

Supplementary Information

Construction of Benzoheterocycles by the Reaction of α - Arylglyoxylic Acids And *Ortho*-Functionalized Aniline under Mild and Minimal Conditions

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Table of Contents

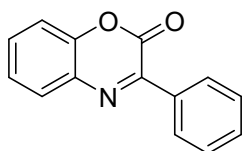
1. General information	S1
2. Characterization data for products	S1
3. References.....	S6
4. Copies of ¹ H and ¹³ C spectra.....	S7

1. General information

Column chromatography was performed using silica gel (200-300 mesh) or thin layer chromatography was performed using silica gel (GF254). IR spectra were recorded on a new Fourier transform infrared spectroscopy. ^1H and ^{13}C NMR spectra were recorded on 400, 100 MHz NMR spectrometer using CDCl_3 as solvent unless otherwise stated. HRMS were made by means of ESI with the Thermo Scientific LTQ Orbitrap XL mass spectrometer. Unless otherwise noted, all reagents were weighed and handled in air, and all reactions were carried out in a sealed tube under an atmosphere of argon. Oil bath was used for reactions that require heating. Unless otherwise noted, reagents were purchased from commercial suppliers and used without further purification.

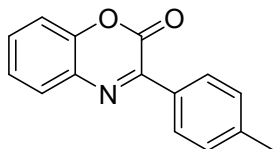
2. Characterization data for products

3-Phenyl-benzo[1,4]oxazin-2-one (3a)^[1]



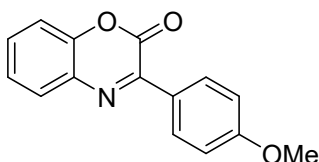
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.4; White solid; Yield 91%; M.p. = 108-109 °C; ^1H NMR (400 MHz, CDCl_3): δ 8.33 (dd, J = 8.1, 1.5 Hz, 2H), 7.83 (dd, J = 7.9, 1.4 Hz, 1H), 7.57-7.44 (m, 4H), 7.37 (td, J = 7.8, 1.2 Hz, 1H), 7.31 (dd, J = 8.2, 1.0 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ = 152.3, 150.9, 146.5, 134.1, 131.7, 131.4, 131.1, 129.4, 128.4, 125.5, 116.2.

3-p-Tolyl-benzo[1,4]oxazin-2-one (3b)^[1]



Purified by TLC (ethyl acetate/petroleum ether = 1:20, v:v), R_f = 0.7; Brown solid; Yield 87%; M.p. = 108-109 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.27-8.25 (d, J = 8.4 Hz, 2H), δ = 7.85-7.82 (dd, J = 1.6, 8.0 Hz, 1H), δ = 7.52-7.47 (dt, J = 1.6, 8.0 Hz, 1H), δ = 7.40-7.36 (dt, J = 0.8, 8.0 Hz, 1H), δ = 7.33-7.30 (m, 3H), 2.44 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ = 152.3, 150.6, 146.4, 142.0, 131.7, 131.4, 130.8, 129.4, 129.3, 129.1, 125.5, 116.1, 21.6.

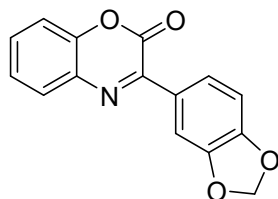
3-p-Tolyl-benzo[1,4]oxazin-2-one (3c)^[1]



Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.4; Beige solid; Yield 97%; M.p. = 162-163 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.41-8.39 (d, J = 8.8 Hz, 2H), δ = 7.82-7.80 (d, J = 8.0 Hz, 1H), δ = 7.49-7.45 (t, J = 8.0 Hz, 1H), δ = 7.39-7.35 (t, J = 8.0 Hz, 1H), δ = 7.32-7.30 (d, J = 8.4 Hz, 1H), 7.01-6.99 (d, J = 8.8 Hz, 2H), 3.89 (s, 3H); ^{13}C NMR (100 MHz,

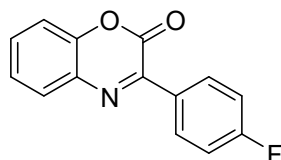
CDCl₃): δ = 162.4, 152.5, 149.9, 146.3, 131.8, 131.4, 130.4, 129.1, 126.8, 125.4, 116.1, 113.8, 55.4.

3-(Benzo[1,3]dioxol-5-yl)-benzo[1,4]oxazin-2-one (3d)



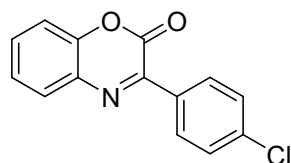
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.6; Yellow solid; Yield 52%; M.p. = 161-163 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.09 (dd, J = 2.0, 8.0 Hz, 1H), 7.89 (s, 1H), 7.80 (d, J = 7.6 Hz, 1H), 7.50-7.46 (t, J = 8.0 Hz, 1H), 7.39-7.35 (t, J = 7.6 Hz, 1H), 7.32-7.30 (d, J = 8.4 Hz, 1H), 6.92-6.90 (d, J = 8.0 Hz, 1H), 6.05 (s, 2H); ¹³C NMR (100 MHz, CDCl₃): δ = 152.3, 150.6, 149.4, 147.9, 146.3, 131.6, 130.6, 129.1, 128.3, 125.5, 125.3, 116.0, 109.3, 108.1, 101.6; IR (KBr) 2359, 2341, 1738, 1601, 1504, 1482, 1465, 1441, 1276, 1250, 1223, 1085, 1036, 761 cm⁻¹. HRMS (ESI): m/z [M+Na]⁺ calcd for C₁₅H₉NaNO₄ 290.0424, found 290.0436.

3-(4-Fluoro-phenyl)-benzo[1,4]oxazin-2-one (3e)^[1]



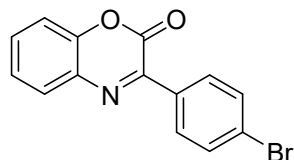
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.7; Beige solid; Yield 86%; M.p. > 180 °C; ¹H NMR (400 MHz, CDCl₃): δ = 8.43-8.39 (m, 2H), δ = 7.85-7.83 (d, J = 8.0 Hz, 1H), δ = 7.54-7.50 (dt, J = 1.6, 8.0 Hz, 1H), δ = 7.42-7.38 (t, J = 7.2 Hz, 1H), δ = 7.35-7.33 (dd, J = 1.2, 8.0 Hz, 1H), 7.20-7.16 (t, J = 8.8 Hz, 2H); ¹³C NMR (100 MHz, CDCl₃): δ = 164.8 (d, J = 251.8 Hz), 152.3, 149.5, 146.4, 131.9, 131.8, 131.5, 131.2, 130.3, 129.4, 125.6, 116.2, 115.6, 115.4.

3-(4-Chloro-phenyl)-benzo[1,4]oxazin-2-one (3f)^[1]



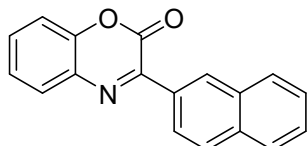
Purified by TLC (ethyl acetate/petroleum ether = 1:4, v:v), R_f = 0.3; Beige solid; Yield 94%; M.p. = 165-166 °C; ¹H NMR (400 MHz, CDCl₃): δ = 8.35-8.33 (d, J = 8.4 Hz, 2H), δ = 7.85-7.83 (dd, J = 1.2, 8.0 Hz, 1H), δ = 7.55-7.51 (t, J = 7.2 Hz, 1H), δ = 7.47-7.45 (d, J = 8.8 Hz, 2H), δ = 7.42-7.38 (t, J = 7.6 Hz, 1H), 7.35-7.33 (d, J = 8.8 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃): δ = 152.1, 149.5, 146.5, 137.8, 132.5, 131.5, 131.4, 130.8, 129.5, 128.7, 125.7, 116.2.

3-(4-Bromo-phenyl)-benzo[1,4]oxazin-2-one (3g)^[1]



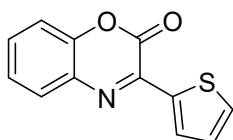
Purified by TLC (ethyl acetate/petroleum ether = 1:4, v:v), R_f = 0.3; Beige solid; Yield 77%; M.p. = 152-153 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.27-8.25 (d, J = 8.4 Hz, 2H), δ = 7.85-7.83 (dd, J = 0.8, 8.0 Hz, 1H), δ = 7.63-7.61 (d, J = 8.8 Hz, 2H), δ = 7.55-7.51 (dt, J = 0.8, 8.4 Hz, 1H), δ = 7.42-7.38 (t, J = 7.6 Hz, 1H), 7.34-7.32 (d, J = 8.4 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ = 152.1, 149.6, 146.4, 132.9, 131.7, 131.6, 131.5, 131.0, 129.5, 126.5, 125.7, 116.2.

3-Naphthalen-2-yl-benzo[1,4]oxazin-2-one (3h)^[1]



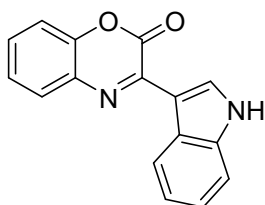
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.7; Yellow solid; Yield 62%; M.p. > 180 °C; ^1H NMR (400 MHz, CDCl_3): δ = 9.07 (s, 1H), δ = 8.42-8.39 (dd, J = 2.0, 8.8 Hz, 1H), δ = 8.02-8.00 (d, J = 8.0 Hz, 1H), δ = 7.95-7.87 (m, 3H), δ = 7.60-7.51 (m, 3H), δ = 7.43-7.40 (t, J = 7.6 Hz, 1H), δ = 7.37-7.35 (d, J = 8.4 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ = 152.4, 150.2, 146.4, 134.7, 132.8, 131.7, 131.4, 131.1, 129.6, 129.4, 128.0, 127.9, 127.6, 126.5, 125.6, 125.3, 116.1.

3-Thiophen-2-yl-benzo[1,4]oxazin-2-one (3i)^[1]



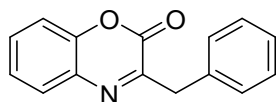
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.5; Beige solid; Yield 90%; M.p. > 180 °C; ^1H NMR (400 MHz, CDCl_3): δ 8.42 (dd, J = 1.2, 4.0 Hz, 1H), 7.78 (dd, J = 1.6, 8.0 Hz, 1H), 7.62-7.60 (dd, J = 1.2, 5.2 Hz, 1H), 7.49-7.45 (dt, J = 1.6, 7.6 Hz, 1H), 7.38 - 7.35 (m, 1H), 7.32 - 7.30 (dd, J = 1.2, 8.0 Hz, 1H), 7.22 - 7.15 (t, J = 4.4 Hz, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ = 151.5, 146.0, 145.6, 138.5, 133.3, 132.5, 131.5, 130.5, 128.9, 128.6, 125.7, 116.2.

3-(Indol-3-yl)-benzo[1,4]oxazin-2-one (3j)^[2]



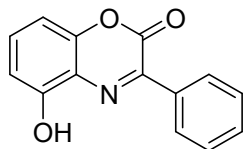
Purified by TLC (ethyl acetate/petroleum ether = 1:4, v:v), R_f = 0.4; Yellow solid; Yield 61%; M.p. > 180 °C; ^1H NMR (400 MHz, DMSO-d_6): δ = 11.98 (s, 1H), δ = 8.77-8.75 (m, 1H), δ = 8.70-8.69 (d, J = 2.8 Hz, 1H), δ = 7.87-7.85 (d, J = 7.6 Hz, 1H), δ = 7.55-7.53 (m, 1H), δ = 7.49-7.45 (m, 1H), δ = 7.44-7.39 (m, 2H), δ = 7.30-7.24 (m, 2H); ^{13}C NMR (100 MHz, DMSO-d_6): δ = 152.5, 148.4, 145.3, 137.1, 134.2, 132.4, 129.1, 128.2, 126.4, 125.8, 123.5, 123.3, 122.0, 116.4, 112.7, 111.10.

3-Benzyl-benzo[1,4]oxazin-2-one (3k)^[3]



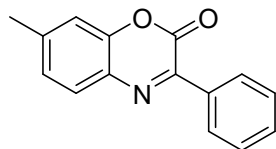
Purified by TLC (ethyl acetate/petroleum ether = 1:10, v:v), R_f = 0.5; White solid; Yield 40%; M.p. = 125-127 °C; $^1\text{H NMR}$ (400 MHz, CDCl_3): δ = 7.74-7.72 (dd, J = 1.6, 8.0 Hz, 1H), δ = 7.46-7.42 (m, 3H), δ = 7.34-7.29 (m, 3H), δ = 7.26-7.22 (m, 2H), δ = 4.19 (s, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ = 156.3, 152.8, 146.6, 135.5, 131.3, 130.8, 129.6, 129.1, 128.7, 127.1, 125.5, 116.4, 40.6.

5-hydroxy-3-phenyl-benzo[1,4]oxazin-2-one (3l)^[3]



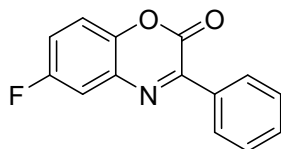
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.5; Yellow solid; Yield 78%; M.p. > 180 °C; $^1\text{H NMR}$ (400 MHz, CDCl_3): δ = 8.30-8.26 (m, 2H), δ = 7.56-7.47 (m, 3H), δ = 7.43-7.39 (t, J = 8.4 Hz), 7.30 (1H, s), δ = 6.94-6.92 (dd, J = 1.2, 8.2 Hz 1H), δ = 6.85-6.83 (dd, J = 1.2, 8.4 Hz, 1H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ = 153.3, 152.8, 148.0, 147.0, 133.7, 132.7, 131.6, 129.4, 128.5, 120.5, 110.6, 107.1.

7-Methyl-3-phenyl-benzo[1,4]oxazin-2-one (3m)^[1]



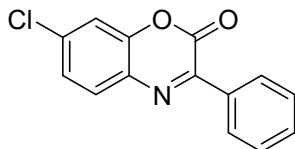
Purified by TLC (ethyl acetate/petroleum ether = 1:4, v:v), R_f = 0.6; Yellow solid; Yield 95%; M.p. = 150-151 °C; $^1\text{H NMR}$ (400 MHz, CDCl_3): δ = 8.32-8.30 (m, 2H), 7.73-7.71 (d, J = 8.4 Hz, 1H) δ = 7.52-7.47 (m, 3H), δ = 7.21-7.18 (dd, J = 2.0, 8.0 Hz, 1H), δ = 7.13 (s, 1H), δ = 2.48 (s, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ = 152.5, 149.6, 146.4, 142.6, 134.3, 131.2, 129.8, 129.3, 129.0, 128.3, 126.7, 116.2, 21.8.

6-Fluoro-3-phenyl-benzo[1,4]oxazin-2-one (3n)^[2]



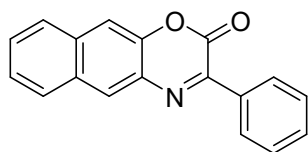
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.6; Yellow solid; Yield 98%; M.p. = 142-143 °C; $^1\text{H NMR}$ (400 MHz, CDCl_3): δ = 8.39 - 8.28 (m, 2H), δ = 7.61 - 7.44 (m, 4H), δ = 7.32-7.29 (m, 1H), δ = 7.28 - 7.20 (m, 1H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ = 160.6, 151.9, 151.8, 142.8, 133.7, 132.1, 131.8, 129.6, 128.4, 118.5, 118.3, 117.2, 117.1, 115.1, 114.9.

7-Chloro-3-phenyl-benzo[1,4]oxazin-2-one (3o)^[2]



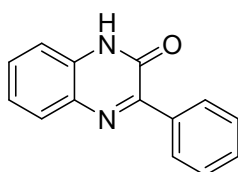
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.5; Brown solid; Yield 86%; M.p. = 104-106 °C, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ = 8.34-8.31 (m, 2H), 7.79-7.72 (d, J = 8.4 Hz, 1H), 7.57-7.48 (m, 3H), 7.38-7.35 (m, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ = 151.5, 150.6, 146.8, 136.85, 133.8, 131.7, 130.3, 130.2, 129.5, 128.5, 126.2, 116.5.

3-Phenyl-naphtho[1,4]oxazin-2-one (3p)^[3]



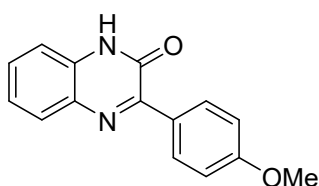
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.5; White solid; Yield 63%; M.p. >180 °C; ¹H NMR (400 MHz, CDCl₃): δ = 8.00 (d, J = 8.0 Hz, 1H), δ = 7.90 (d, J = 8.0 Hz, 1H), δ = 7.70-7.69 (m, 1H), δ = 7.62-7.50 (m, 5H); ¹³C NMR (100 MHz, CDCl₃): δ = 152.2, 151.1, 144.2, 134.2, 133.9, 131.5, 130.9, 130.8, 129.5, 129.2, 128.9, 128.5, 128.4, 127.4, 126.0, 112.3.

3-Phenylquinoxalin-2(1H)-one (3q)^[4]



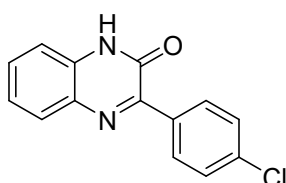
Purified by TLC (ethyl acetate/petroleum ether = 1:1, v:v), R_f = 0.4; Yellow solid; Yield 80%; M.p. > 180 °C; ¹H NMR (400 MHz, DMSO-d₆): δ = 12.56 (s, 1H), δ = 8.27-8.25 (m, 2H), δ = 7.82-7.80 (d, J = 8.0 Hz, 1H), δ = 7.54-7.44 (m, 4 H), δ = 7.33-7.28 (m, 2 H); ¹³C NMR (100 MHz, DMSO-d₆): δ = 155.1, 154.6, 136.1, 132.5, 130.2, 130.7, 129.7, 129.2, 128.4, 123.9, 115.6.

3-(4-methoxyphenyl)quinoxalin-2(1H)-one (3r)^[4]



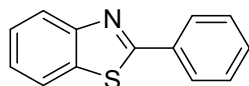
Purified by TLC (ethyl acetate/petroleum ether = 1:4, v:v), R_f = 0.3; White solid; Yield 92%; M.p. > 180 °C; ¹H NMR (400 MHz, DMSO-d₆): δ = 12.48 (s, 1 H), 8.37-8.35 (d, J = 8.8 Hz, 2 H), δ = 7.76-7.78 (d, J = 8.0 Hz, 1 H), δ = 7.49-7.45 (t, J = 7.6 Hz, 1H), δ = 7.30-7.25 (m, 2 H), δ = 7.02-7.00 (d, J = 8.8 Hz, 2 H), δ = 3.85 (s, 3 H); ¹³C NMR (100 MHz, DMSO-d₆): δ = 161.5, 155.2, 153.6, 132.5, 132.2, 131.5, 130.2, 128.9, 128.6, 123.8, 115.5, 113.8, 55.8.

