Supporting Information

A Sequential Au(I)/TBAF-Promoted Rapid and Selective Functionalization of Heteroarene N-Oxides with Alkynes

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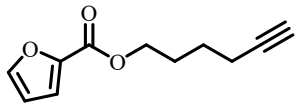
Contents

1. General information

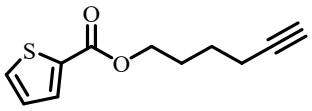
All reactions were carried out in air unless otherwise stated. For thin layer chromatography (TLC), Yantai pre-coated TLC plates (HSGF 254) were used, and compounds were visualized with a UV light at 254 nm. Column chromatography separations were performed on silica gel (300–400 mesh). Ethyl acetate and petroleum ether were used as eluents. NMR spectra were recorded on a JEOL ECZ400 400 MHz spectrometers (400 MHz for ^{1}H, 101 MHz for ^{13}C) with TMS as an internal standard and $CDCl_3$ as solvent. Chemical shifts were reported in δ (ppm) referenced to the residual solvent peak of $CDCl_3$ (δ 7.26) for 1H NMR and $CDCl_3$ (δ 77.0) for ^{13}C NMR. Multiplicity abbreviated as: s, singlet; d, doublet; t, triplet; q, quartet; se-Pt, Septet; m, multiplet. Coupling constants were reported in Hertz (Hz). Fourier transform infrared spectra (FT-IR) were recorded on Agilent Technologies Cary 630 instrument. High resolution mass spectra (HRMS) were performed on Agilent G6550A Q-TOF (ESI). Melting points were measured on micro melting point apparatus and uncorrected. Unless otherwise noted, all commercialized reagents were used as received without further purification. Analytical grade solvents were used. The alkynes were prepared according to the known literature.

2. Characterization of alkynes

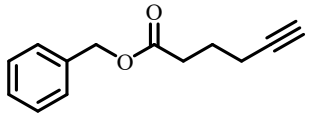
The alkynes were prepared according to the known literature.[1-5]



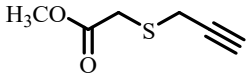
hex-5-yn-1-yl furan-2-carboxylate (2l).[1] Colorless liquid. (0.246 g, 64%, 2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.60 – 7.57 (m, 1H), 7.17 (d, *J* = 3.5 Hz, 1H), 6.50 (ddd, *J* = 3.5, 1.7, 0.7 Hz, 1H), 4.33 (t, *J* = 6.7 Hz, 2H), 2.27 (td, *J* = 6.6 Hz, 2.2 Hz, 2H), 1.96 (td, *J* = 2.6, 0.7 Hz, 1H), 1.92 – 1.85 (m, 2H), 1.67 (dt, *J* = 14.4, 7.2 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 158.9, 146.4, 144.9, 118.0, 111.9, 83.9, 68.9, 64.5, 27.9, 25.0, 18.2.



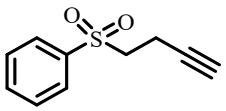
hex-5-yn-1-yl thiophene-2-carboxylate (2t).[2] Colorless liquid. (0.354 g, 85%, 2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.80 (dd, *J* = 3.7, 1.1 Hz, 1H), 7.54 (dd, *J* = 5.0, 1.1 Hz, 1H), 7.10 (dd, *J* = 4.9, 3.8 Hz, 1H), 4.32 (t, *J* = 6.4 Hz, 2H), 2.27 (td, *J* = 7.0, 2.6 Hz, 2H), 1.97 (t, *J* = 2.6 Hz, 1H), 1.92 – 1.85 (m, 2H), 1.69 (p, *J* = 7.1 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 162.4, 134.0, 133.5, 132.4, 127.9, 84.0, 68.9, 64.7, 27.9, 25.1, 18.2.



benzyl hex-5-ynoate (2u).[3] Colorless liquid. (0.316 g, 78%, 2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.40 – 7.31 (m, 5H), 5.13 (s, 2H), 2.51 (t, *J* = 7.4 Hz, 2H), 2.27 (td, *J* = 6.9, 2.6 Hz, 2H), 1.97 – 1.95 (m, 1H), 1.88 (p, *J* = 7.2 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 173.0, 136.1, 128.7, 128.4, 128.3, 83.4, 69.3, 66.4, 33.1, 23.7, 18.0.



methyl 2-(prop-2-yn-1-ylthio)acetate (Substrate of 6t).[4] Colorless liquid. (0.150g, 52%, 2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 3.75 (s, 3H), 3.43 (s, 2H), 3.40 (d, *J* = 2.6 Hz, 2H), 2.28 (t, *J* = 2.6 Hz, 1H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 170.6, 79.0, 72.0, 52.6, 32.5, 20.1.

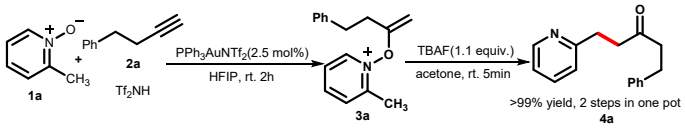


(but-3-yn-1-ylsulfonyl)benzene (Substrate of 6u).[5] White solid. (0.291 g, 75%, 2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.92 (dd, *J* = 8.3, 1.3 Hz, 2H), 7.68 (t, *J* = 7.4 Hz, 1H), 7.59 (t, *J* = 7.6 Hz, 2H), 3.33 – 3.29 (m, 2H), 2.65 – 2.61 (m, 2H), 1.95 (t, *J* = 2.7 Hz, 1H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 138.6, 134.2, 129.6, 128.4, 79.4, 70.7, 54.7, 13.4.

3. Optimization of reaction conditions using TBAF as a base reagent.

The reaction proved highly compatible with a sequential Au/TBAF catalytic system, as initial screening experiments showed (Table S1, entry 1). Inspired by the above result, we then investigated the F sources and solvents to potentially render this rearrangement reaction. First, we investigated the effect of different fluoride sources. Sub-stituting TBAF with TMAF led to a slightly reduced yield of 87%, while using KF as the fluoride source gave a moderate yield of 71% (entries 2-3). A much lower yield of 30% was observed with $NEt_3 \cdot 3HF$ (entry 4), suggesting that $NEt_3 \cdot 3HF$ might not be a strong enough base or might not provide sufficient free fluoride ions for effi-cient reaction progression. Replacing TBAF with DIPEA or triethylamine reduced 4a yields to 65% and 81%, emphasizing TBAF's critical role in enhancing efficiency within the sequential Au/TBAF catalytic system (entries 5-6). Reducing the amount of TBAF to 0.4 equivalents resulted in a significantly lower yield (entry 7). However, the yield improved to >99% when the temperature was increased to 60°C, even with 0.4 equivalents of TBAF (entry 8). Further reducing the TBAF to 0.2 equivalents still produced a reasonable yield of 83%, though the reaction required 24 hours (entry 9). Finally, we examined the role of different solvents. Polar solvents like THF performed well but were slightly less efficient (entry 10), whereas HFIP and methanol signifi-cantly hindered the reaction, likely due to their polarity and potential interactions with TBAF (entries 11-12).

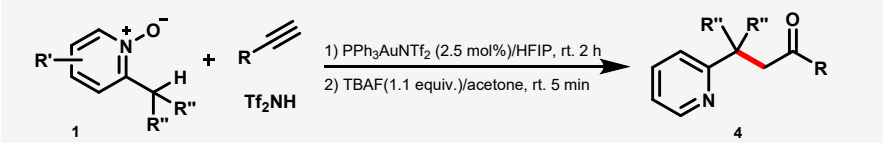
Table S1. Optimization of reaction conditions using TBAF as a base reagent.



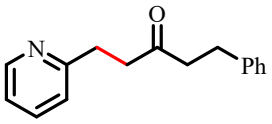
Entry	Deviation from the initially conditions	Yield
1	none	>99%
2	TMAF instead of TBAF, 5h	87%
3	KF instead of TBAF, 8h	71%
4	NEt_3•3HF instead of TBAF, 8h	30%
5	DIPEA instead of TBAF	65%
6	Et3N instead of TBAF	81%
7	0.4 equiv. TBAF, rt, 12h	45%
8	0.4 equiv. TBAF, 60 °C, 10h	>99%
9	0.2 equiv. TBAF was used, 60 °C, 24h	83%
10	Same with entry 6, THF instead	90%
11	Same with entry 6, HFIP instead	16%
12	Same with entry 6, MeOH instead	45%

[a] 0.12 mmol of **1a**, 0.1 mmol of **2a**, 0.11 mmol of Tf2NH, 0.11 mmol of TBAF, solvent (0.5 mL). [b]Yield determined by ^{1}H NMR by comparison with internal standard.

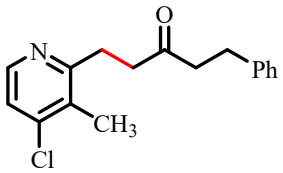
4. A general procedure for Table 1



A solution of substituted 2-methylpyridine N-oxide (0.24 mmol, 1.2 eq.), $HNTf_2$ (0.22 mmol, 1.1 eq.) in HFIP (0.5 mL) was stirred at room temperature for 15 min. The alkynes (0.20 mmol) and PPh_3AuNTf_2 (5.0 μmol, 2.5 mol%) were added and stirred at room temperature for another 2 hours. Upon completion, the HFIP was removed under reduced pressure. TBAF (0.22 mmol, 1.1 equiv.) and acetone (1 mL) were then added to the residue and stirred at room temperature for 5 min. The crude reaction mixture was then purified by column chromatography to afford the final product.

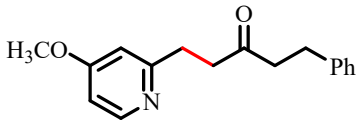


1-phenyl-5-(pyridin-2-yl)pentan-3-one (4a).[6] Light yellow liquid. (45.5mg, 95%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.48 (dd, *J* = 4.9, 0.8 Hz, 1H), 7.57 (td, *J* = 7.7, 1.8 Hz, 1H), 7.27 (t, *J* = 7.3 Hz, 2H), 7.20 – 7.15 (m, 4H), 7.10 (dd, *J* = 7.5, 4.9 Hz, 1H), 3.07 (t, *J* = 7.2 Hz, 2H), 2.93 – 2.88 (m, 4H), 2.77 (t, *J* = 7.4 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.3, 160.5, 149.3, 141.2, 136.5, 128.6, 128.4, 126.2, 123.3, 121.3, 44.5, 41.8, 31.8, 29.8.

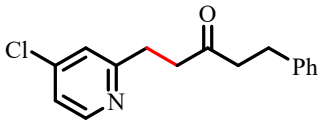


1-(4-chloro-3-methylpyridin-2-yl)-5-phenylpentan-3-one (4b). Yellow liquid. (40.3 mg, 70%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.15 (d, *J* = 5.2 Hz, 1H), 7.29 (d, *J* = 7.6 Hz, 2H), 7.19 (dd, *J* = 6.6, 4.6 Hz, 3H), 7.12 (d, *J* = 5.3 Hz, 1H), 3.09 (t, *J* = 6.9 Hz, 2H), 2.92 (t, *J* = 5.8 Hz, 4H), 2.86 (dd, *J* = 8.4, 5.7 Hz, 2H), 2.37 (s, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.6, 160.0, 146.4, 144.2, 141.3, 130.0,

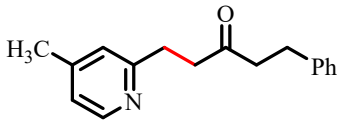
128.6, 128.5, 126.2, 122.4, 44.6, 40.0, 29.9, 29.4, 15.1. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{17}H_{19}ClNO$ 288.1150; found 288.1145.



1-(4-methoxypyridin-2-yl)-5-phenylpentan-3-one (4c). Colorless liquid. (48.5 mg, 90%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.29 (d, *J* = 4.3 Hz, 1H), 7.25 (d, *J* = 7.1 Hz, 2H), 7.16 (t, *J* = 8.7 Hz, 3H), 6.70 (s, 1H), 6.65 – 6.64 (m, 1H), 3.82 (s, 3H), 3.00 (t, *J* = 6.3 Hz, 2H), 2.89 (t, *J* = 6.9 Hz, 4H), 2.76 (t, *J* = 7.0 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.3, 166.1, 162.2, 150.4, 141.2, 128.6, 128.4, 126.2, 109.0, 107.9, 55.1, 44.5, 41.8, 32.0, 29.8. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{17}H_{20}NO_2$ 270.1489; found 270.1480.

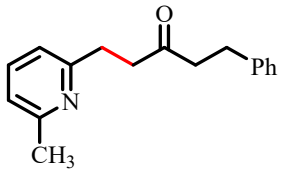


1-(4-chloropyridin-2-yl)-5-phenylpentan-3-one (4d). Colorless liquid. (49.8 mg, 91%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.35 (d, *J* = 5.3 Hz, 1H), 7.26 (t, *J* = 7.3 Hz, 2H), 7.20 – 7.14 (m, 4H), 7.10 (dd, *J* = 5.3, 1.8 Hz, 1H), 3.03 (t, *J* = 7.0 Hz, 2H), 2.89 (t, *J* = 7.2 Hz, 4H), 2.77 (t, *J* = 7.4 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.9, 162.2, 150.1, 144.3, 141.1, 128.6, 128.4, 126.2, 123.7, 121.8, 44.4, 41.3, 31.4, 29.8. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{16}H_{16}ClNONa$ 296.0813; found 296.0813.

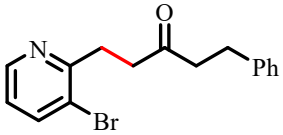


1-(4-methylpyridin-2-yl)-5-phenylpentan-3-one (4e). Colorless liquid. (43.1 mg, 85%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.33 (d, *J* = 5.0 Hz, 1H), 7.26 (t, *J* = 7.3 Hz, 2H), 7.20 – 7.15 (m, 3H), 6.99 (s, 1H), 6.92 (d, *J* = 5.0 Hz, 1H), 3.01 (t, *J* = 7.3 Hz, 2H), 2.92 – 2.87 (m, 4H), 2.78 – 2.75 (m, 2H), 2.30 (s, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.4, 160.3, 149.0, 147.6, 141.2, 128.6, 128.4,

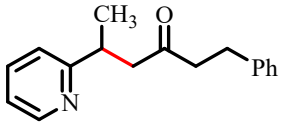
126.2, 124.2, 122.4, 44.5, 41.9, 31.7, 29.8, 21.1. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{17}H_{19}NONa$ 276.1359; found 276.1358.



1-(6-methylpyridin-2-yl)-5-phenylpentan-3-one (4f) [7]**.** Colorless liquid. (48.6 mg, 96%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.45 (t, *J* = 7.7 Hz, 1H), 7.28 – 7.25 (m, 2H), 7.20 – 7.15 (m, 3H), 6.95 (d, *J* = 7.6 Hz, 2H), 3.03 (t, *J* = 7.3 Hz, 2H), 2.88 (dt, *J* = 14.1, 7.4 Hz, 4H), 2.80 – 2.76 (m, 2H), 2.49 (s, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.4, 159.9, 157.9, 141.3, 136.7, 128.6, 128.4, 126.2, 120.8, 120.1, 44.6, 42.2, 32.0, 29.8, 24.6.

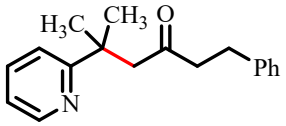


1-(3-bromopyridin-2-yl)-5-phenylpentan-3-one (4g). Yellow liquid. (42.0 mg, 66%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.36 – 8.30 (m, 1H), 7.75 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.23 (d, *J* = 7.2 Hz, 2H), 7.16 (d, *J* = 7.3 Hz, 3H), 6.95 (dd, *J* = 8.0, 4.7 Hz, 1H), 3.19 (t, *J* = 7.1 Hz, 2H), 2.89 (dd, *J* = 12.8, 6.9 Hz, 4H), 2.86 – 2.82 (m, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.1, 158.5, 147.5, 141.4, 140.1, 128.6, 128.5, 126.2, 122.7, 121.7, 44.6, 39.9, 31.2, 29.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{16}H_{17}BrNO$ 318.0488; found 318.0479.

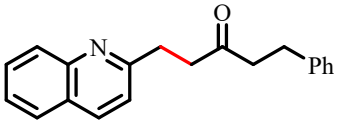


1-phenyl-5-(pyridin-2-yl)hexan-3-one (4h). Colorless liquid. (38.0 mg, 75%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.50 (s, 1H), 7.59 (t, *J* = 7.2 Hz, 1H), 7.25 (d, *J* = 8.5 Hz, 2H), 7.14 (dt, *J* = 18.6, 9.4 Hz, 5H), 3.47 (q, *J* = 6.3 Hz, 1H), 3.09 (dd, *J* = 16.8, 7.1 Hz, 1H), 2.84 (t, *J* = 6.8 Hz, 2H), 2.73 – 2.63 (m, 3H), 1.27 (d, *J* = 6.0 Hz, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.3, 164.9, 149.2, 141.2,

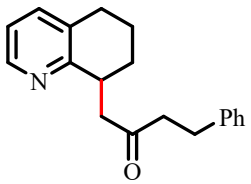
136.6, 128.6, 128.4, 126.1, 122.5, 121.5, 49.1, 44.9, 37.1, 29.7, 21.2. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{17}H_{19}NONa$ 276.1359; found 276.1352.



5-methyl-1-phenyl-5-(pyridin-2-yl)hexan-3-one (4i). Colorless liquid. (16.0 mg, 30%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.50 (s, 1H), 7.31 – 7.28 (m, 4H), 7.21 (d, *J* = 6.8 Hz, 1H), 7.16 (d, *J* = 7.1 Hz, 2H), 7.06 – 7.05 (m, 1H), 3.71 (s, 2H), 2.94 (d, *J* = 7.3 Hz, 2H), 2.80 (t, *J* = 7.0 Hz, 2H), 1.20 (d, *J* = 5.5 Hz, 6H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.7, 165.4, 148.4, 140.8, 138.5, 128.7, 128.5, 126.8, 126.4, 121.2, 47.2, 43.9, 31.6, 30.0, 22.2. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{18}H_{22}NO$ 268.1696; found 268.1687.

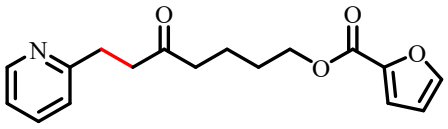


1-phenyl-5-(quinolin-2-yl)pentan-3-one (4j) [8]. Colorless liquid. (42.8 mg, 74%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.04 (d, *J* = 8.4 Hz, 1H), 7.97 (d, *J* = 8.5 Hz, 1H), 7.77 (d, *J* = 8.1 Hz, 1H), 7.67 (t, *J* = 7.7 Hz, 1H), 7.48 (t, *J* = 7.5 Hz, 1H), 7.31 – 7.24 (m, 3H), 7.18 (d, *J* = 7.5 Hz, 3H), 3.28 (t, *J* = 7.1 Hz, 2H), 3.03 (t, *J* = 7.0 Hz, 2H), 2.95 – 2.91 (m, 2H), 2.88 – 2.84 (m, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.4, 161.0, 147.9, 141.3, 136.3, 129.5, 128.9, 128.6, 128.4, 127.7, 126.9, 126.2, 125.9, 121.9, 44.6, 41.3, 32.5, 29.9.

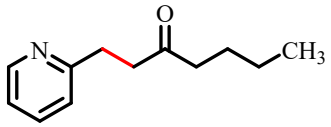


4-phenyl-1-(5,6,7,8-tetrahydroquinolin-8-yl)butan-2-one (4k). Colorless liquid. (53.1mg,95%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.33 – 8.28 (m, 1H), 7.30 (dd, *J* = 23.8, 7.6 Hz, 3H), 7.19 (dd, *J* = 12.4, 7.1 Hz, 3H), 7.01 (dd, *J* = 7.6, 4.7 Hz, 1H), 3.50 – 3.39 (m, 1H), 3.18 (dd, *J* = 16.5, 5.0 Hz, 1H), 2.99 – 2.92 (m, 2H), 2.92 – 2.84 (m, 1H), 2.83 – 2.70 (m, 3H), 2.58 (dd, *J* = 16.5, 8.2 Hz, 1H), 2.11 – 1.98

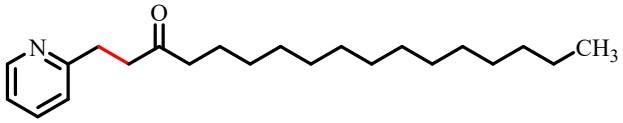
(m, 1H), 1.89 – 1.80 (m, 1H), 1.80 – 1.68 (m, 1H), 1.62 – 1.48 (m, 1H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.6, 159.0, 146.8, 141.5, 136.8, 132.4, 128.6, 128.5, 126.1, 121.2, 48.3, 44.9, 37.5, 30.0, 29.2, 21.1. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{21}NONa$ 302.1515; found 302.1515.



5-oxo-7-(pyridin-2-yl)heptyl furan-2-carboxylate (4l). Colorless liquid. (49.4 mg, 82%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.48 – 8.46 (m, 1H), 7.58 – 7.54 (m, 2H), 7.17 – 7.15 (m, 2H), 7.08 (dd, *J* = 7.2, 4.7 Hz, 1H), 6.48 (dd, *J* = 3.5, 1.7 Hz, 1H), 4.27 (t, *J* = 6.1 Hz, 2H), 3.05 (t, *J* = 7.2 Hz, 2H), 2.91 (t, *J* = 7.2 Hz, 2H), 2.50 (t, *J* = 6.8 Hz, 2H), 1.70 (dt, *J* = 6.3, 2.8 Hz, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 160.5, 158.9, 149.2, 146.4, 144.8, 136.5, 123.4, 121.4, 118.0, 111.9, 64.7, 42.3, 41.6, 31.8, 28.2, 20.2. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{17}H_{19}NO_4Na$ 324.1206; found 324.1197.

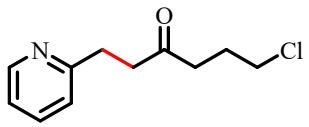


1-(pyridin-2-yl)heptan-3-one (4m) [9]. Colorless liquid. (33.3 mg, 87%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.49 (dd, *J* = 4.9, 0.8 Hz, 1H), 7.56 (td, *J* = 7.7, 1.8 Hz, 1H), 7.17 (d, *J* = 7.8 Hz, 1H), 7.09 (dd, *J* = 7.5, 4.9 Hz, 1H), 3.05 (t, *J* = 7.3 Hz, 2H), 2.91 (t, *J* = 7.2 Hz, 2H), 2.42 (t, *J* = 7.5 Hz, 2H), 1.54 (dt, *J* = 15.1, 7.5 Hz, 2H), 1.28 (dq, *J* = 14.6, 7.3 Hz, 2H), 0.87 (t, *J* = 7.3 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 210.6, 160.7, 149.3, 136.5, 123.4, 121.3, 42.8, 41.7, 31.9, 26.1, 22.4, 14.0.

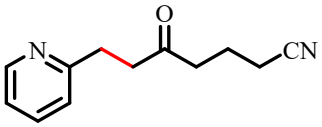


1-(pyridin-2-yl)heptadecan-3-one (4n). Colorless solid. (56.4 mg, 85%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.48 (d, *J* = 3.7 Hz, 1H), 7.56 (td, *J* = 7.7, 1.8 Hz, 1H), 7.17 (d, *J* = 7.8 Hz, 1H), 7.08 (dd, *J* = 7.0, 5.3 Hz, 1H), 3.04 (t, *J* =

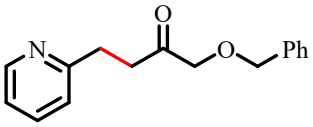
7.3 Hz, 2H), 2.90 (t, *J* = 7.2 Hz, 2H), 2.40 (t, *J* = 7.5 Hz, 2H), 1.56 – 1.52 (m, 2H), 1.23 (s, 22H), 0.86 (t, *J* = 6.9 Hz, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 210.6, 160.7, 149.2, 136.5, 123.4, 121.3, 43.1, 41.7, 31.9 (d, *J* = 20.7 Hz), 30.2 – 29.1 (m), 24.0, 22.8, 14.2. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{22}H_{38}NO_4$ 332.2948; found 332.2940.



6-chloro-1-(pyridin-2-yl)hexan-3-one (4o). Colorless liquid. (39.4 mg, 93%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.49 (d, *J* = 4.8 Hz, 1H), 7.57 (td, *J* = 7.7, 1.8 Hz, 1H), 7.17 (d, *J* = 7.8 Hz, 1H), 7.09 (dd, *J* = 7.0, 5.4 Hz, 1H), 3.55 (t, *J* = 6.3 Hz, 2H), 3.07 (t, *J* = 7.2 Hz, 2H), 2.93 (t, *J* = 7.1 Hz, 2H), 2.65 (t, *J* = 7.0 Hz, 2H), 2.04 (p, *J* = 6.7 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.1, 160.3, 149.2, 136.5, 123.3, 121.4, 44.6, 41.6, 39.5, 31.7, 26.4. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{11}H_{15}ClNO$ 212.0837; found 212.0832.

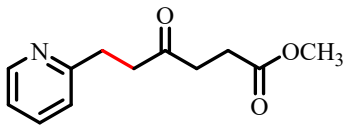


5-oxo-7-(pyridin-2-yl) heptanenitrile (4p). Colorless liquid. (34.6 mg, 90%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.48 (d, *J* = 4.7 Hz, 1H), 7.57 (td, *J* = 7.6, 1.8 Hz, 1H), 7.17 (d, *J* = 7.8 Hz, 1H), 7.10 (dd, *J* = 7.3, 5.1 Hz, 1H), 3.09 (t, *J* = 7.0 Hz, 2H), 2.90 (t, *J* = 7.0 Hz, 2H), 2.67 (t, *J* = 6.8 Hz, 2H), 2.40 (t, *J* = 7.0 Hz, 2H), 1.92 (p, *J* = 6.9 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.5, 160.1, 149.2, 136.5, 123.3, 121.5, 119.5, 41.3, 40.6, 31.7, 19.5, 16.5. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{12}H_{15}N_2O$ 203.1179; found 203.1170.

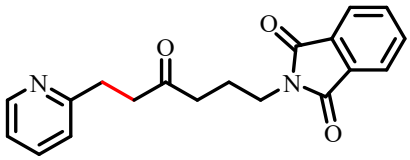


1-(benzyloxy)-4-(pyridin-2-yl)butan-2-one (4q) [6]**.** Colorless liquid. (47.0 mg, 92%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.47 (d, *J* = 4.5 Hz, 1H), 7.57 (t, *J* = 7.2 Hz, 1H), 7.35 – 7.28 (m, 5H), 7.17 (d, *J* = 7.8 Hz, 1H), 7.10 – 7.07 (m, 1H),

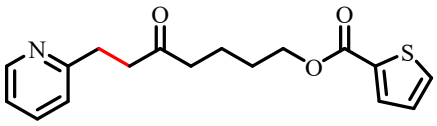
4.58 (s, 2H), 4.12 (s, 2H), 3.11 (t, *J* = 7.1 Hz, 2H), 2.95 (t, *J* = 7.1 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.1, 160.2, 149.3, 137.4, 136.5, 128.6, 128.1 (d, *J* = 3.3 Hz), 123.3, 121.4, 75.2, 73.4, 37.8, 31.3.



1-(pyridin-2-yl)heptan-3-one (4r). Colorless liquid. (39.8 mg,90%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.5 (dd, *J* = 4.9, 1.6 Hz, 1H), 7.6 (td, *J* = 7.7, 1.8 Hz, 1H), 7.2 (d, *J* = 7.8 Hz, 1H), 7.1 (dd, *J* = 7.5, 4.9 Hz, 1H), 3.65 (s, 3H), 3.07 (t, *J* = 6.9 Hz, 2H), 2.96 (t, *J* = 6.9 Hz, 2H), 2.77 (t, *J* = 6.6 Hz, 2H), 2.58 (t, *J* = 6.5 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.2, 173.4, 160.4, 149.3, 136.5, 123.3, 121.4, 51.9, 41.5, 37.3, 31.7, 27.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{12}H_{15}NO_3Na$ 244.0944; found 244.0942.

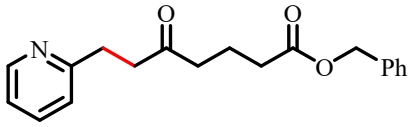


2-(4-oxo-6-(pyridin-2-yl)hexyl)isoindoline-1,3-dione (4s). White solid. (61.9 mg, 96%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.46 (d, *J* = 4.3 Hz, 1H), 7.83 – 7.82 (m, 2H), 7.71 – 7.69 (m, 2H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.15 (d, *J* = 7.7 Hz, 1H), 7.07 (t, *J* = 5.9 Hz, 1H), 3.69 (t, *J* = 6.6 Hz, 2H), 3.04 (t, *J* = 7.1 Hz, 2H), 2.90 (t, *J* = 7.1 Hz, 2H), 2.50 (t, *J* = 7.1 Hz, 2H), 1.95 (p, *J* = 6.5 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.8, 168.6, 160.5, 149.3, 136.4, 134.1, 132.2, 123.4, 123.3, 121.3, 41.6, 39.9, 37.3, 31.7, 22.8. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{18}N_2O_3Na$ 345.1210; found 345.1204.

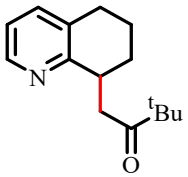


5-oxo-7-(pyridin-2-yl)heptyl thiophene-2-carboxylate (4t). Colorless liquid. (46.3mg, 73%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.47 (d, *J* = 4.8 Hz, 1H), 7.77 (dd, *J* = 3.7, 1.3 Hz, 1H), 7.57 – 7.52 (m, 2H), 7.16 (d, *J* = 7.8 Hz, 1H), 7.07 (td, *J* = 5.3, 1.6 Hz, 2H), 4.27 – 4.24 (m, 2H), 3.06 (t, *J* = 7.2 Hz, 2H), 2.91

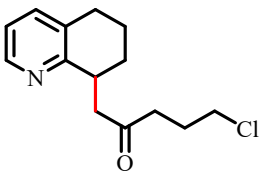
(t, *J* = 7.2 Hz, 2H), 2.51 (t, *J* = 6.9 Hz, 2H), 1.72 – 1.70 (m, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.8, 162.4, 160.5, 149.3, 136.5, 134.0, 133.5, 132.4, 127.9, 123.4, 121.4, 64.9, 42.3, 41.6, 31.8, 28.3, 20.3. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{17}H_{19}NO_3SNa$ 340.0978; found 340.0977.



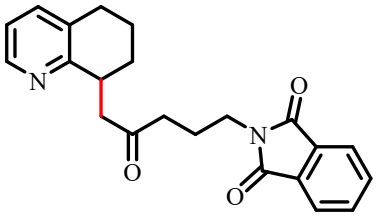
benzyl 5-oxo-7-(pyridin-2-yl)heptanoate (4u). Colorless liquid. (59.2 mg, 95%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.47 – 8.46 (m, 1H), 7.56 (td, *J* = 7.7, 1.8 Hz, 1H), 7.35 – 7.30 (m, 5H), 7.16 (d, *J* = 7.8 Hz, 1H), 7.08 (dd, *J* = 7.5, 4.9 Hz, 1H), 5.10 (s, 2H), 3.05 (t, *J* = 7.2 Hz, 2H), 2.88 (t, *J* = 7.2 Hz, 2H), 2.50 (t, *J* = 7.2 Hz, 2H), 2.36 (t, *J* = 7.3 Hz, 2H), 1.91 (p, *J* = 7.3 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.4, 173.1, 160.5, 149.3, 136.4, 136.1, 128.7, 128.3, 123.3, 121.3, 66.3, 41.6 (d, *J* = 13.9 Hz), 33.4, 31.7, 19.0. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{21}NO_3Na$ 334.1414; found 334.1413.



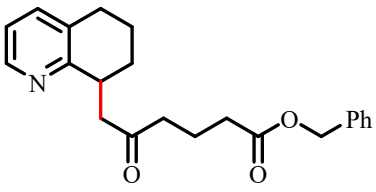
3,3-dimethyl-1-(5,6,7,8-tetrahydroquinolin-8-yl)butan-2-one (4v). Colorless liquid. (36.6 mg, 79%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.34 – 8.32 (m, 1H), 7.33 (d, *J* = 7.6 Hz, 1H), 7.00 (dd, *J* = 7.6, 4.7 Hz, 1H), 3.48 – 3.46 (m, 1H), 3.25 (dd, *J* = 17.7, 3.6 Hz, 1H), 2.85 – 2.74 (m, 3H), 2.05 – 2.00 (m, 1H), 1.87 – 1.73 (m, 2H), 1.55 – 1.47 (m, 1H), 1.16 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 215.1, 159.6, 146.9, 136.7, 132.6, 121.1, 44.3, 42.2, 36.8, 29.4, 28.9, 26.6, 21.0. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{15}H_{22}NO$ 232.1696; found 232.1694.



5-chloro-1-(5,6,7,8-tetrahydroquinolin-8-yl)pentan-2-one (4w). Colorless liquid. (47.8 mg, 95%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.30 (d, *J* = 4.2 Hz, 1H), 7.32 (d, *J* = 7.5 Hz, 1H), 7.00 (dd, *J* = 7.6, 4.7 Hz, 1H), 3.60 (t, *J* = 6.3 Hz, 2H), 3.44 (dt, *J* = 13.9, 6.1 Hz, 1H), 3.13 (dd, *J* = 16.3, 5.6 Hz, 1H), 2.82 – 2.74 (m, 3H), 2.66 – 2.55 (m, 2H), 2.13 – 2.02 (m, 3H), 1.90 – 1.83 (m, 1H), 1.80 – 1.72 (m, 1H), 1.61 – 1.52 (m, 1H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.3, 158.9, 146.7, 136.8, 132.4, 121.3, 48.1, 44.7, 39.9, 37.7, 29.3, 29.1, 26.6, 21.2. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{14}H_{19}ClNO$ 252.1150; found 252.1149.

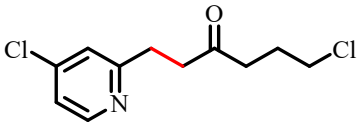


2-(4-oxo-5-(5,6,7,8-tetrahydroquinolin-8-yl)pentyl)isoindoline-1,3-dione (4x). White solid. (66.7 mg, 92%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.30 – 8.29 (m, 1H), 7.84 (dd, *J* = 5.5, 3.0 Hz, 2H), 7.71 (dd, *J* = 5.4, 3.1 Hz, 2H), 7.31 (d, *J* = 7.6 Hz, 1H), 6.98 (dd, *J* = 7.6, 4.7 Hz, 1H), 3.73 (td, *J* = 6.8, 1.8 Hz, 2H), 3.41 (ddd, *J* = 13.6, 8.4, 5.4 Hz, 1H), 3.16 (dd, *J* = 16.6, 5.0 Hz, 1H), 2.77 – 2.74 (m, 2H), 2.64 – 2.50 (m, 3H), 2.08 – 1.97 (m, 3H), 1.85 – 1.80 (m, 1H), 1.80 – 1.70 (m, 1H), 1.59 – 1.55 (m, 1H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.1, 168.5, 159.0, 146.7, 136.7, 134.0, 132.3, 132.2, 123.3, 121.1, 47.9, 40.3, 37.5, 37.4, 29.1, 22.9, 21.0. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{22}H_{22}N_2O_3Na$ 385.1523; found 385.1516.

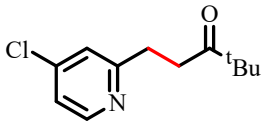


benzyl 5-oxo-6-(5,6,7,8-tetrahydroquinolin-8-yl)hexanoate (4y). Colorless liquid. (58.3 mg, 83%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.29 (dd, *J* = 4.7, 1.6 Hz, 1H), 7.35 – 7.31 (m, 6H), 6.99 (dd, *J* = 7.6, 4.7 Hz, 1H), 5.11 (s, 2H), 3.50 – 3.43 (m, 1H), 3.12 (dd, *J* = 16.4, 5.3 Hz, 1H), 2.75 (t, *J* = 7.1 Hz, 2H), 2.64 – 2.49 (m, 3H), 2.45 – 2.41 (m, 2H), 2.05 – 2.00 (m, 1H), 1.94 (p, *J* = 7.3 Hz, 2H), 1.85 – 1.84

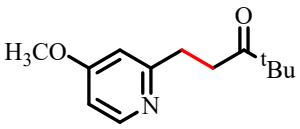
(m, 1H), 1.83 – 1.75 (m, 1H), 1.58 – 1.54 (m, 1H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.6, 173.3, 159.0, 146.7, 136.7, 136.1, 132.4, 128.7, 128.32, 128.30, 121.2, 66.3, 48.1, 42.0, 37.5, 33.4, 29.3, 29.1, 21.1, 19.1. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{22}H_{25}NO_3Na$ 374.1727; found 374.1725.



6-chloro-1-(4-chloropyridin-2-yl)hexan-3-one (4z). Colorless liquid. (40.4 mg, 82%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.36 (d, *J* = 5.4 Hz, 1H), 7.20 (d, *J* = 1.9 Hz, 1H), 7.11 (dd, *J* = 5.4, 1.9 Hz, 1H), 3.55 (t, *J* = 6.3 Hz, 2H), 3.05 (t, *J* = 7.0 Hz, 2H), 2.92 (t, *J* = 7.0 Hz, 2H), 2.65 (t, *J* = 7.0 Hz, 2H), 2.03 (p, *J* = 6.7 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.7, 162.1, 150.1, 144.3, 123.6, 121.8, 44.5, 41.1, 39.5, 31.5, 26.4. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{11}H_{14}Cl_2NO$ 246.0447; found 246.0439.

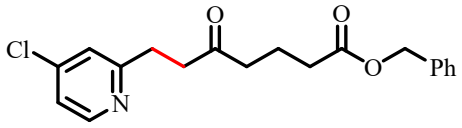


1-(4-chloropyridin-2-yl)-4,4-dimethylpentan-3-one (4aa). White solid. (40.2 mg, 89%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.37 (d, *J* = 5.4 Hz, 1H), 7.21 (d, *J* = 1.9 Hz, 1H), 7.10 (dd, *J* = 5.4, 2.0 Hz, 1H), 3.00 – 2.99 (m, 4H), 1.12 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 214.9, 162.8, 150.1, 144.3, 123.8, 121.7, 44.2, 35.7, 31.9, 26.6. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{12}H_{17}ClNO$ 226.0993; found 226.0993.

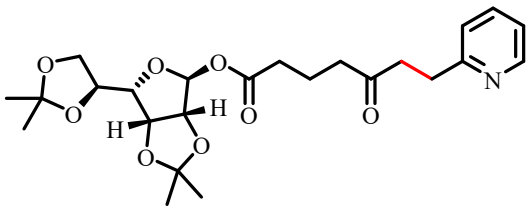


1-(4-methoxypyridin-2-yl)-4,4-dimethylpentan-3-one (4ab). Colorless liquid. (35.4 mg, 80%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.30 (d, *J* = 5.8 Hz, 1H), 6.70 (d, *J* = 2.5 Hz, 1H), 6.63 (dd, *J* = 5.8, 2.5 Hz, 1H), 3.82 (s, 3H), 2.97 (s, 4H), 1.11 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 215.3, 166.1, 162.8, 150.5, 109.1,

107.8, 55.1, 44.2, 36.2, 32.4, 26.5. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{13}H_{20}NO_2$ 222.1489; found 222.1489.

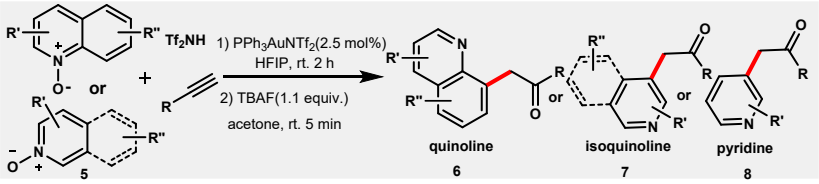


benzyl 7-(4-chloropyridin-2-yl)-5-oxoheptanoate (4ac). Colorless liquid. (60.2 mg, 87%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.34 (d, *J* = 5.4 Hz, 1H), 7.35 – 7.32 (m, 5H), 7.19 (d, *J* = 1.7 Hz, 1H), 7.09 (dd, *J* = 5.4, 1.9 Hz, 1H), 5.10 (s, 2H), 3.02 (t, *J* = 7.0 Hz, 2H), 2.87 (t, *J* = 7.1 Hz, 2H), 2.50 (t, *J* = 7.2 Hz, 2H), 2.37 (t, *J* = 7.3 Hz, 2H), 1.91 (p, *J* = 7.3 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.9, 173.1, 162.2, 150.1, 144.3, 136.0, 128.7, 128.3, 123.6, 121.8, 66.3, 41.6, 41.0, 33.3, 31.4, 19.0. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{20}ClNO_3Na$ 368.1024; found 368.1020.

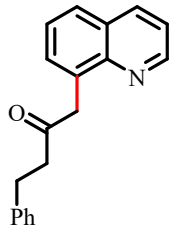


(3aR,4S,6S,6aR)-6-((S)-2,2-dimethyl-1,3-dioxolan-4-yl)-2,2-dimethyltetrahydrofuro[3,4-d][1,3]dioxol-4-yl 5-oxo-7-(pyridin-2-yl)heptanoate (15). Light yellow liquid. (75.1 mg, 81%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.46 (d, *J* = 4.0 Hz, 1H), 7.58 (td, *J* = 7.7, 1.8 Hz, 1H), 7.18 (d, *J* = 7.8 Hz, 1H), 7.11 (dd, *J* = 8.0, 4.4 Hz, 1H), 6.15 (q, *J* = 3.8 Hz, 1H), 4.93 – 4.90 (m, 1H), 4.68 (dd, *J* = 5.9, 3.7 Hz, 1H), 4.13 – 4.10 (m, 1H), 4.11 – 4.00 (m, 1H), 3.86 – 3.83 (m, 1H), 3.78 – 3.74 (m, 1H), 3.06 – 3.02 (m, 3H), 2.90 – 2.87 (m, 3H), 2.53 – 2.51 (m, 2H), 2.33 – 2.29 (m, 2H), 1.90 – 1.87 (m, 2H), 1.47 (d, *J* = 3.7 Hz, 3H), 1.33 (d, *J* = 3.7 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.6, 171.8, 160.3, 149.1, 136.9, 123.6, 121.6, 113.3, 100.5, 84.8, 81.0, 79.9, 69.8, 63.5, 41.8, 41.3, 33.4, 31.7, 26.1, 24.9, 18.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{24}H_{33}NO_8Na$ 486.2098; found 486.2096.

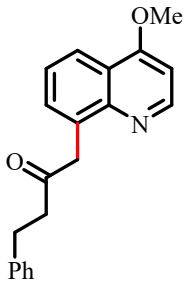
5. A general procedure for Table 2



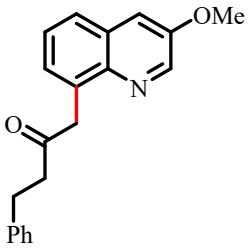
A solution of substituted quinoline N-oxide (0.24 mmol, 1.2 eq.), $HNTf_2$ (0.22 mmol, 1.1 eq.) in HFIP (0.5 mL) was stirred at room temperature for 15 min. The alkynes (0.20 mmol) and PPh_3AuNTf_2 (5.0 μmol, 2.5 mol%) were added and stirred at room temperature for another 2 hours. Upon completion, the HFIP was removed under reduced pressure. TBAF (1.1 eq.) and acetone (1 mL) were then added to the residue and stirred at room temperature for 5 min. The crude reaction mixture was then purified by column chromatography to afford the final product.



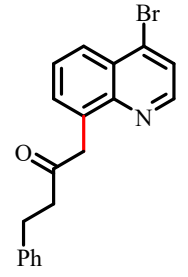
4-phenyl-1-(quinolin-8-yl)butan-2-one (6a). White solid. (46.3 mg, 84%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.86 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.75 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.55 (d, *J* = 5.5 Hz, 1H), 7.51 – 7.47 (m, 1H), 7.39 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.26 – 7.22 (m, 2H), 7.18 – 7.14 (m, 3H), 4.32 (s, 2H), 2.92 (s, 4H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.4, 149.8, 146.8, 141.5, 136.4, 134.2, 130.8, 128.6, 128.53, 128.51, 127.4, 126.5, 126.1, 121.3, 45.8, 44.2, 30.0. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{17}NONa$ 298.1202; found 298.1204.



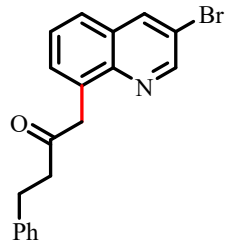
1-(4-methoxyquinolin-8-yl)-4-phenylbutan-2-one (6b). White solid. (50.7 mg, 83%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.70 (d, *J* = 5.2 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.3 Hz, 1H), 7.52 (d, *J* = 7.0 Hz, 1H), 7.47 – 7.40 (m, 1H), 7.23 (d, *J* = 7.5 Hz, 2H), 7.15 (dd, *J* = 12.6, 7.0 Hz, 3H), 6.74 (d, *J* = 5.2 Hz, 1H), 4.29 (s, 2H), 4.03 (s, 3H), 2.91 – 2.89 (m, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.5, 162.6, 147.7, 141.5, 133.6, 131.1, 128.52, 128.48, 126.0, 125.4, 121.7, 121.4, 100.3, 55.9, 46.2, 44.0, 29.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{20}H_{19}NO_2Na$ 328.1308; found 328.1299.



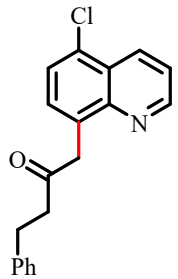
1-(3-methoxyquinolin-8-yl)-4-phenylbutan-2-one (6c). White solid. (28.0mg, 46%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.61 (d, *J* = 2.9 Hz, 1H), 7.65 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.39 – 7.36 (m, 2H), 7.26 – 7.23 (m, 2H), 7.18 – 7.13 (m, 3H), 4.29 (s, 2H), 3.94 (s, 3H), 2.94 – 2.86 (m, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.4, 153.3, 143.8, 141.5, 134.0, 129.2, 128.51, 128.48, 128.1, 127.1, 126.8, 126.4, 126.0, 112.6, 55.6, 46.0, 44.0, 29.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{20}H_{19}NO_2Na$ 328.1308; found 328.1309.



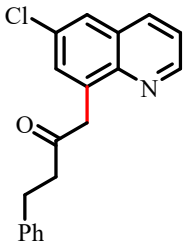
1-(4-bromoquinolin-8-yl)-4-phenylbutan-2-one (6e). White solid. (25.5mg, 36%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.58 (d, *J* = 4.6 Hz, 1H), 8.13 (dd, *J* = 6.3, 3.6 Hz, 1H), 7.68 (d, *J* = 4.6 Hz, 1H), 7.58 (t, *J* = 6.3 Hz, 2H), 7.26 (t, *J* = 7.2 Hz, 2H), 7.24 – 7.15 (m, 3H), 4.30 (s, 2H), 2.93 (s, 4H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.9, 149.1, 147.5, 141.4, 134.8, 134.5, 131.8, 128.5, 128.2, 127.7, 126.5, 126.1, 125.3, 46.0, 44.2, 29.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{16}BrNONa$ 376.0307; found 376.0304.



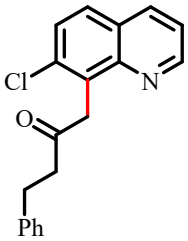
1-(3-bromoquinolin-8-yl)-4-phenylbutan-2-one (6f). White solid. (29.7 mg, 42%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.80 (d, *J* = 2.3 Hz, 1H), 8.27 (d, *J* = 2.3 Hz, 1H), 7.65 (dd, *J* = 7.9, 1.7 Hz, 1H), 7.55 – 7.48 (m, 2H), 7.28 – 7.24 (m, 2H), 7.20 – 7.15 (m, 3H), 4.27 (s, 2H), 2.93 (s, 4H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.8, 150.7, 144.8, 141.3, 137.5, 134.5, 131.1, 129.4, 128.5, 127.7, 126.5, 126.1, 117.6, 45.7, 44.2, 29.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{16}BrNONa$ 376.0307; found 376.0302.



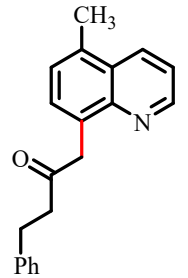
1-(5-chloroquinolin-8-yl)-4-phenylbutan-2-one (6g). White solid. (24.2 mg, 39%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.88 (dd, *J* = 4.1, 1.3 Hz, 1H), 8.57 (dd, *J* = 8.5, 1.4 Hz, 1H), 7.57 (d, *J* = 7.7 Hz, 1H), 7.50 (dd, *J* = 8.5, 4.2 Hz, 1H), 7.45 (d, *J* = 7.7 Hz, 1H), 7.26 (t, *J* = 7.2 Hz, 2H), 7.20 – 7.15 (m, 3H), 4.28 (s, 2H), 2.94 (s, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.8, 150.3, 147.3, 141.3, 133.6, 133.2, 130.6, 130.4, 128.5, 126.6, 126.5, 126.1, 122.0, 45.6, 44.3, 29.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{16}ClNONa$ 332.0813; found 332.0806.



1-(6-chloroquinolin-8-yl)-4-phenylbutan-2-one (6h). White solid. (21.1 mg, 34%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.82 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.05 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.73 (d, *J* = 2.3 Hz, 1H), 7.50 (d, *J* = 2.3 Hz, 1H), 7.41 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.26 (t, *J* = 7.2 Hz, 2H), 7.20 – 7.16 (m, 3H), 4.27 (s, 2H), 2.95 (s, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.4, 149.9, 145.2, 141.3, 136.4, 135.5, 132.0, 131.5, 129.1, 128.5 (d, *J* = 2.9 Hz), 126.2, 125.9, 122.2, 45.4, 44.4, 29.9. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{19}H_{16}ClNONa$ 332.0813; found 332.0812.

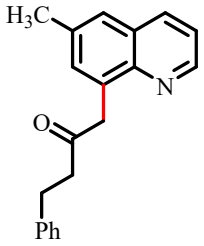


1-(7-chloroquinolin-8-yl)-4-phenylbutan-2-one (6i). White solid. (44.6 mg,72%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.87 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.12 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.69 (d, *J* = 8.8 Hz, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.39 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.29 – 7.25 (m, 2H), 7.19 (d, *J* = 6.8 Hz, 3H), 4.60 (s, 2H), 2.99 – 2.90 (m, 4H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.6, 150.6, 147.5, 141.4, 135.8, 132.4, 128.54,128.52, 128.0, 127.9, 127.0, 126.1, 121.3, 44.3, 42.8, 29.9. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{19}H_{16}ClNONa$ 332.0813; found 332.0813.

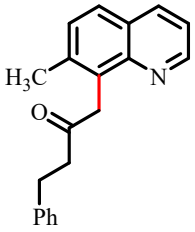


1-(5-methylquinolin-8-yl)-4-phenylbutan-2-one (6j). White solid. (38.2 mg,66%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.86 (dd, *J* = 4.1, 1.7 Hz, 1H),

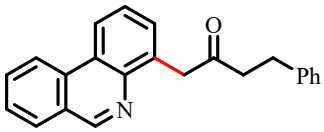
8.31 (dd, *J* = 8.5, 1.7 Hz, 1H), 7.44 – 7.40 (m, 2H), 7.31 (d, *J* = 7.7 Hz, 1H), 7.26 – 7.22 (m, 2H), 7.18 – 7.13 (m, 3H), 4.28 (s, 2H), 2.95 – 2.87 (m, 4H), 2.67 (s, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.7, 149.2, 146.9, 141.5, 134.1, 132.8, 132.3, 130.4, 128.53, 128.48, 127.9, 126.9, 126.0, 120.8, 45.9, 44.0, 30.0, 18.7. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{20}H_{19}NONa$ 312.1359; found 312.1354.



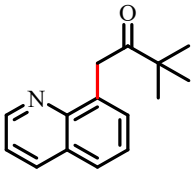
1-(6-methylquinolin-8-yl)-4-phenylbutan-2-one (6k). White solid. (23.2 mg, 40%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.79 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.05 (dd, *J* = 8.2, 1.5 Hz, 1H), 7.50 (s, 1H), 7.38 – 7.34 (m, 2H), 7.26 – 7.23 (m, 2H), 7.18 – 7.14 (m, 3H), 4.29 (s, 2H), 2.92 (s, 4H), 2.50 (s, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.5, 148.9, 141.5, 136.3, 135.8, 133.7, 133.1, 128.7, 128.53, 128.49, 126.3, 126.0, 121.3, 45.7, 44.1, 29.9, 21.7. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{20}H_{20}NO$ 290.1539; found 290.1536.



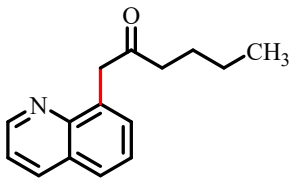
1-(7-methylquinolin-8-yl)-4-phenylbutan-2-one (6l). White solid. (46.3mg, 80%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.84 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.09 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.65 (d, *J* = 8.4 Hz, 1H), 7.39 (d, *J* = 8.4 Hz, 1H), 7.33 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.23 (d, *J* = 7.5 Hz, 2H), 7.18 – 7.12 (m, 3H), 4.48 (s, 2H), 2.94 – 2.84 (m, 4H), 2.43 (s, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.4, 149.7, 147.0, 141.5, 138.5, 136.2, 131.7, 129.8, 128.5, 126.8, 126.6, 126.0, 120.4, 43.8, 42.3, 30.0, 20.6. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{20}H_{20}NO$ 290.1539; found 290.1536.



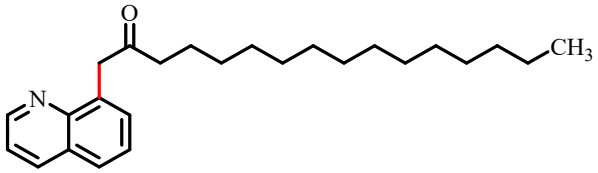
1-(phenanthridin-4-yl)-4-phenylbutan-2-one (6m) [10]. Light yellow liquid. (52.7 mg, 81%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.22 (s, 1H), 8.62 (d, *J* = 8.3 Hz, 1H), 8.57 – 8.49 (m, 1H), 8.04 (d, *J* = 7.8 Hz, 1H), 7.87 (t, *J* = 7.3 Hz, 1H), 7.72 (t, *J* = 7.4 Hz, 1H), 7.67 – 7.56 (m, 2H), 7.29 – 7.20 (m, 2H), 7.16 (t, *J* = 6.5 Hz, 3H), 4.39 (s, 2H), 2.94 (s, 4H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.5, 152.8, 141.5, 134.9, 132.8, 131.1, 130.3, 128.9, 128.6, 128.5, 127.7, 126.9, 126.4, 126.0, 124.4, 122.2, 121.8, 46.5, 44.1, 30.0.



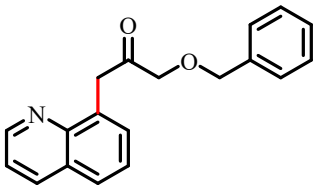
3,3-dimethyl-1-(quinolin-8-yl)butan-2-one (6n) [10]. Colorless liquid. (38.2 mg, 84%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.84 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.12 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.73 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.56 – 7.47 (m, 2H), 7.36 (dd, *J* = 8.2, 4.2 Hz, 1H), 4.49 (s, 2H), 1.33 (s, 9H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 214.0, 149.5, 146.8, 136.3, 135.0, 130.7, 128.4, 127.0, 126.3, 121.1, 44.9, 39.3, 26.9.



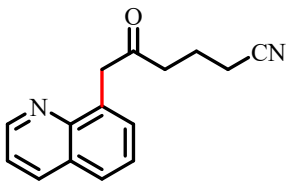
1-(quinolin-8-yl)hexan-2-one (6o) [10]. Colorless liquid. (36..8mg, 81%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.88 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.75 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.58 (d, *J* = 5.8 Hz, 1H), 7.53 – 7.47 (m, 1H), 7.39 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.33 (s, 2H), 2.58 (t, *J* = 7.4 Hz, 2H), 1.59 – 1.55 (m, 2H), 1.34 – 1.24 (m, 2H), 0.87 (t, *J* = 7.3 Hz, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.6, 149.8, 146.8, 136.4, 134.5, 130.7, 128.6, 127.3, 126.4, 121.3, 45.6, 42.5, 26.1, 22.4, 14.0.



1-(quinolin-8-yl)hexadecan-2-one (6p). Colorless solid. (51.5mg, 70%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.88 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.75 (dd, *J* = 8.1, 1.3 Hz, 1H), 7.58 (dd, *J* = 7.0, 1.3 Hz, 1H), 7.53 – 7.47 (m, 1H), 7.39 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.33 (s, 2H), 2.57 (t, *J* = 7.4 Hz, 2H), 1.62 – 1.56 (m, 2H), 1.32 – 1.23 (m, 22H), 0.88 (t, *J* = 6.7 Hz, 3H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 209.6, 149.7, 136.4, 134.5, 130.7, 128.6, 127.3, 126.4, 121.3, 45.6, 42.8, 32.1, 29.83, 29.79, 29.75, 29.62, 29.55, 29.5, 29.3, 24.0, 22.8, 14.3. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{25}H_{38}NO$ 368.2948; found 368.2951.

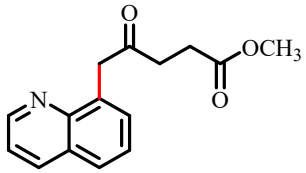


1-(benzyloxy)-3-(quinolin-8-yl)propan-2-one (6q). Colorless liquid. (45.5mg,78%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.83 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.76 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.60 (d, *J* = 6.9 Hz, 1H), 7.54 – 7.47 (m, 1H), 7.42 – 7.27 (m, 7H), 4.64 (s, 2H), 4.40 (s, 2H), 4.33 (s, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.7, 149.7, 146.6, 137.6, 136.4, 133.8, 131.0, 128.6, 128.1, 128.0 127.5, 126.5, 121.3, 75.1, 73.4, 42.2. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{17}NO_2Na$ 314.1151; found 314.1141.

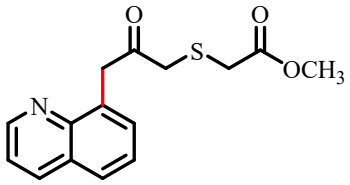


5-oxo-6-(quinolin-8-yl)hexanenitrile (6r) [10]. Colorless liquid. (41.0mg, 86%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.89 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.77 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.61 – 7.54 (m, 1H), 7.53 – 7.46 (m, 1H), 7.41 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.29 (s, 2H), 2.83 (t, *J* = 6.7 Hz, 2H), 2.40

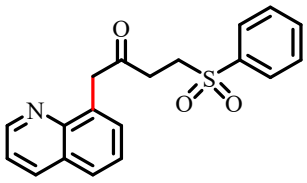
(t, *J* = 7.0 Hz, 2H), 1.94 (p, *J* = 6.8 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.7, 149.9, 146.6, 136.4, 134.2, 130.8, 128.6, 127.6, 126.5, 121.4, 119.7, 46.0, 40.3, 19.7, 16.5.



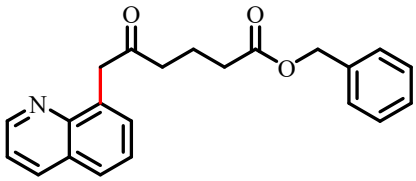
methyl 4-oxo-5-(quinolin-8-yl)pentanoate (6s). Colorless liquid. (36.0mg, 70%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.88 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.76 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.64 – 7.57 (m, 1H), 7.51 (dd, *J* = 8.1, 7.1 Hz, 1H), 7.40 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.37 (s, 2H), 3.64 (s, 3H), 2.93 (t, *J* = 6.7 Hz, 2H), 2.59 (t, *J* = 6.7 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.4, 173.6, 149.8, 146.8, 136.4, 134.1, 130.9, 128.6, 127.5, 126.5, 121.3, 51.9, 45.6, 37.2, 28.1. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{15}H_{15}NO_3Na$ 280.0944; found 280.0937.



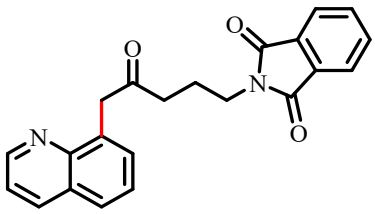
methyl 2-((2-oxo-3-(quinolin-8-yl)propyl)thio)acetate (6t). Light yellow liquid. (39.4mg, 68%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.86 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.76 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.62 (d, *J* = 8.1 Hz, 1H), 7.51 (dd, *J* = 8.1, 7.1 Hz, 1H), 7.40 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.45 (s, 2H), 3.70 (s, 3H), 3.65 (s, 2H), 3.34 (s, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 203.4, 170.6, 149.8, 146.6, 136.4, 134. 0, 131.0, 128.6, 127.6, 126.5, 121.4, 52.5, 44.15, 41.5, 33.3. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{15}H_{15}NO_3SNa$ 312.0665; found 312.0658.



1-(phenylsulfonyl)-3-(quinolin-8-yl)propan-2-one (6u). Light yellow liquid. (39.7mg, 61%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.80 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.15 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.88 – 7.82 (m, 2H), 7.76 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.64 (t, *J* = 7.5 Hz, 1H), 7.57 – 7.44 (m, 4H), 7.40 (dd, *J* = 8.3, 4.2 Hz, 1H), 4.28 (s, 2H), 3.53 – 3.25 (t, 2H), 3.22 – 2.95 (t, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 204.8, 149.9, 146.5, 139.1, 136.5, 133.9, 133.5, 130.9, 129.4, 128.6, 128.1, 127.8, 126.5, 121.4, 51.0, 45.8, 35.2. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{17}NO_3SNa$ 362.0821; found 362.0823.

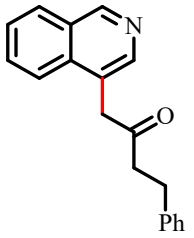


benzyl 5-oxo-6-(quinolin-8-yl)hexanoate (6v). Colorless liquid. (61.1mg, 88%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.84 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.13 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.75 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.56 (dd, *J* = 7.3, 1.0 Hz, 1H), 7.49 (dd, *J* = 8.0, 7.1 Hz, 1H), 7.40 – 7.28 (m, 6H), 5.09 (s, 2H), 4.29 (s, 2H), 2.68 (t, *J* = 7.1 Hz, 2H), 2.39 (t, *J* = 7.4 Hz, 2H), 1.96 (p, *J* = 7.2 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.4, 173.3, 149.8, 146.7, 136.3, 136.1, 134.3, 130.7, 128.7, 128.6, 128.3, 127.4, 126.4, 121.3, 66.2, 45.7, 41.4, 33.4, 19.1. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{22}H_{21}NO_3Na$ 370.1414; found 370.1413.

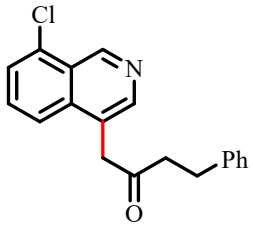


2-(4-oxo-5-(quinolin-8-yl)pentyl)isoindoline-1,3-dione (6w). Colorless solid. (61.6mg, 86%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.82 (dd, *J* =

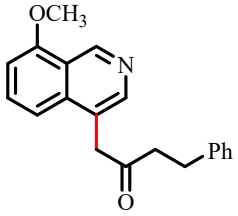
4.2, 1.8 Hz, 1H), 8.10 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.81 (dd, *J* = 5.4, 3.0 Hz, 2H), 7.73 – 7.64 (m, 3H), 7.57 (dd, *J* = 7.0, 1.2 Hz, 1H), 7.51 – 7.42 (m, 1H), 7.39 – 7.29 (m, 1H), 4.31 (s, 2H), 3.68 (t, *J* = 6.9 Hz, 2H), 2.67 (t, *J* = 7.3 Hz, 2H), 1.98 (p, *J* = 7.1 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.9, 168.5, 149.7, 146.7, 136.3, 134.2, 134.0, 132.2, 130.8, 128.5, 127.4, 126.4, 123.3, 121.2, 45.6, 39.6, 37.4, 22.9. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{22}H_{18}N_2O_3Na$ 381.1210; found 381.1201.



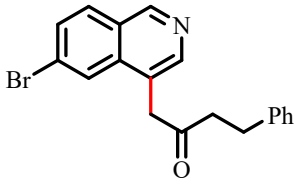
1-(isoquinolin-4-yl)-4-phenylbutan-2-one (7a) [10]. White solid. (28.1 mg, 51%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.19 (s, 1H), 8.37 (s, 1H), 7.99 (d, *J* = 8.1 Hz, 1H), 7.73 – 7.68 (m, 2H), 7.64 – 7.60 (m, 1H), 7.23 (t, *J* = 7.3 Hz, 2H), 7.18 – 7.14 (m, 1H), 7.09 (d, *J* = 6.9 Hz, 2H), 4.03 (s, 2H), 2.89 (dd, *J* = 8.2, 5.3 Hz, 2H), 2.80 (dd, *J* = 8.4, 5.4 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 207.0, 152.6, 144.2, 140.7, 135.1, 131.1, 128.6, 128.4, 127.5, 126.3, 124.6, 123.3, 45.7, 43.4, 29.9.



