Supporting Information

Ball milling synthesis of *S*-quinolyl xanthates *via* coupling of haloquinolines with potassium *O*-alkyl xanthates

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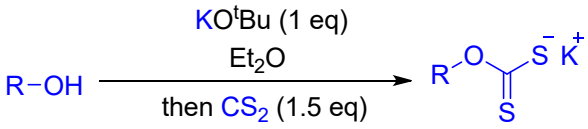
1. General information

Unless otherwise specified, all reagents and solvents were obtained from commercial suppliers and used without further purification. ^{1}H, ^{13}C and ^{19}F NMR spectra were recorded at 400, 100 and 376 MHz, respectively. Chemical shifts were quoted in ppm relative to $CDCl_3$ (δ_H = 7.26, δ_C = 77.0 ppm). Datas are reported as follows: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, dd = doublet of doublet, etc. The reactions were monitored by thin-layer chromatography (TLC) using GF254 silica gel-coated TLC plates. Mass spectra were performed on a spectrometer operating on ESI-TOF. Melting points were measured on a melting point apparatus and were uncorrected.

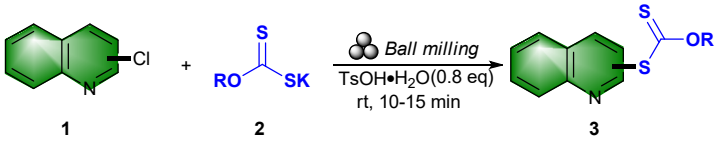
2. Experimental Section

General procedure for the preparation of *O*-alkyl xanthates 2



O-alkyl xanthates **2** were synthesized according to Wu's work.[1] In a N_2-filled glovebox, an oven-dried 50 mL round-bottom flask equipped with a magnetic stir bar was charged sequentially with alcohol (2.0 mmol, 1.0 equiv.), KO^{t}Bu (2.0 mmol, 1.0 equiv.), and dry Et_2O (20 mL). The flask was sealed with a septum cap and transferred out of the glovebox, and a balloon was attached. The reaction mixture was stirred at room temperature for 30 minutes, followed by the addition of CS_2 (3.0 mmol, 1.5 equiv.) via syringe and continued to be stirred for 3 hours at room temperature. The precipitate formed was collected by filtration, washed with Et_2O (2 × 10 mL), and dried in vacuo to afford the desired product.

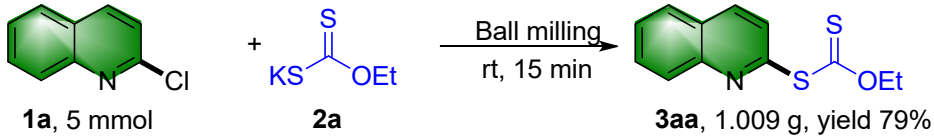
General procedure for the preparation of *S*-quinolyl xanthates



A mixture of chlorinated quinoline **1** (0.5 mmol, 1 eq), *O*-alkyl xanthate **2** (0.75 mmol, 1.5 eq) and p-toluene sulfonic acid (0.4 mmol, 0.8 eq) were milled in a stainless steel jar charged with 1 ball (10 mm) of the same material at 20 Hz for 10 – 15 min. After completion, ethyl acetate (10 mL) and water (10

mL) were added to the mixture, the organic layer was separated and the aqueous layer was further extracted with ethyl acetate (2 × 10 mL). The combined organic layers were dried with anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The resulting organic residue was purified by flash chromatography column over silica gel to afford the desired S-quinolyl xanthates **3.**

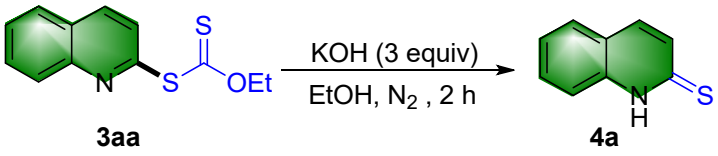
Gram-scale synthesis of 3aa



1a, 5 mmol **2a** **3aa**, 1.009 g, yield 79%

A mixture of 2-chloroquinoline **1a** (5 mmol, 0.815 g), potassium *O*-ethyl xanthate **2a** (7.5 mmol, 1.199 g) and p-toluene sulfonic acid (4 mmol, 0.761 g) were milled in a stainless steel jar charged with 1 ball (10 mm) of the same material at 20Hz for 15 min. After completion, ethyl acetate (30 mL) and water (30 mL) were added to the mixture, the organic layer was separated and the aqueous layer was further extracted with ethyl acetate (2 × 20 mL). The combined organic layers were dried with anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The resulting organic residue was purified by flash chromatography column over silica gel to afford 1.009 g of **3aa,** isolated yield 79%.

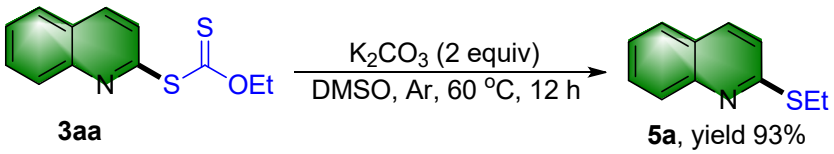
Synthesis of 4a *via* hydrolysis of 3aa



3aa **4a**

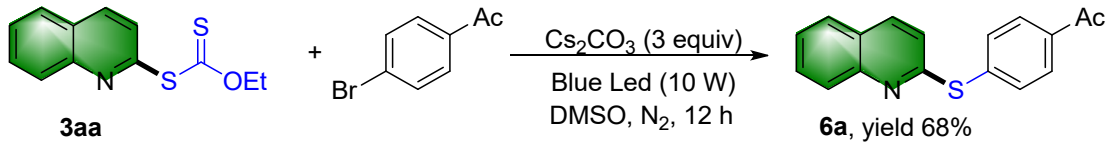
The experiment was carried out according to Karchava's work.[2] *O*-ethyl S-quinolin-2-yl carbonodithioate **3aa** (0.5 mmol, 0.1245 g) and KOH (1.5 mmol, 0.271 g) were dissolved in anhydrous ethanol (5 mL), the mixture was stirred at room temperature under N_2 atmosphere for 2 h. After completion, CH_2Cl_2 (10 mL) and water (10 mL) were added to the mixture, the organic layer was separated and the aqueous layer was further extracted with CH_2Cl_2 (2 × 10 mL). The combined organic layers were dried with anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The resulting organic residue was purified by flash chromatography column over silica gel (EA/PE 1:4 - 1:2) to afford 0.070 g f **4a,** isolated yield 87%.

Synthesis of 5a *via* the release of carbonyl sulfide from 3aa



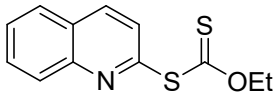
The experiment was carried out according to Wang's work.[3] *O*-ethyl S-quinolin-2-yl carbonodithioate **3aa** (0.5 mmol, 0.1245 g) and K_2CO_3 (1 mmol, 0.138 g) were dissolved in DMSO (5 mL), the mixture was stirred at 60 °C under argon atmosphere for 12 h. After completion, CH_2Cl_2 (10 mL) and water (10 mL) were added to the mixture, the organic layer was separated and the aqueous layer was further extracted with CH_2Cl_2 (2 × 10 mL). The combined organic layers were dried with anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The resulting organic residue was purified by flash chromatography column over silica gel (EA/PE 1:20- 1:10) to afford 0.088 g f **5a,** isolated yield 93%.

Synthesis of 6a *via* the coupling of 3aa with 1-(4-bromophenyl)ethanone



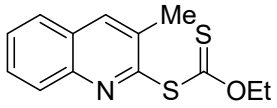
The experiment was carried out according to Karchava's work.[2] *O*-ethyl S-quinolin-2-yl carbonodithioate **3aa** (0.5 mmol, 0.1245 g), 1-(4-bromophenyl)ethanone (0.75mmol, 0.148 g) and Cs_2CO_3 (1.5 mmol, 0.489 g) were dissolved in DMSO (5 mL), the reaction mixture was stirred at room temperature under the irradiation of 10 W blue LED lamps (440 – 445 nm) and N_2 atmosphere for 12 h. After completion, CH_2Cl_2 (10 mL) and water (10 mL) were added to the mixture, the organic layer was separated and the aqueous layer was further extracted with CH_2Cl_2 (2 × 10 mL). The combined organic layers were dried with anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The resulting organic residue was purified by flash chromatography column over silica gel (EA/PE 1:10-1:6) to afford 0.095 g f **6a,** isolated yield 68%.

3. Characterization data of products

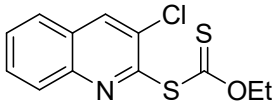


***O*-ethyl *S*-quinolin-2-yl carbonodithioate (3aa):** Yellow oil (105.8 mg, 85%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.69 (d, *J* = 8.5 Hz, 1H), 7.61 (t, *J* = 7.5 Hz, 1H), 4.63 (q, *J* = 7.1 Hz, 2H), 1.32 (t, *J* = 7.1 Hz,

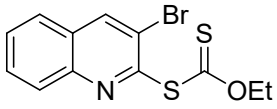
3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.5, 153.0, 148.3, 137.0, 130.2, 129.5, 127.8, 127.6, 127.3, 127.2, 70.3, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{12}NOS_2$: 250.0355; found: 250.0357.



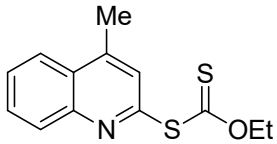
***O*-ethyl *S*-(3-methylquinolin-2-yl) carbonodithioate (3ba):** Yellow oil (99.9 mg, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.5 Hz, 1H), 8.03 (s, 1H), 7.76 (d, *J* = 8.1 Hz, 1H), 7.67 (t, *J* = 7.5 Hz, 1H), 7.56 (t, *J* = 7.4 Hz, 1H), 4.57 (q, *J* = 7.0 Hz, 2H), 2.58 (s, 3H), 1.26 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 153.0, 147.1, 137.1, 134.9, 129.3, 129.2, 128.4, 127.9, 126.7, 70.2, 20.2, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NOS_2$: 264.0511; found: 264.0512.



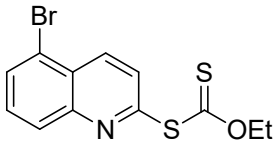
***O*-ethyl *S*-(3-chloroquinolin-2-yl) carbonodithioate (3ca):** Yellow oil (90.5 mg, 64%). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.26 (s, 1H), 8.11 (d, *J* = 8.4 Hz, 1H), 7.83 – 7.69 (m, 2H), 7.63 (t, *J* = 7.5 Hz, 1H), 4.58 (q, *J* = 7.1 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 208.7, 150.9, 146.5, 136.3, 132.6, 130.4, 129.7, 129.0, 128.6, 126.7, 70.6, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}ClNOS_2$: 283.9965; found: 283.9968.



***O*-ethyl *S*-(3-bromoquinolin-2-yl) carbonodithioate (3da):** Yellow oil (101.4 mg, 62%). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.47 (s, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.77 (t, *J* = 7.7 Hz, 2H), 7.64 (t, *J* = 7.5 Hz, 1H), 4.60 (q, *J* = 7.1 Hz, 2H), 1.28 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, Chloroform-*d*) δ 208.7, 152.1, 146.9, 140.1, 130.5, 129.7, 128.9, 128.7, 126.5, 122.8, 70.5, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9459; found: 327.9462.

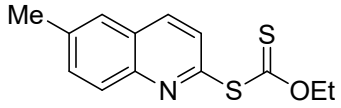


***O*-ethyl *S*-(4-methylquinolin-2-yl) carbonodithioate (3ea):** Yellow oil (96.0 mg, 73%). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.12 (d, *J* = 8.4 Hz, 1H), 8.00 (d, *J* = 8.3 Hz, 1H), 7.74 (t, *J* = 7.6 Hz, 1H), 7.62 (t, *J* = 7.6 Hz, 1H), 7.53 (s, 1H), 4.63 (q, *J* = 7.1 Hz, 2H), 2.72 (s, 3H), 1.32 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.7, 152.6, 148.1, 145.6, 130.1, 129.8, 127.6, 127.5, 127.4, 123.8, 70.2, 18.7, 13.5.HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{12}NOS_2$: 264.0511; found: 264.0513.

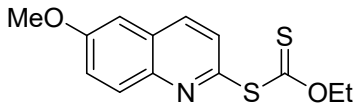


***O*-ethyl *S*-(5-bromoquinolin-2-yl) carbonodithioate (3fa):** Yellow oil (109.5 mg, 67%). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.53 (d, *J* = 8.8 Hz, 1H), 8.07 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 7.5 Hz, 1H), 7.78 (d, *J* = 8.7 Hz, 1H), 7.58 (t, *J* = 8.0 Hz, 1H), 4.64 (q, *J* = 7.1 Hz, 2H), 1.34 (t, *J* = 7.1 Hz, 3H). ^{13}C

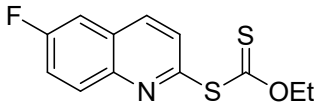
NMR (100 MHz, $CDCl_3$) δ 209.7, 154.3, 148.8, 136.4, 131.4, 130.4, 129.4, 128.1, 126.8, 121.7, 70.5, 13.5. HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9459; found: 327.9461.



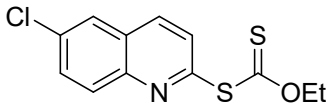
***O*-ethyl *S*-(6-methylquinolin-2-yl) carbonodithioate (3ga):** Yellow oil (101.3 mg, 77%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, J = 8.5 Hz, 1H), 8.01 (d, J = 8.5 Hz, 1H), 7.63 (d, J = 8.5 Hz, 1H), 7.58 (d, J = 12.7 Hz, 2H), 4.62 (q, J = 7.1 Hz, 2H), 2.54 (s, 3H), 1.31 (t, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.8, 151.8, 147.0, 138.0, 136.3, 132.4, 129.2, 127.3, 127.2, 126.4, 70.3, 21.6, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{12}NOS_2$: 264.0511; found: 264.0514.



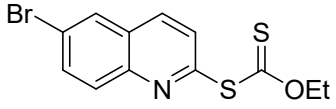
***O*-ethyl *S*-(6-methoxyquinolin-2-yl) carbonodithioate (3ha):** Yellow oil (100.5 mg, 72%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, J = 8.5 Hz, 1H), 8.00 (d, J = 9.2 Hz, 1H), 7.61 (d, J = 8.5 Hz, 1H), 7.38 (dd, J = 9.2, 2.3 Hz, 1H), 7.07 (d, J = 2.1 Hz, 1H), 4.61 (q, J = 7.1 Hz, 2H), 3.92 (s, 3H), 1.30 (t, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 211.2, 158.8, 149.7, 144.5, 135.7, 131.0, 128.6, 127.7, 122.9, 104.9, 70.3, 55.6, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NO_22S_2$: 280.0460; found: 280.0464.



***O*-ethyl *S*-(6-fluoroquinolin-2-yl) carbonodithioate (3ia):** Yellow oil (94.8 mg, 71%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.13 (t, J = 8.5 Hz, 2H), 7.71 (d, J = 8.5 Hz, 1H), 7.56 – 7.43 (m, 2H), 4.63 (q, J = 7.1 Hz, 2H), 1.33 (t, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 161.2 (d, $J_{C\text{-}F}$ = 249.1 Hz), 152.4 (d, $J_{C\text{-}F}$ = 2.9 Hz), 145.4, 136.3 (d, $J_{C\text{-}F}$ = 5.4 Hz), 132.2 (d, $J_{C\text{-}F}$ = 9.3 Hz), 128.2 (d, $J_{C\text{-}F}$ = 10.3 Hz), 128.0, 120.5 (d, $J_{C\text{-}F}$ = 25.7 Hz), 110.7 (d, $J_{C\text{-}F}$ = 21.9 Hz), 70.4, 13.5; ^{19}F NMR (376 MHz, $CDCl_3$) δ -110.76; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}FNOS_2$: 268.0261; found: 268.0262.

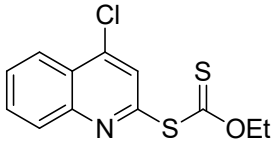


***S*-(6-chloroquinolin-2-yl) *O*-ethyl carbonodithioate (3ja):** Yellow oil (103.3 mg, 73%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, J = 8.5 Hz, 1H), 8.06 (d, J = 9.0 Hz, 1H), 7.83 (s, 1H), 7.70 (dd, J = 13.7, 8.8 Hz, 2H), 4.64 (q, J = 7.1 Hz, 2H), 1.34 (t, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.1, 153.5, 146.7, 135.9, 133.7, 131.1, 128.1, 127.9, 126.3, 70.5, 13.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}ClNOS_2$: 283.9965; found: 283.9963.

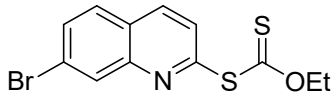


***S*-(6-bromoquinolin-2-yl) *O*-ethyl carbonodithioate (3ka):** Yellow oil (104.6 mg, 64%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, J = 8.3 Hz, 1H), 7.98 (d, J = 14.2 Hz, 2H), 7.80 (d, J = 8.8 Hz, 1H), 7.71 (d, J = 8.3 Hz, 1H), 4.63 (q, J = 6.4 Hz, 2H), 1.33 (t, J = 6.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ

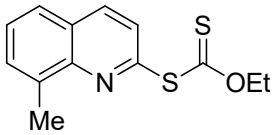
210.0, 153.7, 146.8, 135.8, 133.7, 131.2, 129.6, 128.3, 128.0, 121.9, 70.5, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9460; found: 327.9462.



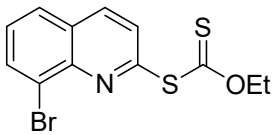
***S*-(4-chloroquinolin-2-yl) *O*-ethyl carbonodithioate (3la):** Yellow oil (103.3 mg, 73%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.4 Hz, 1H), 8.12 (d, *J* = 8.4 Hz, 1H), 7.84 – 7.75 (m, 2H), 7.69 (t, *J* = 7.6 Hz, 1H), 4.64 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.3, 152.8, 148.7, 142.9, 131.0, 129.8, 128.7, 126.7, 125.5, 124.0, 70.5, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}ClNOS_2$: 283.9965; found: 283.9968.



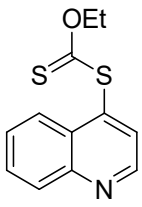
***S*-(7-bromoquinolin-2-yl) *O*-ethyl carbonodithioate (3ma):** Yellow oil (111.2 mg, 68%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.5 Hz, 1H), 8.08 (d, *J* = 7.2 Hz, 1H), 7.81 (d, *J* = 8.2 Hz, 1H), 7.76 (d, *J* = 8.5 Hz, 1H), 7.45 (t, *J* = 7.8 Hz, 1H), 4.66 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.9, 154.9, 145.4, 137.2, 133.8, 128.6, 128.1, 127.8, 127.4, 124.9, 70.4, 13.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9460; found: 327.9457.



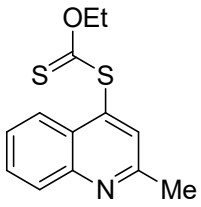
***O*-ethyl *S*-(8-methylquinolin-2-yl) carbonodithioate (3na):** Yellow oil (107.8 mg, 82%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.5 Hz, 1H), 7.68 (d, *J* = 8.6 Hz, 2H), 7.59 (d, *J* = 7.0 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 1H), 4.66 (q, *J* = 7.2 Hz, 2H), 2.80 (s, 3H), 1.35 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.9, 152.1, 147.5, 137.7, 137.0, 130.2, 127.5, 127.3, 126.6, 125.5, 70.2, 17.8, 13.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NOS_2$: 264.0511; found: 264.0511.



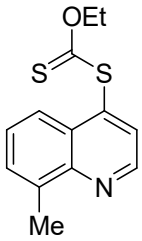
***S*-(8-bromoquinolin-2-yl) *O*-ethyl carbonodithioate (3oa):** Yellow oil (91.5 mg, 56%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.5 Hz, 1H), 8.08 (d, *J* = 7.2 Hz, 1H), 7.81 (d, *J* = 8.2 Hz, 1H), 7.76 (d, *J* = 8.5 Hz, 1H), 7.45 (t, *J* = 7.8 Hz, 1H), 4.66 (q, *J* = 7.1 Hz), 1.36 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.9, 154.8, 145.4, 137.2, 133.8, 128.6, 128.1, 127.8, 127.4, 124.9, 70.4, 13.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9460; found: 327.9466.



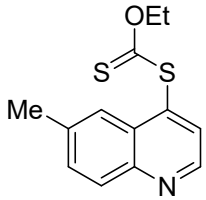
***O*-ethyl *S*-quinolin-4-yl carbonodithioate (3pa):** Yellow oil (95.9 mg, 77%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.93 (d, *J* = 3.9 Hz, 1H), 8.18 (dd, *J* = 22.0, 8.4 Hz, 2H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.60 (t, *J* = 7.1 Hz, 2H), 4.51 (q, *J* = 7.0 Hz, 2H), 1.13 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.8, 149.8, 148.7, 137.7, 130.0, 130.0, 128.5, 127.9, 127.7, 125.2, 70.6, 13.3; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{12}NOS_2$: 250.0355; found: 250.0357.



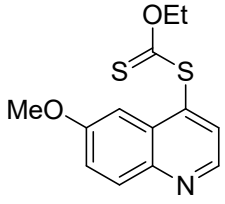
***O*-ethyl *S*-(2-methylquinolin-4-yl) carbonodithioate (3qa):** Yellow oil (113.1 mg, 86%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.3 Hz, 1H), 8.05 (d, *J* = 8.4 Hz, 1H), 7.70 (t, *J* = 7.6 Hz, 1H), 7.57 – 7.48 (m, 2H), 4.51 (q, *J* = 7.1 Hz, 2H), 2.75 (s, 3H), 1.13 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.1, 158.6, 148.4, 137.6, 129.9, 129.2, 128.7, 126.7, 126.6, 125.0, 70.5, 25.1, 13.3; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NOS_2$: 264.0511; found: 264.0507.



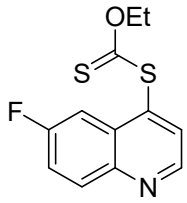
***O*-ethyl *S*-(8-methylquinolin-4-yl) carbonodithioate (3ra):** Yellow oil (99.9 mg, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.98 – 8.88 (m, 1H), 8.08 (d, *J* = 8.3 Hz, 1H), 7.60 (t, *J* = 6.3 Hz, 2H), 7.48 (t, *J* = 7.6 Hz, 1H), 4.53 (q, *J* = 7.0 Hz, 2H), 2.83 (s, 3H), 1.16 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.2, 147.9, 148.5, 137.8, 137.7, 130.2, 128.5, 127.7, 127.3, 123.3, 70.5, 18.4, 13.3; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NOS_2$: 264.0511; found: 264.0509.



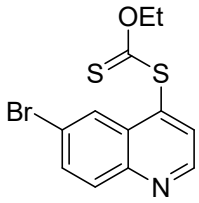
***O*-ethyl *S*-(6-methylquinolin-4-yl) carbonodithioate (3sa):** Yellow oil (101.3 mg, 77%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.77 (d, *J* = 4.3 Hz, 1H), 7.96 (d, *J* = 8.6 Hz, 1H), 7.88 (s, 1H), 7.49 (d, *J* = 5.0 Hz, 2H), 4.46 (q, *J* = 7.1 Hz, 2H), 2.46 (s, 3H), 1.08 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.2, 148.9, 147.5, 138.0, 136.9, 132.3, 129.8, 128.5, 128.1, 124.0, 70.6, 21.9, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NOS_2$: 264.0511; found: 264.0514.



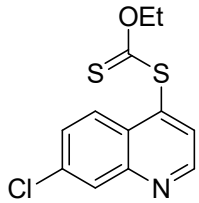
***O*-ethyl *S*-(6-methoxyquinolin-4-yl) carbonodithioate (3ta):** Yellow oil (101.8 mg, 73%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.77 (d, *J* = 3.6 Hz, 1H), 8.03 (d, *J* = 9.1 Hz, 1H), 7.57 (d, *J* = 3.9 Hz, 1H), 7.47 – 7.34 (m, 2H), 4.53 (q, *J* = 7.1 Hz, 2H), 3.91 (s, 3H), 1.17 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.8, 158.7, 147.1, 145.0, 135.9, 131.6, 129.9, 128.3, 122.8, 102.7, 70.5, 55.6, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NO_22S_2$: 280.0460; found: 280.0465.



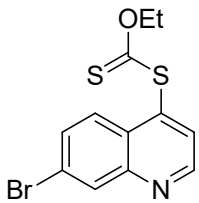
***O*-ethyl *S*-(6-fluoroquinolin-4-yl) carbonodithioate (3ua):** Yellow oil (109.5 mg, 82%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.89 (d, *J* = 4.4 Hz, 1H), 8.15 (dd, *J* = 9.2, 5.4 Hz, 1H), 7.82 (dd, *J* = 9.7, 2.6 Hz, 1H), 7.63 (d, *J* = 4.3 Hz, 1H), 7.56 – 7.47 (m, 1H), 4.54 (q, *J* = 7.1 Hz, 2H), 1.18 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.3, 161.2 (d, $J_{C\text{-}F}$ = 248.6 Hz), 149.1 (d, $J_{C\text{-}F}$ = 2.9 Hz), 145.9, 137.2 (d, $J_{C\text{-}F}$ = 5.9 Hz), 132.7 (d, $J_{C\text{-}F}$ = 9.2 Hz), 129.9 (d, $J_{C\text{-}F}$ = 10.3 Hz), 128.7, 120.3 (d, $J_{C\text{-}F}$ = 25.7 Hz), 108.9 (d, $J_{C\text{-}F}$ = 23.8 Hz), 70.7, 13.3; ^{19}F NMR (376 MHz, $CDCl_3$) δ -110.25; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}FNOS_2$: 268.0261; found: 268.0263.



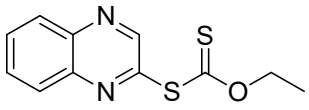
***O*-ethyl *S*-(6-bromoquinolin-4-yl) carbonodithioate (3va):** Yellow oil (137.3 mg, 84%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.92 (d, *J* = 4.3 Hz, 1H), 8.35 (d, *J* = 1.4 Hz, 1H), 8.00 (d, *J* = 8.9 Hz, 1H), 7.80 (dd, *J* = 8.9 Hz, 1.4 Hz, 1H), 7.62 (d, *J* = 4.3 Hz, 1H), 4.55 (q, *J* = 7.1 Hz, 2H), 1.20 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.1, 150.2, 147.4, 136.8, 133.5, 131.7, 129.7, 128.8, 127.5, 122.2, 70.8, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9460; found: 327.9455.



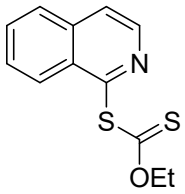
***O*-ethyl *S*-(7-chloroquinolin-4-yl)carbonodithioate (3wa):** Yellow oil (117.4 mg, 83%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.93 (d, *J* = 4.3 Hz, 1H), 8.31 – 8.06 (m, 1H), 7.60 (d, *J* = 4.3 Hz, 1H), 7.54 (d, *J* = 9.0 Hz, 1H), 4.53 (q, *J* = 7.1 Hz, 2H), 1.17 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.3, 151.0, 149.1, 137.9, 135.9, 128.9, 128.6, 128.1, 127.1, 126.8, 70.7, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}ClNOS_2$: 283.9965; found: 283.9967.



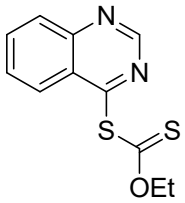
***O*-ethyl *S*-(7-bromoquinolin-4-yl) carbonodithioate (3xa):** Yellow oil (143.9 mg, 88%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.02 – 8.86 (m, 1H), 8.32 (s, 1H), 8.07 (d, *J* = 8.9 Hz, 1H), 7.67 (d, *J* = 8.9 Hz 1H), 7.62 (d, *J* = 4.2 Hz 1H), 4.52 (q, *J* = 7.1 Hz, 2H), 1.17 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.2, 150.9, 149.3, 138.0, 132.3, 131.1, 128.2, 127.3, 126.8, 124.2, 70.7, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}BrNOS_2$: 327.9460; found: 327.9464.



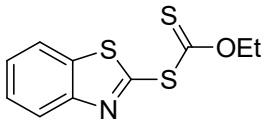
***O*-ethyl *S*-quinoxalin-2-yl carbonodithioate (3ya):** Yellow oil (97.5 mg, 78%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.99 (s, 1H), 8.10 (t, *J* = 6.3 Hz, 2H), 7.84 – 7.75 (m, 2H), 4.63 (q, *J* = 7.1 Hz, 2H), 1.34 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.0, 149.6, 142.4, 141.0, 131.1, 130.6, 129.4, 129.2, 70.8, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{11}H_{11}N_2OS_2$: 251.0307; found: 251.0308.



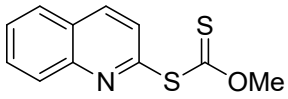
***O*-ethyl *S*-isoquinolin-1-yl carbonodithioate (3za):** Yellow oil (79.1 mg, 63%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (d, *J* = 5.5 Hz, 1H), 8.38 (d, *J* = 8.4 Hz, 1H), 7.89 (d, *J* = 8.2 Hz, 1H), 7.79 – 7.71 (m, 2H), 7.67 (t, *J* = 7.6 Hz, 1H), 4.51 (q, *J* = 7.0 Hz, 2H), 1.13 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.2, 153.2, 142.8, 137.1, 130.9, 130.7, 128.5, 127.2, 127.1, 122.8, 70.3, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{12}NOS_2$: 250.0355; found: 250.0358.



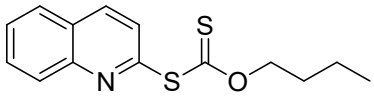
O-ethyl S-quinazolin-4-yl carbonodithioate (4aa): Yellow oil (95.0 mg, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.74 (d, *J* = 8.2 Hz, 1H), 8.27 (s, 1H), 7.80 (t, *J* = 7.5 Hz, 1H), 7.72 (d, *J* = 8.0 Hz, 1H), 7.56 (t, *J* = 7.6 Hz, 1H), 4.76 (q, *J* = 7.1 Hz, 2H), 1.52 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 191.6, 184.6, 141.6, 141.6, 135.1, 129.9, 129.8, 129.2, 128.3, 72.3, 13.1; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{11}H_{11}N_2OS_2$: 251.0307; found: 251.0309.



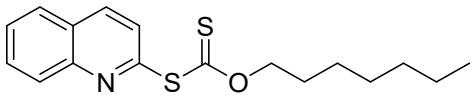
***S*-benzo[d]thiazol-2-yl *O*-ethyl carbonodithioate (4ba):** Yellow oil (43.3 mg, 34%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.1 Hz, 1H), 7.91 (d, *J* = 7.9 Hz, 1H), 7.49 (dt, *J* = 25.5, 7.4 Hz, 2H), 4.71 (q, *J* = 7.1 Hz, 2H), 1.43 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 206.1, 157.9, 152.4, 137.5, 126.6, 126.1, 123.8, 121.3, 71.2, 13.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{10}H_{10}NOS_3$: 255.9919; found: 255.9923.



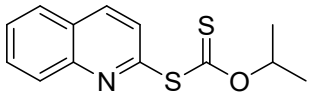
***O*-methyl *S*-quinolin-2-yl carbonodithioate (3ab):** Yellow oil (97.5 mg, 83%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.5 Hz, 1H), 8.13 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.76 (t, *J* = 7.7 Hz, 1H), 7.70 (d, *J* = 8.5 Hz, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 4.14 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 211.4, 152.9, 148.4, 137.2, 130.2, 129.6, 127.9, 127.6, 127.4, 127.1, 60.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{11}H_{10}NOS_2$: 236.0198; found: 236.0199.



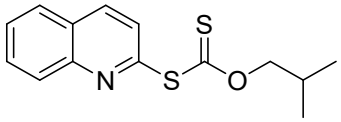
***O*-butyl *S*-quinolin-2-yl carbonodithioate (3ac):** Yellow oil (113.6 mg, 82%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.5 Hz, 1H), 8.10 (d, *J* = 8.5 Hz, 1H), 7.82 (d, *J* = 8.1 Hz, 1H), 7.73 (t, *J* = 7.7 Hz, 1H), 7.66 (d, *J* = 8.5 Hz, 1H), 7.58 (t, *J* = 7.5 Hz, 1H), 4.53 (t, *J* = 6.5 Hz, 2H), 1.66 – 1.58 (m, 2H), 1.29 – 1.18 (m, 2H), 0.79 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.3, 152.8, 148.2, 136.9, 130.1, 129.4, 127.7, 127.5, 127.2, 127.0, 74.1, 29.8, 18.8, 13.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{14}H_{16}NOS_2$: 278.0668; found: 278.0671.



***O*-heptyl *S*-quinolin-2-yl carbonodithioate (3ad):** Yellow oil (118.1 mg, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.13 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.76 (t, *J* = 7.7 Hz, 1H), 7.69 (d, *J* = 8.5 Hz, 1H), 7.61 (t, *J* = 7.5 Hz, 1H), 4.54 (t, *J* = 6.4 Hz, 2H), 1.70 – 1.58 (m, 2H), 1.25 – 1.12 (m, 8H), 0.82 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 152.8, 148.4, 136.9, 130.2, 129.6, 127.8, 127.5, 127.3, 127.2, 74.5, 31.5, 28.7, 28.0, 25.7, 22.4, 14.0; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{17}H_{22}NOS_2$: 320.1137; found: 320.1139.

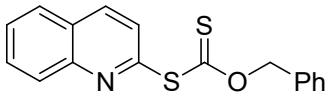


***O*-isopropyl *S*-quinolin-2-yl carbonodithioate (3ae):** Yellow oil (119.7 mg, 91%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.4 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.74 (t, *J* = 7.6 Hz, 1H), 7.67 (d, *J* = 8.4 Hz, 1H), 7.60 (t, *J* = 7.4 Hz, 1H), 5.77 – 5.68 (m, 1H), 1.32 (d, *J* = 6.2 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.7, 153.2, 148.2, 136.8, 130.1, 129.5, 127.7, 127.5, 127.2, 127.2, 78.6, 21.1; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{14}NOS_2$: 264.0511; found: 264.0506.

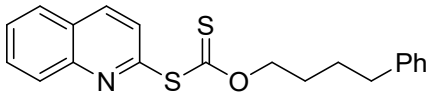


***O*-isobutyl *S*-quinolin-2-yl carbonodithioate (3af):** Yellow oil (101.1 mg, 73%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.4 Hz, 1H), 8.13 (d, *J* = 8.4 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.76 (t, *J* = 7.6 Hz, 1H), 7.70 (d, *J* = 8.4 Hz, 1H), 7.61 (t, *J* = 7.4 Hz, 1H), 4.32 (d, *J* = 6.3 Hz, 2H), 2.02 – 1.88 (m, 1H), 0.80 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 152.6, 148.3, 137.0, 130.2, 129.5,

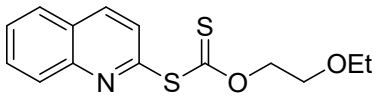
127.9, 127.5, 127.3, 127.2, 80.3, 27.4, 18.9; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{14}H_{16}NOS_2$: 278.0668; found: 278.0666.



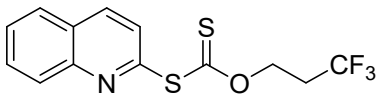
***O*-benzyl *S*-quinolin-2-yl carbonodithioate (3ag):** Yellow oil (102.6 mg, 66%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 (d, *J* = 8.4 Hz, 2H), 7.72 (d, *J* = 8.1 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 1H), 7.55 (d, *J* = 8.4 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 1H), 7.22 – 7.08 (m, 5H), 5.49 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.3, 152.7, 148.4, 137.0, 134.0, 130.2, 129.5, 128.6, 128.4, 128.2, 127.8, 127.5, 127.3, 127.1, 75.3; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{17}H_{14}NOS_2$: 312.0511; found: 312.0514.



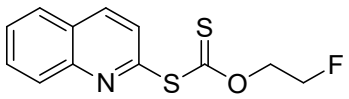
***O*-(4-phenylbutyl) *S*-quinolin-2-yl carbonodithioate (3ah):** Yellow oil (146.5 mg, 83%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 – 7.99 (m, 2H), 7.76 (d, *J* = 8.1 Hz, 1H), 7.67 (t, *J* = 7.7 Hz, 1H), 7.63 – 7.49 (m, 2H), 7.11 (dt, *J* = 25.9, 7.5 Hz, 3H), 6.94 (d, *J* = 7.3 Hz, 2H), 4.49 (t, *J* = 6.3 Hz, 2H), 2.42 (t, *J* = 7.6 Hz, 2H), 1.62 (dt, *J* = 14.3, 6.4 Hz, 2H), 1.51 – 1.41 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 152.7, 148.3, 141.6, 137.0, 130.2, 129.6, 128.2, 128.2, 127.9, 127.5, 127.3, 127.1, 125.8, 74.2, 35.2, 27.6, 27.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{20}H_{20}NOS_2$: 354.0981; found: 354.0987.



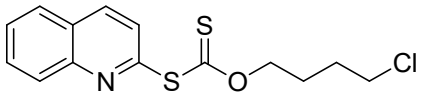
***O*-(2-ethoxyethyl) *S*-quinolin-2-yl carbonodithioate (3ai):** Yellow oil (108.4 mg, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.5 Hz, 1H), 8.11 (d, *J* = 8.5 Hz, 1H), 7.83 (d, *J* = 8.1 Hz, 1H), 7.80 – 7.69 (m, 2H), 7.60 (t, *J* = 7.5 Hz, 1H), 4.77 – 4.61 (m, 2H), 3.72 – 3.59 (m, 2H), 3.36 (q, *J* = 7.0 Hz, 2H), 1.08 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 153.1, 148.2, 136.9, 130.1, 129.5, 127.8, 127.5, 127.3, 127.1, 73.1, 67.3, 66.6, 15.0; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{14}H_{16}NO_2S_2$: 294.0617; found: 294.0622.



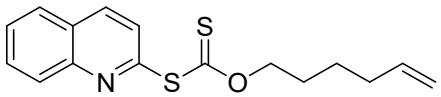
***O*-(3,3,3-trifluoropropyl) *S*-quinolin-2-yl carbonodithioate (3aj):** Yellow oil (128.4 mg, 81%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.5 Hz, 1H), 8.13 (d, *J* = 8.5 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.77 (t, *J* = 7.7 Hz, 1H), 7.68 (d, *J* = 8.5 Hz, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 4.76 (t, *J* = 6.2 Hz, 2H), 2.52 (qt, *J* = 10.7, 6.3 Hz, 2H); ^{13}C NMR (100 MHz, CDCl3) δ 210.2, 152.2, 148.4, 137.3, 130.3, 129.5, 128.0, 127.6, 127.4, 127.1, 125.3 (q, $J_{C\text{-}F}$ = 275.2 Hz), 65.9 (q, $J_{C\text{-}F}$ = 3.5 Hz), 32.8 (q, $J_{C\text{-}F}$ = 29.6 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -64.93; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{13}H_{11}F_3NOS_2$: 318.0229; found: 318.0236.



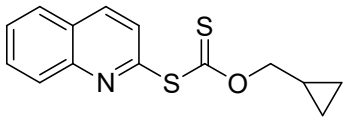
***O*-(2-fluoroethyl) *S*-quinolin-2-yl carbonodithioate (3ak):** Yellow oil (88.1 mg, 66%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.5 Hz, 1H), 8.13 (d, *J* = 8.5 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.81 – 7.69 (m, 2H), 7.62 (t, *J* = 7.5 Hz, 1H), 4.88 – 4.81 (m, 1H), 4.80 – 4.75 (m, 1H), 4.74 – 4.68 (m, 1H), 4.64 – 4.56 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.6, 152.8, 148.4, 137.2, 130.3, 129.5, 127.9, 127.6, 127.4, 127.1, 80.2 (d, $J_{C\text{-}F}$ = 171.4 Hz), 72.1 (d, $J_{C\text{-}F}$ = 19.9 Hz); HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{12}H_{11}FNOS_2$: 268.0261; found: 268.0263.



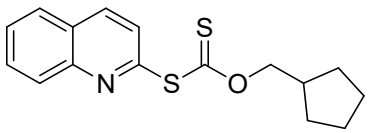
***O*-(4-chlorobutyl) *S*-quinolin-2-yl carbonodithioate (3al):** Yellow oil (110.4 mg, 71%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.5 Hz, 1H), 8.14 (d, *J* = 8.5 Hz, 1H), 7.87 (d, *J* = 8.1 Hz, 1H), 7.77 (t, *J* = 7.7 Hz, 1H), 7.69 (d, *J* = 8.4 Hz, 1H), 7.63 (t, *J* = 7.5 Hz, 1H), 4.59 (t, *J* = 6.1 Hz, 2H), 3.40 (t, *J* = 6.3 Hz, 2H), 1.88 – 1.80 (m, 2H), 1.75 – 1.67 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.4, 152.6, 148.4, 137.2, 130.3, 129.6, 128.0, 127.6, 127.4, 127.1, 73.2, 44.1, 28.9, 25.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{14}H_{15}ClNOS_2$: 312.0278; found: 312.0282.



***O*-hex-5-en-1-yl *S*-quinolin-2-yl carbonodithioate (3am):** Yellow oil (115.2 mg, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.74 (t, *J* = 7.6 Hz, 1H), 7.67 (d, *J* = 8.5 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 5.61 (td, *J* = 16.9, 6.7 Hz, 1H), 4.95 – 4.83 (m, 2H), 4.54 (t, *J* = 6.4 Hz, 2H), 1.92 (q, *J* = 7.1 Hz, 2H), 1.66 (dt, *J* = 14.4, 6.6 Hz, 2H), 1.30 (q, *J* = 7.6 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.3, 152.7, 148.3, 137.8, 137.0, 130.2, 129.5, 127.8, 127.5, 127.2, 127.1, 114.8, 74.2, 32.9, 27.3, 24.9; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{16}H_{18}NOS_2$: 304.0824; found: 304.0827.

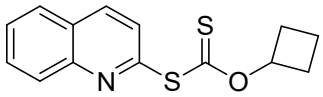


***O*-(cyclopropylmethyl) *S*-quinolin-2-yl carbonodithioate (3an):** Yellow oil (101.8 mg, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.79 – 7.69 (m, 2H), 7.60 (t, *J* = 7.5 Hz, 1H), 4.42 (d, *J* = 7.4 Hz, 2H), 1.19 (tt, *J* = 8.0, 4.8 Hz, 1H), 0.55 (q, *J* = 5.4 Hz, 2H), 0.28 (q, *J* = 5.1 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.6, 153.2, 148.3, 136.9, 130.1, 129.5, 127.8, 127.5, 127.3, 127.2, 79.2, 9.1, 3.4; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{14}H_{14}NOS_2$: 276.0511; found: 276.0508.

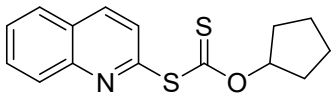


***O*-(cyclopentylmethyl) *S*-quinolin-2-yl carbonodithioate (3ao):** Yellow oil (130.3 mg, 86%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.5 Hz, 1H), 8.11 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.74 (t, *J* = 7.7 Hz, 1H), 7.68 (d, *J* = 8.4 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 4.42 (d, *J* = 6.9 Hz, 2H), 2.24 – 2.15 (m, 1H), 1.59 (dd, *J* = 11.8, 6.7 Hz, 2H), 1.42 (s, 4H), 1.13 (dt, *J* = 12.3, 7.3 Hz, 2H); ^{13}C

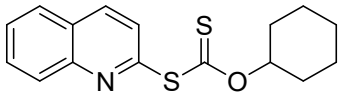
NMR (100 MHz, $CDCl_3$) δ 210.3, 152.7, 148.3, 136.9, 130.1, 129.5, 127.8, 127.5, 127.2, 127.1, 78.1, 37.9, 29.1, 25.2; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{16}H_{18}NOS_2$: 304.0824; found: 304.0826.



