Visible-light-induced iminyl radical formation via electron-donor-acceptor complexes: A photocatalyst-free approach to phenanthridines and quinolines

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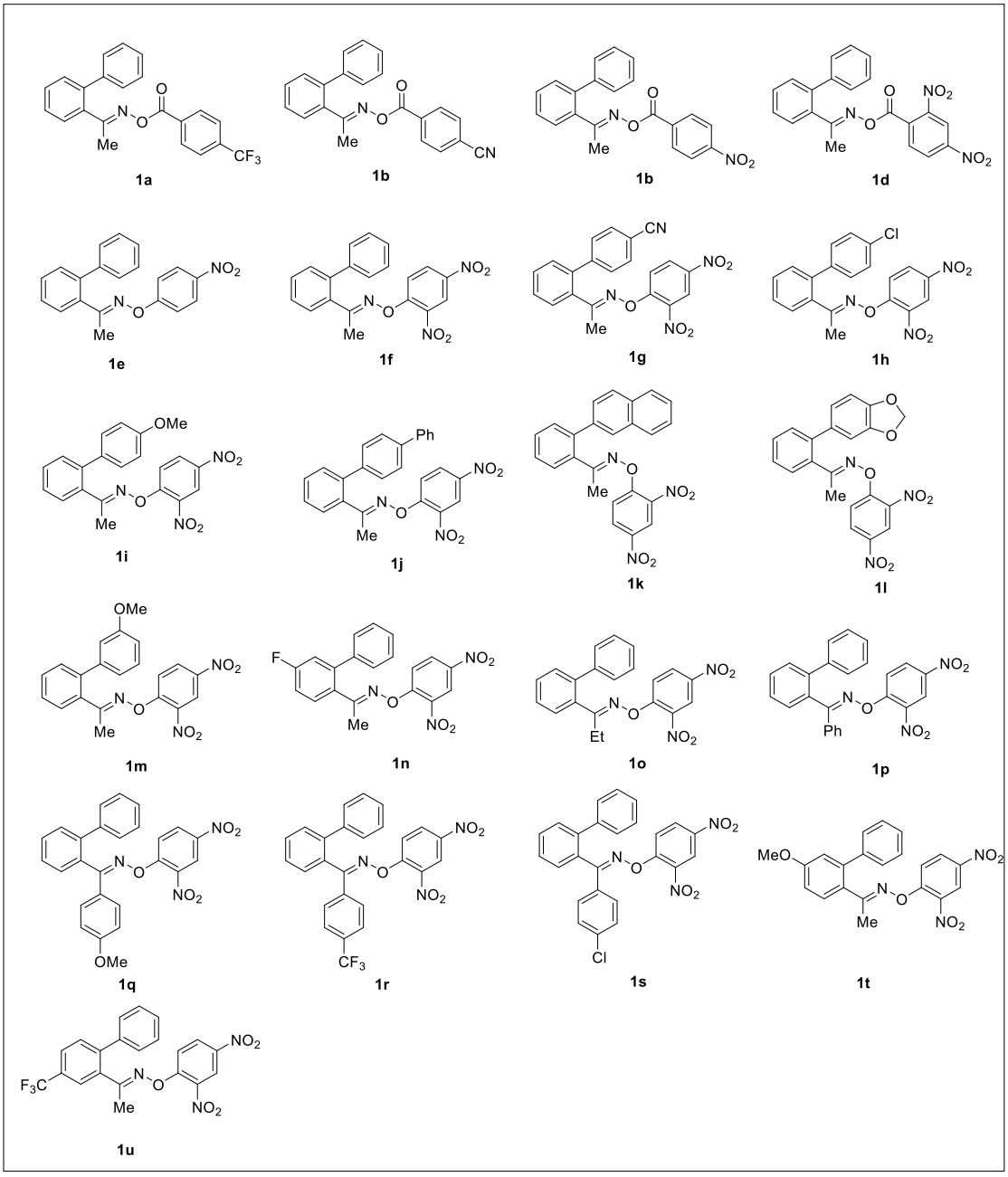
Supporting information

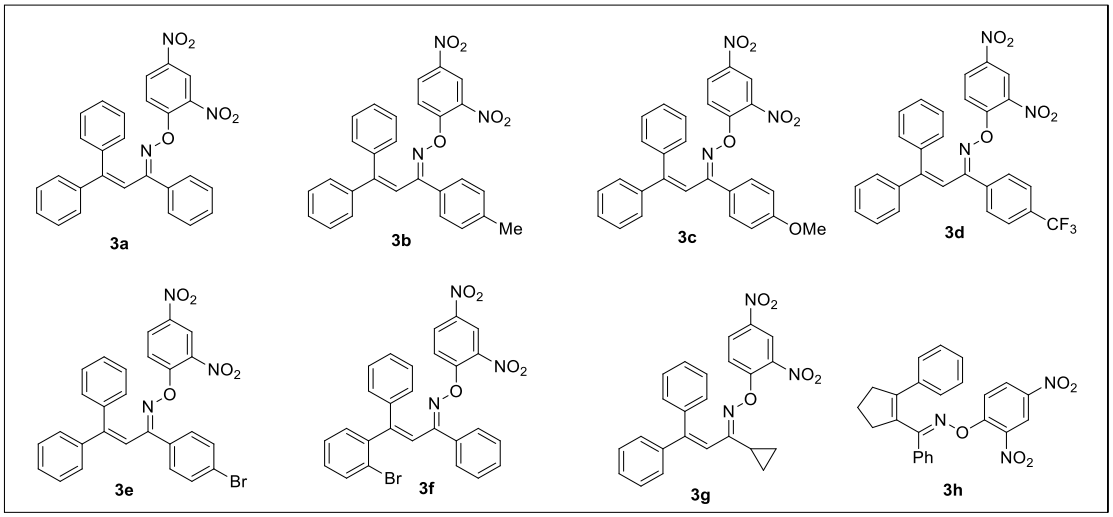
Table of Contents

1. General methods.

MeOH, THF was dried according to Purification of Common Laboratory Chemicals. Other reagents were used without further purification. Thin layer chromatography (TLC) was performed on EMD precoated plates (silica gel 60 F254, Art 5715) and visualized by fluorescence quenching under UV light and by staining with phosphomolybdic acid or potassium permanganate, respectively. Column chromatography was performed on EMD Silica Gel 60 (300–400 Mesh) using a forced flow of 0.5–1.0 bar. ^{1}H NMR (400 MHz), ^{13}C NMR (101 MHz) and ^{19}F (376MHz) were measured on a Bruker AVANCE III–400 spectrometer. Chemical shifts are expressed in parts per million (ppm) with respect to the residual solvent peak. Coupling constants are reported as Hertz (Hz), signal shapes and splitting patterns are indicated as follows: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. Infrared (IR) spectra were recorded on a Nicolet 6700 spectrophotometer and are reported as wavenumber (cm^{-1}). UV-Vis spectra were recorded in 1 cm path quartz cuvettes on a PerkinElmer Lambda 35 spectrometer.

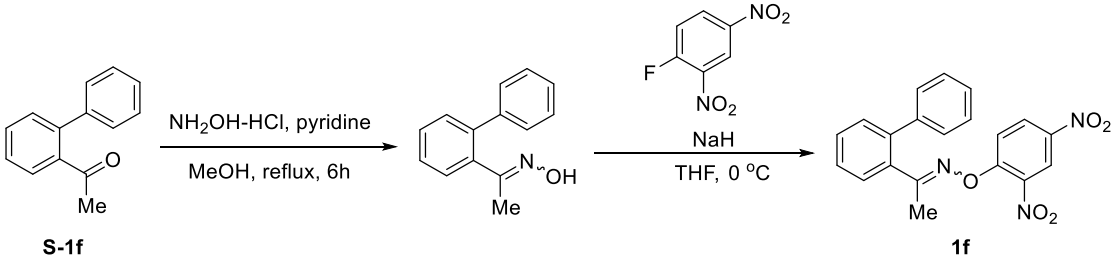
2. List of oxime ethers.





3. General procedure 1: Synthesis of oxime ethers 1.[1]

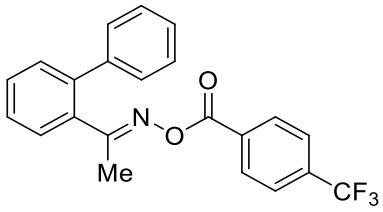
Acyl oximes **1a-1d** were prepared according to the literature.[2] Oxime ethers **1e** and **1f** was prepared following the General Procedure 1.



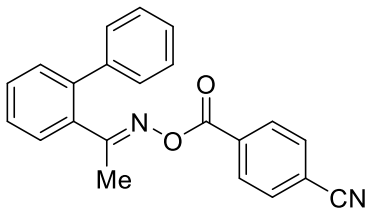
A mixture of 1-(biphenyl-2-yl)ethanone (S-1f, 980 mg, 5.0 mmol), hydroxylamine hydrochloride (417 mg, 6.0 mmol) and pyridine (593 mg, 7.5 mmol) in MeOH (20 mL) was stirred under reflux for 6 h. MeOH was then removed under vacuo and the residue was dissolved in EtOAc (25 mL) , then extracted with saturated NaCl (25 mL) twice, dried with Na_2SO_4 and concentrated under vacuum. Purification by column chromatography on silica gel (EtOAc:hexane = 1:10), gave the 1-([1,1'-biphenyl]-2-yl)ethan-1-one oxime (0.98 g, 92%).

A solution of 1-([1,1'-biphenyl]-2-yl)ethan-1-one oxime (0.98 g, 4.6 mmol) in dry THF (20 mL) under nitrogen was cooled to 0 °C and treated with NaH (0.18 g, 60% dispersion in mineral oil). The mixture was allowed to warm to room temperature over 0.5 h. The fluorobenzene derivative (0.86 g, 4.6 mmol) was then added and stirred for another 10 min. Then, the mixture was poured into saturated NaCl (25 mL)

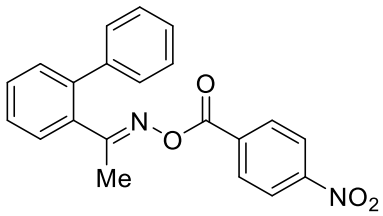
and extracted with EtOAc (25 mL) twice, dried with Na_2SO_4 and concentrated under vacuum. Purification by recrystallization with EtOAc and hexane, afforded **1f** (1.40g, 74%).



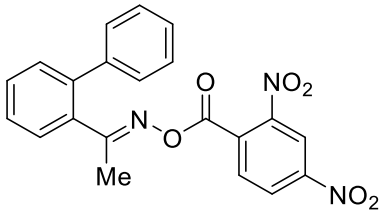
(*E*)-1-([1,1'-biphenyl]-2-yl)ethan-1-one O-(4-(trifluoromethyl)benzoyl) oxime (1a):[2] 75% for 2 steps . ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.1 Hz, 2H), 7.74 (d, *J* = 8.2 Hz, 2H), 7.61 (dd, *J* = 7.5, 0.9 Hz, 1H), 7.56 – 7.49 (m, 1H), 7.50 – 7.34 (m, 7H), 1.89 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.53, 162.61, 140.68, 140.46, 134.88, 134.75 (q, *J* = 33.1 Hz), 132.53, 130.38, 130.15, 130.09, 129.79, 129.00, 128.70, 127.77, 127.55, 125.61 (q, *J* = 3.7 Hz), 123.60 (q, *J* = 272.4 Hz), 18.36.



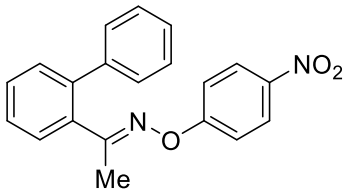
(*E*)-4-((1-(Biphenyl-2-yl)ethylideneaminooxy)carbonyl)benzonitrile (1b):[2] 81% for 2 steps. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.5 Hz, 2H), 7.78 (d, *J* = 8.5 Hz, 2H), 7.62 – 7.57 (m, 1H), 7.53 (td, *J* = 7.6, 1.3 Hz, 1H), 7.47 – 7.35 (m, 7H), 1.89 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.78, 162.21, 140.68, 140.41, 134.74, 133.13, 132.41, 130.41, 130.23, 130.19, 129.76, 128.99, 128.72, 127.80, 127.56, 117.89, 116.73, 18.40.



(*E*)-1-([1,1'-biphenyl]-2-yl)ethan-1-one O-(4-nitrobenzoyl) oxime (1c): 67% for 2 steps. Solid, m. p. 149 – 152 °C. IR (neat, cm^{-1}) 1735, 1603, 1525, 1347, 1259, 1071, 743. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 – 8.24 (m, 4H), 7.64 – 7.57 (m, 1H), 7.53 (td, *J* = 9.7, 4.8 Hz, 1H), 7.47 – 7.36 (m, 7H), 1.91 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.92, 161.97, 150.69, 140.71, 140.40, 134.71, 134.69, 130.81, 130.43, 130.26, 129.76, 128.99, 128.73, 127.82, 127.57, 123.74, 18.43. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{21}H_{17}N_2O_4$: 361.1183; found: 361.1183.

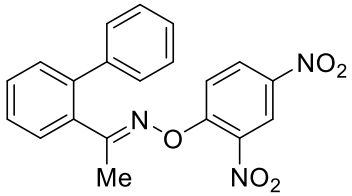


(*E*)-1-([1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrobenzoyl) oxime (1d): 37% for 2 steps. Solid, m. p. 117 – 119 °C. IR (neat, cm^{-1}) 1600, 1511, 1341, 1254, 1176, 891, 832. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.88 (d, *J* = 2.1 Hz, 1H), 8.60 – 8.54 (m, 1H), 7.94 (d, *J* = 8.4 Hz, 1H), 7.54 – 7.46 (m, 1H), 7.46 – 7.29 (m, 8H), 1.79 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.10, 163.19, 148.88, 147.40, 140.72, 140.11, 134.14, 132.90, 131.20, 130.45, 130.32, 129.29, 128.87, 128.73, 128.06, 127.86, 127.51, 119.62, 18.39. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{21}H_{16}N_3O_6$: 406.1034; found: 406.1034.

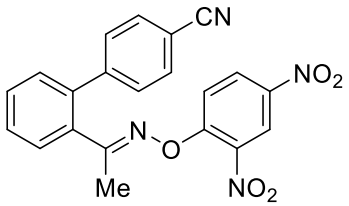


(*E*)-1-([1,1'-biphenyl]-2-yl)ethan-1-one O-(4-nitrophenyl) oxime (1e): 35% for 2

steps. Solid, m. p. 126 – 128 °C. IR (neat, cm^{-1}) 1605, 1590, 1506, 1487, 1332, 1234, 785, 686. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 9.2 Hz, 2H), 7.52 (t, *J* = 6.9 Hz, 2H), 7.47 – 7.34 (m, 7H), 7.18 (d, *J* = 9.2 Hz, 2H), 1.97 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.14, 163.83, 142.34, 140.96, 140.91, 135.29, 130.67, 129.80, 129.33, 128.97, 128.64, 127.56, 127.51, 125.68, 114.47, 17.53. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{20}H_{17}N_2O_3$: 333.1234; found: 333.1234.

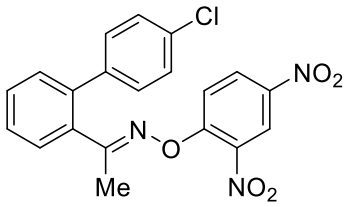


(*E*)-1-([1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1f): 69% for 2 steps. Solid, m. p. 151-153 °C. IR (neat, cm^{-1}) 1599, 1526, 1475, 1347, 1262, 1144, 879, 760. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.88 (d, *J* = 2.7 Hz, 1H), 8.34 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.61 (d, *J* = 9.4 Hz, 1H), 7.58 – 7.52 (m, 2H), 7.50 – 7.33 (m, 7H), 2.11 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.90, 157.38, 141.18, 140.74, 135.94, 134.17, 130.85, 130.28, 129.32, 129.27, 128.90, 128.75, 127.70, 127.61, 122.03, 117.43, 18.37. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{20}H_{16}N_3O_5$: 378.1084; found: 378.1084.

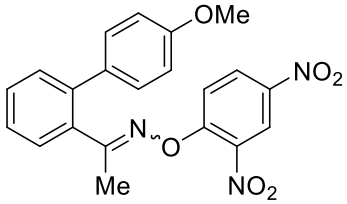


(*E*)-2'-(1-((2,4-dinitrophenoxy)imino)ethyl)-[1,1'-biphenyl]-4-carbonitrile (1g): 30% for 2 steps. Solid, m. p. 182 – 185 °C. IR (neat, cm^{-1}) 1600, 1534, 1516, 1343, 1315, 883, 846, 582. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.89 (d, *J* = 2.7 Hz, 1H), 8.37 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.77 – 7.70 (m, 2H), 7.66 (d, *J* = 9.4 Hz, 1H), 7.63 – 7.48 (m, 5H), 7.45 (dd, *J* = 7.5, 0.7 Hz, 1H), 2.15 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.89, 157.05, 145.45, 141.01, 139.07, 136.06, 134.19, 132.48, 130.62, 130.55, 129.65,

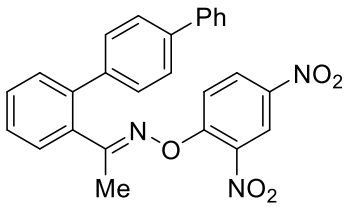
129.61, 129.31, 128.79, 122.14, 118.40, 117.09, 111.69, 18.59. HRMS (DART Positive) ([M+H]$^+$) Calcd. For $C_{21}H_{15}N_4O_5$: 403.1035; found: 403.1035.



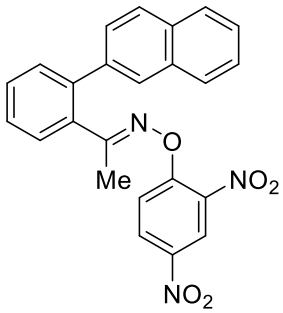
(*E*)-1-(4'-chloro-[1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1h): 42% for 2 steps. Solid, m. p. 148 – 151 ^{o}C. IR (neat, cm^{-1}) 1599, 1520, 1469, 1341, 1257, 925, 742. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.88 (d, *J* = 2.7 Hz, 1H), 8.37 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.66 (d, *J* = 9.4 Hz, 1H), 7.58 – 7.38 (m, 6H), 7.34 – 7.29 (m, 2H), 2.13 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.58, 157.24, 140.86, 139.81, 139.14, 136.00, 134.16, 134.02, 130.69, 130.38, 130.18, 129.41, 129.32, 128.97, 127.97, 122.07, 117.28, 18.48. HRMS (DART Positive) ([M+H]$^+$) Calcd. For $C_{20}H_{15}ClN_3O_5$: 412.0695; found: 412.0695.



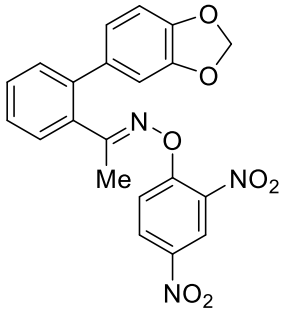
1-(4'-Methoxy-[1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1i): 50% for 2 steps. (*E*/*Z* = 1:0.1), Solid, m. p. 111 – 115 ^{o}C. IR (neat, cm^{-1}): 1597, 1522, 1342, 1267, 882, 765. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.89-8.87 (m, 1H), 8.38 (dd, *J* = 9.4, 2.8 Hz, 1H), 8.34 (d, *J* = 2.7 Hz, 1H), 7.82 (d, *J* = 9.4 Hz, 1H), 7.71 (d, *J* = 9.4 Hz, 1H), 7.56 – 7.39 (m, 4.5H), 7.32 – 7.27 (m, 2.2H), 6.98 – 6.92 (m, 2.2H), 3.84 (s, 3H), 3.80 (s, 0.3H), 2.12 (s, 0.3H), 2.06 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.53, 167.12, 159.77, 159.42, 157.45, 157.39, 142.03, 140.97, 140.76, 140.72, 135.97, 134.19, 134.16, 132.81, 130.71, 130.28, 130.00, 129.79, 129.35, 129.25, 127.68, 127.16, 122.07, 121.42, 117.45, 114.71, 114.21, 113.06, 55.35, 18.44, 18.37. HRMS (DART Positive) ([M+H]$^+$) Calcd. For $C_{21}H_{18}N_3O_6$: 408.1190; found: 408.1190.



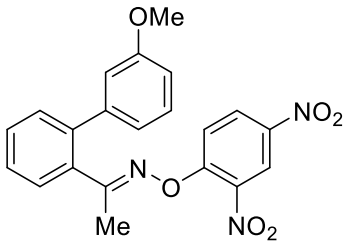
(*E*)-1-([1,1':4',1''-terphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1j): 17% for 2 steps. Solid, m. p. 192 – 194 ºC. IR (neat, cm^{-1}) 1599, 1527, 1477, 1336, 1312, 1060, 921, 750. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.90 (d, *J* = 2.7 Hz, 1H), 8.34 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.72 – 7.45 (m, 13H), 7.42 – 7.38 (m, 1H), 2.20 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.96, 157.35, 140.72, 140.62, 140.18, 139.58, 135.96, 134.18, 130.80, 130.33, 129.37, 129.32, 128.93, 127.68, 127.66, 127.40, 127.02, 122.03, 117.37, 18.52. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{26}H_{20}N_3O_5$: 454.1397; found: 454.1395.



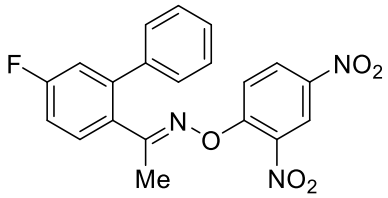
(*E*)-1-(2-(naphthalen-2-yl)phenyl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1k): 50% for 2 steps. Solid, m. p. 121 – 125 ºC. IR (neat, cm^{-1}) 1597, 1531, 1514, 1340, 1312, 1064, 923, 760. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.82 (d, *J* = 2.7 Hz, 1H), 8.02 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.90 – 7.82 (m, 4H), 7.60 – 7.43 (m, 7H), 7.37 (d, *J* = 9.4 Hz, 1H), 2.14 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.67, 157.25, 141.15, 140.69, 138.39, 135.86, 134.33, 133.38, 132.51, 131.14, 130.33, 129.32, 129.15, 128.38, 128.05, 127.83, 127.75, 126.94, 126.77, 126.56, 121.96, 117.38, 18.34. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{24}H_{18}N_3O_5$: 428.1241; found: 428.1241.



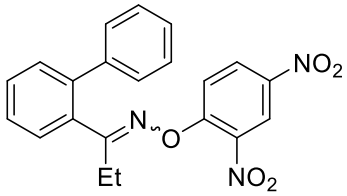
(*E*)-1-(2-(Benzo[d][1,3]dioxol-5-yl)phenyl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1l): 31% for 2 steps. Solid, m. p. 168 – 170 ºC. IR (neat, cm^{-1}) 1603, 1528, 1505, 1477, 1342, 1258, 1034, 876, 764. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.89 (d, *J* = 2.7 Hz, 1H), 8.40 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.87 (d, *J* = 9.4 Hz, 1H), 7.55 – 7.46 (m, 2H), 7.46 – 7.38 (m, 2H), 6.87 – 6.79 (m, 3H), 6.00 (s, 2H), 2.10 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.35, 157.42, 147.97, 147.46, 140.75, 140.70, 135.98, 134.38, 134.21, 130.69, 130.26, 129.38, 129.35, 127.39, 122.62, 122.09, 117.40, 109.27, 108.61, 101.35, 18.44. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{21}H_{16}N_3O_7$: 422.0983; found: 422.0982.



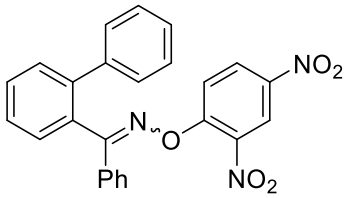
(*E*)-1-(3'-Methoxy-[1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1m): 23% for 2 steps. Solid, m. p. 144 – 147 ºC. IR (neat, cm^{-1}) 1602, 1528, 1458, 1340, 1266, 1068, 791. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.89 (d, *J* = 2.7 Hz, 1H), 8.36 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.71 (d, *J* = 9.4 Hz, 1H), 7.57 – 7.43 (m, 4H), 7.33 (td, *J* = 7.5, 1.0 Hz, 1H), 6.96 – 6.90 (m, 3H), 3.80 (s, 3H), 2.11 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.11, 159.76, 157.39, 142.02, 140.97, 140.76, 135.98, 134.19, 130.69, 130.24, 129.78, 129.32, 129.24, 127.67, 122.06, 121.42, 117.44, 114.71, 113.05, 55.33, 18.37. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{21}H_{18}N_3O_6$: 408.1190; found: 408.1190.



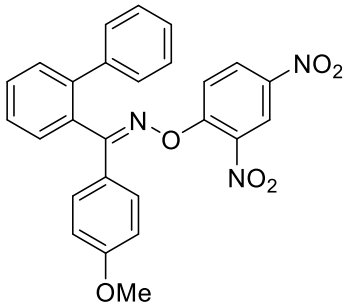
(*E*)-1-(5-Fluoro-[1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1n): 25% for 2 steps. Solid, m. p. 182 – 185 °C. IR (neat, cm^{-1}) 1604, 1529, 1338, 1313, 1254, 916, 839, 698. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.88 (d, *J* = 2.7 Hz, 1H), 8.35 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.62 (d, *J* = 9.4 Hz, 1H), 7.52 (dd, *J* = 8.5, 5.7 Hz, 1H), 7.47 – 7.33 (m, 5H), 7.20 – 7.13 (m, 2H), 2.08 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.08, 163.50 (d, *J* = 251.3 Hz), 157.24, 143.64 (d, *J* = 8.3 Hz), 140.84, 139.63 (d, *J* = 1.6 Hz), 136.00, 131,35 (d, *J* = 8.8 Hz), 130.33 (d, *J* = 3.3 Hz), 129.30, 128.90, 128.70, 128.24, 122.03, 117.78 (d, *J* = 22.2 Hz), 117.37, 114.56 (d, *J* = 21.5 Hz), 18.40. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{20}H_{15}FN_3O_5$: 396.0990; found: 396.0990.



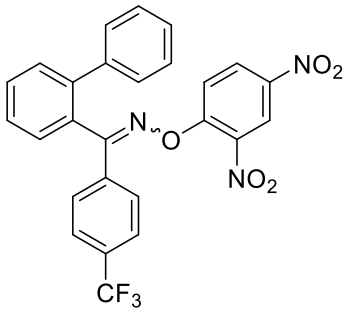
1-([1,1'-Biphenyl]-2-yl)propan-1-one O-(2,4-dinitrophenyl) oxime (1o): 73% for 2 steps. (*E/Z* = 1:0.3), Solid, m. p. 85 – 86 °C. IR (neat, cm^{-1}) 1599, 1522, 1342, 1306, 1266, 865, 740. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.88 (d, J = 2.6 Hz, 1H), 8.76 (d, J = 2.6 Hz, 0.3H), 8.35 – 8.32 (m, 1.2H), 7.75 (d, J = 9.4 Hz, 0.3H), 7.63 (d, J = 9.4 Hz, 1H), 7.59 – 7.23 (m, 11.6H), 2.51 (q, J = 7.6 Hz, 2H), 2.39 (s, 0.5H), 1.08 (t, J = 7.4 Hz, 0.9H), 0.99 (t, J = 7.6 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.80, 170.00, 157.53, 157.24, 141.08, 140.68, 140.58, 140.27, 139.31, 135.95, 132.91, 132.27, 130.78, 130.19, 130.01, 129.73, 129.67, 129.32, 129.00, 128.95, 128.70, 128.42, 128.27, 127.69, 127.66, 127.63, 127.52, 127.19, 122.03, 121.79, 117.41, 117.08, 29.28, 24.92, 14.16, 10.45. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{21}H_{18}N_3O_5$: 392.1241; found: 392.1240.



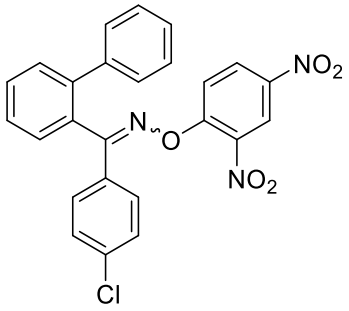
[1,1'-Biphenyl]-2-yl(phenyl)methanone O-(2,4-dinitrophenyl) oxime (1p): 13% for 2 steps. (*E/Z* = 0.16:1), Solid, m. p. 85 – 88 ºC. IR (neat, cm^{-1}) 1601, 1522, 1340, 1257, 1237, 924, 741, 691. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 – 8.70 (m, 1.H), 8.45 (dd, *J* = 9.4, 2.7 Hz, 0.16H), 8.26 – 8.10 (m, 1.11H), 7.67 – 6.95 (m, 16.99H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.63, 164.76, 157.43, 156.97, 142.84, 141.64, 141.25, 140.89, 140.67, 140.41, 135.97, 134.30, 134.06, 131.94, 131.41, 131.33, 130.98, 130.94, 130.75, 130.67, 130.47, 130.31, 130.05, 129.07, 128.93, 128.80, 128.75, 128.69, 128.45, 128.16, 128.13, 127.89, 127.51, 127.44, 127.23, 127.15, 121.80, 121.64, 117.67, 116.84. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{25}H_{18}N_3O_5$: 440.1241; found: 440.1241.



(*E*)-[1,1'-biphenyl]-2-yl(4-methoxyphenyl)methanone O-(2,4-dinitrophenyl) oxime (1q): 40% for 2 steps. Solid, m. p. 152 – 154 ºC. IR (neat, cm^{-1}) 1601, 1533, 1521, 1340, 1248, 1144, 742. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.79 (d, *J* = 2.7 Hz, 1H), 8.15 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.61 – 7.54 (m, 3H), 7.51 – 7.38 (m, 3H), 7.35 – 7.20 (m, 5H), 6.95 (d, *J* = 9.4 Hz, 1H), 6.90 – 6.85 (m, 2H), 3.83 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.99, 161.46, 157.62, 142.80, 141.23, 140.76, 135.93, 134.24, 133.14, 131.34, 130.87, 130.27, 129.06, 128.96, 128.39, 127.41, 127.10, 124.19, 121.79, 117.71, 113.33, 55.41. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{26}H_{20}N_3O_6$: 470.1347; found: 470.1345.

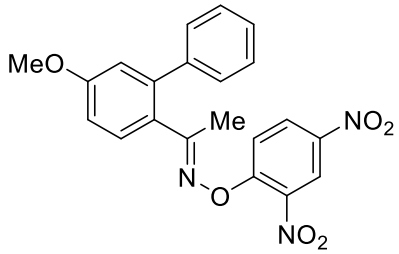


[1,1'-Biphenyl]-2-yl(4-(trifluoromethyl)phenyl)methanone O-(2,4-dinitrophenyl) oxime (1r): 47% for 2 steps. (*E/Z* = 1:1), Solid, m. p. 121 – 125 °C. IR (neat, cm^{-1}) 1600, 1536, 1516, 1318, 1126, 1065, 920, 743. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 (d, *J* = 2.7 Hz, 1H), 8.75 (d, *J* = 2.7 Hz, 1H), 8.32 – 8.26 (m, 2H), 7.77 – 7.44 (m, 16H), 7.34 – 7.07 (m, 12H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.54, 163.85, 157.04, 156.60, 142.92, 141.63, 141.21, 141.08, 140.81, 140.12, 137.70, 136.21, 136.07, 135.29, 133.54, 132.83 (q, *J* = 32.3 Hz), 131.98 (q, *J* = 33.3 Hz), 131.03, 130.98, 130.83, 130.66, 130.62, 130.25, 130.21, 129.17, 129.04, 128.93, 128.85, 128.73, 128.41, 128.20, 128.10, 127.64, 127.63, 127.40, 127.35, 125.59 (q, *J* = 3.7 Hz), 124.65 (q, *J* = 3.7 Hz), 123.69 (q, *J* = 272.7 Hz), 123.60 (q, *J* = 273.7 Hz), 121.89, 121.69, 117.62, 116.89. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{26}H_{17}F_3N_3O_5$: 508.1115; found: 508.1114.

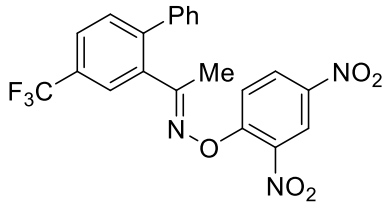


[1,1'-Biphenyl]-2-yl(4-chlorophenyl)methanone O-(2,4-dinitrophenyl) oxime (1s): 18% for 2 steps. (*E/Z* = 0.3:1), Solid, m. p. 129 – 131 °C. IR (neat, cm^{-1}) 1602, 1533, 1471, 1339, 1315, 1256, 926, 741. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 (d, *J* = 2.7 Hz, 0.3H), 8.74 (d, *J* = 2.7 Hz, 1H), 8.28 – 8.22 (m, 1.3H), 7.63 – 7.44 (m, 6.8H), 7.40 – 7.32 (m, 2.6H), 7.32 – 7.18 (m, 3.6H), 7.17 – 7.05 (m, 5.2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.69, 163.88, 157.21, 156.76, 142.85, 141.54, 141.05, 140.89, 140.86,

140.19, 137.63, 136.81, 136.09, 133.72, 132.67, 131.89, 131.08, 130.97, 130.64, 130.46, 130.22, 130.14, 129.76, 129.13, 129.00, 128.90, 128.64, 128.41, 128.15, 128.10, 127.53, 127.32, 127.28, 121.86, 121.66, 117.60, 116.82. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{25}H_{17}ClN_3O_5$: 474.0846; found: 474.0847.



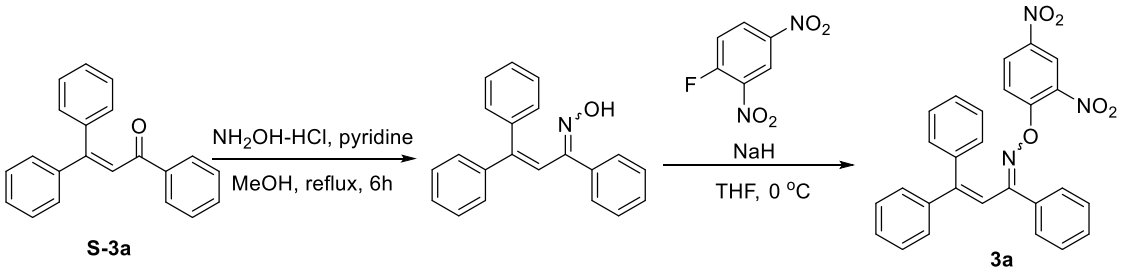
(E)-1-(5-methoxy-[1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl)(1t): 24% for 2 steps. Solid, ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.87 (d, *J* = 2.7 Hz, 1H), 8.32 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.55 (d, *J* = 9.4 Hz, 1H), 7.51 – 7.31 (m, 6H), 7.04 – 6.91 (m, 2H), 3.89 (s, 3H), 2.09 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.34, 160.89, 157.44, 142.90, 140.88, 140.58, 135.86, 130.81, 129.24, 128.75, 128.70, 127.72, 126.56, 121.96, 117.40, 116.31, 112.95, 55.52, 18.39. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{21}H_{17}N_3O_6$: 408.1190; found: 408.1180.



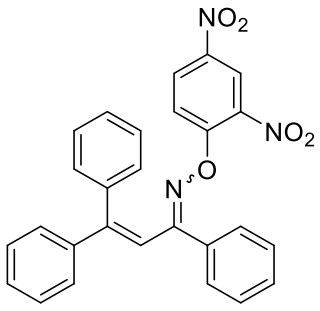
(E)-1-(4-(trifluoromethyl)-[1,1'-biphenyl]-2-yl)ethan-1-one O-(2,4-dinitrophenyl) oxime (1u): 48% for 2 steps. (*E/Z* = 4:1), Solid, ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.90 (d, *J* = 2.7 Hz, 1H), 8.40 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.86 – 7.76 (m, 2H), 7.73 (d, *J* = 9.4 Hz, 1H), 7.61 (d, *J* = 7.9 Hz, 1H), 7.51 – 7.34 (m, 5H), 2.08 (s, 3H). ^{13}C NMR (101 MHz, CDCl3) δ 165.95, 157.05, 144.67, 141.03, 139.25, 136.04, 134.91, 131.36, 129.97 (q, *J* = 33.4 Hz), 129.47, 129.39, 129.02, 128.74, 128.56, 126.90 (q, *J* = 3.6 Hz), 126.33 (q, *J* = 3.9 Hz), 123.75 (q, *J* = 273.4 Hz), 122.07, 117.39, 18.23.

4. General procedure 2: Synthesis of oxime ethers 3.[1]

S-3a was prepared from Meyer–Schuster rearrangement of propargyl alcohols into α,β-unsaturated carbonyl compounds.[3]

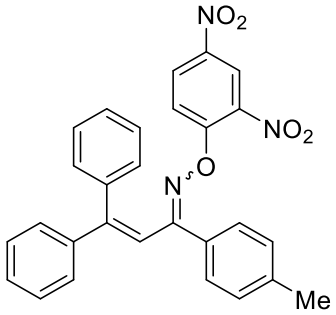


A mixture of 1,3,3-triphenylprop-2-en-1-one (**S-3a**, 1.42 g, 5.0 mmol), hydroxylamine hydrochloride (417 mg, 6.0 mmol) and pyridine (593 mg, 7.5 mmol) in MeOH (20 mL) was stirred under reflux for 6 h. MeOH was then removed under vacuo and the residue was dissolved in EtOAc (25 mL) , then extracted with saturated NaCl (25 mL) twice, dried with Na_2SO_4 and concentrated under vacuum. Purification by column chromatography on silica gel (EtOAc : hexane = 1:10), gave the oxime. (1.42 g, 95%)
A solution of oxime (0.98 g, 4.6 mmol) in dry THF (20 mL) under nitrogen was cooled to 0 °C and treated with NaH (0.18 g, 60% dispersion in mineral oil). The mixture was allowed to warm to room temperature over 0.5 h. The fluorobenzene derivative (0.86 g, 4.6 mmol) was then added and stirred for another 10 min. Then, the mixture was poured into saturated NaCl (25 mL) and extracted with EtOAc (25 mL) twice, dried with Na_2SO_4 and concentrated under vacuum. Purification by recrystallization with EtOAc and hexane, afforded **3a** (1.71g, 80%).

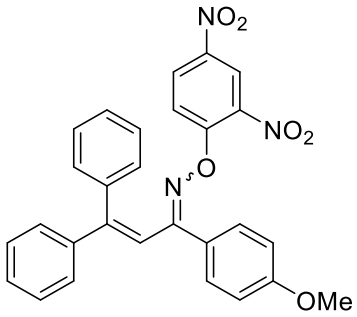


1,3,3-Triphenylprop-2-en-1-one O-(2,4-dinitrophenyl) oxime (3a): 64% for 2 steps. (*E/Z* = 1:0.43), Solid, m. p. 101-103 °C. IR (neat, cm^{-1}) 1602, 1519, 1340, 1255, 693,

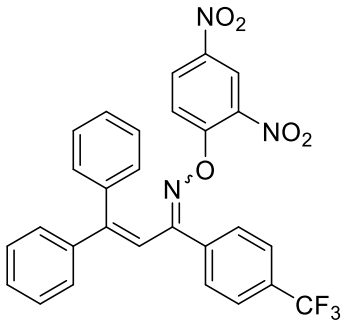
571. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.65 (d, *J* = 2.2 Hz, 1H), 8.58 (d, *J* = 2.2 Hz, 0.43H), 8.16 (dd, *J* = 9.3, 2.3 Hz, 1H), 7.96 (dd, *J* = 9.4, 2.4 Hz, 0.32H), 7.68 – 6.45 (m, 24.31H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.29, 161.77, 157.31, 153.16, 152.20, 141.34, 140.98, 140.78, 140.69, 140.14, 139.19, 135.97, 135.86, 133.34, 131.48, 130.72, 129.75, 129.68, 129.61, 129.30, 129.26, 129.12, 128.96, 128.76, 128.63, 128.57, 128.52, 128.47, 128.38, 128.31, 128.23, 127.93, 127.80, 121.92, 121.72, 121.22, 117.72, 117.20. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{27}H_{20}N_3O_5$: 466.1397; found: 466.1396.



3,3-Diphenyl-1-(p-tolyl)prop-2-en-1-one O-(2,4-dinitrophenyl) oxime (3b): 17% for 2 steps. (*E/Z* = 1:0.8), Solid, m. p. 114-118 ^{o}C. IR (neat, cm^{-1}) 1602, 1523, 1340, 1256, 924, 833, 741, 693. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 (d, *J* = 2.7 Hz, 1H), 8.76 (d, *J* = 2.7 Hz, 0.8H), 8.29 (dd, *J* = 9.4, 2.7 Hz, 1H), 8.07 (dd, *J* = 9.4, 2.8 Hz, 0.8H), 7.70 – 7.66 (m, 2.6H), 7.56 (d, *J* = 8.2 Hz, 2H), 7.45 – 7.24 (m, 15.2H), 7.12 (d, *J* = 8.0 Hz, 2H), 7.01 (s, 4.4H), 6.79 (s, 1H), 6.65 (s, 0.8H), 6.55 (d, *J* = 9.4 Hz, 0.8H), 2.39 (s, 2.4H), 2.35 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.03, 161.38, 157.44, 157.33, 152.75, 151.80, 141.36, 141.23, 141.04, 140.72, 140.55, 140.28, 139.27, 135.93, 130.46, 129.91, 129.58, 129.36, 129.22, 129.18, 129.11, 128.97, 128.94, 128.89, 128.70, 128.58, 128.49, 128.35, 128.10, 127.84, 127.65, 121.83, 121.68, 121.36, 117.76, 117.26, 117.04, 21.54, 21.44. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{28}H_{22}N_3O_5$: 480.1554; found: 480.1554.

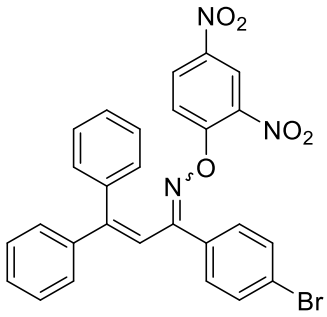


1-(4-Methoxyphenyl)-3,3-diphenylprop-2-en-1-one O-(2,4-dinitrophenyl) oxime (3c): 20% for 2 steps. (*E/Z* = 1:0.8), Solid, m. p. 166-168 ºC. IR (neat, cm^{-1}) 1755, 1535, 1353, 1278, 1238, 1051, 743. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 (d, *J* = 2.7 Hz, 1H), 8.29 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.69 (d, *J* = 9.4 Hz, 1H), 7.63 (d, *J* = 8.8 Hz, 2H), 7.45 – 7.37 (m, 5H), 7.02 (s, 5H), 6.83 (d, *J* = 8.8 Hz, 2H), 6.78 (s, 1H), 3.81 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.60, 161.74, 157.40, 152.58, 141.05, 140.45, 139.26, 135.89, 129.74, 129.34, 129.09, 128.99, 128.69, 128.50, 128.39, 127.87, 125.54, 121.85, 117.35, 117.01, 113.95, 55.41. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{28}H_{22}N_3O_6$: 496.1503; found: 496.1501.

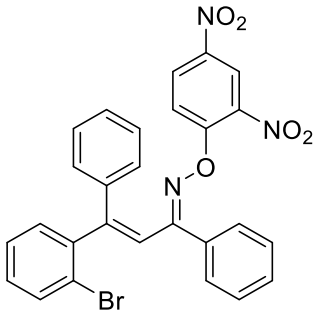


3,3-Diphenyl-1-(4-(trifluoromethyl)phenyl)prop-2-en-1-one O-(2,4-dinitrophenyl) oxime (3d): 56% for 2 steps. (*E/Z* = 1:0.64), Solid, m. p. 58-60 ºC. IR (neat, cm^{-1}) 1603, 1542, 1341, 1321, 1063, 925, 831, 697. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.87 (d, *J* = 2.7 Hz, 1H), 8.78 (d, *J* = 2.7 Hz, 0.58H), 8.38 (dd, *J* = 9.4, 2.7 Hz, 1H), 8.22 (dd, *J* = 9.4, 2.7 Hz, 0.64H), 7.83 (d, *J* = 9.4 Hz, 1H), 7.66-7.57 (m, 4.95H), 7.49 – 7.34 (m, 10.84H), 7.25-7.24 (m, 0.64H), 7.16 – 7.11 (m, 1.63H), 7.10 – 6.94 (m, 6.56H), 6.80 (s, 0.69H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.40, 161.33, 157.00, 156.91, 154.24, 153.47, 141.08, 141.04, 140.44, 139.38, 138.80, 136.90, 136.19, 135.98, 134.81, 131.94 (q, *J* = 32.3 Hz), 131.84 (q, *J* = 33.3 Hz), 129.84, 129.80, 129.70, 129.61,

129.51, 129.19, 129.07 , 128.82, 128.73, 128.62, 128.57, 128.47, 128.29, 128.03, 127.99, 125.14 (q, *J* = 4.0 Hz), 124.93 (q, *J* = 4.0 Hz), 123.69 (q, *J* = 273.7 Hz), 123.64 (q, *J* = 275.7 Hz), 122.02, 121.84, 120.47, 117.61, 117.30, 116.37. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{28}H_{19}F_3N_3O_5$: 534.1271; found: 534.1269.

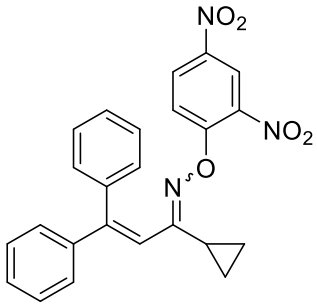


1-(4-Bromophenyl)-3,3-diphenylprop-2-en-1-one O-(2,4-dinitrophenyl) oxime (3e): 24% for 2 steps. (*E/Z* = 1:0.36), Solid, m. p. 60-65 ^oC. IR (neat, cm^{-1}) 1601, 1524, 1339, 1256, 1065, 829, 696. ^1H NMR (400 MHz, $CDCl_3$) δ 8.84 (d, *J* = 2.7 Hz, 1H), 8.77 (d, *J* = 2.7 Hz, 0.36H), 8.34 (dd, *J* = 9.4, 2.7 Hz, 1H), 8.15 (dd, *J* = 9.4, 2.8 Hz, 0.36H), 7.77 (d, *J* = 9.4 Hz, 1H), 7.53 – 7.27 (m, 13.70H), 7.20 – 7.18 (m, 0.81H), 7.09 – 6.96 (m, 5.08H), 6.93 (s, 1H), 6.84 (d, *J* = 9.4 Hz, 0.36H), 6.70 (s, 0.36H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.47, 160.99, 157.10, 153.65, 152.92, 141.15, 140.96, 140.90, 140.64, 139.75, 138.95, 136.11, 135.93, 132.24, 131.58, 131.37, 131.23, 130.14, 129.70, 129.64, 129.62, 129.42, 129.09, 129.00, 128.71, 128.57, 128.55, 128.32, 127.97, 127.89, 125.10, 121.94, 121.77, 120.67, 117.64, 117.21, 116.57. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{27}H_{19}BrN_3O_5$: 544.0503; found: 544.0502.

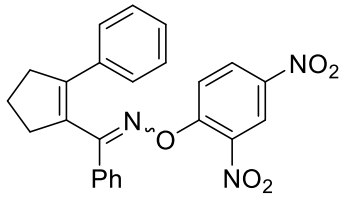


(1*Z*,2*E*)-3-(2-bromophenyl)-1,3-diphenylprop-2-en-1-one O-(2,4-dinitrophenyl)

oxime (3f): 20% for 2 steps. Solid, m. p. 171-173 ^{o}C. IR (neat, cm^{-1}) 1600, 1530, 1338, 1304, 927, 754. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.79 (d, *J* = 2.7 Hz, 1H), 8.29 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.90 – 7.84 (m, 2H), 7.72 (d, *J* = 9.4 Hz, 1H), 7.64 – 7.56 (m, 2H), 7.47 – 7.35 (m, 4H), 7.27 – 7.23 (m, 1H), 7.07 – 6.94 (m, 5H), 6.50 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.48, 157.12, 151.38, 142.43, 140.69, 138.44, 135.86, 133.18, 132.79, 131.70, 131.20, 129.80, 128.99, 128.73, 128.44, 128.25, 127.90, 127.61, 122.89, 121.84, 120.62, 116.96. HRMS (DART Positive) ([M+H]$^{+}$) Calcd. For $C_{27}H_{19}BrN_3O_5$: 544.0503; found: 544.0502.



1-Cyclopropyl-3,3-diphenylprop-2-en-1-one O-(2,4-dinitrophenyl) oxime (3g): 19% for 2 steps. (*E/Z* = 1:0.2), Solid, m. p. 84-86 ^{o}C. IR (neat, cm^{-1}) 1604, 1522, 1341, 927, 771. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.80 (d, *J* = 2.7 Hz, 1H), 8.32 (dd, *J* = 9.4, 2.8 Hz, 1H), 7.70 (d, *J* = 9.4 Hz, 1H), 7.52 – 7.45 (m, 0.6H), 7.39 – 7.17 (m, 12.59H), 6.81 (s, 1H), 1.37 – 1.31 (m, 1H), 1.26 (s, 0.2H), 1.06 – 1.02 (m, 0.4H), 0.96 – 0.92 (m, 2H), 0.80 – 0.75 (m, 0.4H), 0.71 – 0.64 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$): δ 171.09, 166.92, 157.40, 151.57, 141.15, 140.37, 140.21, 139.45, 137.62, 135.82, 131.51, 129.99, 129.75, 129.37, 129.12, 129.07, 128.65, 128.53, 128.46, 128.34, 128.23, 127.89, 126.72, 123.37, 122.04, 121.96, 119.90, 117.43, 117.00, 15.11, 14.74, 9.42, 8.32. HRMS (DART Positive) ([M+H]$^{+}$) Calcd. For $C_{24}H_{20}N_3O_5$: 430.1397; found: 430.1397.



Phenyl(2-phenylcyclopent-1-en-1-yl)methanone O-(2,4-dinitrophenyl) oxime (3h): 47% for 2 steps. Solid, m. p. 55-57 ºC. IR (neat, cm^{-1}) 1602, 1524, 1341, 1238, 1065, 892, 693. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 (d, *J* = 2.7 Hz, 1H), 8.77 (d, *J* = 2.7 Hz, 0.37H), 8.36 (dd, *J* = 9.4, 2.7 Hz, 1H), 8.18 (dd, *J* = 9.4, 2.8 Hz, 0.45H), 7.91 (d, *J* = 9.4 Hz, 1H), 7.79 – 7.73 (m, 2H), 7.61 – 7.57 (m, 0.9H), 7.54 – 7.52 (m, 0.45H), 7.49 – 7.36 (m, 4.35H), 7.24 – 7.02 (m, 7.97H), 3.10 – 2.94 (m, 23,06H), 2.88 – 2.75 (m, 3.24H), 2.28 – 2.19 (m, 2.51H), 2.16 – 2.10 (m, 1.17H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.07, 162.71, 157.47, 157.41, 149.77, 144.51, 140.75, 140.63, 137.14, 136.16, 135.96, 131.94, 131.85, 131.63, 131.44, 130.53, 130.09, 129.86, 129.13, 129.11, 129.03, 128.93, 128.18, 128.09, 127.87, 127.64, 127.59, 127.42, 126.51, 121.95, 121.77, 121.25, 117.58, 116.90, 39.41, 37.86, 37.07, 36.78, 23.36, 22.46. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{27}H_{18}BrN_3O_5$: 430.1397; found: 430.1397.

