

## Supporting Information

### Highly Enantioselective 1,6-Addition of Dienolates to Coumarins and Chromones through N-Heterocyclic Carbene Catalysis

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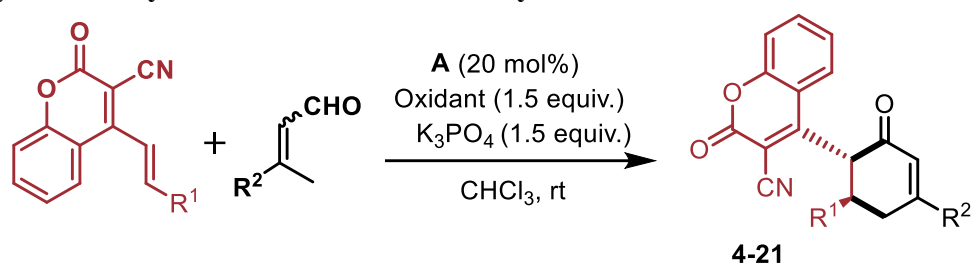
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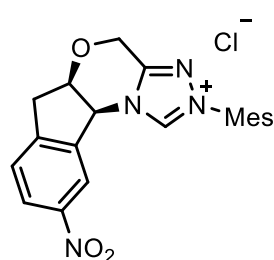
## 1. General information

- Chemicals were purchased from Acros or Aldrich and used without further purification unless otherwise noted. Solvents were predistilled according to standard laboratory methods.
- Cyanocoumarin-derived 1,6-Michael acceptors<sup>1</sup> and nitrochromone-derived 1,6-Michael acceptors<sup>2</sup> were prepared according to reported literatures.
- Chromatographic purification of the products was performed on Merck silica gel 60, particle size 0.040-0.063 mm (230-240 mesh, flash).
- Analytical TLC: SIL G-25 UV254 from Macherey&Nagel. Visualization of the developed TLC plates was performed with ultraviolet irradiation (254 nm) or by staining with basic potassium permanganate solution.
- Mass spectra were acquired on a Finnigan SSQ7000 (EI/CI) spectrometer and high resolution mass spectra on a Finnigan MAT 95 (EI/CI) or on a ThermoFisher Scientific LTQOrbitrap XL (ESI). All signals over 10% relative intensity are listed.
- IR spectra were taken on a Perkin-Elmer FT-IR Spectrum 100 using a Diamant/KRS5 ATR. Evaluation was done using the supplementary software. The absorption bands are given in wave numbers ( $\text{cm}^{-1}$ ).
- <sup>1</sup>H- and <sup>13</sup>C- NMR spectra were recorded at ambient temperature on Varian Mercury 300, VNMRS 600 and Inova 400 instruments. The chemical shifts are reported in ppm downfield of tetramethylsilane (TMS) and referenced to residual solvent peaks resonance as internal standard. The order of citation in parentheses is a) multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd= doublet of doublet, ddd= doublet of doublet of doublet, td = triplet of doublet, m = multiplet), b) coupling constants, c) number of protons. Coupling constants (*J*) are reported in Hertz (Hz).
- Analytical HPLC was performed on a Hewlett-Packard 1100 Series instrument using chiral stationary phases (CHIRALPAK AS, CHIRALPAK IC, CHIRALPAK IB).

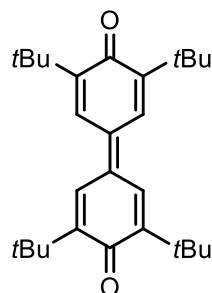
## 2 Asymmetric synthesis of functionalized cyanocoumarins



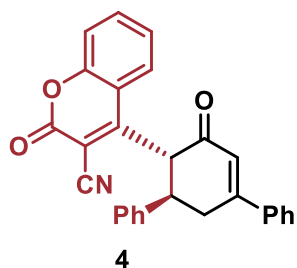
Pre-NHC



Oxidant

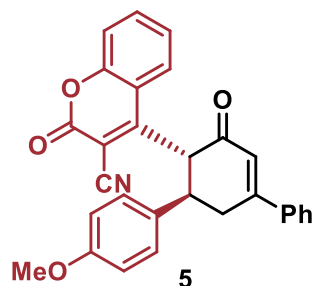


A 10 mL glass tube equipped with a stirring bar was charged with substrate cyanocoumarin (0.2 mmol, 1.0 equiv.), oxidant (0.3 mmol, 1.5 equiv., 124 mg), the enal (0.4 mmol, 2.0 equiv.),  $K_3PO_4$  (0.3 mmol, 1.5 equiv., 63.6 mg), 4Å MS (100 mg), NHC (0.04 mmol, 20 mol%, 18.6 mg) and anhydrous  $CHCl_3$  (2.0 mL). The resulting solution was flushed with argon and stirred at room temperature for 24 h and was directly purified by flash chromatography using *n*-hexane and ethyl acetate as the eluent to provide the desired product (**4-21**).



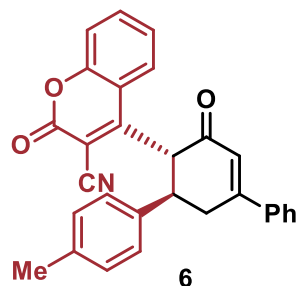
### 2-Oxo-4-((3'*R*,4'*R*)-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2H-chromene-3-carbonitrile (**4**)

Yield: 60.9 mg, 73%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T = 30 °C; retention time: 11.10 min (minor), 15.29 min (major), e.r.: 99:1; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.70 – 7.55 (m, 4H), 7.52 – 7.43 (m, 3H), 7.40 – 7.20 (m, 5H), 7.10 (d, *J* = 5.6 Hz, 2H), 6.76 (s, 1H), 4.73 (d, *J* = 13.1 Hz, 1H), 4.14 – 4.04 (m, 1H), 3.45 – 3.25 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.0, 162.4, 160.3, 155.9, 153.6, 138.4, 137.2, 134.6, 131.2, 129.2 (2C), 129.1 (2C), 128.5, 127.6, 127.0 (2C), 126.4 (2C), 124.8, 123.8, 118.3, 115.9, 113.7, 106.4, 59.6, 47.7, 36.5 ppm; **IR (ATR)**: 3455, 3048, 2227, 2095, 1734, 1660, 1602, 1551, 1493, 1446, 1363, 1243, 1148, 1074, 874, 751, 692 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>19</sub>NO<sub>3</sub>Na<sup>+</sup>: 440.1257; found 440.1243.



**4-((3'*R*,4'*R*)-4''-methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (5)**

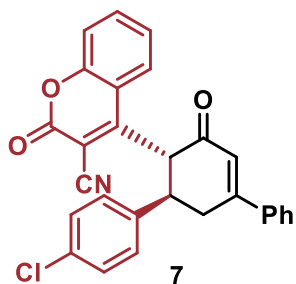
Yield: 58.1 mg, 65%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 14.28 min (minor), 19.48 min (major), e.r.: 94.5:5.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.68 – 7.56 (m, 4H), 7.52 – 7.42 (m, 3H), 7.38 – 7.30 (m, 2H), 7.01 (d, *J* = 8.0 Hz, 2H), 6.80 – 6.64 (m, 3H), 4.68 (d, *J* = 13.0 Hz, 1H), 4.07 – 4.04 (m, 1H), 3.75 (s, 3H), 3.40 – 3.20 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.3, 162.6, 160.4, 159.3, 156.1, 153.6, 137.3, 134.6, 131.1, 130.4, 129.1 (2C), 128.1 (2C), 127.7, 126.4 (2C), 124.8, 123.8, 118.3, 115.9, 114.5 (2C), 113.7, 106.4, 59.9, 55.2, 47.0, 36.9 ppm; **IR (ATR)**: 3454, 2922, 2230, 2063, 1729, 1657, 1601, 1552, 1510, 1449, 1366, 1304, 1246, 1178, 1080, 1030, 961, 881, 830, 753, 692 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>4</sub>Na<sup>+</sup>: 470.1363; found 470.1346.



**4-((3'*R*,4'*R*)-4''-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (6)**

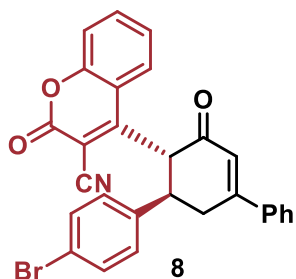
Yield: 72.3 mg, 85%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 11.40 min (minor), 15.76 min (major), e.r.: 94.5:5.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.70 – 7.70 (m, 4H), 7.53 – 7.40 (m, 3H), 7.38 – 7.30 (m, 2H), 7.01 (dd, *J* = 35.6, 6.8 Hz, 4H), 6.74 (s, 1H), 4.70 (d, *J* = 12.9 Hz, 1H), 4.12 - 4.00 (m, 1H), 3.42 – 3.20 (m, 2H), 2.27 (s, 3H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.2, 162.6, 160.4, 156.1, 153.5, 138.2, 137.2, 135.4, 134.6, 131.1, 129.9 (2C), 129.1 (2C), 127.7, 126.9 (2C), 126.4 (2C), 124.8, 123.8, 118.3, 115.9, 113.7, 106.3, 59.7, 47.4, 36.7, 21.1 ppm; **IR (ATR)**: 3455, 2923, 2230, 2062, 1730, 1657, 1601, 1553, 1495, 1447, 1365, 1244, 1079, 960, 879, 813, 753, 692 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>3</sub>Na<sup>+</sup>: 454.1414; found 454.1394.





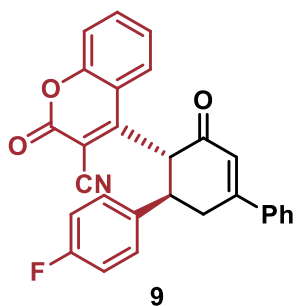
**4-((3'R,4'R)-4''-Chloro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (7)**

Yield: 76.7 mg, 85%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 9.88 min (minor), 13.00 min (major), e.r.: 95.5:4.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.68 – 7.55 (m, 4H), 7.52 – 7.43 (m, 3H), 7.39 – 7.31 (m, 2H), 7.22 (d, *J* = 7.7 Hz, 2H), 7.05 (d, *J* = 7.7 Hz, 2H), 6.75 (s, 1H), 4.68 (d, *J* = 13.0 Hz, 1H), 4.14 – 4.05 (m, 1H), 3.37 – 3.23 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.7, 162.2, 160.1, 155.9, 153.6, 137.0, 137.0, 134.8, 134.2, 131.3, 129.5 (2C), 129.2 (2C), 128.4 (2C), 127.5, 126.4 (2C), 125.0, 123.8, 118.4, 115.7, 113.7, 106.3, 59.23, 47.0, 36.5 ppm; **IR (ATR)**: 3452, 2922, 2230, 2060, 1730, 1657, 1600, 1551, 1491, 1447, 1364, 1243, 1143, 1082, 967, 923, 877, 827, 752, 690 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>18</sub>NO<sub>3</sub>ClNa<sup>+</sup>: 474.0867; found 474.0846.



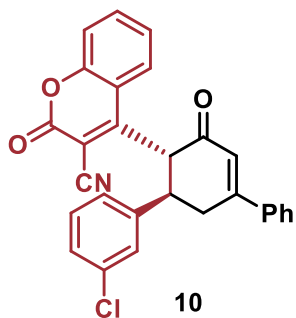
**4-((3'R,4'R)-4''-Bromo-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (8)**

Yield: 69.3 mg, 70%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 10.28 min (minor), 13.70 min (major), e.r.: 95.5:4.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.69 – 7.60 (m, 3H), 7.57 – 7.44 (m, 4H), 7.43 – 7.28 (m, 4H), 7.00 (d, *J* = 7.5 Hz, 2H), 6.76 (s, 1H), 4.70 (d, *J* = 13.0 Hz, 1H), 4.12 – 4.04 (m, 1H), 3.38 – 3.23 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.7, 162.0, 160.0, 153.6, 155.9, 137.4, 137.0, 134.8, 132.4 (2C), 131.3, 129.2 (2C), 128.7 (2C), 127.5, 126.4 (2C), 124.9, 123.8, 122.4, 118.5, 115.7, 113.7, 106.4, 59.2, 47.1, 36.5 ppm; **IR (ATR)**: 3454, 2233, 2100, 1998, 1731, 1658, 1600, 1550, 1489, 1445, 1364, 1226, 1145, 1076, 1005, 909, 823, 747 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>18</sub>NO<sub>3</sub>BrNa<sup>+</sup>: 518.0362; found 518.0344.



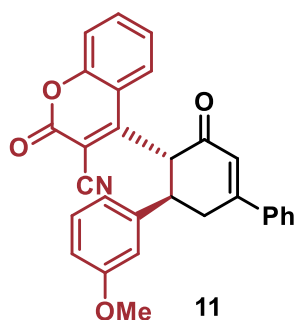
**4-((3'R,4'R)-4''-fluoro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (9)**

Yield: 64.4 mg, 74%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 9.79 min (minor), 12.88 min (major), e.r.: 99.5:0.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.70 – 7.55 (m, 4H), 7.53 – 7.43 (m, 3H), 7.40 – 7.31 (m, 2H), 7.11 – 7.06 (m, 2H), 6.95 – 6.93 (m, 2H), 6.75 (s, 1H), 4.68 (d, *J* = 13.0 Hz, 1H), 4.19 – 4.00 (m, 1H), 3.42 – 3.20 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.8, 163.1, 162.3, 161.5, 160.2, 153.6, 137.1, 134.7, 134.3, 131.2, 129.1 (2C), 128.7, 128.7, 127.5, 126.4 (2C), 124.9, 123.8, 118.4, 116.3, 116.2, 115.7, 113.7, 106.4, 59.6, 46.9, 36.6 ppm; **IR (ATR)**: 3456, 2930, 2231, 1734, 1663, 1602, 1554, 1507, 1447, 1366, 1226, 1154, 1083, 942, 837, 755, 691 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>18</sub>NO<sub>3</sub>FNa<sup>+</sup>: 458.1163; found 458.1147.



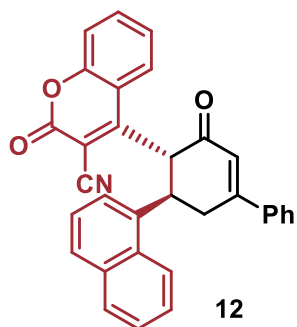
**4-((3'R,4'R)-3''-chloro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (10)**

Yield: 65.8 mg, 73%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 9.10 min (minor), 13.23 min (major), e.r.: 96:4; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.70 – 7.58 (m, 3H), 7.55 – 7.41 (m, 4H), 7.40 – 7.30 (m, 2H), 7.25 – 7.18 (m, 2H), 7.05 (d, *J* = 7.9 Hz, 2H), 6.75 (s, 1H), 4.69 (d, *J* = 12.9 Hz, 1H), 4.00 – 4.10 (m, 1H), 3.37 – 3.21 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.6, 162.0, 160.0, 155.9, 153.6, 140.5, 137.0, 135.0, 134.8, 131.3, 130.6, 129.2, 128.7, 127.45, 126.4, 125.1, 125.0, 123.8, 118.4, 115.7, 113.6, 106.4, 59.1, 47.3, 36.3 ppm; **IR (ATR)**: 3454, 2925, 2229, 2076, 1730, 1658, 1600, 1553, 1487, 1445, 1363, 1245, 1145, 1079, 1046, 996, 877, 836, 754, 694 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>18</sub>NO<sub>3</sub>ClNa<sup>+</sup>: 474.0867; found 474.0851.



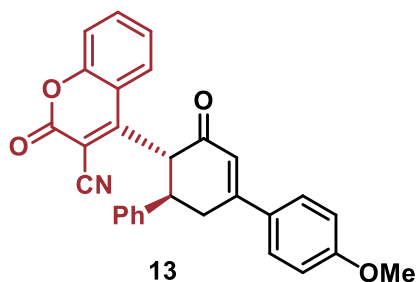
**4-((3'*R*,4'*R*)-3''-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3,1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (11)**

Yield: 64.4 mg, 72%, yellow foam; CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 11.66 min (minor), 16.35 min (major), e.r.: 93:7; <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) δ 7.66 – 7.56 (m, 4H), 7.51 – 7.43 (m, 3H), 7.38 – 7.32 (m, 2H), 7.16 – 7.11 (m, 1H), 6.77 – 6.73 (m, 2H), 6.69 – 6.58 (m, 2H), 4.73 (d, *J* = 13.1 Hz, 1H), 4.09 – 4.04 (m, 1H), 3.74 (s, 3H), 3.41 – 3.26 (m, 2H) ppm; <sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>) δ 194.1, 162.4, 160.3, 159.9, 156.1, 139.9, 137.2, 134.6, 131.2, 130.3, 129.1, 127.6, 126.4, 124.9, 123.8, 119.3, 118.3, 115.9, 114.2, 113.8, 112.3, 106.3, 59.4, 55.2, 47.7, 36.3 ppm; HPLC: IR (ATR): 2924, 2229, 2070, 1728, 1656, 1597, 1557, 1489, 1447, 1370, 1268, 1151, 1045, 861, 755, 697 cm<sup>-1</sup>; HRMS (ESI): *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>4</sub>Na<sup>+</sup>: 470.1363; found 470.1350.



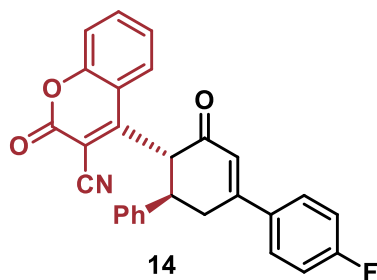
**4-((3*R*,4*R*)-3-(Naphthalen-1-yl)-5-oxo-2,3,4,5-tetrahydro-[1,1'-biphenyl]-4-yl)-2-oxo-2H-chromene-3-carbonitrile (12)**

Yield: 56.0 mg, 60%, yellow foam; HPLC: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 11.76 min (minor), 21.03 min (major), e.r.: 92:8; <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.94 (d, *J* = 7.2 Hz, 1H), 7.83 – 7.72 (m, 3H), 7.65 (d, *J* = 6.4 Hz, 2H), 7.61 – 7.55 (m, 2H), 7.48 – 7.40 (m, 5H), 7.32 – 7.26 (m, 1H), 7.14 (d, *J* = 7.8 Hz, 1H), 7.07 – 7.03 (m, 1H), 6.84 (s, 1H), 5.18 – 5.08 (m, 1H), 4.93 (d, *J* = 12.9 Hz, 1H), 3.47 – 3.34 (m, 2H) ppm; <sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>) δ 194.5, 162.2, 160.5, 155.8, 153.6, 137.1, 134.7, 134.5, 133.9, 131.2, 130.5, 129.3, 129.1 (2C), 129.0, 127.6, 126.4 (2C), 126.0, 125.8, 125.7, 124.9, 124.7, 123.8, 121.0, 118.3, 115.9, 113.8, 106.5, 59.4, 40.3, 37.2 ppm; IR (ATR): 3059, 2926, 2229, 2072, 1720, 1660, 1600, 1551, 1495, 1447, 1363, 1320, 1246, 1216, 1080, 1052, 923, 870, 800, 763, 681 cm<sup>-1</sup>; HRMS (ESI): *m/z* [M+Na]<sup>+</sup> calcd for C<sub>32</sub>H<sub>21</sub>NO<sub>3</sub>Na<sup>+</sup>: 490.1414; found 490.1398.



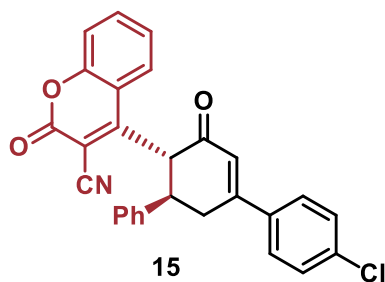
**4-((3'R,4'R)-4-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (13)**

Yield: 44.7 mg, 50%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 18.24 min (major), 22.61 min (minor), e.r.: 99:1; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.62 (dd, *J* = 19.9, 8.3 Hz, 4H), 7.37 – 7.30 (m, 2H), 7.27 – 7.22 (m, 3H), 7.09 (d, *J* = 6.2 Hz, 2H), 6.98 (d, *J* = 8.6 Hz, 2H), 6.73 (s, 1H), 4.70 (d, *J* = 13.0 Hz, 1H), 4.11 – 4.02 (m, 1H), 3.88 (s, 3H), 3.37 – 3.26 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.0, 162.6, 162.2, 159.6, 156.0, 153.5, 138.5, 134.5, 129.2 (2C), 129.1, 128.5, 128.2 (2C), 127.7, 127.0 (2C), 124.8, 121.8, 118.3, 115.9, 114.5 (2C), 113.7, 106.3, 59.5, 55.5, 47.7, 36.2 ppm; **IR (ATR)**: 2926, 2229, 2068, 1729, 1659, 1596, 1556, 1486, 1446, 1369, 1264, 1154, 1044, 860, 754, 695 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>4</sub>Na<sup>+</sup>: 470.1363; found 470.1346.



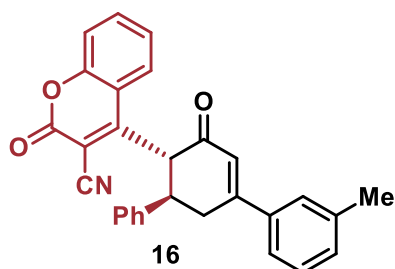
**4-((3'R,4'R)-4-Fluoro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (14)**

Yield: 74.8 mg, 86%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 9.97 min (minor), 13.32 min (major), e.r.: 94:6; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.71 – 7.53 (m, 4H), 7.52 – 7.43 (m, 1H), 7.39 – 7.32 (m, 2H), 7.26 – 7.04 (m, 6H), 6.75 (dd, *J* = 18.6, 1.9 Hz, 1H), 4.73 (dd, *J* = 13.1, 3.8 Hz, 1H), 4.16 – 4.02 (m, 1H), 3.44 – 3.21 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.9, 164.4 (*J*<sub>C-F</sub> = 253.7), 162.3, 158.9, 155.9, 153.5, 138.3, 134.6, 133.3, 129.3 (2C), 128.5 (2C), 128.5 (2C), 127.6, 127.0 (2C), 124.8, 123.6, 118.3, 116.3 (*J*<sub>C-F</sub> = 22.7), 115.8, 113.6, 106.4, 59.5, 47.6, 36.5 ppm; **IR (ATR)**: 2925, 2230, 2159, 1729, 1660, 1599, 1554, 1508, 1449, 1367, 1287, 1230, 1160, 1080, 1041, 909, 883, 833, 753, 698 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>18</sub>NO<sub>3</sub>FNa<sup>+</sup>: 458.1163; found 458.1145.



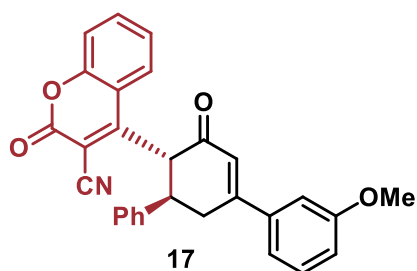
**4-((3'R,4'R)-4-chloro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3,1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (15)**

Yield: 55.9 mg, 62%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 10.27 min (minor), 13.97 min (major), e.r.: 94:6; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.68 – 7.68 (m, 1H), 7.62 – 7.52 (m, 3H), 7.49 – 7.30 (m, 4H), 7.26 – 7.06 (m, 5H), 6.74 (s, 1H), 4.72 (d, *J* = 13.1 Hz, 1H), 4.12 – 4.08 (m, 1H), 3.43 – 3.20 (m, 2H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.9, 162.2, 158.8, 155.9, 153.5, 138.2, 137.4, 135.6, 134.7, 129.4 (2C), 129.3 (2C), 128.6, 127.7 (2C), 127.6, 127.0 (2C), 124.9, 124.0, 118.4, 115.8, 113.7, 106.4, 59.5, 47.6, 36.4 ppm; **IR (ATR)**: 3455, 2922, 2229, 2163, 1907, 1729, 1659, 1599, 1550, 1489, 1451, 1363, 1221, 1086, 1009, 962, 884, 823, 752, 700 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>18</sub>NO<sub>3</sub>ClNa<sup>+</sup>: 474.0867; found 474.0858.



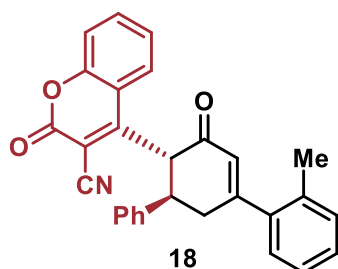
**4-((3'R,4'R)-3-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3,1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (16)**

Yield: 64.7 mg, 75%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 11.05 min (minor), 15.13 min (major), e.r.: 96.5:3.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.68 – 7.63 (t, *J* = 7.6 Hz, 1H), 7.59 (d, *J* = 7.9 Hz, 1H), 7.49 – 7.41 (m, 2H), 7.39 – 7.21 (m, 7H), 7.10 (d, *J* = 5.9 Hz, 2H), 6.76 (d, *J* = 1.7 Hz, 1H), 4.72 (d, *J* = 13.1 Hz, 1H), 4.11 – 4.06 (m, 1H), 3.43 – 3.24 (m, 2H), 2.42 (s, 3H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.1, 162.4, 160.5, 156.0, 153.6, 138.9, 138.4, 137.2, 134.6, 132.0, 129.3 (2C), 129.0, 128.5, 127.6, 127.1, 127.0 (2C), 124.8, 123.7, 123.6, 118.3, 115.9, 113.7, 106.4, 59.6, 47.8, 36.5, 21.5 ppm; **IR (ATR)**: 3450, 2922, 2230, 2075, 1946, 1729, 1657, 1598, 1533, 1448, 1363, 1225, 1079, 1038, 969, 873, 753, 697 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>3</sub>Na<sup>+</sup>: 454.1414; found 454.1402.



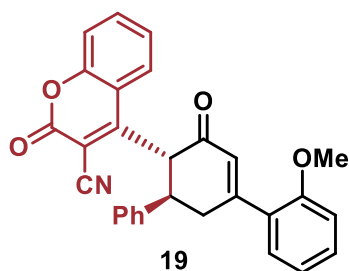
**4-((3'*R*,4'*R*)-3-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (17)**

Yield: 69.7 mg, 78%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T = 30 °C; retention time: 14.10 min (minor), 18.27 min (major), e.r.: 94:6; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.67- 7.61 (m, 1H), 7.59 (d, *J* = 8.0 Hz, 1H), 7.42 – 7.29 (m, 3H), 7.28 – 7.18 (m, 4H), 7.16 – 6.99 (m, 4H), 6.74 (d, *J* = 1.6 Hz, 1H), 4.71 (d, *J* = 13.0 Hz, 1H), 4.12 – 4.06 (m, 1H), 3.85 (s, 3H), 3.43 – 3.22 (m, 2H) ppm; **<sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)** δ 194.1, 162.4, 160.3, 160.0, 156.0, 153.5, 138.7, 138.4, 134.6, 130.1, 129.2 (2C), 128.5, 127.7, 127.0 (2C), 124.9, 124.0, 118.8, 118.3, 116.6, 115.8, 113.7, 112.0, 106.3, 59.6, 55.5, 47.7, 36.5 ppm; **IR (ATR)**: 3449, 2923, 2230, 2161, 2077, 1920, 1727, 1654, 1596, 1556, 1510, 1449, 1368, 1238, 1178, 1074, 1028, 960, 877, 826, 753, 701 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>4</sub>Na<sup>+</sup>: 470.1363; found 470.1345.



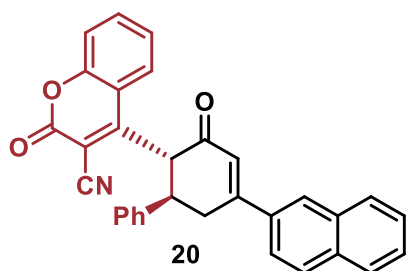
**4-((3'*R*,4'*R*)-2-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (18)**

Yield: 53.4 mg, 62%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T = 30 °C; retention time: 7.05 min (minor), 10.91 min (major), e.r.: 97:3; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.70 – 7.56 (m, 2H), 7.42 – 7.37 (m, 1H), 7.37 – 7.18 (m, 8H), 7.13 – 7.03 (m, 2H), 6.35 (d, *J* = 2.4 Hz, 1H), 4.72 (d, *J* = 13.0 Hz, 1H), 4.15 – 4.05 (m, 1H), 3.39 – 3.28 (m, 1H), 3.01 (dd, *J* = 18.0, 2.4 Hz 1H), 2.46 (s, 3H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.8, 164.0, 162.3, 155.9, 153.6, 139.2, 138.1, 134.6, 134.1, 131.1, 129.3, 129.2 (2C), 128.5, 127.5, 127.4, 127.1, 126.9 (2C), 126.2, 124.9, 118.4, 115.9, 113.7, 106.4, 59.9, 48.1, 39.4, 20.5 ppm; **IR (ATR)**: 3451, 2923, 2229, 2157, 1908, 1728, 1664, 1601, 1551, 1489, 1450, 1365, 1284, 1243, 1214, 1187, 1076, 1039, 968, 884, 828, 753, 699 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>3</sub>Na<sup>+</sup>: 454.1414; found 454.1400.



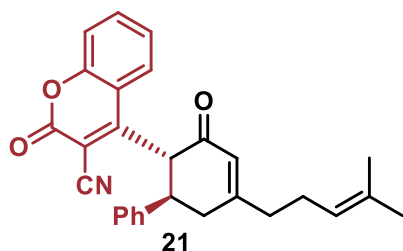
**4-((3'R,4'R)-2-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-2-oxo-2H-chromene-3-carbonitrile (19)**

Yield: 53.6 mg, 60%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 10.99 min (minor), 13.41 min (major), e.r.: 97.5:2.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 7.67 – 7.62 (m, 2H), 7.45 – 7.30 (m, 4H), 7.24 – 7.17 (m, 3H), 7.09 (d, *J* = 6.6 Hz, 2H), 7.04 (t, *J* = 7.2 Hz, 1H), 6.99 (d, *J* = 8.2 Hz, 1H), 6.59 (s, 1H), 4.73 (d, *J* = 12.9 Hz, 1H), 4.11 – 4.04 (m, 1H), 3.89 (s, 3H), 3.52 – 3.42 (m, 1H), 3.21 (dd, *J* = 18.0, 3.0 Hz, 1H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.3, 162.9, 162.1, 156.9, 156.1, 153.5, 138.7, 134.6, 131.6, 129.1 (2C), 129.0, 128.3, 127.8, 127.1 (2C), 126.7, 126.6, 125.0, 121.0, 118.2, 116.0, 113.8, 111.4, 106.2, 60.1, 55.6, 48.2, 38.2 ppm; **IR (ATR)**: 2926, 2227, 2157, 2080, 1914, 1725, 1672, 1602, 1549, 1484, 1448, 1359, 1287, 1242, 1153, 1078, 1029, 930, 871, 746, 702 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>29</sub>H<sub>21</sub>NO<sub>4</sub>Na<sup>+</sup>: 470.1363; found 470.1343.



**4-((1R,2R)-5-(Naphthalen-2-yl)-3-oxo-1,2,3,6-tetrahydro-[1,1'-biphenyl]-2-yl)-2-oxo-2H-chromene-3-carbonitrile (20)**

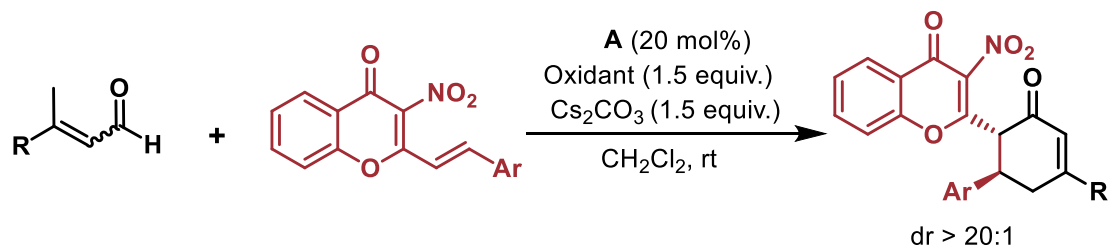
Yield: 84.1 mg, 90%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 14.41 min (minor), 18.82 min (major), e.r.: 99:1; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.12 (s, 1H), 7.96 – 7.83 (m, 3H), 7.78 – 7.51 (m, 5H), 7.40 – 7.36 (m, 1H), 7.35 – 7.08 (m, 6H), 6.91 (s, 1H), 4.77 (d, *J* = 13.0 Hz, 1H), 4.20 – 4.10 (m, 1H), 3.51 – 3.42 (m, 2H); **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 194.1, 162.5, 159.8, 156.0, 153.5, 138.5, 134.7, 234.4, 134.2, 133.0, 129.3 (2C), 129.0, 128.9, 128.6, 128.0, 127.8, 127.7, 127.1 (2C), 127.1, 127.1, 124.9, 124.0, 123.0, 118.3, 115.9, 113.7, 106.3, 59.6, 47.7, 36.4 ppm; **IR (ATR)**: 3452, 3056, 2321, 2228, 2082, 1898, 1730, 1658, 1597, 1552, 1493, 1447, 1369, 1276, 1223, 1146, 1077, 904, 854, 814, 751, 699 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>32</sub>H<sub>21</sub>NO<sub>3</sub>Na<sup>+</sup>: 490.1414; found 490.1394.



**4-((1*R*,2*R*)-5-(4-Methylpent-3-en-1-yl)-3-oxo-1,2,3,6-tetrahydro-[1,1'-biphenyl]-2-yl)-2-oxo-2H-chromene-3-carbonitrile (21)**

Yield: 42.3 mg, 50%, yellow foam; **HPLC**: CHIRALPAK IC; *n*-Hexane/EtOH = 7/3; flow rate 1.0 mL/min; T= 30 °C; retention time: 7.34 min (minor), 12.98 min (major), e.r.: 94:6; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.65 – 7.61 (m, 1H), 7.50 (d, *J* = 7.8 Hz, 1H), 7.35 – 7.31 (m, 2H), 7.24 – 7.16 (m, 3H), 7.05 – 6.97 (m, 2H), 6.22 (s, 1H), 5.14 (t, *J* = 7.0 Hz, 1H), 4.56 (d, *J* = 13.0 Hz, 1H), 3.95 – 3.82 (m, 1H), 3.04 – 2.93 (m, 1H), 2.71 (dd, *J* = 18.3, 4.4 Hz, 1H), 2.48 – 2.25 (m, 4H), 1.74 (s, 3H), 1.66 (s, 3H) ppm; **<sup>13</sup>C NMR (151 MHz, CDCl<sub>3</sub>)** δ 193.9, 167.1, 162.5, 155.9, 153.5, 138.4, 134.5, 133.5, 129.0, 129.1 (2C), 128.4, 127.6, 126.9 (2C), 126.9, 124.7, 122.2, 118.3, 115.9, 113.6, 106.2, 59.7, 47.6, 38.2, 38.1, 25.7, 25.5, 17.8 ppm; **IR (ATR)**: 3422, 2922, 2229, 2168, 2106, 1988, 1914, 1712, 1661, 1600, 1553, 1496, 1448, 1377, 1303, 1216, 1152, 1085, 1040, 992, 903, 867, 842, 759, 701 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>25</sub>NO<sub>3</sub>Na<sup>+</sup>: 446.1727; found 446.1726.

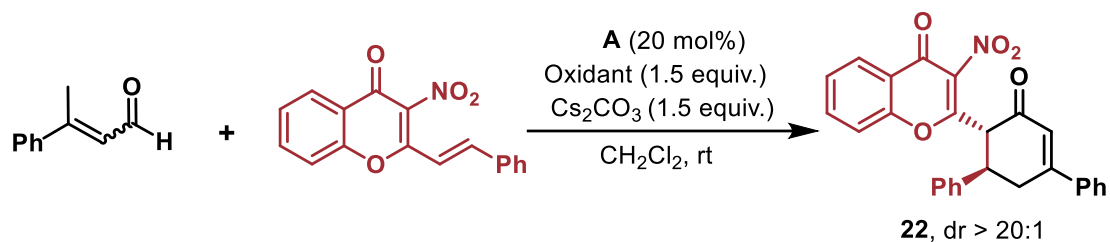
**3 Asymmetric synthesis of functionalized nitrochromones.**



A 10 mL glass tube equipped with a stirring bar was charged with nitrochromones (0.2 mmol, 1.0 equiv.), oxidant (0.3 mmol, 1.5 equiv., 124 mg), the enal (0.4 mmol, 2.0 equiv.), Cs<sub>2</sub>CO<sub>3</sub> (0.3 mmol, 1.5 equiv., 97.7 mg), 4Å MS (100 mg), NHC (0.04 mmol, 20 mol%, 18.6 mg) and anhydrous DCM (2.0 mL). The resulting solution was flushed with argon and stirred at room temperature for 24 h and was directly purified by flash chromatography using *n*-hexane and ethyl acetate (4:1) as the eluent to provide the desired product (**22-39**).

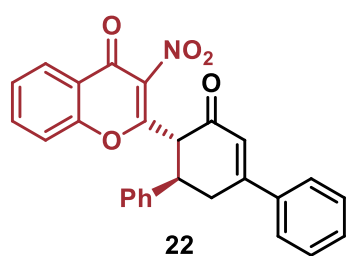
**Table S1** Optimization of reaction conditions.





Entry	Solvent	Base	Yield of <b>22</b> (%) <sup>a</sup>	Er <sup>b</sup>
1	Toluene	Cs <sub>2</sub> CO <sub>3</sub>	76	89:11
2	Toluene	K <sub>2</sub> CO <sub>3</sub>	70	85:15
3	Toluene	Na <sub>2</sub> CO <sub>3</sub>	72	85:15
4	Toluene	CsOAc	77	86:14
5	Toluene	KOAc	75	86:14
6	Toluene	K <sub>3</sub> PO <sub>4</sub>	76	86.5:13.5
7	Toluene	KHCO <sub>3</sub>	50	85:15
8	Toluene	DIPEA	trace	--
9	CHCl <sub>3</sub>	Cs <sub>2</sub> CO <sub>3</sub>	56	94:6
10	DCM	Cs <sub>2</sub> CO <sub>3</sub>	65	94.5:5.5
11	CH <sub>3</sub> CN	Cs <sub>2</sub> CO <sub>3</sub>	52	85.5:14.5
12	Mesitylene	Cs <sub>2</sub> CO <sub>3</sub>	60	82:18
14	MTBE	Cs <sub>2</sub> CO <sub>3</sub>	56	84.5:15.5
15	Dioxane	Cs <sub>2</sub> CO <sub>3</sub>	68	86:14
16	PhCl	Cs <sub>2</sub> CO <sub>3</sub>	66	88:12

<sup>a</sup>Yield of isolated product **22** after chromatography, <sup>b</sup>The er value was determined by HPLC analysis of the purified product on a chiral stationary phase.

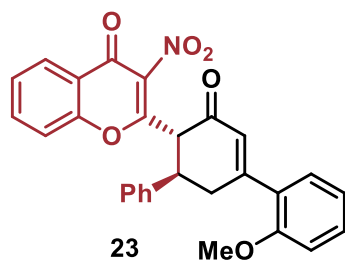


**3-Nitro-2-((3'R,4'R)-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-4H-chromen-4-one (22)**

Yield: 58.8 mg, 65%, yellow foam; **HPLC**: CHIRALPAK AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T = 30 °C; retention time: 14.42 min (major), 29.39 min (minor), e.r.: 94.5:5.5.

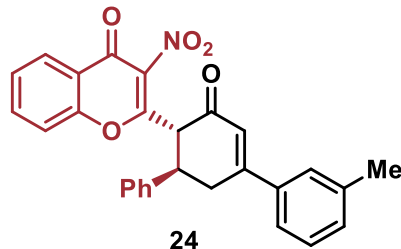
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.19 (d, *J* = 8.0 Hz, 1H), 7.76 – 7.70 (m, 1H), 7.61 (d, *J* = 6.9 Hz, 2H), 7.52-7.42 (m, 5H), 7.35-7.27 (m, 5H), 6.69 (s, 1H), 4.62 (d, *J* = 12.8 Hz, 1H), 4.14-4.03 (m, 4.8 Hz, 1H), 3.32 – 3.15 (m, 2H) ppm; <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) δ 191.9, 167.9, 162.6, 159.3, 155.0, 141.5, 139.5, 137.3, 135.0, 130.9, 129.3 (2C), 129.1 (2C), 128.3, 126.9 (2C), 126.6, 126.4, 126.3 (2C), 123.9, 123.5, 117.9, 55.4, 44.5, 36.9 ppm; **IR (ATR)**: 2925, 2326, 1666, 1614, 1527,

1459, 1372, 1245, 1208, 1135, 1031, 894, 759, 693  $\text{cm}^{-1}$ ; **HRMS (ESI):**  $m/z$   $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{27}\text{H}_{19}\text{NO}_5\text{Na}^+$ : 460.1155; found 460.1147.



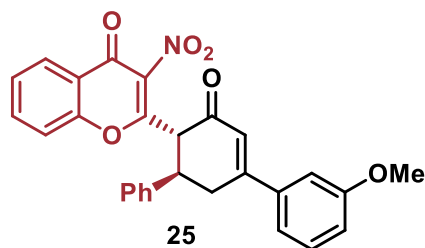
**2-((3'R,4'R)-2-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (23)**

Yield: 58.0 mg, 62%, yellow foam; **HPLC:** CHIRALPAK IB; *n*-heptane/EtOH = 8/2; flow rate 0.7 mL/min; T= 30 °C; retention time: 17.21 min (minor), 20.60 min (major), 95:5 e.r.;  **$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )**  $\delta$  8.16 (d,  $J$  = 7.8 Hz, 1H), 7.75 – 7.71 (m, 1H), 7.52-7.38 (m, 3H), 7.36 – 7.16 (m, 6H), 7.08 – 6.94 (m, 2H), 6.49 (s, 1H), 4.62 (d,  $J$  = 13.0 Hz, 1H), 4.10 – 4.04 (m, 1H), 3.89 (s, 3H), 3.35 – 3.11 (m, 2H) ppm;  **$^{13}\text{C}$  NMR (150 MHz,  $\text{CDCl}_3$ )**  $\delta$  192.0, 167.9, 162.8, 161.0, 156.7, 155.0, 141.5, 139.7, 134.9, 131.2, 129.1 (2C), 128.9, 128.0 (2C), 126.9 (2C), 126.8, 126.5, 126.3, 123.5, 120.9, 117.9, 111.3, 55.7, 55.5, 45.0, 38.5 ppm; **IR (ATR):** 2924, 2328, 1656, 1606, 1532, 1459, 1369, 1295, 1235, 1128, 1028, 891, 755, 697  $\text{cm}^{-1}$ ; **HRMS (ESI):**  $m/z$   $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{28}\text{H}_{21}\text{NO}_6\text{Na}^+$ : 490.1261; found 490.1245.



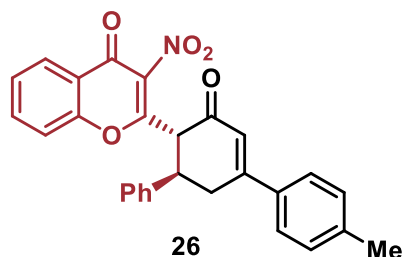
**2-((3'R,4'R)-3-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (24)**

Yield: 54.1 mg, 60%, yellow foam; **HPLC:** CHIRALPAK AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 11.94 min (major), 21.87 min (minor), e.r.: 90.5:9.5;  **$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )**  $\delta$  8.16 – 8.10 (m, 1H), 7.71 – 7.64 (m, 1H), 7.46 – 7.15 (m, 11H), 6.63 (d,  $J$  = 1.7 Hz, 1H), 4.57 (d,  $J$  = 13.1 Hz, 1H), 4.09 – 3.99 (m, 1H), 3.29 – 3.07 (m, 2H), 2.38 (s, 3H) ppm;  **$^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )**  $\delta$  191.8, 167.9, 162.6, 159.5, 155.0, 141.5, 139.5, 138.7, 137.2, 134.9, 131.7, 129.3 (2C), 128.9, 128.2, 126.9, 126.9 (2C), 126.5, 126.4, 123.7, 123.4, 123.4, 55.3, 44.5, 36.9, 21.4 ppm; **IR (ATR):** 2917, 2326, 1671, 1614, 1520, 1461, 1366, 1218, 1142, 1090, 1023, 892, 850, 758, 691  $\text{cm}^{-1}$ ; **HRMS (ESI):**  $m/z$   $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{28}\text{H}_{21}\text{NO}_5\text{Na}^+$ : 474.1312; found 474.1300.



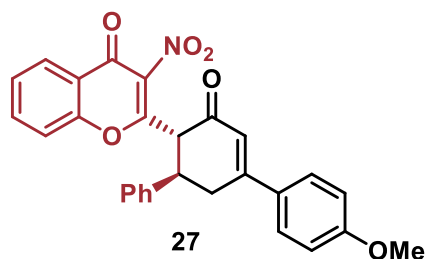
**2-((3'R,4'R)-3-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (25)**

Yield: 53.9 mg, 58%, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 14.80 min (major), 27.72 min (minor), e.r.: 93:7; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.15 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.71 - 7.67 (m, 1H), 7.56 (d, *J* = 8.9 Hz, 2H), 7.45 - 7.38 (m, 2H), 7.30 - 7.26 (m, 4H), 7.24 - 7.19 (m, 1H), 6.95 (d, *J* = 8.9 Hz, 2H), 6.62 (d, *J* = 2.3 Hz, 1H), 4.56 (d, *J* = 13.1 Hz, 1H), 4.06 - 4.00 (m, 1H), 3.86 (s, 3H), 3.24 (dd, *J* = 18.1, 4.4 Hz, 1H), 3.15 - 3.12 (m, 1H) ppm; **<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** δ 191.8, 167.9, 162.5, 160.0, 159.2, 155.0, 141.5, 139.4, 138.7, 134.9, 130.0, 129.3 (2C), 128.2, 126.9 (2C), 126.5, 126.4, 124.0, 123.5, 118.7, 117.8, 116.4, 111.8, 55.4, 55.4, 44.4, 36.9 ppm; **IR (ATR)**: 2923, 2324, 1741, 1657, 1607, 1526, 1460, 1526, 1460, 1368, 1264, 1207, 1136, 1094, 1035, 891, 846, 761, 695 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>21</sub>NO<sub>6</sub>Na<sup>+</sup>: 490.1261; found 490.1254.



