Palladium-Catalyzed Intermolecular Oxidative Cyclization of *N*-Aryl Enamines with Isocyanides through Double sp^2 C-H Bonds Cleavage: Facile Synthesis of 4-Aminoquinoline Derivatives

Qiang Zheng,[a] Puying Luo,*,[b] Yuqing Lin,[a] Wenfan Chen,[a] Xiuxiu Liu,[a] Yadong Zhang,[a] and Qiuping Ding,*,[a]

[a] *Key Laboratory of Functional Small Organic Molecules, Ministry of Education and College of Chemistry & Chemical Engineering, Jiangxi Normal University, Nanchang, Jiangxi 330022, China. Fax: +86 791 88120380; Tel: +86 791 88120380. E-mail: dqpjxnu@gmail.com*

[b] *Department of Obstetrics and Gynecology, Jiangxi Provincial people's Hospital, Nanchang, Jiangxi 330006, P. R. China. E-mail:* luopuying1979@gmail.com

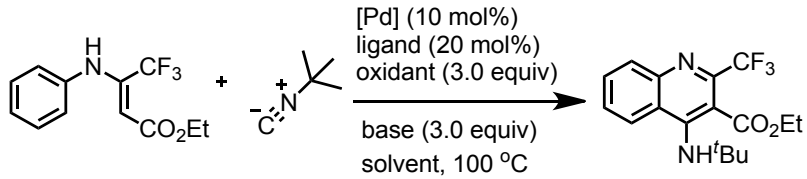
Supporting Information

1. The Optimization of Reaction Conditions.

2. Experimental procedure, and characterization data, ^{1}H, ^{13}C, and ^{19}F NMR spectra of compounds **3**.

3. NMR spectra of compounds **3**.

1. The Optimization of Reaction Conditions



1a **2** **3a**

entry	[Pd]	oxidant	ligand	base	solvent	Yield (%)[b]
1	$Pd(OAc)_2$	$Cu(OAc)_2$	-	K_2CO_3	Toluene	30
2	$Pd(OAc)_2$	$CuCl_2$	-	K_2CO_3	Toluene	28
3	$Pd(OAc)_2$	1,4-benzoquinone	-	K_2CO_3	Toluene	NR
4	$Pd(OAc)_2$	$K_2S_2O_8$	-	K_2CO_3	Toluene	13
5	$Pd(OAc)_2$	Ag_2CO_3	-	K_2CO_3	Toluene	trace
6	$Pd(OAc)_2$	$Cu(OAc)_2$	-	-	Toluene	NR
7	$Pd(OAc)_2$	$Cu(OAc)_2$	-	DBU	Toluene	NR
8	$Pd(OAc)_2$	$Cu(OAc)_2$	-	Cs_2CO_3	Toluene	37
9	$Pd(OAc)_2$	$Cu(OAc)_2$	-	NaO^tBu	Toluene	trace
10	$Pd(OAc)_2$	$Cu(OAc)_2$	-	K_2HPO_4	Toluene	NR
11	$Pd(OAc)_2$	$Cu(OAc)_2$	PCy_3	Cs_2CO_3	Toluene	35
12	$Pd(OAc)_2$	$Cu(OAc)_2$	PPh_3	Cs_2CO_3	Toluene	37
13	$Pd(OAc)_2$	$Cu(OAc)_2$	Ad_2P^nBu	Cs_2CO_3	Toluene	40
14	$Pd(OAc)_2$	$Cu(OAc)_2$	Xantphos	Cs_2CO_3	Toluene	35
15	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Toluene	57

16	$Pd(OAc)_2$	$Cu(OAc)_2$	3,8-dibromo-1,10-phen	Cs_2CO_3	Toluene	47
17	$Pd(OAc)_2$	$Cu(OAc)_2$	4,7-diphenyl-1,10-Phen	Cs_2CO_3	Toluene	52
18	$Pd(OAc)_2$	$Cu(OAc)_2$	4,7-dihydroxy-1,10-phen	Cs_2CO_3	Toluene	38
19	$Pd(OAc)_2$	$Cu(OAc)_2$	2,9-dimethyl-1,10-phen	Cs_2CO_3	Toluene	35
20	$Pd(TFA)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Toluene	42
21	$Pd_2(dba)_3$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Toluene	Trace
22	$PdCl_2(MeCN)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Toluene	41
23	$PdCl_2(PCy_3)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Toluene	Trace
24	$PdCl_2(PhCN)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Toluene	48
25	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Chlorobenzene	32
26	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	Dioxane	Trace
27	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	DMF	Trace
28	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	DCM	42
29	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	DMSO	Trace
30	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	THF	22
31	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	MeCN	33
32	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	DCE	61
33[c]	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	DCE	65
34[c,d]	$Pd(OAc)_2$	$Cu(OAc)_2$	1,10-phen	Cs_2CO_3	DCE	71

[a] Reaction conditions: all reaction were performed with *N*-phenyl enamine **1a** (0.2 mmol), *tert*-butyl isocyanide **2a** (3.0 equiv), [Pd] (10 mol%), ligand (20 mol%), oxidant (3.0 equiv), base (3.0 equiv), solvent (2.0 mL), at 100 °C for 16 h, at the atmosphere of N_2; [b] Isolated yield based on enamine **1a**, NR = no reaction; [c] At 80 °C; [d] *tert*-Butyl isocyanide was added for three times with equal amount (at the first, second, and third hour).

2. Typical procedure for palladium-catalyzed oxidative cyclization/isocyanide insertion of *N*-aryl enamines. A mixture of *N*-aryl enamine **1** (0.3 mmol) and isocyanide **2** (0.3 mmol), $Cu(OAc)_2$ (0.9 mmol, 3.0 equiv), $Pd(OAc)_2$ (10 mol%),

1,10-phen (20 mol%), Cs_2CO_3 (0.9 mmol, 3.0 equiv) and DCE (2.5 mL) were added into a tube under N_2. The mixture was stirred at 80 °C for 1 h, and then injected the second equivalent of isocyanide **2**. Subsequently, the third equivalent isocyanide **2** were added into the mixture after another hour. The reaction was monitored by TLC analysis for about 16 h. After being cooling to room temperature, evaporation of the solvent under reduced pressure followed purification by silica gel chromatography using petroleum ether/ethyl acetate (30:1) as eluent to provide the desired products **3**.

ethyl 4-(tert-butylamino)-2-(trifluoromethyl)quinoline-3-carboxylate (3a): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a yellow oil (48 mg, 71% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, *J* = 8.0 Hz 1H), 8.11 (d, *J* = 8.0 Hz 1H), 7.78 (t, *J* = 8.0 Hz 1H), 7.59 (t, *J* = 8.0 Hz 1H), 5.13 (s, 1H), 4.44 (q, *J* = 8.0 Hz, 2H), 1.42 (t, *J* = 6.0 Hz, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.2, 153.8, 147.6, 144.9 (q, $^2J_{CF}$ = 33.6 Hz), 131.4, 129.9, 127.2, 127.0, 126.9, 121.4 (q, $^1J_{CF}$ = 272.7 Hz), 118.4, 62.5, 57.3, 31.3, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.6. HRMS (ESI): *m/z* $[M + Na]^+$ calcd for $C_{17}H_{19}F_3N_2NaO_2$; 363.1296; found: 363.1289.

ethyl 4-(tert-butylamino)-6-isopropyl-2-(trifluoromethyl)quinoline-3-carboxylate (3b): Isolated (Rf = 0.8, EtOAc–petroleum ether = 1:30) as a yellow oil (91 mg, 80% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (s, 1H), 8.04 (d, *J* = 8.7 Hz, 1H), 7.68 (d, *J* = 7.3 Hz, 1H), 5.09 (s, 1H), 4.44 (q, *J* = 7.1 Hz, 2H), 3.15-3.09 (m, 1H), 1.42 (t, *J* = 7.1 Hz, 3H), 1.36 (d, *J* = 6.9 Hz, 6H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.4, 153.3, 147.8, 144.6, 144.0 (q, $^2J_{CF}$ = 34.0 Hz), 131.6, 129.7, 127.2, 123.0, 121.5 (q, $^1J_{CF}$ = 275.7 Hz), 118.5, 62.4, 57.1, 34.3, 31.3, 29.7, 23.7, 13.8; ^{19}F NMR

(376 MHz, $CDCl_3$) δ -63.47. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{20}H_{26}F_3N_2O_2$; 383.1946; found: 383.1962.

ethyl 4-(tert-butylamino)-6-methyl-2-(trifluoromethyl)quinoline-3-carboxylate (3c): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a white solid (40 mg, 56% yield), mp: 66-68 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 8.12 (s, 1H), 8.00 (d, *J* = 8.3 Hz, 1H), 7.60 (d, *J* = 8.4 Hz, 1H), 4.42 (q, 2H), 2.56 (s, 3H), 1.42 (t, *J* = 6.4 Hz, 3H), 1.24 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.3, 153.0, 146.1, 144.0 (q, $^2J_{CF}$ = 34.1 Hz), 137.3, 133.7, 129.6, 127.2, 125.8, 121.4 (q, $^1J_{CF}$ = 275.9 Hz), 118.6, 62.4, 57.0, 31.3, 21.8, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.48. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{22}F_3N_2O_2$; 355.1633; found: 355.1633.

ethyl 4-(tert-butylamino)-6-methoxy-2-(trifluoromethyl)quinoline-3-carboxylate (3d): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a white solid (44 mg, 63% yield), mp: 87-89 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 8.01 (d, *J* = 9.2 Hz, 1H), 7.67 (s, 1H), 7.42 (d, *J* = 9.1 Hz, 1H), 4.89 (s, 1H), 4.44 (q, *J* = 7.1 Hz, 2H), 3.96 (s, 3H), 1.42 (t, *J* = 7.1 Hz, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.3, 158.6, 152.0 , 143.5, 142.4 (q, $^2J_{CF}$ = 34.0 Hz), 131.4, 128.9, 124.1, 121.5 (q, $^1J_{CF}$ = 275.7 Hz), 119.5, 104.9, 62.4, 57.2, 55.6, 31.3, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.32. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{22}F_3N_2O_3$; 371.1583; found: 371.1583.

ethyl4-(tert-butylamino)-6-(dimethylamino)-2-(trifluoromethyl)quinoline-3-carboxylate (3e): Isolated (Rf = 0.4, EtOAc–petroleum ether = 1:30) as a yellow solid (42 mg, 37% yield), mp: 58-60 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 12.0 Hz, 1H), 7.39-7.33 (m, 2H), 4.79 (s, 1H), 4.42 (q, *J* = 6.7 Hz, 2H), 3.12 (s, 6H),

1.41 (t, J = 8.0 Hz, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.7, 150.7, 149.1 , 141.1, 140.1 (q, $^2J_{CF}$ = 32.9 Hz), 130.7, 129.3, 124.5 (q, $^1J_{CF}$ = 275.1 Hz), 120.4, 119.3, 104.2, 62.2, 56.9, 40.5, 31.4, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.46. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{19}H_{25}F_3N_3O_2$; 384.1899; found: 384.1896.

ethyl 4-(tert-butylamino)-6-phenoxy-2-(trifluoromethyl)quinoline-3-carboxylate (3f): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a yellow oil (57 mg, 44% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, J = 8.0 Hz, 1H), 7.59-7.57 (m, 2H), 7.43 (t, J = 8.0 Hz, 2H), 7.26-7.21 (m, 1H), 7.12 (d, J = 8.0 Hz, 2H), 4.89 (s, 1H), 4.44-4.38 (q, J = 8.0 Hz, 2H), 1.40 (t, J = 8.0 Hz, 3H), 1.06 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.1, 157.3, 155.6, 152.4, 144.0, 143.2 (q, $^2J_{CF}$ = 32.9 Hz), 131.8, 130.2, 129.8, 128.4, 124.8, 124.6, 120.6, 121.4 (q, $^1J_{CF}$ = 275.1 Hz), 119.4, 118.8, 111.1; 62.5, 56.8, 31.1, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.48. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{23}H_{24}F_3N_2O_3$; 433.1739; found: 433.1733.

ethyl4-(tert-butylamino)-6-fluoro-2-(trifluoromethyl)quinoline-3-carboxylate (3g): Isolated (Rf = 0.6, EtOAc–petroleum ether = 1:30) as a yellow oil (38 mg, 56% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 9.1, 5.5 Hz, 1H), 7.98 (dd, J = 9.8, 2.5 Hz, 1H), 7.55 (t, J = 8.5 Hz, 1H), 4.98 (s, 1H), 4.44 (d, J = 14.3, 7.2 Hz, 2H), 1.42 (t, J = 7.2 Hz, 3H), 1.24 (s, 9H); ^{13}C NMR (100MHz, $CDCl_3$) δ 166.9, 161.1 (d, $^1J_{CF}$ = 249.0 Hz), 153.2, 144.6, 144.3 (q, $^2J_{CF}$ = 31.0 Hz), 137.2, 132.5, 128.7, 121.5, 121.2 (q, $^1J_{CF}$ = 274.0 Hz), 110.4, 62.6, 57.3, 31.2, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.66, -110.31. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{17}H_{19}F_4N_2O_2$; 359.1383; found: 359.1391.

ethyl 4-(tert-butylamino)-6-chloro-2-(trifluoromethyl)quinoline-3-carboxylate (3h): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a white solid (44 mg, 59% yield), mp: 71-73 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (s, 1H), 8.05 (d, *J* = 8.0 Hz, 1H), 7.71 (d, *J* = 8.0 Hz, 1H), 4.44 (q, *J* = 8.0 Hz, 2H), 1.42 (t, *J* = 8.0 Hz, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 153.0, 145.9, 145.1 (q, $^{2}J_{CF}$ = 34.0 Hz), 133.5, 132.3, 131.4, 128.0, 125.9, 121.2 (q, $^{1}J_{CF}$ = 275.0 Hz), 119.2, 62.7, 57.4, 31.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.73. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{17}H_{19}ClF_3N_2O_2$; 375.1087; found: 375.1092.

ethyl 6-bromo-4-(tert-butylamino)-2-(trifluoromethyl)quinoline-3-carboxylate (3i): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a white solid (51 mg, 61% yield), mp: 80-82 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (s, 1H), 7.97 (d, *J* = 8.0 Hz, 1H), 7.84 (d, *J* = 8.0 Hz, 1H), 5.10 (s, 1H), 4.44 (q, *J* = 8.0 Hz, 2H), 1.42 (t, *J* = 8.0 Hz, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 152.9, 146.2, 145.3 (q, $^{2}J_{CF}$ = 33.7 Hz), 134.9, 131.5, 129.3, 128.4, 121.6, 120.4 (q, $^{1}J_{CF}$ = 274.7 Hz), 119.1, 62.6, 57.4, 31.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.75. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{17}H_{19}BrF_3N_2O_2$; 419.0582; found: 419.0577.

ethyl4-(tert-butylamino)-6-(trifluoromethoxy)-2-(trifluoromethyl)quinoline-3-carboxylate (3j): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a yellow solid (44 mg, 53% yield), mp: 45-47 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (d, *J* = 8.0 Hz, 1H), 8.12 (d, *J* = 8.0 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 5.11 (s, 1H), 4.45 (q, *J* = 8.0 Hz, 2H), 1.43 (t, *J* = 8.0 Hz, 3H), 1.24 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 153.7, 147.6, 145.7, 145.4 (q, $^{2}J_{CF}$ = 34.0 Hz), 132.2, 127.9, 125.4, 121.9, 121.2 (q,

$^{1}J_{CF}$ = 274.0 Hz), 119.3, 116.9, 62.7, 57.4, 31.2, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -57.75, -63.78. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{19}F_6N_2O_3$; 425.1300; found: 425.1307.

ethyl 4-(tert-butylamino)-6-cyano-2-(trifluoromethyl)quinoline-3-carboxylate (3k): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a yellow solid (34 mg, 47% yield), mp: 83-85 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.70 (s, 1H), 8.19 (d, *J* = 8.7 Hz, 1H), 7.91 (d, *J* = 8.7 Hz, 1H), 4.46 (q, *J* = 7.2 Hz, 2H), 1.43 (t, *J* = 7.2 Hz, 3H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.4, 154.4, 148.7, 147.6 (q, $^{2}J_{CF}$ = 34.3 Hz), 133.3, 131.9, 131.3, 126.5, 121.2 (q, $^{1}J_{CF}$ = 273 Hz), 119.2, 118.2, 110.7, 62.9, 57.9, 31.4, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -64.01. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{19}F_3N_3O_2$; 366.1429; found: 366.1425.

diethyl 4-(tert-butylamino)-2-(trifluoromethyl)quinoline-3,6-dicarboxylate (3l): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a yellow solid (61 mg, 47% yield), mp: 62-64 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.08 (s, 1H), 8.34 (d, *J* = 8.2 Hz, 1H), 8.12 (d, *J* = 8.7 Hz, 1H), 5.53 (s, 1H), 4.49-4.42 (m, 4H), 1.48-1.41 (m, 6H), 1.32 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.9, 165.7, 155.1, 149.5, 146.9 (q, $^{2}J_{CF}$ = 34.1 Hz), 130.8, 130.1, 130.0, 128.4, 125.5, 121.2 (q, $^{1}J_{CF}$ = 276.7 Hz), 117.4, 62.6, 61.5, 57.5, 31.5, 14.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.85. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{20}H_{23}F_3N_2O_4$; 413.1688; found: 413.1684.

ethyl 4-(tert-butylamino)-7-methyl-2-(trifluoromethyl)quinoline-3-carboxylate (3m): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a yellow solid (46 mg, 65% yield), mp: 83-85 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (d, *J* = 8.0 Hz, 1H), 7.89 (s,

1H), 7.41 (d, J = 8.0 Hz, 1H), 5.11 (s, 1H), 4.45-4.40 (q, J = 6.7 Hz, 2H), 2.56 (s, 3H), 1.42 (t, J = 8.0 Hz, 3H), 1.23 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.4, 153.6 , 147.9, 144.9 (q, $^2J_{CF}$ = 34.0 Hz), 142.2, 129.3, 128.9, 126.7, 125.1 , 121.4 (q, $^1J_{CF}$ = 274.5 Hz), 117.8, 62.4, 57.2, 31.3, 21.6, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.58. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{22}F_3N_2O_2$; 355.1633; found: 355.1621.

ethyl 4-(tert-butylamino)-2,7-bis(trifluoromethyl)quinoline-3-carboxylate (3n): Isolated (Rf = 0.6, EtOAc–petroleum ether = 1:30) as a yellow oil (35 mg, 43% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (d, J = 8.8 Hz, 1H), 8.43 (s, 1H), 7.75 (d, J = 8.8 Hz, 1H), 5.24 (s, 1H), 4.46 (q, J = 7.2 Hz, 2H), 1.44 (t, J = 7.1 Hz, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.7, 153.9, 146.8, 146.3 (q, J = 34.5 Hz), 133.2 (q, $^2J_{CF}$ = 32.8 Hz), 128.8, 128.4, 127.6, 122.6 (q, $^1J_{CF}$ = 271.0 Hz), 122.5, 119.6, 62.8, 57.7, 56.1, 31.3, 30.0, 29.9, 13.9, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.10, -63.97. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{19}F_6N_2O_2$; 409.1351; found: 409.1342.

ethyl 7-bromo-4-(tert-butylamino)-2-(trifluoromethyl)quinoline-3-carboxylate (3o): Isolated (Rf = 0.6, EtOAc–petroleum ether = 1:30) as a white solid (43 mg, 51% yield), mp: 53-55 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (s, 1H), 8.13 (d, J = 12.0 Hz, 1H), 7.58 (d, J = 12.0 Hz, 1H), 5.10 (s, 1H), 4.38-4.33 (q, J = 6.7 Hz, 2H), 1.34 (t, J = 6.0 Hz, 3H), 1.16 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.9, 154.1, 148.3, 145.9 (q, $^2J_{CF}$ = 33.0 Hz), 132.1, 130.5, 128.3, 126.1, 125.9, 121.1 (q, $^1J_{CF}$ = 275.0 Hz), 118.5, 62.6, 57.5, 31.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.82. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{17}H_{19}BrF_3N_2O_2$; 419.0582; found: 419.0578.

ethyl 4-(tert-butylamino)-7-chloro-2-(trifluoromethyl)quinoline-3-carboxylate

(3p): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a yellow solid (48 mg, 51% yield), mp: 46-48 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, J = 12.0 Hz, 1H), 8.11 (s, 1H), 7.52 (d, J = 12.0 Hz, 1H), 5.18 (s, 1H), 4.46-4.41 (q, J = 6.7 Hz, 2H), 1.42 (t, J = 8.0 Hz, 3H), 1.24 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.9, 154.0, 148.1 , 146.0 (q, $^{2}J_{CF}$ = 34.0 Hz), 137.7, 128.7, 128.4, 127.9, 125.6, 121.1 (q, $^{2}J_{CF}$ = 275.0 Hz), 118.5, 62.6, 57.5, 31.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.82. HRMS (ESI): *m/z* [M + H]$^{+}$ calcd for $C_{17}H_{19}ClF_3N_2O_2$; 375.1087; found: 375.1100.

ethyl 4-(tert-butylamino)-7-fluoro-2-(trifluoromethyl)quinoline-3-carboxylate (3q): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a white solid (27 mg, 25% yield), mp: 79-81 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, J = 8.5 Hz, 1H), 7.92-7.65 (m, 1H), 7.29 – 7.18 (m, 1H), 5.49 (s, 1H), 4.42 (q, J = 7.2 Hz, 2H), 1.41 (t, J = 7.2 Hz, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.7, 158.8 (d, $^{1}J_{CF}$ = 257.2 Hz), 151.7, 148.8, 145.7 (q, $^{2}J_{CF}$ = 33.0 Hz), 130.6, 126.8, 121.1 (q, $^{1}J_{CF}$ = 276.3 Hz), 118.2, 116.9, 113.2 (d, $^{2}J_{CF}$ = 23.6 Hz), 62.4, 58.5, 30.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -64.08, -108.45. HRMS (ESI): *m/z* [M + H]$^{+}$ calcd for $C_{17}H_{19}F_4N_2O_2$; 359.1383; found: 353.1390.

ethyl 4-(tert-butylamino)-8-fluoro-2-(trifluoromethyl)quinoline-3-carboxylate (3q'): Isolated (Rf = 0.8, EtOAc–petroleum ether = 1:30) as a yellow oil (48 mg, 45% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (dd, J = 9.2, 6.1 Hz, 1H), 7.66 (dd, J = 9.6, 2.1 Hz, 1H), 7.29 (t, J = 7.4 Hz, 1H), 5.11 (s, 1H), 4.36 (q, J = 7.1 Hz, 2H), 1.35 (t, J = 7.1 Hz, 3H), 1.16 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.0, 164.3 (d, J^{1} = 254.1 Hz), 154.1, 149.1 (d, $^{3}J_{CF}$ = 13.4 Hz), 146.1 (q, J^{2} = 34.1 Hz), 129.5 (d, $^{3}J_{CF}$ =

9.9 Hz), 124.2, 121.2 (q, $^{1}J_{CF}$ = 276.3 Hz), 117.9, 117.4 (d, $^{2}J_{CF}$ = 25.0 Hz), 113.5 (d, $^{2}J_{CF}$ = 20.8 Hz), 62.6, 57.5, 31.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -64.08, -108.45. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{17}H_{18}F_4N_2NaO_2$; 381.1202; found: 381.1199.

ethyl 4-(tert-butylamino)-8-methyl-2-(trifluoromethyl)quinoline-3-carboxylate (3r): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a white solid (42 mg, 60% yield), mp: 48-50 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.0 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 7.46 (t, *J* = 8.0 Hz, 1H), 5.05 (s, 1H), 4.46-4.41 (q, *J* = 6.7 Hz, 2H), 2.79 (s, 3H), 1.42 (t, *J* = 8.0 Hz, 3H), 1.22 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.5, 153.7, 146.7, 143.4 (q, $^{2}J_{CF}$ = 34.0 Hz), 138.1, 131.5, 127.4, 126.7, 124.7, 121.5 (q, $^{1}J_{CF}$ = 275.0 Hz), 118.4 (s), 62.4, 57.1, 31.3, 17.8, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.54. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{22}F_3N_2O_2$; 355.1633; found: 355.1636.

ethyl 4-(tert-butylamino)-8-ethyl-2-(trifluoromethyl)quinoline-3-carboxylate (3s): Isolated (Rf = 0.7, EtOAc–petroleum ether = 1:30) as a white oil (48 mg, 65% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 7.6 Hz, 1H), 7.61 (d, *J* = 6.7 Hz, 1H), 5.49 (t, *J* = 8.8 Hz, 1H), 5.05 (s, 1H), 4.43 (q, *J* = 7.2 Hz, 2H), 3.28 (q, *J* = 7.5 Hz, 2H), 1.42 (t, *J* = 7.2 Hz, 3H), 1.37 (t, *J* = 7.5 Hz, 4H), 1.22 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.5, 153.7, 146.1, 143.8, 143.3 (q, $^{2}J_{CF}$ = 33.8 Hz), 129.9, 127.4, 126.9, 124.7, 121.5 (q, $^{1}J_{CF}$ = 276.0 Hz), 118.4, 62.4, 57.1, 31.3, 24.6, 14.9, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.59. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{19}H_{24}F_3N_2O_2$; 369.1790; found: 369.1774.

ethyl4-(tert-butylamino)-8-methoxy-2-(trifluoromethyl)quinoline-3-carboxylate

(3t): Isolated (Rf = 0.4, EtOAc–petroleum ether = 1:30) as a yellow solid (40 mg, 62% yield), mp: 55-57 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.0 Hz, 1H), 7.51 (t, *J* = 6.7 Hz, 1H), 7.12 (d, *J* = 8.0 Hz, 1H), 5.03 (s, 1H), 4.46-4.41 (q, *J* = 6.7 Hz, 2H), 4.08(s, 3H), 1.42 (t, *J* = 8.0 Hz 3H), 1.23 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.2,155.7, 153.6, 143.5 (q, $^{2}J_{CF}$ = 34.0 Hz), 139.6, 128.7, 127.3, 121.4 (q, $^{2}J_{CF}$ = 274.0 Hz), 119.3, 118.5, 109.8, 62.5, 57.2, 56.4, 31.2, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.21. HRMS (ESI): *m/z* $[M + Na]^+$ calcd for $C_{18}H_{21}F_3N_2NaO_3$; 393.1402; found: 393.1401.

ethyl 4-(tert-butylamino)-8-fluoro-2-(trifluoromethyl)quinoline-3-carboxylate (3u): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a yellow solid (34 mg, 49% yield), mp: 45-46 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.0 Hz, 1H), 7.56-7.45 (m, 2H), 5.18 (s, 1H), 4.47-4.42 (q, *J* = 6.7 Hz, 2H), 4.43 (t, *J* = 6.0 Hz, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.9, 158.1 (q, $^{1}J_{CF}$ = 258.0 Hz), 153.9, 145.1 (q, $^{2}J_{CF}$ = 35.0 Hz), 138.1, 128.8, 126.7, 122.6, 121.1 (q, $^{1}J_{CF}$ = 275.0 Hz), 119.1, 115.5, 62.7, 57.6, 31.3, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.67, -123.03. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{17}H_{19}F_4N_2O_2$; 359.1383; found: 359.1392.

ethyl 4-(tert-butylamino)-8-chloro-2-(trifluoromethyl)quinoline-3-carboxylate (3v): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a yellow oil (66 mg, 59% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.5, 1.1 Hz, 1H), 7.88 (dd, *J* = 7.4, 1.1 Hz, 1H), 7.48 (t, *J* = 8.0 Hz, 1H), 4.45 (q, *J* = 7.2 Hz, 2H), 1.42 (t, *J* = 7.2 Hz, 3H), 1.23 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.9, 154.3, 145.2 (q, $^{2}J_{CF}$ = 34.5 Hz), 144.1, 134.2, 131.6, 128.7, 126.7, 125.9, 121.2 (q, $^{1}J_{CF}$ = 273 Hz), 119.1, 62.7, 57.6,

31.3, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.65. HRMS (ESI): *m/z* $[M + Na]^+$ calcd for $C_{17}H_{18}ClF_3N_2NaO_2$; 397.0907; found: 397.0908.

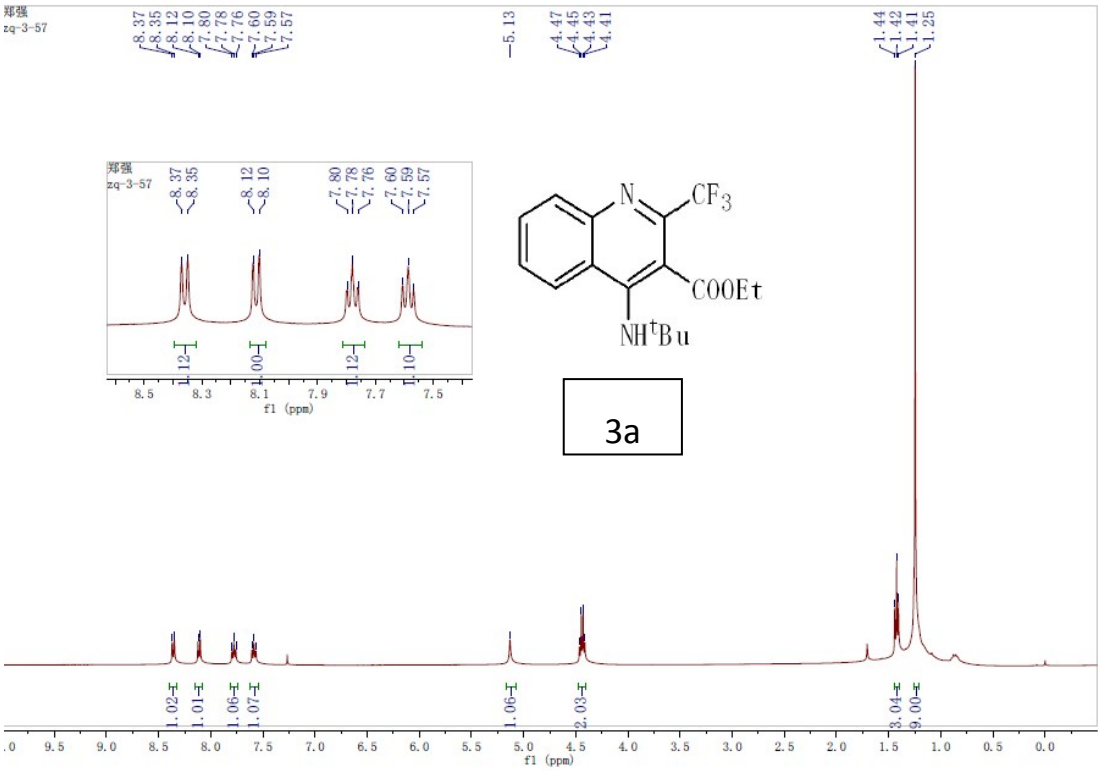
ethyl 4-(tert-butylamino)-2,8-bis(trifluoromethyl)quinoline-3-carboxylate (3w): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a white solid (42 mg, 49% yield), mp: 59-61 ^oC; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (d, J = 8.0 Hz, 1H), 8.12 (d, J = 8.0 Hz, 1H), 7.61 (t, J = 8.0 Hz, 1H), 5.21 (s, 1H), 4.48-4.42 (q, J = 8.0 Hz, 2H), 1.42 (t, J = 6.0 Hz, 3H), 1.23 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 153.9, 145.4 (q, $^2J_{CF}$ = 34.0 Hz), 144.1, 131.2, 129. 9, 128.5 (q, $^2J_{CF}$ = 29.7 Hz), 127.8, 125.5, 123.6 (q, $^1J_{CF}$ = 272.0 Hz), 121.0 (q, $^1J_{CF}$ = 275.0 Hz), 119.2, 62.7, 57.7, 31.3, 13.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -60.28, -64.06. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{18}H_{19}F_6N_2O_2$; 409.1351; found: 409.1345.