3-(4-Chlorophenyl)quinoxalin-2(1H)-one (3s)^[4]



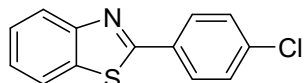
Purified by TLC (ethyl acetate/petroleum ether = 1:1, v:v), R_f = 0.4; Yellow solid; Yield 91%; M.p. > 180 °C; ¹H NMR (400 MHz, DMSO-d₆): δ = 12.62 (s, 1H), δ = 8.34-8.32 (d, J = 8.8 Hz, 2 H), δ = 7.81-7.79 (d, J = 8.0 Hz, 2 H), δ = 7.54-7.50 (m, 3 H), δ = 7.31-7.27 (m, 2H); ¹³C NMR (100 MHz, DMSO-d₆): δ = 13C NMR (100 MHz, DMSO-d₆) δ 155.0, 153.2, 135.6, 134.8, 132.5, 132.4, 131.4, 131.0, 129.3, 128.4, 124.0, 115.6.

2-Phenylbenzo[d]thiazole (4t)^[5]



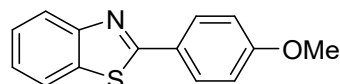
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.6; White solid; Yield 96%; M.p. = 122-123 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.12-8.08 (m, 3H), δ = 7.91-7.89 (d, J = 7.6 Hz, 1H), δ = 7.52-7.48 (m, 4H), δ = 7.41-7.37 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ = 166.7, 154.1, 137.1, 135.1, 132.1, 129.3, 128.7, 126.5, 125.5, 123.3, 121.7.

2-(4-chlorophenyl)benzothiazole (4u)^[5]



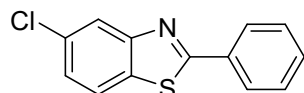
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.5; White solid; Yield 95%; M.p. = 115-116 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.08-8.01 (m, 3H), 7.92-7.90 (d, J = 8.0 Hz, 1H) δ = 7.53-7.45 (m, 3H), δ = 7.42-7.38 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ = 166.7, 154.1, 137.1, 135.1, 132.1, 129.3, 128.7, 126.5, 125.5, 123.3, 121.7.

2-(4-Methoxyphenyl)benzo[d]thiazole (4v)^[5]



Purified by TLC (ethyl acetate/petroleum ether = 1:15 v:v), R_f = 0.6; Beige solid; Yield 90%; M.p. = 132-133 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.06-8.02 (m, 3H), δ = 7.88-7.86 (d, J = 8.0 Hz, 1H), δ = 7.49-7.45 (m, 1H), δ = 7.38-7.34 (m, 1H), δ = 7.01-6.99 (d, J = 8.8 Hz, 2H), δ = 3.88 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3): δ = 167.9, 161.9, 154.2, 134.9, 129.1, 126.4, 126.2, 124.8, 122.8, 121.5, 114.4, 55.5.

5-Chloro-2-phenylbenzo[d]thiazole (4w)^[5]



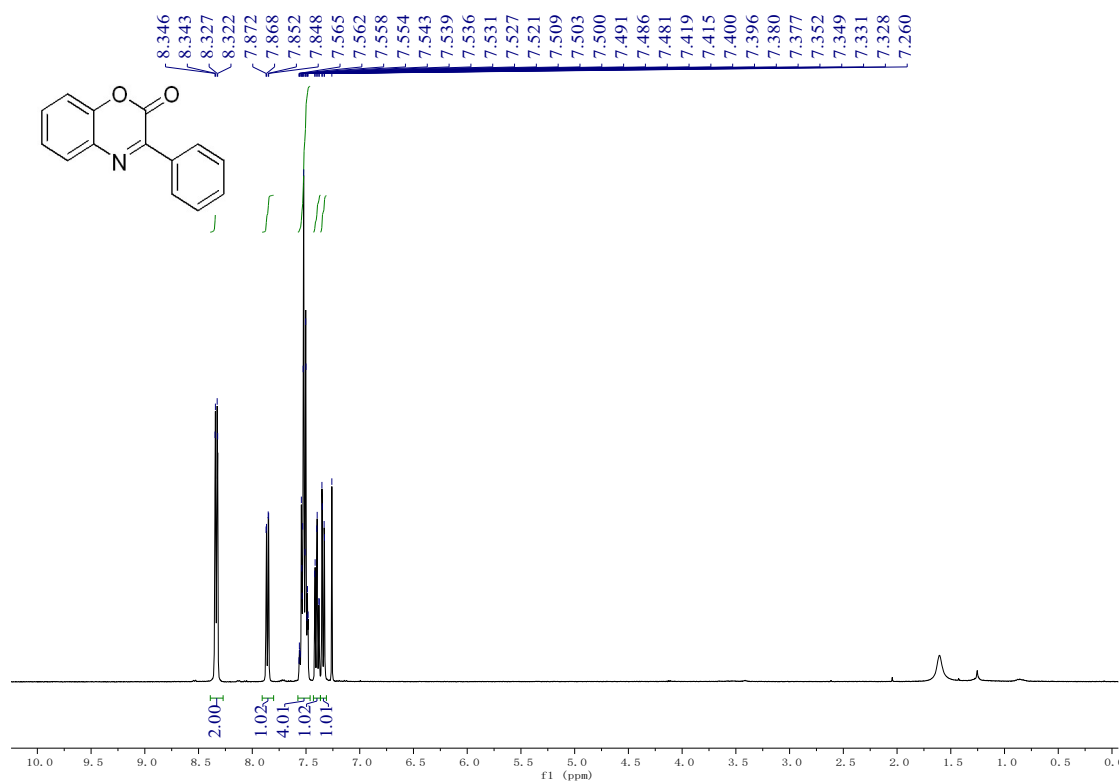
Purified by TLC (ethyl acetate/petroleum ether = 1:15, v:v), R_f = 0.6; White solid; Yield 70%; M.p. = 148-149 °C; ^1H NMR (400 MHz, CDCl_3): δ = 8.09-8.05 (m, 3H), δ = 7.82-7.80 (d, J = 8.4 Hz, 1H), 7.51-7.50 (m, 3H), 7.37 (dd, J = 2.0, 8.4 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ = 13C NMR (101 MHz, Chloroform-d) δ = 170.0, 155.0, 133.3, 133.2, 132.3, 131.4, 129.1, 127.6, 125.7, 123.1, 122.4.

3. References

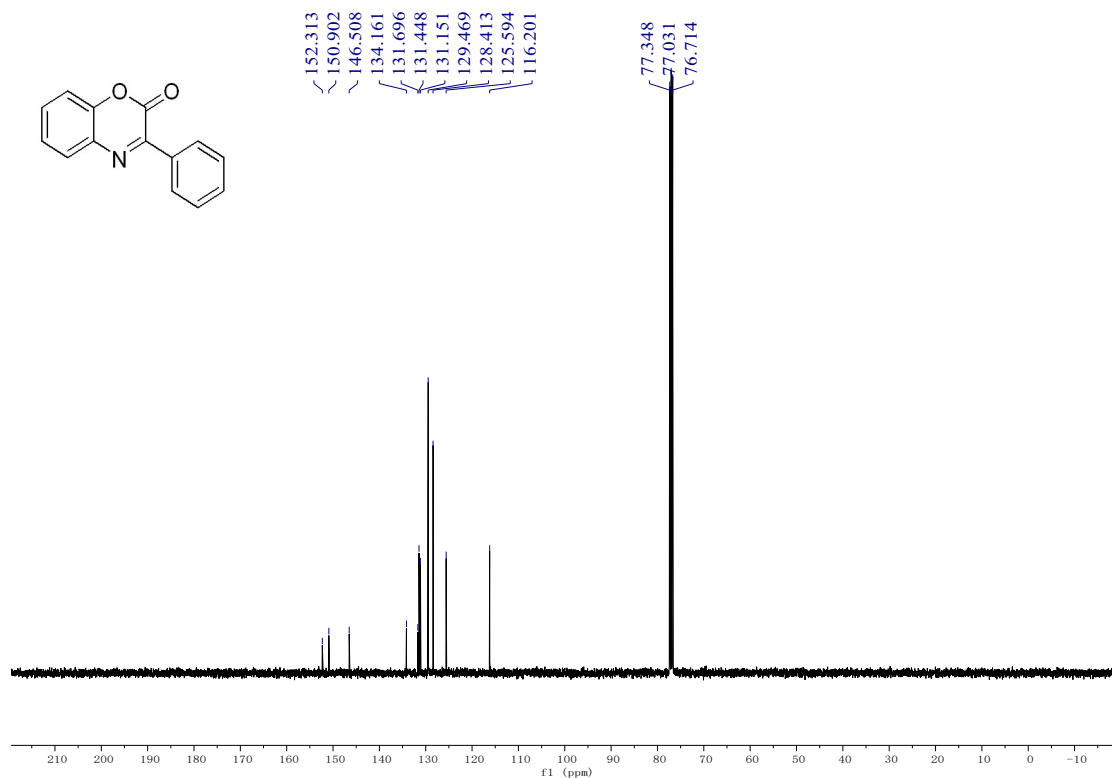
- [1] H. Wang, H. Yang, Y. Li, X.-H. Duan, *RSC Adv.* **2014**, *4*, 8720.
- [2] L. Long, J. Wang, L. Gu, S. Yang, L. Qiao, G. Luo, Z. Wang, *J. Org. Chem.* **2021**, *86*, 12084.
- [3] Z. Han, G. Liu, R. Wang, X.-Q. Dong, X. Zhang, *Chem. Sci.* **2019**, *10*, 4328.
- [4] Y. Liao, H. Qi, S. Chen, P. Jiang, W. Zhou, G.-J. Deng, *Org. Lett.* **2012**, *14*, 6004.
- [5] M. P. Bertrand, S. Coantic, L. Feray, R. Nouguier, P. Perfetti, *Tetrahedron* **2000**, *56*, 3951.

4. Copies of ^1H and ^{13}C NMR spectra

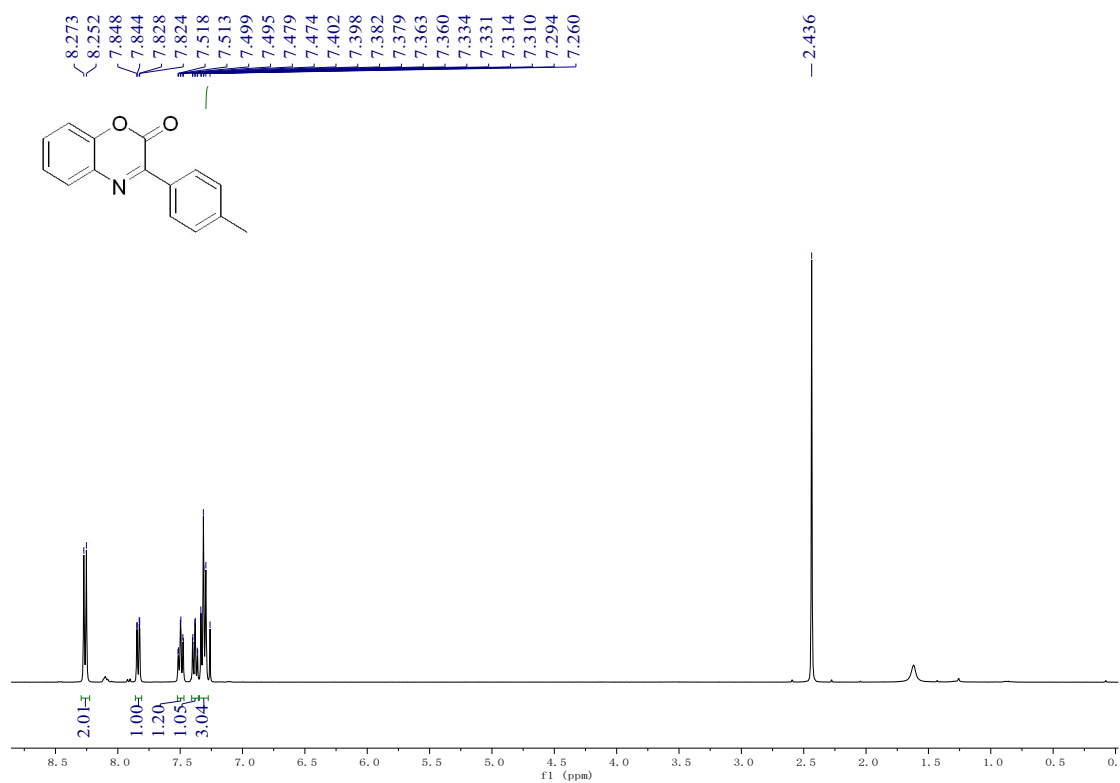
^1H NMR spectrum of 3a (400 MHz, CDCl_3)



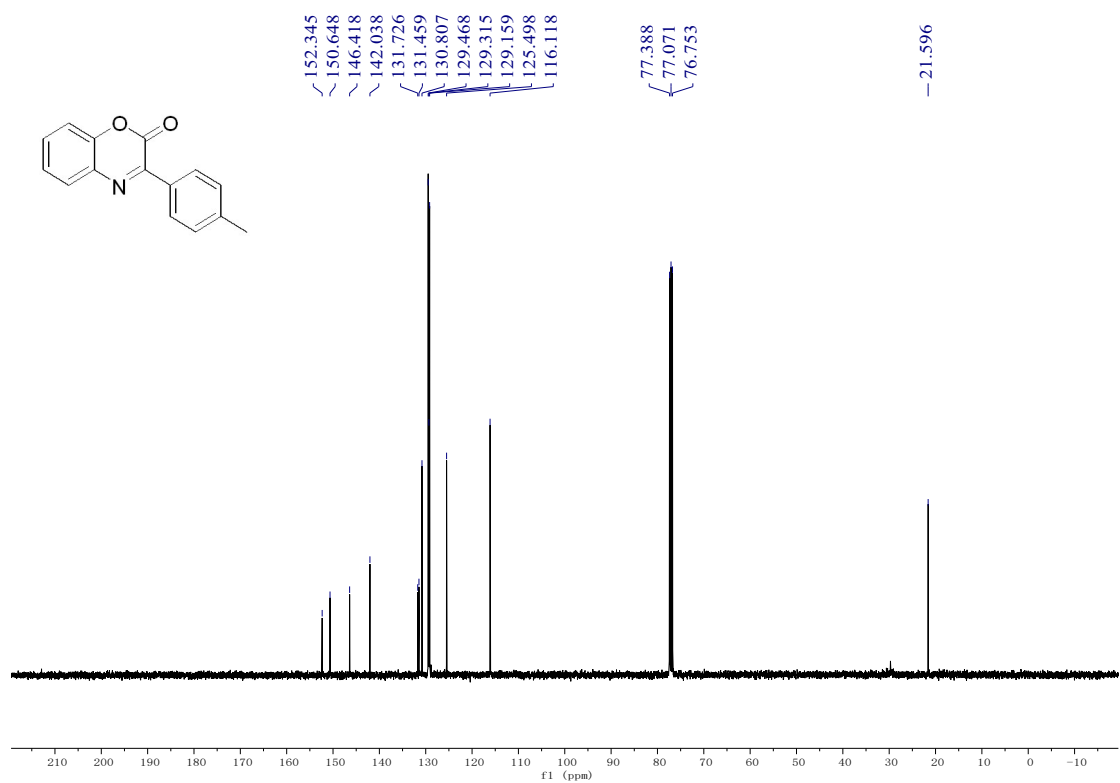
^{13}C NMR spectrum of 3a (100 MHz, CDCl_3)



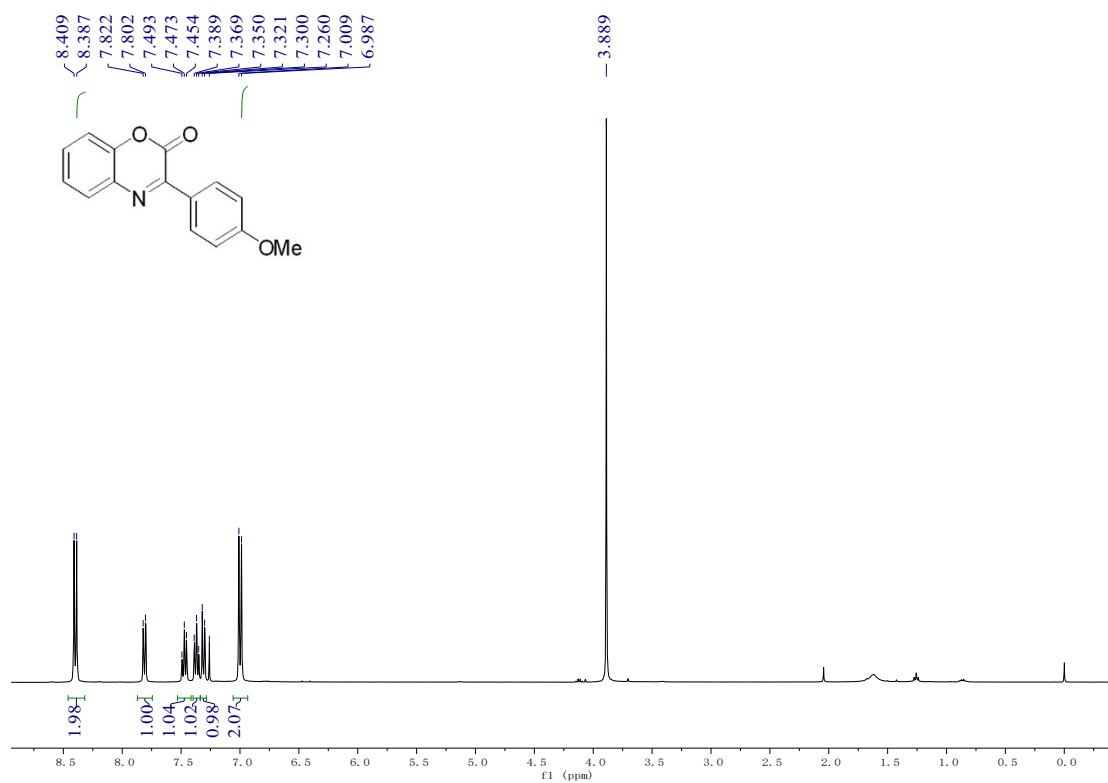
¹H NMR spectrum of 3b (400 MHz, CDCl₃)