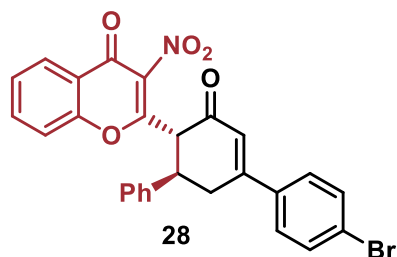
**2-((3'R,4'R)-4-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (26)**

Yield: 63.2 mg, 70%, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 12.42 min (major), 23.95 min (minor), e.r.: 90.5:9.5; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 8.16 - 8.10 (m, 1H), 7.71 - 7.65 (m, 1H), 7.50 - 7.36 (m, 4H), 7.31 - 7.16 (m, 7H), 6.63 (d, *J* = 1.8 Hz, 1H), 4.56 (d, *J* = 13.1 Hz, 1H), 4.08 - 3.99 (m, 1H), 3.27 - 3.08 (m, 2H), 2.38 (s, 3H) ppm; **<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** δ 191.8, 167.9, 162.6, 159.2, 155.0, 141.5, 141.5, 139.5, 134.9, 134.2, 129.7 (2C), 129.2 (2C), 128.2, 126.9 (2C), 126.5, 126.3, 126.2 (2C), 123.5, 123.0, 117.8, 55.3, 44.4, 36.7, 21.4 ppm; **IR (ATR)**: 2920, 2323, 1665, 1603, 1527, 1460, 1367, 1247, 1138, 1024, 893, 809, 758, 695 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>21</sub>NO<sub>5</sub>Na<sup>+</sup>: 474.1312; found 474.1298.



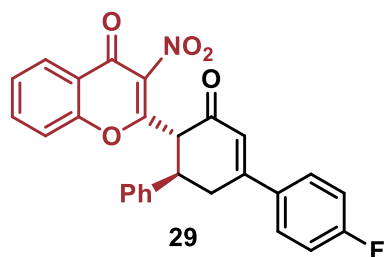
**2-((3'R,4'R)-4-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (27)**

Yield: 42.0 mg, 45% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 17.80 min (major), 33.00 min (minor), e.r.: 88.5:11.5; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 8.17 – 8.11 (m, 1H), 7.72 – 7.64 (m, 1H), 7.55 (d, *J* = 8.9 Hz, 2H), 7.43 – 7.37 (m, 2H), 7.29 – 7.18 (m, 5H), 6.93 (d, *J* = 8.9 Hz, 2H), 6.61 (d, *J* = 2.0 Hz, 1H), 4.55 (d, *J* = 13.1 Hz, 1H), 4.07 – 3.96 (m, 1H), 3.84 (s, 3H), 3.23 (dd, *J* = 18.1, 4.5 Hz, 1H), 3.15 – 3.06 (m, 1H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.7, 167.9, 162.7, 162.0, 158.5, 155.0, 141.5, 139.6, 134.9, 129.2 (2C), 129.2, 128.1, 128.0 (2C), 126.9 (2C), 126.6, 126.3, 123.5, 121.9, 117.8, 114.4 (2C), 55.4, 55.2, 44.4, 36.6 ppm; **IR (ATR)**: 2925, 2301, 1741, 1662, 1596, 1520, 1459, 1366, 1236, 1184, 1027, 893, 823, 761, 694 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>28</sub>H<sub>21</sub>NO<sub>6</sub>Na<sup>+</sup>: 490.1261; found 490.1255.



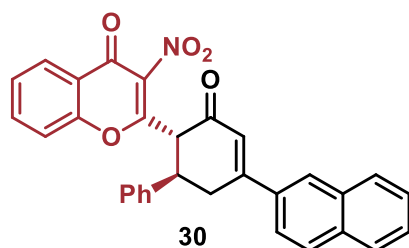
**2-((3'R,4'R)-4-Bromo-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (28)**

Yield: 43.3 mg, 42% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 14.37 min (major), 22.88 min (minor), e.r.: 89.5:10.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.16 (d, *J* = 8.0 Hz, 1H), 7.72 – 7.67 (m, 1H), 7.58 (d, *J* = 8.4 Hz, 2H), 7.48 – 7.39 (m, 4H), 7.31 – 7.25 (m, 4H), 7.23 – 7.19 (m, 1H), 6.63 (s, 1H), 4.58 (d, *J* = 13.2 Hz, 1H), 4.08 – 4.02 (m, 1H), 3.21 – 3.12 (m, 2H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.7, 167.9, 162.3, 157.8, 154.9, 141.4, 139.2, 136.1, 135.0, 132.3 (2C), 129.3 (2C), 128.3, 127.7 (2C), 126.8 (2C), 126.6, 126.4, 125.5, 124.1, 123.5, 117.8, 55.3, 44.3, 36.7 ppm; **IR (ATR)**: 2921, 2086, 1740, 1663, 1609, 1525, 1459, 1373, 1216, 1138, 1072, 1006, 892, 809, 754, 688 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>27</sub>H<sub>18</sub>NO<sub>5</sub>BrNa<sup>+</sup>: 538.0261; found 538.0258.



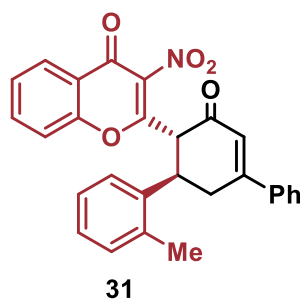
**2-((3'R,4'R)-4-Fluoro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (29)**

Yield: 39.1 mg, 43% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 14.47 min (major), 30.29 min (minor), e.r.: 89.5:10.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.16 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.72 - 7.68 (m, 1H), 7.61 - 7.55 (m, 2H), 7.45 - 7.40 (m, 2H), 7.31 - 7.25 (m, 4H), 7.23 - 7.19 (m, 1H), 7.16 - 7.12 (m, 2H), 6.61 (d, *J* = 1.9 Hz, 1H), 4.58 (d, *J* = 13.2 Hz, 1H), 4.00 - 4.01 (m, 1H), 3.24 - 3.11 (m, 2H); **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.7, 167.9, 165.1, 163.5, 162.4, 157.9, 155.0, 141.5, 139.3, 135.0, 133.3 (d, *J* = 3.0 Hz), 129.3 (2C), 128.4, 128.3, 128.3, 126.8 (2C), 126.6, 126.4, 123.5, 123.7, 117.8, 116.2 (d, *J* = 21.0 Hz), 55.2, 44.4, 36.9 ppm; **IR (ATR)**: 2922, 2322, 1739, 1667, 1599, 1523, 1460, 1366, 1227, 1155, 1092, 1018, 967, 897, 831, 798, 758, 697 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>27</sub>H<sub>18</sub>NO<sub>5</sub>FNa<sup>+</sup>: 478.1061; found 478.1053.



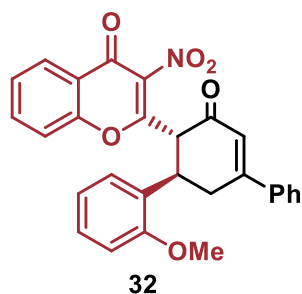
**2-((1R,2R)-5-(Naphthalen-2-yl)-3-oxo-1,2,3,6-tetrahydro-[1,1'-biphenyl]-2-yl)-3-nitro-4H-chromen-4-one (30)**

Yield: 58.0 mg, 60% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 14.19 min (major), 20.70 min (minor), e.r.: 94:6; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.15 (dd, *J* = 8.0, 1.6 Hz, 1H), 8.06 - 8.03 (m, 1H), 7.92 - 7.82 (m, 3H), 7.73 - 7.67 (m, 2H), 7.59 - 7.52 (m, 2H), 7.47 - 7.39 (m, 2H), 7.35 - 7.28 (m, 4H), 7.25 - 7.22 (m, 1H), 6.81 (d, *J* = 2.3 Hz, 1H), 4.64 (d, *J* = 13.2 Hz, 1H), 4.15 - 4.09 (m, 1H), 3.40 (dd, *J* = 18.1, 4.4 Hz, 1H), 3.30 - 3.24 (m, 1H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.9, 167.9, 162.6, 158.8, 155.0, 141.5, 139.5, 135.0, 134.3, 134.3, 133.0, 129.3 (2C), 128.9, 128.8, 128.3, 127.8, 127.7, 127.0, 126.9 (2C), 126.8, 126.6, 126.4, 124.0, 123.5, 123.0, 117.9, 55.4, 44.5, 36.8 ppm; **IR (ATR)**: 2924, 2288, 1741, 1663, 1603, 1524, 1459, 1372, 1276, 1230, 1135, 1024, 894, 846, 800, 757, 695 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+Na]<sup>+</sup> calcd for C<sub>31</sub>H<sub>21</sub>NO<sub>5</sub>Na<sup>+</sup>: 510.1312; found 510.1305.



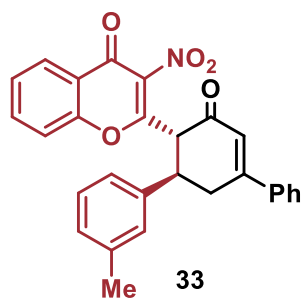
**2-((3'R,4'R)-2''-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (31)**

Yield: 49.8 mg, 55% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 11.70 min (major), 27.47 min (minor), e.r.: 93:7; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 8.13 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.71 – 7.64 (m, 1H), 7.58 – 7.54 (m, 2H), 7.46 – 7.35 (m, 6H), 7.23 – 7.19 (m, 1H), 7.11 – 7.02 (m, 2H), 6.65 (d, *J* = 2.2 Hz, 1H), 4.71 (d, *J* = 13.2 Hz, 1H), 4.41 – 4.32 (m, 1H), 3.18 – 3.00 (m, 2H), 2.38 (s, 3H) ppm; **<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** δ 192.2, 167.8, 162.6, 159.1, 154.9, 141.5, 137.5, 137.2, 135.0, 134.9, 131.0, 130.9, 129.0 (2C), 127.7, 127.2, 126.6, 126.4, 126.2 (2C), 125.6, 123.7, 123.5, 117.7, 54.7, 38.9, 36.7, 19.4 ppm; **IR (ATR)**: 2929, 2100, 1734, 1663, 1616, 1525, 1461, 1367, 1213, 1138, 1100, 1026, 894, 757, 693 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>28</sub>H<sub>22</sub>NO<sub>5</sub><sup>+</sup>: 452.1493; found 452.1495.



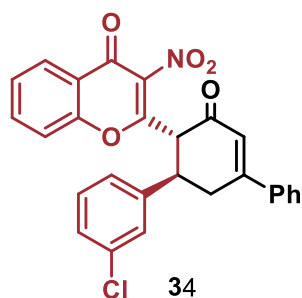
**2-((3'R,4'R)-2''-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (32)**

Yield: 56.0 mg, 60% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 11.99 min (major), 17.32 min (minor), e.r.: 95:5; **<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 8.17 (d, *J* = 7.8 Hz, 1H), 7.74 – 7.70 (m, 1H), 7.64-7.59 (m, 2H), 7.50 - 7.40 (m, 5H), 7.24 – 7.10 (m, 2H), 6.90 – 6.75 (m, 2H), 6.67 (s, 1H), 5.13 (d, *J* = 12.7 Hz, 1H), 4.21 (d, *J* = 9.7 Hz, 1H), 3.83 (s, 3H), 3.66 – 3.52 (m, 1H), 3.11 (d, *J* = 18.0 Hz, 1H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 193.0, 168.1, 163.5, 160.4, 157.6, 155.1, 141.5, 137.7, 134.8, 130.7, 129.5, 129.0 (2C), 126.5, 126.5, 126.3 (2C), 126.2, 123.8, 123.5, 121.0, 117.9, 111.3, 54.9 (2C), 53.3, 33.8 ppm; **IR (ATR)**: 2925, 2326, 1740, 1661, 1612, 1524, 1459, 1366, 1236, 1136, 1017, 879, 795, 753, 694 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+K]<sup>+</sup> calcd for C<sub>28</sub>H<sub>21</sub>NO<sub>6</sub>K<sup>+</sup>: 506.1001; found 506.0997.



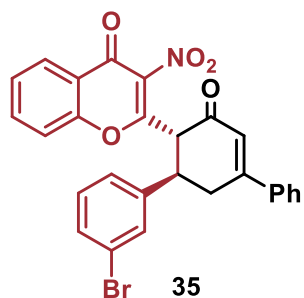
**2-((3'*R*,4'*R*)-3''-Methyl-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (33)**

Yield: 63.1 mg, 45% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 11.92 min (major), 19.53 min (minor), e.r.: 95:5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.15 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.72 – 7.68 (m, 1H), 7.59 – 7.56 (m, 2H), 7.48 – 7.40 (m, 5H), 7.15 – 7.09 (m, 2H), 7.03 (dd, *J* = 19.9, 7.6 Hz, 2H), 6.65 (d, *J* = 2.2 Hz, 1H), 4.59 (d, *J* = 13.2 Hz, 1H), 4.05 – 3.99 (m, 1H), 3.26 – 3.14 (m, 2H), 2.26 (s, 3H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 192.0, 167.9, 162.7, 159.4, 155.0, 141.5, 139.4, 139.1, 137.3, 134.9, 130.9, 129.1, 129.0, 129.0 (2C), 127.4, 126.5, 126.4, 126.3 (2C), 124.1, 123.8, 123.5, 117.9, 55.3, 44.4, 37.0, 21.4 ppm; **IR (ATR)**: 2928, 2086, 1740, 1664, 1611, 1528, 1461, 1375, 1210, 1138, 1041, 964, 884, 763, 693 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+K]<sup>+</sup> calcd for C<sub>28</sub>H<sub>21</sub>NO<sub>5</sub>K<sup>+</sup>: 490.1051; found 490.1035.



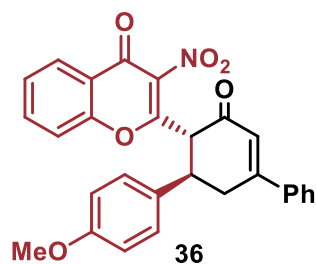
**2-((3'*R*,4'*R*)-3''-Chloro-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (34)**

Yield: 47.4 mg, 50% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 14.97 min (major), 26.42 min (minor), e.r.: 93.5:6.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.19 (dd, *J* = 7.9, 1.3 Hz, 1H), 7.74 – 7.70 (m, 1H), 7.58 (dd, *J* = 8.0, 1.4 Hz, 2H), 7.50 – 7.41 (m, 5H), 7.33 – 7.29 (m, 1H), 7.25 – 7.17 (m, 3H), 6.66 (d, *J* = 2.2 Hz, 1H), 4.55 (d, *J* = 13.2 Hz, 1H), 4.08 – 4.01 (m, 1H), 3.27 – 3.12 (m, 2H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.4, 167.9, 162.0, 159.1, 155.0, 141.5, 141.4, 137.0, 135.1, 135.0, 131.1, 130.6, 129.1 (2C), 128.5, 127.4, 126.6, 126.5, 126.3 (2C), 124.9, 123.8, 123.5, 117.9, 54.9, 44.0, 36.7 ppm; **IR (ATR)**: 2923, 2084, 1664, 1608, 1573, 1527, 1462, 1368, 1302, 1246, 1200, 1136, 1102, 1028, 969, 907, 882, 794, 763, 691 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>27</sub>H<sub>19</sub>NO<sub>5</sub>Cl<sup>+</sup>: 472.0946; found 472.0949.



**2-((3'*R*,4'*R*)-3''-Bromo-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (35)**

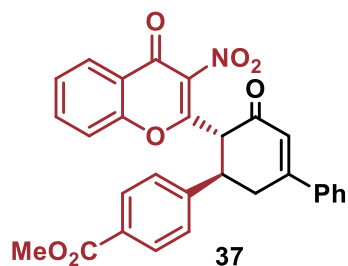
Yield: 53.4 mg, 51% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 16.14 min (major), 27.30 min (minor), e.r.: 88.5:11.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.17 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.75 – 7.70 (m, 1H), 7.59 – 7.55 (m, 2H), 7.50 – 7.42 (m, 6H), 7.35 (d, *J* = 8.1 Hz, 1H), 7.27 – 7.22 (m, 1H), 7.18 – 7.14 (m, 1H), 6.65 (d, *J* = 2.2 Hz, 1H), 4.55 (d, *J* = 13.2 Hz, 1H), 4.06 – 4.02 (m, 1H), 3.27 – 3.12 (m, 2H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.3, 167.8, 161.9, 159.1, 155.0, 141.7, 141.5, 137.0, 135.1, 131.4, 131.0, 130.9, 130.4, 129.1 (2C), 126.6, 126.5, 126.3, 125.4 (2C), 123.8, 123.5, 123.2, 117.8, 54.9, 44.0, 36.7 ppm; **IR (ATR)**: 2922, 2082, 1663, 1624, 1572, 1520, 1461, 1383, 1360, 1315, 1269, 1244, 1196, 1134, 1071, 1029, 997, 908, 882, 795, 765, 726, 690 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>27</sub>H<sub>19</sub>NO<sub>5</sub>Br<sup>+</sup>: 516.0441; found 516.0443.



**2-((3'*R*,4'*R*)-4''-Methoxy-5'-oxo-2',3',4',5'-tetrahydro-[1,1':3',1''-terphenyl]-4'-yl)-3-nitro-4H-chromen-4-one (36)**

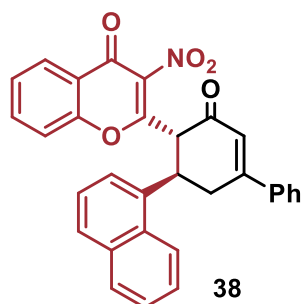
Yield: 49.0 mg, 52% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 19.75 min (major), 38.68 min (minor), e.r.: 88:12; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.16 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.72 – 6.69 (m, 1H), 7.59 – 7.56 (m, 2H), 7.49 – 7.41 (m, 5H), 7.20 (d, *J* = 8.7 Hz, 2H), 6.79 (d, *J* = 8.7 Hz, 2H), 6.65 (d, *J* = 2.2 Hz, 1H), 4.54 (d, *J* = 13.2 Hz, 1H), 4.03 – 3.98 (m, 1H), 3.72 (s, 3H), 3.24 – 3.11 (m, 2H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 192.0, 159.4, 159.2, 155.0, 137.3, 135.0, 131.4, 130.9, 129.0, 128.0, 126.6, 126.4, 126.3, 123.9, 117.9, 114.6, 55.6, 55.2, 43.8, 37.1 ppm; **IR (ATR)**: 2916, 2108, 1665, 1605, 1518, 1462, 1360, 1308, 1251, 1183, 1135, 1106, 1061, 1032, 929, 891, 856, 825, 797, 756, 689, 660 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>28</sub>H<sub>22</sub>NO<sub>6</sub><sup>+</sup>: 468.1442; found 468.1441.





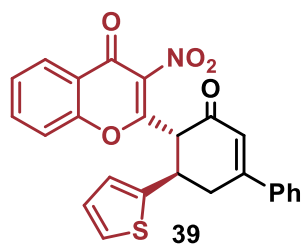
**Methyl (1'*R*,6'*R*)-6'-(3-nitro-4-oxo-4H-chromen-2-yl)-5'-oxo-1',2',5',6'-tetrahydro-[1,1':3,1''-terphenyl]-4-carboxylate (5q)**

Yield: 51.0 mg, 51% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 21.48 min (major), 45.33 min (minor), e.r.: 100:0; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.16 (d, *J* = 7.9 Hz, 1H), 7.95 (d, *J* = 8.3 Hz, 2H), 7.73 – 7.67 (m, 1H), 7.58 (d, *J* = 6.7 Hz, 2H), 7.50 – 7.35 (m, 7H), 6.66 (d, *J* = 1.7 Hz, 1H), 4.60 (d, *J* = 13.1 Hz, 1H), 4.17 – 4.11 (m, 1H), 3.86 (s, 3H), 3.28 – 3.14 (m, 2H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.3, 167.7, 166.3, 161.8, 159.0, 154.9, 144.4, 141.5, 137.1, 135.1, 131.0, 130.6 (2C), 130.1, 129.1 (2C), 127.1 (2C), 126.6, 126.5, 126.3 (2C), 123.9, 123.5, 117.8, 54.9, 52.2, 44.3, 36.5 ppm; **IR (ATR)**: 2923, 2085, 1718, 1662, 1609, 1576, 1529, 1462, 1374, 1279, 1248, 1198, 1106, 1024, 967, 900, 860, 796, 759, 695 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>29</sub>H<sub>22</sub>NO<sub>7</sub><sup>+</sup>: 496.1391; found 496.1393.



**2-((3*R*,4*R*)-3-(Naphthalen-1-yl)-5-oxo-2,3,4,5-tetrahydro-[1,1'-biphenyl]-4-yl)-3-nitro-4H-chromen-4-one (38)**

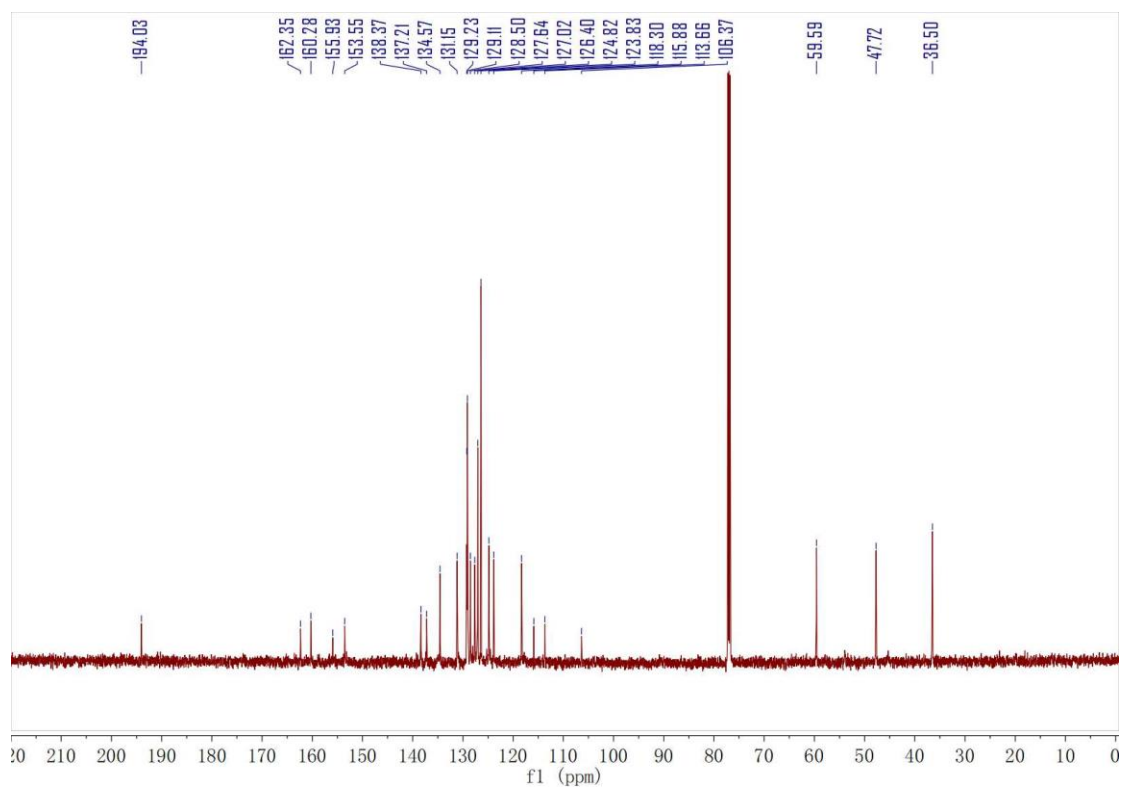
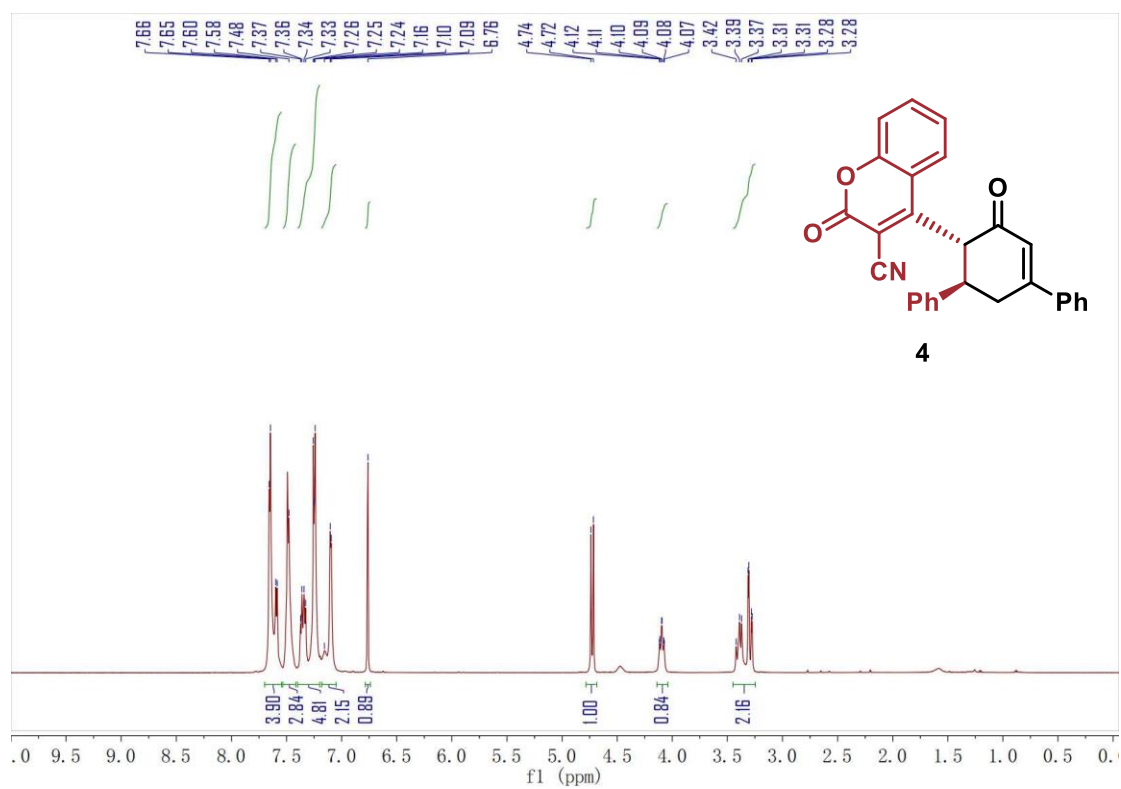
Yield: 54.0 mg, 55% yield, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 16.02 min (major), 35.01 min (minor), e.r.: 95.5:4.5; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.23 (d, *J* = 8.6 Hz, 1H), 8.09 – 8.04 (m, 1H), 7.81 (d, *J* = 8.1 Hz, 1H), 7.73 (d, *J* = 8.2 Hz, 1H), 7.65 (d, *J* = 7.2 Hz, 1H), 7.58 (d, *J* = 7.1 Hz, 2H), 7.55 – 7.41 (m, 7H), 7.31 – 7.28 (m, 1H), 7.16 (d, *J* = 8.5 Hz, 1H), 6.74 (d, *J* = 2.2 Hz, 1H), 5.08 – 5.03 (m, 1H), 4.90 (d, *J* = 13.1 Hz, 1H), 3.38 (dd, *J* = 18.4, 4.2 Hz, 1H), 3.25 – 3.13 (m, 1H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 192.2, 167.8, 162.4, 159.3, 154.7, 141.5, 137.1, 135.7, 134.7, 134.0, 131.0, 130.7, 129.4, 129.1 (2C), 128.4, 126.6, 126.4, 126.3 (2C), 126.2, 125.9, 125.8, 123.8, 123.7, 123.4, 121.5, 117.8, 54.9, 37.5, 37.3 ppm; **IR (ATR)**: 2924, 2108, 1662, 1611, 1575, 1465, 1376, 1299, 1240, 1202, 1138, 1104, 1030, 917, 860, 782, 758, 729, 695 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>31</sub>H<sub>22</sub>NO<sub>5</sub><sup>+</sup>: 488.1493; found 488.1450.

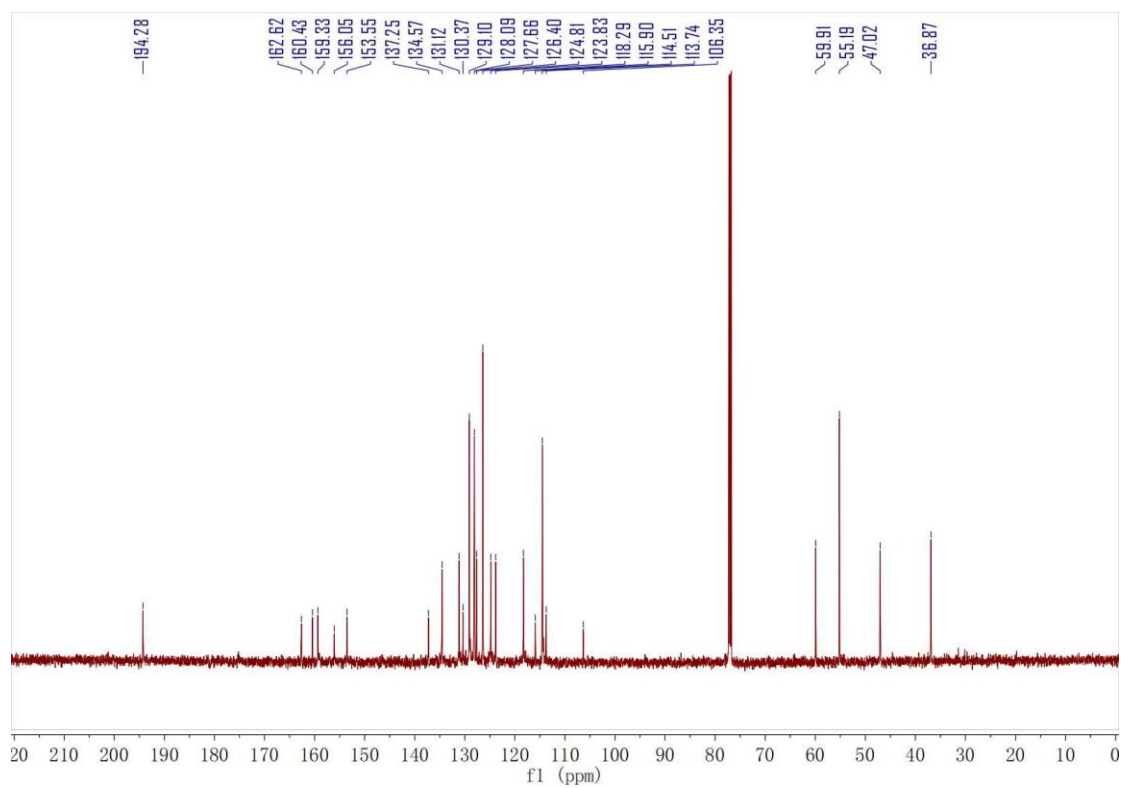
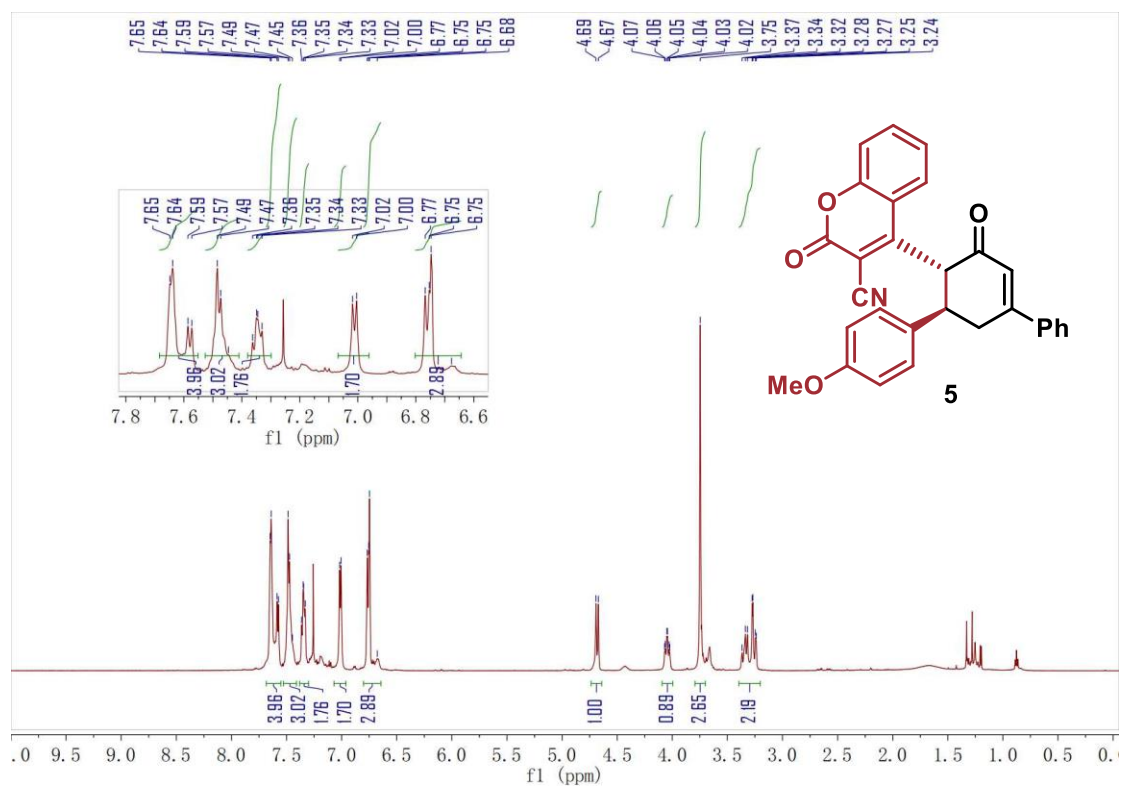


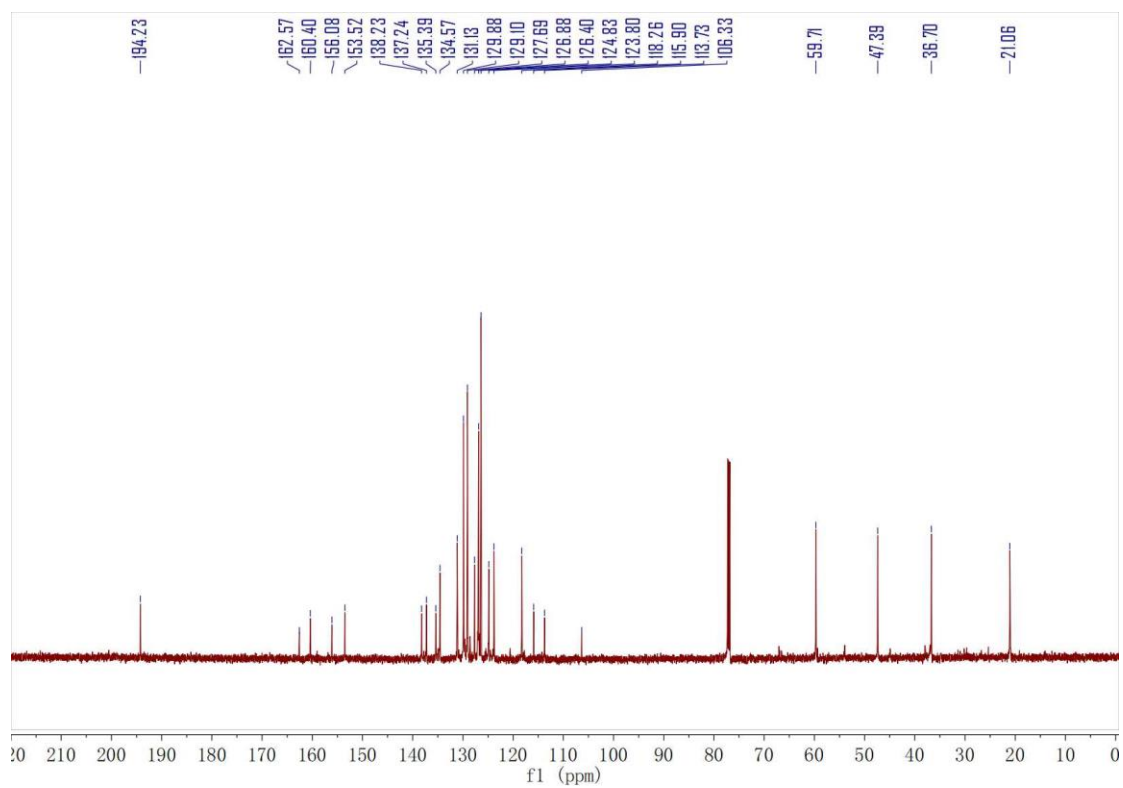
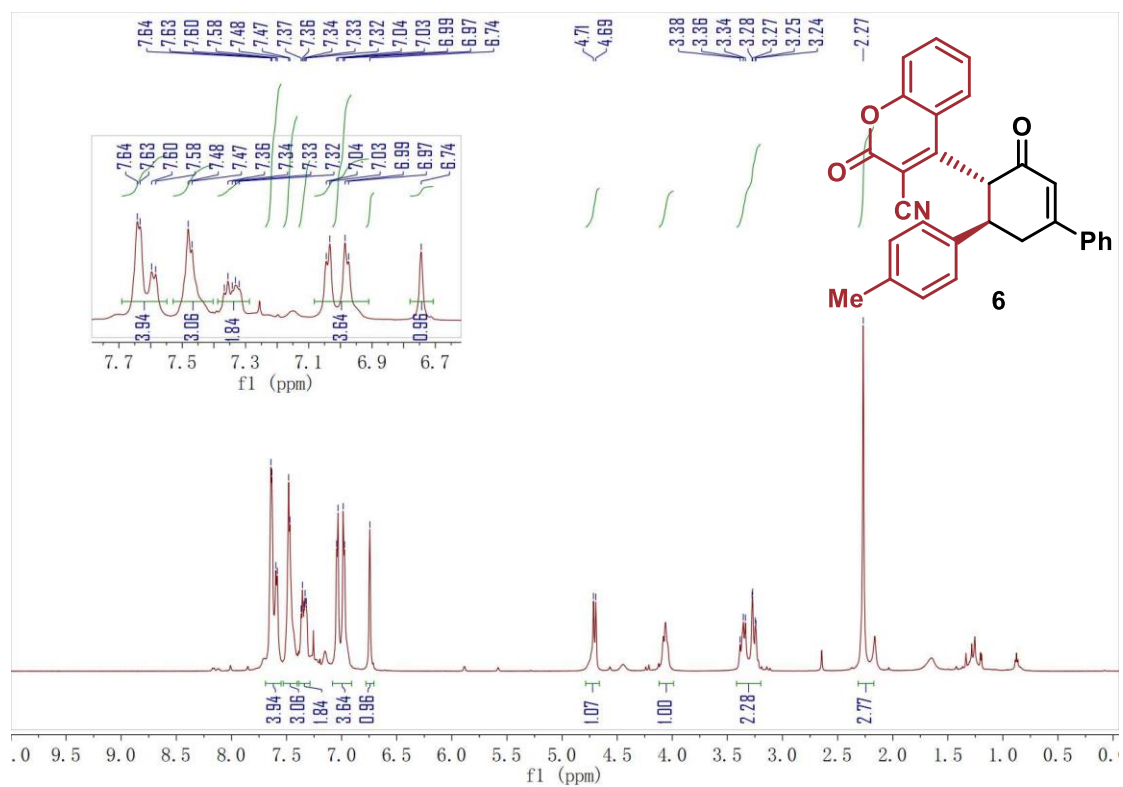
**3-Nitro-2-((3*R*,4*R*)-5-oxo-3-(thiophen-2-yl)-2,3,4,5-tetrahydro-[1,1'-biphenyl]-4-yl)-4H-chromen-4-one (39)**

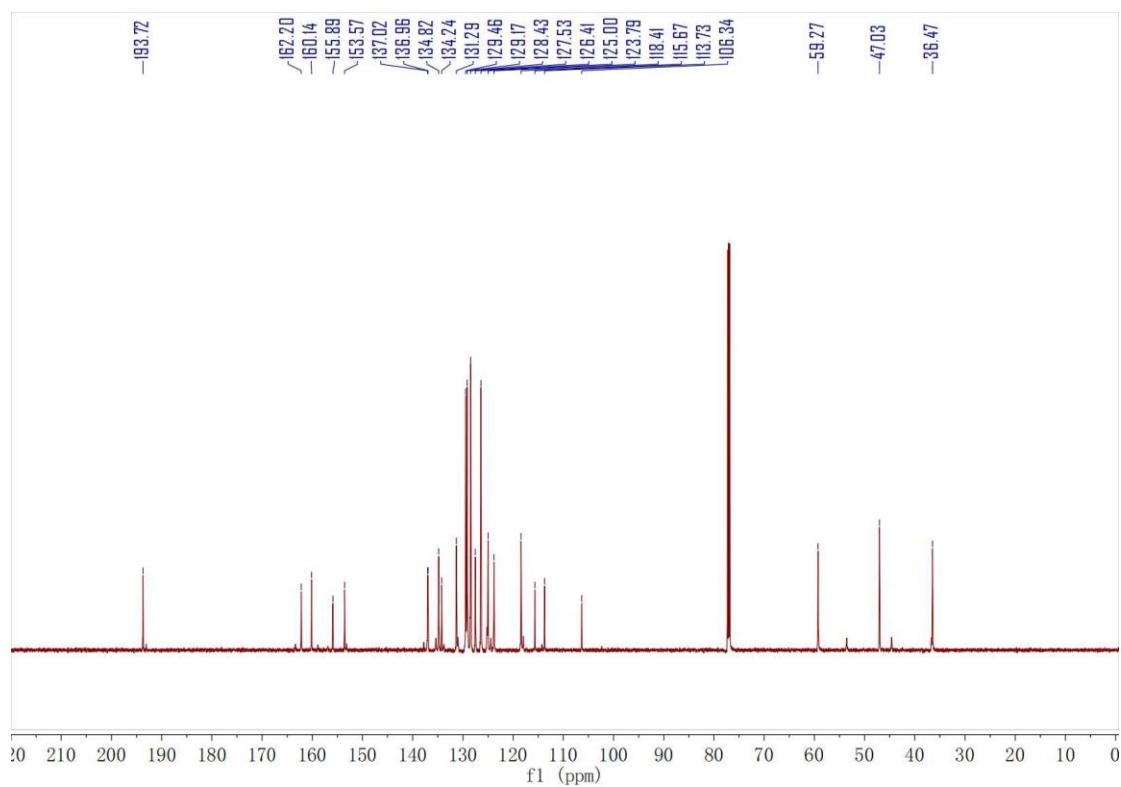
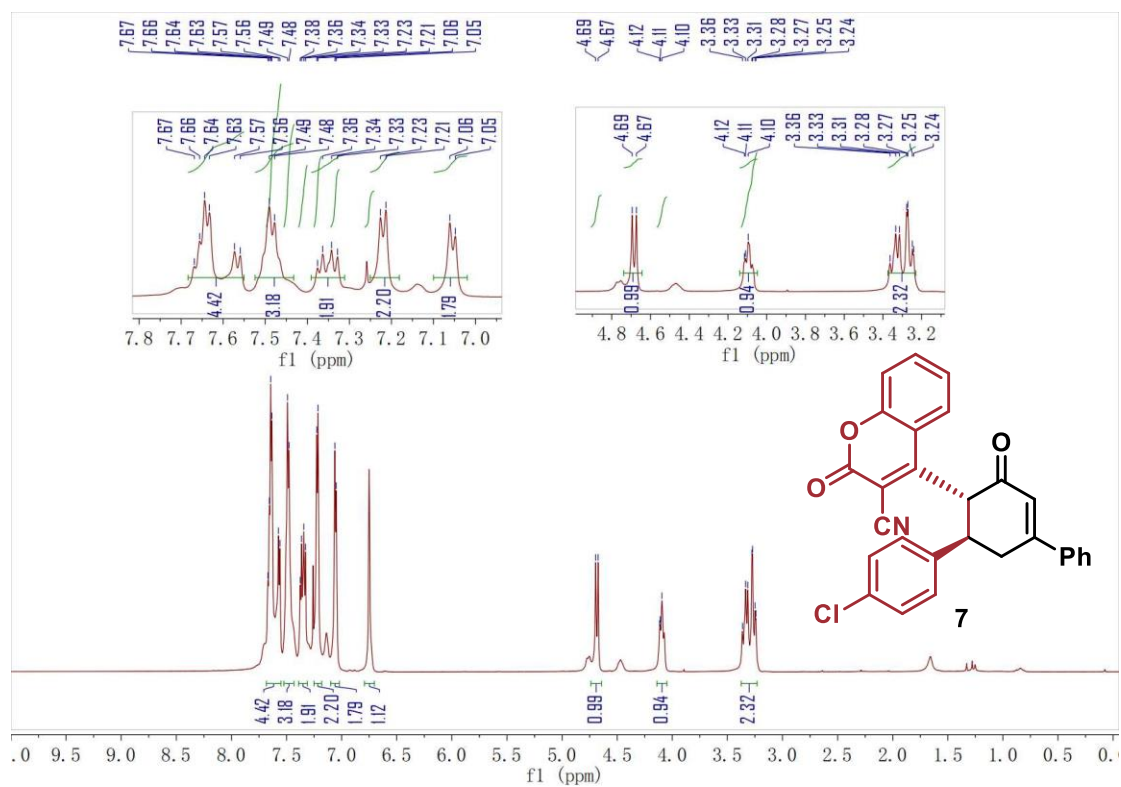
Yield: 44.3 mg, 50%, yellow foam; **HPLC**: CHIRALPA1K AS; *n*-heptane/EtOH = 7/3; flow rate 0.7 mL/min; T= 30 °C; retention time: 16.21 min (major), 34.64 min (minor), e.r.: 87:13; **<sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>)** δ 8.21 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.76 – 7.72 (m, 1H), 7.59 (dd, *J* = 7.9, 1.5 Hz, 2H), 7.51 – 7.44 (m, 5H), 7.15 – 7.12 (m, 1H), 6.93 (d, *J* = 3.2 Hz, 1H), 6.86 (dd, *J* = 5.0, 3.6 Hz, 1H), 6.66 (d, *J* = 2.3 Hz, 1H), 4.47 (d, *J* = 12.9 Hz, 1H), 4.38 (td, *J* = 12.7, 12.1, 4.2 Hz, 1H), 3.39 (dd, *J* = 18.1, 4.3 Hz, 1H), 3.27 – 3.25 (m, 1H) ppm; **<sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>)** δ 191.2, 167.9, 162.4, 159.1, 155.0, 142.5, 141.5, 137.1, 135.0, 131.0, 129.1 (2C), 127.4, 126.7, 126.5, 126.3 (2C), 124.9, 124.8, 124.1, 123.6, 118.0, 57.1, 39.4, 37.5 ppm; **IR (ATR)**: 2922, 2084, 1739, 1660, 1607, 1574, 1526, 1461, 1363, 1296, 1252, 1201, 1133, 1027, 876, 794, 758, 717, 688 cm<sup>-1</sup>; **HRMS (ESI)**: *m/z* [M+H]<sup>+</sup> calcd for C<sub>25</sub>H<sub>18</sub>NO<sub>5</sub>S<sup>+</sup>: 444.0900; found 444.0891.