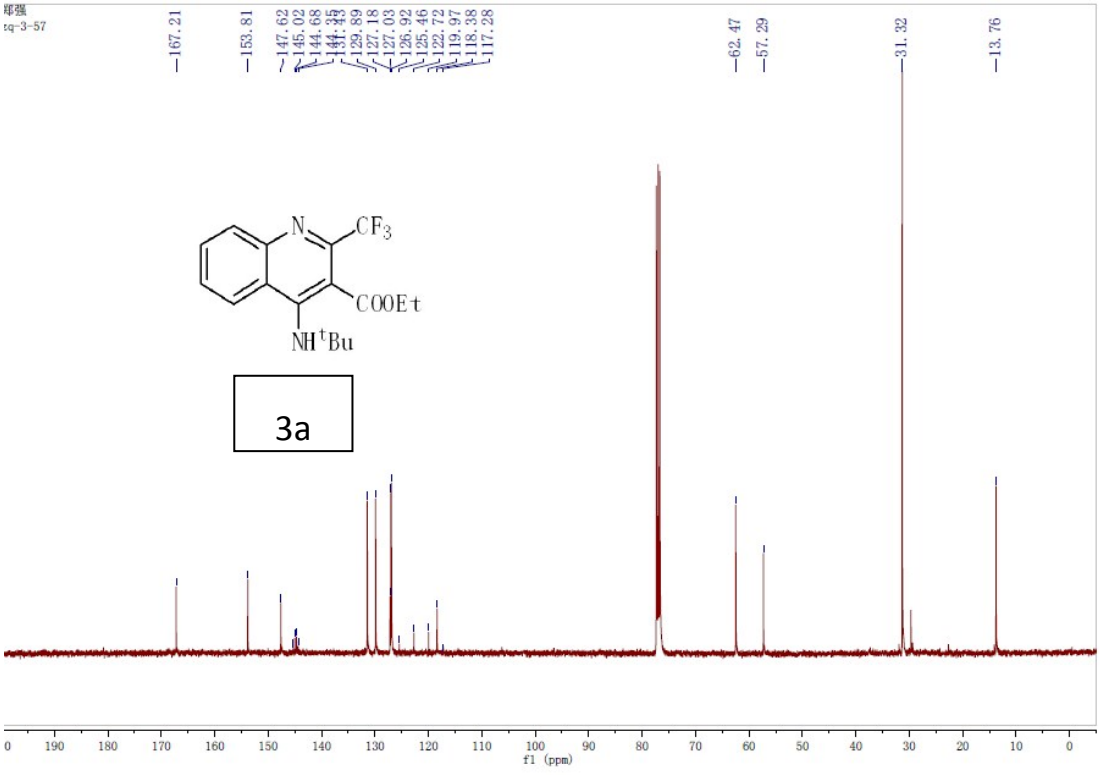
ethyl6-isopropyl-4-(tricyclo[4.4.1.13,9]dodecan-12-ylamino)-2-(trifluoromethyl)quinoline-3-carboxylate (3x): Isolated (Rf = 0.5, EtOAc–petroleum ether = 1:30) as a yellow solid (92 mg, 65% yield), ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (s, 1H), 8.02 (d, J = 8.4 Hz, 1H), 7.68 (d, J = 8.4 Hz, 1H), 4.98 (s, 1H), 4.45 (q, J = 6.8 Hz, 2H), 3.15-3.11 (m, 1H), 2.08-2.05 (m, 3H), 1.80-1.77 (m, 6H), 1.65-1.55 (m, 6H), 1.68-1.61 (m, 2H), 1.43 (t, J = 7.2 Hz, 3H), 1.37 (d, J = 6.8 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.4, 152.7, 147.5, 146.3, 143.9 (q, $^2J_{CF}$ = 33.7 Hz), 131.7, 129.5, 127.4, 123.2, 121.5 (q, $^1J_{CF}$ = 276.0 Hz), 118.6, 62.4, 57.8, 54.9, 44.8, 44.7, 36.1, 36.0, 34.3, 30.1, 29.9, 23.7, 13.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.45. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{26}H_{32}F_3N_2O_2$; 461.2416; found: 461.2419.

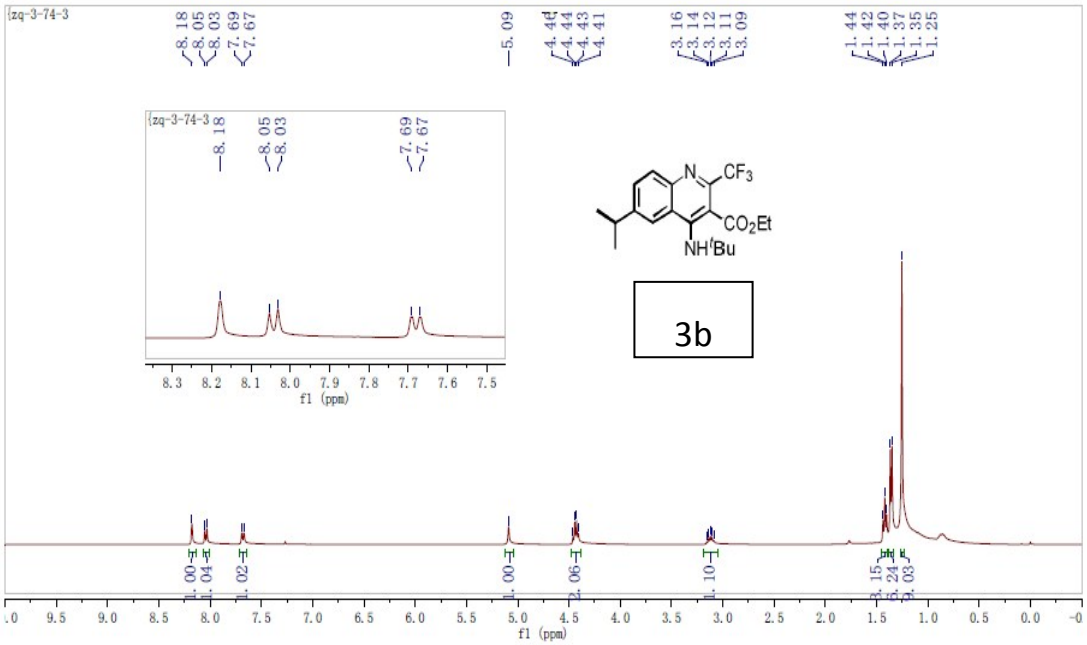
ethyl4-(cyclohexylamino)-6-isopropyl-2-(trifluoromethyl)quinoline-3-carboxylate

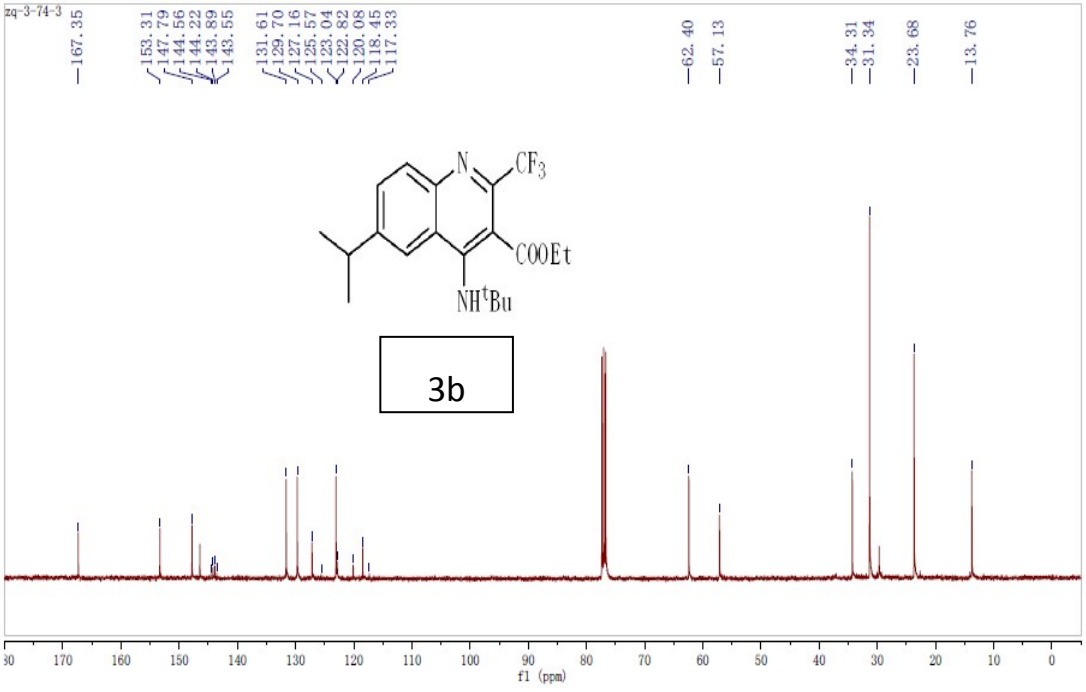
(3y): Isolated (Rf = 0.6, EtOAc–petroleum ether = 1:30) as a yellow oil (36 mg, 30% yield), ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (d, *J* = 8.4 Hz, 1H), 7.85 (s, 1H), 7.65 (d, *J* = 8.4 Hz, 1H), 6.23 (d, *J* = 9.6 Hz, 1H), 4.41 (q, *J* = 7.2 Hz, 2H), 3.74-3.70 (m, 1H), 3.12-3.06 (m,1H), 2.12-2.08 (m, 2H), 1.82-1.77 (m, 2H), 1.68-1.61 (m, 2H), 1.40 (t, *J* = 7.2 Hz, 3H), 1.35 (d, *J* = 6.8 Hz, 6H); 1.29-1.18 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.8, 153.3, 147.7, 146.3, 145.1 (q, $^{2}J_{CF}$ = 33.4 Hz), 131.2, 130.5, 121.5 (q, $^{1}J_{CF}$ = 276.0 Hz), 121.2, 120.2, 108.7, 62.2, 57.5, 34.7, 34.3, 25.40, 24.9, 23.83, 13.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.38. HRMS (ESI): *m/z* $[M + H]^+$ calcd for $C_{22}H_{28}F_3N_2O_2$; 409.2103; found: 409.2105.

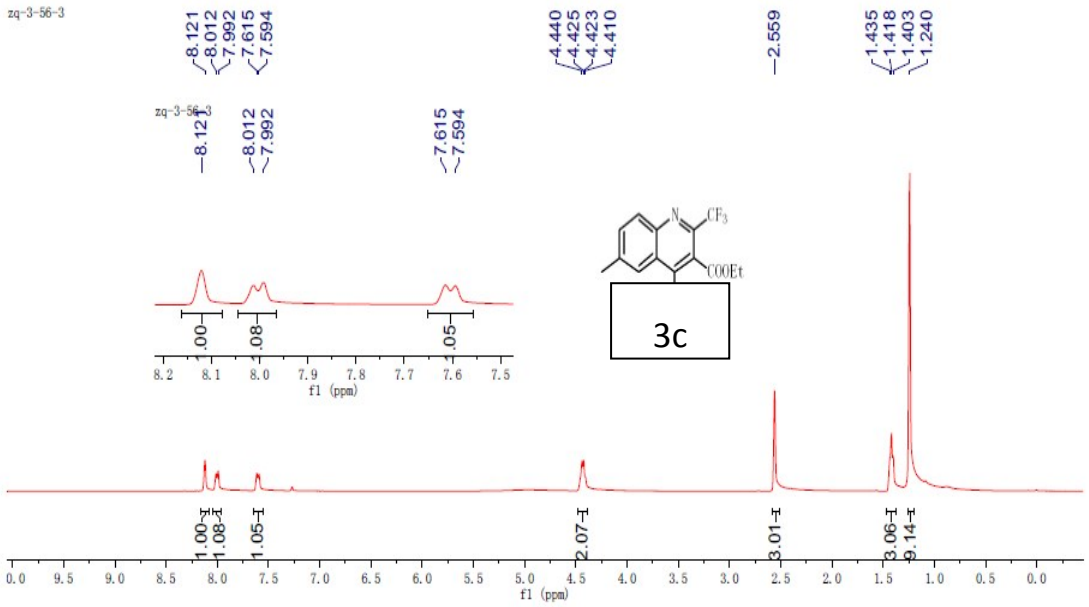
2. The Copies of ^{1}H, ^{13}C NMR Spectra

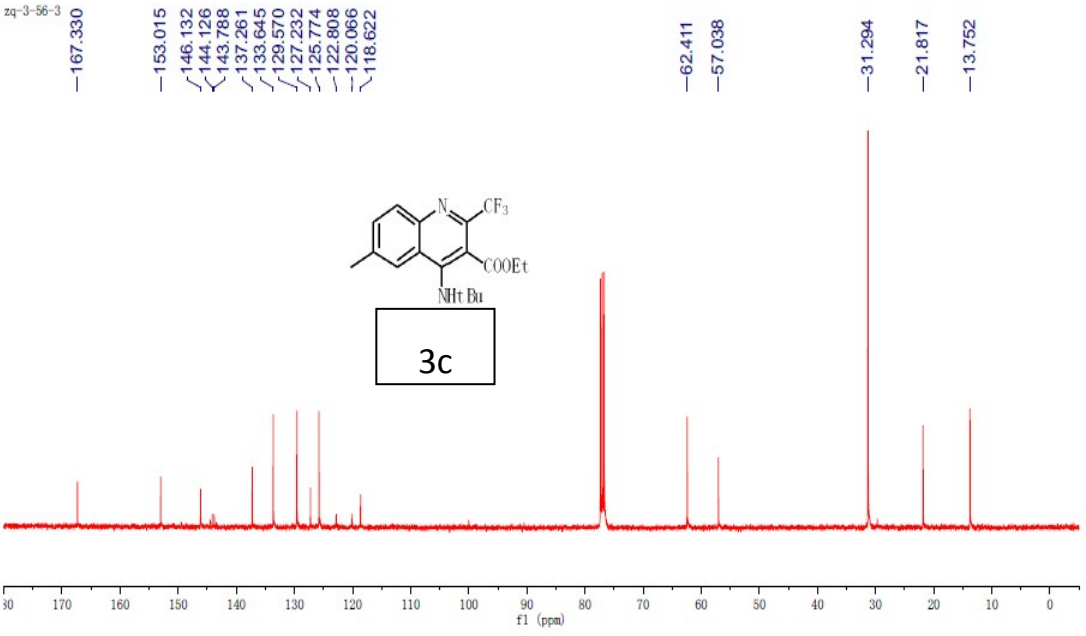

郑强
zq-3-57
8.37
8.35
8.12
8.10
7.80
7.78
7.76
7.60
7.59
7.57
5.13
4.47
4.45
4.43
4.41
1.44
1.42
1.41
1.25
1.02
1.01
1.06
1.07
1.06
2.03
3.04
9.00
f1 (ppm)
N
CF3
COOEt
NHtBu
3a

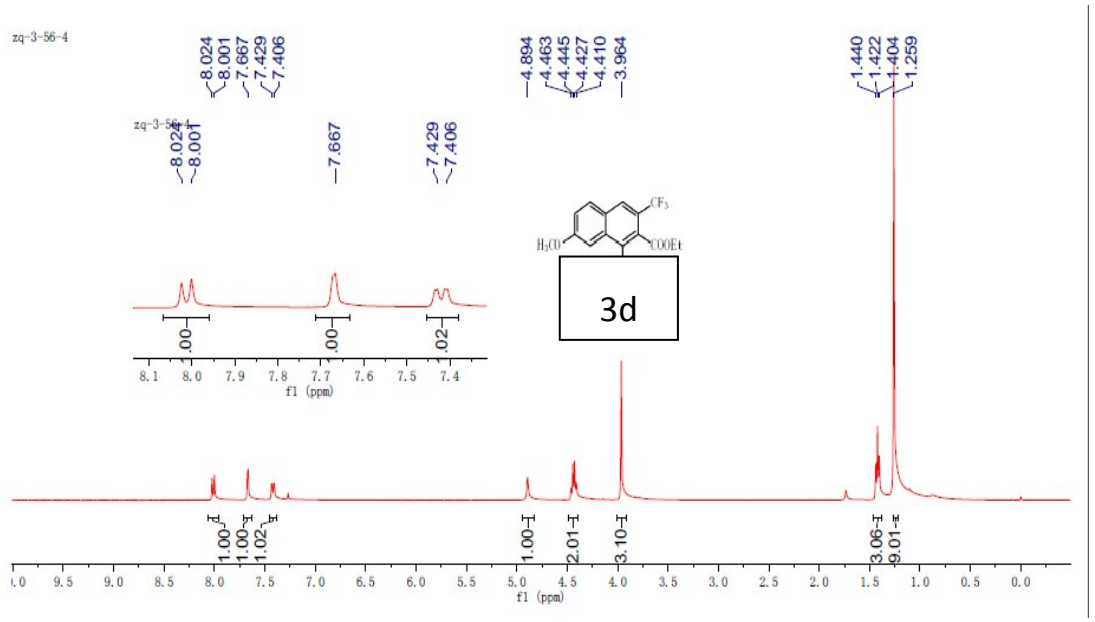

郑强
zq-3-57
167.21
153.81
147.62
145.02
144.68
131.43
129.89
127.18
127.03
126.92
125.46
122.72
119.97
118.38
117.28
62.47
57.29
31.32
13.76
f1 (ppm)
N
CF3
COOEt
NHtBu
3a

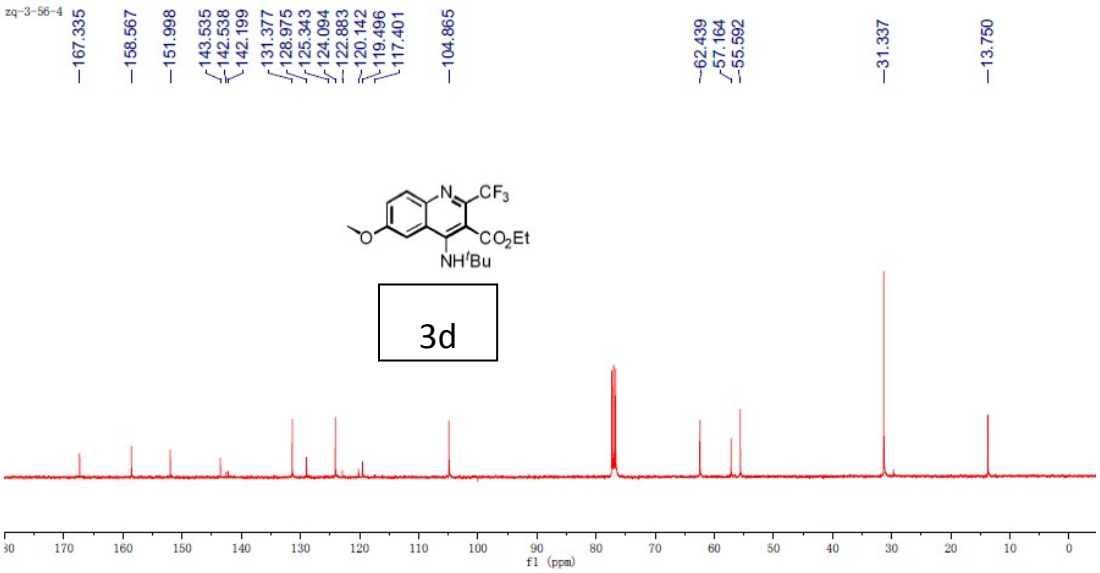

zq-3-74-3
8.18
8.05
8.03
7.69
7.67
5.09
4.44
4.44
4.43
4.41
3.16
3.14
3.12
3.11
3.09
1.44
1.42
1.40
1.37
1.35
1.25
f1 (ppm)
CF3
CO2Et
NHtBu
3b

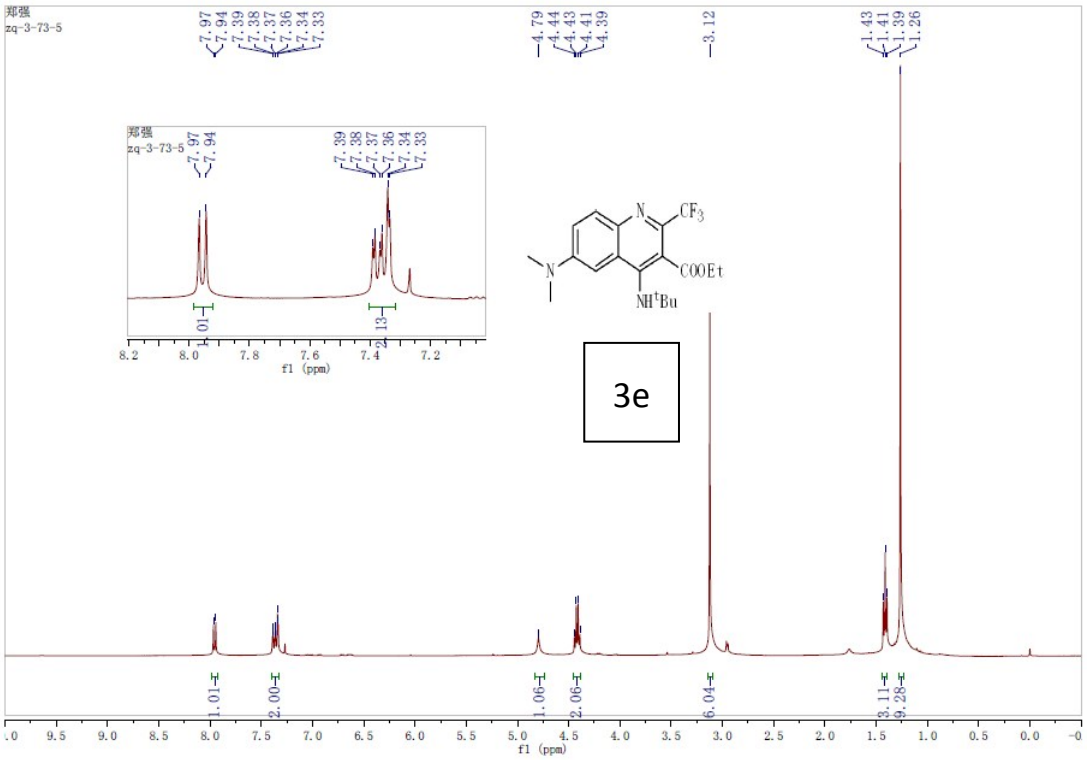

zq-3-74-3
167.35
153.31
147.79
144.56
144.22
143.89
143.55
131.61
129.70
127.16
125.57
123.04
122.82
120.08
118.45
117.33
62.40
57.13
34.31
31.34
23.68
13.76
f1 (ppm)
CF3
COOEt
NHtBu
3b

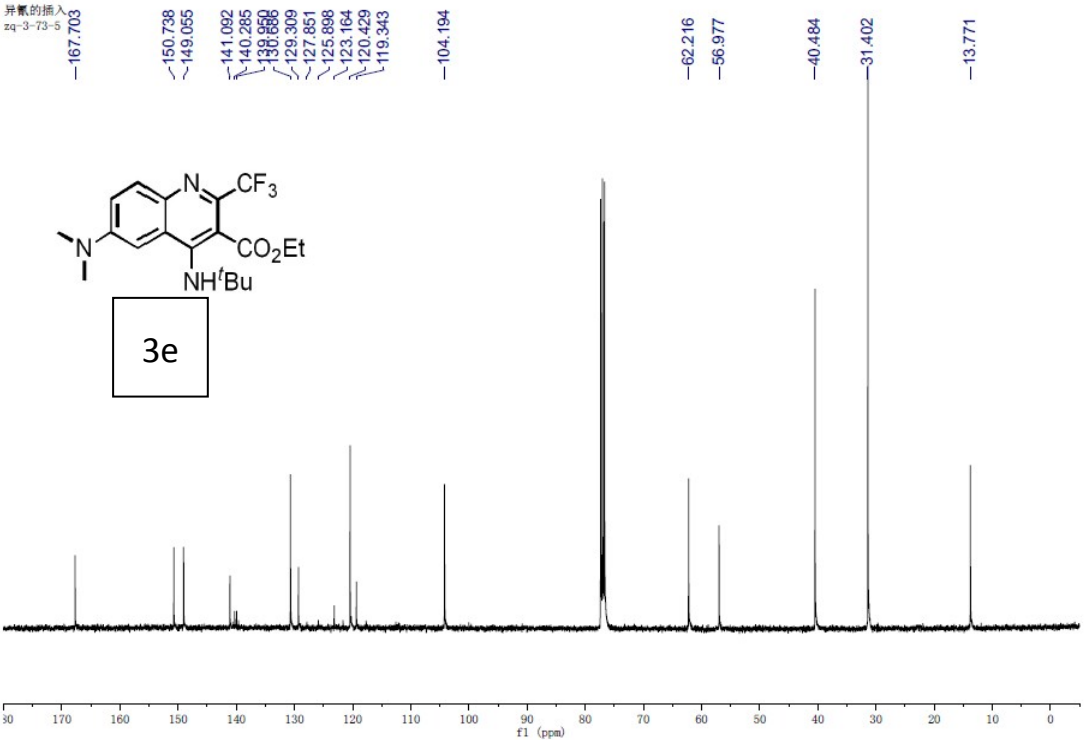

zq-3-56-3
8.121
8.012
7.992
7.615
7.594
4.440
4.425
4.423
4.410
2.559
1.435
1.418
1.403
1.240
1.00
1.08
1.05
2.07
3.01
3.06
9.14
f1 (ppm)
3c

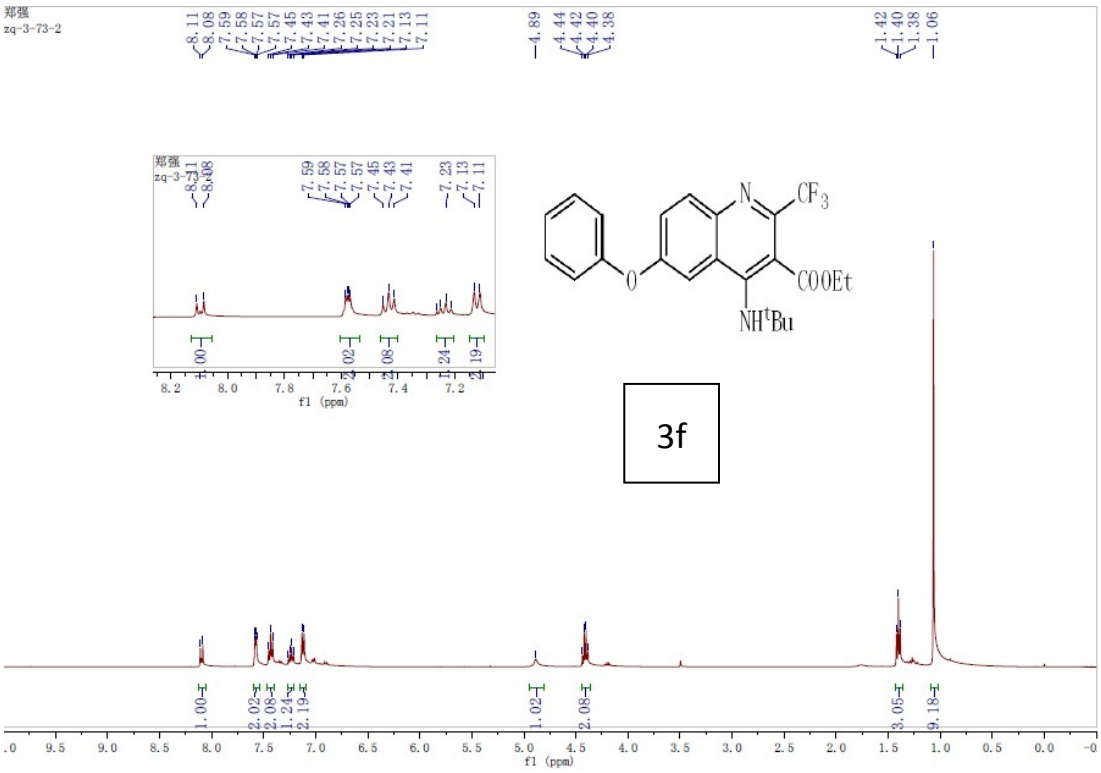

zq-3-56-3
167.330
153.015
146.132
144.126
143.788
137.261
133.645
129.570
127.232
125.774
122.808
120.066
118.622
62.411
57.038
31.294
21.817
13.752
NHtBu
3c
f1 (ppm)

