Electronic Supplementary Material (ESI) for Green Chemistry.

Supporting Information

Metal- and Photosensitizer-free Cross-Dehydrogenative Coupling through Photoinduced Energy Transfer

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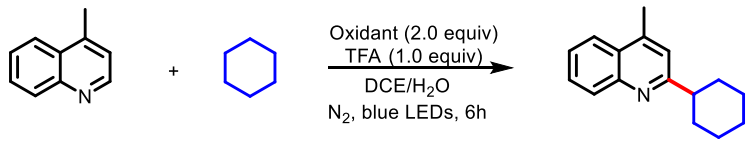
1. General information

Unless otherwise specified, all reagents and solvents were obtained from commercial suppliers and used without further purification. The light source (Kessil PR160L-390 nm; Kessil PR160L-427 nm; A160WE TUNA BLUE) were purchased from Kessil. Thin layer chromatography (TLC) with Merck TLC silica gel 60 F254 plate was used to check reaction progress. ^{1}H and ^{13}C NMR spectra were recorded on a Bruker UltraShield Plus 600 MHz (151 MHz) instrument, which uses the deuterium lock signal to reference the spectra. ^{19}F NMR spectra were recorded on a Bruker 700 MHz spectrometer. The solvent residual peaks, e.g., of chloroform ($CDCl_3$: δ 7.26 ppm and δ 77.23 ppm), were used as references. Data are reported as follows: multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, m = multiplet, dd = doublet of doublet, etc), coupling constant (J/Hz) and integration. HRMS (ESI) spectra were obtained using a Waters Q-Tof premier^{TM} mass spectrometer. Ultraviolet-visible (UV-vis) spectrometry was performed by Agilent Cary 5000 series UV-vis-NIR spectrometer. Fluorescence quenching was performed on VARIAN CARY Eclipse fluorescence spectrophotometer.

2. Table of Reaction Optimization

Table S1. Screening of oxidant[a]

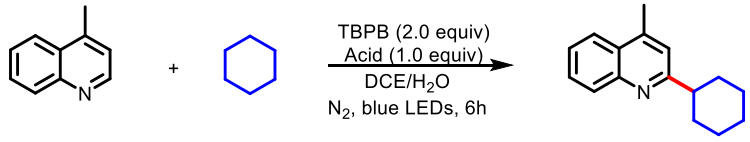


1a **2a** **3a**

entry[a]	Oxidant	yield (%)[b]
1	DTBP	56
2	DCP	88
3	H_2O_2	23
4	TBPB	95
5	BPO	90
6	TBHP	15
7	Air	70
8[c]	DTBP	73
9[c]	H_2O_2	71

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.2 mL), oxidant (2.0 equiv.), TFA (0.2 mmol), H_2O (200 μL), and DCE (2.0 mL) under N_2 at room temperature (25 °C), blue LEDs for 6 h. [b] Determined by ^1H NMR spectroscopy using 1,3,5-trimethoxybenzene as an internal standard. [c] Reaction time: 18 h.

Table S2. Screening of acid[a]

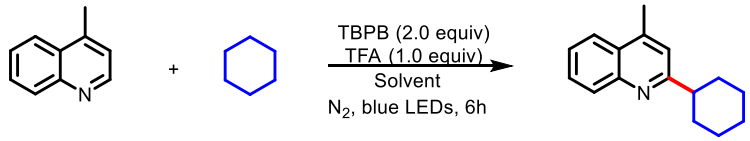


1a **2a** **3a**

entry[a]	Acid	yield (%)[b]
1	H_3PO_4	68
2	TFA	95
3	TfOH	90
4	HCl	37
5	CH_3COOH	65
6	TsOH	88

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.2 mL), TBPB (2.0 equiv.), Acid (0.2 mmol), H_2O (200 μL), and DCE (2.0 mL) under N_2 at room temperature (25 °C), blue LEDs for 6 h. [b] Determined by ^1H NMR spectroscopy using 1,3,5-trimethoxybenzene as an internal standard.

Table S3. Screening of solvent[a]



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

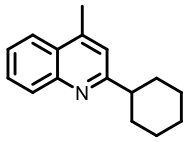
entry[a]	solvent	yield (%)[b]
1[c]	DCE	56
2	Toluene	49
3	DMSO	25
4	MeCN	75
5	Acetone	83
6	EA	70
7	DCE/H_2O (10:1)	95
8	DCE/H_2O (5:1)	92
9	DCE/H_2O (1:1)	67

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.2 mL), TBPB (2.0 equiv.), TFA (0.2 mmol), solvent (2.0 mL), H_2O (200 μL) under N_2 at room temperature (25 °C), blue LEDs for 6 h. [b] Determined by ^1H NMR spectroscopy using 1,3,5-trimethoxybenzene as an internal standard. [c] Without water.

3. General procedure

To a 10 mL vial equipped with a Teflon septum and a magnetic stir bar was added heteroarene (**1**) (0.20 mmol, 1.0 equiv.), alkane (**2**) (0.2 mL), *tert*-Butyl peroxybenzoate (TBPB) (76 μL, 0.40 mmol, 2.0 equiv.), TFA (15 μL, 0.20 mmol, 1.0 equiv.), H_2O (200 μL) and 2.0 mL of dichloroethane (DCE). The above mixture was vigorously stirred under the irradiation of 40 W blue LEDs in N_2 atmosphere for 6 hours. After completion, the reaction mixture was quenched with saturated sodium carbonate and extracted with dichloromethane (3×10 mL). The collected organic layer was washed with brine, dried with sodium sulfate. After the solvent was removed under reduced pressure, the crude product was purified by preparative thin layer chromatography or flash column chromatography.

4. Characterization data of products



2-cyclohexyl-4-methylquinoline (3a)

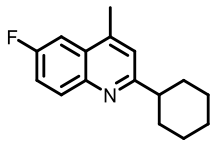
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (42.75 mg, 95%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.05 (d, *J* = 8.4 Hz, 1H), 7.93 (d, *J* = 8.3 Hz, 1H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.5 Hz, 1H), 7.16 (s, 1H), 2.88 (t, *J* = 12.1 Hz, 1H), 2.67 (s, 3H), 2.06 – 1.97 (m, 2H), 1.89 (d, *J* = 13.1 Hz, 2H), 1.79 (d, *J* = 12.9 Hz, 1H), 1.68 – 1.58 (m, 2H), 1.47 (q, *J* = 12.9 Hz, 2H), 1.37 – 1.30 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.59, 147.72, 144.34, 129.59, 129.03, 127.14, 125.46, 123.65, 120.35, 47.70, 32.95, 26.69, 26.25, 18.94.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{16}H_{19}N^+$ 226.1596; Found 226.1597.



2-cyclohexyl-6-fluoro-4-methylquinoline (3b)

Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow solid (34.02 mg, 70%).

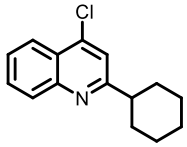
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.03 (dd, *J* = 8.8, 5.7 Hz, 1H), 7.51 (d, *J* = 9.8 Hz, 1H), 7.41 (t, *J* = 8.6 Hz, 1H), 7.17 (s, 1H), 2.85 (t, *J* = 12.0 Hz, 1H), 2.61 (s, 3H), 1.99 (d, *J*

= 12.8 Hz, 2H), 1.88 (d, *J* = 12.9 Hz, 2H), 1.78 (d, *J* = 12.9 Hz, 1H), 1.61 (q, *J* = 12.6 Hz, 2H), 1.45 (q, *J* = 12.9 Hz, 2H), 1.32 (d, *J* = 12.8 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 165.91 (d, *J* = 3.0 Hz), 160.07 (d, *J* = 246.1 Hz), 144.79, 143.80 (d, *J* = 4.5 Hz), 131.91 (d, *J* = 9.1 Hz), 127.78 (d, *J* = 9.1 Hz), 121.00, 118.91 (d, *J* = 25.7 Hz), 107.26 (d, *J* = 21.1 Hz), 47.52, 32.92, 26.66, 26.22, 18.97.

^{19}F NMR (659 MHz, $CDCl_3$) δ -114.57.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{16}H_{18}FN^+$ 244.1457; Found 244.1451.



4-chloro-2-cyclohexylquinoline (3c)

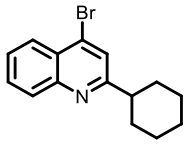
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (38.22 mg, 78%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.3 Hz, 1H), 8.06 (d, *J* = 8.3 Hz, 1H), 7.73 (t, *J* = 7.6 Hz, 1H), 7.57 (t, *J* = 7.6 Hz, 1H), 7.42 (s, 1H), 2.91 (d, *J* = 11.9 Hz, 1H), 2.02 (d, *J* = 12.4 Hz, 2H), 1.90 (d, *J* = 13.1 Hz, 2H), 1.79 (d, *J* = 12.9 Hz, 1H), 1.61 (q, *J* = 13.8, 12.7 Hz, 2H), 1.46 (q, *J* = 12.9 Hz, 2H), 1.34 (t, *J* = 14.5 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.94, 148.74, 142.82, 130.33, 129.40, 126.75, 125.27, 124.04, 119.93, 47.51, 32.83, 26.57, 26.14.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{16}ClN^+$ 246.1044; Found 246.1047.



4-bromo-2-cyclohexylquinoline (3d)

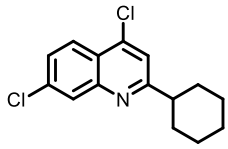
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (41.62 mg, 72%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.3 Hz, 1H), 8.05 (s, 1H), 7.72 (t, *J* = 7.5 Hz, 1H), 7.63 (s, 1H), 7.57 (t, *J* = 7.5 Hz, 1H), 2.90 (s, 1H), 2.03 (d, *J* = 12.5 Hz, 2H), 1.90 (d, *J* = 12.8 Hz, 2H), 1.79 (d, *J* = 12.8 Hz, 1H), 1.61 (q, *J* = 12.6 Hz, 2H), 1.46 (q, *J* = 12.8 Hz, 2H), 1.34 (t, *J* = 12.9 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.86, 148.53, 134.40, 130.39, 129.44, 127.06, 126.70, 126.64, 123.84, 47.33, 32.84, 26.56, 26.13.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{16}BrN^+$ 290.0539; Found 290.0536.



4,7-dichloro-2-cyclohexylquinoline (3e)

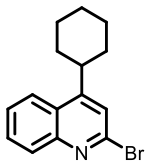
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (45.20 mg, 81%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.21 – 7.99 (m, 2H), 7.51 (d, *J* = 8.9 Hz, 1H), 7.40 (s, 1H), 2.86 (t, *J* = 11.9 Hz, 1H), 2.01 (d, *J* = 12.8 Hz, 2H), 1.90 (d, *J* = 13.1 Hz, 2H), 1.79 (d, *J* = 13.0 Hz, 1H), 1.61 (t, *J* = 12.4 Hz, 2H), 1.45 (q, *J* = 12.9 Hz, 2H), 1.33 (t, *J* = 12.8 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.27, 149.20, 142.68, 136.35, 128.47, 127.69, 125.45, 123.77, 120.28, 47.44, 32.71, 26.52, 26.10.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{15}Cl_2N^+$ 280.0654; Found 280.0658.



2-bromo-4-cyclohexylquinoline (3f)

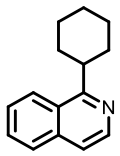
Obtained as a yellow oil (39.30 mg, 68%).

Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.4 Hz, 2H), 7.69 (t, *J* = 7.4 Hz, 1H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.38 (s, 1H), 3.28 (t, *J* = 9.2 Hz, 1H), 1.97 (dd, *J* = 38.7, 8.8 Hz, 4H), 1.85 (d, *J* = 13.2 Hz, 1H), 1.53 (q, *J* = 10.6, 10.0 Hz, 4H), 1.34 (d, *J* = 12.1 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 156.53, 148.99, 142.71, 130.04, 129.74, 126.76, 125.94, 123.42, 122.33, 39.19, 33.55, 26.93, 26.28.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{16}BrN^+$ 290.0539; Found 290.0542.



1-cyclohexylisoquinoline (3g)

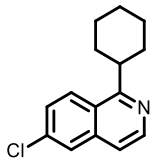
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (33.34 mg, 79%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.48 (d, *J* = 5.5 Hz, 1H), 8.22 (d, *J* = 8.4 Hz, 1H), 7.83 – 7.78 (m, 1H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.58 (t, *J* = 7.5 Hz, 1H), 7.48 (d, *J* = 5.4 Hz, 1H), 3.56 (t, *J* = 10.7 Hz, 1H), 1.96 (dd, *J* = 29.6, 12.9 Hz, 4H), 1.87 – 1.80 (m, 3H), 1.57 – 1.50 (m, 2H), 1.44 – 1.36 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 165.83, 142.01, 136.52, 129.68, 127.68, 126.94, 126.41, 124.87, 119.02, 41.67, 32.72, 27.02, 26.38.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{17}N^+$ 212.1434; Found 212.1439.



6-chloro-1-cyclohexylisoquinoline (3h)

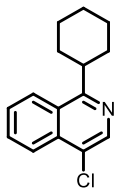
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (43.12 mg, 88%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.53 – 8.42 (m, 1H), 8.19 – 8.09 (m, 1H), 7.76 (s, 1H), 7.49 (d, *J* = 9.0 Hz, 1H), 7.37 (d, *J* = 5.6 Hz, 1H), 3.48 (t, *J* = 11.6 Hz, 1H), 1.93 (t, *J* = 11.3 Hz, 4H), 1.81 (d, *J* = 11.9 Hz, 3H), 1.51 (q, *J* = 13.0 Hz, 2H), 1.41 – 1.34 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 165.93, 143.13, 137.35, 135.82, 127.84, 126.70, 126.35, 124.57, 118.08, 41.78, 32.67, 26.91, 26.28.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{16}ClN^+$ 246.1044; Found 246.1047.



4-chloro-1-cyclohexylisoquinoline (3i)

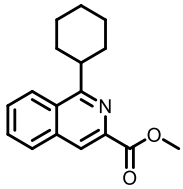
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow solid (44.10 mg, 90%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.52 (s, 1H), 8.23 (t, *J* = 7.4 Hz, 2H), 7.77 (t, *J* = 8.0 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 1H), 3.62 – 3.44 (m, 1H), 1.97 – 1.92 (m, 4H), 1.81 (t, *J* = 12.0 Hz, 3H), 1.52 (q, *J* = 13.1 Hz, 2H), 1.39 (t, *J* = 12.9 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 164.82, 140.79, 133.90, 130.66, 127.74, 127.26, 126.32, 125.17, 124.30, 41.62, 32.70, 26.93, 26.30.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{16}ClN^+$ 246.1044; Found 246.1045



methyl 1-cyclohexylisoquinoline-3-carboxylate (3j)

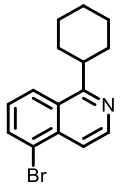
Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

Obtained as a white solid (46.81 mg, 87%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.39 (s, 1H), 8.29 – 8.25 (m, 1H), 7.93 (d, *J* = 7.3 Hz, 1H), 7.73 – 7.68 (m, 2H), 4.02 (s, 3H), 3.60 – 3.53 (m, 1H), 1.95 (p, *J* = 14.2, 12.4 Hz, 6H), 1.81 (d, *J* = 12.5 Hz, 1H), 1.57 – 1.50 (m, 2H), 1.43 (t, *J* = 12.8 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.99, 166.22, 140.78, 136.12, 130.20, 129.13, 127.86, 125.06, 122.52, 52.78, 42.17, 32.35, 26.90, 26.18.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{17}H_{19}NO_2^+$ 270.1489; Found 270.1490.



5-bromo-1-cyclohexylisoquinoline (3k)

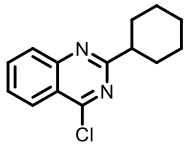
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (46.82 mg, 81%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.58 (d, *J* = 5.9 Hz, 1H), 8.20 (d, *J* = 8.5 Hz, 1H), 7.93 (d, *J* = 7.4 Hz, 1H), 7.86 (d, *J* = 5.9 Hz, 1H), 7.42 (t, *J* = 8.0 Hz, 1H), 3.58 – 3.51 (m, 1H), 1.94 (d, *J* = 16.1 Hz, 5H), 1.81 (t, *J* = 11.1 Hz, 4H), 1.53 – 1.48 (m, 2H), 1.38 (d, *J* = 12.9 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.19, 143.40, 135.60, 133.48, 127.54, 127.16, 124.59, 122.72, 117.81, 41.88, 32.82, 26.96, 26.31.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{16}BrN^+$ 290.0539; Found 290.0533.



4-chloro-2-cyclohexylquinazoline (3l)

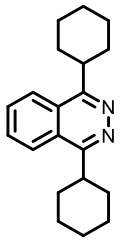
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (22.14 mg, 45%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 10.72 (s, 1H), 8.27 (d, *J* = 7.9 Hz, 1H), 7.76 (q, *J* = 17.1, 12.4 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 2.71 (s, 1H), 2.06 (d, *J* = 12.3 Hz, 2H), 1.93 (d, *J* = 13.0 Hz, 2H), 1.81 (d, *J* = 12.4 Hz, 1H), 1.71 (q, *J* = 11.7 Hz, 2H), 1.45 (q, *J* = 12.7 Hz, 2H), 1.40 – 1.33 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 163.63, 159.97, 149.47, 134.91, 127.44, 126.57, 126.41, 120.94, 44.89, 30.73, 26.09, 25.83.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{14}H_{15}ClN_2^+$ 246.7393; Found 246.7390.



1,4-dicyclohexylphthalazine (3m)

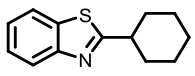
Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

Obtained as a white solid (47.04 mg, 80%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22 – 8.09 (m, 1H), 7.89 – 7.77 (m, 1H), 3.50 – 3.39 (m, 1H), 2.07 – 1.92 (m, 6H), 1.81 (d, *J* = 12.7 Hz, 1H), 1.51 (q, *J* = 12.5, 11.5 Hz, 2H), 1.38 (q, *J* = 12.6 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 161.94, 131.26, 125.08, 124.34, 40.58, 32.46, 27.03, 26.38.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{20}H_{26}N_2^+$ 295.2169; Found 295.2166.



2-cyclohexylbenzo[d]thiazole (3n)

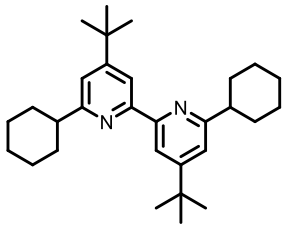
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (30.38 mg, 70%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.1 Hz, 1H), 7.84 (d, *J* = 8.0 Hz, 1H), 7.44 (t, *J* = 7.7 Hz, 1H), 7.33 (t, *J* = 7.6 Hz, 1H), 3.11 (t, *J* = 11.7 Hz, 1H), 2.21 (d, *J* = 12.1 Hz, 2H), 1.89 (d, *J* = 13.3 Hz, 2H), 1.77 (d, *J* = 13.0 Hz, 1H), 1.64 (q, *J* = 12.6 Hz, 2H), 1.45 (q, *J* = 12.8 Hz, 2H), 1.33 (t, *J* = 12.7 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 177.73, 153.24, 134.67, 125.91, 124.62, 122.68, 121.68, 43.59, 33.57, 26.21, 25.93.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{13}H_{15}NS^+$ 218.0998; Found 218.0995.



5,5'-di-tert-butyl-6,6'-dicyclohexyl-3,3'-bipyridine (3o)

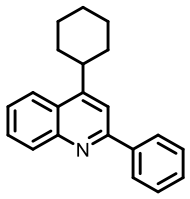
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (63.95 mg, 74%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.21 (s, 2H), 7.12 (s, 2H), 2.77 (t, *J* = 11.2 Hz, 2H), 2.03 (d, *J* = 12.5 Hz, 4H), 1.88 (d, *J* = 12.9 Hz, 5H), 1.78 (d, *J* = 12.6 Hz, 2H), 1.62 (q, *J* = 12.3 Hz, 5H), 1.52 – 1.43 (m, 5H), 1.38 (s, 19H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 165.67, 160.70, 156.45, 117.61, 115.99, 46.80, 35.05, 33.26, 30.89, 26.84, 26.41.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{30}H_{44}N_2^+$ 433.3538; Found 433.3540.



4-cyclohexyl-2-phenylquinoline (3p)

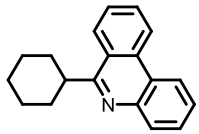
Prepared according to *general procedure*. Eluent: PE/ (DCM) (2:1).

Obtained as a colorless solid (30.42 mg, 53%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22 (d, *J* = 7.5 Hz, 1H), 8.15 (d, *J* = 7.8 Hz, 2H), 8.10 (d, *J* = 8.4 Hz, 1H), 7.76 (s, 1H), 7.71 (t, *J* = 7.5 Hz, 1H), 7.54 (q, *J* = 7.1 Hz, 3H), 7.46 (t, *J* = 7.3 Hz, 1H), 3.39 (t, *J* = 11.2 Hz, 1H), 2.09 (d, *J* = 11.9 Hz, 2H), 1.97 (d, *J* = 12.6 Hz, 2H), 1.88 (d, *J* = 13.4 Hz, 1H), 1.60 (dq, *J* = 25.5, 12.9 Hz, 4H), 1.42 – 1.34 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.32, 154.16, 148.44, 140.14, 130.60, 129.20, 129.11, 128.81, 127.68, 125.96, 125.90, 122.88, 115.57, 39.18, 33.70, 27.00, 26.36.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{21}H_{21}N^+$ 288.1752; Found 288.1758.



6-cyclohexylphenanthridine (3q)

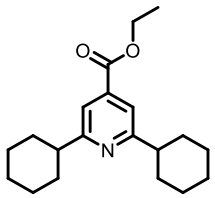
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (40.19 mg, 77%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.65 (d, *J* = 8.2 Hz, 1H), 8.54 (d, *J* = 8.1 Hz, 1H), 8.36 – 8.29 (m, 1H), 8.16 (d, *J* = 7.6 Hz, 1H), 7.81 (t, *J* = 7.5 Hz, 1H), 7.70 (dt, *J* = 14.5, 7.5 Hz, 2H), 7.61 (t, *J* = 7.5 Hz, 1H), 3.63 (t, *J* = 11.3 Hz, 1H), 2.10 (d, *J* = 12.0 Hz, 2H), 1.98 (t, *J* = 12.6 Hz, 4H), 1.86 (d, *J* = 12.8 Hz, 1H), 1.59 (q, *J* = 12.8 Hz, 2H), 1.46 (d, *J* = 12.9 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 165.39, 143.99, 133.12, 130.03, 128.49, 127.17, 126.24, 125.73, 124.83, 123.45, 122.68, 121.92, 42.11, 32.42, 27.01, 26.45.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{19}H_{19}N^+$ 262.1596; Found 262.1600.



ethyl 2,6-dicyclohexylisonicotinate (3r)

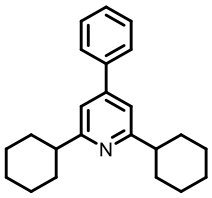
Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

Obtained as a white solid (54.18 mg, 86%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.50 (s, 2H), 4.38 (q, *J* = 7.1 Hz, 2H), 2.74 (t, *J* = 11.5 Hz, 2H), 1.95 (d, *J* = 12.3 Hz, 4H), 1.84 (d, *J* = 12.9 Hz, 4H), 1.74 (d, *J* = 12.8 Hz, 2H), 1.51 (q, *J* = 12.6, 11.3 Hz, 4H), 1.45 – 1.38 (m, 7H), 1.31 – 1.24 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.88, 166.22, 138.37, 117.25, 61.57, 46.70, 33.08, 26.64, 26.21, 14.41.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{20}H_{29}NO_2^+$ 316.2271; Found 316.2270.



2,6-dicyclohexyl-4-phenylpyridine (3s)

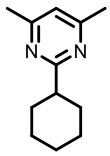
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (52.95 mg, 83%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.63 (d, *J* = 7.6 Hz, 2H), 7.47 (t, *J* = 7.5 Hz, 2H), 7.41 (t, *J* = 7.2 Hz, 1H), 7.18 (s, 2H), 2.77 (t, *J* = 11.3 Hz, 2H), 2.06 – 1.96 (m, 4H), 1.87 (d, *J* = 12.8 Hz, 4H), 1.77 (d, *J* = 12.8 Hz, 2H), 1.56 (q, *J* = 12.6 Hz, 4H), 1.46 (q, *J* = 12.7 Hz, 4H), 1.31 (q, *J* = 12.8 Hz, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.35, 149.12, 139.73, 128.99, 128.59, 127.25, 116.11, 46.88, 33.33, 26.77, 26.33.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{23}H_{29}N^+$ 320.2373; Found 320.2367.



2-cyclohexyl-4,6-dimethylpyrimidine (3t)

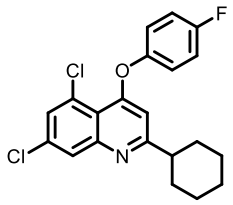
Prepared according to *general procedure*. Eluent: PE/ (EA) (3:1).

Obtained as a colorless oil (36.85 mg, 91%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 6.81 (s, 1H), 2.78 (t, *J* = 11.9 Hz, 1H), 2.43 (s, 7H), 1.97 – 1.90 (m, 2H), 1.82 (d, *J* = 13.0 Hz, 2H), 1.67 (dd, *J* = 48.8, 13.7 Hz, 3H), 1.39 (q, *J* = 12.8 Hz, 2H), 1.30 (d, *J* = 12.7 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 174.04, 166.43, 117.46, 47.76, 32.06, 26.43, 26.06, 24.18.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{12}H_{18}N_2^+$ 191.1504; Found 191.1508.



5,7-dichloro-8-cyclohexyl-4-(4-fluorophenoxy)quinoline (3u)

Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

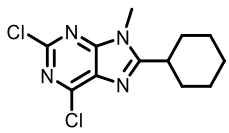
Obtained as a yellow solid (63.02 mg, 81%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.96 (s, 1H), 7.50 (s, 1H), 7.16 (t, *J* = 7.7 Hz, 2H), 7.12 – 7.08 (m, 2H), 6.52 (d, *J* = 2.3 Hz, 1H), 2.69 (t, *J* = 10.8 Hz, 1H), 1.88 (d, *J* = 12.4 Hz, 2H), 1.82 (d, *J* = 12.1 Hz, 2H), 1.72 (d, *J* = 12.8 Hz, 1H), 1.49 – 1.32 (m, 5H), 1.25 (t, *J* = 12.5 Hz, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.68, 162.49, 159.98 (d, *J* = 244.6 Hz), 151.49, 150.43 (d, *J* = 3.0 Hz), 134.91, 130.03, 128.76, 127.61, 122.07 (d, *J* = 9.1 Hz), 117.15 (d, *J* = 24.2 Hz), 117.13, 105.83, 47.35, 32.48, 26.42, 25.98.

^{19}F NMR (659 MHz, $CDCl_3$) δ -117.36.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{21}H_{18}Cl_2FNO^+$ 390.0822; Found 390.0818.



2,6-dichloro-8-cyclohexyl-9-methyl-9H-purine (3v)

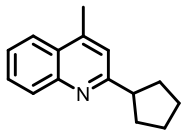
Prepared according to *general procedure*. Eluent: PE/ (EA) (3:1).

Obtained as a white solid (43.74 mg, 77%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 3.84 (s, 3H), 2.91 (t, *J* = 11.6 Hz, 1H), 1.99 (dd, *J* = 29.4, 12.6 Hz, 4H), 1.85 (q, *J* = 12.5 Hz, 3H), 1.43 (dq, *J* = 25.6, 12.4 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 163.23, 154.82, 151.80, 149.67, 130.32, 37.04, 30.90, 29.37, 26.08, 25.61.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{12}H_{14}Cl_2N_4^+$ 285.0668; Found 285.0668.



2-cyclopentyl-4-methylquinoline (4a)

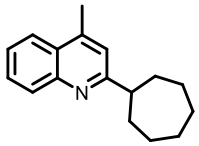
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (38.82 mg, 92%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.4 Hz, 1H), 7.93 (d, *J* = 8.3 Hz, 1H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.5 Hz, 1H), 7.17 (s, 1H), 3.38 – 3.28 (m, 1H), 2.67 (s, 3H), 2.20 – 2.12 (m, 2H), 1.88 (s, 4H), 1.75 (s, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.00, 147.61, 144.20, 129.58, 129.01, 127.06, 125.45, 123.63, 120.75, 48.91, 33.68, 26.16, 18.92.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{17}N^+$ 212.1440; Found 212.1443.



2-cycloheptyl-4-methylquinoline (4b)

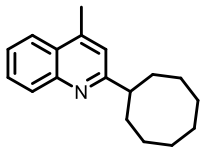
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (45.41 mg, 95%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.05 (d, *J* = 8.1 Hz, 1H), 7.93 (d, *J* = 8.3 Hz, 1H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 7.5 Hz, 1H), 7.14 (s, 1H), 3.04 (t, *J* = 9.8 Hz, 1H), 2.67 (s, 3H), 2.04 (dd, *J* = 10.3, 6.0 Hz, 2H), 1.88 – 1.78 (m, 4H), 1.77 – 1.71 (m, 2H), 1.64 (t, *J* = 8.4 Hz, 4H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.21, 147.45, 144.54, 129.53, 129.09, 127.07, 125.48, 123.66, 120.42, 49.68, 35.21, 28.12, 27.61, 18.98.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{17}H_{21}N^+$ 240.1747; Found 240.1744.



2-cyclooctyl-4-methylquinoline (4c)

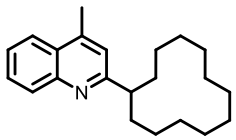
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (45.66 mg, 92%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.05 (d, *J* = 8.3 Hz, 1H), 7.93 (d, *J* = 8.3 Hz, 1H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 7.5 Hz, 1H), 7.13 (s, 1H), 3.11 (t, *J* = 9.7 Hz, 1H), 2.67 (s, 3H), 1.98 (dd, *J* = 13.9, 8.3 Hz, 2H), 1.87 (dd, *J* = 22.8, 13.8 Hz, 4H), 1.75 – 1.61 (m, 8H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.93, 147.45, 144.46, 129.56, 129.06, 127.02, 125.46, 123.65, 120.79, 47.66, 33.66, 26.56, 26.29, 18.99.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{18}H_{23}N^+$ 254.1903; Found 254.1903.



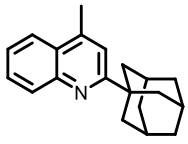
2-cyclododecyl-4-methylquinoline (4d)

Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (55.62 mg, 90%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.08 (d, *J* = 8.4 Hz, 1H), 8.00 – 7.86 (m, 1H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.55 – 7.41 (m, 1H), 7.13 (s, 1H), 3.19 – 3.01 (m, 1H), 2.68 (s, 3H), 1.91 (dq, *J* = 12.8, 6.6 Hz, 2H), 1.74 (dd, *J* = 13.1, 5.8 Hz, 2H), 1.64 – 1.57 (m, 2H), 1.52 – 1.43 (m, 7H), 1.40 – 1.31 (m, 10H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 166.81, 147.79, 143.89, 129.74, 128.88, 127.08, 125.38, 123.63, 121.53, 43.23, 30.28, 24.08, 24.02, 23.85, 23.52, 23.05, 18.93.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{22}H_{31}N^+$ 310.2527; Found 310.2527.



2-((3r,5r,7r)-adamantan-1-yl)-4-methylquinoline (4e)

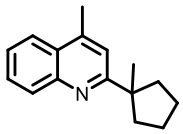
Prepared according to *general procedure* with 2 equiv of adamantane. Eluent: PE/ (EA) (10:1).

Obtained as a white solid (47.09 mg, 85%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.06 (d, *J* = 8.3 Hz, 1H), 7.94 (d, *J* = 8.1 Hz, 1H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.48 (t, *J* = 7.3 Hz, 1H), 7.33 (s, 1H), 2.69 (s, 3H), 2.13 (d, *J* = 22.4 Hz, 9H), 1.83 (s, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.83, 147.66, 143.68, 130.09, 128.75, 126.84, 125.45, 123.56, 118.66, 41.94, 39.69, 37.05, 28.99, 19.13.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{20}H_{23}N^+$ 278.1903; Found 278.1900.



4-methyl-2-(1-methylcyclopentyl)quinoline (4f)

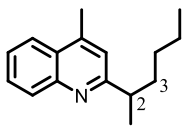
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (29.70 mg, 66%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.23 – 8.01 (m, 1H), 7.94 (d, *J* = 8.2 Hz, 1H), 7.66 (t, *J* = 7.5 Hz, 1H), 7.49 (t, *J* = 7.5 Hz, 1H), 7.30 (s, 1H), 2.69 (s, 3H), 2.38 – 2.24 (m, 2H), 1.78 (d, *J* = 46.5 Hz, 6H), 1.42 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.11, 147.22, 143.75, 129.97, 128.86, 126.73, 125.50, 123.52, 120.22, 50.18, 39.25, 28.53, 24.72, 19.08.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{16}H_{19}N^+$ 226.1596; Found 226.1594.



2-(hexan-2-yl)-4-methylquinoline (4g)

Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as yellow oil (37.11 mg, 76%).

(C_2:C_3 = 2:1) C_2 and C_3 products were obtained as an inseparable mixture. Ratio of C_2: C_3 was determined by the integration of methyl group peaks at **3.06-3.01 ppm** (m, 1H) for C_2 product and **2.86-2.81 ppm** (m, 1H) for C_3 product.

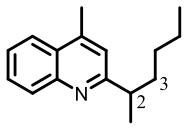
Data for C_2 product: **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.06 (d, *J* = 8.3 Hz, 1H), 7.95 (d, *J* = 8.2 Hz, 1H), 7.66 (ddd, *J* = 8.4, 6.8, 1.4 Hz, 1H), 7.50 (ddd, *J* = 8.2, 6.9, 1.3 Hz, 1H), 7.12 (s, 1H), 3.03 (h, *J* = 6.8 Hz, 1H), 2.69 (s, 3H), 1.86 – 1.58 (m, 3H), 1.37 – 1.25 (m, 2H), 1.34(d, *J* = 6.8 Hz, 3H), 1.23 – 1.12 (m, 1H), 0.85 (t, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.06, 147.68, 144.38, 129.63, 129.03, 125.50, 125.34, 123.69, 120.28, 43.05, 36.94, 30.10, 22.97, 20.94, 19.00, 14.17.

Data for C_3 product: **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.08 (d, *J* = 8.3 Hz, 1H), 7.95 (d, *J* = 8.2 Hz, 1H), 7.66 (ddd, *J* = 8.4, 6.8, 1.4 Hz, 1H), 7.50 (ddd, *J* = 8.2, 6.9, 1.3 Hz, 1H), 7.12 (s, 1H), 2.84 (p, *J* = 7.0 Hz, 1H), 2.69 (s, 3H), 1.86 – 1.58 (m, 2H), 1.37 – 1.25 (m, 3H), 1.23 – 1.12 (m, 1H), 0.85 (t, *J* = 7.0 Hz, 3H), 0.82 (t, *J* = 7.0 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.94, 147.72, 144.10, 129.68, 128.96, 127.16, 125.46, 123.69, 120.84, 50.43, 37.82, 28.68, 20.99, 19.00, 14.40, 12.38.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{16}H_{21}N^+$ 228.1747; Found 228.1747.



4-methyl-2-(pentan-2-yl)quinoline (4h)

Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (29.82 mg, 70%).

(C_2:C_3 = 3:1) C_2 and C_3 products were obtained as an inseparable mixture. Ratio of C_2: C_3 was determined by the integration of methyl group peaks at **3.11 – 3.02 ppm** (m, 1H) for C_2 product and **2.77 – 2.71 ppm** (m, 1H) for C_3 product.

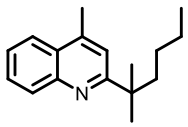
Data for C_2 product: **^{1}H NMR** (40 0 MHz, $CDCl_3$) δ 8.07 (t, J = 7.9 Hz, 1H), 7.94 (d, *J* = 8.2 Hz, 2H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.12 (s, 1H), 3.06 (h, *J* = 7.1 Hz, 1H), 2.68 (s, 1H), 1.84 – 1.74 (m, 1H), 1.69 – 1.61 (m, 1H), 1.43 – 1.32 (m, 1H), 1.35 (d, *J* = 7.0 Hz, 3H), 1.28 – 1.18 (m, 1H), 0.90 (t, *J* = 7.3 Hz, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.02, 147.66, 144.39, 129.61, 129.04, 127.15, 125.51, 123.68, 120.28, 42.57, 39.44, 21.02, 20.87, 19.00, 14.34.

Data for C_3 product: **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.09 (t, *J* = 7.9 Hz, 1H), 7.94 (d, *J* = 8.2 Hz, 2H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.12 (s, 1H), 2.74 (p, *J* = 7.4 Hz, 1H), 2.68 (s, 1H), 1.84 – 1.74 (m, 4H), 0.83 (t, *J* = 7.4 Hz, 6H)

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.74, 147.73, 144.12, 129.68, 128.97, 127.18, 125.48, 123.70, 120.86, 52.31, 28.37, 19.00, 12.38.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{19}N^+$ 214.1590; Found 214.1588.



4-methyl-2-(2-methylhexan-2-yl)quinoline (4i)

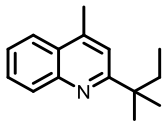
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (30.85 mg, 64%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.05 (d, *J* = 7.9 Hz, 1H), 7.94 (d, *J* = 8.1 Hz, 1H), 7.65 (t, *J* = 7.1 Hz, 1H), 7.49 (t, *J* = 7.1 Hz, 1H), 2.69 (s, 3H), 1.81 – 1.75 (m, 2H), 1.43 (s, 6H), 1.26 – 1.22 (m, 2H), 1.11 – 1.05 (m, 2H), 0.82 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.41, 147.49, 143.44, 130.15, 128.71, 126.62, 125.45, 123.53, 119.47, 43.42, 41.09, 27.96, 27.20, 23.57, 19.15, 14.20.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{17}H_{23}N^+$ 242.1830; Found 242.1835.



4-methyl-2-(tert-pentyl)quinoline (4j)

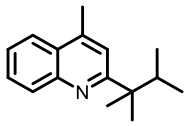
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (32.81 mg, 77%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.07 (d, *J* = 7.9 Hz, 1H), 7.94 (d, *J* = 8.2 Hz, 1H), 7.66 (t, *J* = 7.5 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 1H), 7.31 (s, 1H), 2.69 (s, 3H), 1.85 (q, *J* = 7.3 Hz, 2H), 1.44 (s, 6H), 0.77 – 0.70 (m, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.16, 147.50, 143.45, 130.13, 128.72, 126.60, 125.46, 123.51, 119.51, 41.33, 35.97, 27.48, 19.11, 9.39.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{19}N^+$ 214.1590; Found 214.1592.



2-(2,3-dimethylbutan-2-yl)-4-methylquinoline (4k)

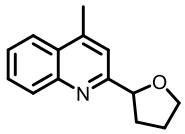
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow oil (31.33 mg, 69%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.06 (s, 1H), 7.94 (d, *J* = 8.3 Hz, 1H), 7.65 (s, 1H), 7.49 (s, 1H), 7.30 (s, 1H), 2.69 (s, 3H), 2.29 (s, 1H), 1.38 (s, 6H), 0.81 (d, *J* = 6.6 Hz, 6H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.00, 147.39, 143.23, 130.16, 128.70, 126.62, 125.44, 123.52, 119.75, 43.98, 37.23, 23.82, 19.17, 18.09.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{16}H_{21}N^+$ 228.3510; Found 228.3519.



