Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Direct C-H Functionalization of Tetrahydro-γ-Carbolines at α-Position

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1. General Information

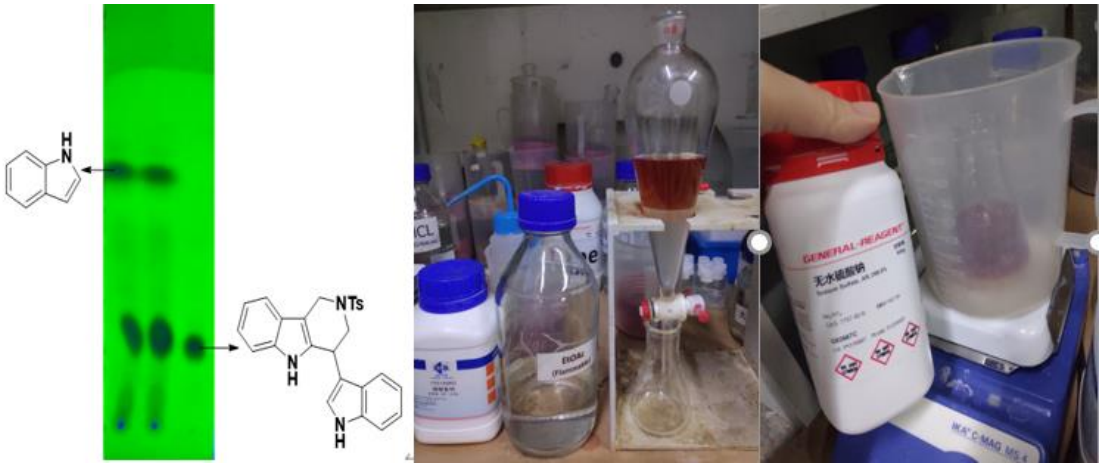
All reactions were performed under a designated atmosphere in flame-dried round bottom flasks, magnetically stirred, unless otherwise noted. All reactions were performed at room temperature (rt., approximately 25 °C) unless otherwise noted. Preparative column chromatography was performed using silica gel 60, particle size 0.063–0.200 mm (70–230 mesh, flash). Analytical TLC was carried out employing silica gel 60 F254 plates (Merck, Darmstadt). Visualization of the developed chromatograms was performed with detection by UV (254 nm and 365 nm). Preparative thin layer chromatography (PTLC) separations were carried out on 0.20 mm Yantai Jiangyou silica gel plates (HSGF254). ^{1}H and ^{13}C nuclear magnetic resonance (NMR) spectra were recorded on a Bruker-400 (^{1}H, 400 MHz; ^{13}C, 101 MHz) spectrometer. Chemical shifts for protons are reported in parts per million and are references to the NMR solvent peak ($CDCl_3$: δ 7.26; DMSO-d_6: 2.50; CD_3OD: δ 3.31). Chemical shifts for carbons are reported in parts per million and are referenced to the carbon resonances of the NMR solvent ($CDCl_3$: δ 77.16; DMSO-d_6: 39.52; CD_3OD: δ 49.00). Signals are listed in ppm, and multiplicity identified as s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet. Chemical shifts were expressed in ppm, and *J* values were given in Hz. High resolution mass Spectrum (HRMS) were obtained from Thermo Fisher Scientific Exactive Plus mass spectrometer. The melting point was determined using the X-4A melting point apparatus (Shanghai Yidian Co., Ltd.) and uncorrected. Concentration under reduced pressure was performed by rotary evaporation at 25–35 ^{o}C at appropriate pressure. Purified compounds were further dried under high vacuum (0.01-0.10 Torr). Yields refer to purified and spectroscopically pure compounds unless otherwise noted. All commercially available starting materials and solvents were reagent grade and used without further purification.

Abbreviations used:
TLC = thin layer chromatography
t-BuOCl = *tert*-butyl hypochlorite
2-MeTHF = 2-methyltetrahydrofuran
PE = petroleum ether
EtOAc = ethyl acetate
DMSO = dimethyl sulfoxide
TMEDA = *N,N,N',N'*-tetramethylethylenediamine

2. Graphical Procedure for Gram-scale Preparation of 46

(Left) *N*-Ts-substituted THγC (1.6325 g, 5.0 mmol); **(Center)** 2-MeTHF used in this reaction; **(Right)** *t*-BuOCl used in this reaction.

(Left) Reaction mixture stirring for 2 min at rt.; **(Center)** indole used in this reaction; **(Right)** Reaction mixture after stirring for 10 min at rt.



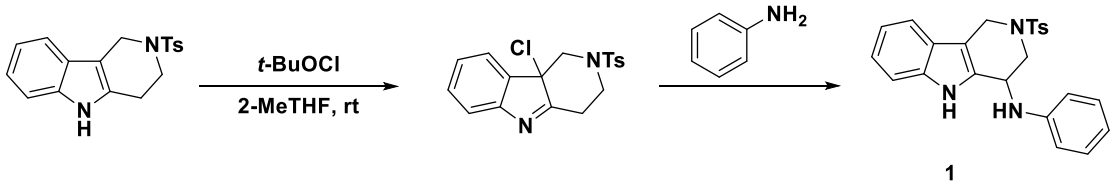
(Left) TLC under UV (PE/EtOAc = 3:1, line 1: reaction mixture; line 2: co-spot of reaction mixture and desire product; line 3: desire product); **(Center)** Dilution and extraction of the organic layer; **(Right)** Dried over anhydrous Na_2SO_4.

(Left) Filtered. **(Center)** The crude product; **(Right)** Purified by chromatography on silica gel (PE/EtOAc = 3:1).

Product after column chromatography.

3. General Procedures

Compound 1



1

N-phenyl-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then aniline (167 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.7 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/EtOAc = 2:1) to provide the desired product (177 mg, 85%) as a white solid.

Physical State: white solid.

Melting Point: 108.7-109.5 ^{o}C.

TLC: R_f = 0.41 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz,$CDCl_3$) δ 8.11 (s, 1H), 7.74 (d, *J* = 7.6 Hz, 2H), 7.44 (d, *J* = 7.7 Hz, 1H), 7.31 (d, *J* = 8.6 Hz, 2H), 7.23 (d, *J* = 7.5 Hz, 3H), 7.18 (d, *J* = 7.8 Hz, 1H), 7.12 (t, *J* = 7.2 Hz, 1H), 6.83 (t, *J* = 7.2 Hz, 1H), 6.73 (d, *J* = 7.5 Hz, 2H), 4.90 (s, 1H), 4.47 (d, *J* = 14.1 Hz, 1H), 4.35 (d, *J* = 14.0 Hz, 1H), 3.64 (d, *J* = 12.0 Hz, 1H), 3.45 – 3.39 (m, 1H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 146.08, 143.79, 136.08, 134.00, 132.19, 129.81, 129.74, 127.60, 124.78, 122.77, 120.01, 119.05, 118.17, 114.04, 111.37, 107.85, 48.61, 47.22, 43.20, 21.55.

HRMS (ESI): calcd for $C_{24}H_{23}N_3O_2S$ $[M + H]^+$*m/z* 418.1584, found 418.1582.

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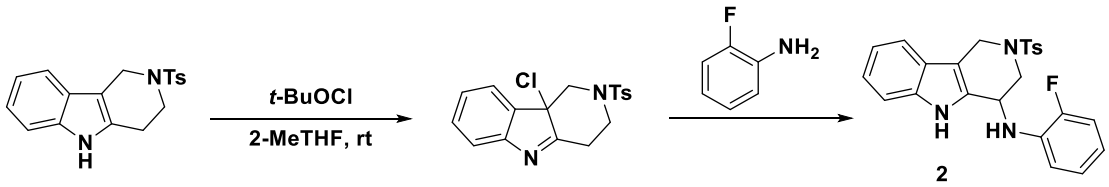
Compound 2



2

N-(2-fluorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-fluoroaniline (167 mg, 1.5 mmol) was added into the mixture. After stirring for another 3.5 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (319 mg, 73%) as a white solid.

Physical State: white solid.

Melting Point: 148.3-149.7 °C.

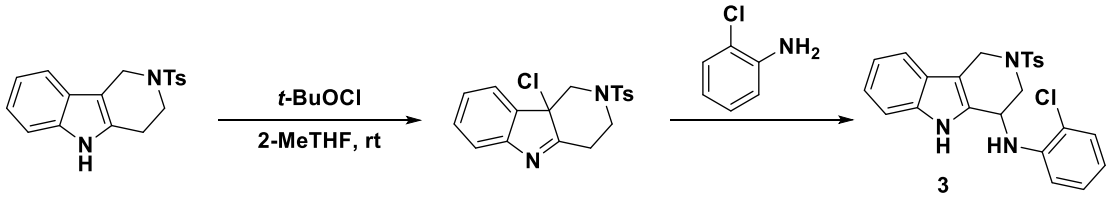
TLC: $\mathbf{R_f}$ = 0.42 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.74 (d, *J* = 7.6 Hz, 2H), 7.45 (d, *J* = 7.7 Hz, 1H), 7.31 (d, *J* = 6.7 Hz, 3H), 7.21 (t, *J* = 7.5 Hz, 1H), 7.13 (t, *J* = 7.4 Hz, 1H), 7.09 – 7.01 (m, 2H), 6.89 (t, *J* = 8.2 Hz, 1H), 6.79 – 6.73 (m, 1H), 4.93 (s, 1H), 4.43 (d, *J* = 4.3 Hz, 2H), 3.77 – 3.72 (m, 1H), 3.36 – 3.31 (m, 1H), 2.41 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 152.01 (d, *J* = 239.6 Hz), 143.83 , 136.14 , 134.37 (d, *J* = 11.4 Hz), 134.03 , 131.60 , 129.82 , 127.57 , 124.94 (d, *J* = 3.5 Hz), 124.80 , 122.88 , 120.08 , 118.61 (d, *J* = 7.0 Hz), 118.24 , 115.31 (d, *J* = 18.8 Hz), 113.35 (d), 111.40 , 108.15 , 48.36 , 47.03 , 43.06 , 21.54 .

HRMS (ESI): calcd for $C_{24}H_{22}FN_3O_2S$ $[M + H]^+$ *m/z* 436.1490, found 436.1476.

Compound 3



3

N-(2-chlorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-chloroaniline (127 mg, 1.0 mmol) was added into the mixture. After stirring for another 2.5 h, he reaction mixture was concentrated under reduced pressure. Silica gel (0.7 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/ EtOAc = 4:1) to provide the desired product (189 mg, 84%) as a white solid.

Physical State: white solid.

Melting Point: 191.3-195.2 ^{o}C.

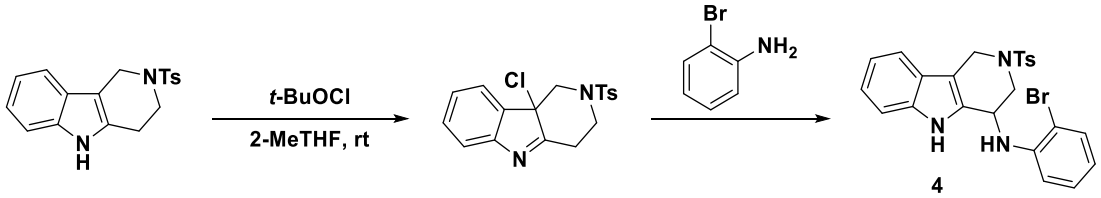
TLC: R_f = 0.38 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz,$CDCl_3$) δ 8.16 (s, 1H), 7.74 (d, *J* = 7.6 Hz, 2H), 7.46 (d, *J* = 7.6 Hz, 1H), 7.30 (d, *J* = 8.5 Hz, 4H), 7.21 (t, *J* = 7.2 Hz, 2H), 7.13 (t, *J* = 7.2 Hz, 1H), 6.87 (d, *J* = 8.0 Hz, 1H), 6.75 (t, *J* = 7.4 Hz, 1H), 4.98 (s, 1H), 4.54 (d, *J* = 13.8 Hz, 2H), 4.35 (d, *J* = 13.9 Hz, 1H), 3.86 (d, *J* = 11.6 Hz, 1H), 3.25 – 3.20 (m, 1H), 2.41 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$/CD_3OD=10:1) δ 143.90, 141.94, 136.25, 133.83, 131.21, 129.79, 129.68, 128.06, 127.48, 124.64, 122.62, 120.04, 119.76, 118.67, 118.05, 111.91, 111.45, 107.73, 48.08, 46.91, 42.99, 21.40.

HRMS (ESI): calcd for $C_{24}H_{22}ClN_3O_2S$ [M + H]$^+$*m/z* 452.1214, found 452.1194.

Compound 4



4

N-(2-bromophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-bromoaniline (259 mg, 1.5 mmol) was added into the mixture. After stirring for another 15 min, the reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (300 mg, 60%) as a white solid.

Physical State: white solid.

Melting Point: 206.4-208.5 °C.

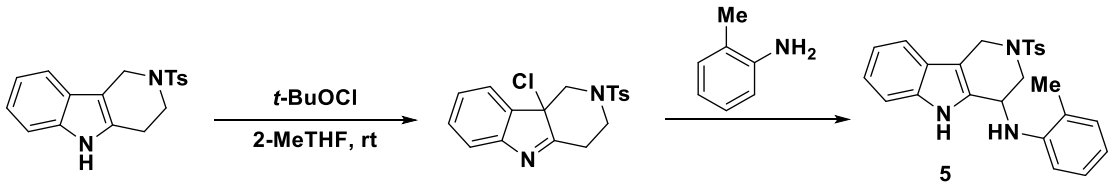
TLC: R_f = 0.40 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (s, 1H), 7.74 (d, *J* = 7.7 Hz, 2H), 7.47 (t, *J* = 6.6 Hz, 2H), 7.33 (d, *J* = 11.0 Hz, 2H), 7.27 – 7.19 (m, 3H), 7.13 (t, *J* = 7.3 Hz, 1H), 6.85 (d, *J* = 8.1 Hz, 1H), 6.69 (t, *J* = 7.5 Hz, 1H), 4.98 (s, 1H), 4.55 (t, *J* = 11.4 Hz, 2H), 4.33 (d, *J* = 14.1 Hz, 1H), 3.89 (d, *J* = 11.8 Hz, 1H), 3.22 – 3.16 (m, 1H), 2.41 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$/CD_3OD=10:1) δ 143.90, 142.96, 136.20, 133.85, 133.02, 131.23, 129.83, 128.82, 127.54, 124.69, 122.70, 119.87, 119.31, 118.12, 112.07, 111.47, 110.63, 107.86, 48.12, 47.17, 43.01, 21.48.

HRMS (ESI): calcd for $C_{24}H_{22}BrN_3O_2S$ $[M + H]^+$*m/z* 496.0689, found 496.0684.

Compound 5



5

N-(o-tolyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then o-toluidine (160 mg, 1.5 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (370mg, 86%) as a white solid.

Physical State: white solid.

Melting Point: 156.5-157.7 ^oC

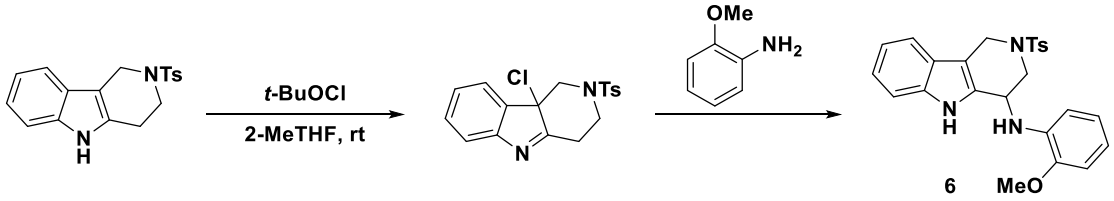
TLC: R_f = 0.35 (PE/ CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz,$CDCl_3$) δ 8.17 (s, 1H), 7.73 (d, *J* = 7.5 Hz, 2H), 7.46 (d, *J* = 7.7 Hz, 1H), 7.30 (d, *J* = 6.2 Hz, 3H), 7.22 – 7.17 (m, 2H), 7.15 – 7.10 (m, 2H), 6.84 (d, *J* = 8.0 Hz, 1H), 6.78 (t, *J* = 7.3 Hz, 1H), 4.96 (s, 1H), 4.50 (d, *J* = 13.9 Hz, 1H), 4.35 (d, *J* = 13.9 Hz, 1H), 3.63 (d, *J* = 11.8 Hz, 1H), 3.45 – 3.39 (m, 1H), 2.42 (s, 3H), 2.10 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 144.11, 143.79, 136.12, 134.01, 132.32, 130.95, 129.81, 127.59, 127.40, 124.80, 123.44, 122.82, 120.05, 118.58, 118.20, 111.41, 110.78, 108.01, 48.68, 47.02, 43.22, 21.56, 17.62.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_2S$ $[M + H]^+$*m/z* 432.1740, found 432.1739.

Compound 6



N-(2-methoxyphenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b] indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added tert-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-methoxyaniline (151 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.9 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (153 mg, 68%) as a white solid.

