Supporting Information

CuCl-photocatalyzed C-H amination of benzoxazoles

Guan-Nan Li,[a,b] Hao-Cong Li,[a] Zhan Lu,[a,b]* and Bing Yu[a]*

[a] Green Catalysis Center, College of Chemistry, Zhengzhou University, Zhengzhou 450001, China. E-mail: bingyu@zzu.edu.cn

[b] Department of Chemistry, Zhejiang University, Hangzhou, Zhejiang 310058, China. E-mail: luzhan@zju.edu.cn

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1. General Information

1.1 Materials and instruments

All the chemical reagents were purchased from commercial sources and directly used without further purification. Reactions were monitored by Thin Layer Chromatography (TLC) using UV light (254/365 nm). Products were purified by column chromatography, which was carried out on 200-300 mesh of silica gel. All the ^{1}H and ^{13}C spectra were recorded on Bruker Avance 400 MHz spectrometer operating at 400 MHz and 101 MHz, respectively. Proton chemical shifts δ were given in ppm using tetramethylsilane as internal standard. All NMR spectra were recorded in $CDCl_3$ at room temperature (20 ± 3 °C). High resolution mass spectra (HRMS) were taken with a 3000-mass spectrometer, using Waters Q-Tof MS/MS system with the ESI technique

1.2 The spectrum of our lamp and the visible-light irradiation instrument

Photochemical reaction was carried out under visible light irradiation by a blue LED at 25 ºC. RLH-18 8-position Photo Reaction System manufactured by Beijing Roger Tech Ltd. was used in this system. Eight 10W blue LEDs were equipped in this Photo reactor. The blue LED's energy peak wavelength is 455.5 nm, peak width at half-height is 22.3 nm. The reaction vessel is borosilicate glass test tube and the distance between it and the lamp is 15 mm, no filter applied.

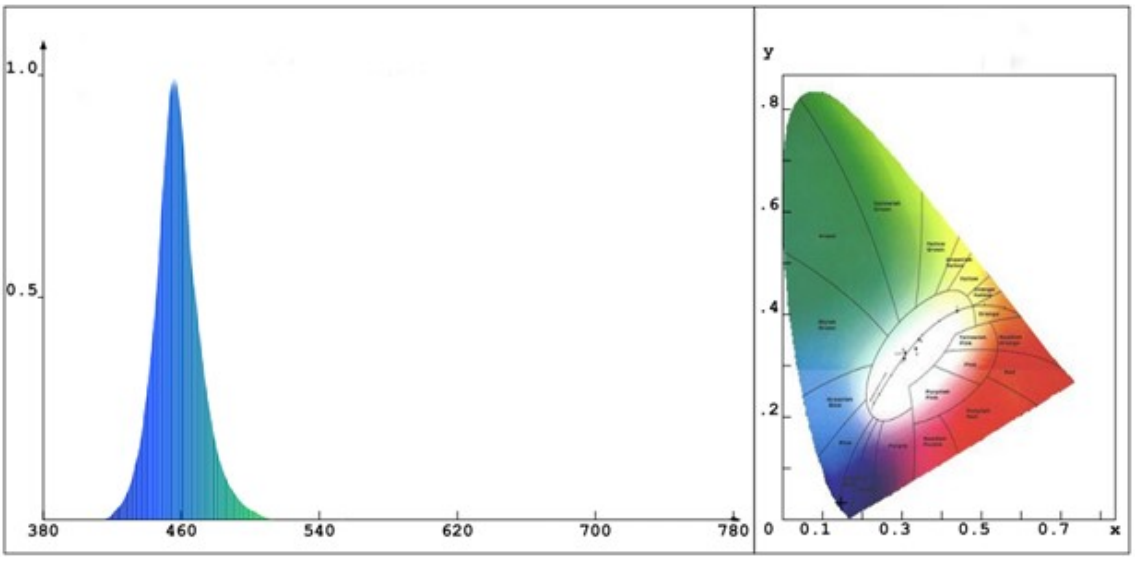


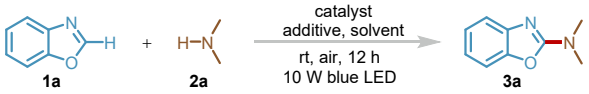
Figure S1a. The spectrum of our lamp (blue LED)

Figure S1b. The visible-light irradiation instrument

2. Experimental procedures

2.1 Optimization of reaction conditions

Table S1. Optimization of reaction conditions[a]

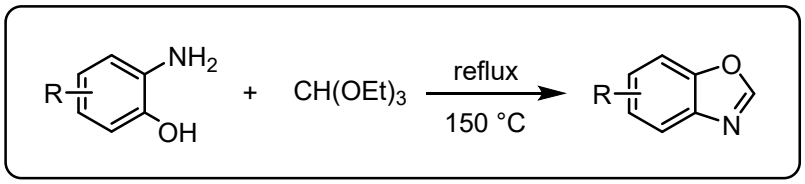


1a + **2a** → **3a**

entry	catalyst (mol%)	additive (equiv)	solvent	yield[b] (%)
1	CuCl (10)	-	THF	8
2	CuCl (10)	-	EtOAc	trace
3	CuCl (10)	-	DMF	N.R.
4	CuCl (10)	-	CH_3CN	5
5	CuCl (10)	-	1,4-dioxane	33
6	Cu_2O (10)	-	1,4-dioxane	N.R.
7	CuCN (10)	-	1,4-dioxane	N.R.
8	CuI (10)	-	1,4-dioxane	15
9	CuBr (10)	-	1,4-dioxane	32
10	CuCl (10)	CH_3COOH (1.2)	1,4-dioxane	53
11	CuCl (10)	PhCOOH (1.2)	1,4-dioxane	47
12	CuCl (10)	CF_3COOH (1.2)	1,4-dioxane	N.R.
13	CuCl (10)	CH_3COOH (2.4)	1,4-dioxane	67
14	CuCl (10)	CH_3COOH (3.6)	1,4-dioxane	25
15	CuCl (5)	CH_3COOH (2.4)	1,4-dioxane	36
16	CuCl (20)	CH_3COOH (2.4)	1,4-dioxane	70
17[c]	CuCl (20)	CH_3COOH (2.4)	1,4-dioxane	80 (72[d])
18	-	CH_3COOH (2.4)	1,4-dioxane	0
19	CuCl (20)	-	1,4-dioxane	53
20[e]	CuCl (20)	CH_3COOH (2.4)	1,4-dioxane	trace

[a]Reaction conditions: **1a** (0.2 mmol), **2a** (0.4 mmol), catalyst, acid, solvent (2 mL), air at room temperature for 12 h under the irradiation of 10 W blue LED (460 nm). N.R. = No Reaction. THF = Tetrahydrofuran. [b]Yields were given by ^1H NMR using 1,1,2,2-tetrachloroethane as an internal standard. [c]**1a** (0.2 mmol), **2a** (0.6 mmol). [d]Isolated yield. [e]In dark.

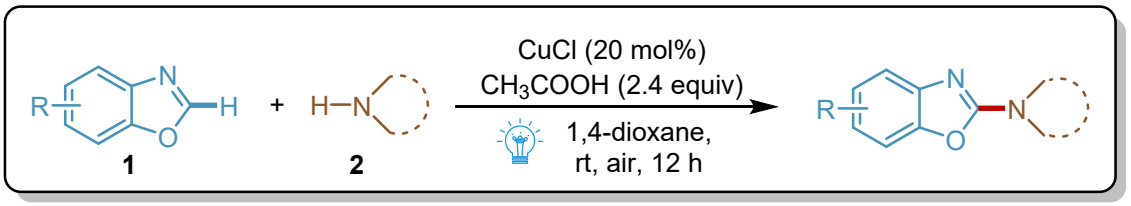
2.2 Preparation of starting materials



Scheme S1. General experimental procedures for substrates

According to previous literature reports,[1] 2-aminophenol derivatives (7 mmol) and triethyl orthoformate (20 mL) were added to a 50 mL double-necked flask under N_2. The resulting mixture was refluxed at 150 ºC for 4-8 h and the progress of the reaction was checked by thin layer chromatography (TLC) until the 2-aminophenol derivative was completely consumed. After the reaction, the excess triethyl orthoformate was removed under reduced pressure. The mixture was diluted with water and ethyl acetate, the aqueous layer was extracted with ethyl acetate (20 mL×3 times). The combined organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by silica gel column chromatography to obtain the desired products.

2.3 General experimental procedures for the desired products



Scheme S2. General experimental procedures for aminated benzoxazole

In a 25 mL reaction tube, **1** (1.0 equiv, 0.2 mmol), **2** (3.0 equiv, 0.6 mmol), CuCl (20 mol%), CH_3COOH (2.4 equiv) were dissolved in 1,4-dioxane (2 mL), and then the tube was stirred in air at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm). After the reaction, the mixture was extracted with water and ethyl acetate, and the organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by column chromatography on silica gel.

2.4 Procedure for the gram-scale experiment for 3b

In a 250 mL flask, **1b** (1.0 equiv, 10 mmol), **2a** (3.0 equiv, 30 mmol), CuCl (20 mol%), CH_3COOH (2.4 equiv) was dissolved in 1,4-dioxane (100 mL). Then the flack was stirred in air at room temperature for 12 h with the irradiation of 10 W blue LED (456 nm). After the reaction, the mixture was extracted with water and ethyl acetate. The aqueous layer was extracted with ethyl acetate (20 mL×3 times), and the combined organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by column chromatography on silica gel.

2.5 Preliminary mechanistic studies

2.5.1 The addition of 1,1-diphenylethylene in the model reaction system

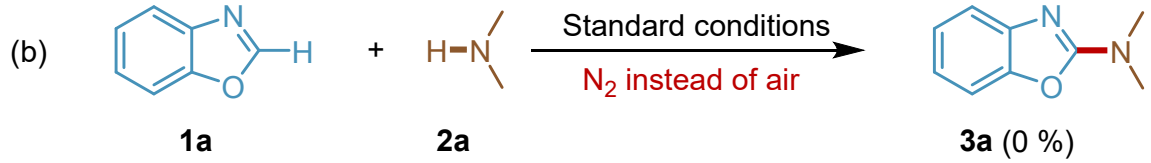
In a 25 mL reaction tube, **1a** (1.0 equiv, 0.2 mmol), **2a** (3.0 equiv, 0.6 mmol), CuCl (20 mol%), CH_3COOH (2.4 equiv) were dissolved in 1,4-dioxane (2 mL), then 1,1-diphenylethylene (3.0 equiv) was added in the mixture. Next, the flack was stirred in air at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm).

(a) **1a** + **2a** —Standard conditions→ **3a**

No scavenger **Yield: 72%**

1,1-diphenylethylene (3.0 equiv) **70%**

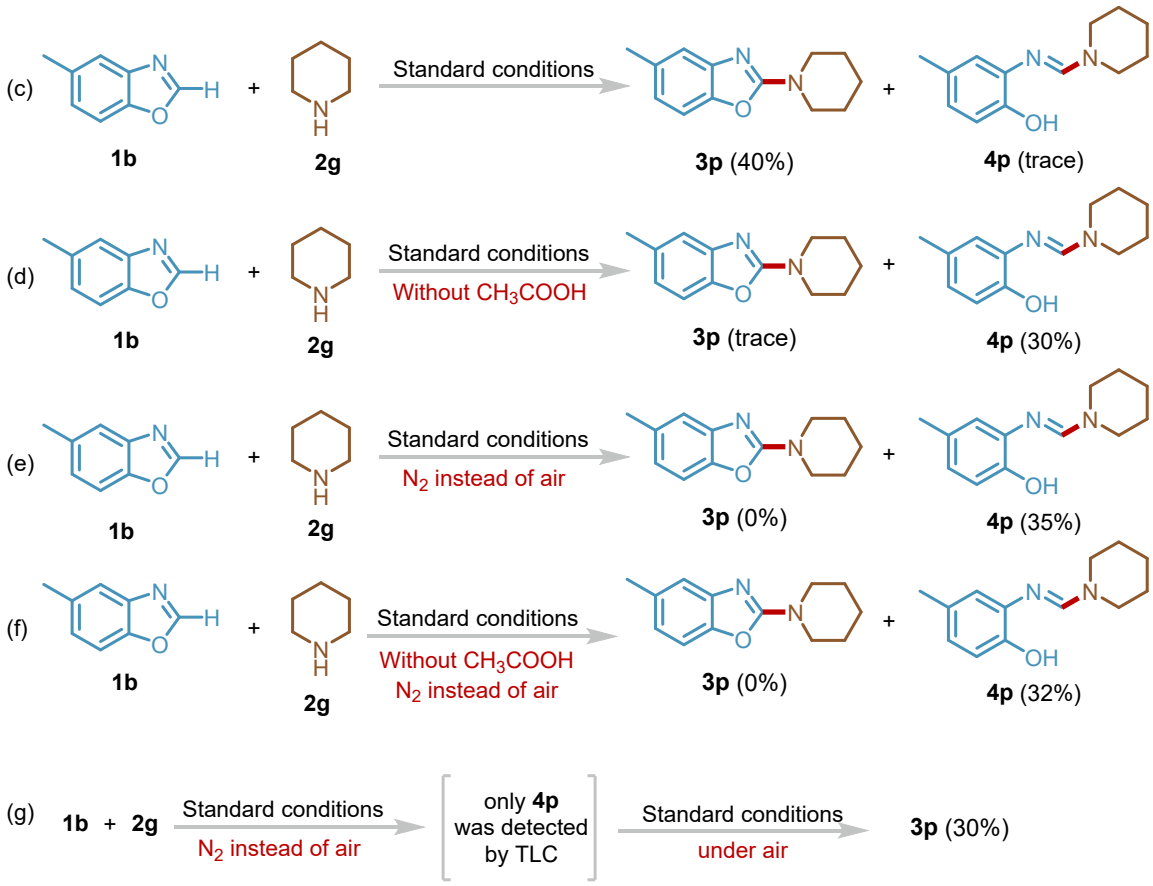
2.5.2 The model reaction was carried under N_2



Scheme S3. The model reaction was carried under N_2

In a 25 mL reaction tube, **1a** (1.0 equiv, 0.2 mmol), **2a** (3.0 equiv, 0.6 mmol), CuCl (20 mol%), CH_3COOH (2.4 equiv) were dissolved in 1,4-dioxane (2 mL), and then the tube was stirred under N_2 at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm). The present transformation was completely inhibited and none of the desired product was detected.

2.5.3 Control experiments



Scheme S4. Control experiments

(c): In a 25 mL reaction tube, **1b** (1.0 equiv, 0.2 mmol), **2g** (3.0 equiv, 0.6 mmol), CuCl (20 mol%), CH_3COOH (2.4 equiv) were dissolved in 1,4-dioxane (2 mL), and then the tube was stirred in air at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm). After the reaction, the mixture was extracted with water and ethyl acetate, and the organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by column chromatography on silica gel.

(d): In a 25 mL reaction tube, **1b** (1.0 equiv, 0.2 mmol), **2g** (3.0 equiv, 0.6 mmol), CuCl (20 mol%) were dissolved in 1,4-dioxane (2 mL), and then the tube was stirred in air at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm). After the reaction, the mixture was extracted with water and ethyl acetate, and the organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by column chromatography on silica

gel.

(e): In a 25 mL reaction tube, **1b** (1.0 equiv, 0.2 mmol), **2g** (3.0 equiv, 0.6 mmol), CuCl (20 mol%), CH_3COOH (2.4 equiv) were dissolved in 1,4-dioxane (2 mL), and then the tube was stirred under N_2 at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm). After the reaction, the mixture was extracted with water and ethyl acetate, and the organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by column chromatography on silica gel.

(f): In a 25 mL reaction tube, **1b** (1.0 equiv, 0.2 mmol), **2g** (3.0 equiv, 0.6 mmol), CuCl (20 mol%) were dissolved in 1,4-dioxane (2 mL), and then the tube was stirred under N_2 at room temperature for 12 h with the irradiation of 10 W blue LED (460 nm). After the reaction, the mixture was extracted with water and ethyl acetate, and the organic layer was washed with saturated brine and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo, and the residue was purified by column chromatography on silica gel.

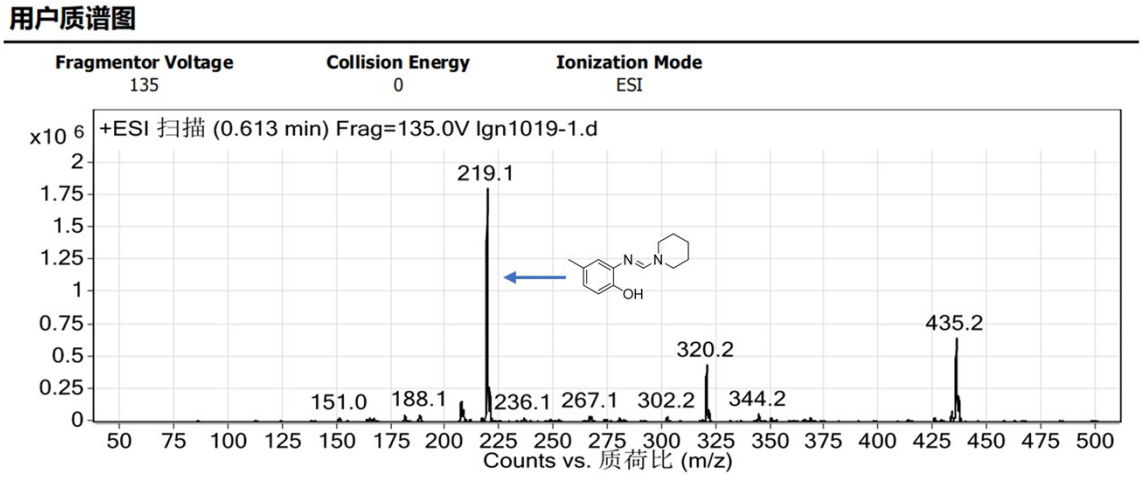
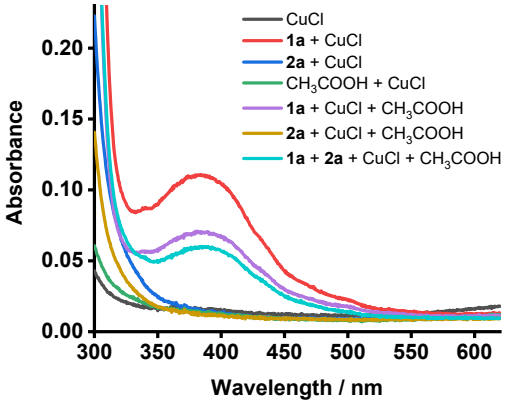


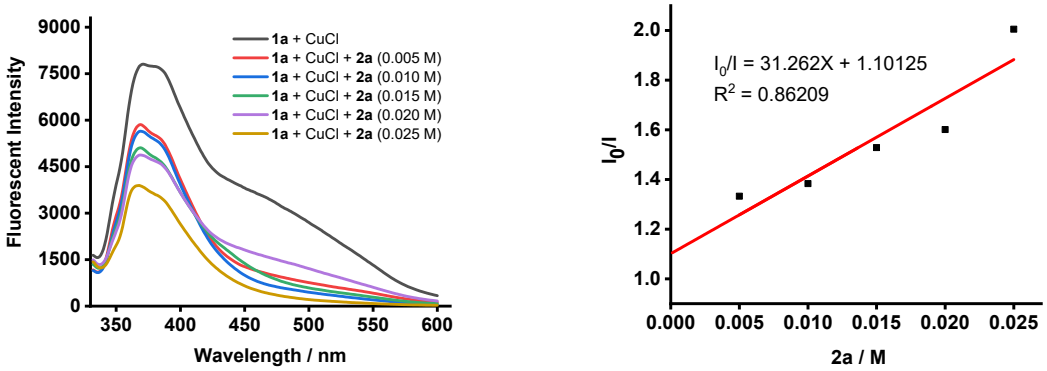
Figure S3. The MS analysis

2.5.4 The UV-Vis light absorption experiment and Luminescence quenching experiments



Scheme S5. The UV-Vis light absorption experiment

Emission intensities were recorded in a 10.0 mm, 4 mL quartz cuvette. The concentration of catalyst was 2×10^{-3} M. The concentration of benzoxazole was 1×10^{-2} M and the concentration of CH_3COOH was 2.4×10^{-2} M. The concentration of dimethylamine was 3×10^{-2} M. All the experiment results had been given in the scheme S5.