4-methyl-2-(tetrahydrofuran-2-yl)quinoline (4l)

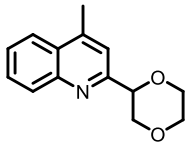
Prepared according to *general procedure*. Eluent: PE/ (EA) (3:1).

Obtained as a yellow solid (25.57 mg, 60%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22 – 8.04 (m, 1H), 7.98 (d, *J* = 8.3 Hz, 1H), 7.69 (t, *J* = 7.6 Hz, 1H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.46 (s, 1H), 5.16 (d, *J* = 6.7 Hz, 1H), 4.18 (q, *J* = 6.9 Hz, 1H), 4.04 (q, *J* = 7.0 Hz, 1H), 2.72 (s, 3H), 2.58 – 2.44 (m, 1H), 2.06 (dd, *J* = 18.8, 6.3 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 163.20, 147.35, 145.21, 129.62, 129.32, 127.60, 126.00, 123.83, 118.73, 82.17, 69.42, 33.48, 26.13, 19.07.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{14}H_{15}NO^+$ 214.1226; Found 214.1223.



2-(1,4-dioxan-2-yl)-4-methylquinoline (4m)

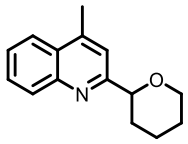
Prepared according to *general procedure*. Eluent: PE/ (EA) (3:1).

Obtained as a yellow solid (36.64 mg, 80%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.4 Hz, 1H), 7.98 (d, *J* = 8.3 Hz, 1H), 7.69 (t, *J* = 7.5 Hz, 1H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.46 (s, 1H), 4.97 – 4.83 (m, 1H), 4.23 (d, *J* = 11.6 Hz, 1H), 4.00 (q, *J* = 12.1, 11.7 Hz, 2H), 3.89 – 3.76 (m, 2H), 3.70 – 3.60 (m, 1H), 2.72 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.92, 147.38, 145.35, 129.91, 129.43, 127.75, 126.36, 123.82, 119.23, 78.90, 71.23, 67.21, 66.56, 19.00.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{14}H_{15}NO_2^+$ 230.1175; Found 230.1172.



4-methyl-2-(tetrahydro-2H-pyran-2-yl)quinoline (4n)

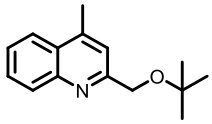
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow solid (35.41 mg, 78%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.06 (d, *J* = 8.4 Hz, 1H), 7.97 (d, *J* = 8.3 Hz, 1H), 7.68 (t, *J* = 7.5 Hz, 1H), 7.52 (t, *J* = 7.4 Hz, 1H), 7.46 (s, 1H), 4.61 (d, *J* = 11.2 Hz, 1H), 4.21 (d, *J* = 11.2 Hz, 1H), 3.75 – 3.64 (m, 1H), 2.71 (s, 3H), 2.10 (d, *J* = 13.1 Hz, 1H), 1.98 (s, 1H), 1.76 (t, *J* = 9.1 Hz, 2H), 1.67 – 1.58 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 162.27, 147.28, 145.16, 129.76, 129.21, 127.67, 125.98, 123.79, 118.94, 81.78, 69.06, 32.94, 26.02, 23.88, 18.99.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{17}NO^+$ 228.1383; Found 228.1383.



2-(tert-butoxymethyl)-4-methylquinoline (4o)

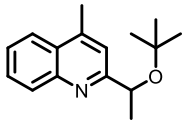
Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

Obtained as a yellow oil (32.98 mg, 72%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.4 Hz, 1H), 7.97 (d, *J* = 8.3 Hz, 1H), 7.68 (t, *J* = 7.6 Hz, 1H), 7.54 – 7.50 (m, 2H), 4.73 (s, 2H), 2.72 (s, 3H), 1.34 (s, 9H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 160.43, 147.23, 145.02, 129.41, 127.61, 125.93, 123.85, 120.21, 74.16, 66.14, 27.85, 19.02.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{15}H_{19}NO^+$ 230.1539; Found 230.1538.



2-(1-(tert-butoxy)ethyl)-4-methylquinoline (4p)

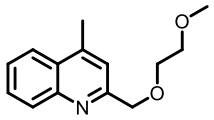
Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

Obtained as a yellow solid (37.42 mg, 77%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.3 Hz, 1H), 8.00 – 7.95 (m, 1H), 7.68 (t, *J* = 7.5 Hz, 1H), 7.56 (s, 1H), 7.52 (t, *J* = 7.3 Hz, 1H), 4.92 (q, *J* = 5.9 Hz, 1H), 2.72 (s, 3H), 1.46 (d, *J* = 6.6 Hz, 3H), 1.19 (s, 9H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 166.80, 147.05, 144.89, 129.44, 129.19, 127.51, 125.83, 123.85, 119.09, 74.80, 72.28, 28.63, 25.11, 19.11.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{16}H_{21}NO^+$ 243.3500; Found 243.3508.



2-((2-methoxyethoxy)methyl)-4-methylquinoline (4q)

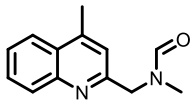
Prepared according to *general procedure*. Eluent: PE/ (EA) (6:1).

Obtained as a yellow oil (32.34 mg, 66%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.06 (d, *J* = 8.4 Hz, 1H), 7.99 (d, *J* = 8.3 Hz, 1H), 7.69 (t, *J* = 7.6 Hz, 1H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.50 (s, 1H), 4.84 (s, 2H), 3.81 – 3.71 (m, 2H), 3.67 – 3.56 (m, 2H), 3.42 (s, 3H), 2.72 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 158.77, 147.31, 145.37, 129.54, 127.72, 126.24, 123.88, 120.27, 74.82, 72.01, 70.26, 59.23, 19.01.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{14}H_{17}NO_2^+$ 232.1332; Found 232.1330.



N-methyl-N-((4-methylquinolin-2-yl)methyl)formamide (4r)

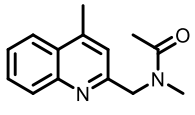
Prepared according to *general procedure*. Eluent: PE/ (EA) (1:1).

Obtained as a colourless oil (32.10 mg, 75%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.4 Hz, 1H), 8.01 (d, *J* = 8.3 Hz, 1H), 7.73 (t, *J* = 7.6 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.54 (s, 1H), 3.17 (d, *J* = 18.6 Hz, 6H), 2.73 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 169.40, 154.07, 146.53, 145.83, 130.31, 129.79, 128.18, 127.34, 123.84, 121.23, 39.18, 35.86, 18.94.

HRMS (ESI) m/z: $[M+Na]^+$ Calcd for $C_{13}H_{14}N_2ONa^+$ 237.0998; Found 237.0996.



N-methyl-N-((4-methylquinolin-2-yl)methyl)acetamide (4s)

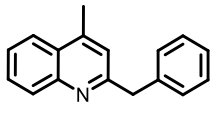
Prepared according to *general procedure*. Eluent: PE/ (EA) (1:1).

Obtained as a colourless oil (32.83 mg, 72%)**.**

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.04 (dd, *J* = 14.7, 8.5 Hz, 1H), 7.98 (dd, *J* = 14.2, 8.4 Hz, 1H), 7.71 (dt, *J* = 14.7, 7.6 Hz, 1H), 7.55 (dt, *J* = 14.9, 7.6 Hz, 1H), 7.24 (s, 1H), 7.11 (s, 0H), 4.85 (s, 1H), 4.75 (s, 1H), 3.05 (s, 3H), 2.72 – 2.65 (m, 3H), 2.20 (d, *J* = 9.2 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 171.61, 171.11, 157.69, 156.86, 147.83, 147.29, 146.11, 145.66, 129.84, 129.64, 129.51, 129.48, 127.60, 127.49, 126.51, 126.31, 123.91, 123.83, 120.86, 118.75, 56.97, 53.28, 36.30, 34.54, 21.94, 21.83, 19.07, 18.92.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{14}H_{16}N_2O^+$ 229.1335; Found 229.1331.



2-benzyl-4-methylquinoline (4t)

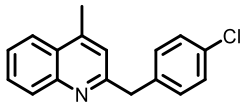
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a yellow solid (24.70 mg, 53%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.13 (d, *J* = 7.6 Hz, 1H), 7.94 (d, *J* = 8.2 Hz, 1H), 7.71 (t, *J* = 7.5 Hz, 1H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.31 (q, *J* = 7.3 Hz, 4H), 7.23 (t, *J* = 6.7 Hz, 1H), 7.07 (s, 1H), 4.32 (s, 2H), 2.62 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 160.88, 147.39, 145.20, 139.33, 129.50, 129.37, 128.77, 127.03, 126.64, 126.03, 123.79, 122.34, 45.41, 18.91.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{17}H_{15}N^+$ 234.1204; Found 234.2255.



2-(4-chlorobenzyl)-4-methylquinoline (4u)

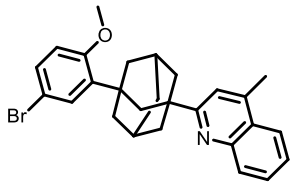
Prepared according to *general procedure*. Eluent: PE/ (EA) (10:1).

Obtained as a colorless oil (23.50 mg, 44%).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.4 Hz, 1H), 7.95 (d, *J* = 8.3 Hz, 1H), 7.71 (t, *J* = 7.6 Hz, 1H), 7.53 (t, *J* = 7.5 Hz, 1H), 7.25 (s, 4H), 7.04 (s, 1H), 4.26 (s, 2H), 2.63 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 160.30, 147.58, 145.24, 137.87, 132.49, 130.65, 129.56, 129.50, 128.87, 127.04, 126.12, 123.82, 122.19, 44.75, 18.90.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{17}H_{14}ClN^+$ 268.0893; Found 268.0892.



2-(3-(5-bromo-2-methoxyphenyl)adamantan-1-yl)-4-methylquinoline (4v)

Prepared according to *general procedure* with 2 equiv of 1-(5-Bromo-2-methoxy-phenyl)adamantane (differin precursor). Eluent: PE/ (EA) (3:1).

Obtained as a white solid (76.53 mg, 83%).

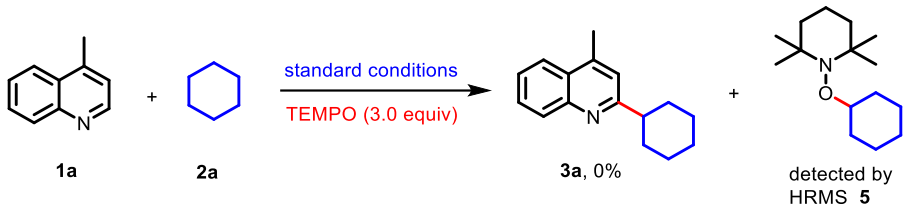
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.10 (d, *J* = 7.8 Hz, 1H), 7.95 (d, *J* = 8.1 Hz, 1H), 7.68 (t, *J* = 7.5 Hz, 1H), 7.51 (t, *J* = 7.3 Hz, 1H), 7.40 (s, 1H), 7.36 (s, 1H), 7.29 (d, *J* = 8.6 Hz, 1H), 6.74 (d, *J* = 8.6 Hz, 1H), 3.81 (s, 3H), 2.70 (s, 3H), 2.39 (s, 2H), 2.35 (s, 2H), 2.20 (d, *J* = 12.3 Hz, 4H), 2.14 (d, *J* = 11.9 Hz, 4H), 1.85 (s, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 168.32, 158.01, 147.62, 143.76, 140.26, 130.09, 129.91, 129.60, 128.78, 126.86, 125.51, 123.54, 118.67, 113.45, 113.38, 55.36, 44.52, 41.16, 40.66, 39.76, 38.27, 36.30, 29.62, 19.13.

HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{27}H_{28}BrNO^+$ 462.4310; Found 462.4313.

5. Mechanistic studies

5.1 Free radical-trapping experiment



A 10 mL oven-dried quartz tube equipped with a magnetic stirrer was charged with lepidine (**1a**, 26.4 μL, 0.20 mmol, 1.0 equiv.), cyclohexane (**2a**, 0.10 mL), *tert*-Butyl peroxybenzoate (TBPB) (76 μL, 1.0 mmol, 2.0 equiv.), TFA (15 μL, 0.20 mmol, 1.0 equiv.), TEMPO (2,2,6,6-tetramethyl-1-piperidinyloxy, 0.60 mmol, 3.0 equiv.), H_2O (200 μL), and 1,2-dichloroethane (DCE, 2.0 mL). The reaction vessel was exposed to 40 W blue LEDs irradiation at room temperature under N_2 atmosphere with stirring for 6 h. After the reaction was stopped, no desired product **3a** was detected in the mixture, while an adduct (**5**) of TEMPO with a cyclohexyl radical was formed, which was detected by HRMS. The model reaction was completely inhibited, indicating that a radical pathway was involved in the reaction.

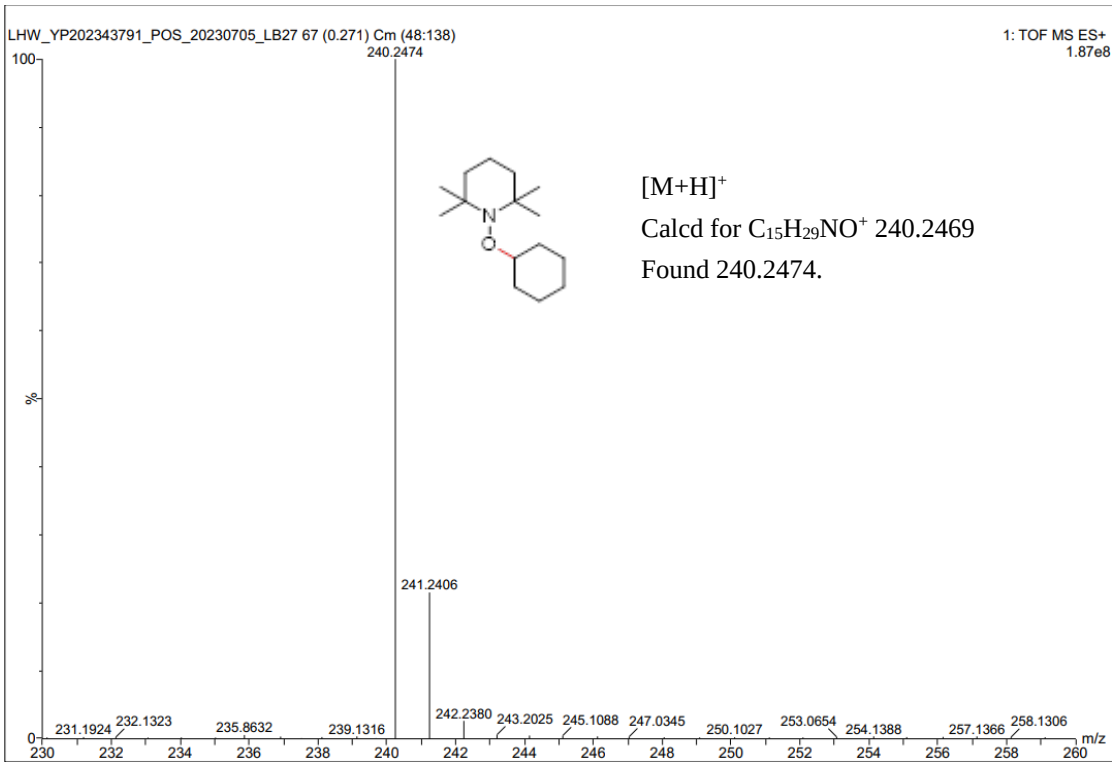
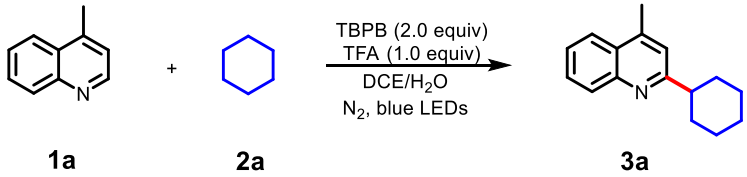


Figure S1. HRMS analysis of **5**

5.2 Light on/off experiment

The reaction between **1a** and **2a** was conducted under the standard conditions on a 0.2 mmol scale. The mixture was subjected to sequential periods of stirring under visible light irradiation (40 W, blue LEDs) followed by stirring in the absence of light. At the end of each period, a small portion (100 to 150 μL) of the reacting solution was taken by a syringe, basified with sat $NaHCO_3$ (aq), extracted with EtOAc, and the volatiles were removed under reduced pressure to obtain the crude sample, which was taken for ^1H NMR analysis.



Time (h)	Light	Yields of **1a** to **3a** (%)
1	On	47
2	OFF	47
3	On	63
4	OFF	63
5	On	78
6	OFF	78

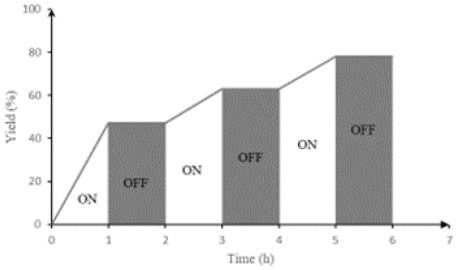


Figure S2. Time frame for the yield of 1a to 3a

From the light on/off experiments, we found that the reaction needed continual irradiation of light, and thus it is not a photo-initiated reaction. Finding suggest that a radical chain pathway is unlikely.

5.3 UV-Vis spectroscopic investigation

Preparation. Two formulated solutions were prepared with degassed DCE in 10 mL volumetric flasks. For flask A, lepidine (**1a**, 4MeQL, 1.0 mmol, 132 μL), was added; for flask B, lepidine (**1a**, 4MeQL, 1.0 mmol, 132 μL) and TFA (76 μL, 1.0 mmol) were added. All these flasks were diluted to 10 mL to set the concentration to be 0.10 M.

UV-Vis spectrometric experiments. A quartz cuvette (1 cm × 1 cm × 3.5 cm) was filled with 2 mL of the abovementioned 0.10 M solutions from flasks A and B to perform the UV-vis experiment (500 nm to 200 nm). The resulting spectra are shown in Figure S3.

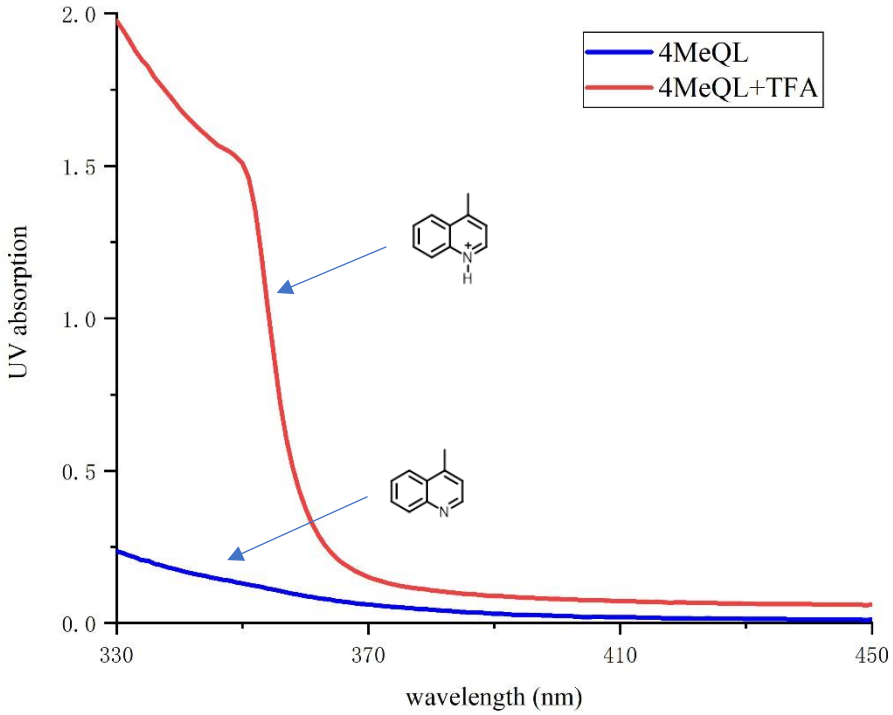


Figure S3. UV-Vis spectra of lepidine with and without acid.

5.4 Stern-Volmer plot

5.4.1: Fluorescent change with the addition of TBPB without and with acid (*all the fluorescence spectra were obtained at 320 nm exciting wavelength*) and the concentration of the lepidine is 0.1 μM.

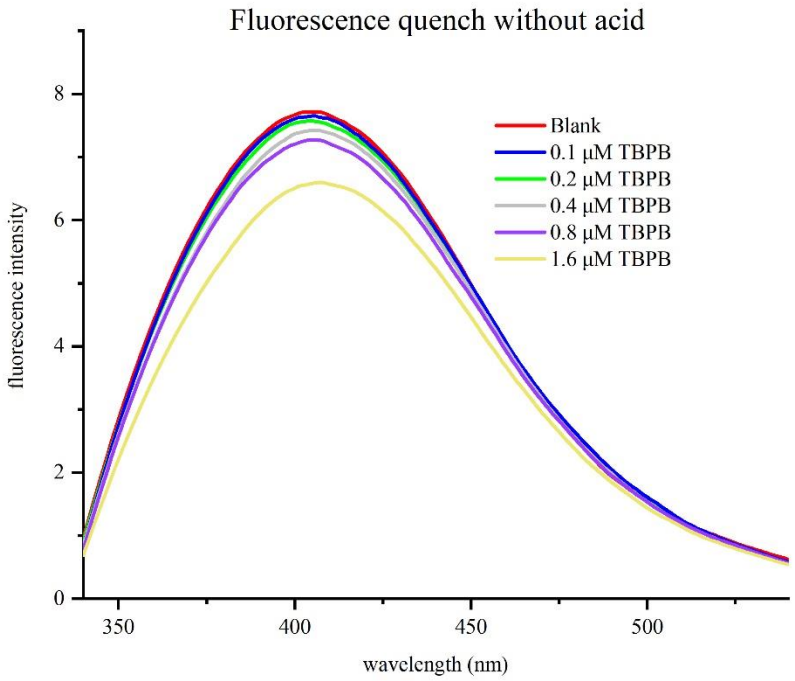


Figure S4. fluorescence quenching of TBPB without acid.

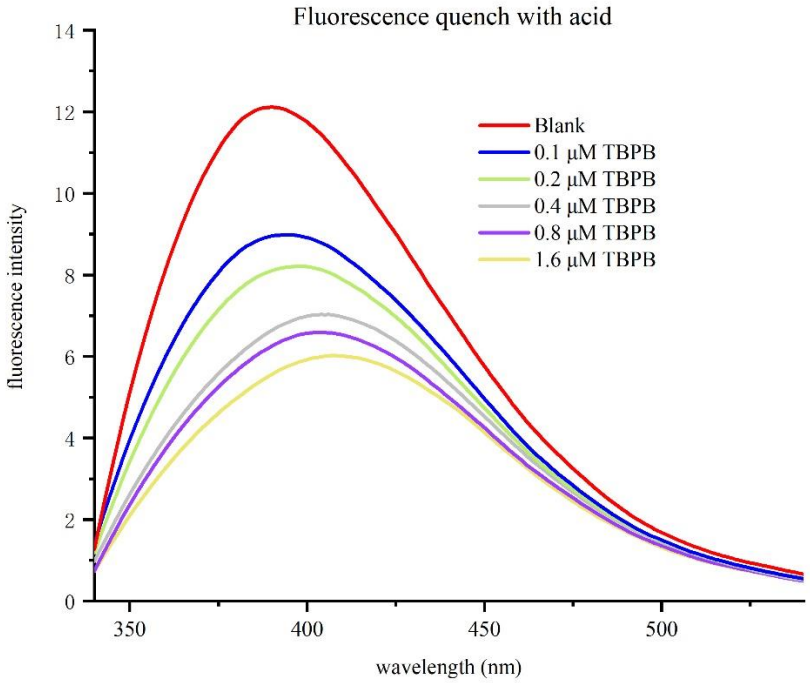


Figure S5. fluorescence quenching of TBPB with acid.

5.4.2 Stern-Volmer plot without and with acid

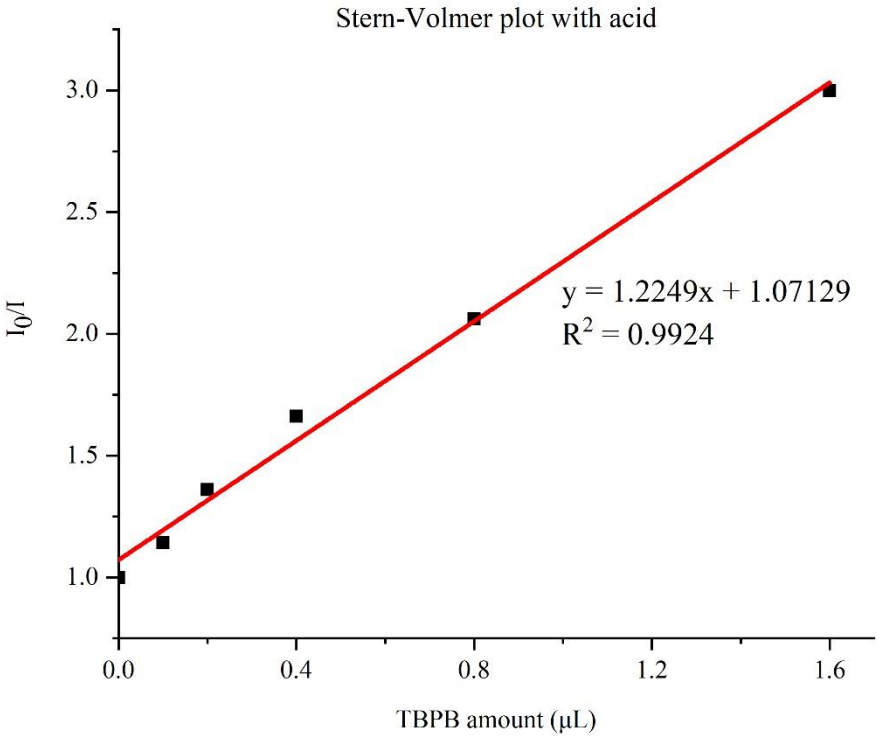


Figure S6. Stern-Volmer analysis of TBPB and lepidine with acid.

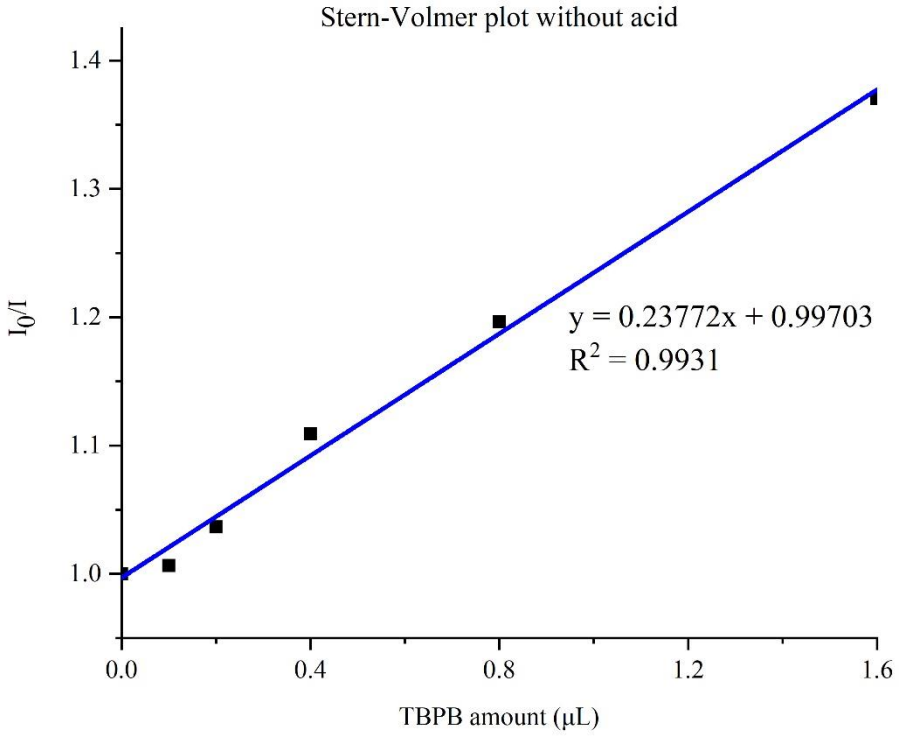


Figure S7. Stern-Volmer analysis of TBPB and lepidine without acid.

5.5 NMR analysis in $CDCl_3$

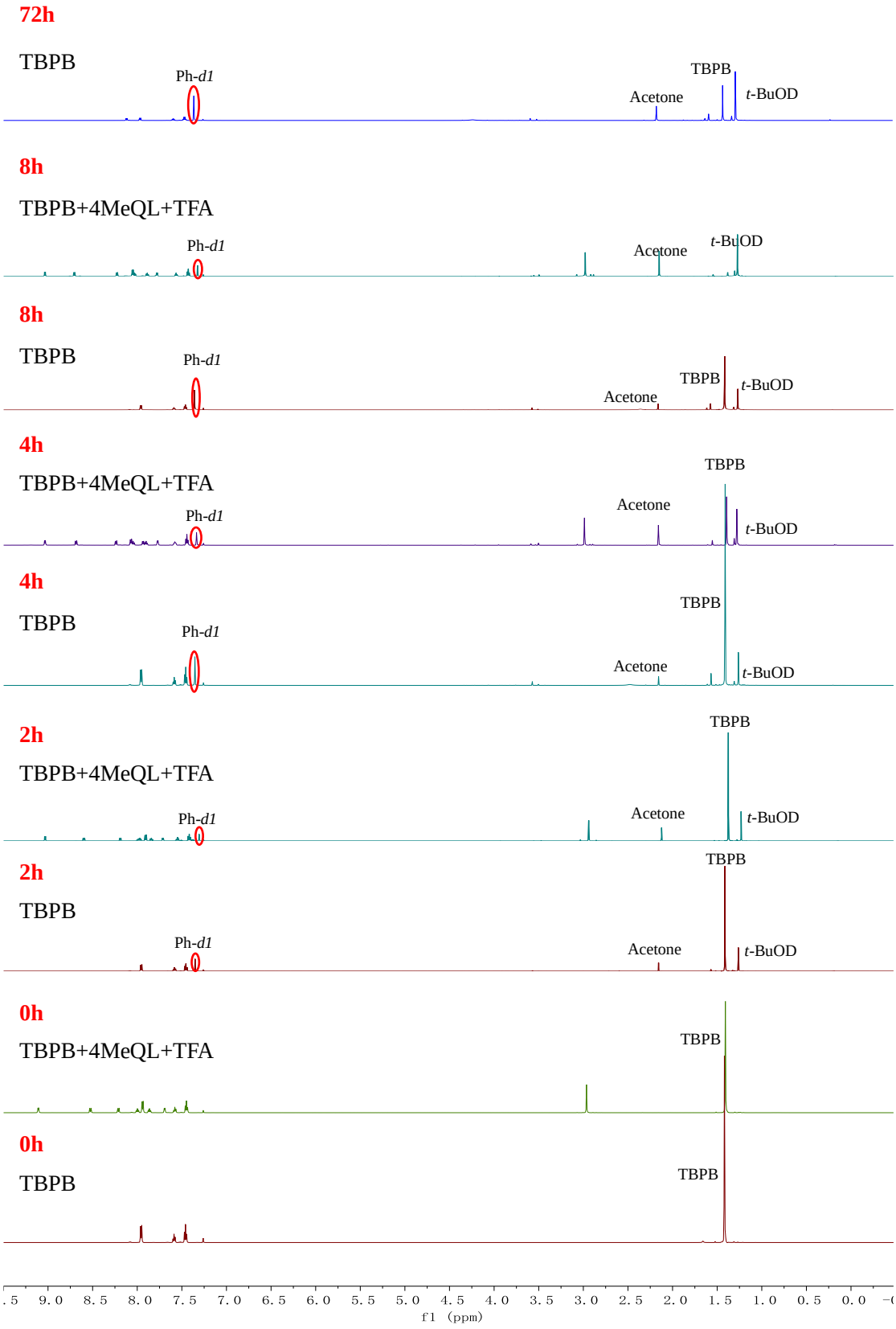
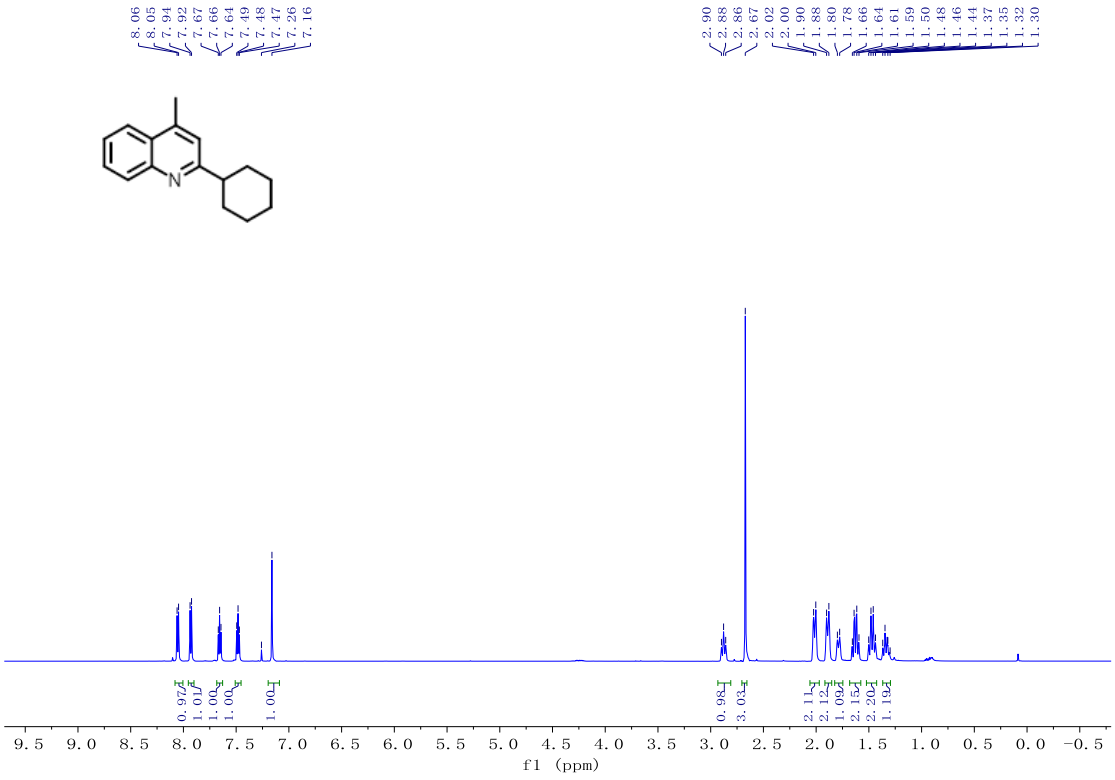


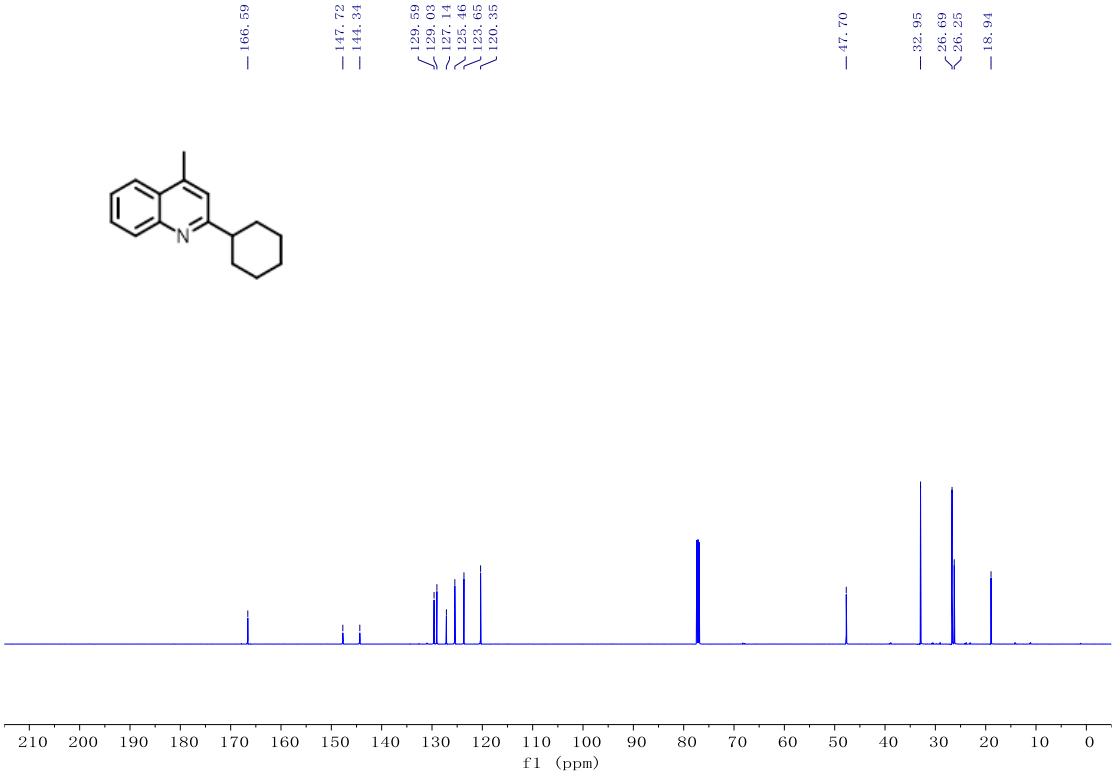
Figure S8. Complete conversion of TBPB to *t*-BuOH and acetone under blue LEDs irradiation in 8 h in $CDCl_3$.