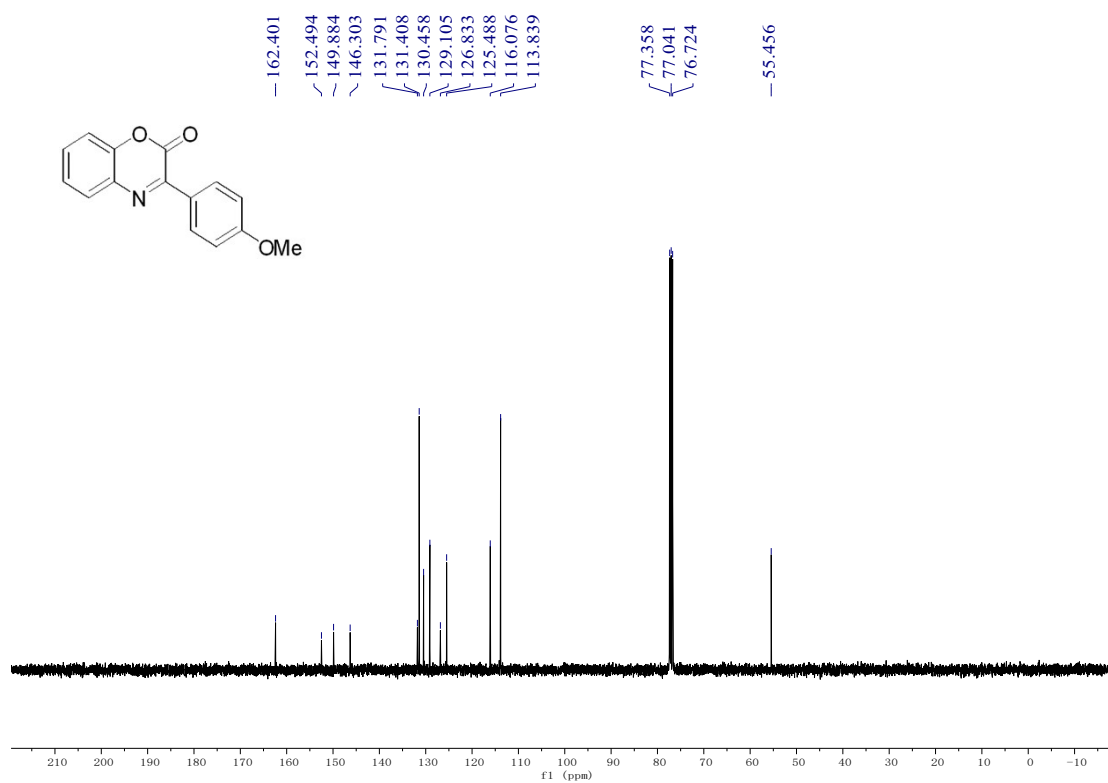
¹³C NMR spectrum of 3b (100 MHz, CDCl₃)



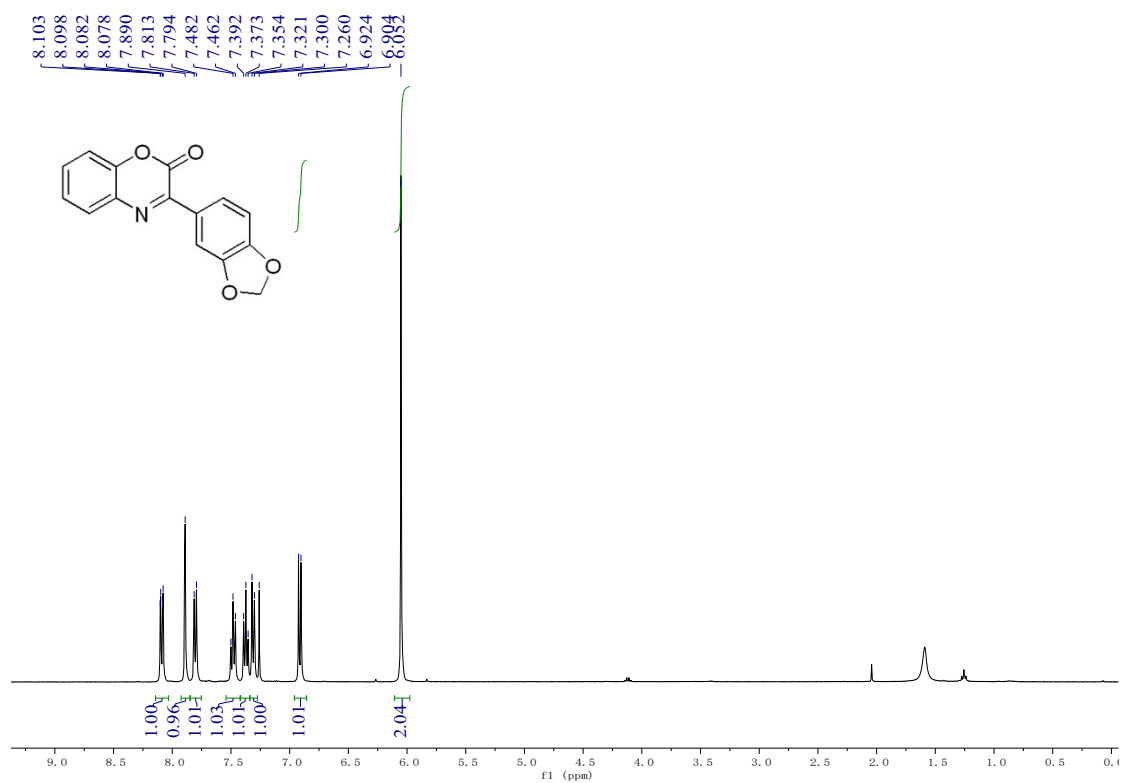
¹H NMR spectrum of 3c (400 MHz, CDCl₃)



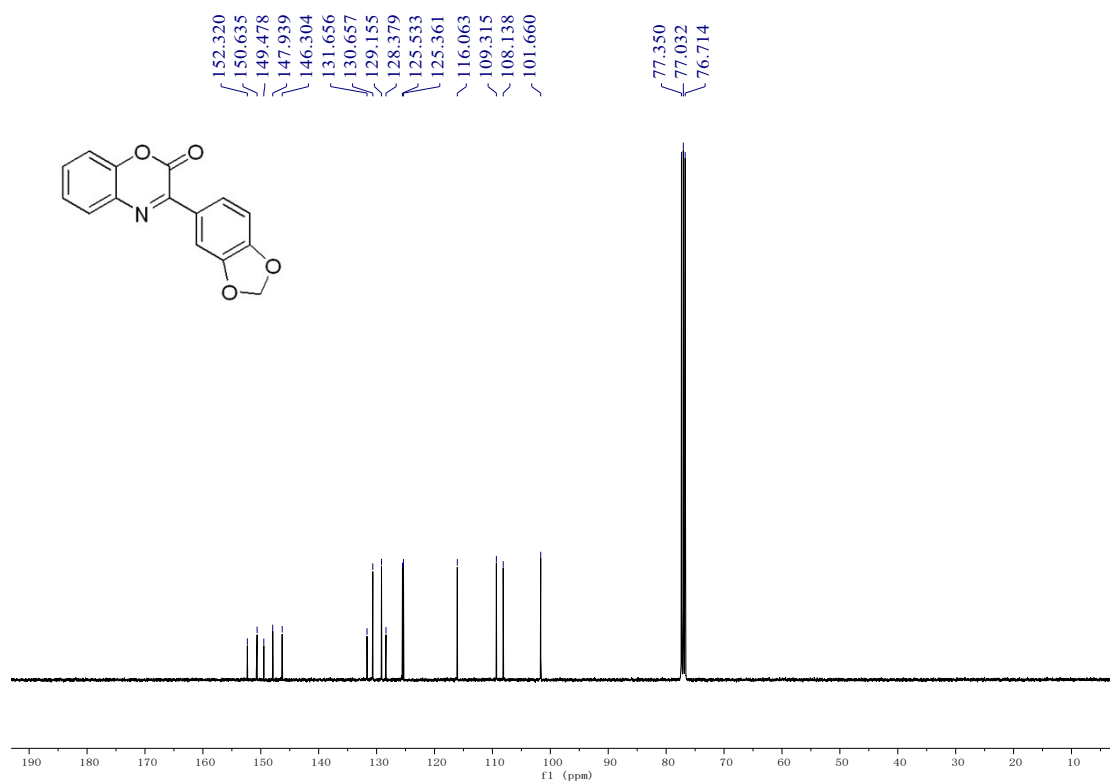
¹³C NMR spectrum of 3c (100 MHz, CDCl₃)



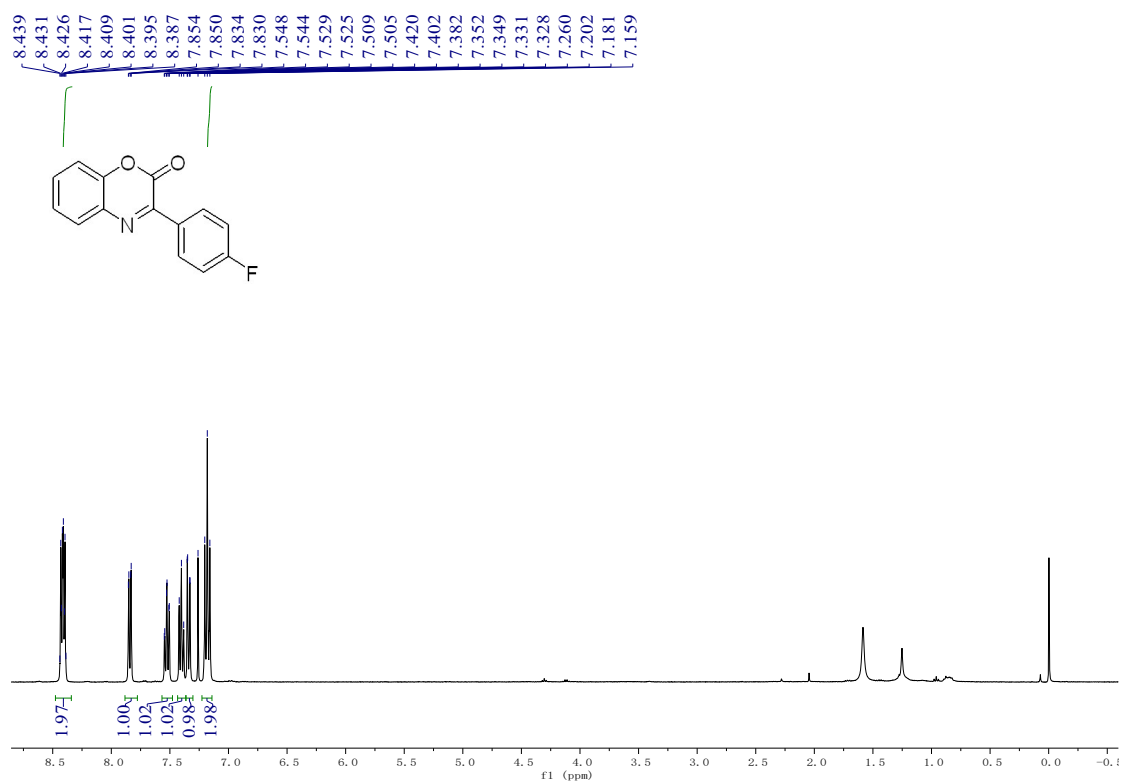
¹H NMR spectrum of 3d (400 MHz, CDCl₃)



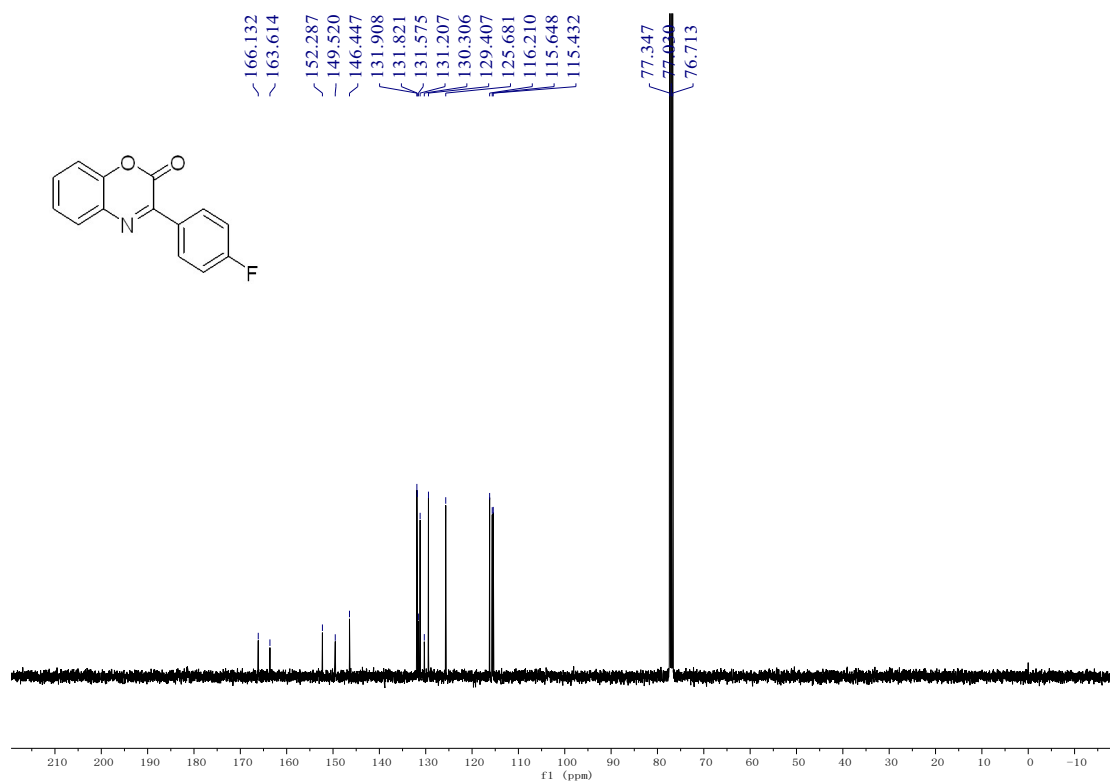
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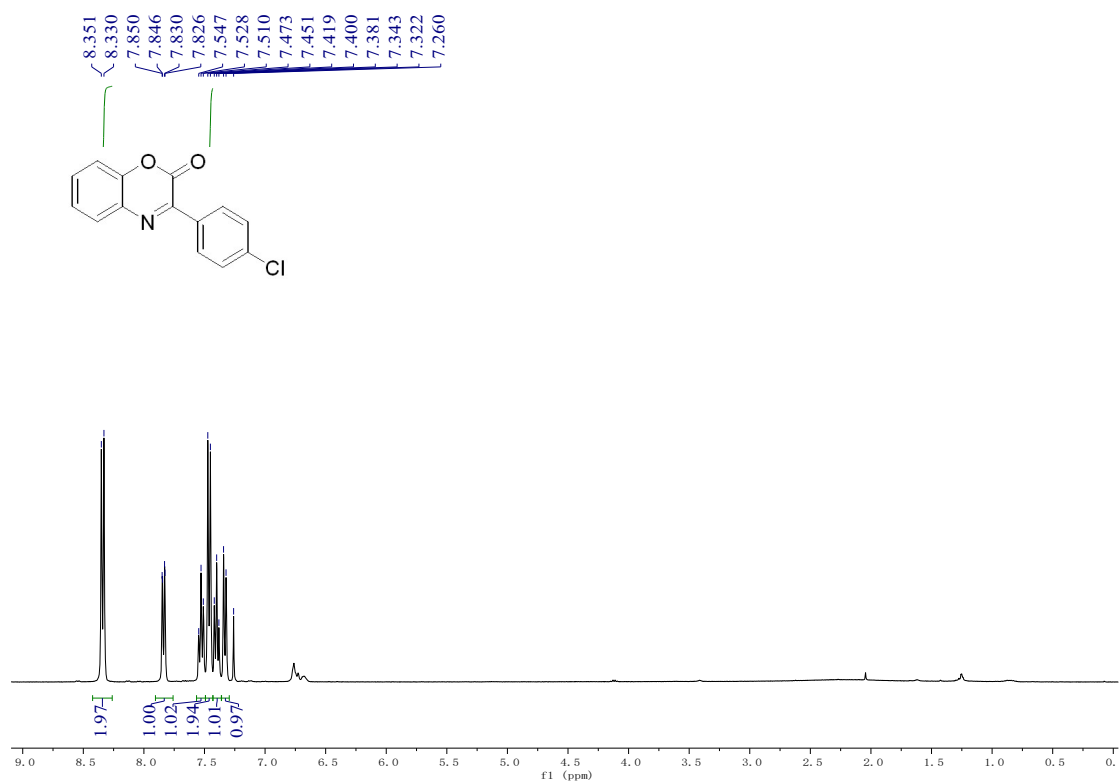
¹H NMR spectrum of 3e (400 MHz, CDCl₃)