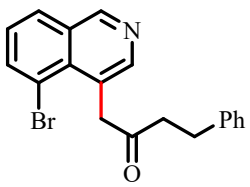
1-(8-chloroisoquinolin-4-yl)-4-phenylbutan-2-one (7b). Yellow solid. (35.3 mg, 57%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.62 (s, 1H), 8.43 (s, 1H), 7.63 (dd, *J* = 6.8, 1.6 Hz, 1H), 7.61 – 7.52 (m, 2H), 7.24 – 7.15 (m, 3H), 7.08 (d, *J* = 6.8 Hz, 2H), 4.03 (s, 2H), 2.88 (dd, *J* = 8.2, 5.0 Hz, 2H), 2.82 (dd, *J* = 7.9, 4.7 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.5, 149.7, 145.3, 140.5, 136.5, 133.3, 130.8, 128.6, 128.4, 127.8, 126.4, 125.8, 124.2, 122.5, 45.7, 43.4, 29.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{19}H_{17}ClNO$ 310.0993; found 310.0991.



1-(8-methoxyisoquinolin-4-yl)-4-phenylbutan-2-one (7c). Yellow solid. (42.8 mg, 70%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.10 (s, 1H), 8.18 (s, 1H), 7.55 (dd, *J* = 8.1, 0.9 Hz, 1H), 7.49 (t, *J* = 7.9 Hz, 1H), 7.26 (t, *J* = 7.2 Hz, 2H), 7.18 (t, *J* = 8.6 Hz, 3H), 6.96 (d, *J* = 7.6 Hz, 1H), 4.14 (s, 2H), 3.71 (s, 3H), 2.93 (t, *J* = 7.4 Hz, 2H), 2.79 (t, *J* = 7.5 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.5, 155.5, 145.5, 141.3, 130.3, 128.6, 127.6, 126.2, 124.3, 120.7, 109.4, 55.2, 48.6, 43.6, 29.6. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{20}H_{20}NO_2$ 306.1489; found 306.1491.

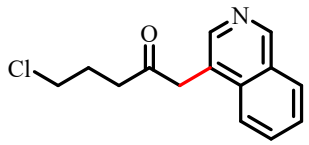


1-(6-bromoisoquinolin-4-yl)-4-phenylbutan-2-one (7d). Yellow solid. (34.7 mg, 49%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.13 (s, 1H), 8.35 (s, 1H), 7.90 (s, 1H), 7.83 (d, *J* = 8.7 Hz, 1H), 7.69 (dd, *J* = 8.7, 1.7 Hz, 1H), 7.27 – 7.21 (m, 2H), 7.17 (d, *J* = 7.2 Hz, 1H), 7.12 (d, *J* = 8.1 Hz, 2H), 3.98 (s, 2H), 2.91 (dd, *J* = 8.1, 4.7 Hz, 2H), 2.85 (dd, *J* = 8.4, 4.8 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.2, 152.4, 145.2, 140.6, 136.2, 131.1, 130.0, 128.7, 128.4, 126.9, 126.4, 126.1, 125.9, 123.6, 45.2, 43.6, 29.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{19}H_{17}BrNO$ 354.0488; found 354.0481.

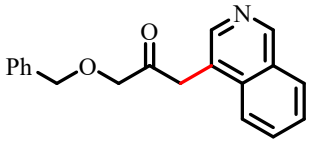


1-(5-bromoisoquinolin-4-yl)-4-phenylbutan-2-one(7e). Yellow solid. (32.6 mg, 46%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*) δ** 9.17 (s, 1H), 8.23 (s, 1H), 7.96 (dd, *J* = 7.8, 3.5 Hz, 2H), 7.40 (t, *J* = 7.8 Hz, 1H), 7.32 – 7.27 (m, 2H), 7.21

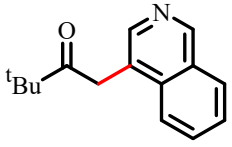
(d, J = 6.5 Hz, 3H), 4.52 (s, 2H), 2.98 (q, J = 3.5 Hz, 4H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.5, 154.0, 148.2, 141.1, 137.6, 133.8, 130.8, 129.3, 128.7, 128.6, 127.6, 126.3, 124.3, 118.3, 47.9, 44.0, 29.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{19}H_{17}BrNO$ 354.0488; found 354.0479.



5-chloro-1-(isoquinolin-4-yl)pentan-2-one (7g). Colorless liquid. (26.8 mg, 54%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.20 (s, 1H), 8.42 (s, 1H), 8.00 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.4 Hz, 1H), 7.76 – 7.74 (m, 1H), 7.64 (td, J = 7.0, 0.9 Hz, 1H), 4.09 (s, 2H), 3.50 (t, J = 6.3 Hz, 2H), 2.70 (t, J = 6.9 Hz, 2H), 2.00 (p, J = 6.7 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.6, 152.7, 144.2, 135.0, 131.1, 128.6, 128.5, 127.5, 124.5, 123.1, 45.3, 44.3, 38.5, 26.2. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{14}H_{15}ClNO$ 248.0837; found 248.0835.

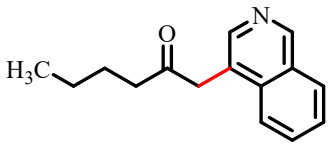


1-(benzyloxy)-3-(isoquinolin-4-yl)propan-2-one (7h). Colorless liquid. (29.1 mg, 50%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.19 (s, 1H), 8.39 (s, 1H), 8.01 (d, J = 7.9 Hz, 1H), 7.82 (d, J = 8.4 Hz, 1H), 7.74 – 7.69 (m, 1H), 7.62 (td, J = 7.4, 0.9 Hz, 1H), 7.38 – 7.30 (m, 5H), 4.59 (s, 2H), 4.20 (s, 2H), 4.16 (s, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 205.6, 152.6, 144.4, 137.0, 135.1, 131.0, 128.7, 128.6, 128.5, 128.3, 128.1, 127.4, 124.0, 123.3, 74.7, 73.7, 41.3. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{19}H_{18}NO_2$ 292.1332; found 292.1326.

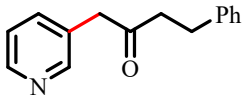


1-(isoquinolin-4-yl)-3,3-dimethylbutan-2-one (7j) [10]. Colorless liquid. (30.9 mg, 68%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.16 (s, 1H), 8.30 (s, 1H), 7.97 (d, J = 8.1 Hz, 1H), 7.69 (dd, J = 4.3, 1.0 Hz, 2H), 7.59 (dt, J = 8.1, 4.0 Hz,

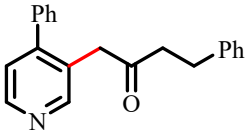
1H), 4.21 (s, 2H), 1.32 (s, 9H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 212.0, 152.3, 144.3, 135.4, 130.6, 128.6, 128.4, 127.1, 125.4, 123.3, 45.0, 38.3, 26.8.



1-(isoquinolin-4-yl)hexan-2-one (7i). Colorless liquid. (35.9 mg, 79%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 9.19 (s, 1H), 8.41 (s, 1H), 7.99 (d, *J* = 8.1 Hz, 1H), 7.84 (d, *J* = 8.4 Hz, 1H), 7.75 – 7.71 (m, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 4.06 (s, 2H), 2.47 (t, *J* = 7.4 Hz, 2H), 1.53 (p, *J* = 7.5 Hz, 2H), 1.23 (dq, *J* = 14.7, 7.3 Hz, 2H), 0.83 (t, *J* = 7.4 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.0, 152.6, 144.3, 135.1, 131.0, 128.6, 128.4, 127.4, 124.8, 123.3, 45.3, 41.7, 25.9, 22.3, 13.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{15}H_{18}NO$ 228.1383; found 228.1380.

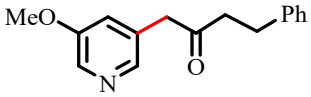


4-phenyl-1-(pyridin-3-yl)butan-2-one (8a). Light yellow liquid. (16.7 mg, 37%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.52 – 8.50 (m, 1H), 8.40 (d, *J* = 1.7 Hz, 1H), 7.48 (d, *J* = 7.9 Hz, 1H), 7.29 – 7.18 (m, 5H), 7.15 (d, *J* = 6.8 Hz, 2H), 3.66 (s, 2H), 2.91 (t, *J* = 7.0 Hz, 2H), 2.84 – 2.81 (m, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.3, 150.5, 148.5, 140.7, 137.2, 129.8, 128.7, 128.5, 126.4, 123.6, 47.1, 44.1, 29.9. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{15}H_{16}NO$ 226.1226; found 226.1217.

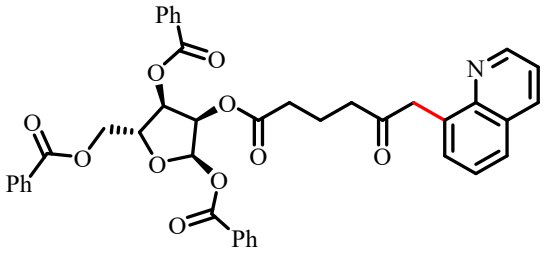


4-phenyl-1-(4-phenylpyridin-3-yl)butan-2-one (8b). Yellow liquid. (22.9 mg, 38%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.56 (d, *J* = 5.0 Hz, 1H), 8.42 (s, 1H), 7.41 (dd, *J* = 4.9, 1.7 Hz, 3H), 7.31 – 7.25 (m, 2H), 7.24 – 7.16 (m, 4H), 7.11 (d, *J* = 6.9 Hz, 2H), 3.69 (s, 2H), 2.80 (t, *J* = 7.5 Hz, 2H), 2.62 (t, *J* = 7.5 Hz, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.6, 151.9, 150.0, 140.8, 138.7, 128.7, 128.6,

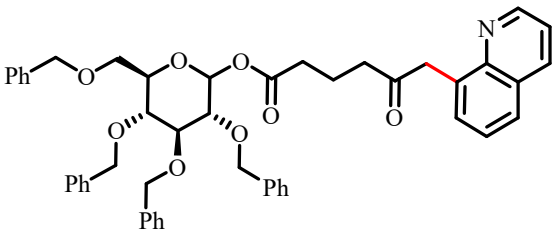
128.43, 128.37, 127.9, 126.3, 124.5, 44.9, 44.3, 29.7. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{21}H_{20}NO$ 302.1539; found 302.1541.



1-(5-methoxypyridin-3-yl)-4-phenylbutan-2-one (8c). Yellow liquid. (20.4 mg, 40%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.22 (d, *J* = 2.8 Hz, 1H), 8.02 (d, *J* = 1.6 Hz, 1H), 7.31 – 7.25 (m, 2H), 7.20 (t, *J* = 7.3 Hz, 1H), 7.15 (d, *J* = 6.9 Hz, 2H), 7.01 – 6.98 (m, 1H), 3.84 (s, 3H), 3.65 (s, 2H), 2.91 (t, *J* = 7.0 Hz, 2H), 2.86 – 2.79 (m, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 206.3, 155.7, 142.6, 140.7, 136.5, 130.3, 128.6, 128.4, 126.4, 121.5, 55.6, 46.9, 44.0, 29.8. **HRMS (ESI-TOF) m/z:** [M + H]$^+$ calcd for $C_{16}H_{18}NO_2$ 256.1332; found 256.1335.



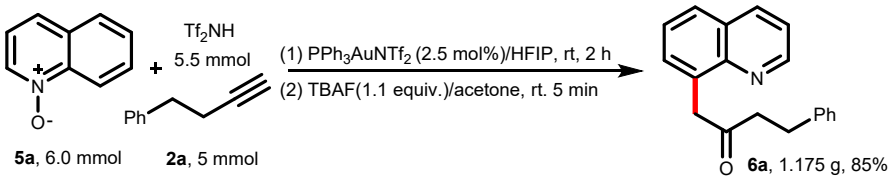
(2R,3R,4R,5R)-5-((benzoyloxy)methyl)-3-((5-oxo-6-(quinolin-8-yl)hexanoyl)oxy) tetrahydrofuran-2,4-diyl dibenzoate (13). Colorless liquid. (123.5mg, 88%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.77 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.11 – 8.08 (m, 6H), 7.72 (dd, *J* = 7.4, 2.3 Hz, 1H), 7.61 – 7.57 (m, 3H), 7.50 – 7.41 (m, 4H), 7.39 – 7.35 (m, 5H), 7.30 (dd, *J* = 8.3, 4.2 Hz, 1H), 6.80 (d, *J* = 4.4 Hz, 1H), 5.77 (dd, *J* = 6.5, 2.1 Hz, 1H), 5.55 (dd, *J* = 6.4, 4.5 Hz, 1H), 4.84 (q, *J* = 3.1 Hz, 1H), 4.71 (dd, *J* = 12.2, 3.1 Hz, 1H), 4.64 – 4.63 (m, 1H), 4.14 (s, 2H), 2.57 (t, *J* = 7.0 Hz, 2H), 2.32 (t, *J* = 7.2 Hz, 2H), 1.84 (p, *J* = 7.1 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.0, 171.9, 166.2, 165.8, 165.3, 149.6, 146.6, 136.3, 134.2, 133.7, 133.6, 133.5, 130.7, 130.0, 129.9, 129.8, 129.6, 129.5, 129.2, 128.69, 128,66, 128.5, 128.4, 127.3, 126.3, 121.2, 94.8, 82.9, 70.80,70.75, 64.1, 45.6, 41.1, 32.7, 18.6. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{41}H_{35}NO_{10}Na$ 724.2153; found 724.2159.



(3R,4S,5R,6R)-3,4,5-tris(benzyloxy)-6-((benzyloxy)methyl)tetrahydro-2H-pyran-2-yl 5-oxo-6-(quinolin-8-yl)hexanoate (14). Colorless liquid. (127.9mg, 82%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.87 (td, *J* = 4.4, 1.7 Hz, 1H), 8.17 – 8.13 (m, 1H), 7.75 – 7.70 (m, 1H), 7.51 (q, *J* = 7.3 Hz, 1H), 7.33 (dt, *J* = 13.2, 5.8 Hz, 20H), 7.18 – 7.17 (m, 2H), 6.44 (d, *J* = 3.5 Hz, 1H), 4.93 (dd, *J* = 17.5, 10.9 Hz, 1H), 4.87 – 4.71 (m, 3H), 4.67 – 4.58 (m, 2H), 4.52 (td, *J* = 12.2, 3.1 Hz, 2H), 4.28 (dd, *J* = 11.6, 3.6 Hz, 2H), 4.00 – 3.96 (m, 1H), 3.80 – 3.73 (m, 4H), 3.61 (dd, *J* = 16.3, 7.9 Hz, 1H), 2.72 (t, *J* = 7.1 Hz, 2H), 2.48 – 2.46 (m, 2H), 1.99 (dq, *J* = 13.4, 7.0 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 208.22, 208.17, 171.84, 171.80, 149.7, 146.7, 138.7, 138.2, 138.1, 136.29, 136.25, 134.3, 130.71, 130.68, 128.6, 128.5, 128.2, 128.2, 128.0, 127.9, 127.84, 127.77, 127.71, 127.4, 127.3, 126.38, 126.35, 121.3, 121.2, 94.1, 90.0, 84.9, 81.8, 81.1, 79.0, 77.2, 75.8, 75.7, 75.6, 75.3, 75.1, 75.0, 73.61, 73.58, 73.2, 73.0, 68.2, 45.7, 41.3, 33.4, 19.0, 18.7. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{49}H_{49}NO_8Na$ 802.3350; found 802.3358.

6. A general procedure for Scheme 2

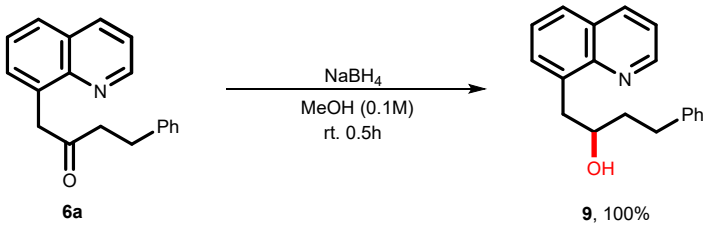
(A) Gram scale synthesis



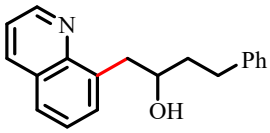
A solution of **5a** (0.87 g, 6.0 mmol, 1.2 eq.), $HNTf_2$ (1.55 g, 5.50 mmol, 1.1 eq.) in HFIP (12 mL) was stirred at room temperature for 15 min. The **2a** (0.65 g, 5.0 mmol) and PPh_3AuNTf_2 (92 mg, 125 μmol, 2.5 mol%) were added and stirred at room temperature for another 2 hours. Upon completion, the HFIP was removed under reduced pressure. TBAF (1.44 g, 5.50 mmol, 1.1 eq.) and acetone (25 mL) were then

added to the residue and stirred at room temperature for 5 min. The crude reaction mixture was then purified by column chromatography to afford the **6a** (1.175 g, 85% yield) as a white solid.

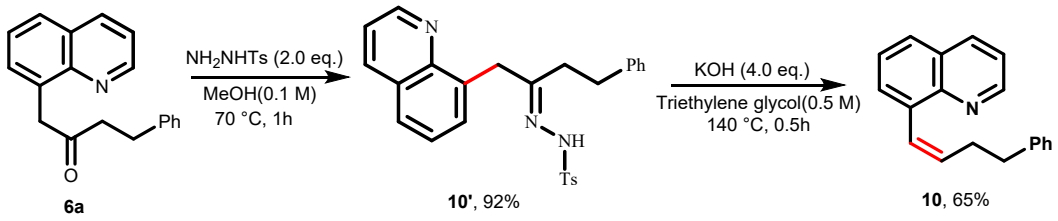
(B) Synthetic transformations



To a well stirred solution of **6a** (110.14 mg, 0.40 mmol) in MeOH (4.0 mL) at 0 °C was added $NaBH_4$ (16.65 mg, 0.44 mmol). The reaction mixture was allowed to warm to room temperature and stirred for 1 h. Water (5 mL) was added to quench excess $NaBH_4$ and the mixture was extracted with CH_2Cl_2 (3 × 5 mL). The combined organic extracts were then dried over Na_2SO_4 and conc. in vacuo. The residue was subjected to silica gel chromatography using Ethyl acetate and Petroleum ether (1:8) as eluents to afford the desired product **9** as a colorless liquid (110.95 mg, 100%) .[7]



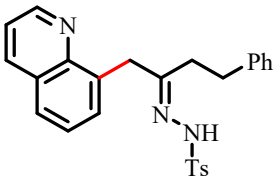
4-phenyl-1-(quinolin-8-yl)butan-2-ol (9). Colorless liquid. (110.95 mg, 100%, 0.4 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.88 (dd, *J* = 4.3, 1.8 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.73 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.55 (dd, *J* = 7.0, 1.2 Hz, 1H), 7.51 – 7.47 (m, 1H), 7.44 (dd, *J* = 8.3, 4.3 Hz, 1H), 7.30 – 7.22 (m, 4H), 7.17 (t, *J* = 7.0 Hz, 1H), 4.03 (dt, *J* = 11.6, 5.2 Hz, 1H), 3.44 (d, *J* = 5.0 Hz, 2H), 2.94 – 2.87 (m, 1H), 2.82 – 2.74 (m, 1H), 1.88 – 1.82 (m, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 149.2, 147.3, 142.8, 138.5, 137.4, 131.5, 128.9, 128.7, 128.4, 126.9, 126.8, 125.7, 121.2, 72.0, 41.5, 39.9, 32.5. **HRMS (ESI-TOF) m/z:** $[M + Na]^+$ calcd for $C_{19}H_{19}NONa$ 300.1359; found 300.1357.



6a **10'**, 92% **10**, 65%

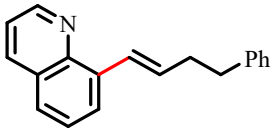
To a solution of **6a** (110.14 mg, 0.40 mmol) in MeOH (4.0 mL) were added NH_2NHTs (148.98 mg, 0.80 mmol), PTSA (4.13 mg, 0.024 mmol). The mixture was stirred at 70℃ for 1 h. The organic solvent was removed under vacuum and the residue was dissolved in CH_2Cl_2, washed with water (3 × 10 mL) and brine (3 × 10 mL), dried, filtered, and evaporated under reduced pressure. The crude reaction mixture was then purified by column chromatography using Ethyl acetate and Petroleum ether (1:4) as eluents to afford the **10′** (163 mg, 92%) as a white solid. [11]

KOH (44.88 mg, 0.8mmol) was added to triethylene glycol (0.5M) and heat to 100 °C until dissolved into a red/orange solution. **10′** (0.37 mmol) was added to the reaction system, and the reaction was heated at 140 ℃ for 0.5 hours. The reaction was cooled to room temperature, then diluted with water and extracted with ethyl acetate (3 × 5 mL). The combined organic extracts were then dried over Na_2SO_4 and conc. in vacuo. The crude product was purified by column chromatography to afford the **10** (62.37 mg, 65%) as a light yellow liquid.

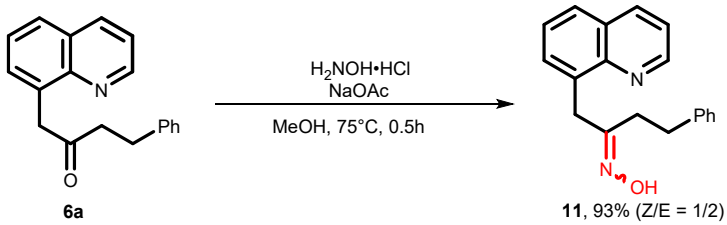


(E)-4-methyl-N'-(4-phenyl-1-(quinolin-8-yl)butan-2-ylidene)benzenesulfonohydrazide (10′). White solid. (163 mg, 92%, 0.4 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 12.98 (s, 1H), 9.01 (d, *J* = 3.1 Hz, 1H), 8.22 (d, *J* = 8.1 Hz, 1H), 7.81 (d, *J* = 7.9 Hz, 2H), 7.75 (d, *J* = 8.1 Hz, 1H), 7.57 (d, *J* = 6.8 Hz, 1H), 7.52 (dd, *J* = 8.1, 4.3 Hz, 1H), 7.46 (t, *J* = 7.5 Hz, 1H), 7.12 (dt, *J* = 17.4, 9.0 Hz, 5H), 6.97 (d, *J* = 6.9 Hz, 2H), 3.99 (s, 2H), 2.79 – 2.75 (m, 2H), 2.57 – 2.53 (m, 2H), 2.31 (s, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 156.5, 148.8, 145.0, 143.2, 141.8, 137.9, 136.4, 134.8, 131.9, 129.2, 128.8, 128.4, 128.3, 128.1, 127.6, 127.1, 125.9,

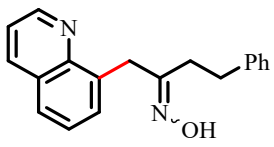
121.7, 37.5, 35.3, 31.9, 21.6. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{26}H_{26}N_3O_2S$ 444.1740; found 444.1732.



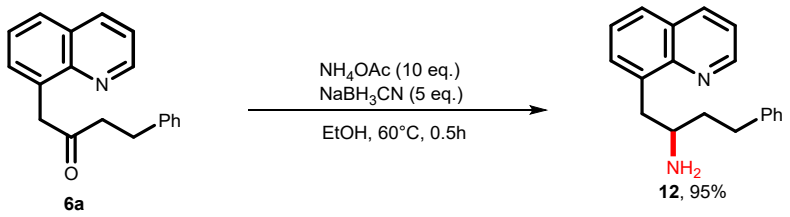
(E)-8-(4-phenylbut-1-en-1-yl)quinolone (10). Light yellow liquid. (62.37 mg, 65%);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.95 (dd, *J* = 4.2, 1.8 Hz, 1H), 8.14 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.86 (d, *J* = 7.2 Hz, 1H), 7.74 – 7.66 (m, 2H), 7.54 – 7.48 (m, 1H), 7.41 (dd, *J* = 8.3, 4.2 Hz, 1H), 7.31 (dd, *J* = 14.4, 7.4 Hz, 5H), 7.21 (t, *J* = 7.0 Hz, 1H), 6.50 (dt, *J* = 16.0, 6.9 Hz, 1H), 2.95 – 2.84 (m, 2H), 2.71 (q, *J* = 6.9 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 149.6, 145.8, 142.1, 136.6, 136.4, 132.6, 128.7, 128.6, 128.5, 126.9, 126.6, 126.3, 126.0, 125.5, 121.2, 36.2, 35.6. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{19}H_{18}N$ 260.1434; found 260.1433.



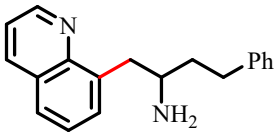
H_2NOH•HCl (16.68 mg, 0.24 mmol) and NaOAc (19.69 mg, 0.24 mmol) were added to a solution of the **6a** (55.07 mg, 0.2 mmol) in MeOH (2.0 mL). The mixture was heated at 75 ℃ for 12 h. After cooling to room temperature, the mixture was diluted with EtOAc (5 mL), washed with brine (5 mL), dried (Na_2SO_4) and concentrated in vacuo. The residue was subjected to silica gel chromatography using Ethyl acetate and Petroleum ether (1:5) as the eluent to provide the corresponding oxime **11** as a colorless liquid (54.0 mg, 93%).



4-phenyl-1-(quinolin-8-yl)butan-2-one oxime (11). Colorless liquid. (54.0 mg, 93%, 0.2 mmol scale); **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.95 (dd, *J* = 4.3, 1.8 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.7 Hz, 1H), 7.74 (td, *J* = 8.3, 1.3 Hz, 1H), 7.63 (dd, *J* = 11.8, 7.1 Hz, 1H), 7.53 – 7.36 (m, 2H), 7.22 (q, *J* = 7.1 Hz, 2H), 7.18 – 7.13 (m, 1H), 7.11 – 7.08 (m, 2H), 4.40 (s, 2H), 2.92 – 2.74 (m, 2H), 2.69 – 2.44 (m, 2H).**^{13}C NMR (101 MHz, Chloroform-*d*)** δ 160.9, 149.4, 146.2, 141.7, 137.1, 135.2, 130.5, 128.6, 128.4, 127.1, 126.8, 126.4, 126.0, 121.4, 36.1, 32.8, 30.4. **HRMS (ESI-TOF) m/z:** [M + Na]$^+$ calcd for $C_{19}H_{18}N_2O_3Na$ 313.1311; found 313.1309.



6a (55.07 mg, 0.2 mmol), NH_4OAc (154.16 mg, 2 mmol), $NaBH_3CN$ (62.84 mg, 1 mmol) were dissolved in ethanol (3 mL) and stir at 60 ℃ for 0.5 h. Dilute the reaction mixture with ethyl acetate. The organic layer is washed with 10% NaOH and salt water and dried with Na_2SO_4. The organic layer is concentrated under reduced pressure. The residue was purified by silica gel column chromatography to provide the product **12** (52.5 mg, 95% yield) as a colorless liquid.[12]



4-phenyl-1-(quinolin-8-yl)butan-2-amine (12). Colorless liquid. (52.5 mg, 95%, 0.2 mmol scale);**^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.85 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.20 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.76 (d, *J* = 8.0 Hz, 1H), 7.53 (d, *J* = 7.0 Hz, 1H), 7.50 – 7.47 (m, 1H), 7.41 (dd, *J* = 8.3, 4.4 Hz, 1H), 7.20 – 7.16 (m, 2H), 7.11 (d, *J* = 7.0 Hz, 3H), 3.59 (dt, *J* = 9.1, 4.7 Hz, 1H), 3.55 – 3.42 (m, 2H), 2.81 – 2.69 (m, 2H), 2.08 – 2.00 (m, 1H), 1.93 – 1.85 (m, 1H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 149.5, 140.2, 138.3,

135.4, 132.6, 129.1, 128.7, 128.5, 128.1, 127.0, 126.3, 121.6, 52.2, 37.8, 35.2, 32.2. **HRMS (ESI-TOF) m/z:** $[M + H]^+$ calcd for $C_{19}H_{21}N_2$ 277.1699; found 277.1695.

7. Reference

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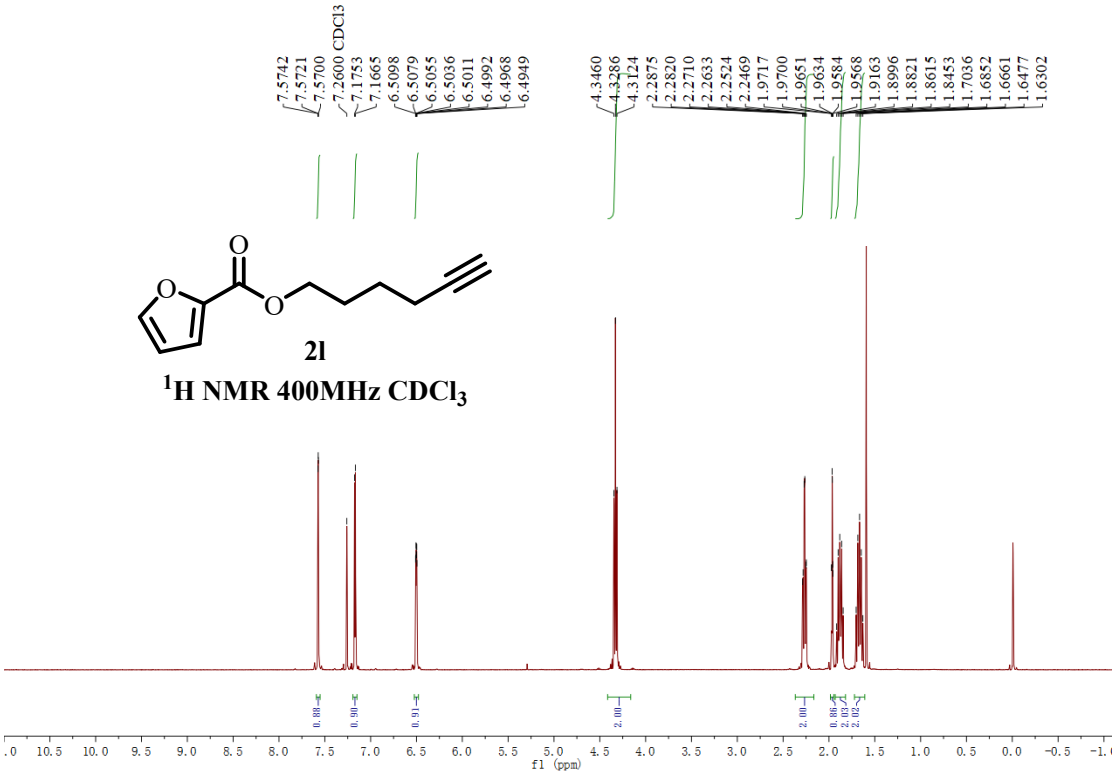
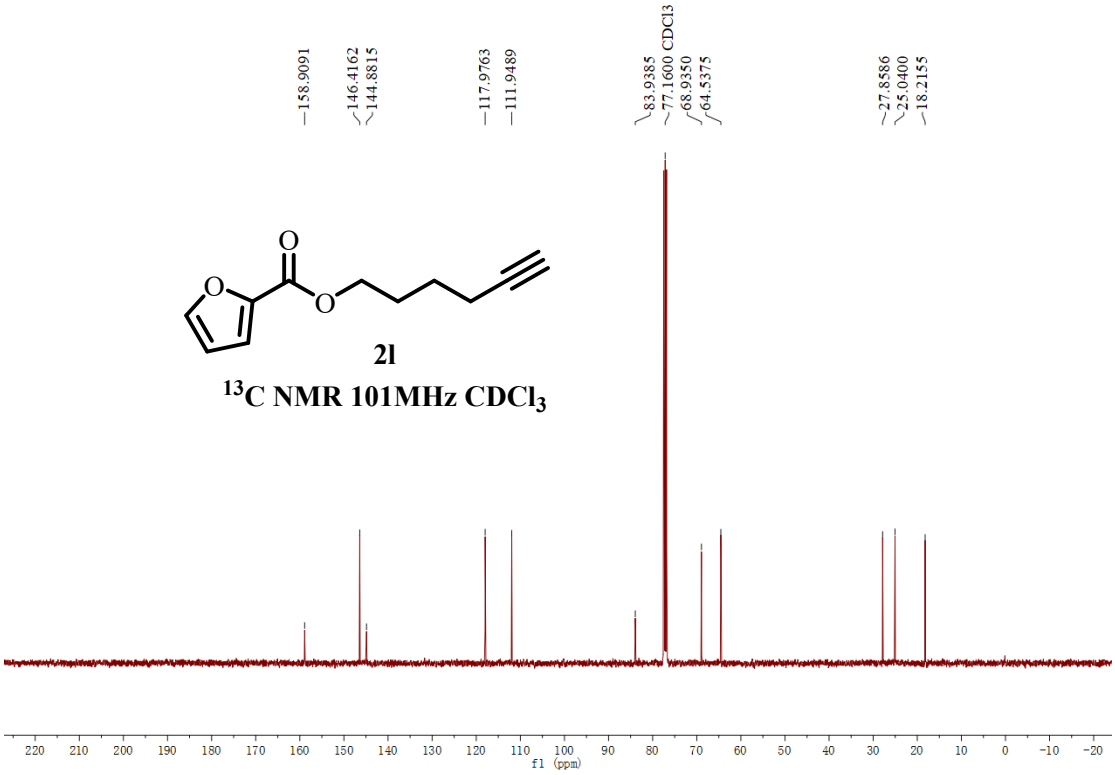
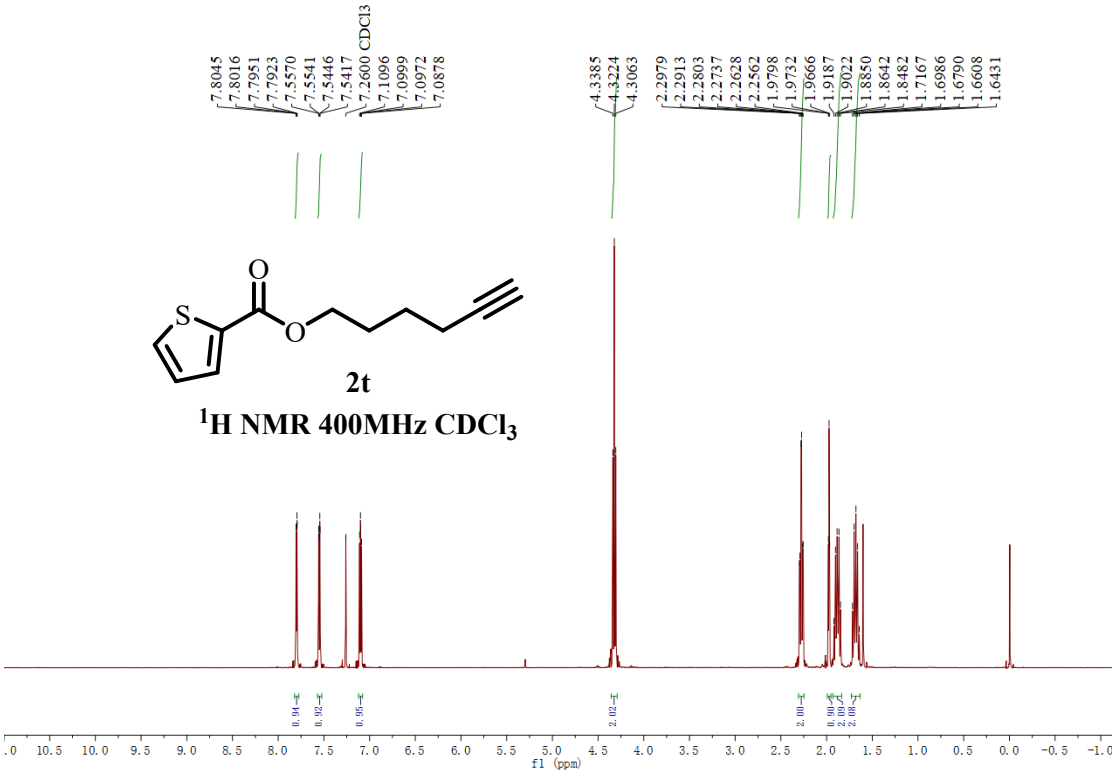
8. NMR spectra







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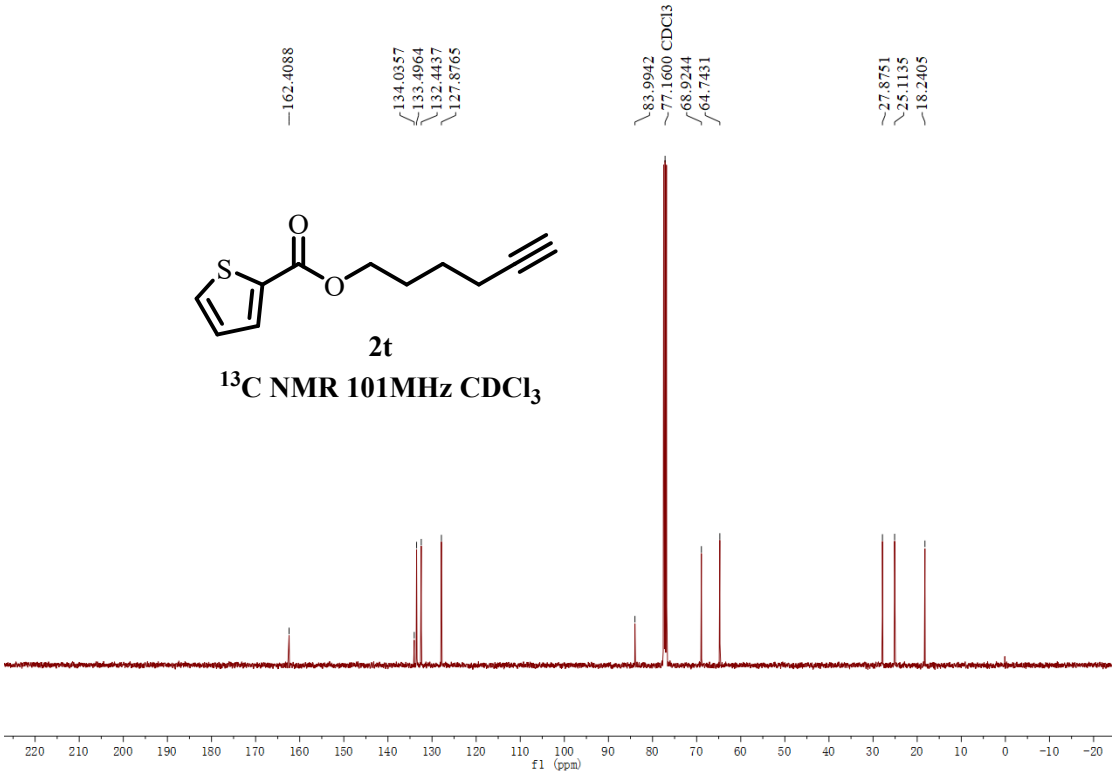
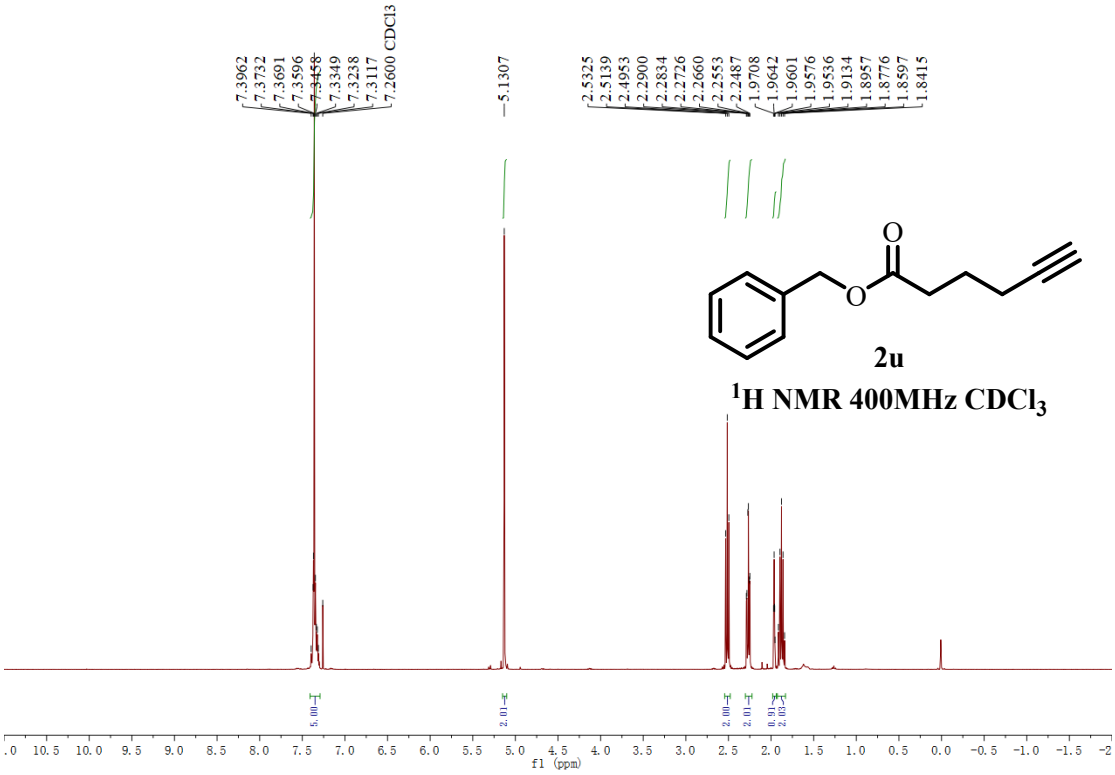


2t

^{13}C NMR 101MHz $CDCl_3$



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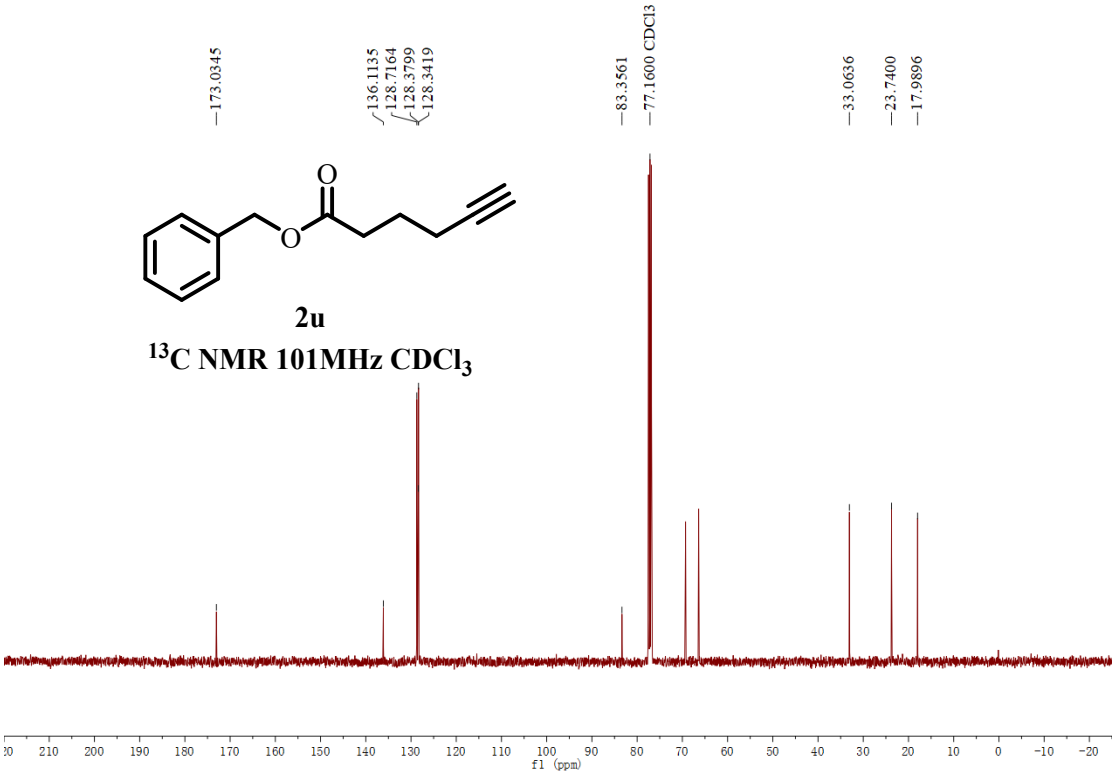

2u

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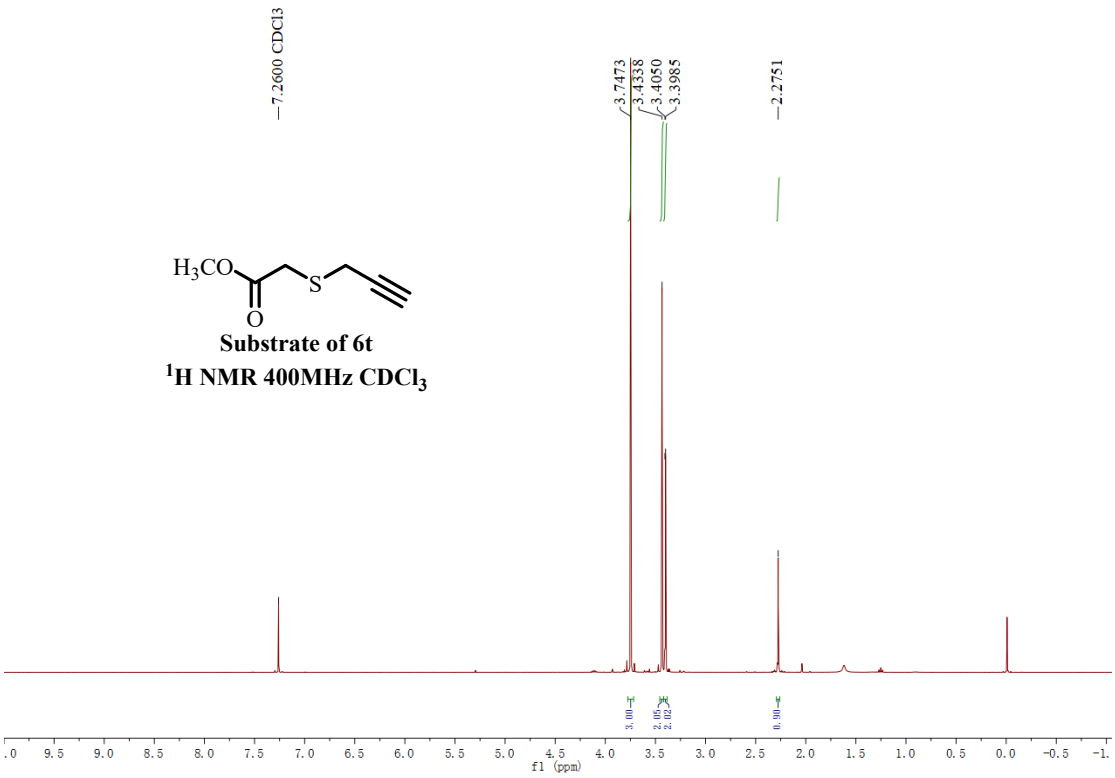

Substrate of 6t

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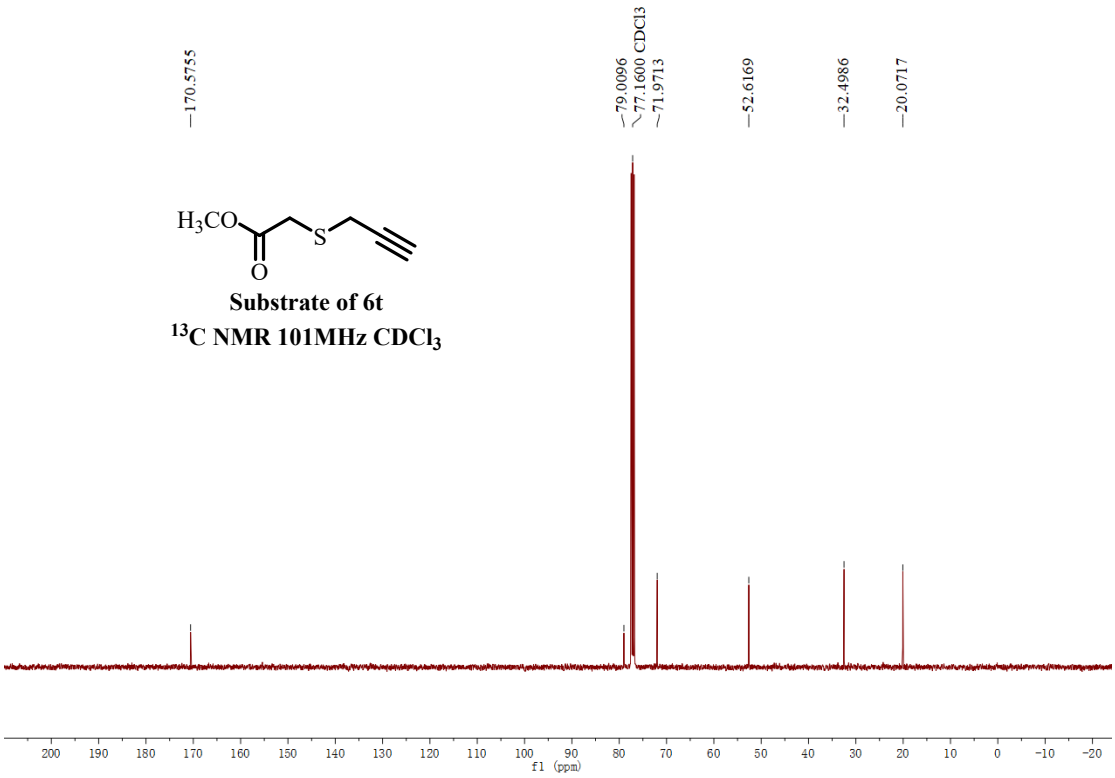

Substrate of 6t

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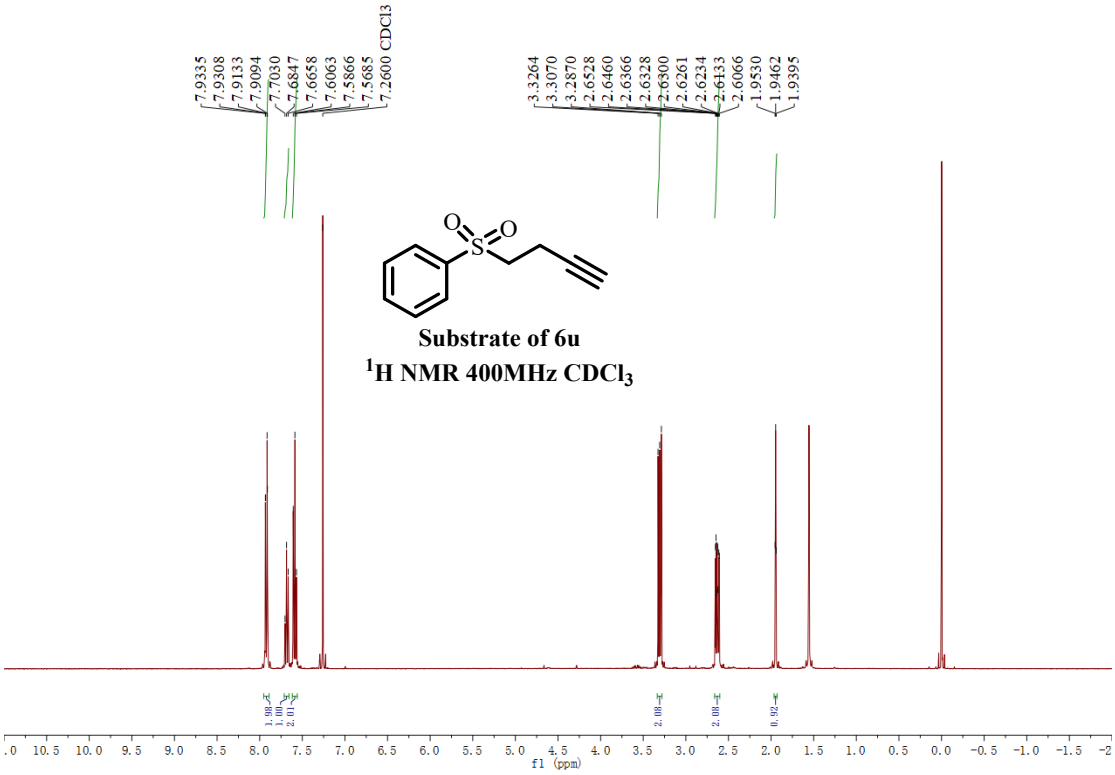
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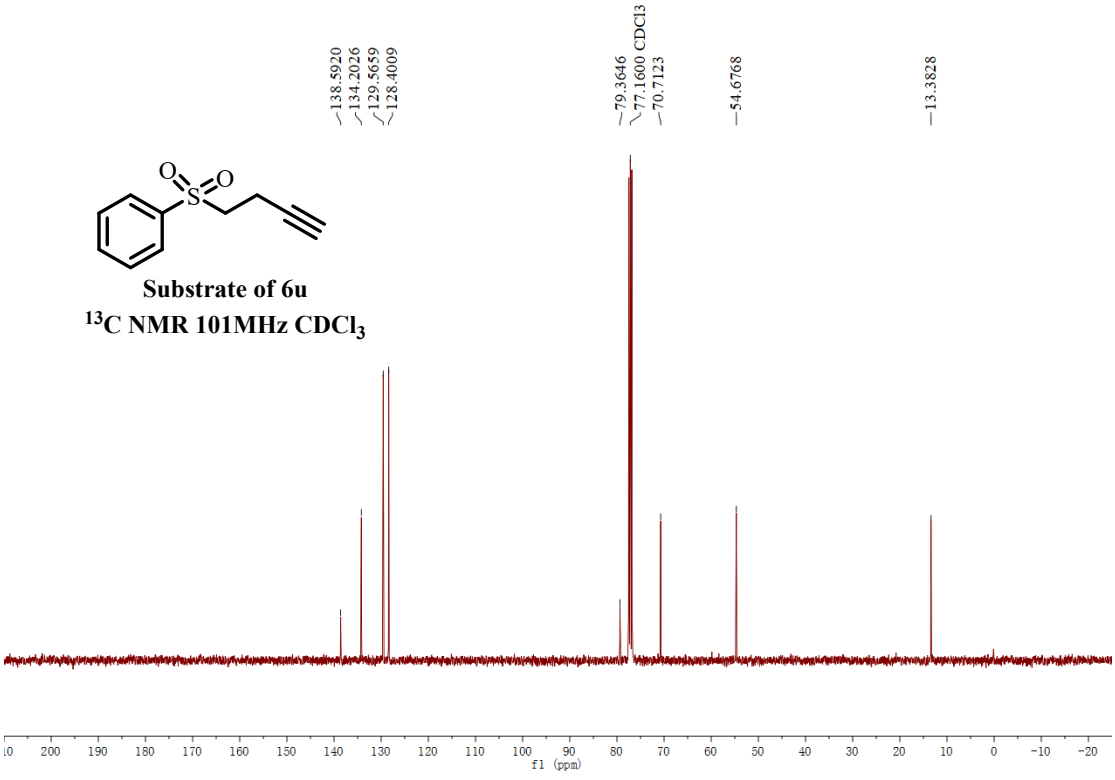
7.9133
7.9094
7.7030
7.6847
7.6658
7.6063
7.5866
7.5685
7.2600 CDCl3
3.3264
3.3070
3.2870
2.6528
2.6460
2.6366
2.6328
2.6300
2.6261
2.6234
2.6133
2.6066
1.9530
1.9462
1.9395
O
S
O
Substrate of 6u
1H NMR 400MHz CDCl3
1.98
1.00
2.01
2.08
2.08
0.92
f1 (ppm)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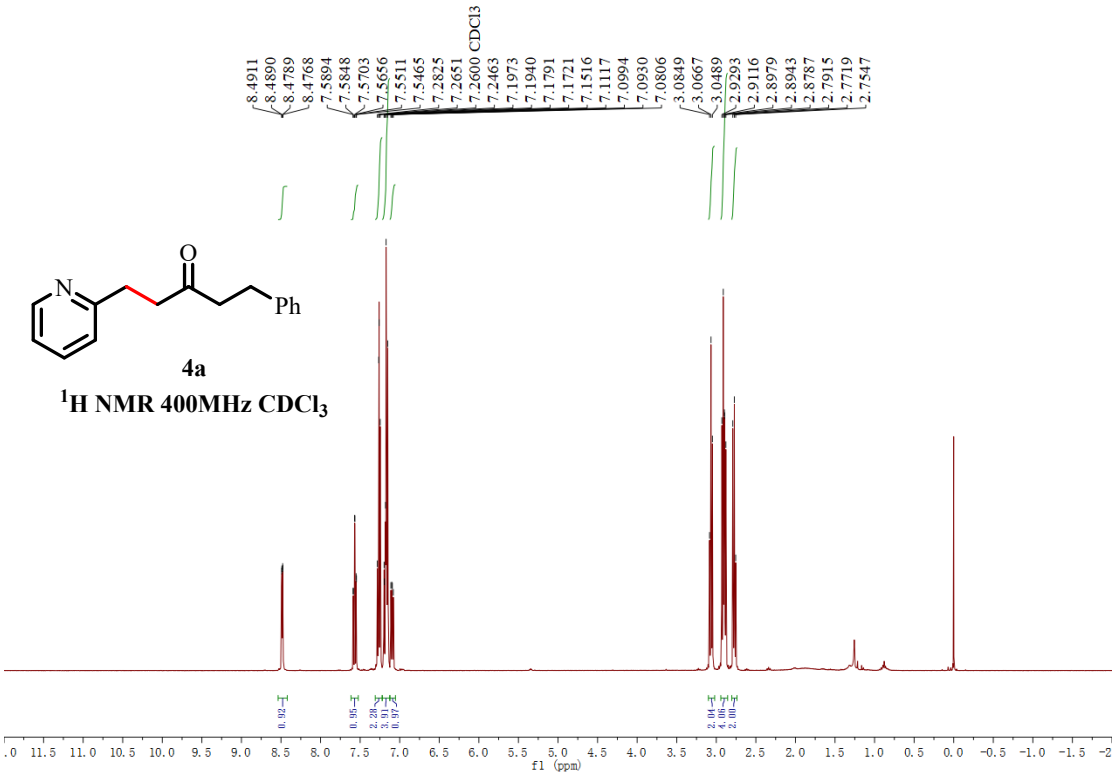
O
S
O
Substrate of 6u
13C NMR 101MHz CDCl3
f1 (ppm)



4a

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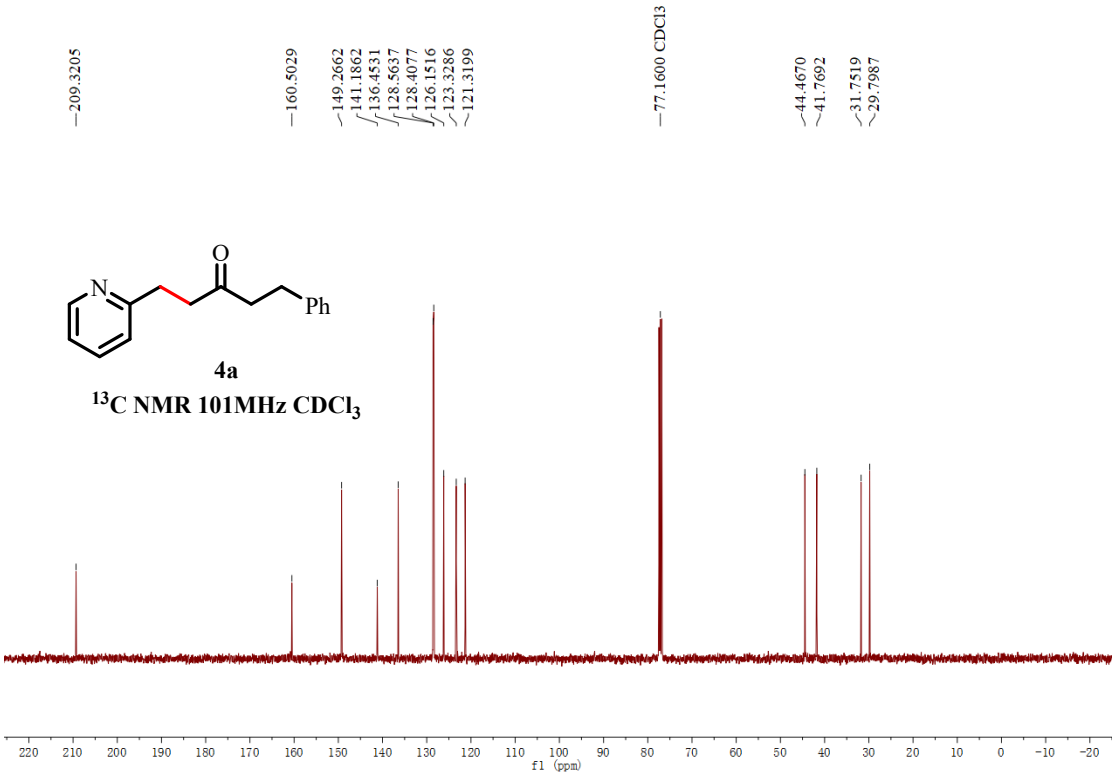
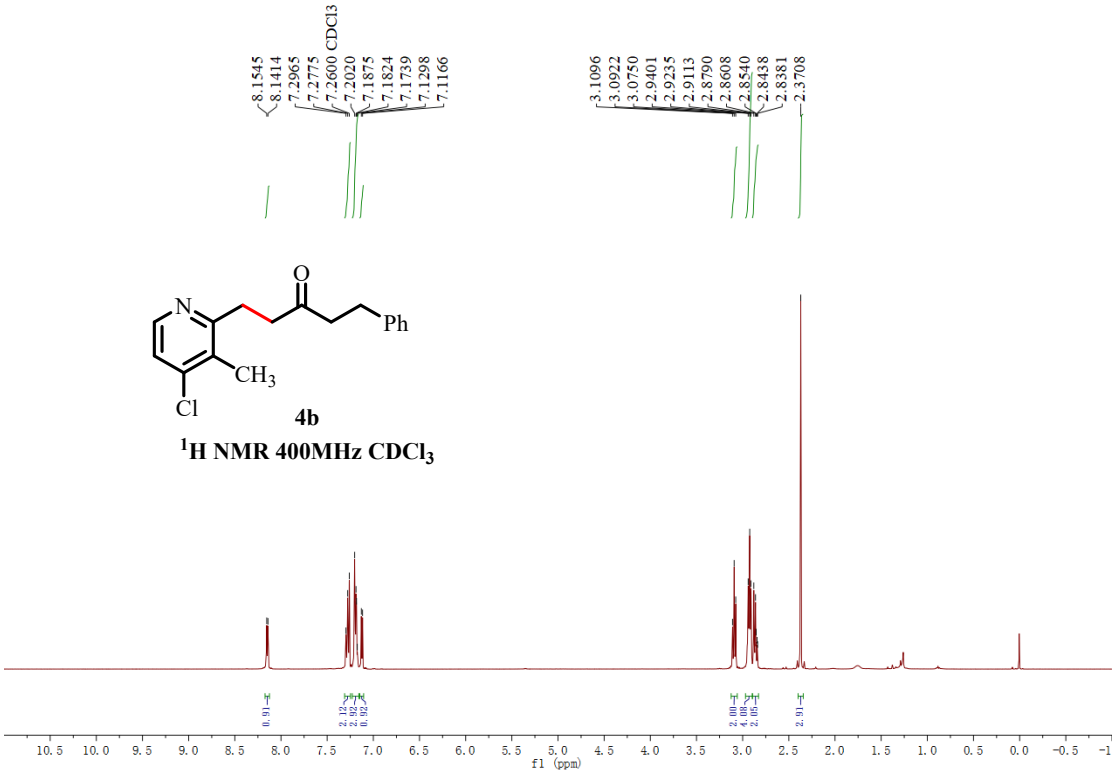


