

Supporting Information

Chemo- and Regioselective Synthesis of C3-Sulfonate Esters and C4-Chloro of Quinolines Under Metal Free Conditions

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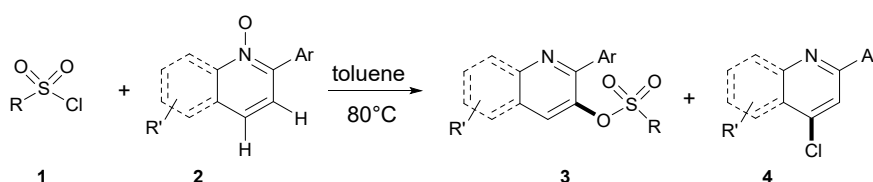
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1. General experimental details

Unless otherwise noted all commercial materials were used without further purification. $^1\text{H-NMR}$ spectra were recorded on a BRUKER AVANCE III HD (400 MHz) spectrometer. Chemical shifts are reported in ppm from tetramethylsilane with the solvent resonance as internal standard (CDCl_3 ; δ 7.26). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quadruplet, br = broad, m = multiplet), coupling constants (Hz) and integration. $^{13}\text{C-NMR}$ spectra were recorded on a BRUKER AVANCE III HD (100 MHz) spectrometer with complete proton decoupling. Chemical shifts are reported in ppm from tetramethylsilane with the solvent resonance as the internal standard (CDCl_3 ; δ 77.16). $^{19}\text{F-NMR}$ spectra were recorded on a BRUKER AVANCE III HD (377 MHz) spectrometer. Mass spectra were measured with an Agilent Technologies 6120 Quadrupole LC/MS. High resolution mass spectrometry (HRMS) were measured with a GCT PremierTM and BRUKER micrOTF-Q III.

2. General procedure for reactions



0.2 mmol Sulfonyl chlorides (**1**) in 2 mL toluene was added into a Schlenk tube charged with 0.42 mmol 2-arylquinoline N-oxides (**2**). The mixture was stirred at 80 °C for 12 hours, then cooled down to room temperature. The mixture was concentrated, and purified by flash column chromatography on silica gel (EA/ PE = 0/50-1/10) to give the product **3** and **4**.

3. X-ray crystal structure of 3na

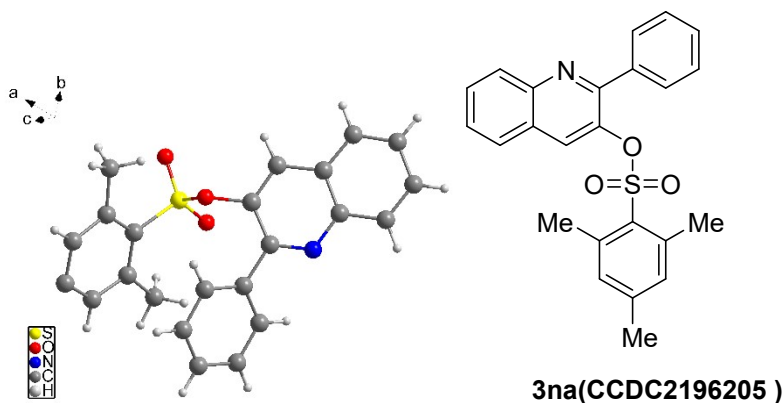


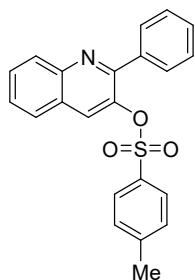
Table 1 Crystallographic Data collection and Refinement result for CD

Identification code	CD
Chemical formula	C ₂₄ H ₂₁ NO ₃ S
Formula weight	403.08
Temperature/ K	293(2)
Wavelength/ Å	1.54178
Crystal system	Triclinic
Space group	<i>P</i> -1
<i>a</i> / Å	9.9176(12)
<i>b</i> / Å	10.2533(12)
<i>c</i> / Å	11.2559(13)
<i>α</i> / °	67.180(4)
<i>β</i> / °	70.253(4)
<i>γ</i> / °	79.073(4)
<i>Z</i>	2
Density (calculated g/cm ³)	1.353
Absorption coefficient /mm ⁻¹	1.661
Reflections collected	11590
Independent reflections	3439 [R(int) = 0.0680]
F(000)	424
Goodness-of-fit on F ²	1.031
R ₁ , wR ₂ (I > 2σ(I)) ^a	0.1156, 0.2850
R ₁ , wR ₂ (all data) ^a	0.1168, 0.2865
^a R ₁ = Σ(F _o - F _c) / Σ F _o ; wR ₂ = [Σw(F _o - F _c ²) / ΣwF _o ²] ^{1/2}	

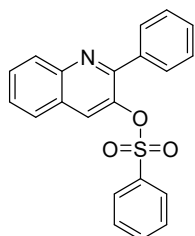
Table 2. Atomic coordinates ($\times 10^4$) and equivalent isotropic displacement parameters ($\text{\AA}^2 \times 10^3$) for CD. $U(\text{eq})$ is defined as one third of the trace of the orthogonalized U_{ij} tensor.

	x	y	z	$U(\text{eq})$
S(1)	5805(1)	2955(1)	2689(1)	18(1)
O(003)	4878(4)	1899(3)	3014(4)	33(1)
O(2)	5739(3)	3073(3)	4098(3)	22(1)
O(004)	7266(3)	2764(3)	1993(3)	27(1)
N(3)	9060(3)	3025(3)	4836(3)	18(1)
C(006)	6922(4)	2549(4)	4618(4)	16(1)
C(007)	8039(4)	4941(4)	3303(4)	17(1)
C(008)	9116(4)	1670(4)	5719(4)	17(1)
C(009)	6960(4)	1180(4)	5470(4)	20(1)
C(00A)	5839(4)	5649(4)	791(4)	19(1)
C(00B)	7992(4)	3465(4)	4287(4)	16(1)
C(00C)	5029(4)	4658(4)	1970(4)	15(1)
C(00D)	8102(4)	697(4)	6060(4)	18(1)
C(00E)	3030(5)	6371(4)	2127(4)	24(1)
C(00F)	2647(4)	3971(5)	3846(4)	24(1)
C(00G)	5169(5)	6990(4)	319(4)	23(1)
C(00H)	9361(5)	5401(4)	2400(4)	24(1)
C(00I)	10252(4)	1239(4)	6315(4)	23(1)
C(00J)	3607(4)	4998(4)	2642(4)	19(1)
C(00K)	6961(5)	7281(4)	2392(5)	29(1)
C(00L)	9370(5)	-1091(4)	7497(4)	26(1)
C(00M)	6827(5)	5898(4)	3298(4)	22(1)
C(00N)	10360(5)	-116(5)	7189(4)	26(1)
C(00O)	8250(5)	-702(4)	6963(4)	24(1)
C(00P)	9472(5)	6771(5)	1488(5)	31(1)
C(00Q)	7345(5)	5396(5)	-3(4)	26(1)
C(00R)	3794(5)	7368(4)	962(4)	25(1)
C(00S)	8255(6)	7712(5)	1491(5)	34(1)
C(00T)	3113(6)	8834(5)	409(6)	41(1)

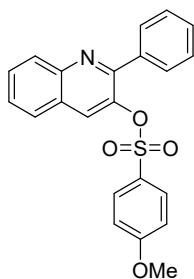
4. Characterization of new products



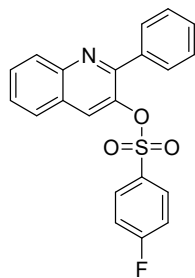
2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3aa. Yield: 61.7 mg, 82% (based on sulfonyl chloride **1**). White solid. m.p. 107-108 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.33 (s, 1H), 8.11 (d, *J* = 8.4 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.74 (ddd, *J* = 1.2, 6.8, 8.4 Hz, 1H), 7.63-7.56 (m, 1H), 7.54-7.48 (m, 2H), 7.39-7.27 (m, 3H), 7.16 (d, *J* = 8.4 Hz, 2H), 6.91 (d, *J* = 8.0 Hz, 2H), 2.33 (s, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.6, 146.6, 145.3, 141.4, 136.5, 131.4, 130.2, 130.1, 129.6, 129.5, 129.5, 128.9, 128.1, 128.0, 127.8, 127.7, 127.5, 21.7; **HRMS [ESI]** calcd for C₂₂H₁₈NO₃S [M+H]⁺ 376.1002, found 376.1008.



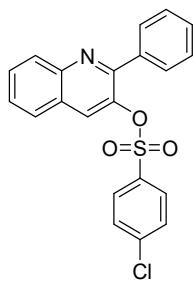
2-phenylquinolin-3-yl benzenesulfonate 3ba. Yield: 61.4 mg, 85% (based on sulfonyl chloride **1**). White solid. m.p. 104-105 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.39-8.30 (m, 1H), 8.19-8.08 (m, 1H), 7.96-7.86 (m, 1H), 7.81-7.71 (m, 1H), 7.67-7.58 (m, 1H), 7.58-7.50 (m, 2H), 7.50-7.41 (m, 1H), 7.41-7.27 (m, 5H), 7.22-7.11 (m, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.5, 146.6, 141.3, 136.4, 134.6, 134.1, 130.2, 130.0, 129.5, 129.5, 128.9, 128.9, 128.2, 128.1, 127.8, 127.7, 127.5; **HRMS [ESI]** calcd for C₂₁H₁₆NO₃S [M+H]⁺ 362.0845, found 362.0841.



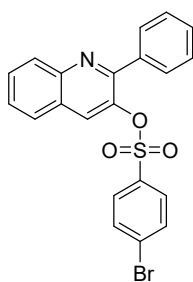
2-phenylquinolin-3-yl 4-methoxybenzenesulfonate 3ca. Yield: 61.8 mg, 79% (based on sulfonyl chloride **1**). White solid. m.p. 102-103 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.33 (s, 1H), 8.11 (d, *J* = 8.4 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.74 (ddd, *J* = 1.2, 6.8, 8.4 Hz, 1H), 7.63-7.58 (m, 1H), 7.58-7.53 (m, 2H), 7.38-7.29 (m, 3H), 7.22-7.16 (m, 2H), 6.58-6.53 (m, 2H), 3.79 (s, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 164.0, 153.5, 146.6, 141.4, 136.6, 130.3, 130.2, 130.2, 129.6, 129.5, 128.9, 128.1, 127.8, 127.7, 127.4, 125.6, 114.1, 55.7; **HRMS [ESI]** calcd for C₂₂H₁₈NO₄S [M+H]⁺ 392.0951, found 392.0956.



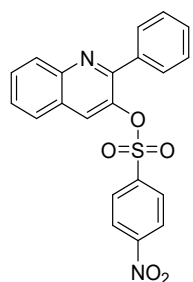
2-phenylquinolin-3-yl 4-fluorobenzenesulfonate 3da. Yield: 66.0 mg, 87% (based on sulfonyl chloride **1**). White solid. m.p. 145-146 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.35 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.76 (dd, *J* = 7.2, 7.2 Hz, 1H), 7.61 (dd, *J* = 7.2, 7.6 Hz, 1H), 7.56-7.50 (m, 2H), 7.40-7.31 (m, 3H), 7.30-7.24 (m, 2H), 6.78 (dd, *J* = 8.4, 8.4 Hz, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 166.0 (d, *J*_{C-F} = 256.0 Hz), 153.3, 146.8, 141.2, 136.4, 131.0 (d, *J*_{C-F} = 9.9 Hz), 130.4, 130.4, 130.4, 129.6, 129.6, 129.1, 128.3, 127.8, 127.7, 127.6, 116.3 (d, *J*_{C-F} = 22.8 Hz); **¹⁹F NMR (377 MHz, CDCl₃)** δ -102.1 (s); **HRMS [ESI]** calcd for C₂₁H₁₅FNO₃S [M+H]⁺ 380.0751, found 380.0751.



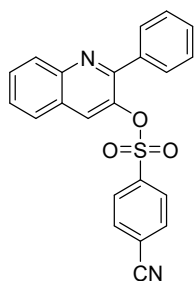
2-phenylquinolin-3-yl 4-chlorobenzenesulfonate 3ea. Yield: 52.2 mg, 66% (based on sulfonyl chloride **1**). White solid. m.p. 146-147 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.34 (s, 1H), 8.12 (d, *J* = 8.8 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.75 (ddd, *J* = 1.2, 7.2, 8.4 Hz, 1H), 7.61 (dd, *J* = 7.2, 7.2 Hz, 1H), 7.53-7.46 (m, 2H), 7.40-7.30 (m, 3H), 7.16 (d, *J* = 8.4 Hz, 2H), 7.05 (d, *J* = 8.4 Hz, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.2, 146.8, 141.1, 141.1, 136.3, 132.7, 130.5, 130.4, 129.6, 129.5, 129.4, 129.2, 129.1, 128.2, 127.8, 127.7, 127.6; **HRMS [ESI]** calcd for C₂₁H₁₅ClNO₃S [M+H]⁺ 396.0456, found 396.0457.



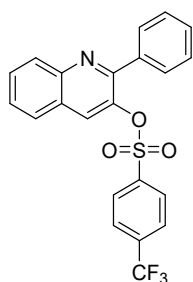
2-phenylquinolin-3-yl 4-bromobenzenesulfonate 3fa. Yield: 59.8 mg, 68% (based on sulfonyl chloride **1**). White solid. m.p. 167-168 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.34 (s, 1H), 8.12 (d, *J* = 8.8 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.76 (dd, *J* = 7.2, 8.0 Hz, 1H), 7.61 (dd, *J* = 7.2, 7.6 Hz, 1H), 7.52-7.45 (m, 2H), 7.41-7.31 (m, 3H), 7.22 (d, *J* = 8.4 Hz, 1H), 7.08 (d, *J* = 8.4 Hz, 1H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.3, 146.8, 141.2, 136.3, 133.3, 132.2, 130.5, 130.4, 129.8, 129.6, 129.5, 129.4, 129.1, 128.2, 127.8, 127.7, 127.7; **HRMS [ESI]** calcd for C₂₁H₁₅BrNO₃S [M+H]⁺ 439.9951, found 439.9947.



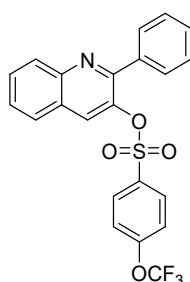
2-phenylquinolin-3-yl 4-nitrobenzenesulfonate 3ga. Yield: 64.2 mg, 79% (based on sulfonyl chloride **1**). Yellow solid. m.p. 168-169 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.34 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.91 (d, *J* = 8.4 Hz, 1H), 7.76 (ddd, *J* = 1.2, 7.2, 8.4 Hz, 1H), 7.61 (ddd, *J* = 0.8, 6.8, 7.6 Hz, 1H), 7.51-7.45 (m, 2H), 7.41-7.31 (m, 3H), 7.22 (d, *J* = 8.4 Hz, 1H), 7.08 (d, *J* = 8.4 Hz, 1H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.2, 146.8, 141.1, 136.3, 133.3, 132.1, 130.5, 130.4, 129.8, 129.6, 129.5, 129.4, 129.1, 128.2, 127.8, 127.7, 127.6; **HRMS [ESI]** calcd for C₂₁H₁₅FNO₃S [M+H]⁺ 407.0696, found 407.0688.



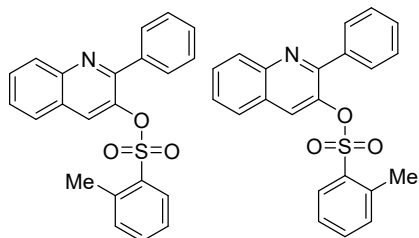
2-phenylquinolin-3-yl 4-cyanobenzenesulfonate 3ha. Yield: 67.3 mg, 87% (based on sulfonyl chloride **1**). White solid. m.p. 128-129 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.35 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.92 (d, *J* = 8.0 Hz, 1H), 7.78 (ddd, *J* = 1.2, 6.8, 8.4 Hz, 1H), 7.63 (ddd, *J* = 0.8, 7.2, 8.0 Hz, 1H), 7.50-7.44 (m, 2H), 7.42-7.29 (m, 7H); **¹³C NMR (101 MHz, CDCl₃)** δ 152.7, 146.9, 140.9, 138.5, 136.2, 132.4, 130.7, 130.6, 129.6, 129.5, 129.3, 128.6, 128.4, 127.8, 127.8, 127.6, 117.7, 116.9; **HRMS [ESI]** calcd for C₂₂H₁₅N₂O₃S [M+H]⁺ 387.0798, found 387.0804.



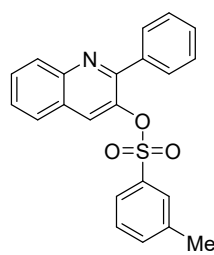
2-phenylquinolin-3-yl 4-(trifluoromethyl)benzenesulfonate 3ia. Yield: 49.8 mg, 58% (based on sulfonyl chloride **1**). White solid. m.p. 92-93 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.37 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.93 (d, *J* = 8.0 Hz, 1H), 7.77 (dd, *J* = 7.6, 8.0 Hz, 1H), 7.63 (dd, *J* = 7.2, 7.6 Hz, 1H), 7.44 (d, *J* = 7.2 Hz, 1H), 7.40-7.32 (m, 5H), 7.28 (dd, *J* = 6.8, 7.6 Hz, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.0, 146.9, 141.1, 137.9, 136.2, 135.5 (q, *J*_{C-F} = 33.0 Hz), 130.6, 130.6, 129.6, 129.4, 129.1, 128.6, 128.4, 127.8, 127.7, 127.7, 125.9 (q, *J*_{C-F} = 3.6 Hz), 123.0 (q, *J*_{C-F} = 271.6 Hz); **¹⁹F NMR (377 MHz, CDCl₃)** δ -63.5 (s); **HRMS [ESI]** calcd for C₂₂H₁₅F₃NO₃S [M+H]⁺ 430.0719, found 430.0718.



2-phenylquinolin-3-yl 4-(trifluoromethoxy)benzenesulfonate 3ja. Yield: 51.7 mg, 58% (based on sulfonyl chloride **1**). White solid. m.p. 62-63 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.36 (s, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.92 (d, *J* = 8.0 Hz, 1H), 7.76 (dd, *J* = 7.2, 8.4 Hz, 1H), 7.62 (dd, *J* = 7.2, 7.6 Hz, 1H), 7.51 (d, *J* = 6.8 Hz, 1H), 7.40-7.27 (m, 5H), 6.91 (d, *J* = 8.4 Hz, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.2, 153.1, 146.8, 141.1, 136.3, 132.6, 130.5 (q, *J*_{C-F} = 2.2 Hz), 130.4, 129.6, 129.5, 129.1, 128.3, 127.8, 127.7, 120.4, 120.2 (q, *J*_{C-F} = 258.6 Hz); **¹⁹F NMR (377 MHz, CDCl₃)** δ -57.5 (s); **HRMS [ESI]** calcd for C₂₂H₁₅F₃NO₄S [M+H]⁺ 446.0668, found 446.0672.

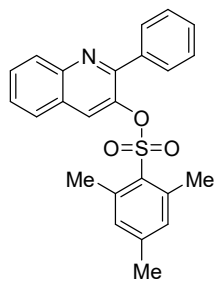


2-phenylquinolin-3-yl 2-methylbenzenesulfonate 3la (mixture of 3la and 3l'a', ratio 4:1). Yield: 52.5 mg, 70% (based on sulfonyl chloride **1**). White solid. m.p. 167-168 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.32 (s, 0.2H, one isomer), 8.22 (s, 0.8H, one isomer), 8.12 (d, *J* = 8.4 Hz, 1H, two isomers), 7.89 (d, *J* = 8.4 Hz, 0.2H, one isomer), 7.84 (d, *J* = 8.0 Hz, 0.8H, one isomer), 7.77-7.69 (m, 1H, two isomers), 7.63-7.51 (m, 3.2H, two isomers), 7.47 (d, *J* = 7.6 Hz, 0.8H, one isomer), 7.42-7.28 (m, 4H, two isomers), 7.18 (d, *J* = 8.4 Hz, 0.3H, one isomer), 7.11-7.02 (m, 1.6H, one isomer), 6.92 (d, *J* = 8.0 Hz, 0.4H, one isomer), 2.33 (s, 0.6H, one isomer), 2.30 (s, 2.4H, one isomer); **¹³C NMR (101 MHz, CDCl₃)** δ 153.8 & 153.5 (two isomers), 146.4 & 145.3 (two isomers), 141.5 & 141.4 (two isomers), 139.4 & 139.2 (two isomers), 136.6 & 136.5 (two isomers), 134.3 & 133.7 (two isomers), 132.8 & 131.4 (two isomers), 130.2 (overlap, two isomers), 130.1 & 130.1 (two isomers), 129.5 & 129.5 (two isomers), 129.3 (overlap, two isomers), 129.0 & 128.9 (two isomers), 128.3 (overlap, two isomers), 128.1 & 128.1 (overlap, two isomers), 128.0 (overlap, two isomers), 127.7 & 127.7 (two isomers), 127.6 (overlap, two isomers), 127.4 (overlap, two isomers), 126.1 (overlap, two isomers), 21.7 & 20.7 (two isomers); **HRMS [ESI]** calcd for C₂₂H₁₈NO₃S [M+H]⁺ 376.1002, found 376.1006.

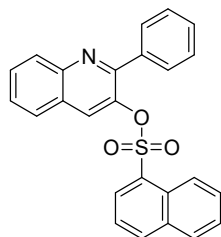


2-phenylquinolin-3-yl 3-methylbenzenesulfonate 3ma. Yield: 53.3 mg, 71%

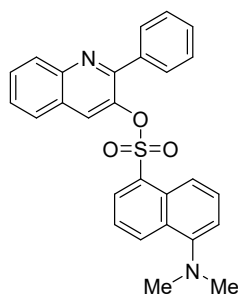
(based on sulfonyl chloride **1**). White solid. m.p. 60-61 °C. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.34 (s, 1H), 8.12 (d, $J = 8.4$ Hz, 1H), 7.90 (d, $J = 8.0$ Hz, 1H), 7.74 (ddd, $J = 1.6, 7.2, 8.4$ Hz, 1H), 7.60 (ddd, $J = 0.8, 7.2, 8.0$ Hz, 1H), 7.56-7.51 (m, 2H), 7.39-7.28 (m, 3H), 7.25 (d, $J = 7.2$ Hz, 1H), 7.10 (d, $J = 8.8$ Hz, 2H), 7.05 (dd, $J = 7.6, 7.6$ Hz, 1H), 2.15 (s, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 153.6, 146.6, 141.4, 139.4, 136.3, 135.1, 134.4, 130.2, 129.9, 129.5, 128.9, 128.6, 128.5, 128.1, 127.8, 127.7, 127.5, 125.4, 21.3; **HRMS [ESI]** calcd for $\text{C}_{22}\text{H}_{18}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 376.1002, found 376.1012.



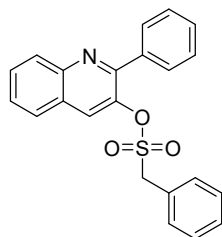
2-phenylquinolin-3-yl 2,4,6-trimethylbenzenesulfonate 3na. Yield: 75.8 mg, 94% (based on sulfonyl chloride **1**). White solid. m.p. 73-74 °C. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.17 (s, 1H), 8.13 (d, $J = 8.4$ Hz, 1H), 7.82 (d, $J = 8.0$ Hz, 1H), 7.72 (dd, $J = 7.2, 7.6$ Hz, 1H), 7.62-7.53 (m, 3H), 7.38-7.28 (m, 3H), 6.73 (s, 2H), 2.25 (s, 3H), 2.23 (s, 6H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 154.1, 146.3, 144.0, 141.4, 140.3, 136.8, 131.9, 130.4, 130.0, 129.6, 129.5, 129.3, 128.8, 128.1, 127.6, 127.5, 127.4, 23.0, 21.1; **HRMS [ESI]** calcd for $\text{C}_{24}\text{H}_{22}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 404.1315, found 404.1309.



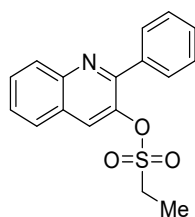
2-phenylquinolin-3-yl naphthalene-1-sulfonate 3oa. Yield: 68.3 mg, 83% (based on sulfonyl chloride **1**). White solid. m.p. 98-99 °C. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.45 (d, $J = 8.4$ Hz, 1H), 8.19 (s, 1H), 8.09 (d, $J = 8.4$ Hz, 1H), 7.97 (d, $J = 8.0$ Hz, 1H), 7.85 (d, $J = 7.2$ Hz, 1H), 7.82 (d, $J = 8.4$ Hz, 2H), 7.72 (dd, $J = 7.6, 7.6$ Hz, 1H), 7.56 (dd, $J = 6.8, 8.0$ Hz, 1H), 7.54 (dd, $J = 6.0, 7.2$ Hz, 1H), 7.46 (dd, $J = 7.2, 8.4$ Hz, 1H), 7.39 (d, $J = 7.2$ Hz, 2H), 7.30 (dd, $J = 7.6, 8.0$ Hz, 1H), 7.09-6.96 (m, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 153.8, 146.4, 141.8, 136.1, 136.1, 134.1, 130.9, 130.9, 130.1, 129.5, 129.4, 129.0, 128.8, 128.6, 128.4, 127.9, 127.6, 127.5, 127.4, 127.1, 124.9, 123.7; **HRMS [ESI]** calcd for $\text{C}_{25}\text{H}_{18}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 412.1002, found 412.0998.



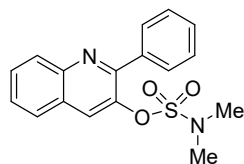
2-phenylquinolin-3-yl 5-(dimethylamino)naphthalene-1-sulfonate 3pa. Yield: 51.0 mg, 56% (based on sulfonyl chloride **1**). Yellow oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.48 (d, $J = 8.4$ Hz, 1H), 8.16 (s, 1H), 8.14 (d, $J = 9.6$ Hz, 1H), 8.09 (d, $J = 8.4$ Hz, 1H), 7.85 (d, $J = 7.2$ Hz, 1H), 7.81 (d, $J = 8.4$ Hz, 1H), 7.72 (dd, $J = 7.2, 8.0$ Hz, 1H), 7.56 (dd, $J = 7.6, 7.6$ Hz, 1H), 7.45 (dd, $J = 7.2$ Hz, 2H), 7.38 (dd, $J = 8.0, 8.4$ Hz, 1H), 7.30 (dd, $J = 8.0, 8.0$ Hz, 1H), 7.13 (d, $J = 7.6$ Hz, 1H), 7.11-7.01 (m, 3H), 7.08-6.96 (m, 3H), 2.88 (s, 6H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 153.9, 151.6, 146.4, 141.9, 136.3, 132.2, 131.2, 130.8, 130.1, 129.9, 129.8, 129.5, 129.4, 129.1, 128.9, 128.6, 127.9, 127.7, 127.6, 127.4, 122.8, 119.6, 115.6, 45.6; **HRMS [ESI]** calcd for $\text{C}_{27}\text{H}_{23}\text{N}_2\text{O}_3\text{S}$ $[\text{M}+\text{H}]^+$ 455.1424, found 455.1424.



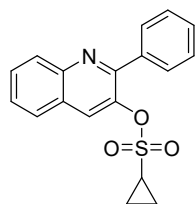
2-phenylquinolin-3-yl phenylmethanesulfonate 3qa. Yield: 49.5 mg, 66% (based on sulfonyl chloride **1**). White solid. m.p. 95-96 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.18 (d, *J* = 8.4 Hz, 1H), 8.09 (s, 1H), 7.90 (dd, *J* = 1.6, 8.4 Hz, 1H), 7.82 (d, *J* = 8.4 Hz, 1H), 7.76 (ddd, *J* = 1.6, 7.2, 8.4 Hz, 1H), 7.60 (ddd, *J* = 0.8, 7.2, 8.0 Hz, 1H), 7.57-7.49 (m, 3H), 7.40-7.30 (m, 3H), 7.26-7.20 (m, 2H), 4.07 (s, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.4, 146.6, 141.4, 136.9, 130.9, 130.3, 129.8, 129.6, 129.6, 129.5, 129.1, 129.1, 128.7, 127.8, 127.7, 127.7, 126.6, 57.8; **HRMS [ESI]** calcd for C₂₂H₁₈NO₃S [M+H]⁺ 376.1002, found 376.1002.



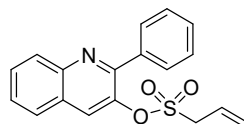
2-phenylquinolin-3-yl ethanesulfonate 3ra. Yield: 38.9 mg, 62% (based on sulfonyl chloride **1**). Colorless oil. **¹H NMR (400 MHz, CDCl₃)** δ 8.30 (s, 1H), 8.17 (d, *J* = 8.8 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 3H), 7.76 (dd, *J* = 7.2, 8.0 Hz, 1H), 7.60 (dd, *J* = 7.2, 7.6 Hz, 1H), 7.57-7.46 (m, 3H), 2.88 (q, *J* = 7.2 Hz, 2H), 1.16 (t, *J* = 7.6 Hz, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.4, 146.6, 141.2, 136.9, 130.2, 129.7, 129.6, 129.5, 129.2, 128.7, 127.8, 127.7, 127.7, 46.4, 7.8; **HRMS [ESI]** calcd for C₁₇H₁₆NO₃S [M+H]⁺ 314.0845, found 314.0848.



2-phenylquinolin-3-yl dimethylsulfamate 3sa. Yield: 26.2 mg, 40% (based on sulfonyl chloride **1**). Pale yellow solid. m.p. 50-51 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.34 (s, 1H), 8.16 (d, *J* = 8.4 Hz, 1H), 7.92-7.84 (m, 3H), 7.74 (dd, *J* = 7.2, 8.4 Hz, 1H), 7.59 (dd, *J* = 6.8, 8.0 Hz, 1H), 7.56-7.43 (m, 3H), 2.58 (s, 6H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.6, 146.3, 142.3, 137.1, 129.9, 129.6, 129.3, 128.5, 128.2, 127.9, 127.7, 127.5, 38.3; **HRMS [ESI]** calcd for C₁₇H₁₇N₂O₃S [M+H]⁺ 329.0954, found 329.0952.

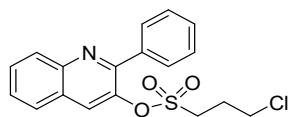


2-phenylquinolin-3-yl cyclopropanesulfonate 3ta. Yield: 59.2 mg, 91% (based on sulfonyl chloride **1**). Colorless solid. m.p. 94-95 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.27 (s, 1H), 8.18 (d, *J* = 8.4 Hz, 1H), 7.98 (d, *J* = 6.8 Hz, 2H), 7.87 (d, *J* = 8.4 Hz, 1H), 7.76 (dd, *J* = 7.6, 7.6 Hz, 1H), 7.60 (dd, *J* = 7.2, 7.6 Hz, 1H), 7.56-7.44 (m, 3H), 2.03-1.94 (m, 1H), 0.99-0.91 (m, 2H), 0.74-0.66 (m, 2H); **¹³C NMR (101 MHz, CDCl₃)** δ 153.4, 146.7, 141.7, 137.1, 130.2, 130.0, 129.6, 129.5, 128.6, 127.8, 127.7, 127.6, 28.6, 6.3; **HRMS [ESI]** calcd for C₁₈H₁₆NO₃S [M+H]⁺ 326.0845, found 326.0849.

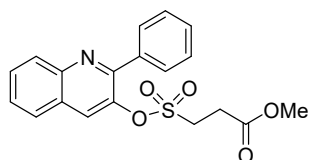


2-phenylquinolin-3-yl prop-2-ene-1-sulfonate 3ua. Yield: 61.8 mg, 95% (based on sulfonyl chloride **1**). Colorless oil. **¹H NMR (400 MHz, CDCl₃)**

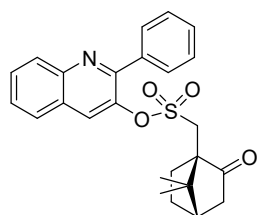
δ 8.28 (s, 1H), 8.18 (d, $J = 8.4$ Hz, 1H), 7.94-7.84 (m, 3H), 7.76 (dd, $J = 7.2, 7.6$ Hz, 1H), 7.60 (dd, $J = 7.6, 7.6$ Hz, 1H), 7.57-7.47 (m, 3H), 5.55-5.53 (m, 1H), 5.34 (d, $J = 10$ Hz, 1H), 5.25 (d, $J = 16.8$ Hz, 1H), 3.57 (d, $J = 7.2$ Hz, 2H); ^{13}C NMR (101 MHz, CDCl_3) δ 153.2, 146.6, 141.2, 136.8, 130.3, 129.8, 129.6, 129.5, 129.0, 128.7, 127.7, 127.7, 125.5, 123.1, 55.9; HRMS [ESI] calcd for $\text{C}_{18}\text{H}_{16}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 326.0845 found 326.0844.



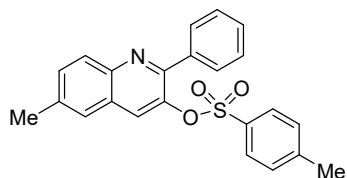
2-phenylquinolin-3-yl 3-chloropropane-1-sulfonate 3va. Yield: 47.7 mg, 66% (based on sulfonyl chloride **1**). Pale yellow solid 75-76 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.29 (s, 1H), 8.18 (d, $J = 8.4$ Hz, 1H), 7.92-7.84 (m, 3H), 7.77 (dd, $J = 7.2, 8.0$ Hz, 1H), 7.61 (dd, $J = 7.2, 7.6$ Hz, 1H), 7.58-7.47 (m, 3H), 3.38 (t, $J = 6.0$ Hz, 2H), 3.01 (t, $J = 7.6$ Hz, 2H), 2.02-1.92 (m, 2H); ^{13}C NMR (101 MHz, CDCl_3) δ 153.3, 146.7, 141.0, 136.8, 130.4, 129.8, 129.6, 129.6, 129.4, 128.8, 127.8, 127.7, 49.0, 42.2, 26.2; HRMS [ESI] calcd for $\text{C}_{18}\text{H}_{17}\text{ClNO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 362.0612, found 362.0608.



methyl 3-(((2-phenylquinolin-3-yl)oxy)sulfonyl)propanoate 3wa. Yield: 53.5 mg, 72% (based on sulfonyl chloride **1**). Pale yellow solid 61-62 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.29 (s, 1H), 8.18 (d, $J = 8.4$ Hz, 1H), 7.88 (d, $J = 8.4$ Hz, 1H), 7.85 (d, $J = 6.8$ Hz, 2H), 7.77 (dd, $J = 7.2, 8.0$ Hz, 1H), 7.61 (dd, $J = 7.2, 8.0$ Hz, 1H), 7.57-7.47 (m, 3H), 3.66 (s, 3H), 3.18 (t, $J = 7.6$ Hz, 2H), 2.46 (t, $J = 7.6$ Hz, 2H); ^{13}C NMR (101 MHz, CDCl_3) δ 169.9, 153.3, 146.7, 141.0, 136.7, 130.4, 129.7, 129.7, 129.6, 129.4, 128.8, 127.8, 127.8, 52.5, 46.8, 27.8; HRMS [ESI] calcd for $\text{C}_{19}\text{H}_{18}\text{NO}_5\text{S}$ $[\text{M}+\text{H}]^+$ 372.0900, found 372.0893.