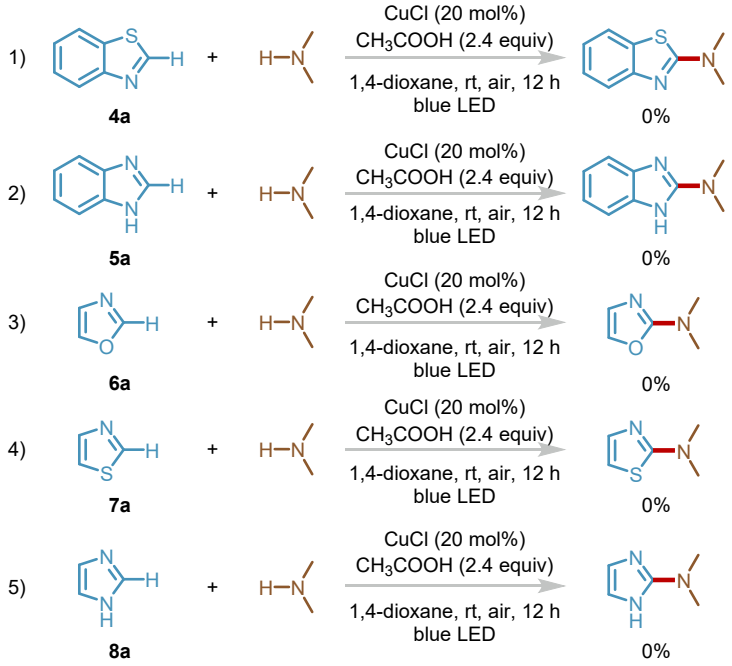


Scheme S6. Luminescence quenching study

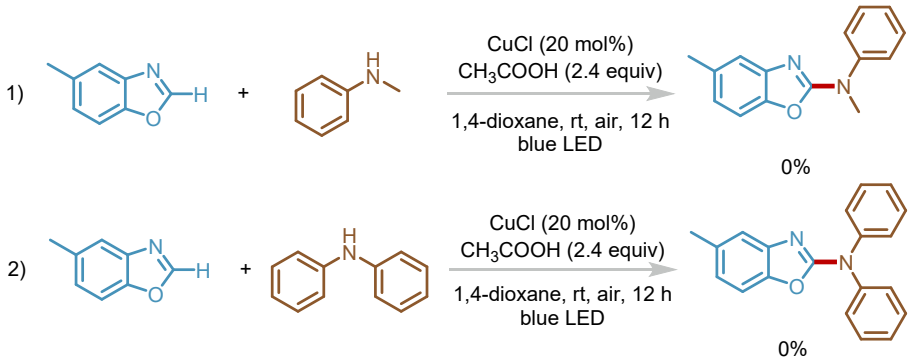
Stern−Volmer fluorescence quenching experiments were run with a freshly prepared solution of 5×10^{-4} M solution of copper complex (**1a** + CuCl) in dry 1,4-dioxane, which was added with an appropriate amount of a quencher (**2a**) in a screw-top quartz cuvette at room temperature. After degassing the sample with a stream of N_2 for 10 min, the emission of the sample was analyzed. All the experiment results had been given in the scheme S6.

2.6 Unsuccessful examples

To further investigate the applicable scope of this reaction, we tried to use other azole compounds. Unfortunately, benzothiazole, benzimidazole, oxazole, thiazole, and imidazole did not react with dimethylamine under standard conditions to obtain the target products.



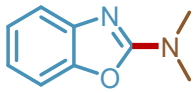
At the same time, we also explored N-methylaniline and diphenylamine as nitrogen coupling reagents to react with 5-methylbenzoxazole, but unfortunately we did not get the corresponding products.



Scheme S7. Unsuccessful examples

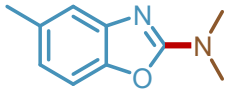
3. Characterization data for products

*N,N-dimethylbenzo[d]oxazol-2-amine (**3a**)*[2]



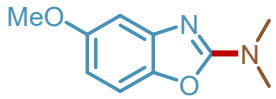
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 8:1, v/v) afforded the title compound as an orange solid (23.3 mg, 72% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 – 7.33 (m, 1H), 7.26 – 7.23 (m, 1H), 7.18 – 7.11 (m, 1H), 7.03 – 6.95 (m, 1H), 3.20 (s, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.1, 149.1, 143.6, 123.9, 120.2, 116.0, 108.6, 37.7.

*N,N,5-trimethylbenzo[d]oxazol-2-amine (**3b**)*[2]



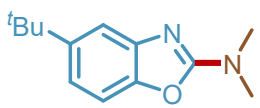
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 8:1, v/v) afforded the title compound as a light yellow solid (31.7 mg, 90% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.16 – 7.14 (m, 1H), 7.10 (d, *J* = 8.1 Hz, 1H), 6.80 – 6.77 (m, 1H), 3.17 (s, 6H), 2.38 (s, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.0, 147.0, 143.4, 133.2, 120.6, 116.1, 107.7, 37.4, 21.2.

*5-methoxy-N,N-dimethylbenzo[d]oxazol-2-amine (**3c**)*[2]



Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 8:1, v/v) afforded the title compound as a white solid (35.3 mg, 92% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.11 (d, *J* = 8.7 Hz, 1H), 6.92 (d, *J* = 2.5 Hz, 1H), 6.55 (dd, *J* = 8.7, 2.6 Hz, 1H), 3.80 (s, 3H), 3.17 (s, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.8, 157.0, 144.6, 143.7, 108.4, 106.6, 101.2, 55.9, 37.6.

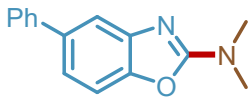
*5-(tert-butyl)-N,N-dimethylbenzo[d]oxazol-2-amine (**3d**)*[3]



Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 20:1, v/v) afforded the title compound as a white solid (31.4 mg, 72% yield); ^{1}H NMR

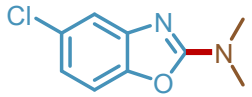
(400 MHz, Chloroform-*d*) δ 7.42 (d, *J* = 1.8 Hz, 1H), 7.15 (d, *J* = 8.4 Hz, 1H), 7.03 (dd, *J* = 8.4, 1.9 Hz, 1H), 3.19 (s, 6H), 1.34 (s, 9H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.3, 147.3, 147.0, 143.3, 117.3, 113.2, 107.6, 37.7, 34.8, 31.8.

*N,N-dimethyl-5-phenylbenzo[d]oxazol-2-amine (**3e**)*[2]



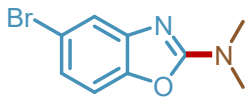
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a white solid (40.9 mg, 86% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 – 7.56 (m, 3H), 7.44 – 7.39 (m, 2H), 7.33 – 7.19 (m, 3H), 3.19 (s, 6H).^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.5, 148.8, 144.3, 141.7, 137.7, 128.7, 127.3, 126.8, 119.6, 114.7, 108.6, 37.7.

*5-chloro-N,N-dimethylbenzo[d]oxazol-2-amine (**3f**)*[2]



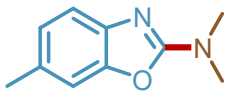
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as an orange solid (25.1 mg, 64% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.29 (d, *J* = 2.1 Hz, 1H), 7.13 (d, *J* = 8.4 Hz, 1H), 6.95 (dd, *J* = 8.4, 2.1 Hz, 1H), 3.19 (s, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.8, 147.7, 145.0, 129.2, 120.0, 116.1, 109.1, 37.7.

*5-bromo-N,N-dimethylbenzo[d]oxazol-2-amine (**3g**)*[2]



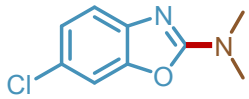
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as an orange solid (31.8 mg, 66% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.47 – 7.42 (m, 1H), 7.09 (d, *J* = 0.9 Hz, 2H), 3.20 (s, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.6, 148.1, 145.5, 122.8, 119.0, 116.6, 109.6, 37.7.

*N,N,6-trimethylbenzo[d]oxazol-2-amine (**3h**)*[4]



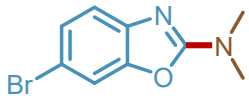
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a white solid (28.1 mg, 80% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.22 (d, *J* = 7.9 Hz, 1H), 7.07 – 7.05 (m, 1H), 6.98 – 6.93 (m, 1H), 3.18 (s, 6H), 2.39 (s, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.9, 149.3, 141.1, 130.2, 124.5, 115.4, 109.2, 37.7, 21.4.

*6-chloro-N,N-dimethylbenzo[d]oxazol-2-amine (**3i**)*[5]



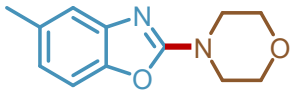
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as an orange solid (28.6 mg, 73% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.25 – 7.21 (m, 2H), 7.14 – 7.10 (m, 1H), 3.19 (s, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.4, 149.2, 142.5, 125.2, 124.1, 116.2, 109.4, 37.7.

*6-bromo-N,N-dimethylbenzo[d]oxazol-2-amine (**3j**)*[5]



Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as an orange solid (34.6 mg, 72% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.39 (d, *J* = 1.8 Hz, 1H), 7.26 (dd, *J* = 8.3, 1.8 Hz, 1H), 7.19 (d, *J* = 8.3 Hz, 1H), 3.19 (s, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 163.1, 149.4, 142.8, 126.8, 116.7, 112.0, 111.9, 37.6.

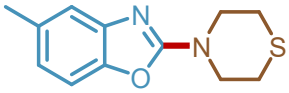
*5-methyl-2-morpholinobenzo[d]oxazole (**3k**)*[6]



Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a white solid (29.2 mg, 67% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.18 – 7.16 (m, 1H), 7.13 (d, *J* = 8.1 Hz, 1H), 6.87 – 6.81 (m, 1H), 3.84 – 3.78 (m, 4H), 3.69 – 3.65 (m, 4H), 2.39 (s, 3H); ^{13}C NMR (101 MHz,

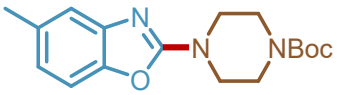
Chloroform-*d*) δ 162.3, 146.9, 142.9, 133.8, 121.6, 116.9, 108.2, 66.2, 45.7, 21.5.

*5-methyl-2-thiomorpholinobenzo[d]oxazole (**3l**)*[7]



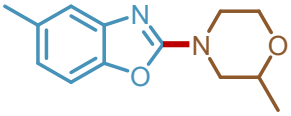
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a white solid (36.0 mg, 77% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.16 – 7.15 (m, 1H), 7.12 (d, *J* = 8.1 Hz, 1H), 6.84 – 6.81 (m, 1H), 4.00 – 3.96 (m, 4H), 2.74 – 2.70 (m, 4H), 2.39 (s, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.9, 146.8, 143.0, 133.8, 121.4, 116.7, 108.1, 48.1, 26.7, 21.5.

*tert-butyl 4-(5-methylbenzo[d]oxazol-2-yl)piperazine-1-carboxylate (**3m**)*[8]



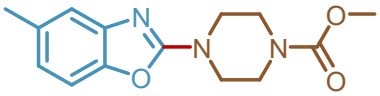
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a white solid (47.5 mg, 75% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.17 – 7.16 (m, 1H), 7.13 (d, *J* = 8.1 Hz, 1H), 6.86 – 6.81 (m, 1H), 3.68 – 3.62 (m, 4H), 3.58 – 3.54 (m, 4H), 2.39 (s, 3H), 1.49 (s, 9H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.2, 154.6, 146.9, 143.0, 133.8, 121.6, 116.8, 108.2, 80.4, 45.4, 28.4, 21.5.

*5-methyl-2-(2-methylmorpholino)benzo[d]oxazole (**3n**)*



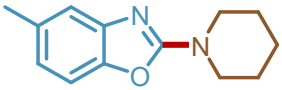
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a colorless oil liquid (30.1 mg, 65% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.16 (s, 1H), 7.12 (d, *J* = 8.1 Hz, 1H), 6.84 (d, *J* = 8.1 Hz, 1H), 4.10 – 3.96 (m, 3H), 3.76 – 3.67 (m, 2H), 3.29 – 3.20 (m, 1H), 2.94 – 2.85 (m, 1H), 2.39 (s, 3H), 1.25 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.2, 146.9, 143.0, 133.8, 121.6, 116.8, 108.2, 71.4, 66.1, 51.5, 45.0, 21.5, 18.6. HRMS (ESI-TOF) *m/z*: $[M + H]^+$ calcd for $C_{13}H_{17}N_2O_2$, 233.1285; found: 233.1292.

*methyl 4-(5-methylbenzo[d]oxazol-2-yl)piperazine-1-carboxylate (**3o**)*



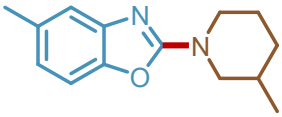
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a white solid (33.0 mg, 60% yield); mp: 136.1 – 137.5 °C; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.16 (s, 1H), 7.13 (d, *J* = 8.1 Hz, 1H), 6.84 (d, *J* = 8.1 Hz, 1H), 3.75 (s, 3H), 3.69 – 3.65 (m, 4H), 3.64 – 3.59 (m, 4H), 2.39 (s, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.0, 155.8, 146.9, 142.9, 133.8, 121.7, 116.9, 108.2, 52.9, 45.4, 43.2, 21.5. HRMS (ESI-TOF) *m/z*: [M + H]$^+$ calcd for $C_{14}H_{18}N_3O_3$, 276.1343; found: 276.1346.

*5-methyl-2-(piperidin-1-yl)benzo[d]oxazole (**3p**)*[6]



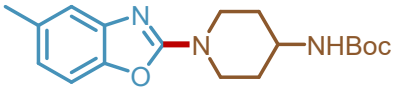
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 30:1, v/v) afforded the title compound as a white solid (17.3 mg, 40% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.15 – 7.13 (m, 1H), 7.09 (d, *J* = 8.1 Hz, 1H), 6.82 – 6.76 (m, 1H), 3.66 – 3.61 (m, 4H), 2.38 (s, 3H), 1.73 – 1.64 (m, 6H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.7, 146.9, 143.5, 133.5, 120.9, 116.4, 107.9, 46.6, 25.3, 24.1, 21.5.

*5-methyl-2-(3-methylpiperidin-1-yl)benzo[d]oxazole (**3q**)*[6]



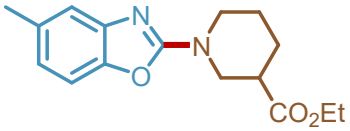
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 30:1, v/v) afforded the title compound as a white solid (23.0 mg, 50% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.15 – 7.13 (m, 1H), 7.09 (d, *J* = 8.1 Hz, 1H), 6.80 – 6.76 (m, 1H), 4.23 – 4.09 (m, 2H), 3.05 – 2.93 (m, 1H), 2.74 – 2.62 (m, 1H), 2.37 (s, 3H), 1.88 – 1.80 (m, 1H), 1.78 – 1.67 (m, 2H), 1.67 – 1.54 (m, 1H), 1.19 – 1.08 (m, 1H), 0.95 (d, *J* = 6.6 Hz, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162. 6, 146.8, 143.5, 133.4, 120.9, 116.4, 107.9, 53.0, 46.0, 32.7, 30.6, 24.8, 21.5, 18.9.

*tert-butyl (1-(5-methylbenzo[d]oxazol-2-yl)piperidin-4-yl)carbamate (**3r**)*



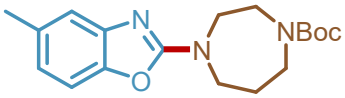
Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 20:1, v/v) afforded the title compound as a white solid (26.5 mg, 40% yield); mp: 170.2 – 171.8 °C; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.15 – 7.14 (m, 1H), 7.10 (d, *J* = 8.1 Hz, 1H), 6.83 – 6.79 (m, 1H), 4.27 – 4.19 (m, 2H), 3.24 – 3.15 (m, 2H), 2.38 (s, 3H), 2.09 – 2.04 (m, 2H), 1.52 – 1.47 (m, 2H), 1.45 (s, 9H), 1.44 – 1.41 (m, 1H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.3, 155.1, 146.9, 143.2, 133.6, 121.3, 116.6, 108.1, 44.8, 31.9, 28.4, 21.5. HRMS (ESI-TOF) *m/z*: [M + H]$^+$ calcd for $C_{18}H_{26}N_3O_3$, 332.1969; found: 332.1974.

*ethyl 1-(5-methylbenzo[d]oxazol-2-yl)piperidine-3-carboxylate (**3s**)*



Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1, v/v) afforded the title compound as a colorless oil liquid (24.8 mg, 43% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.16 – 7.14 (m, 1H), 7.11 (d, *J* = 8.1 Hz, 1H), 6.83 – 6.80 (m, 1H), 4.39 – 4.29 (m, 1H), 4.19 – 4.10 (m, 3H), 3.39 – 3.29 (m, 1H), 3.22 – 3.12 (m, 1H), 2.65 – 2.58 (m, 1H), 2.39 (s, 3H), 2.17 – 2.09 (m, 1H), 1.88 – 1.79 (m, 2H), 1.75 – 1.68 (m, 1H), 1.27 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 172.9, 162.2, 146.9, 143.2, 133.6, 121.3, 116.6, 108.1, 60.7, 47.4, 46.0, 41.0, 27.0, 23.8, 21.5, 14.2. HRMS (ESI-TOF) *m/z*: [M + H]$^+$ calcd for $C_{16}H_{21}N_2O_3$, 289.1547; found: 289.1554.