4a

^{13}C NMR 101MHz $CDCl_3$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7.1166
3.1096
3.0922
3.0750
2.9401
2.9235
2.9113
2.8790
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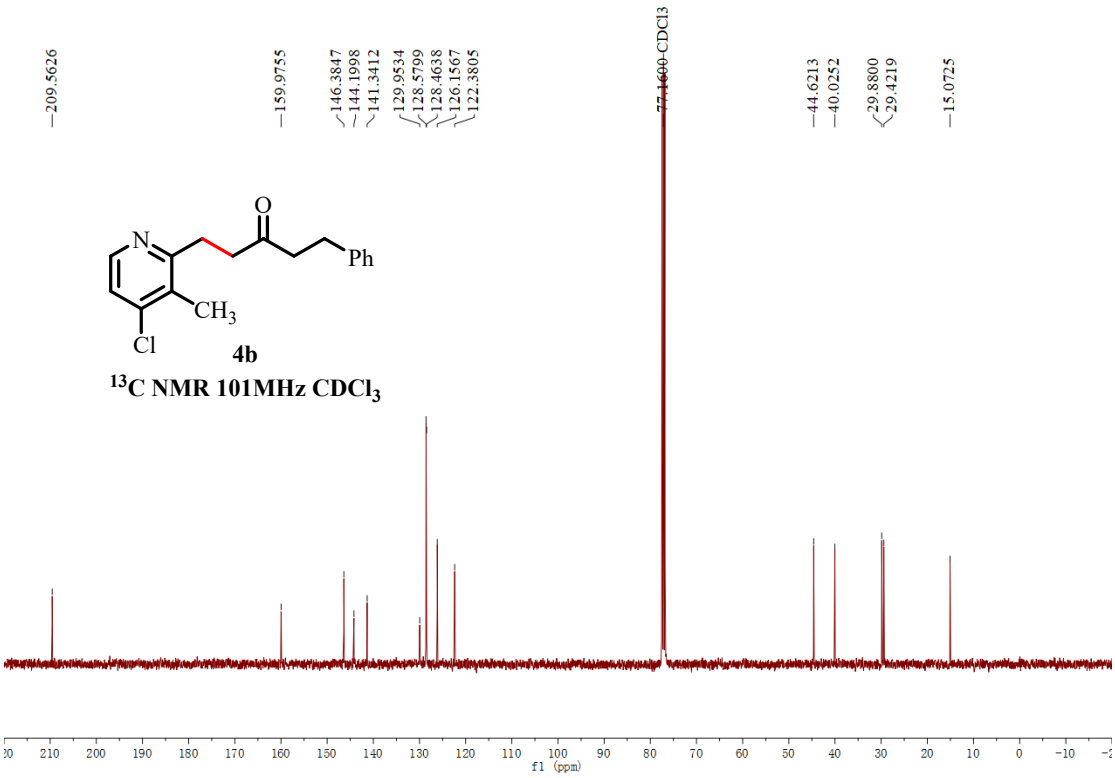
O
N
Ph
CH3
Cl
4b
1H NMR 400MHz CDCl3
f1 (ppm)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Ph
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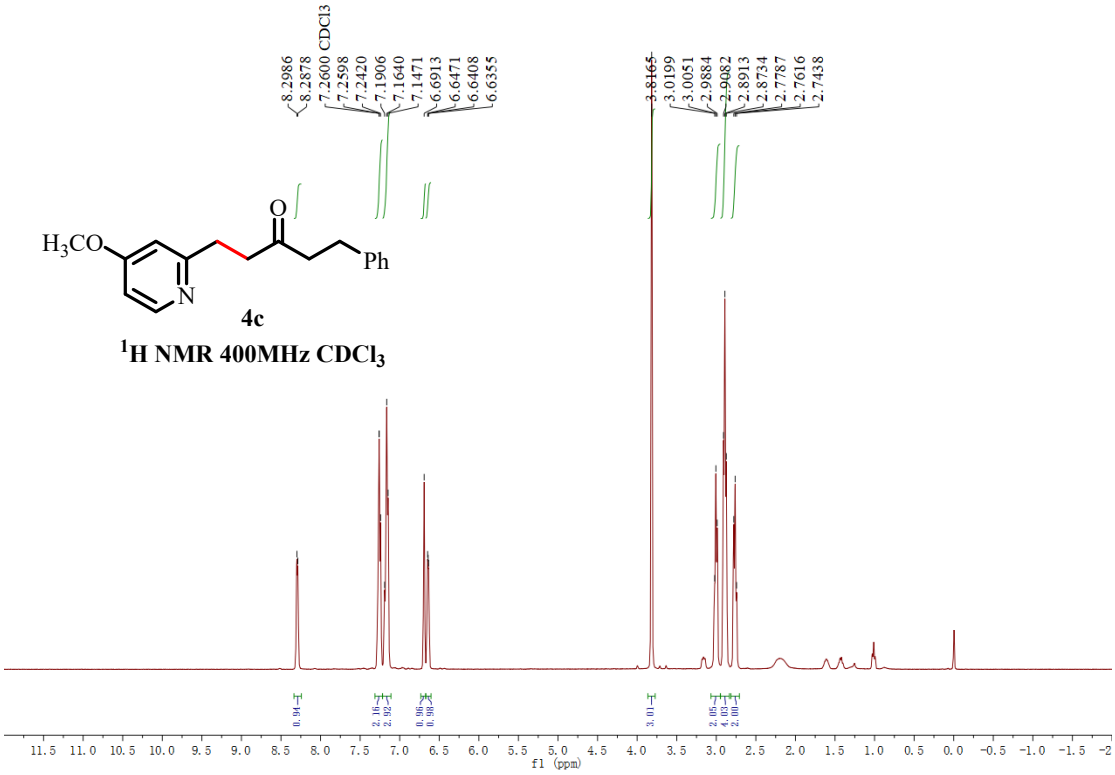
Cl
4b
13C NMR 101MHz CDCl3
f1 (ppm)



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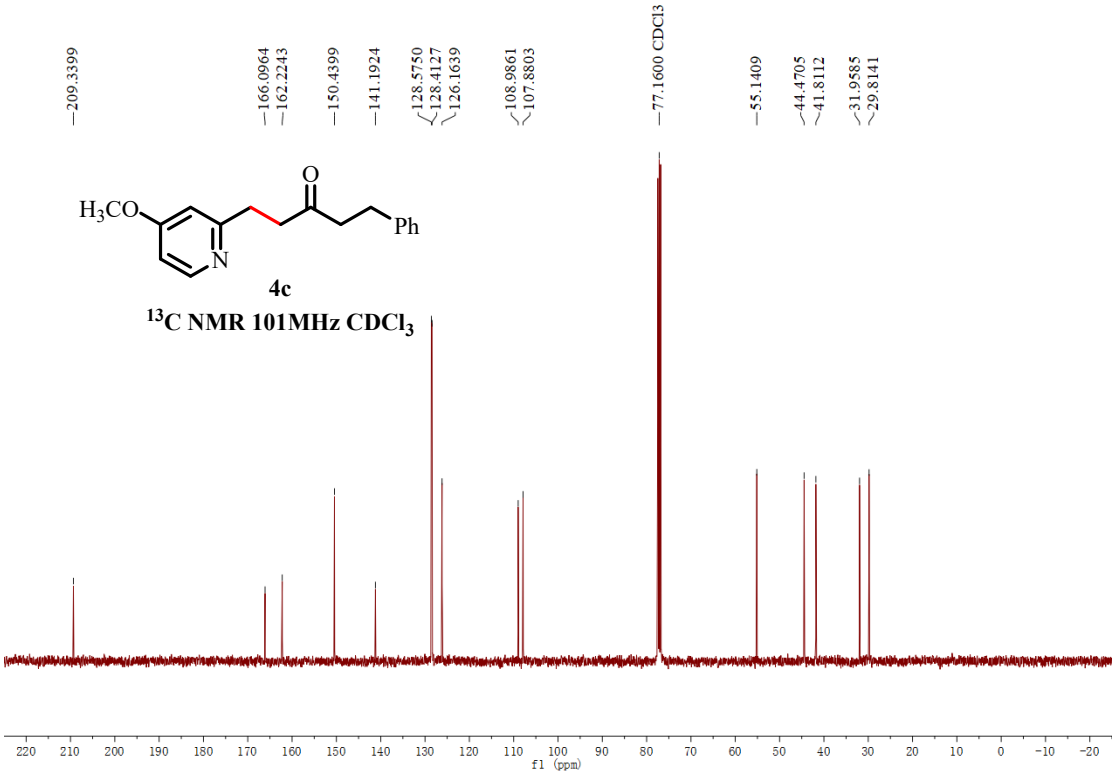

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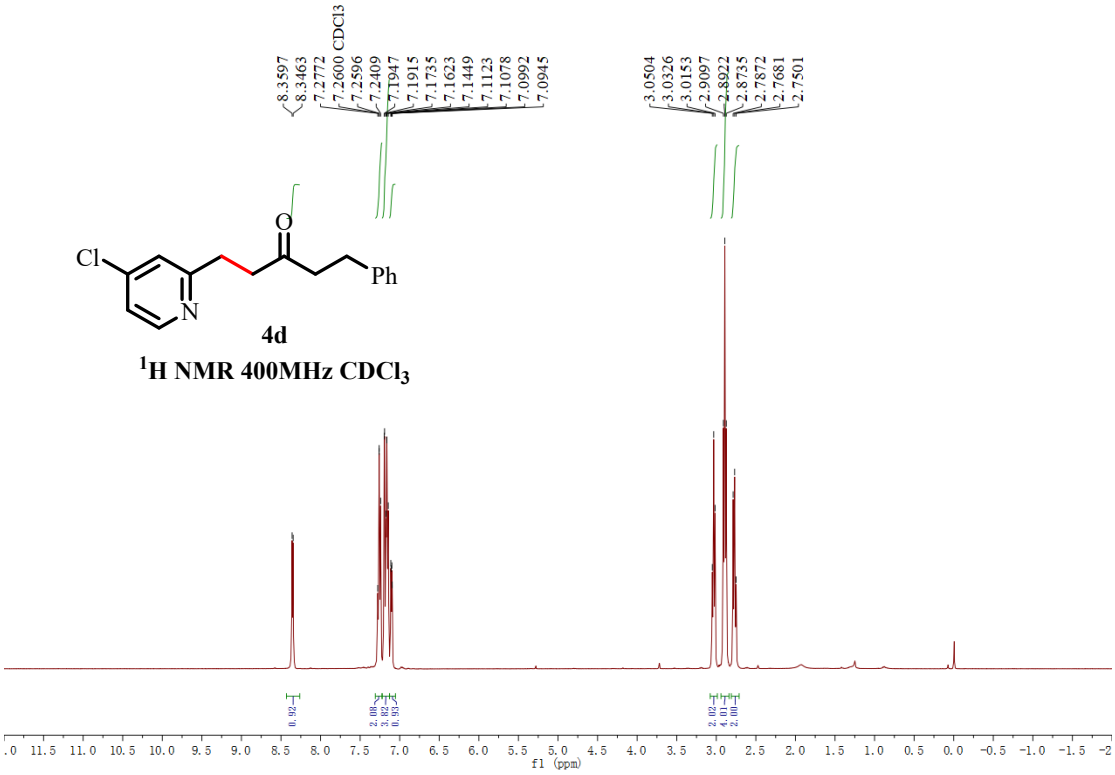

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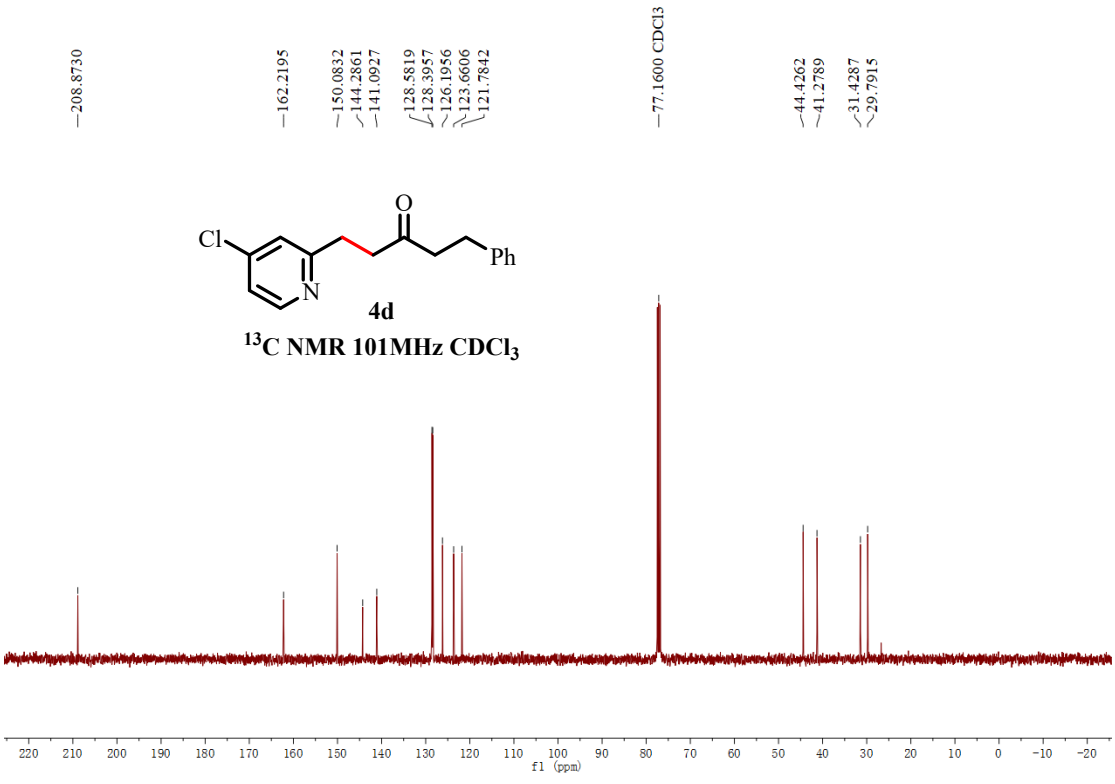

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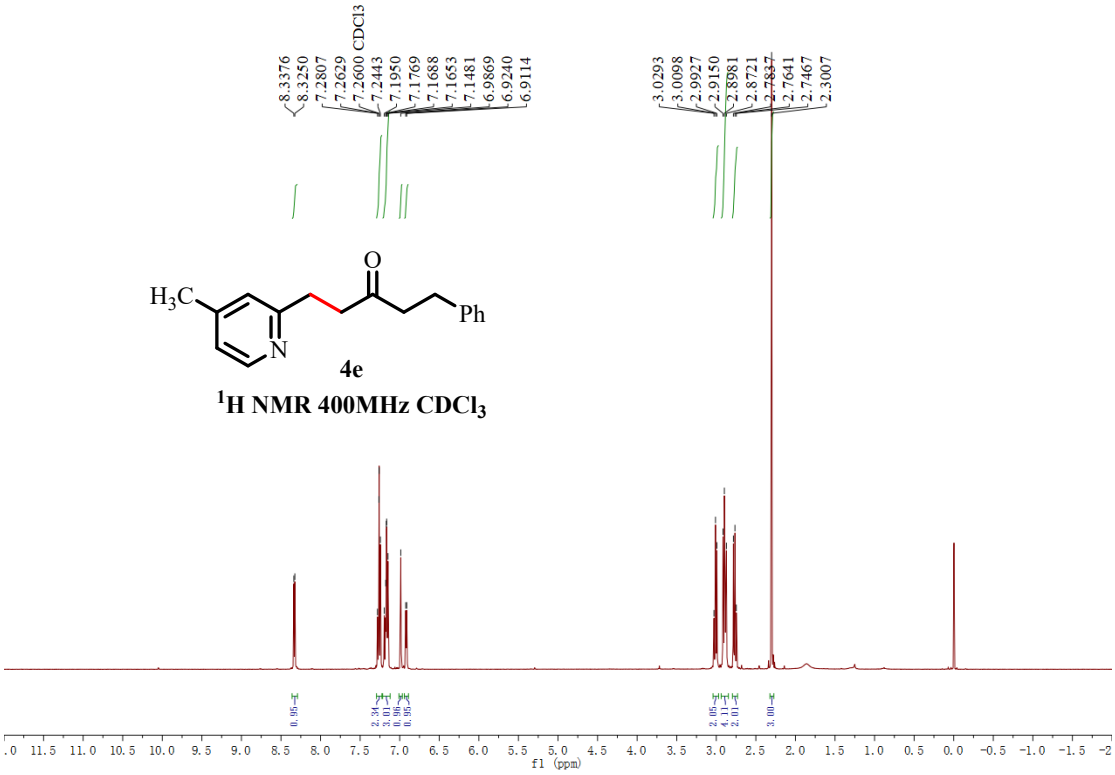

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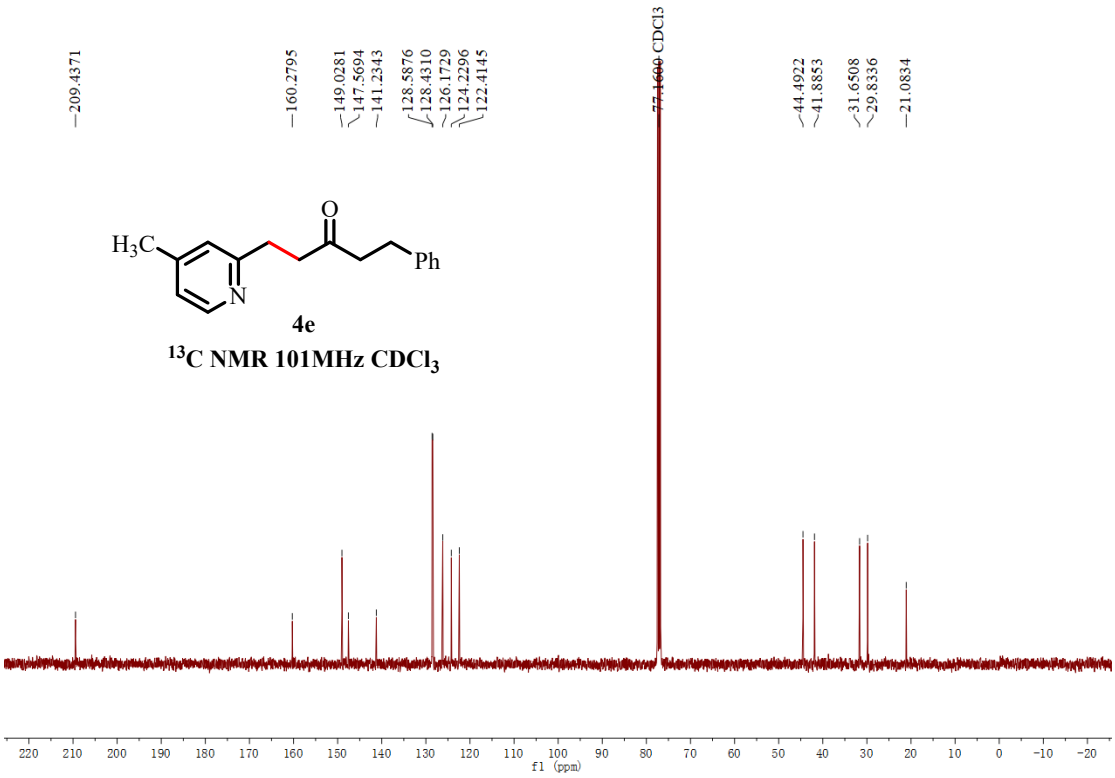

4e

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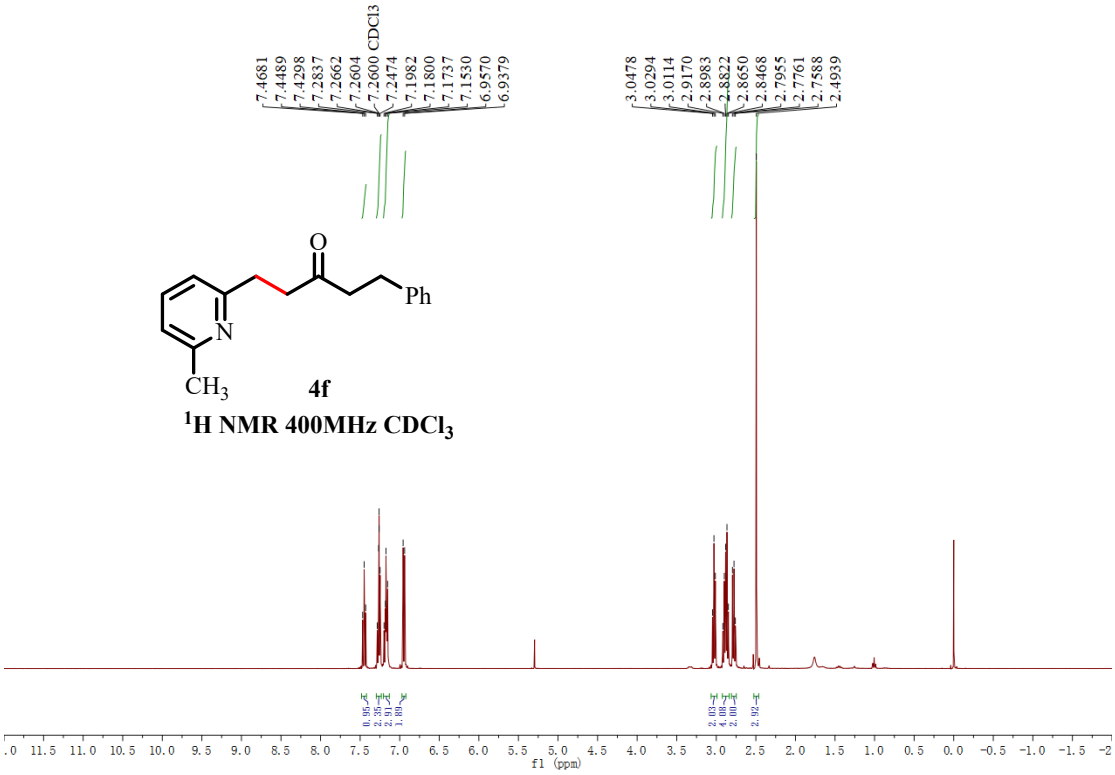

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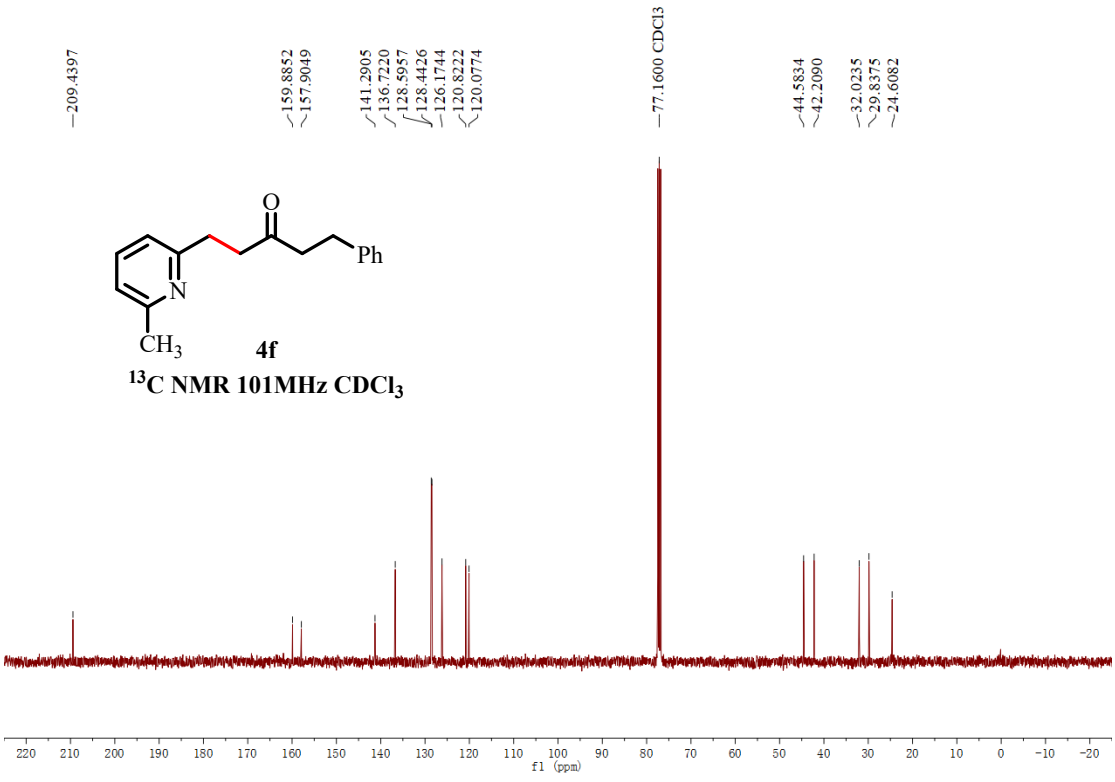

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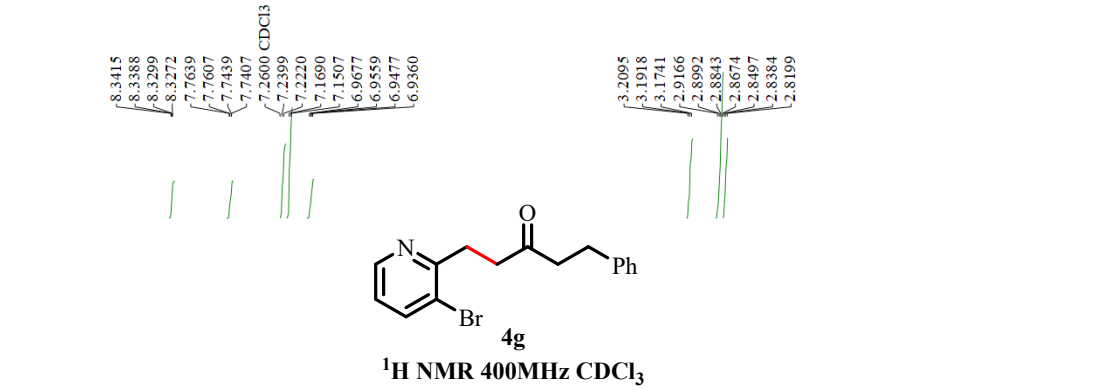

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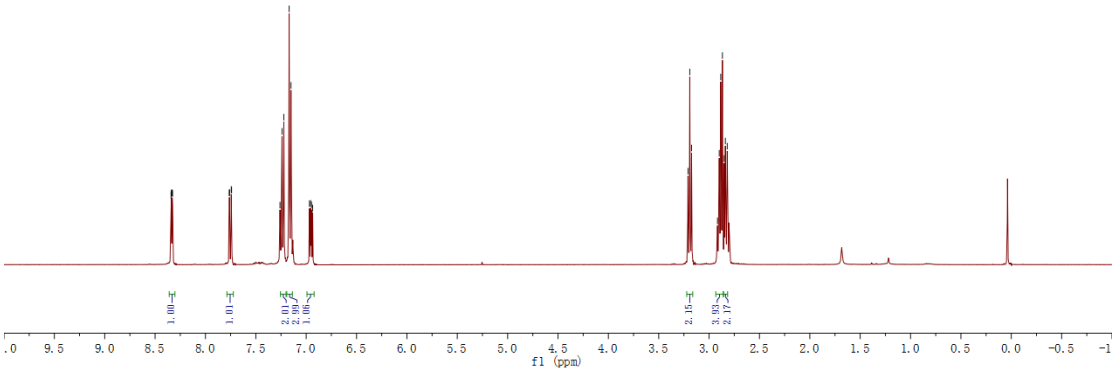

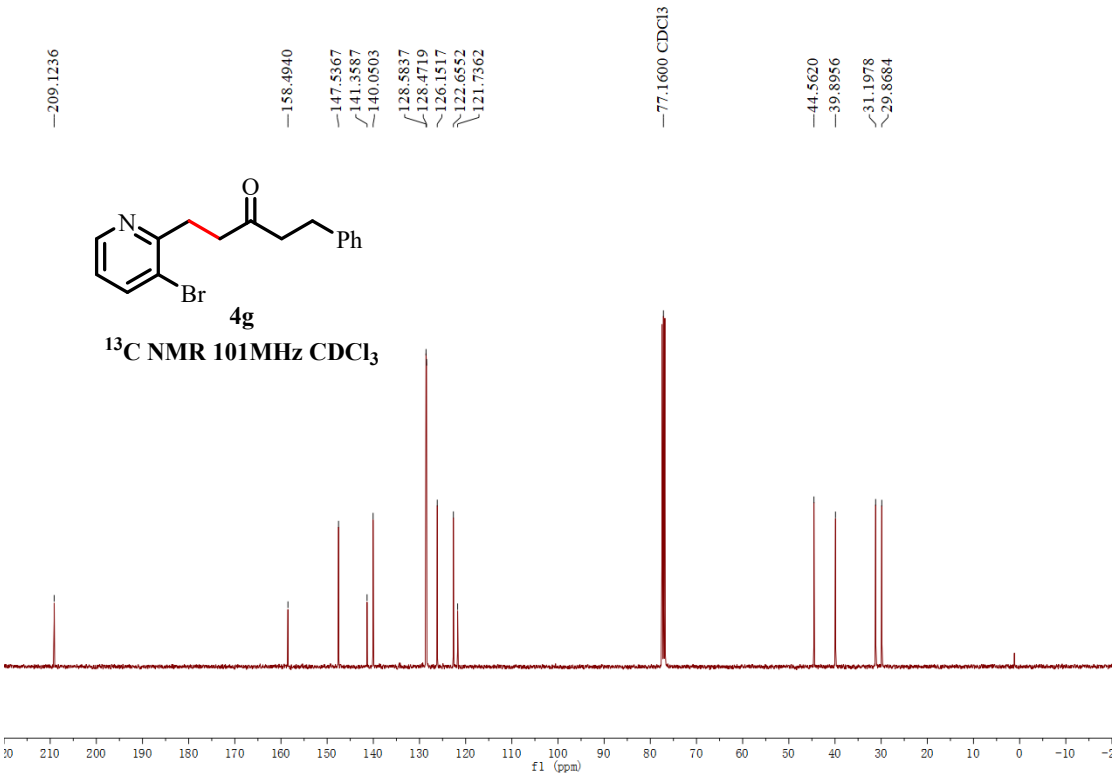

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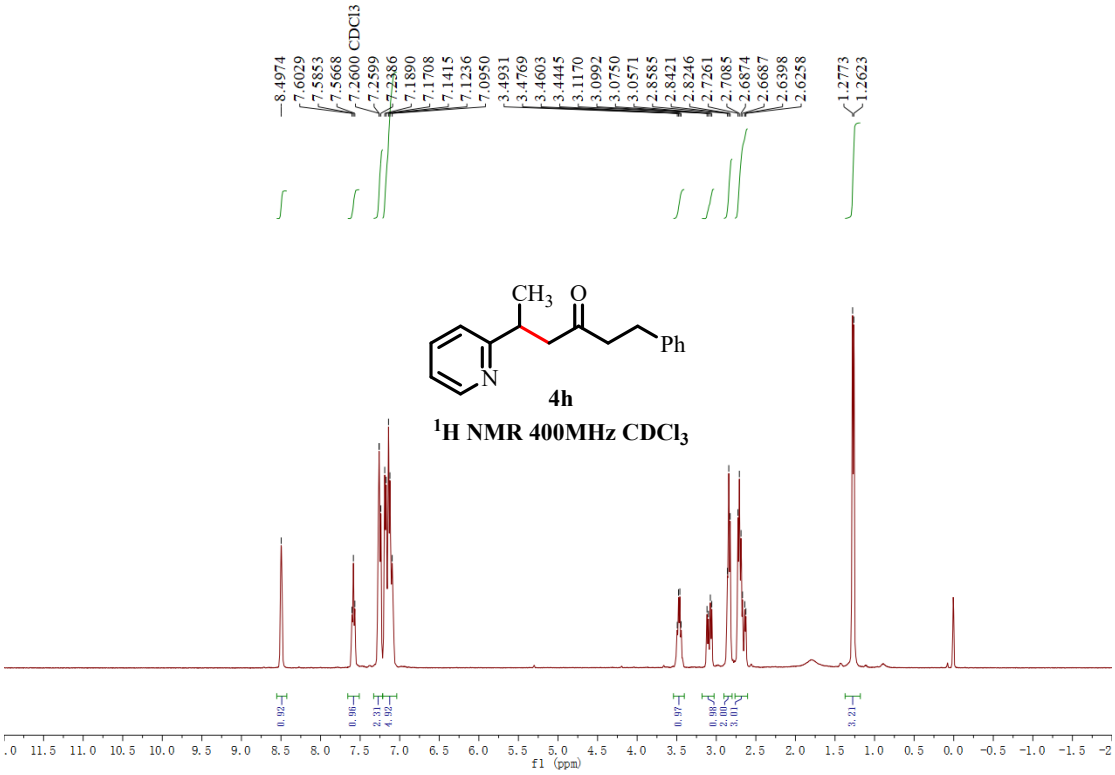
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Ph
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4h
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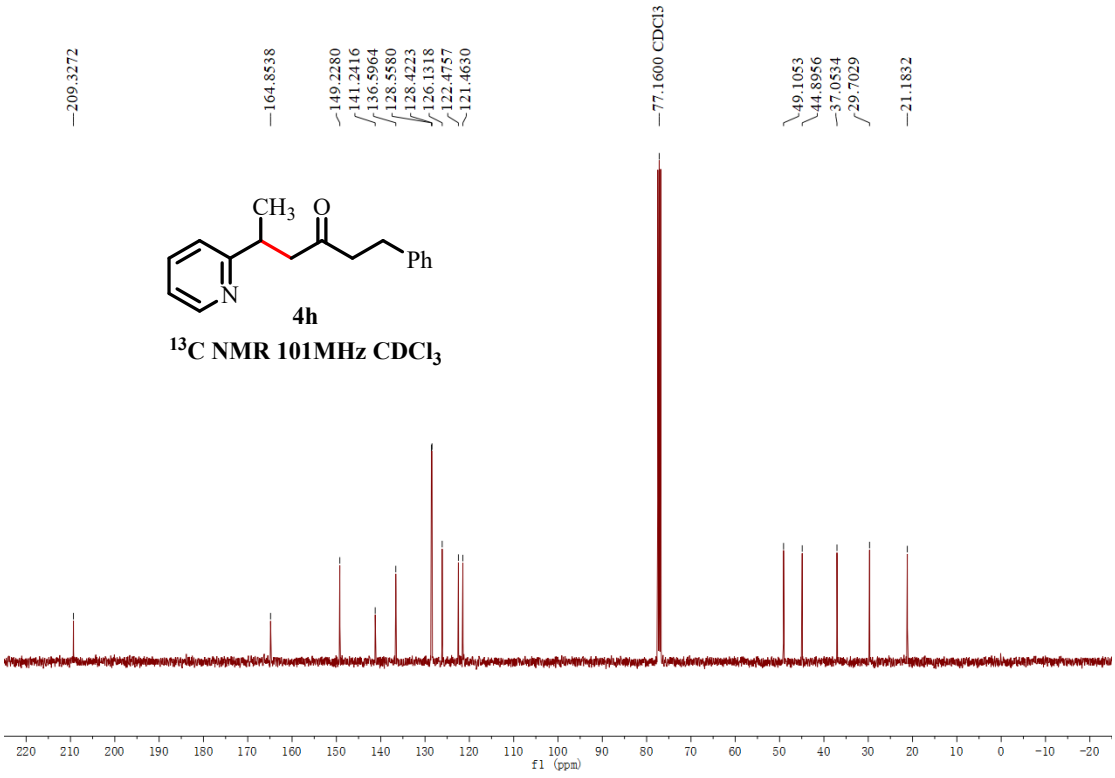
f1 (ppm)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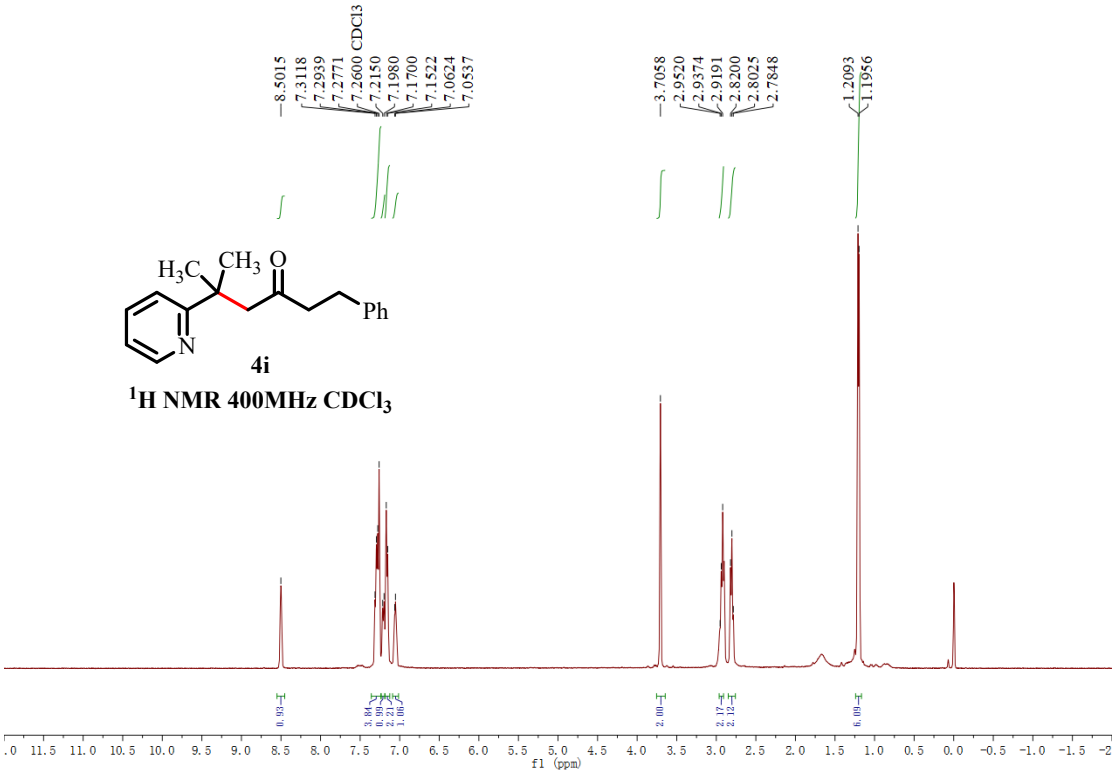
Ph
N
4h
13C NMR 101MHz CDCl3
f1 (ppm)



4i

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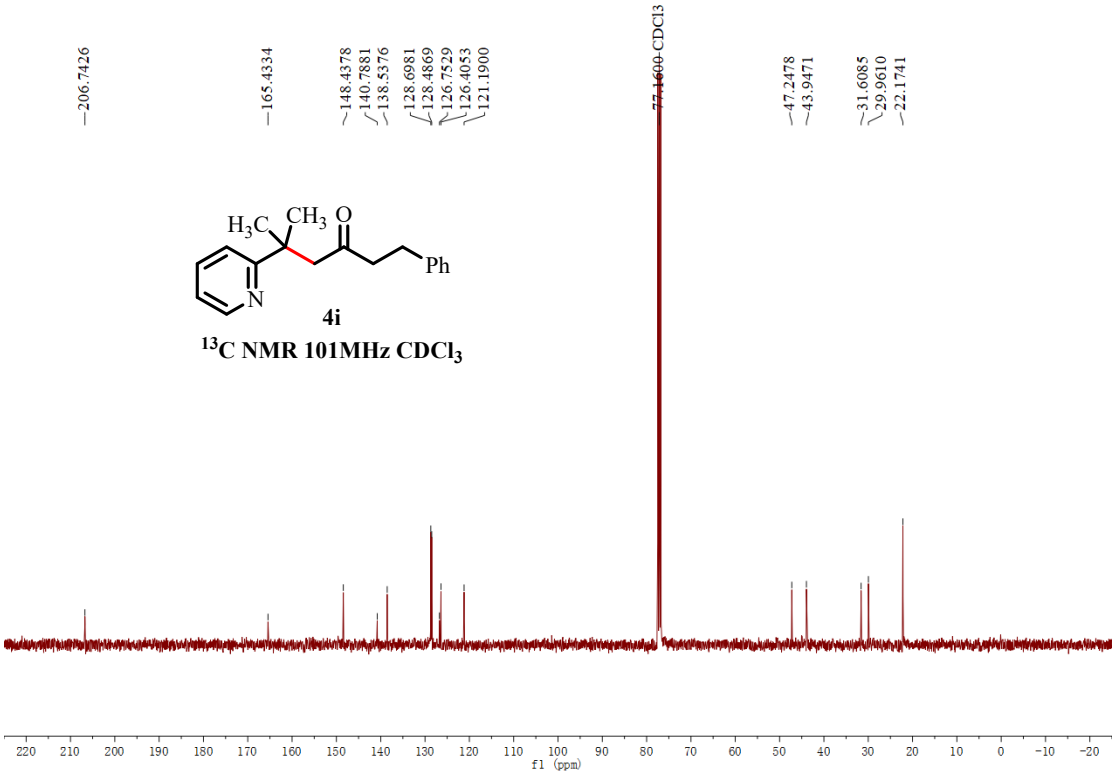

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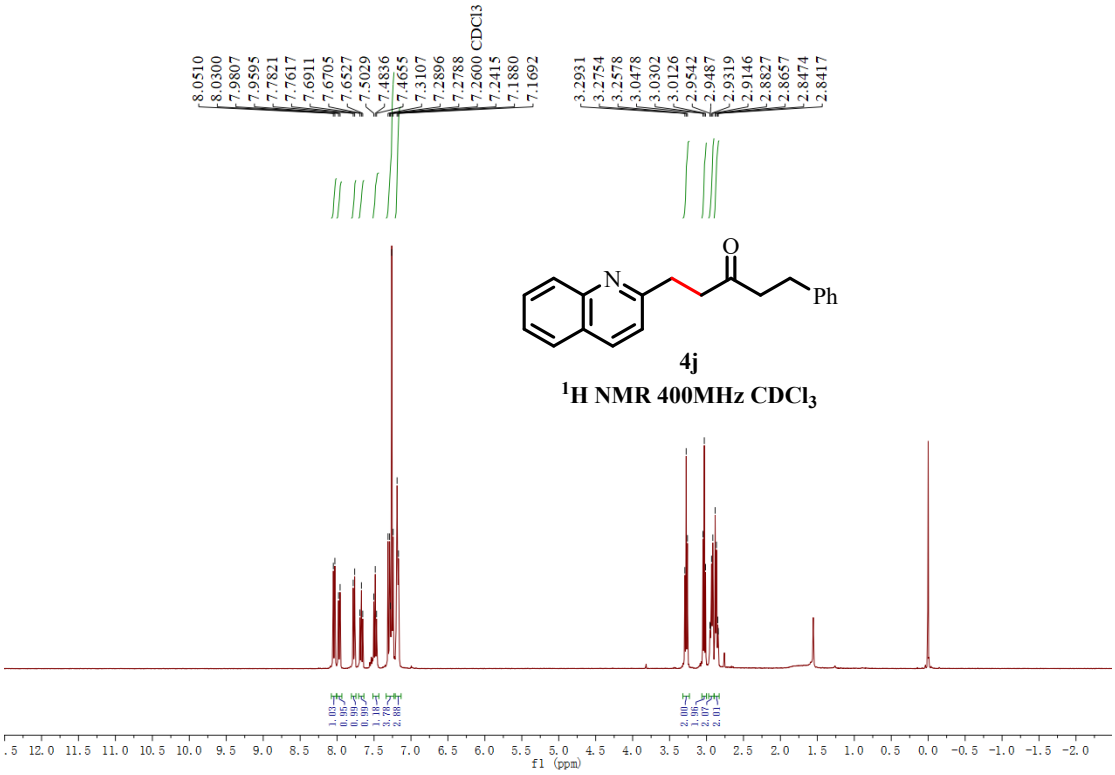

4j

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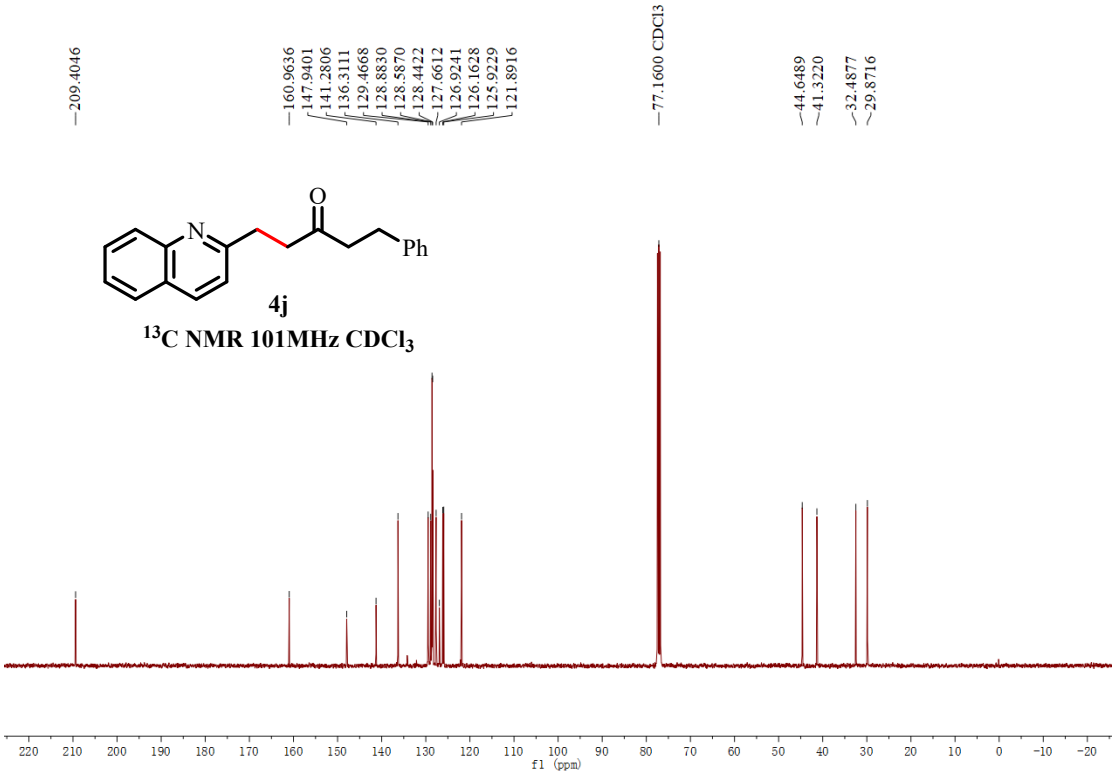

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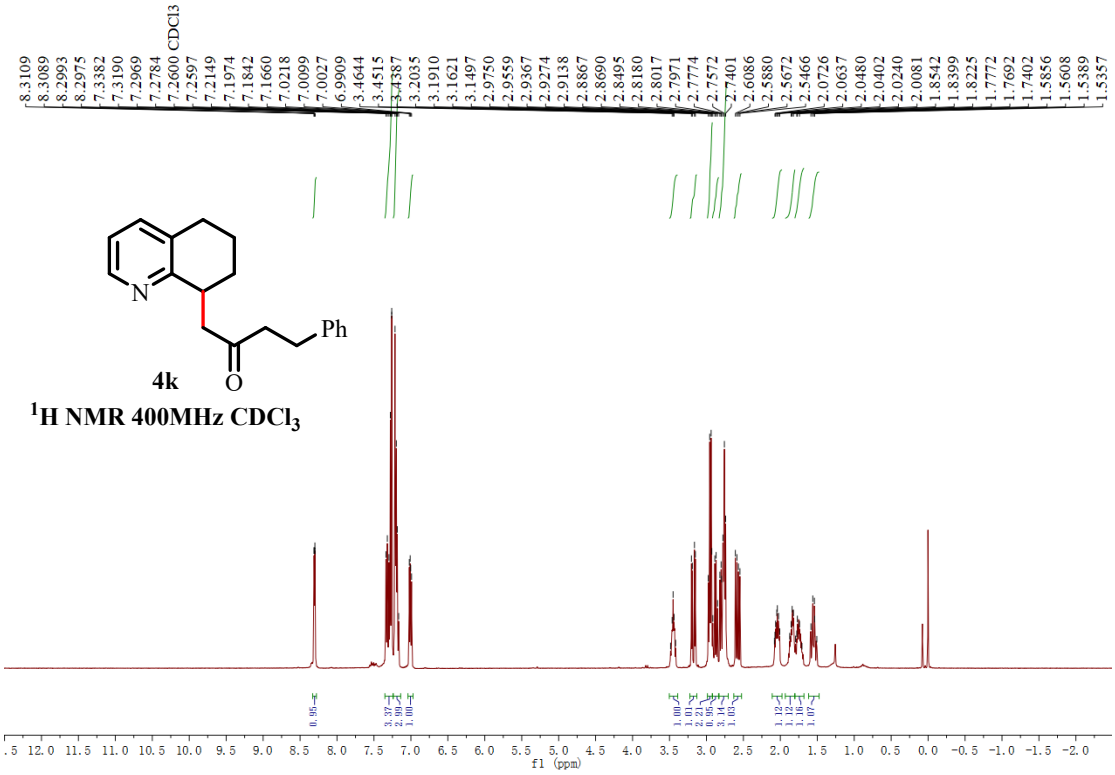
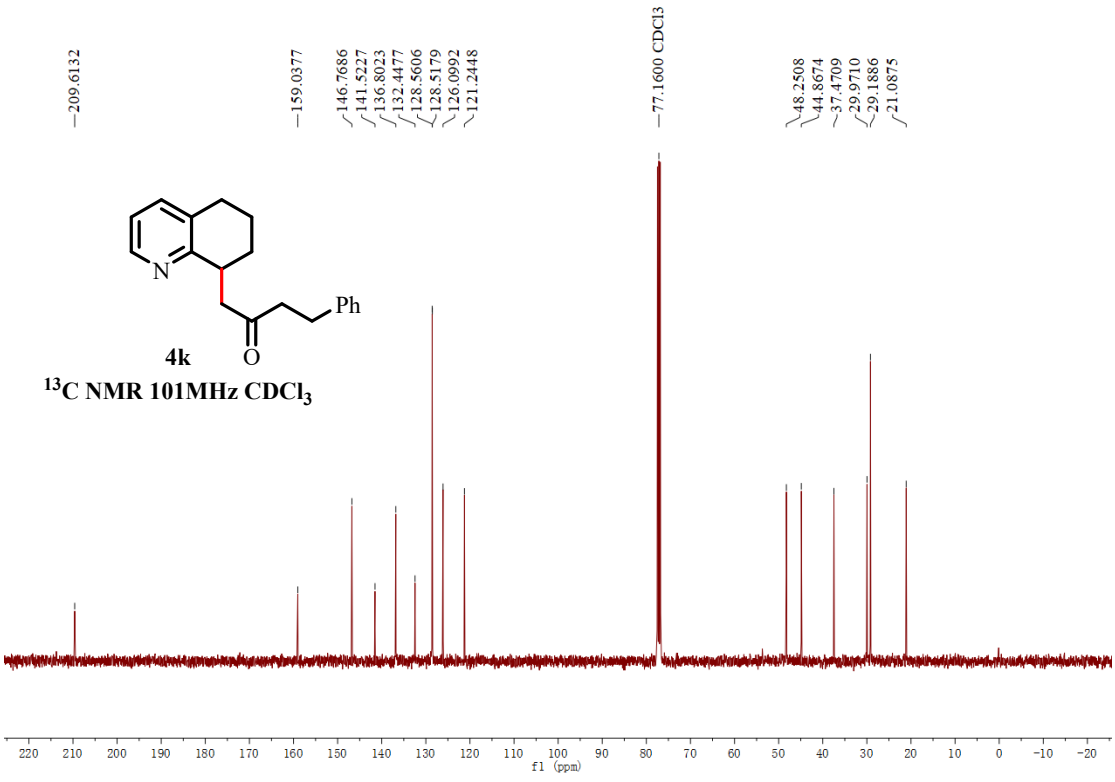
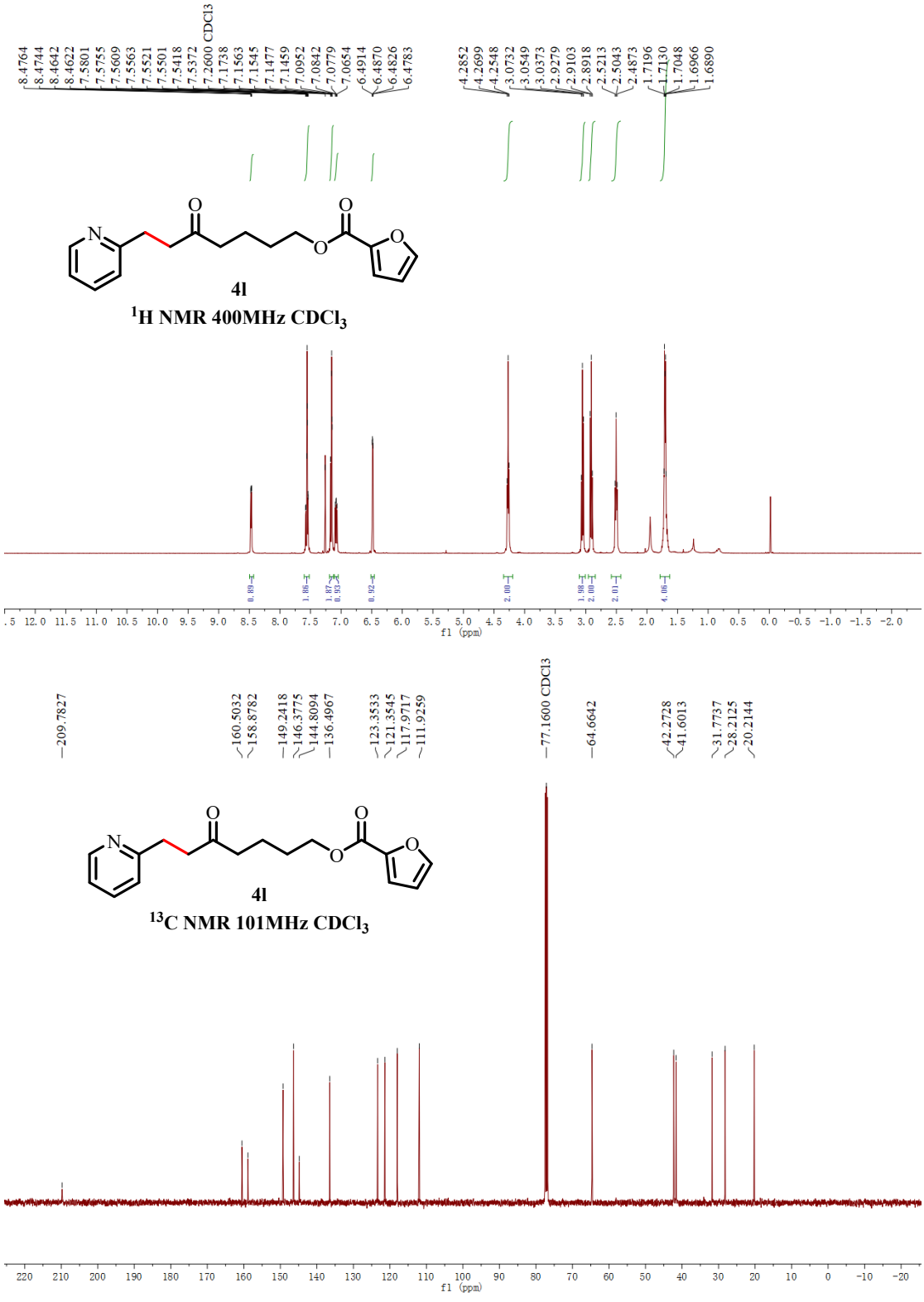


^{1}H NMR 400MHz $CDCl_3$



^{13}C NMR 101MHz $CDCl_3$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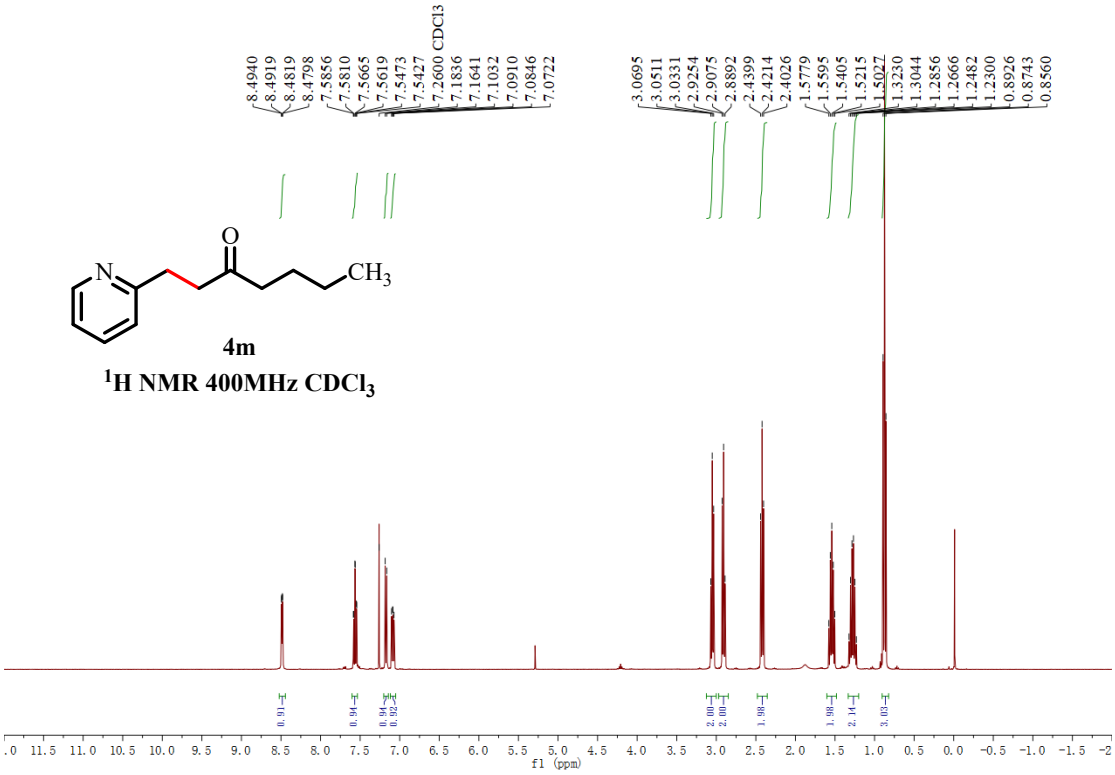
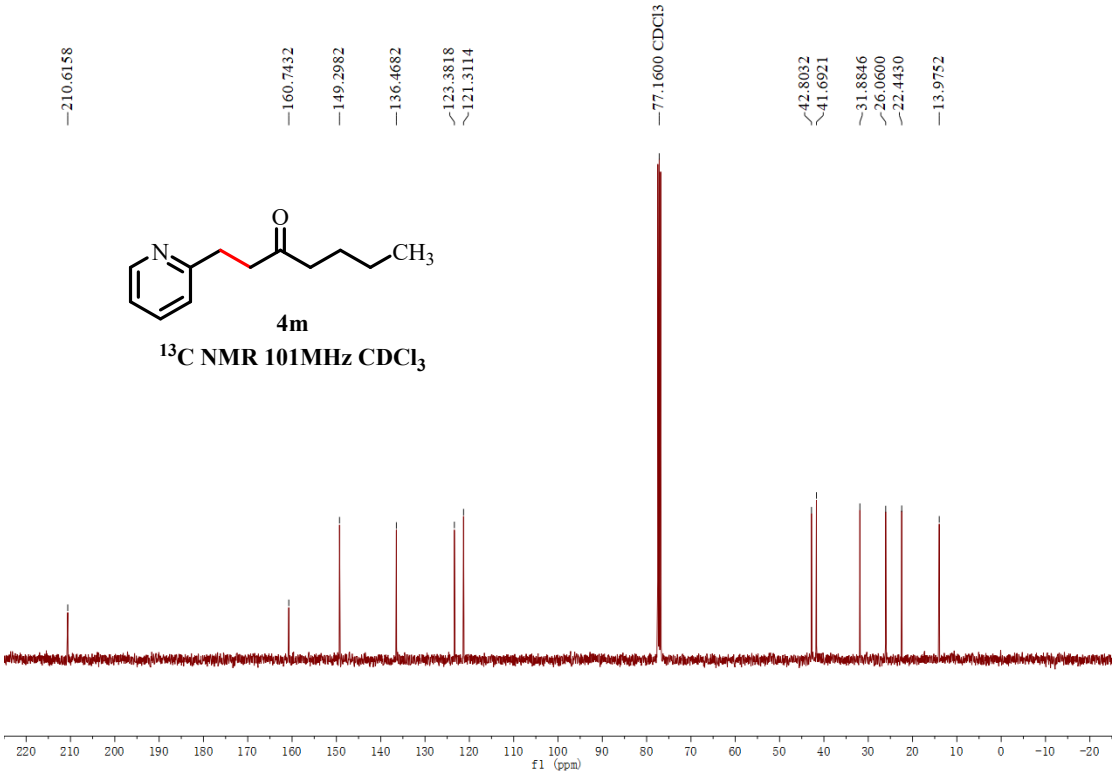
2.9279
2.9103
2.8918
2.5213
2.5043
2.4873
1.7196
1.7130
1.7048
1.6966
1.6890
N
O
O
O
O
4l
1H NMR 400MHz CDCl3
0.89
1.86
1.87
0.92
2.00
1.98
2.00
2.01
4.06
f1 (ppm)
209.7827
160.5032
158.8782
149.2418
146.3775
144.8094
136.4967
123.3533
121.3545
117.9717
111.9259
77.1600 CDCl3
64.6642
42.2728
41.6013
31.7737
28.2125
20.2144
N
O
O
O
O
4l
13C NMR 101MHz CDCl3
f1 (ppm)