Physical State: White solid

Melting Point: 175.9-176.5 ^oC

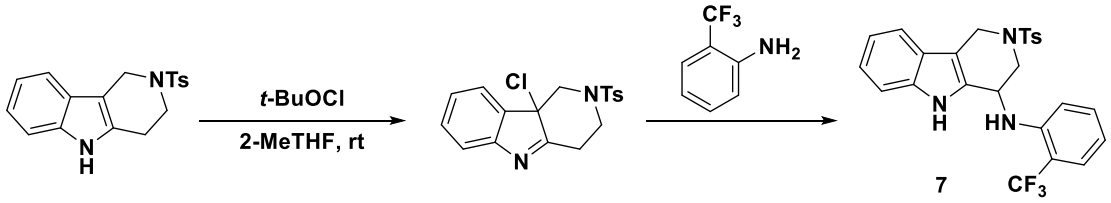
TCL: R_f = 0.70 (PE/CH_2Cl_2 = 1:2)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (s, 1H), 7.74 (d, *J* = 7.6 Hz, 2H), 7.44 (d, *J* = 7.5 Hz, 1H), 7.30 (d, *J* = 6.6 Hz, 3H), 7.19 (t, *J* = 7.0 Hz, 1H), 7.12 (t, *J* = 7.0 Hz, 1H), 6.92 (t, *J* = 6.9 Hz, 1H), 6.80 (t, *J* = 10.2 Hz, 3H), 4.96 (s, 1H), 4.52 (d, *J* = 13.8 Hz, 1H), 4.31 (d, *J* = 14.0 Hz, 1H), 3.87 (d, *J* = 11.8 Hz, 1H), 3.81 (s, 3H), 3.20 – 3.14 (m, 1H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.39, 143.68, 136.06, 135.84, 134.12, 132.57, 129.76, 127.64, 124.91, 122.64, 121.50, 119.97, 118.20, 118.14, 111.34, 110.74, 110.27, 107.73, 55.49, 48.52, 46.84, 43.16, 21.55.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_3S$ $[M + H]^+$*m/z* 448.1689, found 448.1688.

Compound 7



2-tosyl-N-(2-(trifluoromethyl)phenyl)-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-aminobenzotrifluoride (242 mg, 1.5 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (260 mg, 54%) as a white solid.

Physical State: white solid.

Melting Point: 184.2-184.9 °C.

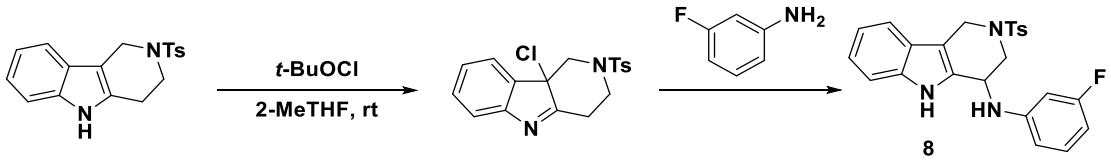
TLC: R_f = 0.55 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (s, 1H), 7.75 (d, *J* = 7.6 Hz, 2H), 7.52 – 7.44 (m, 3H), 7.32 (t, *J* = 9.4 Hz, 3H), 7.22 (t, *J* = 7.5 Hz, 1H), 7.14 (t, *J* = 7.3 Hz, 1H), 6.98 (d, *J* = 8.3 Hz, 1H), 6.87 (t, *J* = 7.5 Hz, 1H), 5.04 (s, 1H), 4.58 (d, *J* = 13.9 Hz, 1H), 4.50 (d, *J* = 9.1 Hz, 1H), 4.27 (d, *J* = 13.9 Hz, 1H), 3.99 – 3.94 (m, 1H), 3.18 – 3.12 (m, 1H), 2.41 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.91 , 143.77 , 143.75 , 136.20 , 133.95 , 133.60 , 131.18 , 129.84 , 127.60 , 127.18 (q, *J* = 5.4 Hz), 124.83 , 122.99 , 120.20 , 118.28 , 117.80 , 114.87 (q, *J* = 29.3 Hz), 112.58 , 111.48 , 108.41 , 48.26 , 47.32 , 43.01 , 21.53 .

HRMS (ESI): calcd for $C_{25}H_{22}F_3N_3O_2S$ $[M + H]^+$ *m/z* 486.1458, found 486.1451.

Compound 8



8

N-(3-fluorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-fluoroaniline (167 mg, 1.5 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (355 mg, 82%) as a white solid.

Physical State: white solid.

Melting Point: 96.2-100.1 ^oC.

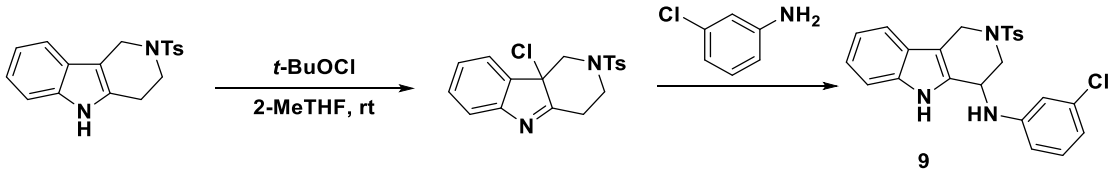
TLC: R_f = 0.40 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (s, 1H), 7.73 (d, *J* = 7.6 Hz, 2H), 7.45 (d, *J* = 7.6 Hz, 1H), 7.38 – 7.27 (m, 3H), 7.23 – 7.09 (m, 3H), 6.58 – 6.42 (m, 2H), 6.38 (d, *J* = 11.1 Hz, 1H), 4.81 (s, 1H), 4.56 (d, *J* = 14.0 Hz, 1H), 4.27 (d, *J* = 13.9 Hz, 1H), 3.53 (q, *J* = 12.1 Hz, 2H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.10 (d, *J* = 244.0 Hz), 147.85 (d, *J* = 10.4 Hz), 143.92 , 136.14 , 133.94 , 131.42 , 130.88 (d, *J* = 10.0 Hz), 129.85 , 127.58 , 124.69 , 122.95 , 120.09 , 118.24 , 111.41 , 109.57 (d, *J* = 2.1 Hz), 108.15 , 105.39 (d, *J* = 21.4 Hz), 100.65 (d, *J* = 25.3 Hz), 48.37 , 46.98 , 43.12 , 21.54 .

HRMS (ESI): calcd for $C_{24}H_{22}FN_3O_2S$ $[M + H]^+$ *m/z* 436.1490, found 436.1476.

Compound 9



9

N-(3-chlorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-chloroaniline (127 mg, 1.0 mmol) was added into the mixture. After stirring for another 2.5 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.7 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/ EtOAc = 4:1) to provide the desired product (219 mg, 89%) as a white solid.

Physical State: white solid.

Melting Point: 105.4-112.3 ^{o}C.

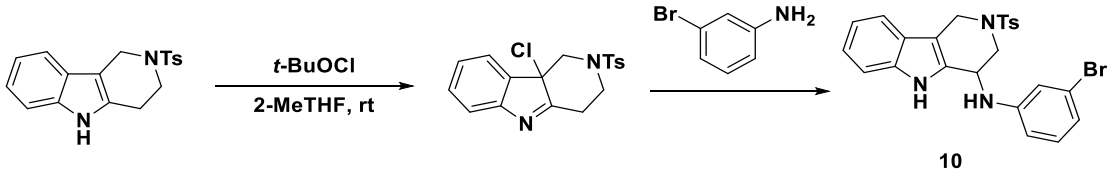
TLC: R_f = 0.31 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (s, 1H), 7.73 (d, *J* = 7.6 Hz, 2H), 7.45 (d, *J* = 7.7 Hz, 1H), 7.31 (t, 3H), 7.20 (t, *J* = 7.8 Hz, 1H), 7.13 (t, *J* = 7.4 Hz, 2H), 6.78 (d, *J* = 7.8 Hz, 1H), 6.66 (s, 1H), 6.57 (d, *J* = 8.1 Hz, 1H), 4.81 (s, 1H), 4.58 (d, *J* = 14.0 Hz, 1H), 4.26 (d, *J* = 14.1 Hz, 1H), 3.57 (d, *J* = 13.8 Hz, 1H), 3.48 (d, *J* = 12.1 Hz, 1H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.27, 143.94, 136.16, 135.34, 134.01, 131.37, 130.72, 129.88, 127.57, 124.69, 122.98, 120.11, 118.80, 118.26, 113.58, 112.09, 111.43, 108.21, 48.39, 46.91, 43.12, 21.56.

HRMS (ESI): calcd for $C_{24}H_{22}ClN_3O_2S$ $[M + H]^+$*m/z* 452.1194, found 452.1214.

Compound 10



10

N-(3-bromophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol*e (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-bromoaniline (259 mg, 1.5 mmol) was added into the mixture. After stirring for another 15 min, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/ EtOAc = 4:1) to provide the desired product (360 mg, 72%) as a white solid.

Physical State: white solid.

Melting Point: 196.2-201.7 ^{o}C.

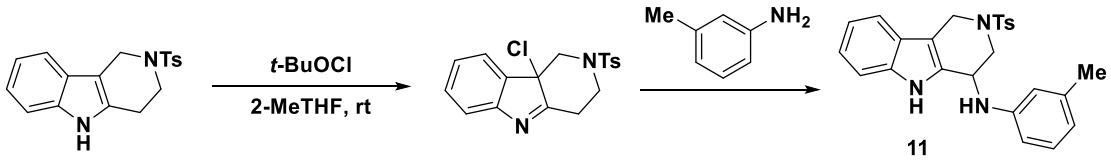
TLC: R_f = 0.31 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz,$CDCl_3$/CD_3OD = 10:1) δ 7.69 (d, *J* = 7.6 Hz, 2H), 7.41 (d, *J* = 7.8 Hz, 1H), 7.29 (d, *J* = 6.9 Hz, 3H), 7.15 (t, *J* = 7.5 Hz, 1H), 7.09 – 7.01 (m, 2H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.81 (s, 1H), 6.59 (d, *J* = 8.0 Hz, 1H), 4.75 (s, 1H), 4.55 (d, *J* = 13.9 Hz, 1H), 4.20 (d, *J* = 13.8 Hz, 1H), 3.55 (d, *J* = 14.3 Hz, 1H), 3.39 (d, *J* = 12.2 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$/CD_3OD = 10:1) δ 147.51, 143.98, 136.17, 133.79, 131.21, 130.91, 129.86, 127.51, 124.55, 123.42, 122.71, 121.48, 119.79, 118.09, 116.44, 112.51, 111.42, 107.68, 48.30, 46.86, 43.13, 21.50.

HRMS (ESI): calcd for $C_{24}H_{22}BrN_3O_2S$ $[M + H]^+$*m/z* 496.0689, found 496.0684.

Compound 11



11

N-(m-tolyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-methylaniline (171 mg, 1.6 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (347 mg, 80%) as a white solid.

Physical State: white solid.

Melting Point: 107.4-110.5 ^oC.

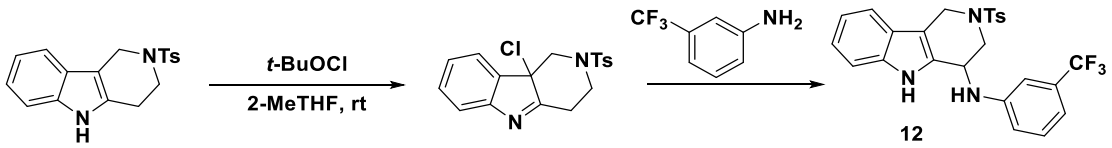
TLC: R_f = 0.29 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (s, 1H), 7.74 (d, *J* = 7.5 Hz, 2H), 7.44 (d, *J* = 7.7 Hz, 1H), 7.34 – 7.27 (m, 3H), 7.19 (t, *J* = 7.5 Hz, 1H), 7.15 – 7.09 (m, 2H), 6.66 (d, *J* = 7.3 Hz, 1H), 6.55 (s, 2H), 4.88 (s, 1H), 4.46 (d, *J* = 13.9 Hz, 1H), 4.35 (d, *J* = 14.0 Hz, 1H), 3.67 – 3.62 (m, 1H), 3.41 – 3.35 (m, 1H), 2.42 (s, 3H), 2.31 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 146.10, 143.78, 139.60, 136.05, 134.01, 132.34, 129.81, 129.60, 127.62, 124.78, 122.73, 120.03, 119.99, 118.16, 114.95, 111.36, 111.01, 107.77, 48.74, 47.19, 43.20, 21.67, 21.56.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_2S$ $[M + H]^+$*m/z* 432.1741, found 432.1739.

Compound 12



2-tosyl-N-(3-(trifluoromethyl)phenyl)-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-aminobenzotrifluoride (242 mg, 1.5 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was concentrated to give crude product under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (293 mg, 60%) as a white solid.

Physical State: white solid.

Melting Point: 211.3-211.9 °C.

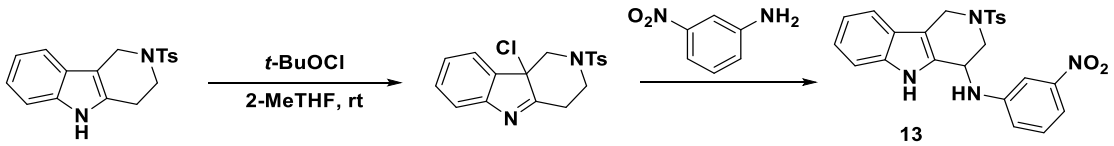
TLC: R_f = 0.44 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.21 (s, 1H), 7.76 (d, *J* = 7.8 Hz, 2H), 7.50 (d, *J* = 7.6 Hz, 1H), 7.43 (d, *J* = 7.5 Hz, 2H), 7.35 (t, *J* = 10.1 Hz, 2H), 7.12 – 6.99 (m, 4H), 6.91 (d, *J* = 7.4 Hz, 1H), 6.57 (d, *J* = 8.4 Hz, 1H), 5.04 – 4.97 (m, 1H), 4.46 (d, *J* = 13.9 Hz, 1H), 4.12 (d, *J* = 13.9 Hz, 1H), 3.47 (d, *J* = 11.8 Hz, 1H), 3.30 (s, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 148.18 , 144.07 , 136.75 , 133.78 , 132.36 , 130.61 – 130.27 (m), 130.35 , 127.93 , 126.40 , 124.79 , 123.69 , 122.19 , 119.31 , 118.40 , 115.89 , 112.60 (q, *J* = 3.5 Hz), 111.96 , 109.21 (q, *J* = 4.0, 3.6 Hz), 106.58 , 48.43 , 46.04 , 43.47 , 21.46 .

HRMS (ESI): calcd for $C_{25}H_{22}F_3N_3O_2S$ $[M + H]^+$ *m/z* 486.1458, found 486.1451.

Compound 13



13

N-(3-nitrophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg,0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-nitroaniline(138 mg, 1.0 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.7 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (210 mg, 91%) as a yellow solid.

Physical State: yellow solid.

Melting Point: 223.2-224.6 ^oC

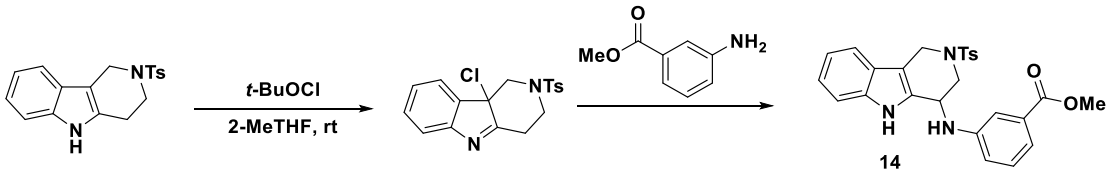
TLC: R_f = 0.23 (PE/EtOAc = 2:1)

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.21 (s, 1H), 7.75 (d, *J* = 7.3 Hz, 2H), 7.56 (s, 1H), 7.51 (d, *J* = 7.5 Hz, 1H), 7.43 (d, *J* = 6.8 Hz, 4H), 7.32 (d, *J* = 7.7 Hz, 1H), 7.19 (d, *J* = 6.1 Hz, 1H), 7.11 (t, 1H), 7.00 (t, *J* = 6.7 Hz, 1H), 6.83 (d, *J* = 7.9 Hz, 1H), 5.02 (s, 1H), 4.49 (d, *J* = 13.8 Hz, 1H), 4.07 (d, *J* = 14.1 Hz, 1H), 3.52 (d, *J* = 11.6 Hz, 1H), 3.26 (d, *J* = 11.8 Hz, 1H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 149.44, 148.75, 144.09, 136.73, 133.74, 132.04, 130.67, 130.35, 127.95, 124.75, 122.27, 119.35, 118.93, 118.44, 111.97, 110.93, 106.73, 106.59, 48.27, 46.07, 43.45, 39.98, 21.46.

HRMS (ESI): calcd for $C_{24}H_{22}N_4O_4S$ $[M + H]^+$*m/z* 463.1435, found 463.1468.

Compound 14



14

methyl 3-((2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-yl)amino)benzoate

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b] indole* (163 mg, 0.5mmol) in 2-methyltetrahydrofuran (10 mL) was added tert-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then methyl 3-aminobenzoate (151 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.9 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (216 mg, 92%) as a white solid.

Physical State: White solid

Melting Point: 198.7-199.2 ^oC.

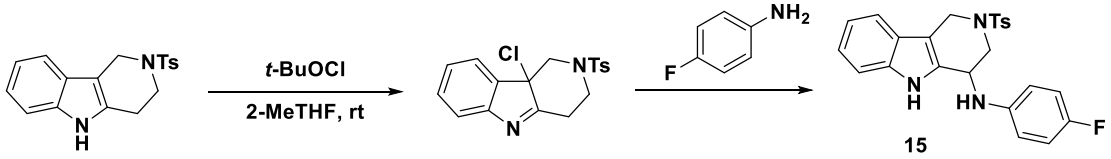
TCL: R_f = 0.70 (PE/EtOAc = 2:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (s, 1H), 7.72 (d, *J* = 7.6 Hz, 2H), 7.49 – 7.42 (m, 2H), 7.39 (s, 1H), 7.33 – 7.28 (m, 3H), 7.26 (s, 1H), 7.19 (t, *J* = 7.4 Hz, 1H), 7.11 (t, *J* = 7.2 Hz, 1H), 6.86 (d, *J* = 8.0 Hz, 1H), 4.90 (s, 1H), 4.60 (d, *J* = 13.9 Hz, 1H), 4.22 (d, *J* = 13.9 Hz, 1H), 3.91 (s, 3H), 3.61 (d, *J* = 12.0 Hz, 1H), 3.44 (d, *J* = 11.9 Hz, 1H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.32, 146.17, 143.84, 136.18, 134.01, 131.55, 131.38, 129.83, 129.69, 127.56, 124.69, 122.90, 120.03, 120.00, 118.68, 118.21, 114.09, 111.43, 108.12, 52.15, 48.42, 46.94, 43.15, 21.53.

