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Supporting Information

Unprecedented Access to β -Arylated Selenophenes through Palladium-Catalysed Direct Arylation

Aymen Skhiri,^[a, b] Ridha Ben Salem,^{*[b]} Jean-François Soulé,^{*[a]} and Henri Doucet^{*[a]}

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Supplementary material

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Aymen Skhiri,^[a,b] Ridha Ben Salem,^{[b]} Jean-François Soulé,^{*[a]} Henri Doucet^{*[a]}*

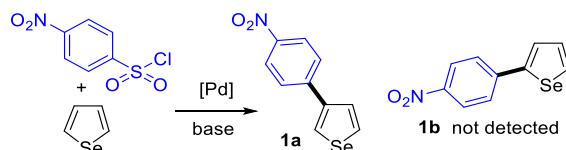
[a] Institut des Sciences Chimiques de Rennes, UMR 6226 CNRS-Université de Rennes 1 "Organométalliques: Matériaux et Catalyse", Campus de Beaulieu, 35042 Rennes, France.

[b] Laboratoire de Chimie Organique Physique (UR 11ES74) Université de Sfax, Faculté des Sciences de Sfax, Route de la Soukra km 4, 3038 Sfax, Tunisia.

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Table 1. Influence of the reaction conditions for the Pd-catalysed coupling of 4-nitrobenzenesulfonyl chloride with selenophene.



| Entry | Catalyst | Base (equiv.) | Solvent | Yield in 1a (%) |
|-------|--|-------------------------------------|-------------|------------------------|
| 1 | Pd(OAc) ₂ | Li ₂ CO ₃ (3) | 1,4-dioxane | 56 |
| 2 | PdCl(C ₃ H ₅)(dppb) | Li ₂ CO ₃ (3) | 1,4-dioxane | 11 |
| 3 | PdCl ₂ | Li ₂ CO ₃ (3) | 1,4-dioxane | 14 |
| 4 | Pd(MeCN) ₂ Cl ₂ | Li ₂ CO ₃ (3) | 1,4-dioxane | 19 |
| 5 | Pd(OAc) ₂ | Li ₂ CO ₃ (6) | 1,4-dioxane | 84 (79) |
| 6 | Pd(OAc) ₂ ^a | Li ₂ CO ₃ (6) | 1,4-dioxane | 38 |
| 7 | Pd(OAc) ₂ | K ₂ CO ₃ (6) | 1,4-dioxane | 33 |
| 8 | Pd(OAc) ₂ | Na ₂ CO ₃ (6) | 1,4-dioxane | 30 |
| 9 | Pd(OAc) ₂ | Cs ₂ CO ₃ (6) | 1,4-dioxane | 5 |
| 10 | Pd(OAc) ₂ | K ₃ PO ₄ (6) | 1,4-dioxane | 18 |
| 11 | Pd(OAc) ₂ | KOAc (6) | 1,4-dioxane | <5 |
| 12 | Pd(OAc) ₂ | Li ₂ CO ₃ (6) | DMSO | 0 |
| 13 | Pd(OAc) ₂ | Li ₂ CO ₃ (6) | xlenes | 7 |
| 14 | Pd(OAc) ₂ | Li ₂ CO ₃ (6) | 1,4-dioxane | 16 ^b |
| 15 | Pd(PPh ₃) ₄ | Li ₂ CO ₃ (6) | 1,4-dioxane | 11 |

Conditions: [Pd] 10 mol%, 4-nitrobenzenesulfonyl chloride (1.5 equiv.), selenophene (1 equiv.), yield determined by GC and crude ^1H NMR, 4 h, yield in parenthesis is isolated **1a**. ^a Pd(OAc)₂ 5 mol%. ^b 120 °C.



General:

Pd(OAc)₂, [Pd(C₃H₅)Cl]₂, 1,4-bis(diphenylphosphino)butane (98%) were purchased from Alfa Aesar. Selenophene (>98%) was purchased from TCI. Li₂CO₃ (>99%) was used. These compounds were not purified before use. DMA (99%) was purchased from Acros. Dioxane analytical grade was not distilled before used. 2-(4-Chlorophenyl)selenophene, 1-(4-(selenophen-2-yl)phenyl)ethan-1-one and 2-(4-methylphenyl)selenophene were prepared using a reported procedure.¹

All reactions were carried out under an inert atmosphere with standard Schlenk techniques. ¹H NMR spectra were recorded on Bruker GPX (400 MHz) spectrometer. Chemical shifts (δ) were reported in parts per million relative to residual chloroform (7.26 ppm for ¹H; 77.0 ppm for ¹³C), constants were reported in Hertz. ¹H NMR assignment abbreviations were the following: singlet (s), doublet (d), triplet (t), quartet (q), doublet of doublets (dd), doublet of triplets (dt), and multiplet (m). ¹³C NMR spectra were recorded at 75 MHz, 100 MHz on the same spectrometer and reported in ppm. All reagents were weighed and handled in air.

2-([1,1'-Biphenyl]-4-yl)selenophene

To a 25 mL oven dried Schlenk tube, 4-bromobiphenyl (0.280 g, 1.2 mmol), selenophene (0.131 g, 1 mmol), KOAc (4 mmol, 0.296 g), DMA (2 mL) and Pd(OAc)₂ (0.02 mmol, 4.4 mg) were successively added. The reaction mixture was evacuated by vacuum-argon cycles (5 times) and stirred at 100 °C (oil bath temperature) for 24 hours. After cooling the reaction at room temperature and concentration, the crude mixture was purified by silica column chromatography (Et₂O/PE) to afford the C2-arylated product in 66% (0.187 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 7.96 (dd, J = 5.6, 1.1 Hz, 1H), 7.68-7.57 (m, 6H), 7.52 (dd, J = 3.8, 1.1 Hz, 1H), 7.45 (t, J = 8.0 Hz, 2H), 7.37 (t, J = 8.0 Hz, 1H), 7.34 (dd, J = 5.6, 3.8 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 150.5, 140.6, 140.5, 135.6, 130.8, 130.2, 129.0, 127.7, 127.6, 127.0, 126.9, 125.4.

General procedure for desulfitative couplings:

To a 25 mL oven dried Schlenk tube, arylsulfonyl chlorides (1.5 mmol), selenophene derivative (1 mmol), Li₂CO₃ (6 mmol, 0.444 g), 1,4-dioxane (2 mL) and Pd(OAc)₂ (0.1 mmol, 22.4 mg) were

successively added. The reaction mixture was evacuated by vacuum-argon cycles (5 times) and stirred at 140 °C (oil bath temperature) for 4-40 hours (see tables or schemes). After cooling the reaction at room temperature and concentration, the crude mixture was purified by silica column chromatography (Et₂O/PE) to afford the arylated products.

3-(4-Nitrophenyl)selenophene (1a)

The reaction of 4-nitrobenzenesulfonyl chloride (0.333 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **1a** in 79% (0.199 g) yield as a white solid: mp 133-136°C.

¹H NMR (400 MHz, CDCl₃): δ 8.32 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.24 (d, *J* = 8.8 Hz, 2H), 8.14 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.72 (d, *J* = 8.8 Hz, 2H), 7.71 (dd, *J* = 5.5, 1.3 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 146.7, 143.3, 142.4, 132.2, 129.1, 128.9, 127.2, 124.3.

elemental analysis: calcd (%) for C₁₀H₇NO₂Se (252.13): C 47.64, H 2.80; found: C 47.54, H 2.98.

4-(Selenophen-3-yl)benzonitrile (2)

The reaction of 4-cyanobenzenesulfonyl chloride (0.303 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **2** in 88% (0.204 g) yield as a yellow solid: mp 140-142°C.

¹H NMR (400 MHz, CDCl₃): δ 8.26 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.13 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.72-7.65 (m, 5H).

¹³C NMR (100 MHz, CDCl₃): δ 142.8, 141.4, 132.8, 132.0, 129.0, 128.2, 127.2, 119.1, 110.6.

elemental analysis: calcd (%) for C₁₁H₇NSe (232.14): C 56.91, H 3.04; found: C 56.87, H 3.14.

3-(4-(Trifluoromethyl)phenyl)selenophene (3)

The reaction of 4-(trifluoromethyl)benzenesulfonyl chloride (0.368 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **3** in 83% (0.228 g) yield as a white solid: mp 128-131°C.

¹H NMR (400 MHz, CDCl₃): δ 8.21 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.12 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.73-7.65 (m, 3H), 7.65 (d, *J* = 8.5 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 143.3, 140.6, 131.6, 129.4, 129.1 (q, *J* = 32.5 Hz), 127.3, 126.9, 125.8 (q, *J* = 3.8 Hz), 124.4 (q, *J* = 272.0 Hz).

elemental analysis: calcd (%) for C₁₁H₇F₃Se (275.13): C 48.02, H 2.56; found: C 48.14, H 2.74.

3-(4-Chlorophenyl)selenophene (4)

The reaction of 4-chlorobenzenesulfonyl chloride (0.317 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **4** in 57% (0.137 g) yield as a white solid: mp 118-120°C.

¹H NMR (400 MHz, CDCl₃): δ 8.12-8.05 (m, 2H), 7.63 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.51 (d, *J* = 8.4 Hz, 2H), 7.35 (d, *J* = 8.4 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 143.5, 135.8, 133.0, 131.3, 129.5, 129.0, 128.0, 125.9.

elemental analysis: calcd (%) for C₁₀H₇ClSe (241.57): C 49.72, H 2.92; found: C 49.57, H 2.84.

3-(4-Fluorophenyl)selenophene (5)

The reaction of 4-fluorobenzenesulfonyl chloride (0.293 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **5** in 72% (0.162 g) yield as a white solid: mp 96-98°C.

¹H NMR (400 MHz, CDCl₃): δ 8.07 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.04 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.62 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.55 (dd, *J* = 8.5, 5.2 Hz, 2H), 7.35 (t, *J* = 8.5 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 162.2 (d, *J* = 246.1 Hz), 143.7, 133.5 (d, *J* = 3.3 Hz), 131.1, 129.6, 125.2, 128.3 (d, *J* = 7.9 Hz), 115.7 (d, *J* = 21.5 Hz).

elemental analysis: calcd (%) for C₁₀H₇FSe (225.12): C 53.35, H 3.13; found: C 53.20, H 3.24.

3-Phenylselenophene (6)²

The reaction of benzenesulfonyl chloride (0.266 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **6** in 71% (0.147 g) yield as a white solid: mp 99-102°C.

¹H NMR (400 MHz, CDCl₃): δ 8.11 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.08 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.69 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.60 (d, *J* = 8.2 Hz, 2H), 7.40 (t, *J* = 8.0 Hz, 2H), 7.30 (t, *J* = 8.0 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 144.8, 137.3, 130.9, 129.7, 128.9, 127.2, 126.8, 125.5.

3-*p*-Tolylselenophene (7)

The reaction of 4-methylbenzenesulfonyl chloride (0.287 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **7** in 73% (0.161 g) yield as a white solid: mp 118-121°C.

¹H NMR (400 MHz, CDCl₃): δ 8.08-8.02 (m, 2H), 7.66 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.49 (d, *J* = 8.2 Hz, 2H), 7.21 (d, *J* = 8.2 Hz, 2H), 2.38 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 144.7, 136.9, 134.6, 130.7, 129.8, 129.6, 126.7, 124.7, 21.3.

elemental analysis: calcd (%) for C₁₁H₁₀Se (221.16): C 59.74, H 4.56; found: C 59.87, H 4.42.

3-(4-*tert*-Butylphenyl)selenophene (8)

The reaction of 4-*tert*-butylbenzene-1-sulfonyl chloride (0.348 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **8** in 54% (0.142 g) yield as a yellow solid: mp 71–73°C.

¹H NMR (400 MHz, CDCl₃): δ 8.10–8.02 (m, 2H), 7.67 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.53 (d, *J* = 8.2 Hz, 2H), 7.42 (d, *J* = 8.2 Hz, 2H), 1.36 (s, 9H).

¹³C NMR (100 MHz, CDCl₃): δ 150.2, 144.7, 134.6, 130.6, 129.8, 126.5, 125.8, 124.9, 34.7, 31.5.

elemental analysis: calcd (%) for C₁₄H₁₆Se (263.24): C 63.88, H 6.13; found: C 63.71, H 6.00.

3-(4-Methoxyphenyl)selenophene (9)

The reaction of 4-methoxybenzenesulfonyl chloride (0.311 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **9** in 31% (0.073 g) yield as a yellow solid: mp 132–135°C.

¹H NMR (400 MHz, CDCl₃): δ 8.05 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.99 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.63 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.52 (d, *J* = 8.2 Hz, 2H), 6.93 (d, *J* = 8.2 Hz, 2H), 3.84 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 159.0, 144.4, 130.7, 130.2, 129.7, 127.9, 123.9, 114.3, 55.5.

elemental analysis: calcd (%) for C₁₁H₁₀OSe (237.16): C 55.71, H 4.25; found: C 55.89, H 4.26.

3-(3-(Trifluoromethyl)phenyl)selenophene (10)

The reaction of 3-(trifluoromethyl)benzenesulfonyl chloride (0.368 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **10** in 82% (0.225 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.17 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.10 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.82 (s, 1H), 7.74 (d, *J* = 8.2 Hz, 1H), 7.66 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.55 (d, *J* = 8.2 Hz, 1H), 7.49 (t, *J* = 8.0 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 143.3, 138.0, 131.6, 131.2 (q, *J* = 32.5 Hz), 130.0, 129.4, 129.3, 126.8, 123.8 (q, *J* = 3.8 Hz), 123.5 (q, *J* = 3.9 Hz), 124.2 (q, *J* = 272.0 Hz).

elemental analysis: calcd (%) for C₁₁H₇F₃Se (275.13): C 48.02, H 2.56; found: C 48.21, H 2.60.

3-(3-Chlorophenyl)selenophene (11)

The reaction of 3-chlorobenzenesulfonyl chloride (0.317 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **11** in 74% (0.178 g) yield as a white solid: mp 54-57°C.

¹H NMR (400 MHz, CDCl₃): δ 8.14 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.08 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.63 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.58 (t, *J* = 1.8 Hz, 1H), 7.46 (d, *J* = 8.2 Hz, 1H), 7.32 (t, *J* = 8.0 Hz, 1H), 7.27 (d, *J* = 8.2 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 143.3, 139.0, 134.8, 131.4, 130.1, 129.4, 127.2, 126.9, 126.5, 124.9.

elemental analysis: calcd (%) for C₁₀H₇ClSe (241.57): C 49.72, H 2.92; found: C 49.55, H 2.97.

3-(3-Fluorophenyl)selenophene (12)

The reaction of 3-fluorobenzenesulfonyl chloride (0.293 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **12** in 76% (0.171 g) yield as a white solid: mp 57-59°C.

¹H NMR (400 MHz, CDCl₃): δ 8.14 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.08 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.64 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.41-7.25 (m, 3H), 7.04-6.95 (m, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 163.3 (d, *J* = 245.4 Hz), 143.5, 139.4, 131.3, 130.3 (d, *J* = 8.5 Hz), 129.4, 126.4, 122.4 (d, *J* = 2.7 Hz), 114.0 (d, *J* = 21.2 Hz), 113.7 (d, *J* = 21.9 Hz).

elemental analysis: calcd (%) for C₁₀H₇FSe (225.12): C 53.35, H 3.13; found: C 53.41, H 3.24.

3-(3,5-Bis(trifluoromethyl)phenyl)selenophene (13)

The reaction of 3,5-bis(trifluoromethyl)benzene-1-sulfonyl chloride (0.468 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **13** in 90% (0.309 g) yield as a white solid: mp 47-49°C.

¹H NMR (400 MHz, CDCl₃): δ 8.29 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.16 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.00 (s, 2H), 7.80 (s, 1H), 7.69 (dd, *J* = 5.5, 1.3 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 141.8, 139.3, 132.7, 132.2 (q, *J* = 33.2 Hz), 129.0, 128.3, 126.7, 123.8 (q, *J* = 272.7 Hz), 120.7 (q, *J* = 3.8 Hz).

elemental analysis: calcd (%) for C₁₂H₆F₆Se (343.13): C 42.00, H 1.76; found: C 42.14, H 1.61.

3-(3,5-Dichlorophenyl)selenophene (14)

The reaction of 3,5-dichlorobenzene-1-sulfonyl chloride (0.368 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **14** in 60% (0.166 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.15 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.09 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.60 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.45 (d, *J* = 2.0 Hz, 2H), 7.28 (t, *J* = 2.0 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 142.0, 140.0, 135.4, 131.8, 129.1, 127.5, 127.0, 125.2.

elemental analysis: calcd (%) for C₁₀H₆Cl₂Se (276.02): C 43.51, H 2.19; found: C 43.29, H 2.17.

3-(3,4-Difluorophenyl)selenophene (15)

The reaction of 3,4-difluorobenzene-1-sulfonyl chloride (0.318 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **15** in 68% (0.165 g) yield as a yellow oil.

¹H NMR (400 MHz, CDCl₃): δ 8.05 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.00 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.63 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.14 (dd, *J* = 8.2, 2.1 Hz, 1H), 7.10 (d, *J* = 2.1 Hz, 1H), 6.90 (d, *J* = 8.2 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 150.6 (dd, *J* = 249.0, 12.4 Hz), 150.0 (dd, *J* = 249.0, 12.4 Hz), 142.7, 134.5, 131.5, 129.3, 126.1, 122.7 (dd, *J* = 6.2, 3.6 Hz), 117.6 (d, *J* = 17.2 Hz), 115.7 (d, *J* = 17.8 Hz).

elemental analysis: calcd (%) for C₁₀H₆F₂Se (243.11): C 49.40, H 2.49; found: C 49.28, H 2.32.

3-(3,4-Dimethoxyphenyl)selenophene (16)

The reaction of 3,4-dimethoxybenzene-1-sulfonyl chloride (0.356 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **16** in 24% (0.064 g) yield as a yellow solid: mp 84-86°C.

¹H NMR (400 MHz, CDCl₃): δ 8.12-8.04 (m, 2H), 7.59 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.41-7.34 (m, 1H), 7.33-7.36 (m, 1H), 7.22-7.12 (m, 1H), 3.94 (s, 3H), 3.91 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 149.2, 148.5, 144.6, 130.8, 130.6, 129.8, 124.2, 119.2, 111.6, 110.3, 56.2, 56.1.

elemental analysis: calcd (%) for C₁₂H₁₂O₂Se (267.18): C 53.94, H 4.53; found: C 53.78, H 4.38.

3-(2-Nitrophenyl)selenophene (17)

The reaction of 2-nitrobenzenesulfonyl chloride (0.333 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **17** in 31% (0.078 g) yield as a brown oil.

¹H NMR (400 MHz, CDCl₃): δ 8.06 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.99 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.81 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.58 (td, *J* = 7.5, 1.3 Hz, 1H), 7.49 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.46 (td, *J* = 7.5, 1.3 Hz, 1H), 7.33 (dd, *J* = 5.5, 1.3 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 148.7, 139.5, 132.4, 132.3, 131.9, 131.1, 130.2, 128.6, 128.3, 124.1.

elemental analysis: calcd (%) for C₁₀H₇NO₂Se (252.13): C 47.64, H 2.80; found: C 47.70, H 2.74.

2-(Selenophen-3-yl)benzonitrile (**18**)

The reaction of 2-cyanobenzenesulfonyl chloride (0.303 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **18** in 88% (0.204 g) yield as a yellow oil.

¹H NMR (400 MHz, CDCl₃): δ 8.34 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.13 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.73 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.65 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.61 (td, *J* = 7.5, 1.3 Hz, 1H), 7.56 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.40 (td, *J* = 7.5, 1.5 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 141.2, 140.9, 134.0, 133.0, 131.4, 130.5, 130.3, 129.7, 127.5, 119.1, 110.8.

elemental analysis: calcd (%) for C₁₁H₇NSe (232.14): C 56.91, H 3.04; found: C 56.99, H 3.21.

3-(2-Chlorophenyl)selenophene (**19**)

The reaction of 2-chlorobenzenesulfonyl chloride (0.317 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **19** in 76% (0.183 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.10 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.06 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.59 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.48 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.43 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.33-7.25 (m, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 141.9, 136.8, 132.6, 131.8, 131.3, 130.2, 129.6, 129.3, 128.5, 126.9.

elemental analysis: calcd (%) for C₁₀H₇ClSe (241.57): C 49.72, H 2.92; found: C 49.82, H 2.69.

3-(Naphthalen-1-yl)selenophene (**20**)

The reaction of naphthalene-1-sulfonyl chloride (0.341 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **20** in 34% (0.087 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.14 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.04 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 1H), 7.87-7.84 (m, 1H), 7.57 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.53-7.42 (m, 4H).

¹³C NMR (100 MHz, CDCl₃): δ 143.6, 136.4, 133.9, 132.7, 132.0, 130.0, 128.5, 128.4, 127.8, 127.0, 126.2, 126.0, 125.9, 125.5.

elemental analysis: calcd (%) for C₁₄H₁₀Se (257.19): C 65.38, H 3.92; found: C 65.34, H 3.98.

3-(2-Chloro-4-fluorophenyl)selenophene (21)

The reaction of 2-chloro-4-fluorobenzene-1-sulfonyl chloride (0.343 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **21** in 89% (0.230 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.08 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.06 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.54 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.40 (dd, *J* = 8.5, 6.1 Hz, 1H), 7.23 (dd, *J* = 8.5, 2.7 Hz, 1H), 7.04 (td, *J* = 8.5, 2.7 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 161.7 (d, *J* = 249.7 Hz), 140.9, 133.3 (d, *J* = 10.3 Hz), 133.1 (d, *J* = 3.6 Hz), 132.1 (d, *J* = 8.7 Hz), 131.7, 129.9, 129.3, 117.6 (d, *J* = 24.7 Hz), 114.2 (d, *J* = 20.9 Hz).
elemental analysis: calcd (%) for C₁₀H₆ClFSe (259.57): C 46.27, H 2.33; found: C 46.29, H 2.44.

3-(2,4-Difluorophenyl)selenophene (22)

The reaction of 2,4-difluorobenzene-1-sulfonyl chloride (0.320 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **22** in 86% (0.209 g) yield as a brown oil.

¹H NMR (400 MHz, CDCl₃): δ 8.18 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.07 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.62 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.55-7.45 (m, 1H), 6.96-6.84 (m, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 162.1 (dd, *J* = 249.2, 1.7 Hz), 159.8 (dd, *J* = 250.1, 1.7 Hz), 137.3 (d, *J* = 1.7 Hz), 130.7 (m), 130.4, 128.6 (d, *J* = 5.0 Hz), 121.0 (m), 111.6 (dd, *J* = 21.0, 3.6 Hz), 104.6 (t, *J* = 26.4 Hz).

elemental analysis: calcd (%) for C₁₀H₆F₂Se (243.11): C 49.40, H 2.49; found: C 49.48, H 2.50.

3-(2,3,4-Trifluorophenyl)selenophene (23)

The reaction of 2,3,4-trifluorobenzene-1-sulfonyl chloride (0.347 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **23** in 90% (0.235 g) yield as a white solid: mp 39-41°C.

¹H NMR (400 MHz, CDCl₃): δ 8.22 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.10 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.61 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.29-7.19 (m, 1H), 7.05-6.93 (m, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 150.2 (dm, *J* = 250.1 Hz), 148.9 (dm, *J* = 248.6 Hz), 140.5 (dt, *J* = 252.4, 15.5 Hz), 136.4 (m), 130.9, 130.2, 129.4 (d, *J* = 5.2 Hz), 123.1 (m), 112.2 (dd, *J* = 17.2, 4.0 Hz).

elemental analysis: calcd (%) for C₁₀H₅F₃Se (261.10): C 46.00, H 1.93; found: C 45.84, H 2.01.

3-(4-Bromophenyl)selenophene (24)

The reaction of 4-bromobenzenesulfonyl chloride (0.384 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **24** in 63% (0.180 g) yield as a white solid: mp 136-139°C.

¹H NMR (400 MHz, CDCl₃): δ 8.11 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.09 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.63 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.52 (d, *J* = 8.6 Hz, 2H), 7.46 (d, *J* = 8.6 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 143.5, 136.2, 132.0, 131.3, 129.4, 128.3, 125.9, 121.1.

elemental analysis: calcd (%) for C₁₀H₇BrSe (286.03): C 41.99, H 2.47; found: C 42.12, H 2.37.

3-(2-Bromophenyl)selenophene (25)

The reaction of 2-bromobenzenesulfonyl chloride (0.384 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **25** in 78% (0.223 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.10-8.00 (m, 2H), 7.66 (dd, *J* = 8.5, 1.2 Hz, 1H), 7.55 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.40 (dd, *J* = 8.5, 1.8 Hz, 1H), 7.34 (td, *J* = 7.5, 1.2 Hz, 1H), 7.19 (td, *J* = 7.5, 1.8 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 143.6, 139.0, 133.4, 131.8, 131.4, 129.5, 129.1, 128.8, 127.4, 122.7.

elemental analysis: calcd (%) for C₁₀H₇BrSe (286.03): C 41.99, H 2.47; found: C 42.07, H 2.57.

3-(4-Bromo-2-ethylphenyl)selenophene (26)

The reaction of 4-bromo-2-ethylbenzene-1-sulfonyl chloride (0.426 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **26** in 74% (0.232 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.05 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.82 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.44 (d, *J* = 2.1 Hz, 1H), 7.38-7.30 (m, 2H), 7.13 (d, *J* = 8.2 Hz, 1H), 2.61 (q, *J* = 7.6 Hz, 2H), 1.14 (t, *J* = 7.6 Hz, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 144.4, 143.3, 136.6, 131.8, 131.7, 131.6, 130.1, 128.8, 127.6, 121.6, 26.4, 15.4.

elemental analysis: calcd (%) for C₁₂H₁₁BrSe (314.08): C 45.89, H 3.53; found: C 45.79, H 3.38.

3-(2-Bromo-5-(trifluoromethyl)phenyl)selenophene (27)

The reaction of 2-bromo-5-(trifluoromethyl)benzene-1-sulfonyl chloride (0.336 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **27** in 81% (0.287 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.12-8.05 (m, 2H), 7.78 (d, *J* = 8.3 Hz, 1H), 7.64 (d, *J* = 2.2 Hz, 1H), 7.55 (dd, *J* = 5.1, 1.7 Hz, 1H), 7.43 (dd, *J* = 8.3, 2.2 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 142.2, 139.9, 134.0, 131.3, 130.3, 130.1, 130.0 (q, *J* = 33.0 Hz), 128.0 (q, *J* = 3.8 Hz), 126.6, 125.3 (q, *J* = 3.7 Hz), 123.9 (q, *J* = 270.0 Hz).

elemental analysis: calcd (%) for C₁₁H₆BrF₃Se (354.02): C 37.32, H 1.71; found: C 37.24, H 1.80.

3-(2-Bromo-4-fluorophenyl)selenophene (28)

The reaction of 2-bromo-4-fluorobenzene-1-sulfonyl chloride (0.411 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **28** in 75% (0.228 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.04 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.00 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.48 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.40 (dd, *J* = 8.4, 2.7 Hz, 1H), 7.35 (dd, *J* = 8.4, 6.0 Hz, 1H), 7.04 (td, *J* = 8.2, 2.7 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 161.6 (d, *J* = 250.9 Hz), 142.6, 135.3, 132.1 (d, *J* = 8.3 Hz), 131.7, 129.8, 129.2, 122.8 (d, *J* = 9.5 Hz), 120.4 (d, *J* = 24.4 Hz), 114.6 (d, *J* = 20.9 Hz).

elemental analysis: calcd (%) for C₁₀H₆BrFSe (304.02): C 39.51, H 1.99; found: C 39.39, H 2.07.

3-(2-Bromo-4,6-difluorophenyl)selenophene (29)

The reaction of 2-bromo-4,6-difluorobenzene-1-sulfonyl chloride (0.438 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **29** in 83% (0.267 g) yield as a white solid: mp 51-54°C.

¹H NMR (400 MHz, CDCl₃): δ 8.08 (dd, *J* = 5.5, 2.5 Hz, 1H), 8.02 (dd, *J* = 2.5, 1.3 Hz, 1H), 7.37 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.28-7.22 (m, 1H), 6.88 (td, *J* = 6.4, 2.6 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 161.7 (d, *J* = 250.0 Hz), 160.4 (d, *J* = 250.0 Hz), 135.1, 131.6, 131.2, 129.9, 124.6 (dd, *J* = 11.5, 5.0 Hz), 123.9 (dd, *J* = 18.8, 4.2 Hz), 116.3 (dd, *J* = 24.2, 3.8 Hz), 103.7 (dd, *J* = 27.6, 25.0 Hz).

elemental analysis: calcd (%) for C₁₀H₅BrF₂Se (322.01): C 37.30, H 1.57; found: C 37.17, H 1.39.

3-(3,4-Dibromophenyl)selenophene (30)

The reaction of 3,4-dibromobenzene-1-sulfonyl chloride (0.501 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **30** in 63% (0.229 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.13 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.09 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.71 (d, *J* = 2.1 Hz, 1H), 7.61 (d, *J* = 8.3 Hz, 1H), 7.60 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.36 (dd, *J* = 8.3, 2.1 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 142.1, 138.0, 133.9, 131.8, 131.7, 129.1, 126.9, 126.8, 125.3, 123.2.

elemental analysis: calcd (%) for C₁₀H₆Br₂Se (364.92): C 32.91, H 1.66; found: C 32.79, H 1.58.

3-(2,5-Dibromophenyl)selenophene (31)

The reaction of 2,5-dibromobenzene-1-sulfonyl chloride (0.501 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **31** in 78% (0.284 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.10-8.02 (m, 2H), 7.53 (d, *J* = 2.4 Hz, 1H), 7.52-7.47 (m, 2H), 7.31 (dd, *J* = 8.5, 2.4 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 142.2, 140.8, 134.7, 134.0, 131.7, 131.4, 130.1, 129.8, 121.3, 121.2.

elemental analysis: calcd (%) for C₁₀H₆Br₂Se (364.92): C 32.91, H 1.66; found: C 32.97, H 1.71.

3-(4-Iodophenyl)selenophene (32)

The reaction of 4-iodobenzenesulfonyl chloride (0.453 g, 1.5 mmol) and selenophene (0.131 g, 1 mmol), affords **32** in 33% (0.110 g) yield as a white solid: mp 172-175°C.

¹H NMR (400 MHz, CDCl₃): δ 8.11 (dd, *J* = 2.5, 1.3 Hz, 1H), 8.08 (dd, *J* = 5.5, 2.5 Hz, 1H), 7.71 (d, *J* = 8.6 Hz, 2H), 7.62 (dd, *J* = 5.5, 1.3 Hz, 1H), 7.32 (d, *J* = 8.6 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 143.6, 137.9, 136.8, 131.3, 129.3, 128.6, 126.0, 92.5.

elemental analysis: calcd (%) for C₁₀H₇ISe (333.03): C 36.07, H 2.12; found: C 36.20, H 2.24.

2-(4-Chlorophenyl)-4-(3-(trifluoromethyl)phenyl)selenophene (33)

The reaction of 3-(trifluoromethyl)benzenesulfonyl chloride (0.368 g, 1.5 mmol) and 2-(4-chlorophenyl)selenophene (0.242 g, 1 mmol), affords **33** in 68% (0.262 g) yield as yellow solid: mp 179-181°C.

¹H NMR (400 MHz, CDCl₃): δ 8.09 (d, *J* = 1.5 Hz, 1H), 7.84 (s, 1H), 7.77 (d, *J* = 8.6 Hz, 1H), 7.75 (d, *J* = 1.5 Hz, 1H), 7.61-7.50 (m, 4H), 7.37 (d, *J* = 8.5 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 150.2, 144.2, 138.0, 134.7, 134.0, 131.3 (q, *J* = 32.1 Hz), 129.8, 129.4, 129.3, 127.6, 126.5, 125.3, 124.2 (q, *J* = 270.5 Hz), 124.0 (q, *J* = 3.9 Hz), 123.4 (q, *J* = 3.8 Hz).

elemental analysis: calcd (%) for C₁₇H₁₀ClF₃Se (385.67): C 52.94, H 2.61; found: C 52.99, H 2.87.

1-(4-(4-(Trifluoromethyl)phenyl)selenophen-2-yl)phenyl)ethan-1-one (34)

The reaction of 4-(trifluoromethyl)benzenesulfonyl chloride (0.368 g, 1.5 mmol) and 1-(4-(selenophen-2-yl)phenyl)ethan-1-one (0.249 g, 1 mmol), affords **34** in 57% (0.224 g) yield as a yellow solid: mp 154-156°C.

¹H NMR (400 MHz, CDCl₃): δ 8.19 (d, *J* = 1.4 Hz, 1H), 7.98 (d, *J* = 8.6 Hz, 2H), 7.90 (d, *J* = 1.4 Hz, 1H), 7.74-7.63 (m, 6H), 2.63 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 197.4, 150.0, 144.4, 140.4, 140.3, 136.4, 129.5 (q, *J* = 32.0 Hz), 129.3, 128.1, 126.8, 126.4, 126.3, 126.0 (q, *J* = 3.8 Hz), 124.2 (d, *J* = 270.0 Hz), 26.7.

elemental analysis: calcd (%) for C₁₉H₁₃F₃OSe (393.27): C 58.03, H 3.33; found: C 57.84, H 3.21.

4-(4-Methoxyphenyl)-2-(*p*-tolyl)selenophene (35)

The reaction of 4-methoxybenzenesulfonyl chloride (0.311 g, 1.5 mmol) and 2-(*p*-tolyl)selenophene (0.221 g, 1 mmol), affords **35** in 58% (0.190 g) yield as a yellow solid: mp 50-52°C.

¹H NMR (400 MHz, CDCl₃): δ 7.86 (d, *J* = 1.4 Hz, 1H), 7.71 (d, *J* = 1.4 Hz, 1H), 7.54 (d, *J* = 8.6 Hz, 2H), 7.49 (d, *J* = 8.6 Hz, 2H), 7.19 (d, *J* = 8.6 Hz, 2H), 6.94 (d, *J* = 8.6 Hz, 2H), 3.85 (s, 3H), 2.37 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 159.0, 150.8, 145.1, 137.8, 133.8, 130.5, 129.7, 127.8, 126.3, 124.9, 122.8, 114.3, 55.5, 21.3.

elemental analysis: calcd (%) for C₁₈H₁₆OSe (327.29): C 66.06, H 4.93; found: C 66.17, H 4.87.

2-([1,1'-Biphenyl]-4-yl)-4-(4-(trifluoromethyl)phenyl)selenophene (36)

The reaction of 4-(trifluoromethyl)benzenesulfonyl chloride (0.368 g, 1.5 mmol) and 2-([1,1'-biphenyl]-4-yl)selenophene (0.283 g, 1 mmol), affords **36** in 55% (0.235 g) yield as a yellow solid: mp 108-110°C.

¹H NMR (400 MHz, CDCl₃): δ 8.15 (d, *J* = 1.3 Hz, 1H), 7.86 (d, *J* = 1.3 Hz, 1H), 7.75 (d, *J* = 8.4 Hz, 2H), 7.70-7.60 (m, 8H), 7.49 (t, *J* = 8.0 Hz, 2H), 7.40 (t, *J* = 8.0 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 151.3, 144.2, 141.0, 140.7, 140.5, 135.1, 129.3 (q, *J* = 32.0 Hz), 129.0, 127.8, 127.7, 127.1, 126.9, 126.8, 126.6, 125.9 (q, *J* = 3.3 Hz), 124.9, 124.2 (d, *J* = 270.2 Hz).

elemental analysis: calcd (%) for C₂₃H₁₅F₃Se (427.33): C 64.65, H 3.54; found: C 64.50, H 3.47.

2-Bromo-4-(4-(trifluoromethyl)phenyl)selenophene (37)

The reaction of 4-(trifluoromethyl)benzenesulfonyl chloride (0.368 g, 1.5 mmol) and 2-bromoselenophene (0.210 g, 1 mmol), affords **37** in 61% (0.216 g) yield as a white solid: mp 97-100°C.

¹H NMR (400 MHz, CDCl₃): δ 8.06 (d, *J* = 1.6 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 2H), 7.61 (d, *J* = 8.4 Hz, 2H), 7.60 (d, *J* = 1.6 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 143.4, 139.7, 132.6, 129.6 (q, *J* = 32.8 Hz), 128.3, 126.7, 126.0 (q, *J* = 3.7 Hz), 124.7 (q, *J* = 272.0 Hz), 116.4.

elemental analysis: calcd (%) for C₁₁H₆BrF₃Se (354.03): C 37.32, H 1.71; found: C 37.42, H 1.88.

2-Bromo-4-(3,4-difluorophenyl)selenophene (38)

The reaction of 3,4-(difluorobenzene-1-sulfonyl chloride (0.320 g, 1.5 mmol) and 2-bromoselenophene (0.210 g, 1 mmol), affords **38** in 64% (0.206 g) yield as a yellow oil.

¹H NMR (400 MHz, CDCl₃): δ 7.92 (dd, *J* = 1.6 Hz, 1H), 7.51 (d, *J* = 1.6 Hz, 1H), 7.34-7.12 (m, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 150.6 (dd, *J* = 249.0, 12.4 Hz), 150.0 (dd, *J* = 249.0, 12.4 Hz), 142.7, 133.5, 132.6, 127.8, 122.5 (dd, *J* = 6.2, 3.6 Hz), 117.8 (d, *J* = 17.1 Hz), 116.3, 115.5 (d, *J* = 18.0 Hz).

elemental analysis: calcd (%) for C₁₀H₅BrF₂Se (322.01): C 37.30, H 1.57; found: C 37.14, H 1.32.

2-Bromo-4-(2-chloro-4-fluorophenyl)selenophene (39)

The reaction of 2-chloro-4-fluorobenzene-1-sulfonyl chloride (0.343 g, 1.5 mmol) and 2-bromoselenophene (0.210 g, 1 mmol), affords **39** in 70% (0.236 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 7.88 (dd, *J* = 1.6 Hz, 1H), 7.43 (dd, *J* = 1.6 Hz, 1H), 7.32 (dd, *J* = 8.6, 6.1 Hz, 1H), 7.19 (dd, *J* = 8.6, 2.6 Hz, 1H), 7.00 (td, *J* = 8.0, 2.6 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 161.9 (d, *J* = 250.5 Hz), 141.1, 134.7, 133.4 (d, *J* = 10.5 Hz), 133.2 (d, *J* = 3.5 Hz), 132.0 (d, *J* = 8.6 Hz), 131.1, 117.5 (d, *J* = 24.7 Hz), 114.8, 114.3 (d, *J* = 21.0 Hz).

elemental analysis: calcd (%) for C₁₀H₅BrClFSe (338.46): C 35.49, H 1.49; found: C 35.70, H 1.65.

2-Bromo-4-(3,4-dibromophenyl)selenophene (40)

The reaction of 3,4-dibromobenzene-1-sulfonyl chloride (0.501 g, 1.5 mmol) and 2-bromoselenophene (0.210 g, 1 mmol), affords **40** in 41% (0.181 g) yield as a yellow solid: mp 82-84°C.

¹H NMR (400 MHz, CDCl₃): δ 7.98 (d, *J* = 1.6 Hz, 1H), 7.76 (d, *J* = 2.2 Hz, 1H), 7.61 (d, *J* = 8.3 Hz, 1H), 7.52 (d, *J* = 1.6 Hz, 1H), 7.28 (dd, *J* = 8.3, 2.2 Hz, 1H).

¹³C NMR (100 MHz, CDCl₃): δ 142.2, 137.0, 134.1, 132.3, 131.5, 128.5, 126.5, 125.4, 123.7, 116.5.

elemental analysis: calcd (%) for C₁₀H₅Br₃Se (443.82): C 27.06, H 1.14; found: C 27.34, H 1.30.

2-Bromo-4-(4-iodophenyl)selenophene (41)

The reaction of 4-iodobenzenesulfonyl chloride (0.453 g, 1.5 mmol) and 2-bromoselenophene (0.210 g, 1 mmol), affords **41** in 26% (0.107 g) yield as a white solid: mp 118-120°C.

¹H NMR (400 MHz, CDCl₃): δ 7.96 (d, *J* = 1.6 Hz, 1H), 7.70 (d, *J* = 8.1 Hz, 2H), 7.53 (d, *J* = 1.6 Hz, 1H), 7.24 (d, *J* = 8.1 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 143.7, 138.1, 135.9, 132.6, 127.6, 126.6, 116.1, 93.1.

elemental analysis: calcd (%) for C₁₀H₆BrISe (411.93): C 29.16, H 1.47; found: C 29.31, H 1.34.

3-(4-Methoxyphenyl)-4-(4-nitrophenyl)selenophene (42)

The reaction of 4-nitrobenzenesulfonyl chloride (0.333 g, 1.5 mmol) and 3-(4-methoxyphenyl)selenophene **9** (0.237 g, 1 mmol), affords **42** in 62% (0.222 g) yield as a yellow solid: mp 232-235°C.

¹H NMR (400 MHz, CDCl₃): δ 8.13-8.05 (m, 3H), 7.93 (d, *J* = 2.8 Hz, 1H), 7.30 (d, *J* = 8.8 Hz, 2H), 7.03 (d, *J* = 8.7 Hz, 2H), 6.80 (d, *J* = 8.7 Hz, 2H), 3.80 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 159.1, 146.7, 145.1, 143.8, 142.3, 131.1, 130.3, 129.9, 129.8, 129.1, 123.5, 113.9, 55.4.

elemental analysis: calcd (%) for C₁₇H₁₃NO₃Se (358.26): C 59.99, H 3.66; found: C 59.78, H 3.51.