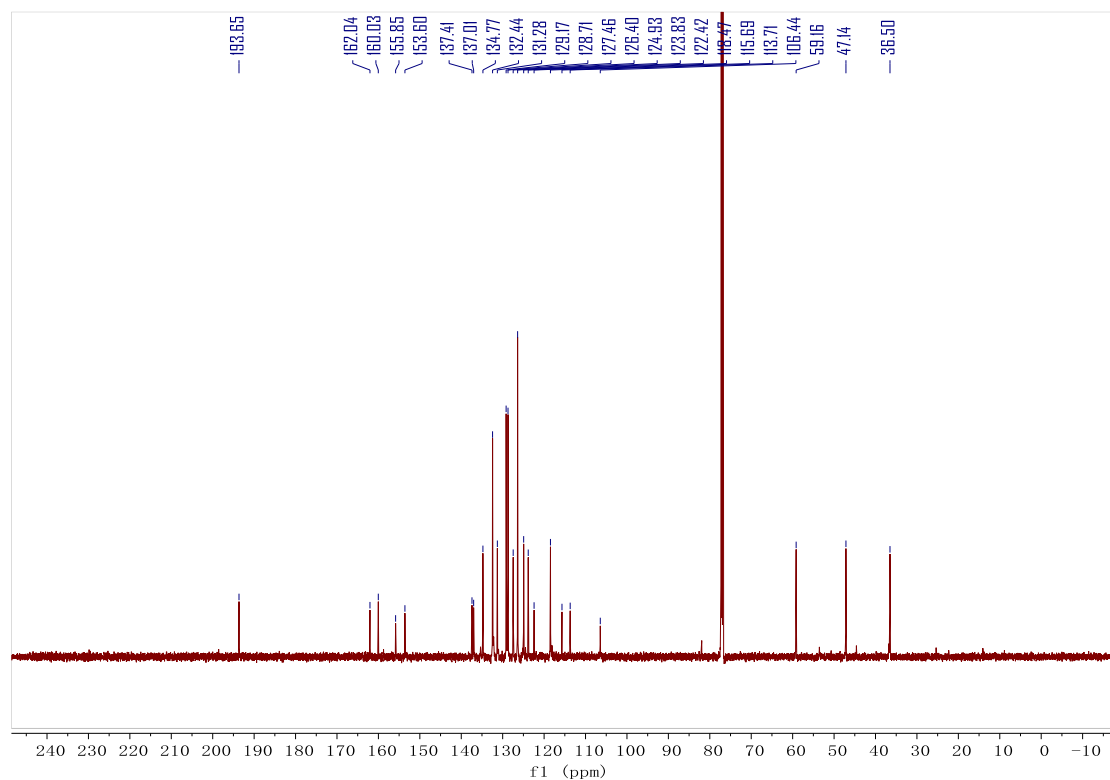
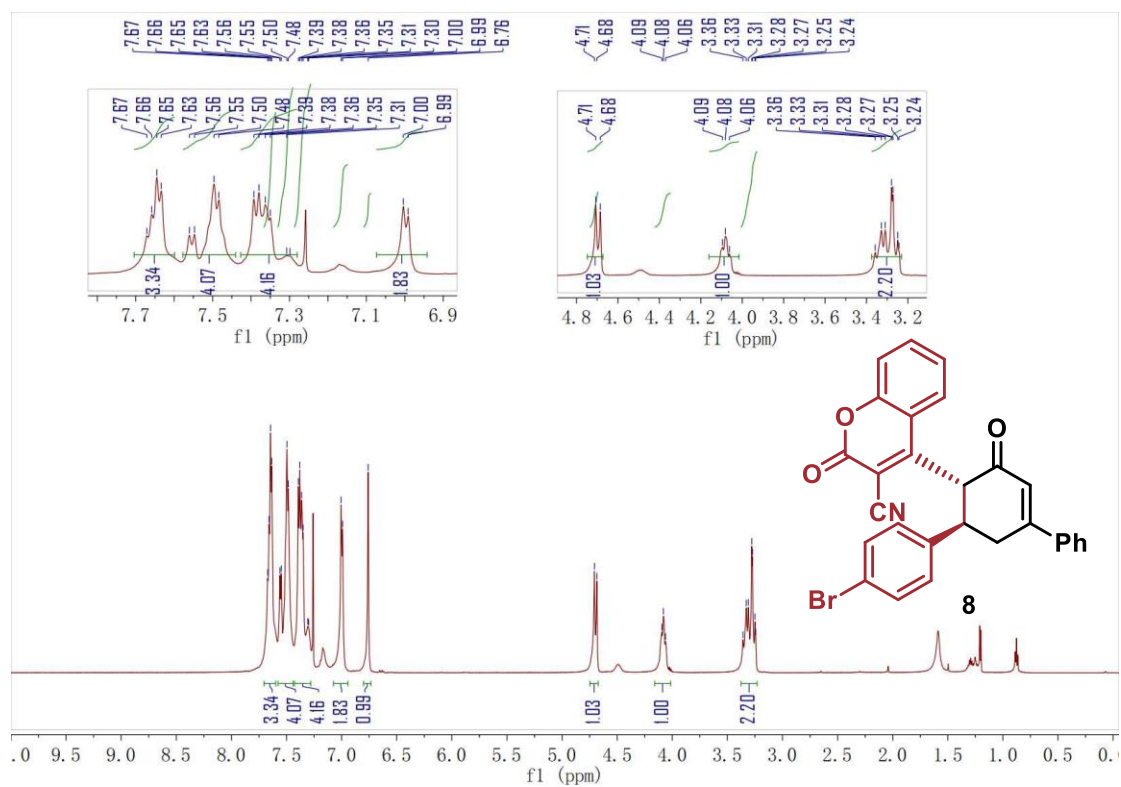
## 4 NMR Spectra

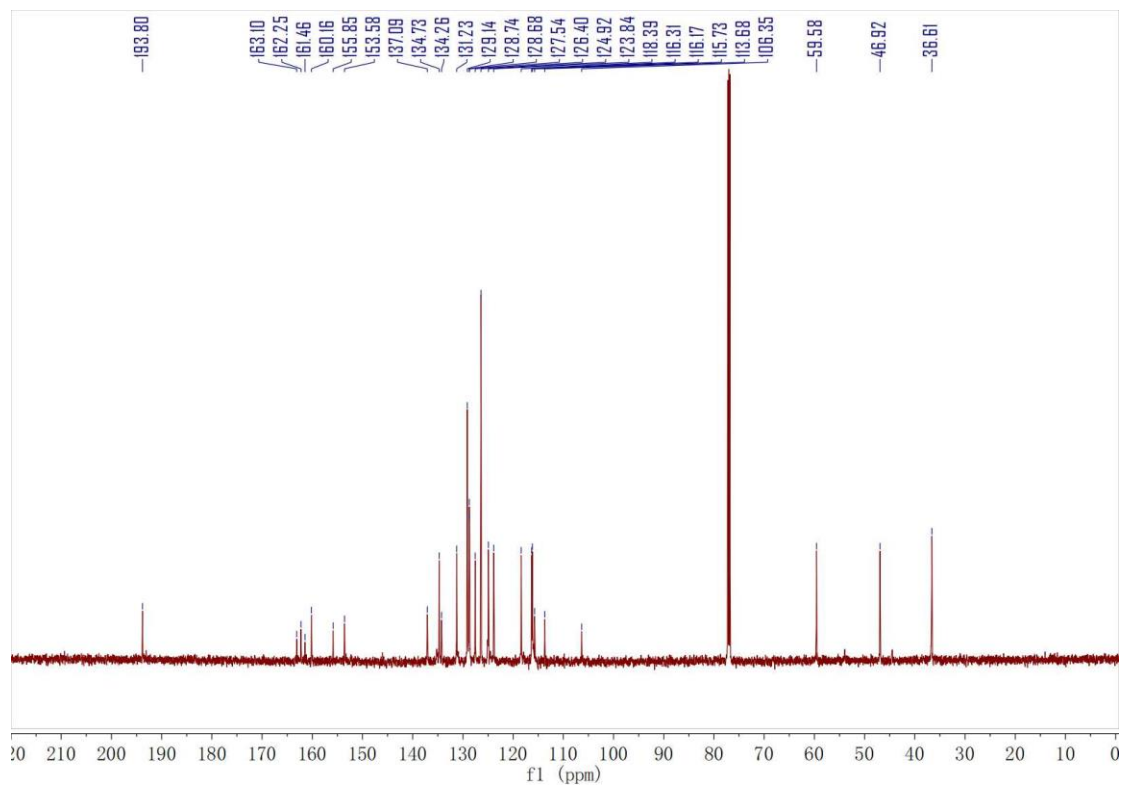
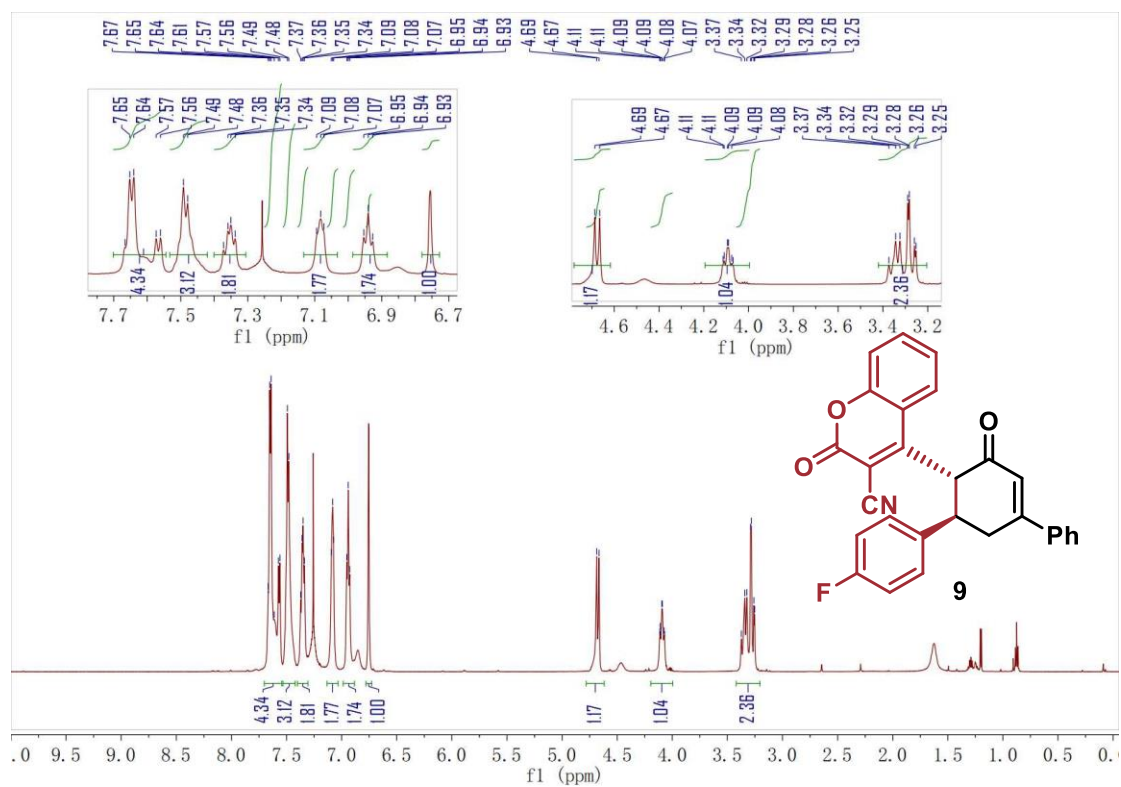




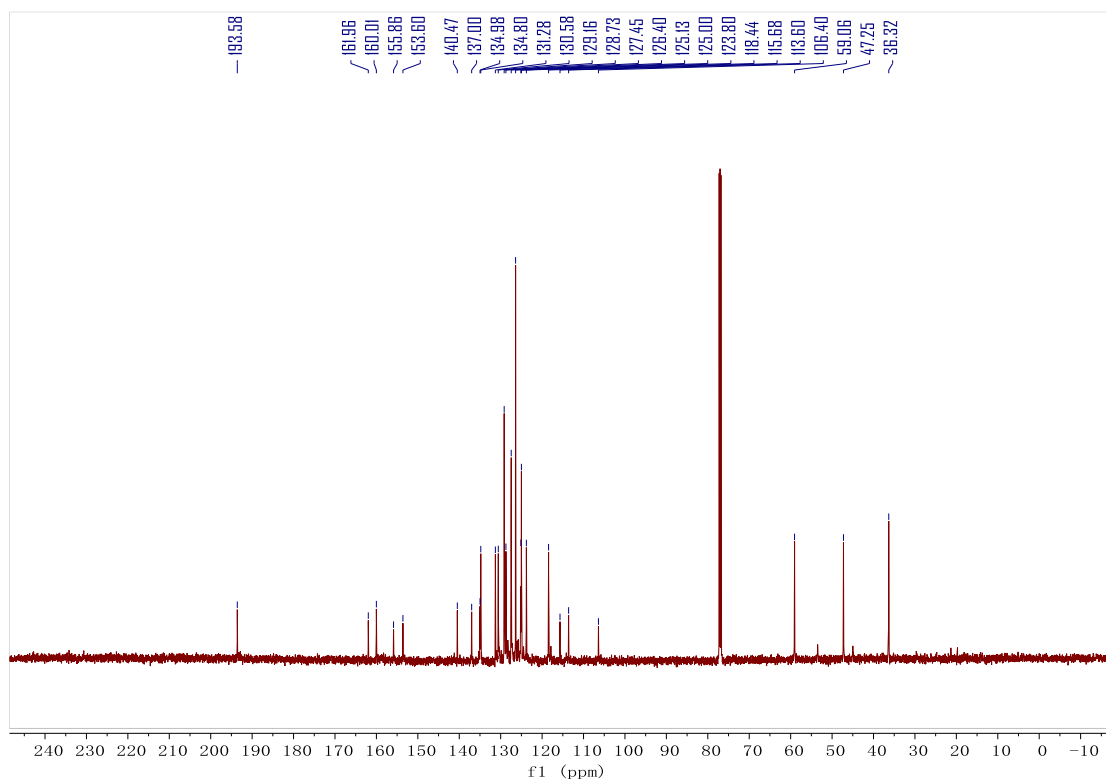
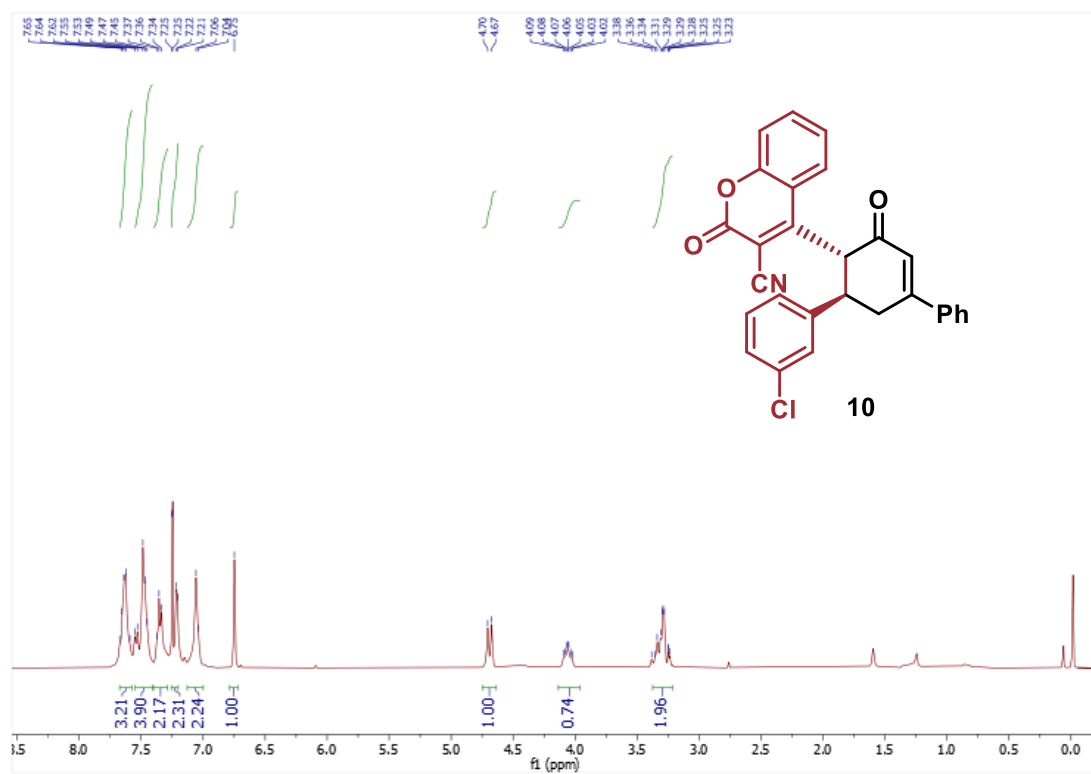


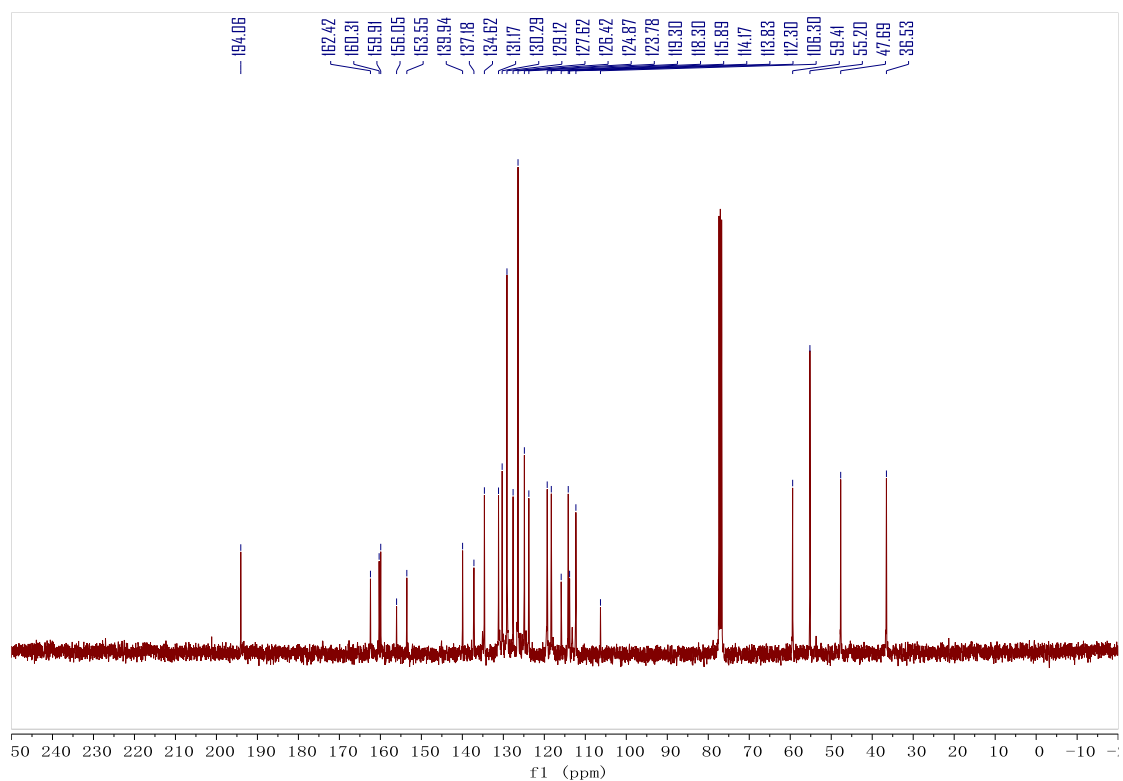
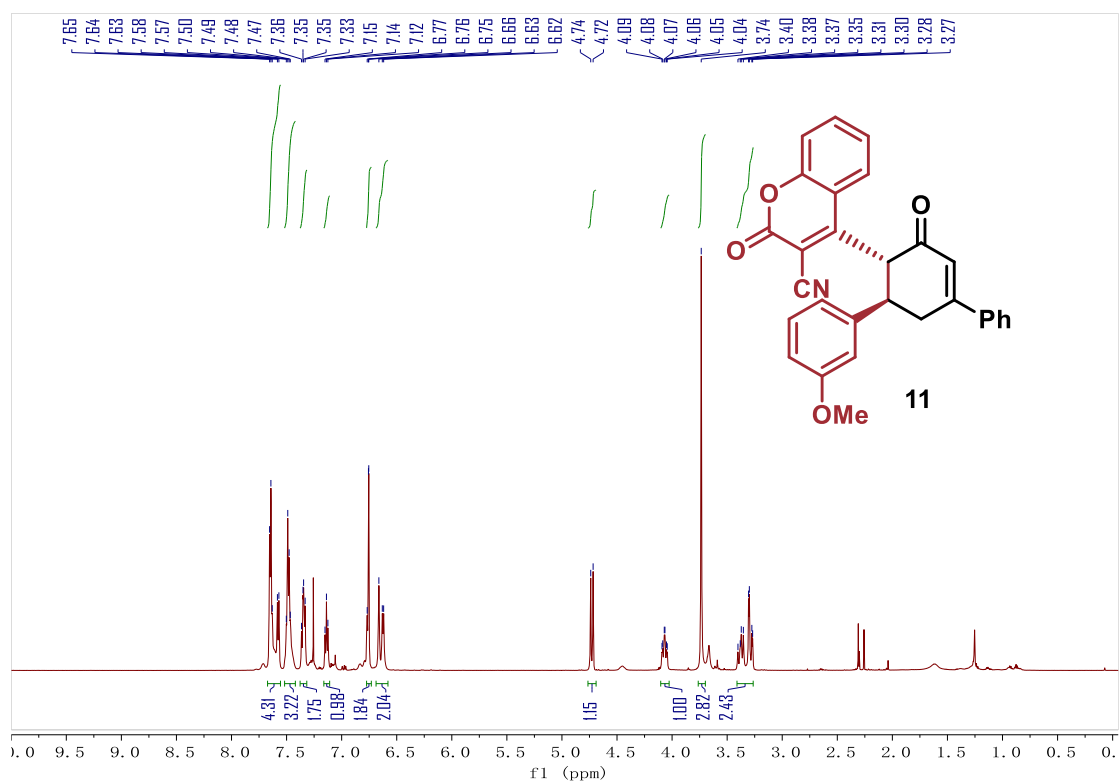


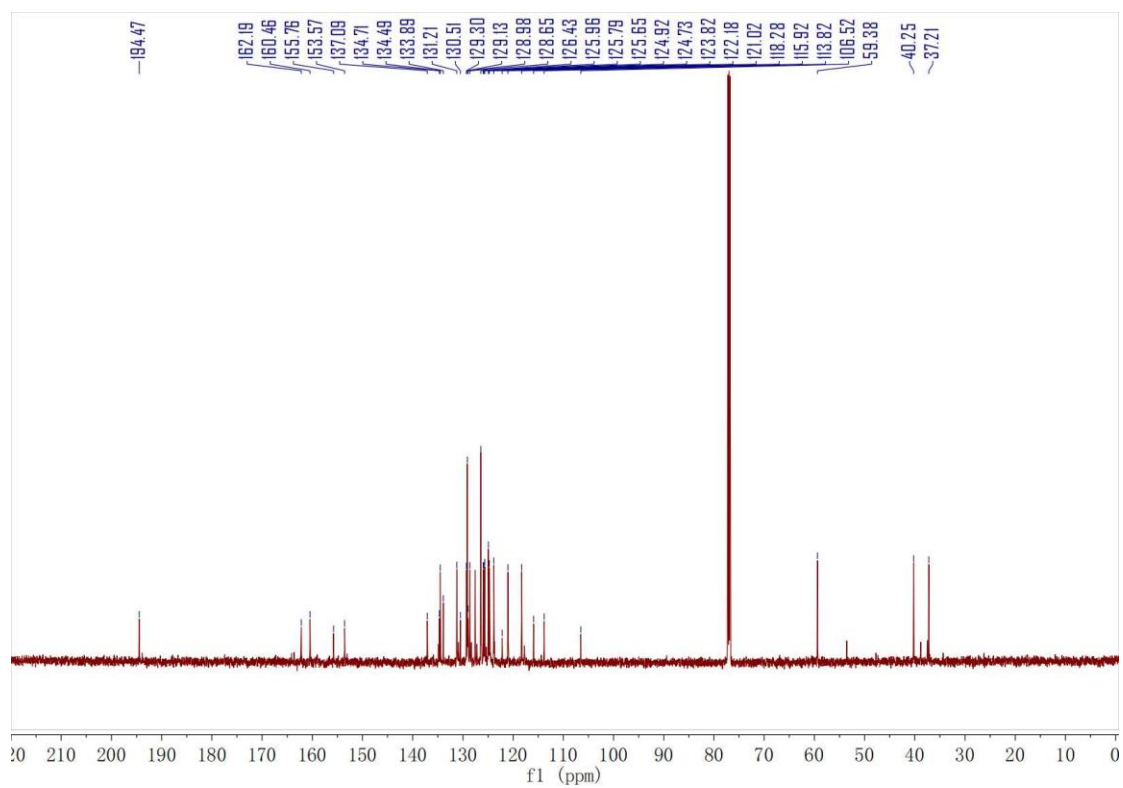
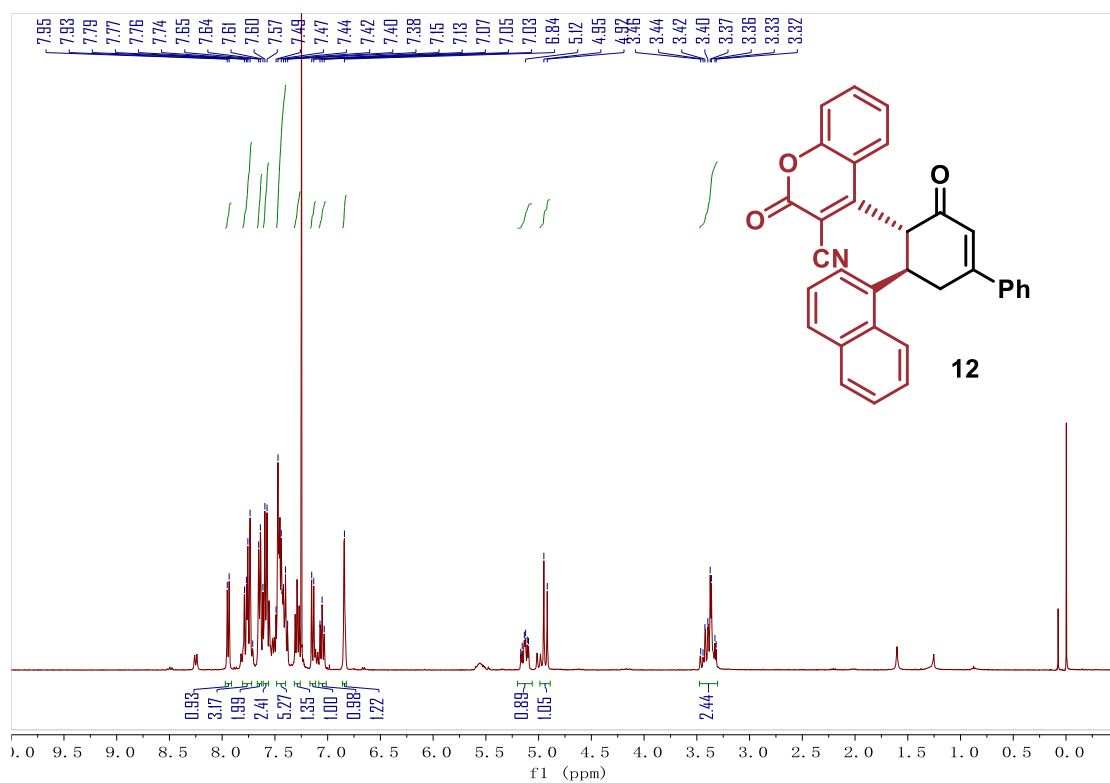


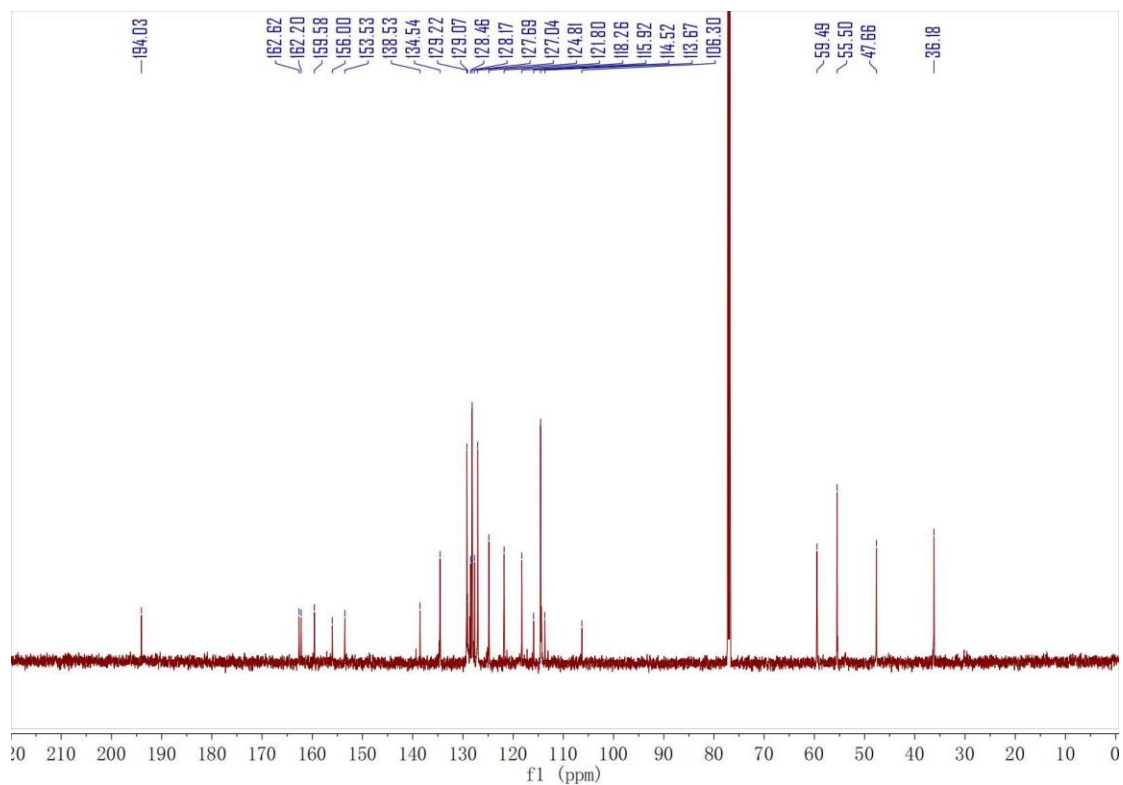
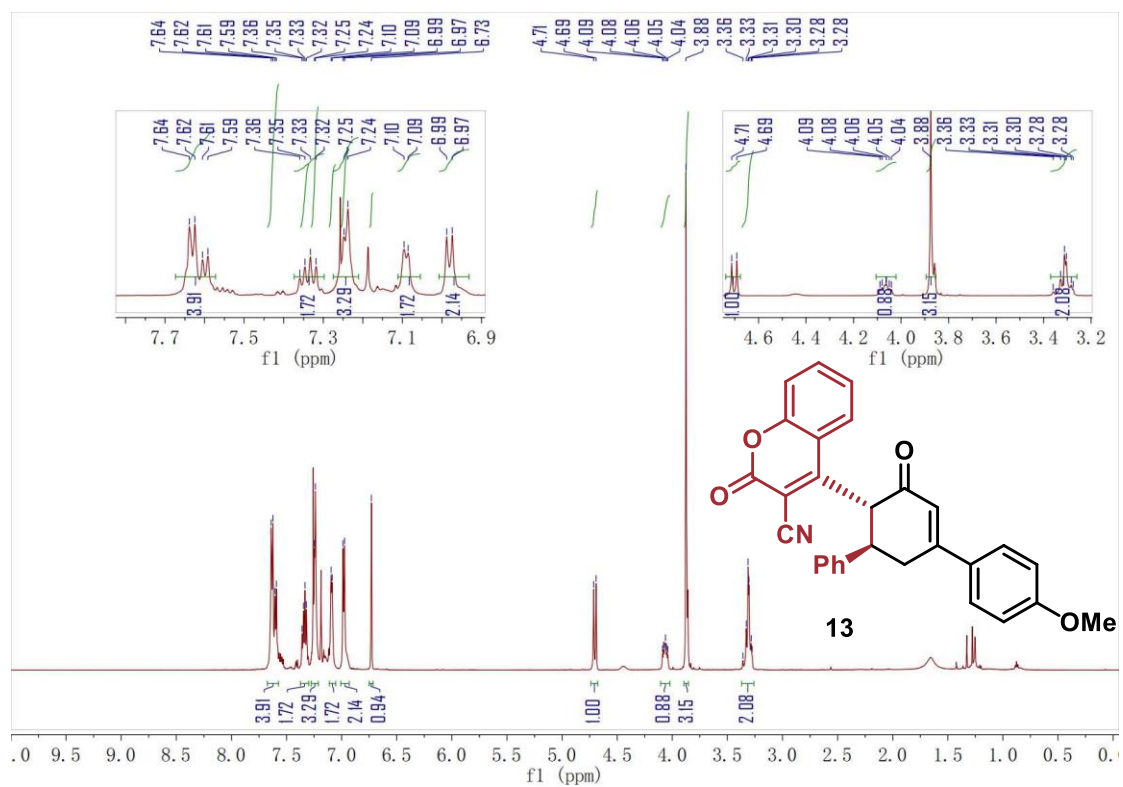


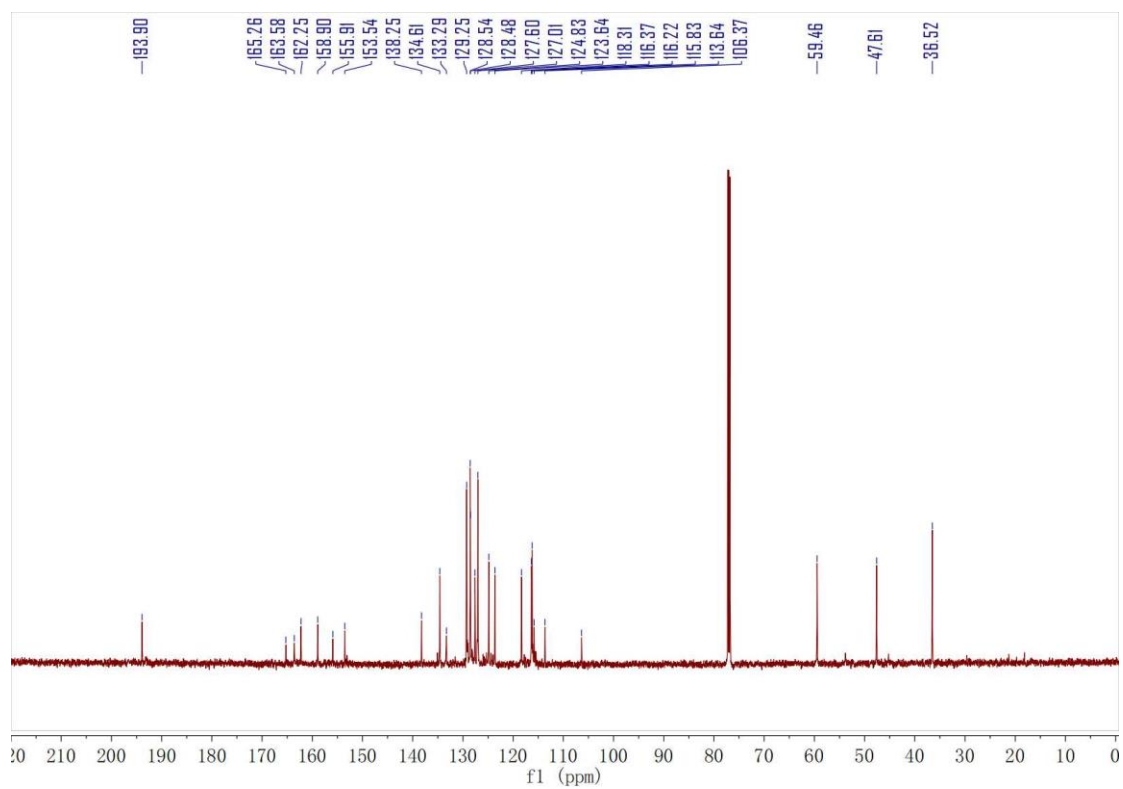
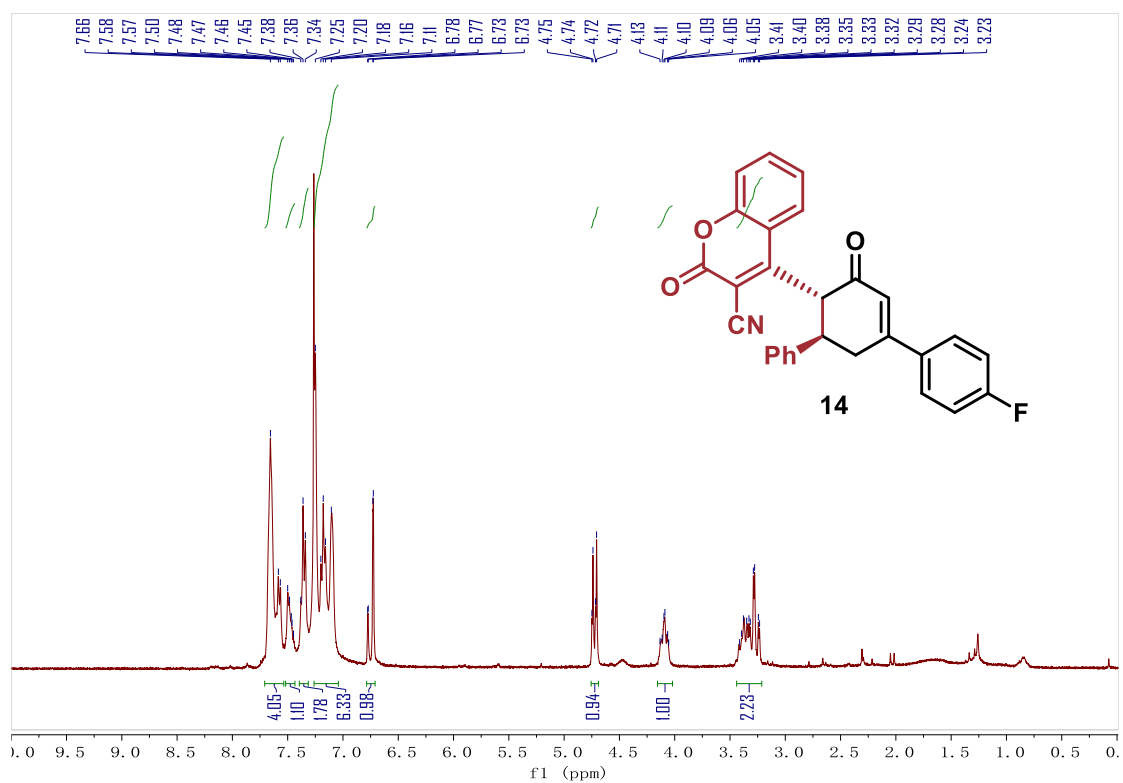


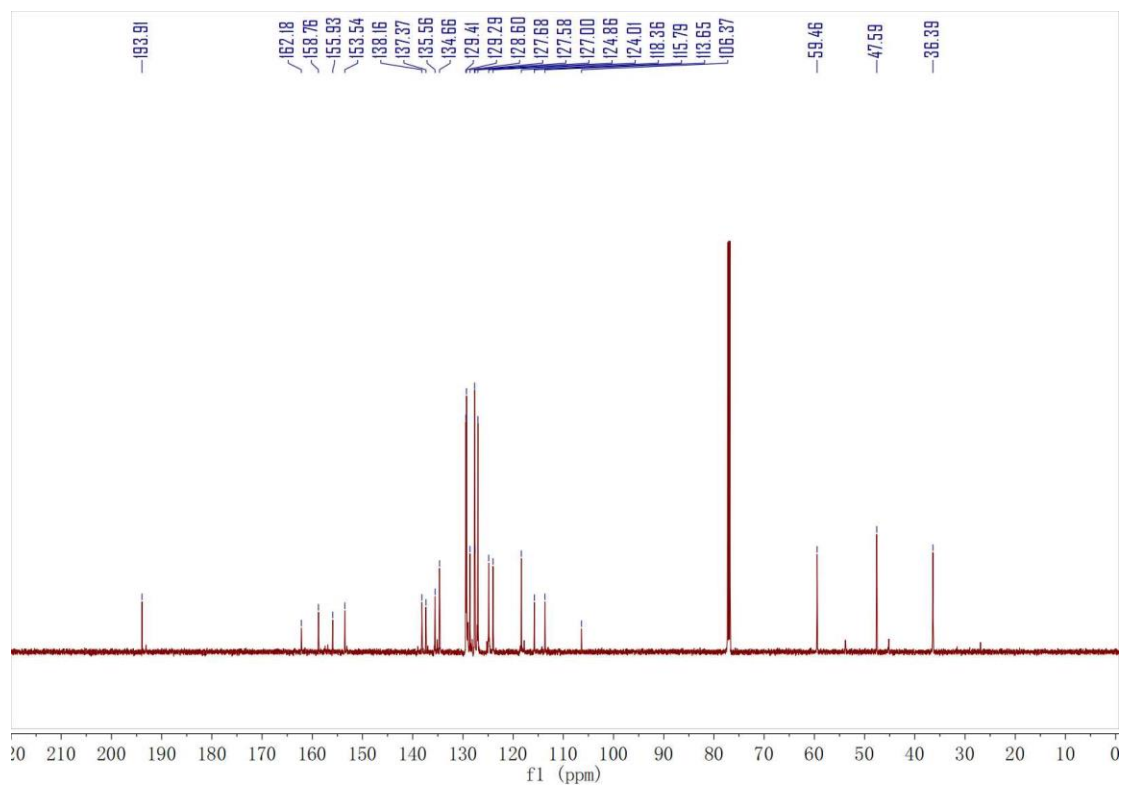
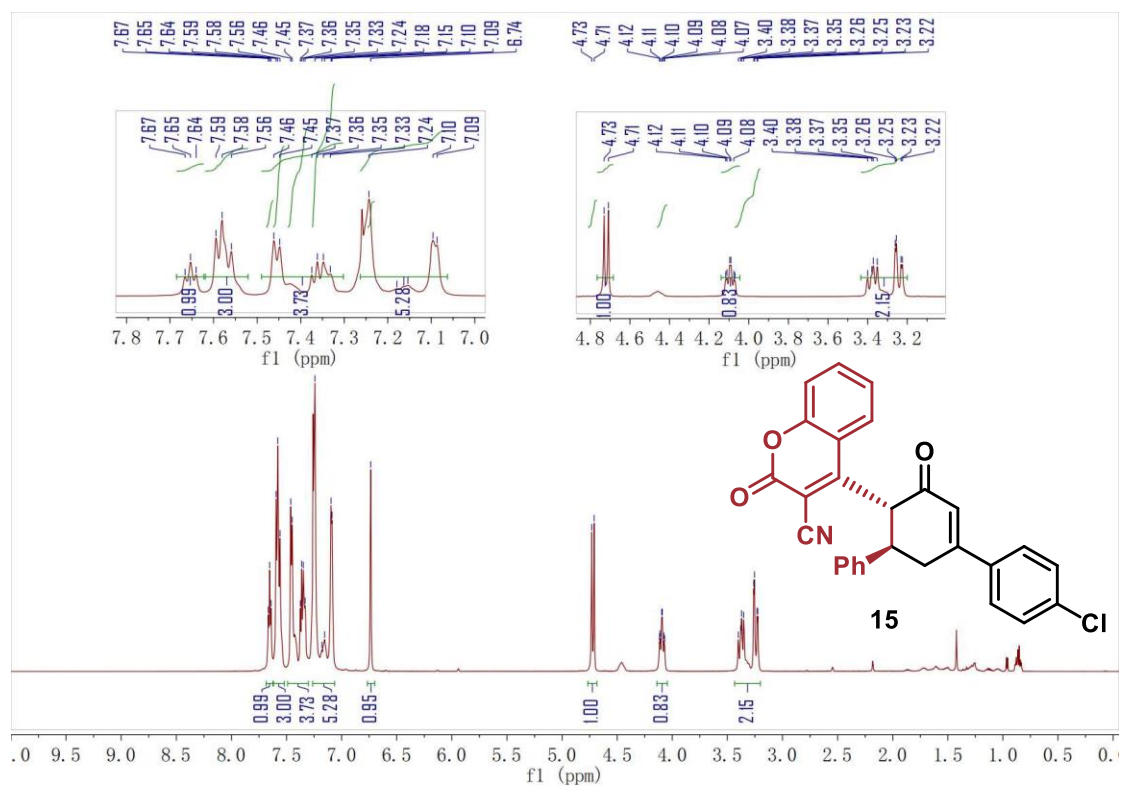