HRMS (ESI): calcd for $C_{26}H_{25}N_3O_4S$ $[M + H]^+$*m/z* 476.1639, found 476.1644.

Compound 15



15

N-(4-fluorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-fluoroaniline (167 mg, 1.5 mmol) was added into the mixture. After stirring for another 2 h, he reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (265 mg, 61%) as a white solid.

Physical State: white solid.

Melting Point: 164.2-165.4 ^oC.

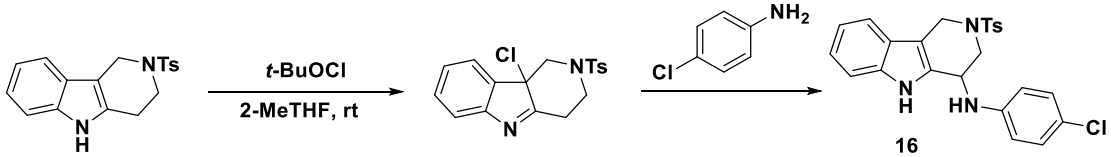
TLC: R_f = 0.30 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz,$CDCl_3$) δ 8.13 (s, 1H), 7.73 (d, *J* = 7.7 Hz, 2H), 7.44 (d, *J* = 7.8 Hz, 1H), 7.31 (t, *J* = 7.5 Hz, 3H), 7.20 (t, *J* = 7.4 Hz, 1H), 7.12 (t, *J* = 7.2 Hz, 1H), 6.94 (t, *J* = 7.9 Hz, 2H), 6.70 – 6.65 (m, 2H), 4.77 (s, 1H), 4.54 (d, *J* = 13.9 Hz, 1H), 4.25 (d, *J* = 13.9 Hz, 1H), 3.54 – 3.45 (m, 2H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.66 (d, *J* = 237.5 Hz), 143.88 , 142.30 (d, *J* = 2.1 Hz), 136.11 , 133.87 , 131.89 , 129.84 , 127.59 , 124.72 , 122.87 , 120.05 , 118.20 , 116.19 (d, *J* = 22.4 Hz), 115.58 (d, *J* = 7.5 Hz), 111.38 , 107.98 , 48.31 , 48.23 , 43.22 , 21.54 .

HRMS (ESI): calcd for $C_{24}H_{22}FN_3O_2S$ $[M + H]^+$*m/z* 436.1490, found 436.1476.

Compound 16



N-(4-chlorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-chloroaniline (255 mg, 2.0 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (325 mg, 72%) as a white solid.

Physical State: white solid.

Melting Point: 192.5-193.2 ^oC.

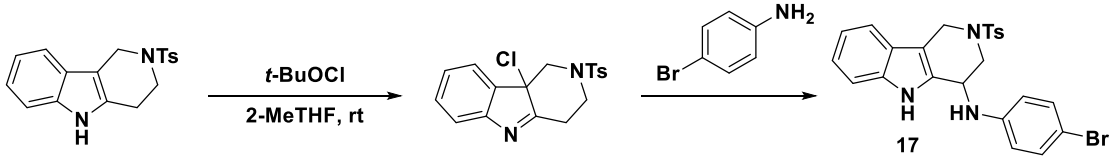
TLC: R_f = 0.34 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.72 (d, *J* = 7.5 Hz, 2H), 7.44 (d, *J* = 7.8 Hz, 1H), 7.31 (t, 3H), 7.19 (dd, *J* = 14.2, 7.4 Hz, 3H), 7.12 (t, *J* = 7.4 Hz, 1H), 6.64 (d, *J* = 7.6 Hz, 2H), 4.81 (s, 1H), 4.54 (d, *J* = 13.9 Hz, 1H), 4.25 (d, *J* = 13.9 Hz, 1H), 3.55 – 3.45 (m, 2H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$/CD_3OD = 15:1) δ 144.72, 143.97, 136.19, 133.60, 131.40, 129.82, 129.37, 127.49, 124.53, 123.38, 122.59, 119.69, 118.01, 115.33, 111.40, 107.52, 48.11, 47.41, 43.17, 21.42.

HRMS (ESI): calcd for $C_{24}H_{22}ClN_3O_2S$ $[M + H]^+$ *m/z* 452.1194, found 452.1214.

Compound 17



N-(4-bromophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-bromoaniline (207 mg, 1.2 mmol) was added into the mixture. After stirring for another 15 min, he reaction mixture was concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (287 mg, 58%) as a white solid.

Physical State: white solid.

Melting Point: 196.9-197.9 ^oC.

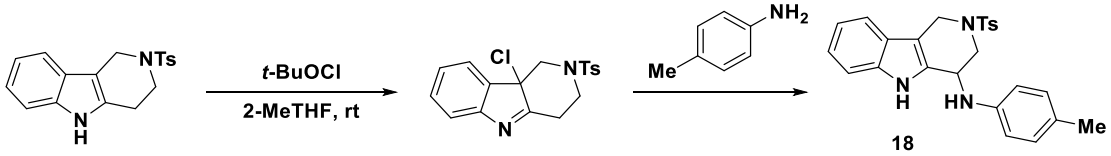
TLC: R_f = 0.40 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.20 (s, 1H), 7.74 (d, *J* = 7.6 Hz, 2H), 7.49 (d, *J* = 7.8 Hz, 1H), 7.43 (d, *J* = 7.8 Hz, 2H), 7.32 (d, *J* = 8.1 Hz, 1H), 7.27 (d, *J* = 8.0 Hz, 2H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.99 (t, *J* = 7.4 Hz, 1H), 6.73 (d, *J* = 8.1 Hz, 2H), 6.27 (d, *J* = 8.8 Hz, 1H), 4.90 (d, *J* = 7.7 Hz, 1H), 4.41 (d, *J* = 13.9 Hz, 1H), 4.11 (d, *J* = 13.9 Hz, 1H), 3.42 (d, *J* = 3.9 Hz, 1H), 3.28 (d, *J* = 9.7 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 146.89, 144.08, 136.71, 133.65, 132.50, 132.04, 130.37, 127.94, 124.77, 122.13, 119.28, 118.35, 115.01, 111.95, 107.47, 106.47, 48.17, 46.23, 43.49, 21.49.

HRMS (ESI): calcd for $C_{24}H_{22}BrN_3O_2S$ $[M + H]^+$*m/z* 496.0869, found 496.0684.

Compound 18



N-(p-tolyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-methylaniline (171 mg, 1.6 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (259 mg, 60%) as a white solid.

Physical State: white solid.

Melting Point: 187.9-189.2 ^oC.

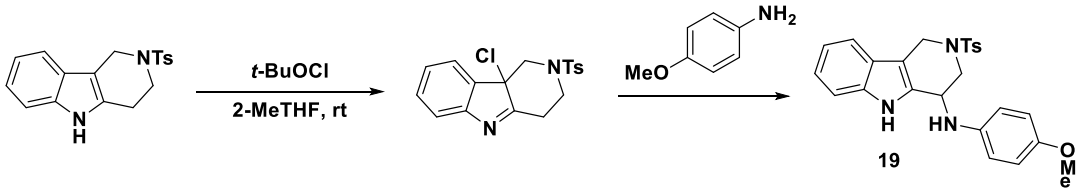
TLC: R_f = 0.25 (PE/CH_2Cl_2 = 1:2)

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.17 (s, 1H), 7.73 (d, *J* = 7.6 Hz, 2H), 7.49 – 7.41 (m, 3H), 7.31 (d, *J* = 8.0 Hz, 1H), 7.08 (t, *J* = 7.4 Hz, 1H), 7.00 – 6.93 (m, 3H), 6.67 (d, *J* = 7.5 Hz, 2H), 5.72 (d, *J* = 9.2 Hz, 1H), 4.89 (s, 1H), 4.32 (d, *J* = 13.9 Hz, 1H), 4.19 (d, *J* = 13.9 Hz, 1H), 3.40 (d, *J* = 11.0 Hz, 1H), 3.29 – 3.25 (m, 1H), 2.39 (s, 3H), 2.19 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 145.25, 144.04, 136.71, 133.79, 133.23, 130.38, 130.01, 127.90, 125.44, 124.86, 121.97, 119.22, 118.26, 113.41, 111.95, 106.20, 48.39, 46.75, 43.56, 21.47, 20.61.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_2S$ $[M + H]^+$*m/z* 432.1740, found 432,1739.

Compound 19



N-(4-methoxyphenyl)-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 10 min. Then 4-methoxyaniline (123 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the organic was concentrated under reduced pressure. Silica gel (0.8 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (147 mg, 66%) as a brown oil.

Physical State: brown oil.

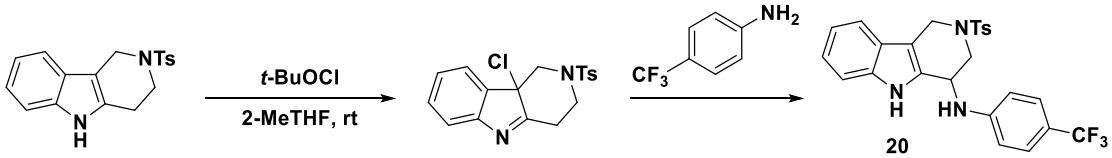
TLC: R_f = 0.25 (PE/EtOAc) = 4:1

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (s, 1H), 7.72 (d, *J* = 7.5 Hz, 2H), 7.43 (d, *J* = 7.7 Hz, 1H), 7.33 – 7.27 (m, 3H), 7.18 (t, *J* = 7.5 Hz, 1H), 7.10 (d, *J* = 7.2 Hz, 1H), 6.82 (d, *J* = 7.4 Hz, 2H), 6.71 (d, *J* = 7.9 Hz, 2H), 4.75 (s, 1H), 4.49 (d, *J* = 13.8 Hz, 1H), 4.27 (d, *J* = 13.8 Hz, 1H), 3.78 (s, 3H), 3.52 – 3.43 (m, 2H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.37, 143.78, 139.87, 136.08, 133.90, 132.42, 129.80, 127.61, 124.76, 122.69, 119.94, 118.14, 116.39, 115.20, 111.36, 107.69, 55.72, 48.78, 48.47, 43.28, 21.54.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_3S$ $[M + H]^+$*m/z* 448.1689, found 448.1688.

Compound 20



2-tosyl-N-(4-(trifluoromethyl)phenyl)-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-aminobenzotrifluoride (242 mg, 1.5 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (340 mg, 70%) as a white solid.

Physical State: white solid.

Melting Point: 224.3-225.7 °C.

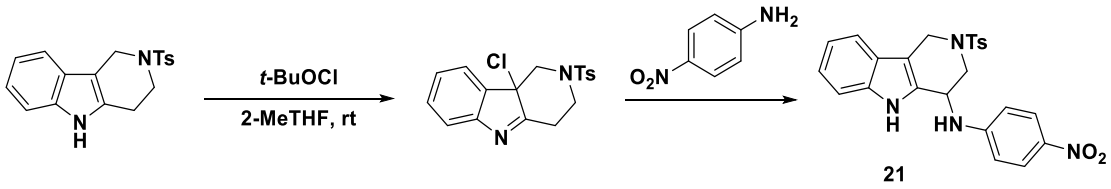
TLC: R_f = 0.43 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.22 (s, 1H), 7.75 (d, *J* = 7.6 Hz, 2H), 7.50 (d, *J* = 7.7 Hz, 1H), 7.44 (d, *J* = 7.9 Hz, 4H), 7.32 (d, *J* = 8.0 Hz, 1H), 7.10 (t, *J* = 7.5 Hz, 1H), 7.00 (t, *J* = 7.4 Hz, 1H), 6.89 – 6.81 (m, 3H), 5.00 (s, 1H), 4.45 (d, *J* = 13.9 Hz, 1H), 4.09 (d, *J* = 14.0 Hz, 1H), 3.50 – 3.45 (m, 1H), 3.27 (d, *J* = 10.8 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 150.71, 144.09, 136.75, 133.65, 132.07, 130.36, 127.97, 126.82 (q), 124.61 (q), 122.22, 119.32, 118.42, 116.38 (d, *J* = 31.9 Hz), 112.30, 111.96, 106.68, 48.31, 45.88, 43.47, 21.46.

HRMS (ESI): calcd for $C_{25}H_{22}F_3N_3O_2S$ $[M + H]^+$ *m/z* 486.1458, found 486.1451.

Compound 21



21

N-(4-nitrophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-nitroaniline (138 mg, 1.0 mmol) was added into the mixture. After stirring for another 2 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.7 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (118 mg, 51%) as a yellow solid.

Physical State: yellow solid.

Melting Point: 239.8-241.3 ^oC

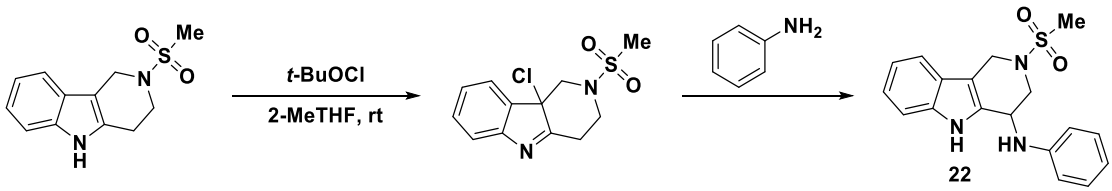
TLC: R_f = 0.30 (PE/EtOAc = 2:1)

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.26 (s, 1H), 8.06 (d, *J* = 9.8 Hz, 2H), 7.75 (d, *J* = 7.3 Hz, 2H), 7.70 (d, *J* = 7.7 Hz, 1H), 7.52 (d, *J* = 7.9 Hz, 1H), 7.44 (d, *J* = 7.8 Hz, 2H), 7.33 (d, *J* = 7.7 Hz, 1H), 7.12 (t, 1H), 7.01 (t, 1H), 6.87 (d, *J* = 8.3 Hz, 2H), 5.09 (s, 1H), 4.54 (d, 1H), 4.04 (d, *J* = 14.1 Hz, 1H), 3.60 (d, *J* = 11.6 Hz, 1H), 3.21 (d, *J* = 11.7 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 153.57, 144.13, 136.81, 136.77, 133.65, 131.18, 130.38, 127.97, 126.72, 124.70, 122.44, 119.43, 118.54, 112.00, 107.10, 99.98, 48.46, 45.95, 43.42, 21.47.

HRMS (ESI): calcd for $C_{24}H_{22}N_4O_4S$ $[M + H]^+$*m/z* 463.1435, found 463.1468.

Compound 22



2-(methylsulfonyl)-N-phenyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-(methylsulfonyl)-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (251 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (119 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then aniline (186 mg, 2.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (207 mg, 61%) as a white solid.

Physical State: white solid.

Melting Point: 113.4-113.8 ^oC

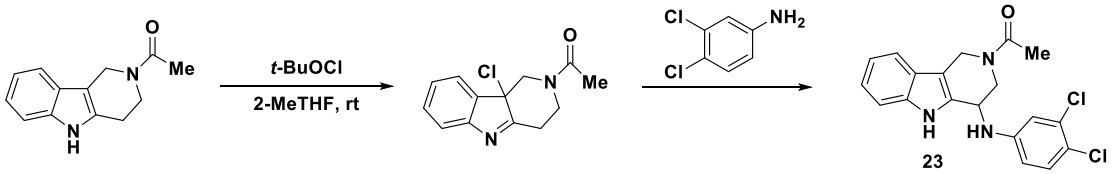
TLC: R_f = 0.78 (PE/EtOAc = 2:1)

^{1}H NMR (400 MHz, $CDCl_3/CD_3OD$ = 20:1) δ 7.43 (d, *J* = 7.5 Hz, 1H), 7.30 (d, *J* = 7.9 Hz, 1H), 7.20 (t, *J* = 6.7 Hz, 3H), 7.11 (t, *J* = 7.1 Hz, 1H), 6.80 (t, *J* = 6.9 Hz, 1H), 6.72 (d, *J* = 7.4 Hz, 2H), 4.86 (s, 1H), 4.60 (d, *J* = 14.1 Hz, 1H), 4.44 (d, *J* = 14.1 Hz, 1H), 3.68 (d, *J* = 12.3 Hz, 1H), 3.54 (d, *J* = 11.8 Hz, 1H), 2.83 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3/CD_3OD$ = 20:1) δ 146.00 , 136.17 (d, *J* = 14.3 Hz), 132.02 (d, *J* = 14.2 Hz), 129.73 , 124.62 (d, *J* = 3.9 Hz), 122.77 , 119.95 , 119.20 , 118.11 , 114.22 , 111.48 (d, *J* = 5.0 Hz), 107.68 (d, *J* = 5.1 Hz), 48.13 , 47.39 , 43.03 , 36.40 .

HRMS (ESI): calcd for $C_{18}H_{19}N_3O_2S$ $[M + H]^+$*m/z* 342.1271, found 342.1271.

Compound 23



1-(4-((3,4-dichlorophenyl)amino)-1,3,4,5-tetrahydro-2H-pyrido[4,3-b]indol-2-yl)ethan-1-one

To a solution of *1-(1,3,4,5-tetrahydro-2H-pyrido[4,3-b]indol-2-yl)ethan-1-one* (107 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (65 mg, 0.55 mmol). The reaction mixture was stirred at rt for 10 min. Then 3,4-dichloroaniline (162 mg, 1.0 mmol) was added into the mixture. After stirring for another 2 h, the organic was concentrated under reduced pressure. Silica gel (1.2 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/EtOAc = 1:1) to provide the desired product (75 mg, 40%) as a white solid.

Physical State: white solid.

