Supporting Information

Squaramide-Catalyzed Asymmetric Michael/Cyclization Tandem Reaction for Synthesis of Chiral Trifluoromethylated Hydroxyimino Tetrahydrobenzofuranones

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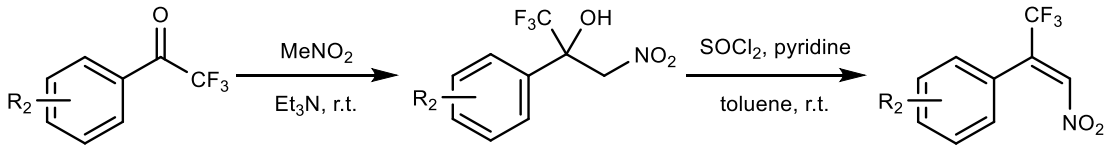
Content

1. General information

Commercially available reagents were used without further purification. Solvents were treated prior to use according to the standard methods. Reactions were monitored by TLC, which was performed on glass-backed silica plates. Column chromatography was performed using silica gel (200 -300 mesh) eluting with ethyl acetate and petroleum ether. Unless otherwise indicated, all ^{1}H NMR and ^{13}C NMR spectra experiments were performed at room temperature using hexadeuterodimethyl sulfoxide as solvent, with TMS (tetramethylsilane) as internal standard. ^{1}H NMR spectra were recorded on 500MHz instrument, ^{13}C NMR on 126 MHz instrument. ^{19}F NMR spectra experiments were recorded on 471 MHz instrument, using $CDCl_3$ as solvent. The peak multiplicities of ^{1}H NMR spectra were abbreviated as follows: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. Chemical shifts (δ) were reported in ppm. Coupling constants (*J*) were given in Hz. Enantiomeric excess was determined by HPLC analysis on chiral Daicel Chiralpak AD-H columns. The solvents of mobile phase used were hexane and isopropanol (sometimes ethanol if necessary). HRMS was measured by micrOTOF-Q III spectrometer. IR data were recorded by Fourier infrared spectrometer.

2. General procedure for the synthesis of trifluoromethylated nitroalkenes **2**[1]



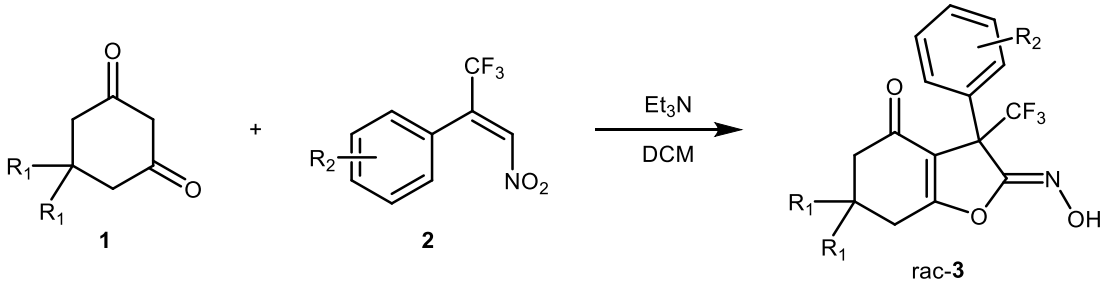
To a solution of the trifluoroacetophenone (1.0 eq.) in $MeNO_2$ (0.5 M) was added Et_3N (1.5 eq.). The mixture was stirred for overnight at room temperature. After diluted with ethyl acetate and washed successively with 1N HCl, water, and brine, the organic phase was separated and dried over anhydrous Na_2SO_4. After filtration, the solvent was removed by rotary evaporation in reduced pressure to afford the corresponding nitroalcohol that was used in the following step without further purifica-

1 (a) J. R. Gao, H. Wu, B. Xiang, W. B. Yu, L. Han and Y. X. Jia, *J. Am. Chem. Soc.*, 2013, **135**, 2983; (b) E. Martinelli, A. C. Vicini, M. Mancinelli, A. Mazzanti, P. Zani, L. Bernardi and M. Fochi, *Chem. Commun.*, 2015, **51**, 658.

tion.

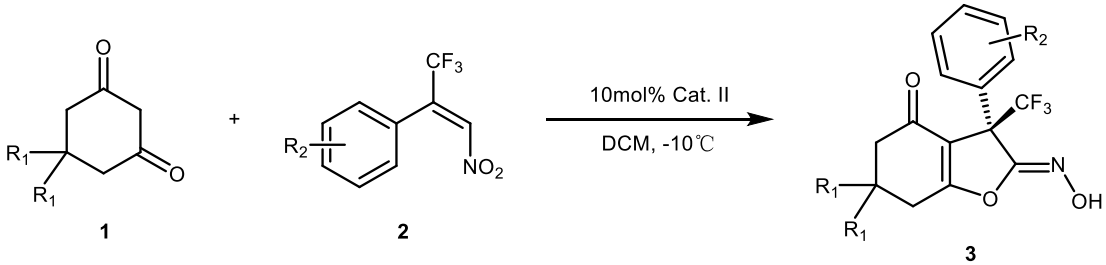
To a solution of the obtained nitroalcohol in toluene (0.25 M) were added $SOCl_2$ (1.5 eq.) and pyridine (2.0 eq.) successively at 0 °C. The mixture was stirred at room temperature for 3h and then diluted with ethyl acetate. After washing with water and brine, the organic phase was separated and dried over anhydrous Na_2SO_4. The solvent was removed by rotary evaporation in reduced pressure and the residue was purified with column chromatography on silica gel, eluted with ethyl acetate/ petroleum ether 1:20 (v/v), to afford the trifluoromethylated nitroalkene.

3. General procedure for the synthesis of racemic hydroxyimino tetrahydrobenzofuranones rac-**3**[2]



To a solution of cyclohexanediones **1** (dimedone **1a**, 1,3-cyclohexane dione **1b**) (0.1mmol) and trifluoromethylated nitroalkenes **2** (0.1mmol) in DCM (1.0 mL) was added Et_3N (0.1 eq.). The mixture was stirred at room temperature until TLC indicated that the reactants were run out. After the reaction mixture was concentrated by rotary evaporation in reduced pressure, the crude residue was purified by column chromatography using ethyl acetate/petroleum ether 1:5 (v/v) to give rac-**3**.

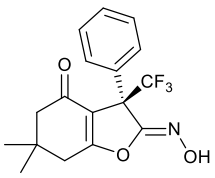
4. General procedure for the synthesis of chiral hydroxyimino tetrahydrobenzofuranones **3**



2 (a) G. H. Wang and C. Y. Yuan, *Heteroat. Chem.*, 1992, **3**, 521; (b) R. Q. Mei, X. Y. Xu, L. Peng, F. Wang, F. Tian and L. X. Wang, *Org. Biomol. Chem.*, 2013, **11**, 1286.

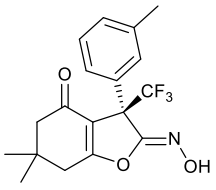
To a solution of cyclohexanediones **1** (0.2mmol) and trifluoromethylated nitroalkenes **2** (0.2mmol) in DCM (2.0 mL) was added catalyst **II** (0.1 eq.). The mixture was stirred at -10℃ until TLC indicated that the reactants were run out. After the reaction mixture was concentrated by rotary evaporation in reduced pressure, the crude residue was purified by column chromatography using ethyl acetate/petroleum ether 1:5 (v/v) to give corresponding enantiomeric hydroxyimino tetrahydrobenzofuranones **3**.

(R,Z)-2-(hydroxyimino)-6,6-dimethyl-3-phenyl-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3aa**): white solid, yield: 74%, ee: 84%.



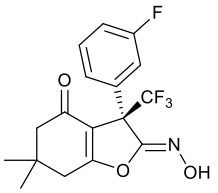
HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 15.72 min, t_{minor} = 12.41 min. IR (KBr) v/cm^{-1} : 3240, 2966, 1692, 1646, 1633, 1378. ^{1}H NMR (500MHz, DMSO-d_6) δ 11.39 (s, 1H), 7.49 (d, *J* = 7.6 Hz, 2H), 7.46 – 7.30 (m, 3H), 2.77 (dd, *J* = 45.1, 18.3 Hz, 2H), 2.36 (dd, *J* = 42.7, 15.9 Hz, 2H), 1.10 (d, *J* = 4.6 Hz, 6H). ^{13}C NMR (126MHz, DMSO-d_6) δ 191.54, 175.53, 152.14, 134.04, 129.06, 129.01, 127.84, 124.85 (q, J_{C-F} = 284.8 Hz), 113.12, 59.44 (q, J_{C-F} =30.2 Hz), 51.74, 36.51, 33.87, 28.49, 27.49. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.14 (s, 3F). HRMS (ESI) Calculated for $C_{17}H_{16}F_3NO_3$ $[M+Na]^+$: 362.0974, found: 362.1062.

(R,Z)-2-(hydroxyimino)-6,6-dimethyl-3-(m-tolyl)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ab**): white solid, yield: 78%, ee: 81%.

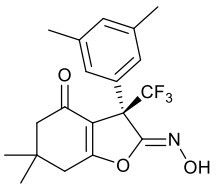


HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 13.89 min, t_{minor} = 10.17 min. IR (KBr) v/cm^{-1} : 3410, 3259, 2962, 2926, 1688, 1666, 1649, 1633, 1608, 1375. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.40 (s, 1H), 7.32 – 7.24 (m, 3H), 7.19 (dd, *J* = 7.0, 0.6 Hz, 1H), 2.77 (dd, *J* = 52.8, 18.3 Hz, 2H), 2.34 (dd, *J* = 51.3, 15.9 Hz, 2H), 2.30 (s, 3H), 1.09 (d, *J* = 8.7 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.50, 175.43, 152.21, 138.25, 134.05, 129.63, 128.95, 128.19, 124.98, 124.87 (q, J_{C-F} = 284.8 Hz), 113.21, 59.39 (q, J_{C-F} =30.2 Hz), 51.75, 36.52, 33.90, 28.49, 27.49, 21.65. ^{19}F NMR (471 MHz, $CDCl_3$) δ -67.94 (s, 3F). HRMS (ESI) Calculated for $C_{18}H_{18}F_3NO_3$ $[M+Na]^+$: 376.1131, found: 376.1219.

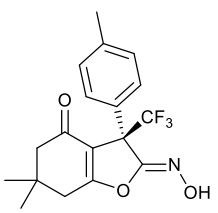
(R,Z)-3-(3-fluorophenyl)-2-(hydroxyimino)-6,6-dimethyl-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ac**): white solid, yield: 70%, ee: 77%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 13.41 min, t_{minor} = 11.14 min. IR (KBr) ν/cm^{-1} : 3250, 2961, 2921, 1692, 1646, 1633, 1377. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.50 (s, 1H), 7.54 – 7.43 (m, 1H), 7.39 – 7.22 (m, 3H), 2.77 (dd, *J* = 57.2, 18.3 Hz, 2H), 2.37 (dd, *J* = 62.1, 15.9 Hz, 2H), 1.08 (d, *J* = 9.2 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.68, 176.13, 162.29 (d, J_{C-F} =244.4 Hz), 151.58, 136.24 (d, J_{C-F} =7.6 Hz), 131.21(d, J_{C-F} =8.8 Hz), 124.60 (q, J_{C-F} = 284.8 Hz), 124.14, 116.18 (d, J_{C-F} =20.2 Hz), 115.12 (d, J_{C-F} =23.9Hz), 112.60, 59.13 (q, J_{C-F} =31.5 Hz), 51.66, 36.52, 33.86, 28.62, 27.34. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.38 (s, 3F), -111.41-111.46 (m, 1F). HRMS (ESI) Calculated for $C_{17}H_{15}F_4NO_3$ $[M+Na]^+$: 380.0880, found: 380.0938.



(R,Z)-3-(3,5-dimethylphenyl)-2-(hydroxyimino)-6,6-dimethyl-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ad**): white solid, yield: 69%, ee: 85%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 10.96 min, t_{minor} = 6.95 min. IR (KBr) ν/cm^{-1} : 3409, 3235, 3160, 2960, 2922, 2849, 1697, 1657, 1634, 1602, 1467, 1377. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.36 (s, 1H), 7.04 (d, *J* = 30.2 Hz, 3H), 2.76 (dd, *J* = 56.2, 18.3 Hz, 2H), 2.36 (dd, *J* = 54.9, 15.9 Hz, 2H), 2.26 (s, 6H), 1.10 (d, *J* = 11.4 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.44, 175.31, 152.25, 138.07, 134.03, 130.34, 125.37, 124.86 (q, J_{C-F} = 284.8 Hz), 113.27, 59.32 (q, J_{C-F} =30.2 Hz), 51.73, 36.49, 33.91, 28.46, 27.47, 21.53. ^{19}F NMR (471 MHz, $CDCl_3$) δ -67.77 (s, 3F). HRMS (ESI) Calculated for $C_{19}H_{20}F_3NO_3$ $[M+Na]^+$: 390.1287, found: 390.1330.

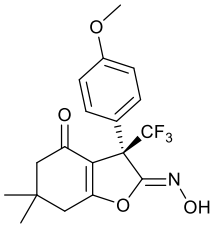


(R,Z)-2-(hydroxyimino)-6,6-dimethyl-3-(p-tolyl)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ae**): white solid, yield: 75%, ee: 74%. HPLC (Chiralpak AD-H, Hexane/EtOH = 90/10, 1 mL/min, 254nm): t_{major} = 17.18 min, t_{minor} = 12.11 min. IR (KBr) ν/cm^{-1} : 3444, 3231, 2962, 2929, 1693, 1645, 1631, 1377. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.36 (s, 1H), 7.37 (d, *J*

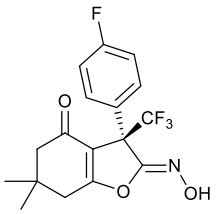


= 8.2 Hz, 2H), 7.21 (d, *J* = 8.2 Hz, 2H), 2.75 (dd, *J* = 42.5, 18.3 Hz, 2H), 2.35 (dd, *J* = 38.8, 15.9 Hz, 2H), 2.29 (s, 3H), 1.09 (d, *J* = 2.4 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.53, 175.37, 152.20, 138.49, 131.06, 129.58, 127.74, 124.87 (q, J_{C-F} = 284.8 Hz), 113.20, 59.19 (q, J_{C-F} =30.2 Hz), 51.76, 36.50, 33.87, 28.45, 27.52, 20.96. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.30 (s, 3F). HRMS (ESI) Calculated for $C_{18}H_{18}F_3NO_3$ $[M+Na]^+$: 376.1131, found: 376.1155.

(R,Z)-2-(hydroxyimino)-3-(4-methoxyphenyl)-6,6-dimethyl-3-(trifluorome thyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3af**): white solid, yield: 65%, ee: 88%. HPLC(Chiralpak AD-H, Hexane/EtOH = 90/ 10, 1 mL/min, 254nm): t_{major} = 26.20 min, t_{minor} = 21.38 min. IR (KBr) v/cm^{-1} : 3223, 2957, 2924, 2850, 1729, 1692, 1648, 1632, 1516, 1463, 1378. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.36 (s, 1H), 7.42 (d, *J* = 8.9 Hz, 2H), 6.98 – 6.92 (m, 2H), 3.75 (s, 3H), 2.74 (dd, *J* = 38.9, 18.3 Hz, 2H), 2.35 (dd, *J* = 36.4, 15.9 Hz, 2H), 1.08 (d, *J* = 2.7 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.69, 175.36, 159.68, 152.21, 129.33, 125.64, 124.88 (q, J_{C-F} = 284.8 Hz), 114.38, 113.16, 58.91 (q, J_{C-F} =30.2 Hz), 55.66, 51.82, 36.52, 33.85, 28.42, 27.54. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.64 (s, 3F). HRMS (ESI) Calculated for $C_{18}H_{18}F_3NO_4$ $[M+Na]^+$: 392.1080, found: 392.1074.

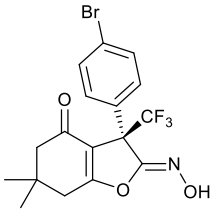


(R,Z)-3-(4-fluorophenyl)-2-(hydroxyimino)-6,6-dimethyl-3-(trifluoromethy l)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ag**): white solid, yield: 81%, ee: 67%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 10.89 min, t_{minor} = 12.28 min. IR (KBr) v/cm^{-1} : 3245, 2963, 1693, 1646, 1633, 1604, 1515, 1378. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.45 (s, 1H), 7.55 (dd, *J* = 8.9, 5.2 Hz, 2H), 7.32 – 7.22 (m, 2H), 2.76 (dd, *J* = 43.3, 18.3 Hz, 2H), 2.36 (dd, *J* = 43.9, 15.9 Hz, 2H), 1.08 (d, *J* = 5.2 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.69, 175.80, 162.42(d, J_{C-F} =247.0 Hz), 151.89, 130.34 (d, J_{C-F} =8.8 Hz), 130.04 (d, J_{C-F} =2.52 Hz), 124.73 (q, J_{C-F} = 284.8 Hz), 115.97 (d, J_{C-F} =21.4 Hz), 112.85, 58.94 (q, J_{C-F} =31.5 Hz), 51.73, 36.52, 33.85, 28.53, 27.44. ^{19}F NMR (471 MHz, $CDCl_3$) δ

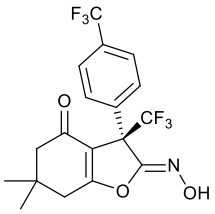


-68.67 (s, 3F), -112.81-112.87 (m, 1F). HRMS (ESI) Calculated for $C_{17}H_{15}F_4NO_3$ $[M+Na]^+$: 380.0880, found: 380.0851.

(R,Z)-3-(4-bromophenyl)-2-(hydroxyimino)-6,6-dimethyl-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ah**): white solid, yield: 75%, ee: 56%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 12.50 min, t_{minor} = 14.34 min. IR (KBr) ν/cm^{-1} : 3368, 2963, 2925, 1694, 1665, 1642, 1495, 1419, 1376. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.47 (s, 1H), 7.64 (d, *J* = 8.8 Hz, 2H), 7.44 (d, *J* = 8.6 Hz, 2H), 2.77 (dd, *J* = 41.3, 18.3 Hz, 2H), 2.35 (dd, *J* = 38.3, 15.9 Hz, 2H), 1.09 (d, *J* = 4.2 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.59, 175.92, 151.71, 133.31, 132.07, 130.13, 124.64 (q, J_{C-F} = 284.8 Hz), 122.66, 112.70, 59.07 (q, J_{C-F} =30.2 Hz), 51.66, 36.51, 33.88, 28.55, 27.44. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.49 (s, 3F). HRMS (ESI) Calculated for $C_{17}H_{15}BrF_3NO_3$ $[M+H]^+$: 418.0260, found: 418.0256.

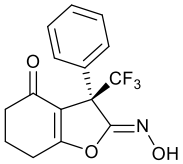


(R,Z)-2-(hydroxyimino)-6,6-dimethyl-3-(trifluoromethyl)-3-(4-(trifluoromethyl)phenyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ai**): white solid, yield: 66%, ee: 72%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 92/8, 1 mL/min, 254nm): t_{major} = 9.67 min, t_{minor} = 12.54 min. IR (KBr) ν/cm^{-1} : 3392, 2967, 2919, 2849, 1692, 1665, 1643, 1619, 1469, 1419, 1378, 1326. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.57 (s, 1H), 7.81 (d, *J* = 8.5 Hz, 2H), 7.70 (d, *J* = 8.4 Hz, 2H), 2.79 (dd, *J* = 42.2, 18.3 Hz, 2H), 2.35 (dd, *J* = 38.3, 16.0 Hz, 2H), 1.09 (d, *J* = 5.2 Hz, 6H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.53, 176.17, 151.66, 138.42, 129.57 (q, J_{C-F} =32.8 Hz), 128.87, 126.09 (q, J_{C-F} =3.8 Hz), 124.63 (q, J_{C-F} =284.8 Hz), 124.34 (q, J_{C-F} =273.4 Hz), 112.64, 59.28 (q, J_{C-F} =30.2 Hz), 51.56, 36.49, 33.90, 28.58, 27.42. ^{19}F NMR (471 MHz, $CDCl_3$) δ -63.01 (s, 3F), -68.26 (s, 3F). HRMS (ESI) Calculated for $C_{18}H_{15}F_6NO_3$ $[M+Na]^+$: 430.0848, found: 430.0788.

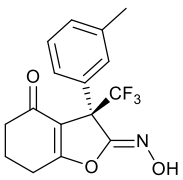


(R,Z)-2-(hydroxyimino)-3-phenyl-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3ba**): white solid, yield: 77%, ee: 71%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 17.92

min, t_{minor} = 20.61 min. IR (KBr) ν/cm^{-1} : 3268, 2972, 2934, 2891, 1689, 1644, 1631, 1585, 1500, 1451, 1423, 1374. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.29 (s, 1H), 7.50 (d, *J* = 7.6 Hz, 2H), 7.42 – 7.34 (m, 3H), 2.83 (t, *J* = 6.2 Hz, 2H), 2.41 (t, *J* = 6.6 Hz, 2H), 2.09 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.96, 176.73, 152.02, 134.11, 129.01, 128.93, 127.87, 124.82 (q, J_{C-F} = 284.8 Hz), 114.11, 59.52 (q, J_{C-F} =30.2 Hz), 37.75, 23.40, 20.79. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.08 (s, 3F). HRMS (ESI) Calculated for $C_{15}H_{12}F_3NO_3$ $[M+Na]^+$: 334.0661, found: 334.0596.



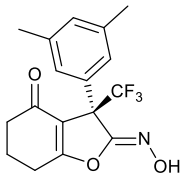
(R,Z)-2-(hydroxyimino)-3-(m-tolyl)-3-(trifluoromethyl)-3,5,6,7-tetrahydro benzofuran-4(2H)-one (**3bb**): white solid, yield: 73%, ee: 86%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 17.85 min, t_{minor} = 16.05 min. IR (KBr) ν/cm^{-1} : 3229, 2920, 2850, 1698, 1646, 1627, 1466, 1382. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.33 (s, 1H), 7.28 (d, *J* = 5.1 Hz, 3H), 7.18 (d, *J* = 3.0 Hz, 1H), 2.83 (t, *J* = 6.2 Hz, 2H), 2.40 (t, *J* = 6.5 Hz, 2H), 2.30 (s, 3H), 2.08 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.94, 176.64, 152.08, 138.19, 134.08, 129.56, 128.89, 128.18, 125.02, 124.83 (q, J_{C-F} = 284.8 Hz), 114.17, 59.45 (q, J_{C-F} =30.2 Hz), 37.75, 23.39, 21.65, 20.80. ^{19}F NMR (471 MHz, $CDCl_3$) δ -67.92 (s, 3F). HRMS (ESI) Calculated for $C_{16}H_{14}F_3NO_3$ $[M+Na]^+$: 348.0818, found: 348.0738.



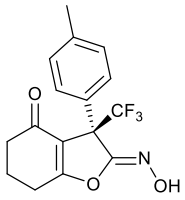
(R,Z)-3-(3-fluorophenyl)-2-(hydroxyimino)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3bc**): white solid, yield: 73%, ee: 78%. HPLC (Chiralpak AD-H, Hexane/EtOH = 90/10, 1 mL/min, 254nm): t_{major} = 25.32 min, t_{minor} = 12.40 min. IR (KBr) ν/cm^{-1} : 3259, 2953, 2922, 2848, 1692, 1650, 1631, 1591, 1493, 1449, 1374. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.46 (s, 1H), 7.51 – 7.45 (m, 1H), 7.36 (dd, *J* = 21.0, 9.5 Hz, 2H), 7.26 (td, *J* = 8.4, 2.4 Hz, 1H), 2.84 (t, *J* = 6.2 Hz, 2H), 2.42 (t, *J* = 6.5Hz, 2H), 2.09 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 192.11, 177.34, 162.29 (d, J_{C-F} =244.4 Hz), 151.54, 136.34 (d, J_{C-F} =7.6 Hz), 131.10 (d, J_{C-F} =7.6 Hz), 124.58 (q, J_{C-F} = 284.8 Hz), 124.17, 116.08 (d, J_{C-F} =20.2 Hz), 115.21 (d, J_{C-F} =23.9 Hz), 113.59, 59.21 (q, J_{C-F} =30.2 Hz), 37.68, 23.44, 20.71. ^{19}F NMR (471 MHz,

$CDCl_3$) δ -68.31 (s, 3F), -111.47-111.53 (m, 1F). HRMS (ESI) Calculated for $C_{15}H_{11}F_4NO_3$ $[M+Na]^+$: 352.0567, found: 352.0476.

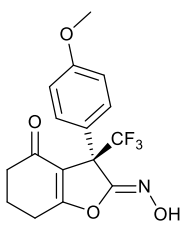
(R,Z)-3-(3,5-dimethylphenyl)-2-(hydroxyimino)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3bd**): white solid, yield: 65%, ee: 85%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 18.36 min, t_{minor} = 11.52 min. IR (KBr) ν/cm^{-1}: 3370, 2960, 2920, 2848, 1703, 1663, 1634, 1605, 1376. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.31 (s, 1H), 7.07 (s, 2H), 6.99 (s, 1H), 2.87 – 2.80 (m, 2H), 2.40 (t, *J* = 6.5 Hz, 2H), 2.25 (s, 6H), 2.14 – 2.02 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.89, 176.52, 152.12, 138.00, 134.05, 130.29, 125.39, 124.84 (q, J_{C-F} = 284.8 Hz), 114.25, 59.39 (q, J_{C-F} =30.2 Hz), 37.76, 23.38, 21.54, 20.79. ^{19}F NMR (471 MHz, $CDCl_3$) δ -67.79 (s, 3F). HRMS (ESI) Calculated for $C_{17}H_{16}F_3NO_3$ $[M+Na]^+$: 362.0974, found: 362.0888.



(R,Z)-2-(hydroxyimino)-3-(p-tolyl)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3be**): white solid, yield: 69%, ee: 87%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 15.12 min, t_{minor} = 20.13 min. IR (KBr) ν/cm^{-1}: 3265, 2921, 2848, 1692, 1647, 1632, 1374. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.31 (s, 1H), 7.37 (d, *J* = 8.2 Hz, 2H), 7.19 (d, *J* = 8.2 Hz, 2H), 2.82 (t, *J* = 6.2 Hz, 2H), 2.39 (dt, *J* = 8.3, 4.5 Hz, 2H), 2.28 (s, 3H), 2.07 (tt, *J* = 21.0, 7.3 Hz, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.97, 176.58, 152.09, 138.40, 131.13, 129.53, 127.78, 124.71 (q, J_{C-F} = 284.8 Hz), 114.19, 59.27 (q, J_{C-F} =30.2 Hz), 37.78, 23.38, 20.97, 20.80. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.23 (s, 3F). HRMS (ESI) Calculated for $C_{16}H_{14}F_3NO_3$ $[M+Na]^+$: 348.0818, found: 348.0739.

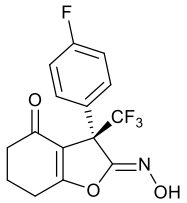


(R,Z)-2-(hydroxyimino)-3-(4-methoxyphenyl)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3bf**): white solid, yield: 66%, ee: 89%. HPLC (Chiralpak AD-H, Hexane/i-PrOH/EtOH = 89/8.3/2.7, 1 mL/min, 254nm): t_{major} = 21.11 min, t_{minor} = 33.84 min. IR (KBr) ν/cm^{-1}: 3394, 3055, 2920, 2849, 1701, 1667, 1636, 1609, 1520, 1372. ^{1}H NMR (500 MHz,



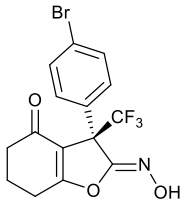
DMSO-d_6) δ 11.32 (s, 1H), 7.43 (d, *J* = 8.8 Hz, 2H), 6.94 (d, *J* = 9.0 Hz, 2H), 3.75 (s, 3H), 2.89 – 2.73 (m, 2H), 2.46 – 2.32 (m, 2H), 2.19 – 2.00 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 192.10, 176.55, 159.63, 152.07, 129.37, 125.73, 124.86 (q, J_{C-F} = 284.8 Hz), 114.31, 114.16, 59.00 (q, J_{C-F} =30.2 Hz), 55.66, 37.83, 23.40, 20.79. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.57 (s, 3F). HRMS (ESI) Calculated for $C_{16}H_{14}F_3NO_4$ $[M+Na]^+$: 364.0767, found: 364.0685.

(R,Z)-3-(4-fluorophenyl)-2-(hydroxyimino)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3bg**): white solid, yield: 70%, ee: 88%.



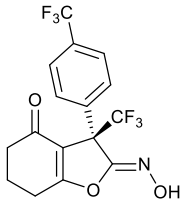
HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 13.65 min, t_{minor} = 16.36 min. IR (KBr) ν/cm^{-1}: 3281, 2957, 2922, 2851, 1691, 1648, 1632, 1606, 1515, 1457, 1419, 1375. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.41 (s, 1H), 7.68 – 7.46 (m, 2H), 7.32 – 7.20 (m, 2H), 2.83 (t, *J* = 6.1Hz, 2H), 2.41 (m, 2H), 2.08 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 192.11, 177.00, 163.38 (d, J_{C-F} =247.0 Hz), 151.80, 130.39 (d, J_{C-F} =8.8 Hz), 130.14 (d, J_{C-F} =3.8 Hz), 124.71 (q, J_{C-F} = 284.8 Hz), 115.87 (d, J_{C-F} =22.7 Hz), 113.85, 59.02 (q, J_{C-F} =30.2 Hz), 37.75, 23.42, 20.74. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.60 (s, 3F), -112.84-112.90 (m, 1F). HRMS (ESI) Calculated for $C_{15}H_{11}F_4NO_3$ $[M+Na]^+$: 352.0567, found: 352.0478.

(R,Z)-3-(4-bromophenyl)-2-(hydroxyimino)-3-(trifluoromethyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3bh**): white solid, yield: 78%, ee: 58%.

