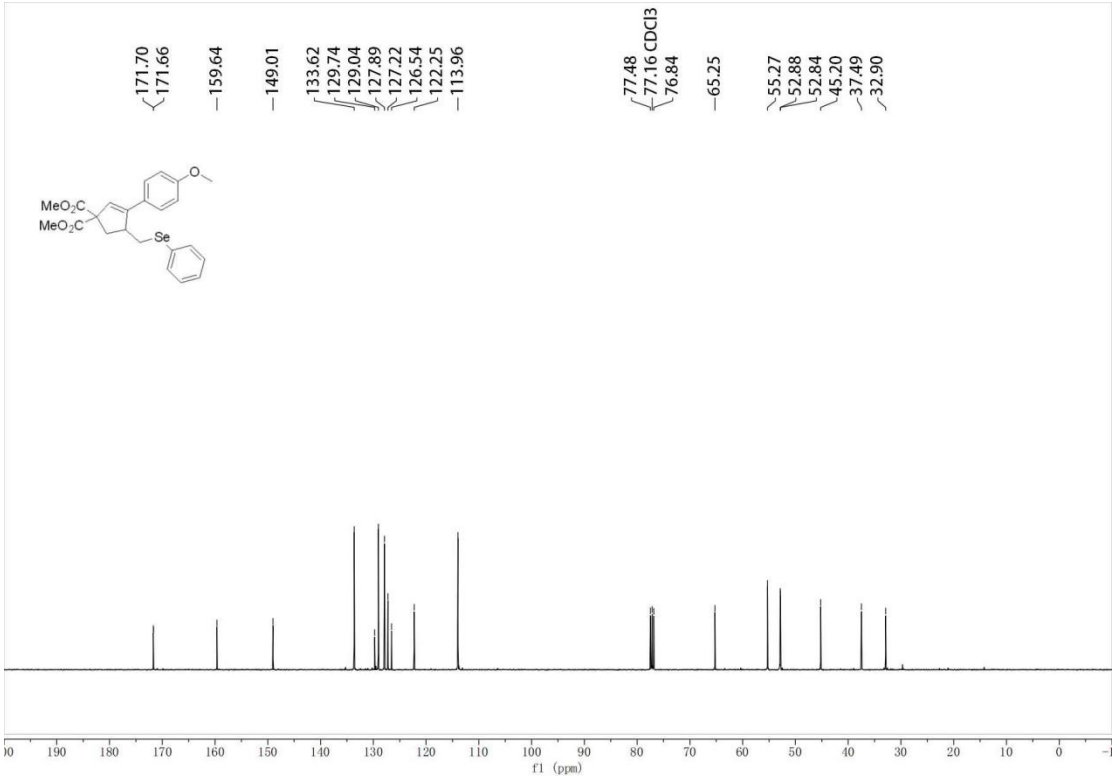
Dimethyl 3-(4-methoxyphenyl)-4-((*p*-tolylthio)methyl)cyclopent-2-ene-1,1-dicarboxylate (6m). Purification of the crude material by silica gel column chromatography (petroleum ether/ethyl acetate = 25:1) furnished the product (yield = 53%, 67.8 mg) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.27 (d, *J* = 8.1 Hz, 2H), 7.22 (d, *J* = 7.9 Hz, 2H), 7.10 (d, *J* = 7.6 Hz, 2H), 6.83 (d, *J* = 8.1 Hz, 2H), 5.99 (s, 1H), 3.80 (s, 3H), 3.76 (s, 3H), 3.72 (s, 3H), 3.41 (t, *J* = 9.7 Hz, 1H), 3.21 (d, *J* = 12.9 Hz, 1H), 2.82 (dd, *J* = 14.4, 8.7 Hz, 1H), 2.70 - 2.62 (m, 2H), 2.33 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.81, 171.73, 159.67, 148.73, 136.64, 132.09, 131.16, 129.71, 127.90, 126.63, 122.43, 113.98, 65.41, 55.36, 52.94, 52.89, 44.60, 39.37, 36.80, 21.09. **HRMS** (m/z) (ESI): calcd for $C_{24}H_{26}O_5SNa^+$ $[M+Na]^+$ 449.1393, found 449.1390.

10. Copies of 1H NMR, 13C NMR and 19F NMR for the products

Dimethyl 3-(4-methoxyphenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4a)**

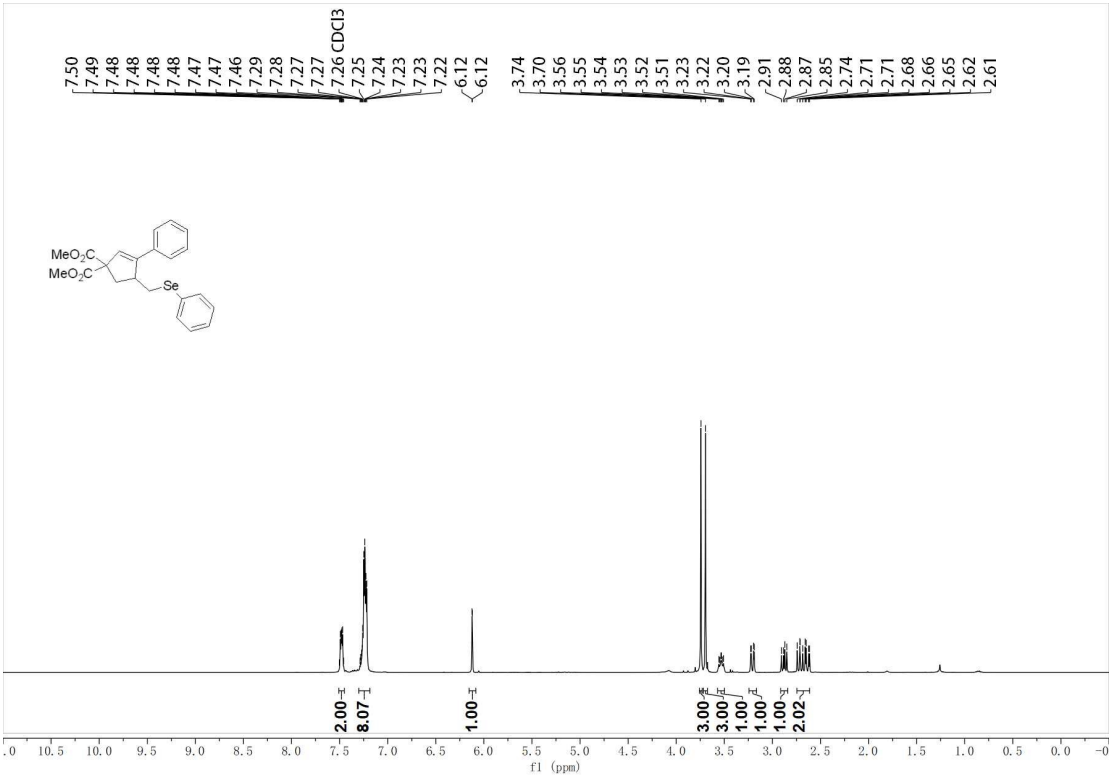


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4a**

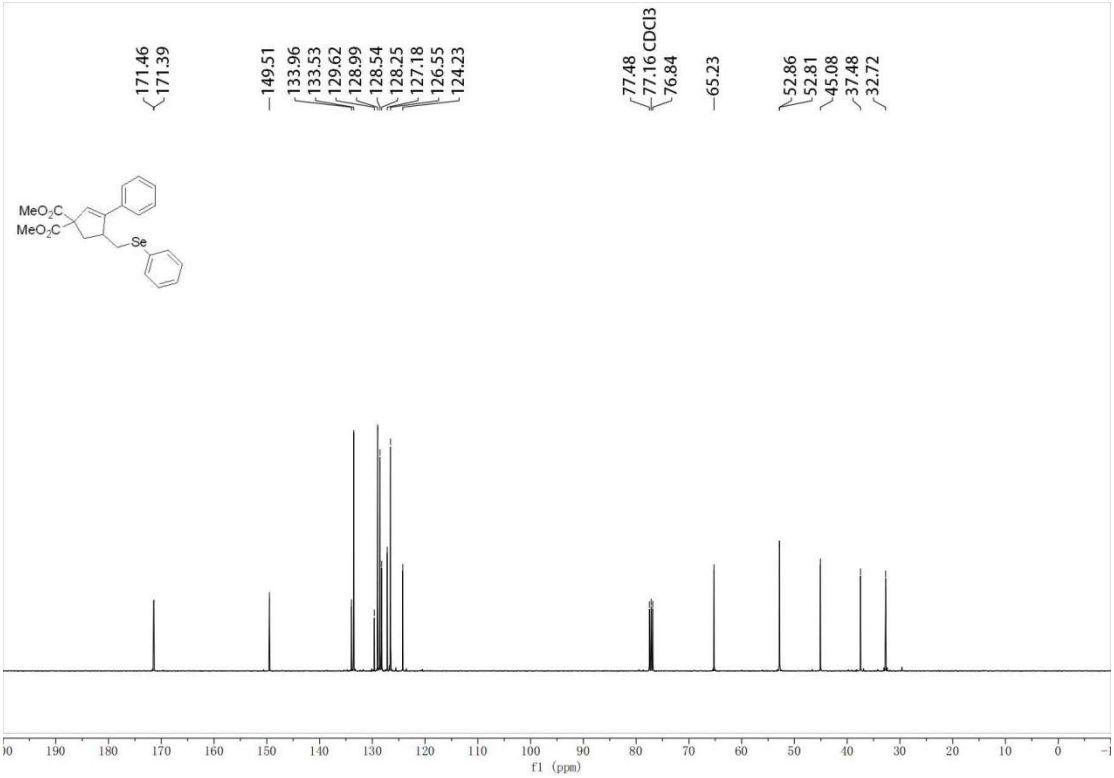


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4a**

Dimethyl 3-phenyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4b)**

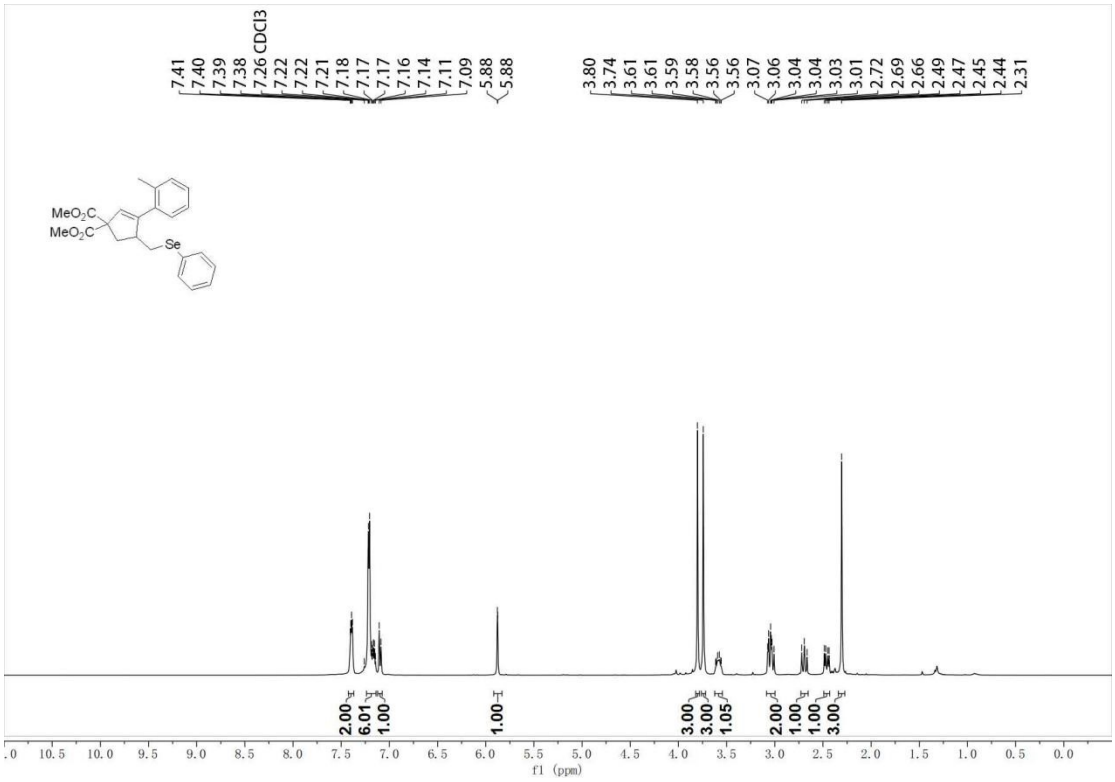


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4b**

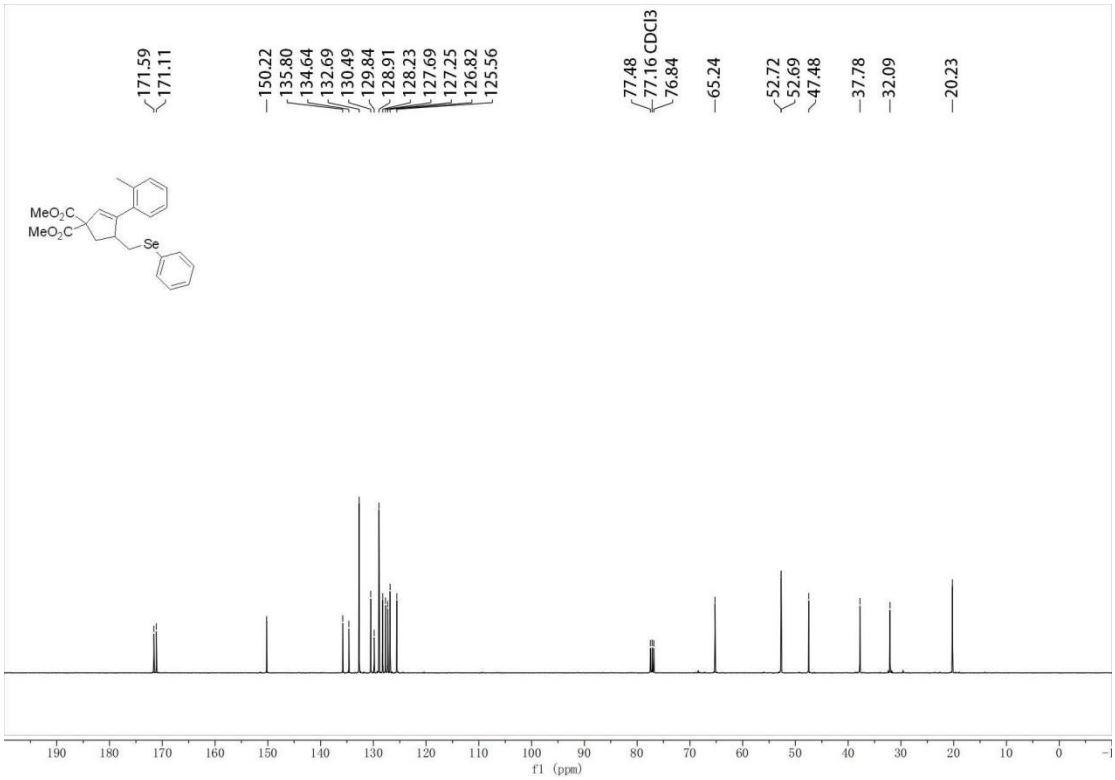


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4b**

Dimethyl 4-((phenylselanyl)methyl)-3-(*o*-tolyl)cyclopent-2-ene-1,1-dicarboxylate **(4c)**

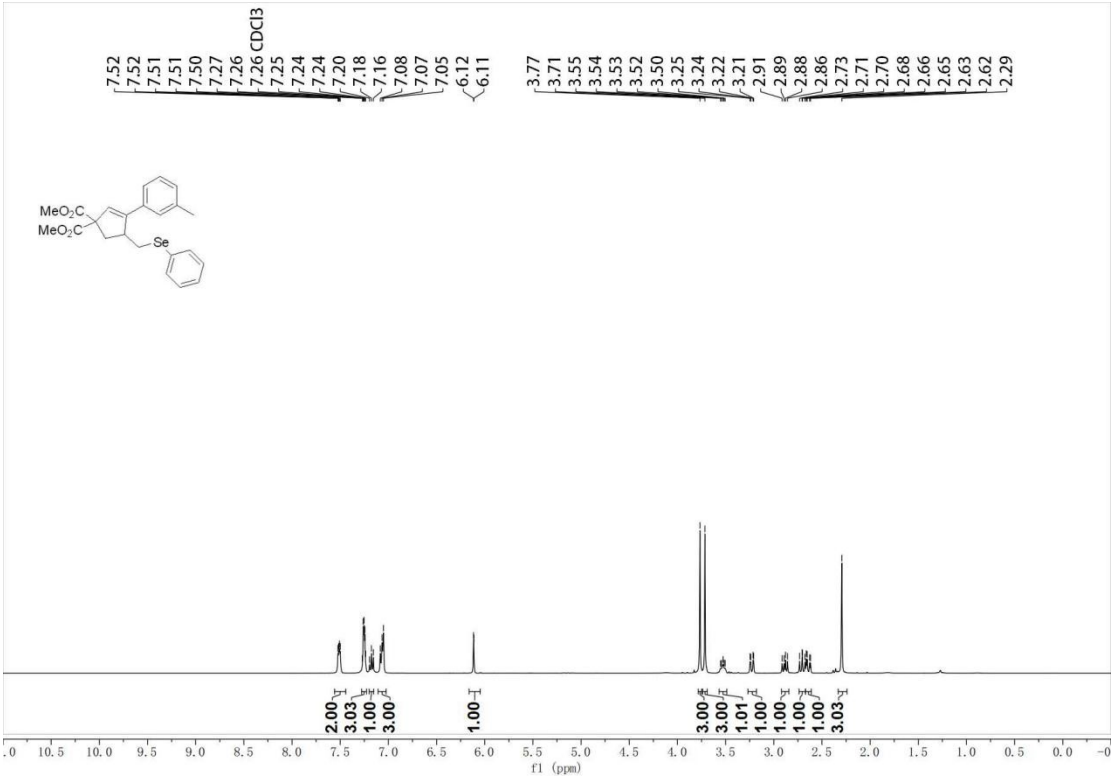


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4c**

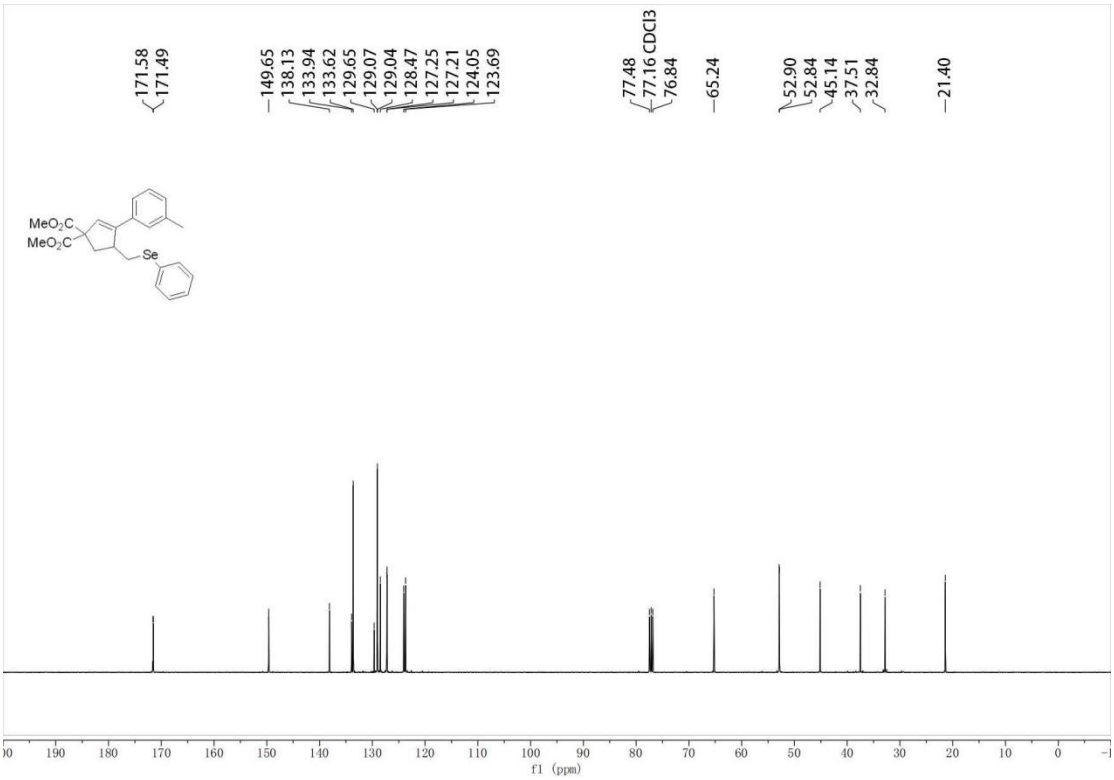


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4c**

Dimethyl 4-((phenylselanyl)methyl)-3-(*m*-tolyl)cyclopent-2-ene-1,1-dicarboxylate **(4d)**

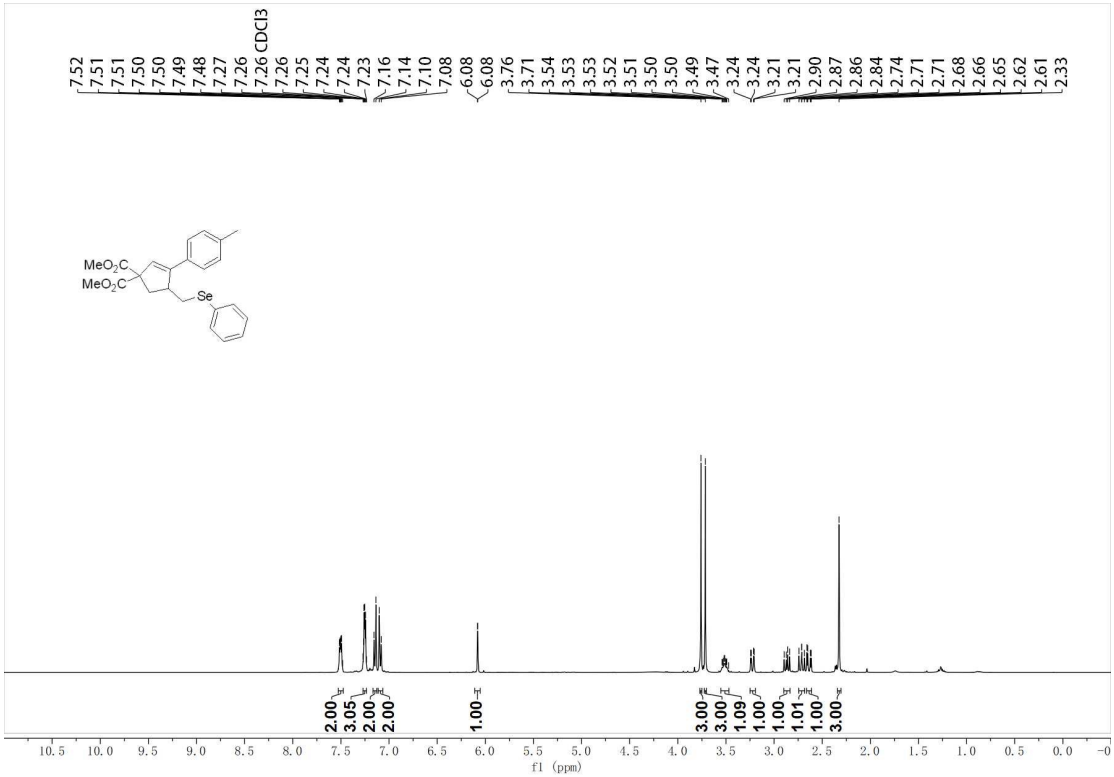


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4d**

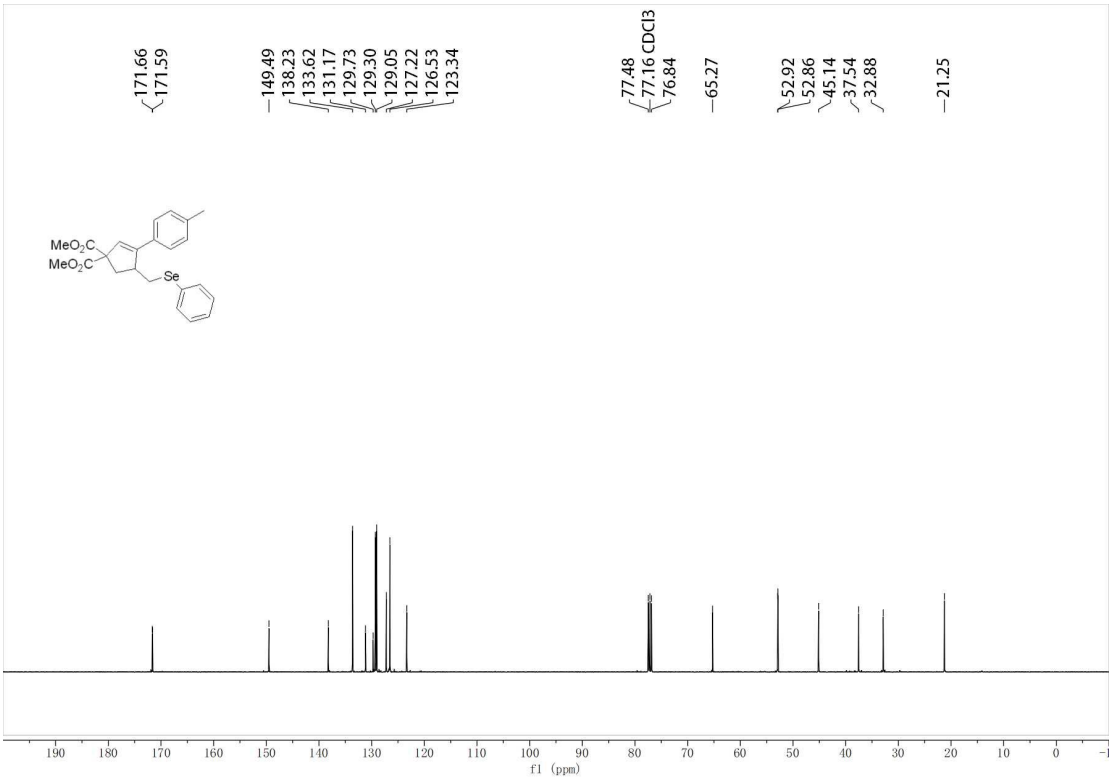


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4d**

Dimethyl 4-((phenylselanyl)methyl)-3-(*p*-tolyl)cyclopent-2-ene-1,1-dicarboxylate **(4e)**