Melting Point: 219.6-220.0 °C

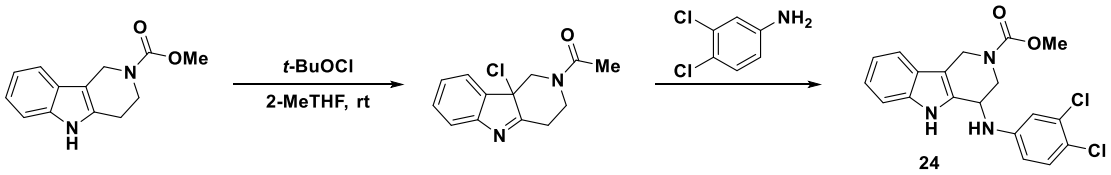
TLC: R_f = 0.32 (PE/EtOAc = 2:1)

^{1}H NMR (400 MHz, DMSO-*d*$_6$) δ 11.15 (s, 1H), 7.50 (d, *J* = 7.6 Hz, 1H), 7.37 – 7.28 (m, 2H), 7.11 (t, *J* = 7.5 Hz, 1H), 7.06 (s, 0.7H), 7.04 – 6.98 (m, 1H), 6.96 (s, 0.3H), 6.81 (d, *J* = 8.7 Hz, 0.7H), 6.73 (d, *J* = 8.6 Hz, 0.3H), 6.63 (d, *J* = 8.2 Hz, 0.7H), 6.42 (d, *J* = 8.5 Hz, 0.3H), 5.19 (d, *J* = 15.7 Hz, 0.6H), 4.92 (d, *J* = 7.3 Hz, 0.7H), 4.81 (d, *J* = 8.6 Hz, 0.4H), 4.76 (s, 0.2H), 4.62 (d, *J* = 15.2 Hz, 0.3H), 4.24 (d, *J* = 15.8 Hz, 0.8H), 4.09 – 4.04 (m, 0.2H), 3.91 (d, *J* = 13.7 Hz, 0.7H), 3.63 (d, *J* = 12.9 Hz, 1H), 2.14 (s, 0.8H), 1.89 (s, 2.2H).

^{13}C NMR (101 MHz, DMSO-*d*$_6$) δ 169.65 (d, *J* = 59.7 Hz), 148.17 (d, *J* = 22.3 Hz), 136.71 (d, *J* = 12.2 Hz), 132.83 (d, *J* = 86.7 Hz), 131.94 (d, *J* = 23.1 Hz), 131.14 (d, *J* = 21.4 Hz), 124.93 (d, *J* = 14.5 Hz), 122.09 (d, *J* = 4.7 Hz), 119.21 , 118.45 , 117.33 (d, *J* = 14.7 Hz), 113.76 (d, *J* = 29.8 Hz), 113.40 (d, *J* = 14.2 Hz), 111.94 (d, *J* = 5.6 Hz), 108.38 (d, *J* = 79.6 Hz), 47.87 , 46.20 (d, *J* = 25.0 Hz), 43.33 (d, *J* = 10.4 Hz), 22.04 (d, *J* = 78.2 Hz).

HRMS (ESI): calcd for $C_{19}H_{17}Cl_2N_3O$ $[M + H]^+$*m/z* 374.0821, found 374.0819.

Compound 24



methyl 4-((3,4-dichlorophenyl)amino)-1,3,4,5-tetrahydro-2H-pyrido[4,3-b]indole-2-carboxylate

To a solution of *methyl 1,3,4,5-tetrahydro-2H-pyrido[4,3-b]indole-2-carboxylate* (163mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (65 mg, 0.55 mmol). The reaction mixture was stirred at rt for 10 min. Then 3,4-dichloroaniline (162 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the organic was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (120 mg, 62%) as white solid.

Physical State: white solid.

Melting Point: 204.3-205.2 °C

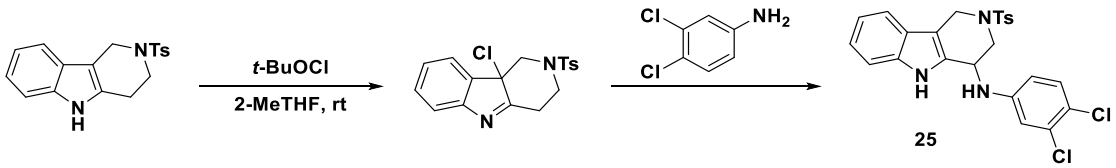
TLC: R_f = 0.32 (PE/EtOAc = 4:1)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (s, 1H), 7.49 (d, *J* = 7.6 Hz, 1H), 7.33 (d, *J* = 8.0 Hz, 1H), 7.26 – 7.19 (m, 2H), 7.14 (t, *J* = 7.3 Hz, 1H), 6.83 (s, 0.9H), 6.76 (s, 0.1H), 6.56 (d, *J* = 8.0 Hz, 0.9H), 6.50 (d, *J* = 10.2 Hz, 0.1H), 4.76 (t, *J* = 52.5 Hz, 3H), 3.97 (d, *J* = 42.3 Hz, 1.6H), 3.73 (d, *J* = 22.3 Hz, 4.4H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 156.34, 148.27, 136.67, 132.72, 131.84, 131.04, 124.87, 122.09, 119.23, 118.39, 117.29, 113.92, 113.52, 111.94, 108.10 (d, *J* = 41.4 Hz), 52.92, 46.01, 45.80, 41.55.

HRMS (ESI): calcd for $C_{19}H_{17}Cl_2N_3O_2$ $[M - H]^-$ *m/z* 388.0625, found 388.0626.

Compound 25



N-(3,4-dichlorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 3,4-dichloroaniline (93 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.8 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/EtOAc = 2:1) to provide the desired product (200 mg, 90%) as a white solid.

Physical State: white solid.

Melting Point: 223.6-225.5°C.

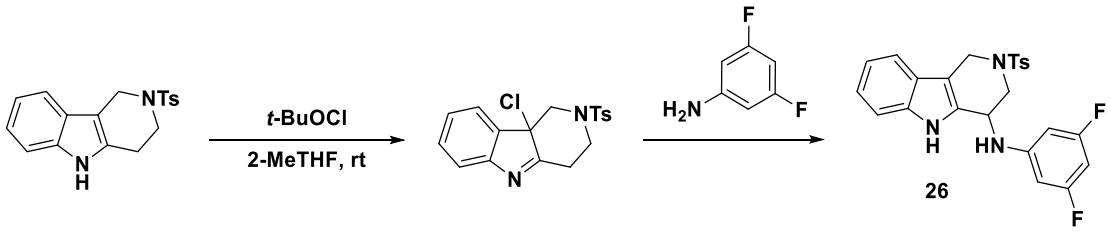
TLC: R_f = 0.30 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.20 (s, 1H), 7.75 (d, *J* = 7.5 Hz, 2H), 7.49 (d, *J* = 7.6 Hz, 1H), 7.44 (d, *J* = 7.5 Hz, 2H), 7.32 (d, *J* = 8.2 Hz, 2H), 7.10 (t, *J* = 7.2 Hz, 1H), 7.00 (d, *J* = 8.9 Hz, 3H), 6.75 (d, *J* = 8.6 Hz, 1H), 6.54 (s, 1H), 4.93 (s, 1H), 4.47 (d, *J* = 13.8 Hz, 1H), 4.05 (d, *J* = 12.9 Hz, 1H), 3.49 (d, *J* = 11.7 Hz, 1H), 3.19 (d, *J* = 11.6 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 147.82, 144.08, 136.74, 133.69, 132.11, 131.92, 131.10, 130.35, 127.97, 124.74, 122.25, 119.34, 118.41, 117.44, 113.85, 113.34, 111.97, 106.68, 48.27, 46.10, 43.44, 21.49.

HRMS (ESI): calcd for $C_{24}H_{21}Cl_2N_3O_2S$ $[M - H]^-$ *m/z* 484.0569, found 484.0568.

Compound 26



N-(3,5-difluorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3,5-difluoroaniline (193 mg, 1.5 mmol) was added into the mixture. After stirring for another 6 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.4S g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (320 mg, 71%) as a white solid.

Physical State: white solid.

Melting Point: 218.5-219.8 °C

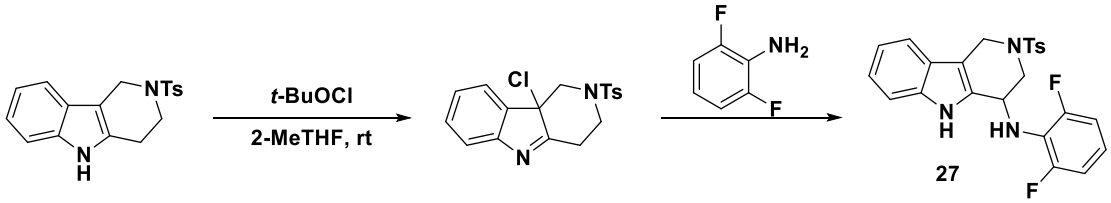
TLC: R_f = 0.42 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (s, 1H), 7.73 (d, *J* = 7.6 Hz, 2H), 7.45 (d, *J* = 7.9 Hz, 1H), 7.32 (d, *J* = 6.7 Hz, 3H), 7.21 (t, *J* = 7.4 Hz, 1H), 7.13 (t, *J* = 7.3 Hz, 1H), 6.23 (t, *J* = 8.8 Hz, 1H), 6.16 (d, *J* = 8.3 Hz, 2H), 4.74 (s, 1H), 4.64 (d, *J* = 14.0 Hz, 1H), 4.20 (d, *J* = 14.0 Hz, 1H), 3.67 (d, *J* = 12.0 Hz, 1H), 3.39 (d, *J* = 12.1 Hz, 1H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$/CD_3OD=20:1) δ 165.44 (d, *J* = 15.9 Hz), 163.00 (d, *J* = 15.9 Hz), 146.28 (d, *J* = 447.1 Hz), 136.26 (d, *J* = 14.2 Hz), 133.78 , 130.74 (d, *J* = 13.9 Hz), 129.86 , 127.52 , 124.53 (d, *J* = 4.0 Hz), 122.84 , 119.88 , 118.15 , 111.44 (d, *J* = 4.9 Hz), 107.96 (d, *J* = 5.3 Hz), 96.61 – 96.03 (m), 93.53 (t, *J* = 26.0 Hz), 48.16 , 46.71 , 43.06 , 21.45 .

HRMS (ESI): calcd for $C_{24}H_{21}F_2N_3O_2S$ $[M - H]^-$ *m/z* 452.1250, found 452.1250.

Compound 27



N-(2,6-difluorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 2,6-difluoroaniline (246 mg, 1.9 mmol) was added into the mixture. After stirring for another 6 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (381 mg, 84%) as a white solid.

Physical State: white solid.

Melting Point: 133.2-134.2 ^oC

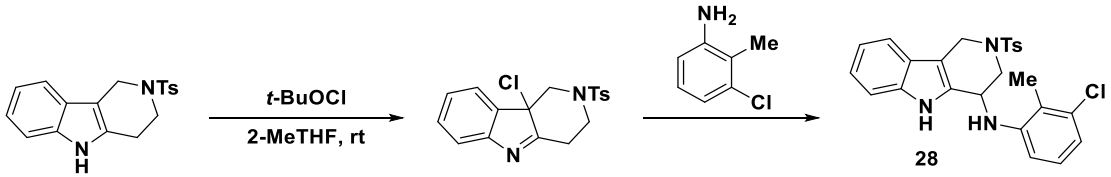
TLC: R_f = 0.43 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (s, 1H), 7.75 (d, *J* = 7.6 Hz, 2H), 7.45 (d, *J* = 7.8 Hz, 1H), 7.32 (d, *J* = 7.2 Hz, 3H), 7.21 (t, *J* = 7.6 Hz, 1H), 7.12 (t, *J* = 7.4 Hz, 1H), 6.89 (t, *J* = 8.1 Hz, 2H), 6.83 – 6.76 (m, 1H), 4.95 (s, 1H), 4.65 (d, *J* = 13.9 Hz, 1H), 4.11 (d, *J* = 13.8 Hz, 1H), 3.71 (d, *J* = 12.3 Hz, 1H), 3.29 (d, *J* = 12.1 Hz, 1H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 153.89 (dd, *J* = 241.7, 6.9 Hz), 143.84 , 136.23 , 133.76 , 131.83 , 129.81 , 127.67 , 124.68 , 123.64 (t, *J* = 14.3 Hz), 122.91 , 120.00 , 119.43 (t, *J* = 9.5 Hz), 118.29 , 112.07 – 111.66 (m), 111.42 , 107.79 , 49.52 , 48.96 , 43.24 , 21.54 .

HRMS (ESI): calcd for $C_{24}H_{21}F_2N_3O_2S$ $[M - H]^-$ *m/z* 452.1250, found 452.1250.

Compound 28



N-(3-chloro-2-methylphenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3-chloro-2-methylaniline 212 mg, 1.5 mmol) was added into the mixture. After stirring for another 6 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:3) to provide the desired product (312 mg, 67%) as a pink solid.

Physical State: pink solid.

Melting Point: 80.5-84.5 ^oC

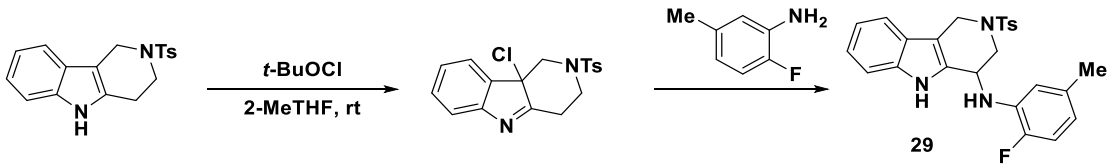
TLC: R_f = 0.46 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (s, 1H), 7.71 (d, *J* = 7.6 Hz, 2H), 7.47 (d, *J* = 7.7 Hz, 1H), 7.31 (t, 3H), 7.22 (t, *J* = 7.5 Hz, 1H), 7.16 – 7.06 (m, 2H), 6.88 (d, *J* = 7.9 Hz, 1H), 6.73 (d, *J* = 8.0 Hz, 1H), 4.91 (s, 1H), 4.56 (d, *J* = 13.9 Hz, 1H), 4.31 (d, *J* = 14.0 Hz, 1H), 3.57 – 3.48 (m, 2H), 2.42 (s, 4H), 2.14 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 145.34, 143.93, 136.18, 135.30, 133.98, 131.63, 129.80, 127.52, 127.43, 124.72, 122.98, 121.16, 120.12, 119.47, 118.25, 111.46, 109.16, 108.29, 48.31, 47.17, 43.10, 21.55, 13.68.

HRMS (ESI): calcd for $C_{25}H_{24}ClN_3O_2S$ $[M + H]^+$*m/z* 466.1351, found 466.1391.

Compound 29



N-(2-fluoro-5-methylphenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-fluoro-5-methylaniline (188 mg, 1.5 mmol) was added into the mixture. After stirring for another 6 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (349 mg, 78%) as a white solid.

Physical State: white solid.

Melting Point: 95.2-96.0 °C

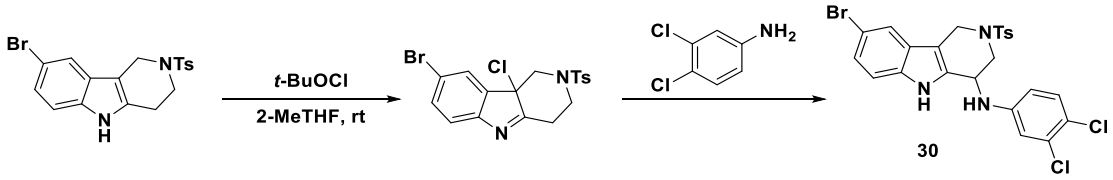
TLC: R_f = 0.44 (PE/CH_2Cl_2 = 1:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.74 (d, *J* = 7.6 Hz, 2H), 7.45 (d, *J* = 7.9 Hz, 1H), 7.31 (d, *J* = 7.6 Hz, 3H), 7.20 (t, *J* = 7.5 Hz, 1H), 7.12 (t, *J* = 7.3 Hz, 1H), 6.90 (t, 1H), 6.70 (d, *J* = 8.2 Hz, 1H), 6.55 (t, *J* = 6.4 Hz, 1H), 4.91 (s, 1H), 4.48 – 4.38 (m, 2H), 3.76 (s, 1H), 3.33 – 3.27 (m, 1H), 2.42 (s, 3H), 2.32 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.31 (d, *J* = 236.8 Hz), 143.82 , 136.13 , 134.51 (d, *J* = 3.5 Hz), 134.08 , 133.93 (d, *J* = 11.8 Hz), 131.76 , 129.81 , 127.58 , 124.80 , 122.85 , 120.06 , 119.01 (d, *J* = 6.9 Hz), 118.22 , 114.92 (d, *J* = 18.9 Hz), 114.08 (d), 111.39 , 108.07 , 48.53 , 47.03 , 43.06 , 21.55 , 21.29 .

HRMS (ESI): calcd for $C_{25}H_{24}FN_3O_2S$ $[M + H]^+$*m/z* 450.1646, found 450.1634.

Compound 30



8-bromo-N-(3,4-dichlorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *8-bromo-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (405 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3,4-dichloroaniline (210 mg, 1.3 mmol) was added into the mixture. After stirring for another 40 min, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (395 mg, 70%) as a white solid.

Physical State: white solid.

Melting Point: 241.6-242.7 ^oC.