5. Optical absorption spectrum of the mixture of 1f and Et_3N.

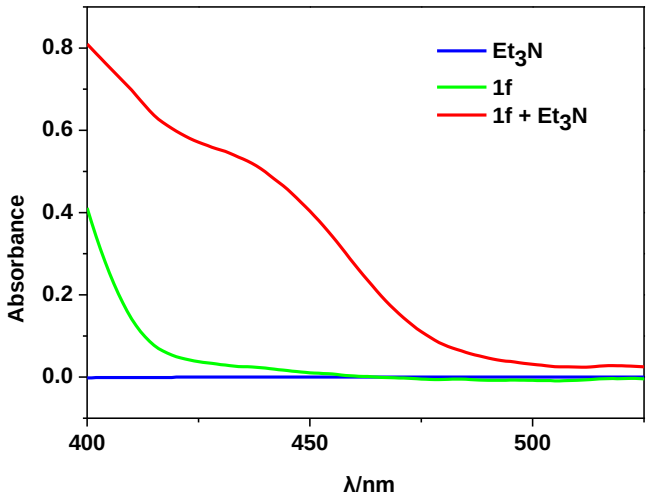


Figure S1: UV/Vis spectrum (recorded 0.5 mmol in CH_3CN) of **1f**, and 1:1 mixture of Et_3N and **1f**.

6. Determination of the donor/acceptor ratio of EDA in CH_3CN.

A Job's plot was constructed to evaluate the stoichiometry of the EDA complex between oxime ethers and Et_3N in solution. Solutions containing equal molar concentrations of the donor (Et_3N, $1.25*10^{-2}$ M) and the acceptor (**1f**, $1.25*10^{-2}$ M) were prepared and then mixed to cover donor/acceptor ratio from 0% to 100 % donor.

All the absorption spectra were recorded in 1 cm path quartz cuvettes. Table 1 summarizes the observed absorption (Abs(EDA)) associated to the variation of the donor/acceptor ratio at λ_{max} (425 nm) of the EDA complex.

Table S1: Values of Abs(EDA) for EDA in CH_3CN for different donor/acceptor ratios.

Ratio acceptor/donor	(% in Et_3N)	**1f (**10^{-2} M)	Et_3N (10^{-2} M)	Abs_{EDA}
10/0	0	1.25	0	0.104
9/1	10	1.125	0.125	0.262
8/2	20	1.00	0.25	0.302
7/3	30	0.875	0.375	0.351
6/4	40	0.75	0.50	0.399
5/5	50	0.625	0.625	0.451
4/6	60	0.50	0.75	0.367
3/7	70	0.375	0.875	0.341
2/8	80	0.25	1.00	0.283
1/9	90	0.125	1.125	0.219
0/10	100	0	1.25	0

From the above data, a symmetrical curve was obtained on plotting Abs_{EDA} vs. the donor/acceptor ratio. The maximum absorption is obtained for a 1:1 mixture of **1f** and Et_3N, indicating that this is the stoichiometry of the EDA complex in solution.

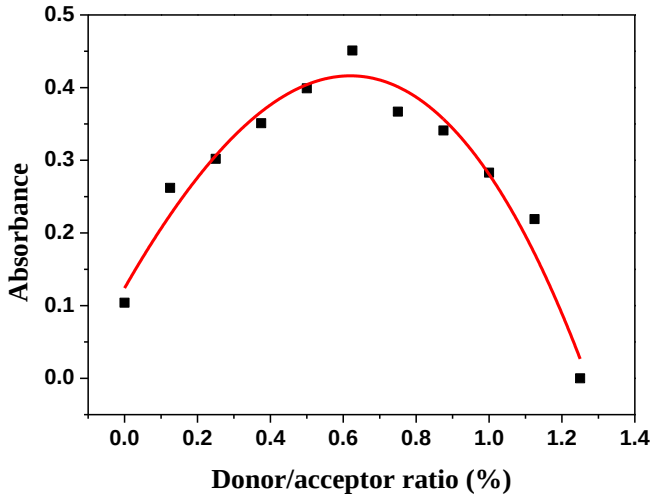


Figure S2: Job's plot

7. Determination of the association constant (K_{EDA}).

The association constant of the EDA complex formed between 1f and Et_3N was determined spectrophotometrically in CH_3CN, employing the Benesi-Hildebrand methodology. We measured the absorption at 425 nm of solutions with constant concentration of 1f ($2.0*10^{-3}$M) but increased donor/acceptor ratios, adding an excess of Et_3N. All the absorption spectra were recorded in 1 cm path quartz cuvettes. Data obtained by UV-visible for EDA in CH_3CN are showed in table 2.

Table S2: Data obtained by UV-visible for EDA in CH_3CN, with [1f] = $2.0*10^{-3}$M.

$Et_3N(10^{-3}M)$	$1/ Et_3N (M^{-1})$	Abs_{EDA}	$1/(Abs_{EDA}-A_0)$
2.0	500	0.095	15.873
4.0	250	0.131	10.101
6.0	166.7	0.16	7.812
8.0	125	0.2	5.952
10.0	100	0.241	4.784

12.0	83.3	0.278	4.065
14.0	71.4	0.323	3.436
16.0	62.5	0.37	2.958

According to equation 1 (A_0 (0.032) and A are the absorption in the absence and presence of Et_3N), respectively, A_{max} is the maximum absorption in the presence of Et_3N, and K_{EDA} is the equilibrium constant. n is the stoichiometry of the EDA complex, herein n = 1), a linear plot shown in Figure 2 was obtained for this system. The equilibrium constant K_{EDA} (K_{EDA} = 1.9066/0.0292 = 65.3) was readily obtained from the slope of these plots (Figure 3).

Equation 1

$$\frac{1}{A - A_o} = \frac{1}{A_{max} - A_o}\left(\frac{1}{K_{EDA}[NMM]^n} + 1\right)$$

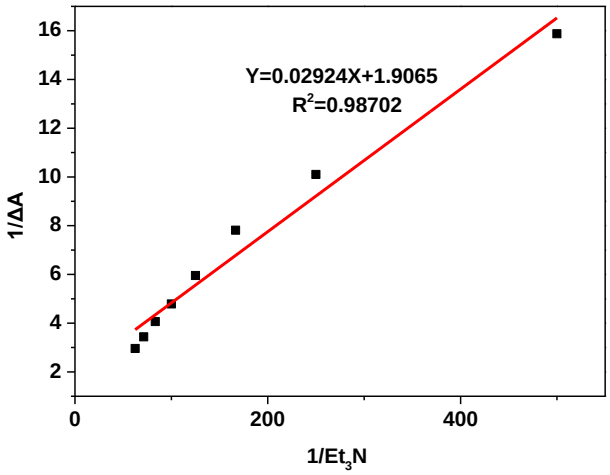
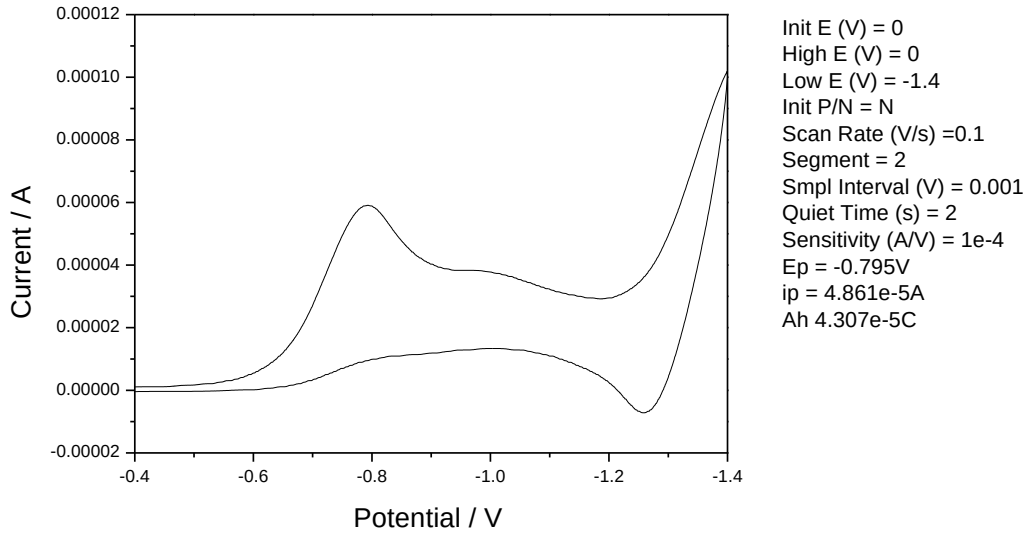


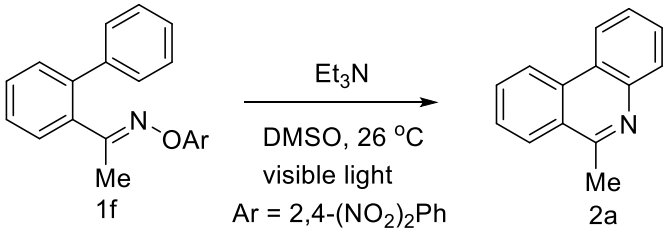
Figure S3: Scott plots

8. Cyclic voltammetry of 1f.

Cyclic voltammogram was recorded in a single cell, constructed from a glass vial, fitted with three electrodes. A glassy carbon disk electrode was used as a working electrode and a platinum wire was used as a counter electrode. The potential was recorded with the reference electrode saturated calomel electrode (SCE) immersed in 0.1 M solution of Et_4NClO_4 in 7 ml DMSO. And the concentration of **1f** is 0.01M. A scan rate of 100 mV/s was used.

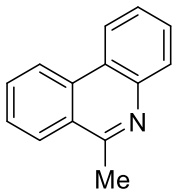


9. General procedure 3: Synthesis of phenanthridines and quinolines.

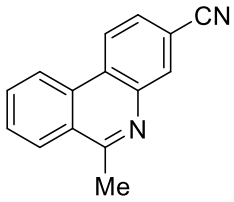


A 10 mL round bottom flask was equipped with a rubber septum and magnetic stir bar and was charged with **1f** (0.1 mmol, 1.0 equiv, 37.7 mg). The flask was evacuated and backfilled with N_2 for 3 times. DMSO (2.0 mL, 0.05 M) and Et_3N (0.4 mmol, 4.0 equiv, 0.056 mL) was then added with syringe under N_2. The mixture was then irradiated by a 5W blue LEDs strip. After the reaction was complete (as judged by TLC analysis), H_2O (2 mL) and EtOAc (2 mL) were added. The layers were separated and the aqueous layer was extracted with EtOAc (2 x 2 mL). The combined organic layers were dried (Na_2SO_4), filtered and evaporated. The residue was then purified by flash chromatography on silica gel (EtOAc : hexane = 1:20) to afford **2a**.

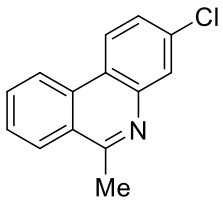
10. Data of compounds 2, and 4.



6-Methylphenanthridine (2a):[2] According to ***General Procedure***, **2a** was obtained as a white solid (19.3 mg, quantitative yield) from **1f**. Reaction time: 2.5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (d, *J* = 8.3 Hz, 1H), 8.46 (d, *J* = 8.1 Hz, 1H), 8.16 – 8.06 (m, 2H), 7.79 – 7.73 (m, 1H), 7.71 – 7.54 (m, 3H), 3.00 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 158.85, 143.67, 132.50, 130.45, 129.34, 128.63, 127.28, 126.50, 126.32, 125.86, 123.76, 122.27, 121.96, 23.40.

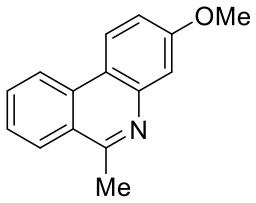


6-Methylphenanthridine-3-carbonitrile (2b):[2] According to ***General Procedure***, **2b** was obtained as a white solid (21.4 mg, 98% yield) from **1g**. Reaction time: 0.5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 (dd, *J* = 12.8, 8.4 Hz, 2H), 8.37 (d, *J* = 1.6 Hz, 1H), 8.25 (d, *J* = 8.1 Hz, 1H), 7.94 – 7.88 (m, 1H), 7.84 – 7.74 (m, 2H), 3.04 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.17, 143.01, 134.38, 131.33, 131.27, 129.13, 127.87, 127.07, 126.83, 126.65, 123.28, 122.82, 118.82, 111.77, 23.47.

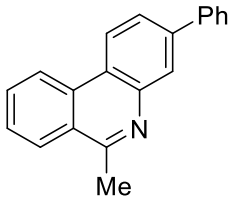


3-Chloro-6-methylphenanthridine (2c):[2] According to ***General Procedure***, **2c** was obtained as a white solid (21.9 mg, 96% yield) from **1h**. Reaction time: 0.75 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (d, *J* = 8.2 Hz, 1H), 8.35 (d, *J* = 8.7 Hz, 1H), 8.15 (d, *J* = 8.1 Hz, 1H), 8.04 (s, 1H), 7.80 (t, *J* = 7.6 Hz, 1H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.51 (d,

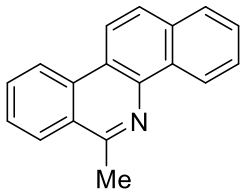
J = 8.7 Hz, 1H), 2.99 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 160.24, 144.36, 134.14, 132.02, 130.82, 128.62, 127.58, 126.78, 126.63, 125.75, 123.28, 122.21, 122.18, 23.40.



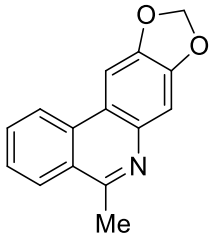
3-Methoxy-6-methylphenanthridine (2d):[2] According to ***General Procedure***, **2d** was obtained as a white solid (22.3 mg, quantitative yield) from **1i**. Reaction time: 2.5 h.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.48 (d, *J* = 8.3 Hz, 1H), 8.38 (d, *J* = 9.0 Hz, 1H), 8.16 (d, *J* = 8.2 Hz, 1H), 7.77 (t, *J* = 7.7 Hz, 1H), 7.59 (t, *J* = 7.6 Hz, 1H), 7.51 (d, *J* = 2.7 Hz, 1H), 7.23 (dd, *J* = 9.0, 2.7 Hz, 1H) , 3.97 (s, 3H), 3.01 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 160.10, 159.40, 145.26, 132.79, 130.54, 126.57, 126.19, 124.98, 123.17, 121.82, 117.77, 117.31, 109.28, 55.55, 23.34.



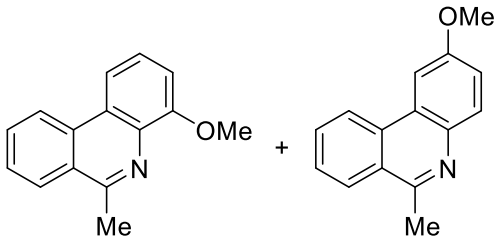
6-Methyl-3-phenylphenanthridine (2e):[2] According to ***General Procedure***, **2e** was obtained as a white solid (26.7 mg, 99% yield) from **1j**. Reaction time: 7h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.59 (d, *J* = 8.2 Hz, 1H), 8.54 (d, *J* = 8.5 Hz, 1H), 8.35 (d, *J* = 1.9 Hz, 1H), 8.19 (d, *J* = 7.8 Hz, 1H), 7.88 – 7.77 (m, 4H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.39 (t, *J* = 7.4 Hz, 1H), 3.04 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.39, 144.04, 141.28, 140.35, 132.41, 130.62, 128.99, 127.68, 127.34, 127.31, 127.23, 126.62, 125.91, 125.45, 122.85, 122.53, 122.36, 23.46.



6-Methylbenzo[c]phenanthridine (2f):[2] According to ***General Procedure***, **2f** was obtained as a white solid (24.3 mg, quantitative yield) from **1k**. Reaction time: 2.5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.44 (d, *J* = 8.2 Hz, 1H), 8.59 (d, *J* = 8.3 Hz, 1H), 8.43 (d, *J* = 8.9 Hz, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 7.91 (t, *J* = 8.1 Hz, 2H), 7.82 – 7.56 (m, 4H), 3.12 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 157.66, 140.47, 133.32, 132.84, 131.87, 130.19, 127.60, 127.18, 126.89, 126.86, 126.74, 126.49, 126.15, 124.84, 122.68, 120.33, 119.86, 23.67.



5-Methyl-[1,3]dioxolo[4,5-c]phenanthridine (2g): According to ***General Procedure***, **2g** was obtained as a white solid (23.2 mg, 98% yield) from **1l**. Reaction time: 18 h Solid, m. p. 187 – 188 ^{o}C. IR (neat, cm^{-1}) 1582, 1497, 1482, 1465, 1375, 1245, 764. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, *J* = 8.3 Hz, 1H), 8.14 (d, *J* = 8.2 Hz, 1H), 7.80 (s, 1H), 7.75 (t, *J* = 7.7 Hz, 1H), 7.60 (t, *J* = 7.6 Hz, 1H), 7.44 (s, 1H), 6.11 (s, 2H), 2.98 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.62, 149.11, 147.51, 140.91, 132.55, 130.10, 126.48, 126.36, 125.03, 122.05, 119.42, 107.19, 101.67, 99.33, 23.04. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{15}H_{12}NO_2$: 238.0863; found: 238.0863.

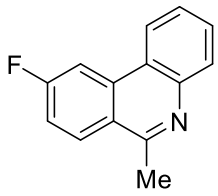


2h **2h'**

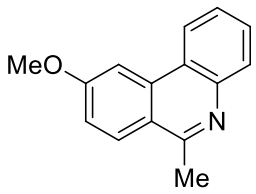
4-Methoxy-6-methylphenanthridine (2h) & 2-Methoxy-6-methylphenanthridine (2h'):[2] According to ***General Procedure***, **2h** and **2h'** were obtained as a white solid (21.3 mg, 96% yield) from **1m**. Reaction time: 0.75 h.

2h:^{1}H NMR (400 MHz, $CDCl_3$) δ 8.61 (d, *J* = 8.3 Hz, 1H), 8.24 (d, *J* = 8.2 Hz, 1H), 8.13 (d, *J* = 8.3 Hz, 1H), 7.86 – 7.80 (m, 1H), 7.73 – 7.67 (m, 1H), 7.56 (t, *J* = 8.1 Hz, 1H), 7.14 (d, *J* = 7.9 Hz, 1H), 4.12 (s, 3H), 3.11 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 157.92, 155.43, 134.62, 132.54, 130.46, 127.46, 126.60, 126.46, 126.06, 124.99, 122.88, 113.94, 108.13, 56.18, 23.90.

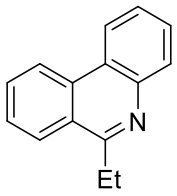
2h': ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56 (d, *J* = 8.2 Hz, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 8.02 (d, *J* = 8.9 Hz, 1H), 7.89 (d, *J* = 2.7 Hz, 1H), 7.85 – 7.80 (m, 1H), 7.75 – 7.65 (m, 1H), 7.34 (dd, *J* = 8.9, 2.7 Hz, 1H), 4.01 (s, 3H), 3.01 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 157.97, 156.25, 132.18, 130.70, 130.13, 127.40, 126.60, 126.06, 124.76, 122.36, 118.29, 103.12, 55.66, 29.72,23.14.



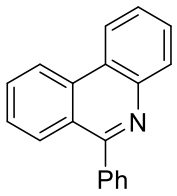
9-Fluoro-6-methylphenanthridine (2i):[2] According to ***General Procedure***, **2i** was obtained as a white solid (20.7 mg, 98% yield) from **1n**. Reaction time: 5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 – 8.32 (m, 1H), 8.24 – 8.11 (m, 2H), 8.08 (d, *J* = 8.2 Hz, 1H), 7.74 – 7.69 (m, 1H), 7.59 (t, *J* = 7.6 Hz, 1H), 7.38 (td, *J* = 8.5, 2.7 Hz, 1H), 2.99 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.75 (d, *J* = 251.3 Hz), 158.17, 144.00, 134.98 (d, *J* = 9.3 Hz), 129.43, 129.32, 126.39, 123.35 (d, *J* = 4.0 Hz), 122.88, 122.13, 116.24 (d, *J* = 23.7 Hz), 107.44 (d, *J* = 22.1 Hz), 23.42. ^{19}F NMR (377 MHz, $CDCl_3$) δ - 107.13.



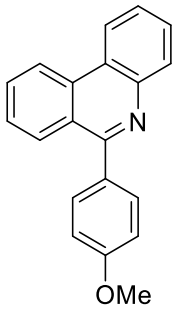
9-methoxy-6-methylphenanthridine（2j） According to ***General Procedure***, **2j** was obtained as a white solid (21.8 mg, 98% yield) from **1t**. Reaction time: 0.5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42 (d, *J* = 8.1 Hz, 1H), 8.10 (d, *J* = 9.0 Hz, 1H), 8.07 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.89 (d, *J* = 2.4 Hz, 1H), 7.69 (ddd, *J* = 8.3, 7.1, 1.4 Hz, 1H), 7.61 – 7.52 (m, 1H), 7.29 – 7.22 (m, 1H), 4.02 (s, 3H), 2.98 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.18, 158.31, 144.16, 134.68, 129.33, 128.74, 128.45, 125.84, 123.67, 121.97, 120.87, 117.30, 102.98, 55.54, 23.33. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{15}H_{13}NO$: 224.1070; found: 224.1067.



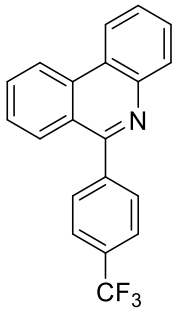
6-Ethylphenanthridine (2k):[2] According to ***General Procedure***, **2j** was obtained as a white solid (19.2 mg, 93% yield) from **1o**. Reaction time: 19 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (d, *J* = 8.3 Hz, 1H), 8.52 (dd, *J* = 8.2, 1.2 Hz, 1H), 8.25 (d, *J* = 7.9 Hz, 1H), 8.13 (dd, *J* = 8.2, 1.0 Hz, 1H), 7.83-7.79 (m, 1H), 7.72-7.65 (m, 2H), 7.63 – 7.58 (m, 1H), 3.40 (q, *J* = 7.6 Hz, 2H), 1.51 (t, *J* = 7.6 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.26, 143.79, 132.95, 130.29, 129.58, 128.59, 127.26, 126.30, 126.25, 125.04, 123.69, 122.52, 121.93, 29.43, 13.61.



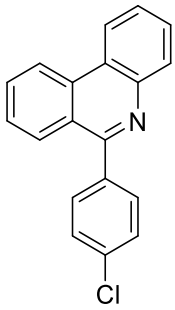
6-Phenylphenanthridine (2l):[2] According to ***General Procedure***, **2k** was obtained as a white solid (25.0 mg, 98% yield) from **1p**. Reaction time: 2 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.67 (d, *J* = 8.3 Hz, 1H), 8.59 (d, *J* = 8.1 Hz, 1H), 8.25 (d, *J* = 8.1 Hz, 1H), 8.09 (d, *J* = 8.2 Hz, 1H), 7.83 (t, *J* = 7.7 Hz, 1H), 7.78 – 7.48 (m, 8H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.30, 143.80, 139.80, 133.46, 130.60, 130.35, 129.78, 128.94, 128.89, 128.76, 128.47, 127.16, 126.98, 125.26, 123.78, 122.22, 121.99.



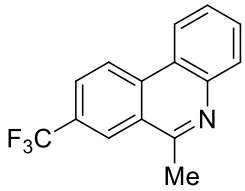
6-(4-Methoxyphenyl)phenanthridine (2m):[2] According to ***General Procedure***, **2l** was obtained as a white solid (27.1 mg, 95% yield) from **1q**. Reaction time: 5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.69 (d, J = 8.3 Hz, 1H), 8.61 (dd, J = 8.1, 0.9 Hz, 1H), 8.23 (dd, J = 8.1, 1.1 Hz, 1H), 8.16 (dd, J = 8.2, 0.5 Hz, 1H), 7.88 – 7.82 (m, 1H), 7.78 – 7.57 (m, 5H), 7.13 – 7.07 (m, 2H), 3.91 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 160.91, 160.15, 143.87, 133.54, 132.29, 131.20, 130.50, 130.24, 128.98, 128.82, 127.09, 126.76, 125.37, 123.64, 122.23, 121.94, 113.91, 55.48.



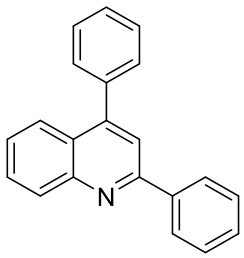
6-(4-(Trifluoromethyl)phenyl)phenanthridine (2n):[2] According to ***General Procedure***, **2m** was obtained as a white solid (29.2 mg, 90% yield) from **1r**. Reaction time: 1.5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72 (d, *J* = 8.3 Hz, 1H), 8.63 (d, *J* = 8.1 Hz, 1H), 8.23 (dd, *J* = 8.1, 1.2 Hz, 1H), 8.01 (d, *J* = 8.2 Hz, 1H), 7.91 – 7.81 (m, 5H), 7.81 – 7.75 (m, 1H), 7.74 – 7.69 (m, 1H), 7.66 – 7.60 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.74, 143.66, 143.36, 133.52, 130.88, 130.84 (q, *J* = 32.5 Hz), 130.41, 130.18, 129.10, 128.34, 127.42, 125.48 (q, *J* = 3.8 Hz), 124.86, 124.19 (q, *J* = 272.2 Hz) 123.87, 122.43, 122.05. ^{19}F NMR (377 MHz, $CDCl_3$) δ - 62.59.



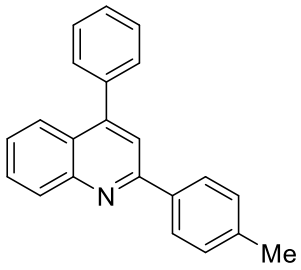
6-(4-Chlorophenyl)phenanthridine (2o):[2] According to ***General Procedure***, **2n** was obtained as a white solid (26.1 mg, 90% yield) from **1s**. Reaction time: 18 h.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.69 (d, *J* = 8.3 Hz, 1H), 8.60 (dd, *J* = 8.1, 1.1 Hz, 1H), 8.22 (dd, *J* = 8.1, 1.2 Hz, 1H), 8.05 (d, *J* = 8.3 Hz, 1H), 7.85 (ddd, *J* = 8.3, 7.1, 1.2 Hz, 1H), 7.78 – 7.73 (m, 1H), 7.71 – 7.66 (m, 3H), 7.64 – 7.59 (m, 1H), 7.56 – 7.51 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.99, 143.72, 138.22, 134.92, 133.51, 131.18, 130.74, 130.35, 128.99, 128.71, 128.51, 127.30, 127.18, 125.01, 123.78, 122.36, 122.01.



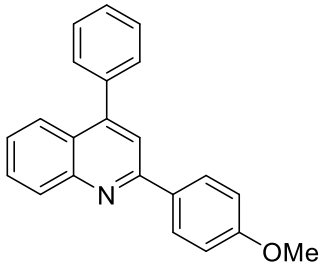
6-methyl-8-(trifluoromethyl)phenanthridine(2p): According to ***General Procedure***, **2p** was obtained as a white solid (26.1 mg, 90% yield) from **1u**. Reaction time: 0.5 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.66 (d, *J* = 8.7 Hz, 1H), 8.49 (d, *J* = 8.1 Hz, 1H), 8.11 (dd, *J* = 8.2, 0.8 Hz, 1H), 8.11(s,1H), 7.99 (dd, *J* = 8.7, 1.5 Hz, 1H), 7.81 – 7.70 (m, 1H), 7.69 – 7.60 (m, 1H), 3.05 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 158.58, 144.36, 134.76, 129.85, 129.64, 129.02 (q, J = 32.9 Hz), 126.90, 126.27(q, J = 3.3 Hz), 125.18, 124.04 (q, J = 273.3 Hz), 123.93 (q, J = 4.2 Hz), 123.38, 122.74, 122.30, 23.31. ^{19}F NMR (377 MHz, $CDCl_3$) δ - 62.11. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{15}H_{10}F_3N$: 262.0838; found: 262.0834.



2,4-Diphenylquinoline (4a):[4] According to ***General Procedure***, **4a** was obtained as a white solid (25.7 mg, 91% yield) from **3a**. Reaction time: 4 h.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.4 Hz, 1H), 8.20-8.17 (m, 2H), 7.90 (dd, *J* = 8.4, 0.9 Hz, 1H), 7.81 (s, 1H), 7.72 (ddd, *J* = 8.4, 6.8, 1.4 Hz, 1H), 7.58 – 7.42 (m, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.95, 149.21, 148.85, 139.70, 138.44, 130.16, 129.61, 129.57, 129.39, 128.89, 128.64, 128.45, 127.64, 126.38, 125.81, 125.69, 119.42.

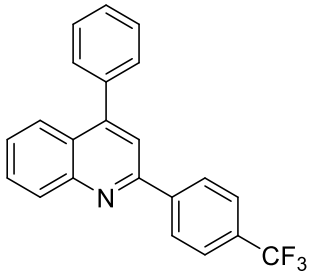


4-Phenyl-2-(p-tolyl)quinolone (4b):[4] According to ***General Procedure***, **4b** was obtained as a white solid (25.5 mg, 86% yield) from **3b**. Reaction time: 24 h.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.5 Hz, 1H), 8.09 (d, *J* = 8.0 Hz, 2H), 7.87 (d, *J* = 8.3 Hz, 1H), 7.78 (s, 1H), 7.70 (dd, *J* = 11.3, 3.9 Hz, 1H), 7.57 – 7.40 (m, 6H), 7.31 (d, *J* = 8.0 Hz, 2H), 2.41 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.88, 149.08, 148.82, 139.46, 138.51, 136.85, 130.04, 129.59, 129.48, 128.60, 128.39, 127.49, 126.16, 125.72, 125.64, 119.24, 21.37.

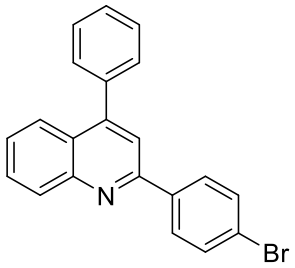


2-(4-Methoxyphenyl)-4-phenylquinoline (4c):[5] According to ***General Procedure***, **4c**

was obtained as a white solid (28.3 mg, 91% yield) from **3c**. Reaction time: 3 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.4 Hz, 1H), 8.15 (d, *J* = 8.8 Hz, 2H), 7.86 (d, *J* = 8.4 Hz, 1H), 7.75 (s, 1H), 7.73 – 7.66 (m, 1H), 7.57 – 7.46 (m, 5H), 7.45 – 7.38 (m, 1H), 7.02 (d, *J* = 8.8 Hz, 2H), 3.85 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 160.87, 156.46, 149.03, 148.85, 138.54, 132.24, 129.94, 129.60, 129.49, 128.95, 128.62, 128.40, 126.01, 125.66, 125.55, 118.94, 114.26, 55.42.

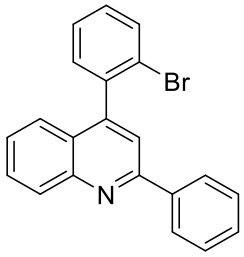


4-Phenyl-2-(4-(trifluoromethyl)phenyl)quinolone (4d):[4] According to ***General Procedure***, **4d** was obtained as a white solid (31.8 mg, 91% yield) from **3d**. Reaction time: 4 h.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, *J* = 8.2 Hz, 2H), 8.24 (d, *J* = 8.4 Hz, 1H), 7.91 (d, *J* = 8.4 Hz, 1H), 7.80 (s, 1H), 7.78 – 7.71 (m, 3H), 7.57 – 7.46 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 155.24, 149.65, 148.82, 142.96, 138.15, 131.12 (q, *J* = 32.4 Hz), 130.26, 129.87, 129.57, 128.71, 128.62, 127.88, 126.92, 126.06, 125.77 (q, *J* = 3.9 Hz), 124.23 (q, *J* = 272.0 Hz), 119.16. ^{19}F NMR (377 MHz, $CDCl_3$) δ - 62.57.

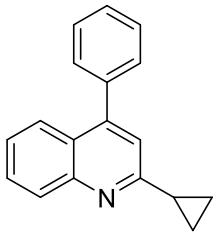


2-(4-Bromophenyl)-4-phenylquinoline (4e):[4] According to ***General Procedure***, **4e** was obtained as a white solid (33.8 mg, 94% yield) from **3e**. Reaction time: 4 h.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.4 Hz, 1H), 8.06 (d, *J* = 8.4 Hz, 2H), 7.89 (d, *J* = 8.4 Hz, 1H), 7.75 (d, *J* = 3.3 Hz, 1H), 7.74 – 7.69 (m, 1H), 7.62 (d, *J* = 8.4 Hz, 2H), 7.56 – 7.42 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 155.57, 149.45, 148.80,

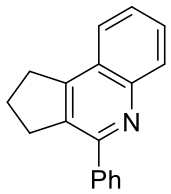
138.50, 138.27, 131.99, 130.12, 129.73, 129.57, 129.13, 128.66, 128.54, 126.59, 125.88, 125.72, 123.98, 118.85.



4-(2-Bromophenyl)-2-phenylquinoline (4f): According to ***General Procedure***, **4f** was obtained as a white solid (33.0 mg, 92% yield) from **3f**. Reaction time: 3 h. Solid, m. p. 113-115 ^{o}C. IR (neat, cm^{-1}) 1601, 1546, 1465, 1405, 1355, 1023, 761. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.25 (d, *J* = 8.5 Hz, 1H), 8.20 (dd, *J* = 5.2, 3.4 Hz, 2H), 7.81 – 7.68 (m, 3H), 7.56 – 7.40 (m, 6H), 7.39 – 7.31 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.82, 148.55, 148.08, 139.54, 139.10, 133.10, 131.35, 130.12, 129.96, 129.72, 129.46, 128.89, 127.65, 127.40, 126.50, 125.73, 125.65, 123.25, 119.75. HRMS (DART Positive) ([M+H]$^{+}$) Calcd. For $C_{21}H_{15}BrN$: 360.0382; found: 360.0383.



2-Cyclopropyl-4-phenylquinoline (4g): According to ***General Procedure***, **4g** was obtained as an oil (23.9 mg, 98% yield) from **3g**. Reaction time: 12 h. Oil. IR (neat, cm^{-1}) 1592, 1554, 1491, 1443, 925, 758, 699. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.4 Hz, 1H), 7.80 (d, *J* = 8.3 Hz, 1H), 7.66 – 7.60 (m, 1H), 7.55 – 7.42 (m, 5H), 7.36 (dd, *J* = 11.2, 4.0 Hz, 1H), 7.09 (s, 1H), 2.31 – 2.20 (m, 1H), 1.23 – 1.04 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.91, 148.52, 148.19, 138.43, 129.53, 129.18, 129.06, 128.51, 128.26, 125.64, 125.36, 125.26, 119.60, 18.13, 10.25. HRMS (DART Positive) ([M+H]$^{+}$) Calcd. For $C_{18}H_{16}N$: 246.1277; found: 246.1277.



4-Phenyl-2,3-dihydro-1H-cyclopenta[c]quinolone (4h): According to ***General Procedure***, **4h** was obtained as an oil (17.1 mg, 70% yield) from **3h**. Reaction time: 24 h. Oil. IR (neat, cm^{-1}) 1577, 1505, 1493, 1358, 1237, 785, 696. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.5 Hz, 1H), 7.85-7.81 (m, 3H), 7.70 – 7.63 (m, 1H), 7.56 – 7.40 (m, 4H), 3.33 (t, *J* = 7.6 Hz, 2H), 3.25 (t, *J* = 7.3 Hz, 2H), 2.31 – 2.22 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.12, 151.36, 147.39, 140.58, 135.05, 129.90, 128.76, 128.62, 128.55, 128.38, 126.13, 125.30, 124.13, 33.70, 31.29, 25.05. HRMS (DART Positive) ($[M+H]^+$) Calcd. For $C_{18}H_{16}N$: 246.1277; found: 246.1277.

11. Reference.

(1) Jacob, D.; Samuel, G. B.; Stephanie, E.; Robert, A. W. D.; Daniele, L. *Angew. Chem. Int. Ed*. **2015**, *54*, 14017.

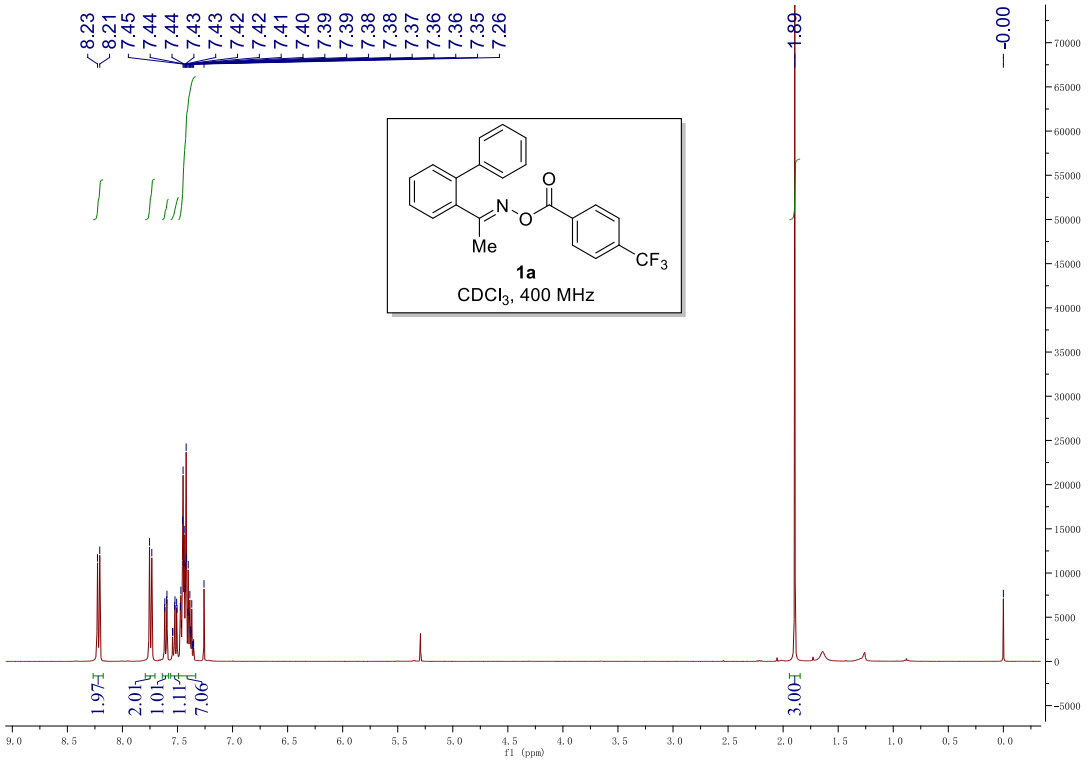
(2) Jiang, H.; An, X. D.; Tong, K.; Zheng, T. Y.; Zhang, Y.; Yu, S. Y. *Angew. Chem. Int. Ed*. **2015**, *54*, 4055.

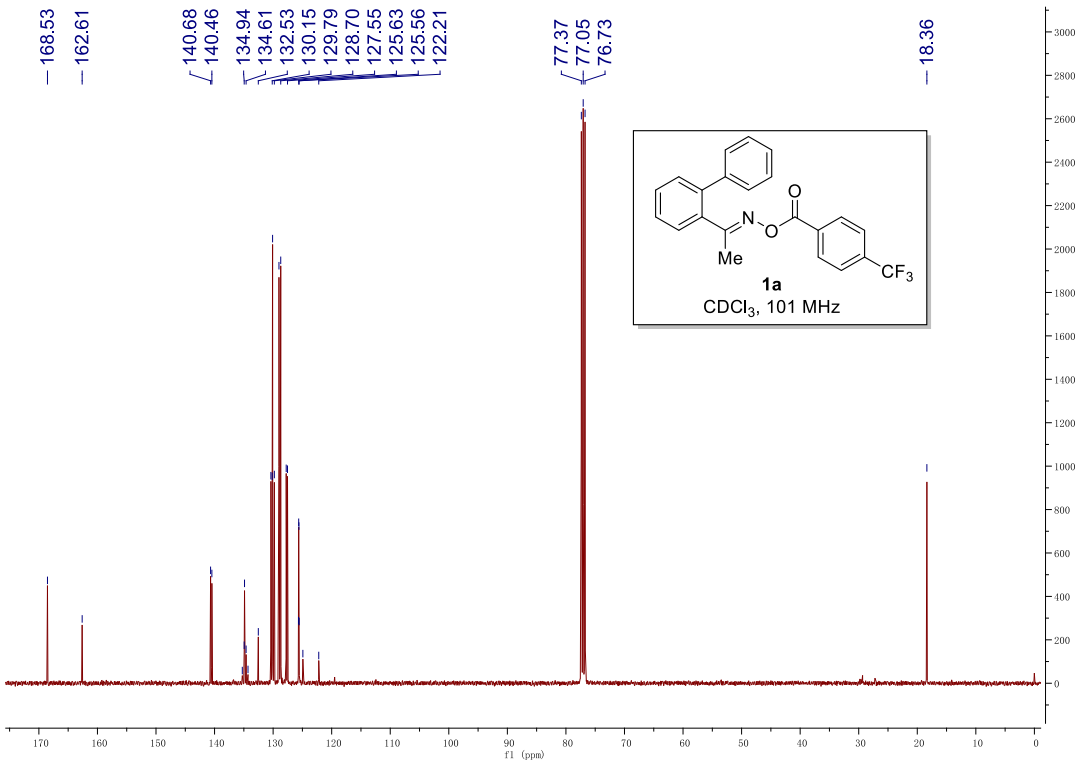
(3) Park, J.; Yun, J.; Kim, J.; Jang, D. J.; Park, C. H.; Lee, K. *Synth. Commun*. **2014**, *44(13)*, 1924.

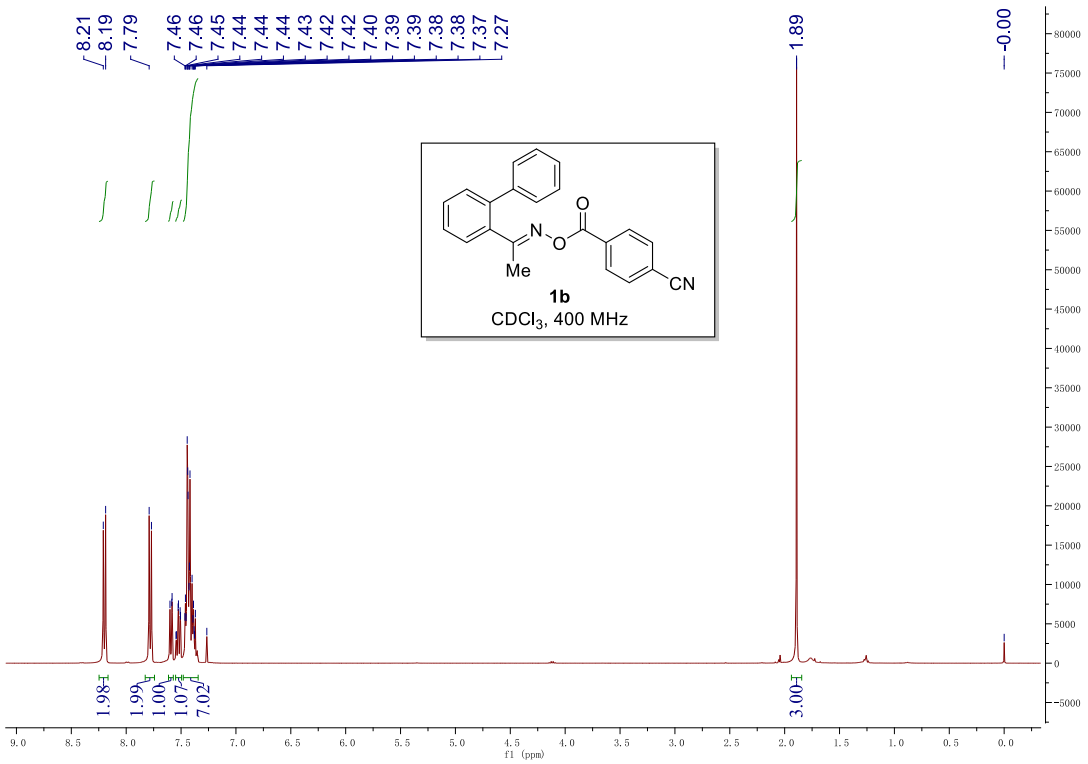
(4) Zhang, Z. H.; Du, H. F. *Org. Lett.* **2015**, *17*, 6266.

(5) André, L. S.; Alisson, R. R.; Gilson, Z. *Eur. J. Org. Chem.* **2015**, 5640.