6. NMR Spectra

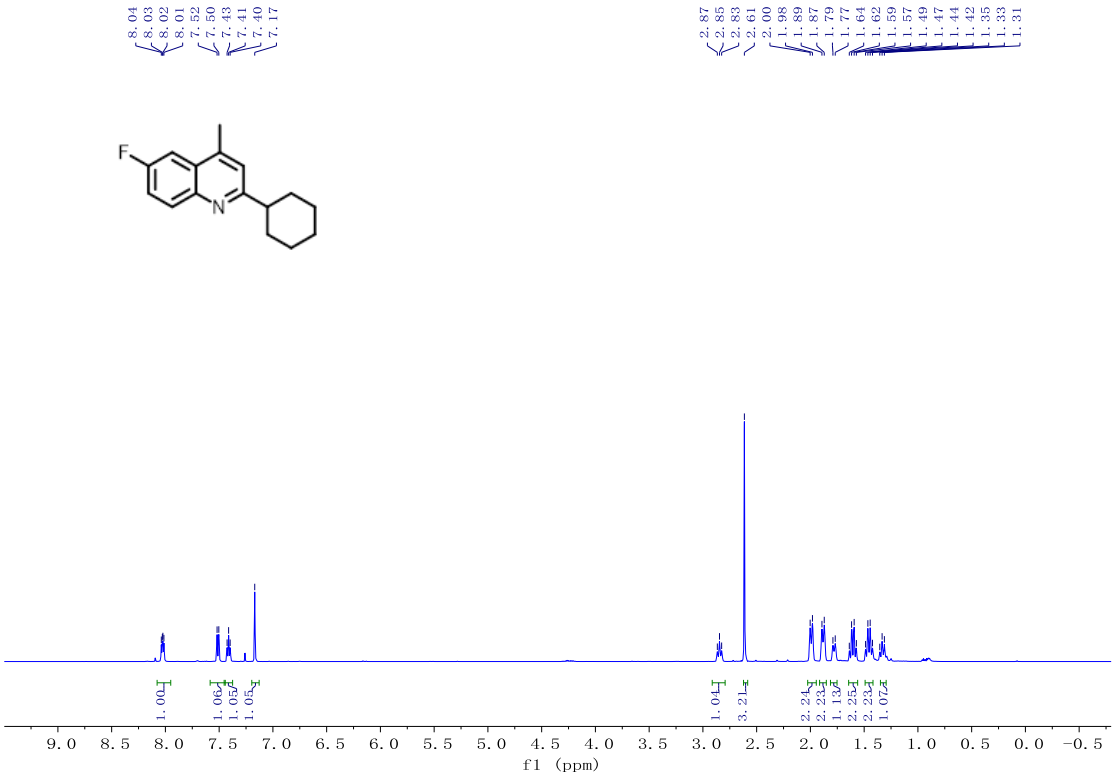
^{1}H NMR of **3a** (600MHz, $CDCl_3$)



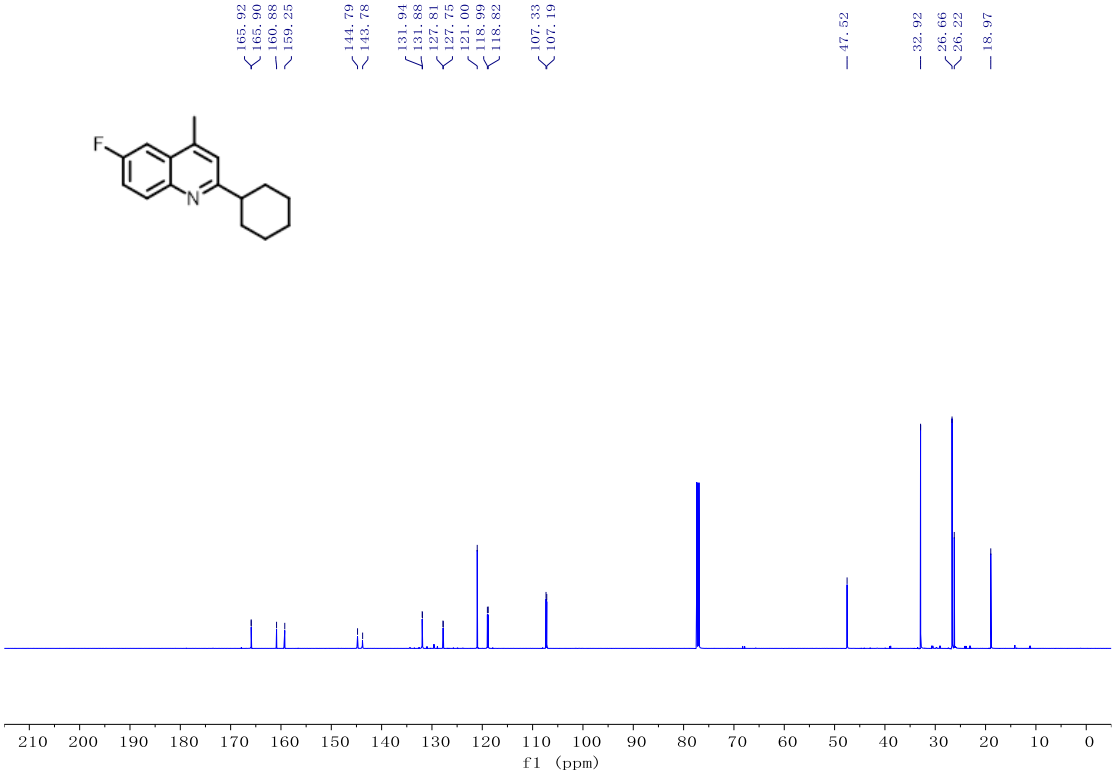
^{13}C NMR of **3a** (151MHz, $CDCl_3$)



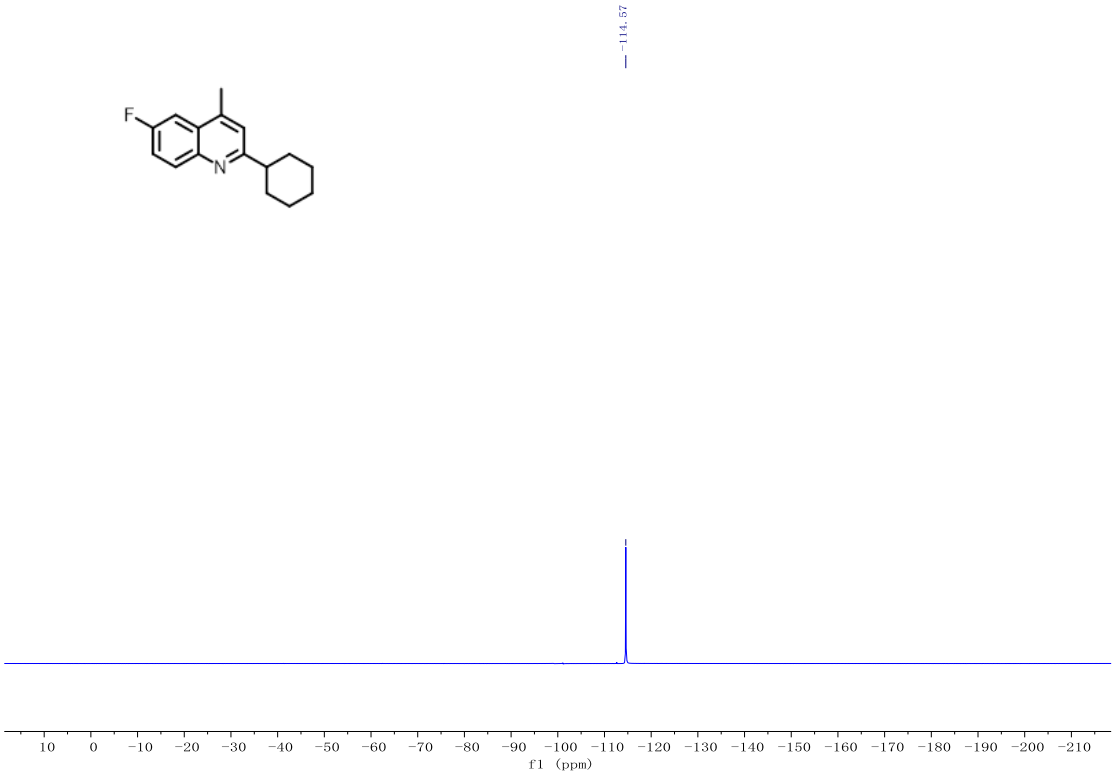
^{1}H NMR of **3b** (600MHz, $CDCl_3$)



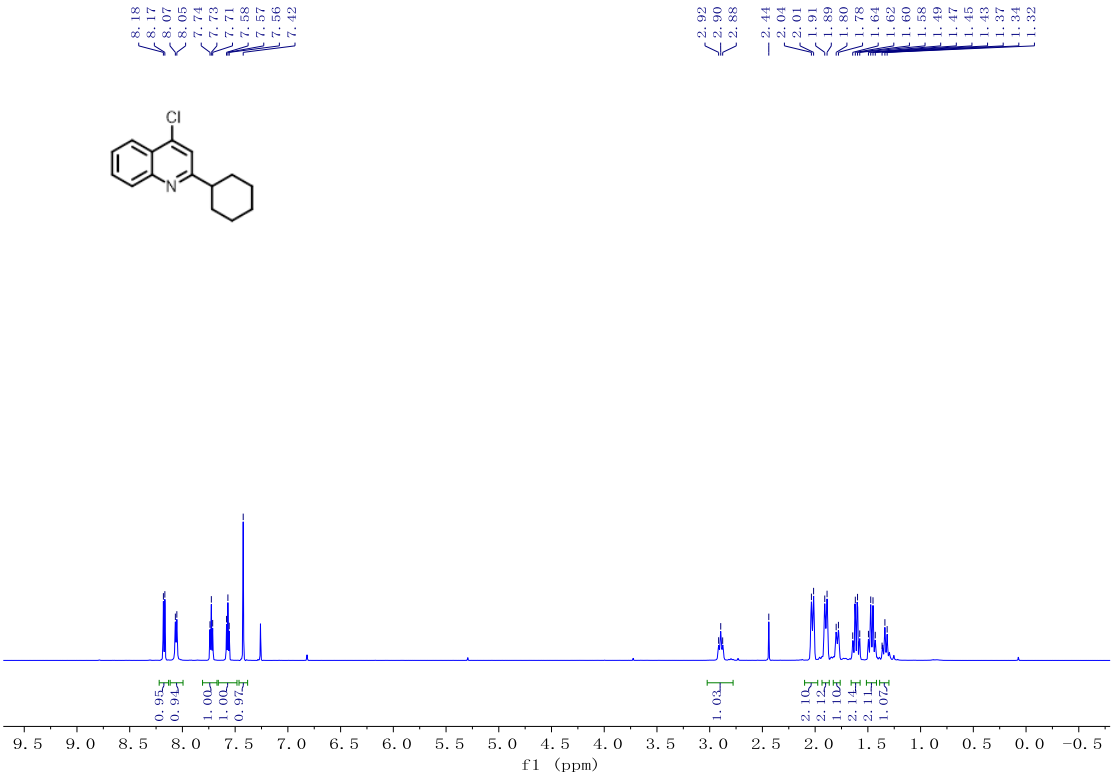
^{13}C NMR of **3b** (151MHz, $CDCl_3$)



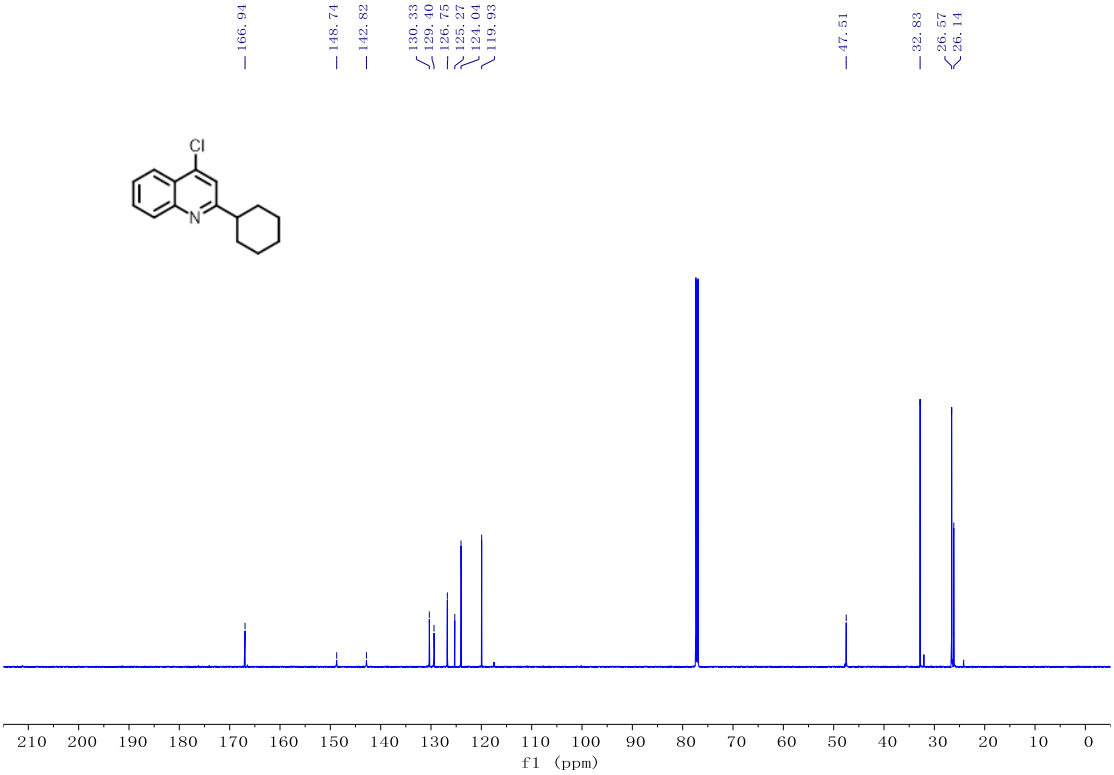
^{19}F NMR of **3b** (376 MHz, $CDCl_3$)



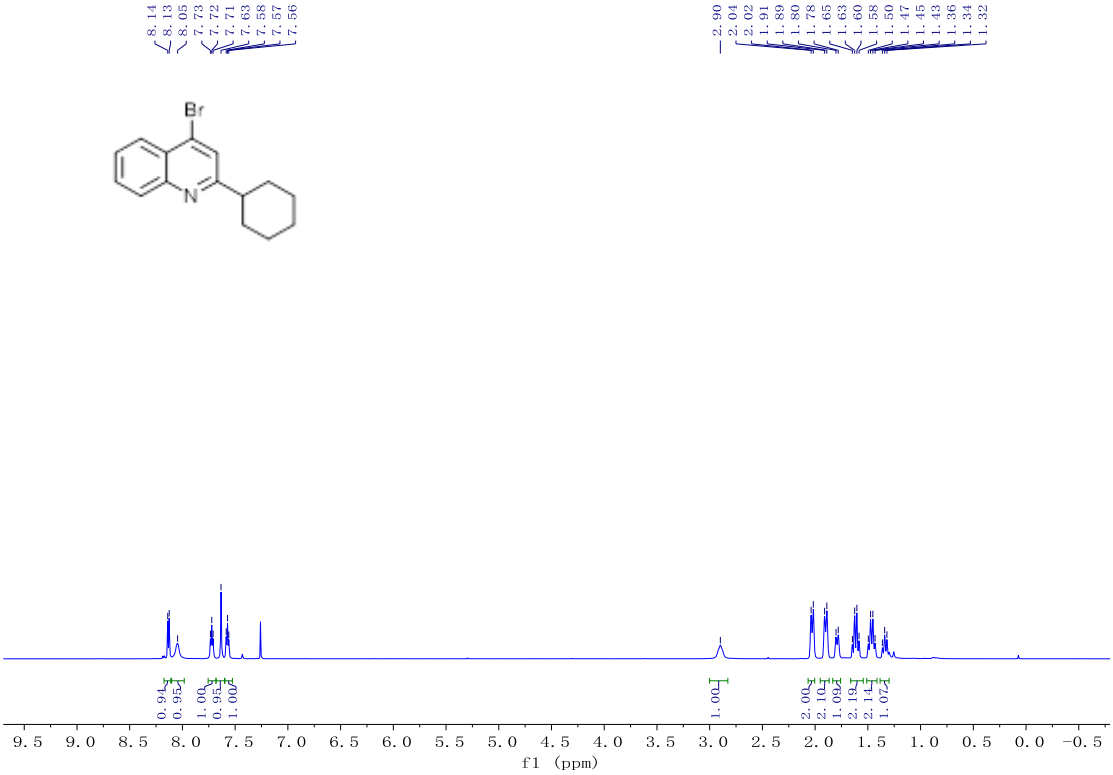
^{1}H NMR of **3c** (600MHz, $CDCl_3$)



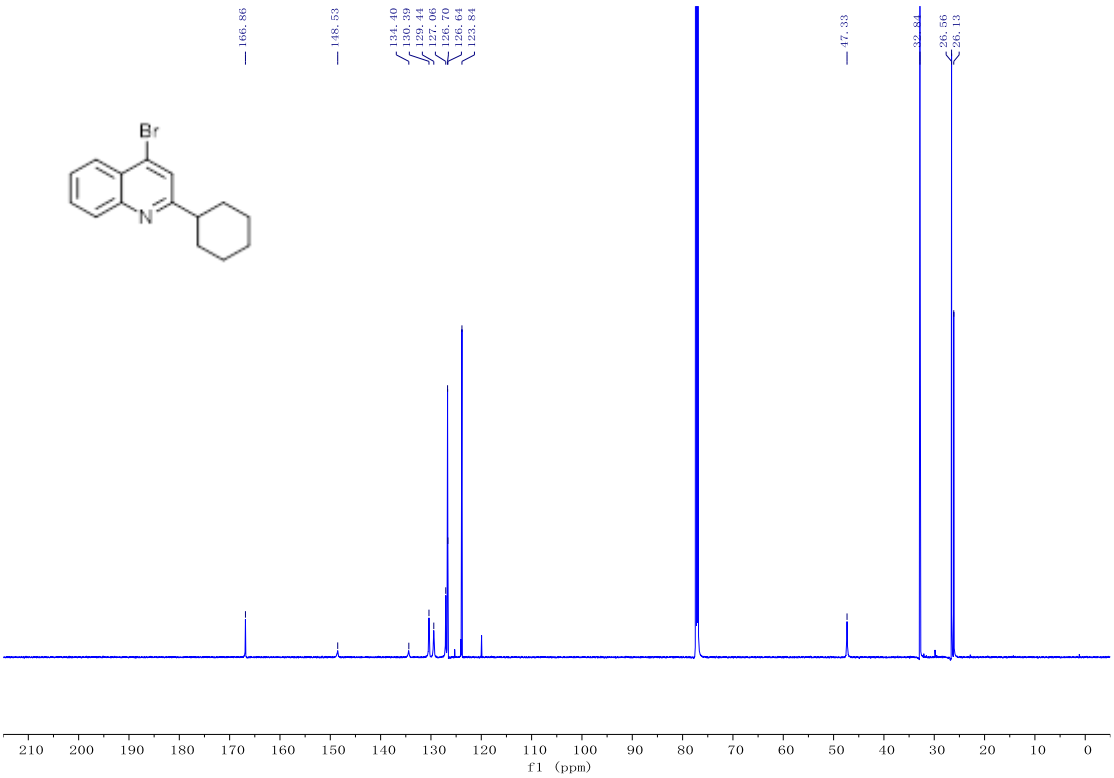
^{13}C NMR of **3c** (151MHz, $CDCl_3$)



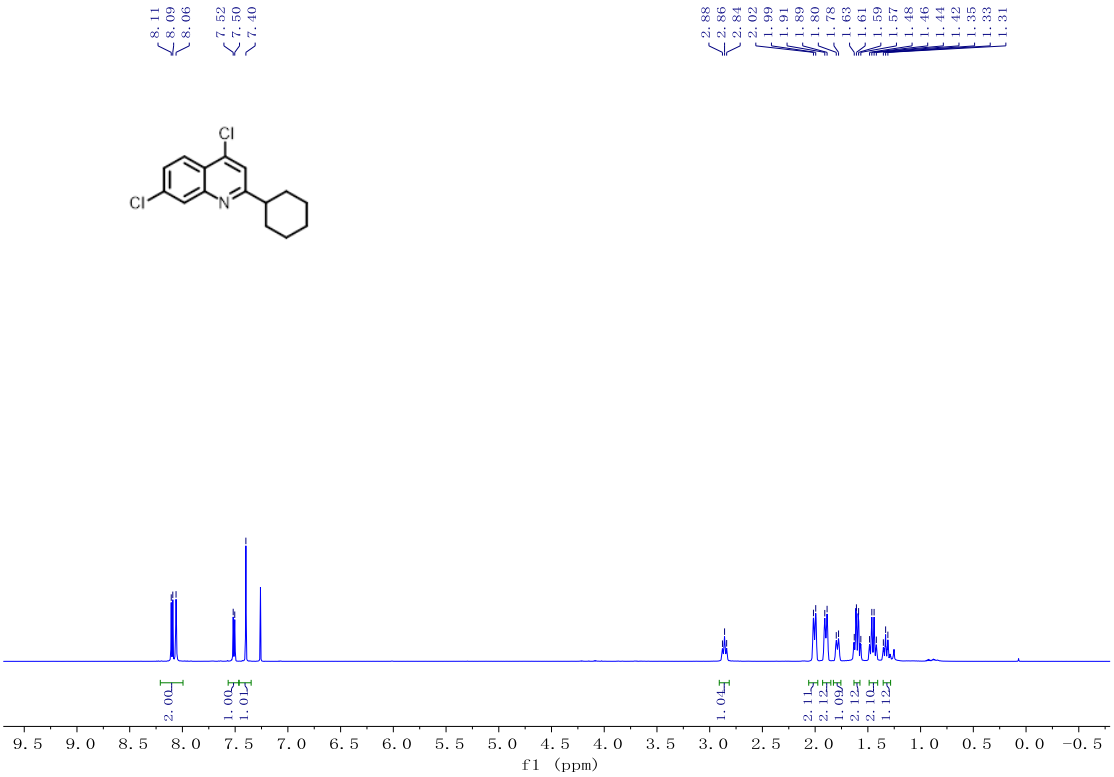
^{1}H NMR of **3d** (600MHz, $CDCl_3$)



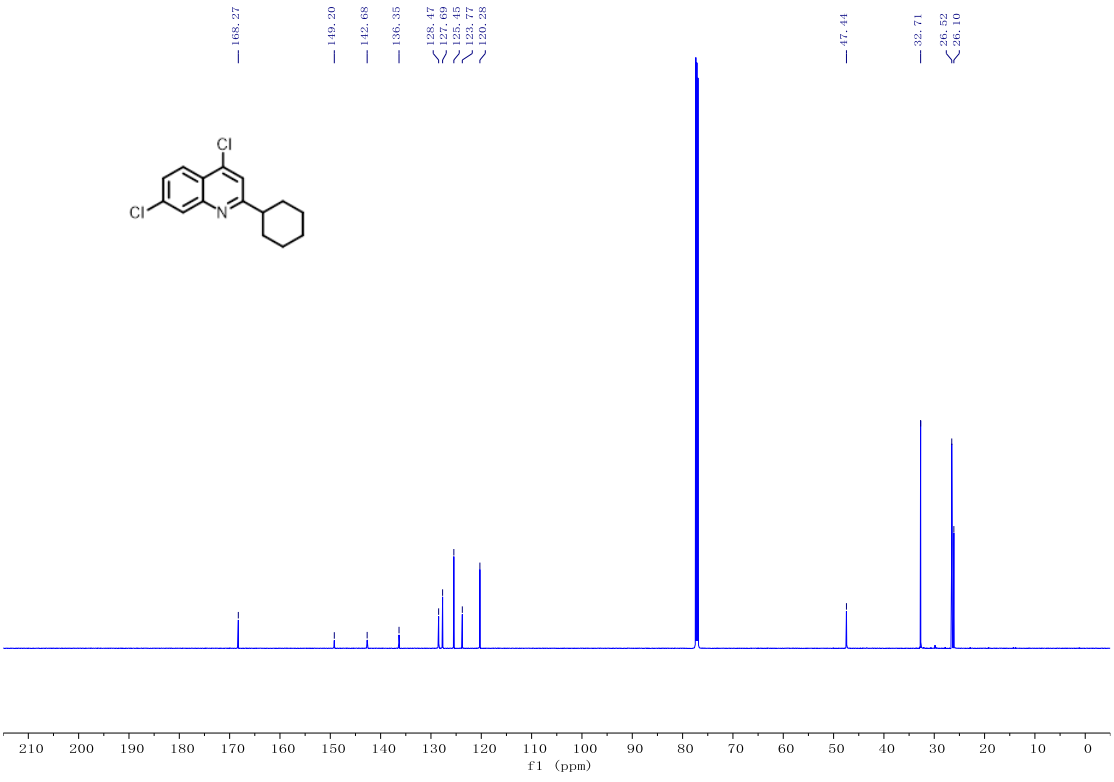
^{13}C NMR of **3d** (151MHz, $CDCl_3$)



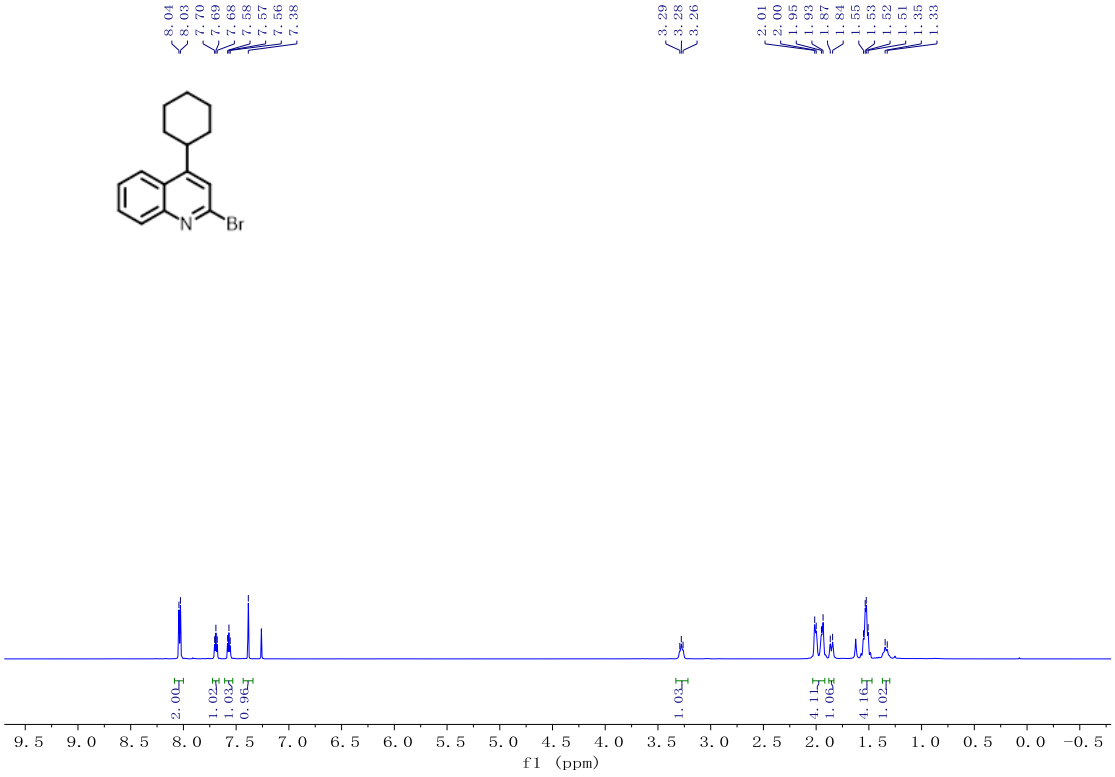
^{1}H NMR of **3e** (600MHz, $CDCl_3$)



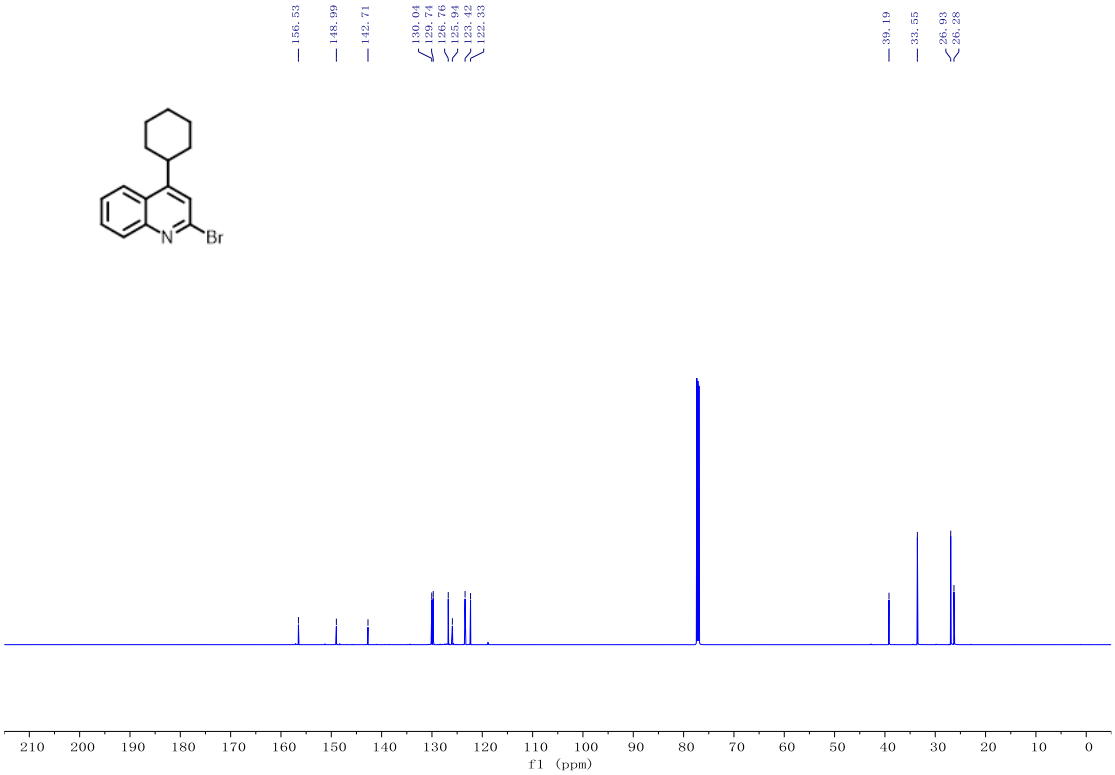
^{13}C NMR of **3e** (151MHz, $CDCl_3$)



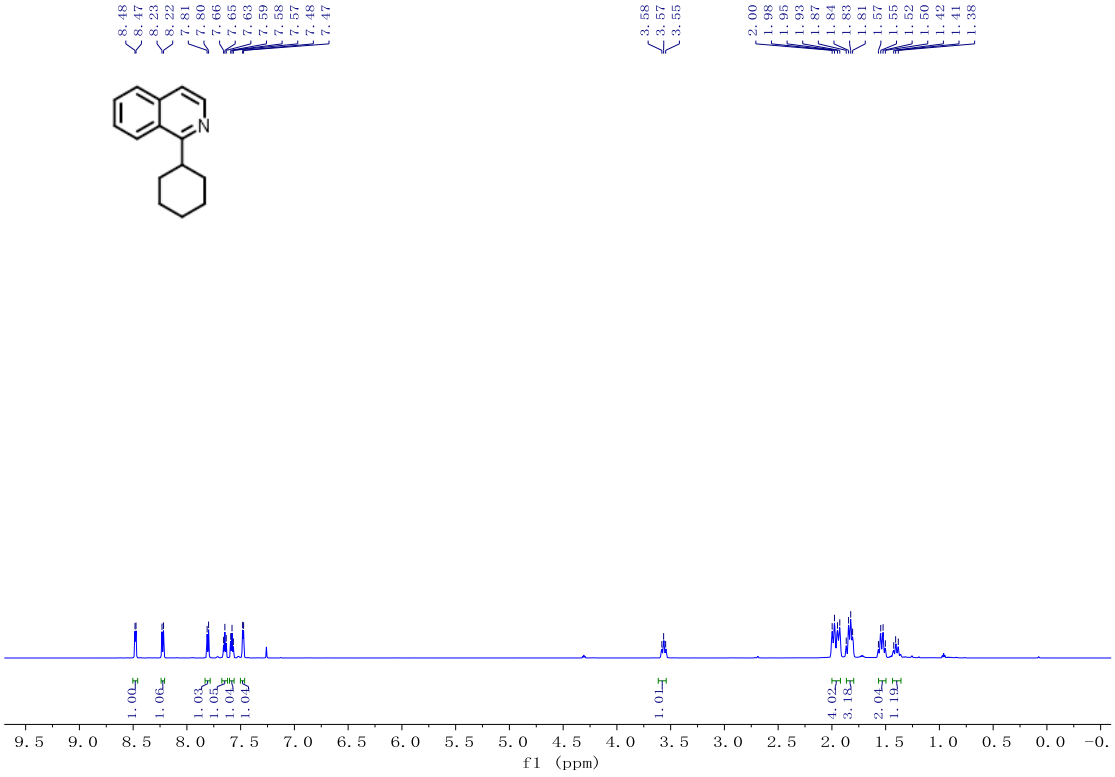
^{1}H NMR of **3f** (600MHz, $CDCl_3$)



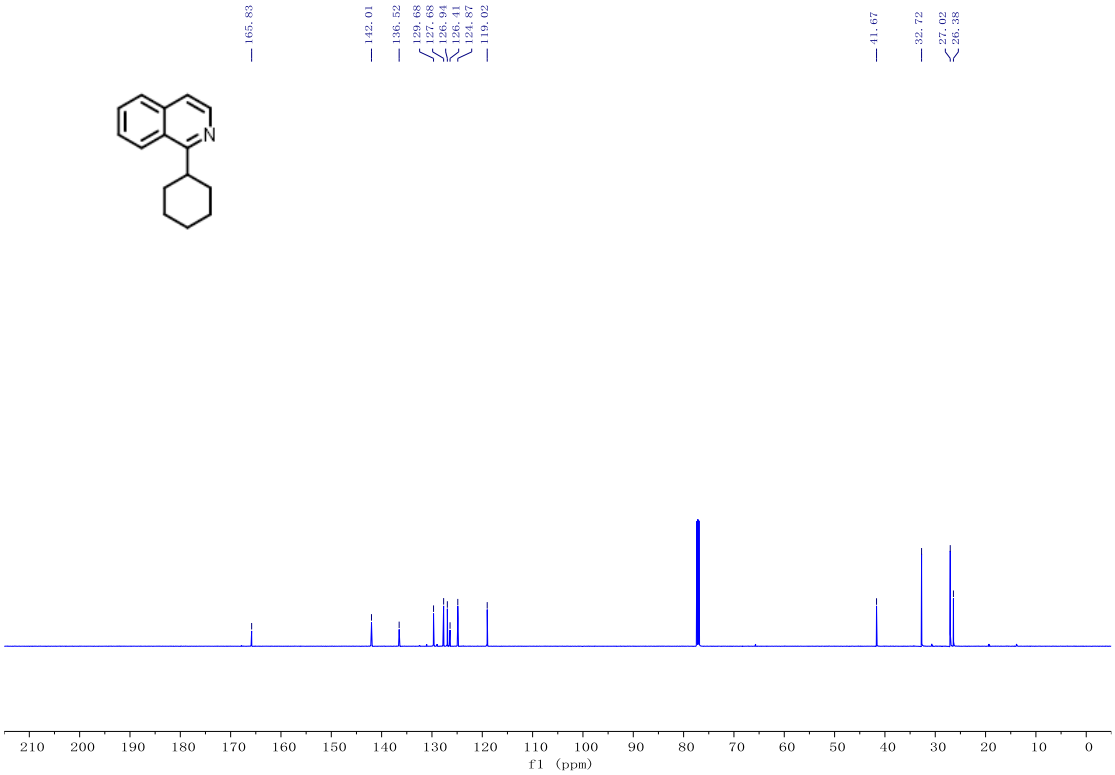
^{13}C NMR of **3f** (151MHz, $CDCl_3$)



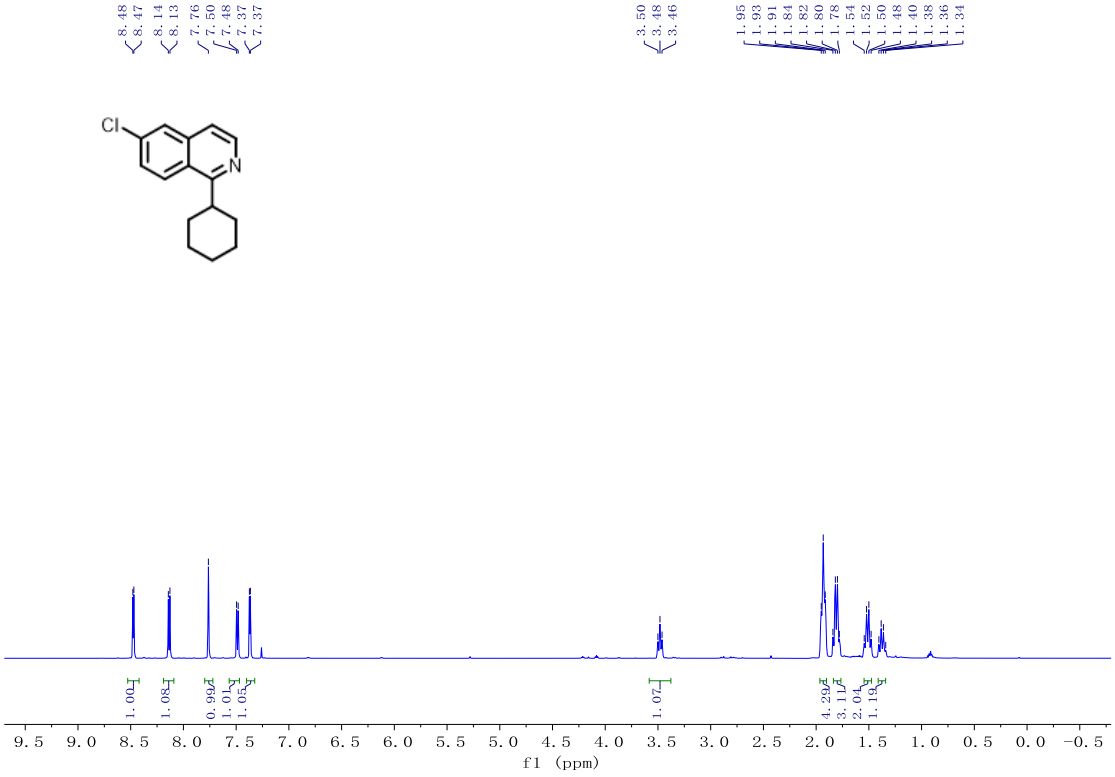
^{1}H NMR of **3g** (600MHz, $CDCl_3$)



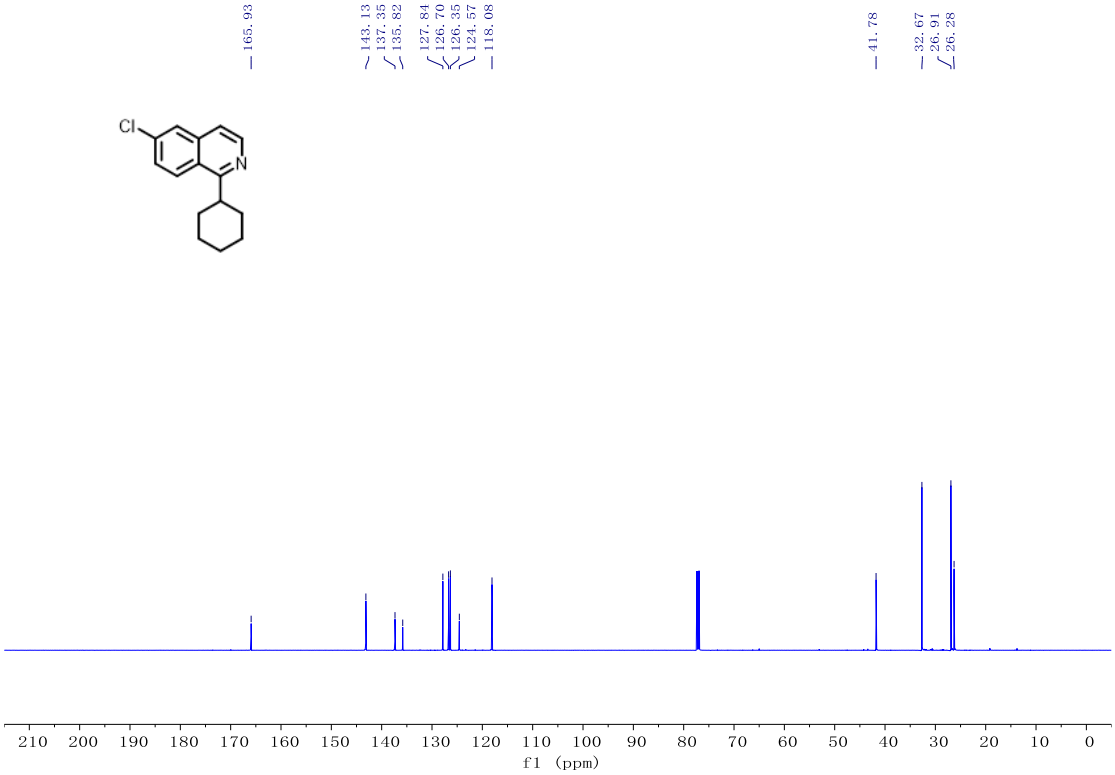
^{13}C NMR of **3g** (151MHz, $CDCl_3$)