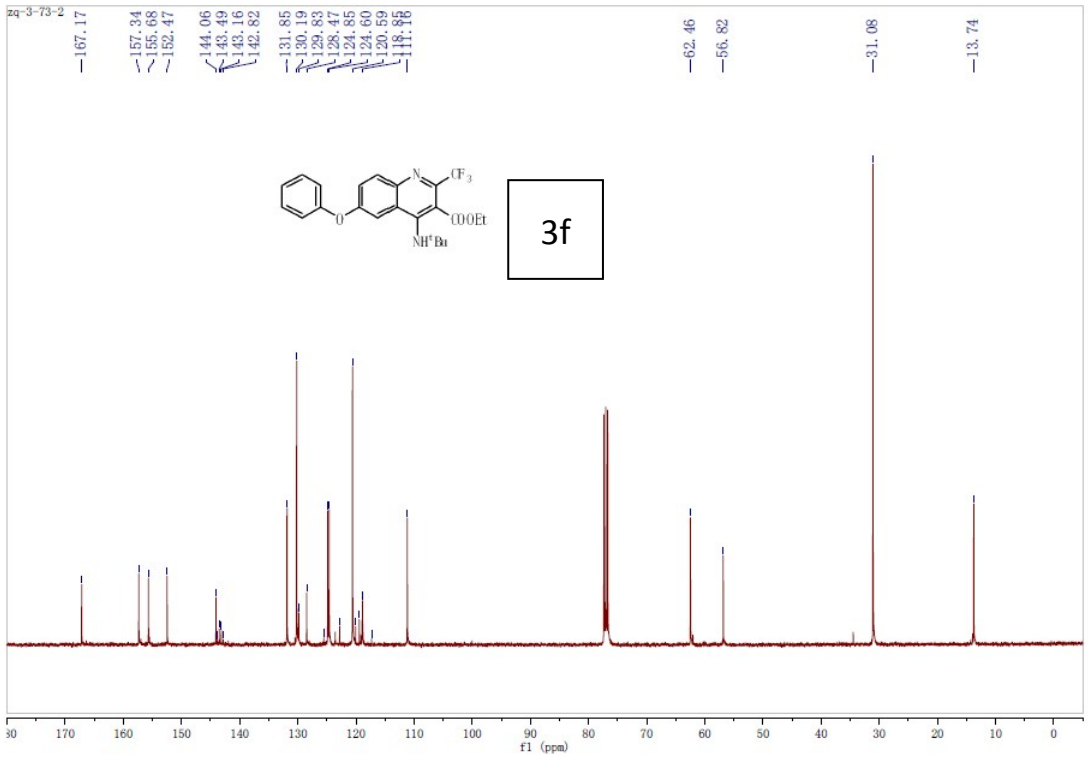

zq-3-56-4
8.024
8.001
7.667
7.429
7.406
4.894
4.463
4.445
4.427
4.410
3.964
1.440
1.422
1.404
1.259
3d

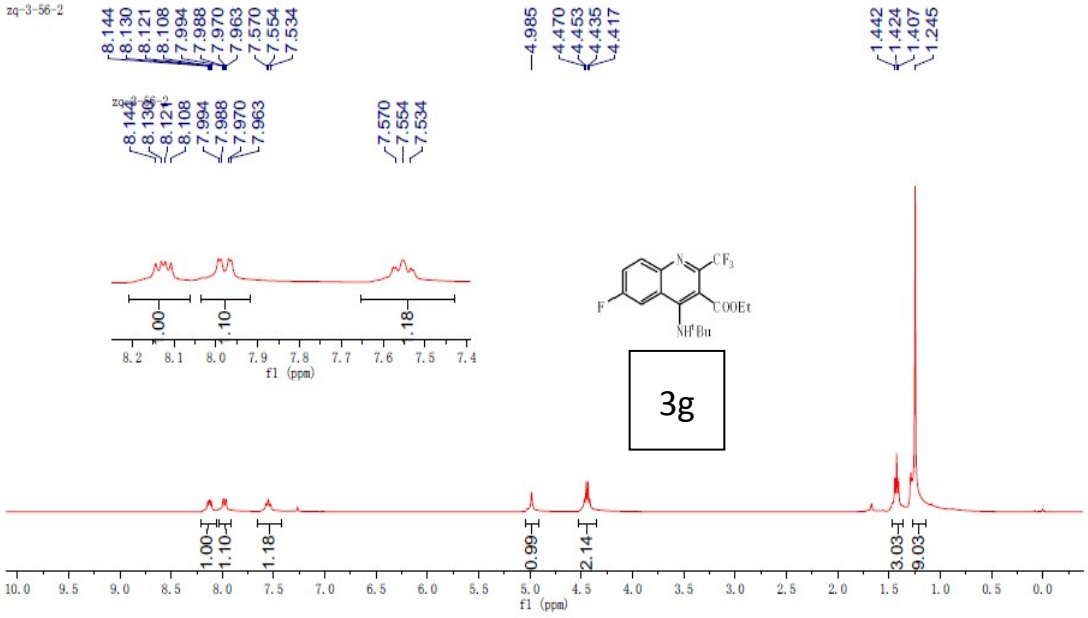

zq-3-56-4
167.335
158.567
151.998
143.535
142.538
142.199
131.377
128.975
125.343
124.094
122.883
120.142
119.496
117.401
104.865
62.439
57.164
55.592
31.337
13.750
3d

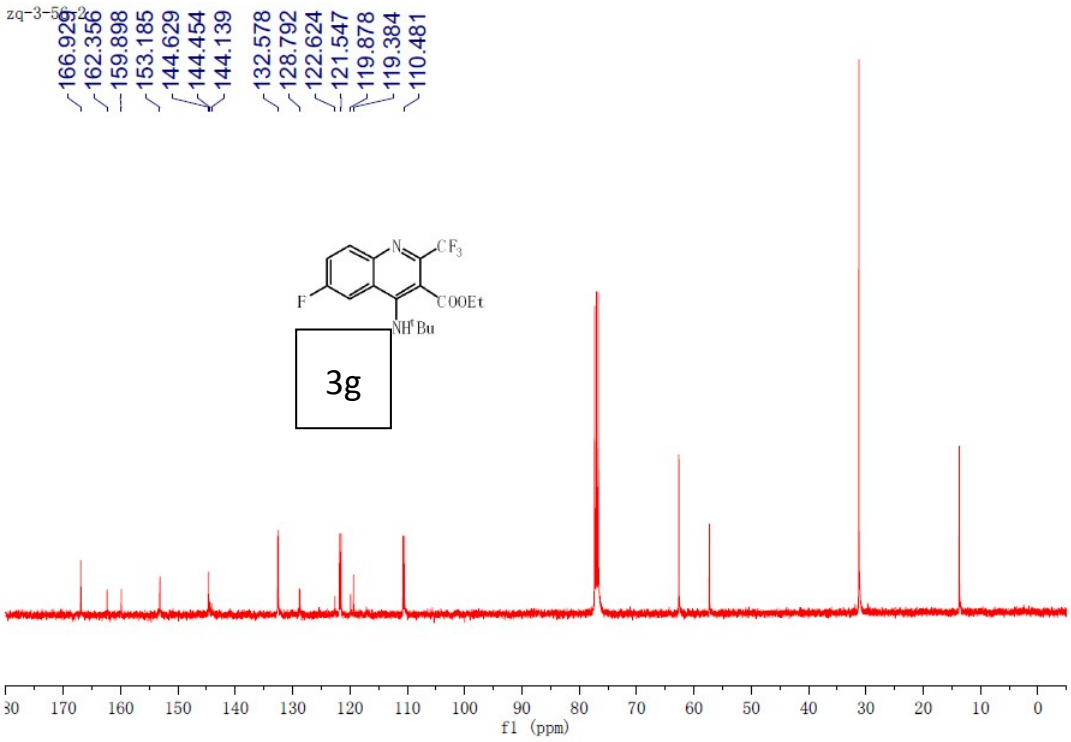

郑强
zq-3-73-5
7.97
7.94
7.39
7.38
7.37
7.36
7.34
7.33
4.79
4.44
4.43
4.41
4.39
3.12
1.43
1.41
1.39
1.26
CF3
N
COOEt
NHtBu
3e
1.01
2.00
1.06
2.06
6.04
3.11
9.28
f1 (ppm)

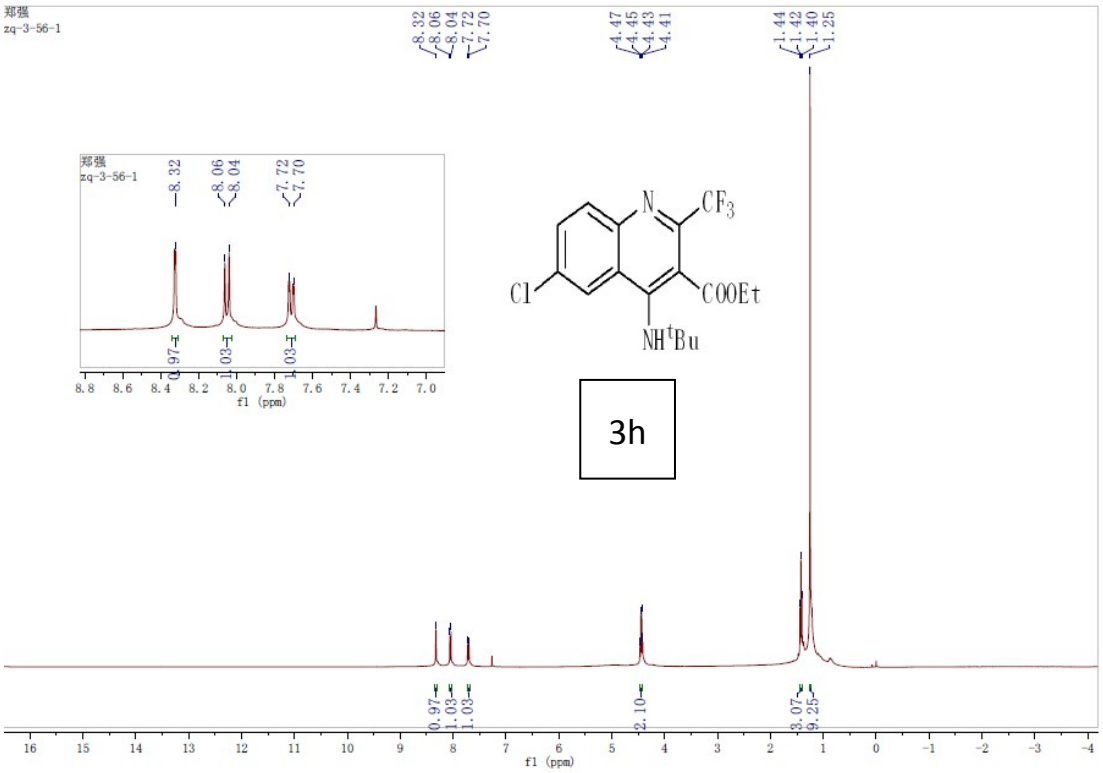

异氰的插入
zq-3-73-5
167.703
150.738
149.055
141.092
140.285
129.309
127.851
125.898
123.164
120.429
119.343
104.194
62.216
56.977
40.484
31.402
13.771
CF3
N
CO2Et
NHtBu
3e
f1 (ppm)

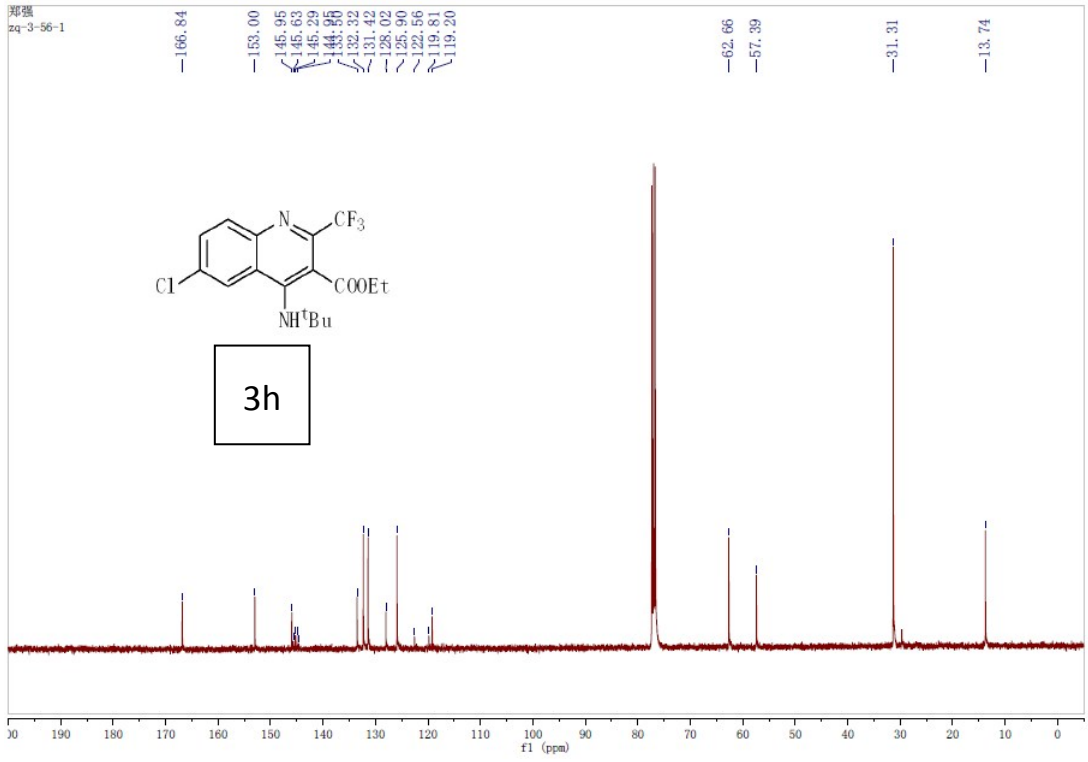

郑强
zq-3-73-2
8.11
8.08
7.59
7.58
7.57
7.57
7.45
7.43
7.41
7.26
7.25
7.23
7.21
7.13
7.11
4.89
4.44
4.42
4.40
4.38
1.42
1.40
1.38
1.06
CF3
N
O
COOEt
NHtBu
3f
f1 (ppm)

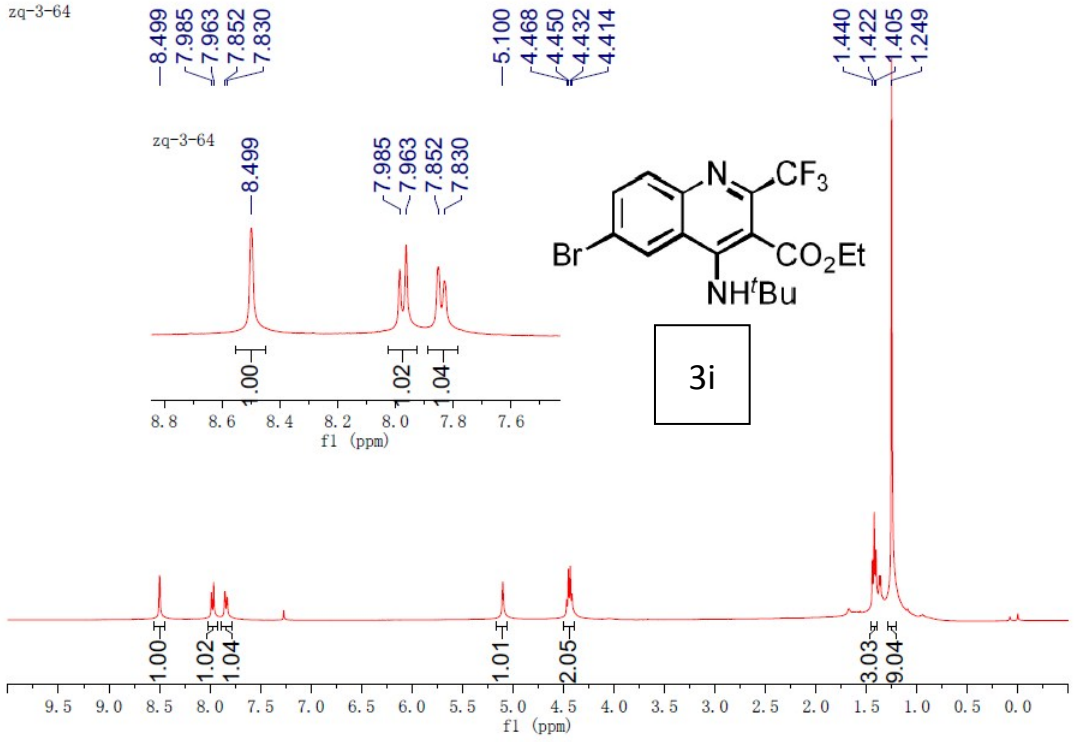

zq-3-73-2
167.17
157.34
155.68
152.47
144.06
143.49
143.16
142.82
131.85
130.19
129.83
128.47
124.85
124.60
120.59
62.46
56.82
31.08
13.74
CF3
N
O
COOEt
NHtBu
3f
f1 (ppm)

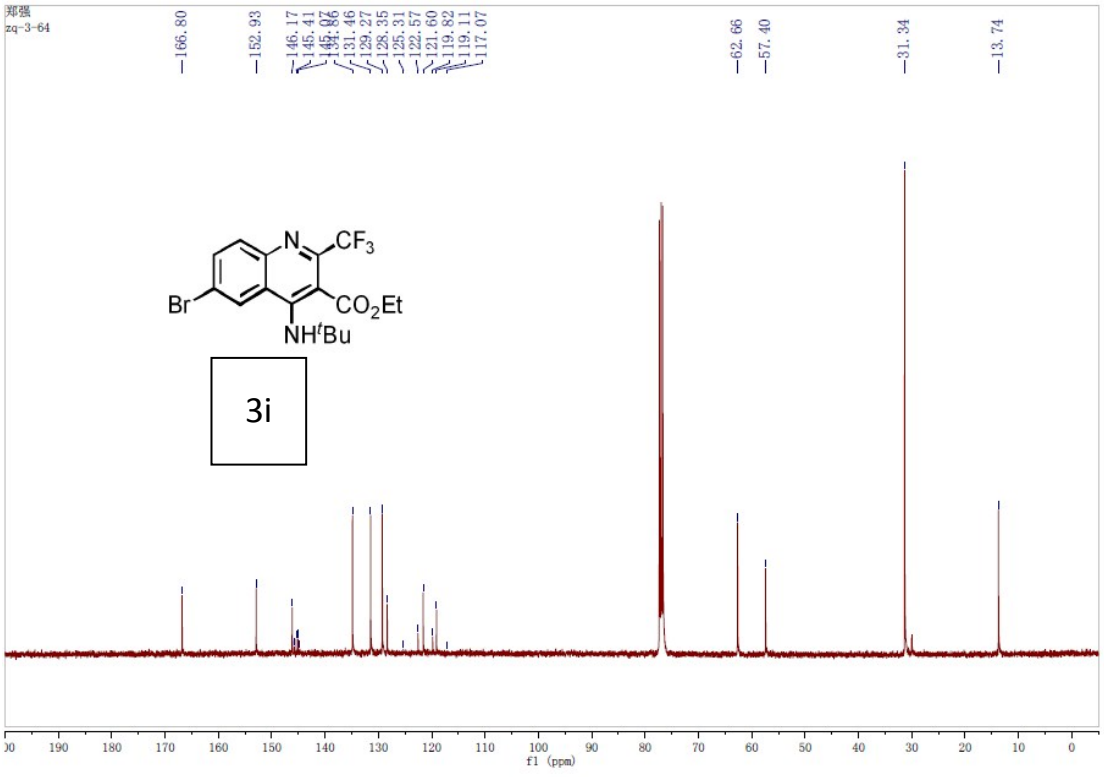

zq-3-56-2
8.144
8.130
8.121
8.108
7.994
7.988
7.970
7.963
7.570
7.554
7.534
4.985
4.470
4.453
4.435
4.417
1.442
1.424
1.407
1.245
1.00
1.10
1.18
0.99
2.14
3.03
9.03
f1 (ppm)
3g

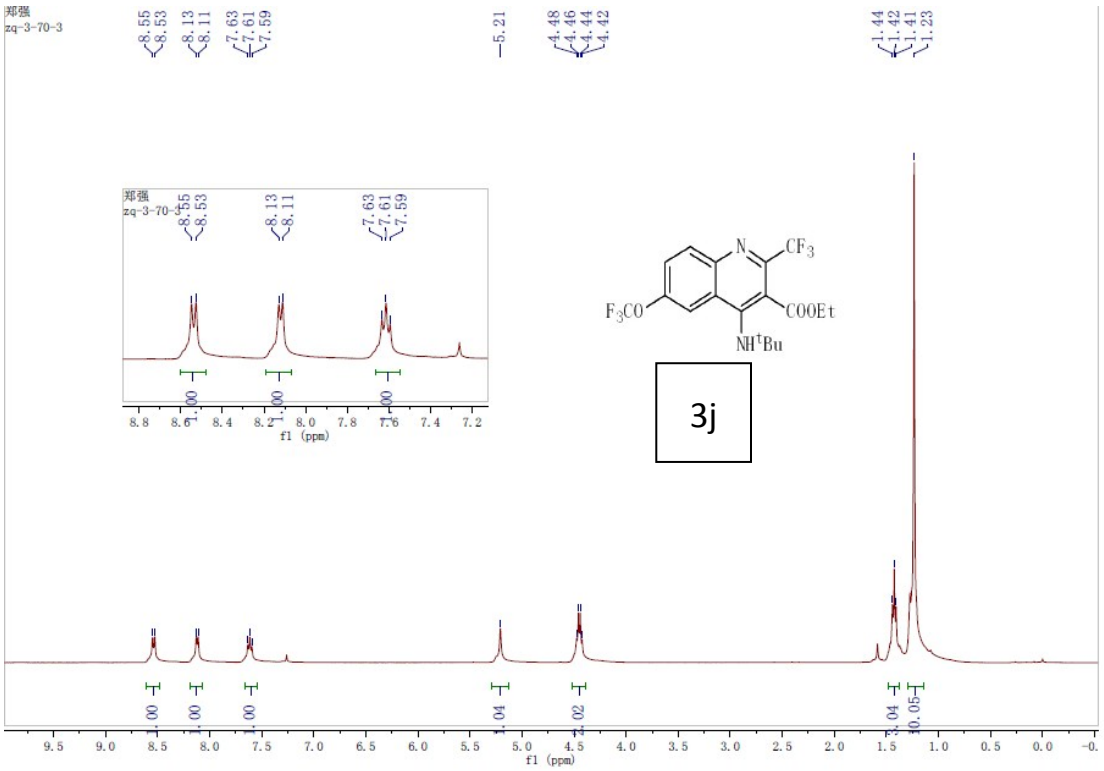

zq-3-56-2
166.929
162.356
159.898
153.185
144.629
144.454
144.139
132.578
128.792
122.624
121.547
119.878
119.384
110.481
f1 (ppm)
3g

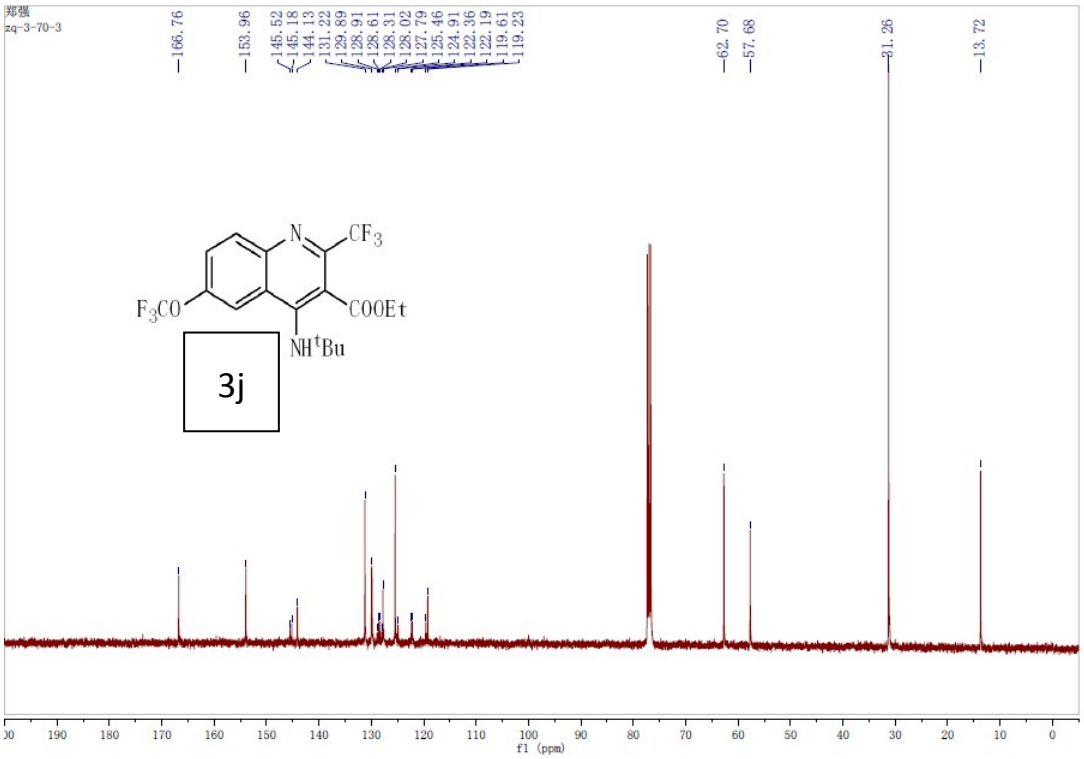

郑强
zq-3-56-1
8.32
8.06
8.04
7.72
7.70
4.47
4.45
4.43
4.41
1.44
1.42
1.40
1.25
0.97
1.03
1.03
2.10
3.07
9.25
f1 (ppm)
Cl
N
CF3
COOEt
NHtBu
3h

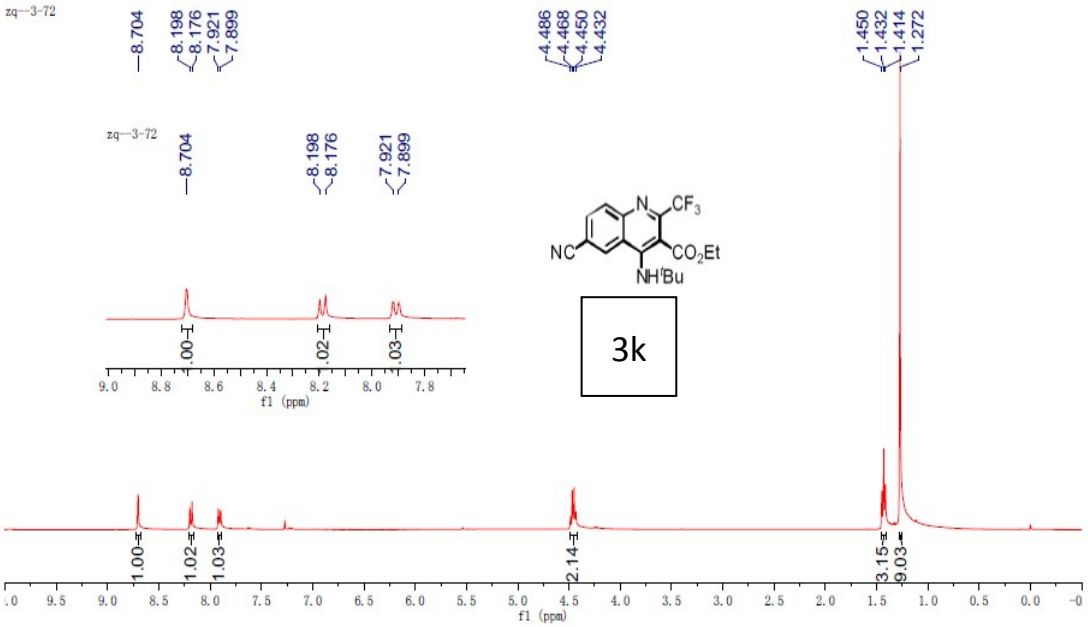

郑强
zq-3-56-1
166.84
153.00
145.95
145.63
145.29
144.95
144.66
132.32
131.42
128.02
125.90
122.56
119.81
119.20
62.66
57.39
31.31
13.74
f1 (ppm)
Cl
N
CF3
COOEt
NHtBu
3h

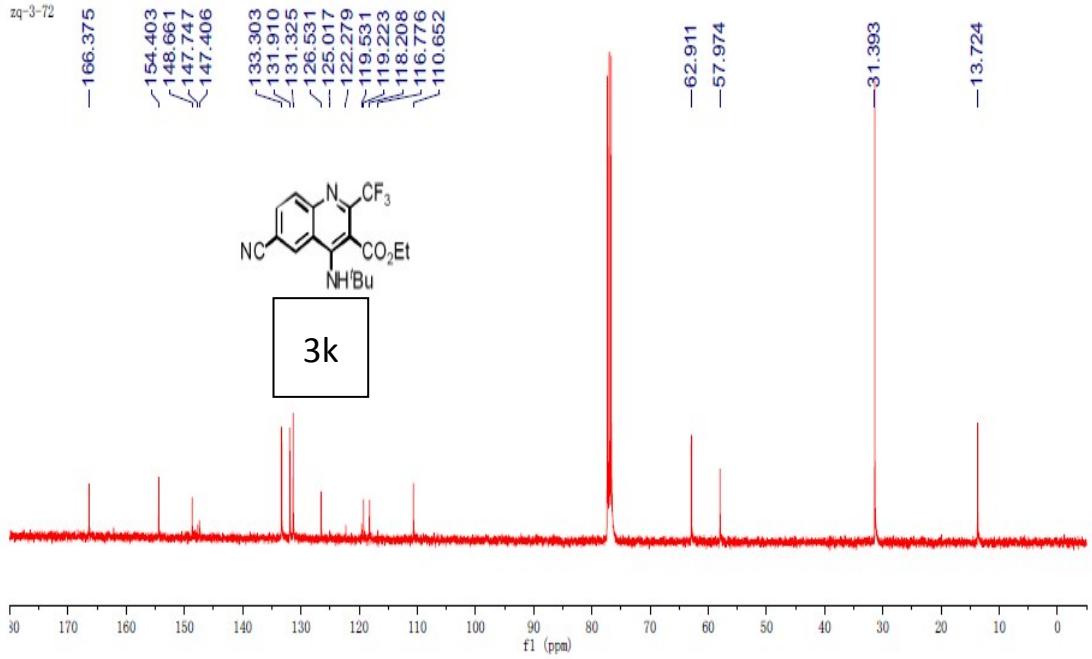

zq-3-64
8.499
7.985
7.963
7.852
7.830
5.100
4.468
4.450
4.432
4.414
1.440
1.422
1.405
1.249
1.00
1.02
1.04
1.01
2.05
3.03
9.04
f1 (ppm)
Br
CF3
CO2Et
NHtBu
3i