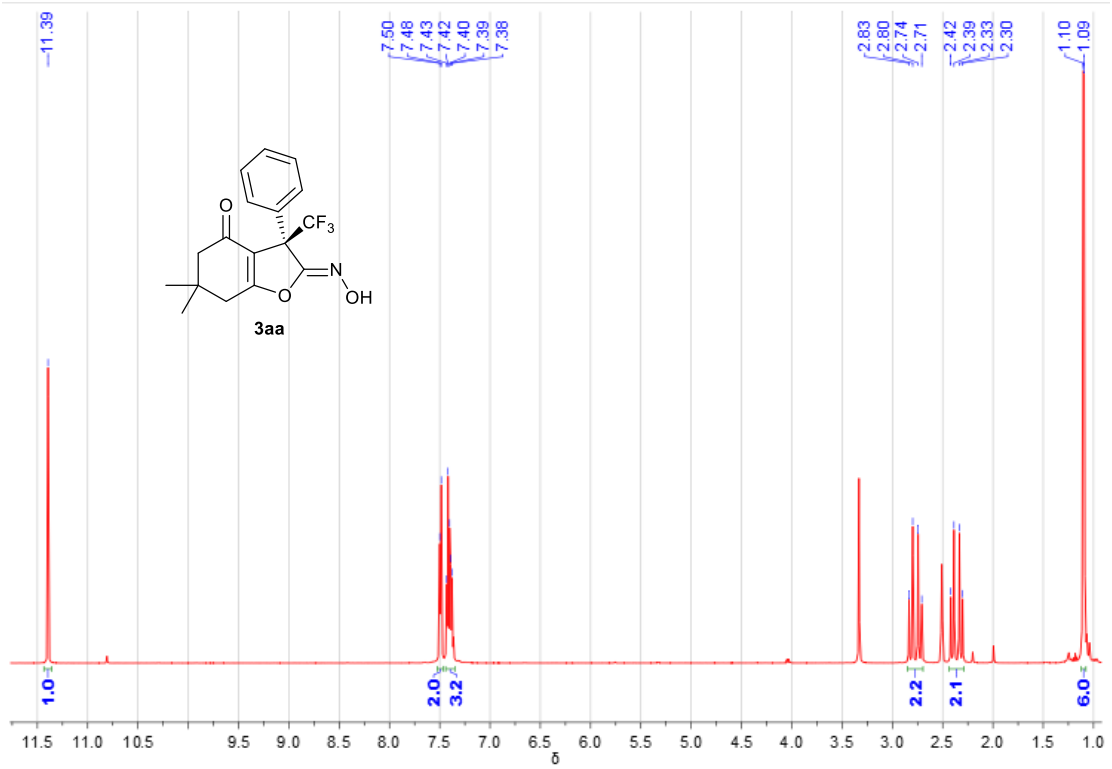


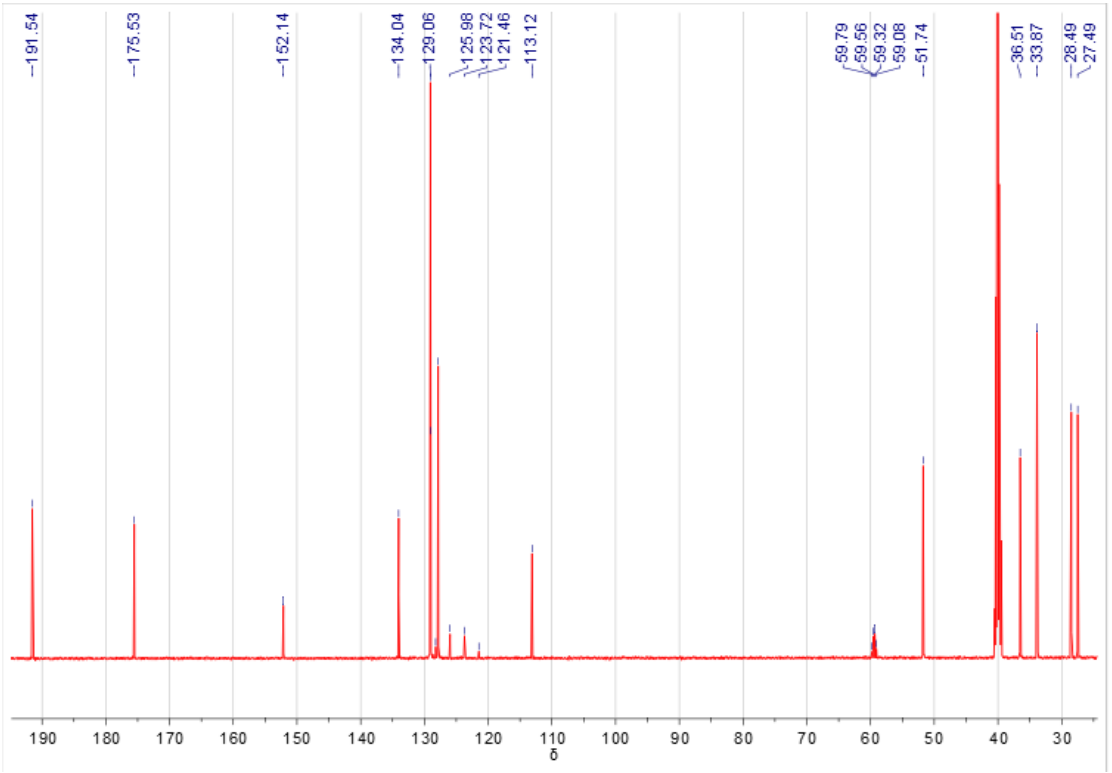
HPLC (Chiralpak AD-H, Hexane/i-PrOH = 90/10, 1 mL/min, 254nm): t_{major} = 15.51 min, t_{minor} = 17.53 min. IR (KBr) ν/cm^{-1}: 3291, 2956, 2922, 2850, 1687, 1652, 1631, 1495, 1373. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.43 (s, 1H), 7.62 (d, *J* = 8.5 Hz, 2H), 7.45 (d, *J* = 8.4 Hz, 2H), 2.83 (t, *J* = 6.1 Hz, 2H), 2.46 – 2.33 (m, 2H), 2.17 – 2.00 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 191.99, 177.10, 151.61, 133.39, 131.95, 130.17, 124.59 (q, J_{C-F} = 284.8 Hz), 122.54, 113.68, 59.13 (q, J_{C-F} =30.2 Hz), 37.65, 23.39, 20.72. ^{19}F NMR (471 MHz, $CDCl_3$) δ -68.41 (s, 3F). HRMS (ESI) Calculated for $C_{15}H_{11}BrF_3NO_3$ $[M+Na]^+$: 411.9767, found: 411.9676.

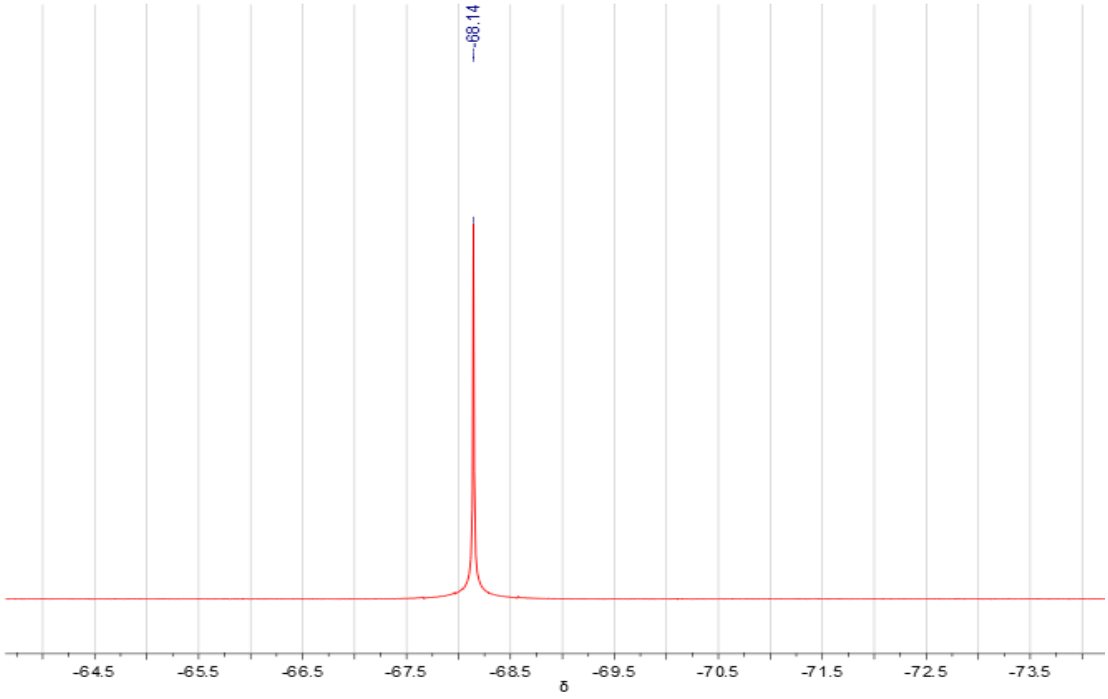
(R,Z)-2-(hydroxyimino)-3-(trifluoromethyl)-3-(4-(trifluoromethyl)phenyl)-3,5,6,7-tetrahydrobenzofuran-4(2H)-one (**3bi**): yellow solid, yield: 68%, ee: 65%. HPLC (Chiralpak AD-H, Hexane/i-PrOH = 95/5, 1 mL/min): t_{major} = 22.29 min, t_{minor} = 25.47 min. IR (KBr) ν/cm^{-1} : 3388, 2925, 2852, 1694, 1654, 1636, 1457, 1419, 1378. ^{1}H NMR (500 MHz, DMSO-d_6) δ 11.48 (d, *J* = 1.2 Hz, 1H), 7.79 (d, *J* = 8.5 Hz, 2H), 7.73 (d, *J* = 8.3 Hz, 2H), 2.85 (t, *J* = 6.1 Hz, 2H), 2.46 – 2.34 (m, 2H), 2.09 (m, 2H). ^{13}C NMR (126 MHz, DMSO-d_6) δ 192.02, 177.42, 151.65, 138.57, 129.54 (q, J_{C-F} =32.8 Hz), 128.95, 126.01 (q, J_{C-F} =3.8 Hz), 124.64 (q, J_{C-F} =284.8 Hz), 124.39 (q, J_{C-F} =272.2 Hz), 113.69, 59.40 (q, J_{C-F} =30.2 Hz), 37.61, 23.44, 20.77. ^{19}F NMR (471 MHz, $CDCl_3$) δ -63.00 (s, 3F), -68.20 (s, 3F). HRMS (ESI) Calculated for $C_{16}H_{11}F_6NO_3$ $[M+Na]^+$: 402.0535, found: 402.0467.

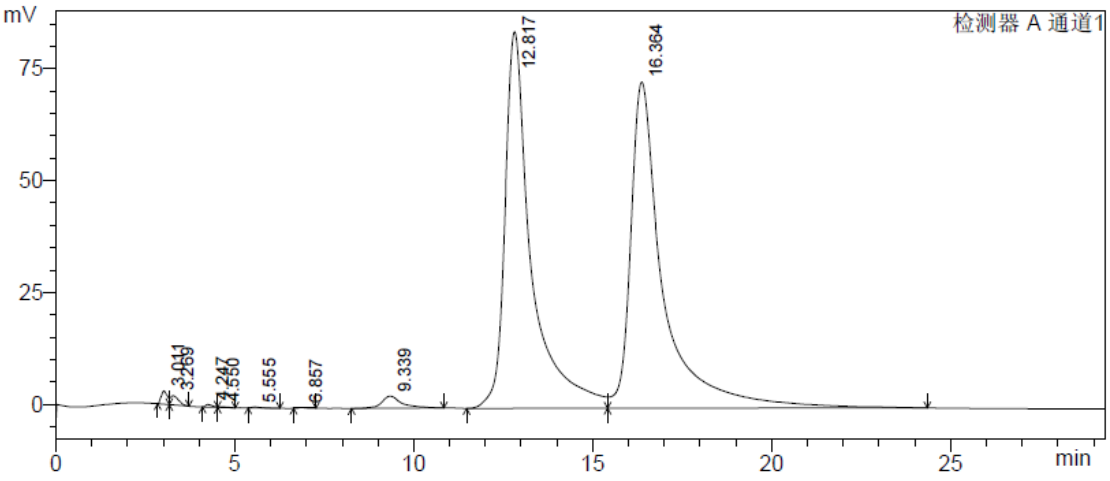


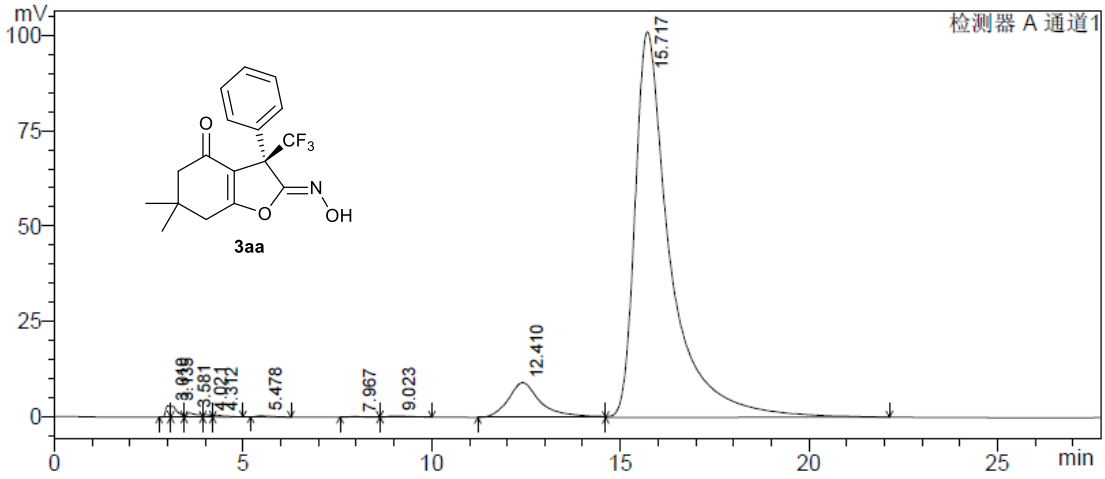
5. Copies of ^{1}H, ^{13}C, ^{19}F NMR spectra and HPLC chromatograms











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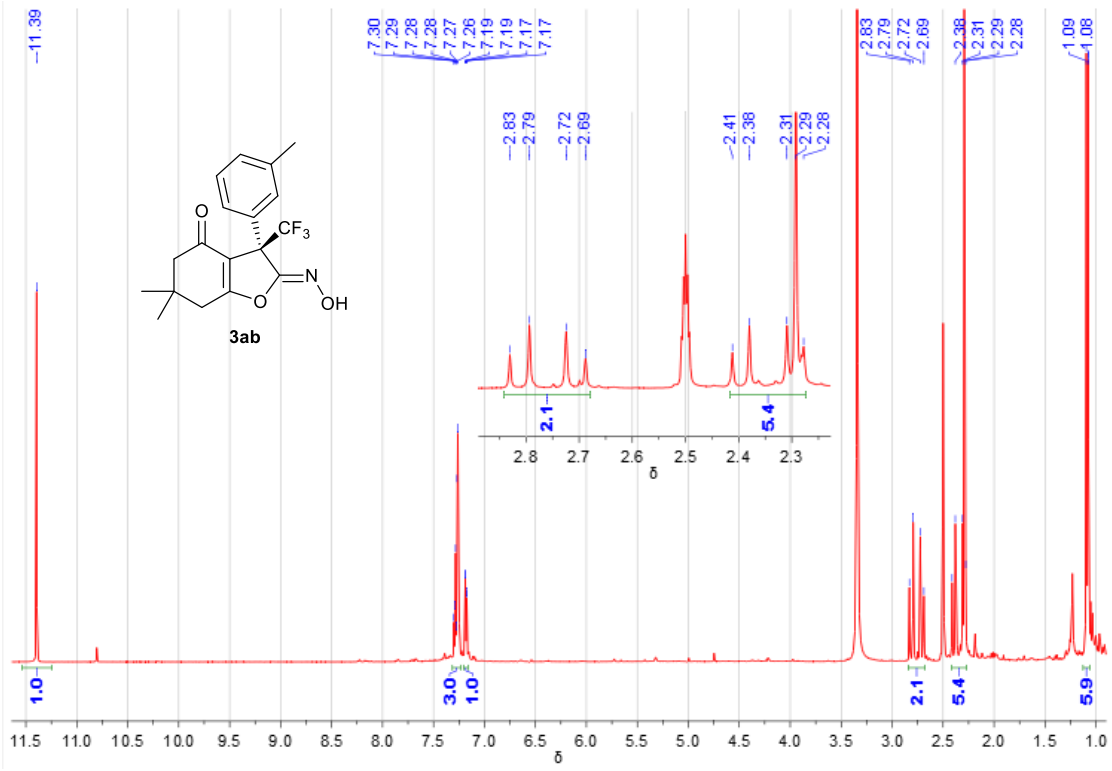
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7.28
7.28
7.27
7.26
7.19
7.19
7.17
7.17
2.83
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2.72
2.69
2.41
2.38
2.31
2.29
2.28
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2.29
2.28
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1.08
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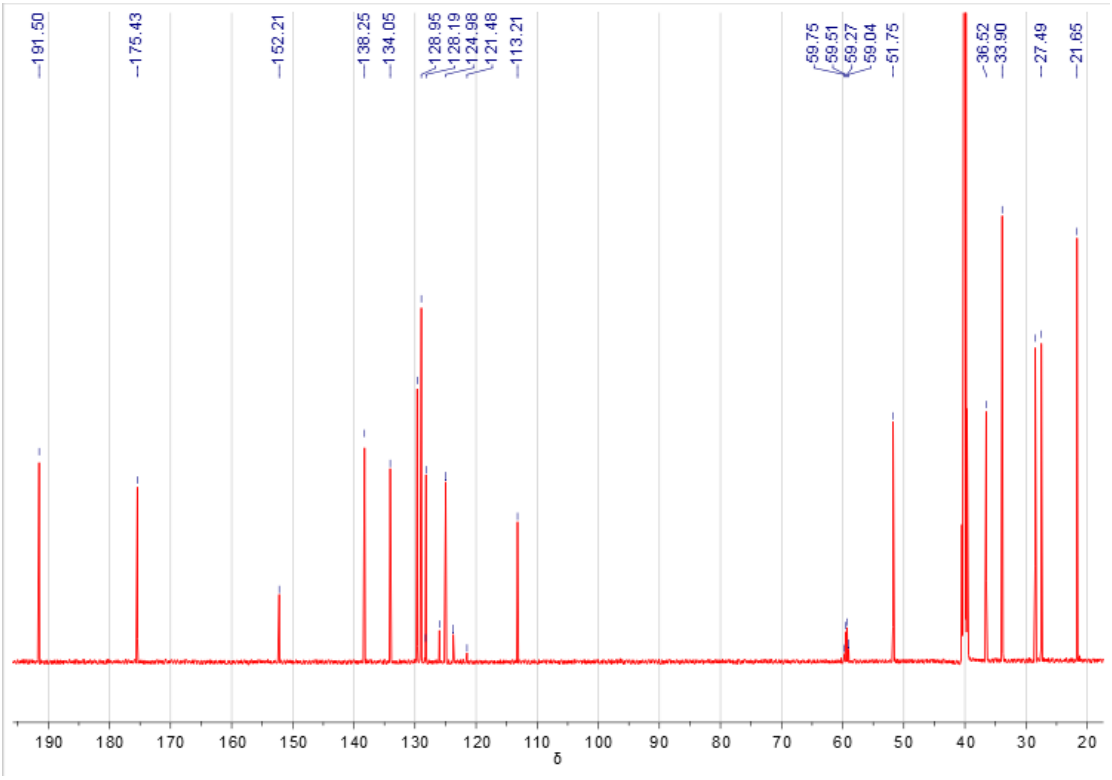
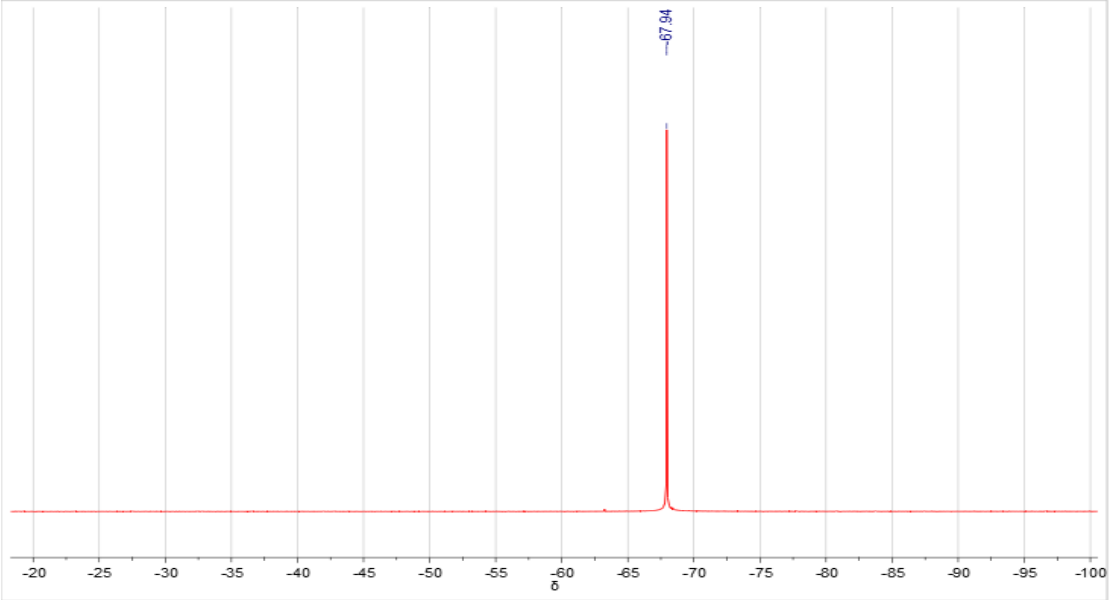
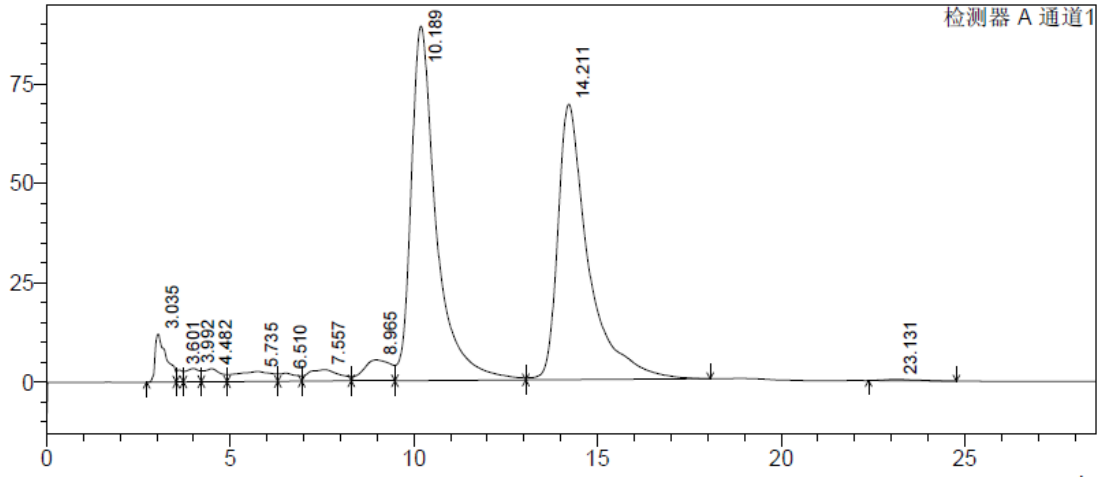
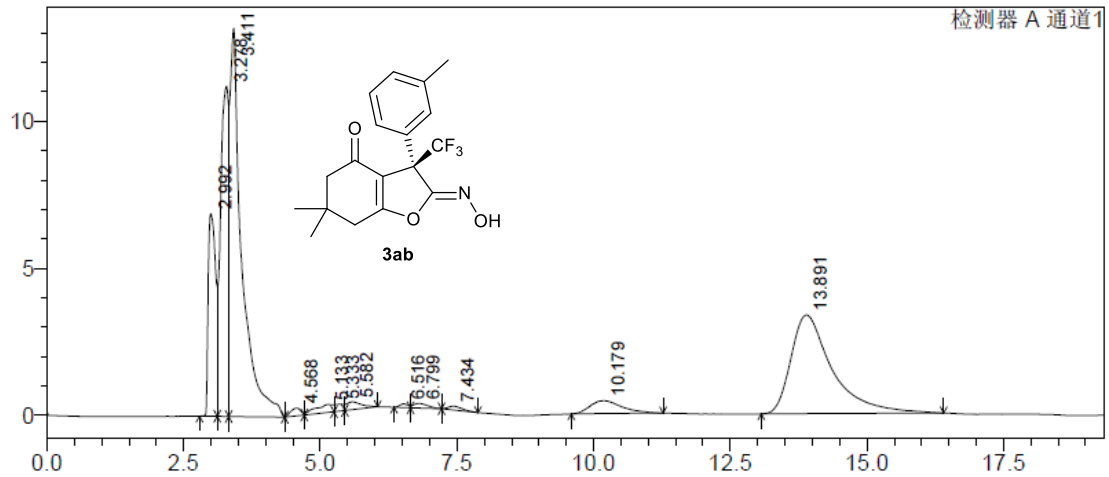
2.1
5.4
5.9
δ


191.50
175.43
152.21
138.25
134.05
128.95
128.19
124.98
121.48
113.21
59.75
59.51
59.27
59.04
51.75
36.52
33.90
27.49
21.65
δ







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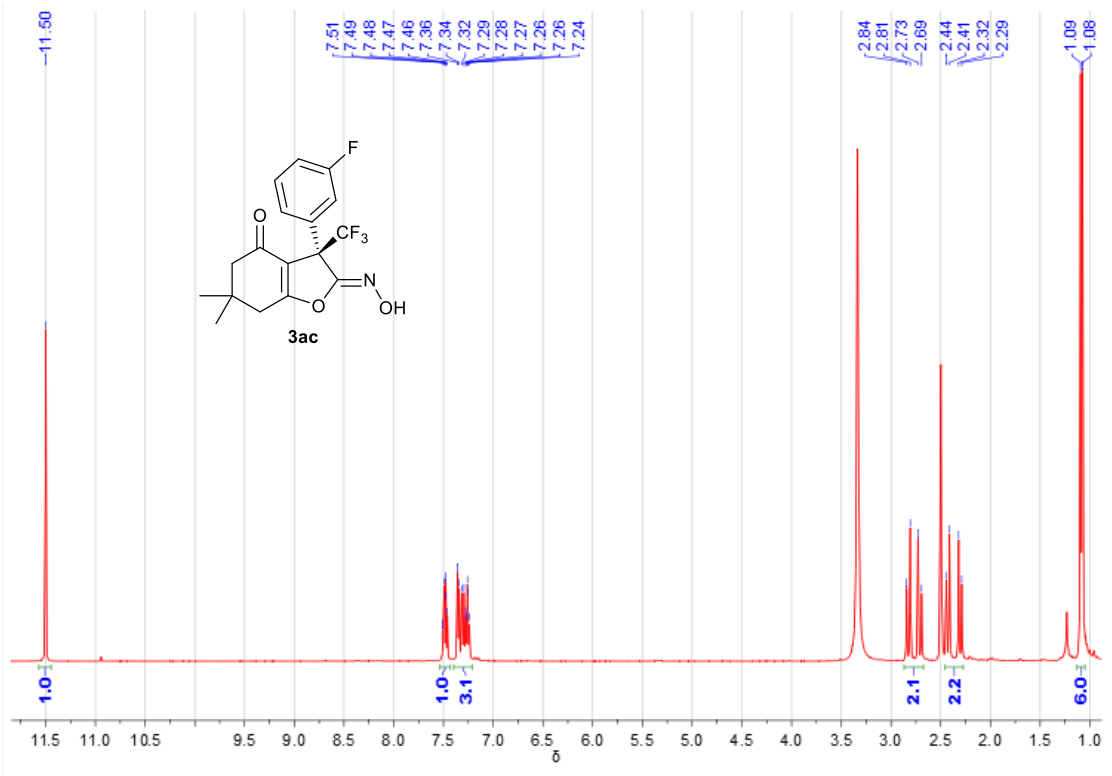
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7.48
7.47
7.46
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7.34
7.32
7.29
7.28
7.27
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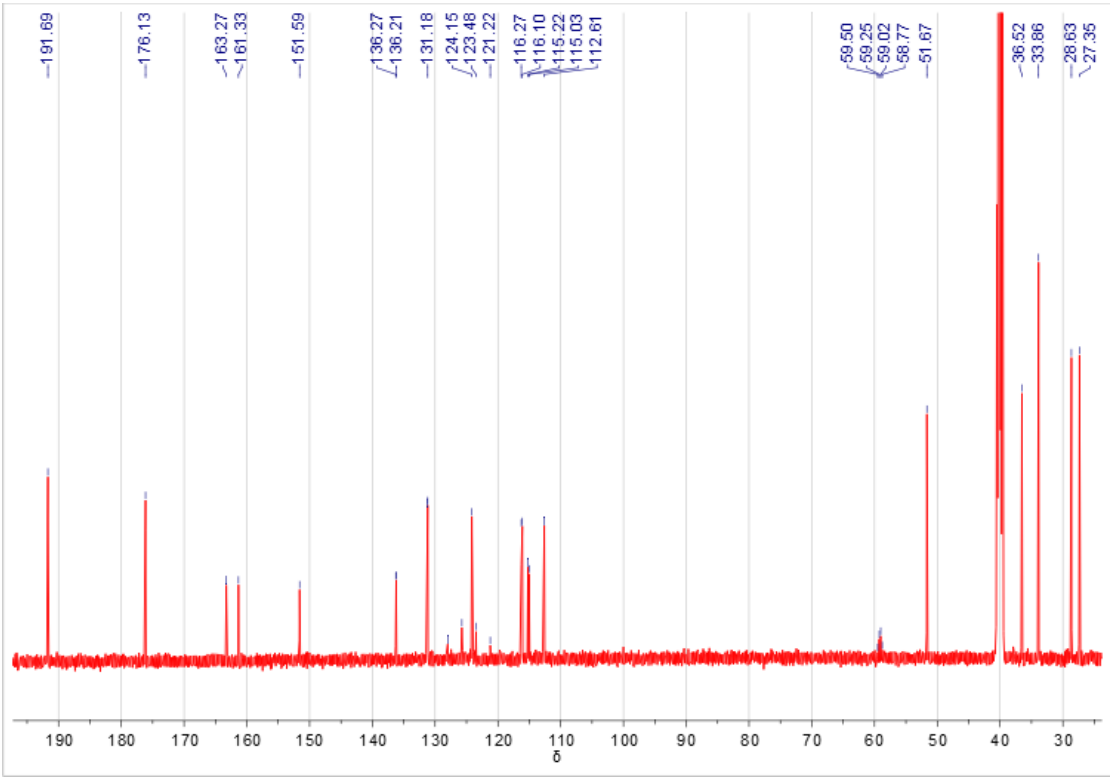
7.26
7.24
2.84
2.81
2.73
2.69
2.44
2.41
2.32
2.29
1.09
1.08
F
O
CF3
N
OH
O
3ac
1.0
1.0
3.1
2.1
2.2
6.0
11.5 11.0 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0
δ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176.13
163.27
161.33
151.59
136.27
136.21
131.18
124.15
123.48
121.22
116.27
116.10
115.22
115.03
112.61
59.50
59.25
59.02
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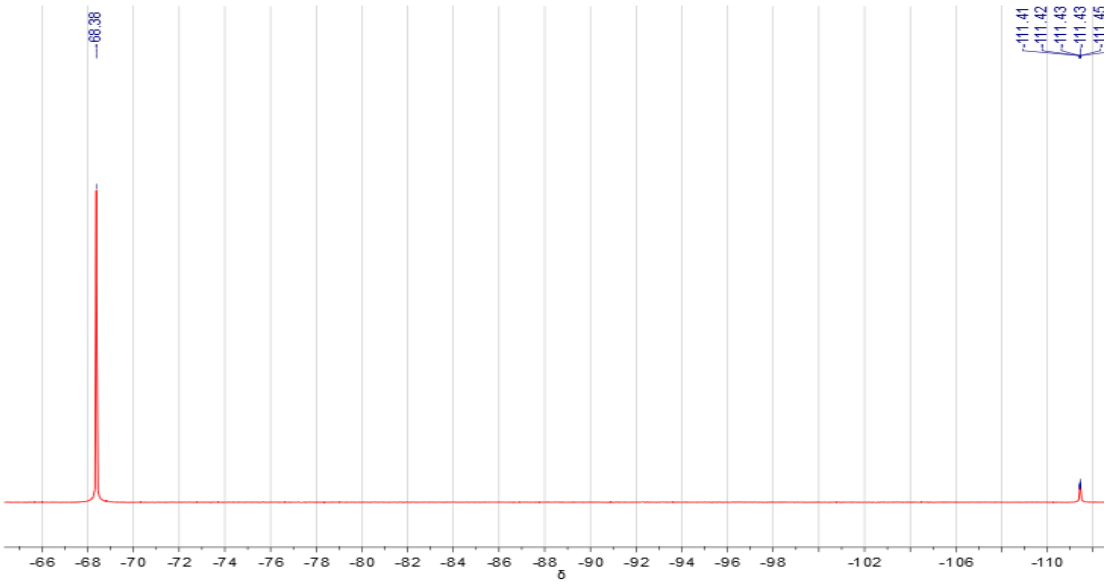
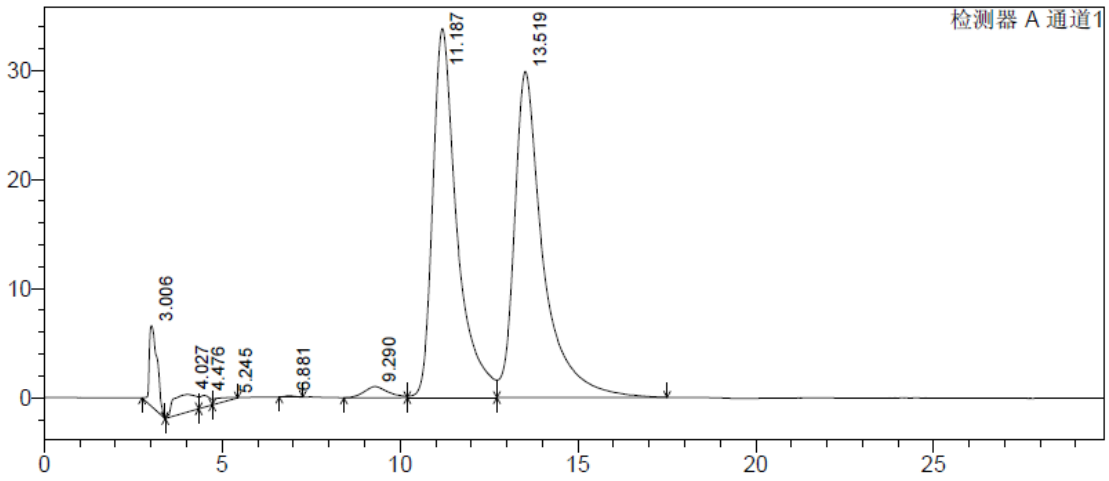
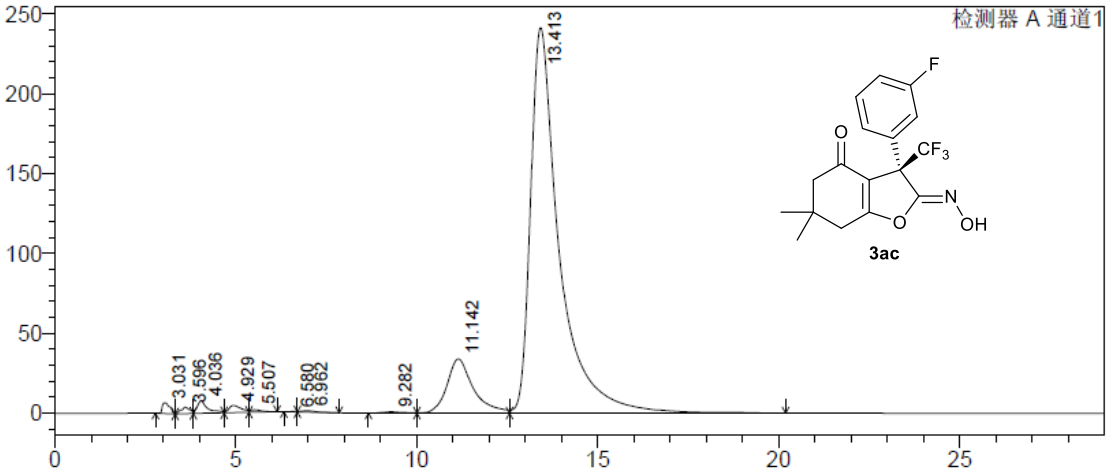
51.67
36.52
33.86
28.63
27.35
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30
δ