3,4-Bis(3-(trifluoromethyl)phenyl)selenophene (43)

The reaction of 3-(trifluoromethyl)benzenesulfonyl chloride (0.736 g, 3 mmol) and selenophene (0.131 g, 1 mmol), affords **43** in 34% (0.142 g) yield as a colourless oil.

¹H NMR (400 MHz, CDCl₃): δ 8.08 (s, 2H), 7.51 (d, *J* = 7.7 Hz, 2H), 7.41 (s, 2H), 7.35 (t, *J* = 7.7 Hz, 2H), 7.26 (d, *J* = 7.7 Hz, 2H).

¹³C NMR (100 MHz, CDCl₃): δ 142.8, 138.5, 132.4, 130.8 (q, *J* = 32.3 Hz), 130.4, 128.8, 126.0 (q, *J* = 4.1 Hz), 124.0 (q, *J* = 272.4 Hz), 123.9 (q, *J* = 3.7 Hz).

elemental analysis: calcd (%) for C₁₈H₁₀F₆Se (419.23): C 51.57, H 2.40; found: C 51.79, H 2.60.

1-(4-(4-Chlorophenyl)-4-(trifluoromethyl)phenyl)selenophen-2-yl)phenyl)ethan-1-one (44)

To a 25 mL oven dried Schlenk tube, 4-bromochlorobenzene (0.192 g, 1 mmol), 1-(4-(4-(trifluoromethyl)phenyl)selenophen-2-yl)phenyl)ethan-1-one **34**, (0.197 g, 0.5 mmol), KOAc (0.098 g, 1 mmol), DMA (2 mL) and Pd(OAc)₂ (2.2 mg, 0.01 mmol) were successively added. The reaction mixture was evacuated by vacuum-argon cycles (5 times) and stirred at 150 °C (oil bath temperature) for 24 hours. After cooling the reaction at room temperature and concentration, the crude mixture was purified by silica column chromatography (Et₂O/PE) to afford **44** in 82% (0.207 g) yield as a white solid: mp 102-105°C.

¹H NMR (400 MHz, CDCl₃): δ 7.98 (d, *J* = 8.5 Hz, 2H), 7.68 (s, 1H), 7.65 (d, *J* = 8.5 Hz, 2H), 7.57 (d, *J* = 8.1 Hz, 2H), 7.40 (d, *J* = 8.1 Hz, 2H), 7.25 (d, *J* = 8.4 Hz, 2H), 7.17 (d, *J* = 8.4 Hz, 2H), 2.63 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 197.3, 148.0, 145.7, 140.7, 140.3, 140.1, 136.4, 134.2, 134.0, 130.6, 130.5, 129.6 (q, *J* = 32.0 Hz), 129.5, 129.4, 129.2, 126.1, 125.7 (q, *J* = 3.8 Hz), 124.2 (q, *J* = 272.0 Hz), 26.7.

elemental analysis: calcd (%) for C₂₅H₁₆ClF₃OSe (503.81): C 59.60, H 3.20; found: C 59.78, H 3.28.

4,4'-(3-(4-Methoxyphenyl)-4-(4-nitrophenyl)selenophene-2,5-diyl)dibenzonitrile (45)

To a 25 mL oven dried Schlenk tube, 4-bromobenzonitrile (0.273 g, 1.5 mmol), 3-(4-methoxyphenyl)-4-(4-nitrophenyl)selenophene **42**, (0.129 g, 0.5 mmol), KOAc (0.147 g, 1.5 mmol), DMA (2 mL) and Pd(OAc)₂ (0.01 mmol, 2.2 mg) were successively added. The reaction mixture was evacuated by vacuum-argon cycles (5 times) and stirred at 150 °C (oil bath temperature) for 24 hours. After cooling the reaction at room temperature and concentration, the crude mixture was purified by silica column chromatography (Et₂O/PE) to afford **45** in 60% (0.168 g) yield as a yellow solid: mp 231-234°C.

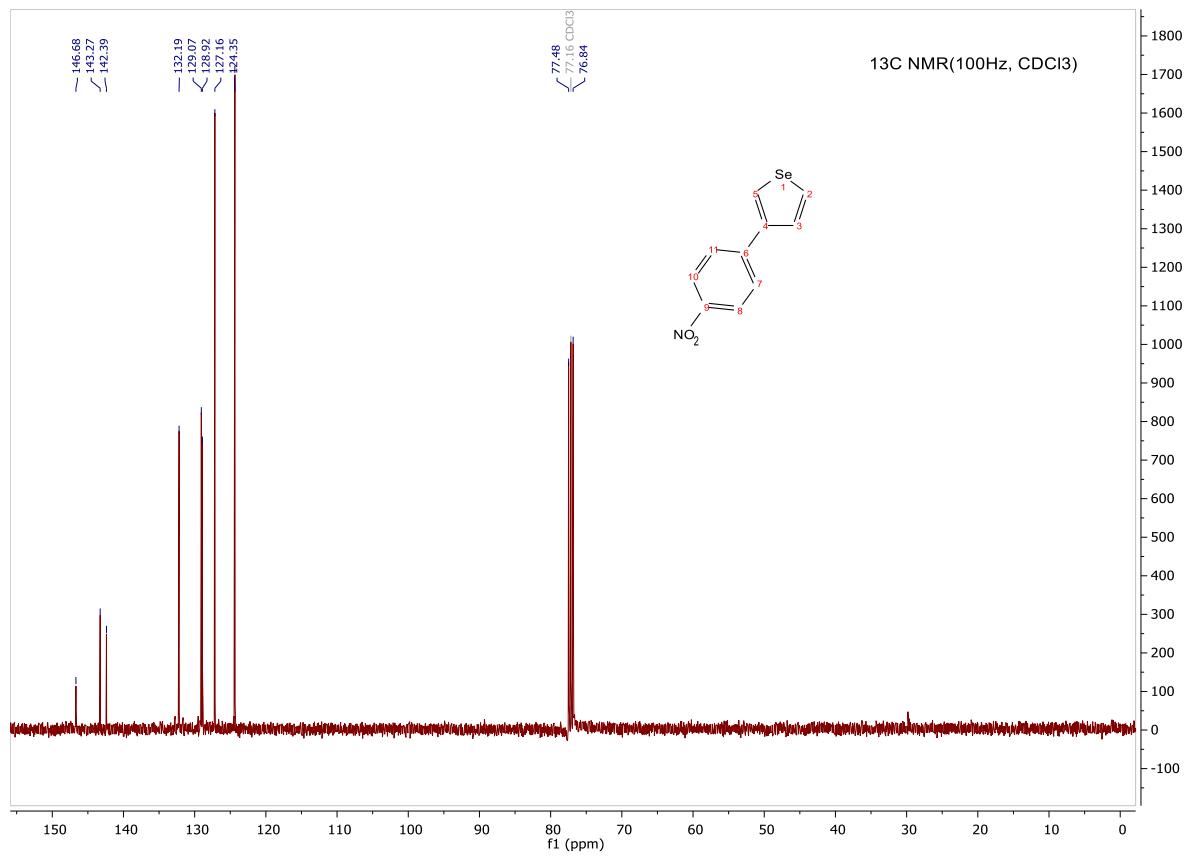
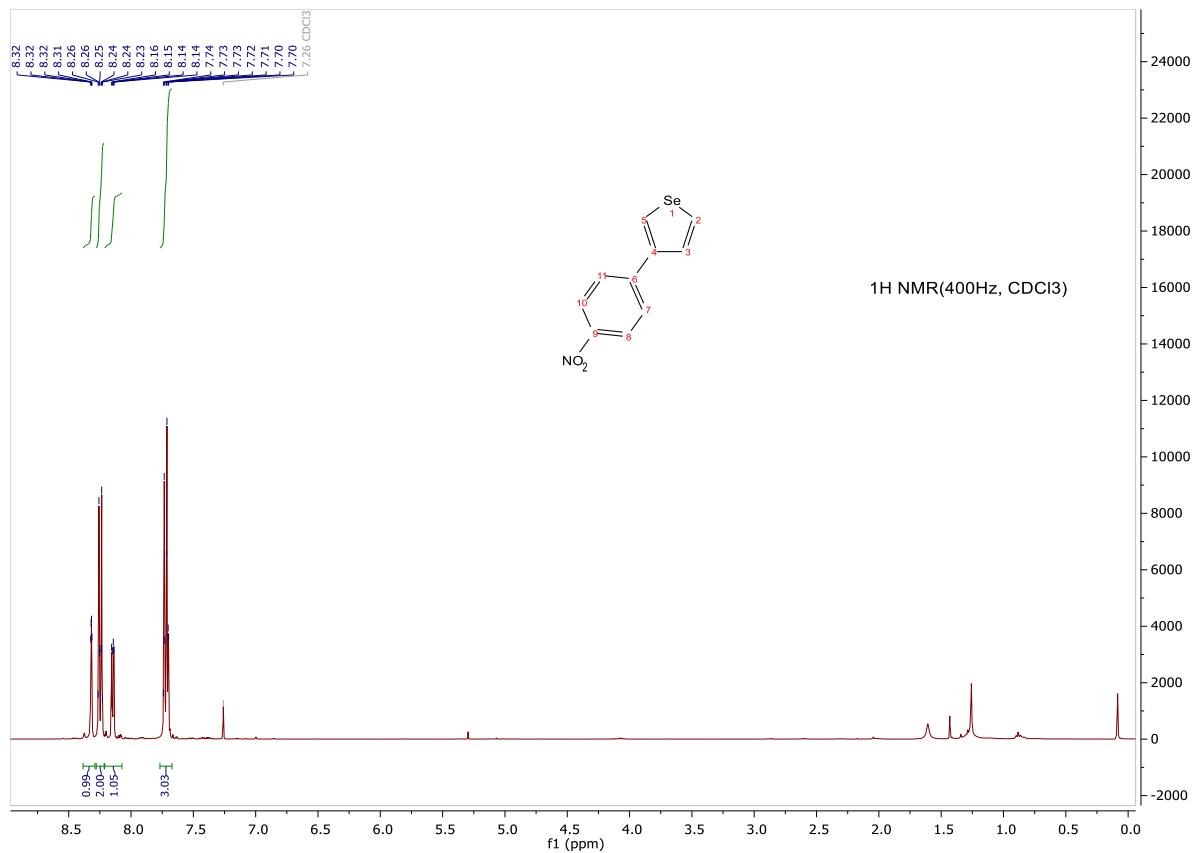
¹H NMR (400 MHz, CDCl₃): δ 7.99 (d, *J* = 8.5 Hz, 2H), 7.52 (d, *J* = 8.5 Hz, 2H), 7.51 (d, *J* = 8.1 Hz, 2H), 7.28-7.21 (m, 4H), 7.06 (d, *J* = 8.5 Hz, 2H), 6.77 (d, *J* = 8.7 Hz, 2H), 6.67 (d, *J* = 8.7 Hz, 2H), 3.74 (s, 3H).

¹³C NMR (100 MHz, CDCl₃): δ 159.2, 146.9, 145.1, 144.6, 144.0, 142.8, 141.4, 140.2, 139.9, 132.6, 132.4, 131.7, 130.0, 129.9, 128.2, 123.5, 118.6, 118.4, 114.2, 111.8, 111.3, 55.3.
elemental analysis: calcd (%) for C₃₁H₁₉N₃O₃Se (560.47): C 66.43, H 3.42; found: C 66.31, H 3.54.

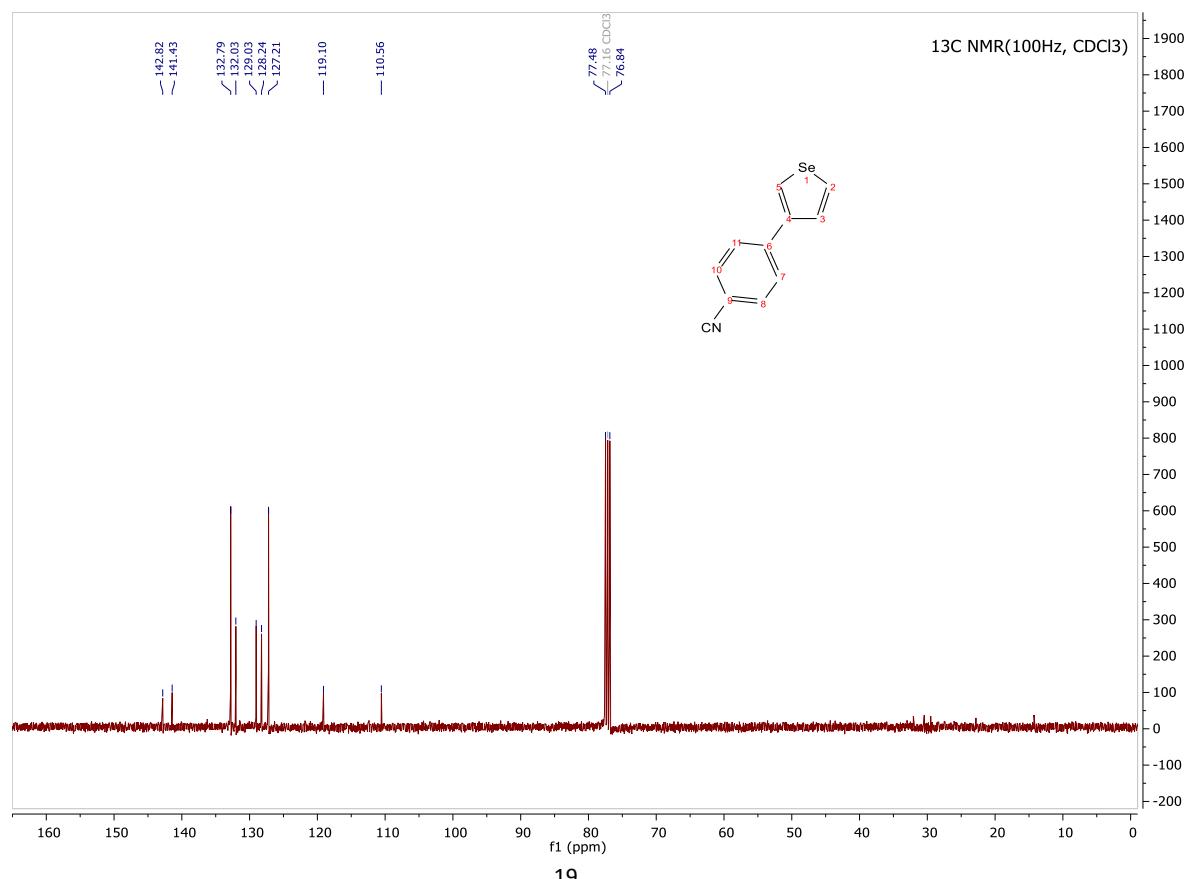
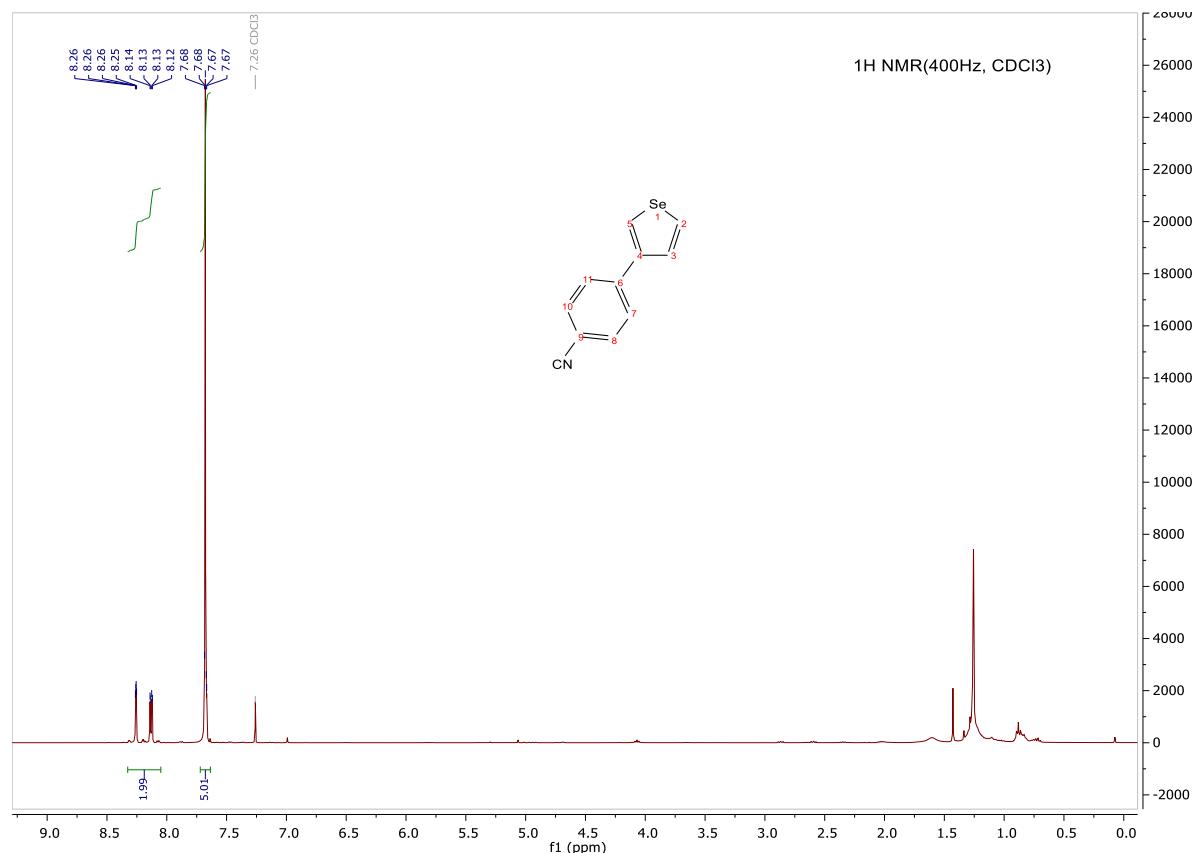
1 D. S. Rampon, L. A. Wessjohann, P. H. Schneider, *J. Org. Chem.* **2014**, *79*, 5987-5992.

2 A. Mehlhorn, F. Fratev, V. Monev, *Tetrahedron* **1981**, *37*, 3627-3634.

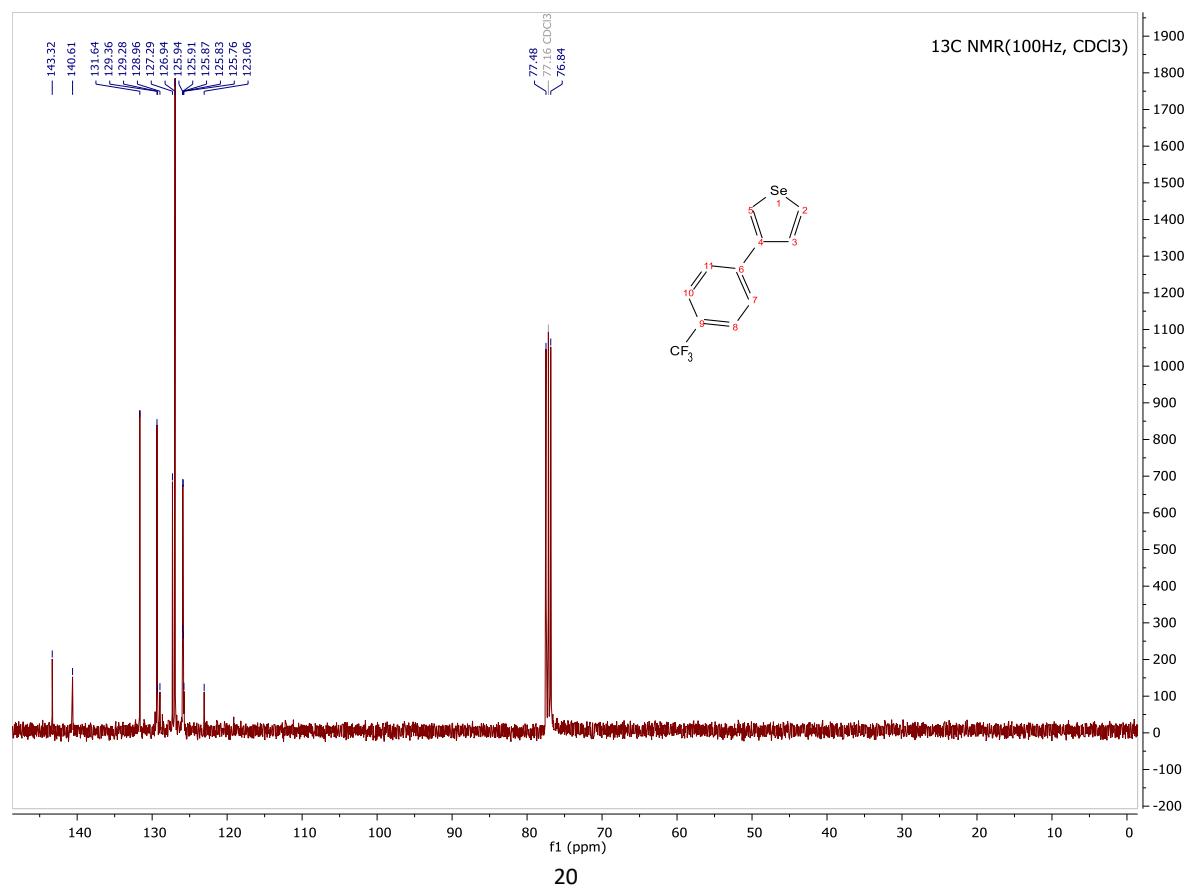
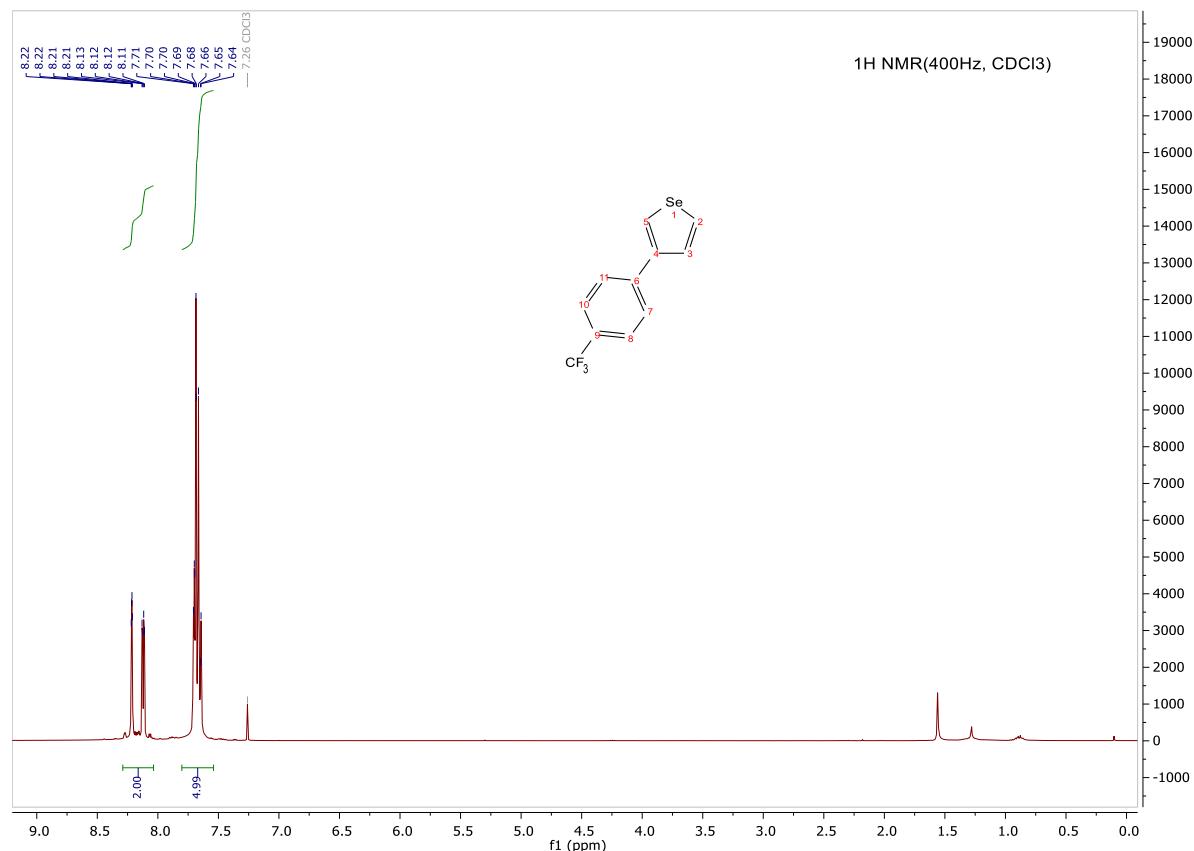
3-(4-Nitrophenyl)selenophene (1a)



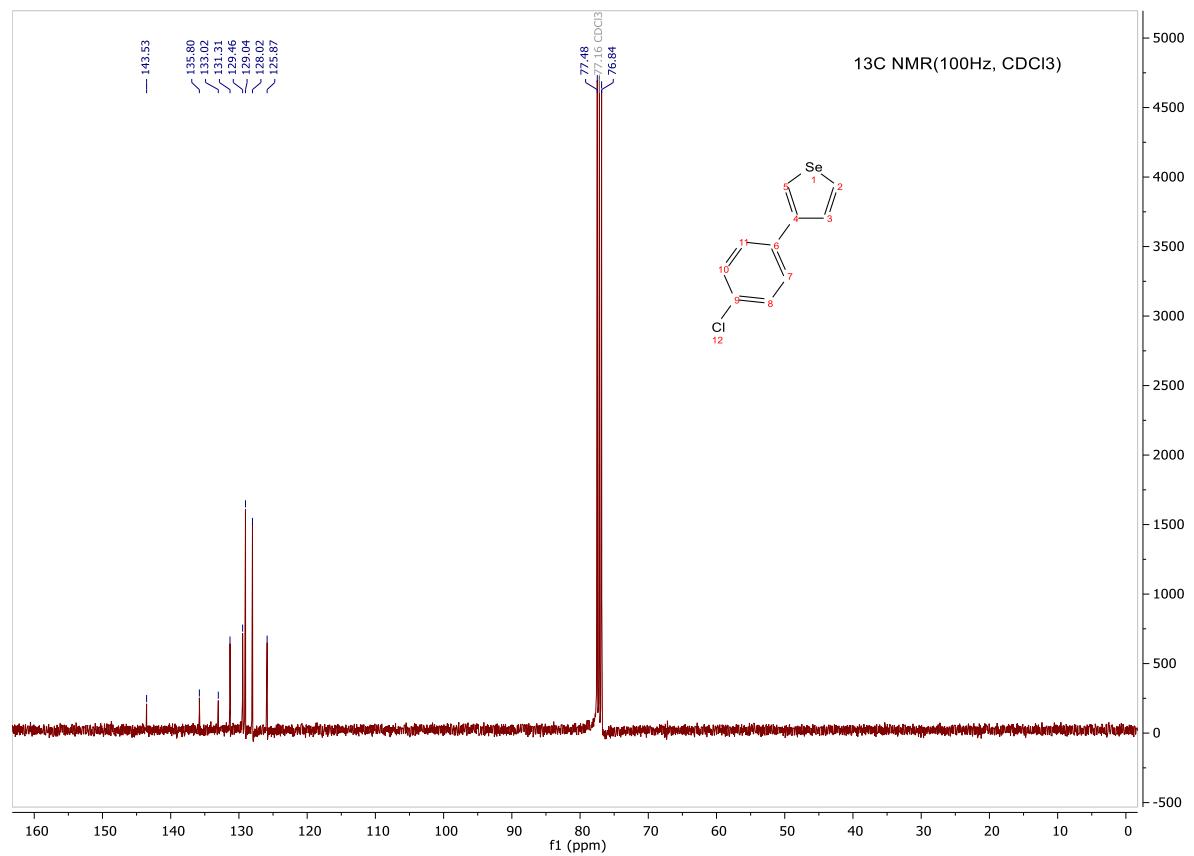
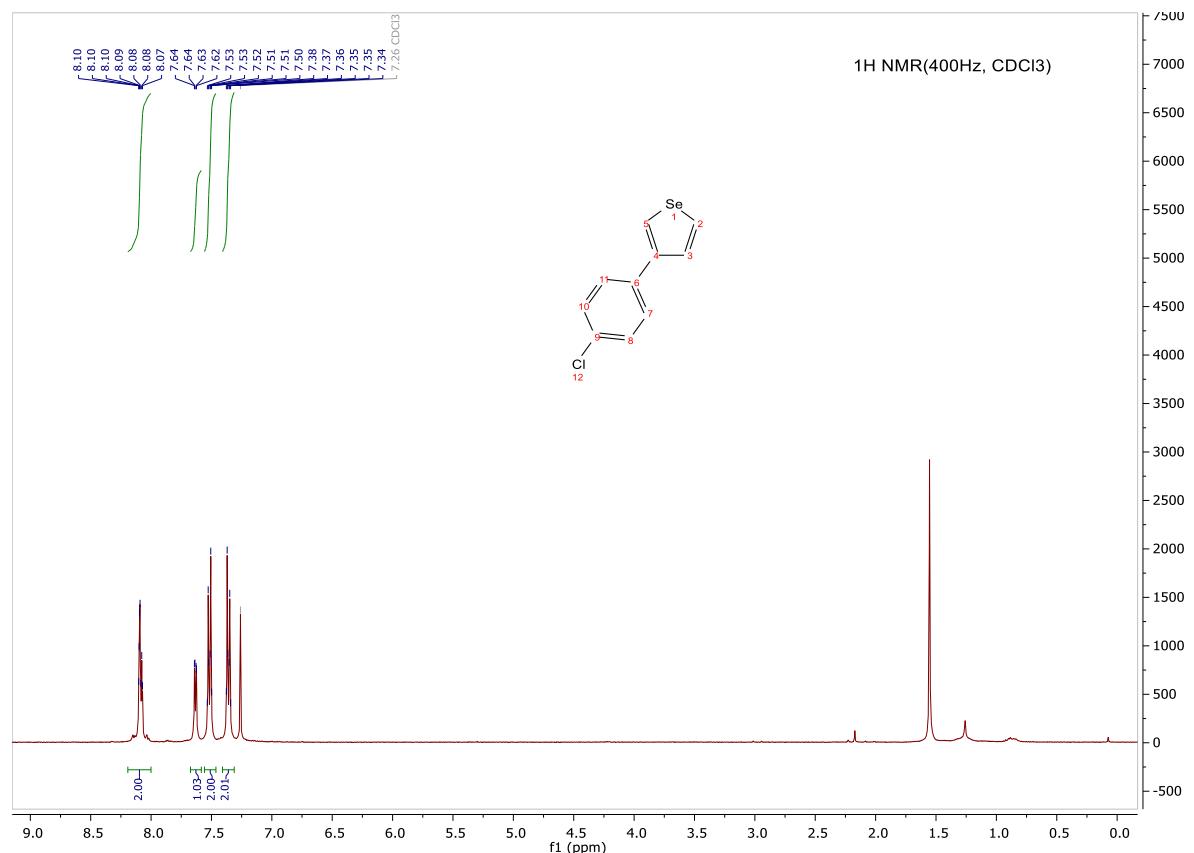
4-(Selenophen-3-yl)benzonitrile (2)



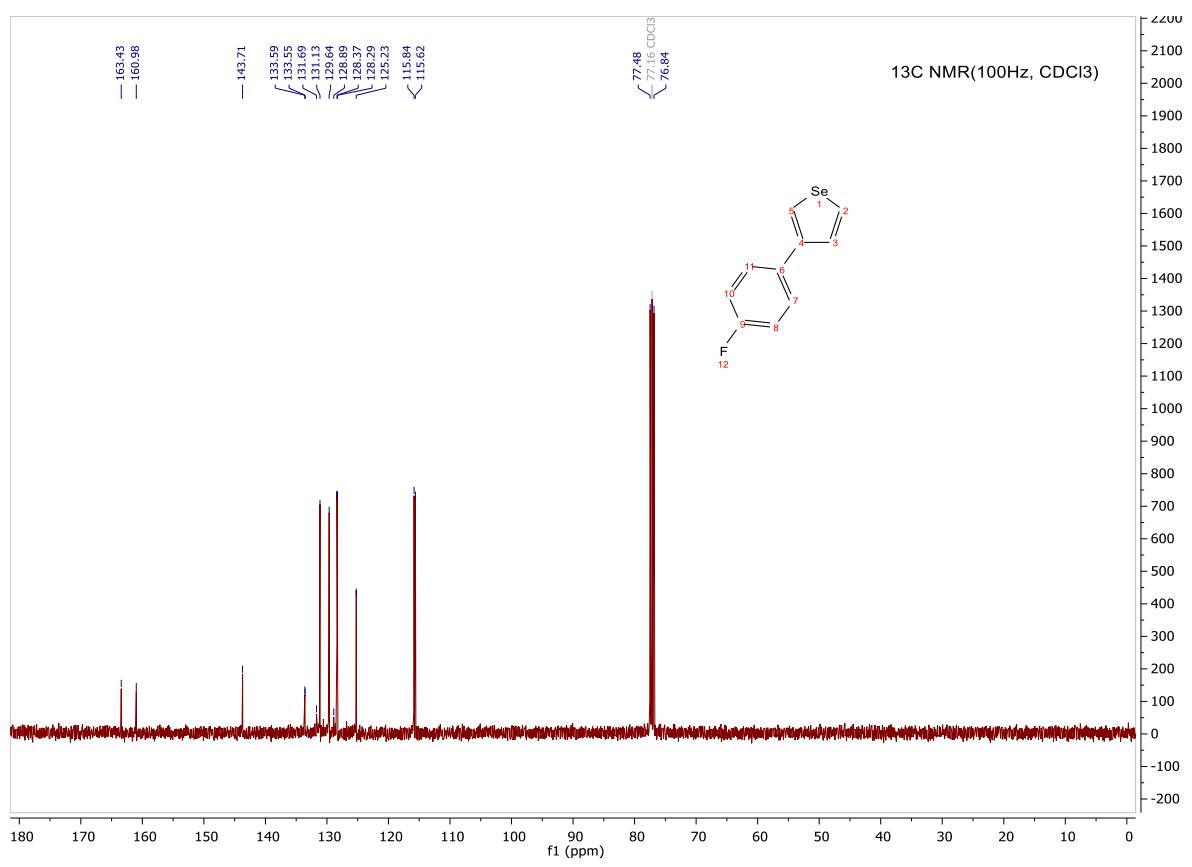
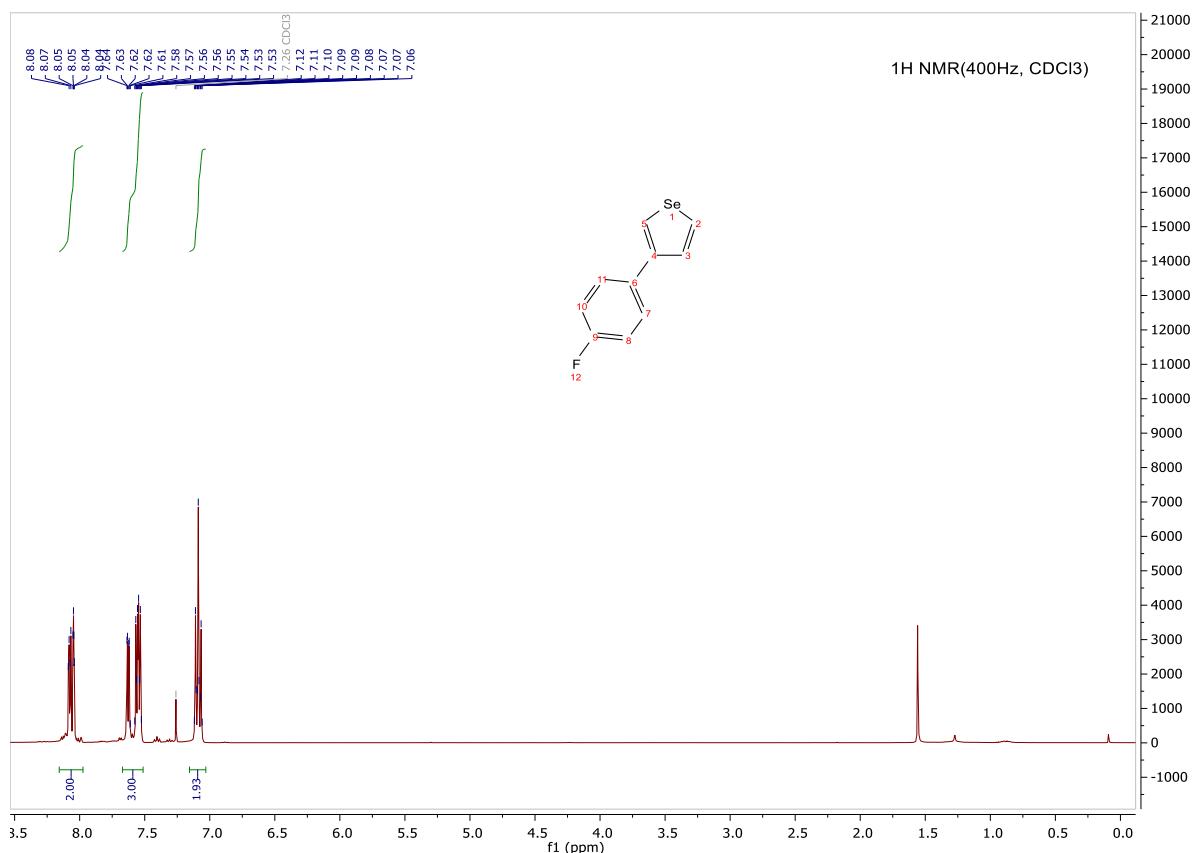
3-(4-(Trifluoromethyl)phenyl)selenophene (3)



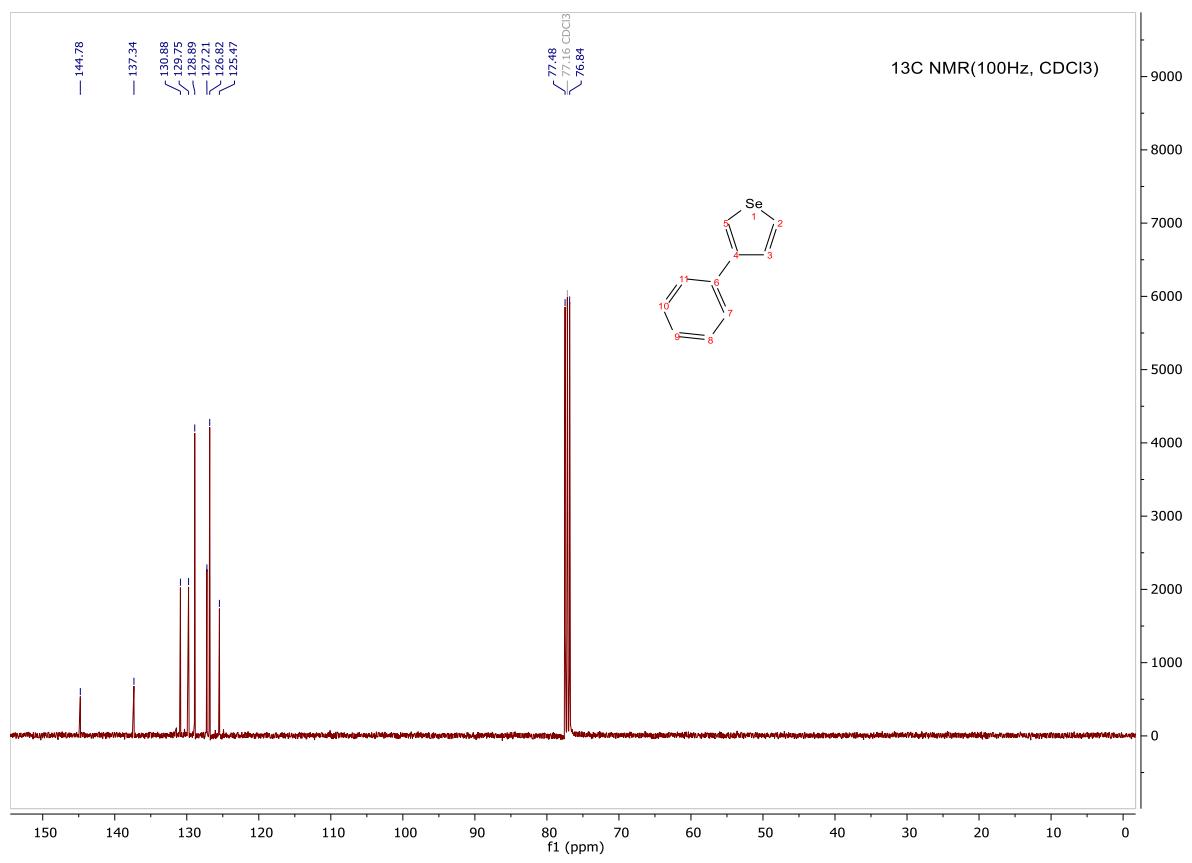
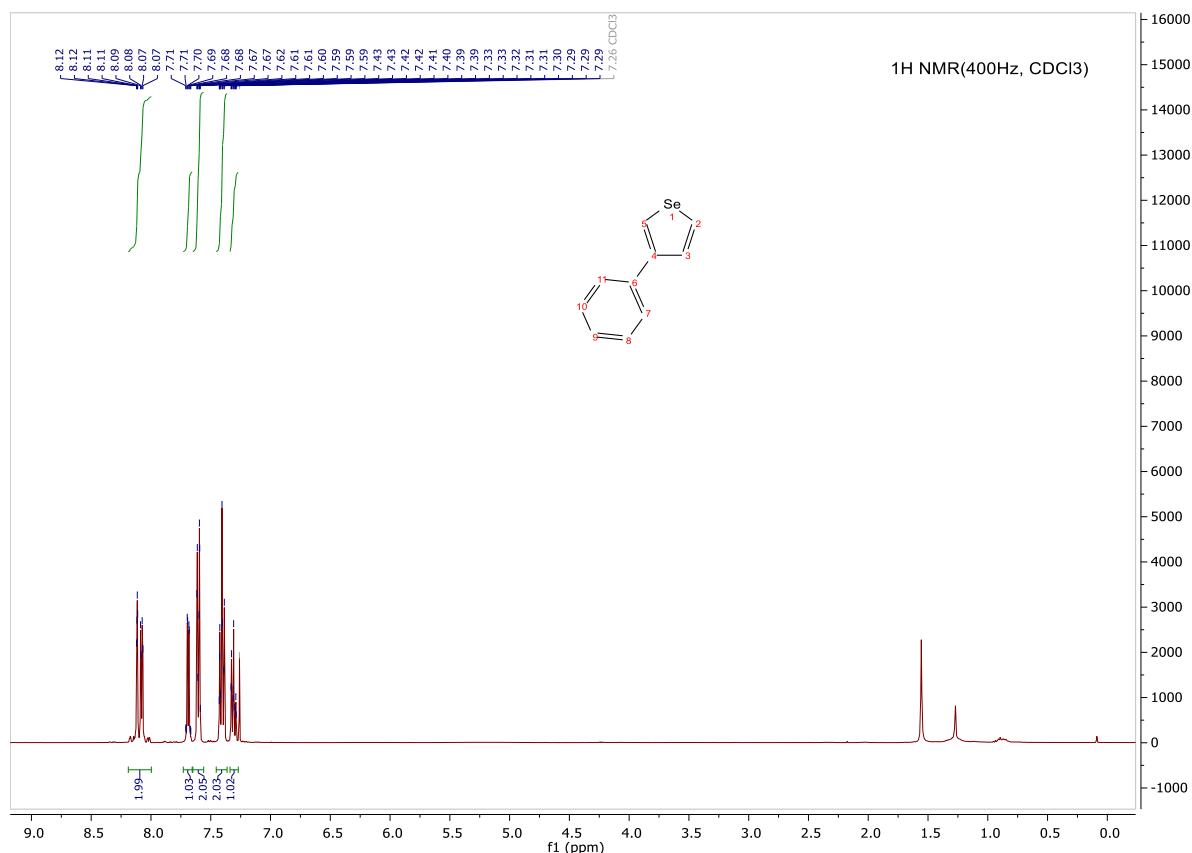
3-(4-Chlorophenyl)selenophene (4)