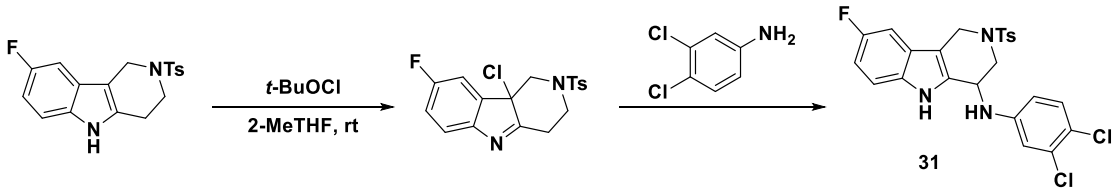
TLC: R_f = 0.40 (PE/EtOAc = 4:1)

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.44 (s, 1H), 7.75 (d, *J* = 8.7 Hz, 3H), 7.44 (d, *J* = 7.6 Hz, 2H), 7.35 – 7.27 (m, 2H), 7.21 (d, *J* = 8.6 Hz, 1H), 6.99 (s, 1H), 6.75 (d, *J* = 8.8 Hz, 1H), 6.58 (d, *J* = 8.6 Hz, 1H), 4.95 (d, *J* = 6.3 Hz, 1H), 4.45 (d, *J* = 14.2 Hz, 1H), 4.05 (d, *J* = 14.0 Hz, 1H), 3.44 (d, *J* = 12.6 Hz, 1H), 3.21 (d, *J* = 11.3 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 147.75, 144.13, 135.42, 133.86, 133.56, 131.92, 131.13, 130.34, 128.00, 126.54, 124.69, 121.05, 117.55, 113.89, 113.86, 113.40, 111.83, 106.66, 48.22, 46.06, 43.36, 21.49.

HRMS (ESI): calcd for $C_{24}H_{20}BrCl_2N_3O_2S$ $[M - H]^-$ *m/z* 561.9764, found 561.9763.

Compound 31



N-(3,4-dichlorophenyl)-8-fluoro-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *8-fluoro-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (344 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 3,4-dichloroaniline (194 mg, 1.2 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (344 mg, 68%) as a light pink solid.

Physical State: light pink solid.

Melting Point: 215.7-216.4 ^oC.

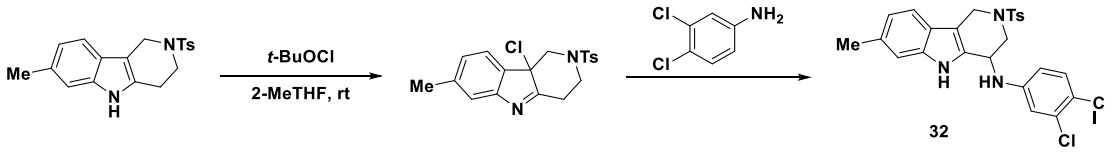
TLC: R_f = 0.39 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.30 (s, 1H), 7.74 (d, *J* = 7.7 Hz, 2H), 7.44 (d, *J* = 7.7 Hz, 2H), 7.32 (d, *J* = 8.9 Hz, 2H), 7.29 (d, *J* = 4.5 Hz, 1H), 7.04 – 6.89 (m, 2H), 6.74 (d, *J* = 8.8 Hz, 1H), 6.55 (d, *J* = 8.7 Hz, 1H), 4.93 (d, *J* = 7.6 Hz, 1H), 4.43 (d, *J* = 14.0 Hz, 1H), 4.02 (d, *J* = 13.6 Hz, 1H), 3.45 (d, *J* = 12.2 Hz, 1H), 3.20 (d, *J* = 11.3 Hz, 1H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 157.21 (d, *J* = 231.8 Hz), 147.75 , 144.13 , 134.25 , 133.63 , 133.36 , 131.91 , 131.11 , 130.35 , 127.96 , 124.88 (d, *J* = 10.3 Hz), 117.51 , 113.85 , 113.37 , 112.89 (d, *J* = 9.8 Hz), 110.27 (d, *J* = 26.0 Hz), 107.05 (d, *J* = 4.6 Hz), 103.52 (d, *J* = 23.6 Hz), 48.20 , 46.11 , 43.35 , 21.47 .

HRMS (ESI): calcd for $C_{24}H_{20}FCl_2N_3O_2S$ $[M - H]^-$ *m/z* 502.0565, found 502.0565.

Compound 32



N-(3,4-dichlorophenyl)-7-methyl-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *7-methyl-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (340 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 5 min. Then 3,4-dichloroaniline (194 mg, 1.2 mmol) was added into the mixture. After stirring for another 30 min, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. Silica gel (1.2 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 2:1 to PE/CH_2Cl_2 = 1:2) to provide the desired product (420 mg, 84%) as a white solid.

Physical State: white solid.

Melting Point: 215.6-216.3 ^oC.

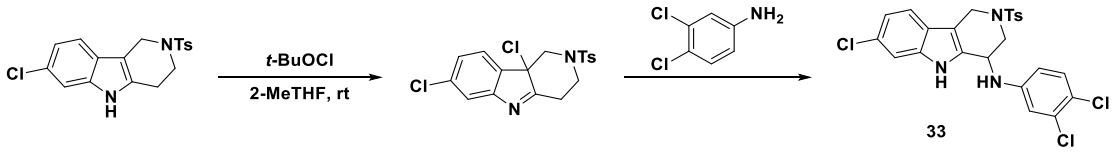
TLC: R_f = 0.43 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.03 (s, 1H), 7.74 (d, *J* = 7.7 Hz, 2H), 7.43 (d, *J* = 7.7 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 1H), 7.31 (d, *J* = 8.7 Hz, 1H), 7.10 (s, 1H), 6.98 (s, 1H), 6.83 (d, *J* = 8.1 Hz, 1H), 6.75 (d, *J* = 8.6 Hz, 1H), 6.52 (d, *J* = 8.5 Hz, 1H), 4.89 (d, *J* = 7.9 Hz, 1H), 4.44 (d, *J* = 13.9 Hz, 1H), 3.99 (d, *J* = 13.9 Hz, 1H), 3.47 (d, *J* = 12.1 Hz, 1H), 3.15 (d, *J* = 11.7 Hz, 1H), 2.39 (s, 3H), 2.36 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 147.81, 144.09, 137.18, 133.62, 131.89, 131.32, 131.28, 131.09, 130.35, 127.96, 122.67, 121.07, 118.10, 117.38, 113.85, 113.32, 111.79, 106.52, 48.24, 46.07, 43.47, 21.93, 21.48.

HRMS (ESI): calcd for $C_{25}H_{23}Cl_2N_3O_2S$ $[M - H]^-$ *m/z* 498.0815, found 498.0813.

Compound 33



7-chloro-N-(3,4-dichlorophenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *7-chloro-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (360 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 10 min. Then 3,4-dichloroaniline (194 mg, 1.2 mmol) was added into the mixture. After stirring for another 30 min, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:1 to PE/CH_2Cl_2 = 1:2) to provide the desired product (330 mg, 63%) as a light yellow solid.

Physical State: light yellow solid.

Melting Point: 210.6-211.3 ^oC.

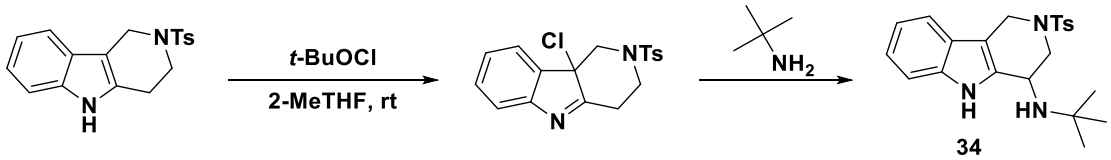
TLC: R_f = 0.43 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.38 (s, 1H), 7.75 (d, *J* = 7.5 Hz, 2H), 7.53 (d, *J* = 8.3 Hz, 1H), 7.43 (d, *J* = 7.4 Hz, 2H), 7.36 (s, 1H), 7.32 (d, *J* = 8.7 Hz, 1H), 7.04 – 6.97 (m, 2H), 6.75 (d, *J* = 8.8 Hz, 1H), 6.55 (d, *J* = 8.5 Hz, 1H), 4.93 (d, *J* = 6.3 Hz, 1H), 4.46 (d, *J* = 14.1 Hz, 1H), 4.05 (d, *J* = 14.1 Hz, 1H), 3.47 (s, 1H), 3.21 (d, *J* = 11.5 Hz, 1H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 147.74, 144.15, 137.13, 133.59, 133.37, 131.92, 131.13, 130.37, 127.96, 126.89, 123.56, 119.93, 119.68, 117.56, 113.87, 113.39, 111.53, 107.08, 48.18, 46.03, 43.28, 21.48.

HRMS (ESI): calcd for $C_{24}H_{20}Cl_3N_3O_2S$ $[M - H]^-$ *m/z* 518.0269, found 518.0268.

Compound 34



34

N-(tert-butyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-methylpropan-2-amine (202 mg, 2.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (CH_2Cl_2/EtOAc = 10:1) to provide the desired product (323 mg, 76%) as yellow oil.

Physical State: yellow oil.

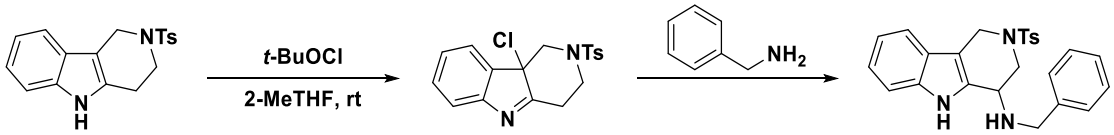
TLC: R_f = 0.60 (CH_2Cl_2/EtOAc = 10:1)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.6 Hz, 2H), 7.37 (d, *J* = 7.8 Hz, 1H), 7.32 (t, 3H), 7.14 (t, *J* = 7.4 Hz, 1H), 7.07 (t, *J* = 7.3 Hz, 1H), 4.51 (d, *J* = 13.7 Hz, 1H), 4.20 (d, *J* = 13.8 Hz, 1H), 4.12 (s, 1H), 3.93 – 3.85 (m, 1H), 2.96 – 2.86 (m, 1H), 2.42 (s, 3H), 1.24 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.65, 135.98, 135.03, 134.45, 129.76, 127.55, 125.38, 122.13, 119.69, 117.90, 111.20, 106.47, 51.48, 46.59, 43.07, 30.37, 29.71, 21.51.

HRMS (ESI): calcd for $C_{22}H_{27}N_3O_2S$ $[M + H]^+$ *m/z* 398.1897, found 398.1895.

Compound 35



35

N-benzyl-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of 2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then benzylamine (214 mg, 2.0 mmol) was added into the mixture. After stirring for another 1h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.5 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/ EtOAc = 2:1) to provide the desired product (213 mg, 50%) as a white solid.

Physical State: white solid.

Melting Point: 177.4-178.6 ^{o}C

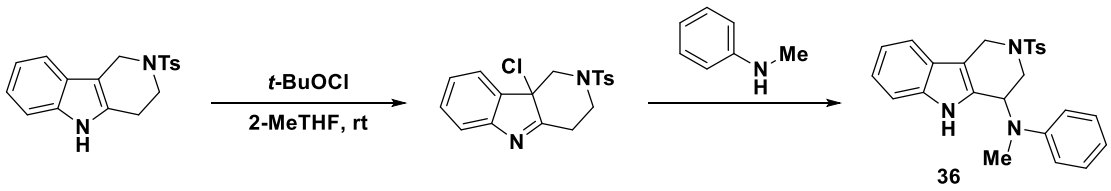
TLC: R_f = 0.62 (CH_2Cl_2/EtOAc = 10:1)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (s, 1H), 7.78 (d, *J* = 7.7 Hz, 2H), 7.42 – 7.32 (m, 7H), 7.29 (d, *J* = 8.6 Hz, 2H), 7.16 (t, *J* = 7.5 Hz, 1H), 7.08 (t, *J* = 7.3 Hz, 1H), 4.50 (d, *J* = 13.7 Hz, 1H), 4.19 (d, *J* = 13.6 Hz, 1H), 4.04 (t, 2H), 3.88 (d, *J* = 12.9 Hz, 1H), 3.68 – 3.62 (m, 1H), 3.39 (d, *J* = 11.7 Hz, 1H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.76, 139.80, 136.03, 133.96, 133.33, 129.84, 128.61, 128.27, 127.59, 127.28, 124.91, 122.40, 119.73, 118.02, 111.27, 107.03, 50.58, 50.55, 47.69, 43.34, 21.56.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_2S$ $[M + H]^+$*m/z* 432.1740, found 432.1739.

Compound 36



N-methyl-N-phenyl-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then N-methylaniline (210 mg, 2 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (234 mg, 54%) as a white solid.

Physical State: white solid.

Melting Point: 110.4-112.3 ^oC

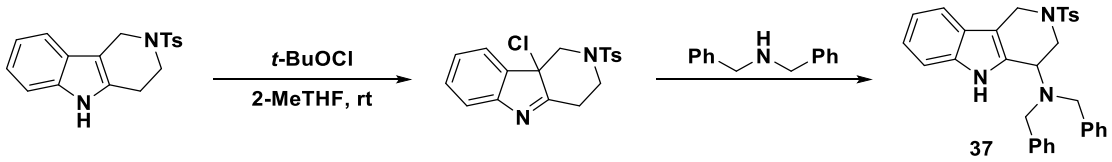
TLC: R_f = 0.56 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (s, 1H), 7.73 (d, *J* = 7.3 Hz, 2H), 7.47 (d, *J* = 7.2 Hz, 1H), 7.32 (t, *J* = 6.6 Hz, 5H), 7.20 (t, *J* = 7.0 Hz, 1H), 7.14 (t, *J* = 6.6 Hz, 1H), 6.94 – 6.84 (m, 3H), 5.27 (s, 1H), 4.50 (d, *J* = 13.8 Hz, 1H), 4.34 (d, *J* = 13.7 Hz, 1H), 3.71 (d, *J* = 11.3 Hz, 1H), 3.28 (t, 1H), 2.70 (s, 3H), 2.44 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 149.06, 143.82, 136.26, 133.81, 131.18, 129.86, 129.62, 127.63, 125.10, 122.66, 119.95, 118.35, 118.13, 113.70, 111.34, 109.18, 52.64, 45.67, 43.16, 33.51, 21.57.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_2S$ $[M + H]^+$*m/z* 432.1740, found 432.1739.

Compound 37



N,N-dibenzyl-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then dibenzylamine (454 mg, 2.3 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.4 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/CH_2Cl_2 = 1:2) to provide the desired product (382 mg, 78%) as a white solid.

Physical State: white solid.

Melting Point: 195.6-197.1 ^oC

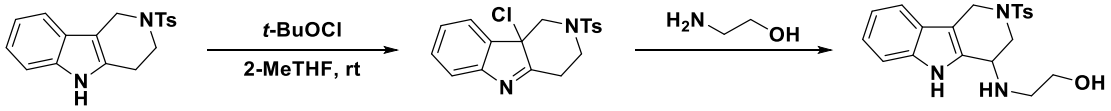
TLC: R_f = 0.68 (PE/CH_2Cl_2 = 1:2).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (s, 1H), 7.77 (d, *J* = 7.1 Hz, 2H), 7.42 (s, 1H), 7.36 (s, 6H), 7.32 (t, 5H), 7.28 (s, 1H), 7.17 (t, *J* = 7.3 Hz, 1H), 7.09 (t, *J* = 7.1 Hz, 1H), 4.50 (d, *J* = 13.7 Hz, 1H), 4.20 (t, 2H), 3.92 (d, *J* = 13.9 Hz, 2H), 3.85 – 3.78 (m, 1H), 3.65 (d, *J* = 13.9 Hz, 2H), 3.40 (d, *J* = 11.6 Hz, 1H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.67, 139.38, 136.11, 133.93, 132.21, 129.82, 128.64, 128.54, 127.64, 127.22, 125.18, 122.38, 119.76, 117.94, 111.19, 109.09, 53.99, 51.78, 43.17, 42.84, 21.57.

HRMS (ESI): calcd for $C_{32}H_{31}N_3O_2S$ $[M + H]^+$*m/z* 522.2210, found 522.2210.

Compound 38



38

2-((2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-yl)amino)ethan-1-ol

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b] indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 2-aminoethan-1-ol (61 mg, 1.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.8 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (CH_2Cl_2/CH_3OH = 20:1) to provide the desired product (88 mg, 46%) as a white solid.

Physical State: White solid

Melting Point: 147.9-149.5 ^oC.

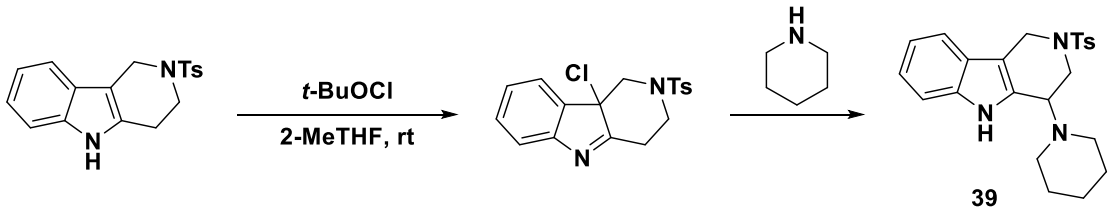
TCL: R_f = 0.58 (CH_2Cl_2/CH_3OH = 10:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.98 – 8.88 (m, 1H), 7.76 (d, *J* = 7.6 Hz, 2H), 7.40 – 7.33 (m, 3H), 7.29 (d, *J* = 8.1 Hz, 1H), 7.14 (t, *J* = 7.2 Hz, 1H), 7.07 (t, *J* = 7.0 Hz, 1H), 4.55 (d, *J* = 13.5 Hz, 1H), 4.06 (d, *J* = 13.6 Hz, 1H), 3.98 (s, 1H), 3.70 (d, *J* = 13.3 Hz, 3H), 3.17 (d, *J* = 11.8 Hz, 1H), 3.09 – 3.03 (m, 1H), 2.86 – 2.80 (m, 1H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$/CD_3OD = 20:1) δ 143.98, 136.20, 133.37, 132.44, 129.87, 127.53, 124.58, 122.26, 119.41, 117.86, 111.41, 106.62, 61.30, 50.73, 47.91, 47.77, 43.44, 21.45.

HRMS (ESI): calcd for $C_{20}H_{23}N_3O_3S$ $[M + H]^+$*m/z* 386.1533, found 386.1531.