Peak	Retention Time	Area	Height	Area%
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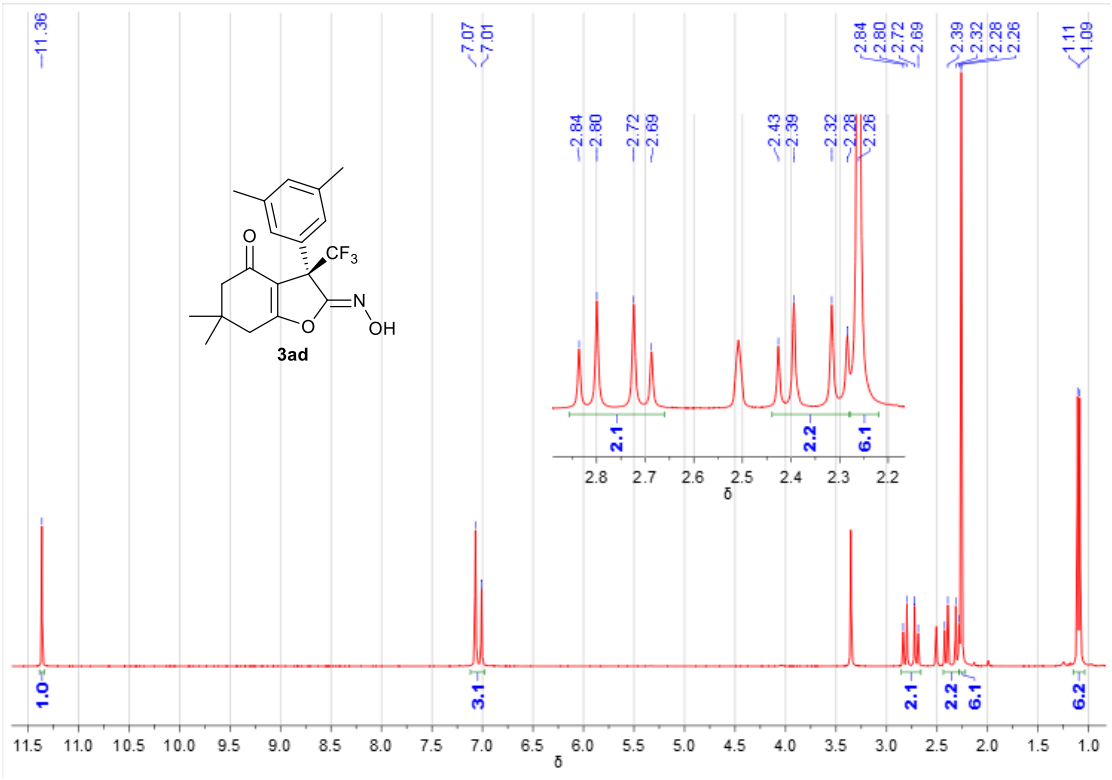
11.36
7.07
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2.84
2.80
2.72
2.69
2.39
2.32
2.28
2.26
1.11
1.09
2.43
2.39
2.1
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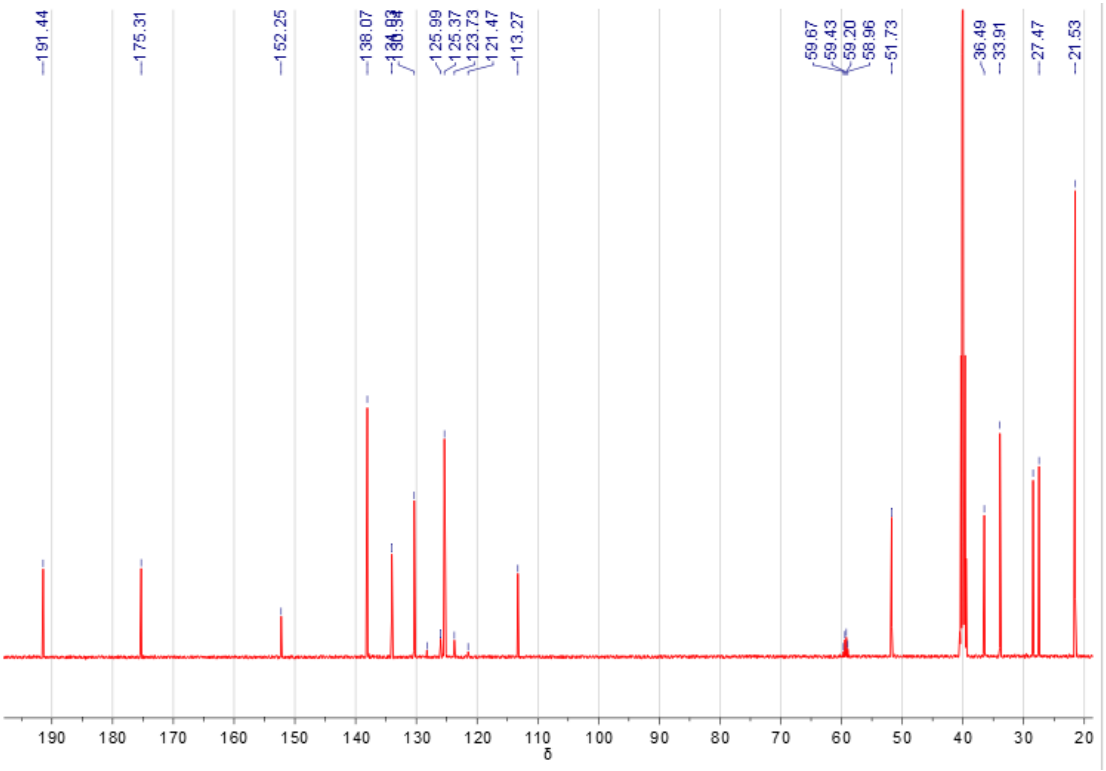
6.2
δ
O
CF3
N
OH
O
3ad


191.44
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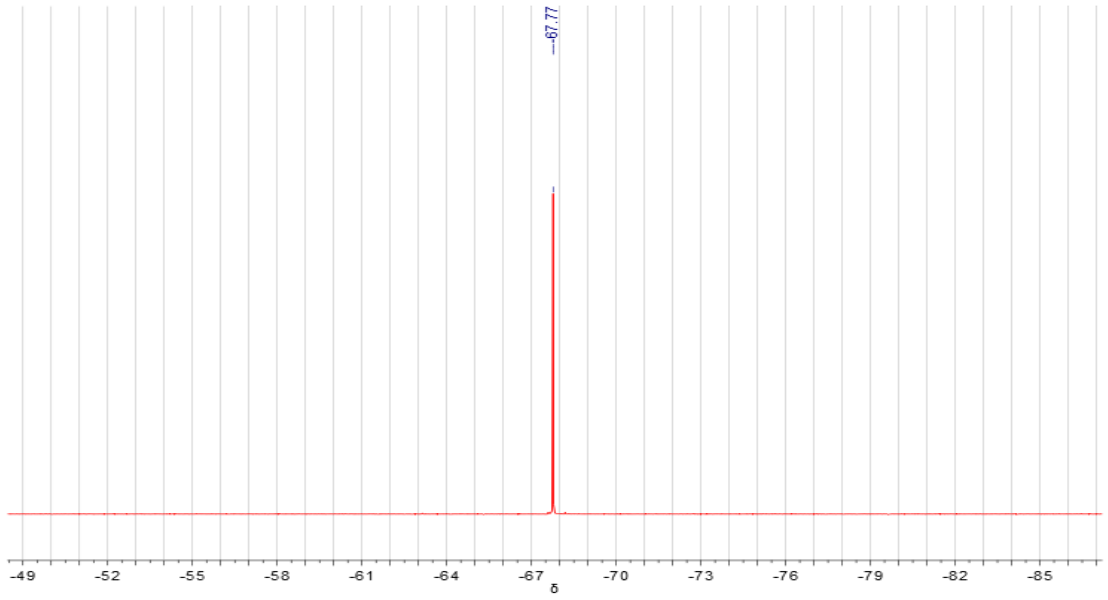
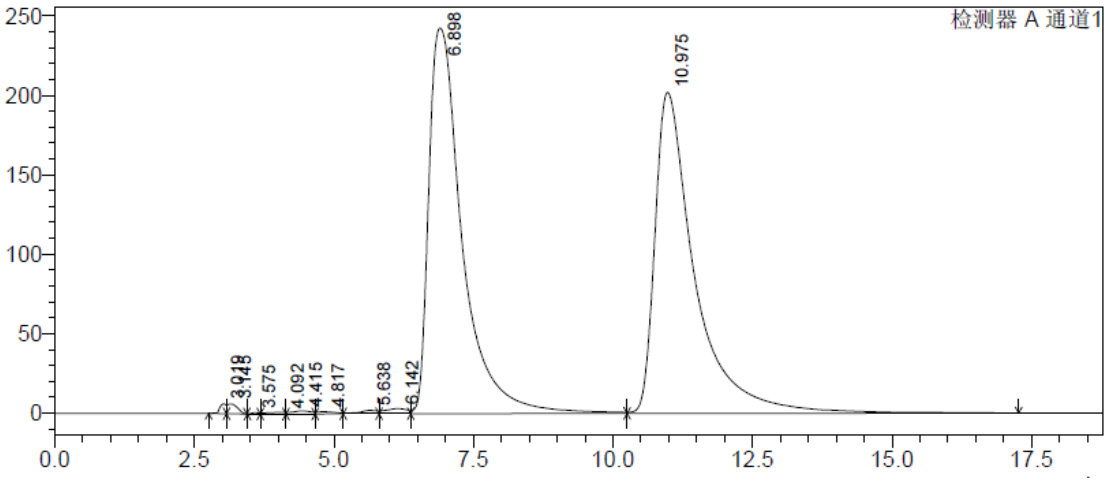
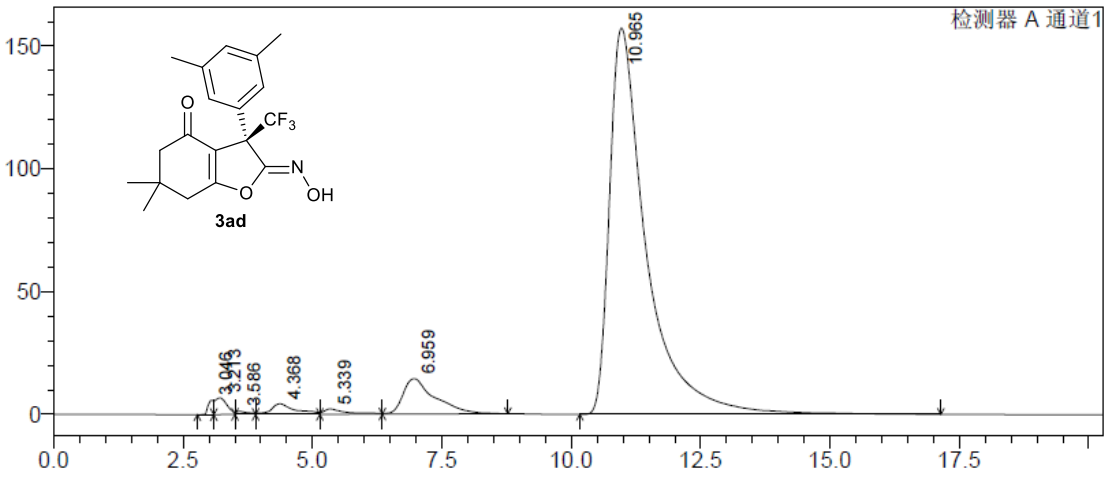
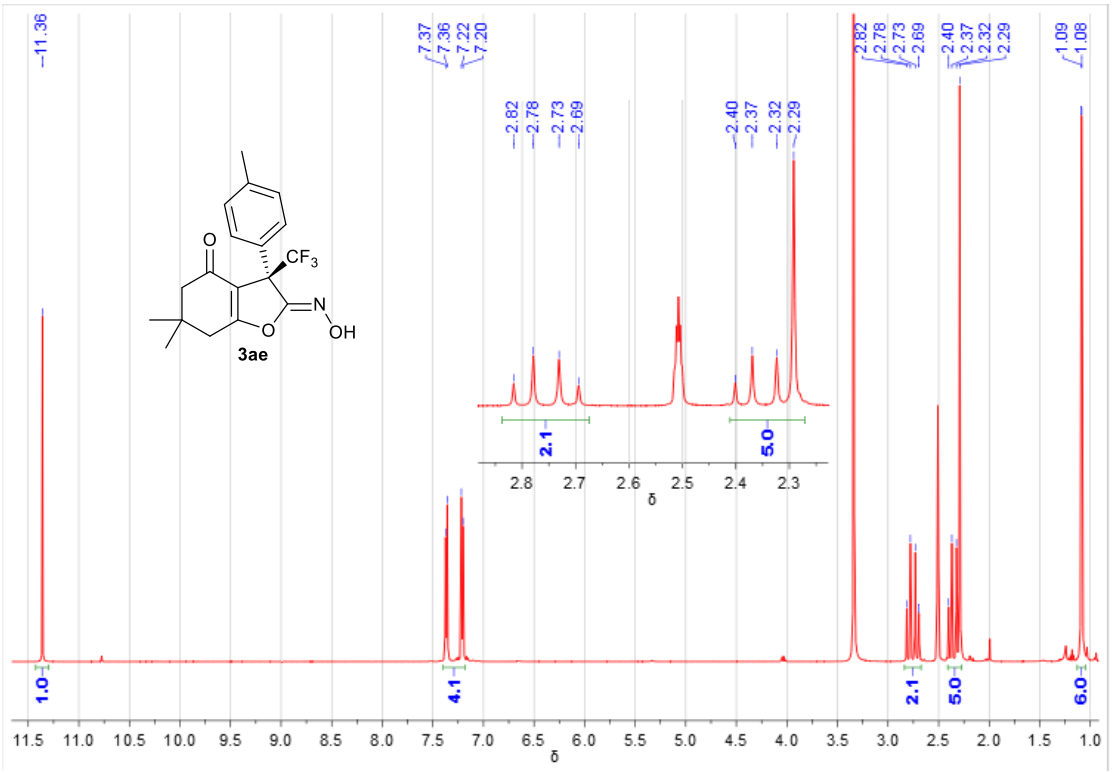
152.25
138.07
125.99
125.37
123.73
121.47
113.27
59.67
59.43
59.20
58.96
51.73
36.49
33.91
27.47
21.53
δ

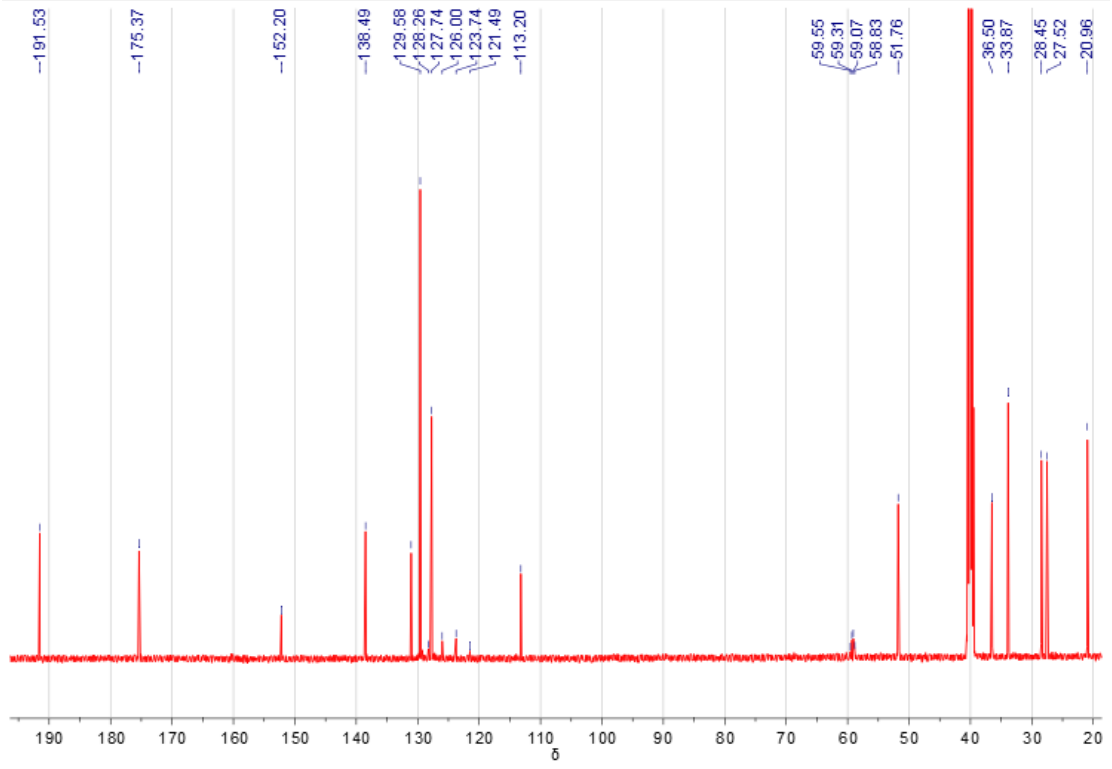


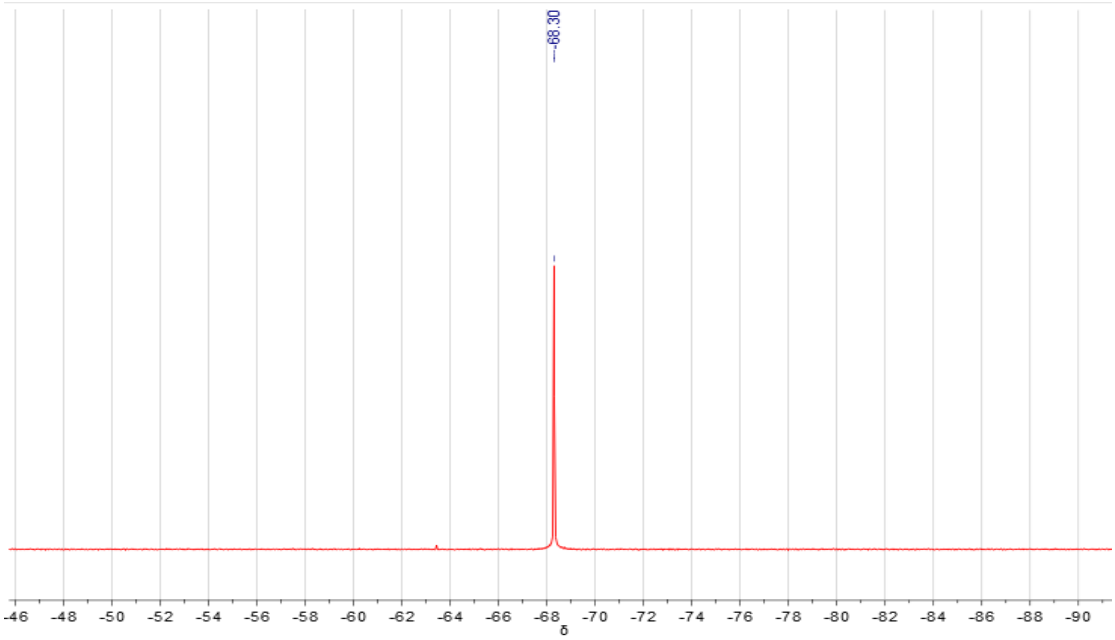


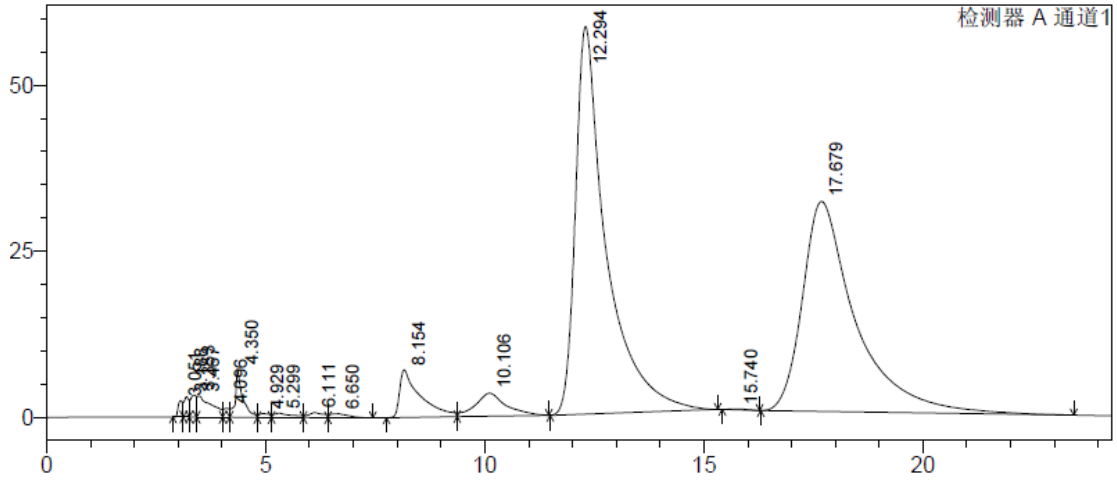


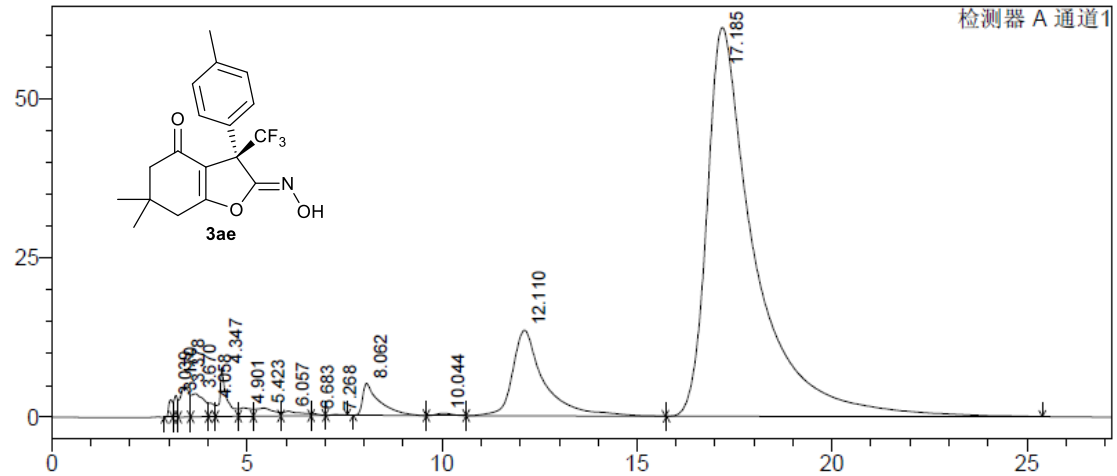
Peak	Retention Time	Area	Height	Area%
1	6.959	616408	14409	7.33
2	10.965	7794293	157364	92.67


11.36
7.37
7.36
7.22
7.20
2.82
2.78
2.73
2.69
2.40
2.37
2.32
2.29
1.09
1.08
O
CF3
N
OH
3ae
2.1
5.0
1.0
4.1
2.1
5.0
6.0
δ

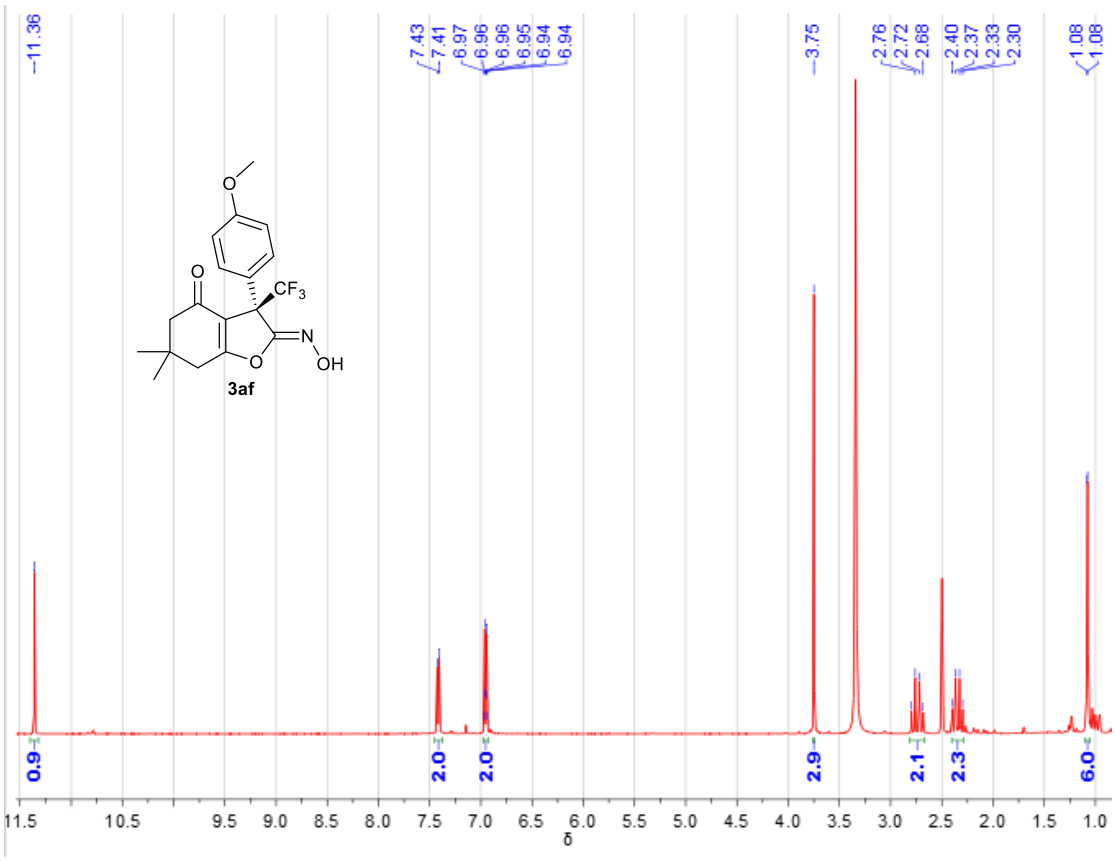

191.53
175.37
152.20
138.49
129.58
128.26
127.74
126.00
123.74
121.49
113.20
59.55
59.31
59.07
58.83
51.76
36.50
33.87
28.45
27.52
20.96
δ