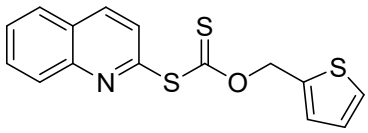
***O*-cyclobutyl *S*-quinolin-2-yl carbonodithioate (3ap):** Yellow oil (107.3 mg, 78%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.77 – 7.66 (m, 2H), 7.60 (t, *J* = 7.5 Hz, 1H), 5.55 – 5.46 (m, 1H), 2.47 – 2.36 (m, 2H), 5.55 – 5.46 (m, 2H), 1.85 – 1.74 (m, 1H), 1.66 – 1.55 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.8, 153.2, 148.2, 136.9, 130.1, 129.5, 127.8, 127.5, 127.2, 127.1, 77.8, 29.9, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{14}H_{14}NOS_2$: 276.0511; found: 276.0506.



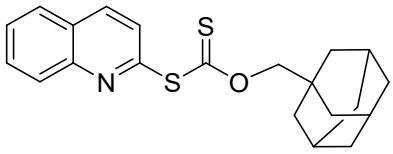
***O*-cyclopentyl *S*-quinolin-2-yl carbonodithioate (3aq):** Yellow oil (124.3 mg, 86%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.66 (d, *J* = 8.5 Hz, 1H), 7.61 (t, *J* = 7.5 Hz, 1H), 5.92 – 5.77 (m, 1H), 1.90 – 1.75 (m, 4H), 1.61 – 1.45 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.4, 153.1, 148.3, 136.8, 130.2, 129.5, 127.8, 127.5, 127.2, 127.0, 88.0, 32.4, 23.7; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{15}H_{16}NOS_2$: 290.0668; found: 290.0667.



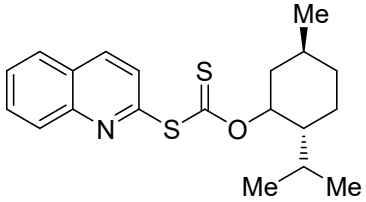
***O*-cyclohexyl *S*-quinolin-2-yl carbonodithioate (3ar):** Yellow oil (125.8 mg, 83%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.68 (d, *J* = 8.5 Hz, 1H), 7.60 (t, *J* = 7.4 Hz, 1H), 5.59 – 5.52 (m, 1H), 1.93 – 1.79 (m, 2H), 1.60 – 1.17 (m, 8H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.4, 153.0, 148.3, 136.8, 130.1, 129.5, 127.7, 127.5, 127.2, 127.1, 82.9, 30.5, 25.0, 23.0; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{16}H_{18}NOS_2$: 304.0824; found: 304.0827.



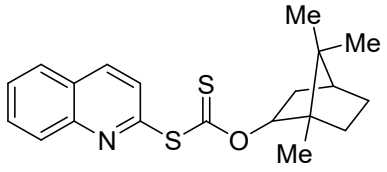
***O*-(thiophen-2-ylmethyl) *S*-quinolin-2-yl carbonodithioate (3as):** Yellow oil (101.4 mg, 64%). ^1H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.5 Hz, 1H), 8.10 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.75 (t, *J* = 8.0 Hz, 2H), 7.60 (t, *J* = 7.5 Hz, 1H), 7.20 (d, *J* = 5.1 Hz, 1H), 6.99 (s, 1H), 6.91 (t, *J* = 4.1 Hz, 1H), 4.47 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 186.9, 151.3, 148.5, 138.6, 137.2, 130.3, 129.4, 127.8, 127.6, 127.5, 127.3, 127.0, 126.4, 125.7, 29.7; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{15}H_{12}NOS_3$: 318.0076; found: 318.0079.



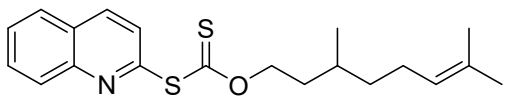
***O*-(adamantan-1-ylmethyl) *S*-quinolin-2-yl carbonodithioate (3at):** Yellow oil (144.0 mg, 78%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.4 Hz, 1H), 8.15 (d, *J* = 8.5 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.77 (t, *J* = 7.7 Hz, 1H), 7.71 (d, *J* = 8.4 Hz, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 4.03 (s, 2H), 1.79 – 1.71 (m, 3H), 1.60 – 1.49 (m, 3H), 1.33 – 1.20 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.1, 152.0, 148.4, 137.1, 130.3, 129.6, 128.0, 127.5, 127.4, 127.4, 83.7, 38.8, 36.5, 33.3, 27.7; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{21}H_{24}NOS_2$: 370.1294; found: 370.1299.



***O*-((2R,5S)-2-isopropyl-5-methylcyclohexyl) *S*-quinolin-2-yl carbonodithioate (3au):** Yellow oil (129.3 mg, 72%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.75 (t, *J* = 7.7 Hz, 1H), 7.69 (d, *J* = 8.5 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 5.45 (td, *J* = 10.8, 4.4 Hz, 1H), 2.28 – 2.20 (m, 1H), 1.84 – 1.74 (m, 1H), 1.69 – 1.58 (m, 2H), 1.52 – 1.34 (m, 2H), 1.10 – 0.72 (m, 12H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.9, 152.9, 148.3, 136.7, 130.1, 129.6, 127.8, 127.5, 127.3, 127.3, 85.0, 47.0, 39.4, 33.9, 31.2, 26.2, 23.4, 21.9, 20.5, 16.7; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{20}H_{26}NOS_2$: 360.1450; found: 360.1457.

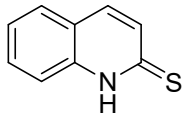


***O*-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl) *S*-quinolin-2-yl carbonodithioate (3av):** Yellow oil (150.0 mg, 84%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.4 Hz, 1H), 8.14 (d, *J* = 8.5 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.76 (t, *J* = 7.6 Hz, 1H), 7.70 (d, *J* = 8.4 Hz, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 5.42 (d, *J* = 9.5 Hz, 1H), 2.47 – 2.36 (m, 1H), 1.69 – 1.63 (m, 1H), 1.62 – 1.49 (m, 1H), 1.23 – 1.18 (m, 1H), 1.11 – 0.95 (m, 3H), 0.86 (s, 3H), 0.77 (d, *J* = 5.9 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 210.0, 152.6, 148.4, 136.9, 130.2, 129.6, 127.8, 127.6, 127.3, 127.2, 91.0, 49.3, 47.8, 44.7, 36.3, 27.5, 27.0, 19.4, 18.8, 13.5; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{20}H_{24}NOS_2$: 358.1294; found: 358.1298.

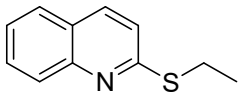


***O*-(3,7-dimethyloct-6-en-1-yl) *S*-quinolin-2-yl carbonodithioate (3aw):** Yellow oil (104.2 mg, 58%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.5 Hz, 1H), 8.12 (d, *J* = 8.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.68 (d, *J* = 8.4 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 4.99 (t, *J* = 6.6 Hz, 1H), 4.64 – 4.54 (m, 2H), 1.88 – 1.76 (m, 2H), 1.73 – 1.67 (m, 1H), 1.65 (s, 3H), 1.55 (s, 3H), 1.50 – 1.32 (m, 2H), 1.26 – 1.16 (m, 1H), 1.13 – 1.02 (m, 1H), 0.79 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (100 MHz,

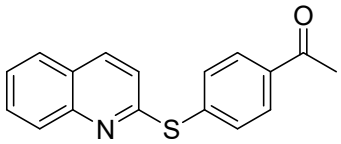
$CDCl_3$) δ 210.4, 152.8, 148.3, 136.9, 131.3, 130.2, 129.5, 127.8, 127.5, 127.3, 127.1, 124.3, 72.9, 36.8, 34.7, 29.3, 25.6, 25.3, 19.1, 17.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{20}H_{26}NOS_2$: 360.1450; found: 360.1454.



quinoline-2(1*H*)-thione (4a): Yellow solid (70.0 mg, 87%). mp: 172–174 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 13.29 (s, 1H), 7.66 (d, *J* = 8.6 Hz, 2H), 7.61 (d, *J* = 7.9 Hz, 1H), 7.56 (t, *J* = 7.6 Hz, 1H), 7.46 (d, *J* = 8.9 Hz, 1H), 7.32 (t, *J* = 7.4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.5, 139.0, 135.7, 131.4, 127.7, 124.9, 122.9, 116.1. The compound spectra data is in accord with the previous literature.[4]



2-(ethylthio)quinoline (5a): Yellow oil (87.9 mg, 93%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.4 Hz, 1H), 7.87 (d, *J* = 8.6 Hz, 1H), 7.71 (d, *J* = 8.0 Hz, 1H), 7.64 (t, *J* = 7.6 Hz, 1H), 7.42 (t, *J* = 7.4 Hz, 1H), 7.20 (d, *J* = 8.6 Hz, 1H), 3.36 (q, *J* = 7.3 Hz, 2H), 1.45 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.5, 148.3, 135.2, 129.5, 128.0, 127.6, 125.9, 125.1, 121.0, 24.2, 14.6. The compound spectra data is in accord with the previous literature.[5]



1-(4-(quinolin-2-ylthio)phenyl)ethanone (6a): Yellow solid (94.9 mg, 68%). mp: 112–113 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (t, *J* = 9.6 Hz, 4H), 8.00 – 7.93 (m, 4H), 7.49 (t, *J* = 7.4 Hz, 1H), 7.15 (d, *J* = 8.7 Hz, 1H), 2.63 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.3, 158.9, 148.1, 138.1, 136.8, 136.7, 133.3, 130.2, 129.1, 128.5, 127.6, 126.3, 126.2, 120.8, 26.6; HRMS (ESI): m/z $[M+H]^+$ calcd for $C_{17}H_{14}NOS$: 280.0791; found: 280.0793.

4. References

1. W.-H. Bao and X. Wu, *J. Org. Chem.*, 2023, **88**, 3975-3980.

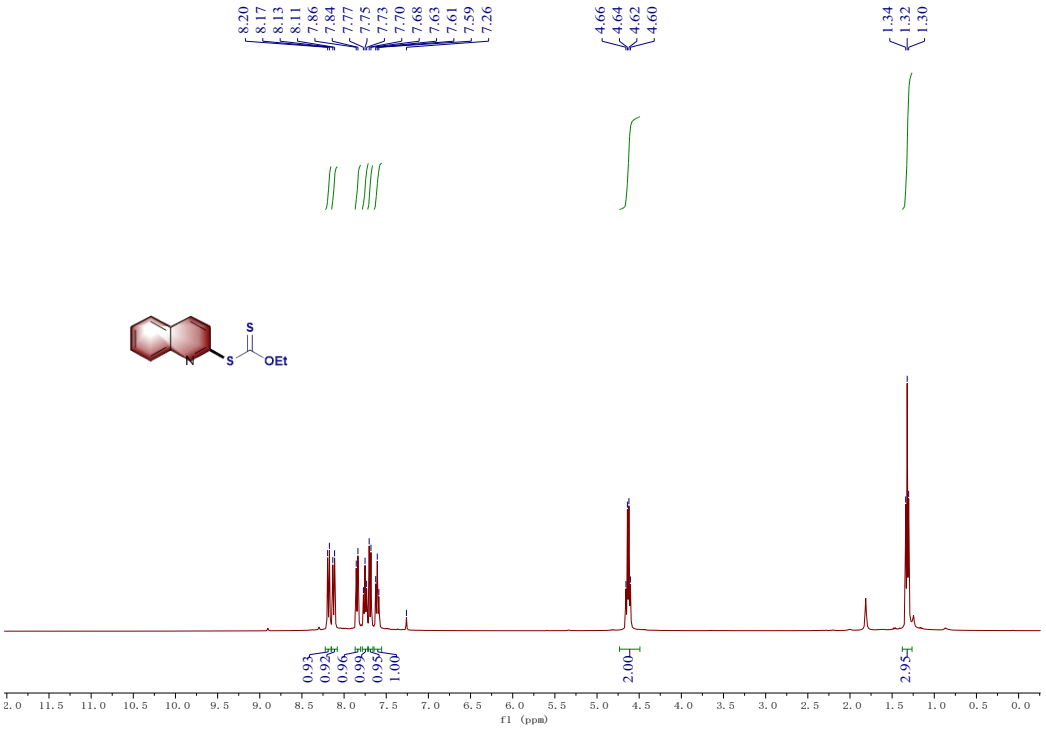
2. D. I. Bugaenko, A. A. Volkov, V. V. Andreychev and A. V. Karchava, *Org. Lett.*, 2023, **25**, 272-276.

3. M. Zhang, B. Wang, Y. Cao, Y. Liu, Z. Wang and Q. Wang, *Org. Lett.*, 2022, **24**, 8895-8900.

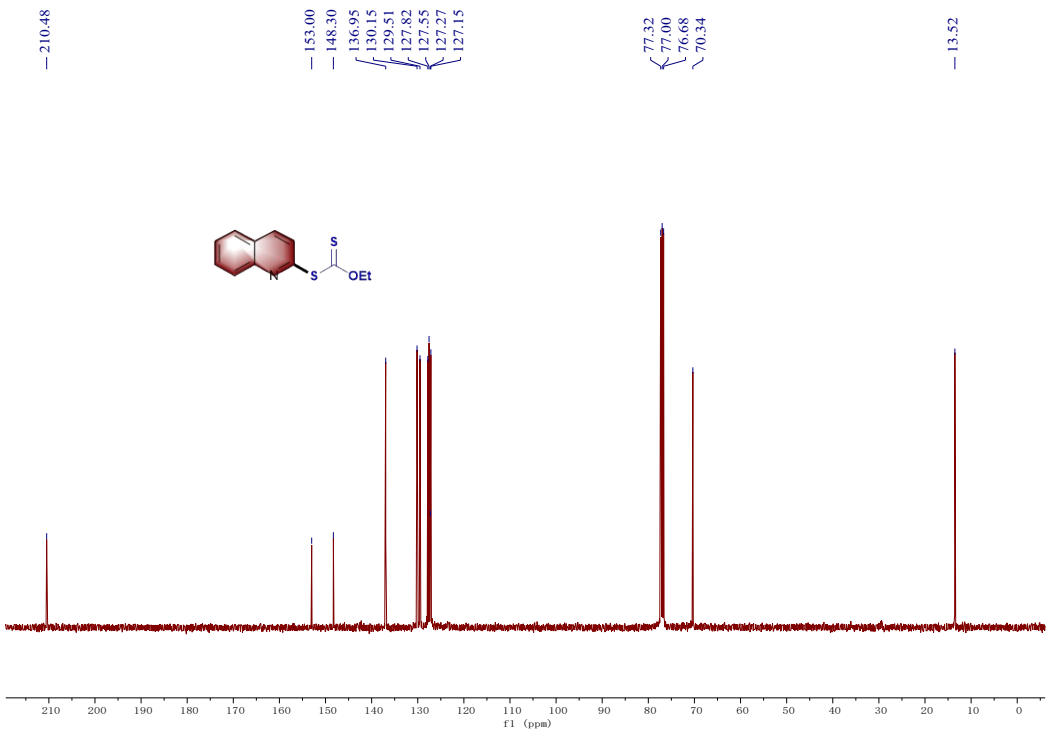
4. D. I. Bugaenko, O. A. Tikhanova and A. V. Karchava, *J. Org. Chem.*, 2023, **88**, 1018-1023.

5. R. Beugelmans, M. Bois-Choussy and B. Boudet, *Tetrahedron*, 1983, **39**, 4153-4161.

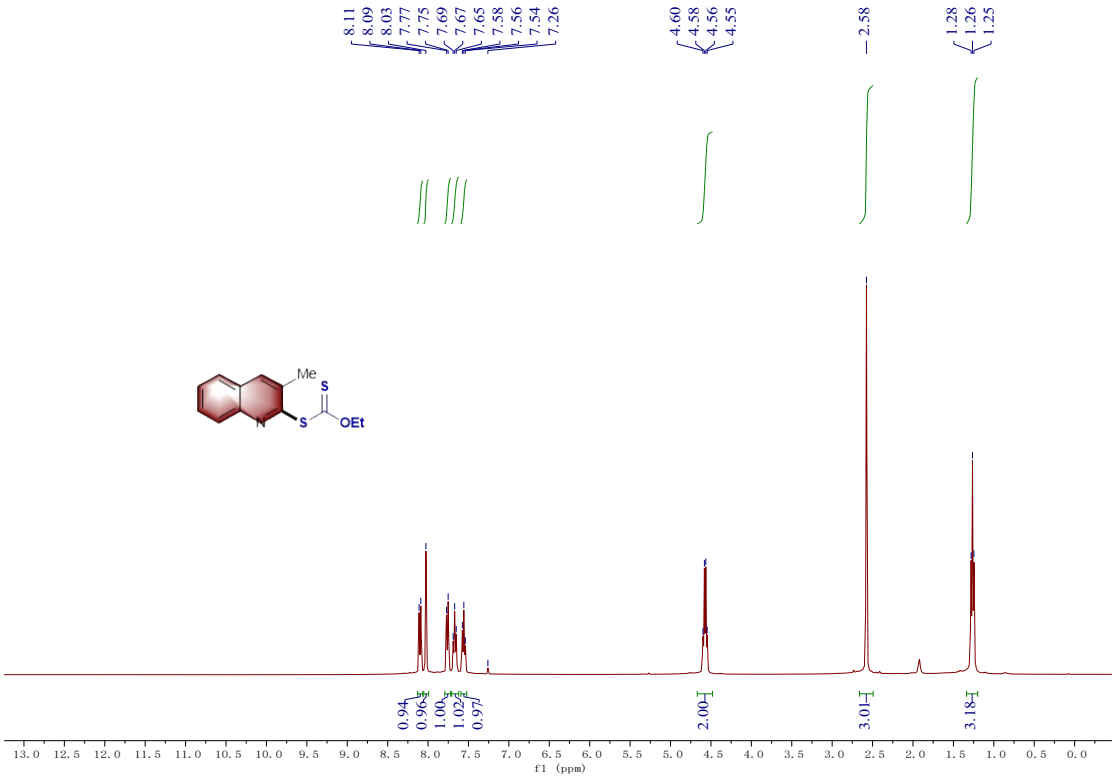
5. ^{1}H and ^{13}C NMR spectra of products