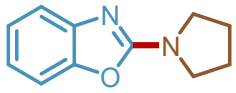
*tert-butyl 4-(5-methylbenzo[d]oxazol-2-yl)-1,4-diazepane-1-carboxylate (**3t**)*



Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 7:1, v/v) afforded the title compound as a colorless oil liquid (33.1 mg, 50% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.15 (s, 1H), 7.11 (d, *J* = 8.1 Hz, 1H), 6.82 – 6.78 (m, 1H), 3.80 – 3.75 (m, 2H), 3.71 (t, *J* = 6.2 Hz, 2H), 3.64 – 3.58 (m, 2H), 3.48 – 3.41 (m, 1H), 3.40 – 3.33 (m, 1H), 2.38 (s, 3H), 2.06 – 1.99 (m, 2H), 1.43 (d, *J* = 6.8 Hz, 9H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 162.0, 155.2, 154.9, 147.1, 143.5, 133.6,

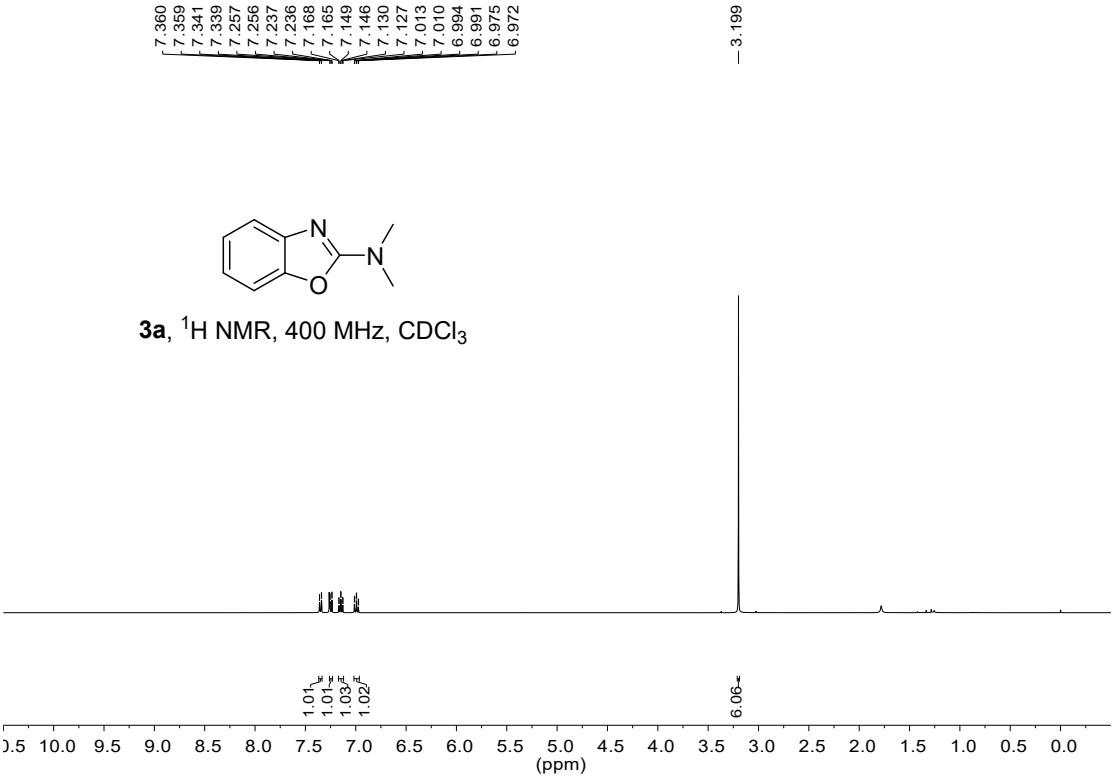
121.0, 116.5, 108.0, 79.9, 49.8, 49.4, 48.0, 47.8, 47.5, 46.4, 46.0, 28.4, 26.7, 26.5, 21.5. HRMS (ESI-TOF) *m/z*: $[M + H]^+$ calcd for $C_{18}H_{26}N_3O_3$, 332.1969; found: 332.1974.

*2-(pyrrolidin-1-yl)benzo[d]oxazole (**3u**)*[2]

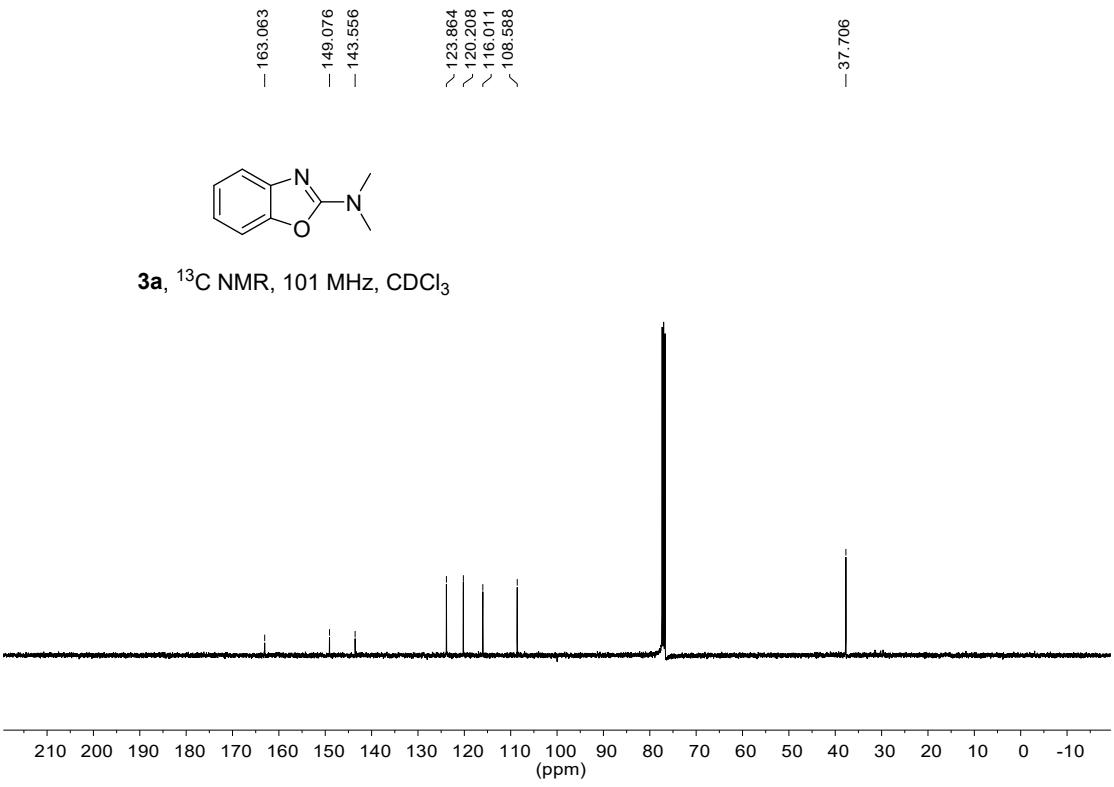


Purification by column chromatography on silica gel (petroleum ether/ethyl acetate = 8:1, v/v) afforded the title compound as a white solid (11.2 mg, 30% yield); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.36 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.26 (d, *J* = 7.7 Hz, 1H), 7.17 – 7.11 (m, 1H), 7.02 – 6.95 (m, 1H), 3.69 – 3.61 (m, 4H), 2.07 – 2.01 (m, 4H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.1, 149.1, 143.7, 123.8, 120.1, 116.0, 108.6, 47.5, 25.7