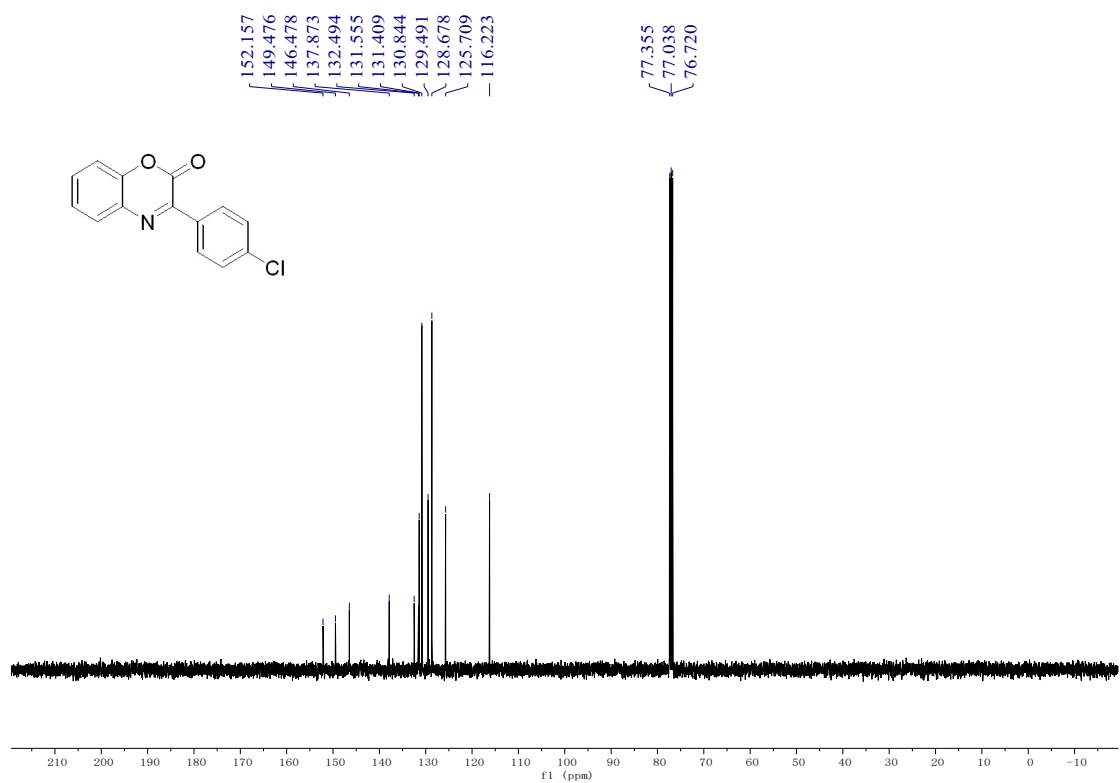
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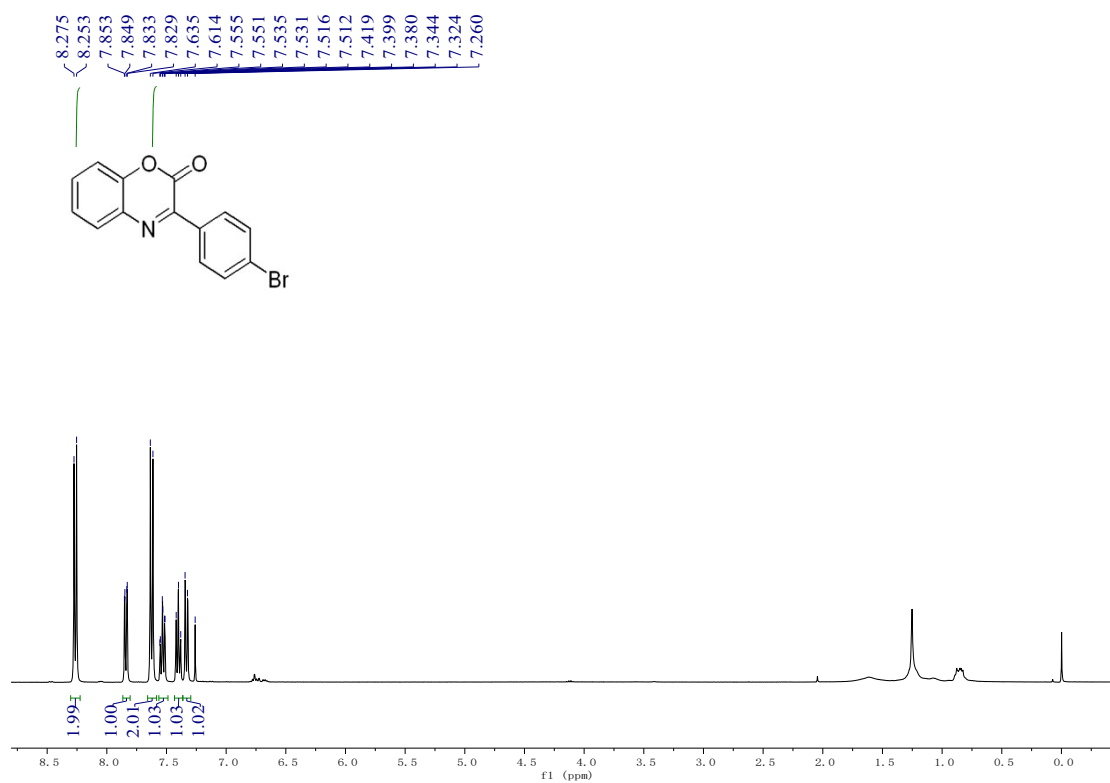
¹H NMR spectrum of 3f (400 MHz, CDCl₃)



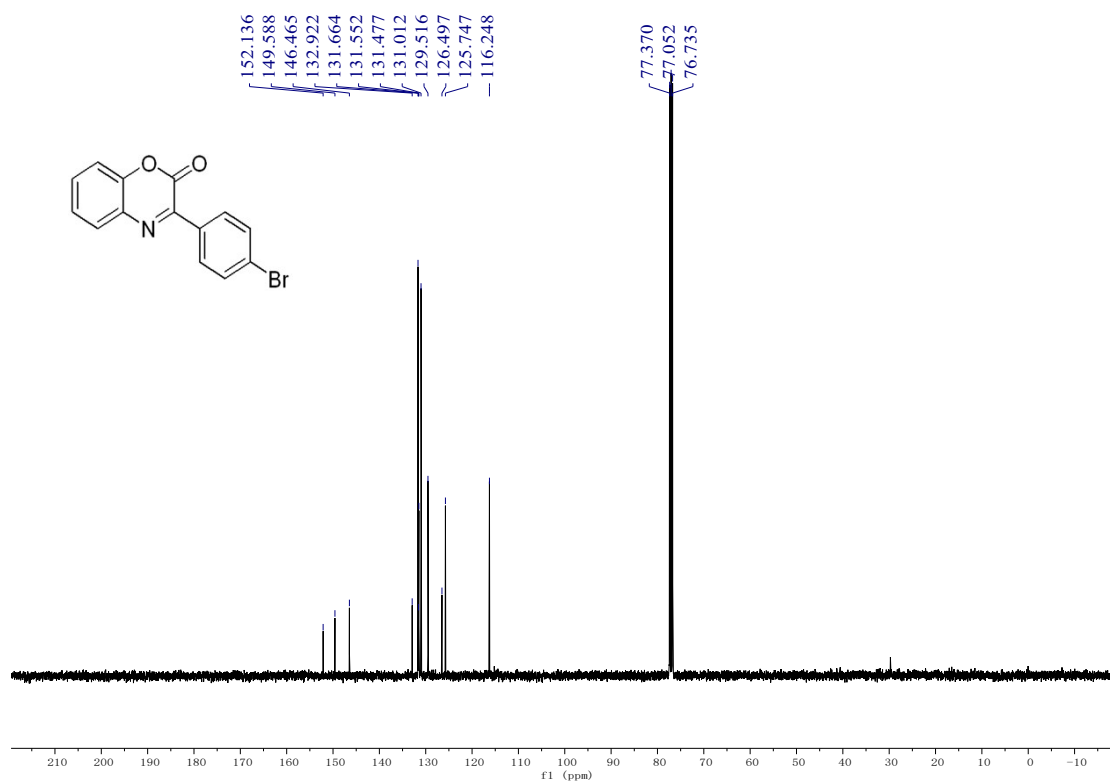
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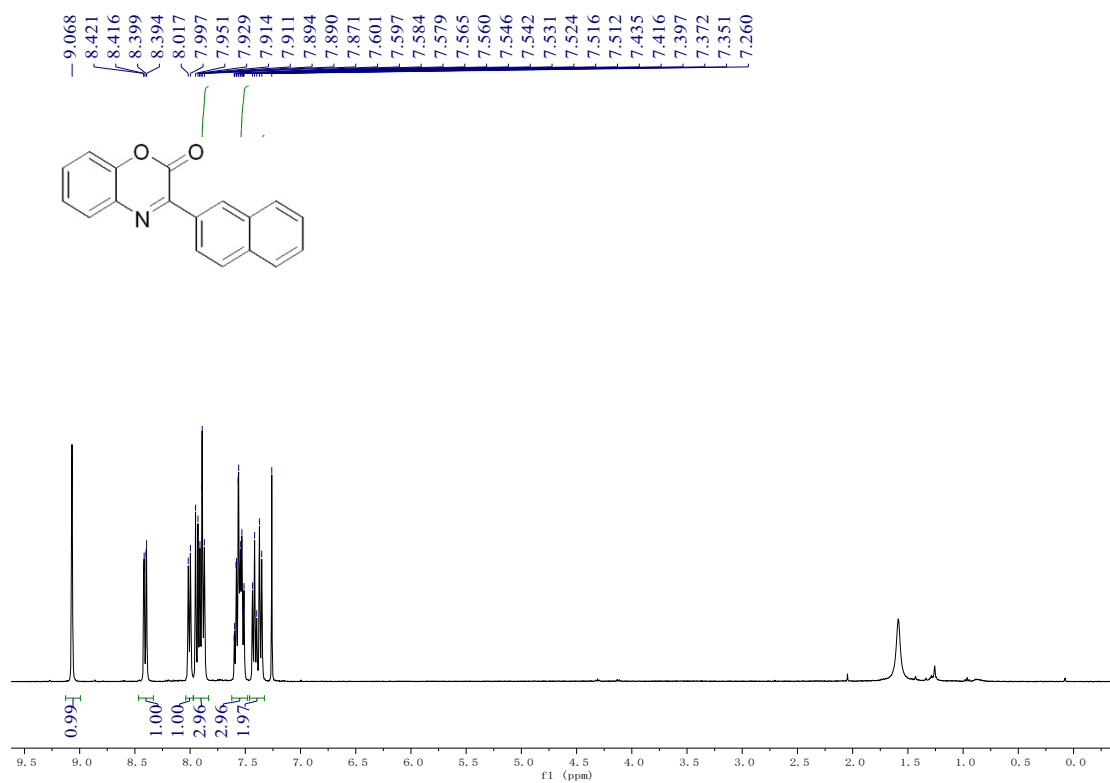
¹H NMR spectrum of 3g (400 MHz, CDCl₃)



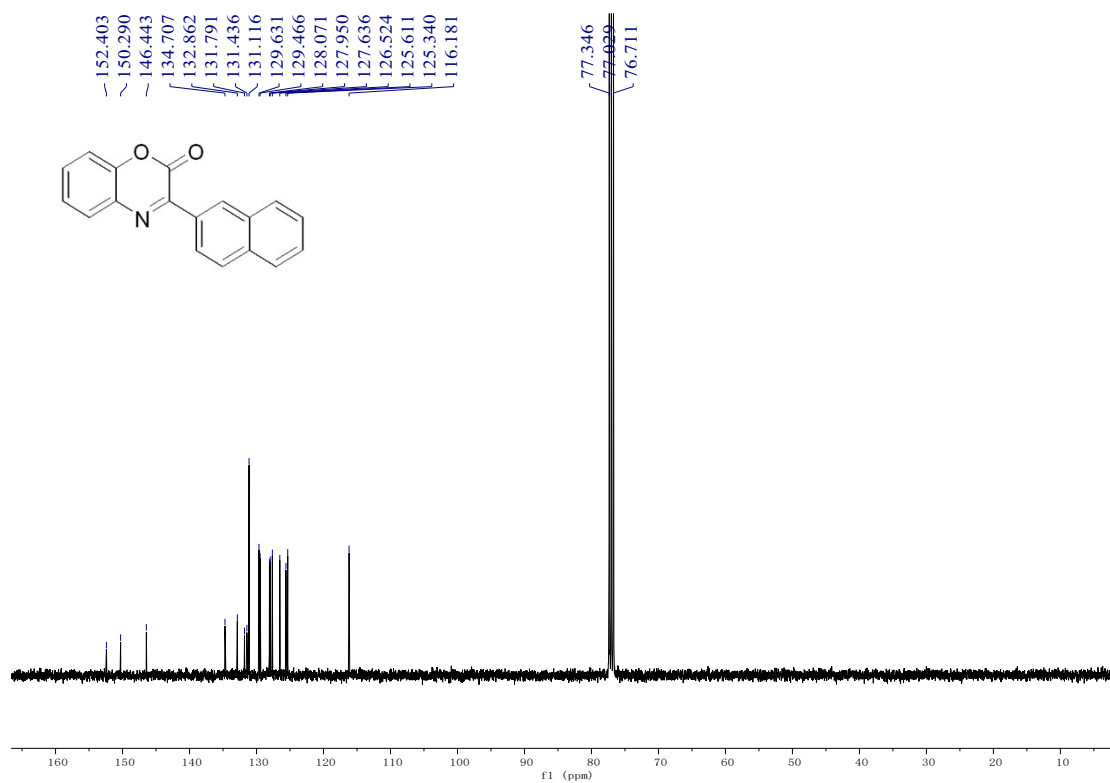
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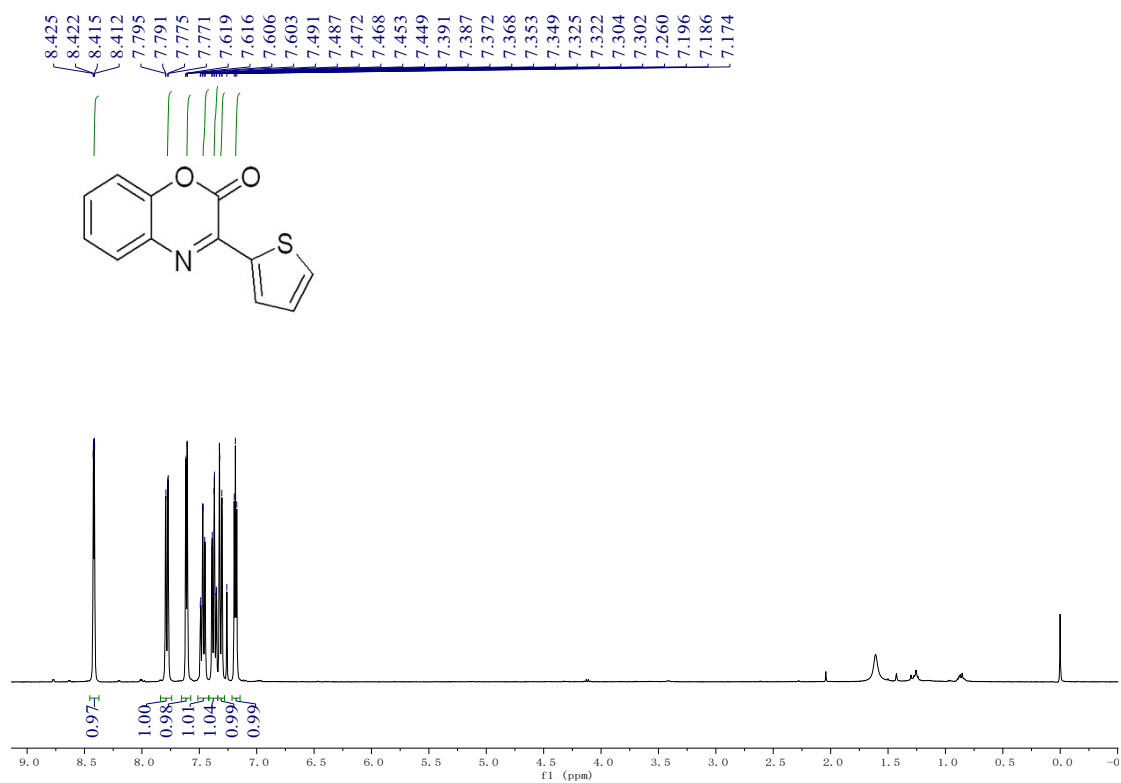
¹H NMR spectrum of 3h (400 MHz, CDCl₃)