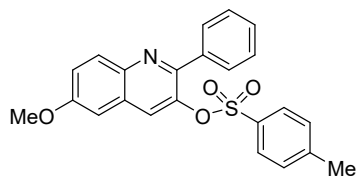


2-phenylquinolin-3-yl ((1R,4S)-7,7-dimethyl-2-oxobicyclo[2.2.1]heptan-1-yl)methanesulfonate 3xa. Yield: 54.0 mg, 62% (based on sulfonyl chloride **1**). White solid, m.p. 175-176 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.28 (s, 1H), 8.19 (d, $J = 8.4$ Hz, 1H), 7.90 (dd, $J = 6.8, 7.6$ Hz, 3H), 7.76 (dd, $J = 7.2, 8.0$ Hz, 1H), 7.60 (dd, $J = 7.6, 7.6$ Hz, 1H), 7.54 (dd, $J = 7.2, 7.6$ Hz, 2H), 7.51-7.45 (m, 1H), 3.30 (d, $J = 14.4$ Hz, 1H), 2.57 (d, $J = 14.8$ Hz, 1H), 2.35-2.17 (m, 2H), 2.04 (t, $J = 4.4$ Hz, 1H), 2.00-1.90 (m, 1H), 1.87 (d, $J = 18.4$ Hz, 1H), 1.61-1.51 (m, 1H), 1.40-1.34 (m, 1H), 0.90 (s, 3H), 0.64 (s, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 213.4, 153.5, 146.7, 141.4, 137.1, 130.3, 129.9, 129.6, 129.5, 129.5, 128.8, 127.9, 127.8, 127.6, 57.9, 49.0, 48.0, 42.8, 42.4, 27.0, 25.0, 19.7, 19.5; HRMS [ESI] calcd for $\text{C}_{25}\text{H}_{26}\text{NO}_4\text{S}$ $[\text{M}+\text{H}]^+$ 436.1577, found 436.1576.



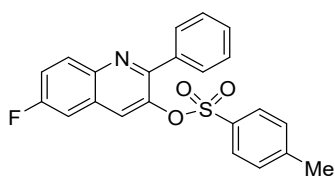
6-methyl-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3ab. Yield: 71.6 mg, 92% (based on sulfonyl chloride **1**). Pale yellow solid 137-138 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.23 (s,

1H), 7.99 (d, $J = 8.4$ Hz, 1H), 7.65 (s, 1H), 7.57 (dd, $J = 1.6, 8.8$ Hz, 1H), 7.52-7.47 (m, 2H), 7.38-7.27 (m, 3H), 7.15 (d, $J = 8.4$ Hz, 2H), 6.90 (d, $J = 8.4$ Hz, 2H), 2.57 (s, 3H), 2.33 (s, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 152.6, 145.3, 145.2, 141.5, 137.6, 136.6, 132.6, 131.5, 129.5, 129.5, 129.5, 129.2, 128.8, 128.1, 128.0, 127.8, 126.5, 21.8, 21.7; HRMS [ESI] calcd for $\text{C}_{23}\text{H}_{20}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 390.1158, found 190.1161.



6-methoxy-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3ac. Yield: 53.4 mg, 66% (based on sulfonyl chloride 1). White solid, m.p. 163-164 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.23 (s, 1H), 7.98 (d, $J = 9.2$ Hz, 1H), 7.49-7.

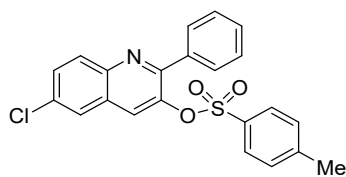
46 (m, 1H), 7.46 (d, $J = 2.0$ Hz, 1H), 7.38 (dd, $J = 2.8, 9.6$ Hz, 1H), 7.35-7.27 (m, 3H), 7.17-7.11 (m, 3H), 6.90 (d, $J = 8.0$ Hz, 2H), 3.97 (s, 3H), 2.33 (s, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 154.1, 146.0, 145.0, 140.1, 139.5, 137.8, 132.5, 130.2, 129.7, 129.6, 129.5, 128.6, 128.2, 128.1, 128.1, 127.1, 124.5, 21.8, 14.0; HRMS [ESI] calcd for $\text{C}_{23}\text{H}_{20}\text{NO}_4\text{S}$ $[\text{M}+\text{H}]^+$ 406.1108, found 406.1110.



6-fluoro-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3ad.

Yield: 54.3 mg, 69% (based on sulfonyl chloride 1). Pale yellow solid 184-185 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.26 (s, 1H), 8.09 (dd, $J = 8.8$ Hz, 1H), 7.87 (d, $J = 2.0$ Hz, 1H), 7.67 (dd, $J = 2.4, 9.2$ Hz, 1H), 7.51 (d, $J = 7.2$ Hz, 1H), 7.40-7.28 (m, 3H), 7.17 (d, $J =$

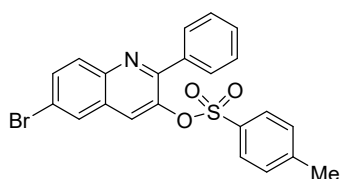
8.0 Hz, 2H), 6.93 (d, $J = 8.4$ Hz, 2H), 2.34 (s, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 161.1 (d, $J_{\text{C-F}} = 248.6$ Hz), 152.9 (d, $J_{\text{C-F}} = 3.0$ Hz), 145.4, 143.8, 142.1, 136.2, 132.1 (d, $J_{\text{C-F}} = 9.4$ Hz), 131.4, 129.6, 129.5, 129.4, 129.0, 128.5 (d, $J_{\text{C-F}} = 10.5$ Hz), 128.1, 128.1, 120.5 (d, $J_{\text{C-F}} = 25.7$ Hz), 110.8 (d, $J_{\text{C-F}} = 22.2$ Hz), 21.8; ^{19}F NMR (377 MHz, CDCl_3) δ -111.8 (s); HRMS [ESI] calcd for $\text{C}_{22}\text{H}_{17}\text{FNO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 394.0908, found 394.0904.



6-chloro-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3ae.

Yield: 50.8 mg, 62% (based on sulfonyl chloride 1). Pale yellow solid 163-164 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.22 (s, 1H), 8.03 (d, $J = 8.8$ Hz, 1H), 7.54-7.47 (m, 4H), 7.40-7.28 (m, 3H), 7.17 (d, $J = 8.4$ Hz, 2H), 6.93 (d, $J = 8.4$ Hz, 2H), 2.34 (s, 3H); ^{13}C

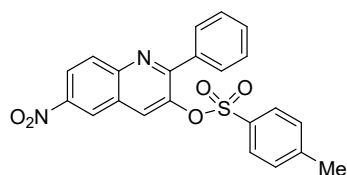
NMR (101 MHz, CDCl_3) δ 153.9, 145.5, 145.0, 142.1, 136.2, 133.4, 131.4, 131.2, 131.1, 129.6, 129.6, 129.2, 128.3, 128.2, 128.1, 126.3, 21.8; HRMS [ESI] calcd for $\text{C}_{22}\text{H}_{17}\text{ClNO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 410.0612, found 410.0623.



6-bromo-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3af.

Yield: 60.7 mg, 67% (based on sulfonyl chloride 1). Pale yellow solid 168-169 °C. ^1H NMR (400 MHz, CDCl_3) δ 8.22 (s, 1H), 8.05 (d, $J = 2.0$ Hz, 1H), 7.96 (d, $J = 9.2$ Hz, 1H), 7.80 (dd, $J = 2.0, 8.8$

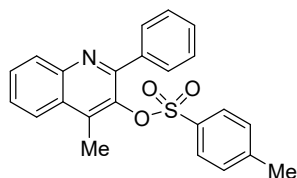
Hz, 1H), 7.54-7.49 (m, 2H), 7.40-7.29 (m, 3H), 7.17 (d, $J = 8.4$ Hz, 2H), 6.93 (d, $J = 8.0$ Hz, 2H), 2.34 (s, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 154.0, 145.5, 145.2, 142.0, 136.2, 133.7, 131.4, 131.2, 129.7, 129.6, 129.6, 129.2, 129.1, 128.8, 128.2, 128.1, 121.6, 21.8; **HRMS [ESI]** calcd for $\text{C}_{22}\text{H}_{17}\text{BrNO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 454.0107, found 454.0110.



6-nitro-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3ag.

Yield: 59.7 mg, 71% (based on sulfonyl chloride **1**). Yellow solid 172-173 °C. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.85 (d, $J = 2.4$ Hz, 1H), 8.49 (dd, $J = 2.4, 9.2$ Hz, 1H), 8.46 (s, 1H), 8.22 (d, $J = 9.2$ Hz, 1H), 7.62-7.57 (m, 2H), 7.45-7.40 (m, 1H), 7.39-7.33 (m, 2H),

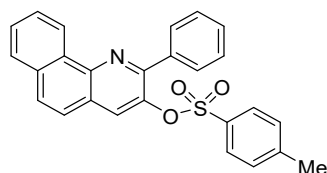
7.21 (d, $J = 8.4$ Hz, 2H), 6.97 (d, $J = 8.0$ Hz, 2H), 2.36 (s, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 157.2, 148.4, 146.1, 145.8, 142.8, 135.7, 131.6, 131.4, 131.3, 129.9, 129.7, 128.3, 128.2, 126.6, 124.5, 123.6, 21.8; **HRMS [ESI]** calcd for $\text{C}_{22}\text{H}_{17}\text{N}_2\text{O}_5\text{S}$ $[\text{M}+\text{H}]^+$ 421.0853, found 421.0845.



4-methyl-2-phenylquinolin-3-yl 4-methylbenzenesulfonate 3ah.

Yield: 48.3 mg, 62% (based on sulfonyl chloride **1**). Pale yellow solid 85-86 °C. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.11 (d, $J = 8.4$ Hz, 1H), 8.04 (d, $J = 8.4$ Hz, 1H), 7.73 (ddd, $J = 1.2, 7.2, 8.0$ Hz, 1H), 7.61 (ddd, $J = 0.8, 7.2, 8.0$ Hz, 1H), 7.54-7.49 (m, 2H), 7.29-7.17 (m, 5H), 6.95 (d, $J = 8.0$ Hz, 2H), 2.85 (s, 3H), 2.36 (s, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 154.0, 146.0, 145.0, 140.1,

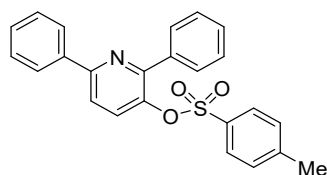
139.5, 137.8, 132.5, 130.2, 129.7, 129.6, 129.5, 128.5, 128.2, 128.1, 128.0, 127.1, 124.5, 21.8, 14.0. **HRMS [ESI]** calcd for $\text{C}_{23}\text{H}_{20}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 390.1158, found 390.1159.



2-phenylbenzo[h]quinolin-3-yl 4-methylbenzenesulfonate 3ai.

Yield: 72.3 mg, 85% (based on sulfonyl chloride **1**). Pale yellow solid 129-130 °C. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 9.26 (dd, $J = 3.6, 6.0$ Hz, 1H), 8.34 (s, 1H), 7.92 (dd, $J = 3.2, 5.6$ Hz, 1H), 7.86 (d, $J = 8.8$ Hz, 1H), 7.74 (d, $J = 8.8$ Hz, 1H), 7.73-7.67 (m, 4H), 7.42-7.31 (m, 3H), 7.18 (d, $J = 8.4$ Hz, 2H), 6.88 (d, $J = 8.4$ Hz, 2H), 2.31 (s, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3) δ 151.0, 145.3, 144.8,

142.2, 136.8, 133.9, 131.3, 131.2, 130.4, 129.9, 129.4, 129.0, 128.8, 128.7, 128.2, 128.0, 127.9, 127.4, 126.1, 124.9, 124.8, 21.7. **HRMS [ESI]** calcd for $\text{C}_{26}\text{H}_{20}\text{NO}_3\text{S}$ $[\text{M}+\text{H}]^+$ 426.1158, found 426.1150.

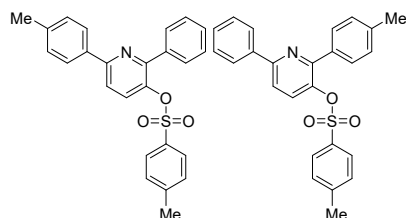


2,6-diphenylpyridin-3-yl 4-methylbenzenesulfonate 3aj.

Yield: 65.8 mg, 82% (based on sulfonyl chloride **1**). Colorless oil. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.06 (d, $J = 6.8$ Hz, 1H), 7.91 (d, $J = 8.4$ Hz, 1H), 7.76 (d, $J = 8.4$ Hz, 1H), 7.57-7.52 (m, 2H), 7.50-7.40 (m, 3H),

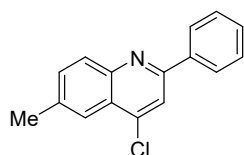
7.34-7.26 (m, 3H), 7.21 (d, $J = 8.0$ Hz, 2H), 6.91 (d, $J = 8.4$ Hz, 2H), 2.32 (s, 3H); $^{13}\text{C NMR}$ (101

MHz, CDCl₃) δ 155.5, 151.5, 145.3, 143.0, 138.2, 136.4, 133.2, 131.3, 129.5, 129.4, 128.9, 128.7, 128.2, 127.9, 127.1, 119.6, 21.7; **HRMS [ESI]** calcd for C₂₄H₂₀NO₃S [M+H]⁺ 402.1158, found 402.1152.

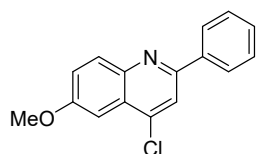


2-phenyl-6-(p-tolyl)pyridin-3-yl 4-methylbenzenesulfonate/6-phenyl-2-(p-tolyl)pyridin-3-yl 4-methylbenzenesulfonate 3ak. Yield: 60.6 mg, 73% (based on sulfonyl chloride 1). Colorless solid 102-103 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.05 (d, *J* = 6.8 Hz, 1H), 7.95 (d, *J* =

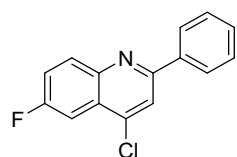
8.0 Hz, 1H), 7.87 (dd, *J* = 6.8, 8.4 Hz, 1H), 7.72 (d, *J* = 8.8 Hz, 1H), 7.59-7.53 (m, 1H), 7.51-7.40 (m, 2H), 7.35-7.19 (m, 5H), 7.10 (d, *J* = 8.0 Hz, 1H), 6.93 (dd, *J* = 6.8, 7.2 Hz, 2H), 2.40 (d, *J* = 4.2 Hz, 3H), 2.33 (d, *J* = 4.2 Hz, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 155.5&155.4 (two isomers), 151.6&151.4 (two isomers), 145.3&145.2 (two isomers), 143.0&142.8 (two isomers), 139.6&133.7 (two isomers), 138.7&138.4 (two isomers), 136.5 &135.5 (two isomers), 133.0&132.9 (two isomers), 131.7&131.5 (two isomers), 129.6&129.5 (two isomers), 129.4 (overlap, two isomers), 129.4&128.7 (two isomers), 129.4&128.8 (two isomers), 128.6&128.3 (two isomers), 128.3&127.9 (two isomers), 127.1&127.0 (two isomers), 119.3&119.2 (two isomers), 21.7&21.7 (two isomers), 21.4&21.4 (two isomers); **HRMS [ESI]** calcd for C₂₅H₂₂NO₃S [M+H]⁺ 416.1315, found 416.1313.



4-chloro-6-methyl-2-phenylquinoline 4ab. Yield: 30.9 mg, 61% (based on sulfonyl chloride 1). Pale yellow solid 68-69 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.15-8.10 (m, 2H), 8.07 (d, *J* = 8.8 Hz, 1H), 7.98 (s, 1H), 7.93 (s, 1H), 7.60 (dd, *J* = 2.0, 8.8 Hz, 1H), 7.56-7.44 (m, 3H), 2.59 (s, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 156.4, 147.8, 142.5, 138.8, 137.5, 132.9, 129.9, 129.7, 129.0, 127.5, 125.3, 122.9, 119.2, 22.0; **HRMS [ESI]** calcd for C₁₆H₁₃ClN [M+H]⁺ 254.0731, found 254.0735.

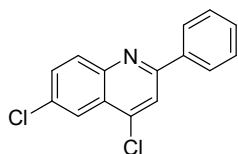


4-chloro-6-methoxy-2-phenylquinoline 4ac. Yield: 27.5 mg, 51% (based on sulfonyl chloride 1). Colorless oil. **¹H NMR (400 MHz, CDCl₃)** δ 8.13-8.09 (m, 2H), 8.07 (d, *J* = 8.8 Hz, 1H), 7.93 (s, 1H), 7.52 (dd, *J* = 7.2, 7.6 Hz, 2H), 7.49-7.39 (m, 3H), 3.98 (s, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 158.7, 154.9, 145.2, 141.6, 138.8, 131.8, 129.5, 129.0, 127.3, 126.4, 123.5, 119.4, 101.7, 55.8; **HRMS [ESI]** calcd for C₁₆H₁₃ClNO [M+H]⁺ 270.0680, found 270.0685.

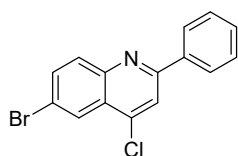


4-chloro-6-fluoro-2-phenylquinoline 4ad. Yield: 34.0 mg, 66% (based on sulfonyl chloride 1). Pale yellow solid 91-92 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.18 (dd, *J* = 5.6, 9.2 Hz, 1H), 8.14-8.10 (m, 2H), 7.99 (s, 1H), 7.84 (dd, *J* = 2.8, 9.2 Hz, 1H), 7.58-7.46 (m, 4H); **¹³C NMR (101 MHz, CDCl₃)** δ 161.2 (d, *J*_{C-F} = 247.9 Hz), 156.8 (d, *J*_{C-F} = 2.9 Hz), 146.2, 142.4, 138.4, 132.8 (d, *J*_{C-F} =

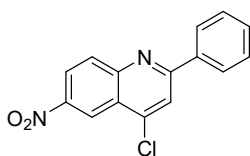
9.1 Hz), 130.0, 129.1, 127.5, 126.3 (d, $J_{C-F} = 10.2$ Hz), 121.0 (d, $J_{C-F} = 25.6$ Hz), 119.8, 107.9 (d, $J_{C-F} = 24.2$ Hz); **^{19}F NMR (377 MHz, CDCl_3) δ -111.2 (s); HRMS [ESI] calcd for $\text{C}_{15}\text{H}_{10}\text{ClFN}$ $[\text{M}+\text{H}]^+$ 258.0480, found 258.0480**



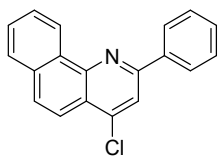
4,6-dichloro-2-phenylquinoline 4ae. Yield: 28.4 mg, 52% (based on sulfonyl chloride **1**). Pale yellow solid 104-105. °C. **^1H NMR (400 MHz, CDCl_3) δ 8.18 (d, $J = 2.0$ Hz, 1H), 8.12 (d, $J = 6.8$ Hz, 2H), 8.09 (d, $J = 12.0$ Hz, 1H), 7.97 (s, 1H), 7.69 (dd, $J = 2.0, 8.8$ Hz, 1H), 7.56-7.46 (m, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 157.5, 147.5, 142.2, 138.2, 133.4, 131.8, 131.6, 130.2, 129.1, 127.6, 126.1, 123.1, 119.9; HRMS [ESI] calcd for $\text{C}_{15}\text{H}_{10}\text{Cl}_2\text{N}$ $[\text{M}+\text{H}]^+$ 274.0185, found 274.0191.**



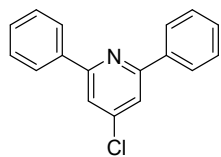
6-bromo-4-chloro-2-phenylquinoline 4af. Yield: 29.8 mg, 47% (based on sulfonyl chloride **1**). Pale yellow solid 113-114 °C. **^1H NMR (400 MHz, CDCl_3) δ 8.36 (d, $J = 2.0$ Hz, 1H), 8.12 (dd, $J = 1.6, 8.4$ Hz, 2H), 8.02 (d, $J = 9.2$ Hz, 1H), 7.96 (s, 1H), 7.82 (dd, $J = 2.0, 8.8$ Hz, 1H), 7.56-7.48 (m, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 157.7, 147.7, 142.0, 138.2, 134.2, 131.8, 130.2, 129.1, 127.6, 126.5, 126.4, 121.6, 121.5; HRMS [ESI] calcd for $\text{C}_{15}\text{H}_{10}\text{BrClN}$ $[\text{M}+\text{H}]^+$ 317.9680, found 317.9678.**



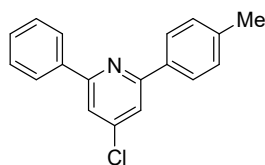
4-chloro-6-nitro-2-phenylquinoline 4ag. Yield: 21.1 mg, 37% (based on sulfonyl chloride **1**). Pale yellow solid 152-153 °C. **^1H NMR (400 MHz, CDCl_3) δ 9.15 (d, $J = 2.4$ Hz, 1H), 8.51 (dd, $J = 2.4, 9.2$ Hz, 1H), 8.27 (d, $J = 9.2$ Hz, 1H), 8.21-8.15 (m, 2H), 8.10 (s, 1H), 7.60-7.52 (m, 3H); ^{13}C NMR (101 MHz, CDCl_3) δ 160.6, 151.2, 145.9, 144.0, 137.5, 132.0, 131.1, 129.3, 127.9, 124.7, 124.2, 121.3, 120.7; HRMS [ESI] calcd for $\text{C}_{15}\text{H}_{10}\text{ClN}_2\text{O}_2$ $[\text{M}+\text{H}]^+$ 285.0425, found 285.0425.**



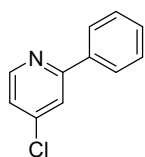
4-chloro-2-phenylbenzo[h]quinolone 4ai. Yield: 37.6 mg, 65% (based on sulfonyl chloride **1**). White solid 94-95 °C. **^1H NMR (400 MHz, CDCl_3) δ 9.48 (d, $J = 8.0$ Hz, 1H), 8.32 (d, $J = 7.6$ Hz, 2H), 8.13 (d, $J = 9.2$ Hz, 1H), 8.09 (s, 1H), 7.94 (d, $J = 8.0$ Hz, 1H), 7.89 (d, $J = 9.2$ Hz, 1H), 7.80-7.71 (m, 2H), 7.58 (dd, $J = 7.2, 7.6$ Hz, 2H), 7.51 (dd, $J = 7.2, 7.2$ Hz, 1H); ^{13}C NMR (101 MHz, CDCl_3) δ 155.7, 147.5, 143.1, 138.8, 134.1, 131.7, 129.9, 129.1, 128.9, 128.6, 128.0, 127.6, 127.5, 125.4, 123.3, 121.0, 119.3. HRMS [ESI] calcd for $\text{C}_{19}\text{H}_{13}\text{ClN}$ $[\text{M}+\text{H}]^+$ 290.0731, found 290.0740.**



4-chloro-2,6-diphenylpyridine 4aj. Yield: 31.3 mg, 59% (based on sulfonyl chloride **1**). Pale yellow solid 109-110 °C. **^1H NMR (400 MHz, CDCl_3) δ 8.16-8.10 (m, 4H), 7.69 (s, 2H), 7.54-7.43 (m, 6H); ^{13}C NMR (101 MHz, CDCl_3) δ 158.4, 145.5, 138.4, 129.8, 128.9, 127.2, 118.9; HRMS [ESI] calcd for $\text{C}_{17}\text{H}_{13}\text{ClN}$ $[\text{M}+\text{H}]^+$ 266.0731, found 266.0735.**

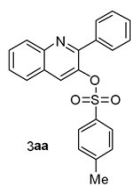
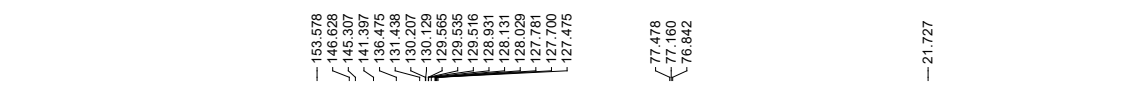
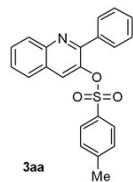
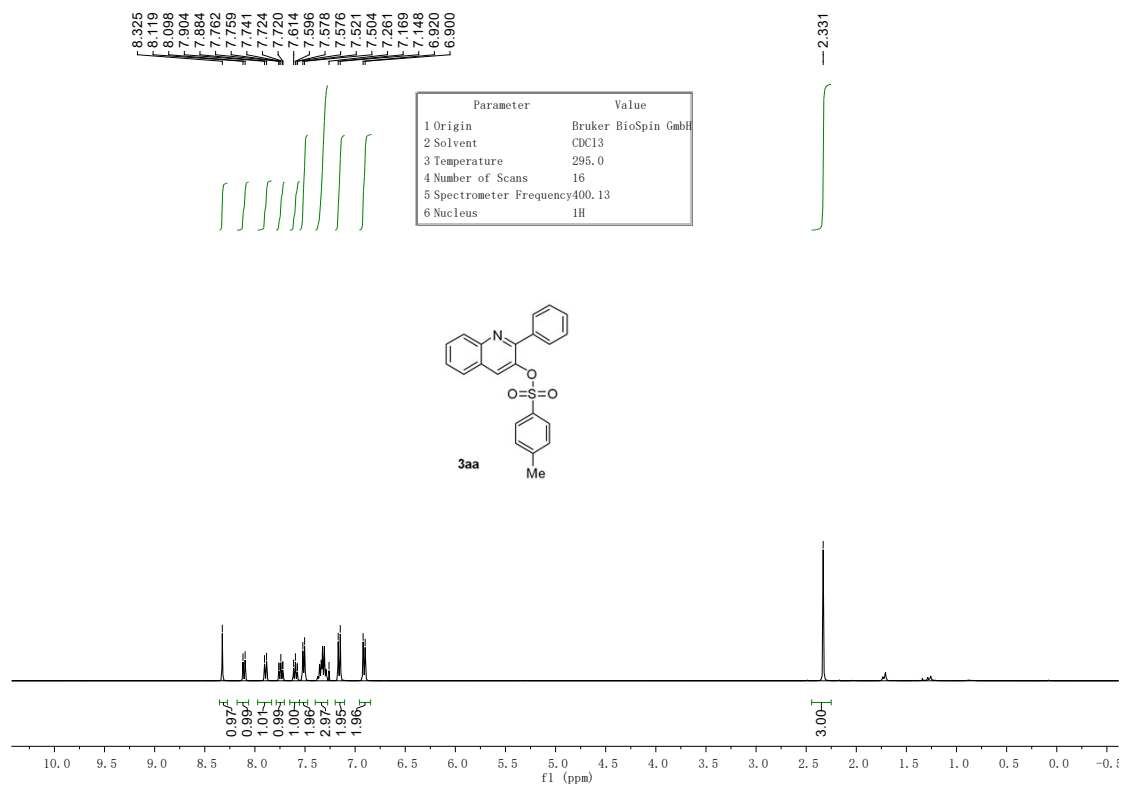


4-chloro-2-phenyl-6-(p-tolyl)pyridine 4ak. Yield: 34.1 mg, 61% (based on sulfonyl chloride **1**). White solid 54-55 °C. **¹H NMR (400 MHz, CDCl₃)** δ 8.12 (d, *J* = 6.8 Hz, 2H), 8.03 (d, *J* = 8.4 Hz, 2H), 7.66 (s, 2H), 7.54-7.42 (m, 3H), 7.31 (d, *J* = 8.0 Hz, 2H), 2.43 (s, 3H); **¹³C NMR (101 MHz, CDCl₃)** δ 158.4, 158.3, 145.4, 139.9, 138.6, 135.7, 129.7, 128.9, 127.2, 127.1, 118.6, 118.5, 21.5; **HRMS [ESI]** calcd for C₁₈H₁₅ClN [M+H]⁺ 280.0888, found 280.0885.

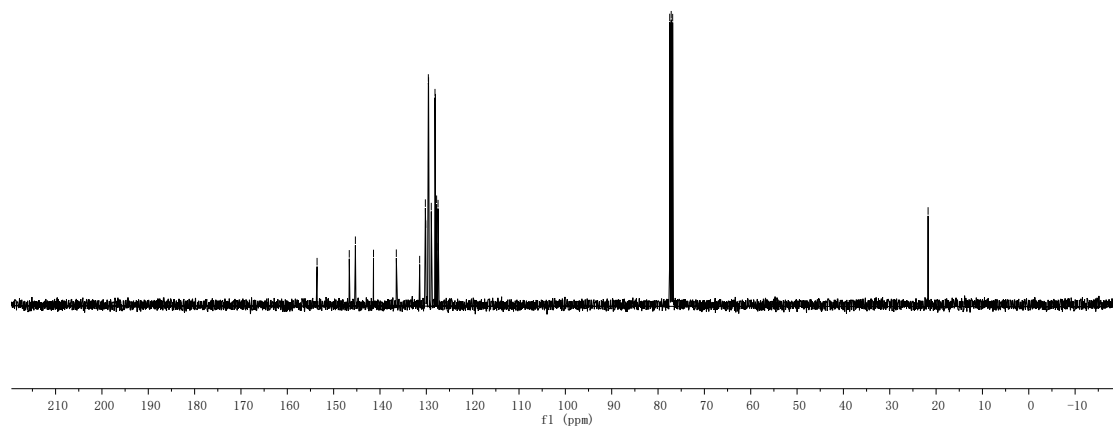


4-chloro-2-phenylpyridine 4al. Yield: 18.2 mg, 48% (based on sulfonyl chloride **1**). Colorless oil. **¹H NMR (400 MHz, CDCl₃)** δ 8.00 (dd, *J* = 1.6, 8.4 Hz, 2H), 7.70 (dd, *J* = 7.6, 7.6 Hz, 1H), 7.65 (d, *J* = 7.6 Hz, 1H), 7.51-7.41 (m, 3H), 7.26 (d, *J* = 7.6 Hz, 1H); **¹³C NMR (101 MHz, CDCl₃)** δ 158.2, 151.5, 139.4, 137.8, 129.7, 128.9, 127.1, 122.7, 118.8; **HRMS [ESI]** calcd for C₁₁H₉ClN [M+H]⁺ 190.0418, found 190.0427.