Compound 39



4-(piperidin-1-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (326 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 2 min. Then piperidine (170 mg, 2.0 mmol) was added into the mixture. After stirring for another 1 h, the reaction mixture was concentrated under reduced pressure. Silica gel (1.3 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (CH_2Cl_2/EtOAc = 5:1) to provide the desired product (243 mg, 59%) as a yellow solid.

Physical State: yellow solid.

Melting Point: 74.6-75.8 ^oC

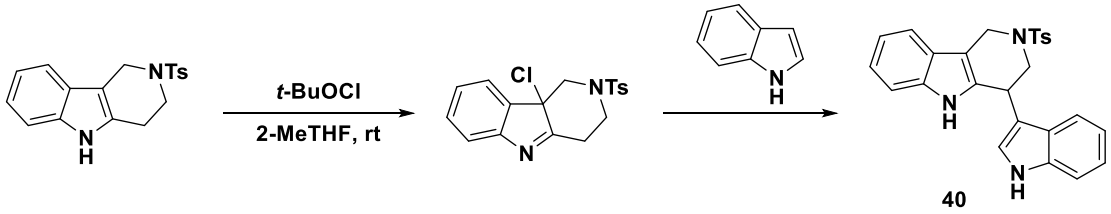
TLC: R_f = 0.25 (CH_2Cl_2/EtOAc = 10:1)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 7.77 (d, *J* = 7.6 Hz, 2H), 7.41 (d, *J* = 7.8 Hz, 1H), 7.37 – 7.32 (m, 3H), 7.17 (t, *J* = 7.5 Hz, 1H), 7.09 (t, *J* = 7.3 Hz, 1H), 4.33 – 4.24 (m, 2H), 4.10 (s, 1H), 3.58 – 3.52 (m, 1H), 3.44 – 3.38 (m, 1H), 2.63 (s, 4H), 2.43 (s, 3H), 1.62 – 1.51 (m, 4H), 1.50 – 1.45 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.71, 136.07, 133.54, 131.81, 129.81, 127.67, 125.11, 122.23, 119.60, 117.93, 111.26, 108.30, 58.17, 50.07, 43.19, 42.40, 26.48, 24.41, 21.55.

HRMS (ESI): calcd for $C_{23}H_{27}N_3O_2S$ $[M + H]^+$*m/z* 410.1897, found 410.1894.

Compound 40



4-(1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then *indole* (88 mg, 0.75 mmol) was added into the mixture. After stirring for another 5 min, the reaction mixture was diluted with EtOAc (20 mL) and then was washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and then concentrated to dryness under vacuum. The residue was purified by silica gel column chromatography (PE/EtOAc = 3:1) to give the desired product (157 mg, 71%) as a white solid.

Procedure for gram-scale of 40

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (1.632 mg, 5 mmol) in 2-methyltetrahydrofuran (30 mL) was added *tert*-butyl hypochlorite (597 mg, 5.5 mmol). The reaction mixture was stirred at rt for 2 min. Then *indole* (878 mg, 7.5 mmol) was added into the mixture. After stirring for another 10 min, the reaction mixture was diluted with EtOAc (80 mL) and then was washed with aqueous saturated $NaHCO_3$ solution (80 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and then concentrated to dryness under vacuum. The residue was purified by silica gel column chromatography (PE/EtOAc = 3:1) to give the desired product (1.652 mg, 75%) as a white solid.

Physical State: white solid.

Melting Point: 84.2-84.6 °C.

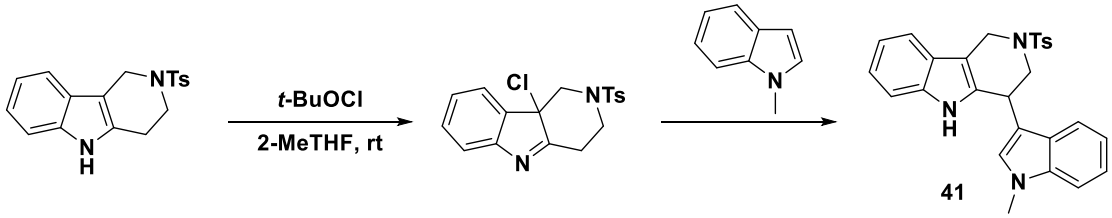
TLC: R_f = 0.45 (PE/EtOAc = 2:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (s, 1H), 7.76 – 7.67 (m, 3H), 7.47 (s, 1H), 7.37 (d, *J* = 8.0 Hz, 1H), 7.28 (s, 1H), 7.17 (t, *J* = 7.5 Hz, 1H), 7.13 – 7.05 (m, 4H), 6.96 (d, *J* = 10.8 Hz, 2H), 4.87 (d, *J* = 13.6 Hz, 1H), 4.62 (s, 1H), 4.19 (d, *J* = 13.7 Hz, 1H), 4.16 – 4.10 (m, 1H), 3.10 (t, *J* = 10.6 Hz, 1H), 2.40 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.48, 136.25, 135.68, 134.08, 133.78, 129.62, 127.34, 125.94, 125.18, 123.31, 122.27, 121.68, 119.74, 119.54, 118.68, 117.54, 112.74, 111.46, 110.98, 105.89, 50.14, 43.21, 33.05, 21.34.

HRMS (ESI): calcd for $C_{26}H_{23}N_3O_2S$ $[M + H]^+$ *m/z* 442.1584, found 442.1587.

Compound 41



4-(1-methyl-1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then *1-methyl-1H-indole* (88 mg, 0.75 mmol) was added into the mixture. After stirring for another 5 min, the reaction mixture was diluted with EtOAc (20 mL) and then was washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and then concentrated to dryness under vacuum. The residue was purified by silica gel column chromatography (PE/EtOAc = 3:1) to give the desired product (178 mg, 78%) as a yellow solid.

Physical State: yellow solid.

Melting Point: 124.0-124.6 ^oC.

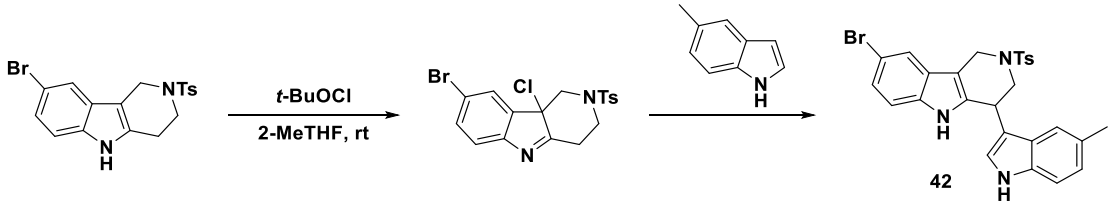
TLC: R_f = 0.35 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (s, 1H), 7.75 (d, *J* = 7.5 Hz, 2H), 7.52 (s, 1H), 7.37 (d, *J* = 8.1 Hz, 1H), 7.31 (d, *J* = 9.5 Hz, 2H), 7.25 (d, *J* = 7.6 Hz, 1H), 7.17 (s, 4H), 7.04 – 6.98 (m, 1H), 6.95 (s, 1H), 4.91 (d, *J* = 13.6 Hz, 1H), 4.69 (s, 1H), 4.24 (d, *J* = 13.7 Hz, 1H), 4.21 – 4.15 (m, 1H), 3.78 (s, 3H), 3.15 (t, *J* = 10.5 Hz, 1H), 2.44 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.31, 136.98, 135.65, 134.19, 133.93, 129.52, 127.77, 127.33, 126.44, 125.22, 121.84, 121.64, 119.50, 119.28, 118.81, 117.54, 111.29, 110.90, 109.40, 105.92, 50.24, 43.16, 32.92, 32.58, 21.32.

HRMS (ESI): calcd for $C_{27}H_{25}N_3O_2S$ $[M + H]^+$ *m/z* 456.1740, found 456.1743.

Compound 42



8-bromo-4-(5-methyl-1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *8-bromo-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (405 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 5 min. Then 5-methyl-1H-indole (196 mg, 1.5 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. Silica gel (1.2 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/EA = 2:1) to provide the desired product (352 mg, 66%) as a white solid.

Physical State: white solid.

Melting Point: 153.0-153.9 ^{o}C.

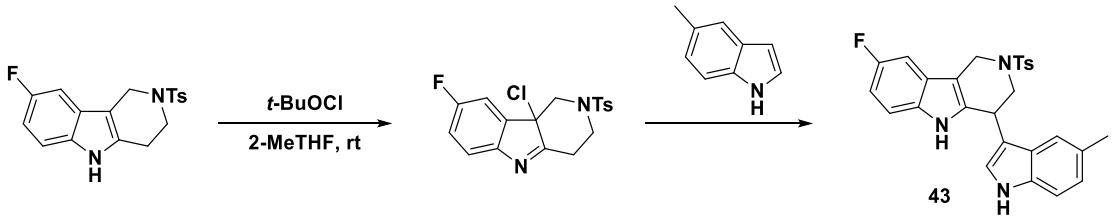
TLC: R_f = 0.26 (PE/EA = 3:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (s, 1H), 7.80 (s, 1H), 7.71 (d, *J* = 7.4 Hz, 2H), 7.59 (s, 1H), 7.29 (d, *J* = 7.7 Hz, 3H), 7.20 (d, *J* = 8.4 Hz, 1H), 7.03 (d, *J* = 6.0 Hz, 3H), 6.94 (s, 1H), 4.80 (d, *J* = 13.7 Hz, 1H), 4.64 (s, 1H), 4.13 (t, *J* = 12.6 Hz, 2H), 3.09 (t, *J* = 10.2 Hz, 1H), 2.41 (s, 3H), 2.32 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.70, 135.91, 134.74, 134.44, 134.01, 129.81, 129.44, 127.55, 127.11, 126.36, 124.63, 124.29, 123.46, 120.41, 118.20, 112.88, 112.53, 112.15, 111.33, 105.78, 50.13, 43.09, 33.20, 21.54, 21.47.

HRMS (ESI): calcd for $C_{27}H_{24}BrN_3O_2S$ $[M + H]^+$ *m/z* 534.0845, found 534.0844.

Compound 43



8-fluoro-4-(5-methyl-1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *8-fluoro-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (344 mg, 1.0 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (120 mg, 1.1 mmol). The reaction mixture was stirred at rt for 15 min. Then 5-methyl-1H-indole (196 mg, 1.5 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. Silica gel (1.1 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/EA = 4:1 to PE/EA = 2:1) to provide the desired product (381 mg, 80%) as a white solid.

Physical State: white solid.

Melting Point: 154.9-155.2 °C.

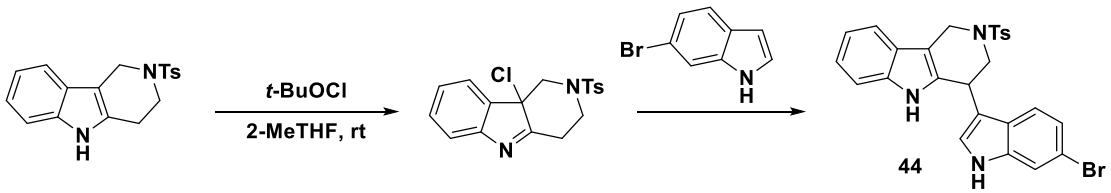
TLC: R_f = 0.24 (PE/EA = 3:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (s, 1H), 7.77 (s, 1H), 7.69 (d, *J* = 7.6 Hz, 2H), 7.28 (s, 2H), 7.09 (d, *J* = 9.3 Hz, 1H), 7.02 (d, *J* = 7.7 Hz, 2H), 6.95 (s, 2H), 6.84 (t, *J* = 8.8 Hz, 1H), 4.78 (d, *J* = 13.6 Hz, 1H), 4.59 (s, 1H), 4.12 (d, *J* = 13.2 Hz, 2H), 3.07 (t, *J* = 10.6 Hz, 1H), 2.41 (s, 3H), 2.32 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 157.83 (d, *J* = 234.9 Hz), 143.70 , 136.39 , 134.73 , 133.98 , 132.29 , 129.81 , 129.38 , 127.55 , 126.42 , 125.68 (d, *J* = 10.0 Hz), 124.24 , 123.44 , 118.21 , 112.25 , 111.68 (d, *J* = 9.6 Hz), 111.34 , 109.92 (d, *J* = 26.1 Hz), 106.23 (d, *J* = 4.6 Hz), 102.91 (d, *J* = 23.8 Hz), 50.21 , 43.19 , 33.24 , 21.53 , 21.47 .

HRMS (ESI): calcd for $C_{27}H_{24}FN_3O_2S$ $[M + H]^+$*m/z* 474.1646, found 474.1645.

Compound 44



To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then *6-bromo-1H-indole* (147 mg, 0.75 mmol) was added into the mixture. After stirring for another 4 h, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel (PE/EtOAc = 3:1) to provide the desired product (170 mg, 65%) as a light pink solid.

Physical State: light pink solid.

Melting Point: >230°C.

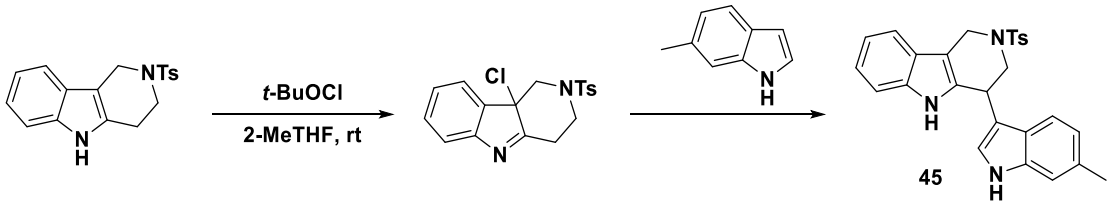
TLC: R_f = 0.42 (PE/EtOAc =2:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 11.19 (s, 1H), 10.74 (s, 1H), 7.71 (s, 1H), 7.69 (s, 1H), 7.57 (s, 1H), 7.49 (d, *J* = 7.6 Hz, 1H), 7.44 – 7.40 (m, 1H), 7.39 (s, 1H), 7.27 – 7.15 (m, 2H), 7.06 (d, *J* = 8.6 Hz, 1H), 7.03 (s, 1H), 7.00 (s, 1H), 6.98 (d, *J* = 7.0 Hz, 1H), 4.72 – 4.58 (m, 1H), 4.49 (d, *J* = 13.7 Hz, 1H), 4.25 (d, *J* = 13.7 Hz, 1H), 3.82 – 3.67 (m, 1H), 3.22 – 3.14 (m, 1H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 143.95, 137.78, 136.60, 134.71, 133.75, 130.30, 127.84, 125.91, 125.53, 125.15, 121.96, 121.43, 120.64, 119.11, 117.98, 114.65, 114.28, 113.68, 111.76, 104.97, 50.86, 43.66, 32.77, 21.48.

HRMS (ESI): calcd for $C_{26}H_{22}BrN_3O_2S$ $[M + H]^+$ *m/z* 518.0543., found 518.0543.

Compound 45



4-(6-methyl-1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then *6-methyl-1H-indole* (98 mg, 0.75 mmol) was added into the mixture. After stirring for another 1.5 h, the reaction mixture was diluted with EtOAc (20 mL) and then was washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and then concentrated to dryness under vacuum. The residue was purified by silica gel column chromatography (PE/EtOAc = 3.5:1) to give the desired product (175 mg, 77%) as a white solid.

Physical State: white solid.

Melting Point: 124.3–124.6°C.

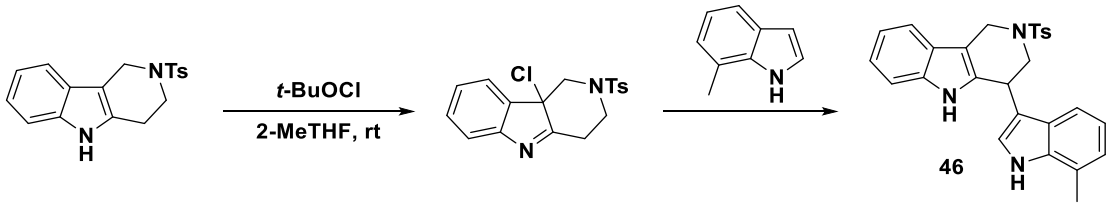
TLC: R_f = 0.20 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (s, 1H), 7.94 – 7.68 (m, 3H), 7.56 (s, 1H), 7.36 (d, *J* = 6.3 Hz, 3H), 7.21 (s, 3H), 7.06 (s, 2H), 6.88 (d, *J* = 7.7 Hz, 1H), 4.98 (d, *J* = 13.6 Hz, 1H), 4.71 (s, 1H), 4.26 (d, *J* = 12.6 Hz, 2H), 3.26 – 3.09 (m, 1H), 2.50 (d, *J* = 4.5 Hz, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.44, 136.75, 135.67, 134.18, 133.83, 132.21, 129.59, 127.35, 125.21, 123.78, 122.62, 121.64, 121.51, 119.51, 118.38, 117.52, 112.55, 111.33, 110.96, 105.85, 50.13, 43.21, 33.15, 21.43, 21.33.

HRMS (ESI): calcd for $C_{27}H_{25}N_3O_2S$ $[M + H]^+$ *m/z* 456.1740, found 456.1743.

Compound 46



4-(7-methyl-1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then *7-methyl-1H-indole* (98 mg, 0.75 mmol) was added into the mixture. After stirring for another 4 h, the reaction mixture was diluted with EtOAc (20 mL), washed with aqueous saturated $NaHCO_3$ solution (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel (PE/EtOAc = 3:1) to provide the desired product (182 mg, 80%) as a light yellow solid.

Physical State: light yellow solid.

Melting Point: 96.1–96.3 ^{o}C.