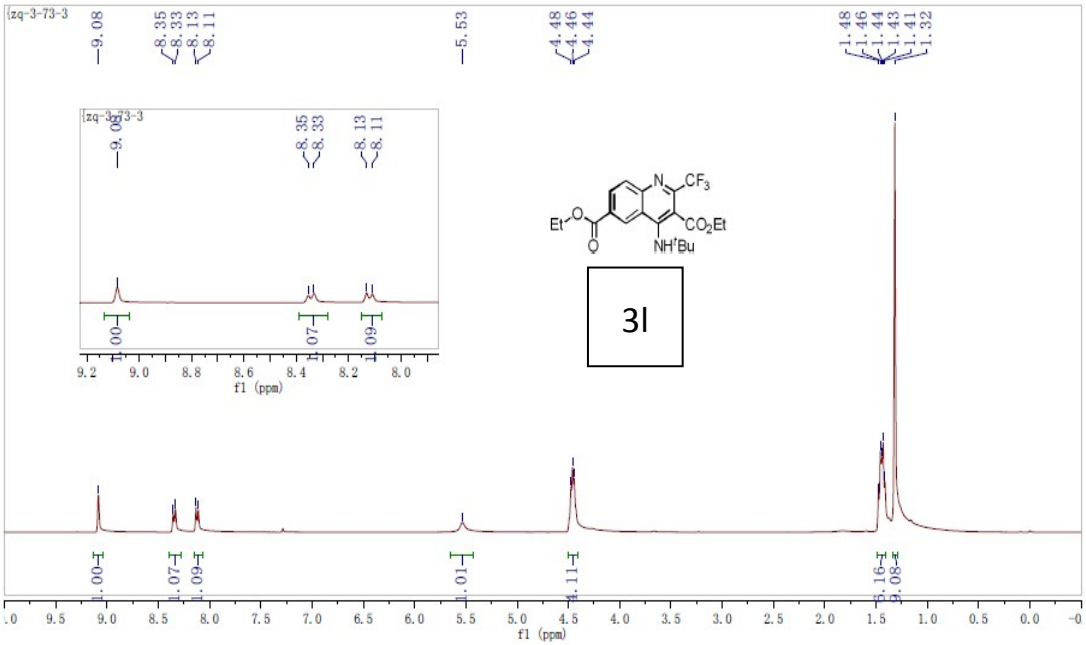

郑强
zq-3-64
166.80
152.93
146.17
145.41
131.46
129.27
128.35
125.31
122.57
121.60
119.82
119.11
117.07
62.66
57.40
31.34
13.74
f1 (ppm)
Br
CF3
CO2Et
NHtBu
3i

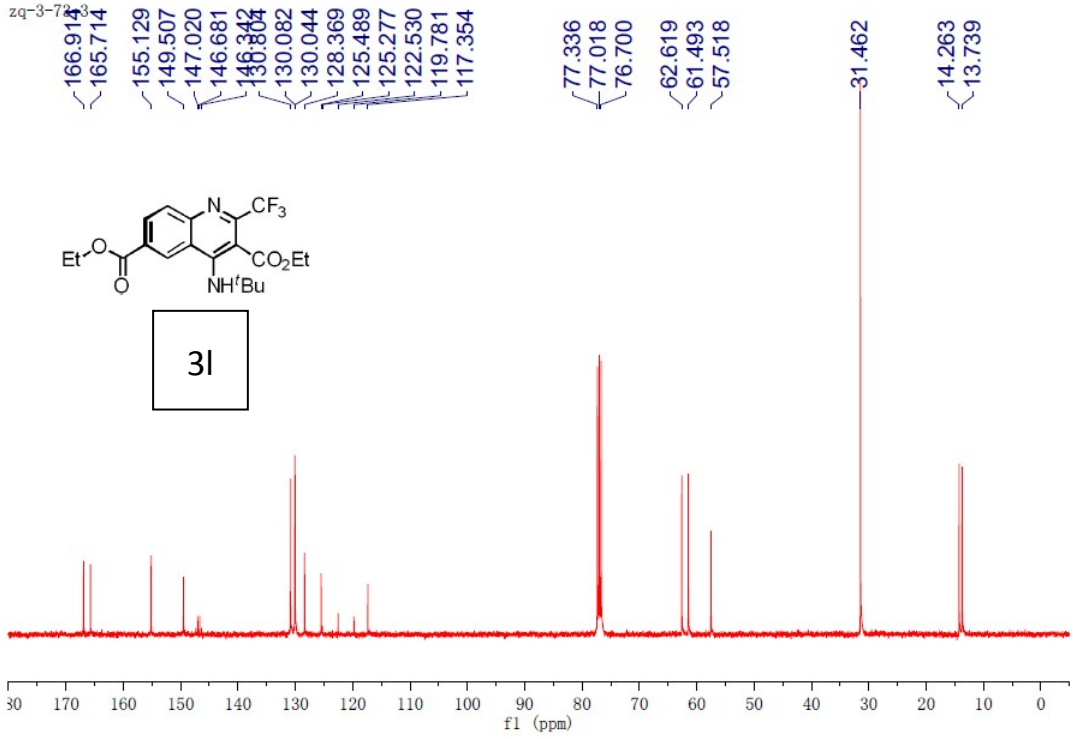

郑强
zq-3-70-3
8.55
8.53
8.13
8.11
7.63
7.61
7.59
5.21
4.48
4.46
4.44
4.42
1.44
1.42
1.41
1.23
f1 (ppm)
3j

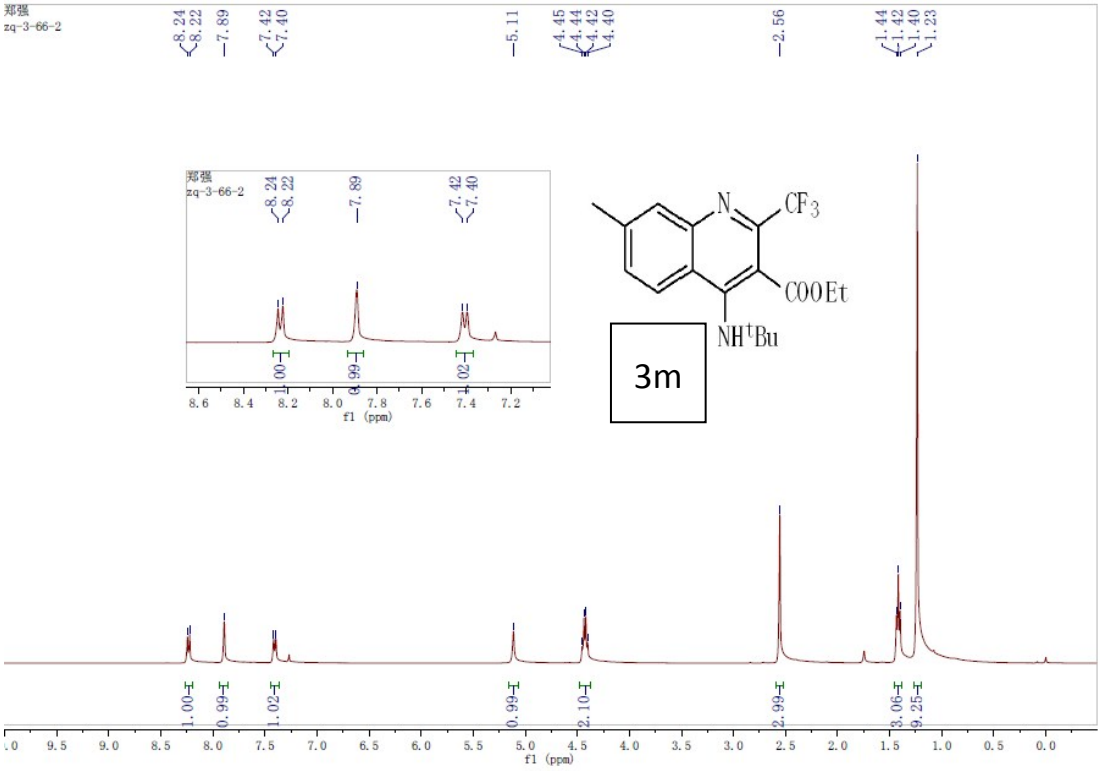

郑强
zq-3-70-3
166.76
153.96
145.52
145.18
144.13
131.22
129.89
128.91
128.61
128.31
128.02
127.79
125.46
124.91
122.36
122.19
119.61
119.23
62.70
57.68
31.26
13.72
f1 (ppm)
3j

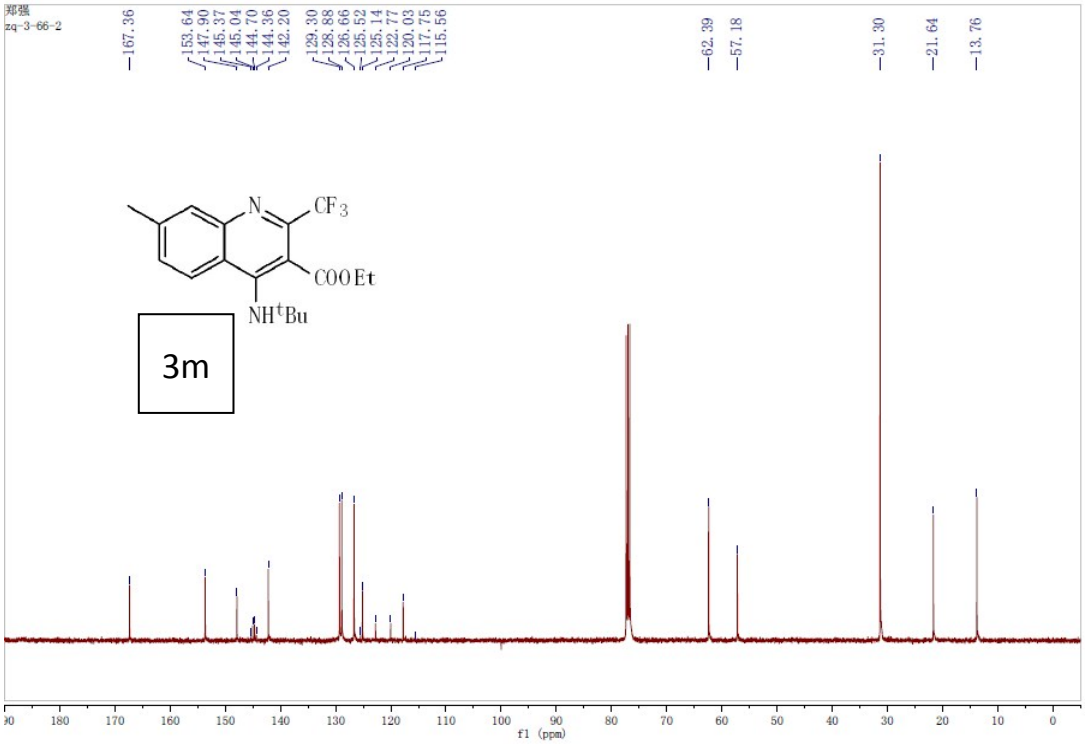

zq-3-72
8.704
8.198
8.176
7.921
7.899
4.486
4.468
4.450
4.432
1.450
1.432
1.414
1.272
1.00
1.02
1.03
2.14
3.15
9.03
f1 (ppm)
NC
CF3
CO2Et
NH'Bu
3k

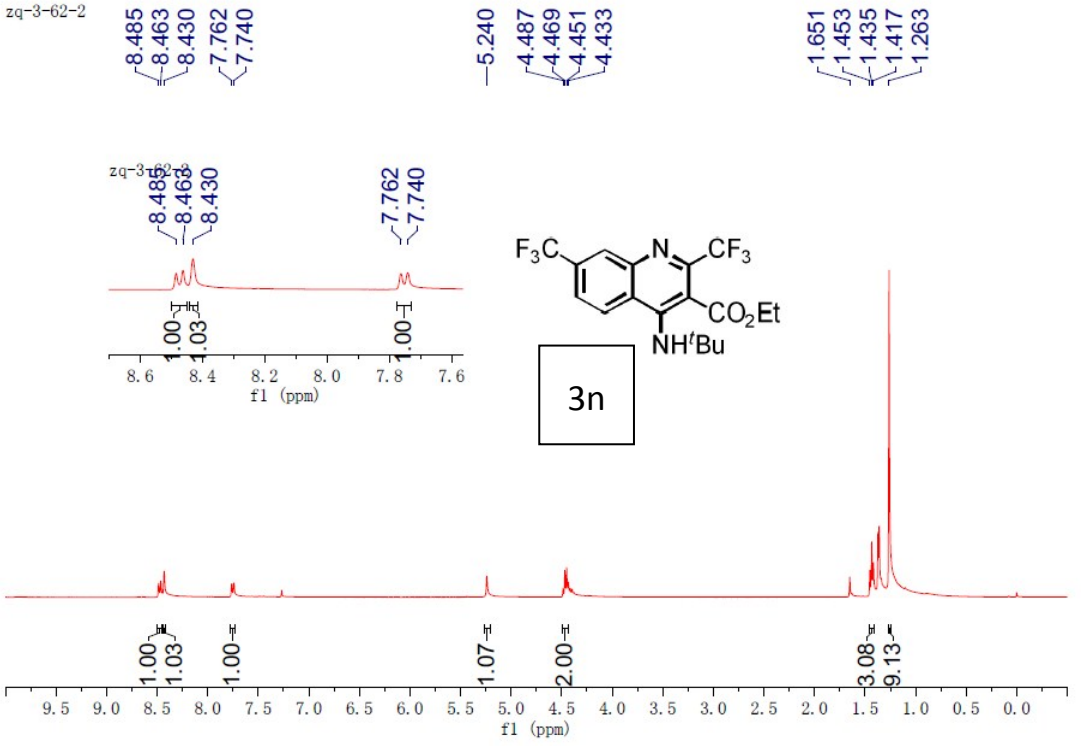

zq-3-72
166.375
154.403
148.661
147.747
147.406
133.303
131.910
131.325
126.531
125.017
122.279
119.531
119.223
118.208
116.776
110.652
62.911
57.974
31.393
13.724
f1 (ppm)
NC
CF3
CO2Et
NH'Bu
3k

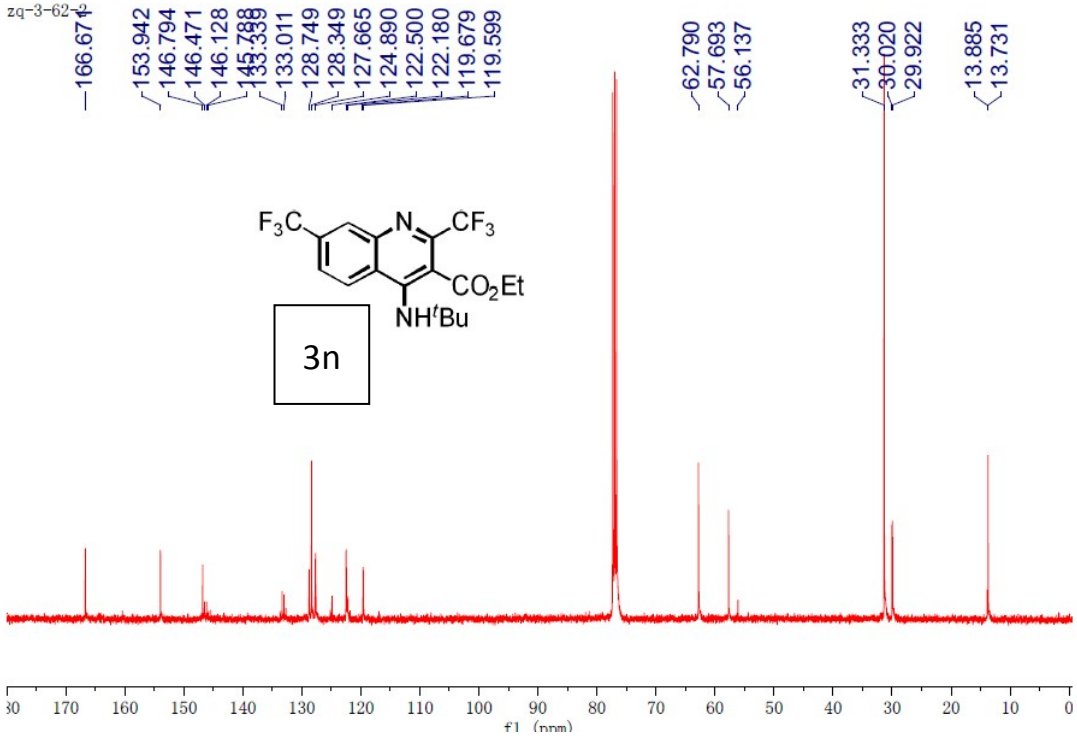

zq-3-73-3
9.08
8.35
8.33
8.13
8.11
5.53
4.48
4.46
4.44
1.48
1.46
1.44
1.43
1.41
1.32
f1 (ppm)
3l

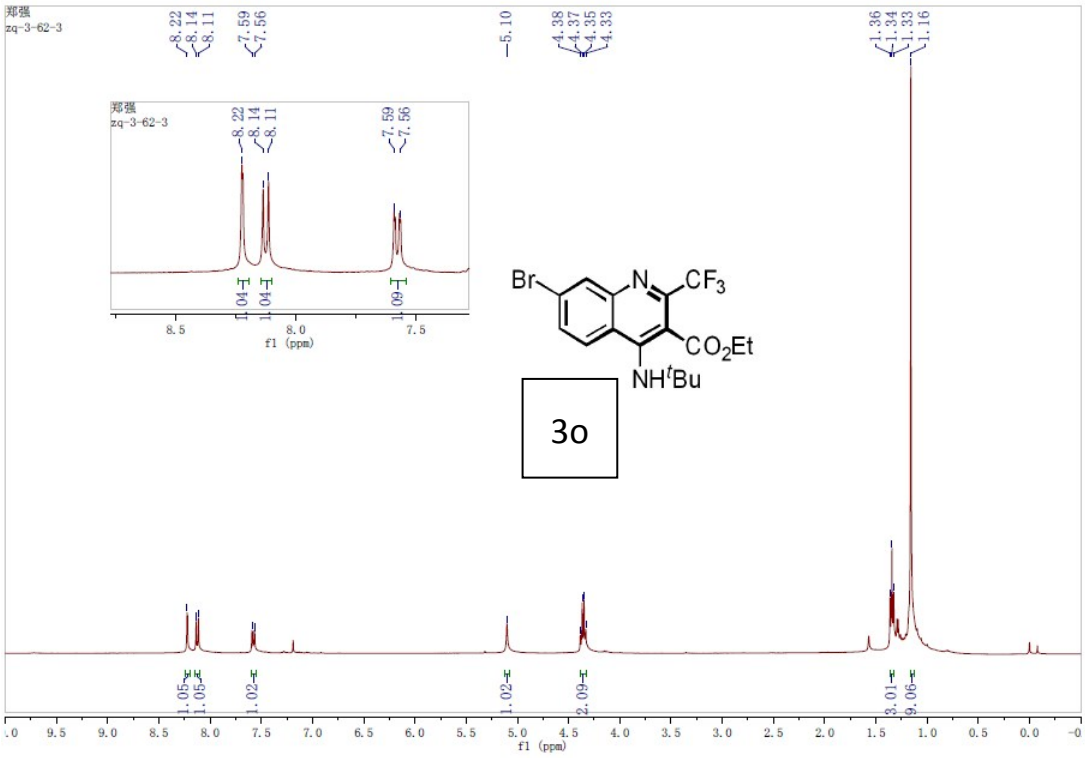

zq-3-73-3
166.914
165.714
155.129
149.507
147.020
146.681
130.082
130.044
128.369
125.489
125.277
122.530
119.781
117.354
77.336
77.018
76.700
62.619
61.493
57.518
31.462
14.263
13.739
f1 (ppm)
3l

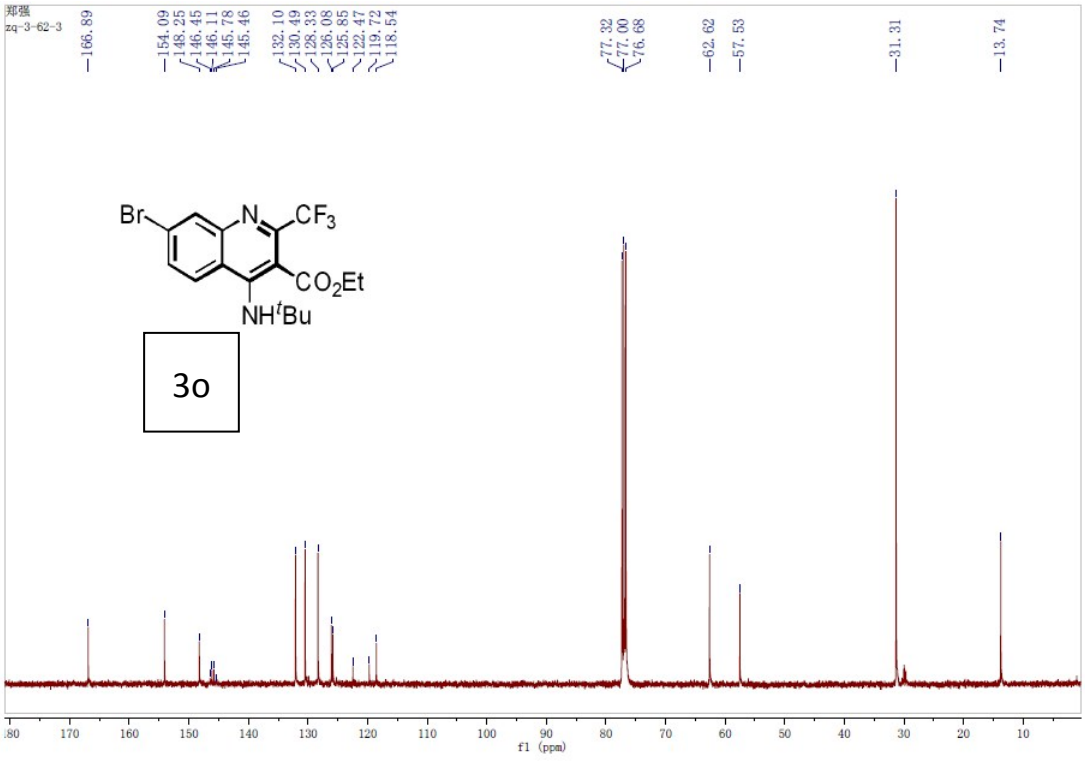

郑强
zq-3-66-2
8.24
8.22
7.89
7.42
7.40
5.11
4.45
4.44
4.42
4.40
2.56
1.44
1.42
1.40
1.23
CF3
COOEt
NHtBu
3m
1.00
0.99
1.02
0.99
2.10
2.99
3.06
9.25
f1 (ppm)

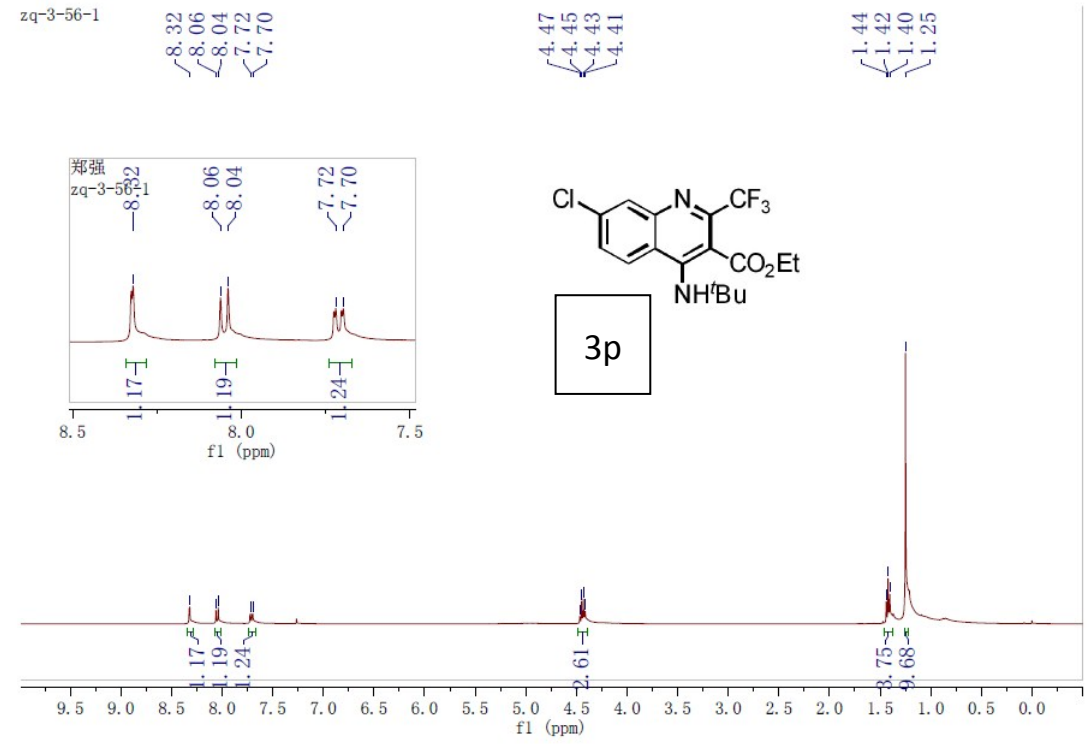

郑强
zq-3-66-2
167.36
153.64
147.90
145.37
145.04
144.70
144.36
142.20
129.30
128.88
126.66
125.52
125.14
122.77
120.03
117.75
115.56
62.39
57.18
31.30
21.64
13.76
CF3
COOEt
NHtBu
3m
f1 (ppm)

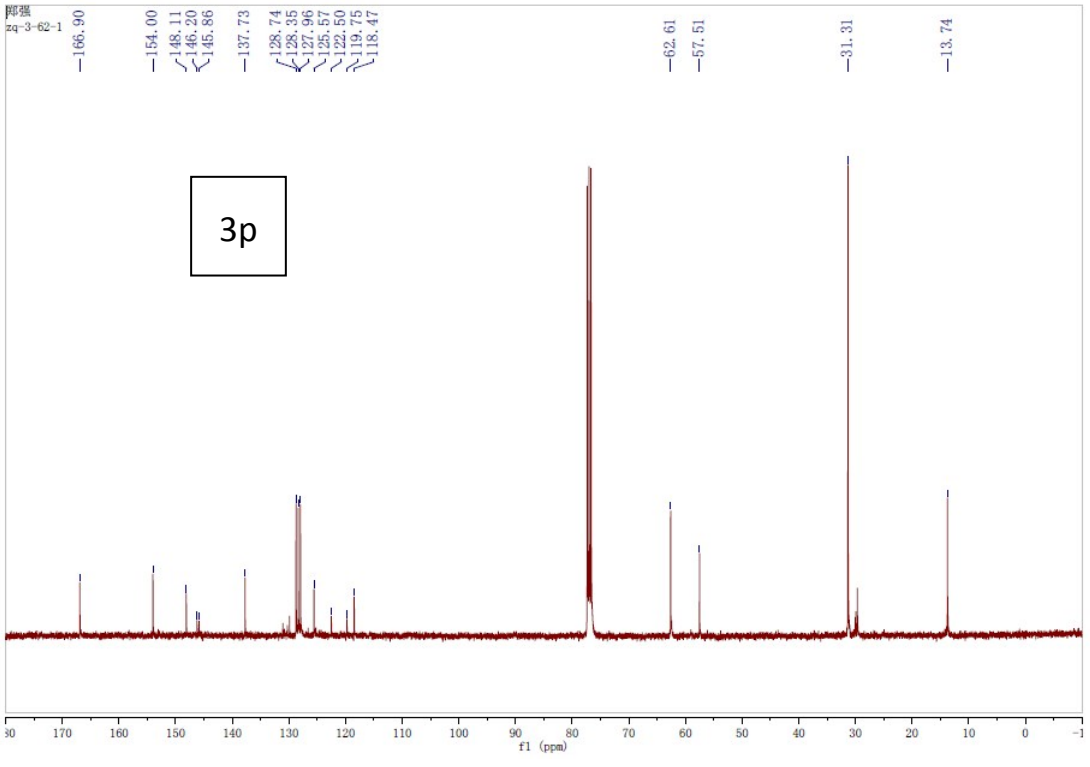

zq-3-62-2
8.485
8.463
8.430
7.762
7.740
5.240
4.487
4.469
4.451
4.433
1.651
1.453
1.435
1.417
1.263
1.00
1.03
1.00
1.07
2.00
3.08
9.13
f1 (ppm)
F3C
N
CF3
CO2Et
NHtBu
3n

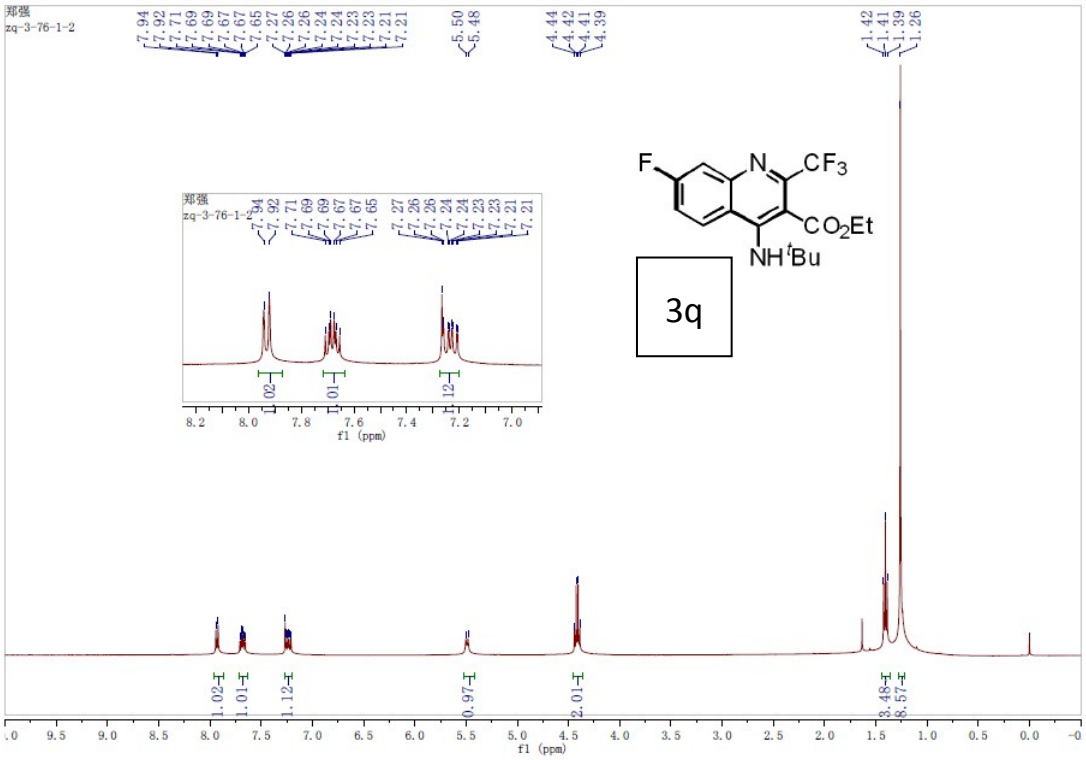

zq-3-62-2
166.674
153.942
146.794
146.471
146.128
133.011
128.749
128.349
127.665
124.890
122.500
122.180
119.679
119.599
62.790
57.693
56.137
31.333
30.020
29.922
13.885
13.731
F3C
N
CF3
CO2Et
NHtBu
3n
f1 (ppm)