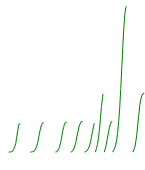
5. Spectroscopic data for products



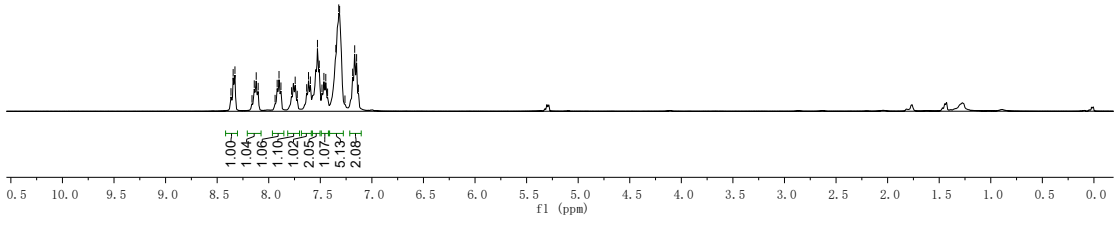
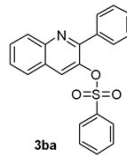
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6 Nucleus	¹³ C



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7.146
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Parameter	Value
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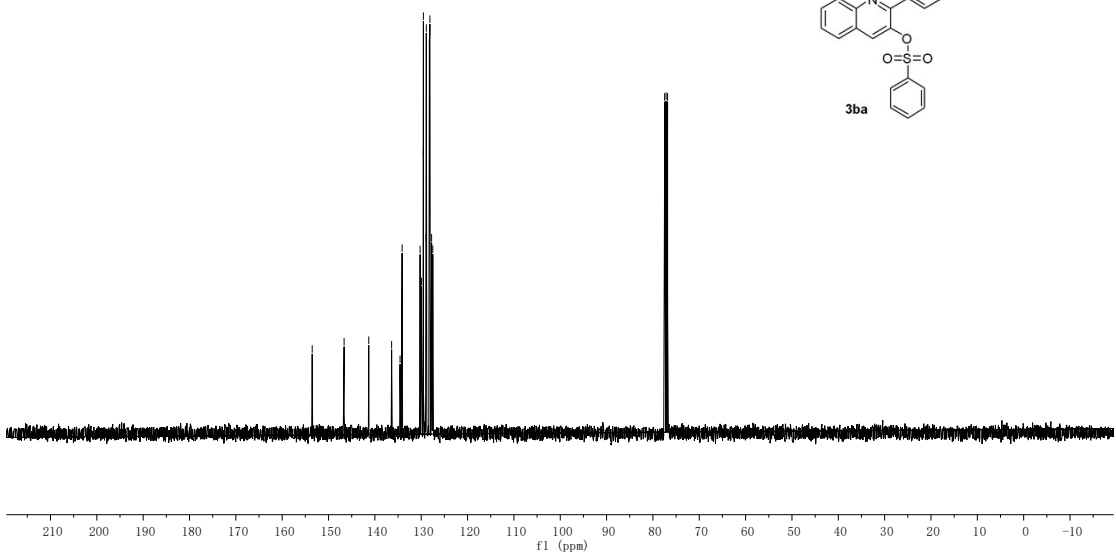
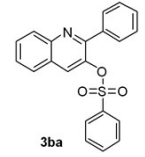


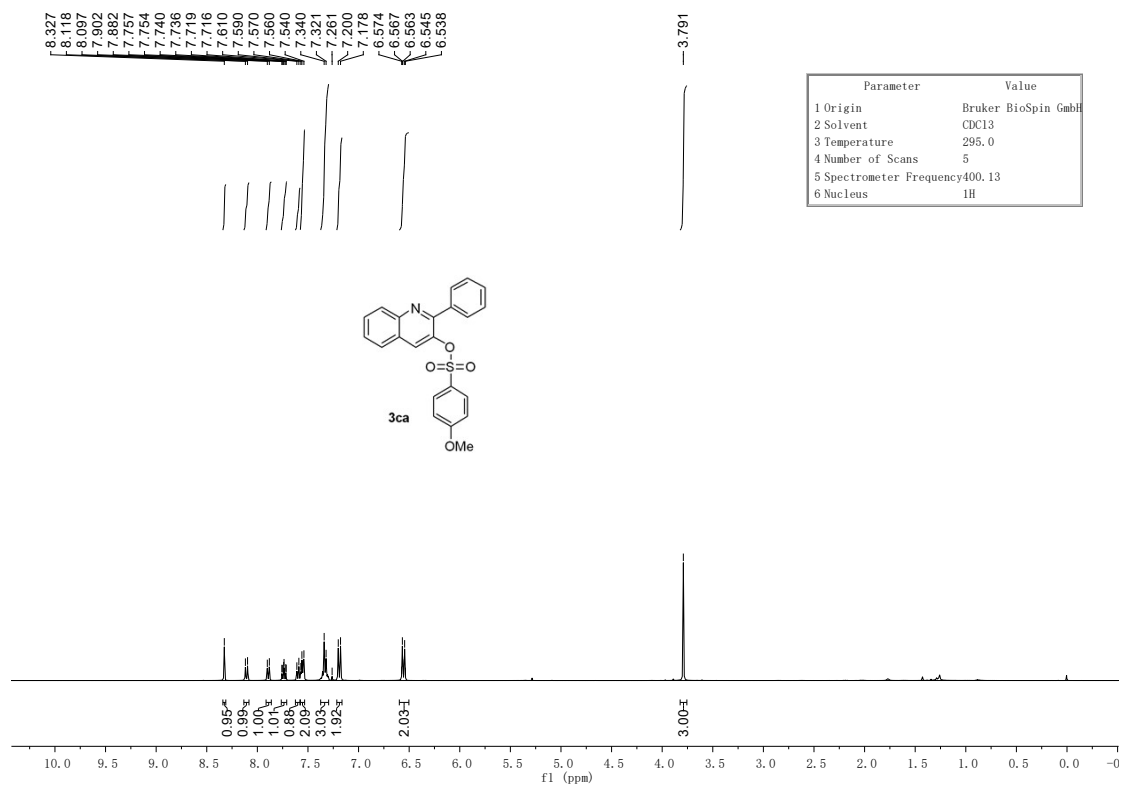
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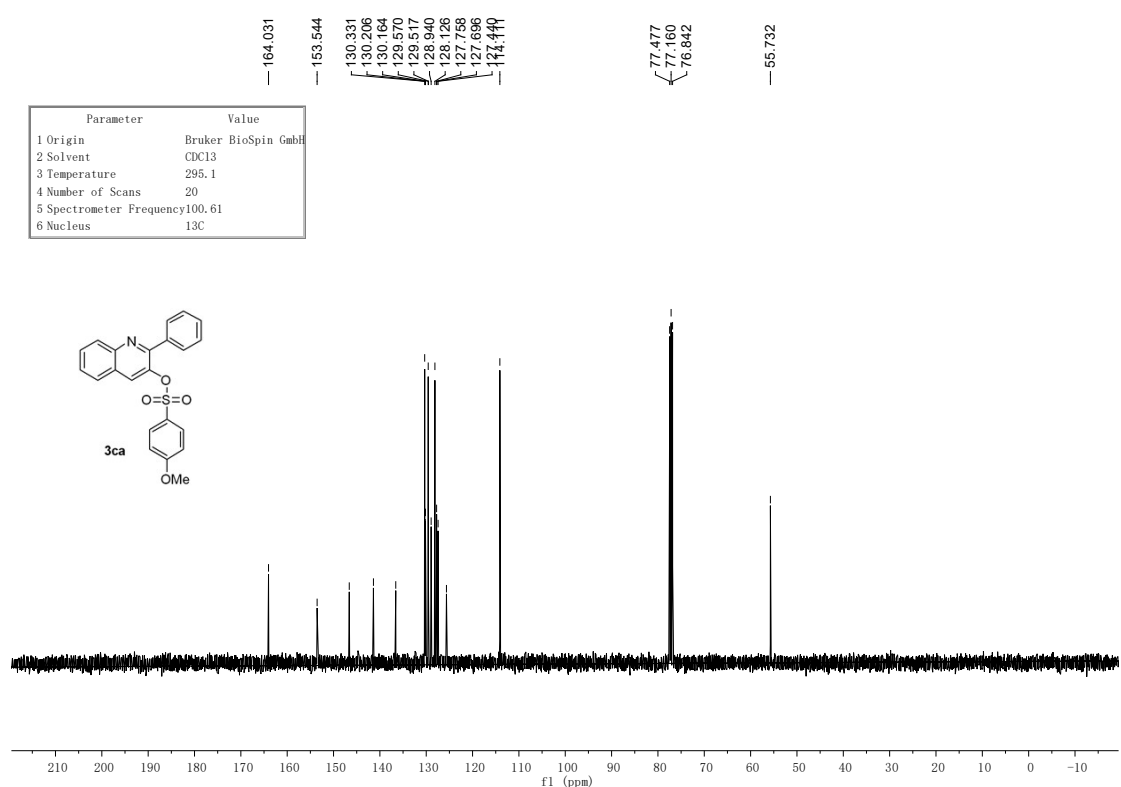
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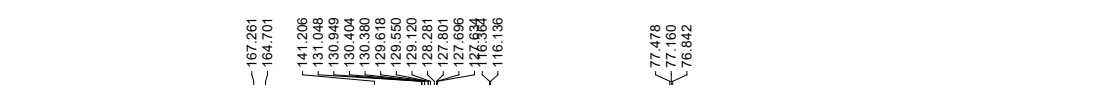
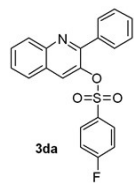
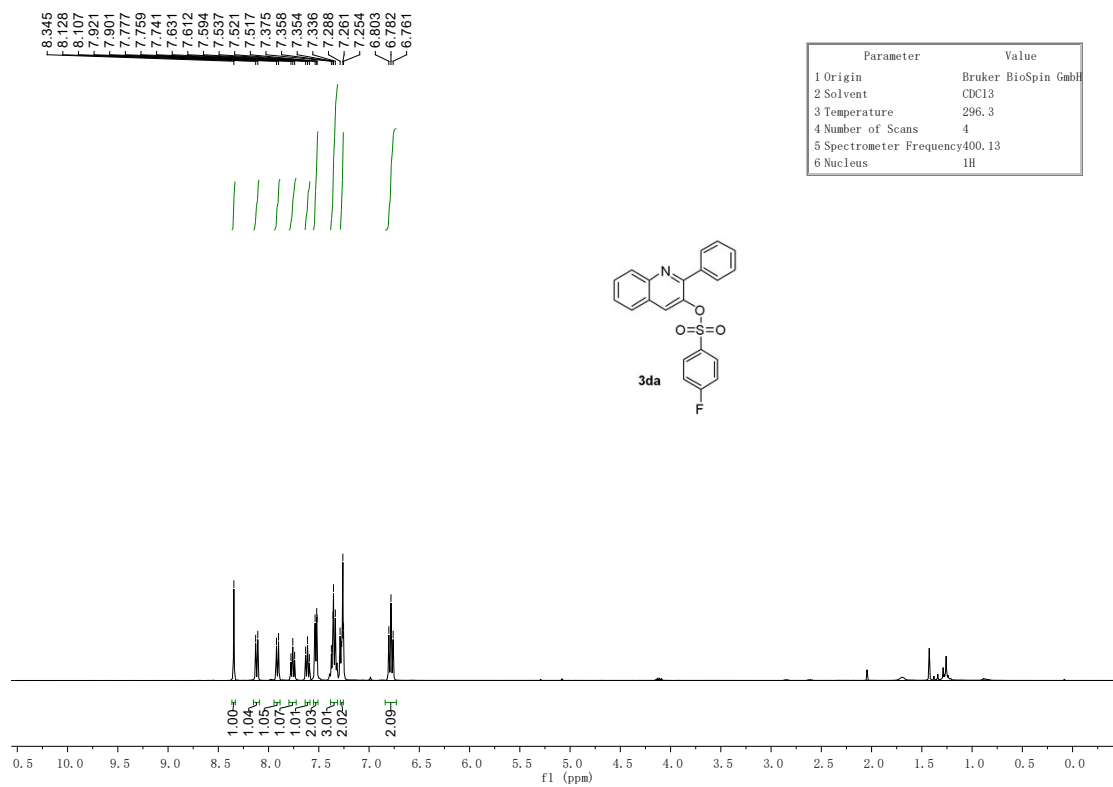




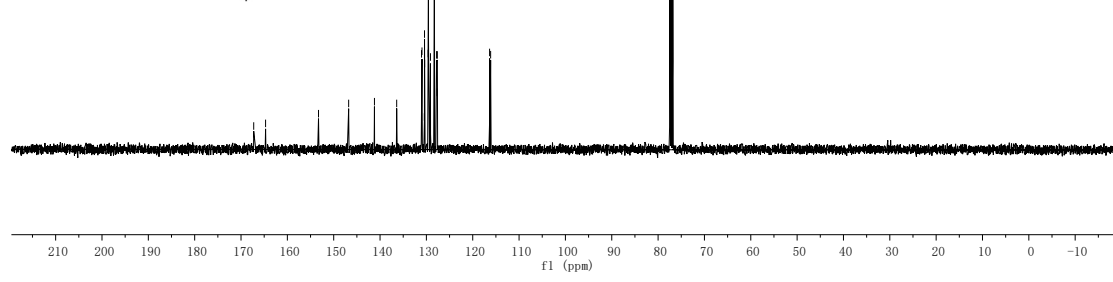
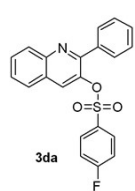
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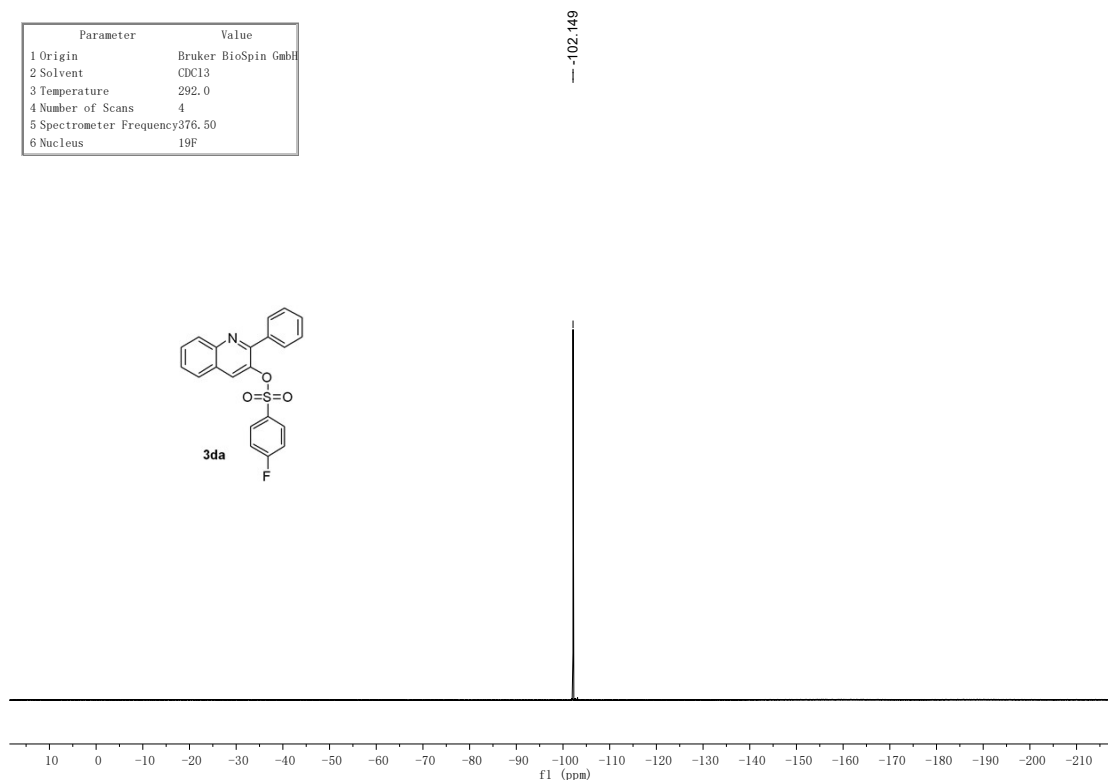
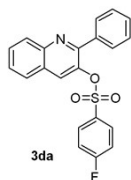
Parameter	Value
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5 Spectrometer Frequency	100.61
6 Nucleus	13C



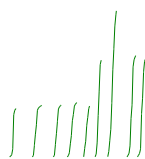
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.7
4 Number of Scans	40
5 Spectrometer Frequency	100.61
6 Nucleus	13C



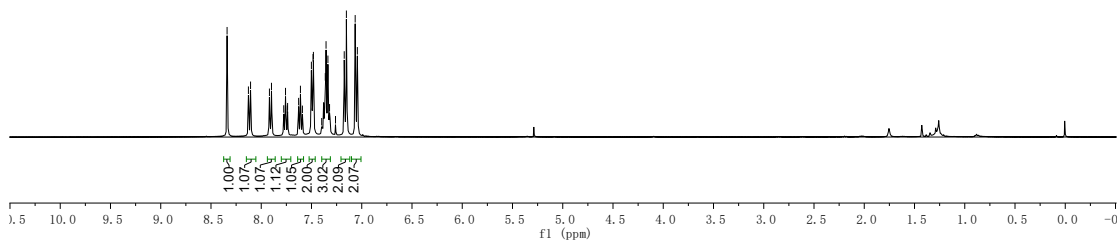
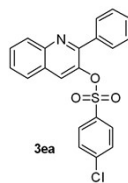
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	292.0
4 Number of Scans	4
5 Spectrometer Frequency	376.50
6 Nucleus	¹⁹ F

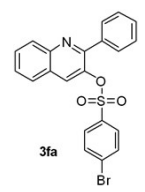
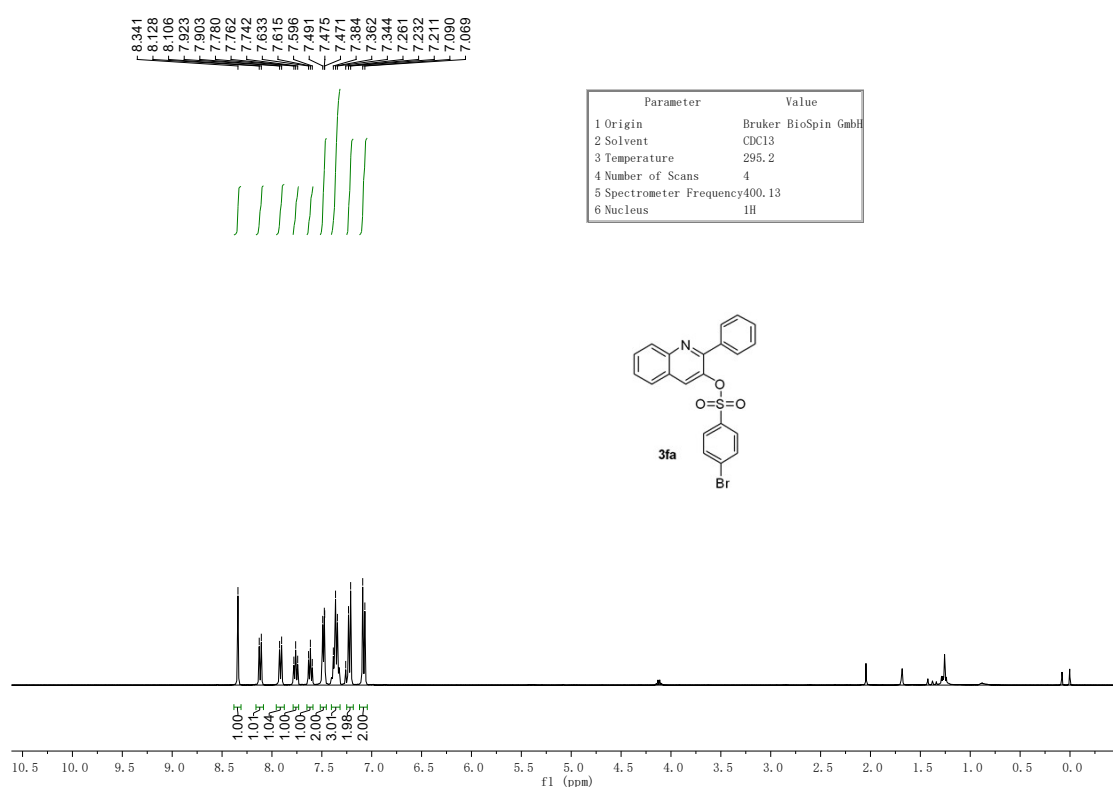
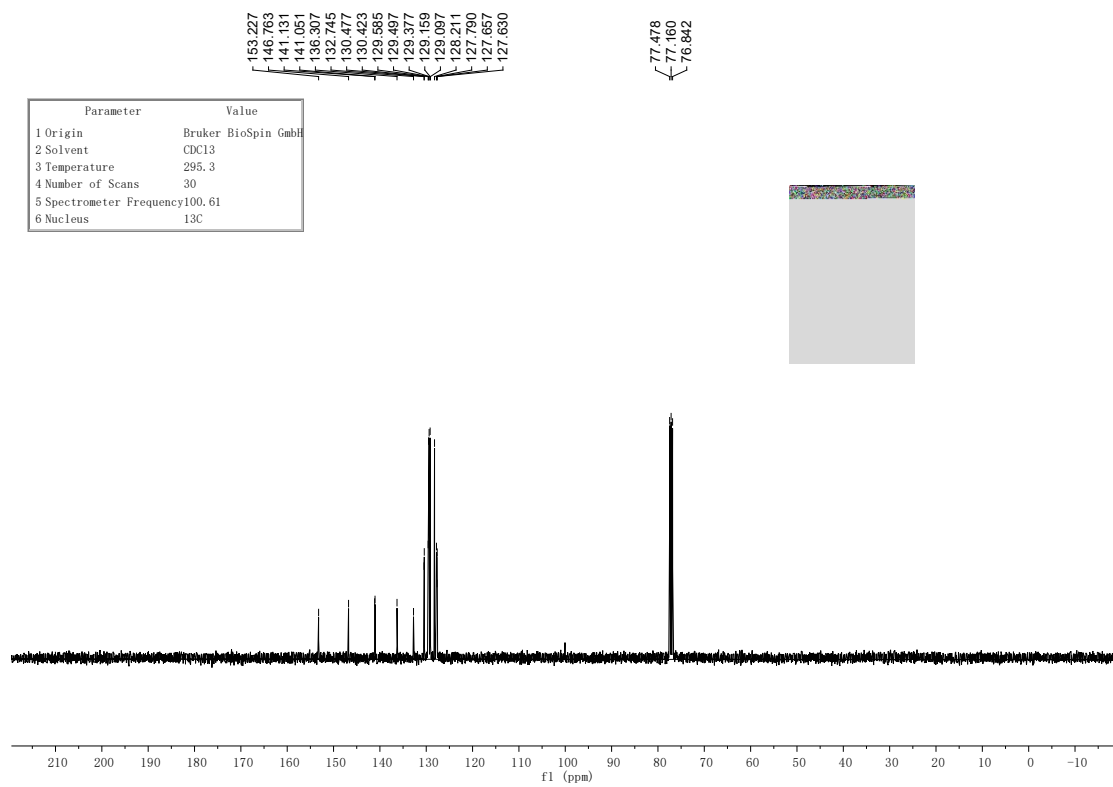


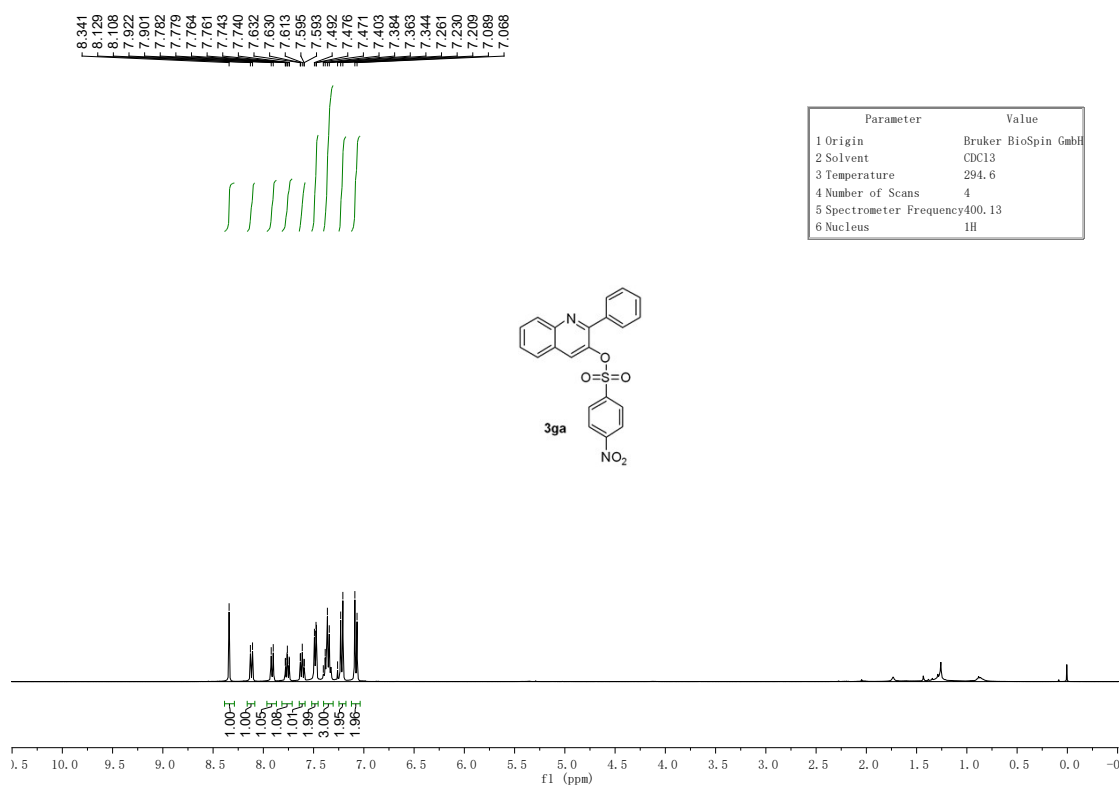
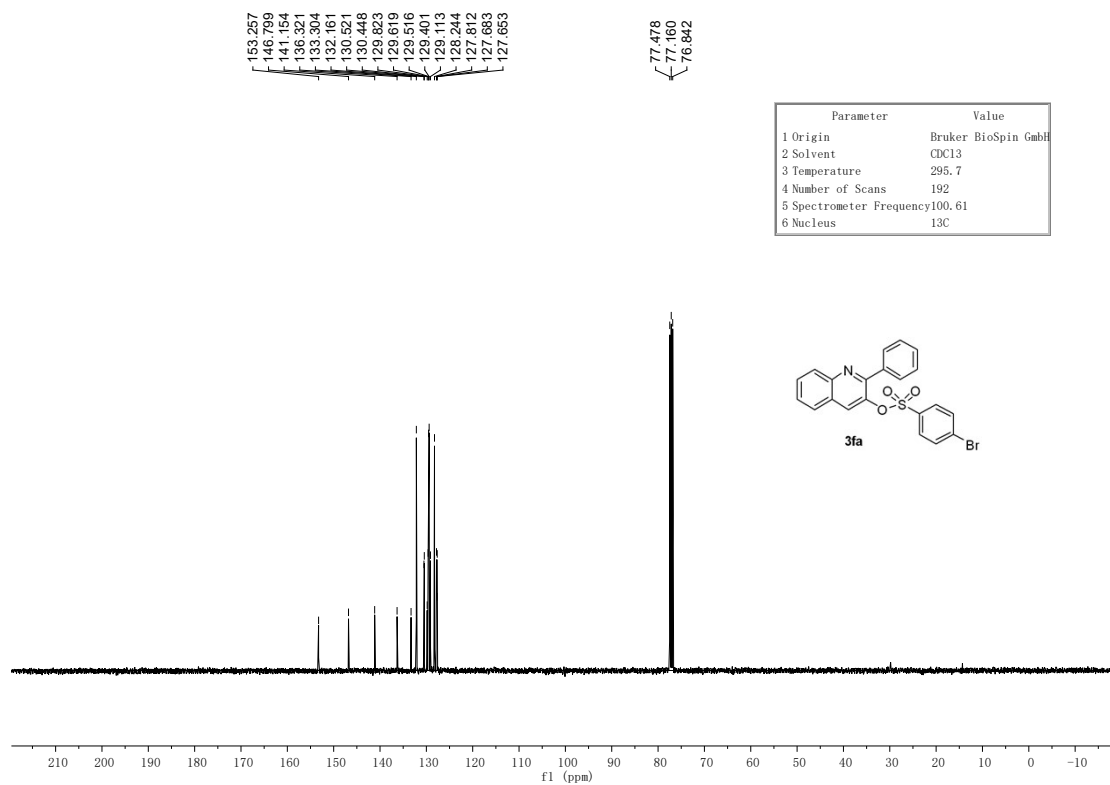
8.340
8.128
8.106
7.918
7.898
7.776
7.736
7.731
7.738
7.628
7.610
7.590
7.501
7.485
7.481
7.398
7.363
7.355
7.337
7.320
7.261
7.174
7.153
7.065
7.044

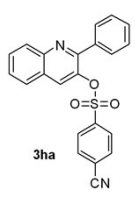
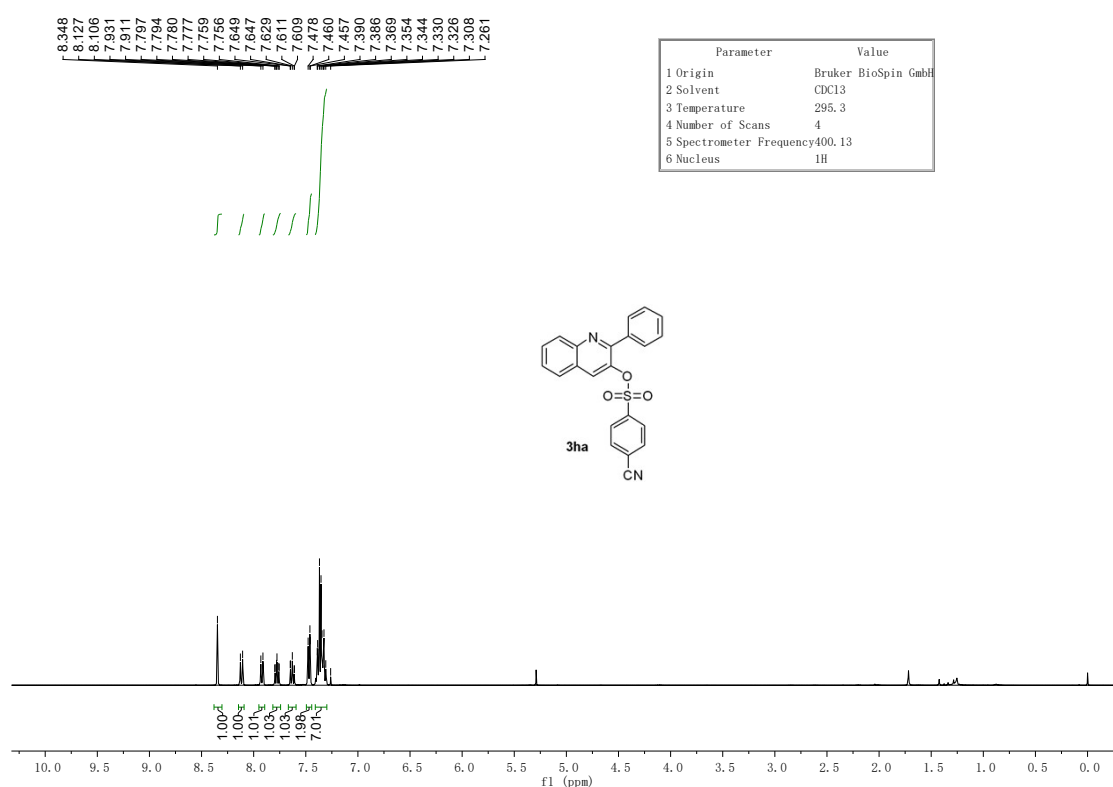
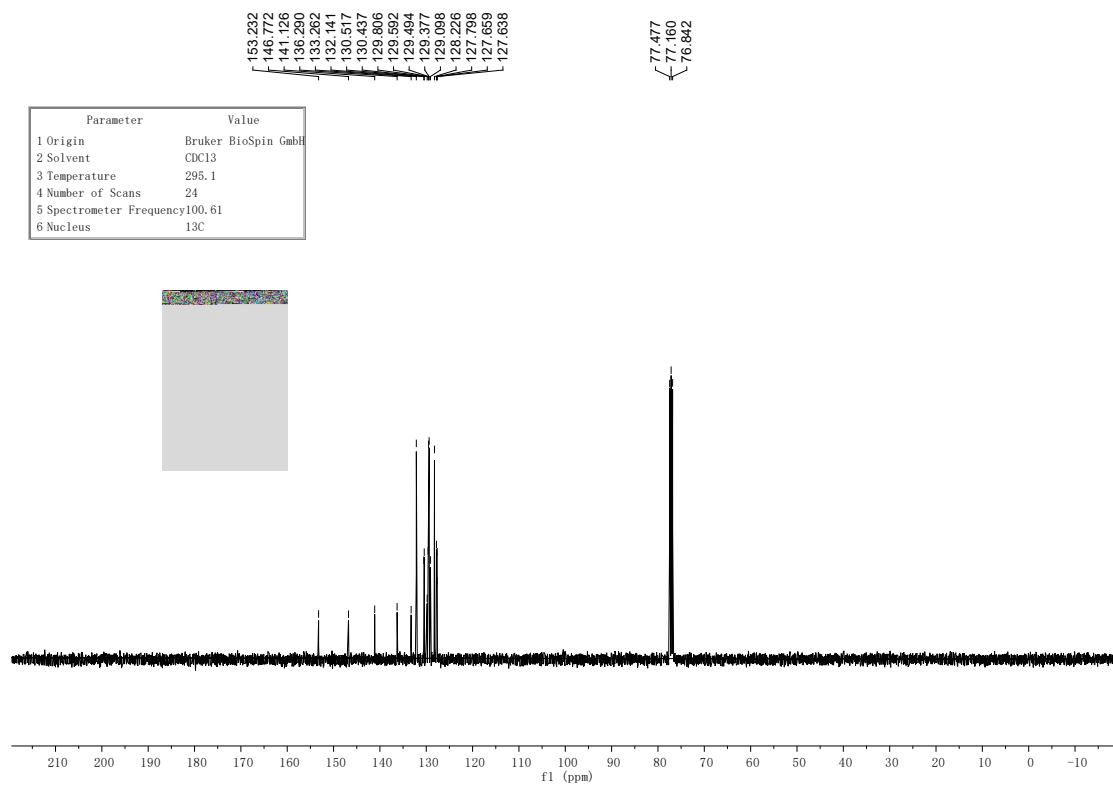