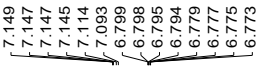
4. NMR copies of products

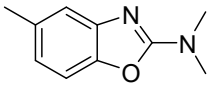


3a, ^{1}H NMR, 400 MHz, $CDCl_3$

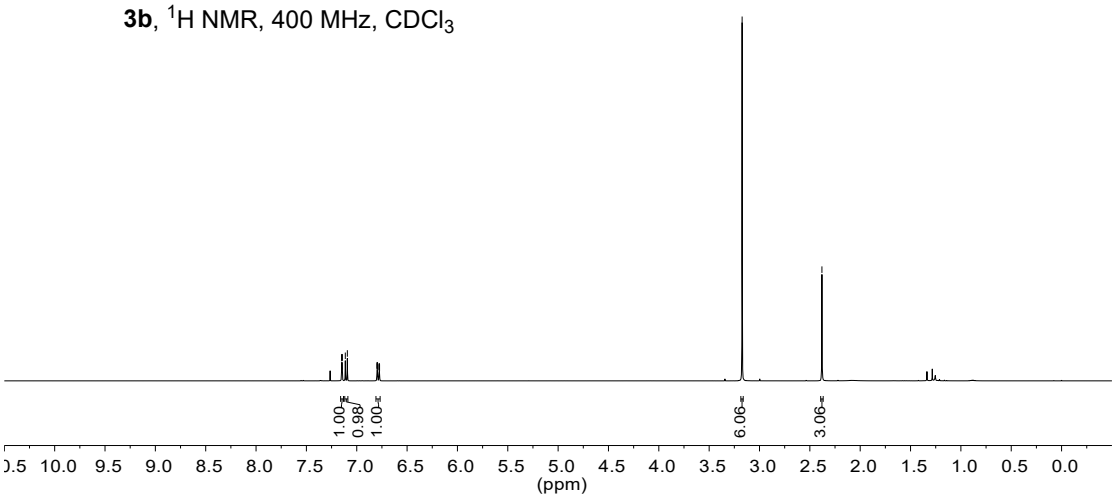


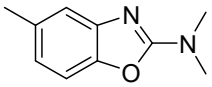
3a, ^{13}C NMR, 101 MHz, $CDCl_3$



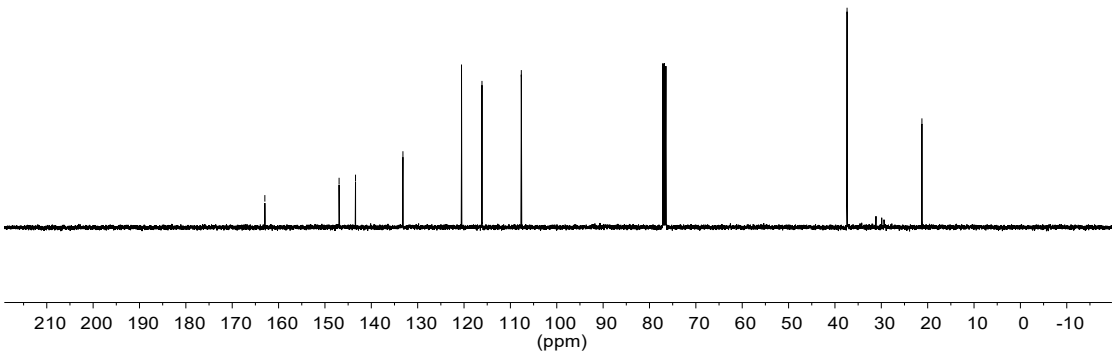


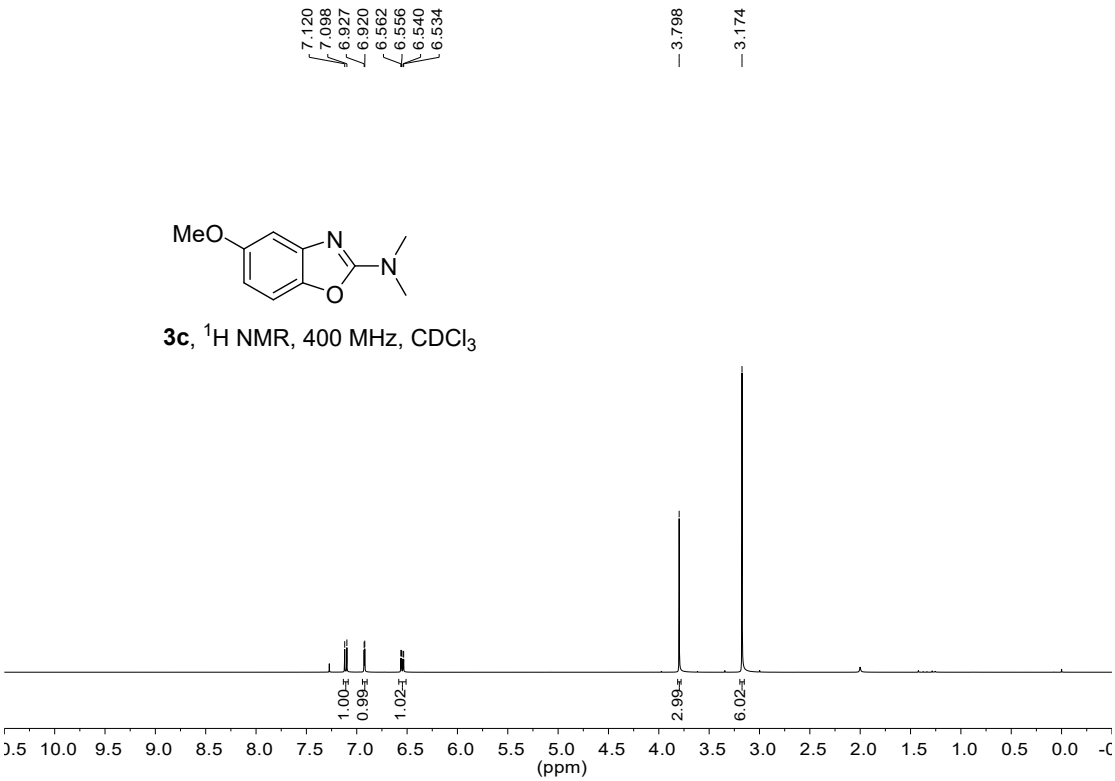
3b, ^{1}H NMR, 400 MHz, $CDCl_3$



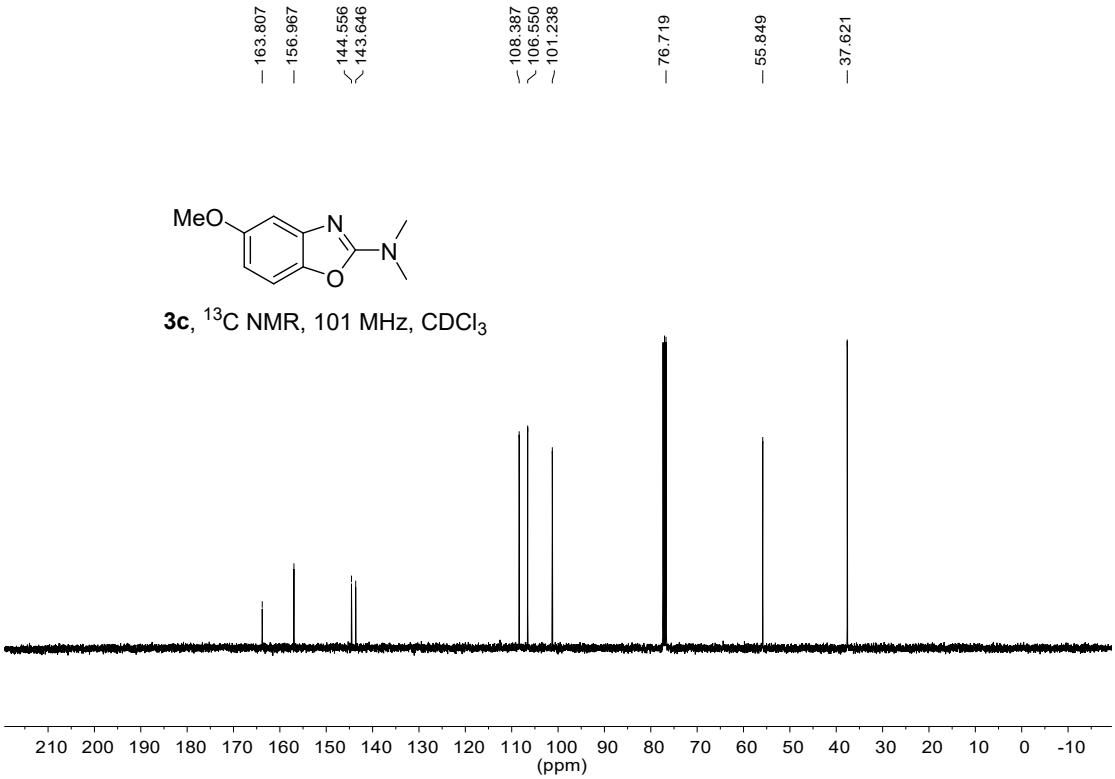


3b, ^{13}C NMR, 101 MHz, $CDCl_3$

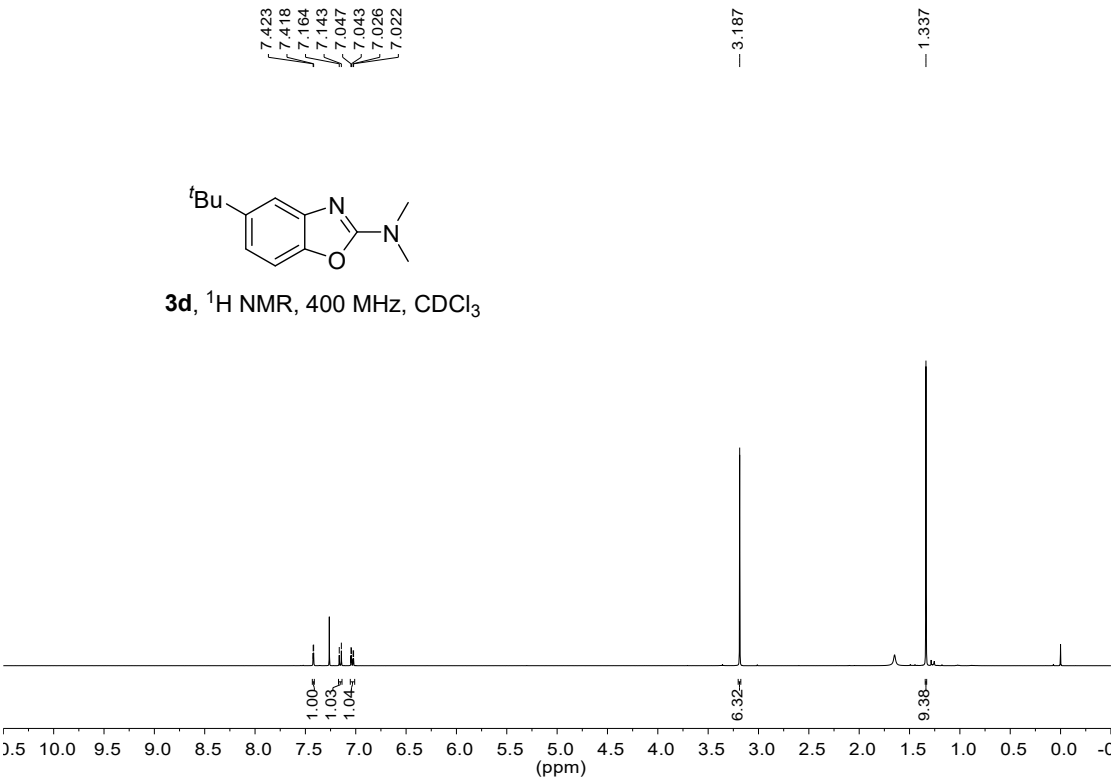




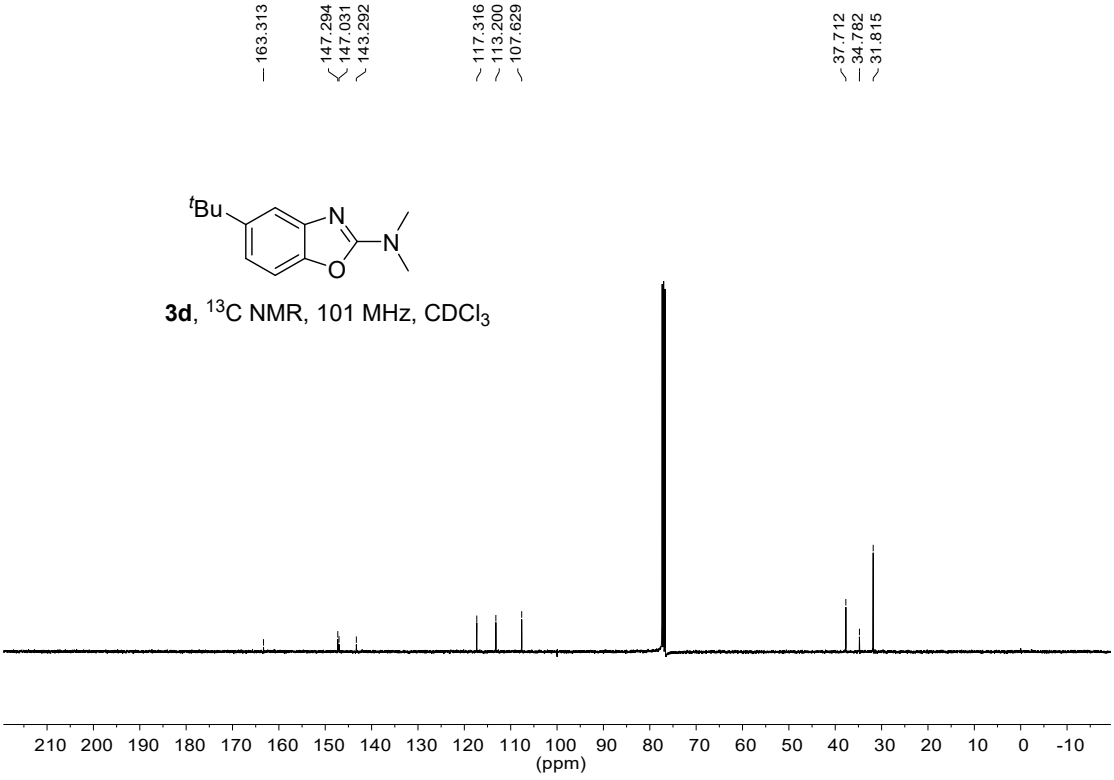
3c, ^{1}H NMR, 400 MHz, $CDCl_3$



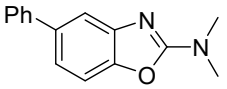
3c, ^{13}C NMR, 101 MHz, $CDCl_3$



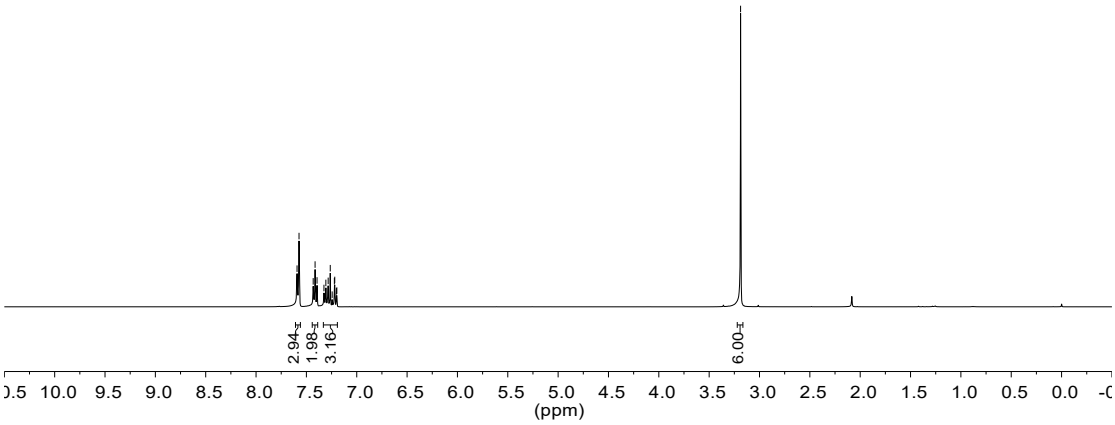
3d, ^{1}H NMR, 400 MHz, $CDCl_3$

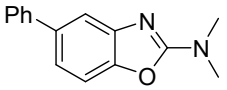