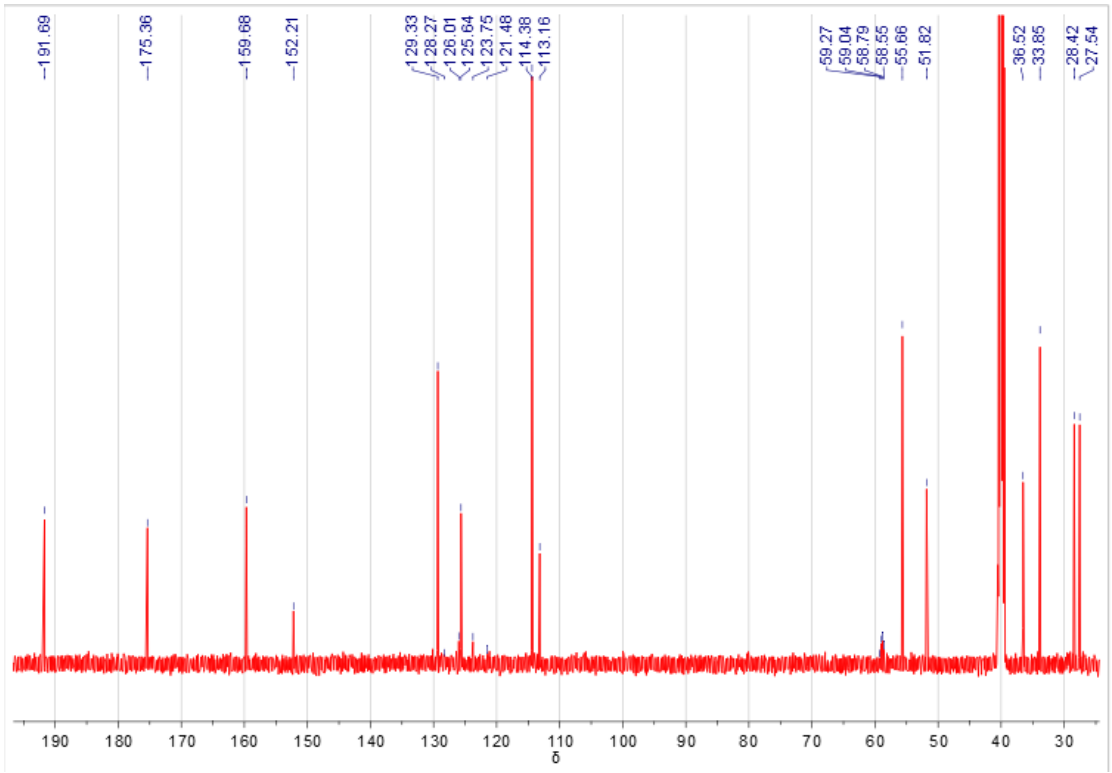


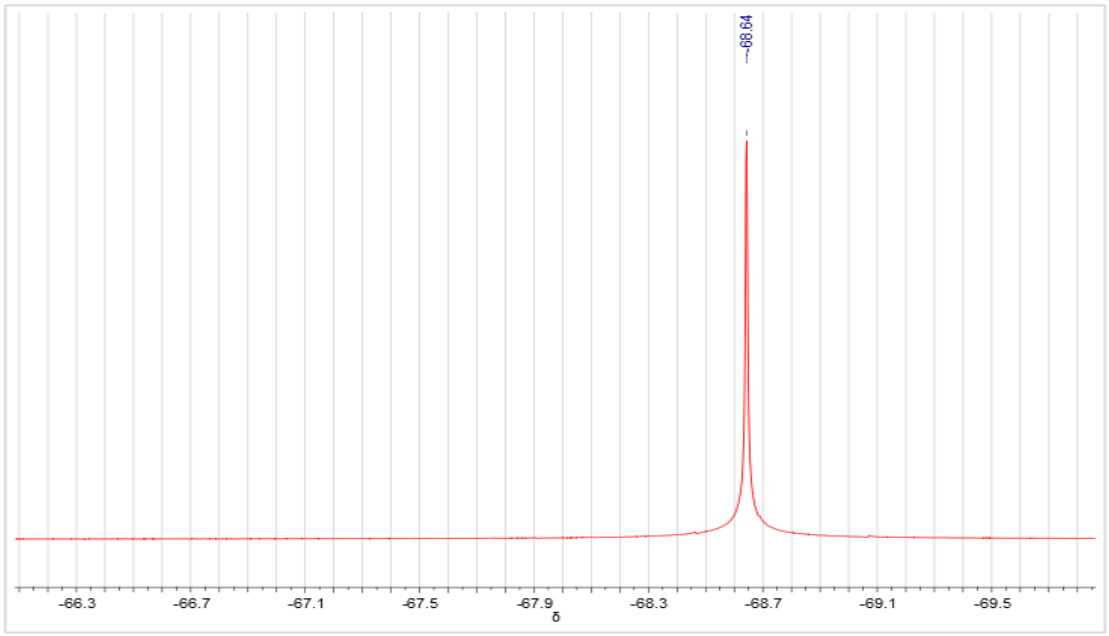


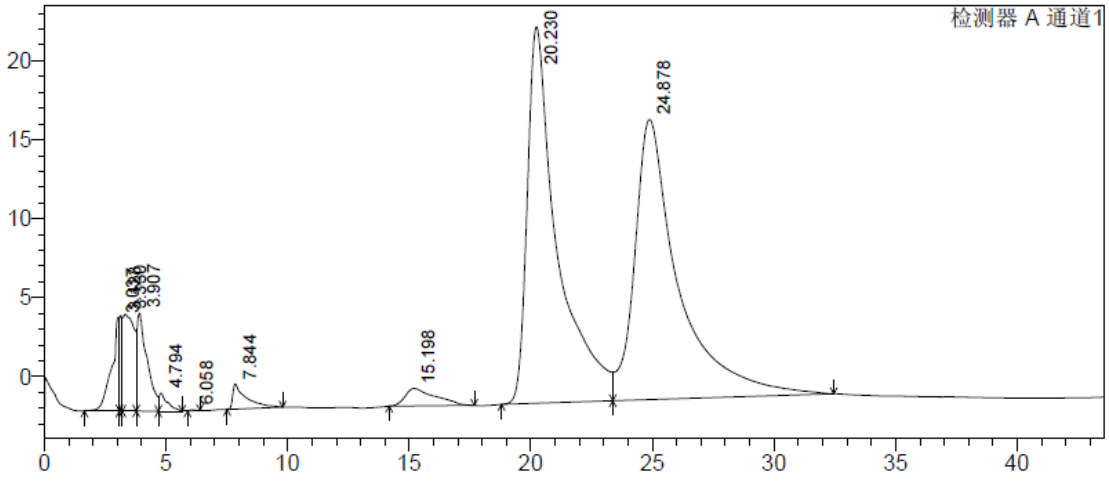


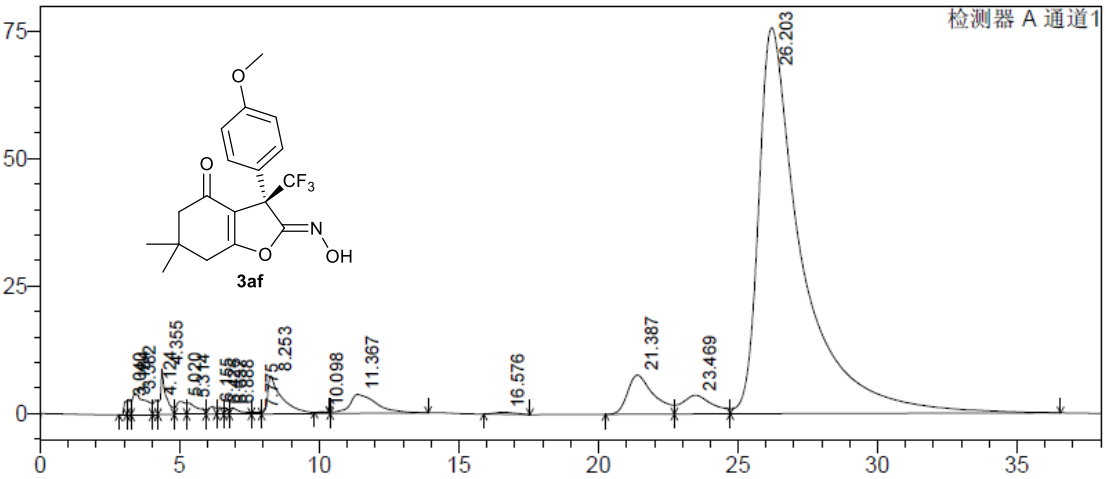
Peak	Retention Time	Area	Height	Area%
1	12.110	754206	13433	12.64
2	17.185	5210919	60996	87.36


11.36
7.43
7.41
6.97
6.96
6.96
6.95
6.94
6.94
3.75
2.76
2.72
2.68
2.40
2.37
2.33
2.30
1.08
1.08
O
CF3
N
OH
O
3af
0.9
2.0
2.0
2.9
2.1
2.3
6.0
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
δ

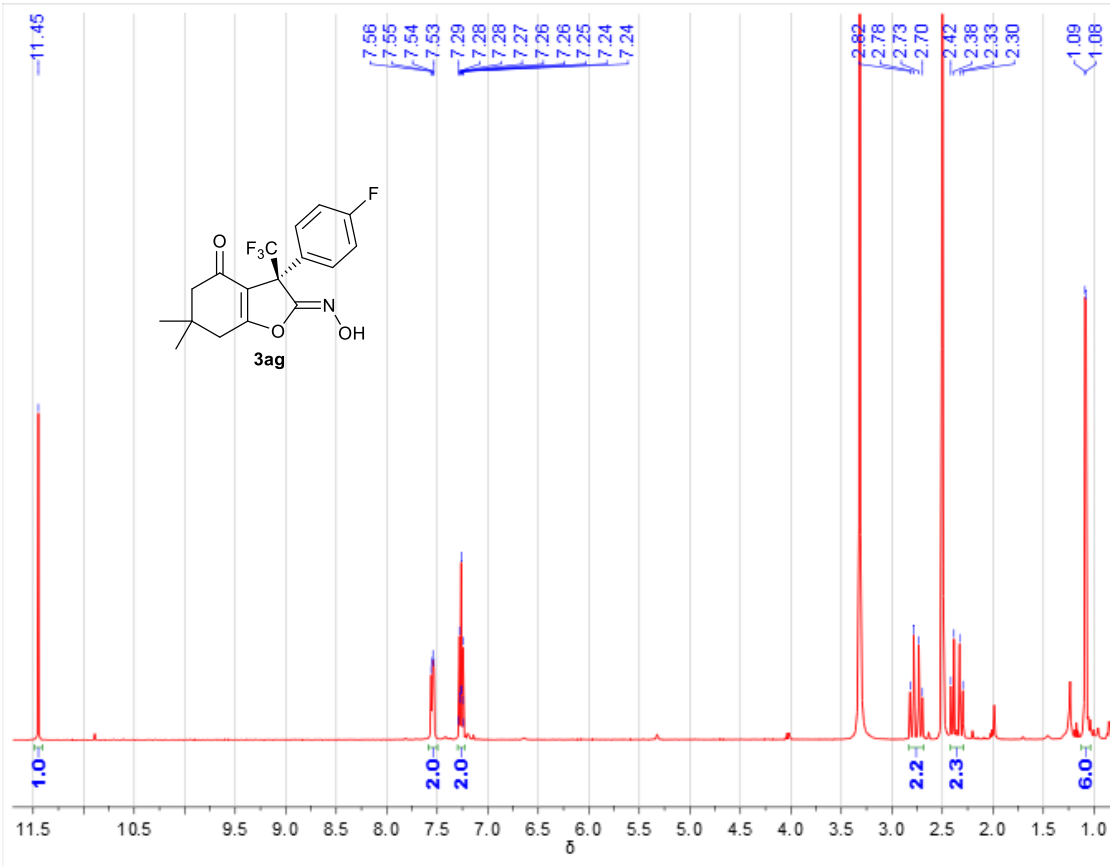

191.69
175.36
159.68
152.21
129.33
128.27
126.01
125.64
123.75
121.48
114.38
113.16
59.27
59.04
58.79
58.55
55.66
51.82
36.52
33.85
28.42
27.54
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
δ

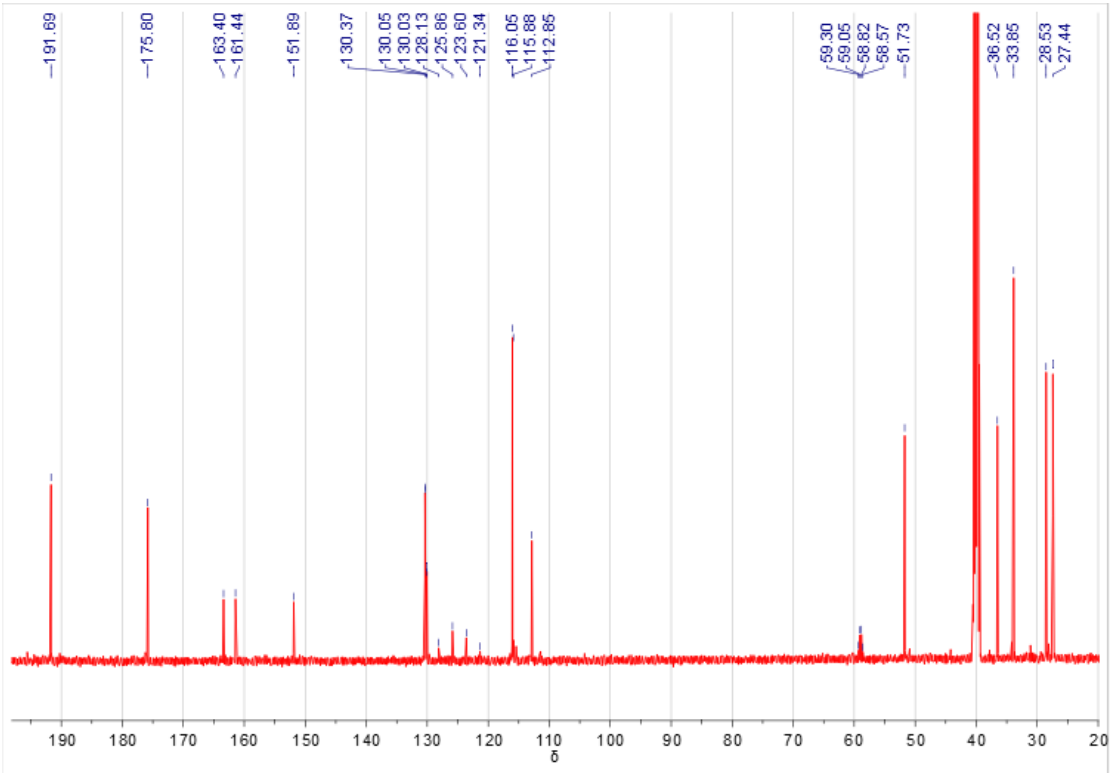


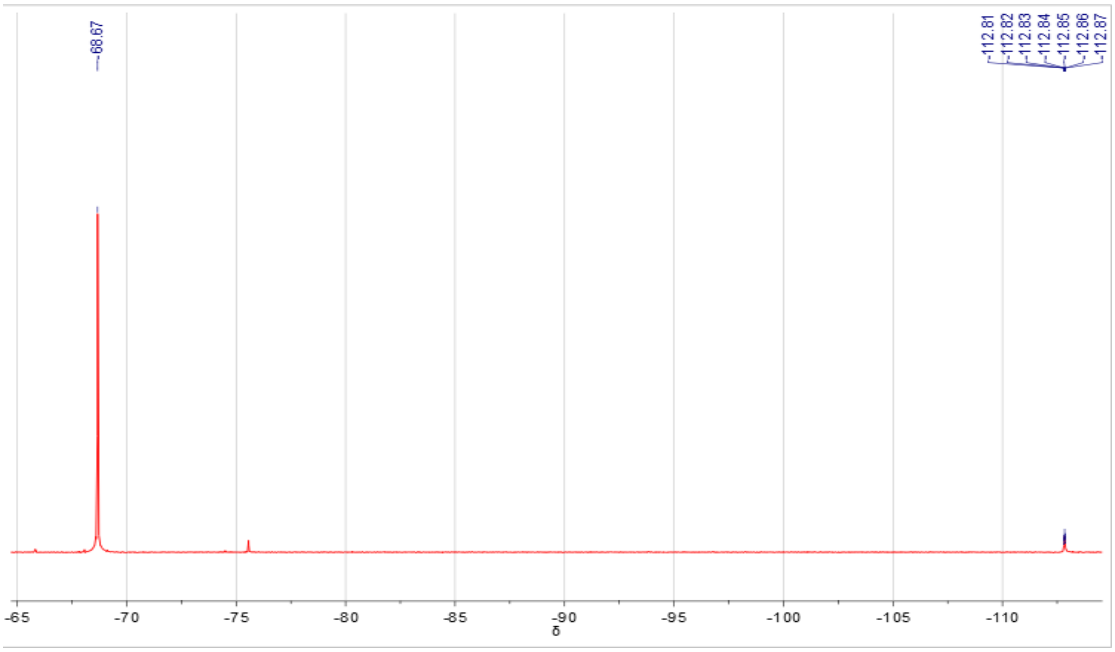


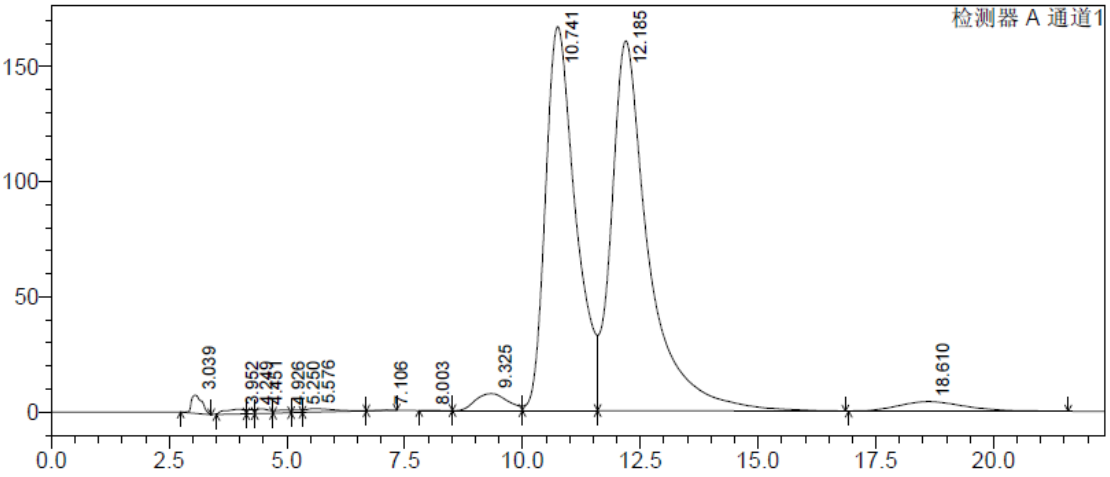


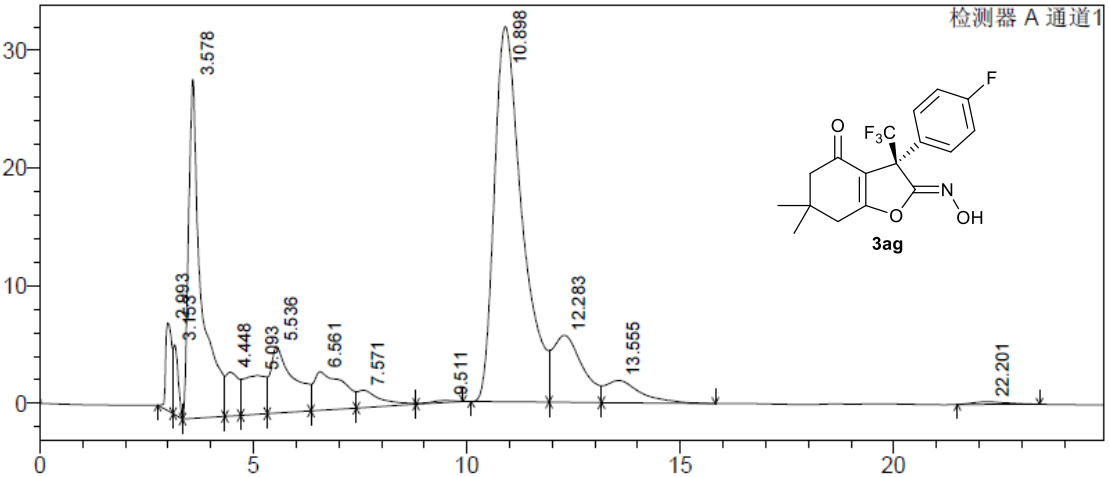
Peak	Retention Time	Area	Height	Area%
1	21.387	501731	7660	5.78
2	26.203	8186631	75631	94.22


11.45
7.56
7.55
7.54
7.53
7.29
7.28
7.28
7.27
7.26
7.26
7.25
7.24
7.24
2.82
2.78
2.73
2.70
2.42
2.38
2.33
2.30
1.09
1.08
F
O
F3C
N
OH
O
3ag
1.0
2.0
2.0
2.2
2.3
6.0
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
δ

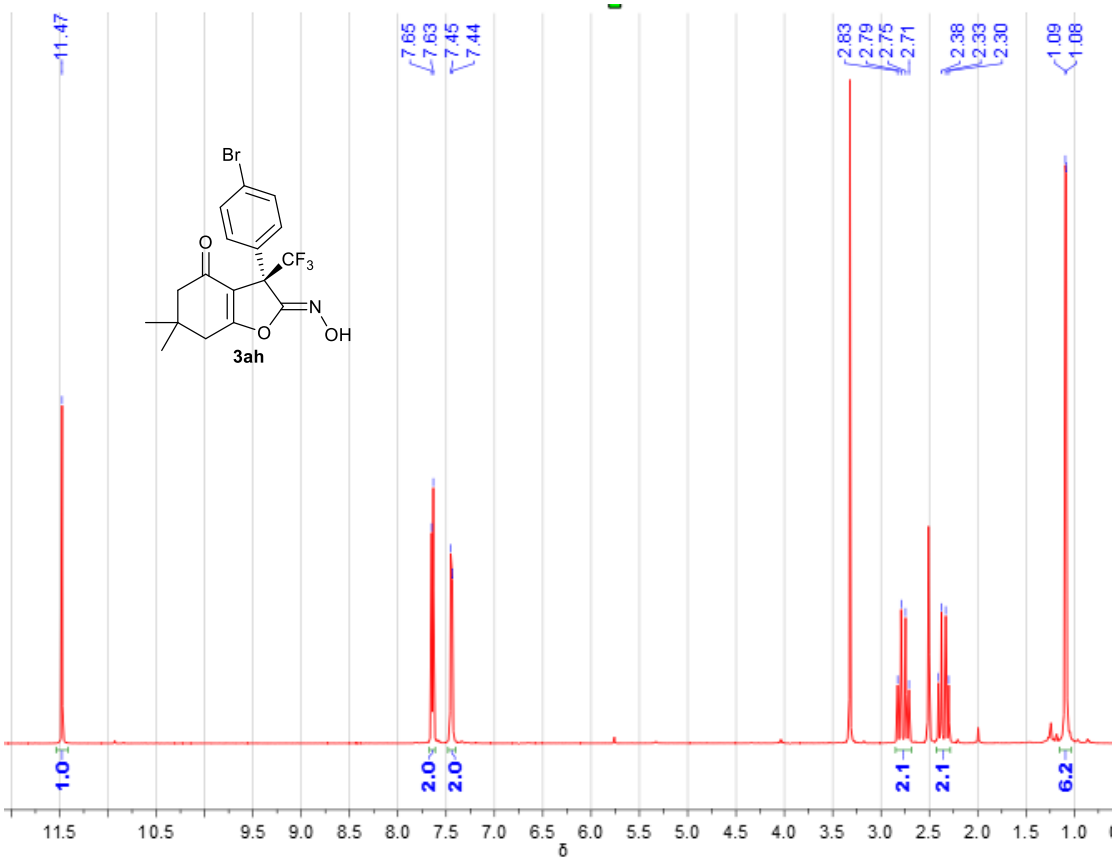

191.69
175.80
163.40
161.44
151.89
130.37
130.05
130.03
128.13
125.86
123.60
121.34
116.05
115.88
112.85
59.30
59.05
58.82
58.57
51.73
36.52
33.85
28.53
27.44
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
δ

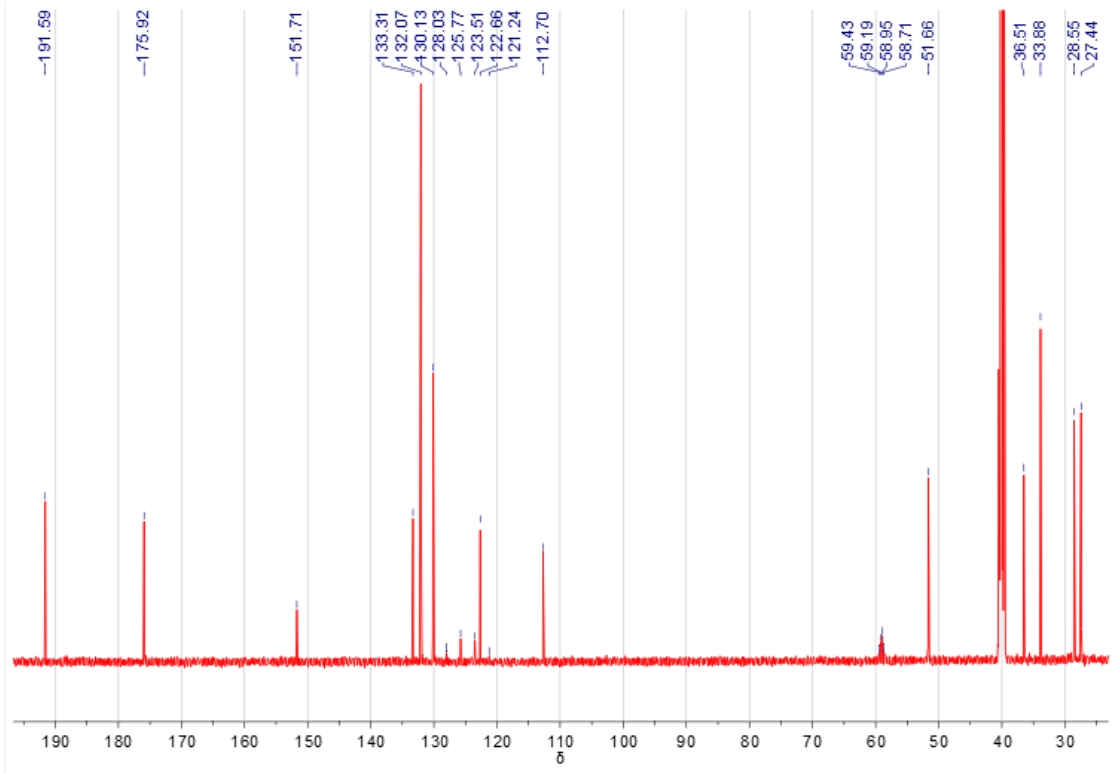


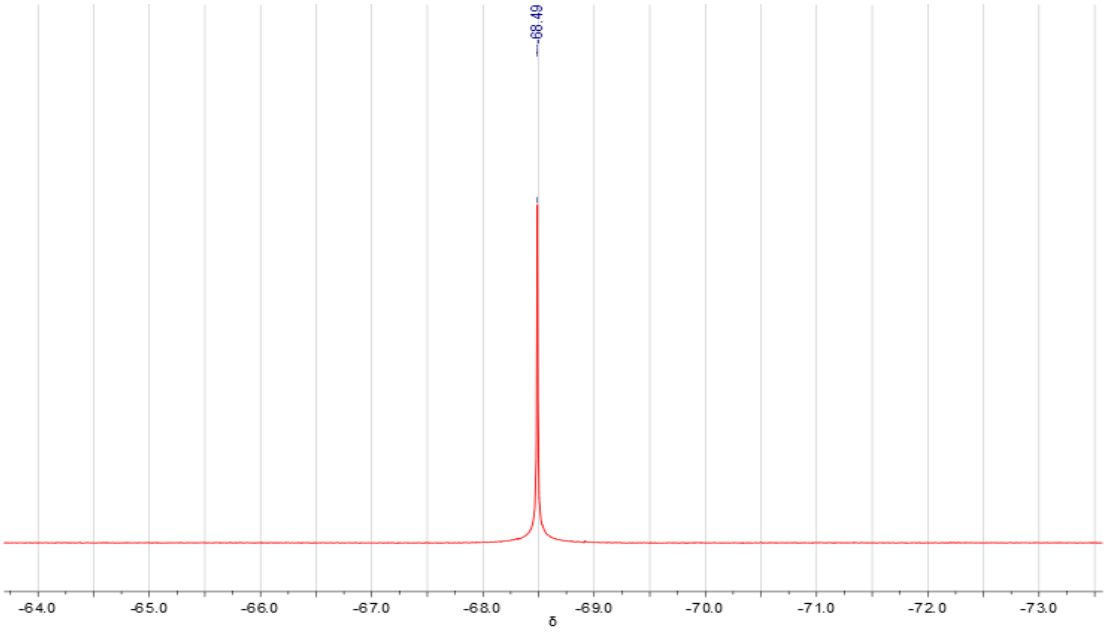


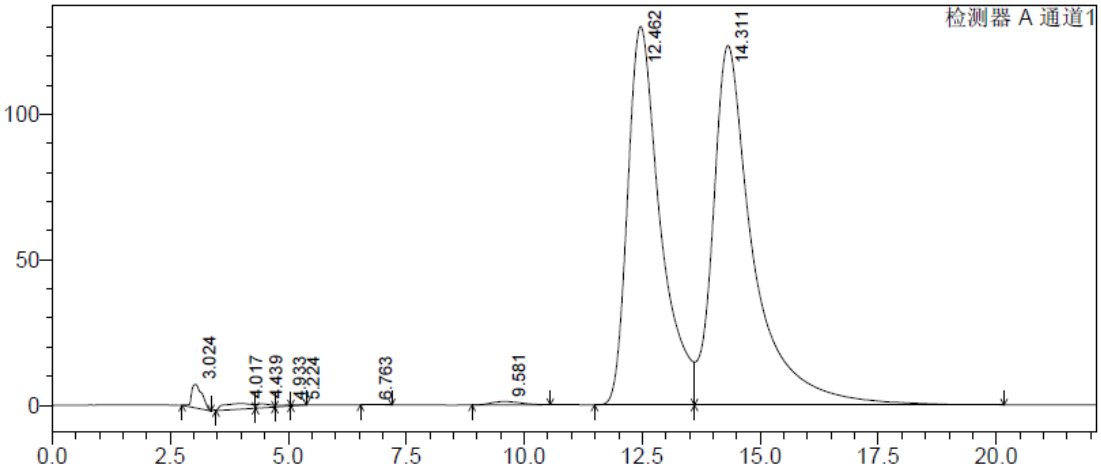


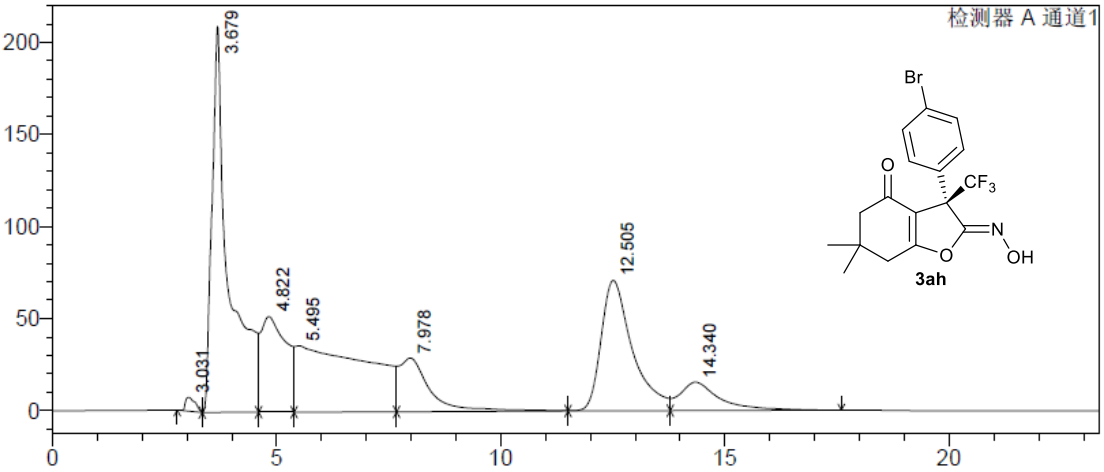
Peak	Retention Time	Area	Height	Area%
1	10.898	1449711	31874	83.84
2	12.283	279481	5688	16.16


11.47
7.65
7.63
7.45
7.44
2.83
2.79
2.75
2.71
2.38
2.33
2.30
1.09
1.08
Br
O
CF3
N
OH
O
3ah
1.0
2.0
2.0
2.1
2.1
6.2
δ