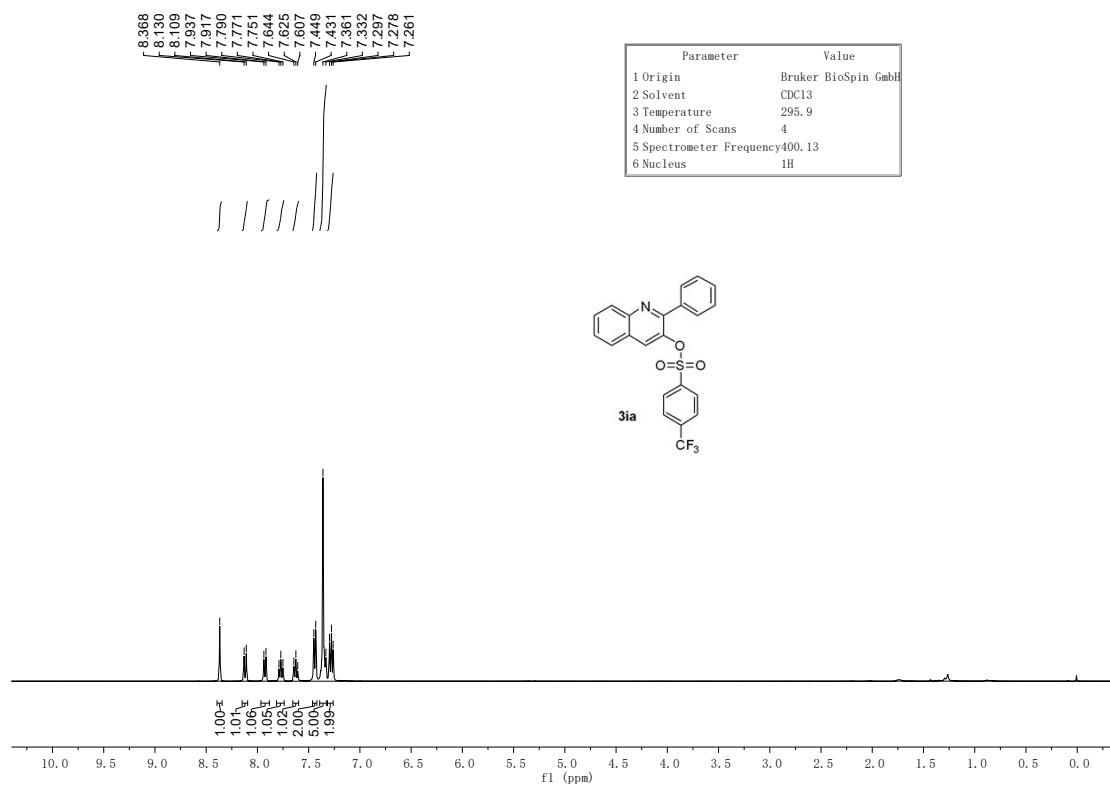
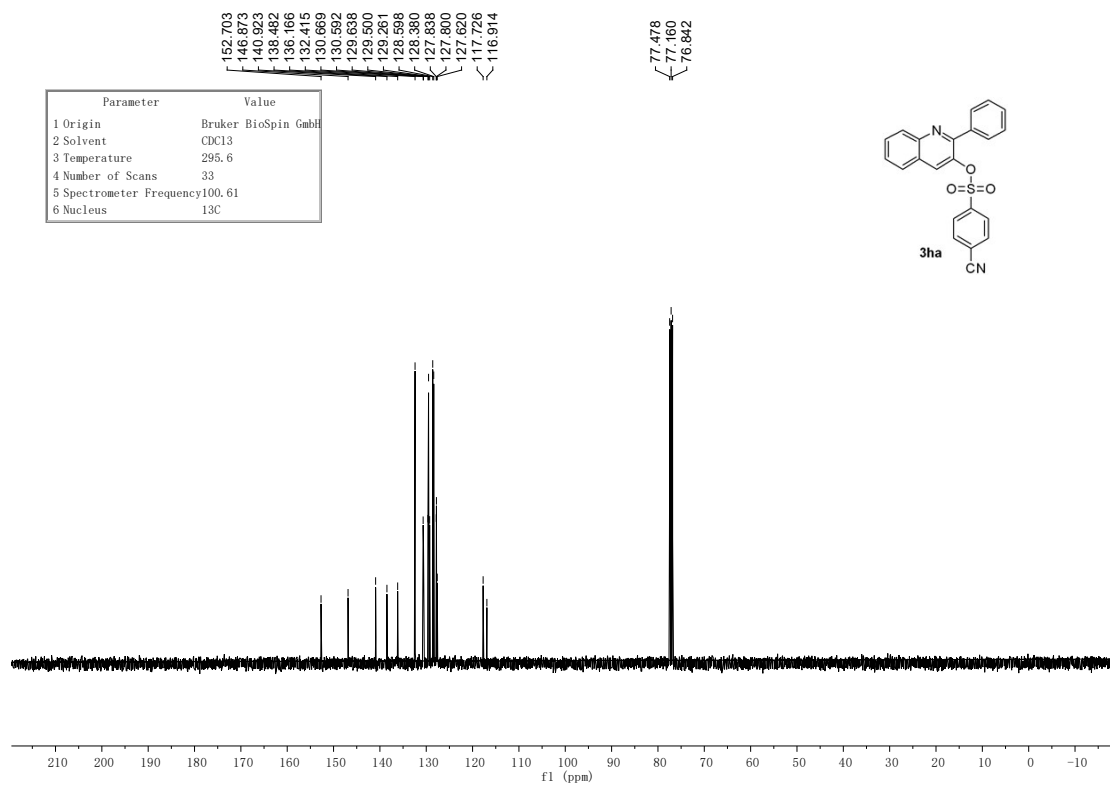
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.8
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	¹ H

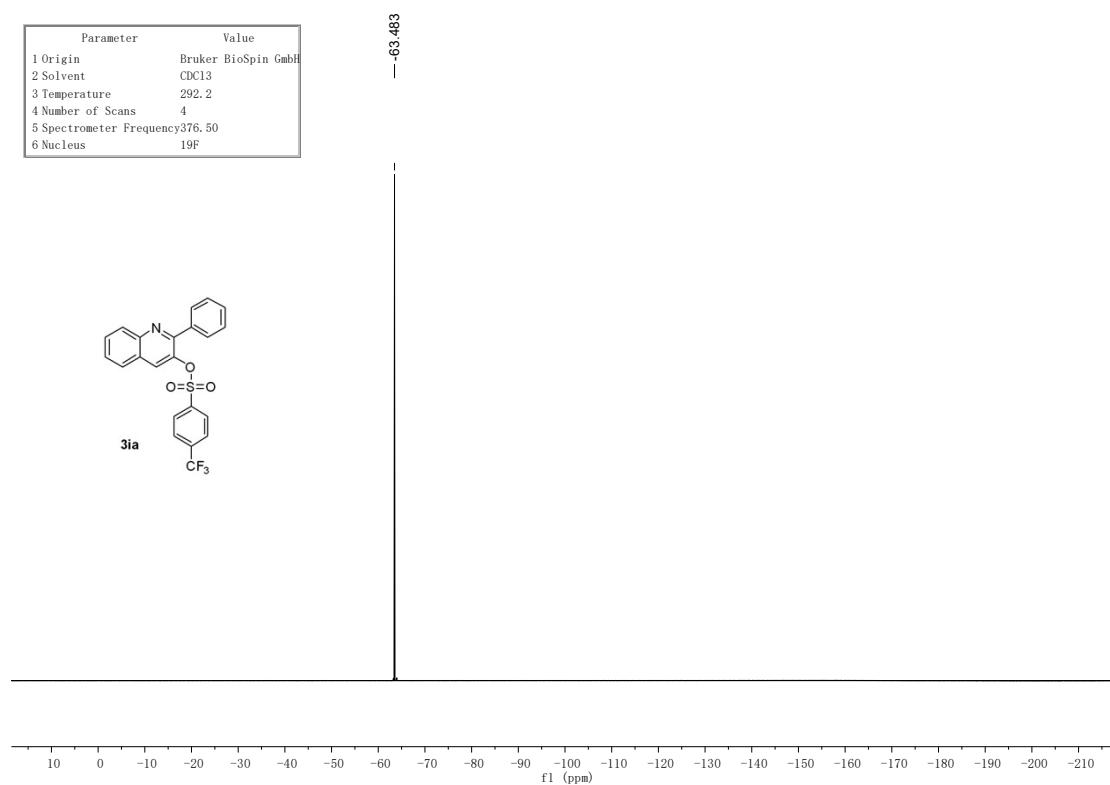
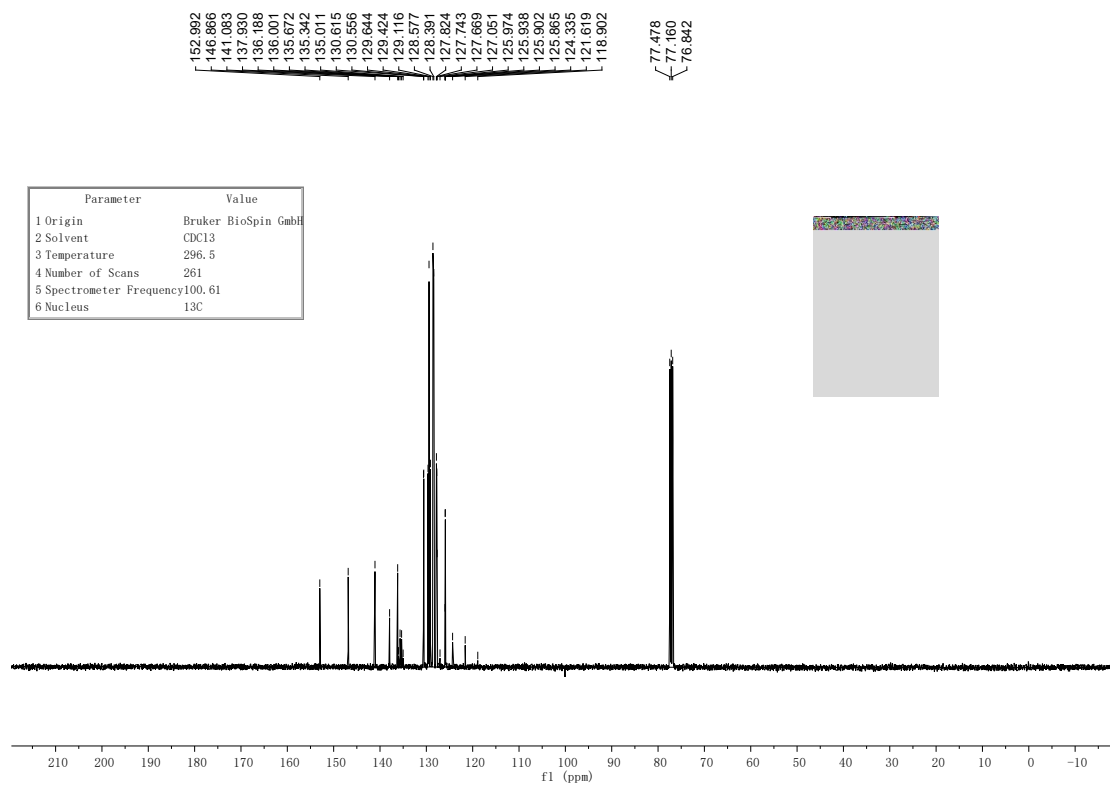




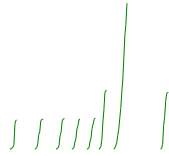




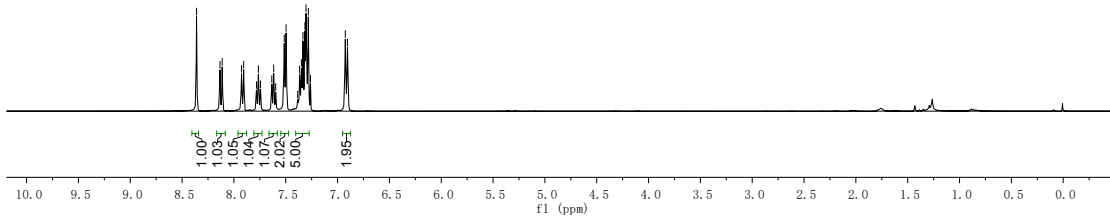
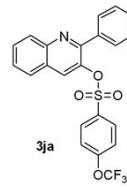




8.360
8.134
8.113
7.926
7.906
7.782
7.764
7.743
7.634
7.616
7.597
7.514
7.497
7.366
7.349
7.334
7.315
7.304
7.282
7.261
6.825
6.804



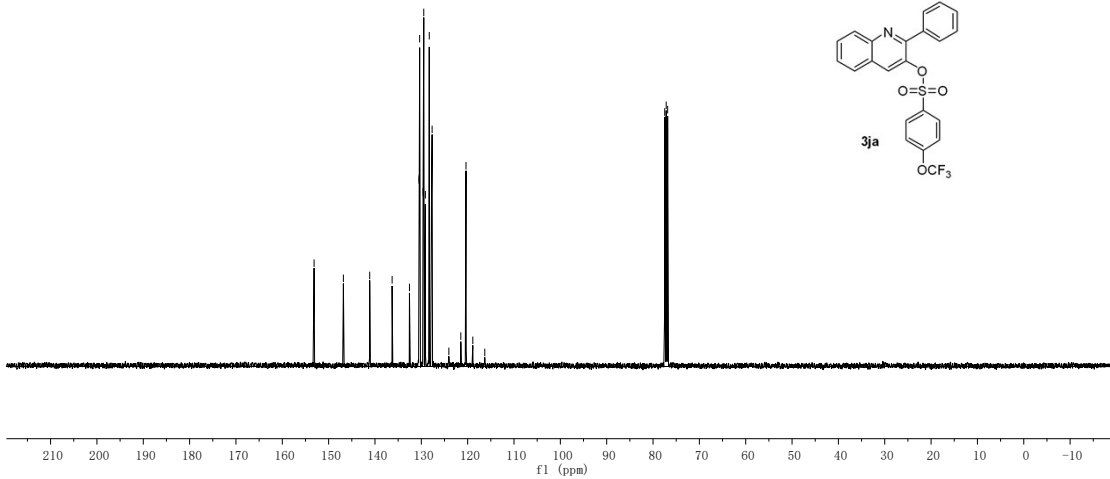
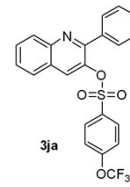
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



153.161
146.818
141.137
136.302
132.558
130.478
130.456
130.359
129.628
129.472
129.124
128.288
127.804
127.671
124.061
121.475
120.357
118.889
116.303

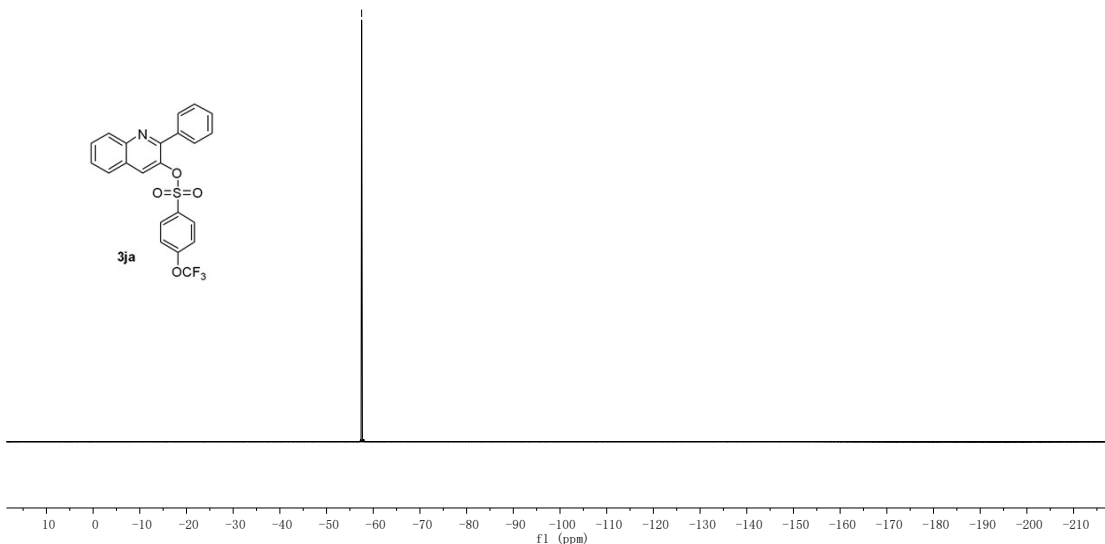
77.477
77.160
76.842

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.2
4 Number of Scans	210
5 Spectrometer Frequency	100.61
6 Nucleus	13C



Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	292.3
4 Number of Scans	4
5 Spectrometer Frequency	376.50
6 Nucleus	19F

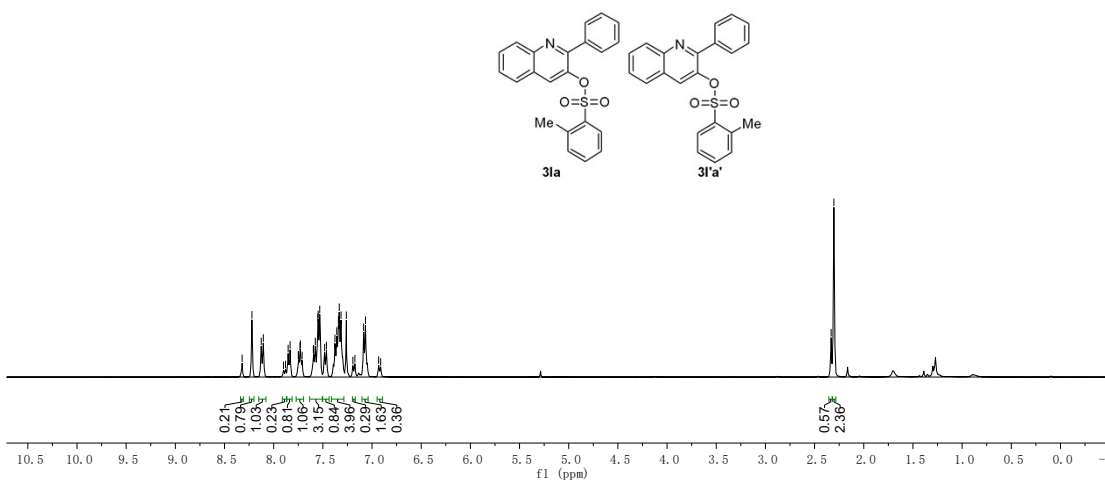
-57.514



8.321
8.221
8.126
8.105
7.900
7.879
7.853
7.833
7.749
7.746
7.732
7.729
7.711
7.597
7.594
7.577
7.551
7.548
7.532
7.482
7.463
7.377
7.359
7.342
7.334
7.315
7.261
7.195
7.174
7.085
7.067
6.932
6.912

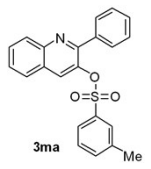
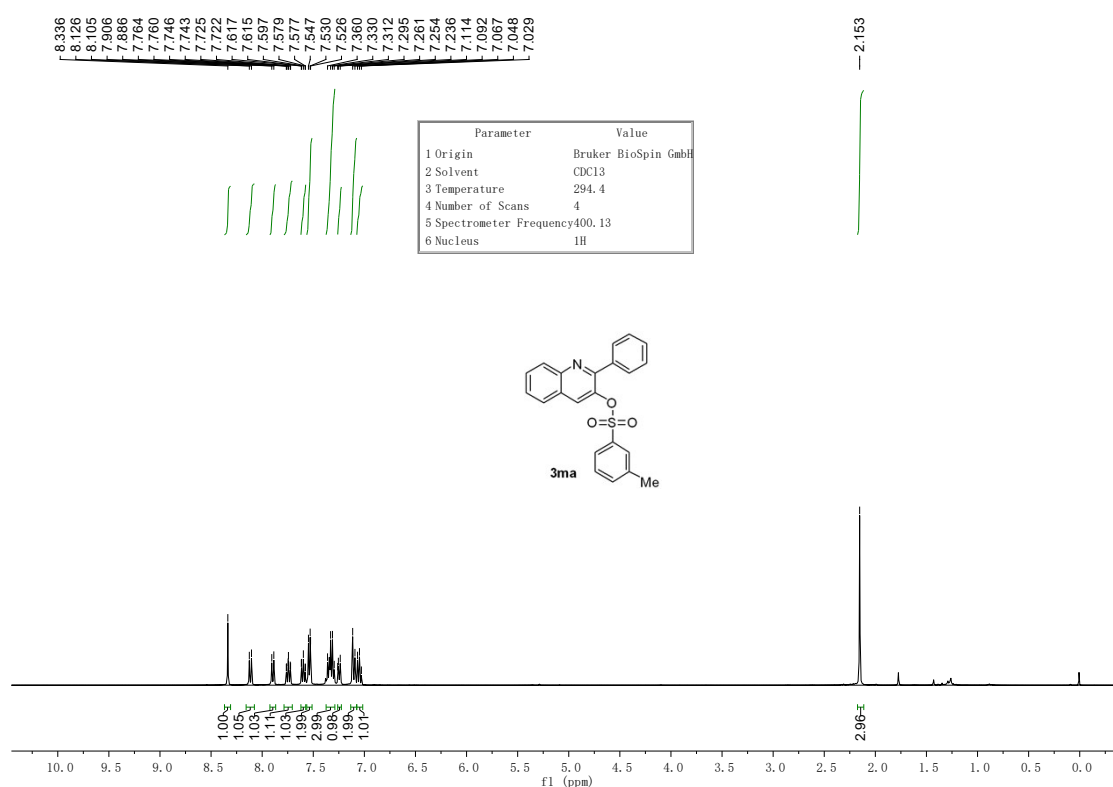
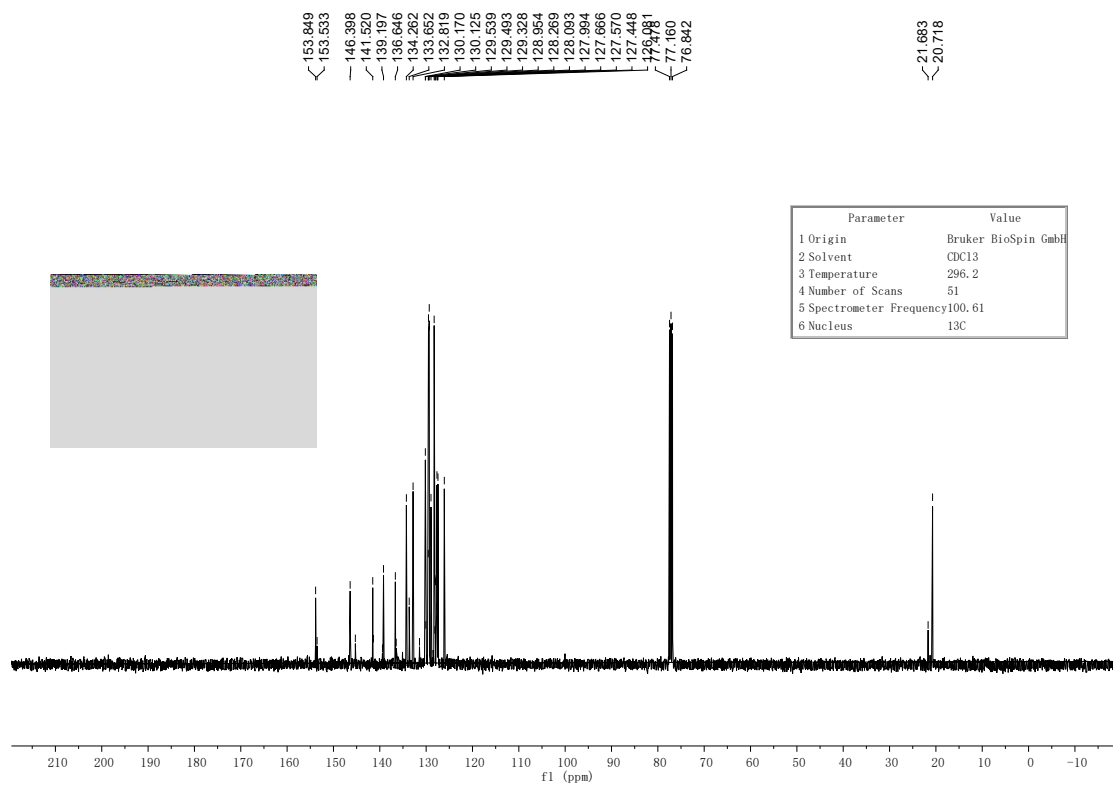
2.332
2.304

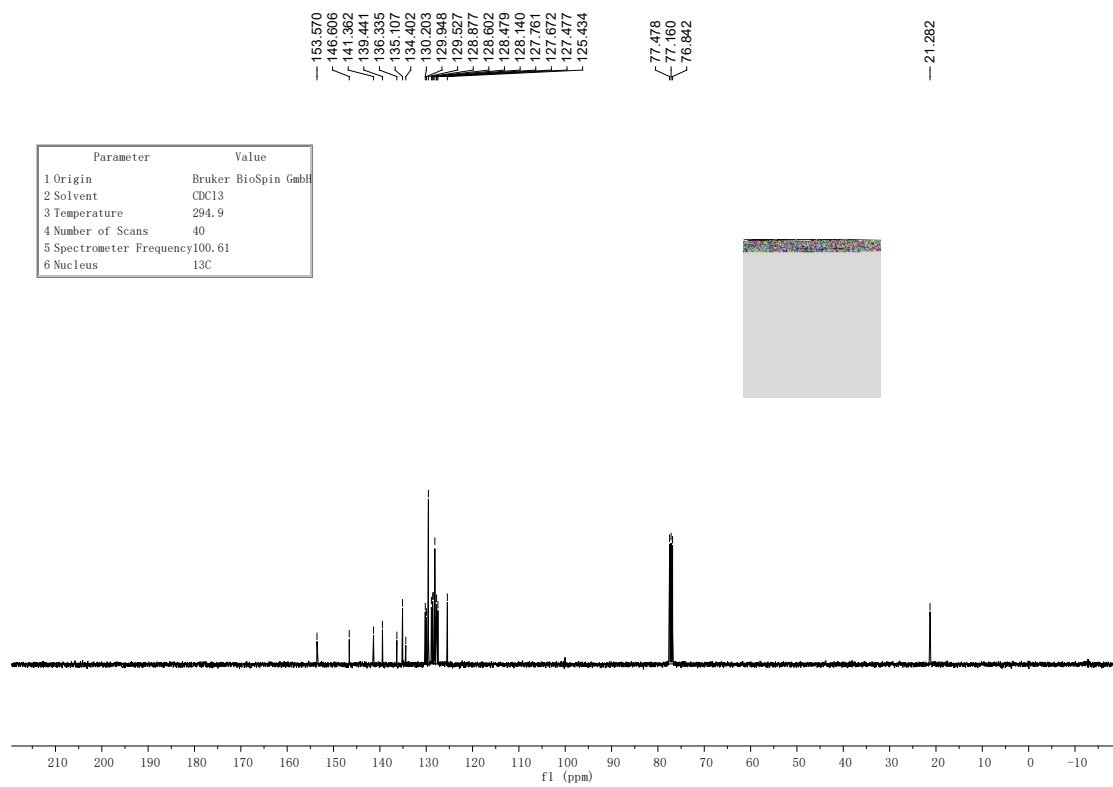
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	305.2
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



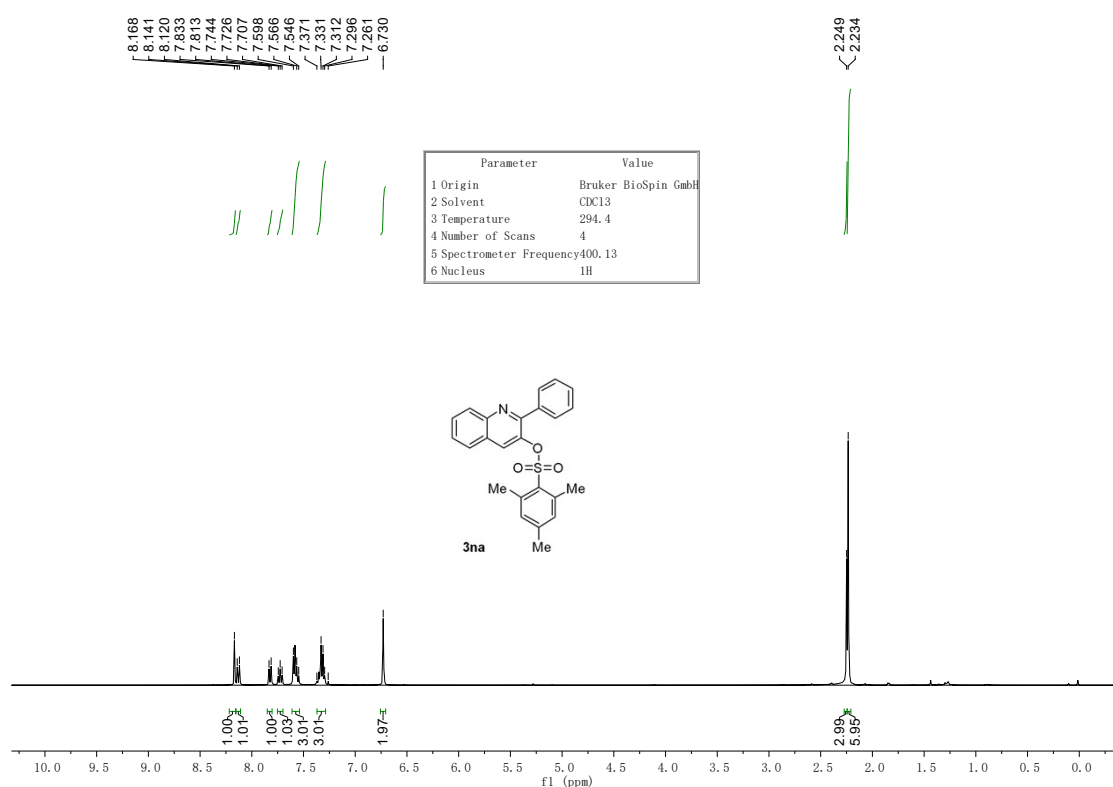
0.21
0.70
1.03
0.23
0.81
1.06
3.15
0.84
3.96
0.29
1.63
0.36

0.57
2.36

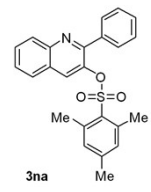




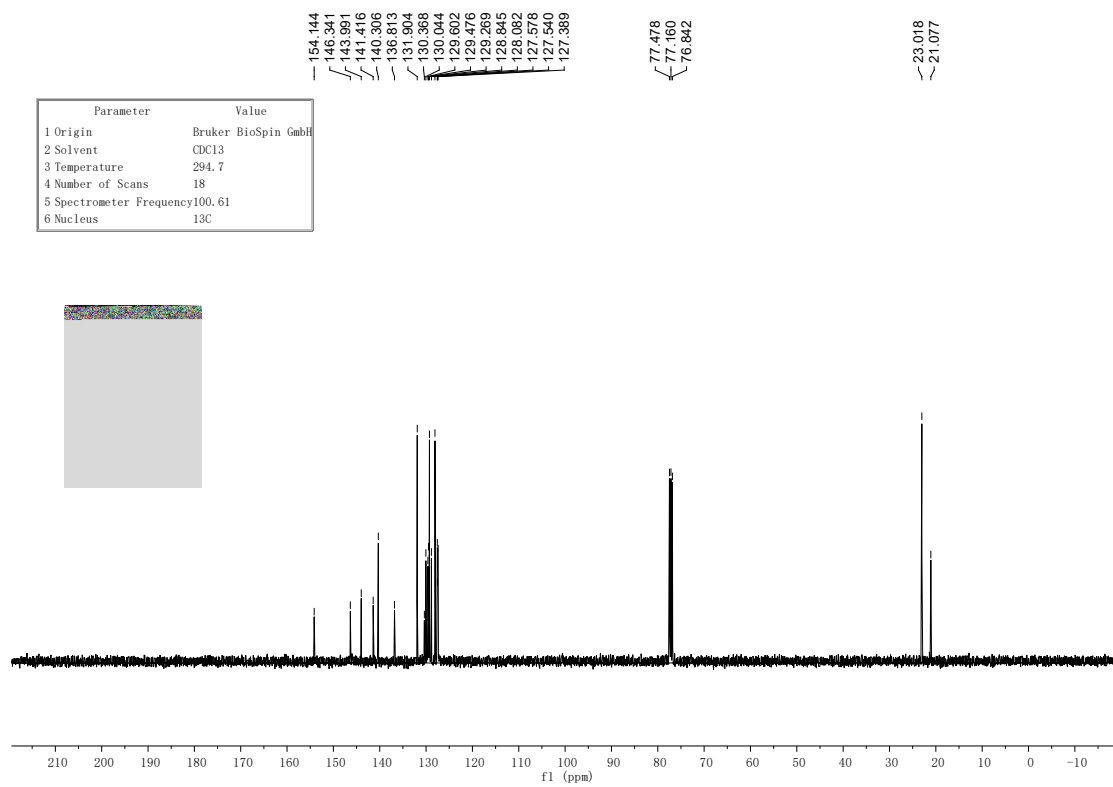
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.9
4 Number of Scans	40
5 Spectrometer Frequency	100.61
6 Nucleus	13C



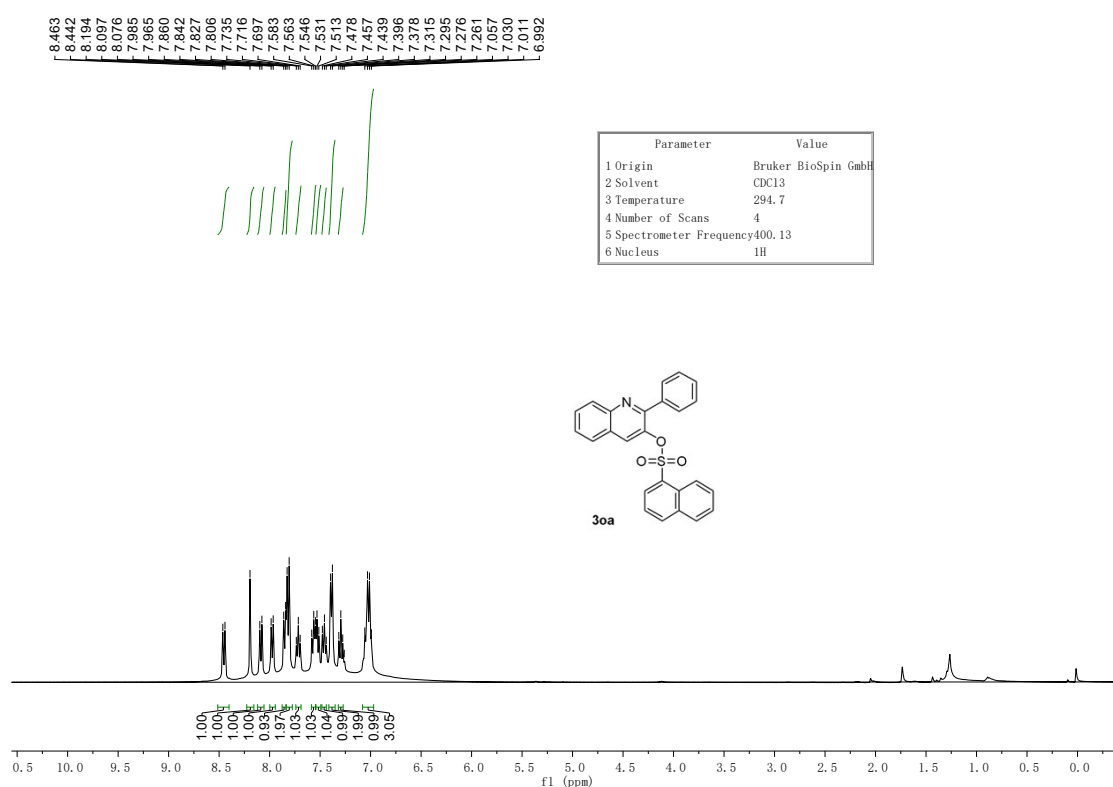
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.4
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



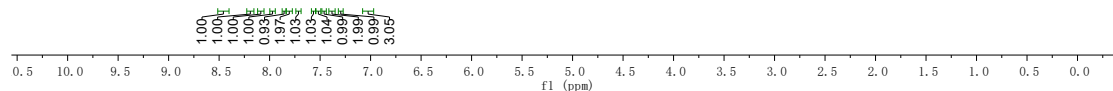
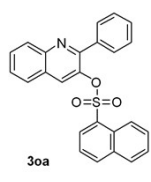
Integration values for the 1H NMR spectrum: 1.00±, 1.01±, 1.00±, 1.09±, 3.01±, 3.01±, 1.97±, 2.99±, 5.95±.