3d, ^{13}C NMR, 101 MHz, $CDCl_3$

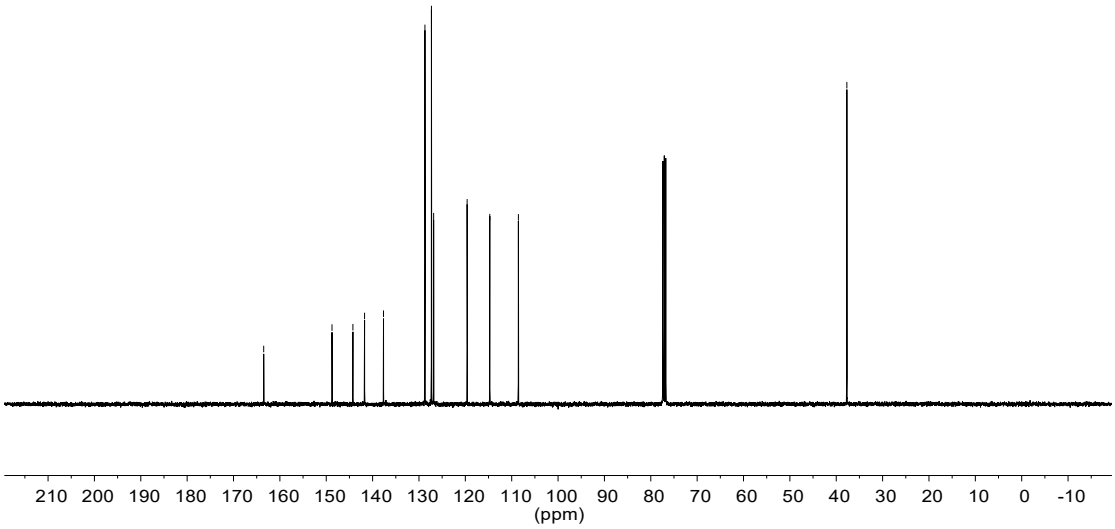


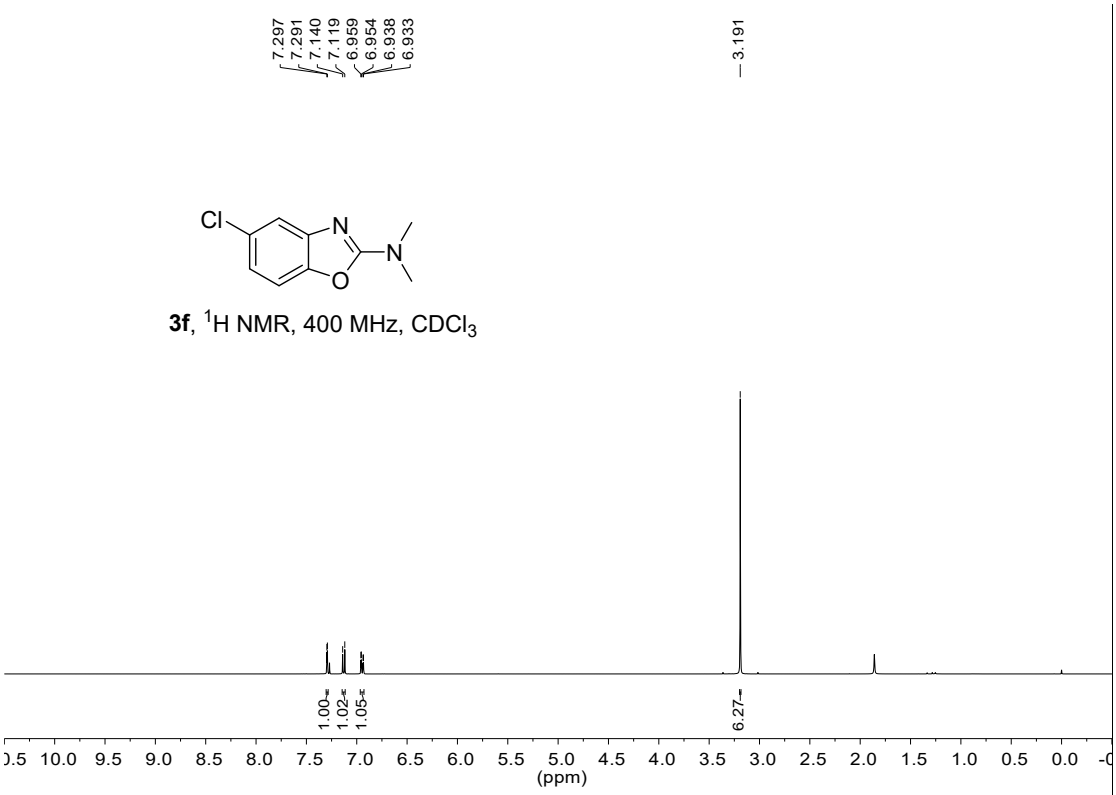
3e, ^{1}H NMR, 400 MHz, $CDCl_3$



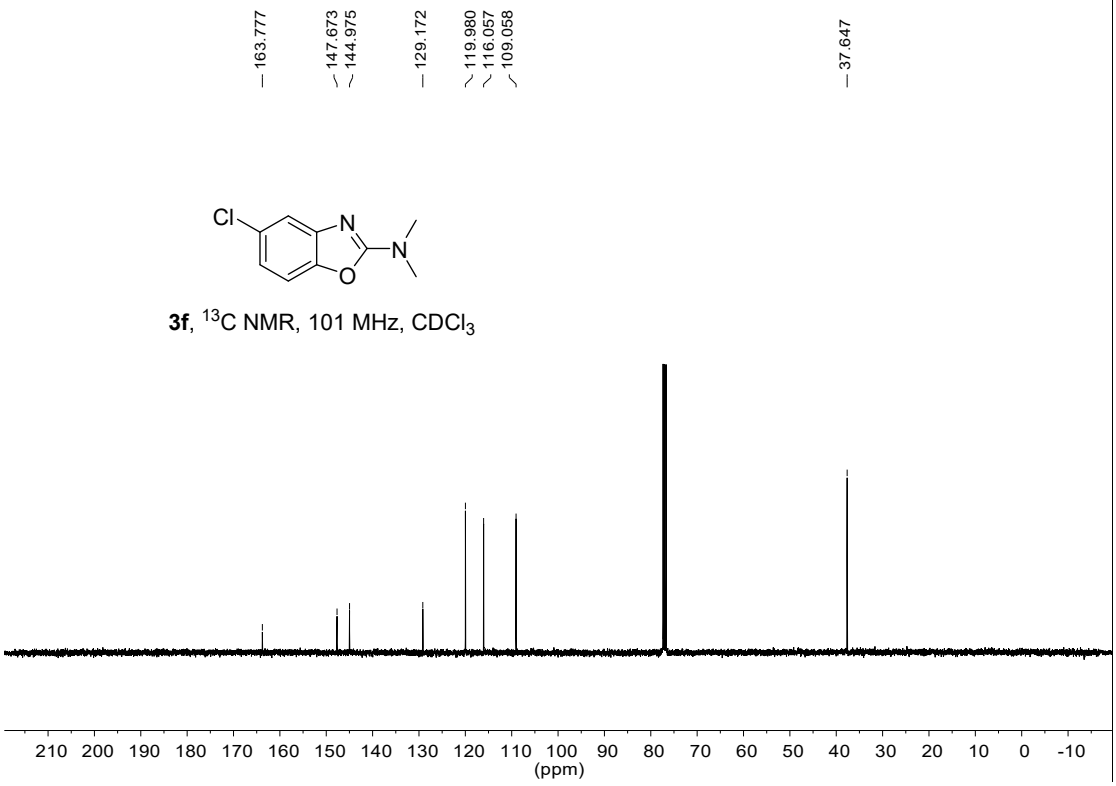


3e, ^{13}C NMR, 101 MHz, $CDCl_3$

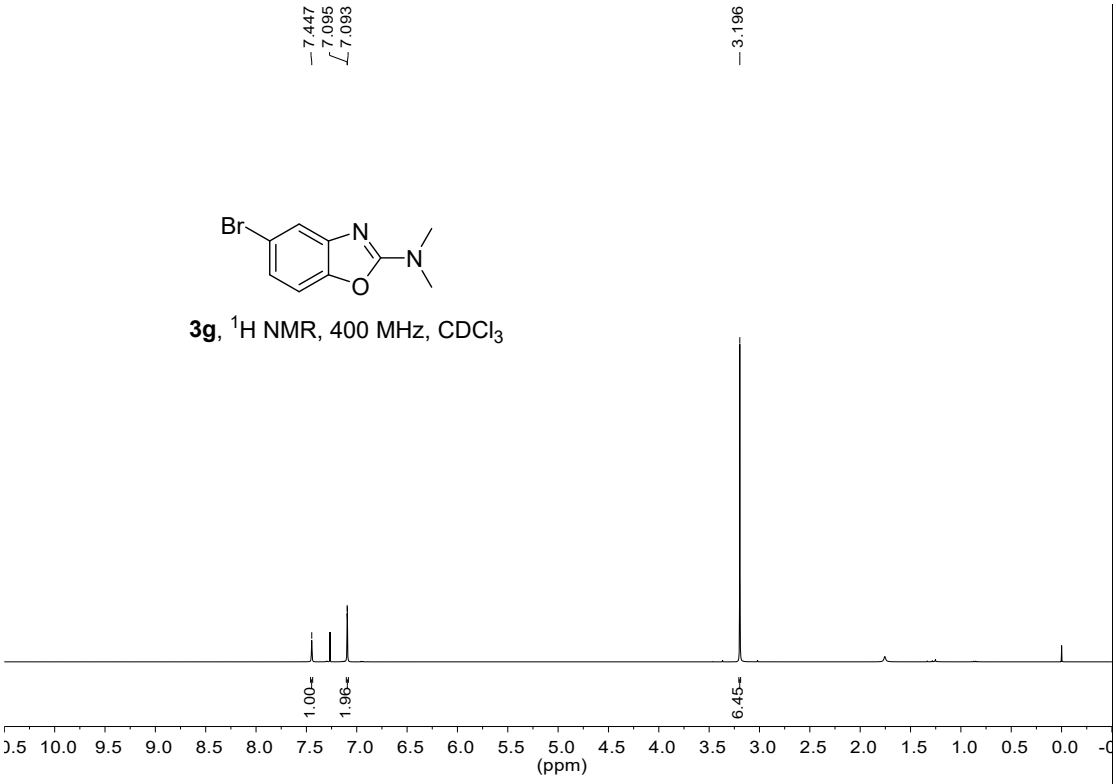




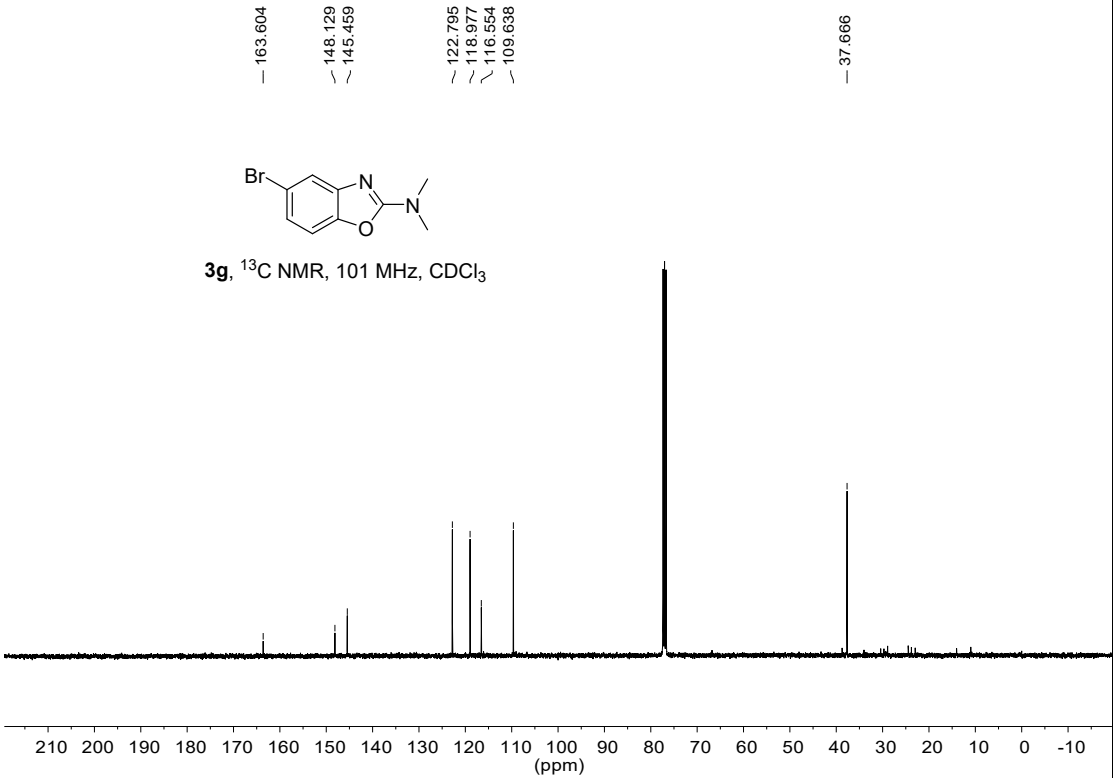
3f, ^{1}H NMR, 400 MHz, $CDCl_3$



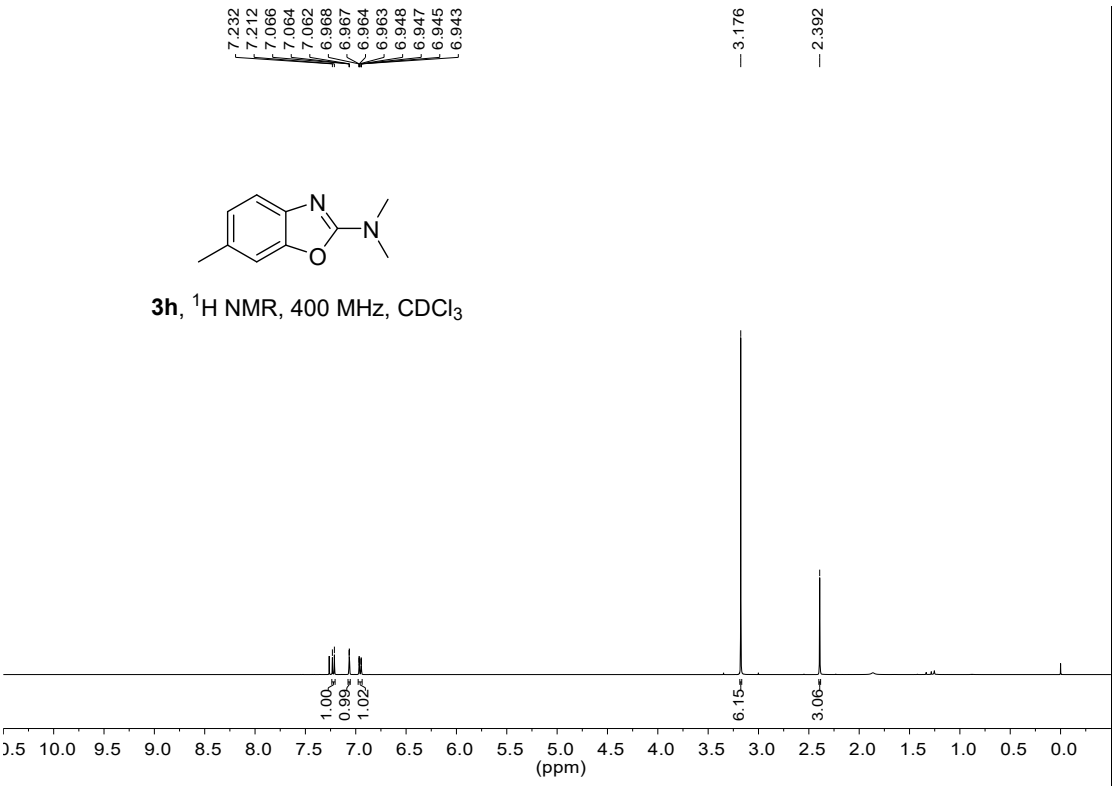
3f, ^{13}C NMR, 101 MHz, $CDCl_3$



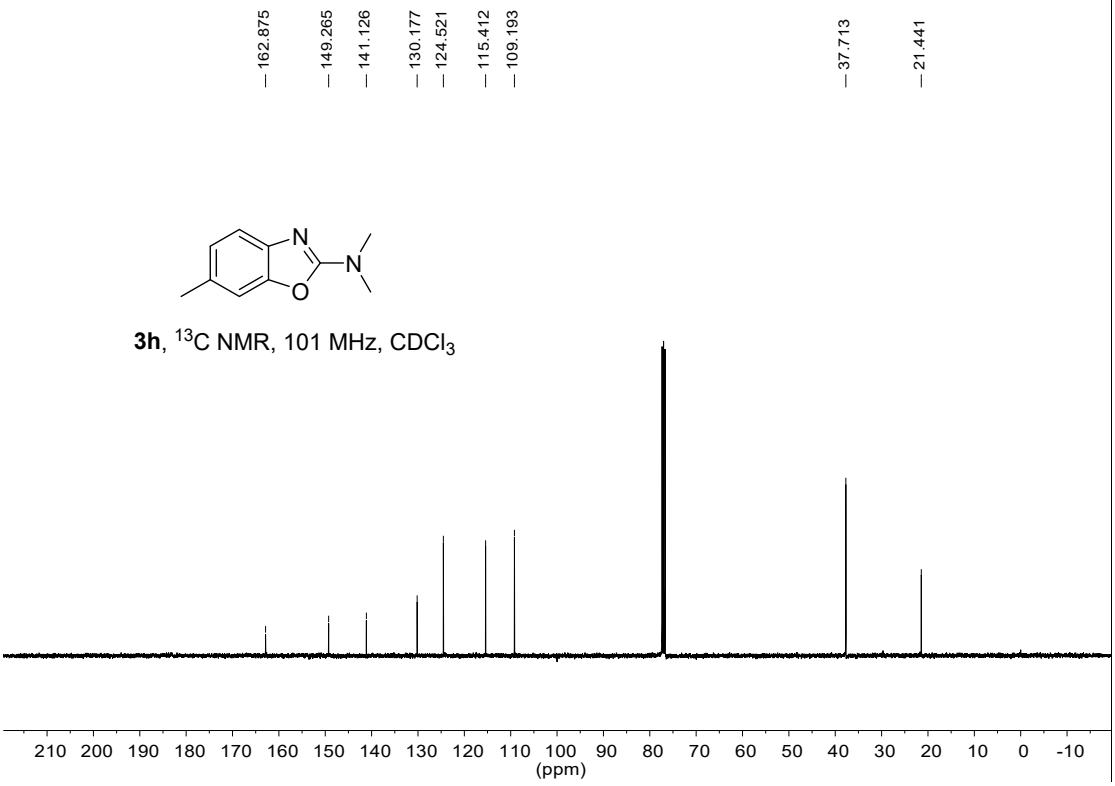
3g, ^{1}H NMR, 400 MHz, $CDCl_3$



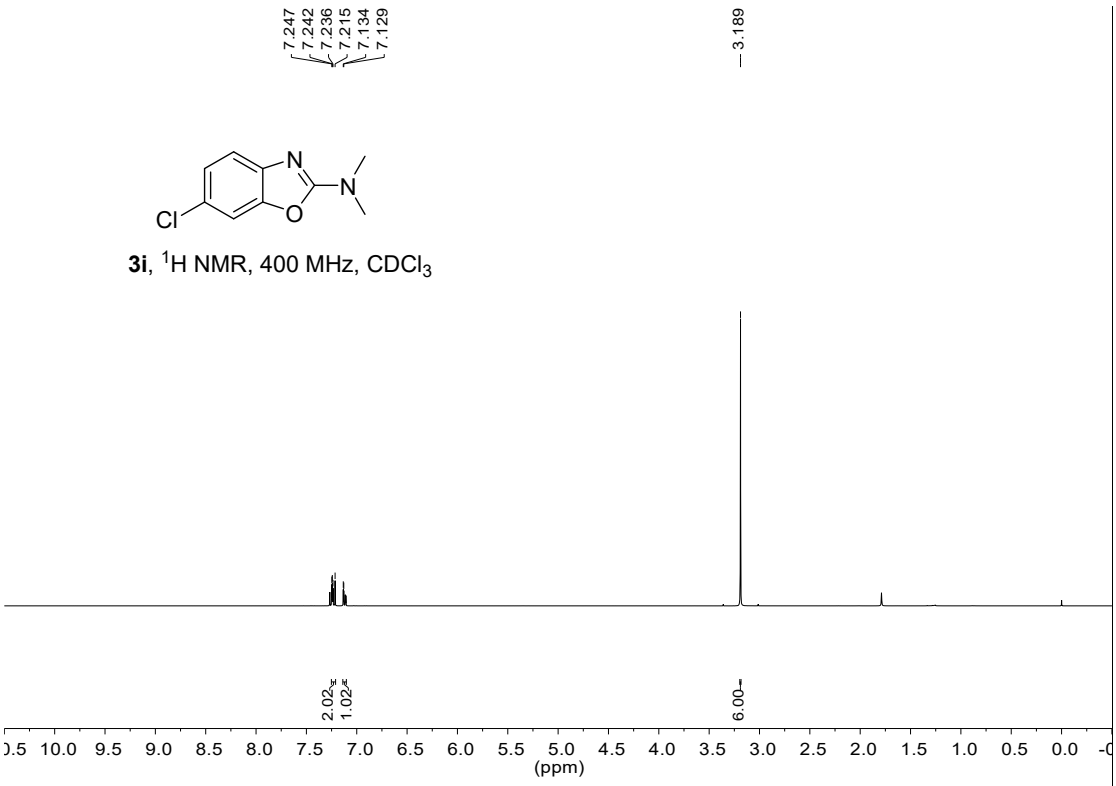
3g, ^{13}C NMR, 101 MHz, $CDCl_3$



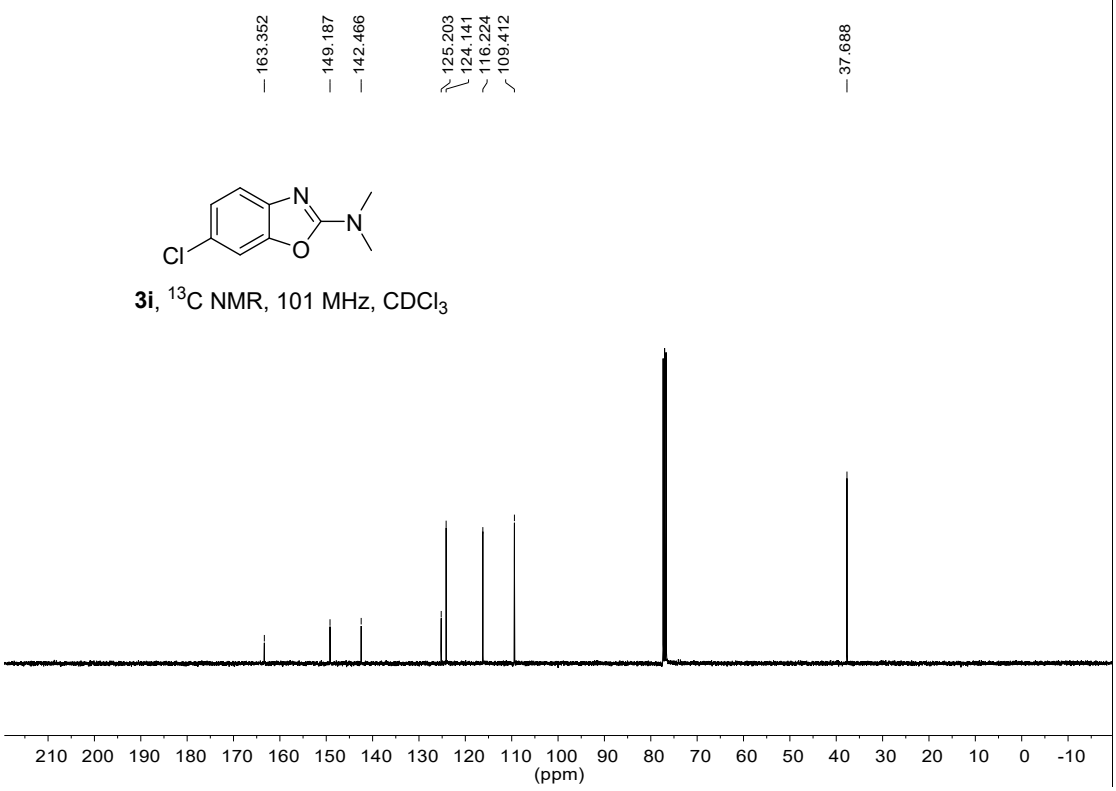
3h, ^{1}H NMR, 400 MHz, $CDCl_3$



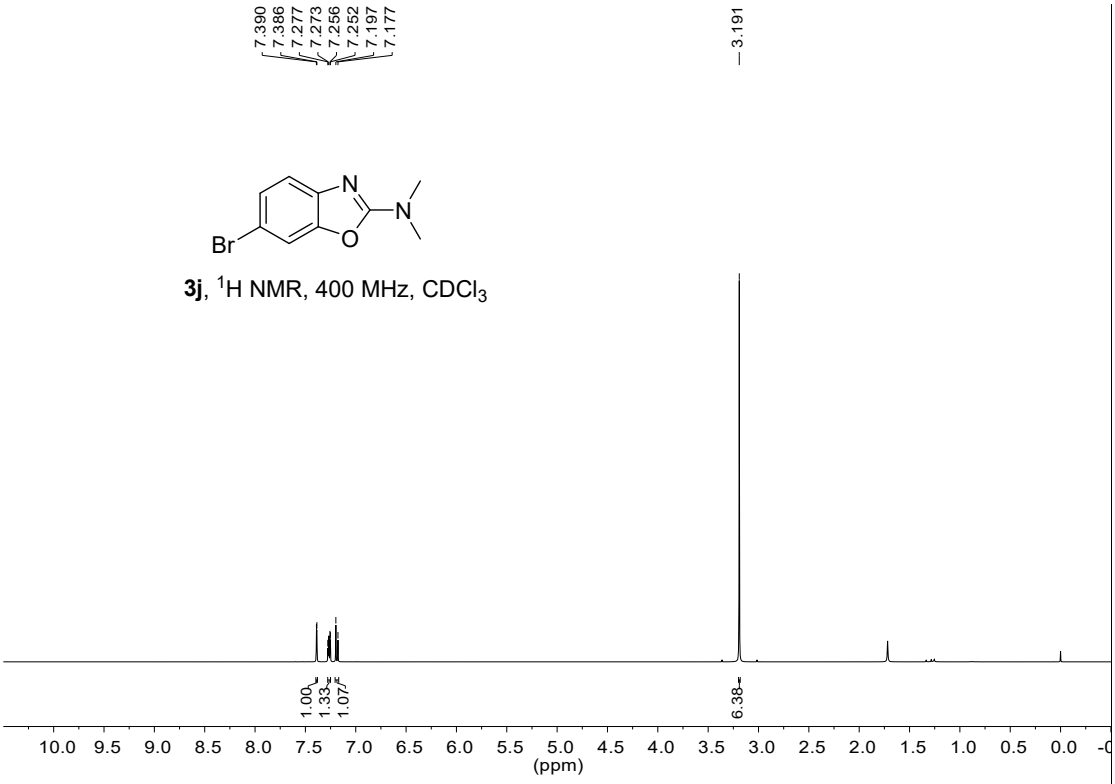
3h, ^{13}C NMR, 101 MHz, $CDCl_3$