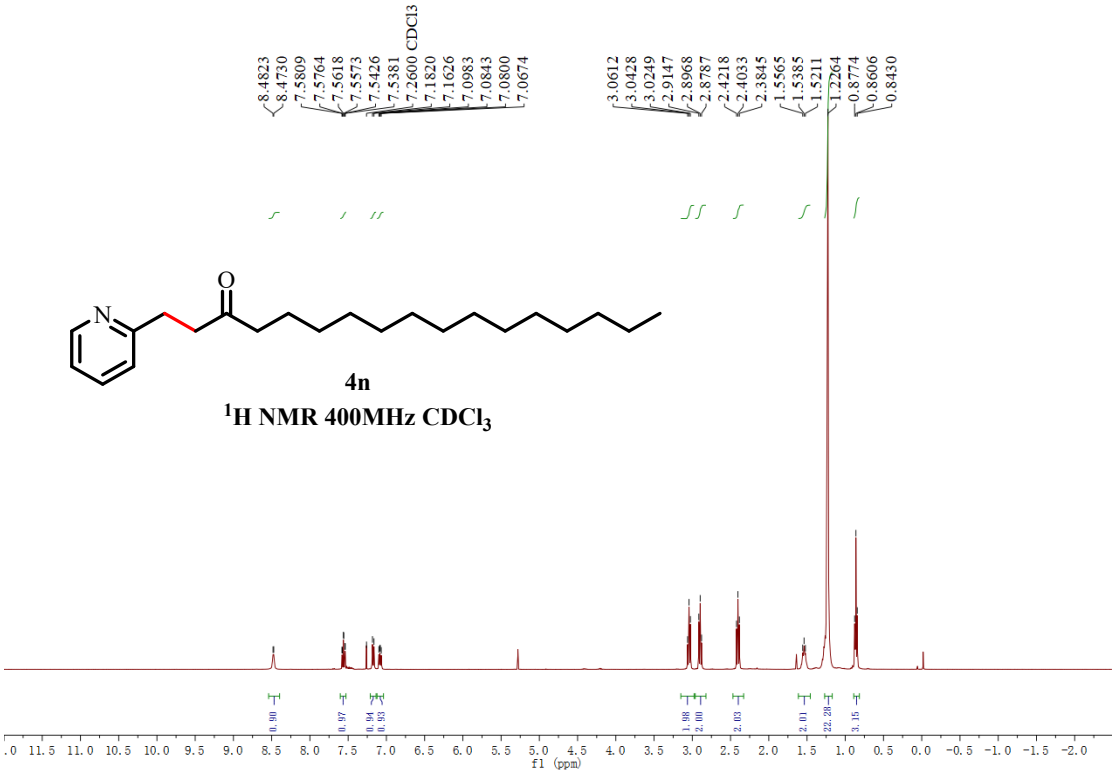
4m

^{1}H NMR 400MHz $CDCl_3$



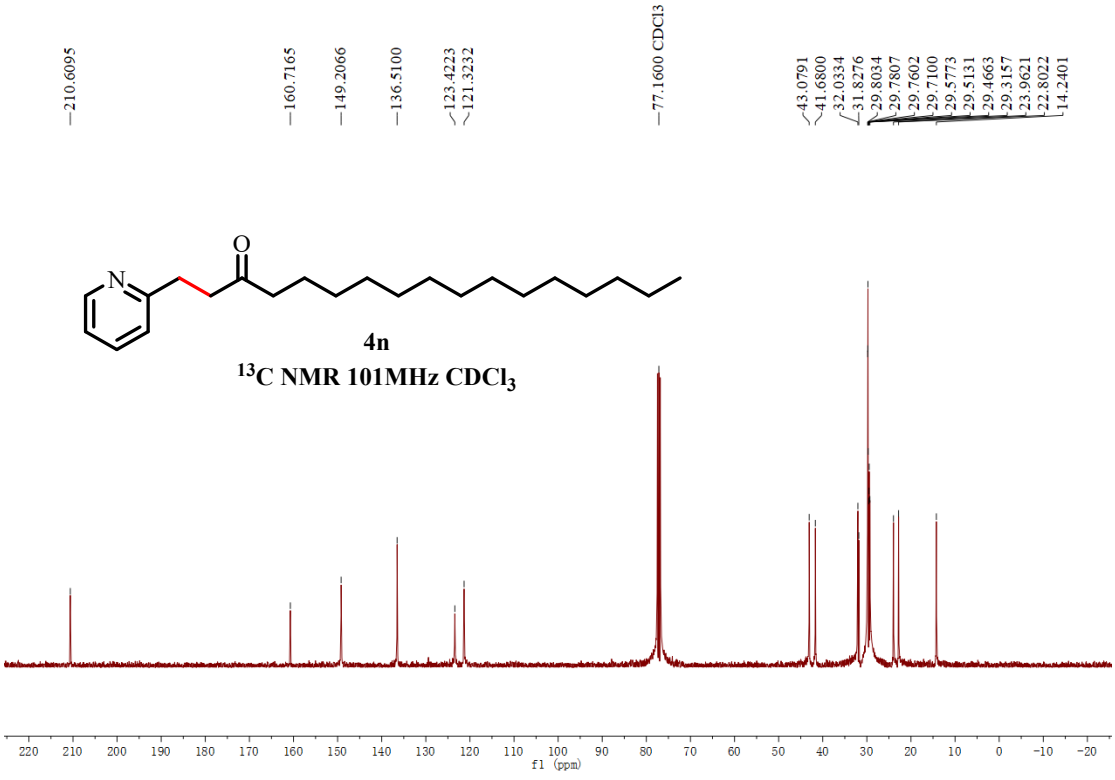
4m

^{13}C NMR 101MHz $CDCl_3$



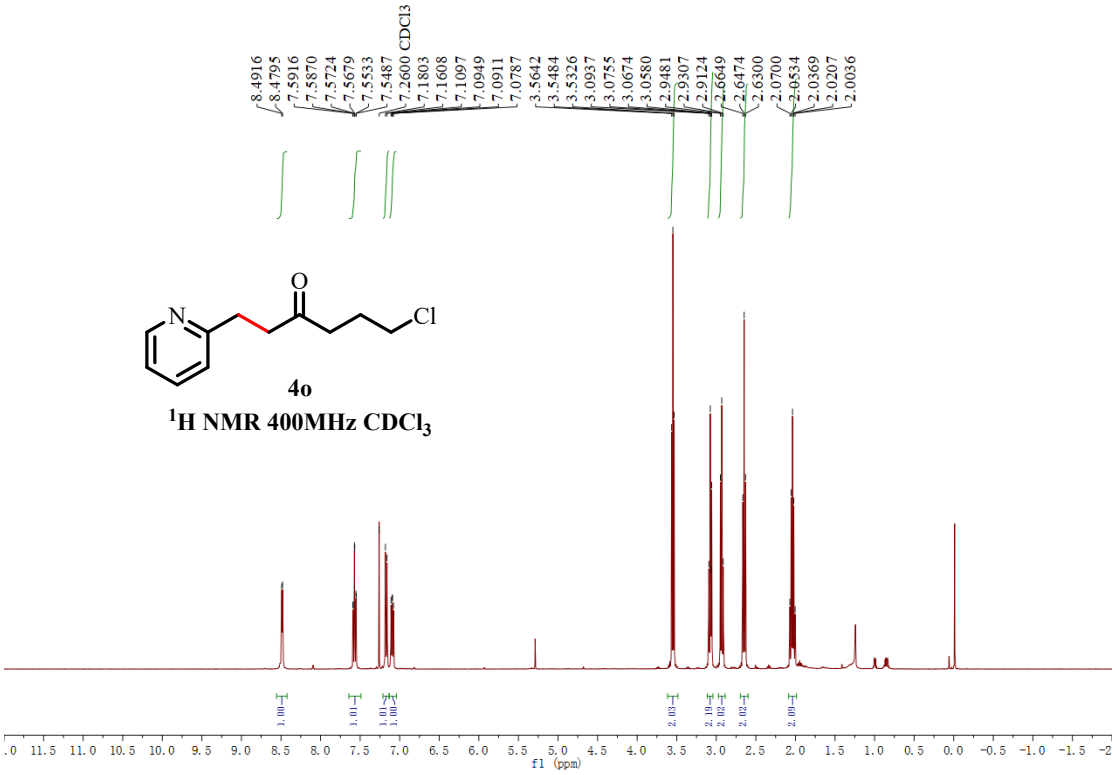
4n

^{1}H NMR 400MHz $CDCl_3$



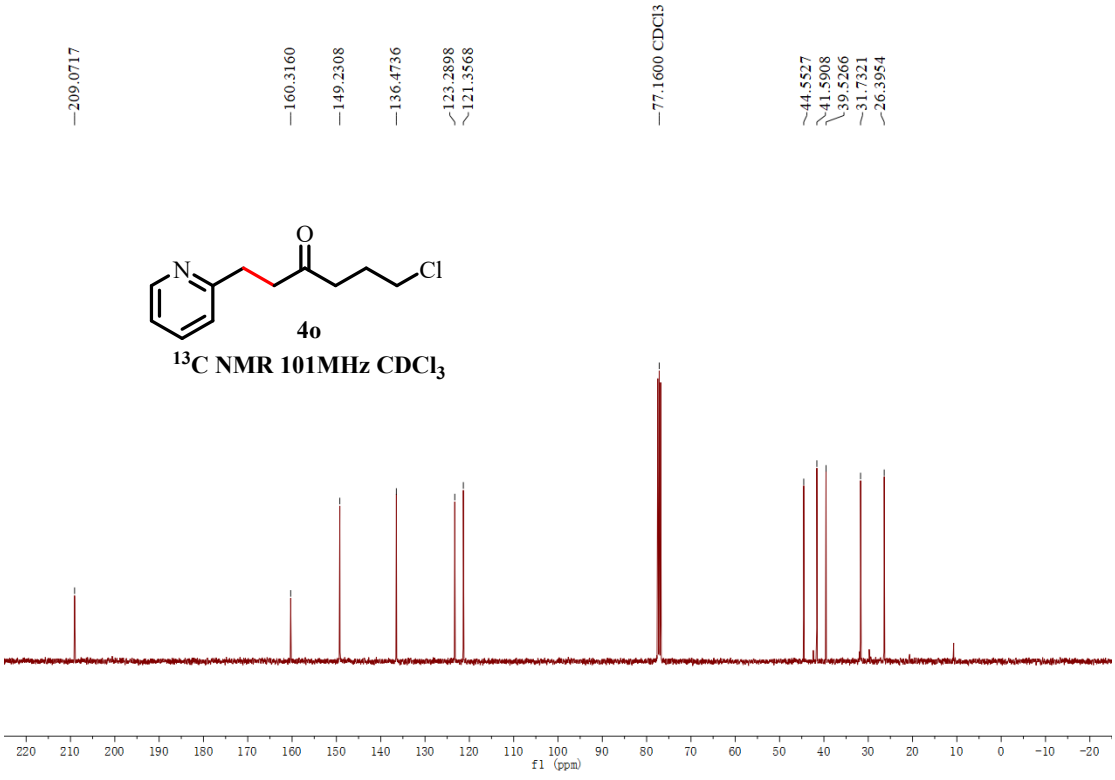
4n

^{13}C NMR 101MHz $CDCl_3$



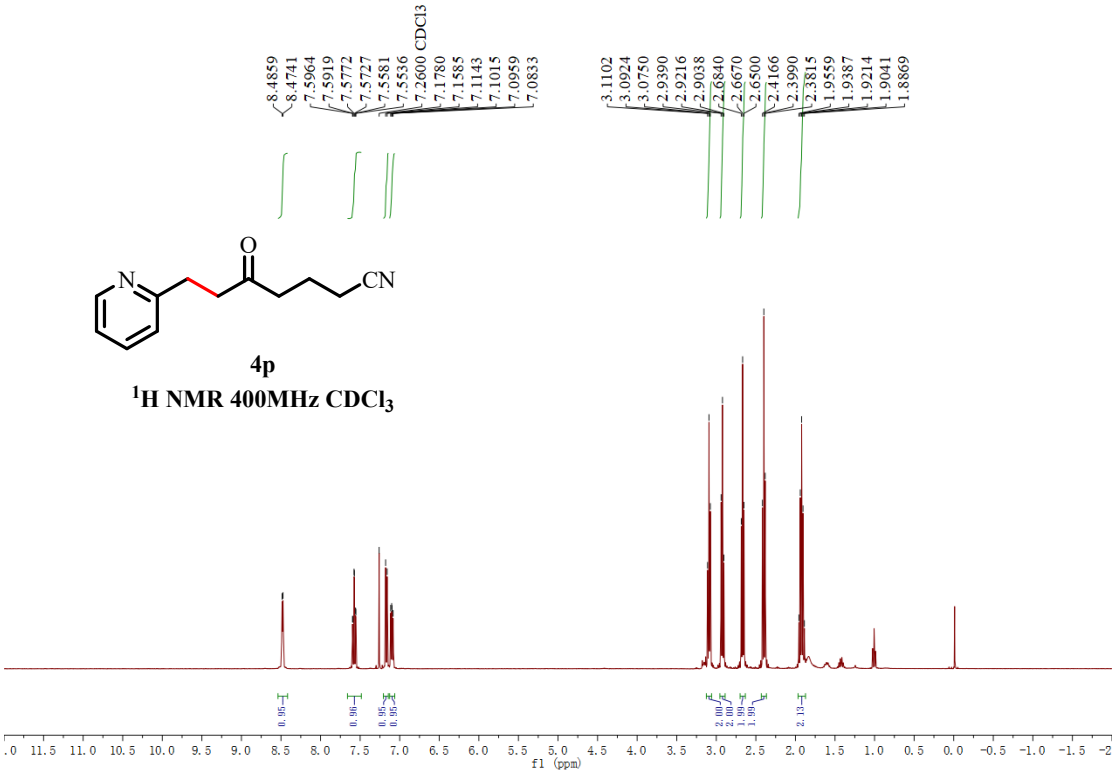
4o

^{1}H NMR 400MHz $CDCl_3$



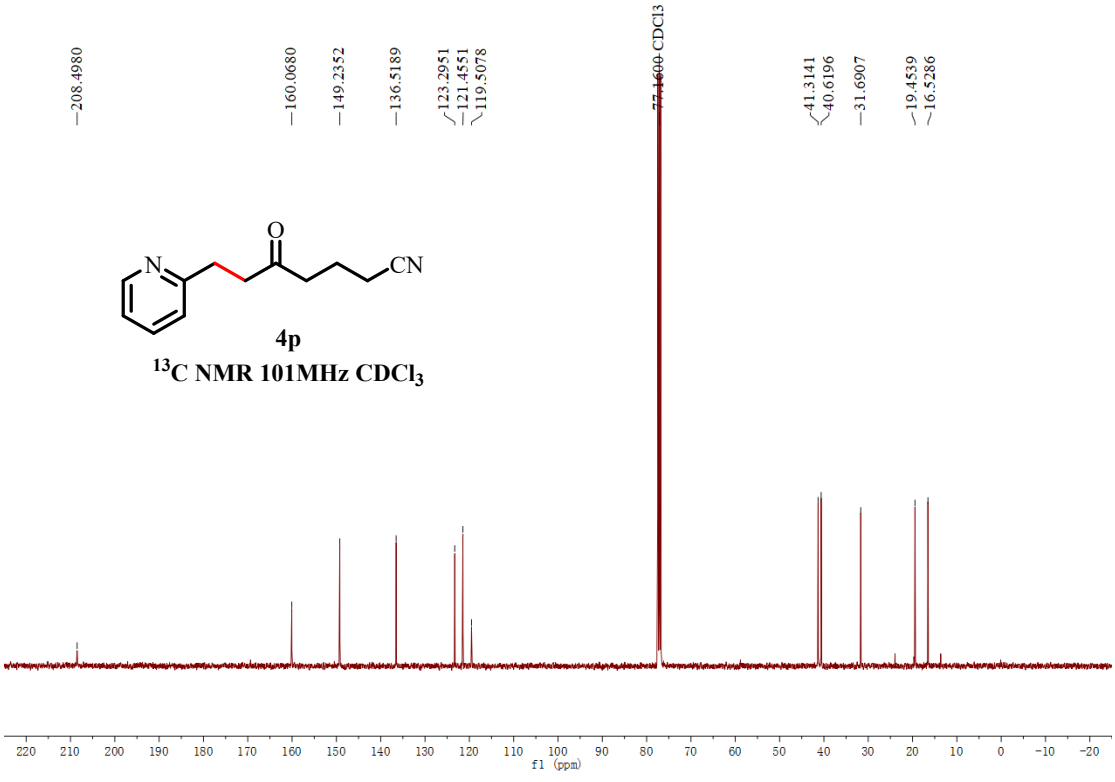
4o

^{13}C NMR 101MHz $CDCl_3$



4p

^{1}H NMR 400MHz $CDCl_3$



4p

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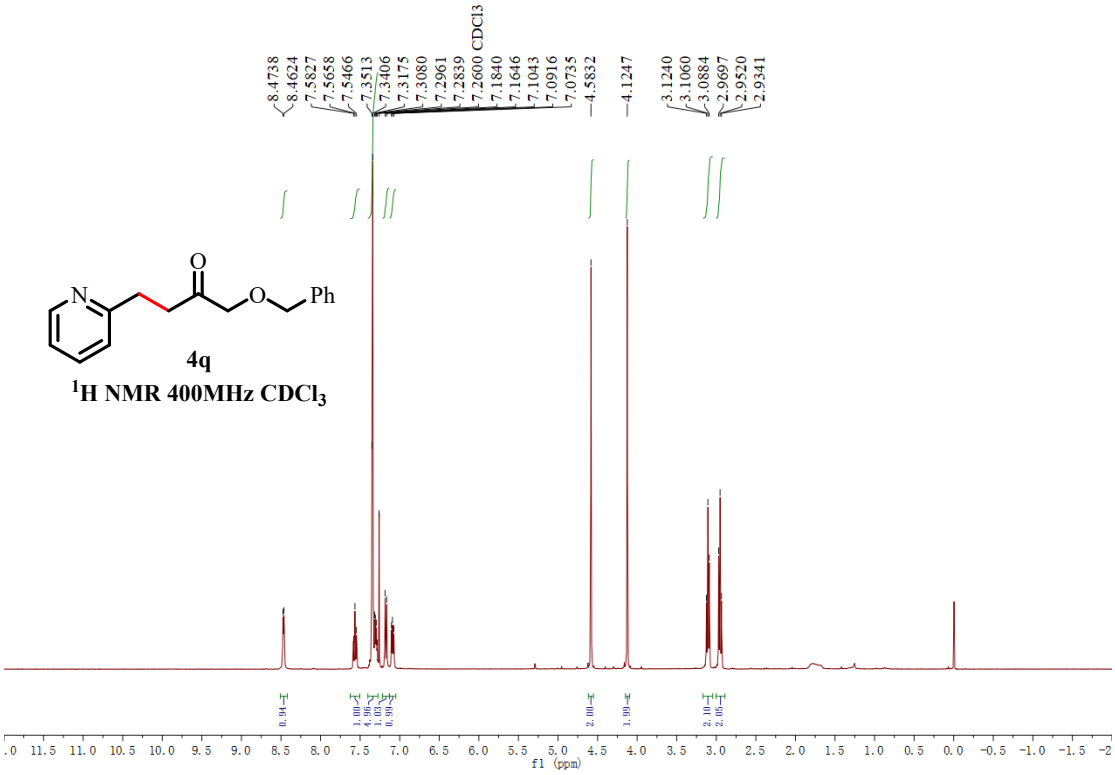
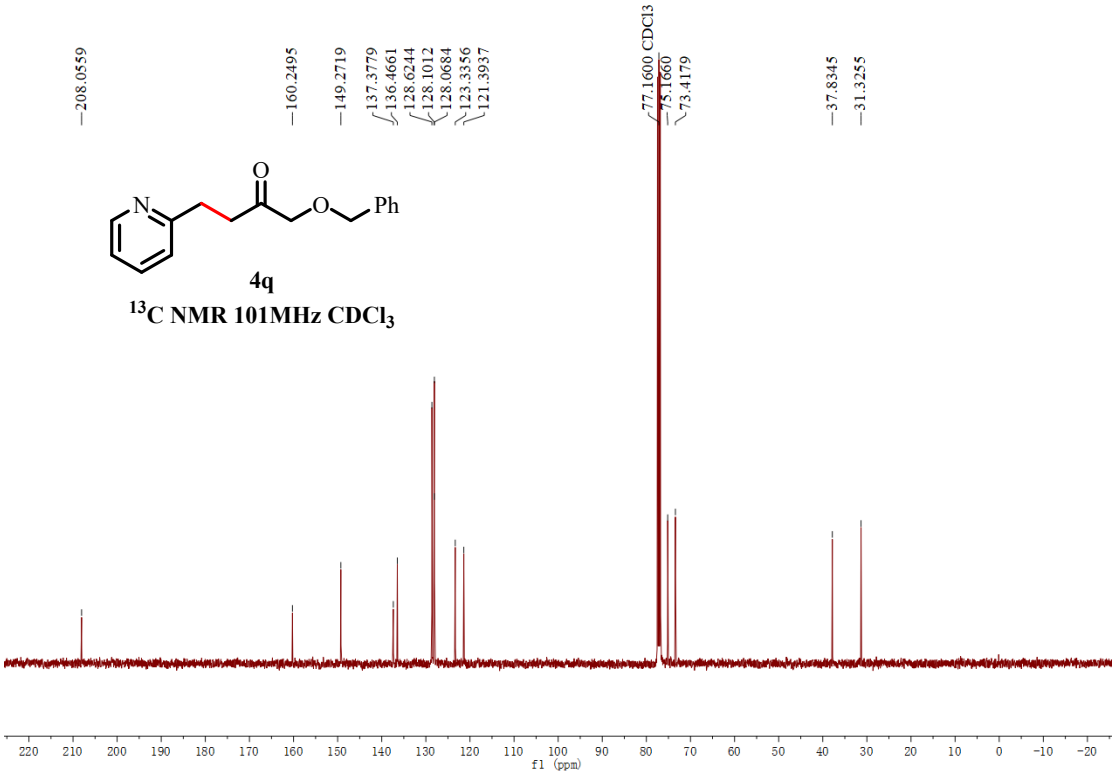


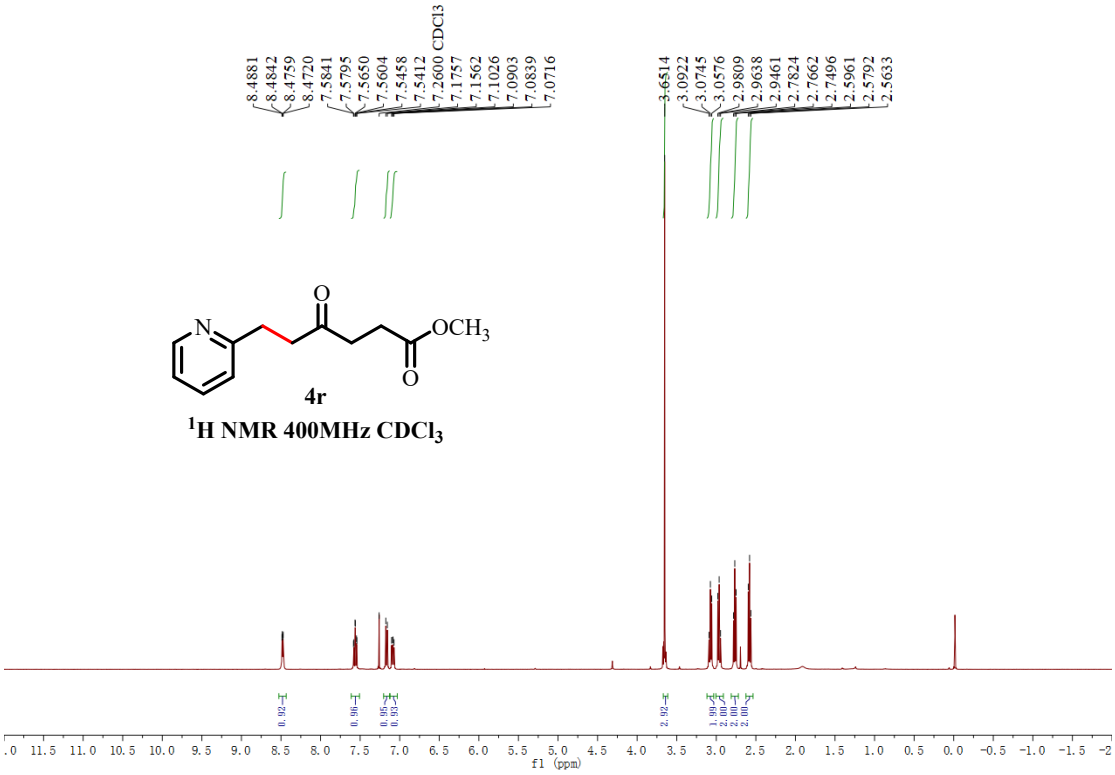
4q

^{1}H NMR 400MHz $CDCl_3$



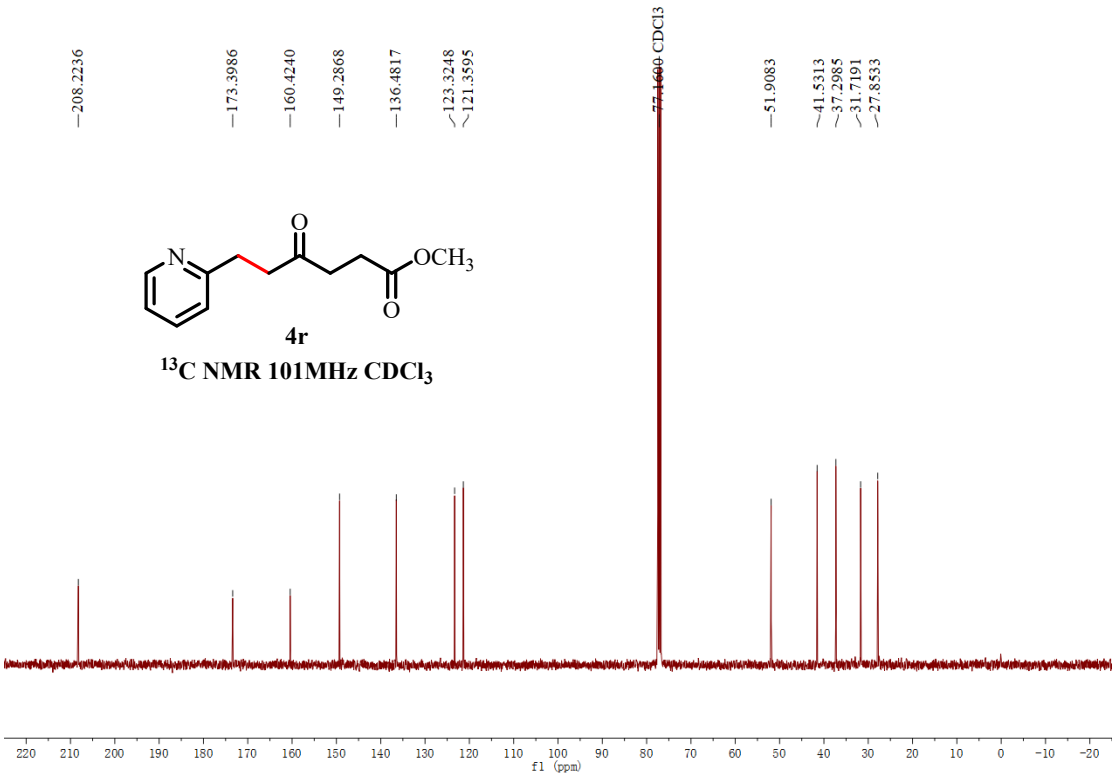
4q

^{13}C NMR 101MHz $CDCl_3$



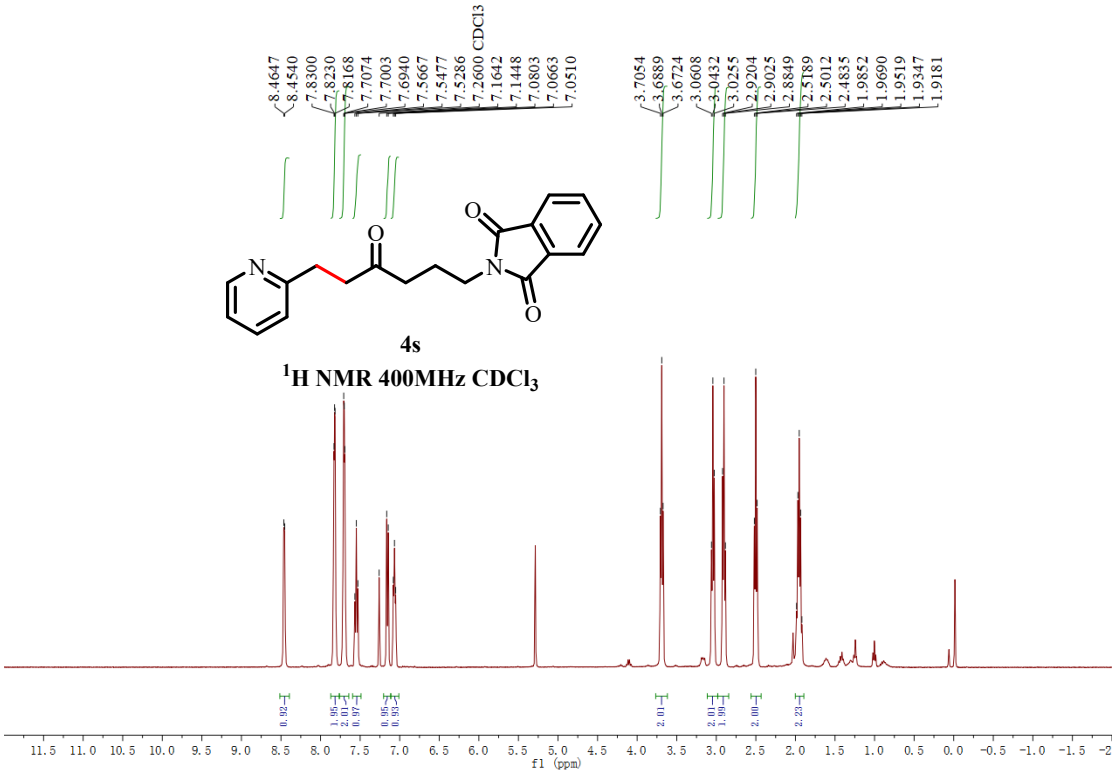
4r

^{1}H NMR 400MHz $CDCl_3$



4r

^{13}C NMR 101MHz $CDCl_3$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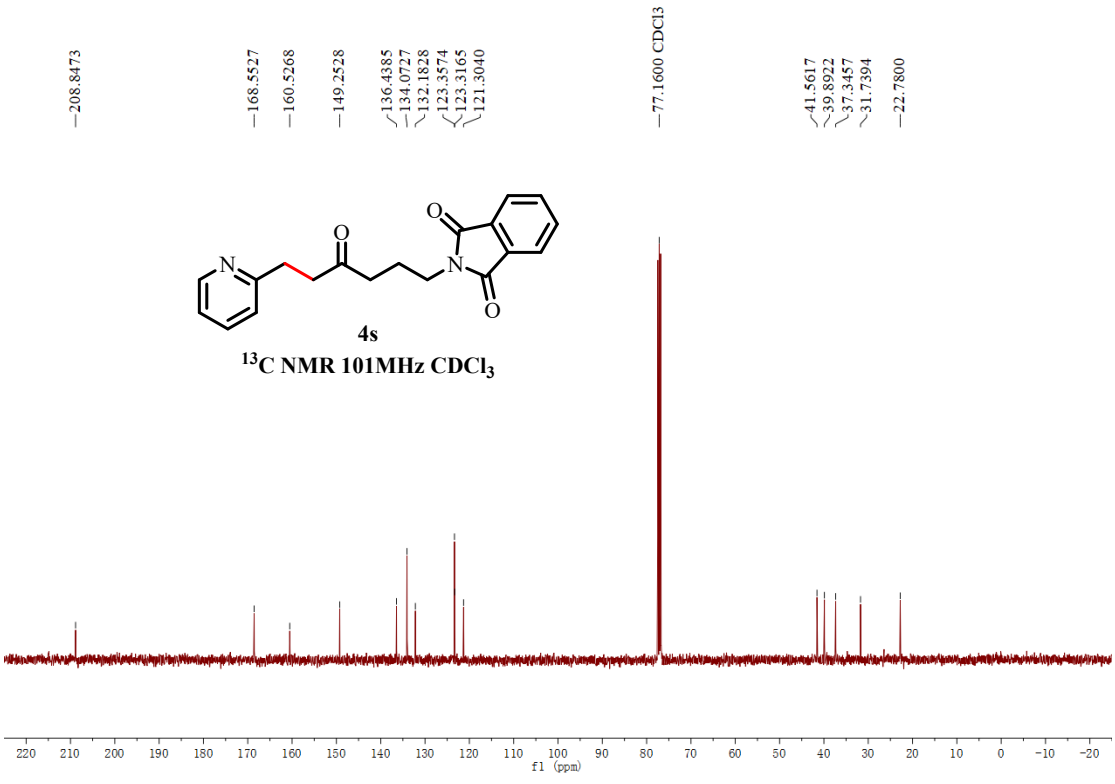
7.8230
7.8168
7.7074
7.7003
7.6940
7.5667
7.5477
7.5286
7.2600 CDCl3
7.1642
7.1448
7.0803
7.0663
7.0510
3.7054
3.6889
3.6724
3.0608
3.0432
3.0255
2.9204
2.9025
2.8849
2.5189
2.5012
2.4835
1.9852
1.9690
1.9519
1.9347
1.9181
O
O
N
O
N
O
4s
1H NMR 400MHz CDCl3
0.92
1.95
2.01
0.97
0.95
0.93
2.01
2.01
1.99
2.00
2.23
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5 -2
f1 (ppm)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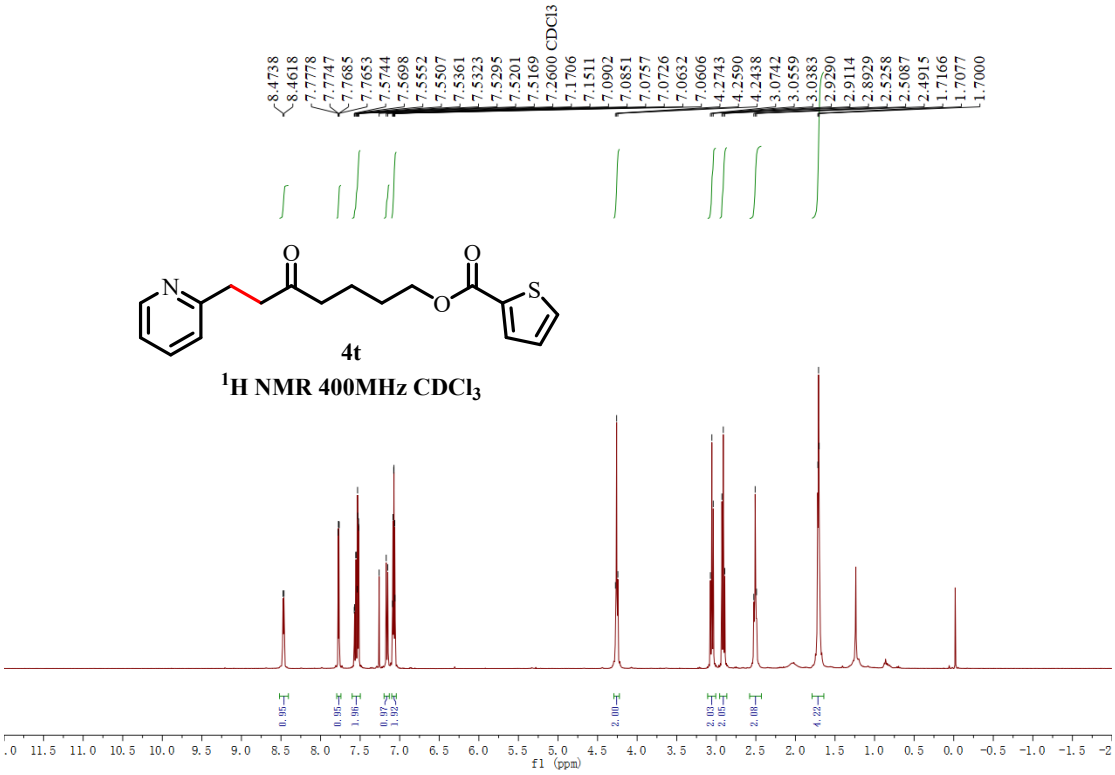
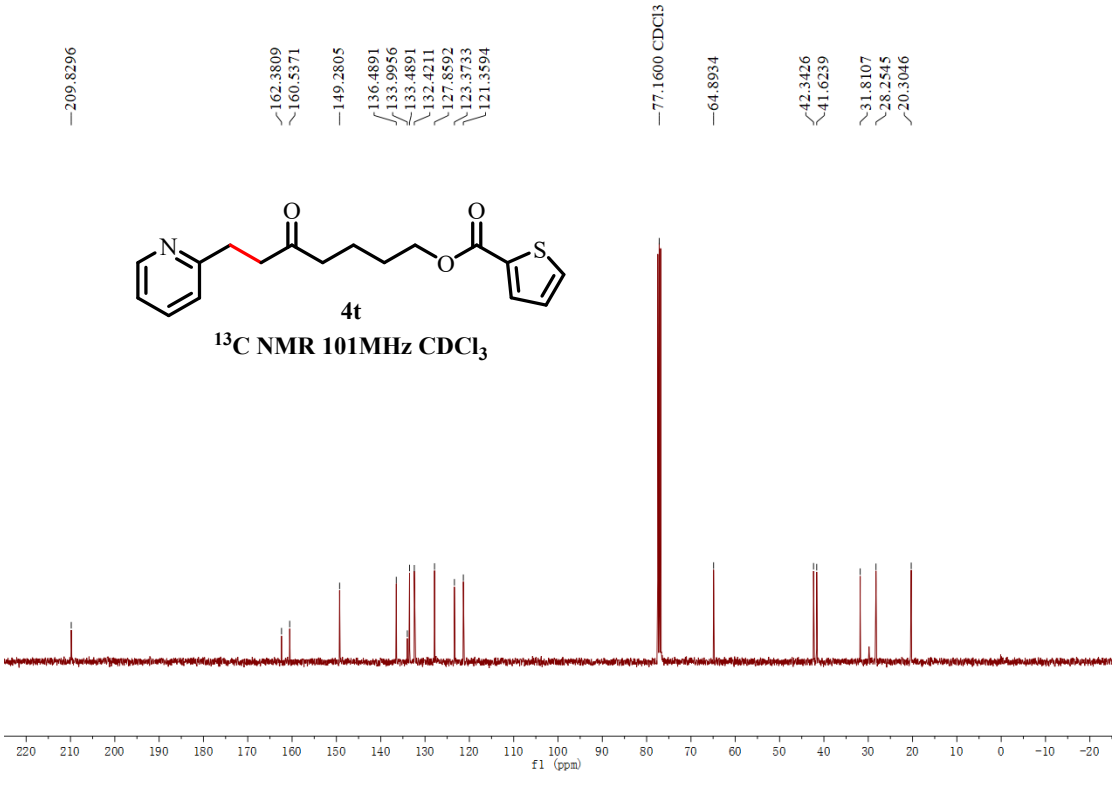
168.5527
160.5268
149.2528
136.4385
134.0727
132.1828
123.3574
123.3165
121.3040
77.1600 CDCl3
41.5617
39.8922
37.3457
31.7394
22.7800
O
O
N
O
4s
13C NMR 101MHz CDCl3
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)



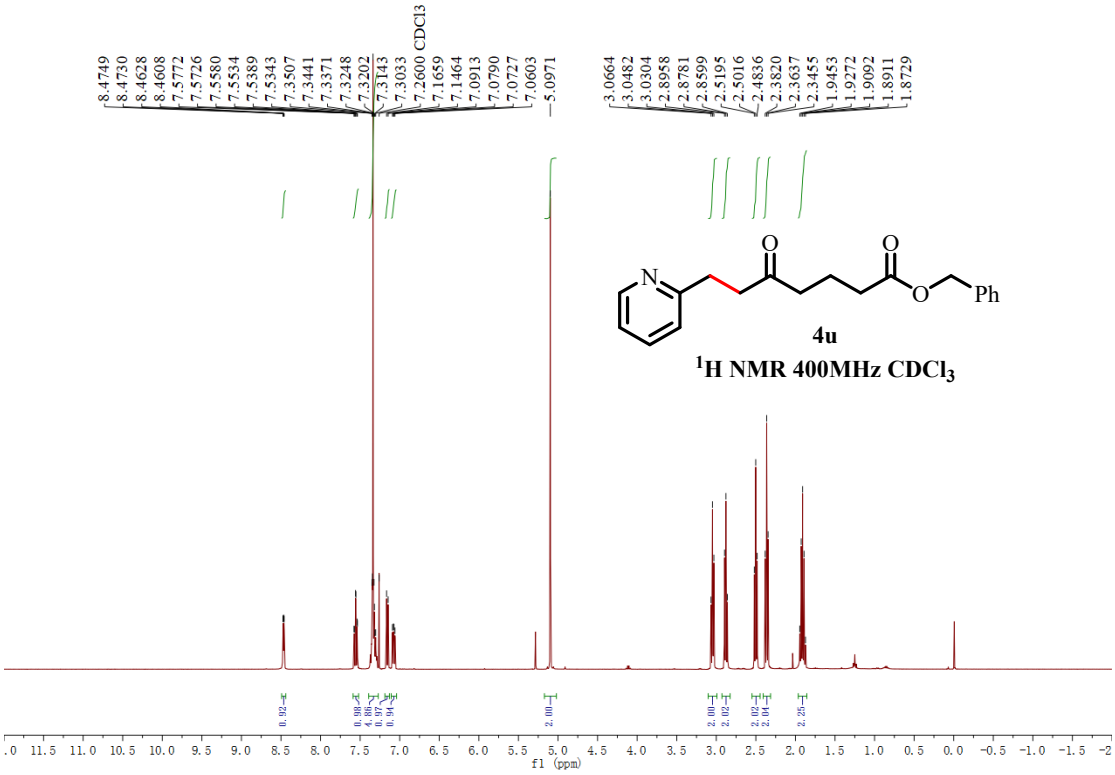
4t

^{1}H NMR 400MHz $CDCl_3$



4t

^{13}C NMR 101MHz $CDCl_3$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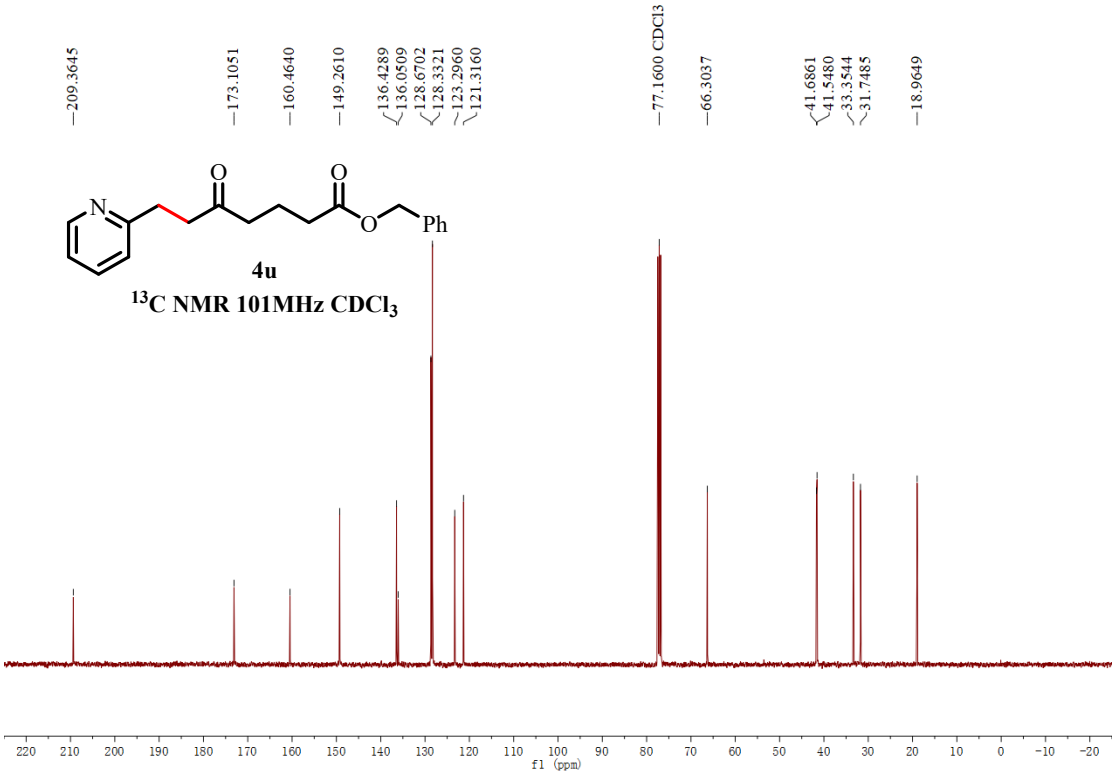
8.4628
8.4608
7.5772
7.5726
7.5580
7.5534
7.5389
7.5343
7.3507
7.3441
7.3371
7.3248
7.3202
7.3143
7.3033
7.2600 CDCl3
7.1659
7.1464
7.0913
7.0790
7.0727
7.0603
5.0971
3.0664
3.0482
3.0304
2.8958
2.8781
2.8599
2.5195
2.5016
2.4836
2.3820
2.3637
2.3455
1.9453
1.9272
1.9092
1.8911
1.8729
N
O
O
O
Ph
4u
1H NMR 400MHz CDCl3
f1 (ppm)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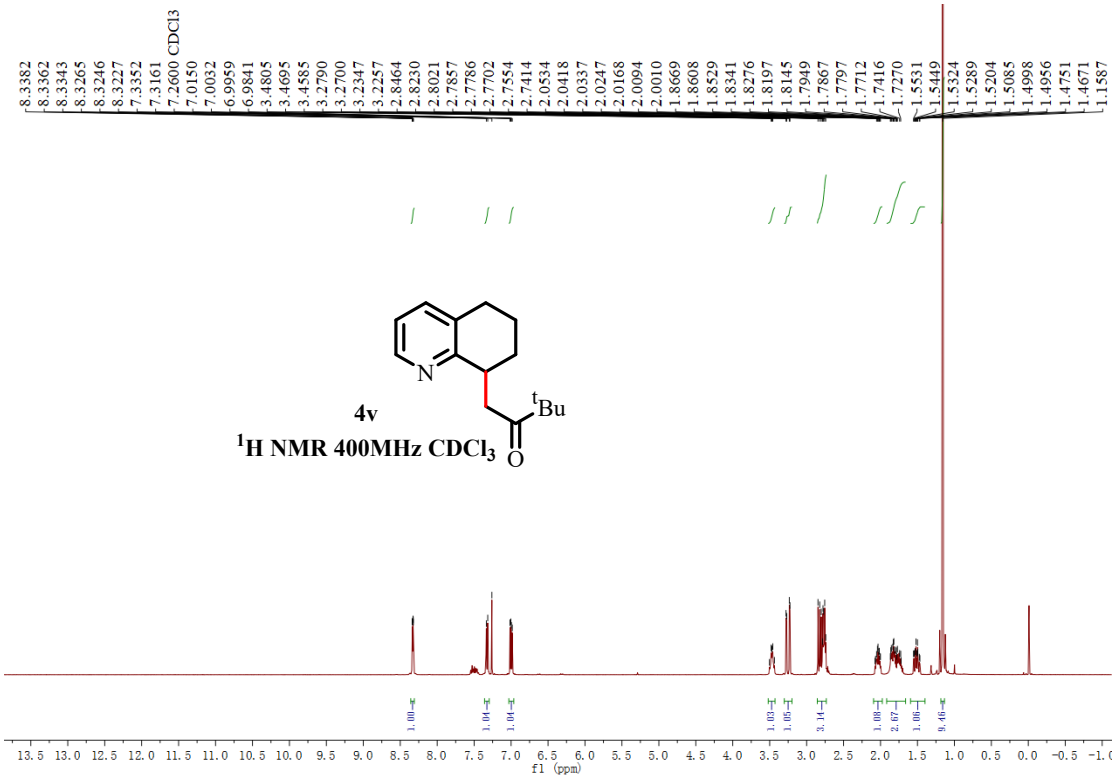
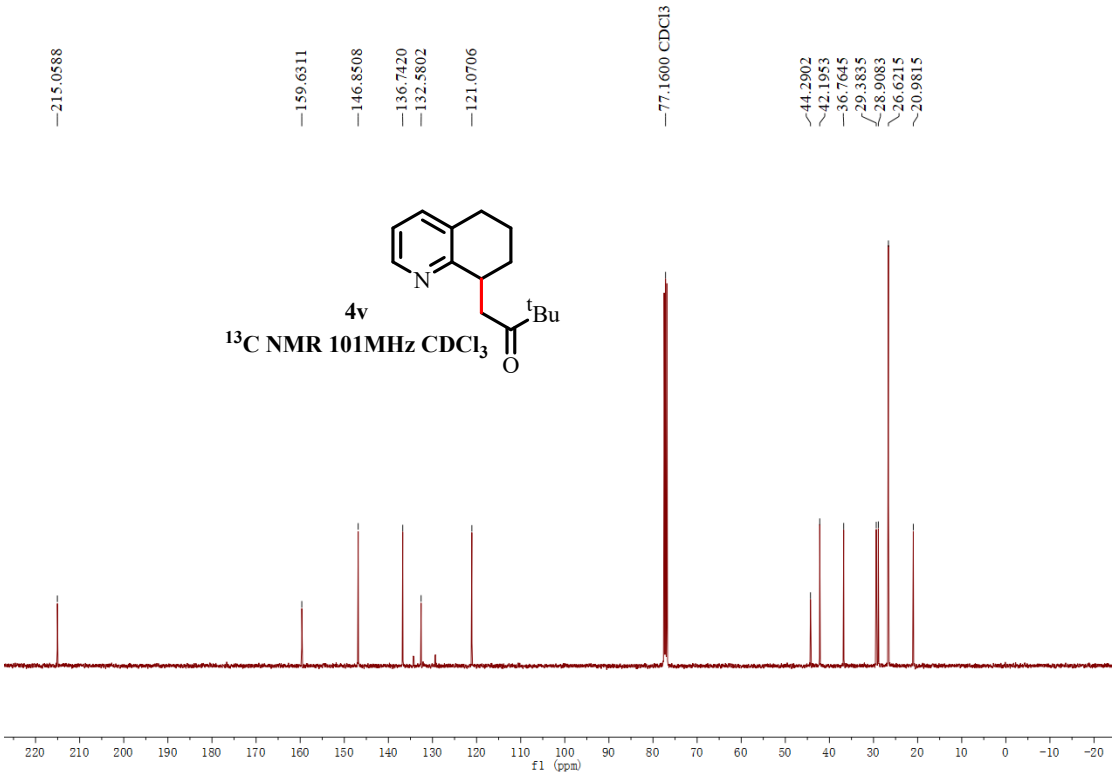
149.2610
136.4289
136.0509
128.6702
128.3321
123.2960
121.3160
77.1600 CDCl3
66.3037
41.6861
41.5480
33.3544
31.7485
18.9649
N
O
O
O
Ph
4u
13C NMR 101MHz CDCl3
f1 (ppm)


8.3382
8.3362
8.3343
8.3265
8.3246
8.3227
7.3352
7.3161
7.2600 CDCl3
7.0150
7.0032
6.9959
6.9841
3.4805
3.4695
3.4585
3.2790
3.2700
3.2347
3.2257
2.8464
2.8230
2.8021
2.7857
2.7786
2.7702
2.7554
2.7414
2.0534
2.0418
2.0337
2.0247
2.0168
2.0094
2.0010
1.8669
1.8608
1.8529
1.8341
1.8276
1.8197
1.8145
1.7949
1.7867
1.7797
1.7712
1.7416
1.7270
1.5531
1.5449
1.5324
1.5289
1.5204
1.5085
1.4998
1.4956
1.4751
1.4671
1.1587
N
tBu
O
4v
1H NMR 400MHz CDCl3
1.00
1.04
1.04
1.03
1.05
3.14
1.08
2.67
1.00
9.46
f1 (ppm)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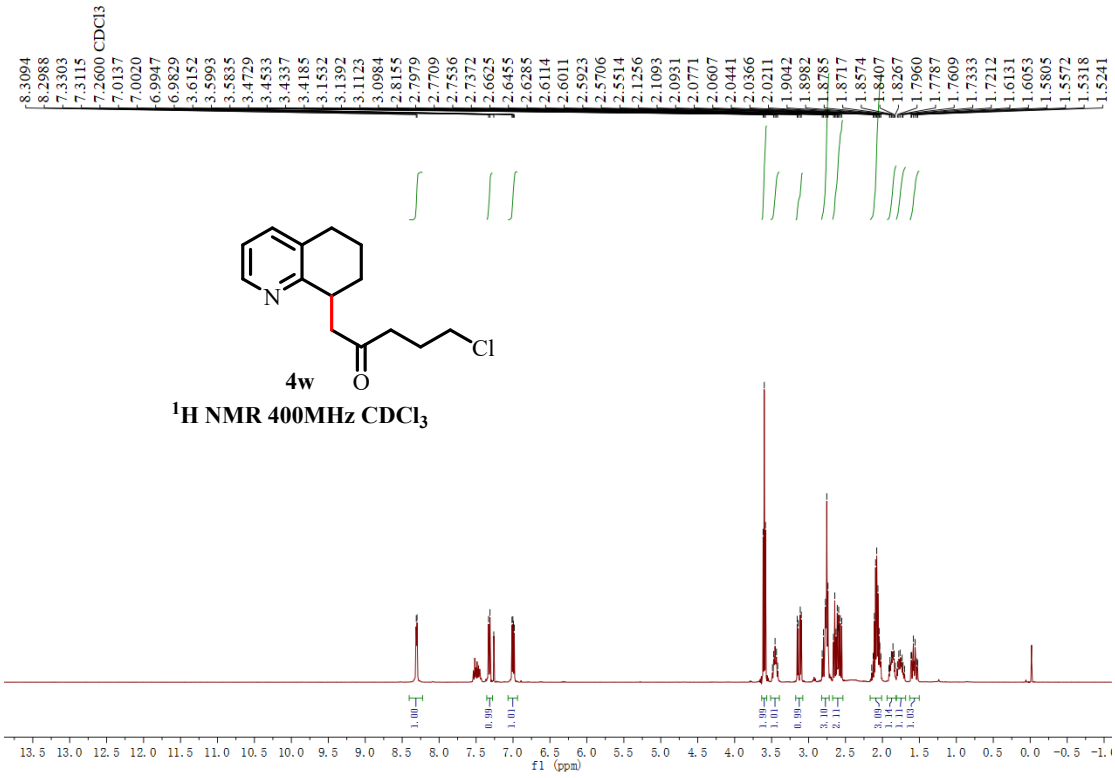
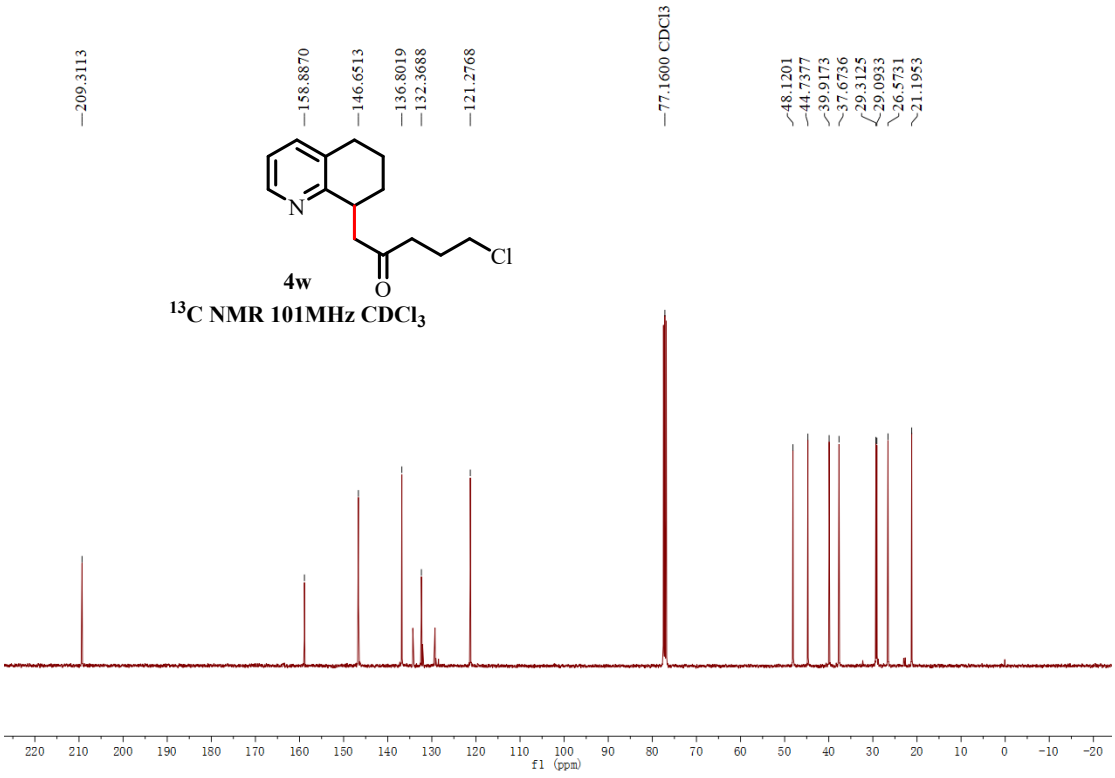
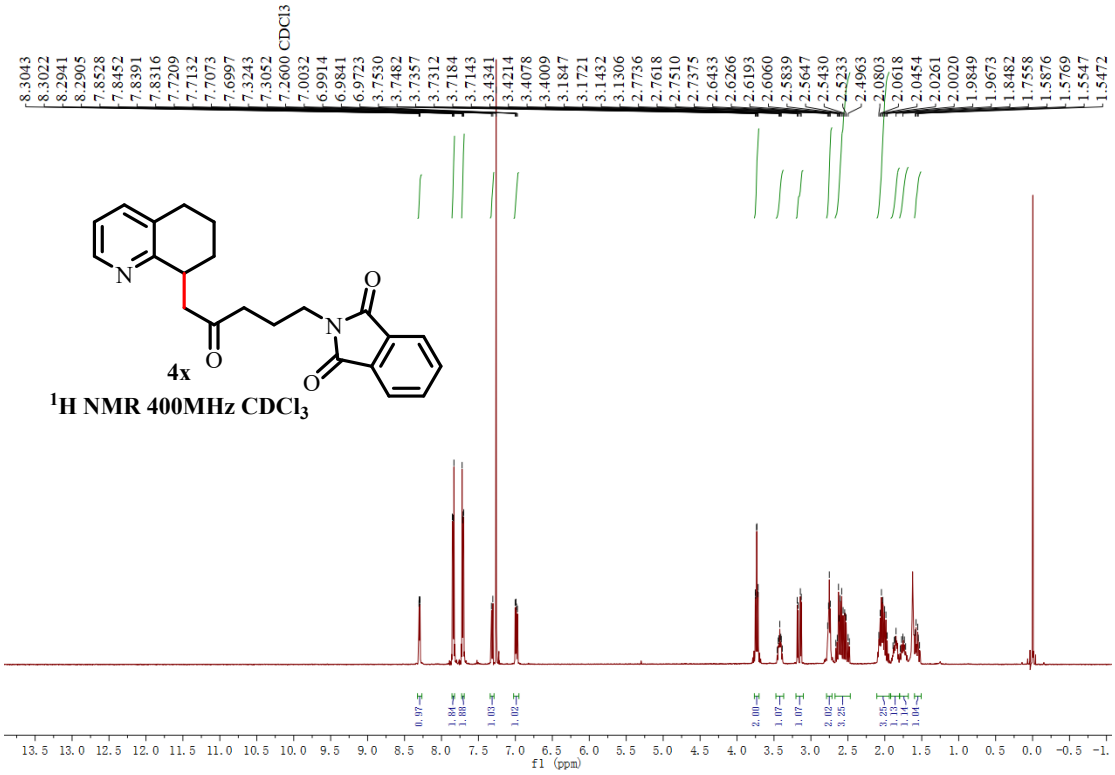
136.7420
132.5802
121.0706
77.1600 CDCl3
44.2902
42.1953
36.7645
29.3835
28.9083
26.6215
20.9815
N
tBu
O
4v
13C NMR 101MHz CDCl3
f1 (ppm)