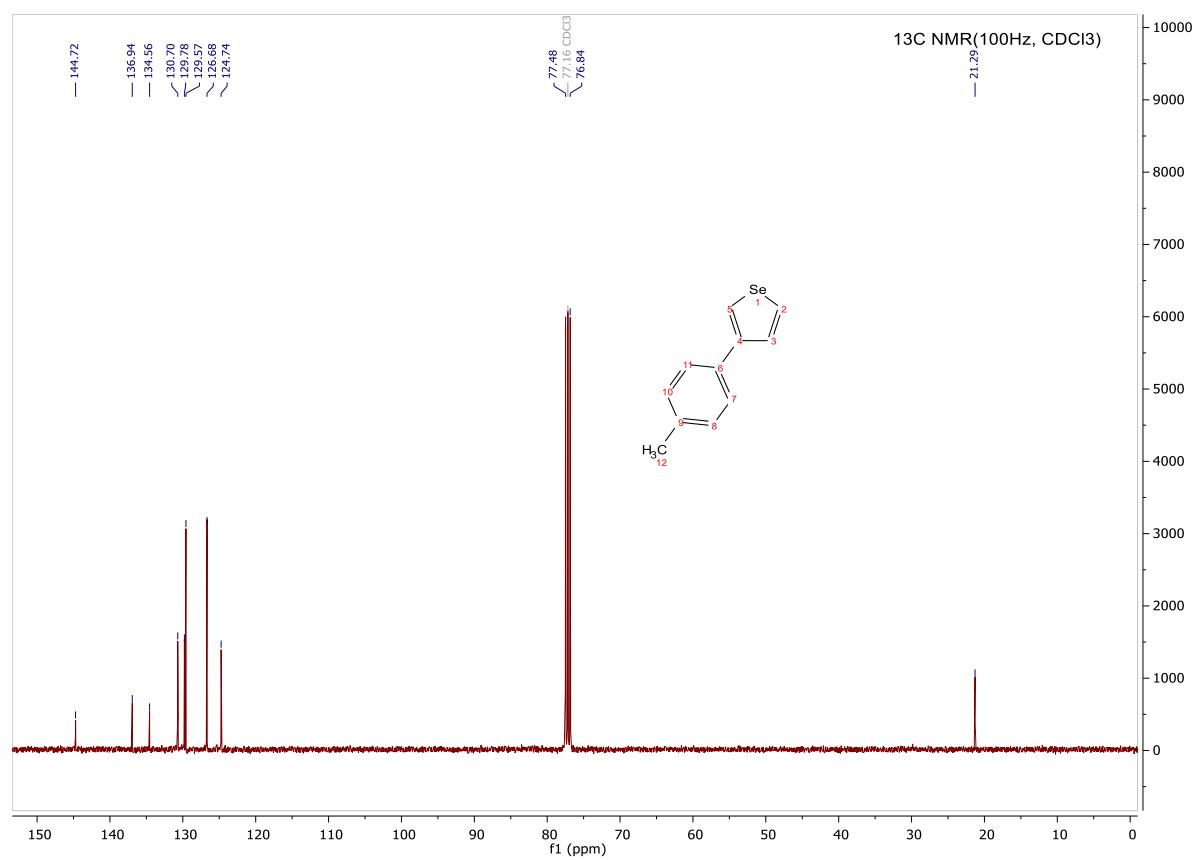
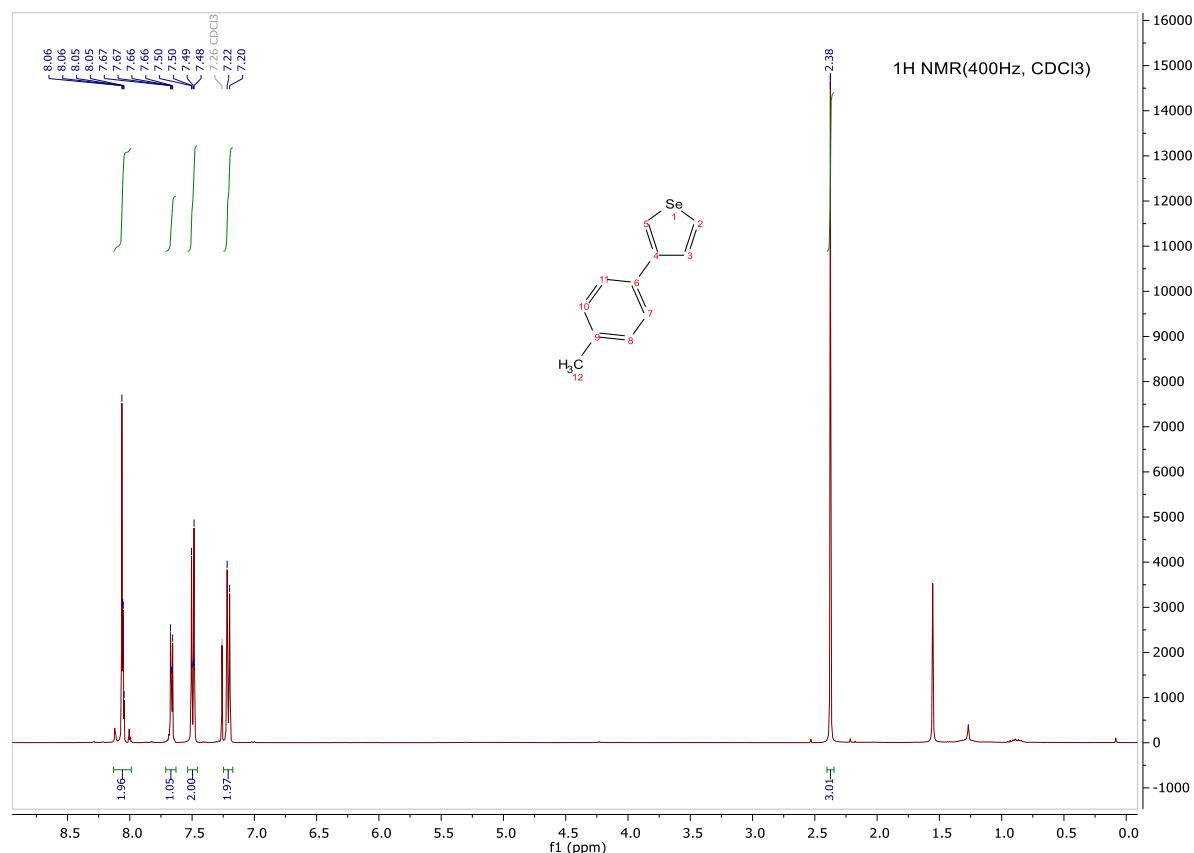
3-(4-Fluorophenyl)selenophene (5)



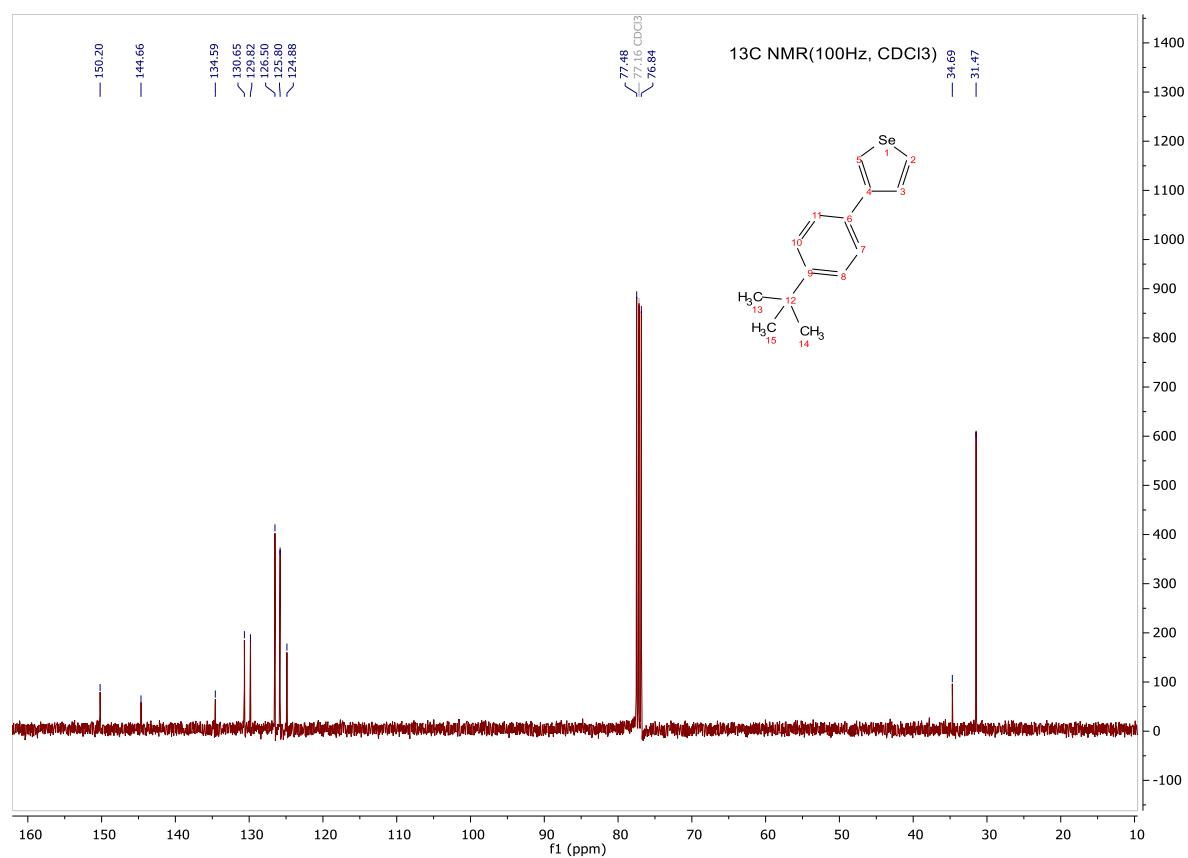
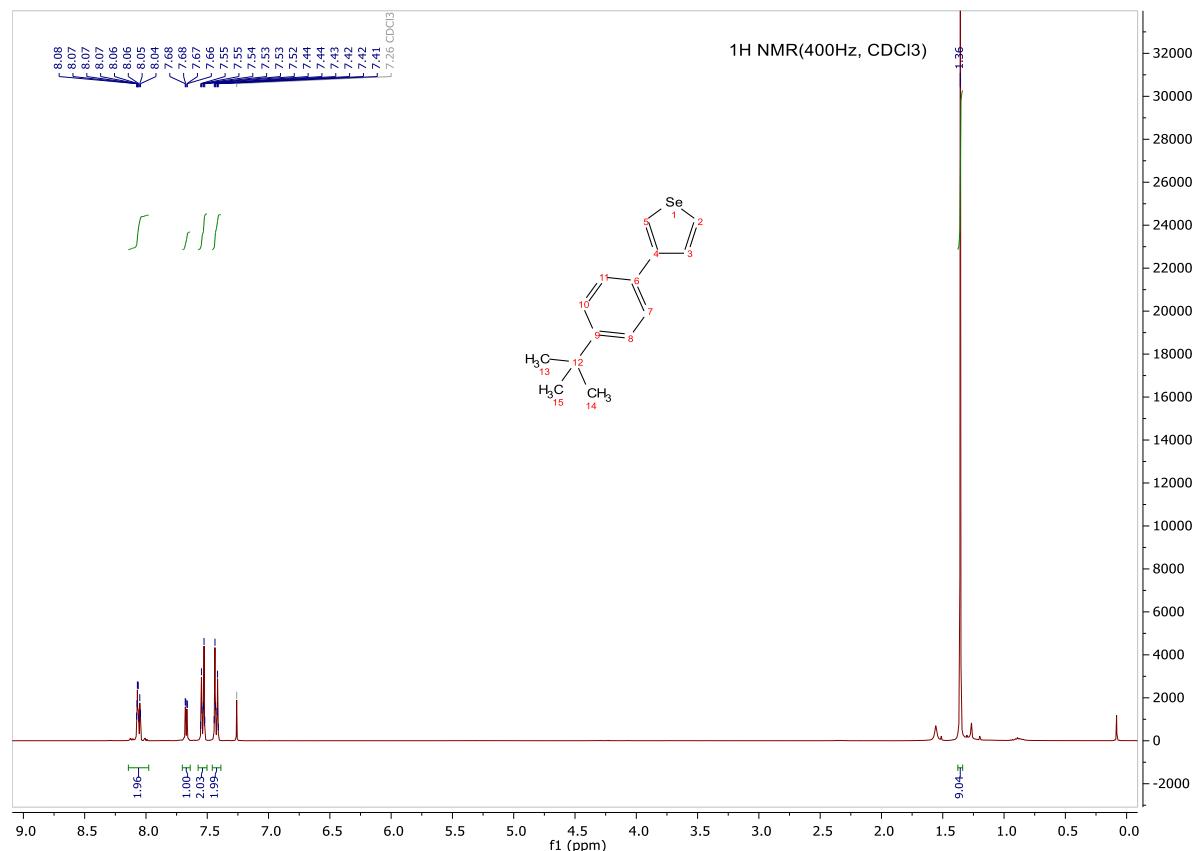
3-Phenylselenophene (6)



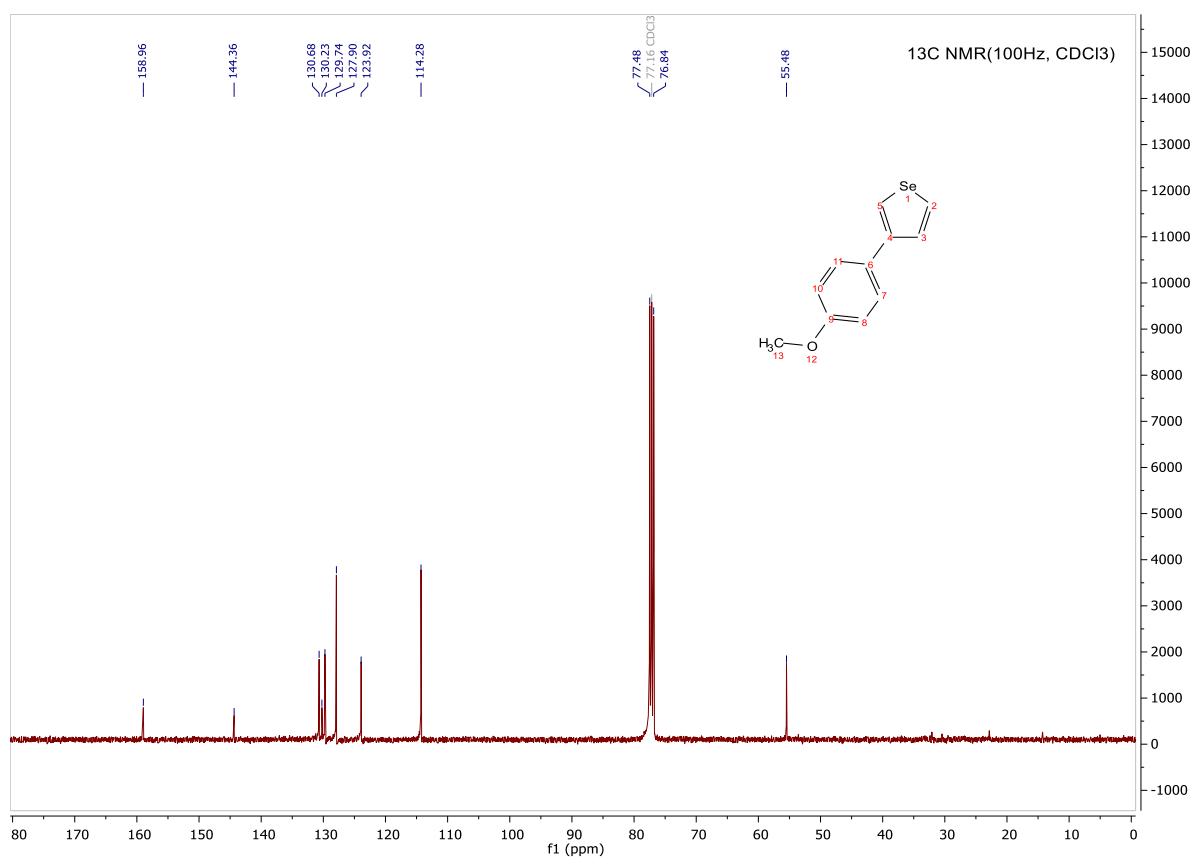
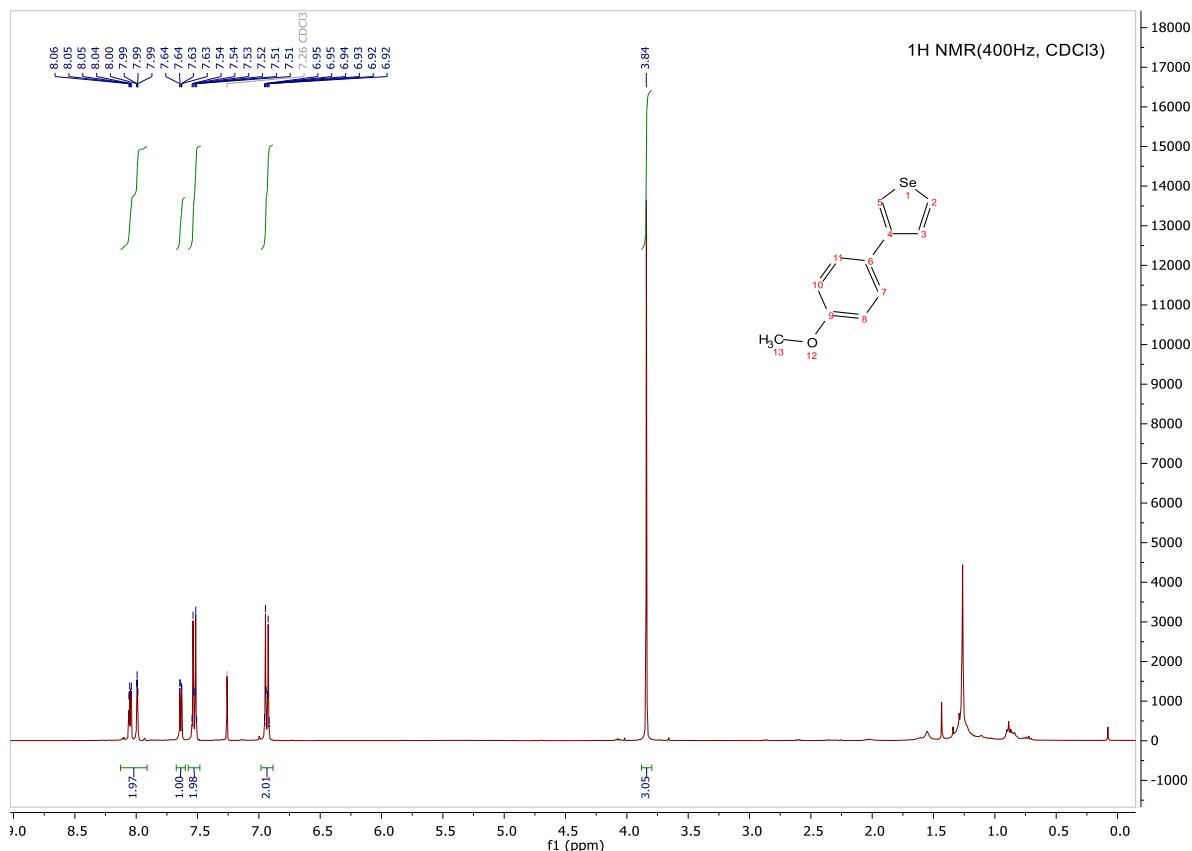
3-p-Tolylselenophene (7)



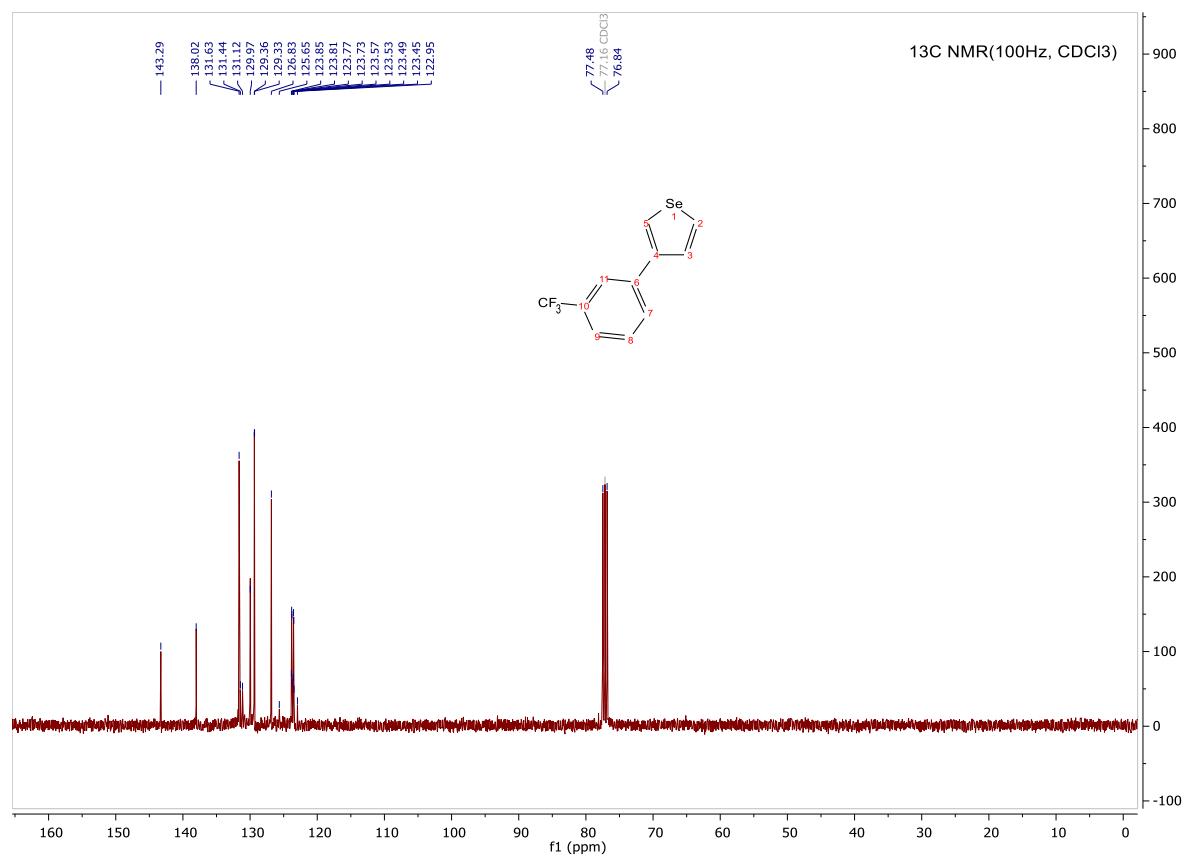
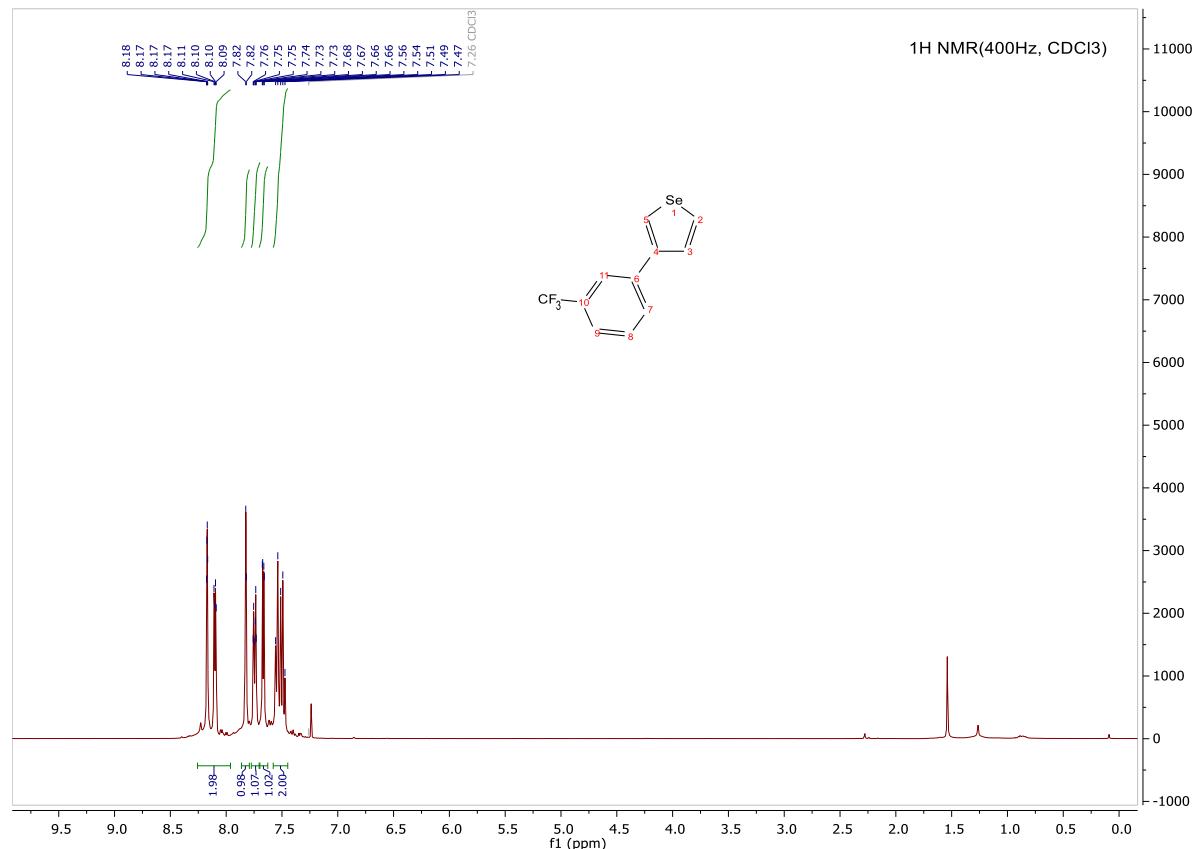
3-(4-*tert*-Butylphenyl)selenophene (8)



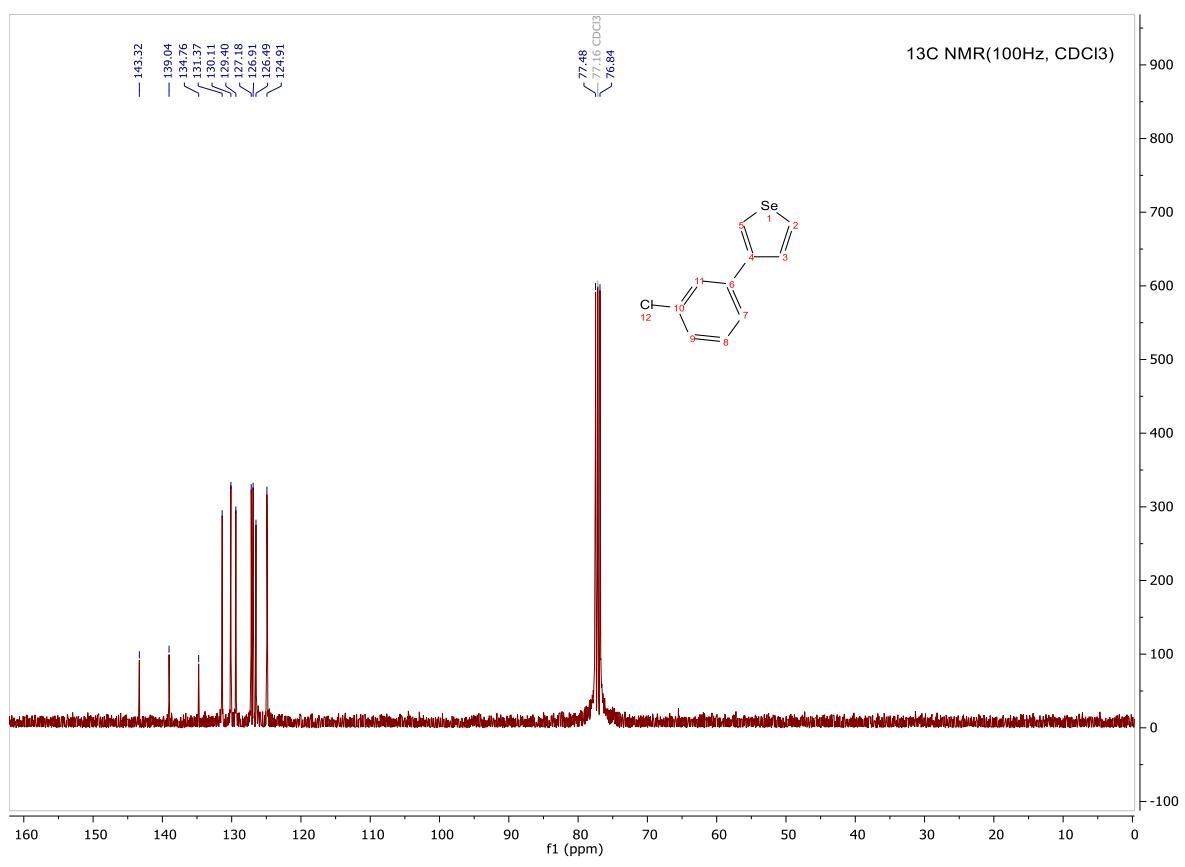
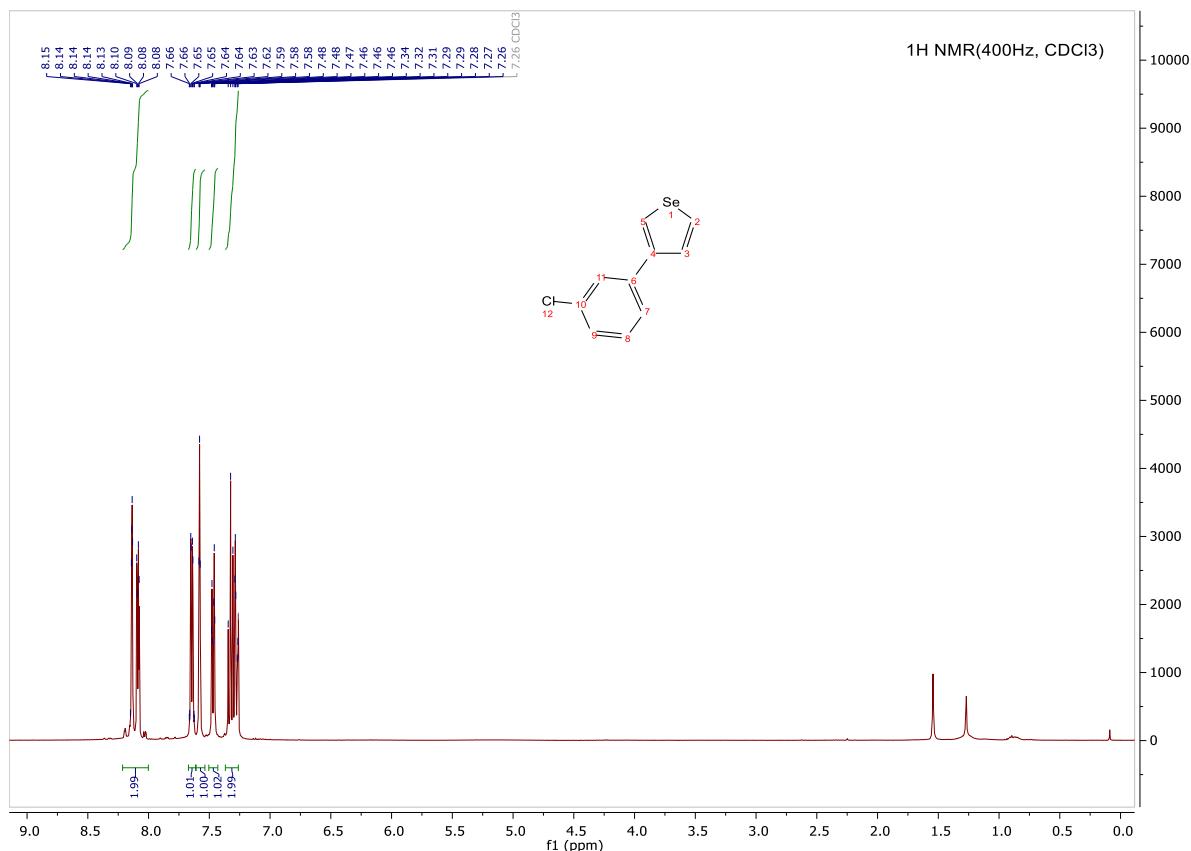
3-(4-Methoxyphenyl)selenophene (9)



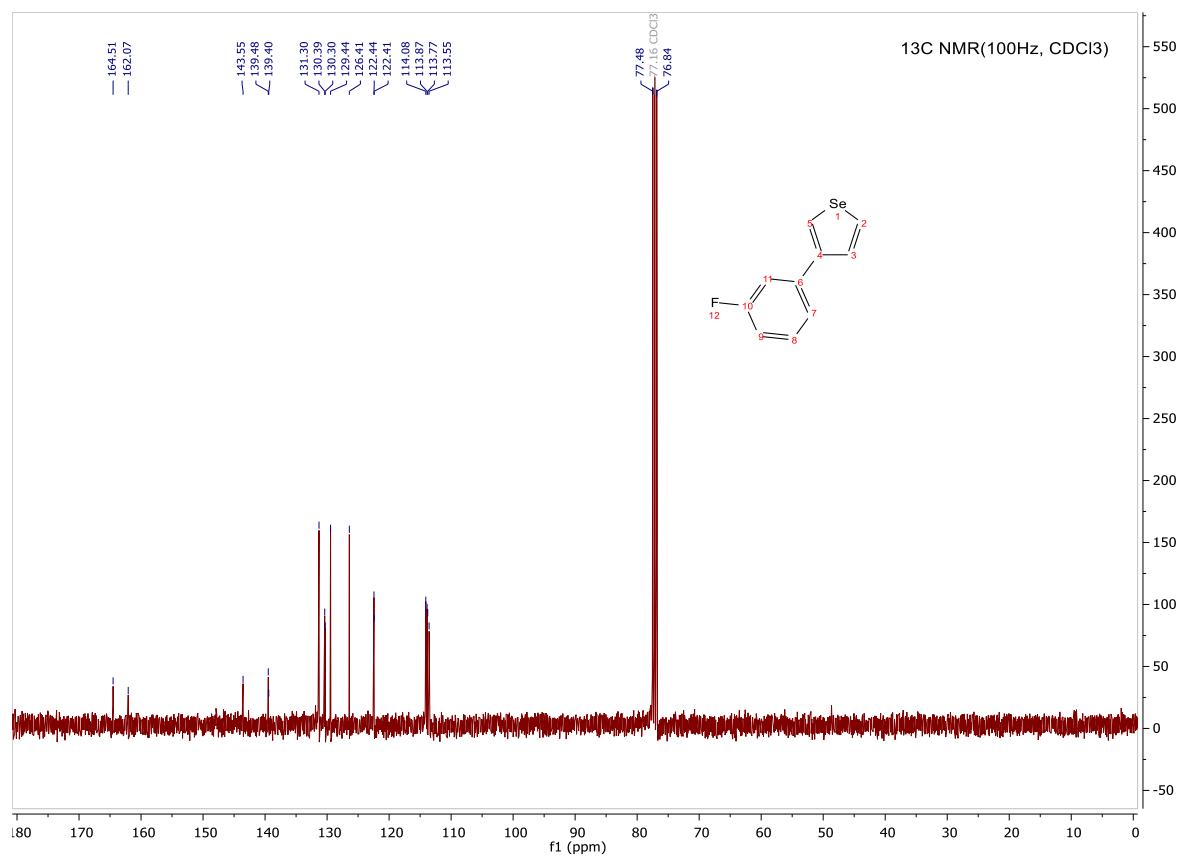
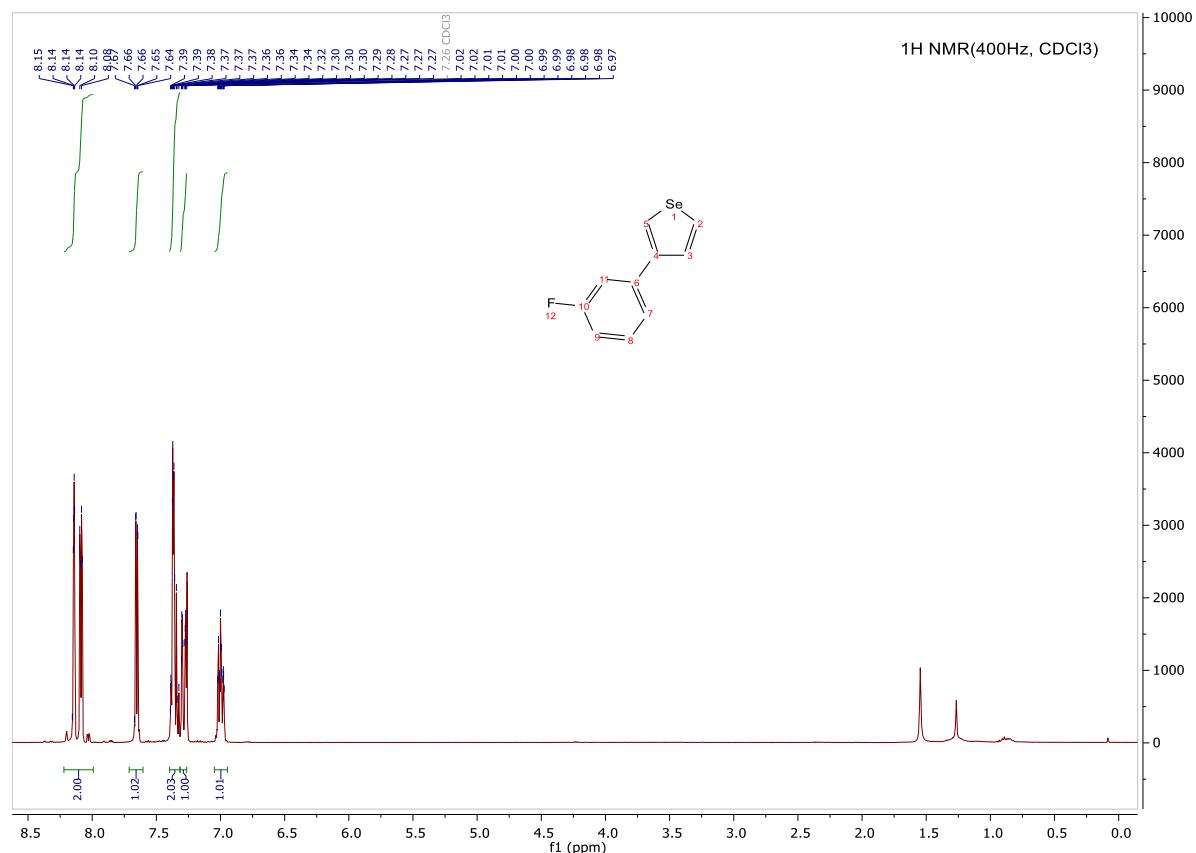
3-(3-(Trifluoromethyl)phenyl)selenophene (10)