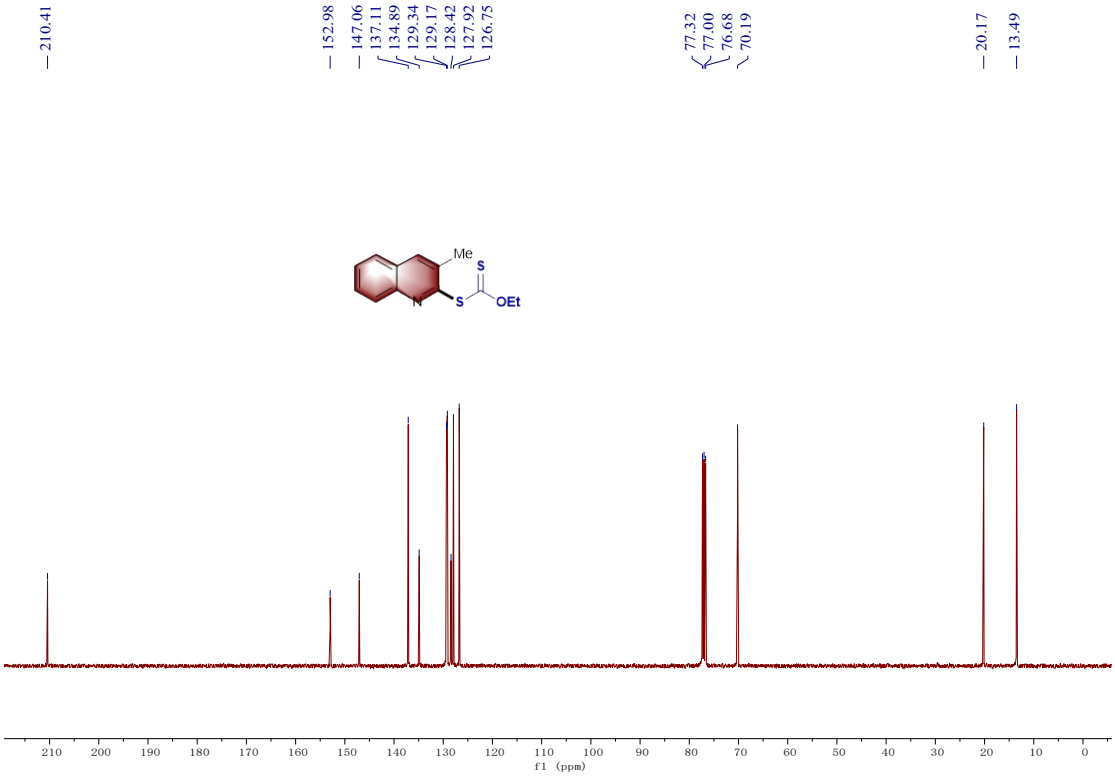
^{1}H spectra of **3aa**



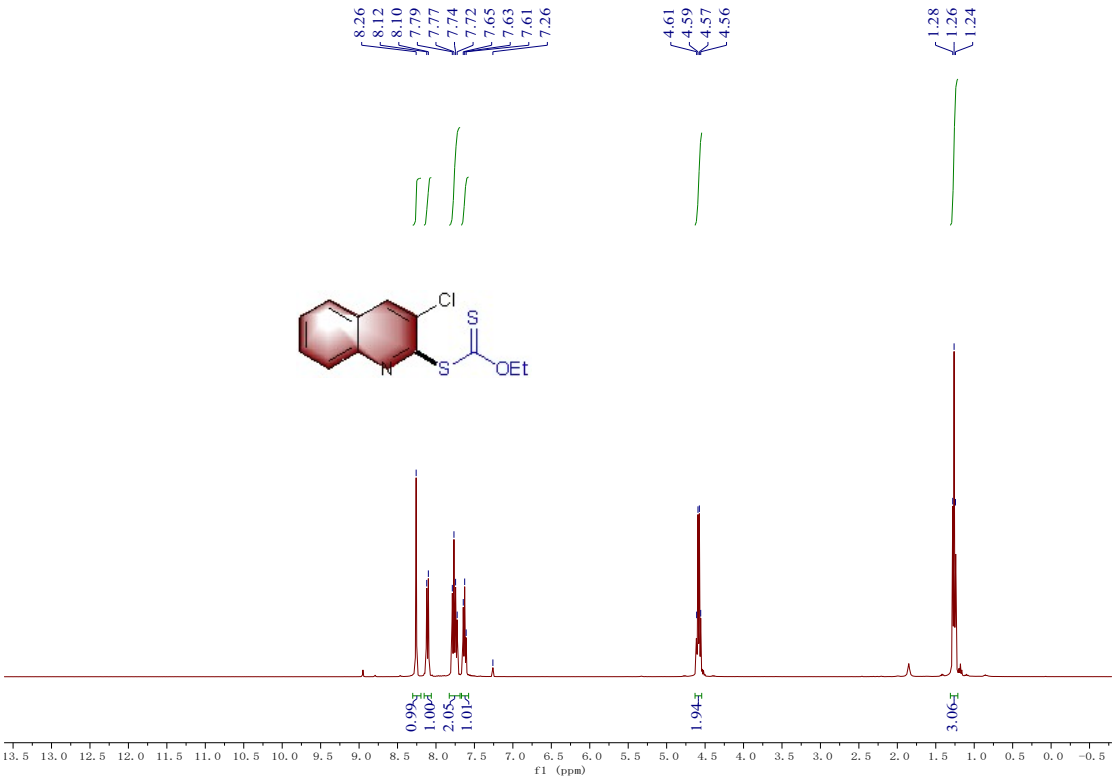
^{13}C spectra of **3aa**



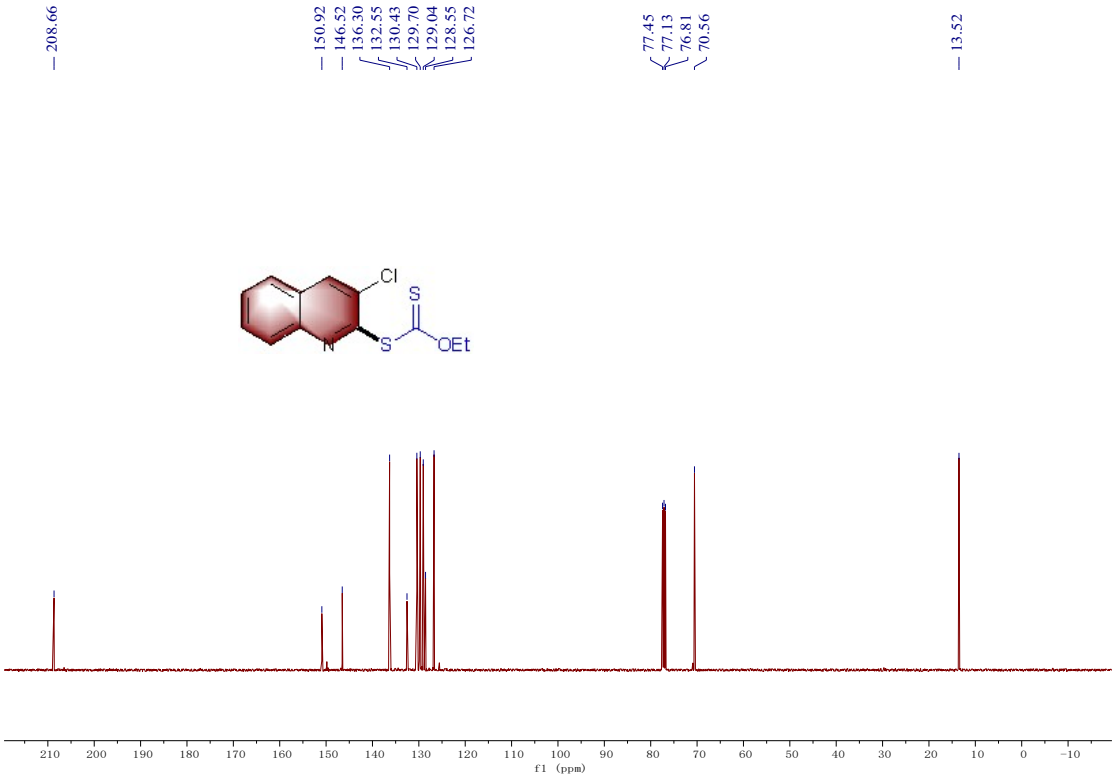
^{1}H spectra of **3ba**



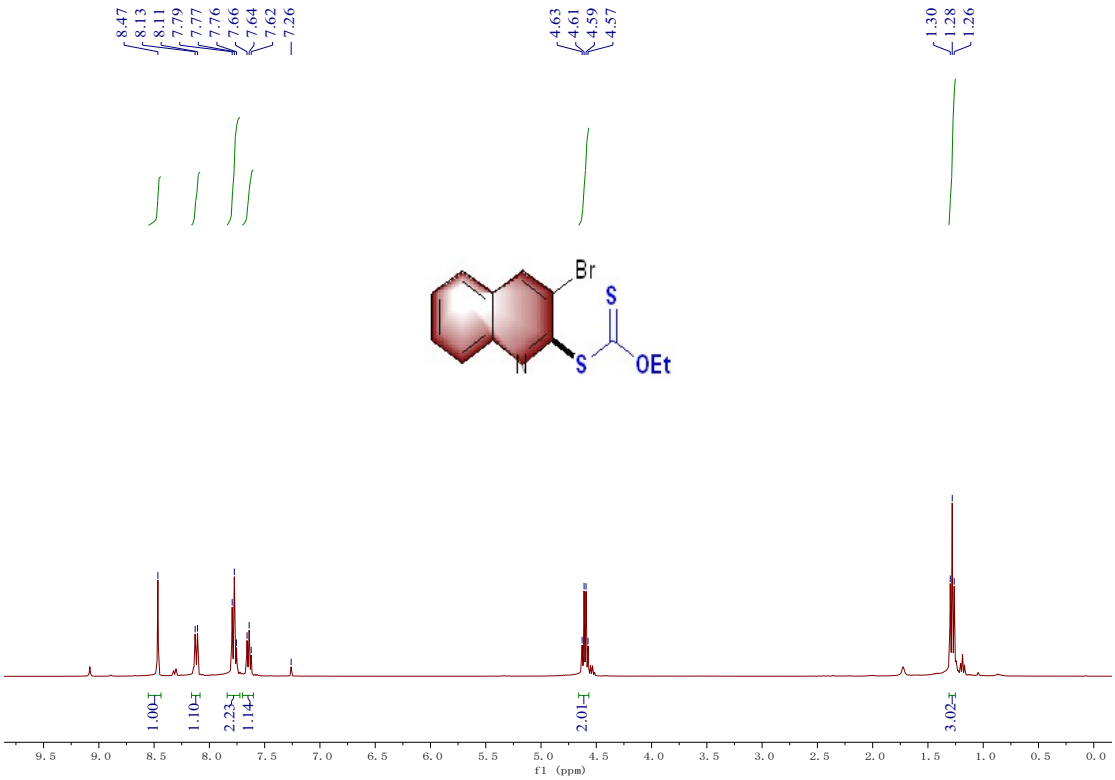
^{13}C spectra of **3ba**



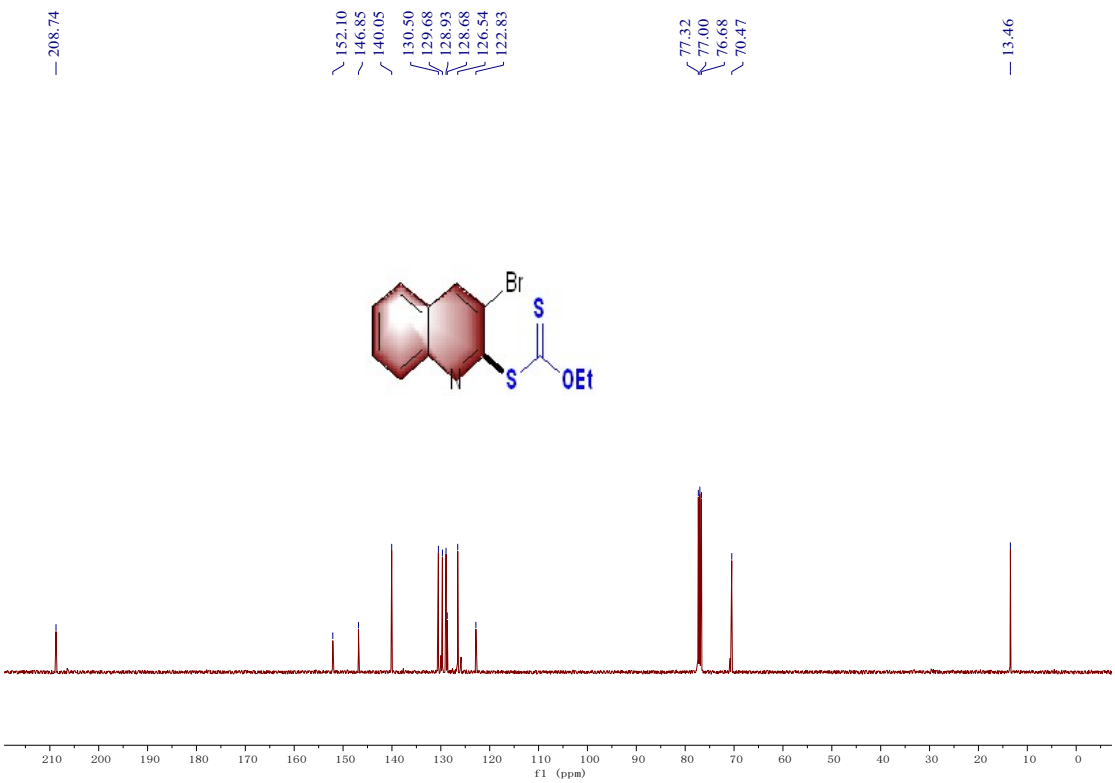
^{1}H spectra of **3ca**



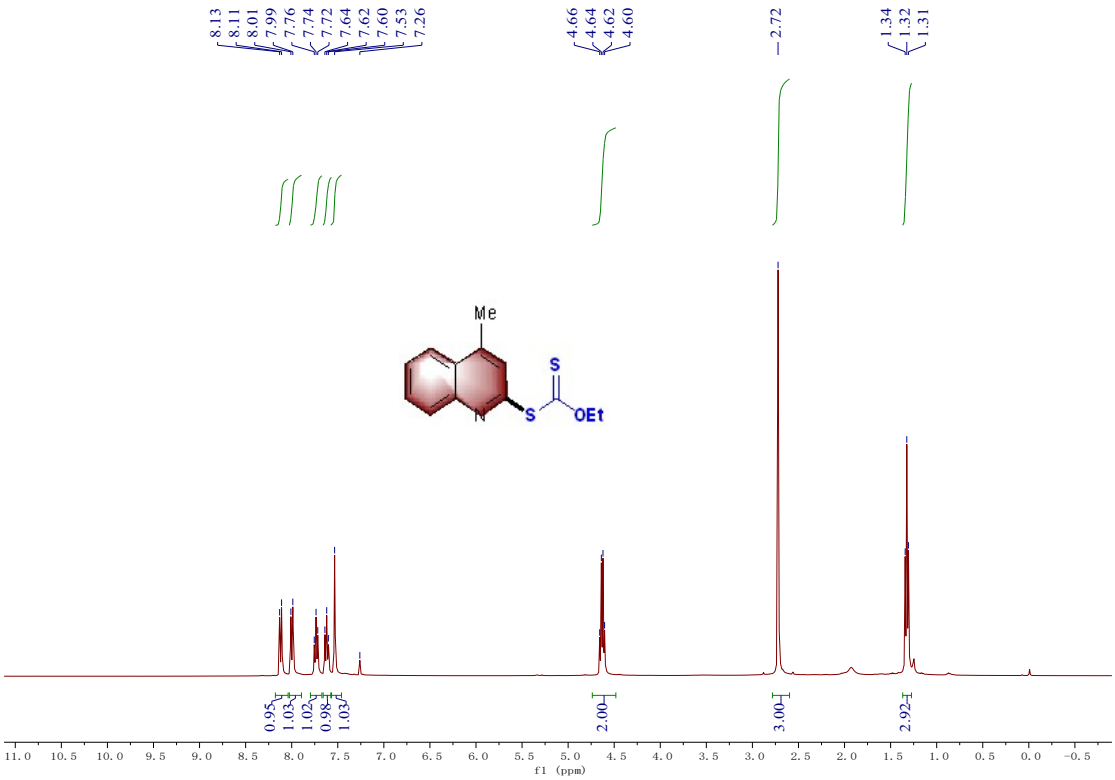
^{13}C spectra of **3ca**



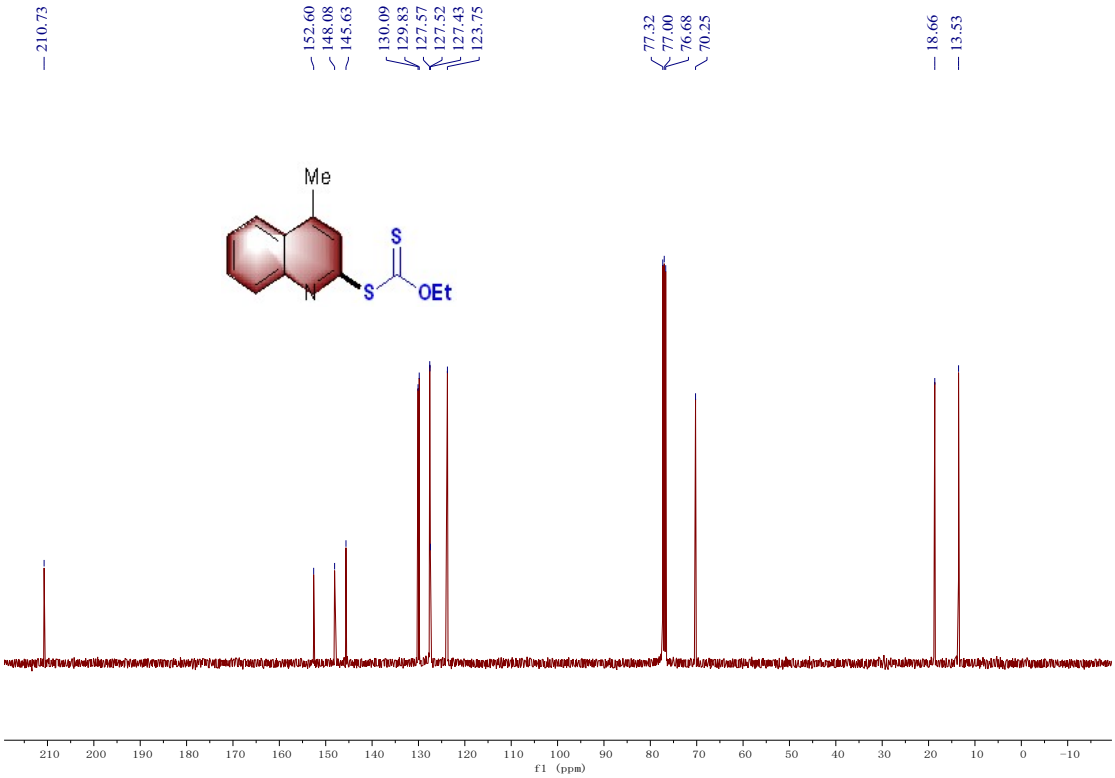
^{1}H spectra of **3da**



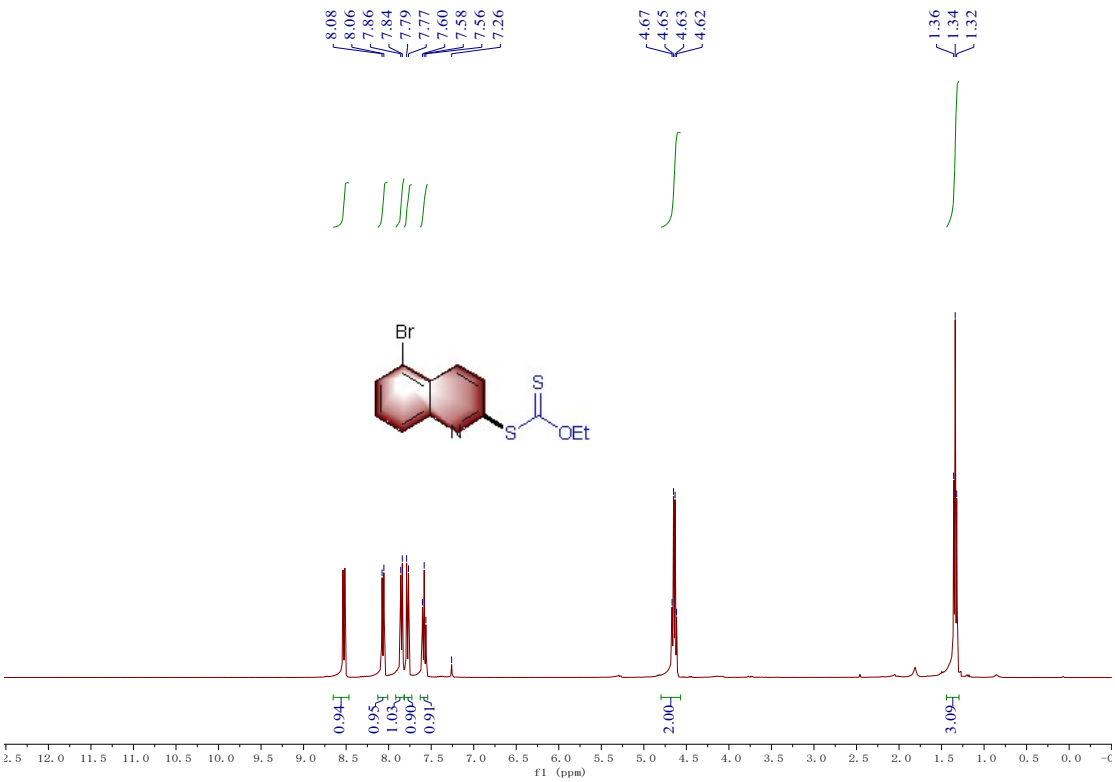
^{13}C spectra of **3da**



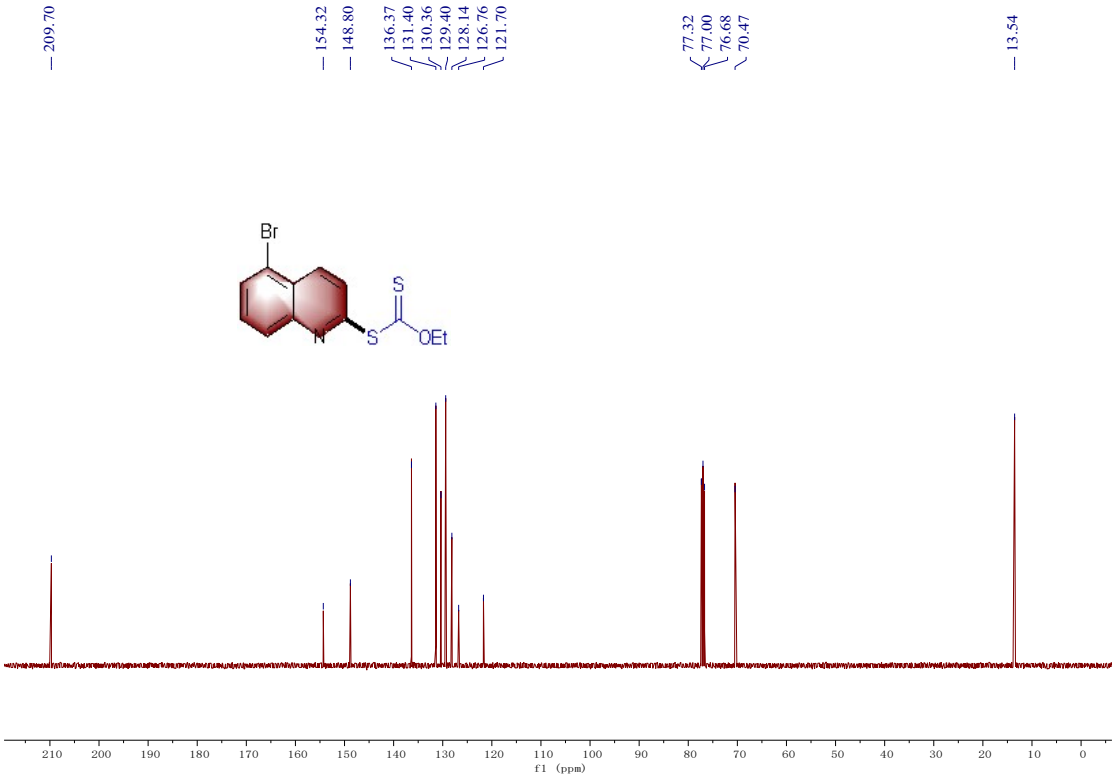
^{1}H spectra of **3ea**



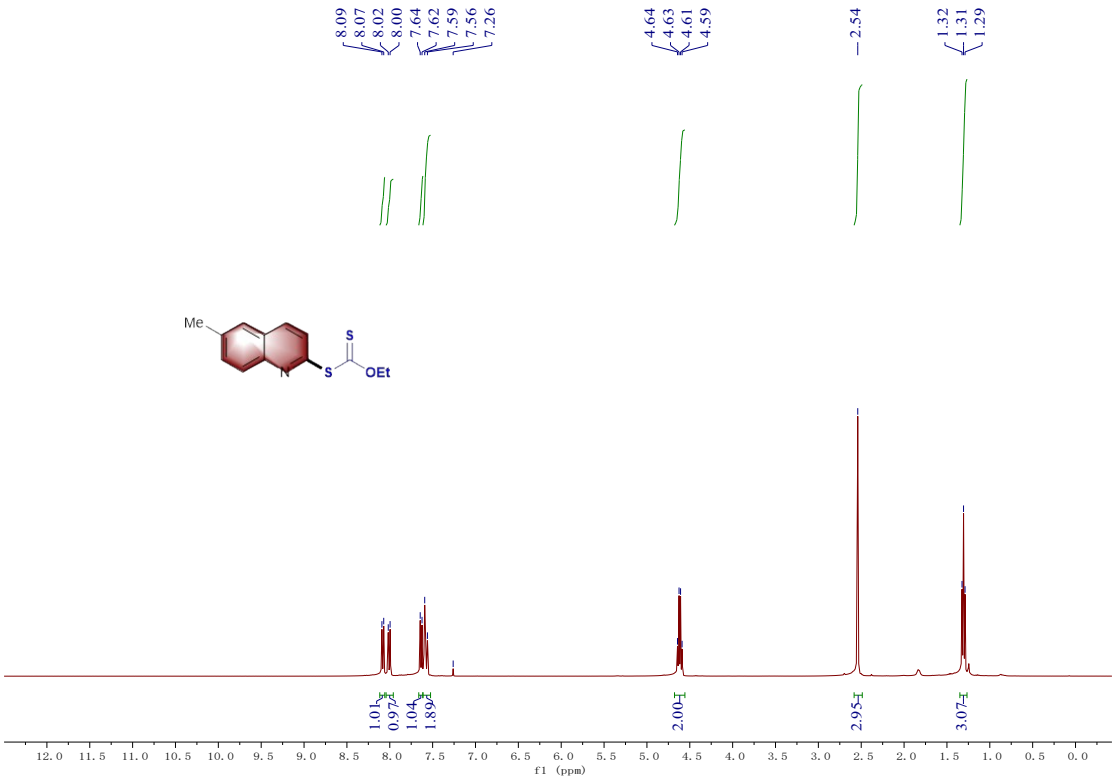
^{13}C spectra of **3ea**



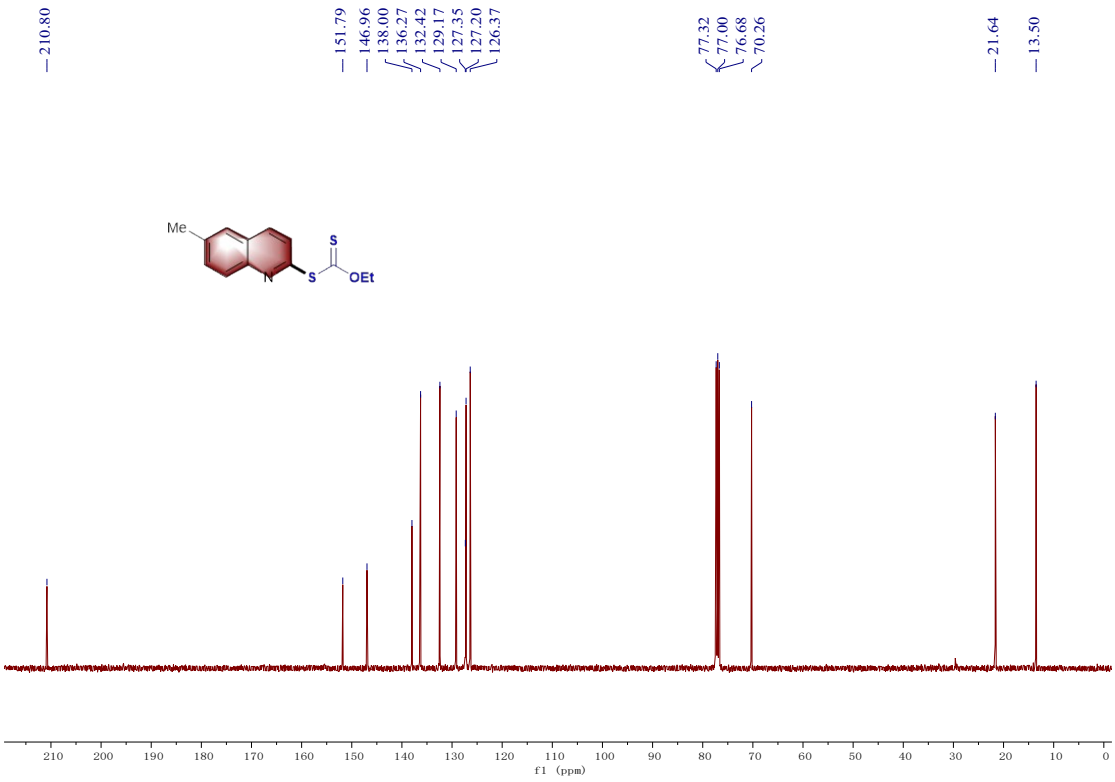
^{1}H spectra of **3fa**



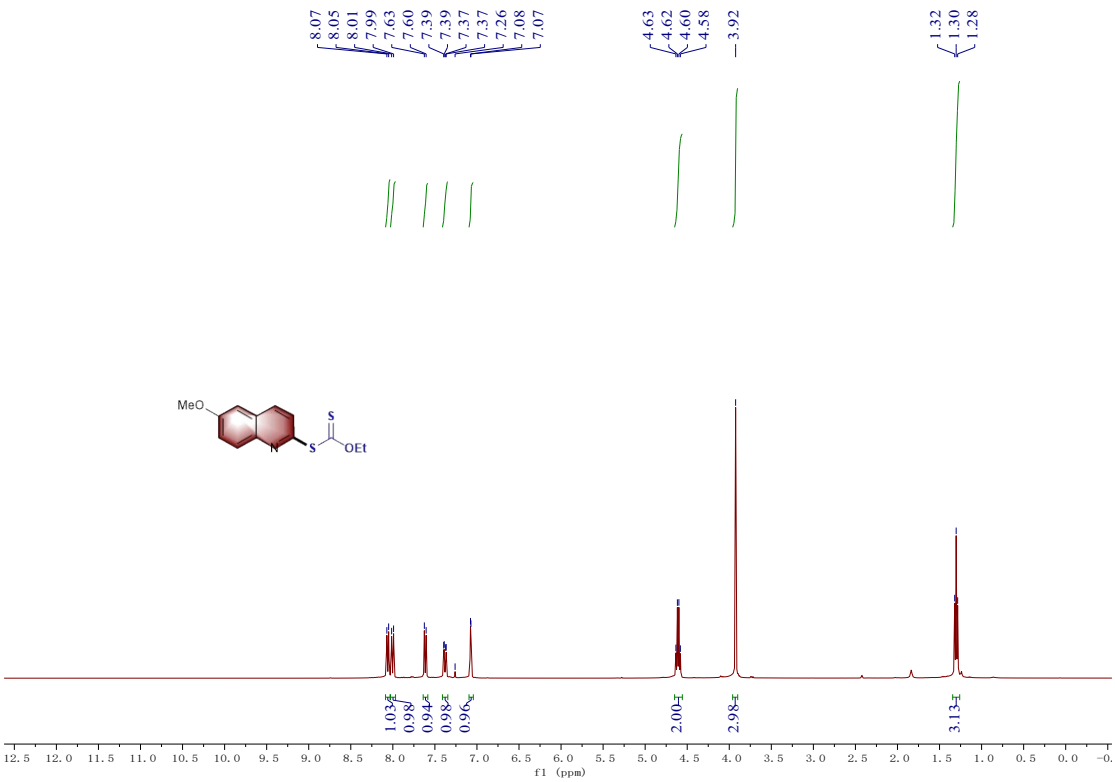
^{13}C spectra of **3fa**



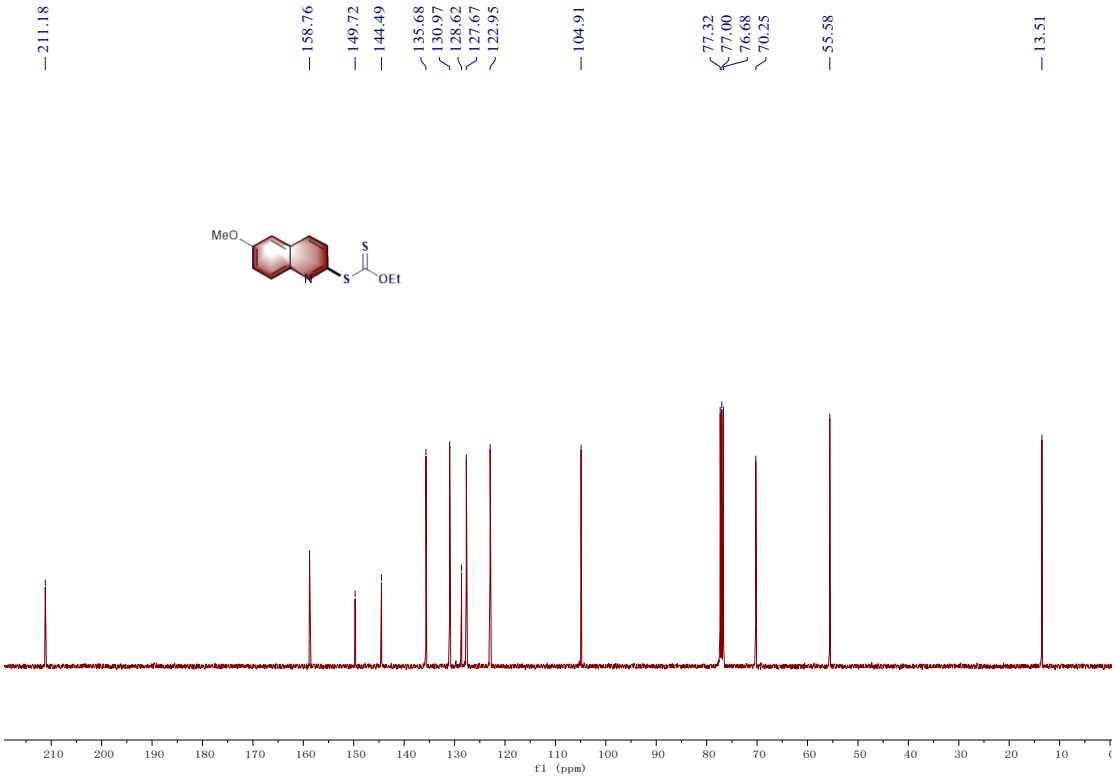
^{1}H spectra of **3ga**



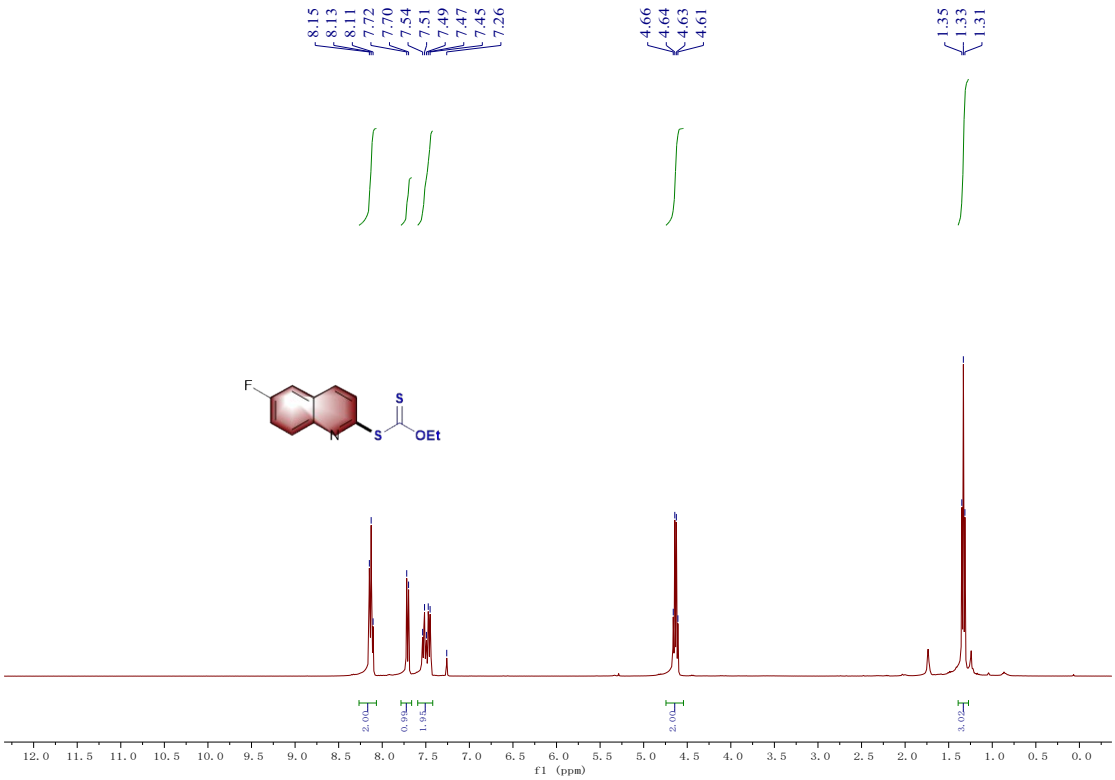
^{13}C spectra of **3ga**



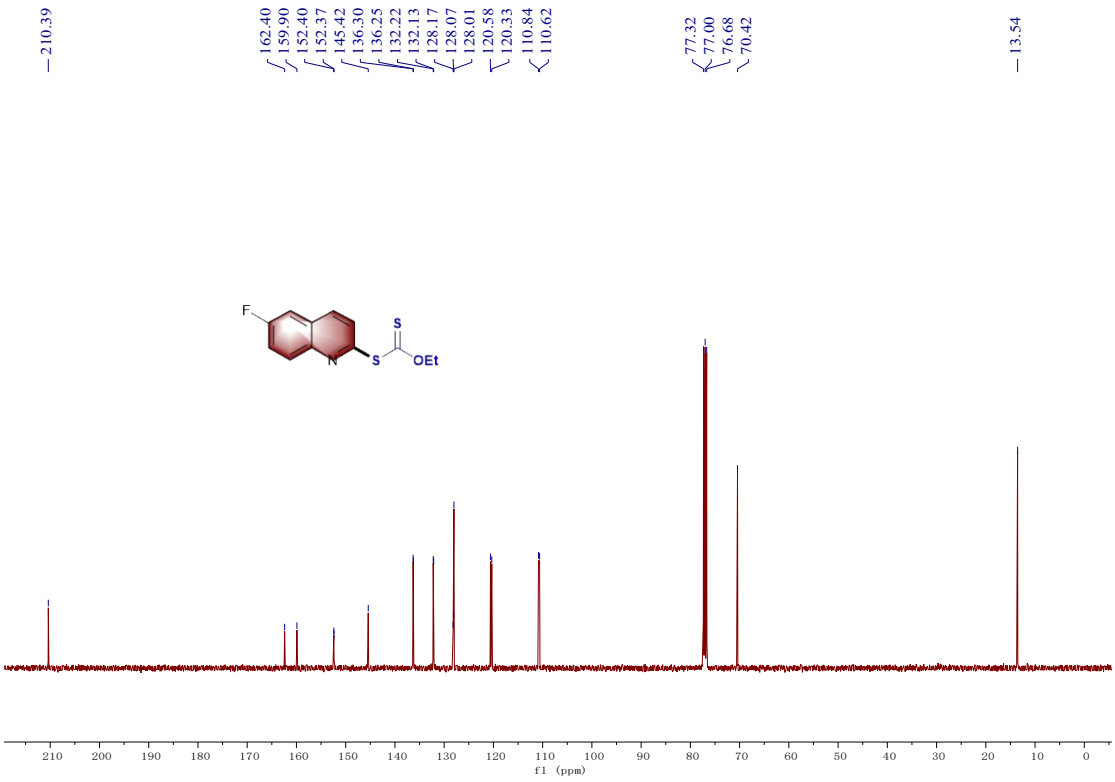
^{1}H spectra of **3ha**



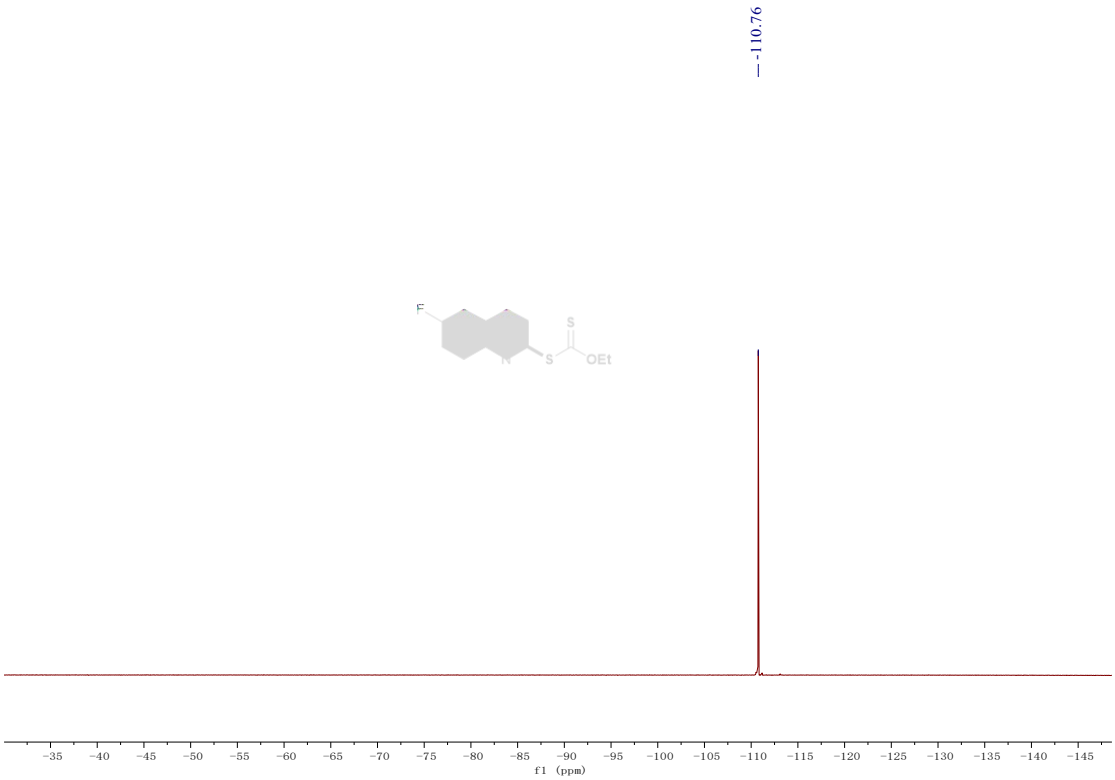
^{13}C spectra of **3ha**



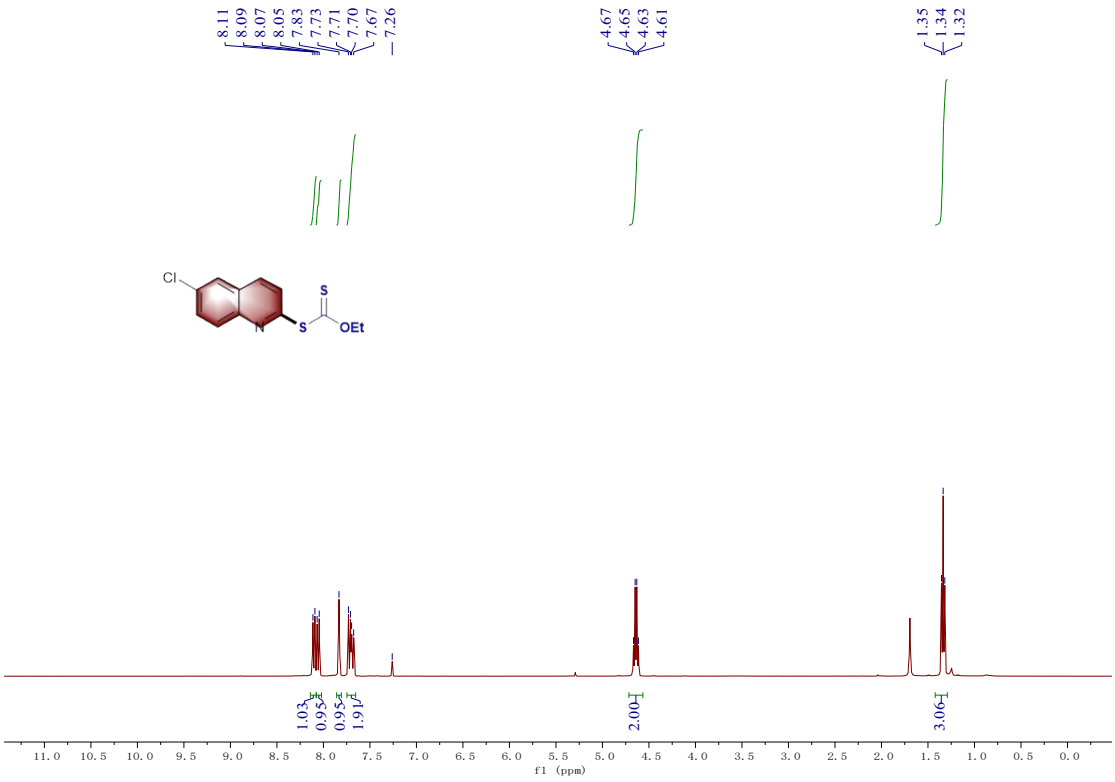
^{1}H spectra of **3ia**



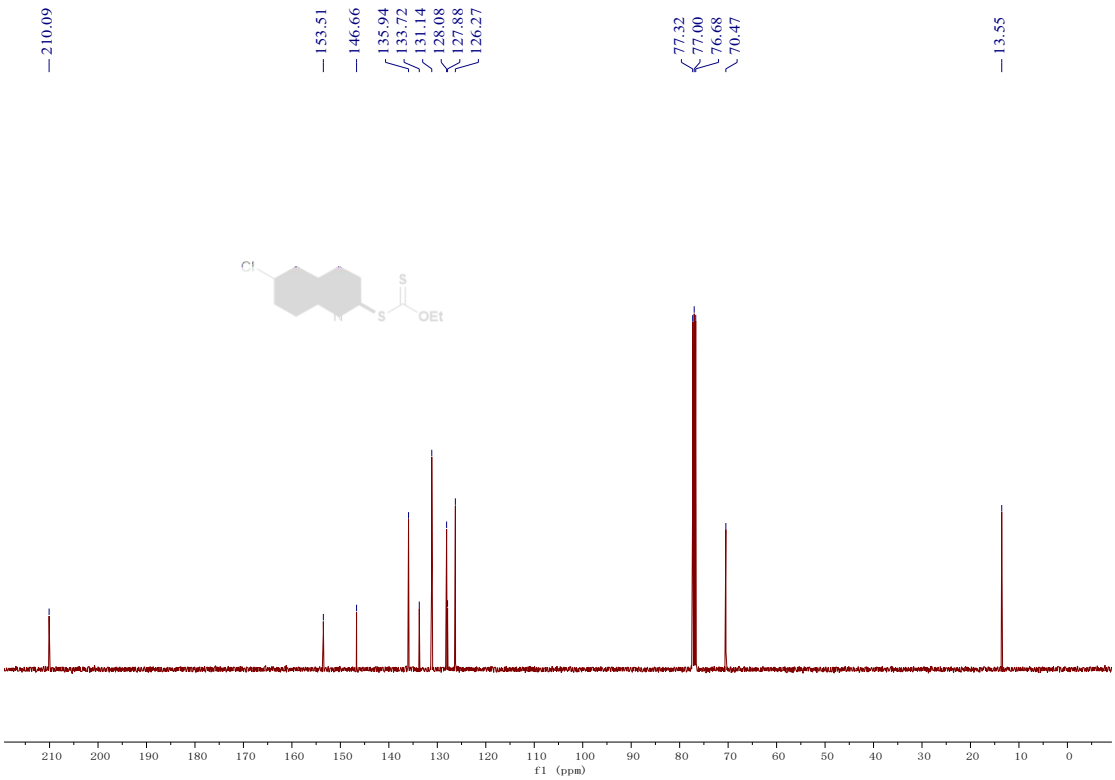
^{13}C spectra of **3ia**



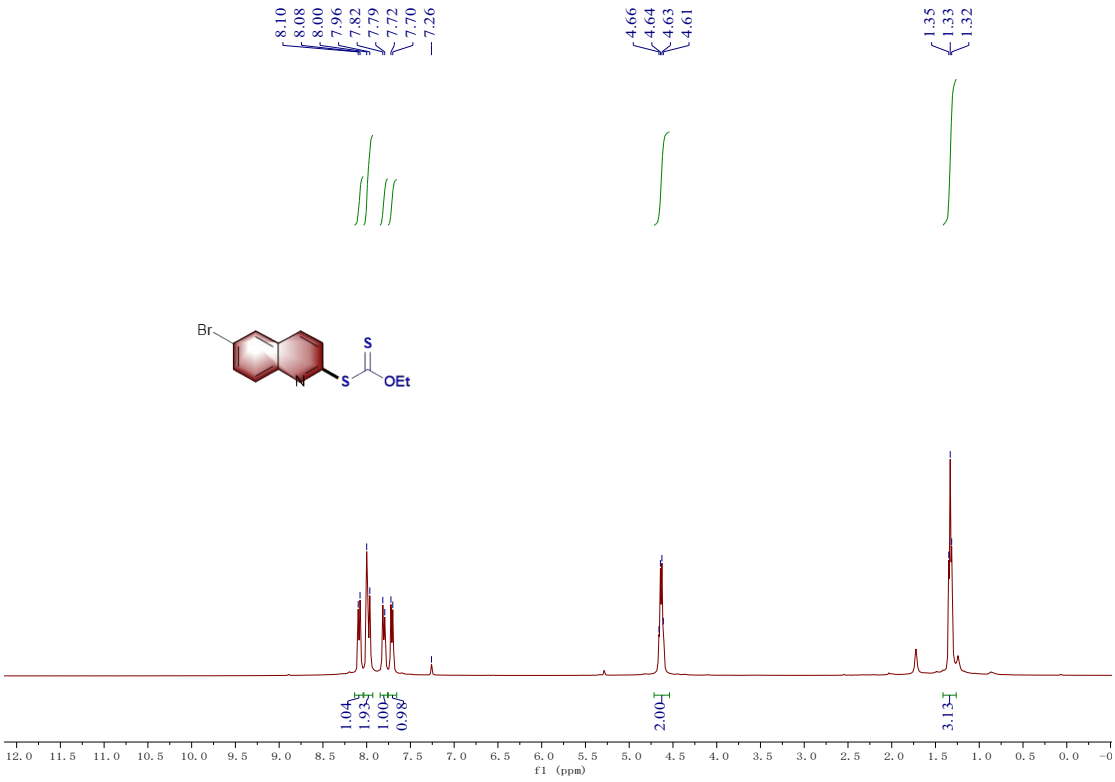
^{19}F spectra of **3ia**



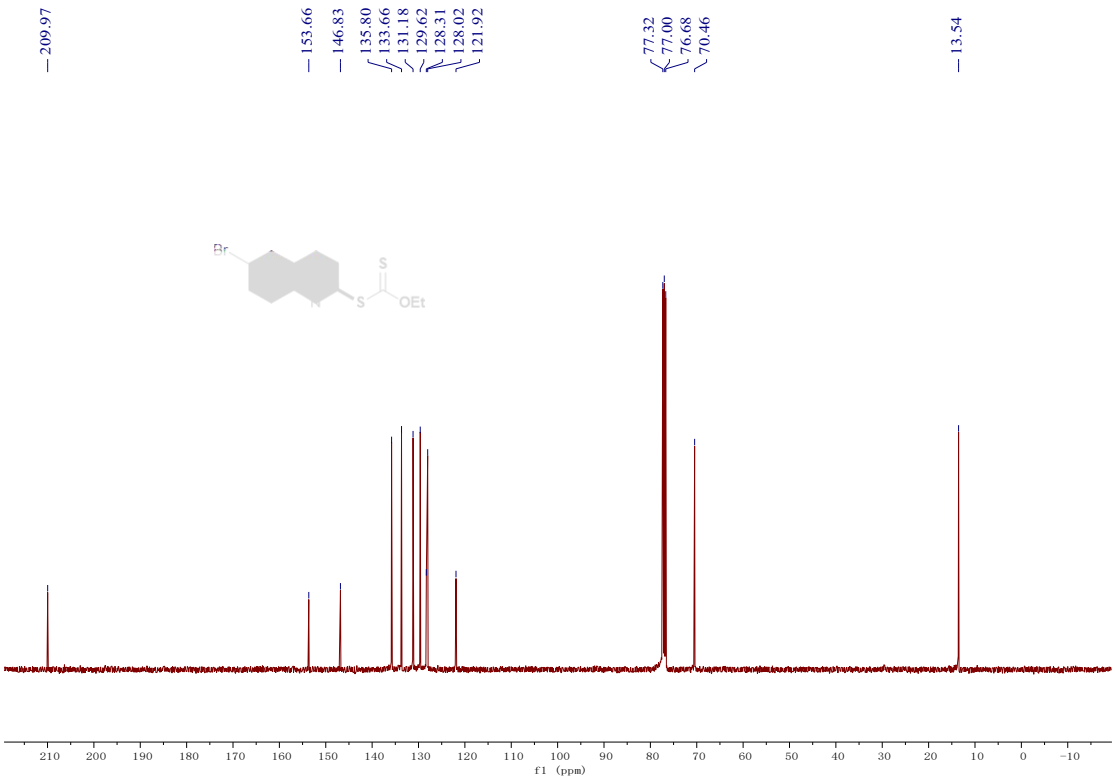
^{1}H spectra of **3ja**



^{13}C spectra of **3ja**



^{1}H spectra of **3ka**



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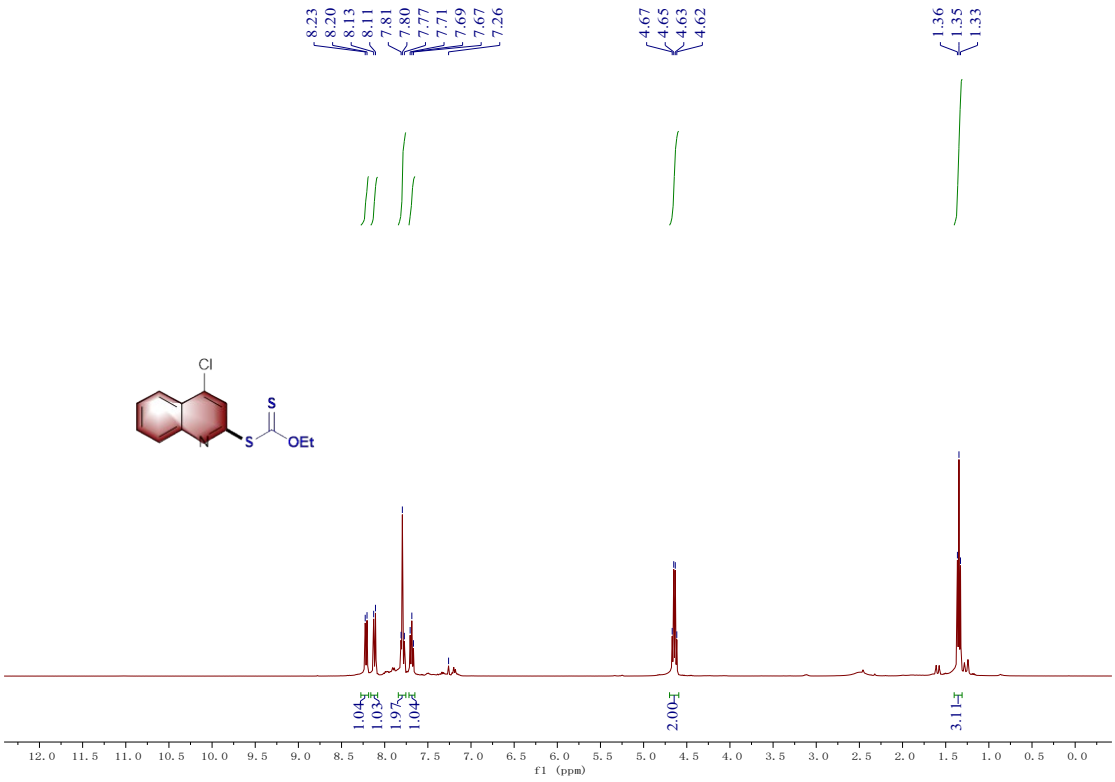
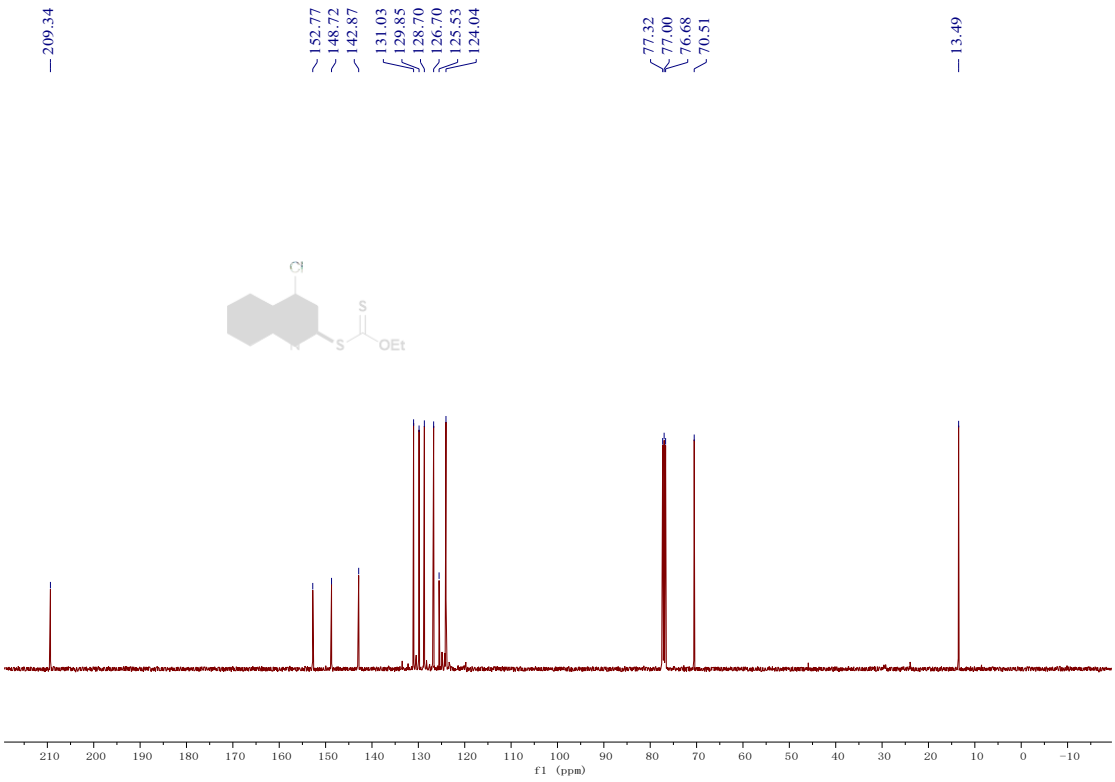
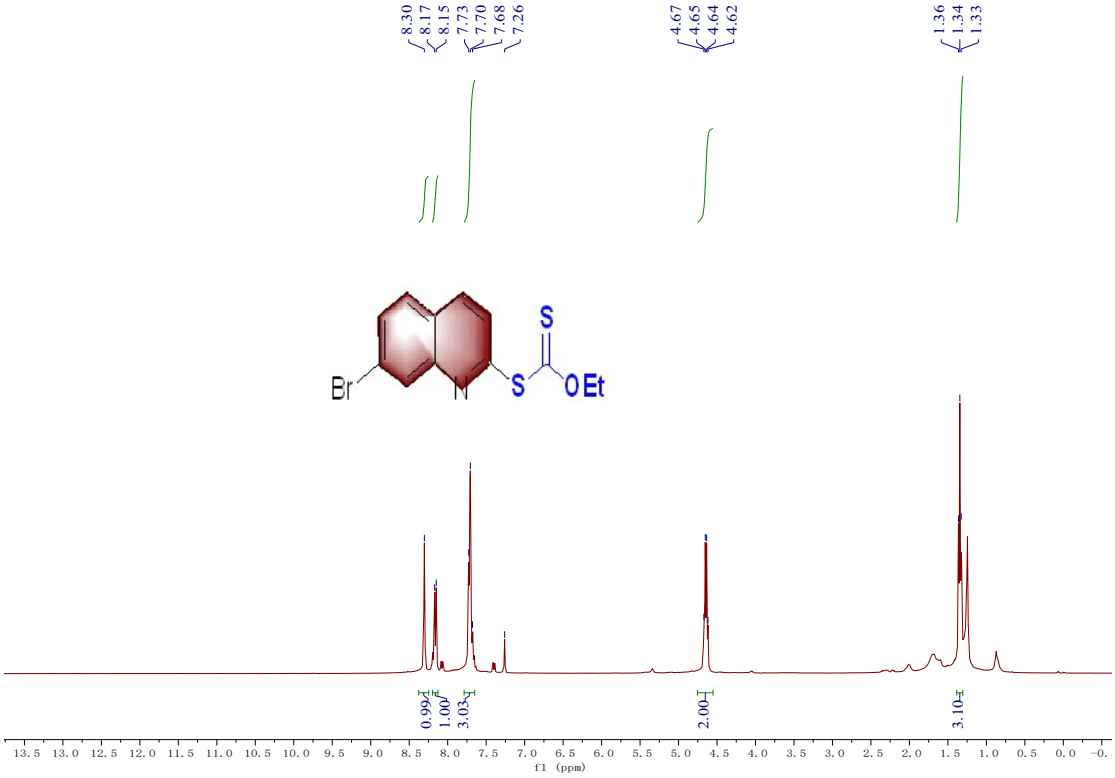