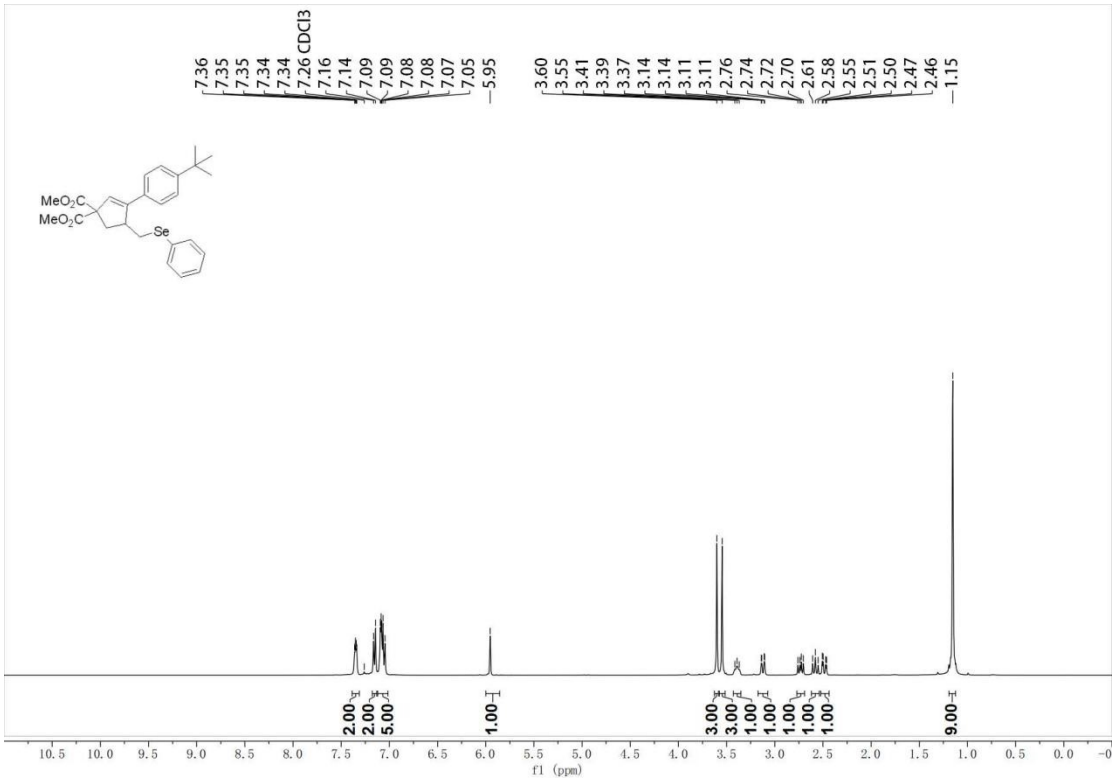


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4e**

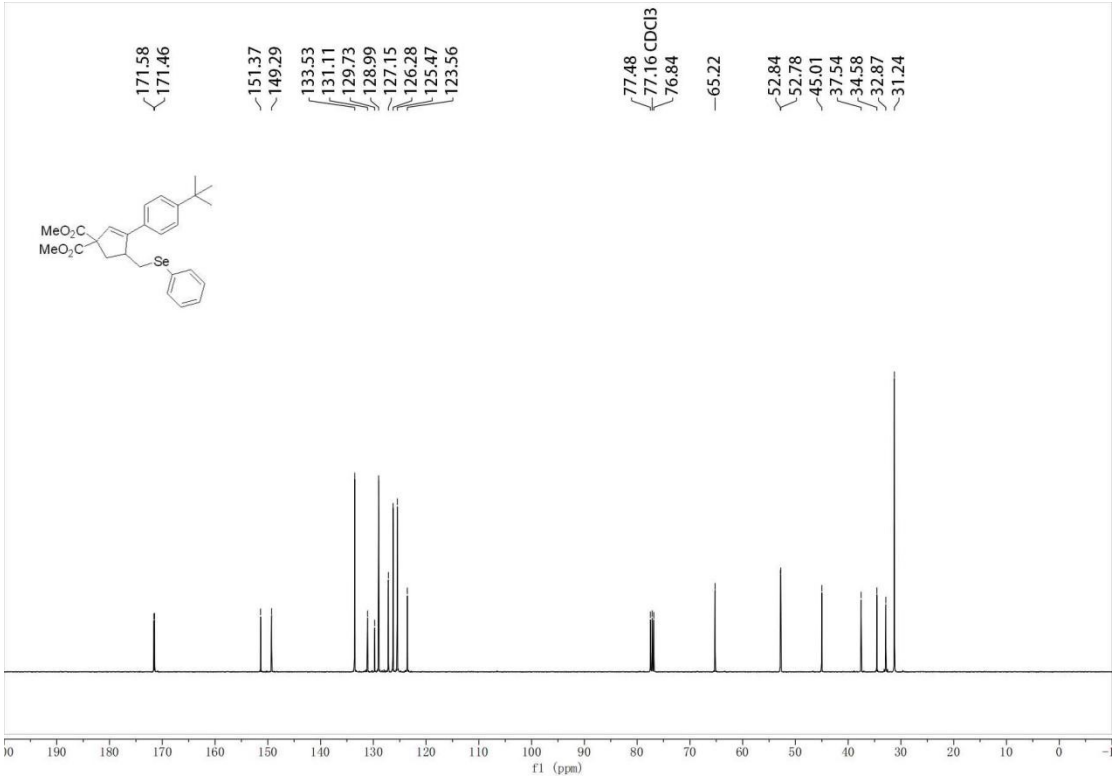


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4e**

Dimethyl 3-(4-(*tert*-butyl)phenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4f)**

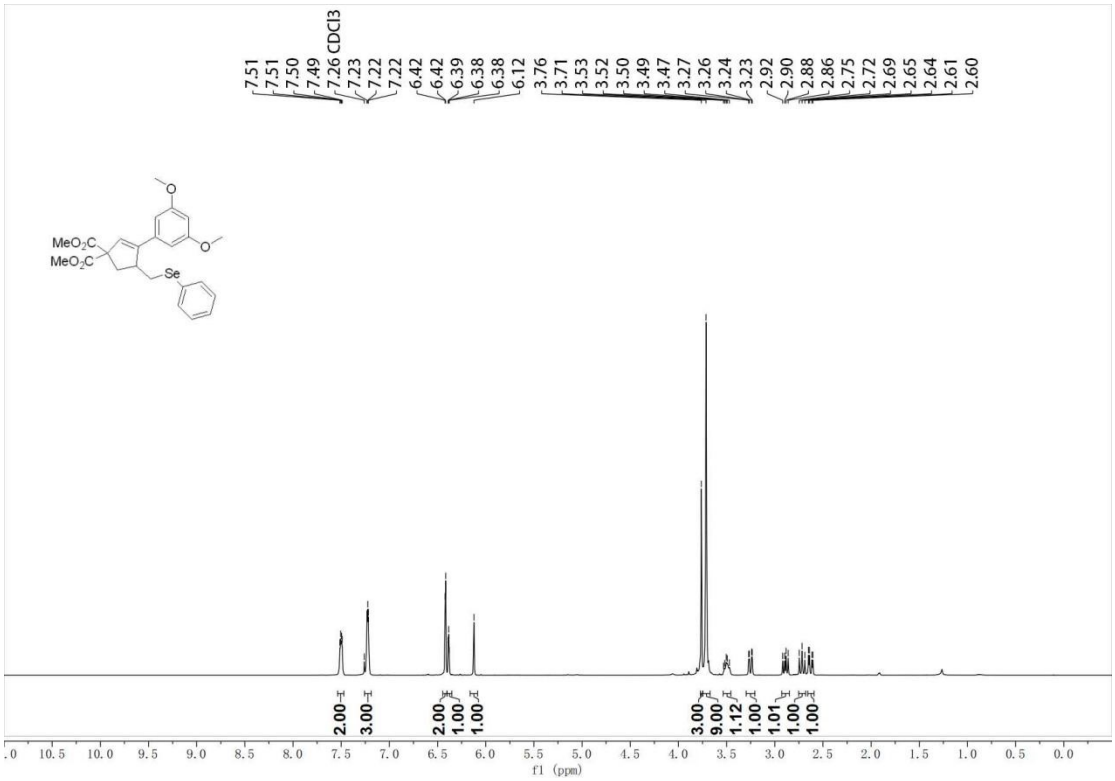


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4f**

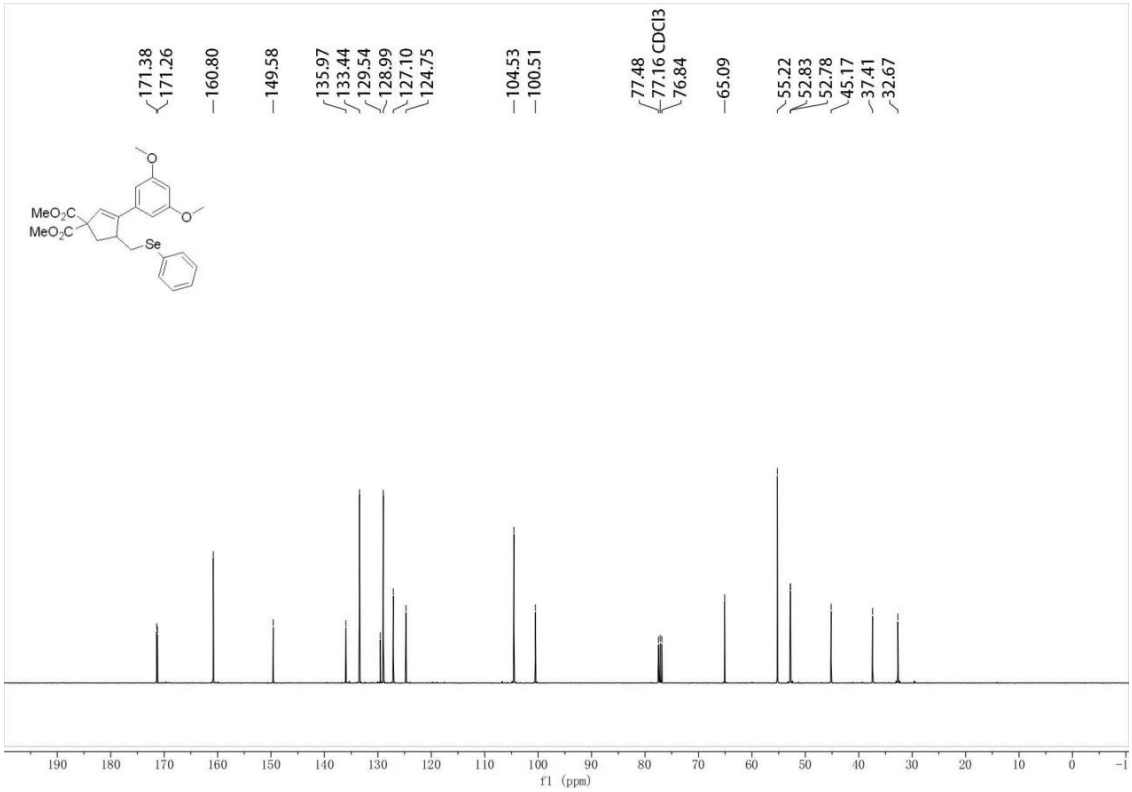


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4f**

Dimethyl 3-(3,5-dimethoxyphenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4g)**

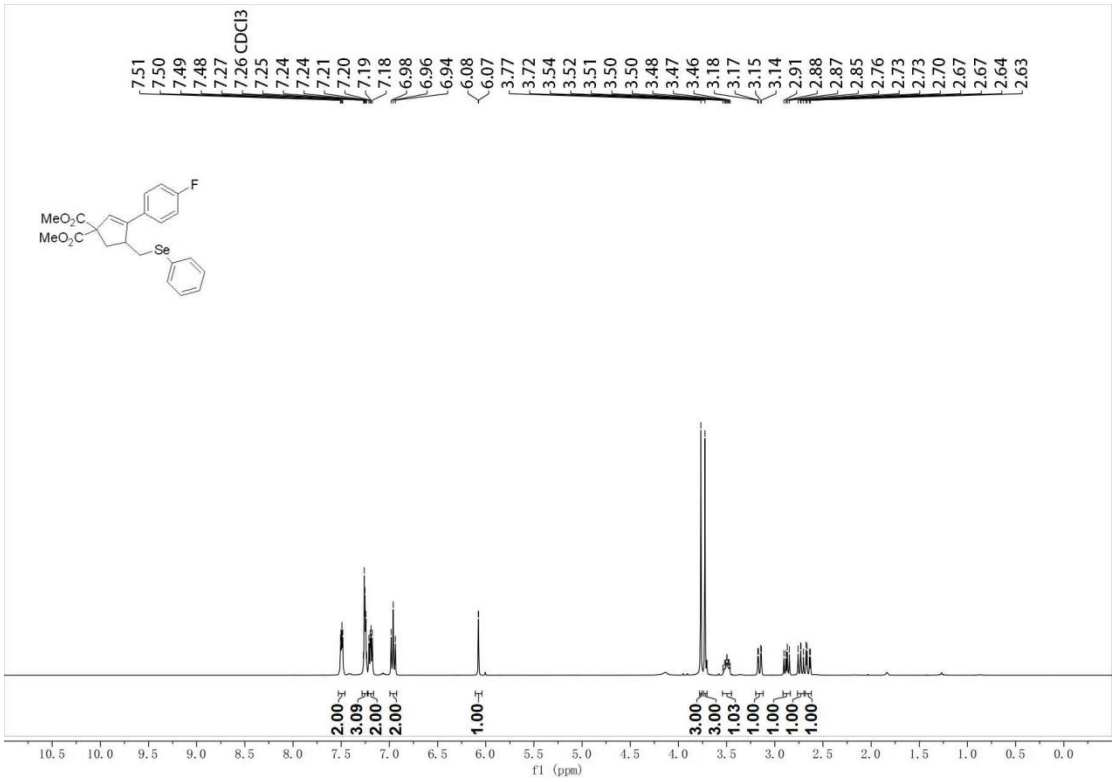


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4g**

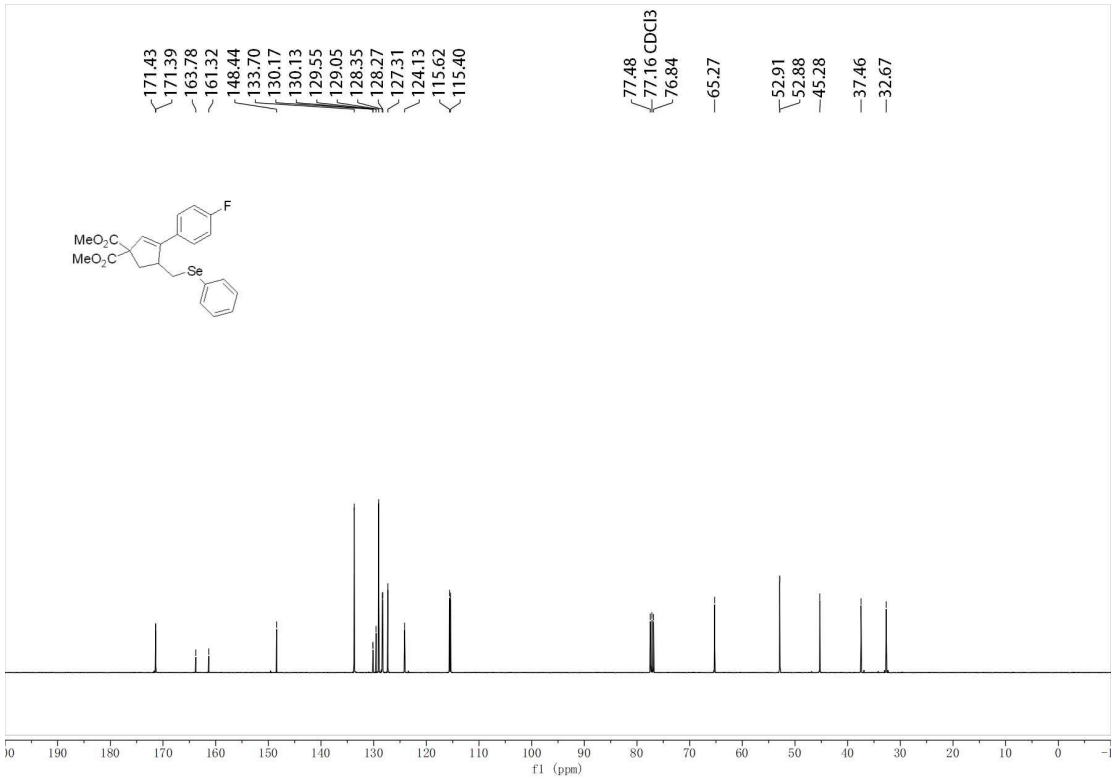


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4g**

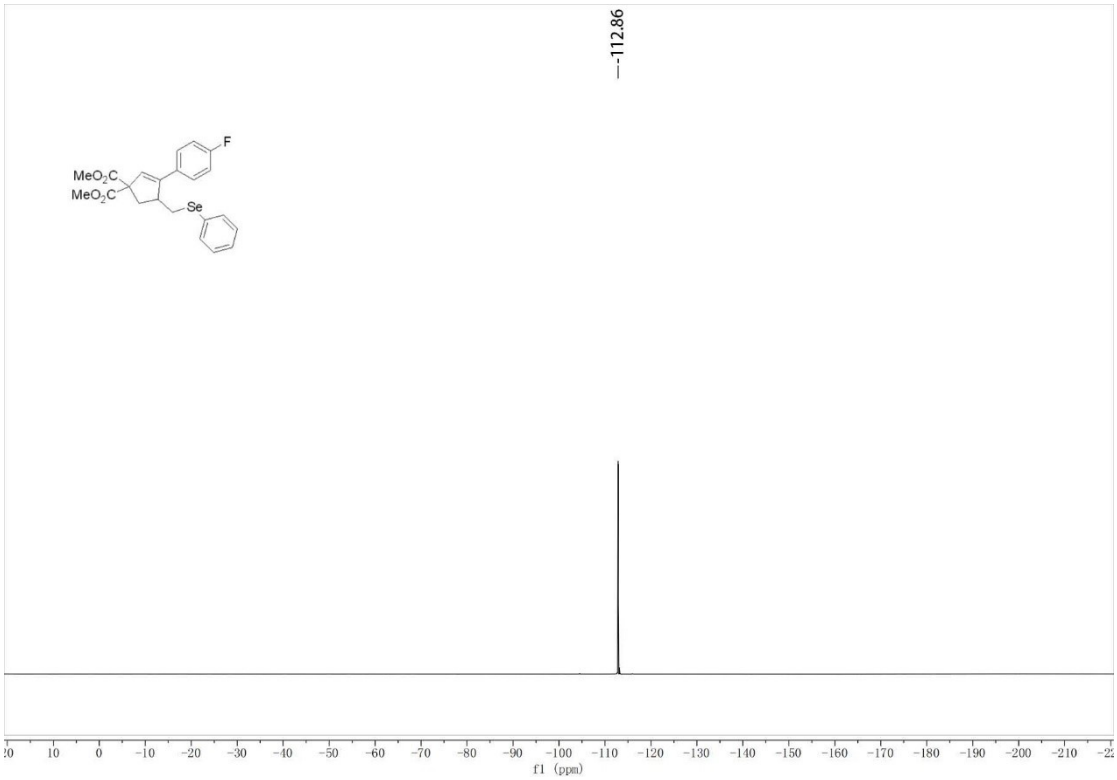
Dimethyl 3-(4-fluorophenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4h)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4h**

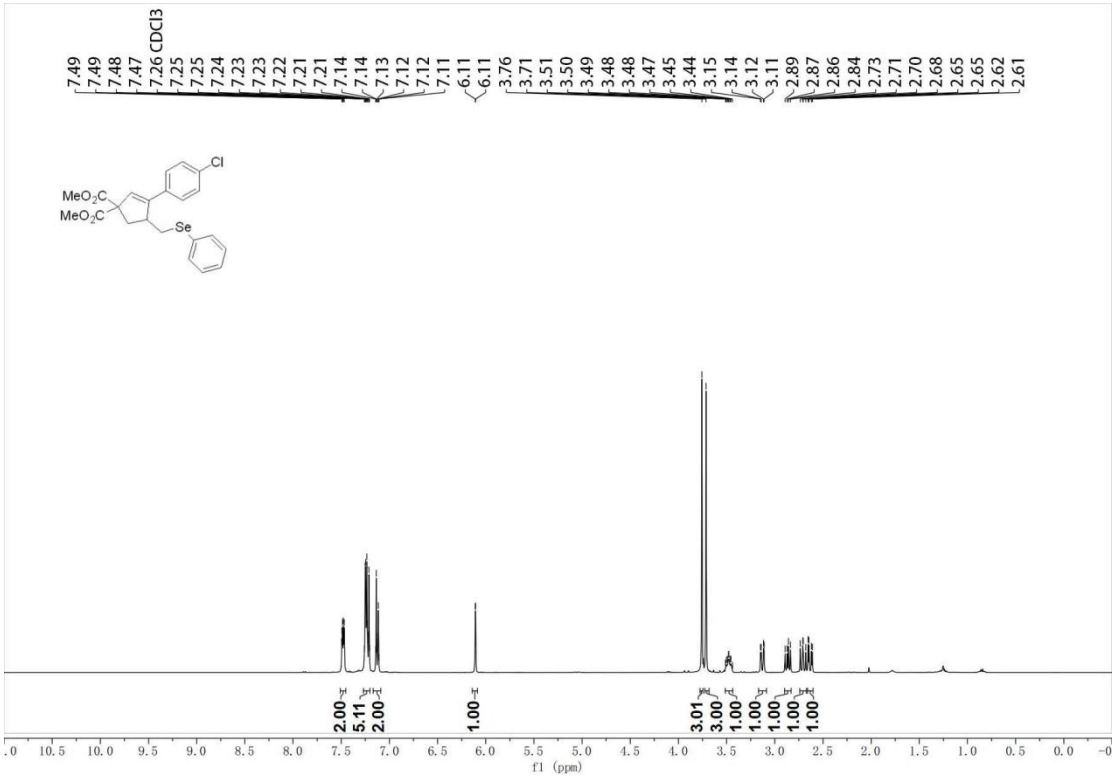


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4h**

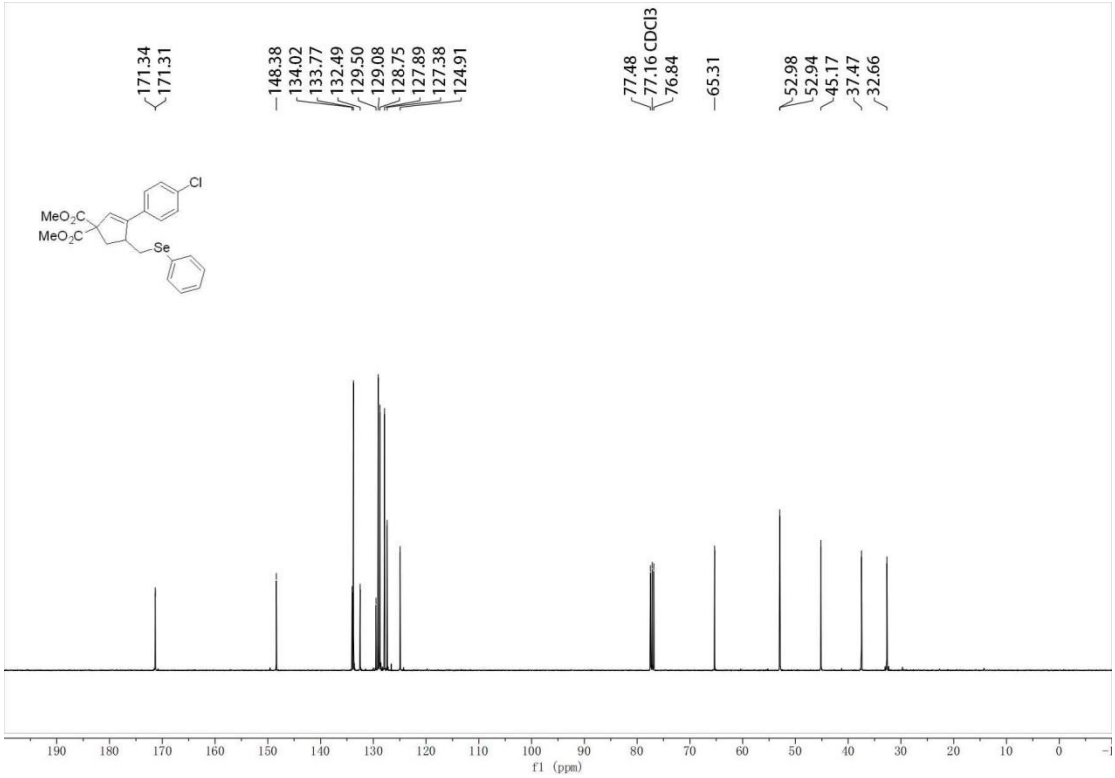


^{19}F NMR (367 MHz, $CDCl_3$) spectrum of **4h**

Dimethyl 3-(4-chlorophenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4i)**

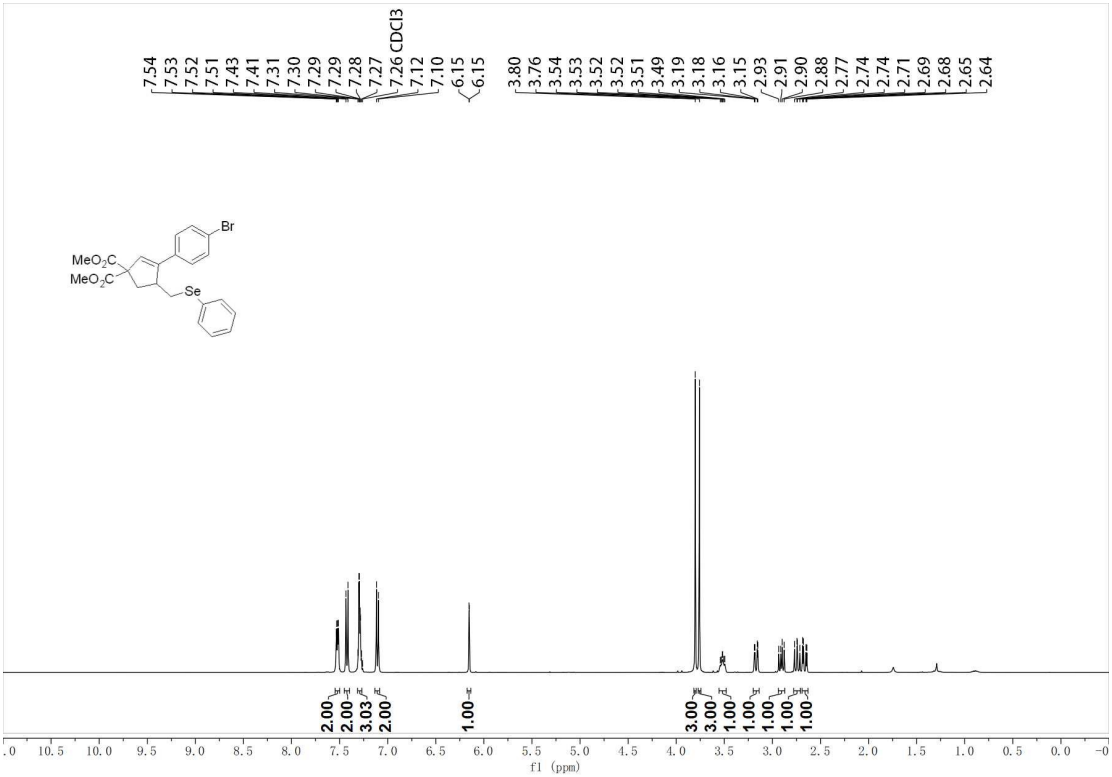


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4i**

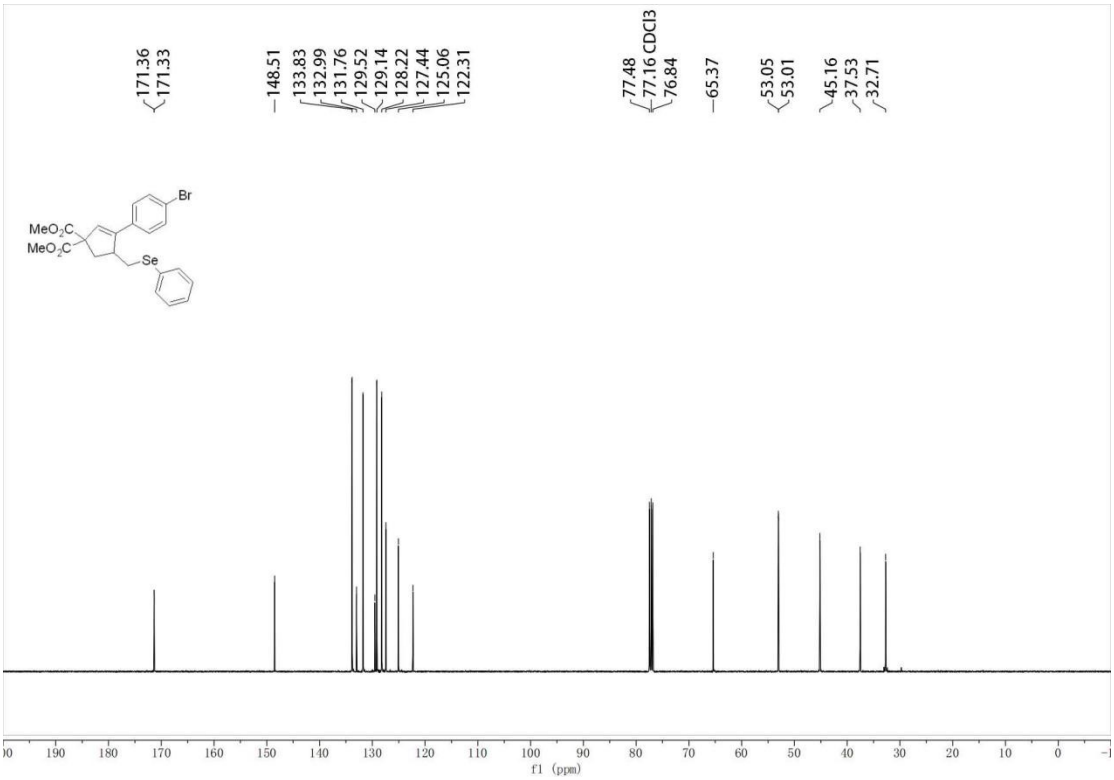


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4i**

Dimethyl 3-(4-bromophenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4j)**