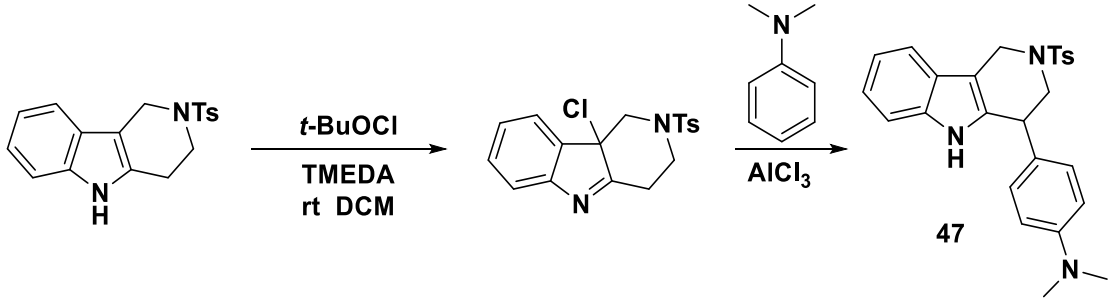
TLC: R_f = 0.20 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (s, 1H), 7.71 (d, *J* = 7.4 Hz, 3H), 7.52 – 7.43 (m, 1H), 7.27 (d, *J* = 7.9 Hz, 2H), 7.11 (d, *J* = 11.2 Hz, 4H), 7.04 – 6.93 (m, 2H), 6.90 (d, *J* = 7.2 Hz, 1H), 4.88 (d, *J* = 13.7 Hz, 1H), 4.74 – 4.57 (m, 1H), 4.25 – 4.09 (m, 2H), 3.11 (s, 1H), 2.49 (s, 3H), 2.40 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.44, 135.76(t, *J* = 14.1 Hz), 134.21(d, *J* = 13.4 Hz), 133.62, 129.51, 127.23, 125.46 (d, *J* = 2.9 Hz), 125.07(d, *J* = 4.1 Hz), 123.24, 123.08, 122.39, 121.42, 120.78(d, *J* = 3.9 Hz), 119.61, 119.25, 117.36, 116.17, 112.82(d, *J* = 6.4 Hz), 110.88(d, *J* = 4.8 Hz), 105.50(d, *J* = 5.0 Hz), 50.13, 43.15, 33.08, 21.18, 16.24.

HRMS (ESI): calcd for $C_{27}H_{25}N_3O_2S$ $[M + H]^+$ *m/z* 456.1740, found 456.1743.

Compound 47



N,N-dimethyl-4-(2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-yl)aniline

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in CH_2Cl_2 (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol) and TMEDA (58 mg, 0.5 mmol) was added after 0.5 min. The reaction mixture was stirred at rt for 2 min. Then *N,N-dimethylaniline* (121 mg, 1.0 mmol) was added into the mixture. After stirring for another 6 h, $AlCl_3$ (133 mg, 1.0 mmol) were added and the reaction mixture was diluted with CH_2Cl_2 (20 mL) then was washed with H_2O (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel (PE/EtOAc = 10:3) to provide the desired product (152 mg, 68%) as a white solid.

Physical State: white solid.

Melting Point: 114.7–116.1 °C.

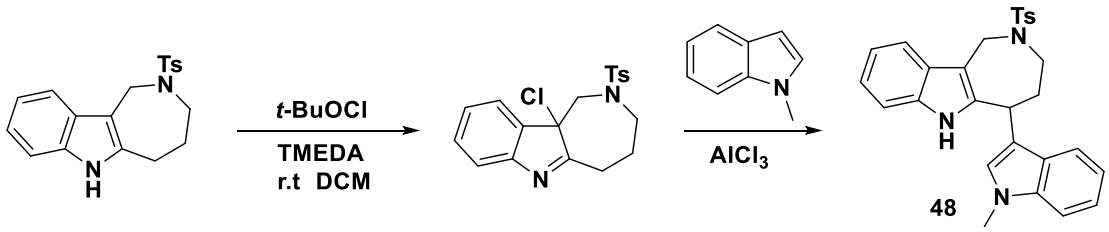
TLC: R_f = 0.21 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, *J* = 7.7 Hz, 2H), 7.69 (s, 1H), 7.46 (d, *J* = 7.3 Hz, 1H), 7.31 (d, *J* = 7.8 Hz, 2H), 7.17 (d, *J* = 7.7 Hz, 1H), 7.15 – 7.09 (m, 2H), 7.01 (d, *J* = 8.0 Hz, 2H), 6.68 (d, *J* = 8.1 Hz, 2H), 4.82 (d, *J* = 13.5 Hz, 1H), 4.28 (t, 1H), 4.14 (d, *J* = 13.9 Hz, 1H), 4.12 – 4.06 (m, 1H), 2.95 (d, *J* = 1.4 Hz, 6H), 2.86 (t, 1H), 2.43 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.19, 143.57, 136.00, 134.45, 133.89, 129.76, 129.37, 127.66, 126.39, 125.33, 121.96, 119.71, 117.76, 112.78, 111.05, 106.97, 51.85, 43.37, 40.75, 40.60, 21.59.

HRMS (ESI): calcd for $C_{26}H_{27}N_3O_2S$ $[M + H]^+$ *m/z* 446.1897, found 446.1895.

Compound 48



5-(1-methyl-1H-indol-3-yl)-2-tosyl-1,2,3,4,5,6-hexahydroazepino[4,3-b]indole

To a solution of *2-tosyl-1,2,3,4,5,6-hexahydroazepino[4,3-b]indole* (170 mg, 0.5 mmol) in CH_2Cl_2 (5 mL) was added *tert*-butyl hypochlorite (60 mg, 0.55 mmol) and TMEDA (58 mg, 0.5 mmol) was added after 0.5 min. The reaction mixture was stirred at rt for 1 min. Then *1-methyl-1H-indole* (121 mg, 1.0 mmol) was added into the mixture. After stirring for another 12 h, $AlCl_3$ (133 mg, 1.0 mmol) were added and the reaction mixture was diluted with CH_2Cl_2 (20 mL) then was washed with H_2O (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel (PE/EtOAc = 4:1) to provide the desired product (218 mg, 93%) as a white solid.

Physical State: white solid.

Melting Point: 119.6-121.3 ^oC.

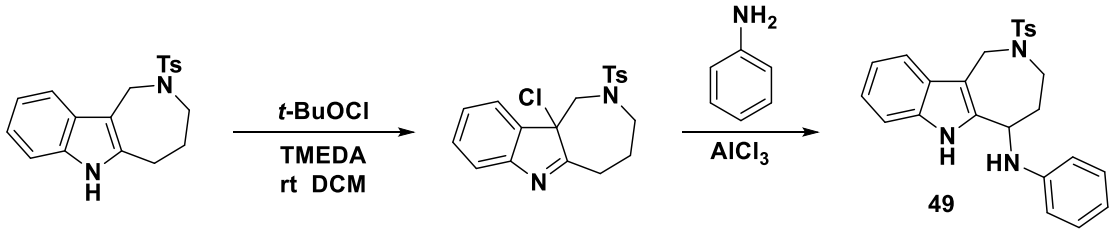
TLC: R_f = 0.28 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (s, 1H), 7.69 (d, *J* = 7.9 Hz, 2H), 7.56 (d, *J* = 6.4 Hz, 1H), 7.41 (d, *J* = 8.2 Hz, 1H), 7.37 (d, *J* = 7.7 Hz, 1H), 7.31 (d, *J* = 7.4 Hz, 1H), 7.28 (s, 2H), 7.11 (d, *J* = 8.8 Hz, 3H), 7.05 (d, *J* = 5.7 Hz, 2H), 4.85 (d, *J* = 10.0 Hz, 1H), 4.25 (d, *J* = 12.8 Hz, 1H), 4.14 (d, *J* = 13.4 Hz, 1H), 3.83 (s, 3H), 3.47 (t, *J* = 12.2 Hz, 1H), 3.25 (d, *J* = 11.2 Hz, 2H), 3.21 (s, 1H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.18, 137.35, 137.07, 136.72, 134.29, 129.79, 129.01, 128.04, 126.90, 126.61, 122.21, 121.36, 119.80, 119.59, 119.25, 117.82, 111.88, 110.65, 110.57, 109.74, 54.37, 50.34, 40.00, 32.93, 26.49, 21.56.

HRMS (ESI): calcd for $C_{28}H_{27}N_3O_2S$ $[M + H]^+$ *m/z* 470.1897, found 470.1895.

Compound 49



N-phenyl-2-tosyl-1,2,3,4,5,6-hexahydroazepino[4,3-b]indol-5-amine

To a solution of *2-tosyl-1,2,3,4,5,6-hexahydroazepino[4,3-b]indole* (170 mg, 0.5 mmol) in CH_2Cl_2 (5 mL) was added tert-butyl hypochlorite (60 mg, 0.55 mmol) and TMEDA (58 mg, 0.5 mmol) was added after 0.5 min. The reaction mixture was stirred at rt for 1 min. Then aniline (70 mg, 0.75 mmol) was added into the mixture. After stirring for another 6 h, $AlCl_3$ (133 mg, 1.0 mmol) were added and the reaction mixture was diluted with CH_2Cl_2 (20 mL) then was washed with H_2O (30 mL). The organic layer was dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was purified by chromatography on silica gel (PE/EtOAc = 4:1) to provide the desired product (174 mg, 80%) as a light yellow solid.

Physical State: light yellow solid

Melting Point: 133.4-134.5 ^oC.

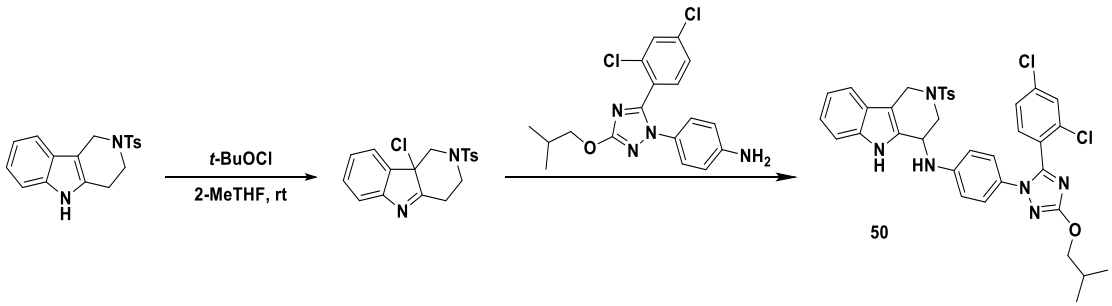
TLC: R_f = 0.41 (PE/EtOAc = 4:1).

^{1}H NMR (400 MHz, DMSO-d_6) δ 10.89 (s, 1H), 7.68 (d, *J* = 7.4 Hz, 2H), 7.45 (d, *J* = 7.7 Hz, 1H), 7.39 (d, *J* = 7.6 Hz, 2H), 7.33 (d, *J* = 7.9 Hz, 1H), 7.15 (t, *J* = 7.3 Hz, 2H), 7.04 (t, *J* = 7.4 Hz, 1H), 6.97 (t, *J* = 7.3 Hz, 1H), 6.78 (d, *J* = 7.8 Hz, 2H), 6.63 (t, *J* = 7.2 Hz, 1H), 5.97 (s, 1H), 4.93 (s, 1H), 3.71 – 3.60 (m, 2H), 3.44 (d, 2H), 3.15 – 3.07 (m, 1H), 2.99 (d, J = 16.7 Hz, 1H), 2.37 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 147.68, 143.64, 136.70, 136.24, 135.21, 130.39, 129.50, 128.50, 127.14, 121.33, 118.83, 118.15, 117.03, 113.35, 111.61, 109.17, 52.61, 50.59, 49.82, 24.95, 21.44.

HRMS (ESI): calcd for $C_{25}H_{25}N_3O_2S$ $[M + H]^+$ *m/z* 432.1740, found 432.1739.

Compound 50



N-(4-(5-(2,4-dichlorophenyl)-3-isobutoxy-1H-1,2,4-triazol-1-yl)phenyl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indol-4-amine

To a solution of *2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (163 mg, 0.5 mmol) in 2-methyltetrahydrofuran (10 mL) was added *tert*-butylhypochlorite (60 mg, 0.55 mmol). The reaction mixture was stirred at rt for 2 min. Then 4-(5-(2,4-dichlorophenyl)-3-isobutoxy-1H-1,2,4-triazol-1-yl) aniline (94 mg, 0.25 mmol) was added into the mixture. After stirring for 3 h, the reaction mixture was concentrated under reduced pressure. Silica gel (0.6 g) was added to the mixture and then the solvent was removed *in vacuo*. The crude product was purified by chromatography on silica gel (PE/EtOAc = 3:1) to provide the desired product (88 mg, 51%) as brown oil.

Physical State: brown oil.

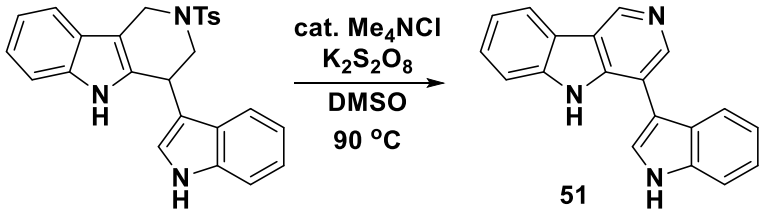
TLC: R_f = 0.60 (PE/EtOAc = 1:1)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (s, 1H), 7.74 (d, *J* = 8.6 Hz, 2H), 7.45 (d, *J* = 7.8 Hz, 1H), 7.39 (d, *J* = 8.4 Hz, 1H), 7.33 (t, 3H), 7.27 – 7.26 (m, 1H), 7.24 – 7.16 (m, 3H), 7.13 (t, *J* = 7.4 Hz, 1H), 6.74 (d, *J* = 8.3 Hz, 2H), 4.89 (s, 1H), 4.59 (d, *J* = 13.9 Hz, 1H), 4.22 (d, *J* = 14.0 Hz, 1H), 4.12 (d, *J* = 6.5 Hz, 2H), 3.70 – 3.60 (m, 1H), 3.48 – 3.38 (m, 1H), 2.43 (s, 3H), 2.19 – 2.12 (m, 1H), 1.06 (d, *J* = 6.6 Hz, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.88, 150.63, 146.97, 143.97, 136.18, 134.22, 133.83, 132.90, 131.17, 130.62, 130.51, 129.91, 128.56, 127.61, 127.54, 127.40, 124.63, 123.03, 120.12, 118.24, 114.10, 111.46, 108.23, 76.01, 48.18, 46.97, 43.22, 28.21, 21.56, 19.10.

HRMS (ESI): calcd for $C_{36}H_{34}Cl_2N_6O_3S$ $[M + H]^+$ *m/z* 701.1863, found 701.1862.

Compound 51



4-(1H-indol-3-yl)-5H-pyrido[4,3-b]indole

To a solution of *4-(1H-indol-3-yl)-2-tosyl-2,3,4,5-tetrahydro-1H-pyrido[4,3-b]indole* (441 mg, 1.0 mmol) in DMSO (8 mL) was added Me_4NCl (11 mg, 0.1 mmol) and $K_2S_2O_8$ (540 mg, 2.0 mmol). The reaction mixture was stirred at 90 °C for 0.5 h. Then the reaction mixture was basified to pH 8−9 using saturated $NaHCO_3$ and extracted with DCM/MeOH = 10:1 (40 mL). The combined organic layers were washed with saturated brine, dried over anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure to afford the crude product, which was purified by silica gel chromatography (DCM/MeOH = 50:1 to DCM/MeOH = 20:1) to give the desired product (190 mg, 67%) as a pink solid.

Physical State: pink solid.

Melting Point: >230°C.

TLC: R_f = 0.42 (DCM/MeOH = 10:1).

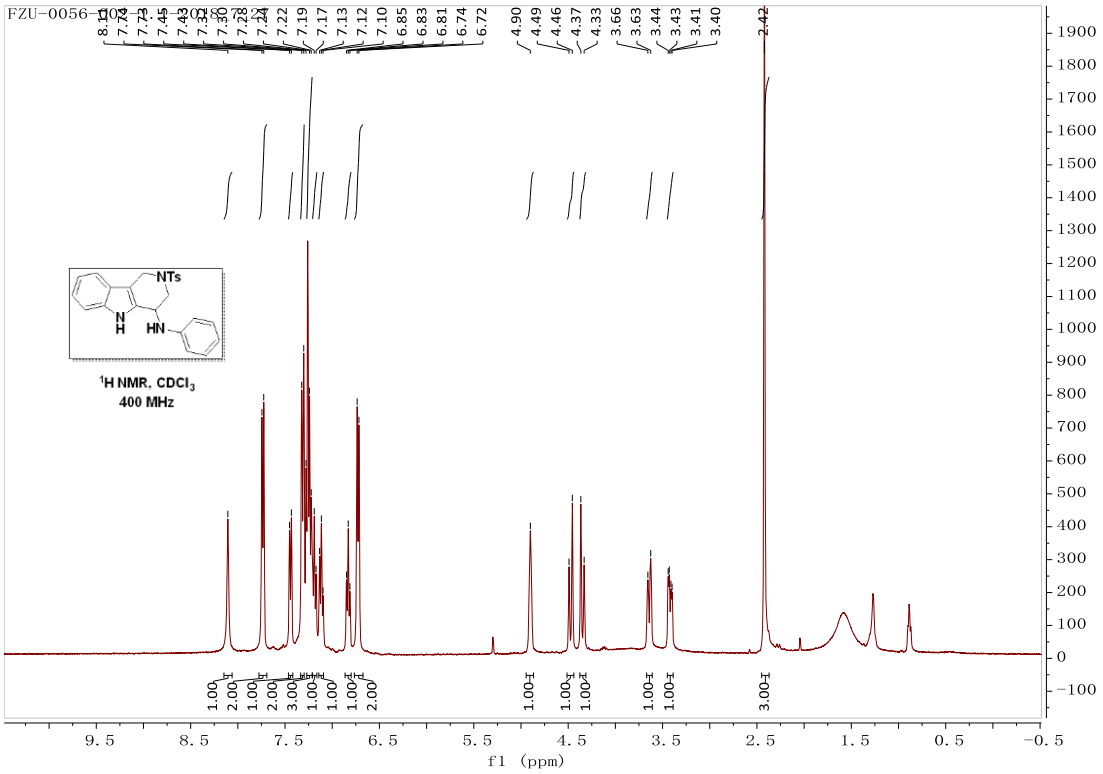
^{1}H NMR (400 MHz, DMSO-d_6) δ 11.66 (s, 1H), 11.53 (s, 1H), 9.32 (s, 1H), 8.63 (s, 1H), 8.29 (d, *J* = 7.7 Hz, 1H), 7.88 (s, 1H), 7.68 (d, *J* = 7.9 Hz, 1H), 7.62 (d, *J* = 8.1 Hz, 1H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 1H), 7.31 (t, *J* = 7.5 Hz, 1H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.14 (t, *J* = 7.4 Hz, 1H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 143.73, 142.14, 140.65, 140.57, 137.08, 126.94, 126.28, 125.44, 122.26, 121.54, 121.02, 120.53, 120.20, 119.53, 112.51, 112.48, 109.60.