12. Copies of NMR spectra.



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7.37
7.27
1.89
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1.98
1.99
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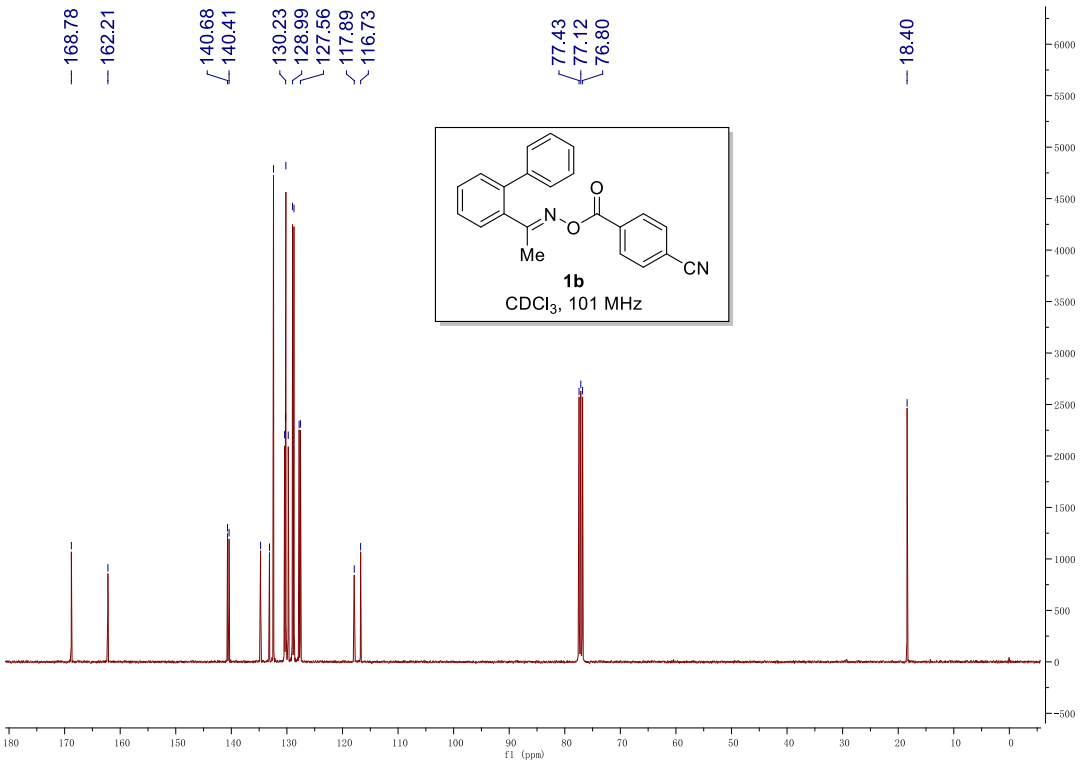
CDCl3, 400 MHz
f1 (ppm)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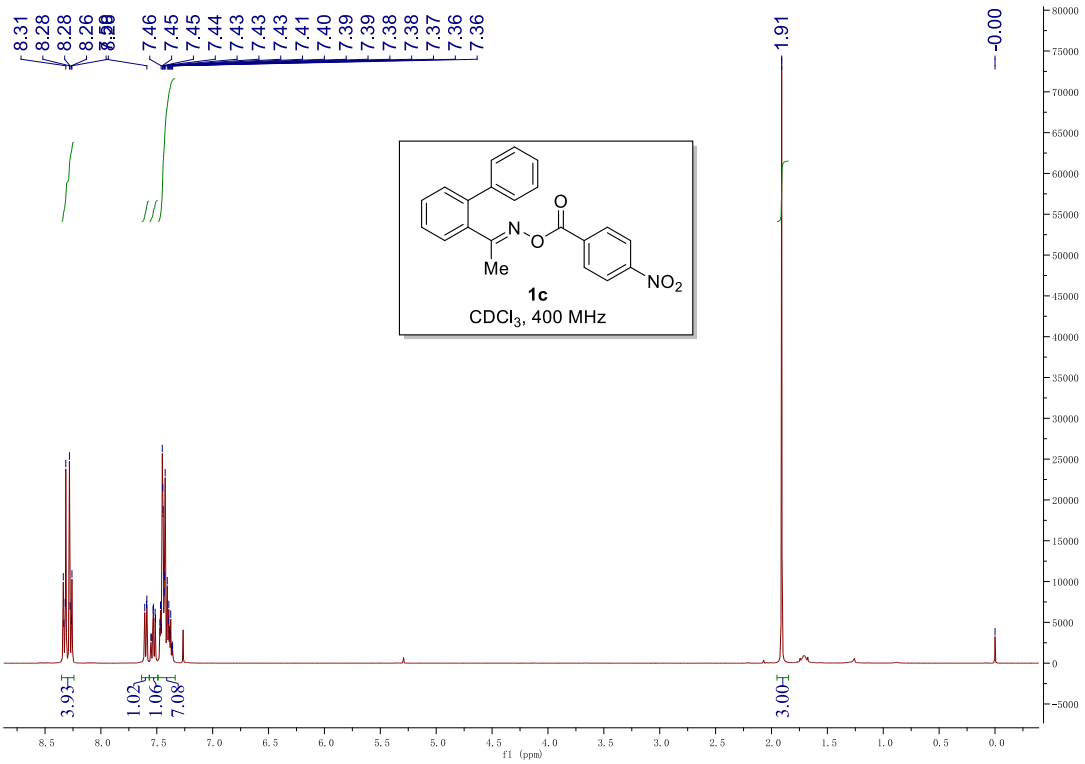
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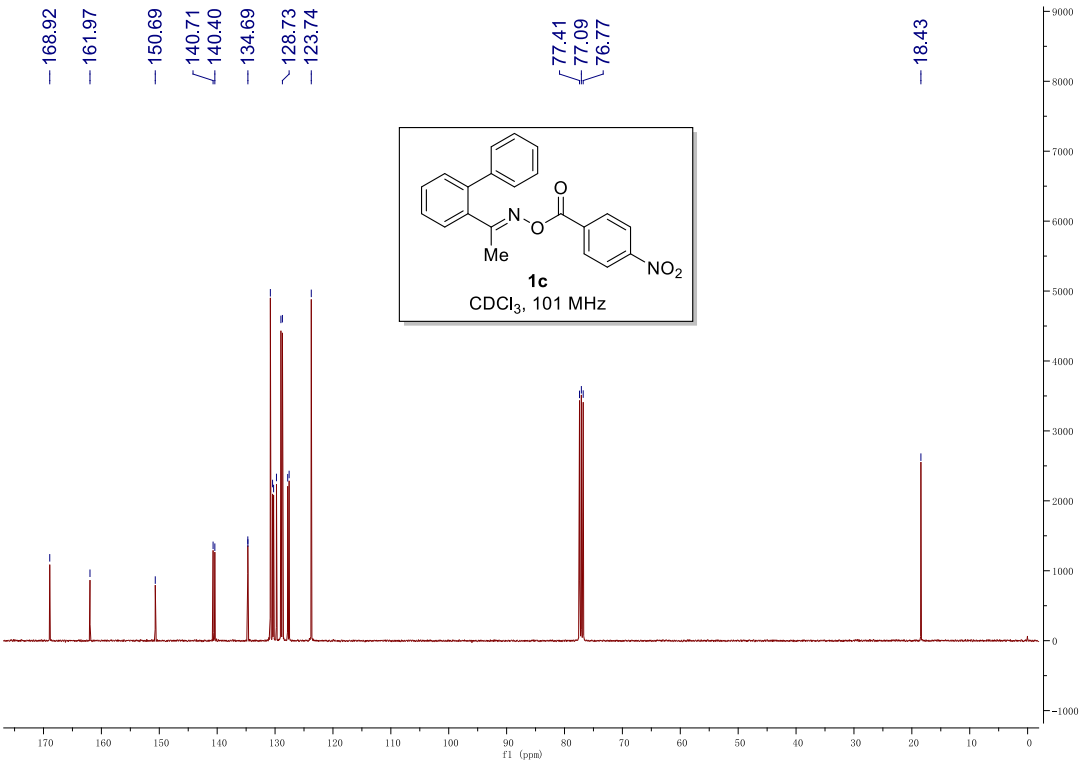
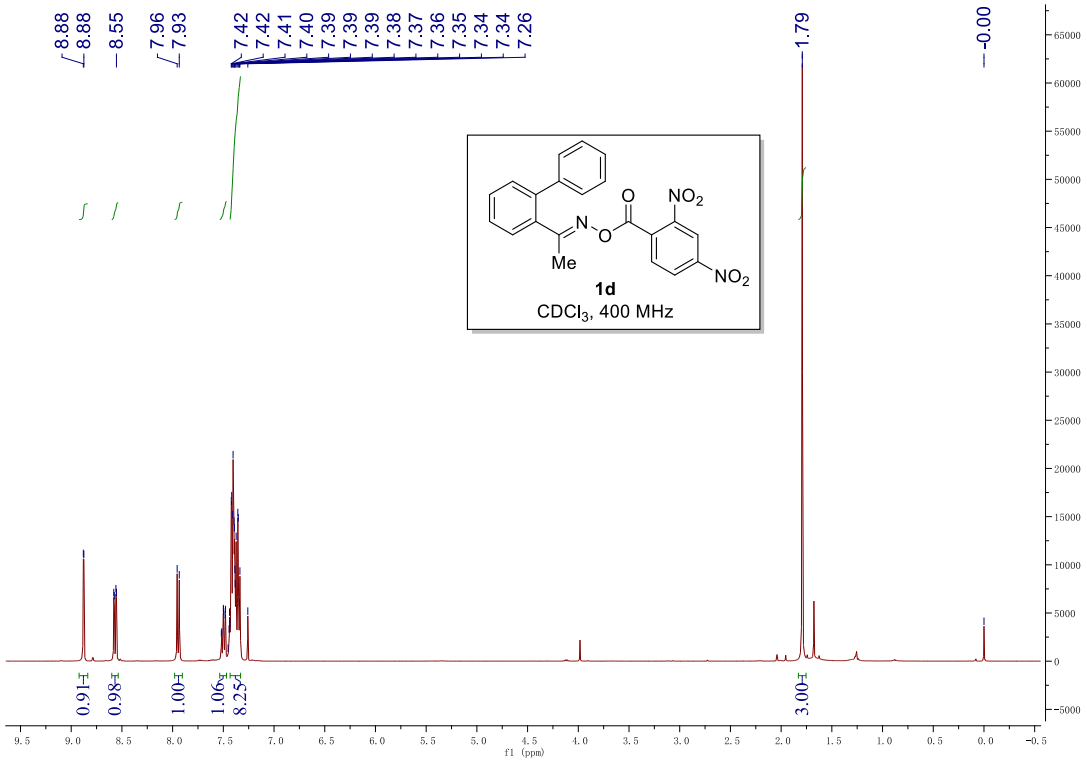
8.28
8.26
7.46
7.45
7.45
7.44
7.43
7.43
7.43
7.41
7.40
7.39
7.39
7.38
7.38
7.37
7.36
7.36
1.91
-0.00
O
N
O
Me
NO2
1c
CDCl3, 400 MHz
3.93
1.02
1.06
7.08
3.00
f1 (ppm)


168.92
161.97
150.69
140.71
140.40
134.69
128.73
123.74
77.41
77.09
76.77
18.43
O
N
O
Me
NO2
1c
CDCl3, 101 MHz
f1 (ppm)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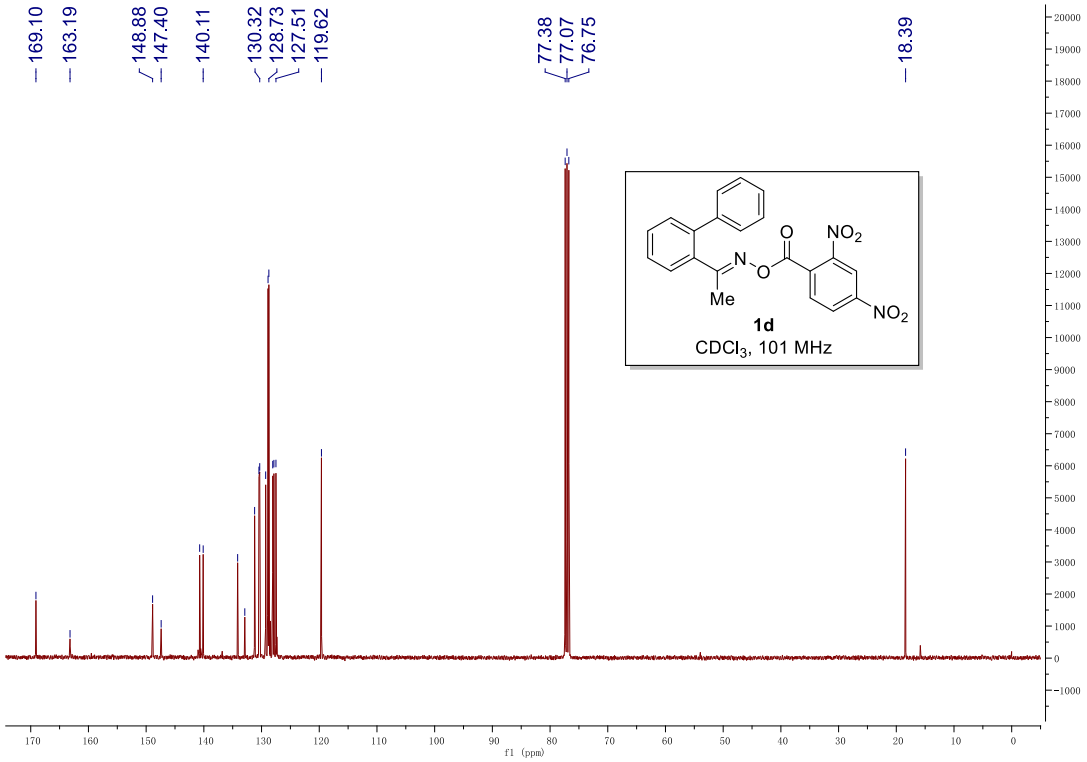
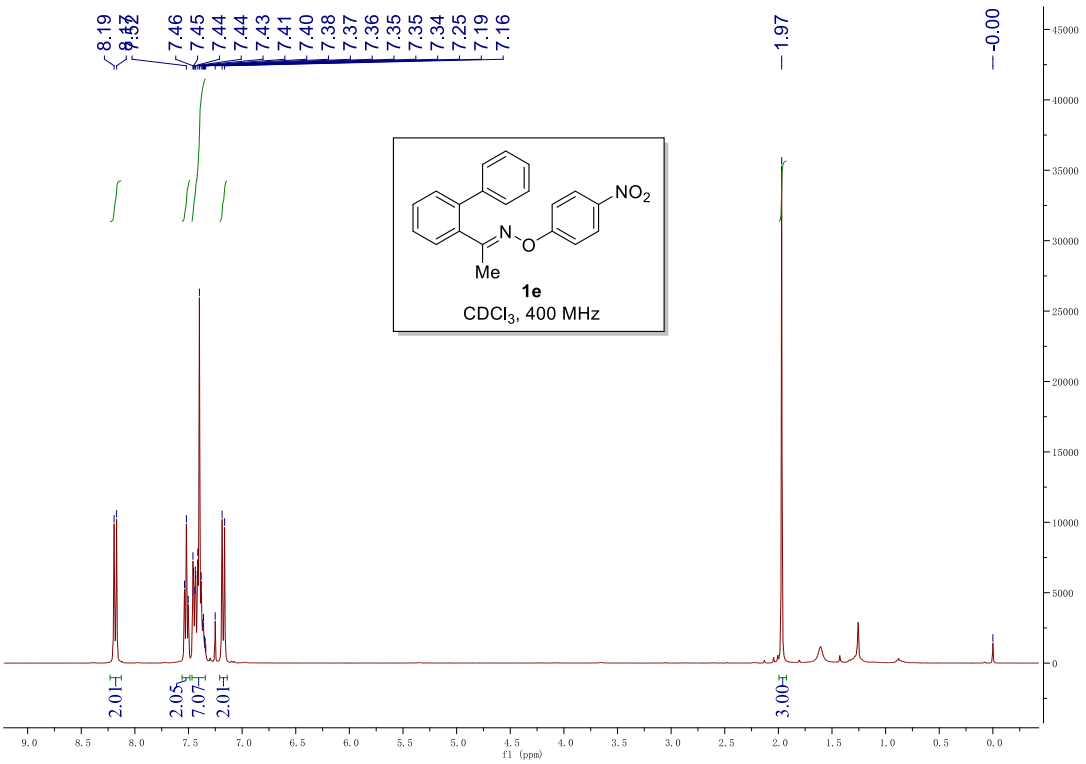
8.88
8.55
7.96
7.93
7.42
7.42
7.41
7.40
7.39
7.39
7.39
7.38
7.37
7.36
7.35
7.34
7.34
7.26
1.79
-0.00
0.91
0.98
1.00
1.06
8.25
3.00
f1 (ppm)
1d
CDCl3, 400 MHz


169.10
163.19
148.88
147.40
140.11
130.32
128.73
127.51
119.62
77.38
77.07
76.75
18.39
f1 (ppm)
1d
CDCl3, 101 MHz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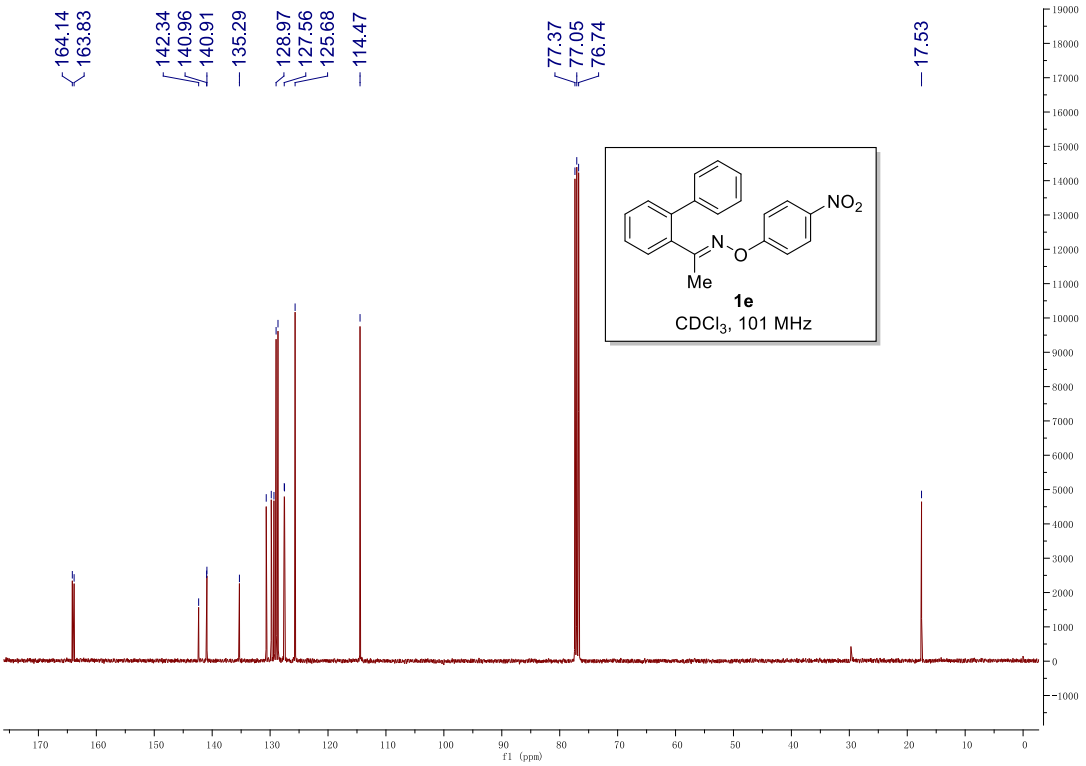
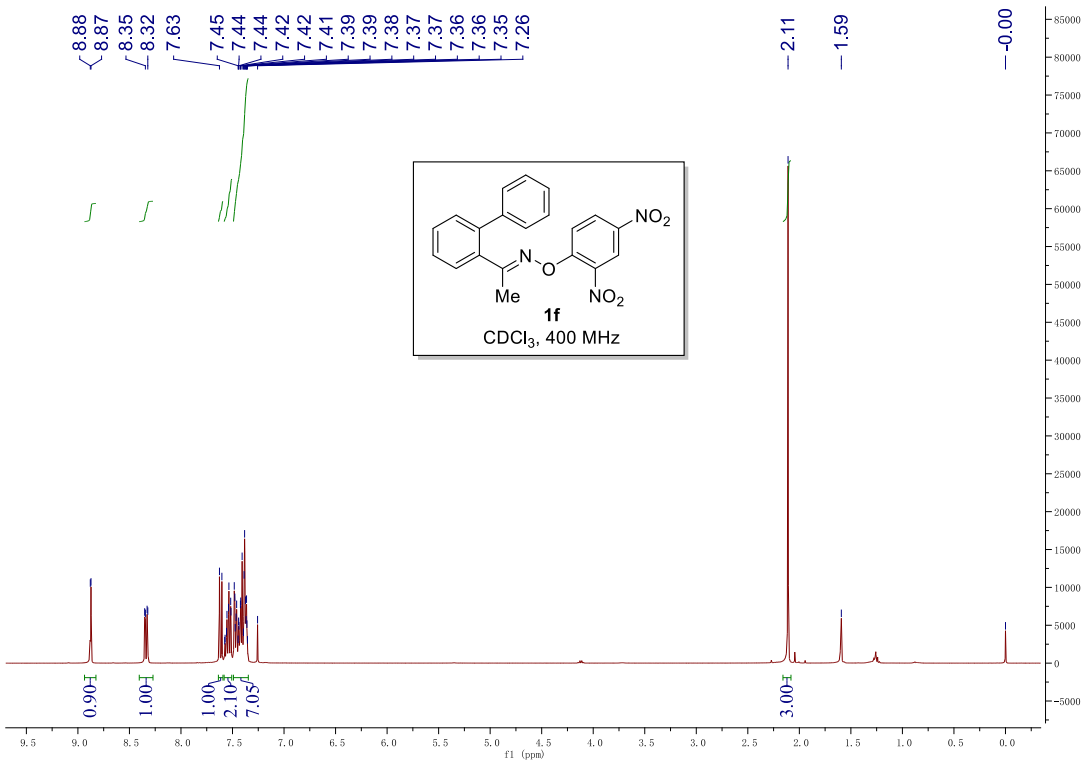
8.17
8.15
7.46
7.45
7.44
7.44
7.43
7.41
7.40
7.38
7.37
7.36
7.35
7.35
7.34
7.25
7.19
7.16
1.97
-0.00
NO2
N
O
Me
1e
CDCl3, 400 MHz
2.01
2.05
7.07
2.01
3.00
f1 (ppm)


164.14
163.83
142.34
140.96
140.91
135.29
128.97
127.56
125.68
114.47
77.37
77.05
76.74
17.53
NO2
N
O
Me
1e
CDCl3, 101 MHz
f1 (ppm)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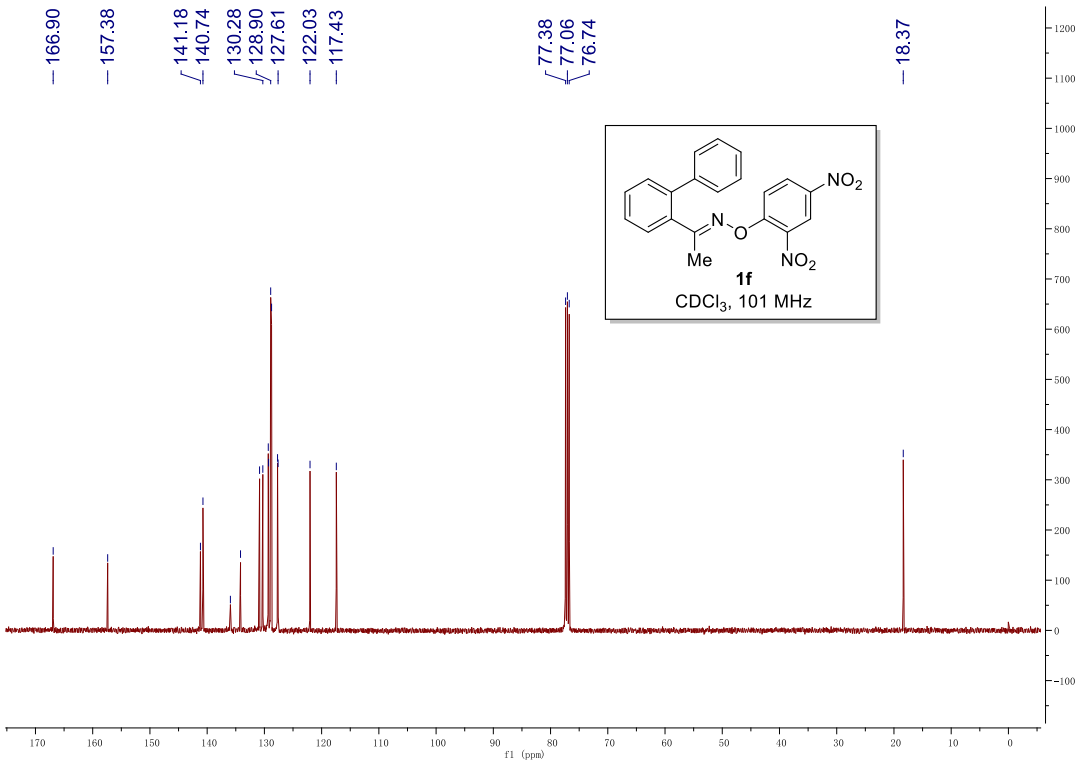
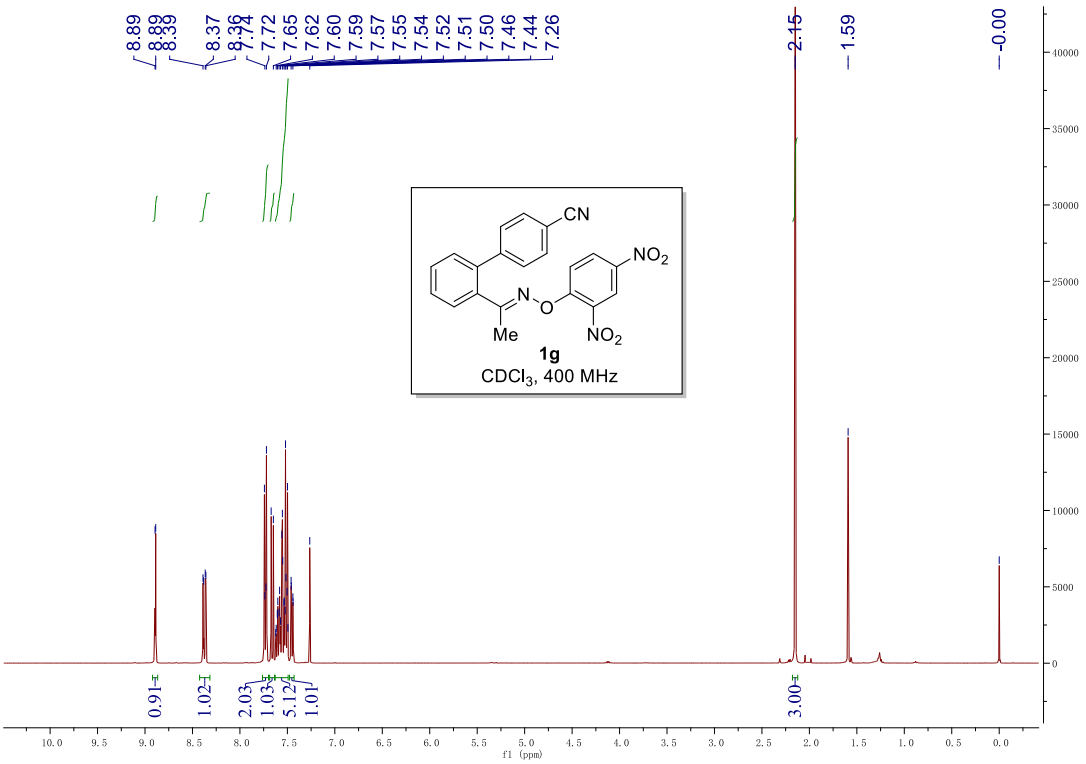
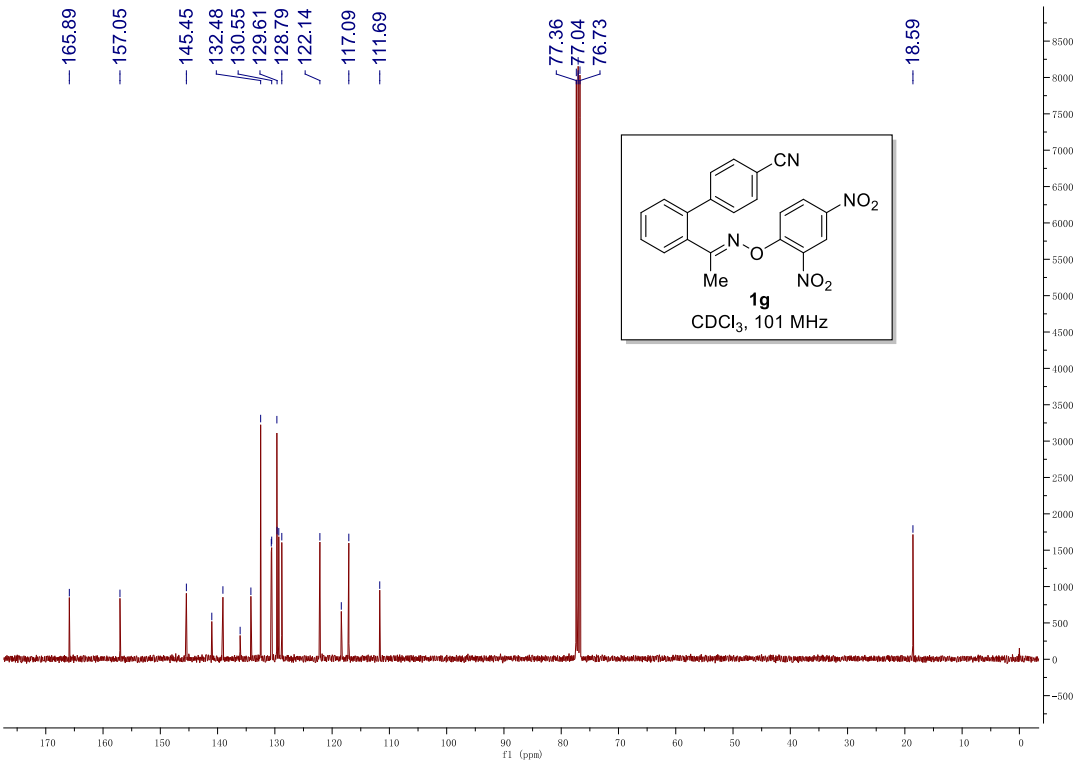
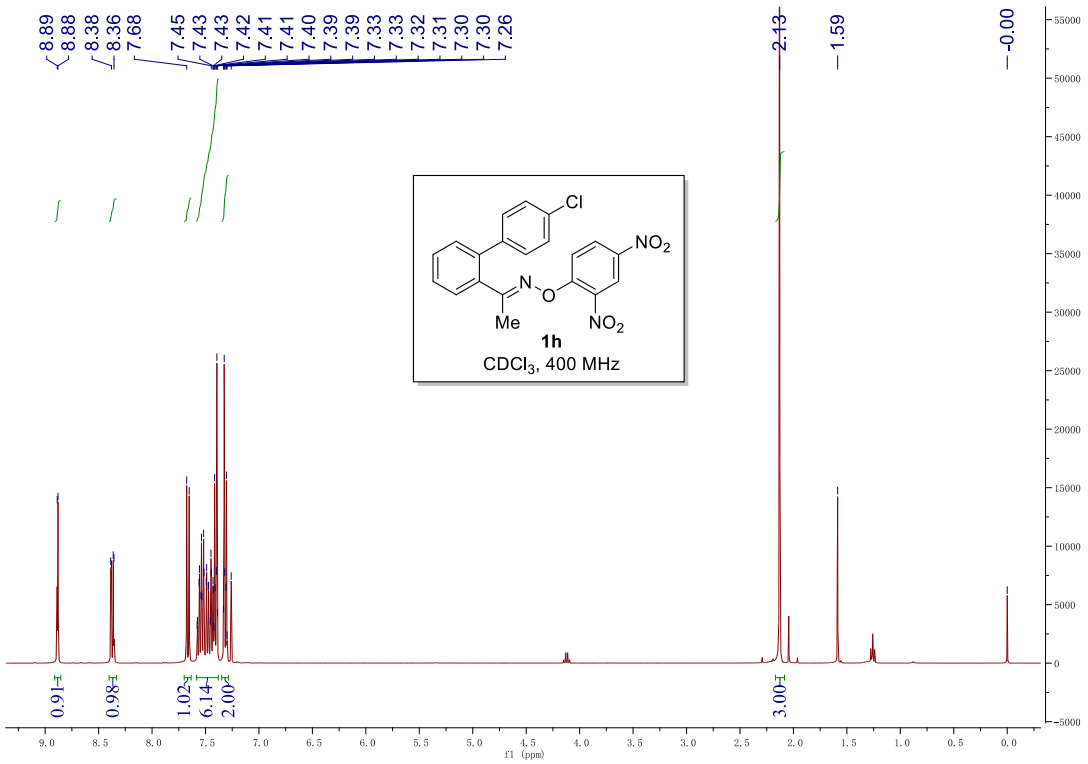
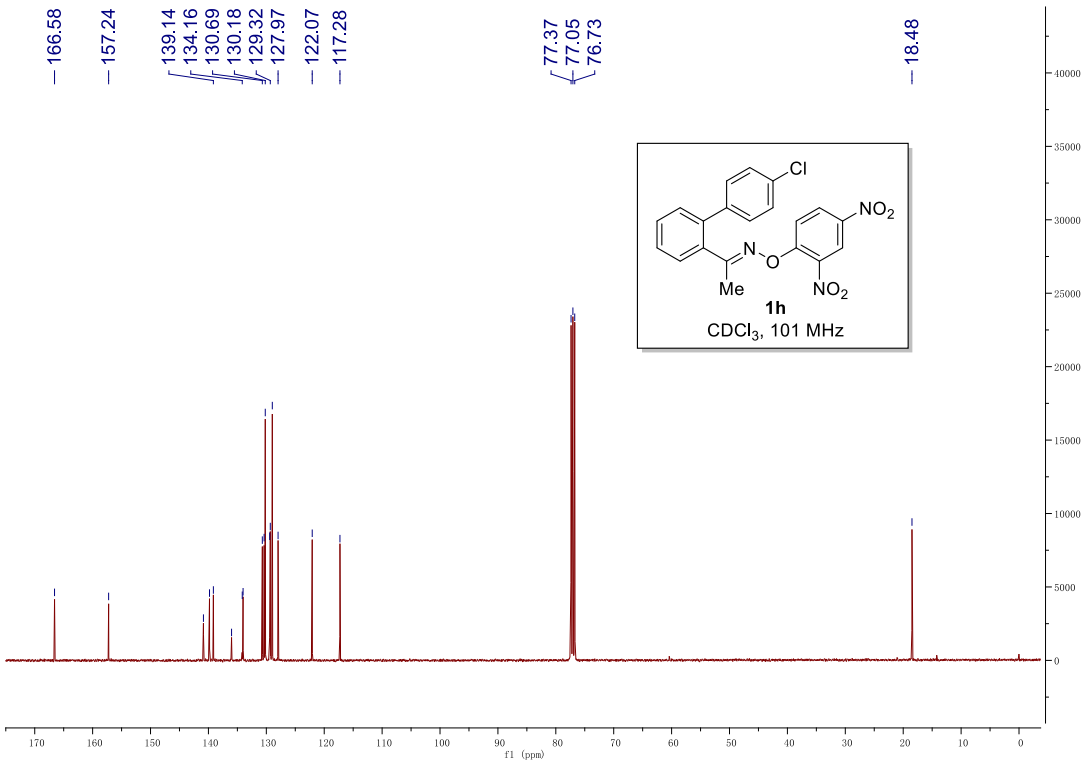
8.87
8.35
8.32
7.63
7.45
7.44
7.44
7.42
7.42
7.41
7.39
7.39
7.38
7.37
7.37
7.36
7.36
7.35
7.26
2.11
1.59
0.00
NO2
N
O
Me
NO2
1f
CDCl3, 400 MHz
0.90
1.00
1.00
2.10
7.05
3.00
f1 (ppm)

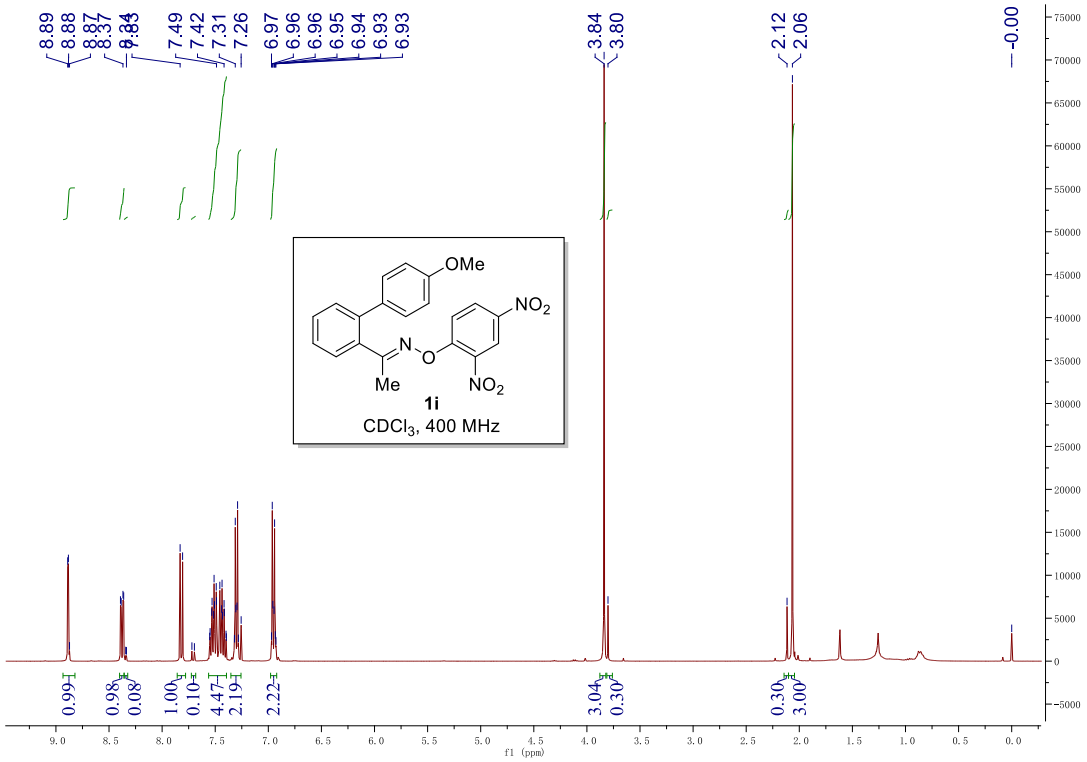

166.90
157.38
141.18
140.74
130.28
128.90
127.61
122.03
117.43
77.38
77.06
76.74
18.37
NO2
N
O
Me
NO2
1f
CDCl3, 101 MHz
f1 (ppm)


8.89
8.89
8.39
8.37
8.36
8.34
7.72
7.65
7.62
7.60
7.59
7.57
7.55
7.54
7.52
7.51
7.50
7.46
7.44
7.26
2.15
1.59
0.00
CN
NO2
N
O
Me
NO2
1g
CDCl3, 400 MHz
0.91
1.02
2.03
1.03
5.12
1.01
3.00
f1 (ppm)


165.89
157.05
145.45
132.48
130.55
129.61
128.79
122.14
117.09
111.69
77.36
77.04
76.73
18.59
CN
NO2
N
O
Me
NO2
1g
CDCl3, 101 MHz
f1 (ppm)


8.89
8.88
8.38
8.36
7.68
7.45
7.43
7.43
7.42
7.41
7.41
7.40
7.39
7.39
7.33
7.33
7.32
7.31
7.30
7.30
7.26
2.13
1.59
0.00
Cl
NO2
N
O
Me
NO2
1h
CDCl3, 400 MHz
0.91
0.98
1.02
6.14
2.00
3.00
f1 (ppm)


166.58
157.24
139.14
134.16
130.69
130.18
129.32
127.97
122.07
117.28
77.37
77.05
76.73
18.48
Cl
NO2
N
O
Me
NO2
1h
CDCl3, 101 MHz
f1 (ppm)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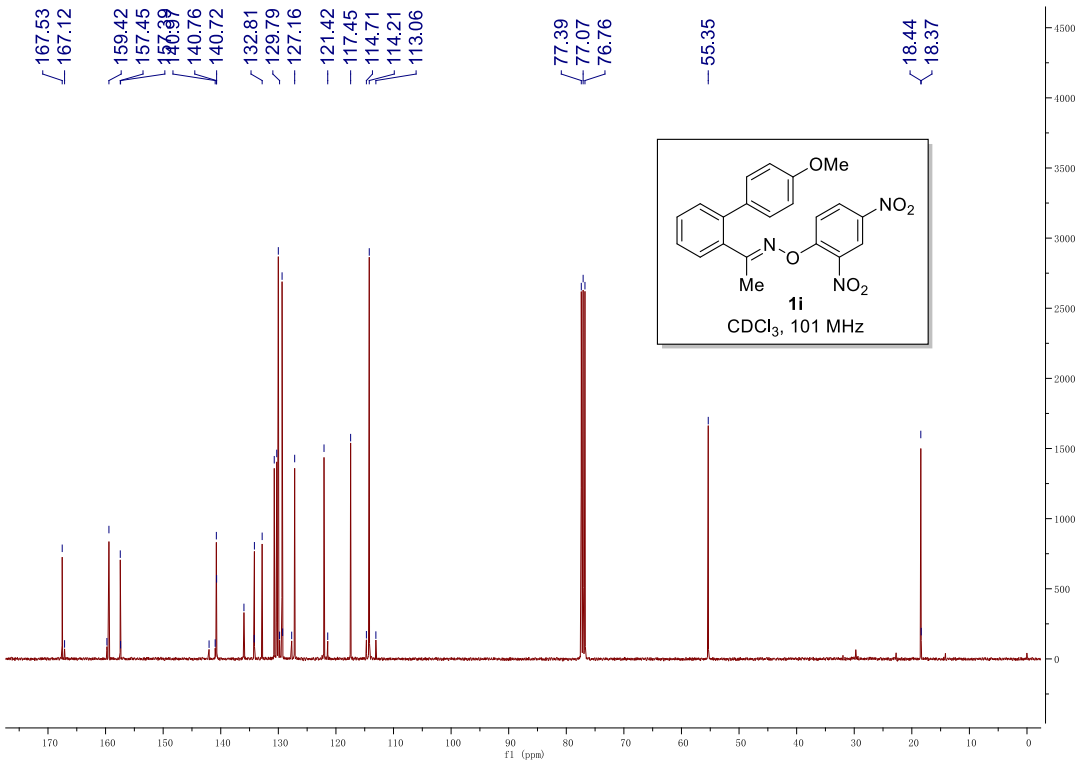
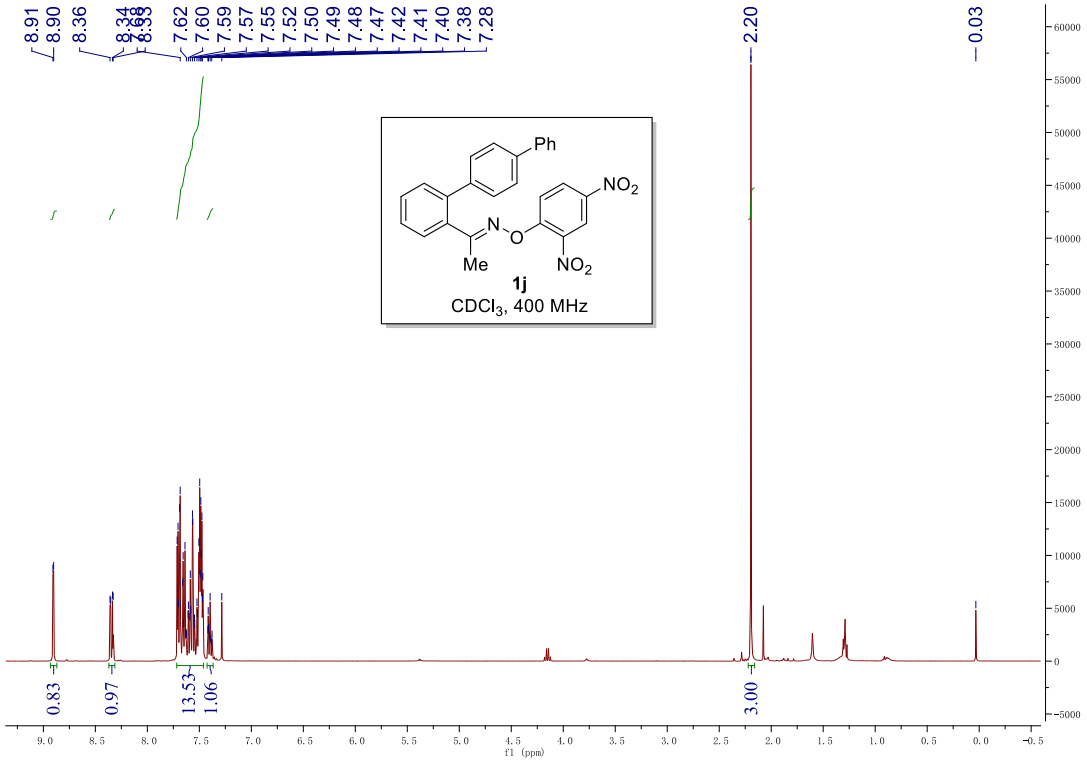
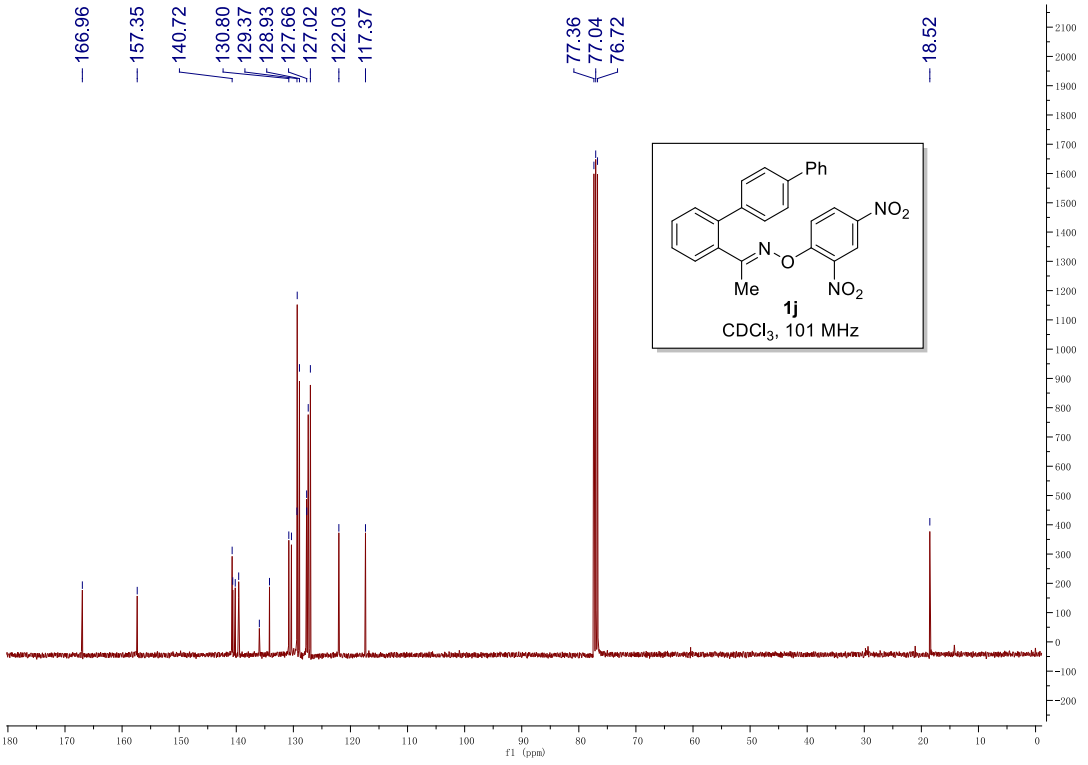
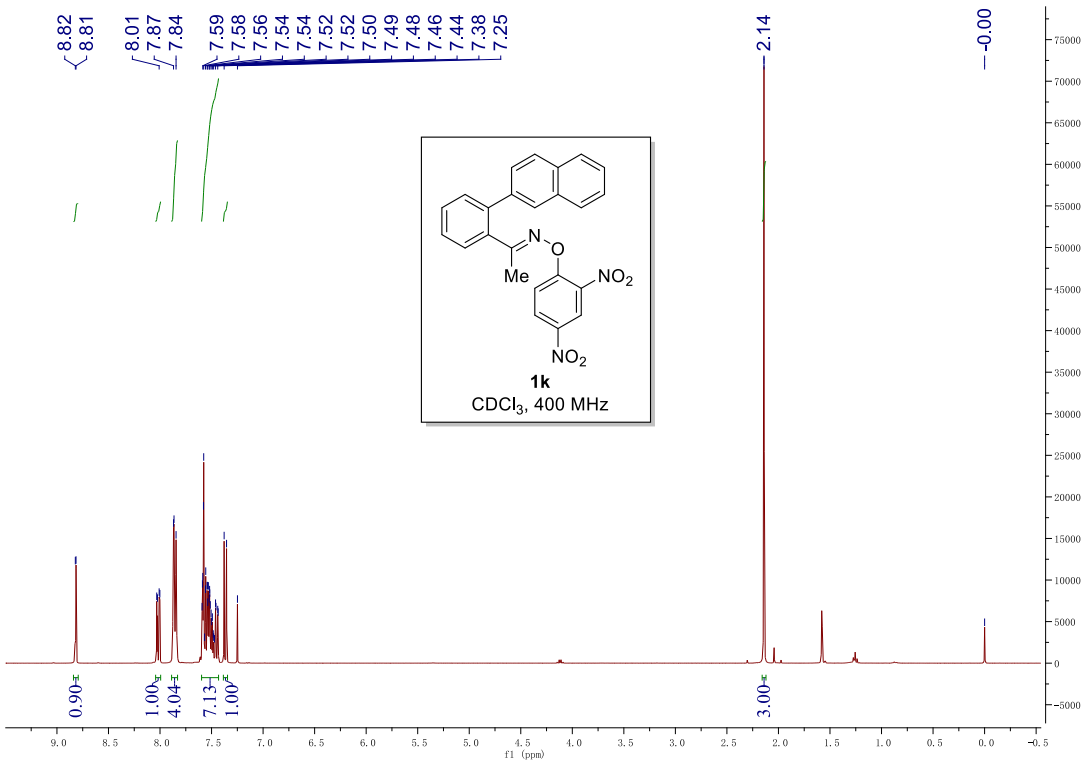
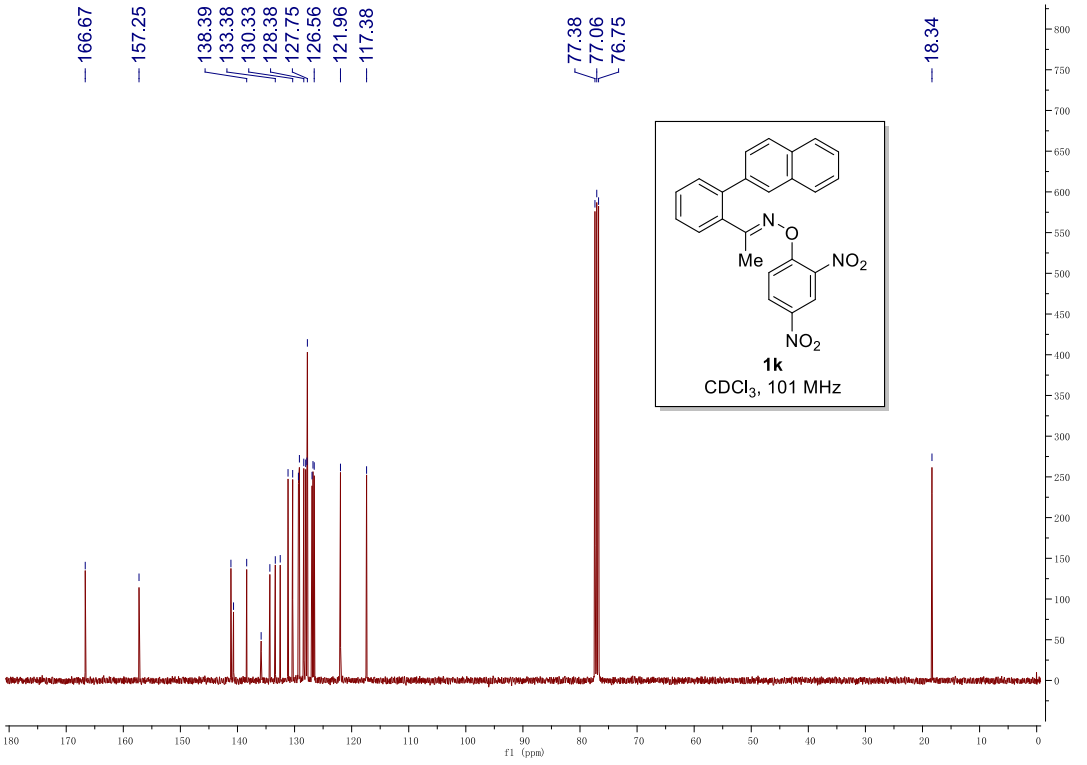
8.88
8.87
8.37
7.49
7.42
7.31
7.26
6.97
6.96
6.96
6.95
6.94
6.93
6.93
3.84
3.80
2.12
2.06
-0.00
OMe
NO2
N
O
Me
NO2
1i
CDCl3, 400 MHz
0.99
0.98
0.08
1.00
0.10
4.47
2.19
2.22
3.04
0.30
0.30
3.00
f1 (ppm)


167.53
167.12
159.42
157.45
140.76
140.72
132.81
129.79
127.16
121.42
117.45
114.71
114.21
113.06
77.39
77.07
76.76
55.35
18.44
18.37
OMe
NO2
N
O
Me
NO2
1i
CDCl3, 101 MHz
f1 (ppm)


8.91
8.90
8.36
7.62
7.60
7.59
7.57
7.55
7.52
7.50
7.49
7.48
7.47
7.42
7.41
7.40
7.38
7.28
2.20
0.03
Ph
NO2
N
O
Me
NO2
1j
CDCl3, 400 MHz
0.83
0.97
13.53
1.06
3.00
f1 (ppm)


166.96
157.35
140.72
130.80
129.37
128.93
127.66
127.02
122.03
117.37
77.36
77.04
76.72
18.52
Ph
NO2
N
O
Me
NO2
1j
CDCl3, 101 MHz
f1 (ppm)