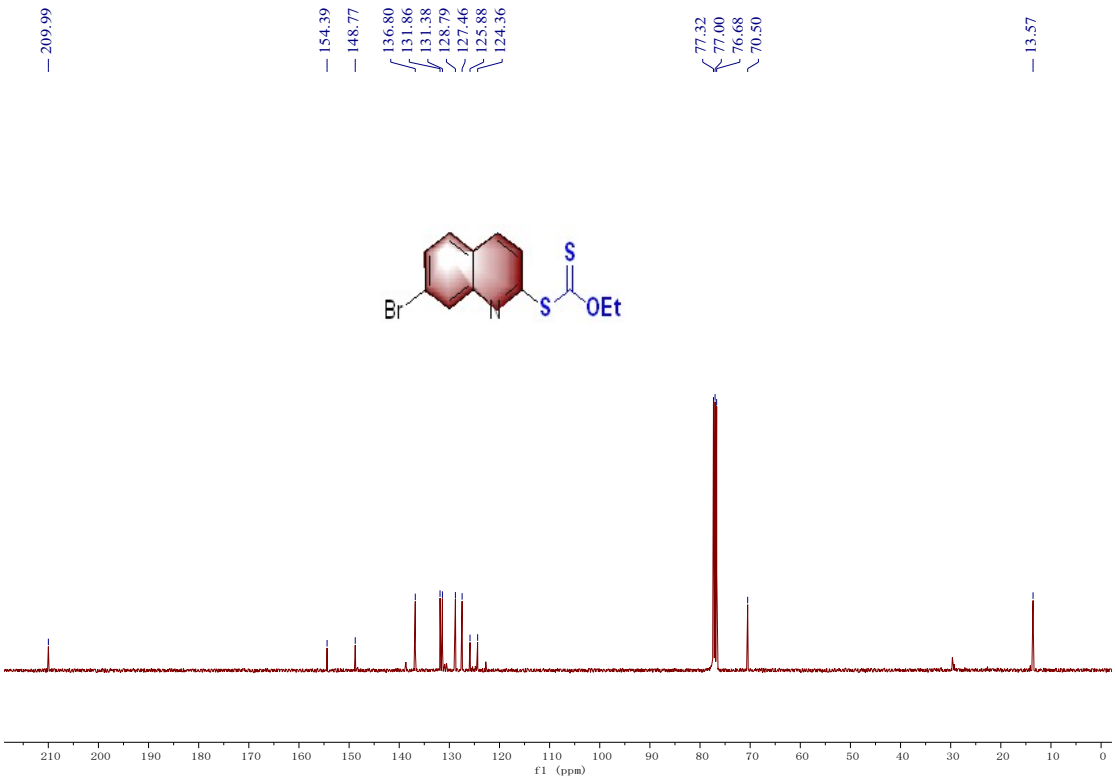
^{1}H spectra of **3la**



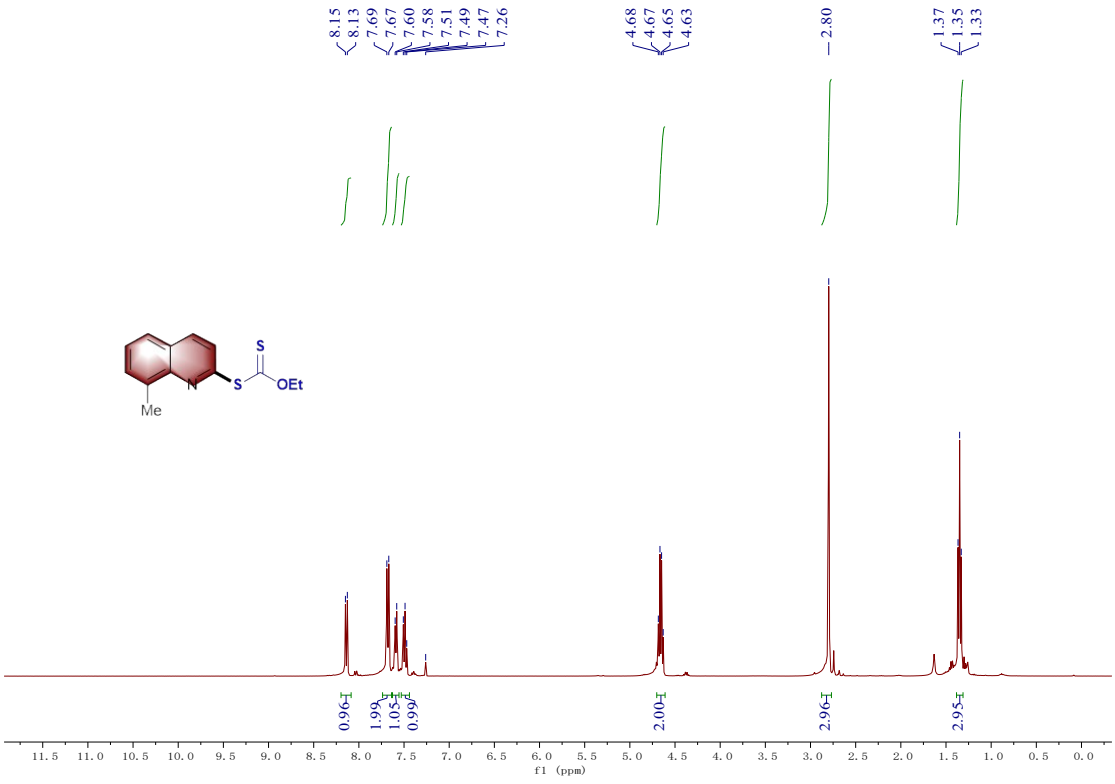
^{13}C spectra of **3la**



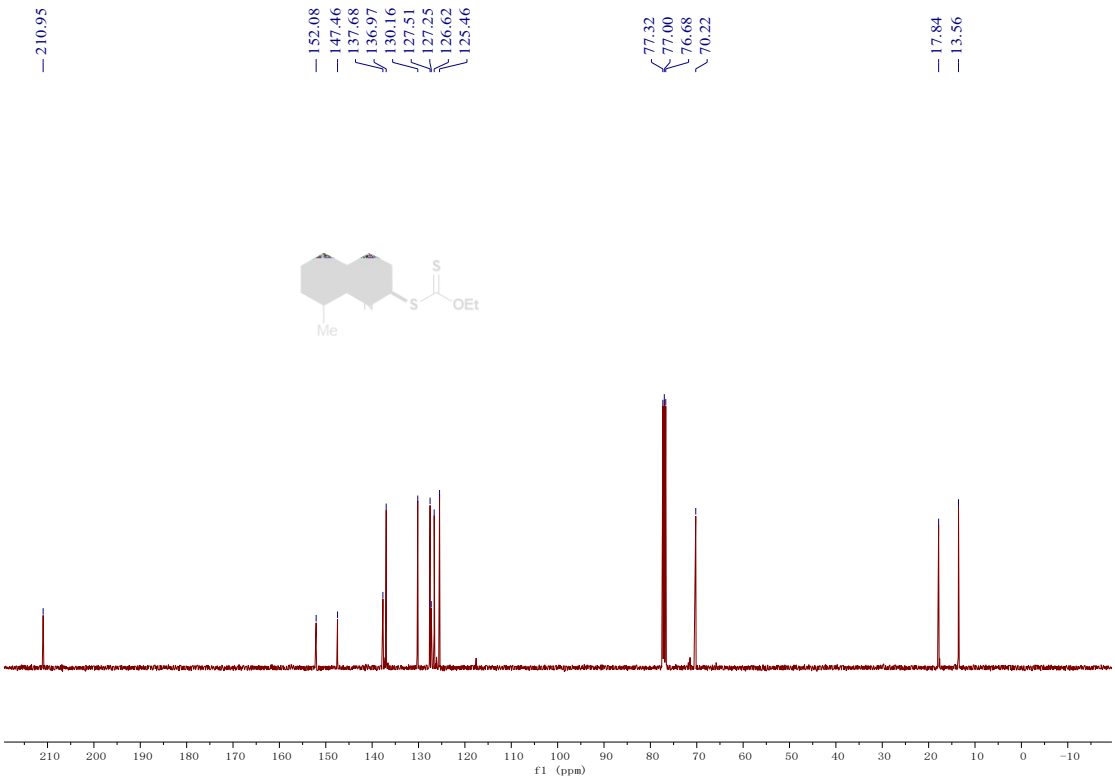
^{1}H spectra of **3ma**



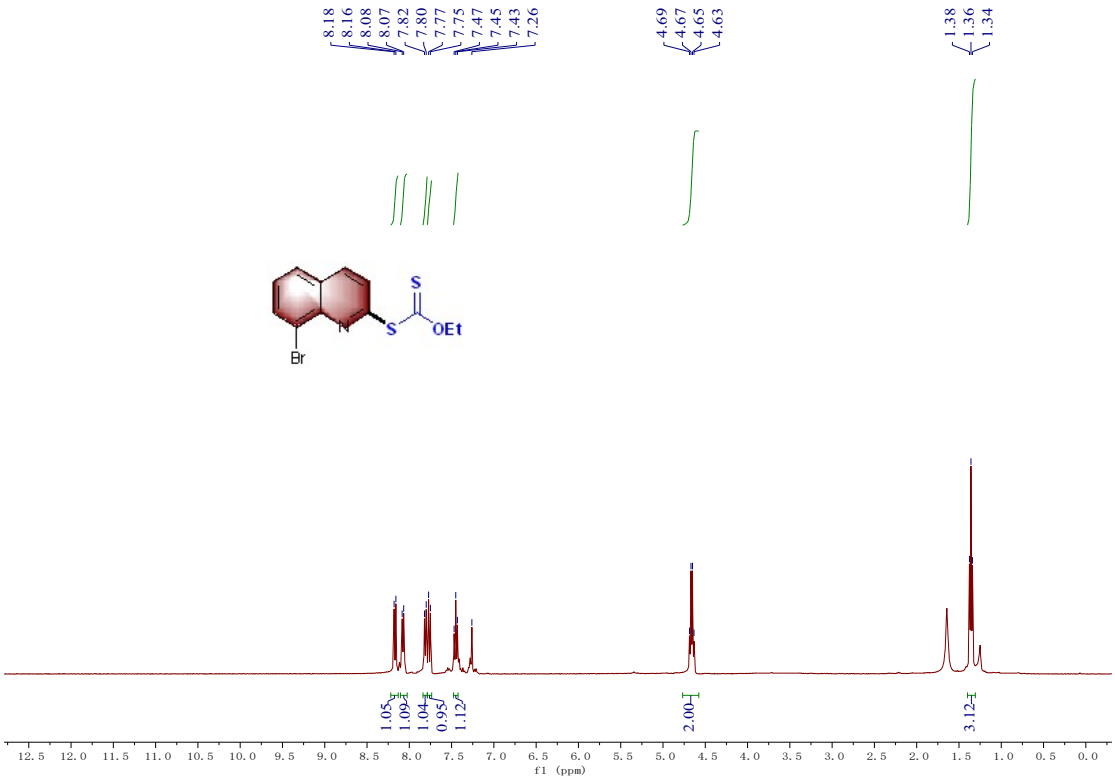
^{13}**C** spectra of **3ma**



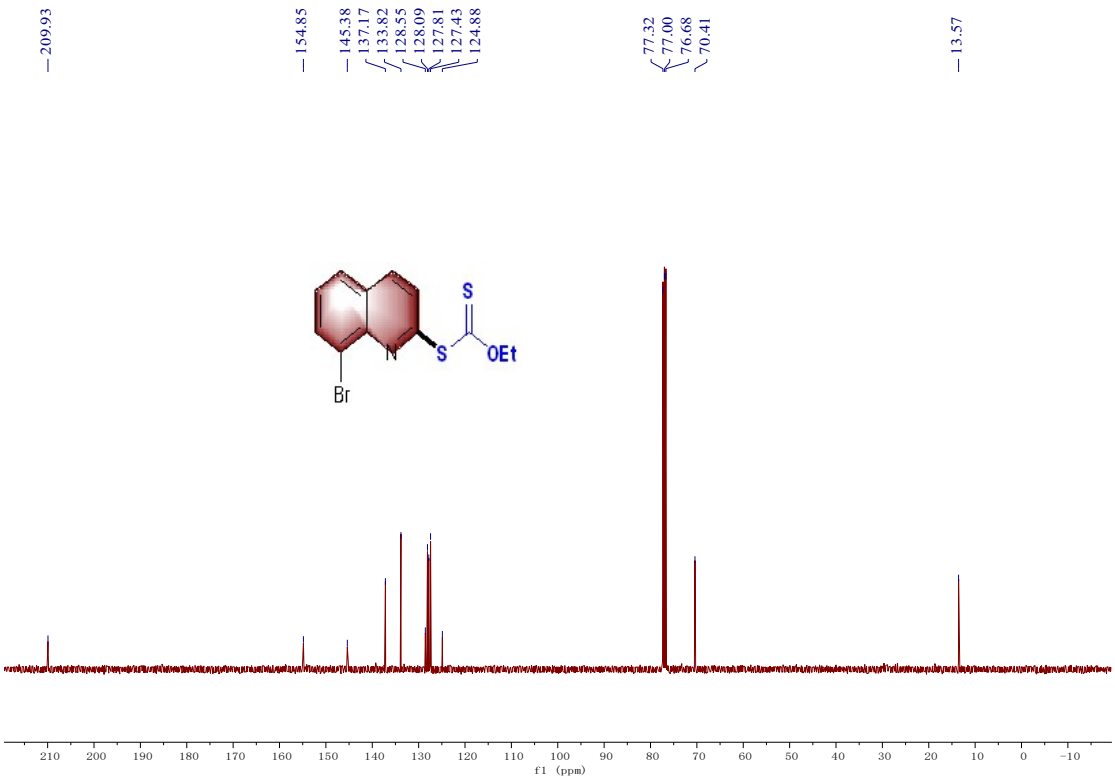
^{1}H spectra of **3na**



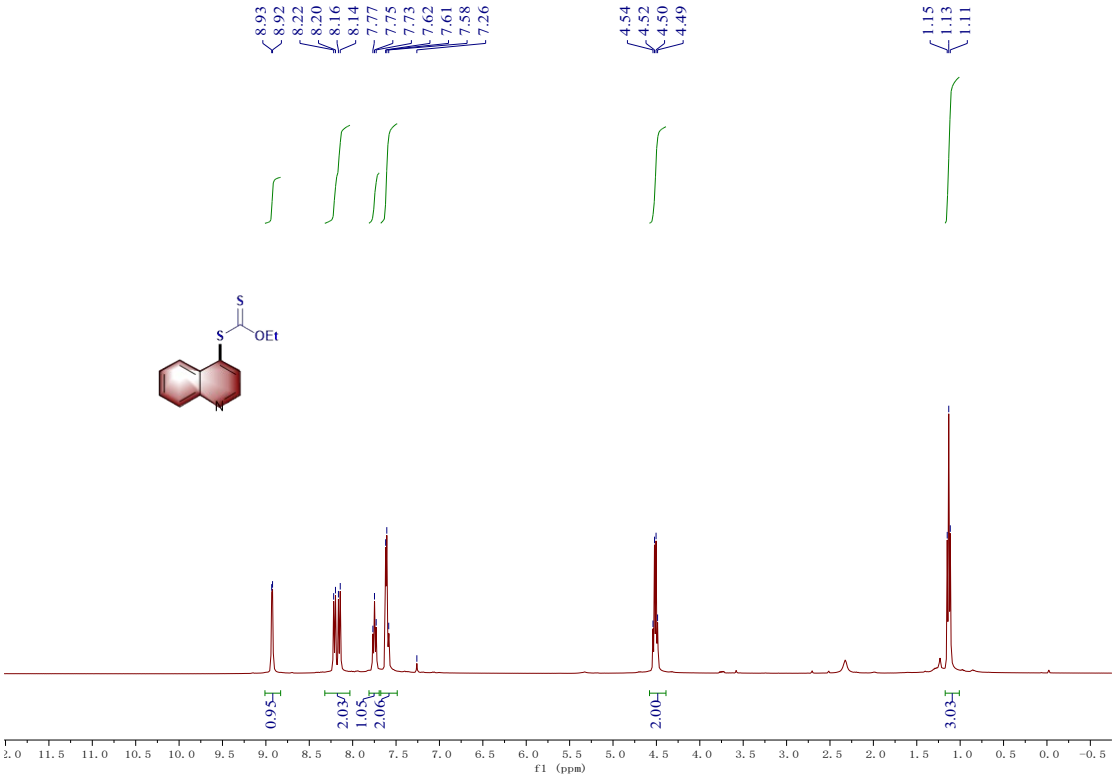
^{13}C spectra of **3na**



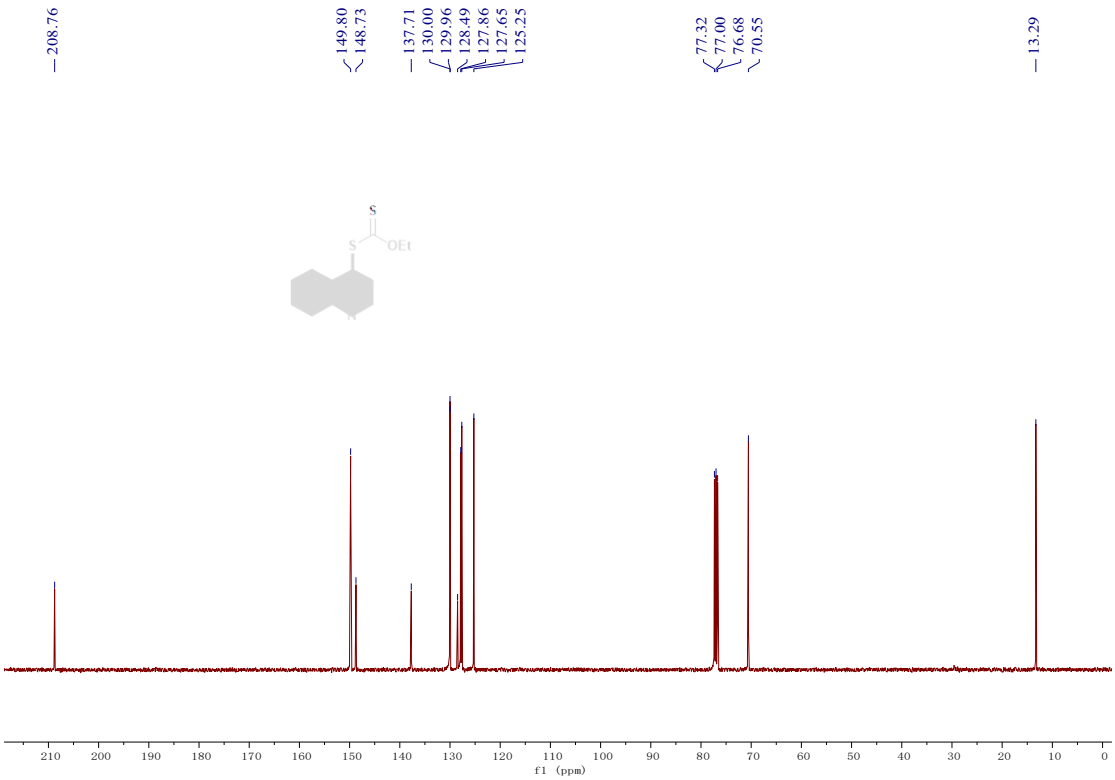
^{1}H spectra of **3oa**



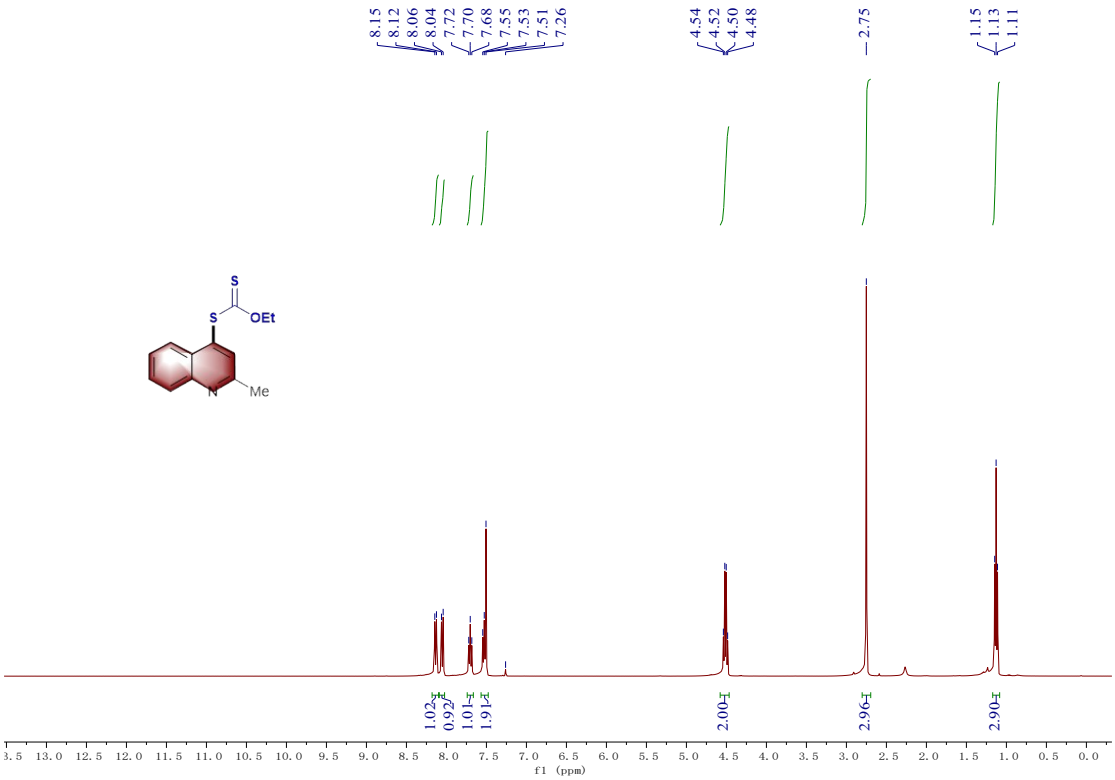
^{13}C spectra of **3oa**



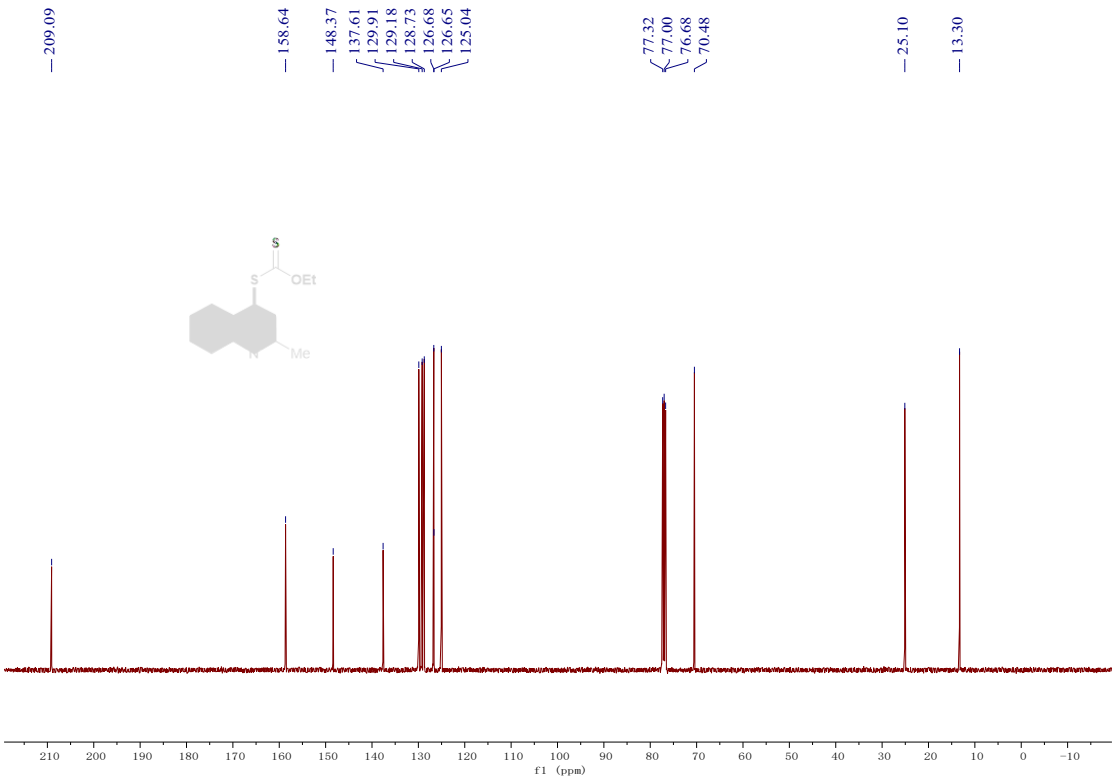
^{1}H spectra of **3pa**



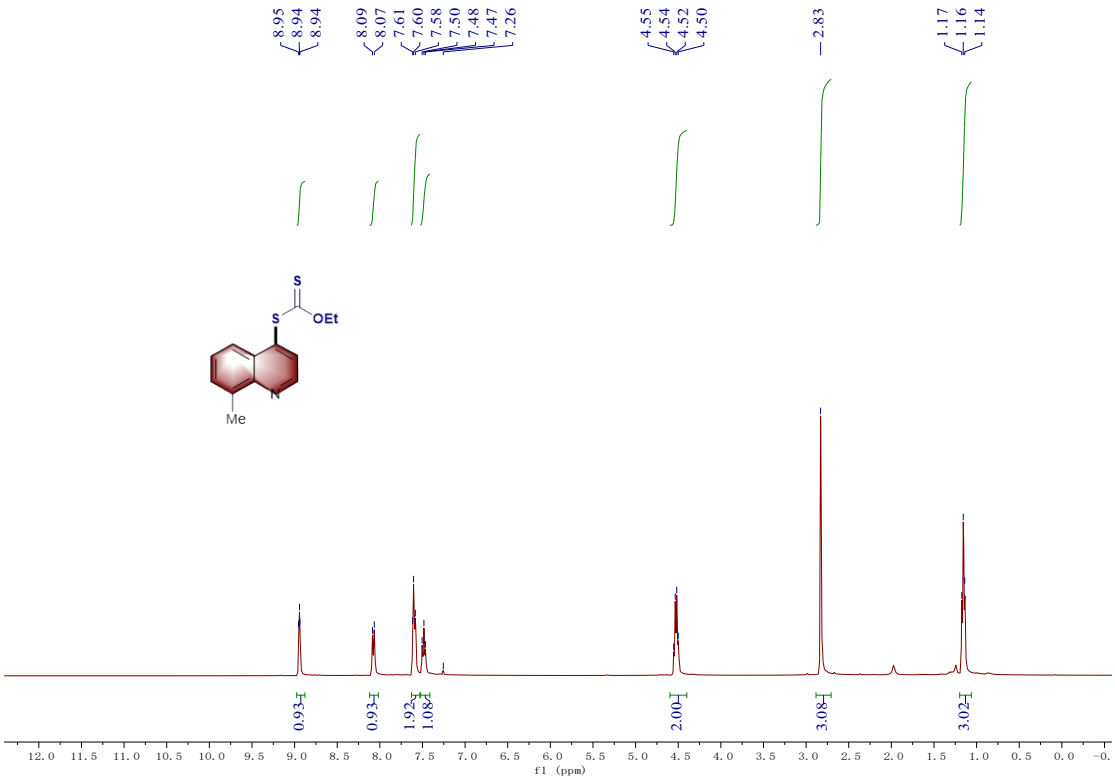
^{13}C spectra of **3pa**



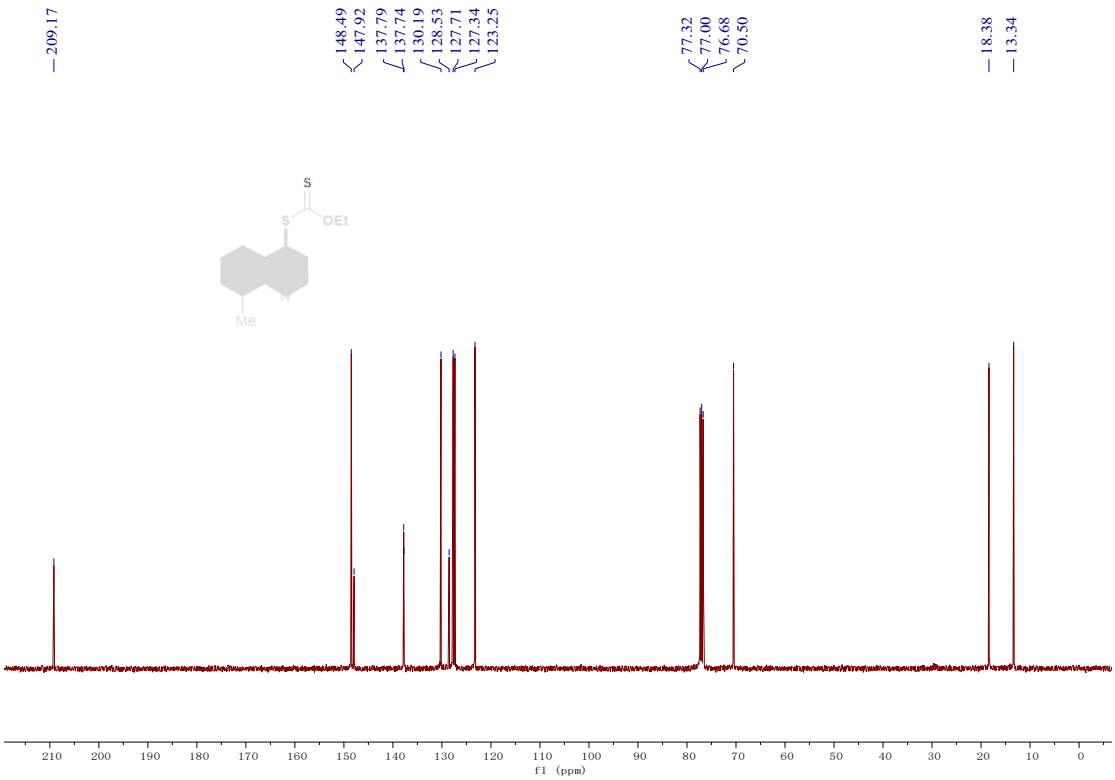
^{1}H spectra of **3qa**



^{13}C spectra of **3qa**



^{1}H spectra of **3ra**



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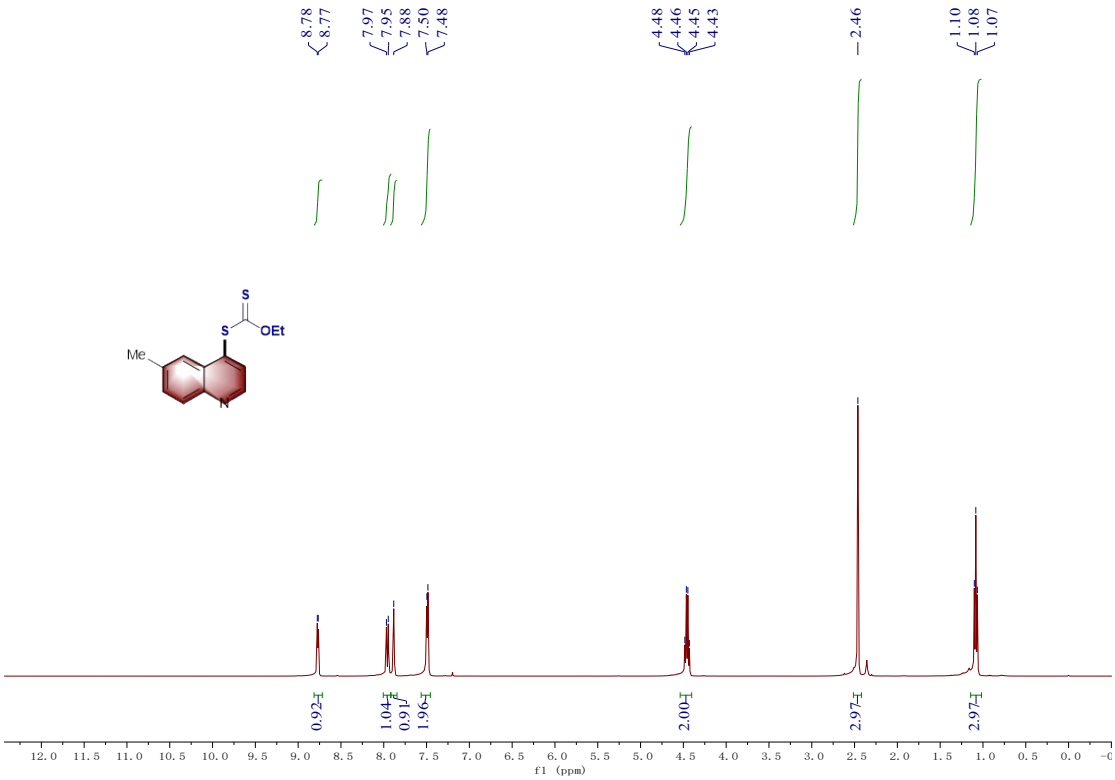

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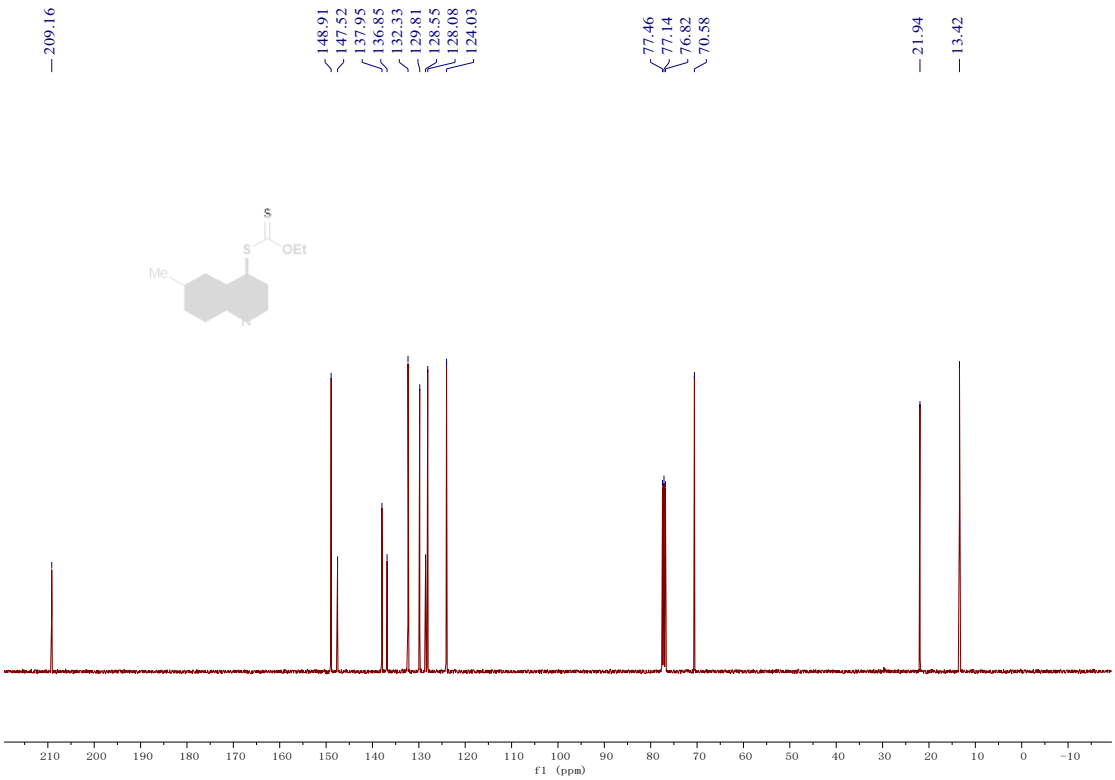

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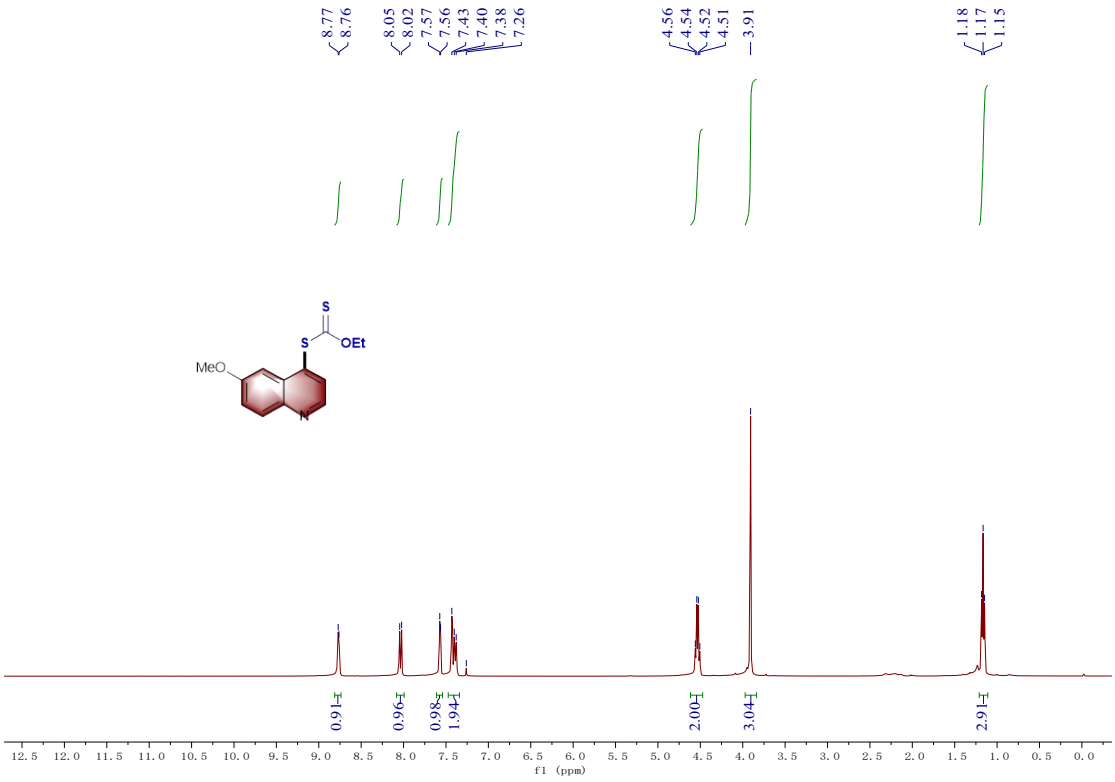
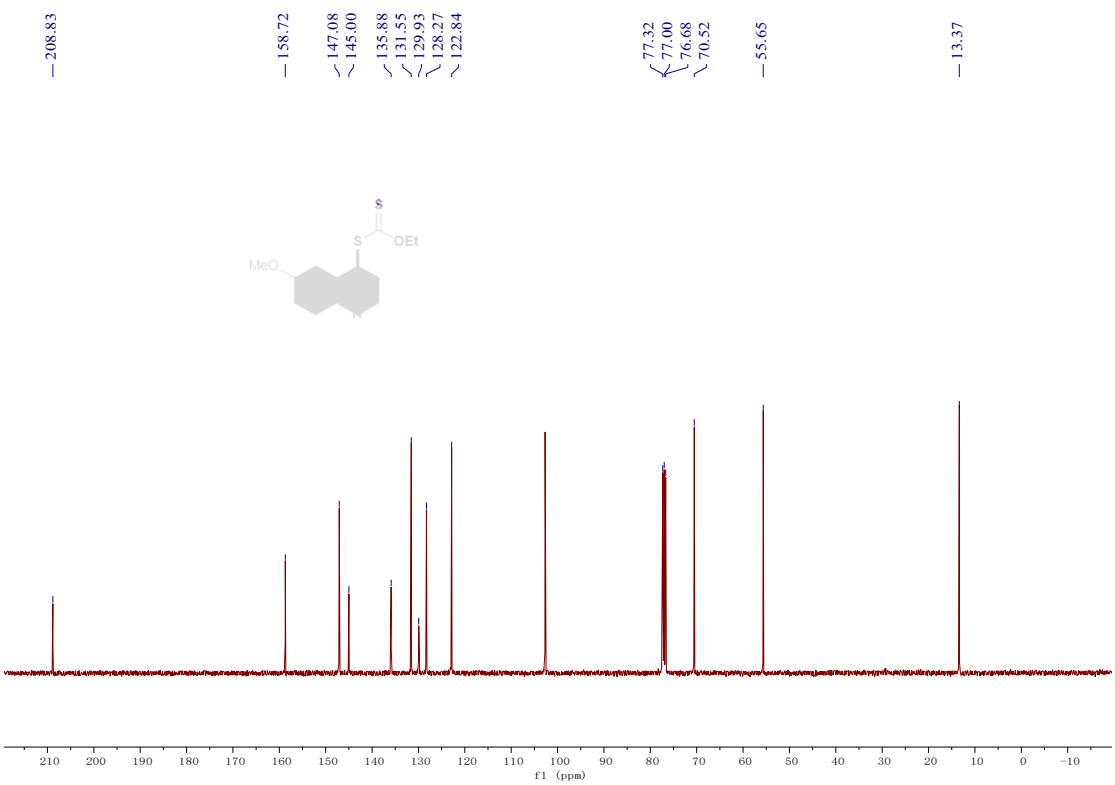
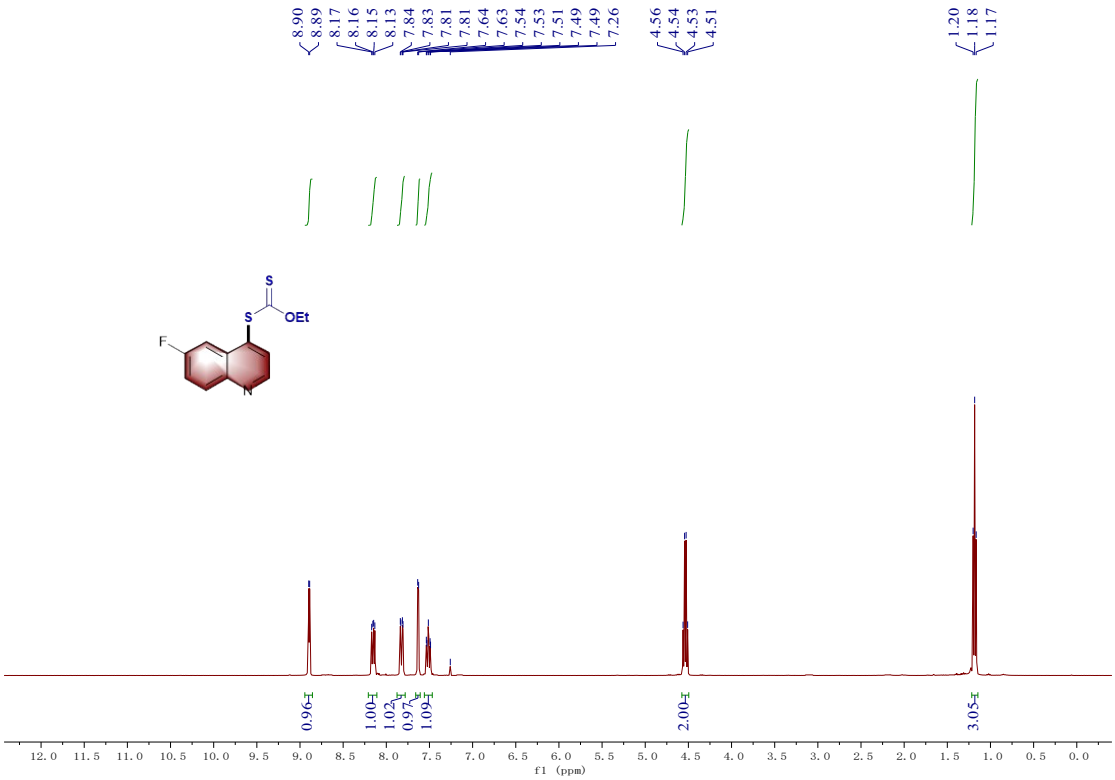


^{1}H spectra of **3ta**



^{13}C spectra of **3ta**



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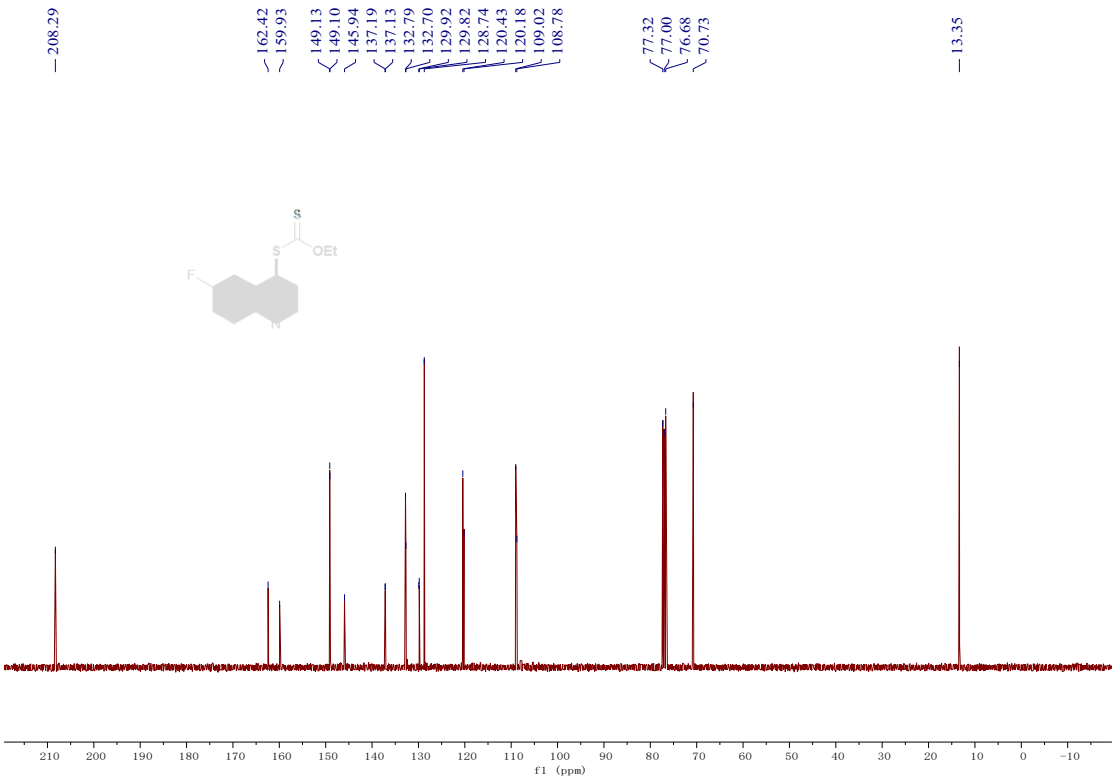

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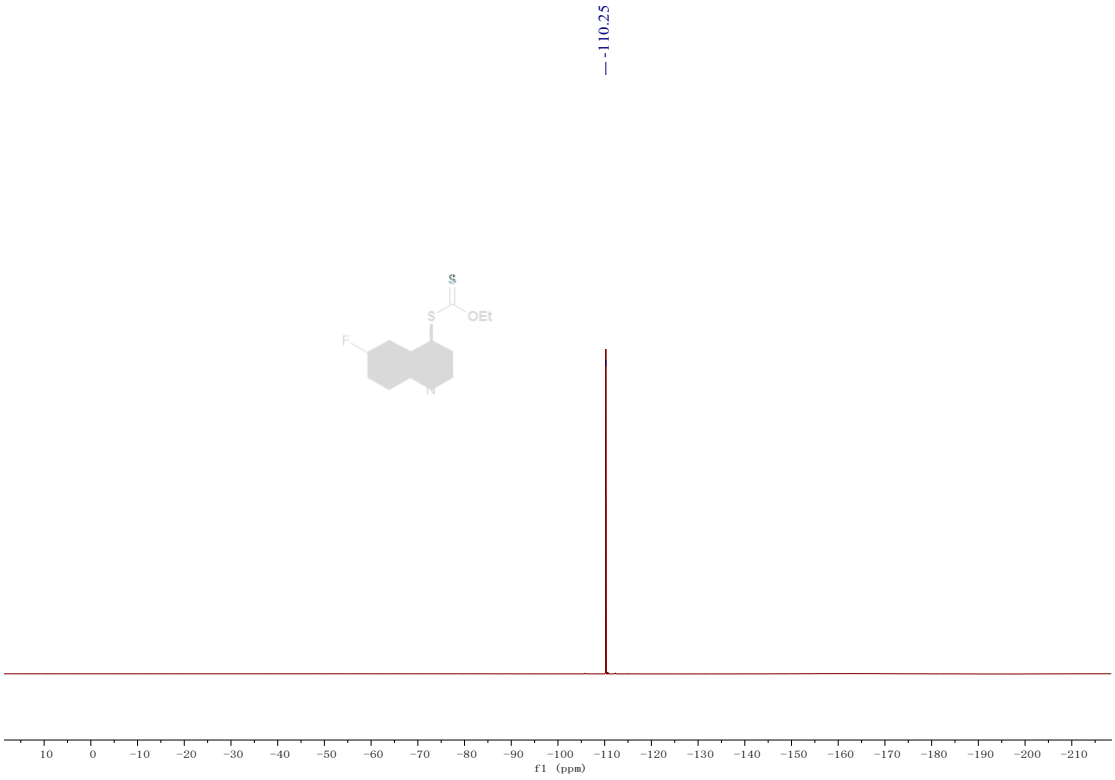
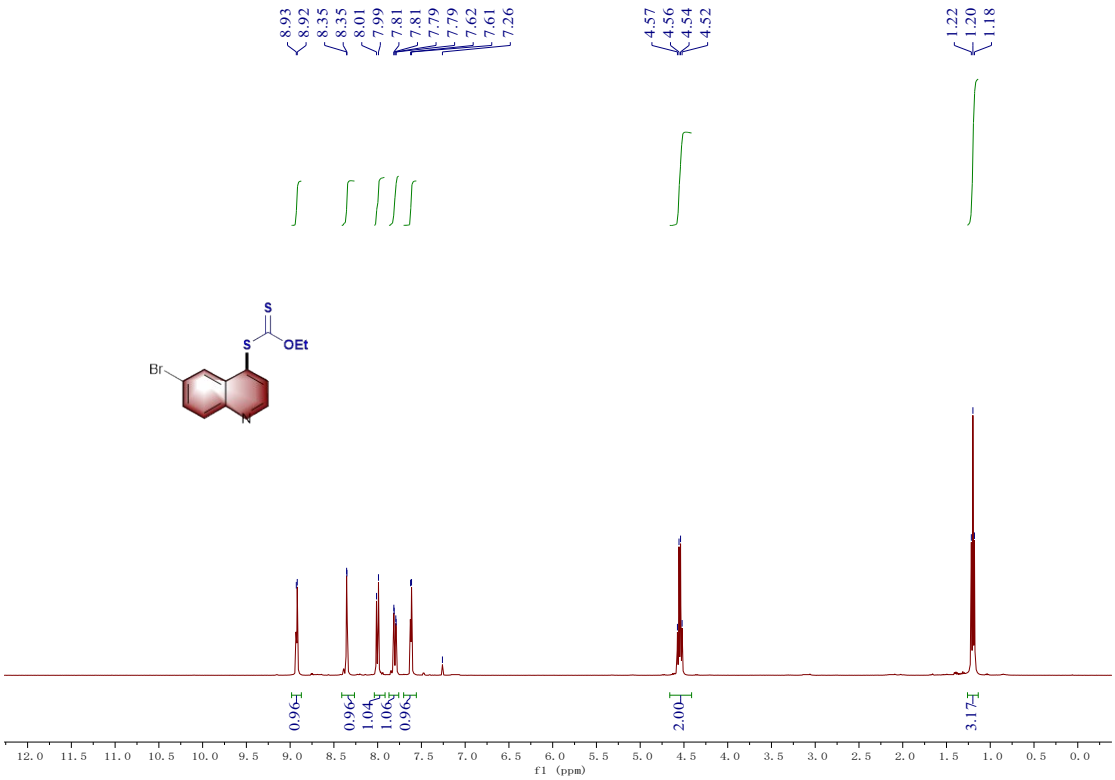
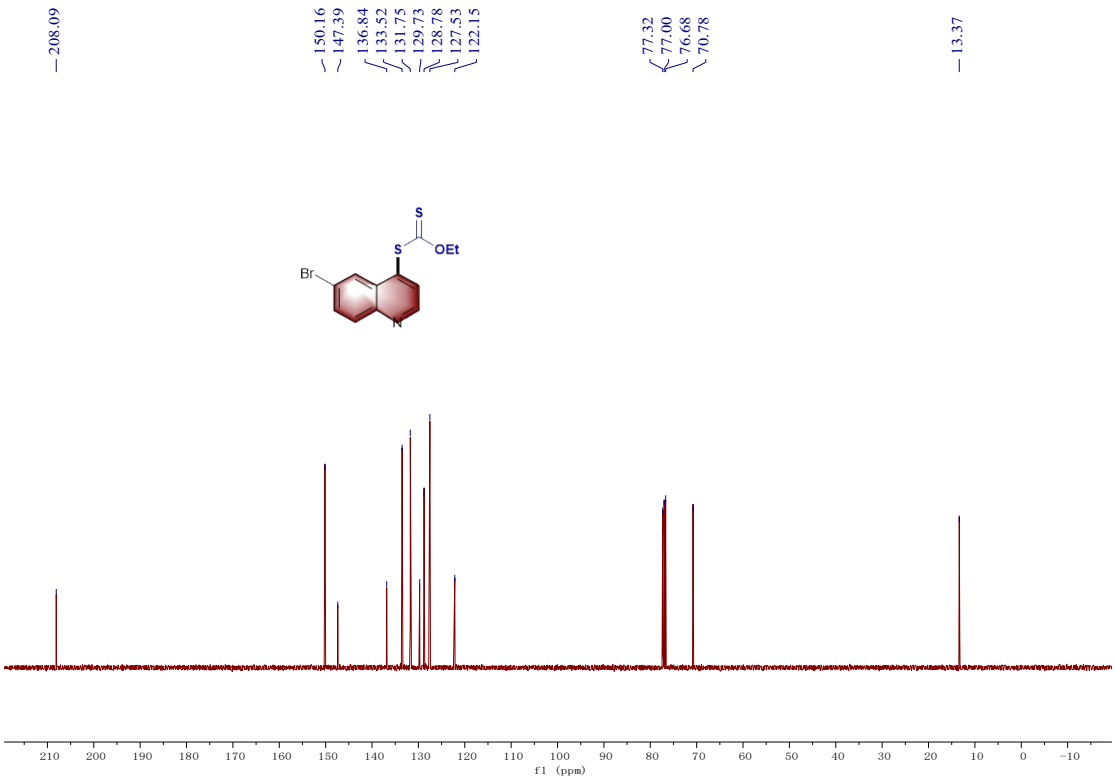