^{1}H NMR 400MHz $CDCl_3$

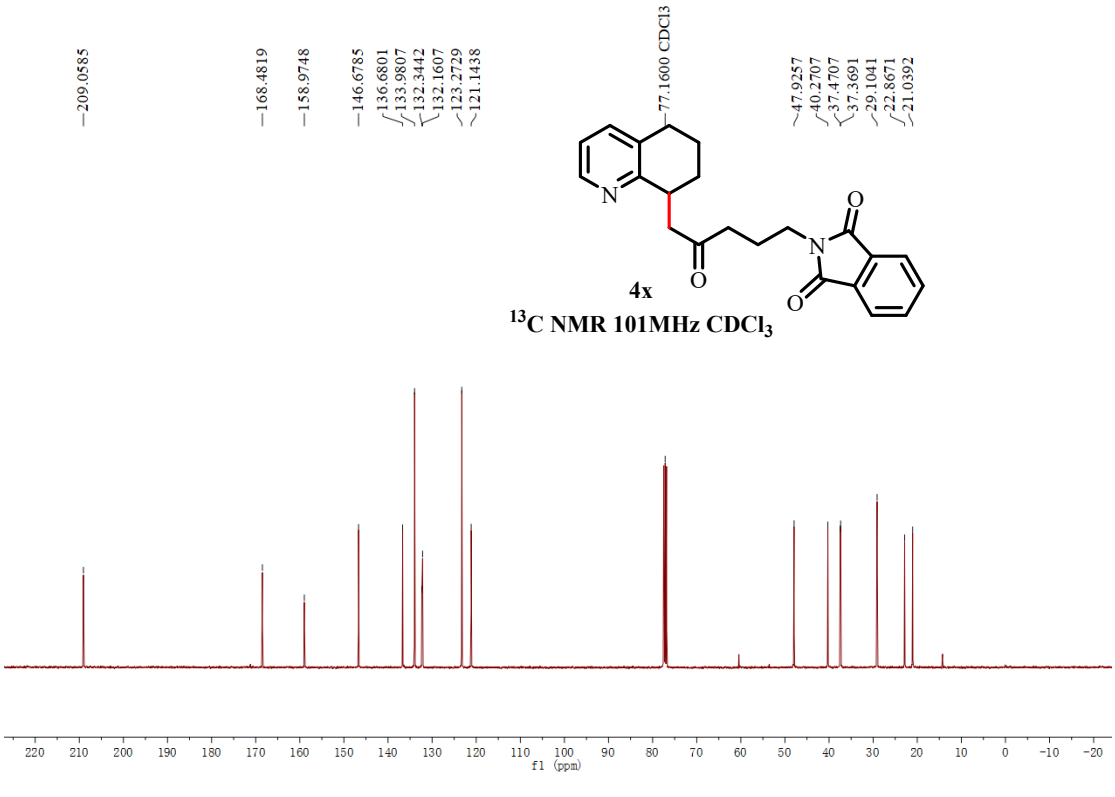


^{13}C NMR 101MHz $CDCl_3$



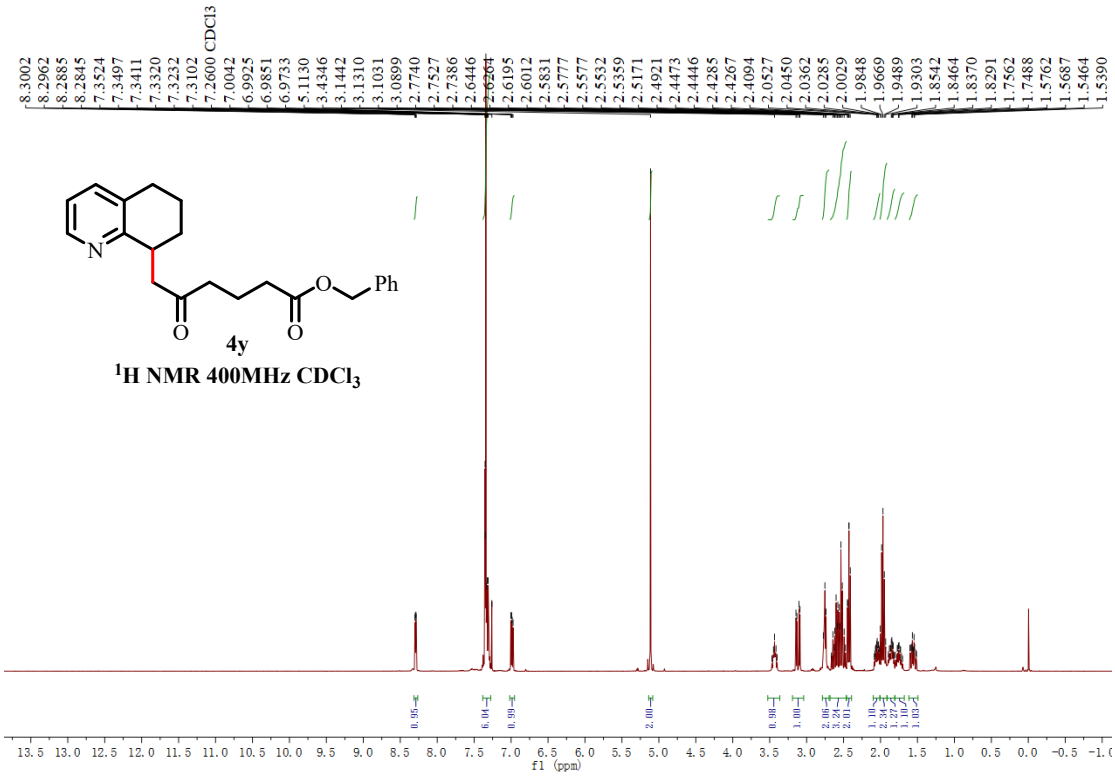
4x

^{1}H NMR 400MHz $CDCl_3$

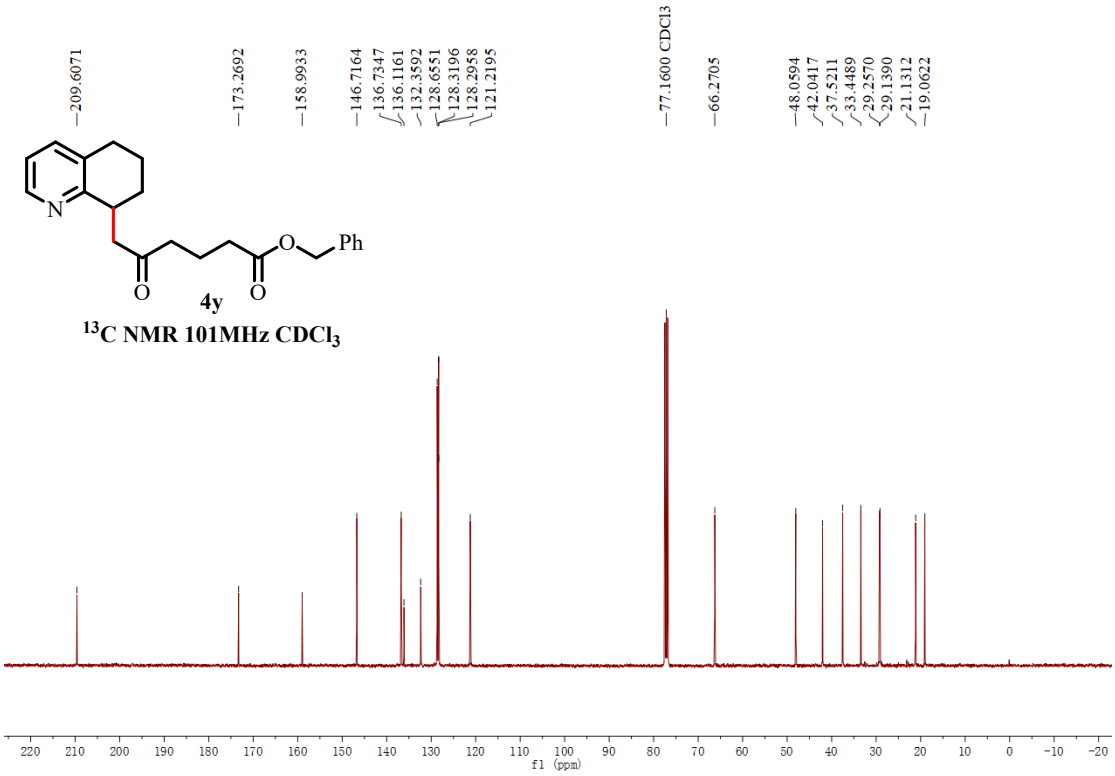


4x

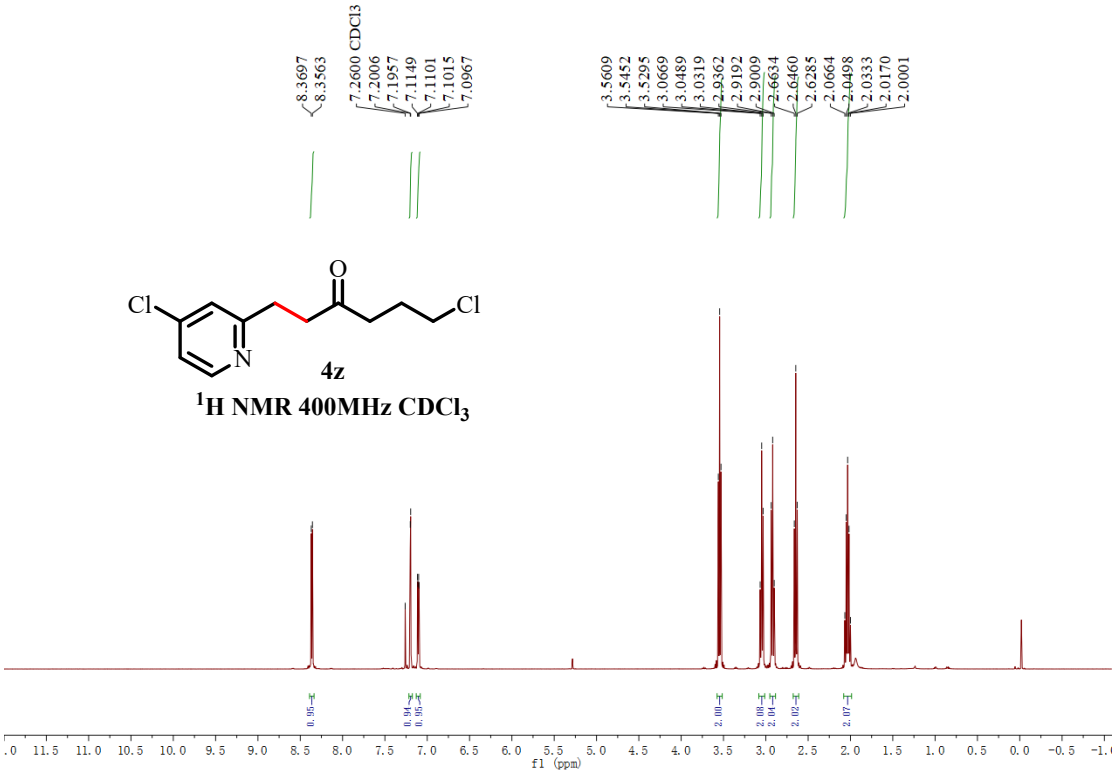
^{13}C NMR 101MHz $CDCl_3$



^{1}H NMR 400MHz $CDCl_3$

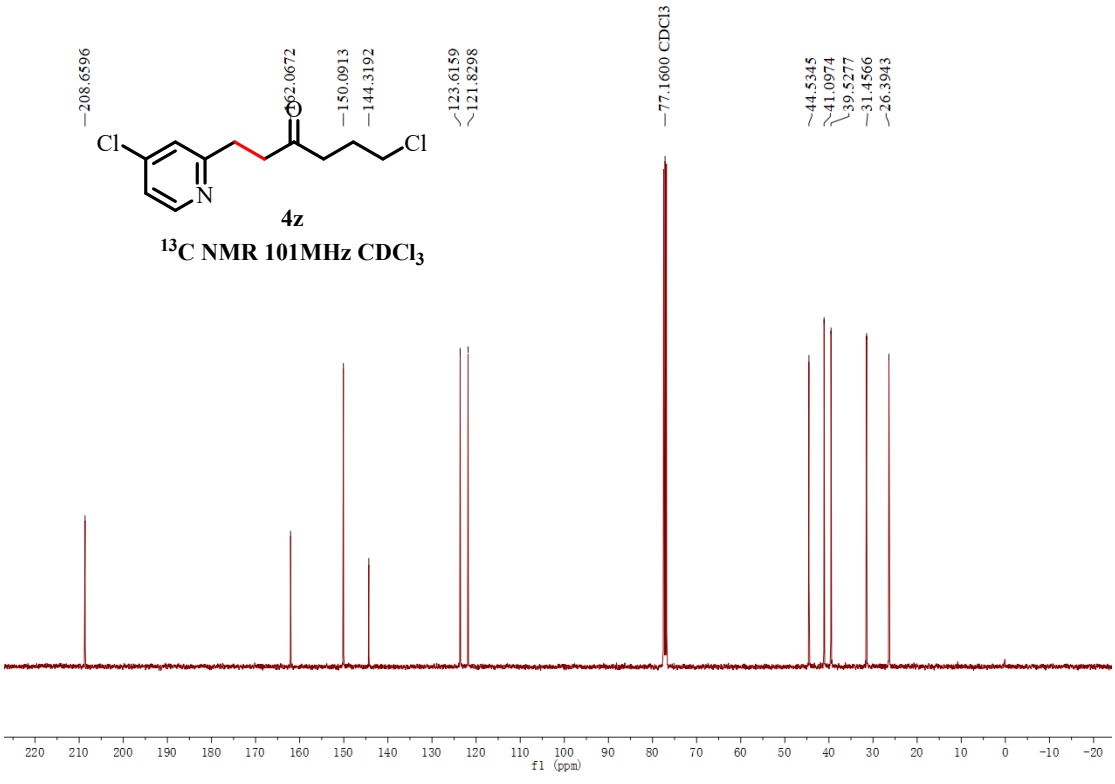


^{13}C NMR 101MHz $CDCl_3$



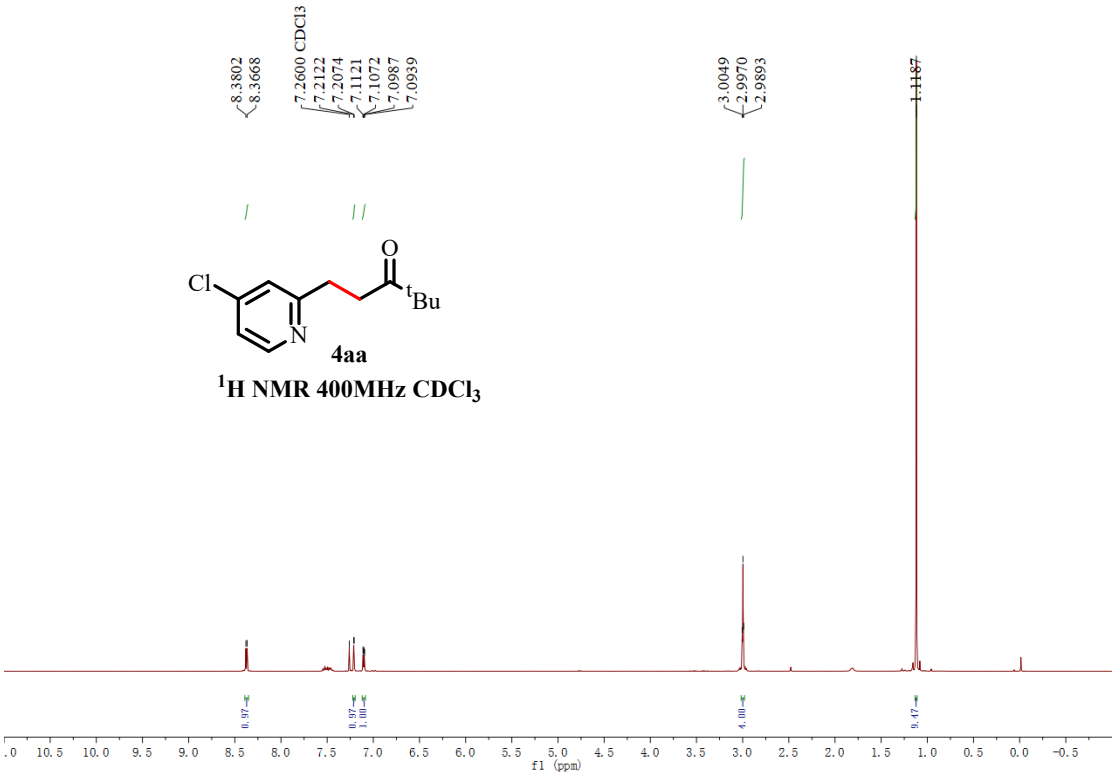
4z

^{1}H NMR 400MHz $CDCl_3$



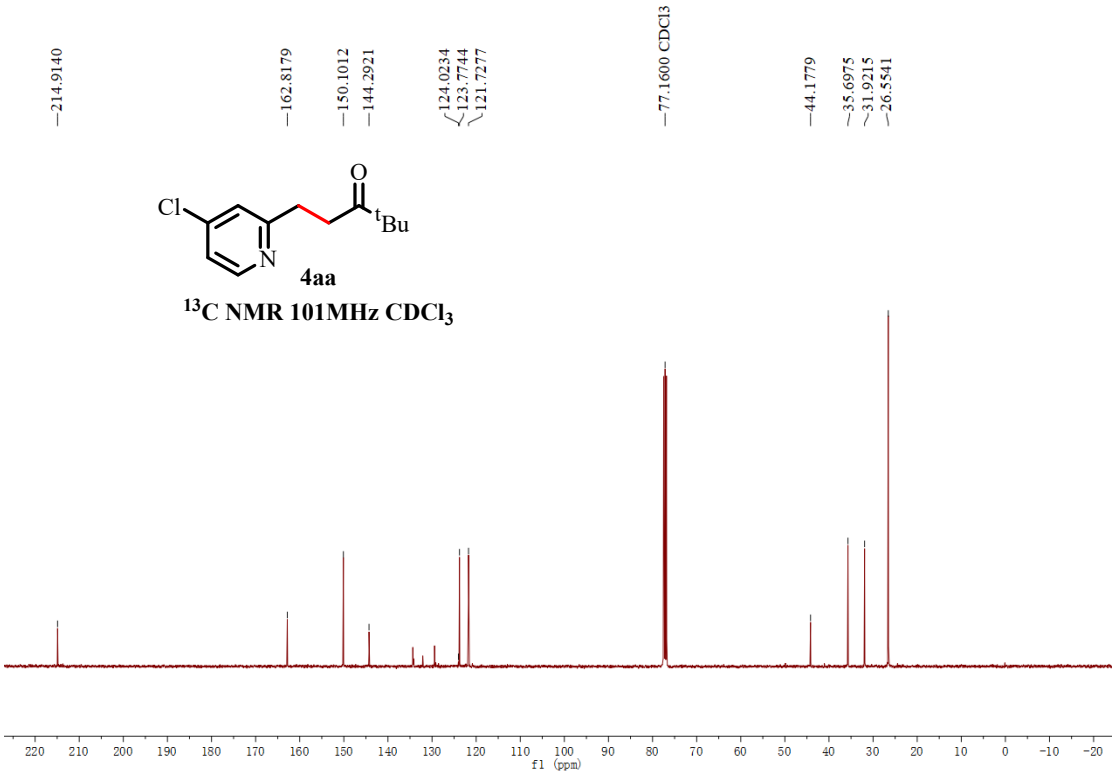
4z

^{13}C NMR 101MHz $CDCl_3$



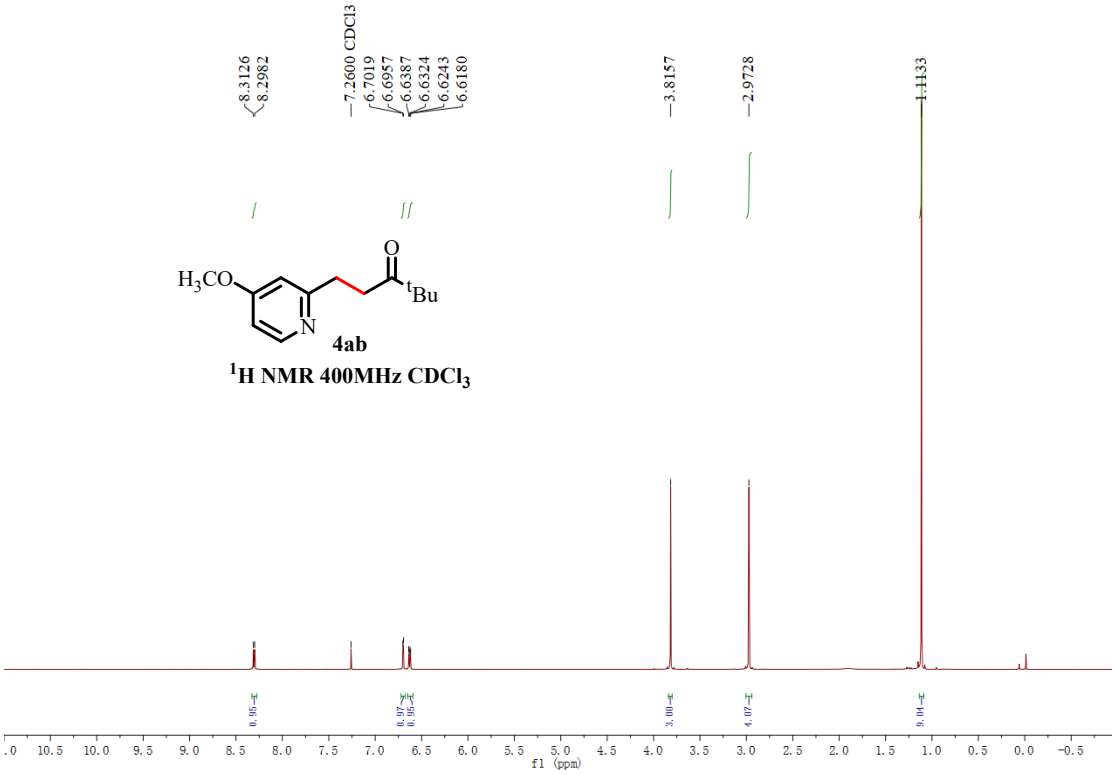
4aa

^{1}H NMR 400MHz $CDCl_3$



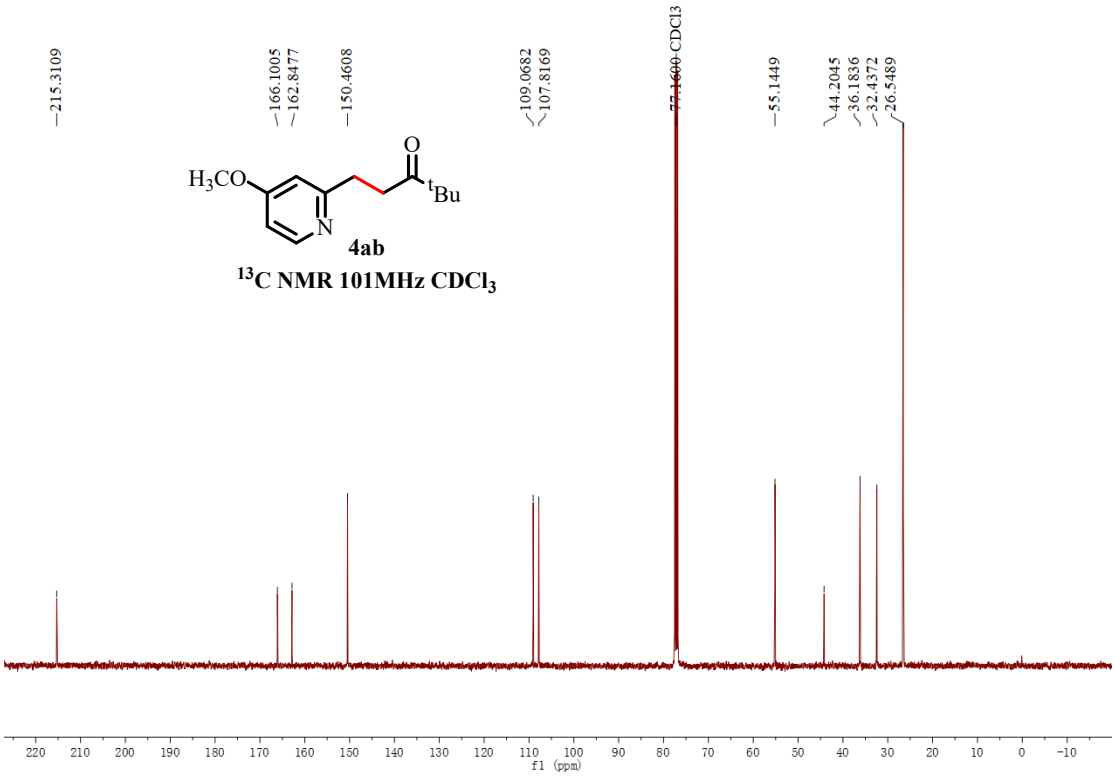
4aa

^{13}C NMR 101MHz $CDCl_3$



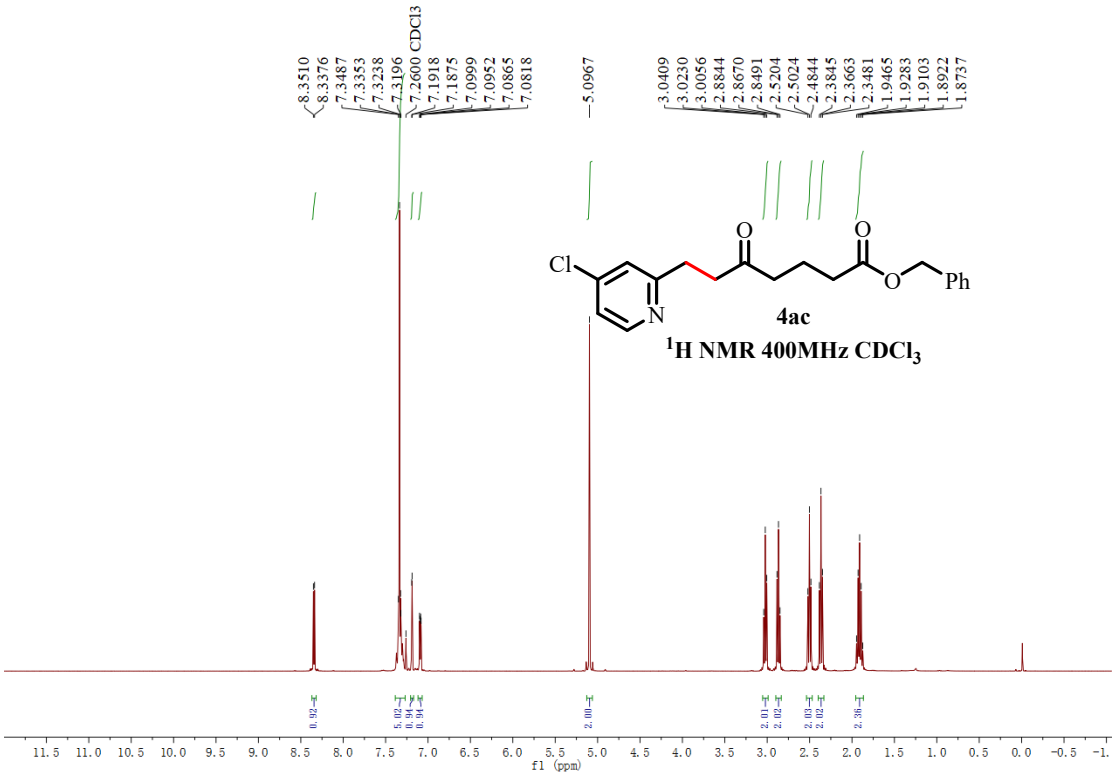
4ab

^{1}H NMR 400MHz $CDCl_3$

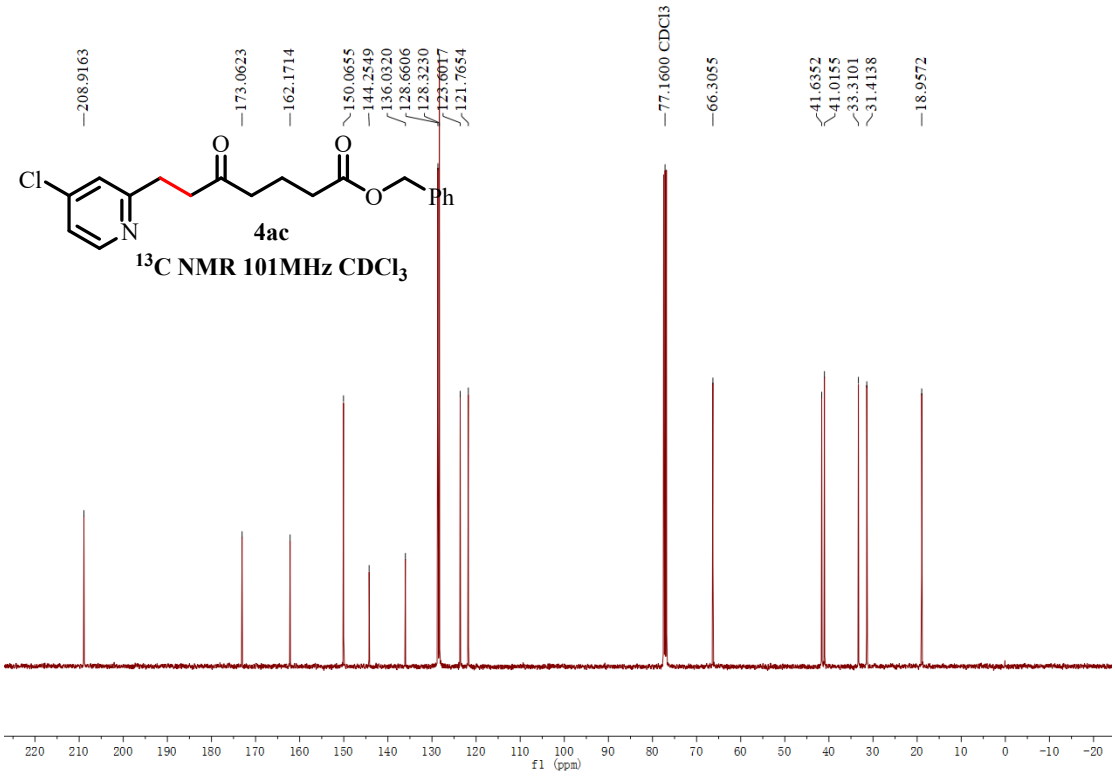


4ab

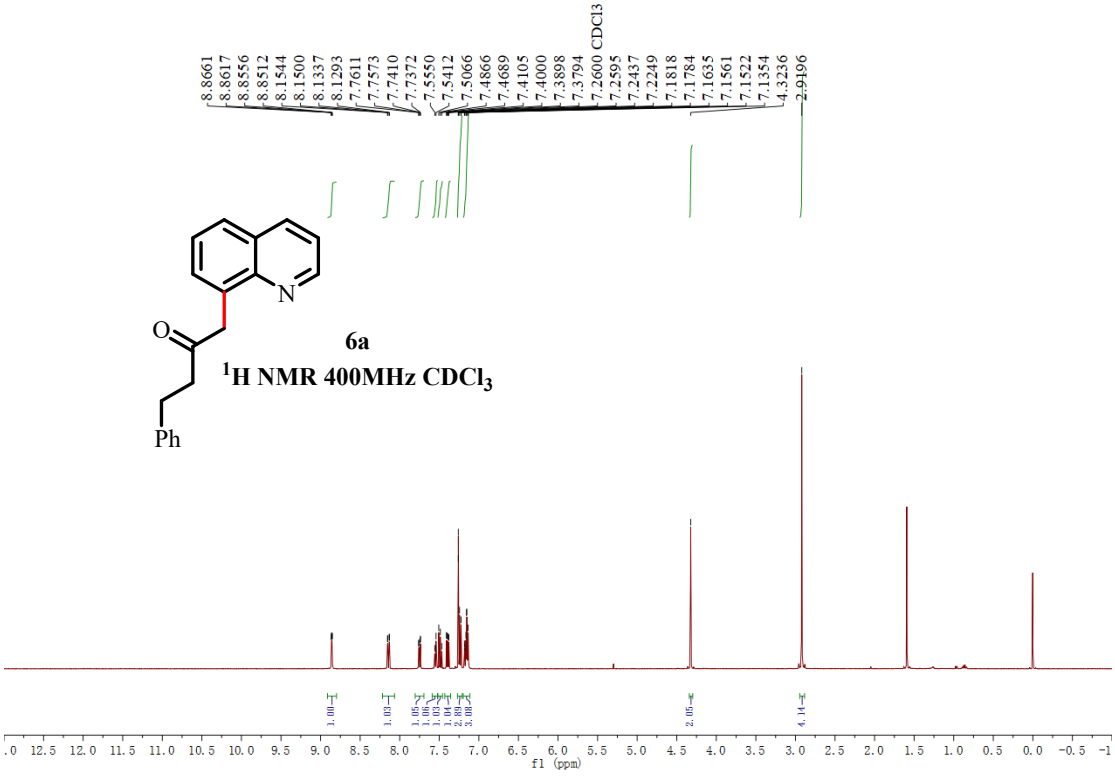
^{13}C NMR 101MHz $CDCl_3$



^{1}H NMR 400MHz $CDCl_3$



^{13}C NMR 101MHz $CDCl_3$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7.7372
7.5550
7.5412
7.5066
7.4866
7.4689
7.4105
7.4000
7.3898
7.3794
7.2600 CDCl3
7.2595
7.2437
7.2249
7.1818
7.1784
7.1635
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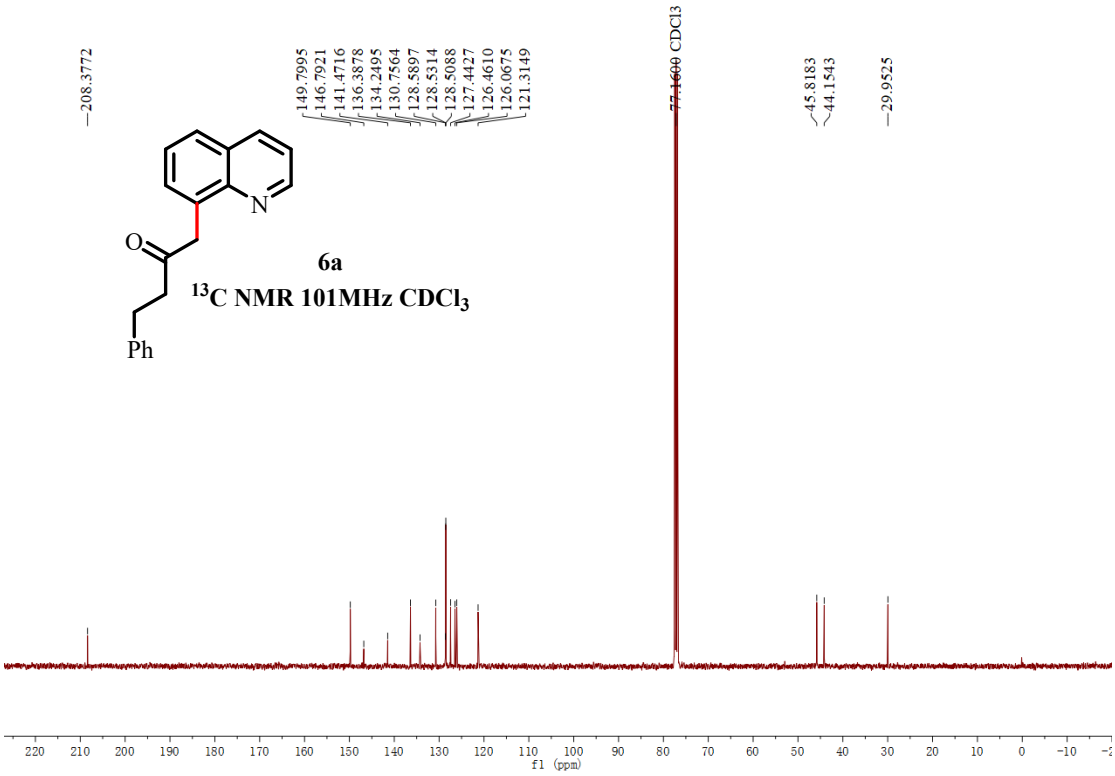
N
Ph
6a
1H NMR 400MHz CDCl3
f1 (ppm)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127.4427
126.4610
126.0675
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77.1600 CDCl3
45.8183
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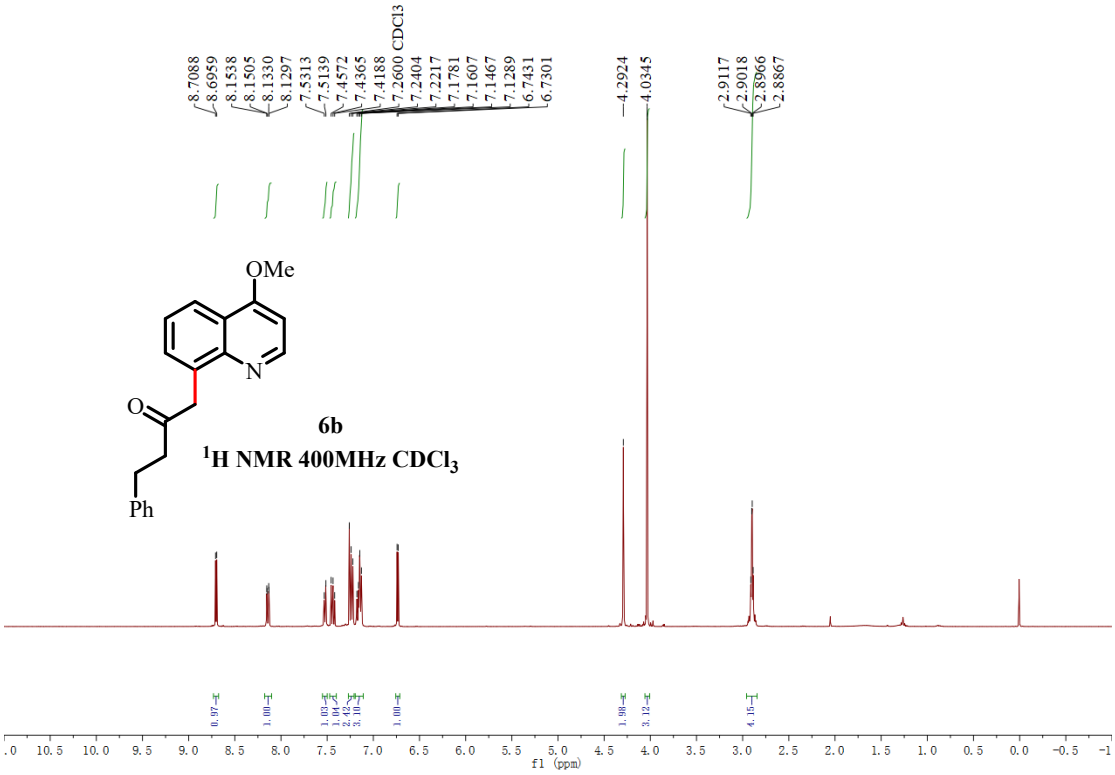
29.9525
O
N
Ph
6a
13C NMR 101MHz CDCl3
f1 (ppm)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7.2600 CDCl3
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7.2217
7.1781
7.1607
7.1467
7.1289
6.7431
6.7301
4.2924
4.0345
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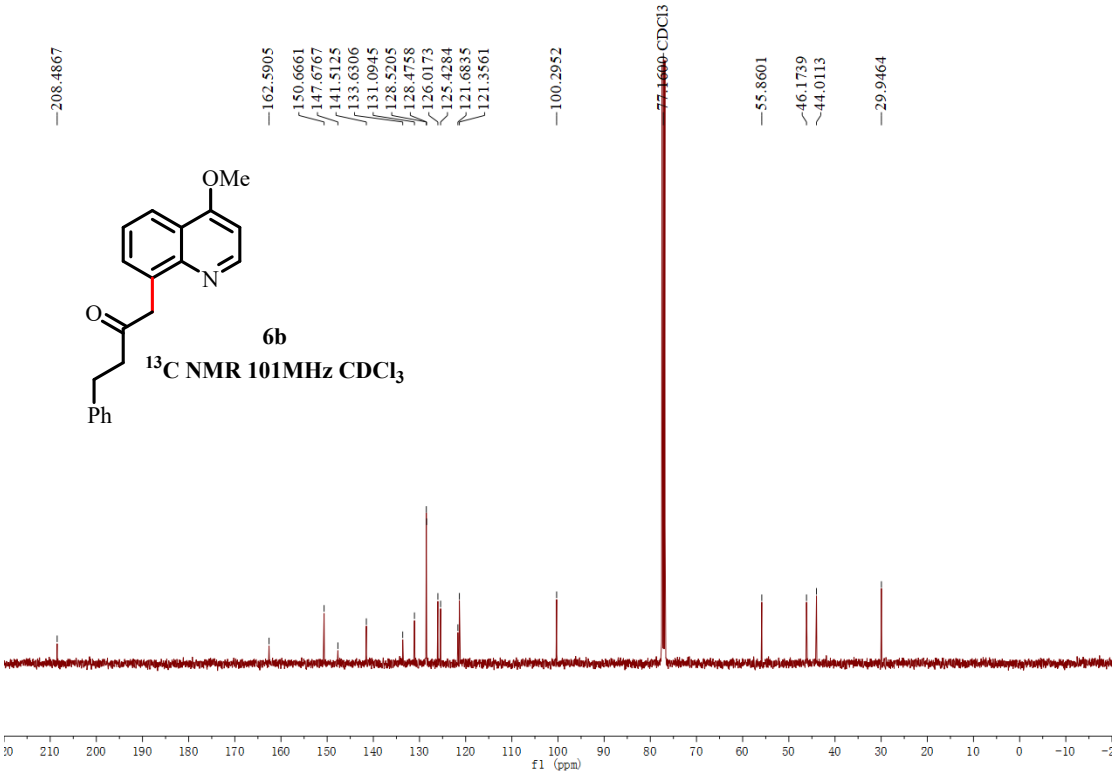
2.8966
2.8867
OMe
N
O
Ph
6b
1H NMR 400MHz CDCl3
f1 (ppm)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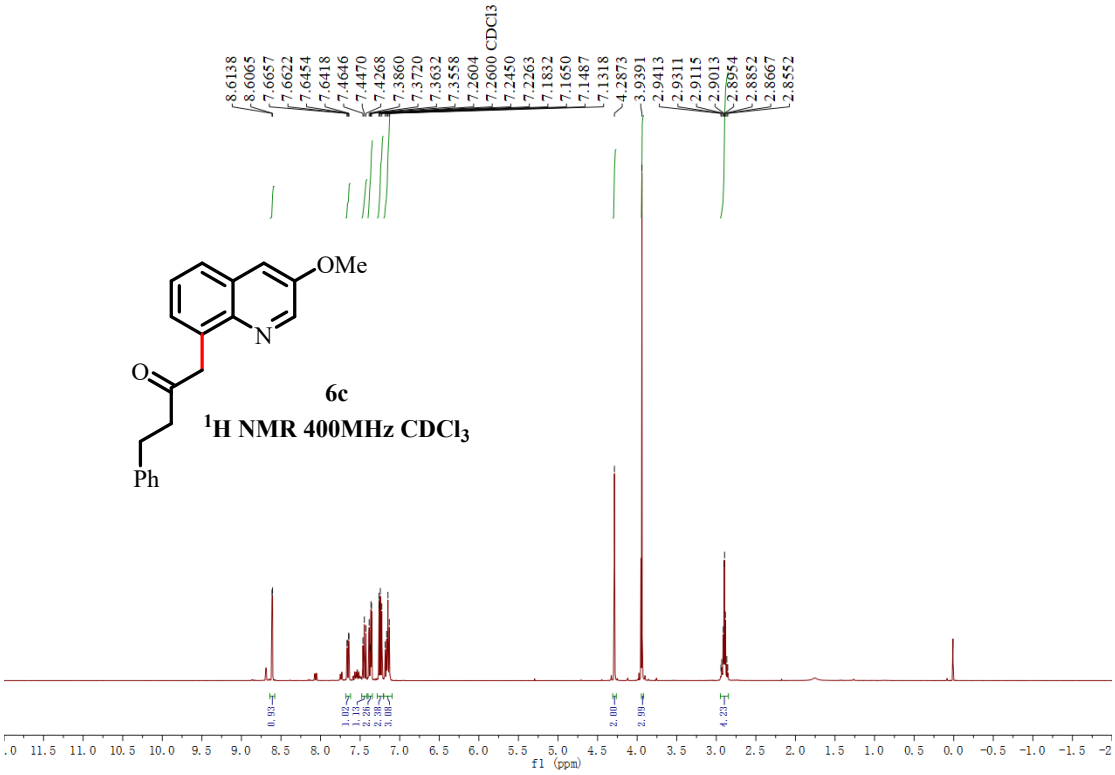
126.0173
125.4284
121.6835
121.3561
100.2952
77.1600 CDCl3
55.8601
46.1739
44.0113
29.9464
OMe
N
O
Ph
6b
13C NMR 101MHz CDCl3
f1 (ppm)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7.3632
7.3558
7.2604
7.2600 CDCl3
7.2450
7.2263
7.1832
7.1650
7.1487
7.1318
4.2873
3.9391
2.9413
2.9311
2.9115
2.9013
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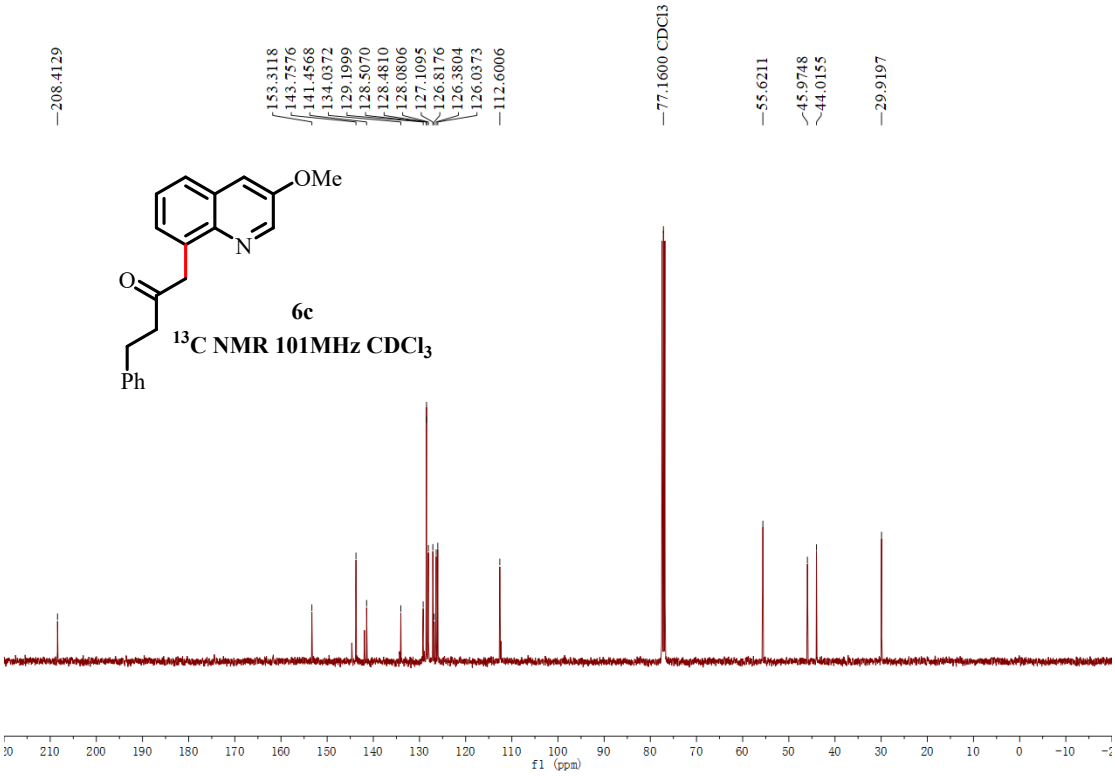
N
O
Ph
6c
1H NMR 400MHz CDCl3
f1 (ppm)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77.1600 CDCl3
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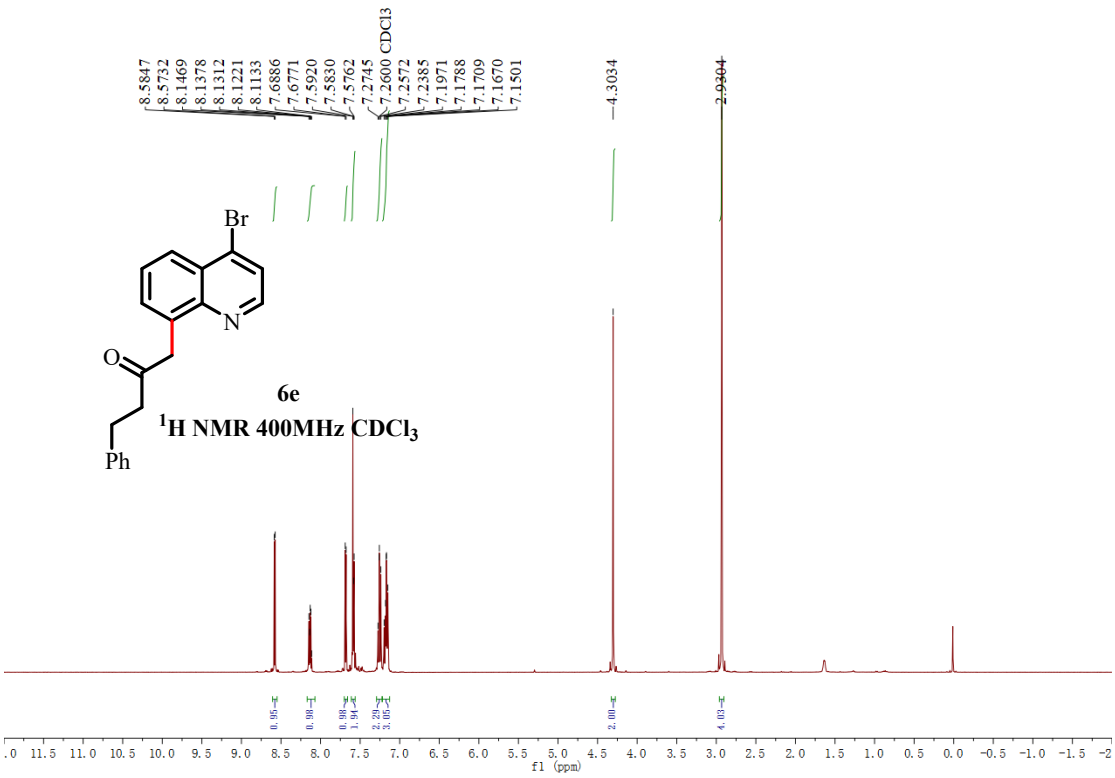
N
O
Ph
6c
13C NMR 101MHz CDCl3
f1 (ppm)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7.2745
7.2600 CDCl3
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7.1788
7.1709
7.1670
7.1501
4.3034
2.9304
Br
N
O
Ph
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3.05
2.00
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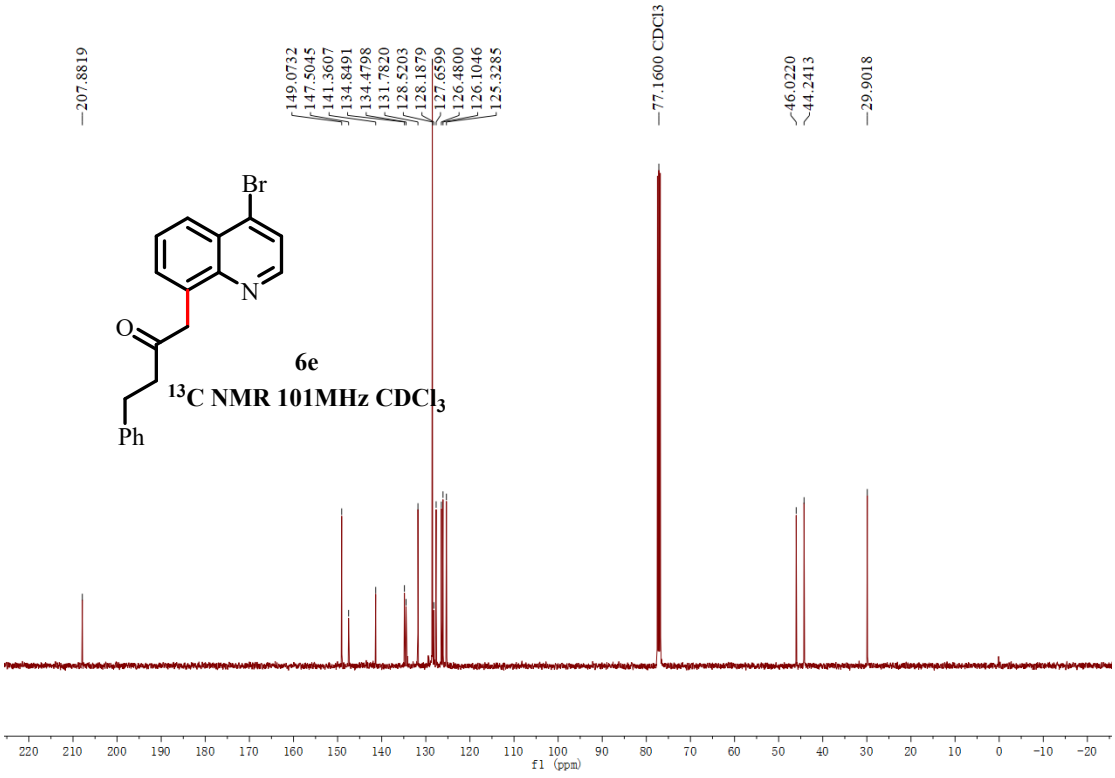
f1 (ppm)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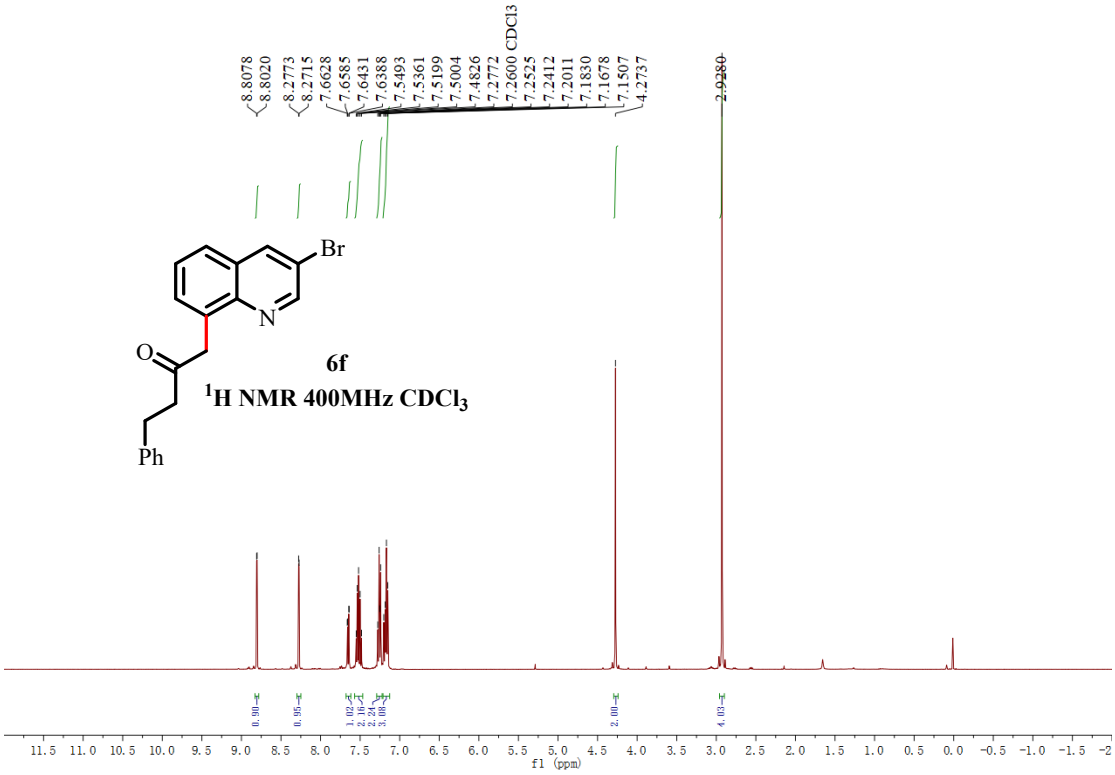
Ph
6e
13C NMR 101MHz CDCl3
f1 (ppm)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7.5004
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7.1830
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Br
N
O
Ph
6f
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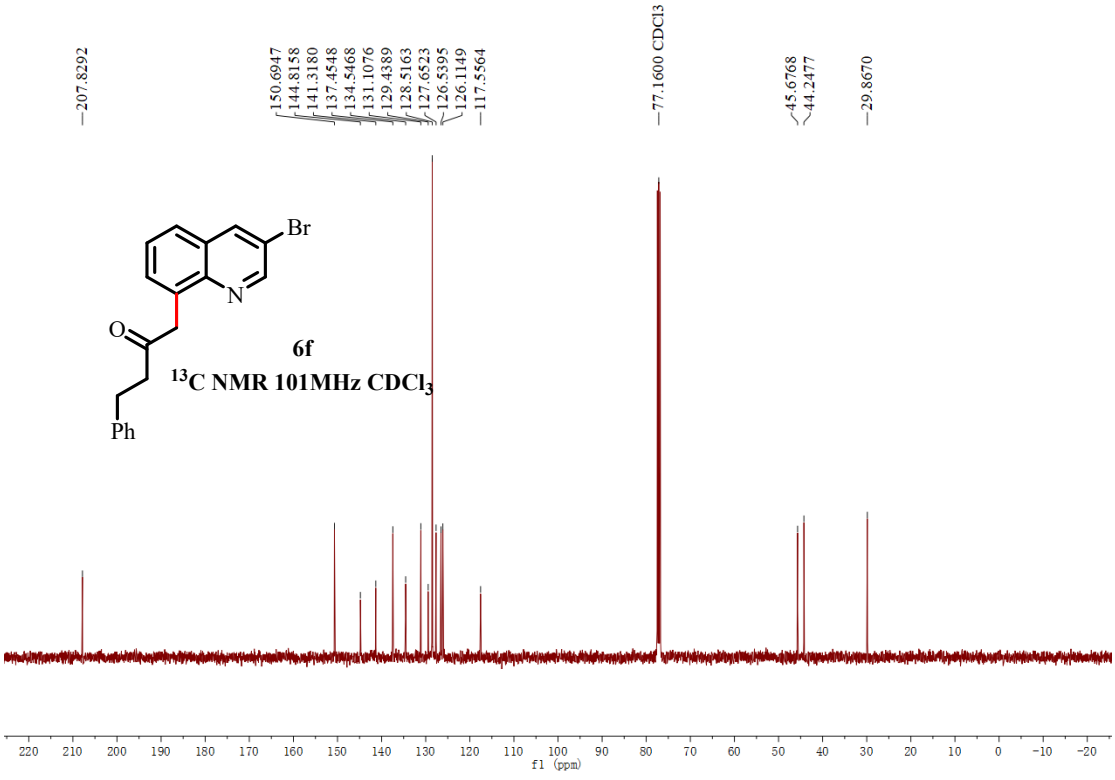
0.95
1.02
2.16
2.24
3.08
2.00
4.03
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5 -2
f1 (ppm)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6f
13C NMR 101MHz CDCl3
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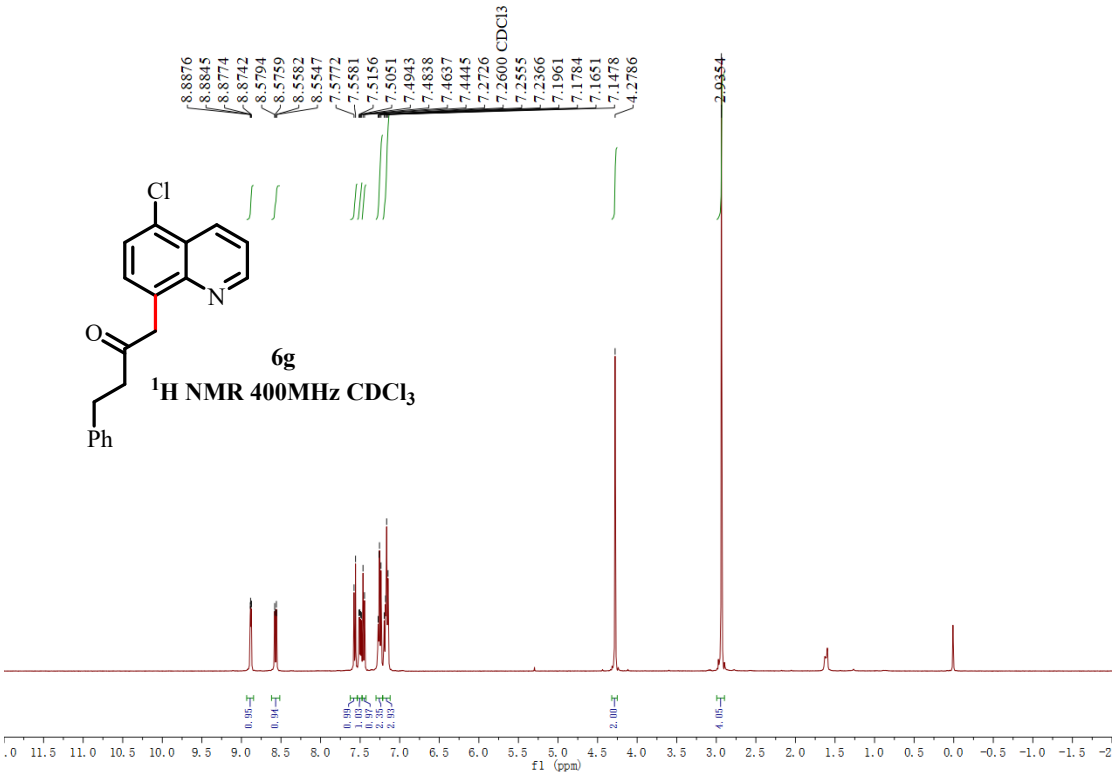
f1 (ppm)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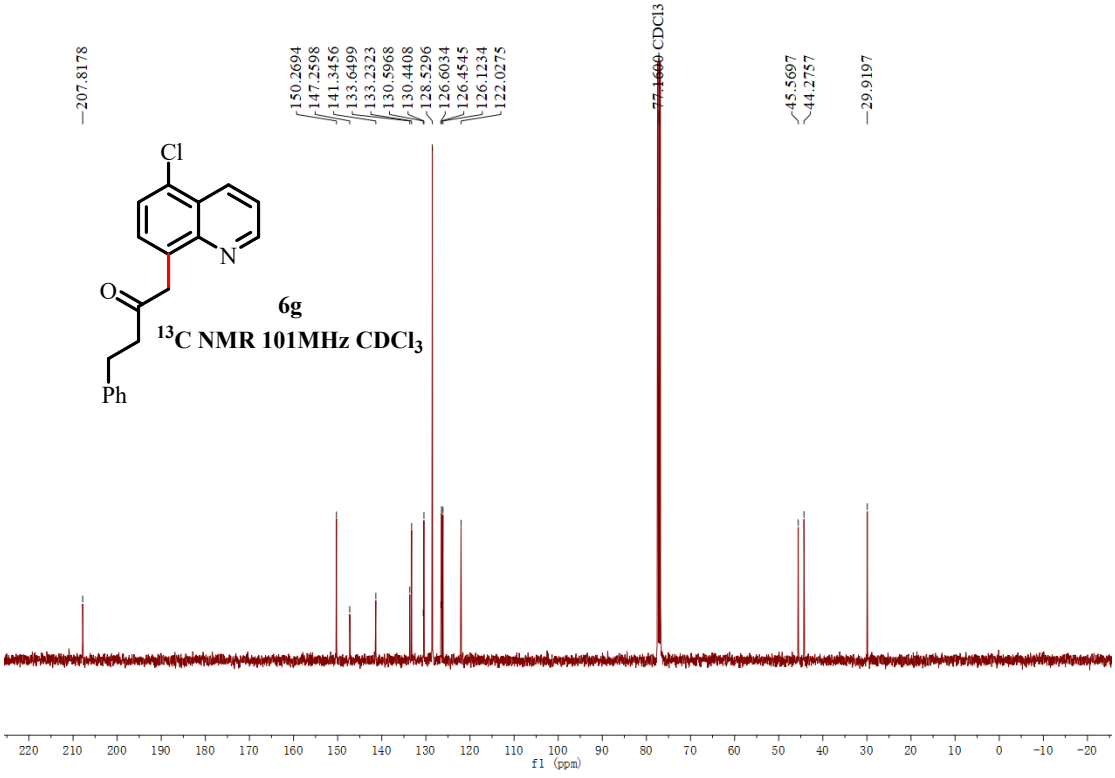
Ph
6g
1H NMR 400MHz CDCl3
f1 (ppm)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122.0275
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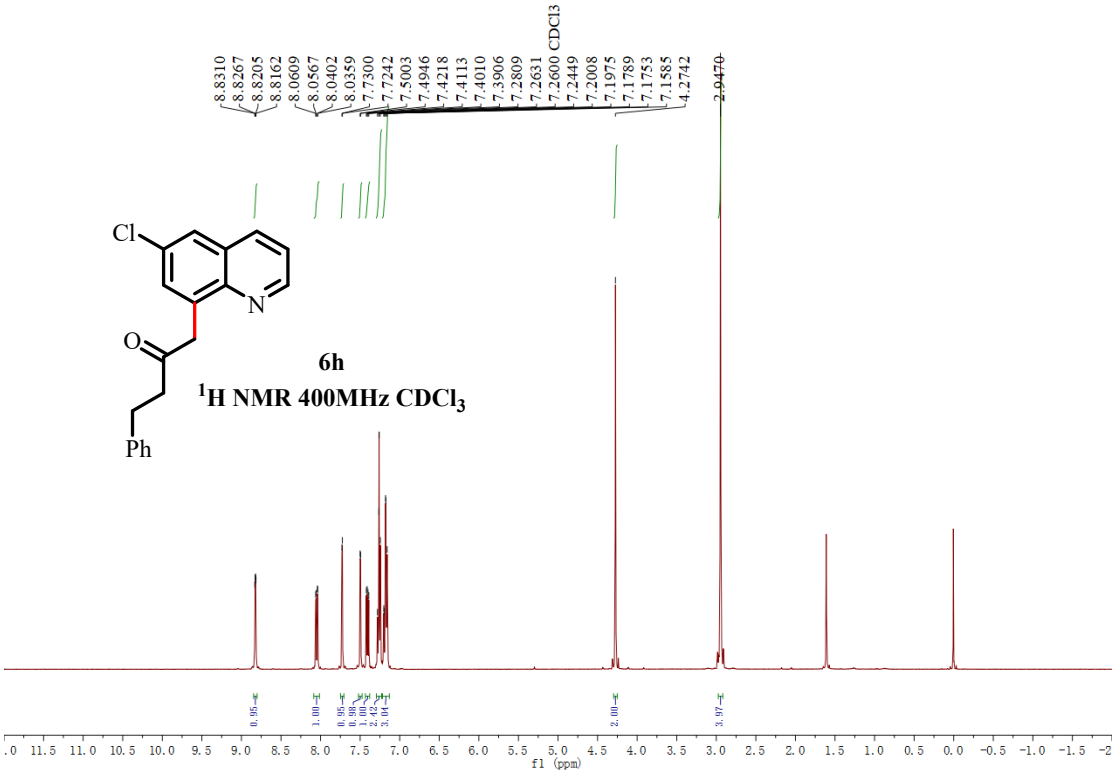
6g
13C NMR 101MHz CDCl3
f1 (ppm)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7.4218
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7.4010
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7.2809
7.2631
7.2600 CDCl3
7.2449
7.2008
7.1975
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Ph
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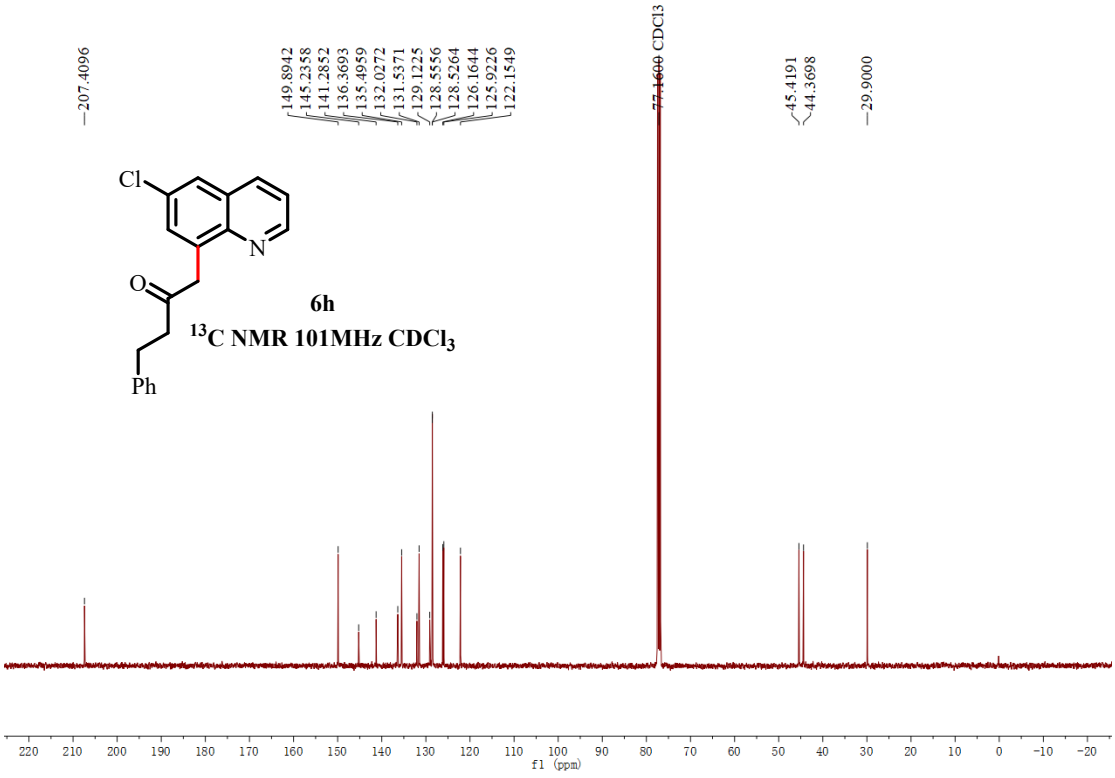
1H NMR 400MHz CDCl3
f1 (ppm)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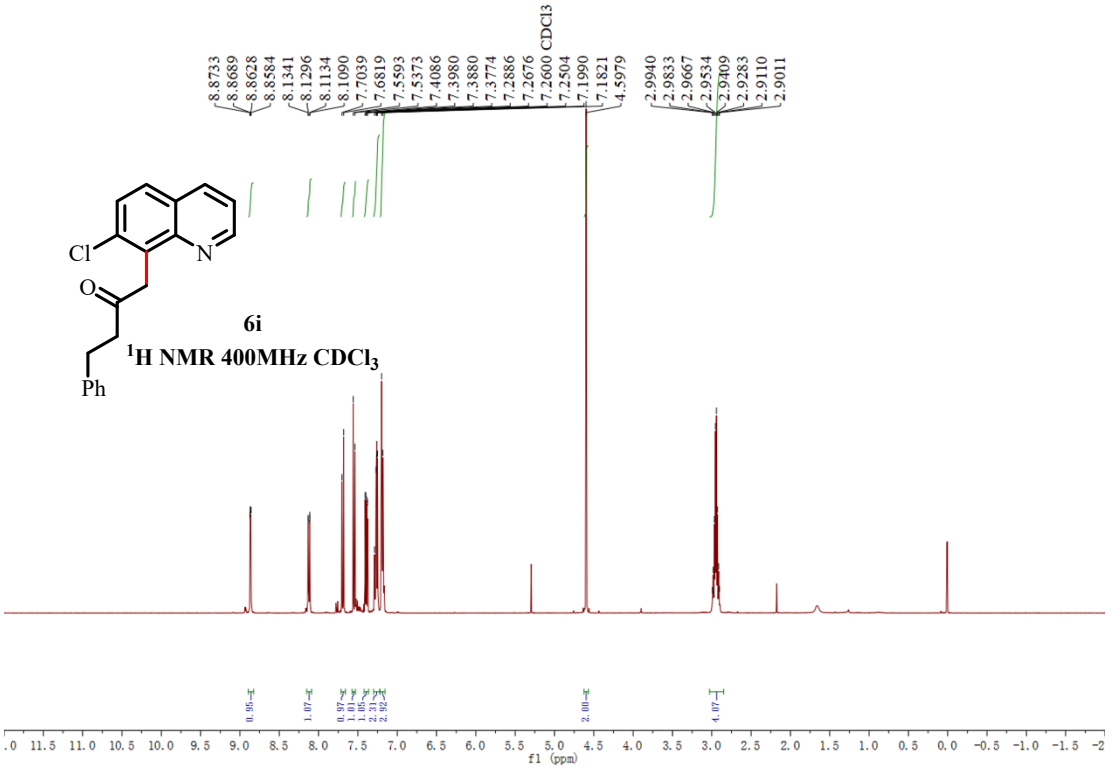
Ph
6h
13C NMR 101MHz CDCl3
f1 (ppm)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2.9283
2.9110
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Cl
N
O
Ph
6i
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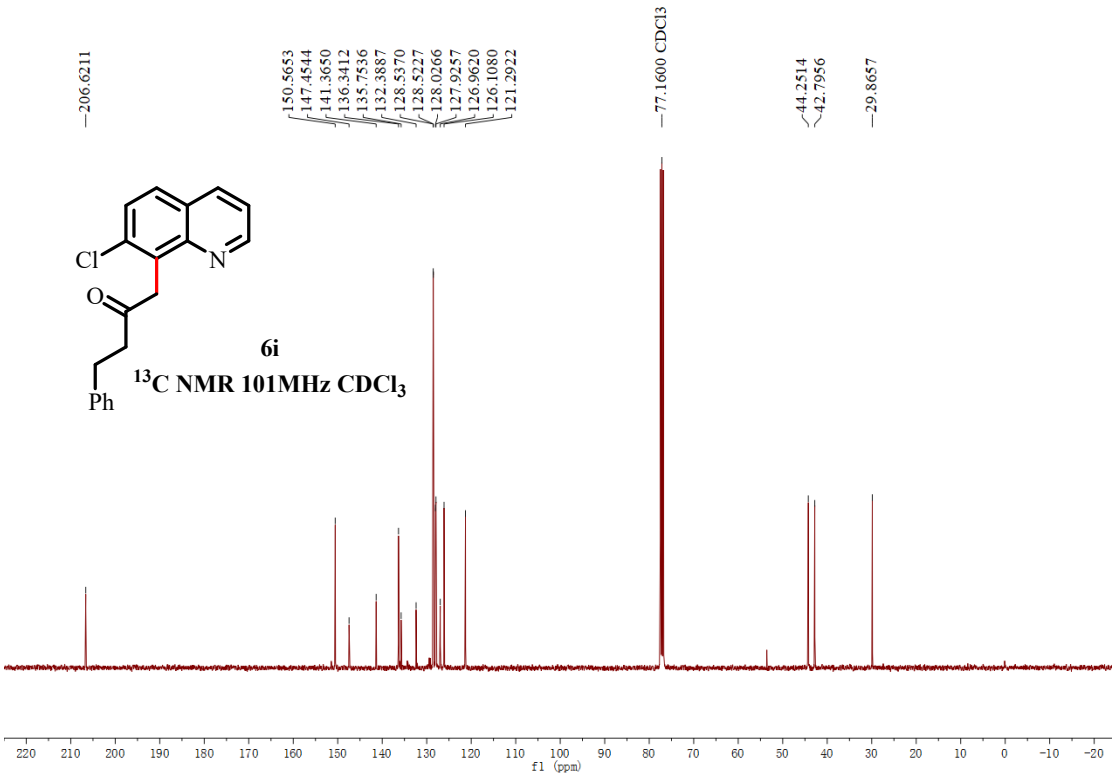
4.07
f1 (ppm)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126.1080
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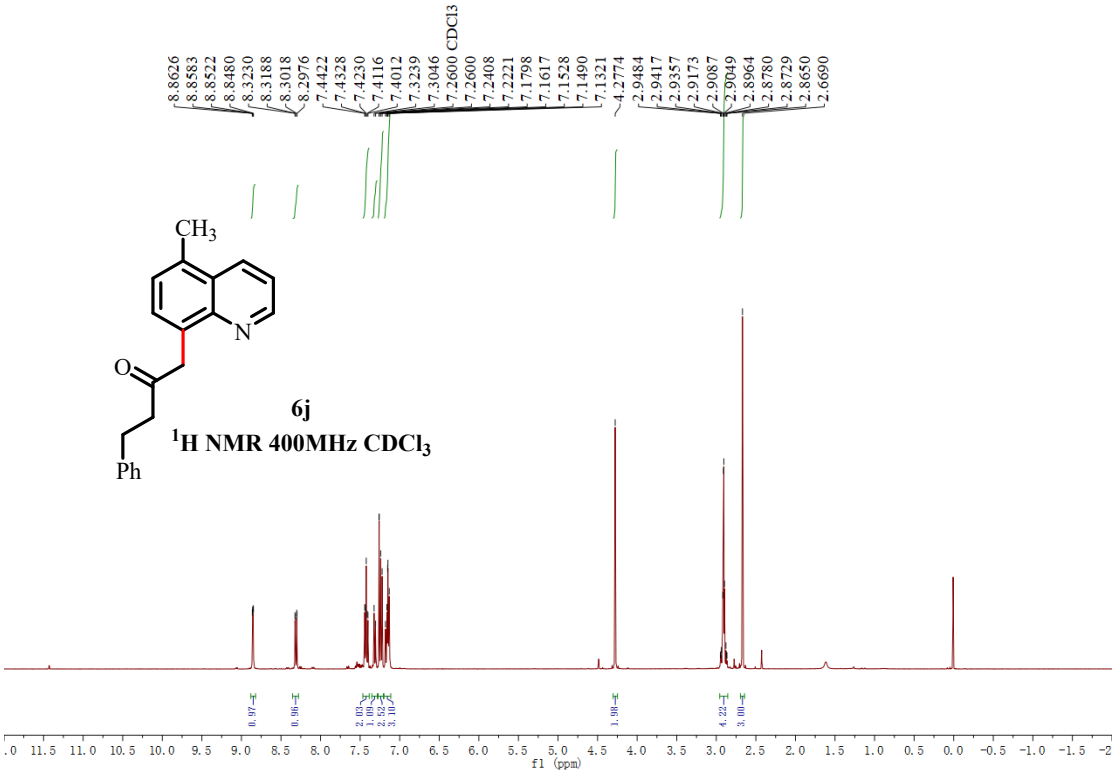
O
Ph
6i
13C NMR 101MHz CDCl3
f1 (ppm)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7.4012
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7.1528
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Ph
6j
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1.98
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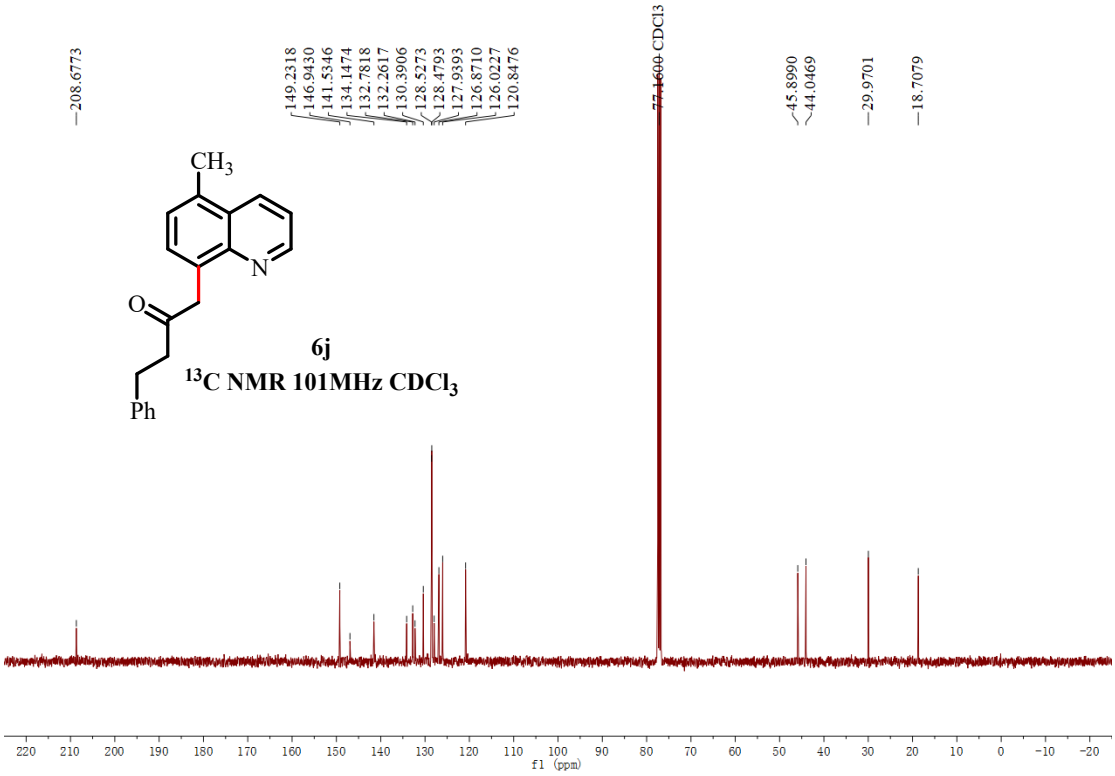
f1 (ppm)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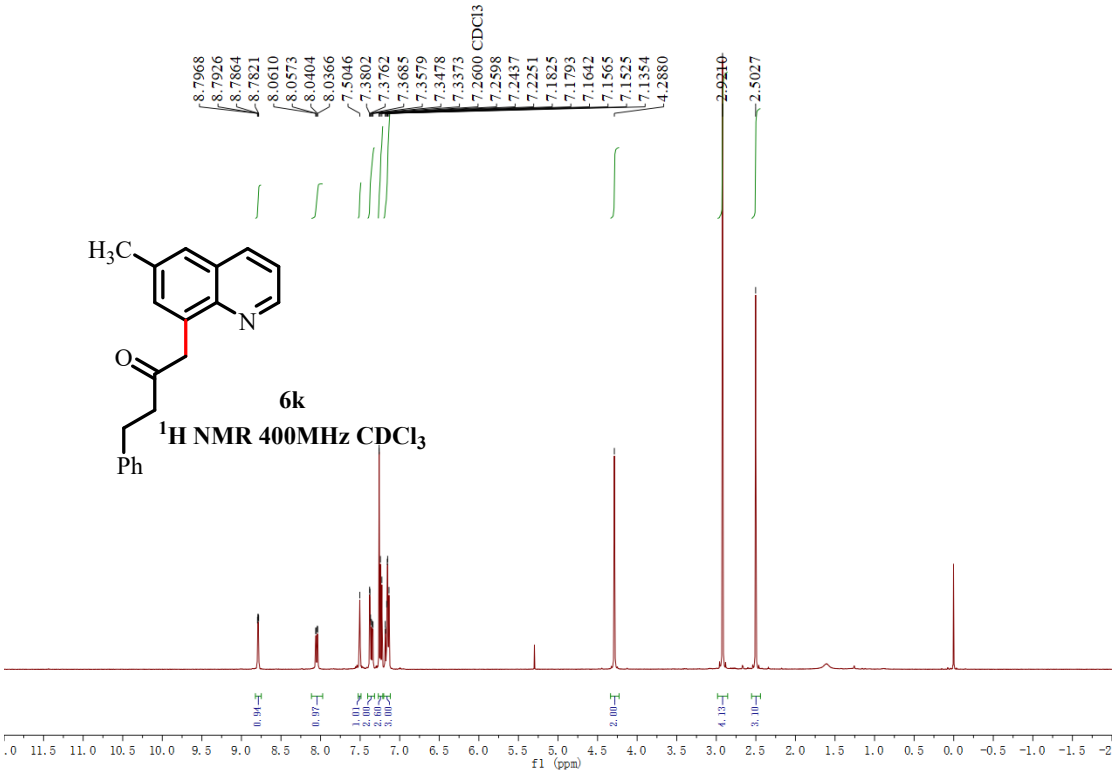
Ph
6j
13C NMR 101MHz CDCl3
f1 (ppm)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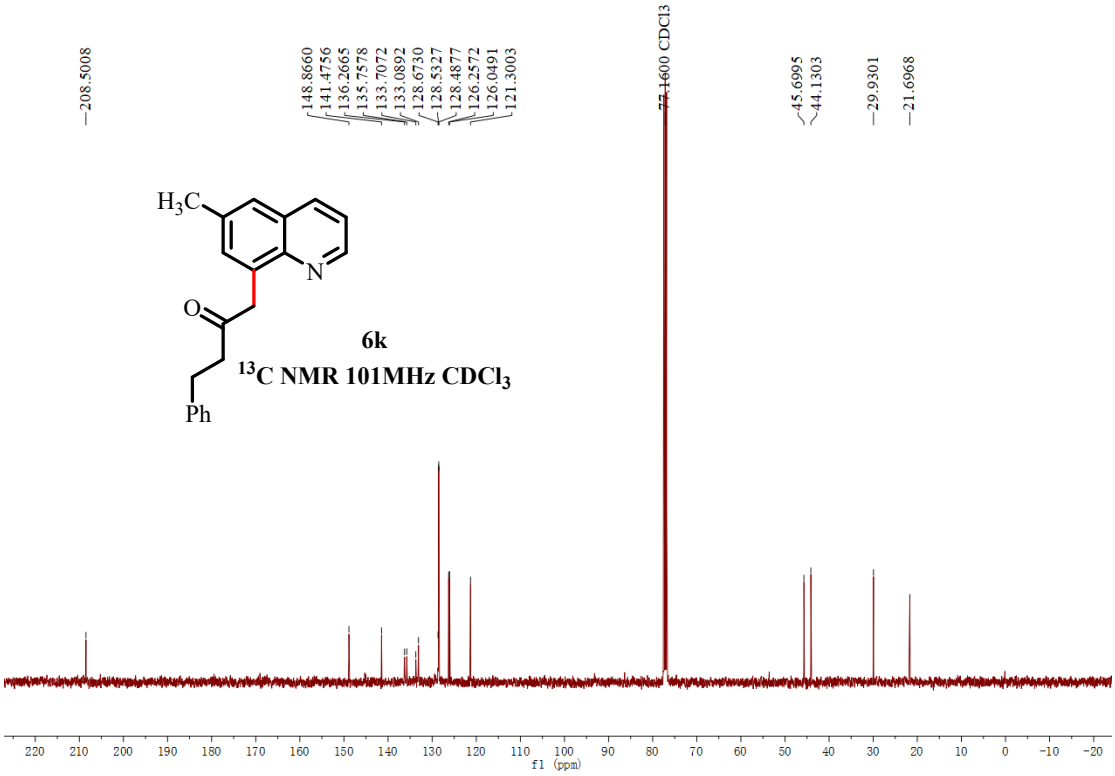
Ph
6k
1H NMR 400MHz CDCl3
f1 (ppm)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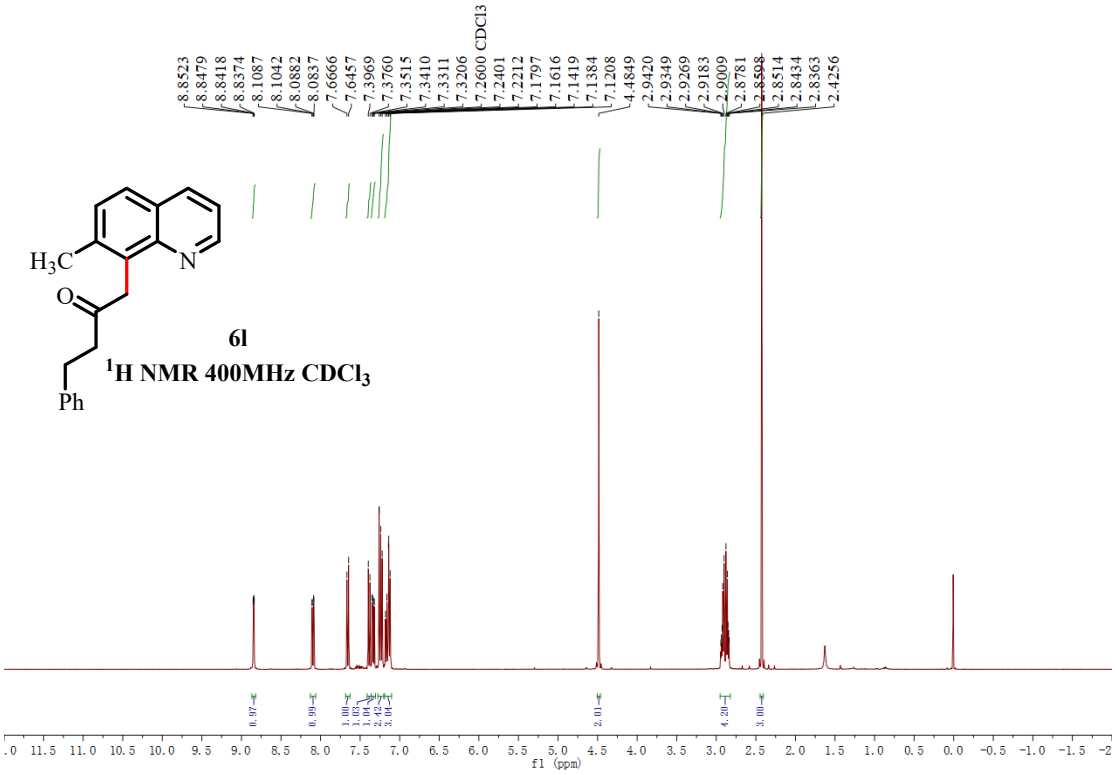
Ph
6k
13C NMR 101MHz CDCl3
f1 (ppm)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H3C
N
O
Ph
6l
1H NMR 400MHz CDCl3
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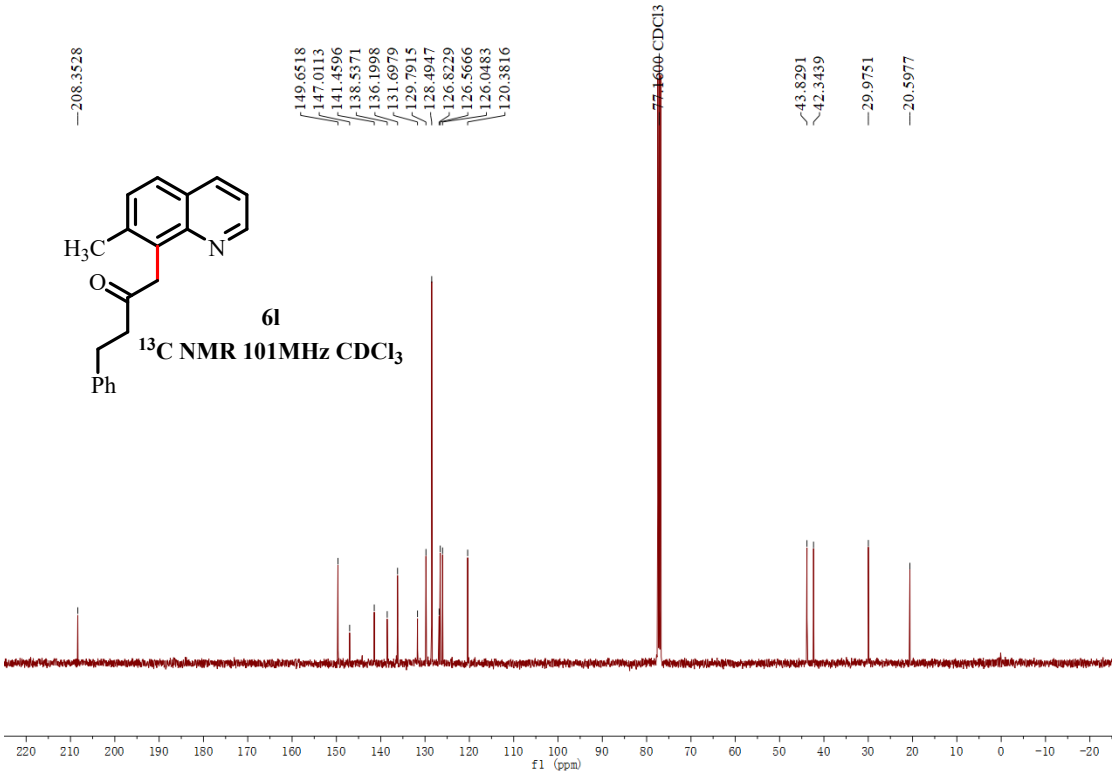
f1 (ppm)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120.3816
77.1600 CDCl3
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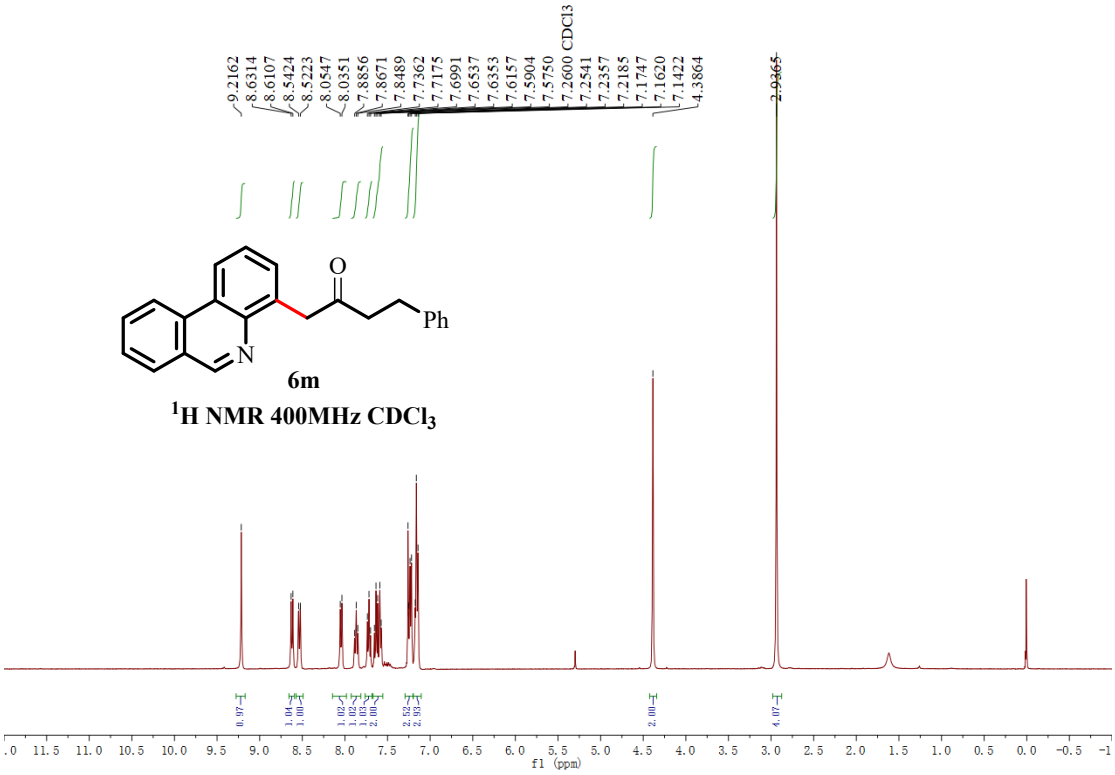
Ph
6l
13C NMR 101MHz CDCl3
f1 (ppm)