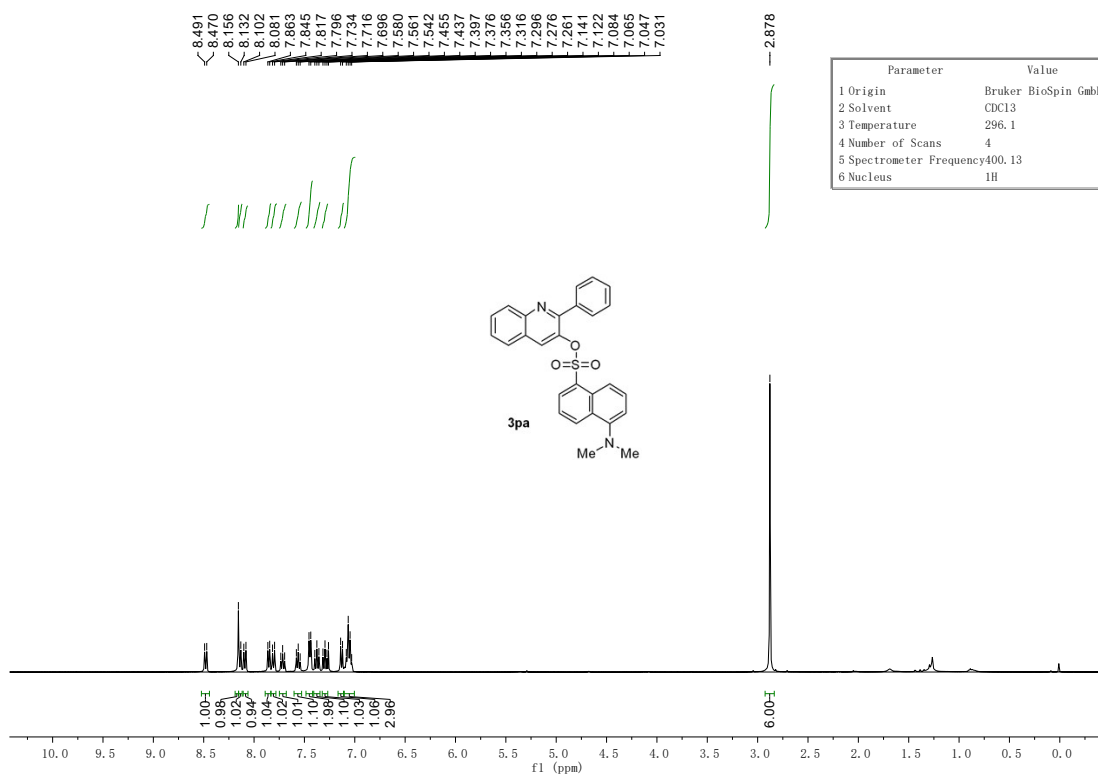
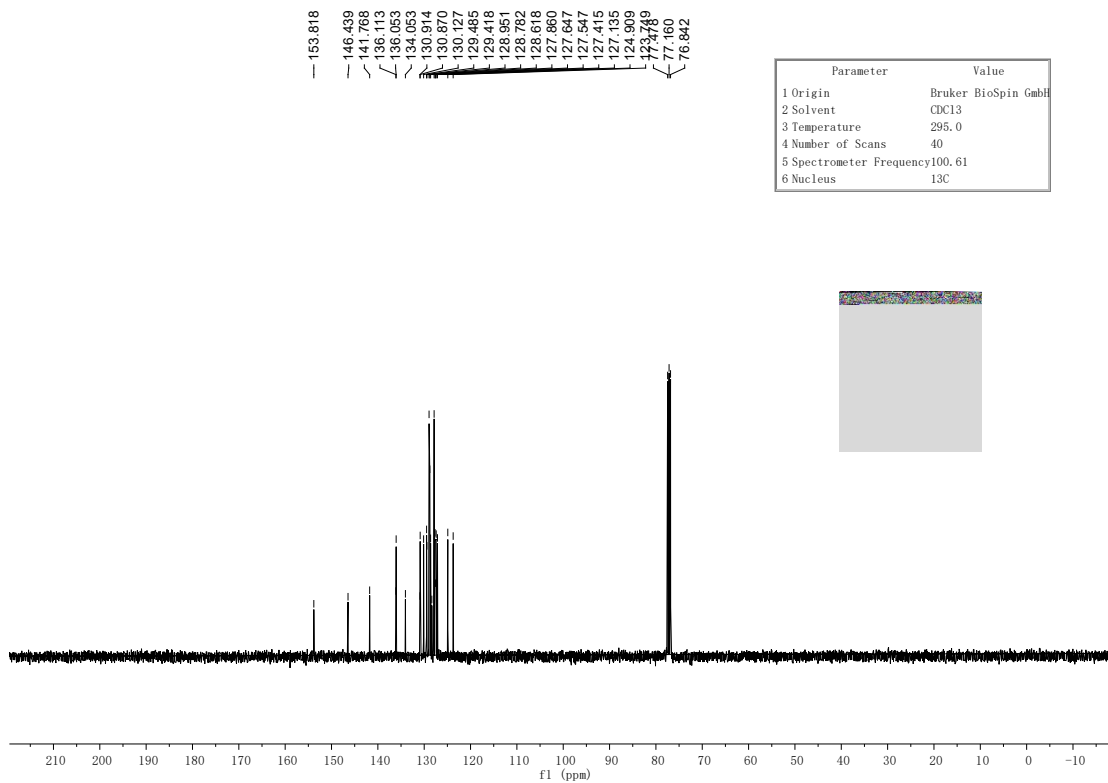


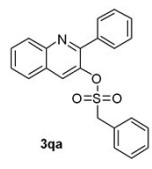
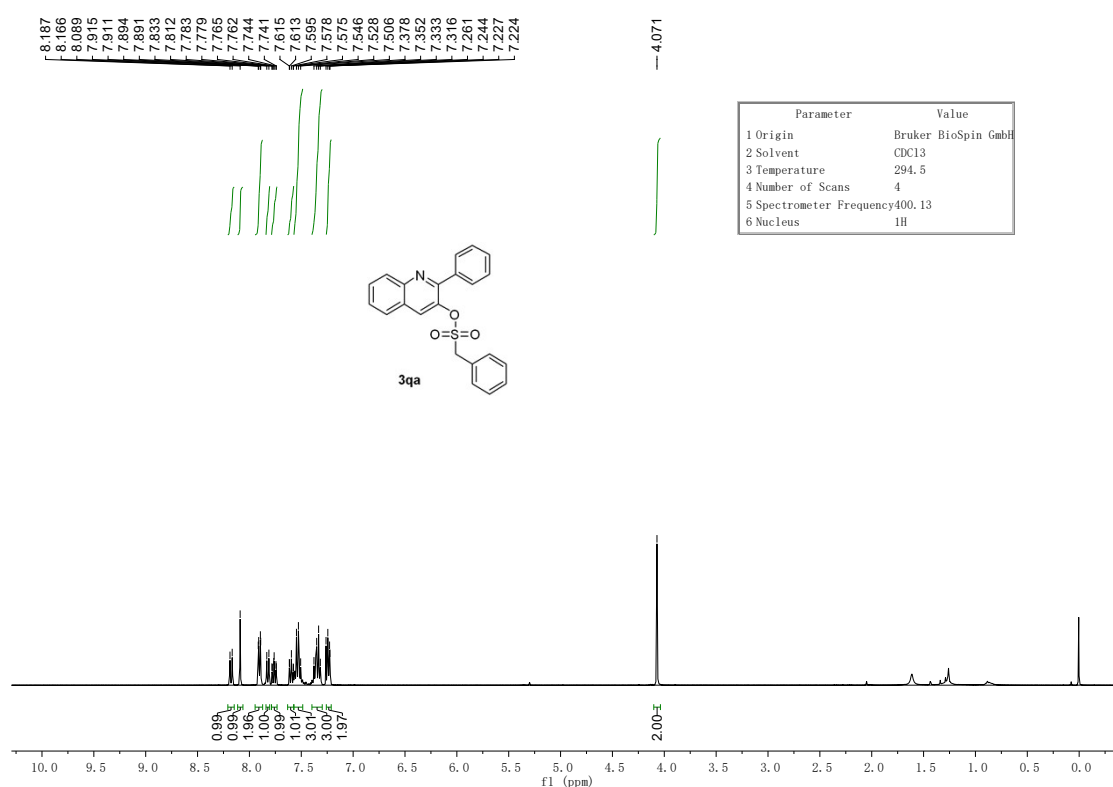
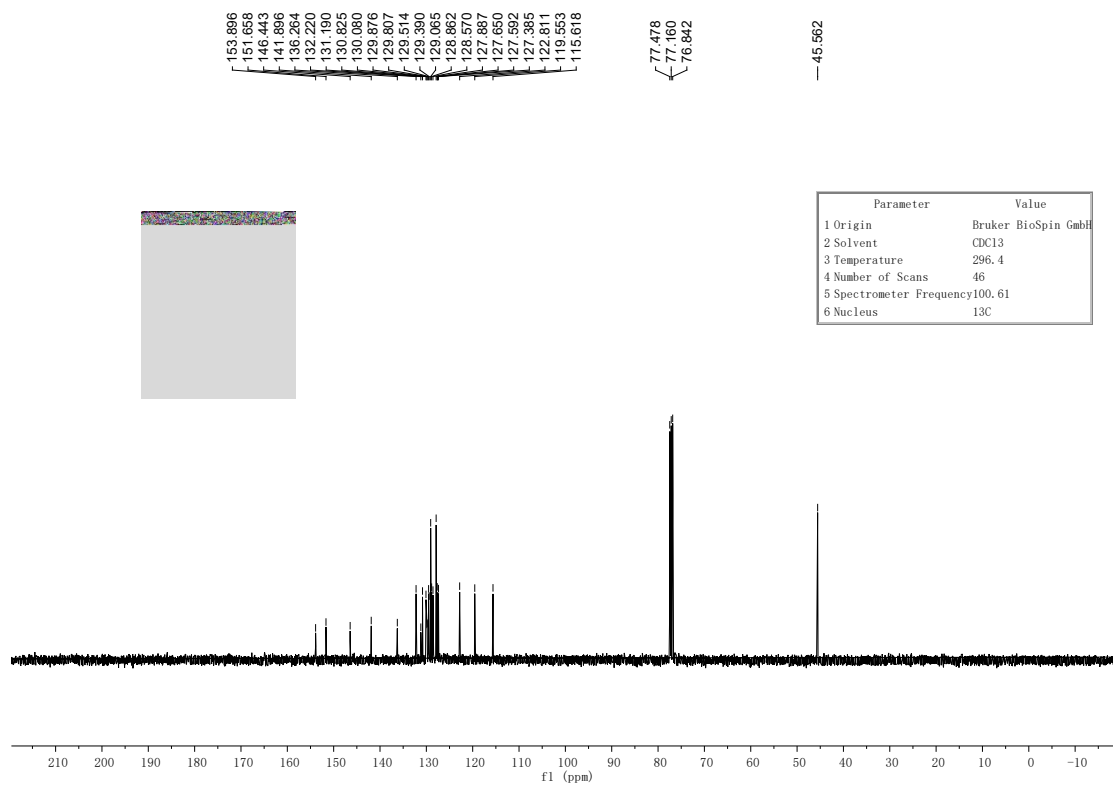
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.7
4 Number of Scans	18
5 Spectrometer Frequency	100.61
6 Nucleus	13C



Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.7
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H





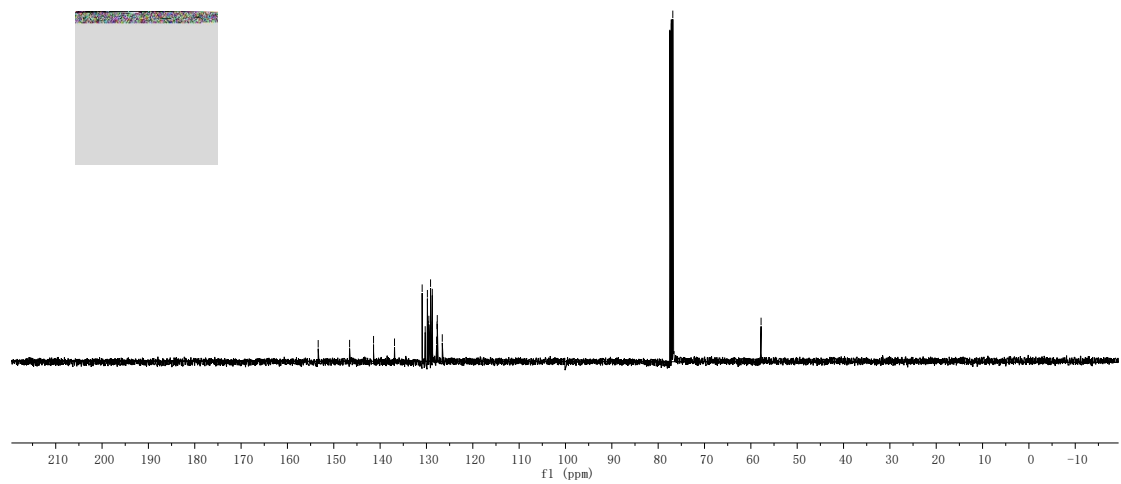


Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.6
4 Number of Scans	100
5 Spectrometer Frequency	100.61
6 Nucleus	¹³ C

153.363
146.585
141.420
136.895
130.927
130.270
129.797
129.621
129.598
129.480
129.117
129.050
128.740
127.810
127.716
127.666
126.586

77.477
77.160
76.842

57.795



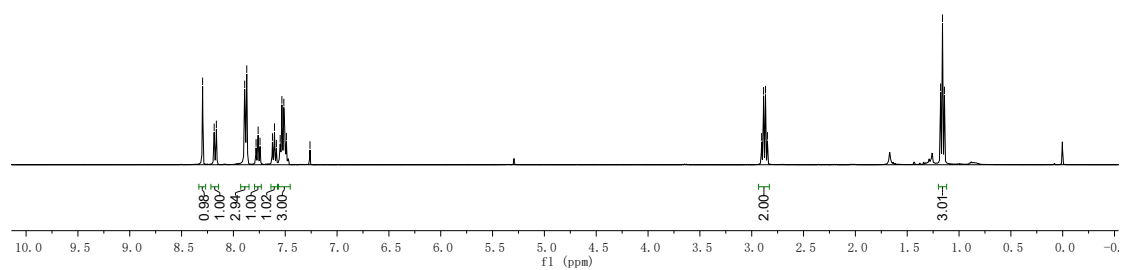
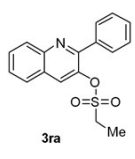
V

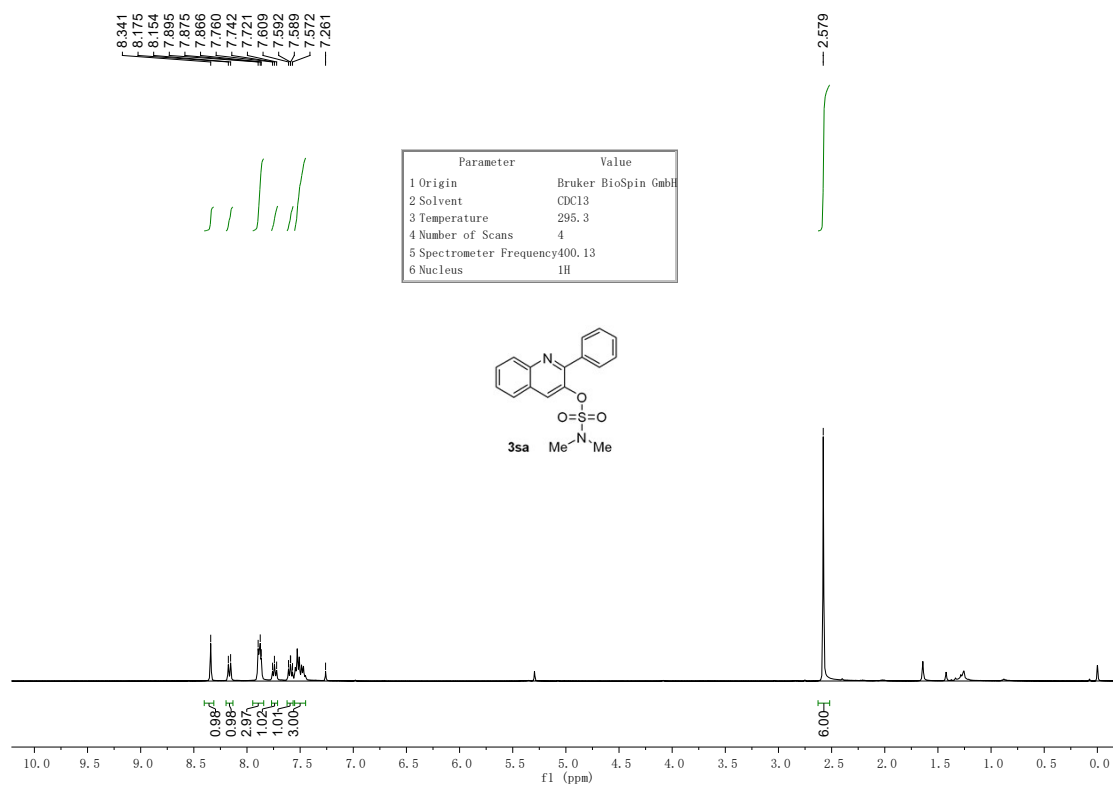
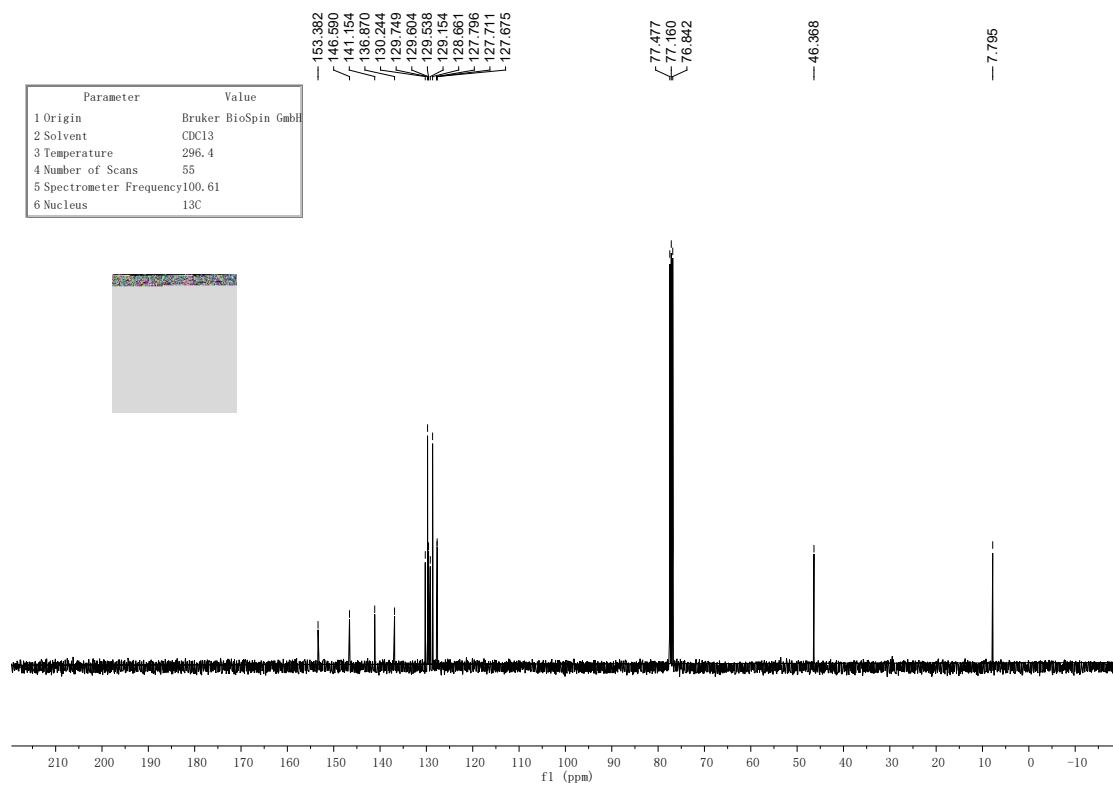
8.297
8.186
8.164
7.891
7.871
7.781
7.761
7.743
7.623
7.566
7.549
7.532
7.514
7.489
7.261

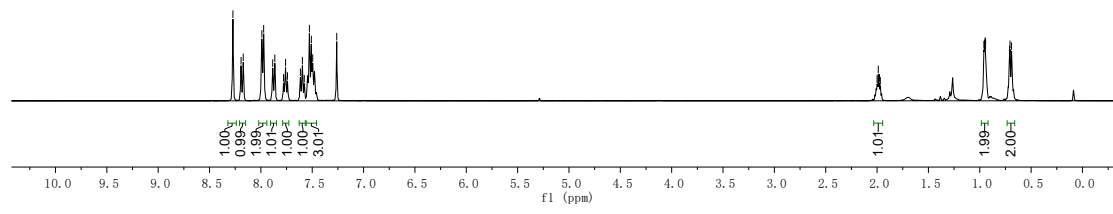
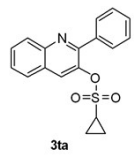
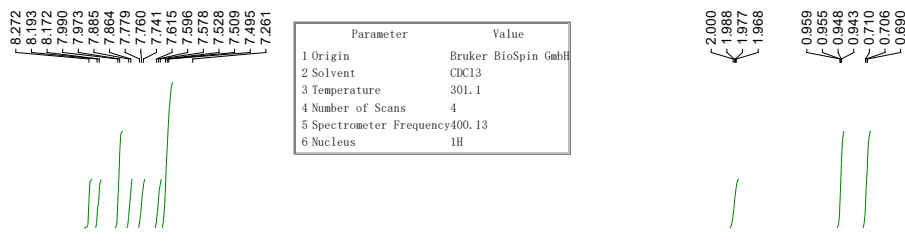
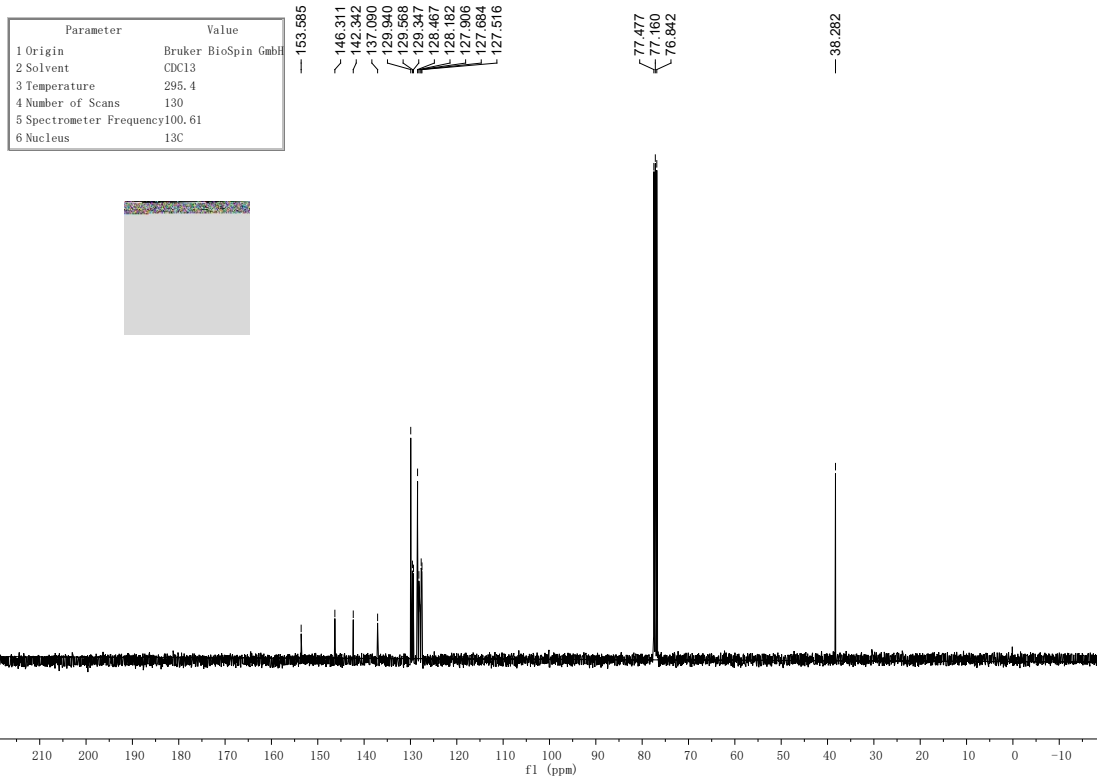
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.1
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	¹ H

2.804
2.886
2.807
2.849

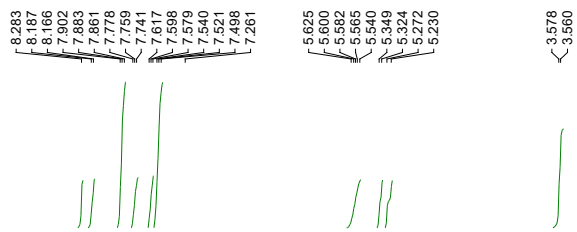
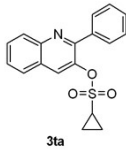
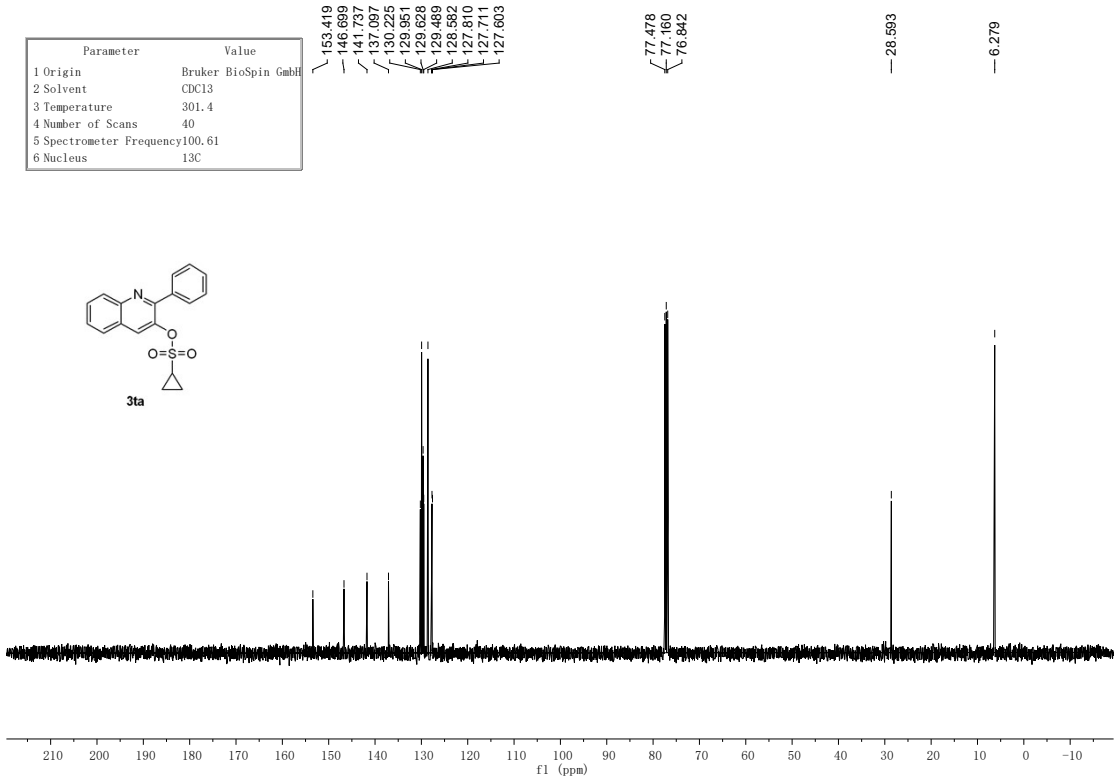
1.178
1.159
1.141



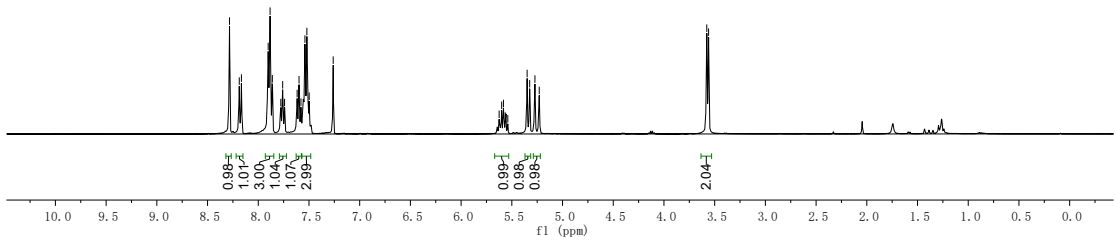
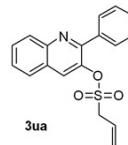


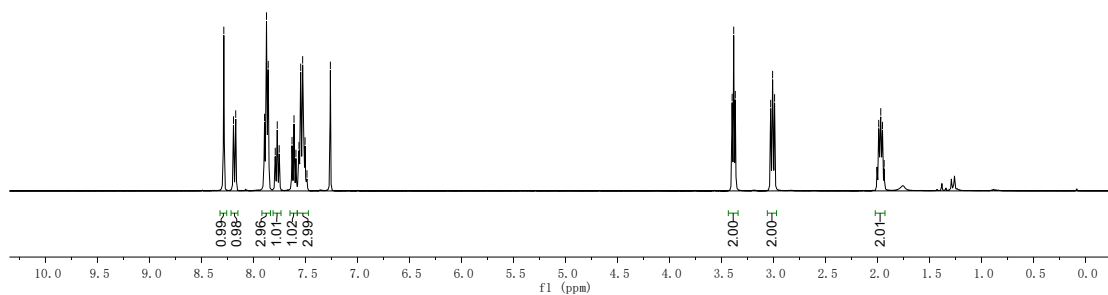
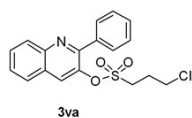
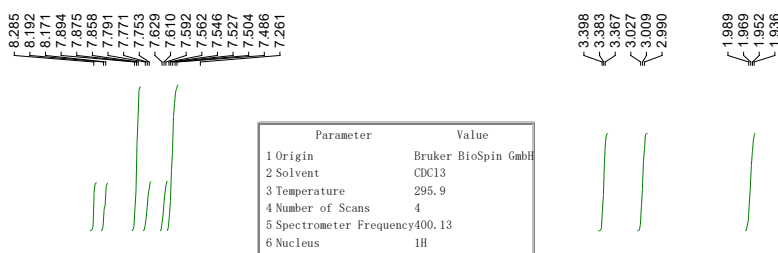
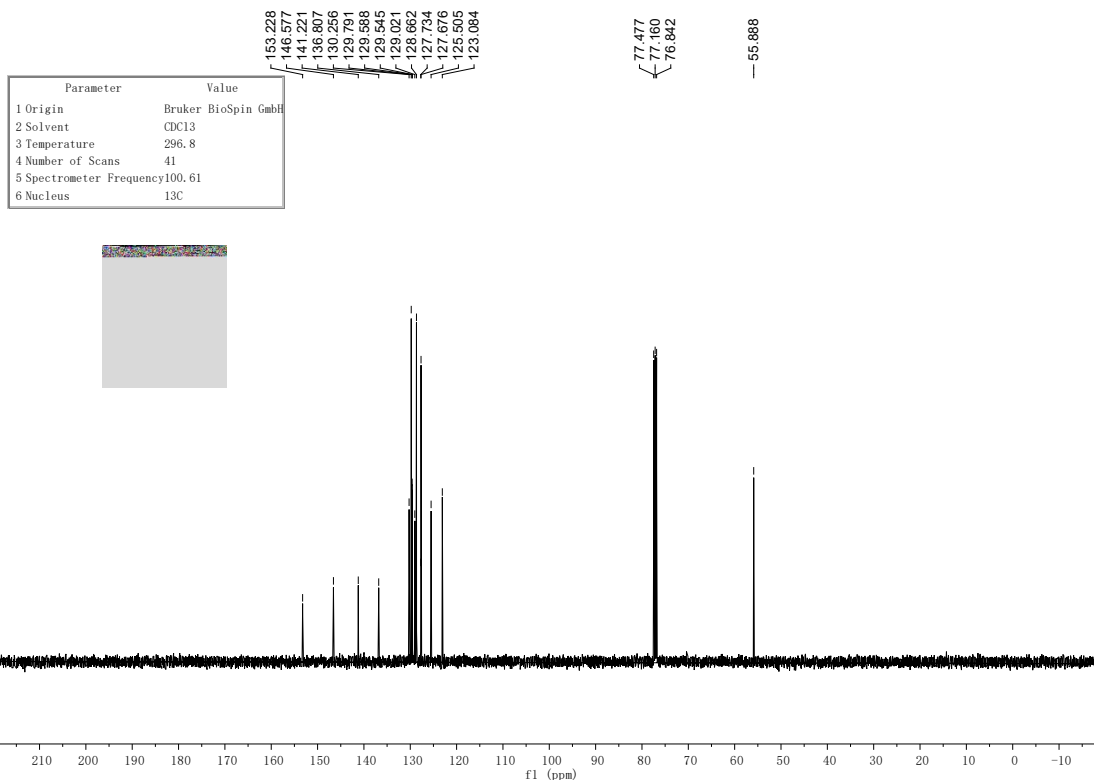