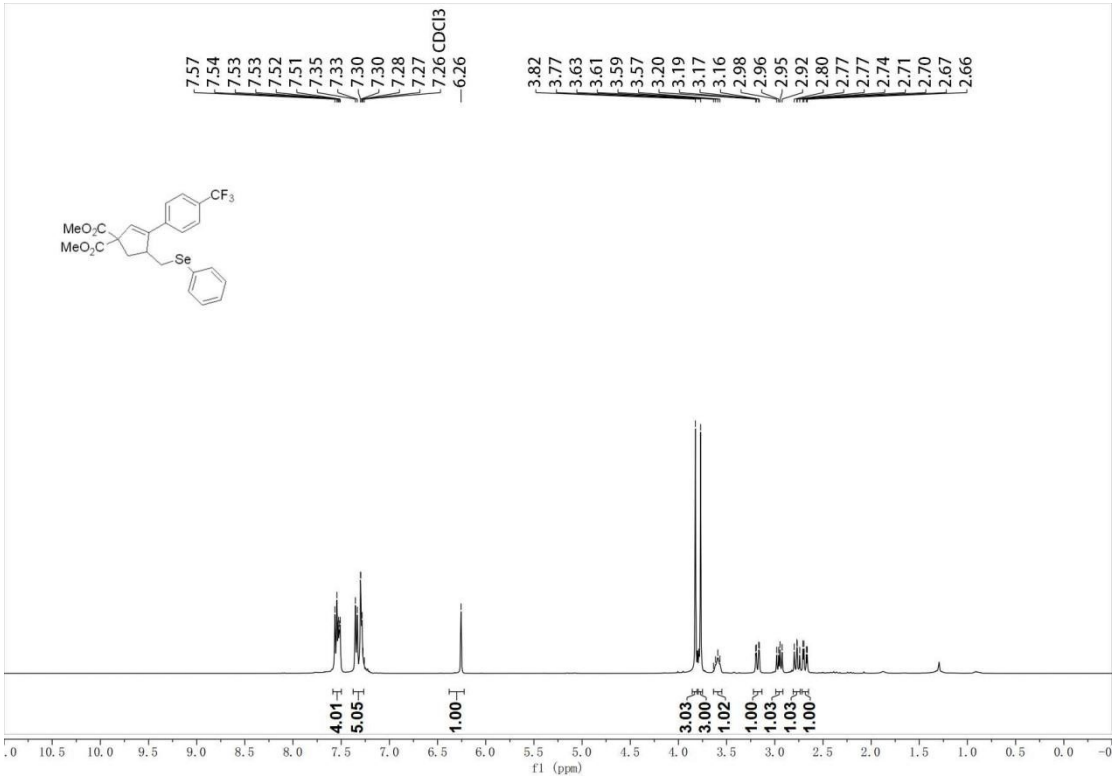


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4j**

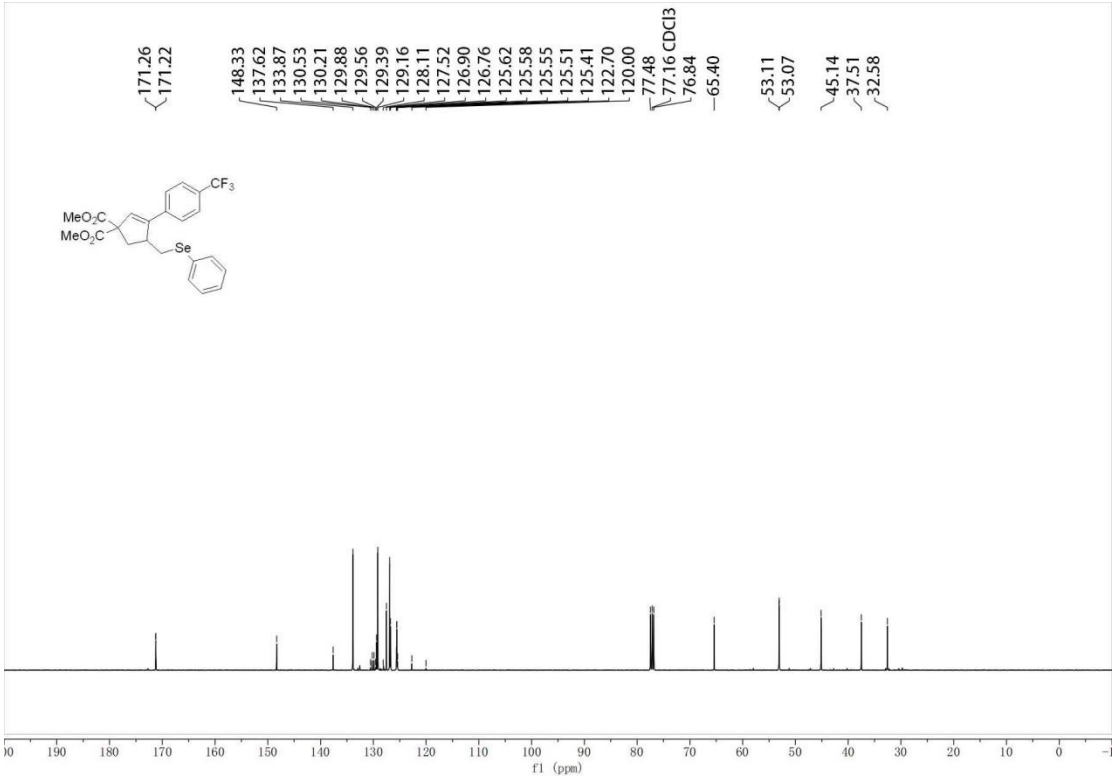


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4j**

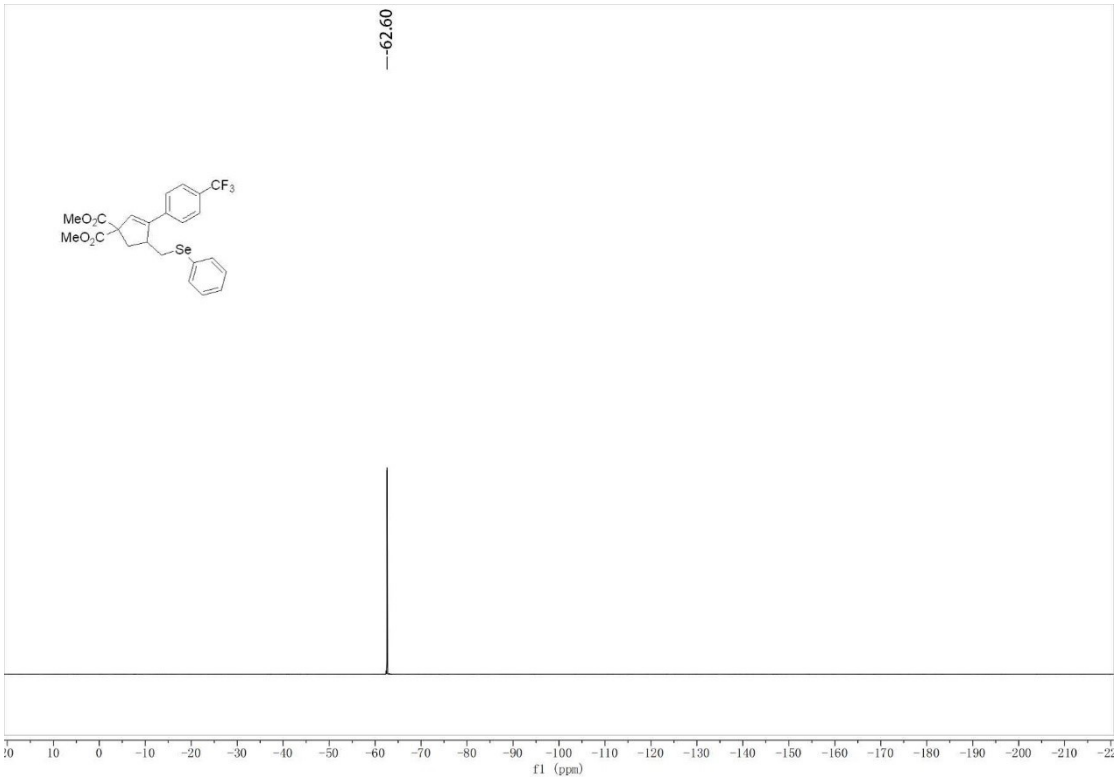
Dimethyl 4-((phenylselanyl)methyl)-3-(4-(trifluoromethyl)phenyl)cyclopent-2-ene-1,1-dicarboxylate **(4k)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4k**

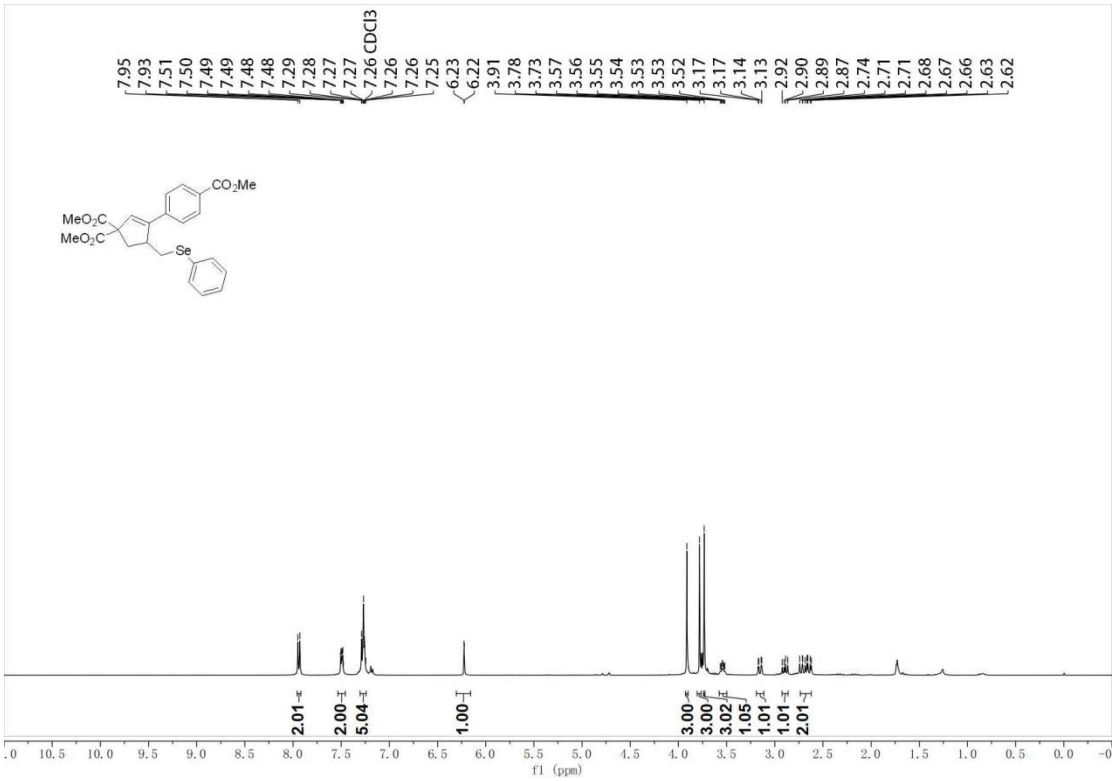


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4k**

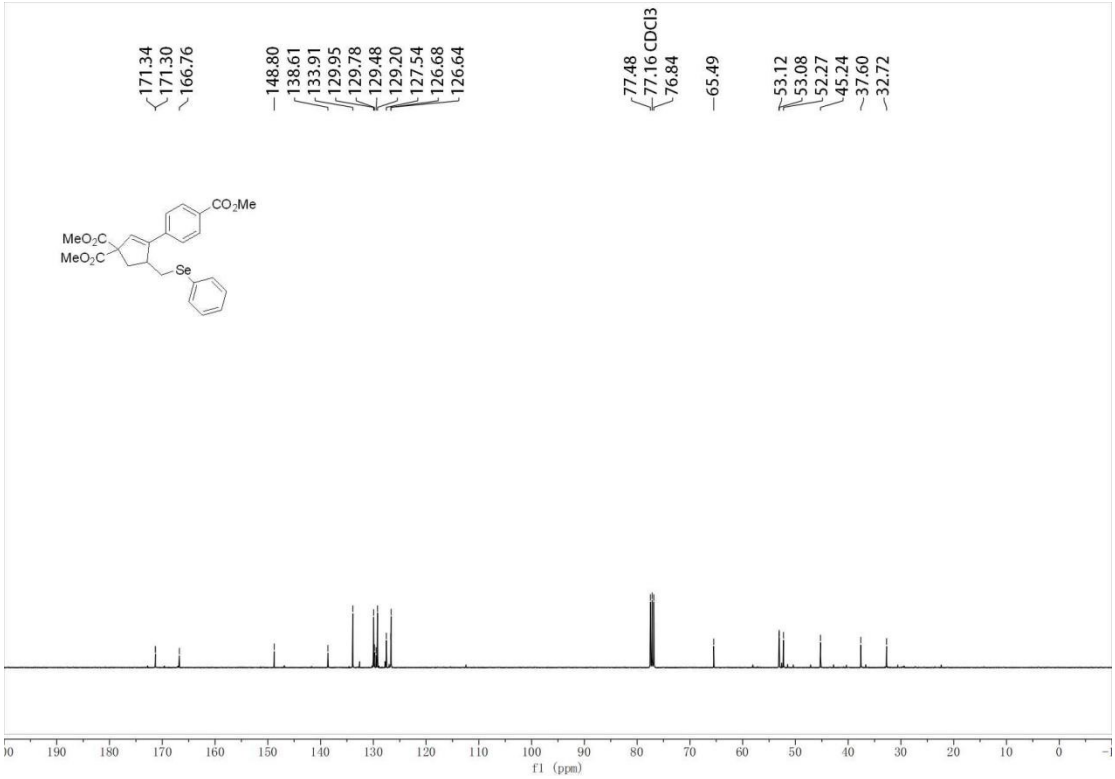


^{19}F NMR (367 MHz, $CDCl_3$) spectrum of **4k**

Dimethyl3-(4-(methoxycarbonyl)phenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4l)**

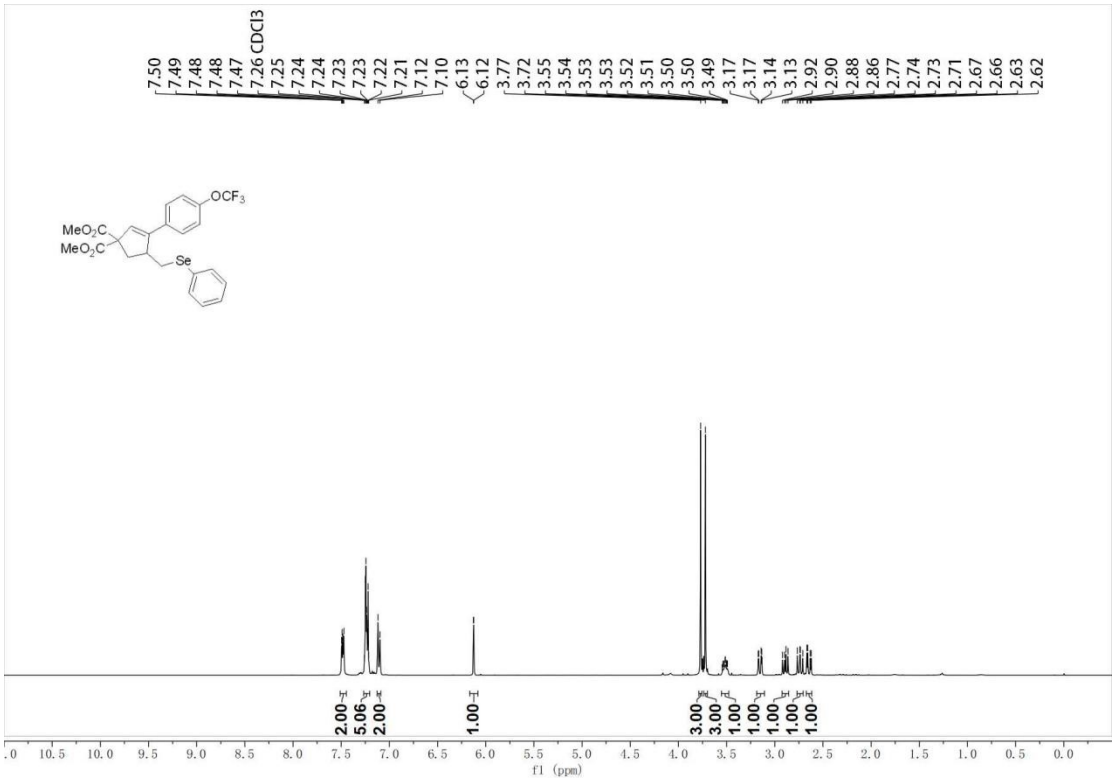


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4l**

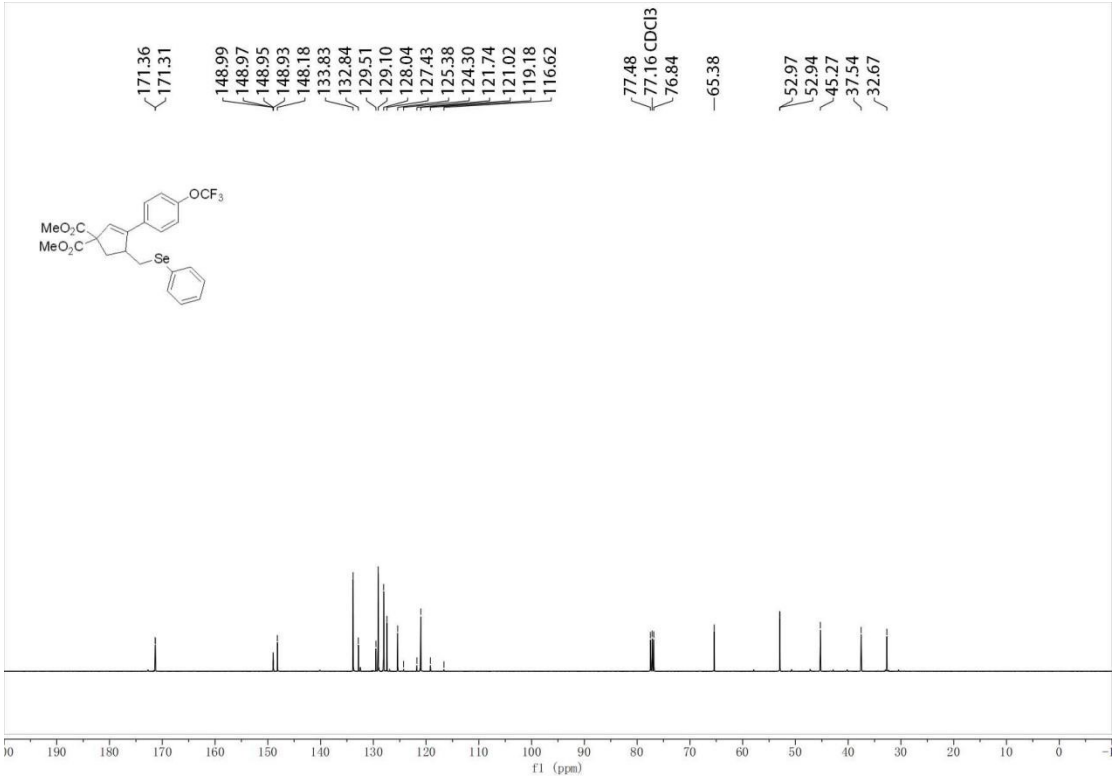


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4l**

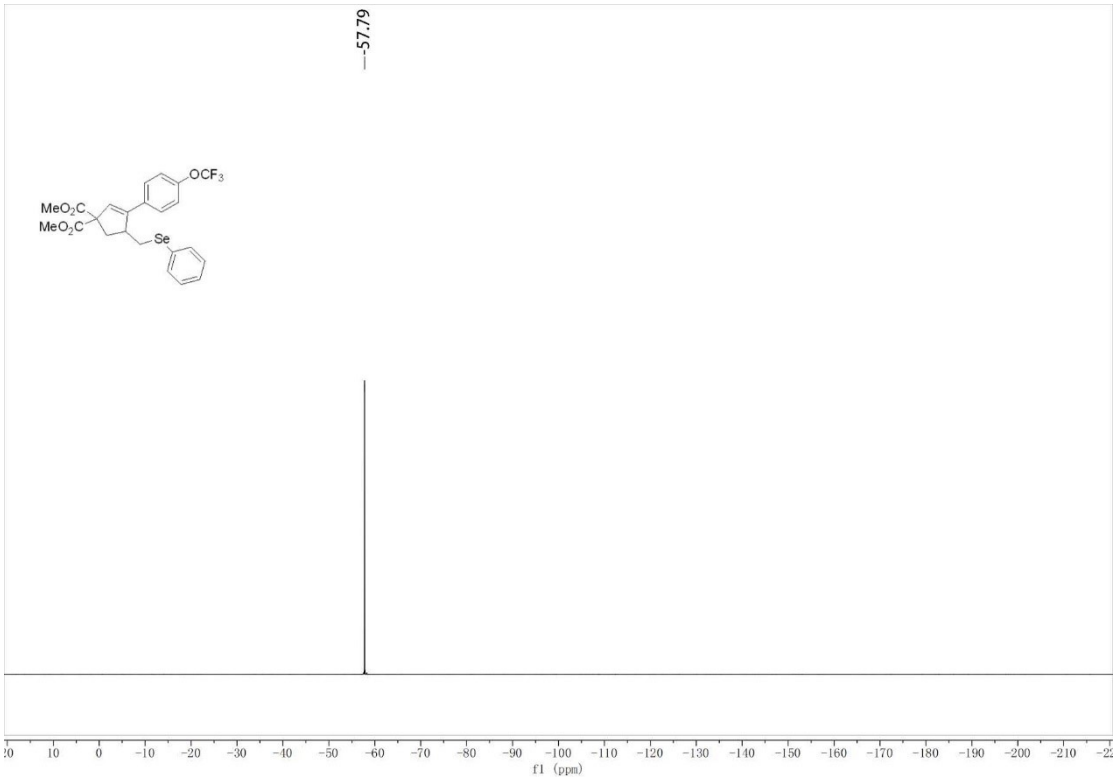
Dimethyl 4-((phenylselanyl)methyl)-3-(4-(trifluoromethoxy)phenyl)cyclopent-2-ene-1,1-dicarboxylate **(4m)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4m**

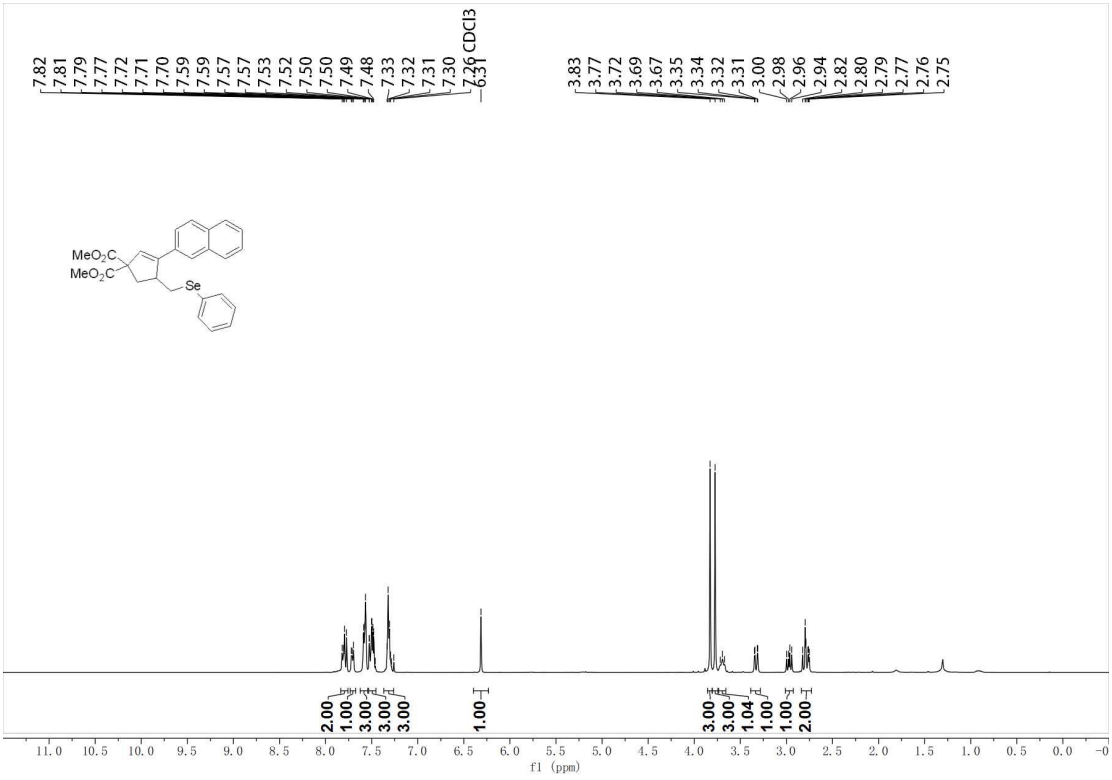


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4m**

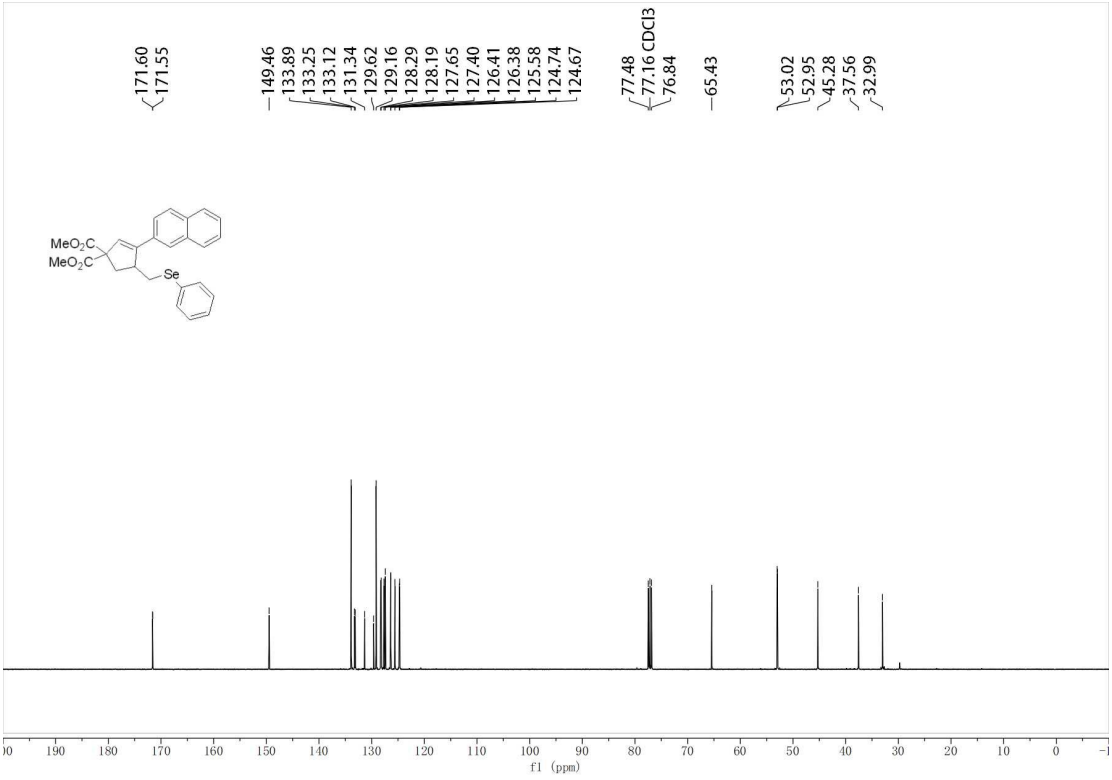


^{19}F NMR (367 MHz, $CDCl_3$) spectrum of **4m**

Dimethyl 3-(naphthalen-2-yl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4n)**