8.82
8.81
8.01
7.87
7.84
7.59
7.58
7.56
7.54
7.54
7.52
7.52
7.50
7.49
7.48
7.46
7.44
7.38
7.25
2.14
-0.00
Me
NO2
NO2
1k
CDCl3, 400 MHz
0.90
1.00
4.04
7.13
1.00
3.00
f1 (ppm)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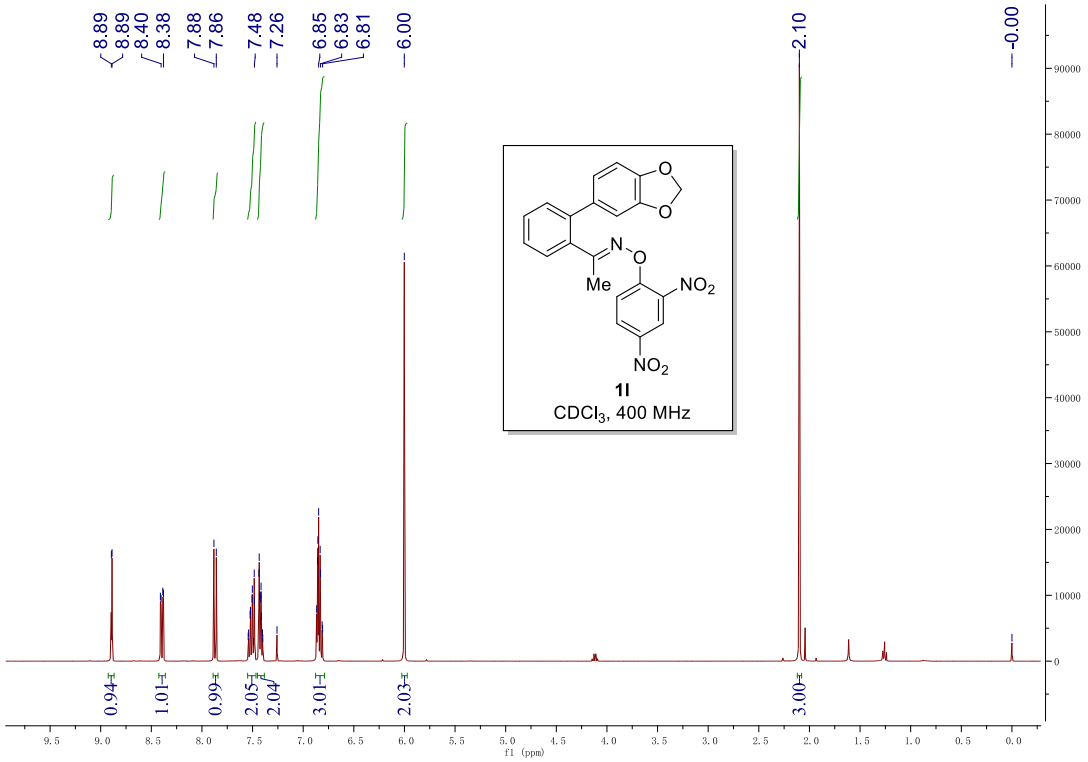
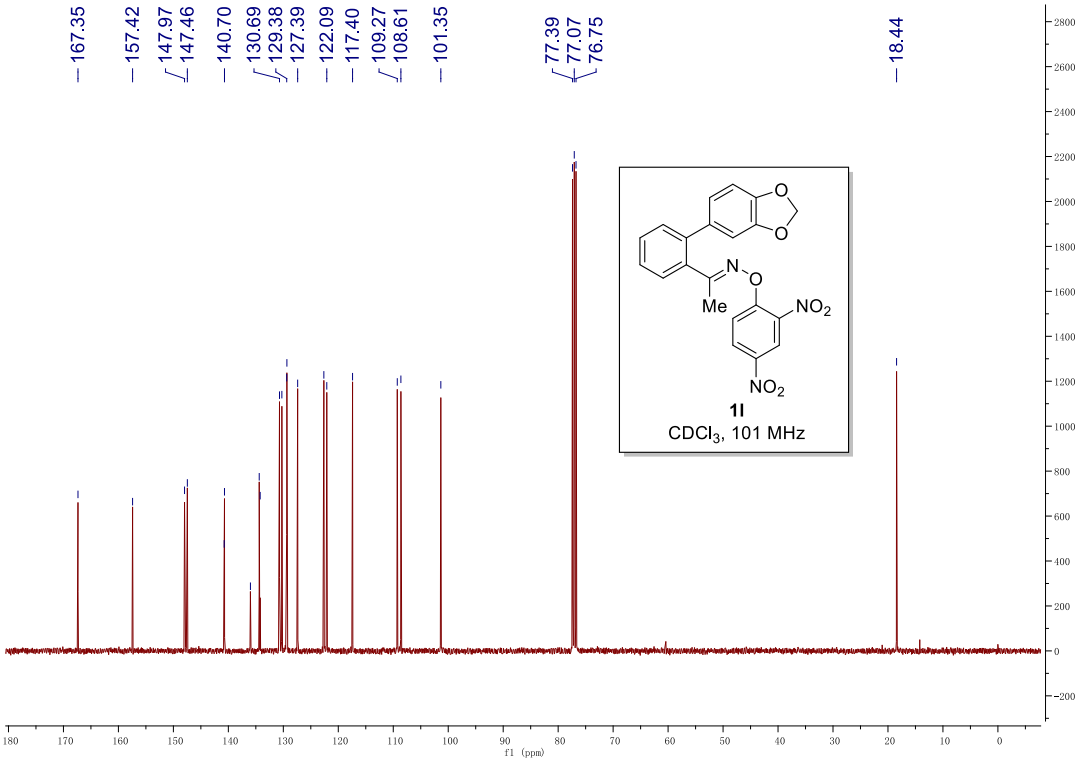
157.25
138.39
133.38
130.33
128.38
127.75
126.56
121.96
117.38
77.38
77.06
76.75
18.34
Me
NO2
NO2
1k
CDCl3, 101 MHz
f1 (ppm)


8.89
8.89
8.40
8.38
7.88
7.86
7.48
7.26
6.85
6.83
6.81
6.00
2.10
-0.00
0.94
1.01
0.99
2.05
2.04
3.01
2.03
3.00
f1 (ppm)
Me
NO2
NO2
1l
CDCl3, 400 MHz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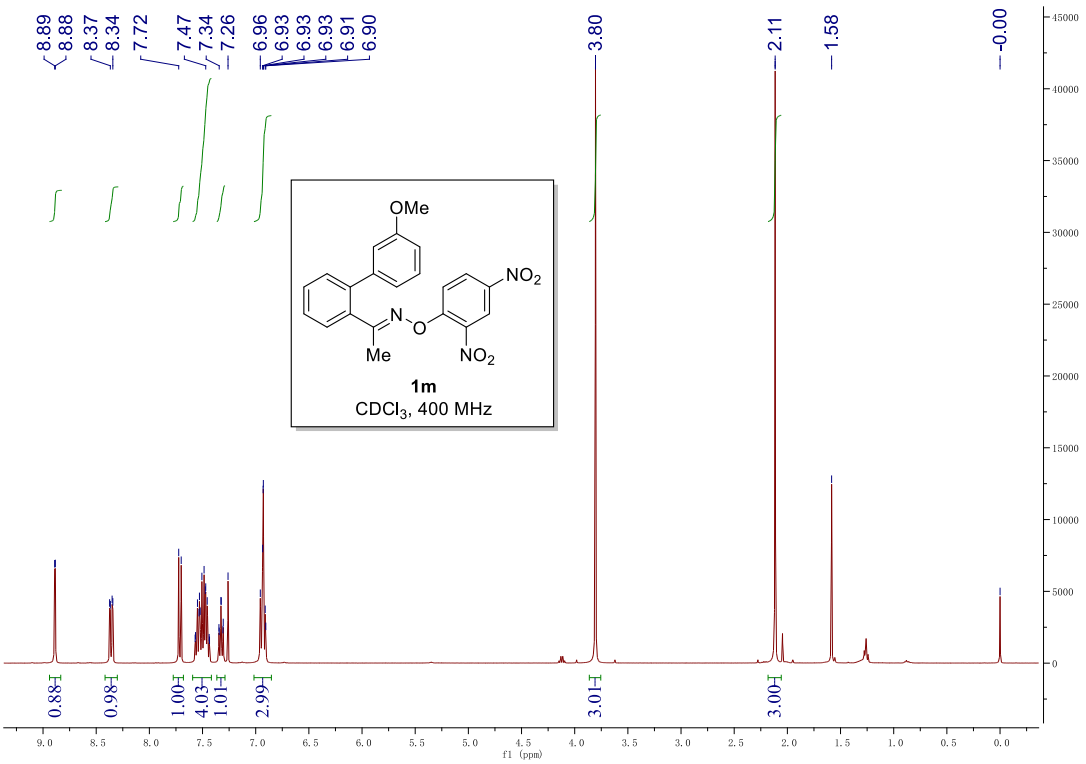
157.42
147.97
147.46
140.70
130.69
129.38
127.39
122.09
117.40
109.27
108.61
101.35
77.39
77.07
76.75
18.44
f1 (ppm)
Me
NO2
NO2
1l
CDCl3, 101 MHz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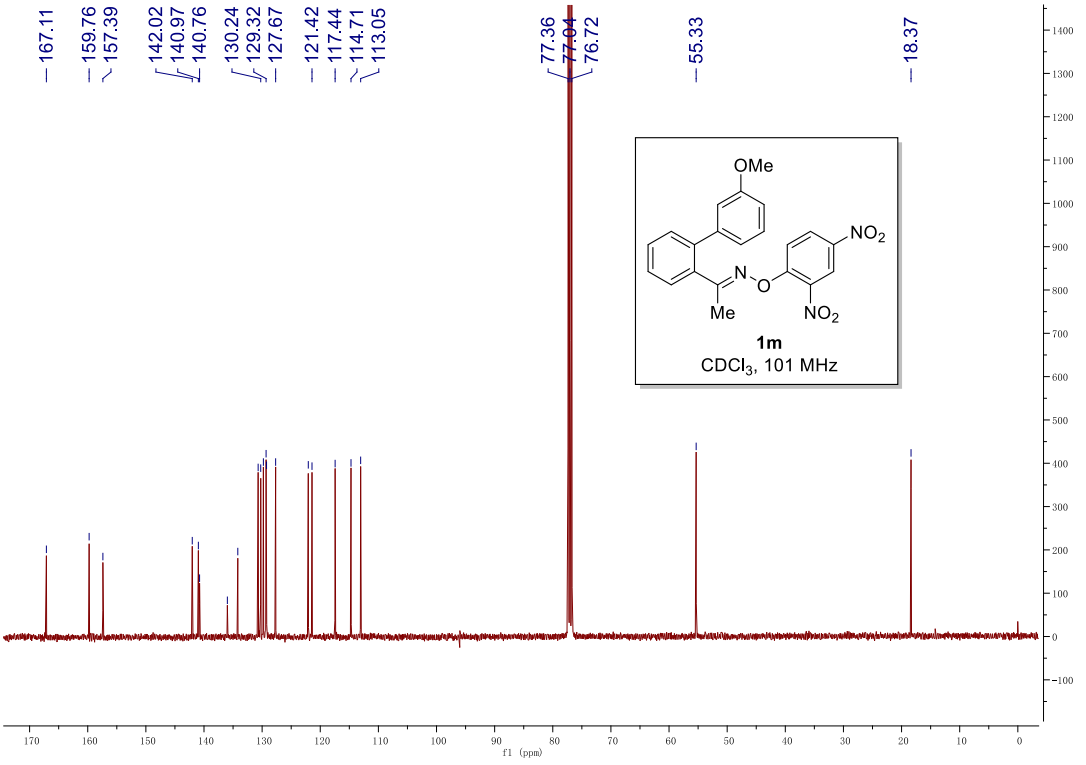
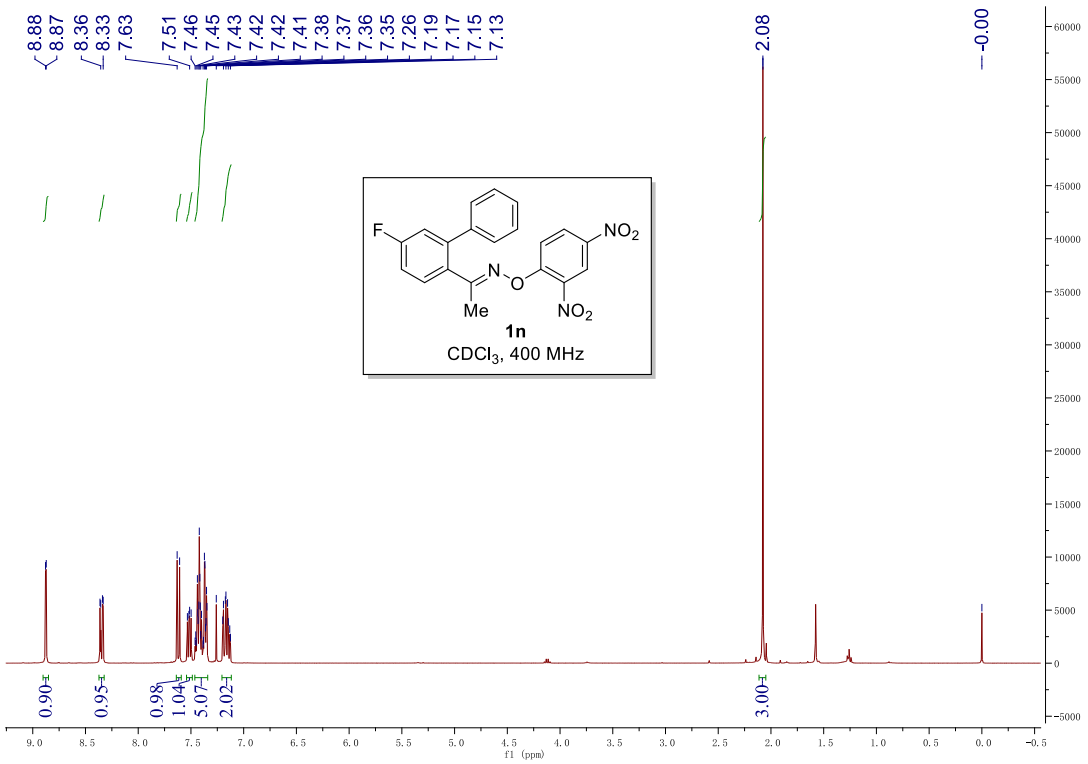
8.88
8.37
8.34
7.72
7.47
7.34
7.26
6.96
6.93
6.93
6.93
6.91
6.90
3.80
2.11
1.58
0.00
OMe
NO2
N
O
Me
NO2
1m
CDCl3, 400 MHz
0.88
0.98
1.00
4.03
1.01
2.99
3.01
3.00
f1 (ppm)


167.11
159.76
157.39
142.02
140.97
140.76
130.24
129.32
127.67
121.42
117.44
114.71
113.05
77.36
77.04
76.72
55.33
18.37
OMe
NO2
N
O
Me
NO2
1m
CDCl3, 101 MHz
f1 (ppm)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8.87
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8.33
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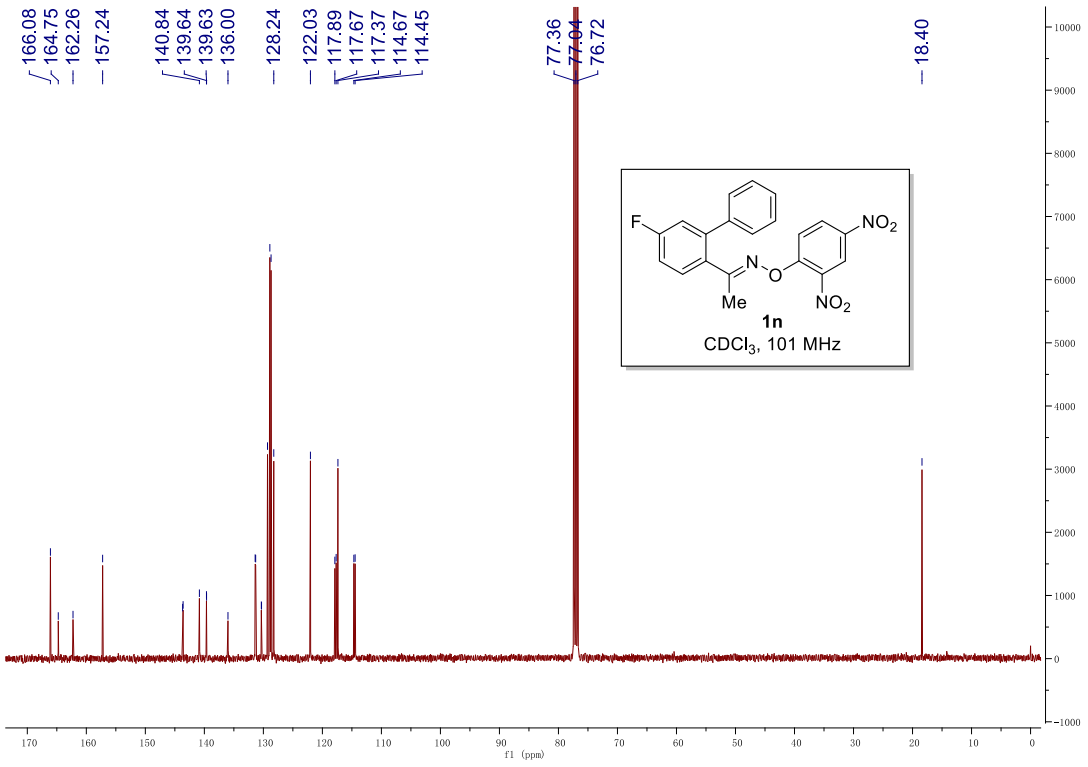
7.51
7.46
7.45
7.43
7.42
7.42
7.41
7.38
7.37
7.36
7.35
7.26
7.19
7.17
7.15
7.13
2.08
-0.00
F
N
O
Me
NO2
NO2
1n
CDCl3, 400 MHz
0.90
0.95
0.98
1.04
5.07
2.02
3.00
f1 (ppm)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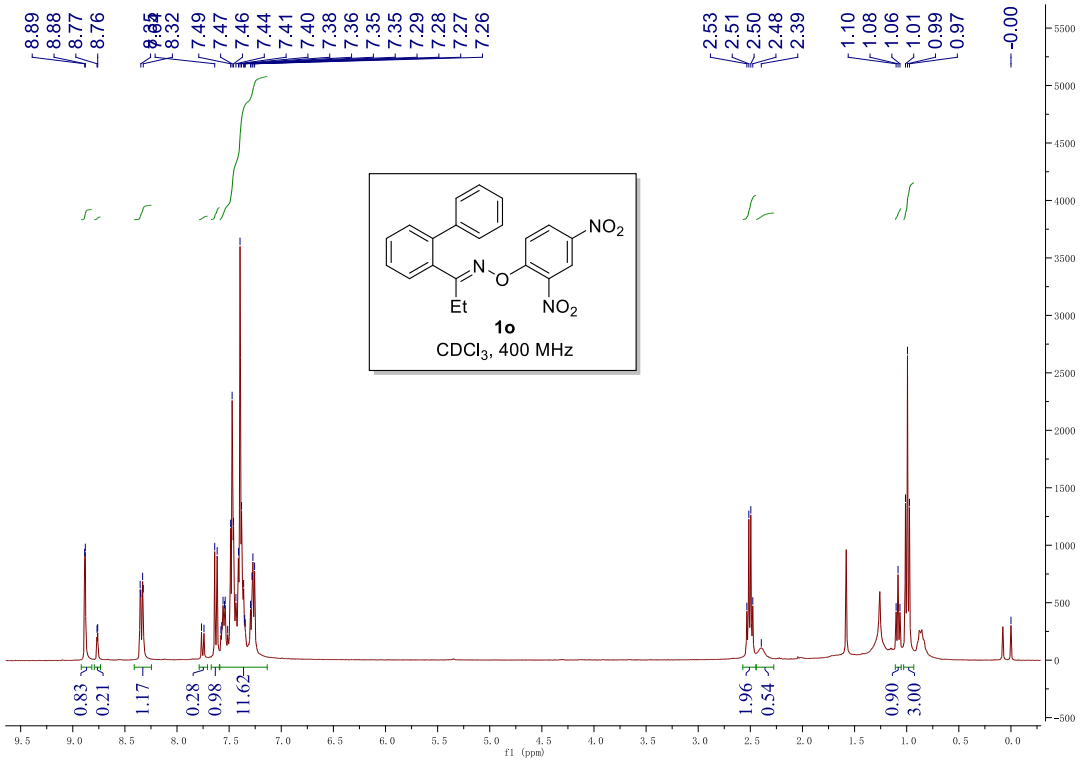
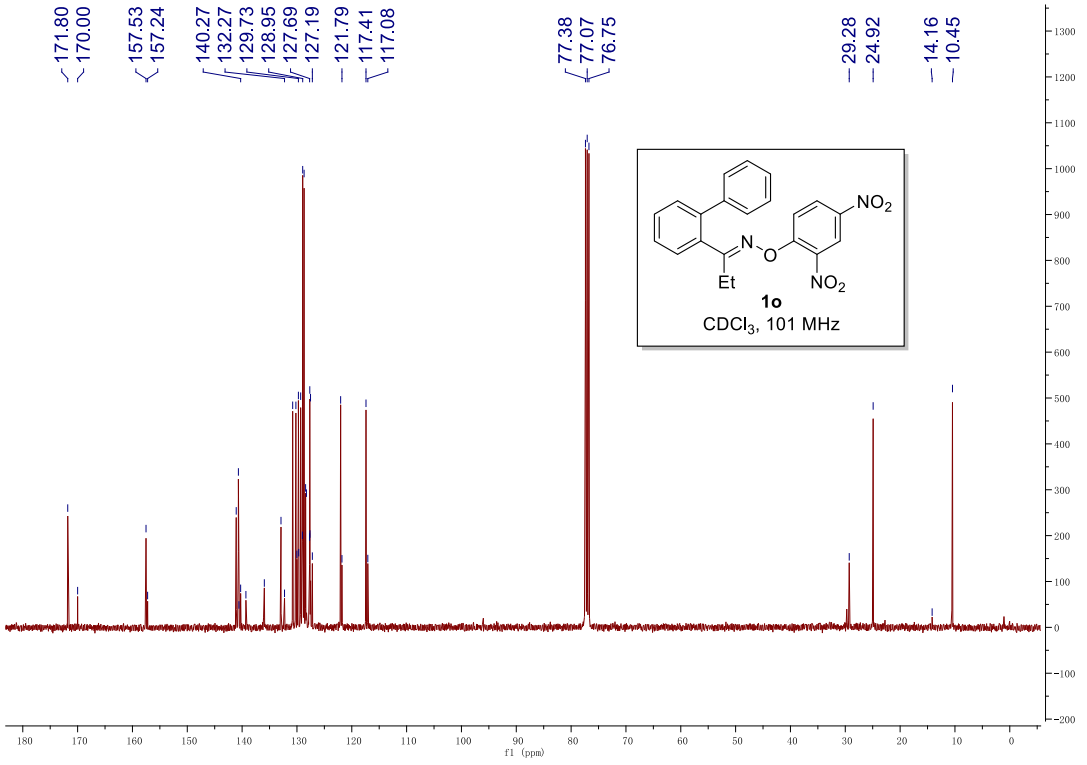
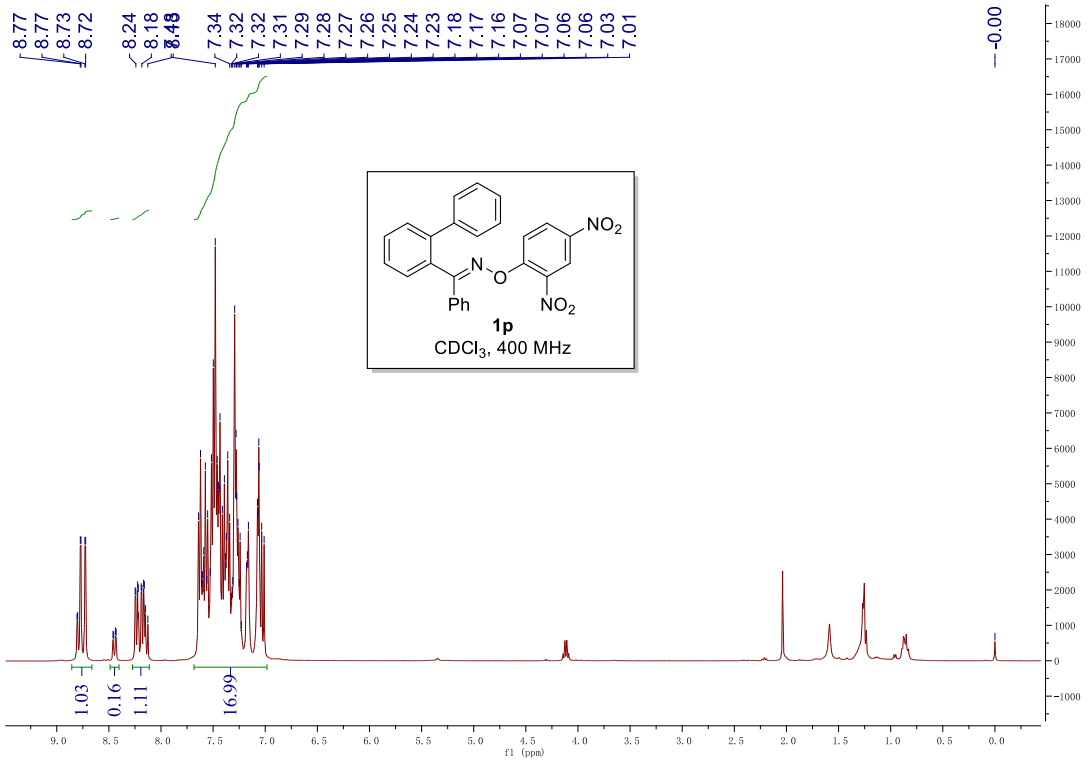
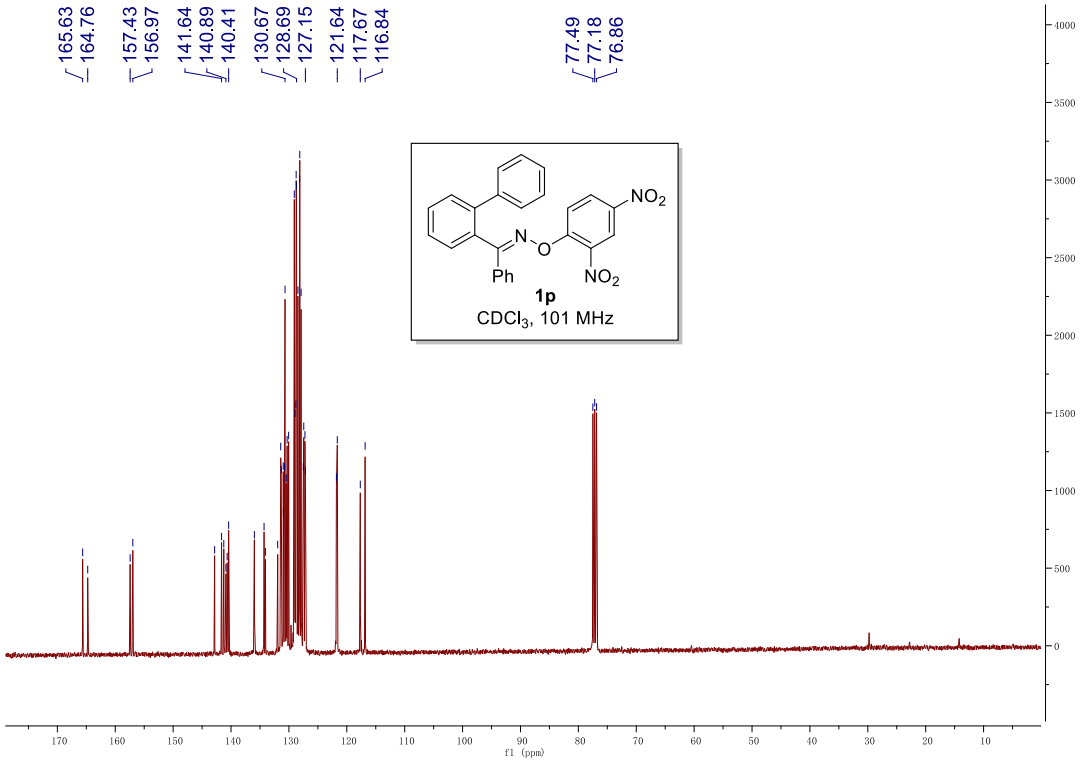
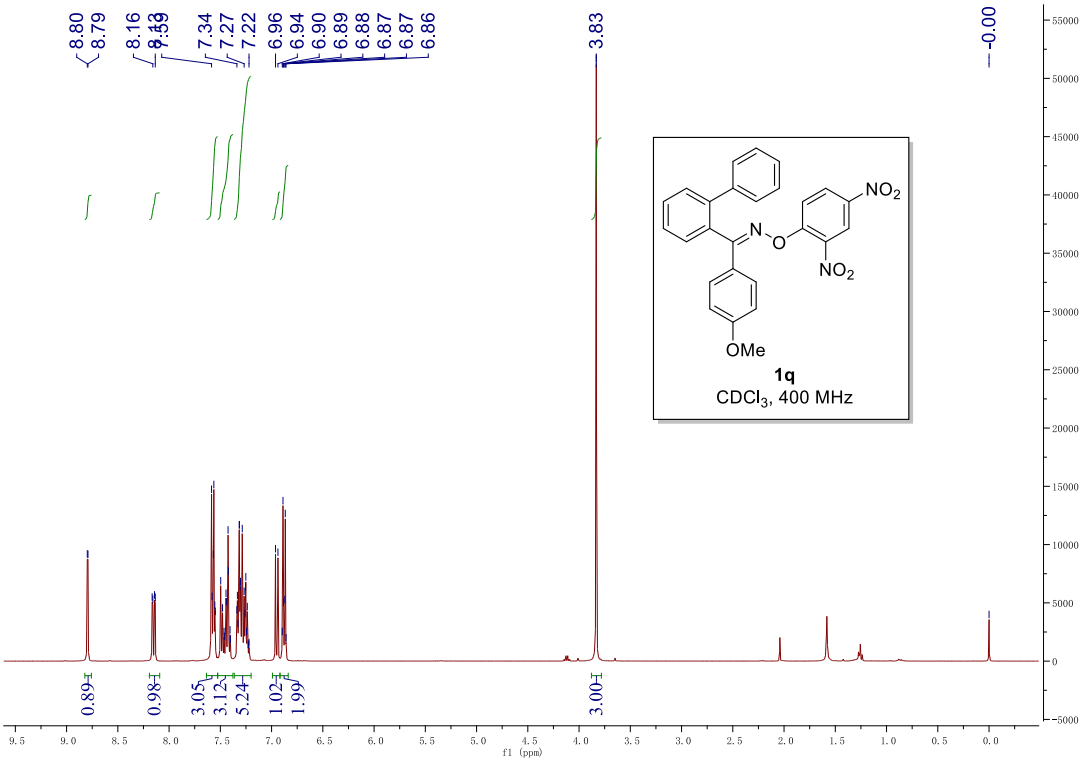
164.75
162.26
157.24
140.84
139.64
139.63
136.00
128.24
122.03
117.89
117.67
117.37
114.67
114.45
77.36
77.04
76.72
18.40
F
N
O
Me
NO2
NO2
1n
CDCl3, 101 MHz
f1 (ppm)

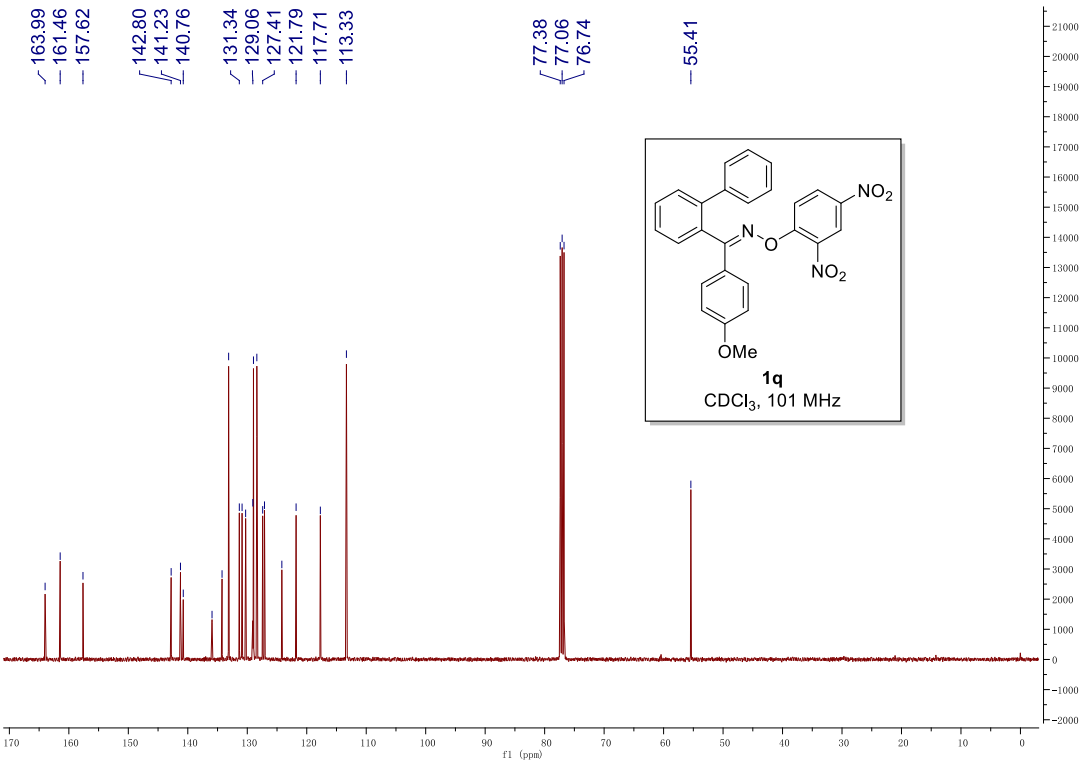

8.89
8.88
8.77
8.76
8.32
7.49
7.47
7.46
7.44
7.41
7.40
7.38
7.36
7.35
7.35
7.29
7.28
7.27
7.26
2.53
2.51
2.50
2.48
2.39
1.10
1.08
1.06
1.01
0.99
0.97
-0.00
0.83
0.21
1.17
0.28
0.98
11.62
1.96
0.54
0.90
3.00
f1 (ppm)
NO2
N
O
Et
NO2
1o
CDCl3, 400 MHz

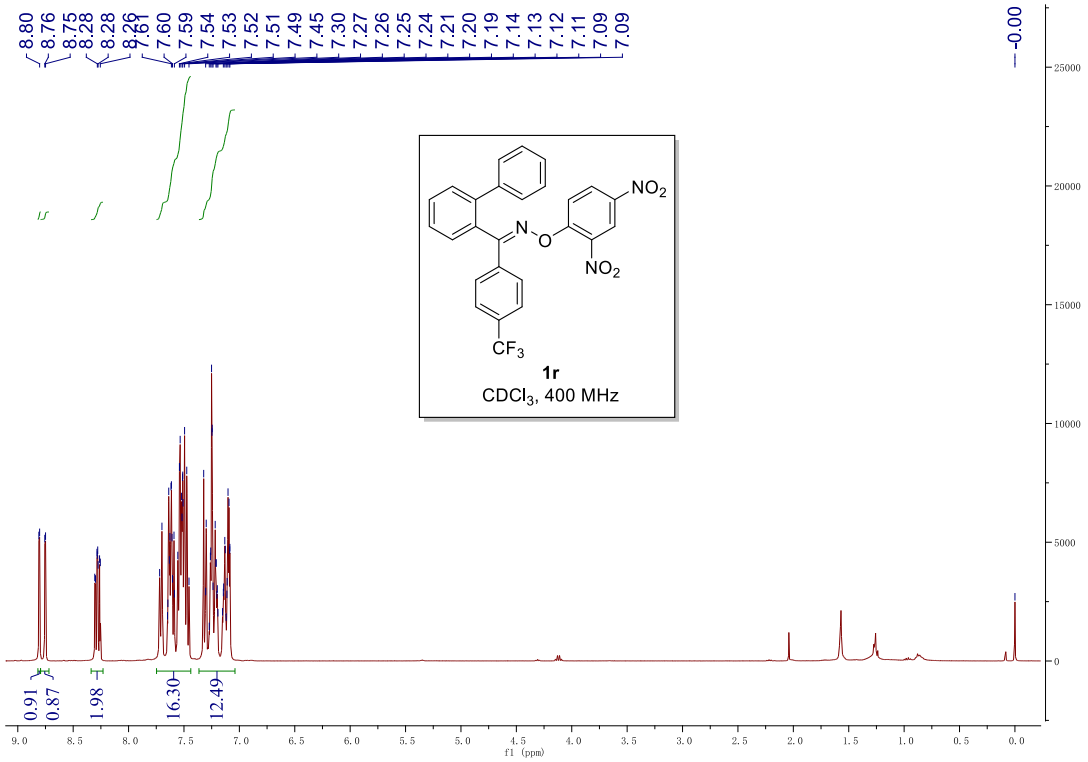

171.80
170.00
157.53
157.24
140.27
132.27
129.73
128.95
127.69
127.19
121.79
117.41
117.08
77.38
77.07
76.75
29.28
24.92
14.16
10.45
f1 (ppm)
NO2
N
O
Et
NO2
1o
CDCl3, 101 MHz

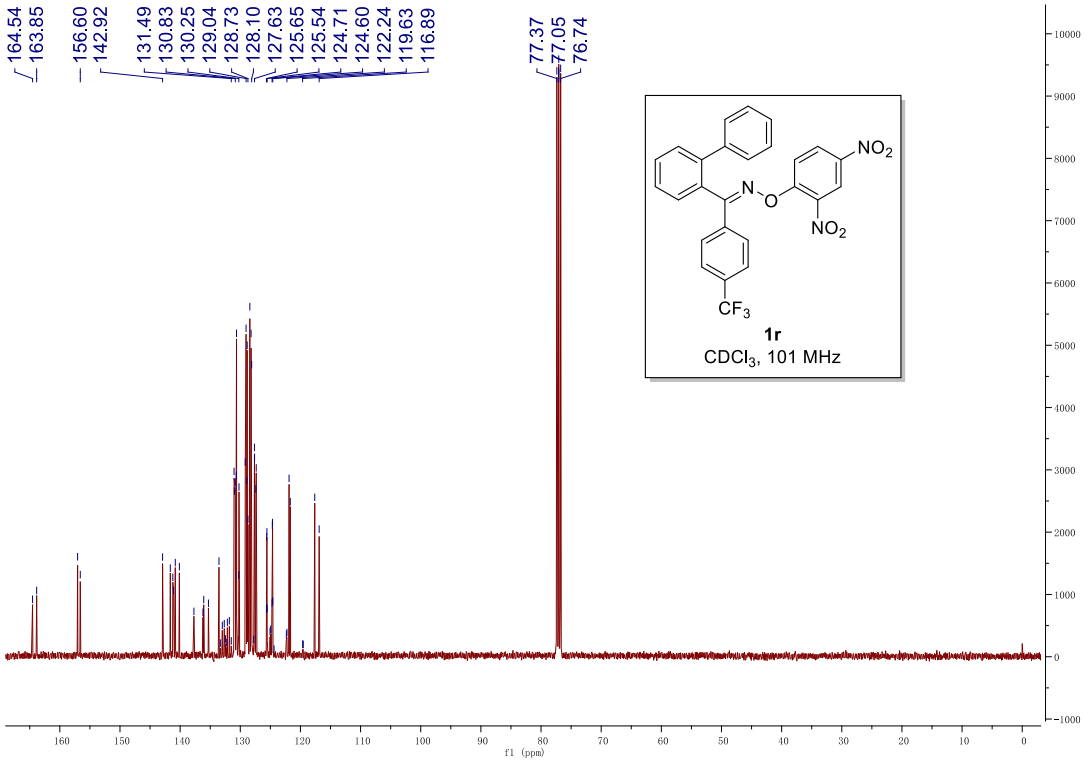

8.77
8.77
8.73
8.72
8.24
8.18
7.34
7.32
7.32
7.31
7.29
7.28
7.27
7.26
7.25
7.24
7.23
7.18
7.17
7.16
7.07
7.07
7.06
7.06
7.03
7.01
-0.00
1.03
0.16
1.11
16.99
f1 (ppm)
NO2
N
O
Ph
NO2
1p
CDCl3, 400 MHz

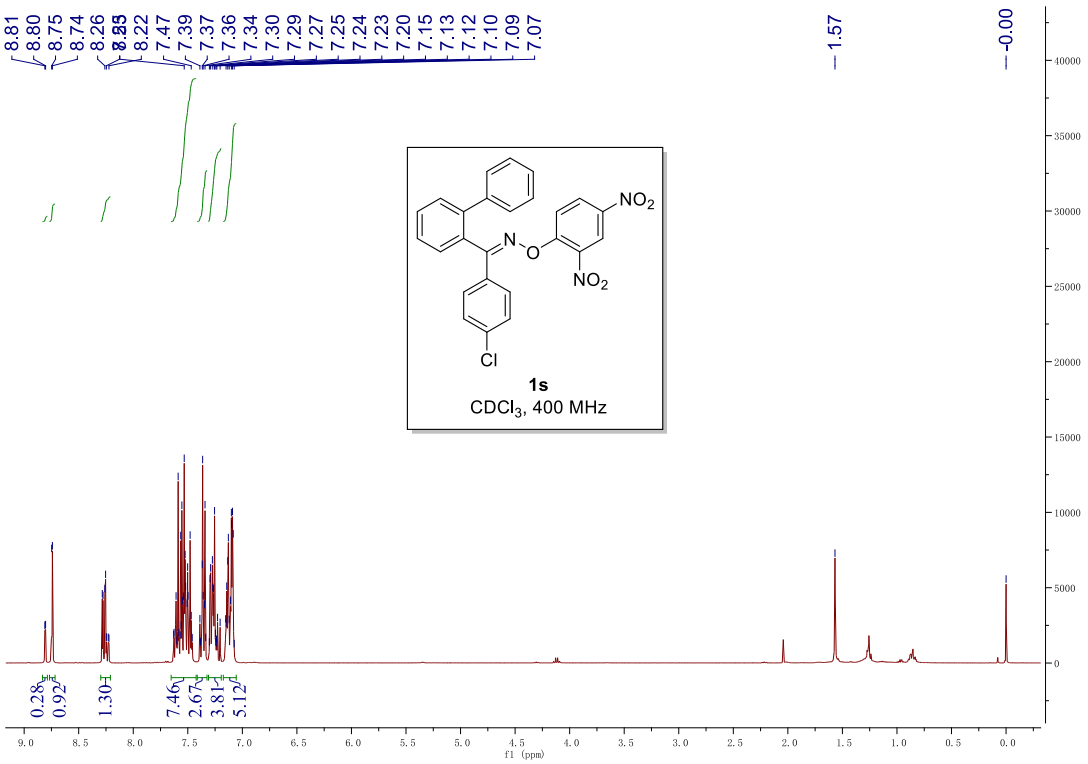

165.63
164.76
157.43
156.97
141.64
140.89
140.41
130.67
128.69
127.15
121.64
117.67
116.84
77.49
77.18
76.86
f1 (ppm)
NO2
N
O
Ph
NO2
1p
CDCl3, 101 MHz

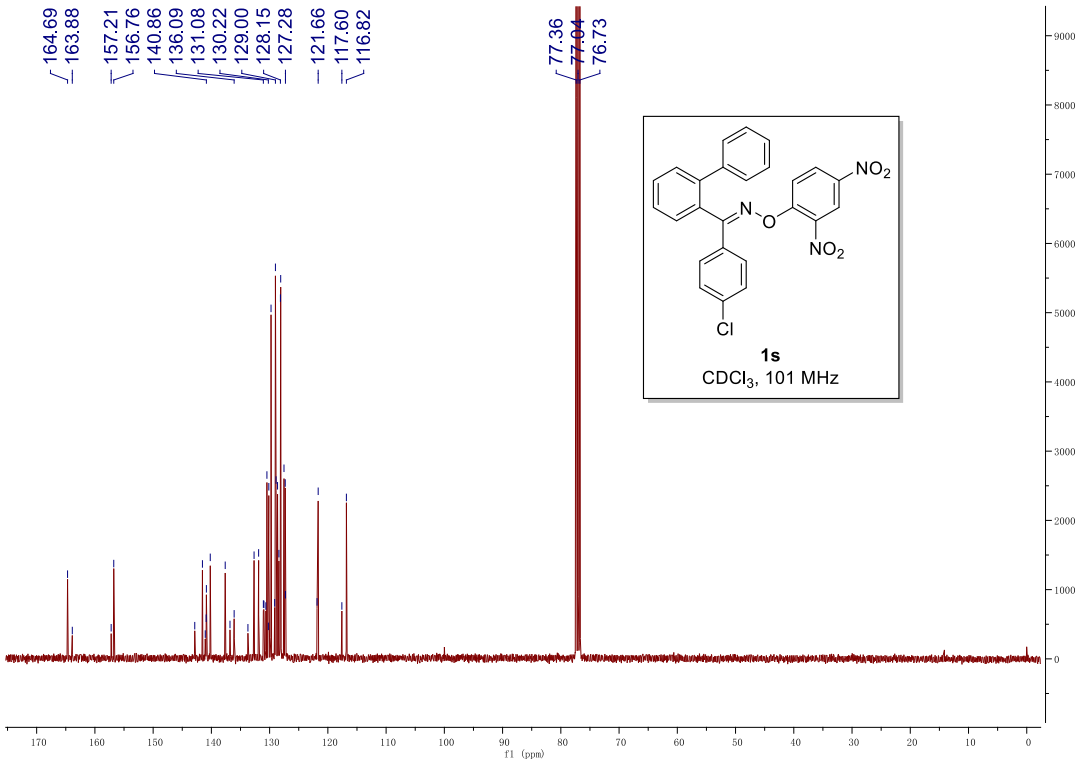

8.80
8.79
8.16
7.34
7.27
7.22
6.96
6.94
6.90
6.89
6.88
6.87
6.87
6.86
3.83
-0.00
0.89
0.98
3.05
3.12
5.24
1.02
1.99
3.00
NO2
NO2
N
O
OMe
1q
CDCl3, 400 MHz
f1 (ppm)

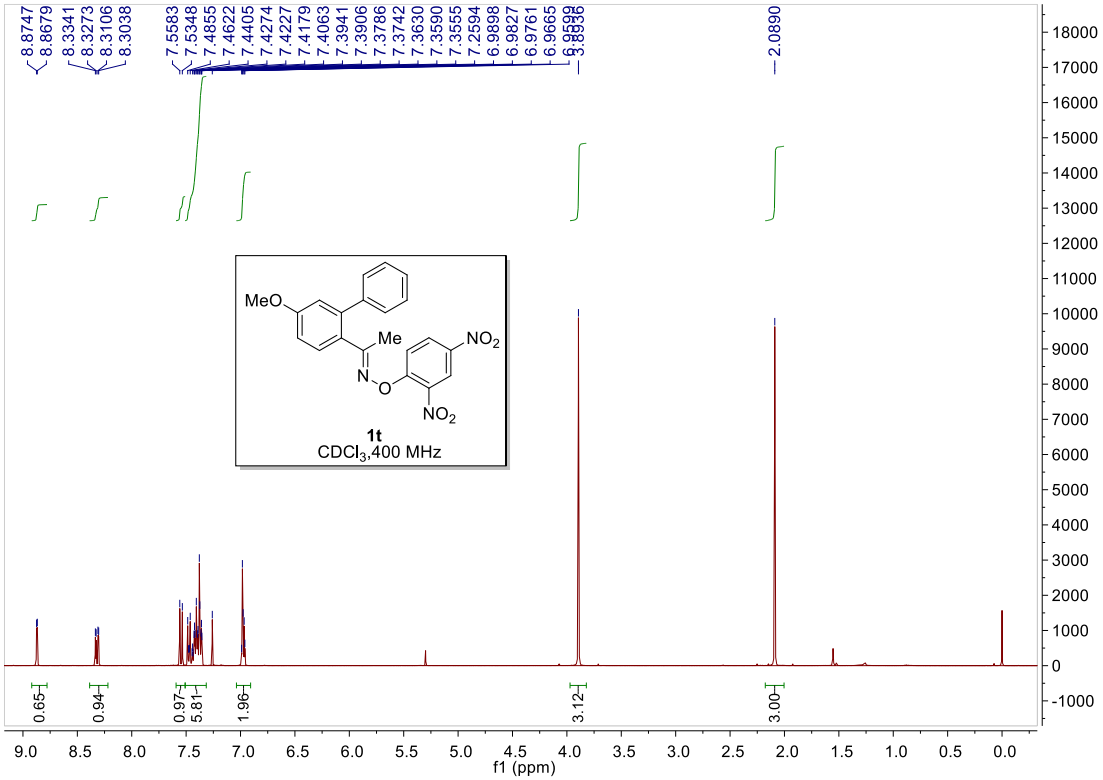

163.99
161.46
157.62
142.80
141.23
140.76
131.34
129.06
127.41
121.79
117.71
113.33
77.38
77.06
76.74
55.41
NO2
NO2
N
O
OMe
1q
CDCl3, 101 MHz
f1 (ppm)

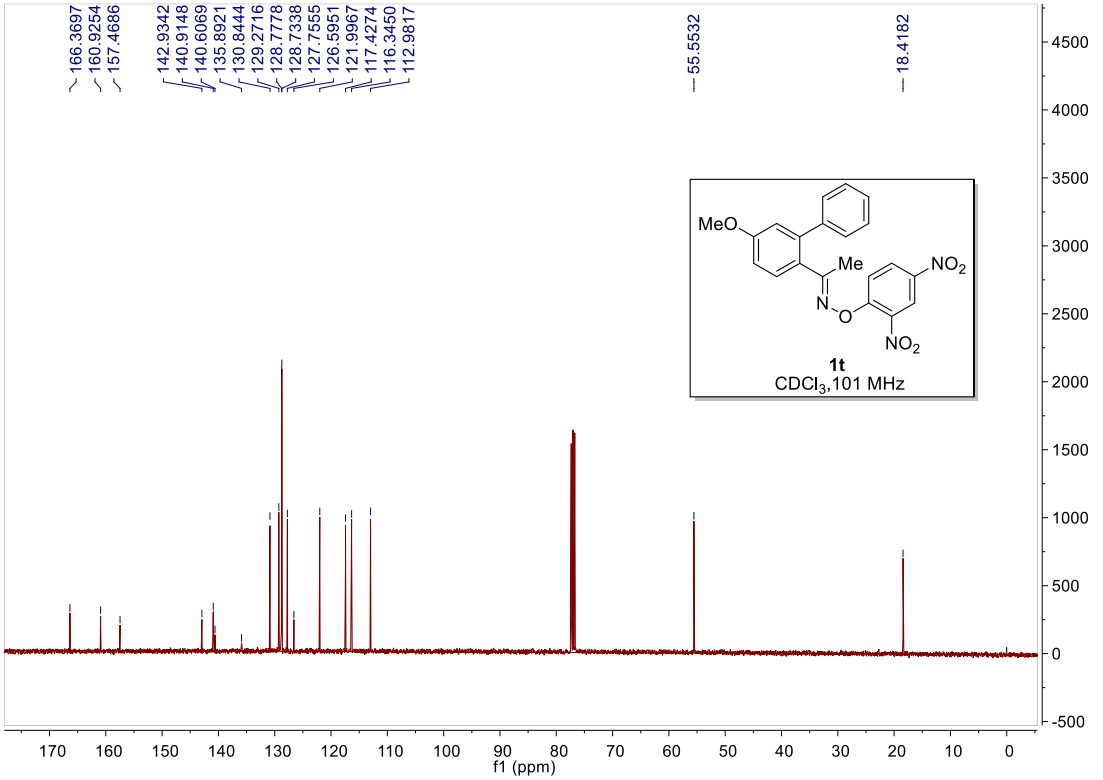

8.80
8.76
8.75
8.28
8.28
8.26
7.61
7.60
7.59
7.54
7.53
7.52
7.51
7.49
7.45
7.30
7.27
7.26
7.25
7.24
7.21
7.20
7.19
7.14
7.13
7.12
7.11
7.09
7.09
-0.00
NO2
NO2
N
O
CF3
1r
CDCl3, 400 MHz
0.91
0.87
1.98
16.30
12.49
f1 (ppm)