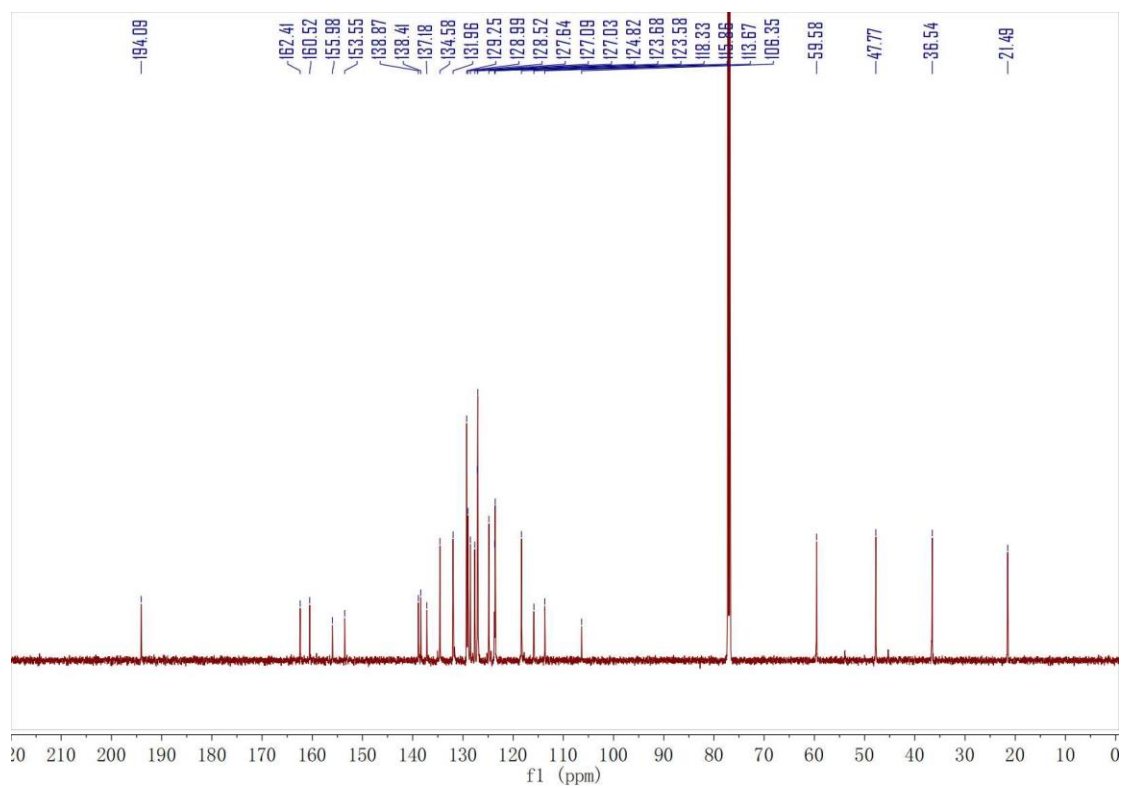
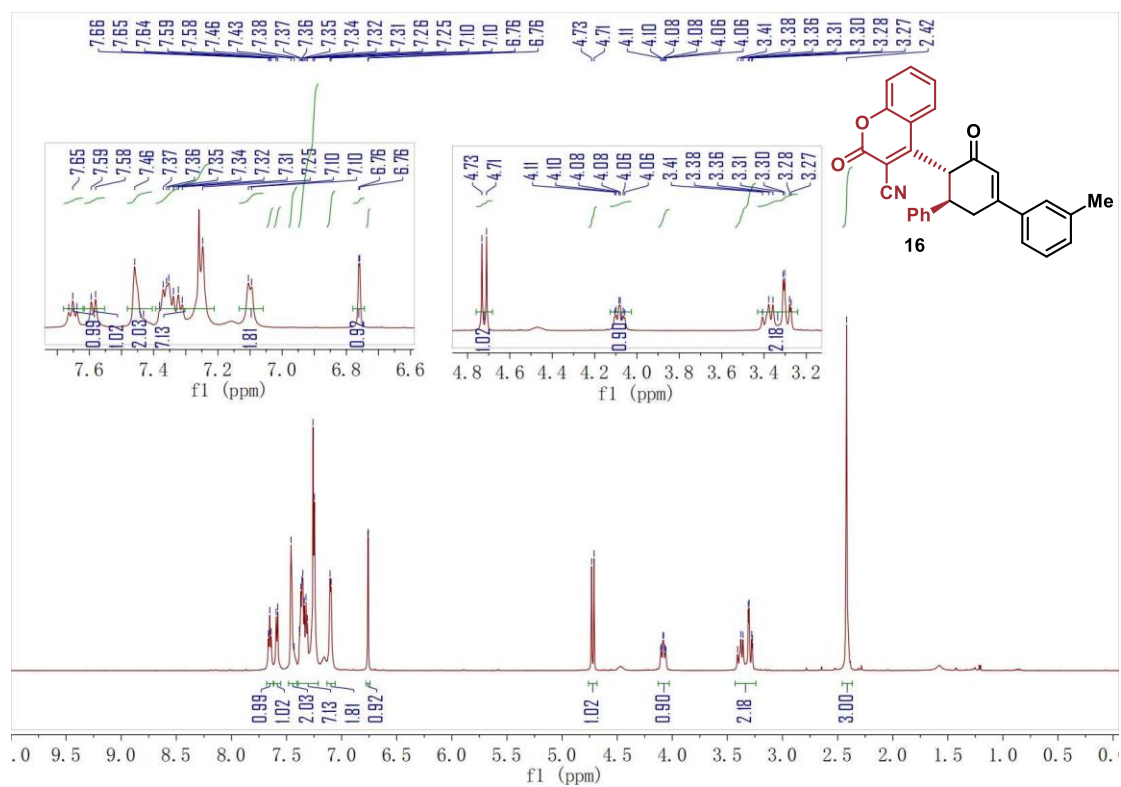


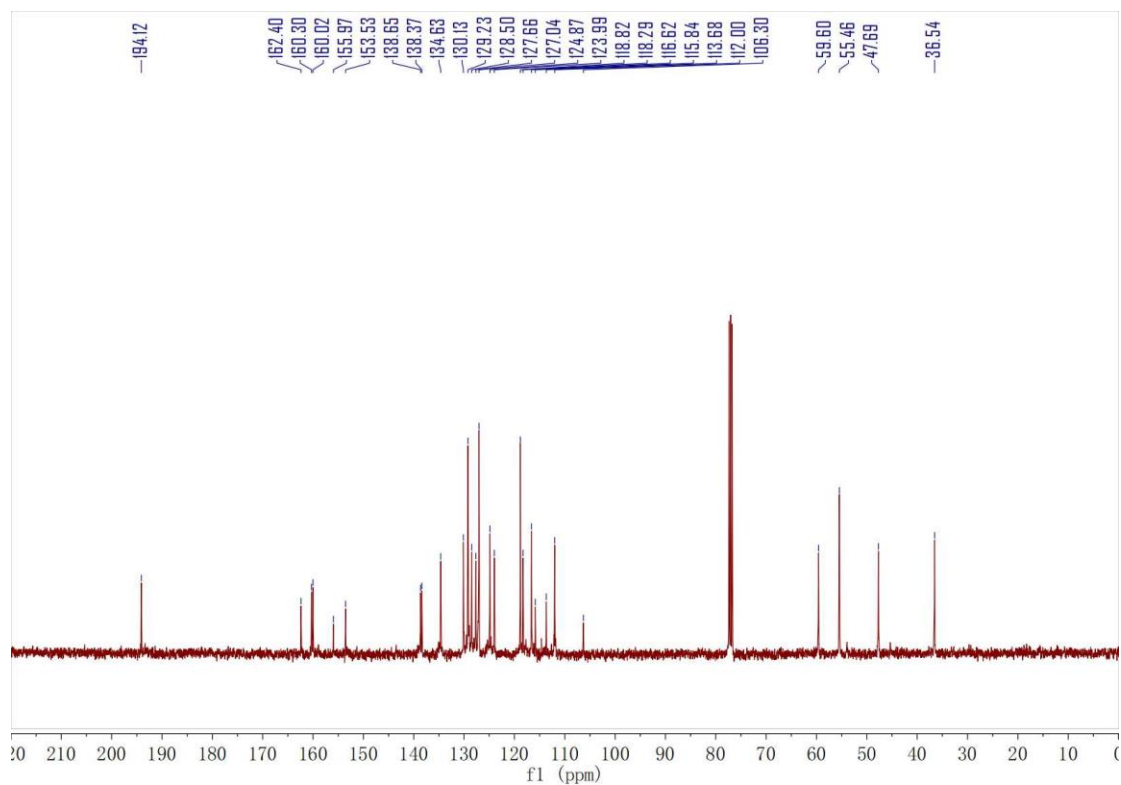
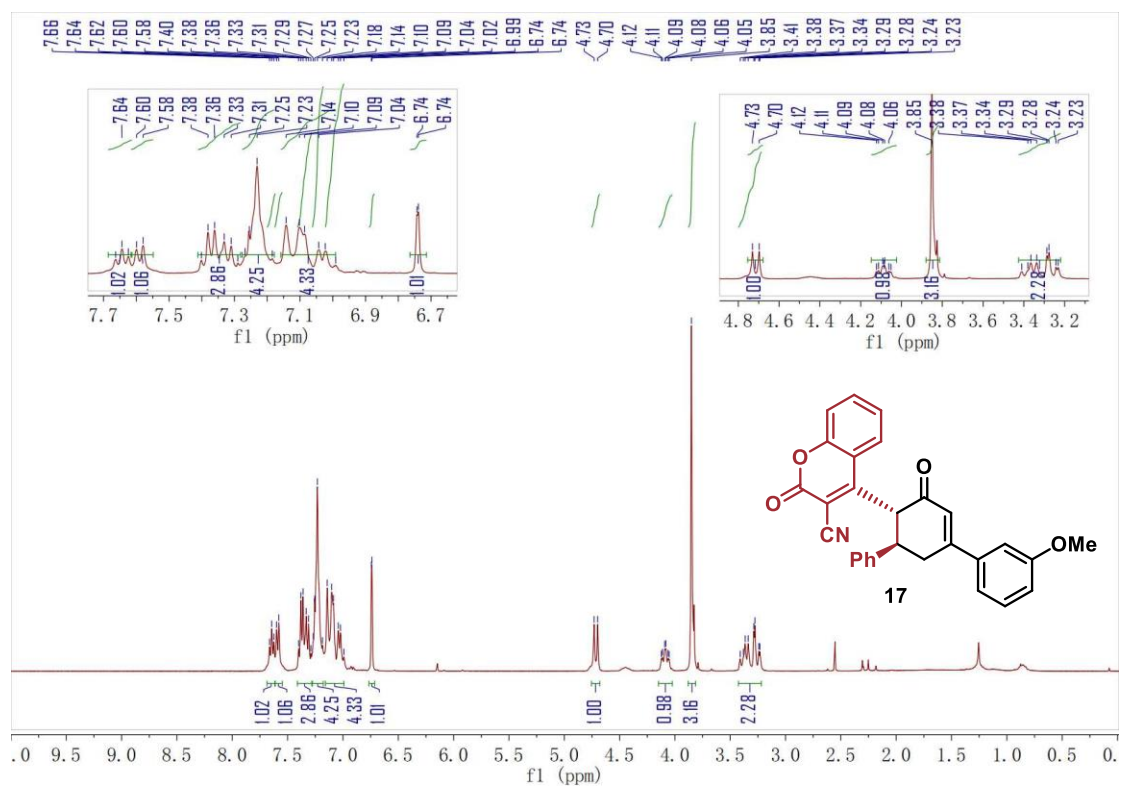




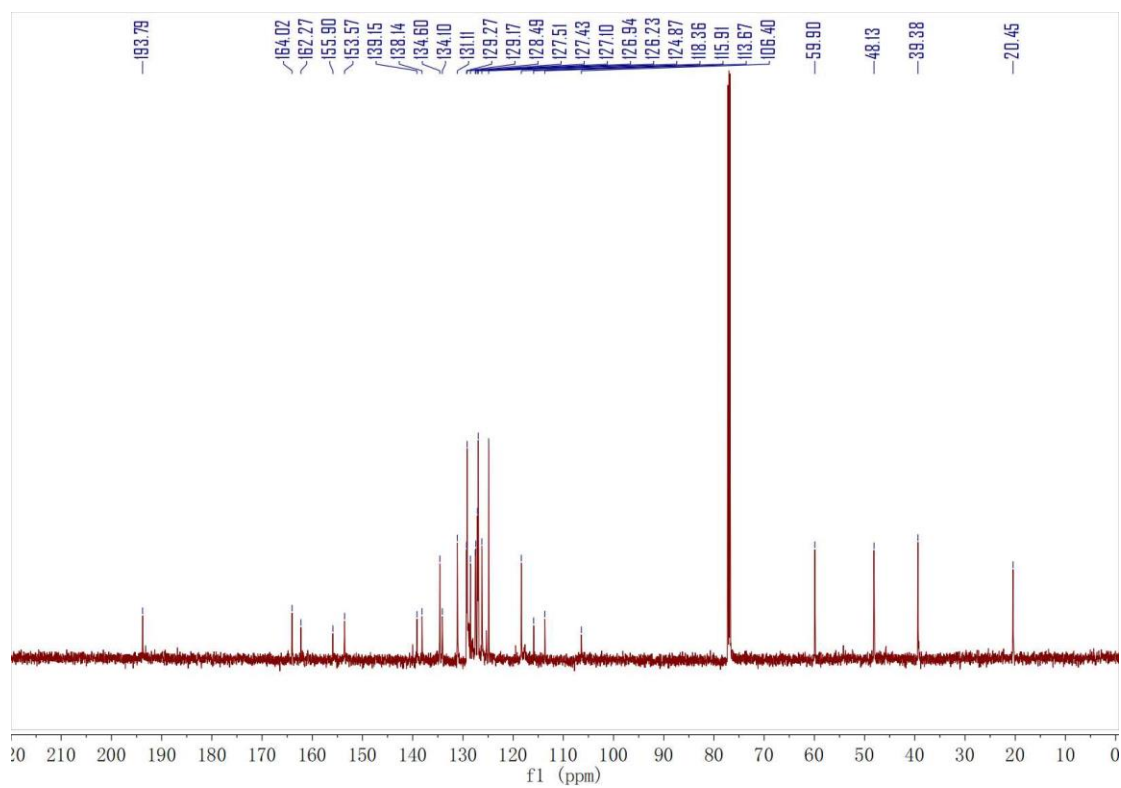
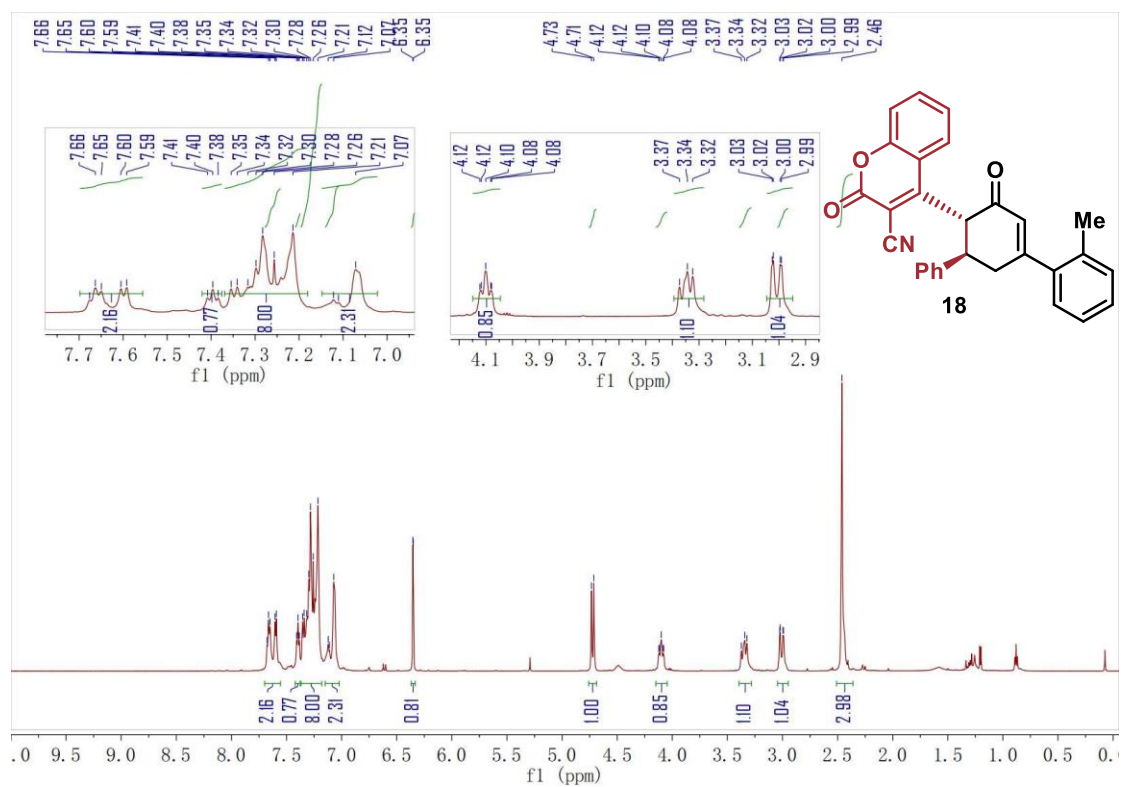


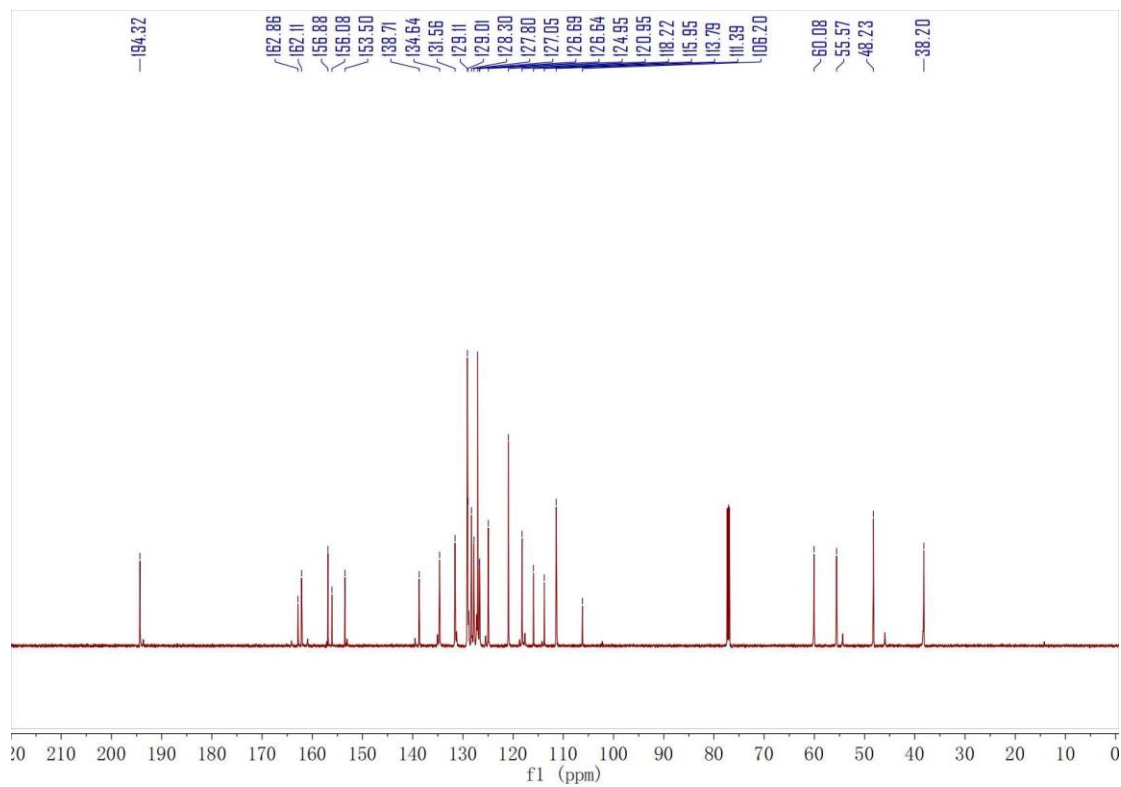
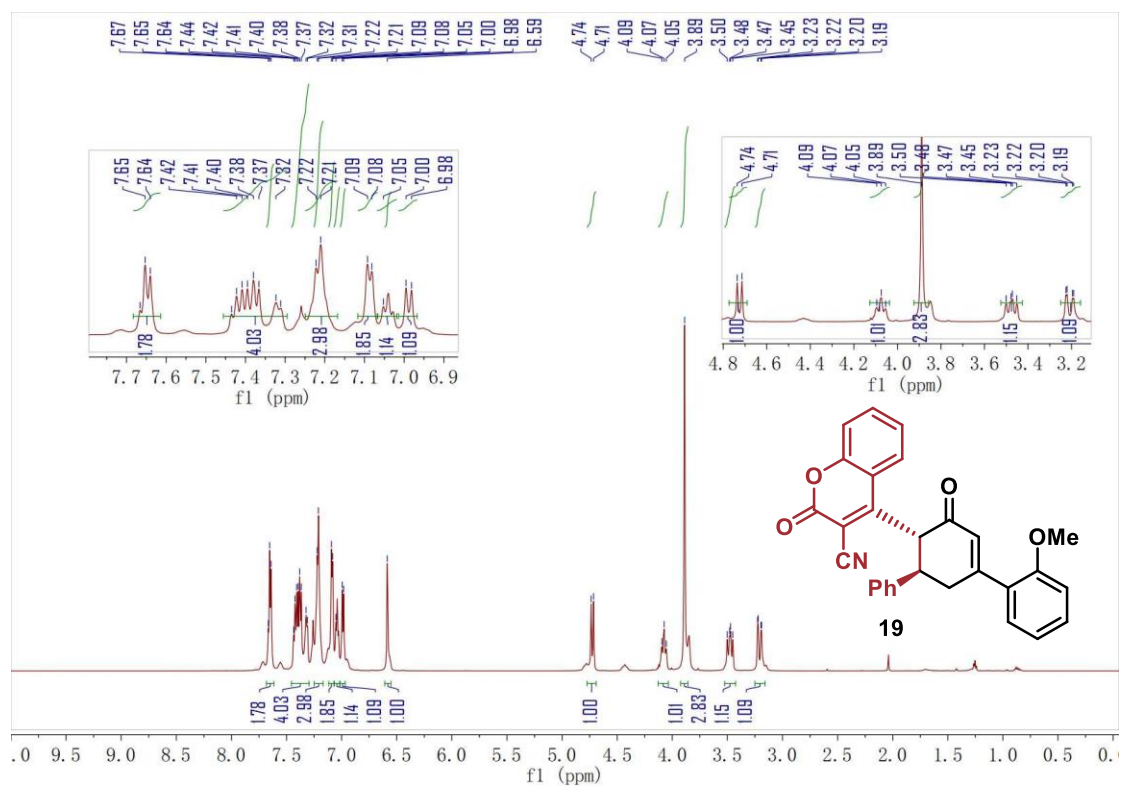


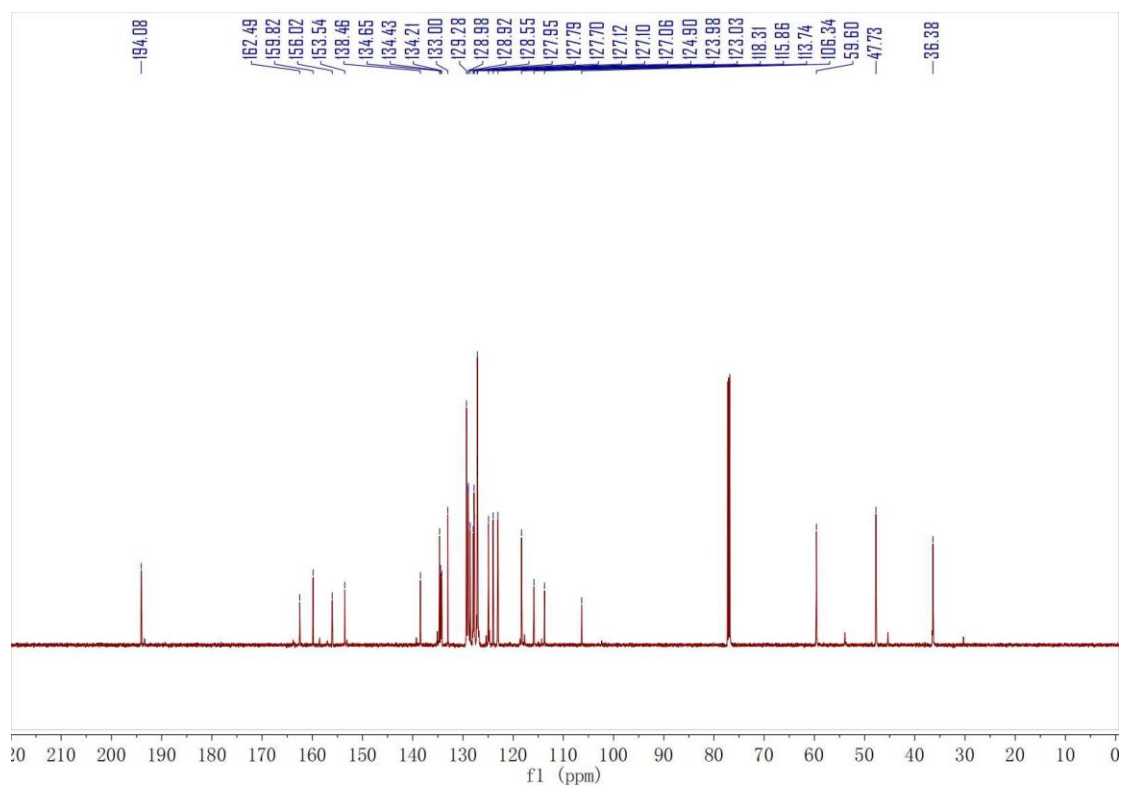
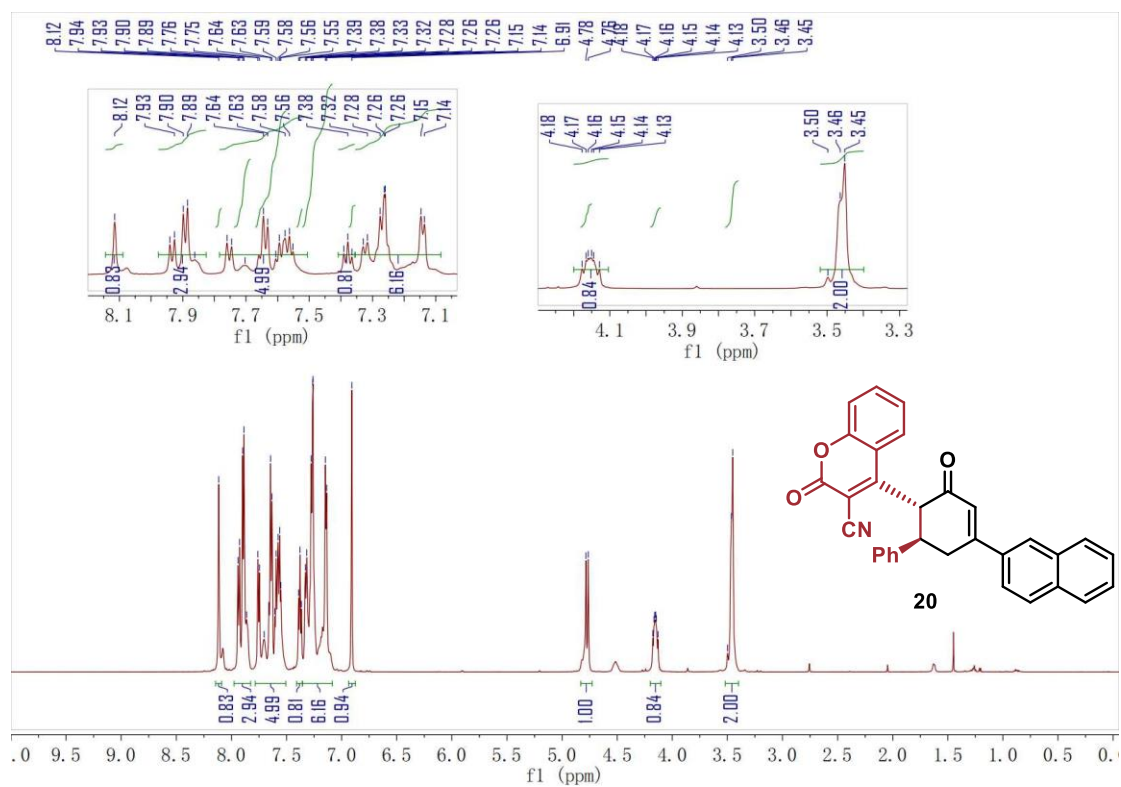


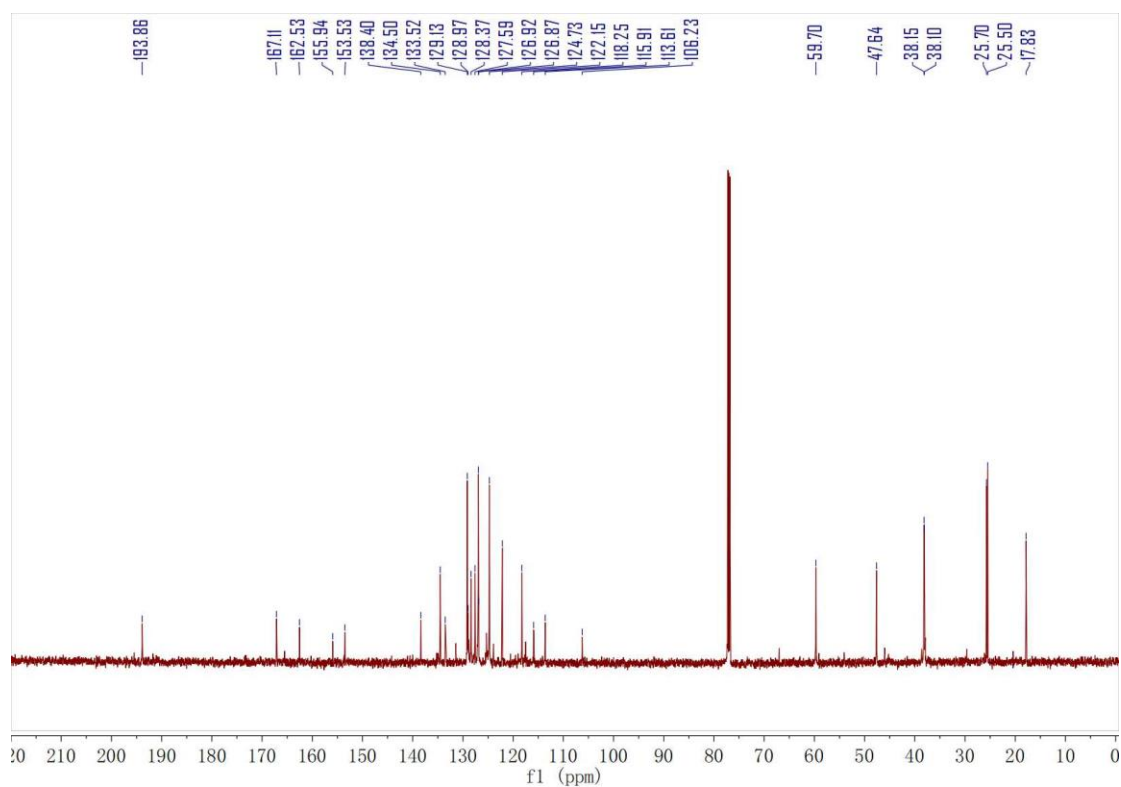
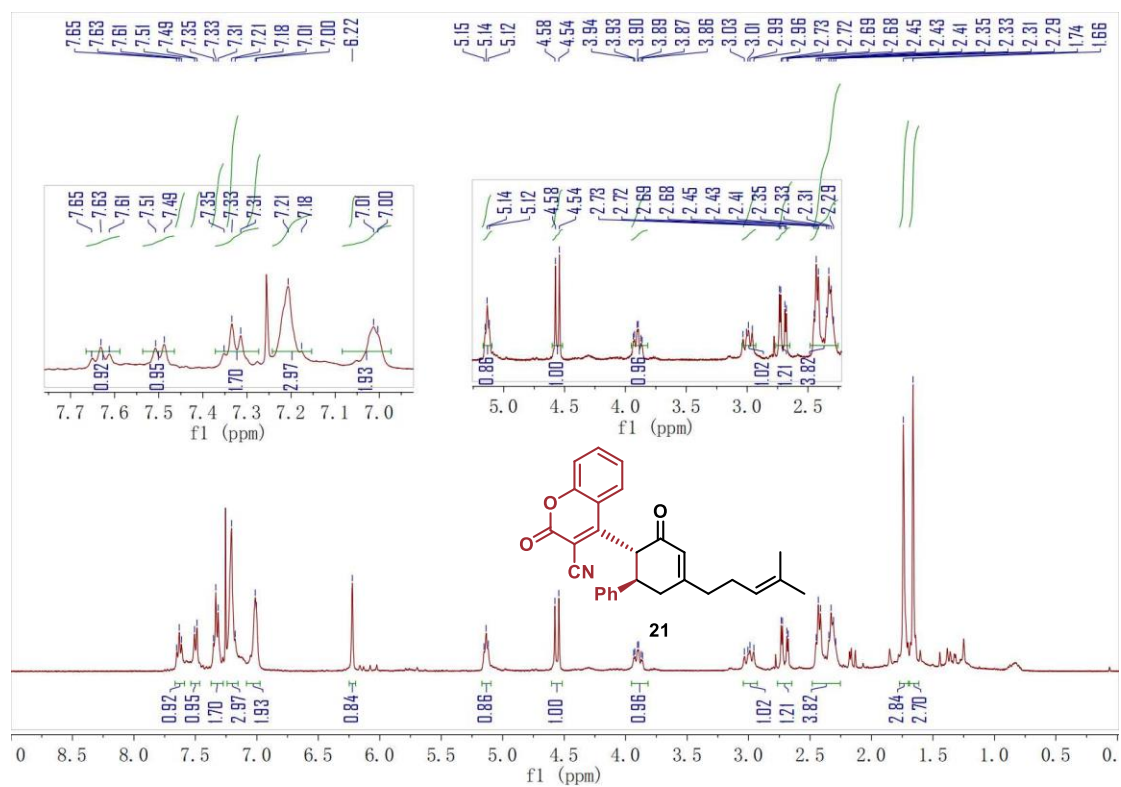


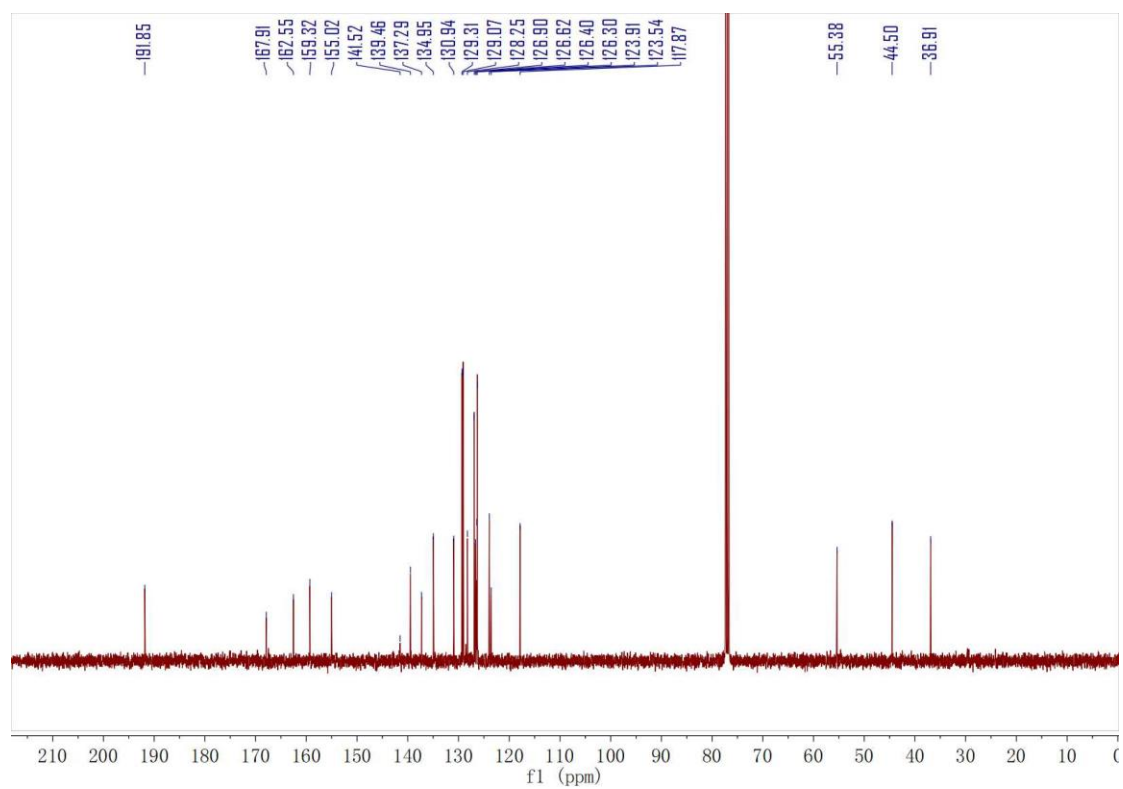
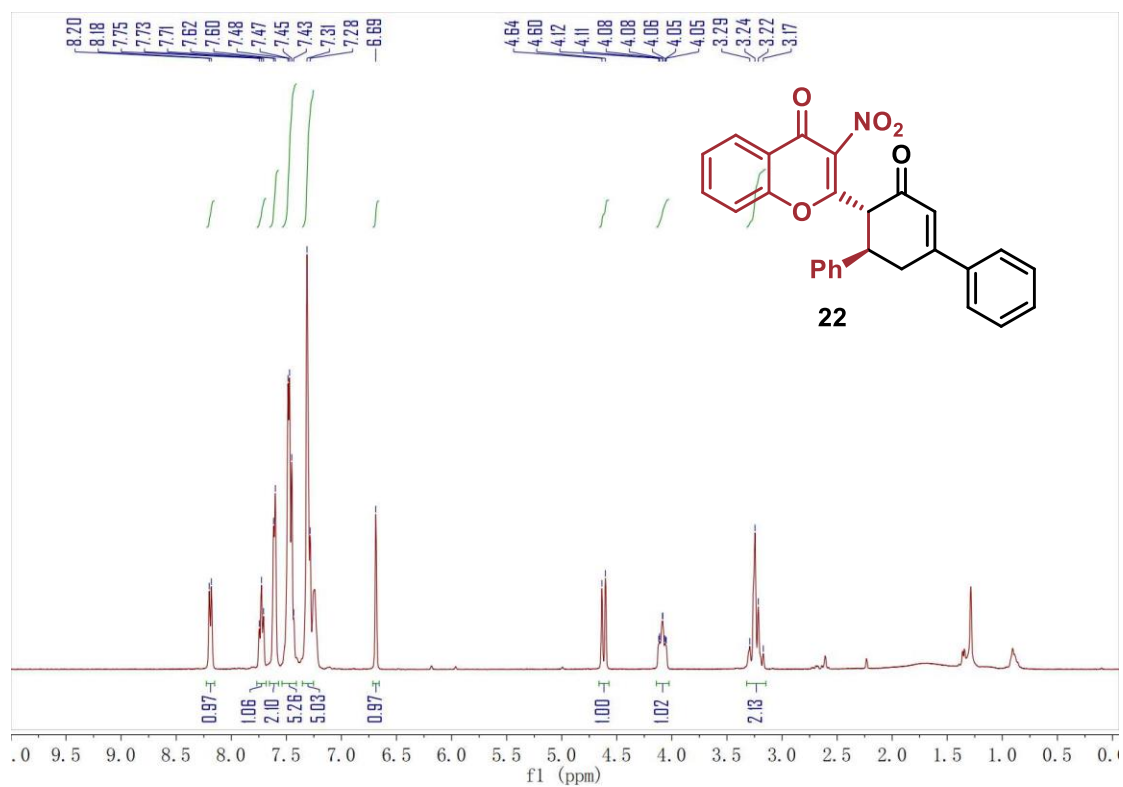


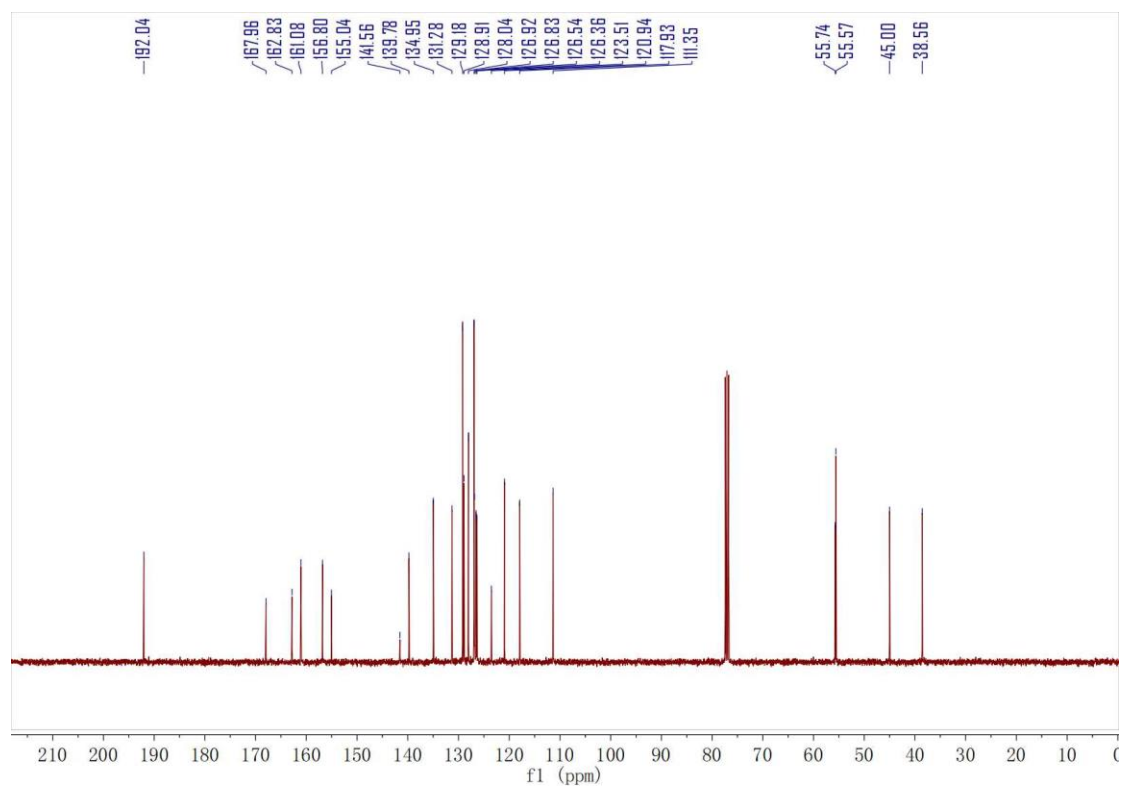
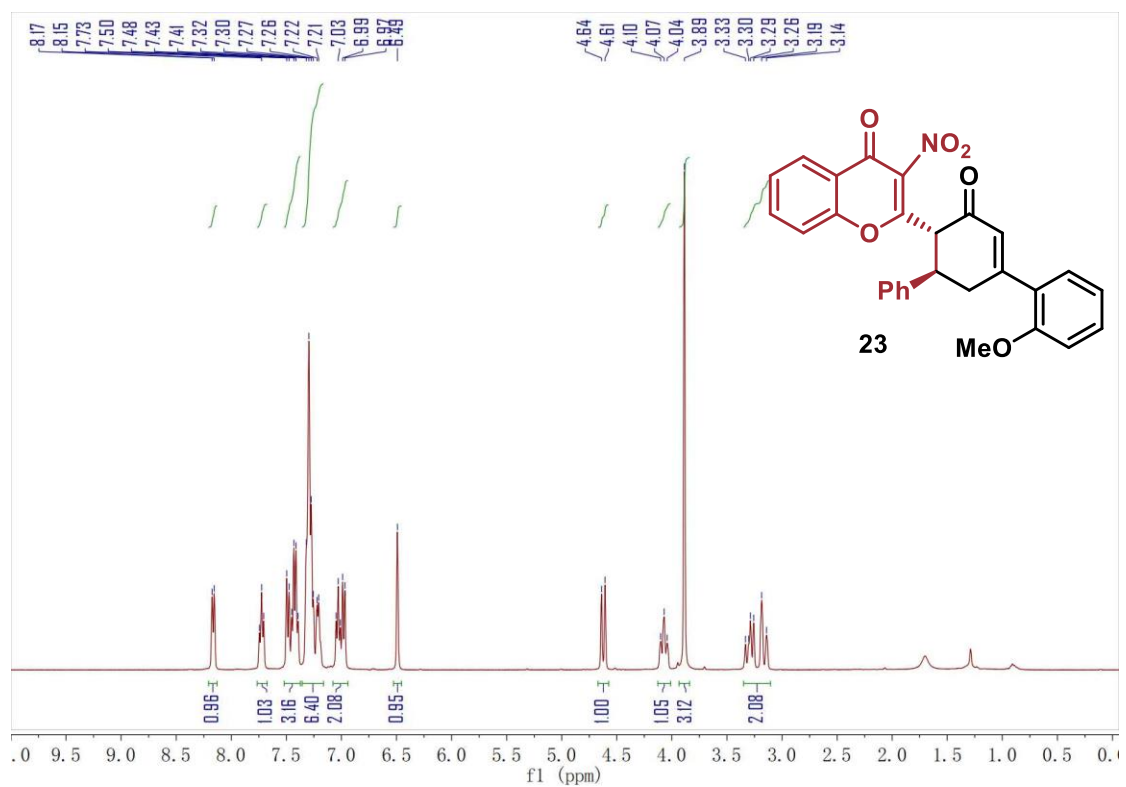