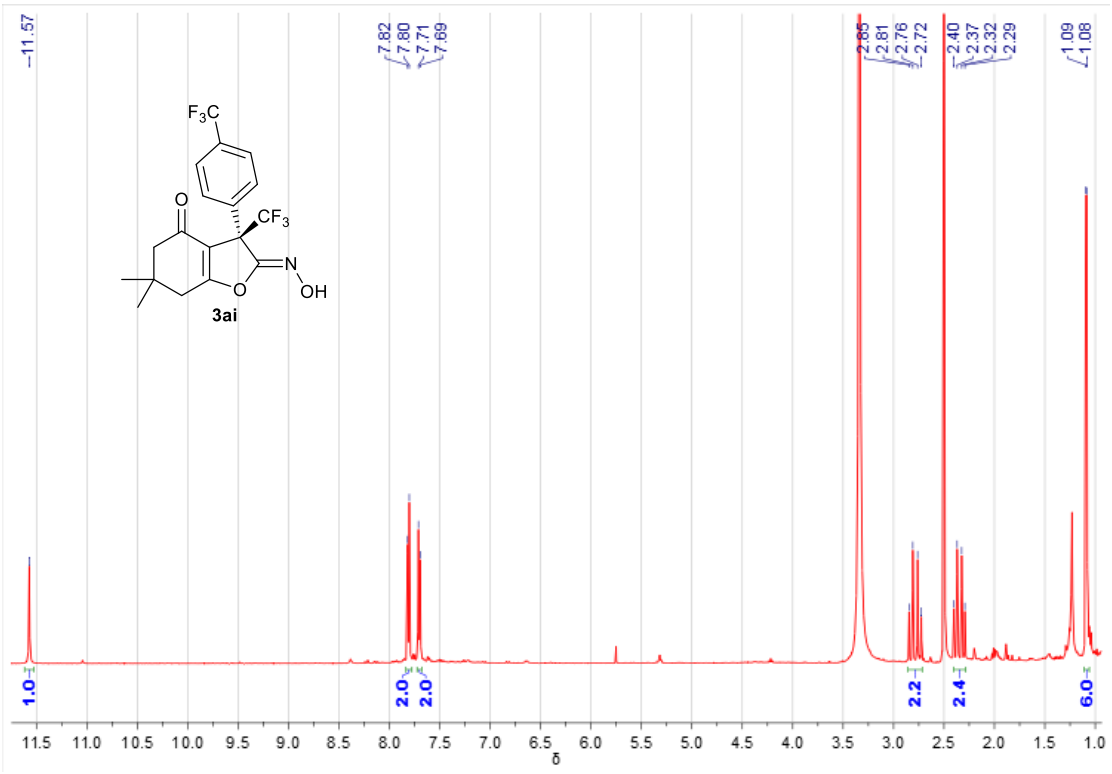

191.59
175.92
151.71
133.31
132.07
130.13
128.03
125.77
123.51
122.66
121.24
112.70
59.43
59.19
58.95
58.71
51.66
36.51
33.88
28.55
27.44
δ

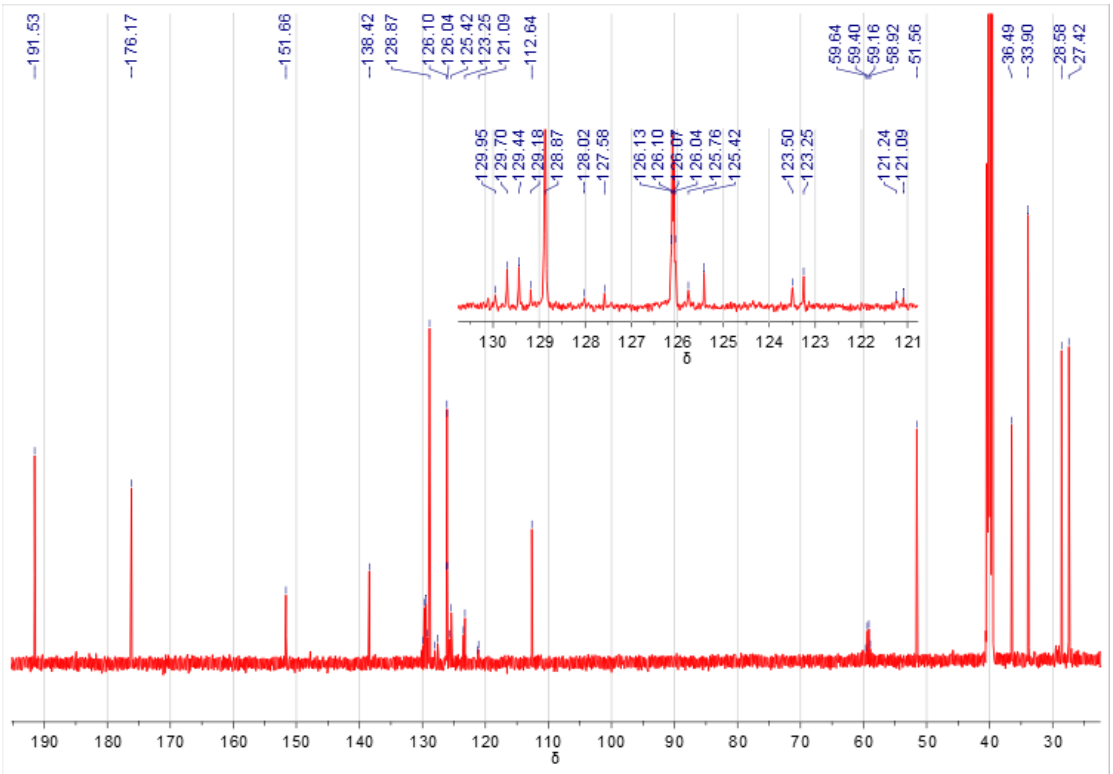


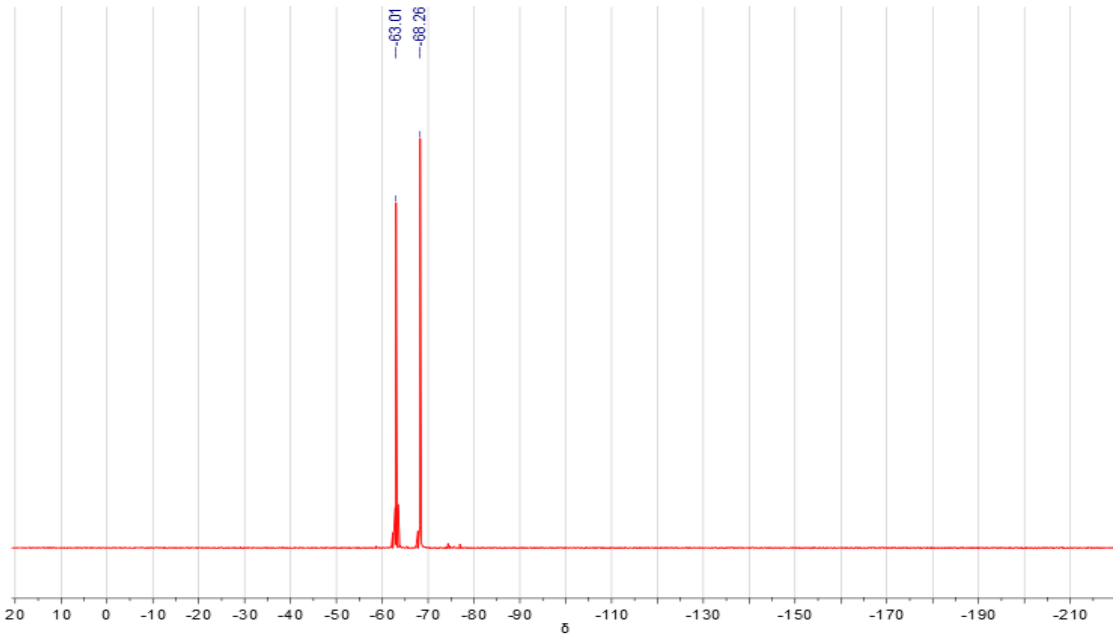


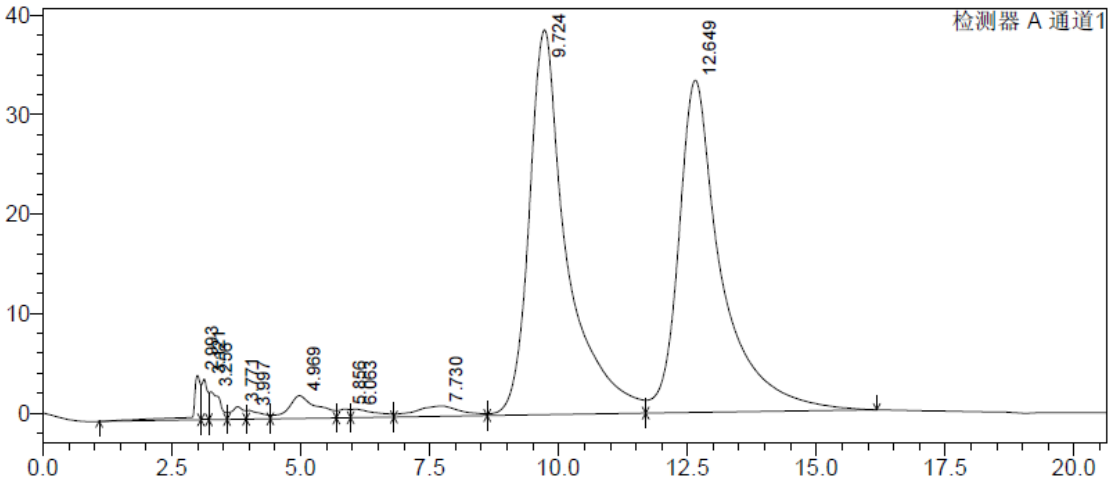


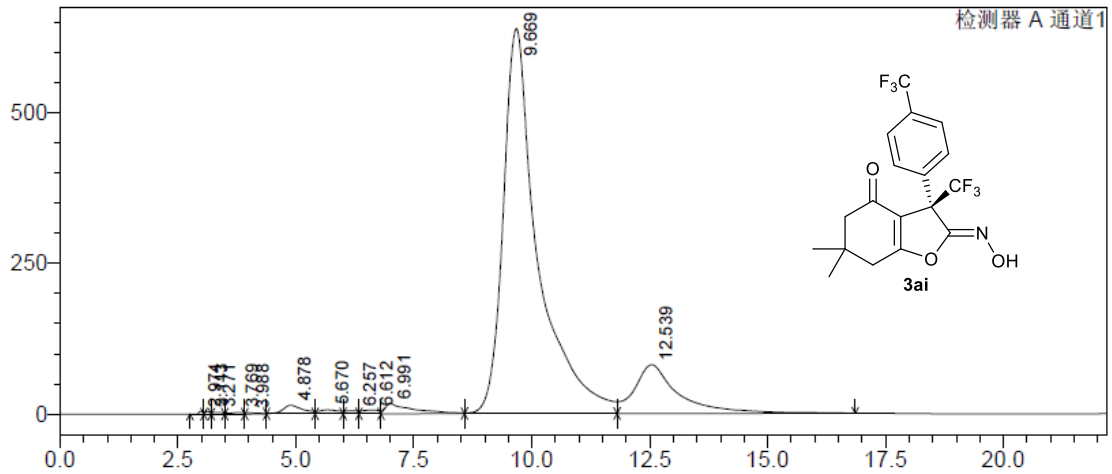
Peak	Retention Time	Area	Height	Area%
1	12.505	3460743	70939	78.21
2	14.340	964120	15468	21.79


F3C
CF3
O
N
OH
O
3ai
11.57
7.82
7.80
7.71
7.69
2.85
2.81
2.76
2.72
2.40
2.37
2.32
2.29
1.09
1.08
1.0
2.0
2.0
2.2
2.4
6.0
δ

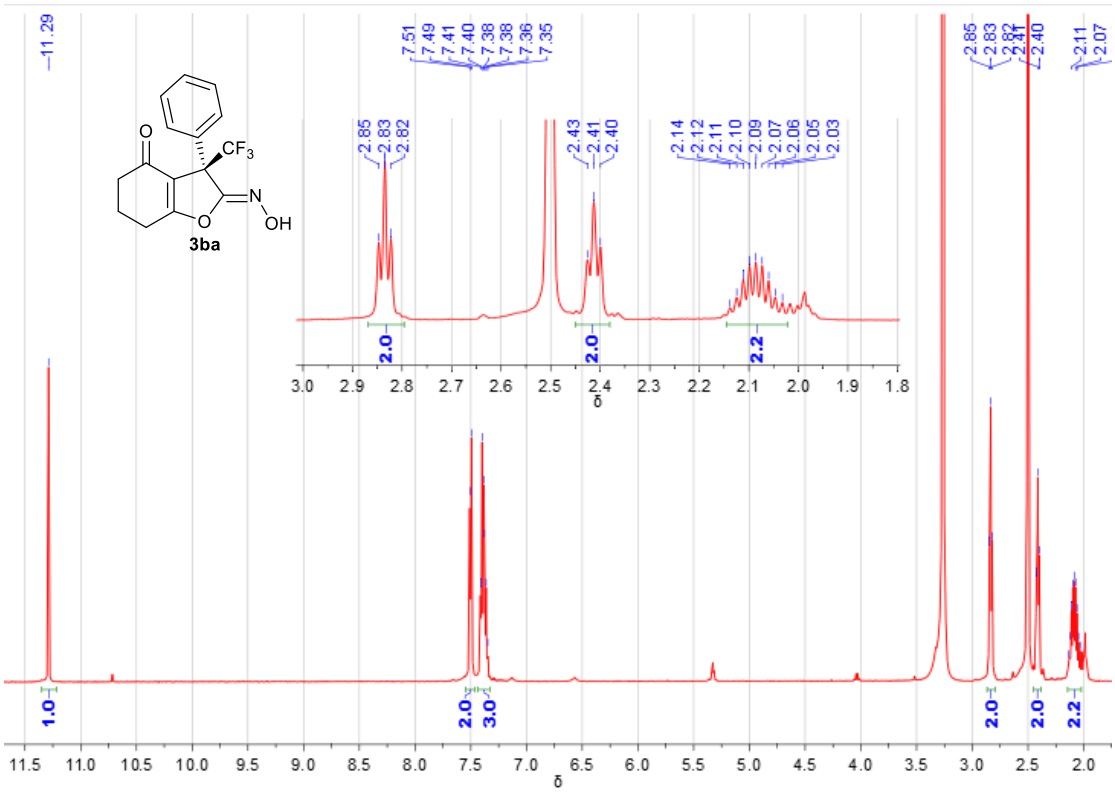

191.53
176.17
151.66
138.42
128.87
126.10
126.04
125.42
123.25
121.09
112.64
59.64
59.40
59.16
58.92
51.56
36.49
33.90
28.58
27.42
129.95
129.70
129.44
129.18
128.87
128.02
127.58
126.13
126.10
126.07
126.04
125.76
125.42
123.50
123.25
121.24
121.09
δ

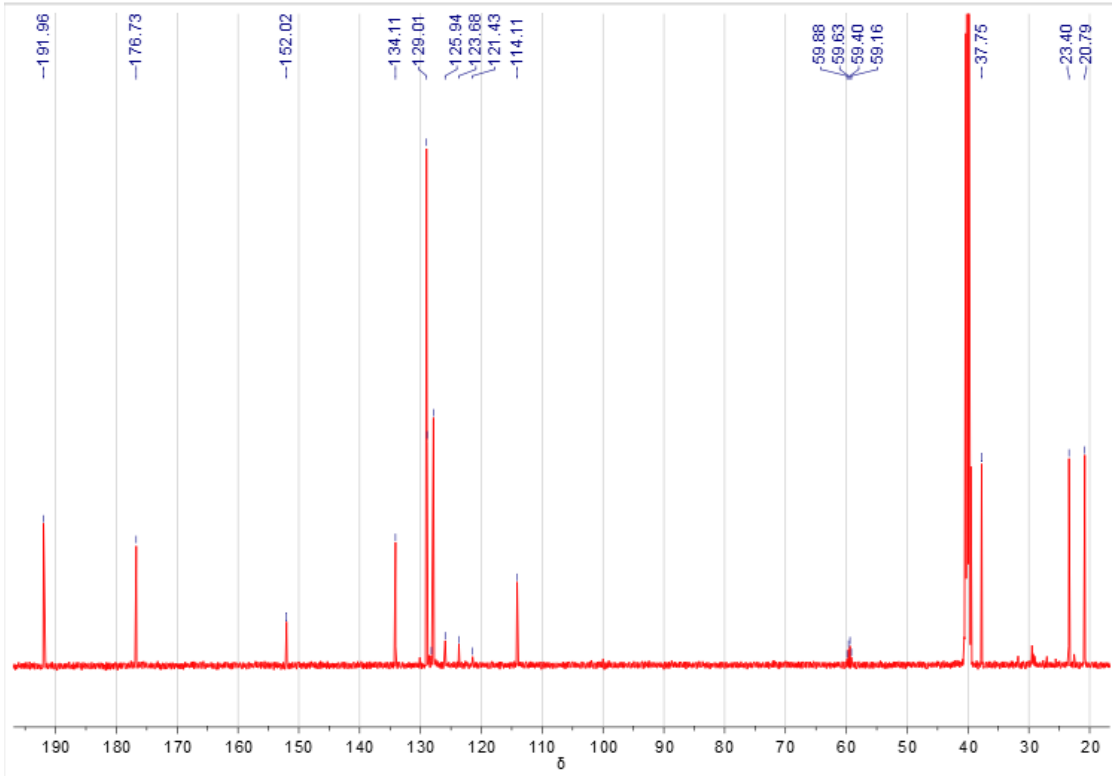


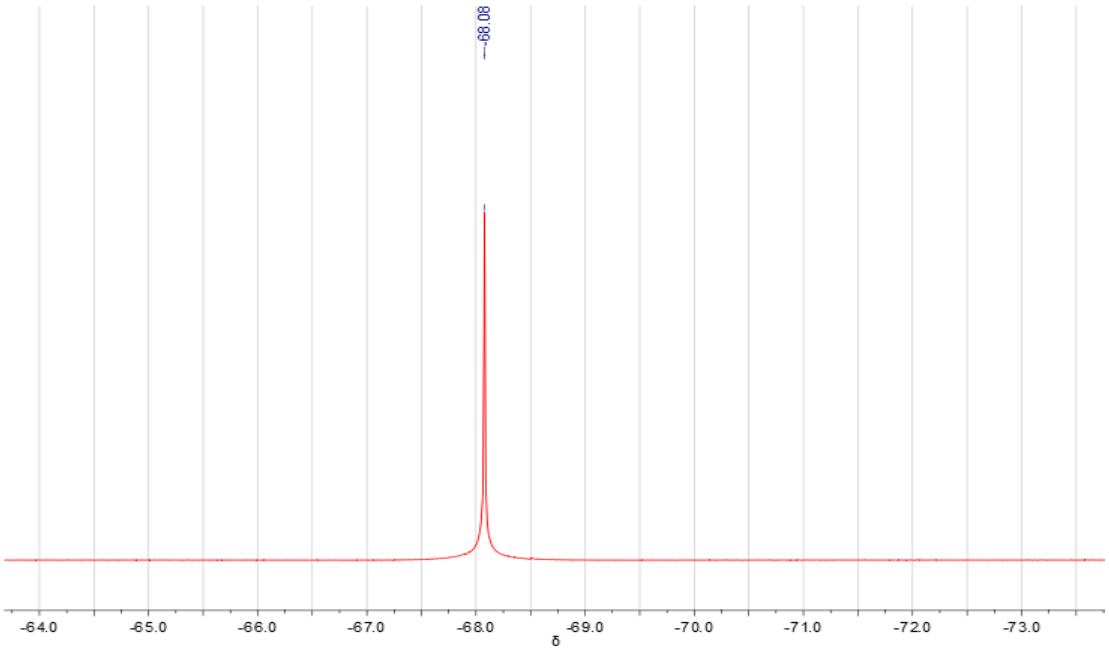


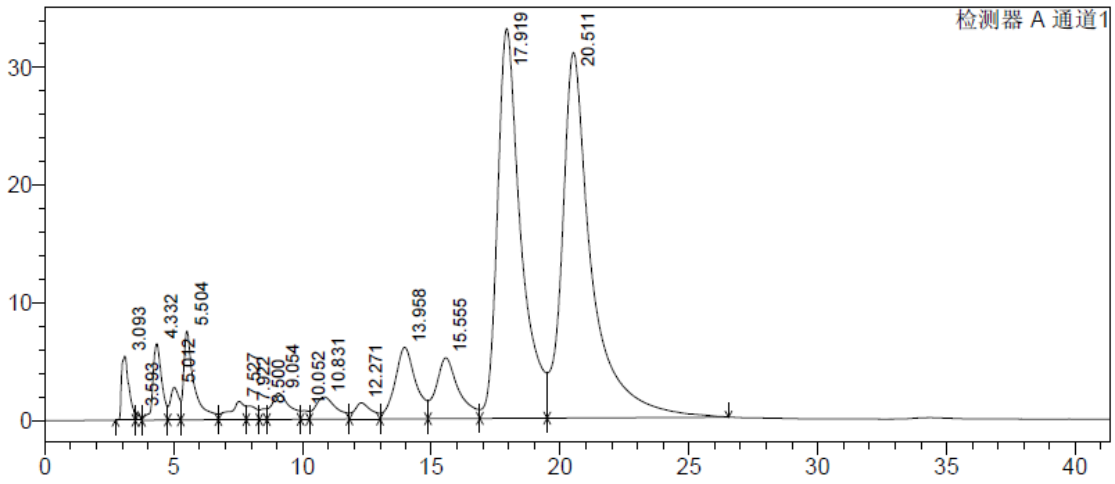


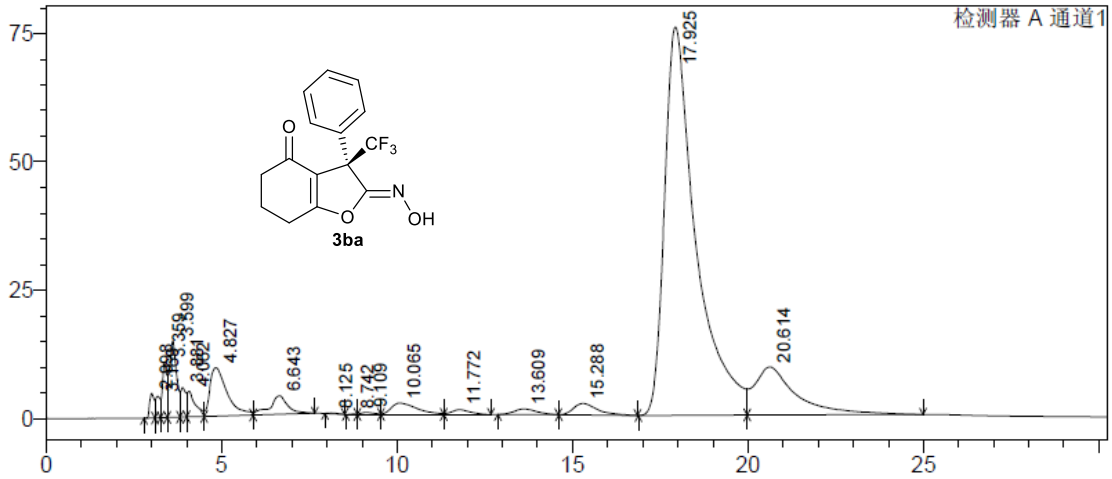
Peak	Retention Time	Area	Height	Area%
1	9.669	32493900	638888	86.13
2	12.539	5231590	80684	13.87


11.29
7.51
7.49
7.41
7.40
7.38
7.38
7.36
7.35
2.85
2.83
2.82
2.43
2.41
2.40
2.14
2.12
2.11
2.10
2.09
2.07
2.06
2.05
2.03
2.85
2.83
2.82
2.41
2.40
2.11
2.07
O
CF3
N
OH
O
3ba
1.0
2.0
3.0
2.0
2.0
2.2
δ

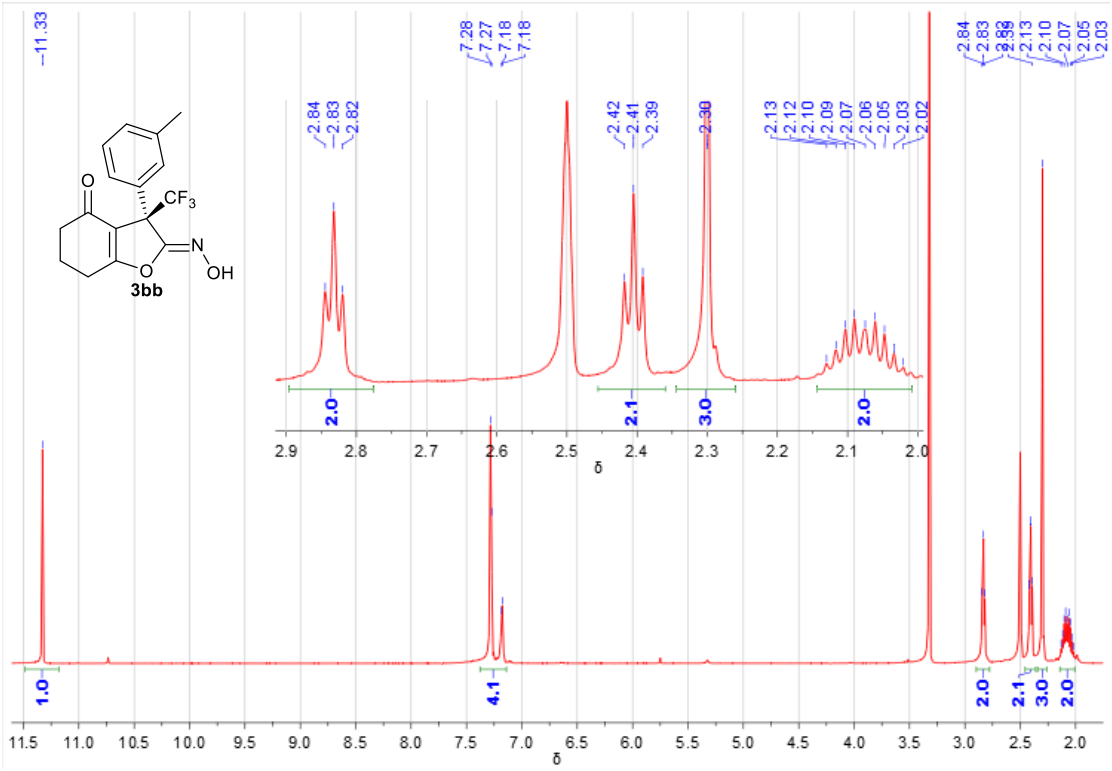

191.96
176.73
152.02
134.11
129.01
125.94
123.68
121.43
114.11
59.88
59.63
59.40
59.16
37.75
23.40
20.79
δ

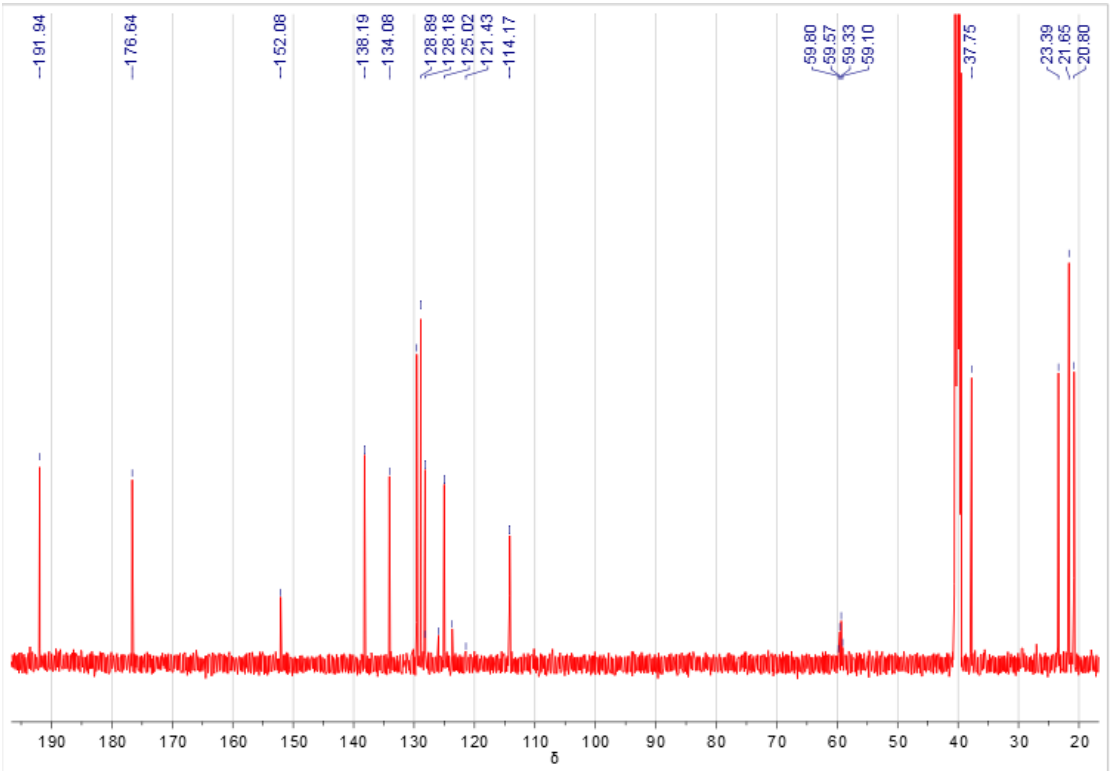


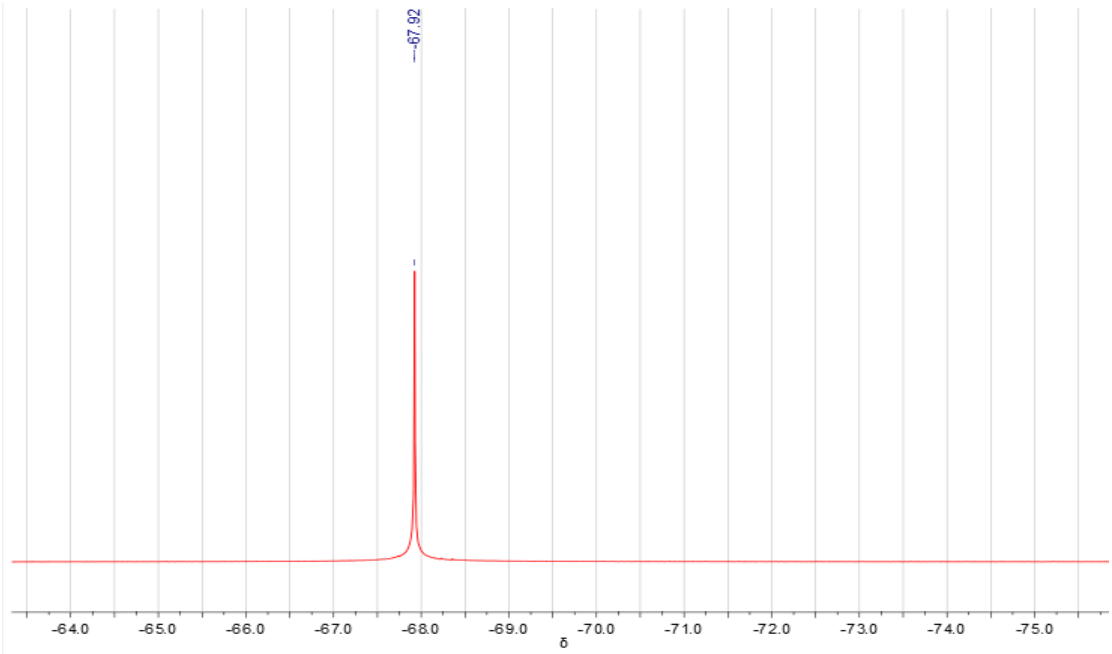


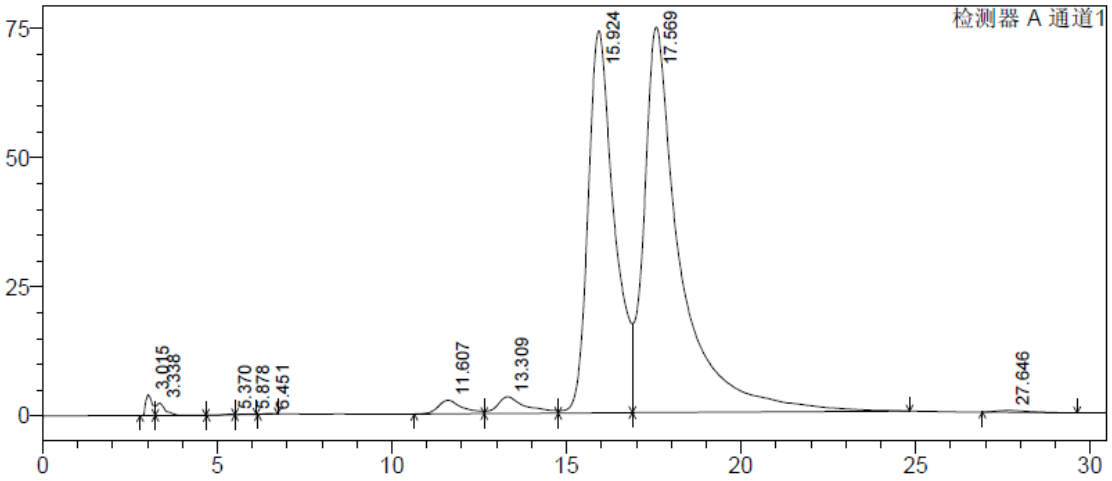


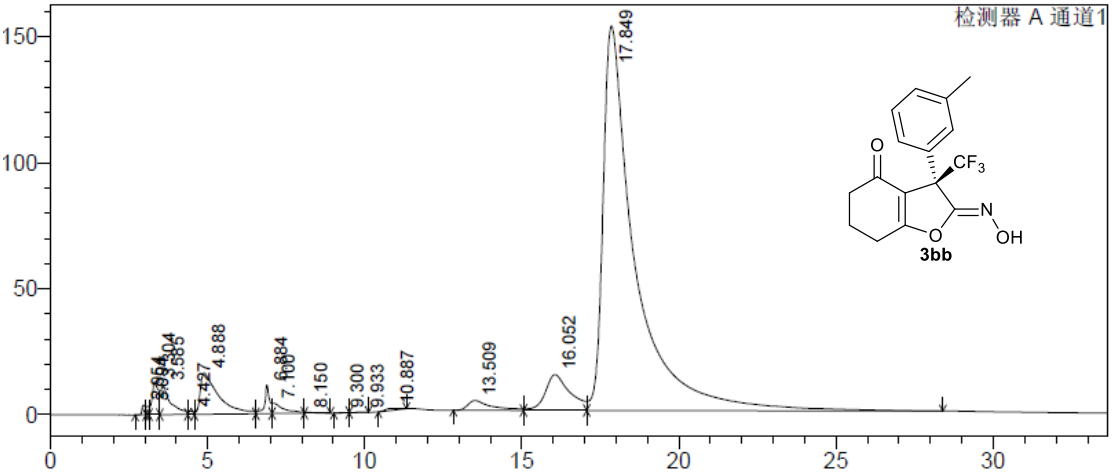
Peak	Retention Time	Area	Height	Area%
1	17.925	4704254	75628	85.80
2	20.614	778588	9356	14.20