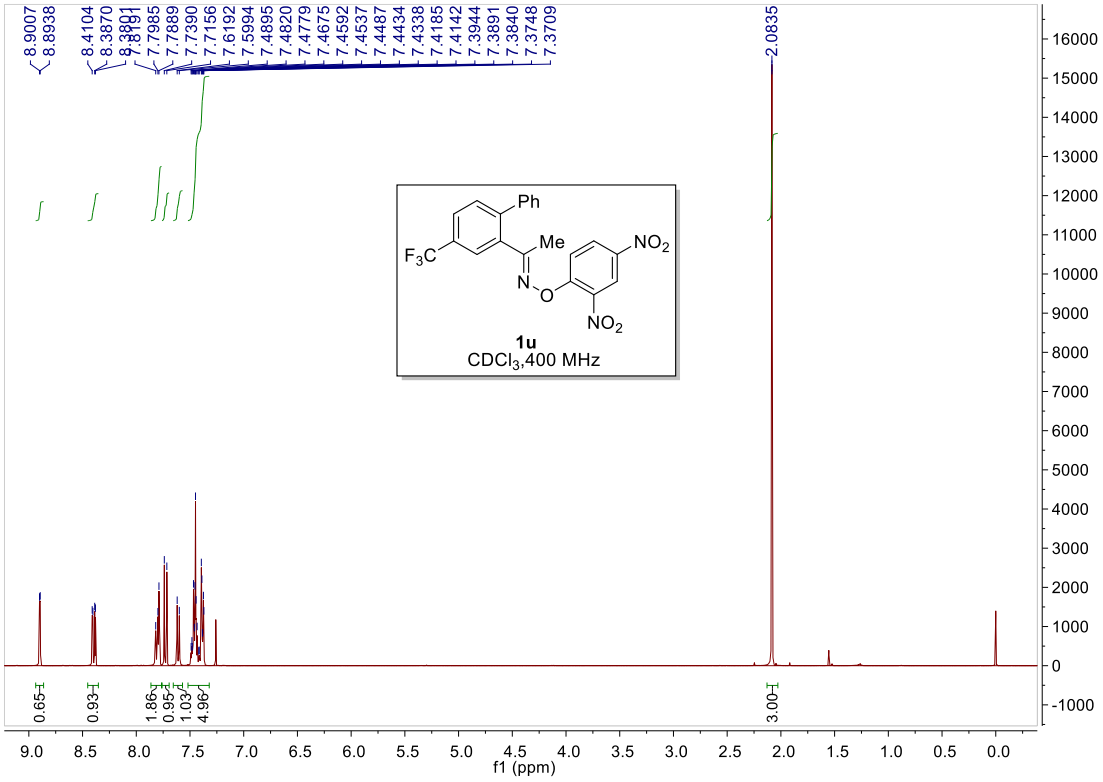

164.54
163.85
156.60
142.92
131.49
130.83
130.25
129.04
128.73
128.10
127.63
125.65
125.54
124.71
124.60
122.24
119.63
116.89
77.37
77.05
76.74
NO2
NO2
N
O
CF3
1r
CDCl3, 101 MHz
f1 (ppm)

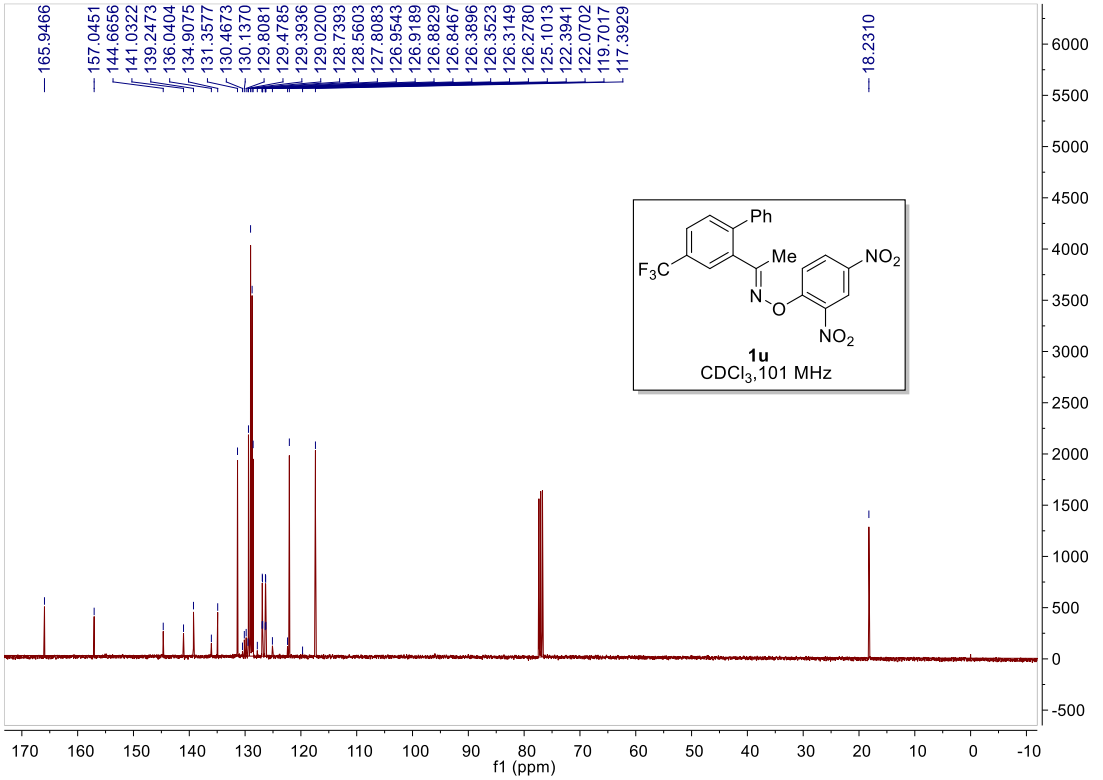

8.81
8.80
8.75
8.74
8.26
8.22
7.47
7.39
7.37
7.36
7.34
7.30
7.29
7.27
7.25
7.24
7.23
7.20
7.15
7.13
7.12
7.10
7.09
7.07
1.57
0.00
NO2
NO2
N
O
Cl
1s
CDCl3, 400 MHz
0.28
0.92
1.30
7.46
2.67
3.81
5.12
f1 (ppm)

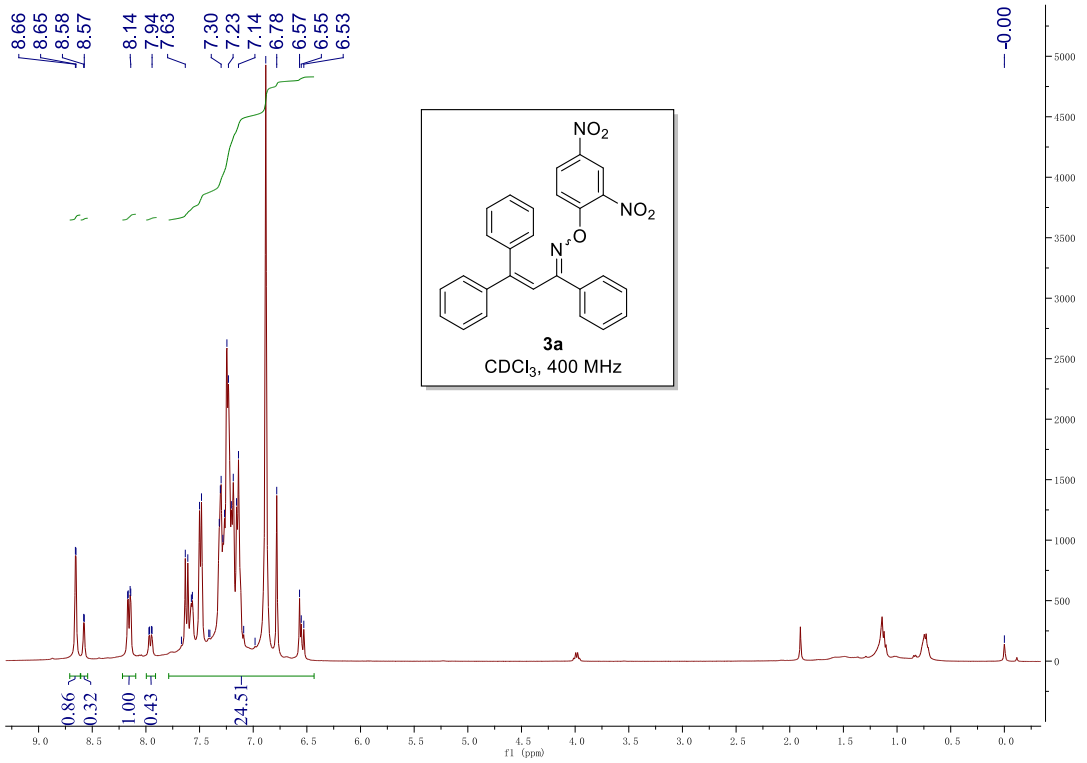

164.69
163.88
157.21
156.76
140.86
136.09
131.08
130.22
129.00
128.15
127.28
121.66
117.60
116.82
77.36
77.04
76.73
NO2
NO2
N
O
Cl
1s
CDCl3, 101 MHz
f1 (ppm)

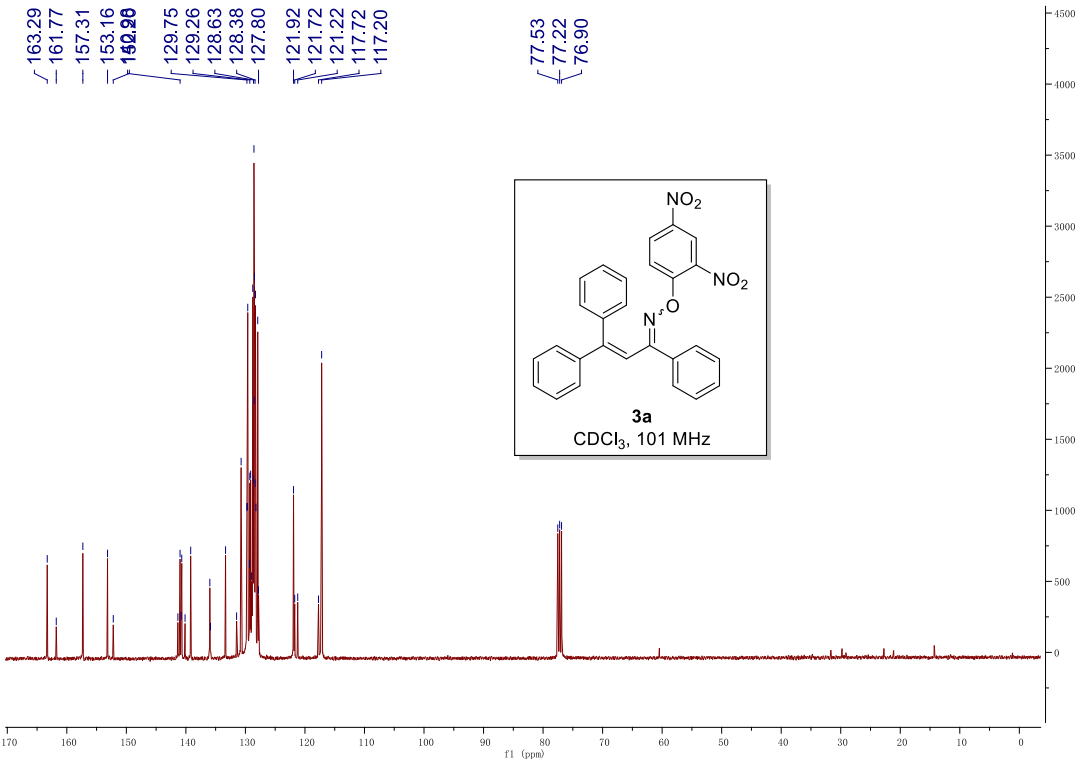

8.8747
8.8679
8.3341
8.3273
8.3106
8.3038
7.5583
7.5348
7.4855
7.4622
7.4405
7.4274
7.4227
7.4179
7.4063
7.3941
7.3906
7.3786
7.3742
7.3630
7.3590
7.3555
7.2594
6.9898
6.9827
6.9761
6.9665
3.8938
2.0890
MeO
Me
NO2
NO2
N
O
1t
CDCl3,400 MHz
0.65
0.94
0.97
5.81
1.96
3.12
3.00
f1 (ppm)

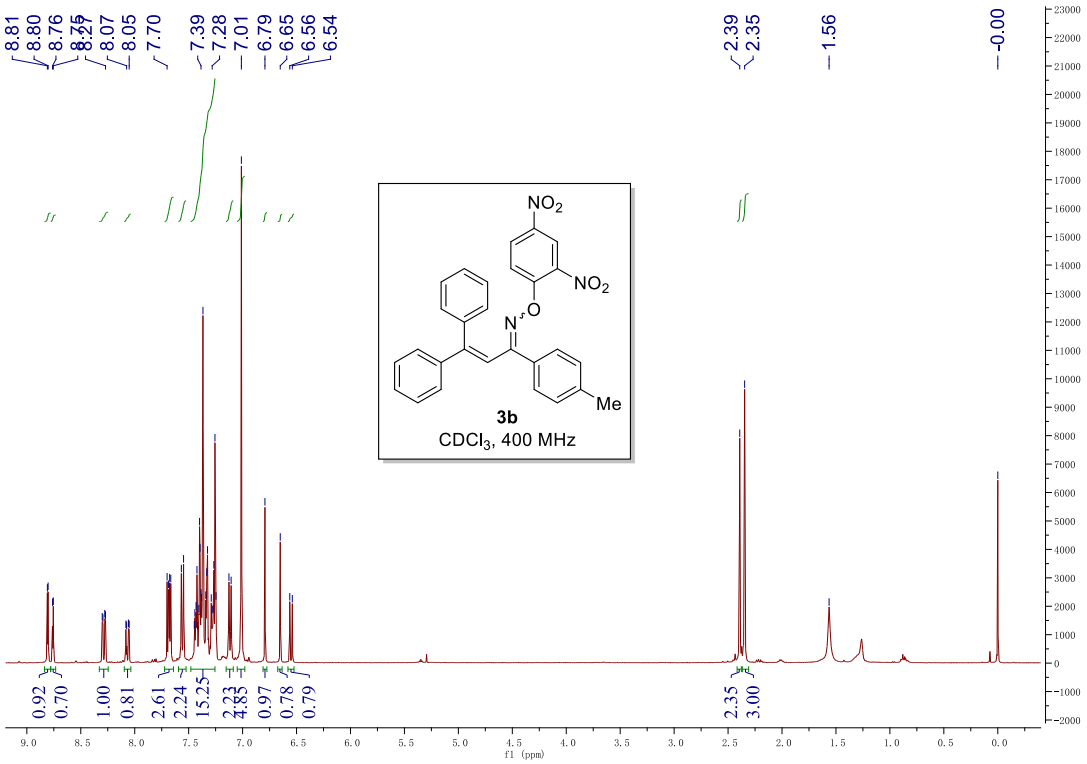

166.3697
160.9254
157.4686
142.9342
140.9148
140.6069
135.8921
130.8444
129.2716
128.7778
128.7338
127.7555
126.5951
121.9967
117.4274
116.3450
112.9817
55.5532
18.4182
MeO
Me
NO2
NO2
N
O
1t
CDCl3,101 MHz
f1 (ppm)

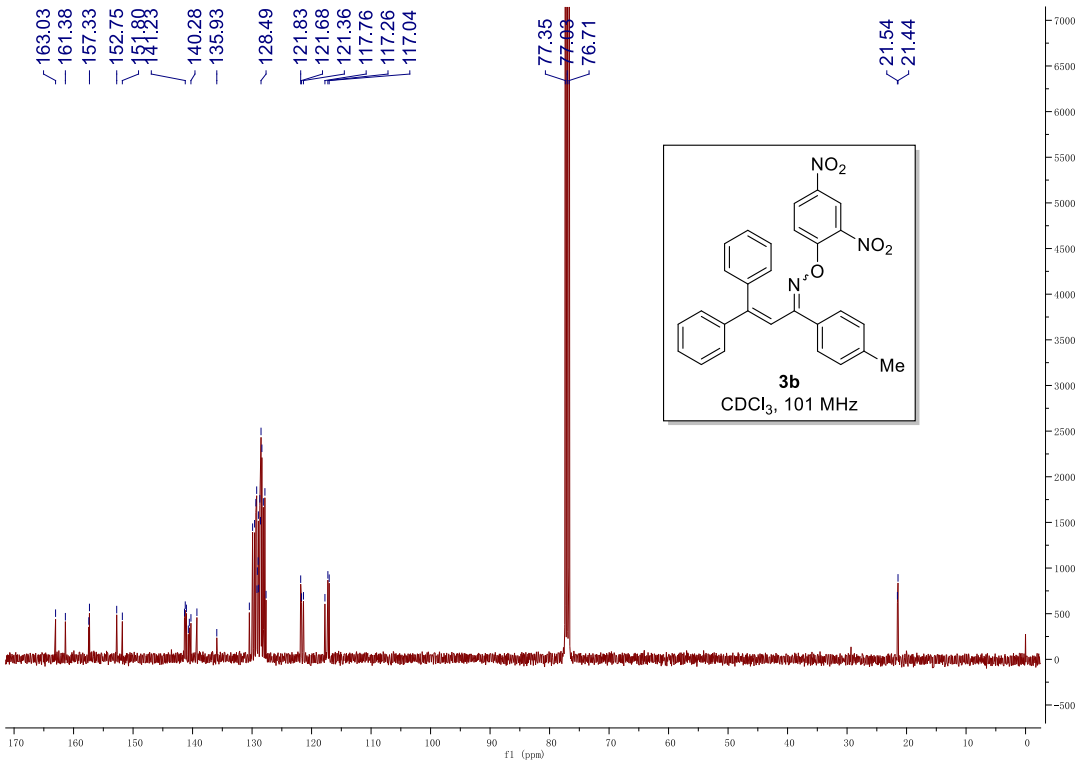

8.9007
8.8938
8.4104
8.3870
7.7985
7.7889
7.7390
7.7156
7.6192
7.5994
7.4895
7.4820
7.4779
7.4675
7.4592
7.4537
7.4487
7.4434
7.4338
7.4185
7.4142
7.3944
7.3891
7.3840
7.3748
7.3709
2.0835
Ph
Me
NO2
F3C
N
O
NO2
1u
CDCl3,400 MHz
0.65
0.93
1.86
0.95
1.03
4.96
3.00
f1 (ppm)

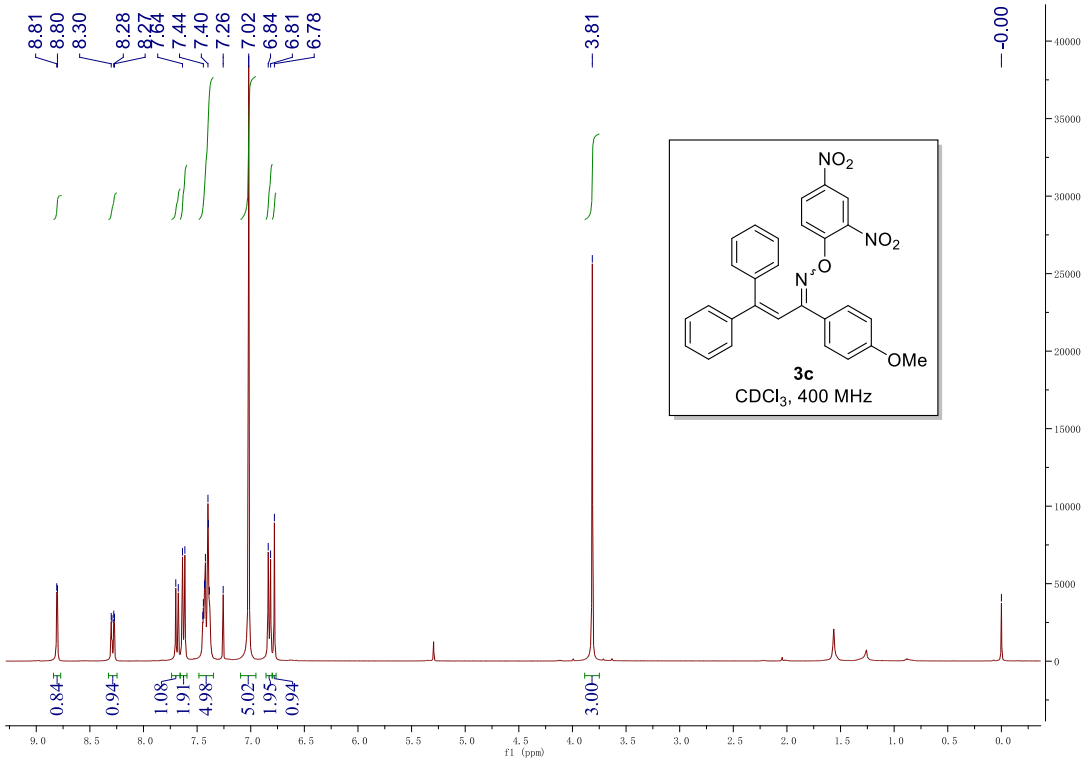

165.9466
157.0451
144.6656
141.0322
139.2473
136.0404
134.9075
131.3577
130.4673
130.1370
129.8081
129.4785
129.3936
129.0200
128.7393
128.5603
127.8083
126.9543
126.9189
126.8829
126.8467
126.3896
126.3523
126.3149
126.2780
125.1013
122.3941
122.0702
119.7017
117.3929
18.2310
Ph
Me
NO2
F3C
N
O
NO2
1u
CDCl3,101 MHz
f1 (ppm)

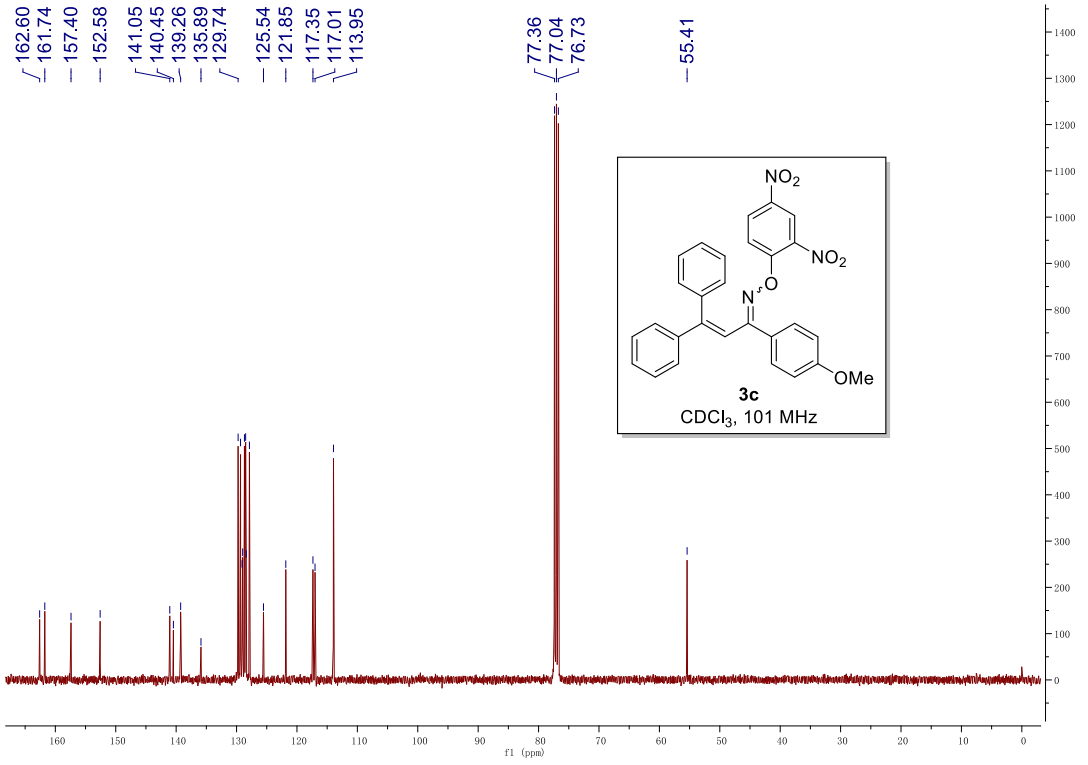

8.66
8.65
8.58
8.57
8.14
7.94
7.63
7.30
7.23
7.14
6.78
6.57
6.55
6.53
-0.00
NO2
NO2
N
O
3a
CDCl3, 400 MHz
0.86
0.32
1.00
0.43
24.51
f1 (ppm)

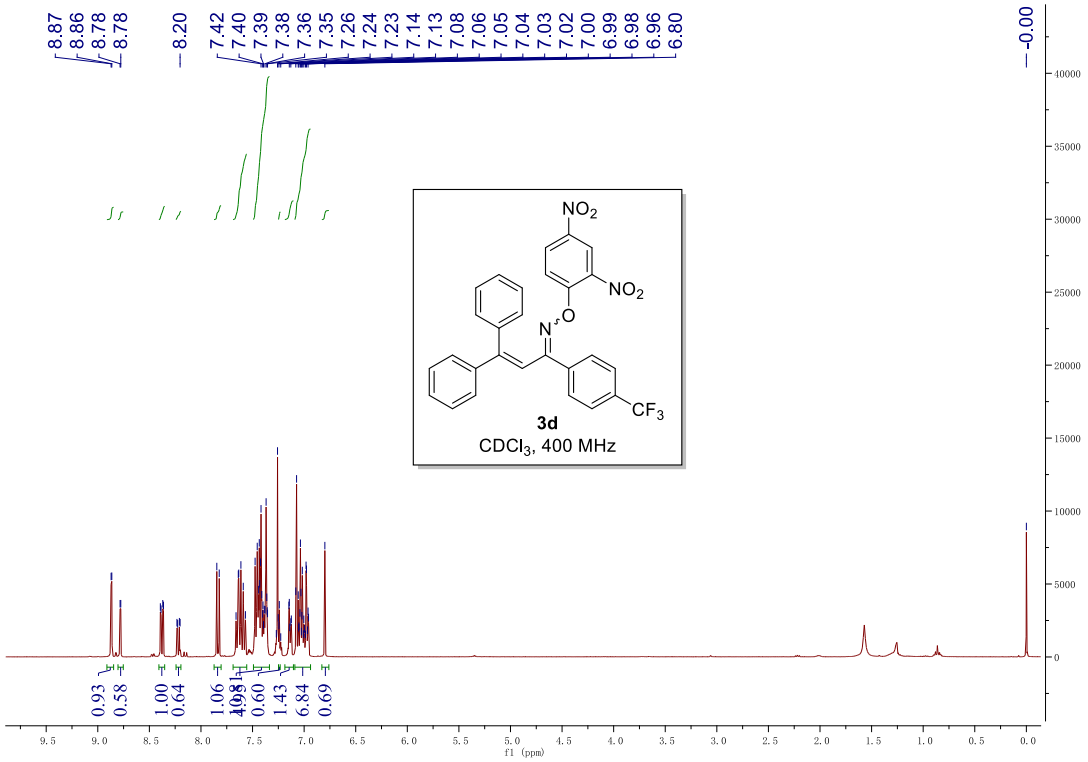

163.29
161.77
157.31
153.16
129.75
129.26
128.63
128.38
127.80
121.92
121.72
121.22
117.72
117.20
77.53
77.22
76.90
NO2
NO2
N
O
3a
CDCl3, 101 MHz
f1 (ppm)

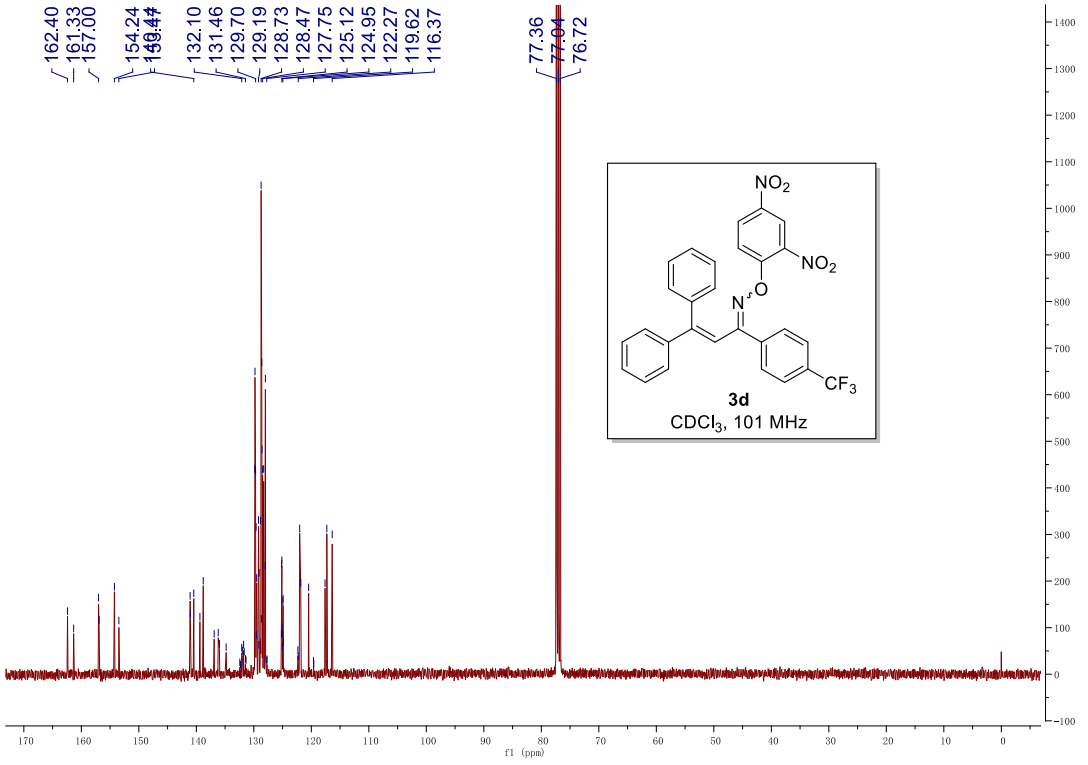

8.81
8.80
8.76
8.07
8.05
7.70
7.39
7.28
7.01
6.79
6.65
6.56
6.54
2.39
2.35
1.56
-0.00
NO2
NO2
N
O
Me
3b
CDCl3, 400 MHz
0.92
0.70
1.00
0.81
2.61
2.24
15.25
2.23
4.85
0.97
0.78
0.79
2.35
3.00
f1 (ppm)

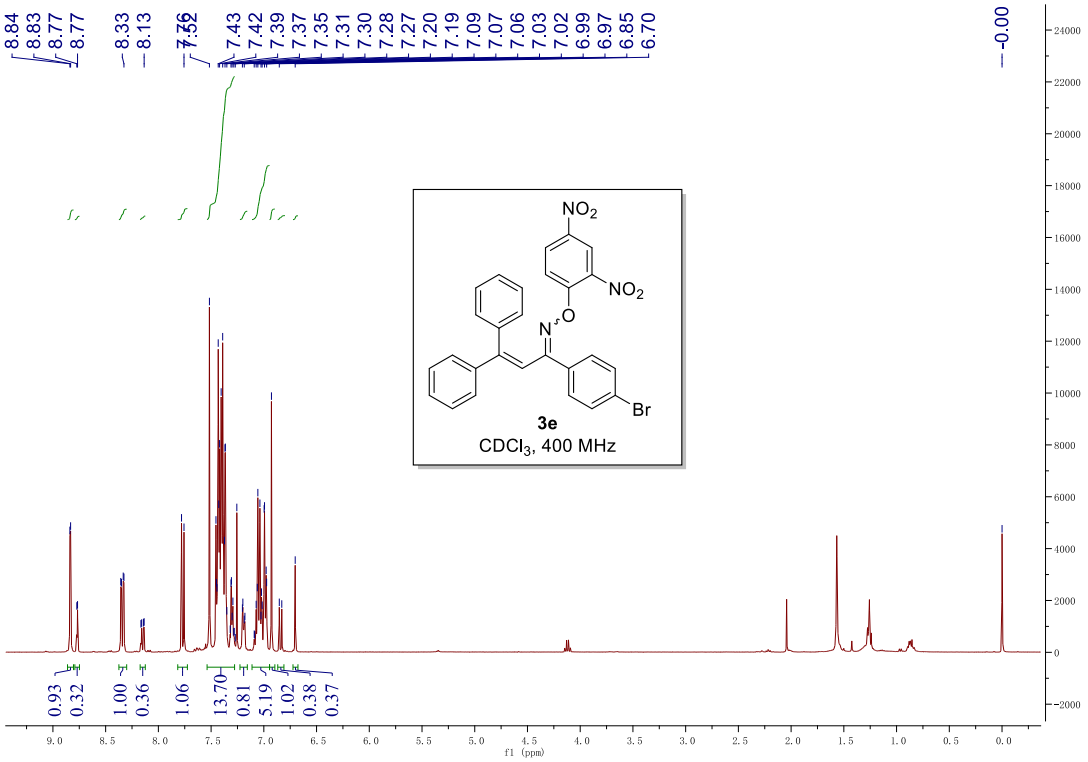

163.03
161.38
157.33
152.75
151.80
141.23
140.28
135.93
128.49
121.83
121.68
121.36
117.76
117.26
117.04
77.35
77.09
76.71
21.54
21.44
NO2
NO2
N
O
Me
3b
CDCl3, 101 MHz
f1 (ppm)

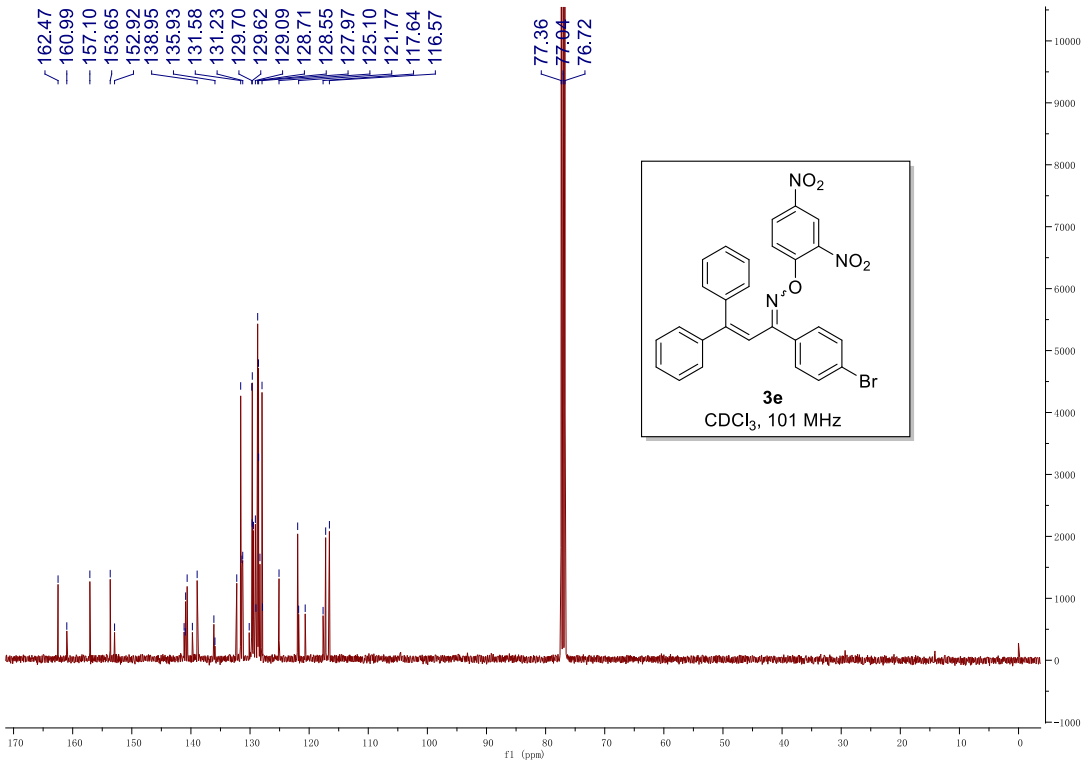

8.81
8.80
8.30
8.28
8.27
7.44
7.40
7.26
7.02
6.84
6.81
6.78
3.81
-0.00
0.84
0.94
1.08
1.91
4.98
5.02
1.95
0.94
3.00
NO2
NO2
O
N
OMe
3c
CDCl3, 400 MHz
f1 (ppm)

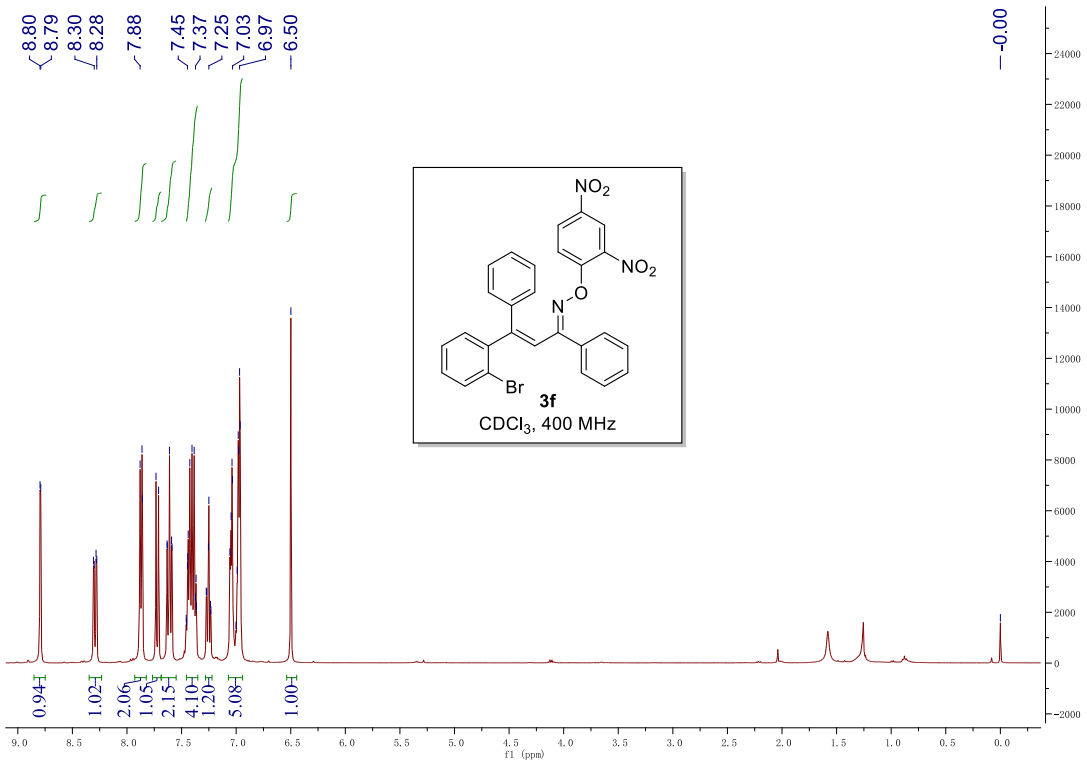

162.60
161.74
157.40
152.58
141.05
140.45
139.26
135.89
129.74
125.54
121.85
117.35
117.01
113.95
77.36
77.04
76.73
55.41
NO2
NO2
O
N
OMe
3c
CDCl3, 101 MHz
f1 (ppm)

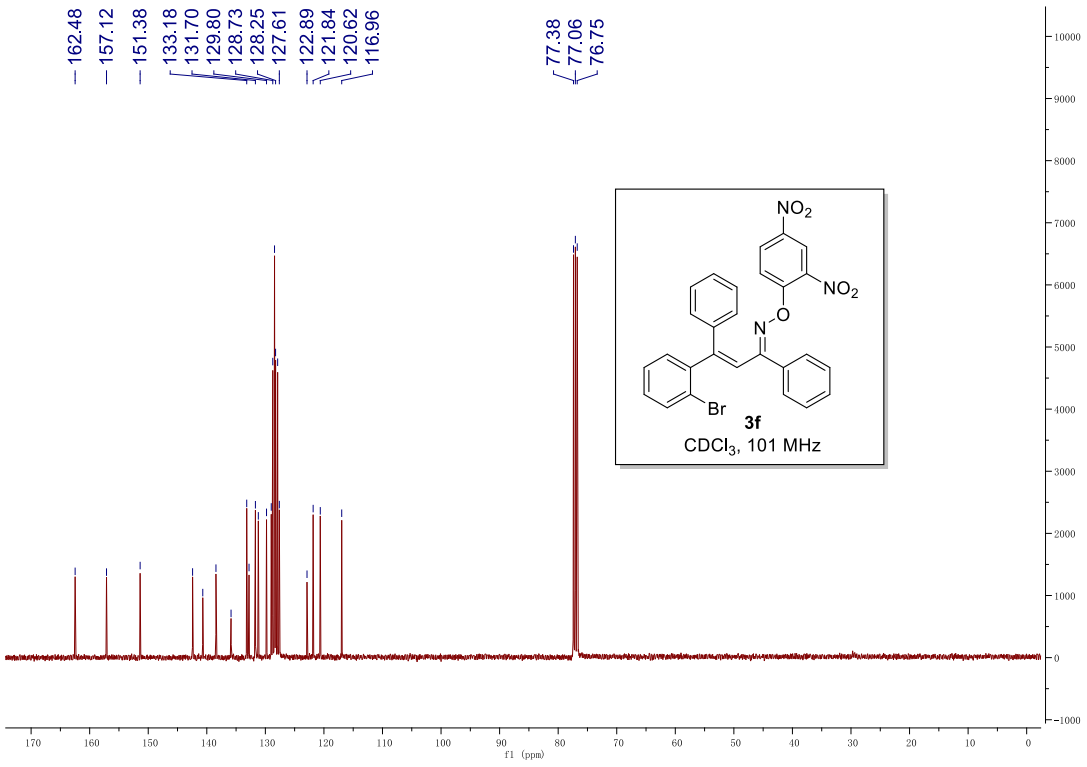

8.87
8.86
8.78
8.78
8.20
7.42
7.40
7.39
7.38
7.36
7.35
7.26
7.24
7.23
7.14
7.13
7.08
7.06
7.05
7.04
7.03
7.02
7.00
6.99
6.98
6.96
6.80
0.00
NO2
NO2
N+
O
CF3
3d
CDCl3, 400 MHz
0.93
0.58
1.00
0.64
1.06
1.03
0.60
1.43
6.84
0.69
f1 (ppm)

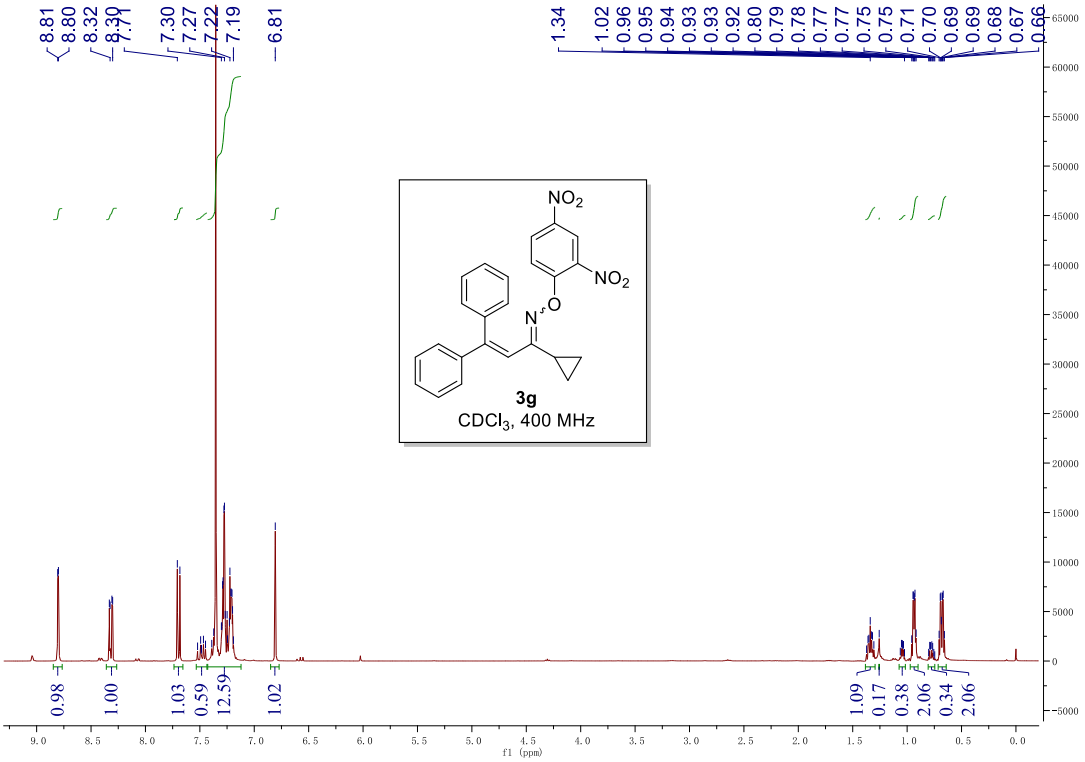

162.40
161.33
157.00
154.24
132.10
131.46
129.70
129.19
128.73
128.47
127.75
125.12
124.95
122.27
119.62
116.37
77.36
77.04
76.72
NO2
NO2
N+
O
CF3
3d
CDCl3, 101 MHz
f1 (ppm)

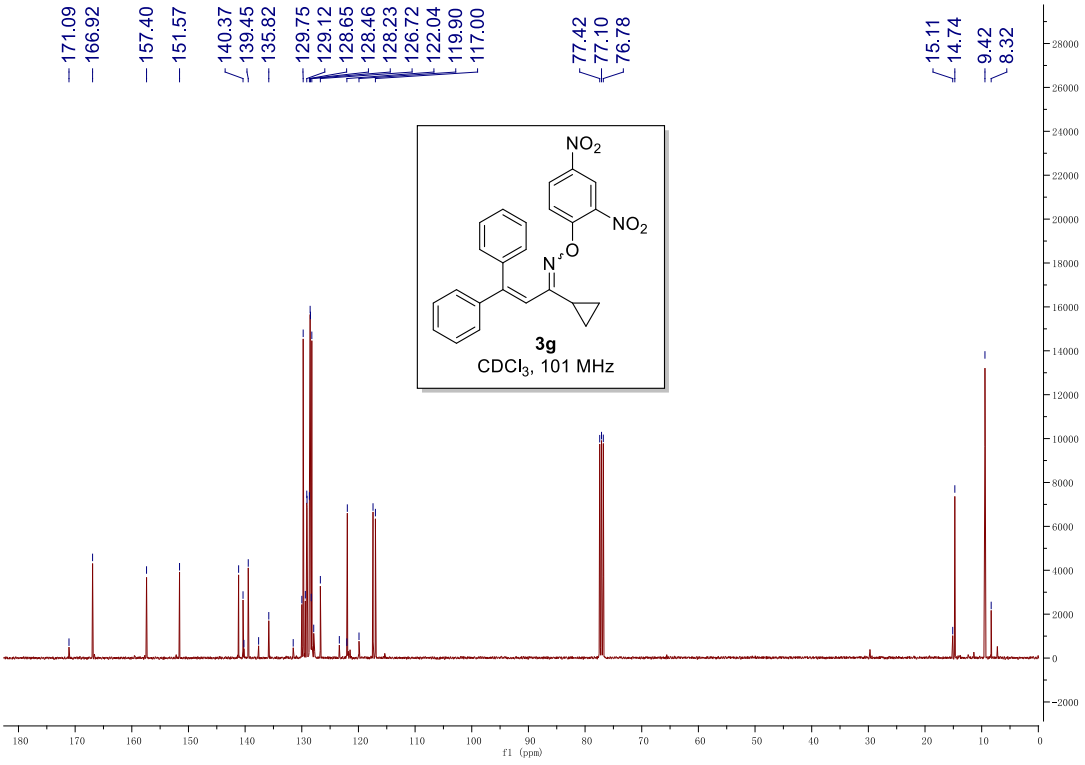

8.84
8.83
8.77
8.77
8.33
8.13
7.56
7.52
7.43
7.42
7.39
7.37
7.35
7.31
7.30
7.28
7.27
7.20
7.19
7.09
7.07
7.06
7.03
7.02
6.99
6.97
6.85
6.70
-0.00
0.93
0.32
1.00
0.36
1.06
13.70
0.81
5.19
1.02
0.38
0.37
f1 (ppm)
NO2
NO2
N
O
Br
3e
CDCl3, 400 MHz

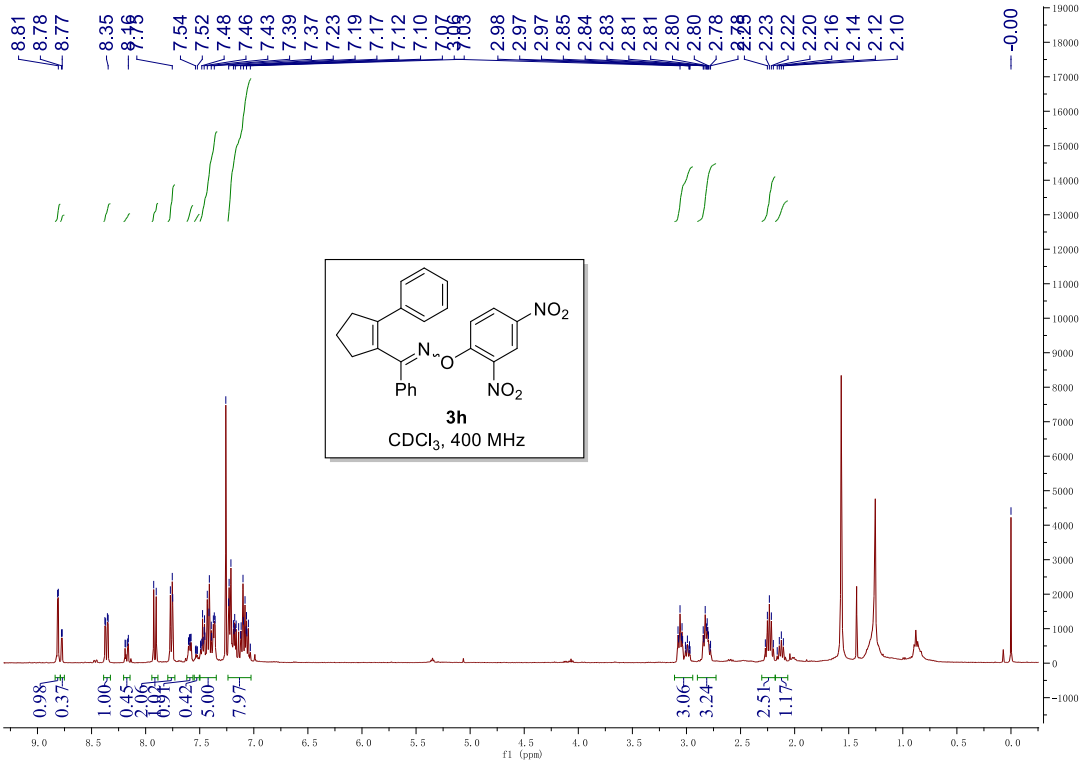

162.47
160.99
157.10
153.65
152.92
138.95
135.93
131.58
131.23
129.70
129.62
129.09
128.71
128.55
127.97
125.10
121.77
117.64
116.57
77.36
77.04
76.72
f1 (ppm)
NO2
NO2
N
O
Br
3e
CDCl3, 101 MHz