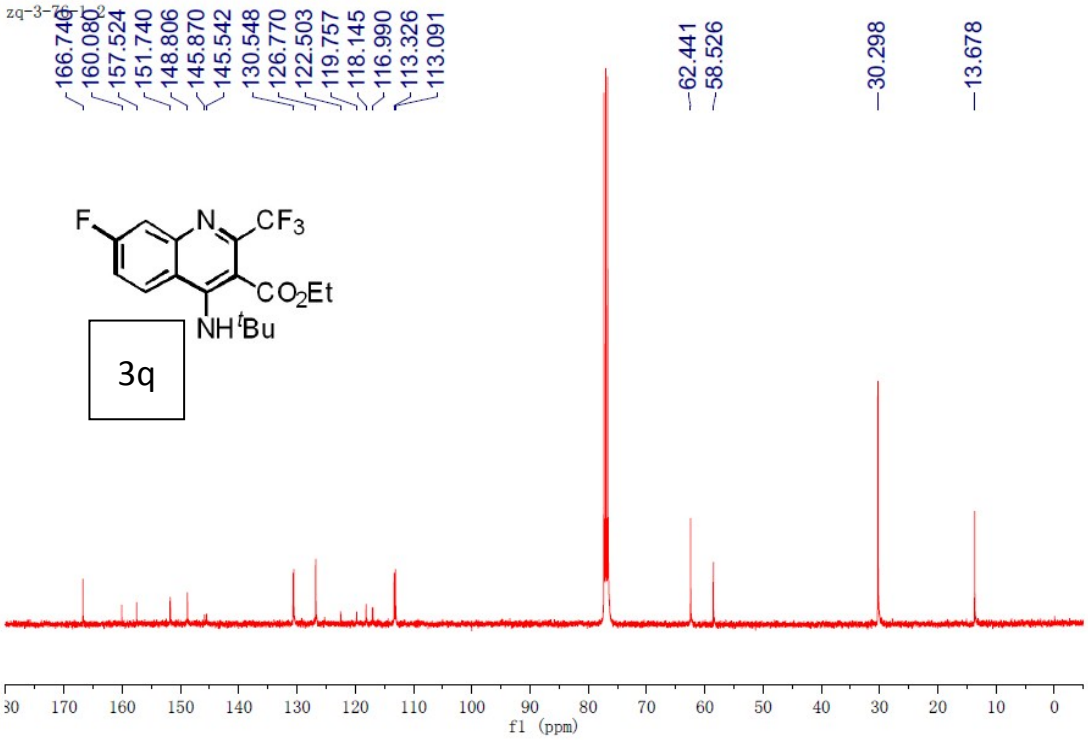

郑强
zq-3-62-3
8.22
8.14
8.11
7.59
7.56
5.10
4.38
4.37
4.35
4.33
1.36
1.34
1.33
1.16
Br
N
CF3
CO2Et
NHtBu
3o
f1 (ppm)

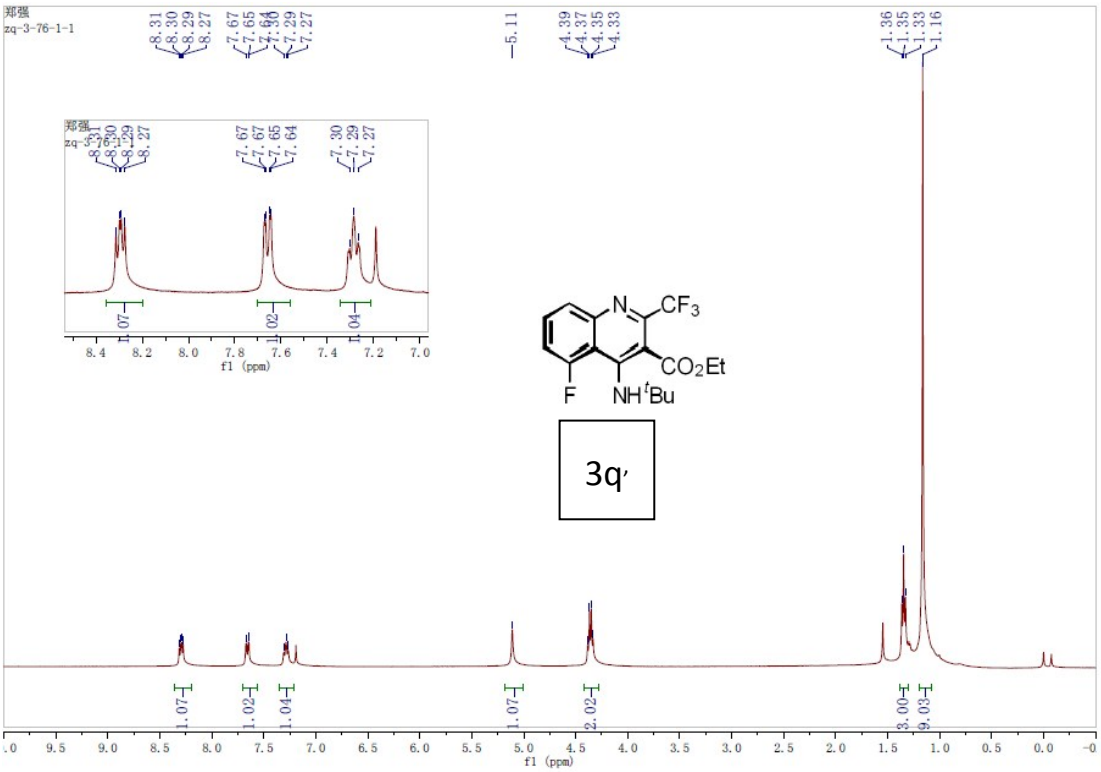

郑强
zq-3-62-3
166.89
154.09
148.25
146.45
146.11
145.78
145.46
132.10
130.49
128.33
126.08
125.85
122.47
119.72
118.54
77.32
77.00
76.68
62.62
57.53
31.31
13.74
Br
N
CF3
CO2Et
NHtBu
3o
f1 (ppm)

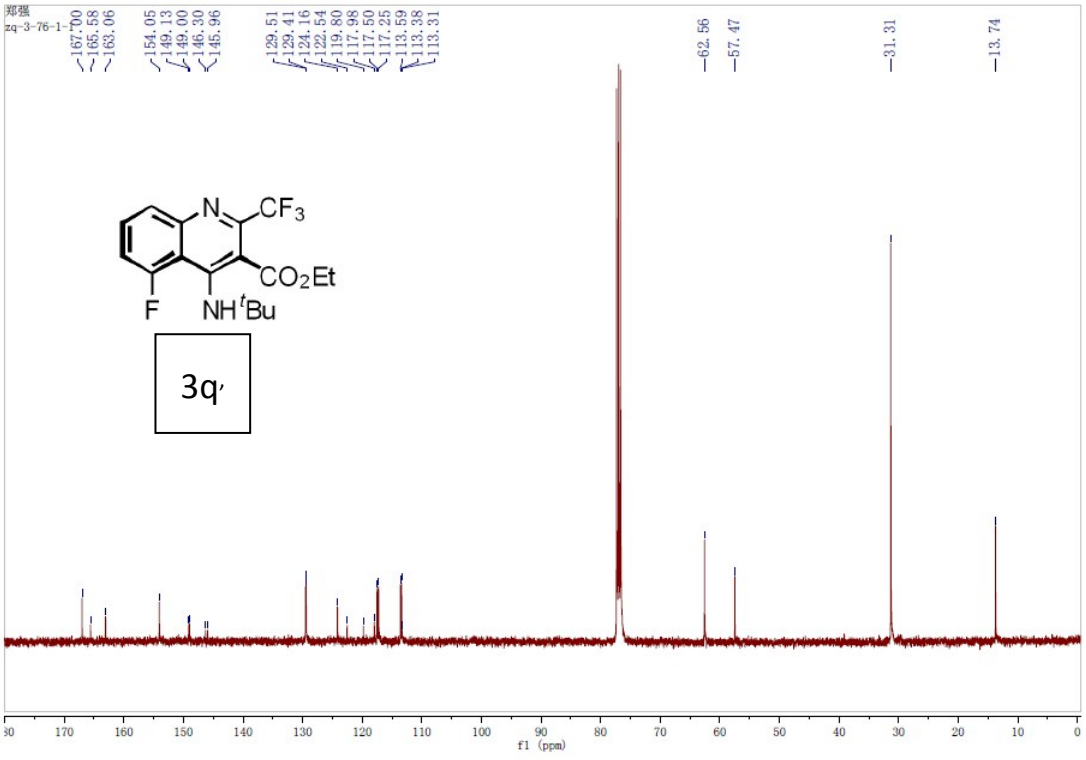

zq-3-56-1
8.32
8.06
8.04
7.72
7.70
4.47
4.45
4.43
4.41
1.44
1.42
1.40
1.25
郑强
zq-3-56-1
1.17
1.19
1.24
8.5
8.0
7.5
f1 (ppm)
Cl
N
CF3
CO2Et
NHtBu
3p
2.61
3.75
9.68
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

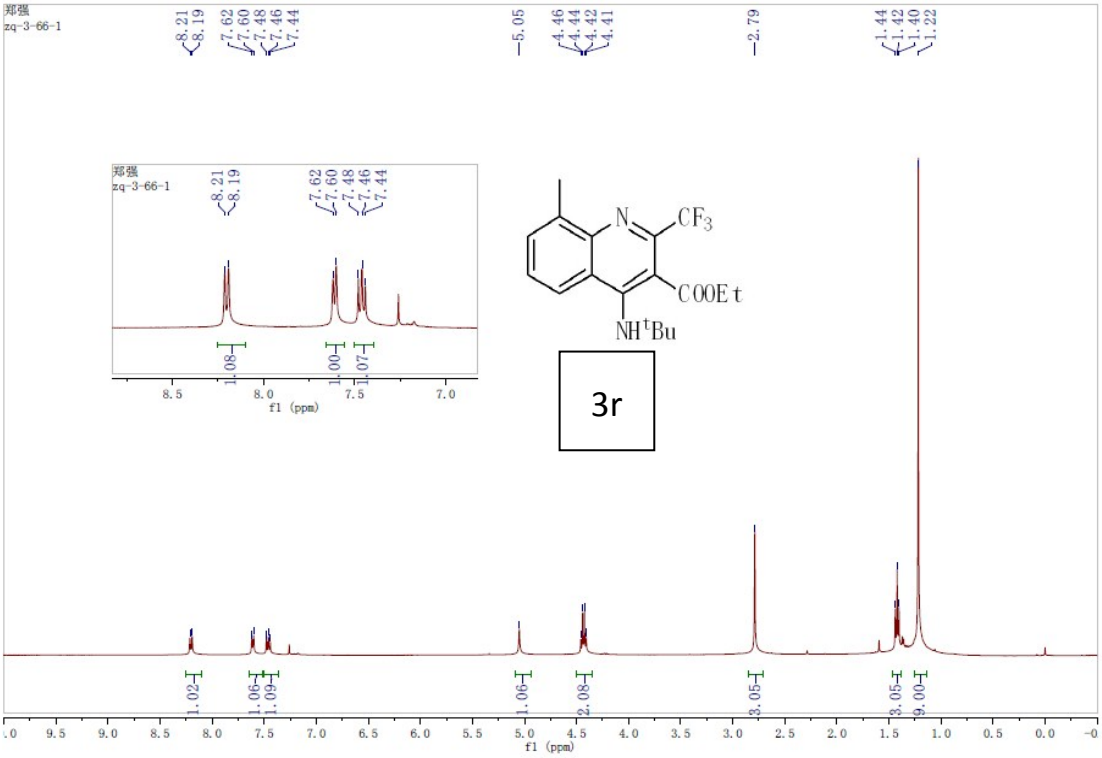

郑强
zq-3-62-1
166.90
154.00
148.11
146.20
145.86
137.73
128.74
128.35
127.96
125.57
122.50
119.75
118.47
62.61
57.51
31.31
13.74
3p
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

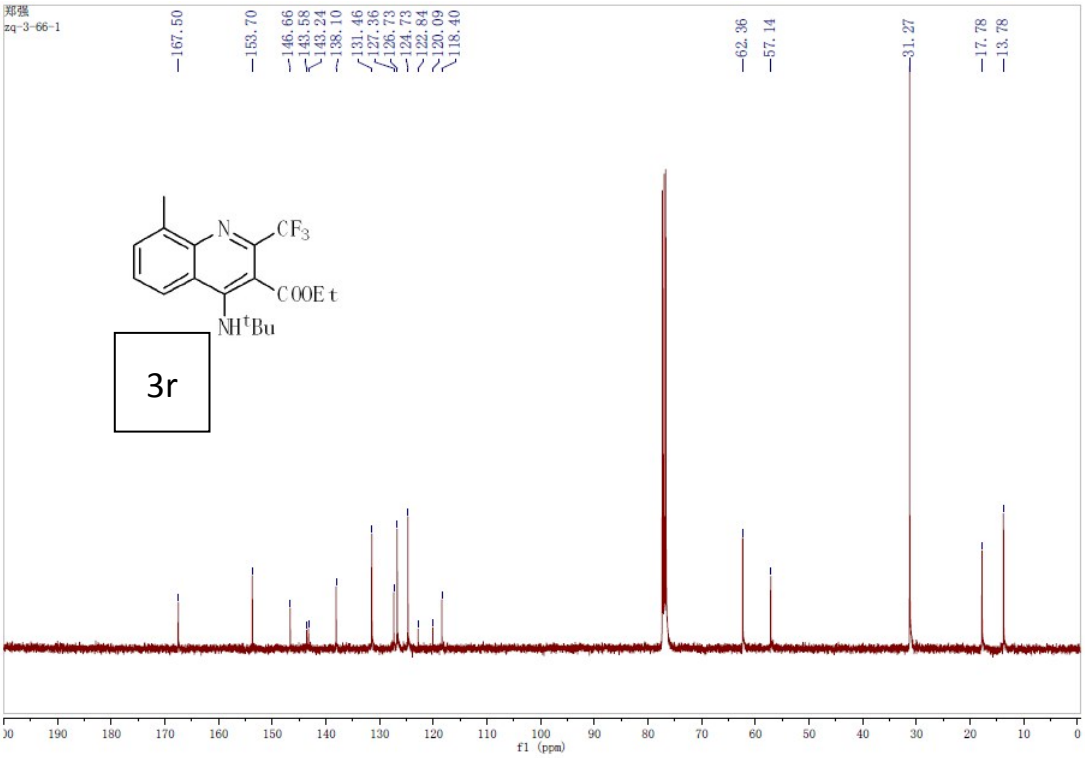

郑强
zq-3-76-1-2
7.94
7.92
7.71
7.69
7.69
7.67
7.67
7.65
7.27
7.26
7.26
7.24
7.24
7.23
7.23
7.21
7.21
5.50
5.48
4.44
4.42
4.41
4.39
1.42
1.41
1.39
1.26
F
N
CF3
CO2Et
NH tBu
3q
1.02
1.01
1.12
0.97
2.01
3.48
8.57
f1 (ppm)

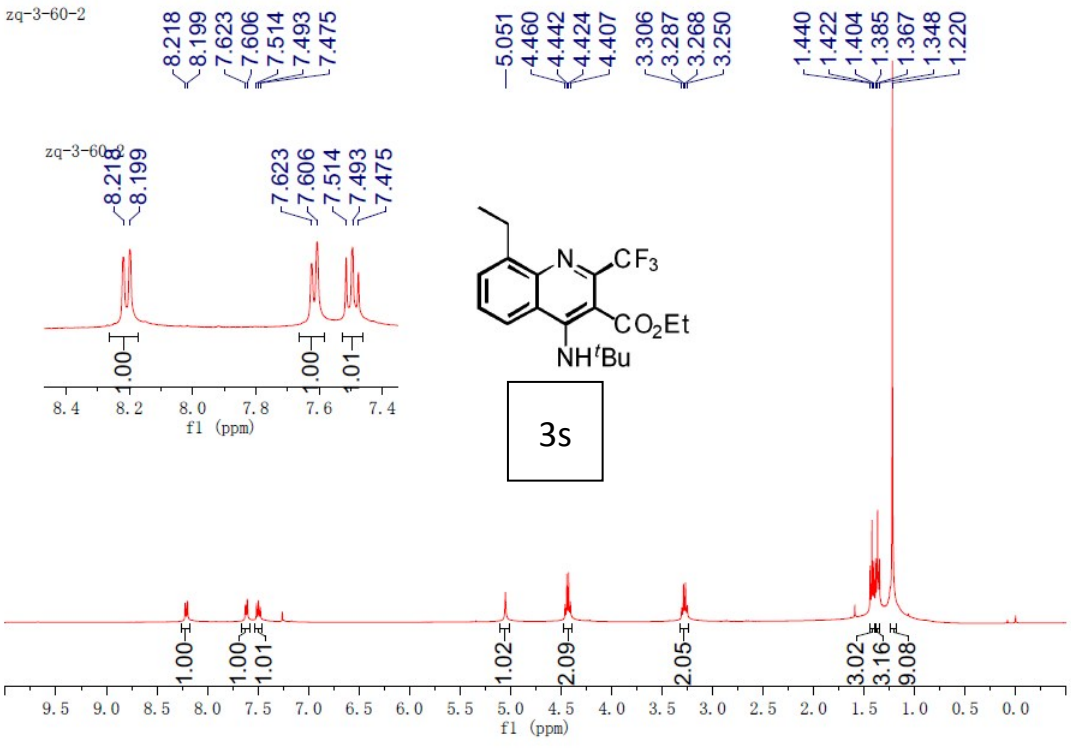

166.746
160.080
157.524
151.740
148.806
145.870
145.542
130.548
126.770
122.503
119.757
118.145
116.990
113.326
113.091
62.441
58.526
30.298
13.678
F
N
CF3
CO2Et
NH tBu
3q
f1 (ppm)

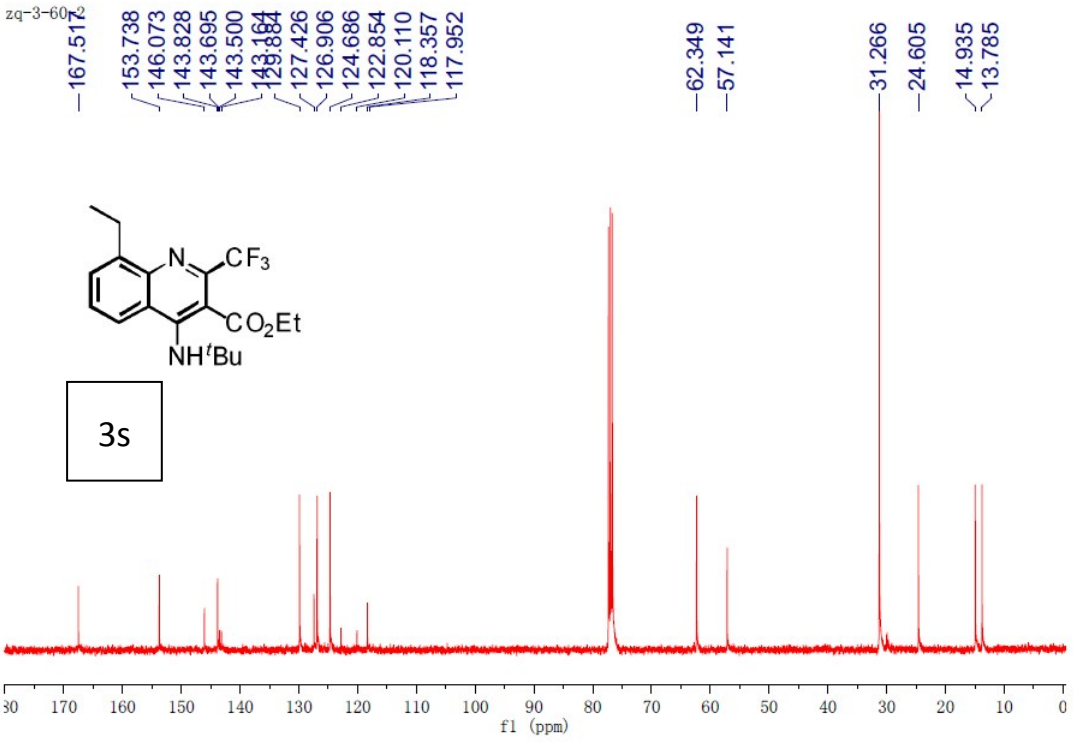

郑强
zq-3-76-1-1
8.31
8.30
8.29
8.27
7.67
7.65
7.64
7.30
7.29
7.27
5.11
4.39
4.37
4.35
4.33
1.36
1.35
1.33
1.16
1.07
1.02
1.04
1.07
2.02
3.00
9.03
f1 (ppm)
CF3
CO2Et
F
NHtBu
3q'

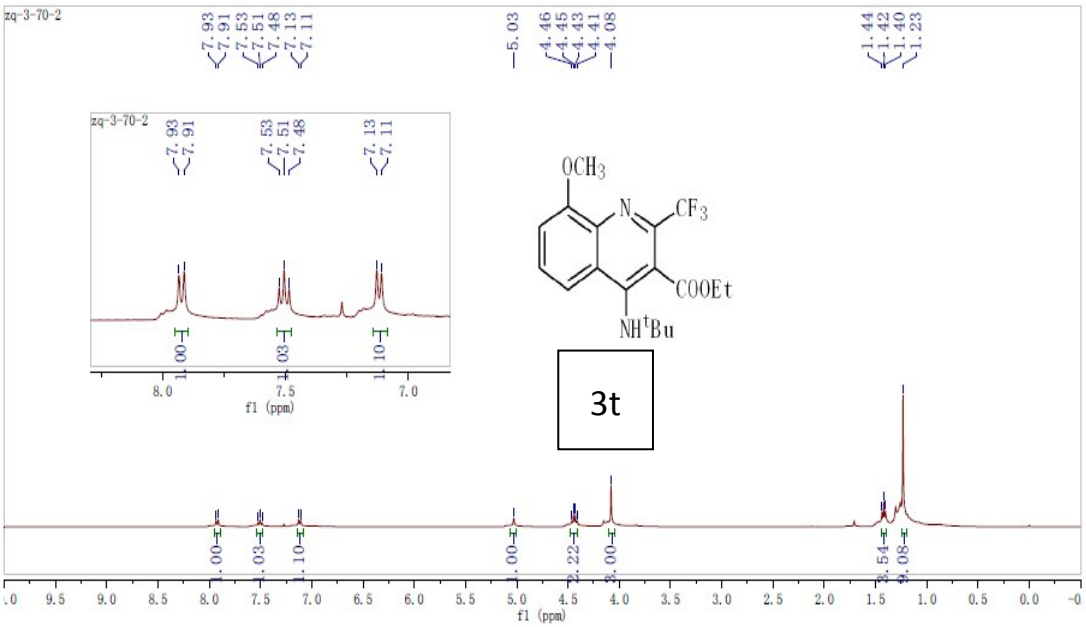

郑强
zq-3-76-1-1
167.70
165.58
163.06
154.05
149.13
149.00
146.30
145.96
129.51
129.41
124.16
122.54
119.80
117.98
117.50
117.25
113.59
113.38
113.31
62.56
57.47
31.31
13.74
f1 (ppm)
CF3
CO2Et
F
NHtBu
3q'

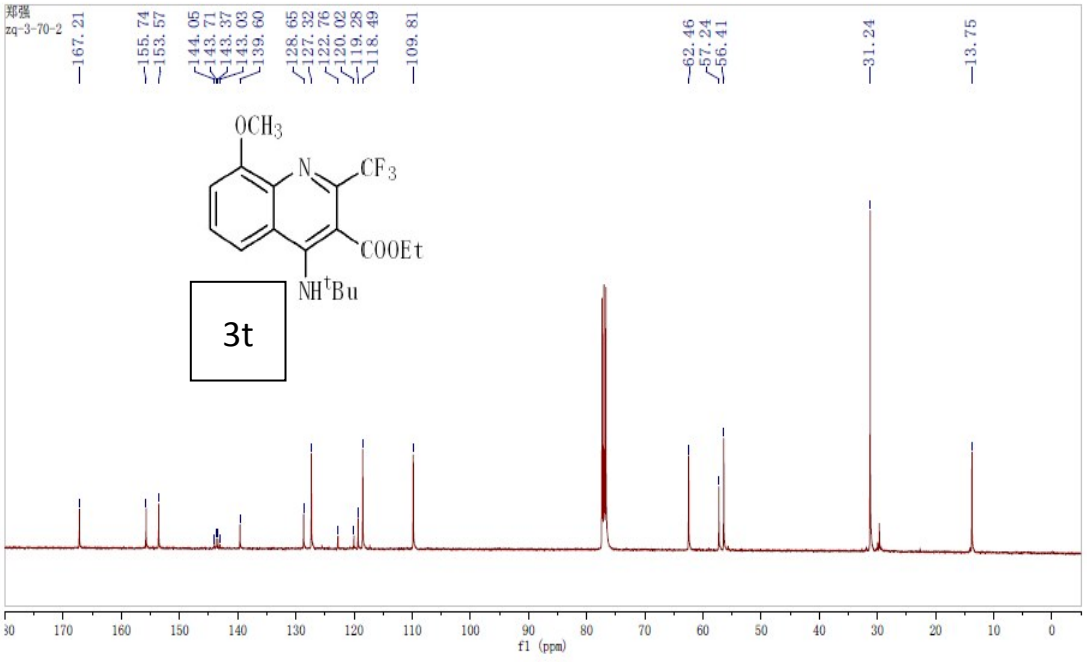

郑强
zq-3-66-1
8.21
8.19
7.62
7.60
7.48
7.46
7.44
5.05
4.46
4.44
4.42
4.41
2.79
1.44
1.42
1.40
1.22
1.02
1.06
1.09
1.06
2.08
3.05
3.05
9.00
f1 (ppm)
CF3
N
COOEt
NHtBu
3r

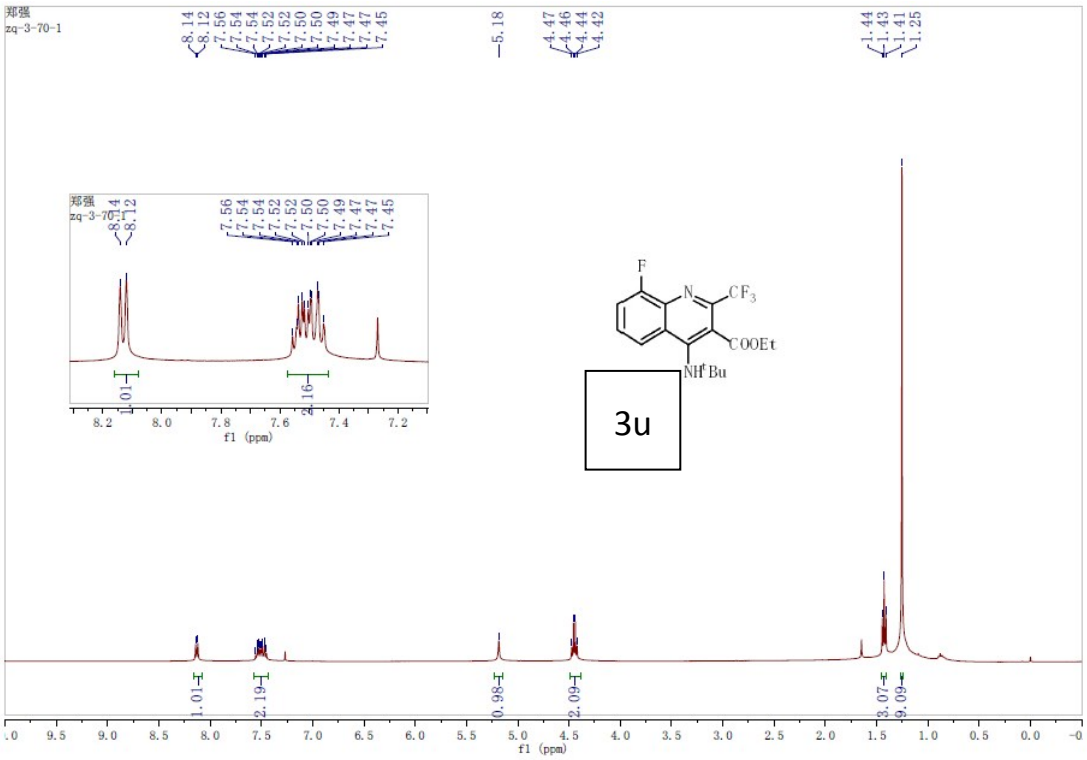

郑强
zq-3-66-1
167.50
153.70
146.66
143.58
143.24
138.10
131.46
127.36
126.73
124.73
122.84
120.09
118.40
62.36
57.14
31.27
17.78
13.78
f1 (ppm)
CF3
N
COOEt
NHtBu
3r

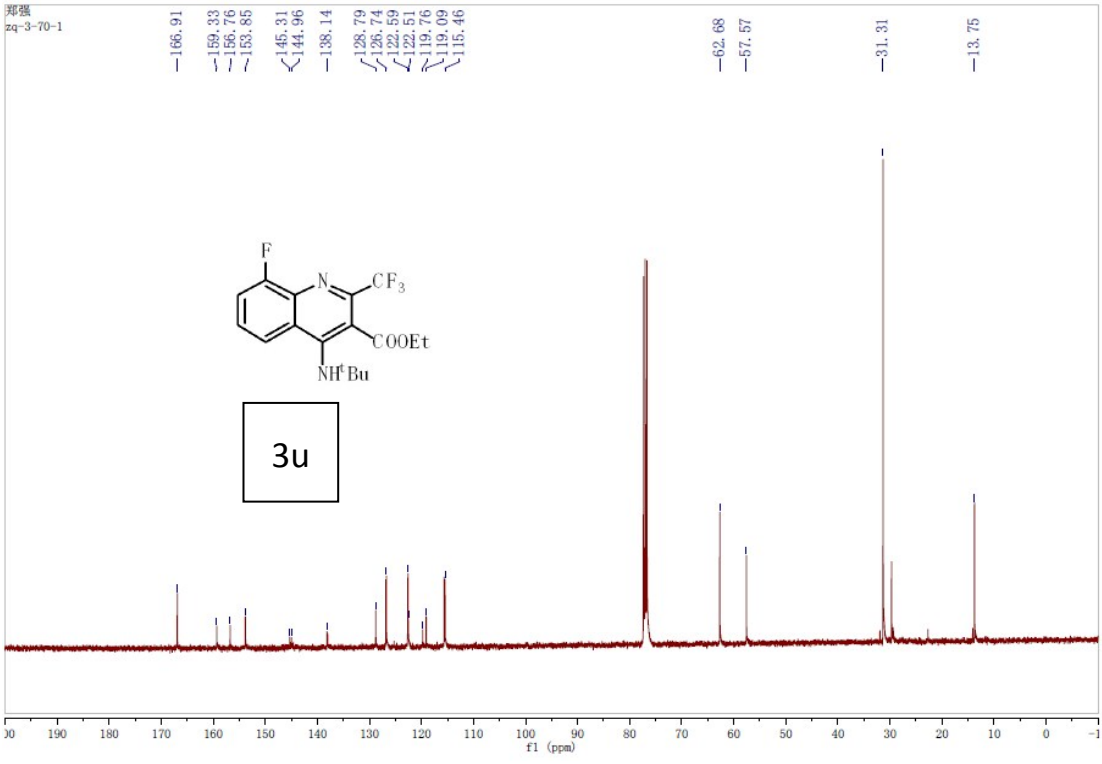

zq-3-60-2
8.218
8.199
7.623
7.606
7.514
7.493
7.475
5.051
4.460
4.442
4.424
4.407
3.306
3.287
3.268
3.250
1.440
1.422
1.404
1.385
1.367
1.348
1.220
1.00
1.00
1.01
1.00
1.00
1.01
1.02
2.09
2.05
3.02
3.16
9.08
f1 (ppm)
CF3
CO2Et
NH'Bu
3s