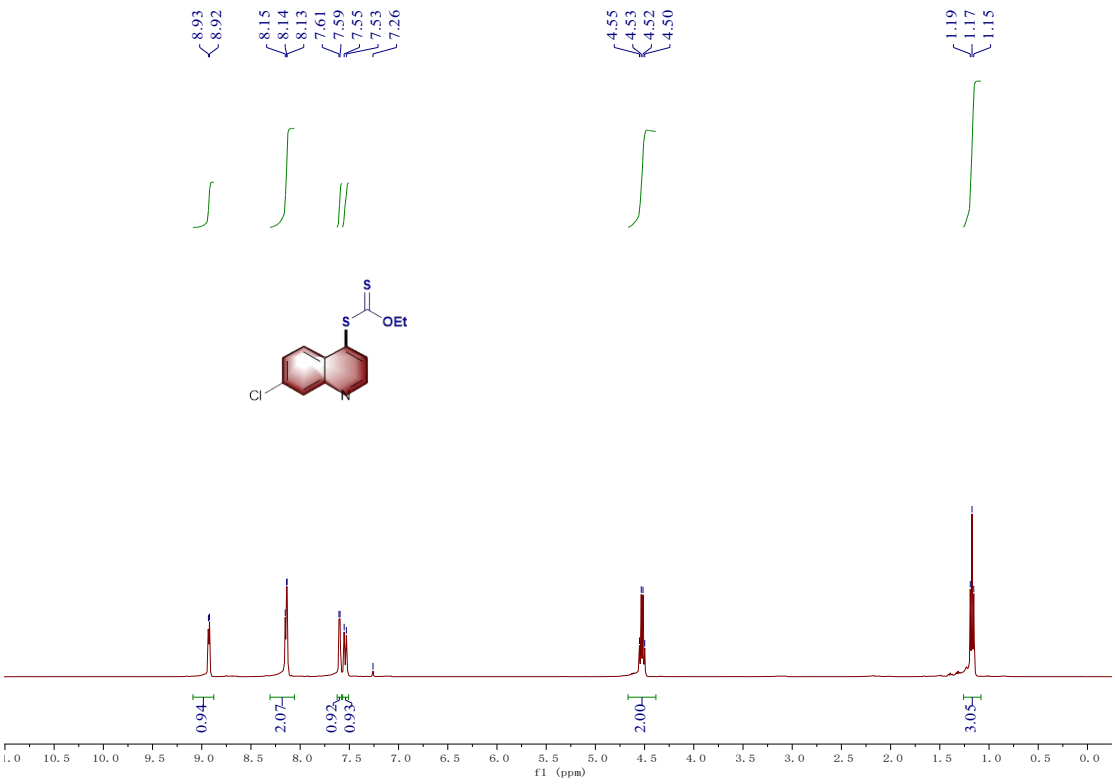
^{19}F spectra of **3ua**



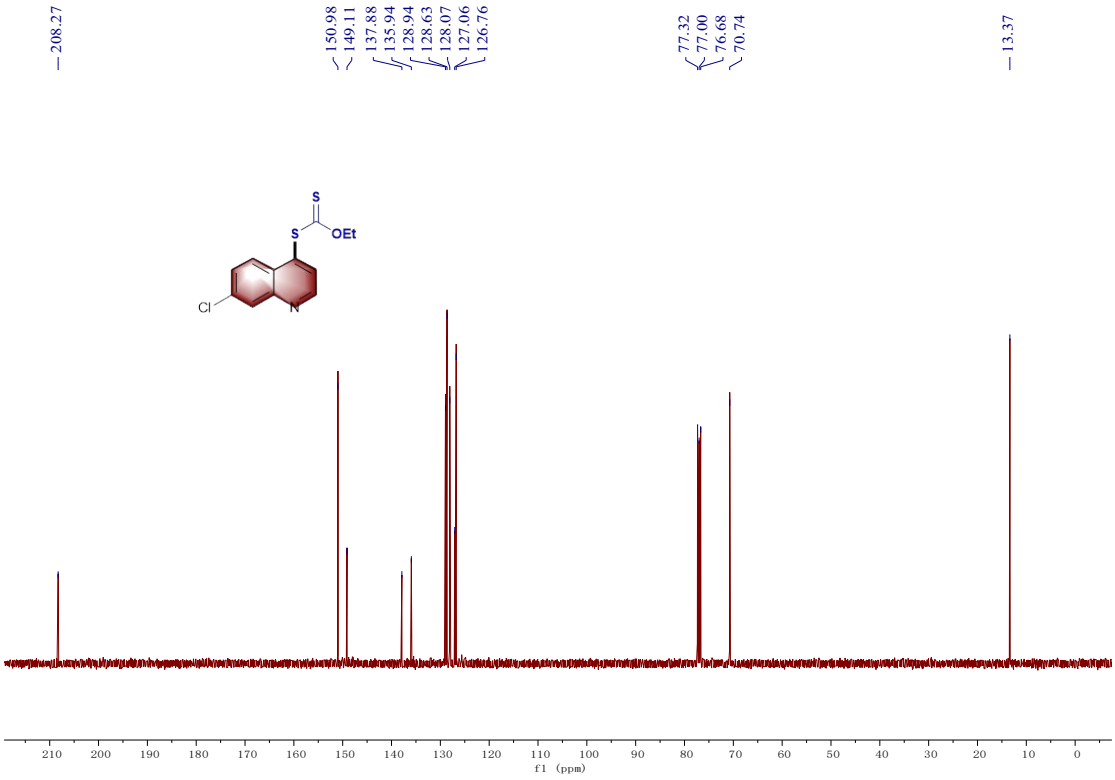
^{1}H spectra of **3va**



^{13}C spectra of **3va**



^{1}H spectra of **3wa**



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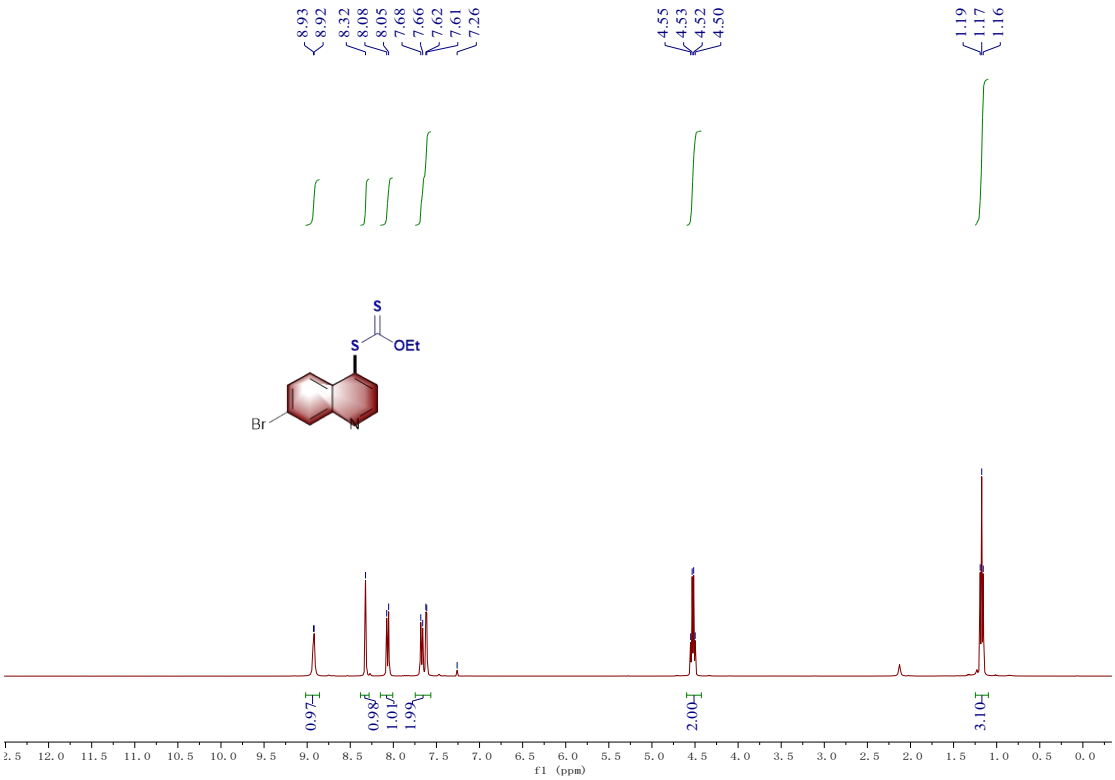
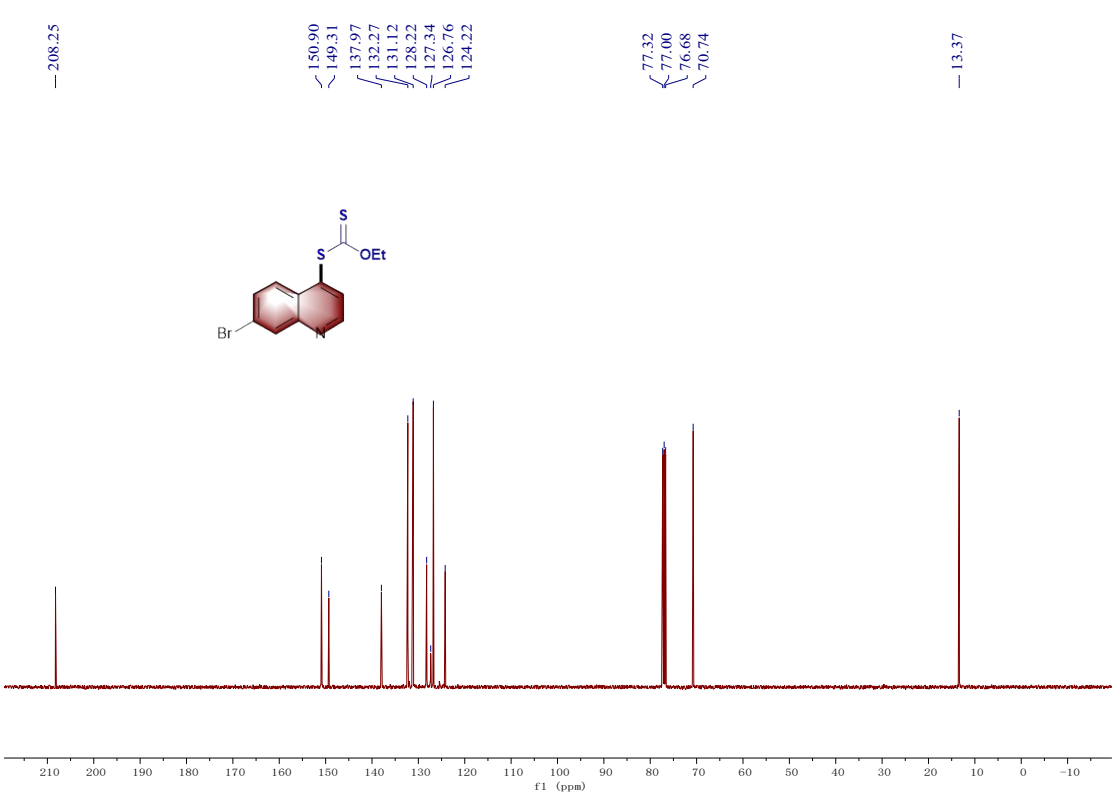
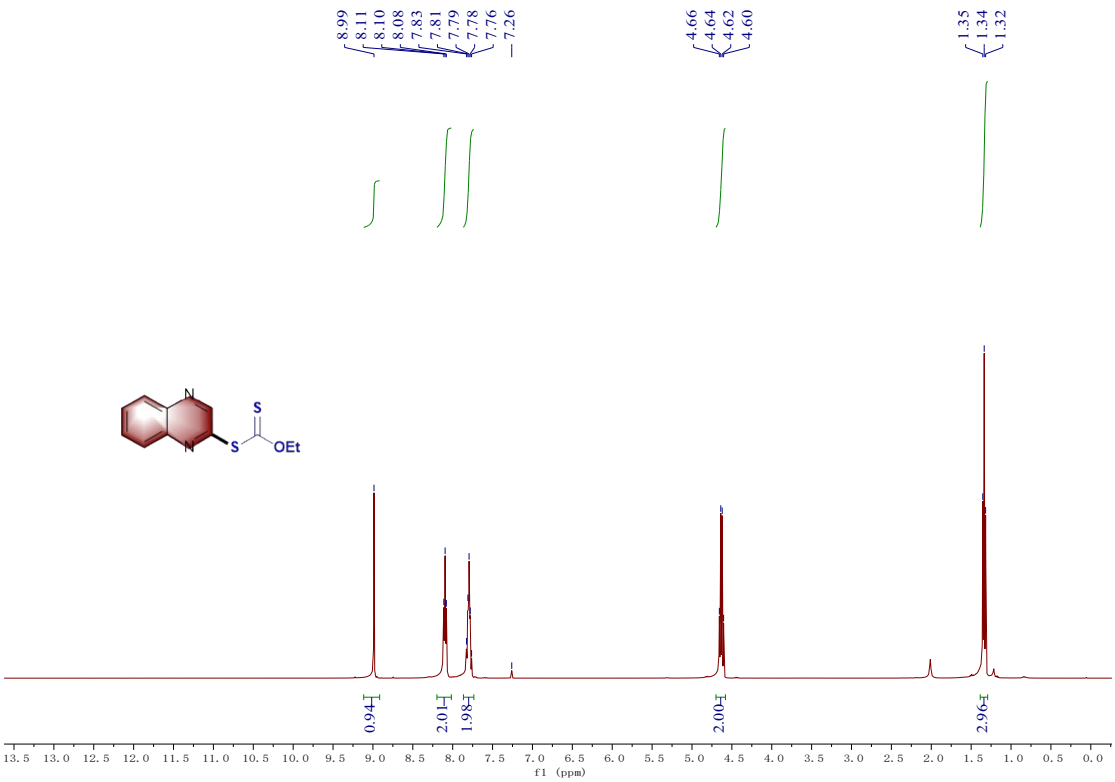


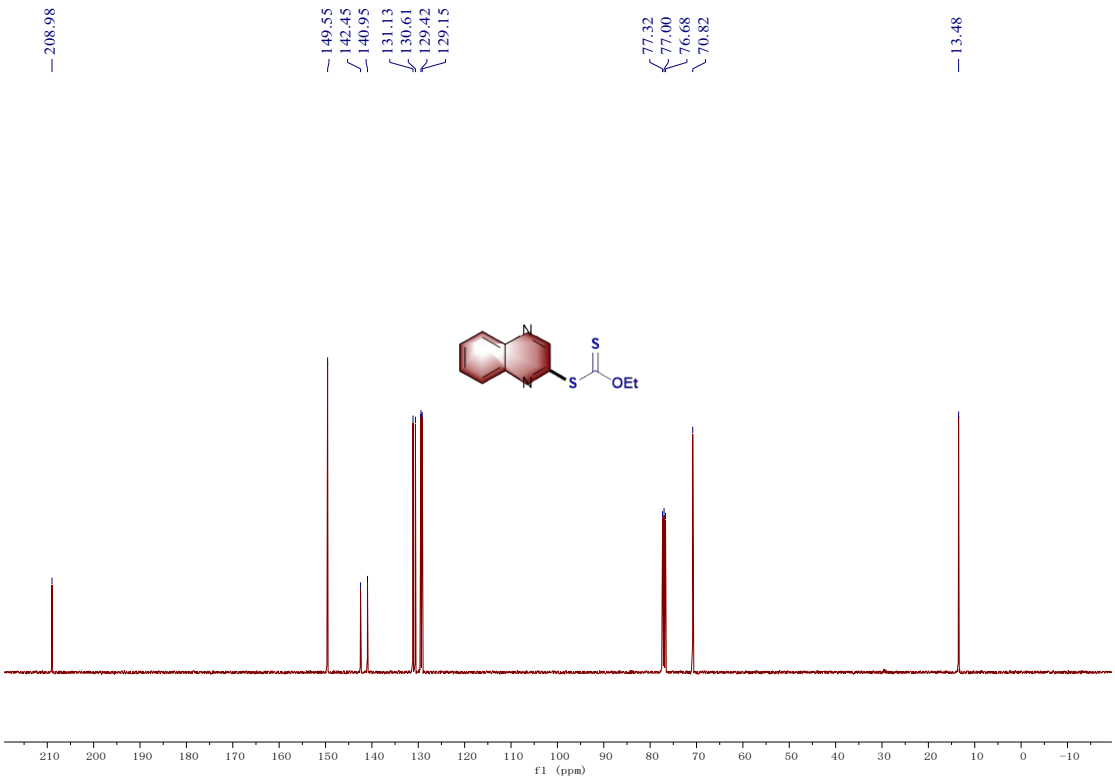
^{1}H spectra of **3xa**



^{13}C spectra of **3xa**



^{1}H spectra of **3ya**



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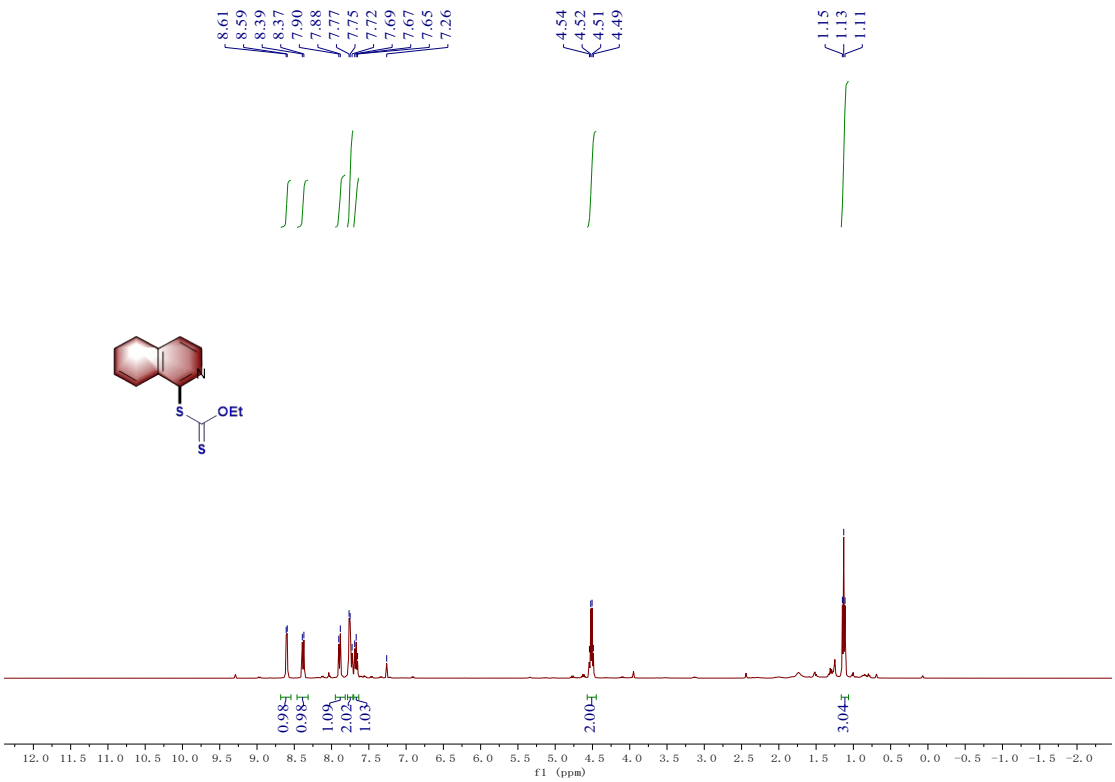

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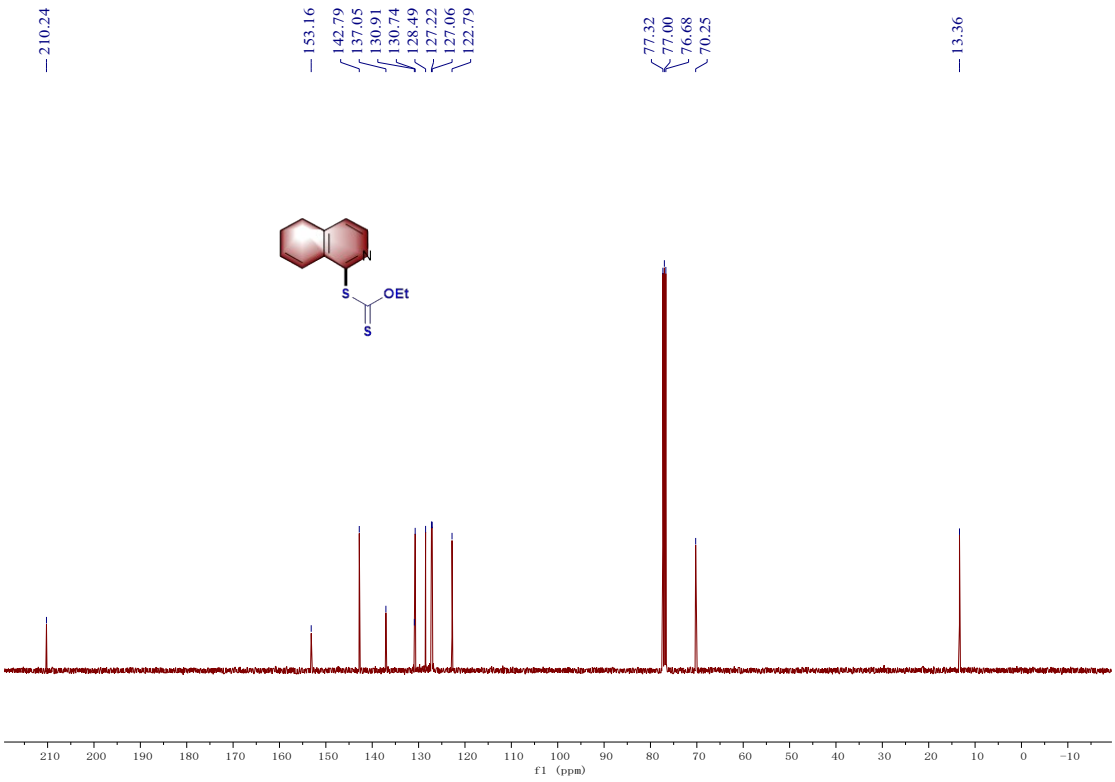

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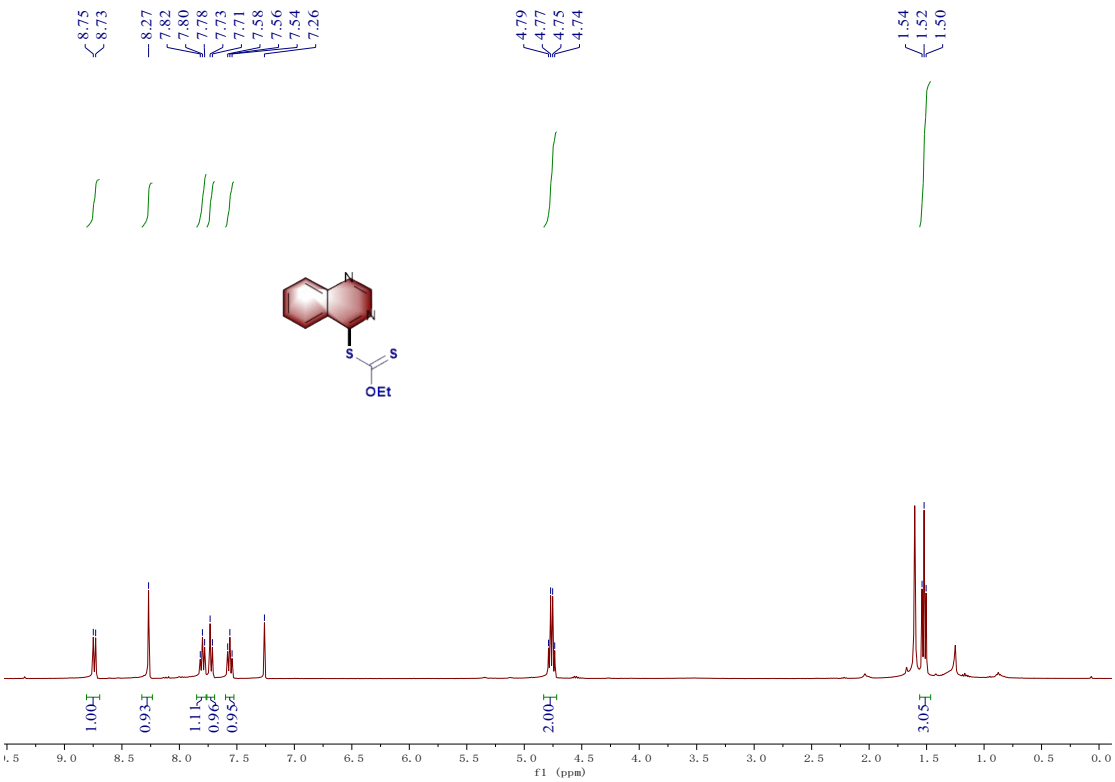

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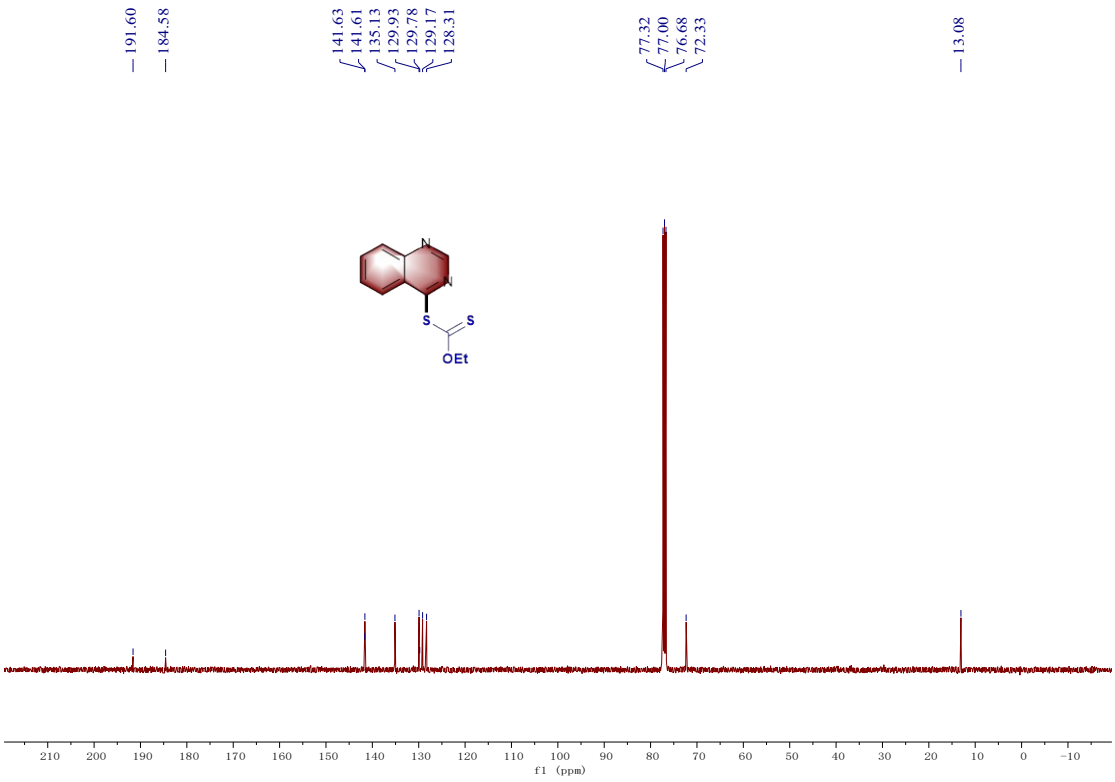

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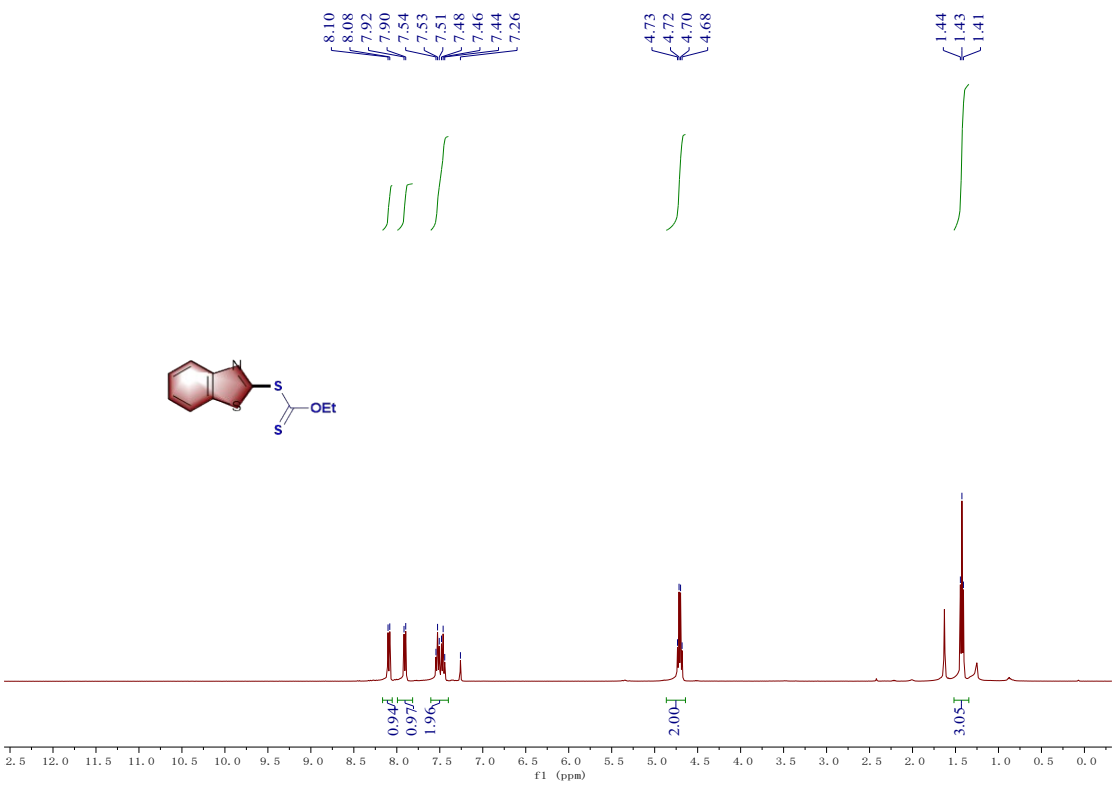

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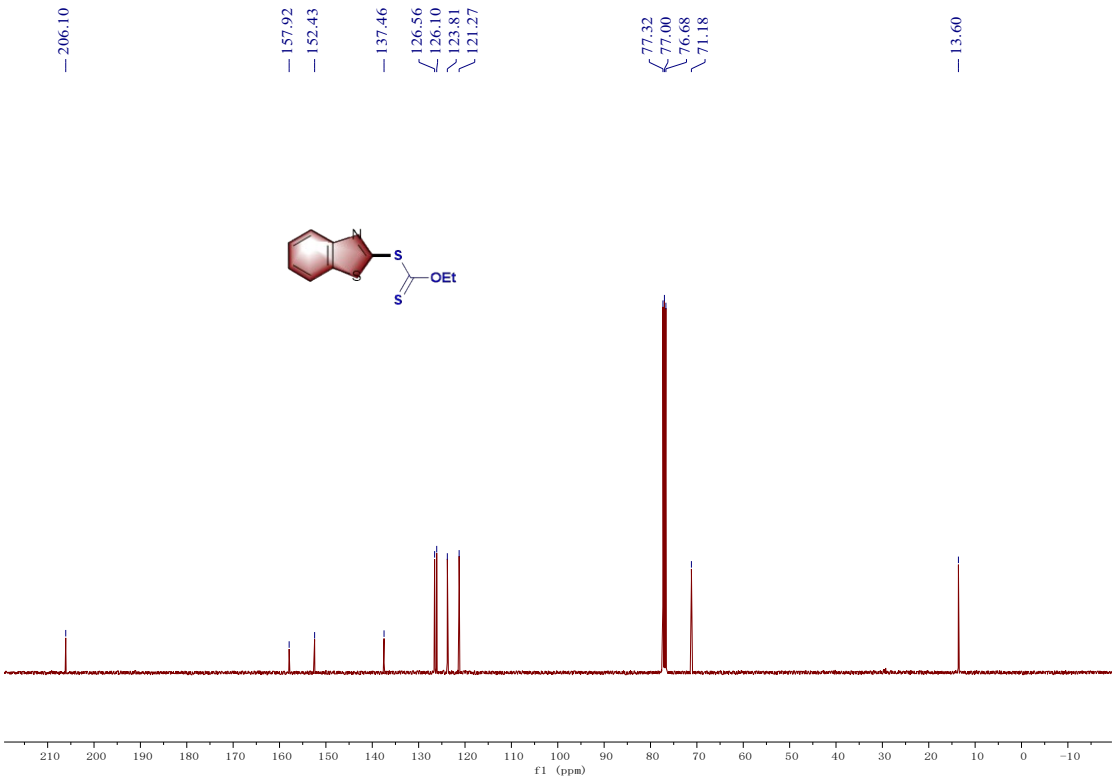

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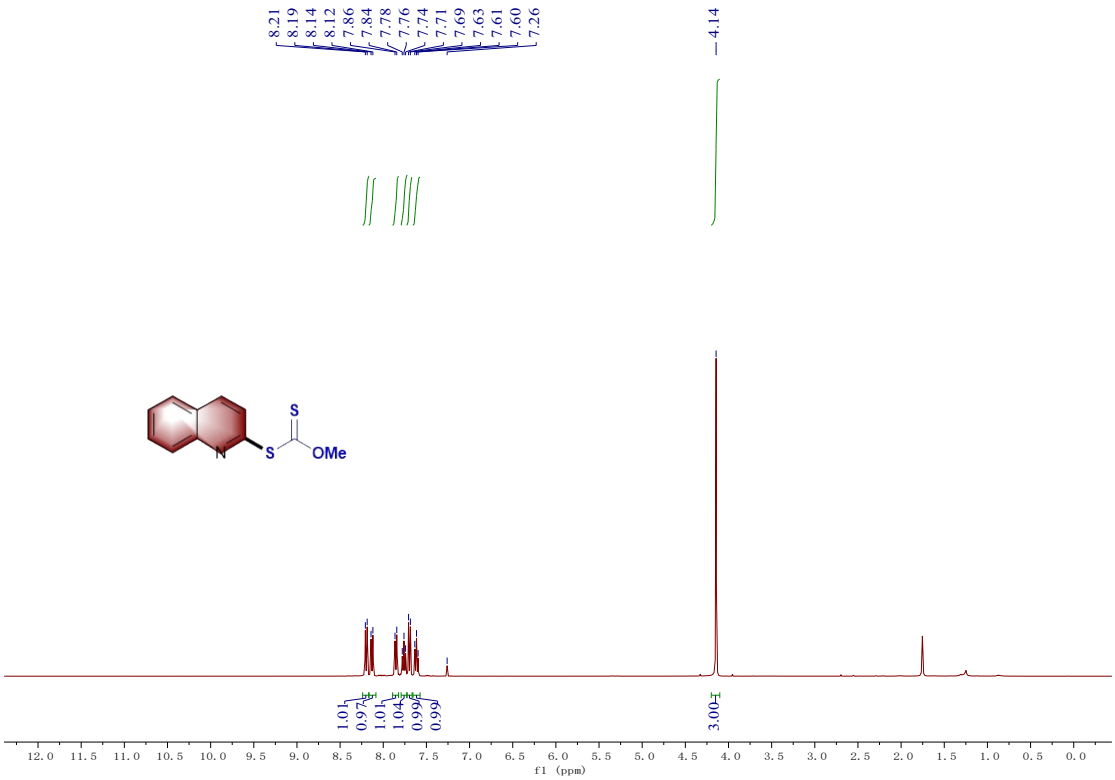

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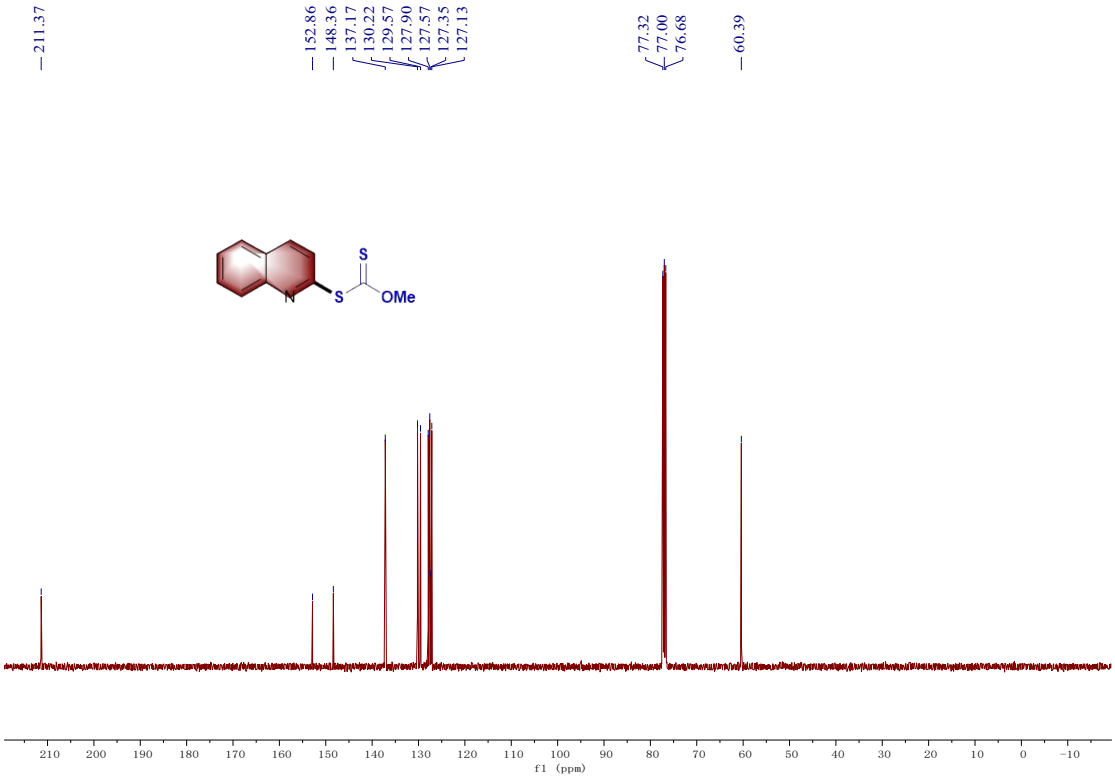
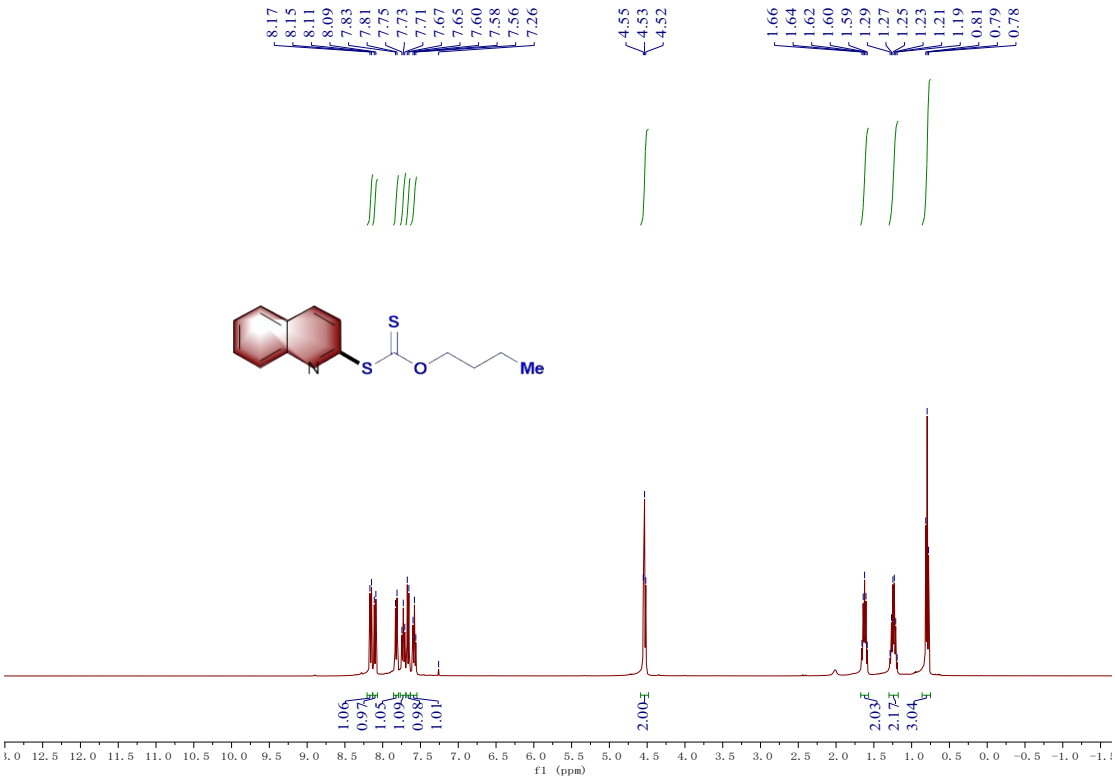