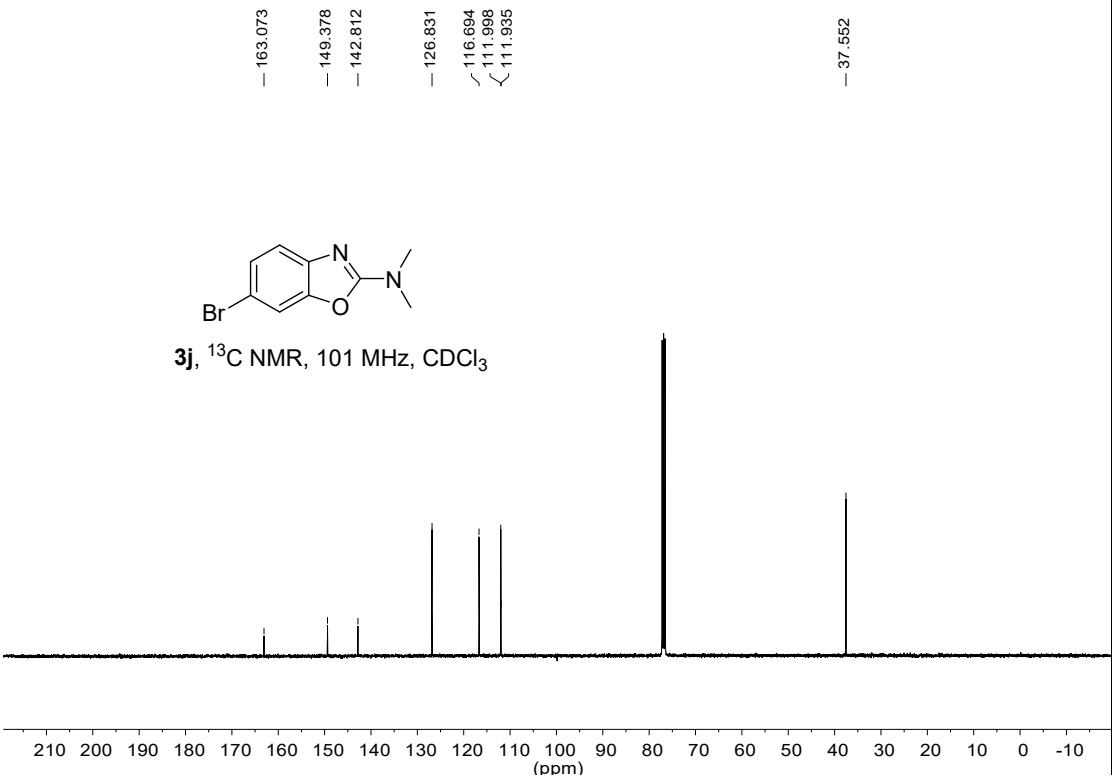
3i, ^{1}H NMR, 400 MHz, $CDCl_3$



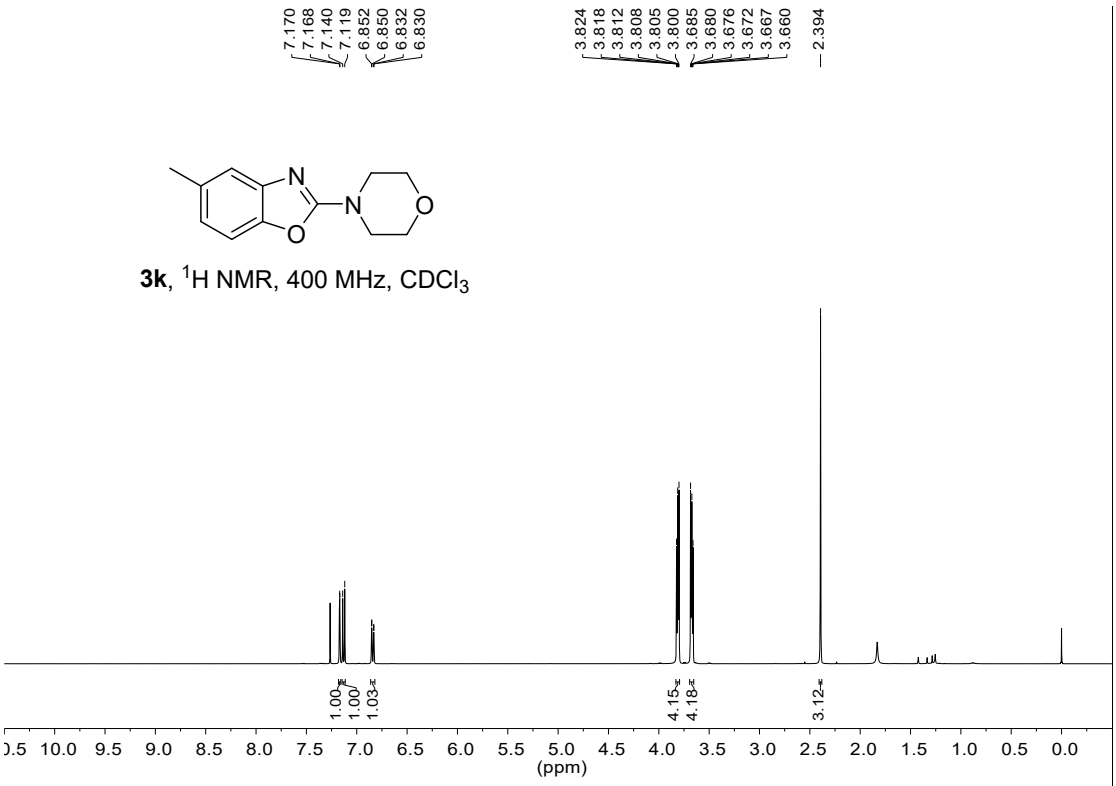
3i, ^{13}C NMR, 101 MHz, $CDCl_3$



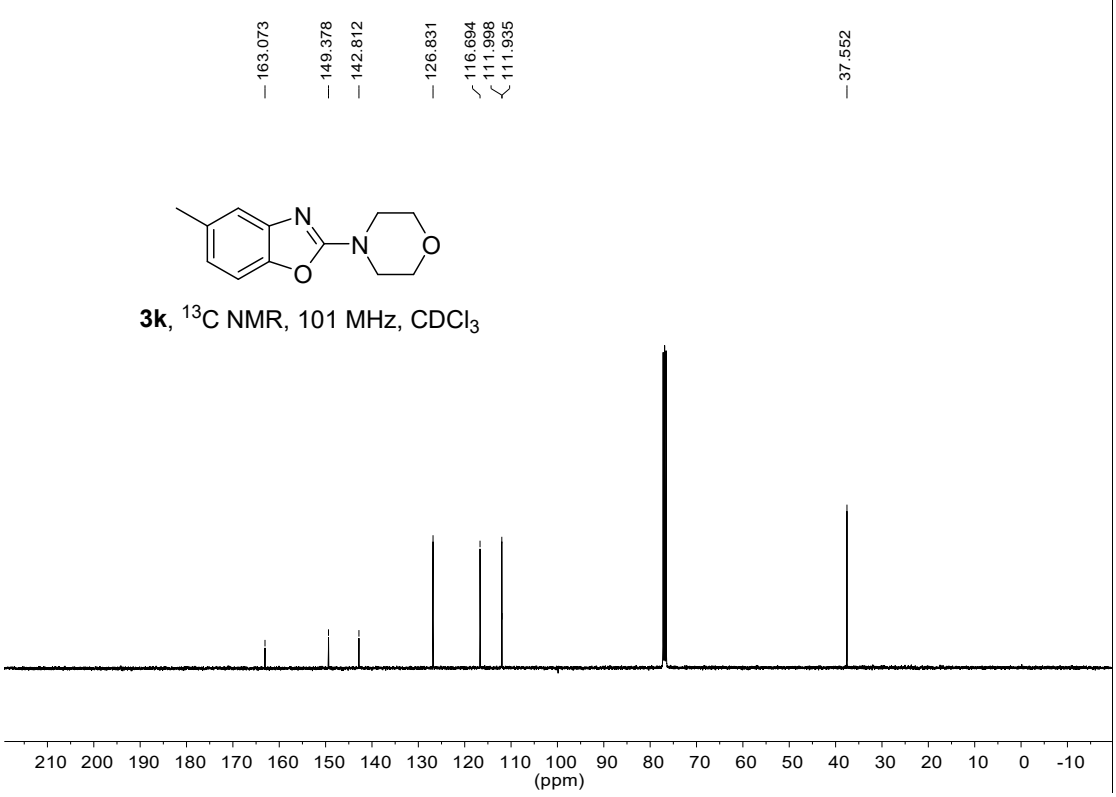
3j, ^{1}H NMR, 400 MHz, $CDCl_3$



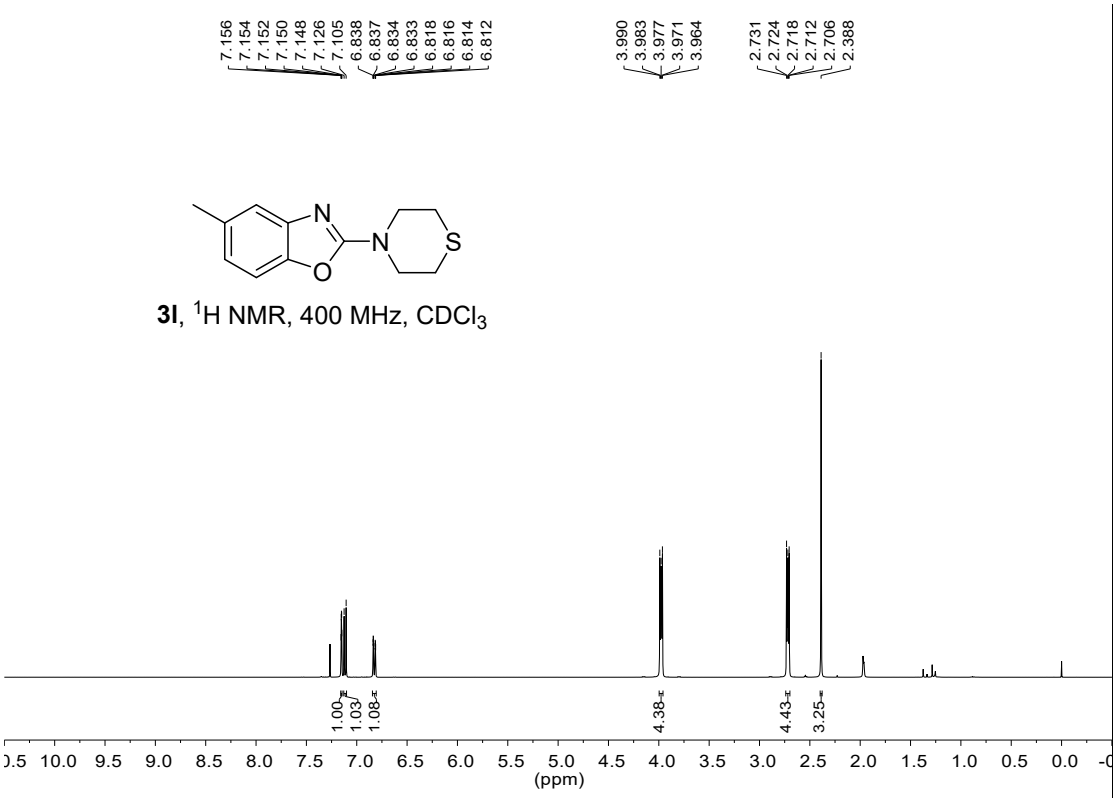
3j, ^{13}C NMR, 101 MHz, $CDCl_3$



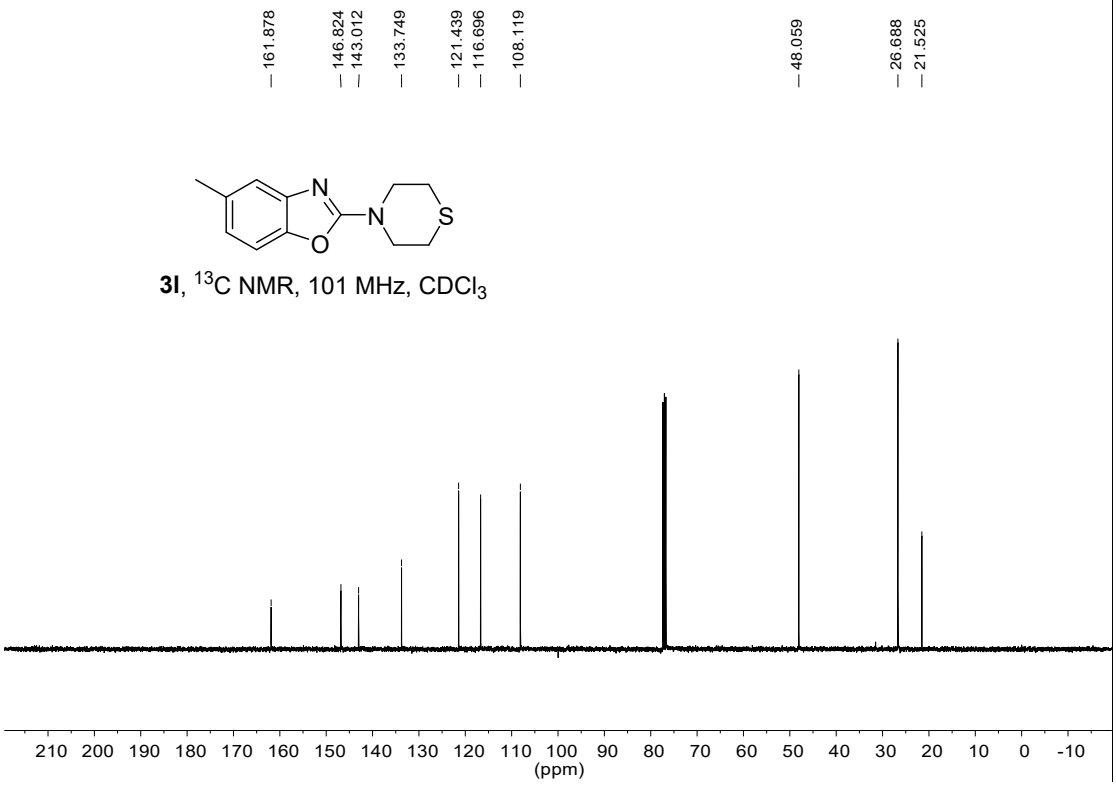
3k, ^{1}H NMR, 400 MHz, $CDCl_3$



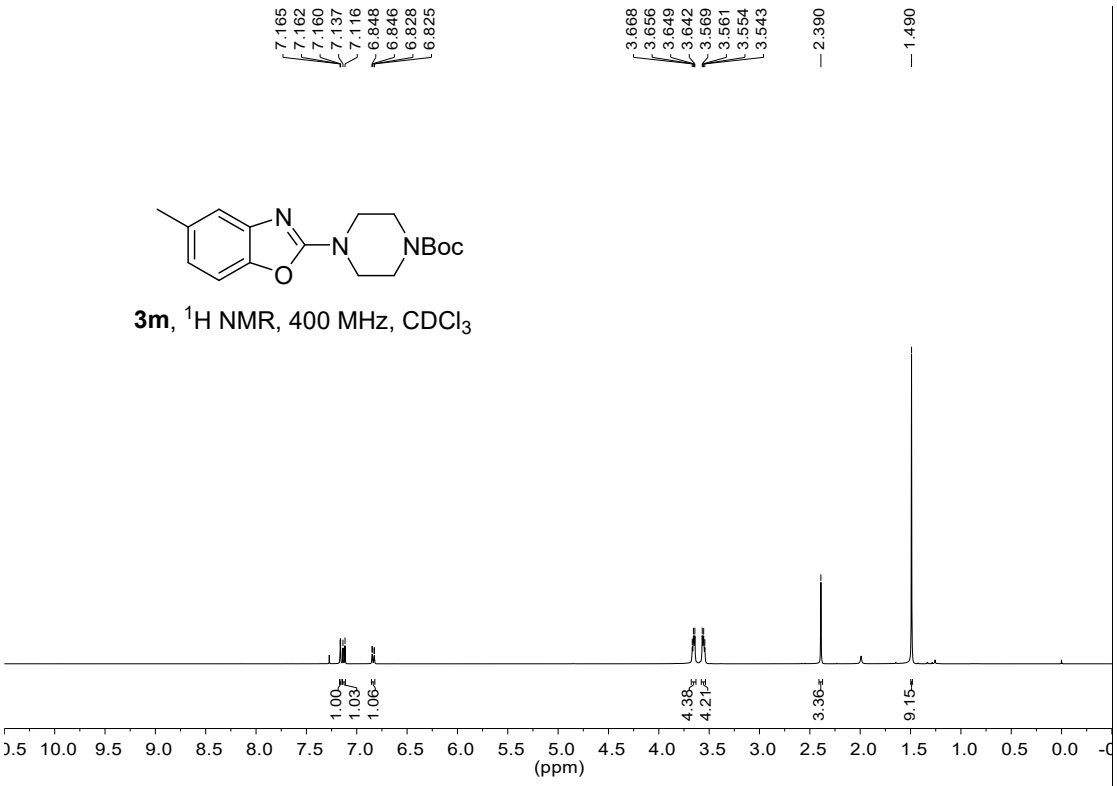
3k, ^{13}C NMR, 101 MHz, $CDCl_3$



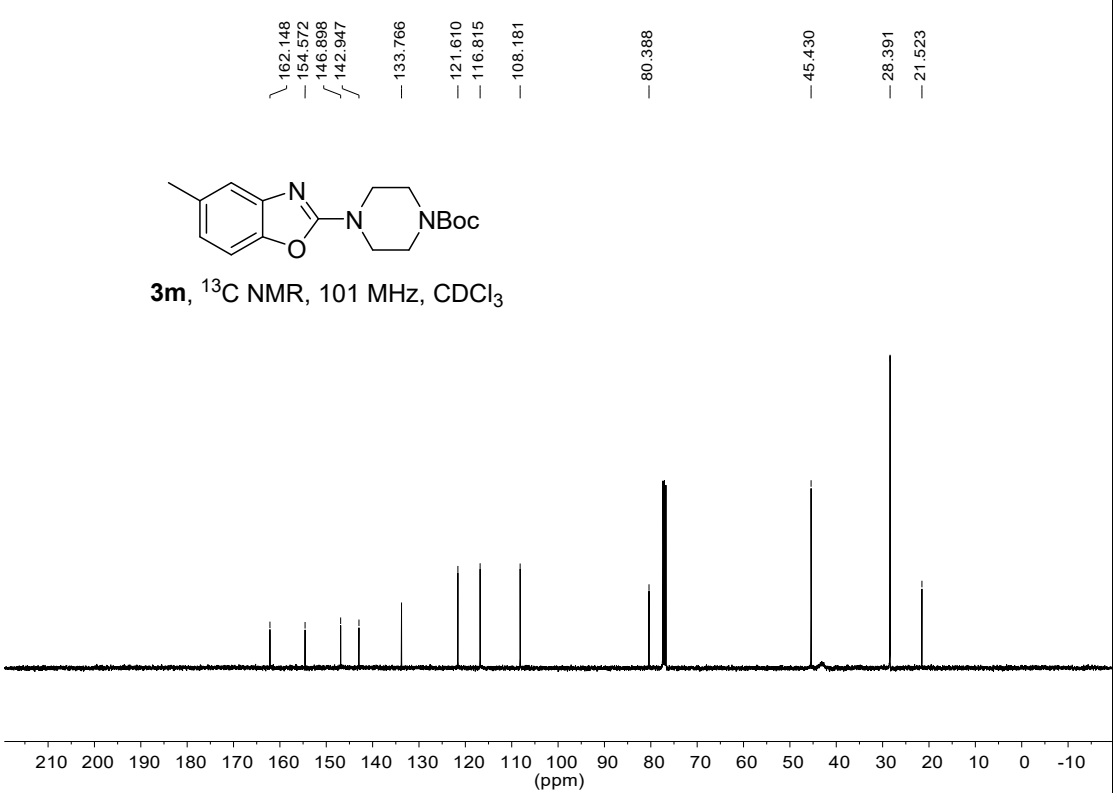
3l, ^{1}H NMR, 400 MHz, $CDCl_3$



3l, ^{13}C NMR, 101 MHz, $CDCl_3$



3m, ^{1}H NMR, 400 MHz, $CDCl_3$



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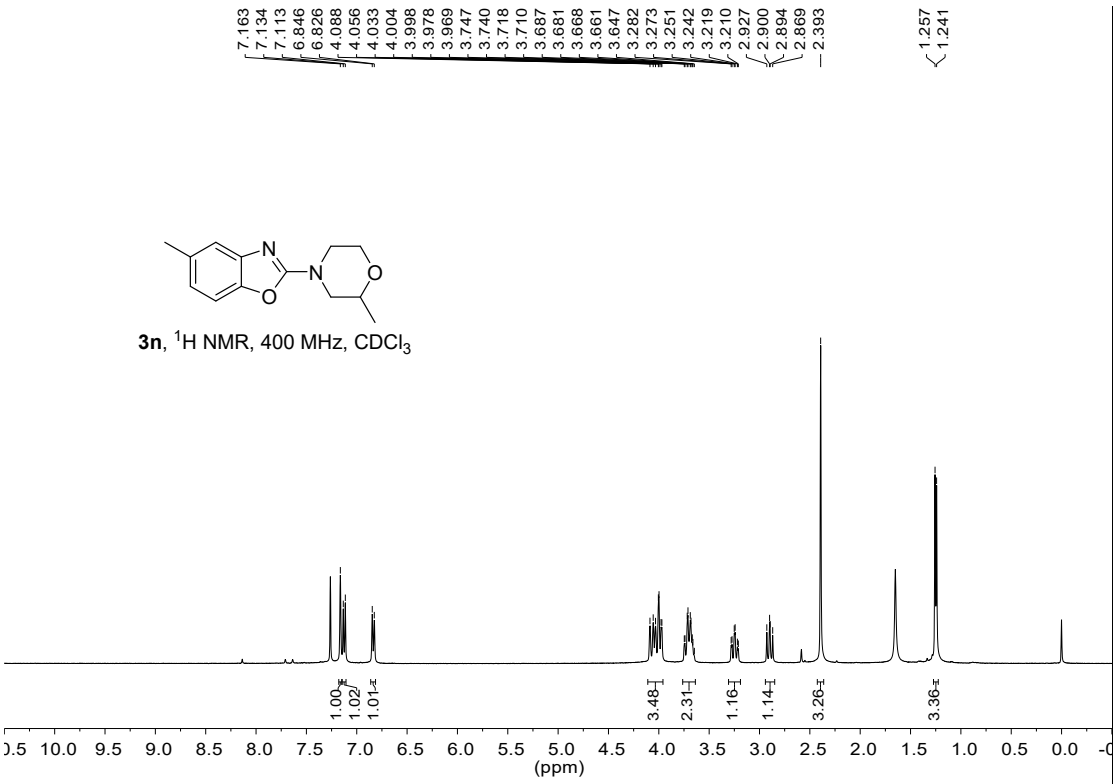
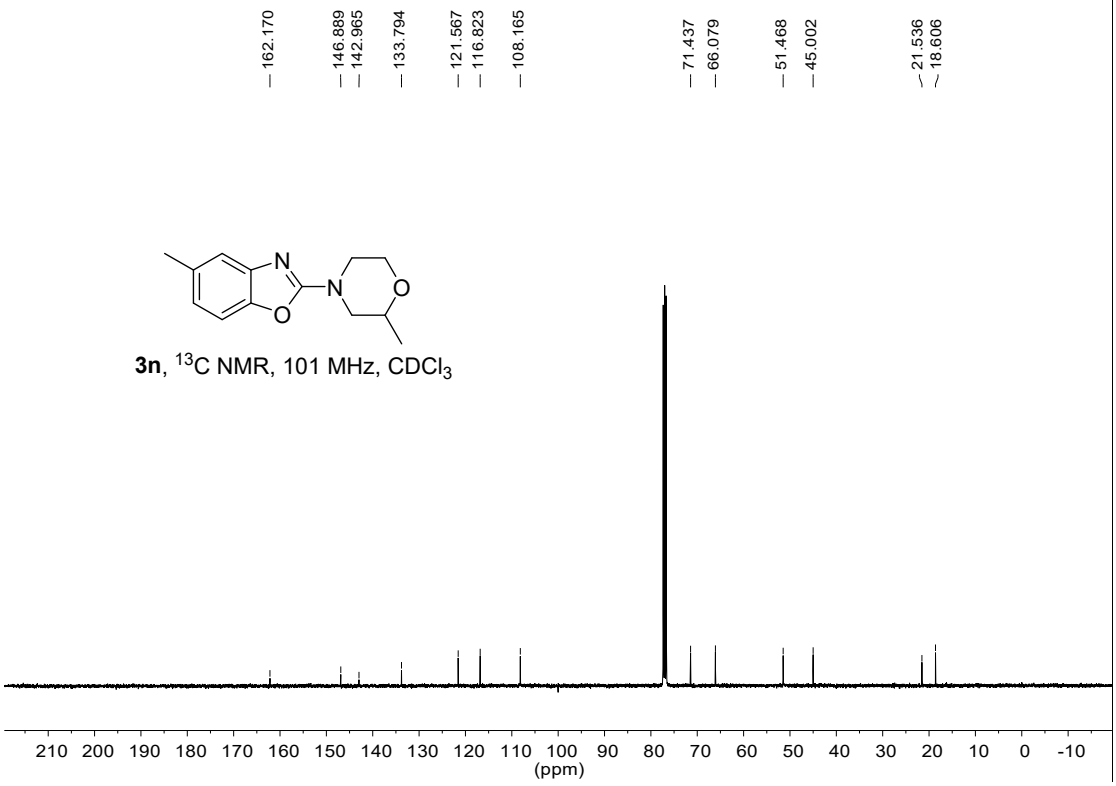
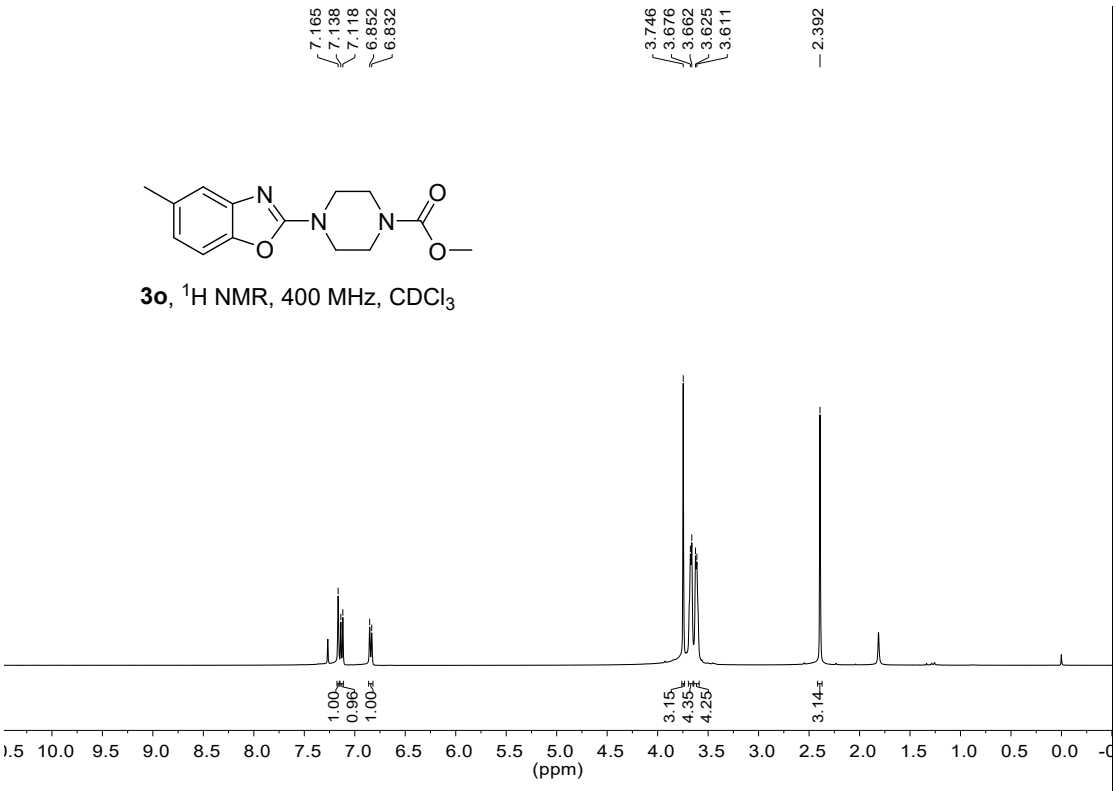