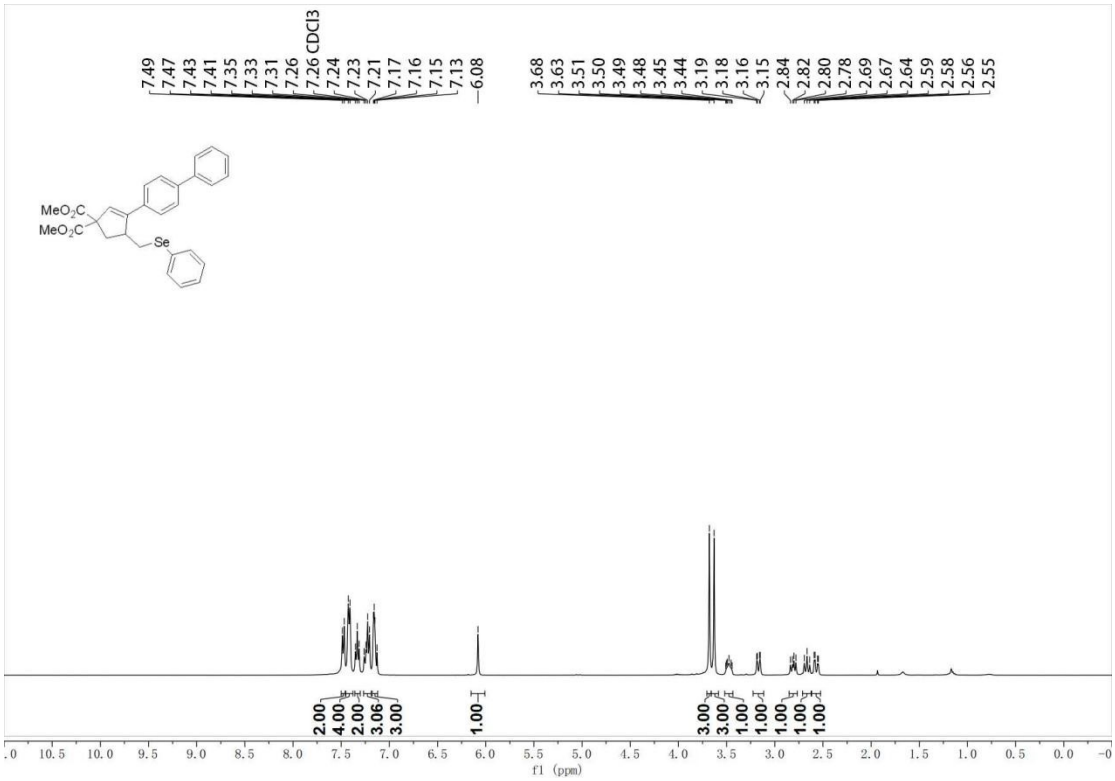


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4n**

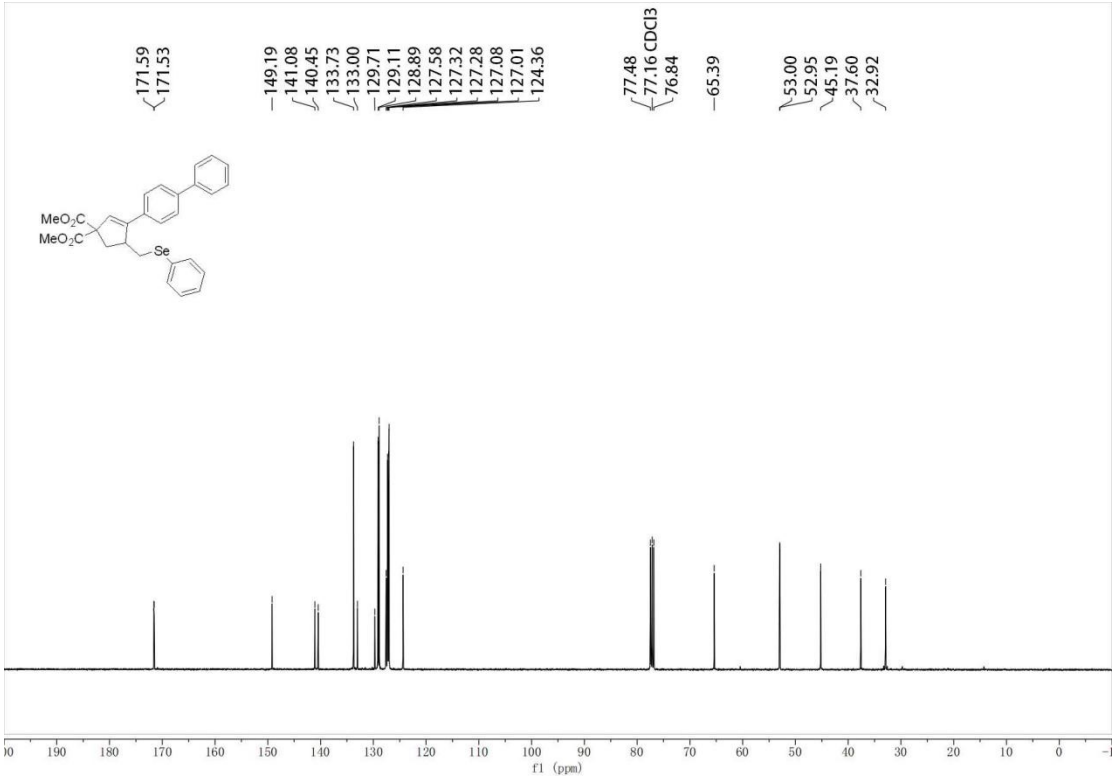


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4n**

Dimethyl 3-([1,1'-biphenyl]-4-yl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(4o)**

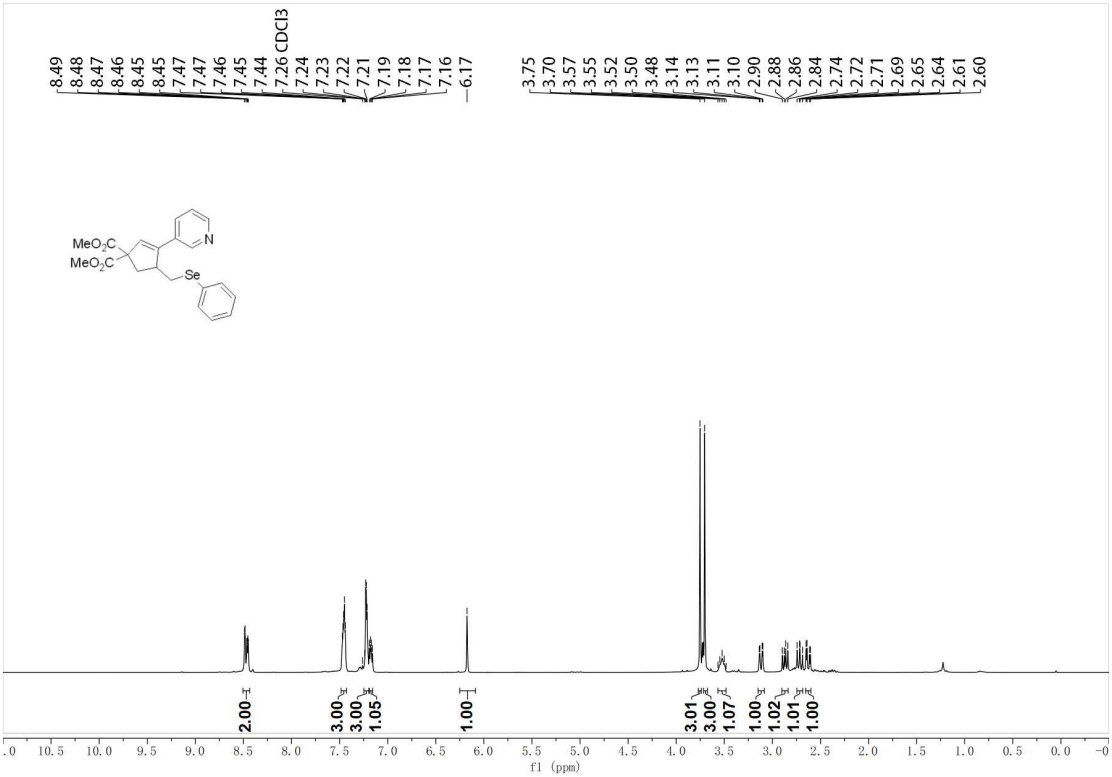


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4o**

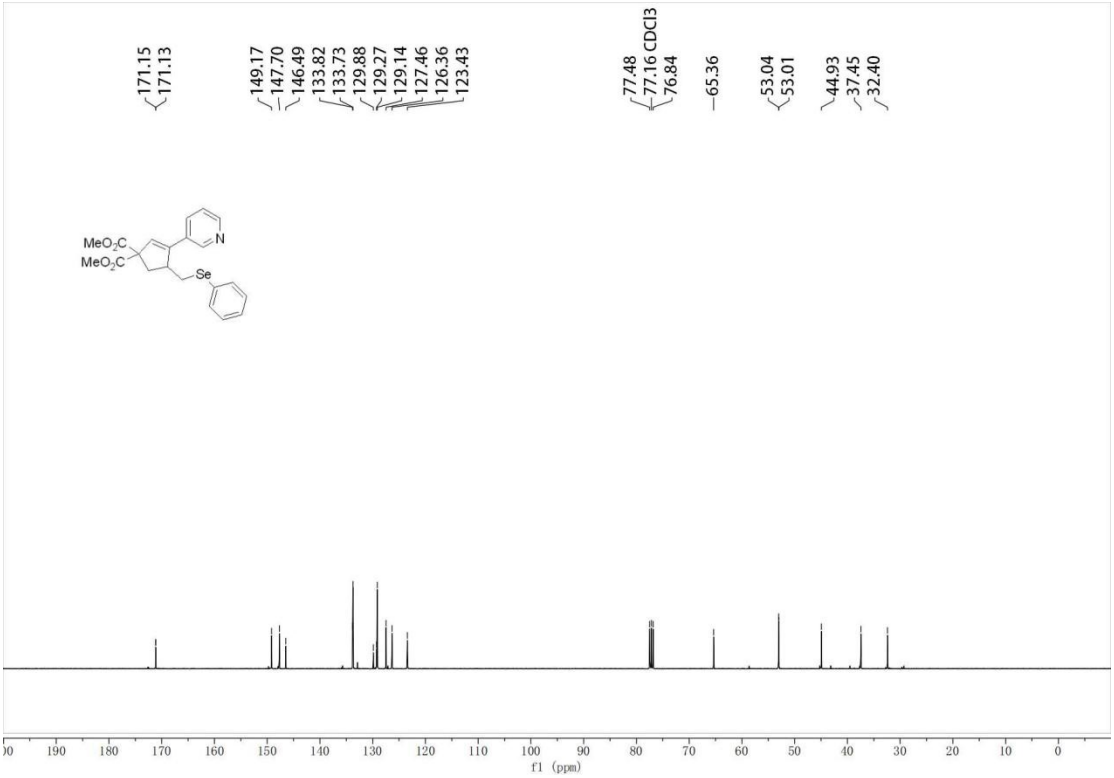


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4o**

Dimethyl 4-((phenylselanyl)methyl)-3-(pyridin-3-yl)cyclopent-2-ene-1,1-dicarboxylate **(4p)**

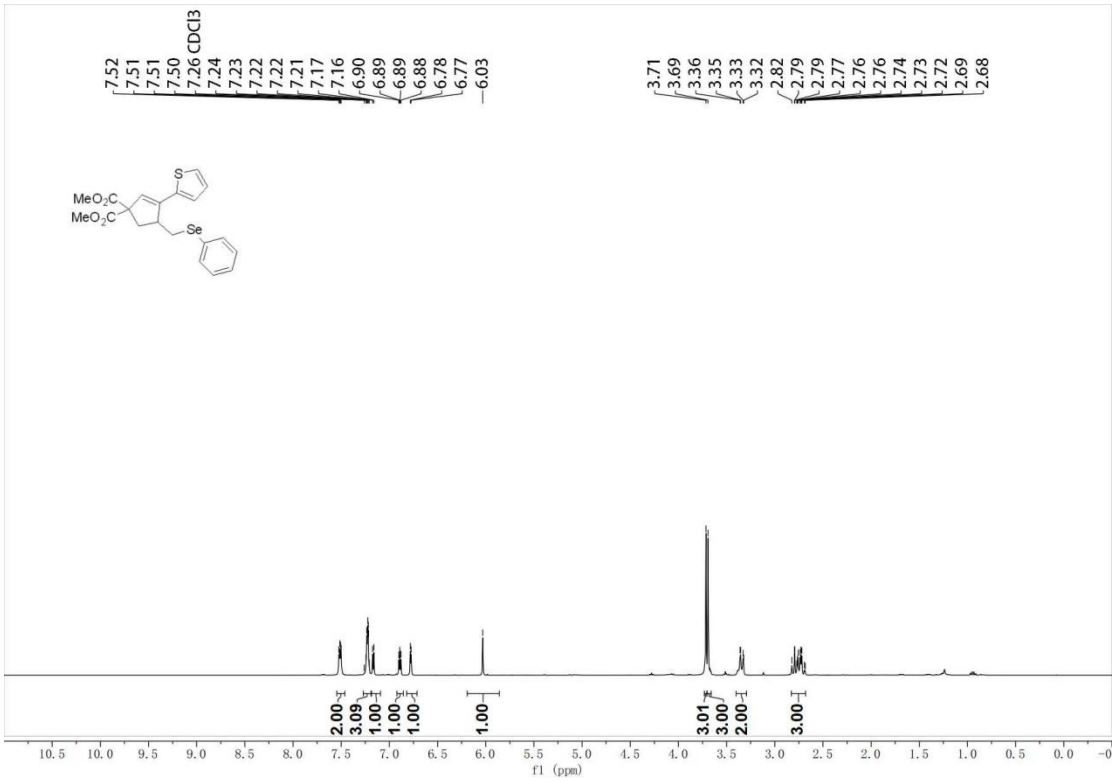


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4p**

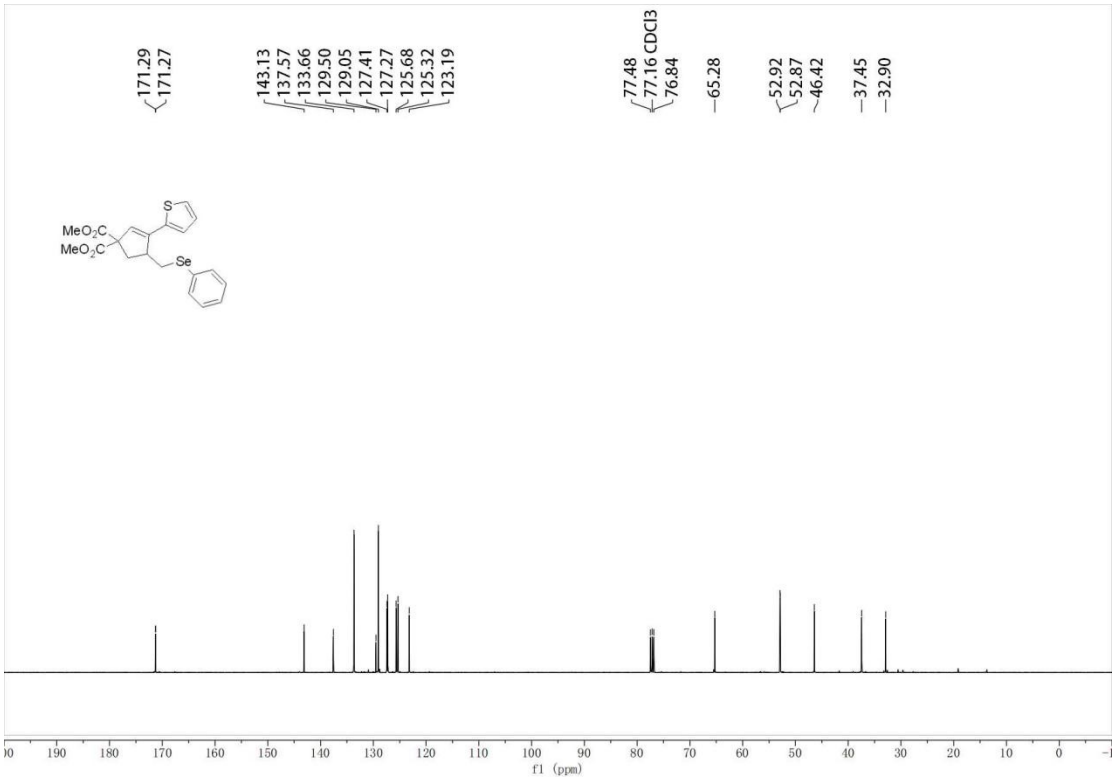


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4p**

Dimethyl 4-((phenylselanyl)methyl)-3-(thiophen-2-yl)cyclopent-2-ene-1,1-dicarboxylate **(4q)**

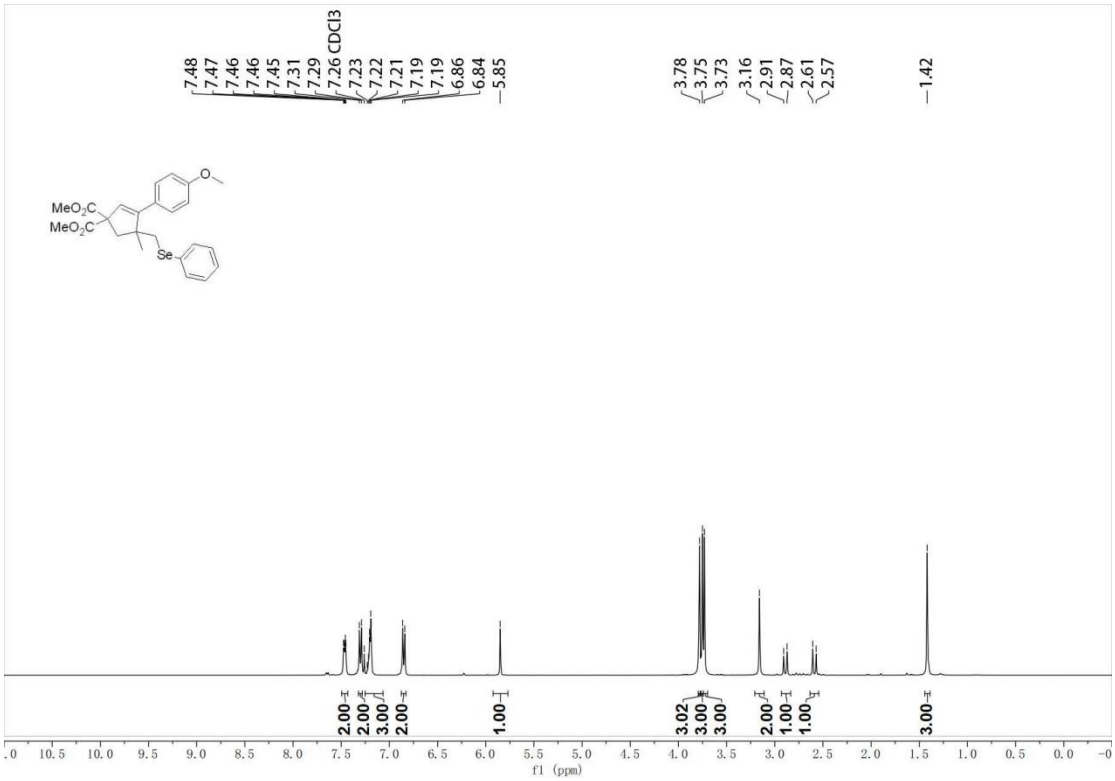


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **4q**

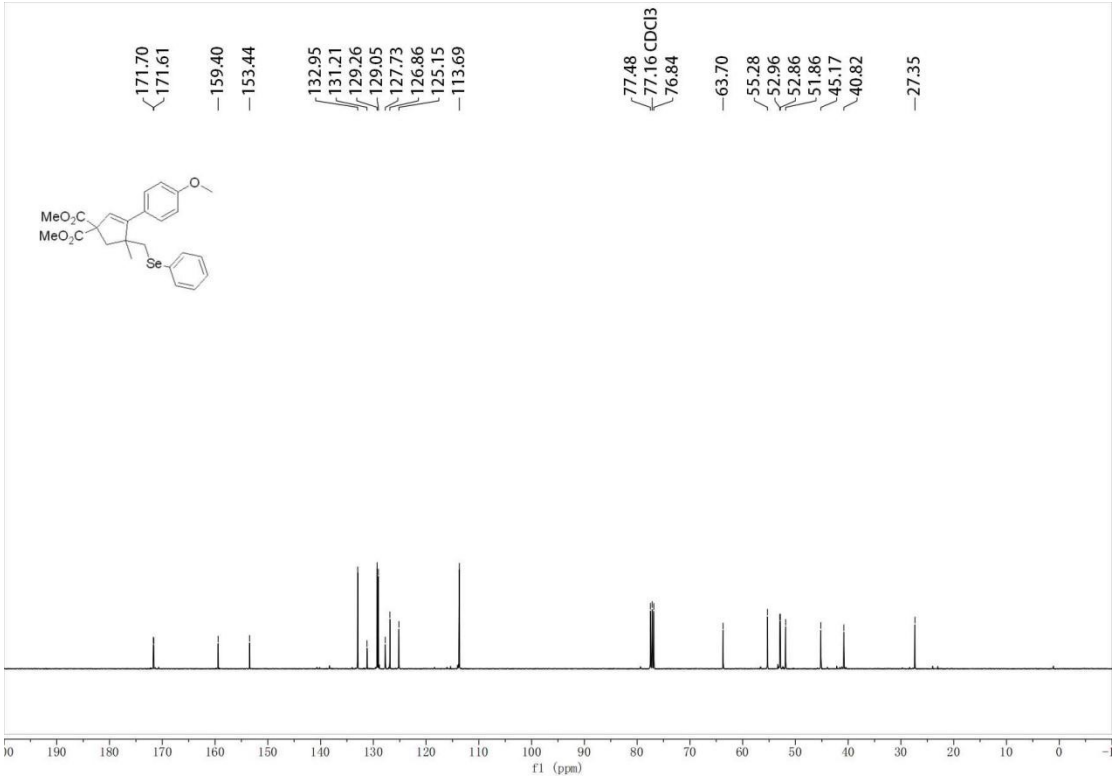


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **4q**

Dimethyl 3-(4-methoxyphenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(5a)**

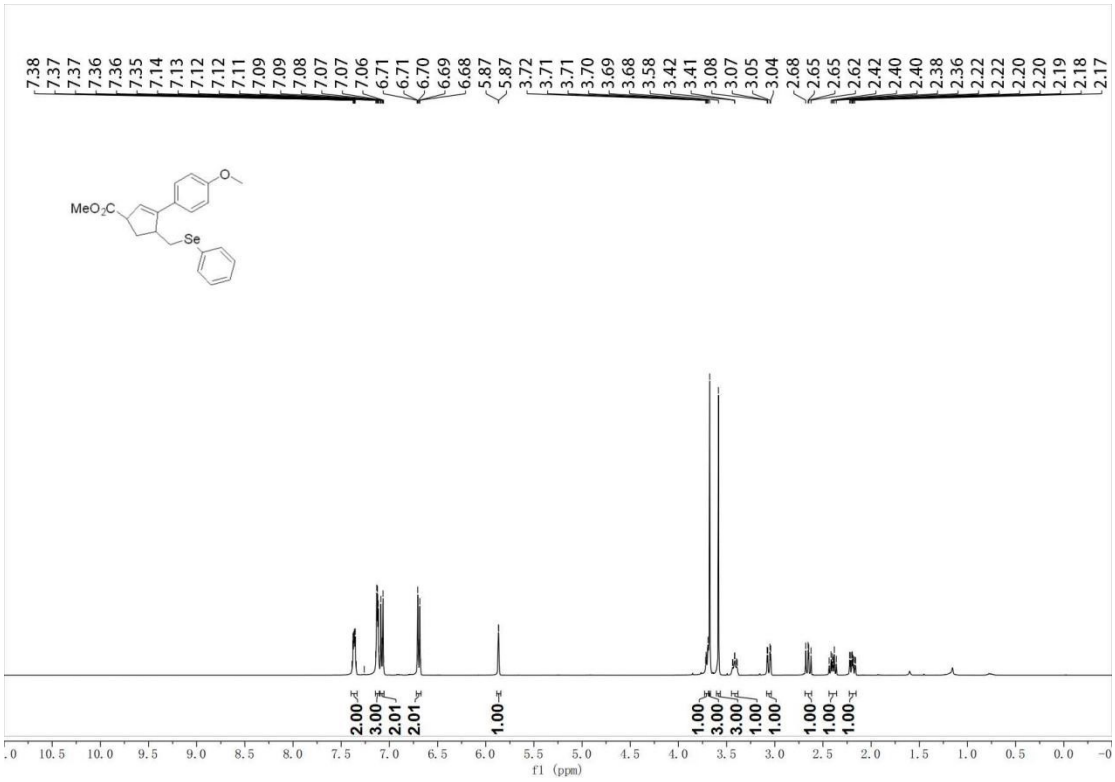


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5a**

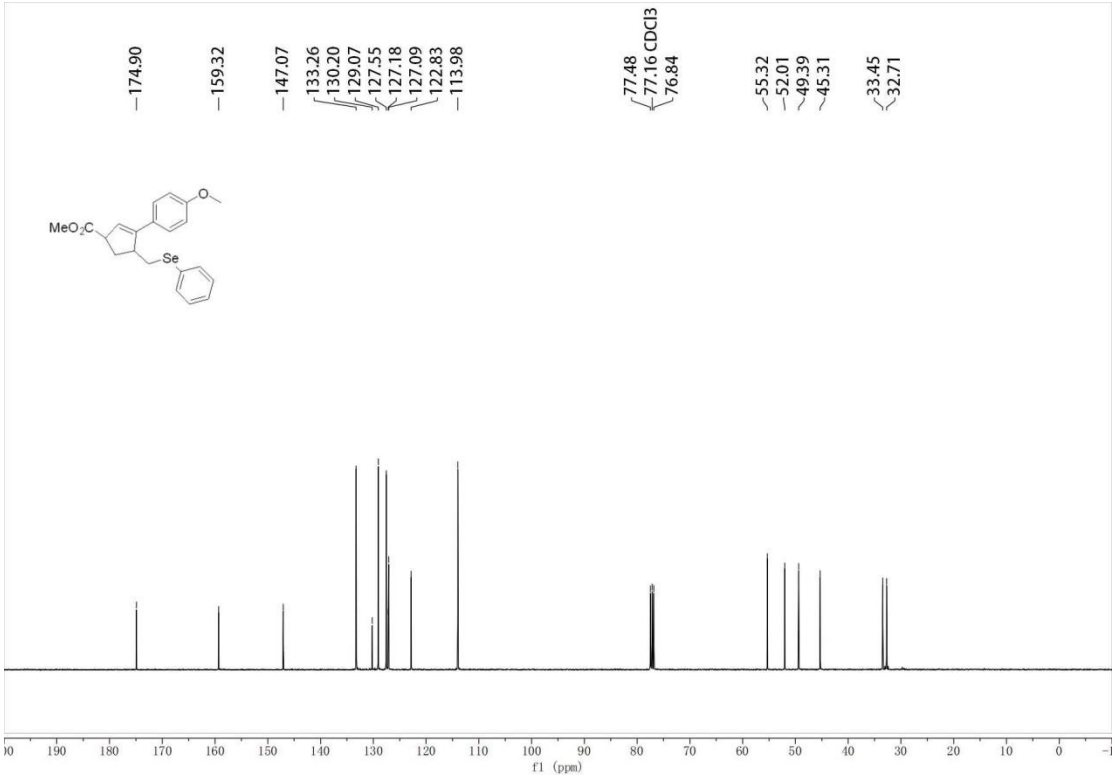


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5a**

Methyl 3-(4-methoxyphenyl)-4-((phenylselanyl)methyl)cyclopent-2-ene-1-carboxylate **(5b)**