^{13}C spectra of **3ab**



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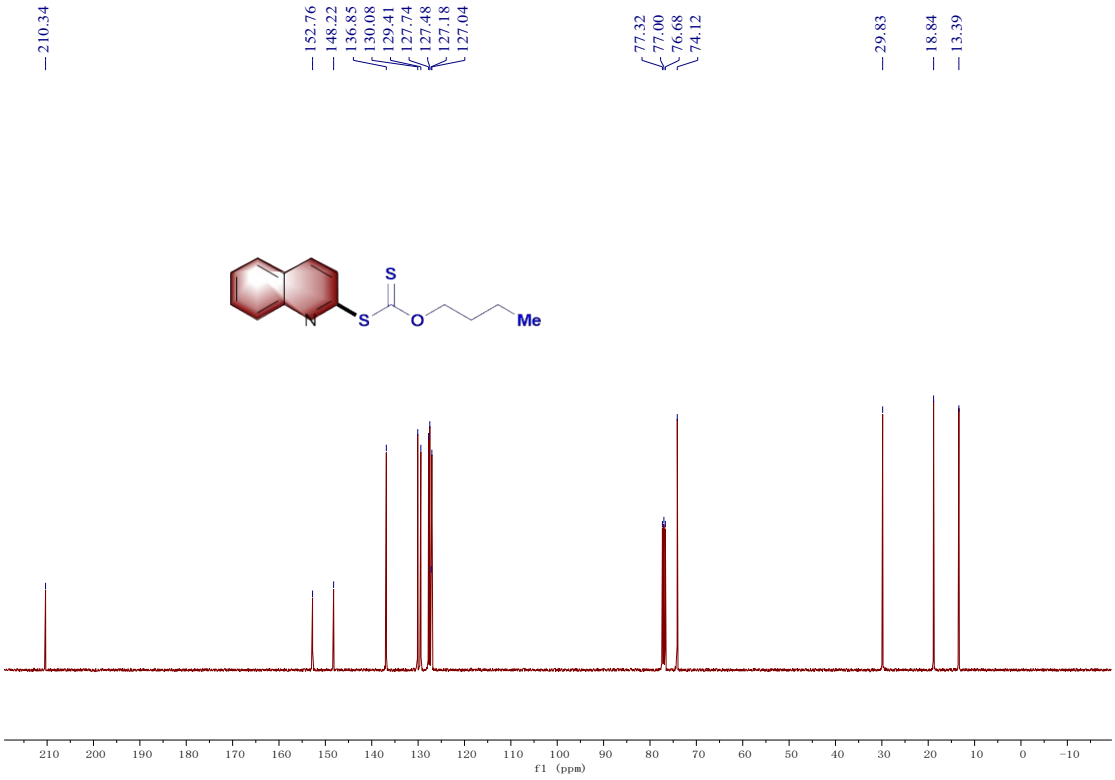
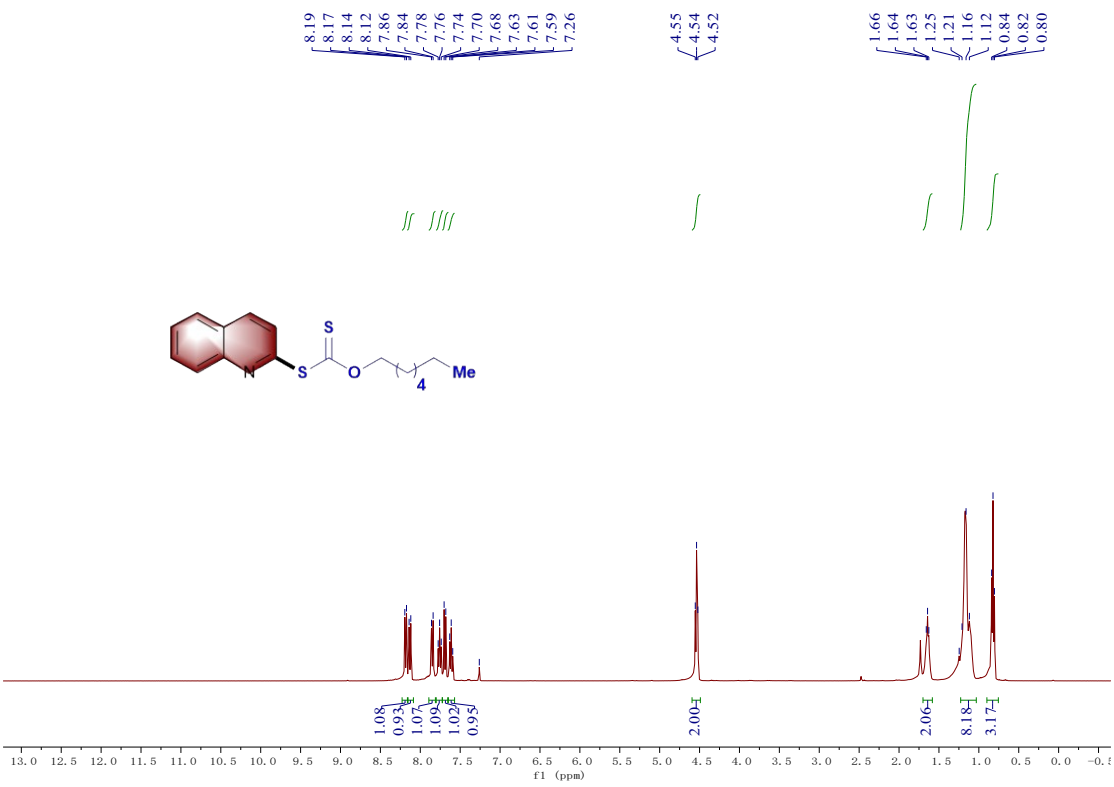


^{13}C spectra of **3ac**



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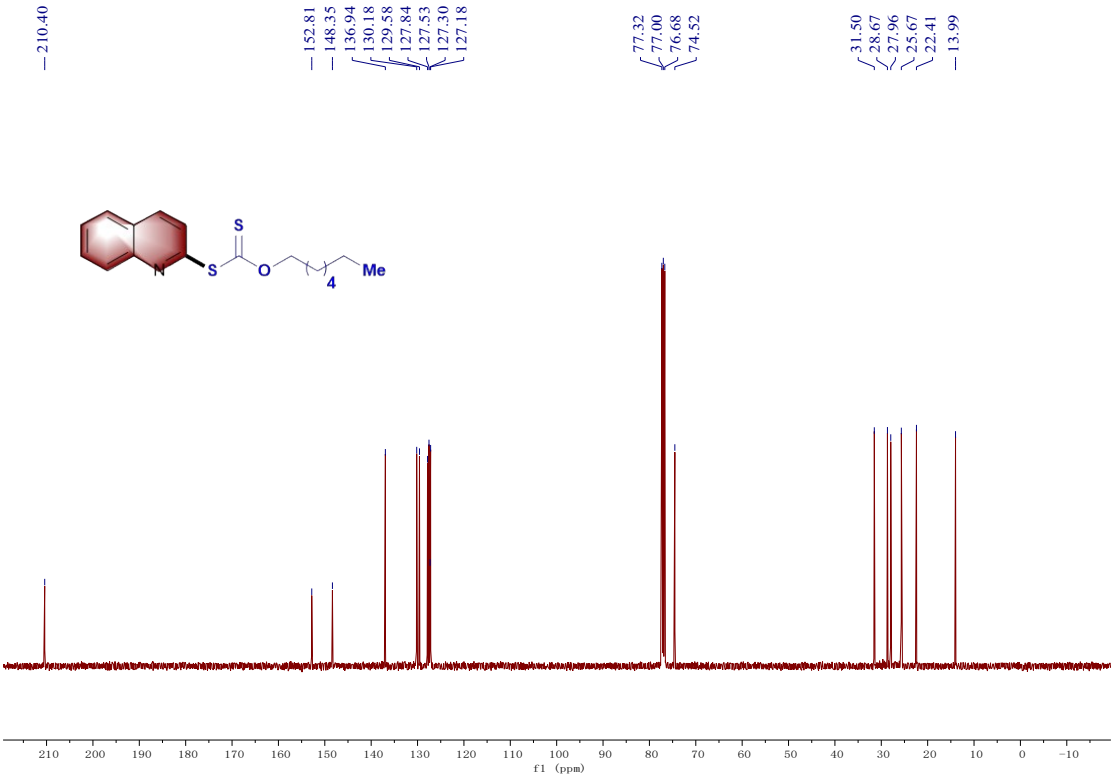

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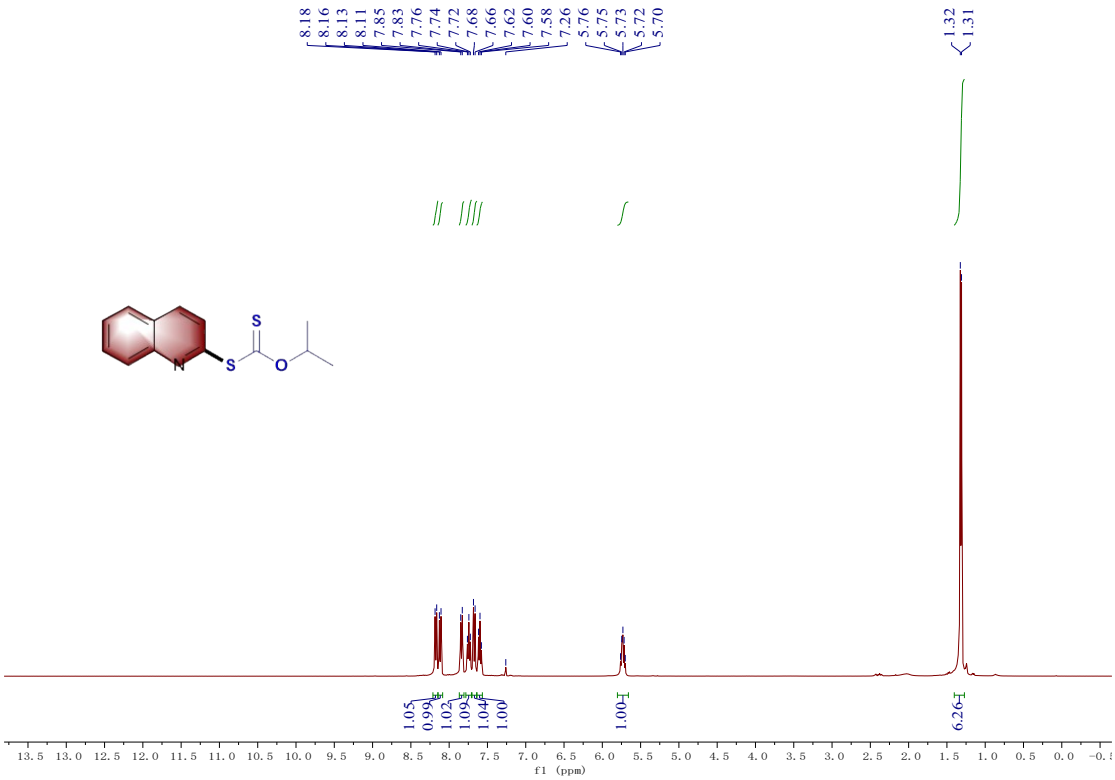

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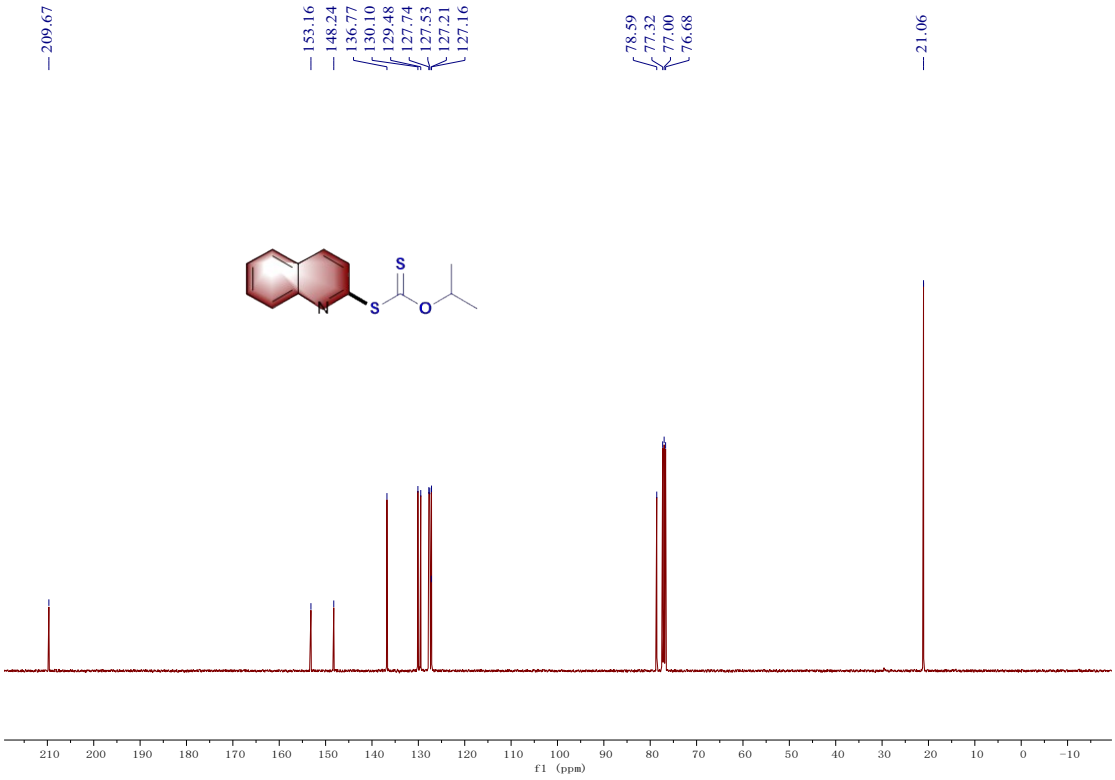

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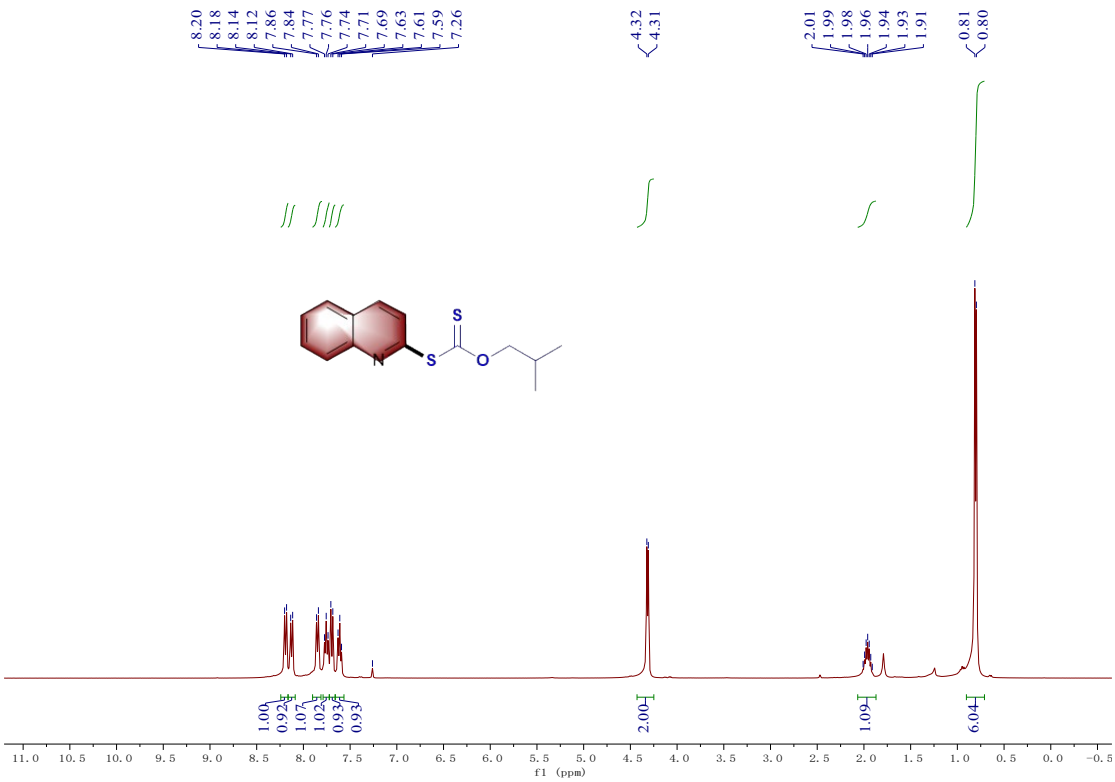

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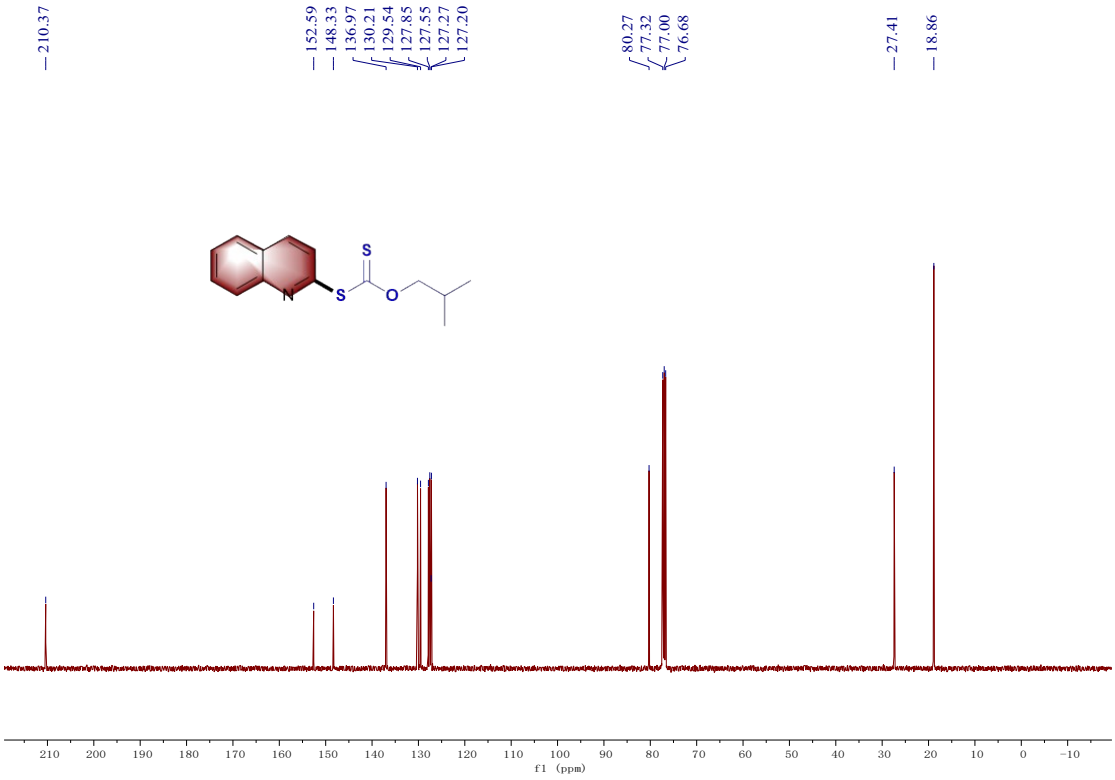

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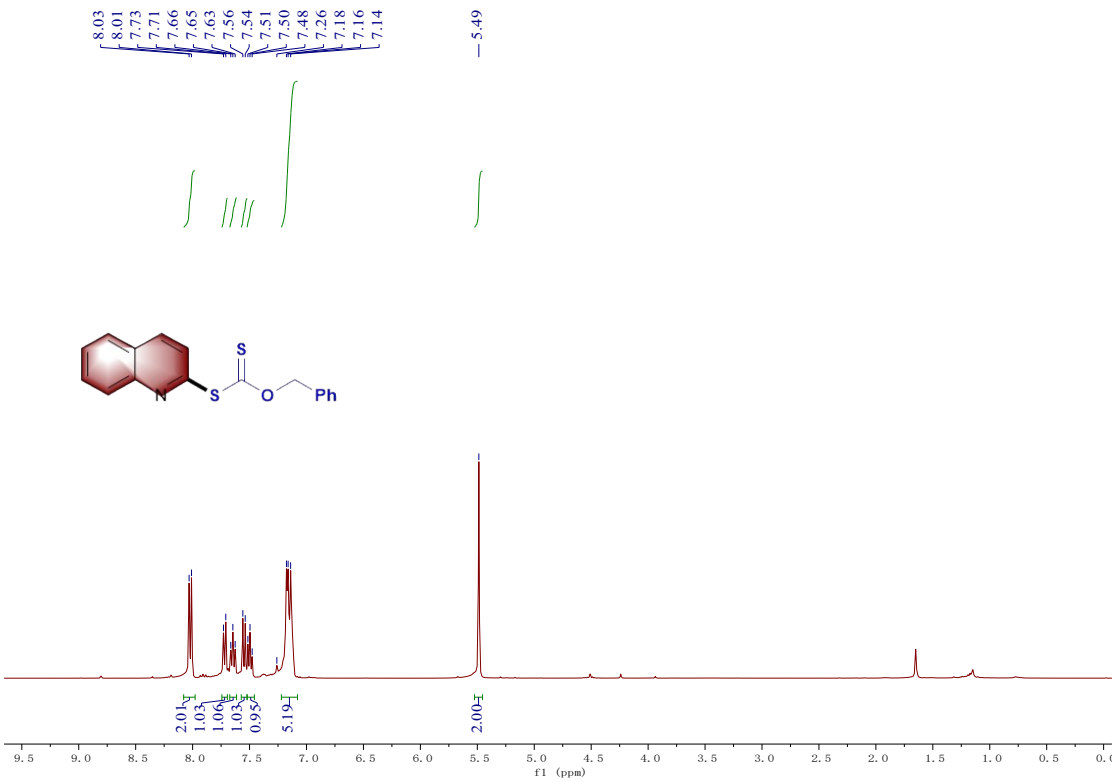

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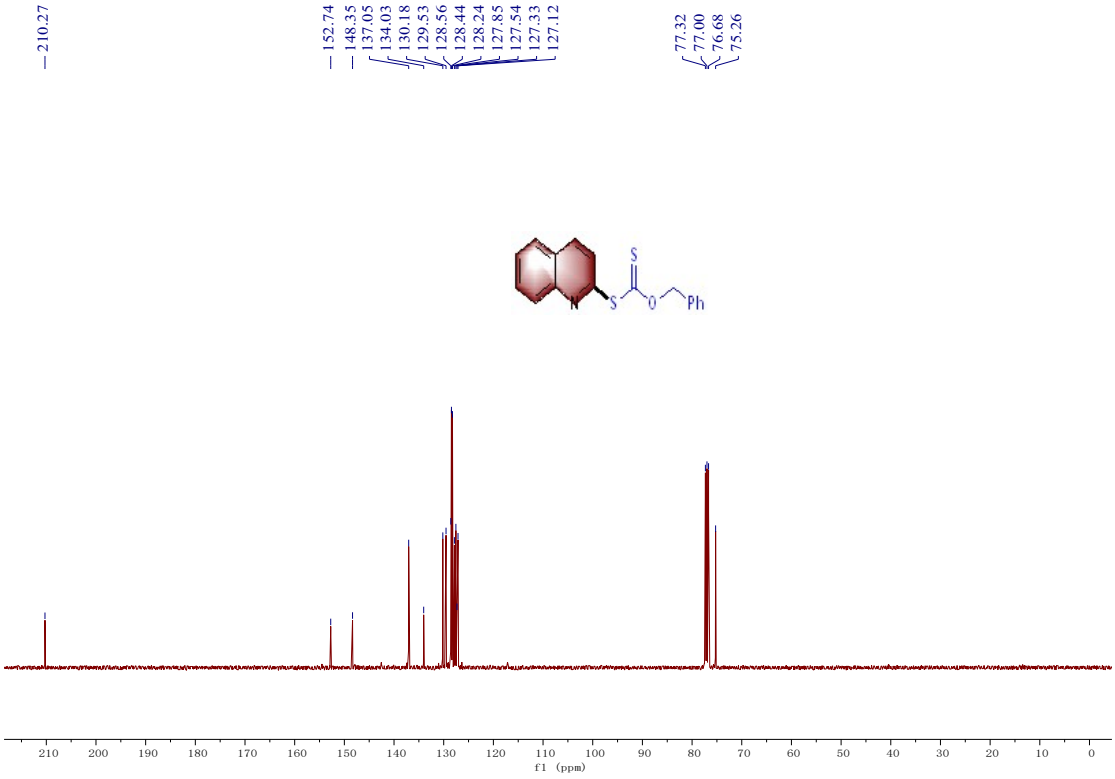

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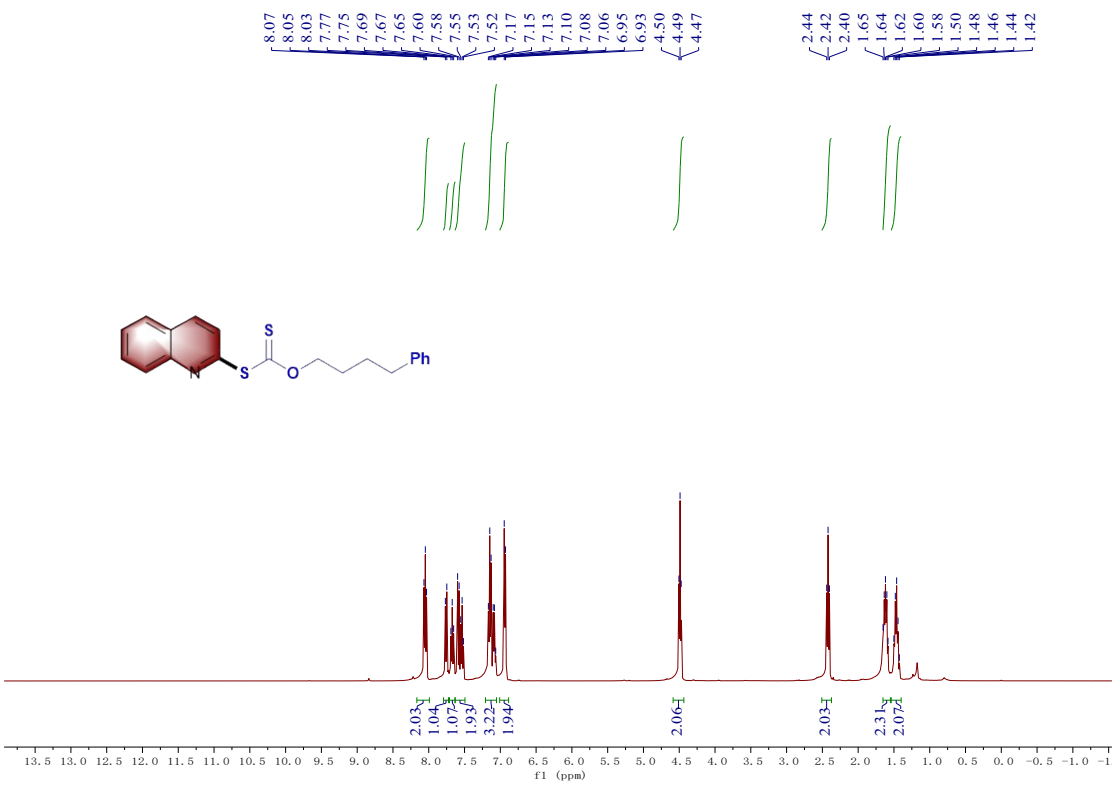

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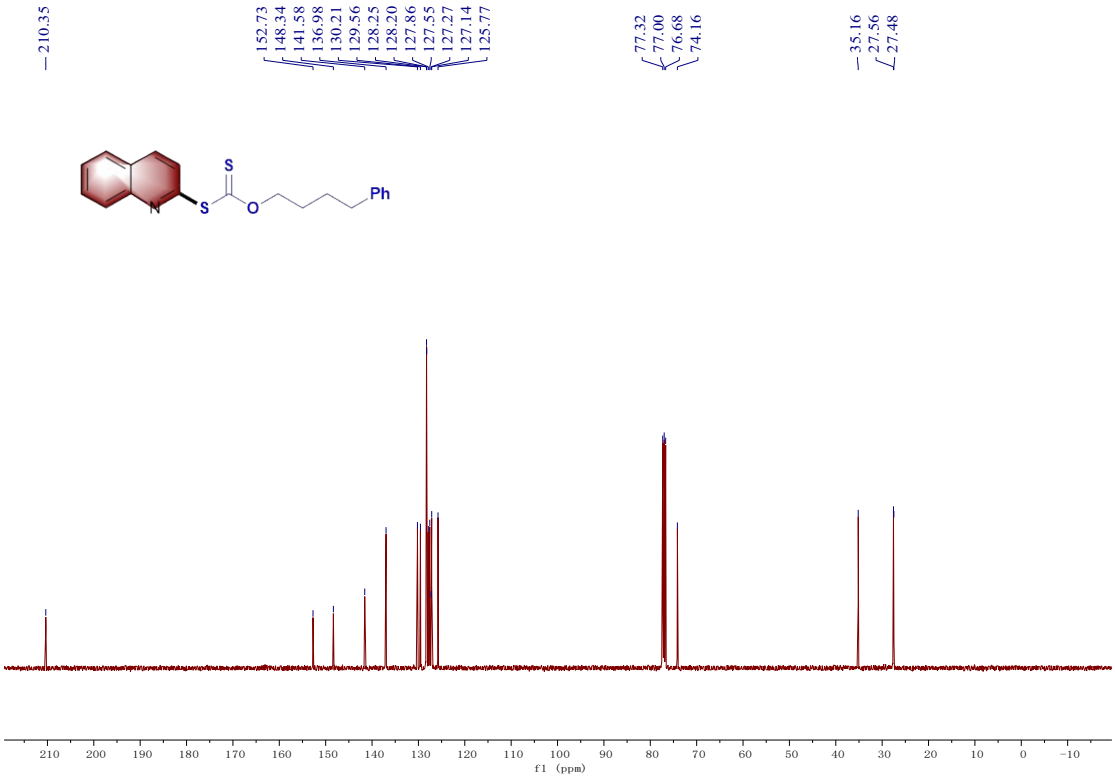

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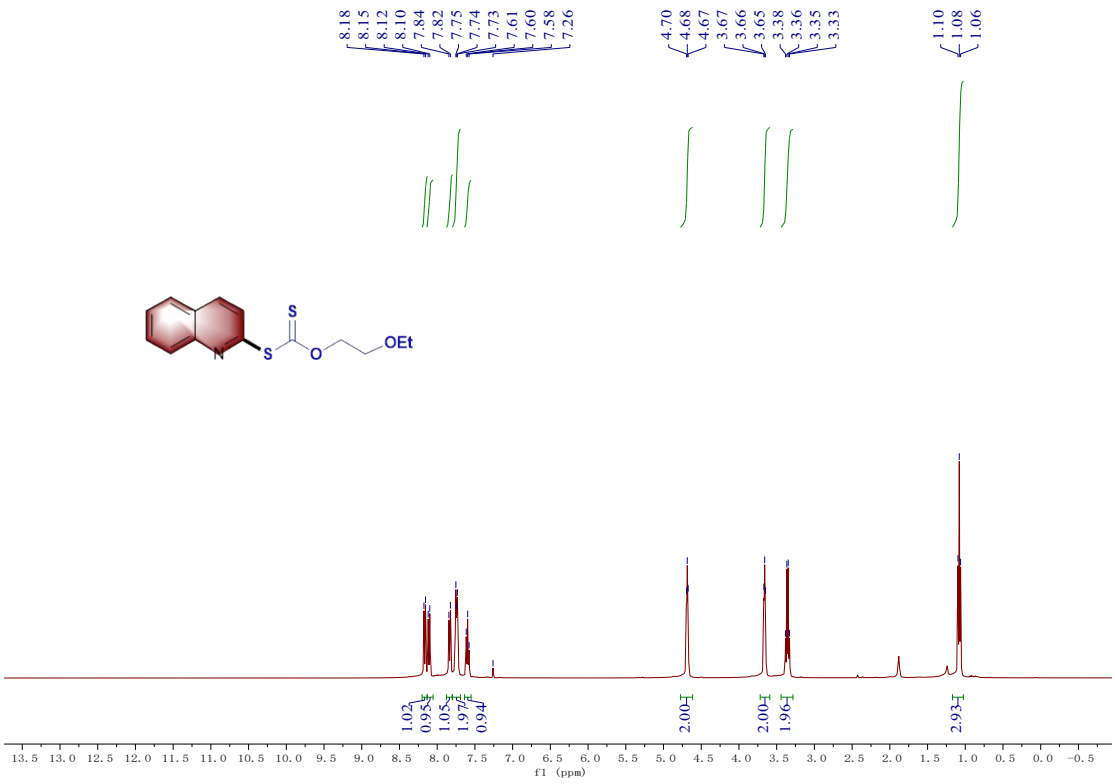

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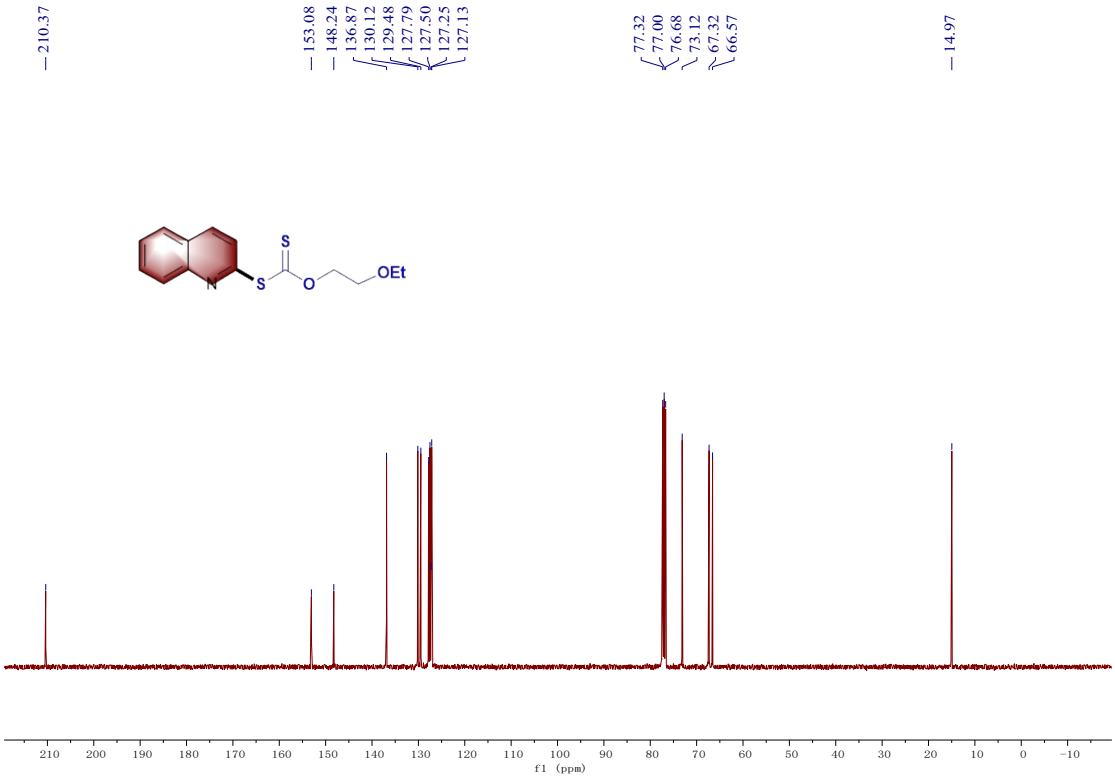

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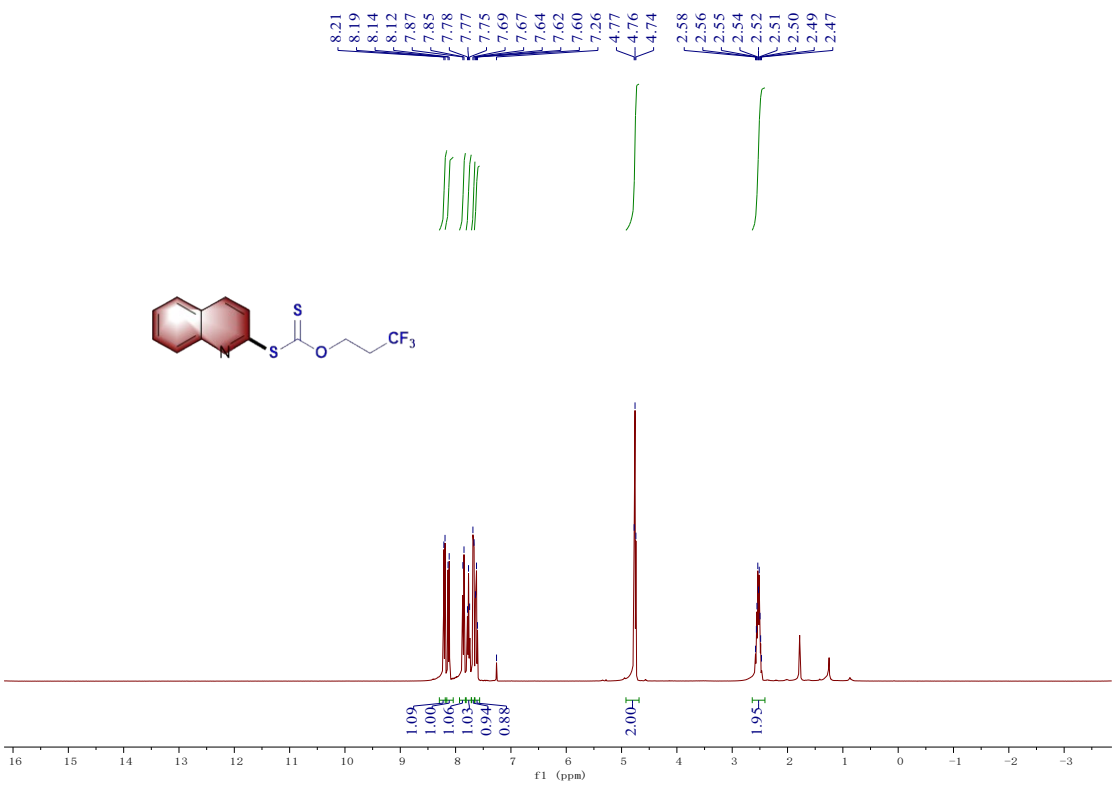

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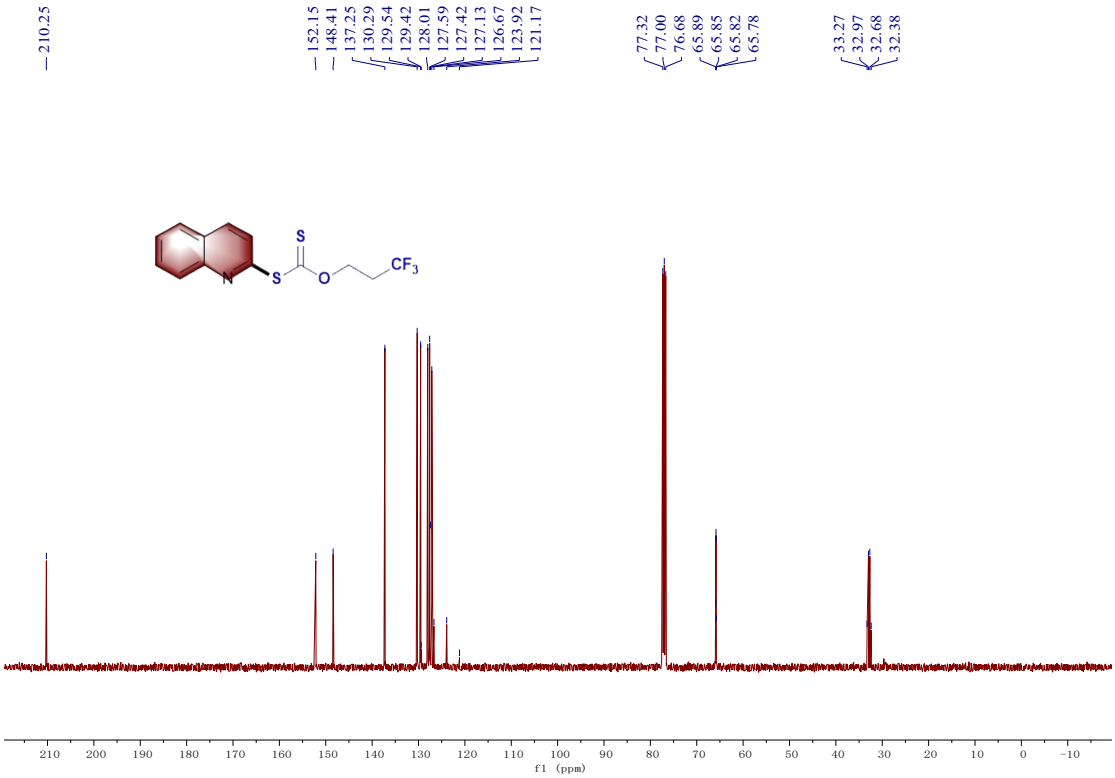

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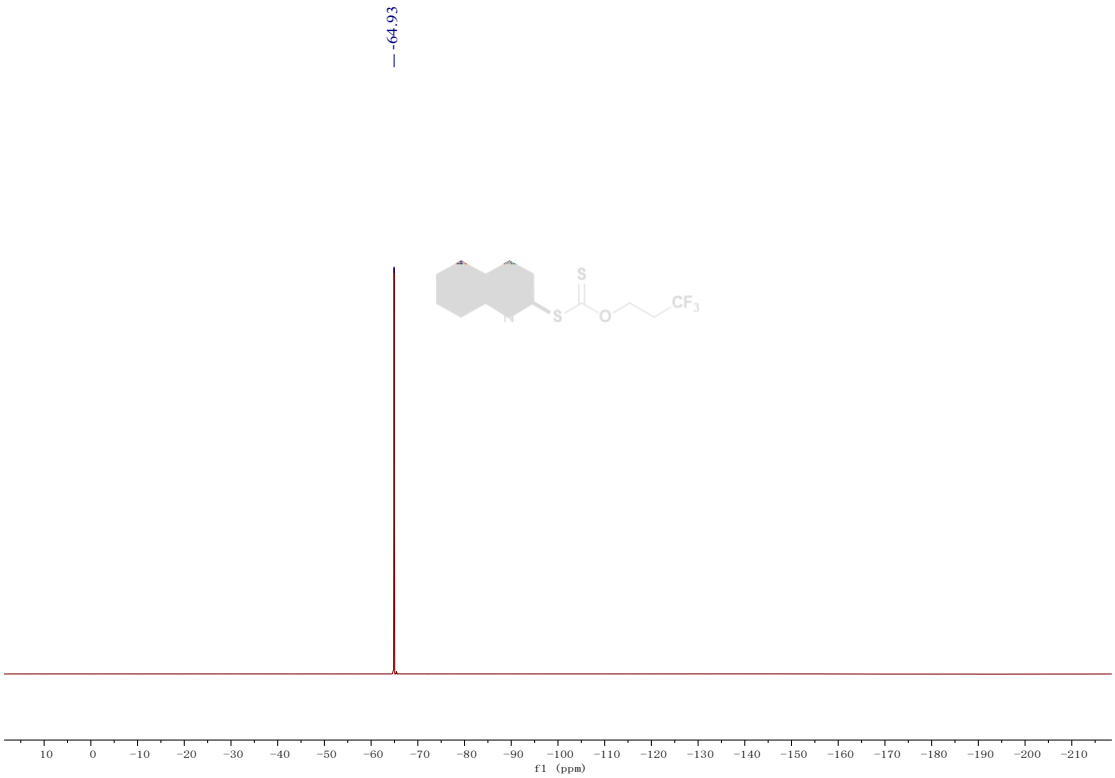