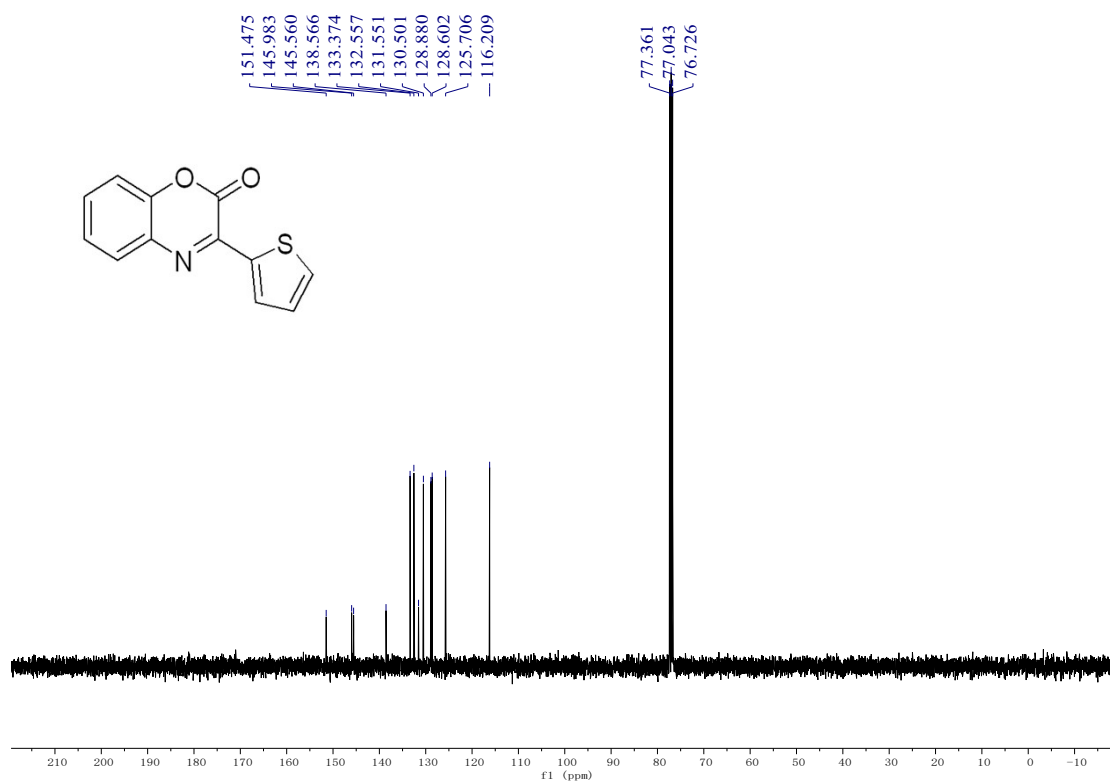
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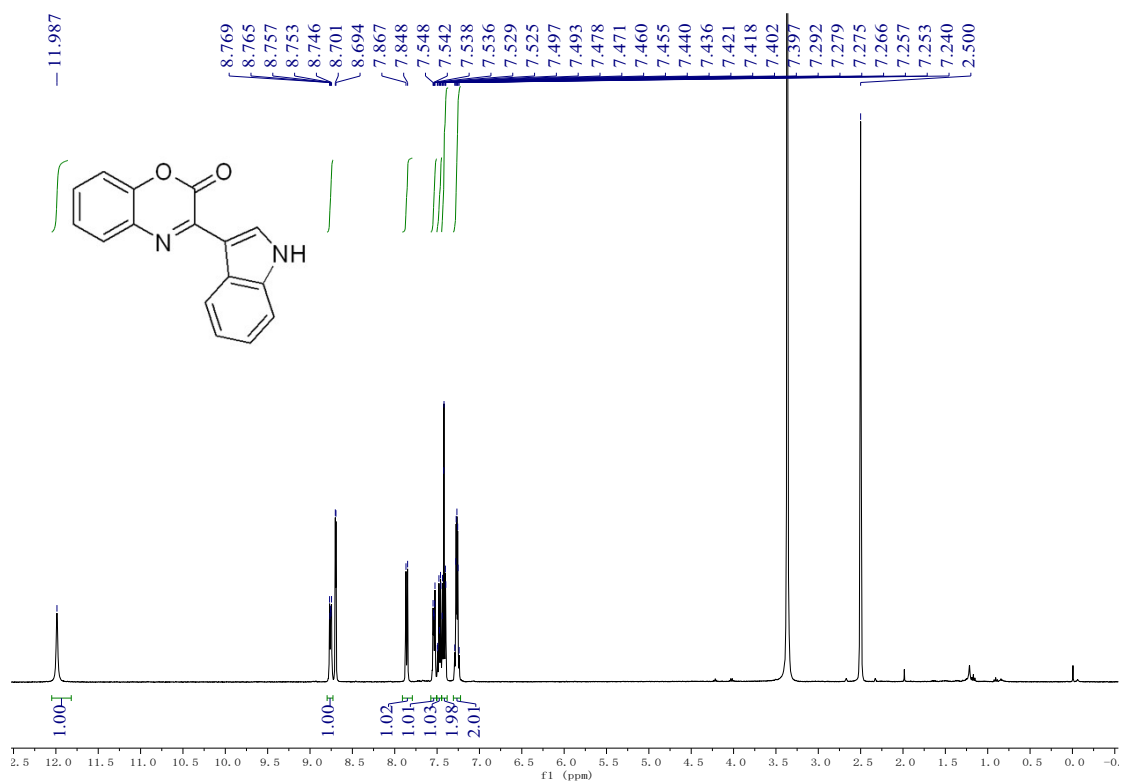
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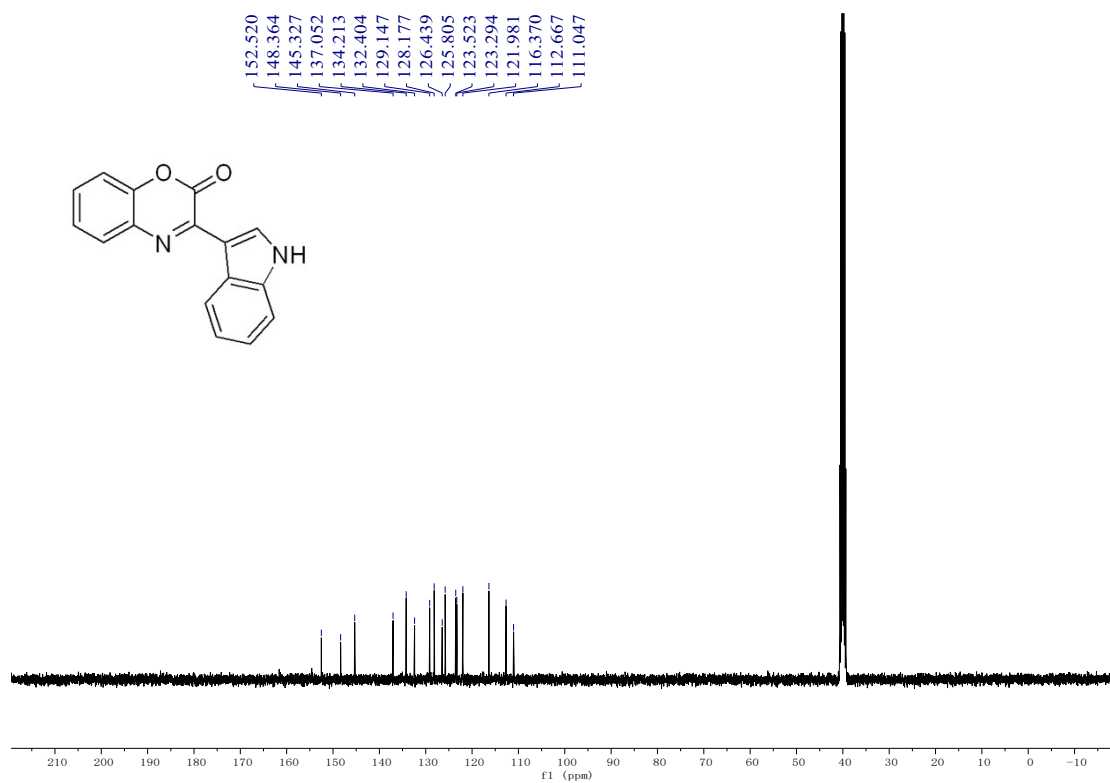
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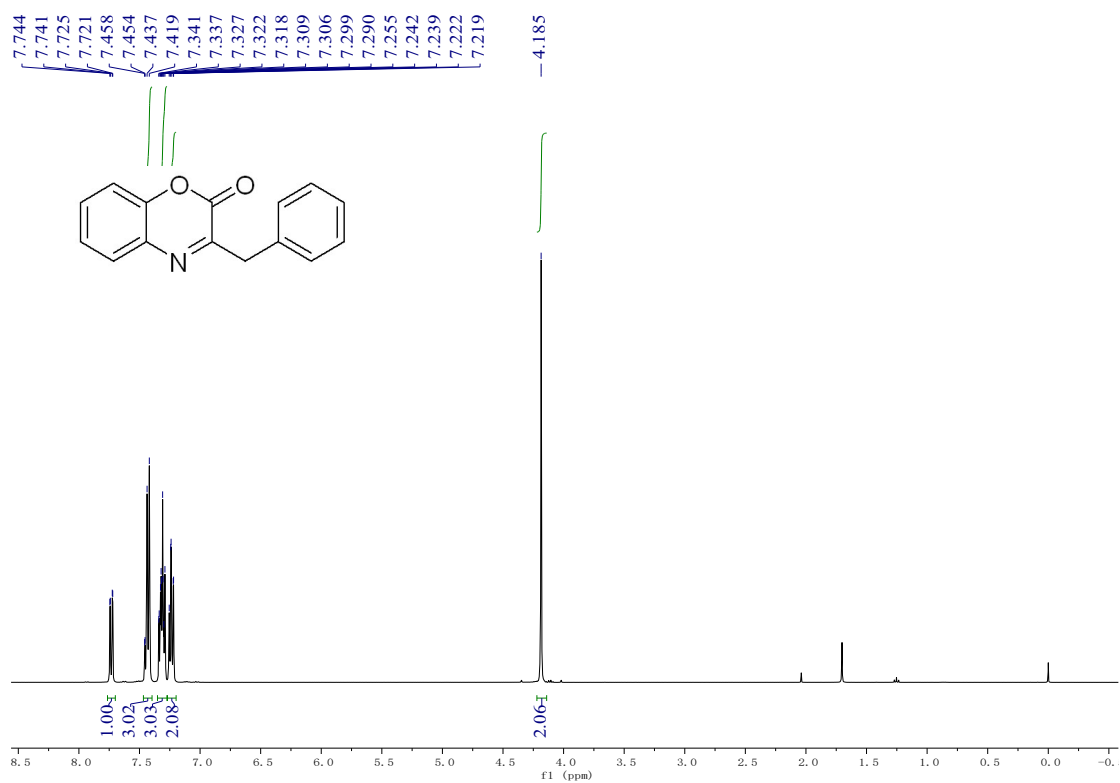
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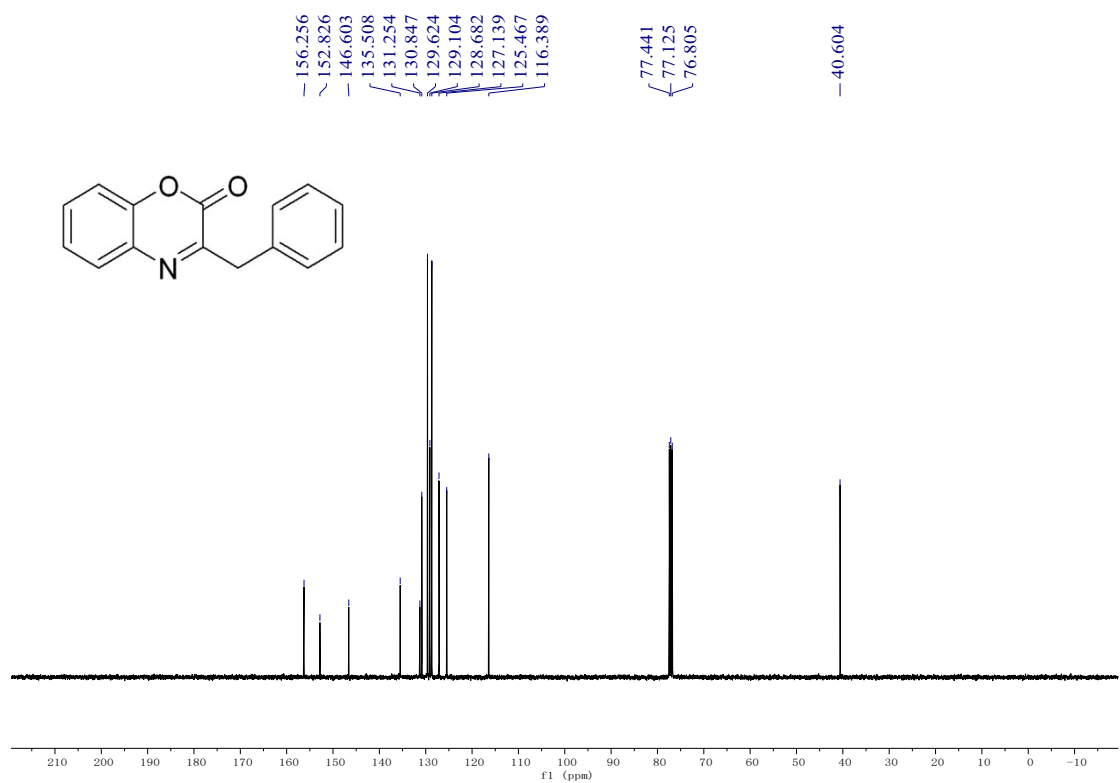
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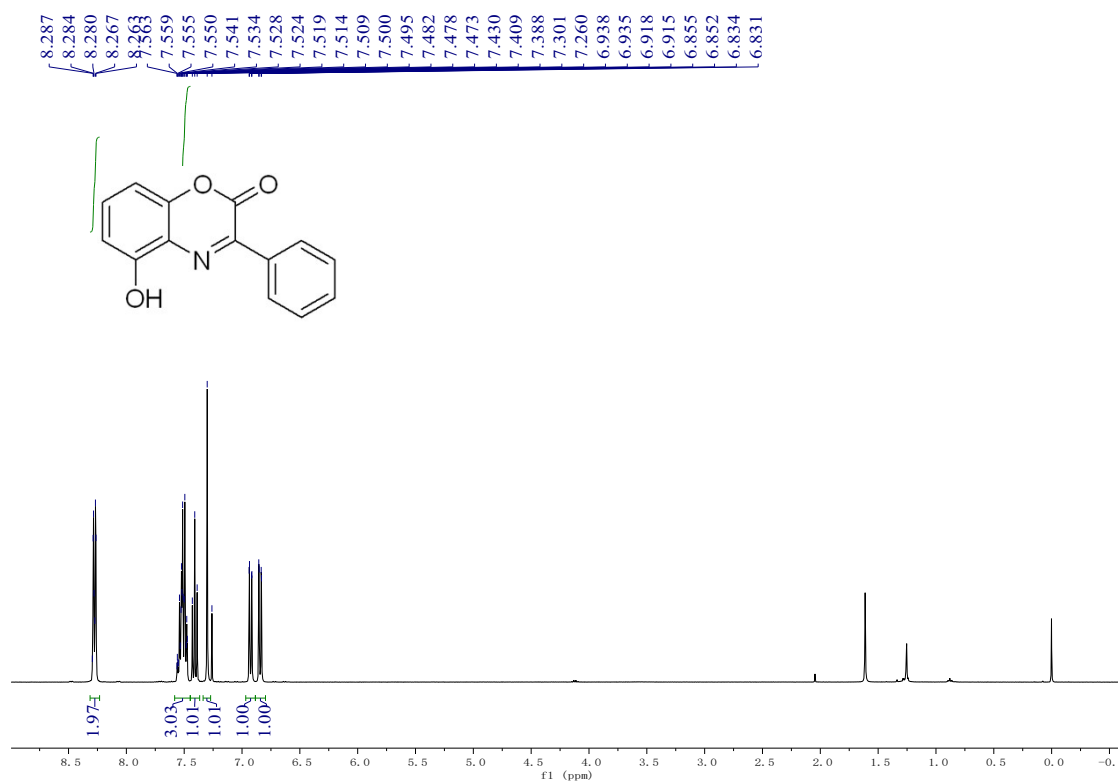
¹H NMR spectrum of 3k (400 MHz, CDCl₃)