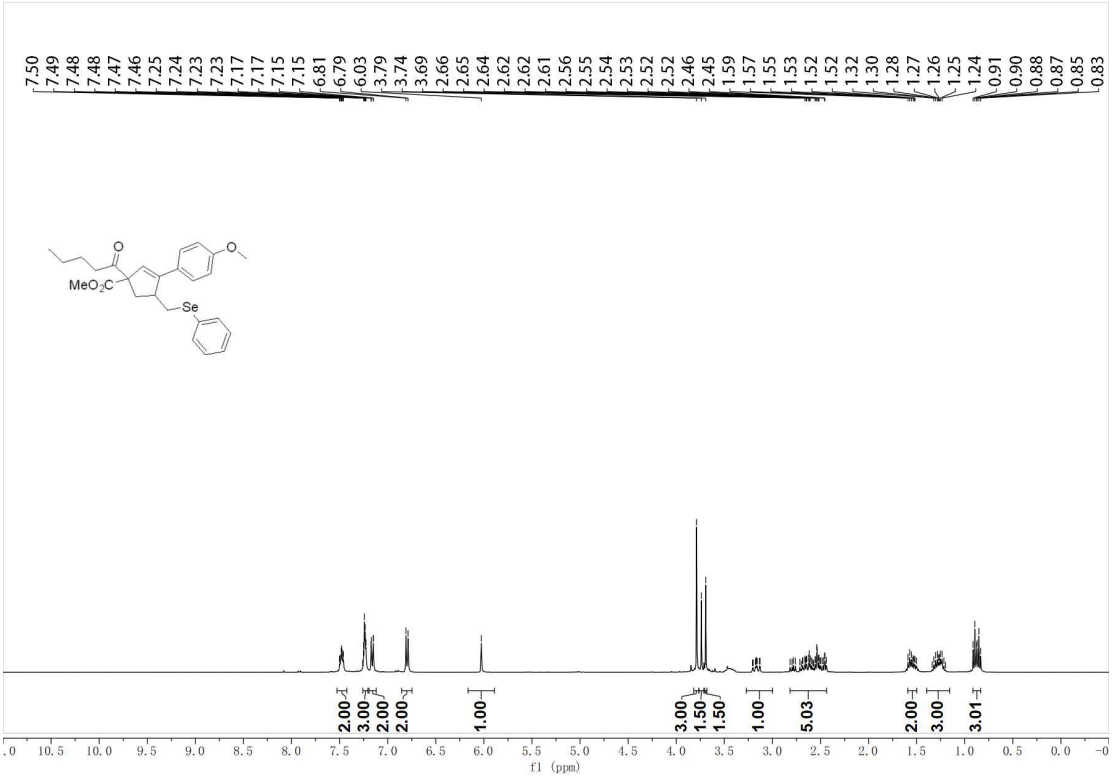


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5b**

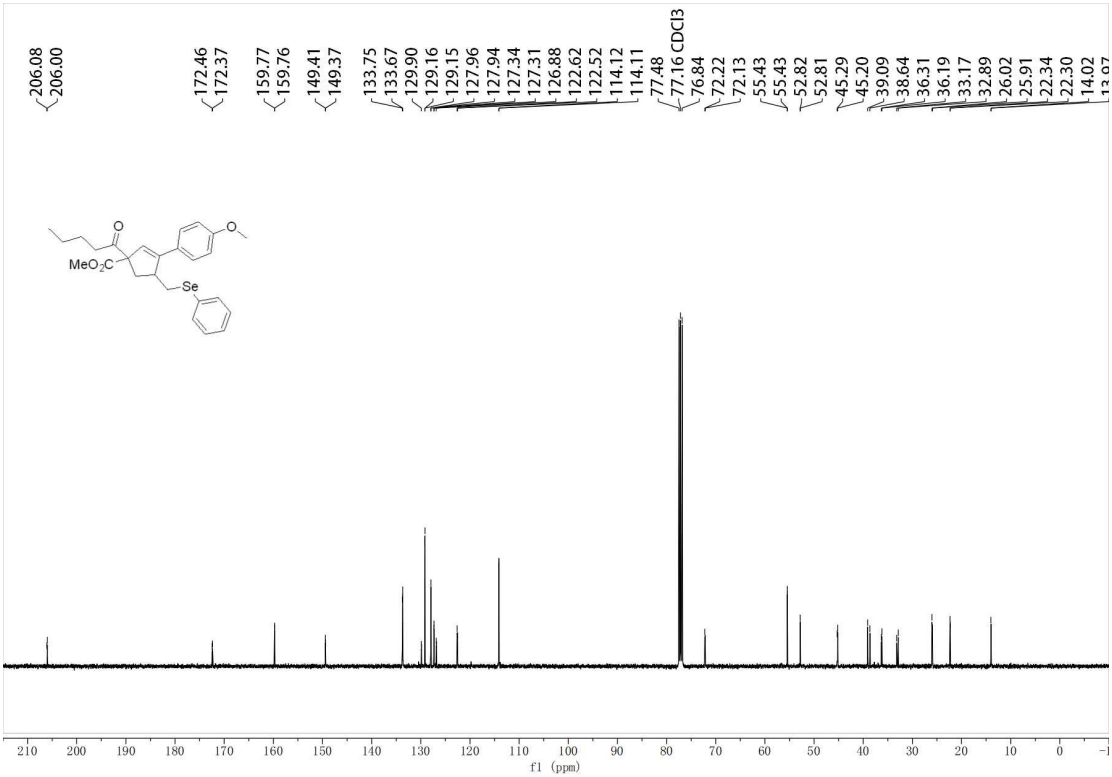


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5b**

Methyl 3-(4-methoxyphenyl)-1-pentanoyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1-carboxylate **(5c)**

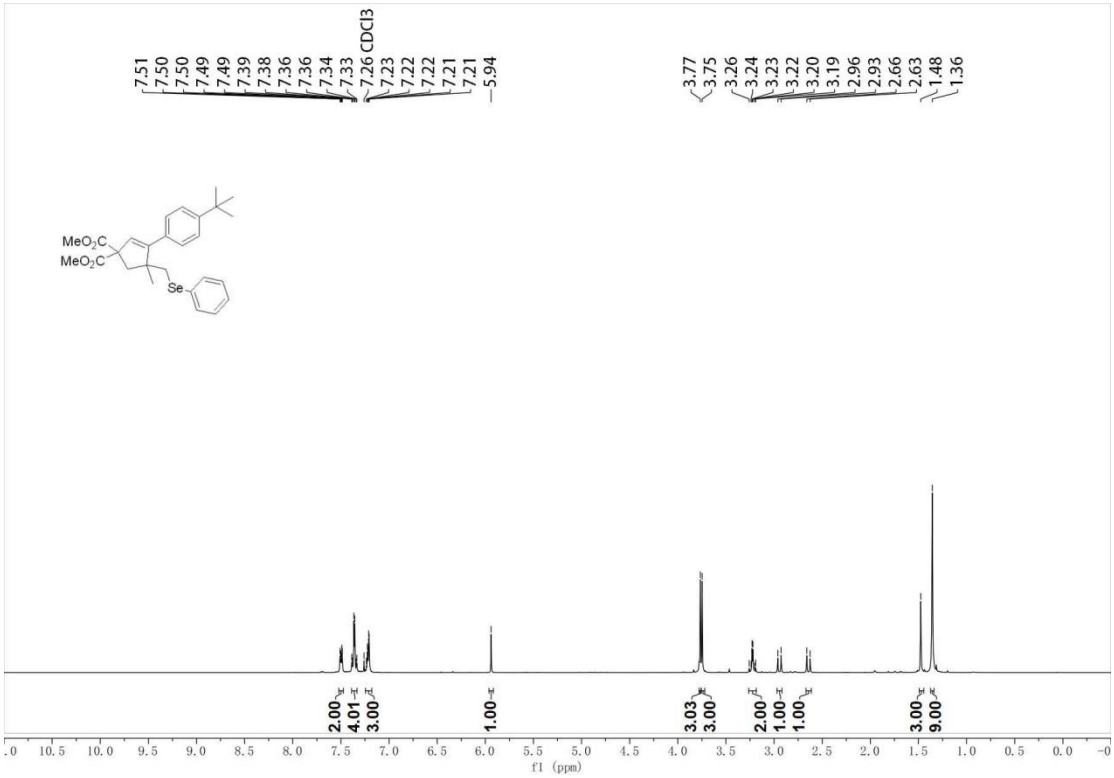


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5c**

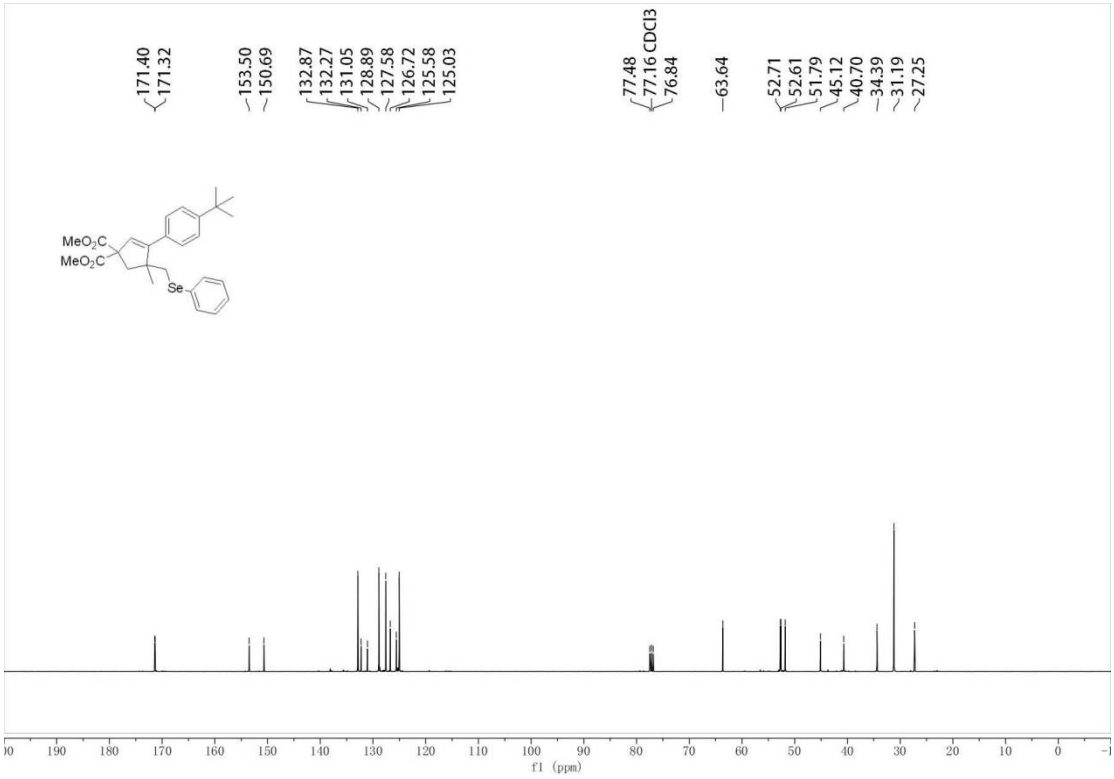


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5c**

Dimethyl 3-(4-(*tert*-butyl)phenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(5d)**

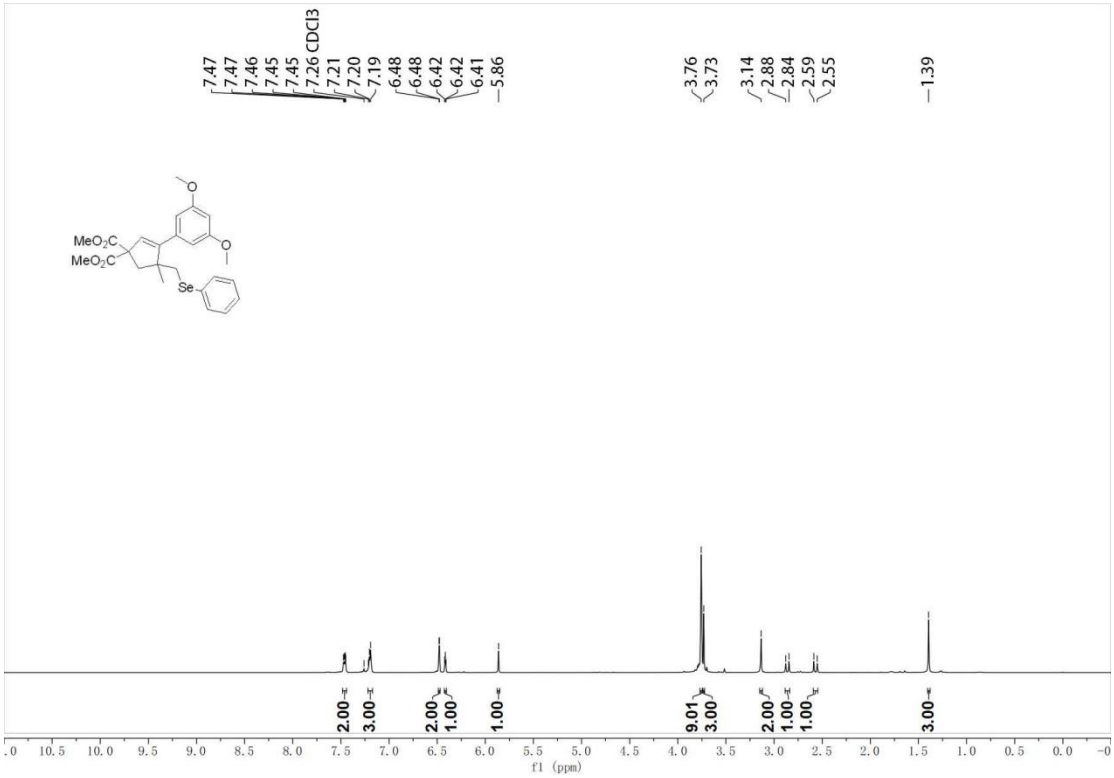


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5d**

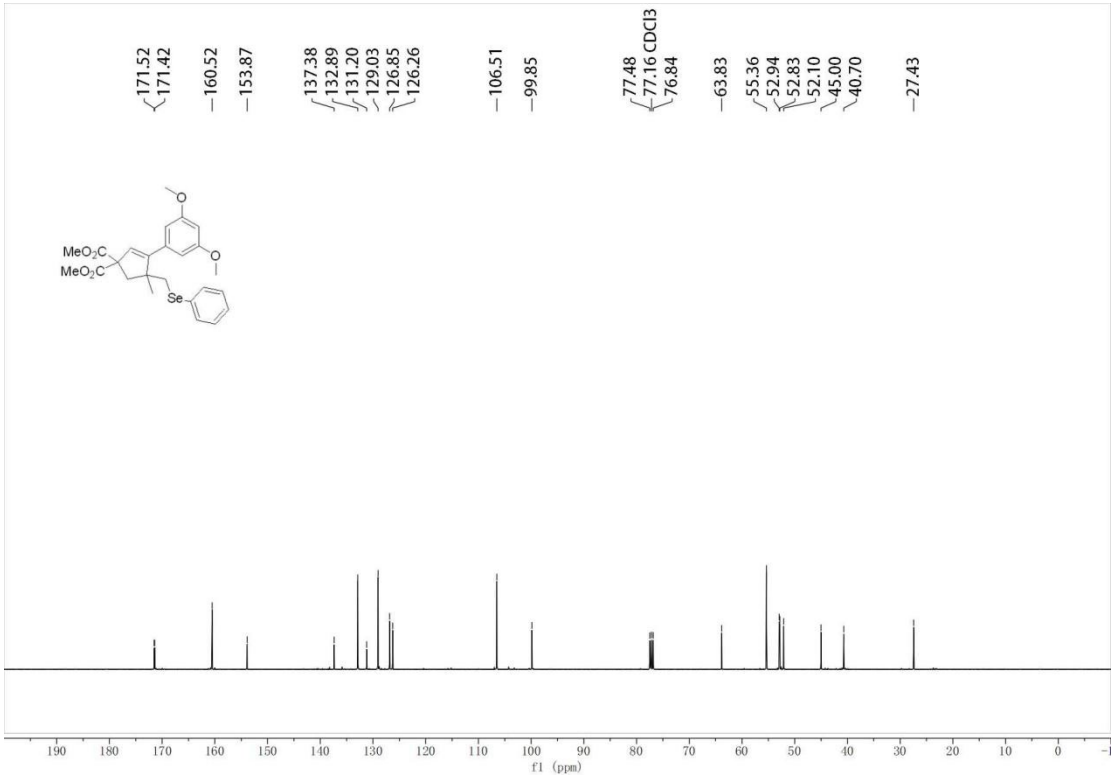


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5d**

Dimethyl 3-(3,5-dimethoxyphenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(5e)**

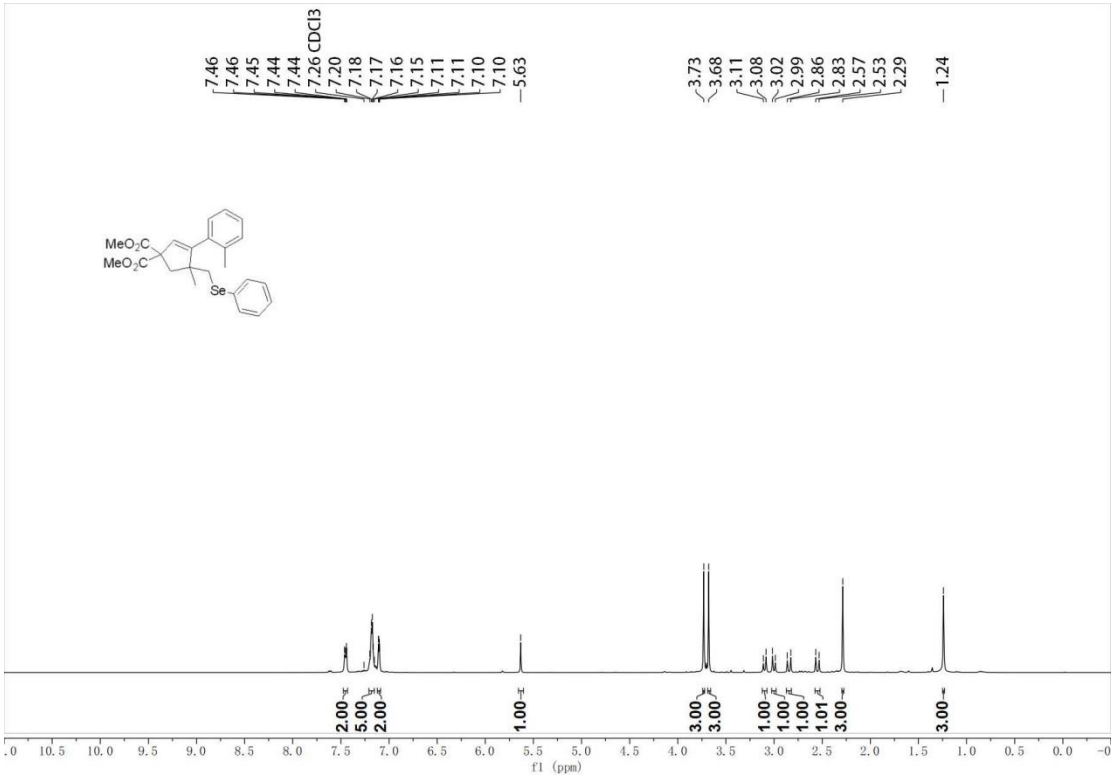


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5e**

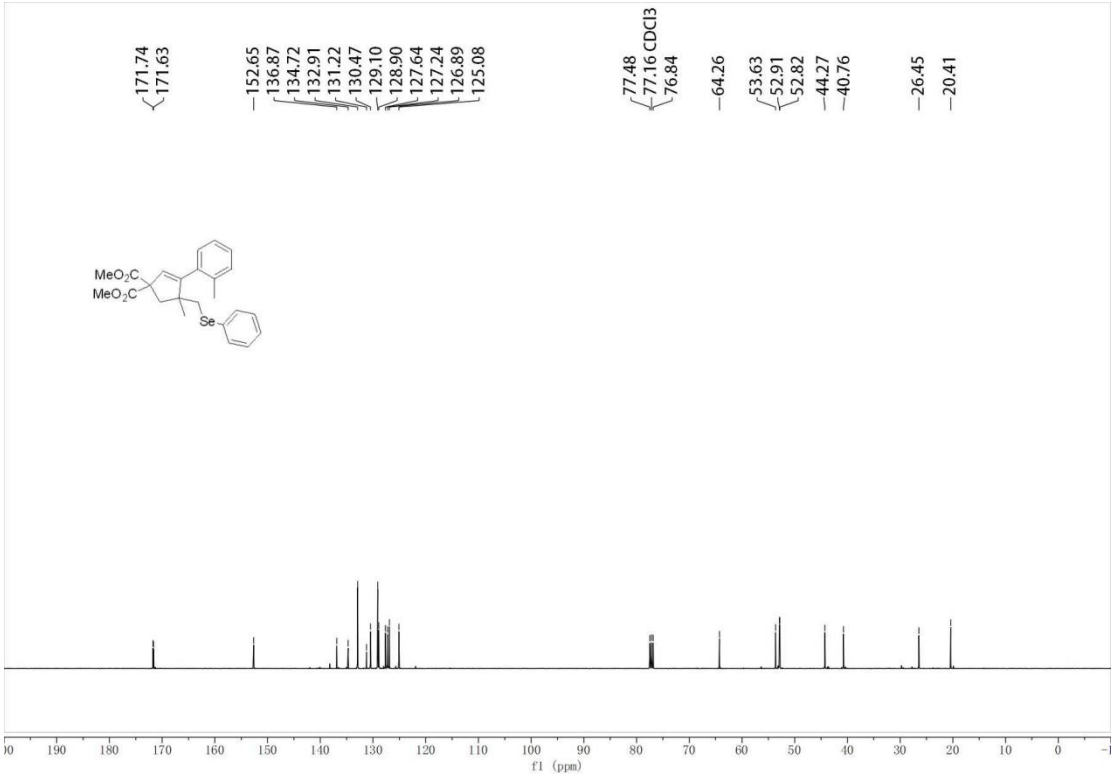


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5e**

Dimethyl 4-methyl-4-((phenylselanyl)methyl)-3-(*o*-tolyl)cyclopent-2-ene-1,1-dicarboxylate **(5f)**

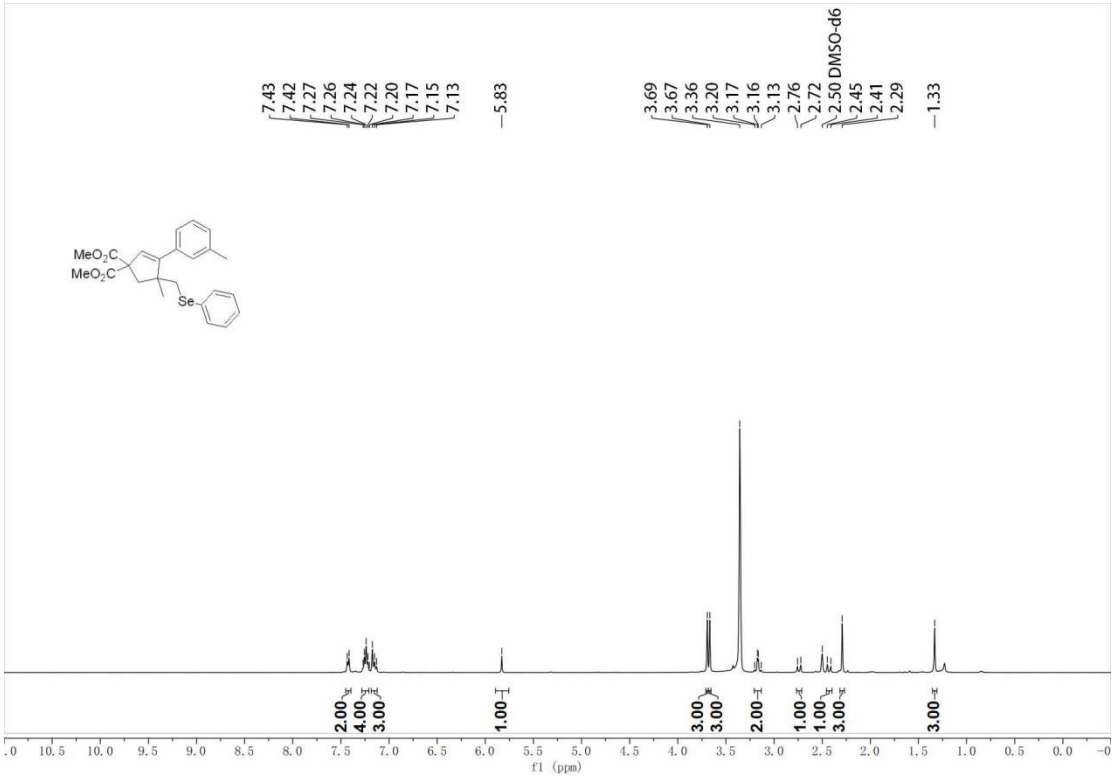


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5f**

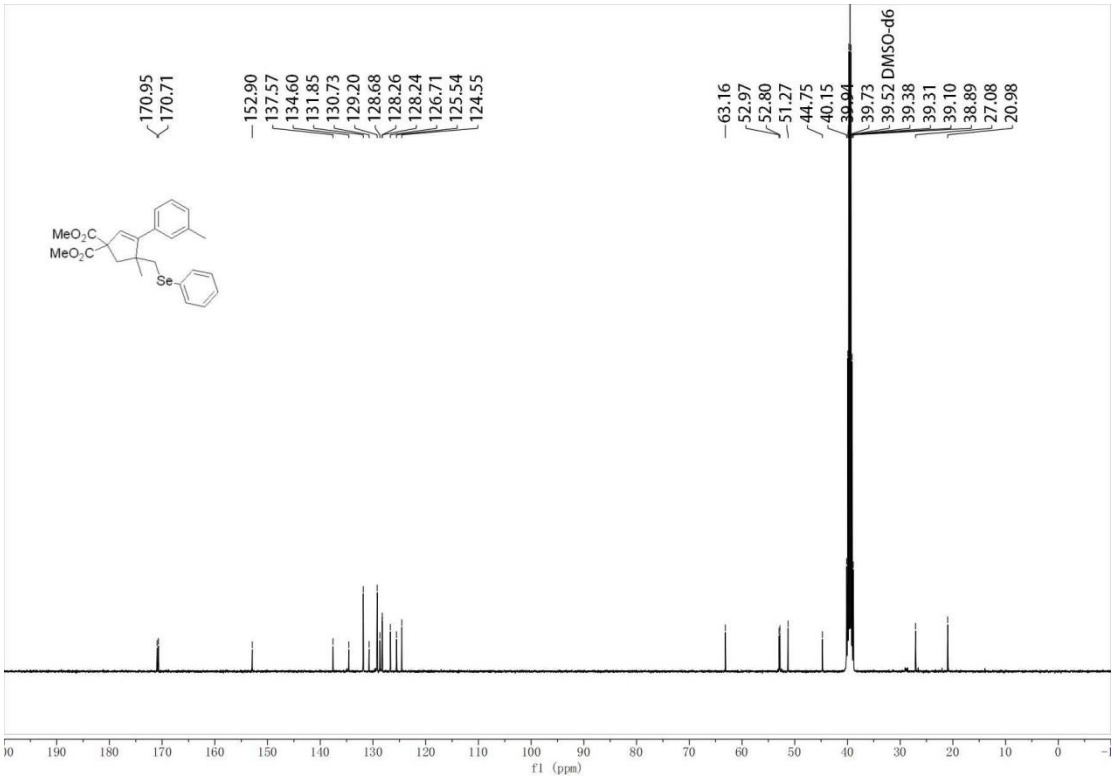


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5f**

Dimethyl 4-methyl-4-((phenylselanyl)methyl)-3-(*m*-tolyl)cyclopent-2-ene-1,1-dicarboxylate **(5g)**