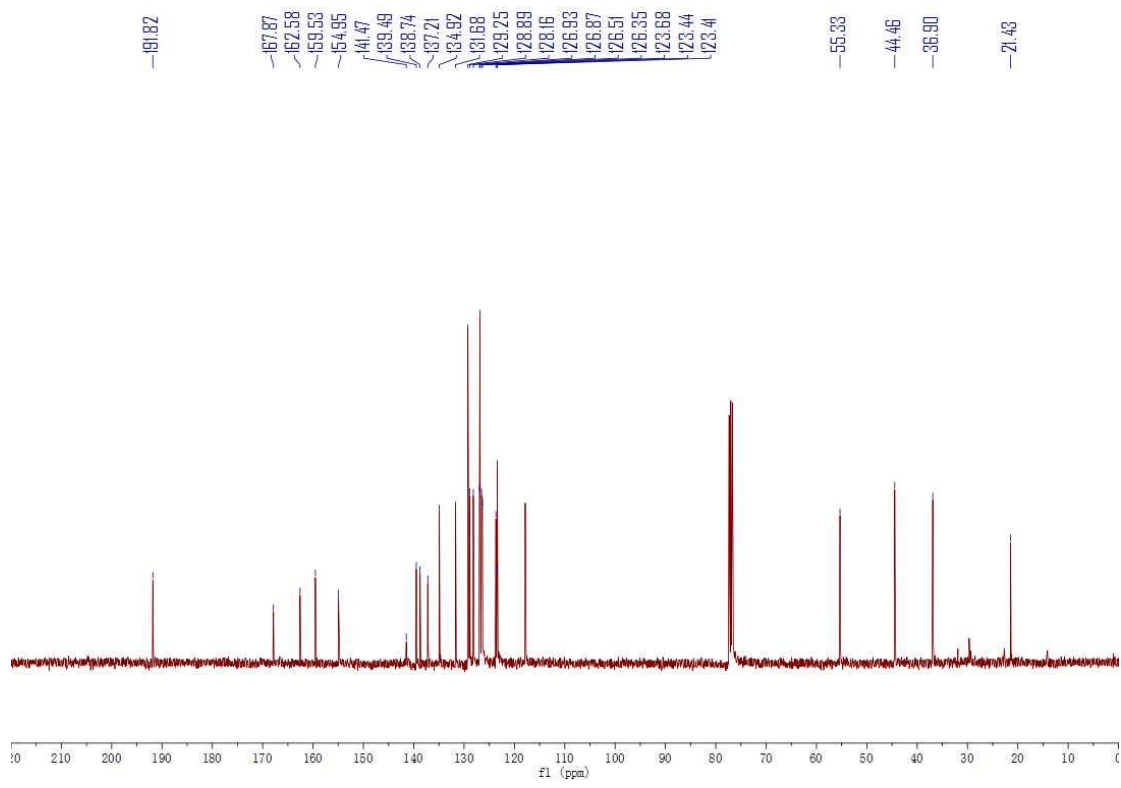
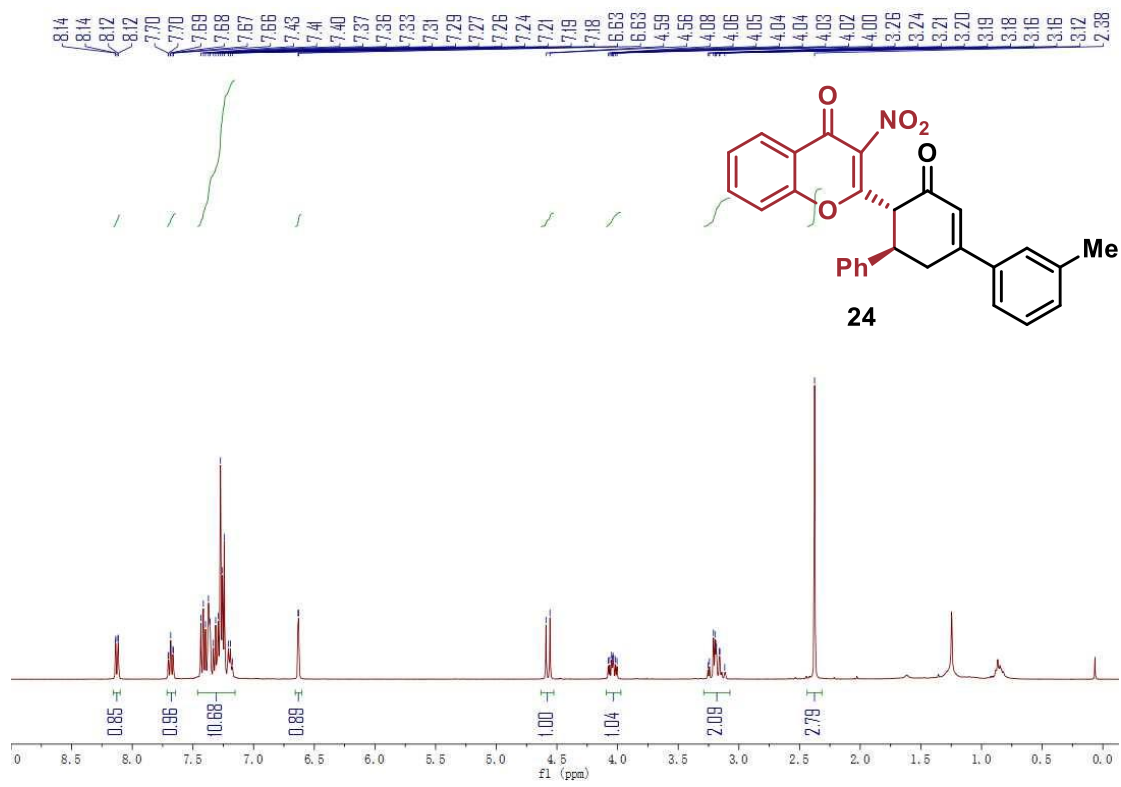




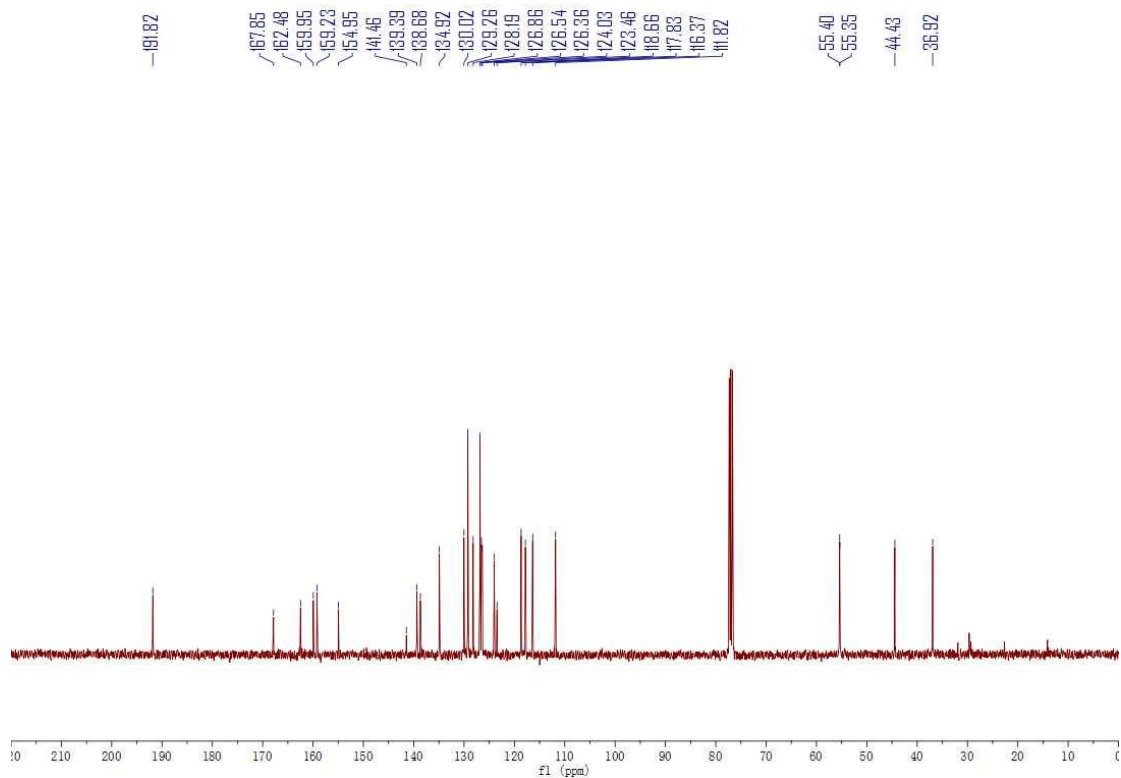
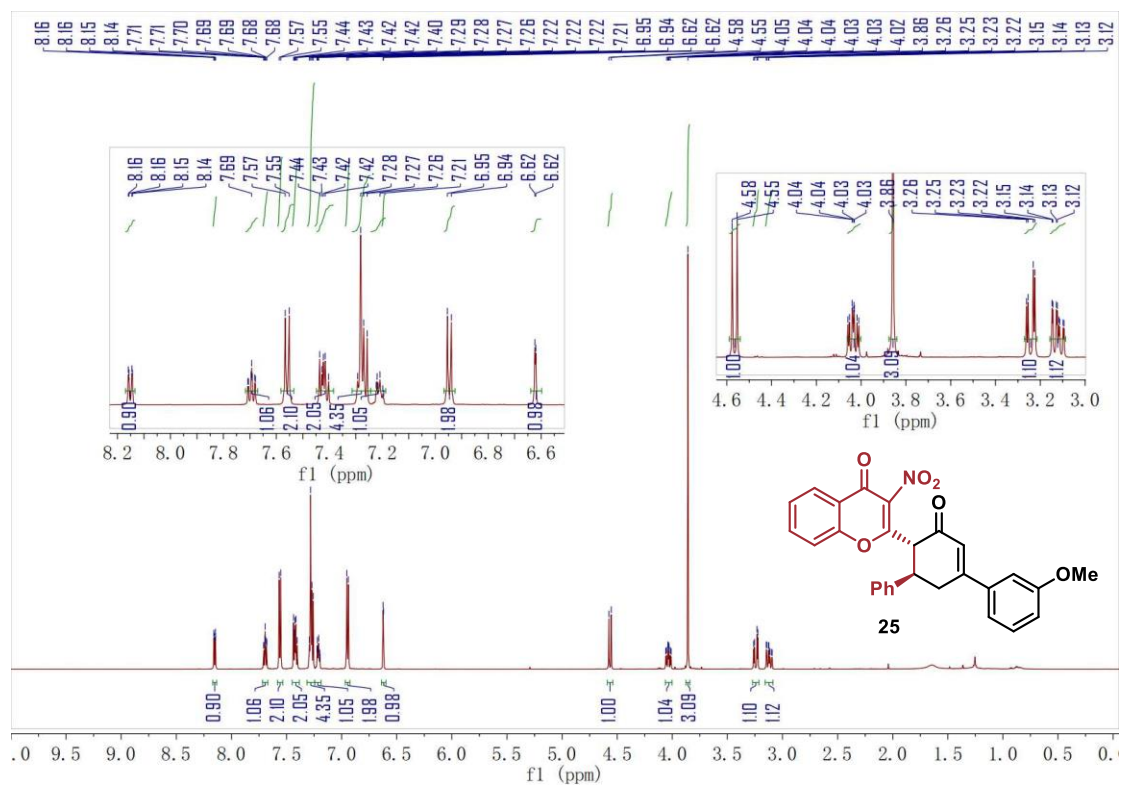




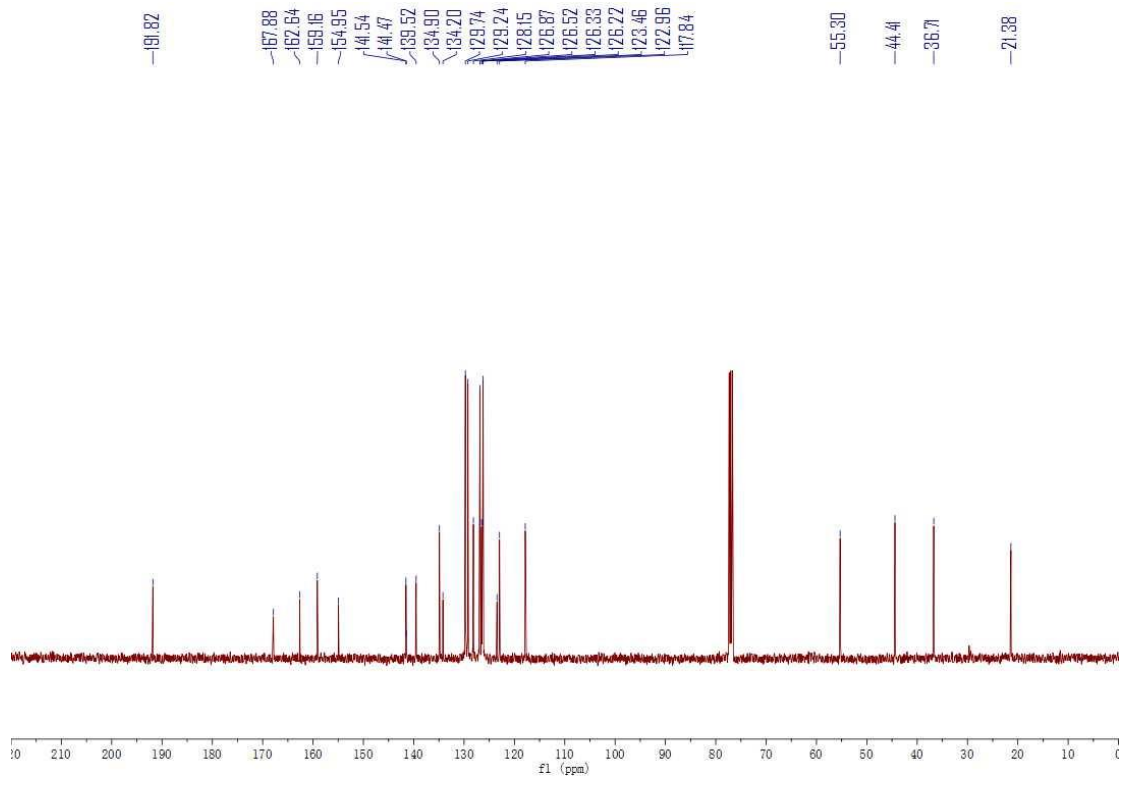
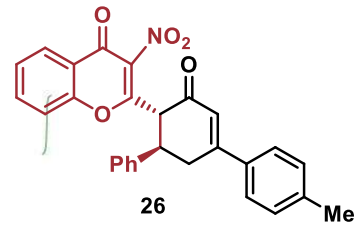
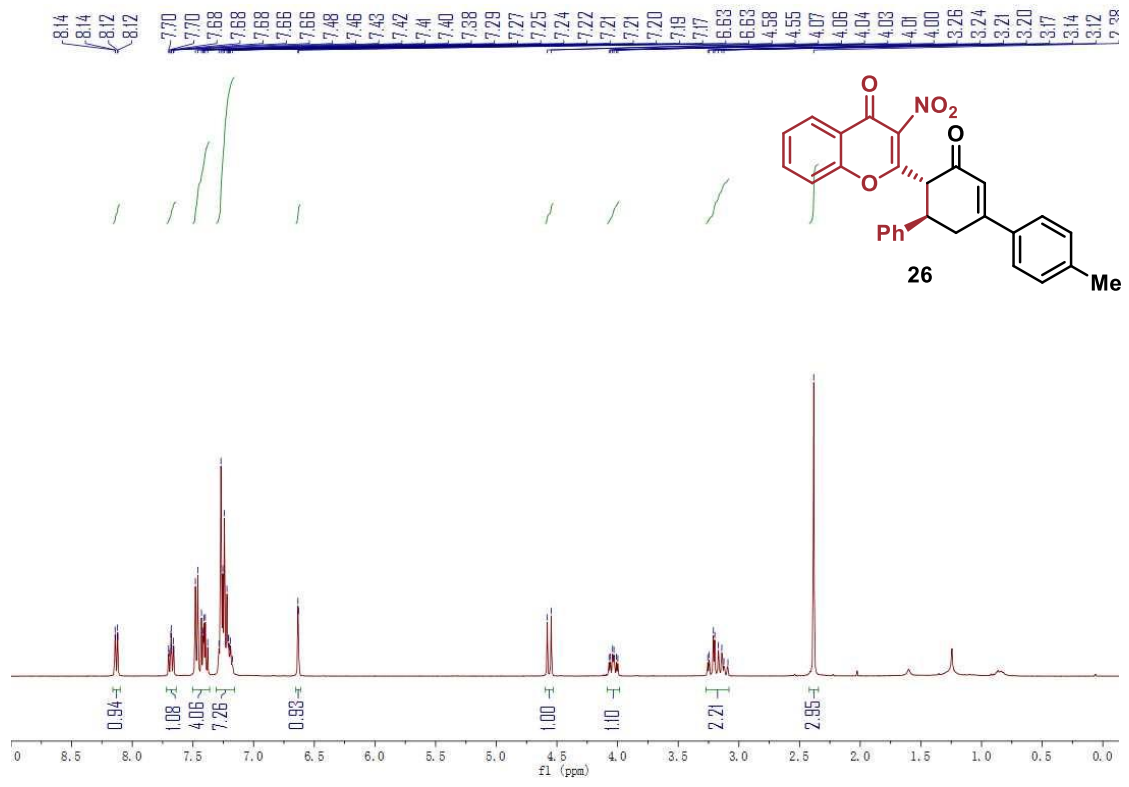


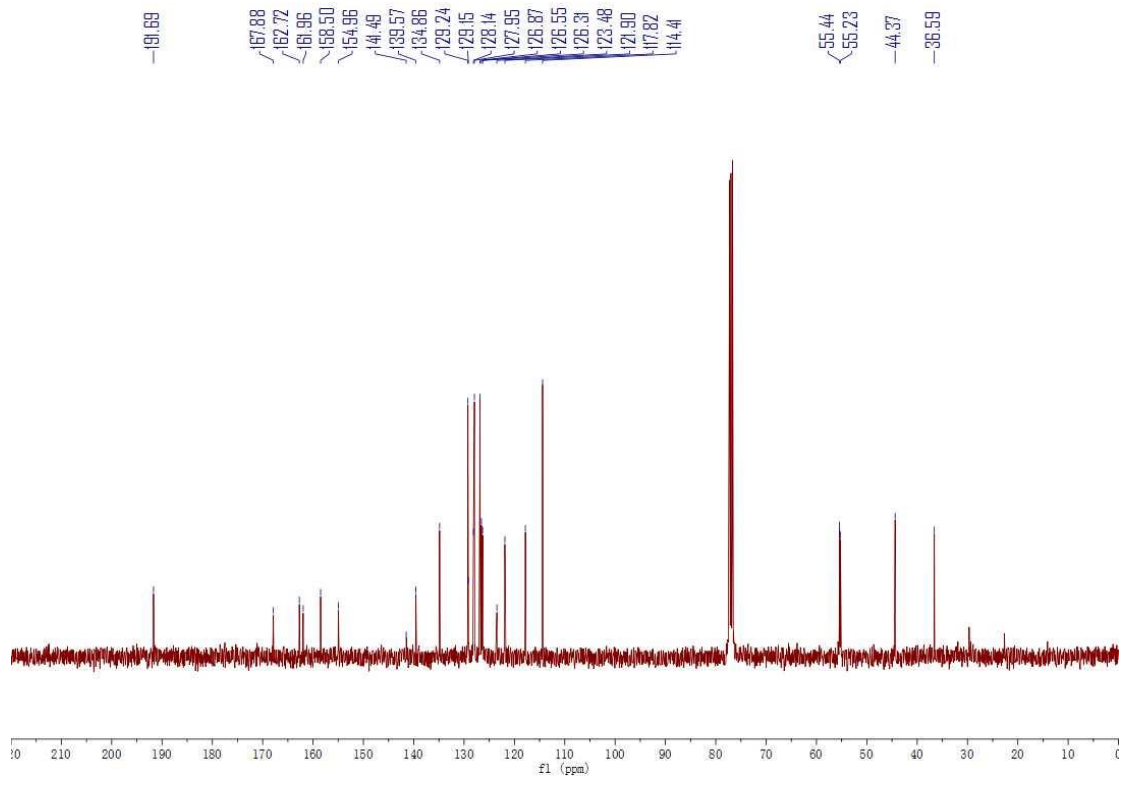
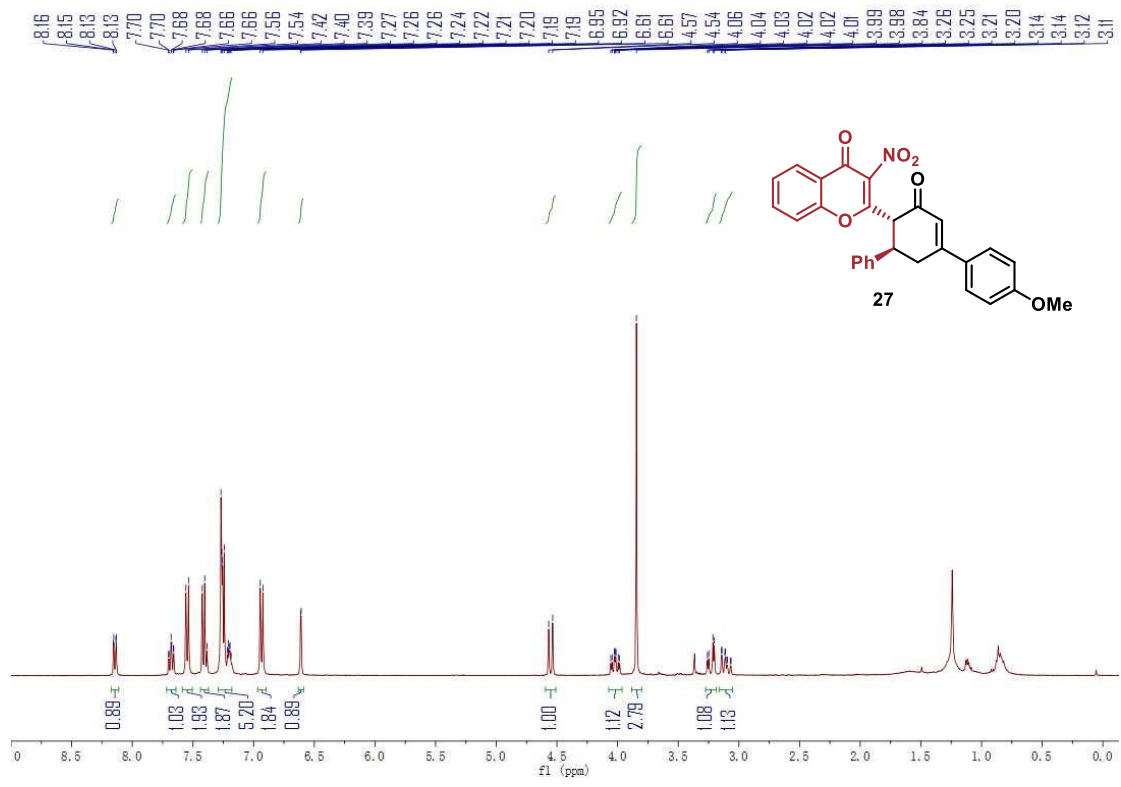


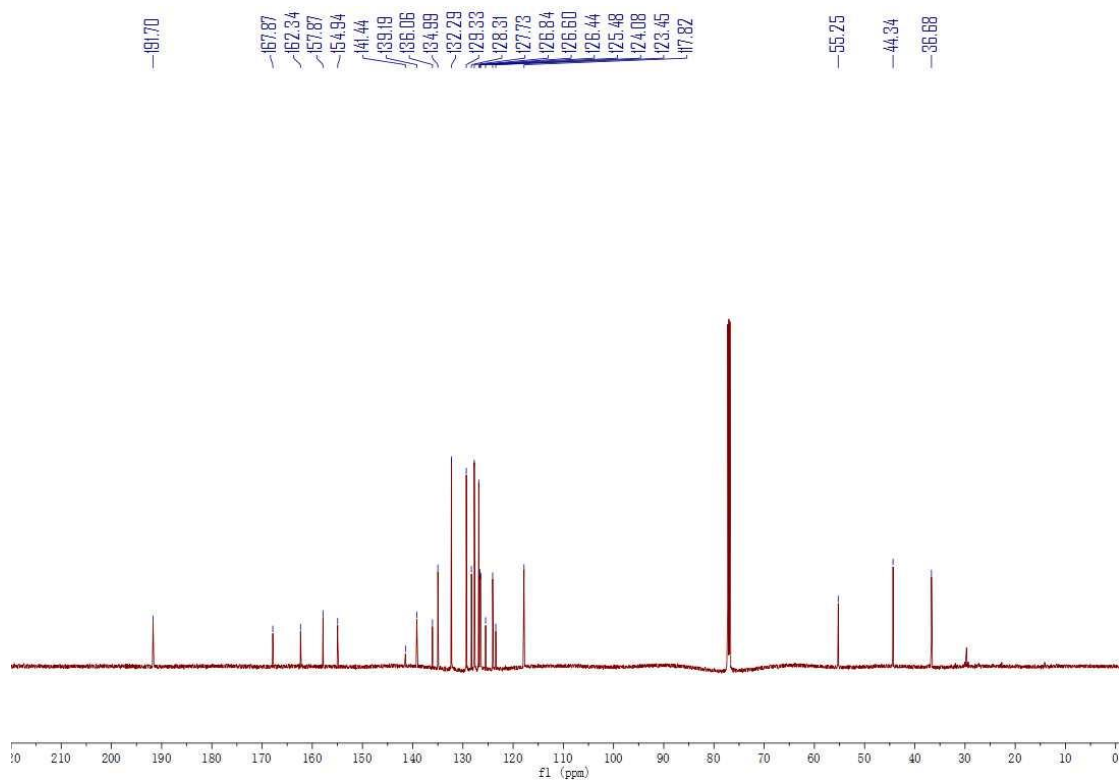
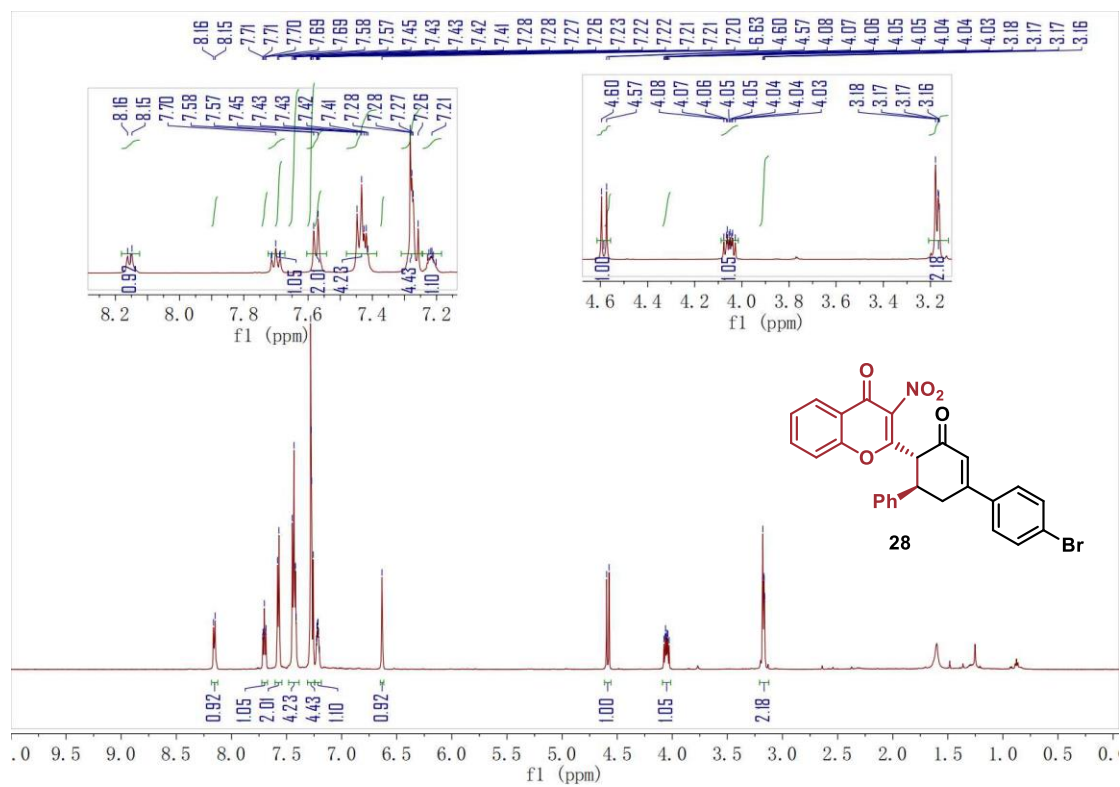


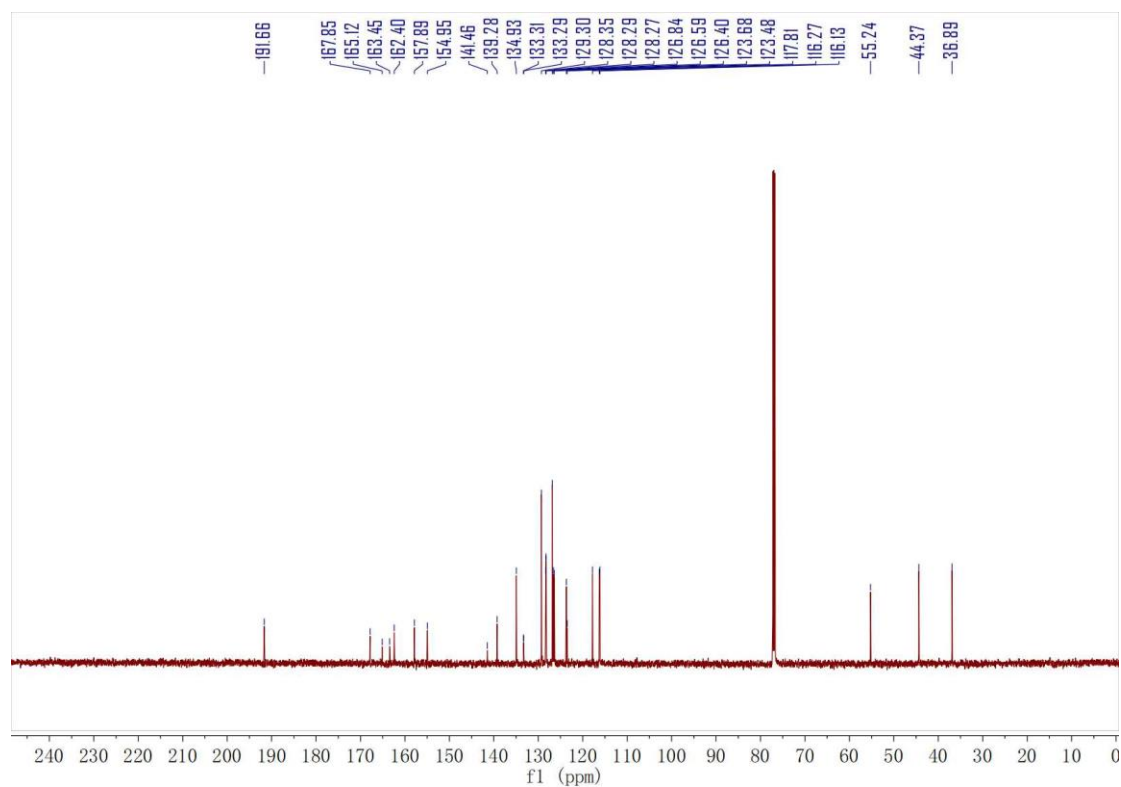
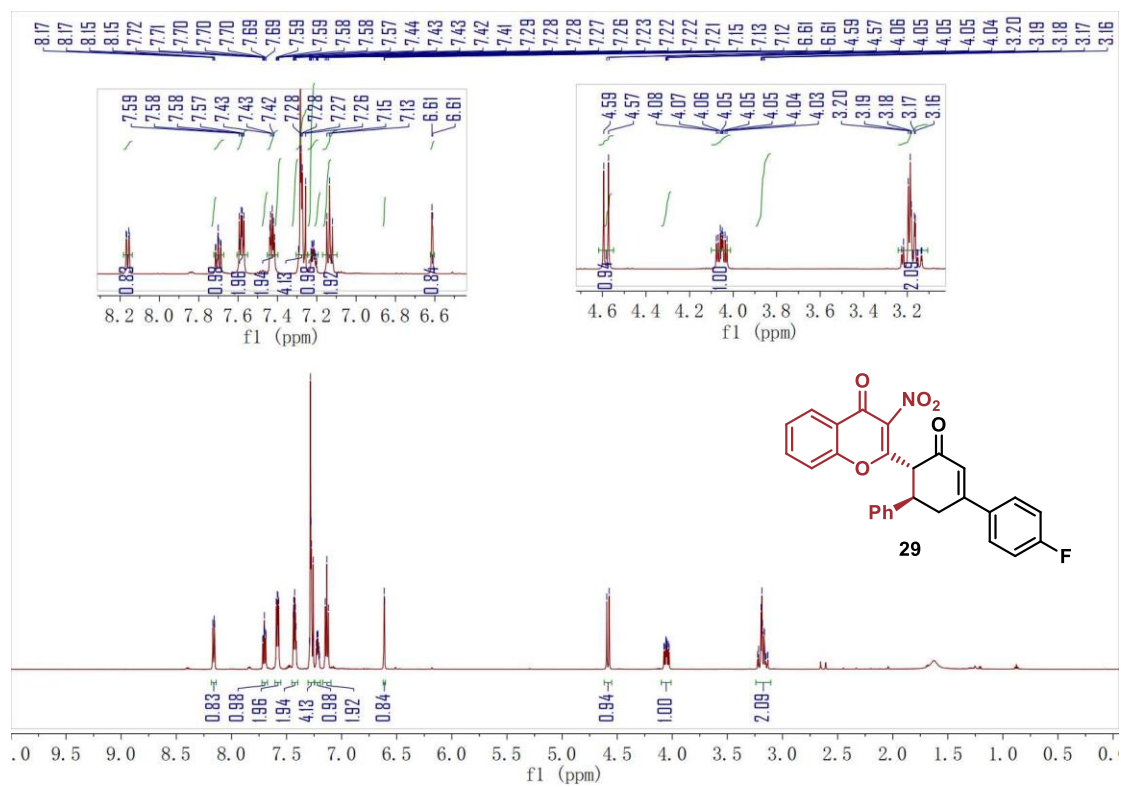


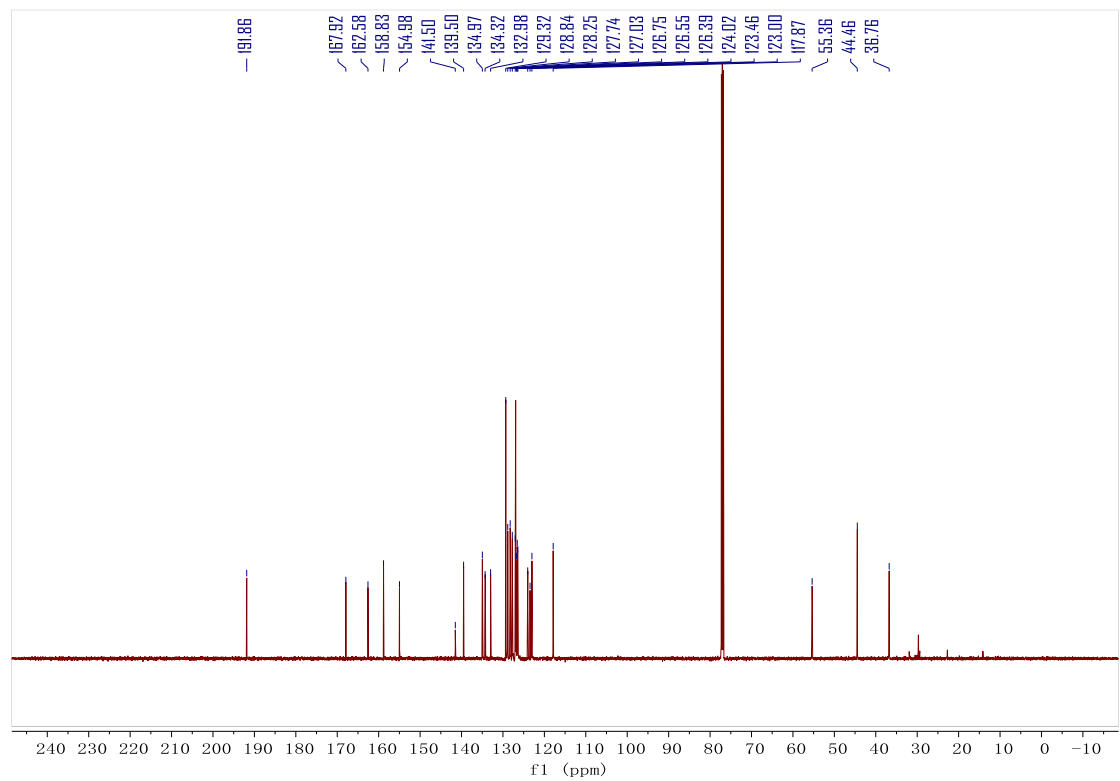
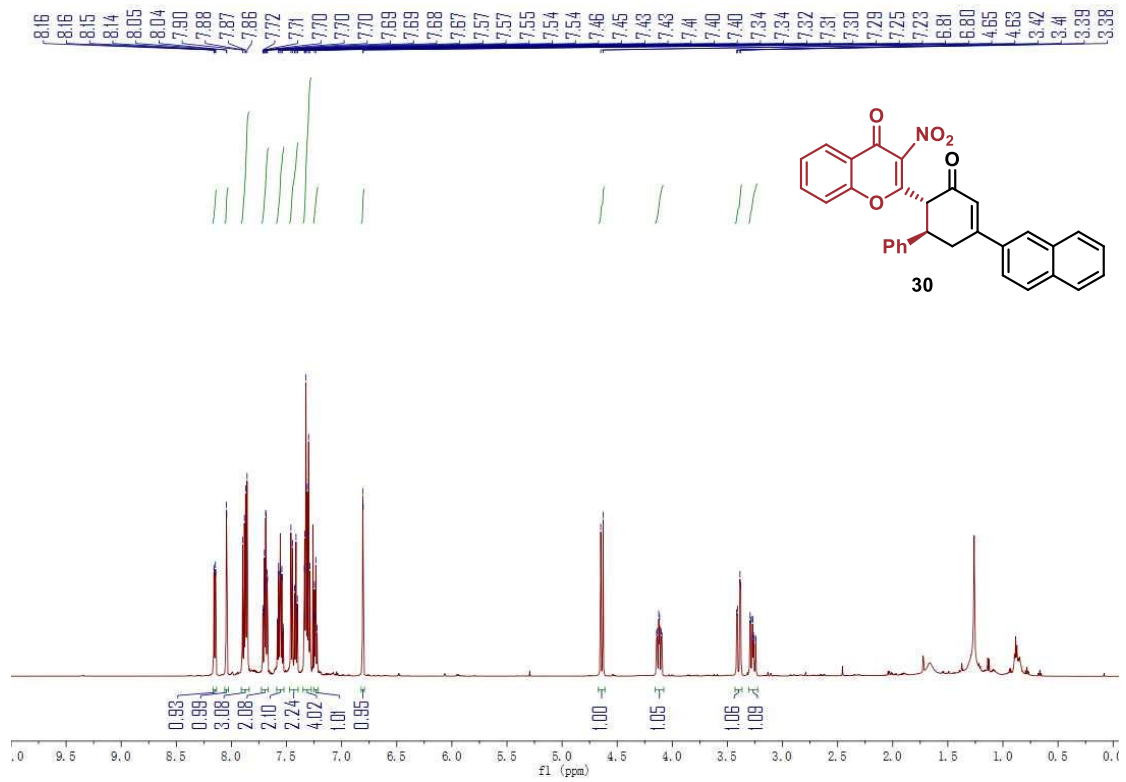


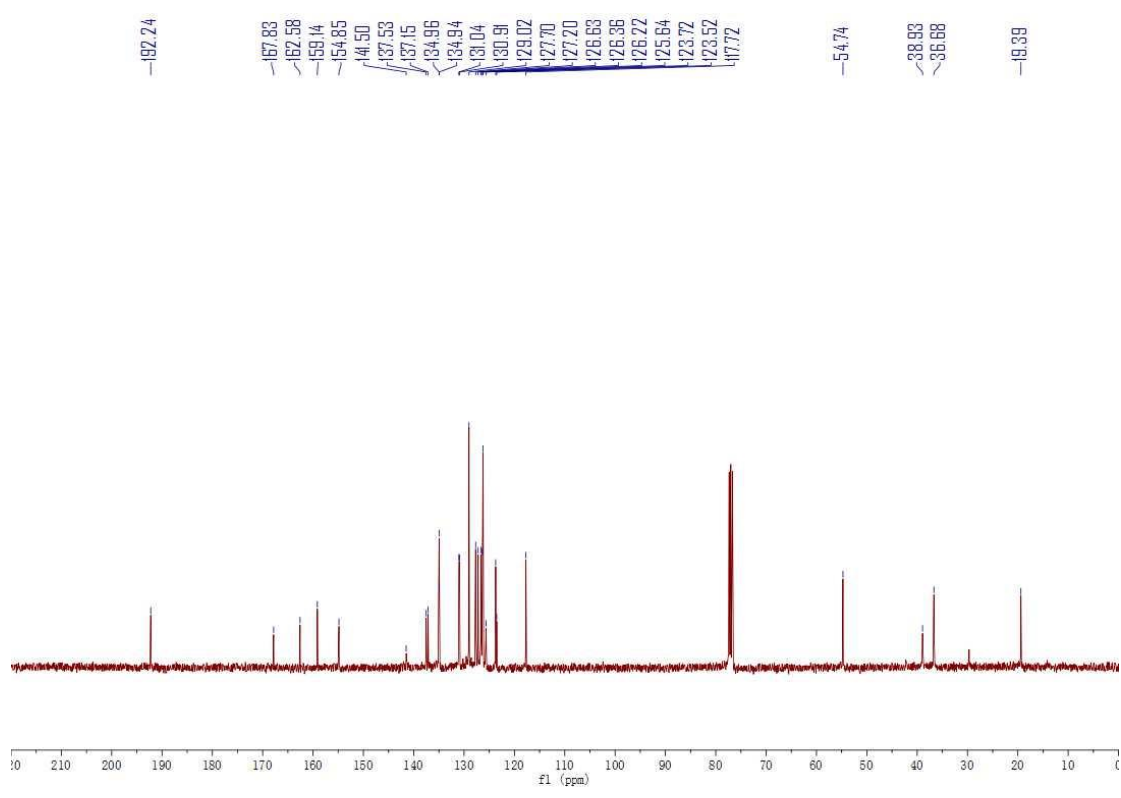
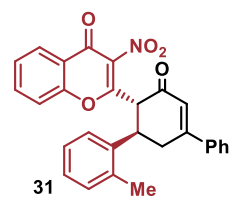
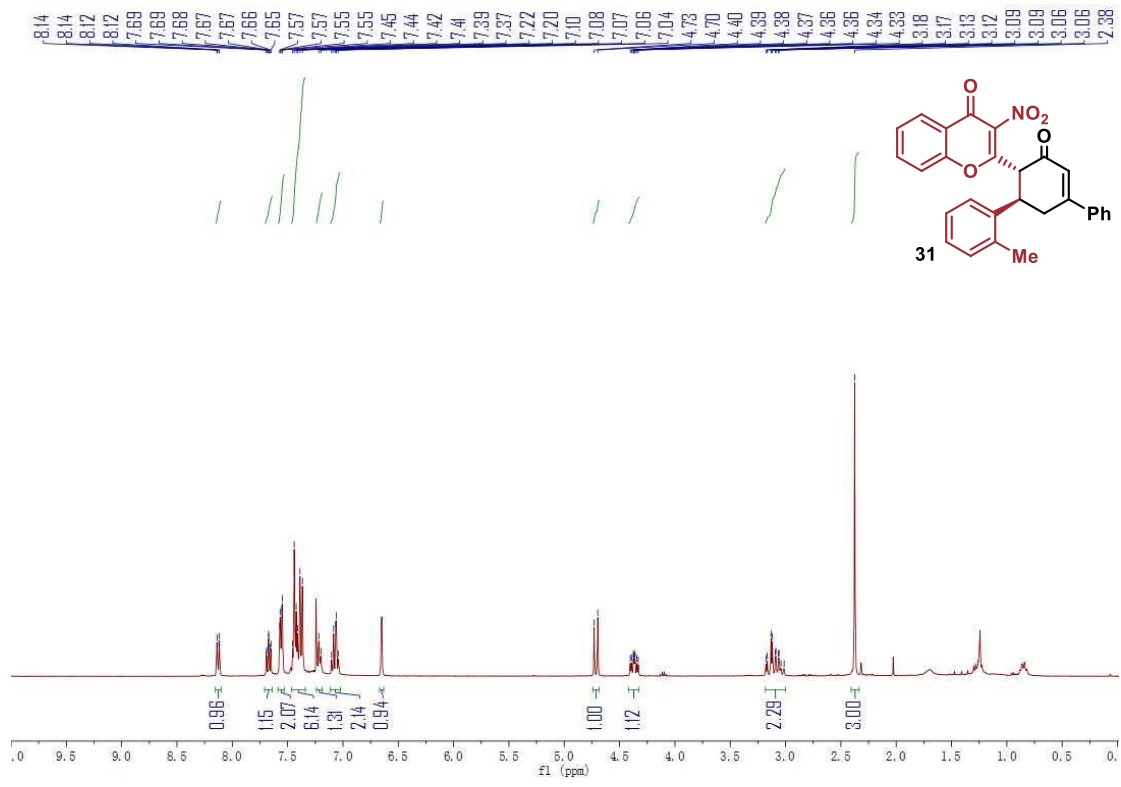


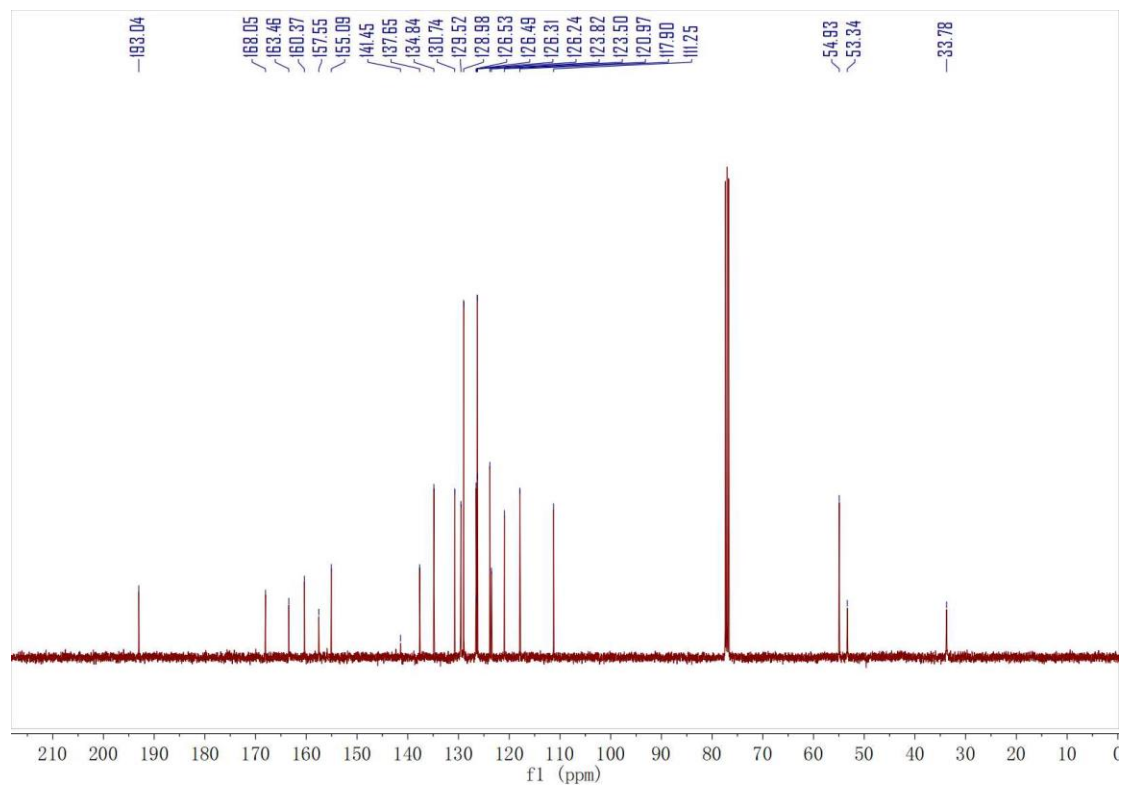
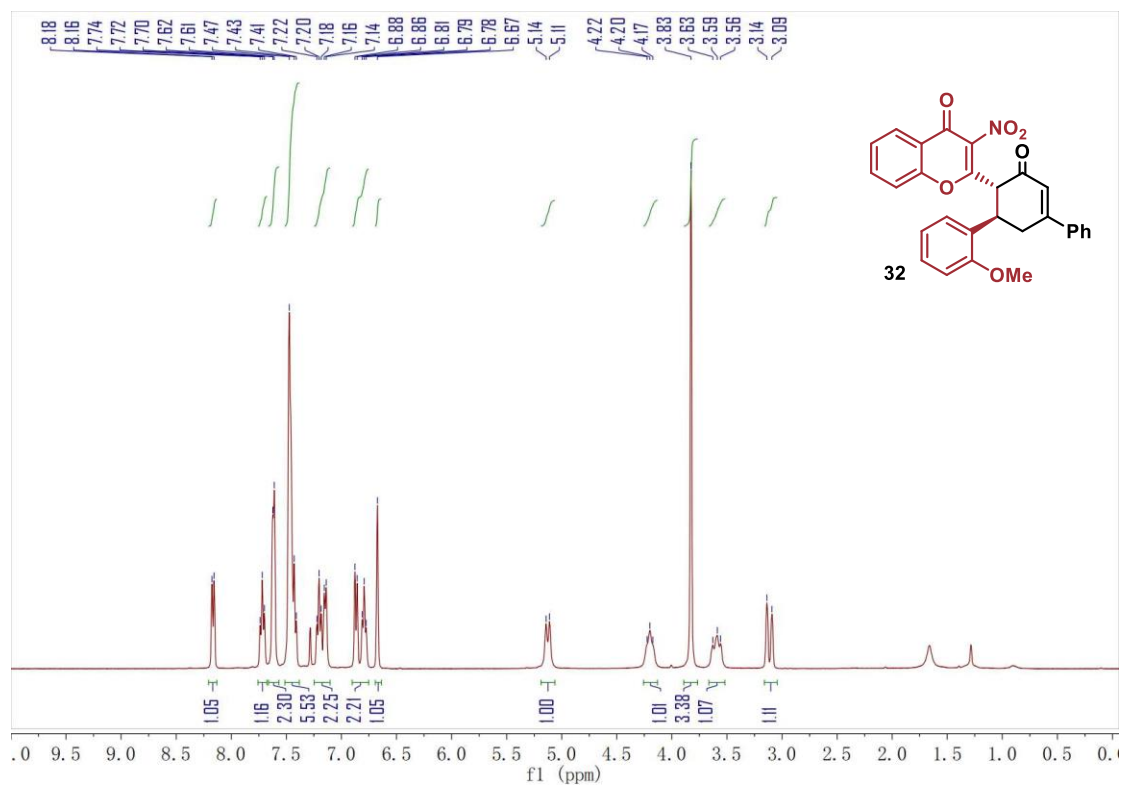