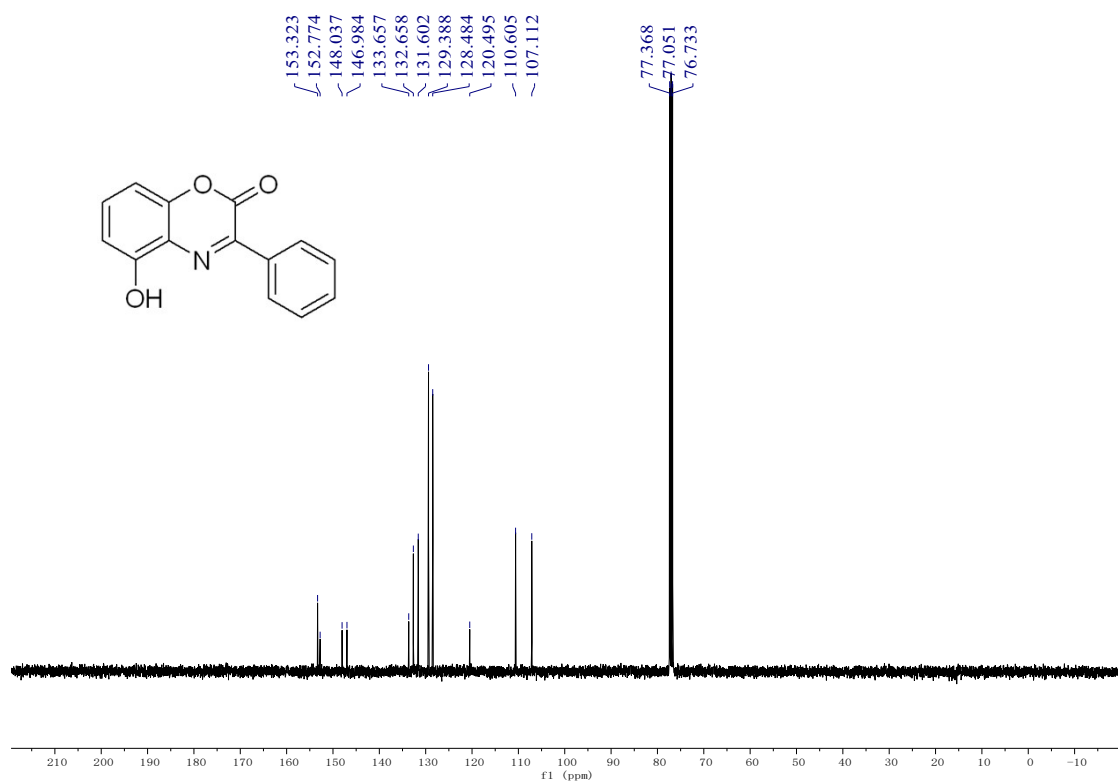
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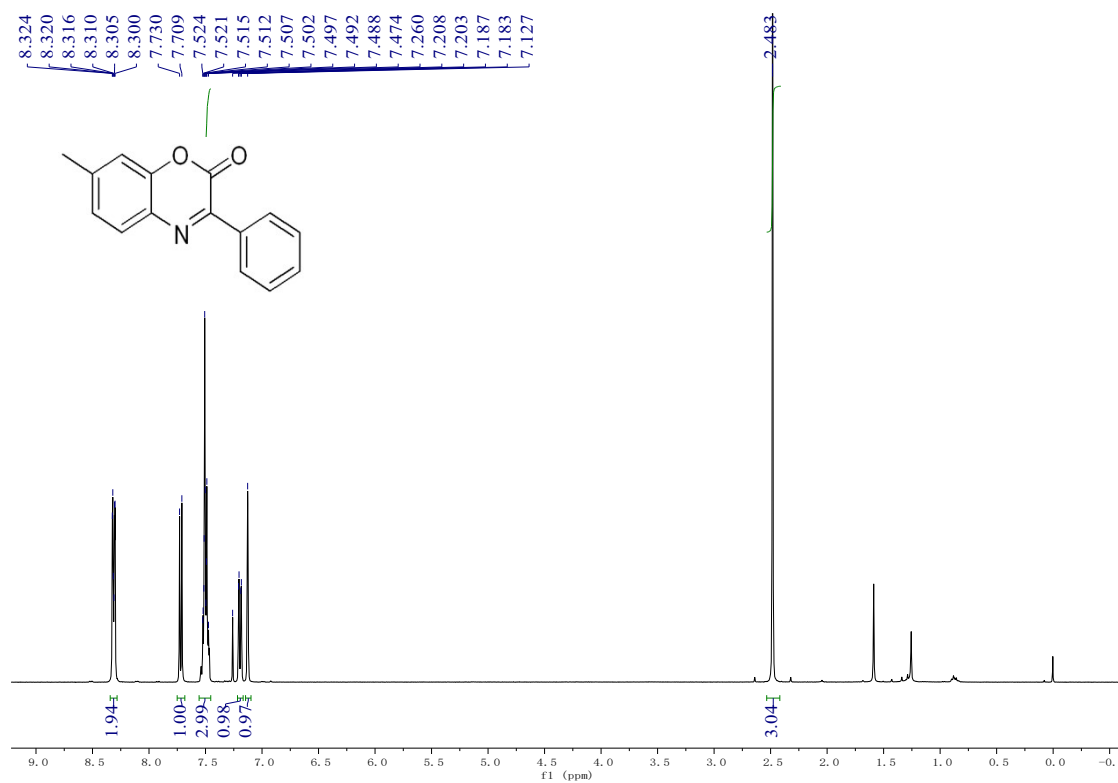
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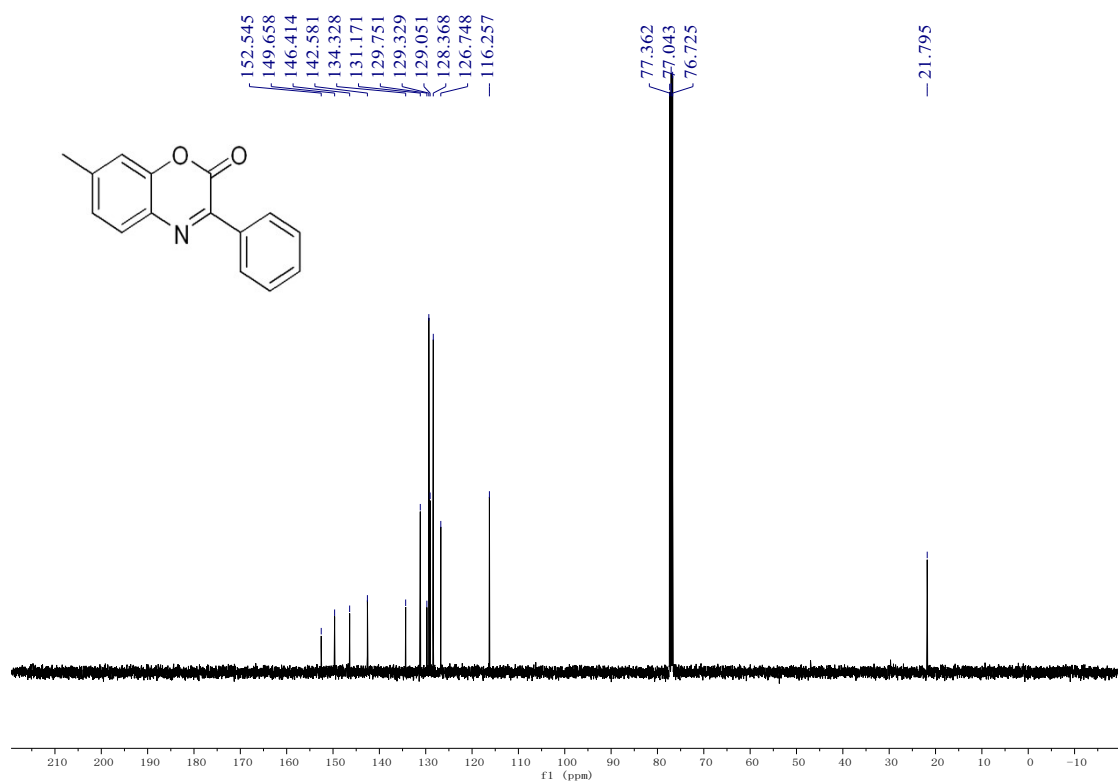
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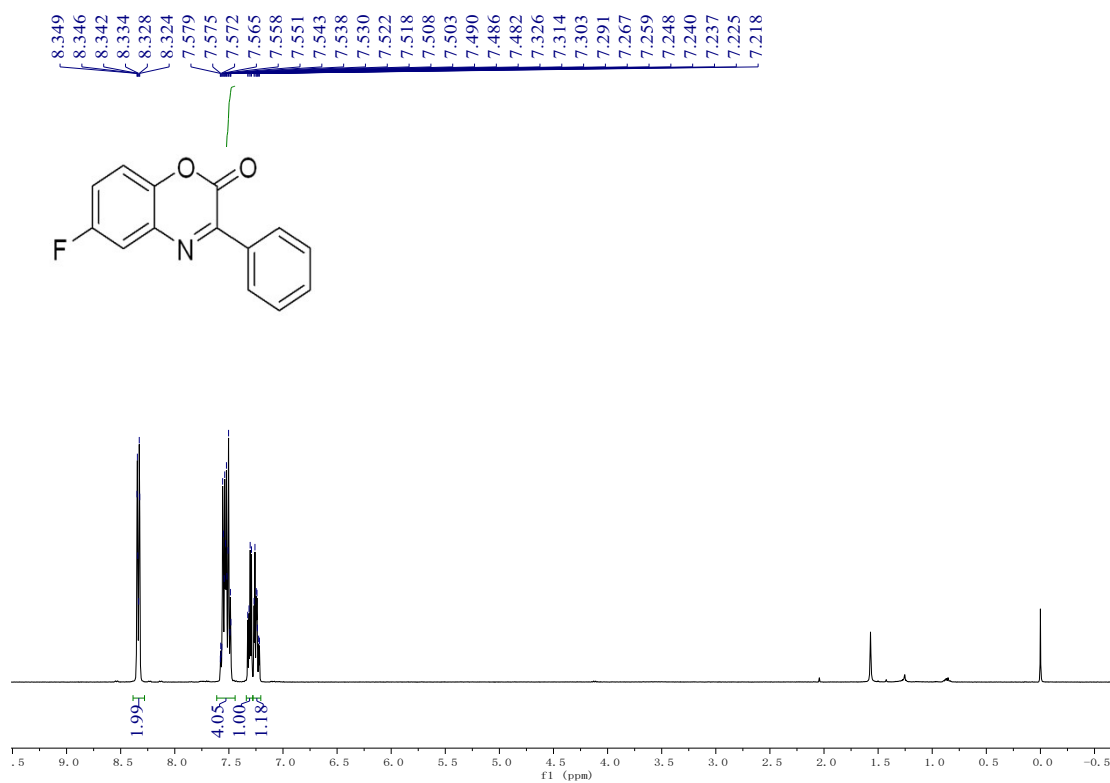
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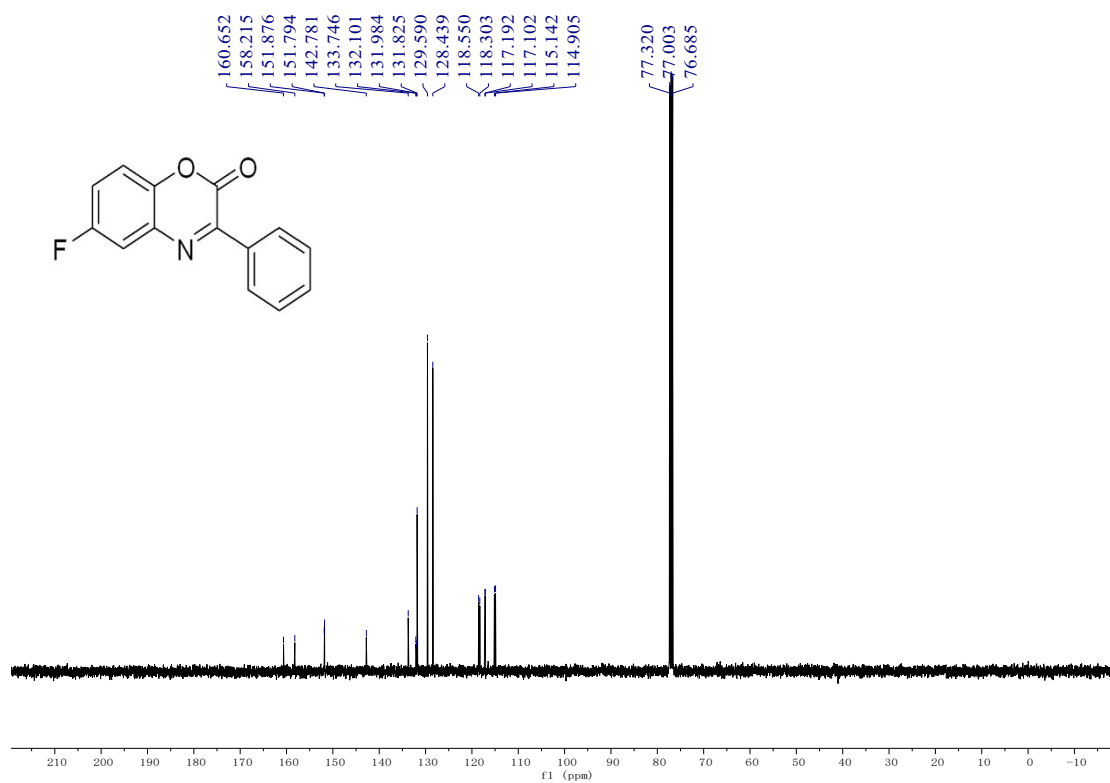
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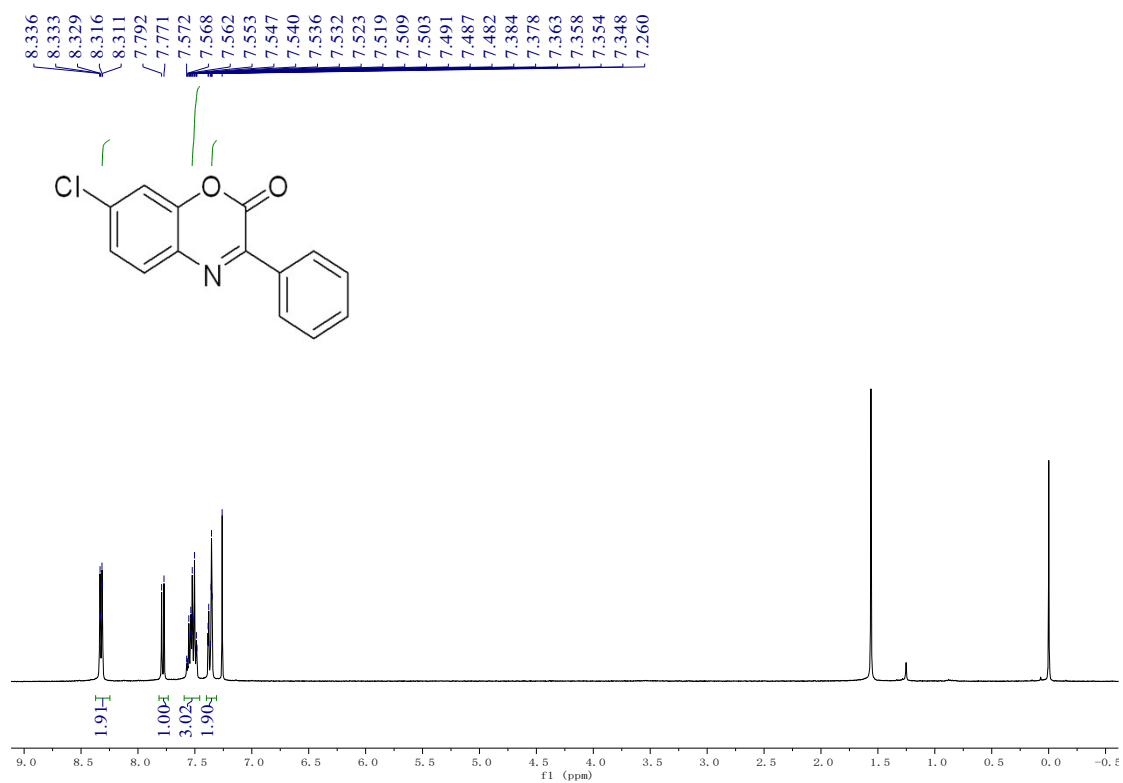
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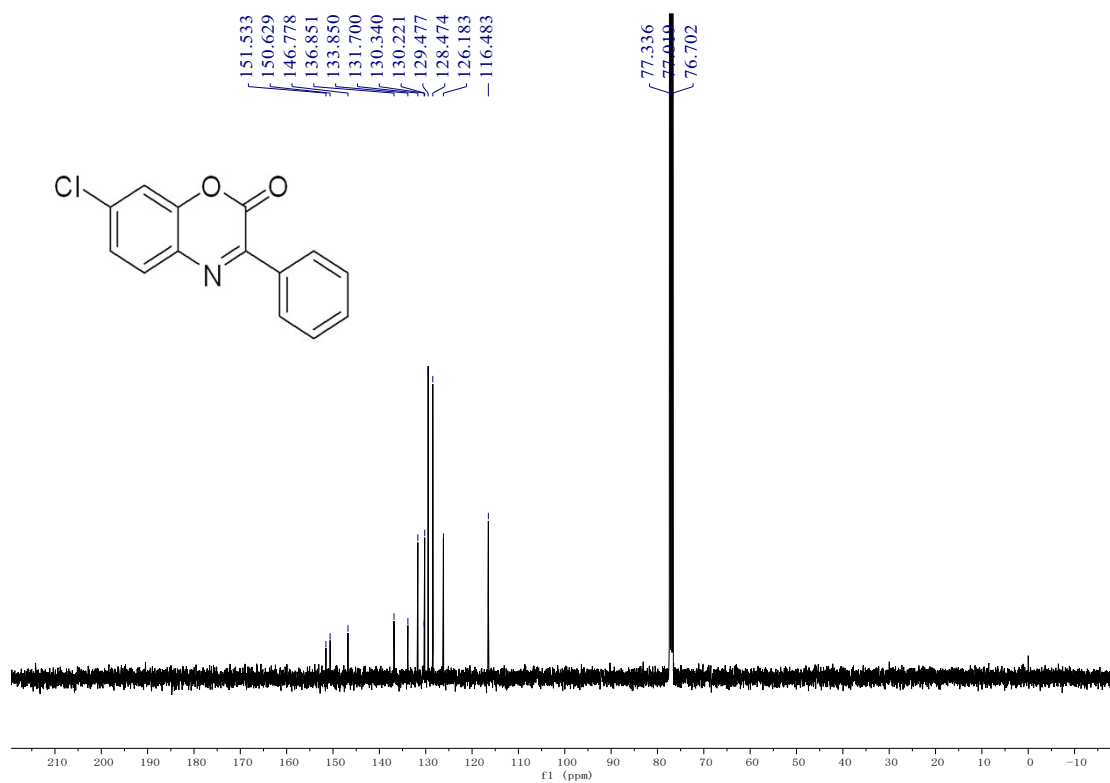
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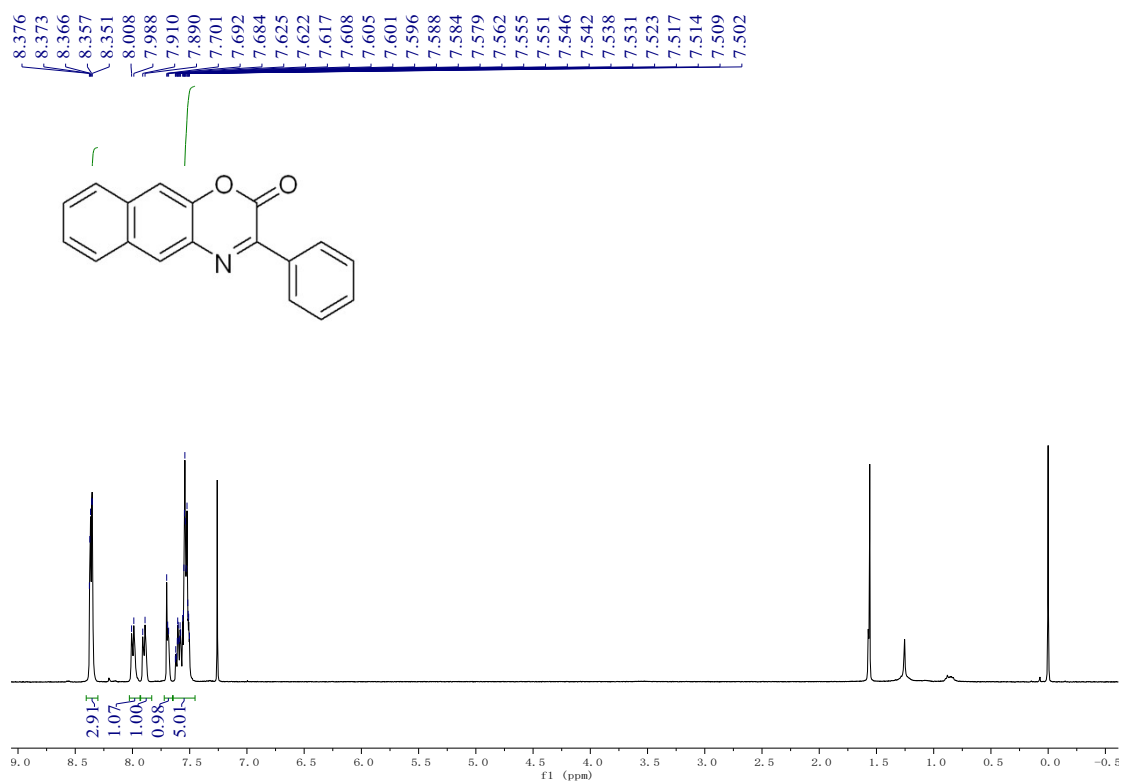
¹H NMR spectrum of 3o (400 MHz, CDCl₃)