6m

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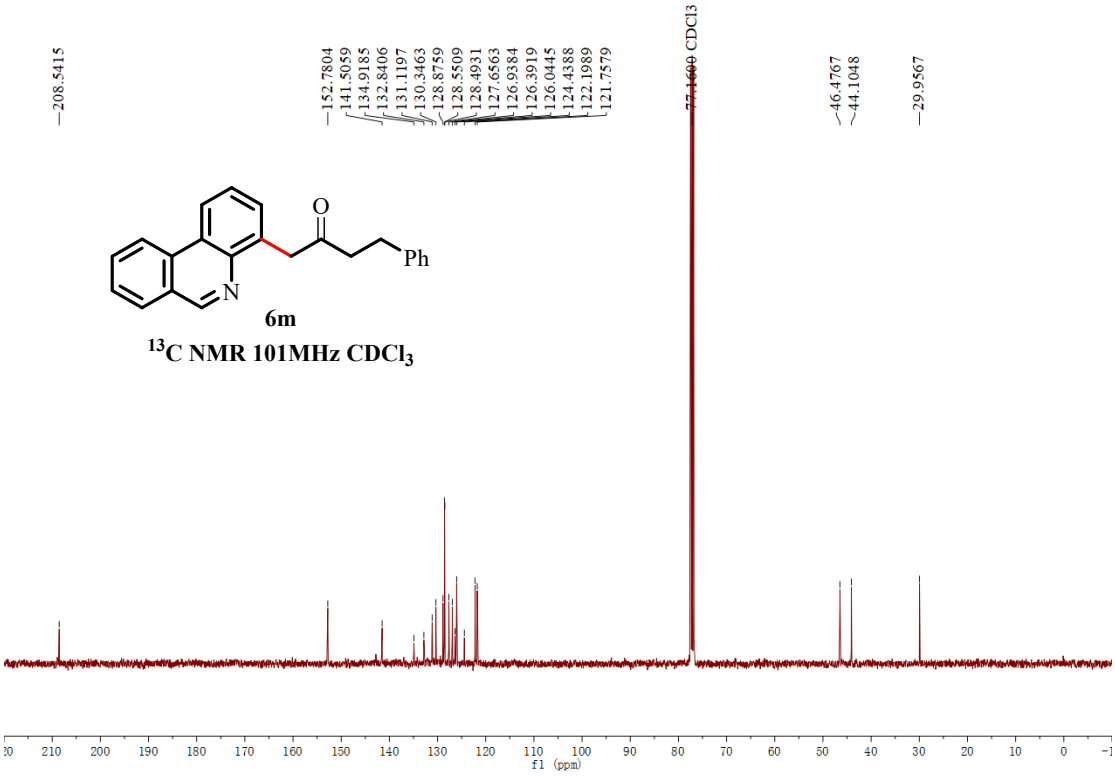

6m

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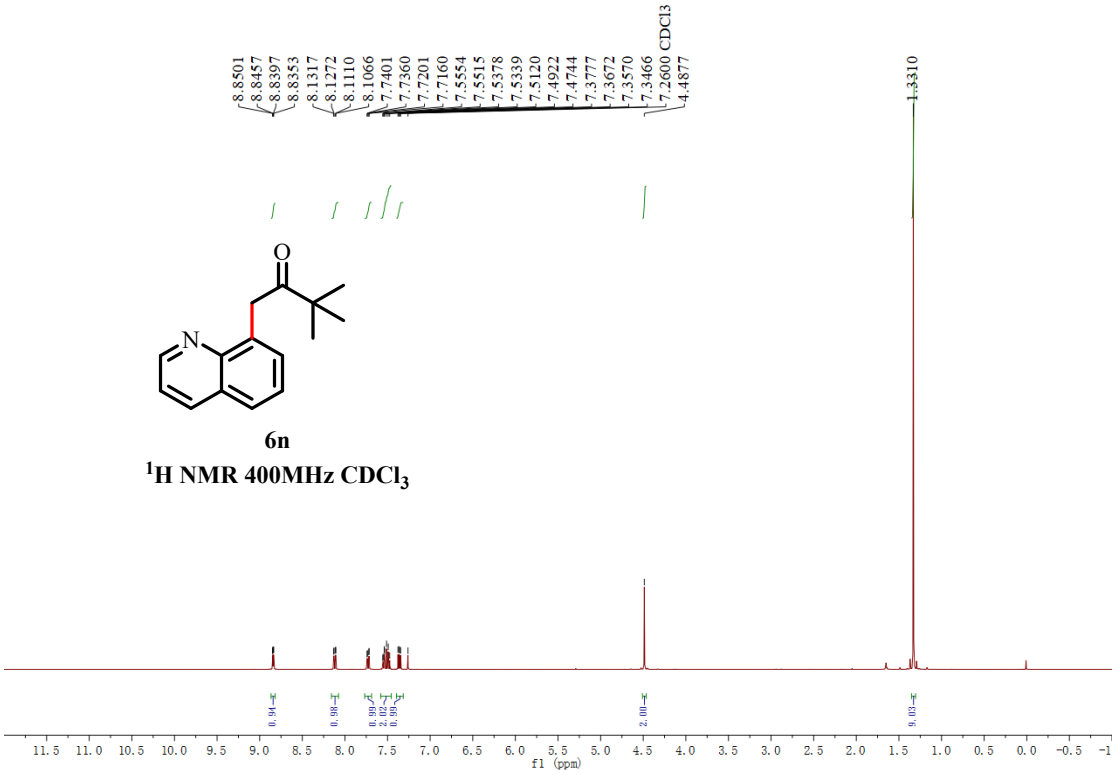
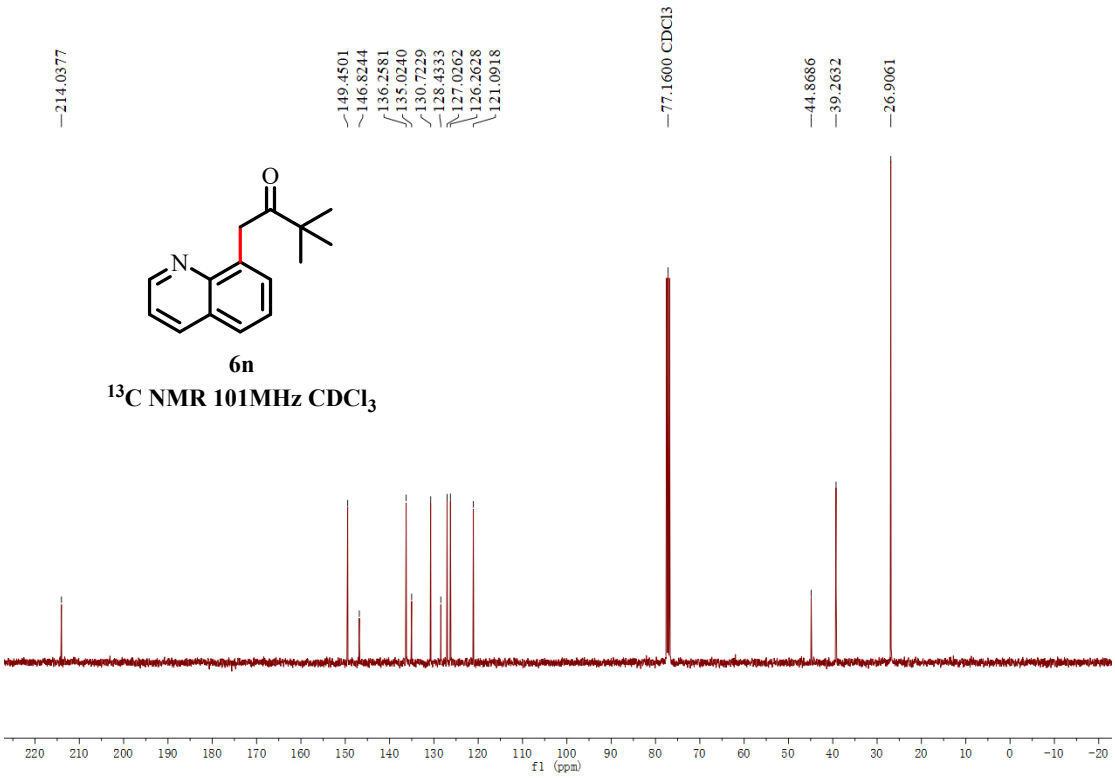


6n

^{1}H NMR 400MHz $CDCl_3$



6n

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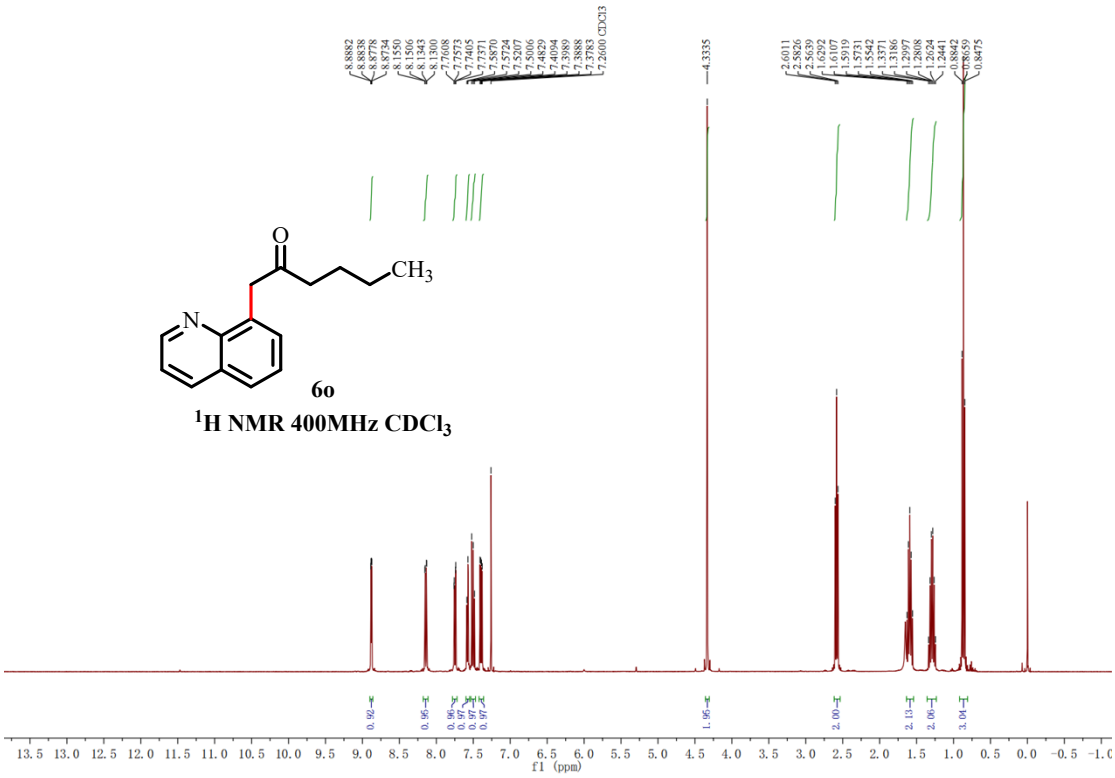

6o

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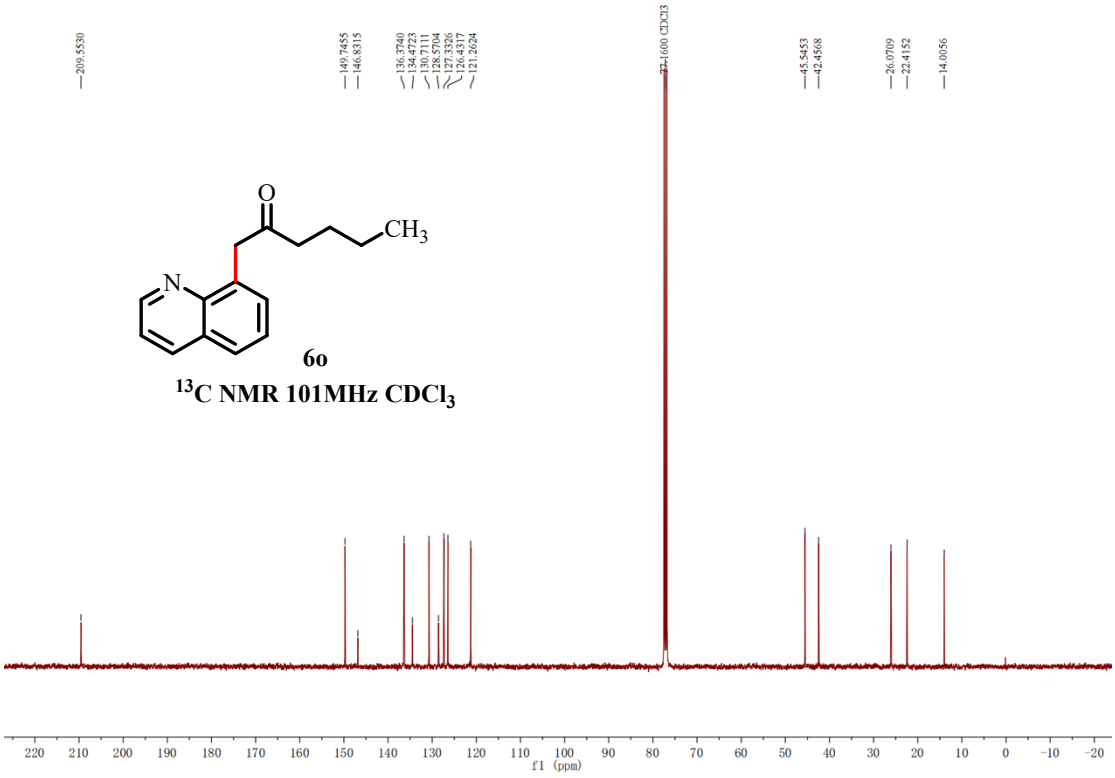
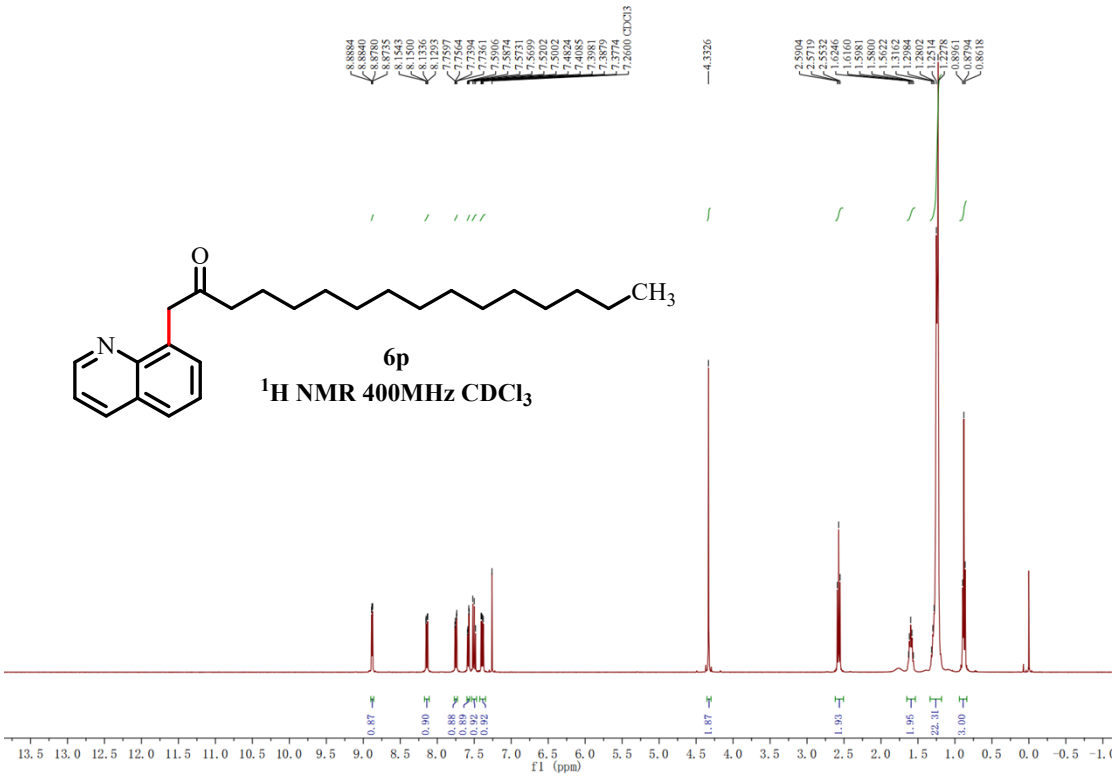


6o

^{13}C NMR 101MHz $CDCl_3$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N
6p
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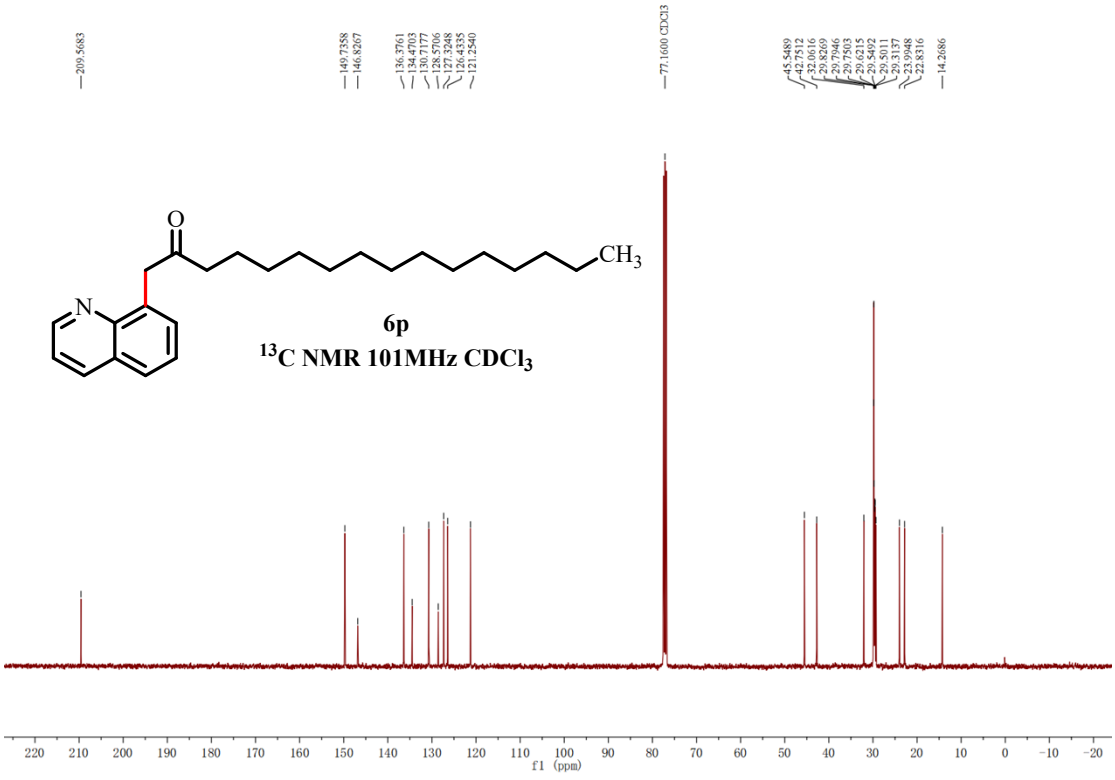
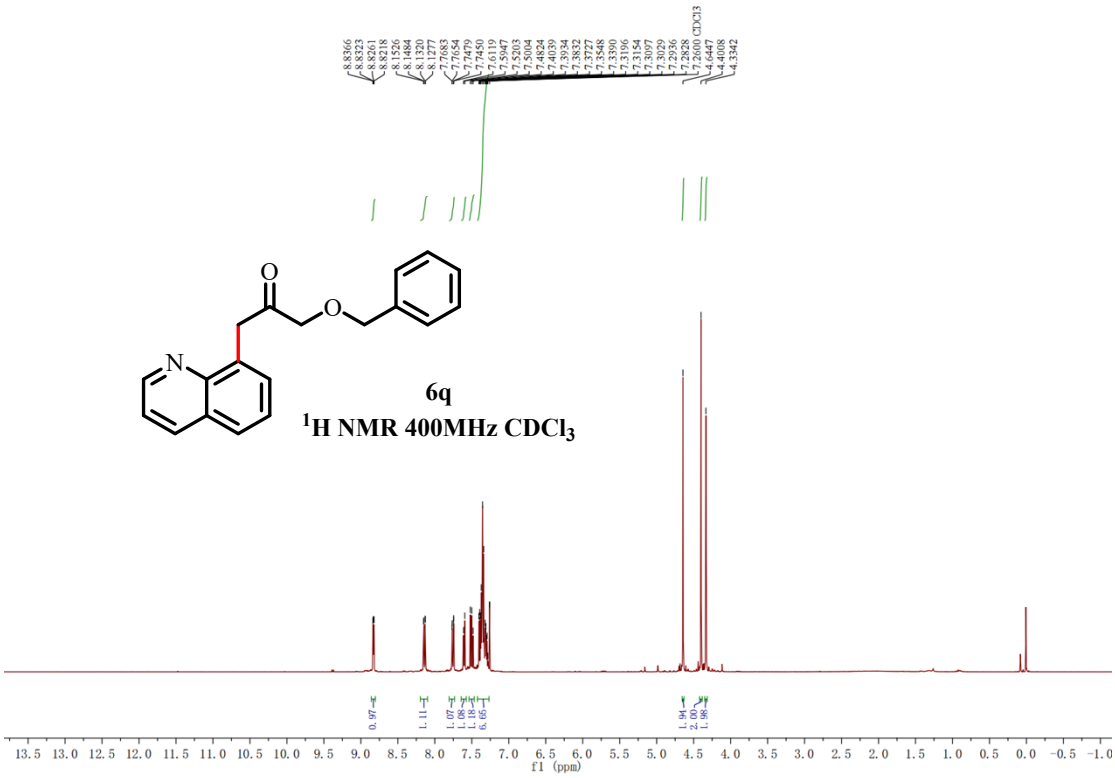

O
CH3
N
6p
13C NMR 101MHz CDCl3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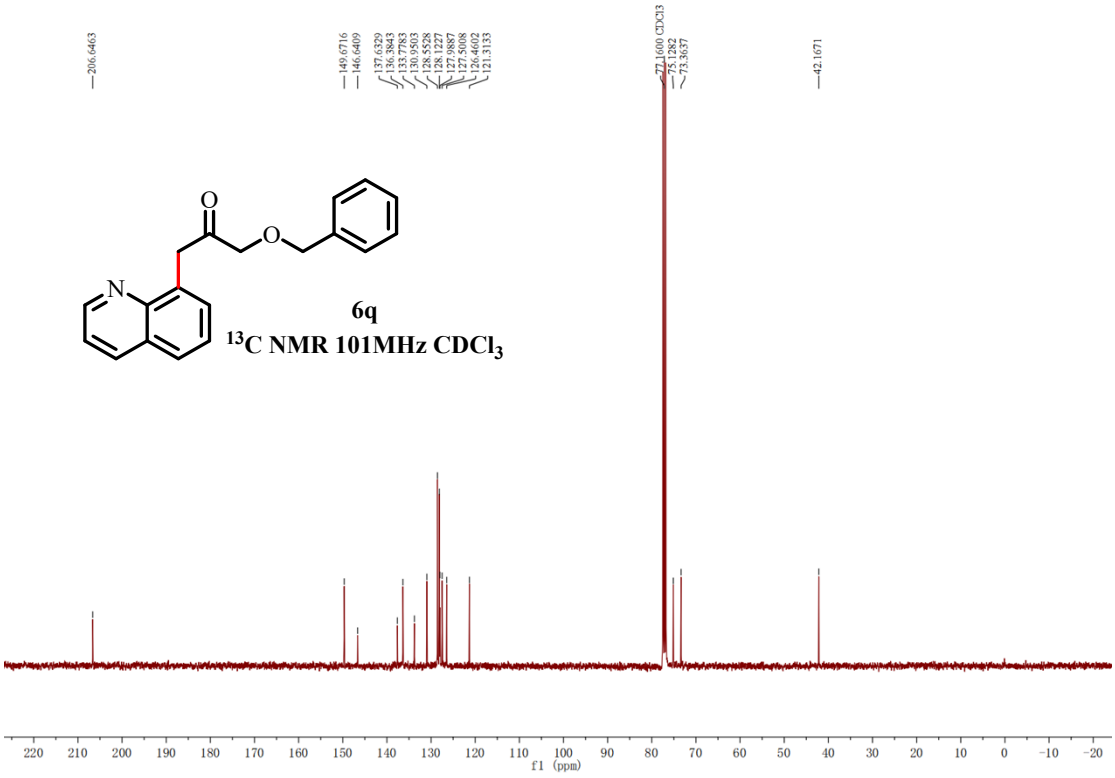
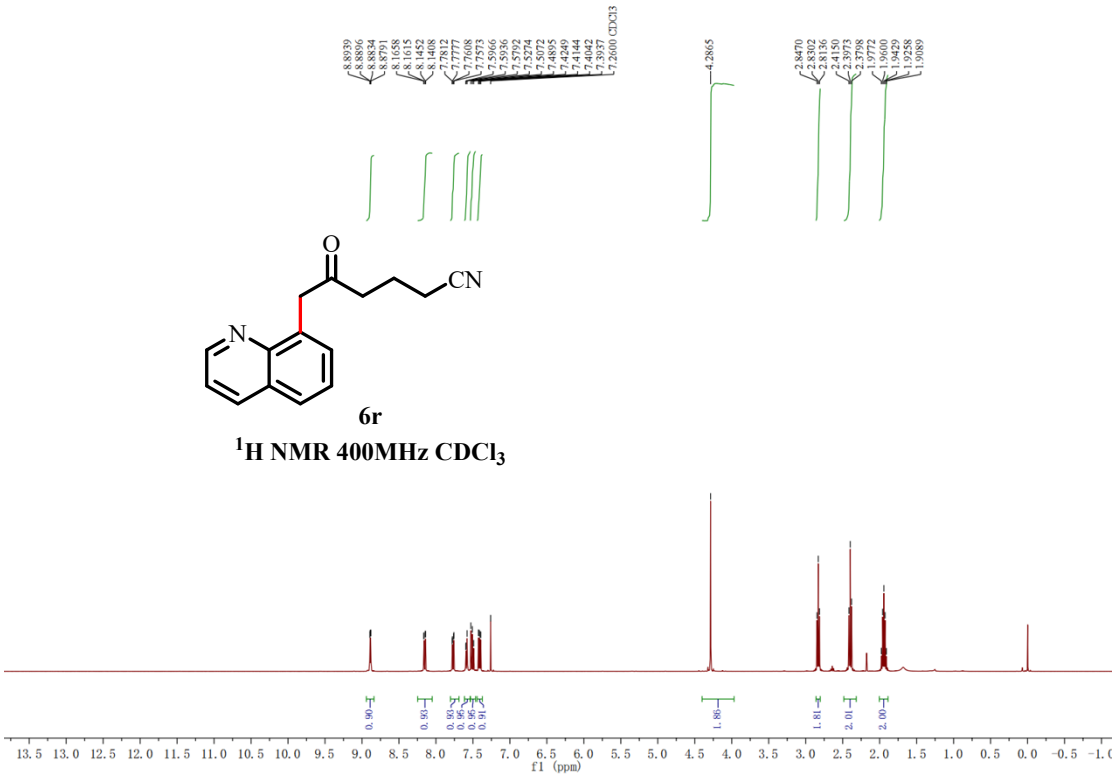
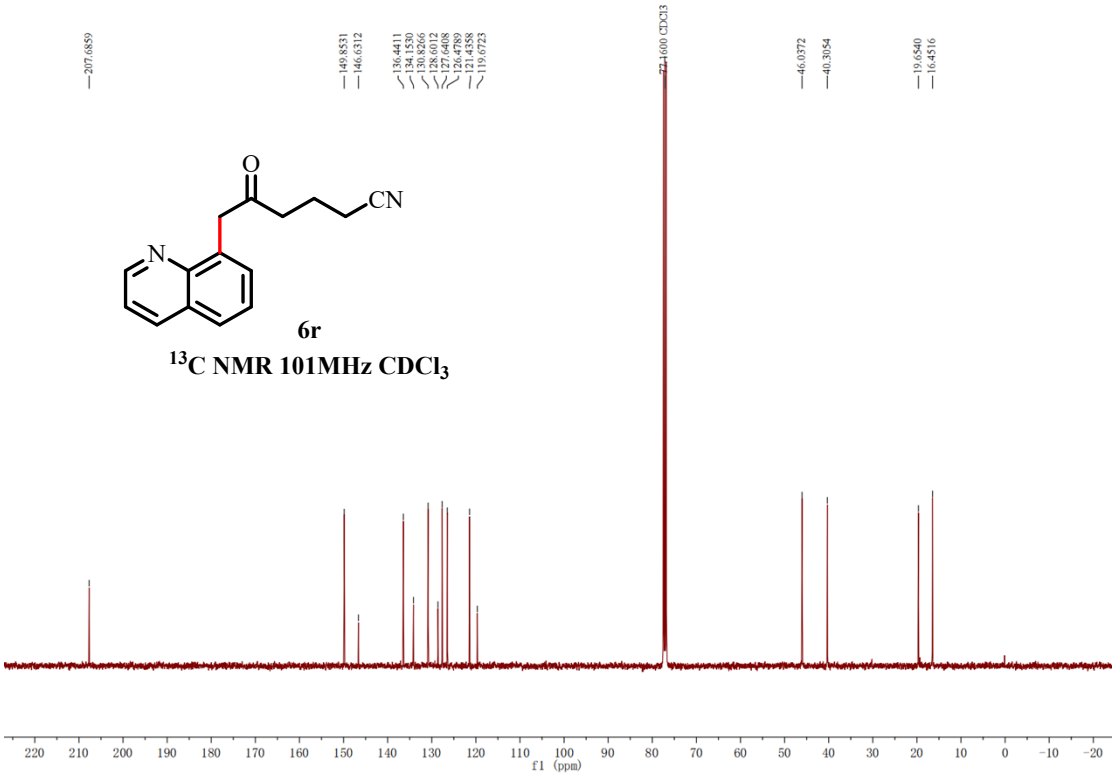
O
N
6q
1H NMR 400MHz CDCl3


O
O
N
6q
13C NMR 101MHz CDCl3



6r

^{1}H NMR 400MHz $CDCl_3$



6r

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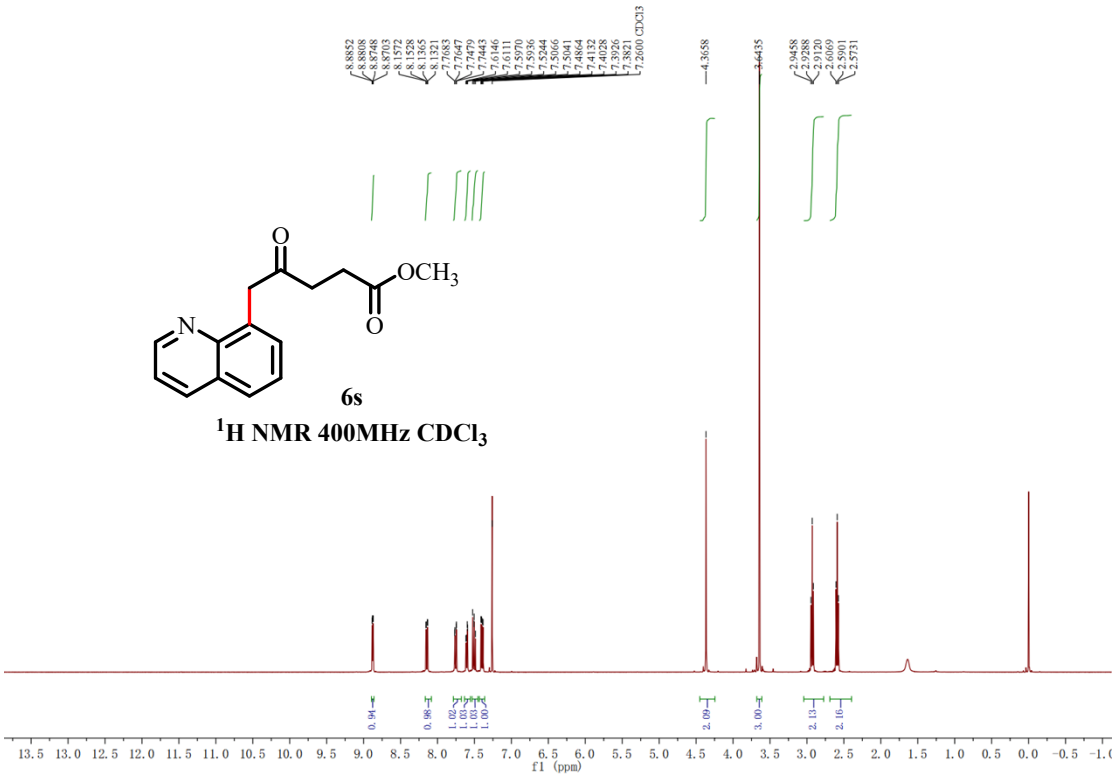

6s

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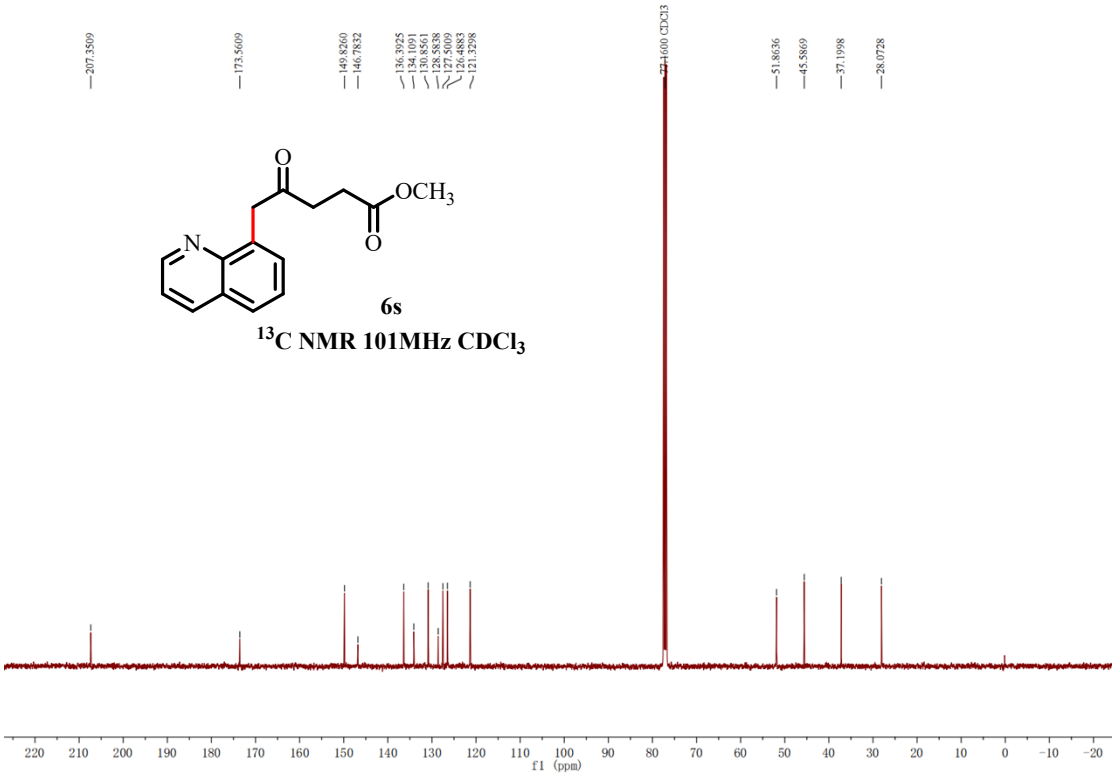

6s

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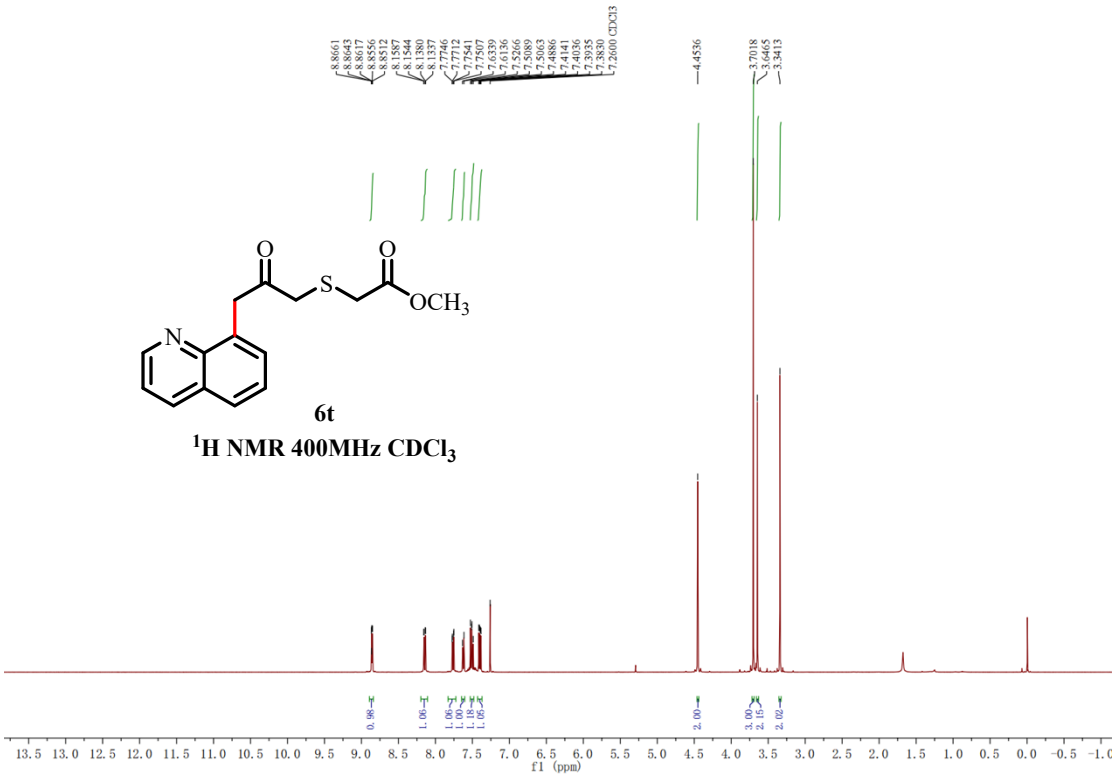
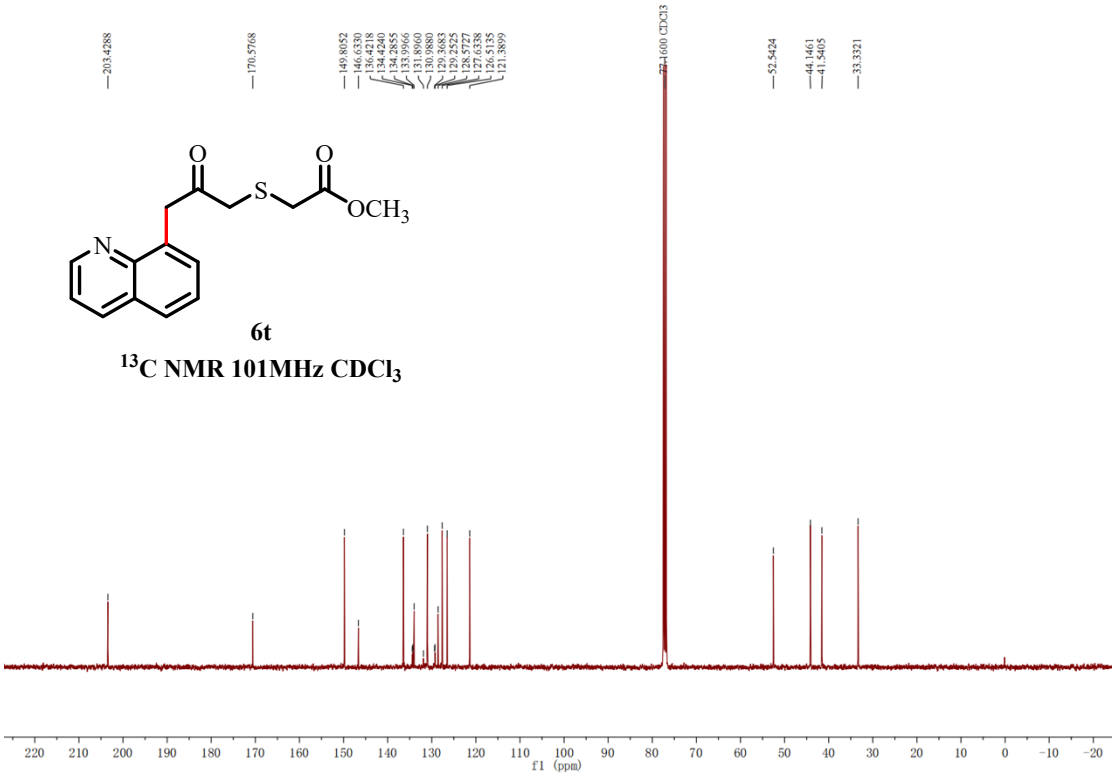