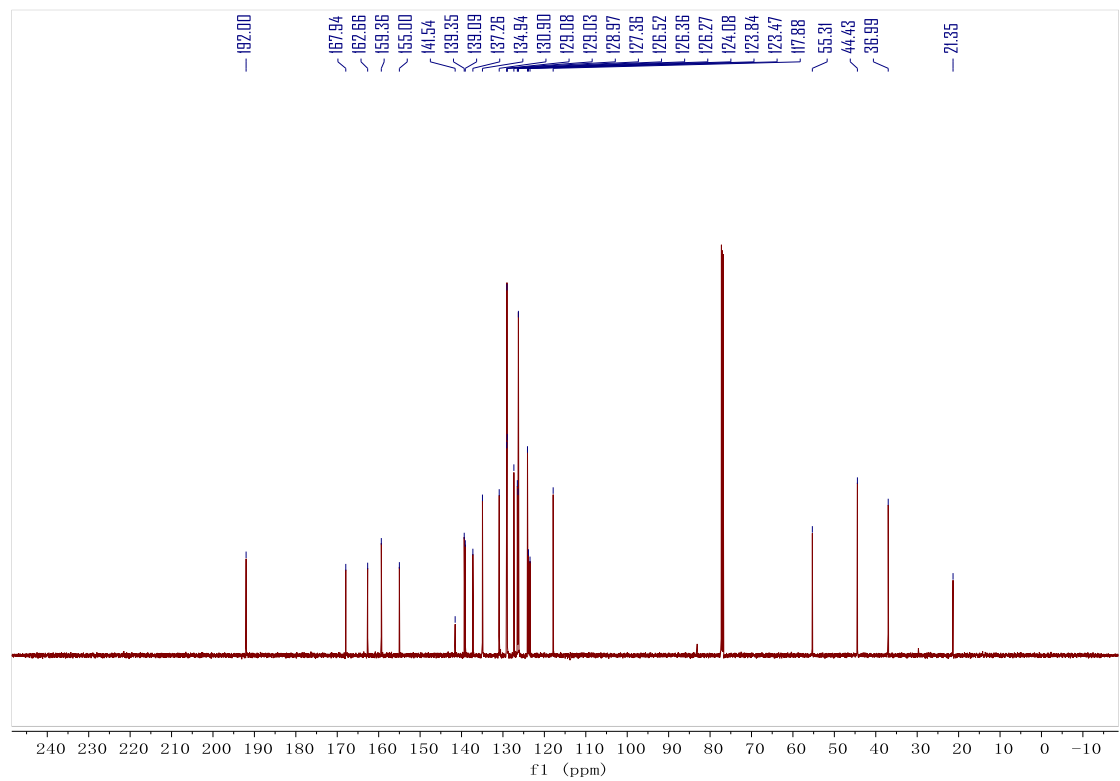
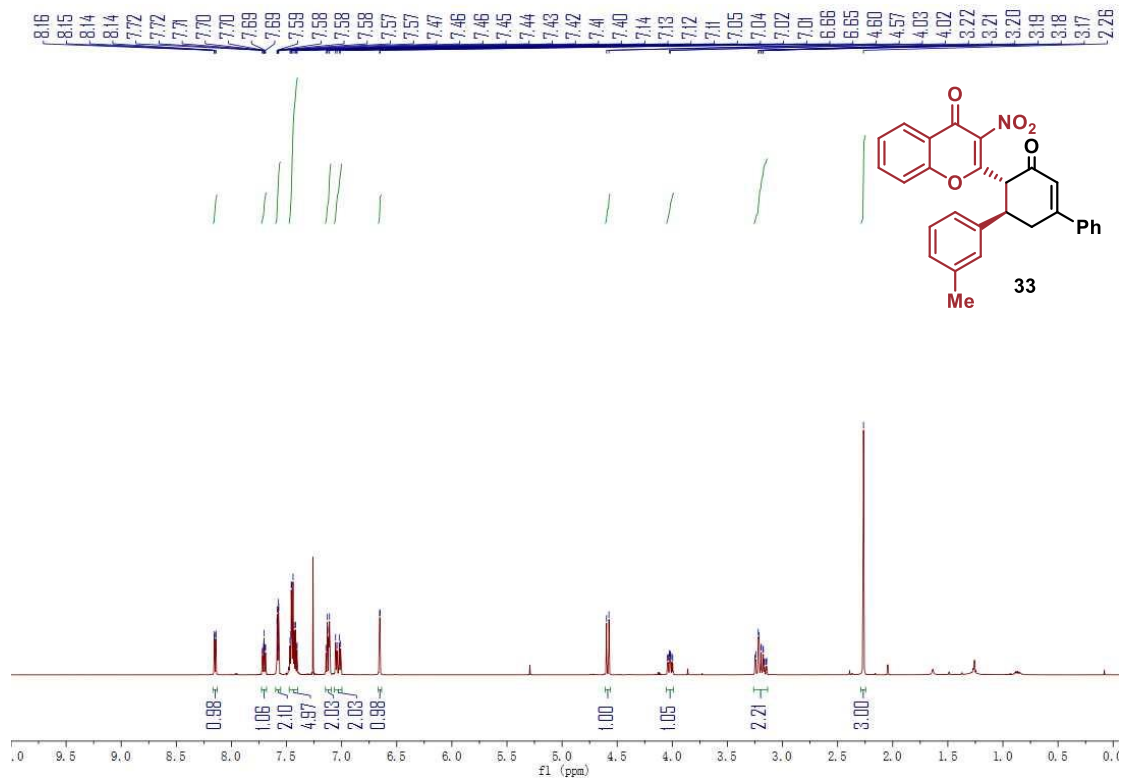




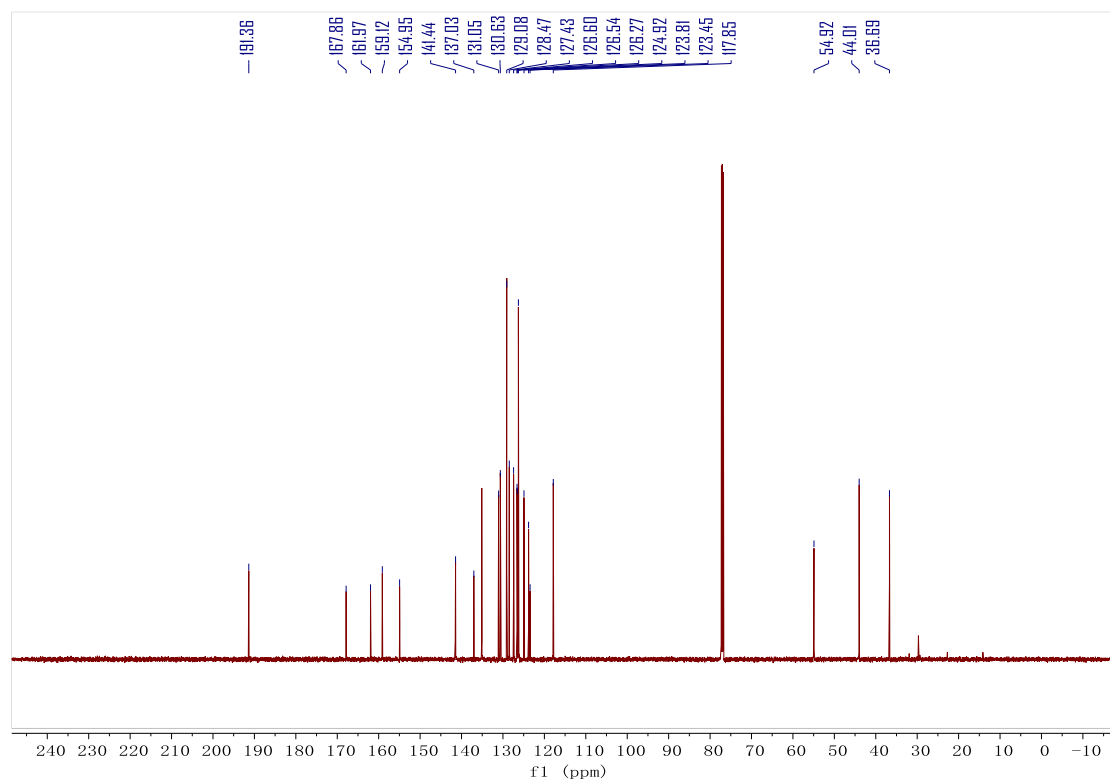
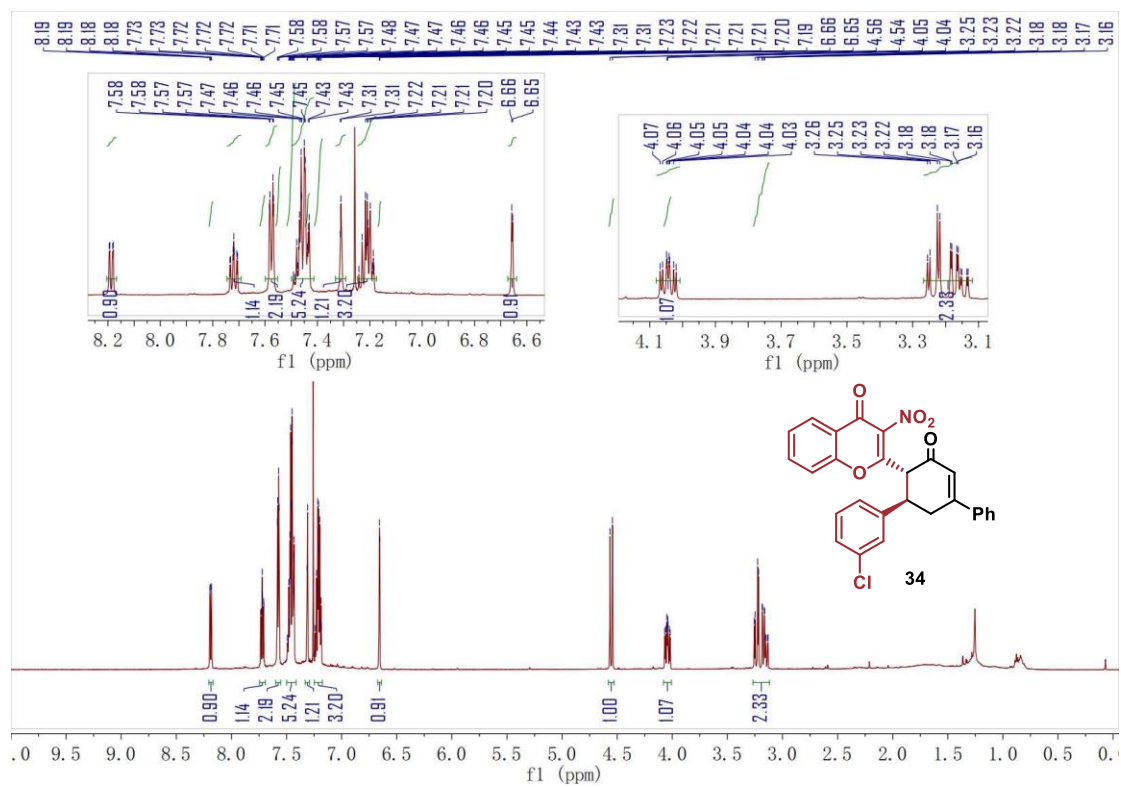


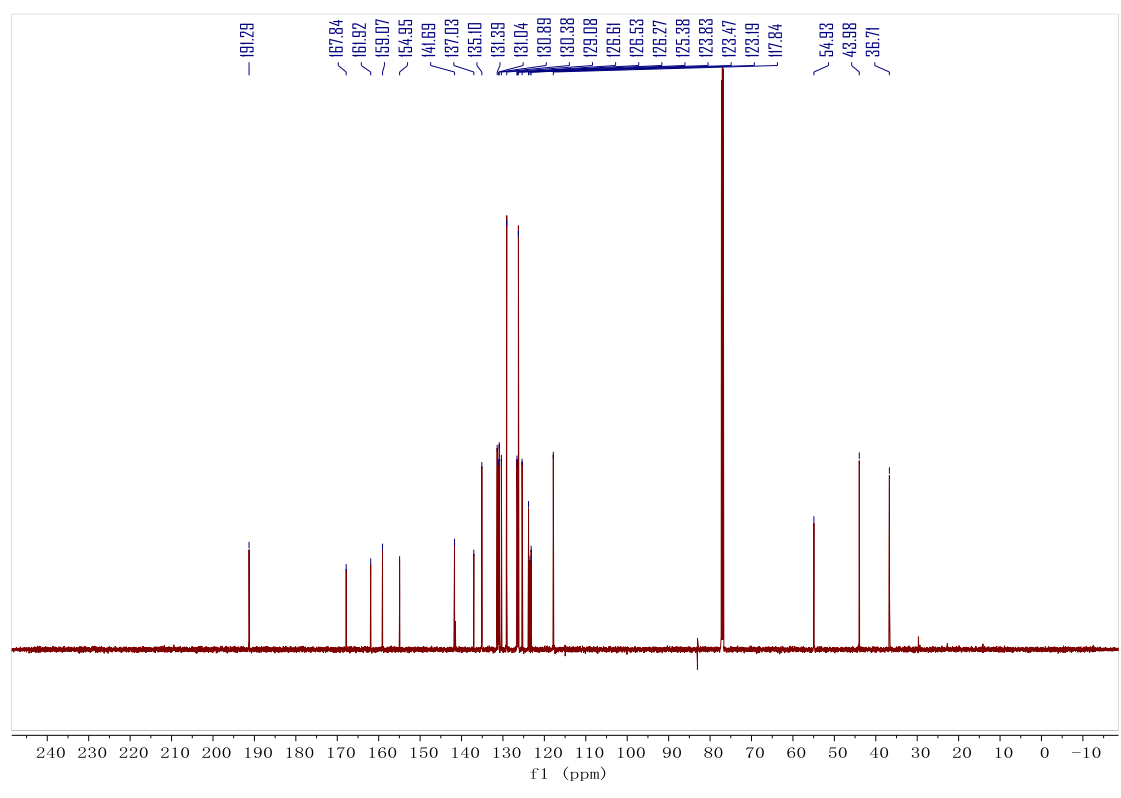
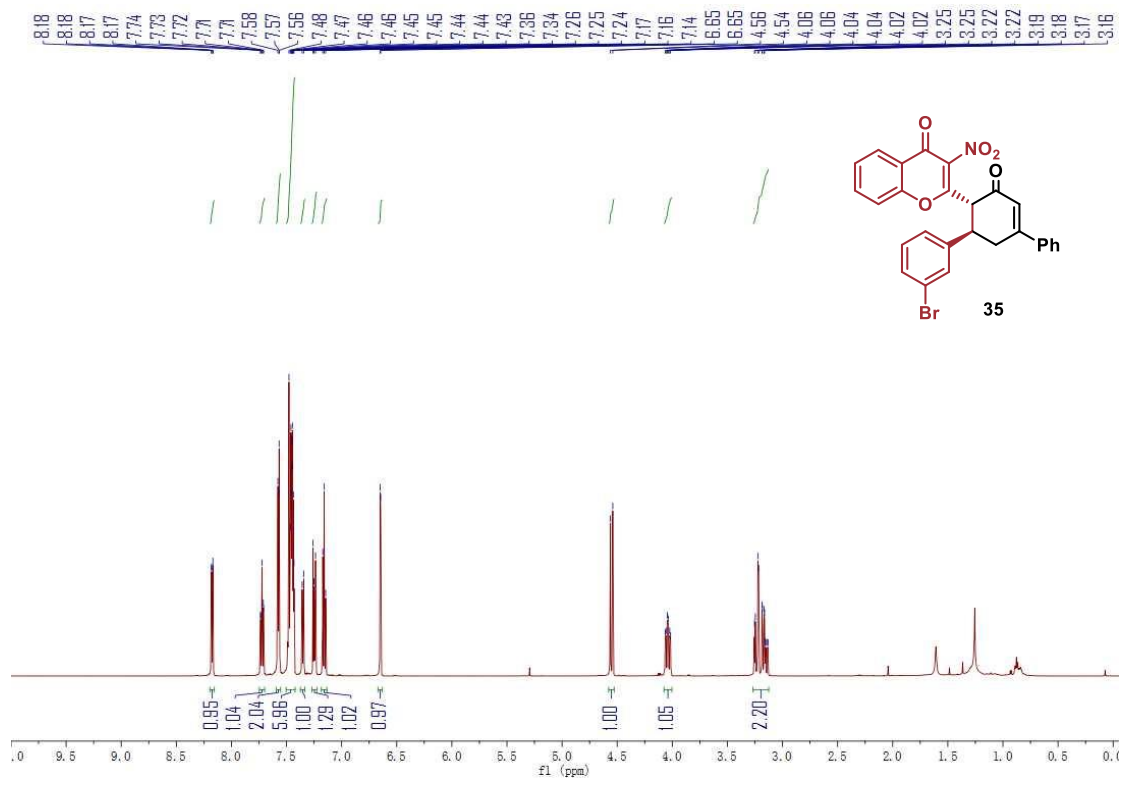


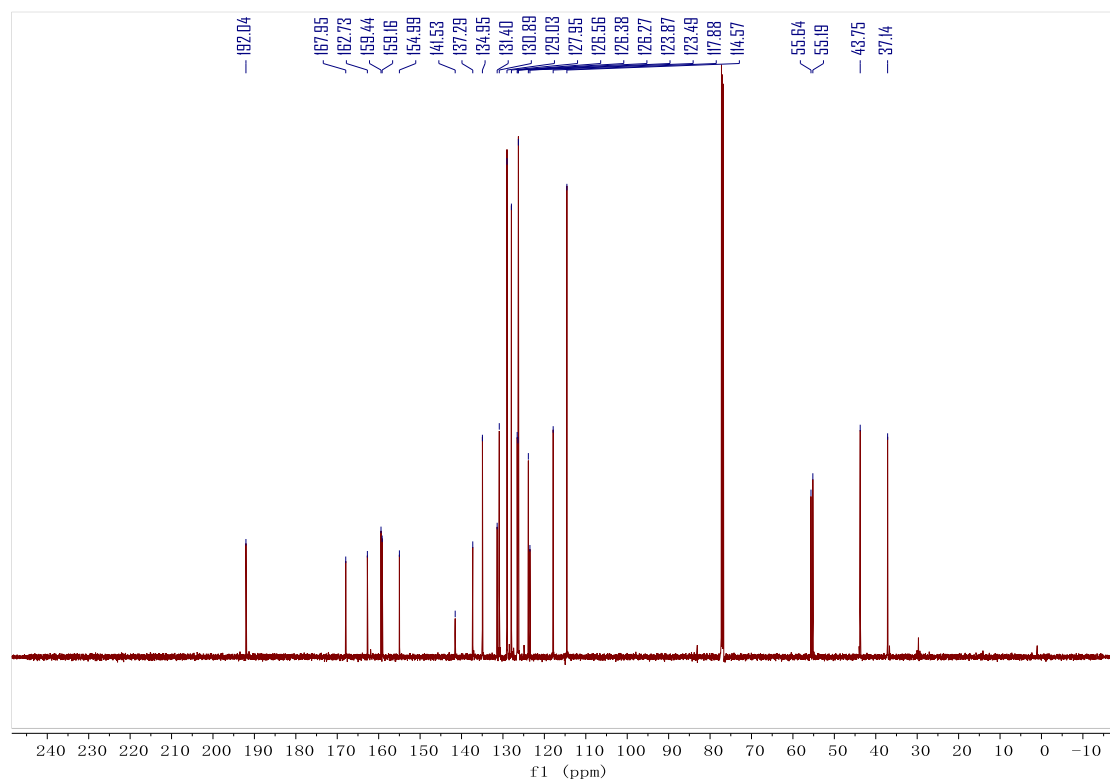
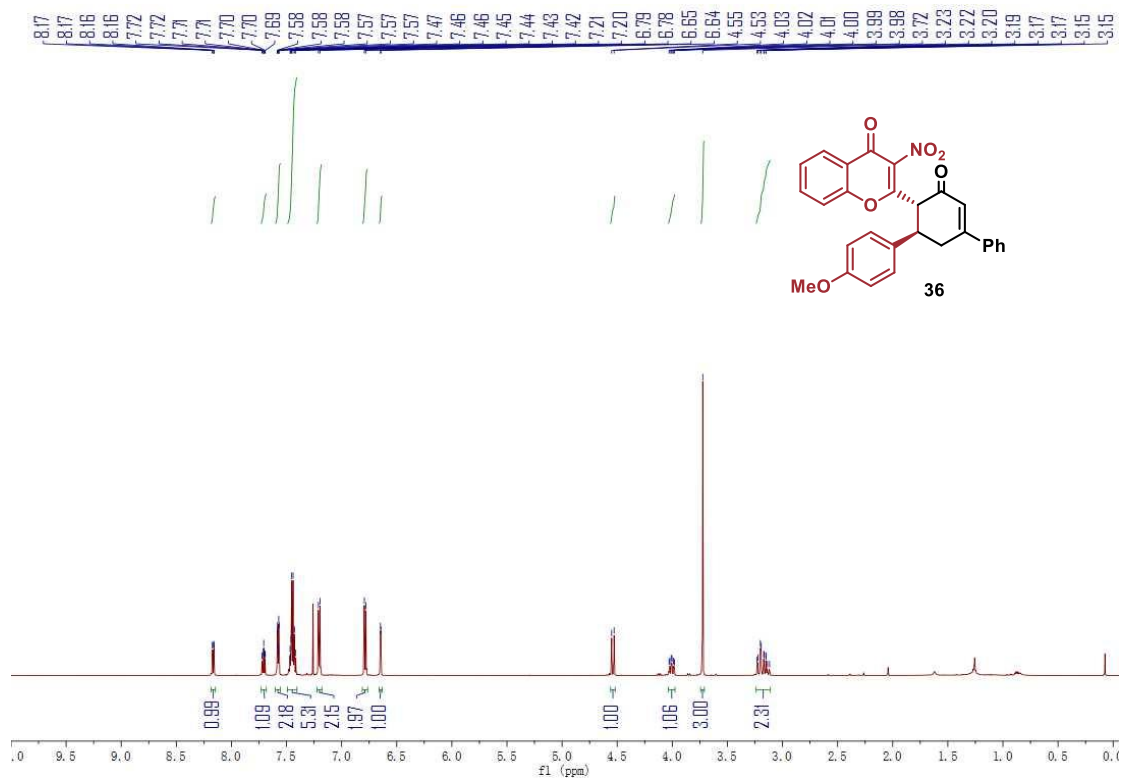


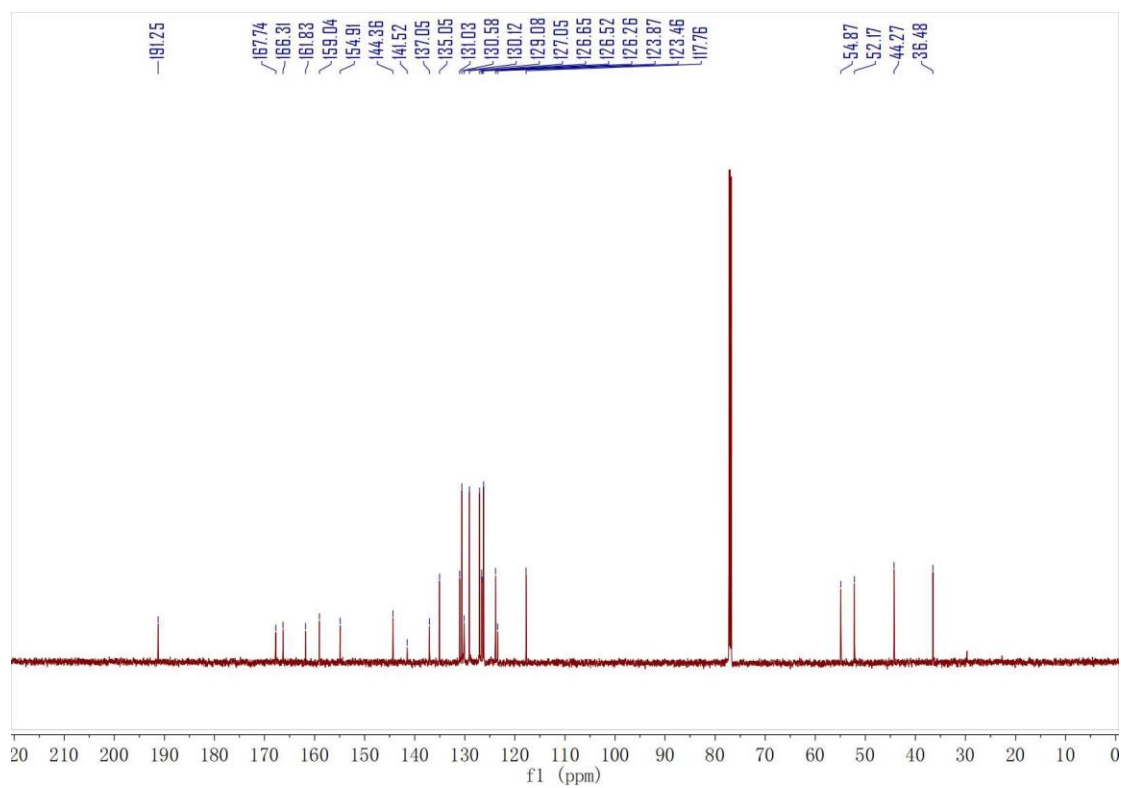
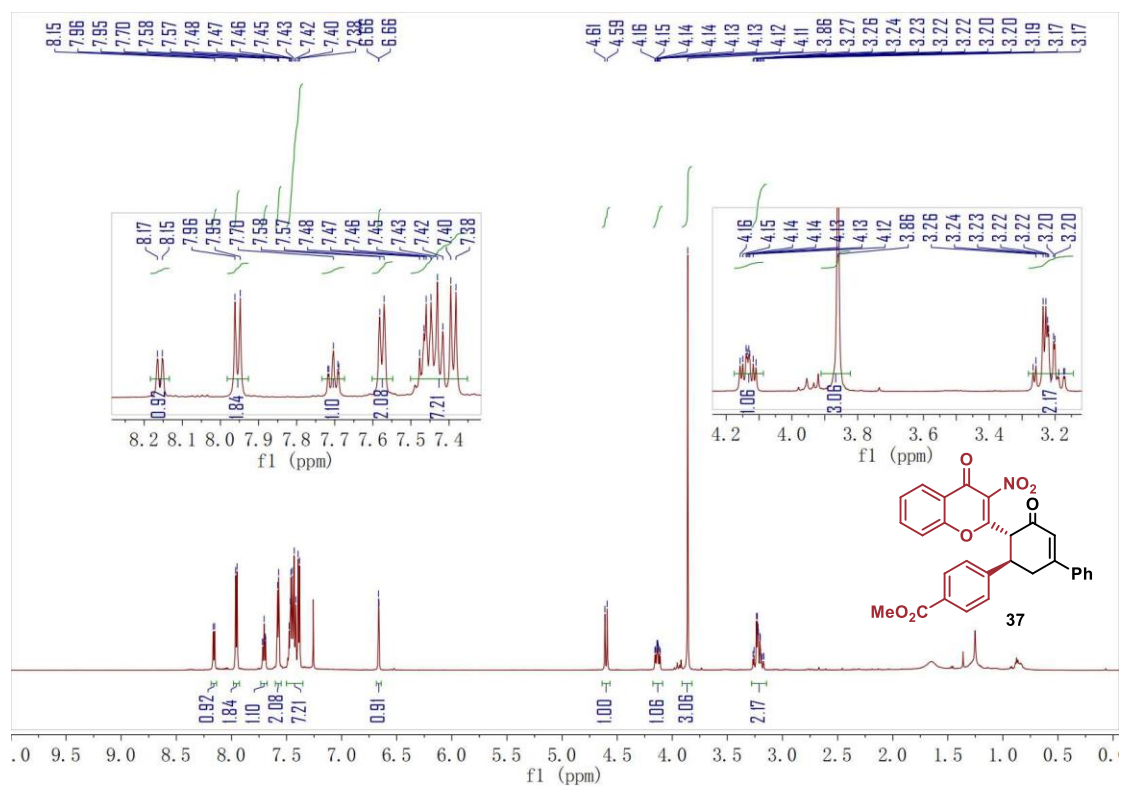


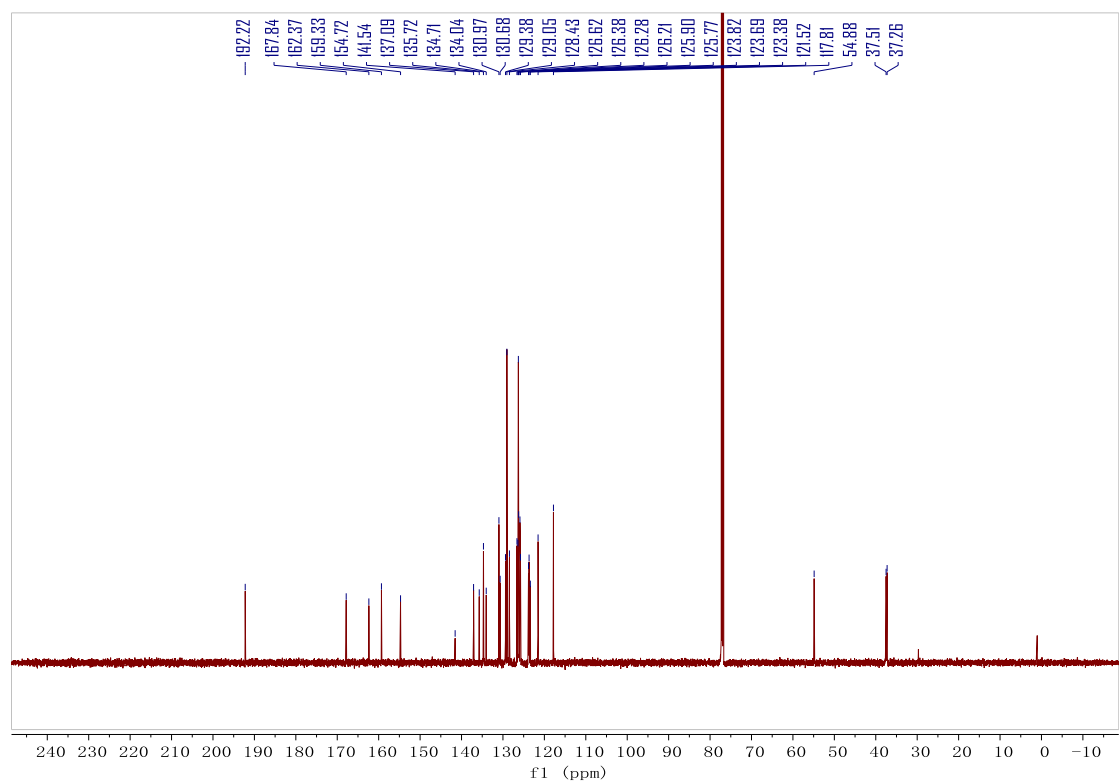
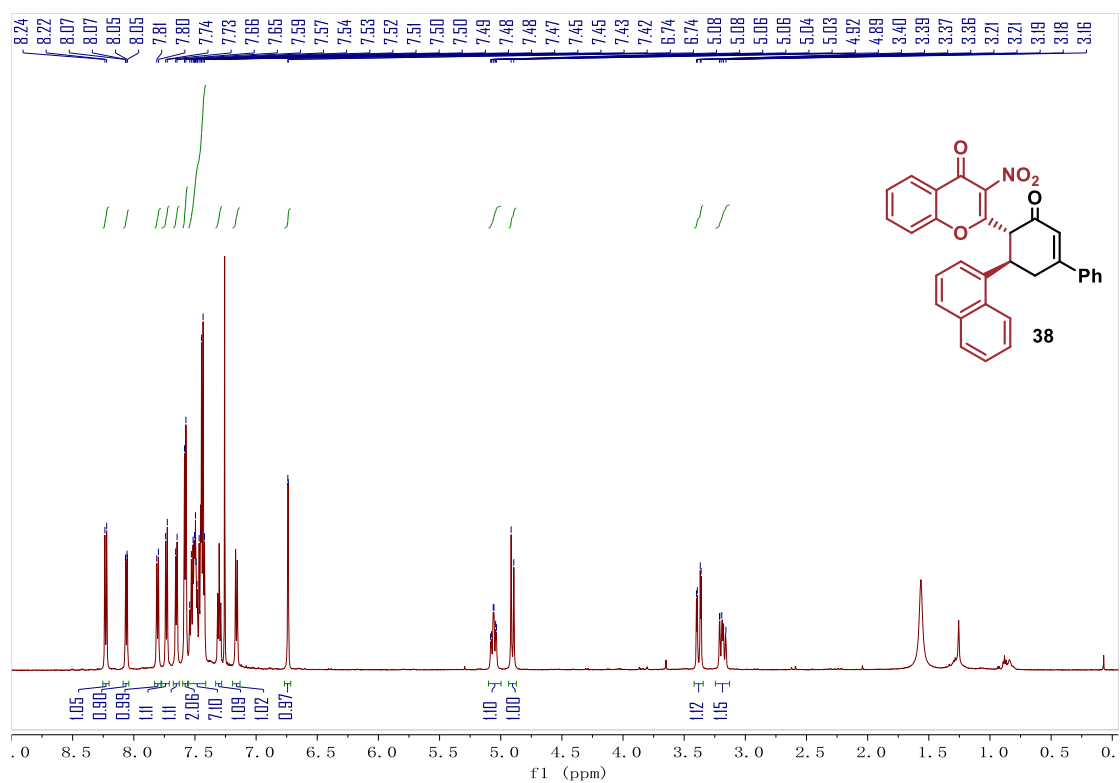


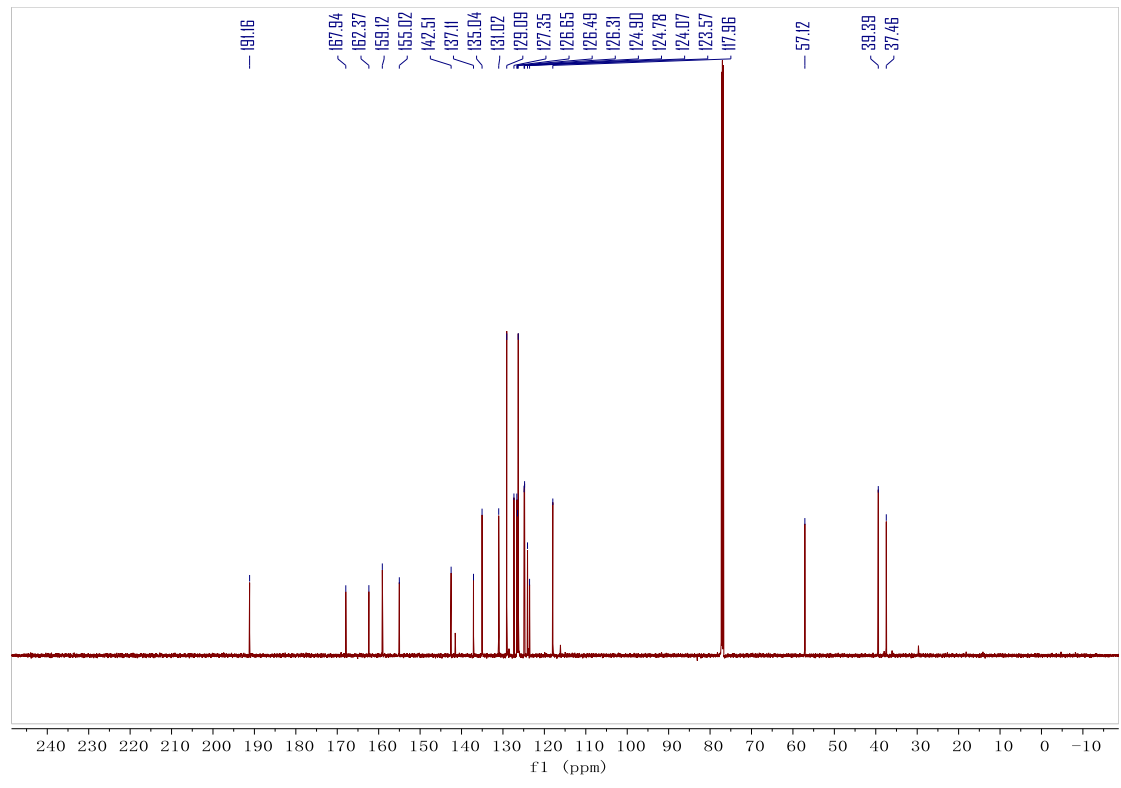
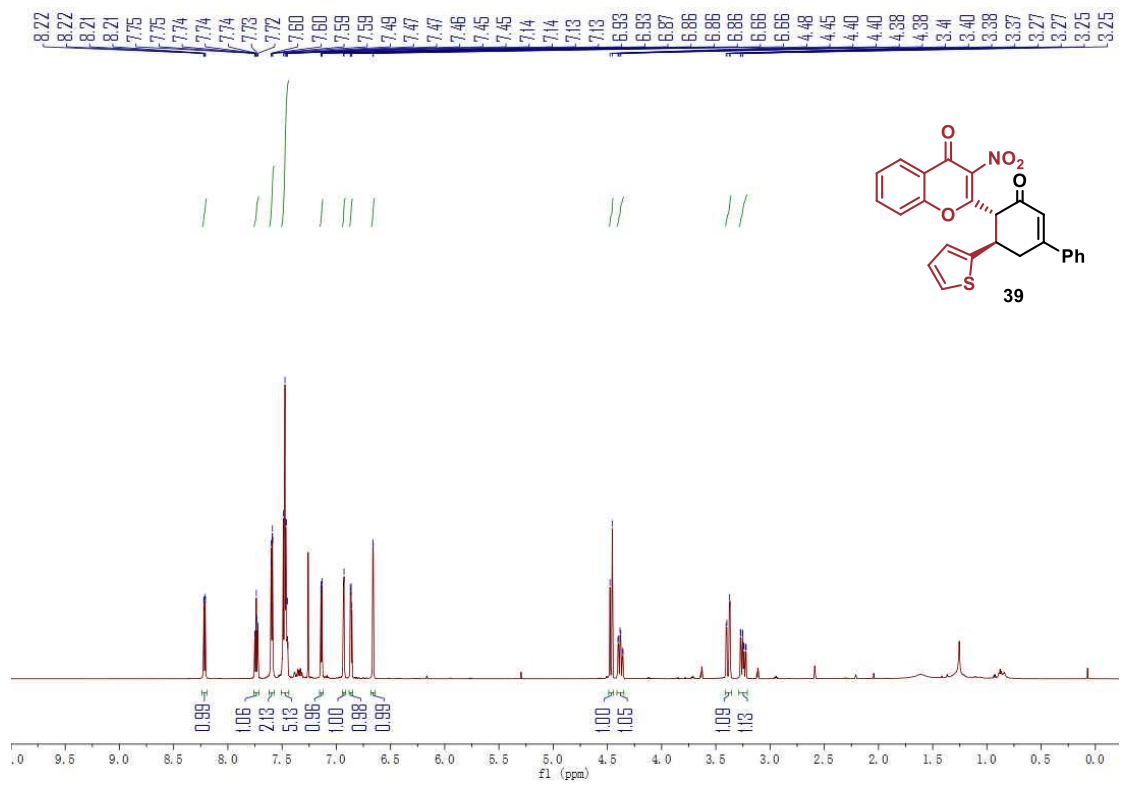




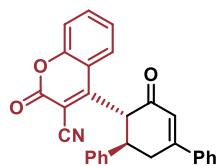








## 5 HPLC Data



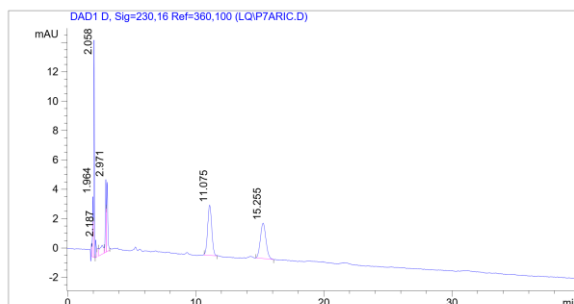
4

Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 15:09:24  
Injektion Date: 30.07.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.4 32.5  
Flow in ml/min: 1.00 1.00

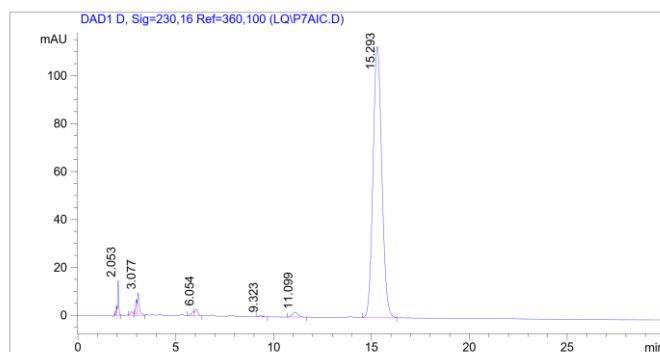


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.96	0.06	4.10	17.14	5.85
2	2.06	0.06	14.81	53.16	18.14
3	2.19	0.07	1.21	6.35	2.17
4	2.68	0.26	0.62	12.92	4.41
5	2.97	0.08	4.95	26.52	9.05
6	3.08	0.09	4.72	28.30	9.65
7	11.08	0.34	3.43	75.96	25.92
8	15.25	0.43	2.42	72.71	24.81
Total				293.07	100.00

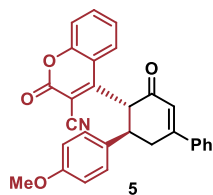
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:36:25  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.4 33.3  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.96	0.06	4.02	16.38	0.43
2	2.05	0.06	14.77	56.29	1.47
3	2.74	0.14	1.69	16.37	0.43
4	2.97	0.08	6.52	32.98	0.86
5	3.08	0.10	9.41	66.62	1.74
6	5.87	0.15	1.63	16.01	0.42
7	6.05	0.16	2.66	28.22	0.74
8	9.32	0.20	0.40	5.94	0.16
9	11.10	0.32	1.97	43.08	1.13
10	15.29	0.48	113.23	3537.95	92.62
Total				3819.83	100.00

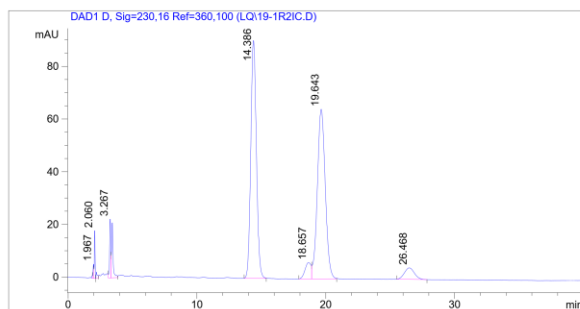


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 10:10:56  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 31.7 32.5  
Flow in ml/min: 1.00 1.00

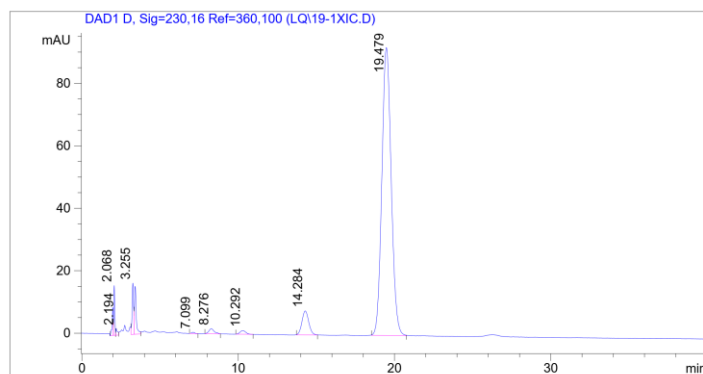


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.97	0.06	5.43	22.88	0.36
2	2.06	0.06	18.15	71.14	1.12
3	2.19	0.09	2.46	15.85	0.25
4	3.27	0.10	22.36	141.50	2.23
5	3.42	0.11	20.94	163.64	2.58
6	14.39	0.47	90.31	2727.01	43.02
7	18.66	0.48	6.20	201.19	3.17
8	19.64	0.67	64.38	2758.27	43.52
9	26.47	0.65	4.38	237.10	3.74
Total				6338.57	100.00