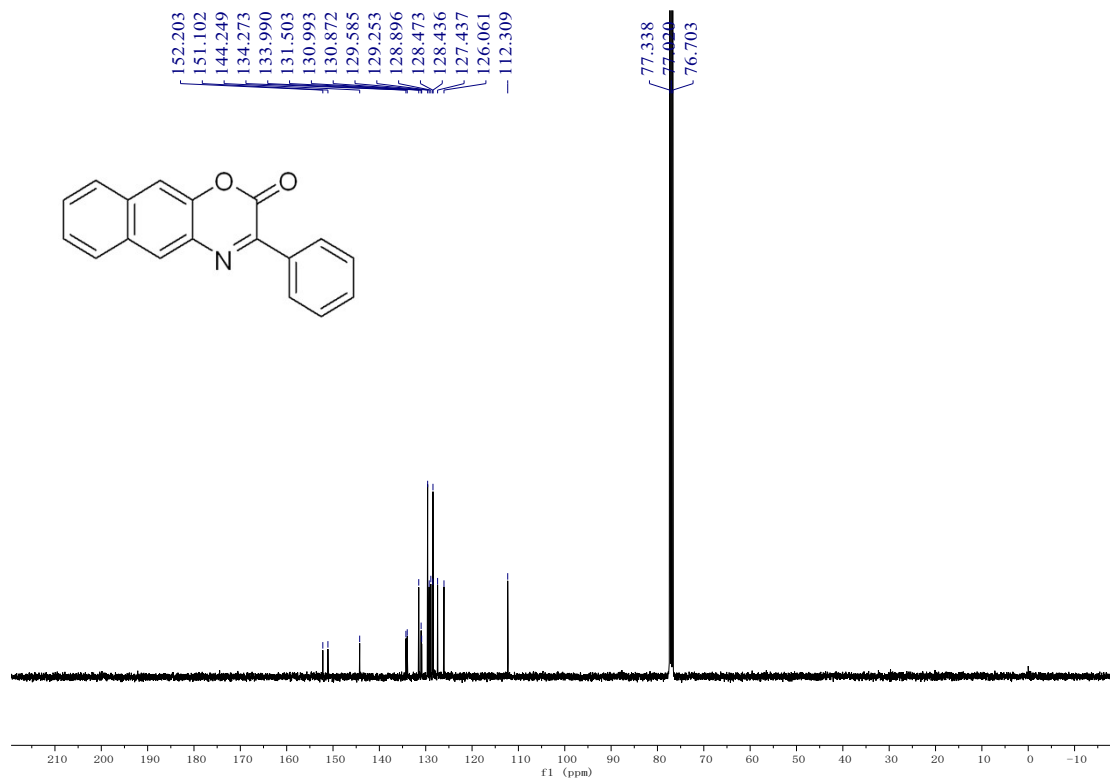
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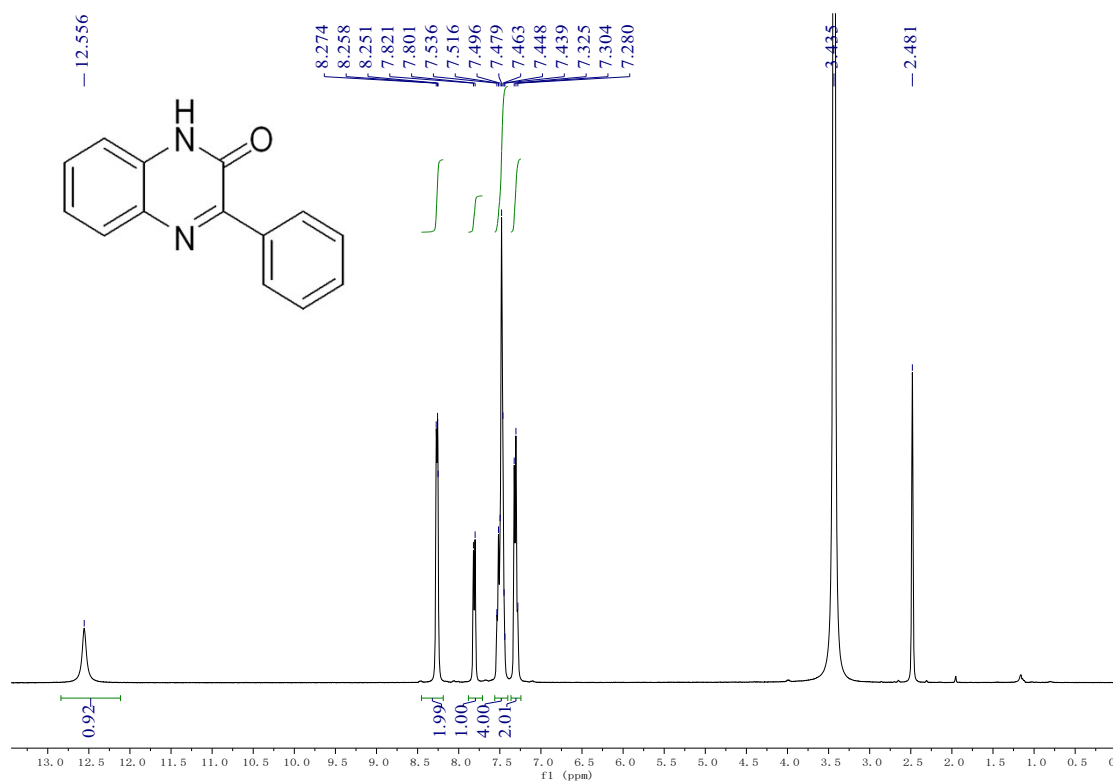
¹H NMR spectrum of 3p (400 MHz, CDCl₃)



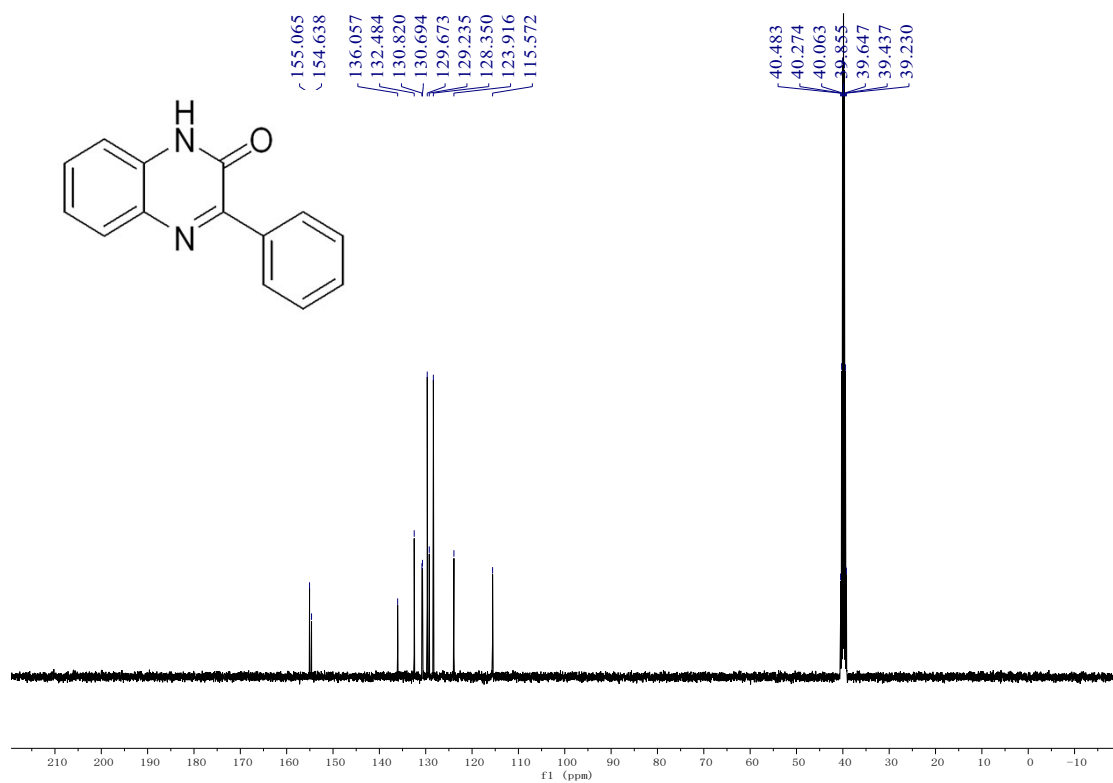
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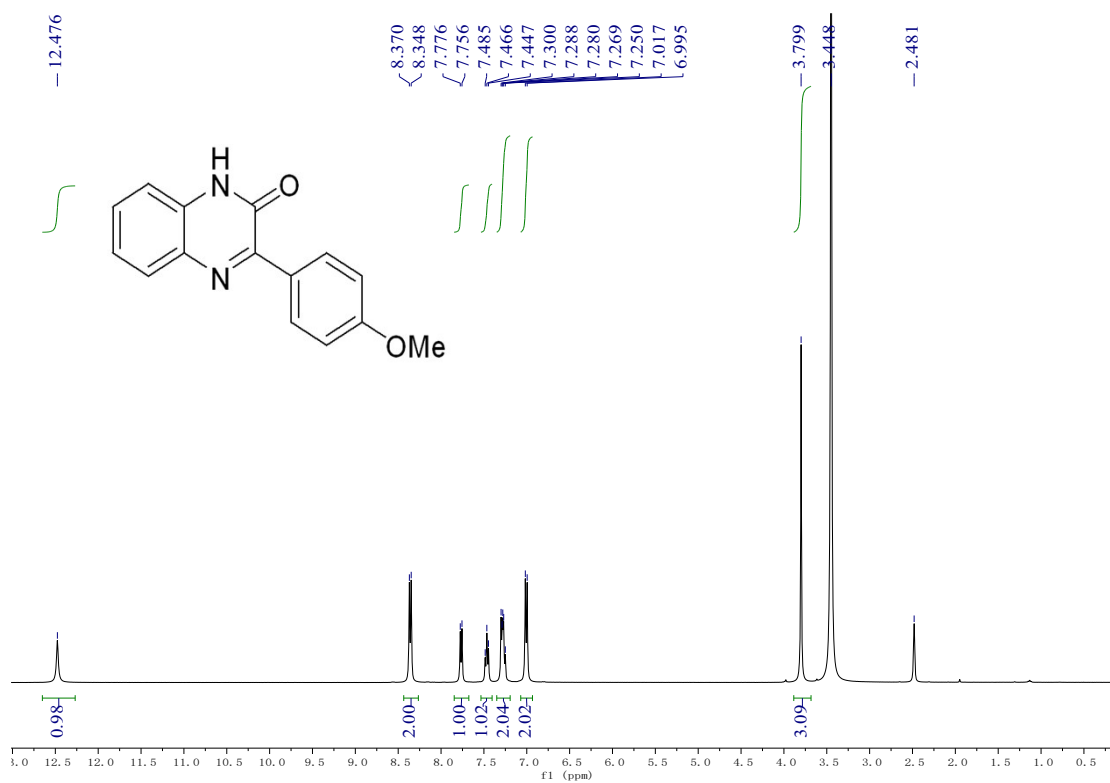
¹H NMR spectrum of 3q (400 MHz, CDCl₃)



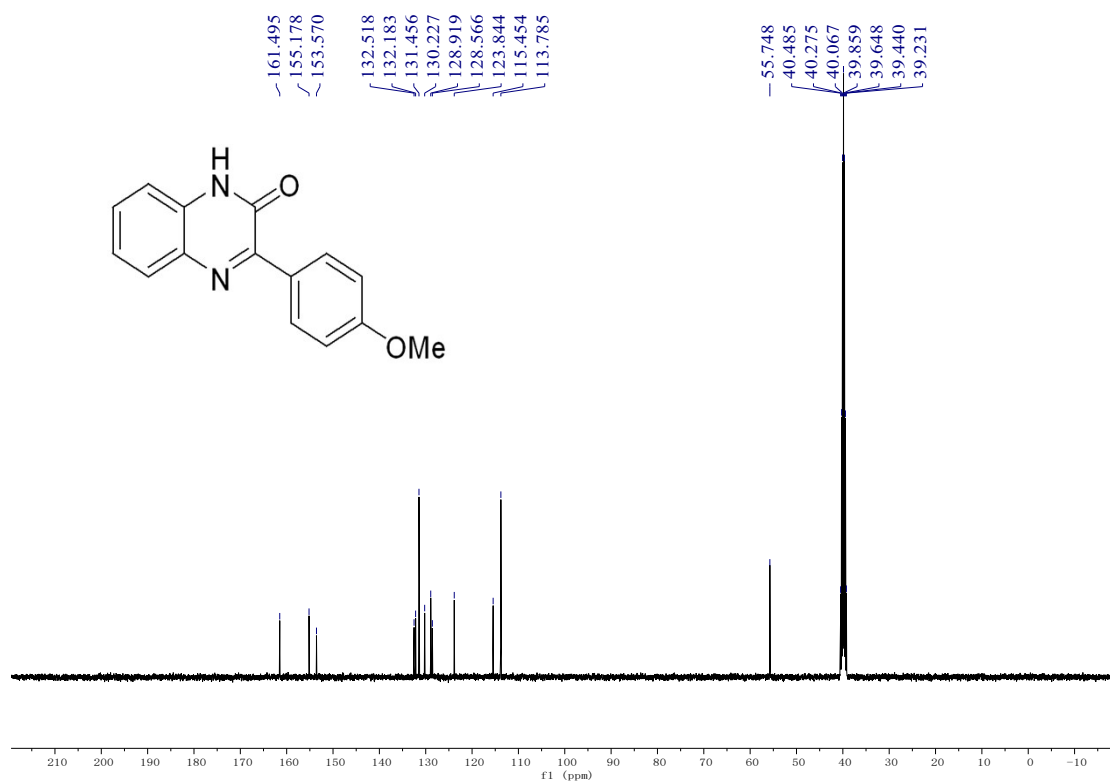
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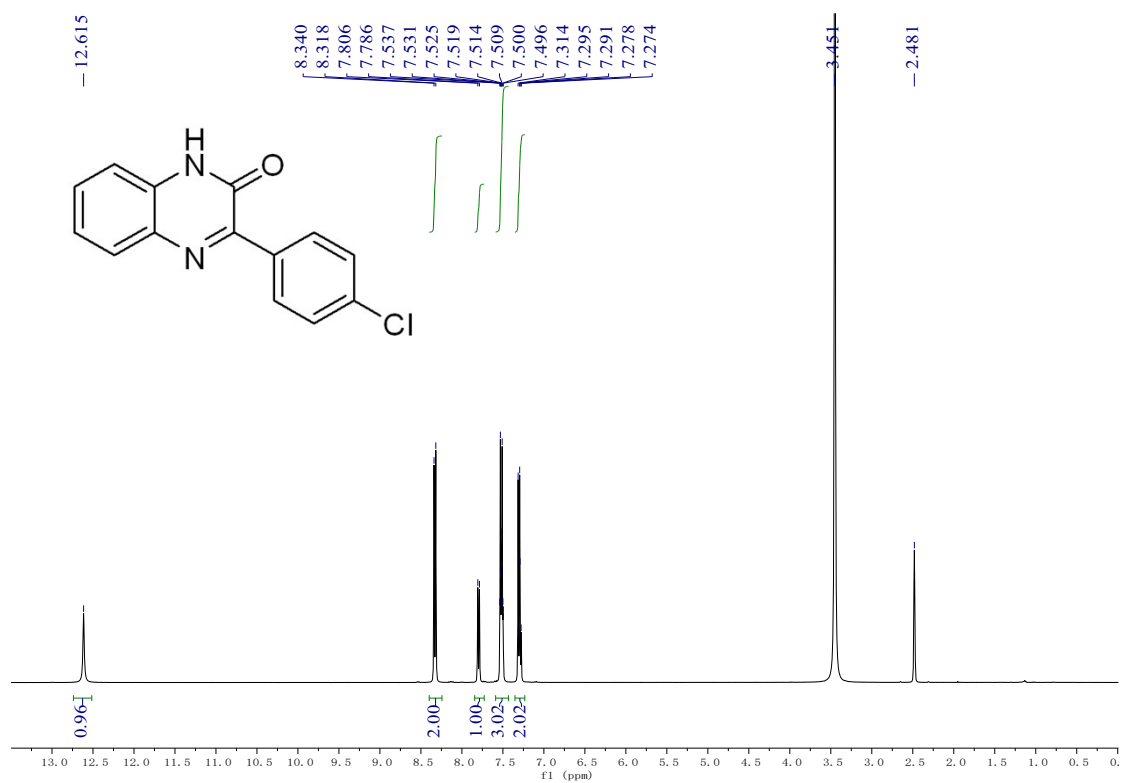
¹H NMR spectrum of 3r (400 MHz, CDCl₃)



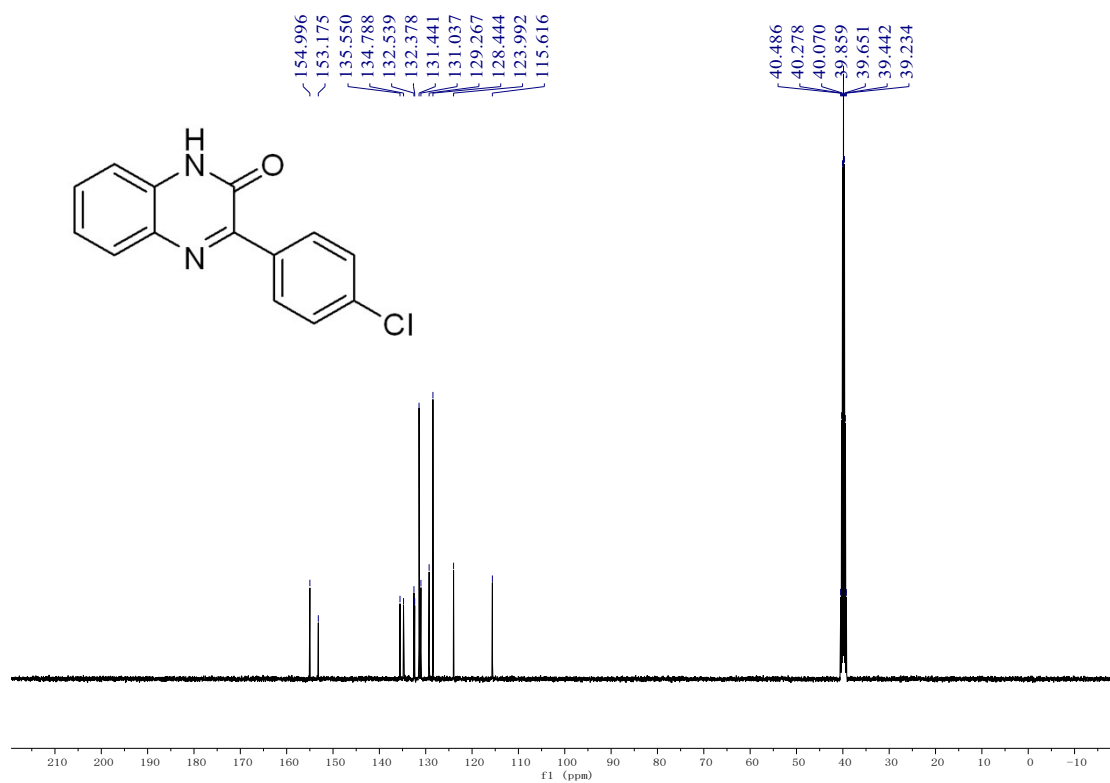
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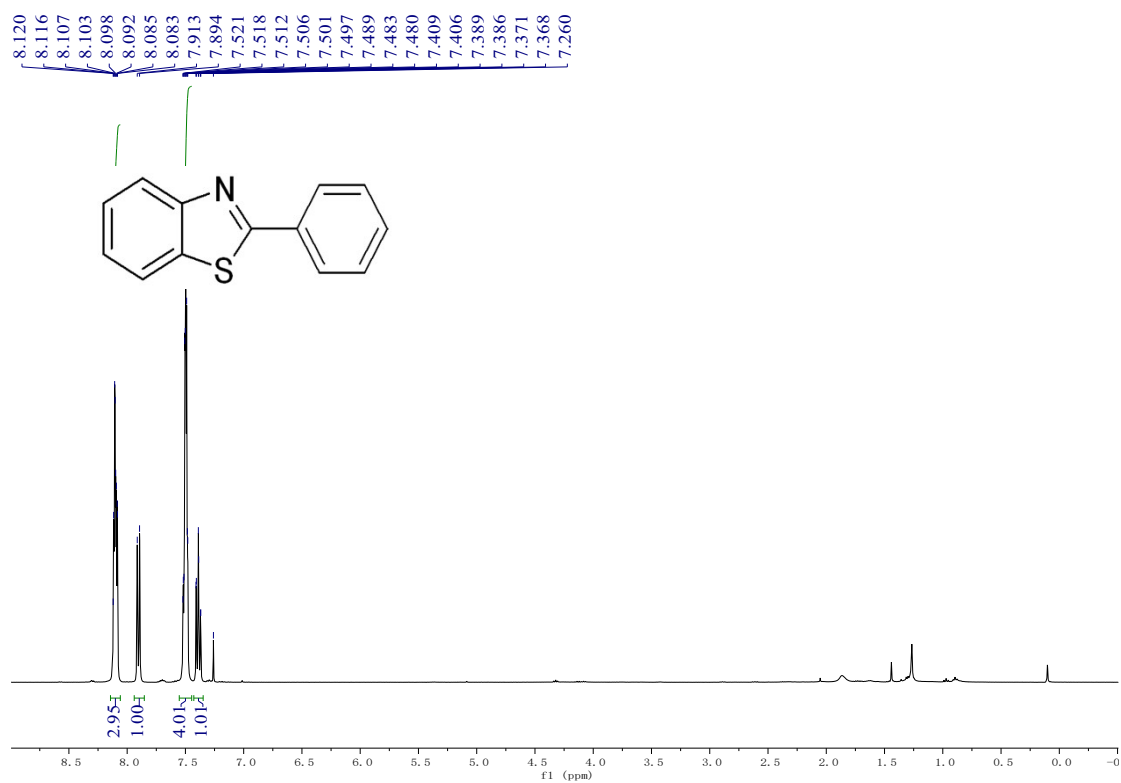
¹H NMR spectrum of 4s (400 MHz, CDCl₃)