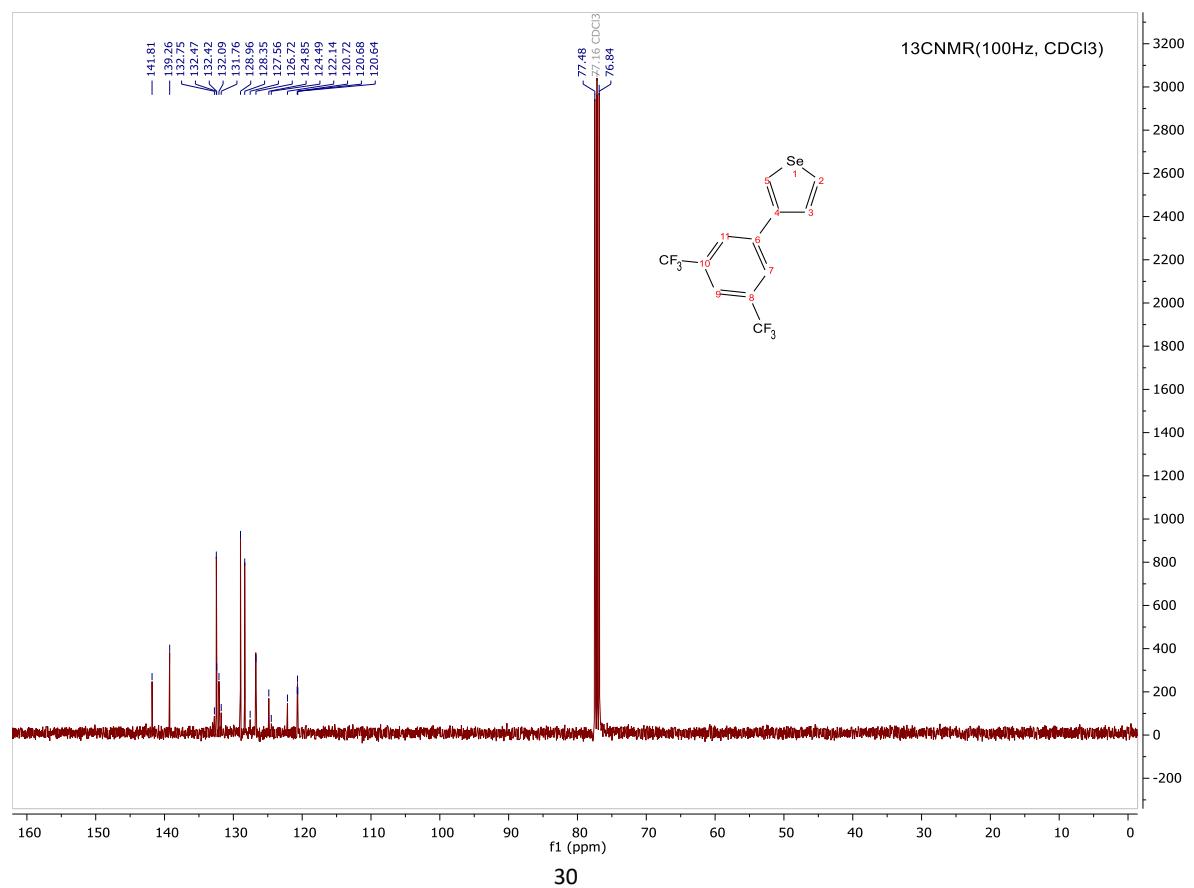
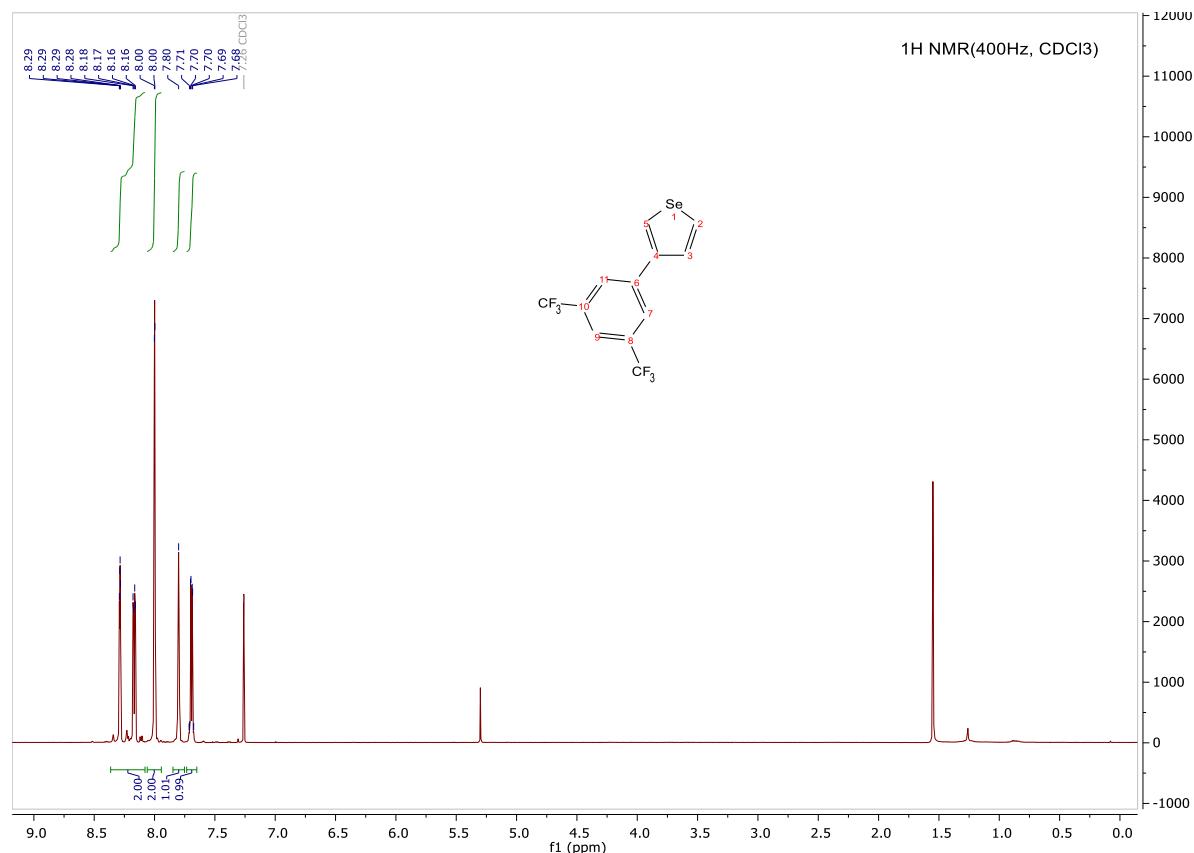
3-(3-Chlorophenyl)selenophene (11)



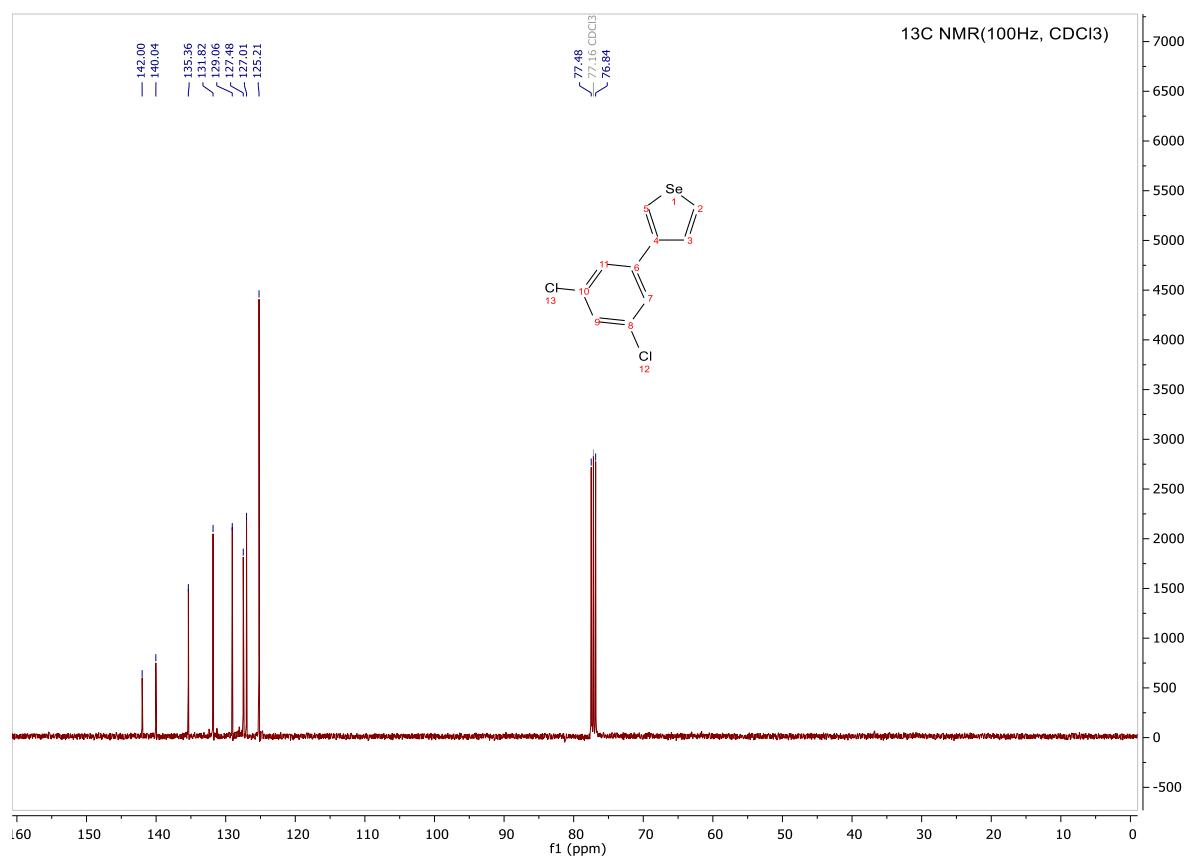
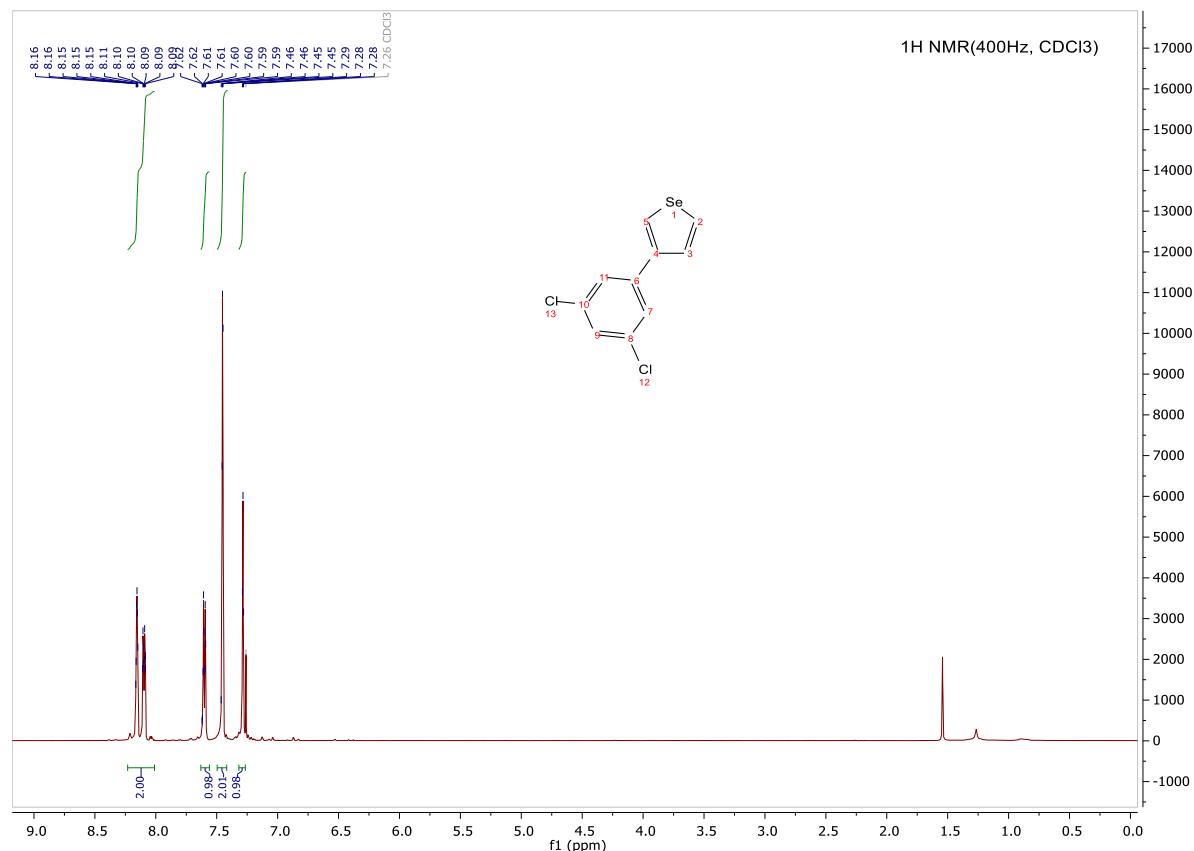
3-(3-Fluorophenyl)selenophene (12)



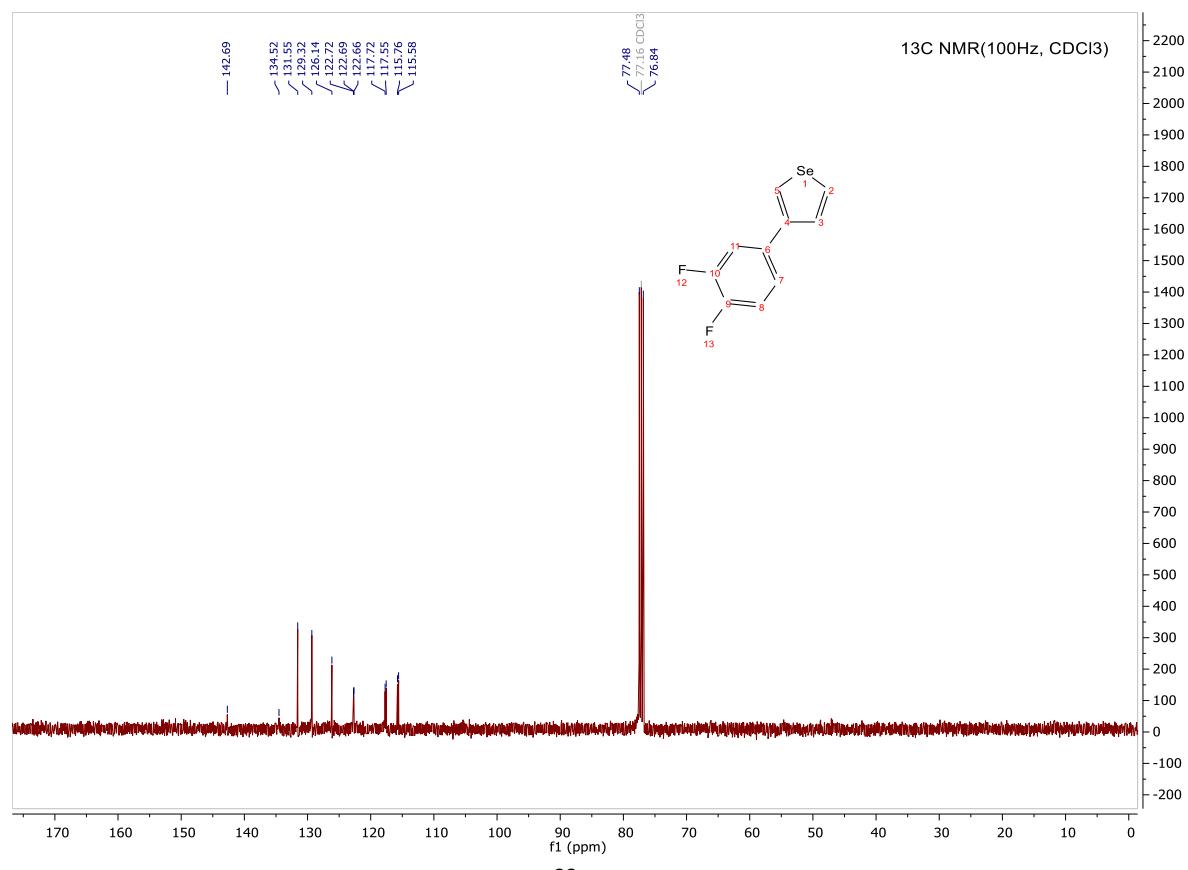
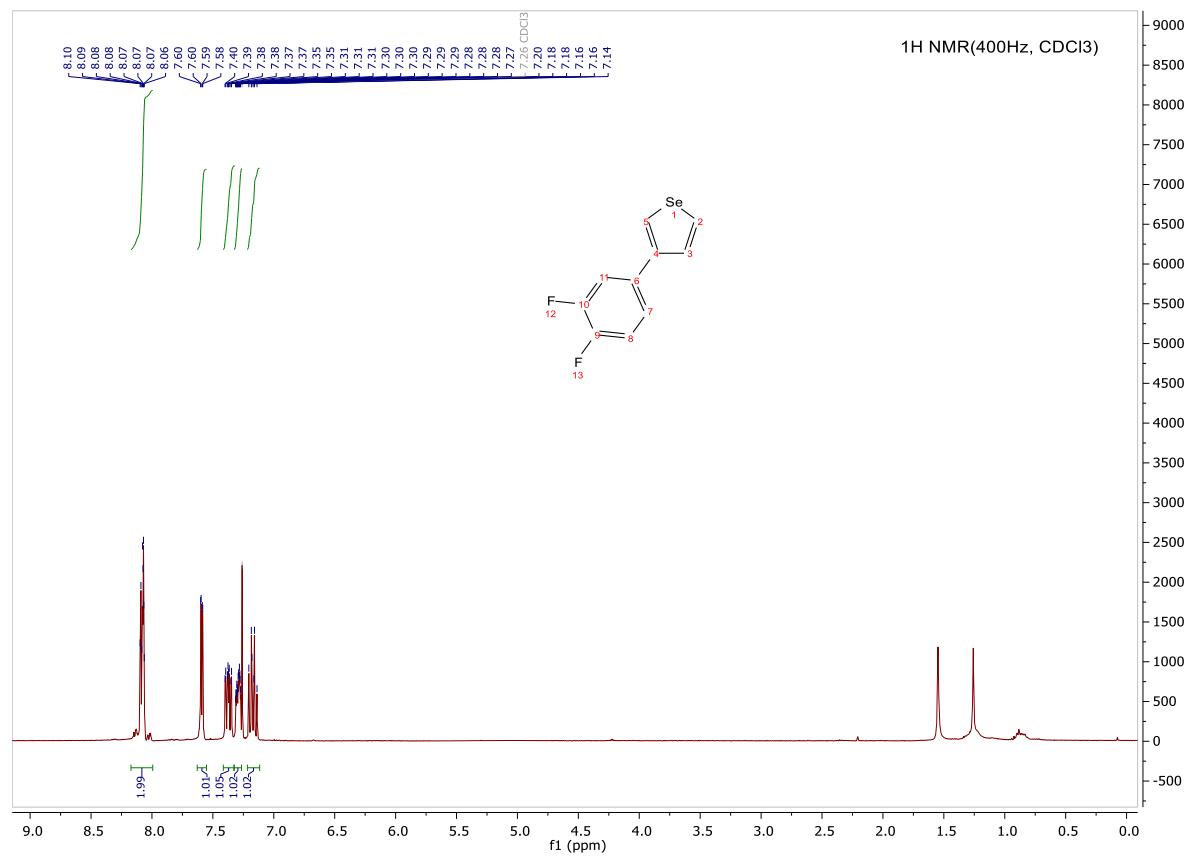
3-(3,5-Bis(trifluoromethyl)phenyl)selenophene (13)



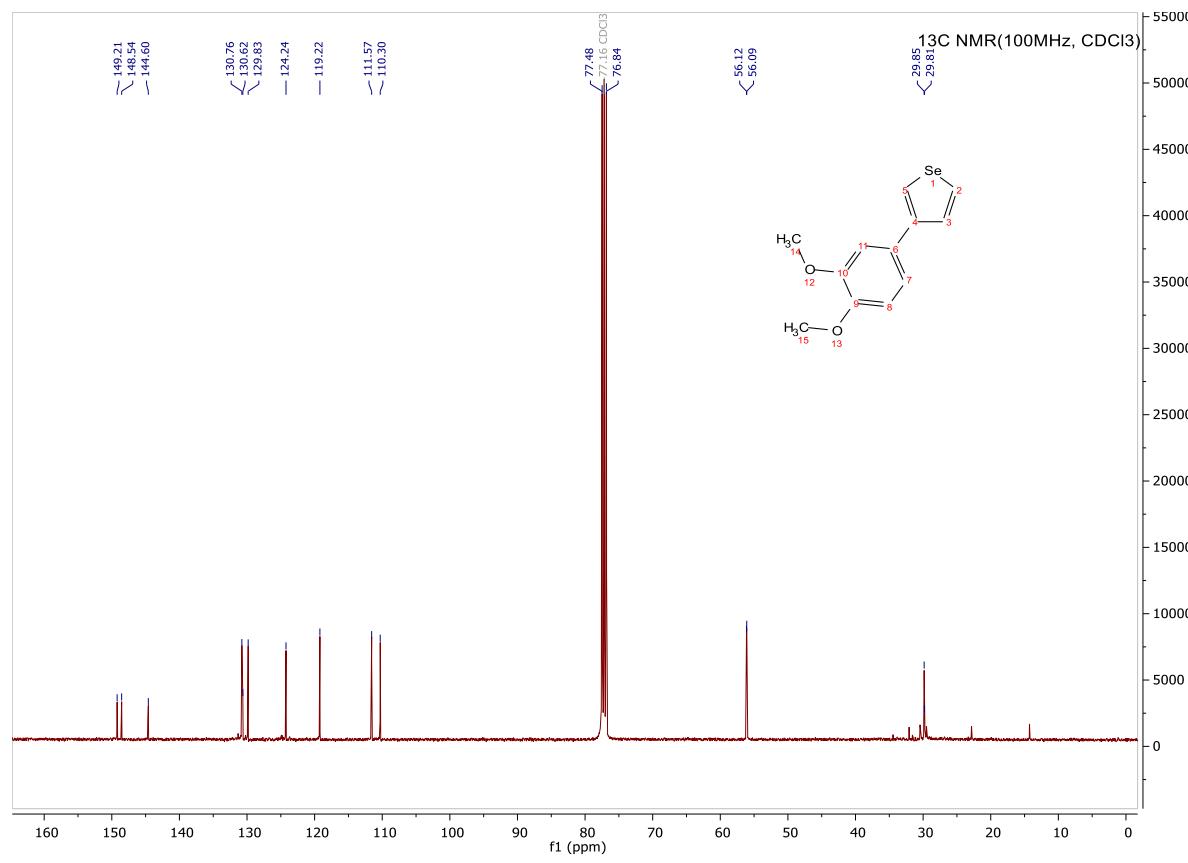
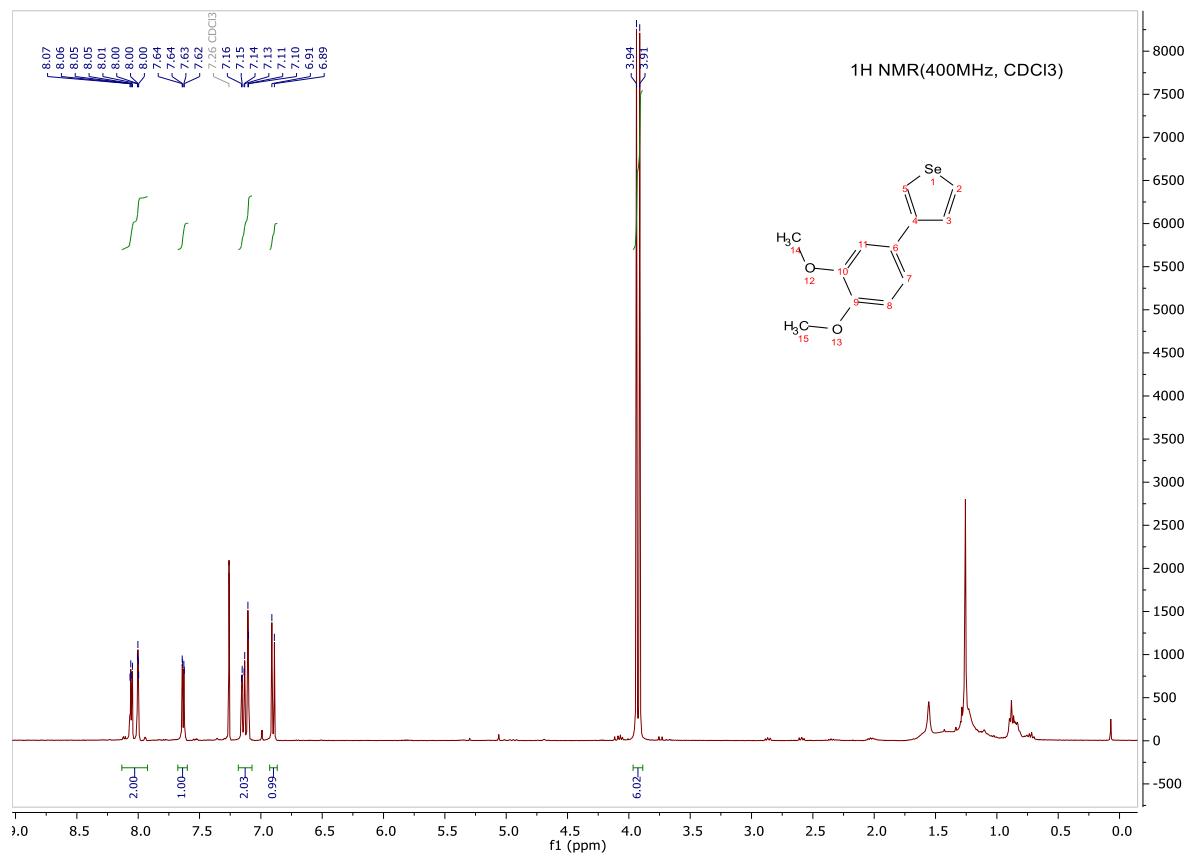
3-(3,5-Dichlorophenyl)selenophene (14)



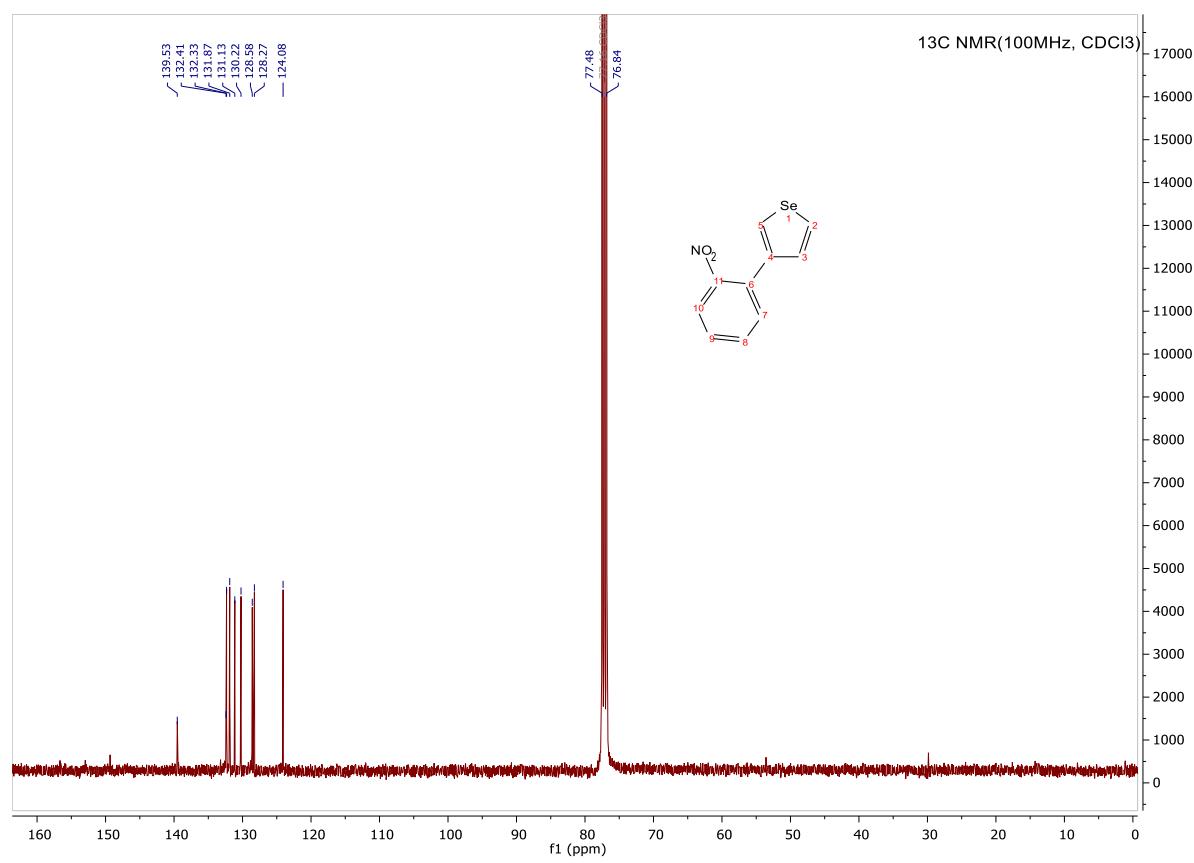
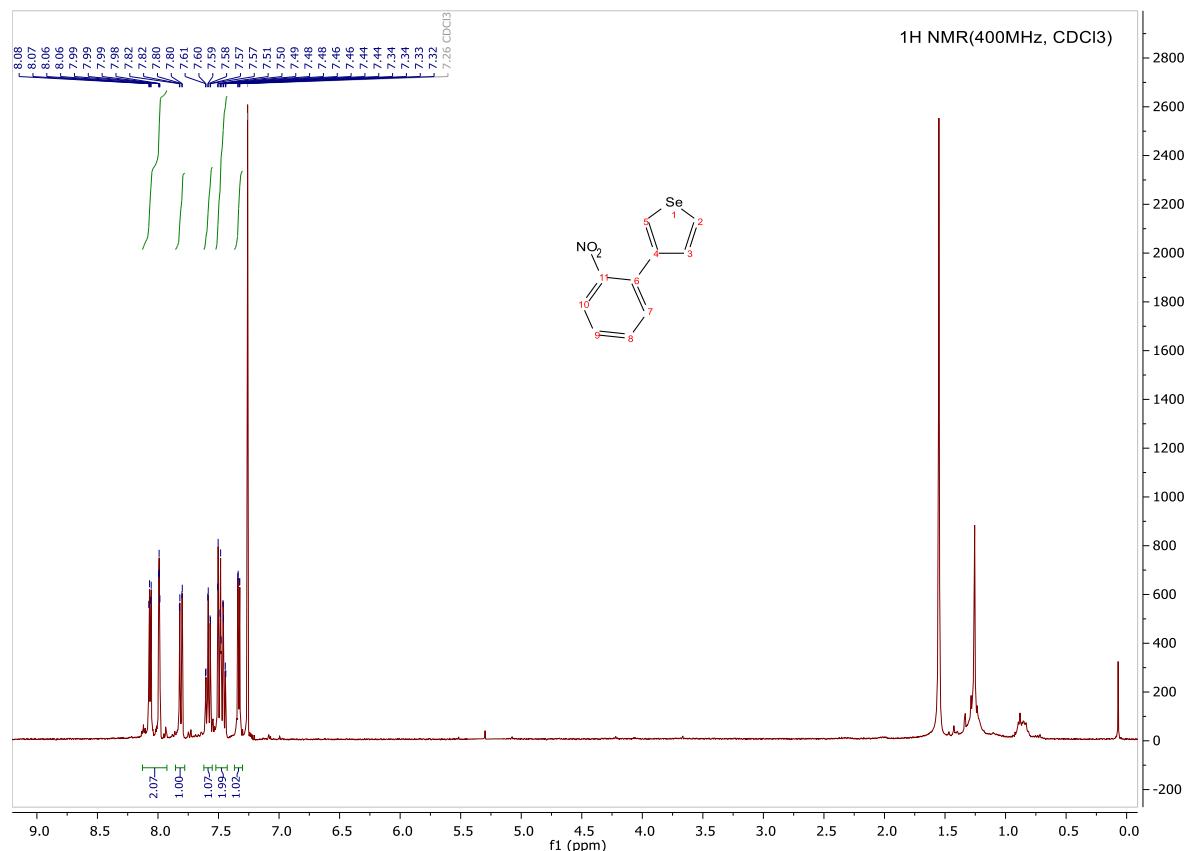
3-(3,4-Difluorophenyl)selenophene (15)



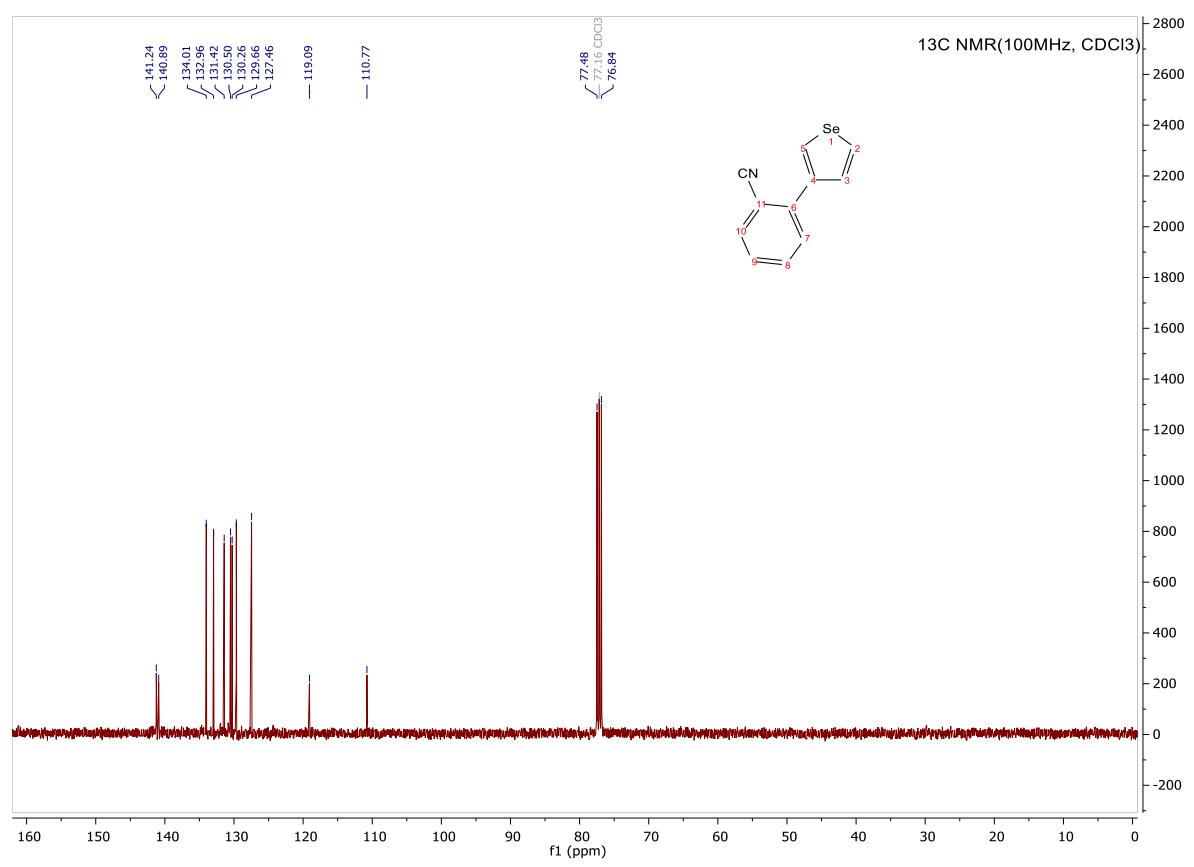
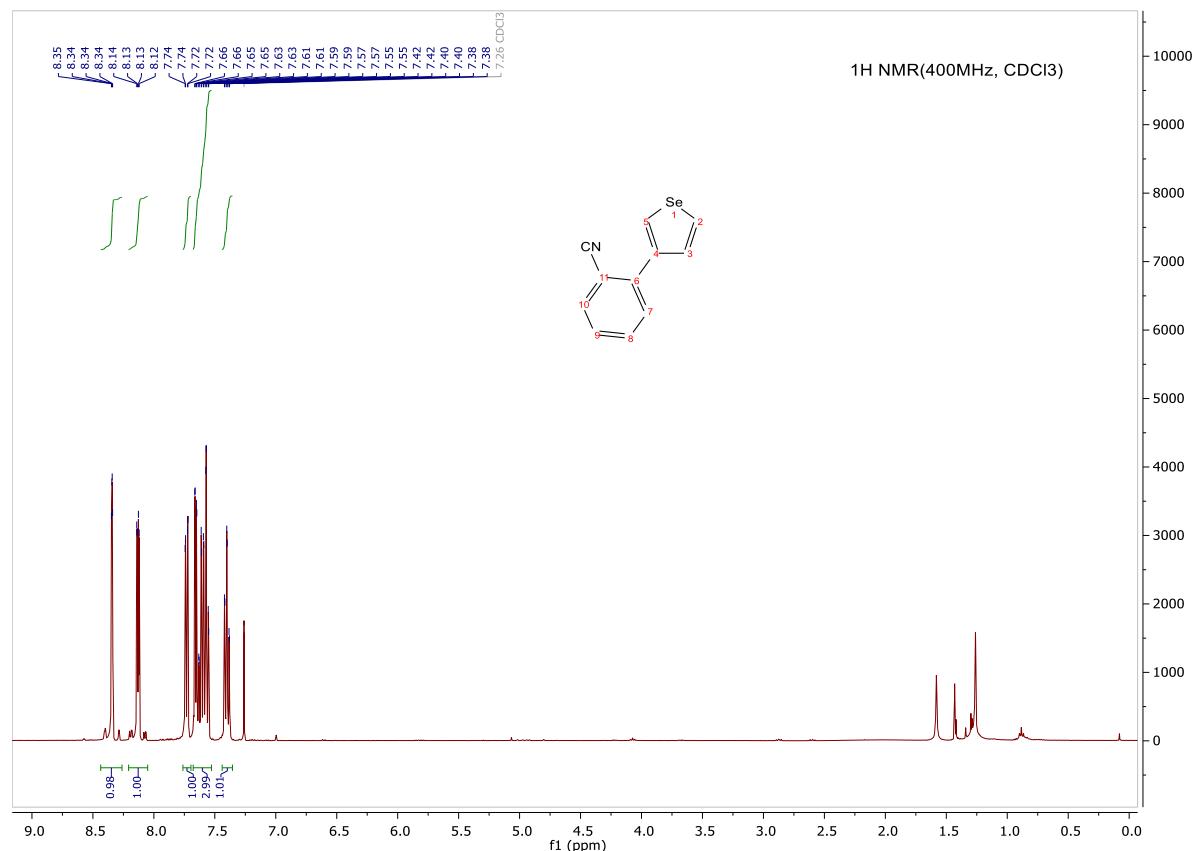
3-(3,4-Dimethoxyphenyl)selenophene (16)