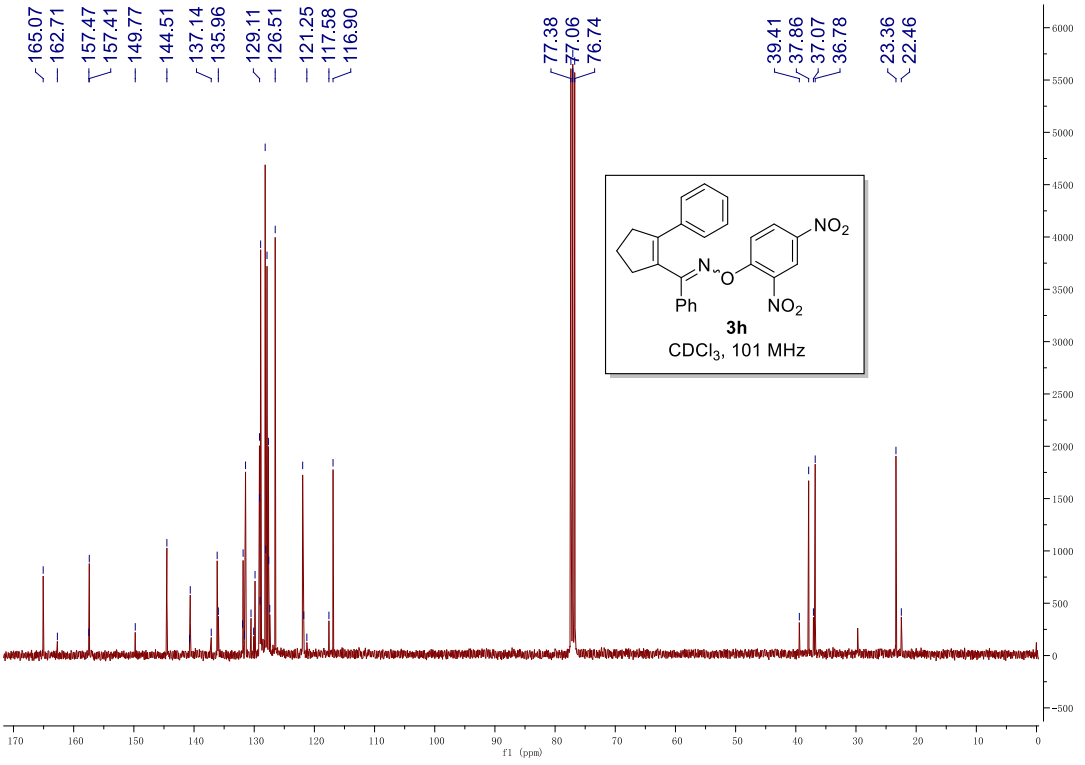

8.80
8.79
8.30
8.28
7.88
7.45
7.37
7.25
7.03
6.97
6.50
-0.00
0.94
1.02
2.06
1.05
2.15
4.10
1.20
5.08
1.00
NO2
NO2
N
O
Br
3f
CDCl3, 400 MHz
f1 (ppm)

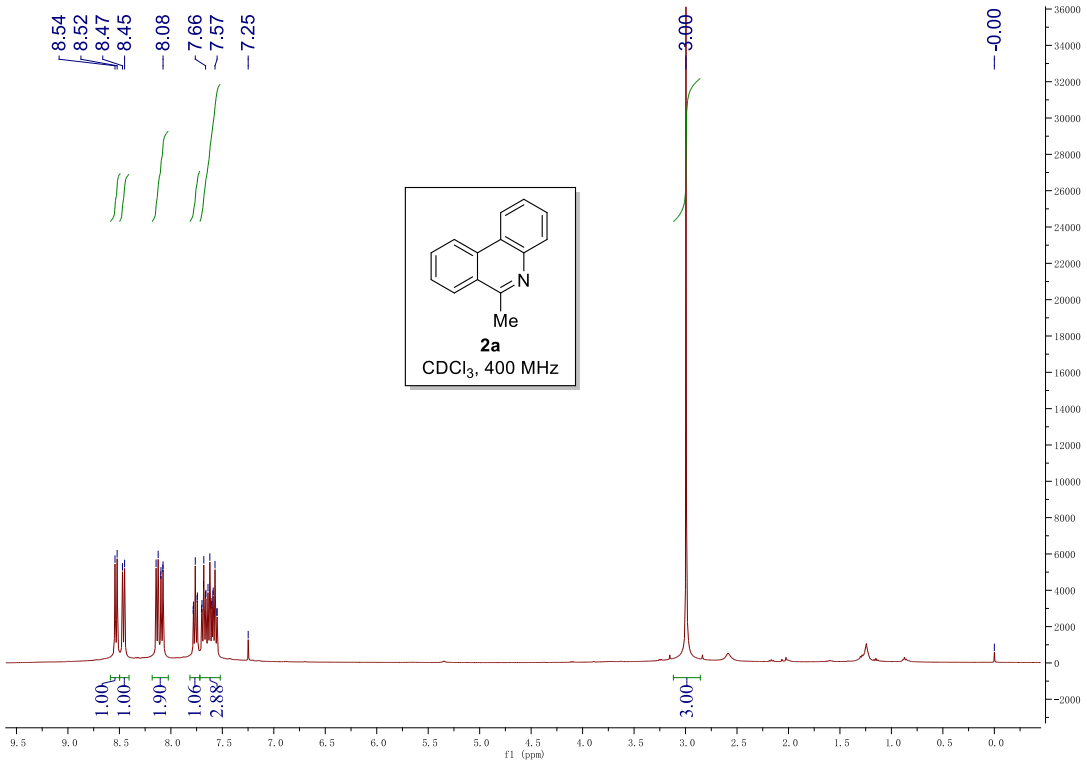

162.48
157.12
151.38
133.18
131.70
129.80
128.73
128.25
127.61
122.89
121.84
120.62
116.96
77.38
77.06
76.75
NO2
NO2
N
O
Br
3f
CDCl3, 101 MHz
f1 (ppm)

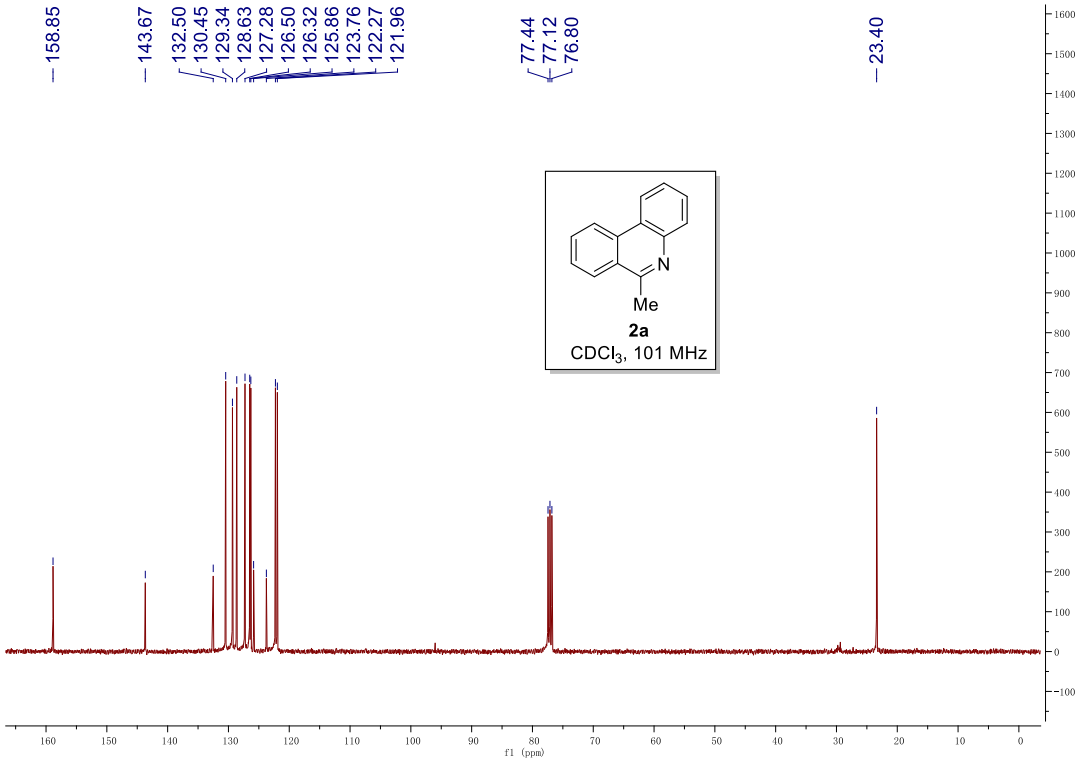

8.81
8.80
8.32
8.30
7.71
7.30
7.27
7.22
7.19
6.81
1.34
1.02
0.96
0.95
0.94
0.93
0.93
0.92
0.80
0.79
0.78
0.77
0.77
0.75
0.75
0.71
0.70
0.69
0.69
0.68
0.67
0.66
NO2
NO2
N
O
3g
CDCl3, 400 MHz
0.98
1.00
1.03
0.59
12.59
1.02
1.09
0.17
0.38
2.06
0.34
2.06
f1 (ppm)

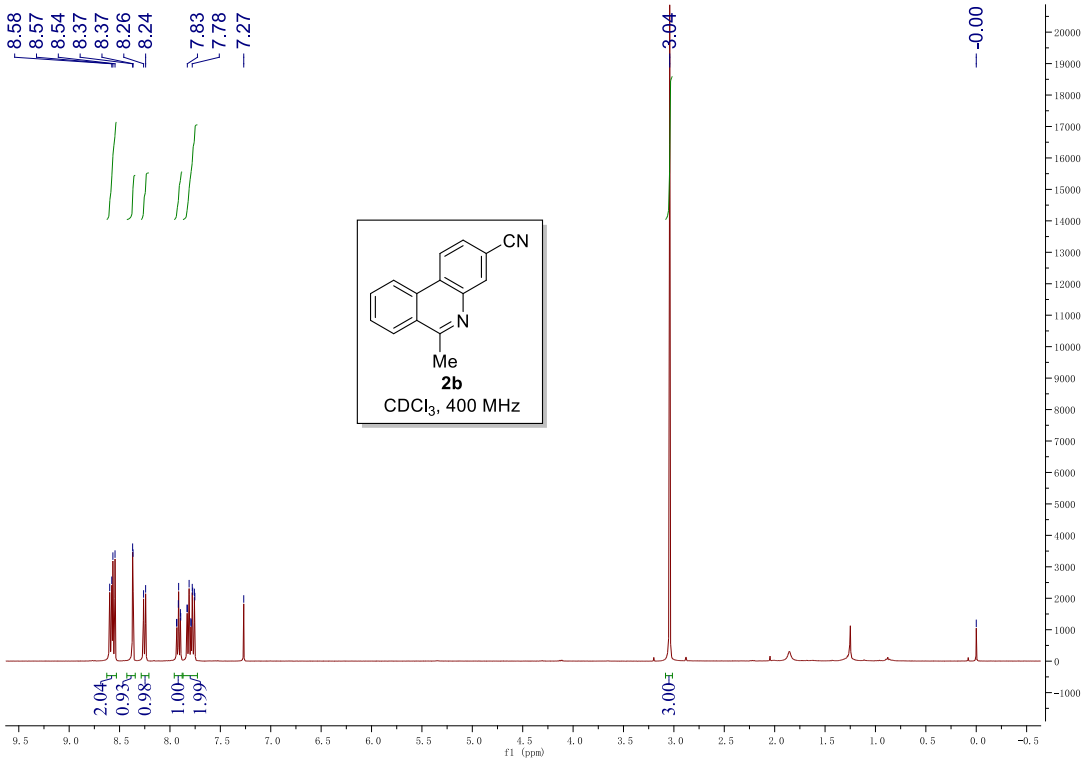

171.09
166.92
157.40
151.57
140.37
139.45
135.82
129.75
129.12
128.65
128.46
128.23
126.72
122.04
119.90
117.00
77.42
77.10
76.78
15.11
14.74
9.42
8.32
NO2
NO2
N
O
3g
CDCl3, 101 MHz
f1 (ppm)

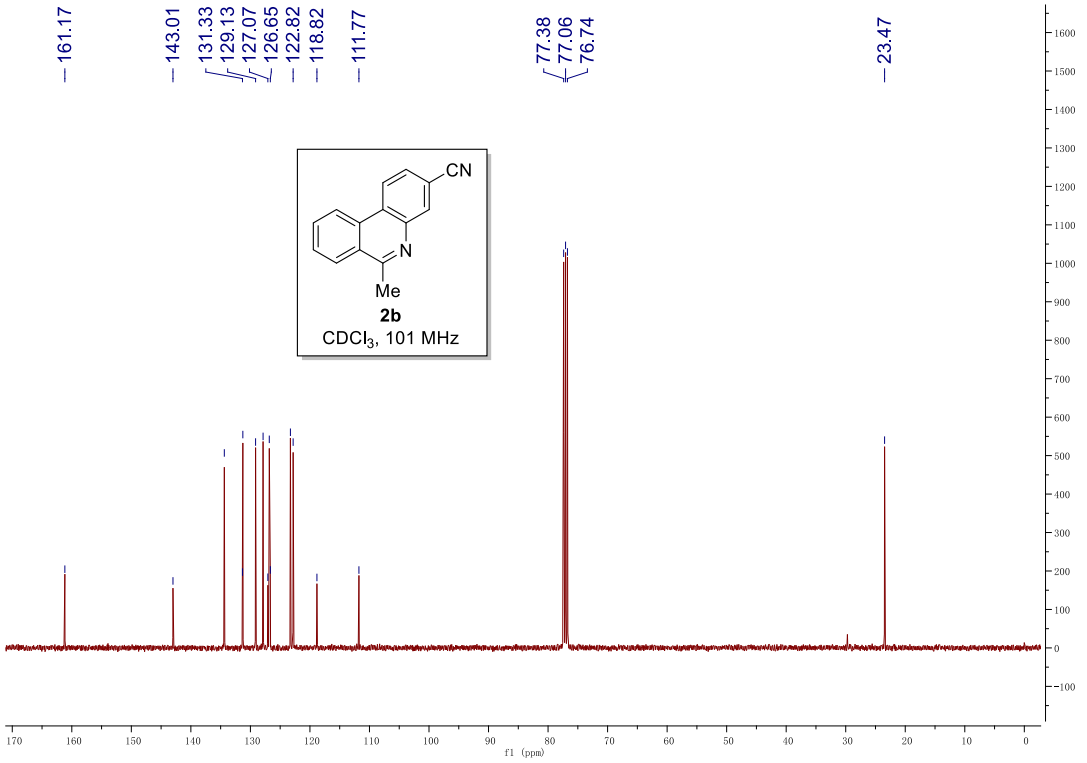

8.81
8.78
8.77
8.35
7.54
7.52
7.48
7.46
7.43
7.39
7.37
7.23
7.19
7.17
7.12
7.10
2.98
2.97
2.85
2.84
2.83
2.81
2.81
2.80
2.80
2.78
2.23
2.22
2.20
2.16
2.14
2.12
2.10
-0.00
NO2
N
O
Ph
NO2
3h
CDCl3, 400 MHz
0.98
0.37
1.00
0.45
2.06
1.01
0.91
0.42
5.00
7.97
3.06
3.24
2.51
1.17
f1 (ppm)

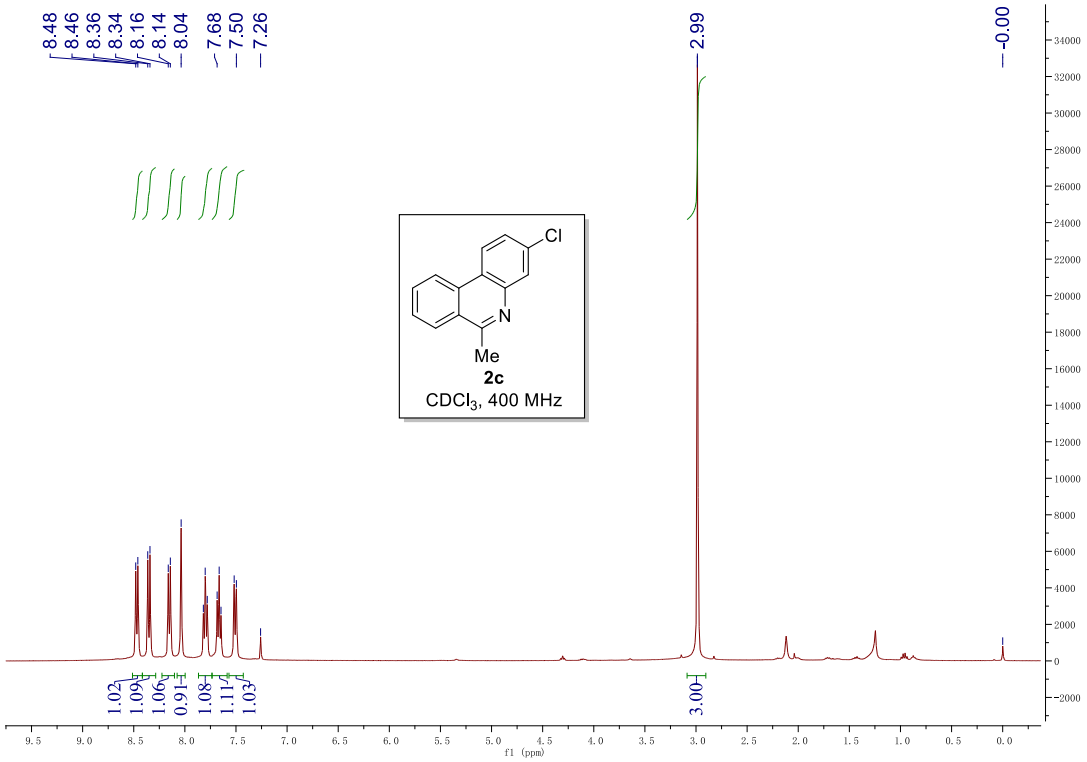

165.07
162.71
157.47
157.41
149.77
144.51
137.14
135.96
129.11
126.51
121.25
117.58
116.90
77.38
77.06
76.74
39.41
37.86
37.07
36.78
23.36
22.46
NO2
N
O
Ph
NO2
3h
CDCl3, 101 MHz
f1 (ppm)

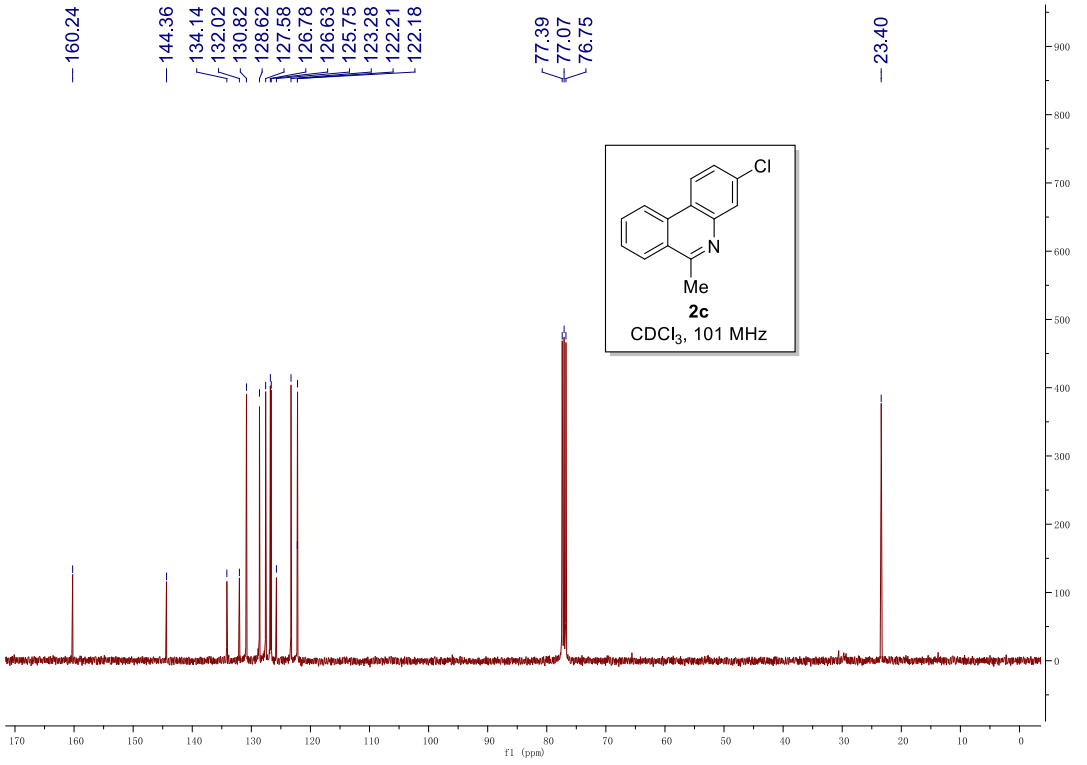

8.54
8.52
8.47
8.45
8.08
7.66
7.57
7.25
3.00
-0.00
N
Me
2a
CDCl3, 400 MHz
1.00
1.00
1.90
1.06
2.88
3.00
f1 (ppm)

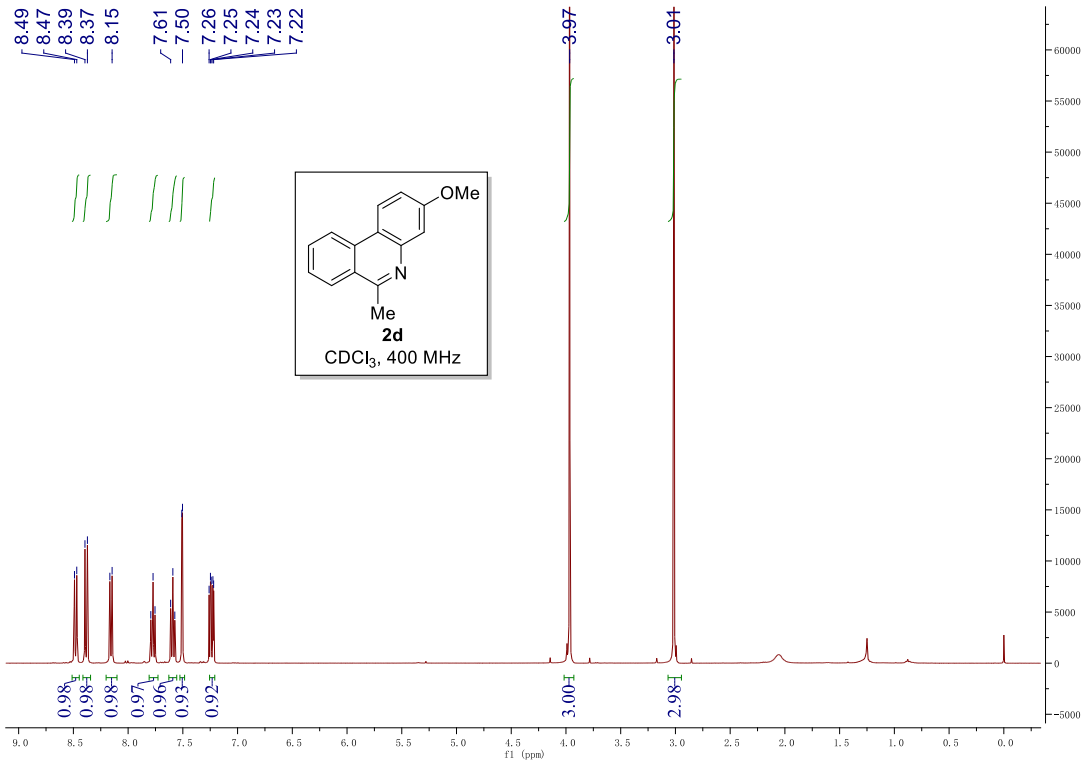

158.85
143.67
132.50
130.45
129.34
128.63
127.28
126.50
126.32
125.86
123.76
122.27
121.96
77.44
77.12
76.80
23.40
N
Me
2a
CDCl3, 101 MHz
f1 (ppm)

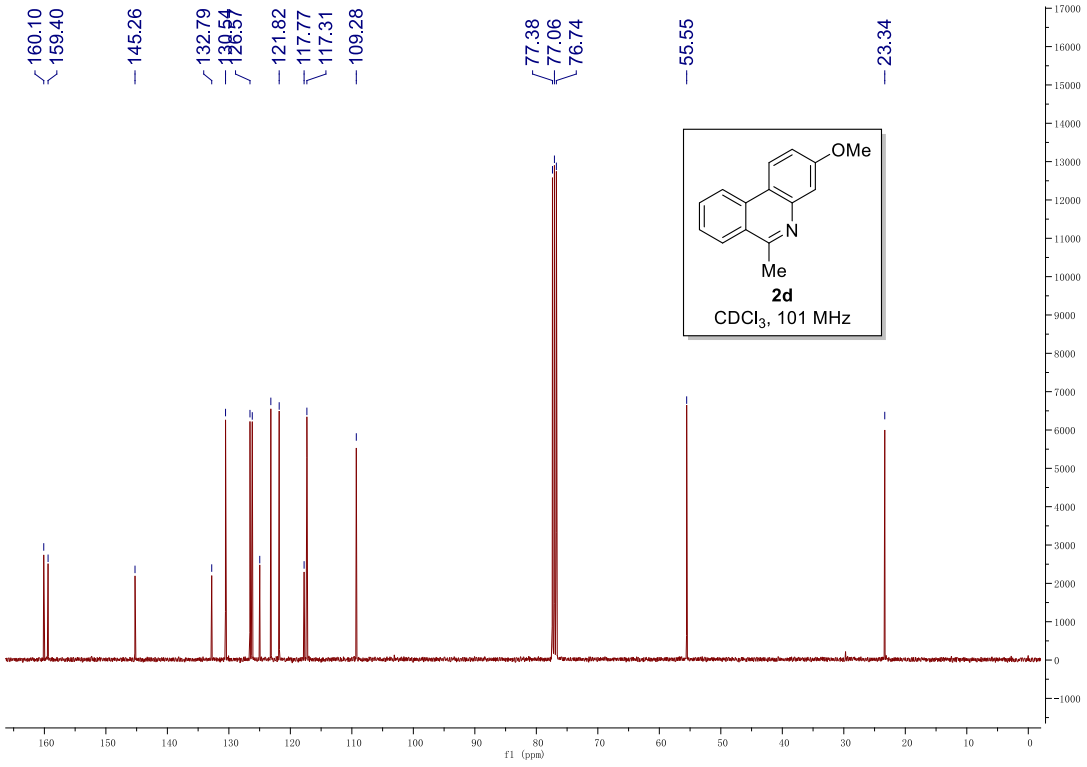

8.58
8.57
8.54
8.37
8.37
8.26
8.24
7.83
7.78
7.27
3.04
-0.00
CN
N
Me
2b
CDCl3, 400 MHz
2.04
0.93
0.98
1.00
1.99
3.00
f1 (ppm)

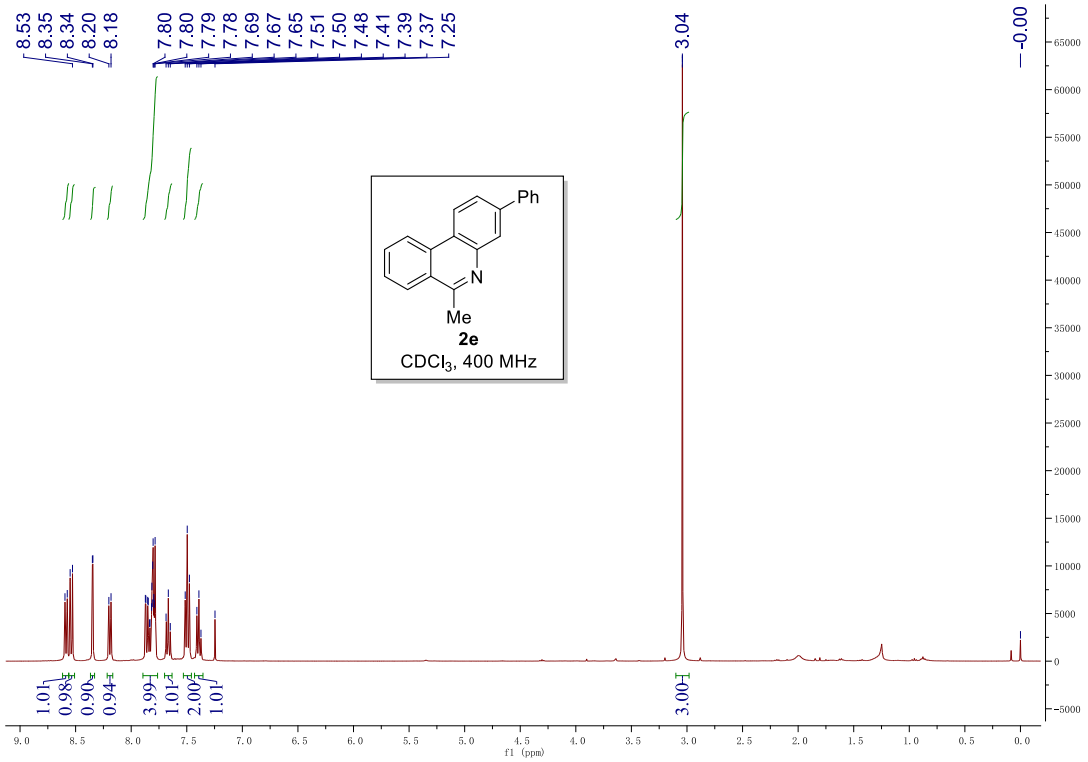

161.17
143.01
131.33
129.13
127.07
126.65
122.82
118.82
111.77
77.38
77.06
76.74
23.47
CN
N
Me
2b
CDCl3, 101 MHz
f1 (ppm)

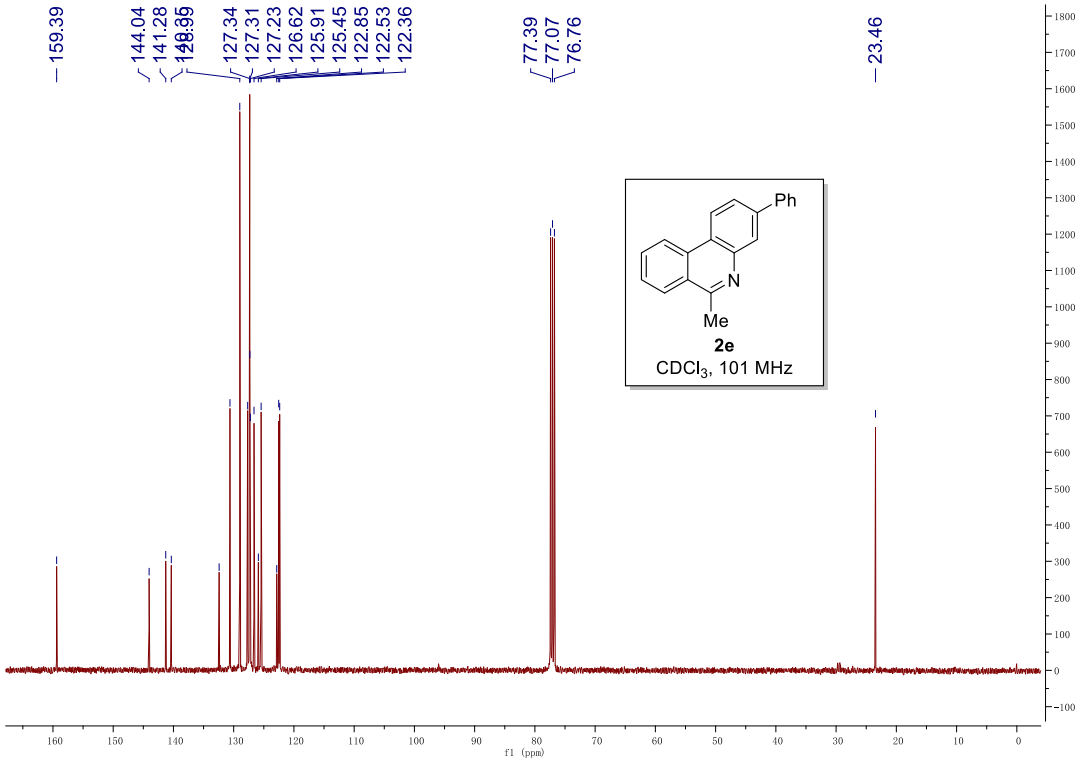

8.48
8.46
8.36
8.34
8.16
8.14
8.04
7.68
7.50
7.26
2.99
-0.00
Cl
N
Me
2c
CDCl3, 400 MHz
1.02
1.09
1.06
0.91
1.08
1.11
1.03
3.00
f1 (ppm)


160.24
144.36
134.14
132.02
130.82
128.62
127.58
126.78
126.63
125.75
123.28
122.21
122.18
77.39
77.07
76.75
23.40
Cl
N
Me
2c
CDCl3, 101 MHz
f1 (ppm)


8.49
8.47
8.39
8.37
8.15
7.61
7.50
7.26
7.25
7.24
7.23
7.22
3.97
3.01
OMe
N
Me
2d
CDCl3, 400 MHz
0.98
0.98
0.98
0.97
0.96
0.93
0.92
3.00
2.98
f1 (ppm)


160.10
159.40
145.26
132.79
130.54
126.57
121.82
117.77
117.31
109.28
77.38
77.06
76.74
55.55
23.34
OMe
N
Me
2d
CDCl3, 101 MHz
f1 (ppm)


8.53
8.35
8.34
8.20
8.18
7.80
7.80
7.79
7.78
7.69
7.67
7.65
7.51
7.50
7.48
7.41
7.39
7.37
7.25
3.04
-0.00
Ph
N
Me
2e
CDCl3, 400 MHz
1.01
0.98
0.90
0.94
3.99
1.01
2.00
1.01
3.00
f1 (ppm)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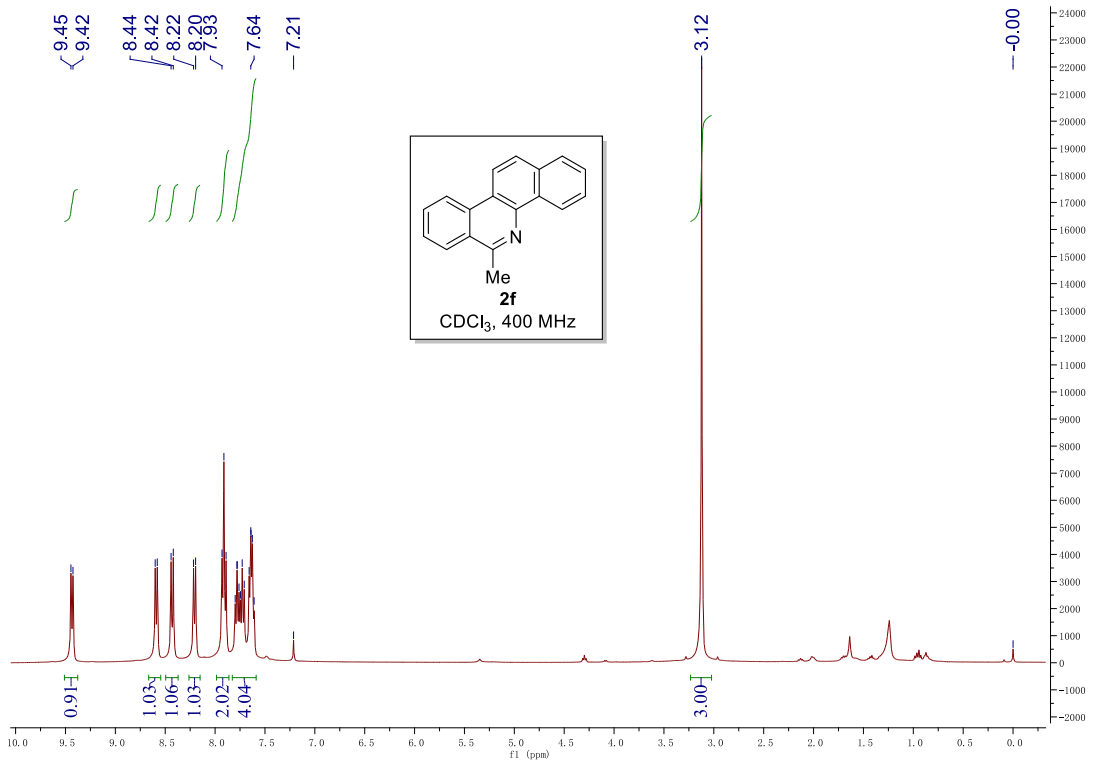
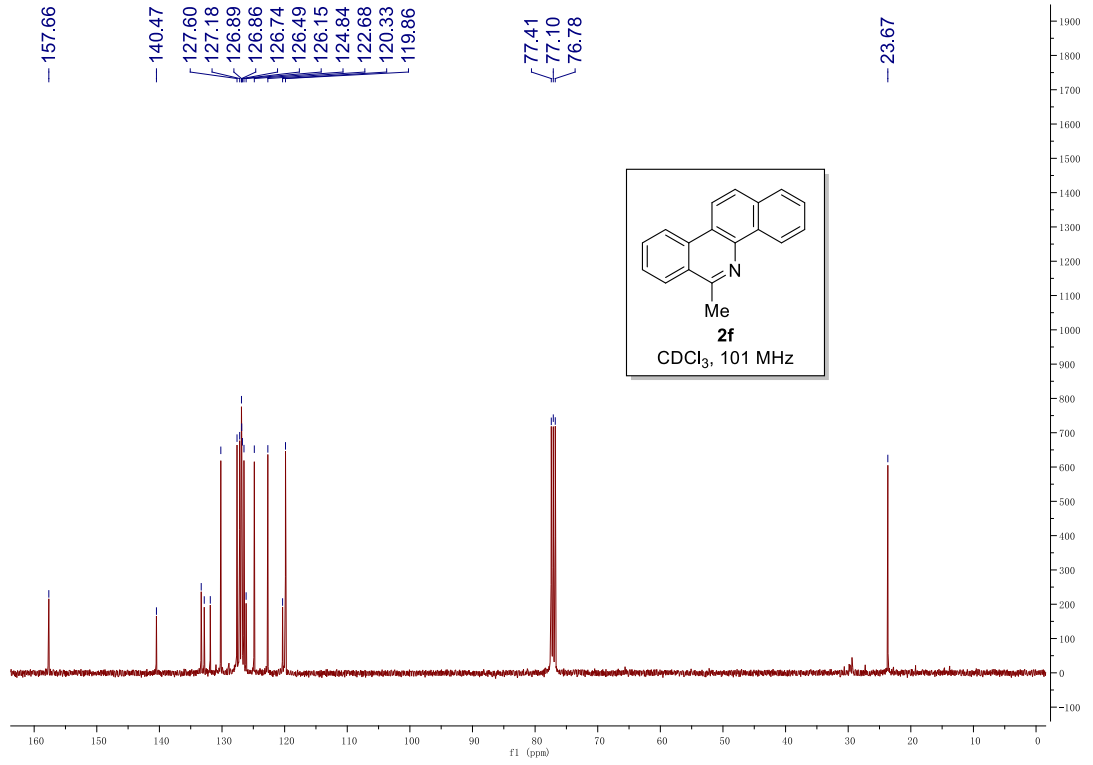
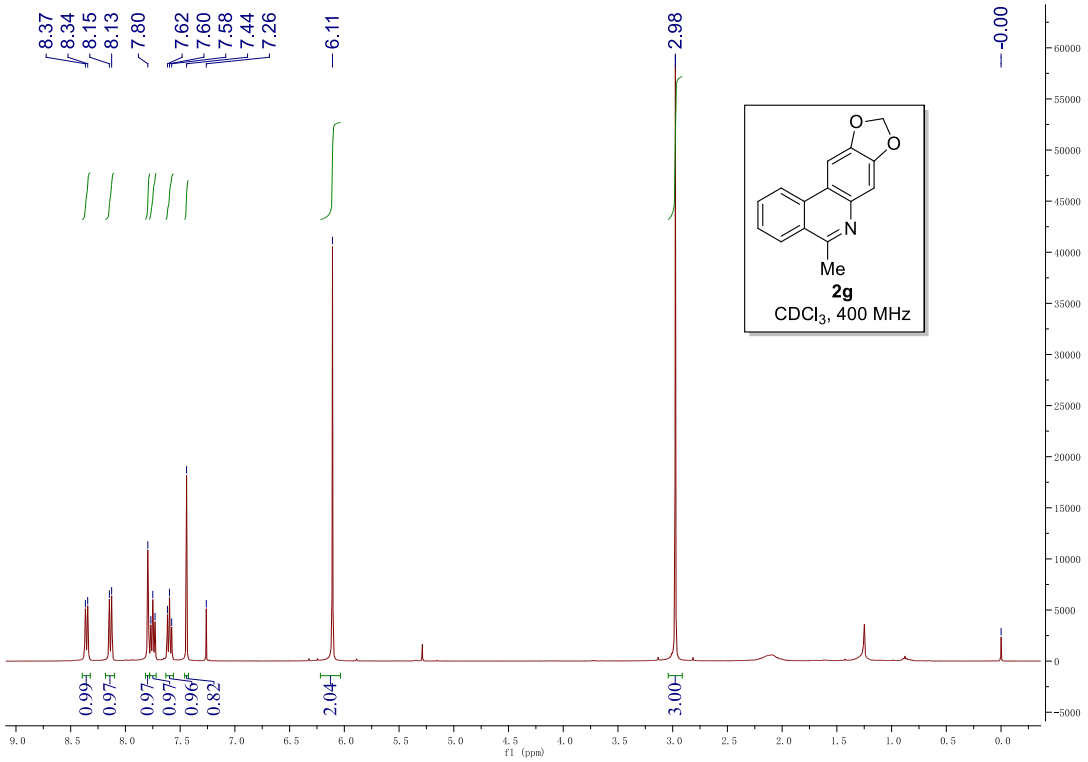
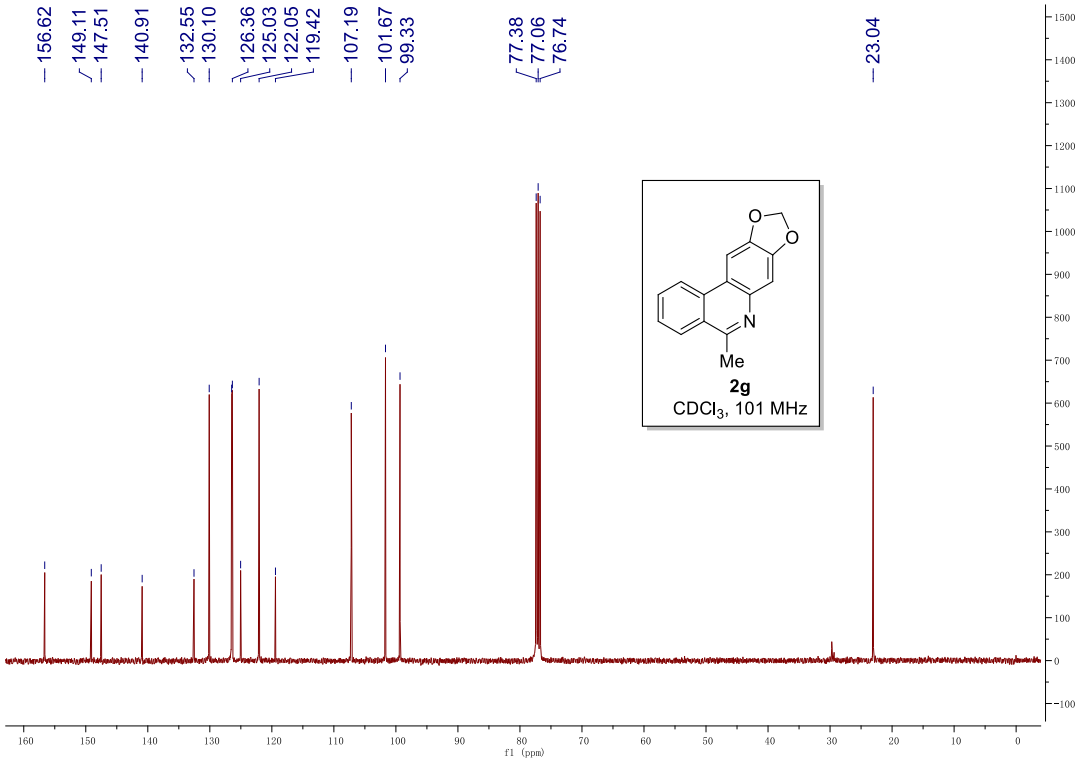
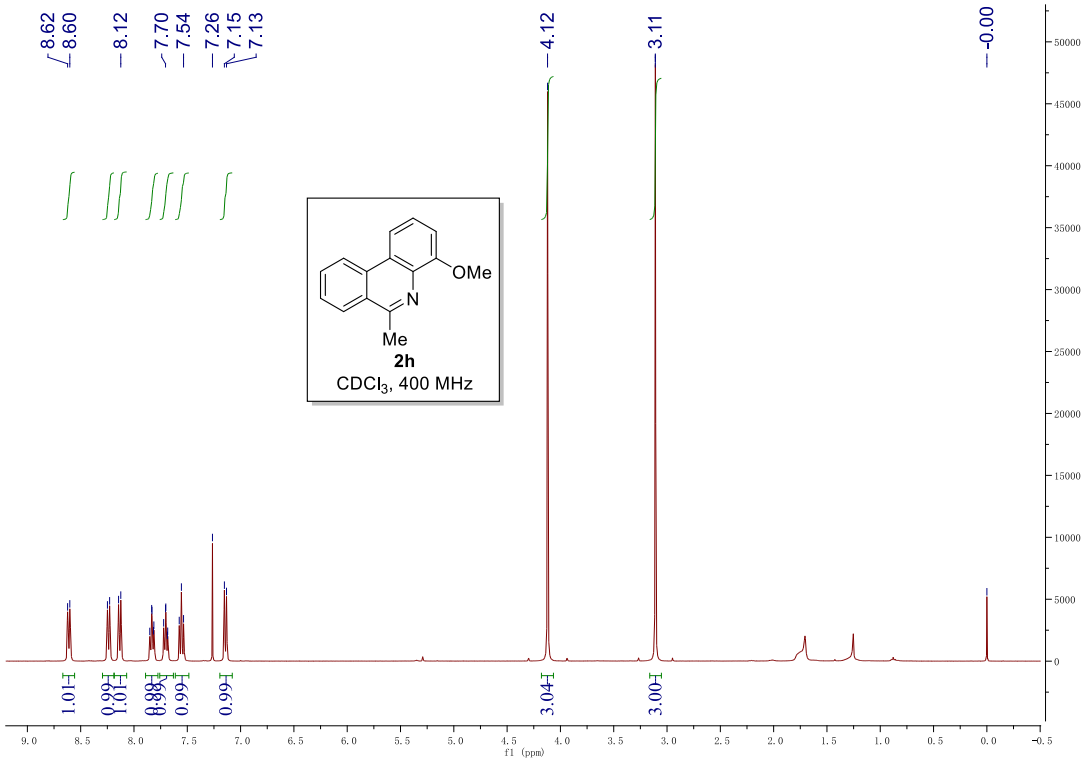
144.04
141.28
128.99
127.34
127.31
127.23
126.62
125.91
125.45
122.85
122.53
122.36
77.39
77.07
76.76
23.46
Ph
N
Me
2e
CDCl3, 101 MHz
f1 (ppm)

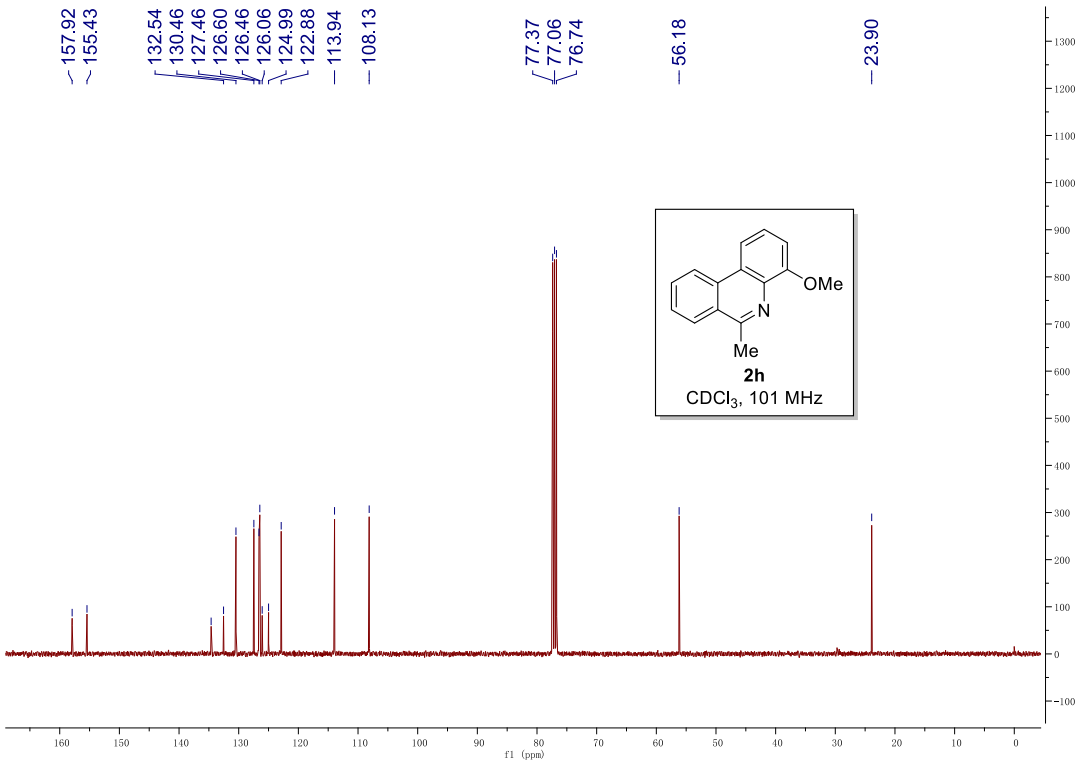

9.45
9.42
8.44
8.42
8.22
8.20
7.93
7.64
7.21
3.12
0.00
N
Me
2f
CDCl3, 400 MHz
0.91
1.03
1.06
1.03
2.02
4.04
3.00
f1 (ppm)