11.33
7.28
7.27
7.18
7.18
2.84
2.83
2.82
2.42
2.41
2.39
2.30
2.13
2.12
2.10
2.09
2.07
2.06
2.05
2.03
2.02
2.84
2.83
2.13
2.10
2.07
2.05
2.03
O
CF3
N
OH
3bb
1.0
4.1
2.0
2.1
3.0
2.0
δ

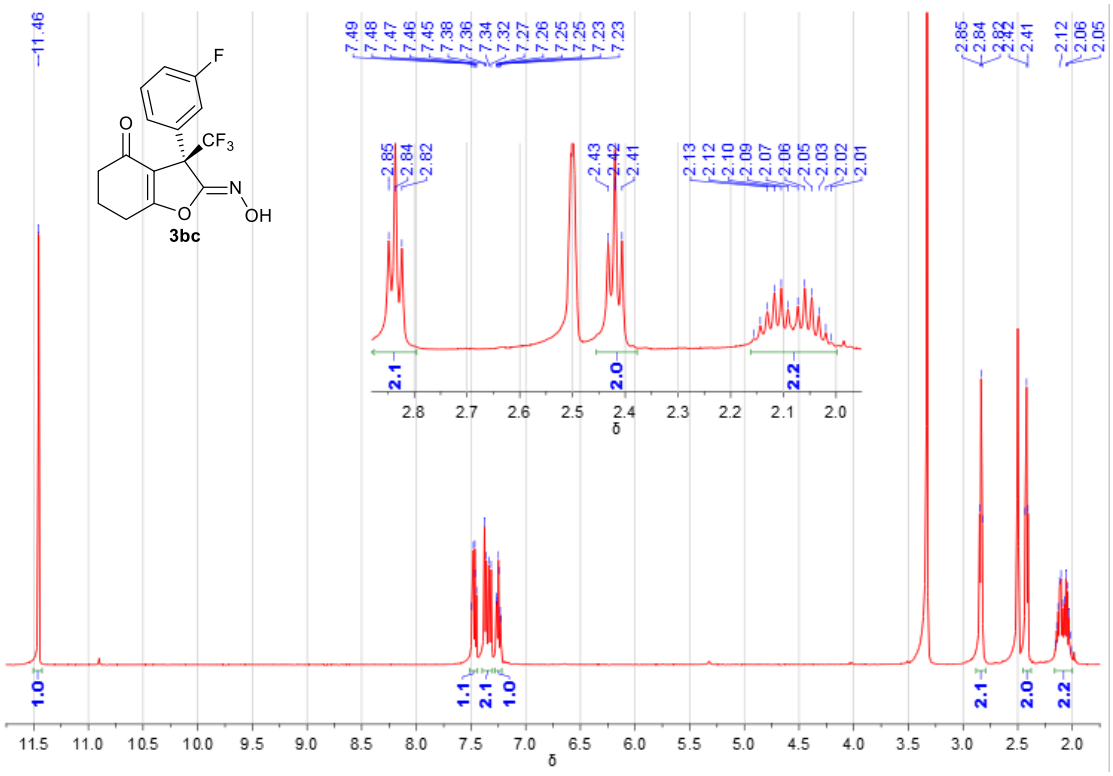

191.94
176.64
152.08
138.19
134.08
128.89
128.18
125.02
121.43
114.17
59.80
59.57
59.33
59.10
37.75
23.39
21.65
20.80
δ

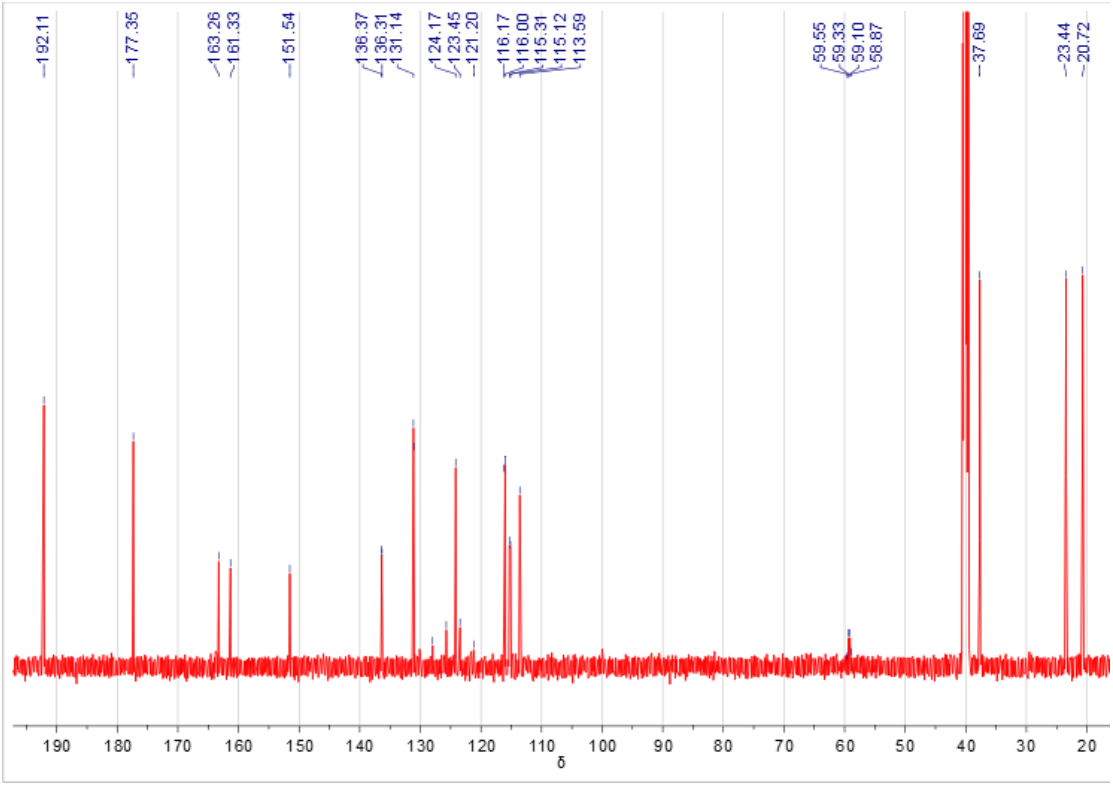


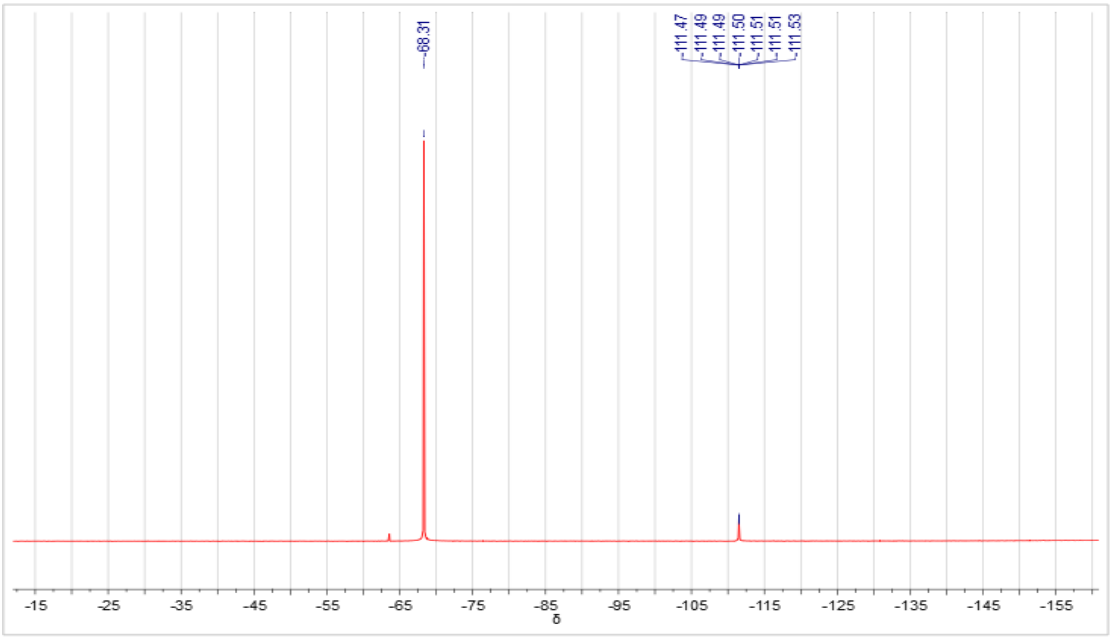


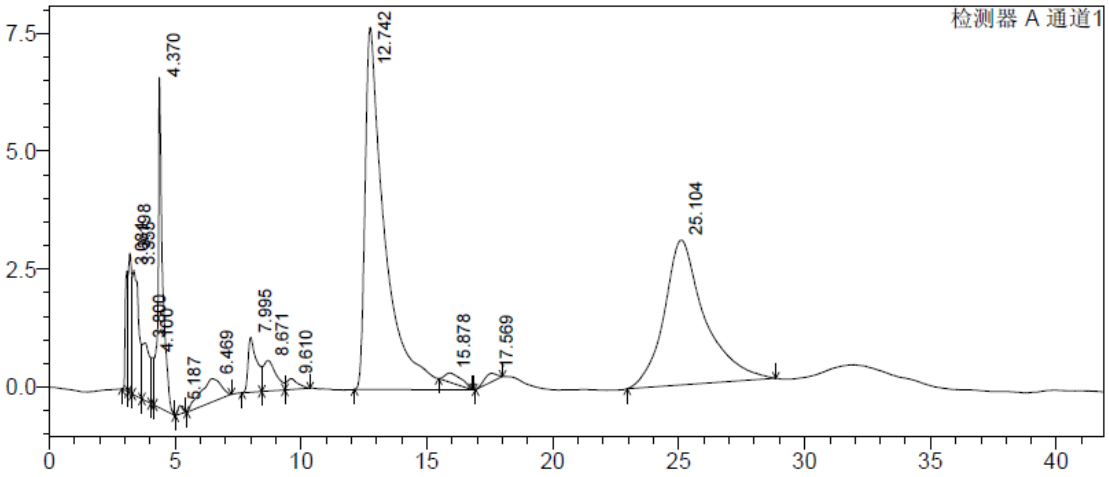


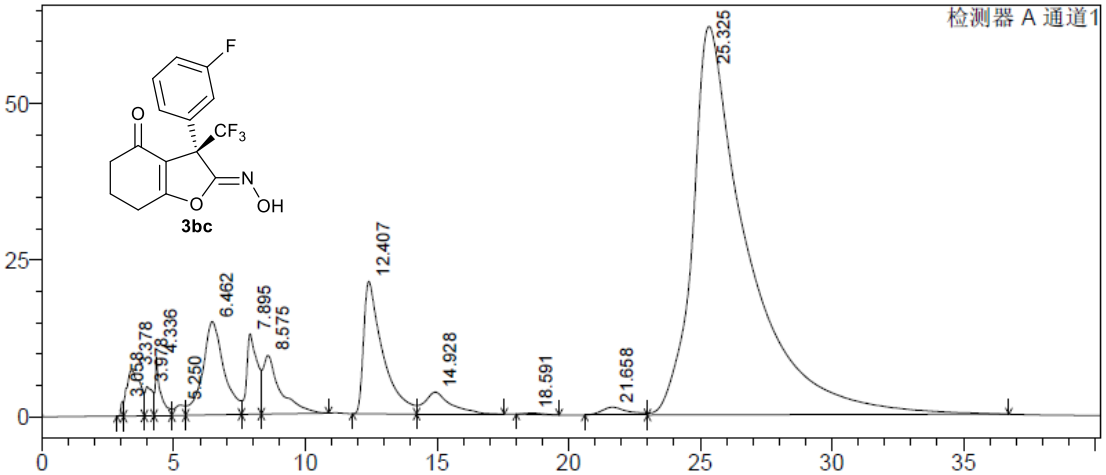
Peak	Retention Time	Area	Height	Area%
1	16.052	771022	14198	6.63
2	17.849	10865955	152453	93.37


F
O
CF3
N
OH
O
3bc
11.46
7.49
7.48
7.47
7.46
7.45
7.38
7.36
7.34
7.32
7.27
7.26
7.25
7.25
7.23
7.23
2.85
2.84
2.82
2.43
2.42
2.41
2.13
2.12
2.10
2.09
2.07
2.06
2.05
2.03
2.02
2.01
2.85
2.84
2.82
2.42
2.41
2.12
2.06
2.05
1.0
1.1
2.1
1.0
2.1
2.0
2.2
δ

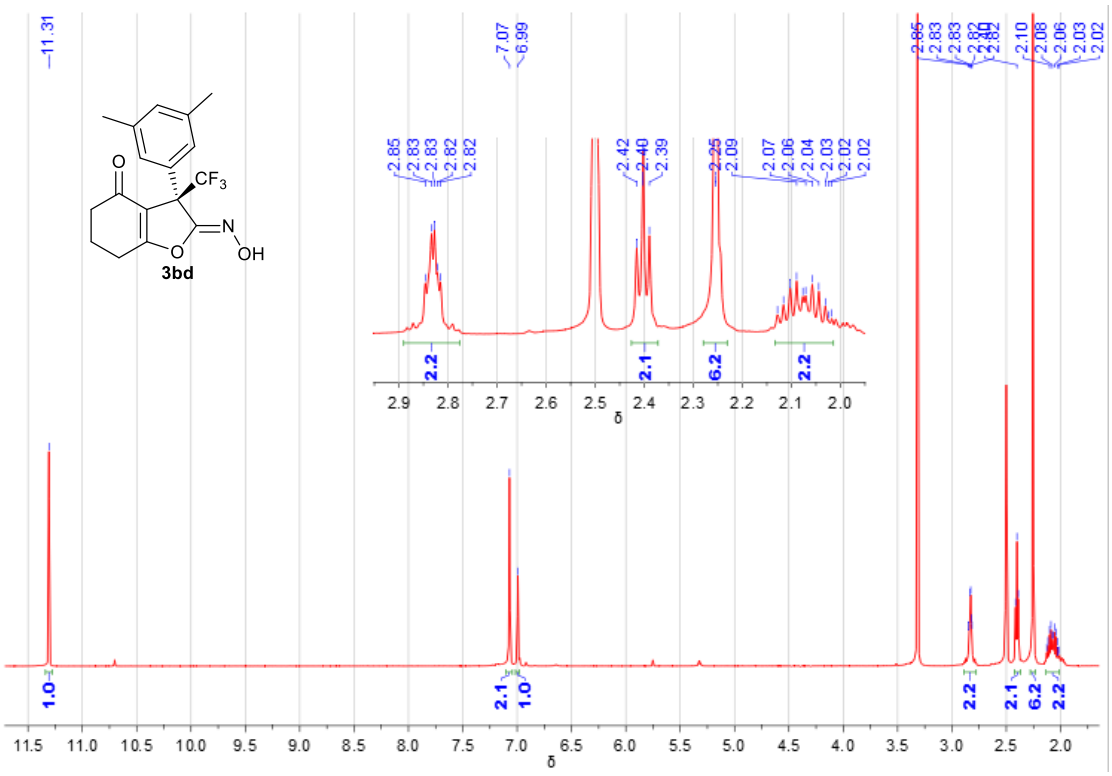

192.11
177.35
163.26
161.33
151.54
136.37
136.31
131.14
124.17
123.45
121.20
116.17
116.00
115.31
115.12
113.59
59.55
59.33
59.10
58.87
37.69
23.44
20.72
δ

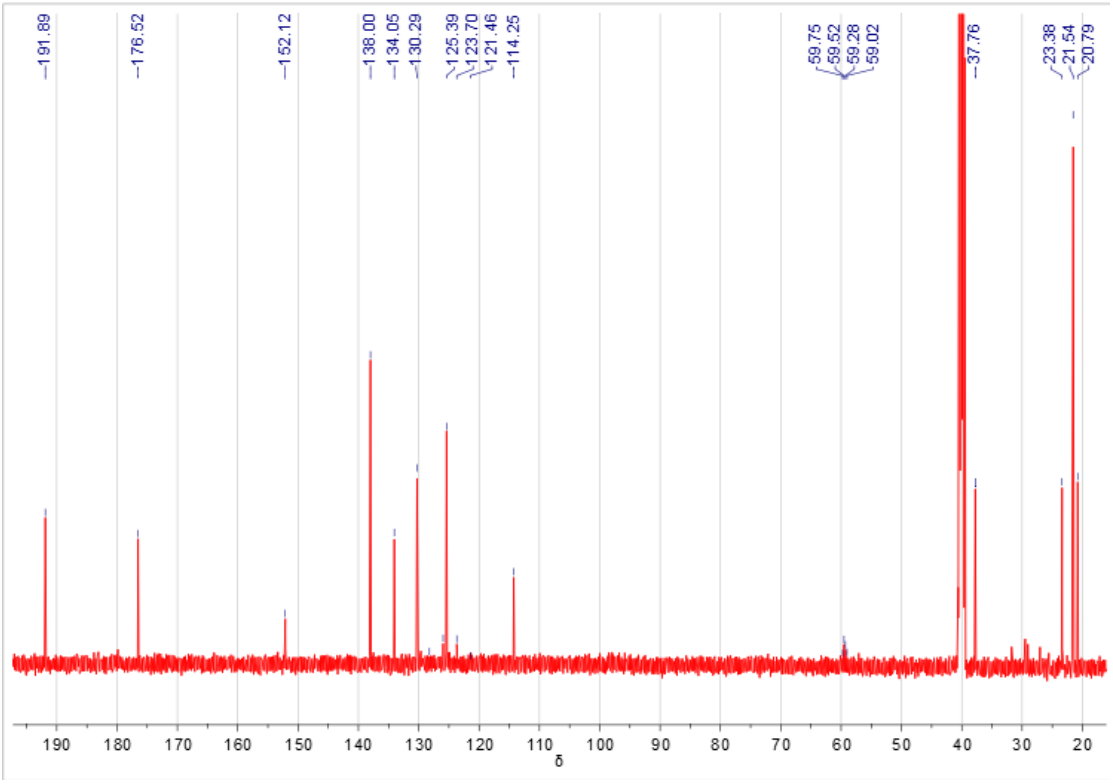


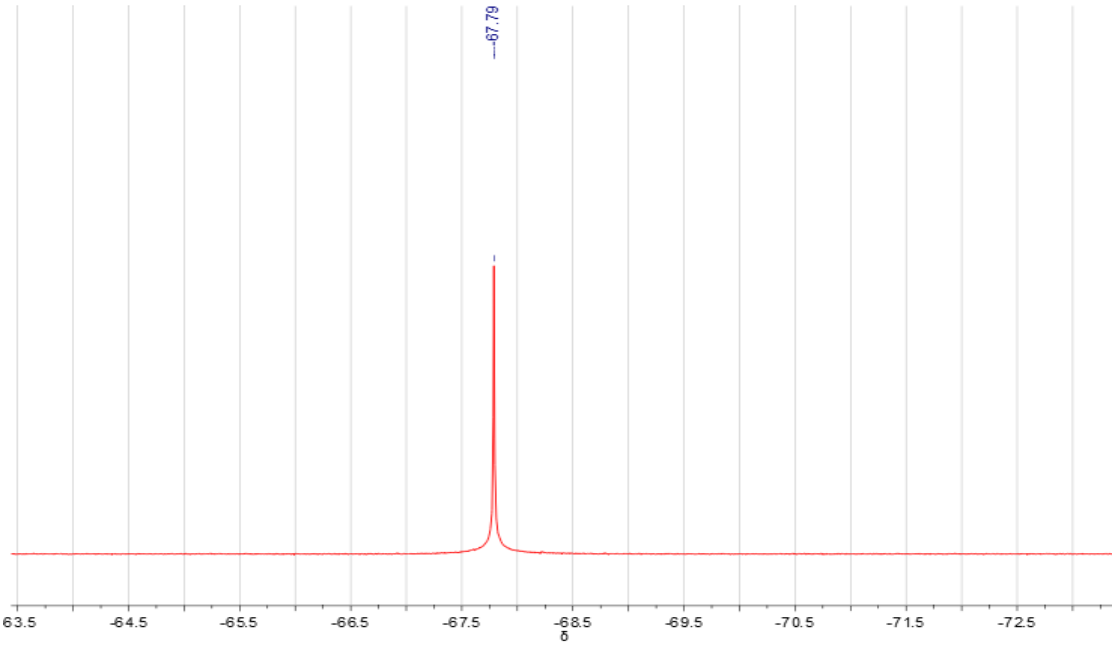


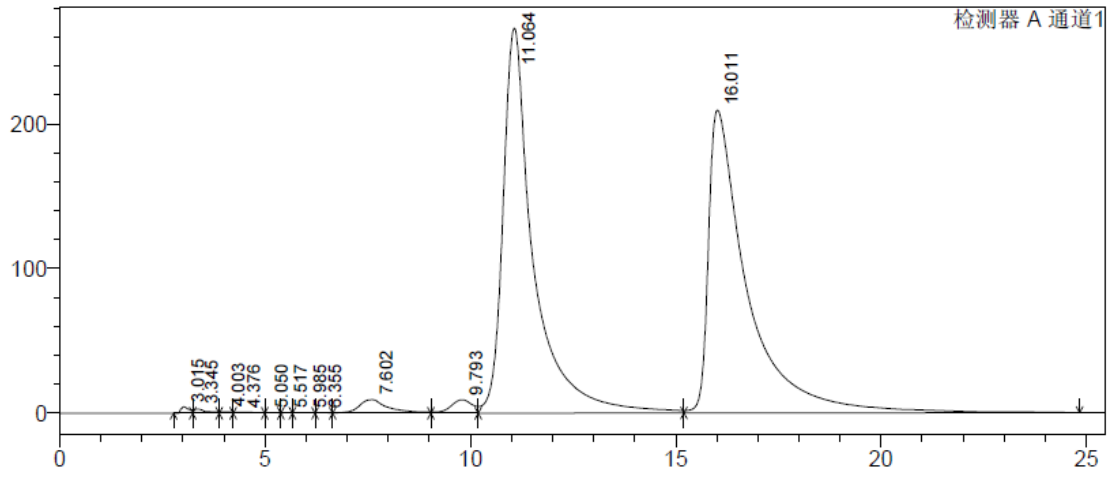


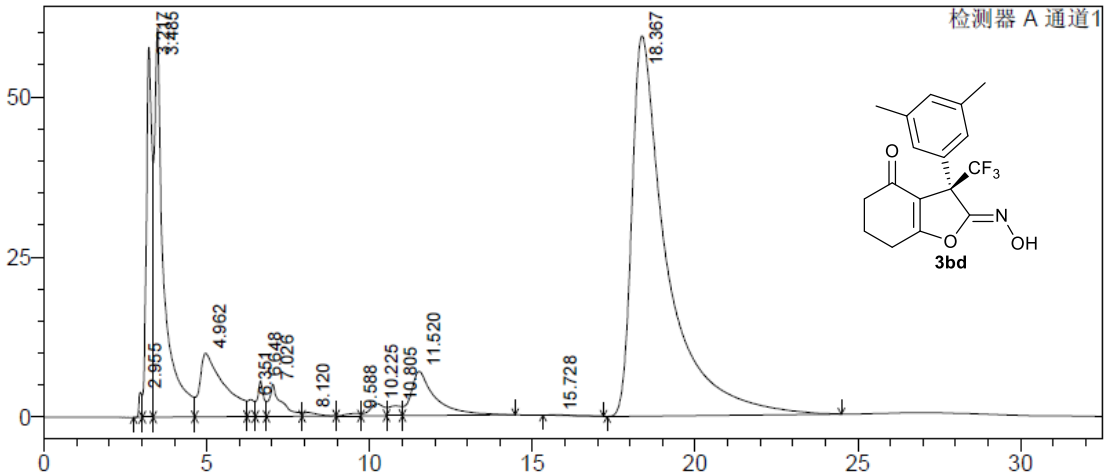
Peak	Retention Time	Area	Height	Area%
1	12.407	1074102	21159	10.67
2	25.325	8991882	62037	89.33