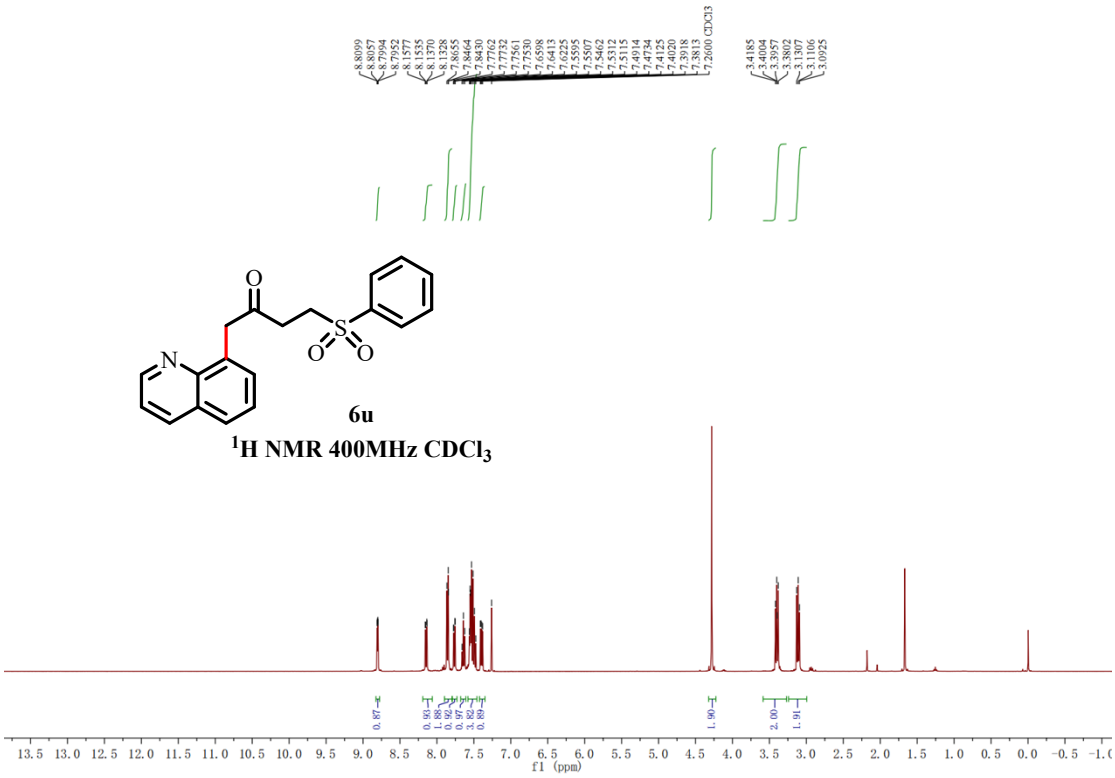
6t

^{1}H NMR 400MHz $CDCl_3$



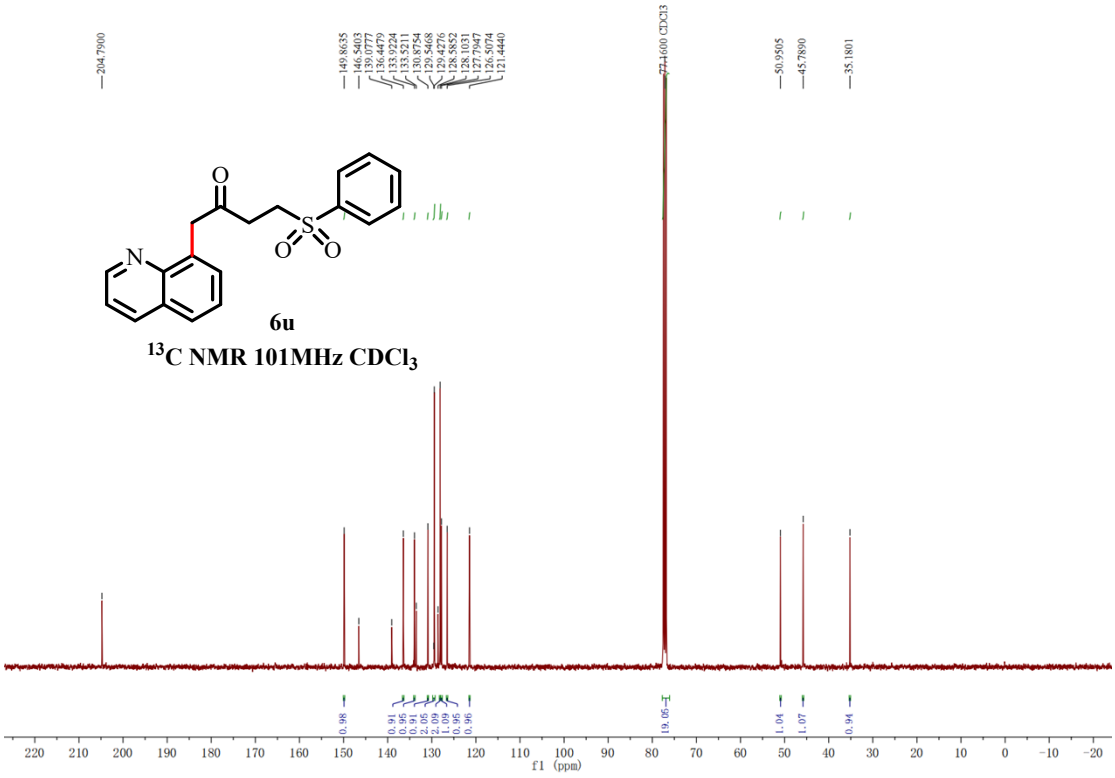
6t

^{13}C NMR 101MHz $CDCl_3$



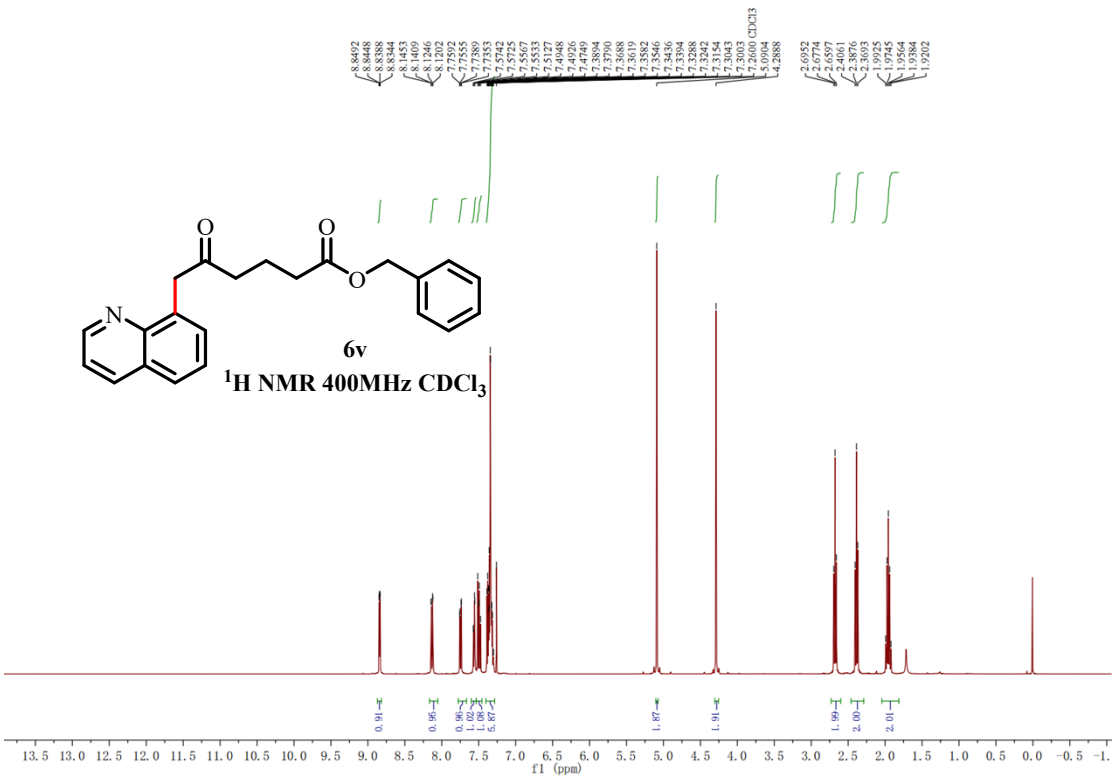
6u

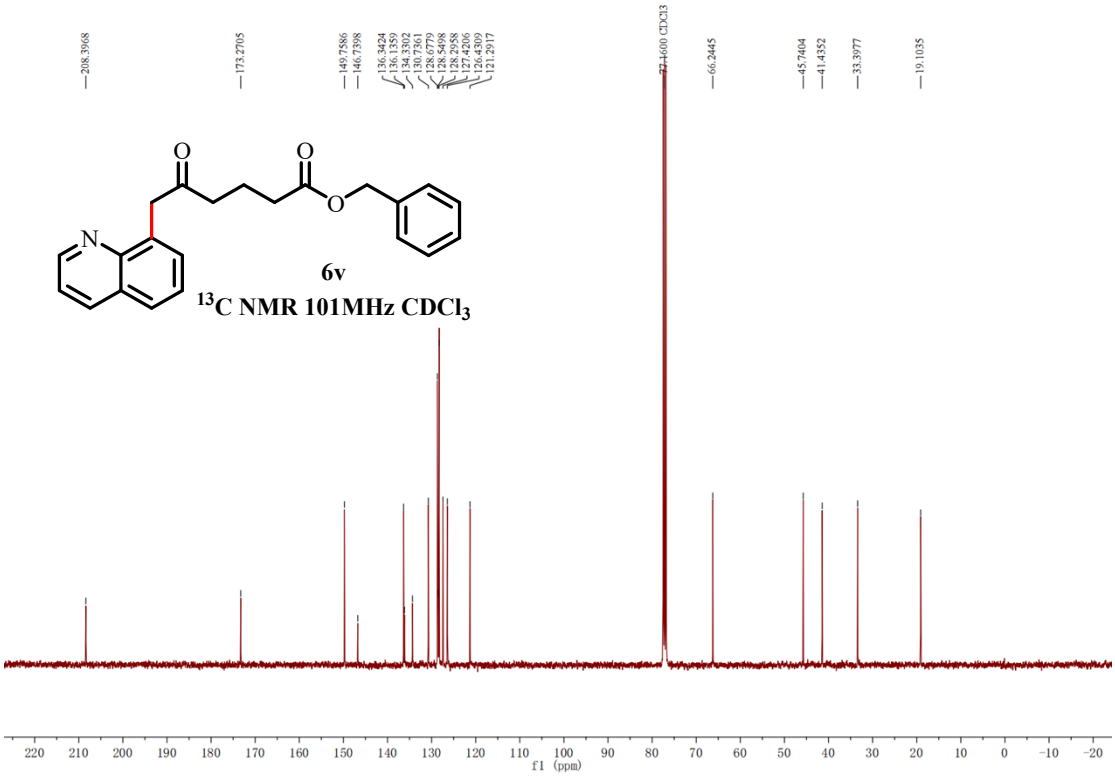
^{1}H NMR 400MHz $CDCl_3$

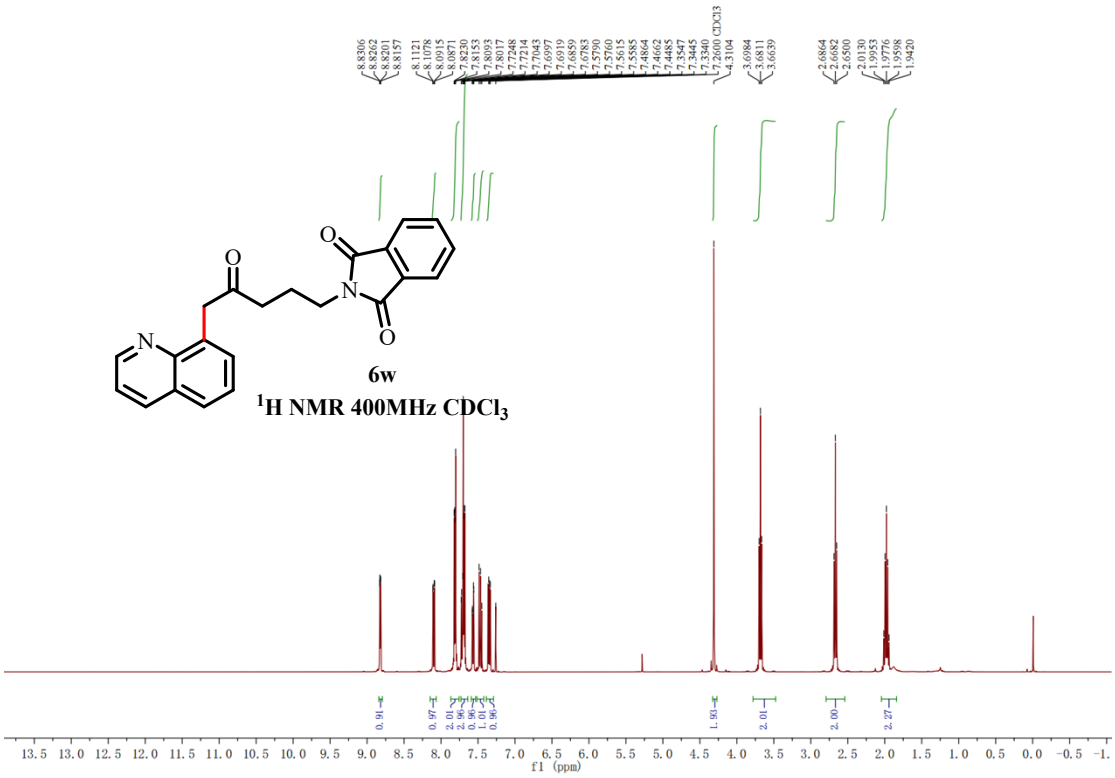


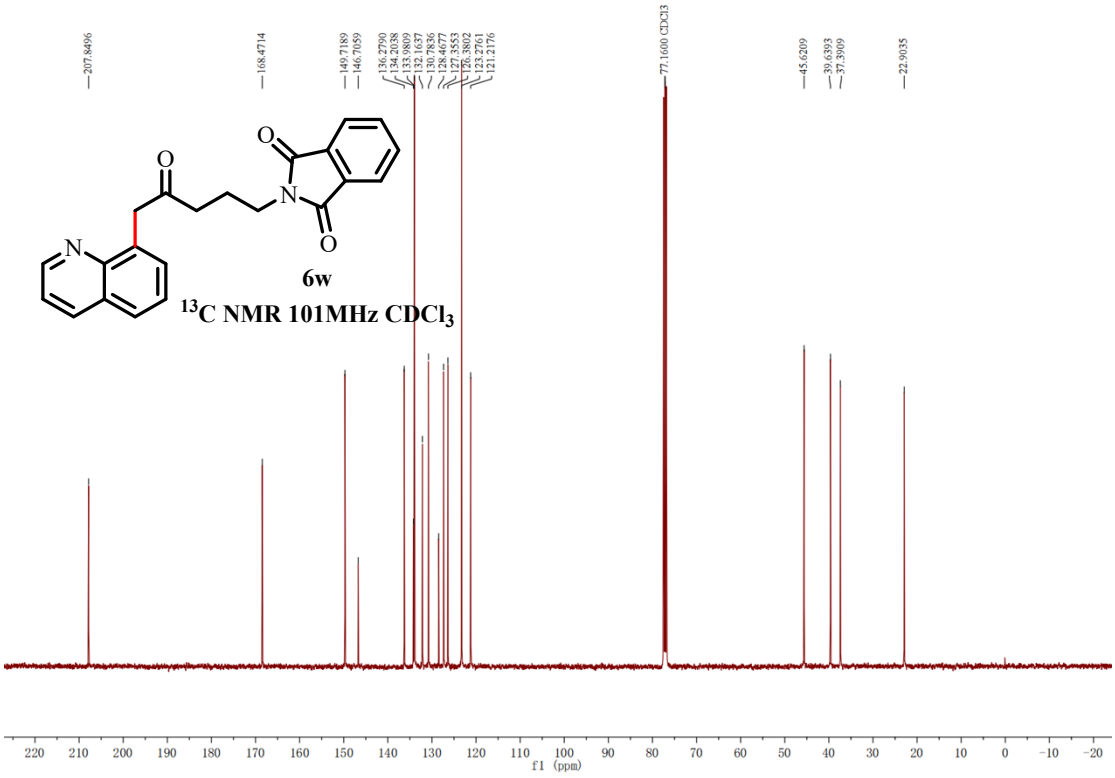
6u

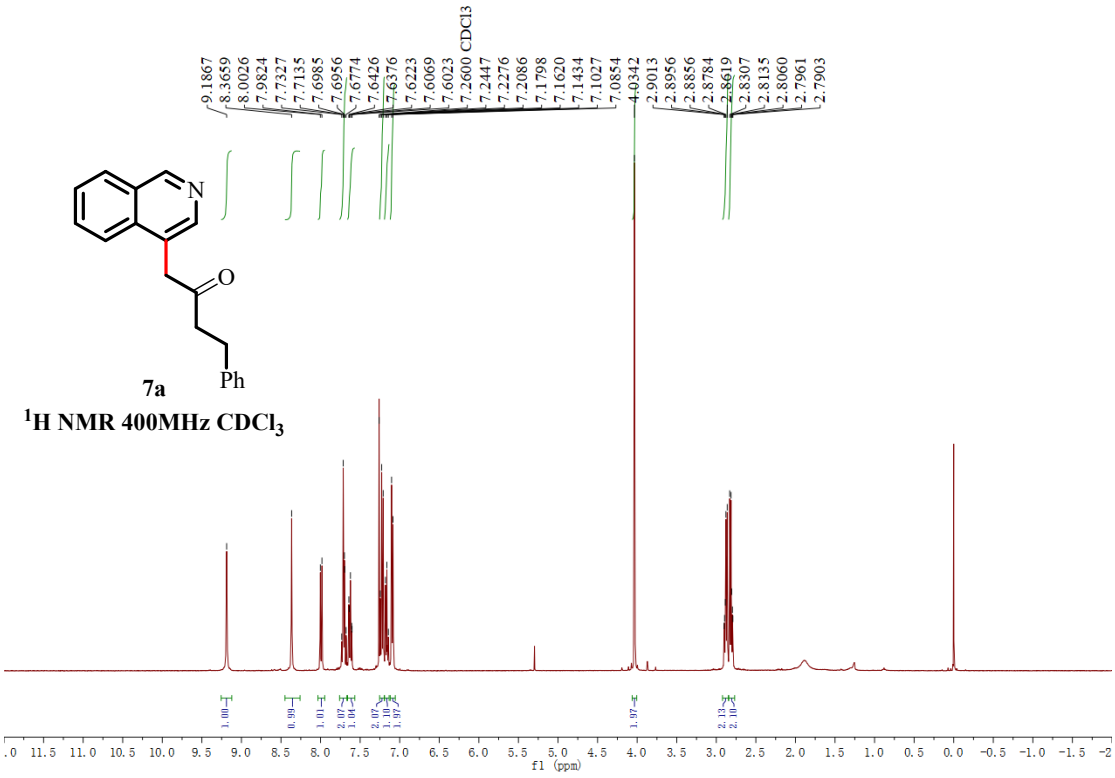
^{13}C NMR 101MHz $CDCl_3$


6v
1H NMR 400MHz CDCl3


6v
13C NMR 101MHz CDCl3

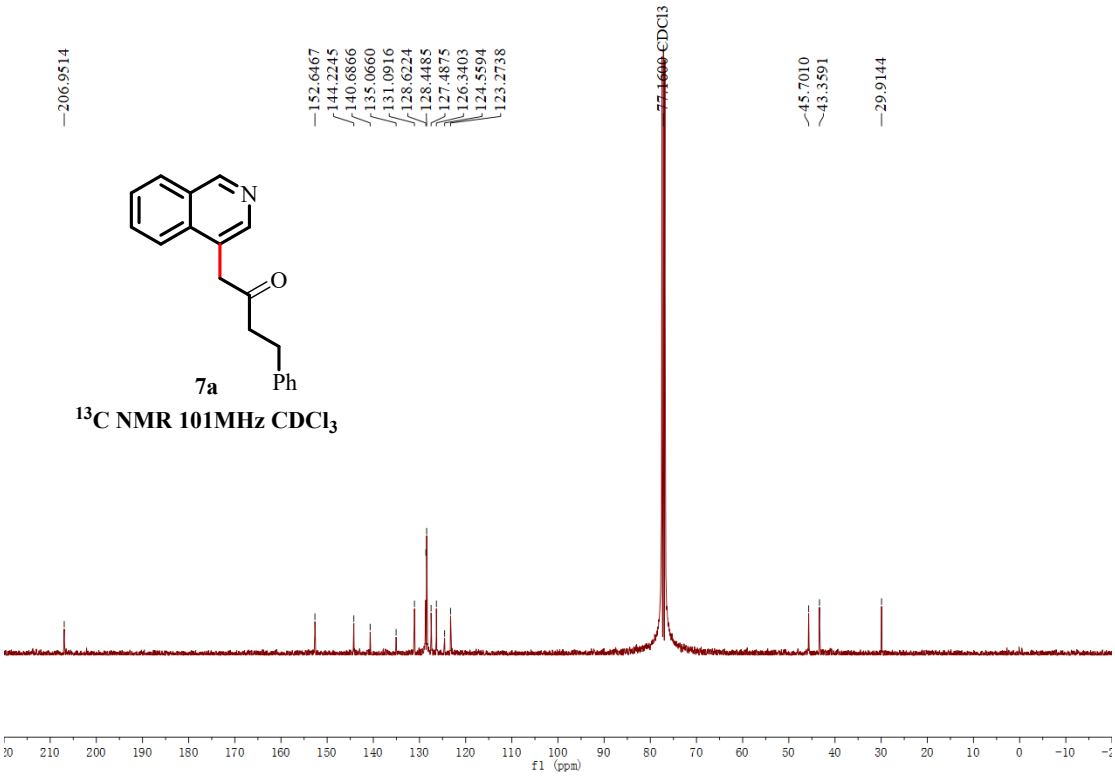

6w
1H NMR 400MHz CDCl3


6w
13C NMR 101MHz CDCl3



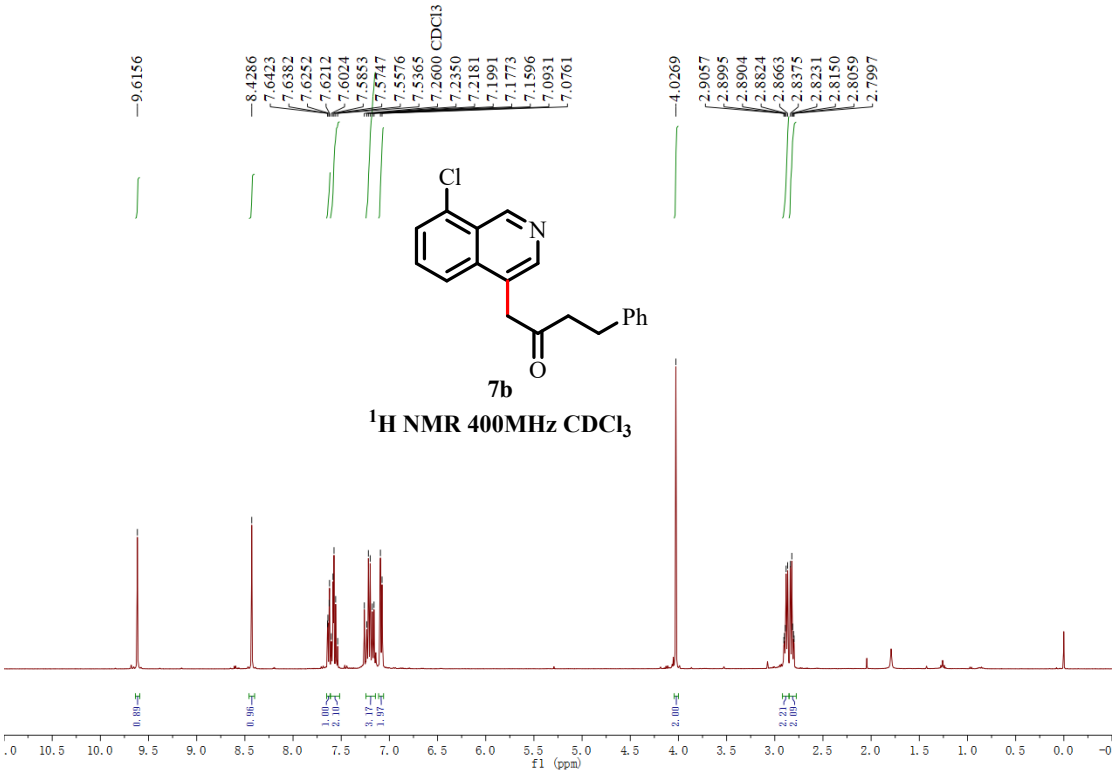
7a

^{1}H NMR 400MHz $CDCl_3$



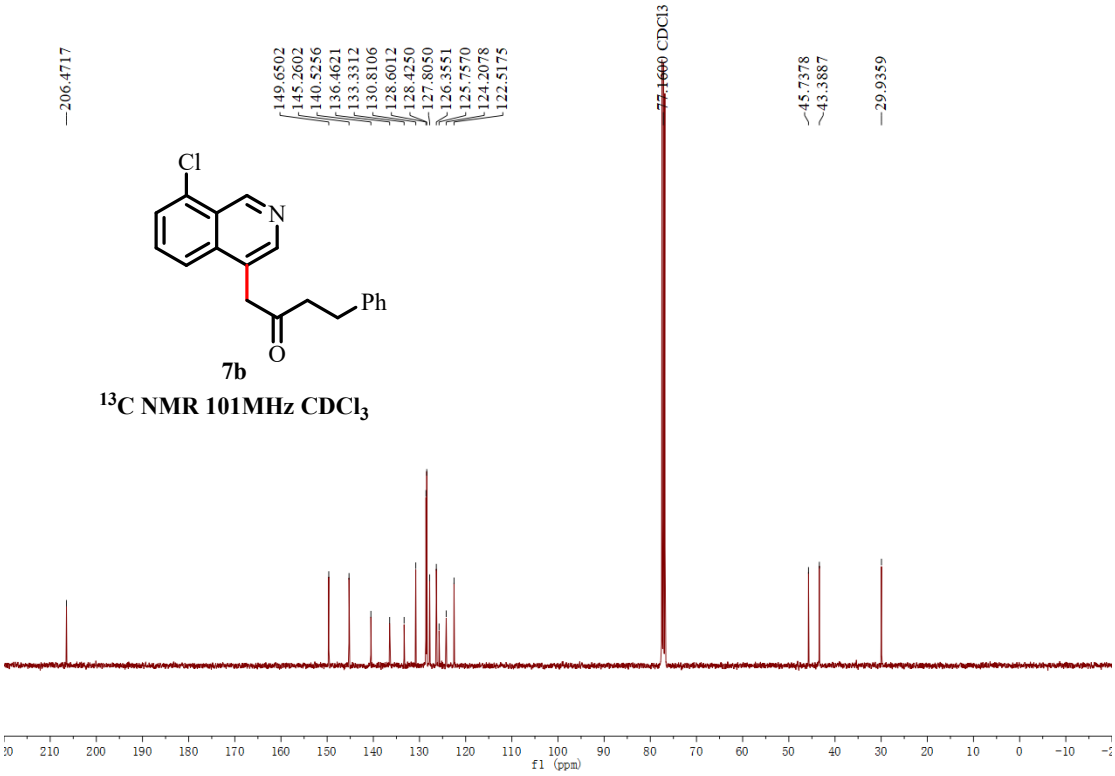
7a

^{13}C NMR 101MHz $CDCl_3$



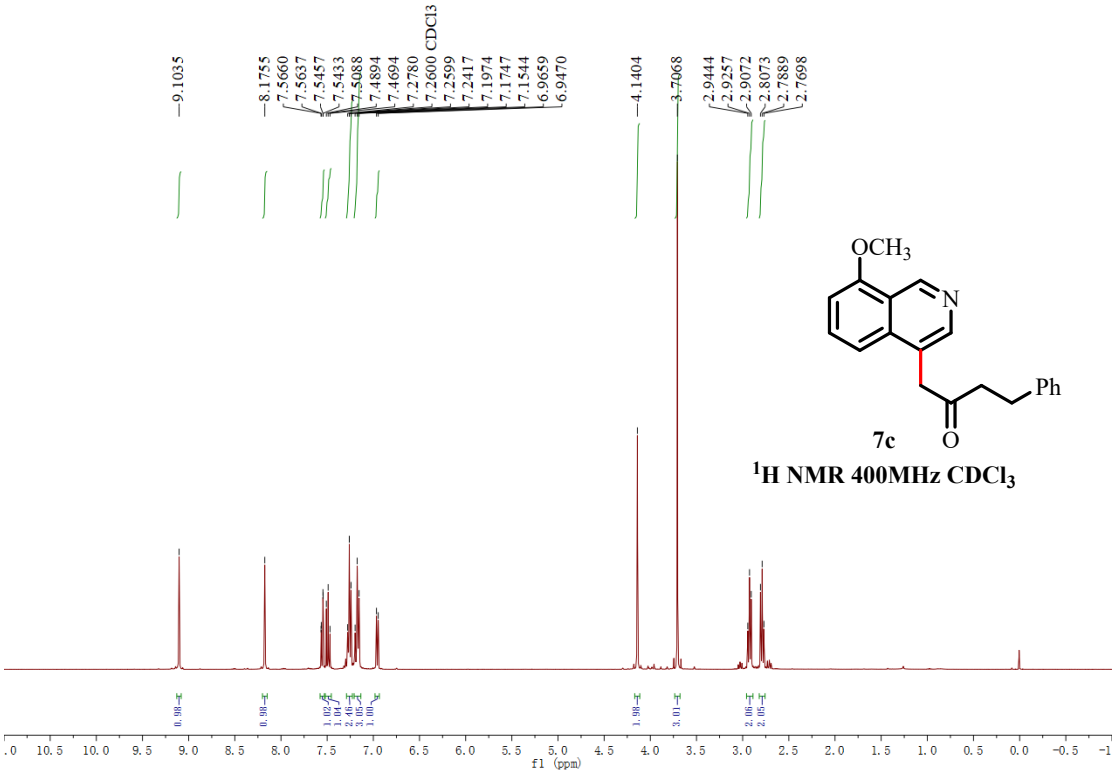
7b

^{1}H NMR 400MHz $CDCl_3$

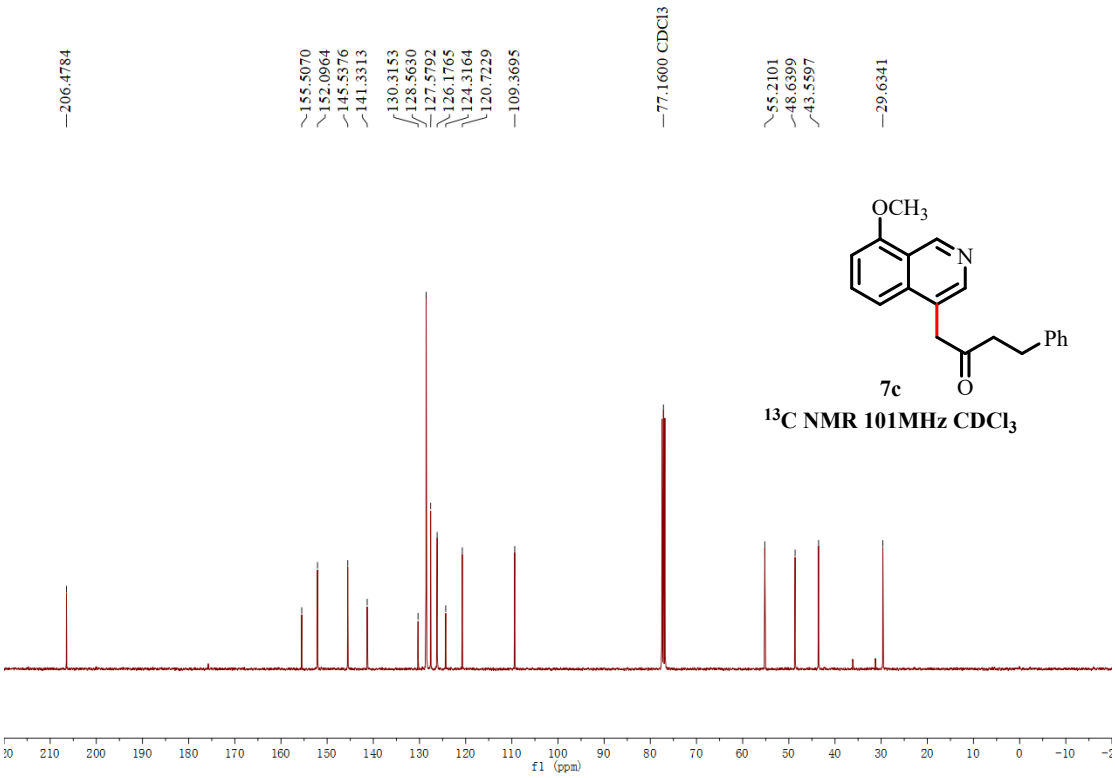


7b

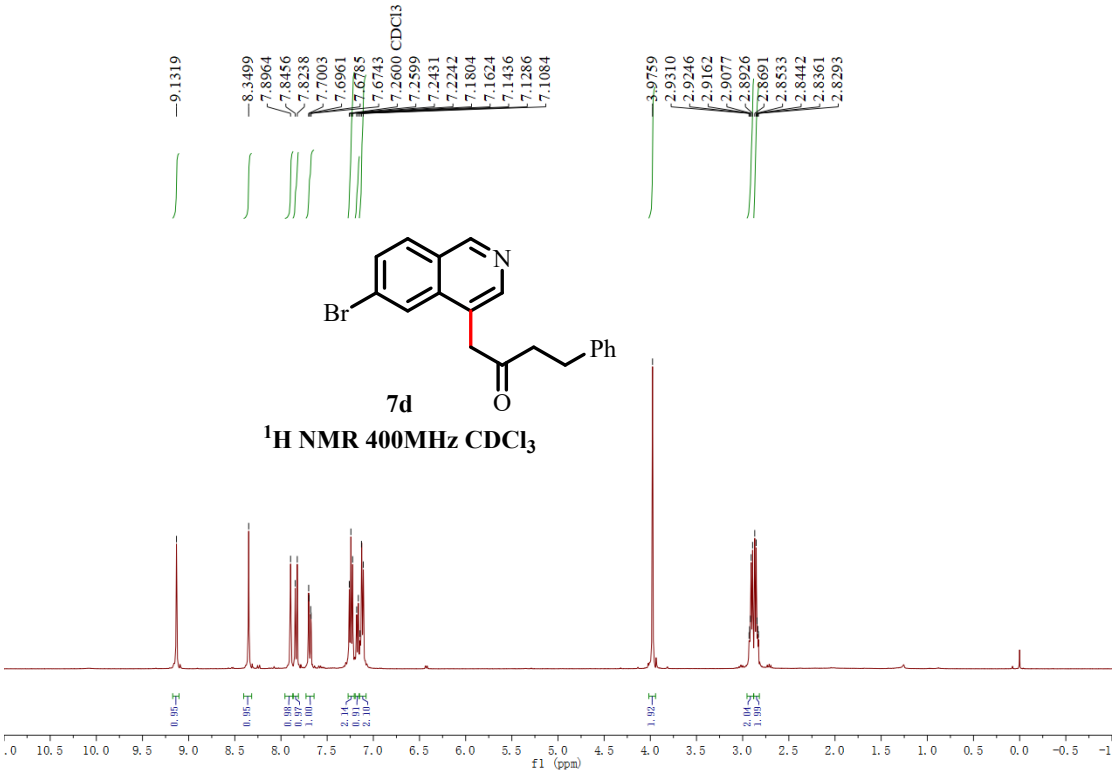
^{13}C NMR 101MHz $CDCl_3$



^{1}H NMR 400MHz $CDCl_3$

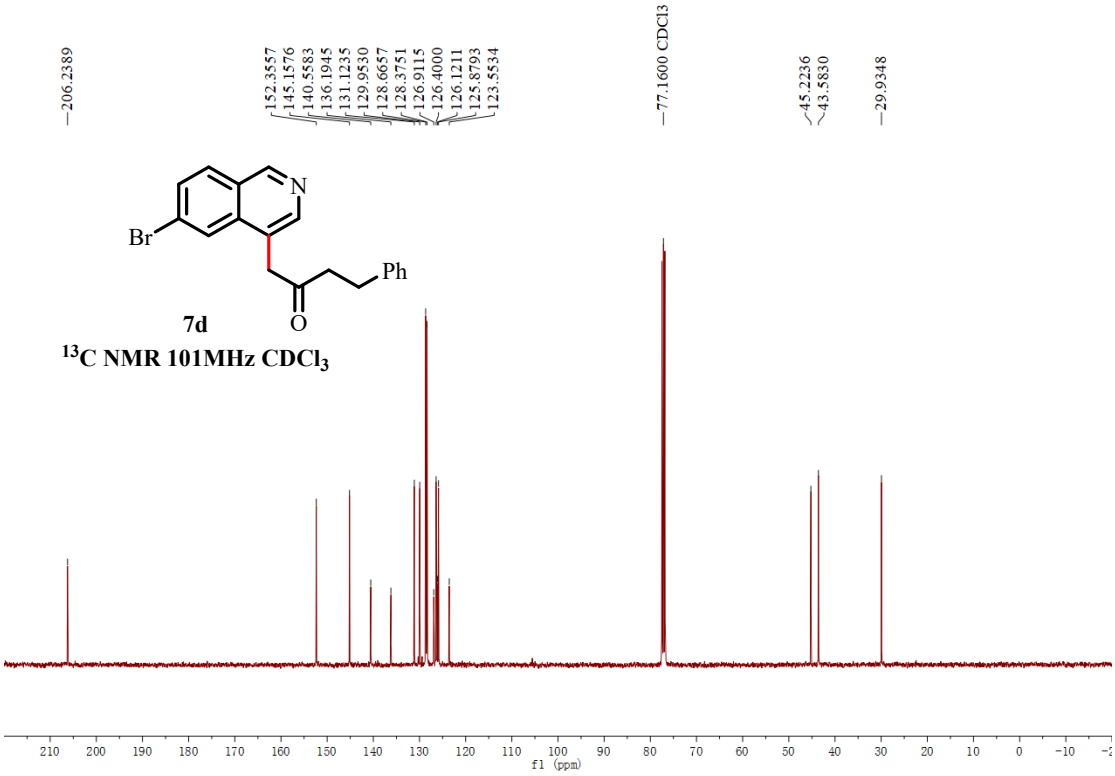


^{13}C NMR 101MHz $CDCl_3$



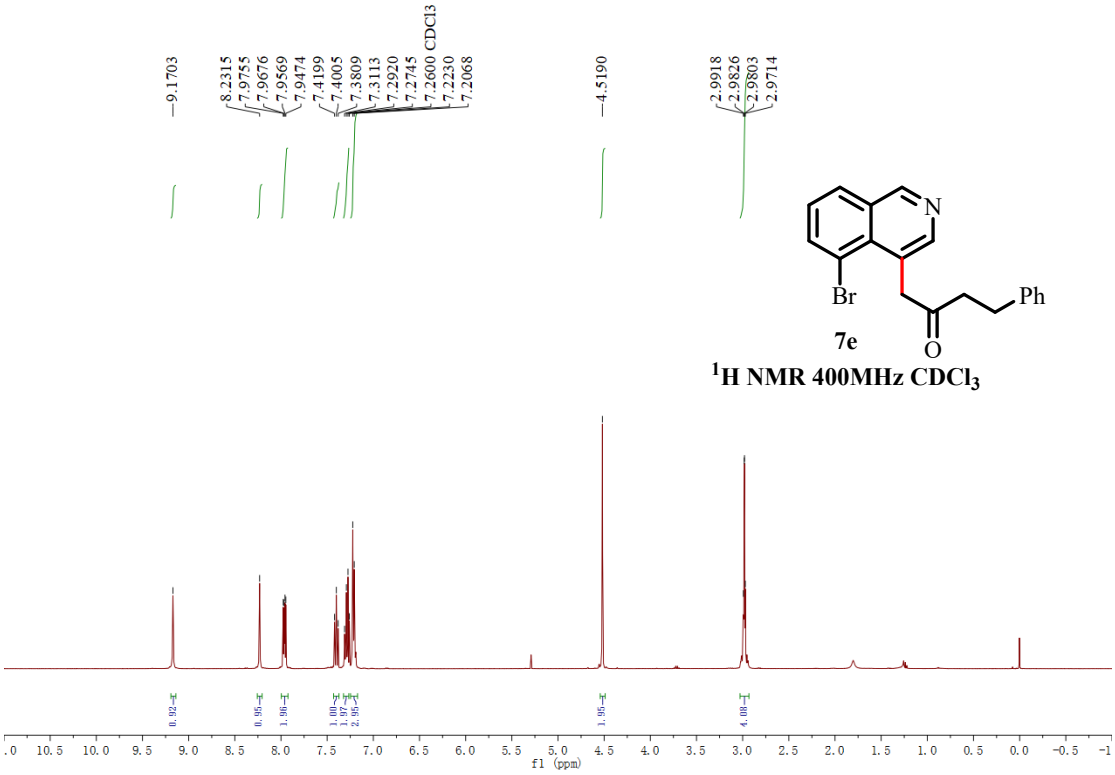
7d

^{1}H NMR 400MHz $CDCl_3$



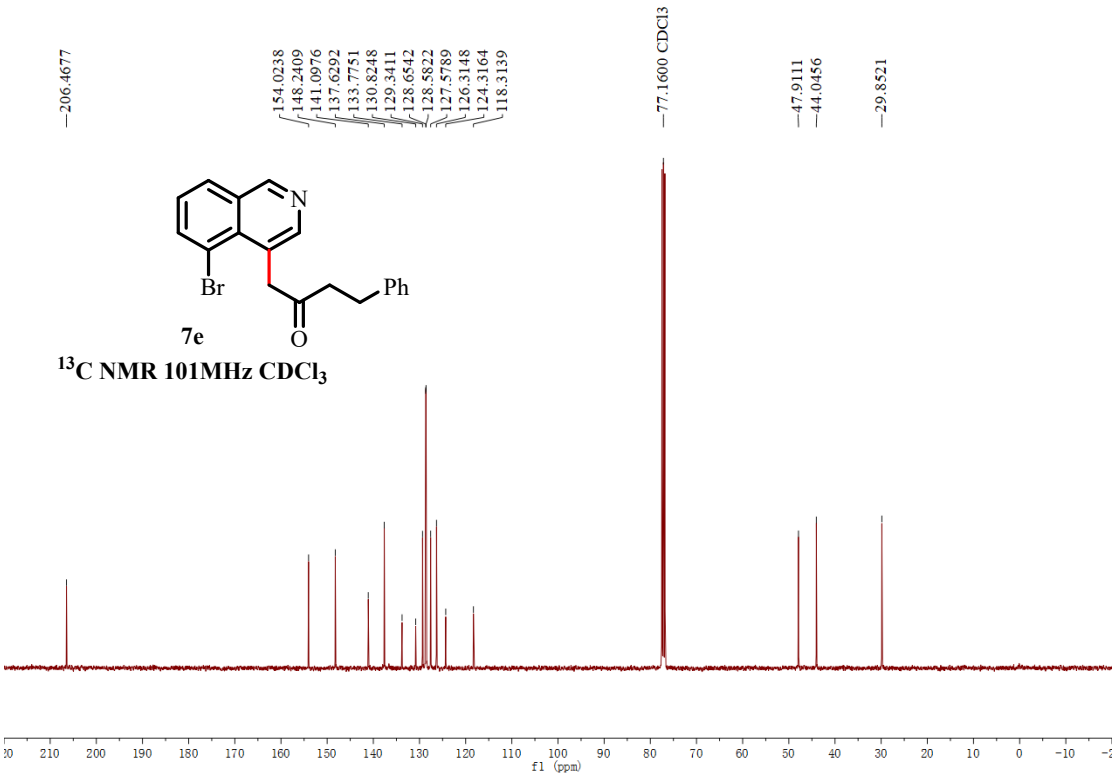
7d

^{13}C NMR 101MHz $CDCl_3$



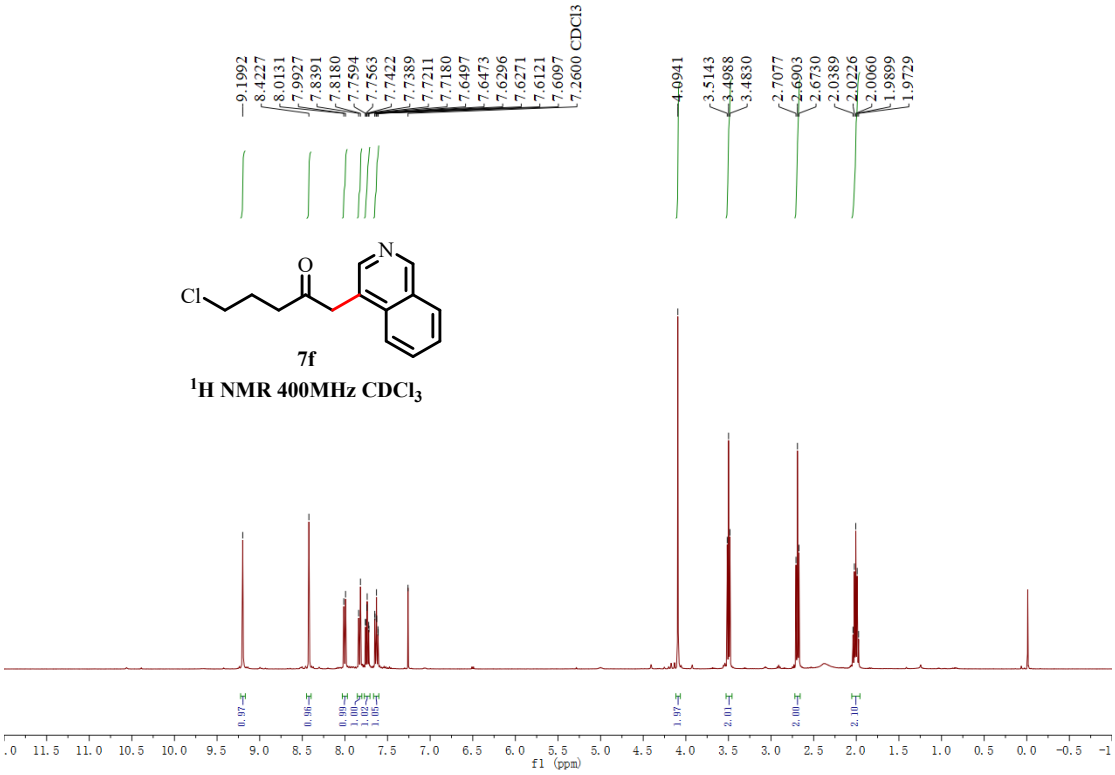
7e

^{1}H NMR 400MHz $CDCl_3$



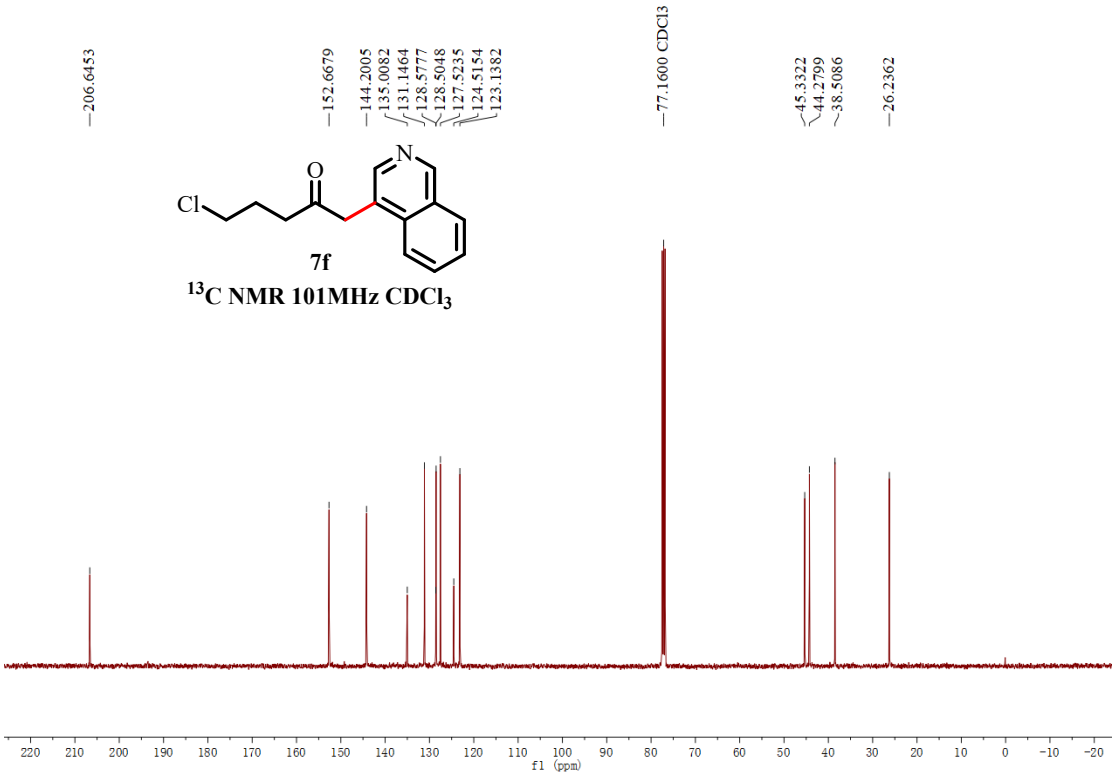
7e

^{13}C NMR 101MHz $CDCl_3$



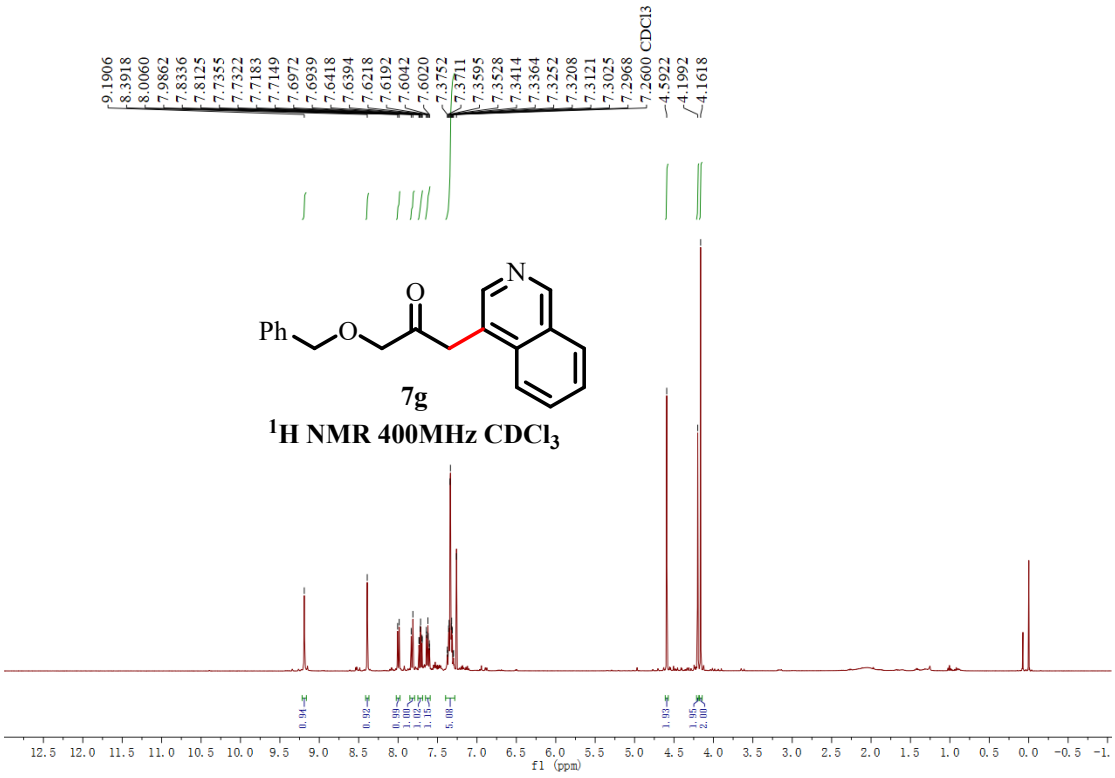
7f

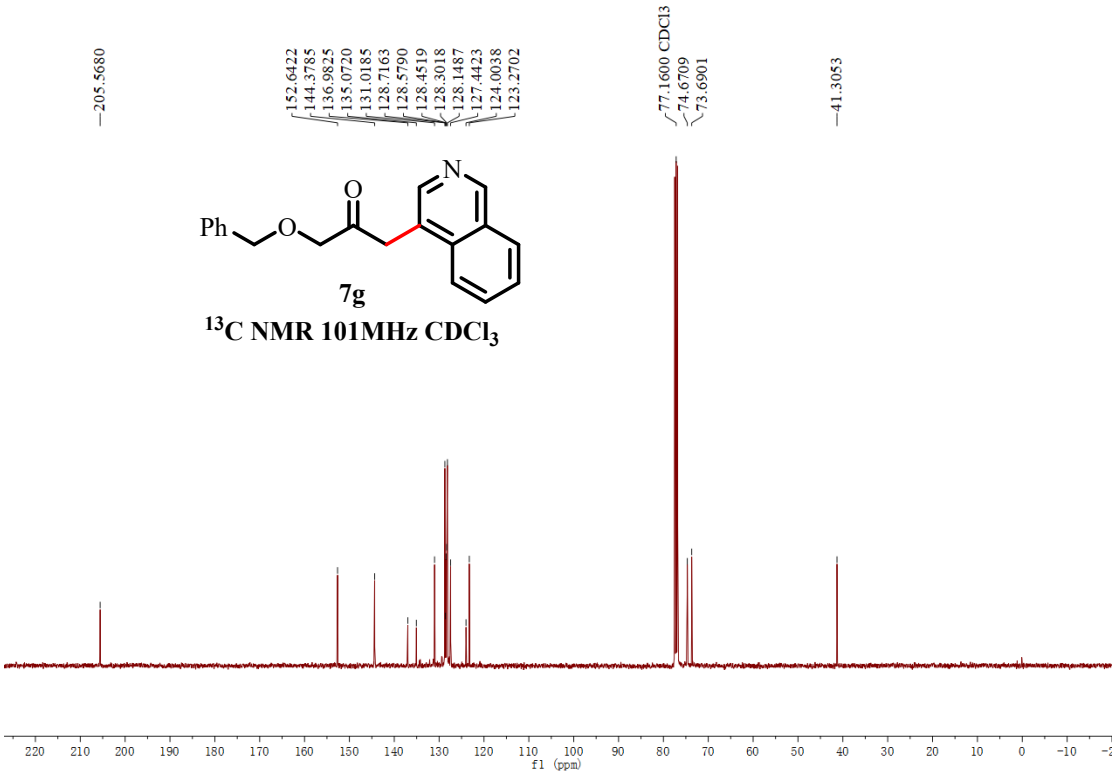
^{1}H NMR 400MHz $CDCl_3$

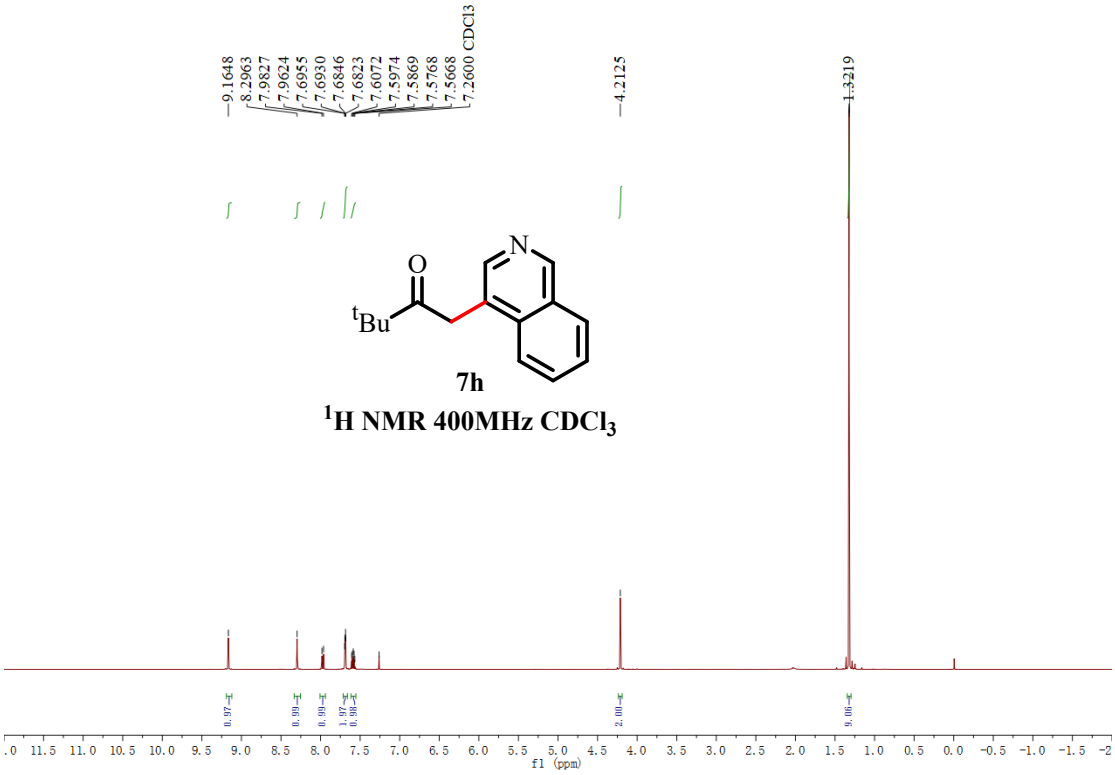


7f

^{13}C NMR 101MHz $CDCl_3$

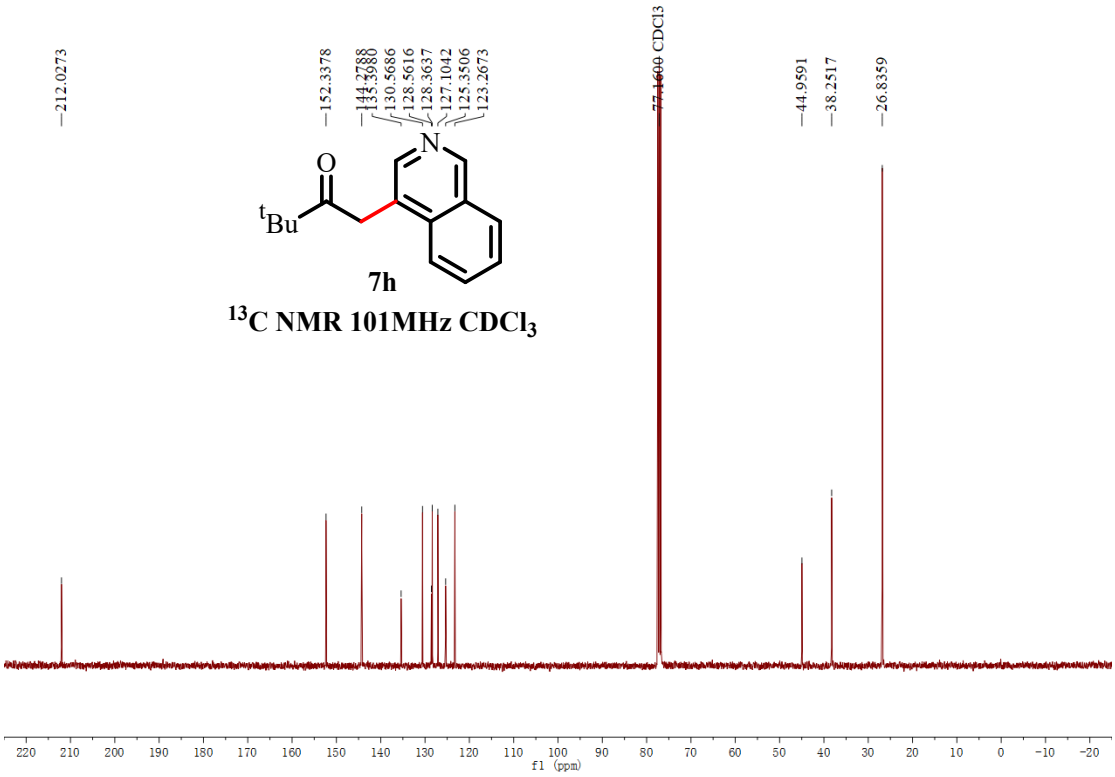

9.1906
8.3918
8.0060
7.9862
7.8336
7.8125
7.7355
7.7322
7.7183
7.7149
7.6972
7.6939
7.6418
7.6394
7.6218
7.6192
7.6042
7.6020
7.3752
7.3711
7.3595
7.3528
7.3414
7.3364
7.3252
7.3208
7.3121
7.3025
7.2968
7.2600 CDCl3
4.5922
4.1992
4.1618
N
O
Ph
O
7g
1H NMR 400MHz CDCl3
f1 (ppm)


205.5680
152.6422
144.3785
136.9825
135.0720
131.0185
128.7163
128.5790
128.4519
128.3018
128.1487
127.4423
124.0038
123.2702
77.1600 CDCl3
74.6709
73.6901
41.3053
N
O
Ph
O
7g
13C NMR 101MHz CDCl3
f1 (ppm)