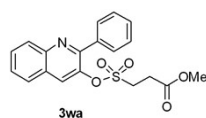
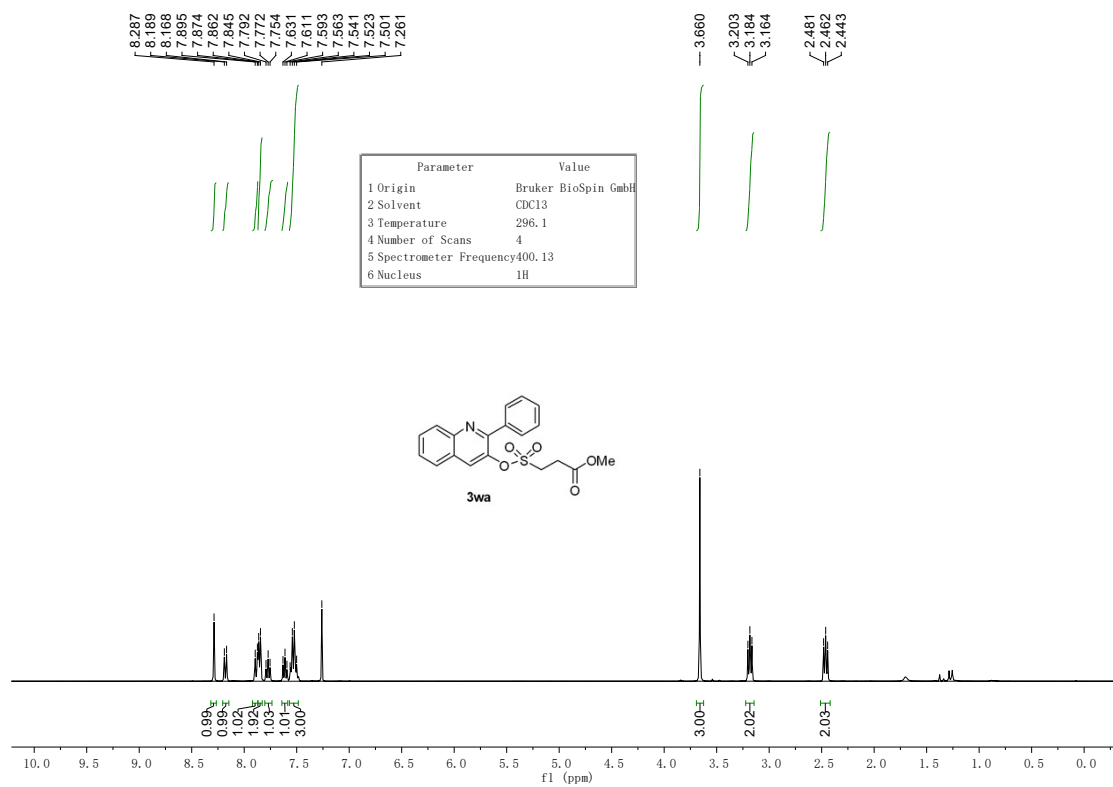
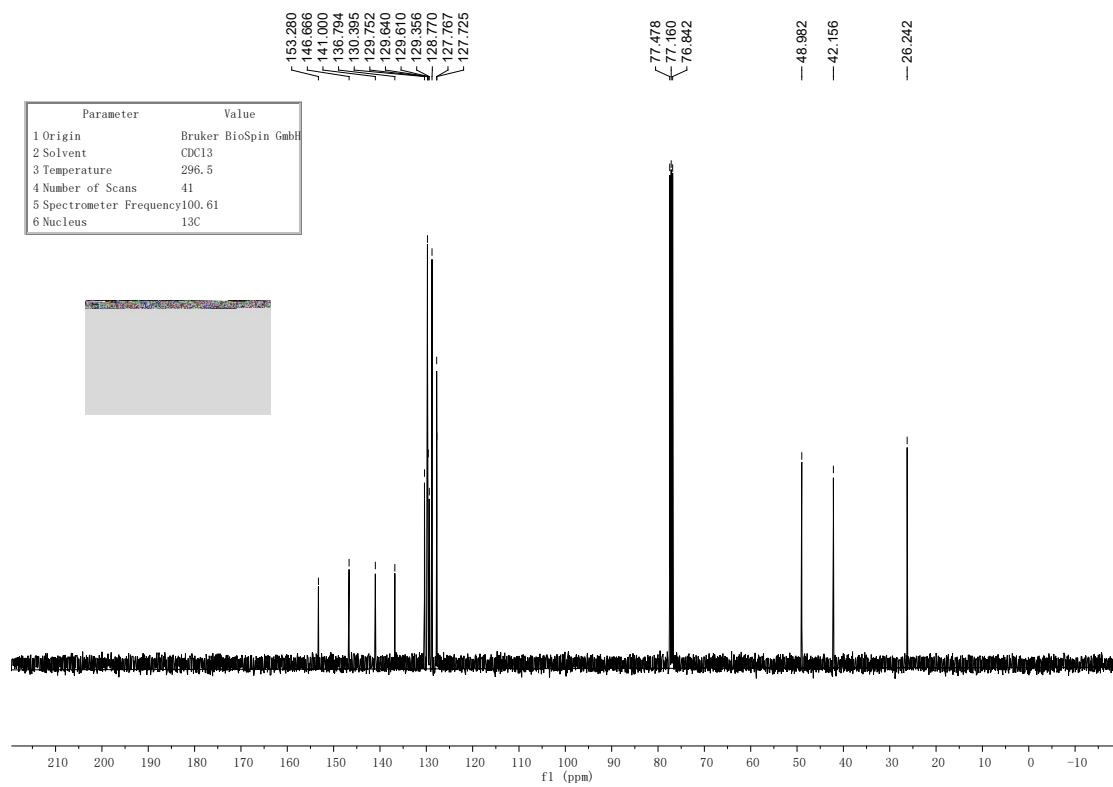
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	301.4
4 Number of Scans	40
5 Spectrometer Frequency	100.61
6 Nucleus	13C

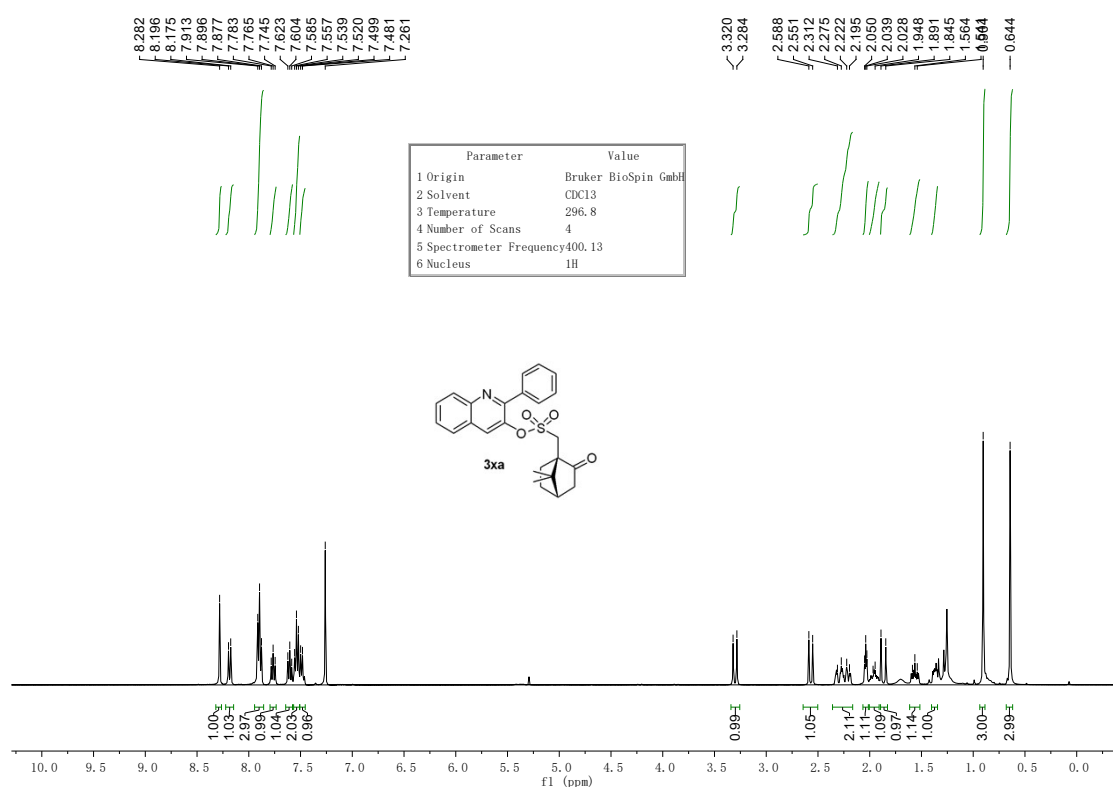
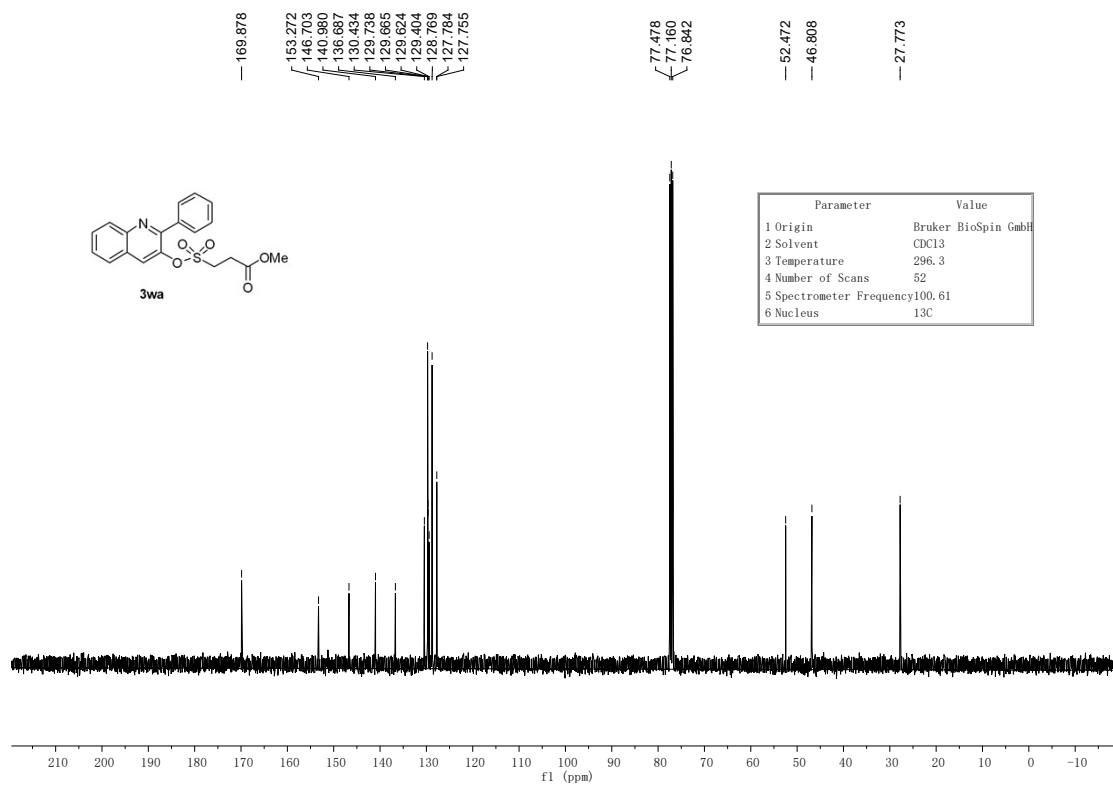


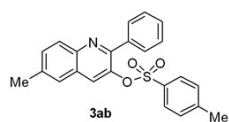
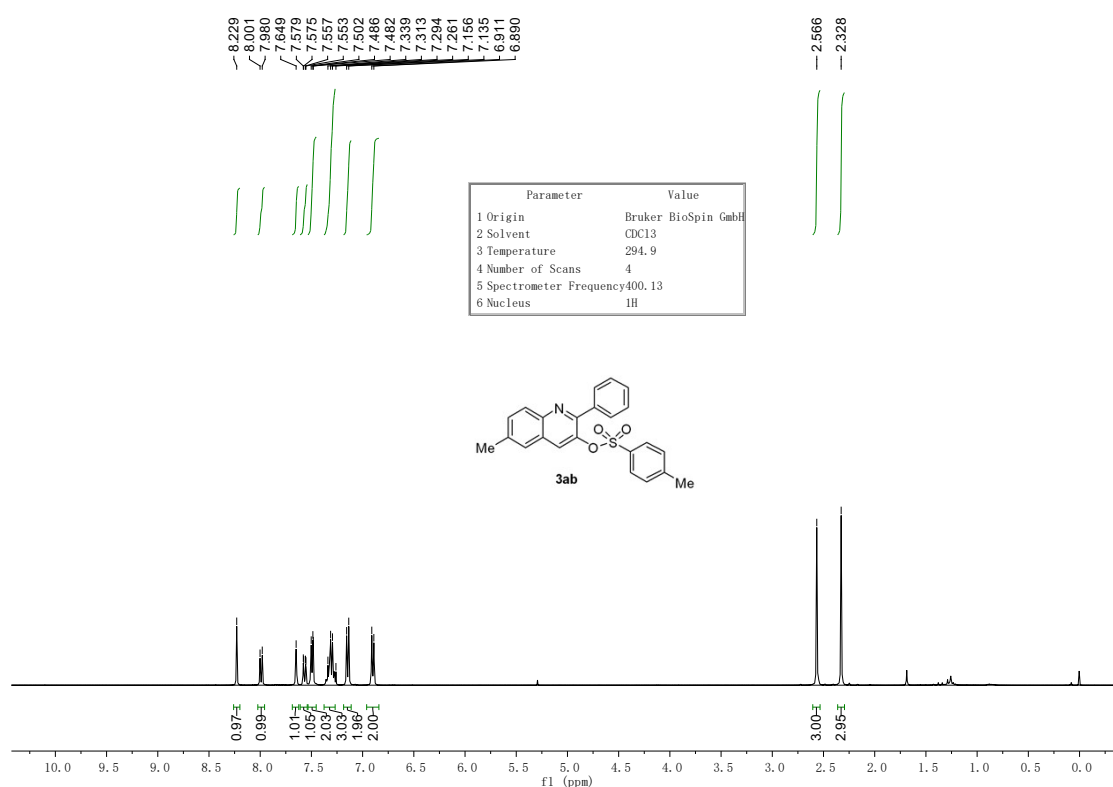
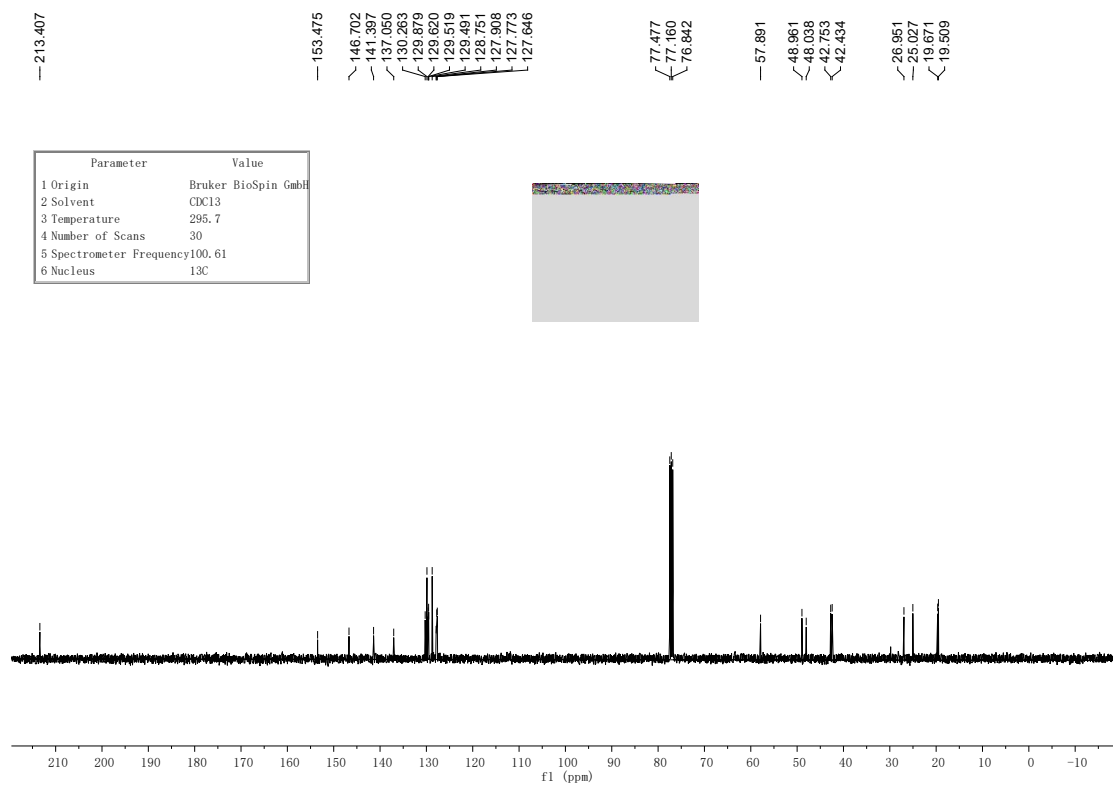
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.6
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H









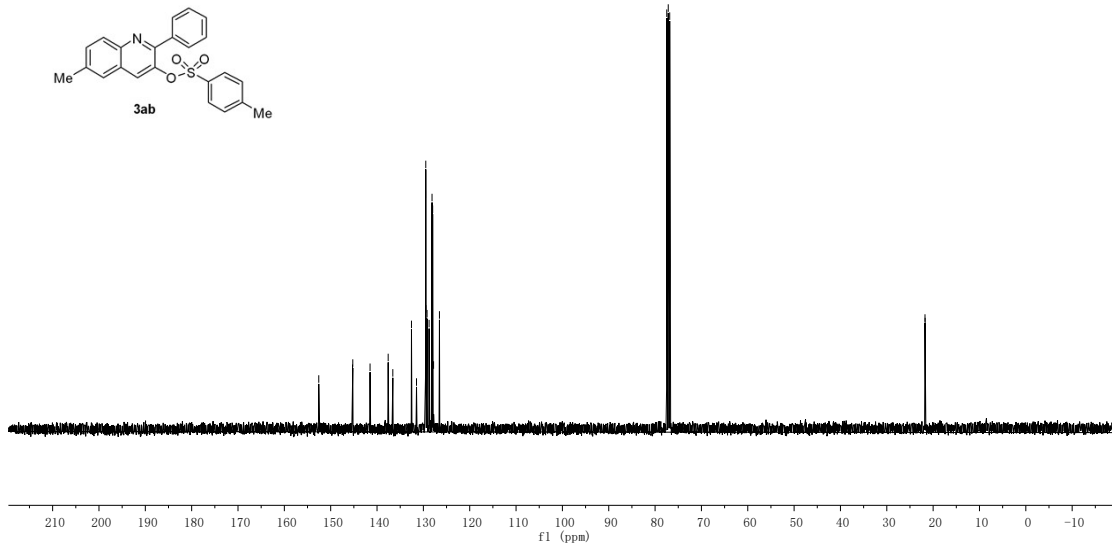
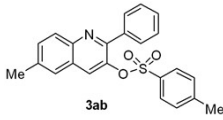


Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.3
4 Number of Scans	73
5 Spectrometer Frequency	100.61
6 Nucleus	¹³ C

152.573
145.288
145.231
141.506
137.593
136.568
131.482
129.528
129.480
129.459
129.206
128.767
128.131
127.894
127.796
126.531

77.478
77.160
76.842

21.756
21.726

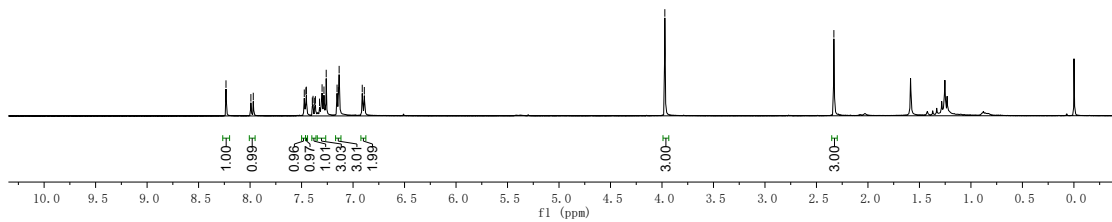
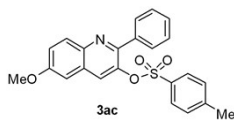


8.234
7.992
7.969
7.474
7.458
7.453
7.396
7.389
7.372
7.366
7.325
7.301
7.283
7.261
7.155
7.143
7.135
6.911
6.891

3.972

2.331

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.3
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	¹ H



1.00

0.99

0.96

0.97

1.04

3.04

1.99

3.00

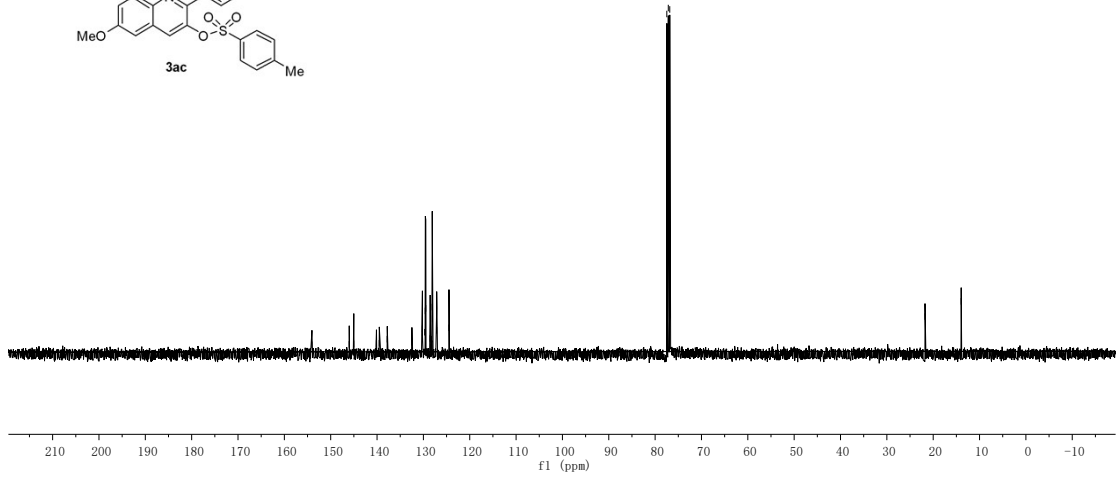
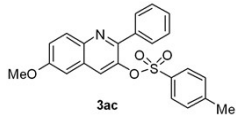
3.00

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.7
4 Number of Scans	42
5 Spectrometer Frequency	100.62
6 Nucleus	¹³ C

154.059
146.013
145.030
140.140
139.528
137.811
132.486
130.225
129.715
129.698
129.492
128.953
128.433
128.053
127.439
124.491

77.478
77.160
76.842

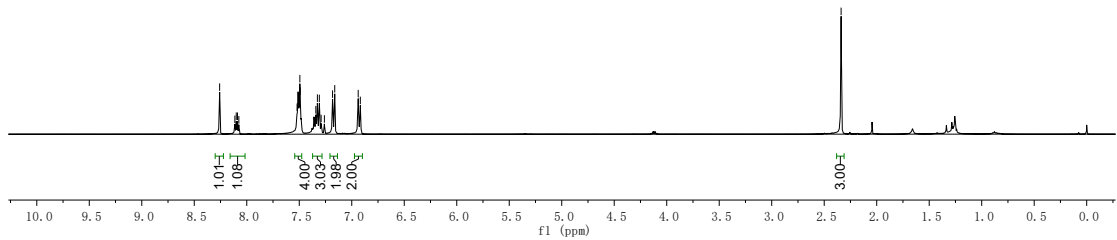
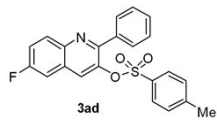
21.771
13.962



8.258
8.113
8.100
8.088
8.075
7.521
7.494
7.491
7.342
7.327
7.309
7.292
7.281
7.183
7.162
6.939
6.918

2.339

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.1
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	¹ H



1.01

1.08

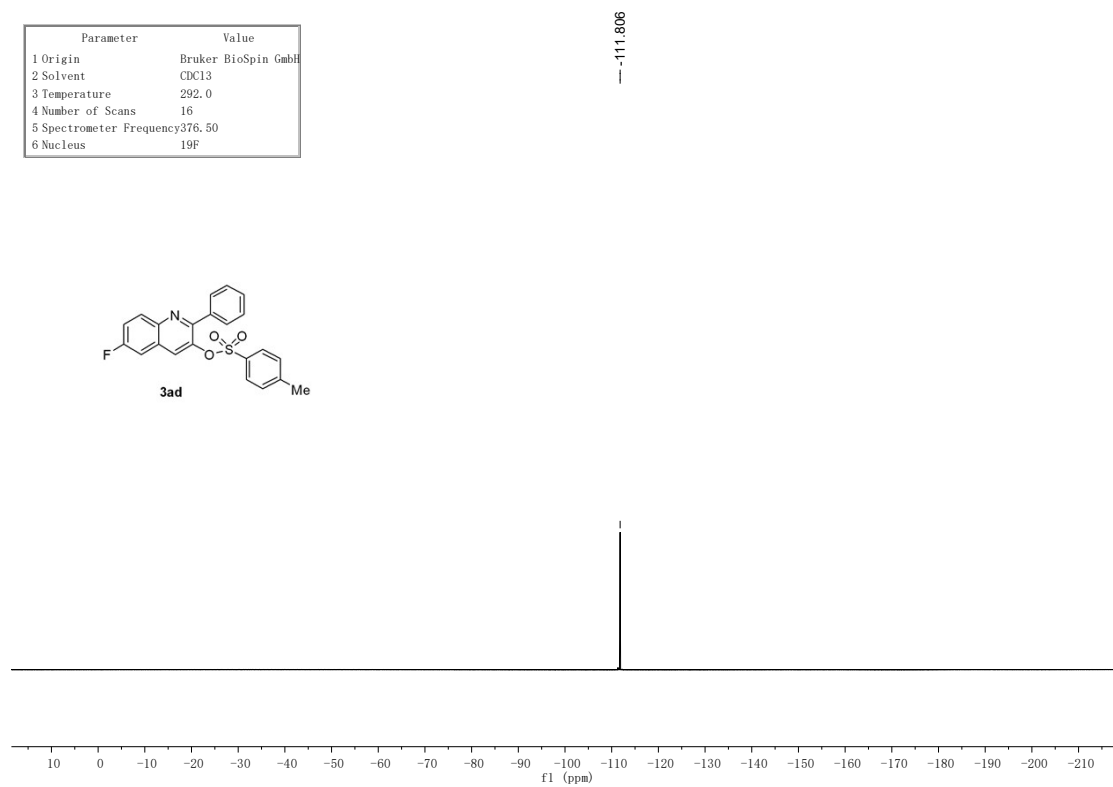
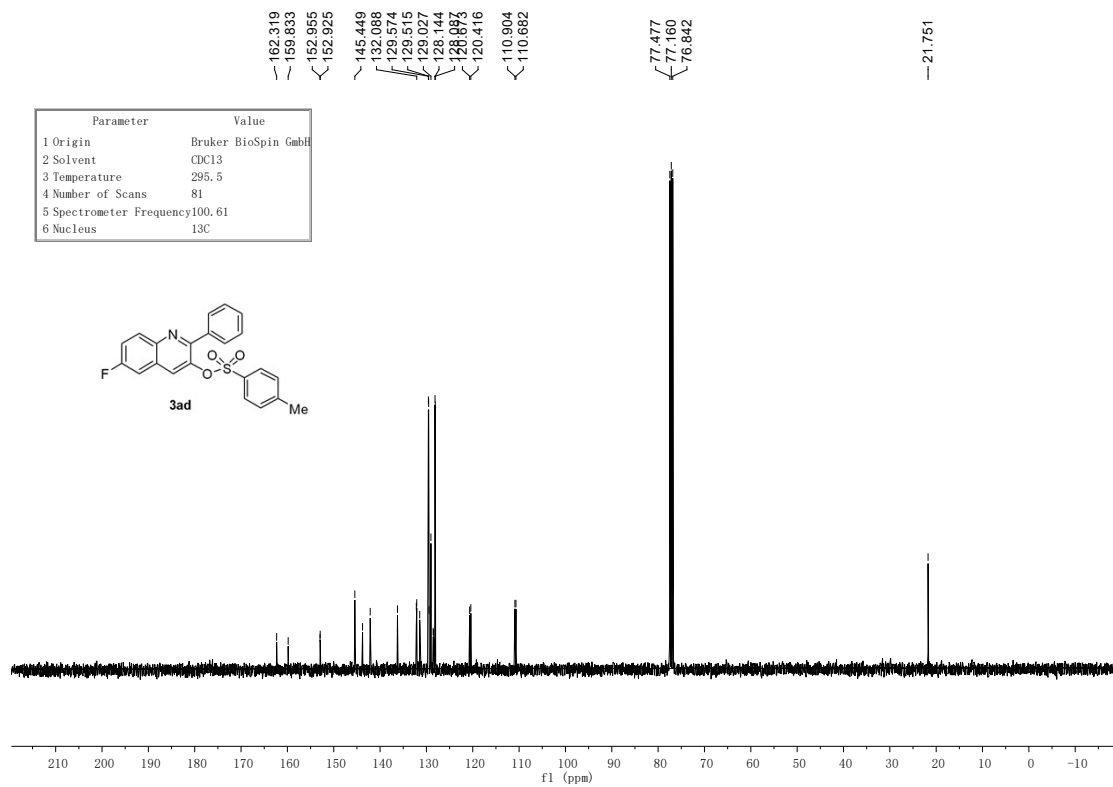
4.00

3.03

1.98

2.00

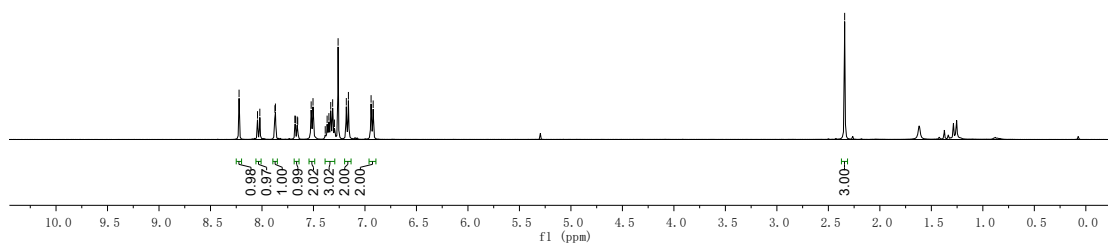
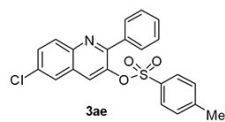
3.00



8.223
8.043
8.021
7.874
7.869
7.681
7.675
7.658
7.523
7.505
7.386
7.368
7.350
7.332
7.314
7.297
7.261
7.181
7.161
6.941

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H

2.342

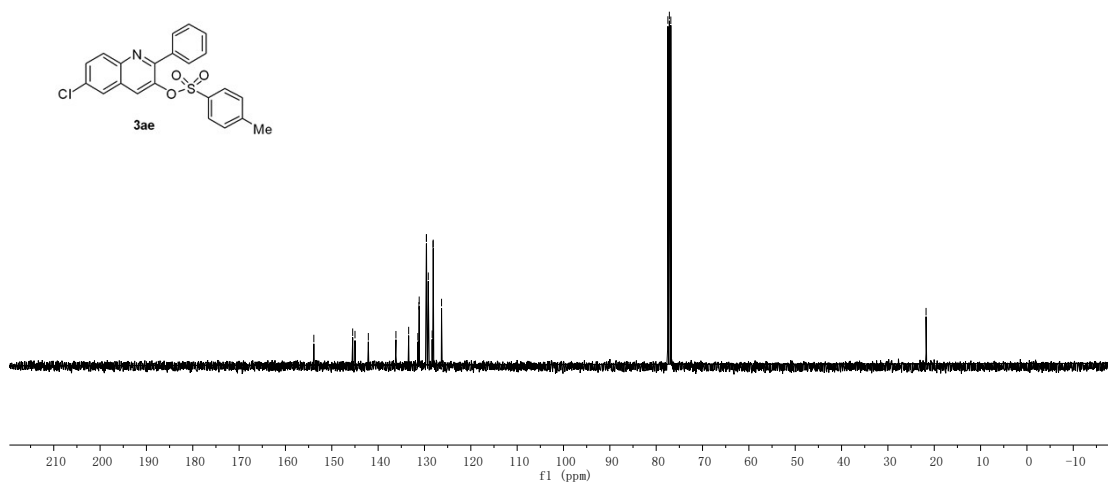
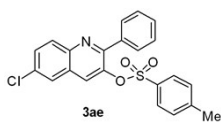


153.875
145.494
144.995
142.118
136.160
133.414
131.432
131.193
131.142
129.599
129.596
129.178
128.348
128.161
128.114
126.316

77.477
77.160
76.842

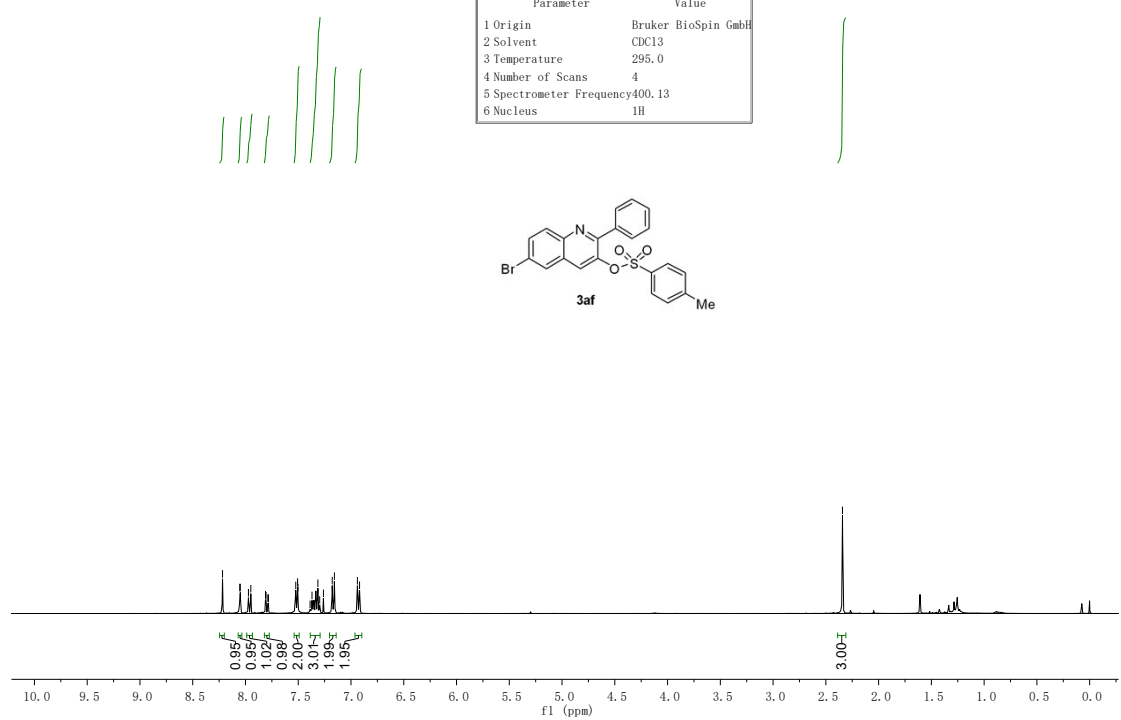
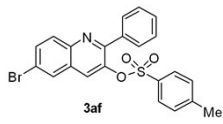
21.767