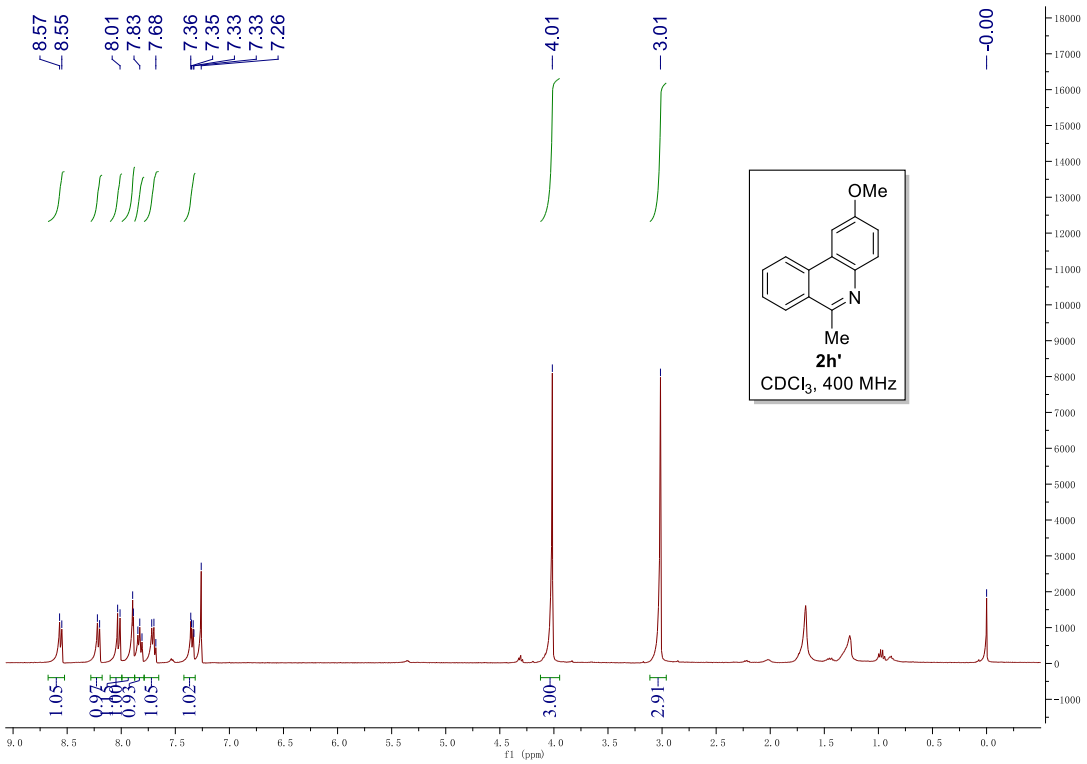

157.66
140.47
127.60
127.18
126.89
126.86
126.74
126.49
126.15
124.84
122.68
120.33
119.86
77.41
77.10
76.78
23.67
N
Me
2f
CDCl3, 101 MHz
f1 (ppm)

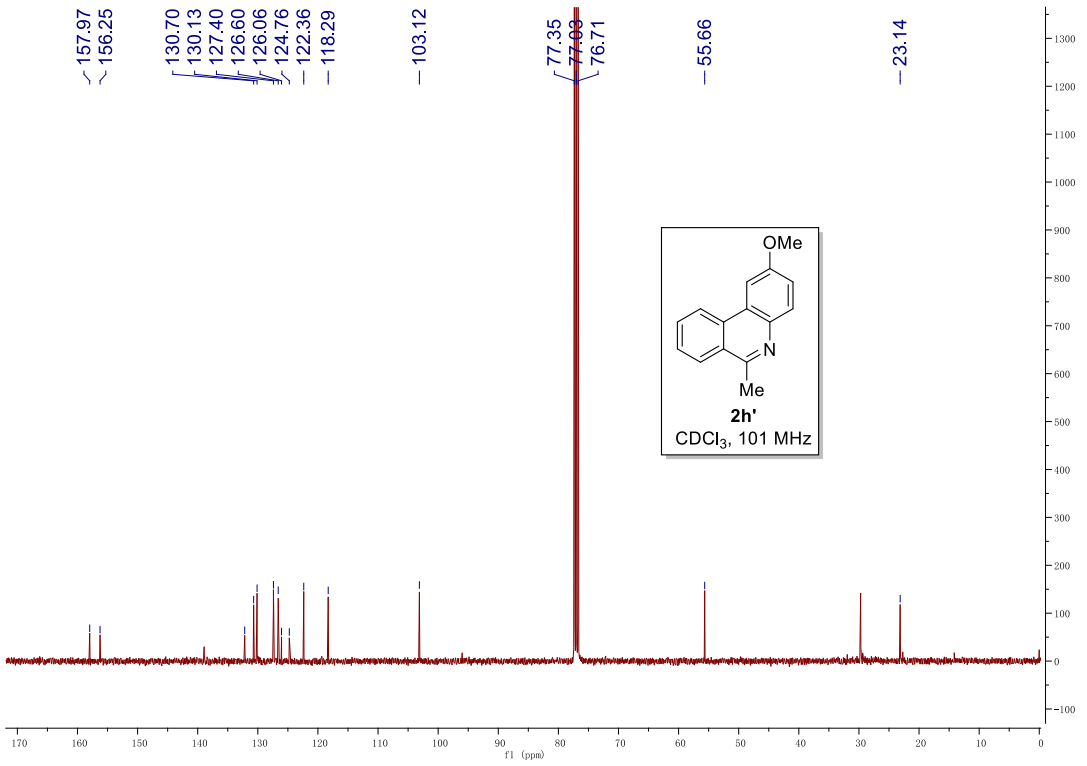

8.37
8.34
8.15
8.13
7.80
7.62
7.60
7.58
7.44
7.26
6.11
2.98
-0.00
0.99
0.97
0.97
0.97
0.96
0.82
2.04
3.00
O
O
N
Me
2g
CDCl3, 400 MHz
f1 (ppm)

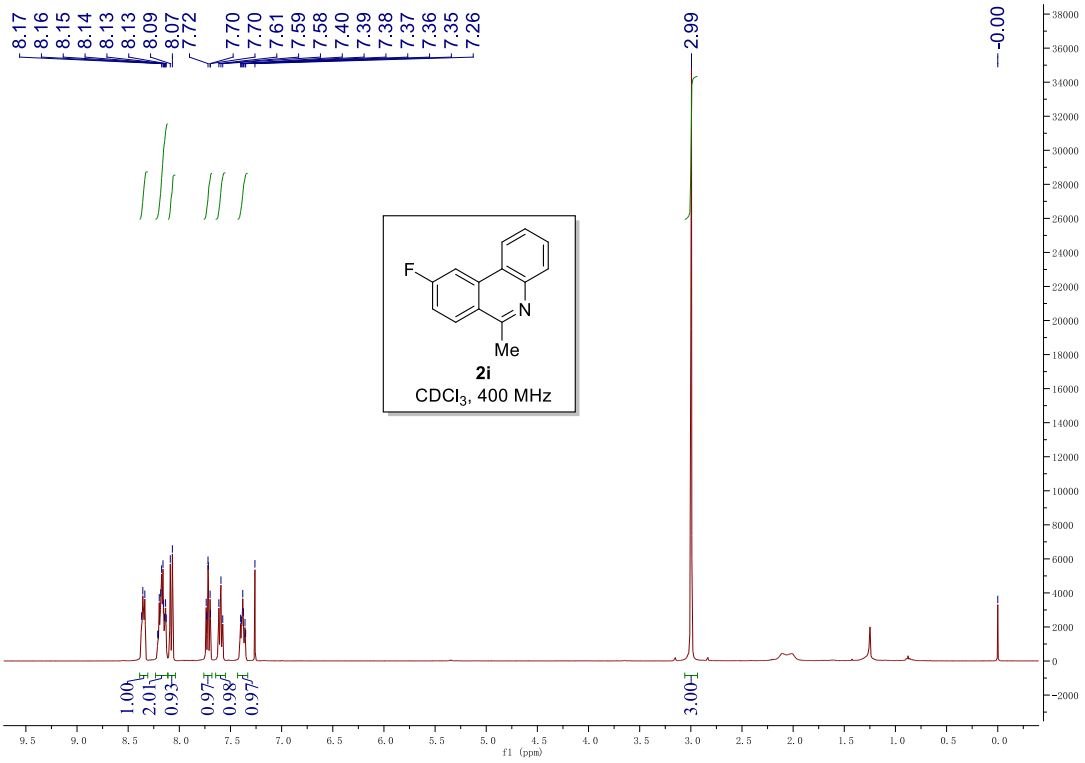

156.62
149.11
147.51
140.91
132.55
130.10
126.36
125.03
122.05
119.42
107.19
101.67
99.33
77.38
77.06
76.74
23.04
O
O
N
Me
2g
CDCl3, 101 MHz
f1 (ppm)

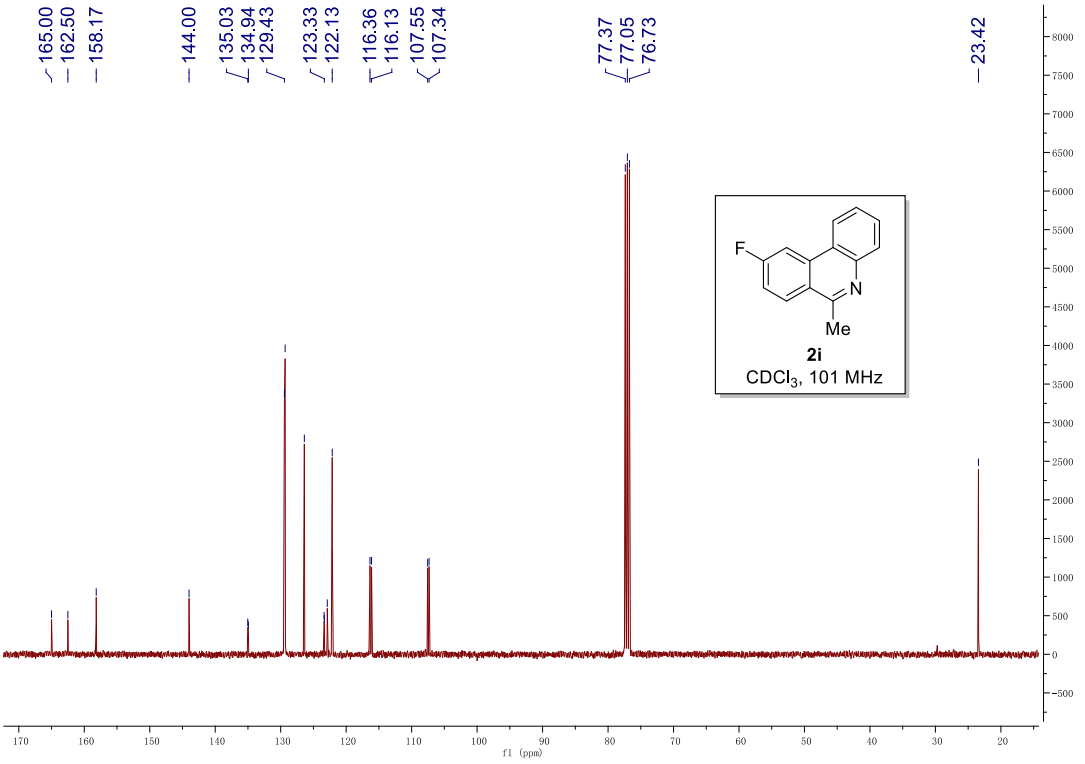

8.62
8.60
8.12
7.70
7.54
7.26
7.15
7.13
4.12
3.11
0.00
OMe
N
Me
2h
CDCl3, 400 MHz
1.01
0.99
0.99
0.99
3.04
3.00
f1 (ppm)

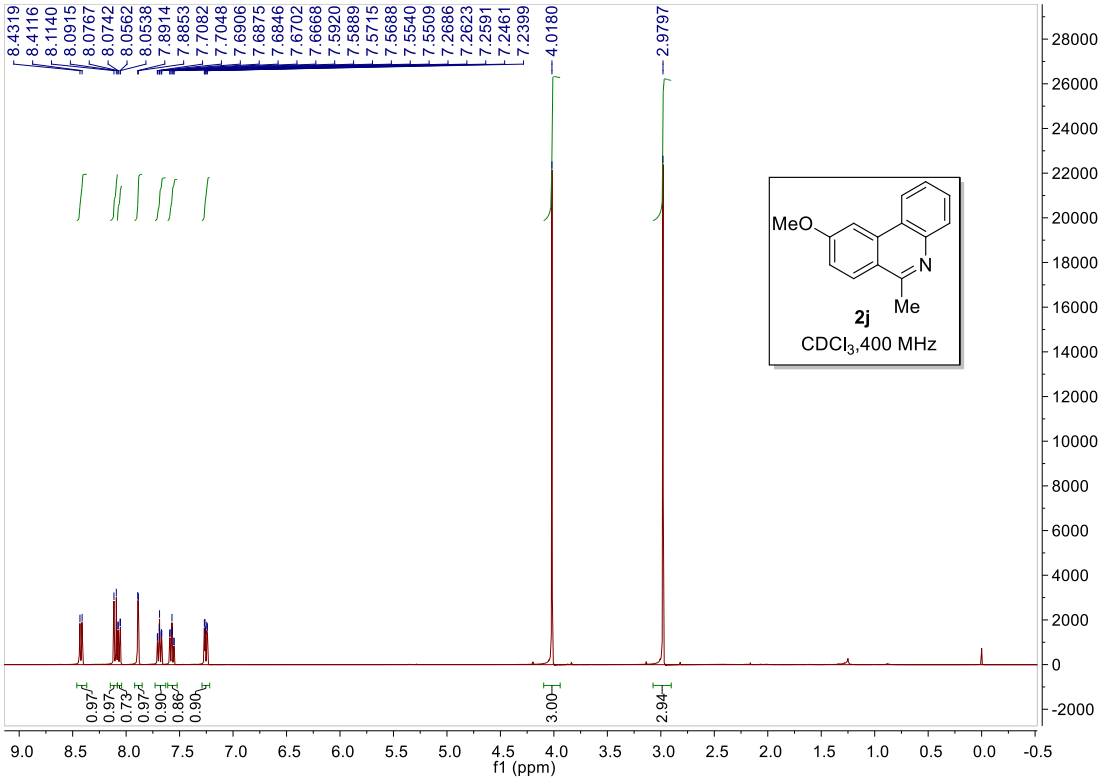

157.92
155.43
132.54
130.46
127.46
126.60
126.46
126.06
124.99
122.88
113.94
108.13
77.37
77.06
76.74
56.18
23.90
OMe
N
Me
2h
CDCl3, 101 MHz
f1 (ppm)

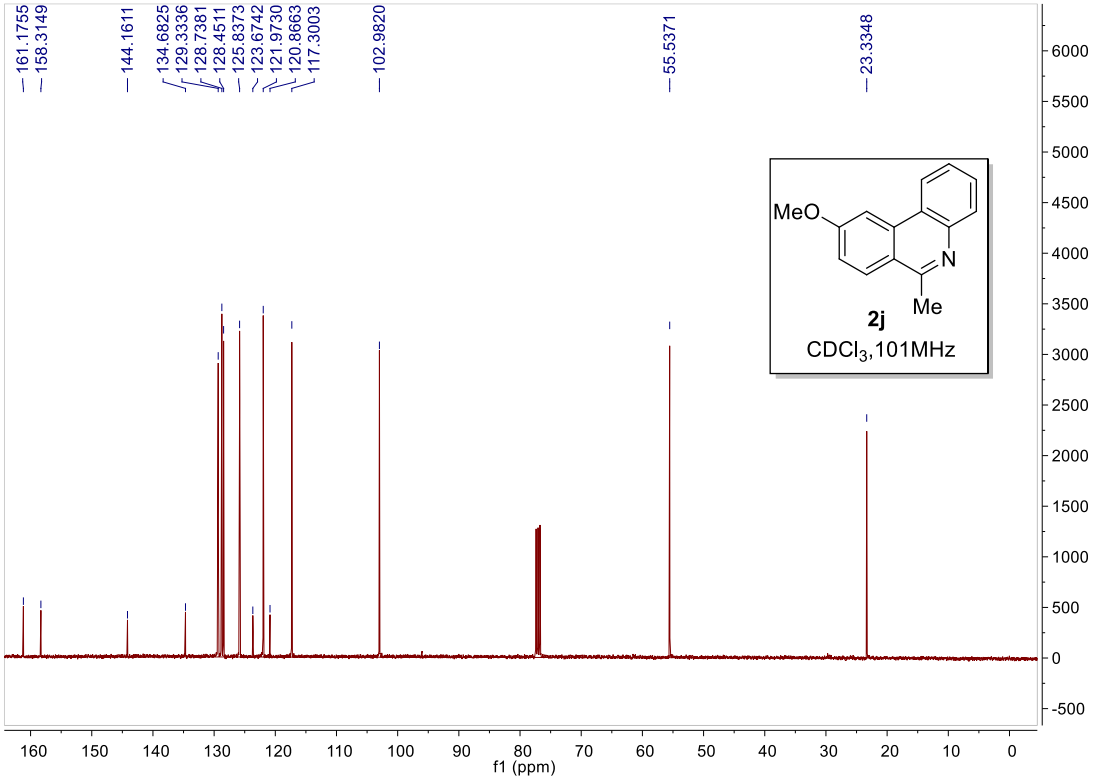

8.57
8.55
8.01
7.83
7.68
7.36
7.35
7.33
7.33
7.26
4.01
3.01
0.00
OMe
N
Me
2h'
CDCl3, 400 MHz
1.05
0.97
1.06
0.93
1.05
1.02
3.00
2.91
f1 (ppm)

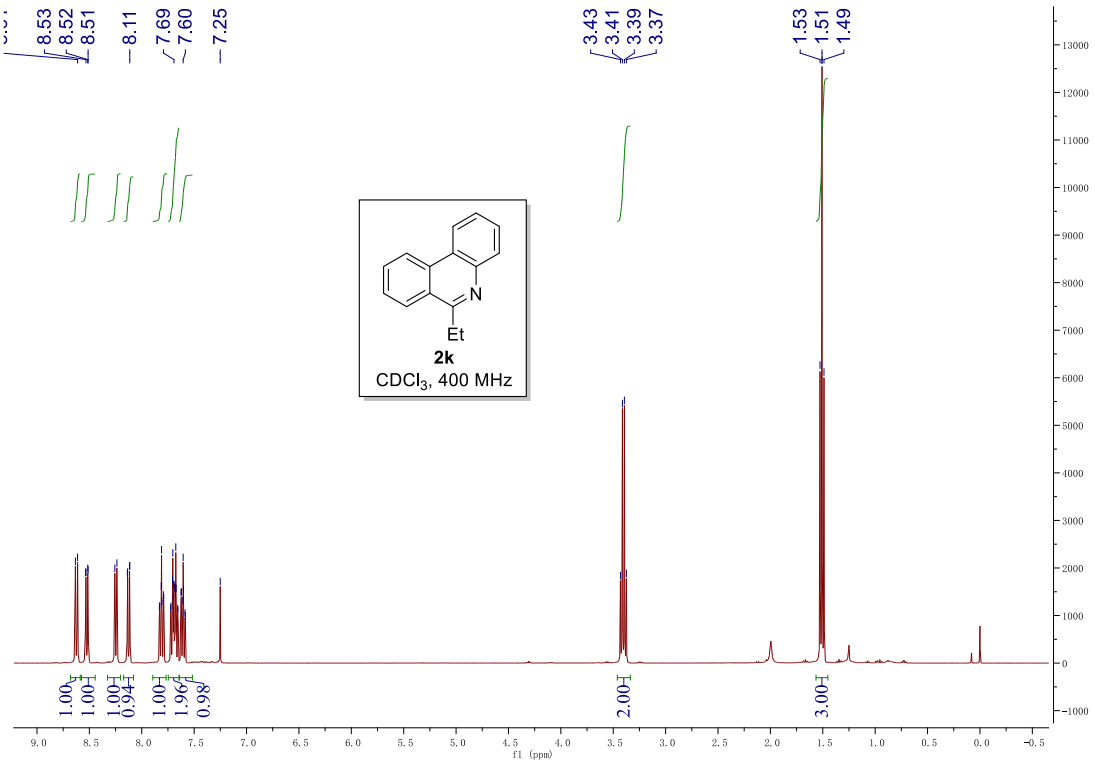

157.97
156.25
130.70
130.13
127.40
126.60
126.06
124.76
122.36
118.29
103.12
77.35
77.03
76.71
55.66
23.14
OMe
N
Me
2h'
CDCl3, 101 MHz
f1 (ppm)

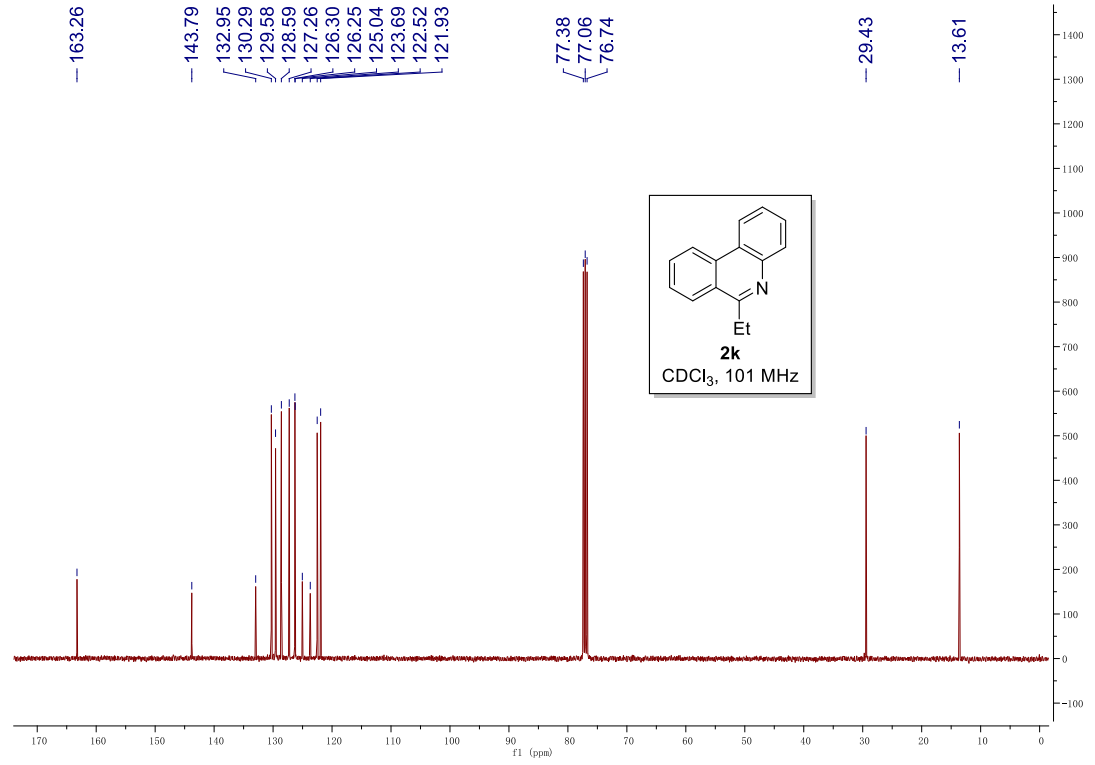

8.17
8.16
8.15
8.14
8.13
8.13
8.09
8.07
7.72
7.70
7.70
7.61
7.59
7.58
7.40
7.39
7.38
7.37
7.36
7.35
7.26
2.99
-0.00
F
N
Me
2i
CDCl3, 400 MHz
1.00
2.01
0.93
0.97
0.98
0.97
3.00
f1 (ppm)

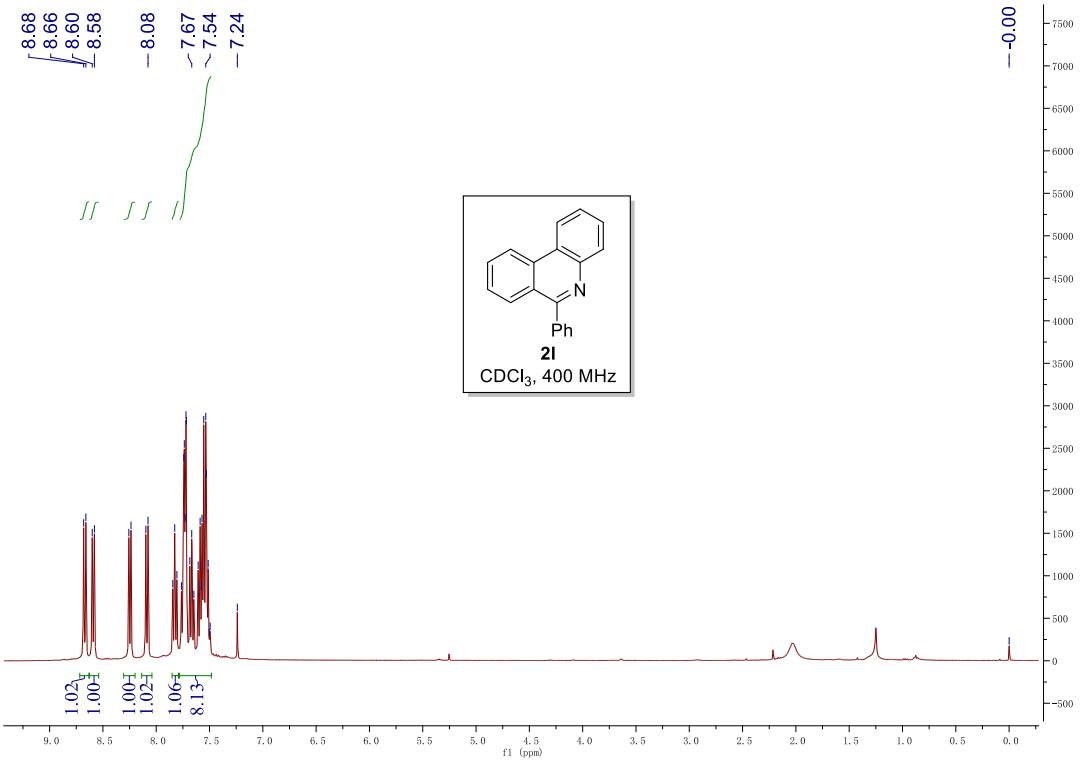

165.00
162.50
158.17
144.00
135.03
134.94
129.43
123.33
122.13
116.36
116.13
107.55
107.34
77.37
77.05
76.73
23.42
F
N
Me
2i
CDCl3, 101 MHz
f1 (ppm)

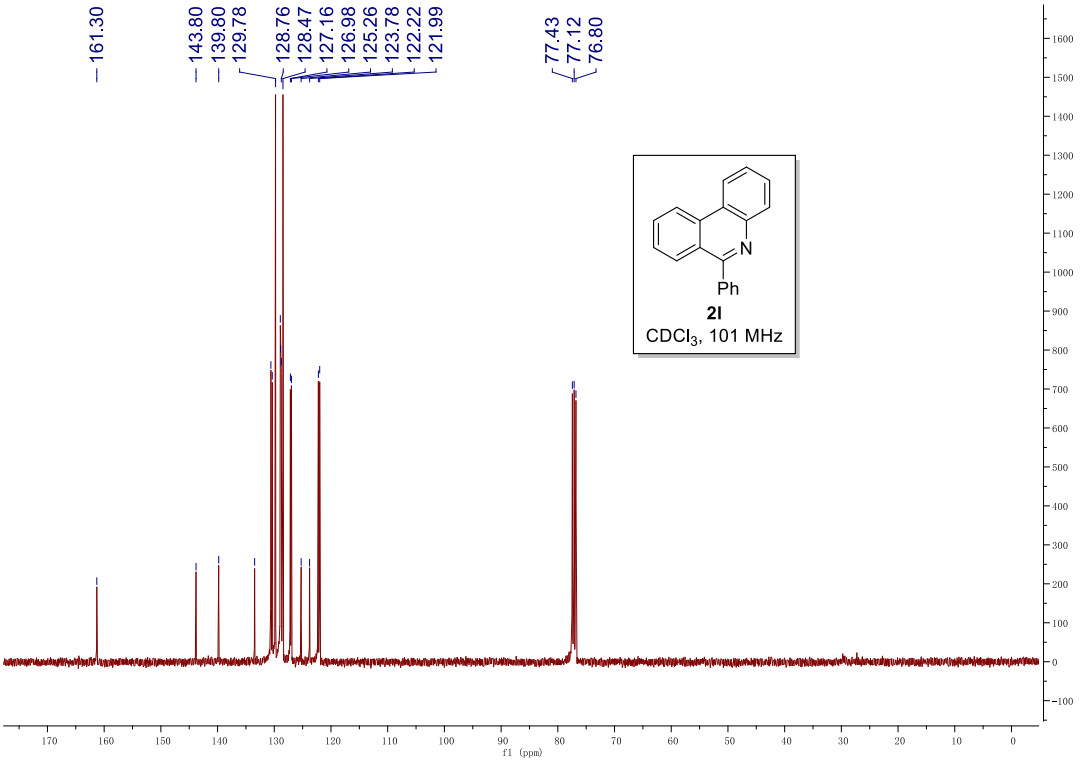

8.4319
8.4116
8.1140
8.0915
8.0767
8.0742
8.0562
8.0538
7.8914
7.8853
7.7082
7.7048
7.6906
7.6875
7.6846
7.6702
7.6668
7.5920
7.5889
7.5715
7.5688
7.5540
7.5509
7.2686
7.2623
7.2591
7.2461
7.2399
4.0180
2.9797
0.97
0.97
0.73
0.97
0.90
0.86
0.90
3.00
2.94
MeO
N
Me
2j
CDCl3,400 MHz
f1 (ppm)

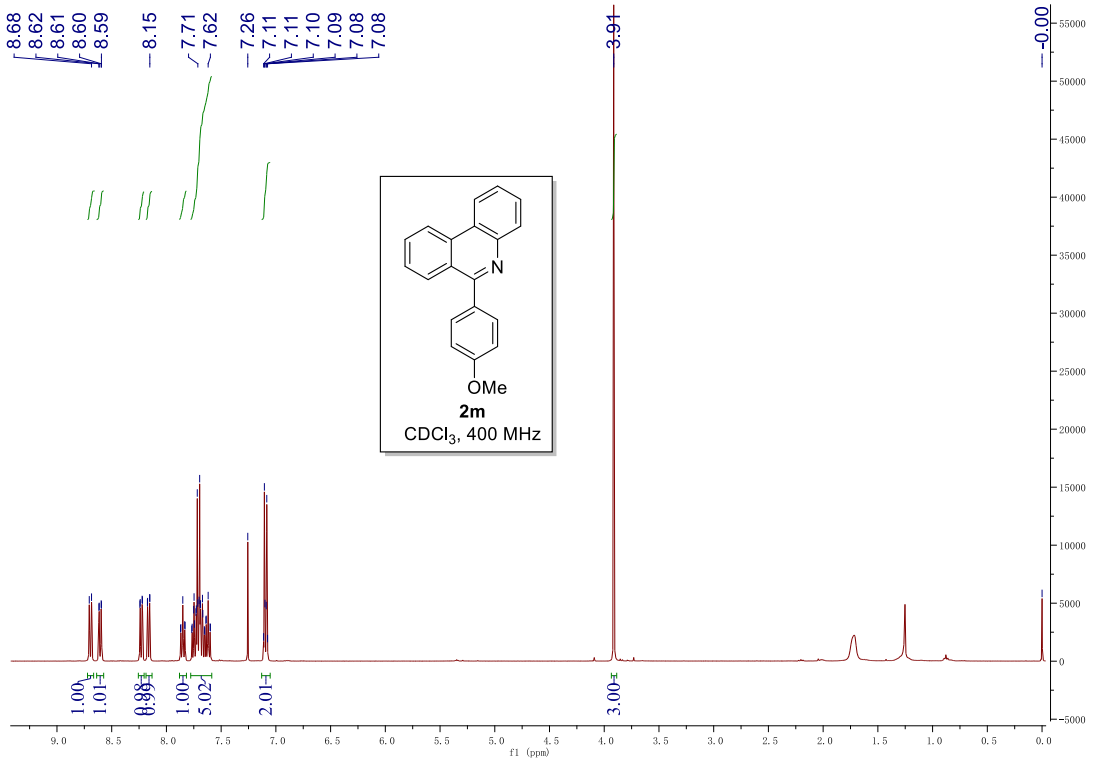

161.1755
158.3149
144.1611
134.6825
129.3336
128.7381
128.4511
125.8373
123.6742
121.9730
120.8663
117.3003
102.9820
55.5371
23.3348
MeO
N
Me
2j
CDCl3,101MHz
f1 (ppm)

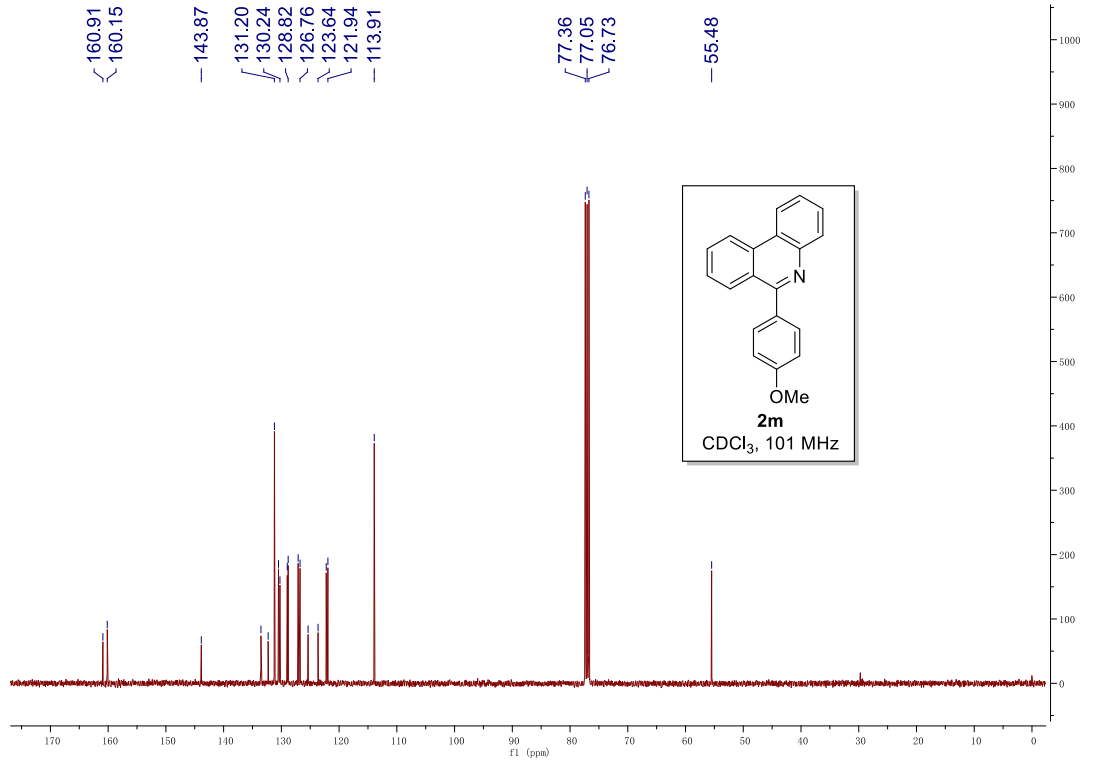

8.53
8.52
8.51
8.11
7.69
7.60
7.25
3.43
3.41
3.39
3.37
1.53
1.51
1.49
N
Et
2k
CDCl3, 400 MHz
1.00
1.00
1.00
0.94
1.00
1.96
0.98
2.00
3.00
f1 (ppm)

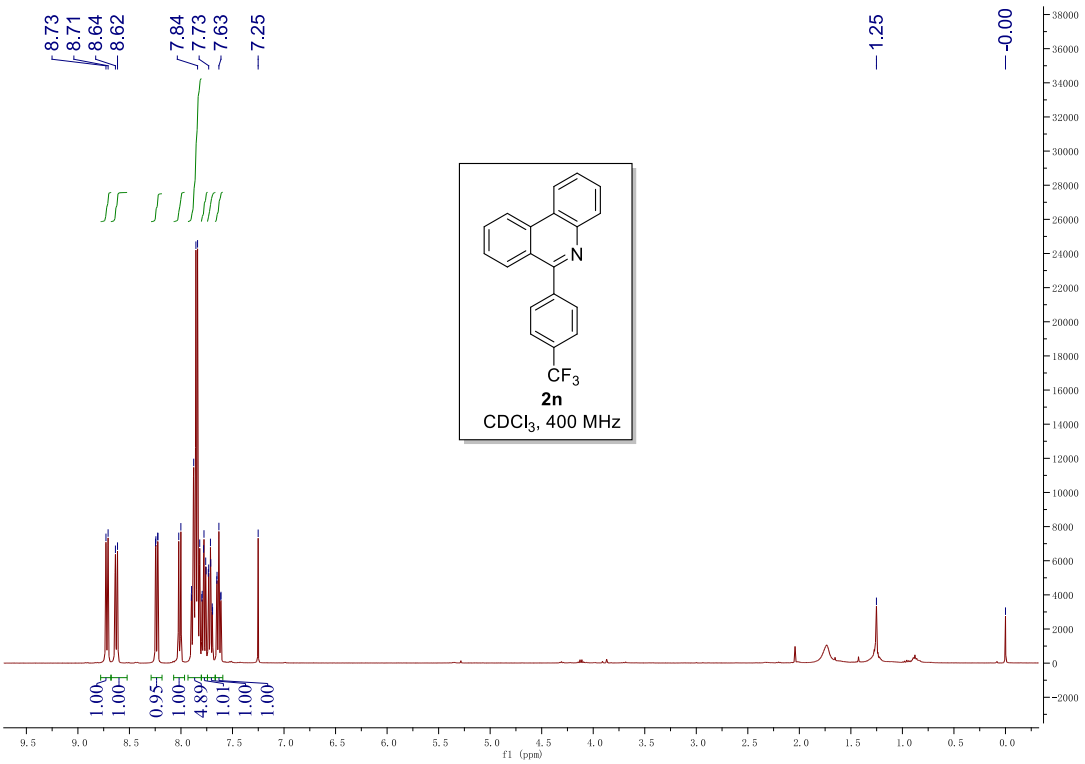

163.26
143.79
132.95
130.29
129.58
128.59
127.26
126.30
126.25
125.04
123.69
122.52
121.93
77.38
77.06
76.74
29.43
13.61
N
Et
2k
CDCl3, 101 MHz
f1 (ppm)

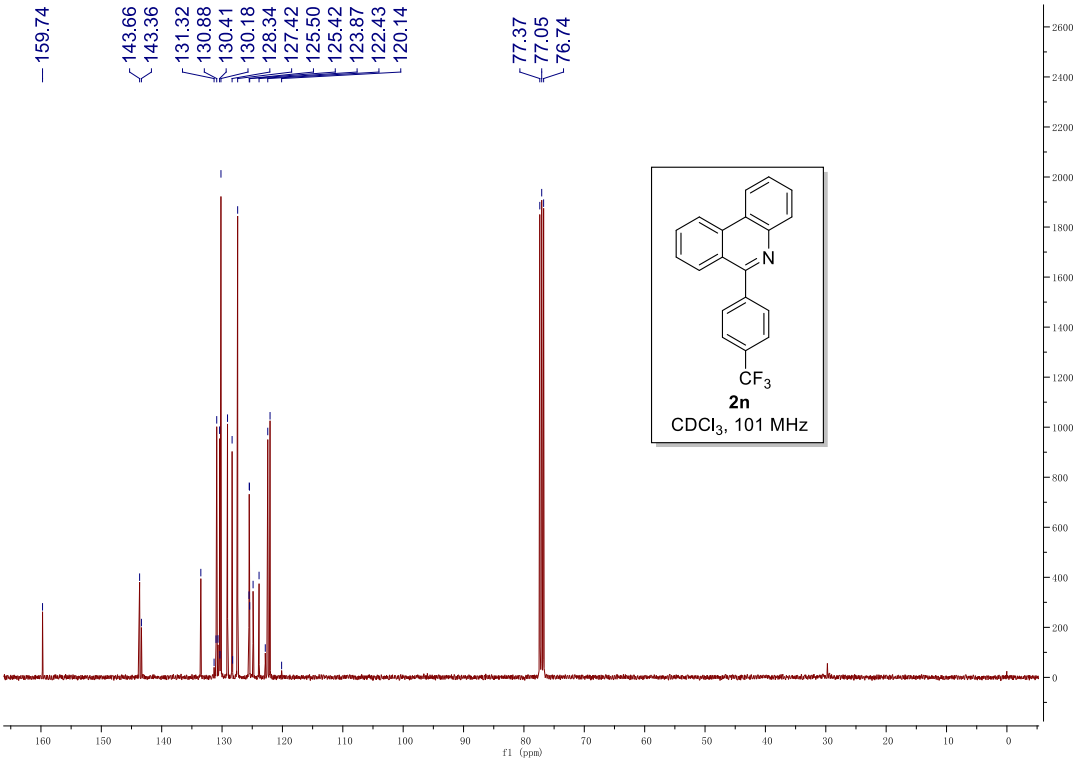

8.68
8.66
8.60
8.58
8.08
7.67
7.54
7.24
-0.00
N
Ph
2l
CDCl3, 400 MHz
1.02
1.00
1.00
1.02
1.06
8.13
f1 (ppm)

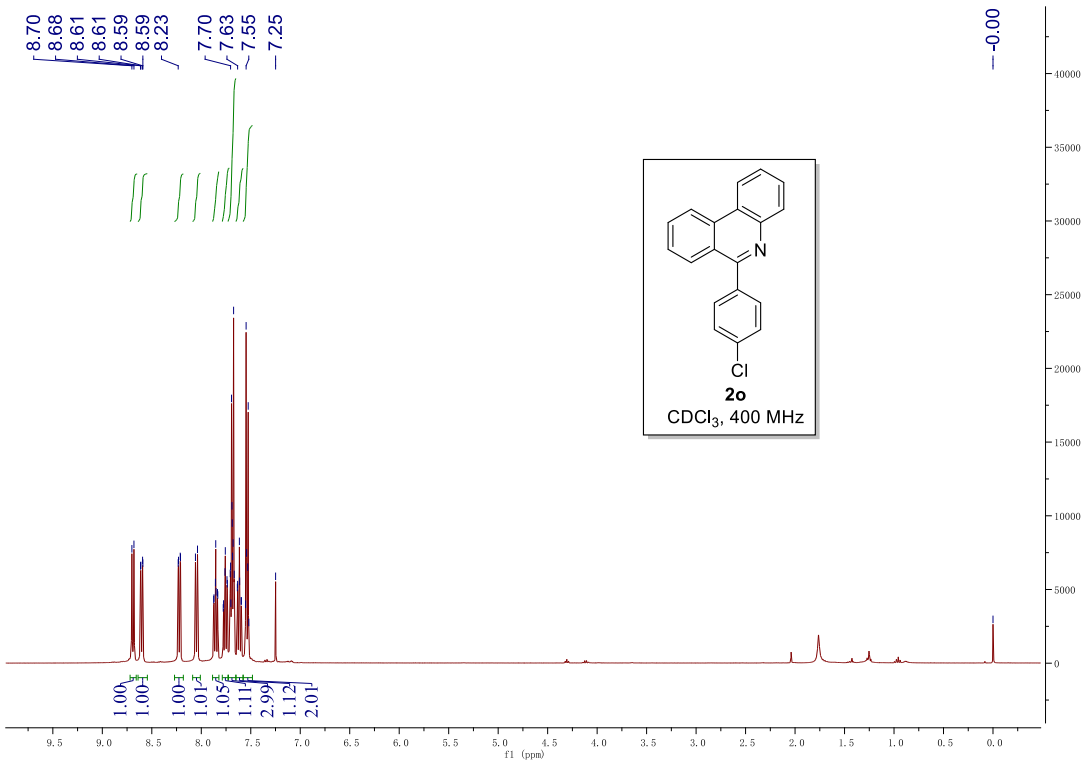

161.30
143.80
139.80
129.78
128.76
128.47
127.16
126.98
125.26
123.78
122.22
121.99
77.43
77.12
76.80
N
Ph
2l
CDCl3, 101 MHz
f1 (ppm)

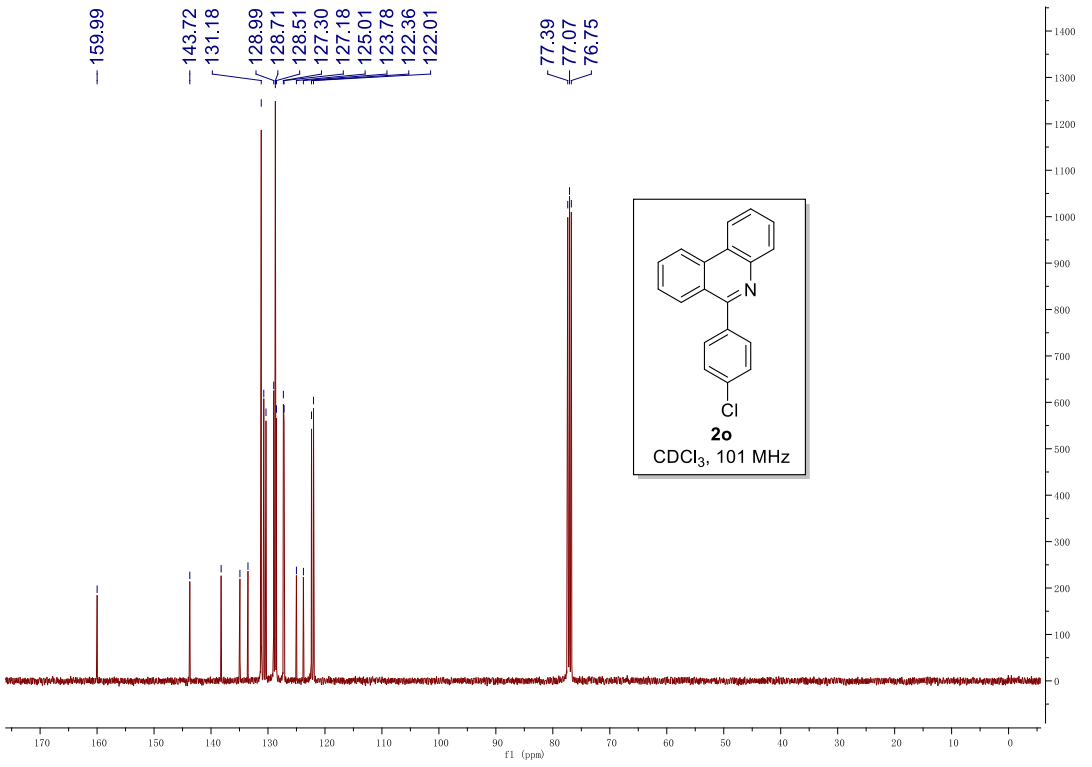

8.68
8.62
8.61
8.60
8.59
8.15
7.71
7.62
7.26
7.11
7.11
7.10
7.09
7.08
7.08
3.91
-0.00
OMe
2m
CDCl3, 400 MHz
1.00
1.01
0.98
0.98
1.00
5.02
2.01
3.00
f1 (ppm)

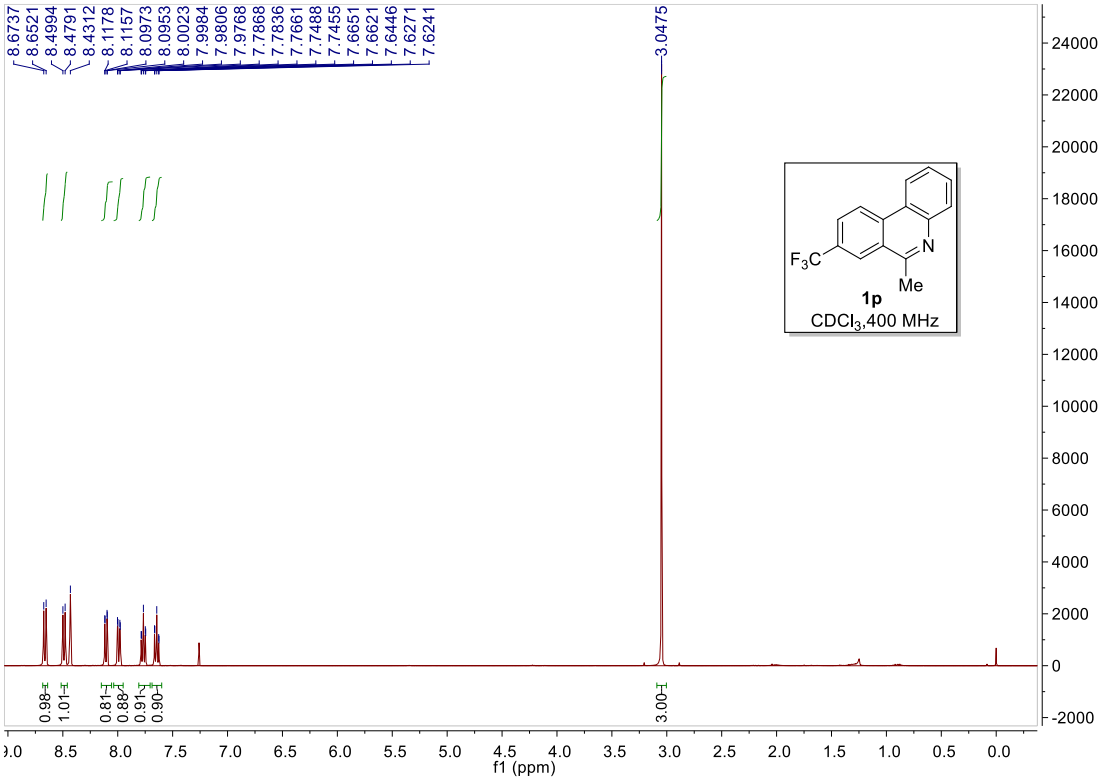

160.91
160.15
143.87
131.20
130.24
128.82
126.76
123.64
121.94
113.91
77.36
77.05
76.73
55.48
OMe
2m
CDCl3, 101 MHz
f1 (ppm)