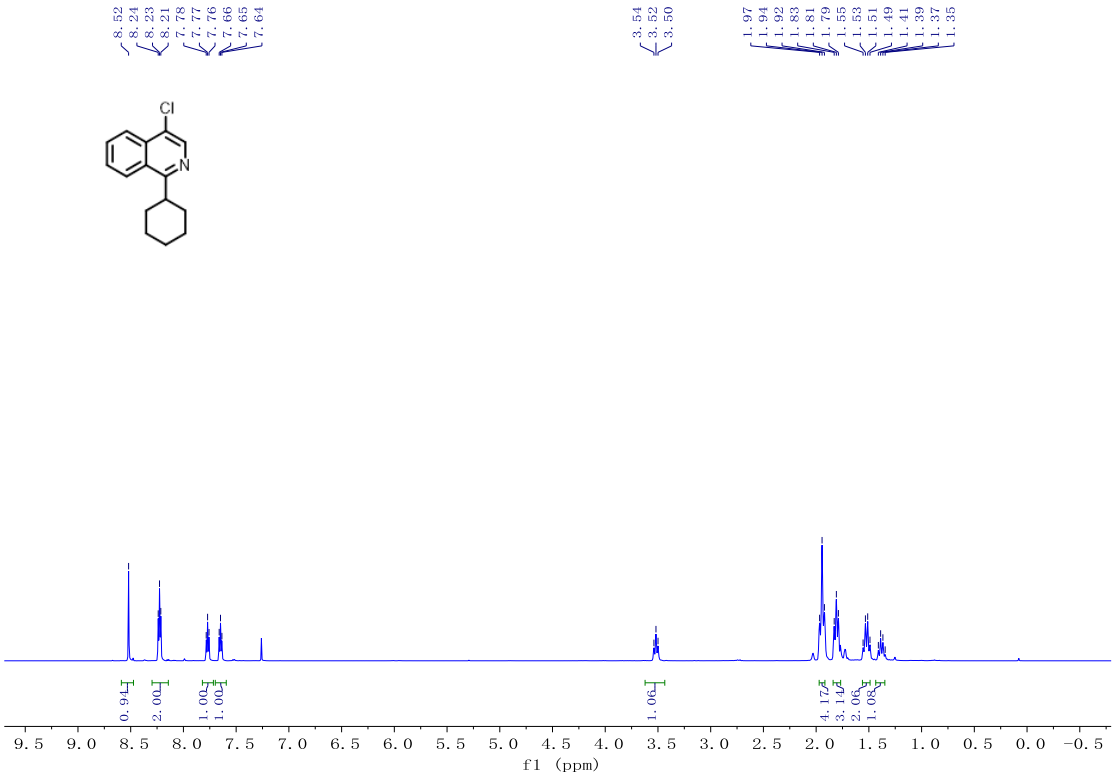
^{1}H NMR of **3h** (600MHz, $CDCl_3$)



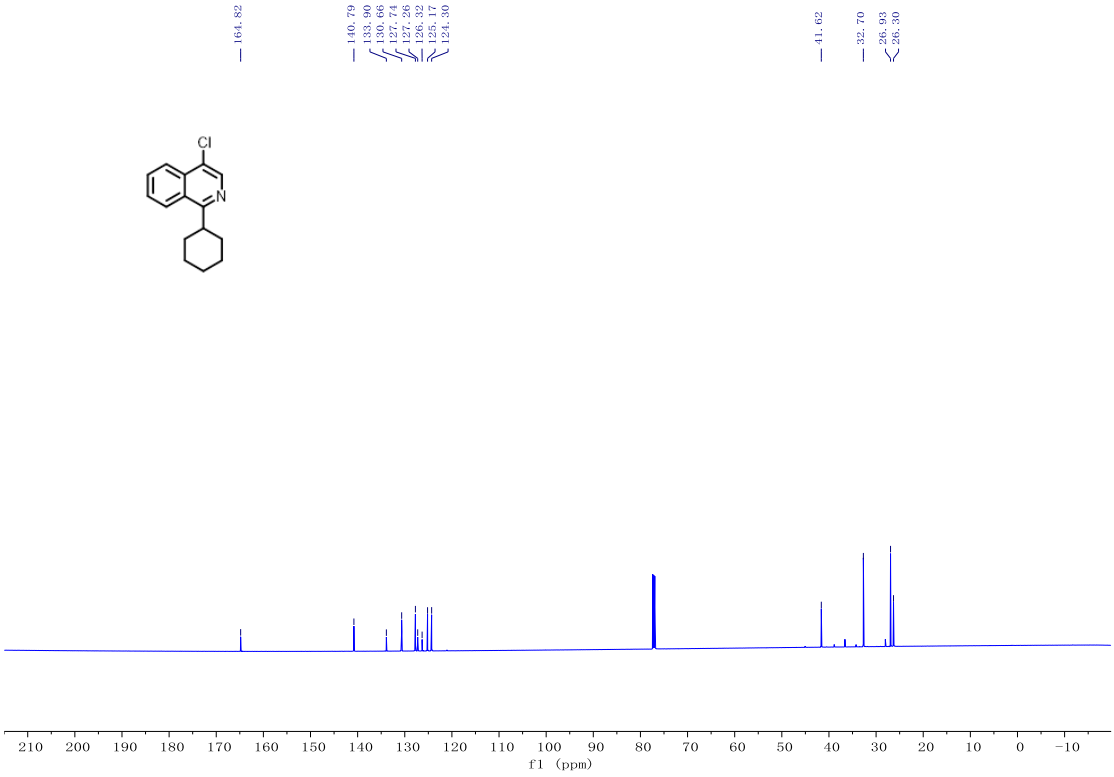
^{13}C NMR of **3h** (151MHz, $CDCl_3$)



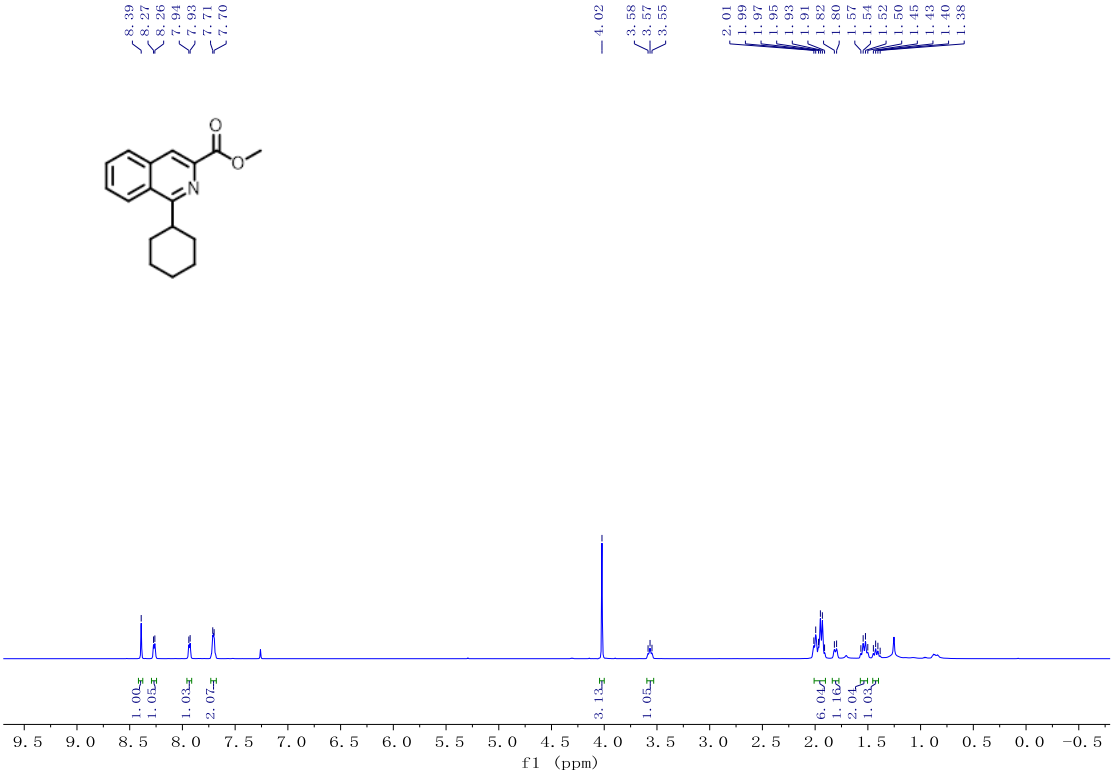
^{1}H NMR of **3i** (600MHz, $CDCl_3$)



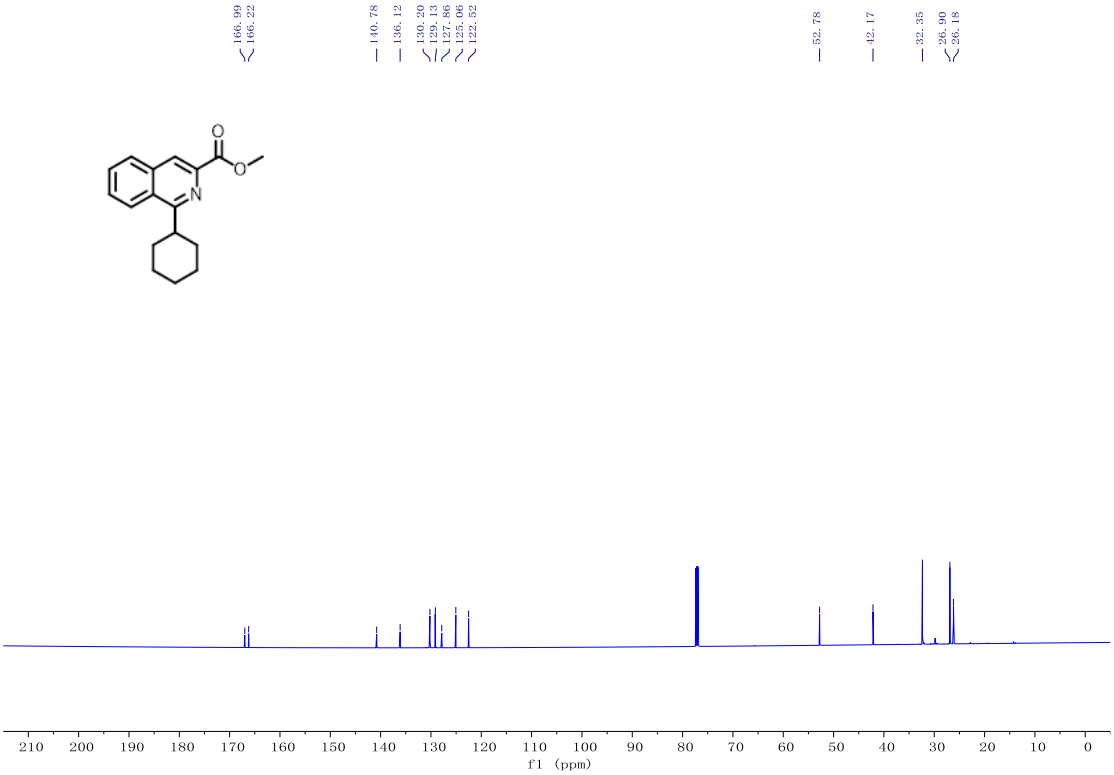
^{13}C NMR of **3i** (151MHz, $CDCl_3$)



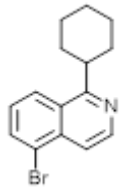
^{1}H NMR of **3j** (600MHz, $CDCl_3$)

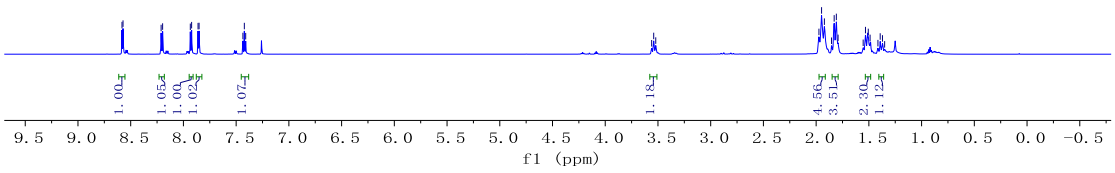


^{13}C NMR of **3j** (151MHz, $CDCl_3$)

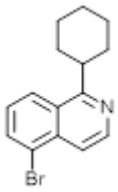


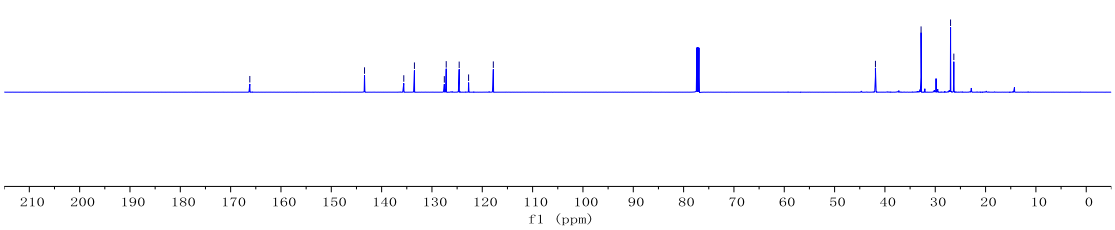
^{1}H NMR of **3k** (600MHz, $CDCl_3$)



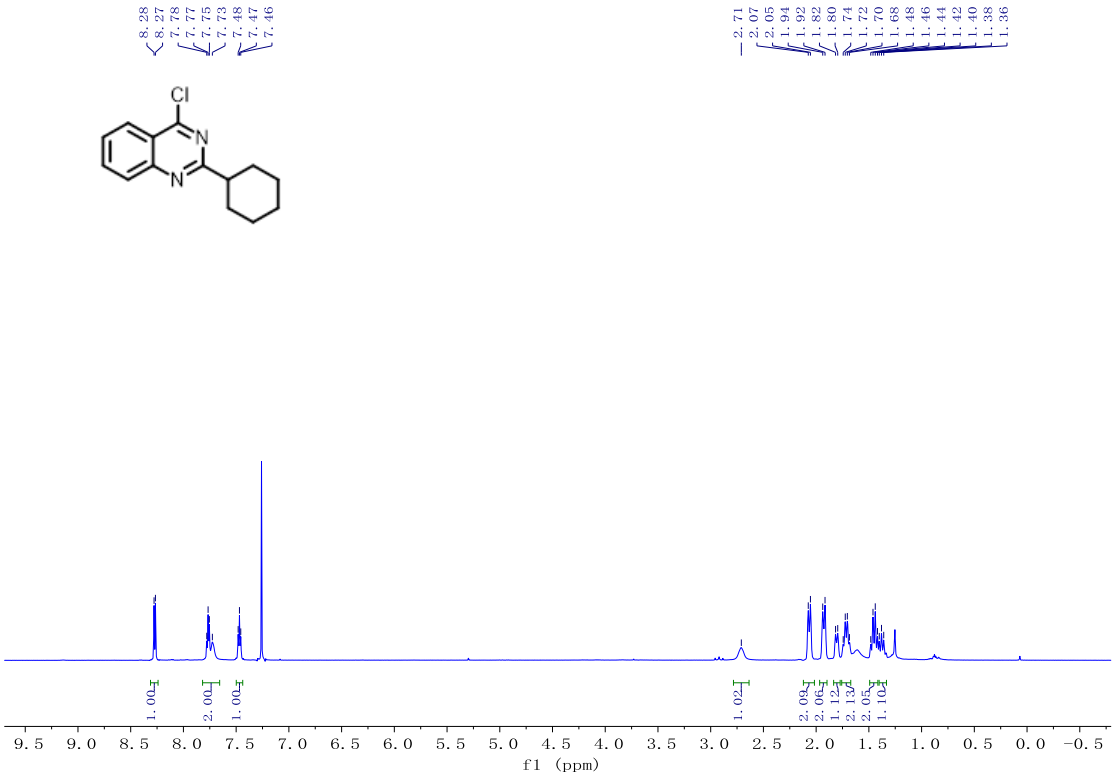


^{13}C NMR of **3k** (151MHz, $CDCl_3$)

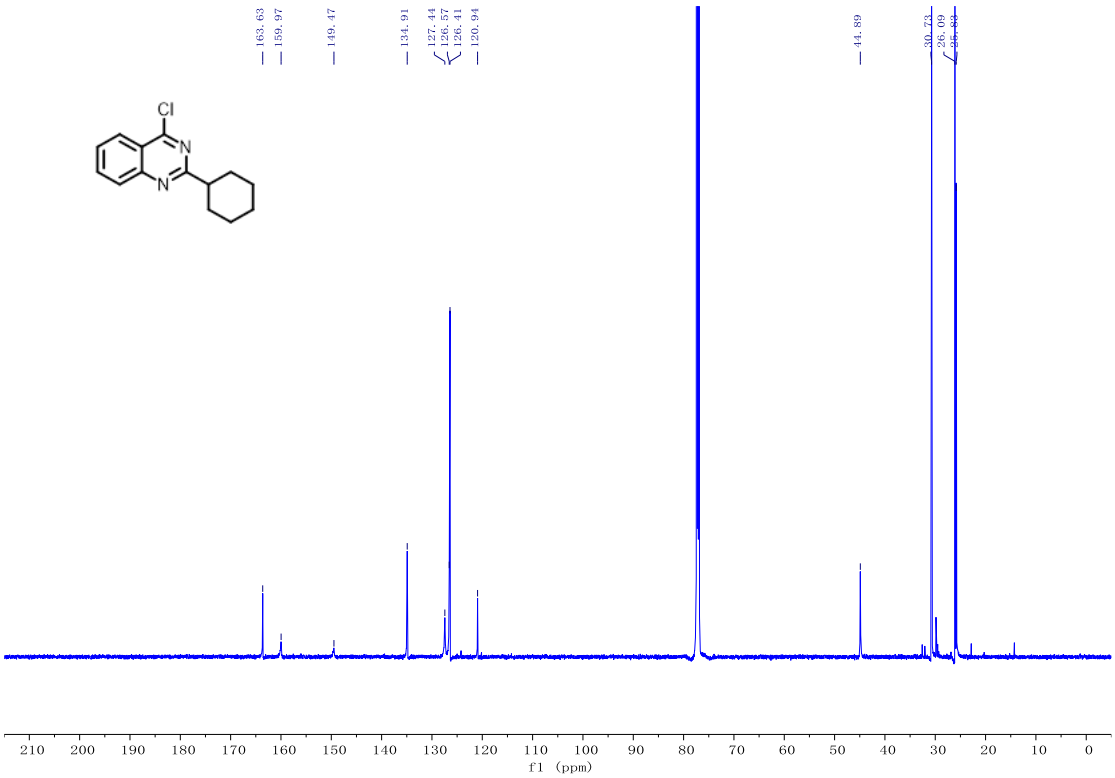




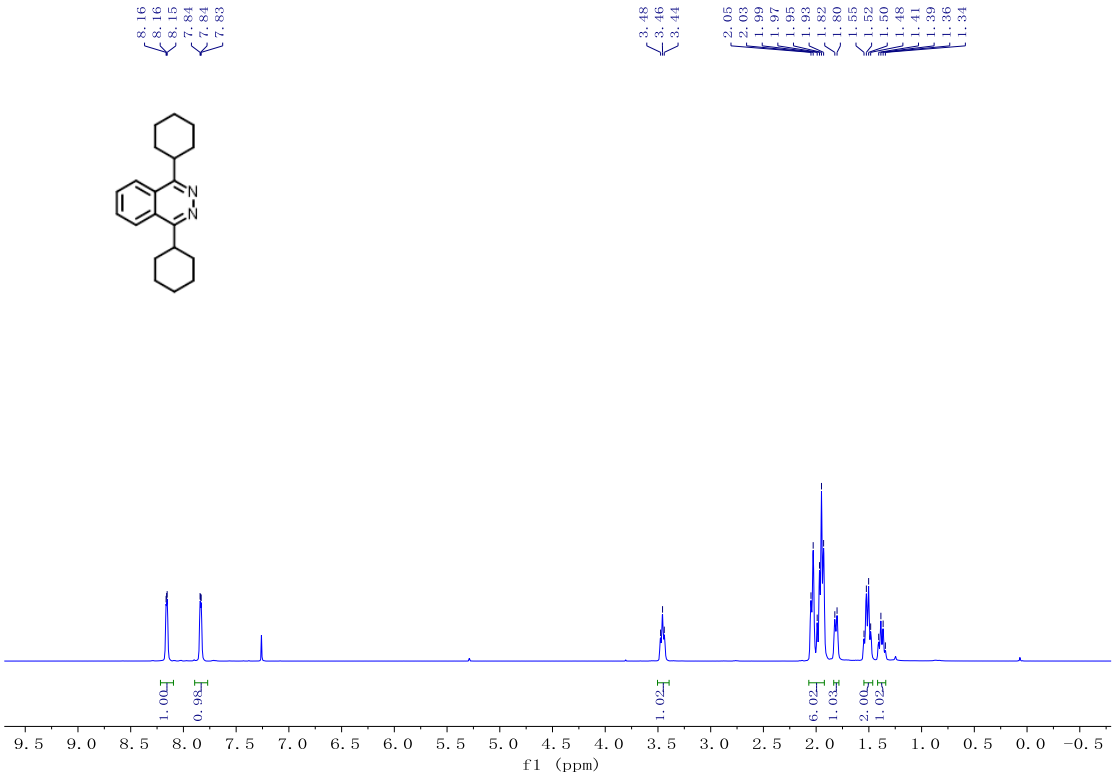
^{1}H NMR of **3l** (600MHz, $CDCl_3$)



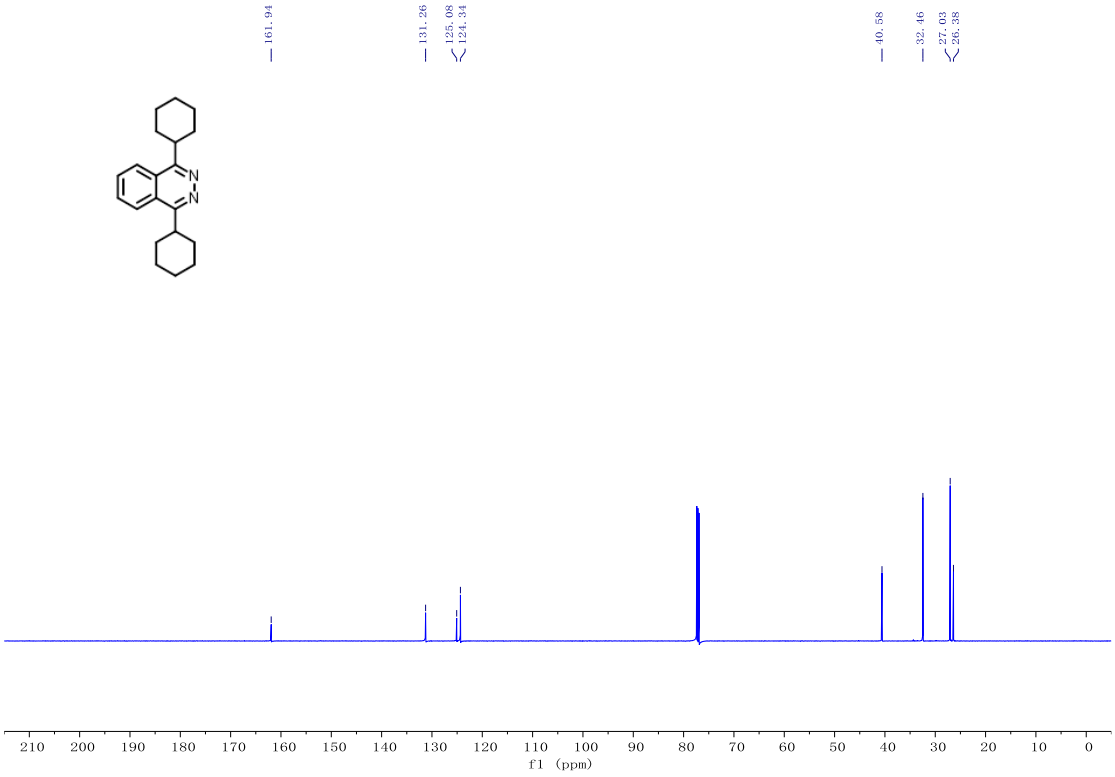
^{13}C NMR of **3l** (151MHz, $CDCl_3$)



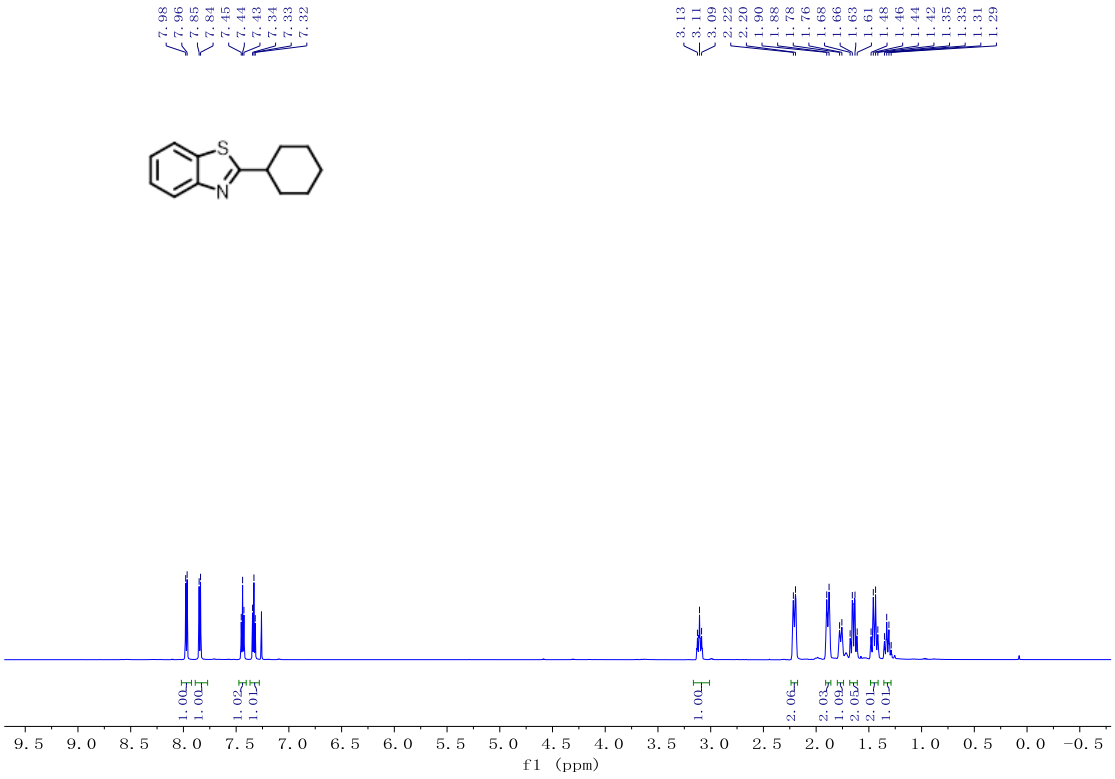
^{1}H NMR of **3m** (600MHz, $CDCl_3$)



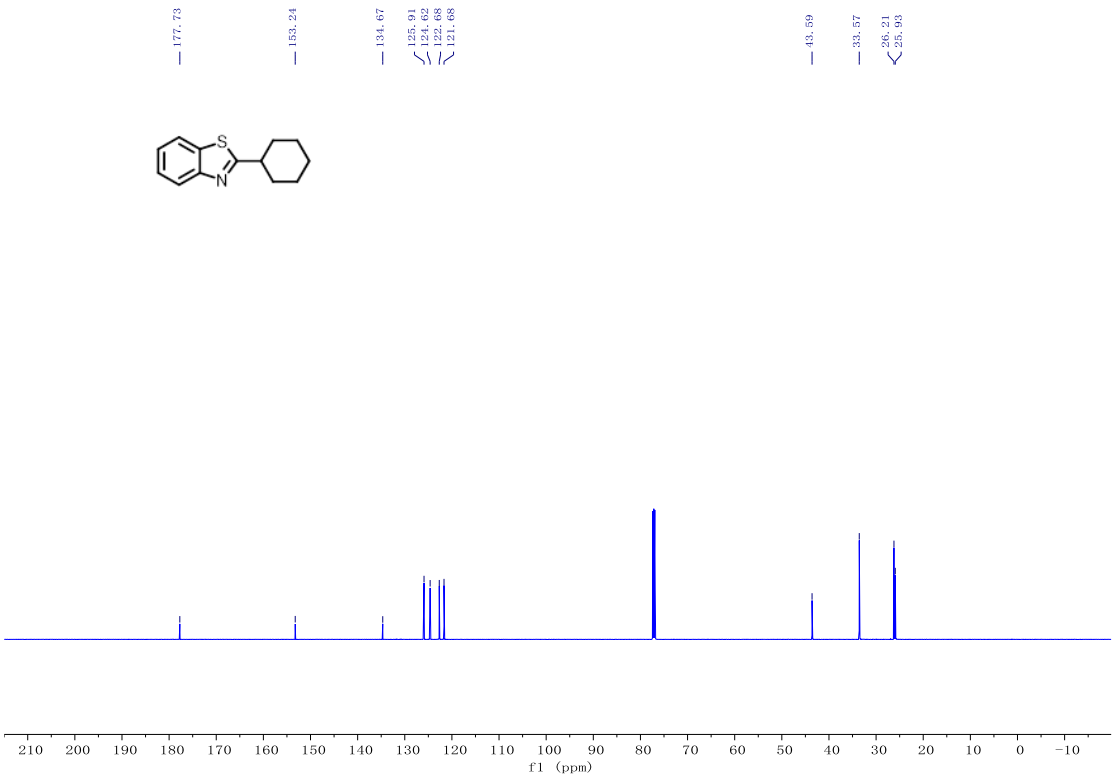
^{13}C NMR of **3m** (151MHz, $CDCl_3$)



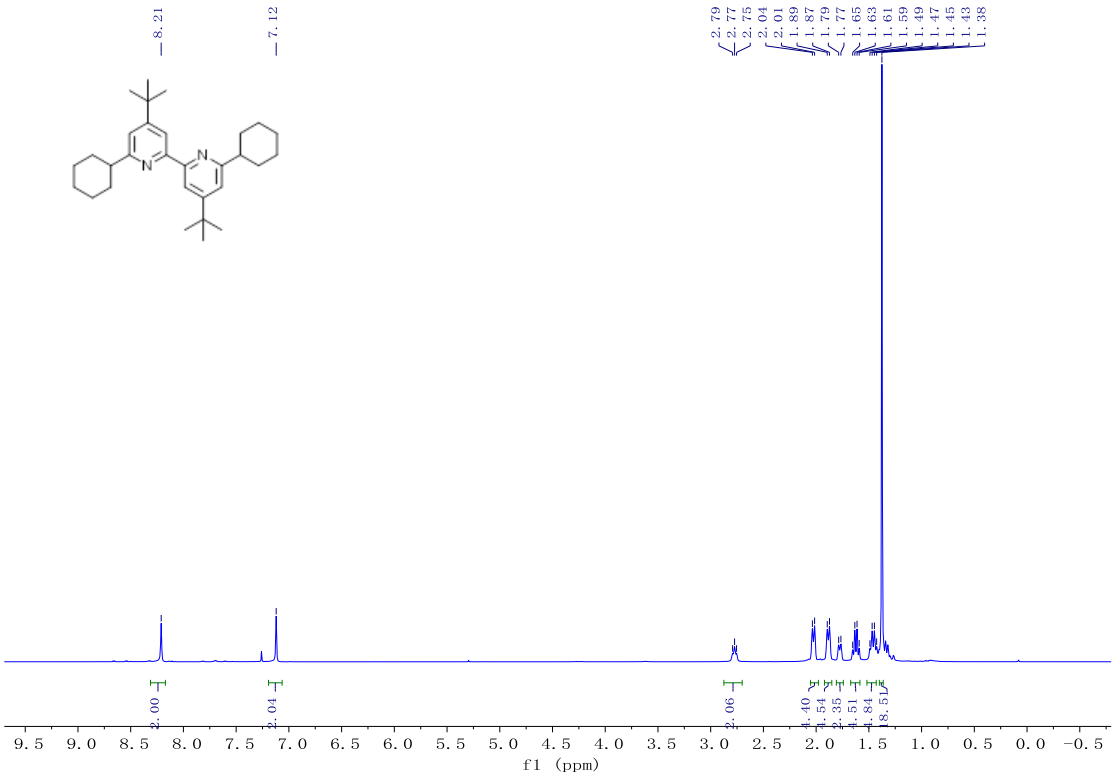
^{1}H NMR of **3n** (600MHz, $CDCl_3$)



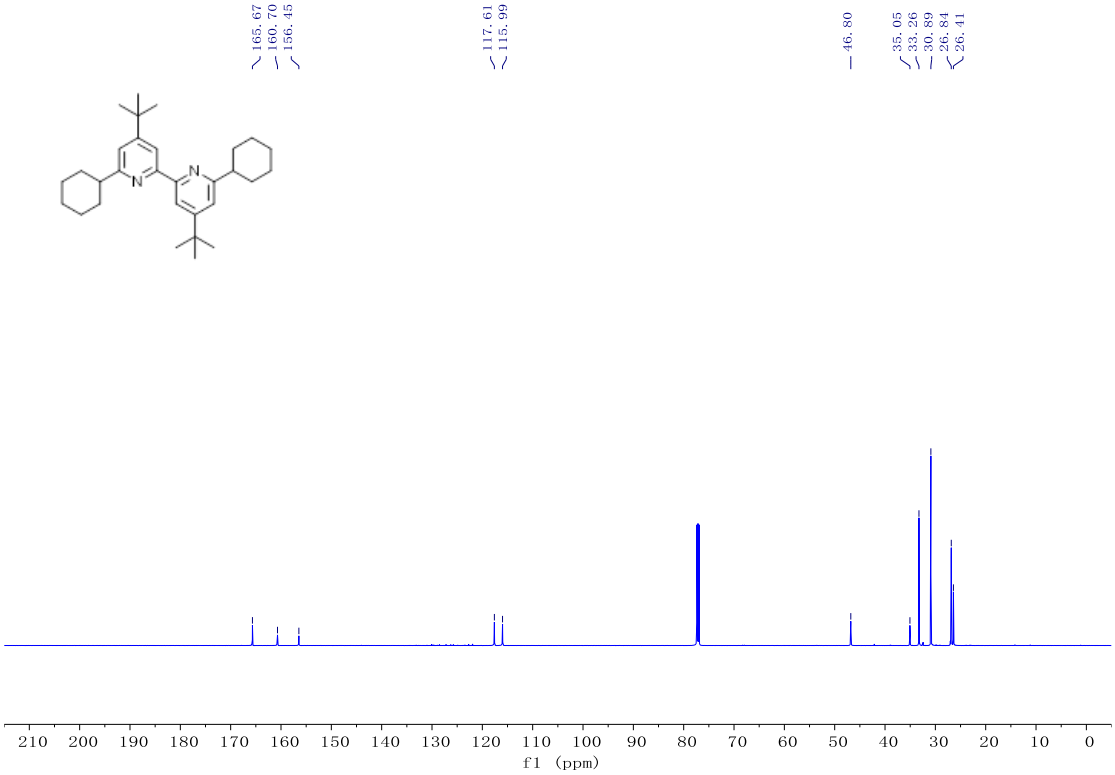
^{13}C NMR of **3n** (151MHz, $CDCl_3$)



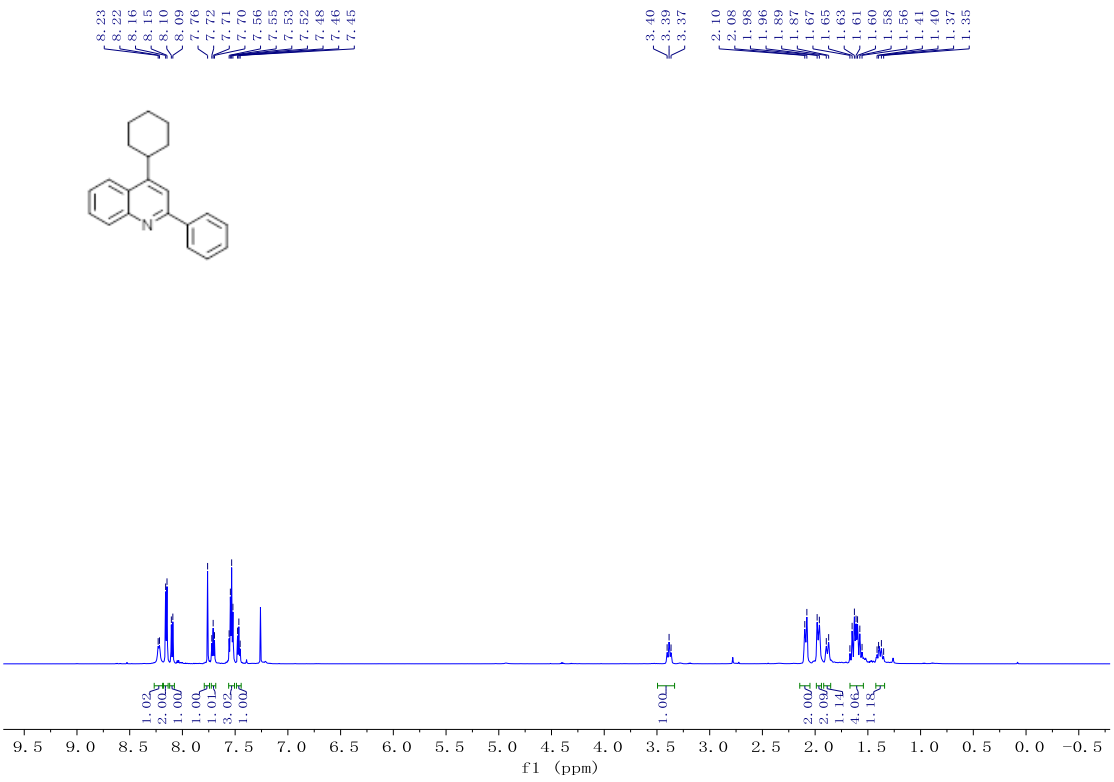
^{1}H NMR of **3o** (600MHz, $CDCl_3$)