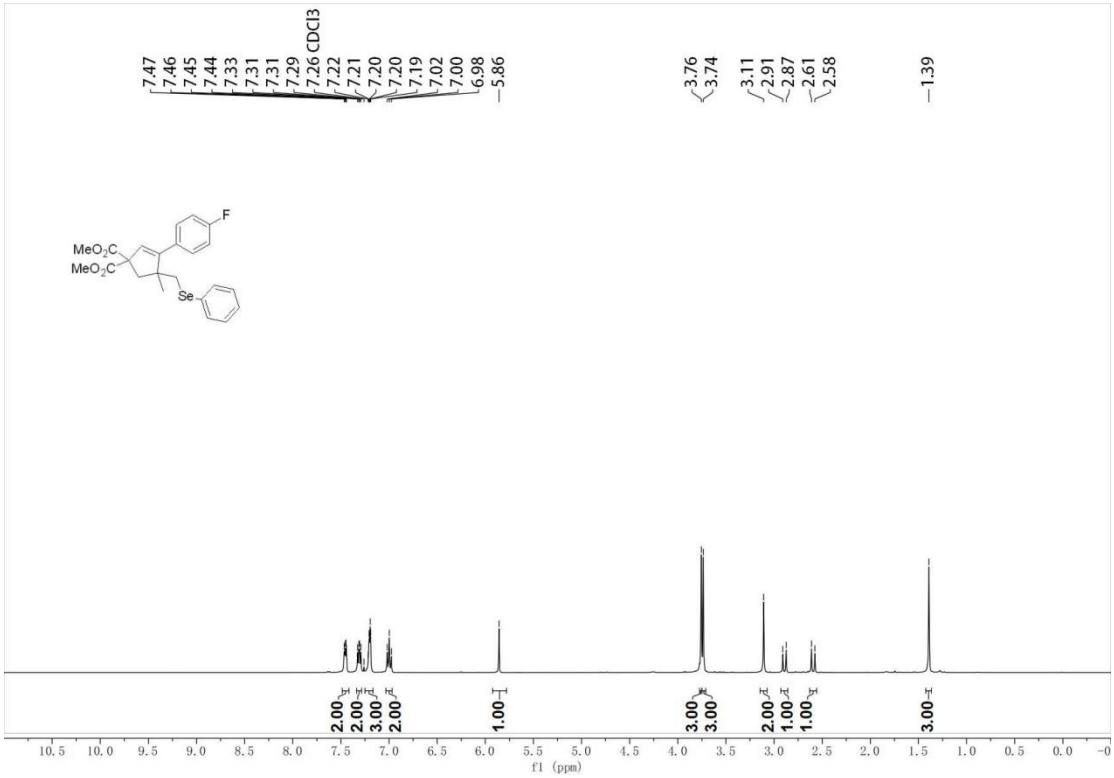


^{1}H NMR (400 MHz, DMSO-d_6) spectrum of **5g**

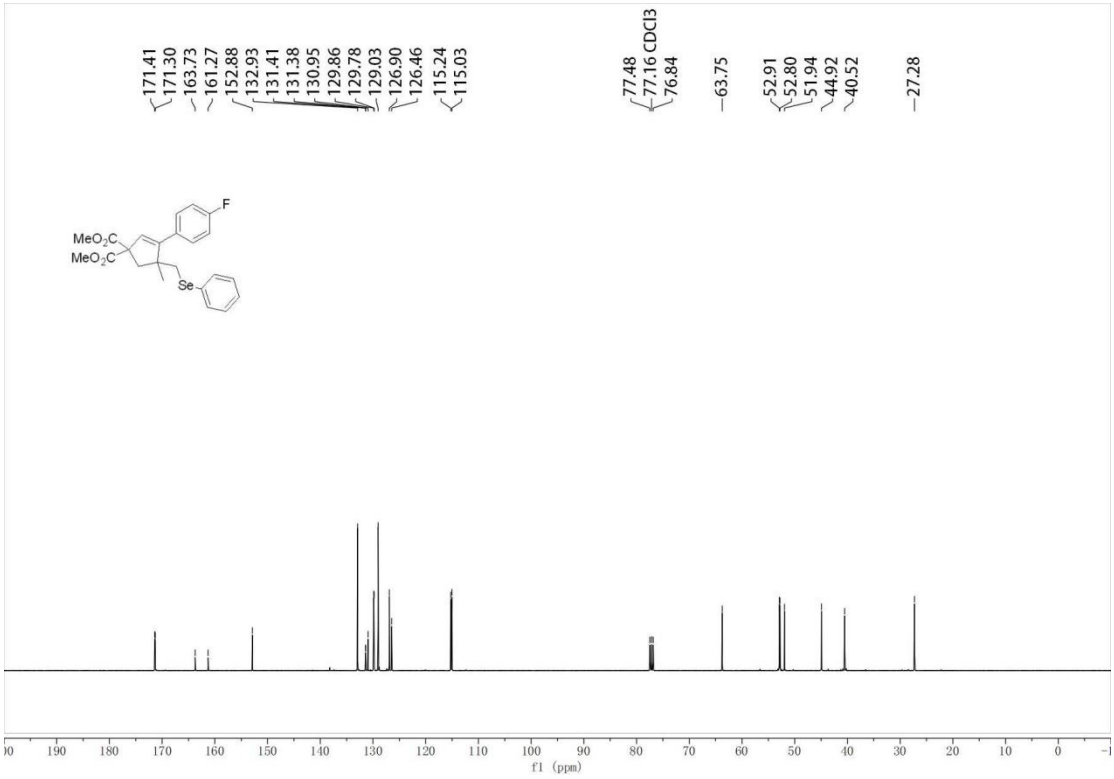


^{13}C NMR (100 MHz, DMSO-d_6) spectrum of **5g**

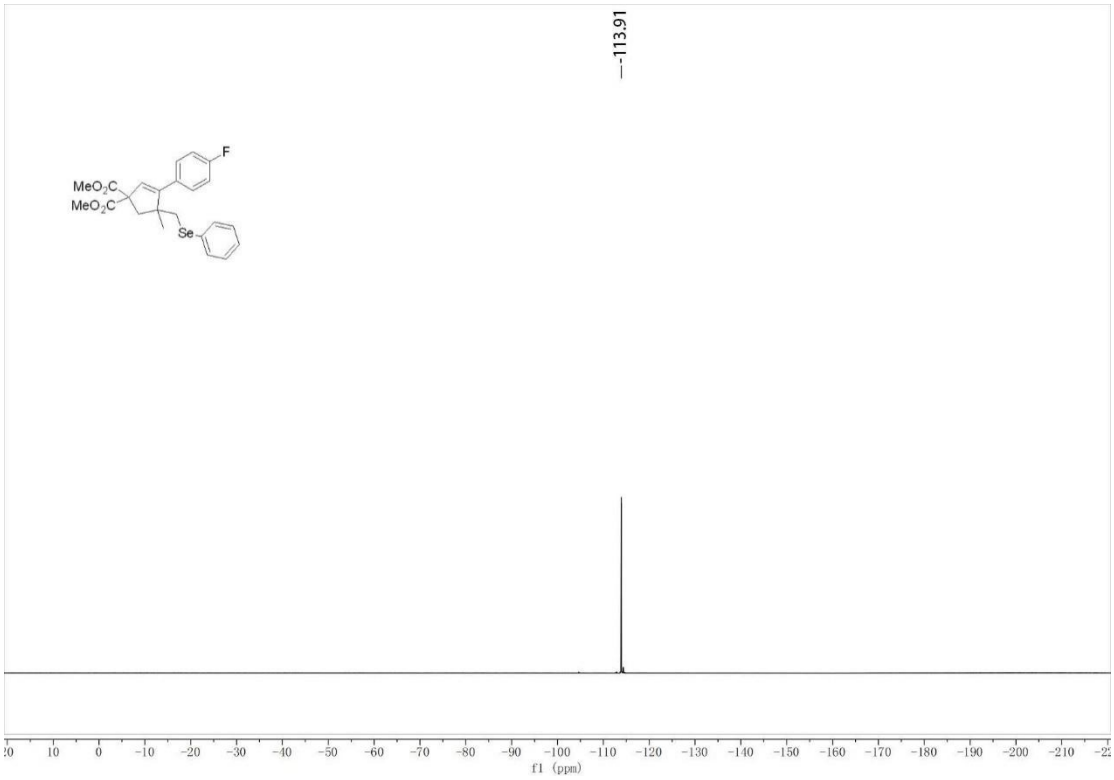
Dimethyl 3-(4-fluorophenyl)-4-methyl-4-((phenylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxy late **(5h)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **5h**

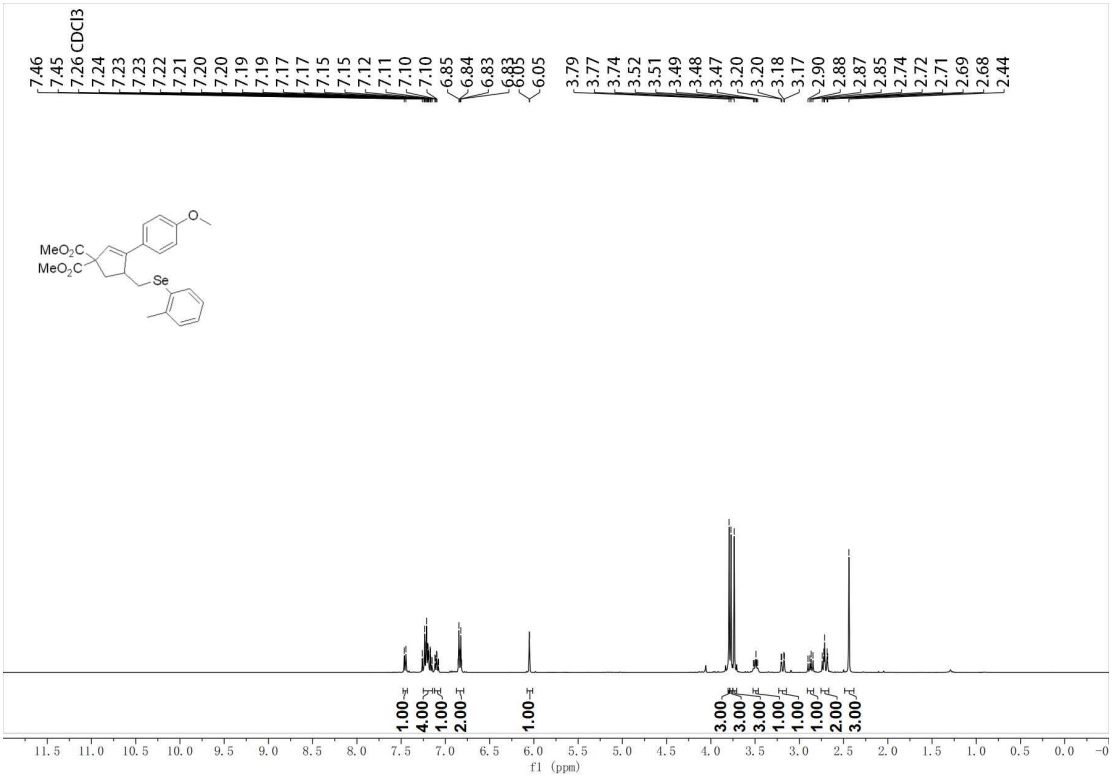


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **5h**

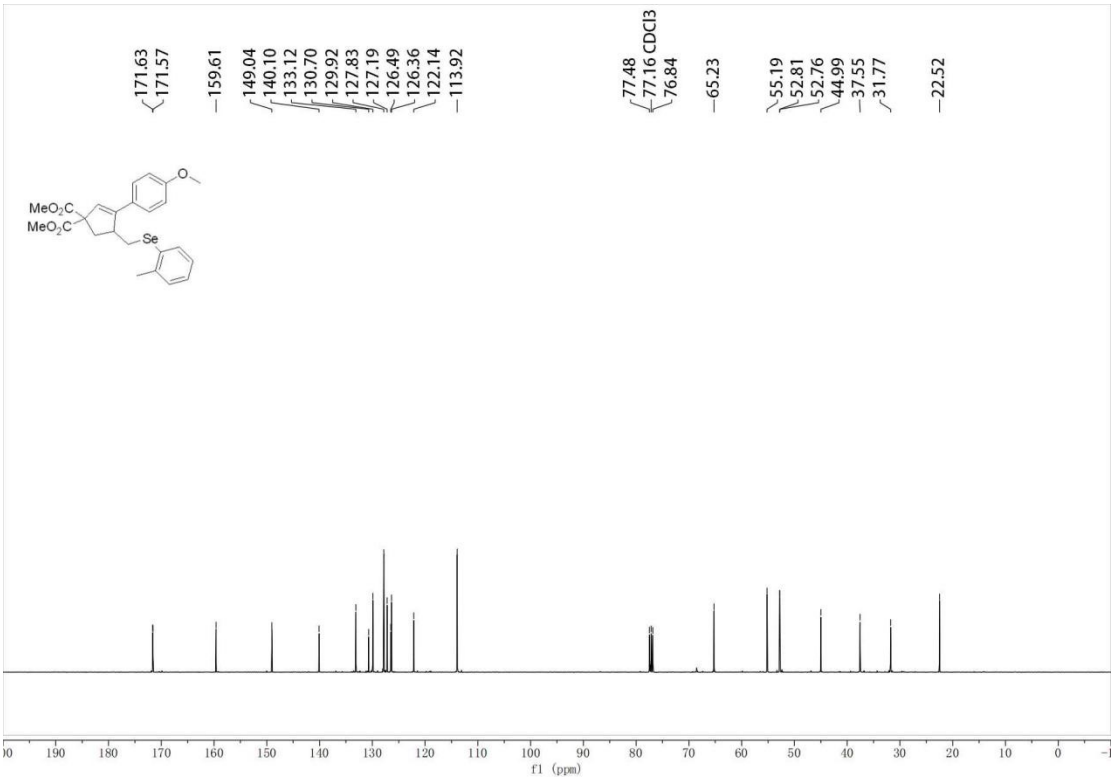


^{19}F NMR (367 MHz, $CDCl_3$) spectrum of **5h**

Dimethyl 3-(4-methoxyphenyl)-4-((*o*-tolylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6b)**

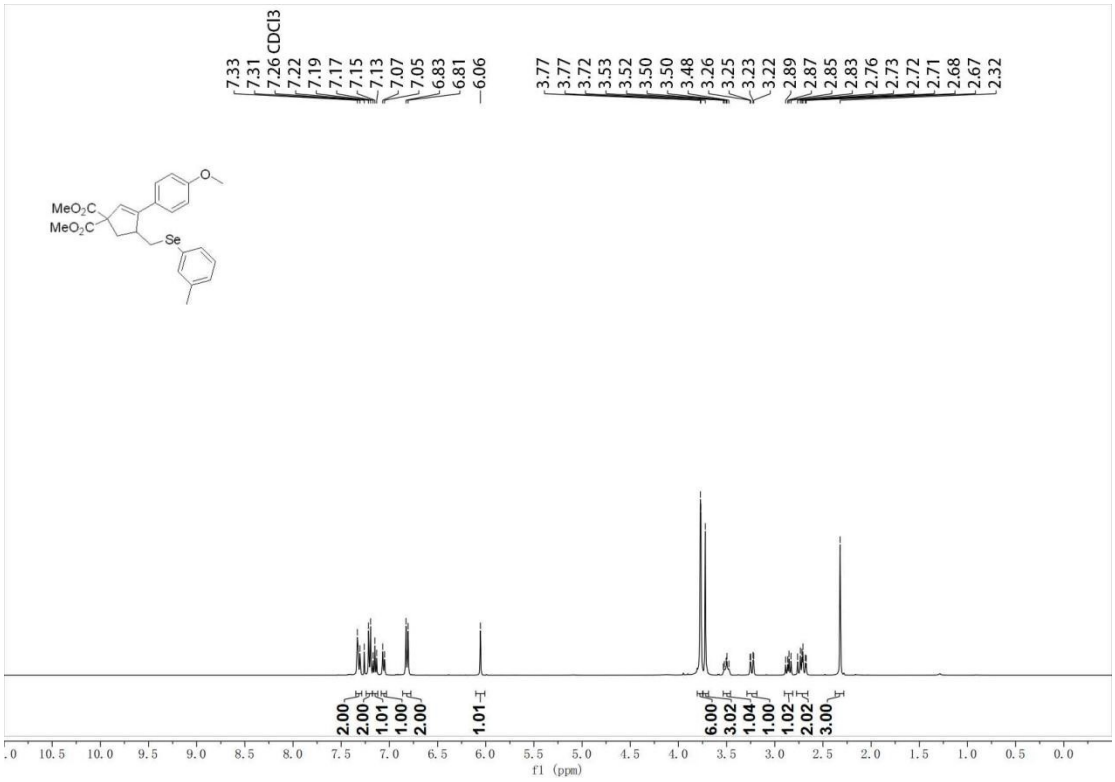


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6b**

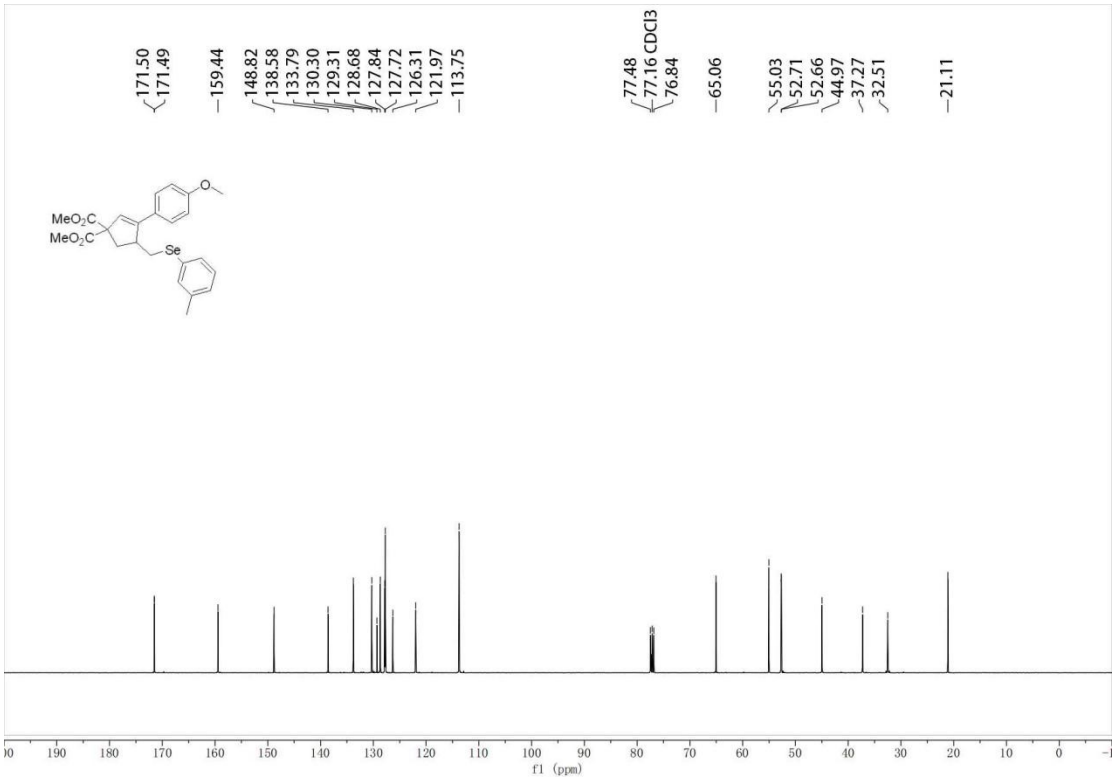


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6b**

Dimethyl 3-(4-methoxyphenyl)-4-((*m*-tolylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6c)**

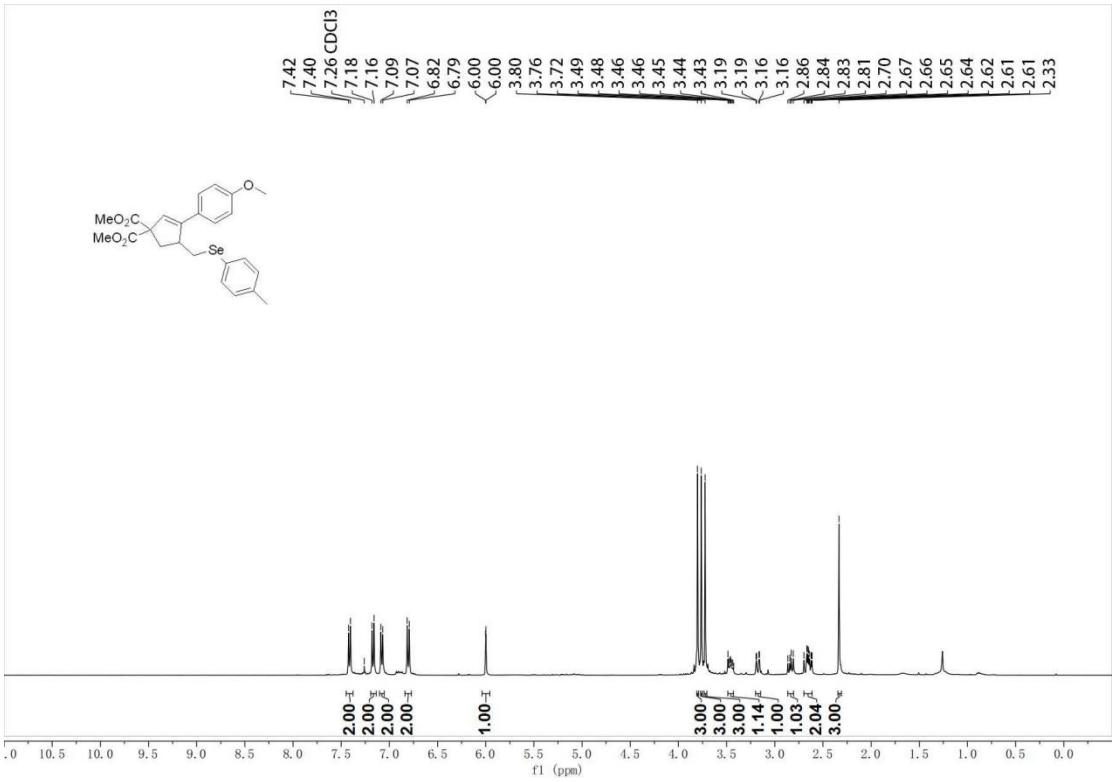


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6c**

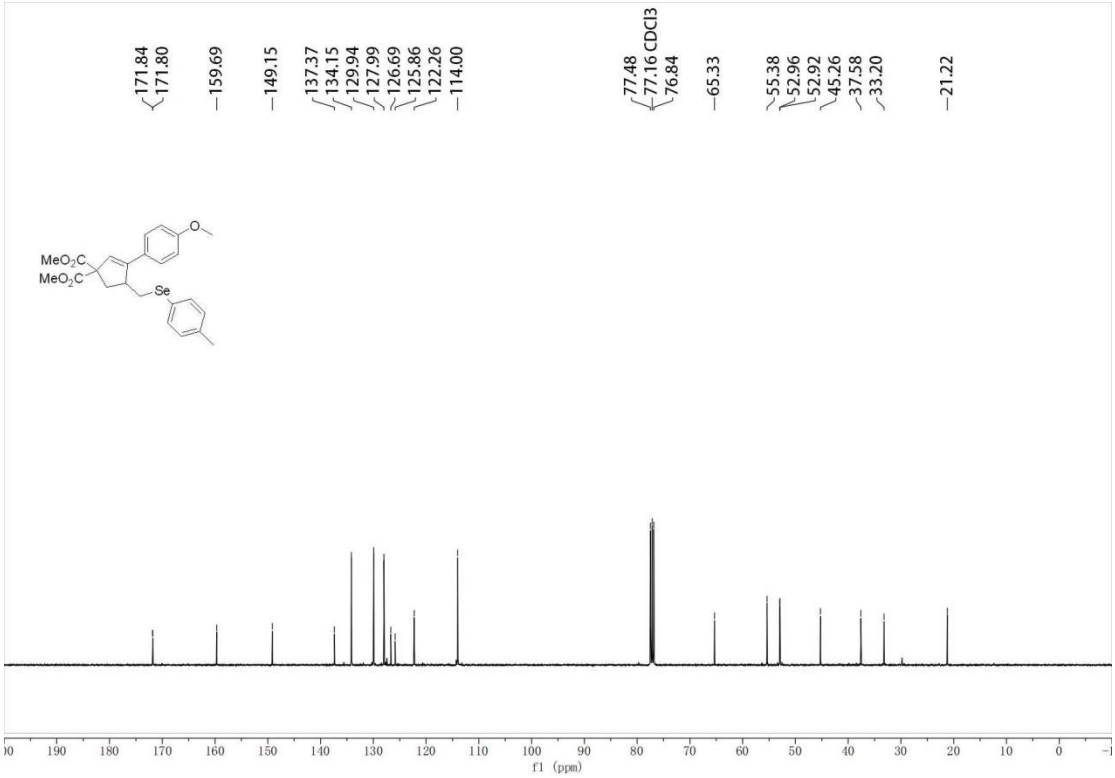


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6c**

Dimethyl 3-(4-methoxyphenyl)-4-((*p*-tolylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6d)**