3bd

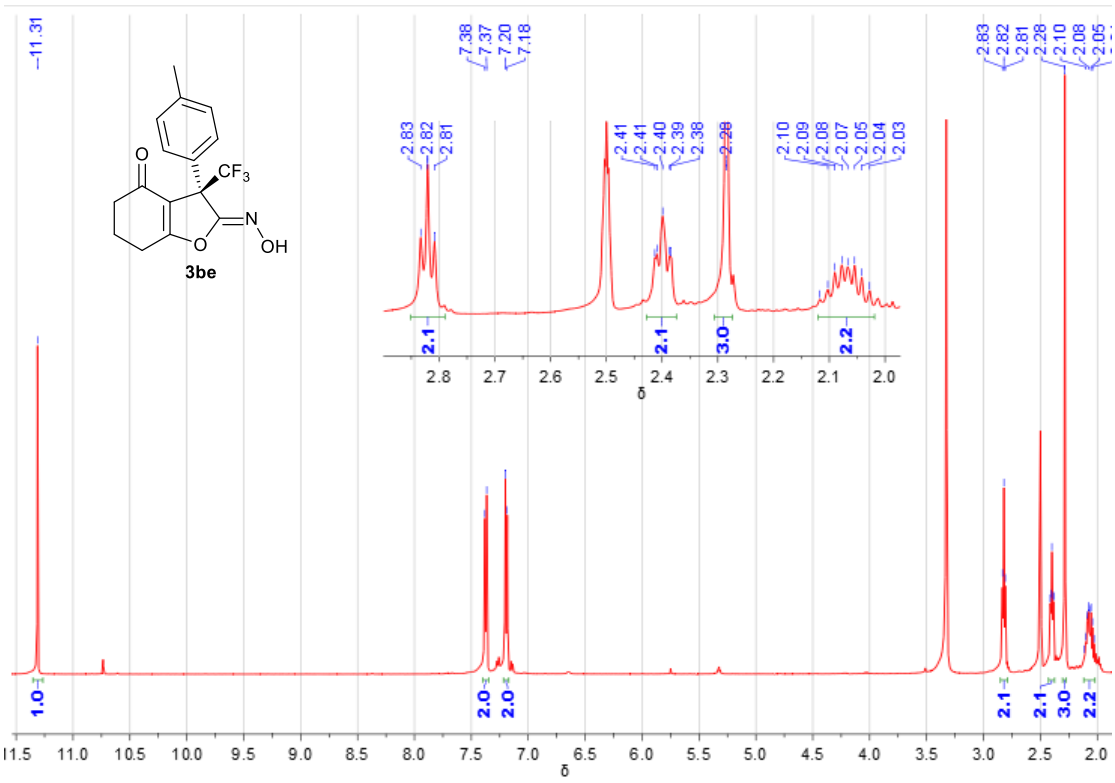


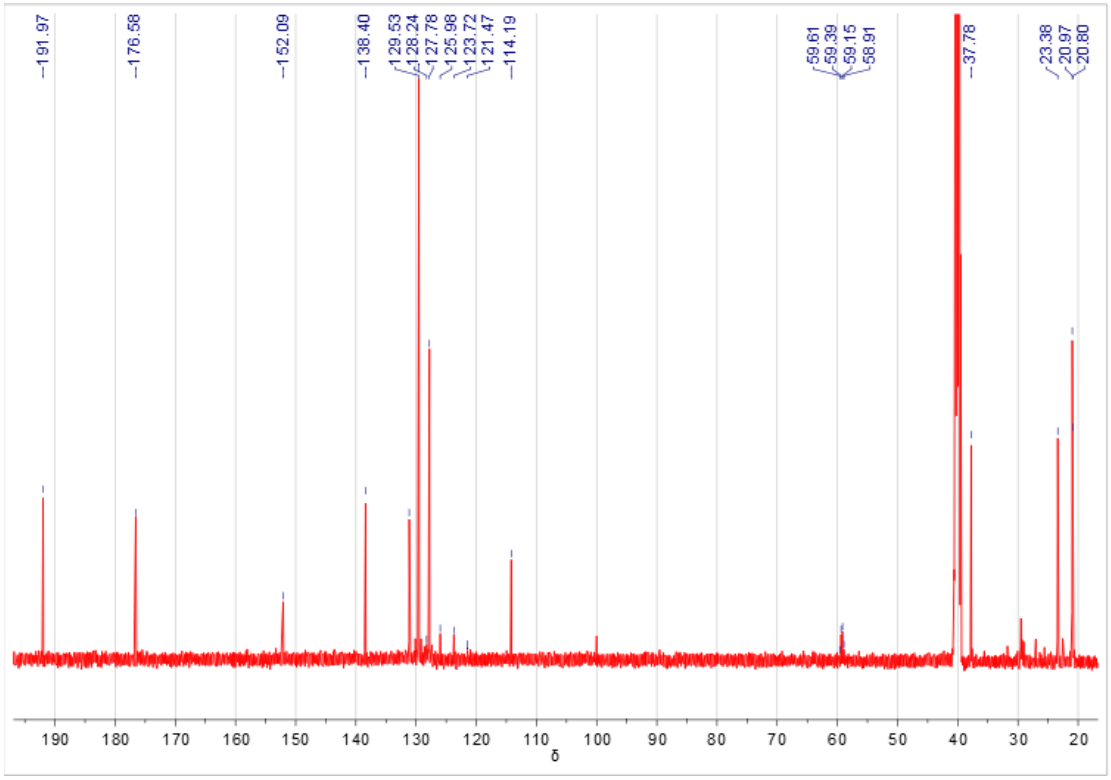


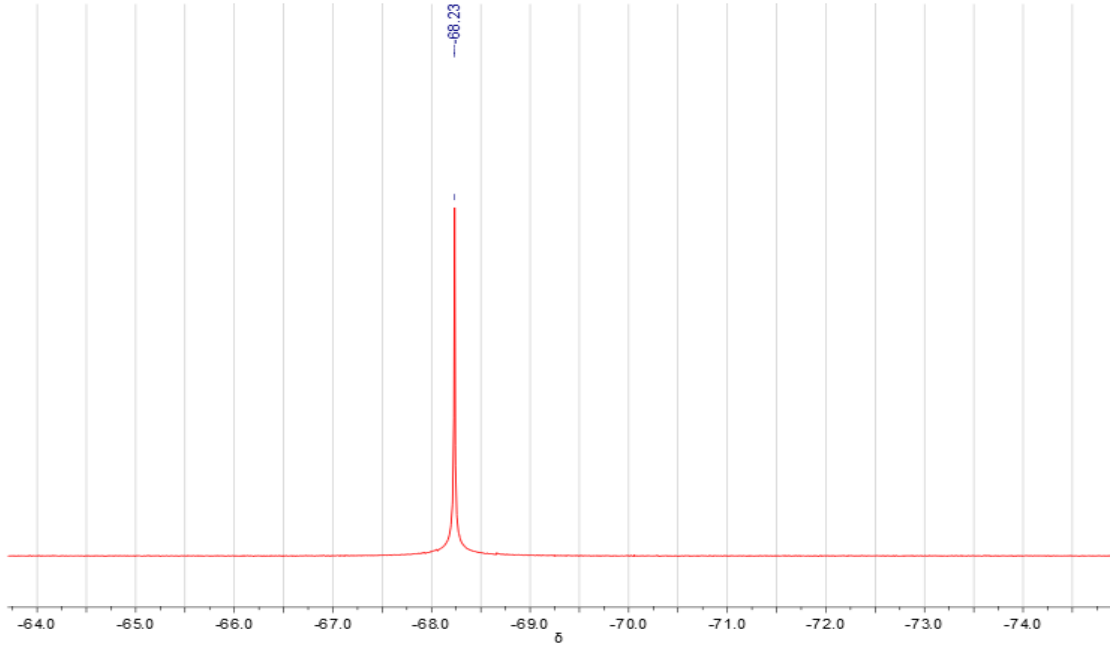


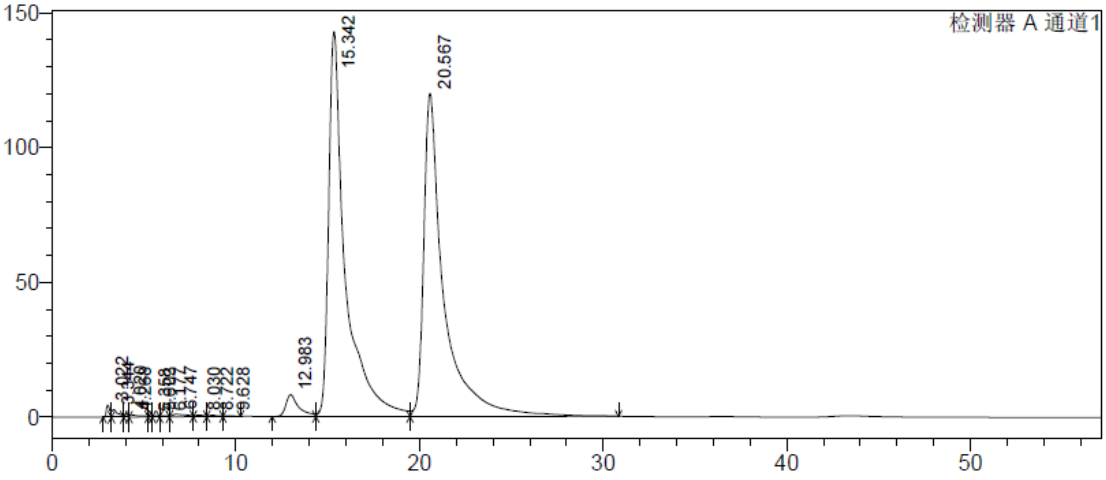


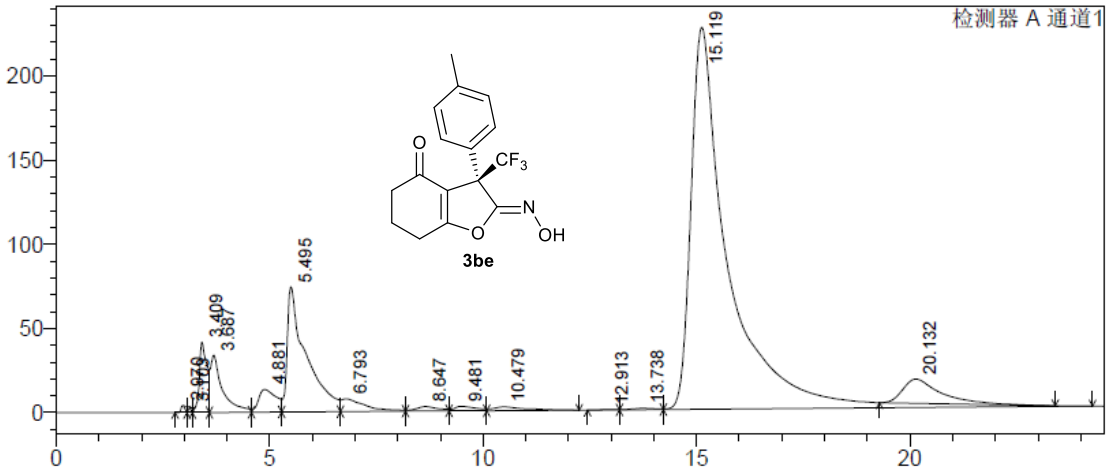
Peak	Retention Time	Area	Height	Area%
1	11.520	352376	6884	7.32
2	18.367	4463947	59409	92.68


11.31
7.38
7.37
7.20
7.18
2.83
2.82
2.81
2.41
2.40
2.39
2.38
2.28
2.10
2.09
2.08
2.07
2.05
2.04
2.03
1.0
2.0
2.0
2.1
2.1
3.0
2.2
δ

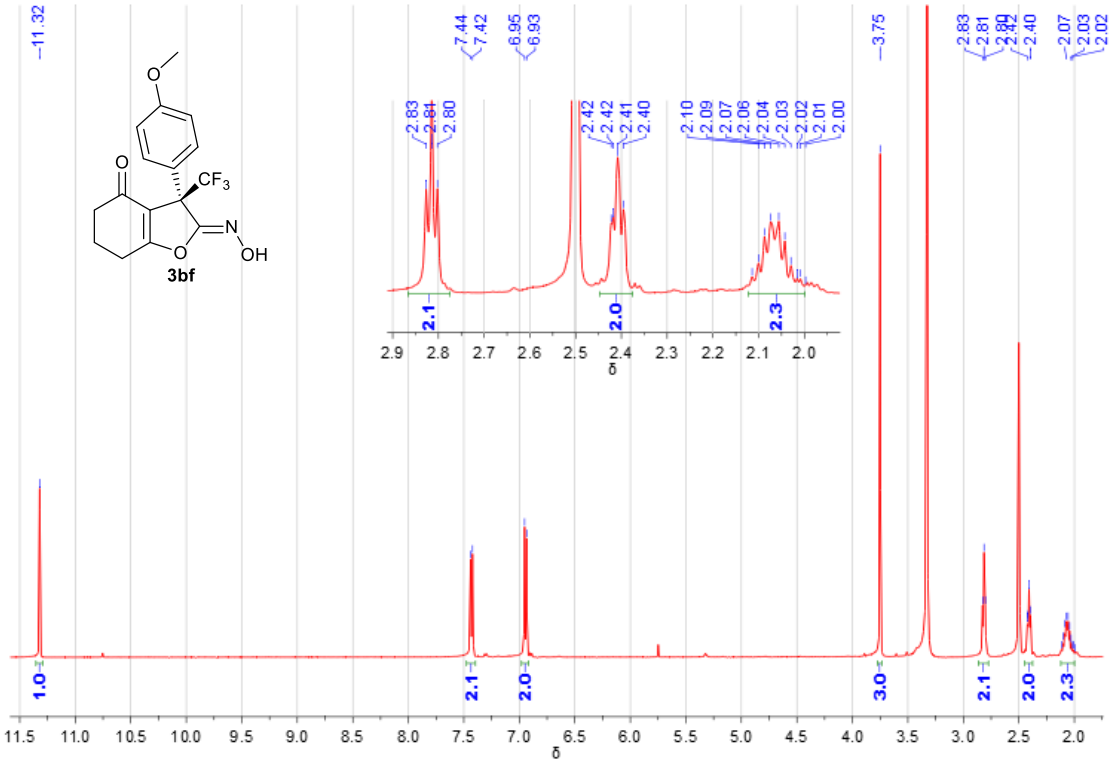

191.97
176.58
152.09
138.40
129.53
128.24
127.78
125.98
123.72
121.47
114.19
59.61
59.39
59.15
58.91
37.78
23.38
20.97
20.80
δ

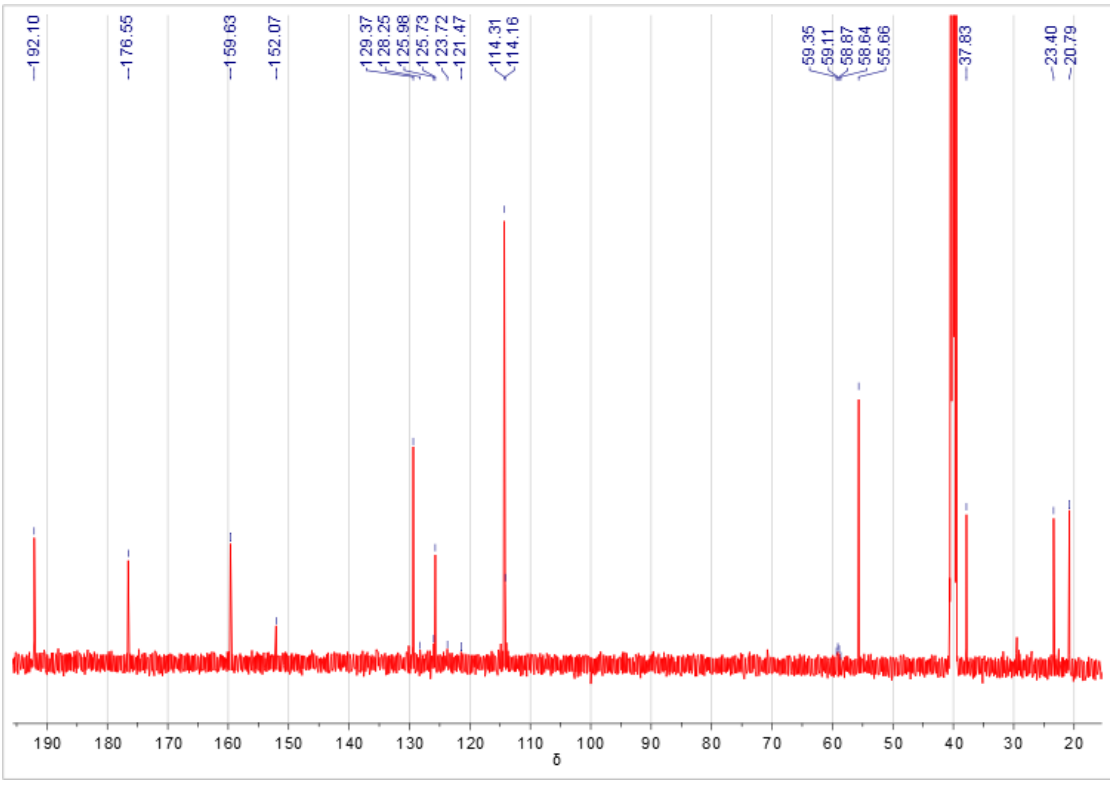


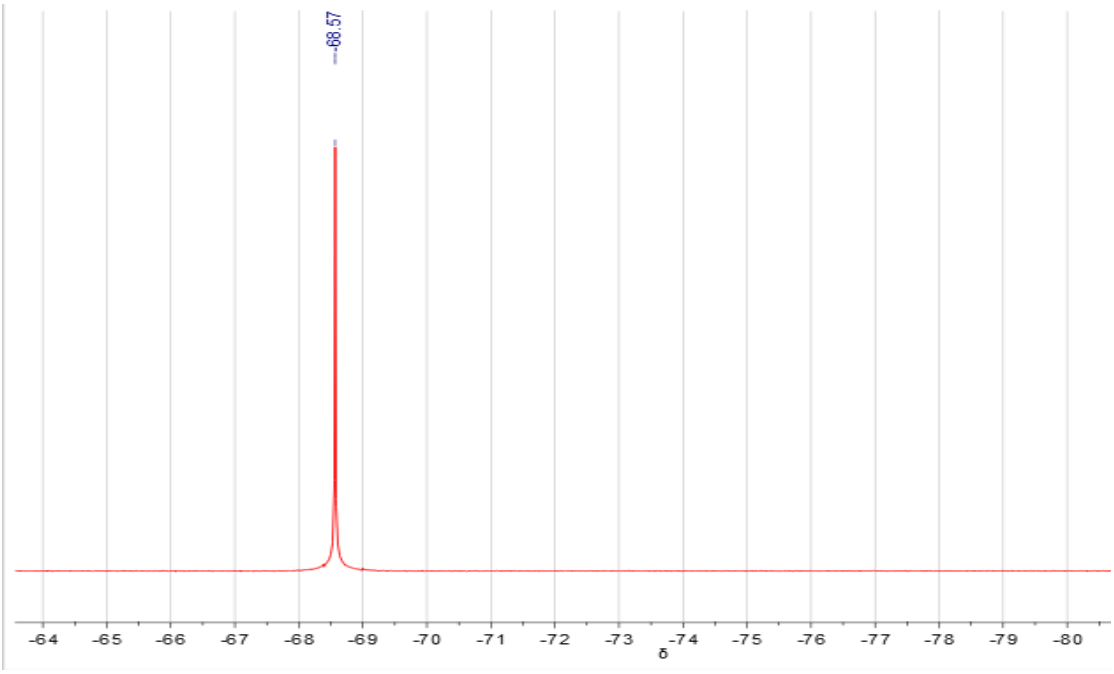


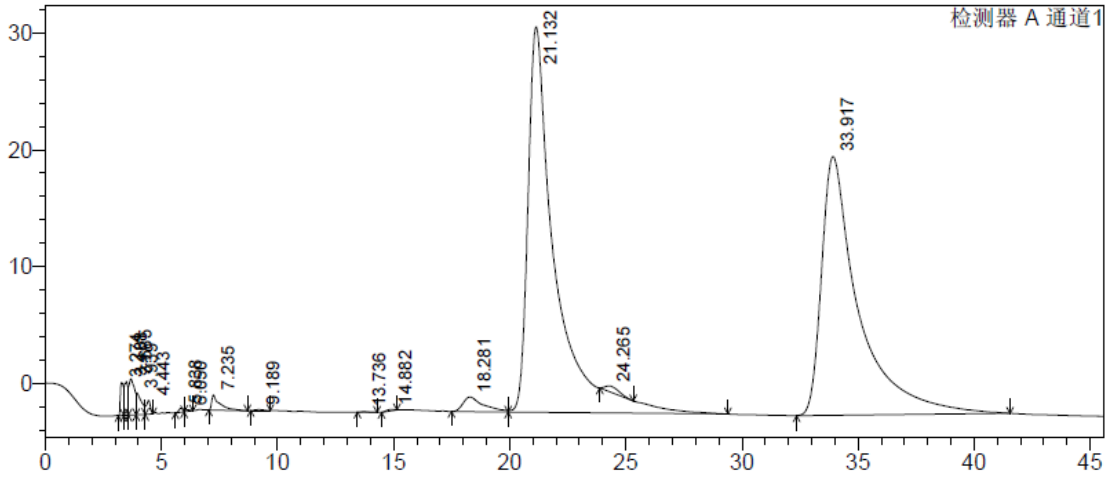


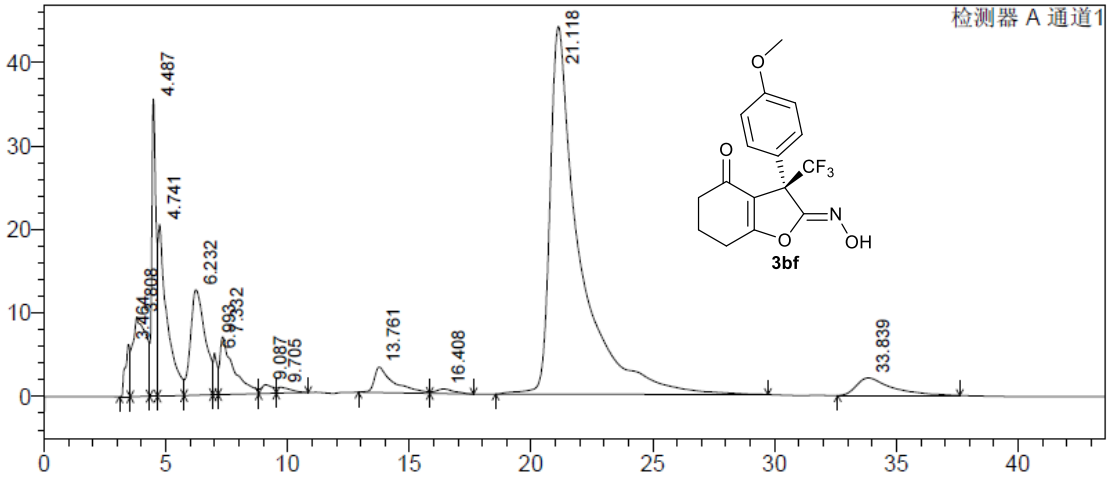
Peak	Retention Time	Area	Height	Area%
1	15.119	13977975	227019	93.90
2	20.132	907897	14415	6.10


11.32
7.44
7.42
6.95
6.93
3.75
2.83
2.81
2.80
2.42
2.42
2.41
2.40
2.10
2.09
2.07
2.06
2.04
2.03
2.02
2.01
2.00
2.07
2.03
2.02
O
O
CF3
N
OH
O
3bf
1.0
2.1
2.0
3.0
2.1
2.0
2.3
δ

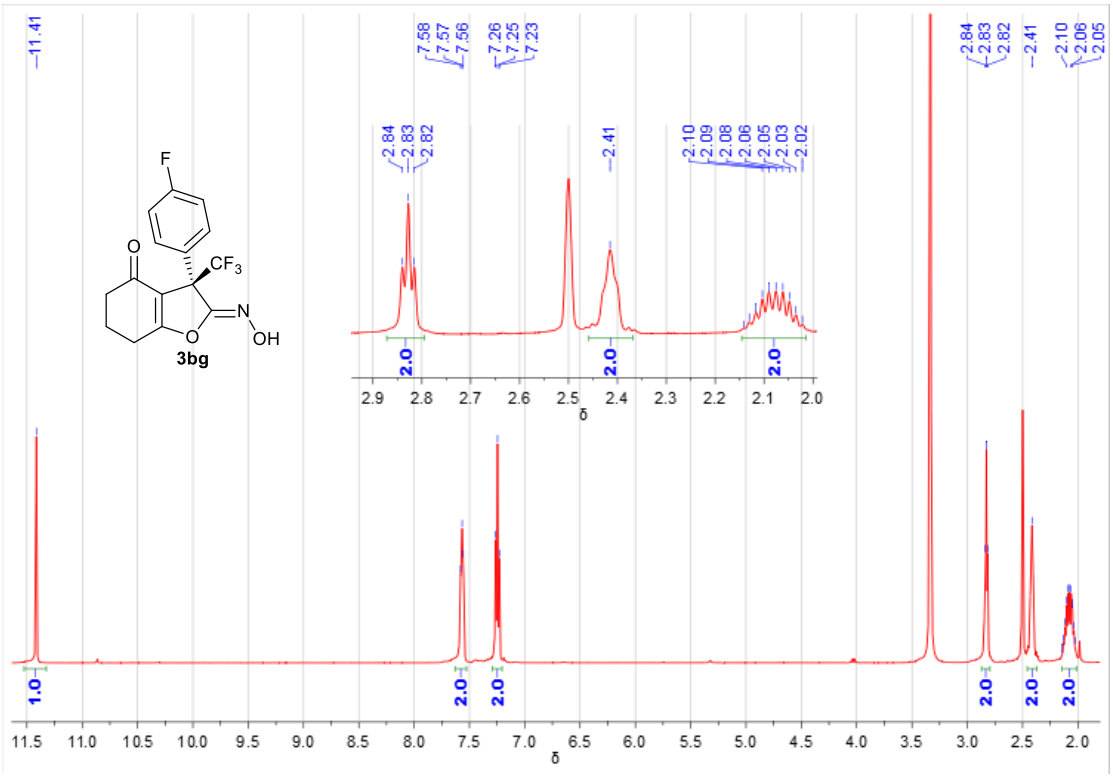

192.10
176.55
159.63
152.07
129.37
128.25
125.98
125.73
123.72
121.47
114.31
114.16
59.35
59.11
58.87
58.64
55.66
37.83
23.40
20.79
δ

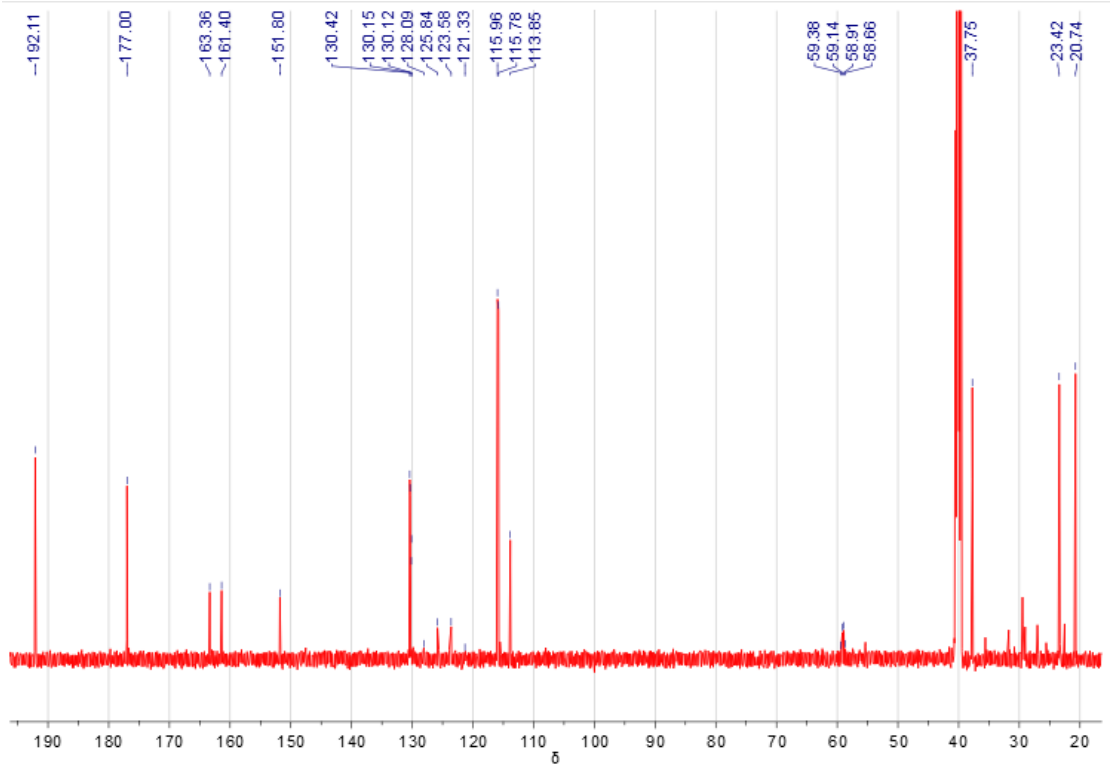


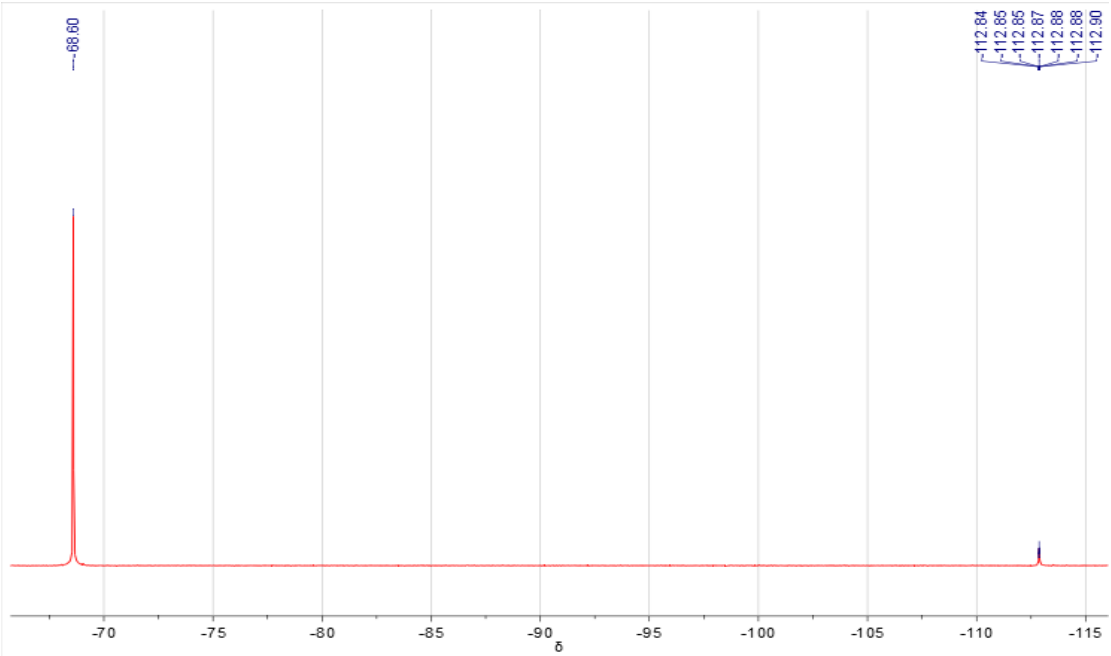


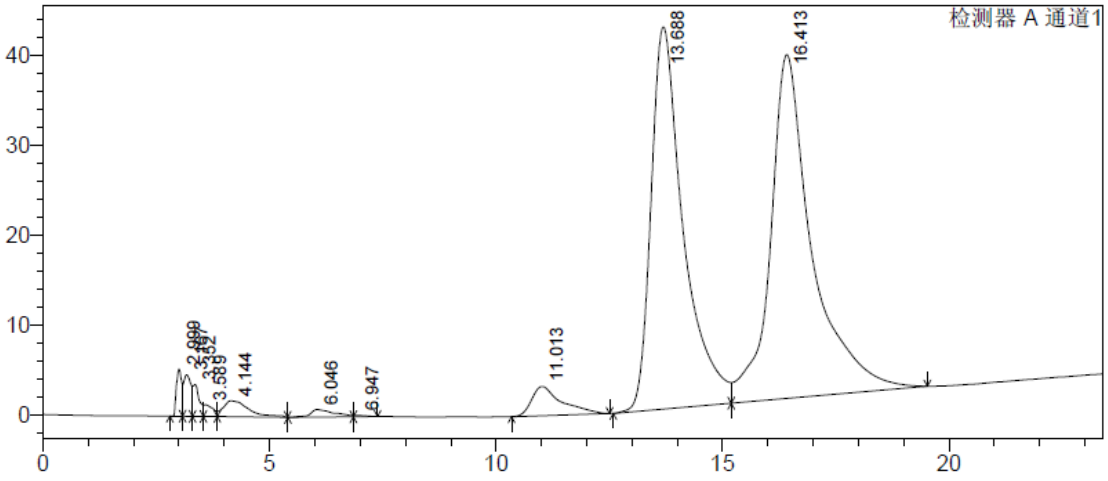


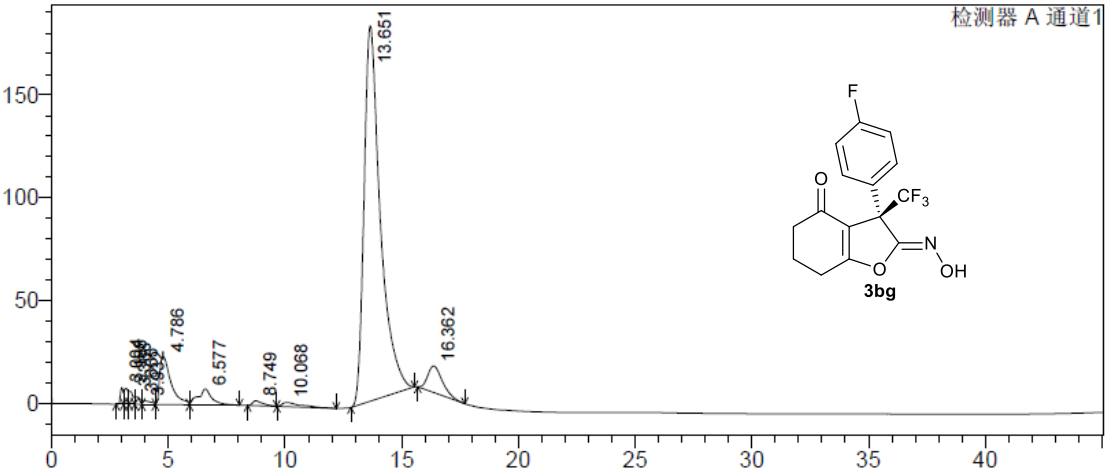
Peak	Retention Time	Area	Height	Area%
1	21.118	3710909	44017	94.57
2	33.839	213049	2113	5.43


F
O
CF3
N
OH
O
3bg
11.41
7.58
7.57
7.56
7.26
7.25
7.23
2.84
2.83
2.82
2.41
2.10
2.09
2.08
2.06
2.05
2.03
2.02
1.0
2.0
δ