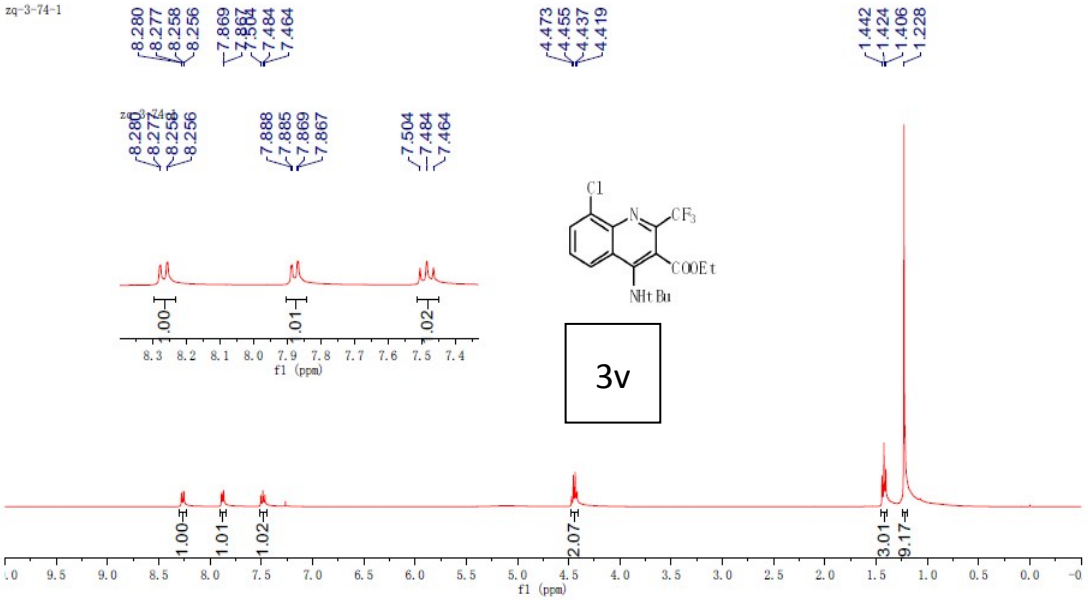

zq-3-60-2
167.517
153.738
146.073
143.828
143.695
143.500
127.426
126.906
124.686
122.854
120.110
118.357
117.952
62.349
57.141
31.266
24.605
14.935
13.785
f1 (ppm)
CF3
CO2Et
NH'Bu
3s

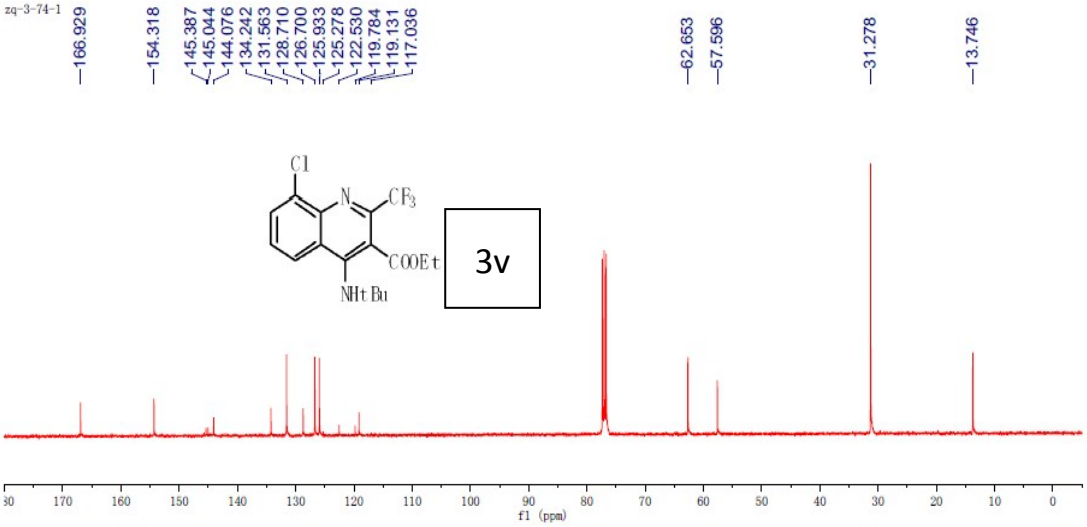

zq-3-70-2
7.93
7.91
7.53
7.51
7.48
7.13
7.11
5.03
4.46
4.45
4.43
4.41
4.08
1.44
1.42
1.40
1.23
OCH3
N
CF3
COOEt
NHtBu
3t
f1 (ppm)

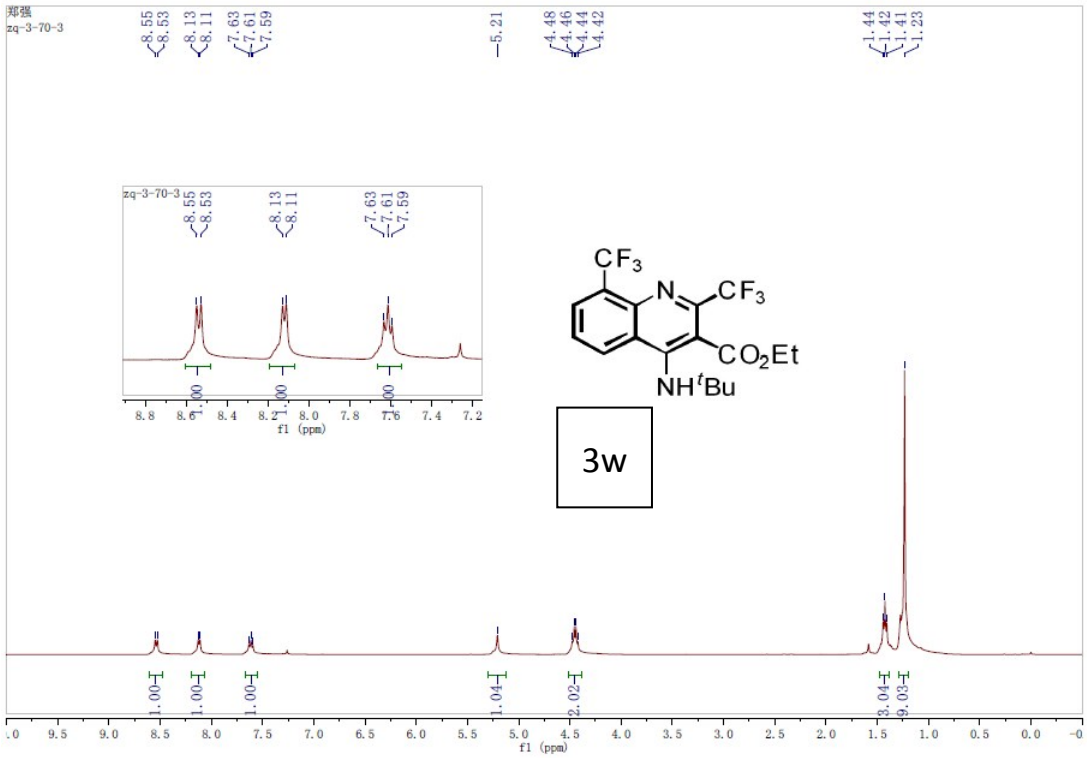

郑强
zq-3-70-2
167.21
155.74
153.57
144.05
143.71
143.37
143.03
139.60
128.65
127.32
122.76
120.02
119.28
118.49
109.81
62.46
57.24
56.41
31.24
13.75
OCH3
N
CF3
COOEt
NHtBu
3t
f1 (ppm)

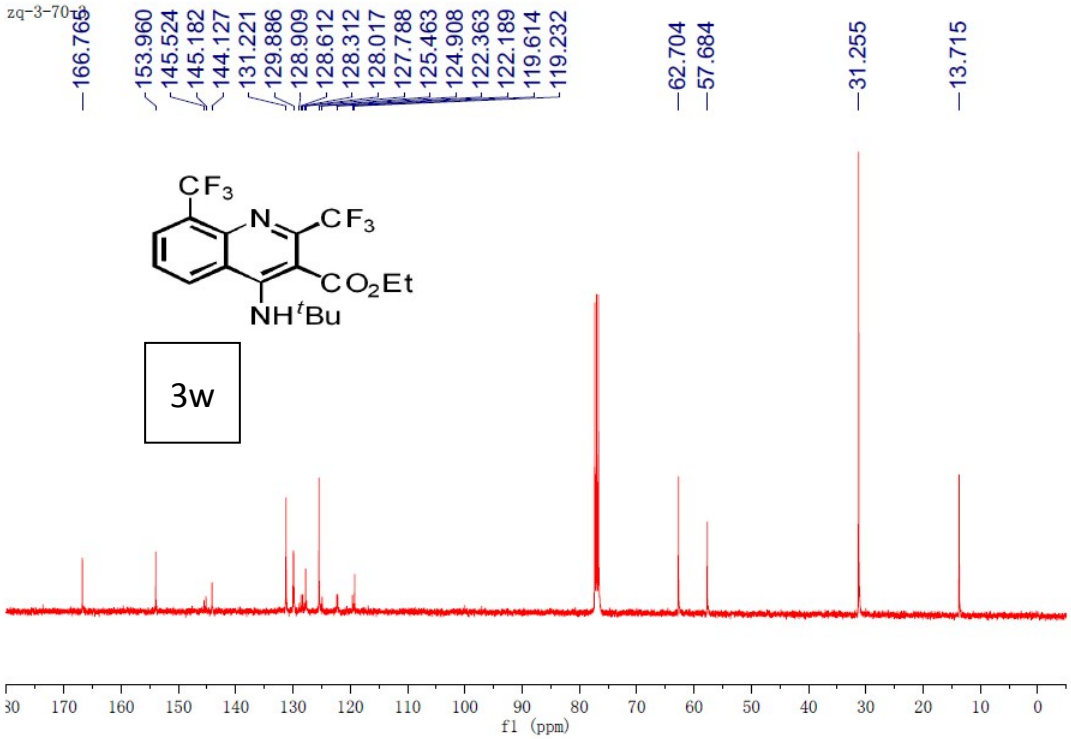

郑强
zq-3-70-1
8.14
8.12
7.56
7.54
7.54
7.52
7.52
7.50
7.50
7.49
7.47
7.47
7.45
5.18
4.47
4.46
4.44
4.42
1.44
1.43
1.41
1.25
1.01
2.19
0.98
2.09
3.07
9.09
f1 (ppm)
F
N
CF3
COOEt
NHtBu
3u

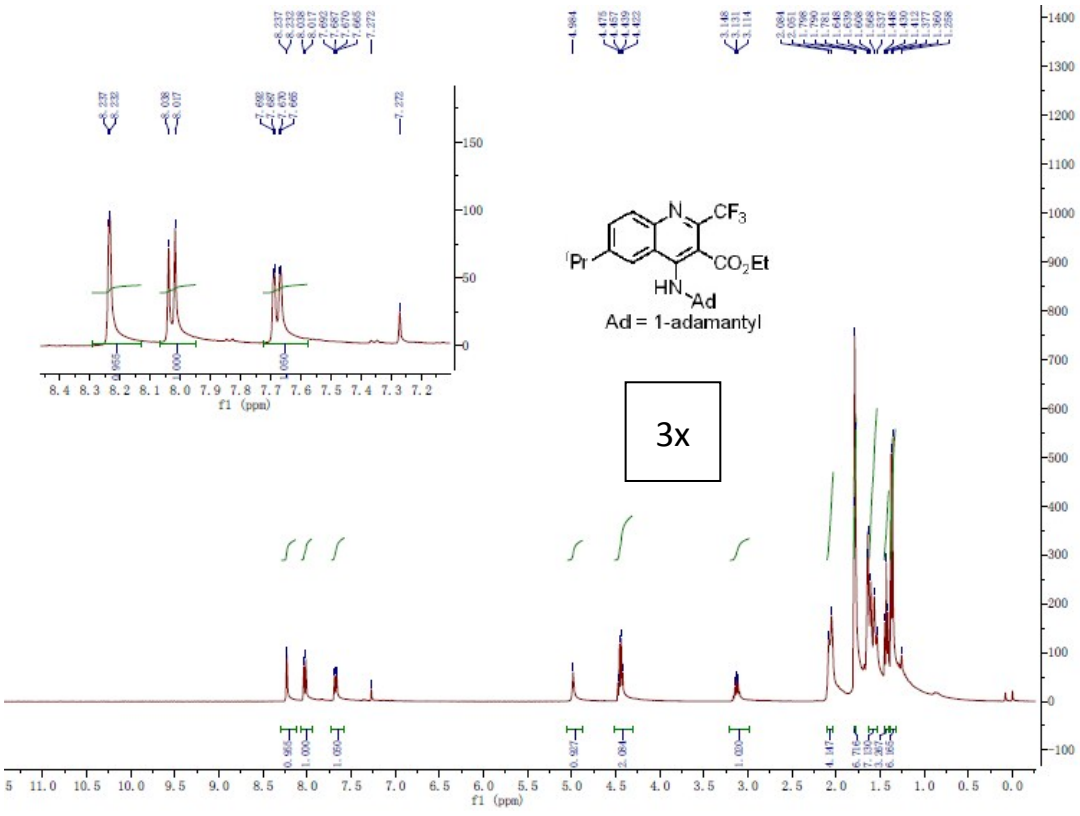

郑强
zq-3-70-1
166.91
159.33
156.76
153.85
145.31
144.96
138.14
128.79
126.74
122.59
122.51
119.76
119.09
115.46
62.68
57.57
31.31
13.75
f1 (ppm)
F
N
CF3
COOEt
NHtBu
3u

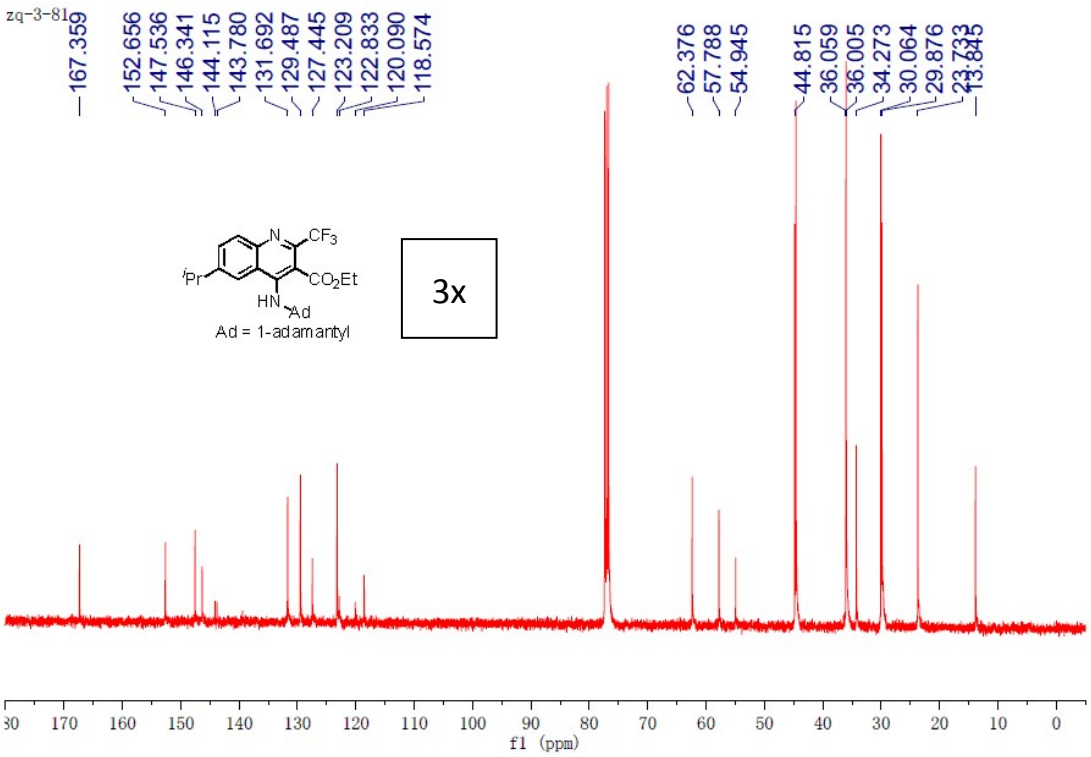

zq-3-74-1
8.280
8.277
8.258
8.256
7.869
7.867
7.504
7.484
7.464
4.473
4.455
4.437
4.419
1.442
1.424
1.406
1.228
Cl
N
CF3
COOEt
NHtBu
3v
1.00
1.01
1.02
2.07
3.01
9.17
f1 (ppm)

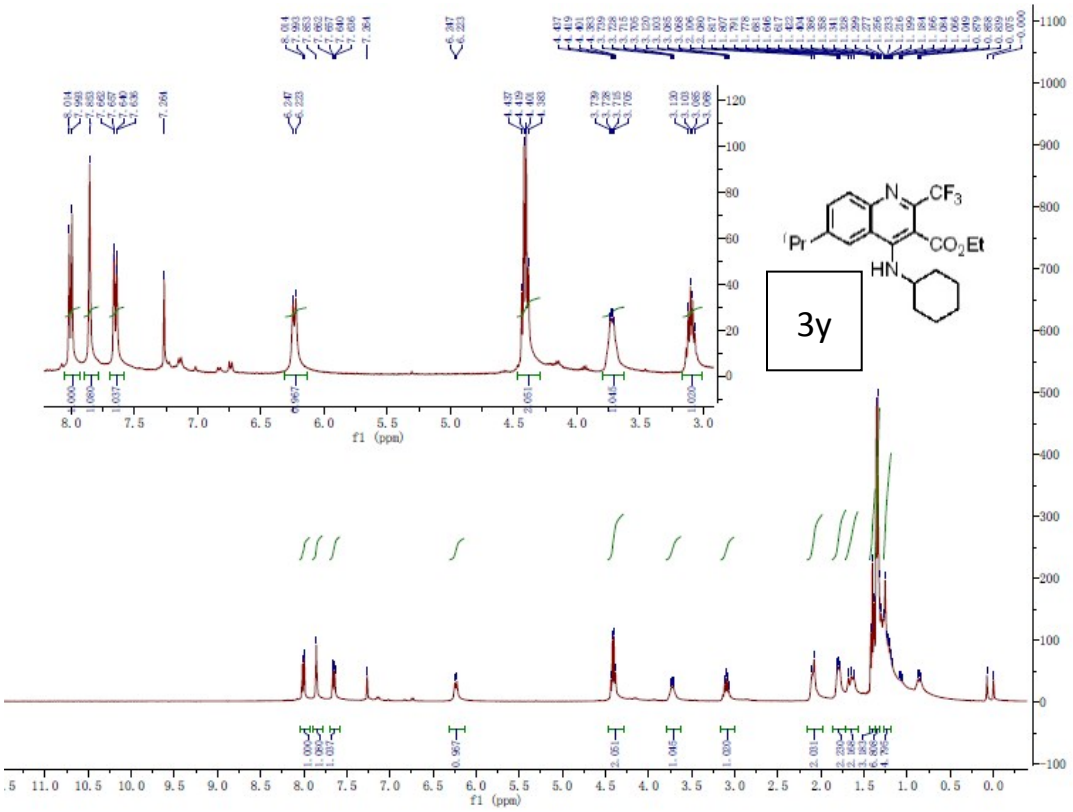

zq-3-74-1
166.929
154.318
145.387
145.044
144.076
134.242
131.563
128.710
126.700
125.933
125.278
122.530
119.784
119.131
117.036
62.653
57.596
31.278
13.746
Cl
N
CF3
COOEt
NHtBu
3v
f1 (ppm)

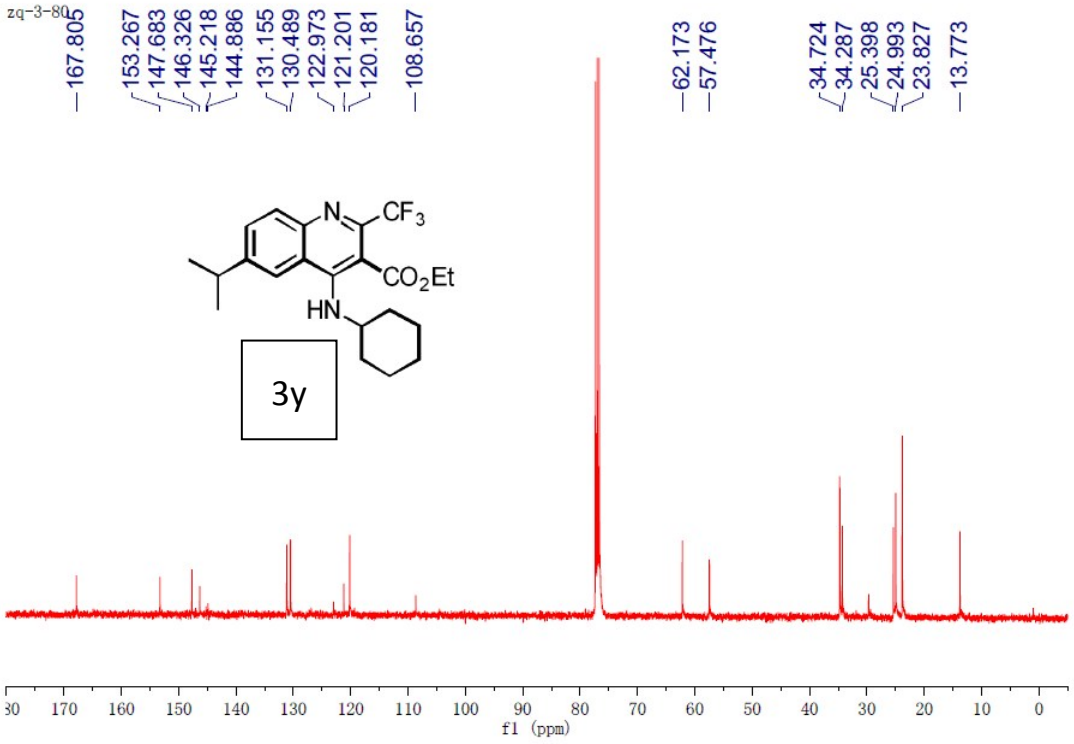

zq-3-70-3
8.55
8.53
8.13
8.11
7.63
7.61
7.59
5.21
4.48
4.46
4.44
4.42
1.44
1.42
1.41
1.23
CF3
N
CF3
CO2Et
NHtBu
3w
f1 (ppm)


166.765
153.960
145.524
145.182
144.127
131.221
129.886
128.909
128.612
128.312
128.017
127.788
125.463
124.908
122.363
122.189
119.614
119.232
62.704
57.684
31.255
13.715
CF3
N
CF3
CO2Et
NHtBu
3w
f1 (ppm)

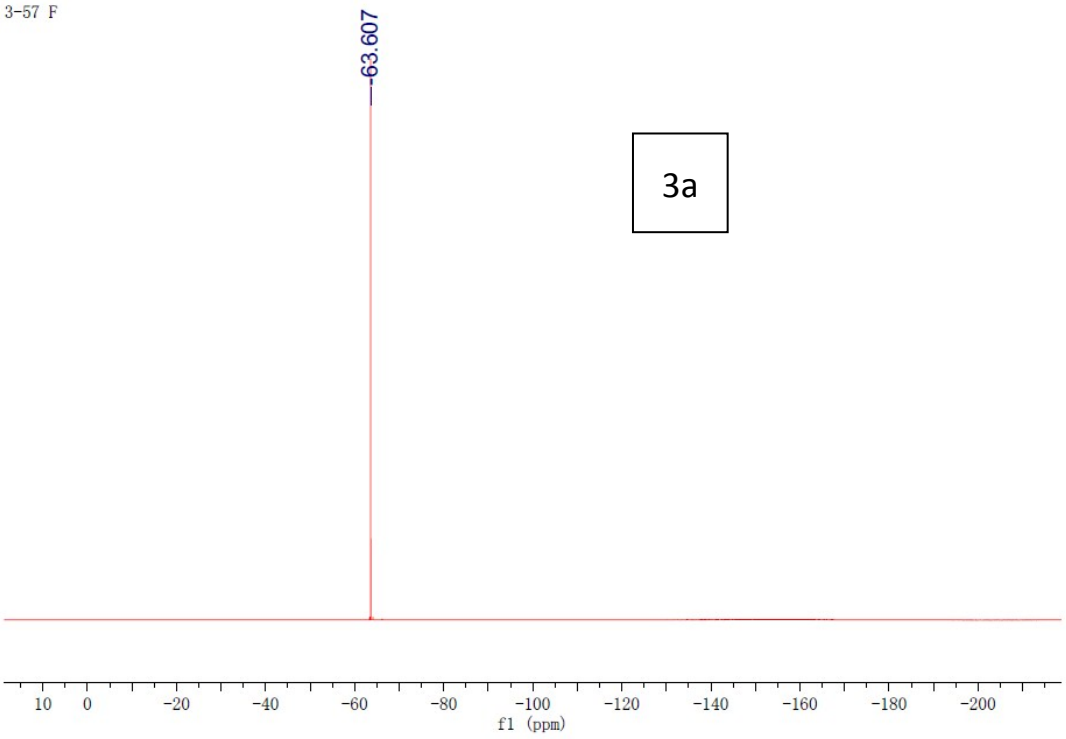

Ad = 1-adamantyl
3x
f1 (ppm)

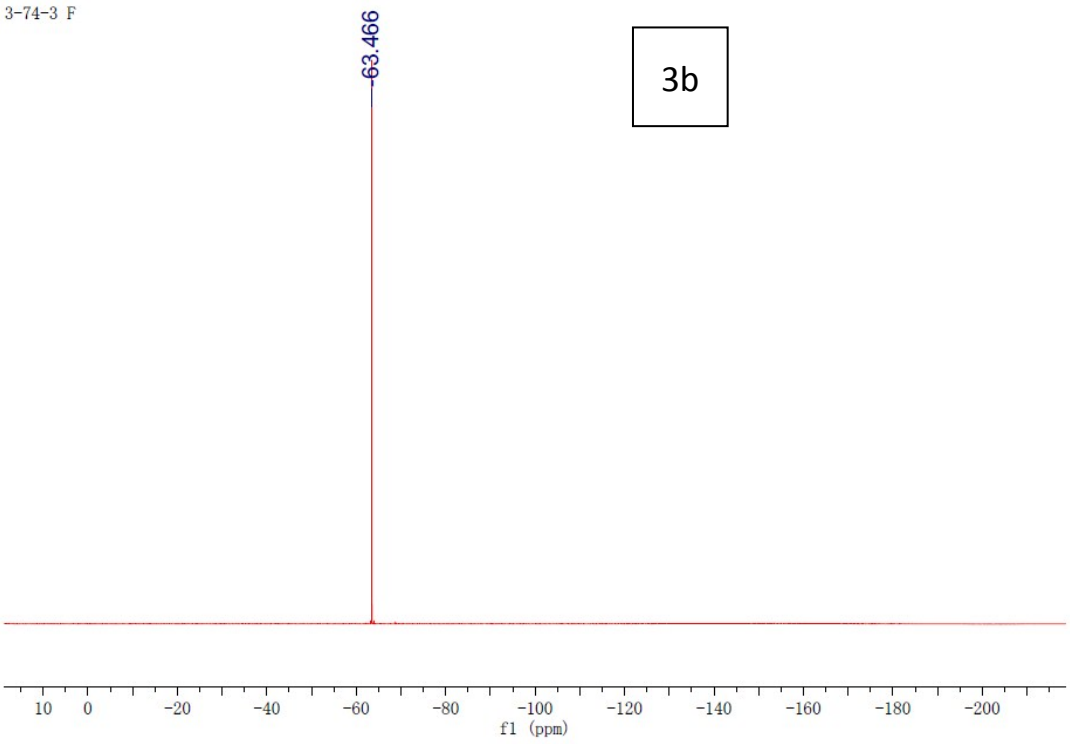

zq-3-81
167.359
152.656
147.536
146.341
144.115
143.780
131.692
129.487
127.445
123.209
122.833
120.090
118.574
62.376
57.788
54.945
44.815
36.059
36.005
34.273
30.064
29.876
23.733
13.845
CF3
iPr
CO2Et
HN
Ad
Ad = 1-adamantyl
3x
f1 (ppm)

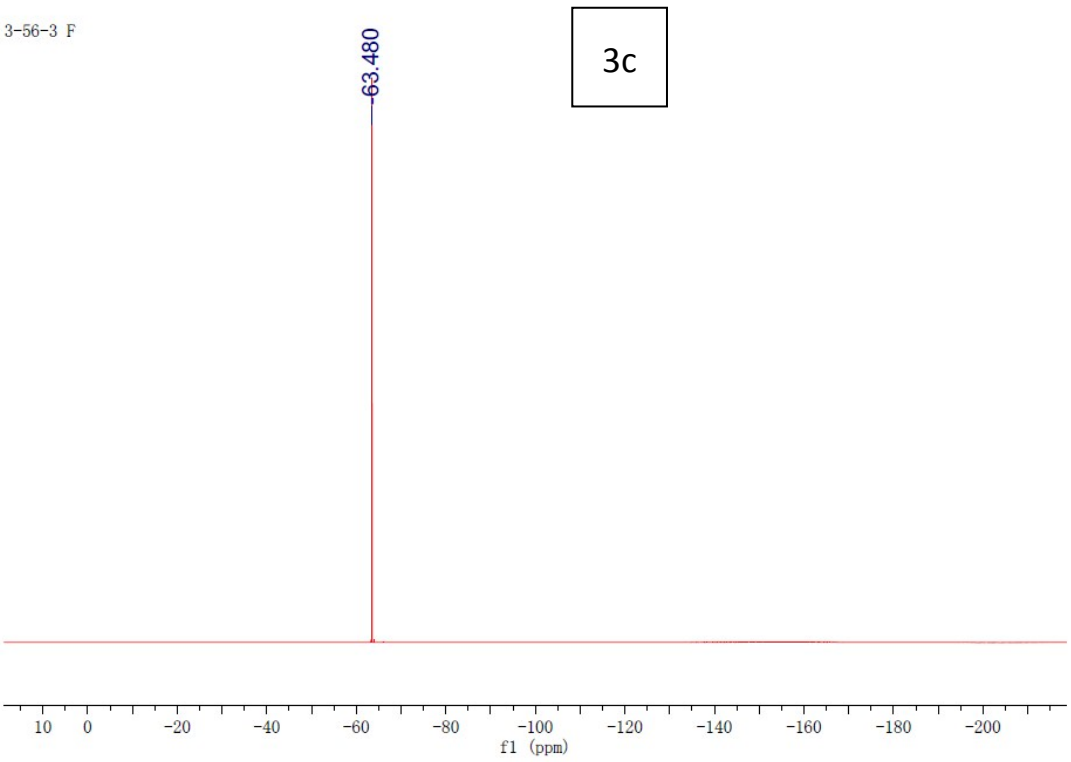

CF3
iPr
CO2Et
HN
3y
f1 (ppm)