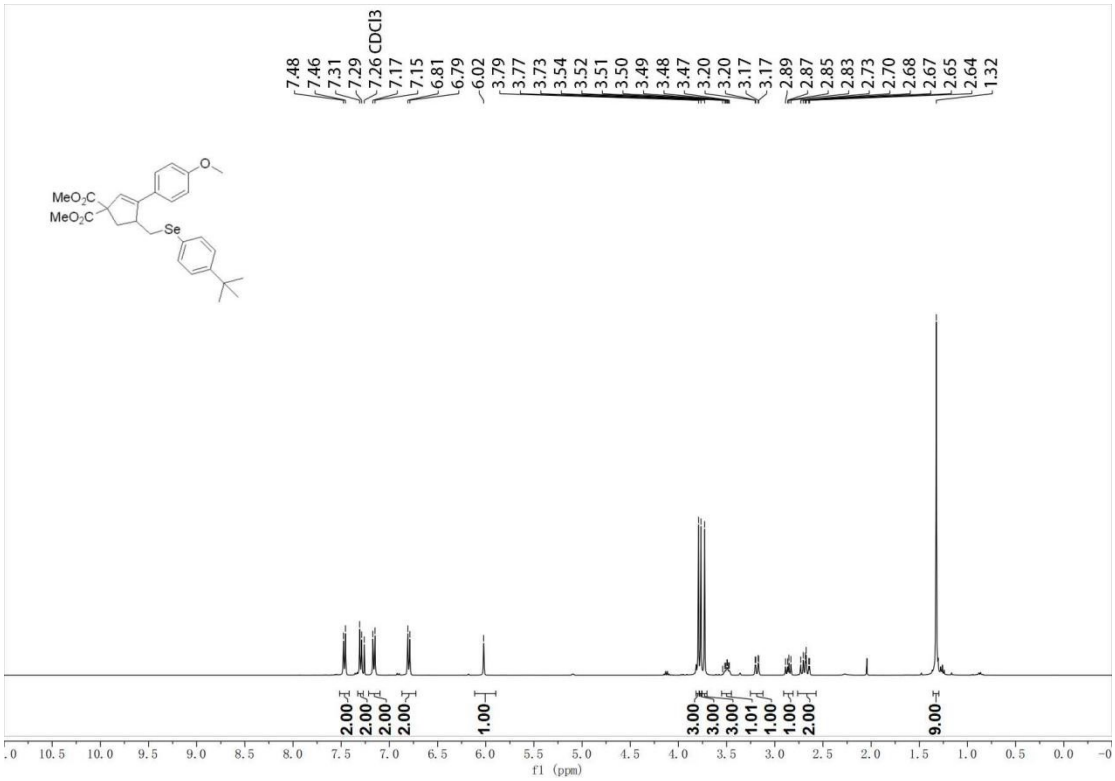


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6d**

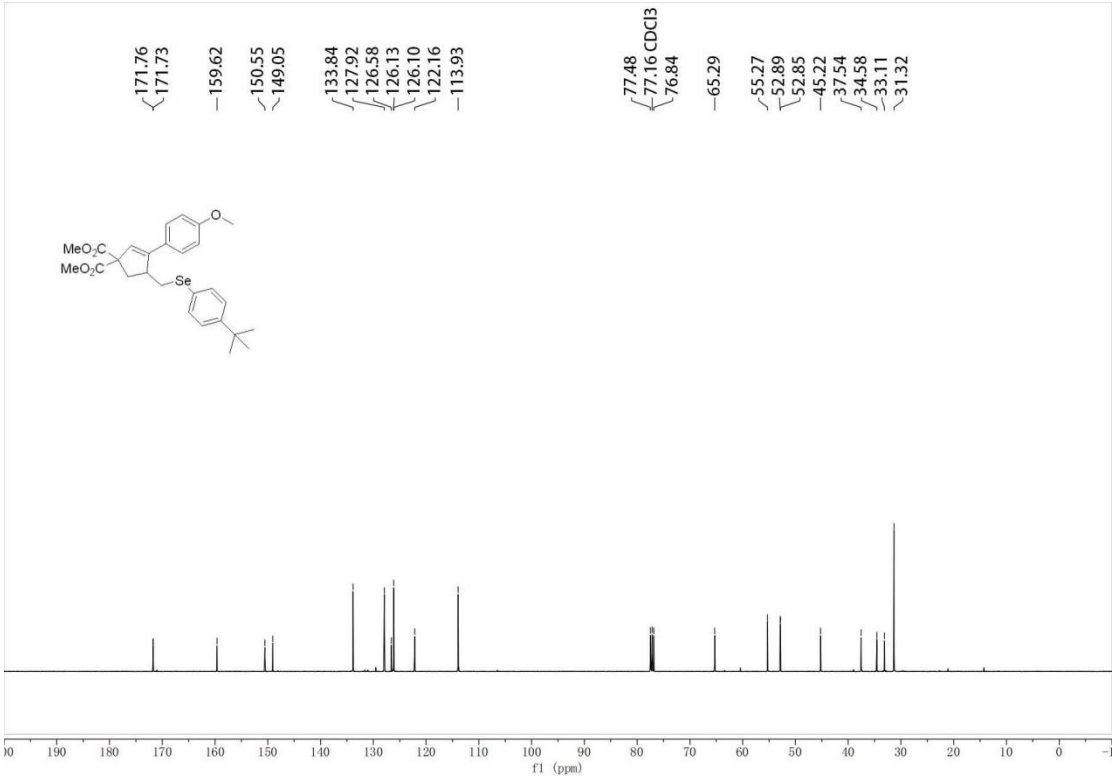


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6d**

Dimethyl 4-(((4-(*tert*-butyl)phenyl)selanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate **(6e)**

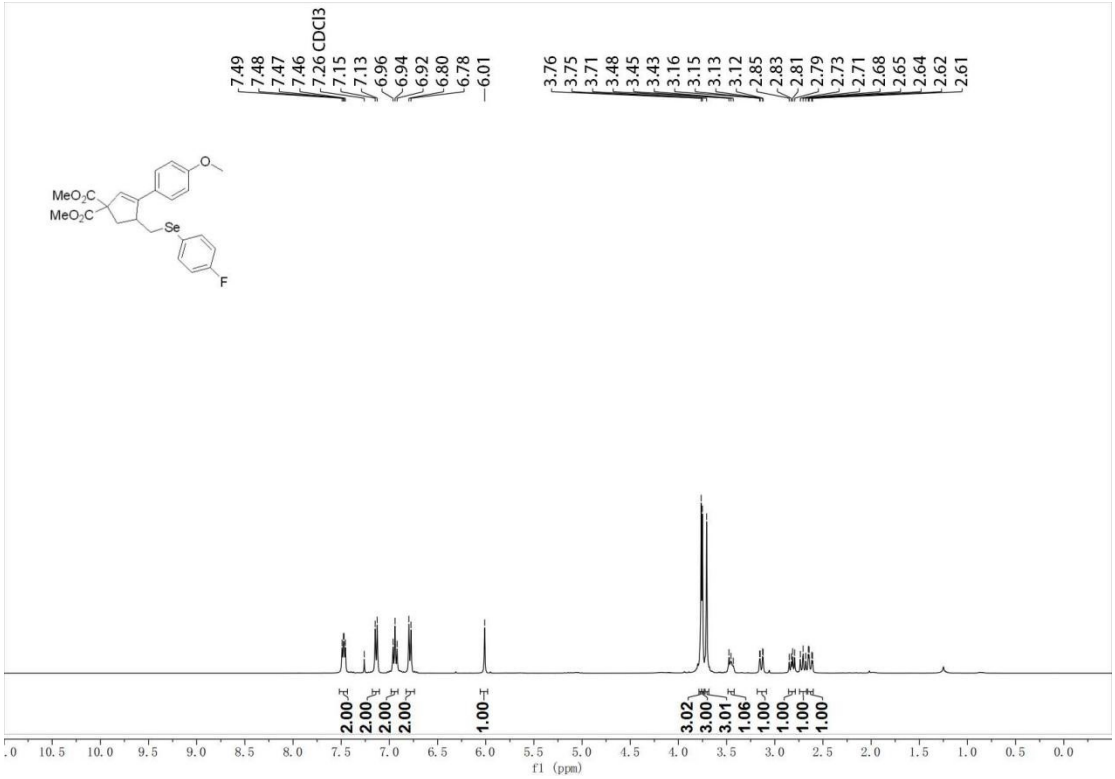


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6e**

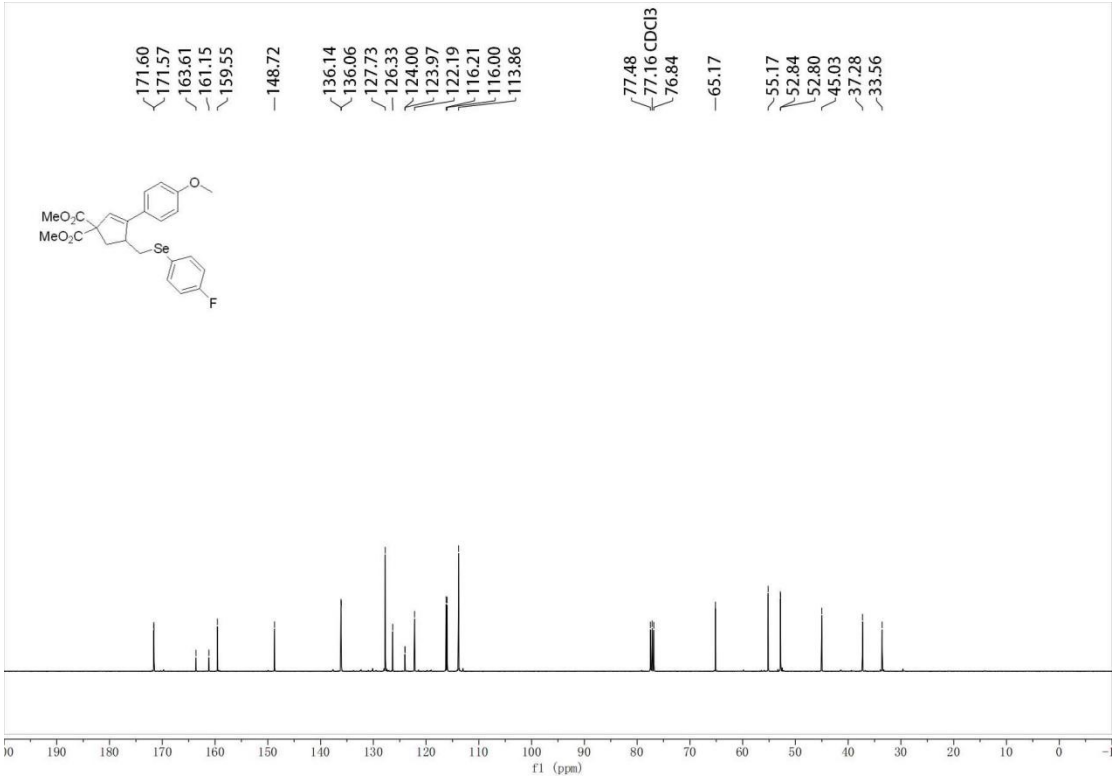


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6e**

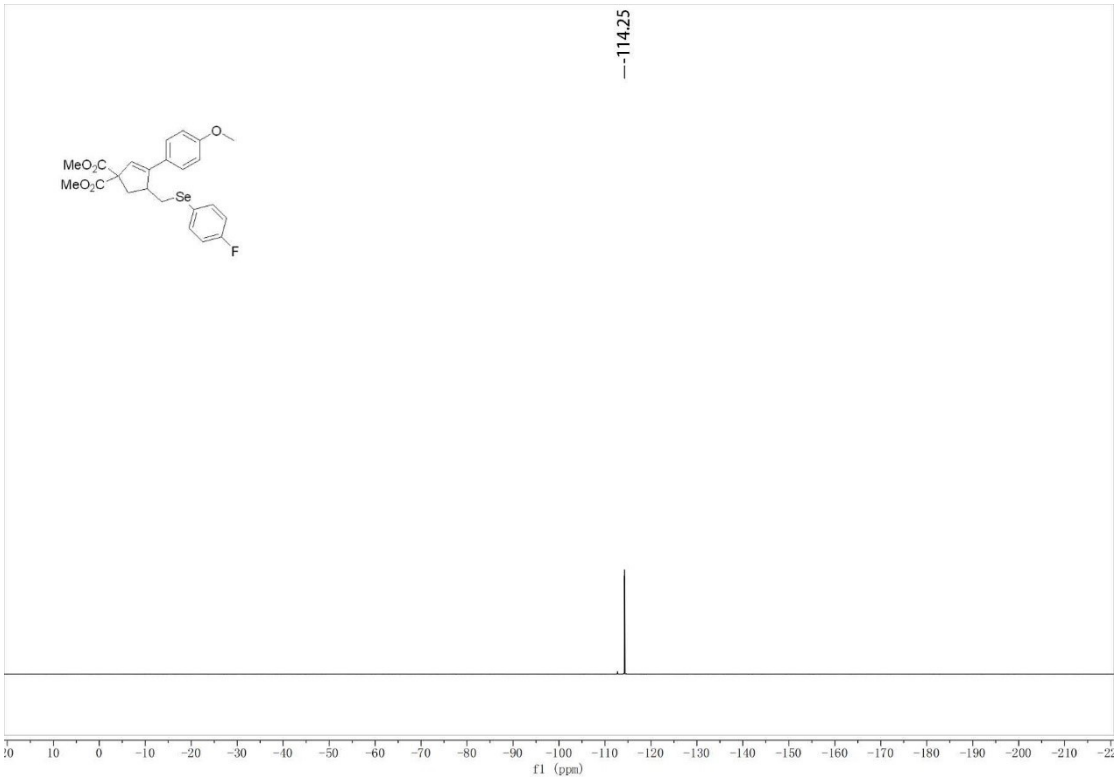
Dimethyl 4-(((4-fluorophenyl)selanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate **(6f)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6f**

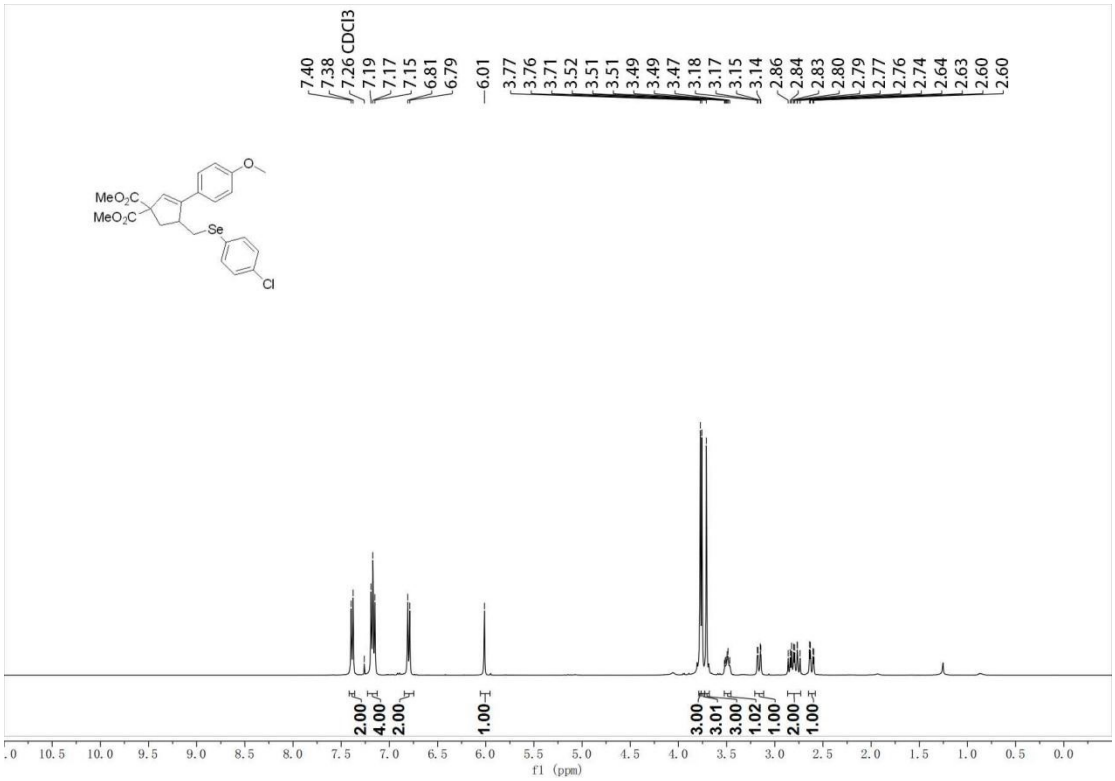


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6f**

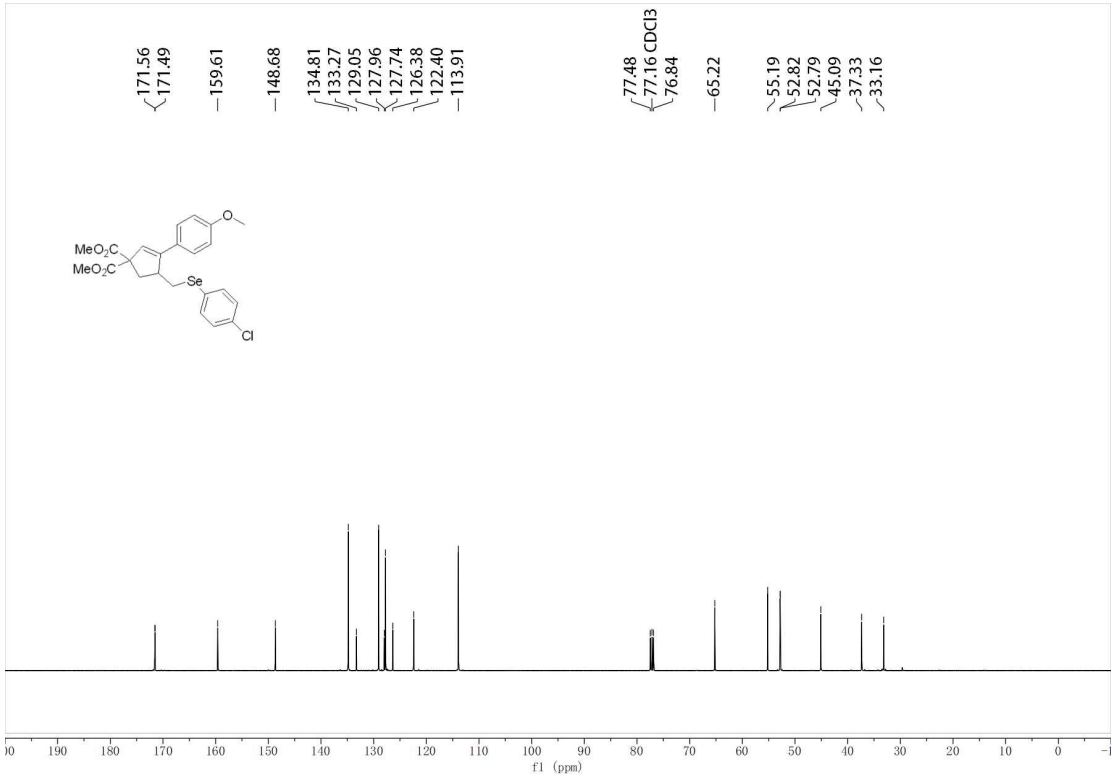


^{19}F NMR (367 MHz, $CDCl_3$) spectrum of **6f**

Dimethyl 4-(((4-chlorophenyl)selanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate **(6g)**

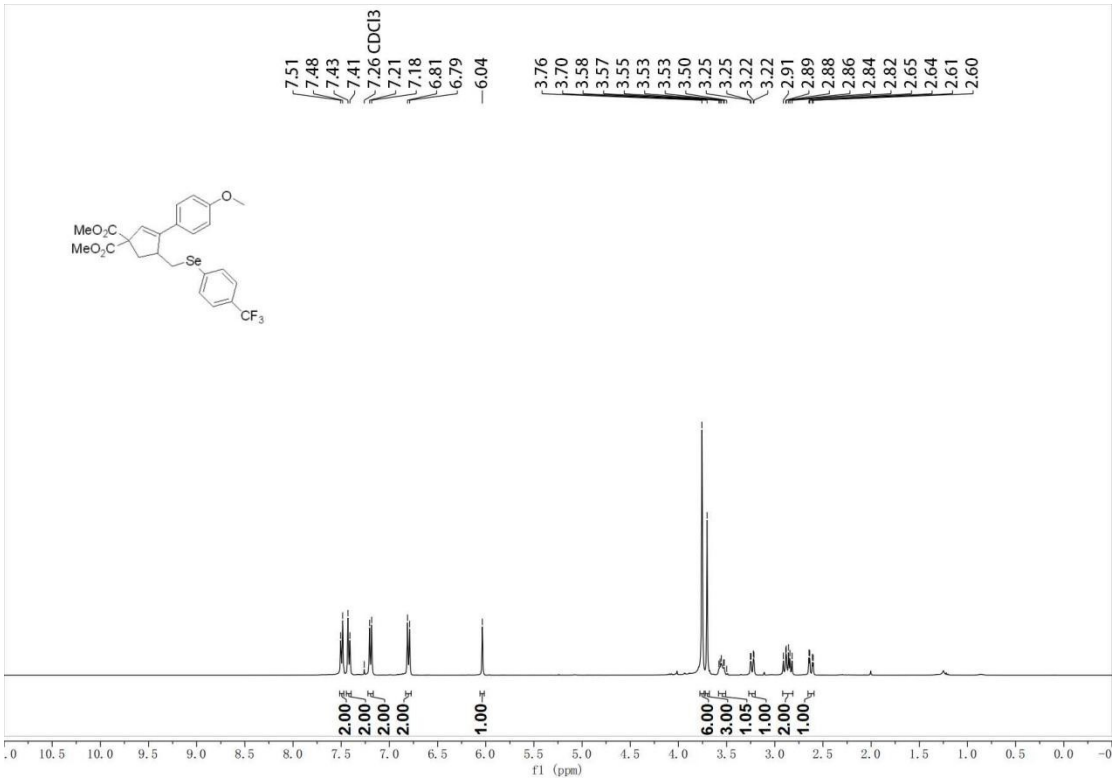


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6g**

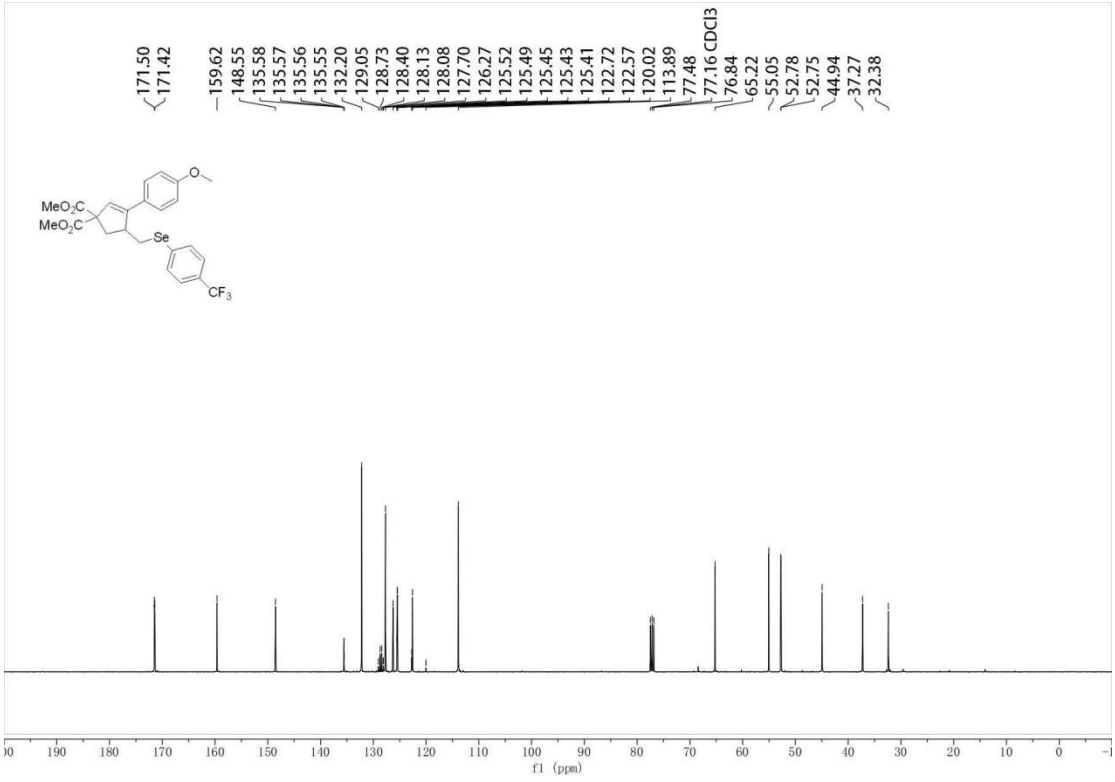


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6g**

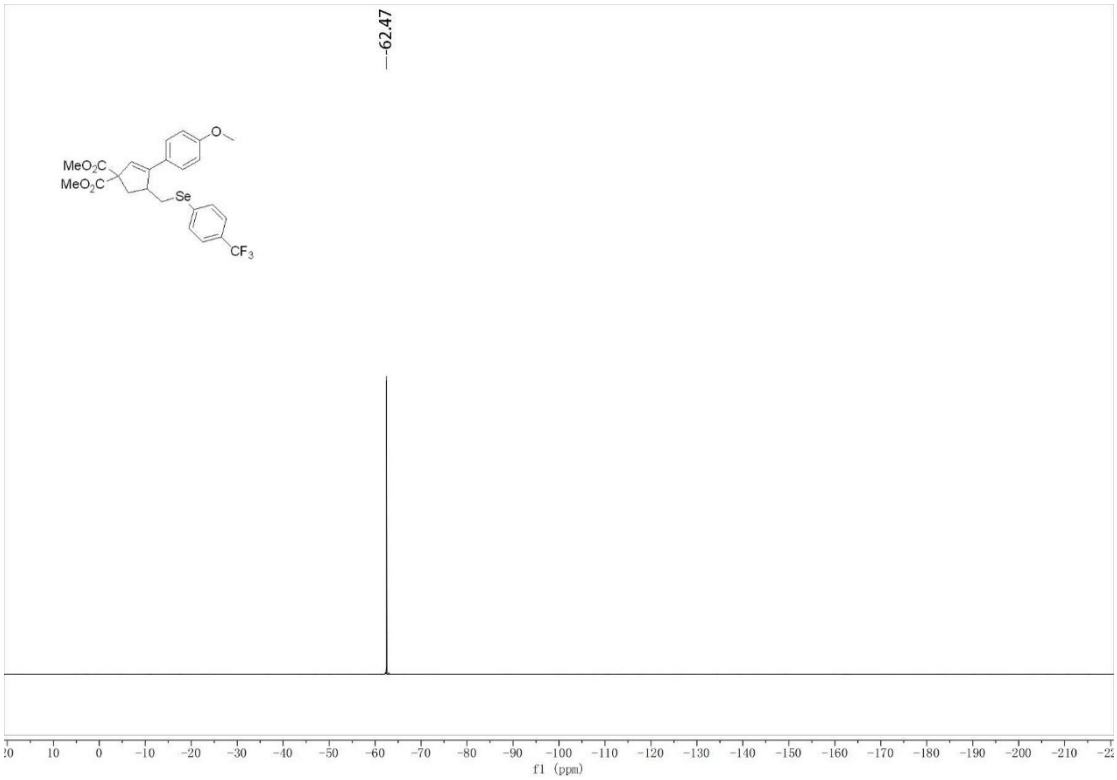
Dimethyl 3-(4-methoxyphenyl)-4-(((4-(trifluoromethyl)phenyl)selanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6h)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6h**