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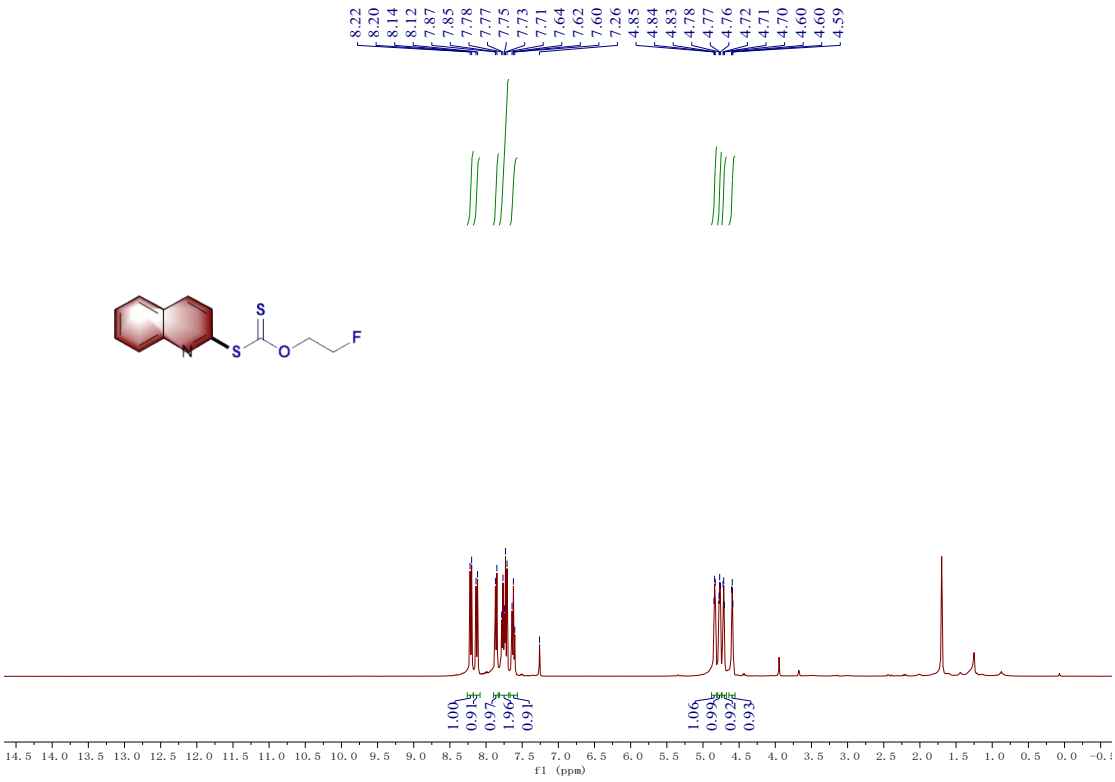

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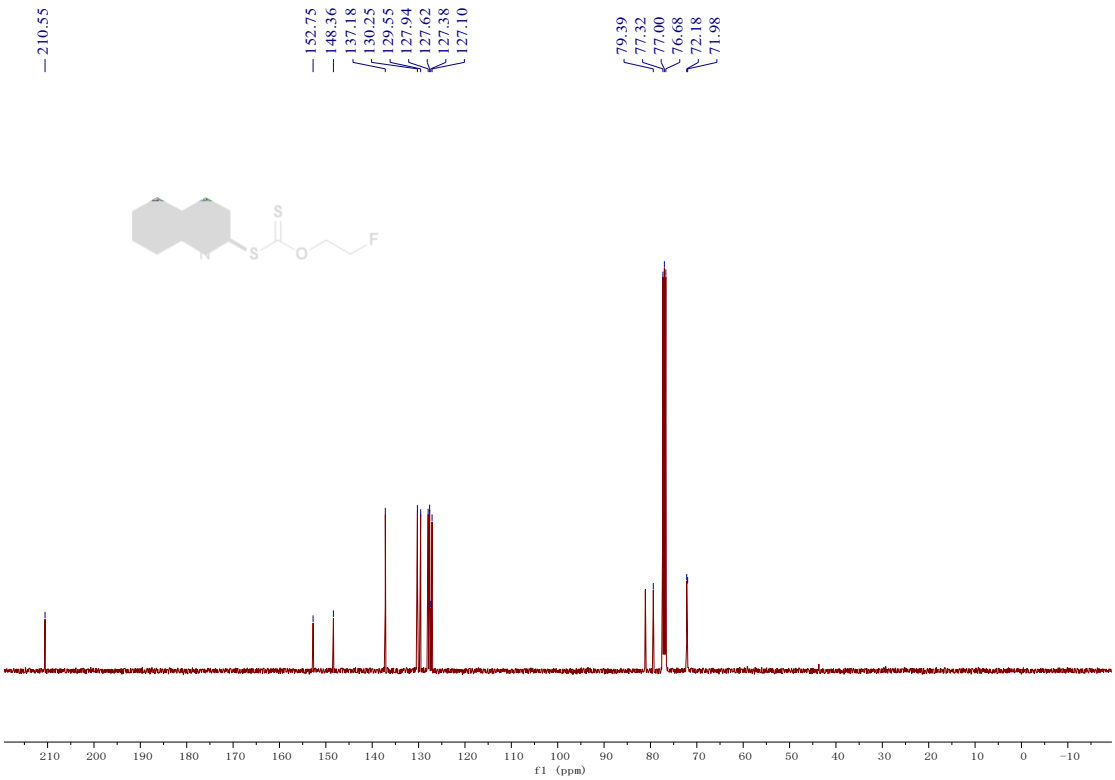
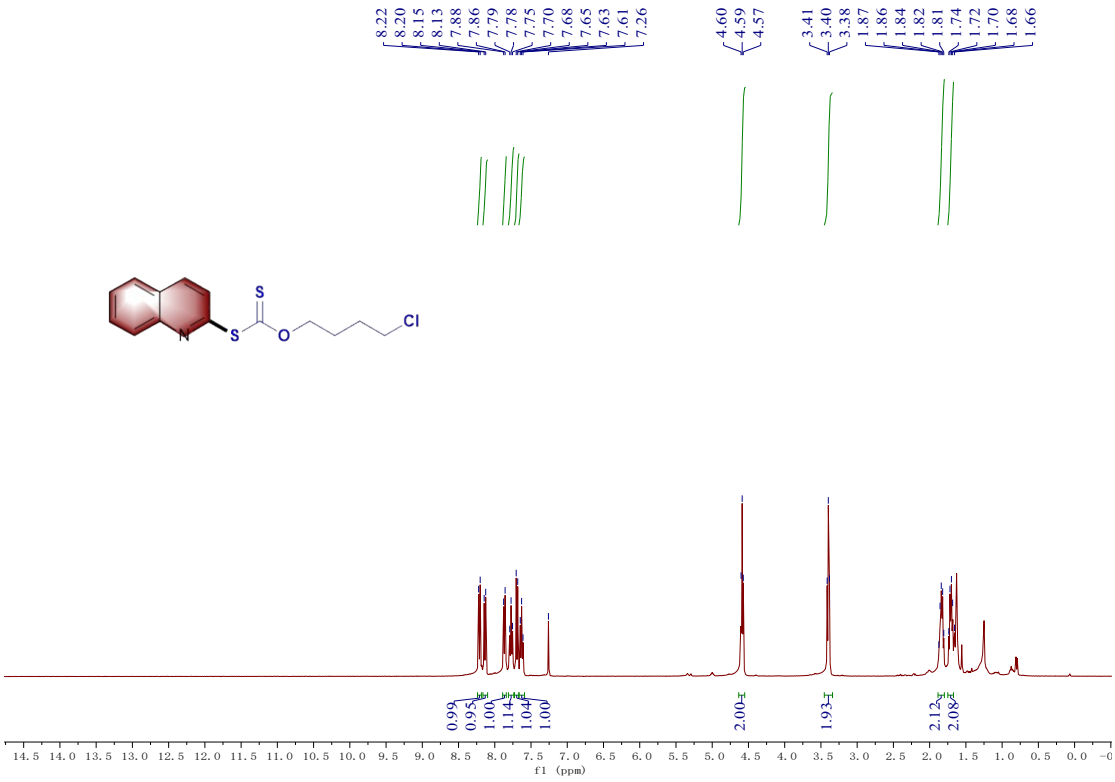
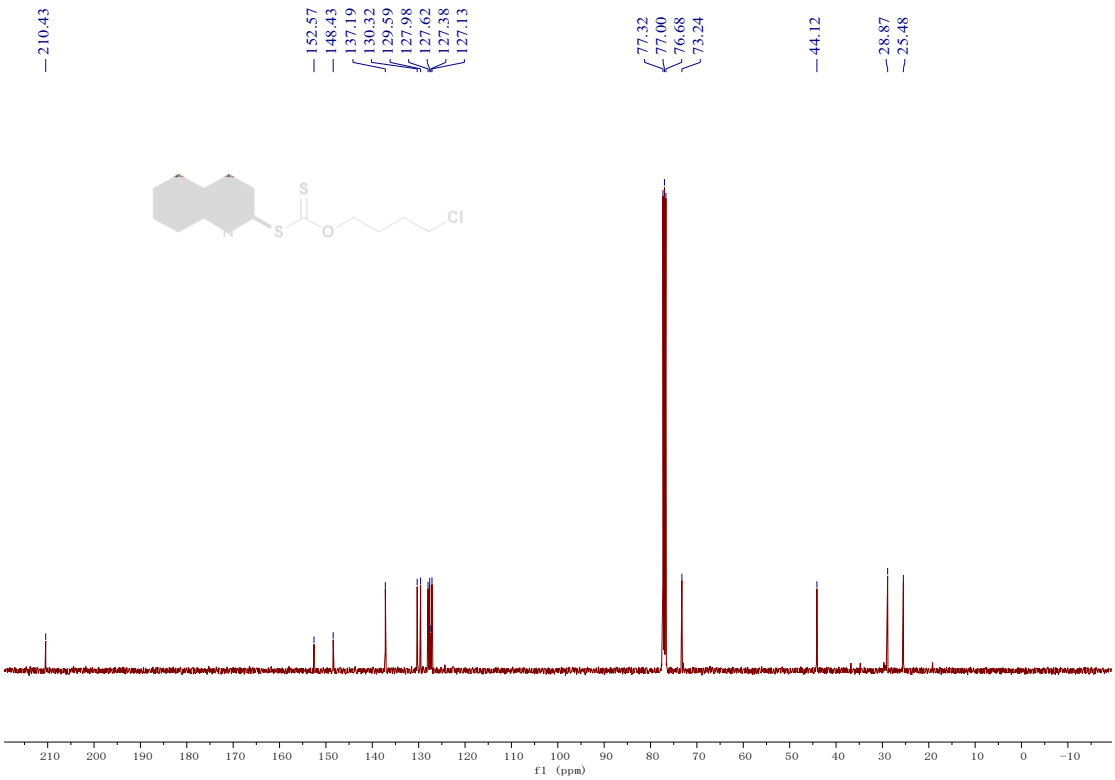


^{13}C spectra of **3ak**



^{1}H spectra of **3al**



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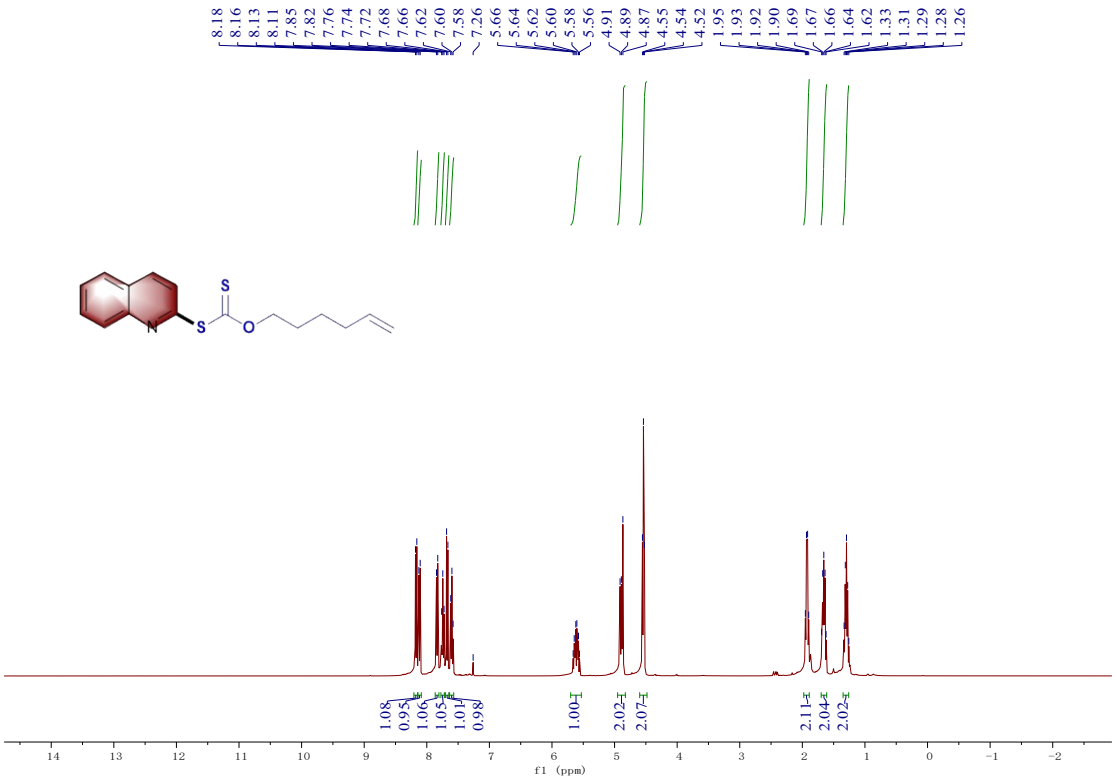
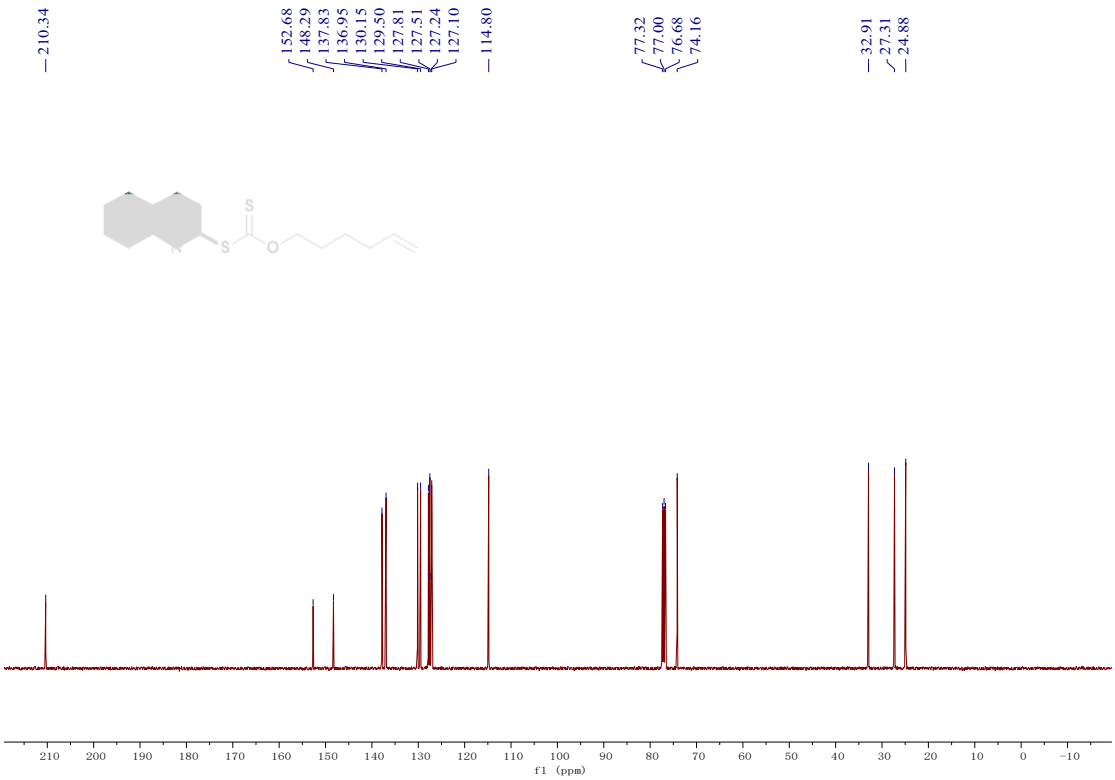
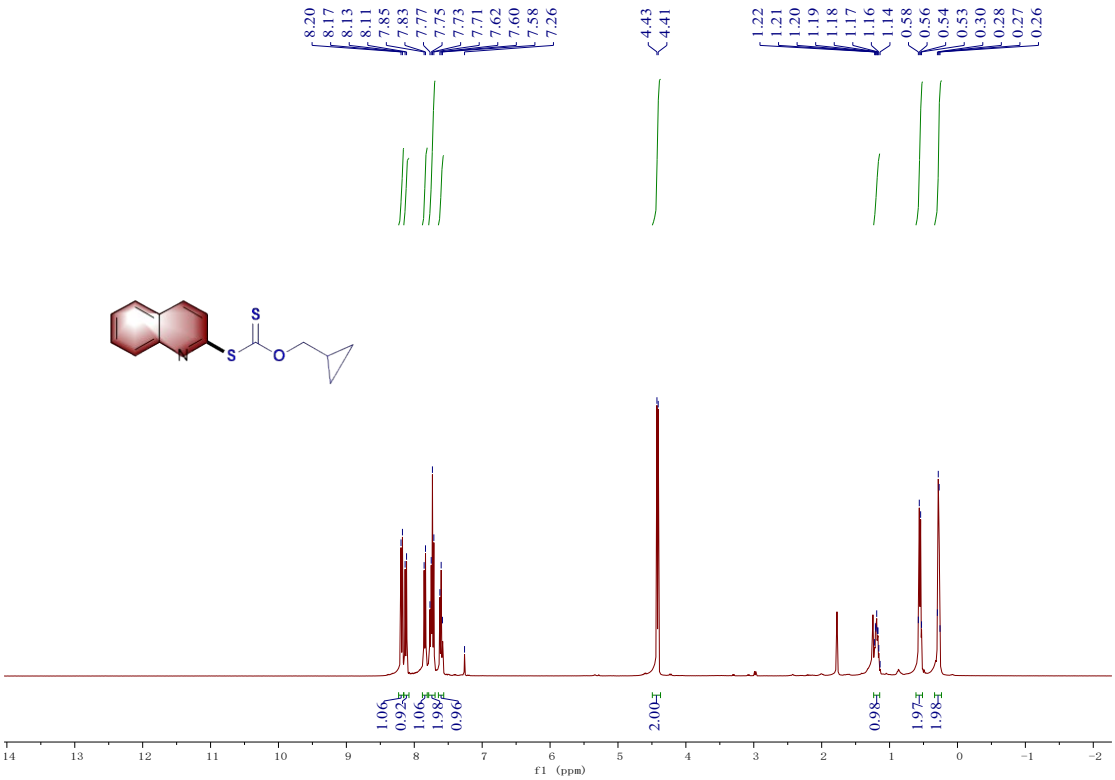


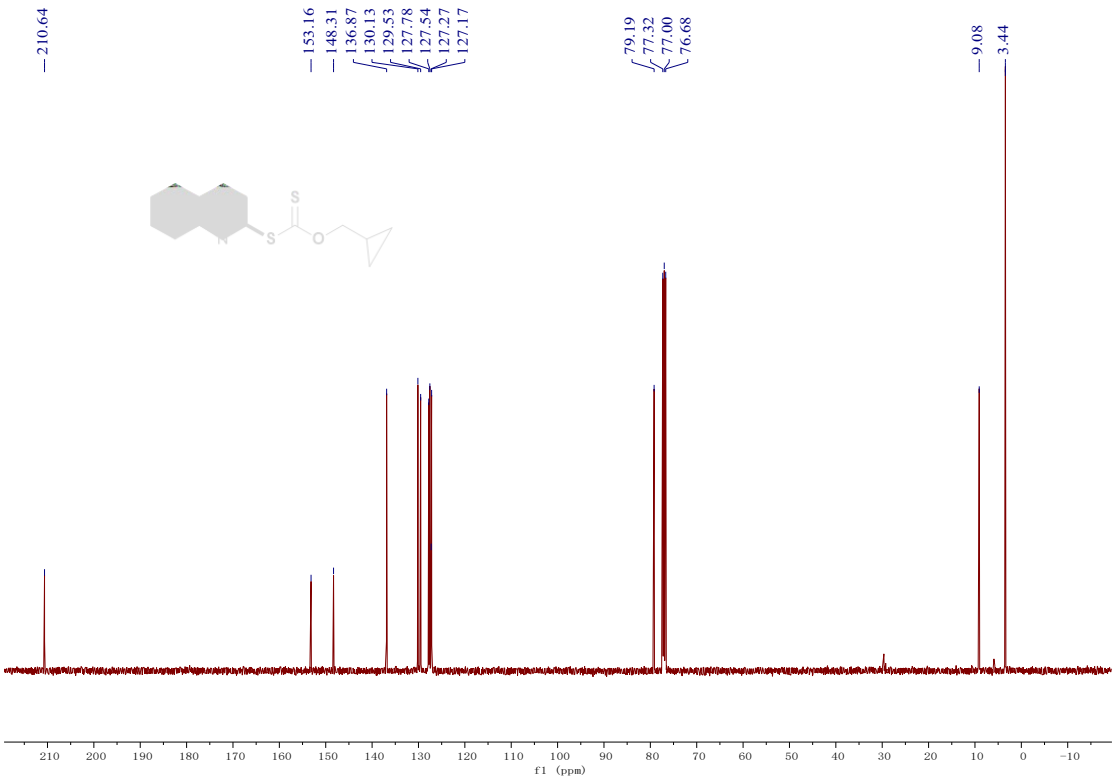
^{1}H spectra of **3am**



^{13}C spectra of **3am**



^{1}H spectra of **3an**



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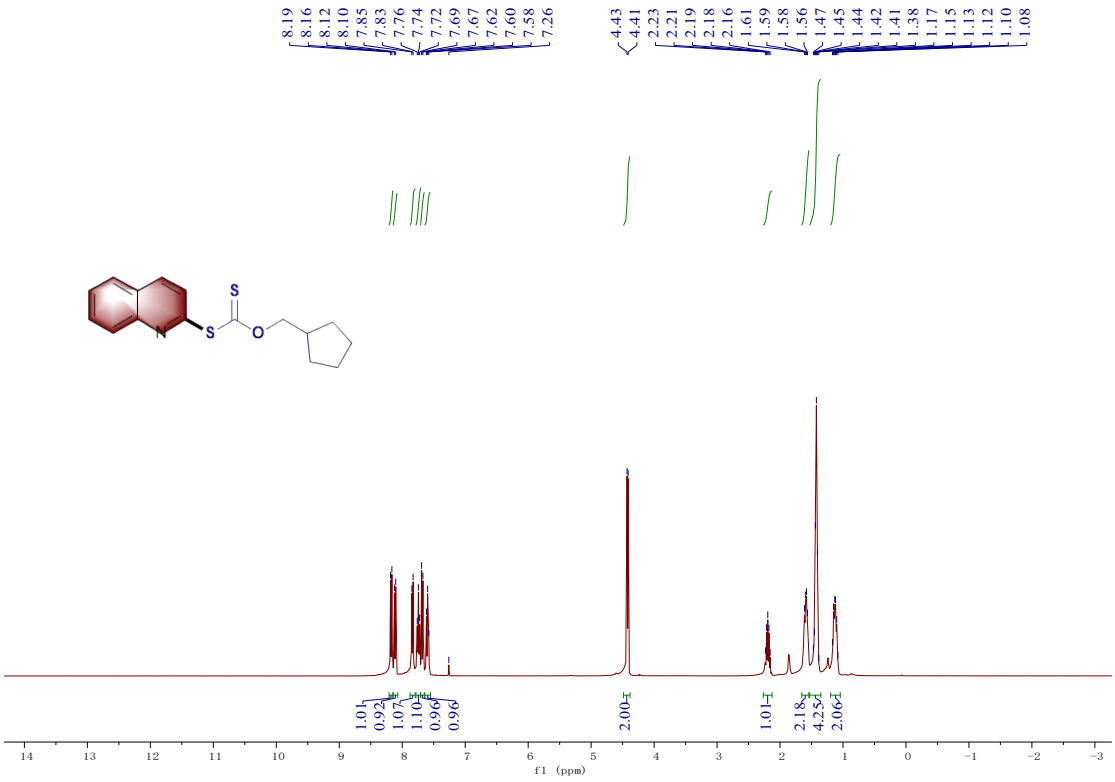
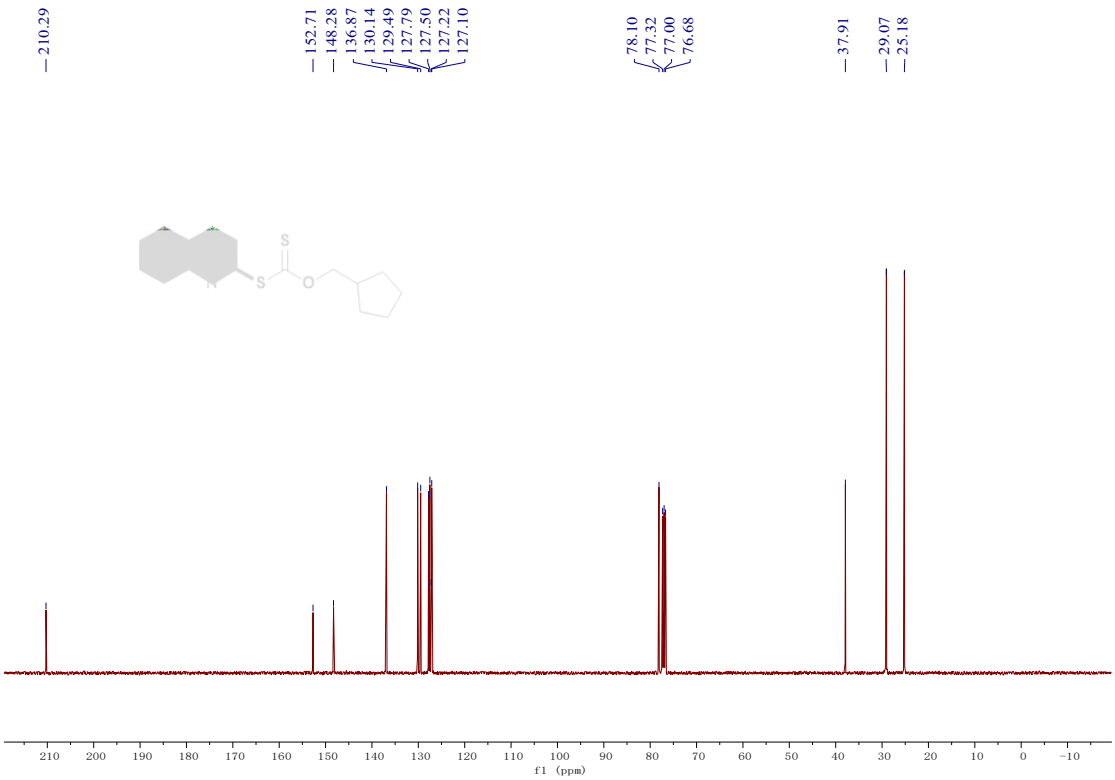
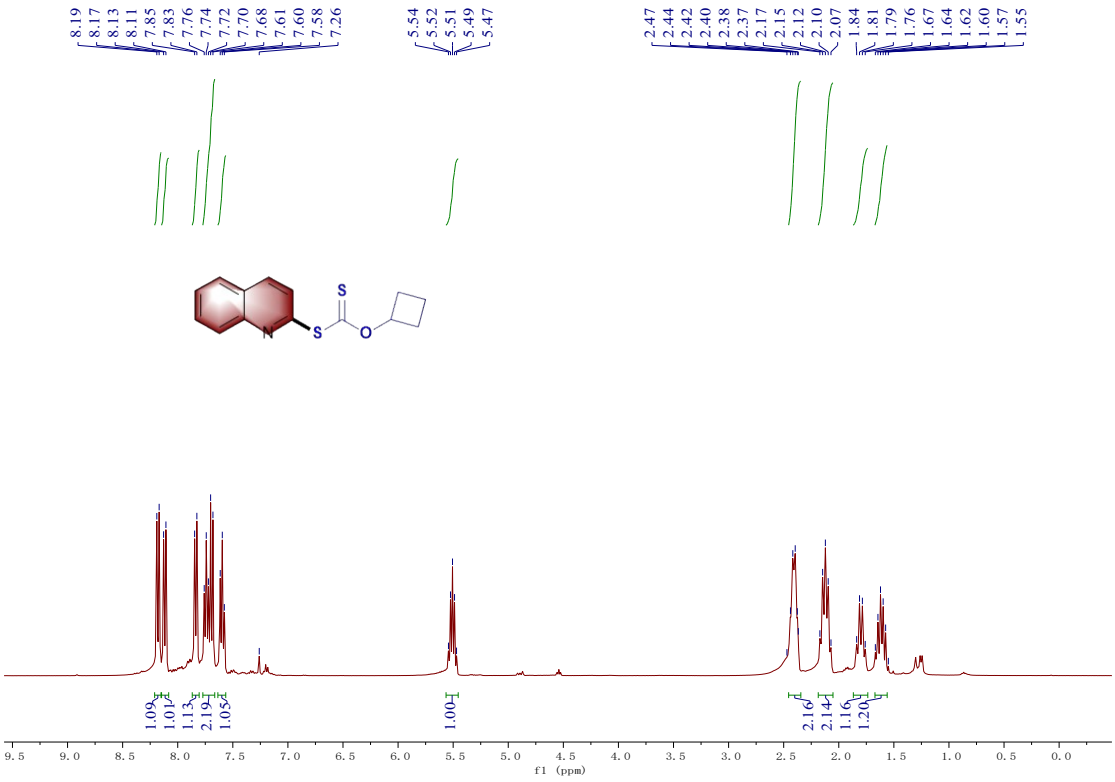


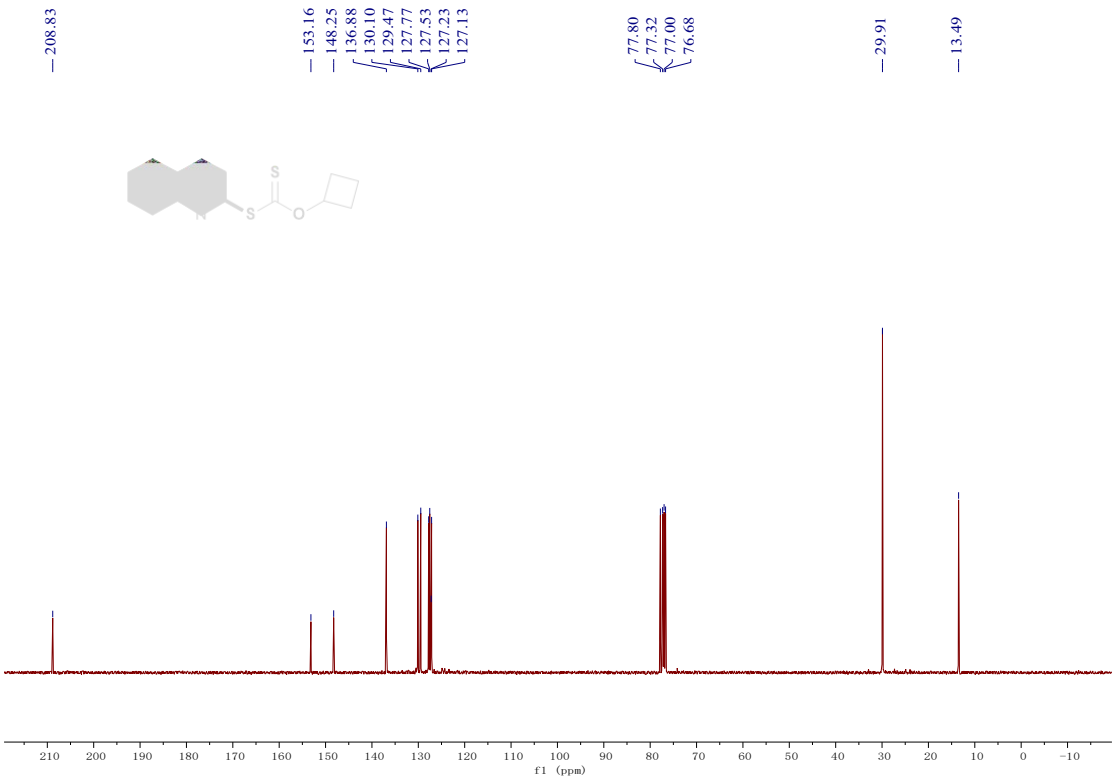
^{1}H spectra of **3ao**



^{13}C spectra of **3ao**



^{1}H spectra of **3ap**



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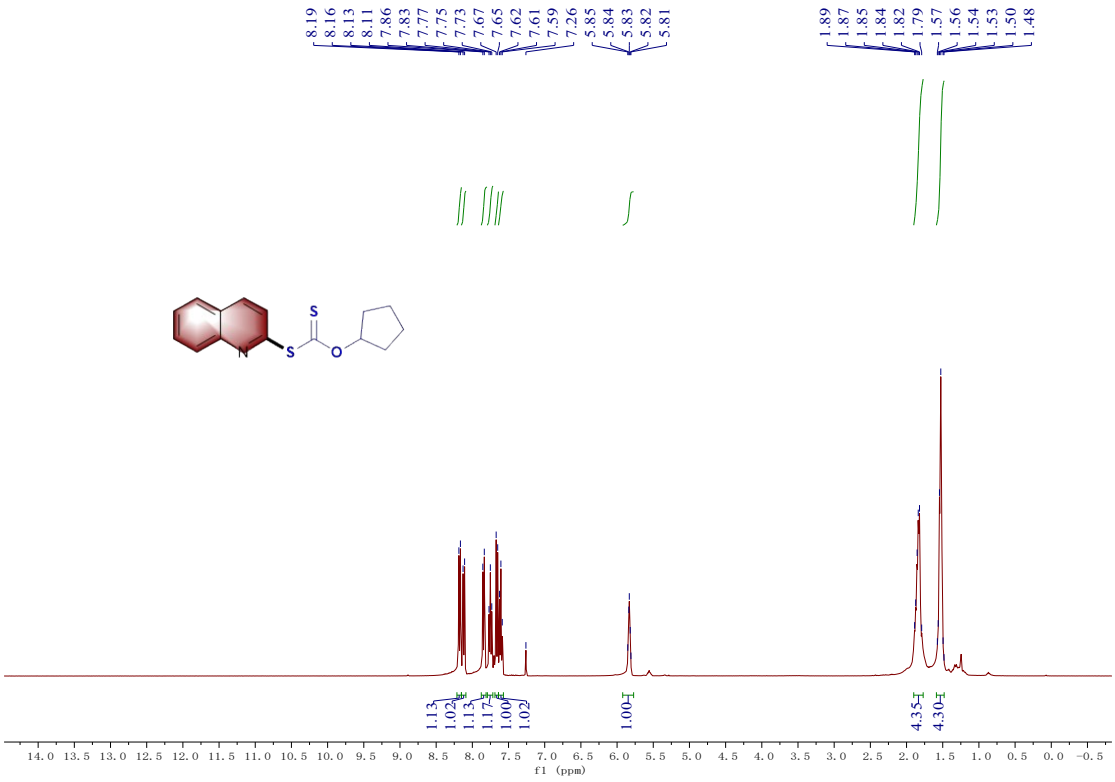
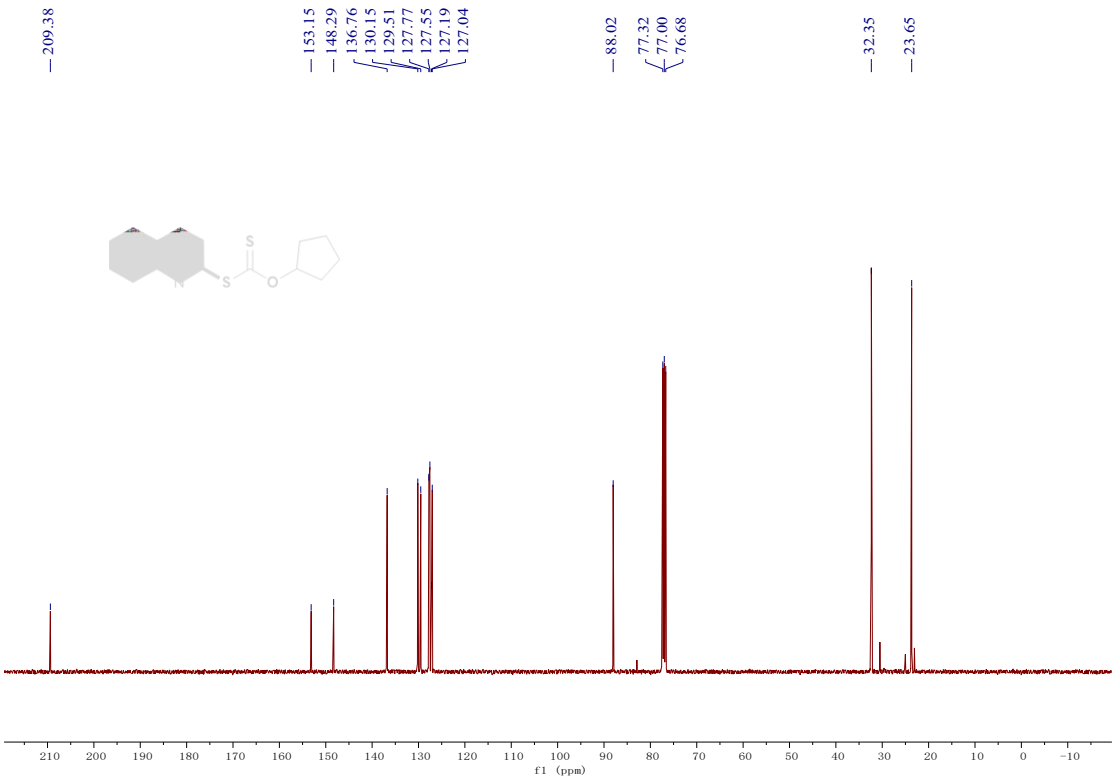
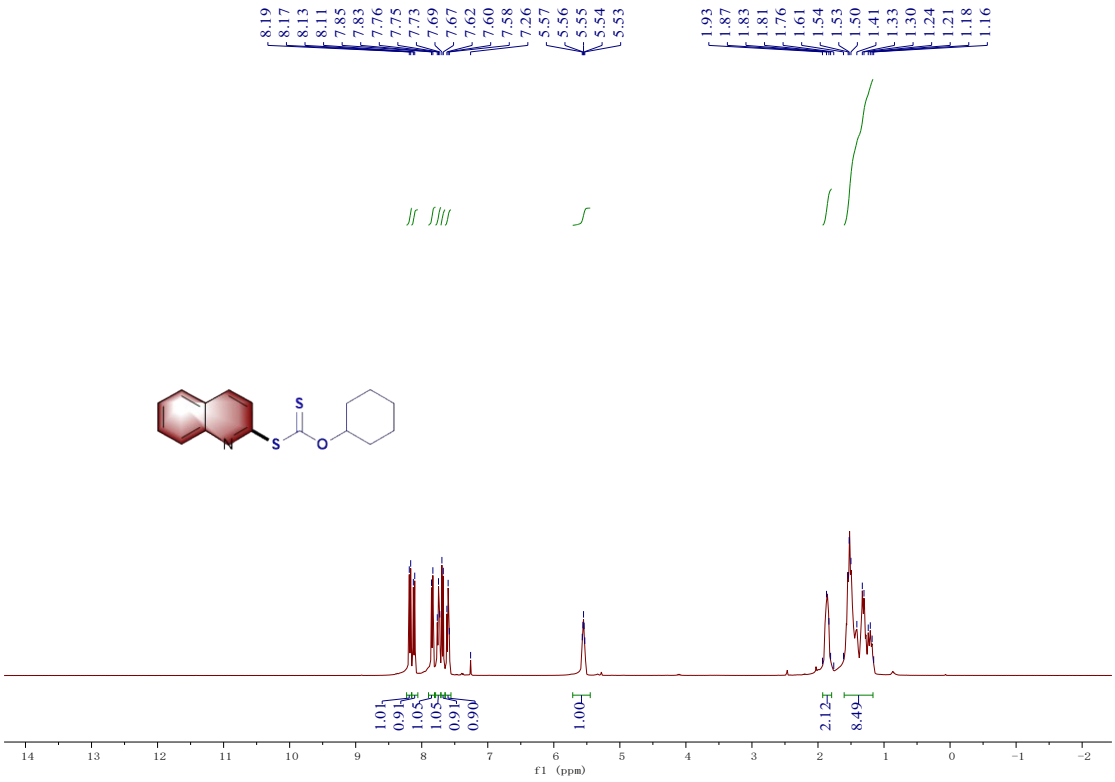