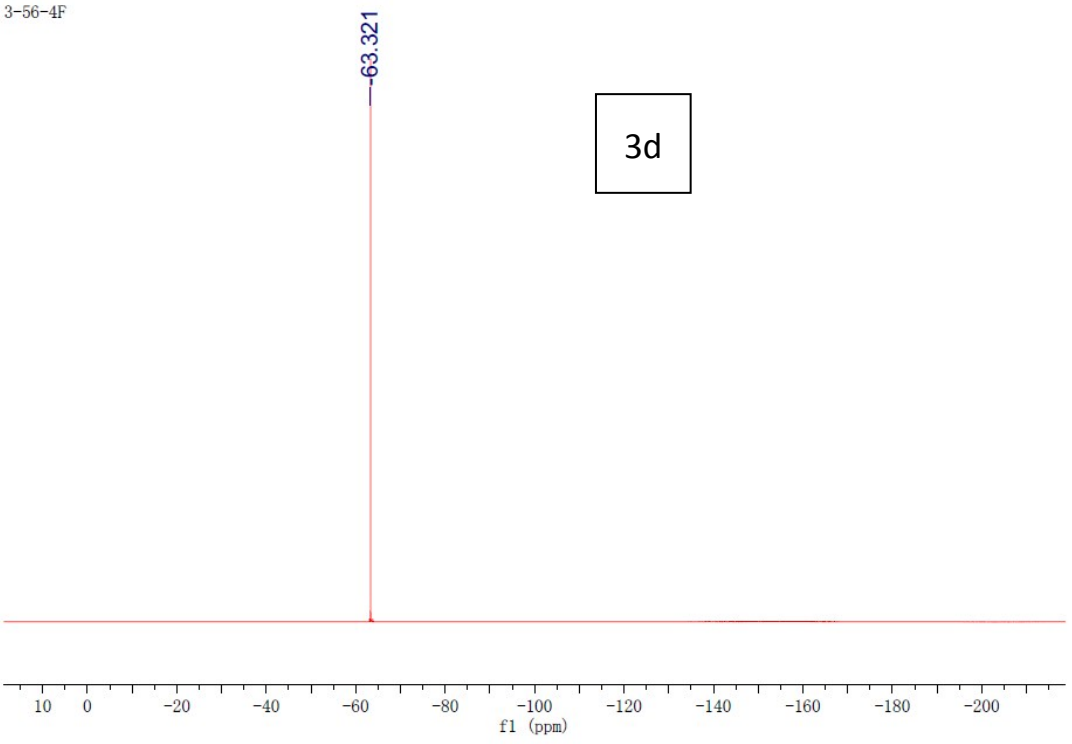


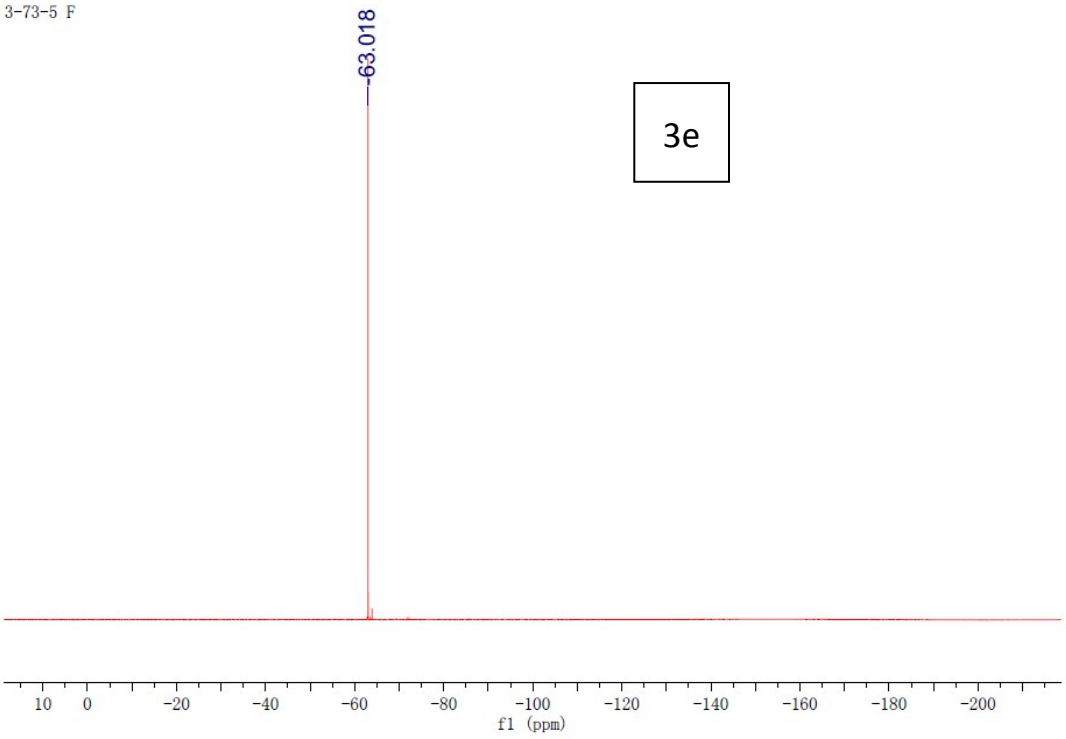
3. The Copies of ^{19}FNMR Spectra of 3

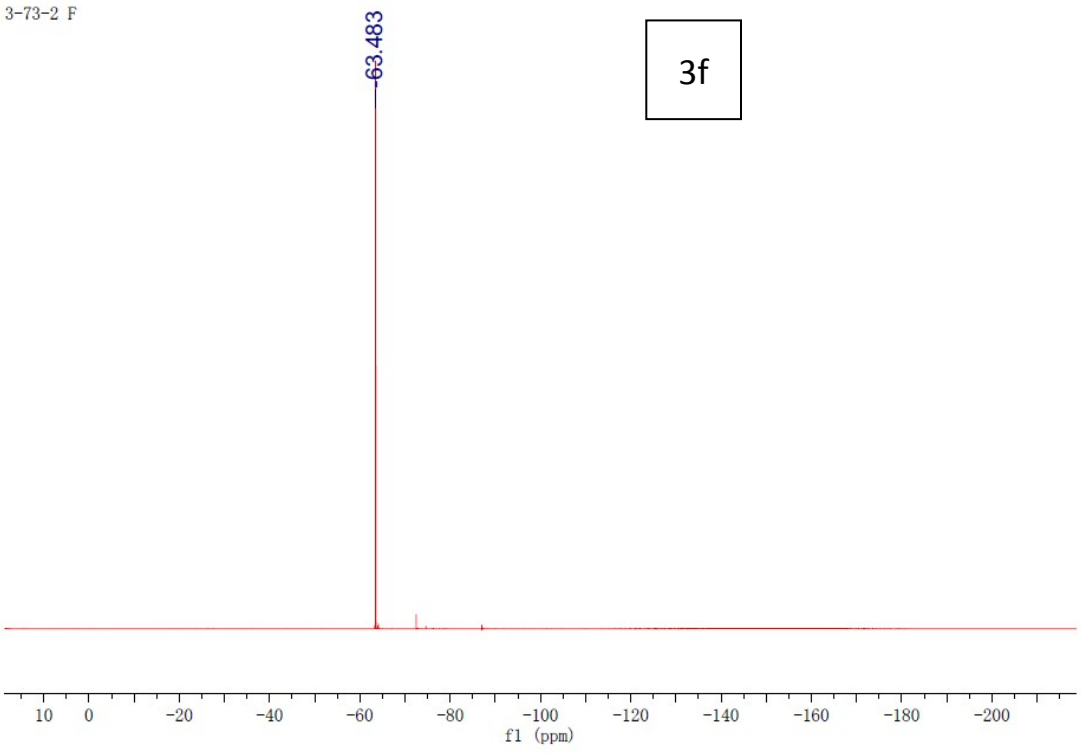

3-57 F
-63.607
3a
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

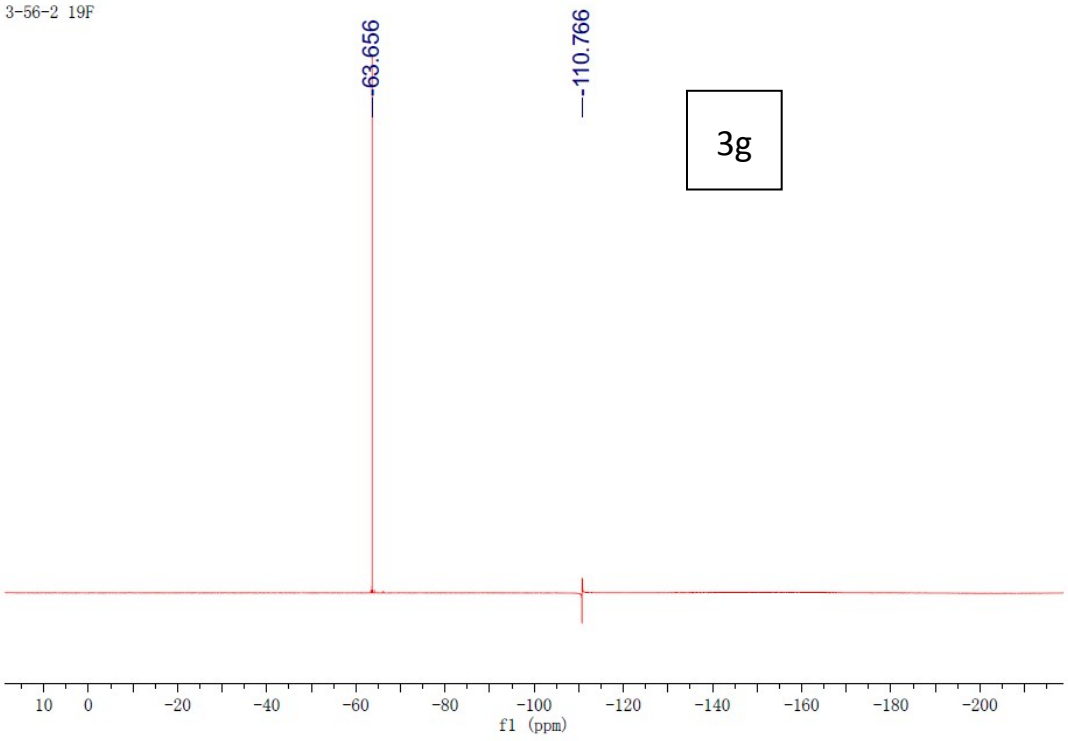

3-74-3 F
-63.466
3b
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

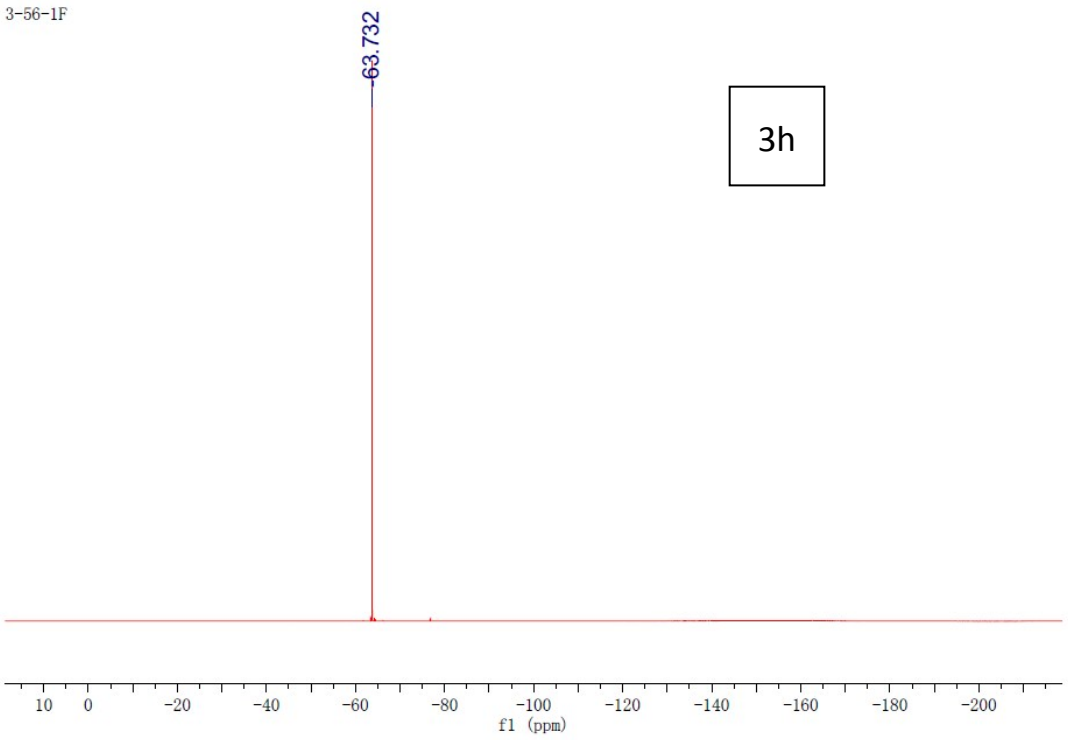

3-56-3 F
-63.480
3c
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

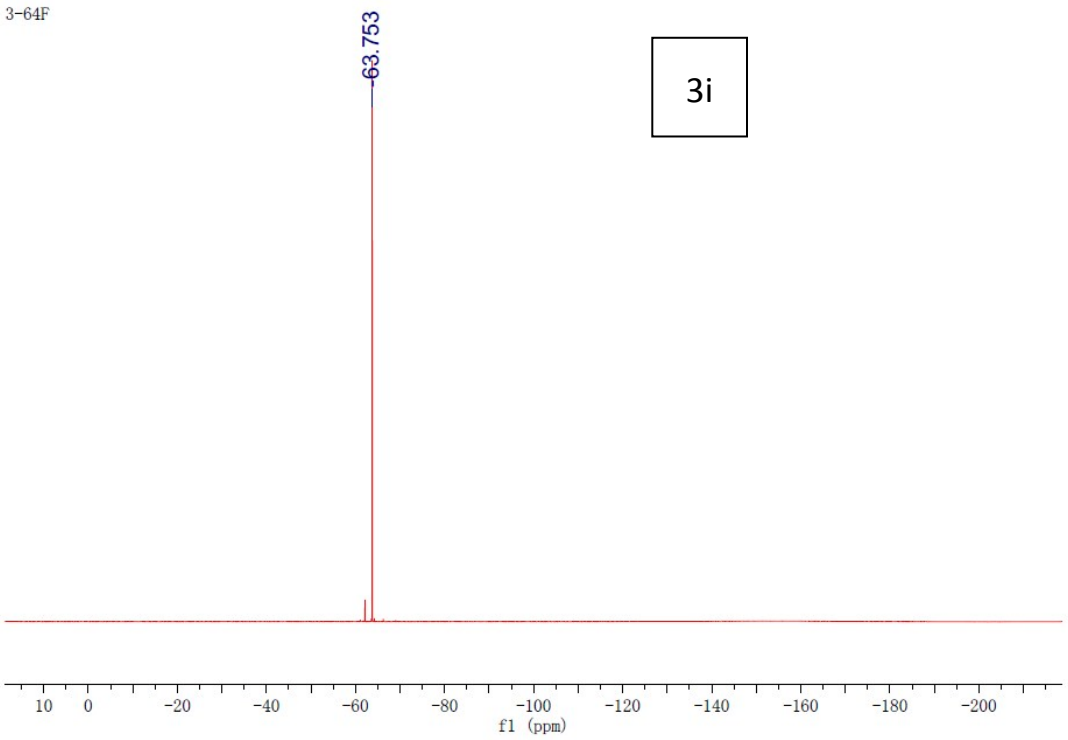

3-56-4F
-63.321
3d
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

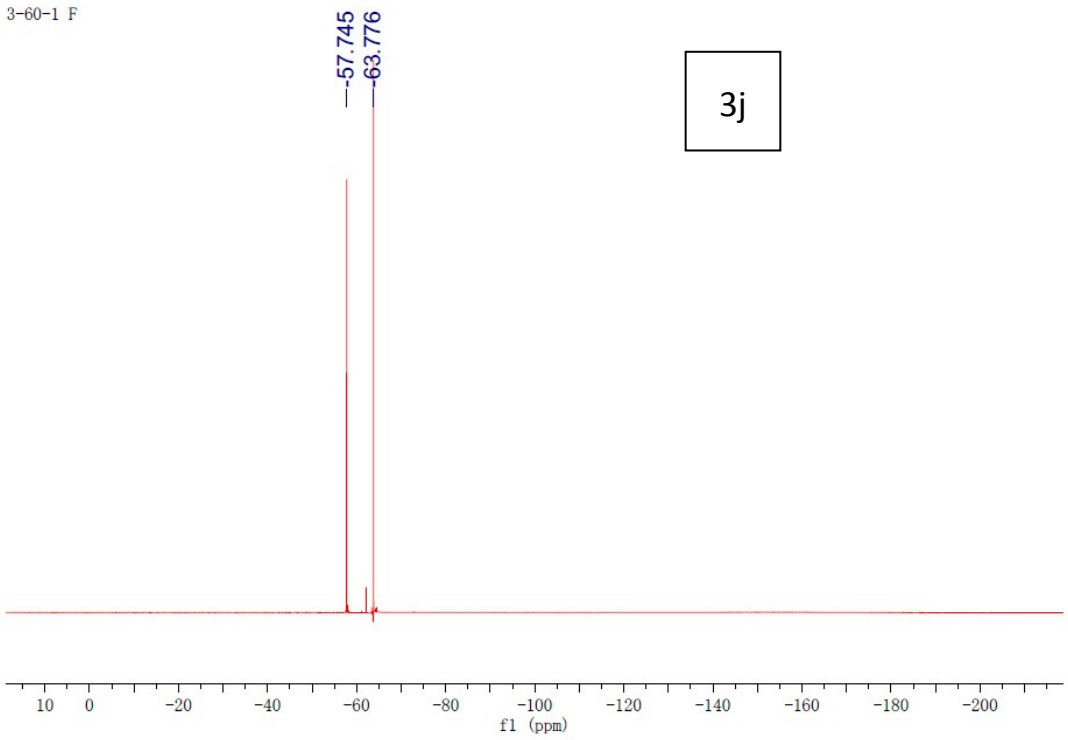

3-73-5 F
-63.018
3e
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

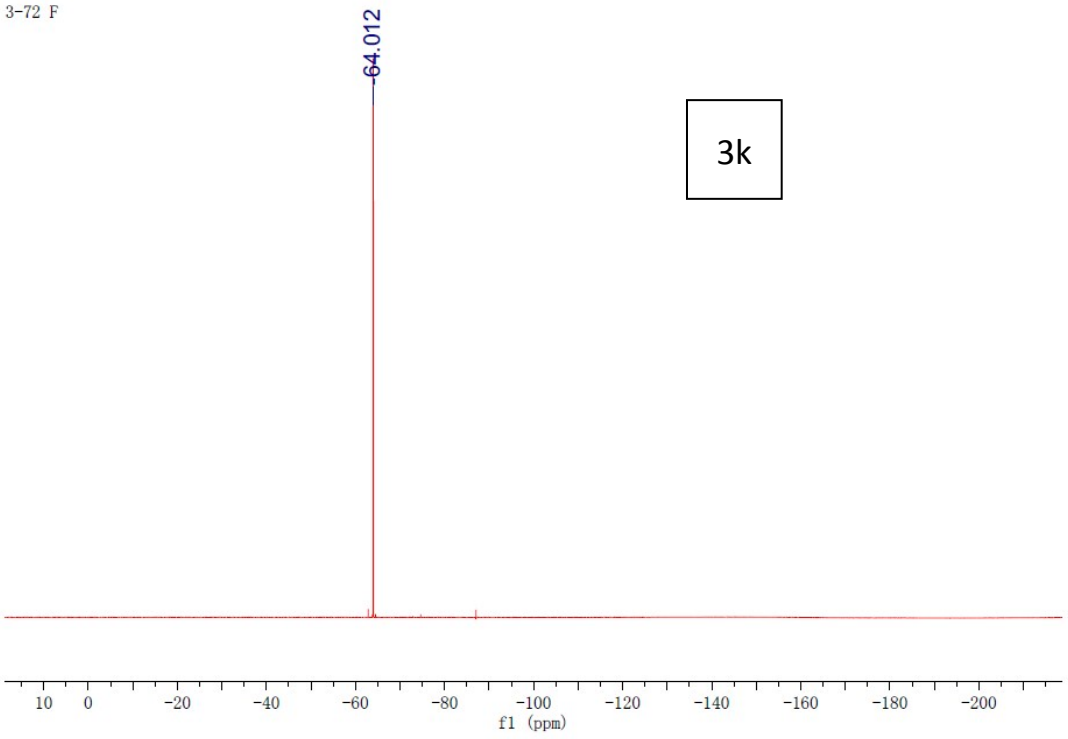

3-73-2 F
-63.483
3f
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

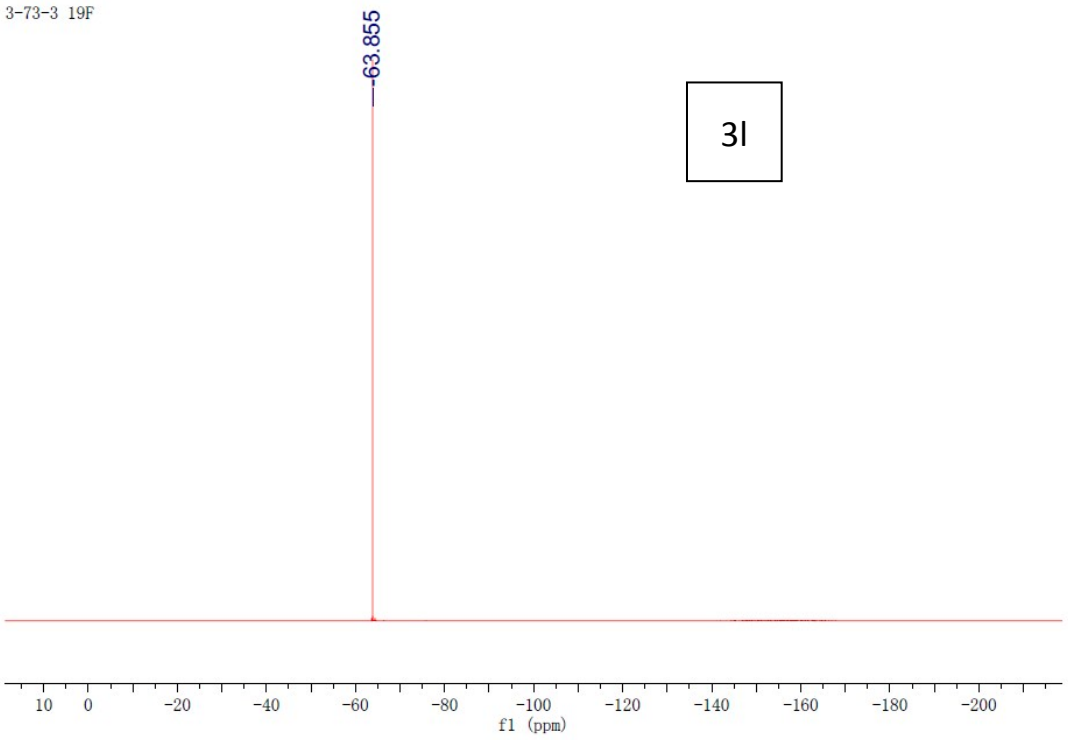

3-56-2 19F
-63.656
-110.766
3g
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

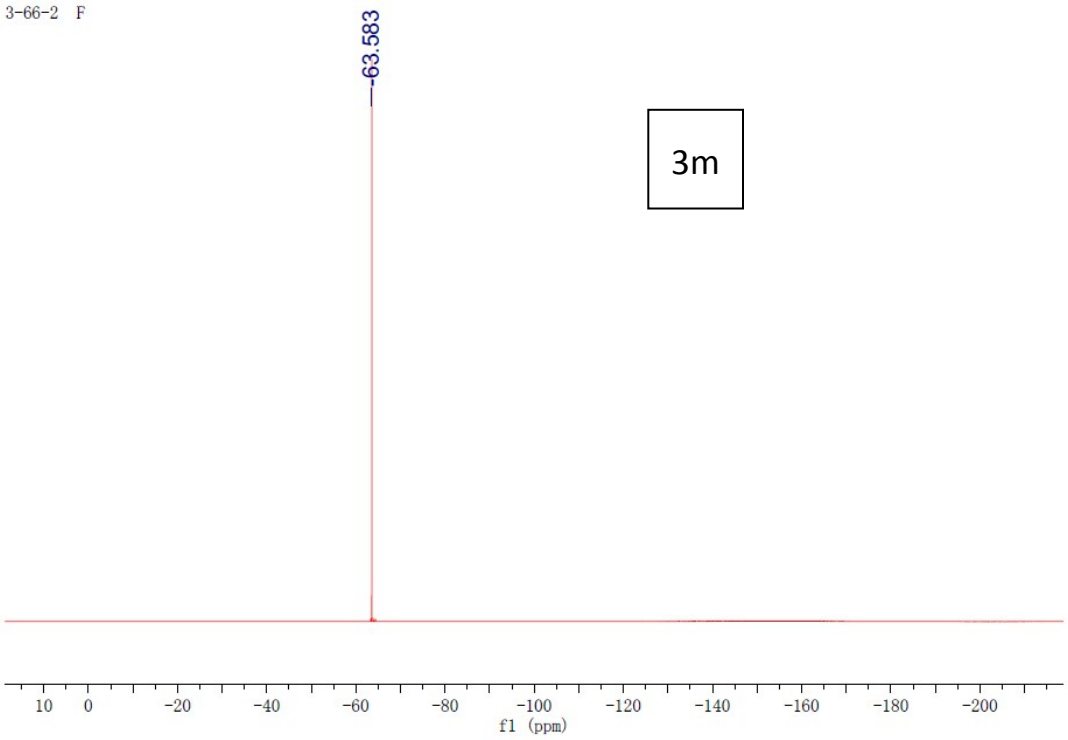

3-56-1F
-63.732
3h
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

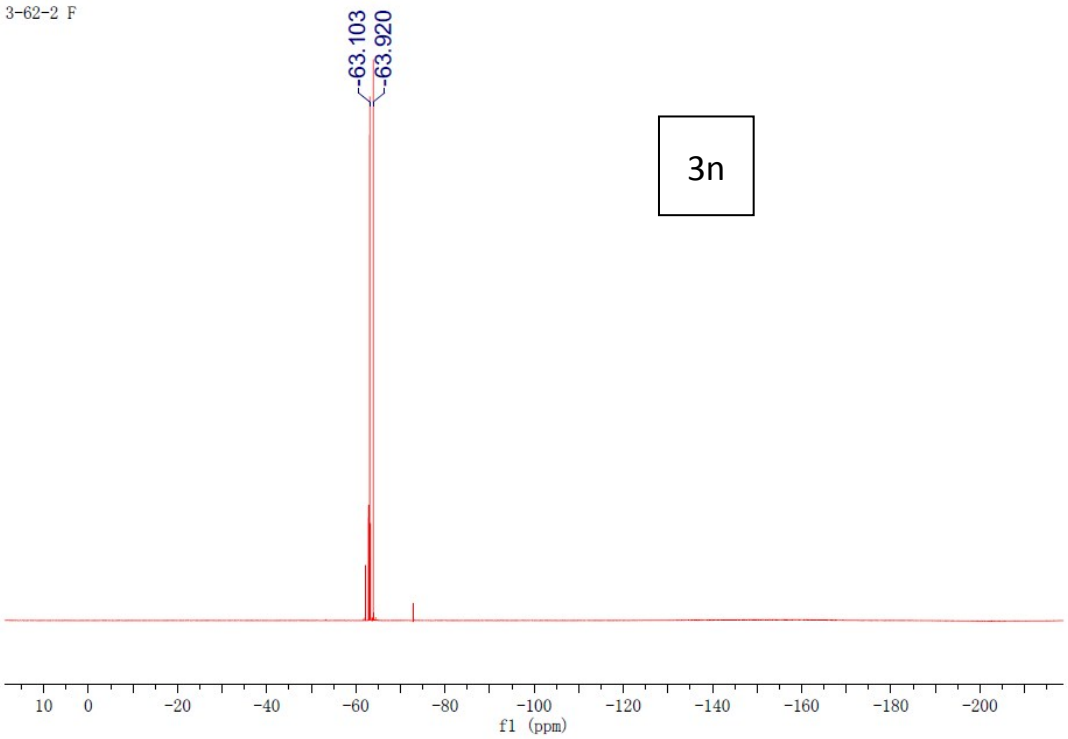

3-64F
-63.753
3i
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

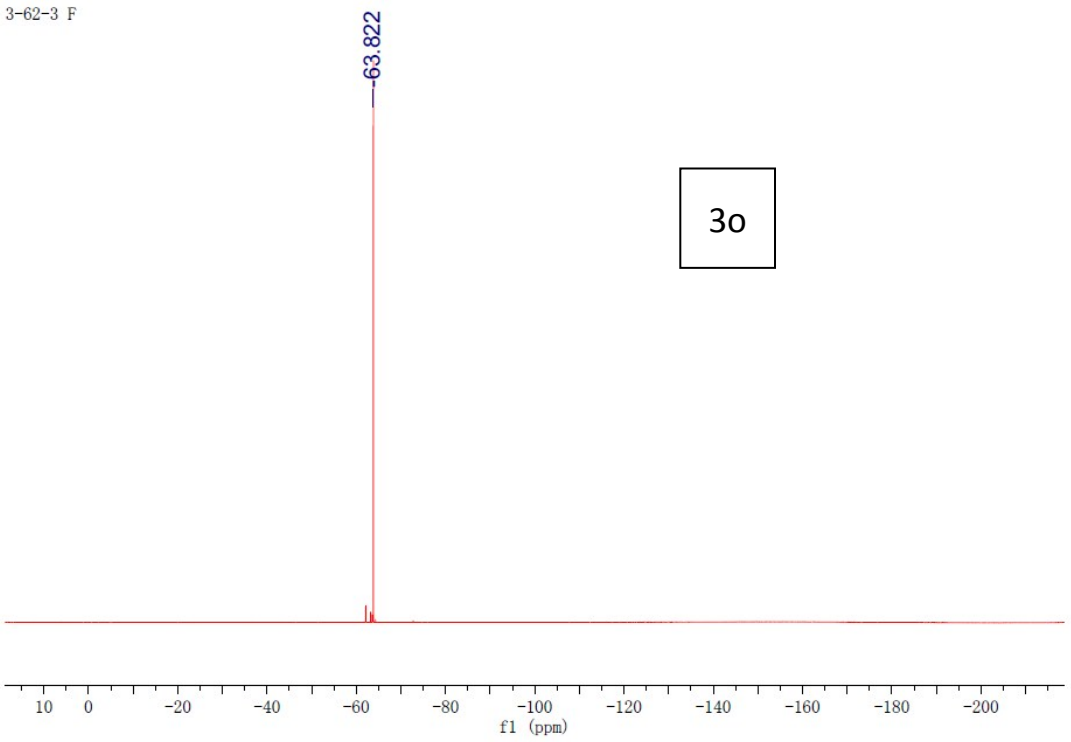

3-60-1 F
-57.745
-63.776
3j
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