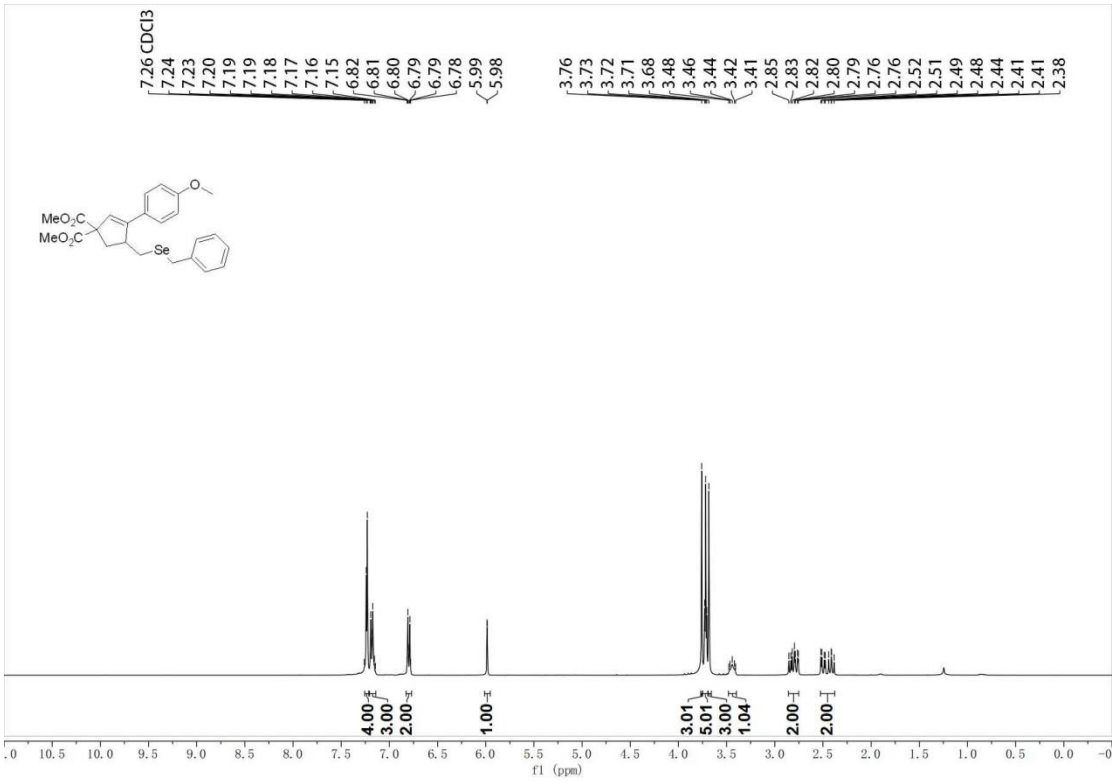


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6h**

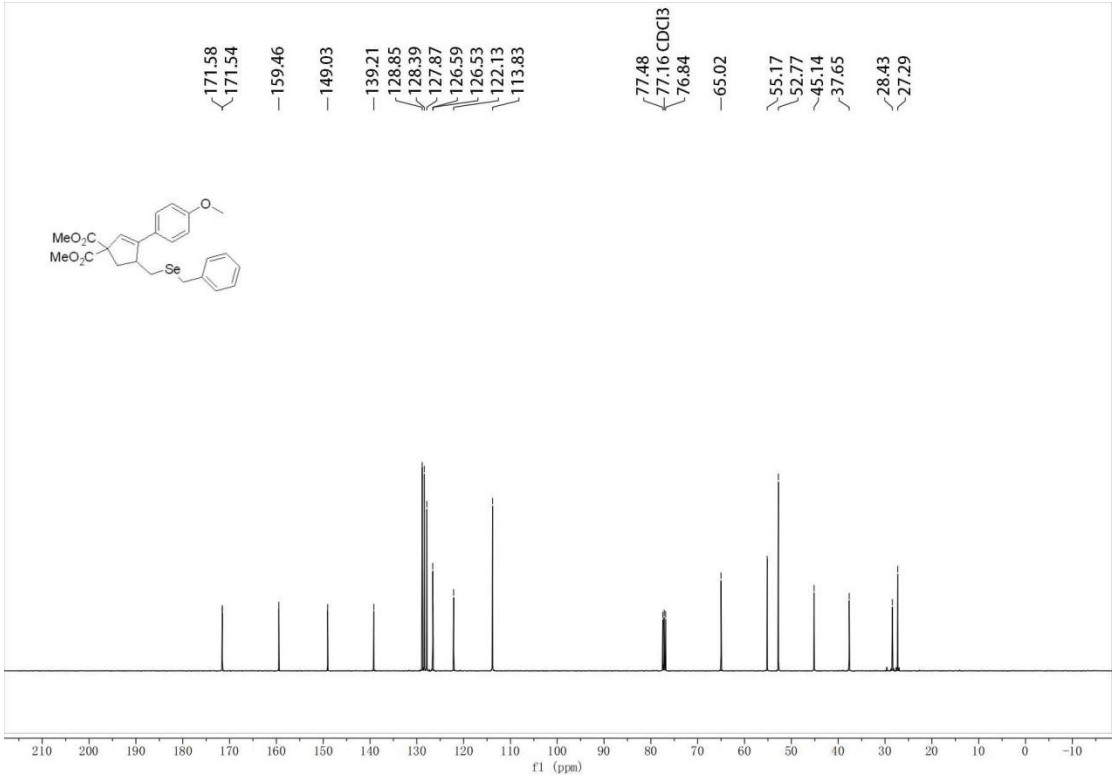


^{19}F NMR (367 MHz, $CDCl_3$) spectrum of **6h**

Dimethyl 4-((benzylselanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate **(6i)**

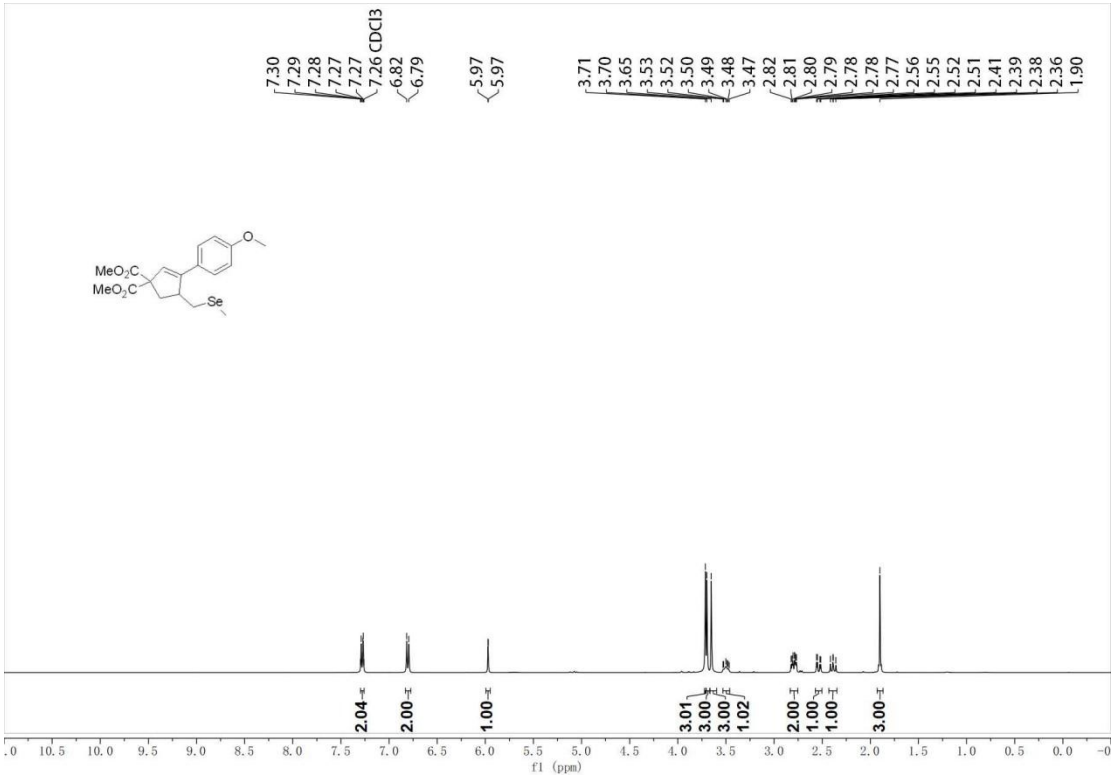


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6i**

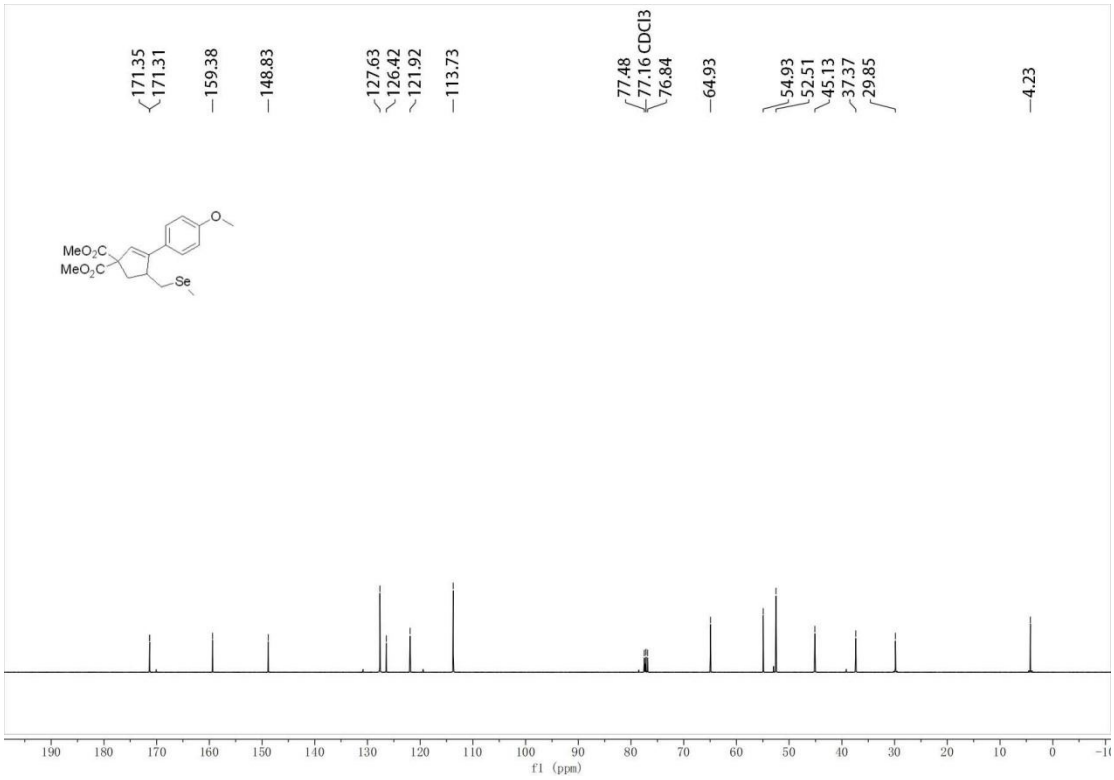


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6i**

Dimethyl 3-(4-methoxyphenyl)-4-((methylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6j)**

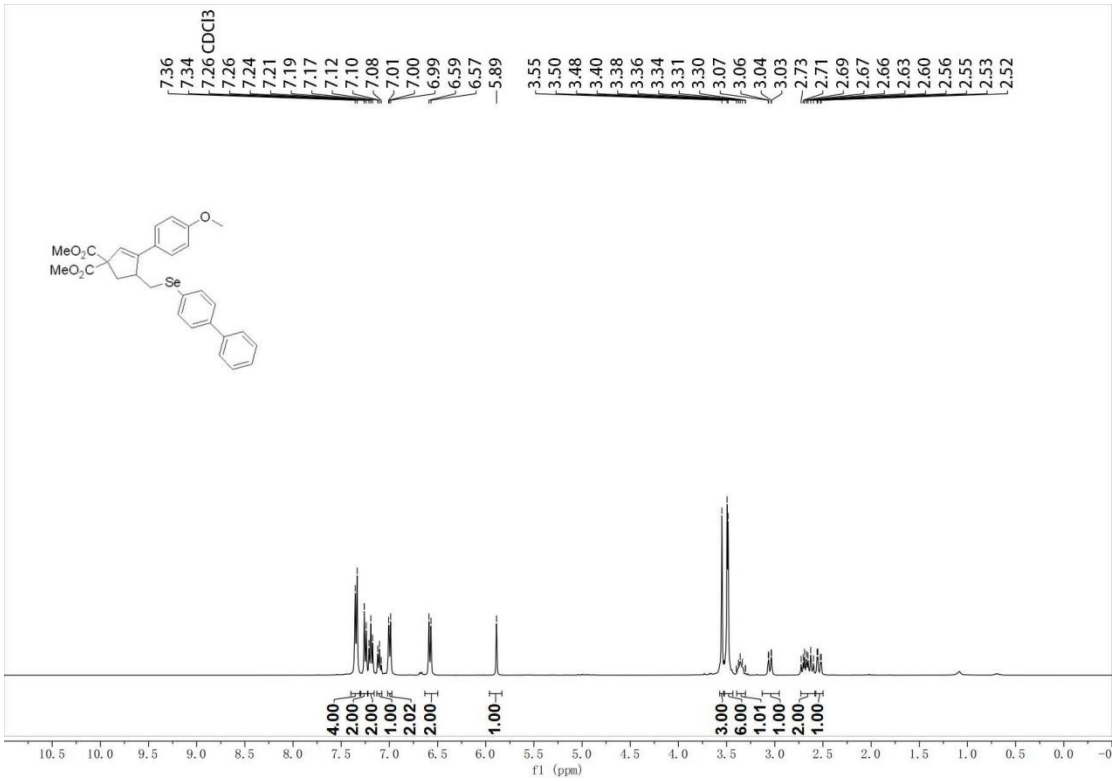


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6j**

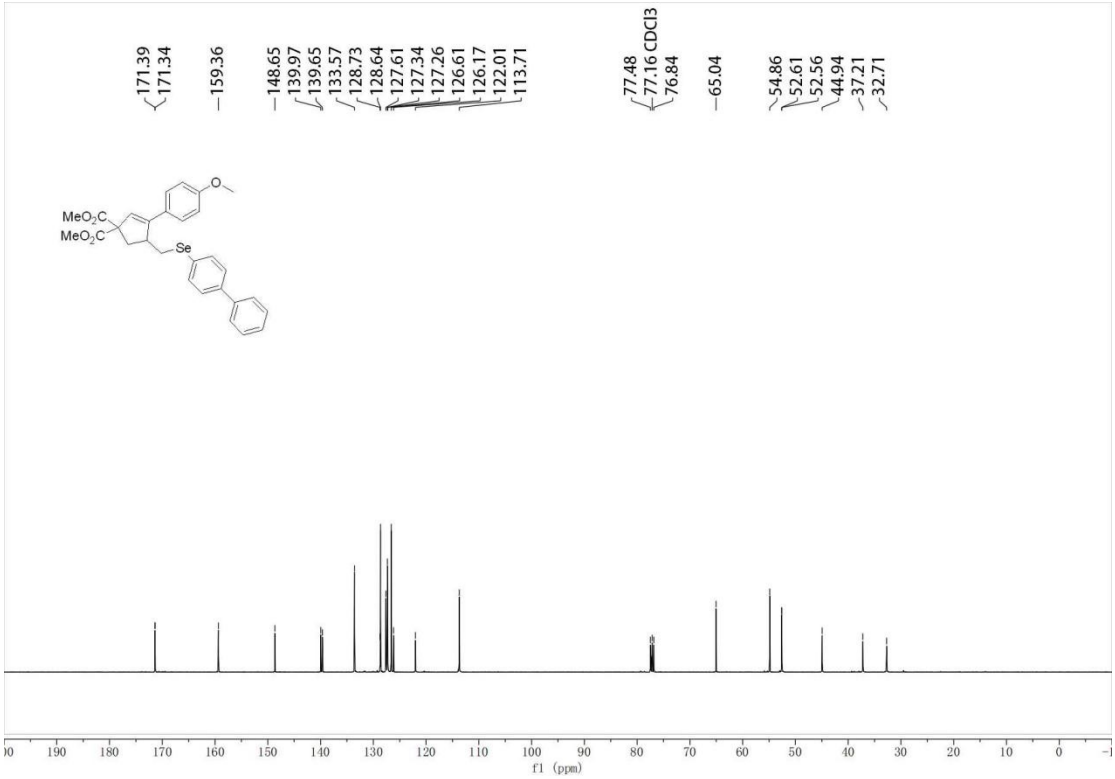


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6j**

Dimethyl 4-(([1,1'-biphenyl]-4-ylselanyl)methyl)-3-(4-methoxyphenyl)cyclopent-2-ene-1,1-dicarboxylate **(6k)**

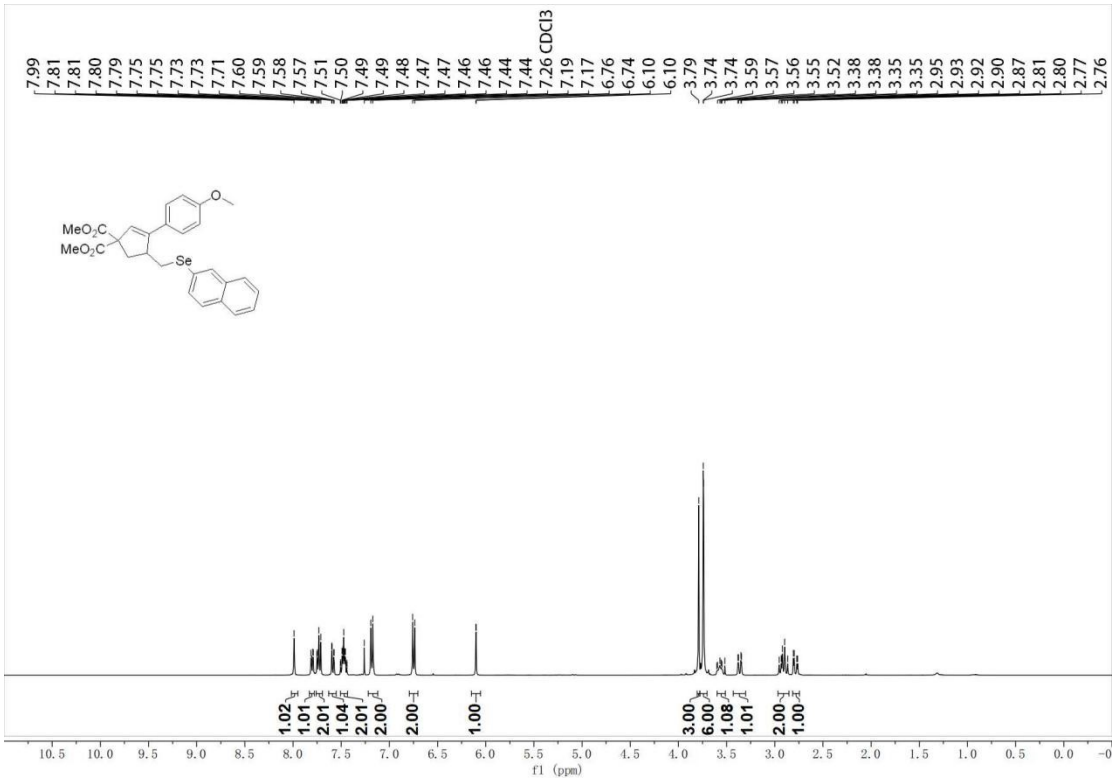


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6k**

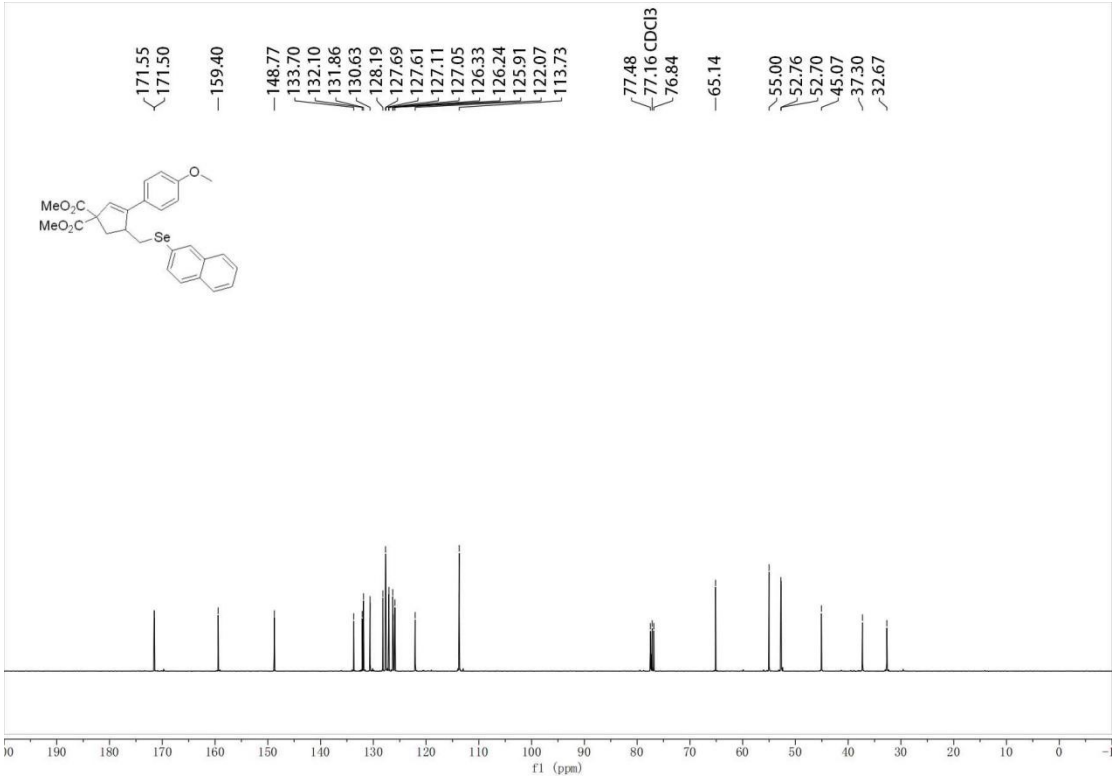


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6k**

Dimethyl 3-(4-methoxyphenyl)-4-((naphthalen-2-ylselanyl)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6l)**

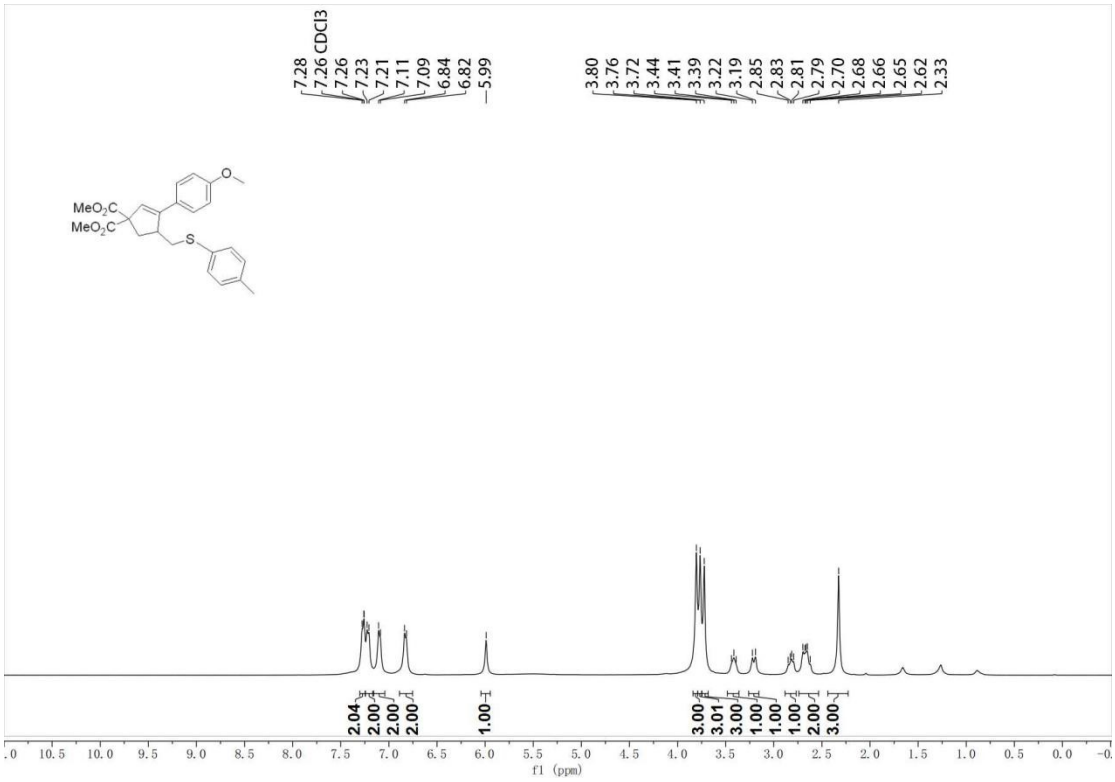


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6l**

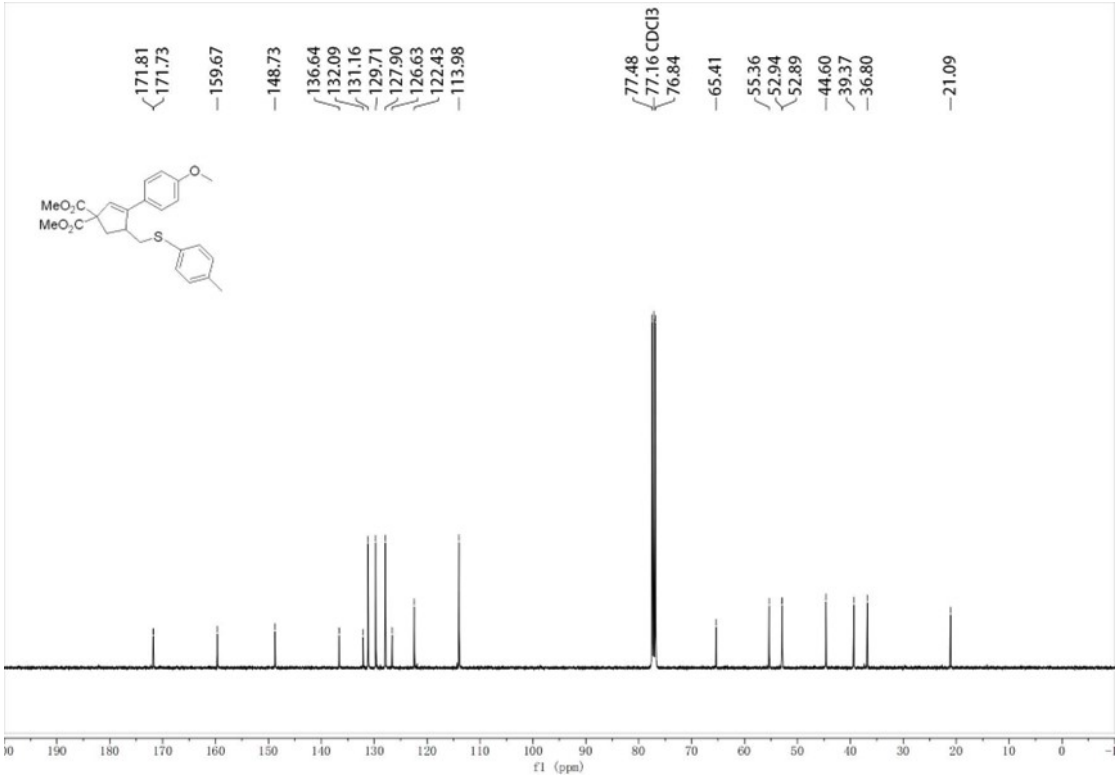


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6l**

Dimethyl 3-(4-methoxyphenyl)-4-((*p*-tolylthio)methyl)cyclopent-2-ene-1,1-dicarboxylate **(6m)**



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of **6m**



^{13}C NMR (100 MHz, $CDCl_3$) spectrum of **6m**