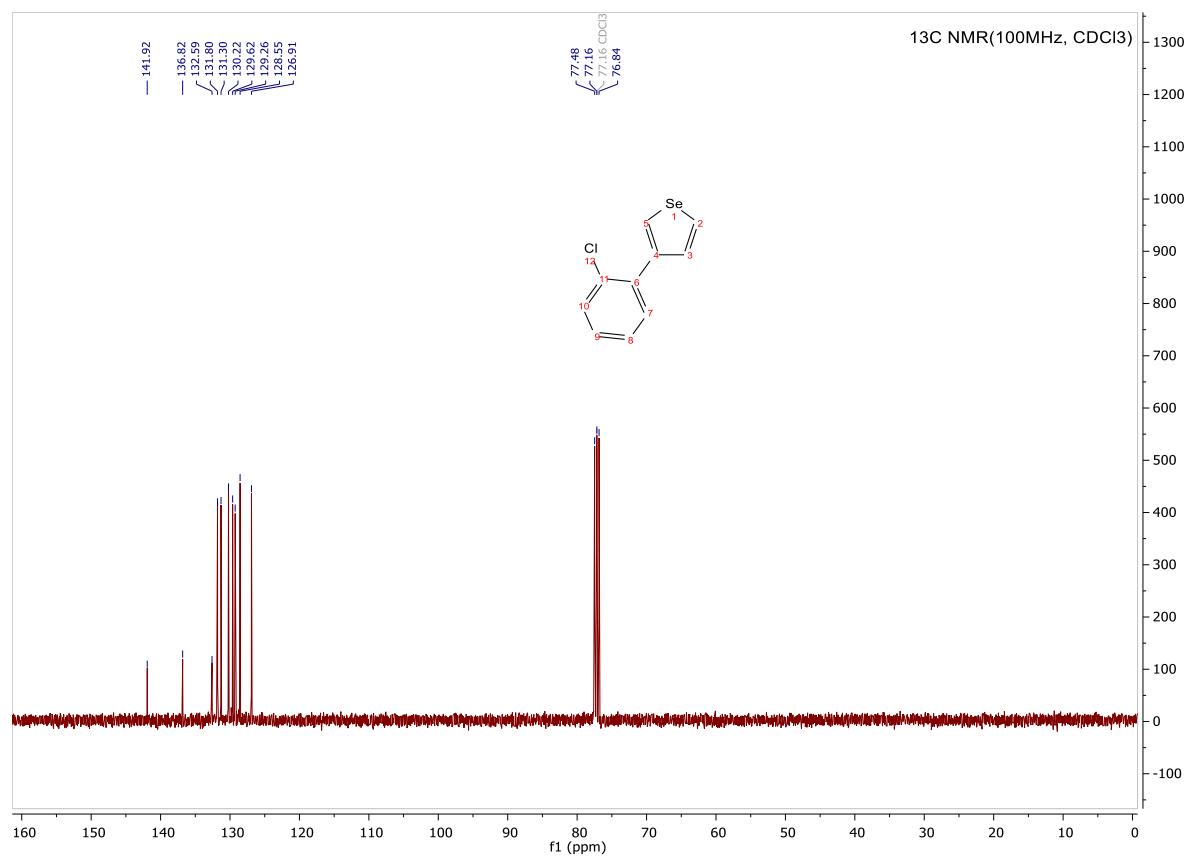
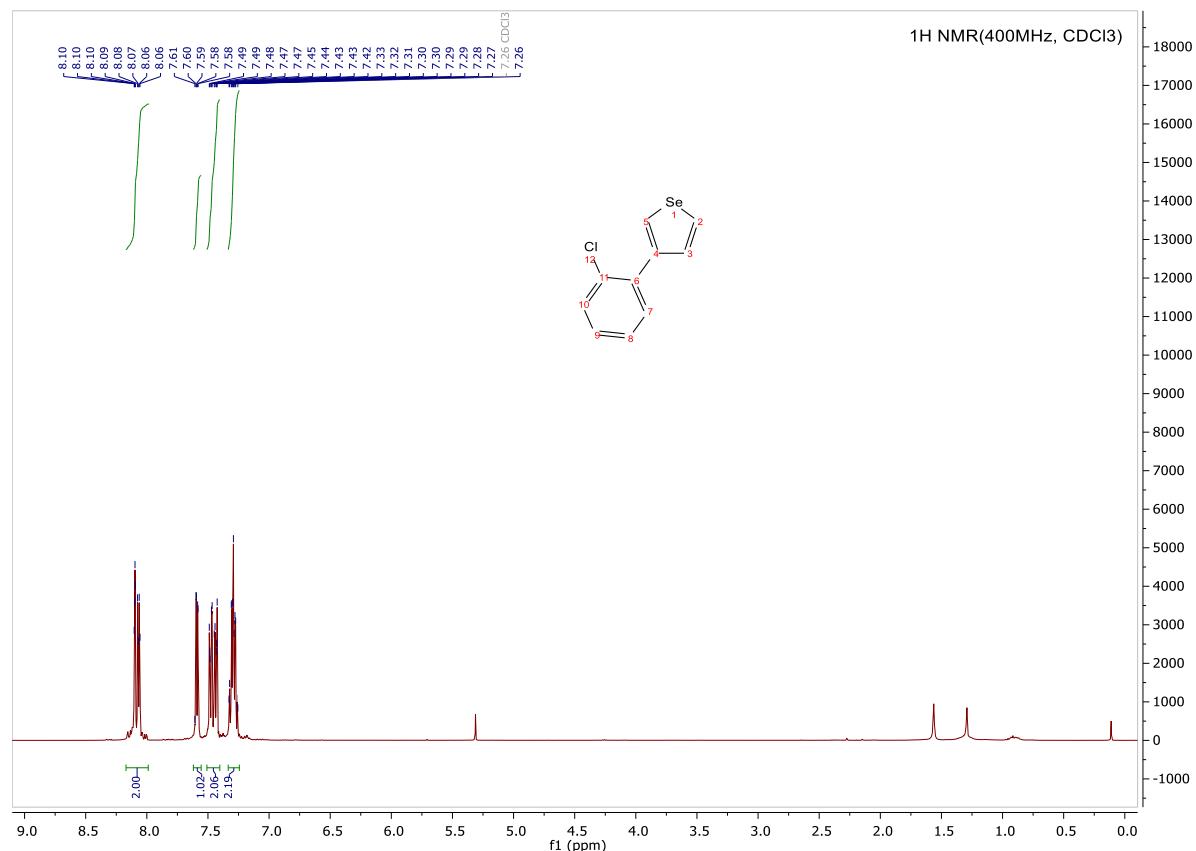
3-(2-Nitrophenyl)selenophene (17)



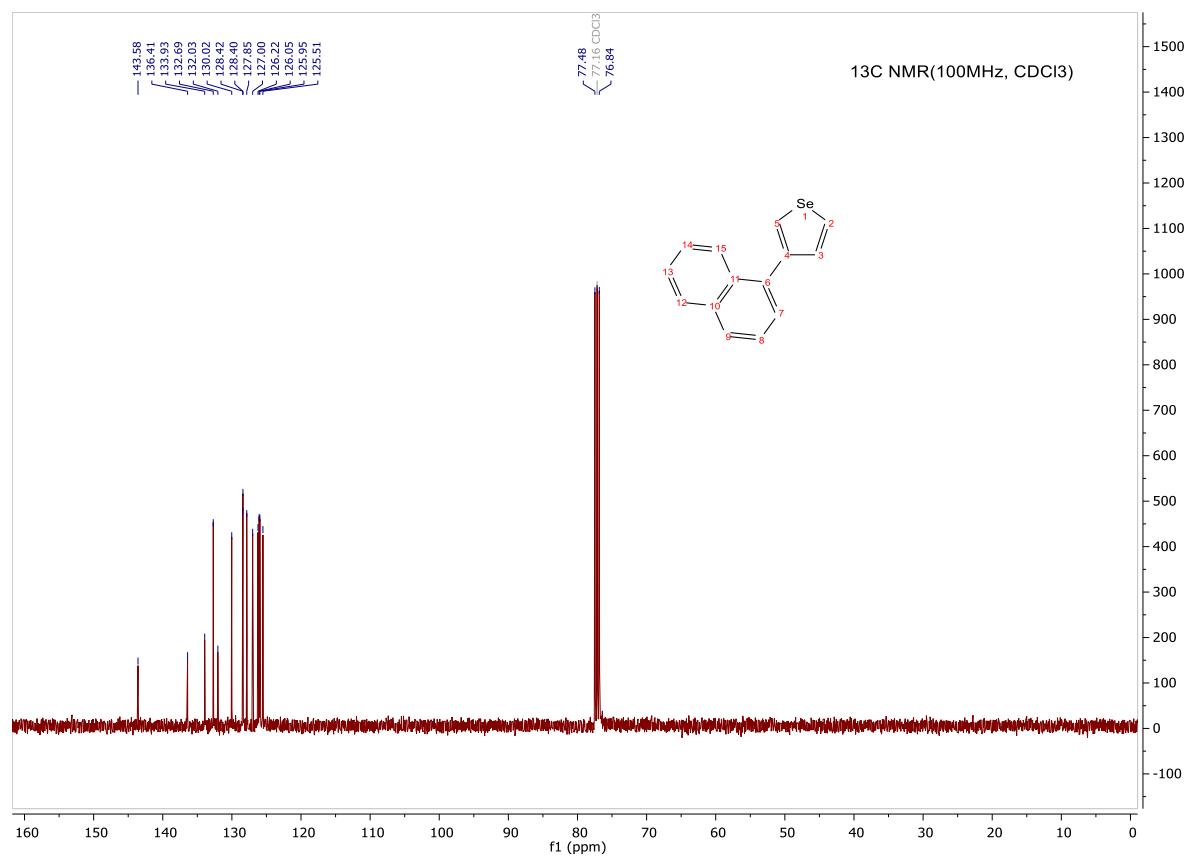
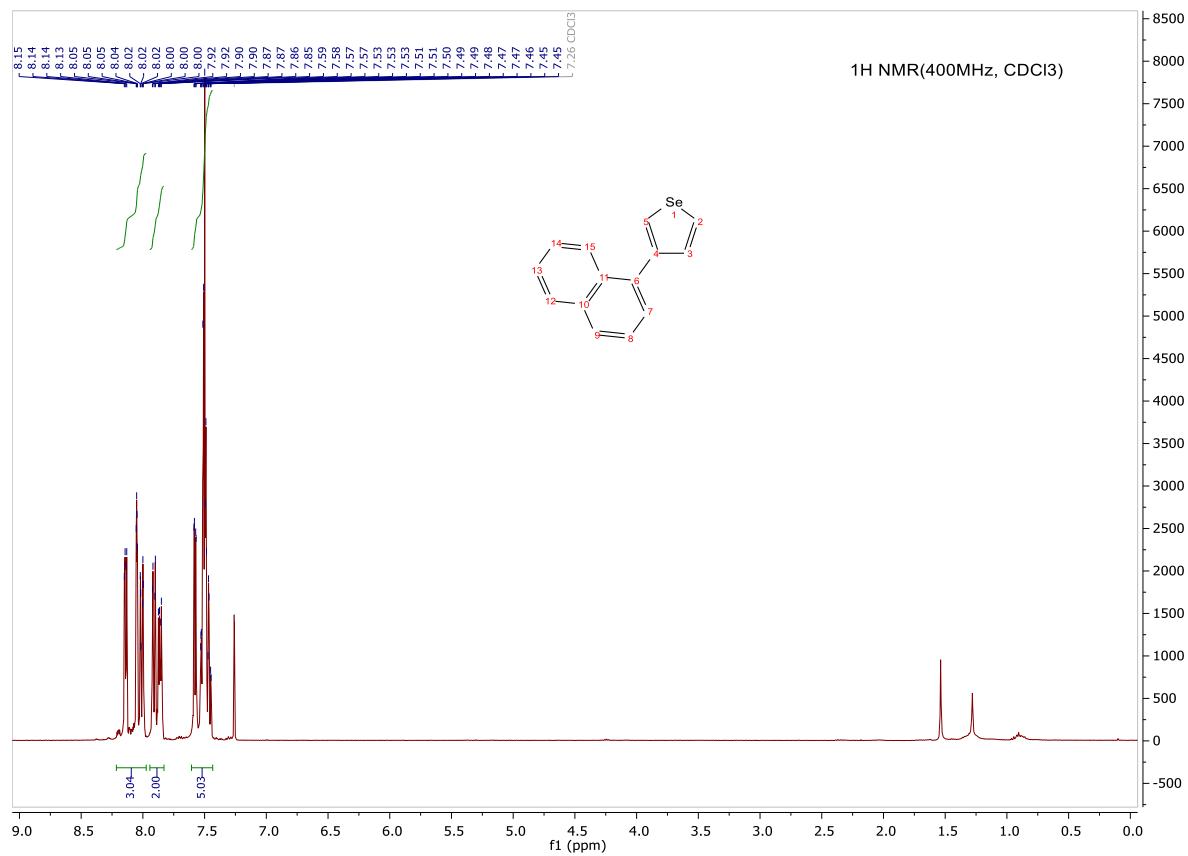
2-(Selenophen-3-yl)benzonitrile (18)



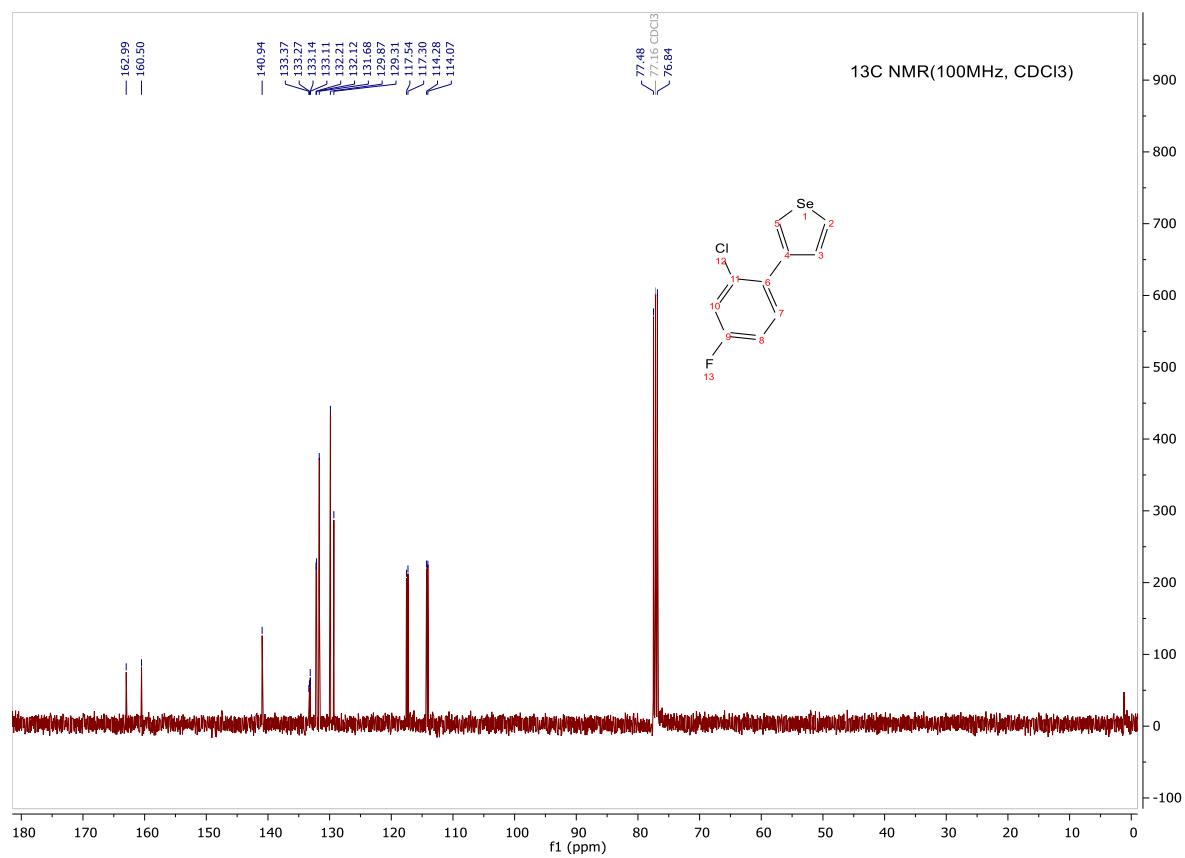
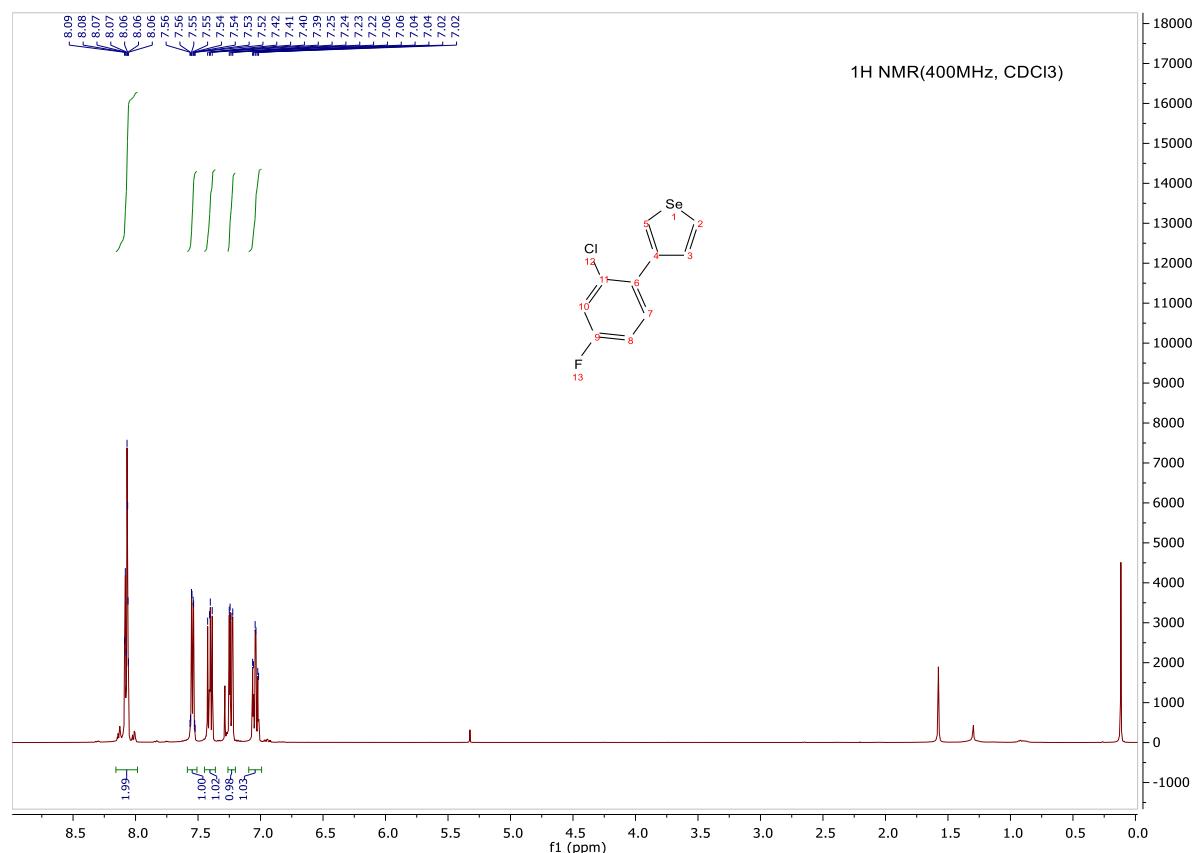
3-(2-Chlorophenyl)selenophene (19)



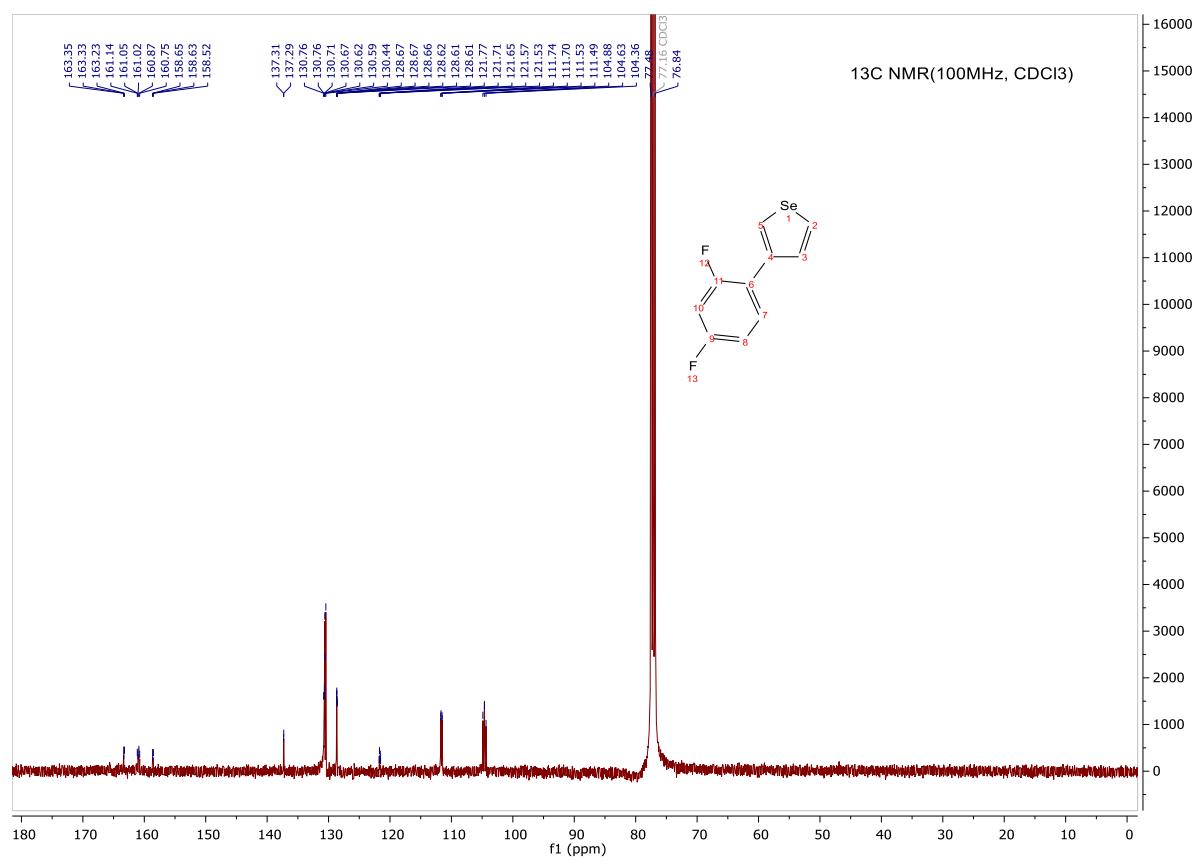
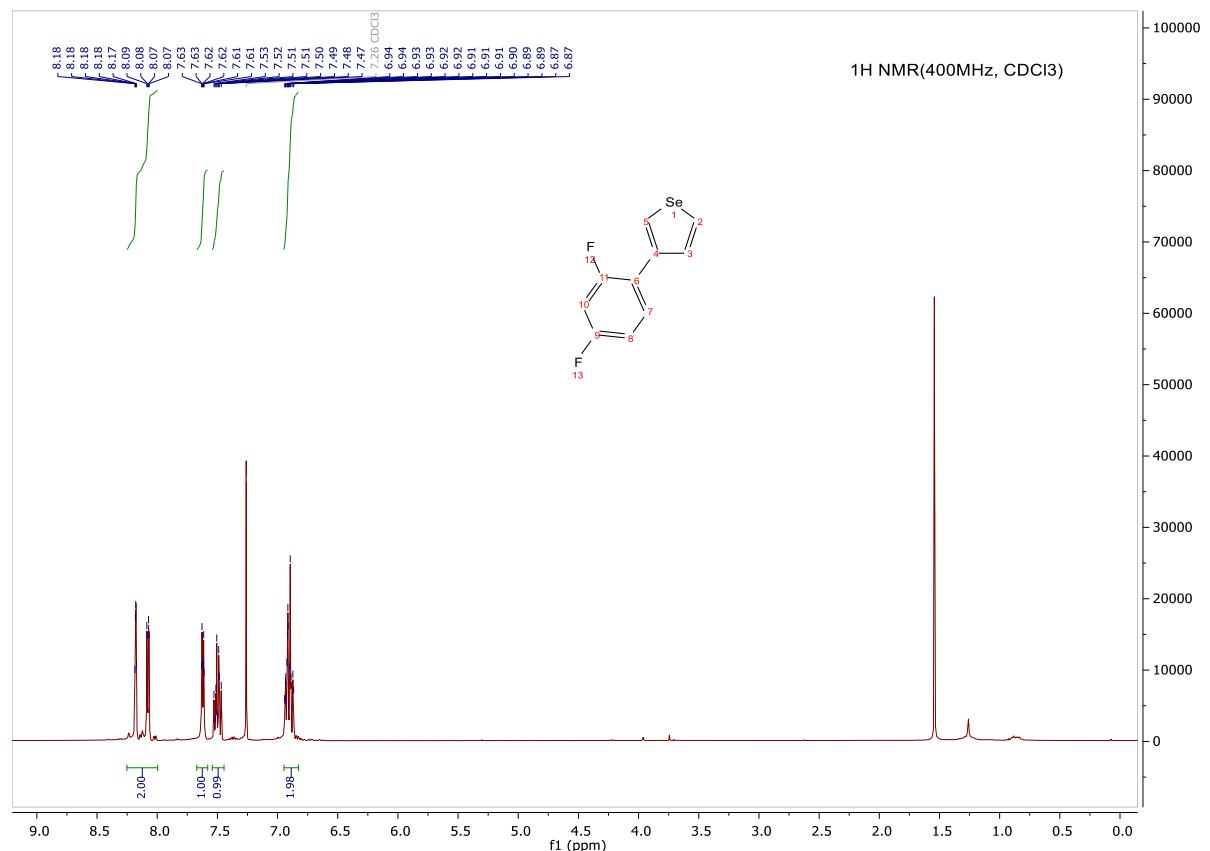
3-(Naphthalen-1-yl)selenophene (20)



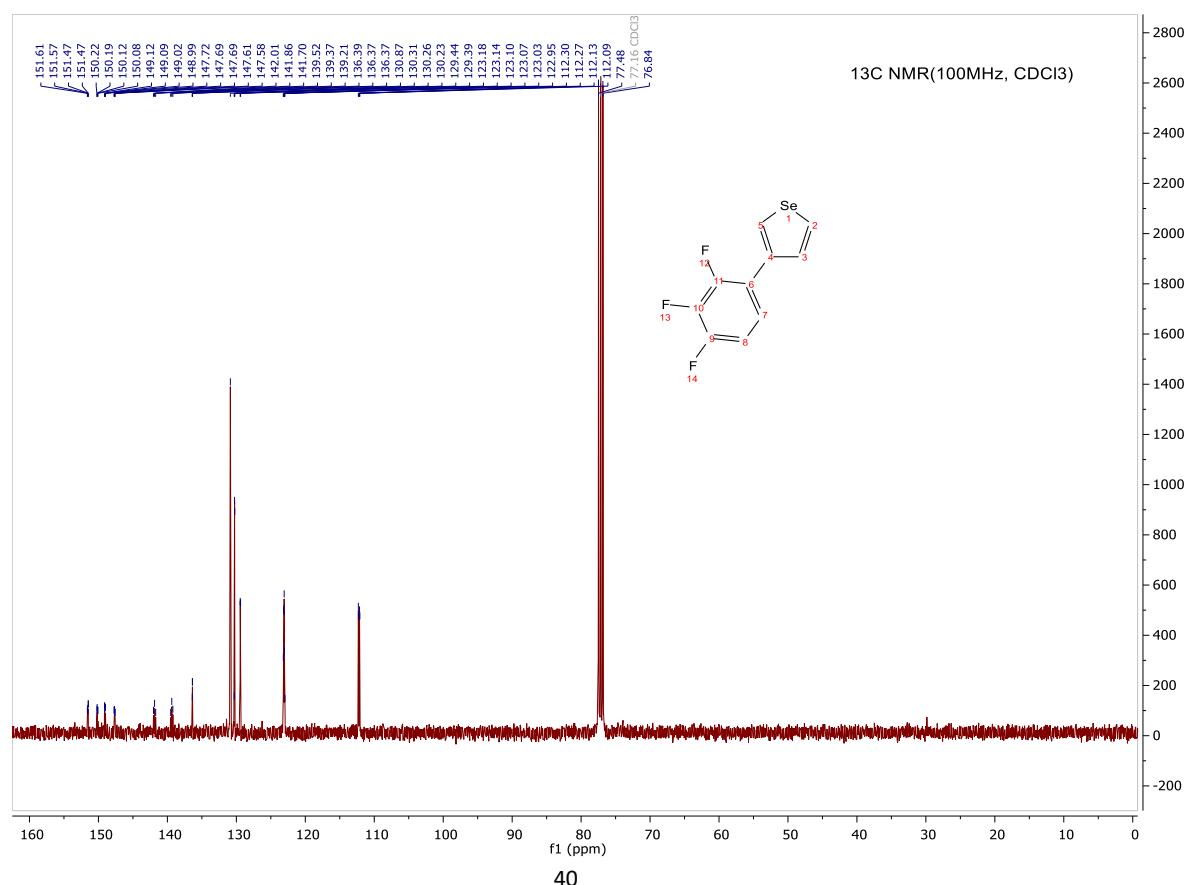
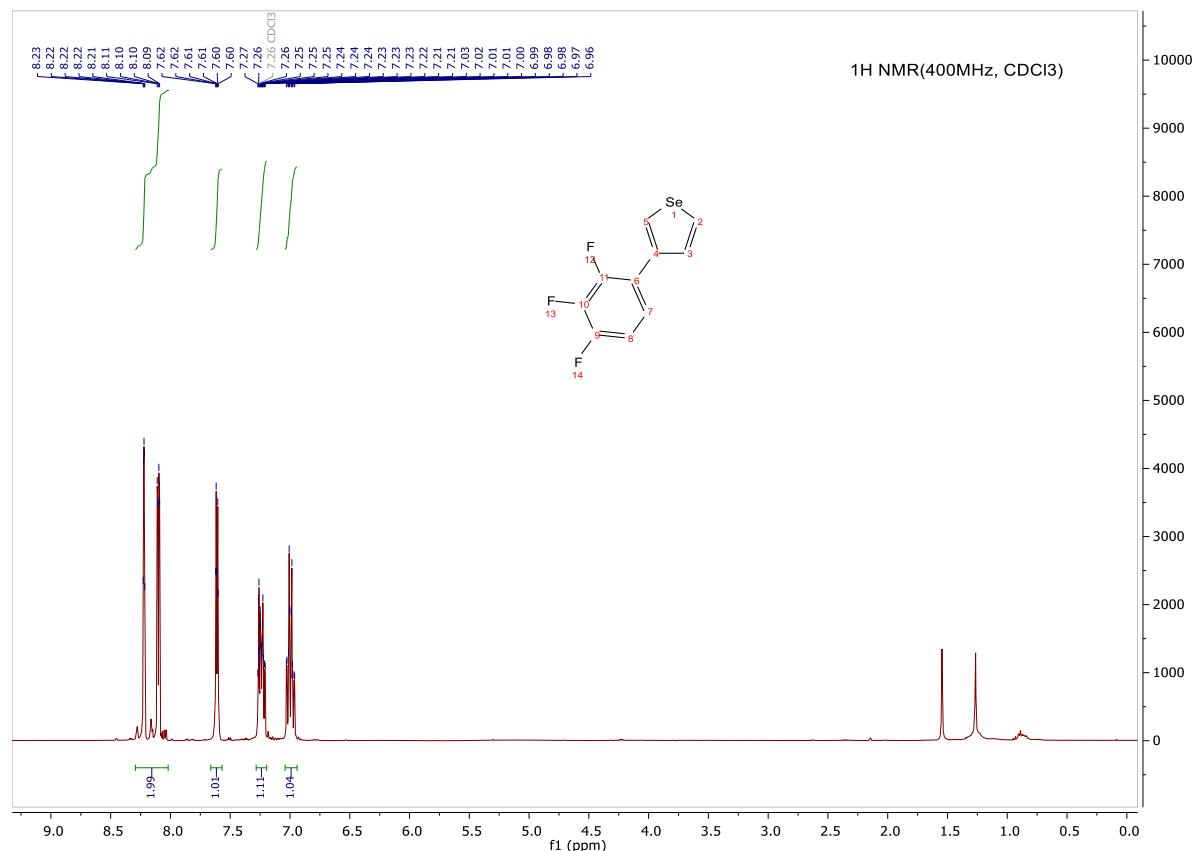
3-(2-Chloro-4-fluorophenyl)selenophene (21)



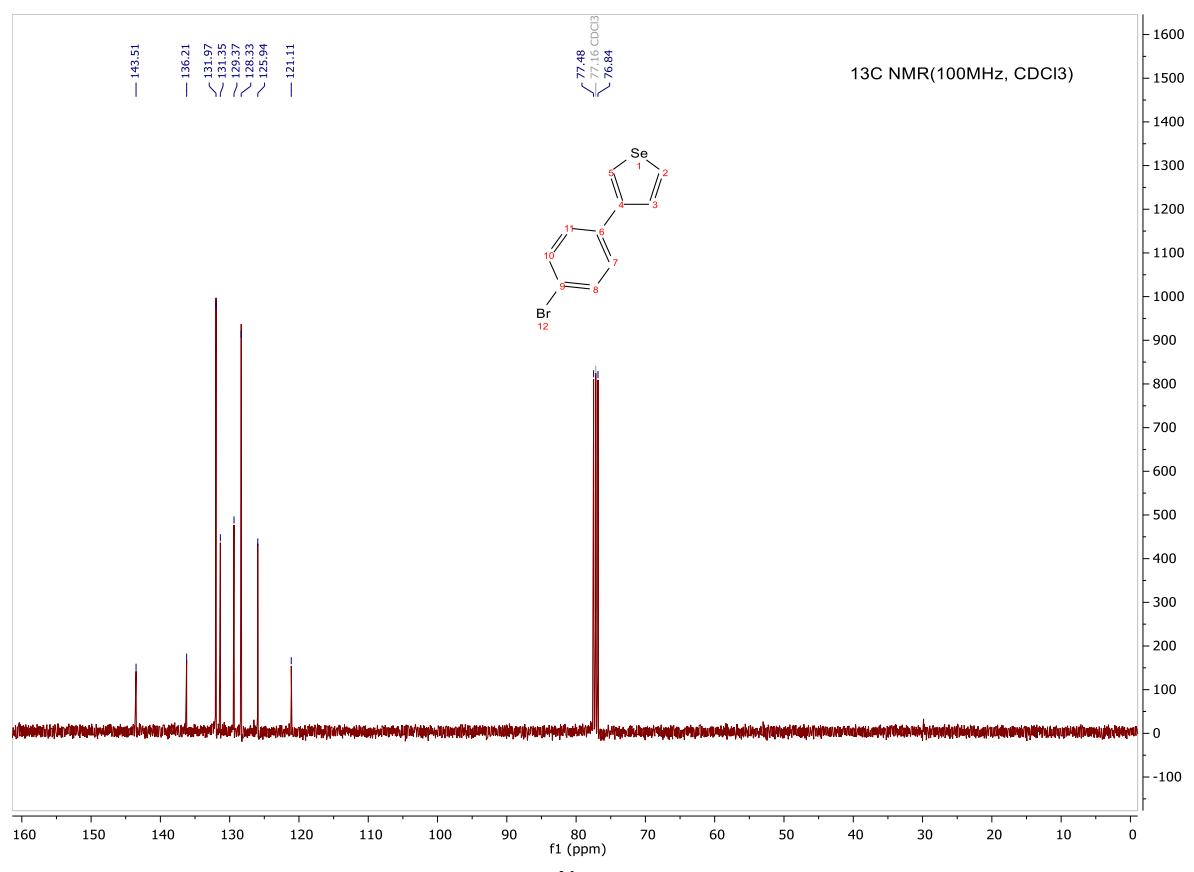
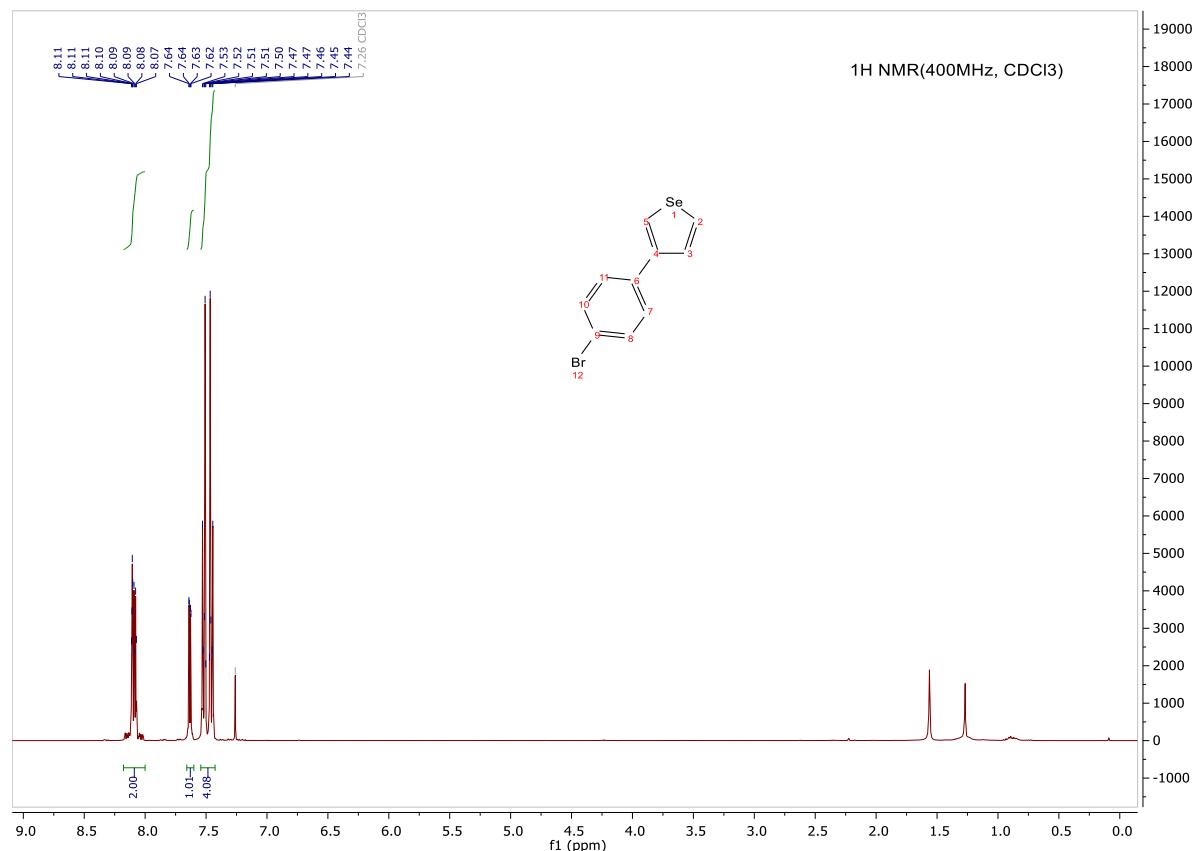
3-(2,4-Difluorophenyl)selenophene (22)



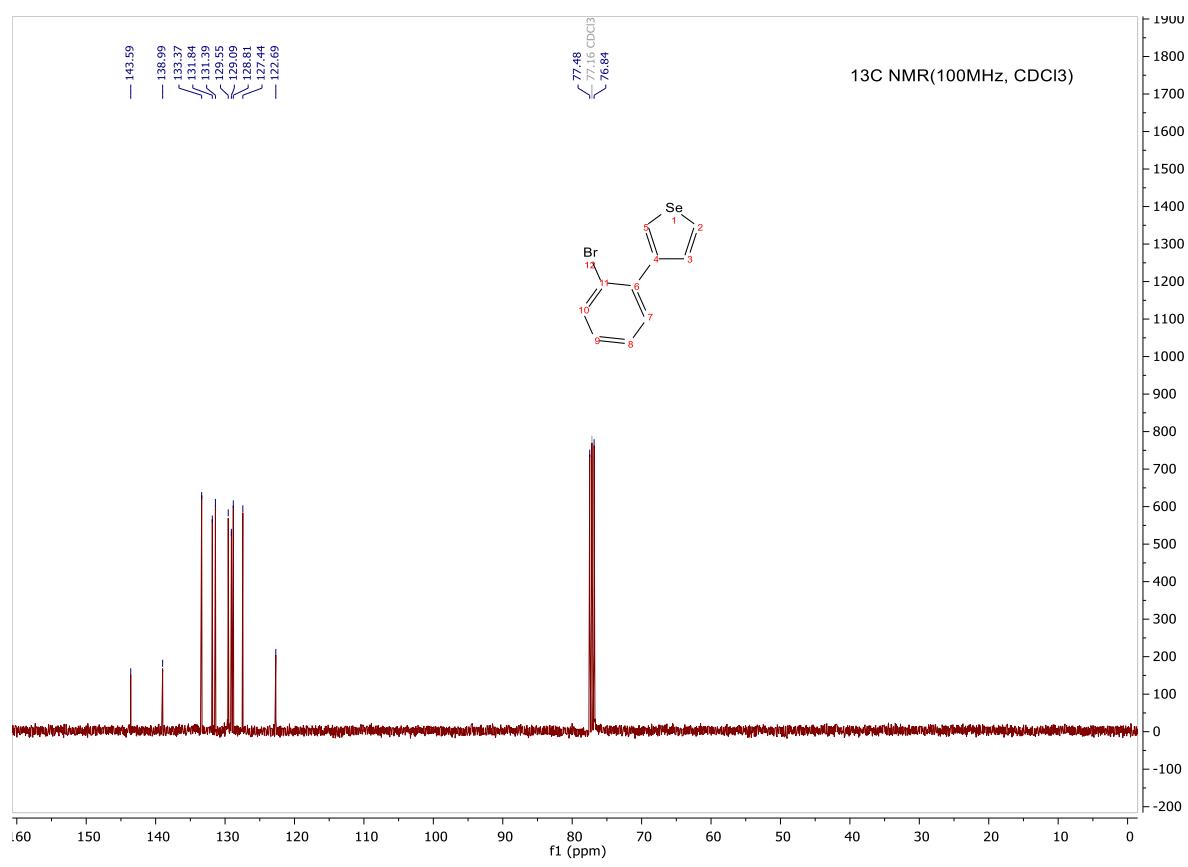
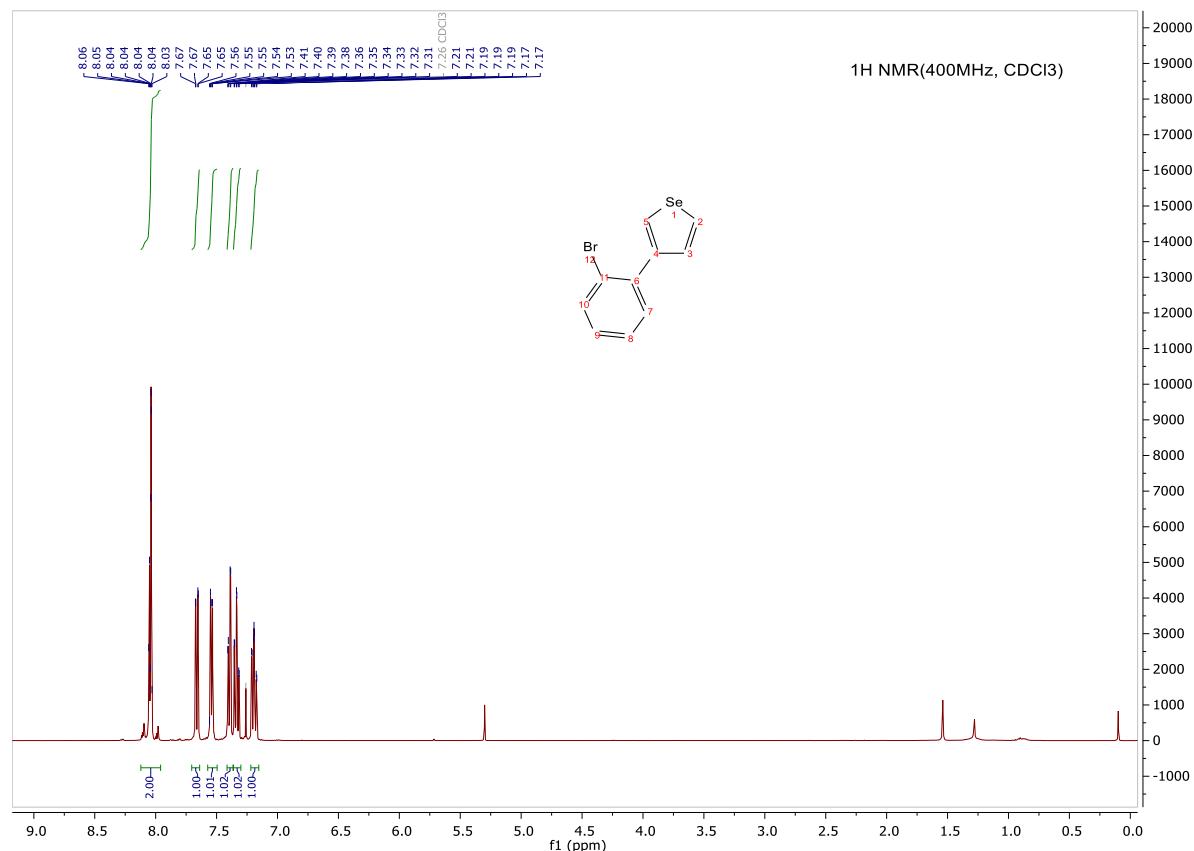
3-(2,3,4-Trifluorophenyl)selenophene (23)