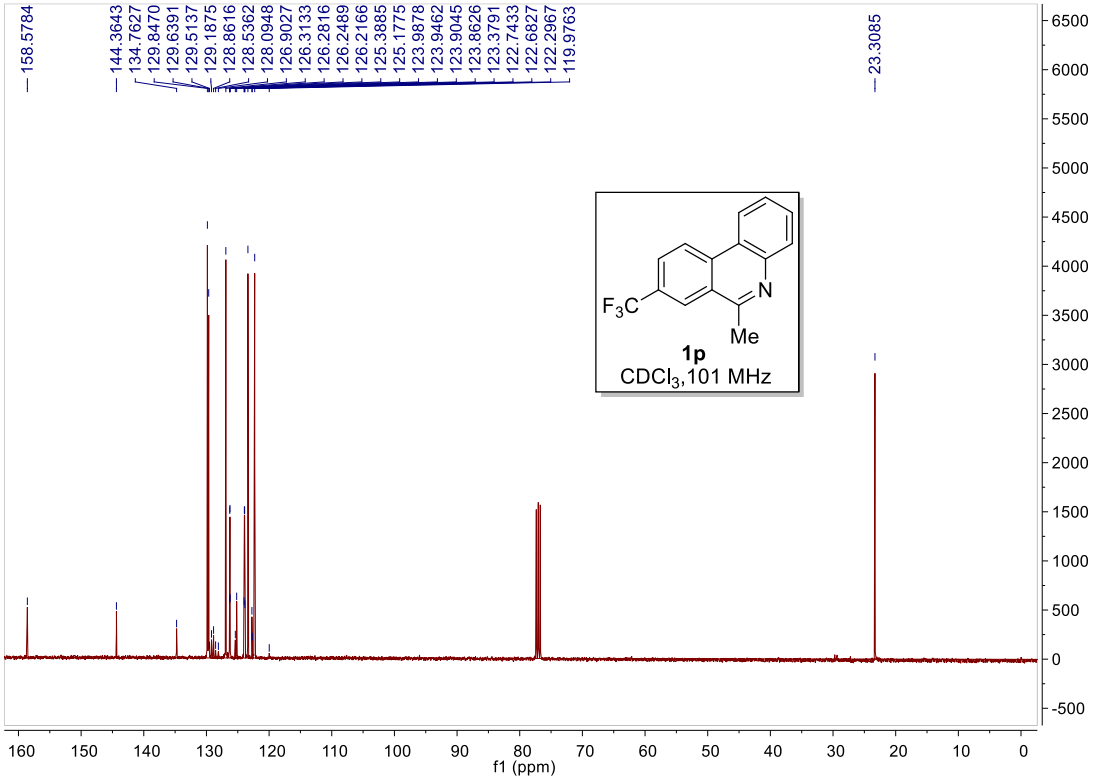

8.73
8.71
8.64
8.62
7.84
7.73
7.63
7.25
1.25
-0.00
1.00
1.00
0.95
1.00
4.89
1.01
1.00
1.00
N
CF3
2n
CDCl3, 400 MHz
f1 (ppm)

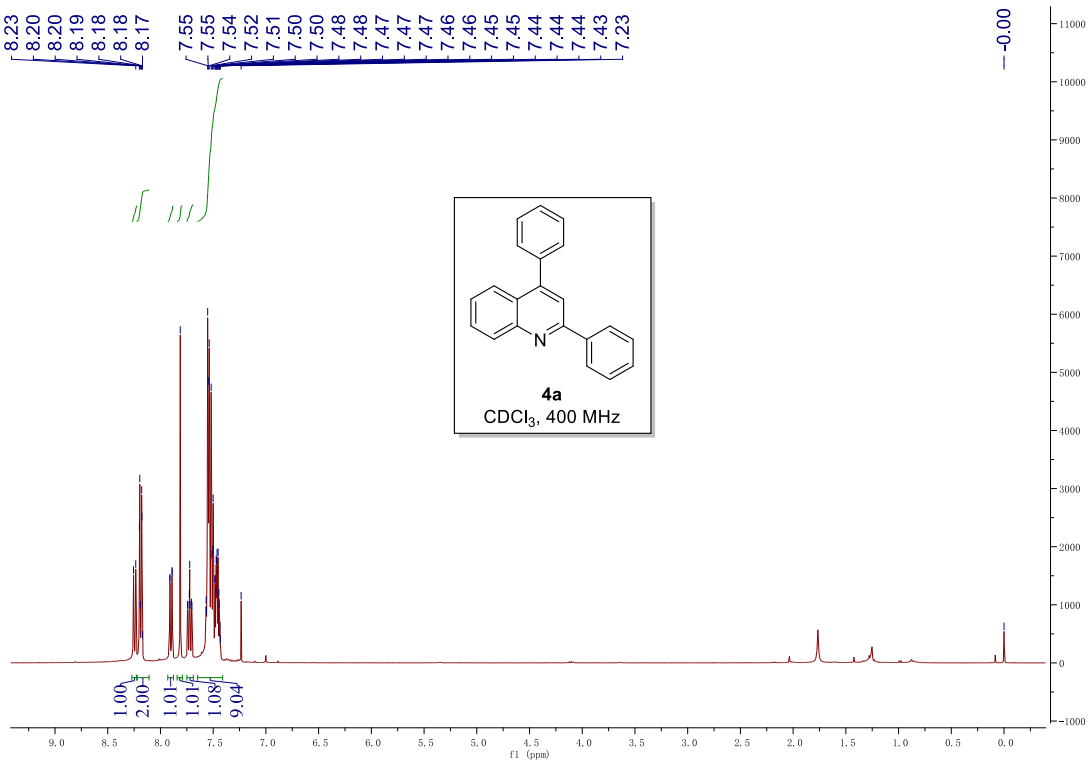

159.74
143.66
143.36
131.32
130.88
130.41
130.18
128.34
127.42
125.50
125.42
123.87
122.43
120.14
77.37
77.05
76.74
N
CF3
2n
CDCl3, 101 MHz
f1 (ppm)

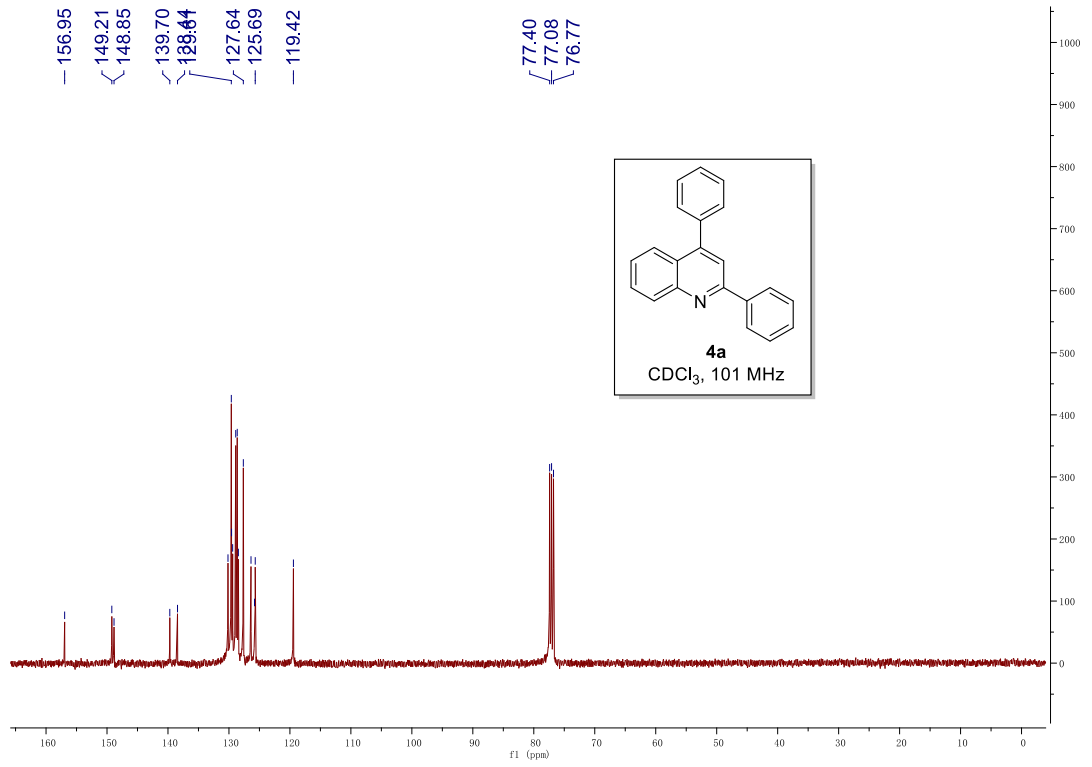

8.70
8.68
8.61
8.61
8.59
8.59
8.23
7.70
7.63
7.55
7.25
-0.00
1.00
1.00
1.00
1.01
1.05
1.11
2.99
1.12
2.01
Cl
2o
CDCl3, 400 MHz
f1 (ppm)

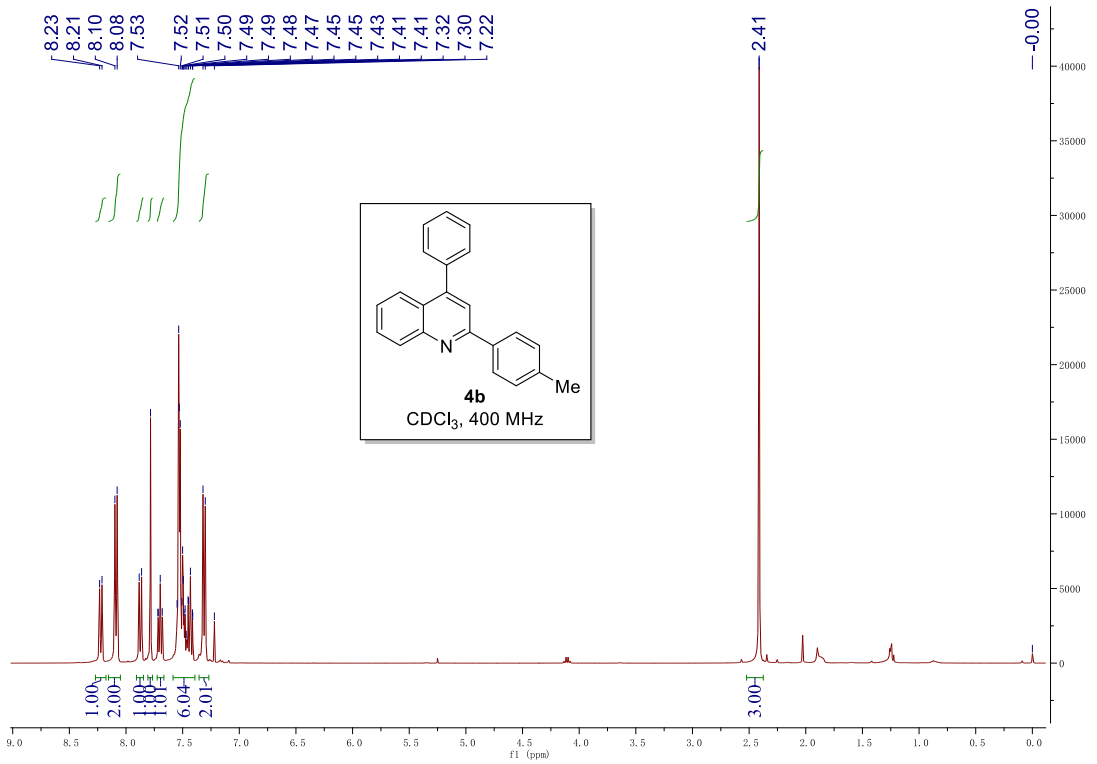

159.99
143.72
131.18
128.99
128.71
128.51
127.30
127.18
125.01
123.78
122.36
122.01
77.39
77.07
76.75
Cl
2o
CDCl3, 101 MHz
f1 (ppm)

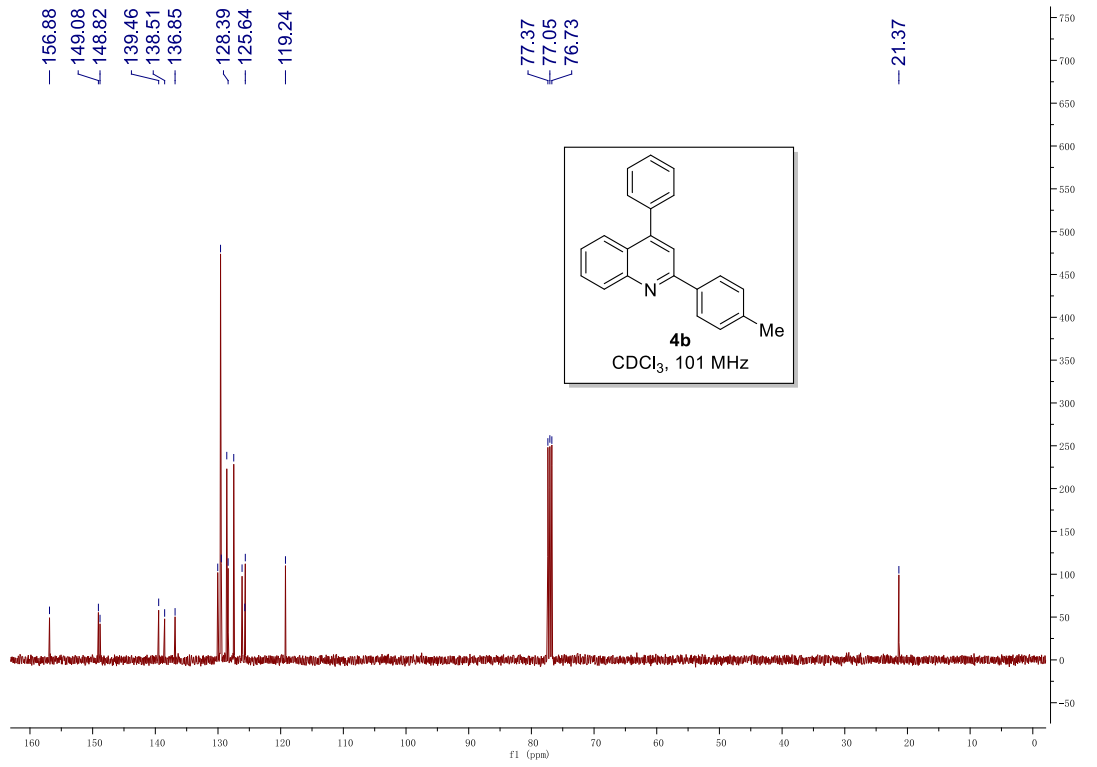

8.6737
8.6521
8.4994
8.4791
8.4312
8.1178
8.1157
8.0973
8.0953
8.0023
7.9984
7.9806
7.9768
7.7868
7.7836
7.7661
7.7488
7.7455
7.6651
7.6621
7.6446
7.6271
7.6241
3.0475
0.98
1.01
0.81
0.88
0.91
0.90
3.00
F3C
N
Me
1p
CDCl3,400 MHz
f1 (ppm)

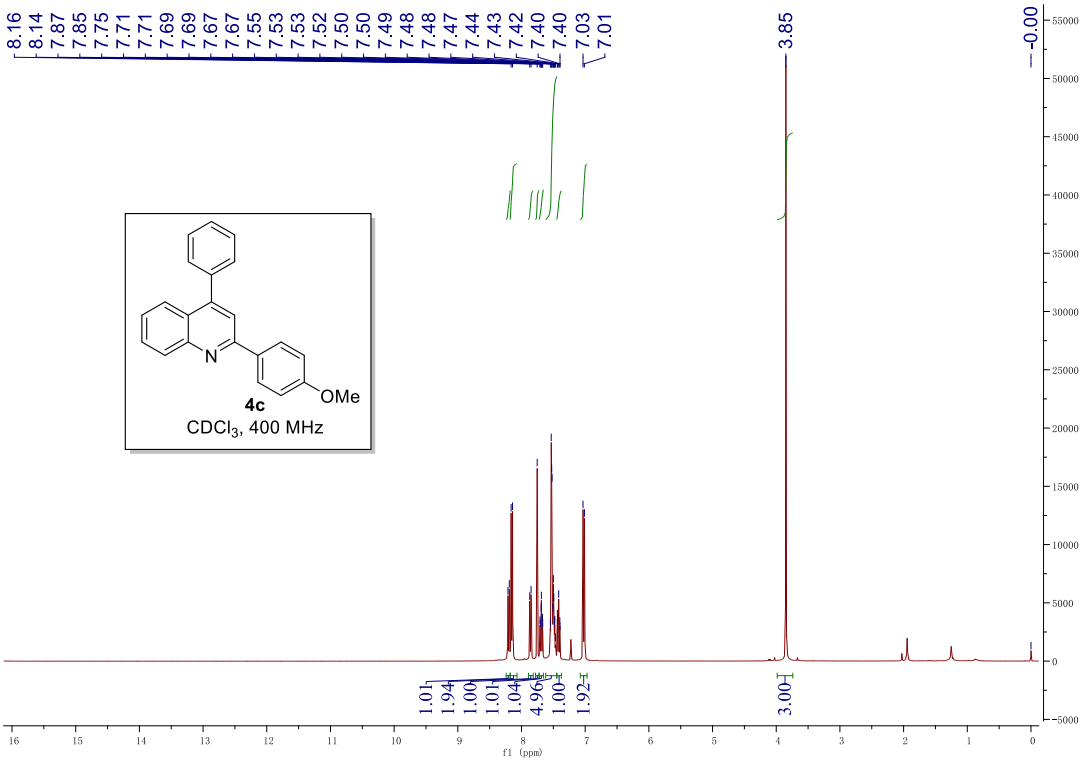

158.5784
144.3643
134.7627
129.8470
129.6391
129.5137
129.1875
128.8616
128.5362
128.0948
126.9027
126.3133
126.2816
126.2489
126.2166
125.3885
125.1775
123.9878
123.9462
123.9045
123.8626
123.3791
122.7433
122.6827
122.2967
119.9763
23.3085
F3C
N
Me
1p
CDCl3,101 MHz
f1 (ppm)

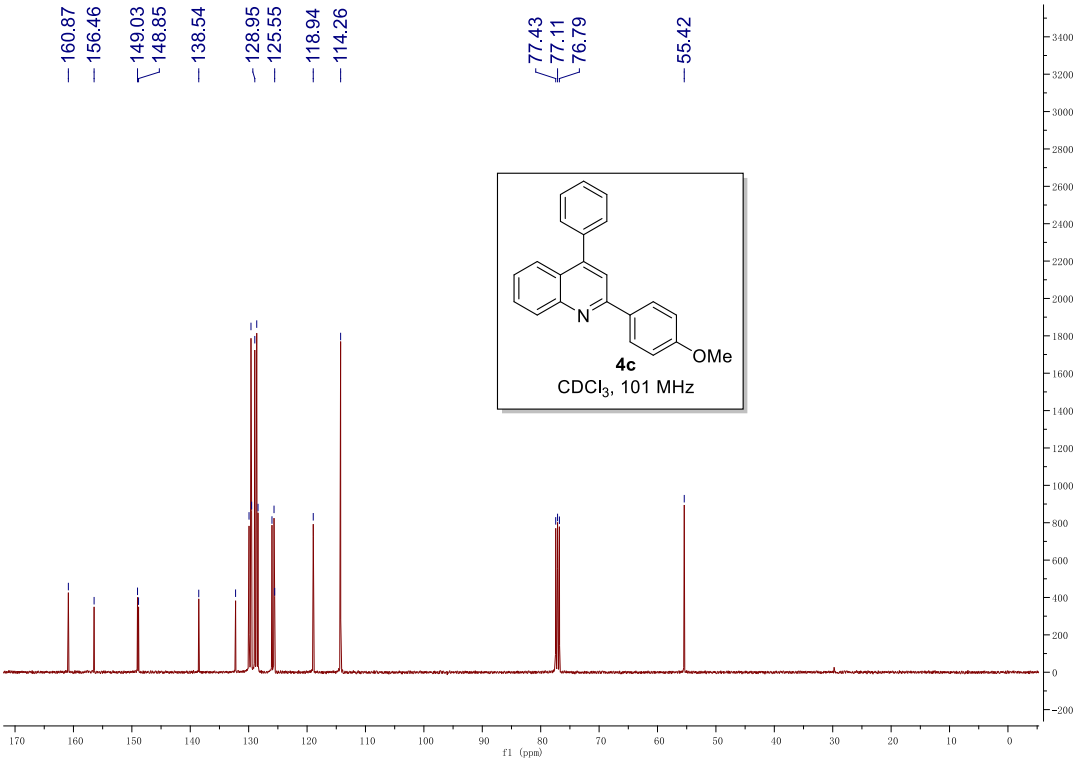

8.23
8.20
8.20
8.19
8.18
8.18
8.17
7.55
7.55
7.54
7.52
7.51
7.50
7.50
7.48
7.48
7.47
7.47
7.47
7.46
7.46
7.45
7.45
7.44
7.44
7.44
7.43
7.23
-0.00
1.00
2.00
1.01
1.01
1.08
9.04
f1 (ppm)
4a
CDCl3, 400 MHz

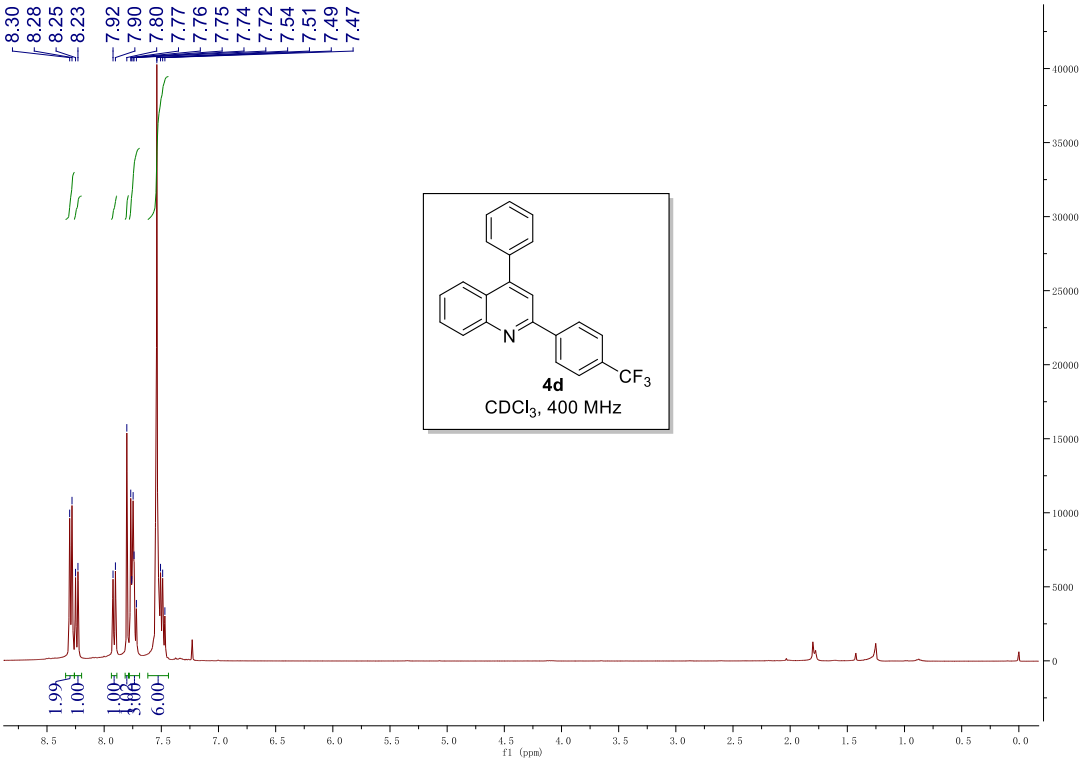

156.95
149.21
148.85
139.70
128.64
127.64
125.69
119.42
77.40
77.08
76.77
f1 (ppm)
4a
CDCl3, 101 MHz

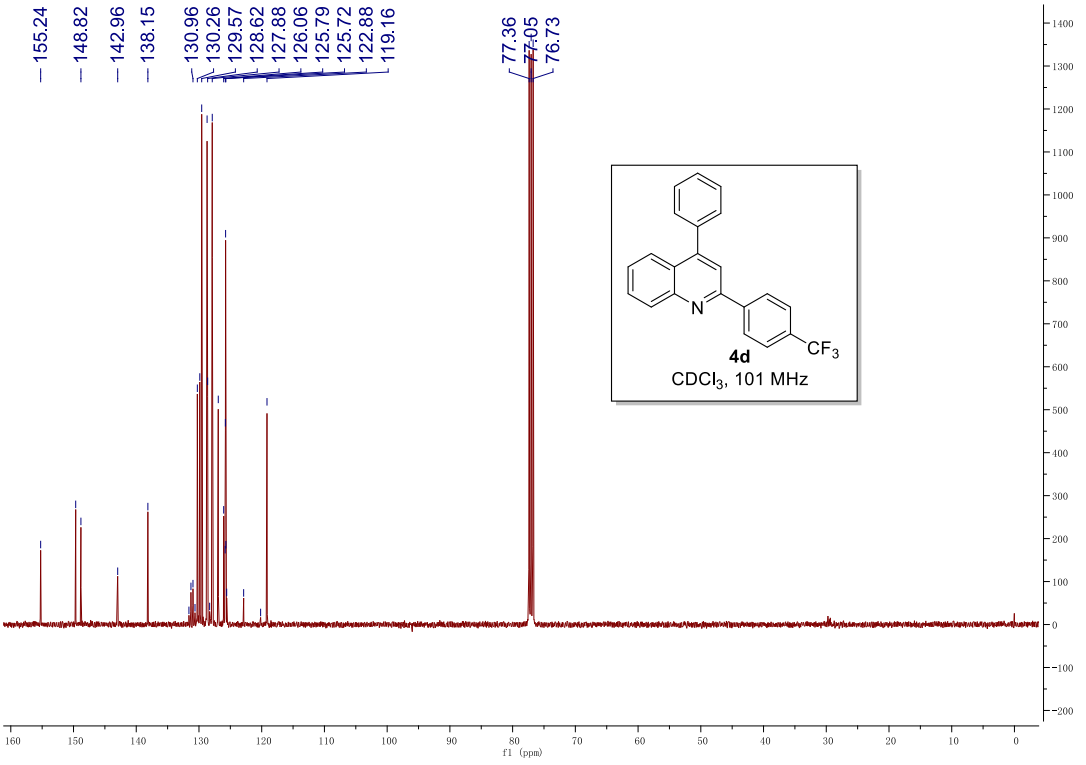

8.23
8.21
8.10
8.08
7.53
7.52
7.51
7.50
7.49
7.49
7.48
7.47
7.45
7.45
7.43
7.41
7.41
7.32
7.30
7.22
2.41
-0.00
1.00
2.00
1.00
1.00
1.01
6.04
2.01
3.00
N
Me
4b
CDCl3, 400 MHz
f1 (ppm)

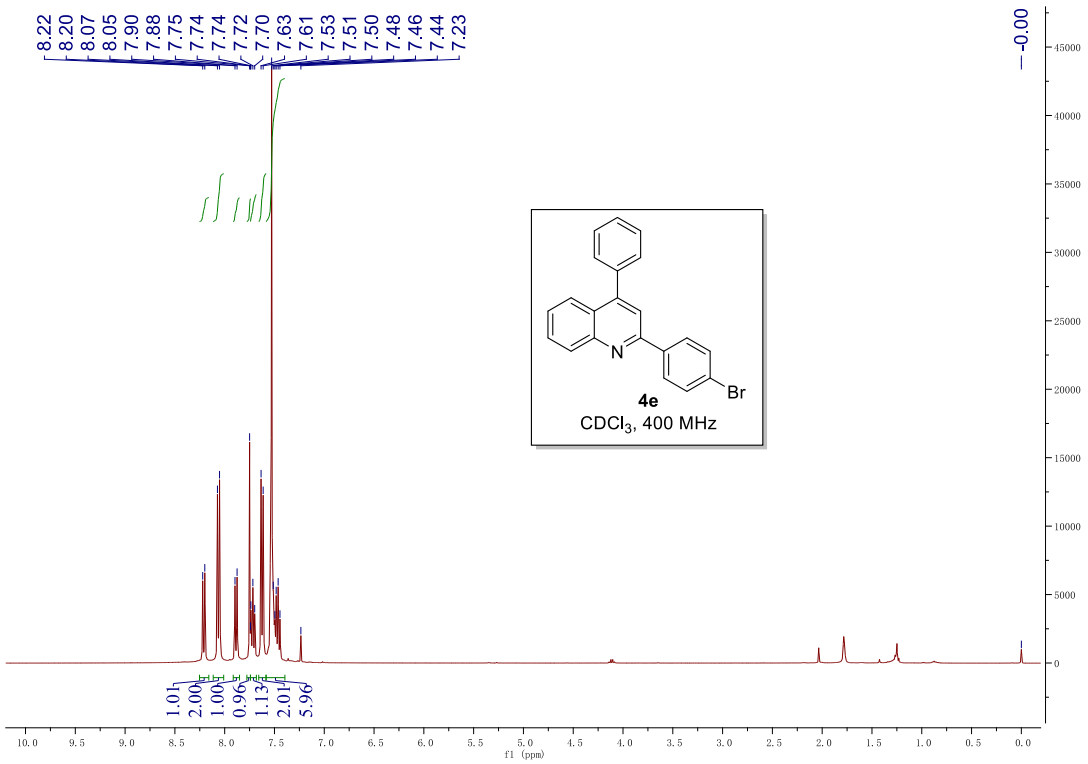

156.88
149.08
148.82
139.46
138.51
136.85
128.39
125.64
119.24
77.37
77.05
76.73
21.37
N
Me
4b
CDCl3, 101 MHz
f1 (ppm)

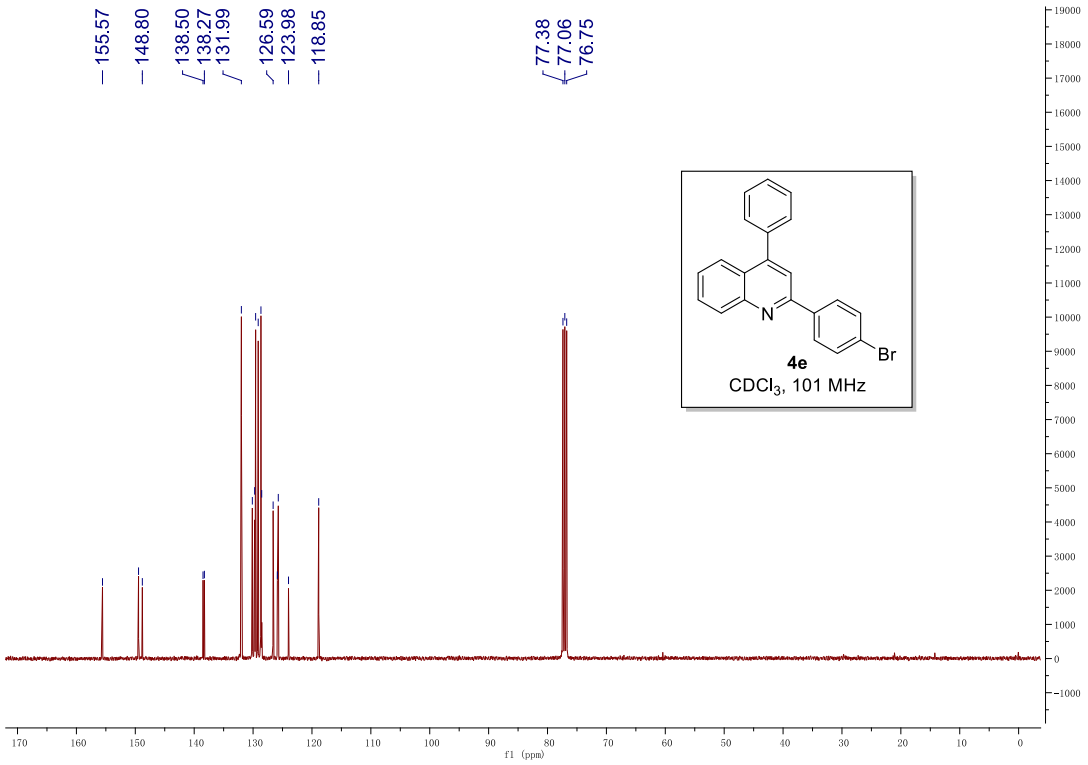

8.16
8.14
7.87
7.85
7.75
7.71
7.71
7.69
7.69
7.67
7.67
7.55
7.53
7.53
7.52
7.50
7.50
7.49
7.48
7.48
7.47
7.44
7.43
7.42
7.40
7.40
7.03
7.01
3.85
-0.00
1.01
1.94
1.00
1.01
1.04
4.96
1.00
1.92
3.00
f1 (ppm)
4c
CDCl3, 400 MHz
N
OMe

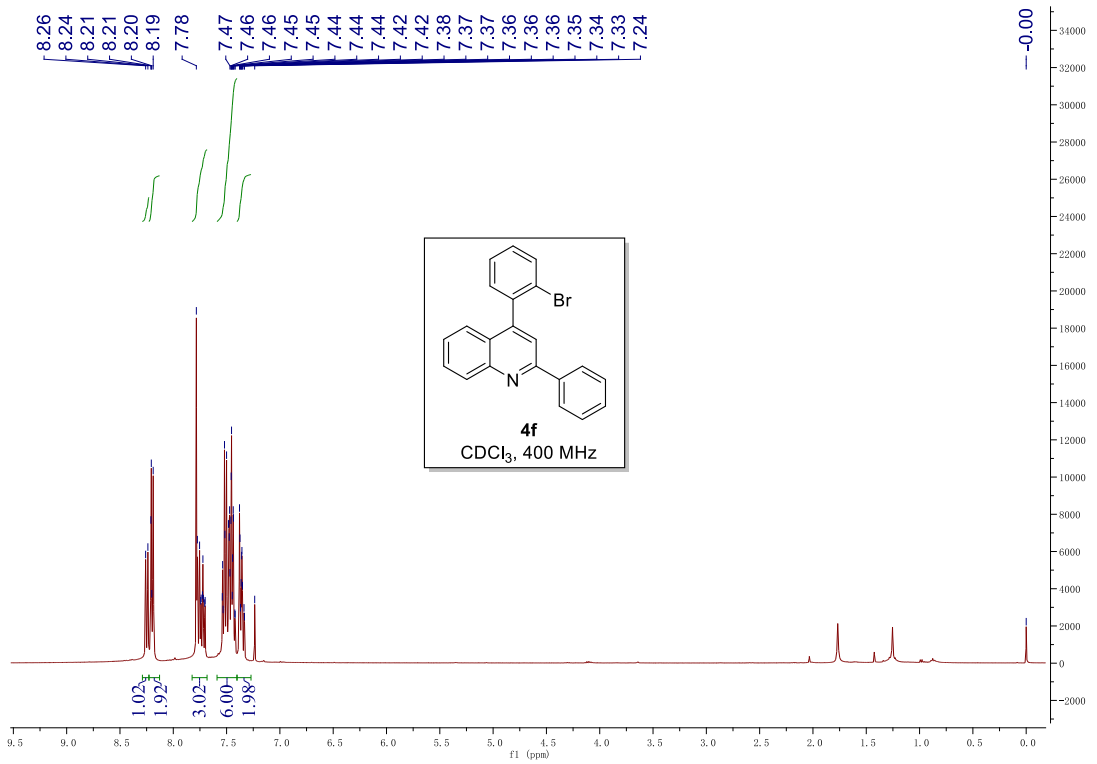

160.87
156.46
149.03
148.85
138.54
128.95
125.55
118.94
114.26
77.43
77.11
76.79
55.42
f1 (ppm)
4c
CDCl3, 101 MHz
N
OMe

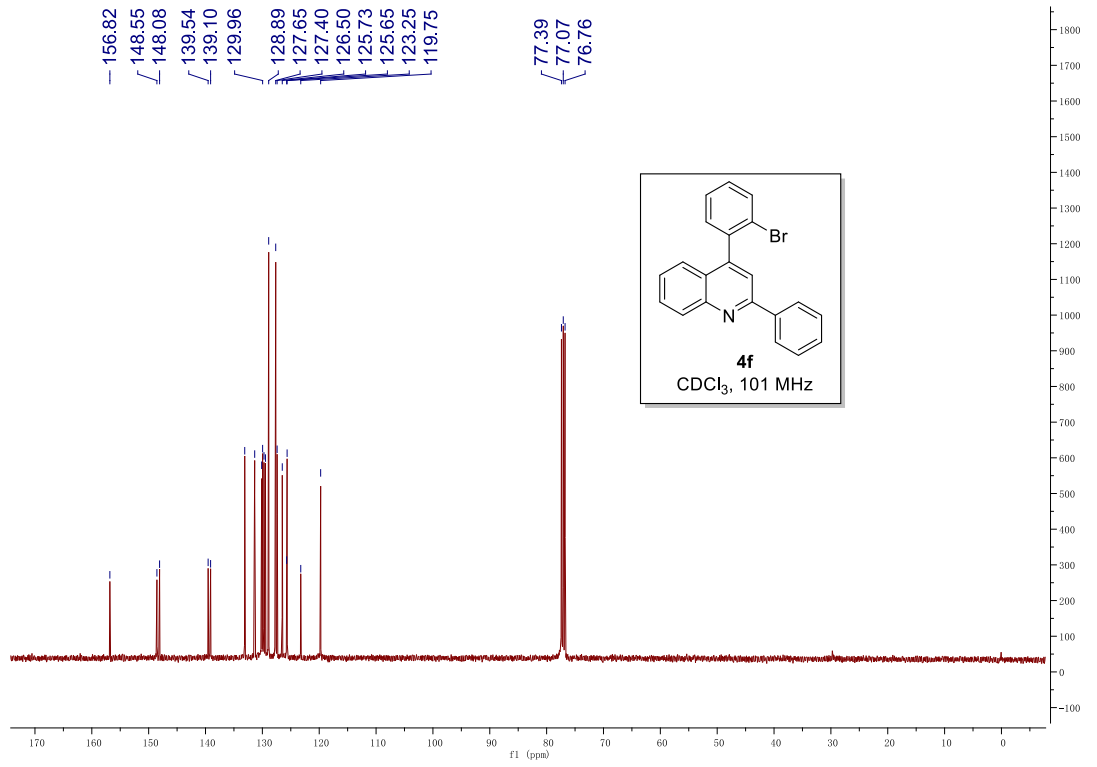

8.30
8.28
8.25
8.23
7.92
7.90
7.80
7.77
7.76
7.75
7.74
7.72
7.54
7.51
7.49
7.47
1.99
1.00
1.00
3.06
6.00
4d
CDCl3, 400 MHz
f1 (ppm)

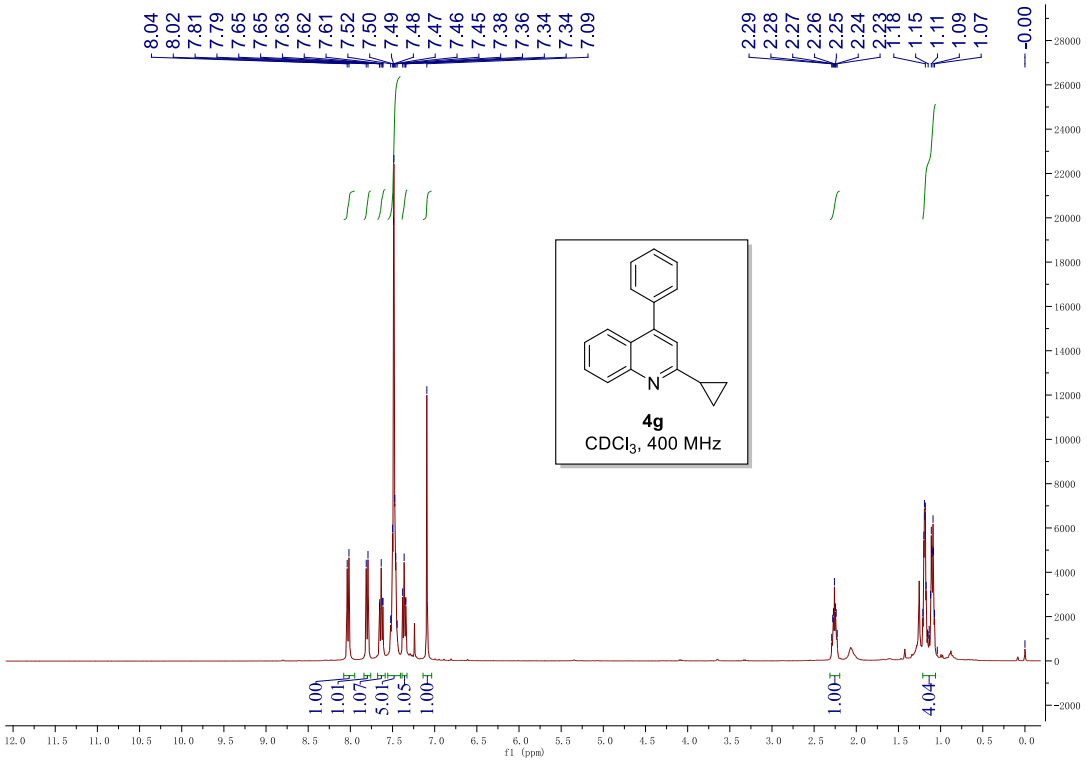

155.24
148.82
142.96
138.15
130.96
130.26
129.57
128.62
127.88
126.06
125.79
125.72
122.88
119.16
77.36
77.05
76.73
4d
CDCl3, 101 MHz
f1 (ppm)

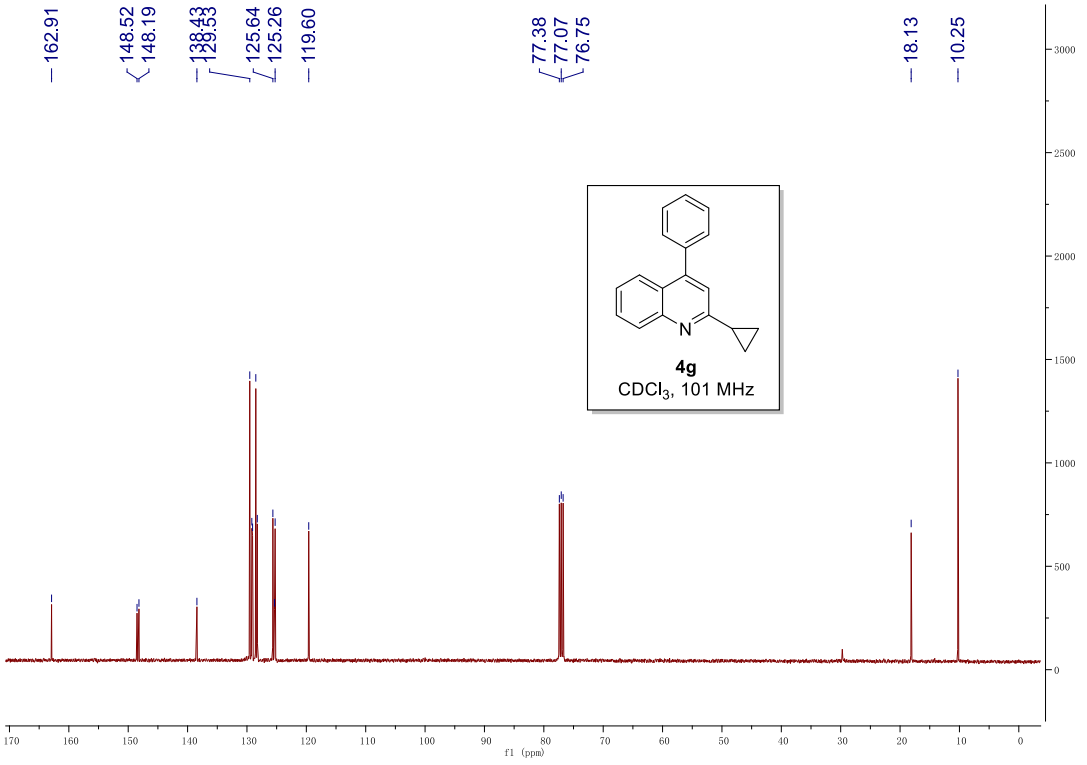

8.22
8.20
8.07
8.05
7.90
7.88
7.75
7.74
7.74
7.72
7.70
7.63
7.61
7.53
7.51
7.50
7.48
7.46
7.44
7.23
-0.00
1.01
2.00
1.00
0.96
1.13
2.01
5.96
4e
CDCl3, 400 MHz
Br
N
f1 (ppm)

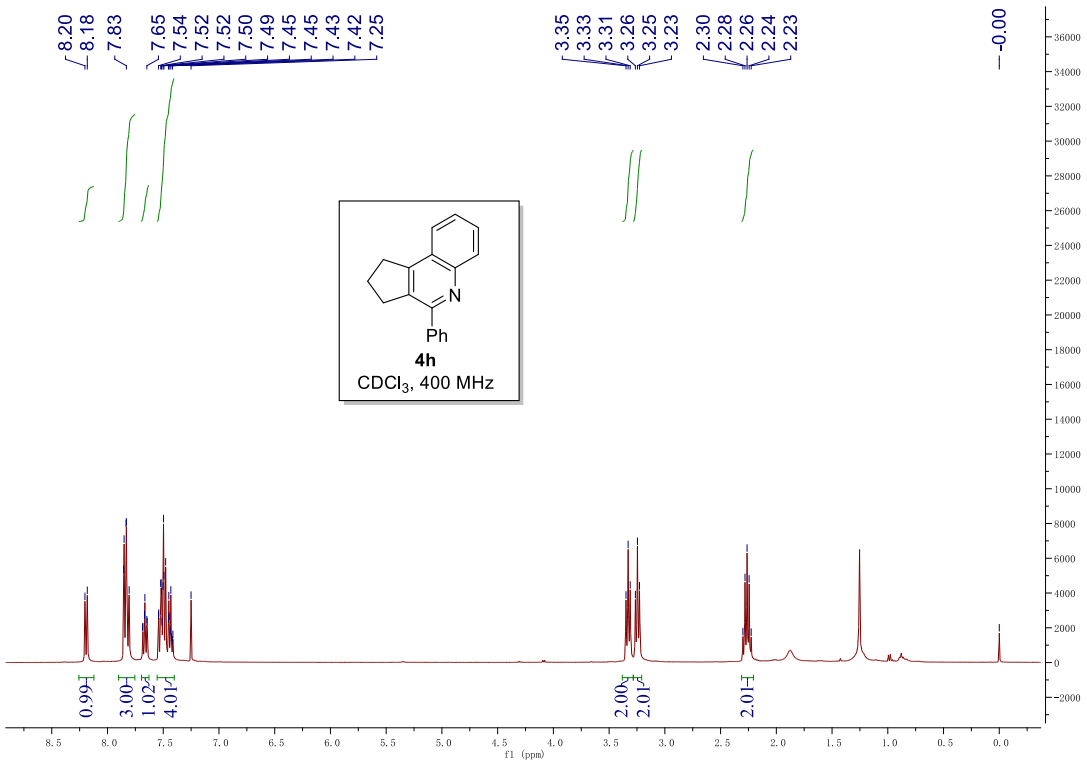

155.57
148.80
138.50
138.27
131.99
126.59
123.98
118.85
77.38
77.06
76.75
4e
CDCl3, 101 MHz
Br
N
f1 (ppm)

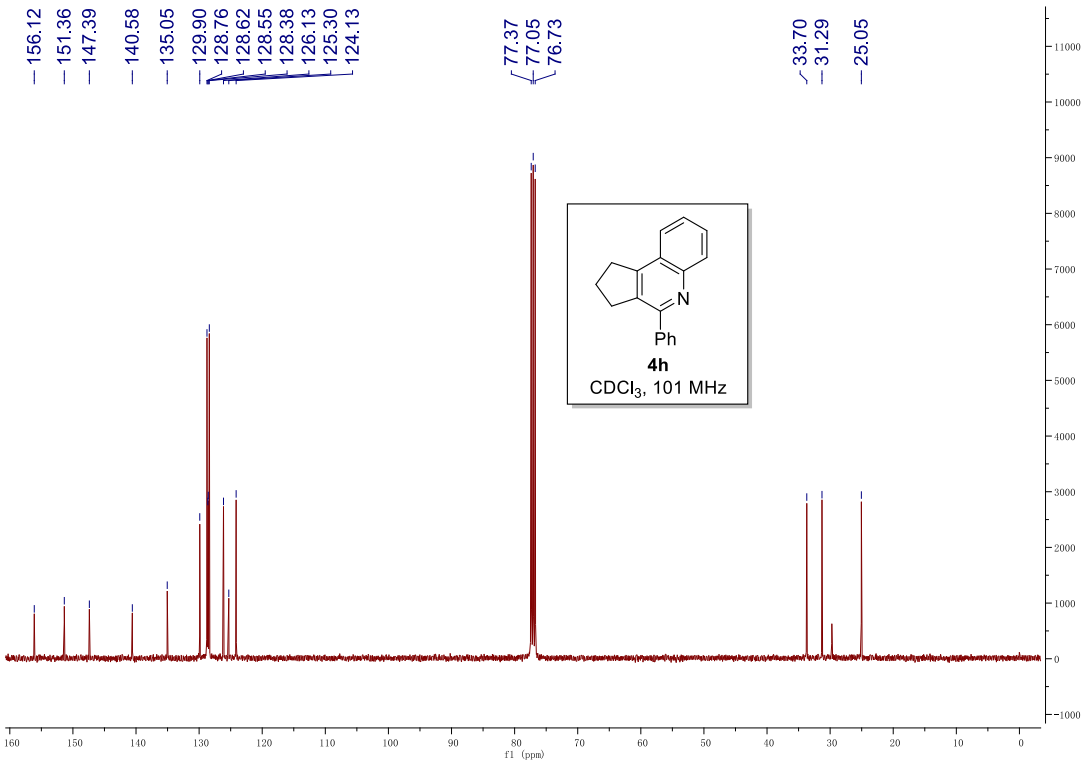

8.26
8.24
8.21
8.21
8.20
8.19
7.78
7.47
7.46
7.46
7.45
7.45
7.44
7.44
7.44
7.42
7.42
7.38
7.37
7.37
7.36
7.36
7.36
7.35
7.34
7.33
7.24
-0.00
Br
N
4f
CDCl3, 400 MHz
1.02
1.92
3.02
6.00
1.98
f1 (ppm)


156.82
148.55
148.08
139.54
139.10
129.96
128.89
127.65
127.40
126.50
125.73
125.65
123.25
119.75
77.39
77.07
76.76
Br
N
4f
CDCl3, 101 MHz
f1 (ppm)


8.04
8.02
7.81
7.79
7.65
7.63
7.62
7.61
7.52
7.50
7.49
7.48
7.47
7.46
7.45
7.38
7.36
7.34
7.09
2.29
2.28
2.27
2.26
2.25
2.24
1.15
1.11
1.09
1.07
-0.00
1.00
1.01
1.07
5.01
1.05
1.00
1.00
4.04
4g
CDCl3, 400 MHz
f1 (ppm)


162.91
148.52
148.19
138.43
129.53
125.64
125.26
119.60
77.38
77.07
76.75
18.13
10.25
4g
CDCl3, 101 MHz
f1 (ppm)


8.20
8.18
7.83
7.65
7.54
7.52
7.52
7.50
7.49
7.45
7.45
7.43
7.42
7.25
3.35
3.33
3.31
3.26
3.25
3.23
2.30
2.28
2.26
2.24
2.23
-0.00
N
Ph
4h
CDCl3, 400 MHz
0.99
3.00
1.02
4.01
2.00
2.01
2.01
f1 (ppm)


156.12
151.36
147.39
140.58
135.05
129.90
128.76
128.62
128.55
128.38
126.13
125.30
124.13
77.37
77.05
76.73
33.70
31.29
25.05
N
Ph
4h
CDCl3, 101 MHz
f1 (ppm)