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

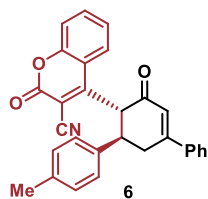
Injektion Time: 14:18:22  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 31.6 32.1  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.97	0.07	8.92	43.61	0.97
2	2.07	0.06	15.95	68.34	1.52
3	2.19	0.10	2.09	15.21	0.34
4	3.25	0.10	16.42	106.10	2.36
5	3.41	0.12	15.33	123.46	2.75
6	7.10	0.19	0.40	5.08	0.11
7	8.28	0.34	1.61	38.71	0.86
8	10.29	0.36	1.18	30.17	0.67
9	14.28	0.46	7.69	231.48	5.15
10	19.48	0.64	92.17	3829.39	85.26
Total				4491.55	100.00



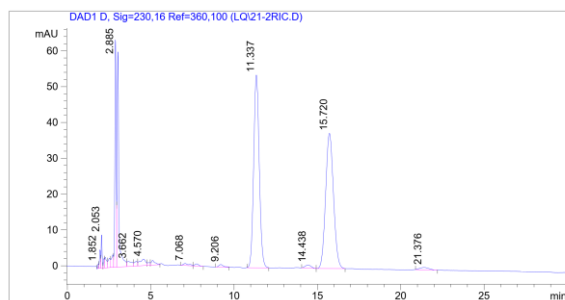


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 09:31:29  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.9 33.7  
Flow in ml/min: 1.00 1.00

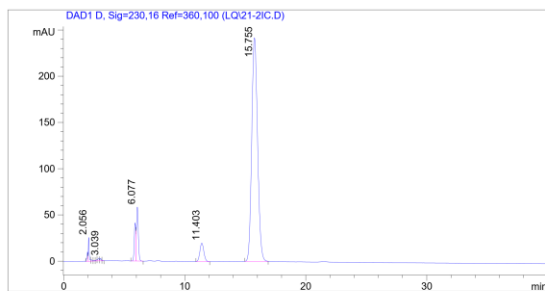


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.85	0.05	1.20	3.92	0.11
2	1.96	0.07	5.15	22.65	0.63
3	2.05	0.06	9.33	36.73	1.02
4	2.19	0.05	2.57	9.09	0.25
5	2.27	0.12	2.95	25.81	0.72
6	2.52	0.14	2.63	27.06	0.75
7	2.72	0.11	3.50	29.49	0.82
8	2.88	0.08	63.55	334.24	9.31
9	3.03	0.10	60.08	414.59	11.55
10	3.66	0.26	1.43	28.60	0.80
11	4.13	0.18	1.31	17.30	0.48
12	4.57	0.33	1.83	43.45	1.21
13	4.88	0.15	0.75	8.67	0.24
14	5.12	0.23	1.33	22.02	0.61
15	7.07	0.32	0.56	13.73	0.38
16	7.75	0.24	0.59	10.05	0.28
17	9.21	0.26	0.71	14.02	0.39
18	11.34	0.36	53.79	1243.44	34.63
19	14.44	0.33	0.85	21.28	0.59
20	15.72	0.51	37.77	1237.98	34.48
21	21.38	0.48	0.65	26.02	0.72
Total				3590.13	100.00

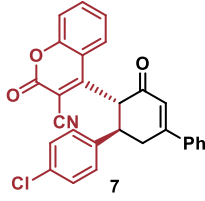
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 08:09:02  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.8 33.4  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.96	0.07	10.22	52.12	0.53
2	2.06	0.07	25.76	119.63	1.22
3	2.30	0.09	1.52	9.98	0.10
4	2.52	0.12	0.71	6.20	0.06
5	2.72	0.09	1.40	8.92	0.09
6	2.88	0.12	3.14	26.47	0.27
7	3.04	0.10	2.82	18.47	0.19
8	3.19	0.09	0.75	4.71	0.05
9	5.89	0.14	41.26	370.11	3.78
10	6.08	0.16	58.46	633.26	6.47
11	11.40	0.36	20.11	465.31	4.76
12	15.76	0.52	241.78	8070.47	82.47
Total				9785.66	100.00

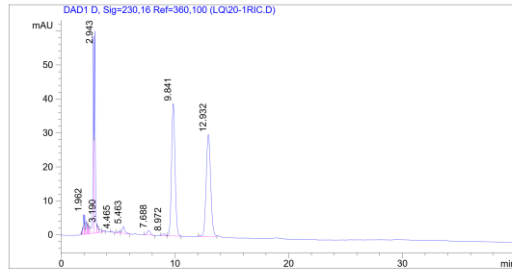


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:43:09  
Injektion Date: 30.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.4 33.0  
Flow in ml/min: 1.00 1.00

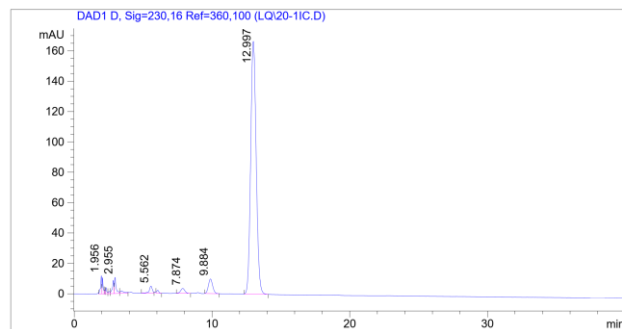


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.85	0.07	1.87	8.57	0.33
2	1.96	0.07	5.97	27.89	1.09
3	2.06	0.06	5.66	25.45	0.99
4	2.19	0.09	3.75	21.86	0.85
5	2.30	0.08	2.70	15.72	0.61
6	2.40	0.09	2.25	13.97	0.55
7	2.82	0.08	58.27	321.51	12.55
8	2.94	0.09	59.69	353.81	13.81
9	3.19	0.09	2.18	13.59	0.53
10	3.33	0.16	0.94	11.72	0.46
11	3.65	0.17	0.42	5.67	0.22
12	4.47	0.13	0.31	2.73	0.11
13	5.05	0.18	0.49	6.12	0.24
14	5.46	0.24	2.04	34.22	1.34
15	7.69	0.31	1.34	27.24	1.06
16	8.97	0.26	0.60	10.75	0.42
17	9.84	0.33	38.99	834.12	32.55
18	12.93	0.43	29.99	827.35	32.29
Total				2562.27	100.00

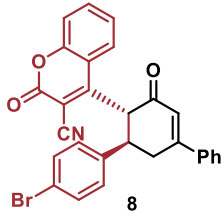
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 08:50:14  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.8 33.7  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.96	0.08	11.98	63.96	1.20
2	2.05	0.07	10.59	49.37	0.92
3	2.20	0.06	2.37	10.01	0.19
4	2.30	0.08	4.12	24.77	0.46
5	2.53	0.10	1.52	11.29	0.21
6	2.83	0.11	8.70	65.83	1.23
7	2.96	0.12	10.61	89.43	1.67
8	3.42	0.25	1.74	34.47	0.64
9	5.56	0.23	4.70	72.87	1.36
10	6.06	0.16	2.00	21.67	0.41
11	7.87	0.32	3.25	71.51	1.34
12	9.88	0.34	9.65	208.20	3.89
13	13.00	0.43	166.57	4624.96	86.47
Total				5348.36	100.00

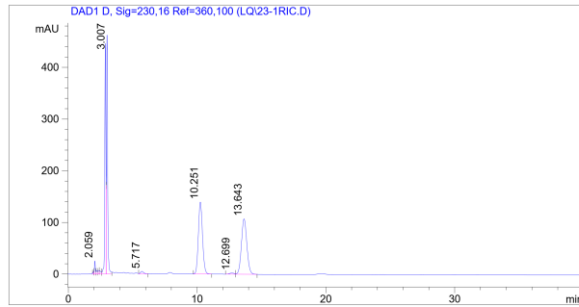


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 13:05:38  
Injektion Date: 30.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.6 33.0  
Flow in ml/min: 1.00 1.00

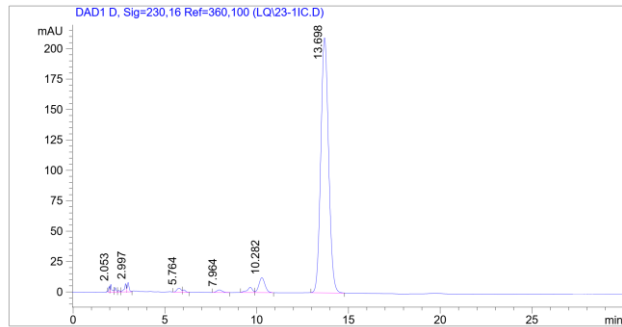


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.97	0.07	5.73	25.99	0.21
2	2.06	0.07	25.81	119.53	0.99
3	2.19	0.08	6.75	38.34	0.32
4	2.35	0.12	7.36	56.82	0.47
5	2.44	0.12	6.86	61.53	0.51
6	2.87	0.09	447.68	2556.05	21.13
7	3.01	0.09	463.34	2804.47	23.18
8	5.72	0.25	4.78	80.68	0.67
9	10.25	0.35	139.34	3137.88	25.94
10	12.70	0.39	2.33	58.90	0.49
11	13.64	0.46	107.21	3156.05	26.09
Total				12096.24	100.00

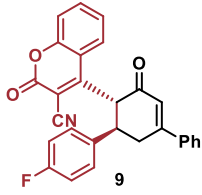
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 10:02:42  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.8 33.3  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.96	0.06	4.59	19.18	0.28
2	2.05	0.08	6.38	35.09	0.51
3	2.30	0.08	3.74	20.61	0.30
4	2.48	0.10	1.34	9.52	0.14
5	2.86	0.11	6.78	51.69	0.75
6	3.00	0.10	7.74	52.87	0.77
7	5.76	0.26	3.19	52.46	0.76
8	6.04	0.16	1.94	20.69	0.30
9	7.96	0.31	2.15	45.41	0.66
10	9.65	0.30	4.35	88.86	1.29
11	10.28	0.35	12.31	280.89	4.08
12	13.70	0.46	209.73	6203.89	90.16
Total				6881.17	100.00

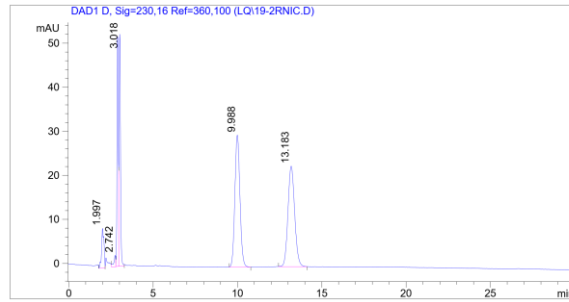


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 10:40:37  
Injektion Date: 30.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.7 33.5  
Flow in ml/min: 1.00 1.00

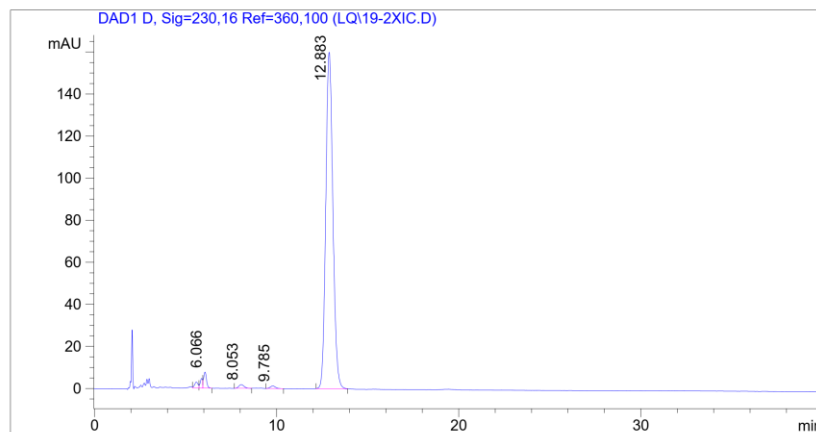


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	2.00	0.14	8.98	88.15	4.56
2	2.74	0.10	2.60	18.22	0.94
3	2.89	0.08	52.18	270.79	14.01
4	3.02	0.09	52.66	301.10	15.57
5	9.99	0.32	29.95	626.29	32.39
6	13.18	0.43	22.80	628.95	32.53
Total				1933.50	100.00

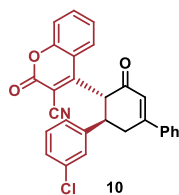
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 14:59:38  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 31.5 32.3  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	5.59	0.21	2.89	38.54	0.84
2	5.88	0.14	4.65	42.40	0.93
3	6.07	0.16	7.71	85.18	1.86
4	8.05	0.31	1.77	35.63	0.78
5	9.79	0.30	1.20	24.65	0.54
6	12.88	0.42	160.09	4341.88	95.04
Total				4568.29	100.00

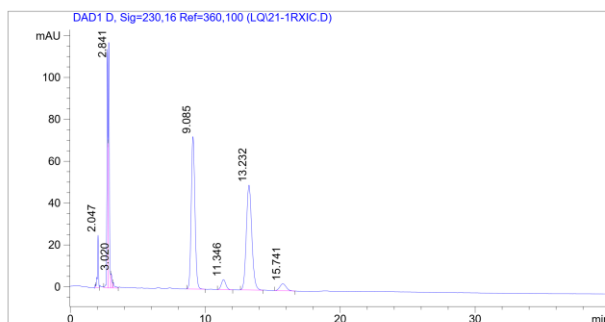


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 15:43:22  
Injektion Date: 05.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 33.1 33.6  
Flow in ml/min: 1.00 1.00

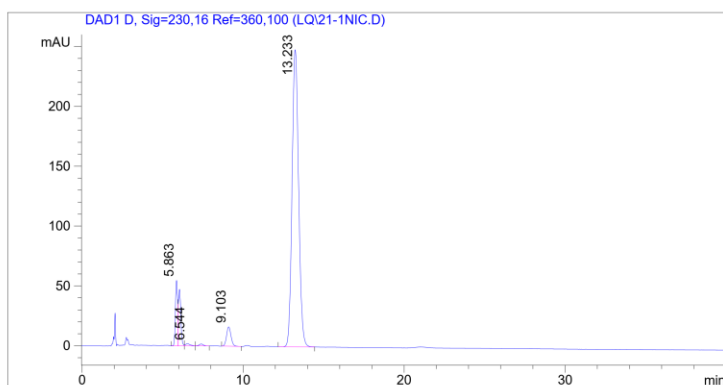


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	2.05	0.07	25.10	119.30	2.70
2	2.74	0.07	114.03	553.80	12.51
3	2.84	0.08	117.28	651.26	14.71
4	3.02	0.10	6.87	45.63	1.03
5	3.18	0.12	2.67	23.62	0.53
6	9.09	0.29	72.76	1390.04	31.41
7	11.35	0.36	4.79	110.60	2.50
8	13.23	0.44	50.07	1420.75	32.10
9	15.74	0.50	3.36	111.05	2.51
Total				4426.04	100.00

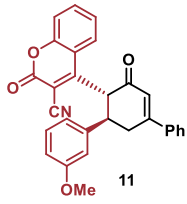
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 14:47:15  
Injektion Date: 05.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.5 33.1  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	5.86	0.15	54.82	529.33	6.31
2	6.05	0.15	47.35	490.03	5.84
3	6.54	0.29	1.96	39.71	0.47
4	7.39	0.29	1.61	30.19	0.36
5	9.10	0.30	16.15	311.14	3.71
6	13.23	0.44	248.29	6984.38	83.30
Total				8384.79	100.00

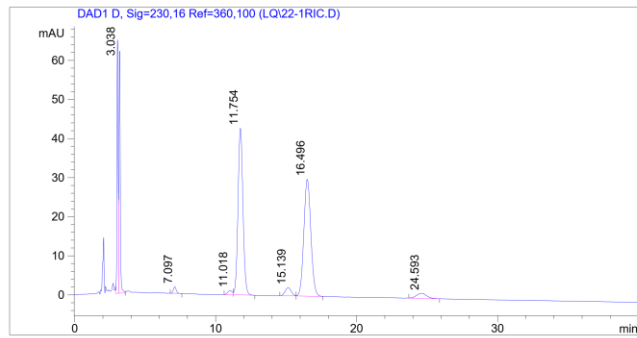


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 10:49:26  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.2 33.0  
Flow in ml/min: 1.00 1.00

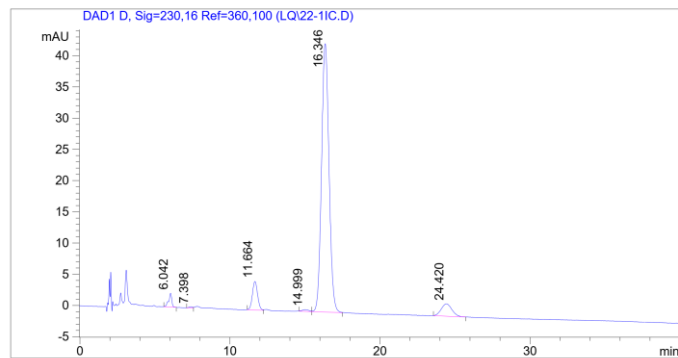


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	3.04	0.09	64.90	363.09	12.03
2	3.18	0.10	61.92	396.11	13.13
3	7.10	0.21	1.71	23.86	0.79
4	11.02	0.32	1.07	22.91	0.76
5	11.75	0.38	42.64	1042.46	34.55
6	15.14	0.46	2.11	64.36	2.13
7	16.50	0.54	29.91	1038.53	34.42
8	24.59	0.61	1.32	65.94	2.19
Total				3017.27	100.00

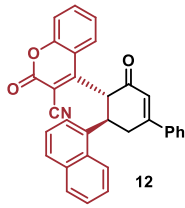
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:30:39  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.2 33.0  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	6.04	0.21	2.22	31.96	1.84
2	7.40	0.21	0.16	2.67	0.15
3	11.66	0.38	4.59	110.95	6.38
4	15.00	0.37	0.30	9.15	0.53
5	16.35	0.54	43.00	1485.89	85.41
6	24.42	0.64	1.99	99.06	5.69
Total				1739.67	100.00

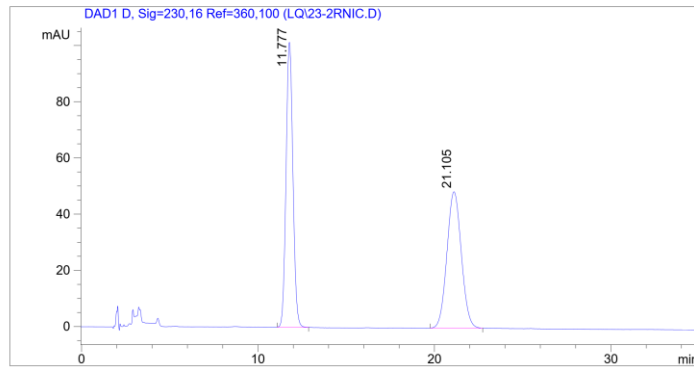


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 12:31:10  
Injektion Date: 08.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.9 33.1  
Flow in ml/min: 1.00 1.00

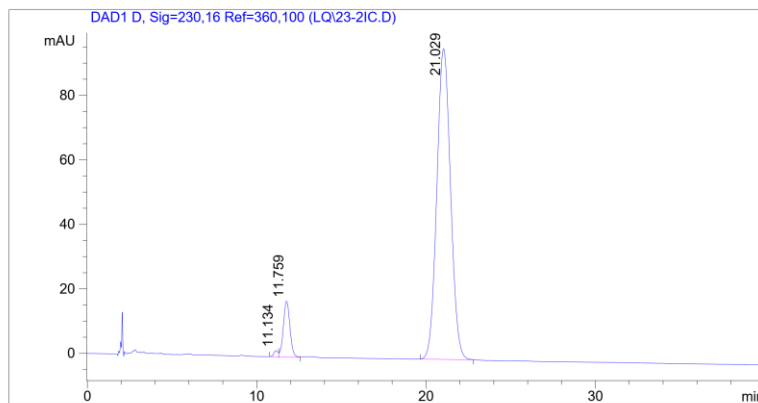


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.78	0.42	101.41	2736.84	49.87
2	21.10	0.88	48.54	2750.66	50.13
Total				5487.50	100.00

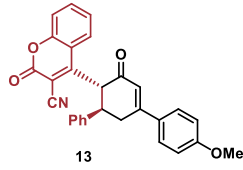
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 12:53:07  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.1 33.4  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.13	0.27	1.93	33.34	0.56
2	11.76	0.42	17.29	468.07	7.89
3	21.03	0.87	96.39	5434.17	91.55
Total				5935.59	100.00

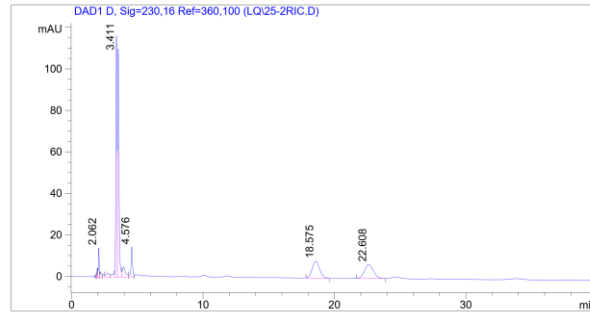


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 13:46:53  
Injektion Date: 30.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.2 32.8  
Flow in ml/min: 1.00 1.00

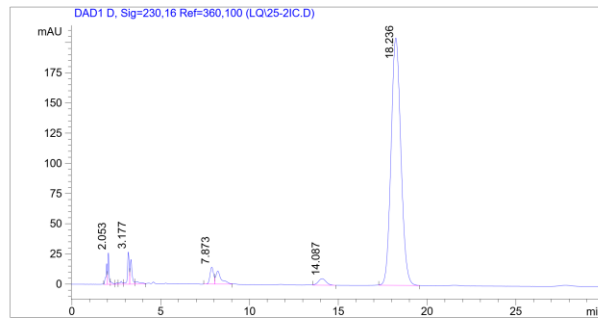


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.85	0.06	1.52	5.69	0.22
2	1.96	0.07	4.73	21.38	0.84
3	2.06	0.07	14.36	63.44	2.51
4	2.19	0.11	2.77	21.97	0.87
5	2.72	0.28	2.25	48.78	1.93
6	3.41	0.10	116.63	731.93	28.91
7	3.55	0.11	110.06	802.31	31.69
8	3.96	0.24	4.97	84.53	3.34
9	4.58	0.12	14.32	112.80	4.45
10	18.57	0.58	8.12	319.52	12.62
11	22.61	0.66	6.66	319.78	12.63
Total				2532.13	100.00

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

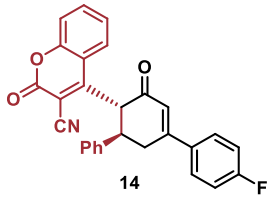
Injektion Time: 10:33:55  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.6 33.4  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.96	0.07	17.23	89.86	0.99
2	2.05	0.06	25.95	112.21	1.23
3	2.20	0.12	1.86	17.62	0.19
4	2.53	0.10	1.23	8.95	0.10
5	2.77	0.13	2.43	24.49	0.27
6	3.18	0.10	26.69	170.70	1.88
7	3.32	0.11	20.47	155.60	1.71
8	3.66	0.31	2.10	47.92	0.53
9	7.87	0.22	14.05	199.48	2.19
10	8.21	0.30	10.84	233.17	2.57
11	14.09	0.45	5.44	164.59	1.81
12	18.24	0.60	204.84	7863.98	86.53
Total				9088.57	100.00



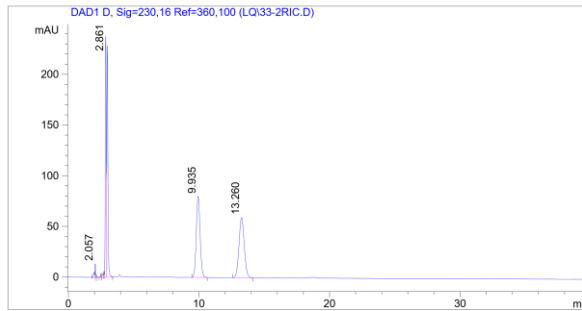


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MF

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 14:28:08  
Injektion Date: 30.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 31.9 32.6  
Flow in ml/min: 1.00 1.00

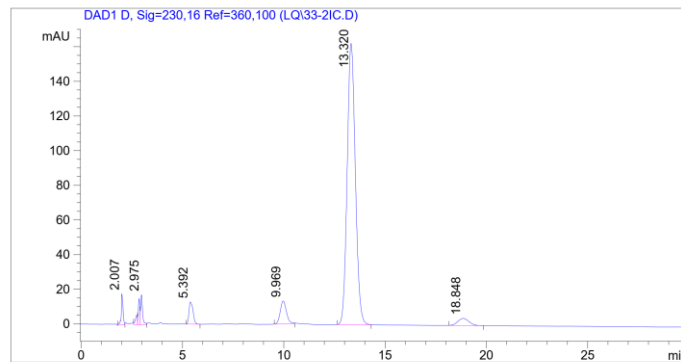


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.97	0.08	4.78	25.35	0.43
2	2.06	0.06	13.65	49.99	0.84
3	2.19	0.10	1.47	11.26	0.19
4	2.53	0.08	1.11	5.77	0.10
5	2.64	0.08	3.58	20.51	0.35
6	2.72	0.04	2.51	6.41	0.11
7	2.86	0.08	238.30	1193.10	20.11
8	2.98	0.09	229.20	1332.86	22.47
9	9.93	0.32	79.87	1626.32	27.42
10	13.26	0.43	59.32	1660.57	27.99
Total				5932.14	100.00

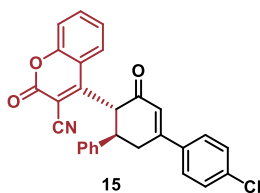
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:05:11  
Injektion Date: 31.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.5 33.5  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	2.01	0.08	17.94	106.75	1.94
2	2.74	0.10	5.40	38.23	0.70
3	2.86	0.08	15.04	79.41	1.44
4	2.97	0.09	17.21	110.00	2.00
5	5.39	0.23	12.83	178.98	3.26
6	9.97	0.33	13.21	279.43	5.08
7	13.32	0.43	162.29	4546.96	82.71
8	18.85	0.52	4.12	157.61	2.87
Total				5497.37	100.00

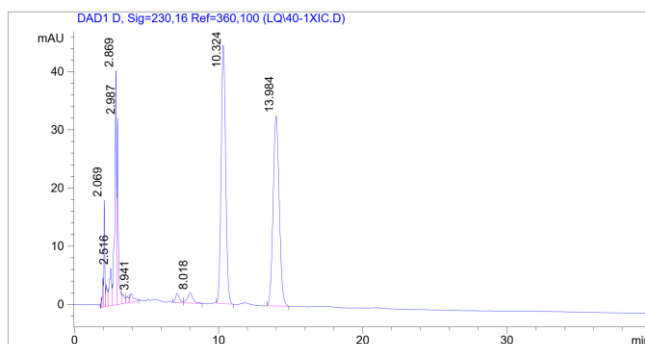


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 17:44:43  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 31.9 32.3  
Flow in ml/min: 1.00 1.00

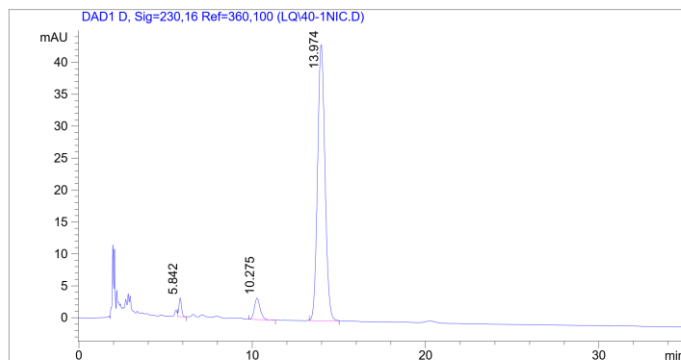


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.86	0.05	1.61	5.58	0.20
2	1.97	0.06	5.05	21.99	0.78
3	2.07	0.06	18.38	78.84	2.81
4	2.20	0.10	3.80	29.96	1.07
5	2.52	0.15	6.49	74.54	2.66
6	2.87	0.11	40.28	318.35	11.35
7	2.99	0.10	32.15	214.45	7.64
8	3.37	0.16	1.53	18.47	0.66
9	3.66	0.16	1.12	13.15	0.47
10	3.94	0.25	1.46	27.12	0.97
11	7.13	0.28	1.55	30.12	1.07
12	8.02	0.38	1.73	46.93	1.67
13	10.32	0.34	44.50	959.96	34.22
14	13.98	0.46	32.71	965.84	34.43
Total				2805.30	100.00

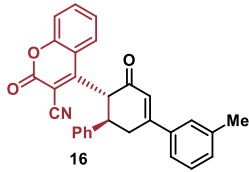
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:54:56  
Injektion Date: 08.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.5 32.8  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	5.84	0.16	2.93	30.86	2.21
2	10.27	0.35	3.37	78.75	5.65
3	13.97	0.46	43.22	1284.57	92.14
Total				1394.17	100.00

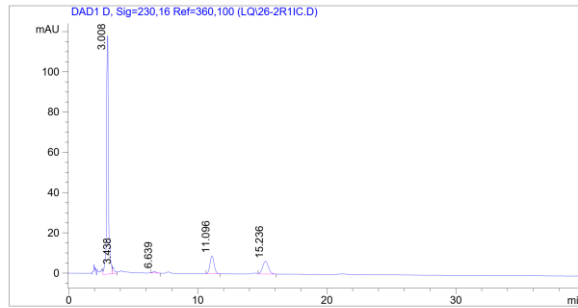


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:33:25  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.0 32.6  
Flow in ml/min: 1.00 1.00

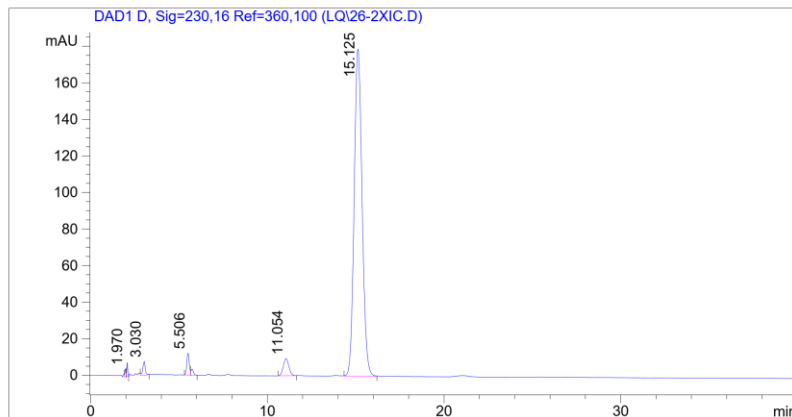


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	3.01	0.16	118.61	1251.09	73.49
2	3.44	0.15	3.14	35.70	2.10
3	6.64	0.26	0.81	15.13	0.89
4	11.10	0.34	8.86	199.88	11.74
5	15.24	0.46	6.38	200.66	11.79
Total				1702.46	100.00

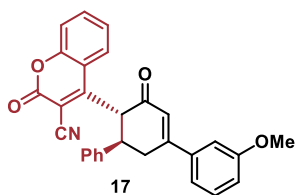
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 15:40:53  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 31.5 32.0  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.97	0.07	4.31	19.86	0.33
2	2.07	0.06	7.63	29.43	0.49
3	3.03	0.14	7.56	75.58	1.25
4	5.51	0.15	11.97	113.57	1.88
5	5.74	0.14	3.26	30.84	0.51
6	11.05	0.33	9.32	205.07	3.39
7	15.13	0.49	178.96	5582.57	92.17
Total				6056.92	100.00

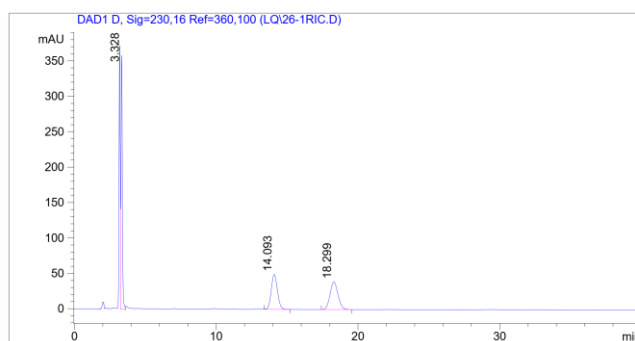


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 13:34:21  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.6 33.1  
Flow in ml/min: 1.00 1.00

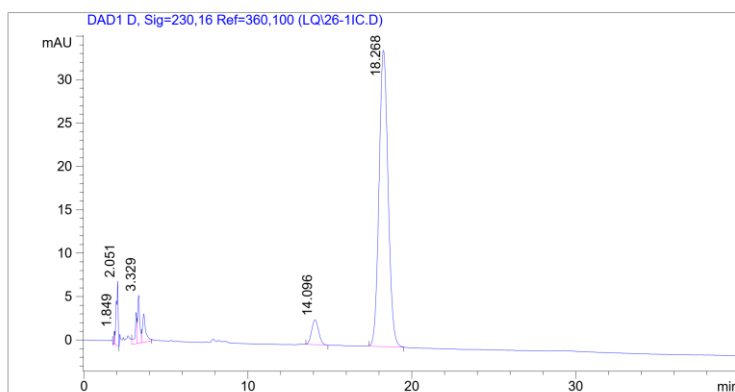


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	3.33	0.10	358.30	2330.11	43.67
2	14.09	0.47	49.47	1493.68	28.00
3	18.30	0.60	39.00	1511.73	28.33
Total				5335.52	100.00

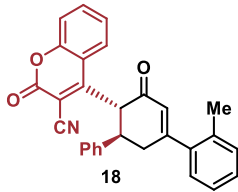
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 14:15:35  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.4 32.9  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.85	0.06	1.43	5.16	0.33
2	2.05	0.10	7.40	56.54	3.58
3	3.18	0.11	3.60	27.99	1.77
4	3.33	0.13	5.53	48.46	3.07
5	3.64	0.19	3.28	44.64	2.83
6	14.10	0.44	2.86	85.09	5.39
7	18.27	0.60	34.13	1309.46	83.02
Total				1577.33	100.00

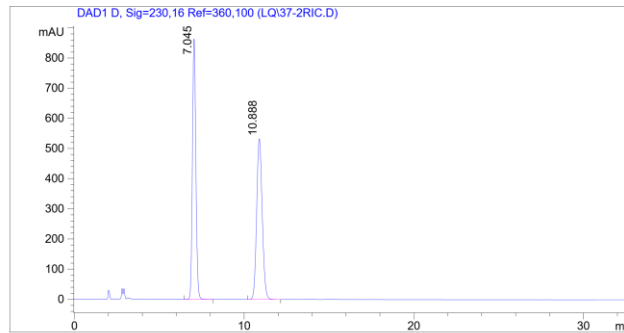


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 14:56:54  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.2 32.6  
Flow in ml/min: 1.00 1.00

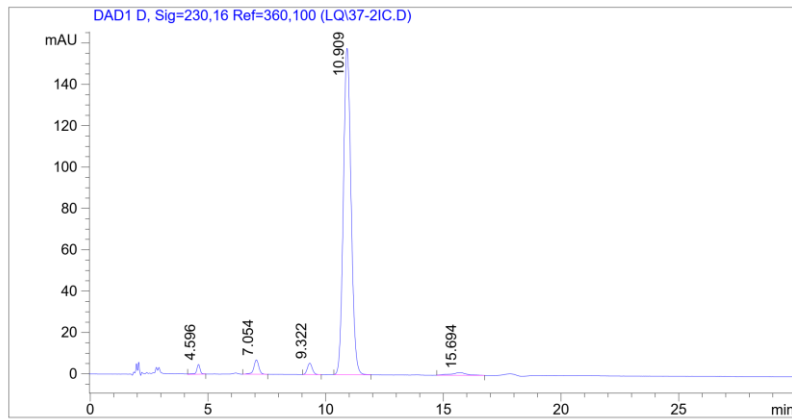


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	7.04	0.22	864.07	12077.90	49.82
2	10.89	0.35	532.74	12164.72	50.18
Total				24242.62	100.00

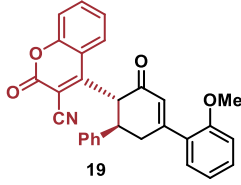
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 15:31:09  
Injektion Date: 06.08.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.7 32.7  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	4.60	0.16	4.77	50.42	1.29
2	7.05	0.23	6.98	103.92	2.67
3	9.32	0.23	5.52	81.08	2.08
4	10.91	0.35	157.92	3597.87	92.38
5	15.69	0.59	1.32	61.48	1.58
Total				3894.77	100.00

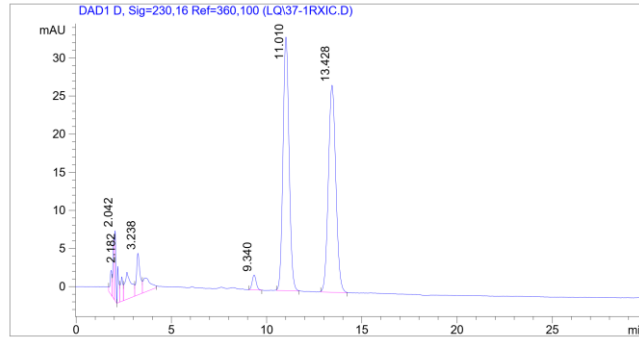


Sample Info: Mobile phase:n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 10:59:54  
Injektion Date: 16.08.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.7 33.1  
Flow in ml/min: 1.00 1.00

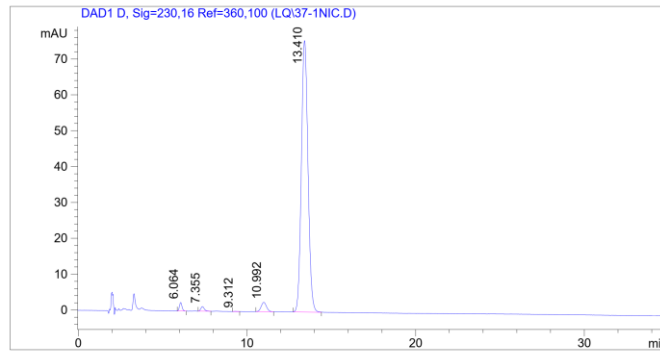


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	1.84	0.10	3.23	22.17	1.18
2	1.98	0.08	8.09	42.61	2.27
3	2.04	0.06	9.23	41.36	2.21
4	2.18	0.08	4.82	26.70	1.42
5	2.39	0.11	3.22	27.28	1.46
6	2.66	0.29	3.56	81.69	4.36
7	3.24	0.19	5.47	72.74	3.88
8	3.61	0.33	1.88	48.68	2.60
9	9.34	0.23	1.96	28.71	1.53
10	11.01	0.34	33.29	738.97	39.44
11	13.43	0.42	27.18	742.77	39.64
Total				1873.69	100.00

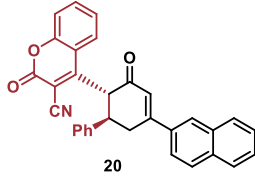
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 11:18:40  
Injektion Date: 08.08.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.9 33.3  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	6.06	0.16	2.39	25.33	1.17
2	7.36	0.21	1.29	18.24	0.84
3	9.31	0.15	0.07	0.85	0.04
4	10.99	0.35	2.61	58.26	2.69
5	13.41	0.42	75.73	2059.53	95.25
Total				2162.21	100.00

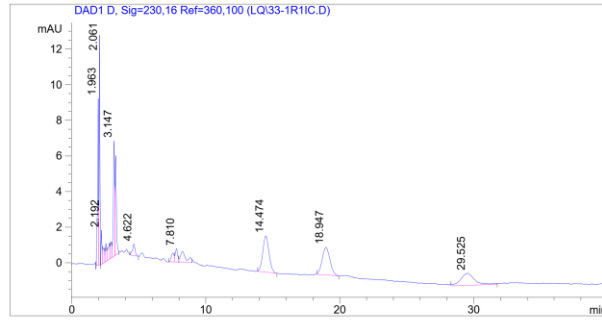


Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 12:14:38  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 32.2 32.4  
Flow in ml/min: 1.00 1.00

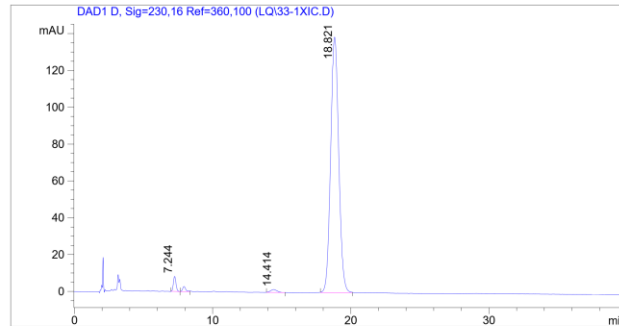


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %	
1	1.96	0.07	9.37	48.82	11.12	
2	2.06	0.06	13.00	49.49	11.27	
3	2.19	0.07	1.94	10.27	2.34	
4	2.38	0.13	0.84	7.47	1.70	
5	2.54	0.09	1.02	6.64	1.51	
6	2.79	0.14	0.87	9.37	2.13	
7	2.90	0.12	0.92	7.51	1.71	
8	3.15	0.10	6.49	42.22	9.61	
9	3.26	0.10	5.58	37.68	8.58	
10	4.62	0.20	0.65	9.12	2.08	
11	7.51	0.19	0.49	7.15	1.63	
12	7.81	0.18	0.75	9.14	2.08	
13	8.26	0.35	0.60	16.94	3.86	
14	14.47	0.42	2.04	65.67	14.95	
15	18.95	0.48	1.56	62.54	14.24	
16	29.52	1.20	0.68	49.16	11.19	
Total					439.20	100.00

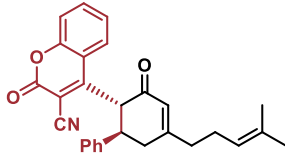
Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 16:22:09  
Injektion Date: 26.07.2019

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0 30.0  
Pressure in bar: 31.4 32.3  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %	
1	7.24	0.20	8.17	107.26	1.84	
2	7.92	0.23	2.73	42.16	0.72	
3	14.41	0.44	1.55	49.63	0.85	
4	18.82	0.63	138.73	5631.89	96.59	
Total					5830.94	100.00



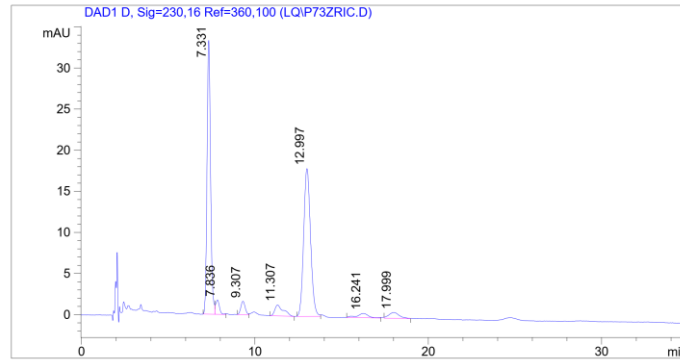
21

Sample Info: Mobile phase: n-Hexane/EtOH 7:3;  
The sample is solved in MP

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

Injektion Time: 16:08:49  
Injektion Date: 08.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.6 33.0  
Flow in ml/min: 1.00 1.00

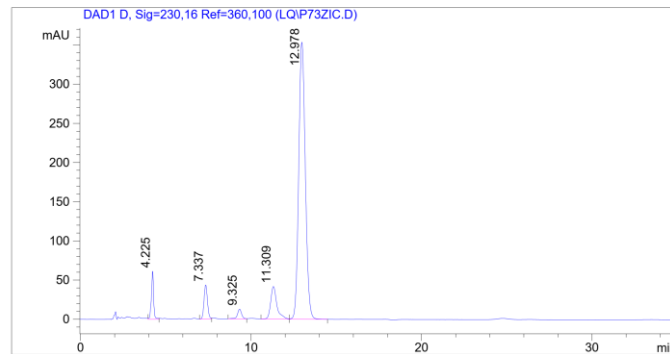


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	7.33	0.22	33.31	473.99	42.05
2	7.84	0.23	1.75	26.73	2.37
3	9.31	0.27	1.64	28.89	2.56
4	11.31	0.48	1.33	46.01	4.08
5	13.00	0.43	17.98	496.82	44.08
6	16.24	0.57	0.54	24.86	2.21
7	18.00	0.50	0.70	29.84	2.65
Total				1127.13	100.00

Methode file: IC.M  
Column-info: Chiralpak IC (150x4,6)mm  
Operator: Analytical Lab 4.03 - 4.04

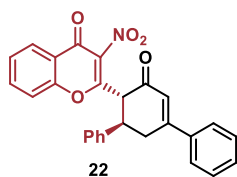
Injektion Time: 16:45:04  
Injektion Date: 08.08.2019

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 32.4 33.2  
Flow in ml/min: 1.00 1.00



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	4.23	0.13	61.19	552.39	4.64
2	7.34	0.22	43.35	605.93	5.09
3	9.32	0.26	12.44	214.10	1.80
4	11.31	0.38	41.55	1049.98	8.82
5	12.98	0.41	353.57	9481.86	79.65
Total				11904.27	100.00

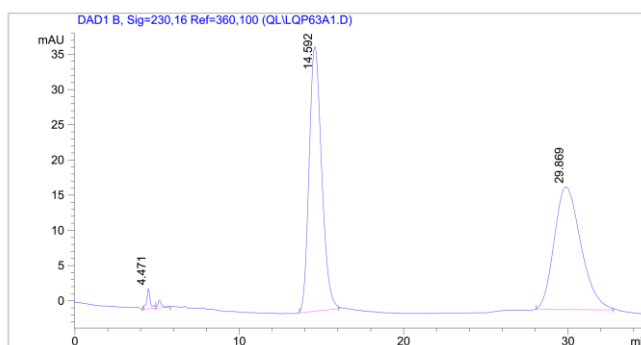




Sample Info: Mobile phase: n-Heptane/EtOH 7:3; Flow 0.7, Chiralpak AS  
 Säule: DAICELAS.M  
 Säuleninfo: Chiralpak AS (250x4,6)mm  
 Operator: Analytik Labor AKEN

Injektion Time: 11:19:14  
 Injektion Date: 10.05.2017

Instrument Conditions: At Start At Stop  
 Temperature in °C: 30.0 °C 30.0 °C  
 Pressure in bar: 38.1 39.3  
 Flow in ml/min: 0.70 0.70