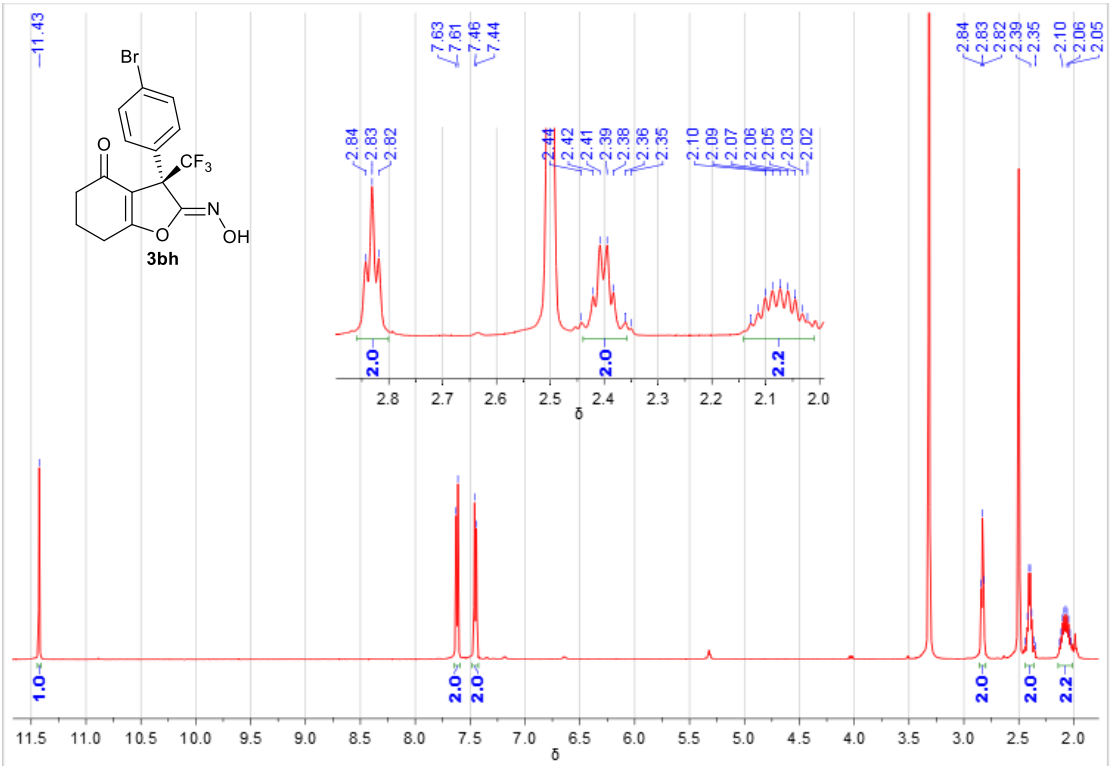

192.11
177.00
163.36
161.40
151.80
130.42
130.15
130.12
128.09
125.84
123.58
121.33
115.96
115.78
113.85
59.38
59.14
58.91
58.66
37.75
23.42
20.74
δ

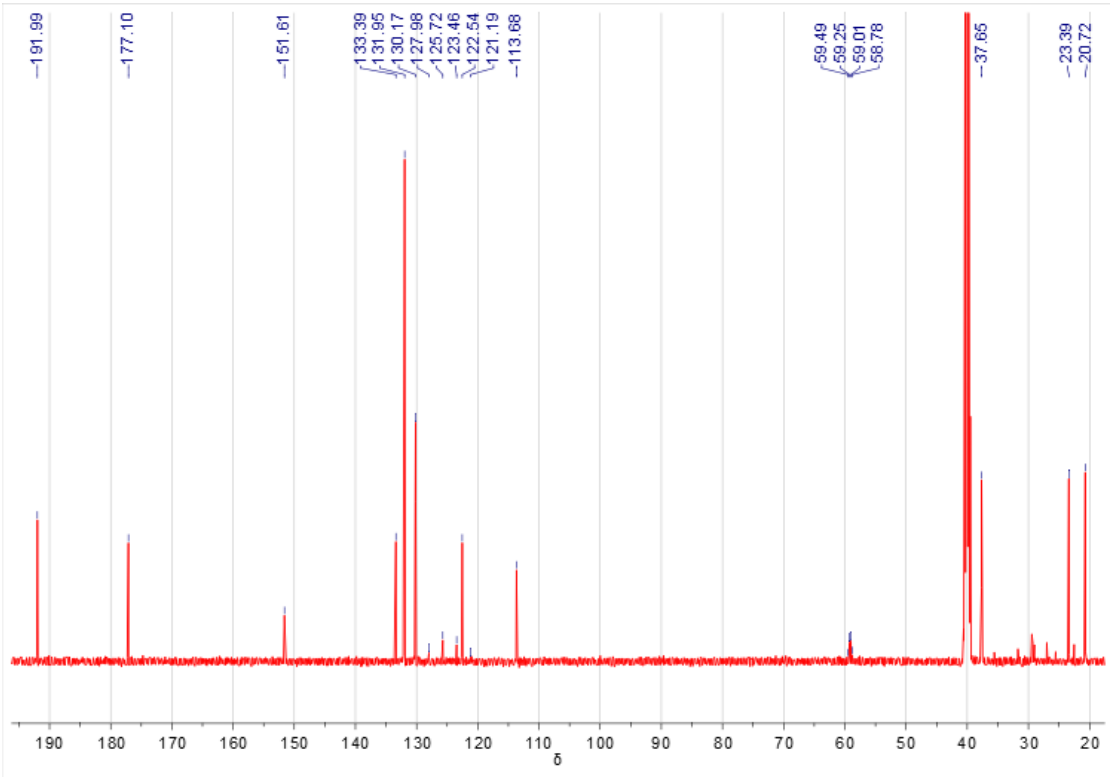


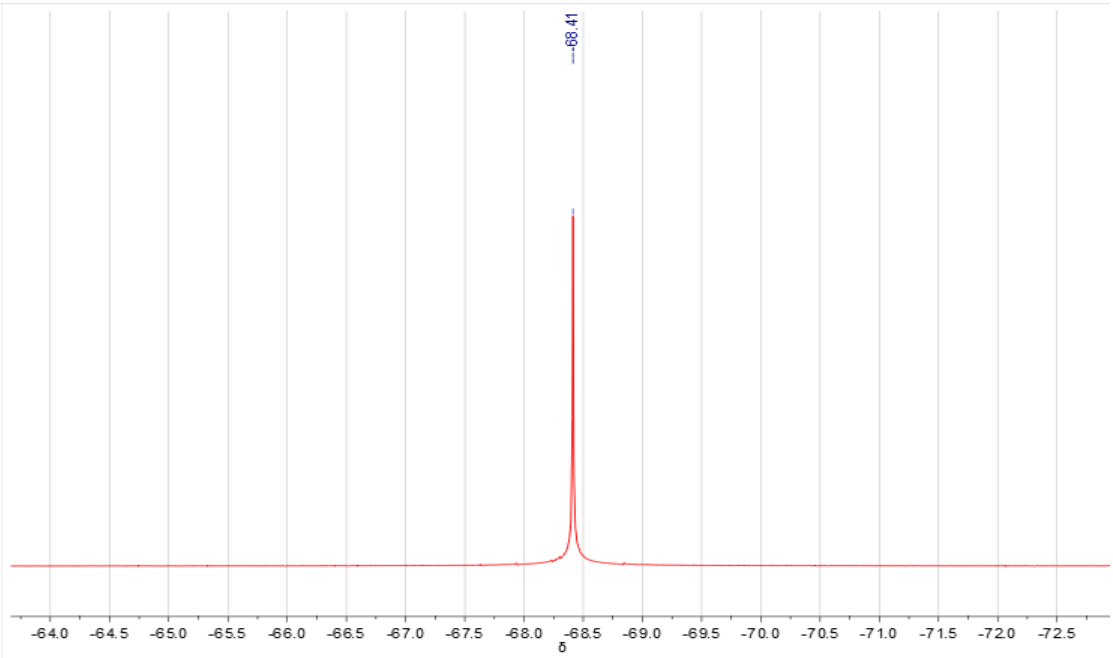


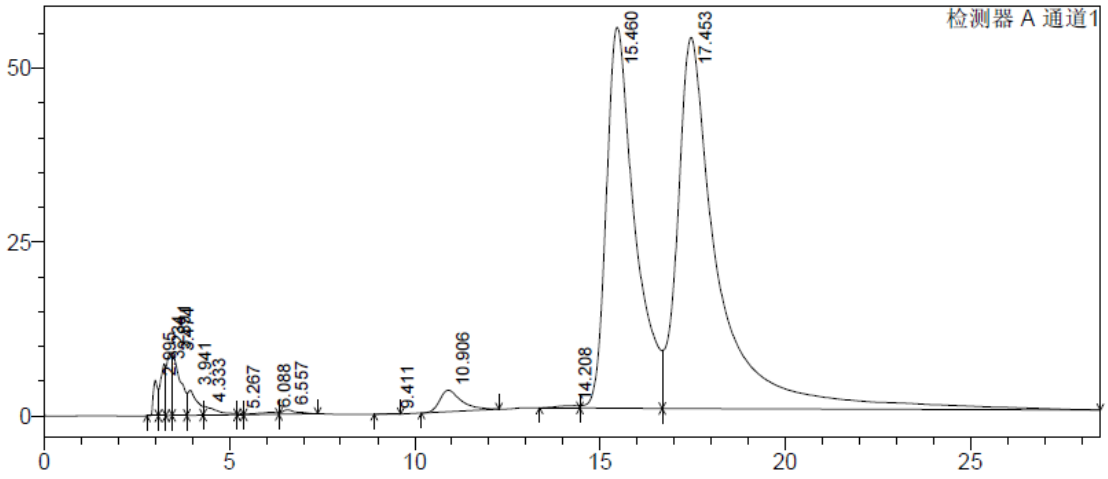


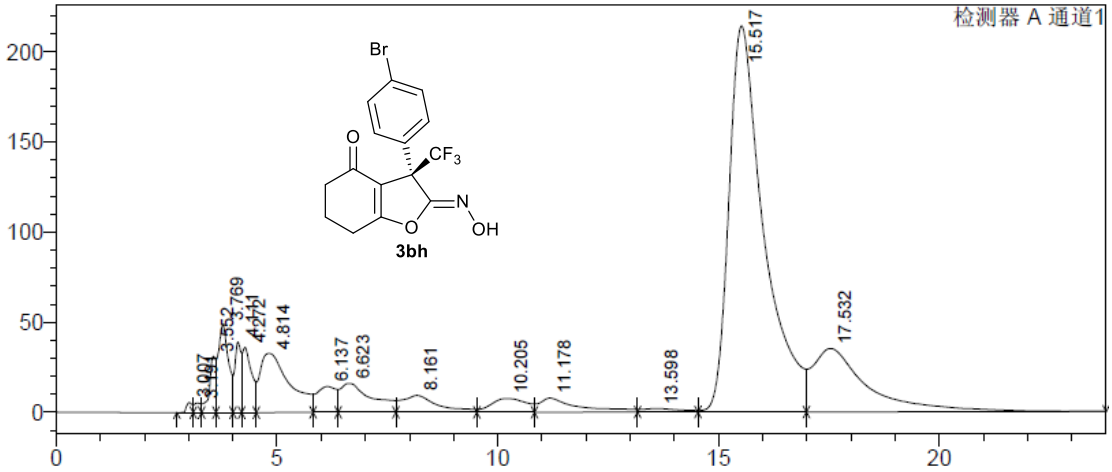
Peak	Retention Time	Area	Height	Area%
1	13.651	8881298	182390	93.99
2	16.362	567935	12843	6.01


Br
O
CF3
N
OH
O
3bh

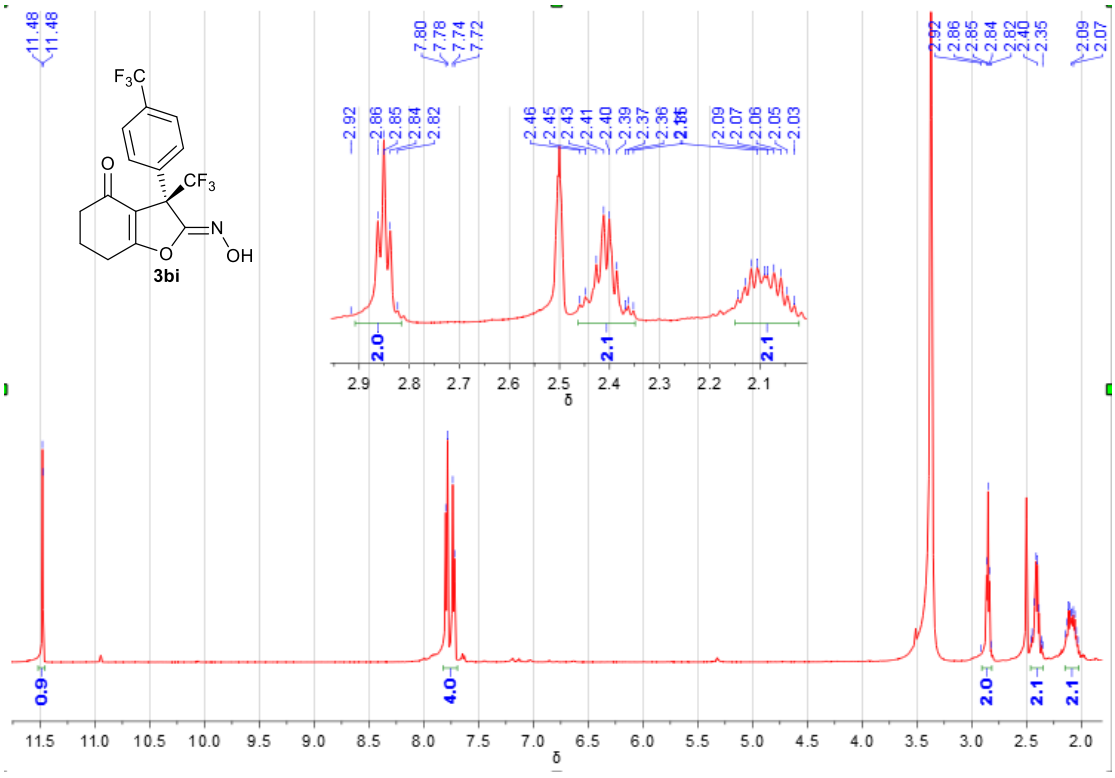


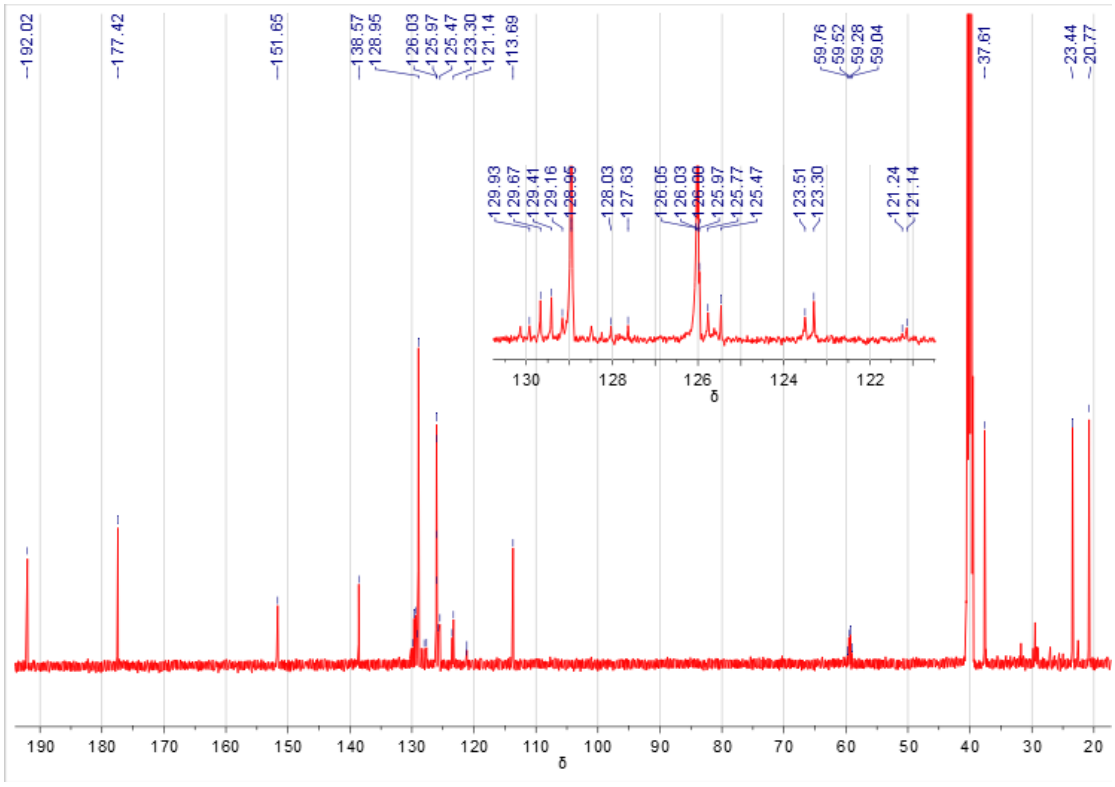


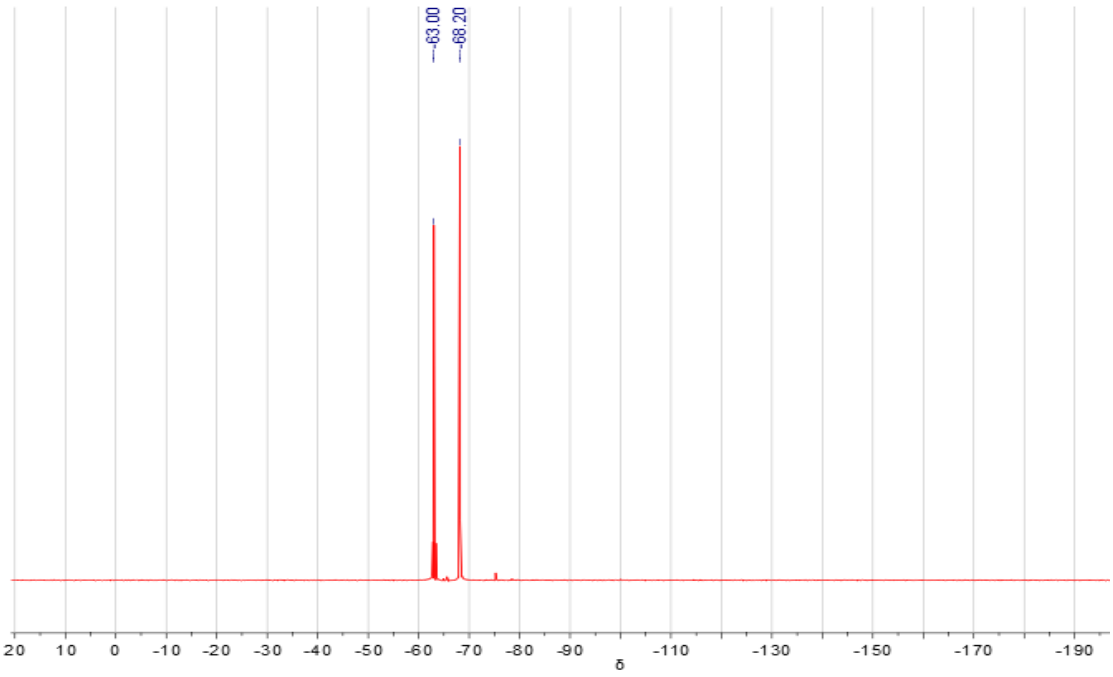


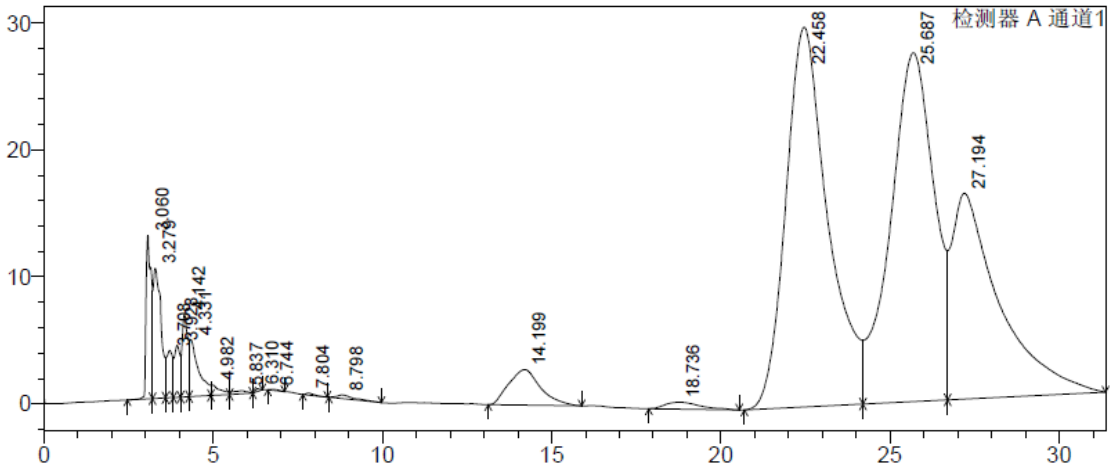


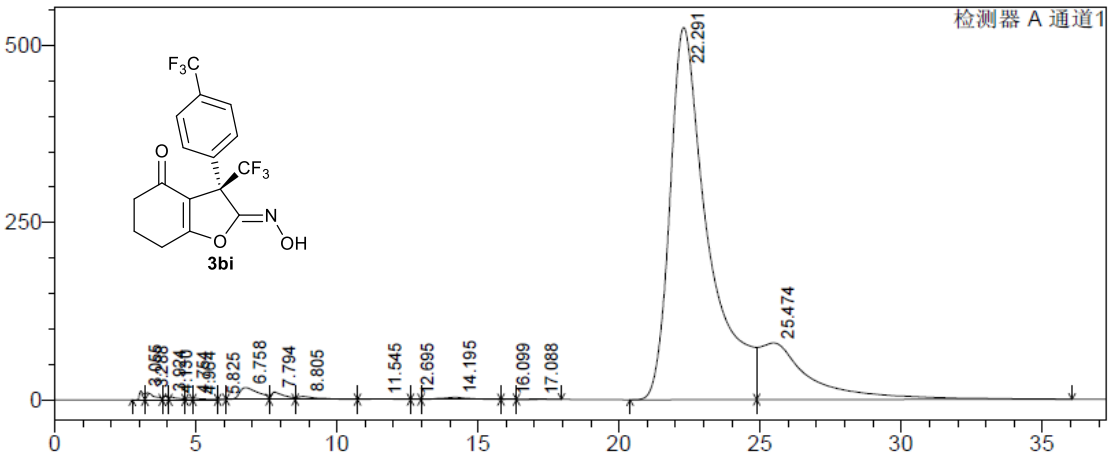
Peak	Retention Time	Area	Height	Area%
1	15.517	11797741	214208	79.39
2	17.532	3063189	35182	20.61


11.48
11.48
7.80
7.78
7.74
7.72
2.92
2.86
2.85
2.84
2.82
2.46
2.45
2.43
2.41
2.40
2.39
2.37
2.36
2.09
2.07
2.06
2.05
2.03
2.92
2.86
2.85
2.84
2.82
2.40
2.35
2.09
2.07
F3C
CF3
O
N
OH
O
3bi
2.0
2.1
2.1
δ
0.9
4.0
2.0
2.1
2.1
δ


192.02
177.42
151.65
138.57
128.95
126.03
125.97
125.47
123.30
121.14
113.69
59.76
59.52
59.28
59.04
37.61
23.44
20.77
129.93
129.67
129.41
129.16
128.05
128.03
127.63
126.05
126.03
126.00
125.97
125.77
125.47
123.51
123.30
121.24
121.14
δ
δ

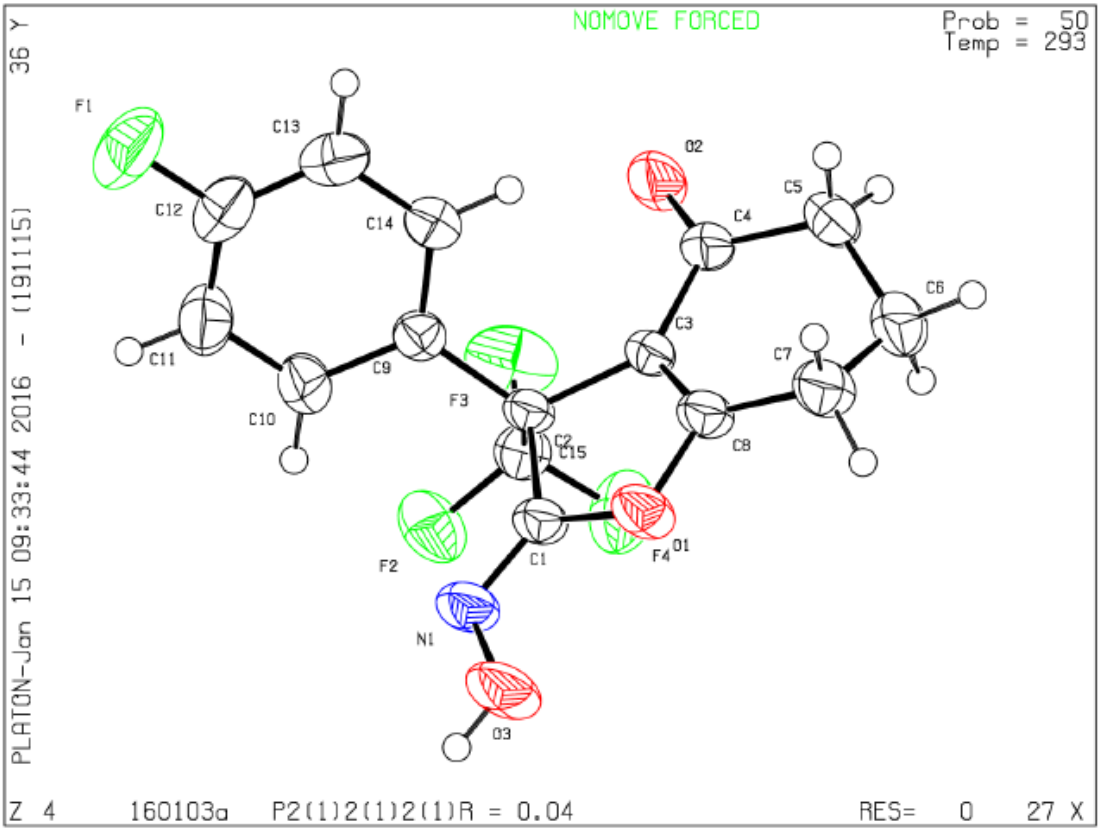






Peak	Retention Time	Area	Height	Area%
1	22.291	49054760	525126	82.87
2	25.474	10141535	79735	17.13

6. X-ray crystal structure and data of **3bg**



checkCIF/PLATON report

Structure factors have been supplied for datablock(s) 160103a

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: 160103a

Bond precision: C-C = 0.0036 A Wavelength=1.54178

Cell: a=8.7967(4) b=9.2428(4) c=17.2636(8)

alpha=90 beta=90 gamma=90

Temperature: 293 K

Calculated Reported

Volume 1403.64(11) 1403.64(11)

Space group P 21 21 21 P2(1)2(1)2(

Hall group P 2ac 2ab ?

Moiety formula C15 H11 F4 N O3 ?

Sum formula C15 H11 F4 N O3 C15 H11 F4 N O3

Mr 329.25 329.25

Dx,g cm-3 1.558 1.558

Z 4 4

Mu (mm-1) 1.263 1.263

F000 672.0 672.0

F000’ 674.88

h,k,lmax 10,10,20 10,10,20

Nref 2477[1447] 2477

Tmin,Tmax 0.618,0.668 0.619,0.688

Tmin’ 0.560

Correction method= # Reported T Limits: Tmin=0.619 Tmax=0.688

AbsCorr = MULTI-SCAN

Data completeness= 1.71/1.00 Theta(max)= 66.450

R(reflections)= 0.0370(2166) wR2(reflections)= 0.0924(2477)

S = 1.075 Npar= 210

The following ALERTS were generated. Each ALERT has the format

test-name_ALERT_alert-type_alert-level.

Click on the hyperlinks for more details of the test.

Alert level C

PLAT089_ALERT_3_C Poor Data / Parameter Ratio (Zmax < 18) ..... 6.89 Note

PLAT934_ALERT_3_C Number of (Iobs-Icalc)/SigmaW > 10 Outliers .... 1 Check

Alert level G

PLAT005_ALERT_5_G No Embedded Refinement Details found in the CIF Please Do !

PLAT007_ALERT_5_G Number of Unrefined Donor-H Atoms ..... 1 Report

PLAT093_ALERT_1_G No s.u.’s on H-positions, Refinement Reported as mixed Check

PLAT199_ALERT_1_G Reported _cell_measurement_temperature ..... (K) 293 Check

PLAT200_ALERT_1_G Reported _diffrn_ambient_temperature ..... (K) 293 Check

PLAT242_ALERT_2_G Low ’MainMol’ Ueq as Compared to Neighbors of C15 Check

PLAT791_ALERT_4_G The Model has Chirality at C2 (Chiral SPGR) R Verify

PLAT850_ALERT_4_G Check Flack Parameter Exact Value 0.00 and s.u. 0.20 Check

PLAT899_ALERT_4_G SHELXL97 is Deprecated and Succeeded by SHELXL 2014 Note

PLAT909_ALERT_3_G Percentage of Observed Data at Theta(Max) Still 74 %

0 **ALERT level A** = Most likely a serious problem - resolve or explain

0 **ALERT level B** = A potentially serious problem, consider carefully

2 **ALERT level C** = Check. Ensure it is not caused by an omission or oversight

10 **ALERT level G** = General information/check it is not something unexpected

3 ALERT type 1 CIF construction/syntax error, inconsistent or missing data

1 ALERT type 2 Indicator that the structure model may be wrong or deficient

3 ALERT type 3 Indicator that the structure quality may be low

3 ALERT type 4 Improvement, methodology, query or suggestion

2 ALERT type 5 Informative message, check

Validation response form

Please find below a validation response form (VRF) that can be filled in and pasted into your CIF.

start Validation Reply Form

_vrf_PLAT089_160103a;

PROBLEM: Poor Data / Parameter Ratio (Zmax < 18) ..... 6.89 Note

RESPONSE: ...;

_vrf_PLAT934_160103a;

PROBLEM: Number of (Iobs-Icalc)/SigmaW > 10 Outliers .... 1 Check

RESPONSE: ...;

end Validation Reply Form

It is advisable to attempt to resolve as many as possible of the alerts in all categories. Often the minor alerts point to easily fixed oversights, errors and omissions in your CIF or refinement strategy, so attention to these fine details can be worthwhile. In order to resolve some of the more serious problems it may be necessary to carry out additional measurements or structure refinements. However, the purpose of your study may justify the reported deviations and the more serious of these should normally be commented upon in the discussion or experimental section of a paper or in the "special_details" fields of the CIF. checkCIF was carefully designed to identify outliers and unusual parameters, but every test has its limitations and alerts that are not important in a particular case may appear. Conversely, the absence of alerts does not guarantee there are no aspects of the results needing attention. It is up to the individual to critically assess their own results and, if necessary, seek expert advice.

Publication of your CIF in IUCr journals

A basic structural check has been run on your CIF. These basic checks will be run on all CIFs

submitted for publication in IUCr journals (*Acta Crystallographica*, *Journal of Applied Crystallography*, *Journal of Synchrotron Radiation*); however, if you intend to submit

to *Acta*

Crystallographica Section C or *E*, you should make sure that full publication checks are run on the final version of your CIF prior to submission.

Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to

CIF submission.

PLATON version of 19/11/2015; check.def file version of 17/11/2015

Datablock 160103a - ellipsoid plot