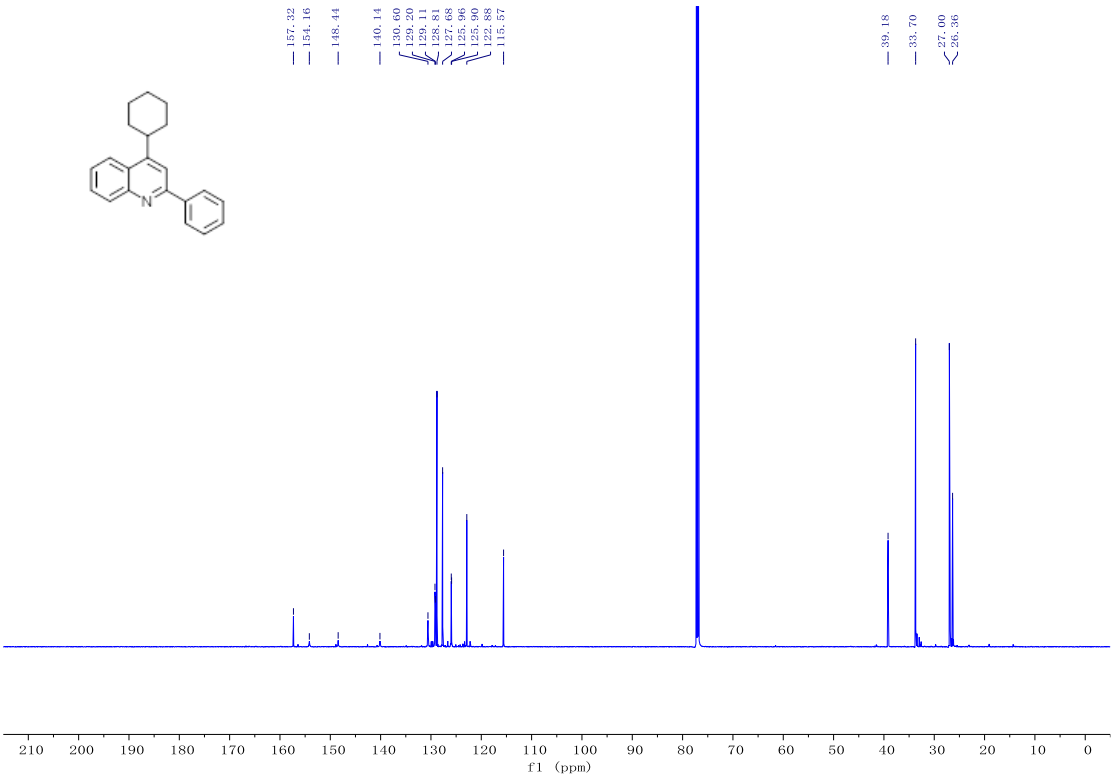
^{13}C NMR of **3o** (151MHz, $CDCl_3$)



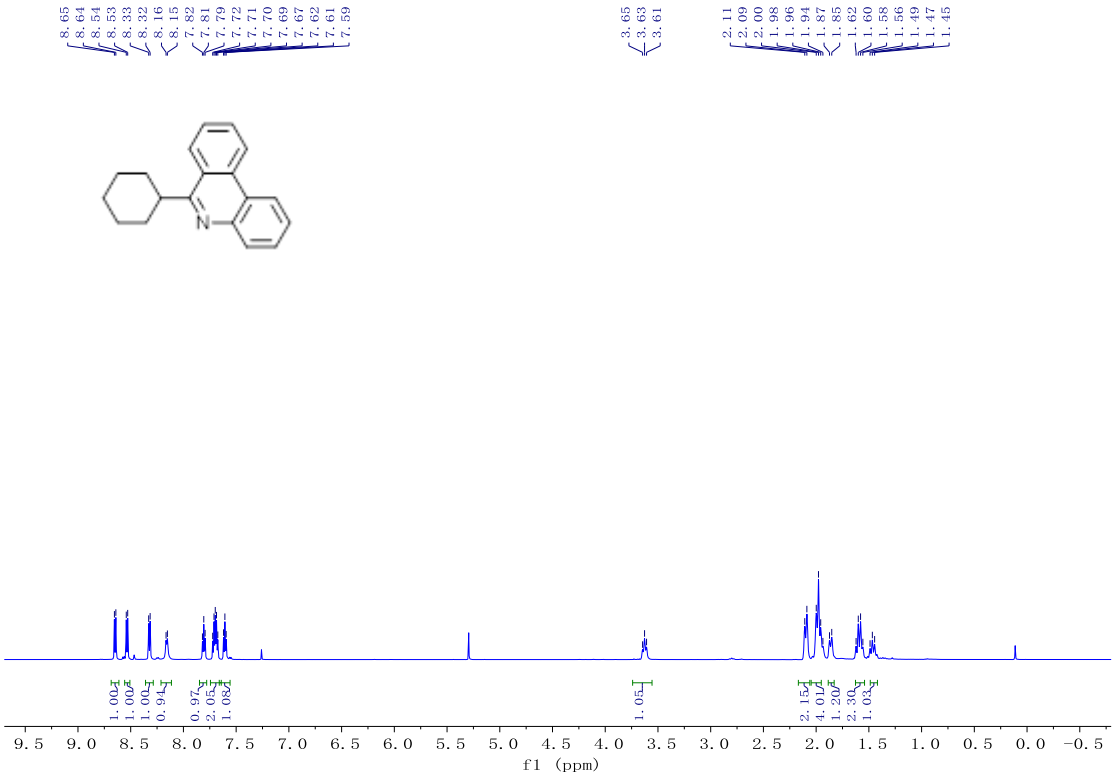
^{1}H NMR of **3p** (600MHz, $CDCl_3$)



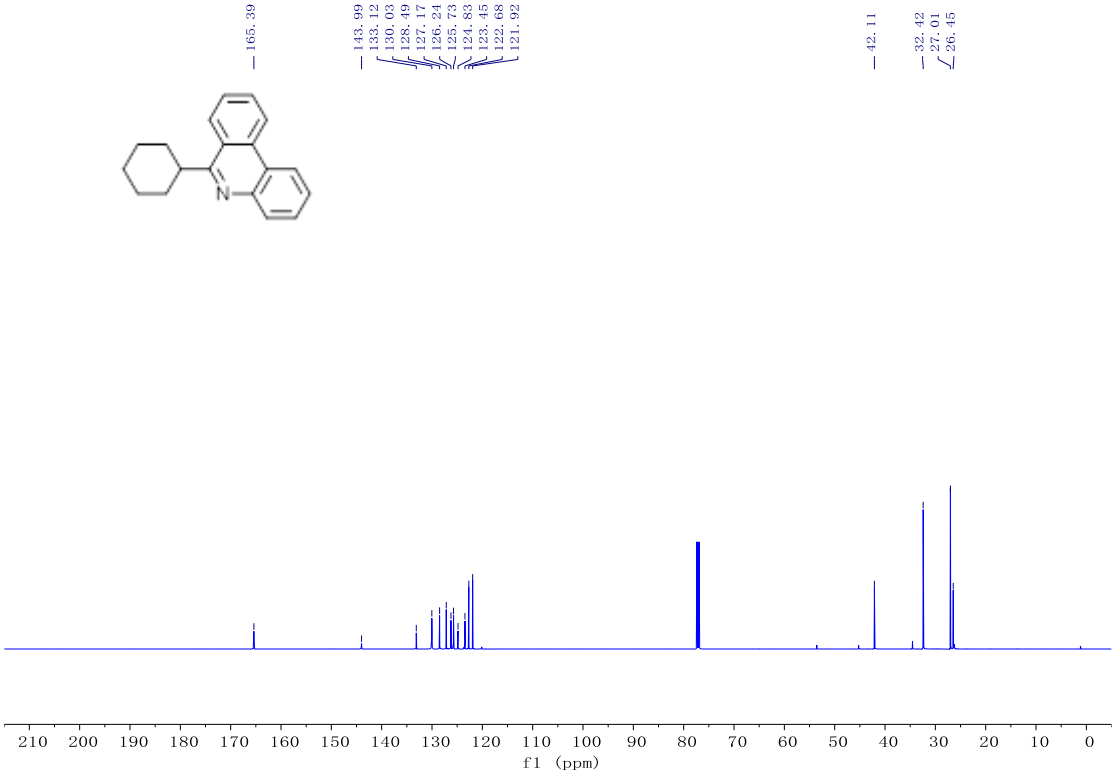
^{13}C NMR of **3p** (151MHz, $CDCl_3$)



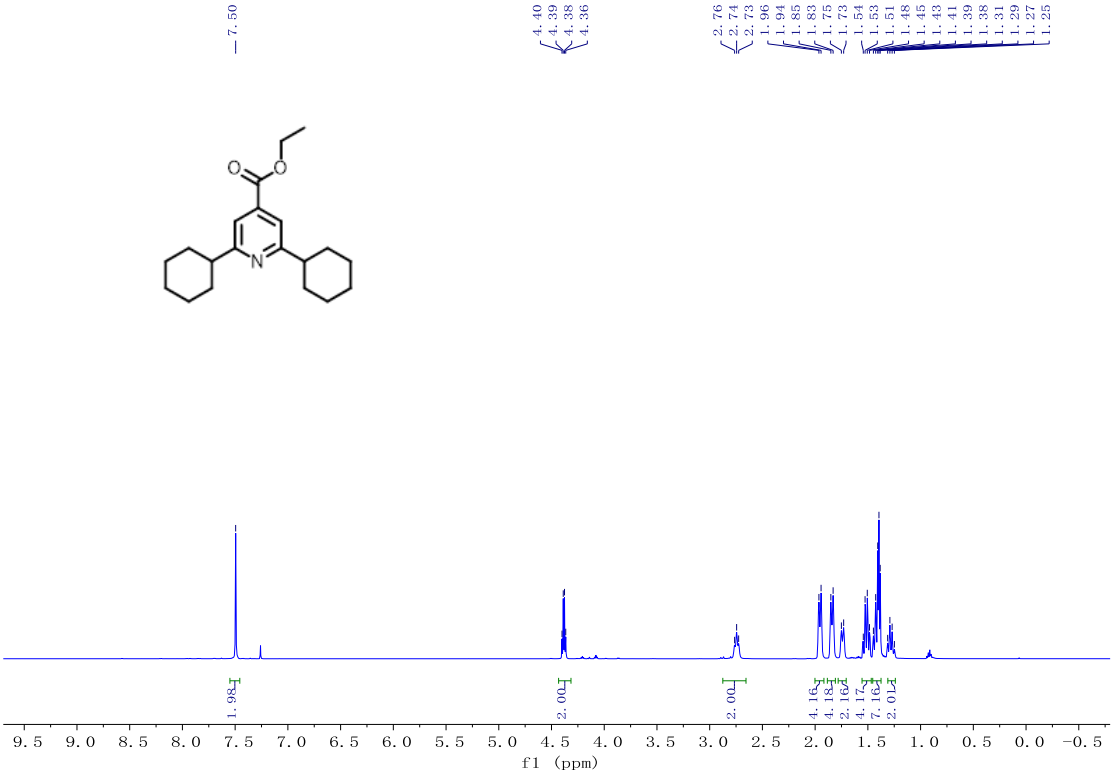
^{1}H NMR of **3q** (600MHz, $CDCl_3$)



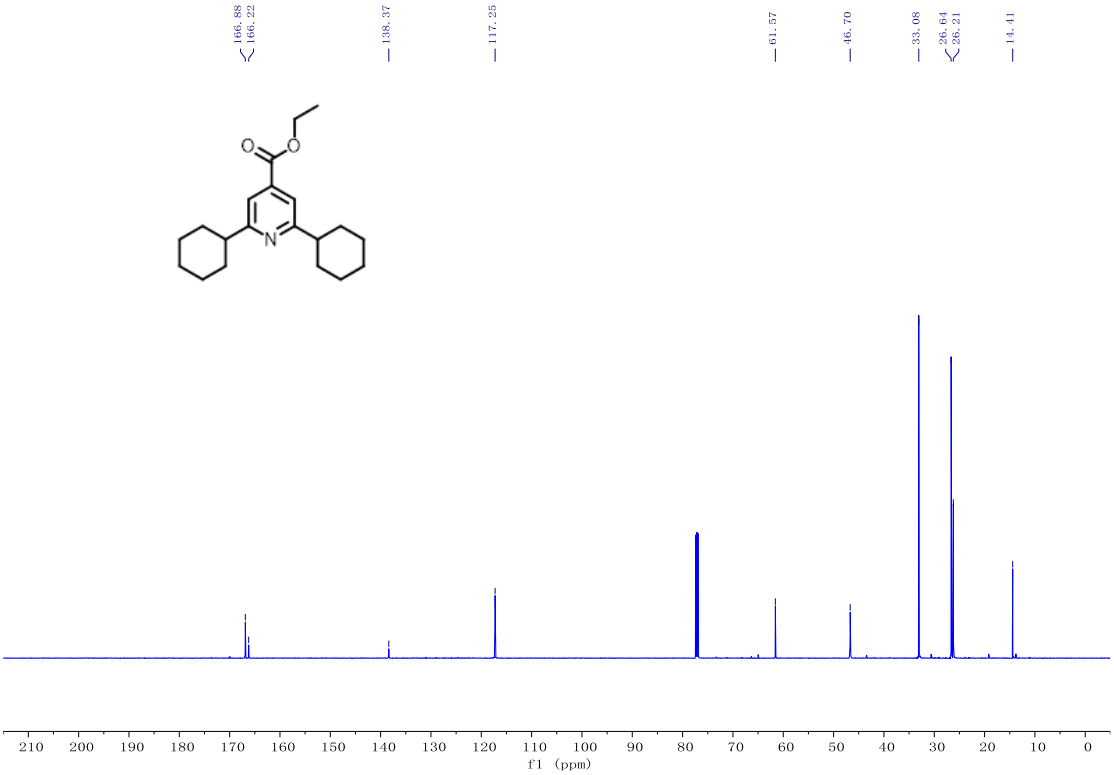
^{13}C NMR of **3q** (151MHz, $CDCl_3$)



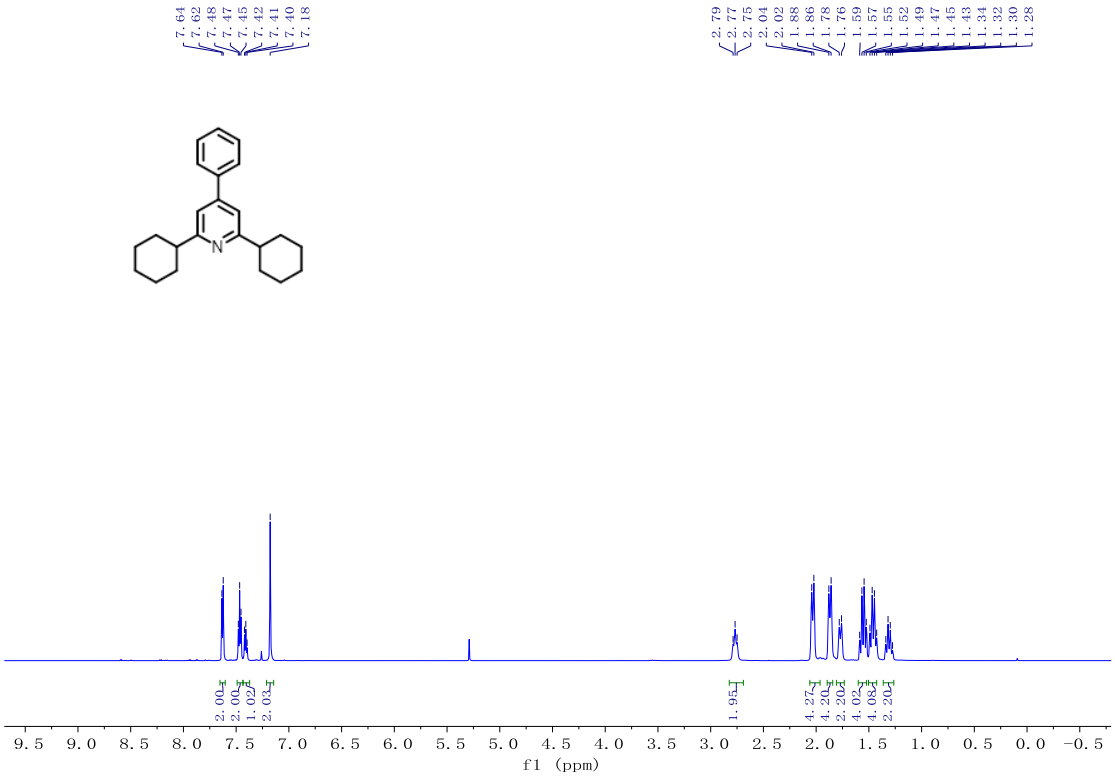
^{1}H NMR of **3r** (600MHz, $CDCl_3$)



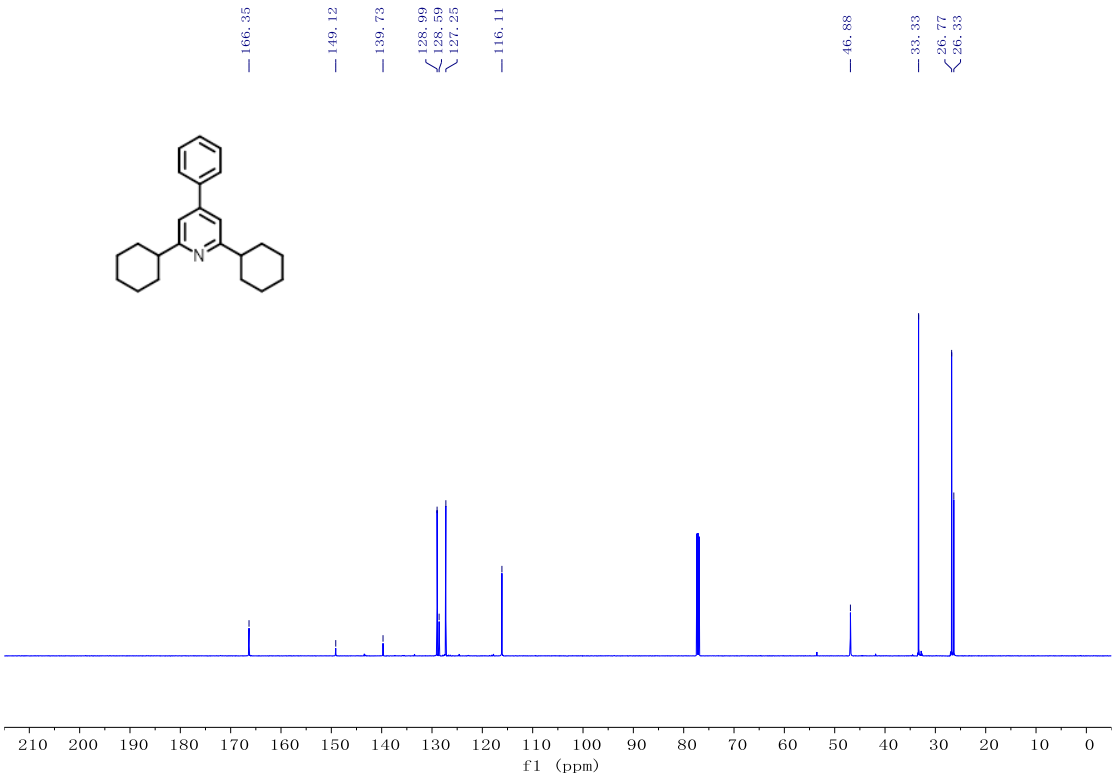
^{13}C NMR of **3r** (151MHz, $CDCl_3$)



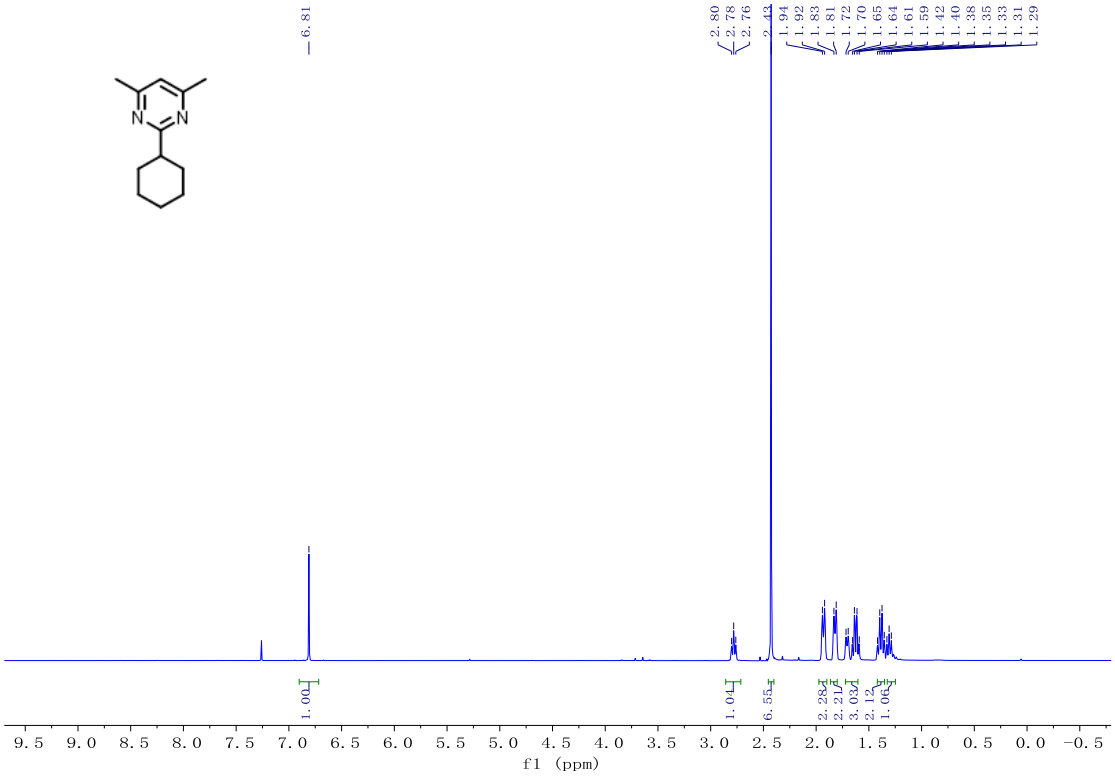
^{1}H NMR of **3s** (600MHz, $CDCl_3$)



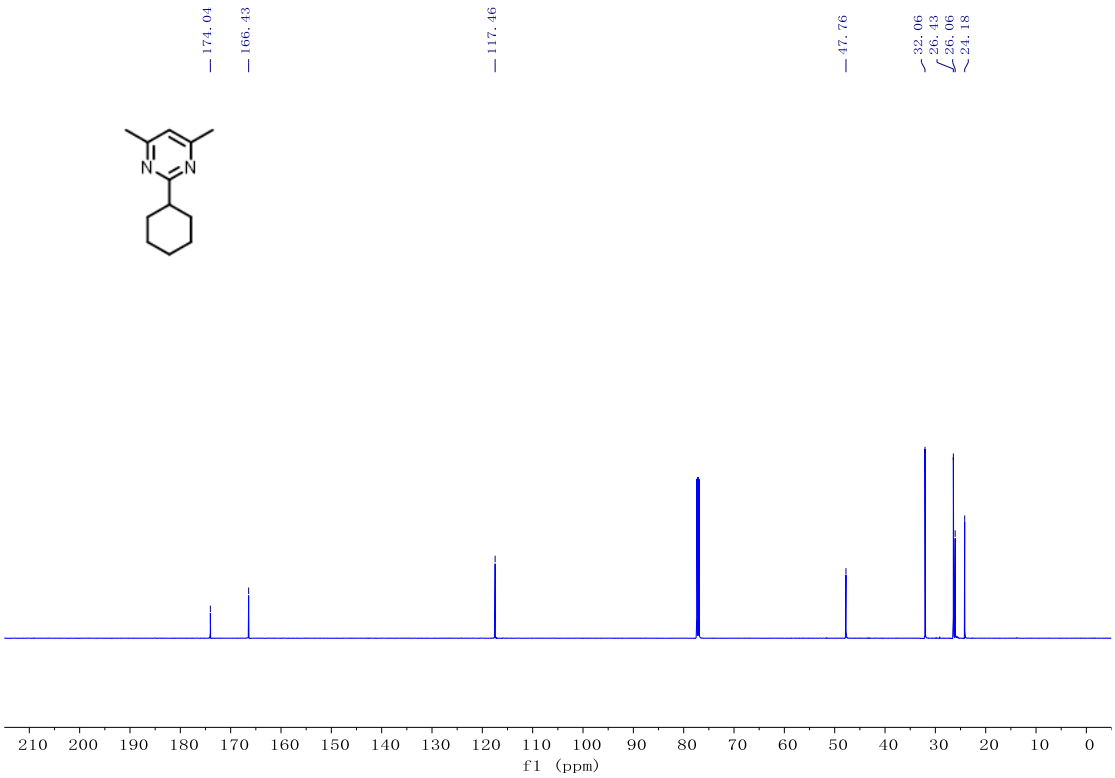
^{13}C NMR of **3s** (151MHz, $CDCl_3$)



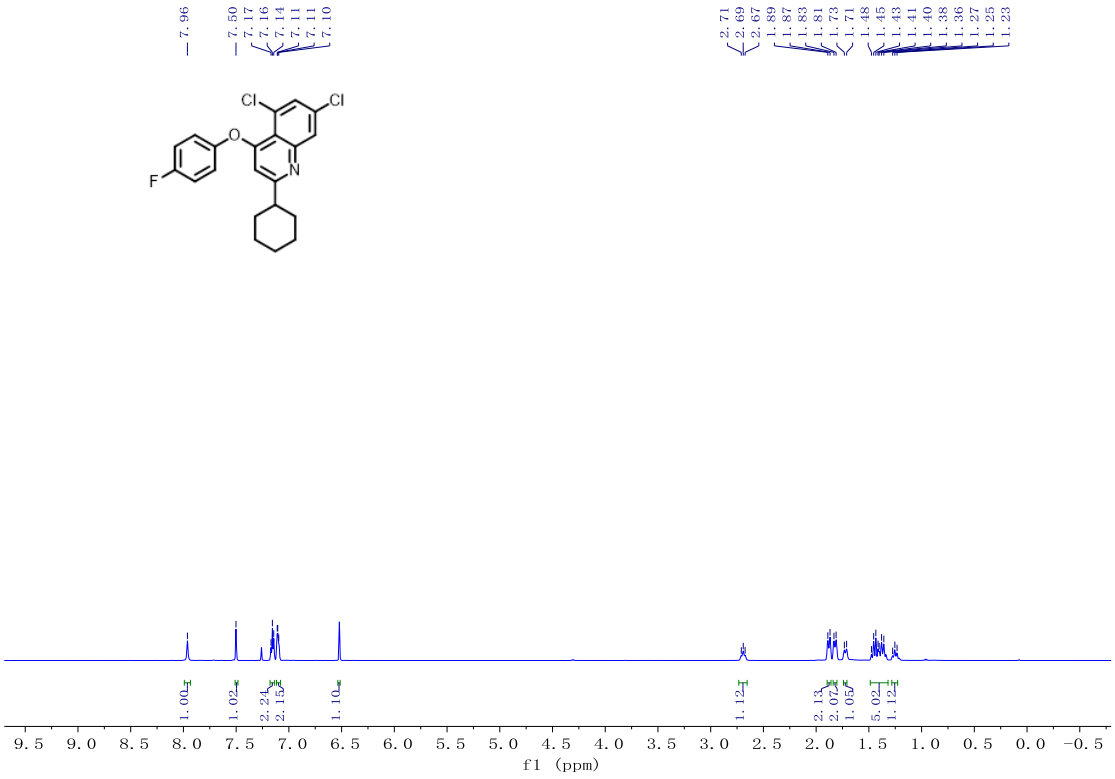
^{1}H NMR of **3t** (600MHz, $CDCl_3$)



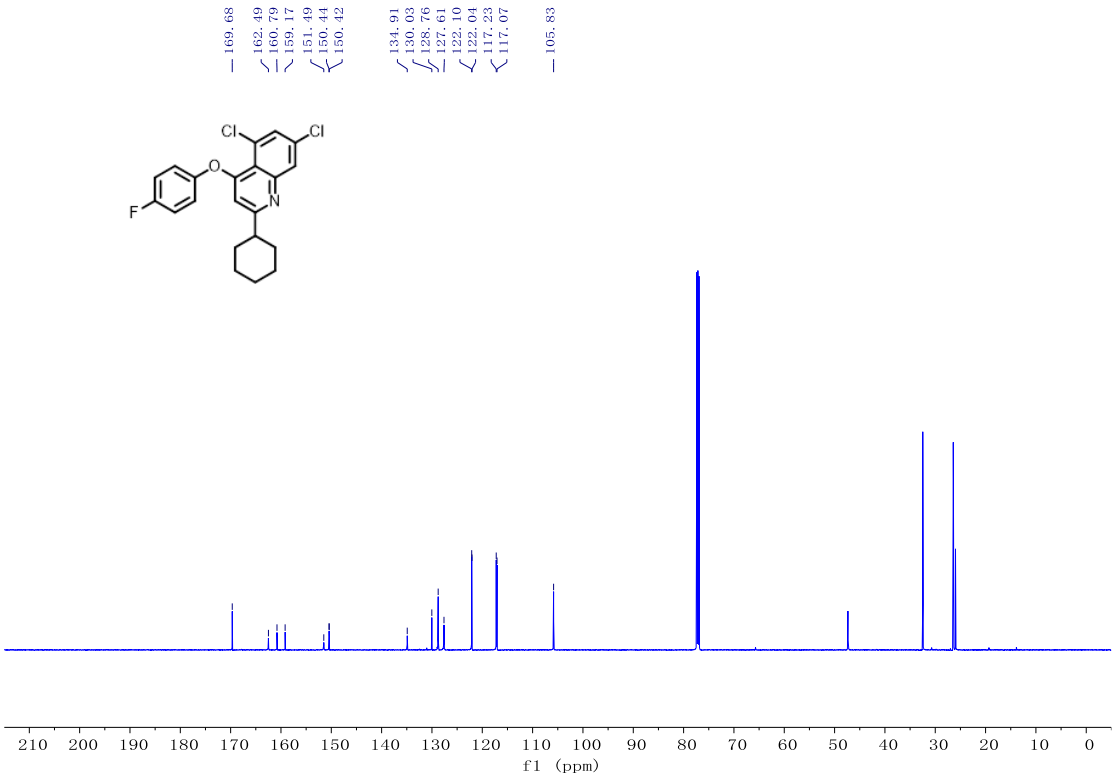
^{13}C NMR of **3t** (151MHz, $CDCl_3$)



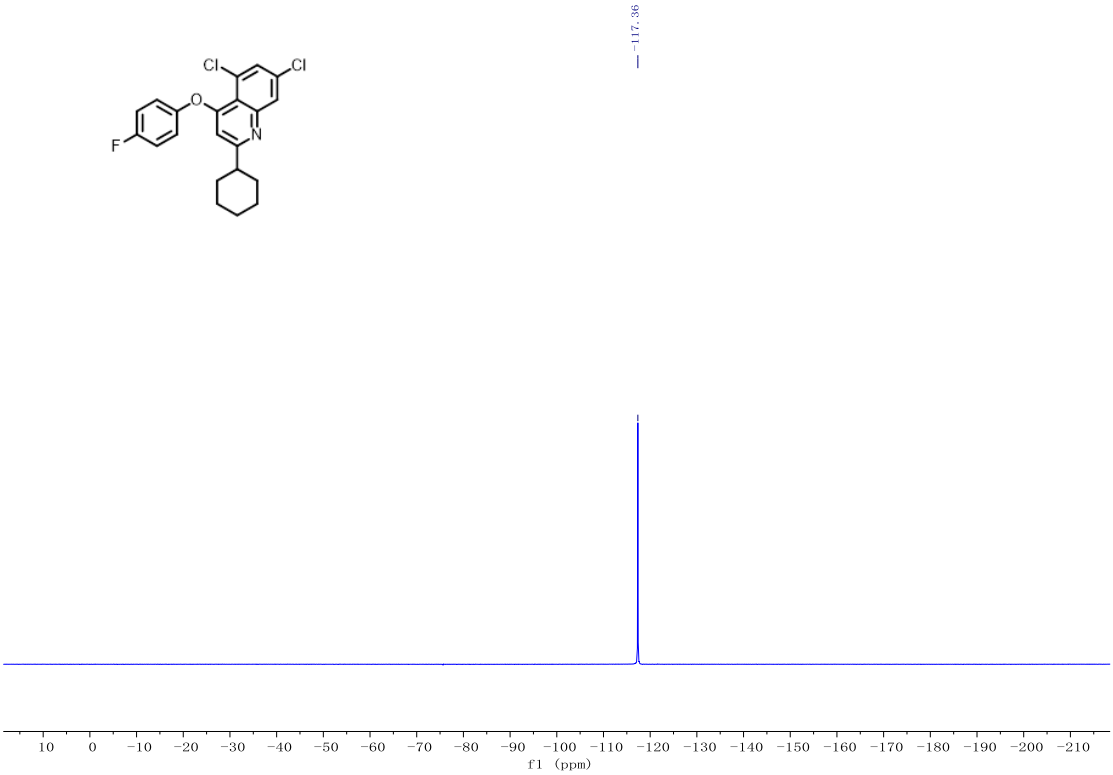
^{1}H NMR of **3u** (600MHz, $CDCl_3$)



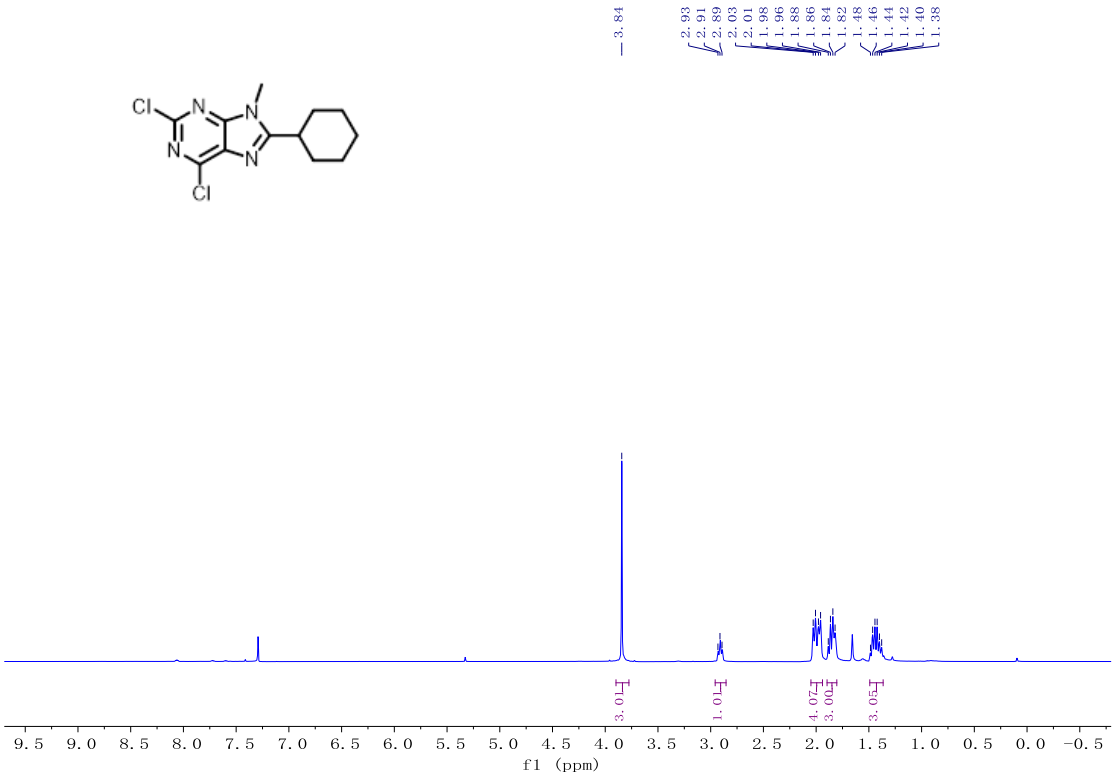
^{13}C NMR of **3u** (151MHz, $CDCl_3$)



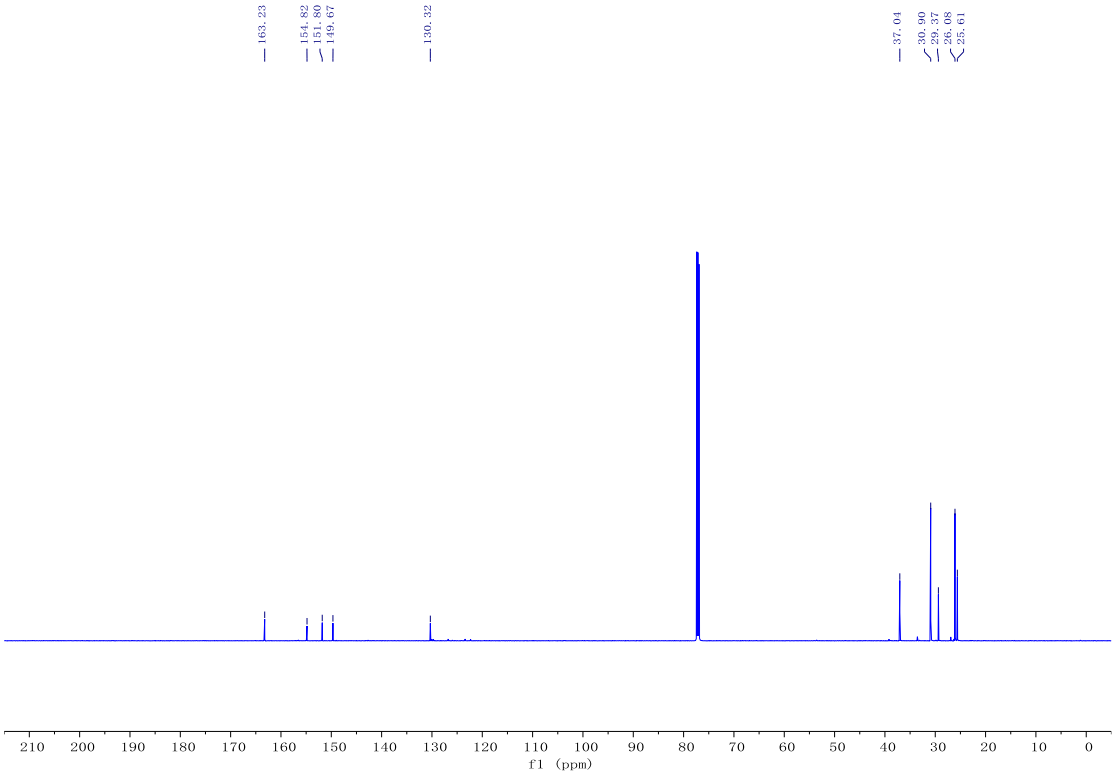
^{19}F NMR of **3u** (376 MHz, $CDCl_3$)