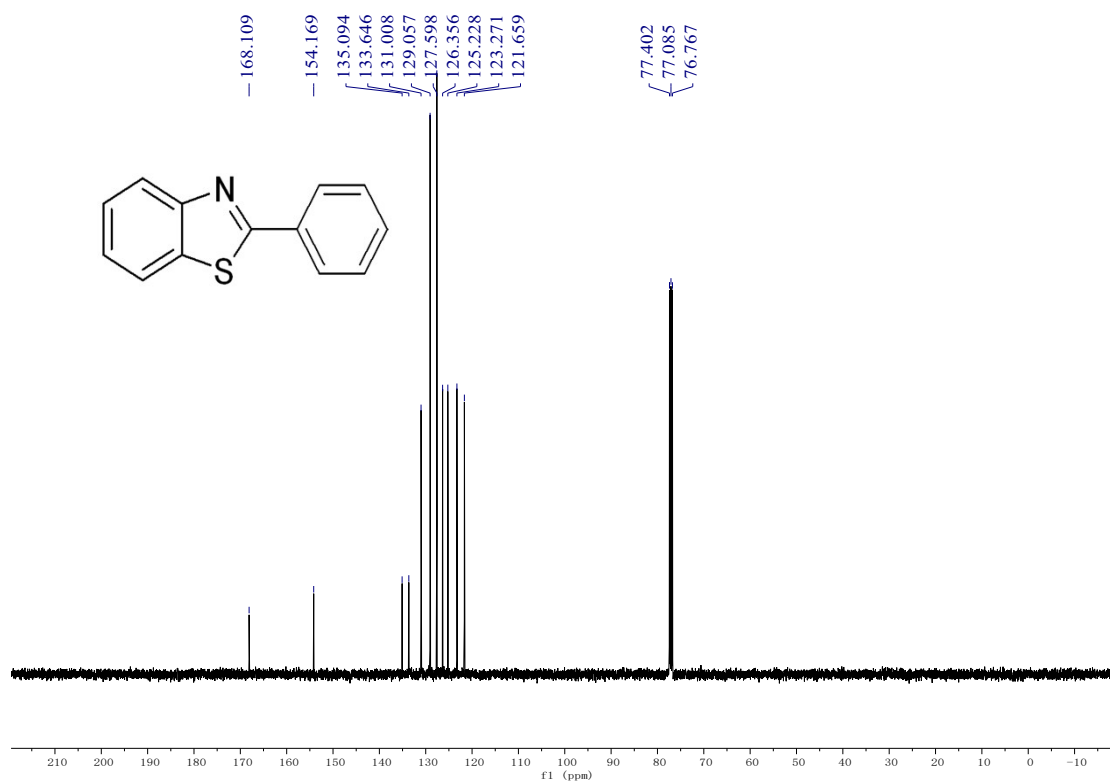
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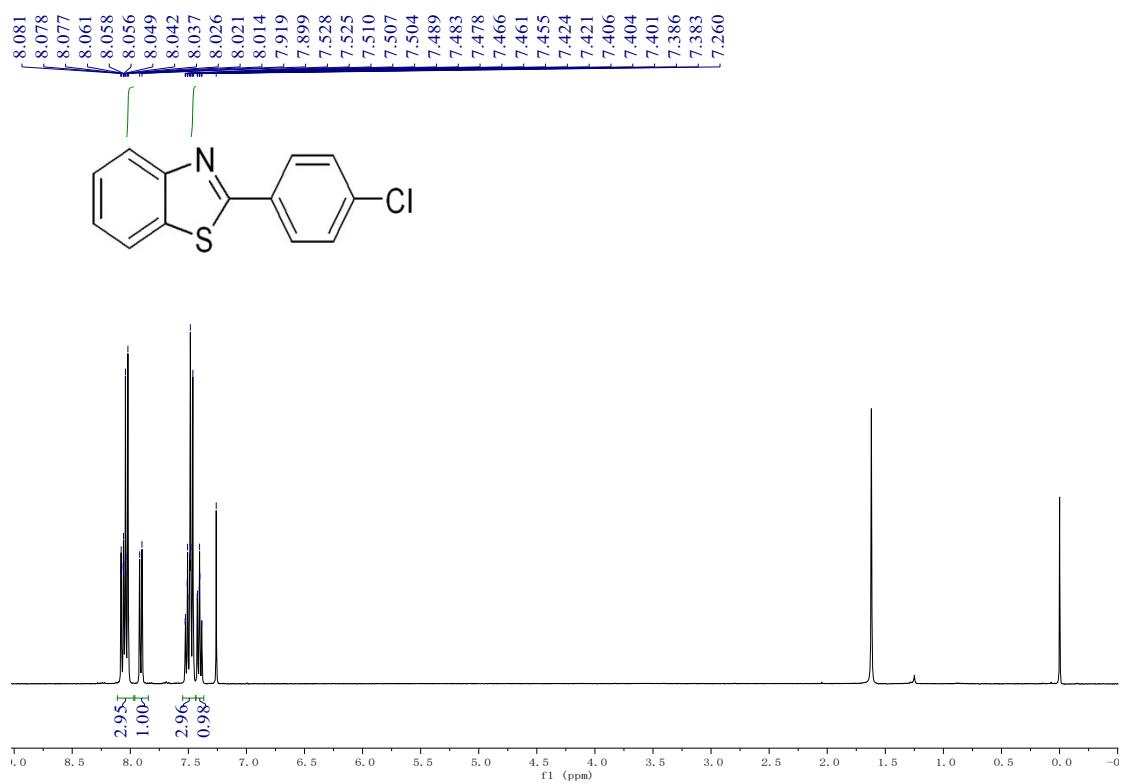
¹H NMR spectrum of 4t (400 MHz, CDCl₃)



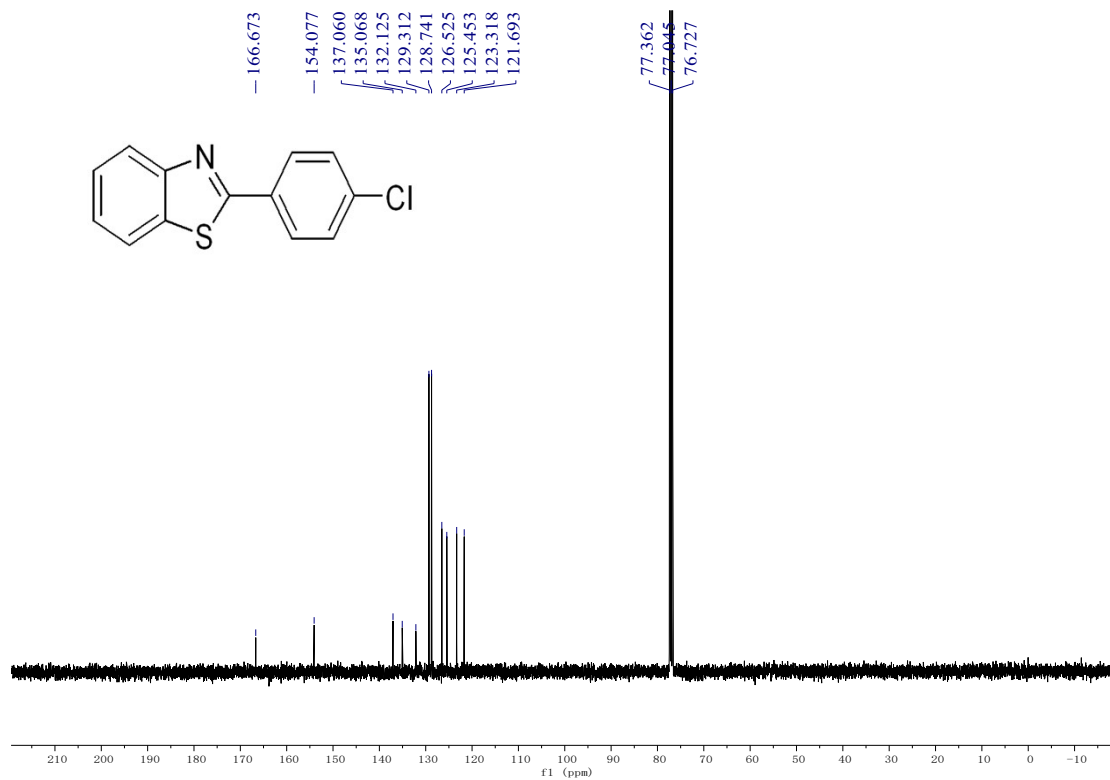
¹³C NMR spectrum of 4t (100 MHz, CDCl₃)



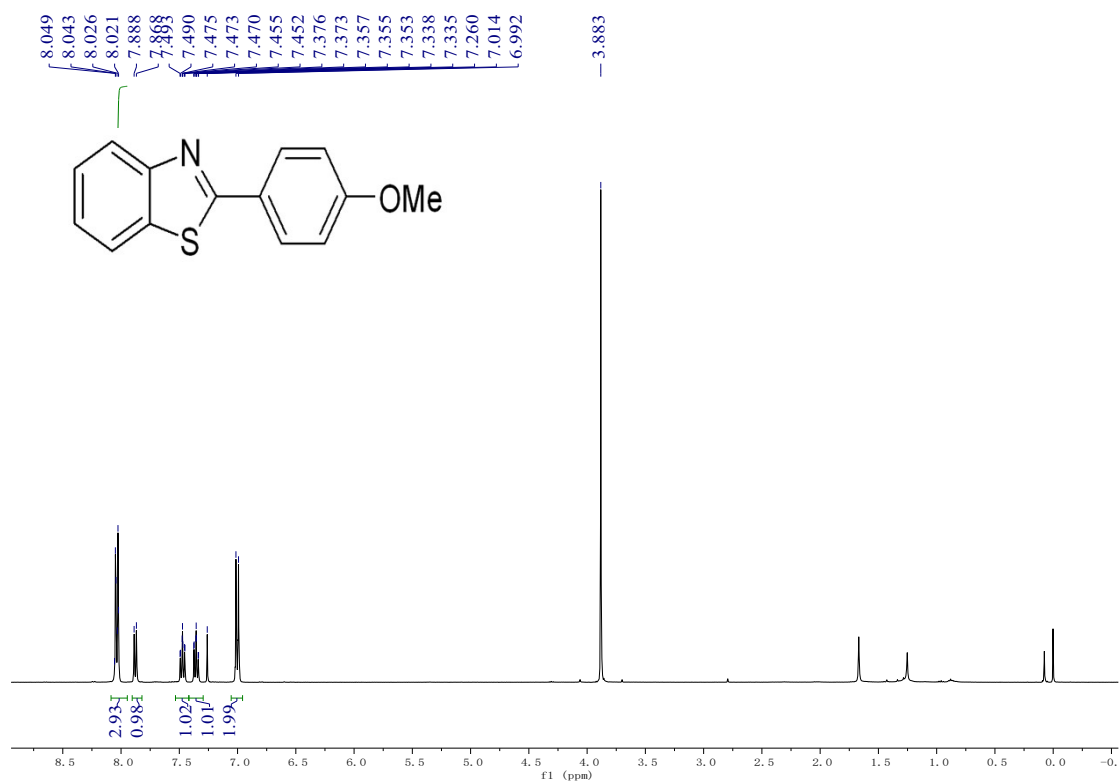
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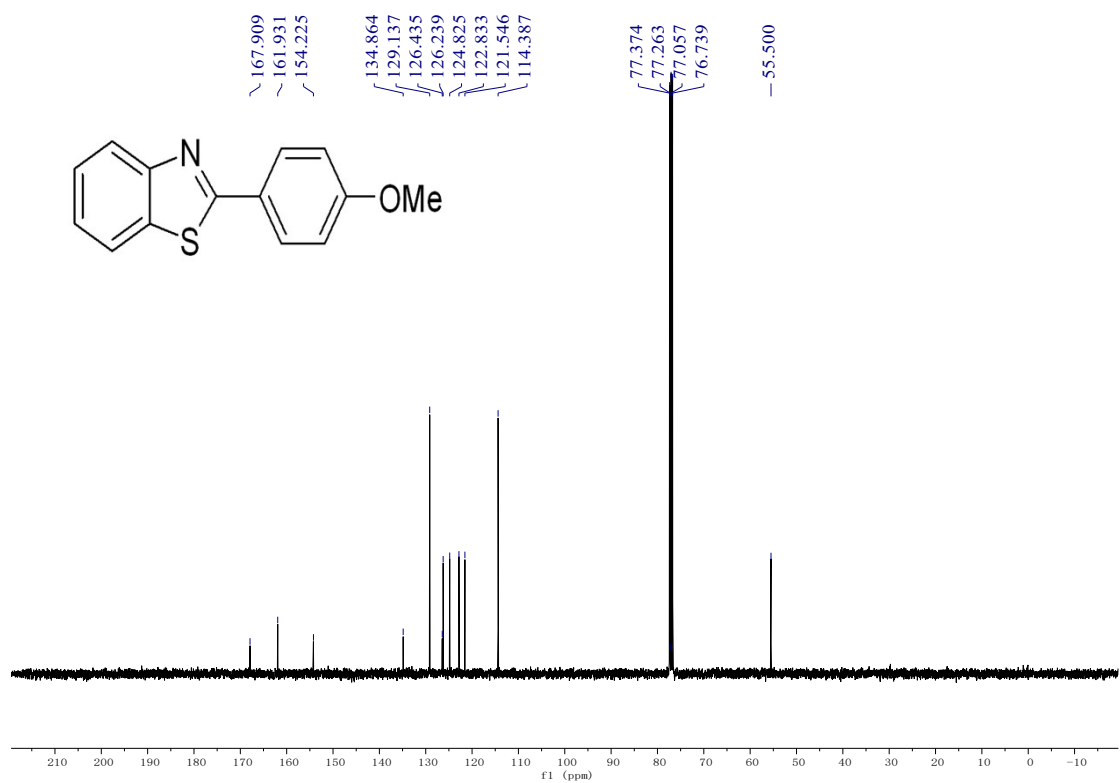
¹³C NMR spectrum of 4u (100 MHz, CDCl₃)



¹H NMR spectrum of 4v (400 MHz, CDCl₃)

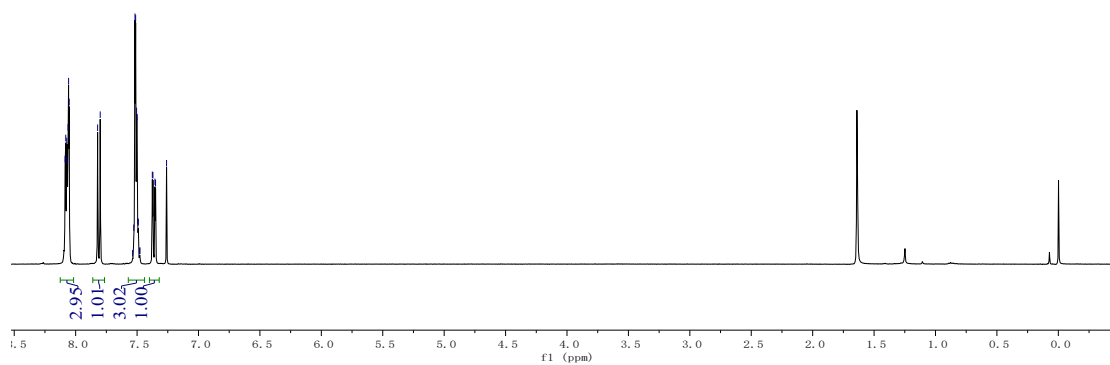
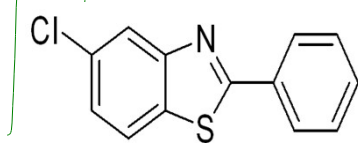


¹³C NMR spectrum of 4v (100 MHz, CDCl₃)



¹H NMR spectrum of 4w (400 MHz, CDCl₃)

8.086
8.081
8.073
8.069
8.062
8.058
8.053
7.821
7.800
7.537
7.527
7.517
7.512
7.504
7.500
7.494
7.490
7.480
7.476
7.376
7.371
7.355
7.350
7.260



¹³C NMR spectrum of 4w (100 MHz, CDCl₃)