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.1
4 Number of Scans	105
5 Spectrometer Frequency	100.61
6 Nucleus	13C



8.217
8.054
8.049
7.972
7.949
7.810
7.805
7.788
7.783
7.523
7.506
7.503
7.388
7.370
7.314
7.297
7.261
7.178
7.157
6.939
6.919

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H

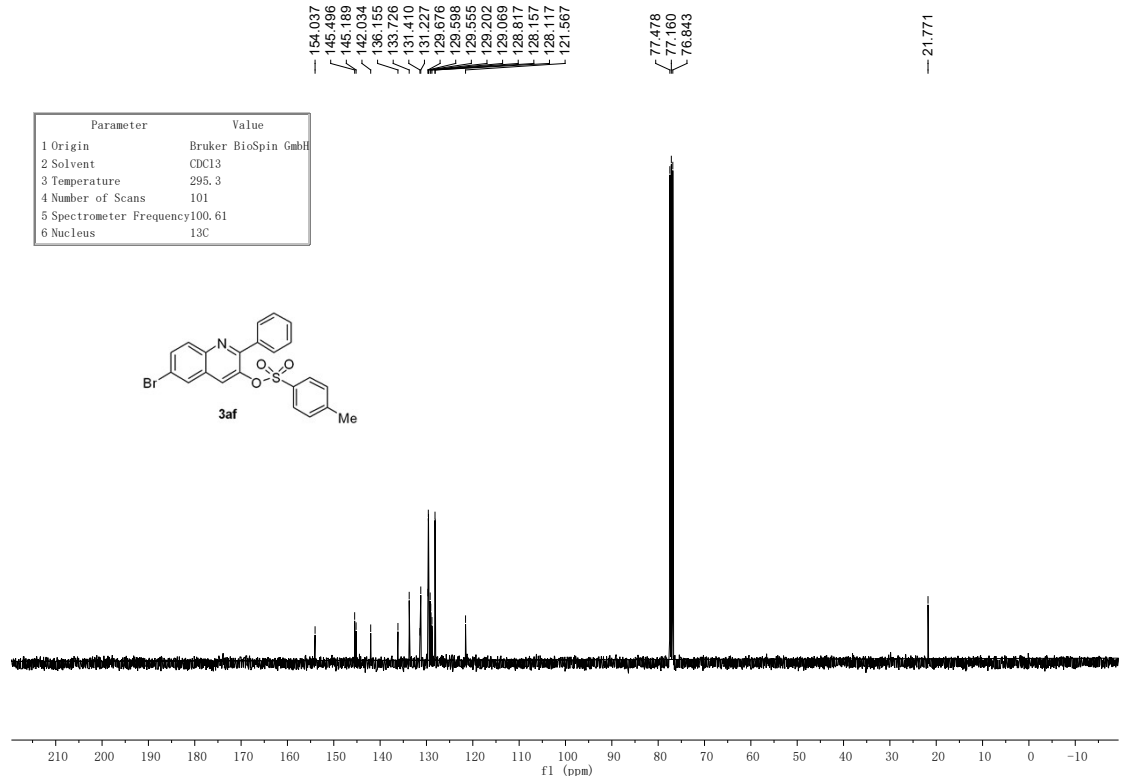
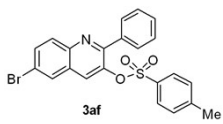


154.037
145.496
145.189
142.034
136.155
133.726
131.410
131.227
129.676
128.898
128.555
128.202
128.049
128.677
128.177
126.177
121.567

77.478
77.160
76.843

21.771

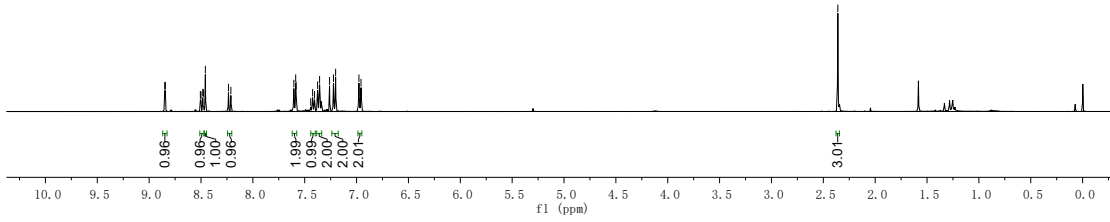
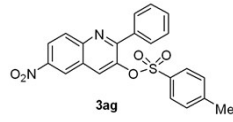
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.3
4 Number of Scans	101
5 Spectrometer Frequency	100.61
6 Nucleus	13C



8.850
8.844
8.483
8.477
8.458
8.235
8.235
8.235
7.587
7.583
7.442
7.442
7.424
7.406
7.376
7.357
7.261
7.223
7.202
6.877
6.857

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H

2.360

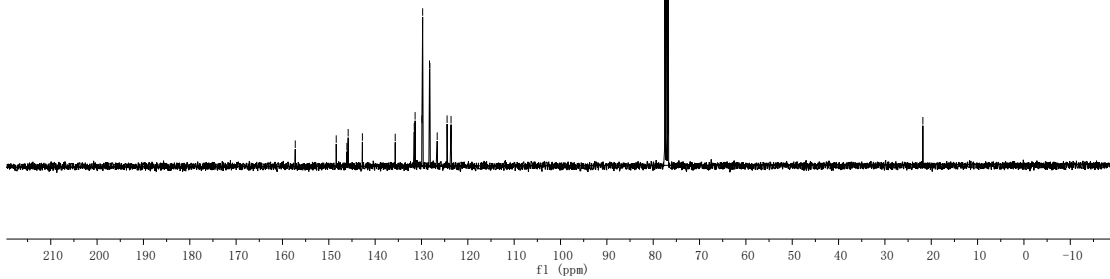
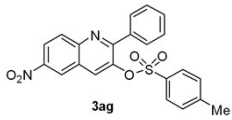


157.240
148.389
146.088
145.523
142.752
135.670
131.565
131.379
130.916
129.748
128.273
128.184
126.611
124.677
123.623

77.477
77.160
76.842

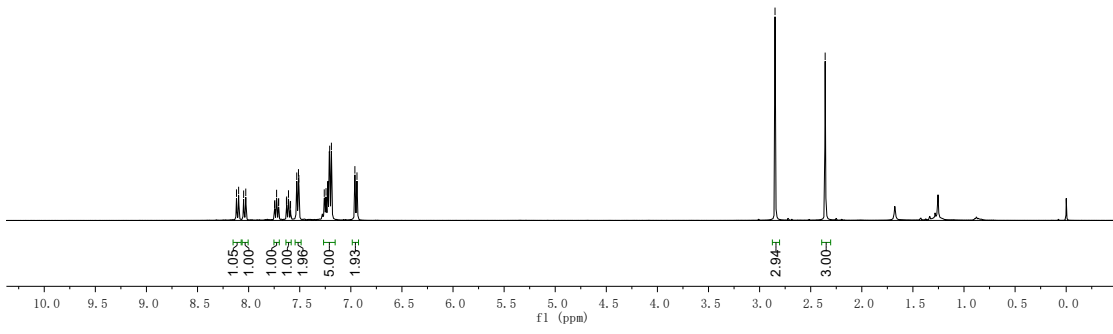
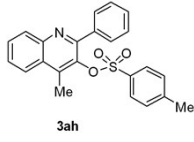
21.808

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.2
4 Number of Scans	200
5 Spectrometer Frequency	100.61
6 Nucleus	13C



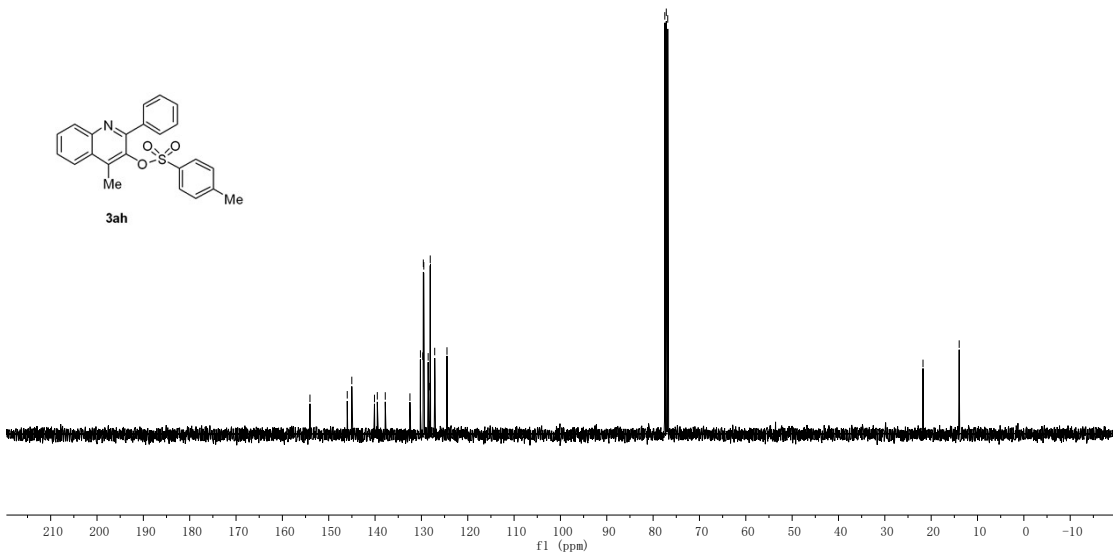
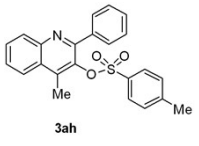
8.119
8.098
8.049
8.028
7.747
7.744
7.726
7.709
7.706
7.630
7.628
7.610
7.592
7.590
7.529
7.512
7.509
7.260
7.243
7.207
7.190
6.960
6.940

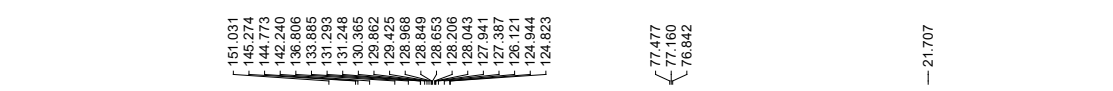
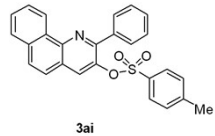
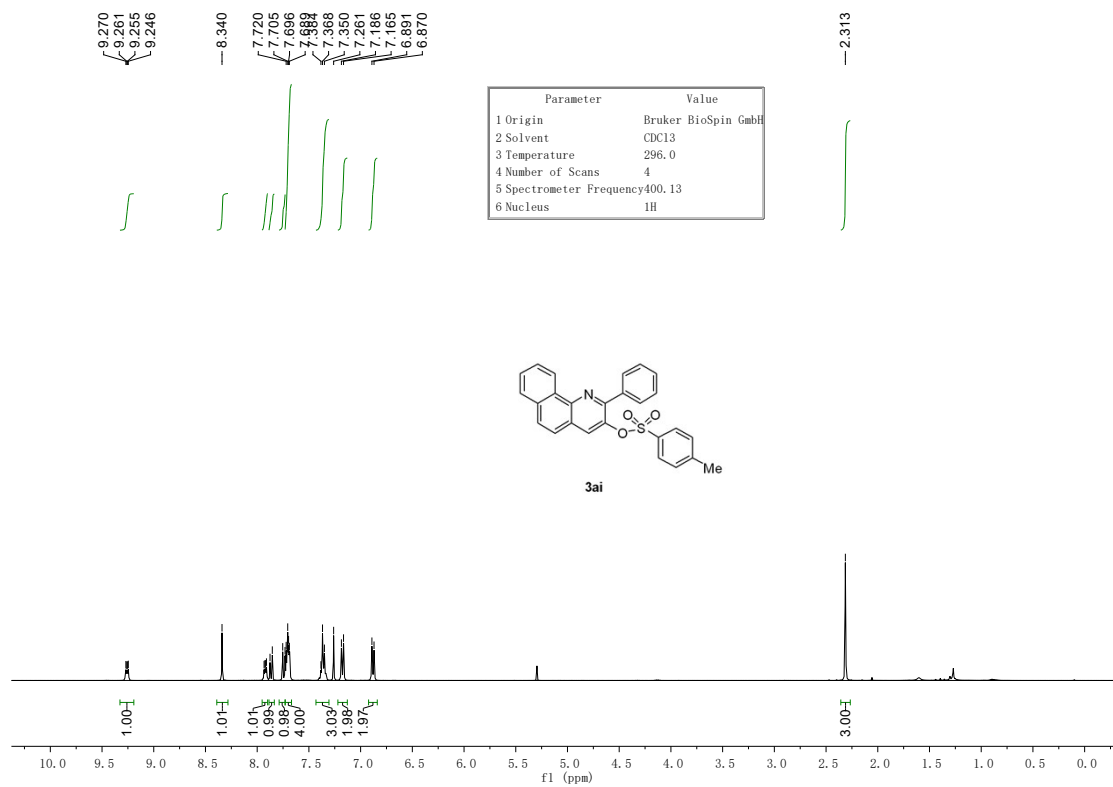
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



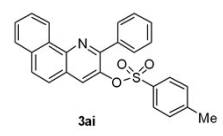
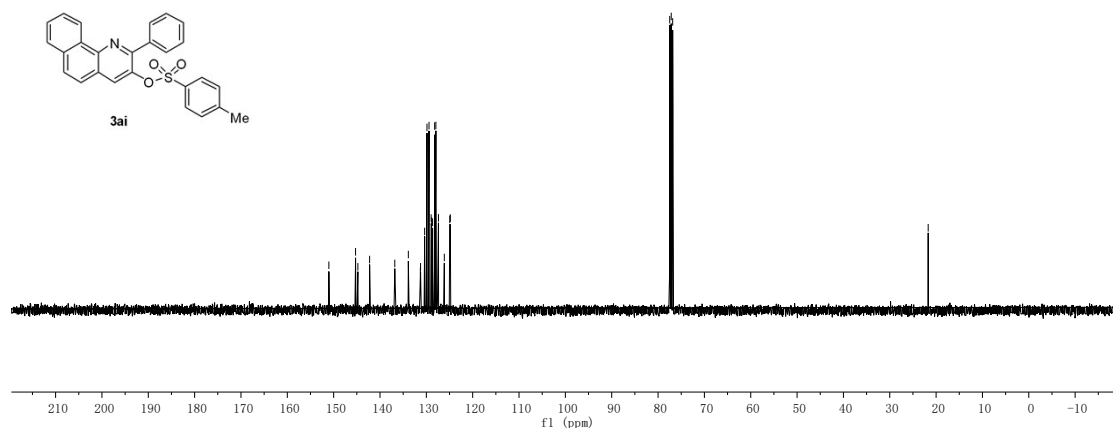
154.049
146.003
145.020
140.130
139.518
137.801
132.477
130.216
129.706
129.588
129.462
128.544
128.224
128.084
127.044
127.130
124.482

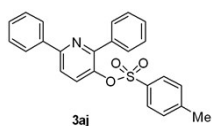
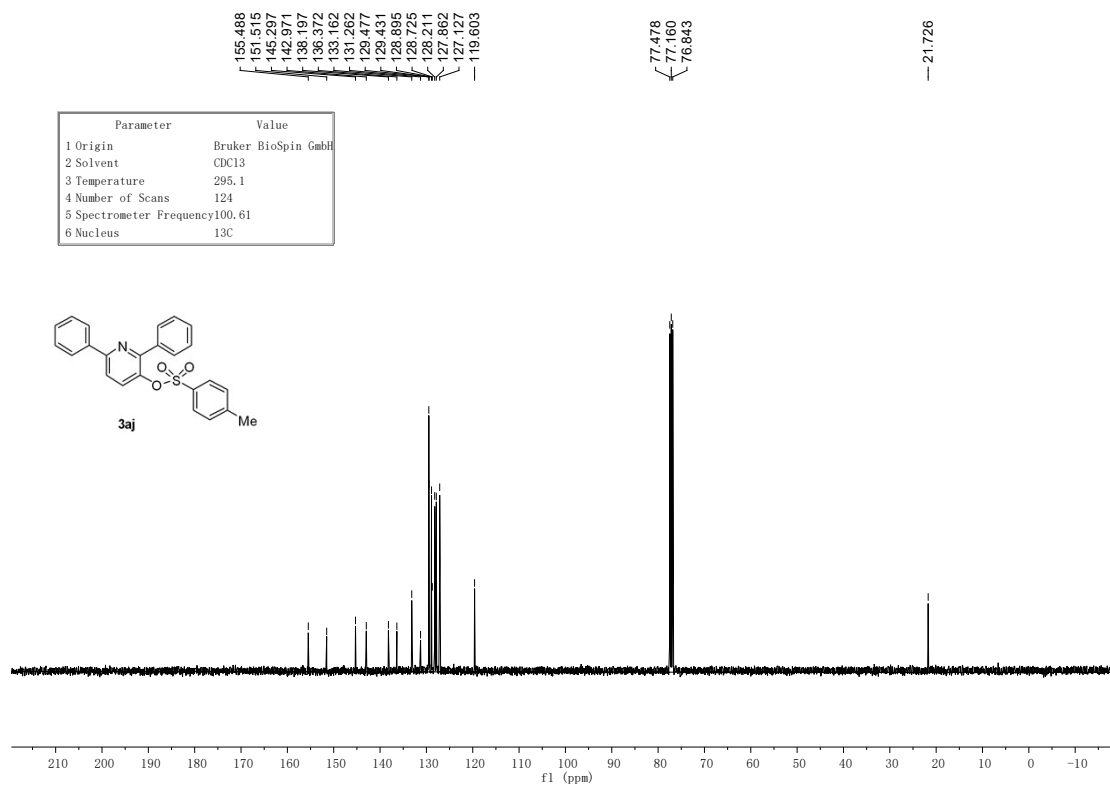
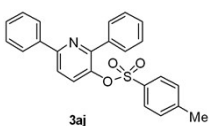
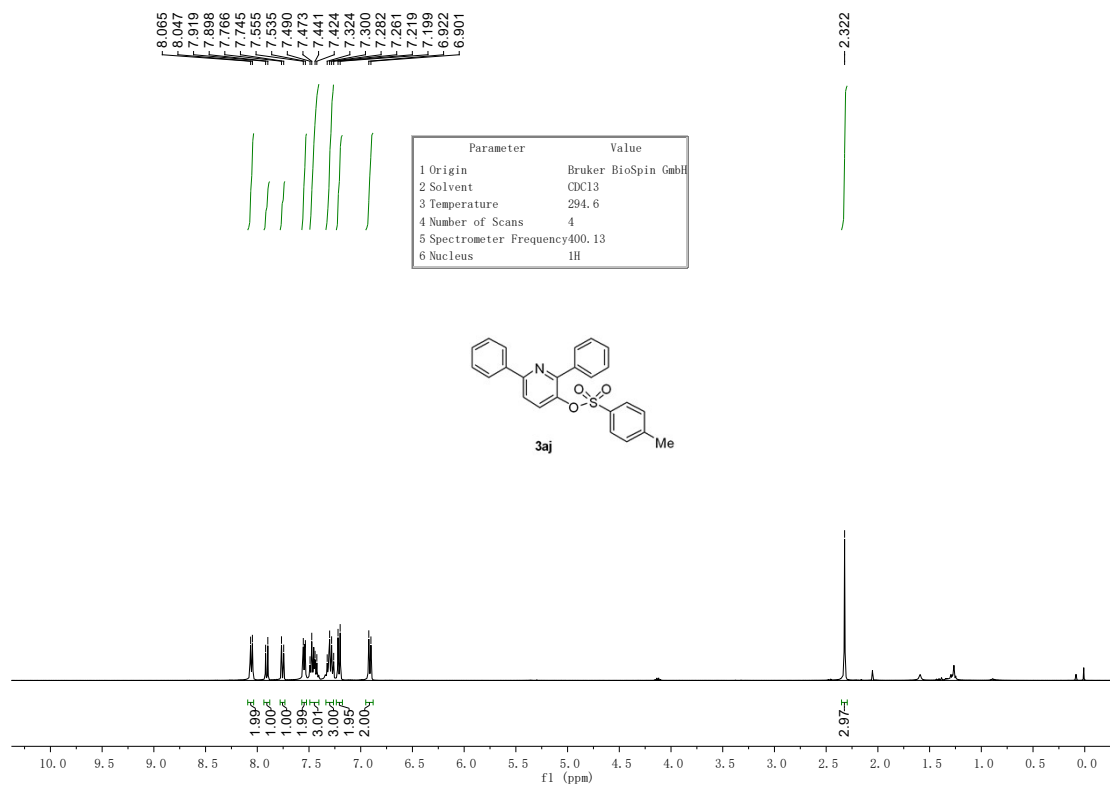
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.7
4 Number of Scans	42
5 Spectrometer Frequency	100.61
6 Nucleus	13C

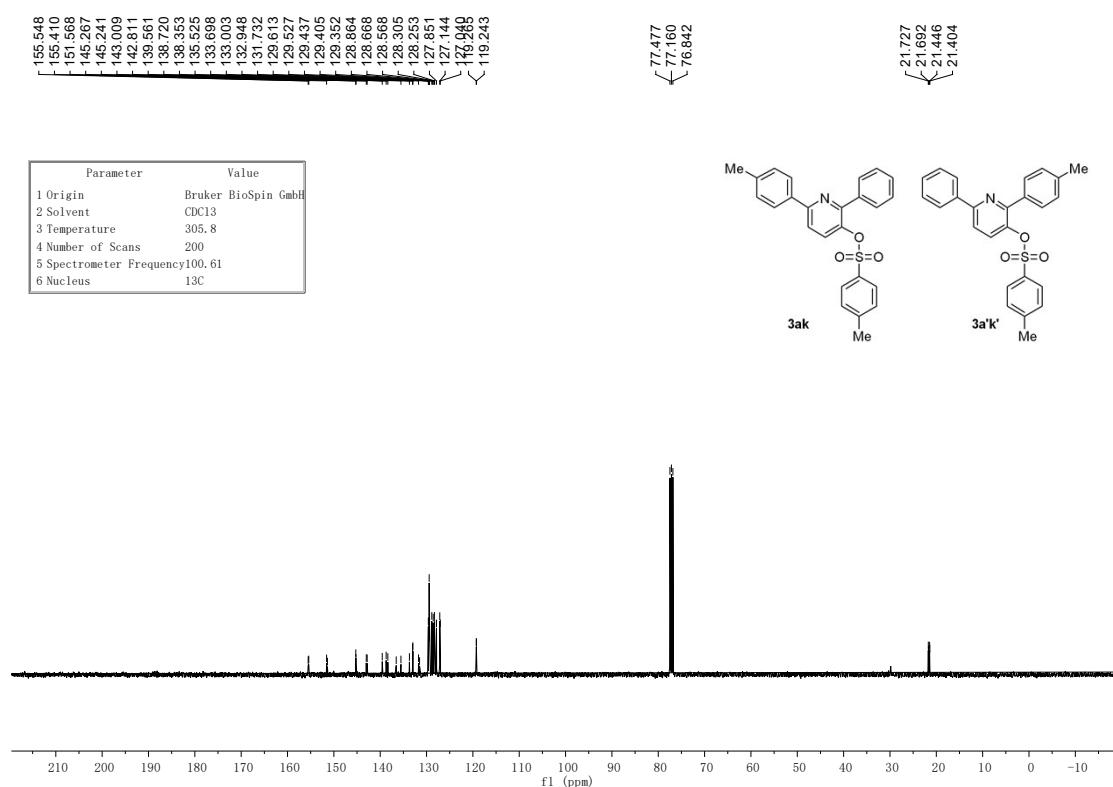
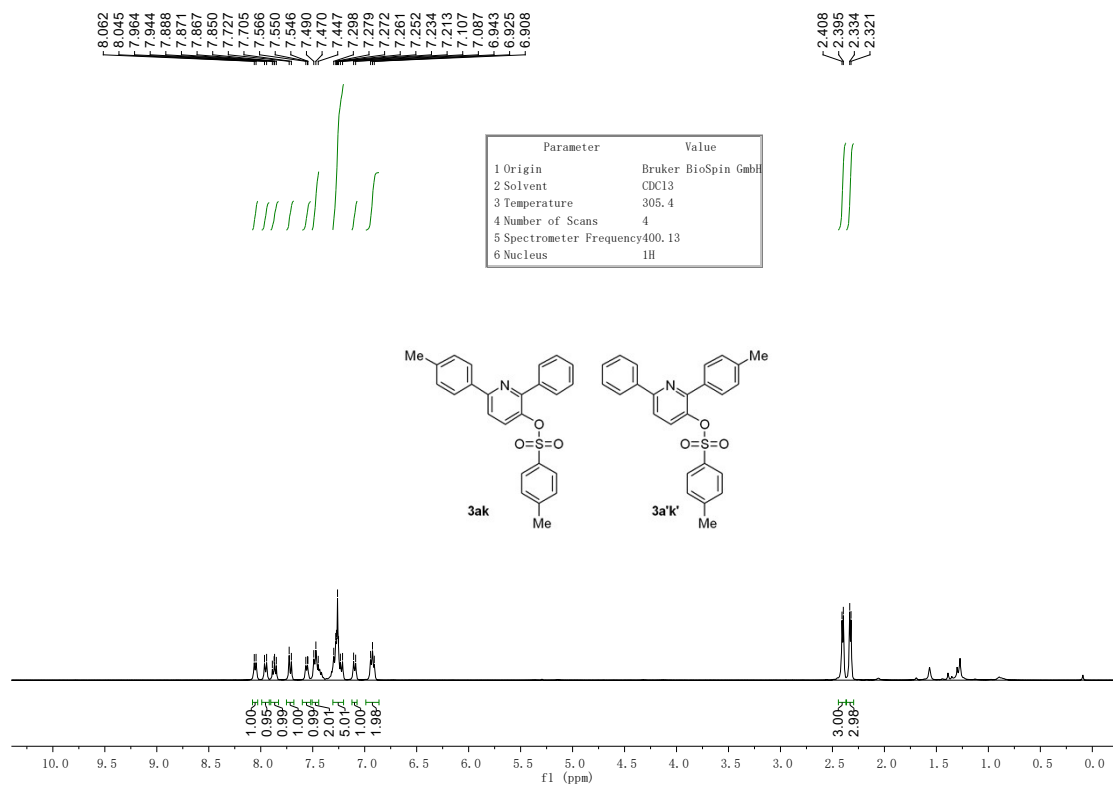


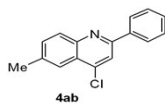
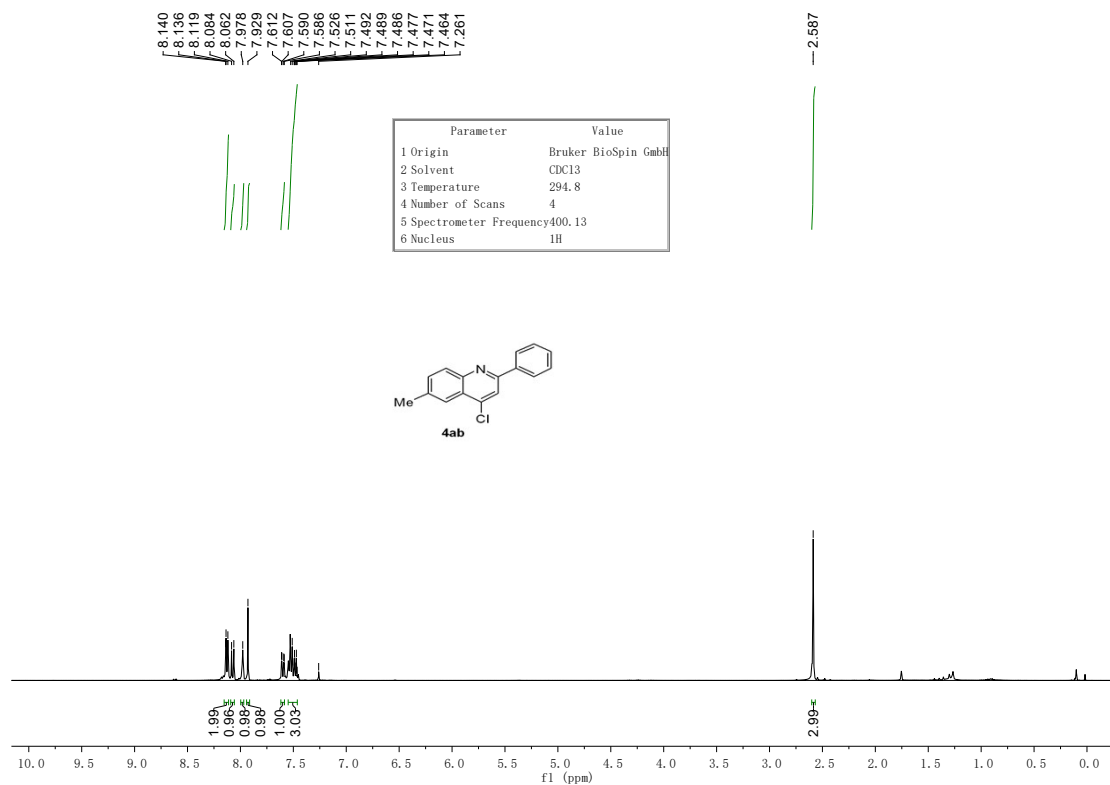


Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.5
4 Number of Scans	41
5 Spectrometer Frequency	100.61
6 Nucleus	13C

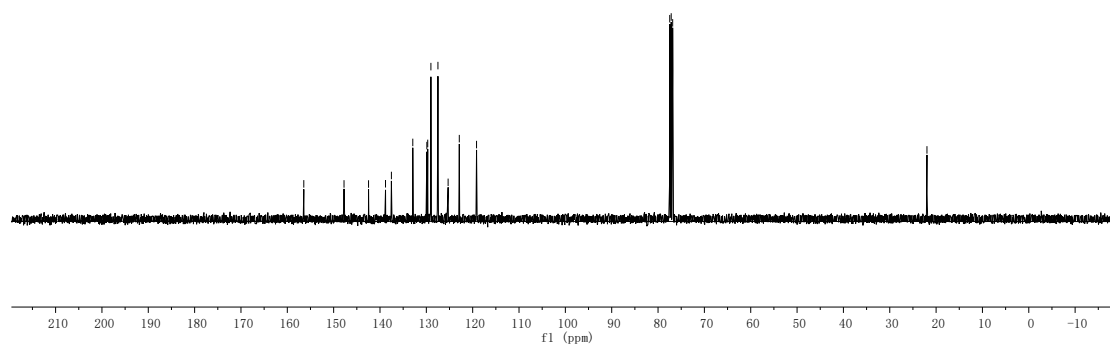
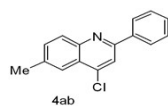


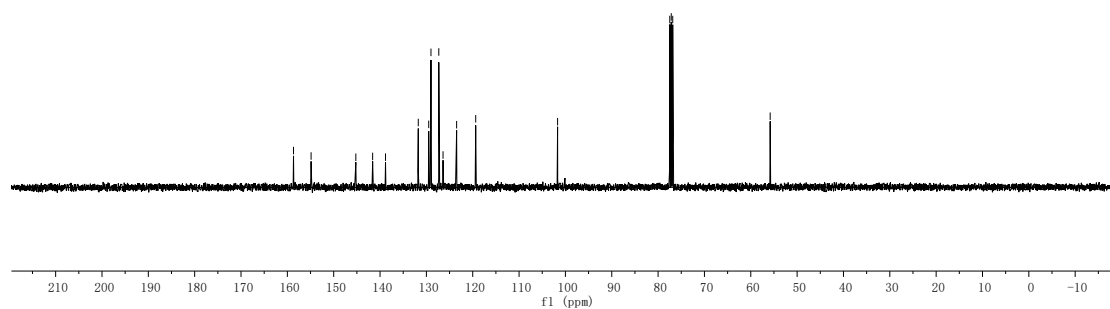
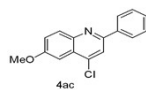
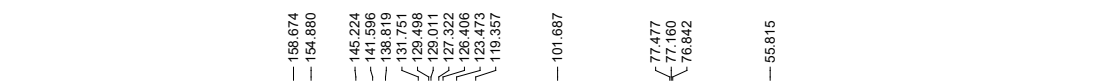
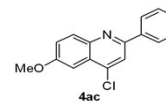
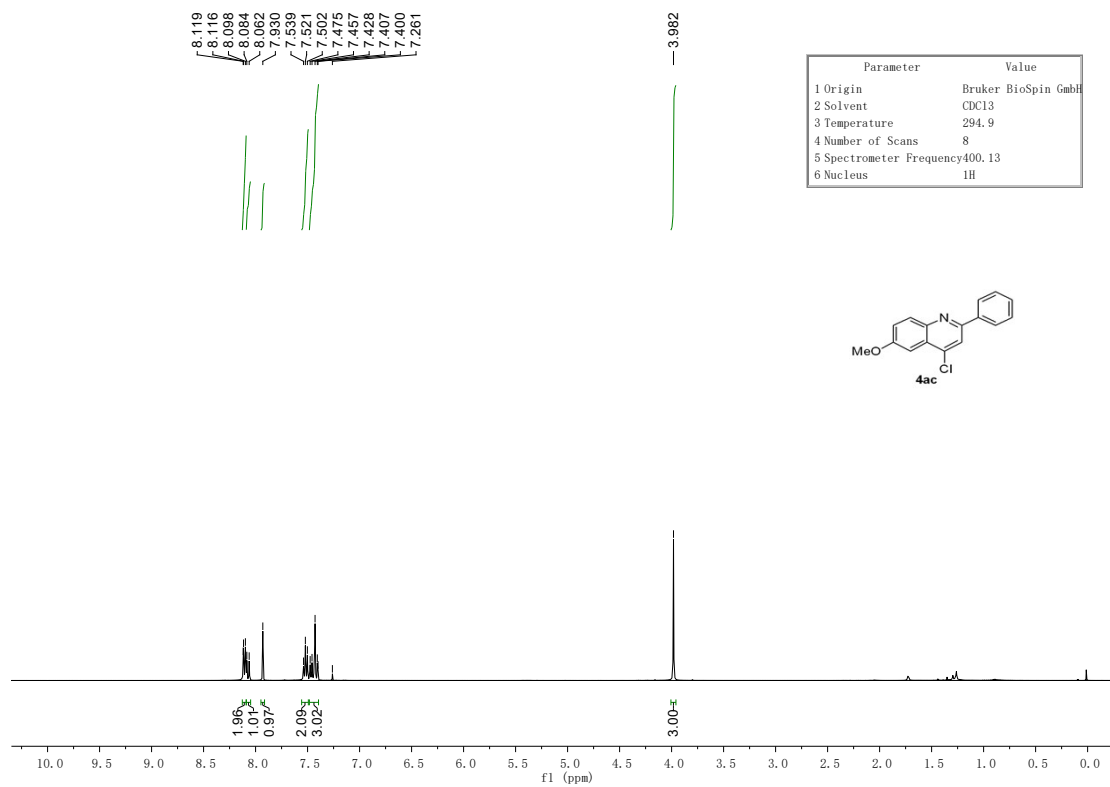