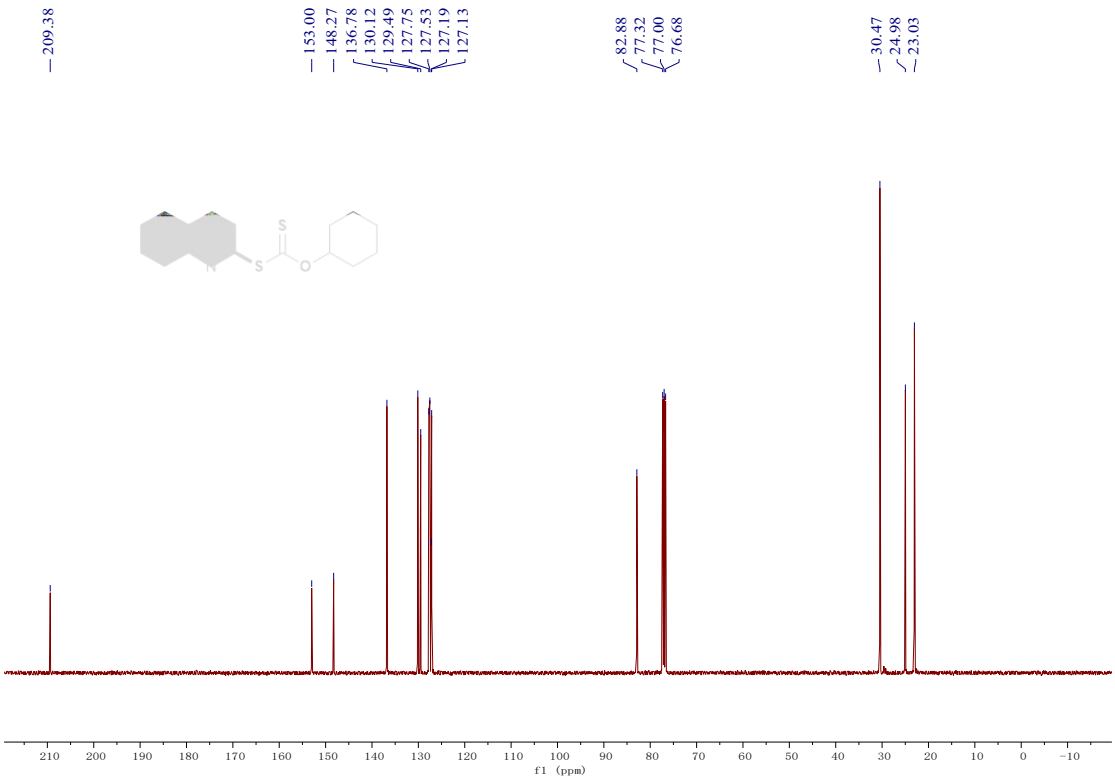
^{1}H spectra of **3aq**



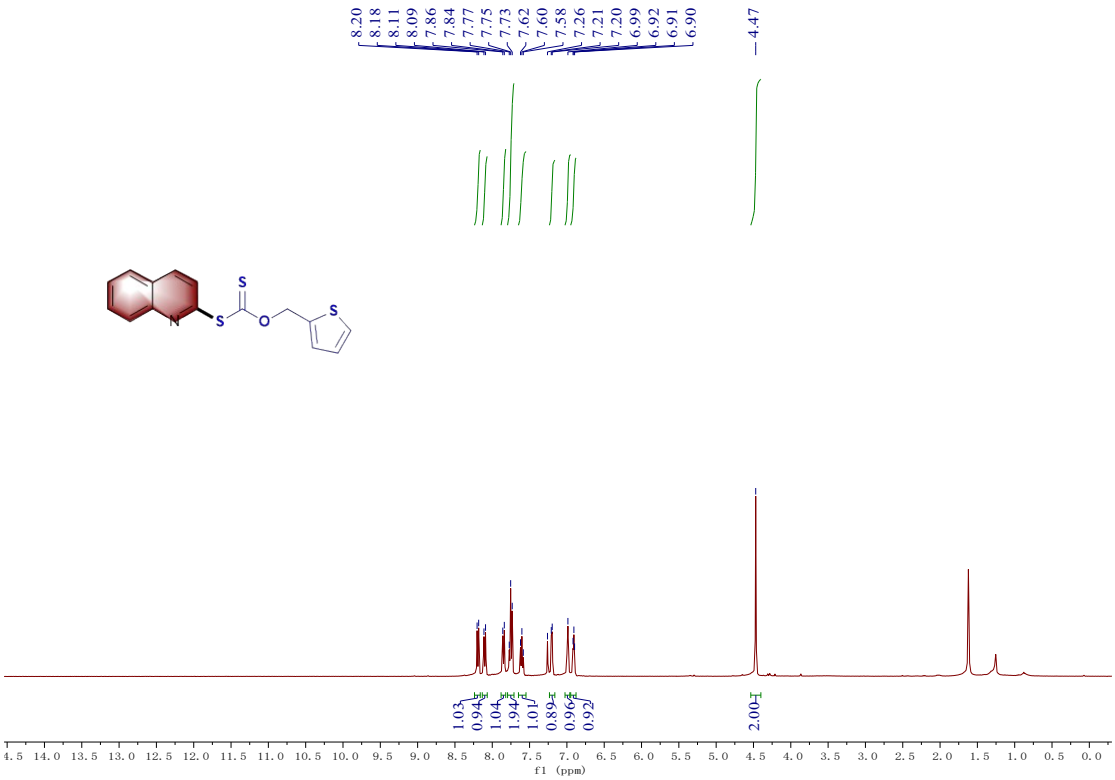
^{13}C spectra of **3aq**



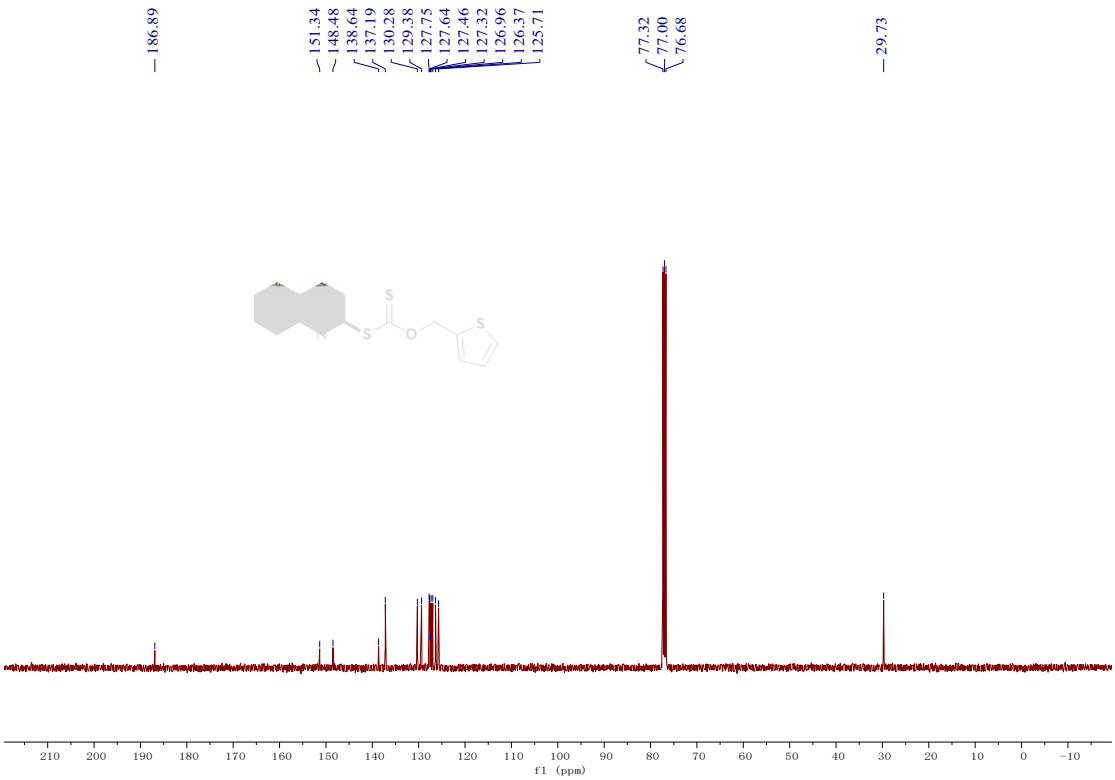
^{1}H spectra of **3ar**



^{13}C spectra of **3ar**



^{1}H spectra of **3as**



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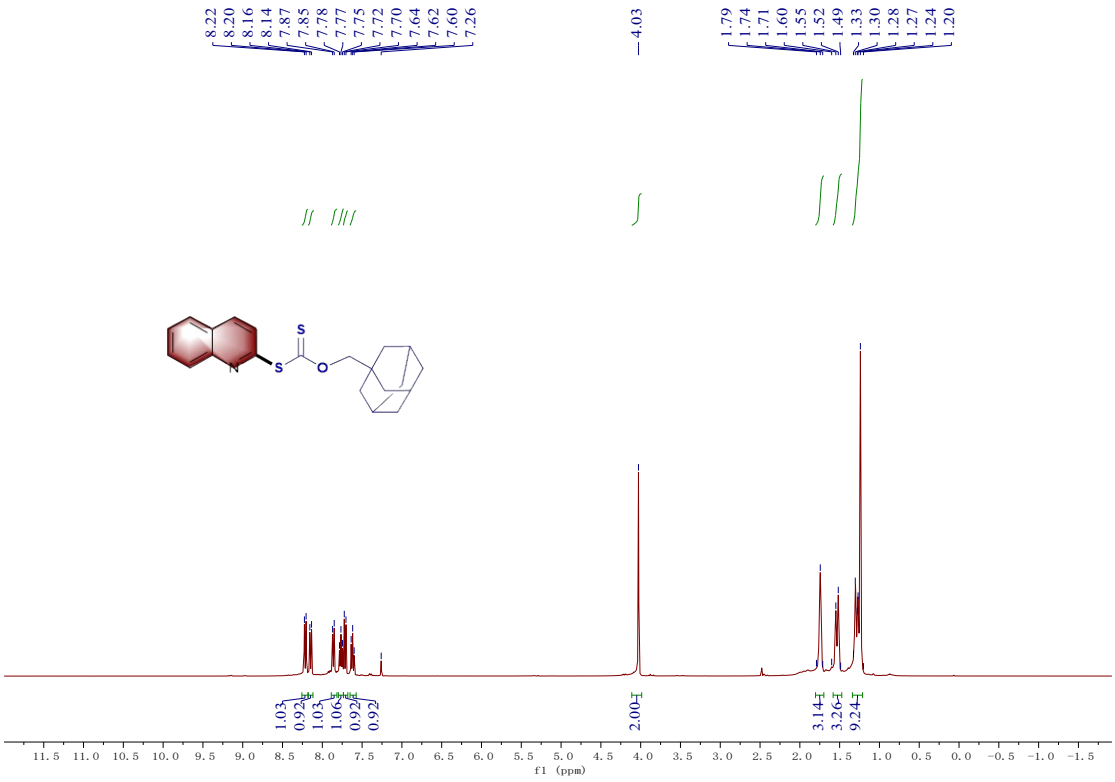
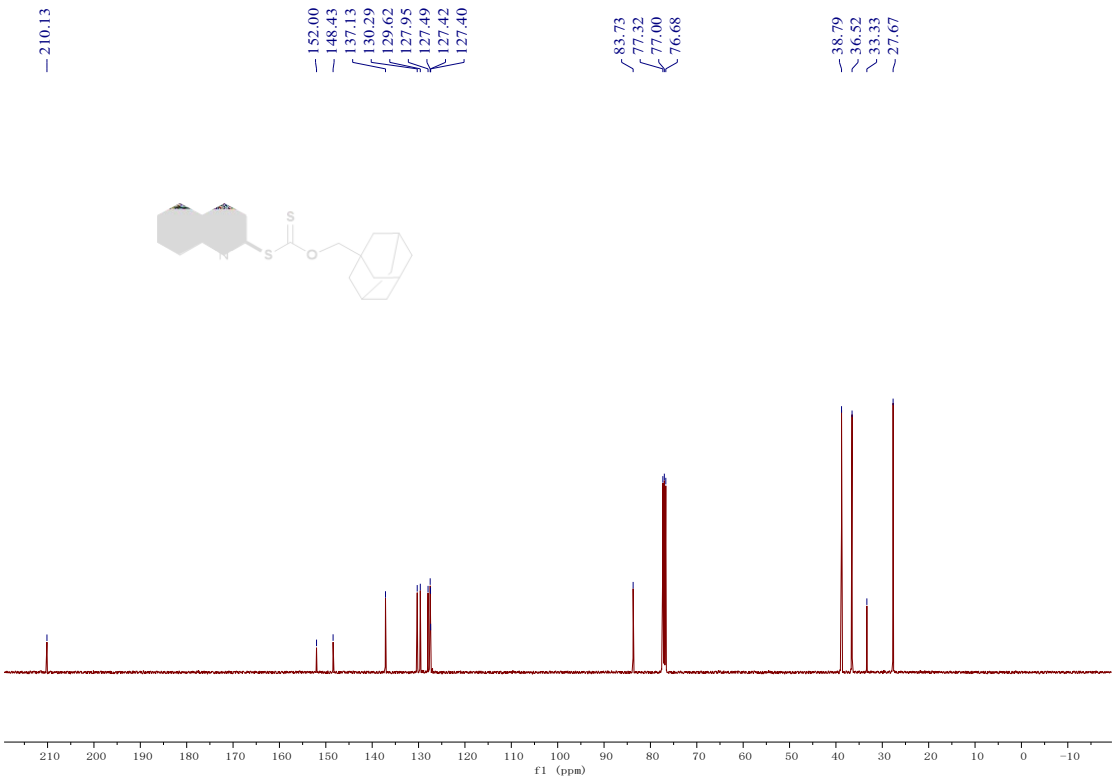
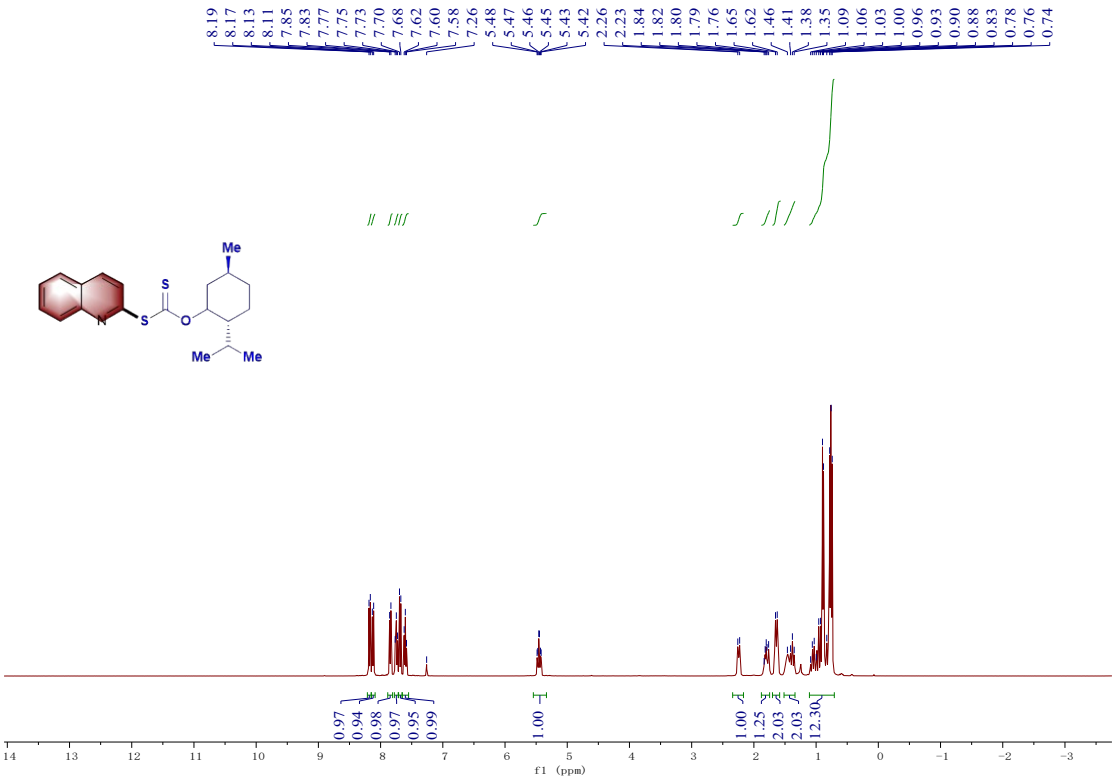


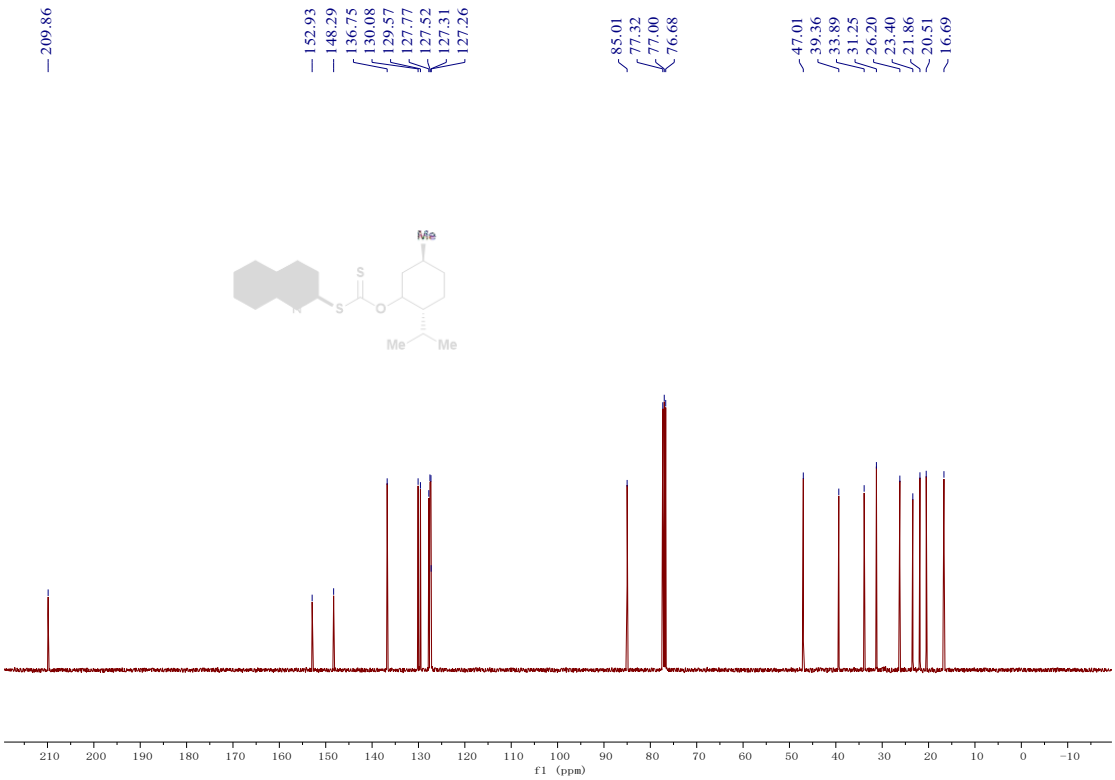
^{1}H spectra of **3at**



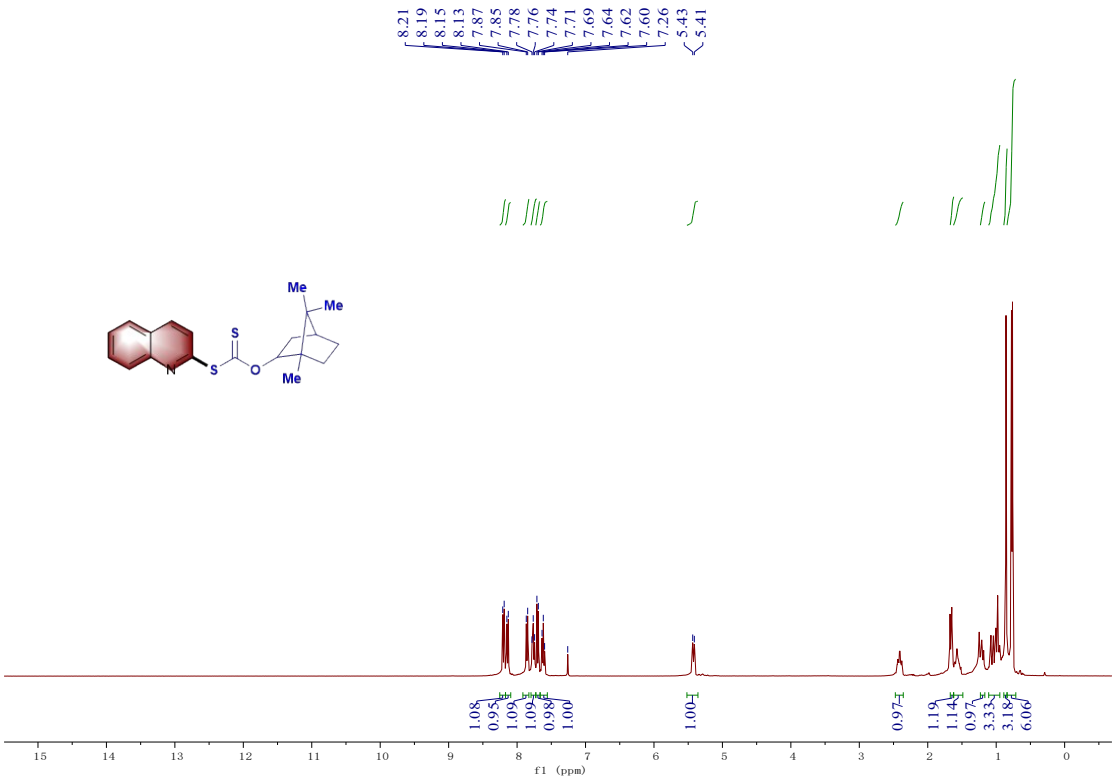
^{13}C spectra of **3at**



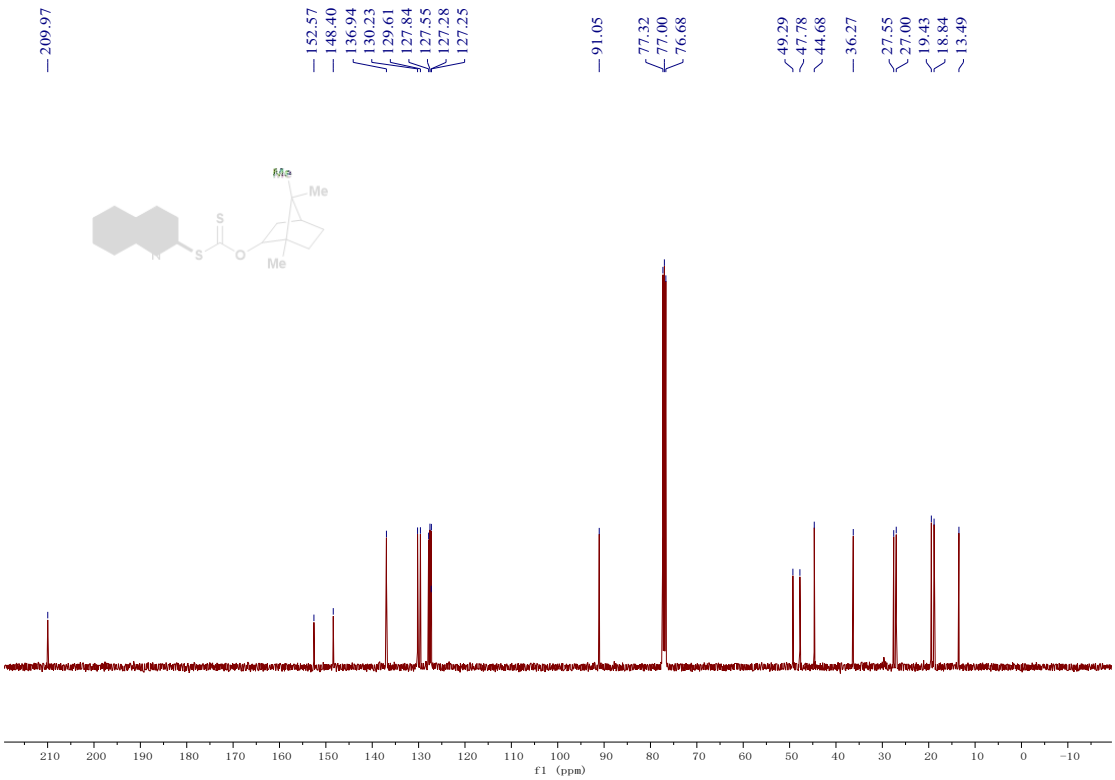
^{1}H spectra of **3au**



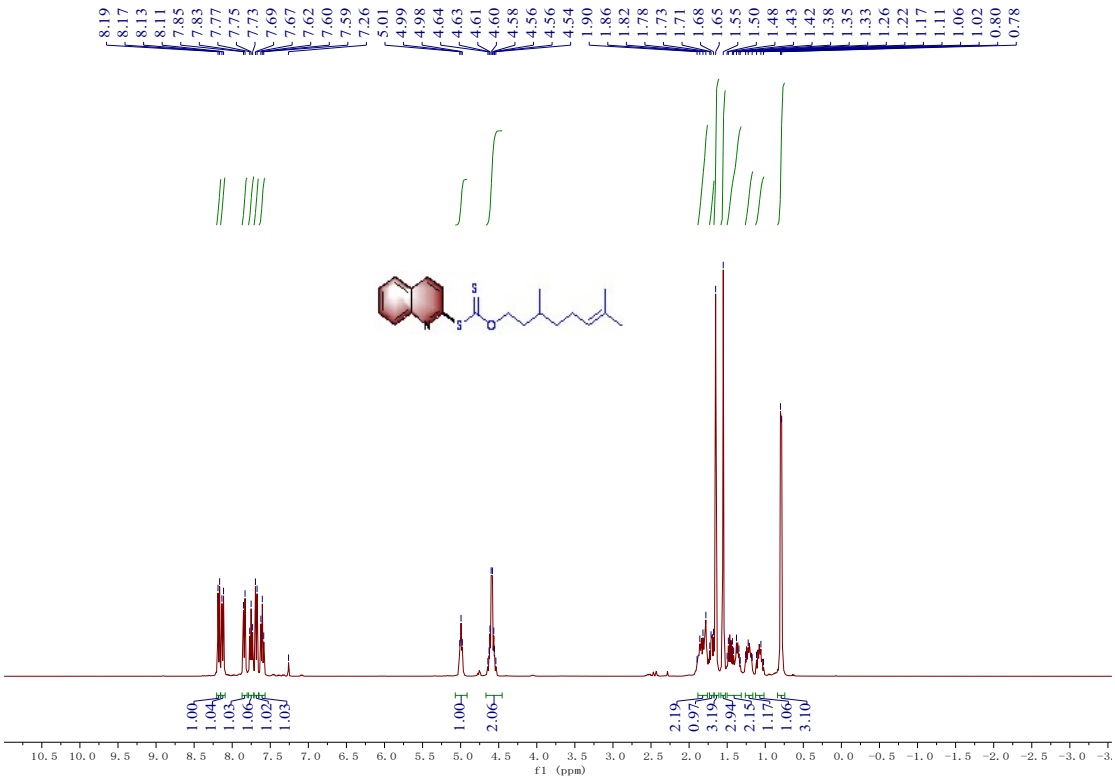
^{13}C spectra of **3au**



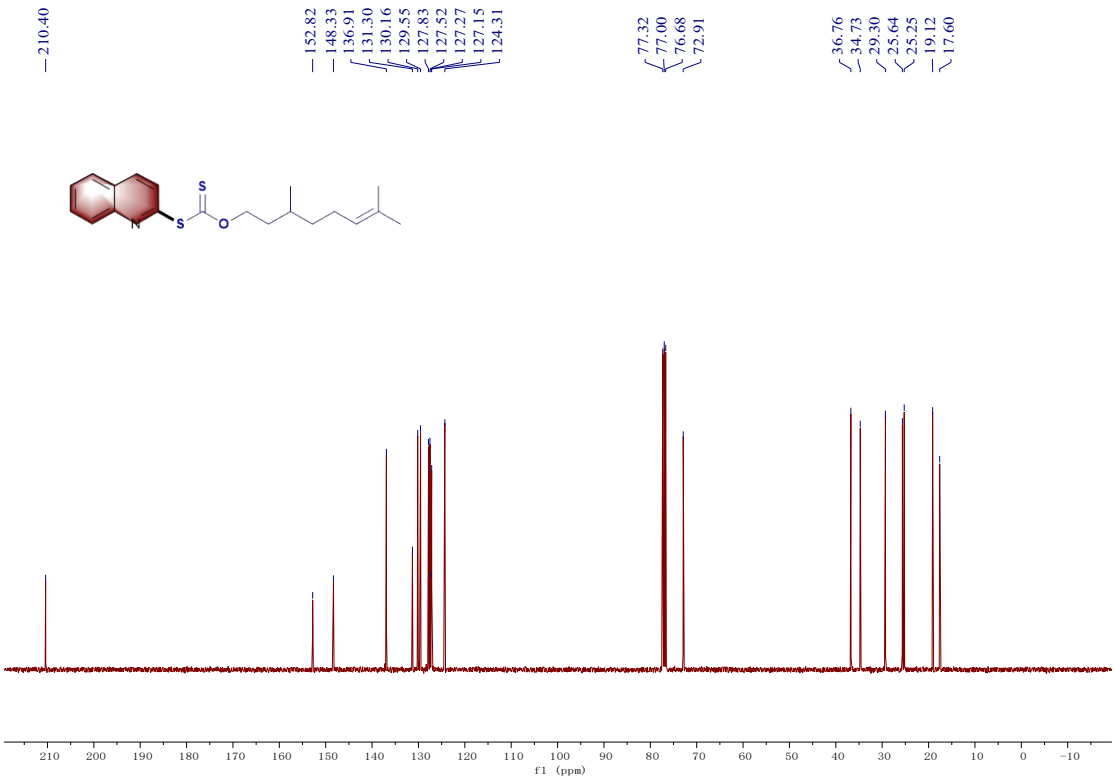
^{1}H spectra of **3av**



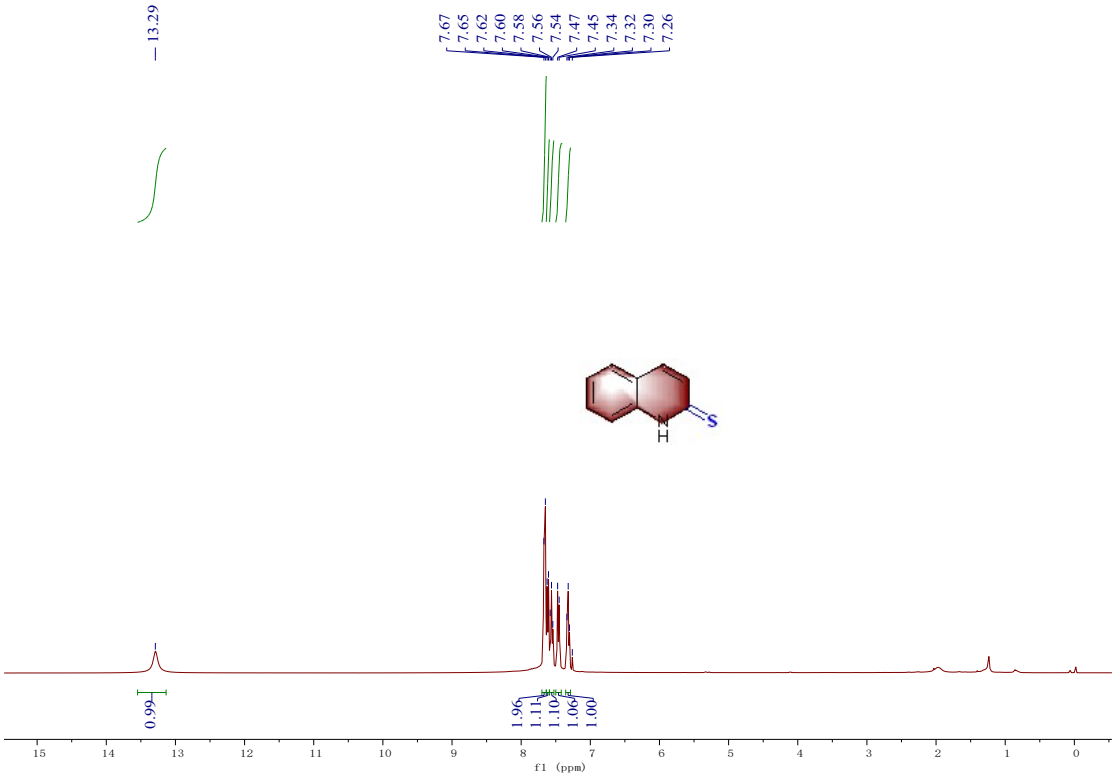
^{13}C spectra of **3av**



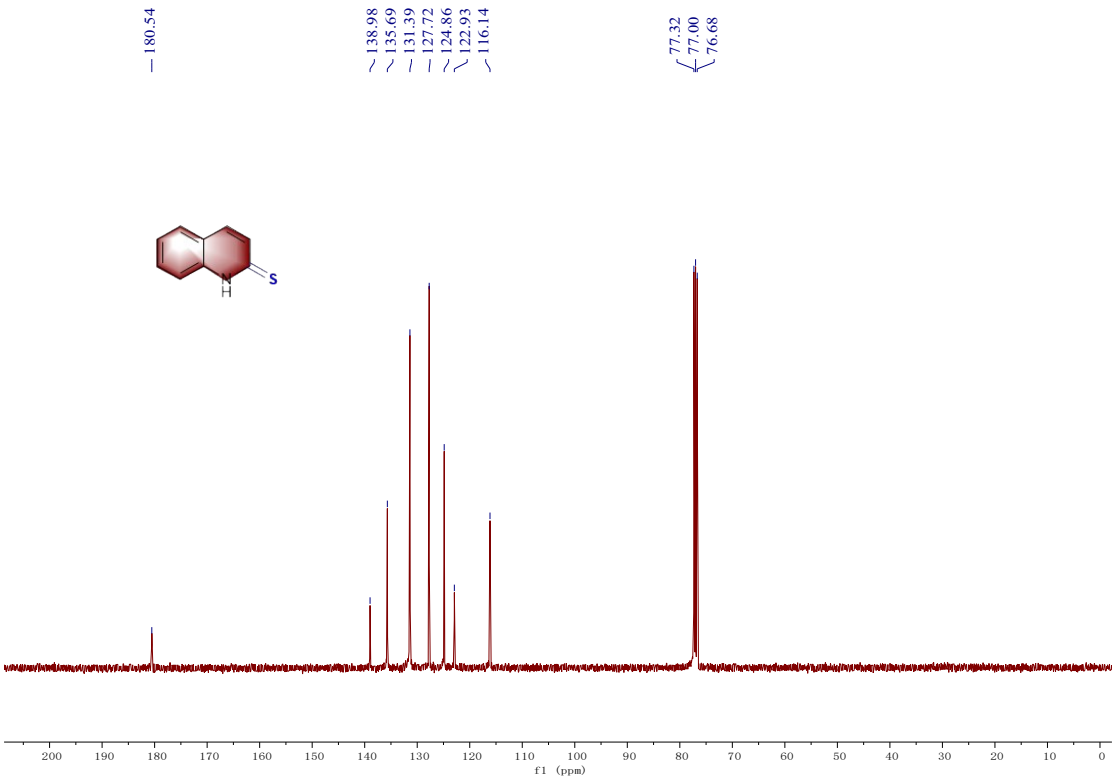
^{1}H spectra of **3aw**



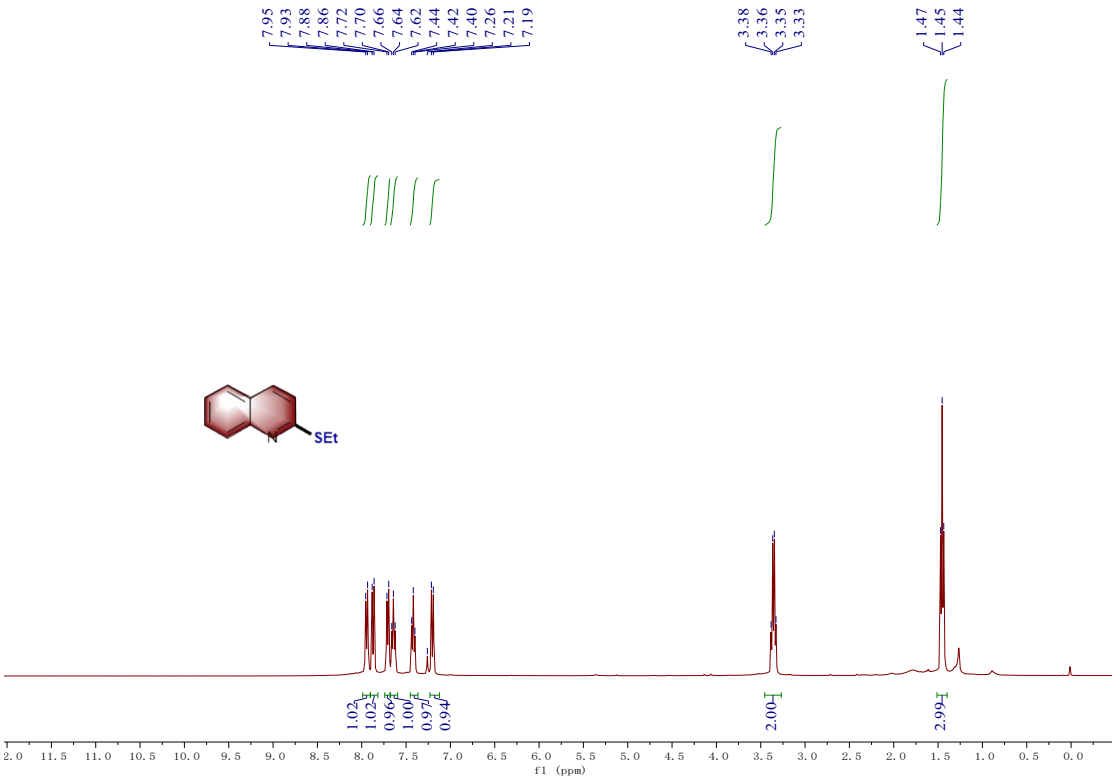
^{13}C spectra of **3aw**



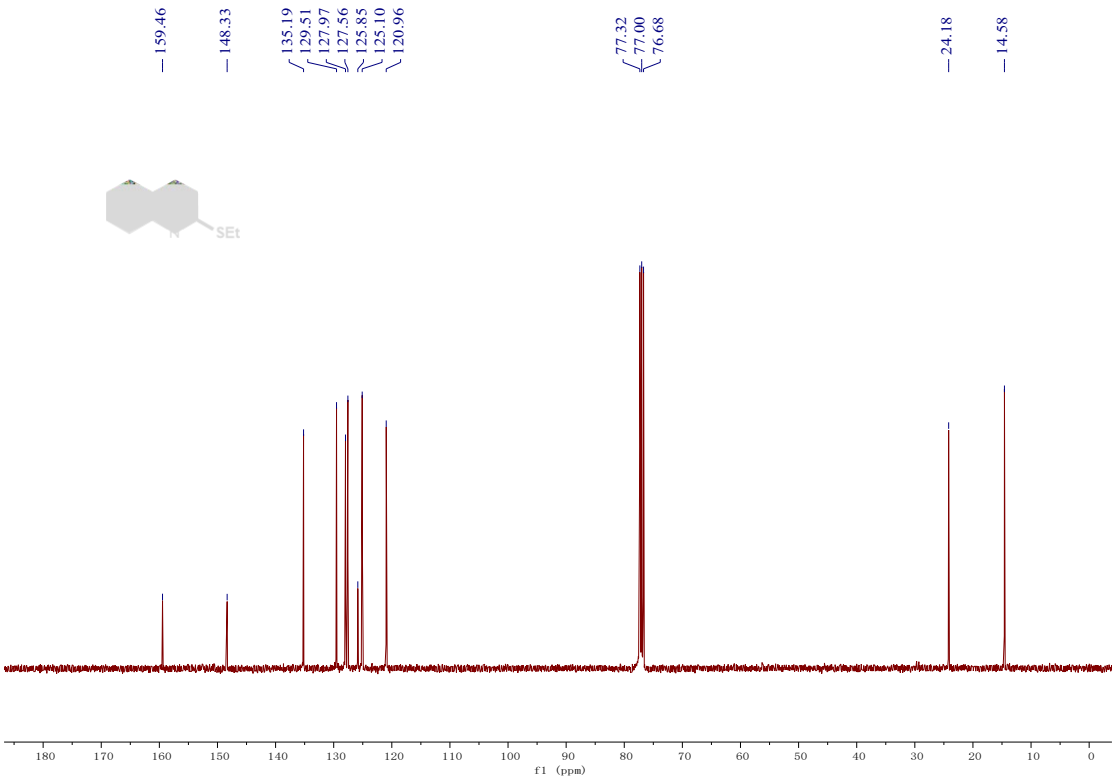
^{1}H spectra of **4a**



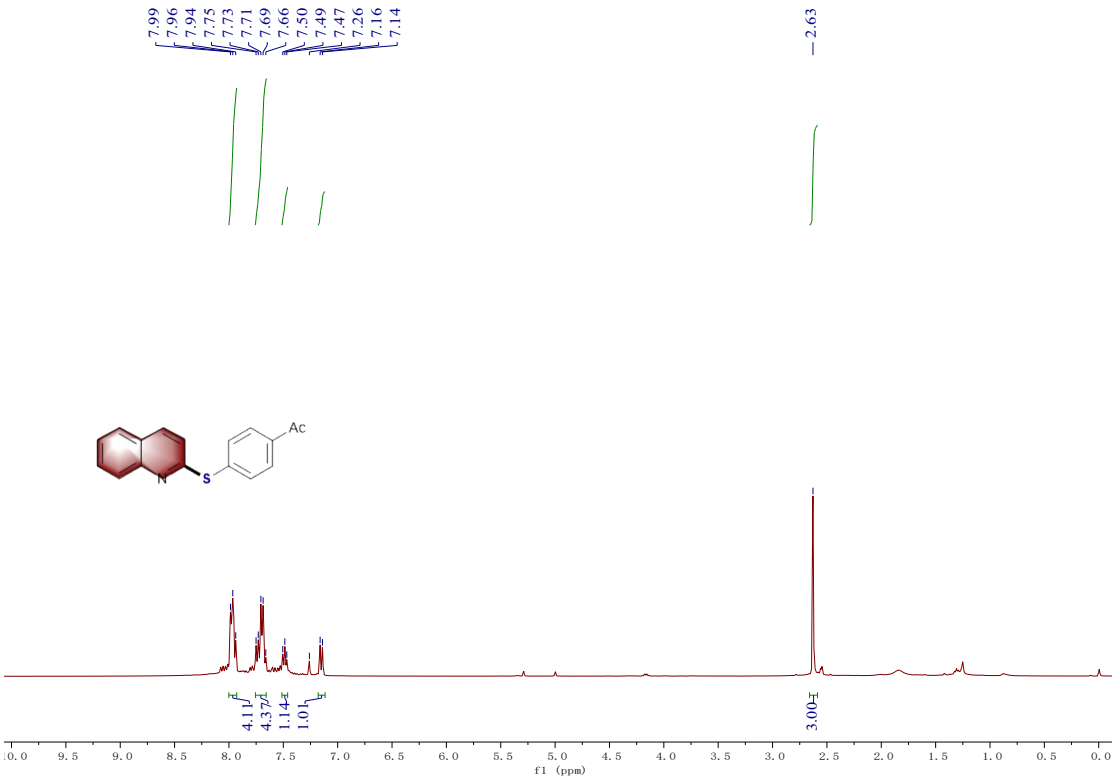
^{13}C spectra of **4a**



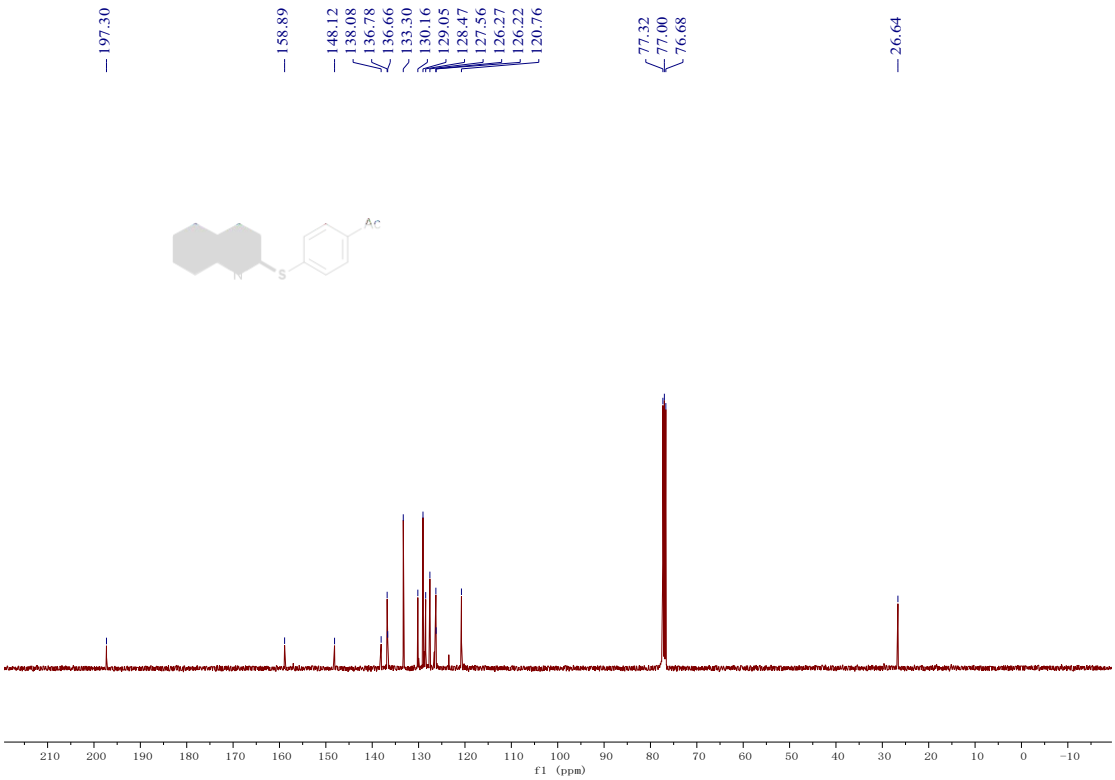
^{1}H spectra of **5a**



^{13}C spectra of **5a**



^{1}H spectra of **6a**



^{13}C spectra of **6a**