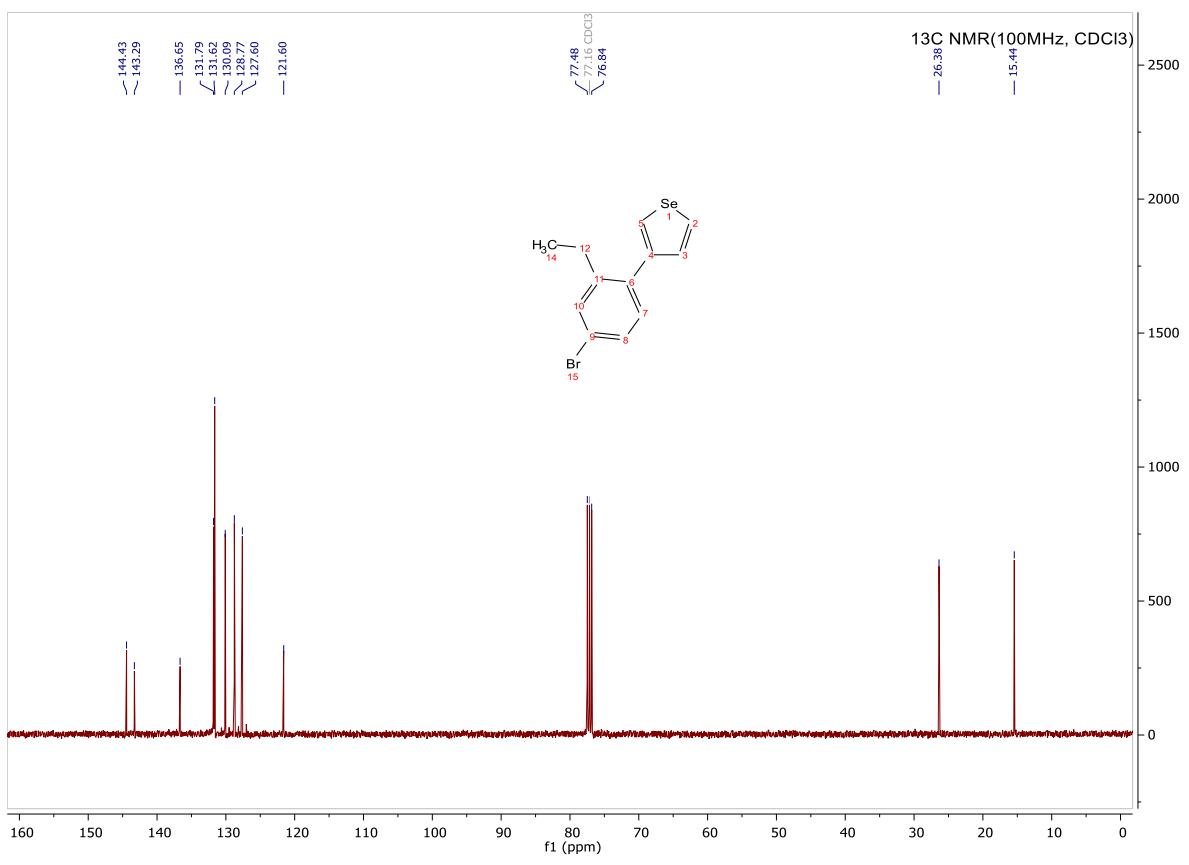
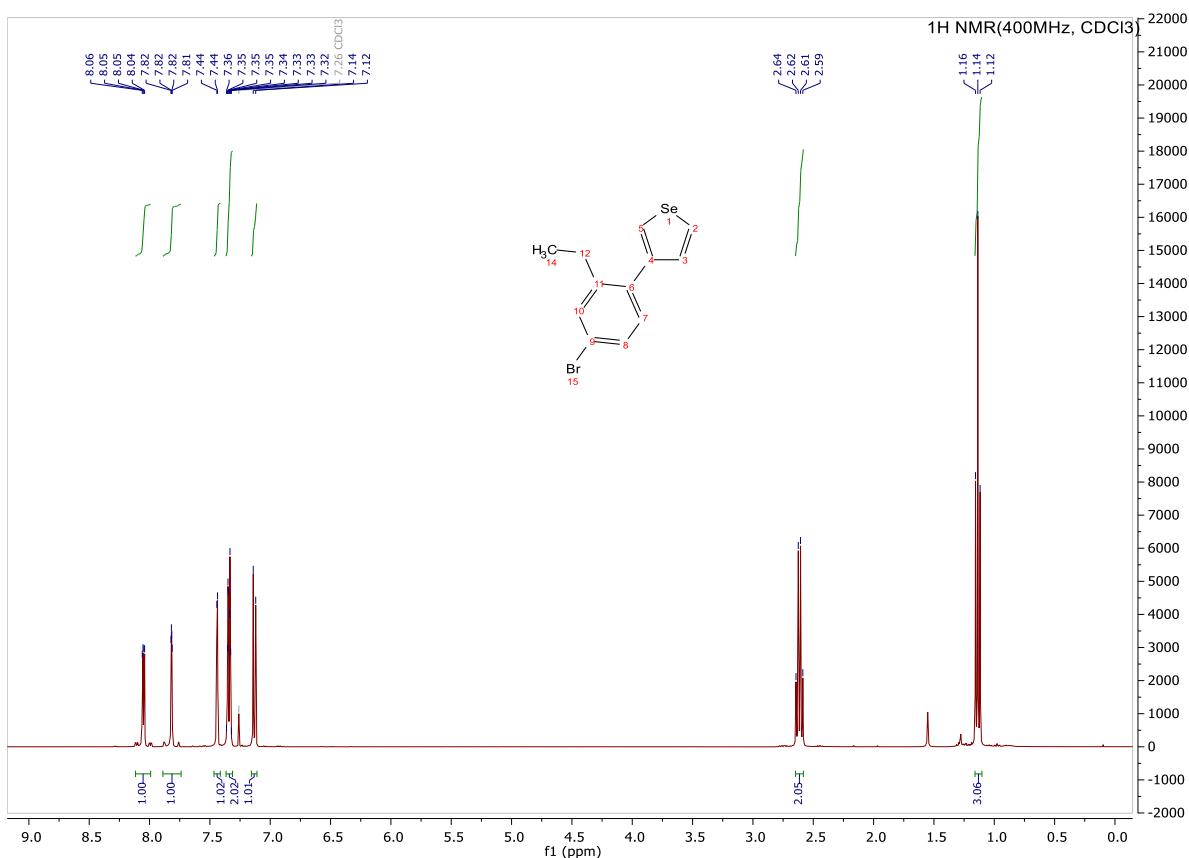
3-(4-Bromophenyl)selenophene (24)



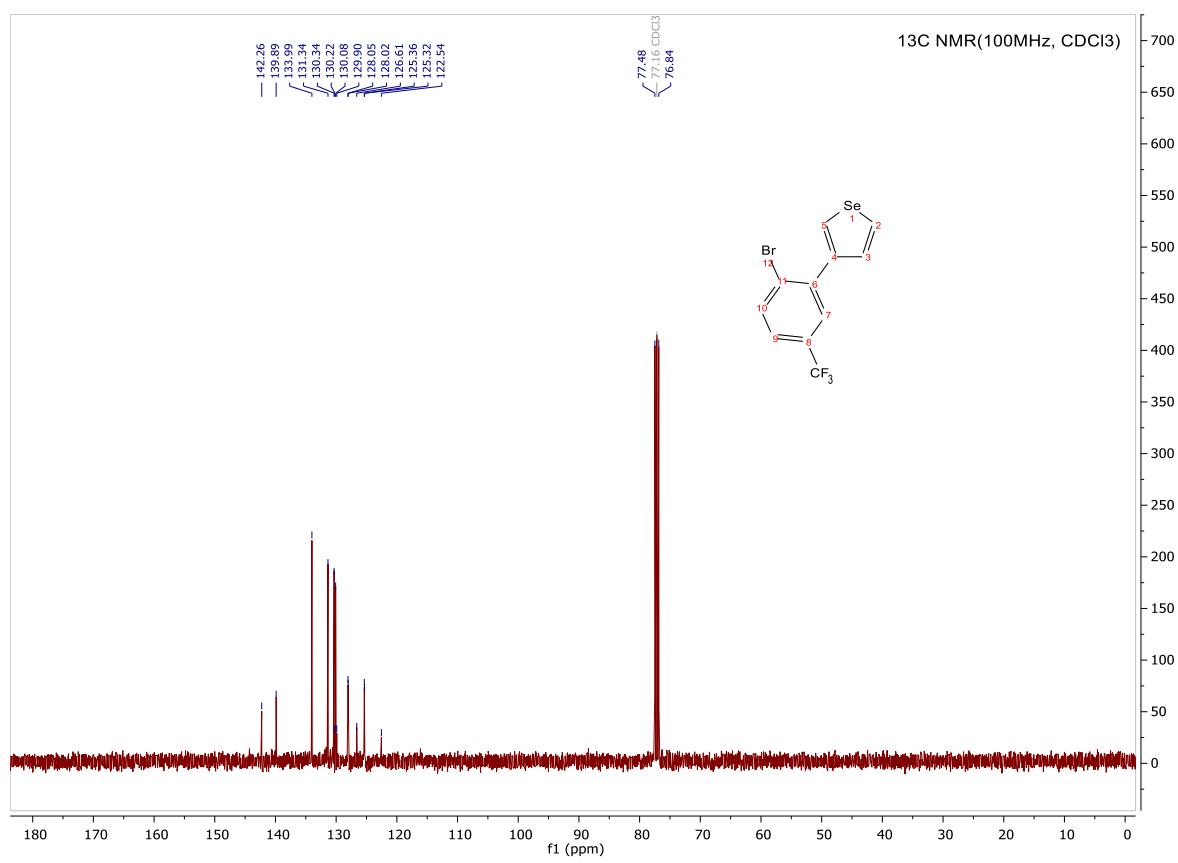
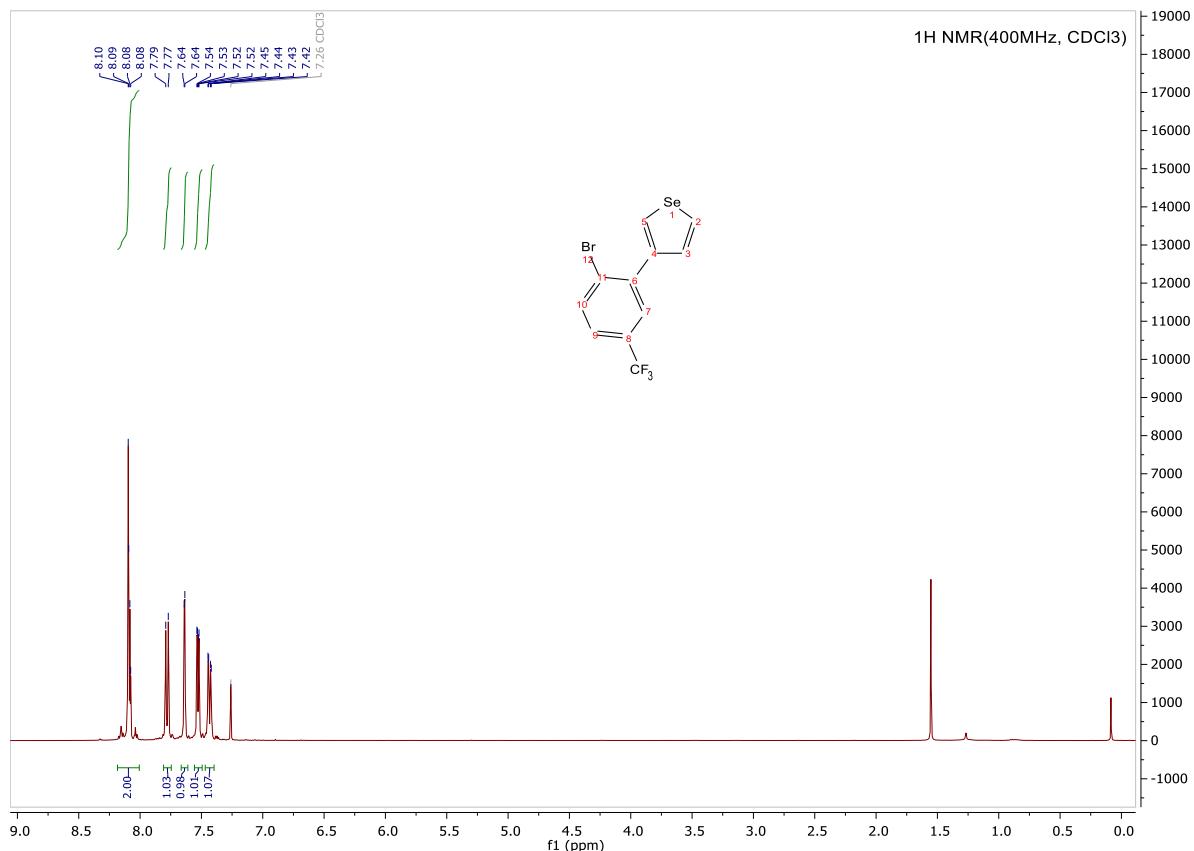
3-(2-Bromophenyl)selenophene (25)



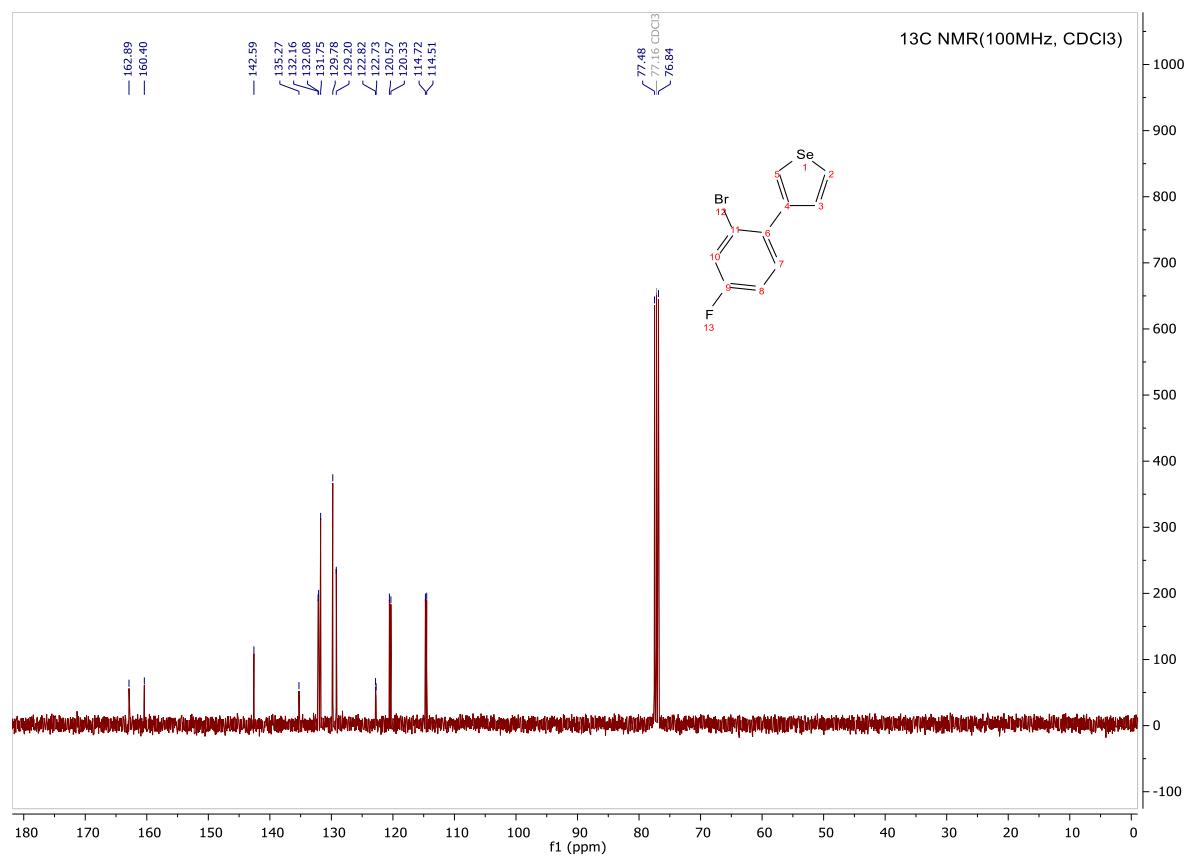
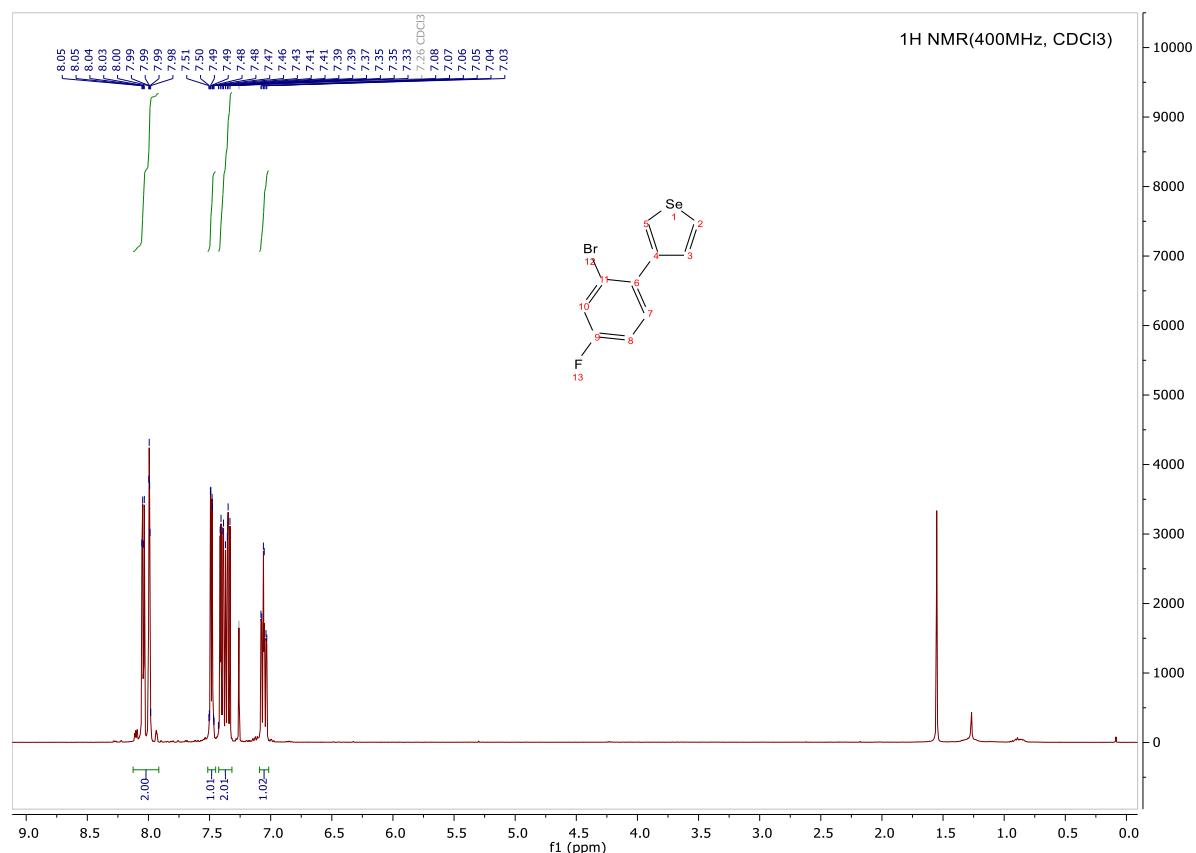
3-(4-Bromo-2-ethylphenyl)selenophene (26)



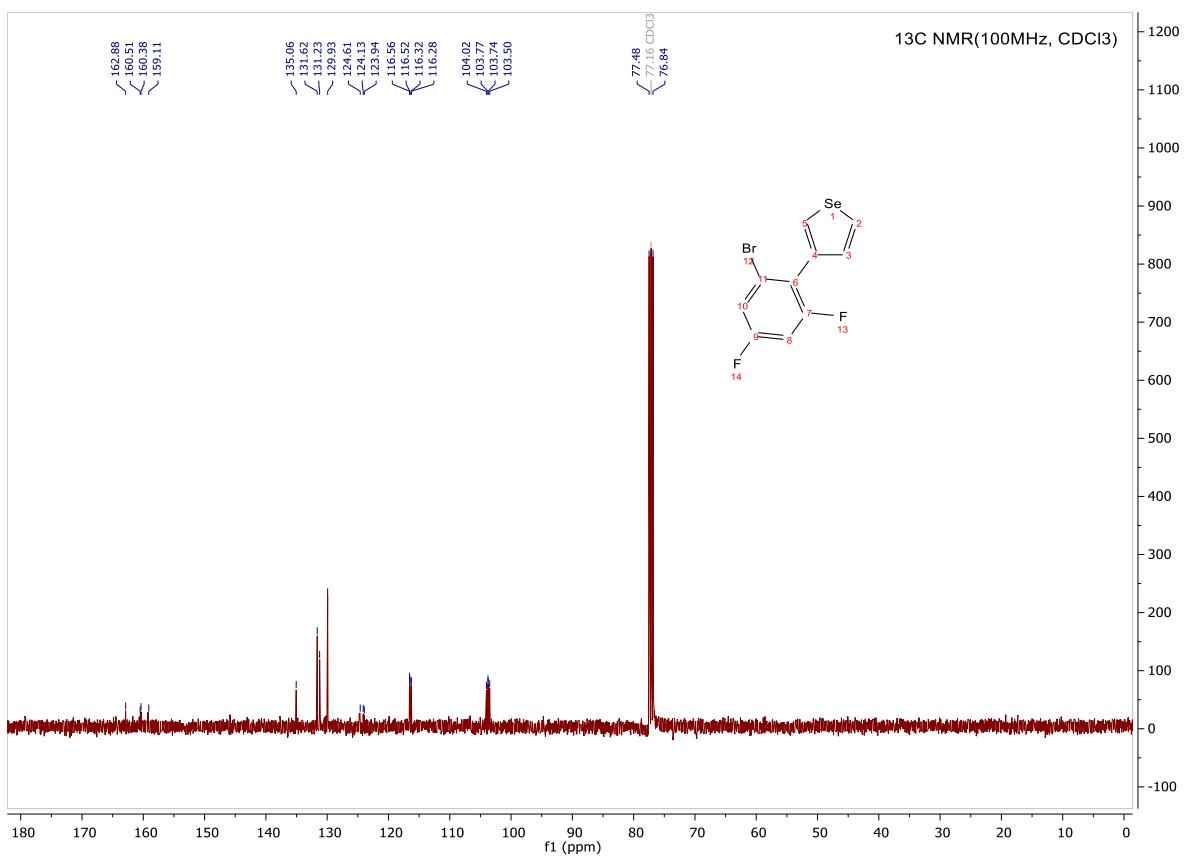
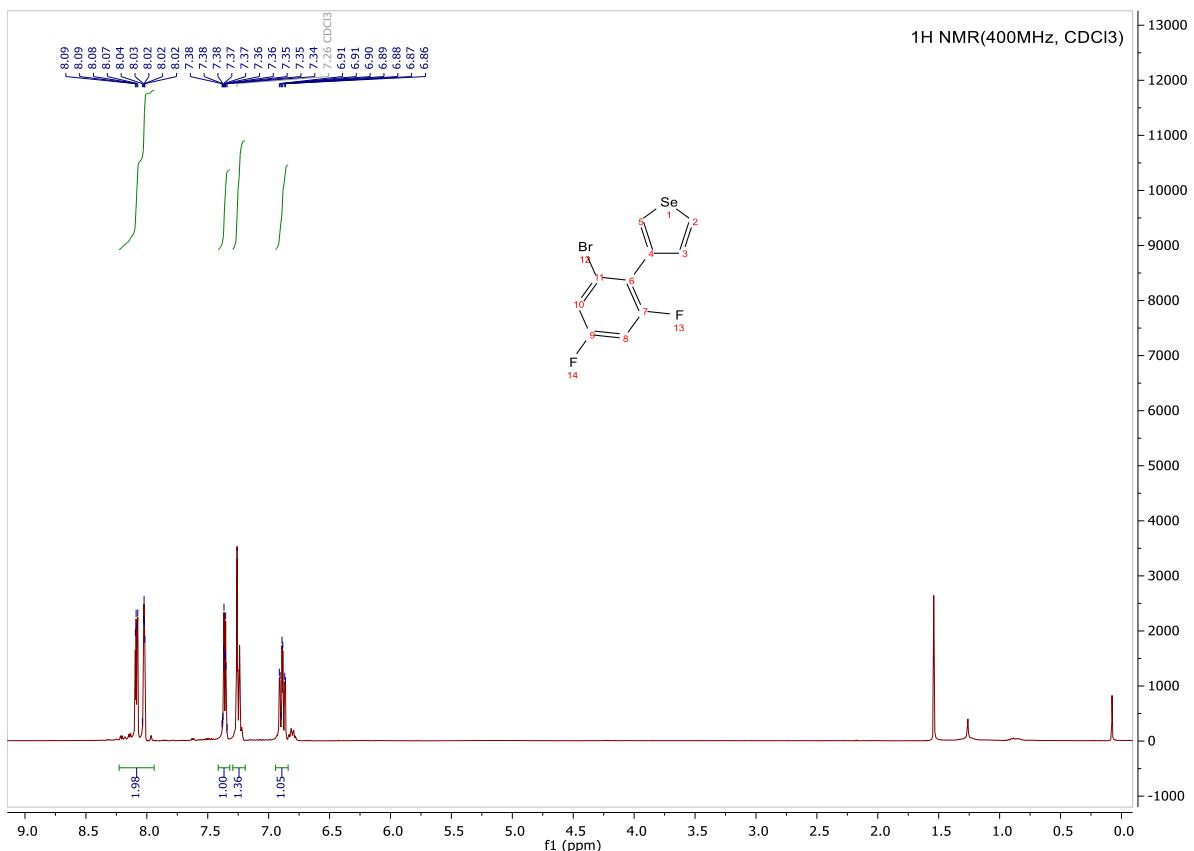
3-(2-Bromo-5-(trifluoromethyl)phenyl)selenophene (27)



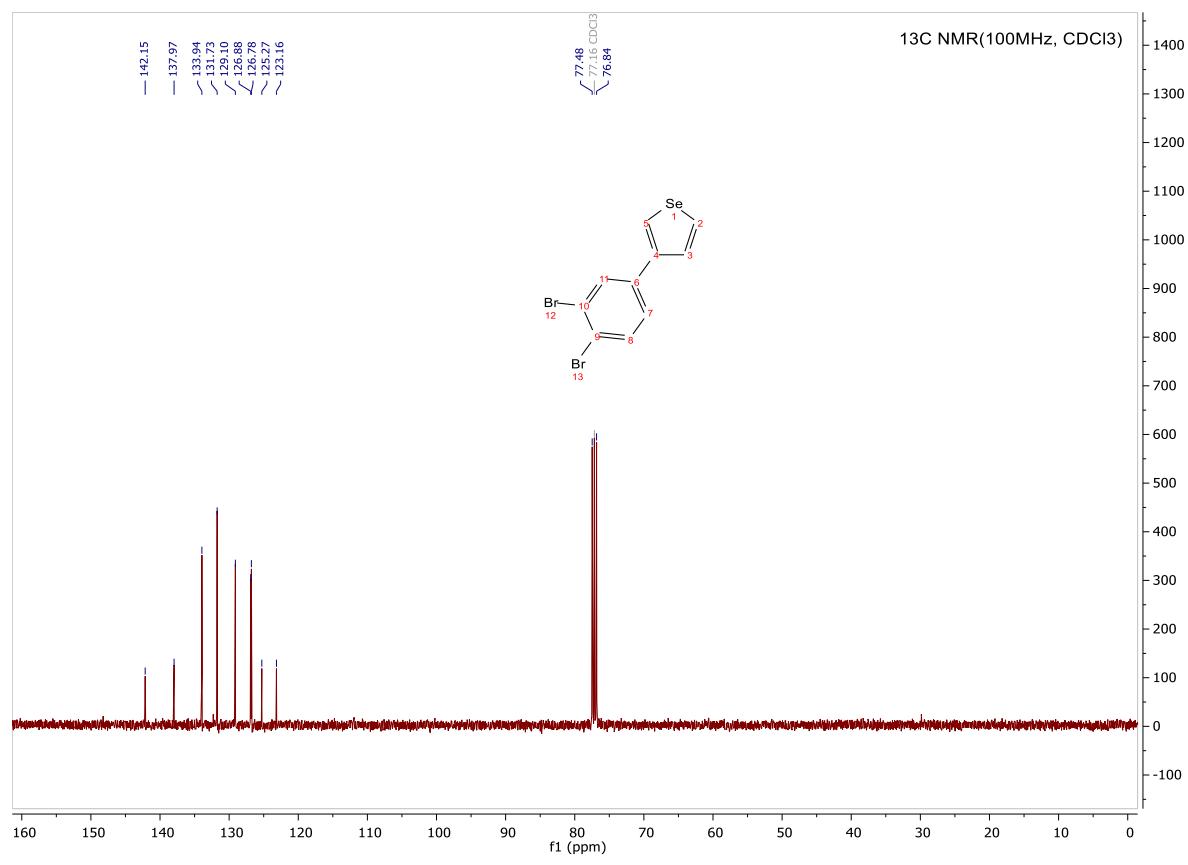
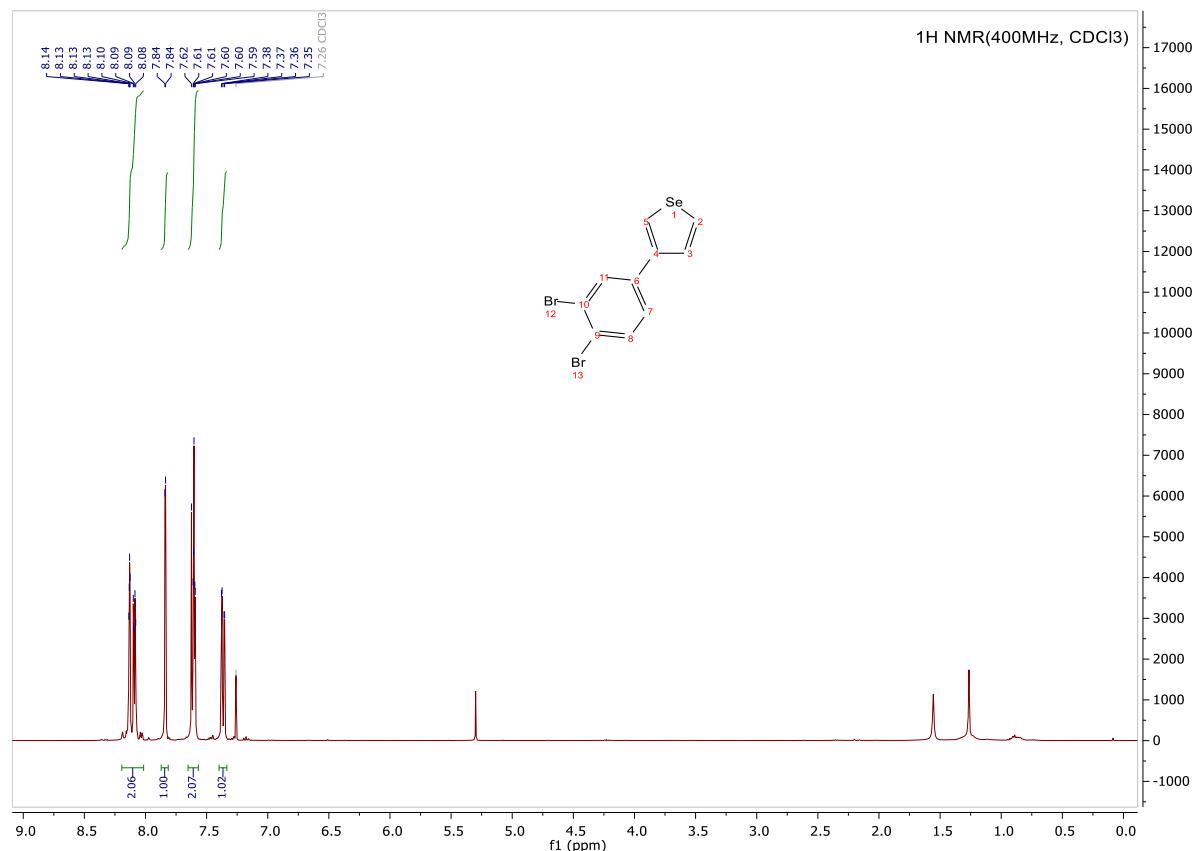
3-(2-Bromo-4-fluorophenyl)selenophene (28)



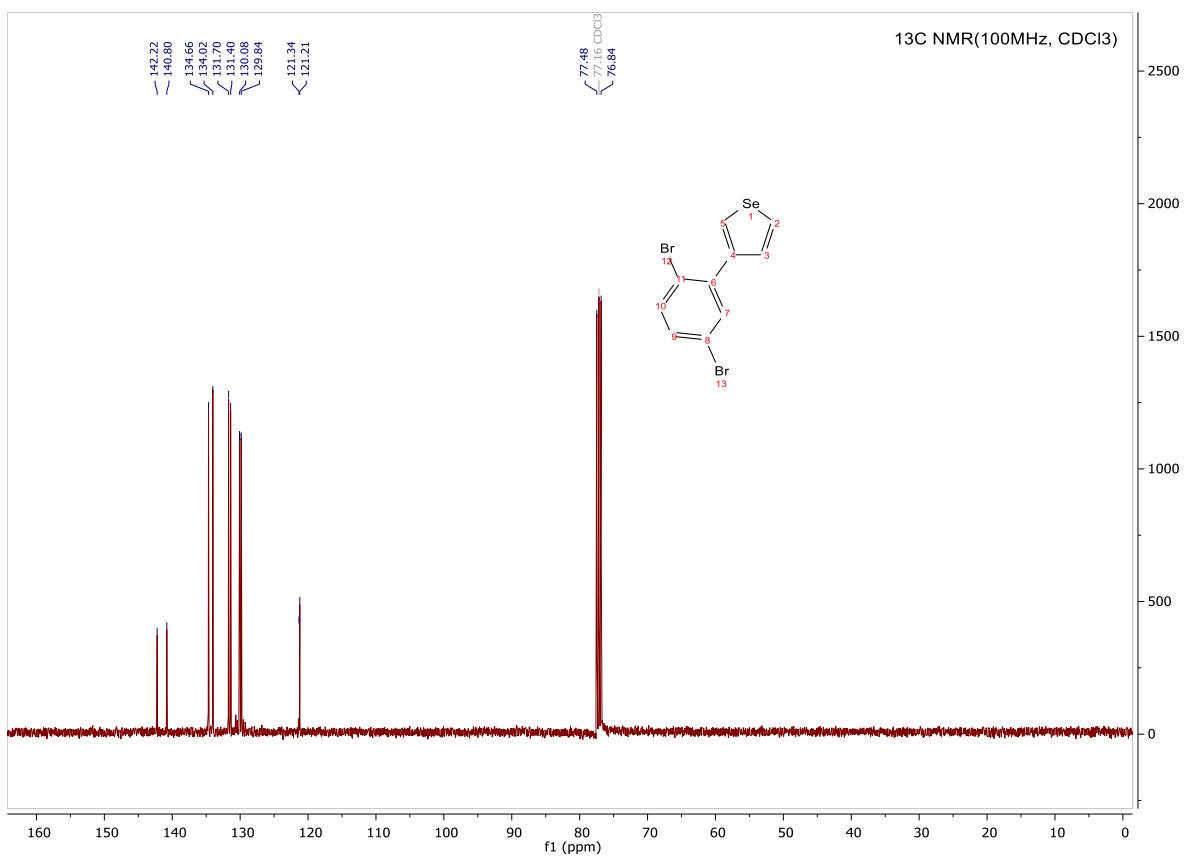
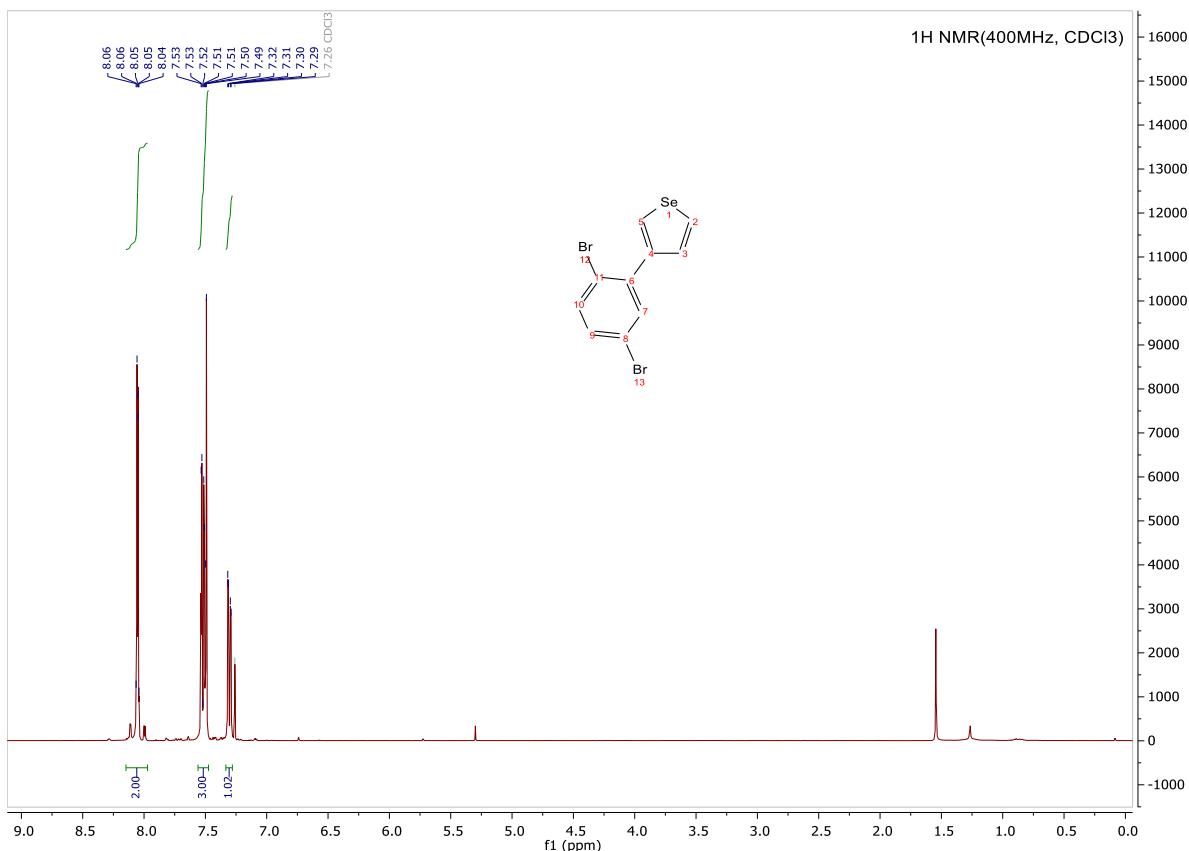
3-(2-Bromo-4,6-difluorophenyl)selenophene (29)