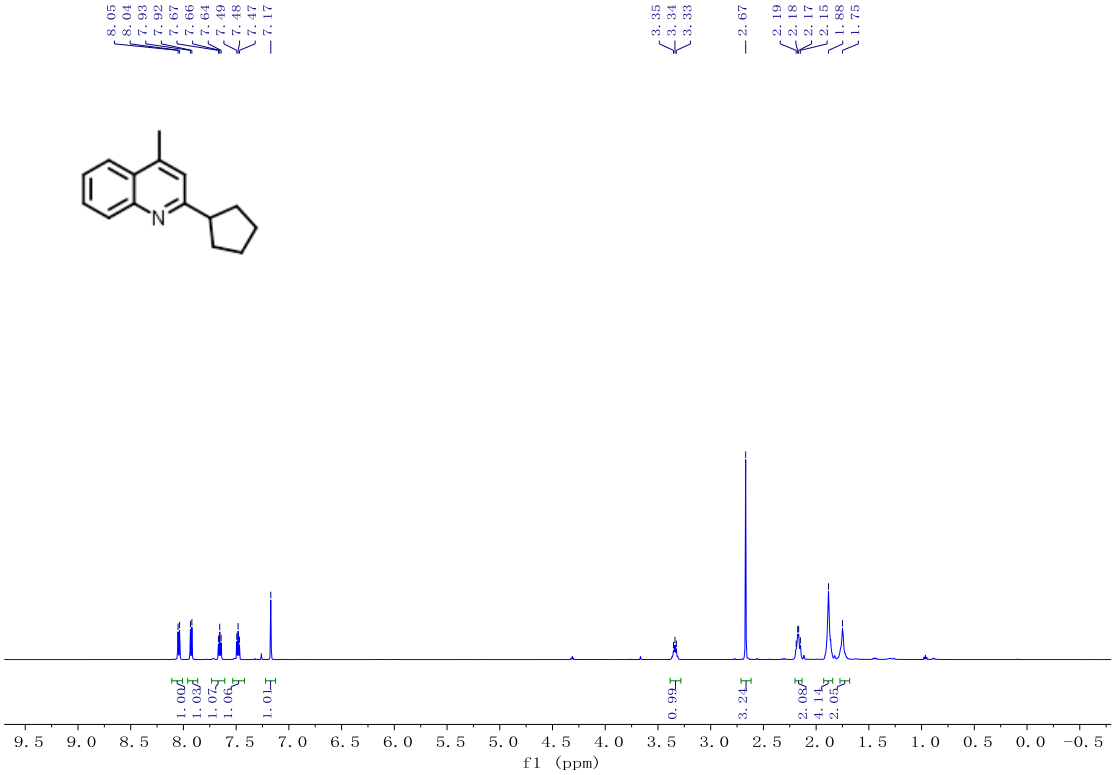
^{1}H NMR of **3v** (600MHz, $CDCl_3$)



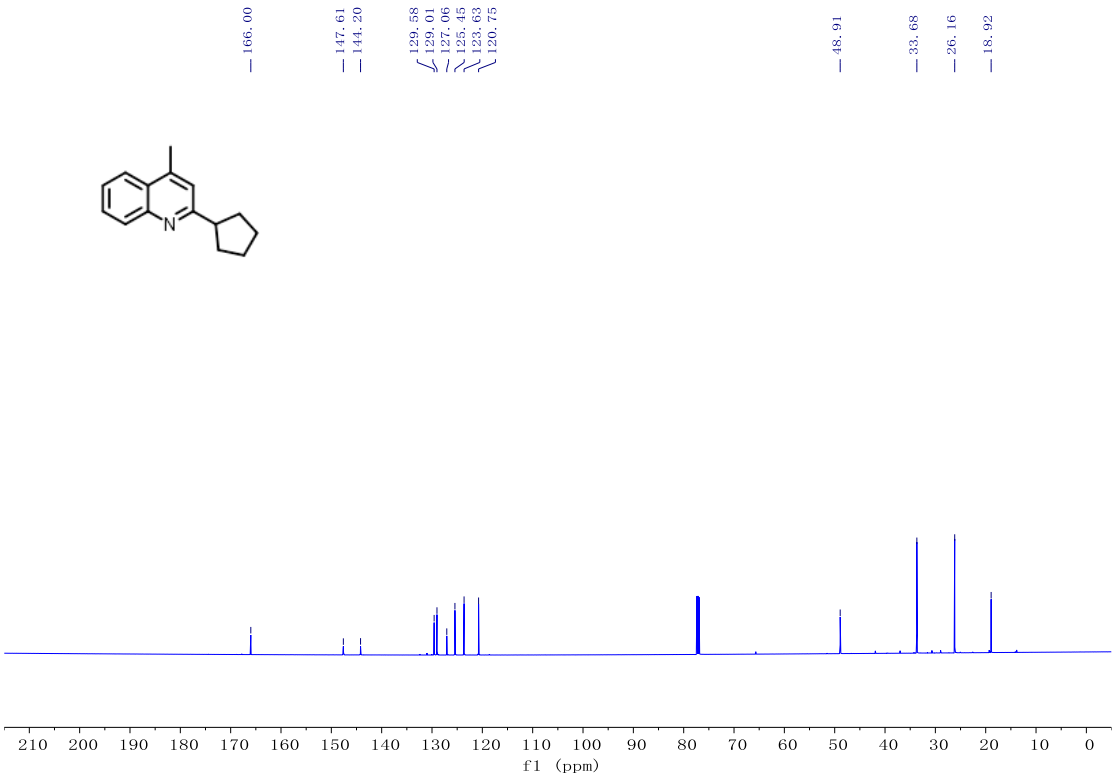
^{13}C NMR of **3v** (151MHz, $CDCl_3$)



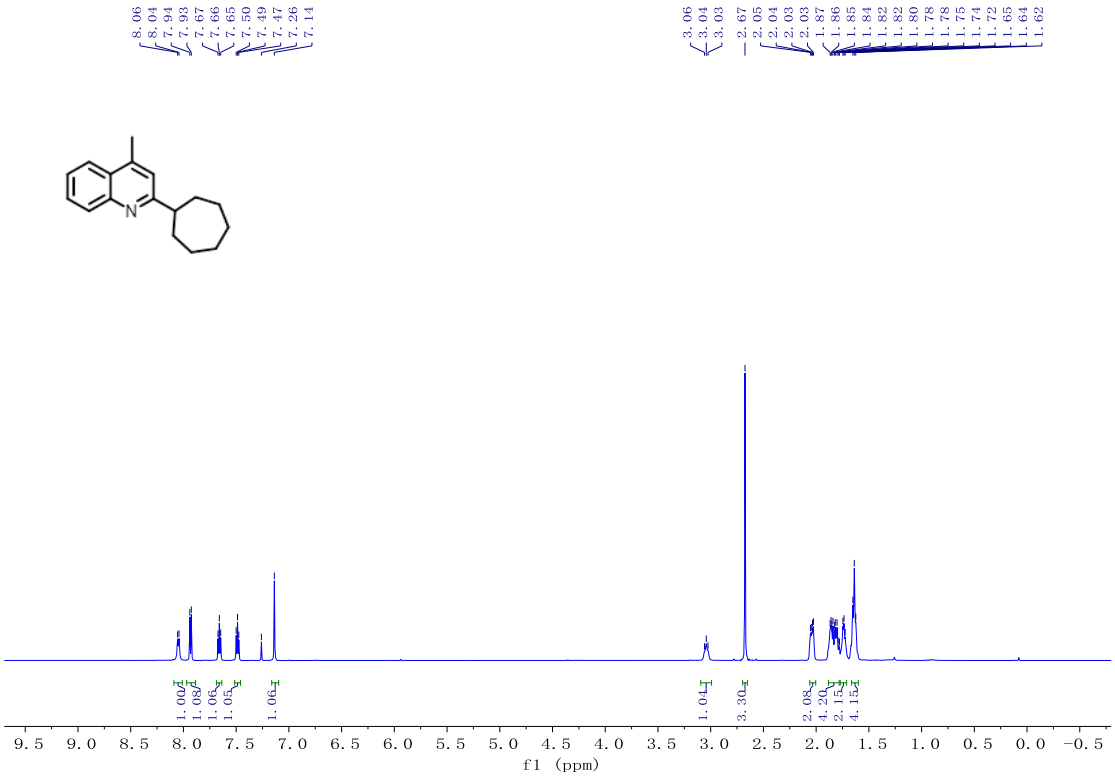
^{1}H NMR of **4a** (600MHz, $CDCl_3$)



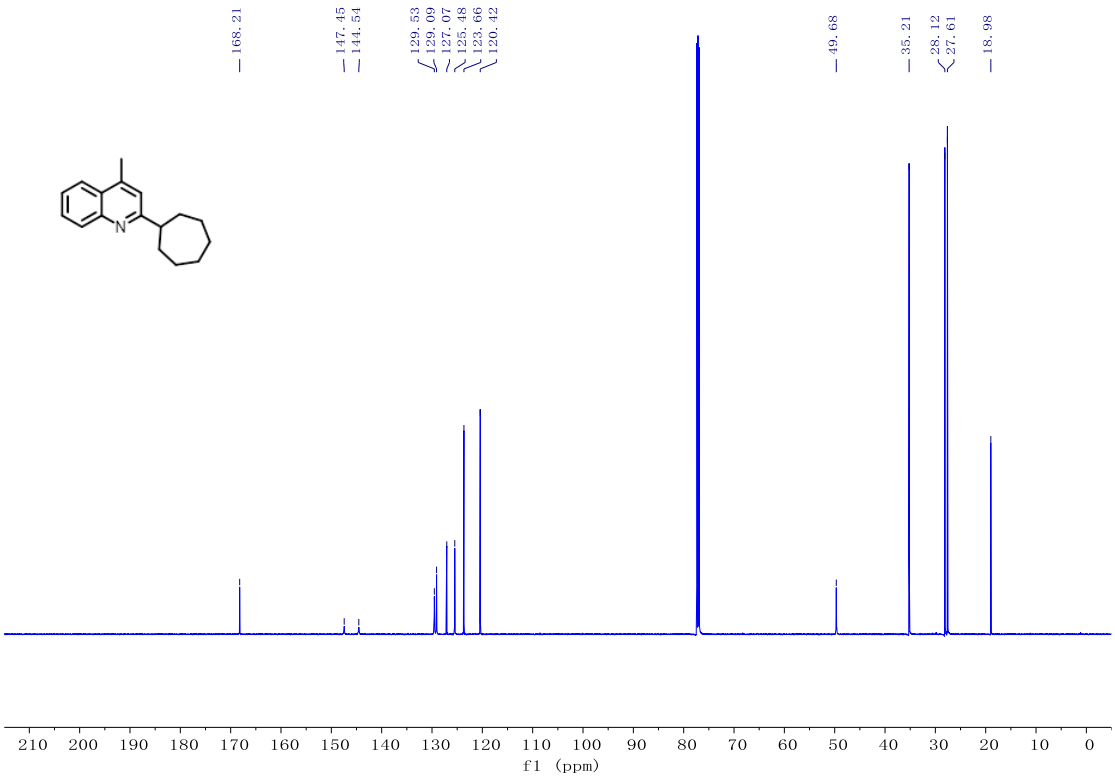
^{13}C NMR of **4a** (151MHz, $CDCl_3$)



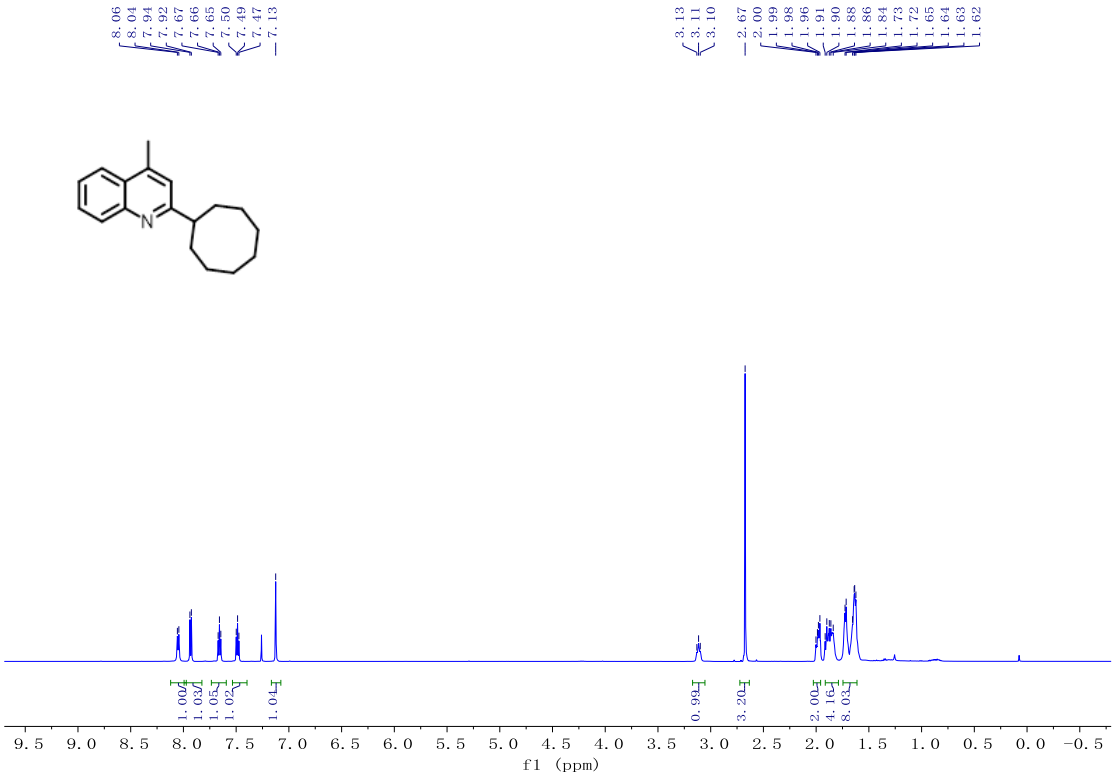
^{1}H NMR of **4b** (600MHz, $CDCl_3$)



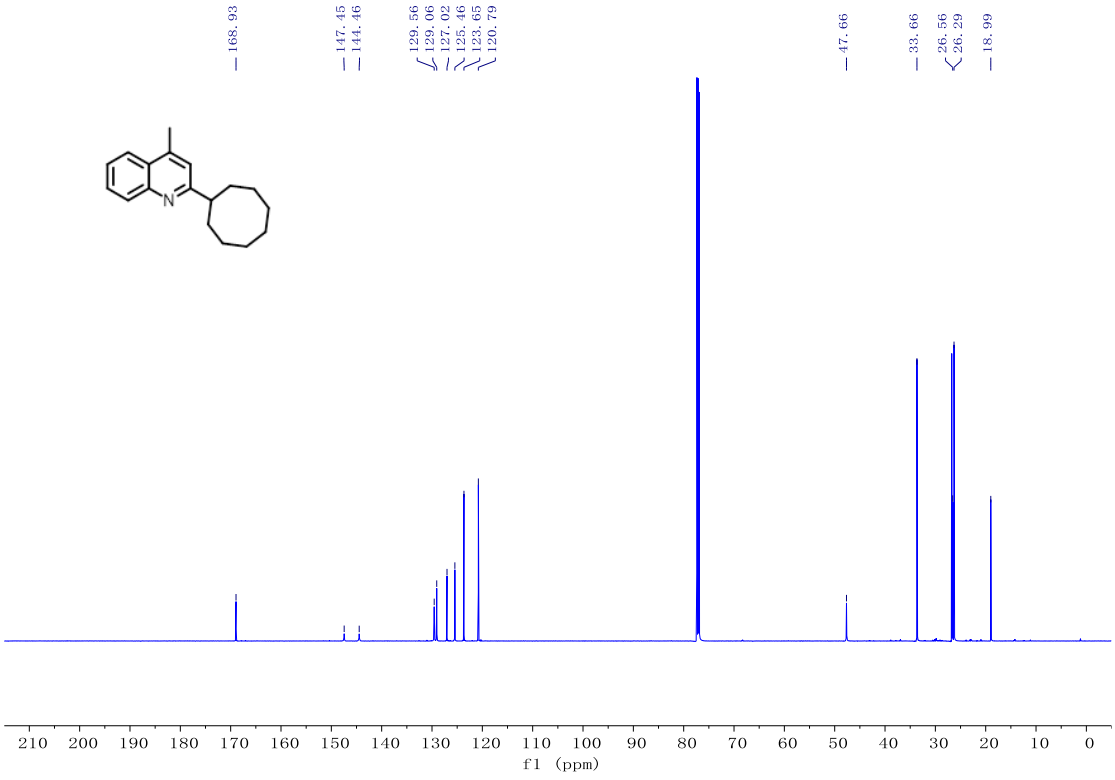
^{13}C NMR of **4b** (151MHz, $CDCl_3$)



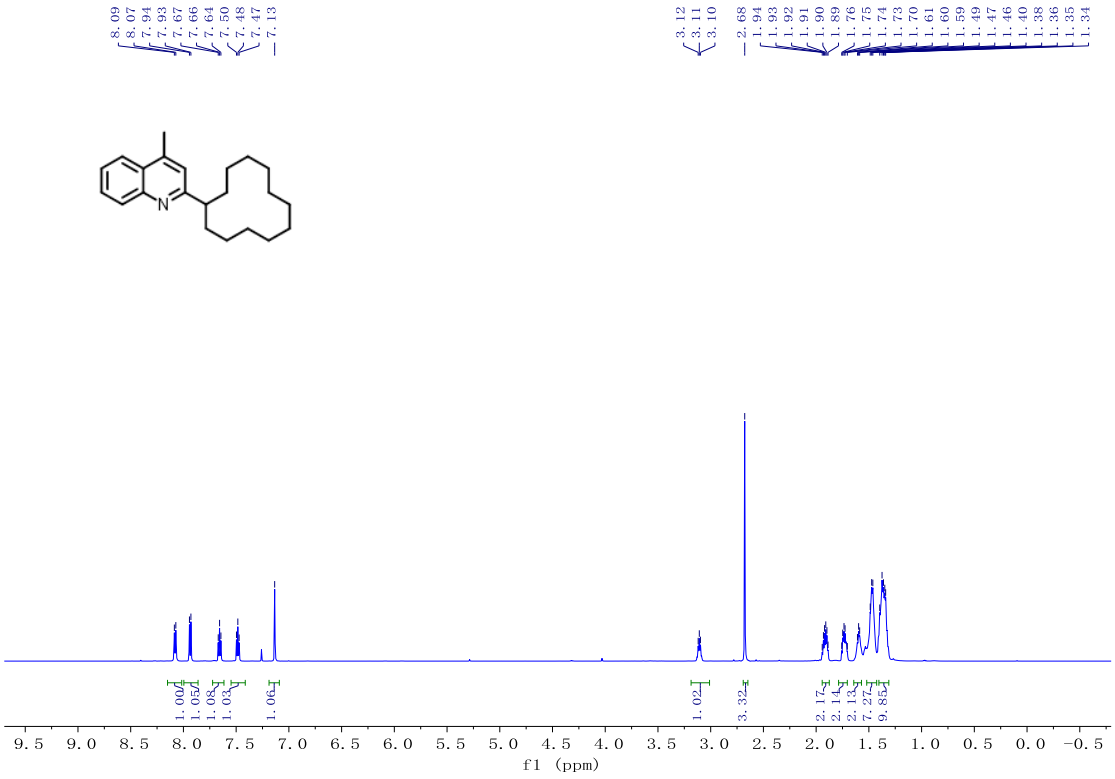
^{1}H NMR of **4c** (600MHz, $CDCl_3$)



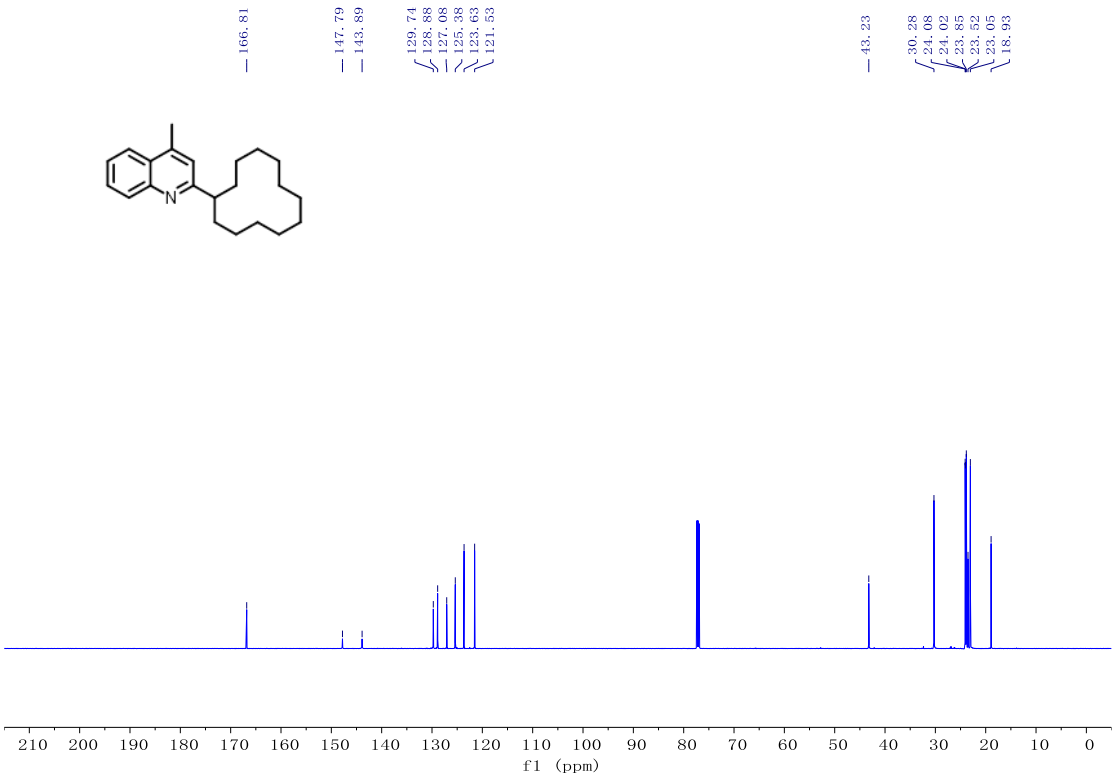
^{13}C NMR of **4c** (151MHz, $CDCl_3$)



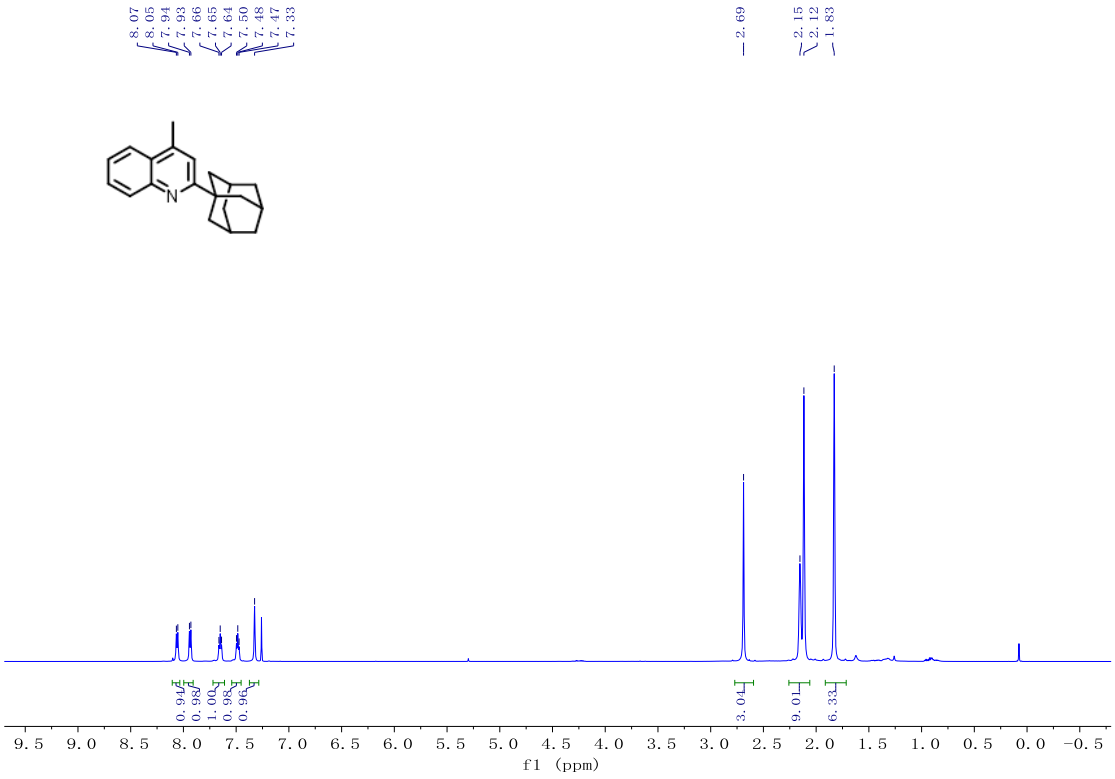
^{1}H NMR of **4d** (600MHz, $CDCl_3$)



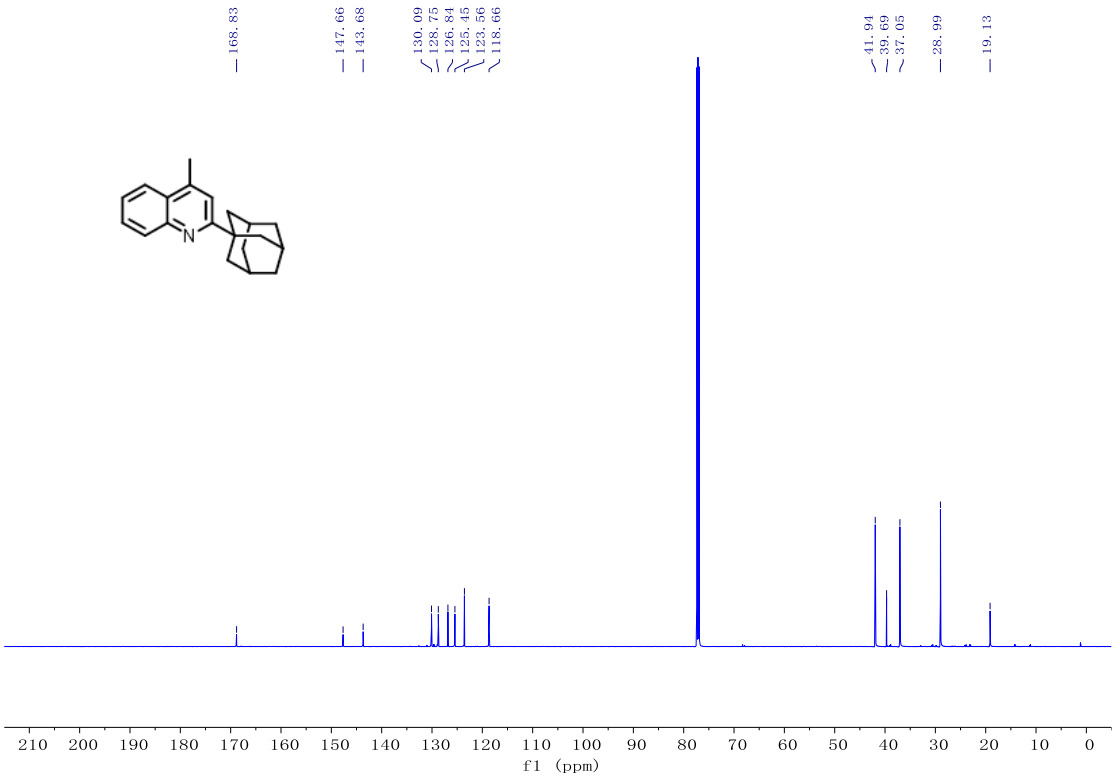
^{13}C NMR of **4d** (151MHz, $CDCl_3$)



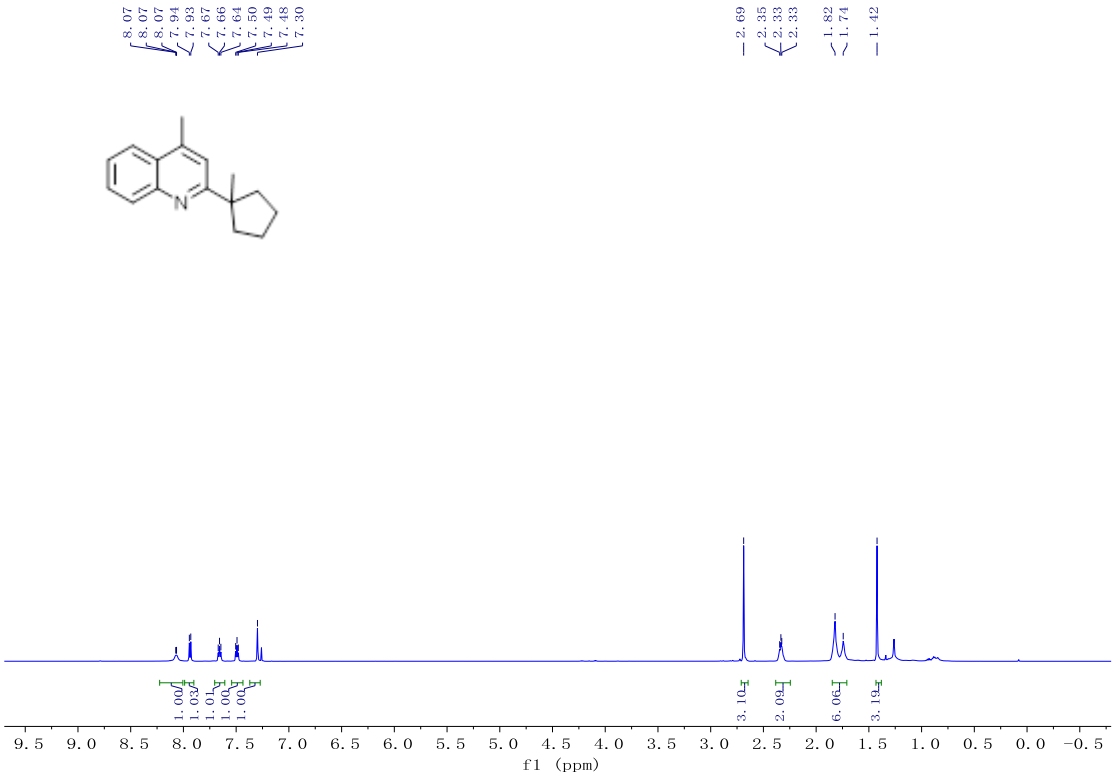
^{1}H NMR of **4e** (600MHz, $CDCl_3$)



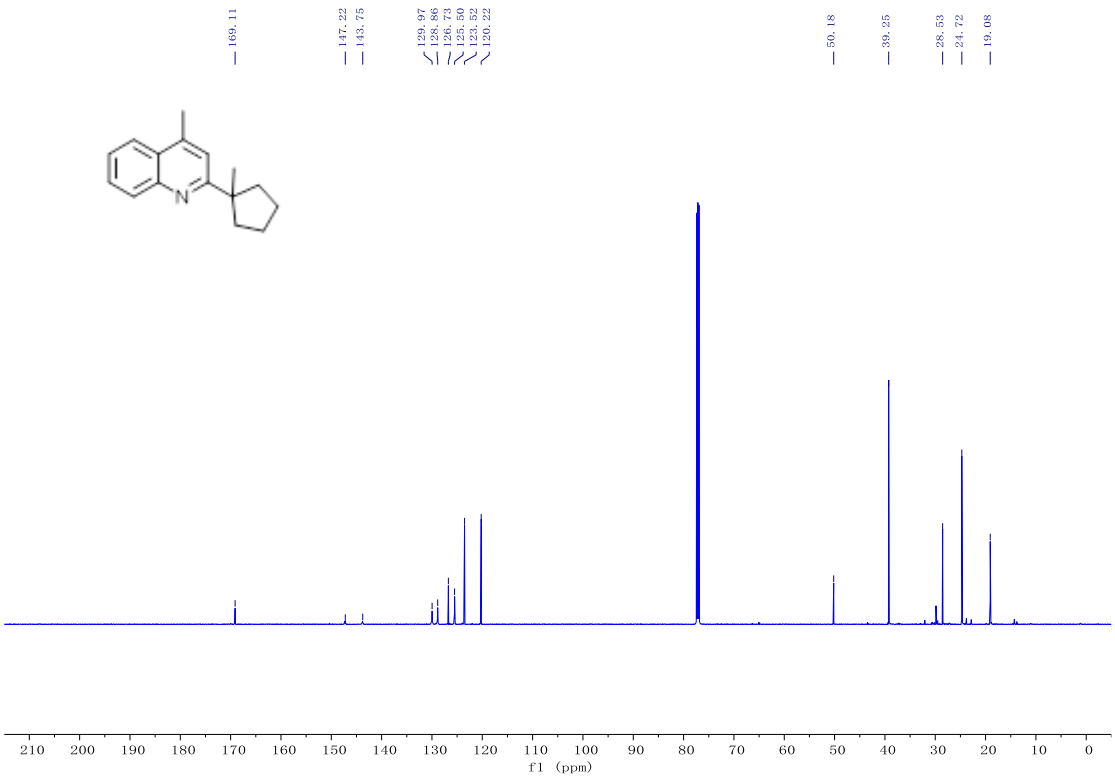
^{13}C NMR of **4e** (151MHz, $CDCl_3$)



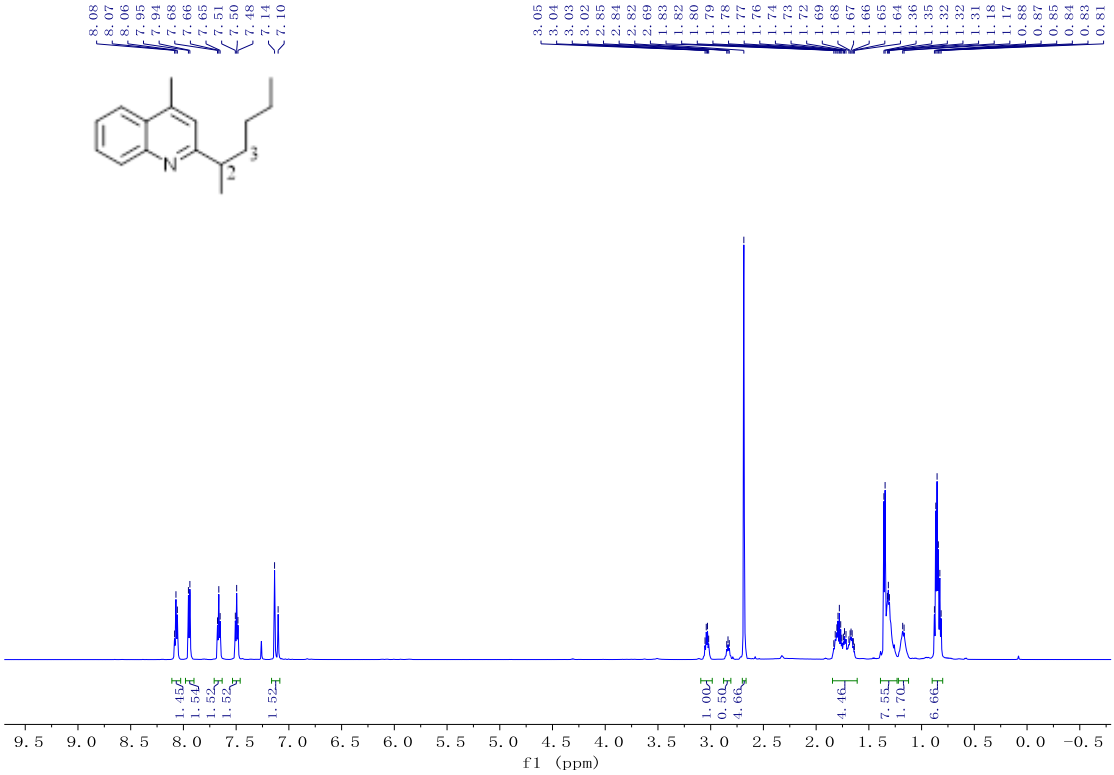
^{1}H NMR of **4f** (600MHz, $CDCl_3$)



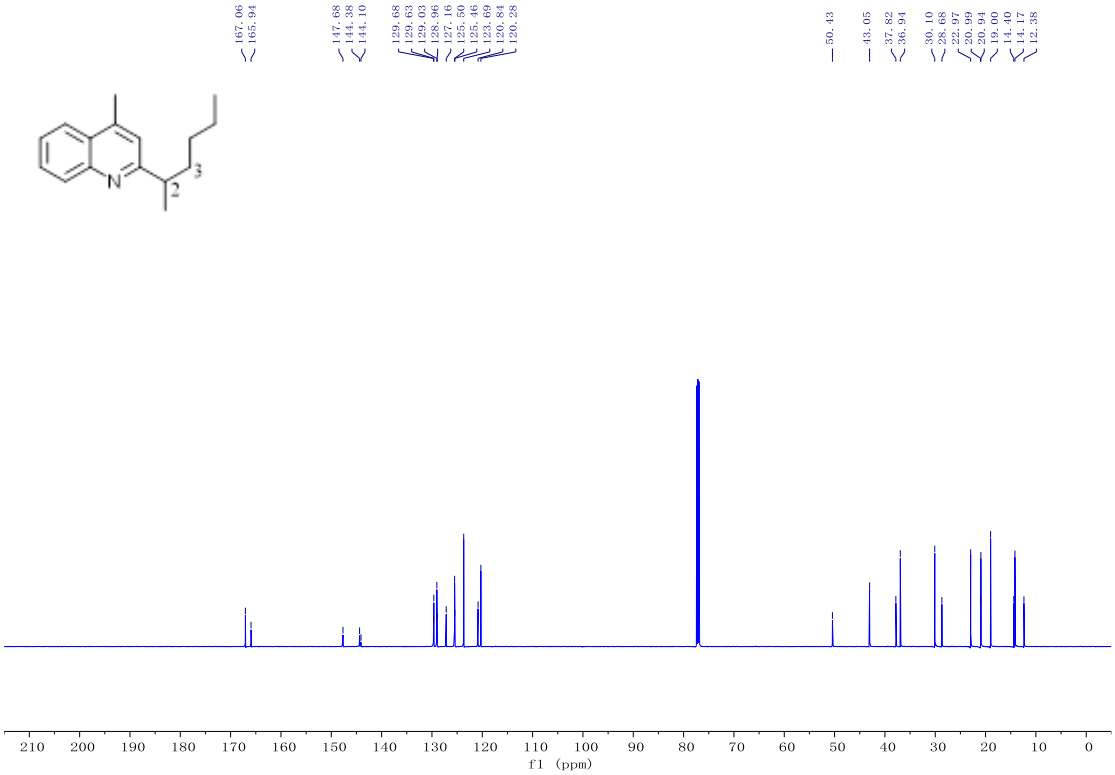
^{13}C NMR of **4f** (151MHz, $CDCl_3$)



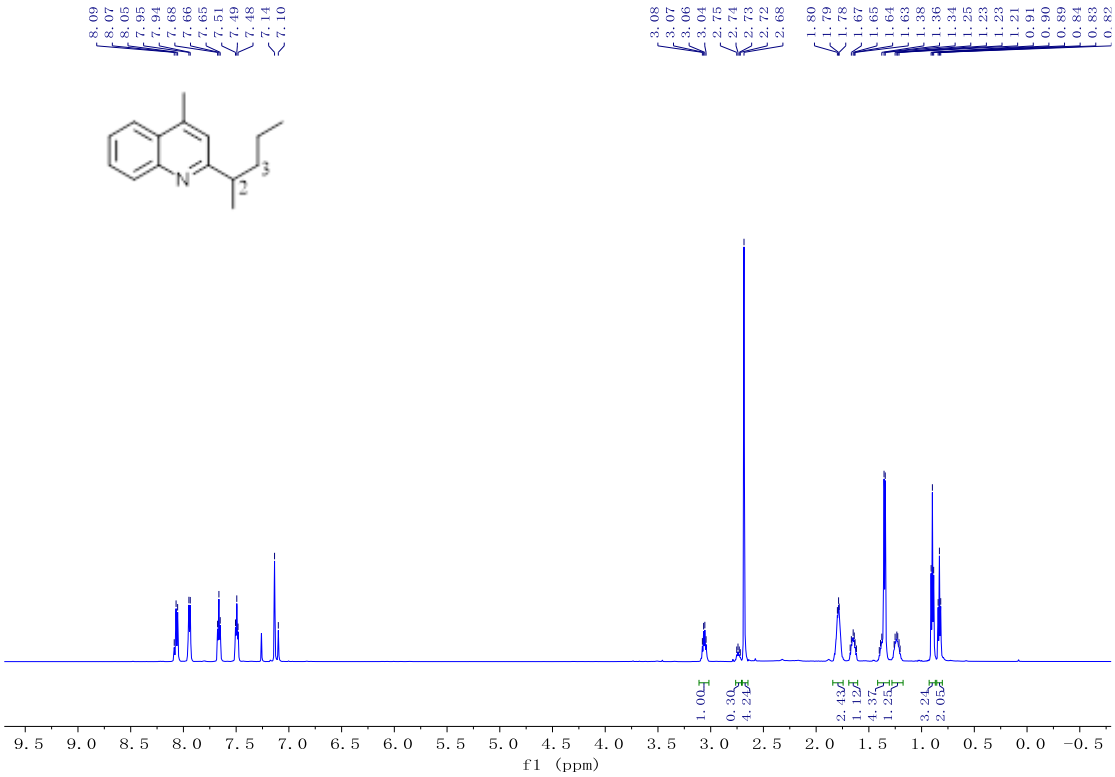
^{1}H NMR of **4g**(600MHz, $CDCl_3$)