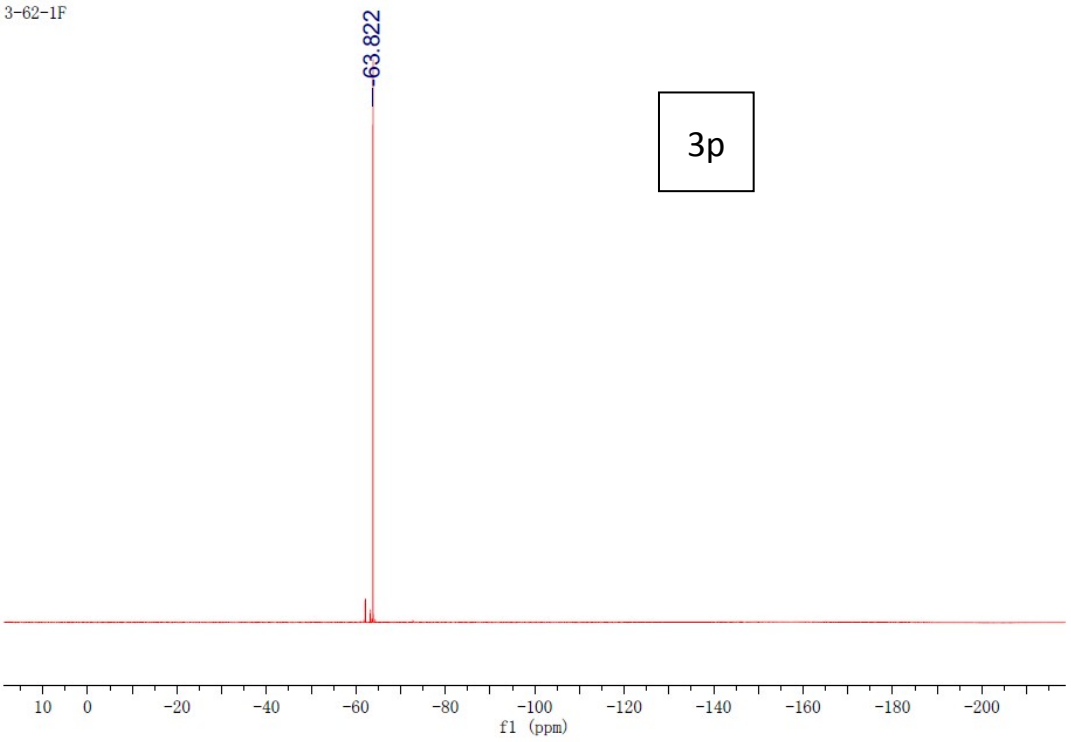

3-72 F
-64.012
3k
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
f1 (ppm)

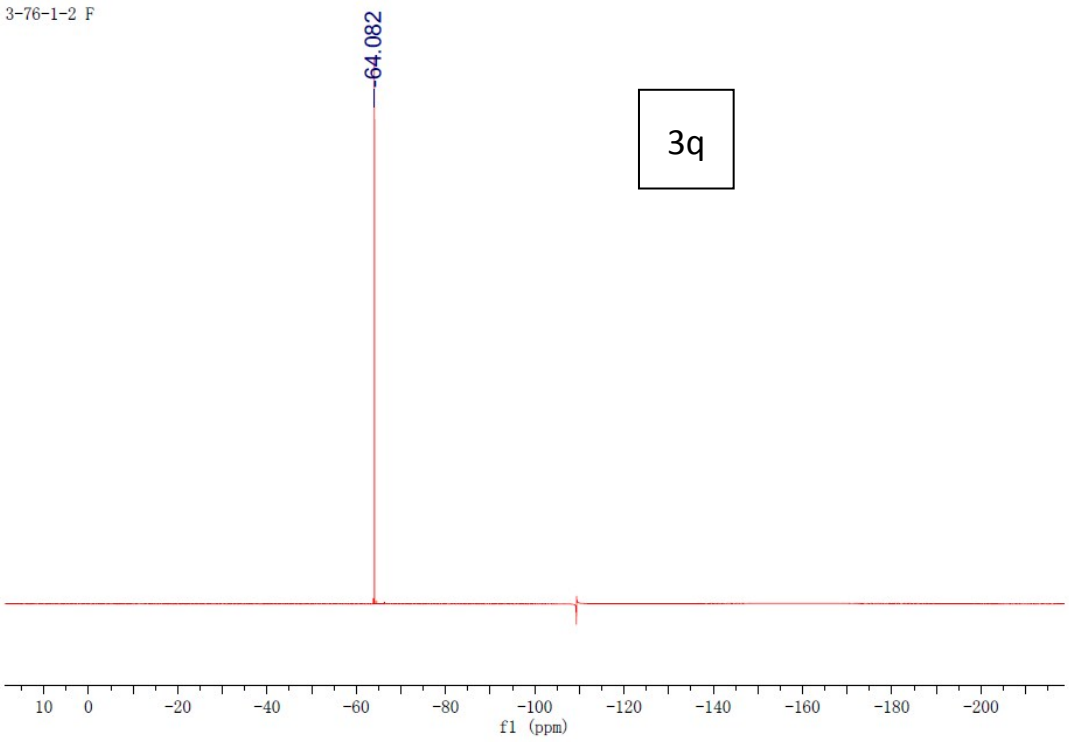

3-73-3 19F
-63.855
3l
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
f1 (ppm)

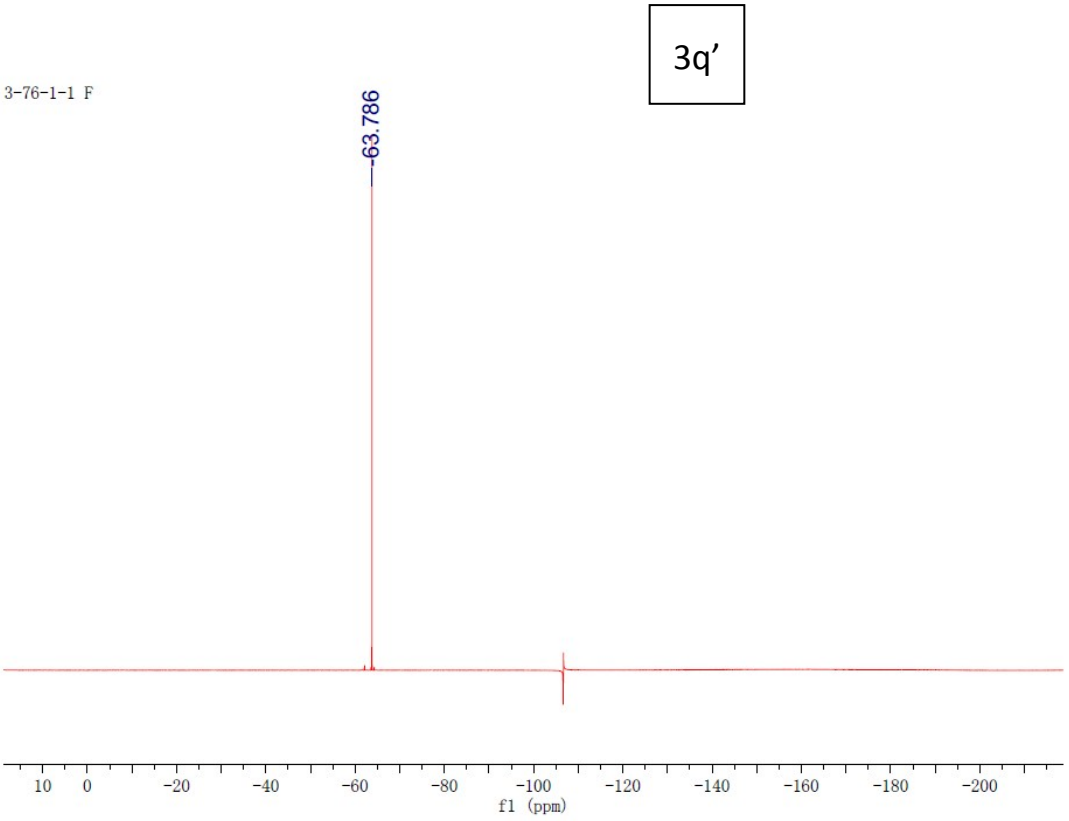

3-66-2 F
-63.583
3m
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

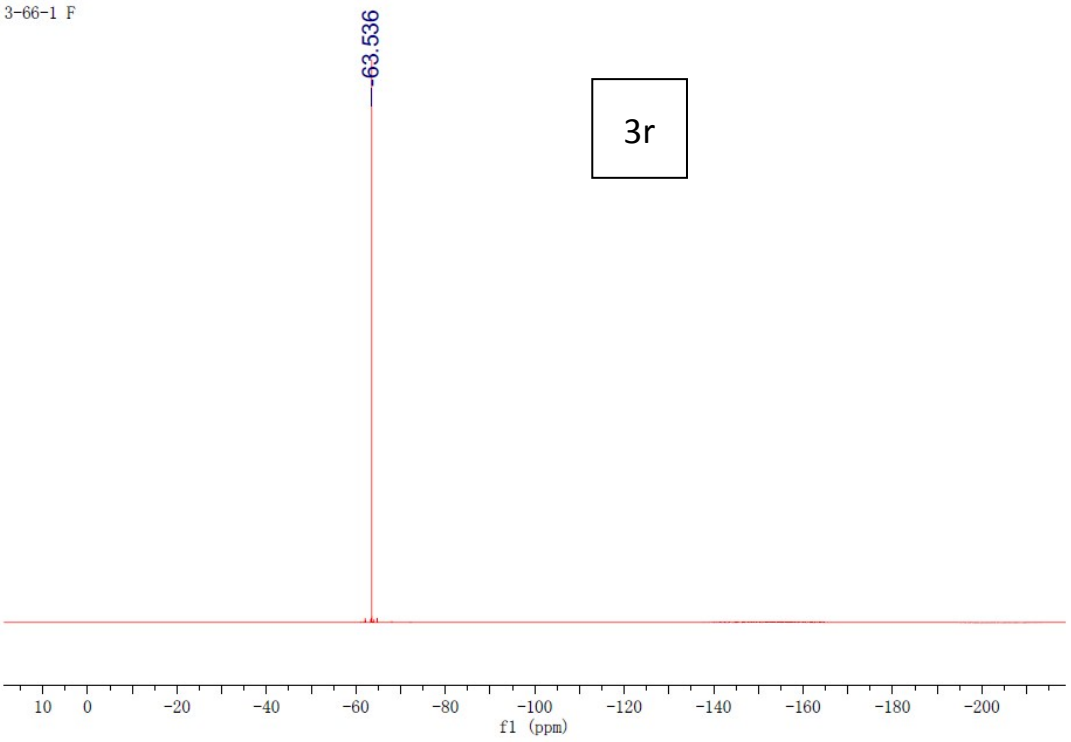

3-62-2 F
-63.103
-63.920
3n
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

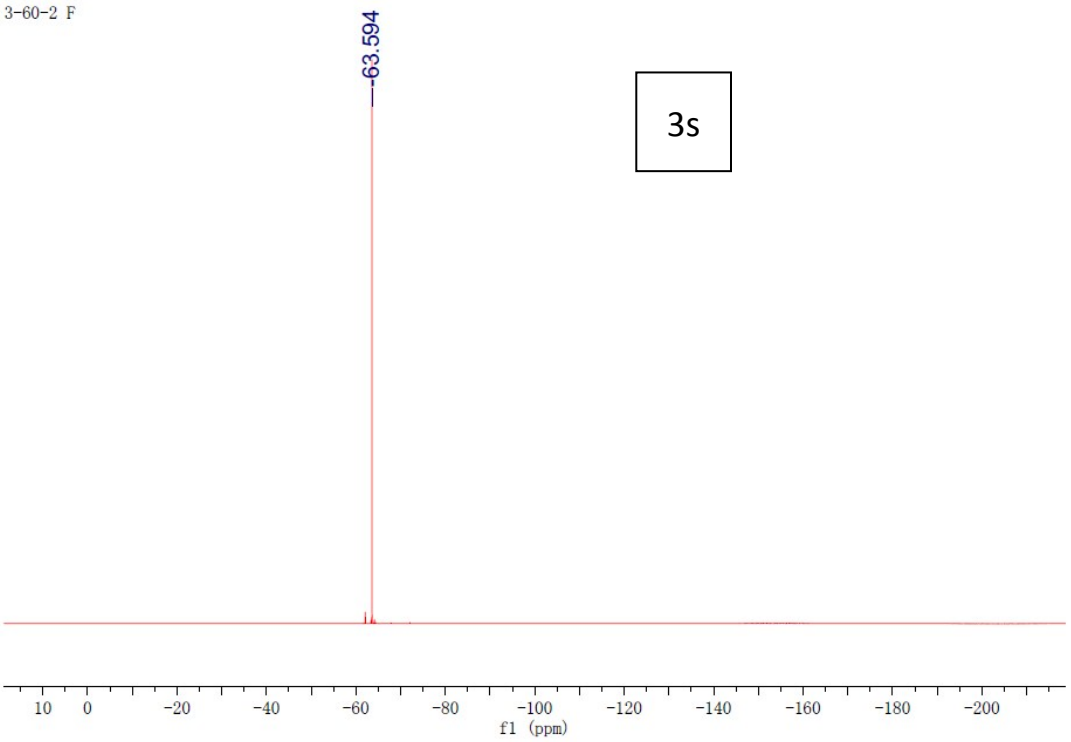

3-62-3 F
-63.822
3o
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
f1 (ppm)

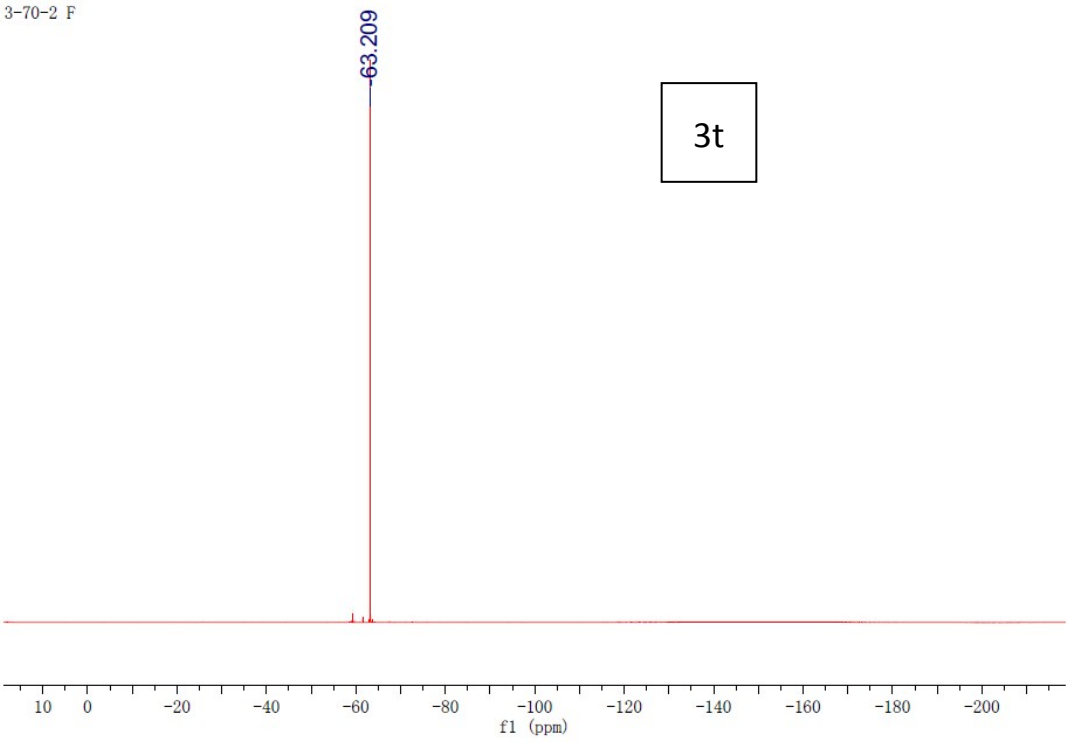

3-62-1F
-63.822
3p
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
f1 (ppm)

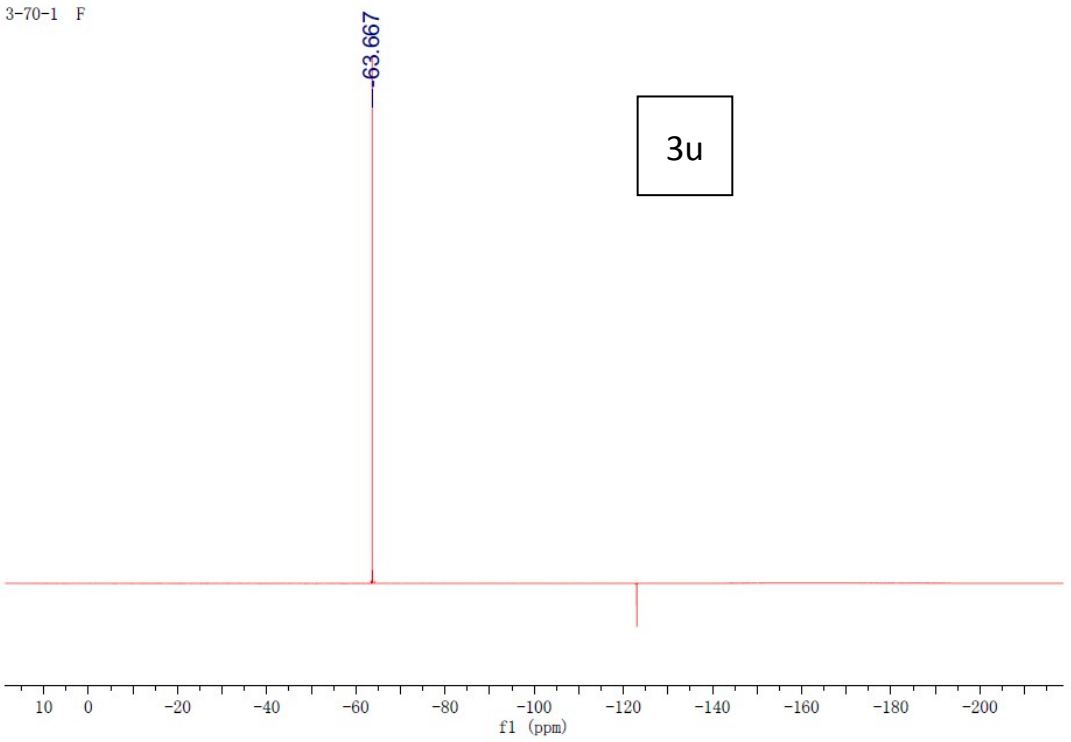

3-76-1-2 F
-64.082
3q
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

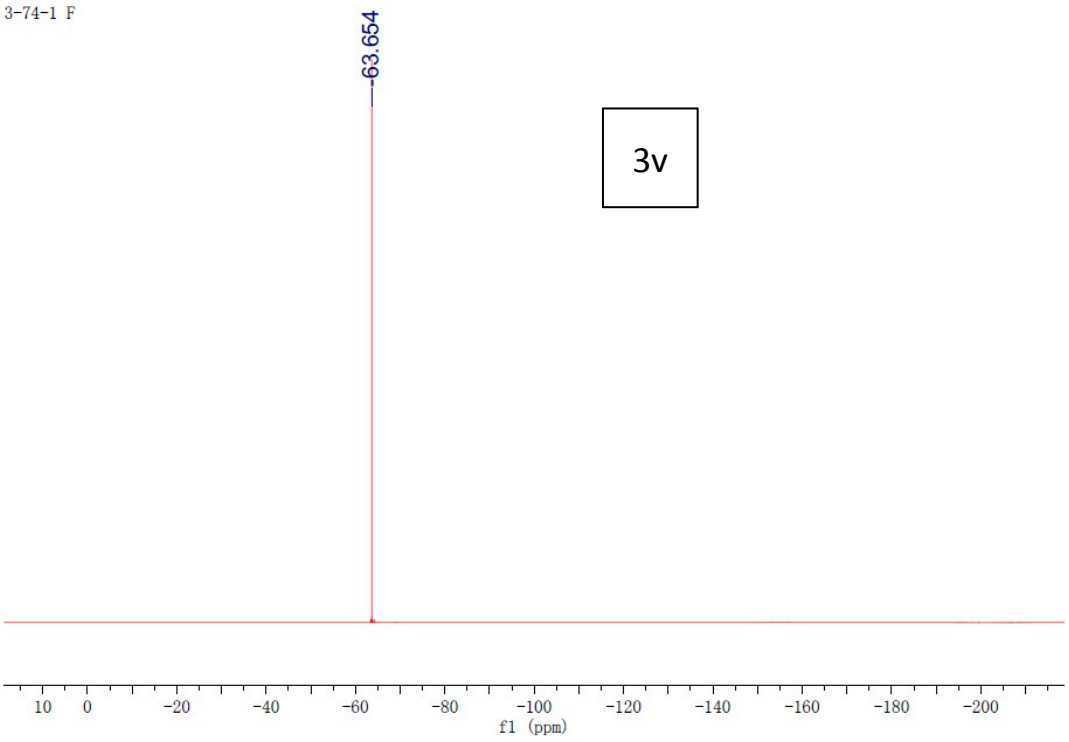

3q'
3-76-1-1 F
-63.786
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

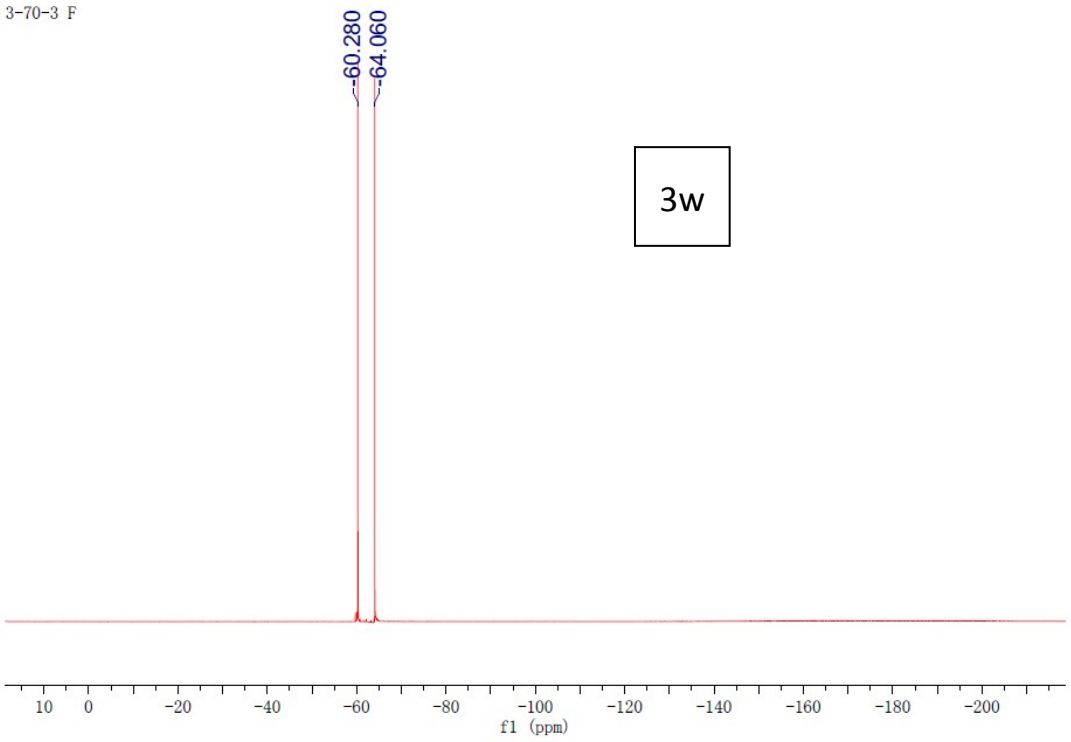

3-66-1 F
-63.536
3r
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

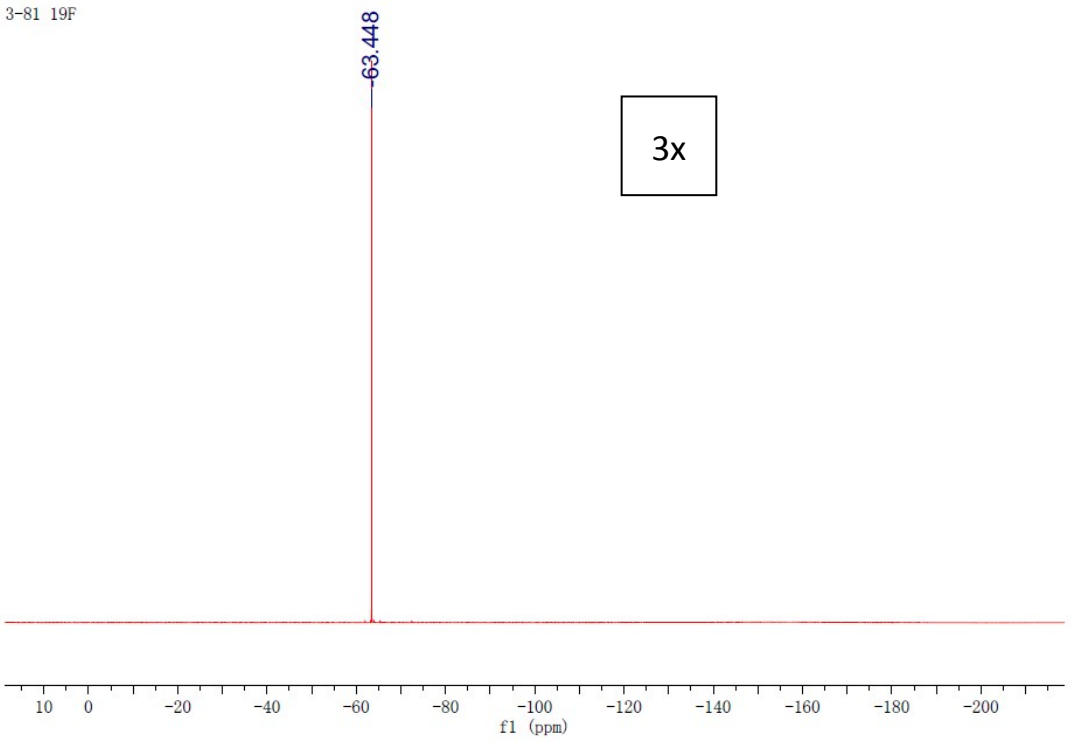

3-60-2 F
-63.594
3s
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)

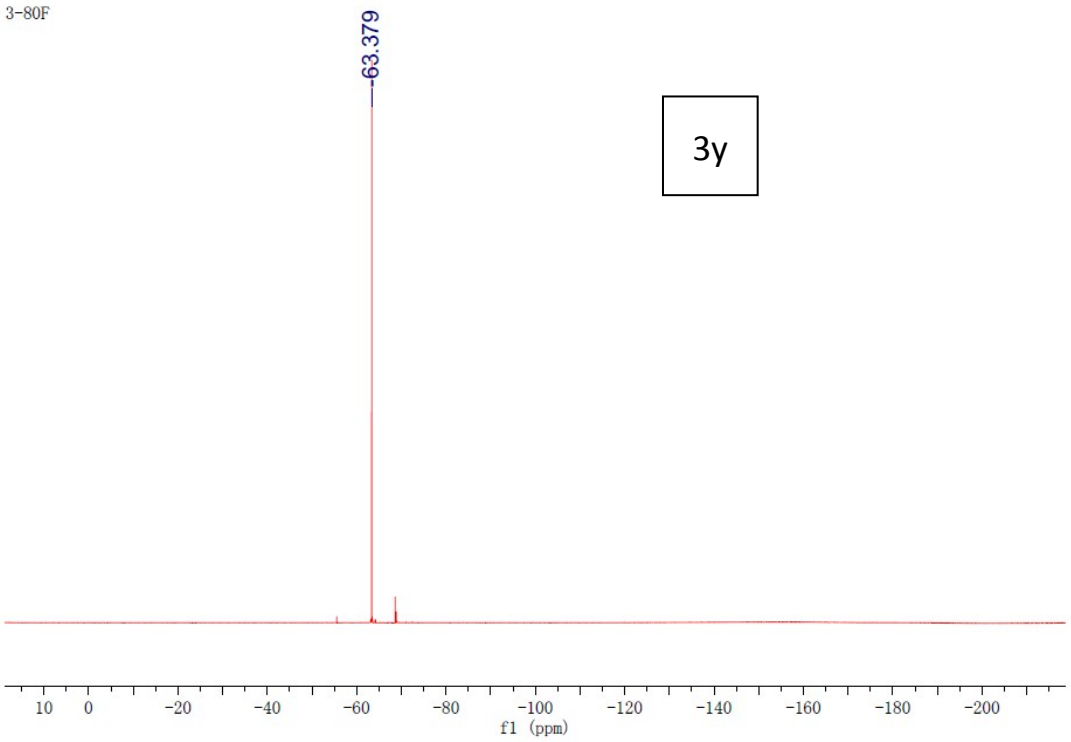

3-70-2 F
-63.209
3t
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)


3-70-1 F
-63.667
3u
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)


3-74-1 F
-63.654
3v
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)


3-70-3 F
-60.280
-64.060
3w
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)


3-81 19F
-63.448
3x
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)


3-80F
-63.379
3y
10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200
f1 (ppm)