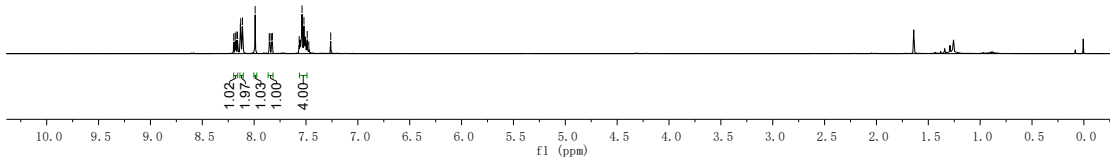
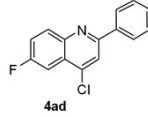
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.2
4 Number of Scans	21
5 Spectrometer Frequency	100.61
6 Nucleus	13C





8.197
8.163
8.174
8.160
8.153
8.149
8.142
7.890
7.847
7.831
7.824
7.566
7.538
7.520
7.488
7.473
7.261

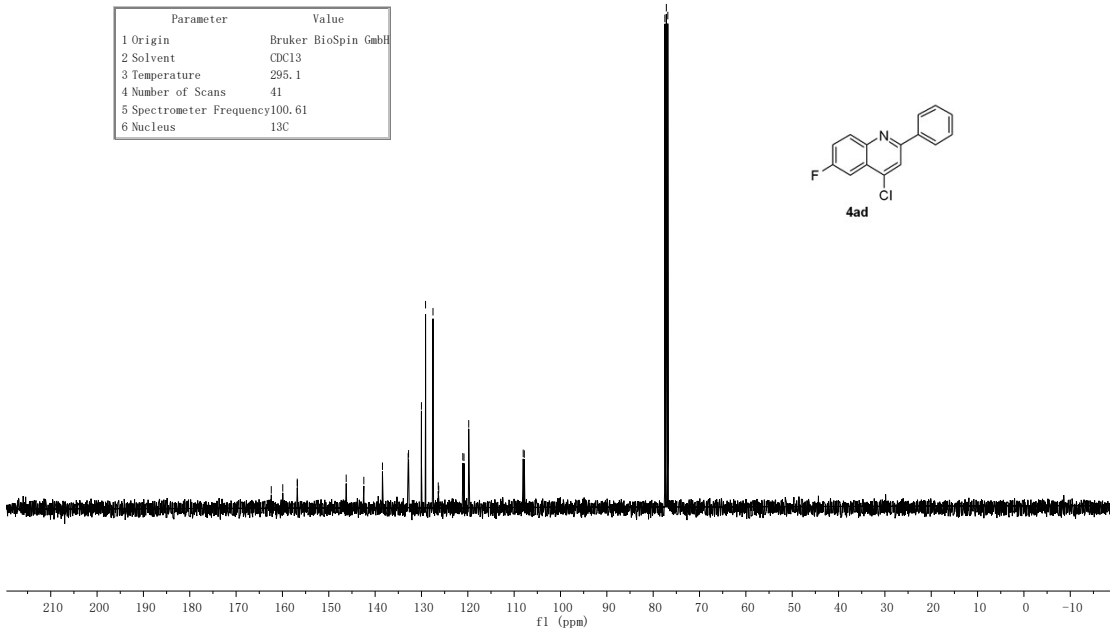
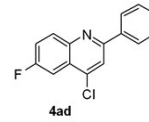
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.1
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



162.410
159.831
156.806
156.777
146.244
142.438
138.417
132.874
132.783
130.008
129.120
127.513
126.378
121.082
120.826
118.894
107.809

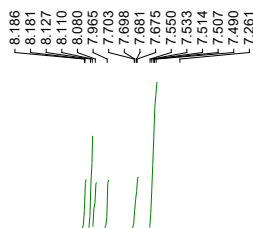
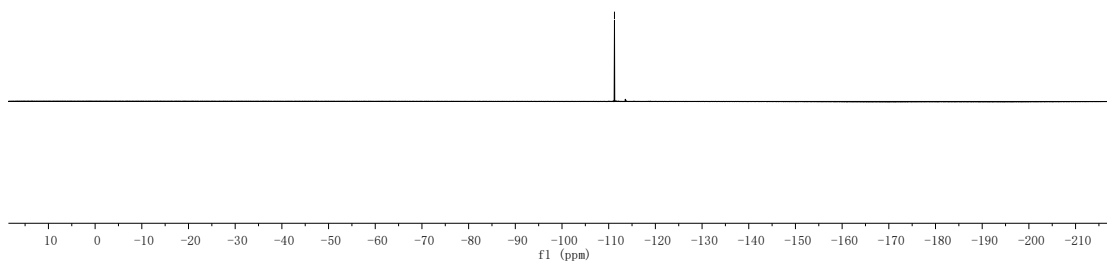
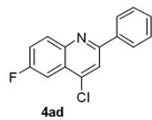
77.477
77.160
76.842

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.1
4 Number of Scans	41
5 Spectrometer Frequency	100.61
6 Nucleus	13C

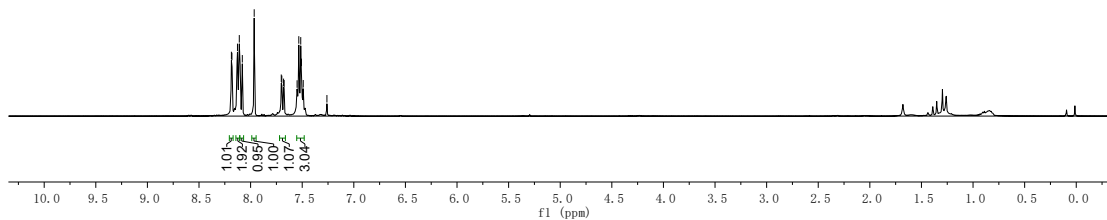
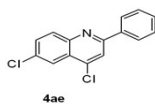


Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	292.0
4 Number of Scans	16
5 Spectrometer Frequency	376.50
6 Nucleus	¹⁹ F

-111.239

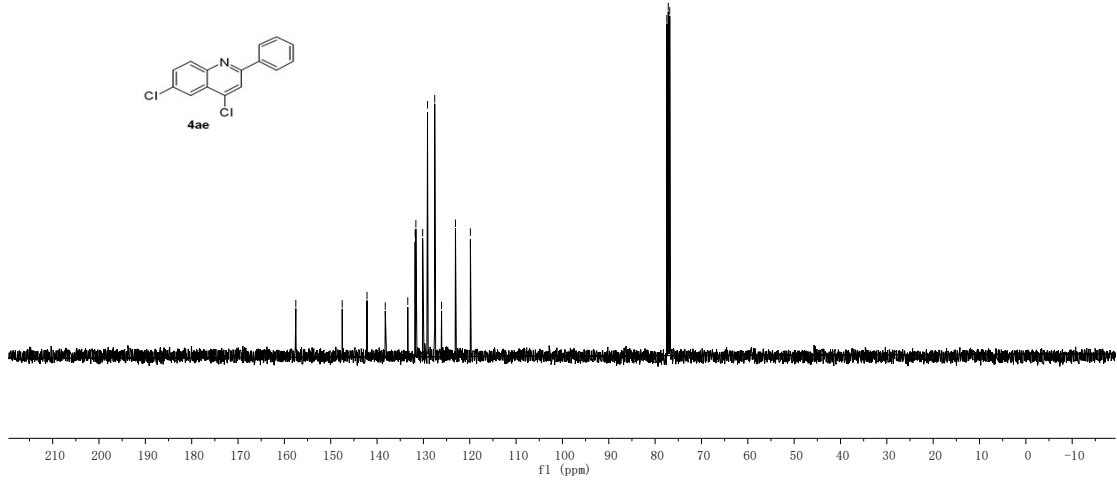
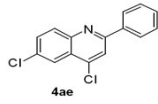


Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	¹ H

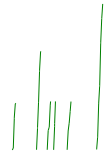


157.532
 147.521
 142.169
 138.232
 133.371
 131.781
 131.626
 130.160
 129.110
 127.558
 126.084
 123.081
 119.859
 77.479
 77.160
 76.844

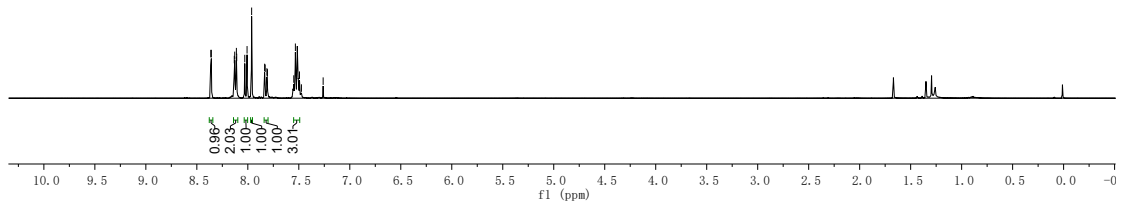
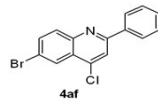
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.2
4 Number of Scans	30
5 Spectrometer Frequency	100.61
6 Nucleus	13C

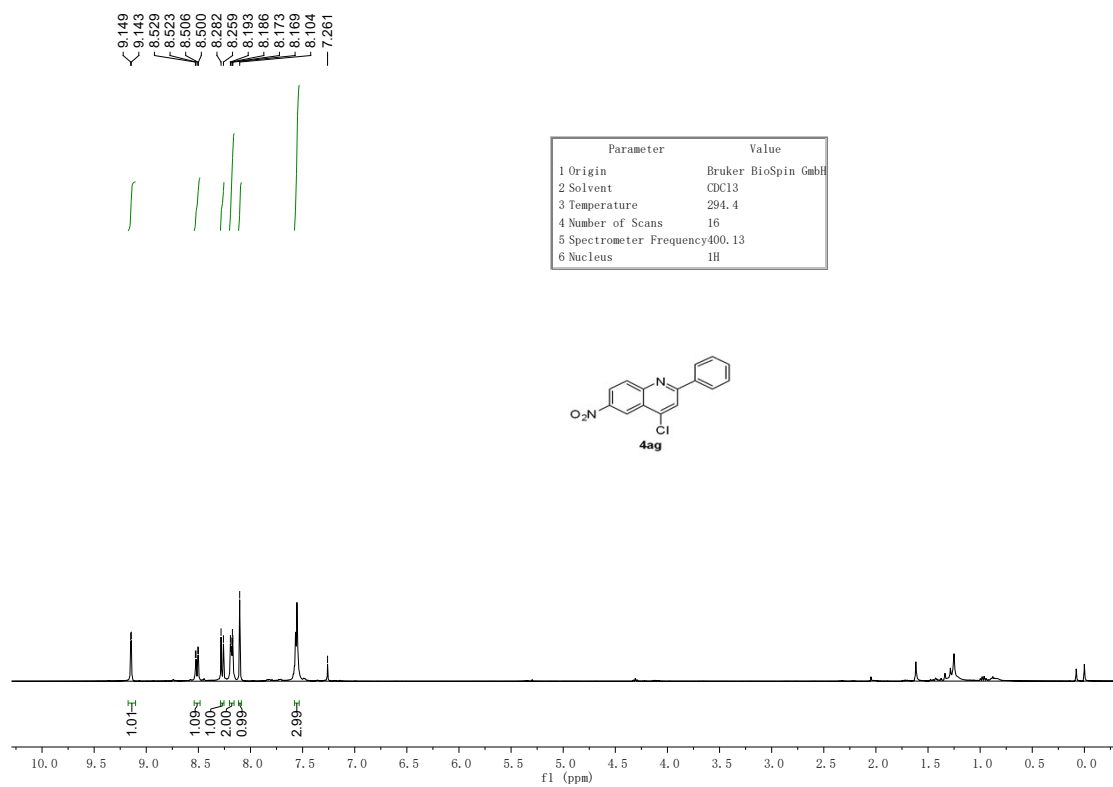
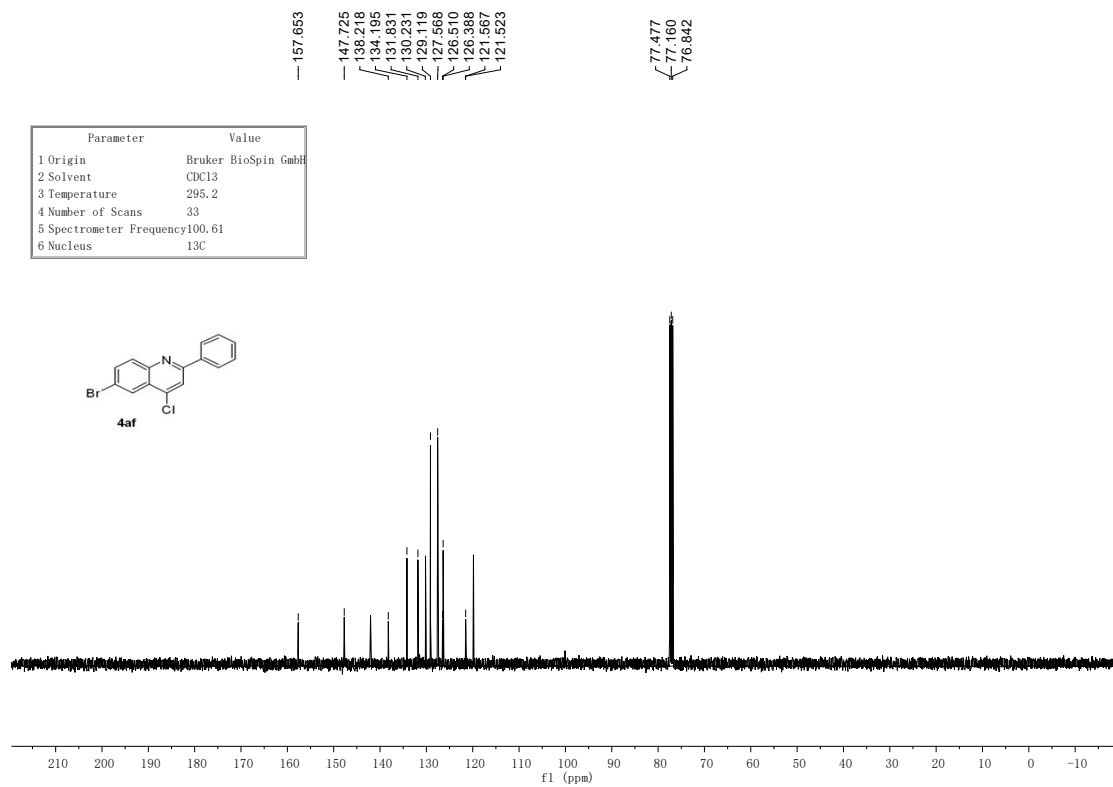


8.363
 8.335
 8.123
 8.112
 8.109
 8.030
 8.007
 7.962
 7.835
 7.830
 7.813
 7.807
 7.549
 7.534
 7.493
 7.474
 7.261



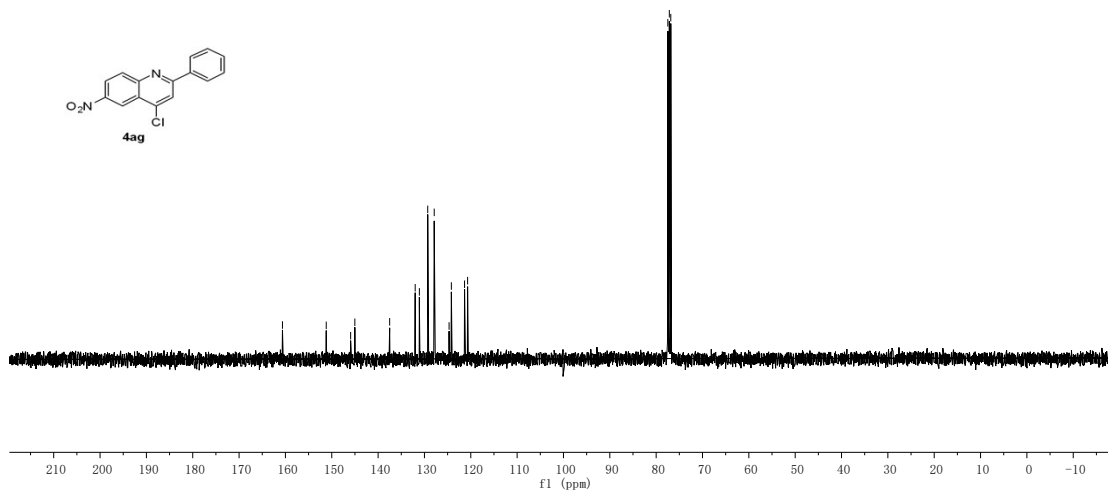
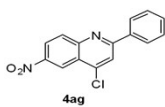
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H





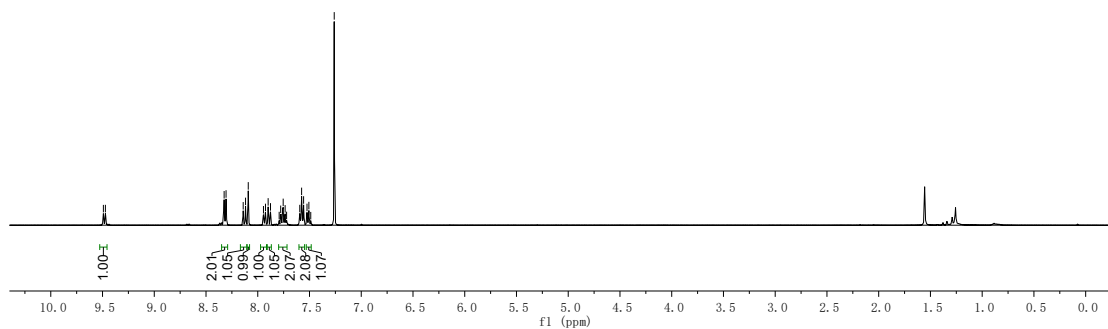
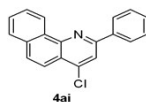
160.640
 151.193
 145.926
 145.019
 137.503
 132.000
 131.095
 129.291
 127.893
 124.686
 124.193
 121.344
 120.686
 77.477
 77.160
 76.842

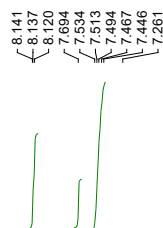
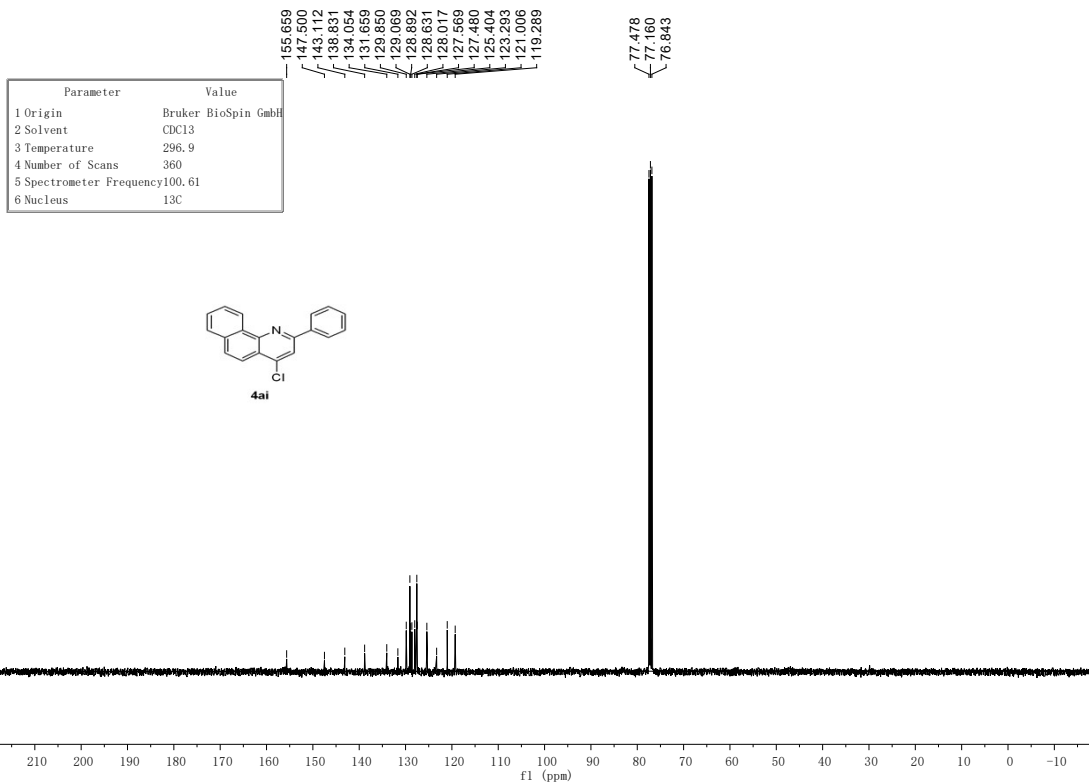
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.0
4 Number of Scans	40
5 Spectrometer Frequency	100.61
6 Nucleus	13C



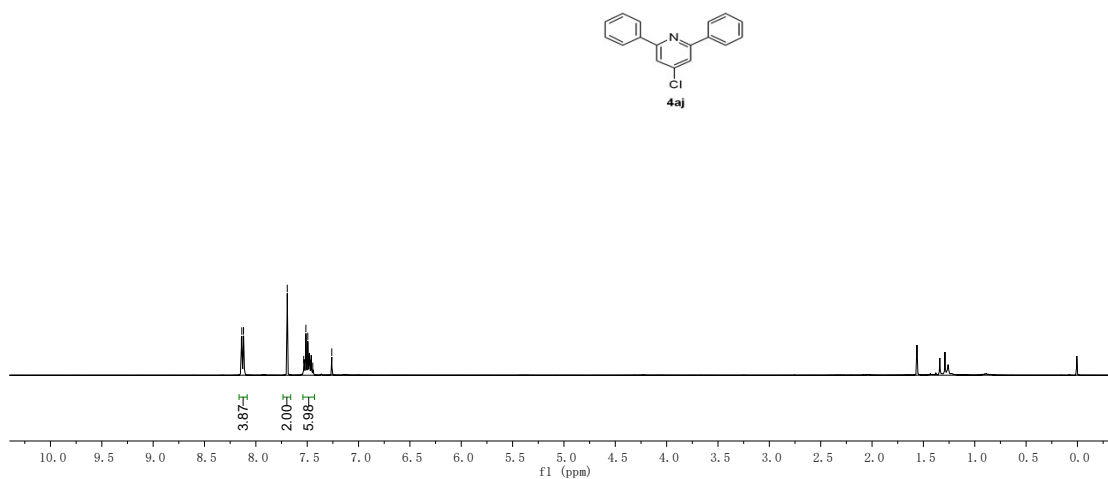
9.492
 8.325
 8.306
 8.141
 8.118
 8.092
 7.945
 7.925
 7.900
 7.877
 7.793
 7.778
 7.754
 7.721
 7.594
 7.576
 7.557
 7.524
 7.506
 7.488
 7.261

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	296.5
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



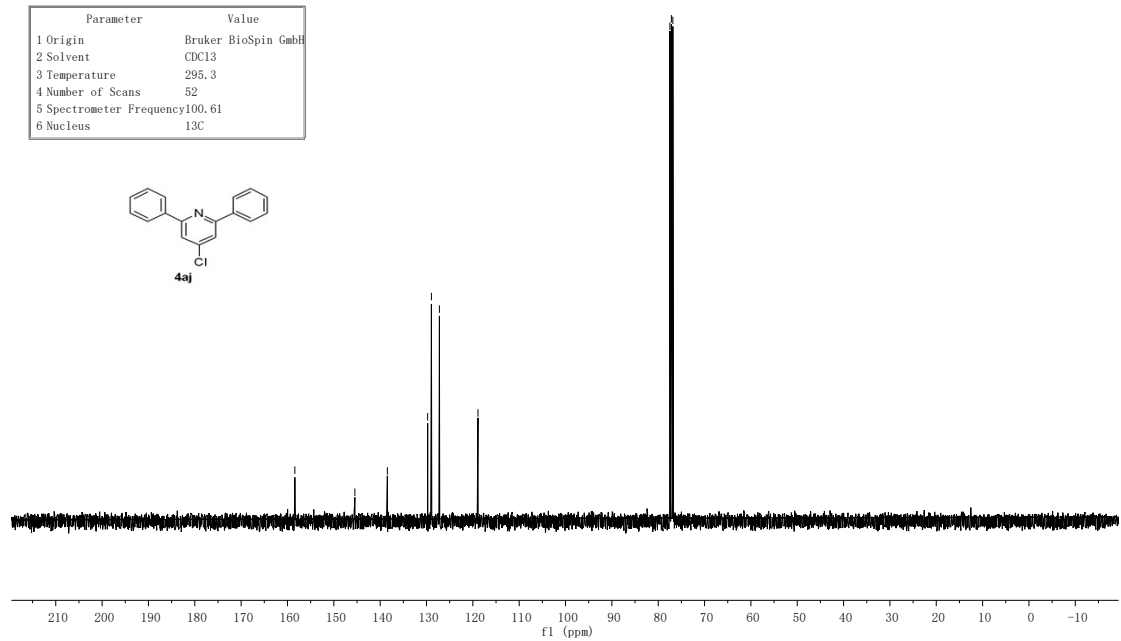
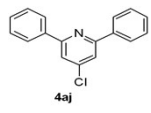


Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.2
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



158.409
 145.455
 138.447
 129.750
 128.942
 127.216
 118.896
 77.477
 77.160
 76.843

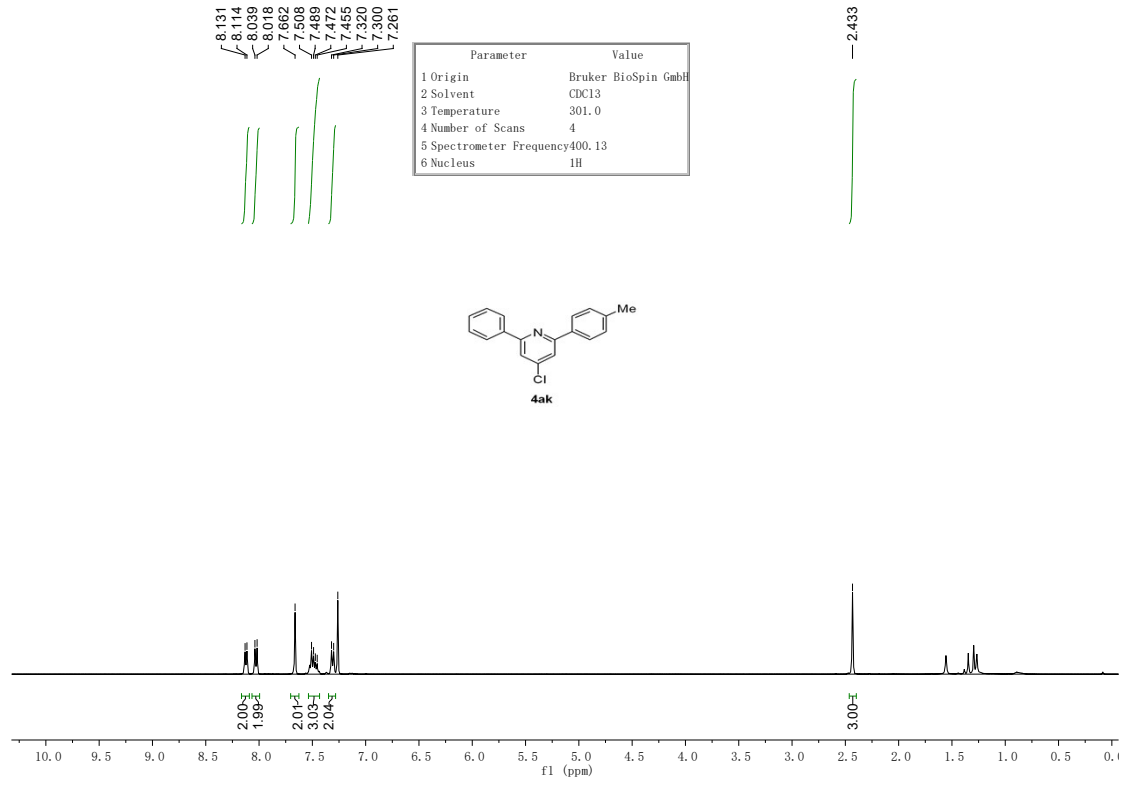
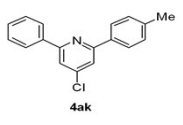
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	295.3
4 Number of Scans	52
5 Spectrometer Frequency	100.61
6 Nucleus	13C



8.131
 8.114
 8.039
 8.018
 7.662
 7.508
 7.489
 7.472
 7.455
 7.320
 7.300
 7.261

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	301.0
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H

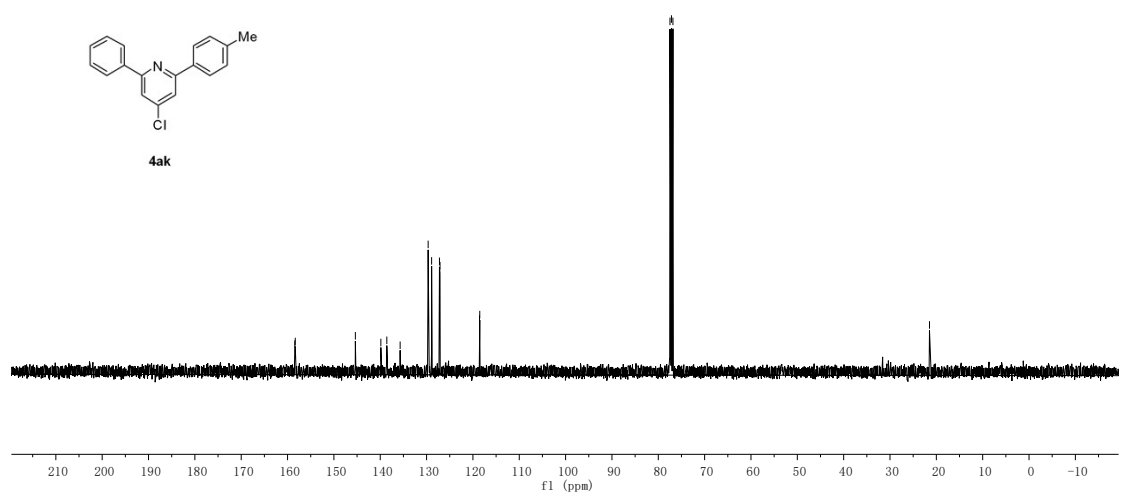
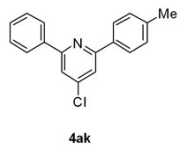
2.433



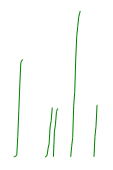
158.443
 158.335
 145.967
 139.866
 138.579
 135.706
 130.662
 128.912
 127.221
 127.102
 118.680
 118.524
 77.477
 77.160
 76.842

21.477

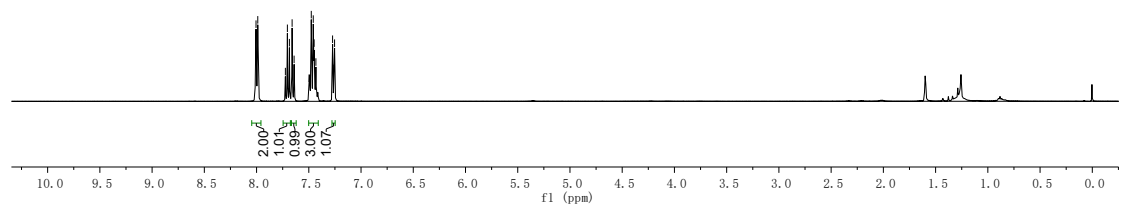
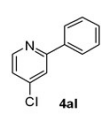
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	301.3
4 Number of Scans	60
5 Spectrometer Frequency	100.61
6 Nucleus	13C



8.009
 8.005
 7.988
 7.724
 7.705
 7.686
 7.660
 7.641
 7.498
 7.476
 7.457
 7.449
 7.432
 7.272
 7.261
 7.253



Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.5
4 Number of Scans	4
5 Spectrometer Frequency	400.13
6 Nucleus	1H



158.242
151.495
139.428
137.845
129.735
128.944
127.122
122.857
118.805
77.477
77.160
76.842

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Solvent	CDCl3
3 Temperature	294.9
4 Number of Scans	32
5 Spectrometer Frequency	100.61
6 Nucleus	13C