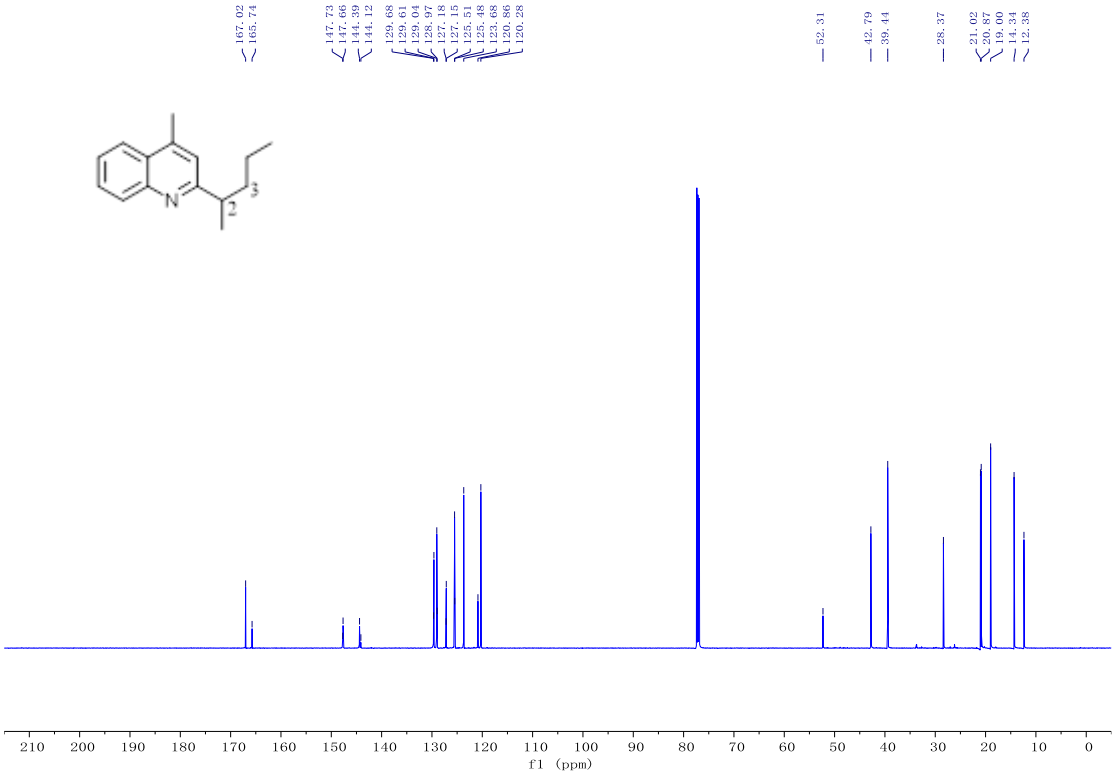
^{13}C NMR of **4g** (151MHz, $CDCl_3$)



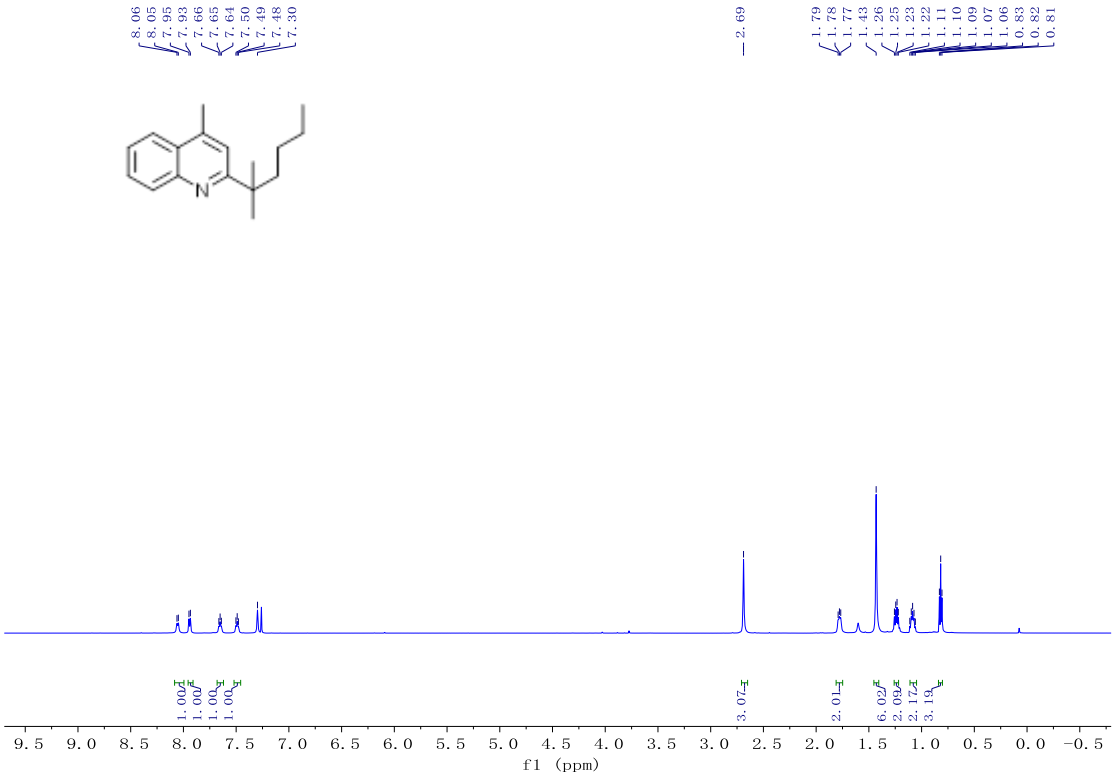
^{1}H NMR of **4h** (600MHz, $CDCl_3$)



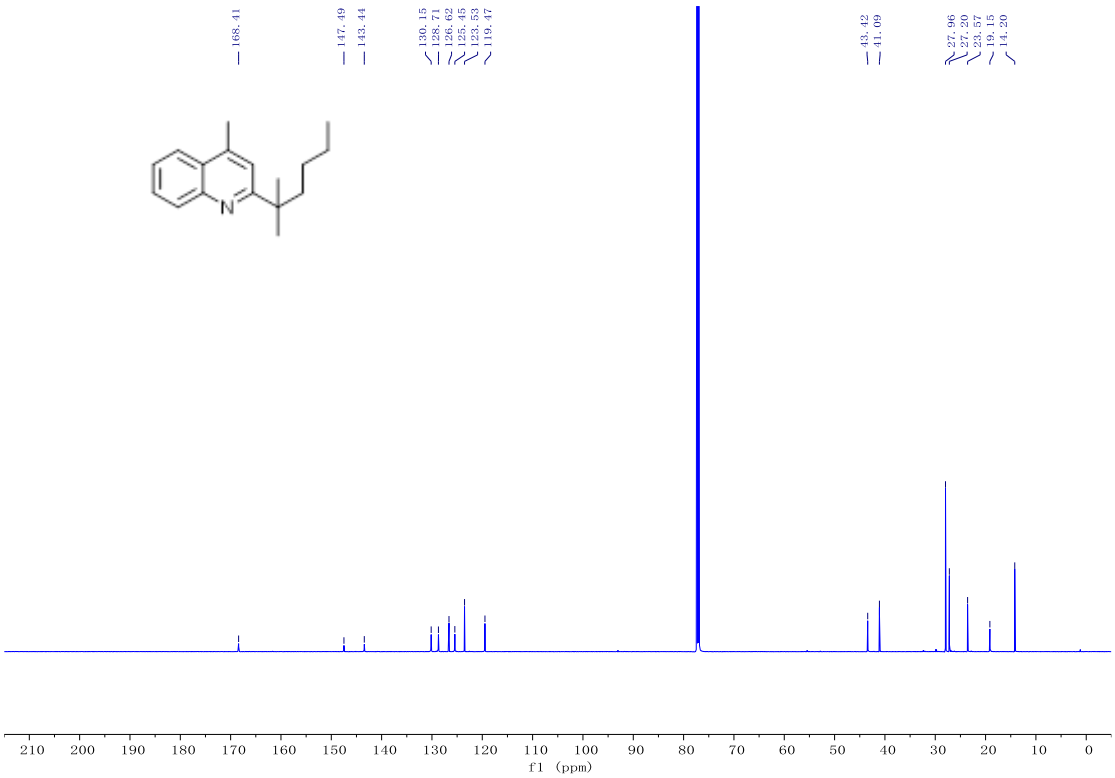
^{13}C NMR of **4h** (151MHz, $CDCl_3$)



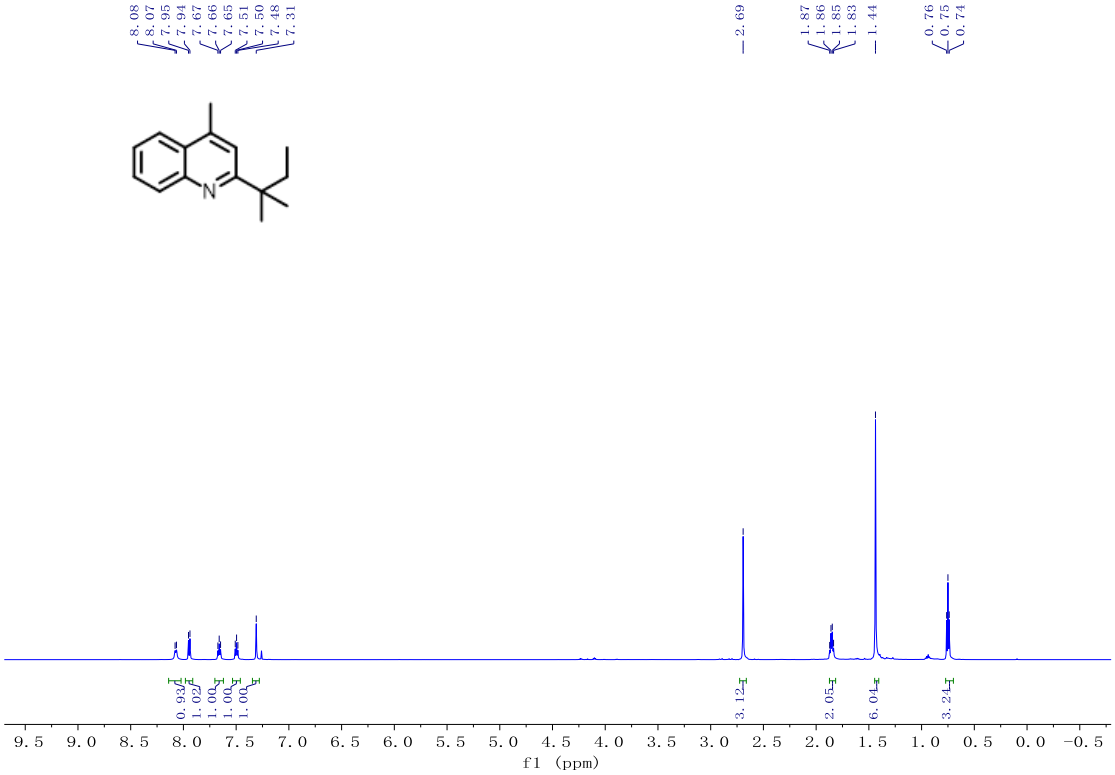
^{1}H NMR of **4i** (600MHz, $CDCl_3$)



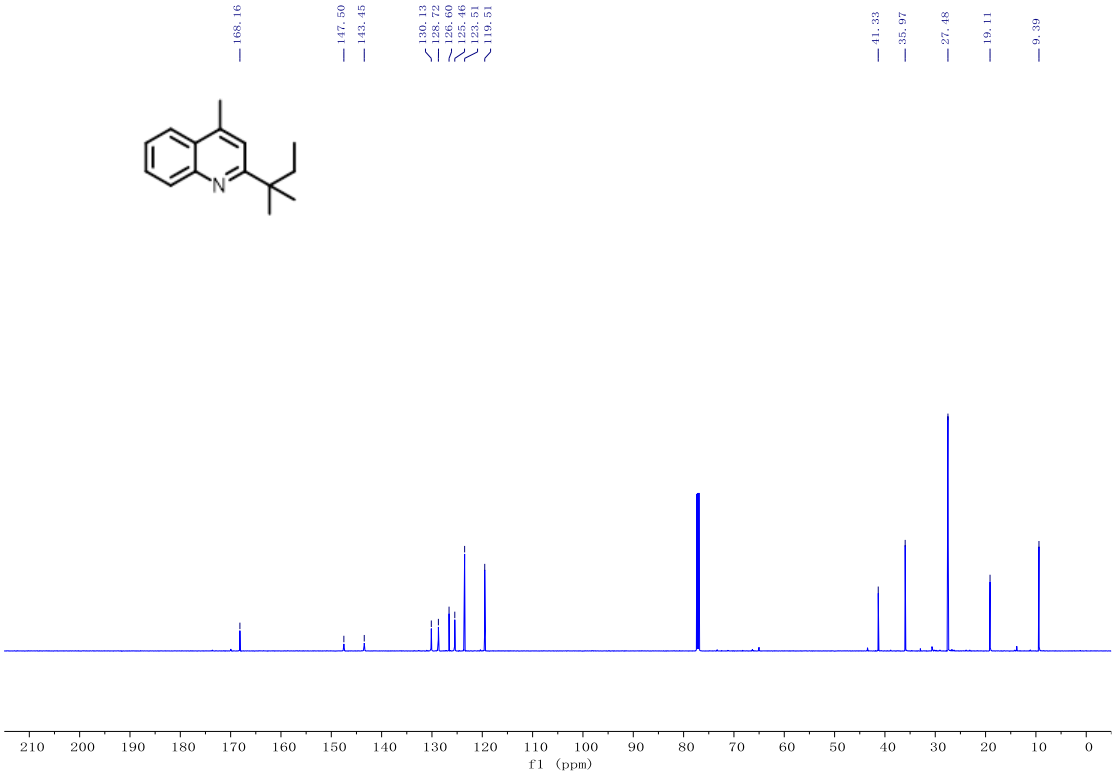
^{13}C NMR of **4i** (151MHz, $CDCl_3$)



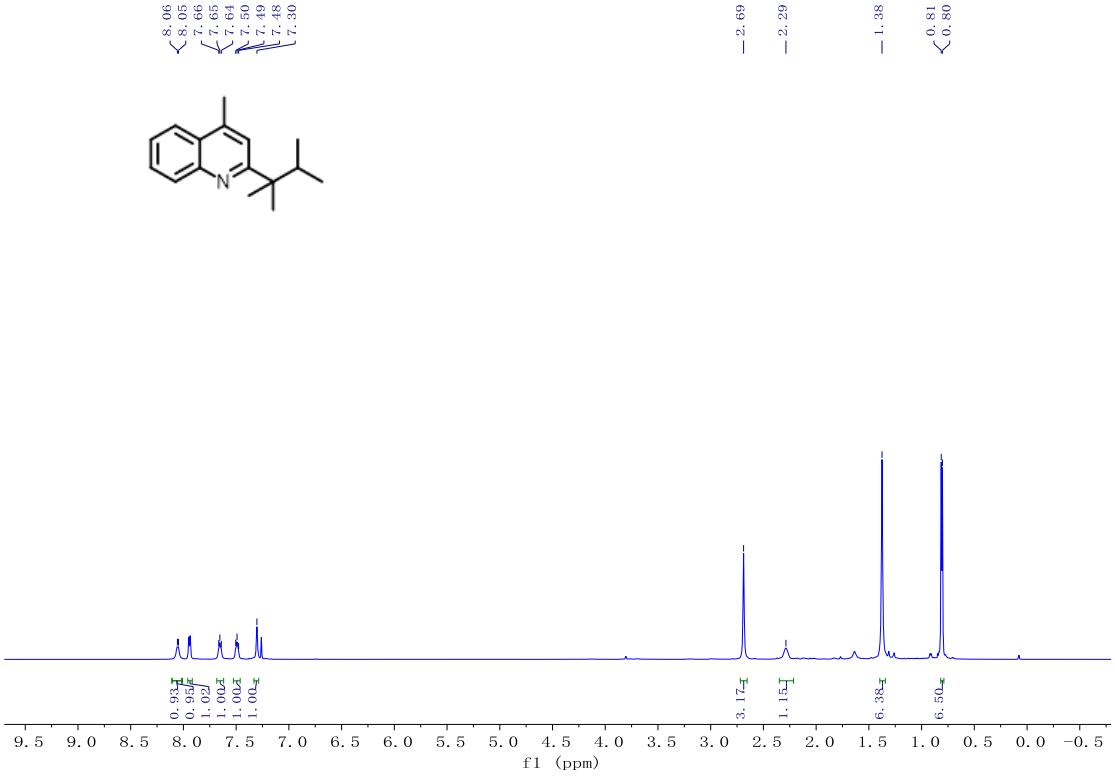
^{1}H NMR of **4j** (600MHz, $CDCl_3$)



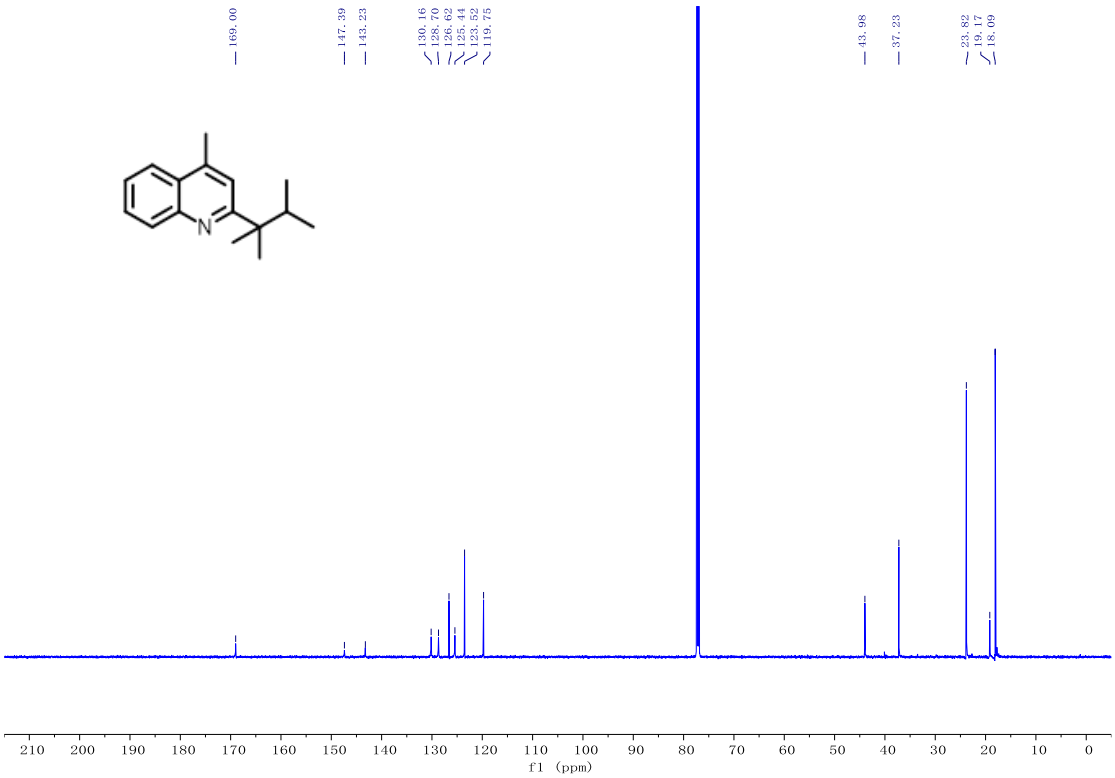
^{13}C NMR of **4j** (151MHz, $CDCl_3$)



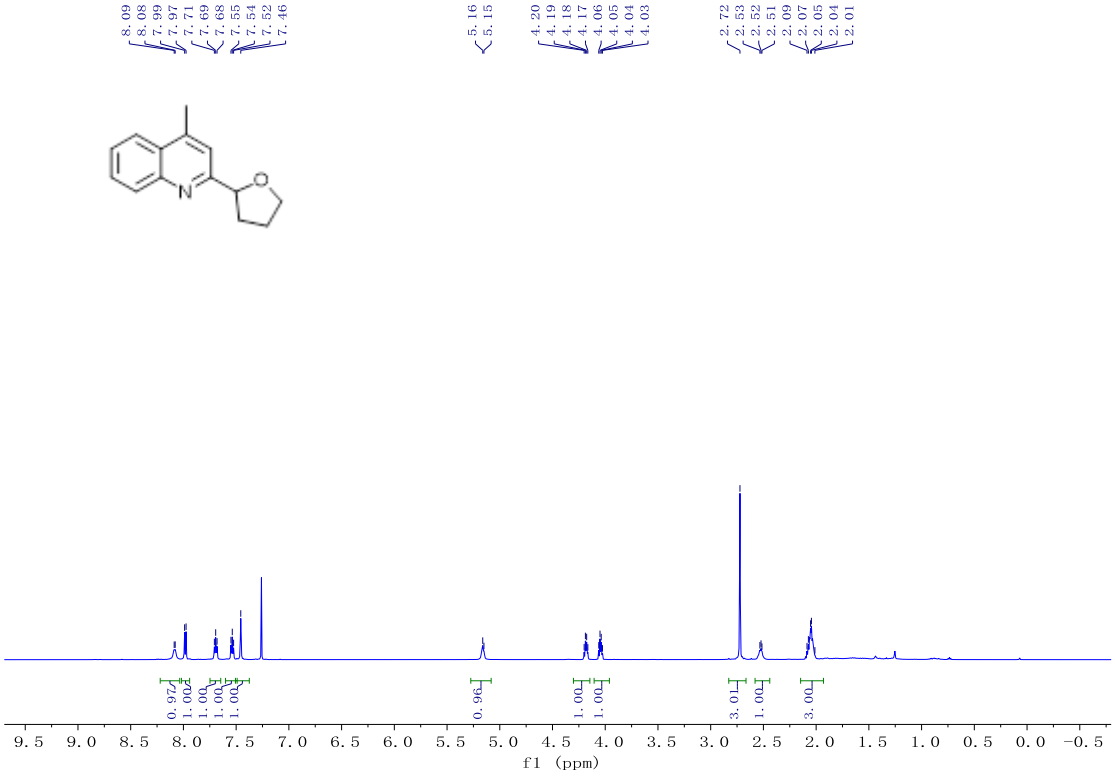
^{1}H NMR of **4k** (600MHz, $CDCl_3$)



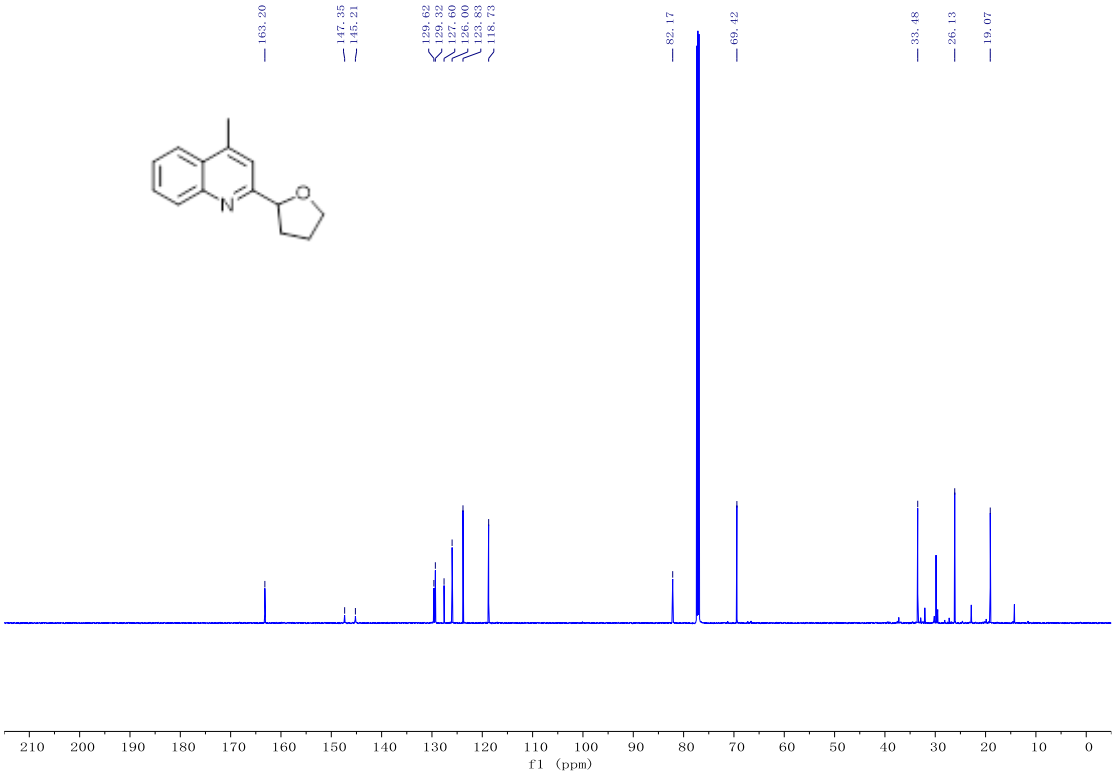
^{13}C NMR of **4k** (151MHz, $CDCl_3$)



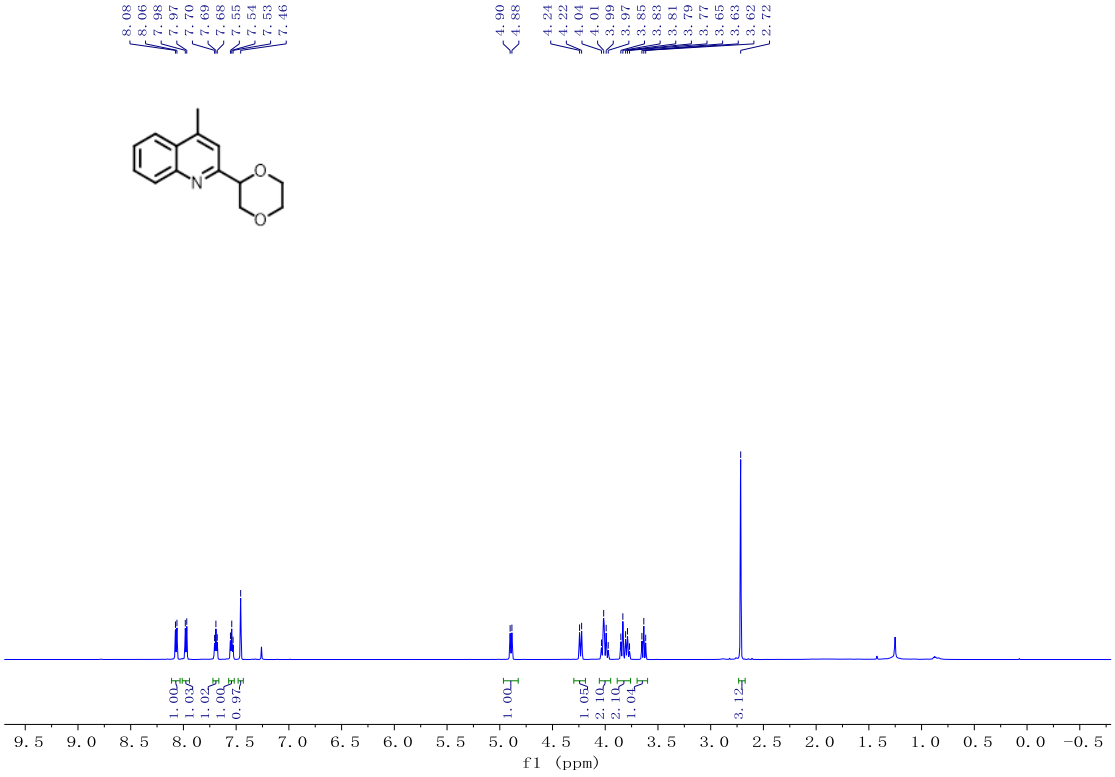
^{1}H NMR of **4l** (600MHz, $CDCl_3$)



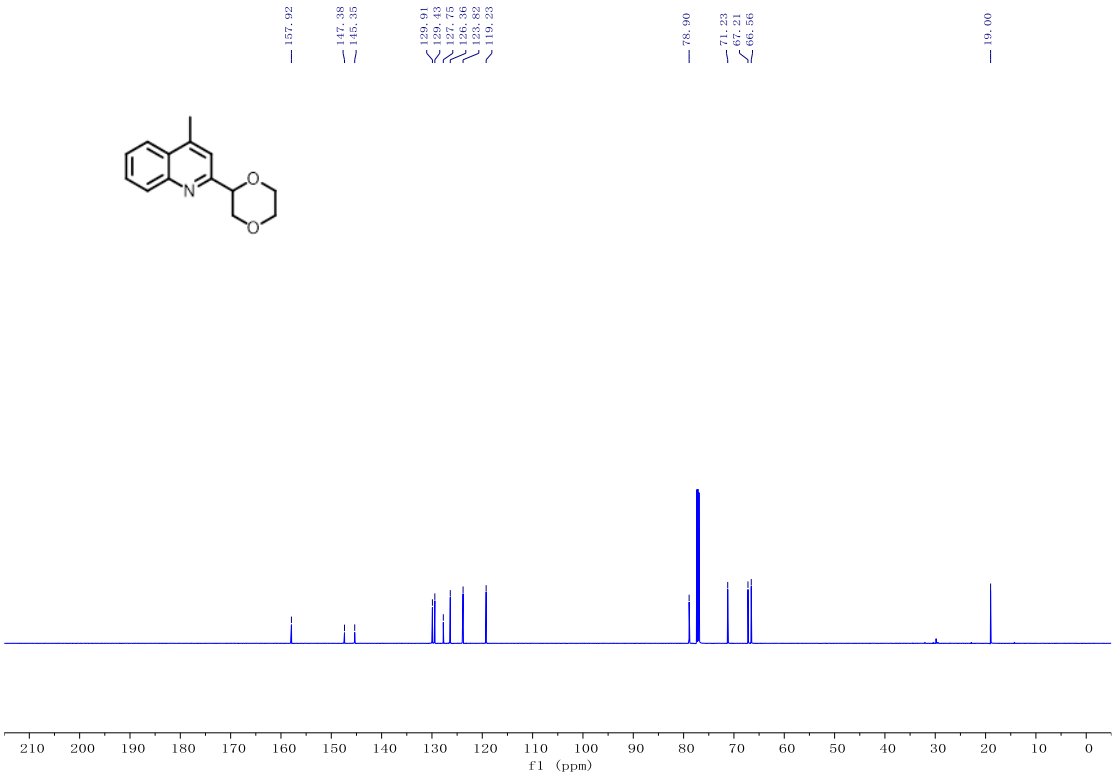
^{13}C NMR of **4l** (151MHz, $CDCl_3$)



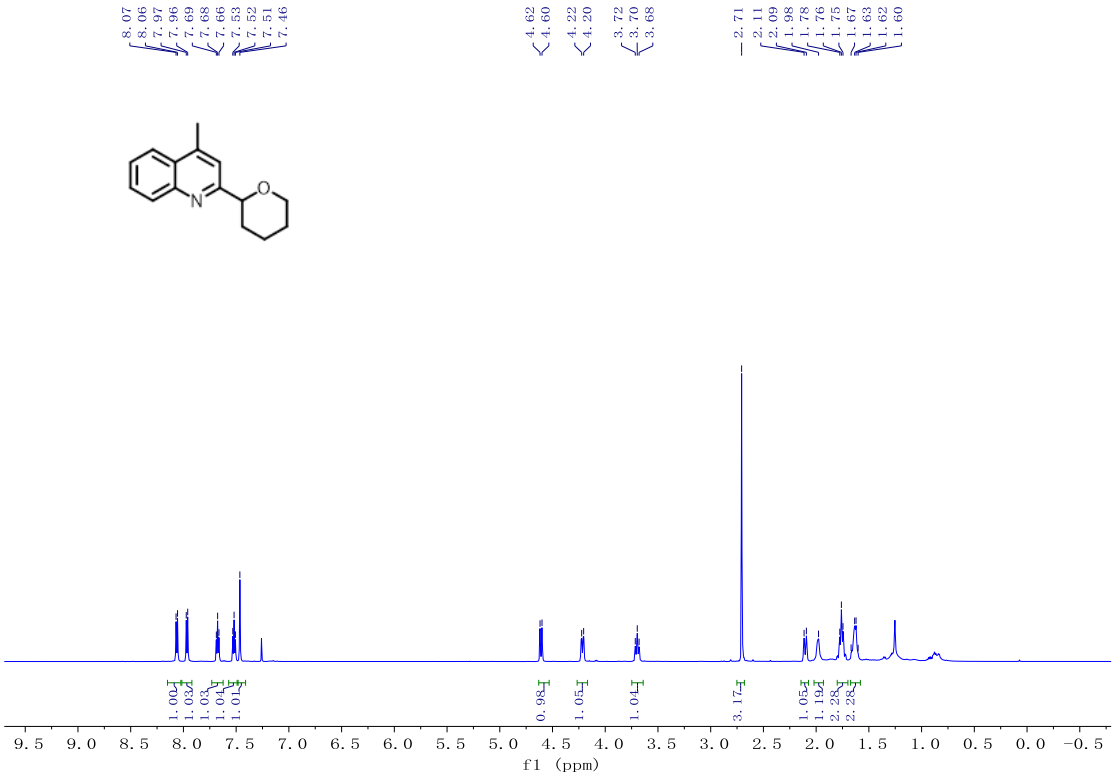
^{1}H NMR of **4m** (600MHz, $CDCl_3$)



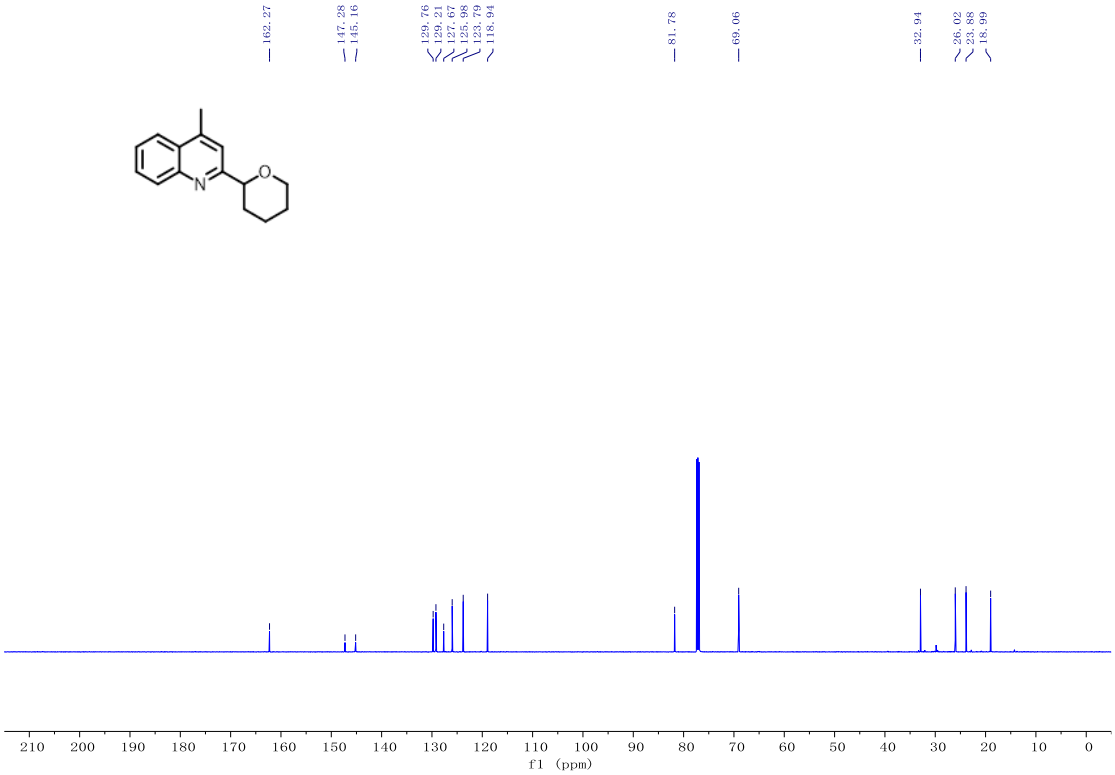
^{13}C NMR of **4m** (151MHz, $CDCl_3$)



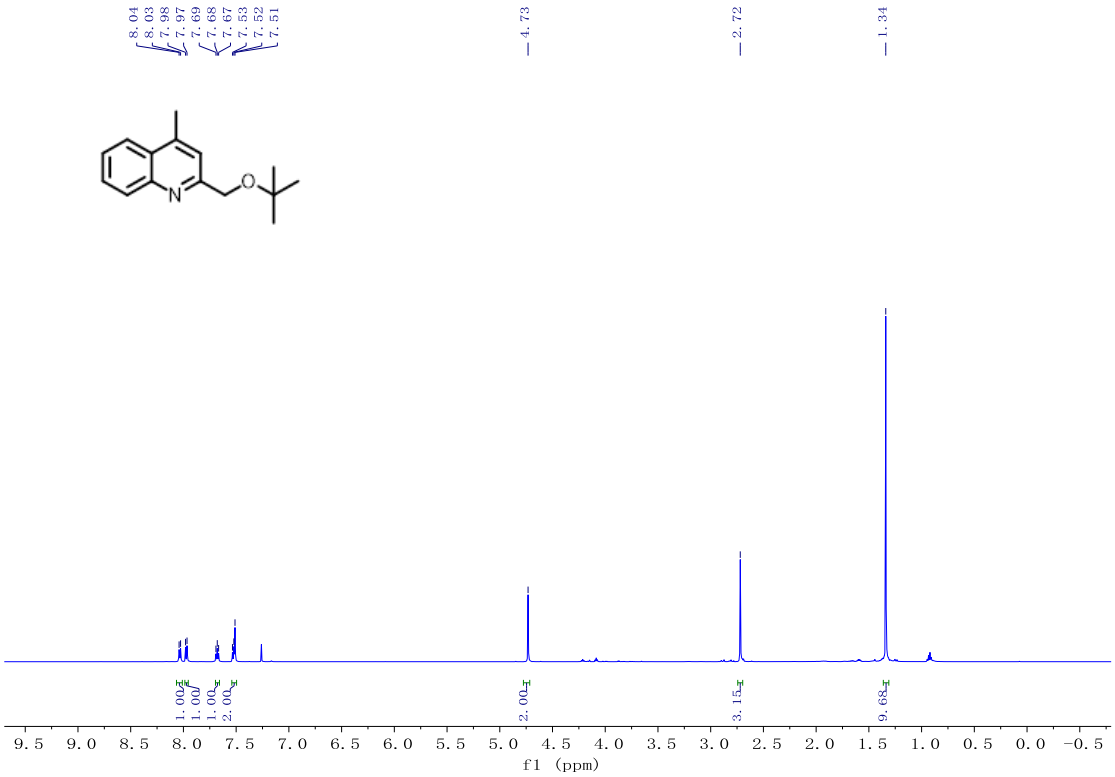
^{1}H NMR of **4n** (600MHz, $CDCl_3$)