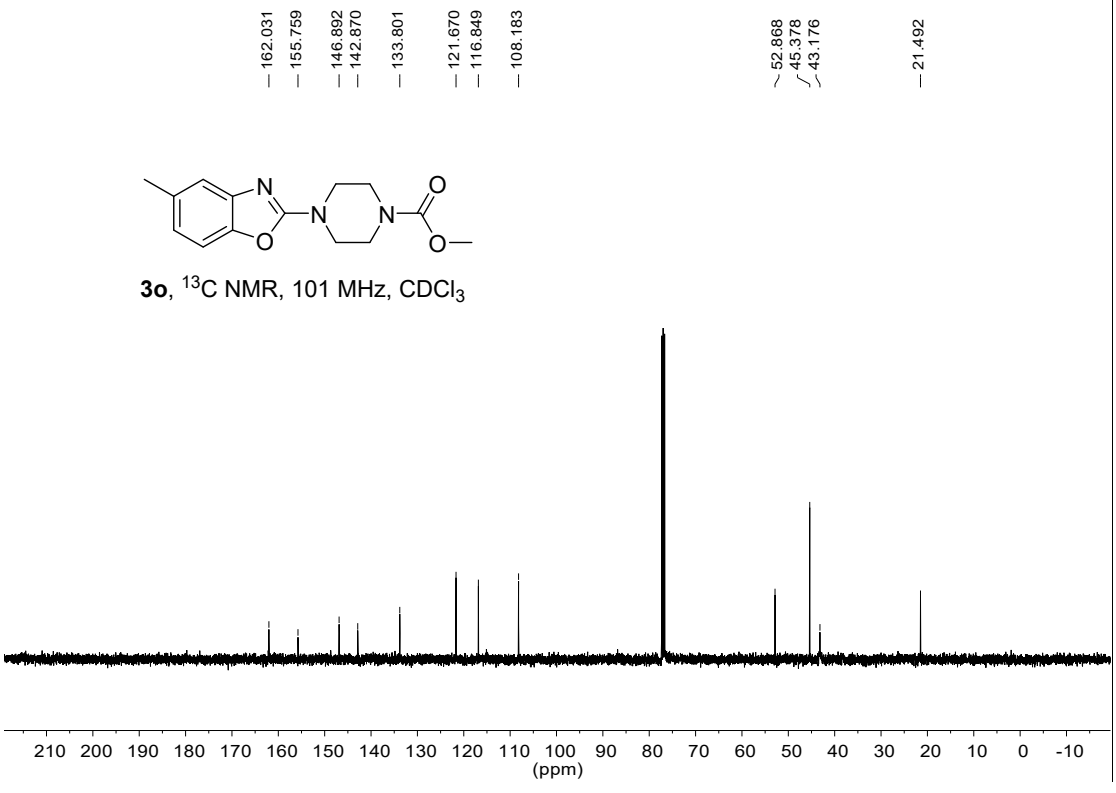
3n, ^{1}H NMR, 400 MHz, $CDCl_3$



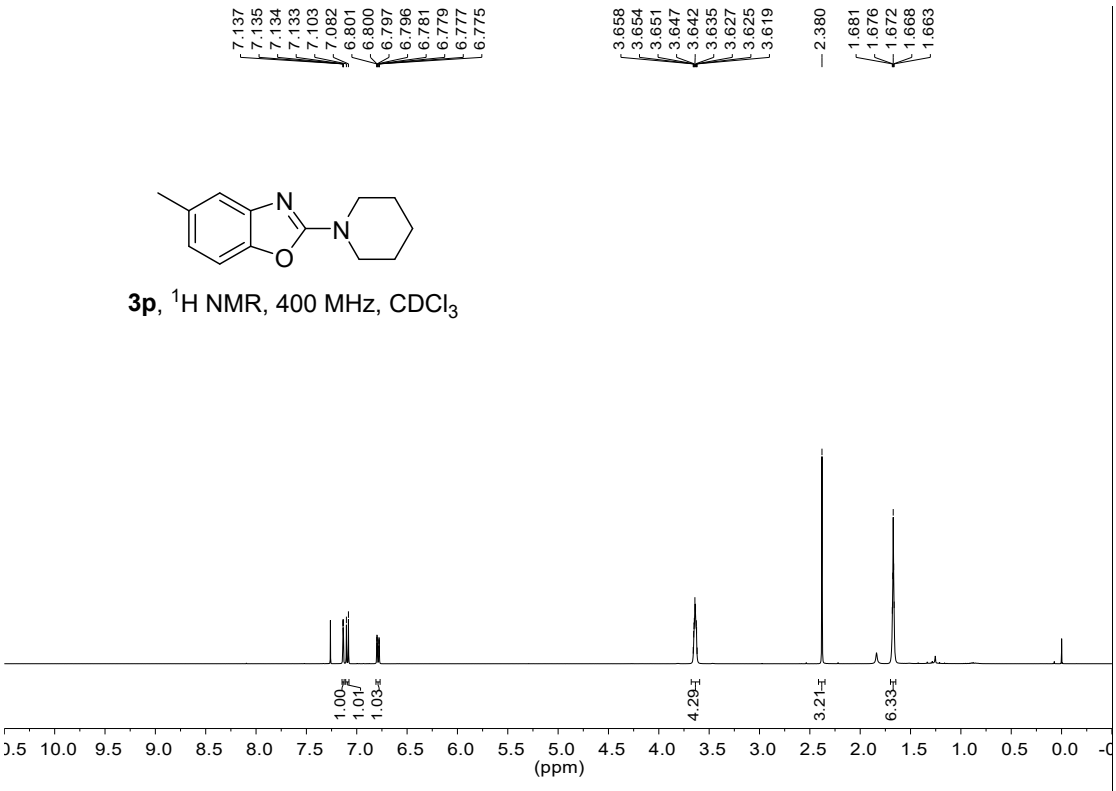
3n, ^{13}C NMR, 101 MHz, $CDCl_3$



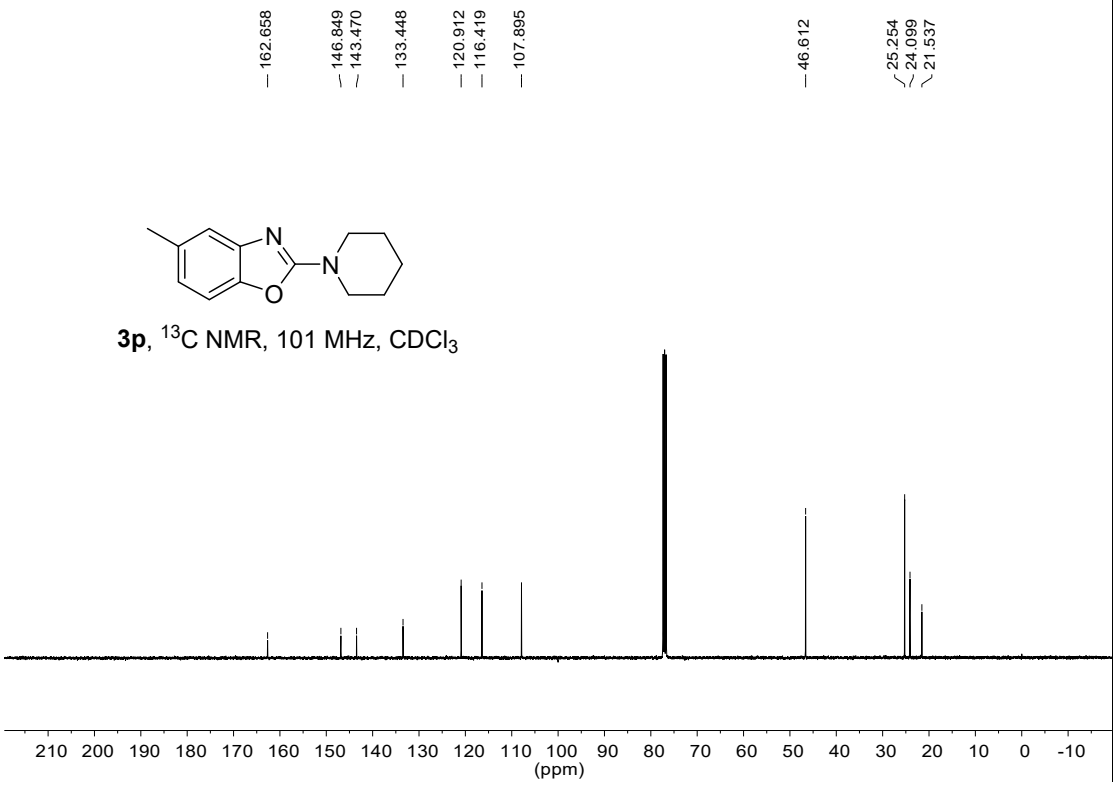
3o, ^{1}H NMR, 400 MHz, $CDCl_3$



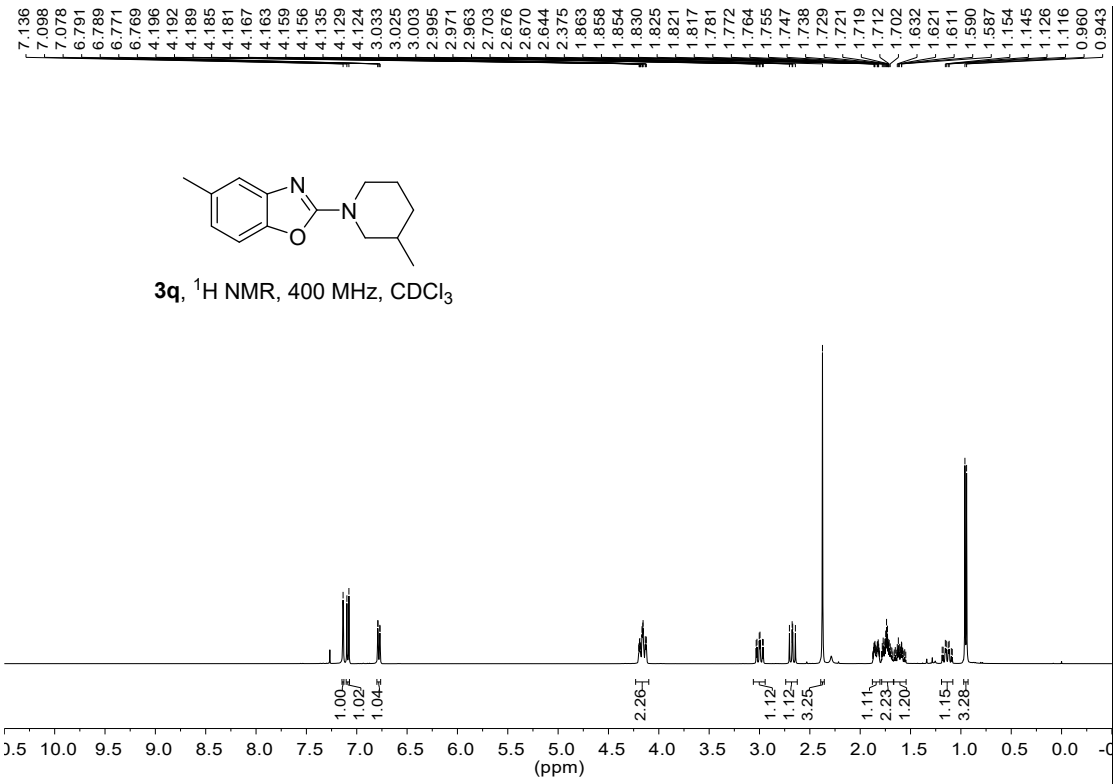
3o, ^{13}C NMR, 101 MHz, $CDCl_3$



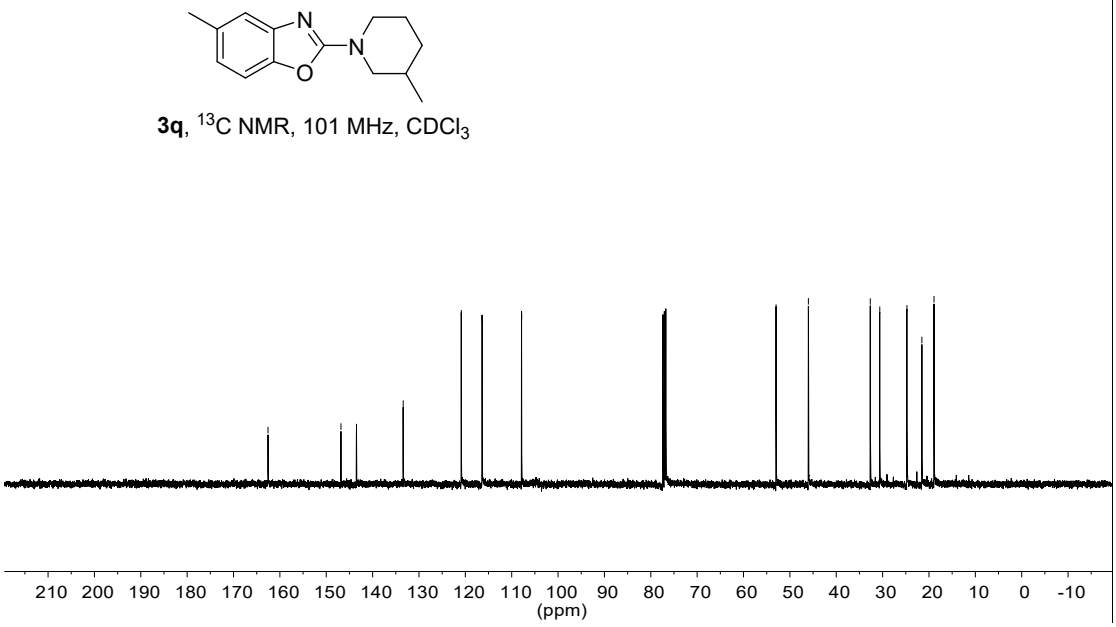
3p, ^{1}H NMR, 400 MHz, $CDCl_3$



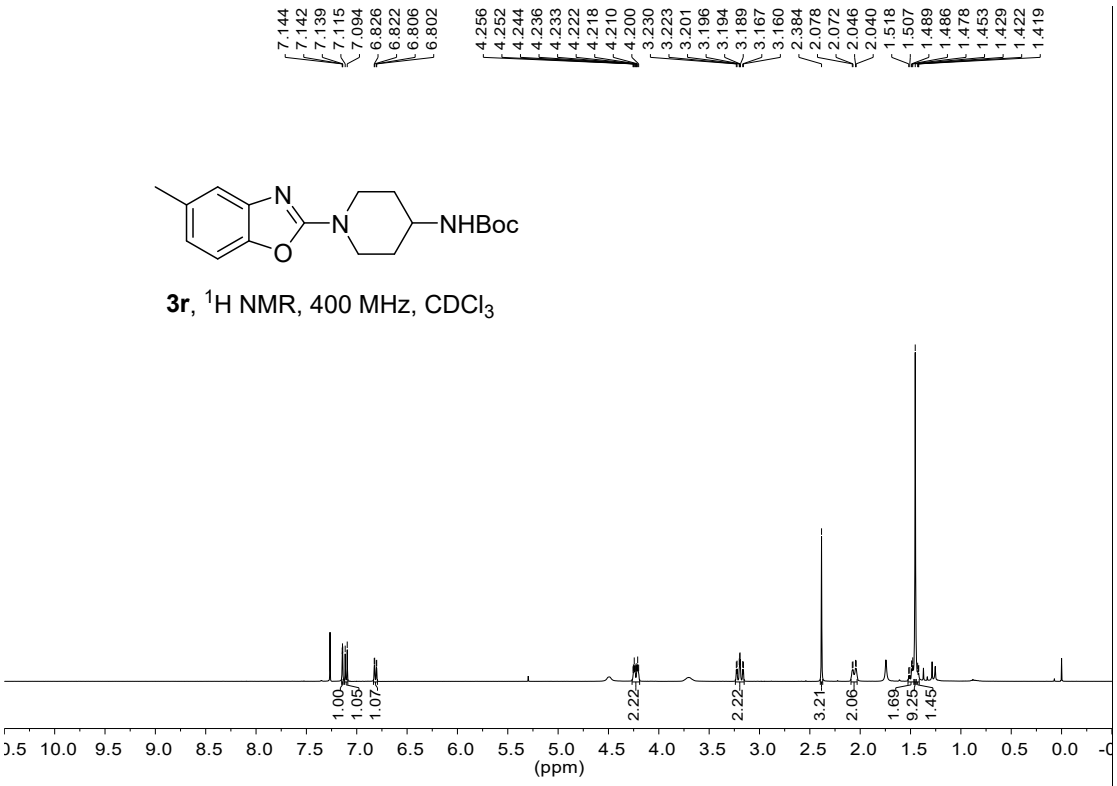
3p, ^{13}C NMR, 101 MHz, $CDCl_3$



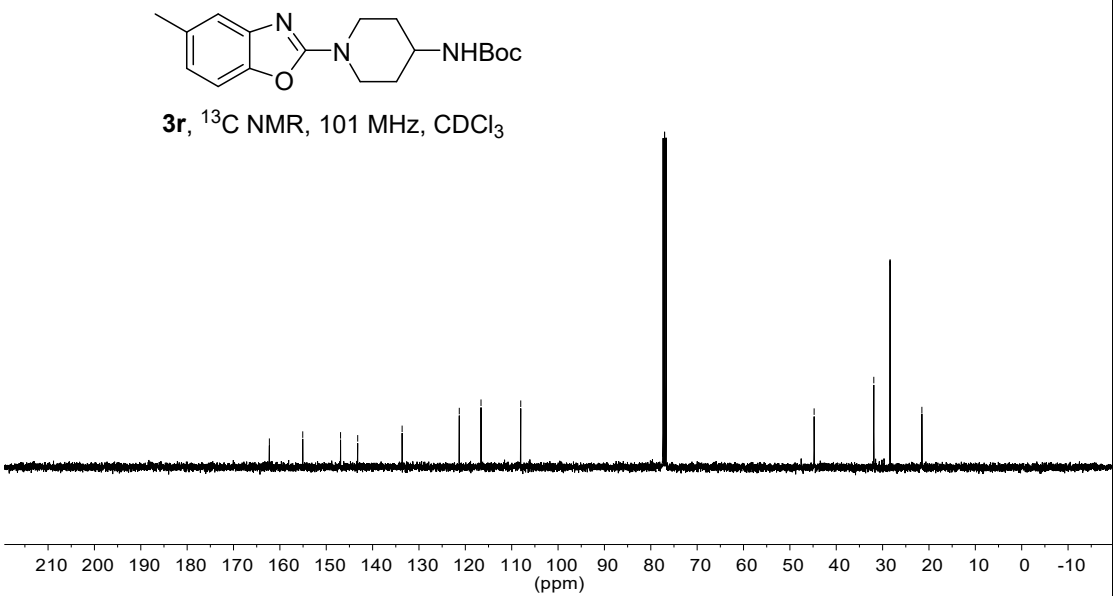
3q, ^{1}H NMR, 400 MHz, $CDCl_3$



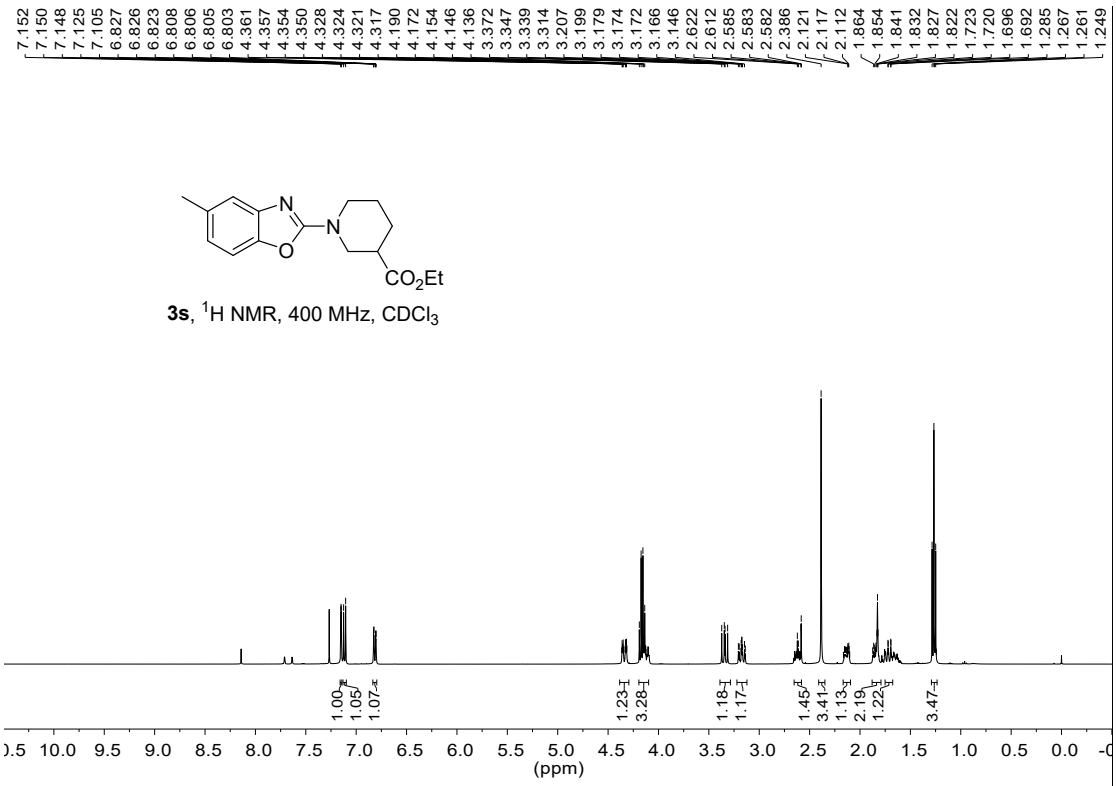