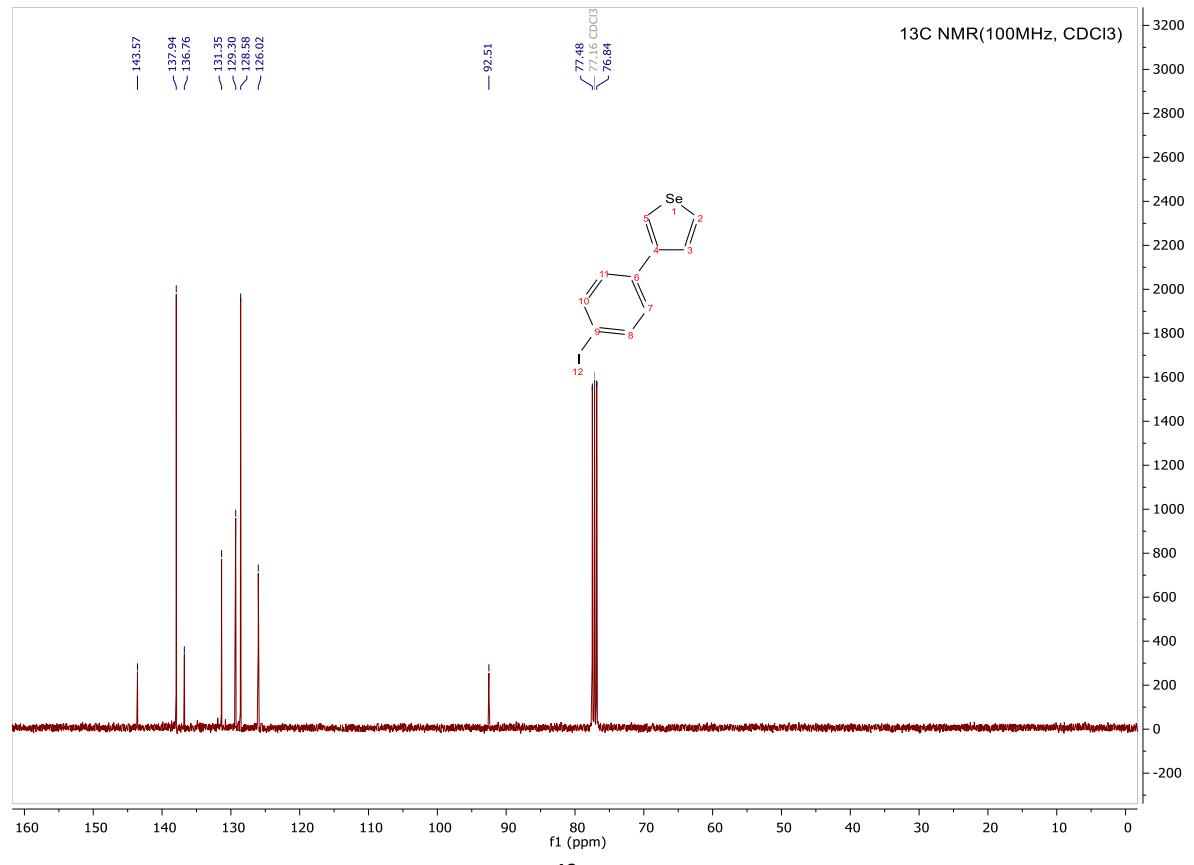
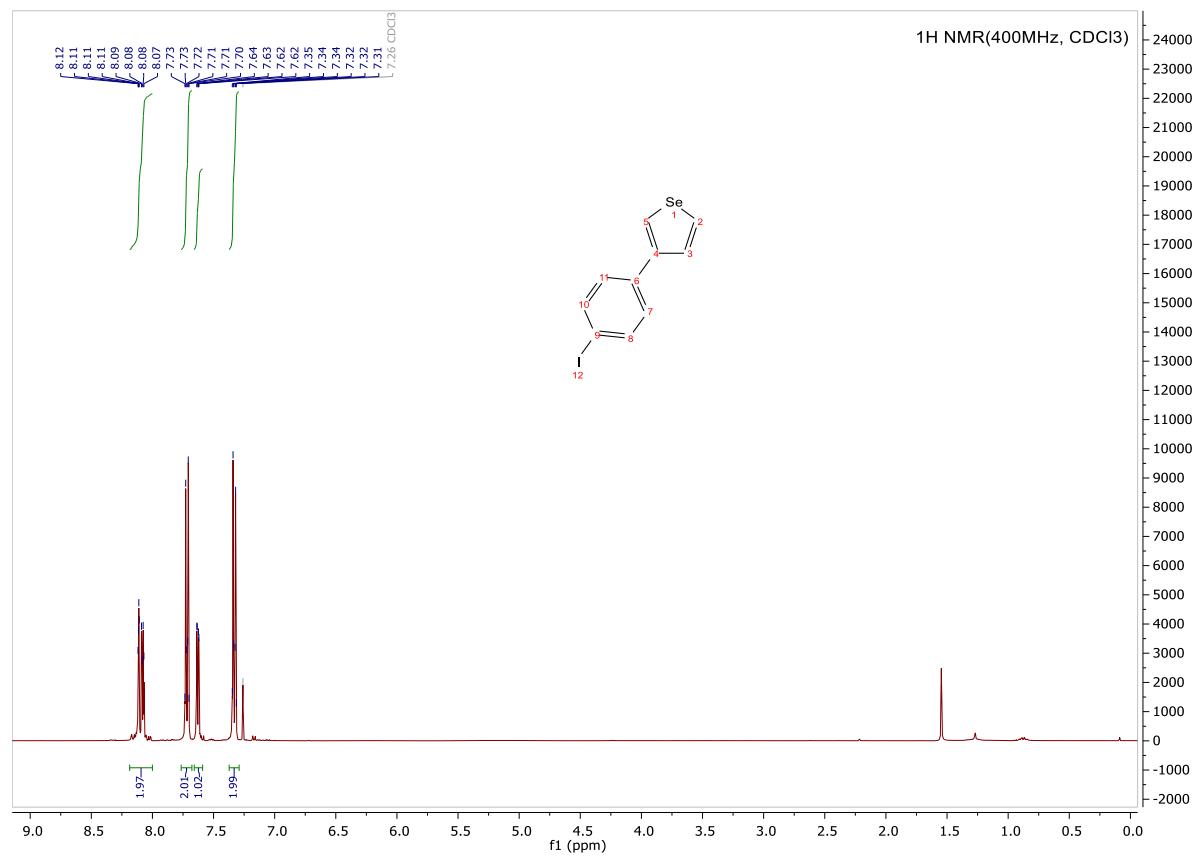
3-(3,4-Dibromophenyl)selenophene (30)



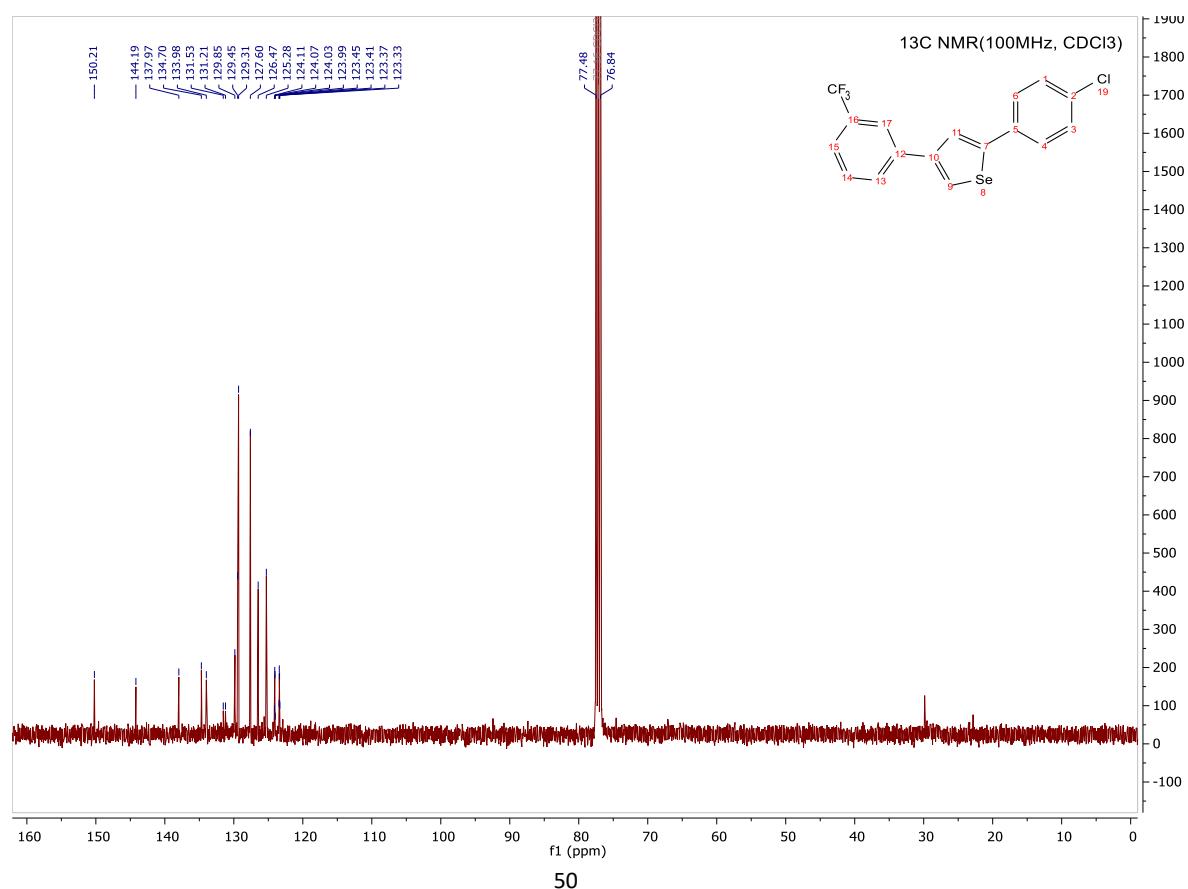
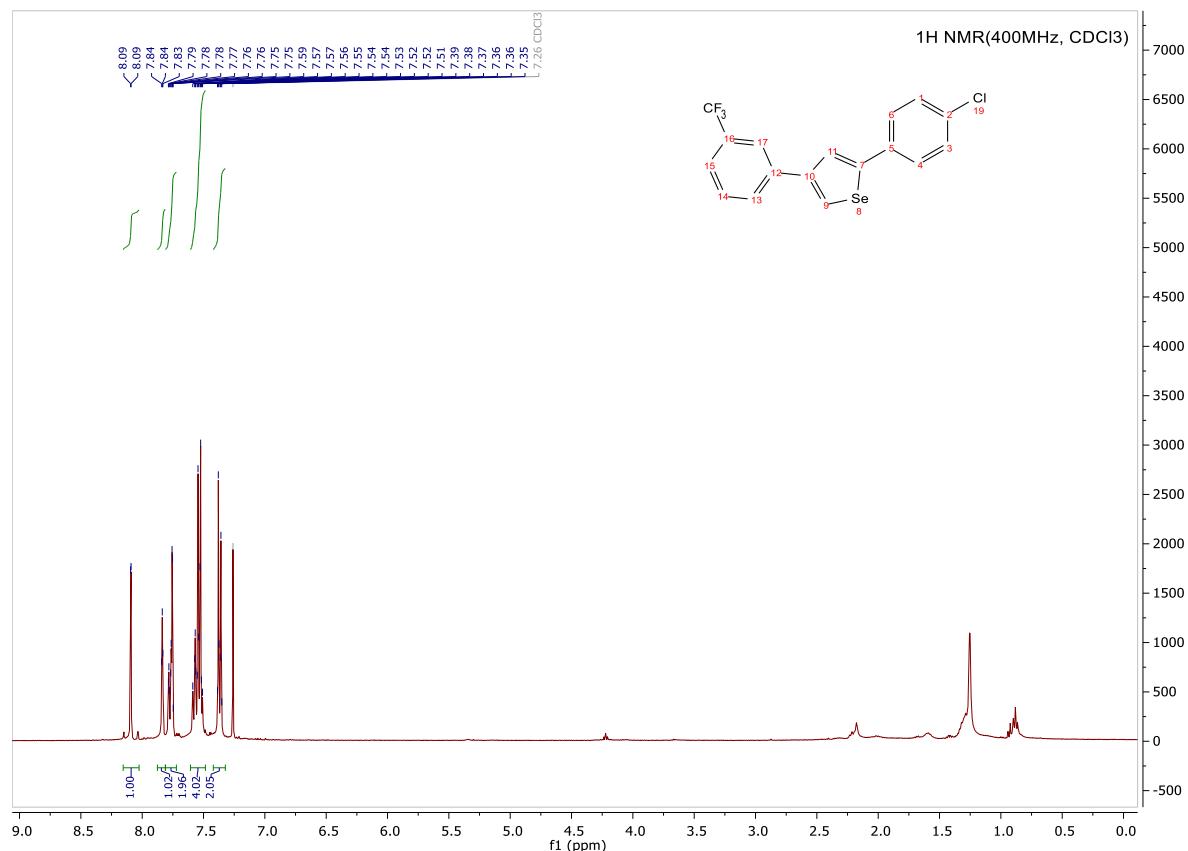
3-(2,5-Dibromophenyl)selenophene (31)



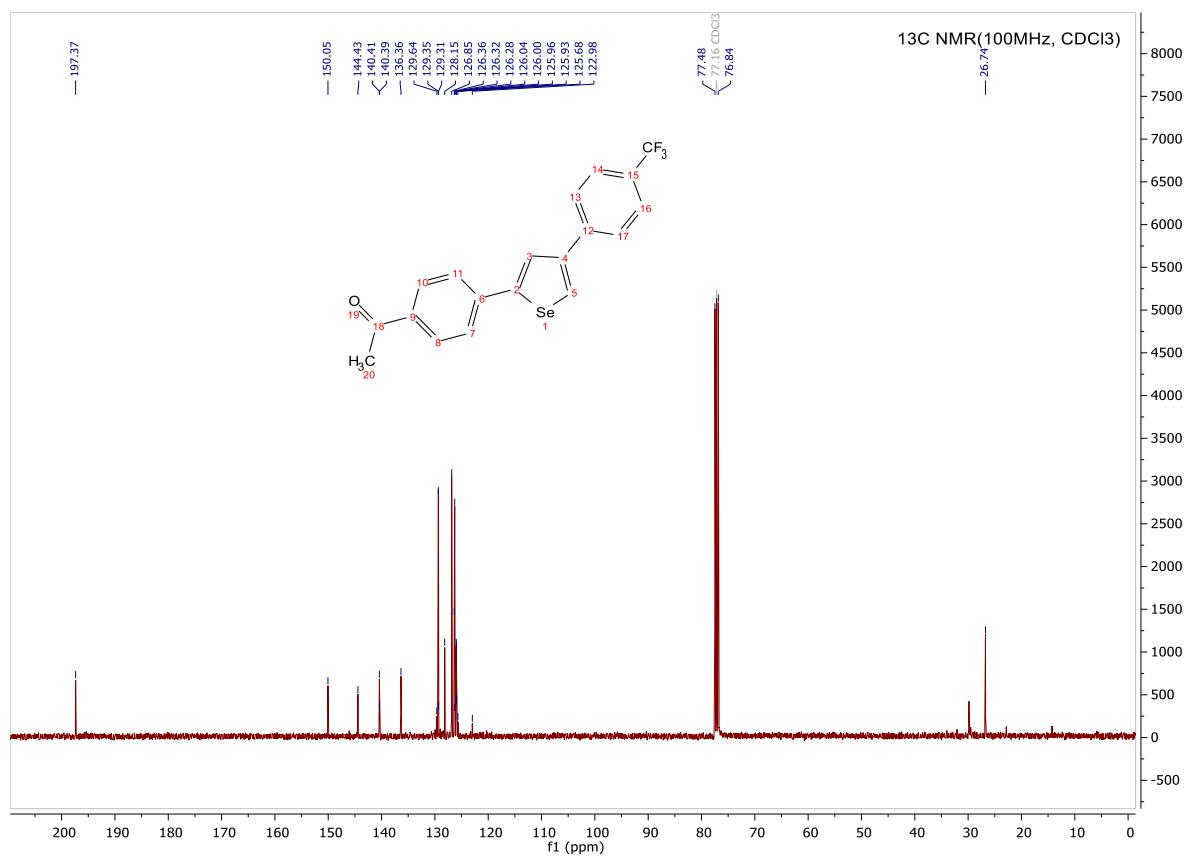
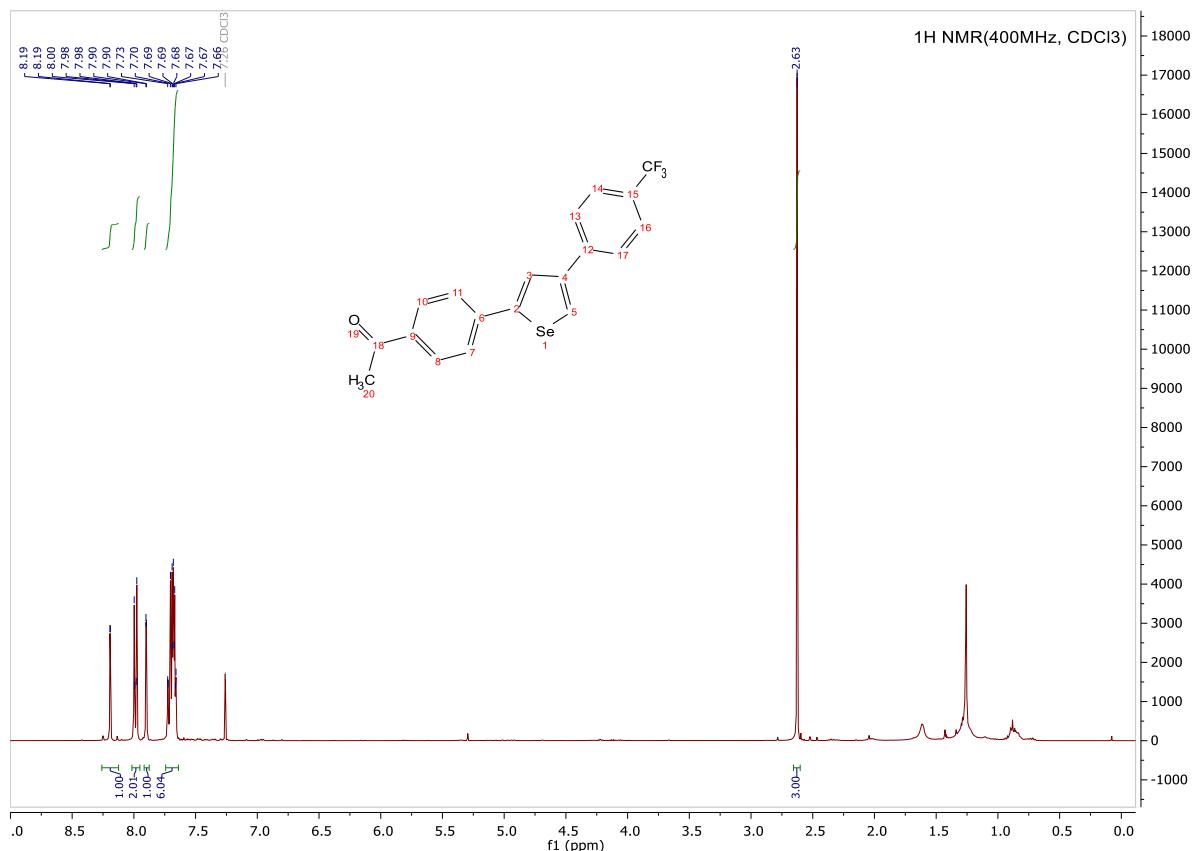
3-(4-Iodophenyl)selenophene (32)



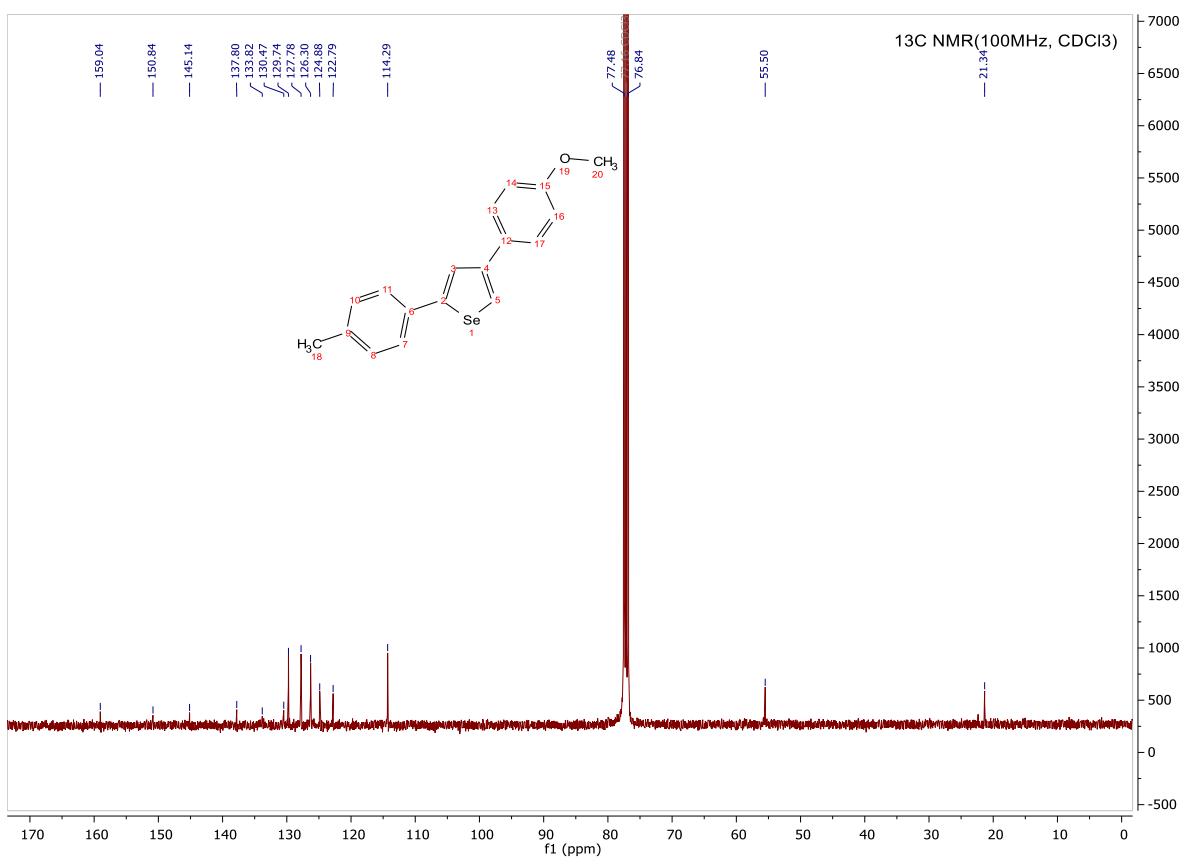
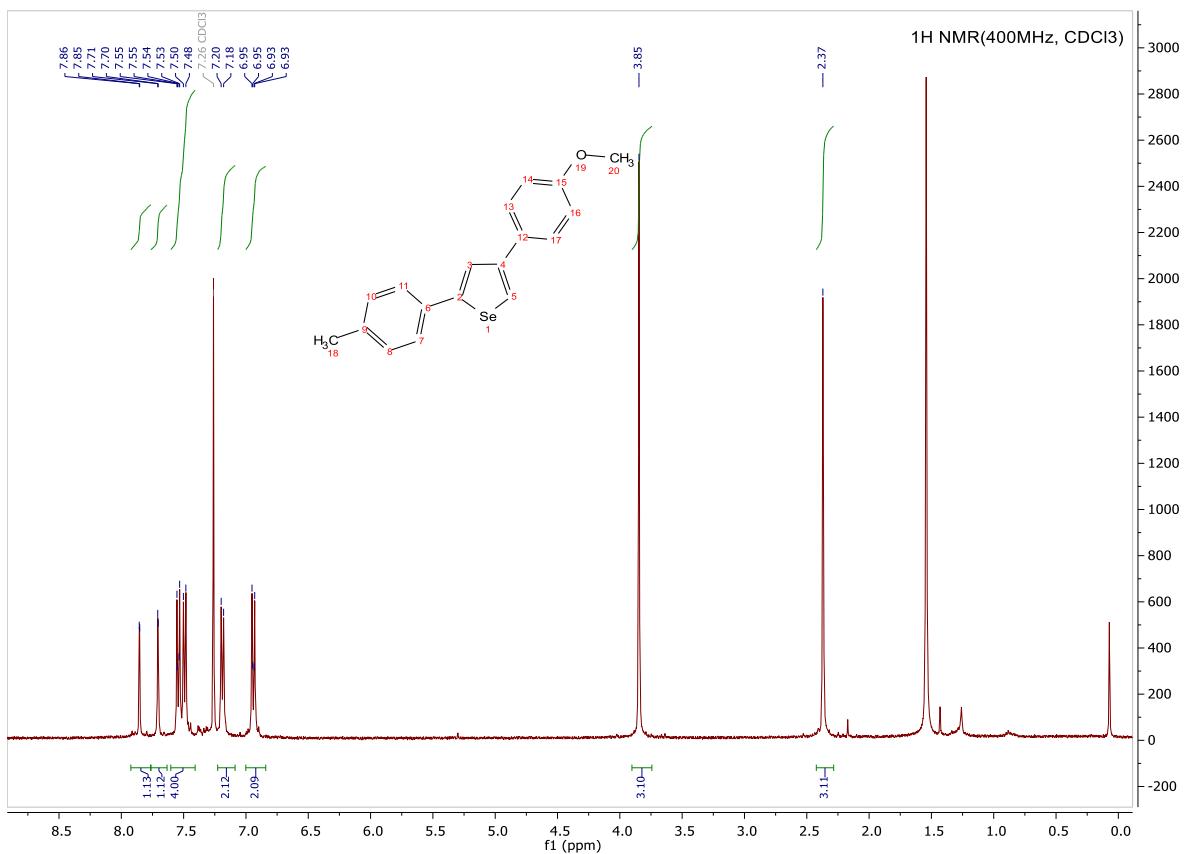
2-(4-Chlorophenyl)-4-(3-(trifluoromethyl)phenyl)selenophene (33)



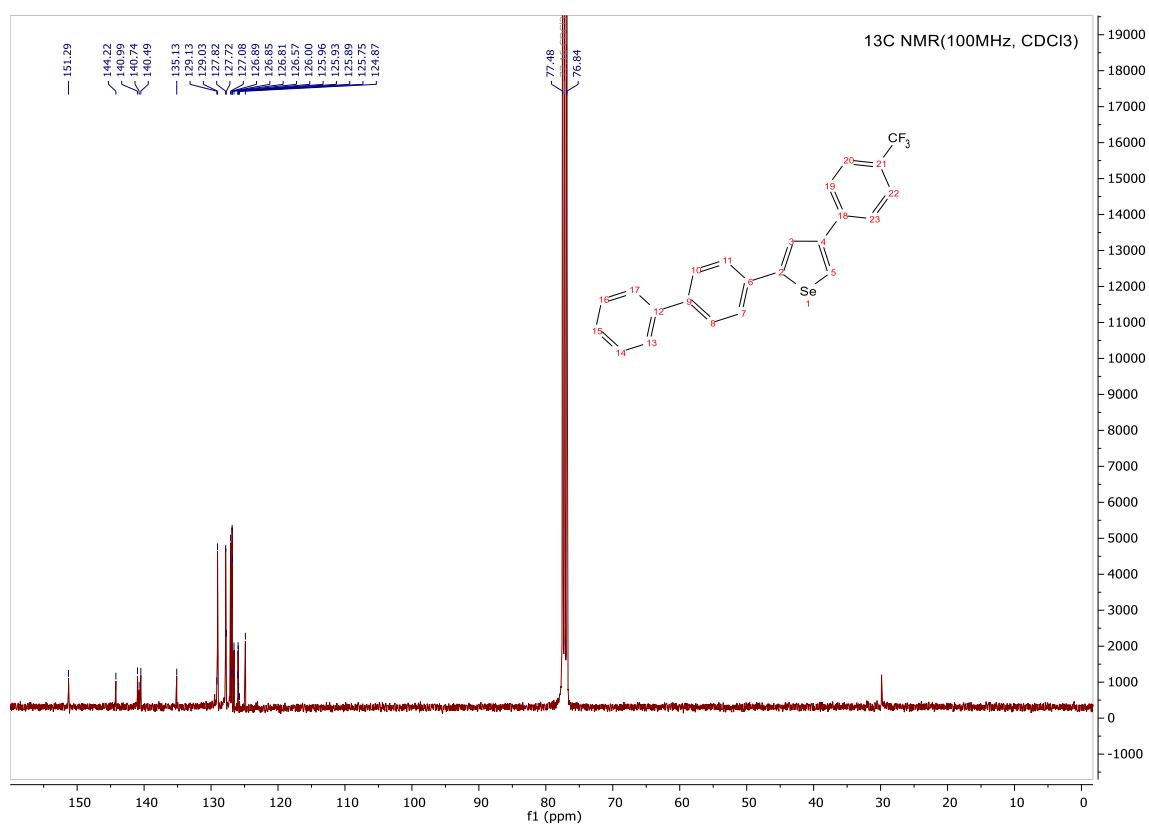
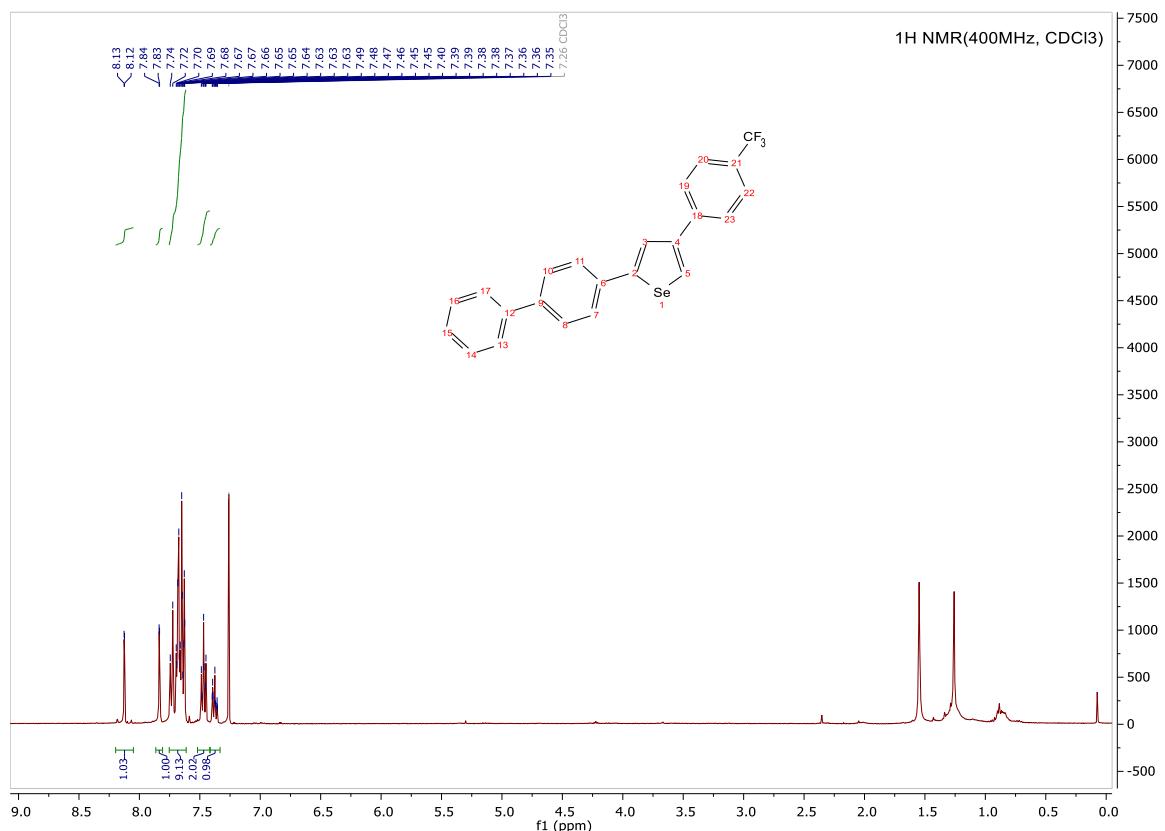
1-(4-(4-(Trifluoromethyl)phenyl)selenophen-2-yl)phenyl)ethan-1-one (34)



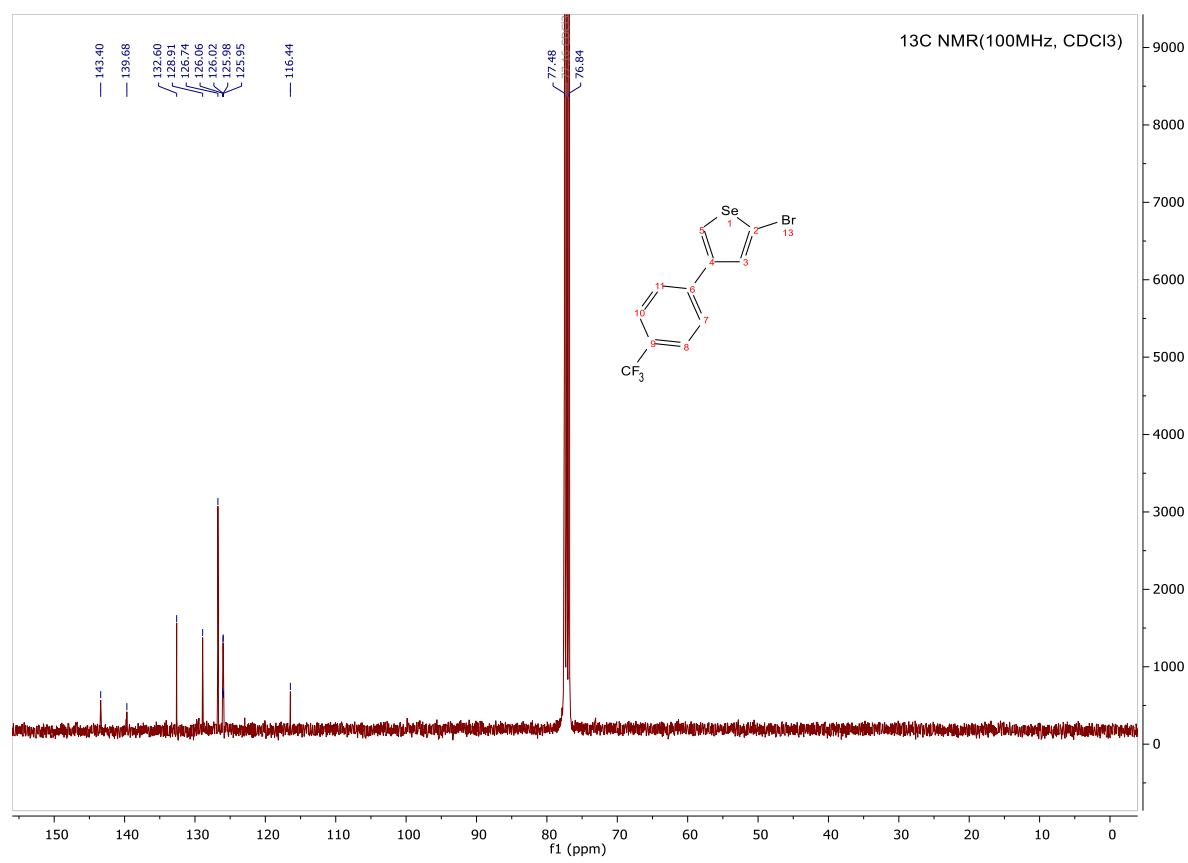
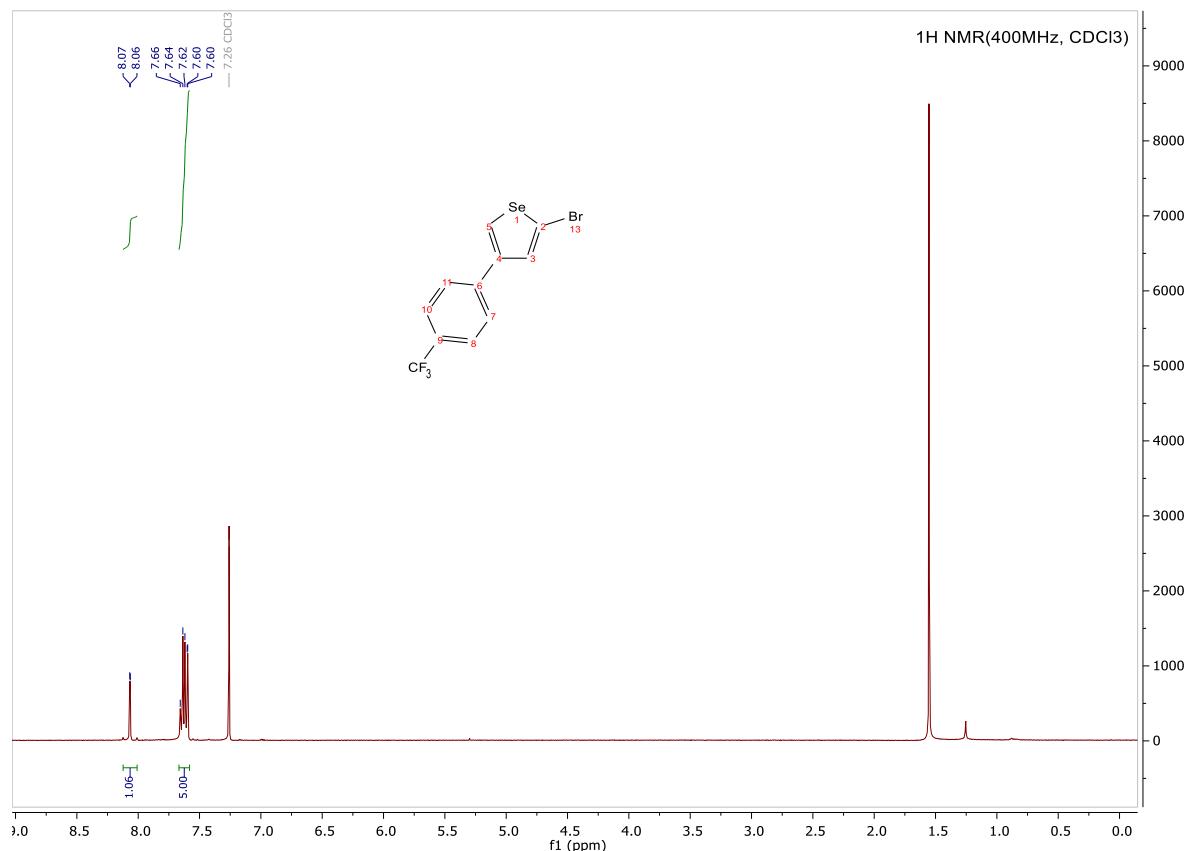
4-(4-Methoxyphenyl)-2-(*p*-tolyl)selenophene (35)