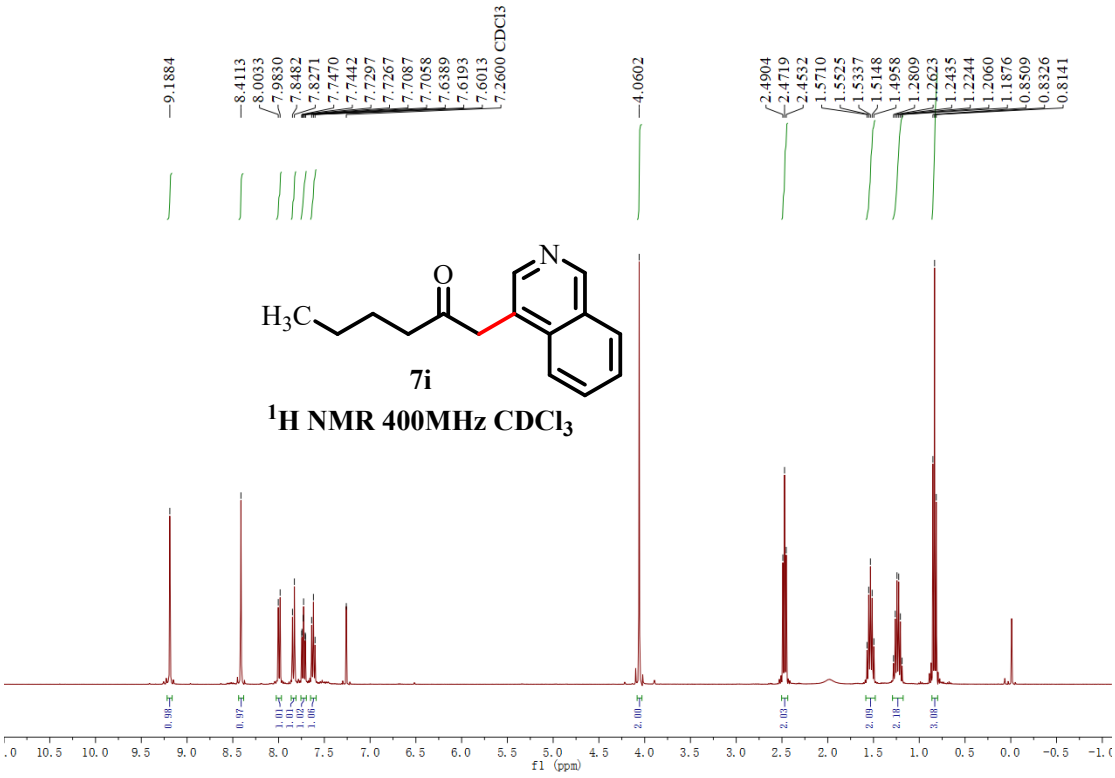
7h

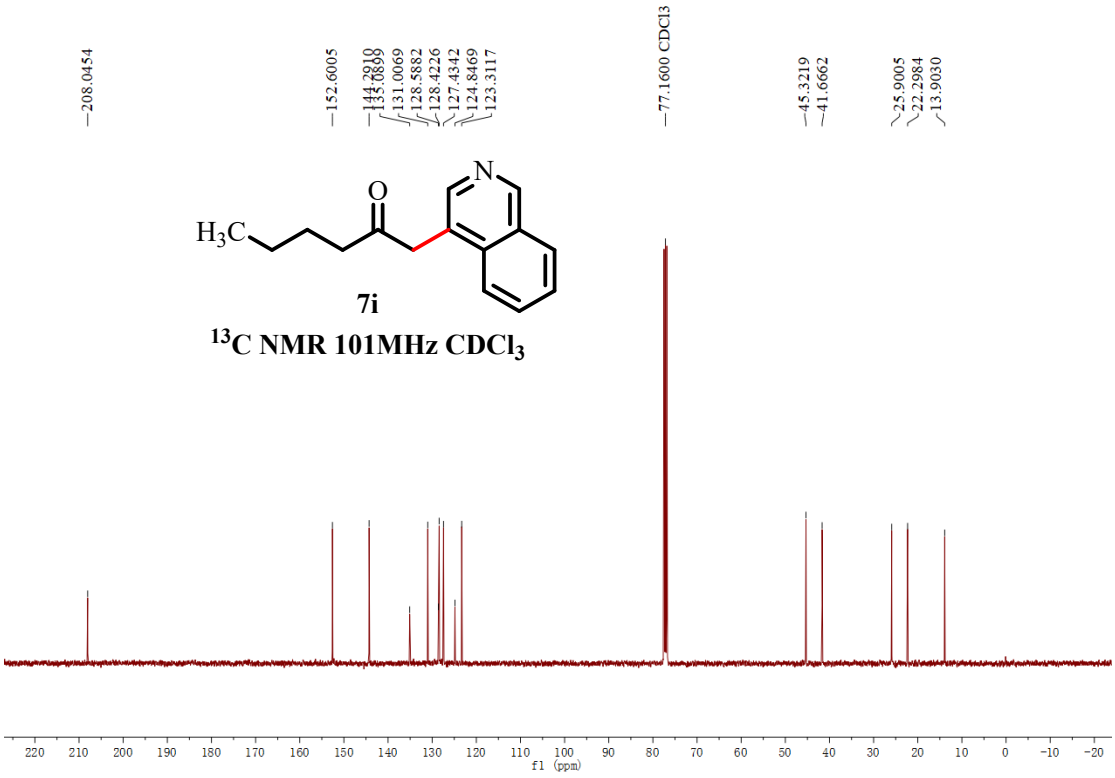
^{1}H NMR 400MHz $CDCl_3$

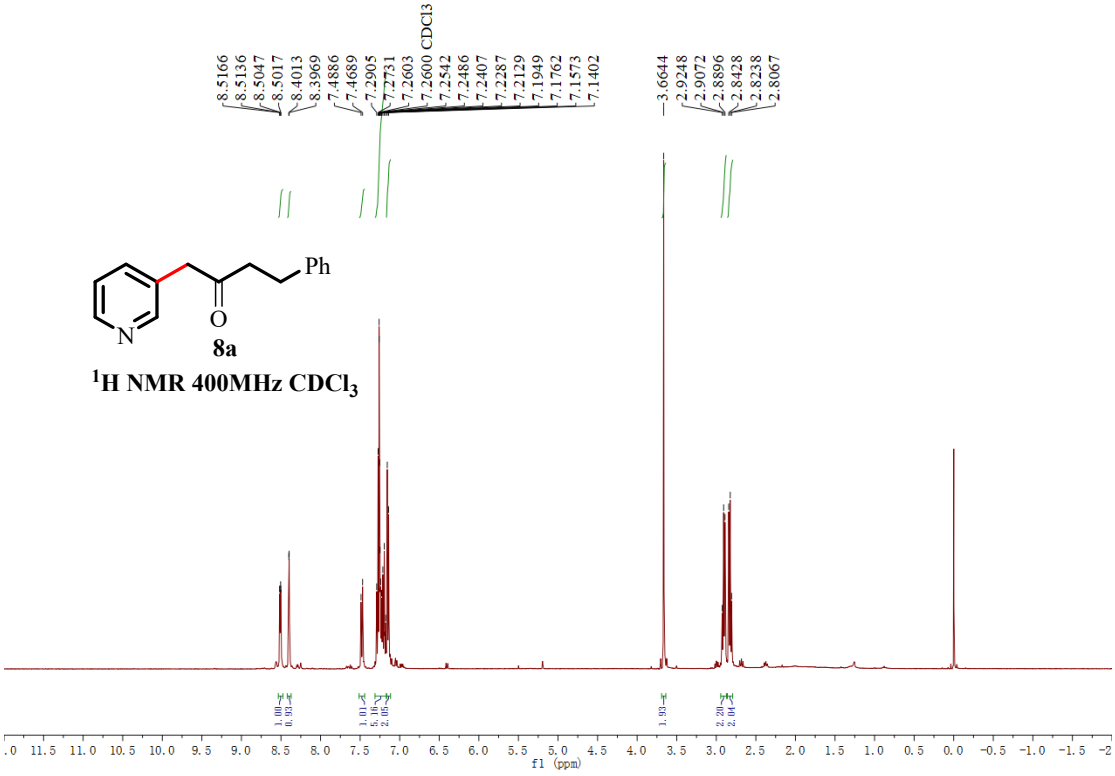


7h

^{13}C NMR 101MHz $CDCl_3$

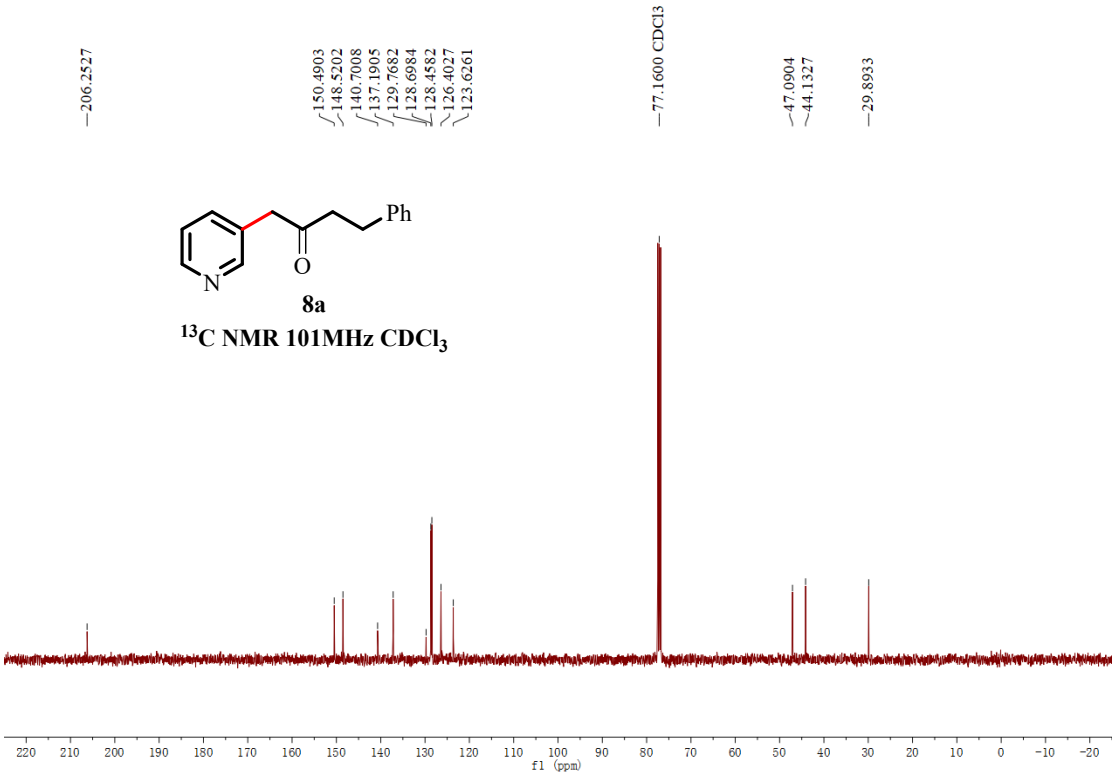

9.1884
8.4113
8.0033
7.9830
7.8482
7.8271
7.7470
7.7442
7.7297
7.7267
7.7087
7.7058
7.6389
7.6193
7.6013
7.2600 CDCl3
4.0602
2.4904
2.4719
2.4532
1.5710
1.5525
1.5337
1.5148
1.4958
1.2809
1.2623
1.2435
1.2244
1.2060
1.1876
0.8509
0.8326
0.8141
O
N
H3C
7i
1H NMR 400MHz CDCl3
f1 (ppm)


208.0454
152.6005
144.2810
135.0899
131.0069
128.5882
128.4226
127.4342
124.8469
123.3117
77.1600 CDCl3
45.3219
41.6662
25.9005
22.2984
13.9030
O
N
H3C
7i
13C NMR 101MHz CDCl3
f1 (ppm)



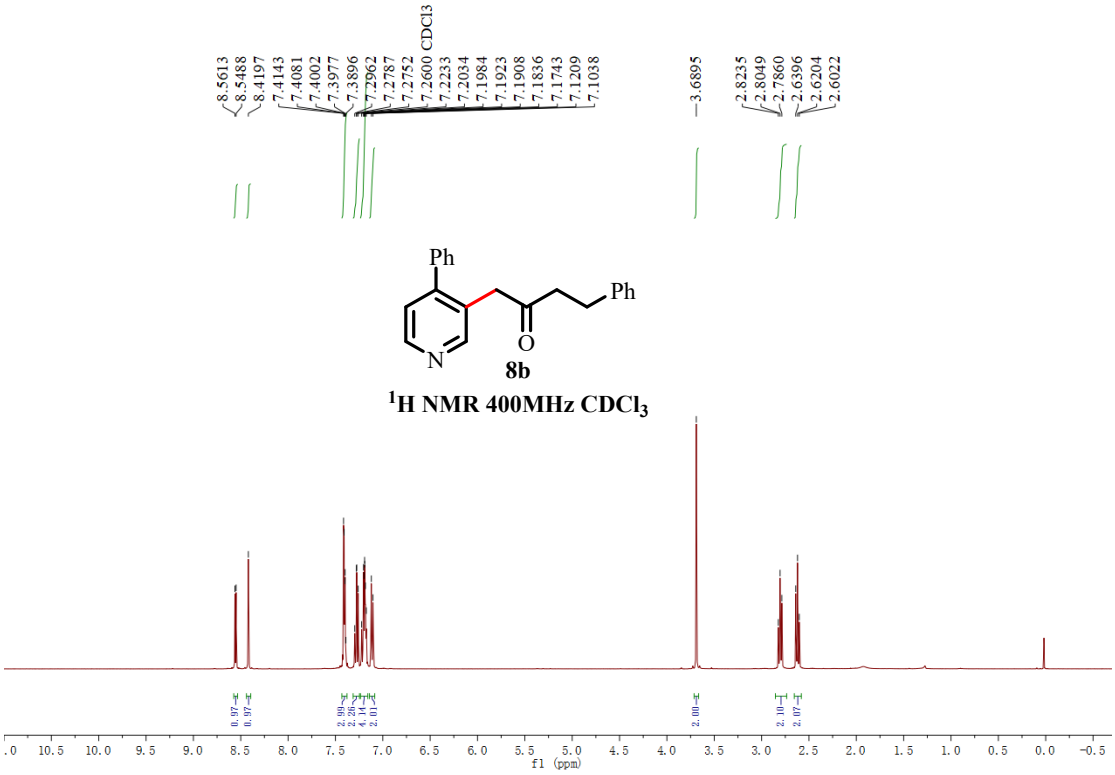
8a

^{1}H NMR 400MHz $CDCl_3$



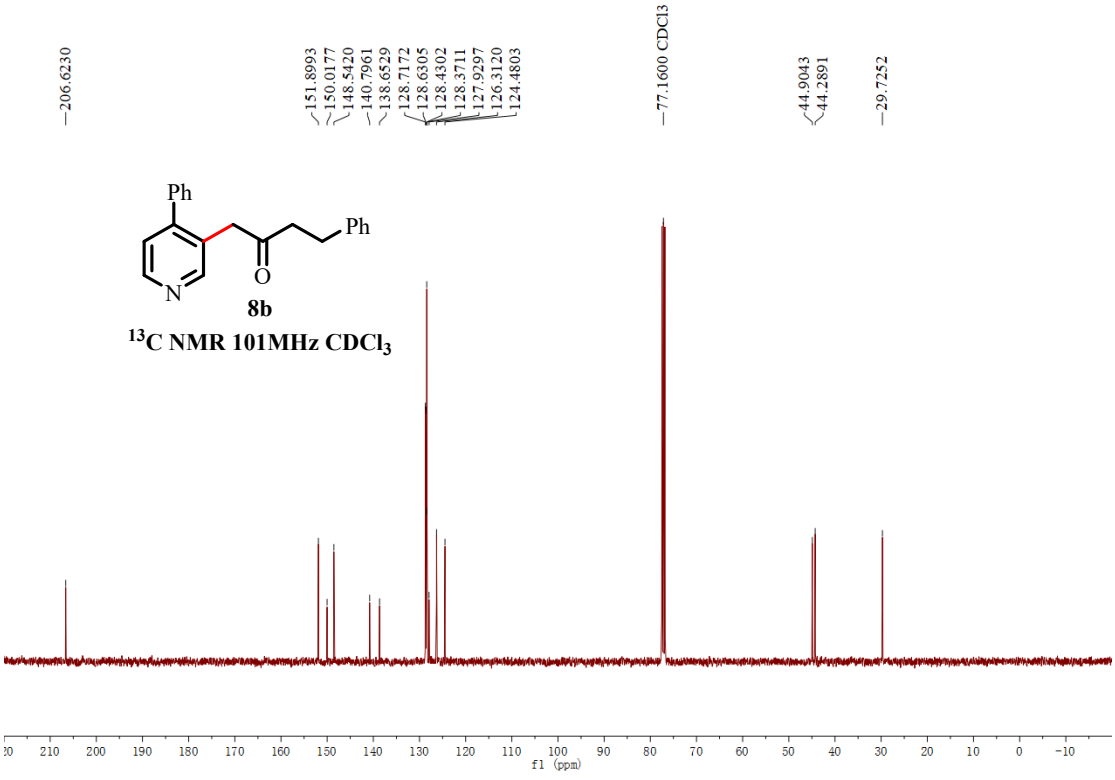
8a

^{13}C NMR 101MHz $CDCl_3$



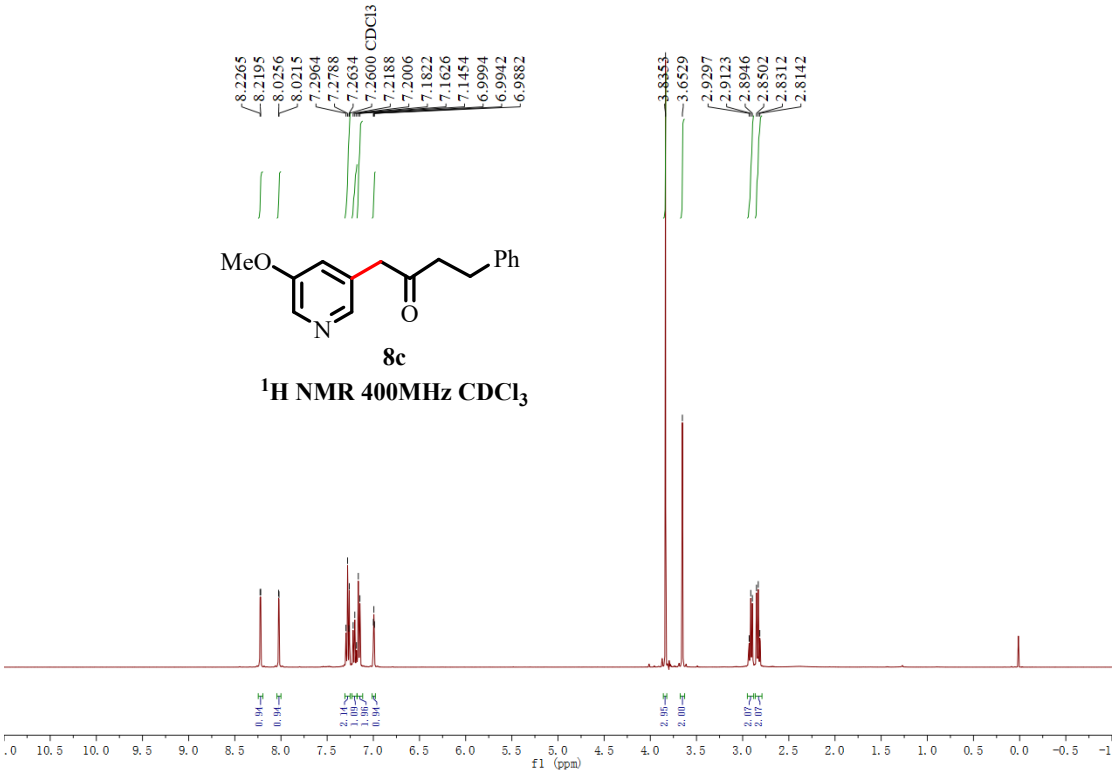
8b

^{1}H NMR 400MHz $CDCl_3$



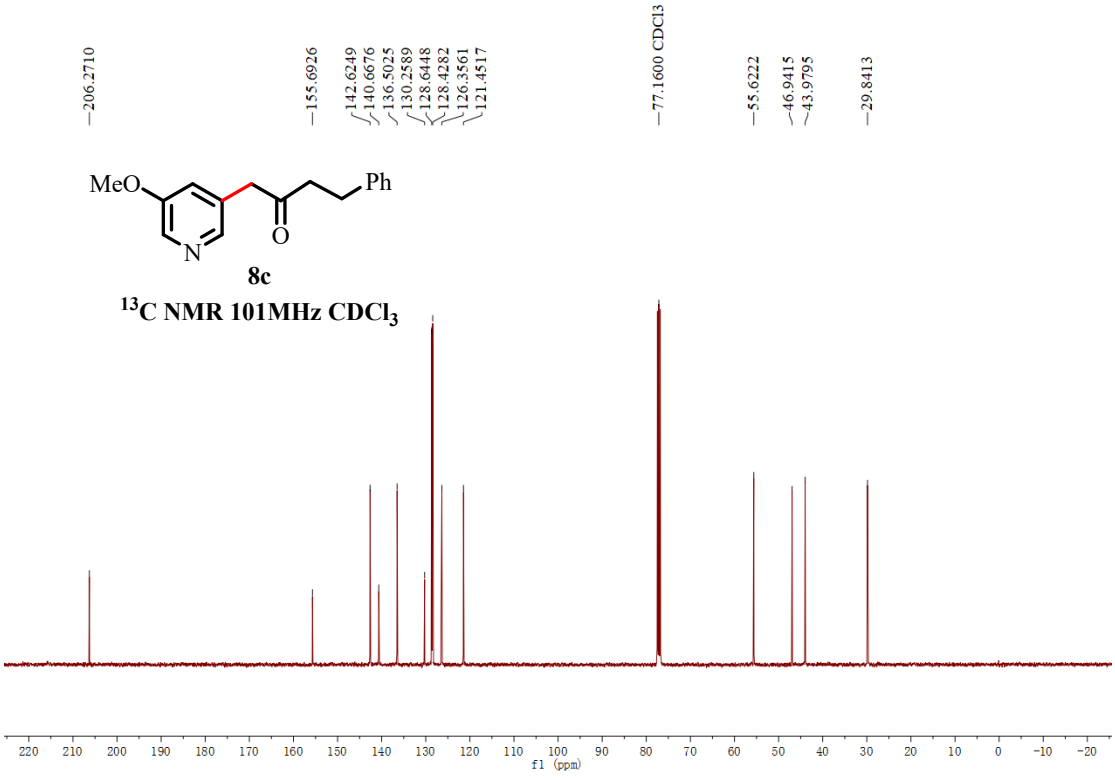
8b

^{13}C NMR 101MHz $CDCl_3$



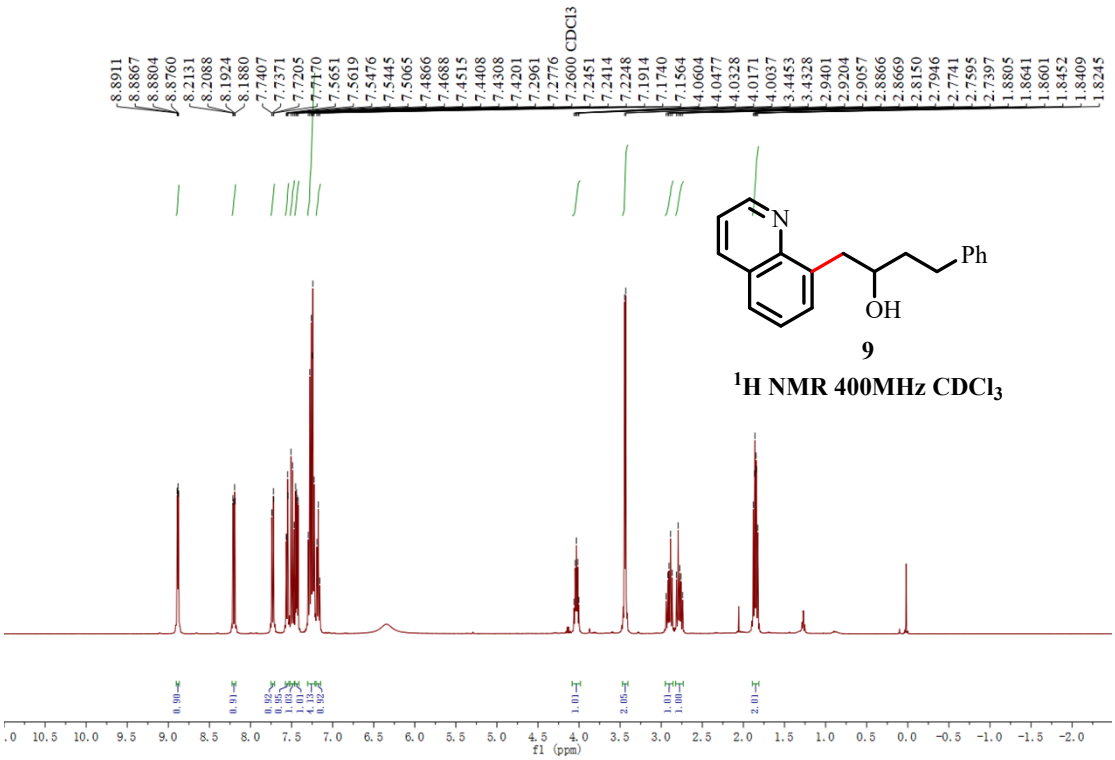
8c

^{1}H NMR 400MHz $CDCl_3$



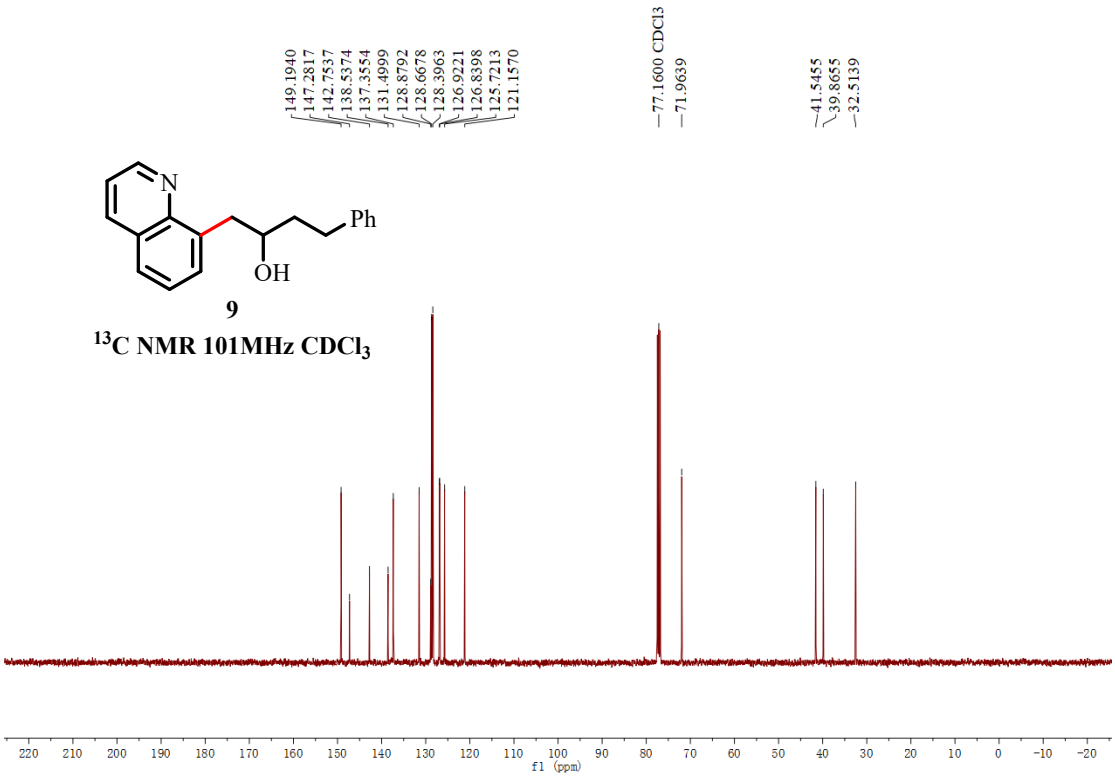
8c

^{13}C NMR 101MHz $CDCl_3$



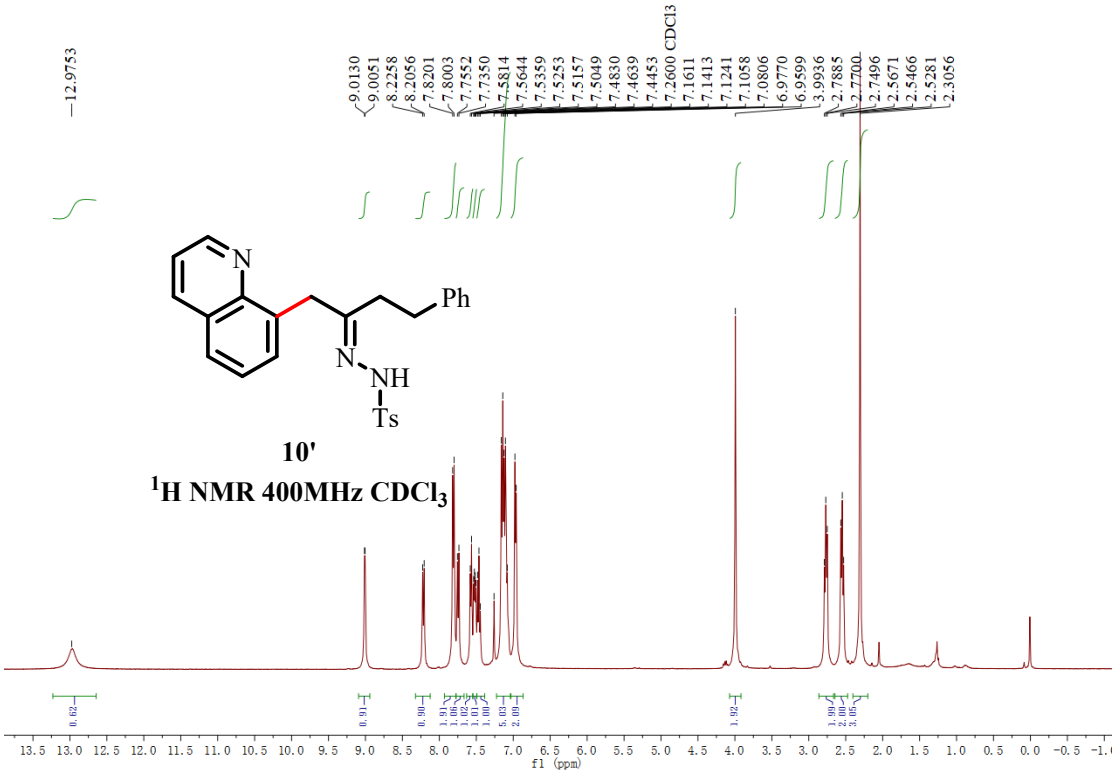
9

^{1}H NMR 400MHz $CDCl_3$



9

^{13}C NMR 101MHz $CDCl_3$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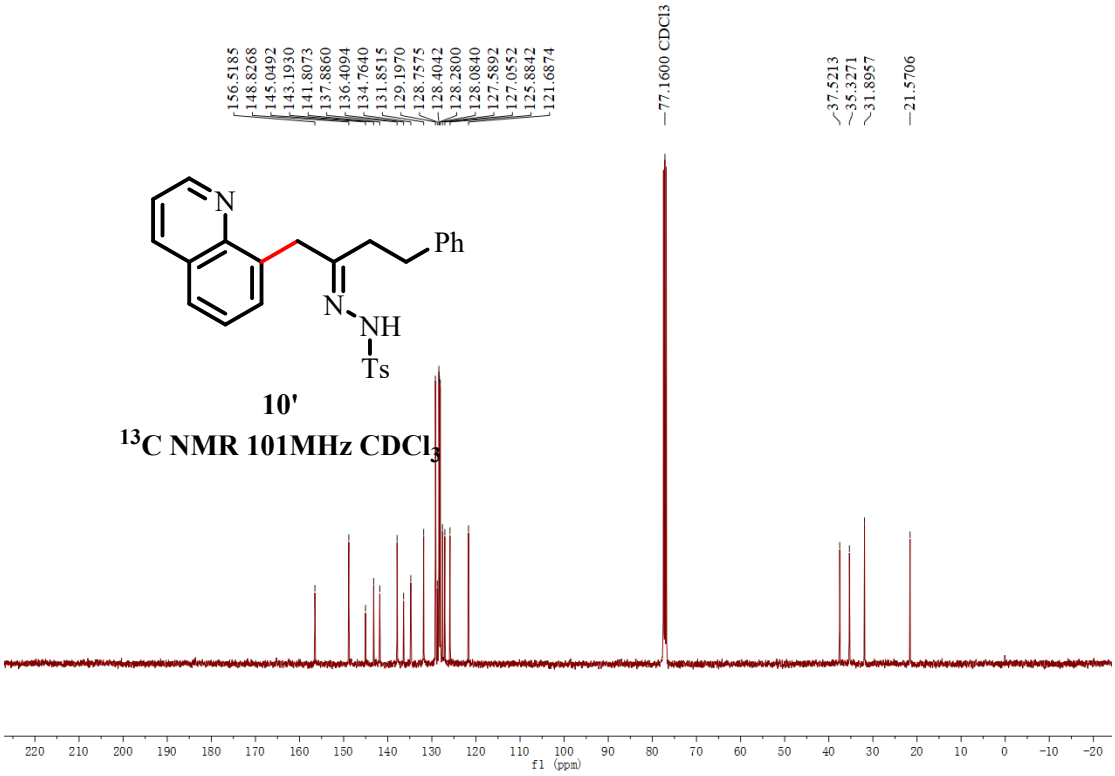
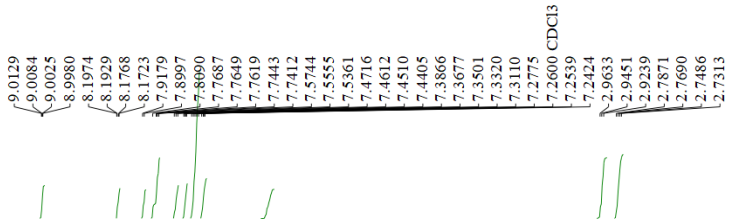
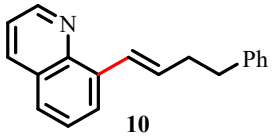
9.0130
9.0051
8.2258
8.2056
8.8201
7.8003
7.7552
7.7350
7.5814
7.5644
7.5359
7.5253
7.5157
7.5049
7.4830
7.4639
7.4453
7.2600 CDCl3
7.1611
7.1413
7.1241
7.1058
7.0806
6.9770
6.9599
3.9936
2.7885
2.7700
2.7496
2.5671
2.5466
2.5281
2.3056
N
Ph
N
NH
Ts
10'
1H NMR 400MHz CDCl3
f1 (ppm)

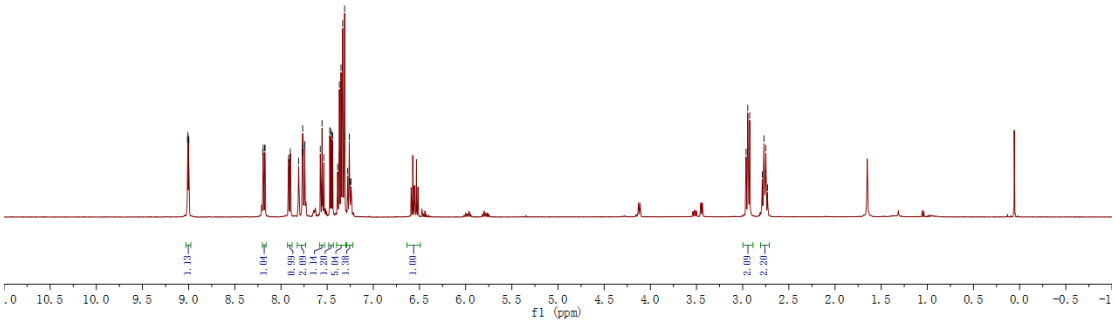

156.5185
148.8268
145.0492
143.1930
141.8073
137.8860
136.4094
134.7640
131.8515
129.1970
128.7575
128.4042
128.2800
128.0840
127.5892
127.0552
125.8842
121.6874
77.1600 CDCl3
37.5213
35.3271
31.8957
21.5706
N
Ph
N
NH
Ts
10'
13C NMR 101MHz CDCl3
f1 (ppm)

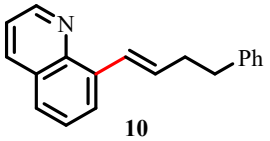




10

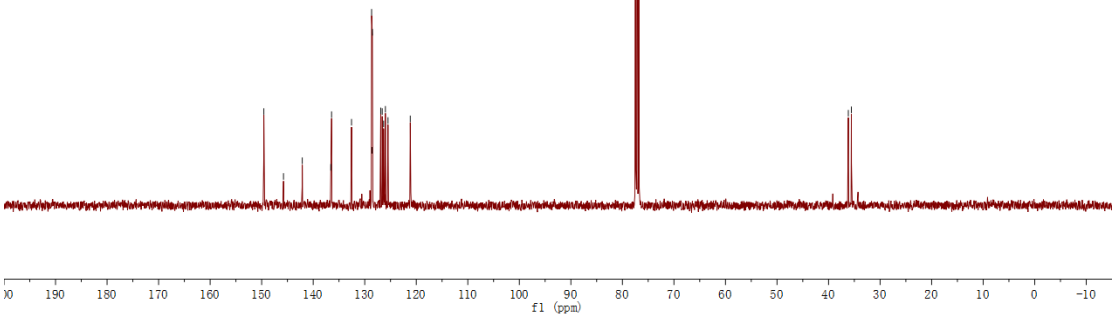
^{1}H NMR 400MHz $CDCl_3$

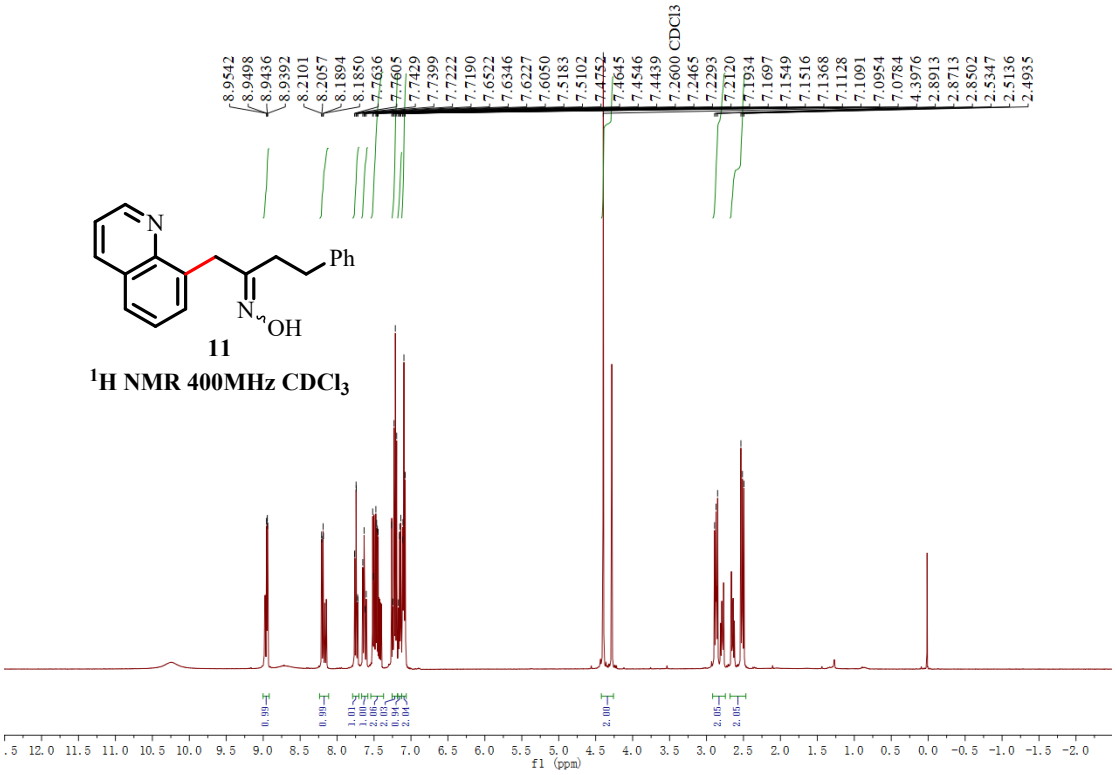




10

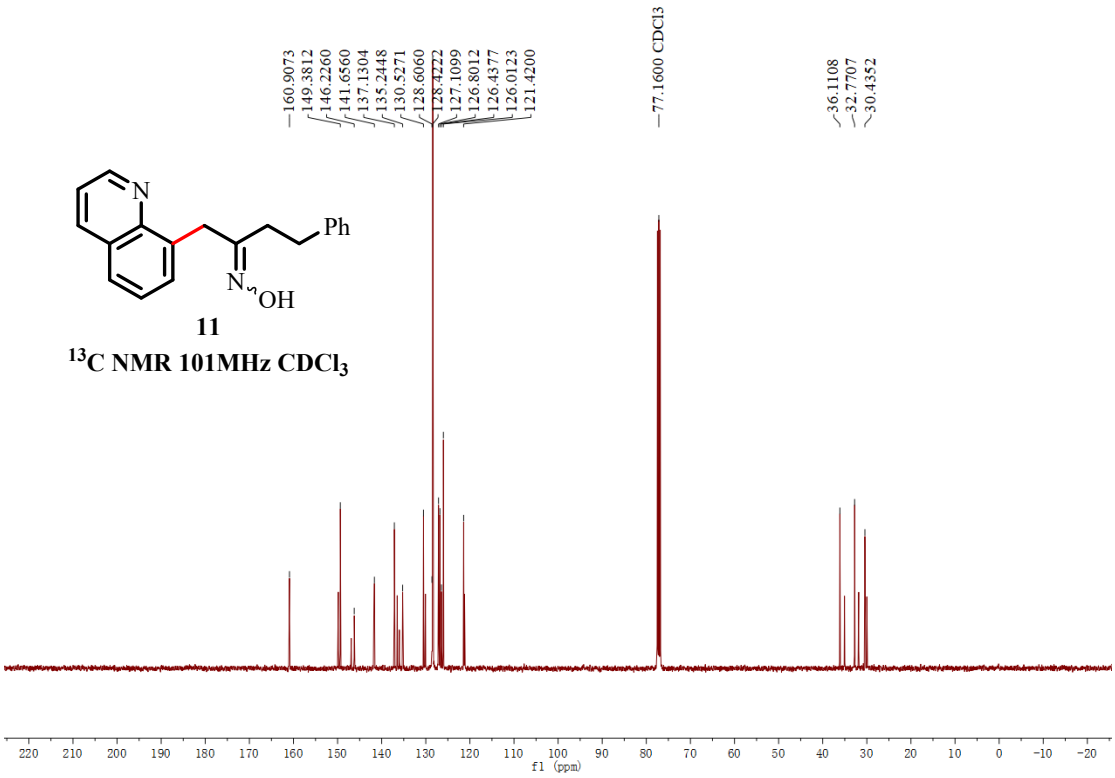
^{13}C NMR 101MHz $CDCl_3$





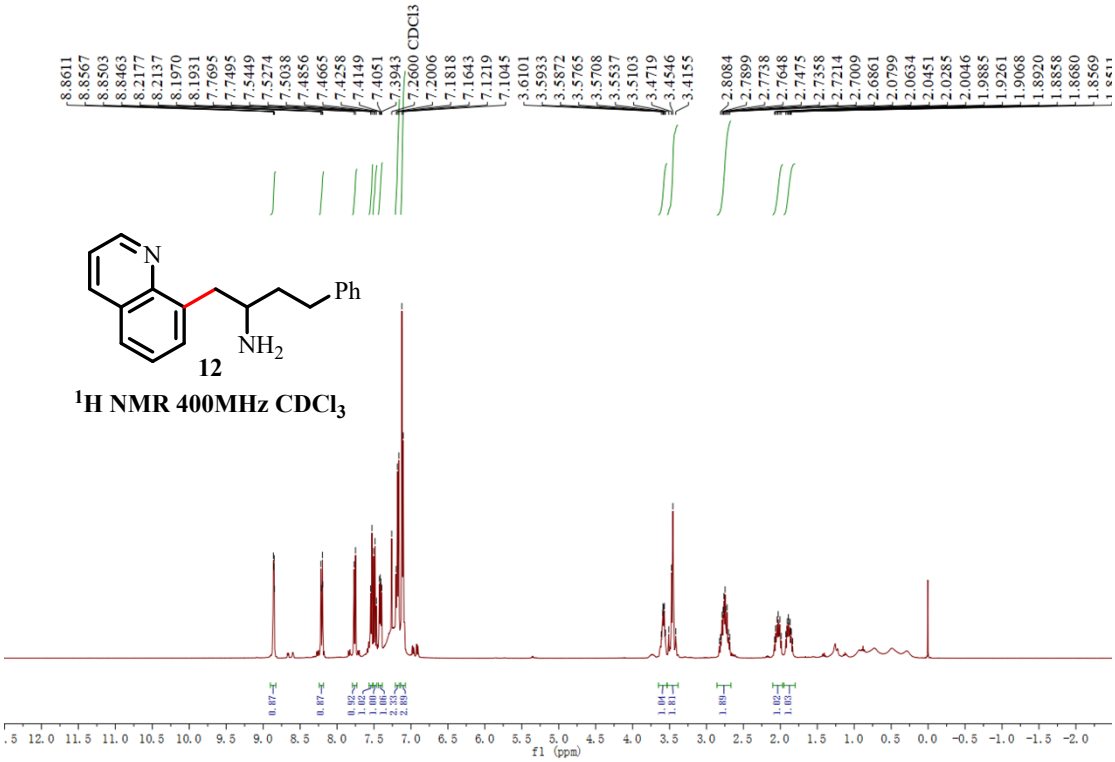
11

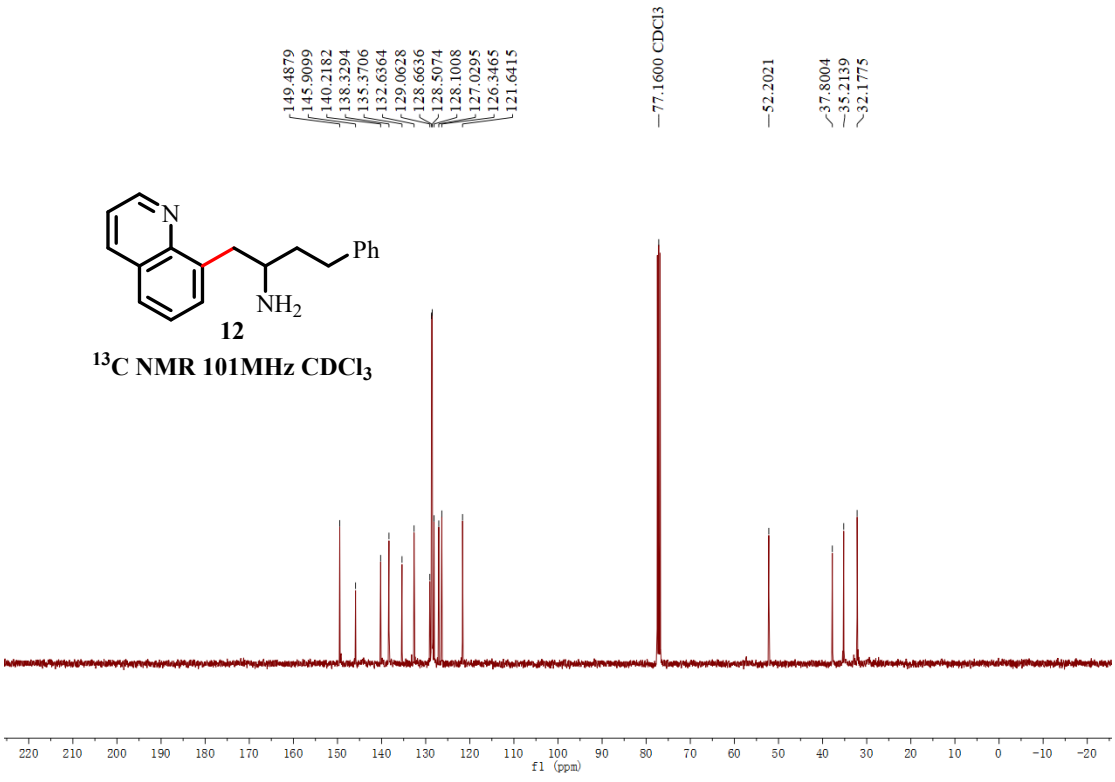
^{1}H NMR 400MHz $CDCl_3$



11

^{13}C NMR 101MHz $CDCl_3$


8.8611
8.8567
8.8503
8.8463
8.2177
8.2137
8.1970
8.1931
7.7695
7.7495
7.5449
7.5274
7.5038
7.4856
7.4665
7.4258
7.4149
7.4051
7.3943
7.2600 CDCl3
7.2006
7.1818
7.1643
7.1219
7.1045
3.6101
3.5933
3.5872
3.5765
3.5708
3.5537
3.5103
3.4719
3.4546
3.4155
2.8084
2.7899
2.7738
2.7648
2.7475
2.7358
2.7214
2.7009
2.6861
2.0799
2.0634
2.0451
2.0285
2.0046
1.9885
1.9261
1.9068
1.8920
1.8858
1.8680
1.8569
N
Ph
NH2
12
1H NMR 400MHz CDCl3
f1 (ppm)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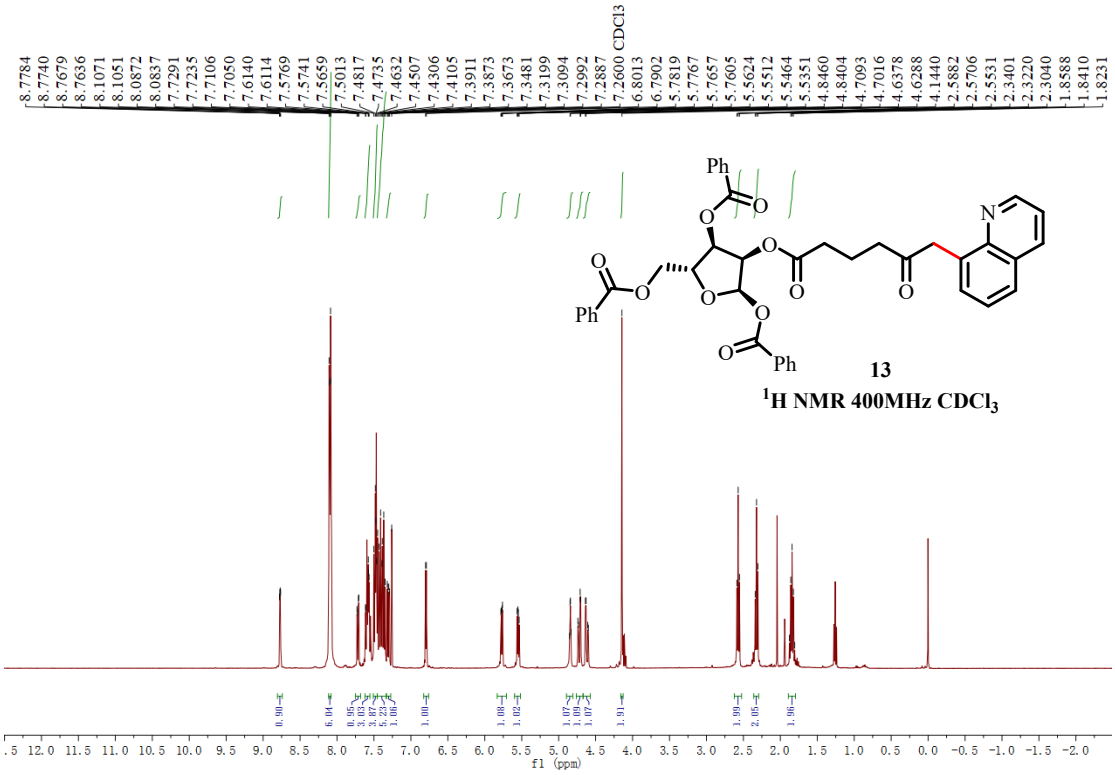
140.2182
138.3294
135.3706
132.6364
129.0628
128.6636
128.5074
128.1008
127.0295
126.3465
121.6415
77.1600 CDCl3
52.2021
37.8004
35.2139
32.1775
N
Ph
NH2
12
13C NMR 101MHz CDCl3
f1 (ppm)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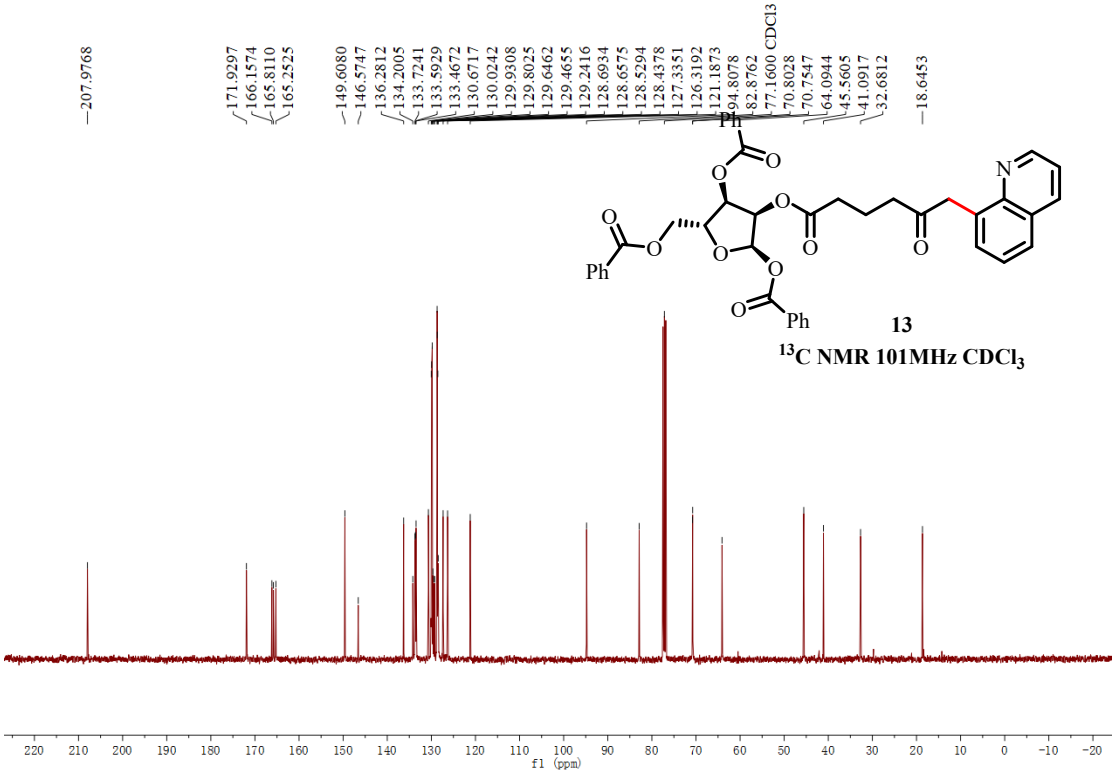
8.7740
8.7679
8.7636
8.1071
8.1051
8.0872
8.0837
7.7291
7.7235
7.7106
7.7050
7.6140
7.6114
7.5769
7.5741
7.5659
7.5013
7.4817
7.4735
7.4632
7.4507
7.4306
7.4105
7.3911
7.3873
7.3673
7.3481
7.3199
7.3094
7.2992
7.2887
7.2600 CDCl3
6.8013
6.7902
5.7819
5.7767
5.7657
5.7605
5.5624
5.5512
5.5464
5.5351
4.8460
4.8404
4.7093
4.7016
4.6378
4.6288
4.1440
2.5882
2.5706
2.5531
2.3401
2.3220
2.3040
1.8588
1.8410
1.8231
Ph
O
O
O
O
O
O
O
O
O
O
Ph
Ph
N
13
1H NMR 400MHz CDCl3
0.90
6.04
0.95
3.03
3.87
5.23
1.00
1.00
1.08
1.02
1.07
1.09
1.07
1.91
1.99
2.05
1.96
f1 (ppm)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171.9297
166.1574
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165.2525
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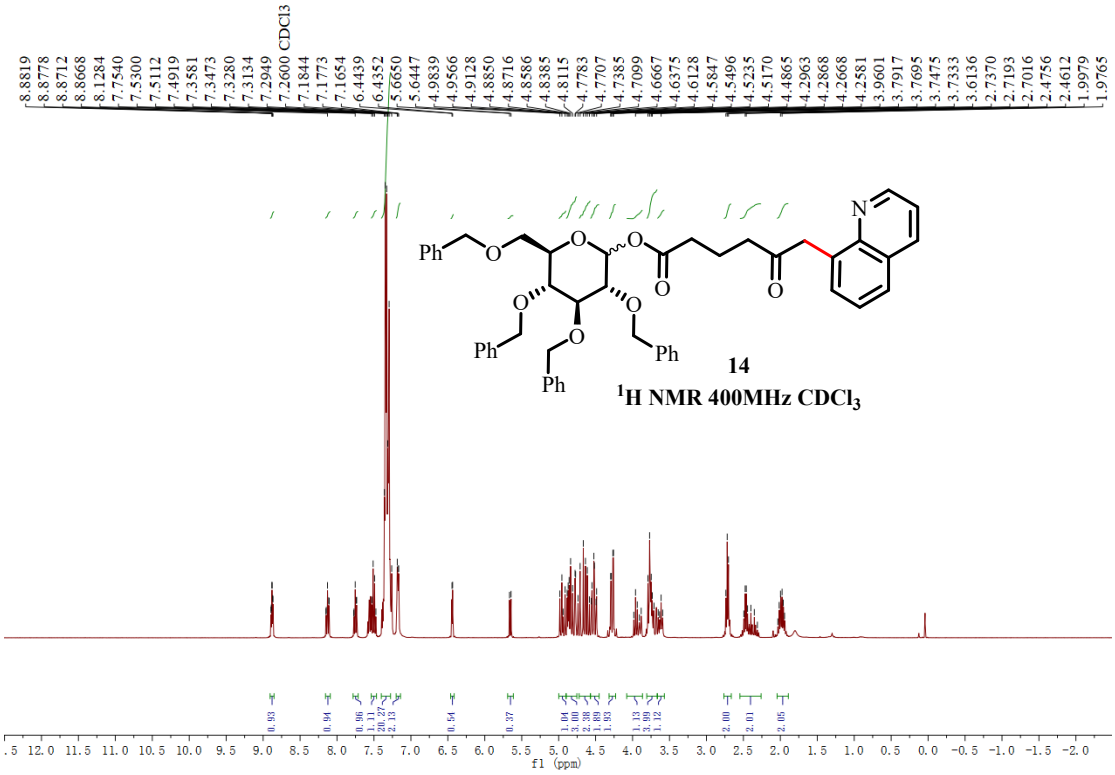
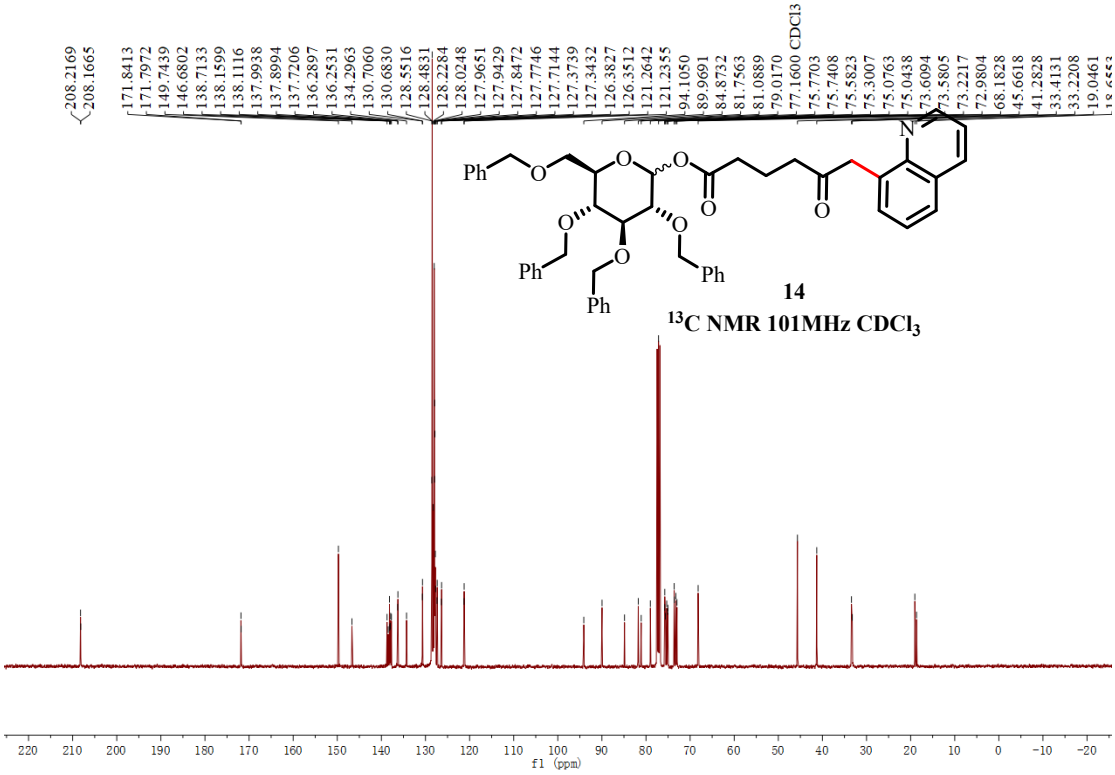
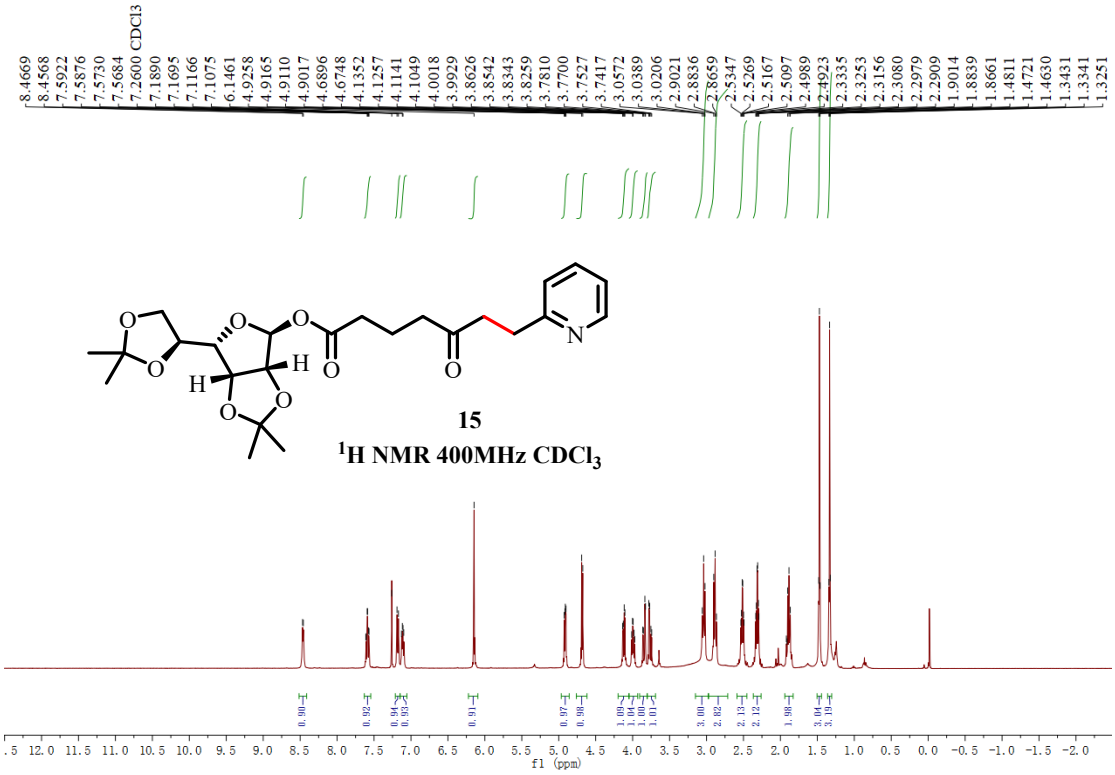
133.4672
130.6717
130.0242
129.9308
129.8025
129.6462
129.4655
129.2416
128.6934
128.6575
128.5294
128.4378
127.3351
126.3192
121.1873
94.8078
82.8762
77.1600 CDCl3
70.8028
70.7547
64.0944
45.5605
41.0917
32.6812
18.6453
Ph
O
O
O
O
O
O
O
O
O
O
Ph
Ph
N
13
13C NMR 101MHz CDCl3
f1 (ppm)

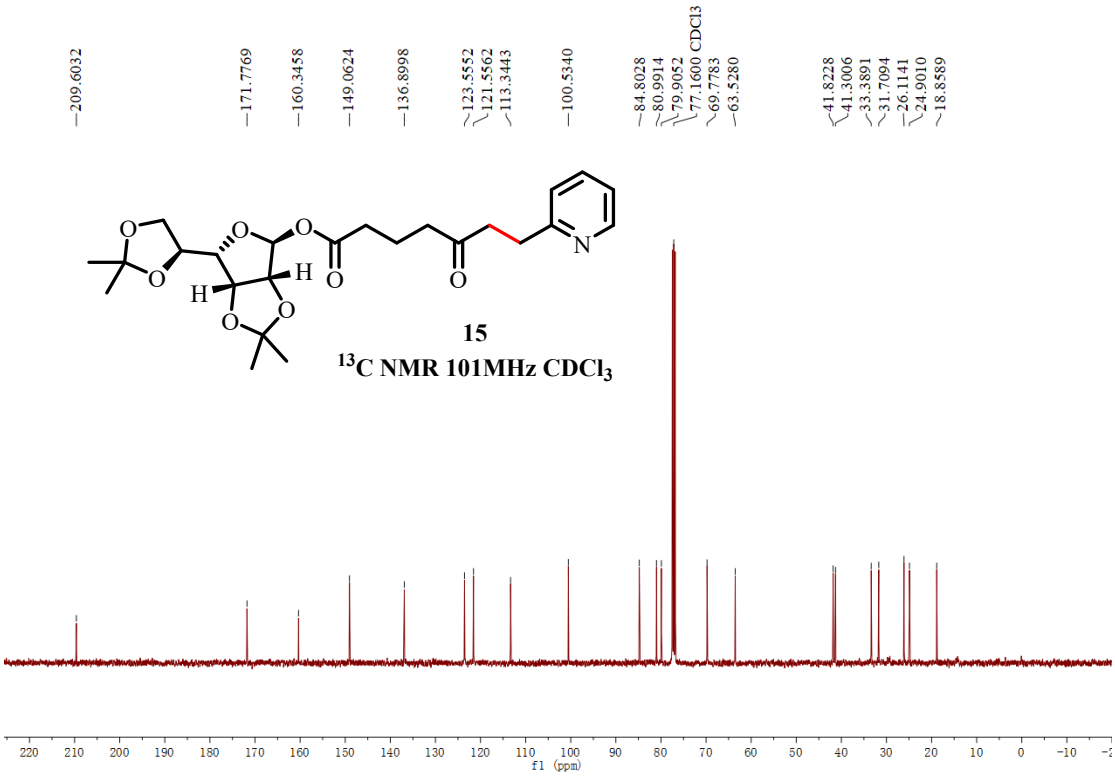

14
^{1}H NMR 400MHz CDCl$_3$


14
^{13}C NMR 101MHz CDCl$_3$



15

^{1}H NMR 400MHz $CDCl_3$



15

^{13}C NMR 101MHz $CDCl_3$