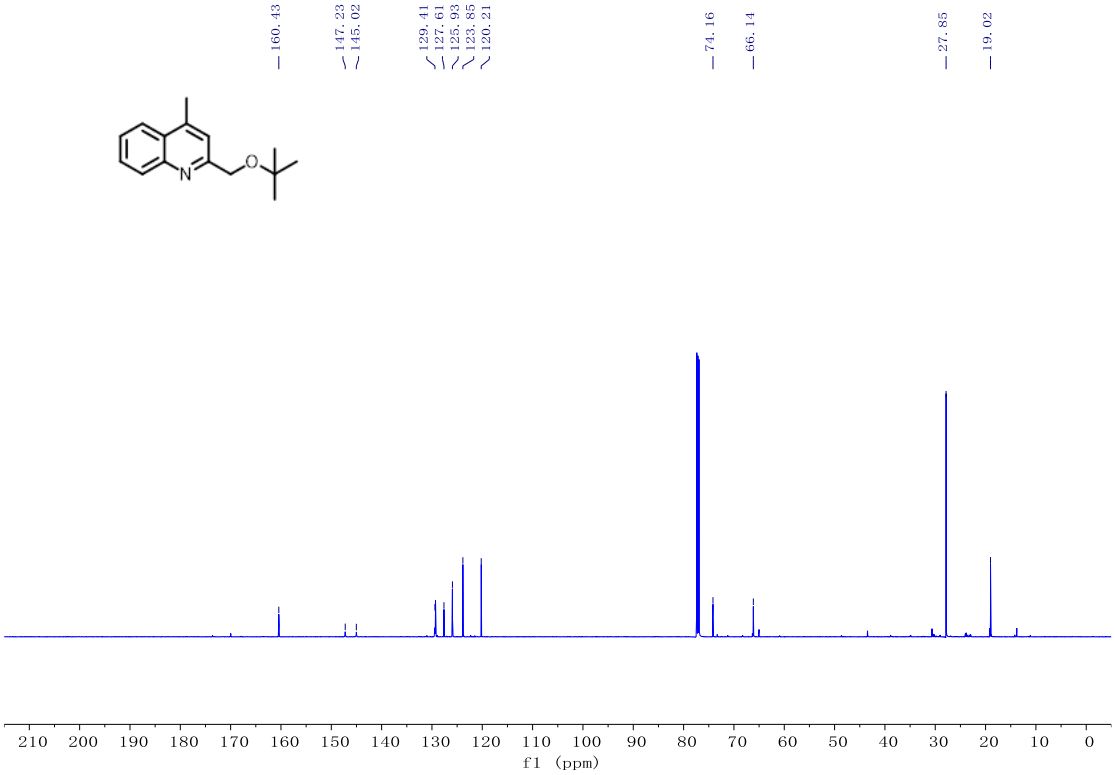
^{13}C NMR of **4n** (151MHz, $CDCl_3$)



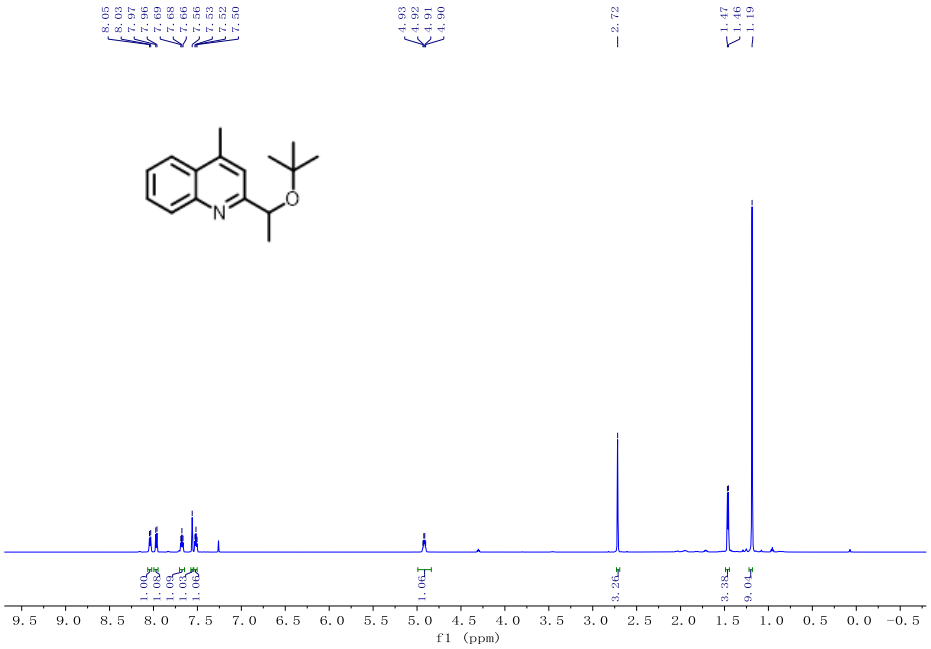
^{1}H NMR of **4o** (600MHz, $CDCl_3$)



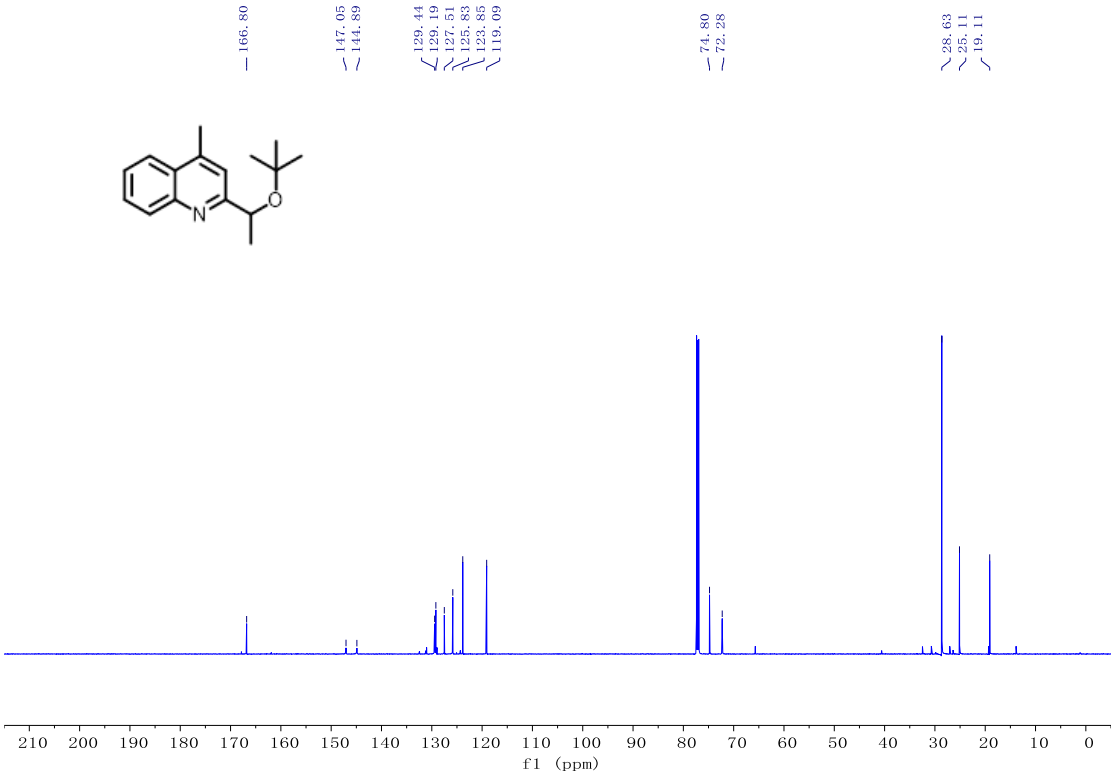
^{13}C NMR of **4o** (151MHz, $CDCl_3$)



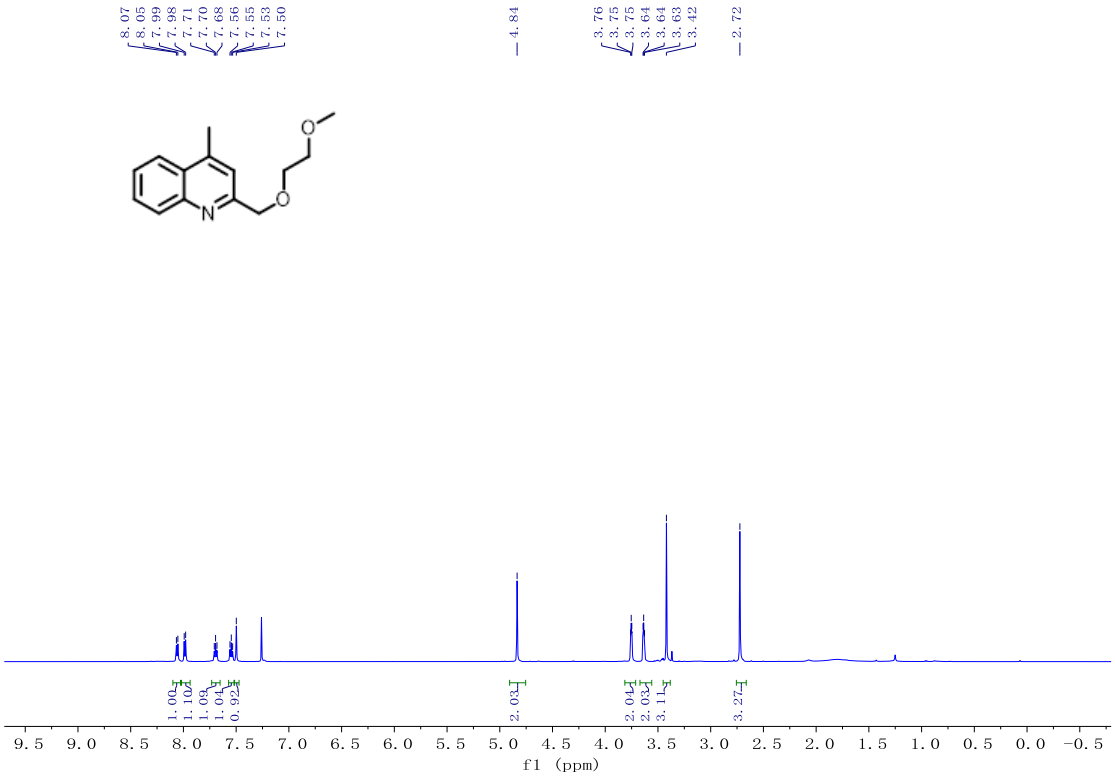
^{1}H NMR of **4p** (600MHz, $CDCl_3$)



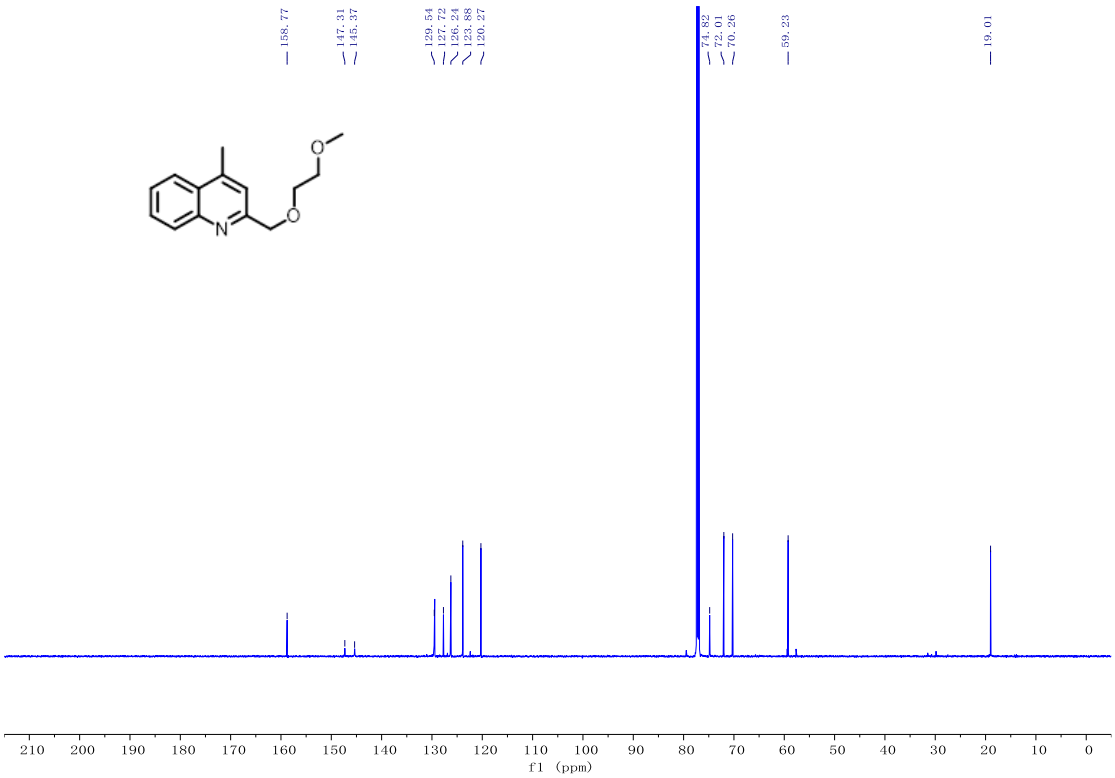
^{13}C NMR of **4p** (151MHz, $CDCl_3$)



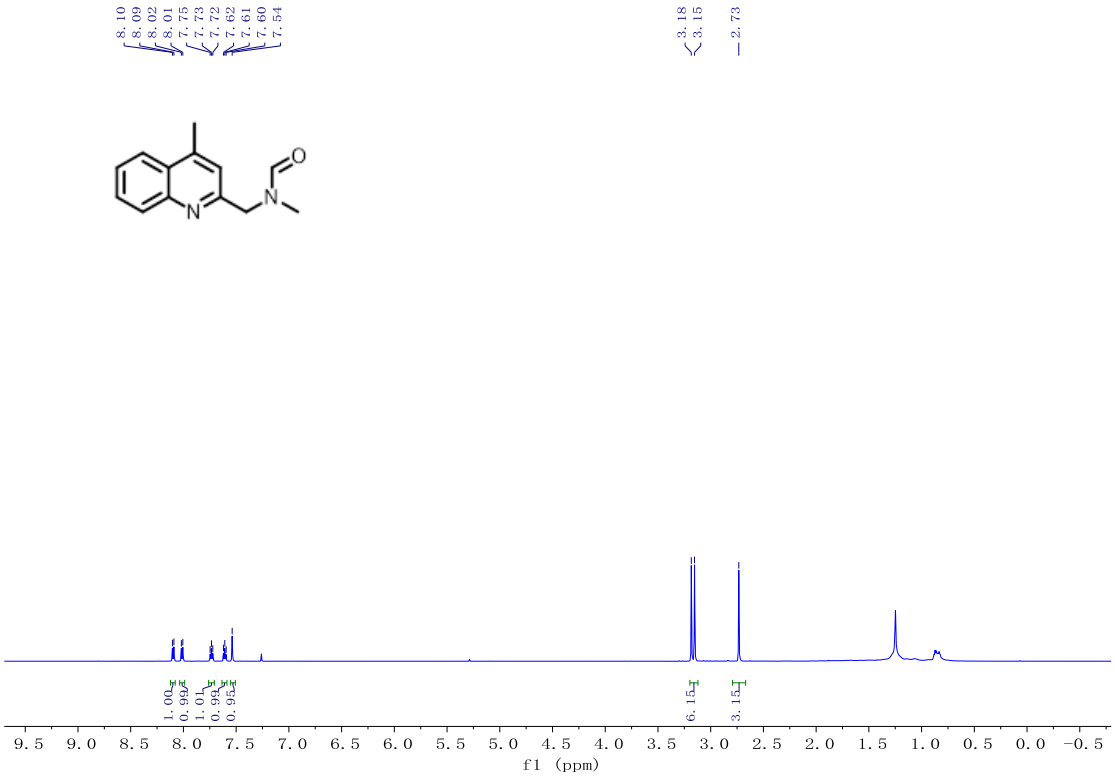
^{1}H NMR of **4q** (600MHz, $CDCl_3$)



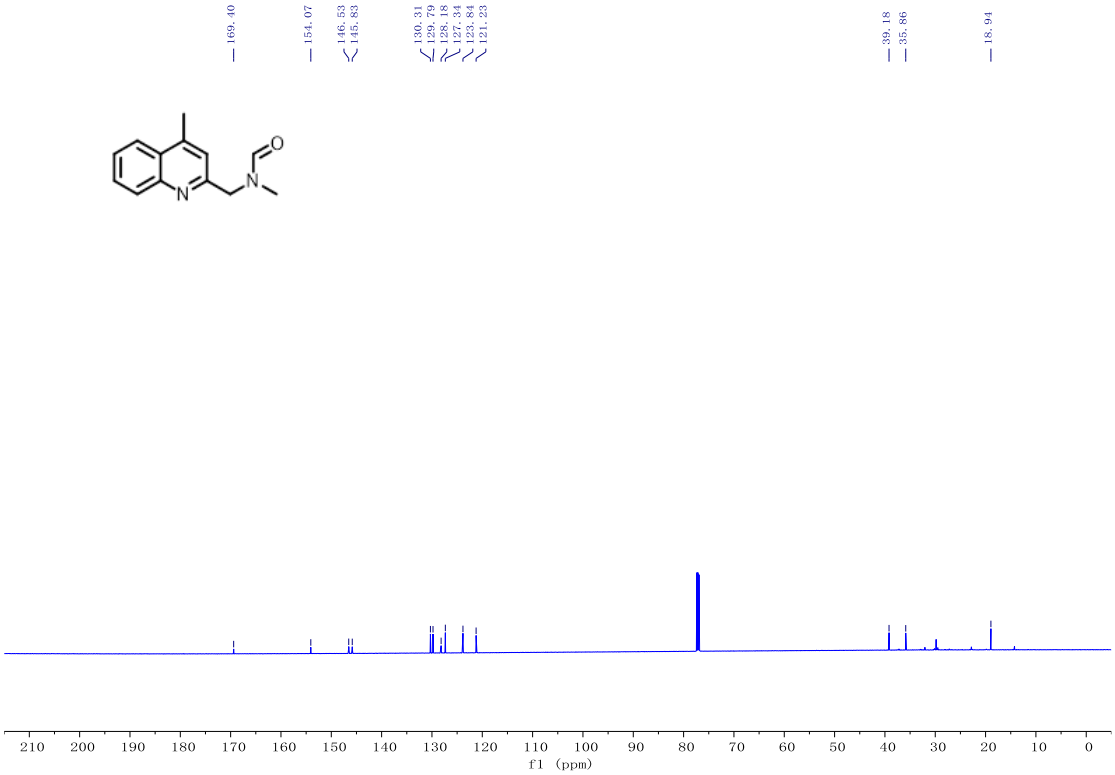
^{13}C NMR of **4q** (151MHz, $CDCl_3$)



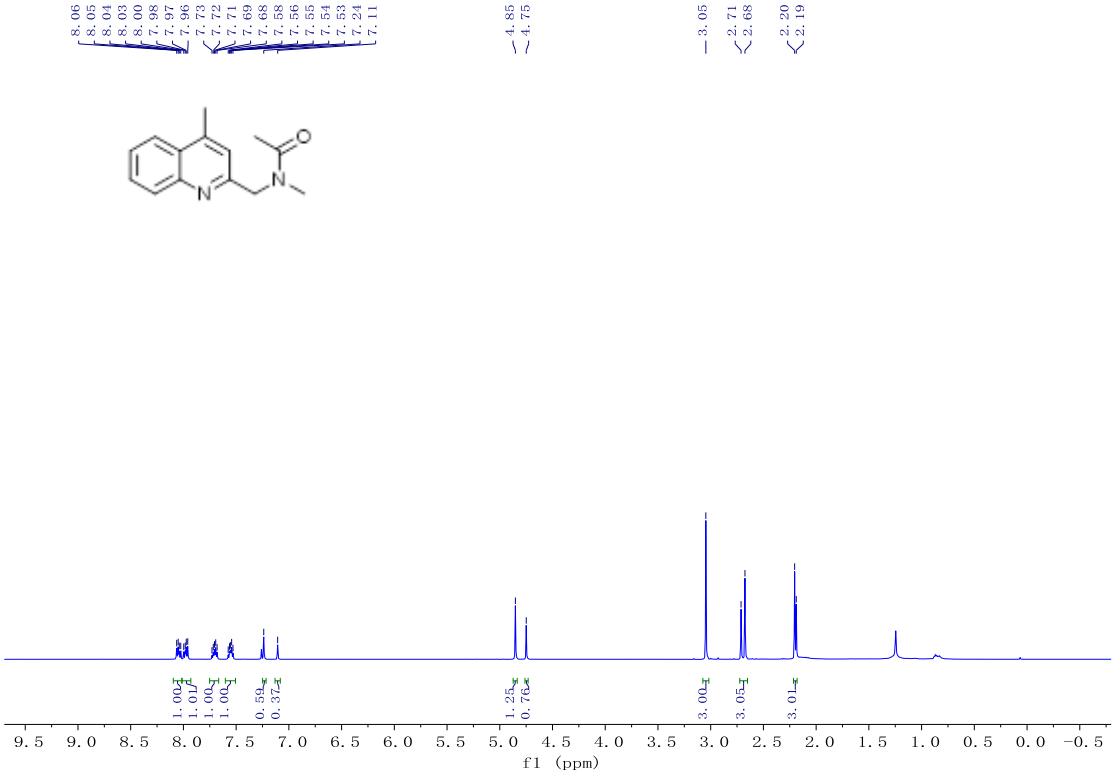
^{1}H NMR of **4r** (600MHz, $CDCl_3$)



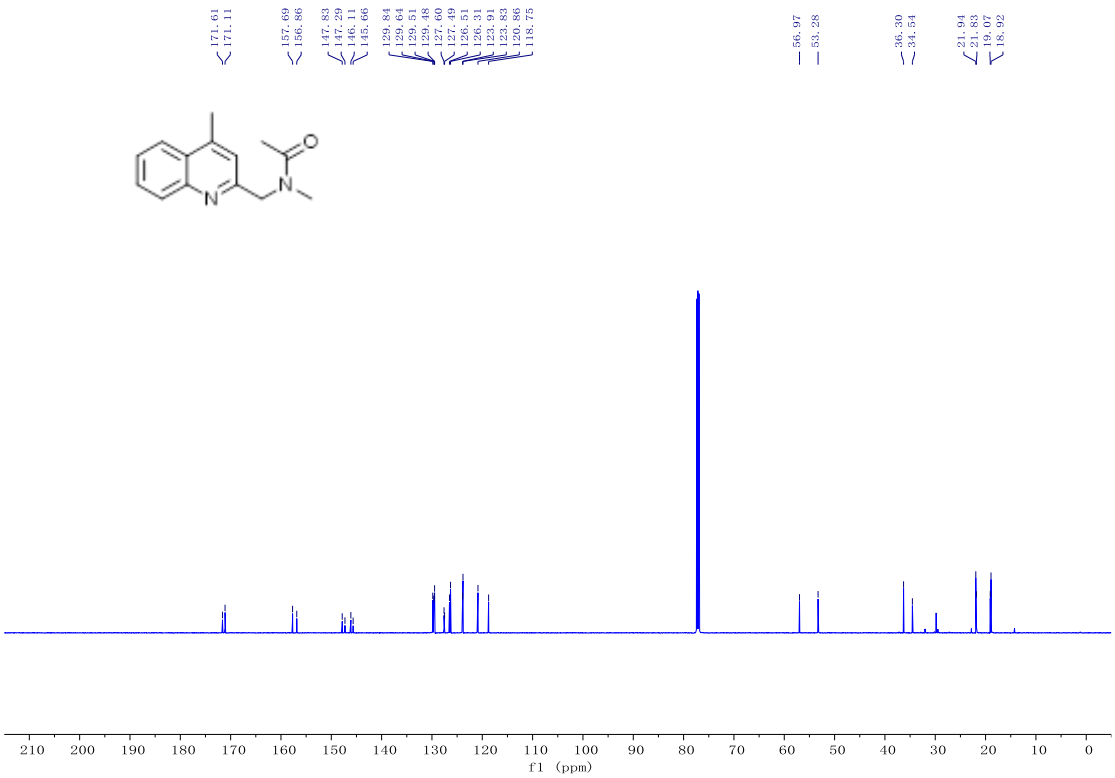
^{13}C NMR of **4r** (151MHz, $CDCl_3$)



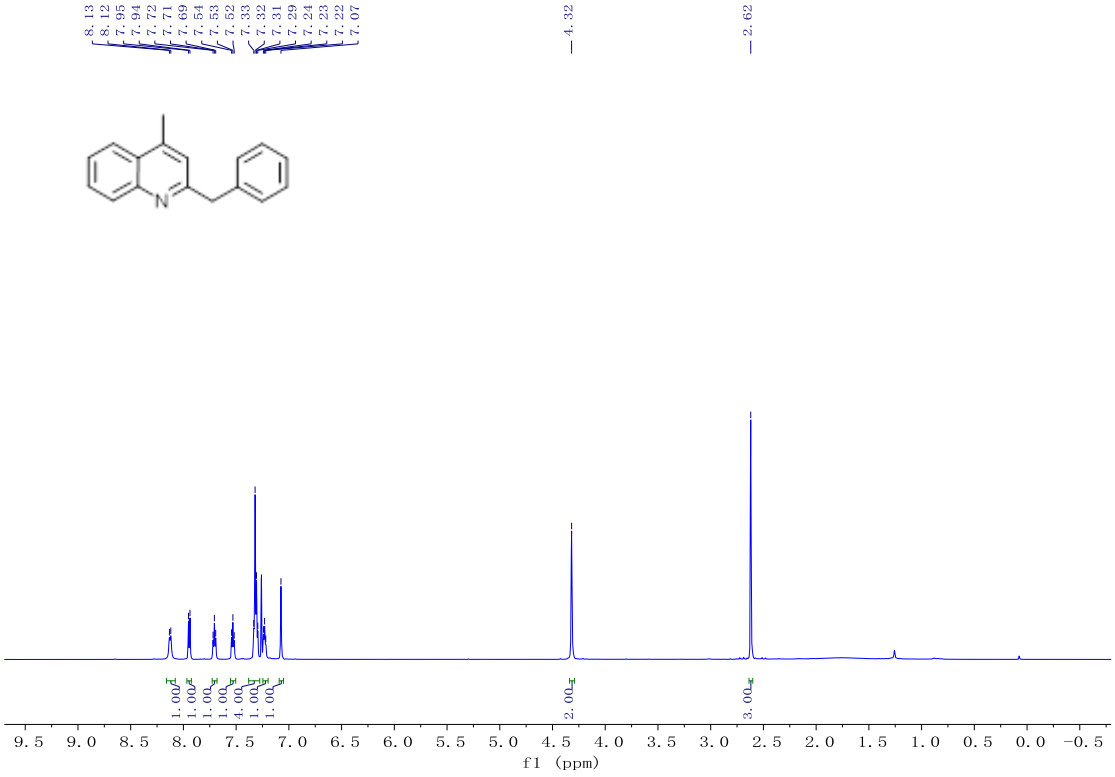
^{1}H NMR of **4s** (600MHz, $CDCl_3$)



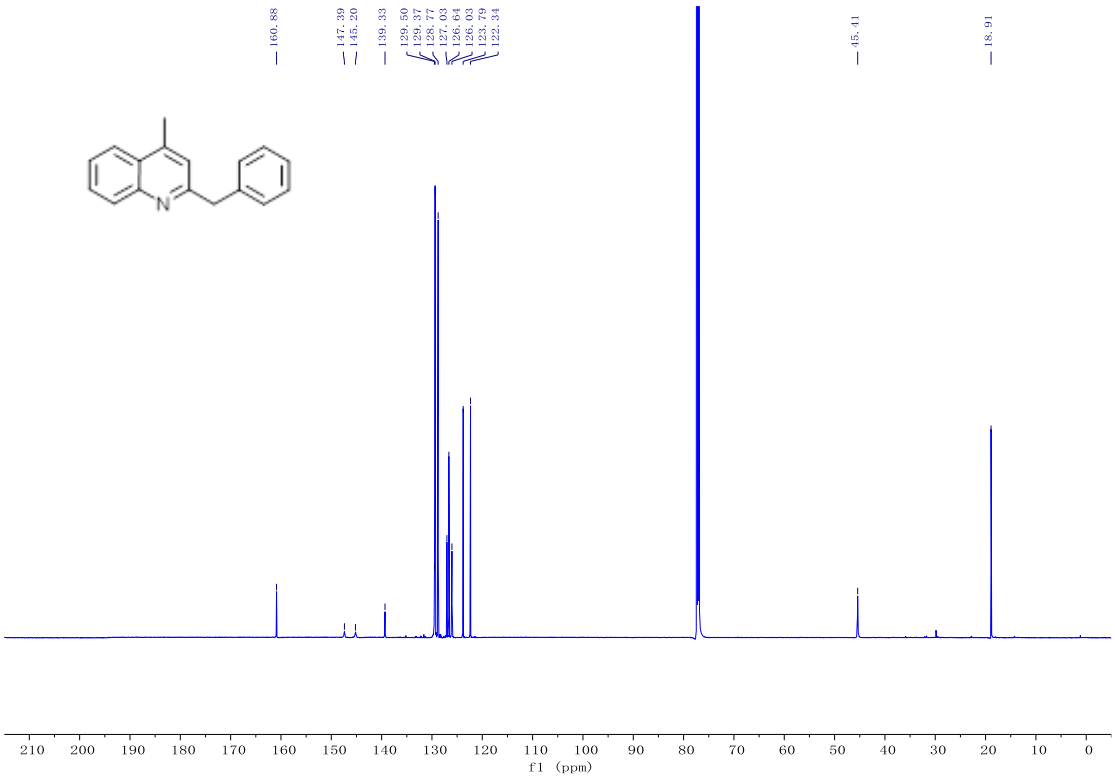
^{13}C NMR of **4s** (151MHz, $CDCl_3$)



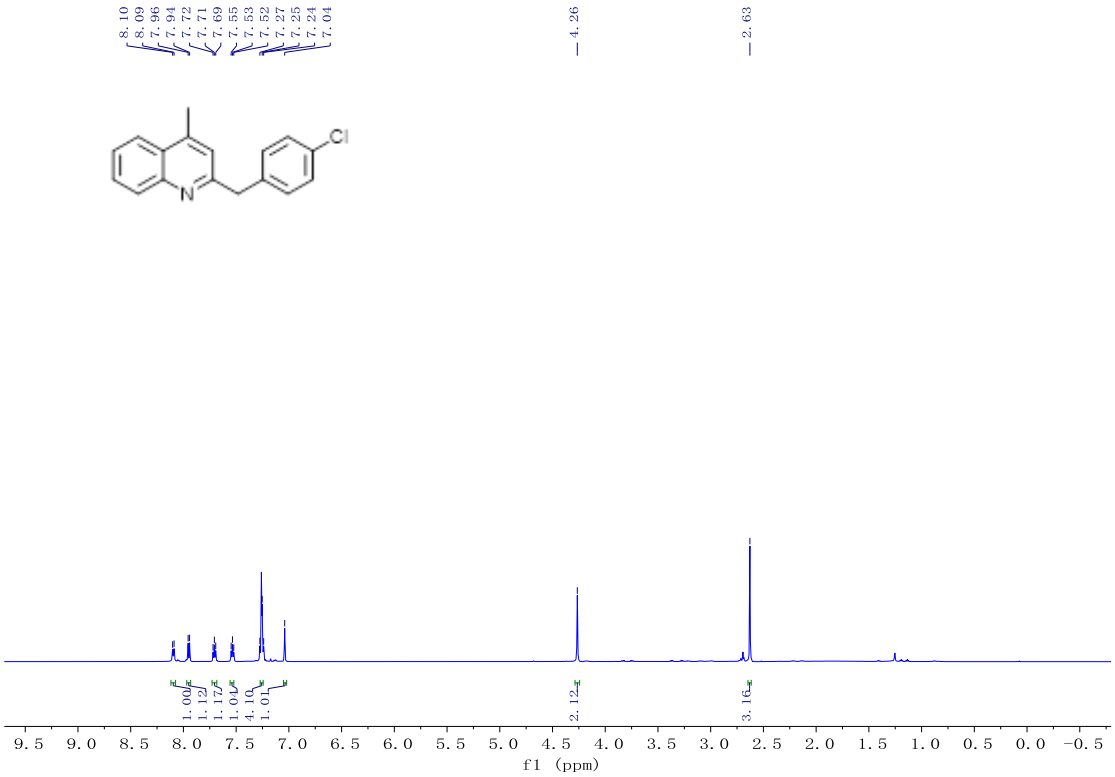
^{1}H NMR of **4t** (600MHz, $CDCl_3$)



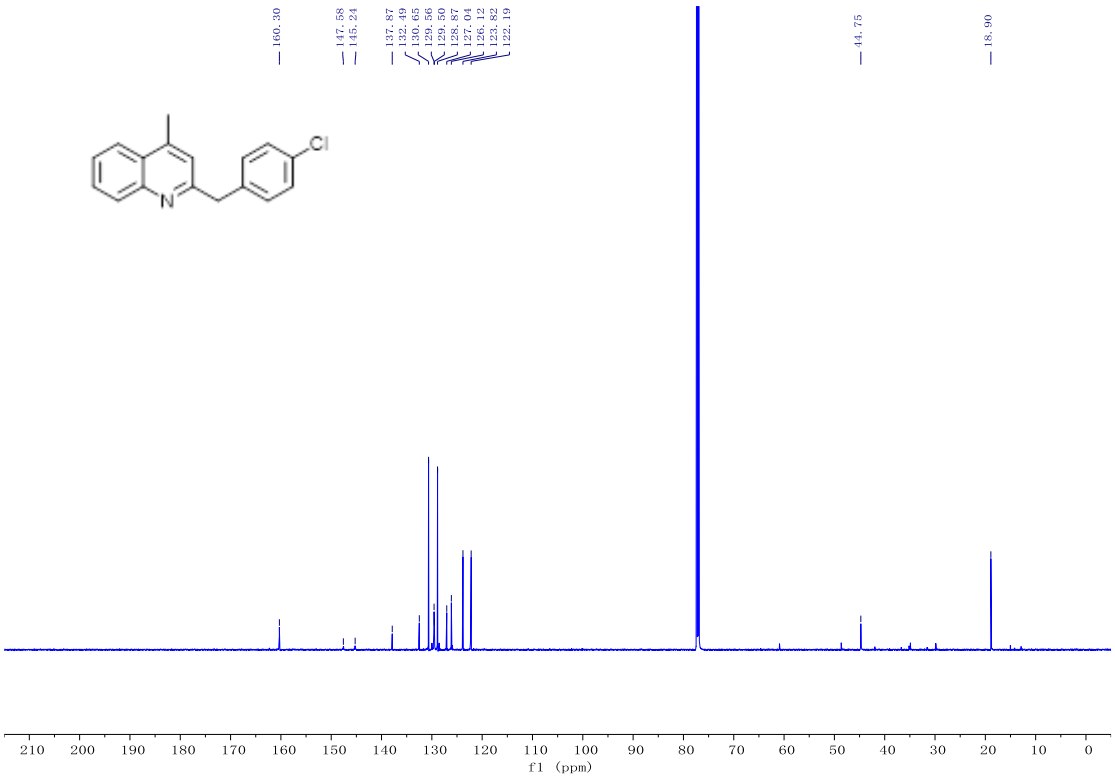
^{13}C NMR of **4t** (151MHz, $CDCl_3$)



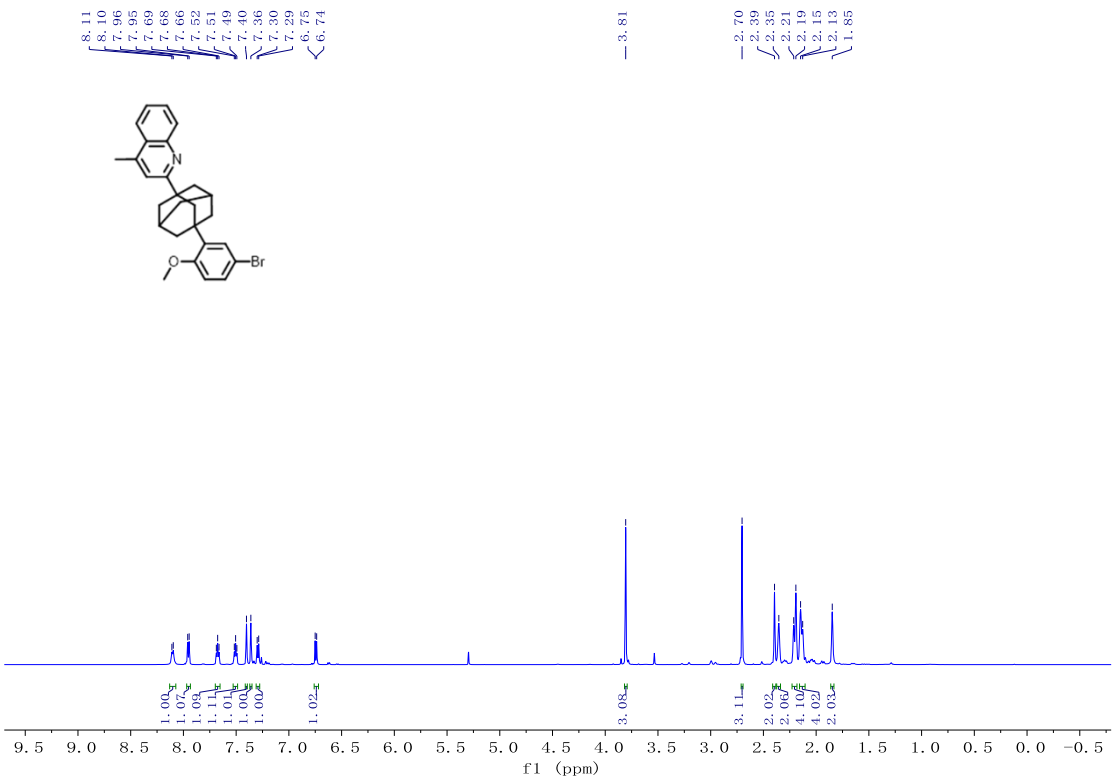
^{1}H NMR of **4u** (600MHz, $CDCl_3$)



^{13}C NMR of **4u** (151MHz, $CDCl_3$)



^{1}H NMR of **4v** (600MHz, $CDCl_3$)



^{13}C NMR of **4v** (151MHz, $CDCl_3$)