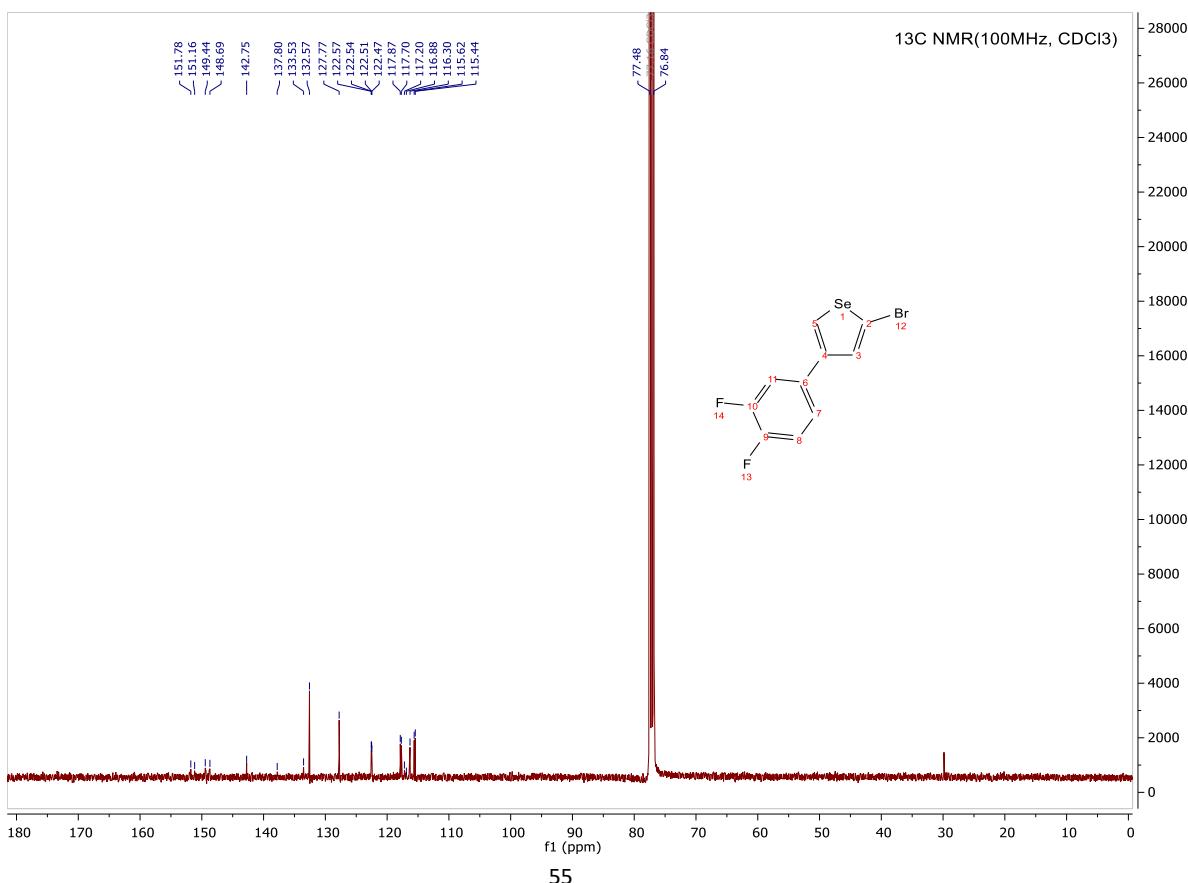
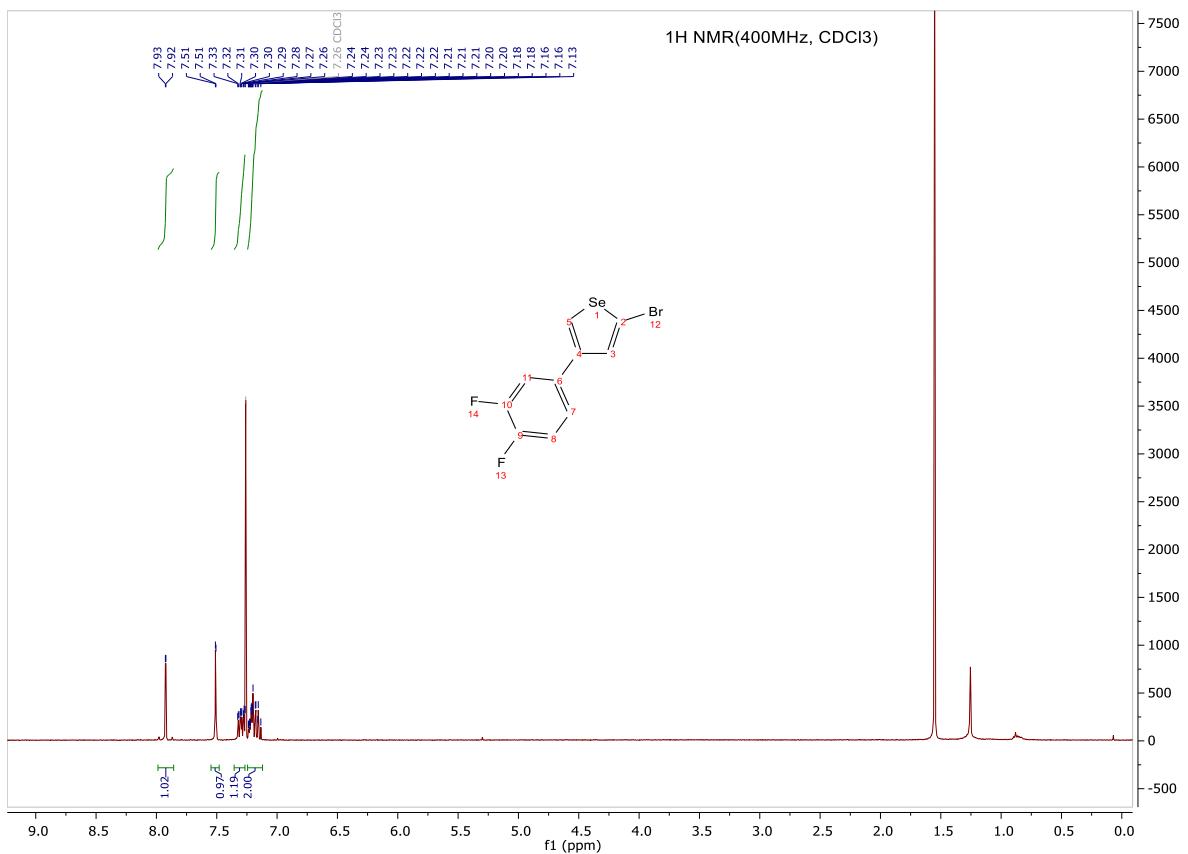
2-([1,1'-Biphenyl]-4-yl)-4-(4-(trifluoromethyl)phenyl)selenophene (36)



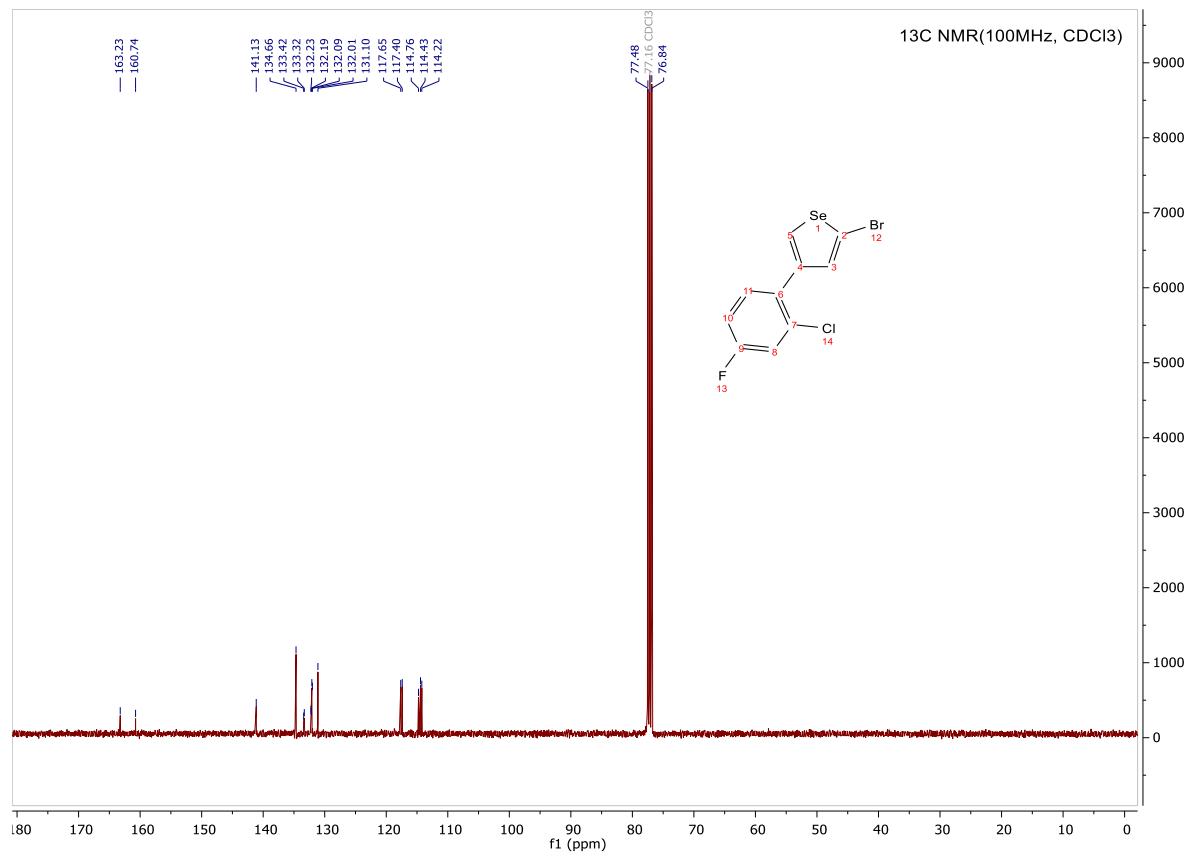
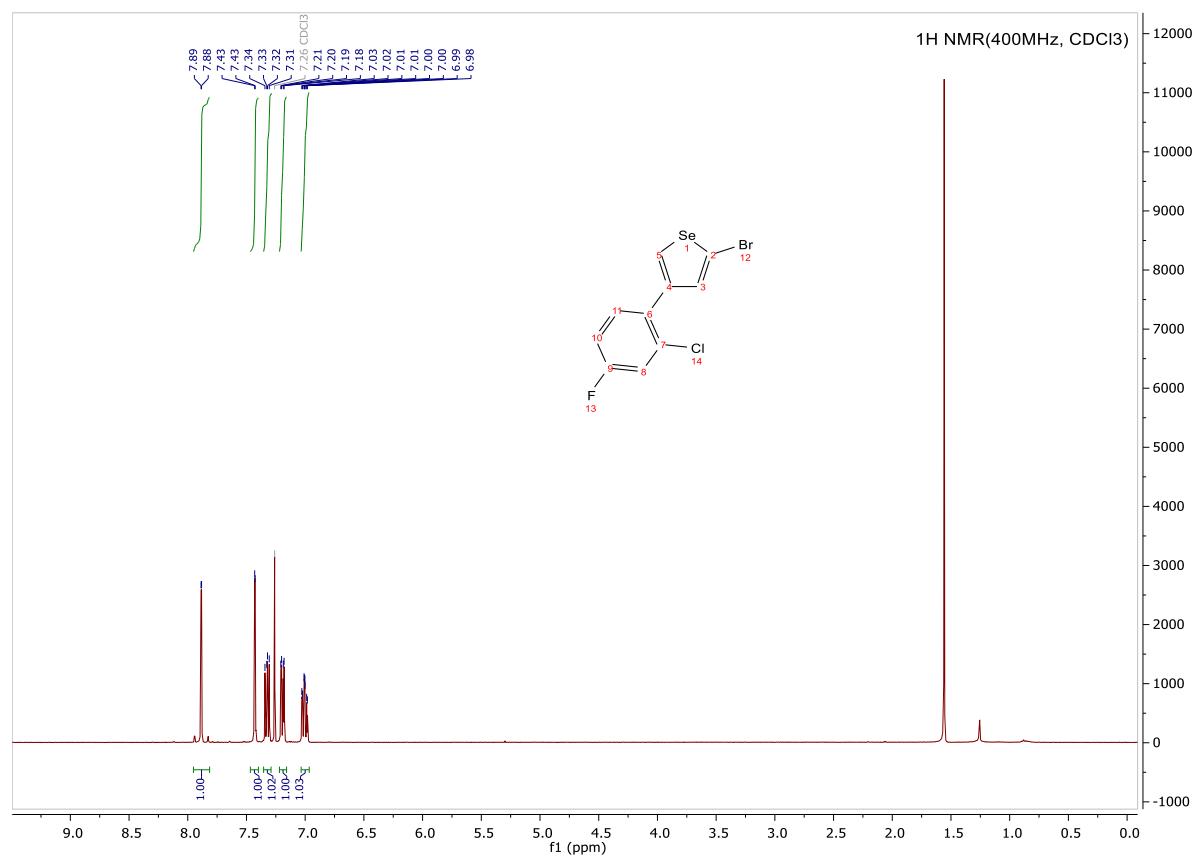
2-Bromo-4-(4-(trifluoromethyl)phenyl)selenophene (37)



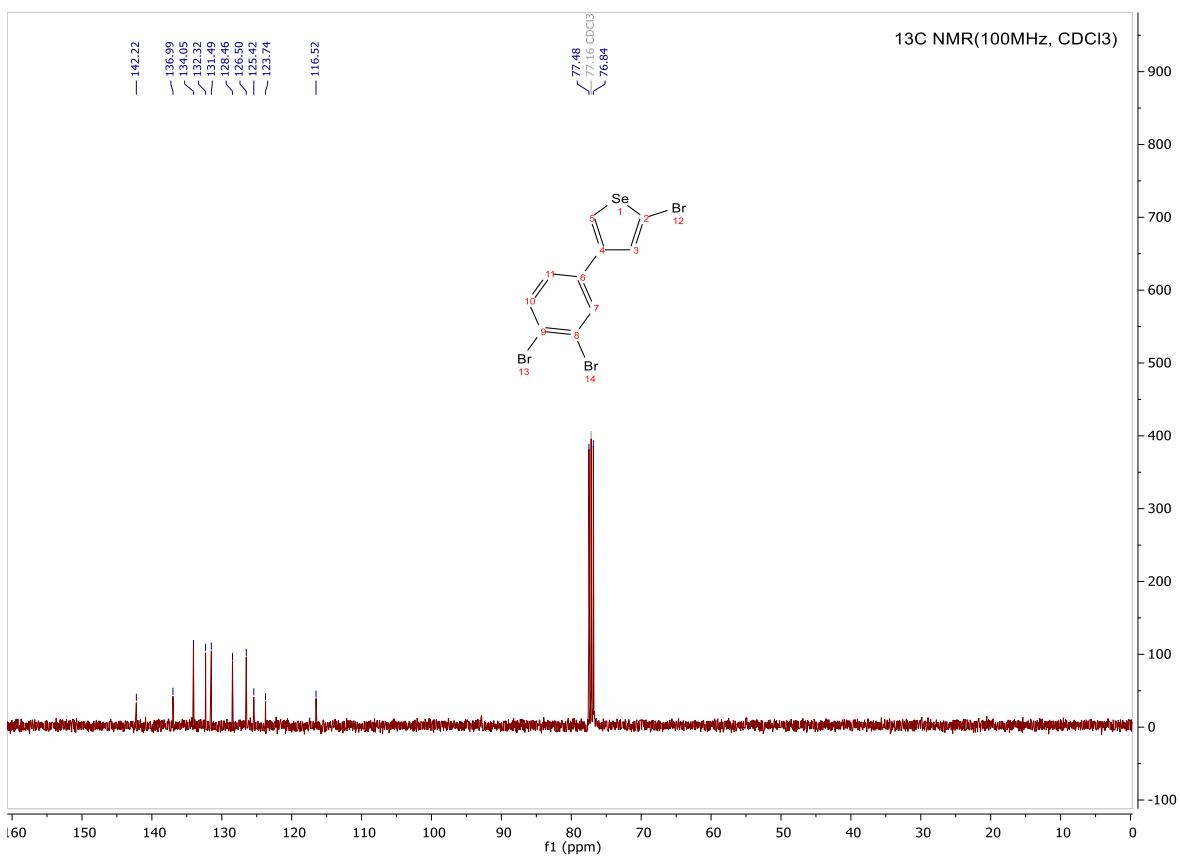
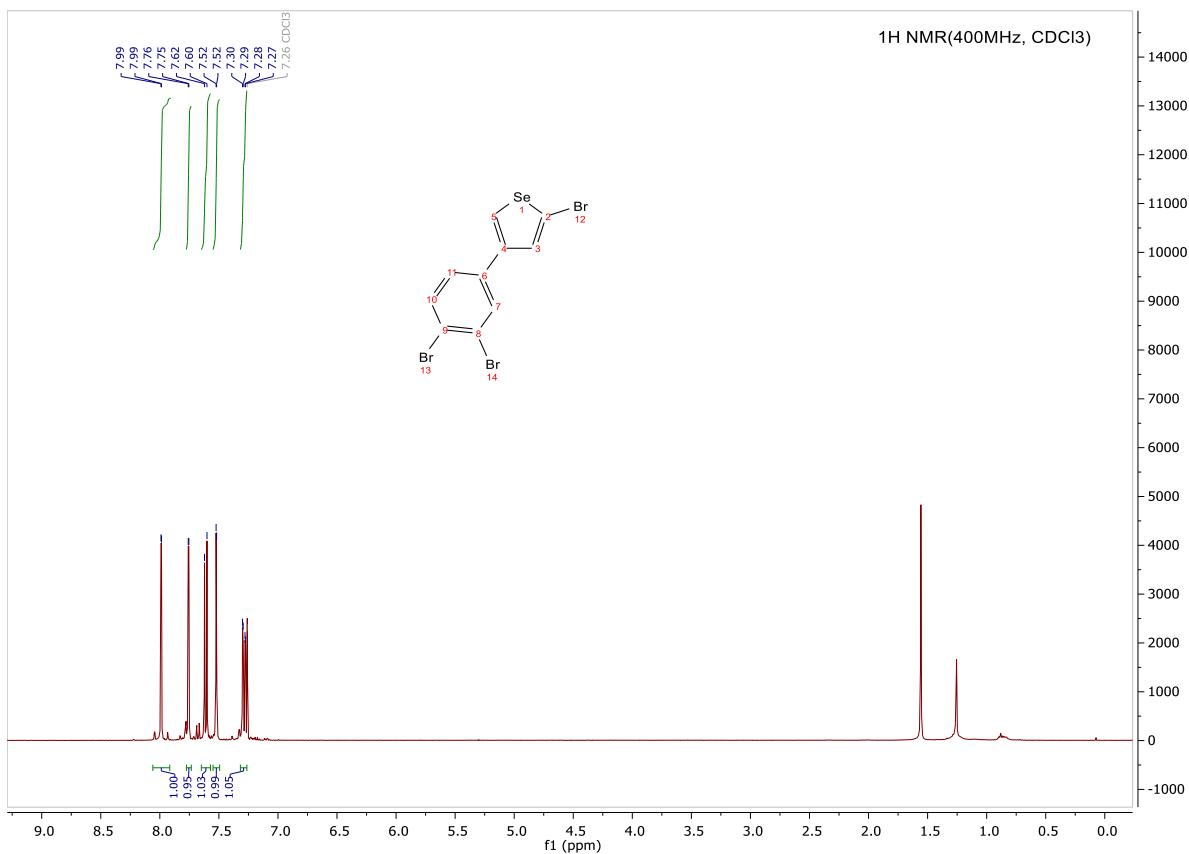
2-Bromo-4-(3,4-difluorophenyl)selenophene (38)



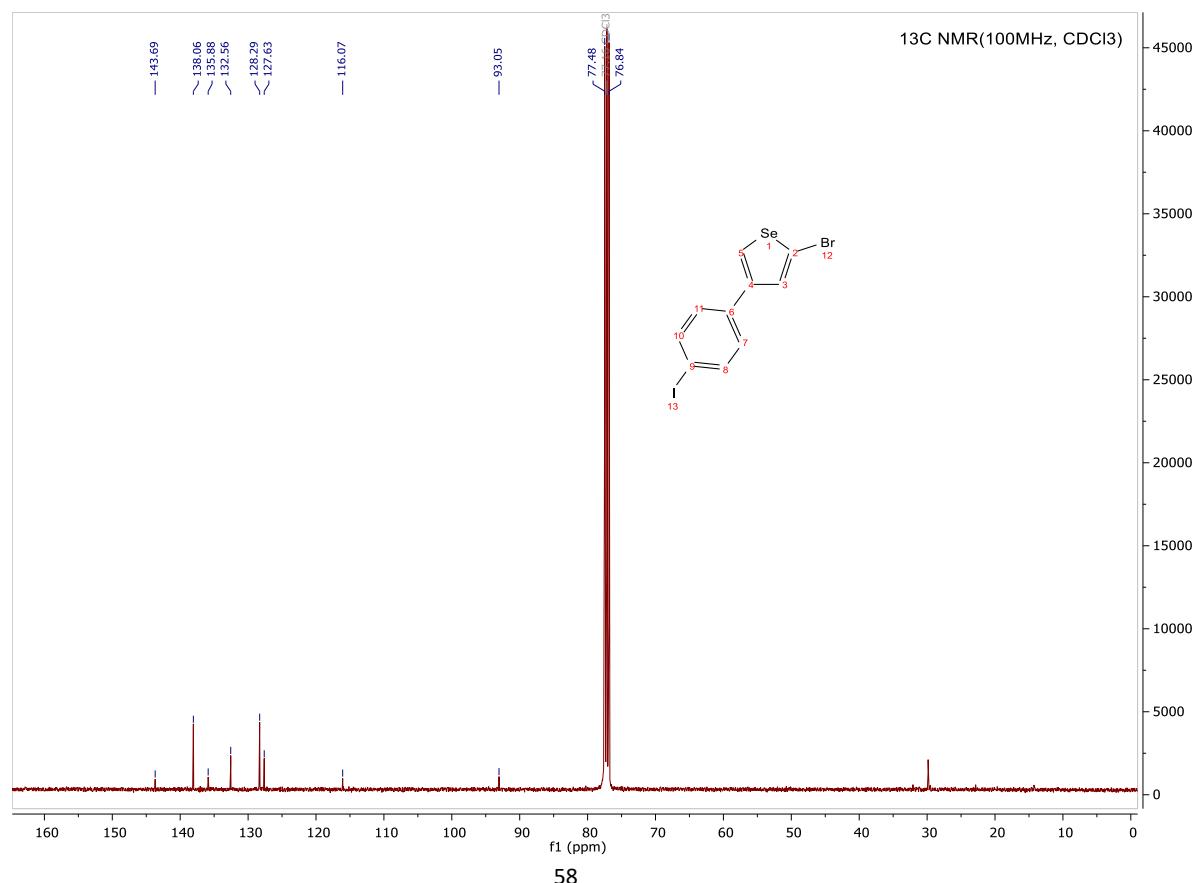
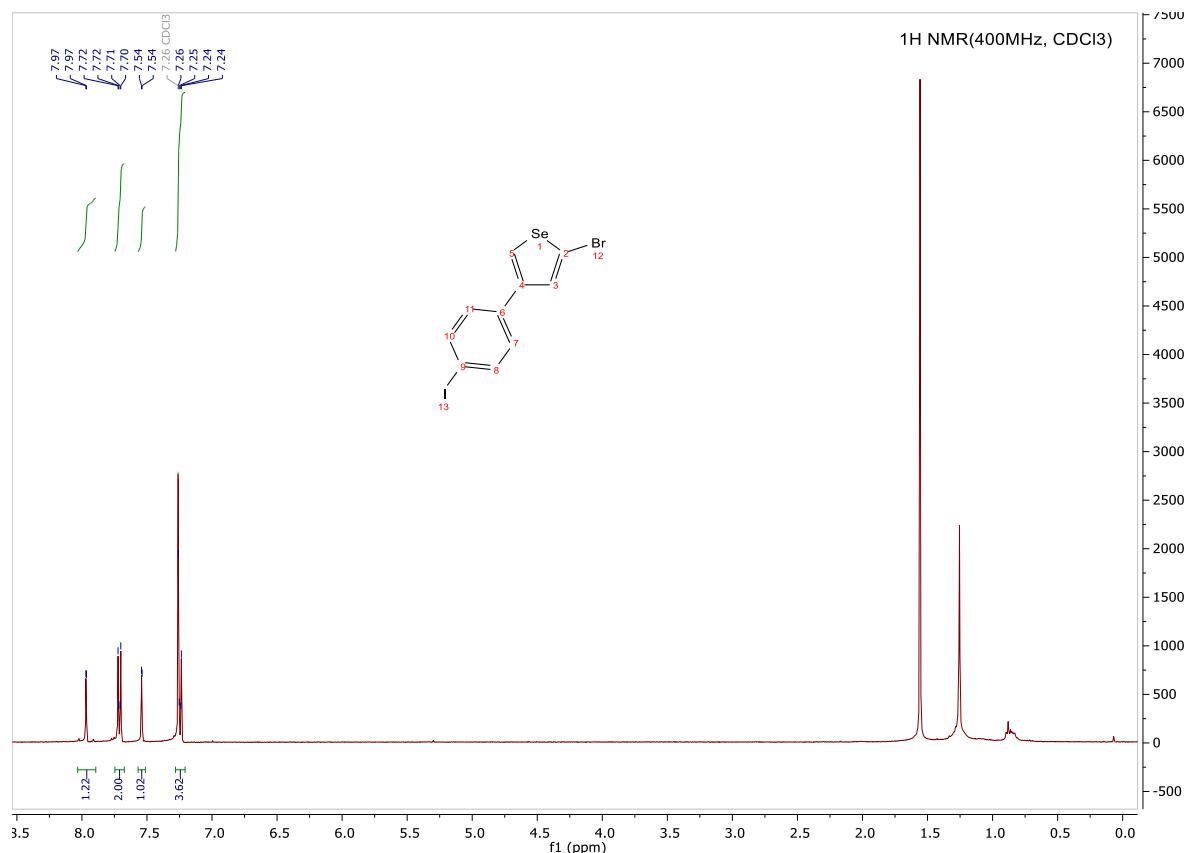
2-Bromo-4-(2-chloro-4-fluorophenyl)selenophene (39)



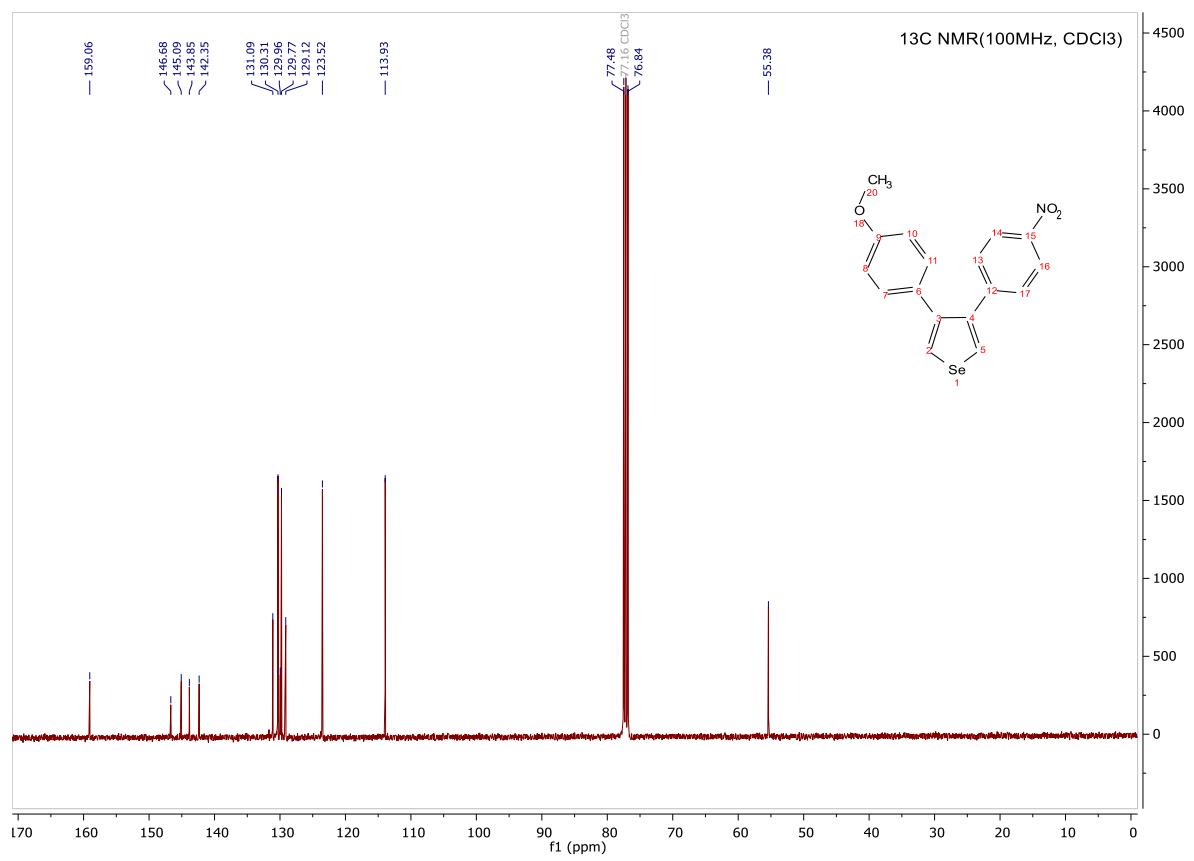
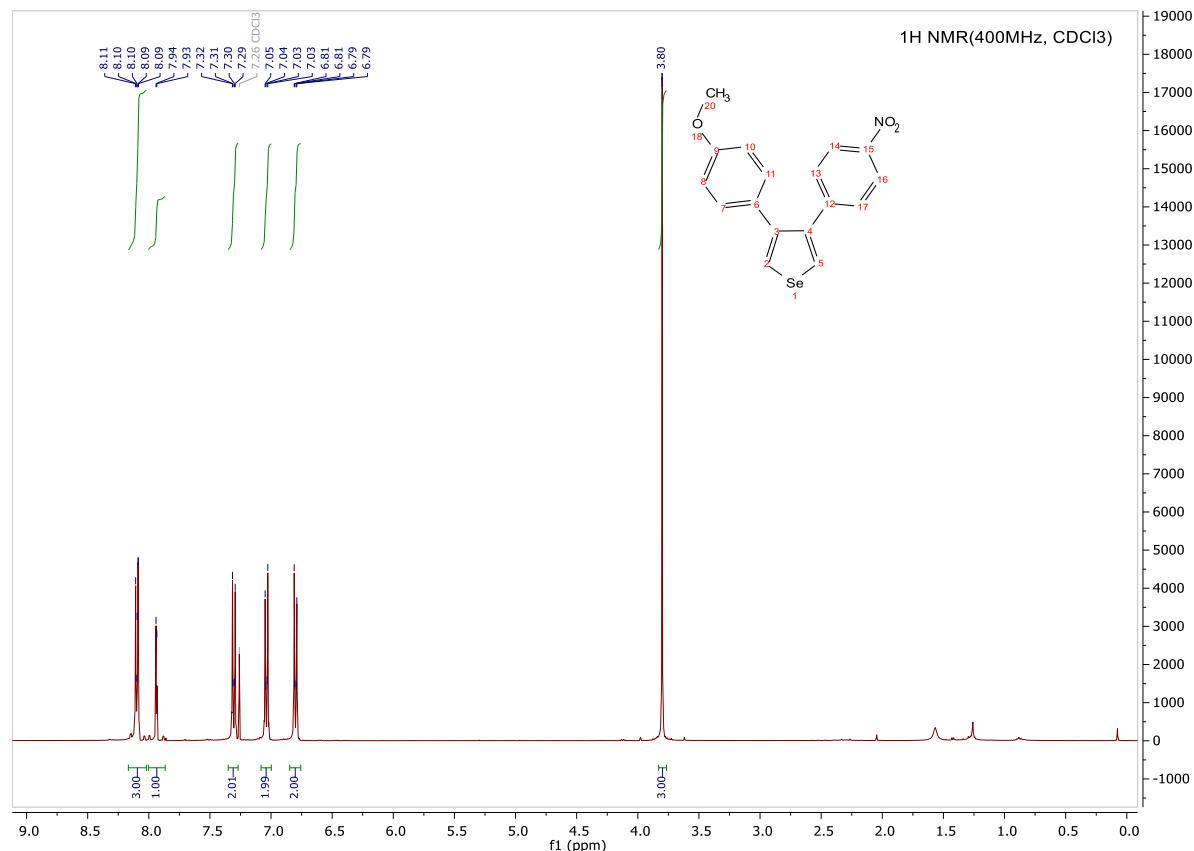
2-Bromo-4-(3,4-dibromophenyl)selenophene (40)



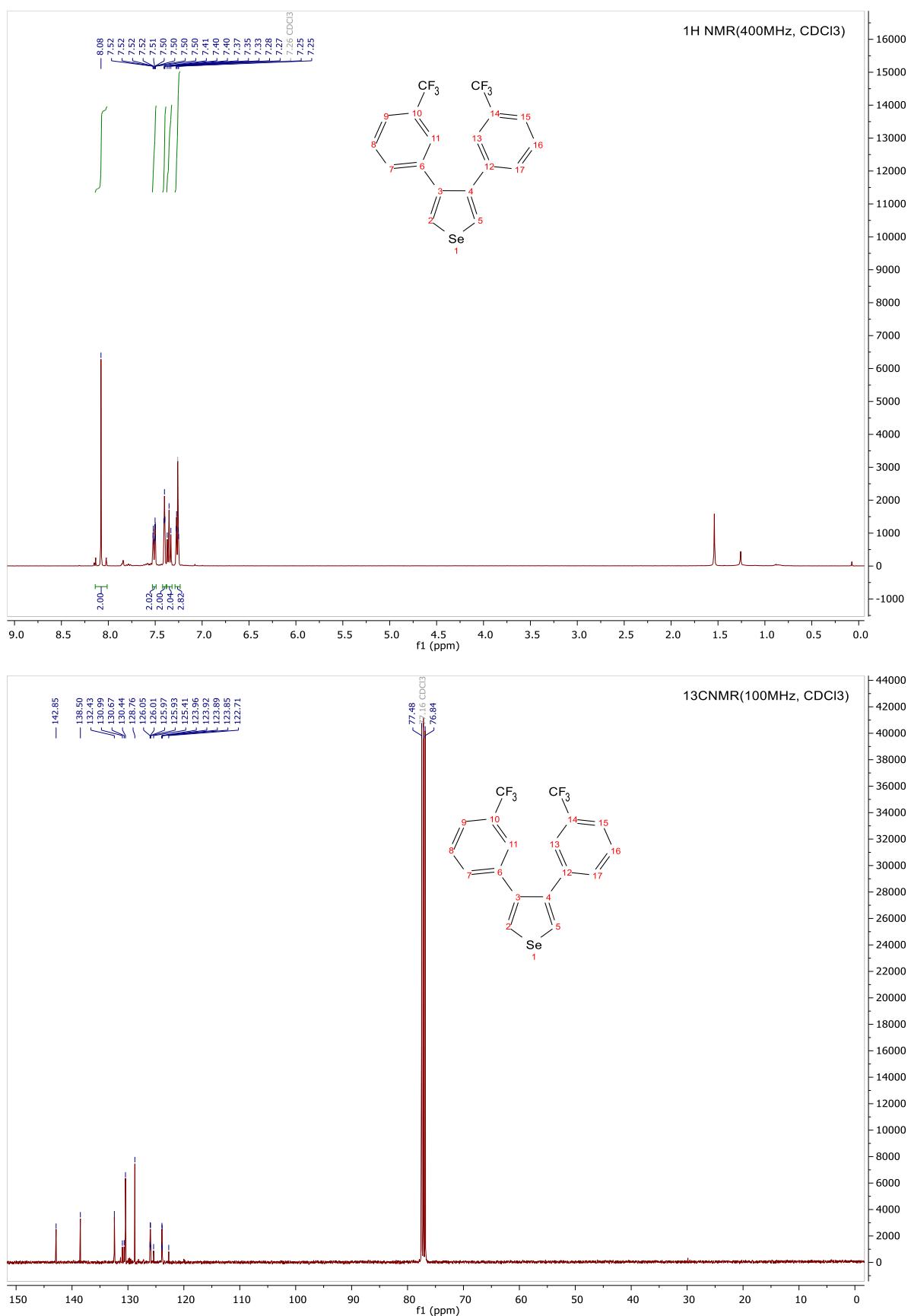
2-Bromo-4-(4-iodophenyl)selenophene (41)



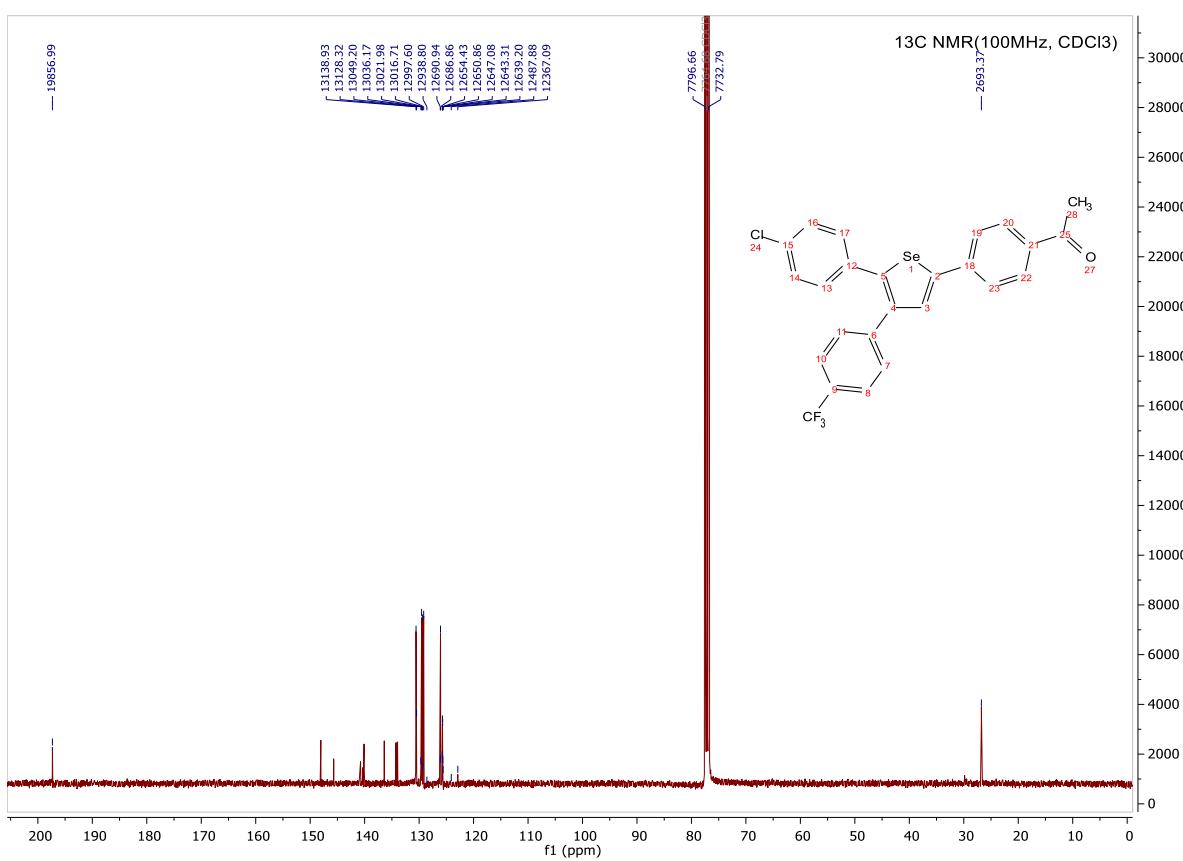
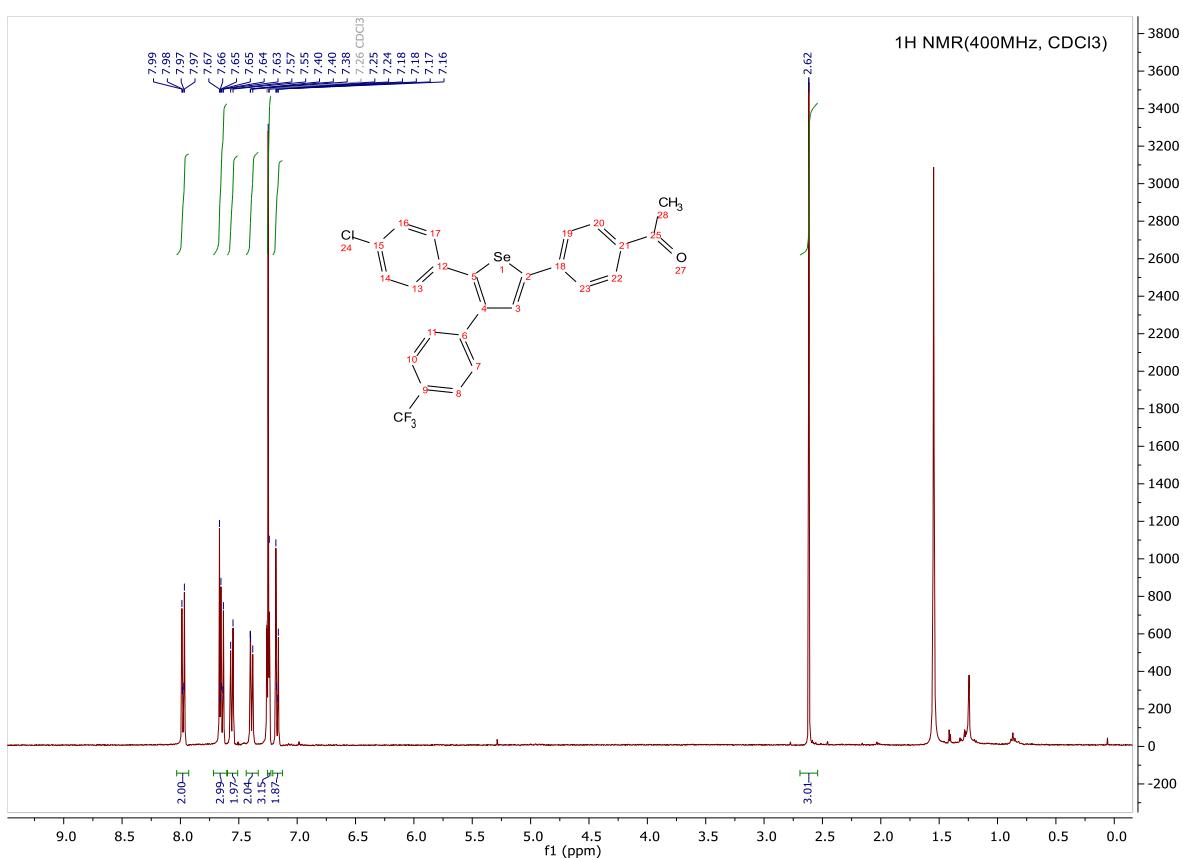
3-(4-Methoxyphenyl)-4-(4-nitrophenyl)selenophene (42)



3,4-Bis(3-(trifluoromethyl)phenyl)selenophene (43)



1-(4-(5-(4-Chlorophenyl)-4-(trifluoromethyl)phenyl)selenophen-2-yl)phenyl)ethan-1-one (44)



4,4'-(3-(4-Methoxyphenyl)-4-(4-nitrophenyl)selenophene-2,5-diyl)dibenzonitrile (45)