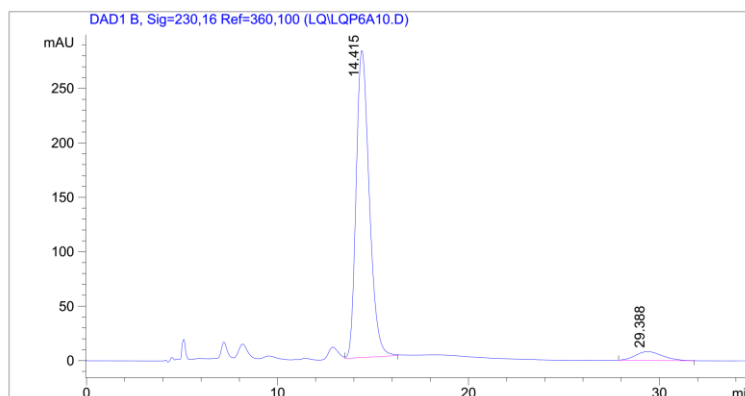


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	4.47	0.22	2.89	44.10	1.10
2	5.14	0.24	1.10	18.76	0.47
3	14.59	0.80	37.59	1989.14	49.47
4	29.87	1.35	17.46	1968.67	48.96
Total				4020.66	100.00

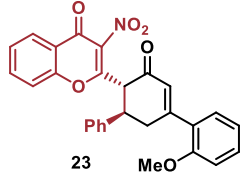
Säule: DAICELAS.M  
 Säuleninfo: Chiralpak AS (250x4,6)mm  
 Operator: Analytik Labor AKEN

Injektion Time: 10:38:47  
 Injektion Date: 02.06.2017

Instrument Conditions: At Start At Stop  
 Temperature in °C: 30.0 °C 30.0 °C  
 Pressure in bar: 25.0 25.5  
 Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.42	0.74	282.20	13496.71	94.46
2	29.39	1.15	8.10	791.43	5.54
Total				14288.14	100.00

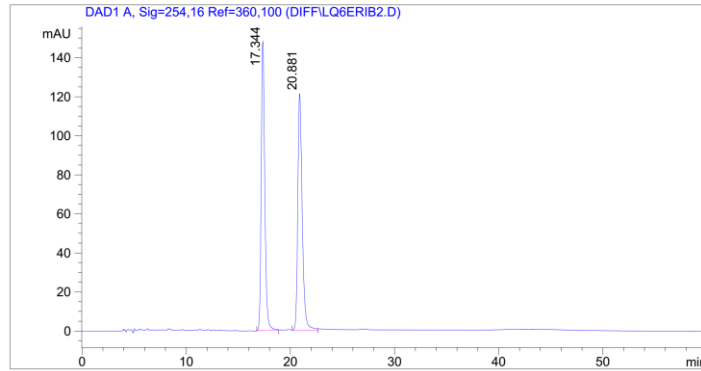


Sample Info: Mobile phase: n-Heptane/EtOH 8:2,  
The sample is solved in DCM/MP

Column: DAICELIB.M  
Column info: Chiralpak IB (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 17:55:01  
Injektion Date: 06.09.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 38.7 38.7  
Flow in ml/min: 0.70 0.70

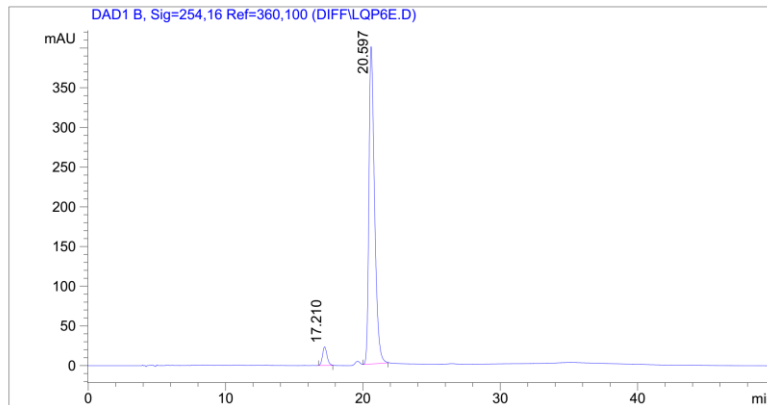


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	17.34	0.36	148.23	3521.97	49.51
2	20.88	0.49	121.14	3591.04	50.49
Total				7113.01	100.00

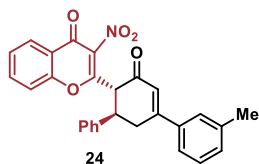
Column: IB.M  
Column-info: Chiralpak IB (250x4,6)mm  
Operator: Analytical Lab 4.04

Injektion Time: 11:31:06  
Injektion Date: 13.10.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 36.3 36.9  
Flow in ml/min: 0.7 0.7



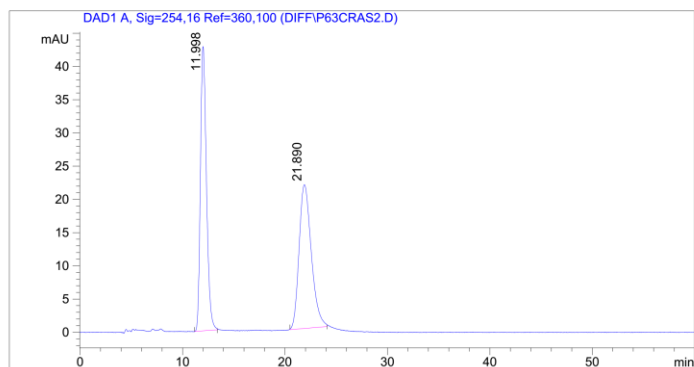
#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	17.21	0.35	23.34	537.75	4.52
2	20.60	0.43	400.08	11348.67	95.48
Total				11886.42	100.00



Sample Info: Mobile phase: n-Heptane/EtOH 7:3; Flow 0.7, Chiralpak AS  
 Säule: DAICELAS.M  
 Säuleninfo: Chiralpak AS (250x4,6)mm  
 Operator: Analytik Labor AKEN

Injektion Time: 15:54:39  
 Injektion Date: 15.05.2017

Instrument Conditions: At Start At Stop  
 Temperature in °C: 30.0 °C 30.0 °C  
 Pressure in bar: 39.1 40.1  
 Flow in ml/min: 0.70 0.70

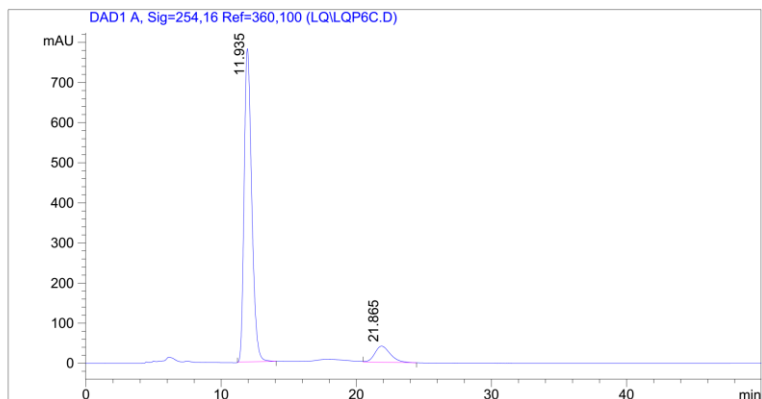


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	12.00	0.63	42.80	1746.29	49.37
2	21.89	1.12	21.64	1791.15	50.63
Total				3537.44	100.00

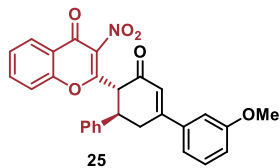
Säule: DAICELAS.M  
 Säuleninfo: Chiralpak AS (250x4,6)mm  
 Operator: Analytik Labor AK Schoenebeck

Injektion Time: 11:25:21  
 Injektion Date: 21.08.2017

Instrument Conditions: At Start At Stop  
 Temperature in °C: 30.0 °C 30.0 °C  
 Pressure in bar: 26.3 26.7  
 Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.93	0.60	780.82	30430.44	90.38
2	21.87	1.18	40.31	3239.91	9.62
Total				33670.35	100.00

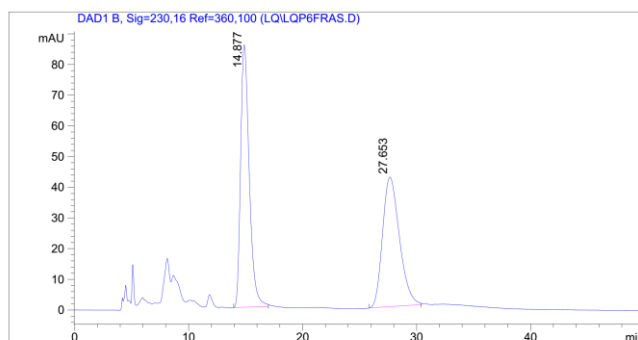


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 22:32:01  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.1 26.6  
Flow in ml/min: 0.70 0.70

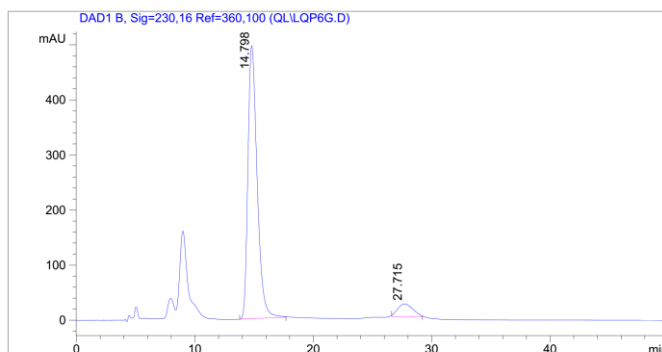


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.88	0.80	85.52	4492.87	50.84
2	27.65	1.55	42.27	4343.75	49.16
Total				8836.61	100.00

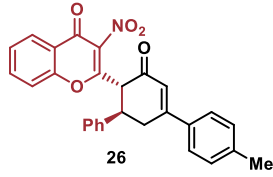
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 15:12:56  
Injektion Date: 23.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 25.8 26.7  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.80	0.83	495.91	26764.85	92.84
2	27.00	0.00	10.66	0.00	0.00
3	27.18	0.00	15.43	0.00	0.00
4	27.45	0.00	21.08	0.00	0.00
5	27.60	0.00	22.63	0.00	0.00
6	27.71	1.50	23.00	2064.77	7.16
7	27.98	0.00	21.01	0.00	0.00
8	28.11	0.00	19.11	0.00	0.00
9	28.37	0.00	14.30	0.00	0.00
10	28.72	0.00	7.84	0.00	0.00
11	28.91	0.00	4.74	0.00	0.00
Total				28829.62	100.00

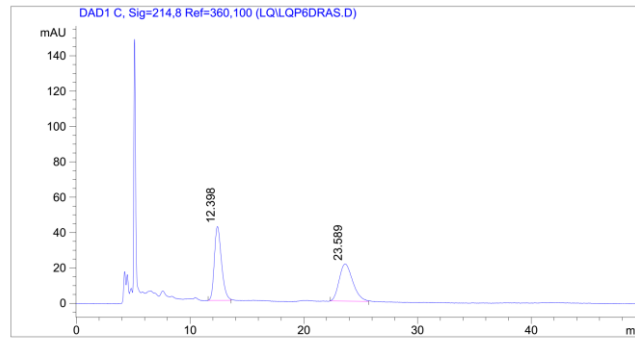


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 11:25:59  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 25.6 25.5  
Flow in ml/min: 0.70 0.70

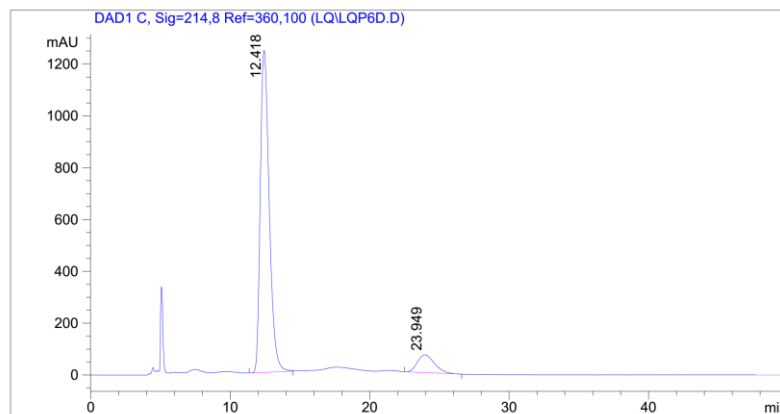


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	12.40	0.66	41.82	1823.04	51.06
2	23.59	0.99	21.03	1747.19	48.94
Total				3570.22	100.00

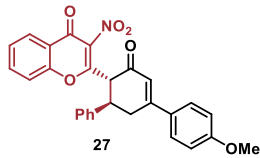
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 12:16:34  
Injektion Date: 21.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 26.3 26.7  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	12.42	0.69	1242.98	55302.56	90.43
2	23.95	1.10	68.70	5855.91	9.57
Total				61158.48	100.00

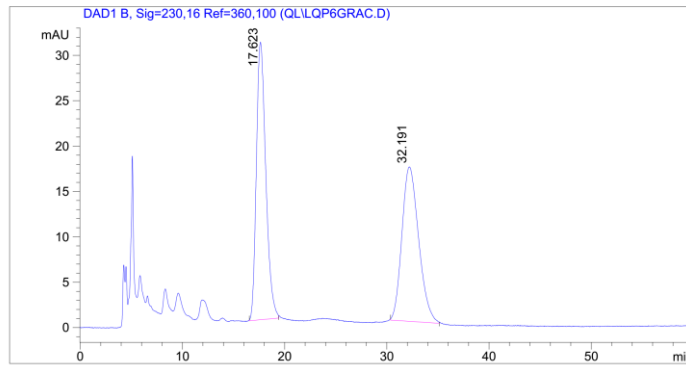


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 12:26:41  
Injektion Date: 29.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 25.9 26.8  
Flow in ml/min: 0.70 0.70

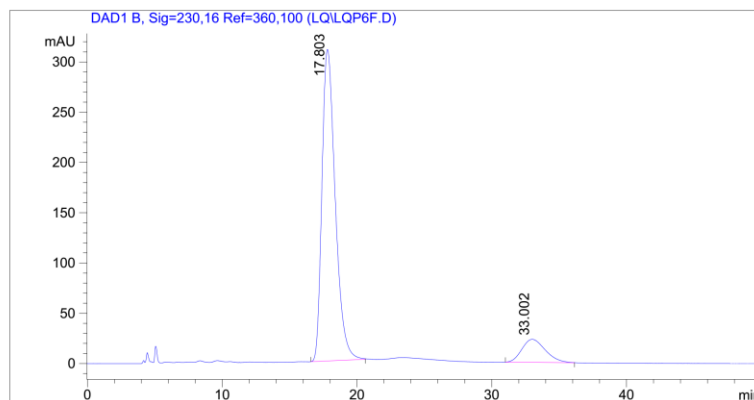


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	17.62	0.95	30.60	1958.84	50.27
2	32.19	1.34	17.03	1937.81	49.73
Total				3896.65	100.00

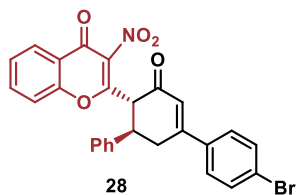
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 13:07:47  
Injektion Date: 21.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 25.7 26.2  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	17.80	1.05	309.92	21189.97	88.34
2	33.00	1.44	23.05	2796.95	11.66
Total				23986.92	100.00

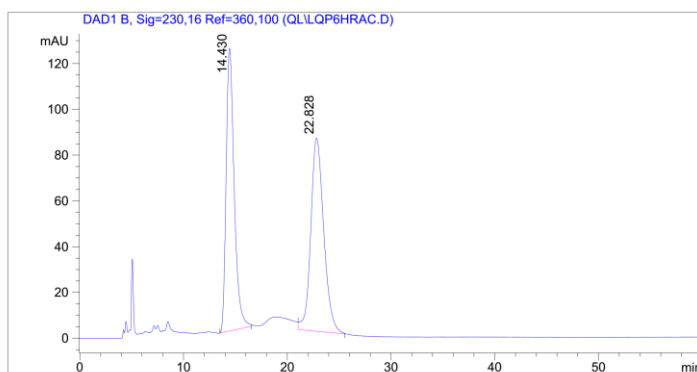


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 11:25:28  
Injektion Date: 29.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 26.6 26.6  
Flow in ml/min: 0.70 0.70

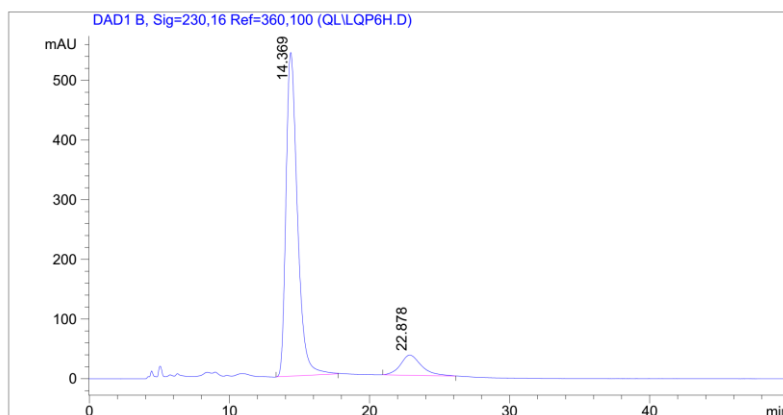


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.43	0.81	123.50	6671.15	47.60
2	22.83	1.29	84.50	7345.15	52.40
Total				14016.31	100.00

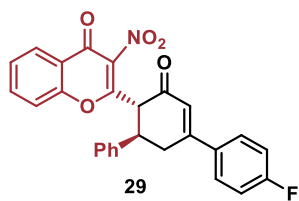
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 16:04:13  
Injektion Date: 23.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 25.8 26.1  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.37	0.86	542.40	30707.58	89.56
2	22.88	1.43	33.95	3579.40	10.44
Total				34286.98	100.00

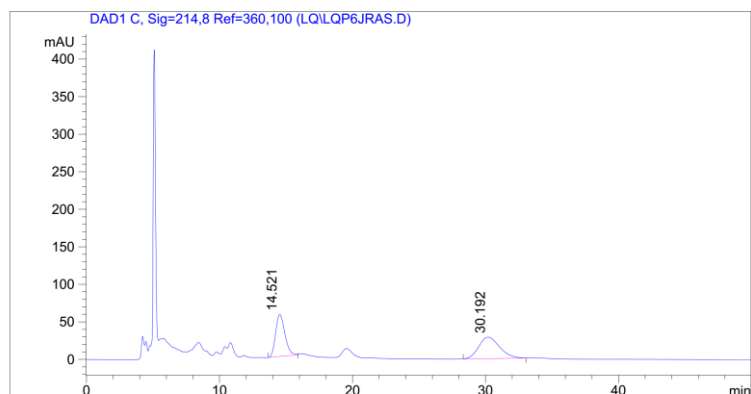


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 13:59:40  
Injektion Date: 23.06.2017

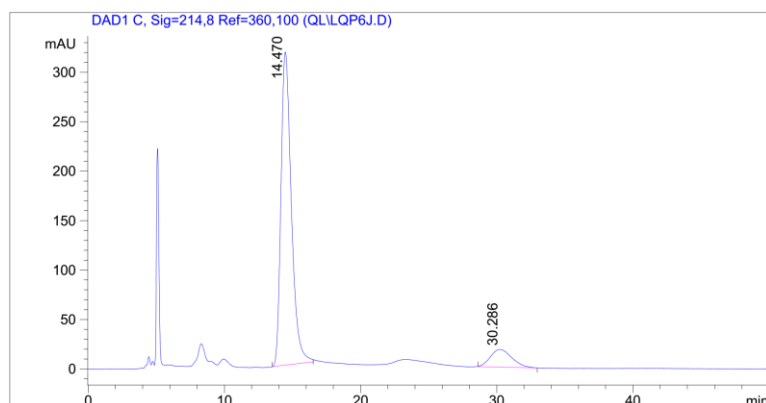
Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 25.3 25.8  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.52	0.74	56.07	2714.64	46.36
2	30.19	1.43	28.69	3140.64	53.64
Total				5855.28	100.00

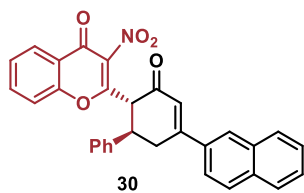
Injektion Time: 16:55:27  
Injektion Date: 23.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.2 26.8  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.47	0.80	316.82	16720.50	89.48
2	30.29	1.33	17.95	1966.02	10.52
Total				18686.53	100.00



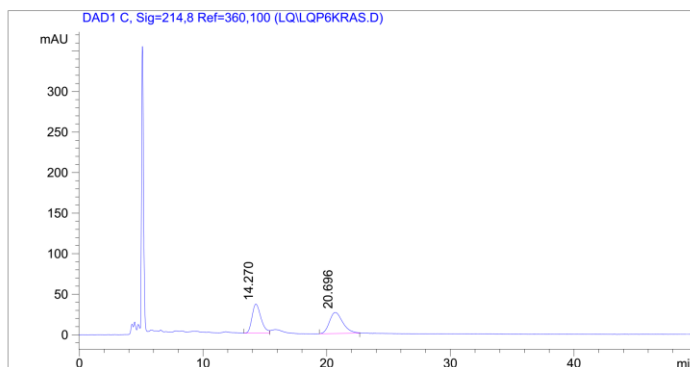


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 14:50:52  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 25.4 26.1  
Flow in ml/min: 0.70 0.70

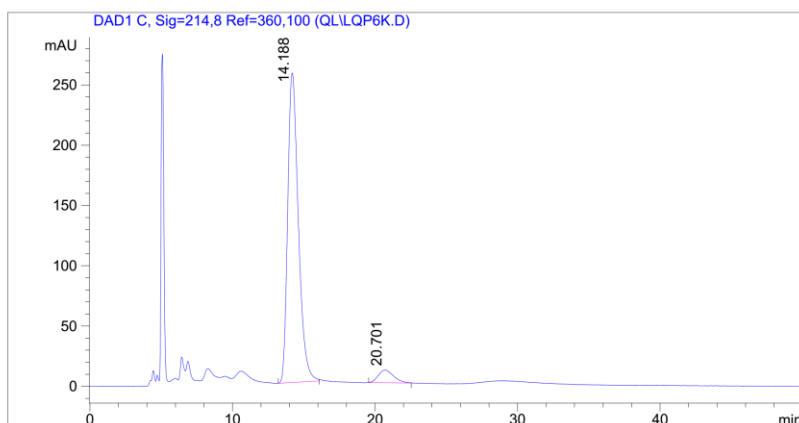


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.27	0.78	36.06	1826.98	48.17
2	20.70	1.08	26.06	1966.13	51.83
Total				3793.11	100.00

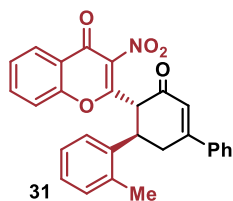
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 17:46:42  
Injektion Date: 23.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 26.0 26.7  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.19	0.81	256.74	13294.36	94.34
2	20.70	0.91	10.64	797.81	5.66
Total				14092.17	100.00

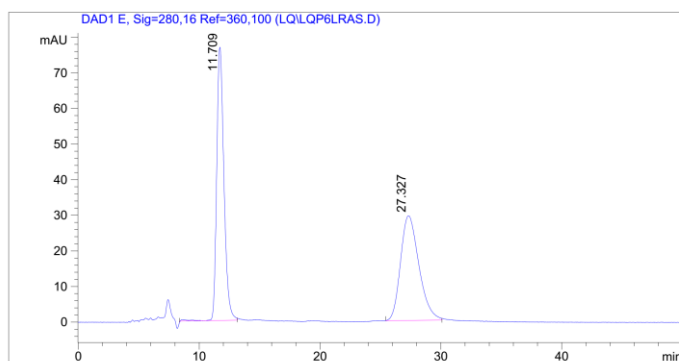


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 15:42:07  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0°C 30.0°C  
Pressure in bar: 25.4 26.0  
Flow in ml/min: 0.70 0.70

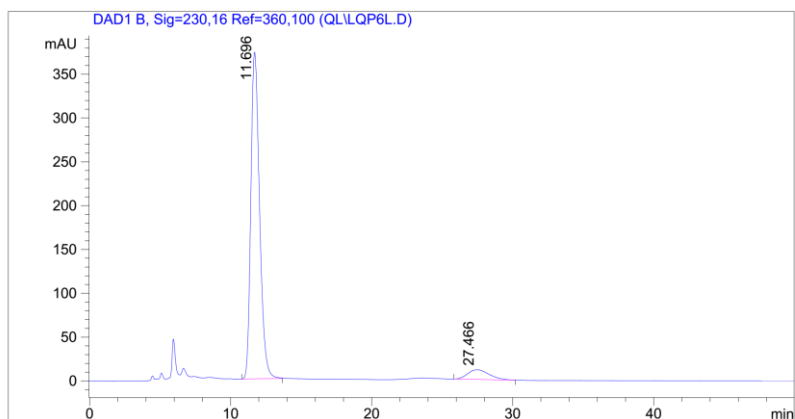


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.71	0.64	76.71	3192.84	50.71
2	27.33	1.55	29.38	3103.16	49.29
Total				6296.00	100.00

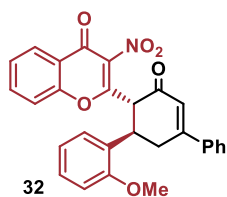
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 18:37:51  
Injektion Date: 23.08.2017

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0°C 30.0°C  
Pressure in bar: 26.1 26.7  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.70	0.66	372.75	15968.83	93.10
2	27.47	1.28	11.13	1182.83	6.90
Total				17151.66	100.00

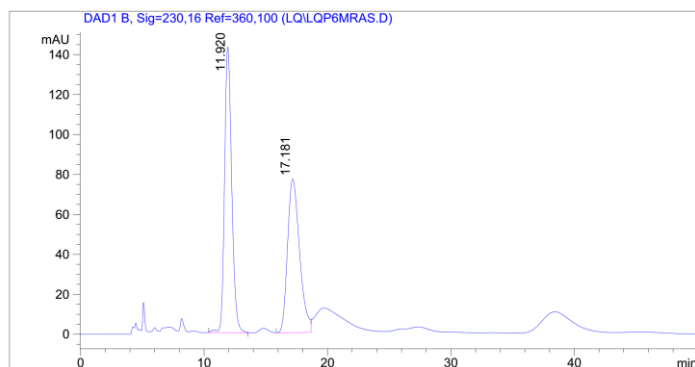


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 16:33:19  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0°C 30.0°C  
Pressure in bar: 25.5 26.2  
Flow in ml/min: 0.70 0.70

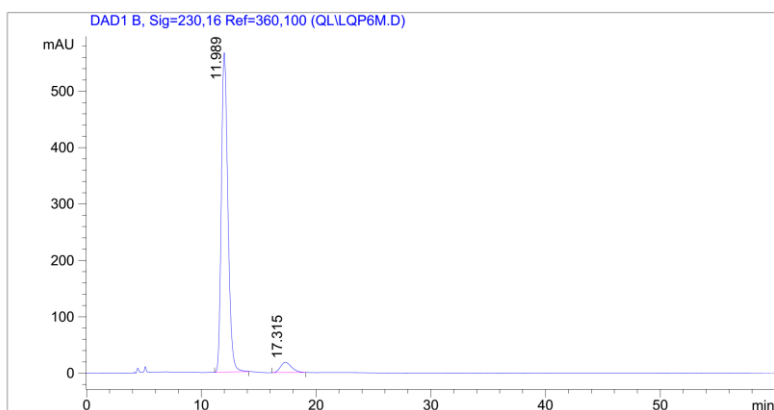


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.92	0.62	143.08	5774.63	52.56
2	17.18	1.05	76.84	5212.39	47.44
Total				10987.02	100.00

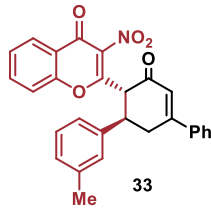
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 15:40:21  
Injektion Date: 28.08.2017

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0°C 30.0°C  
Pressure in bar: 26.3 26.9  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.99	0.61	567.07	22484.47	94.78
2	17.32	0.97	18.25	1237.77	5.22
Total				23722.24	100.00

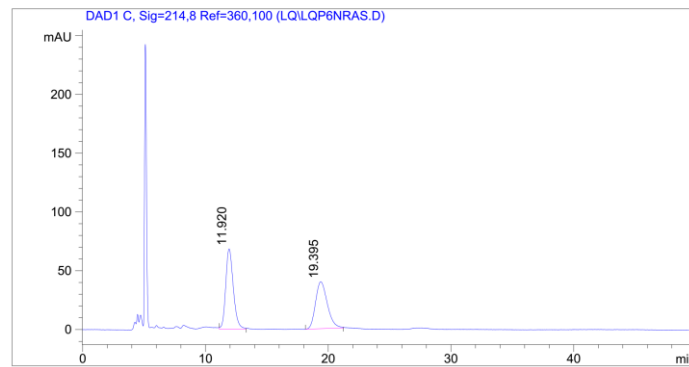


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 17:24:35  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.0 26.4  
Flow in ml/min: 0.70 0.70

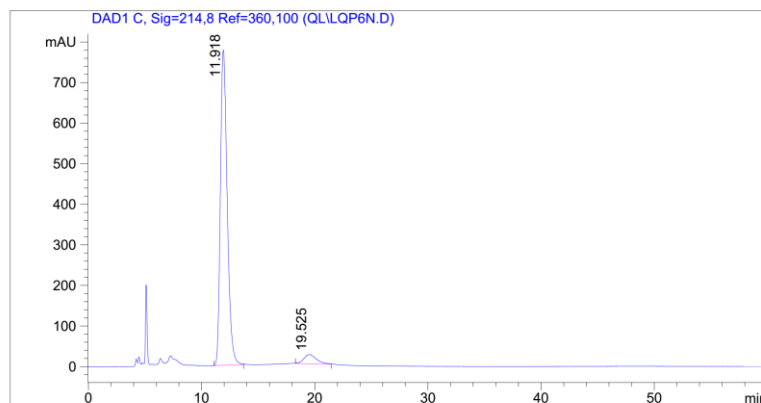


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.92	0.67	68.26	2935.76	52.36
2	19.40	1.03	39.99	2671.08	47.64
Total				5606.85	100.00

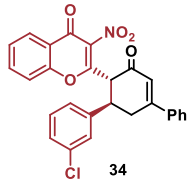
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 16:41:34  
Injektion Date: 28.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.5 26.5  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	11.92	0.65	777.08	32487.76	94.76
2	19.53	0.99	22.92	1798.10	5.24
Total				34285.86	100.00

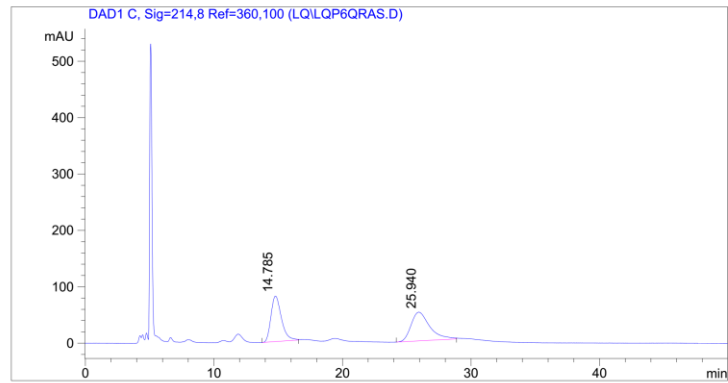


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 19:07:06  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 25.7 26.4  
Flow in ml/min: 0.70 0.70

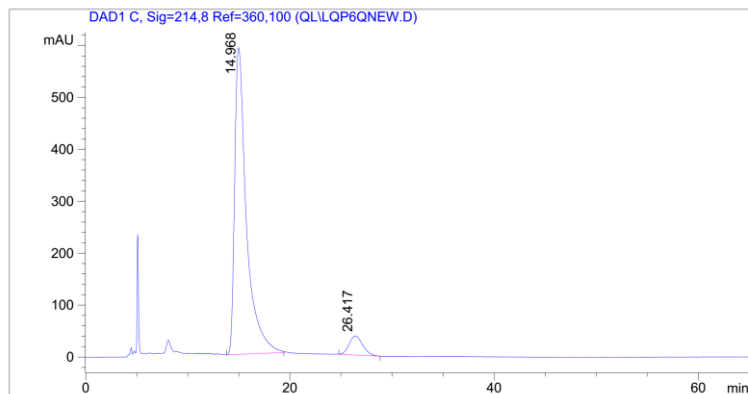


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.79	0.87	80.90	4595.26	47.03
2	25.94	1.49	51.03	5174.71	52.97
Total				9769.97	100.00

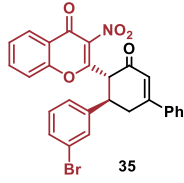
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 14:26:49  
Injektion Date: 07.09.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 29.9 30.0  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.97	1.17	590.61	47276.66	93.28
2	26.42	1.13	37.02	3404.79	6.72
Total				50681.45	100.00

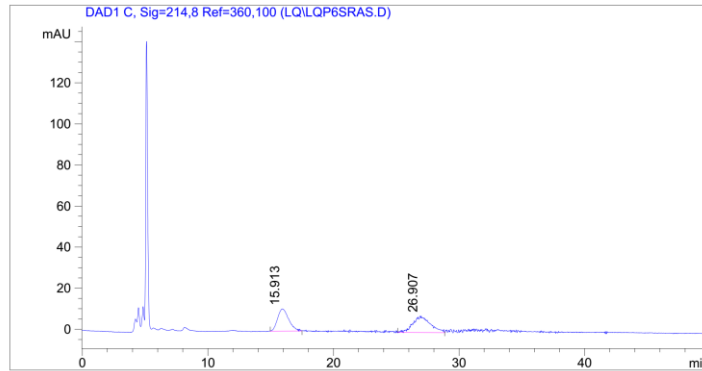


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 20:49:35  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0°C 30.0°C  
Pressure in bar: 25.9 26.2  
Flow in ml/min: 0.70 0.70

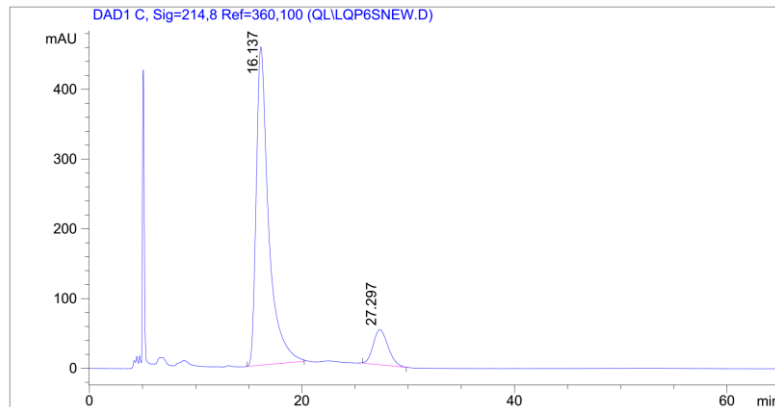


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	15.91	0.87	10.84	671.15	46.81
2	26.91	1.13	8.07	762.71	53.19
Total				1433.86	100.00

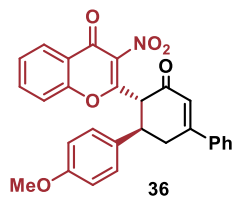
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 15:33:03  
Injektion Date: 07.09.2017

Instrument Conditions: At Start At Stop  
Temperature in°C: 30.0°C 30.0°C  
Pressure in bar: 29.8 29.9  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	16.14	1.14	456.47	36952.69	88.32
2	27.30	1.15	50.27	4887.23	11.68
Total				41839.92	100.00

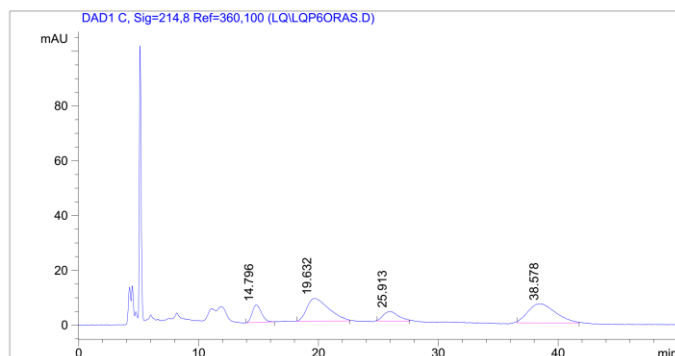


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 18:15:51  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 25.6 25.8  
Flow in ml/min: 0.70 0.70

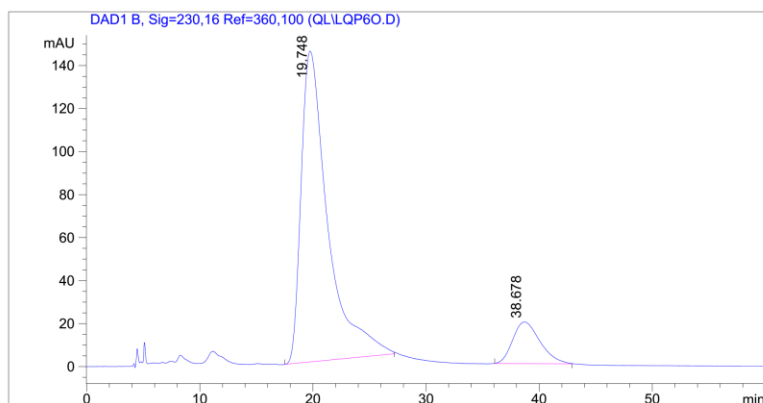


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	14.80	0.65	6.41	344.15	12.20
2	19.63	1.54	8.28	1055.16	37.41
3	25.91	1.04	3.54	308.56	10.94
4	38.58	1.87	7.01	1112.52	39.45
Total				2820.39	100.00

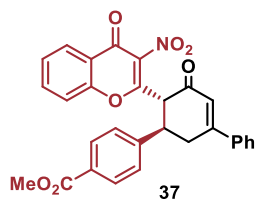
Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 17:42:46  
Injektion Date: 28.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.1 27.0  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	19.75	2.24	144.58	23696.35	87.87
2	38.68	1.98	19.42	3270.60	12.13
Total				26966.95	100.00

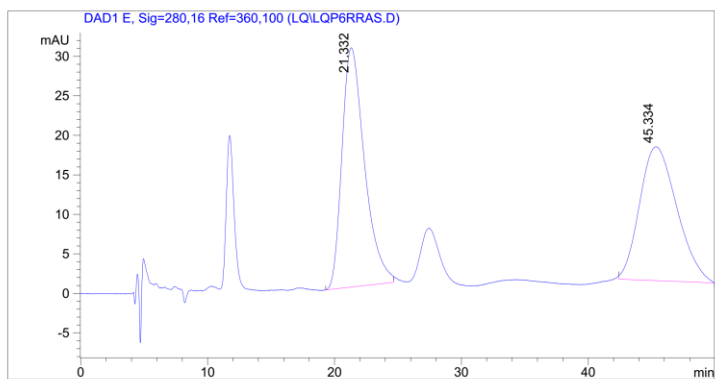


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 19:58:20  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 25.7 26.5  
Flow in ml/min: 0.70 0.70

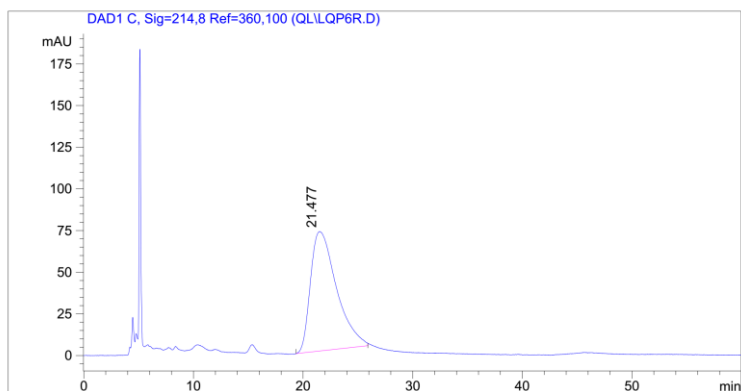


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	21.33	1.79	30.30	3747.23	51.98
2	45.33	2.40	16.96	3461.52	48.02
Total				7208.75	100.00

Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

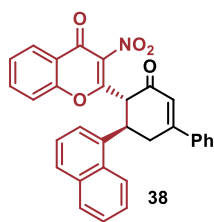
Injektion Time: 19:45:15  
Injektion Date: 28.08.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.5 27.2  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	21.48	1.94	71.74	11822.18	100.00
Total				11822.18	100.00



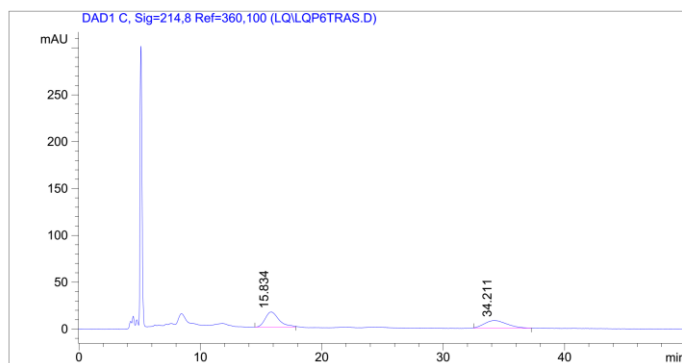


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 23:23:14  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 °C 30.0 °C  
Pressure in bar: 26.1 26.5  
Flow in ml/min: 0.70 0.70

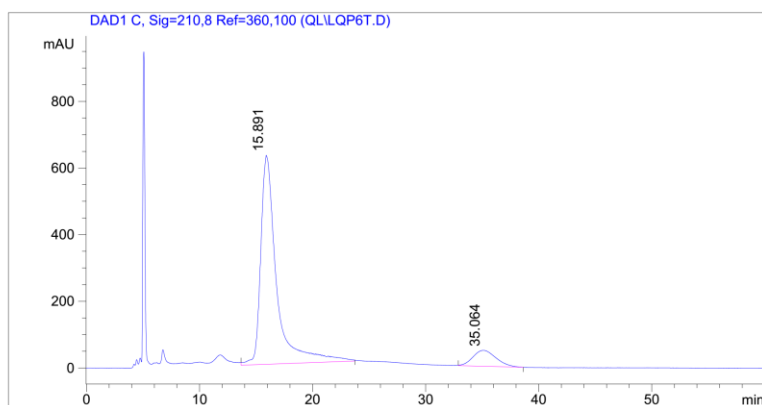


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	15.83	1.10	16.13	1288.34	54.78
2	34.21	1.57	8.14	1063.58	45.22
Total				2351.92	100.00

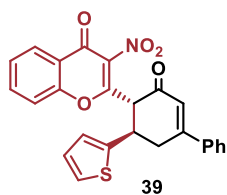
Column: AS.M  
Column-info: Chiralpak AS (250x4,6)mm  
Operator: Analytical Lab 4.04

Injektion Time: 20:45:40  
Injektion Date: 12.10.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0 30.0  
Pressure in bar: 26.2 26.3  
Flow in ml/min: 0.7 0.7



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	15.89	1.63	627.90	61542.00	90.06
2	35.06	1.68	47.81	6795.59	9.94
Total				68337.59	100.00

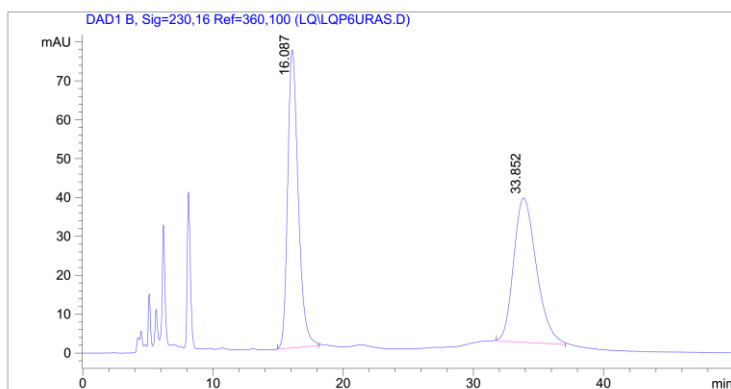


Sample Info: Mobile phase: n-Heptane/EtOH 7:3;  
The sample is solved in DCM/MP

Column: DAICELAS.M  
Column info: Chiralcel OD (250x4,6)mm  
Operator: Analytik Labor AKEN

Injektion Time: 21:40:46  
Injektion Date: 23.06.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 26.1 26.1  
Flow in ml/min: 0.70 0.70

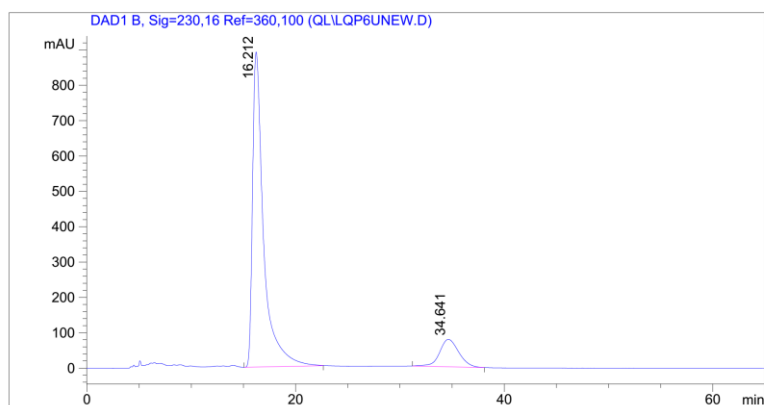


#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	16.09	0.86	76.68	4312.57	48.88
2	33.85	1.83	37.15	4510.35	51.12
Total				8822.93	100.00

Säule: DAICELAS.M  
Säuleninfo: Chiralpak AS (250x4,6)mm  
Operator: Analytik Labor AK Schoenebeck

Injektion Time: 17:45:34  
Injektion Date: 07.09.2017

Instrument Conditions: At Start At Stop  
Temperature in °C: 30.0°C 30.0°C  
Pressure in bar: 29.6 30.1  
Flow in ml/min: 0.70 0.70



#	Ret. Time (min)	Width	Height (mAU)	Area (mAU*s)	Area %
1	16.21	1.08	891.70	65623.46	86.79
2	34.64	1.74	77.66	9992.33	13.21
Total				75615.79	100.00

## 5 References

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2. Paparao C, Rao KV, Sundaramurthy V. *Synthesis*, 1981, 3: 234-236.