3q, ^{13}C NMR, 101 MHz, $CDCl_3$



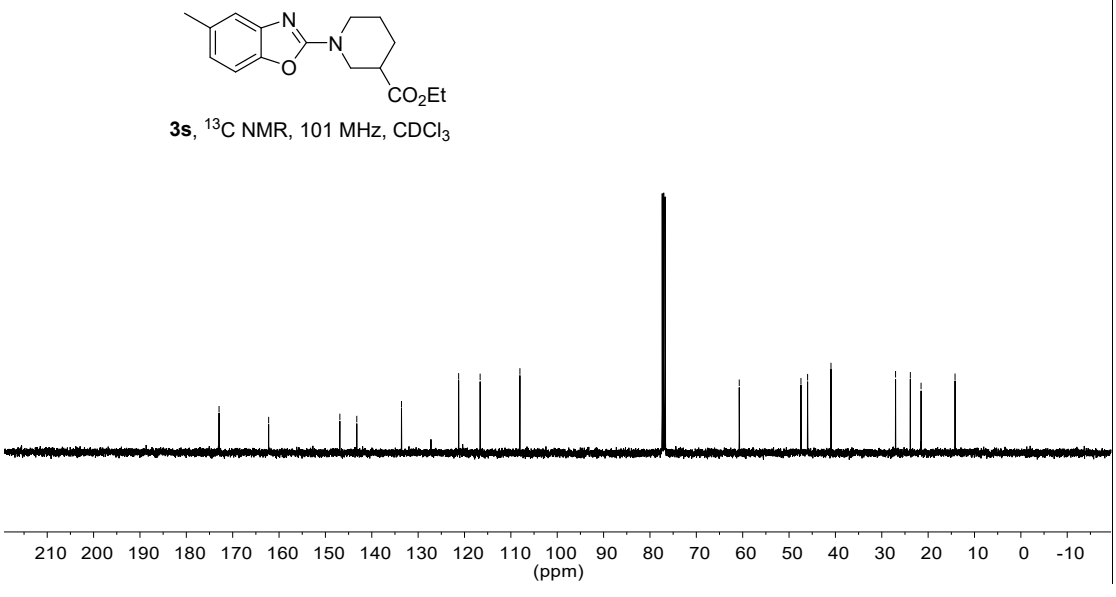
3r, ^{1}H NMR, 400 MHz, $CDCl_3$



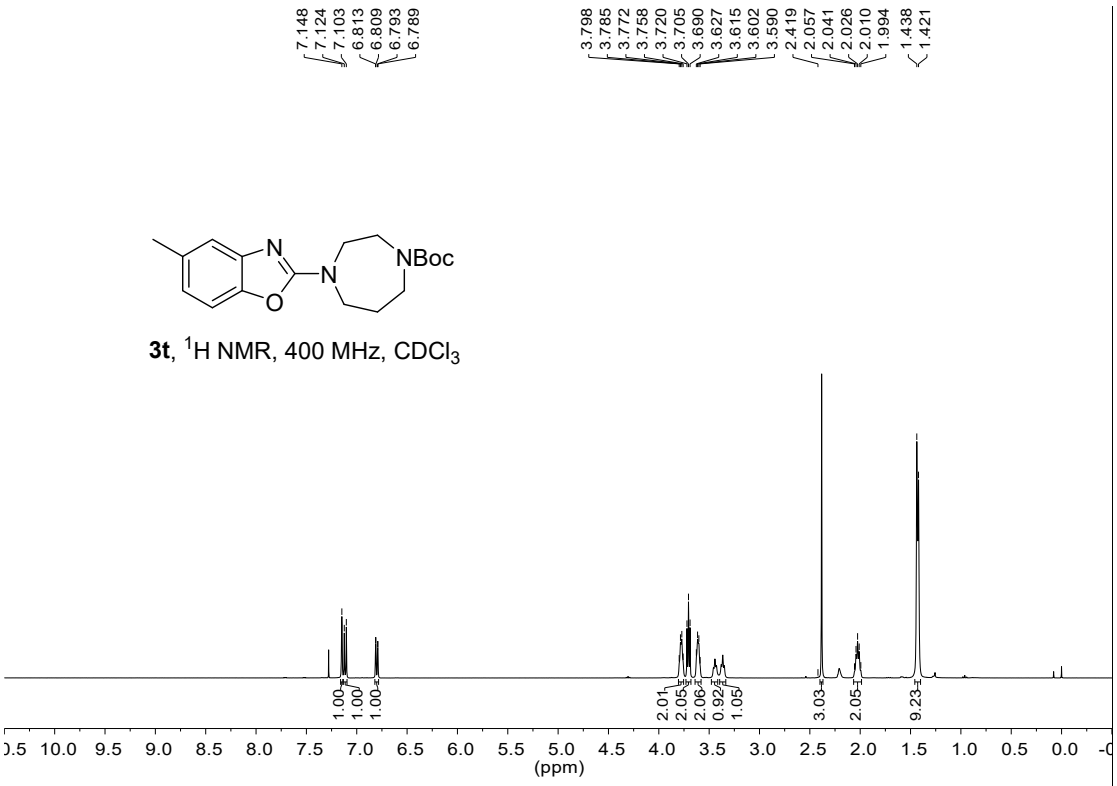
3r, ^{13}C NMR, 101 MHz, $CDCl_3$



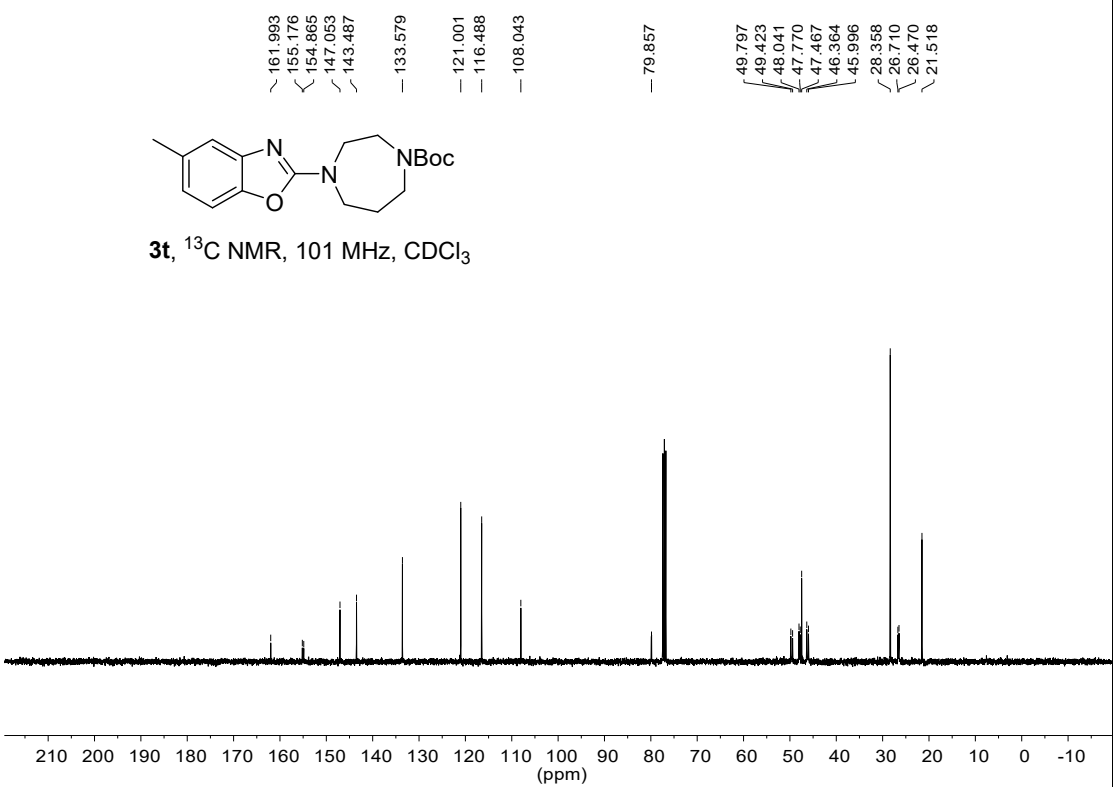
3s, ^{1}H NMR, 400 MHz, $CDCl_3$



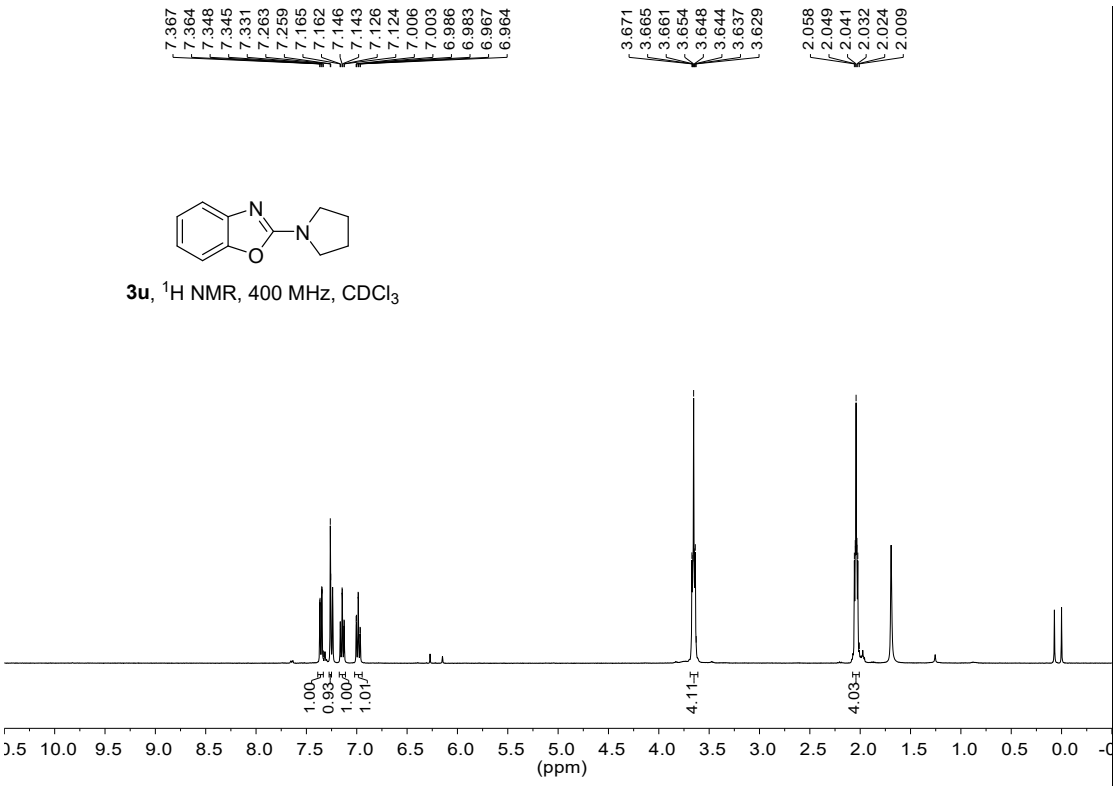
3s, ^{13}C NMR, 101 MHz, $CDCl_3$



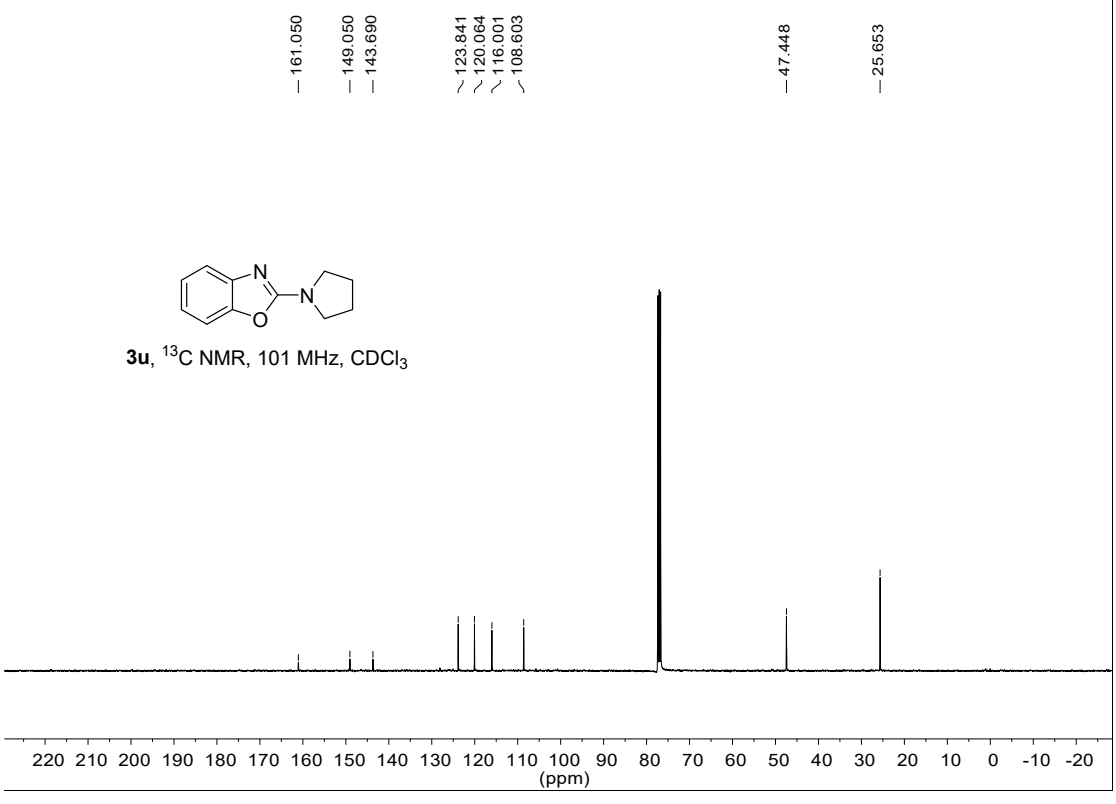
3t, ^{1}H NMR, 400 MHz, $CDCl_3$



3t, ^{13}C NMR, 101 MHz, $CDCl_3$



3u, ^{1}H NMR, 400 MHz, $CDCl_3$



3u, ^{13}C NMR, 101 MHz, $CDCl_3$

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