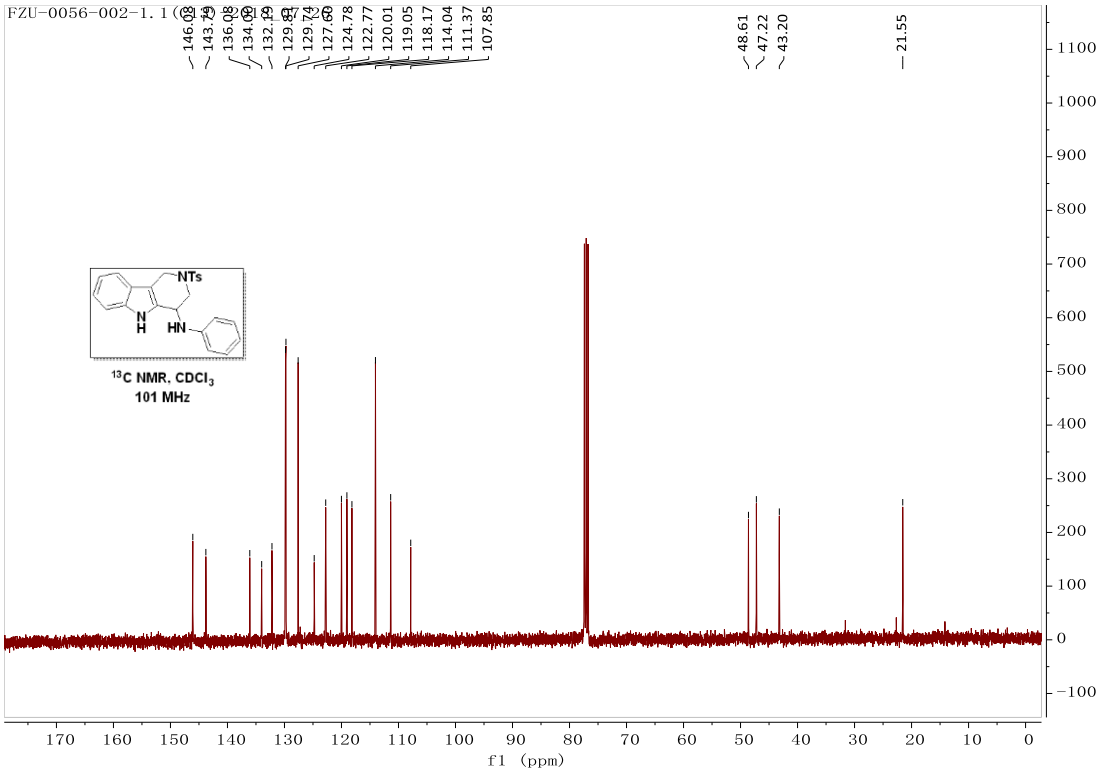
HRMS (ESI): calcd for $C_{19}H_{13}N_3$ $[M + H]^+$ *m/z* 284.1182, found 284.1172.

3. NMR Spectrum

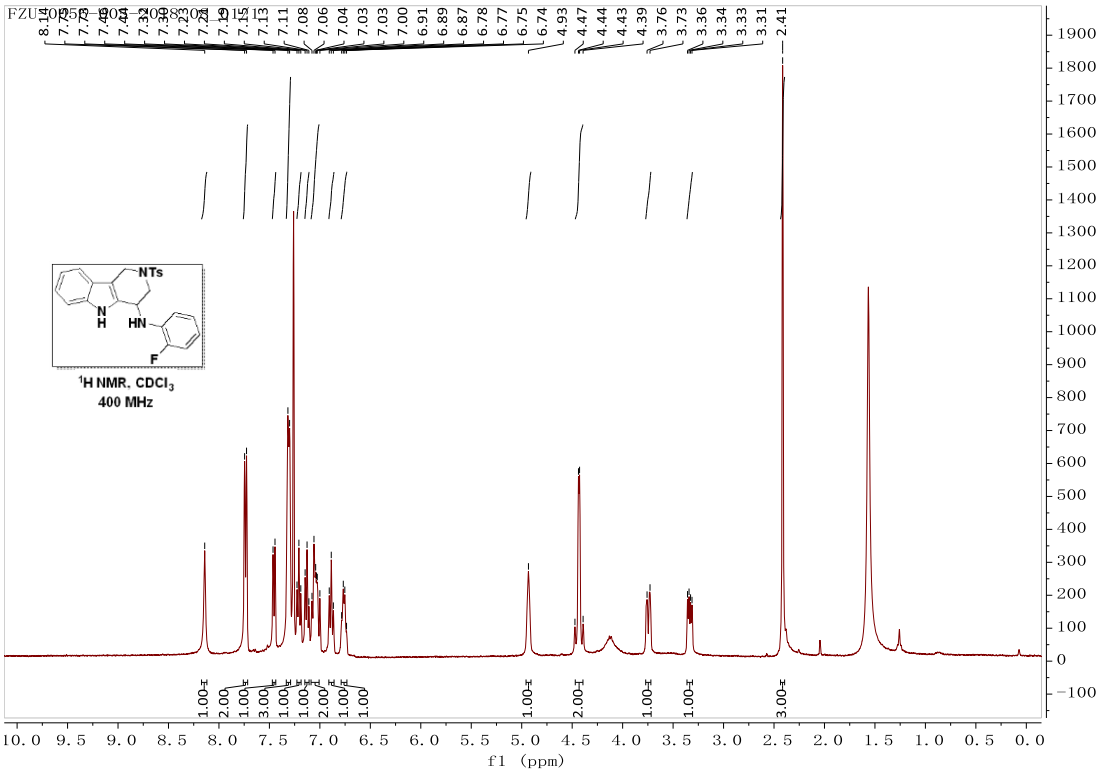
^{1}H NMR Spectrum of 1



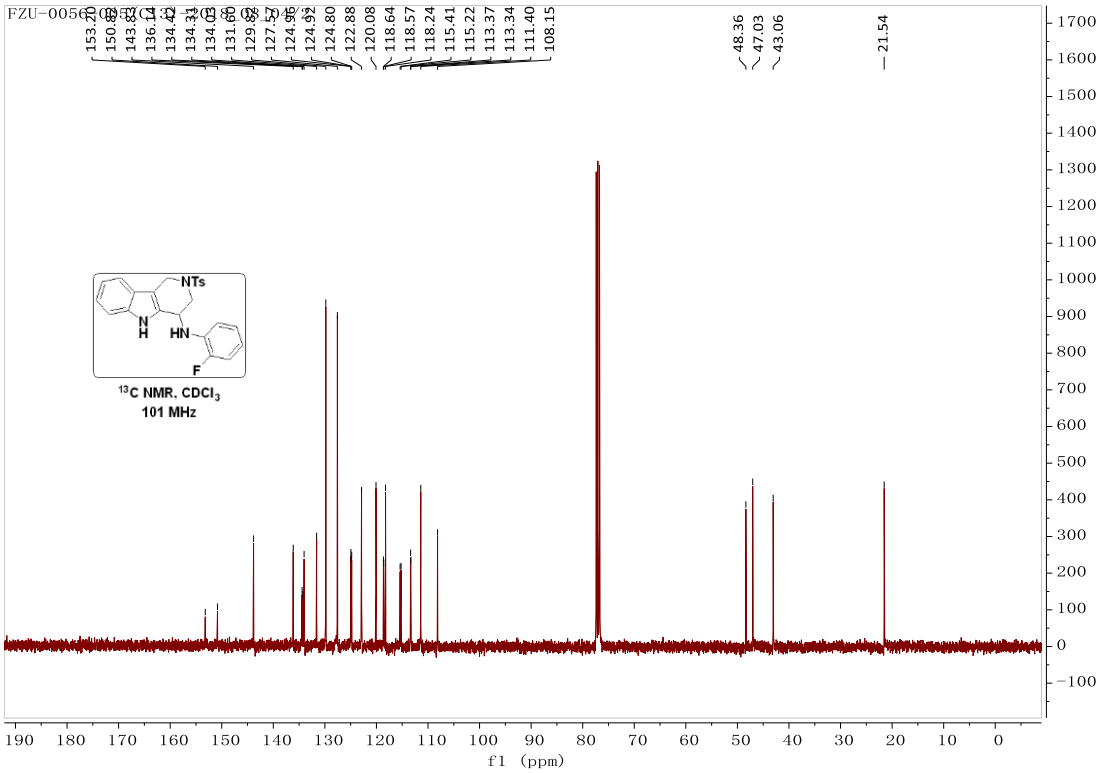
^{13}C NMR Spectrum of 1



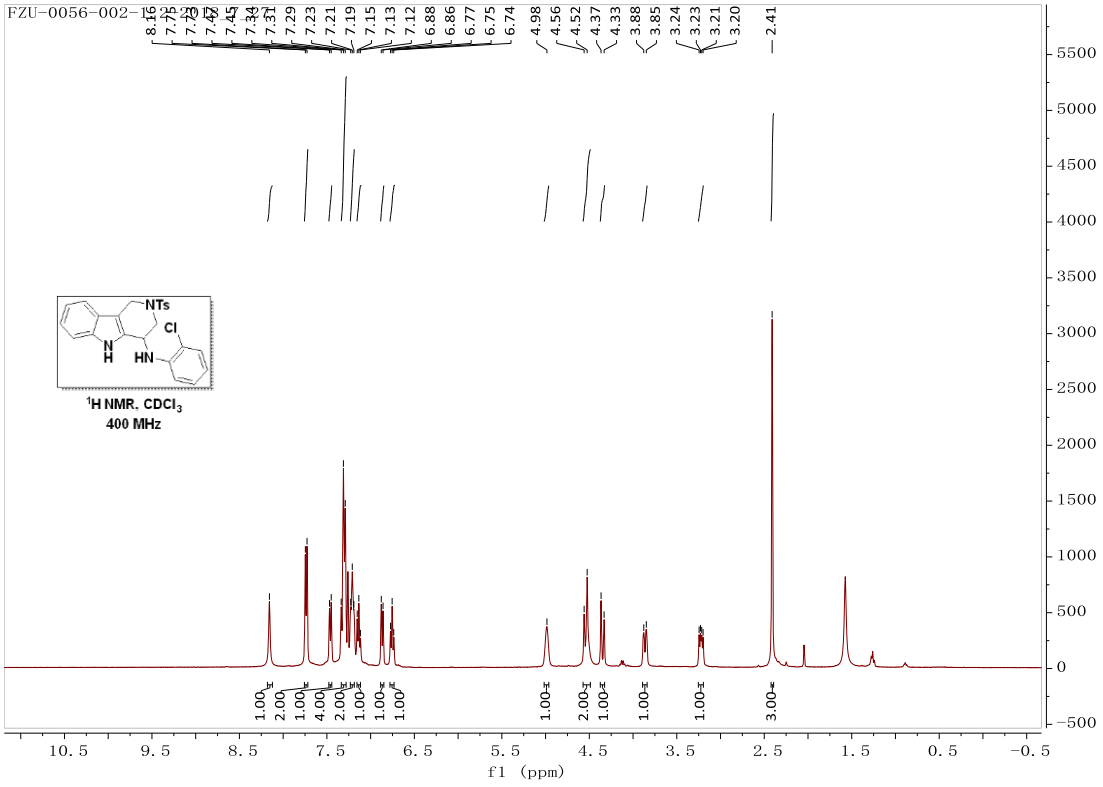
^{1}H NMR Spectrum of 2



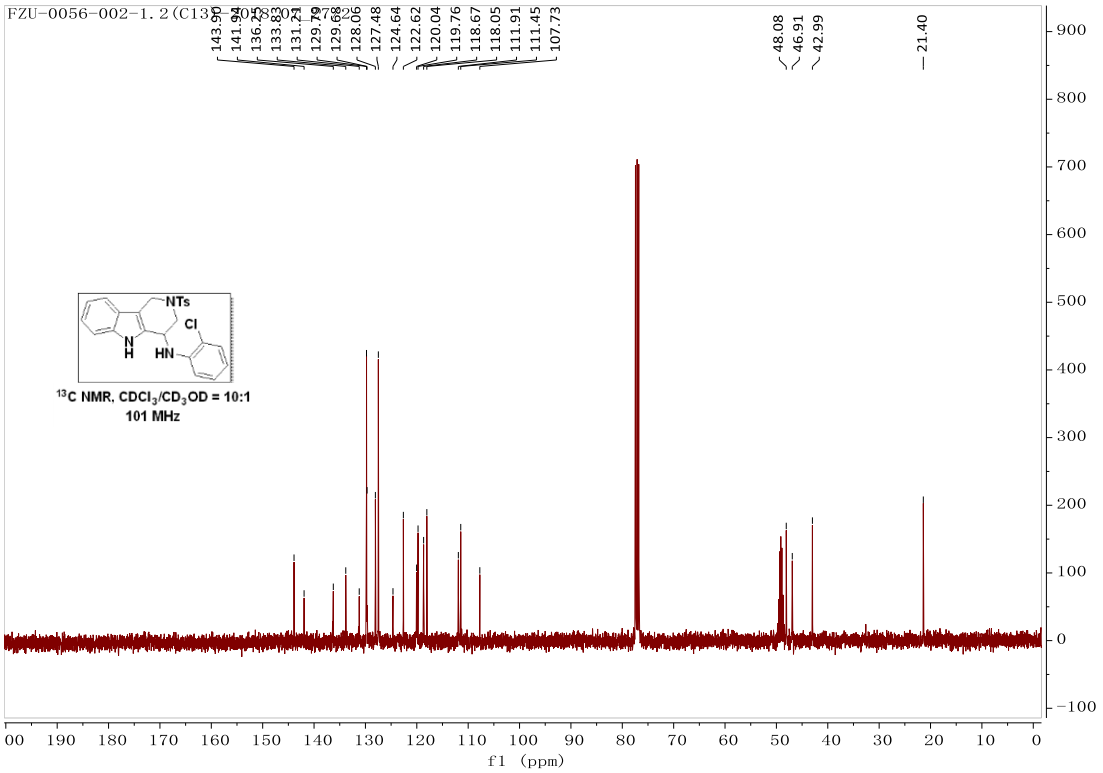
^{13}C NMR Spectrum of 2



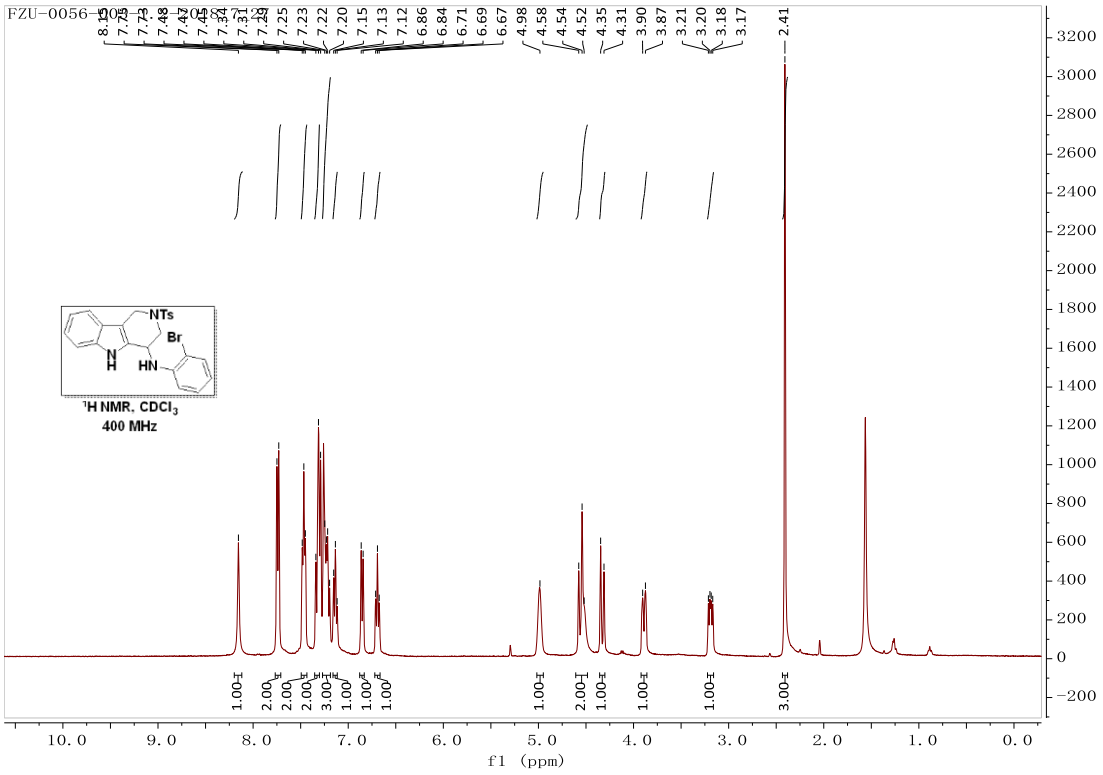
^{1}H NMR Spectrum of 3



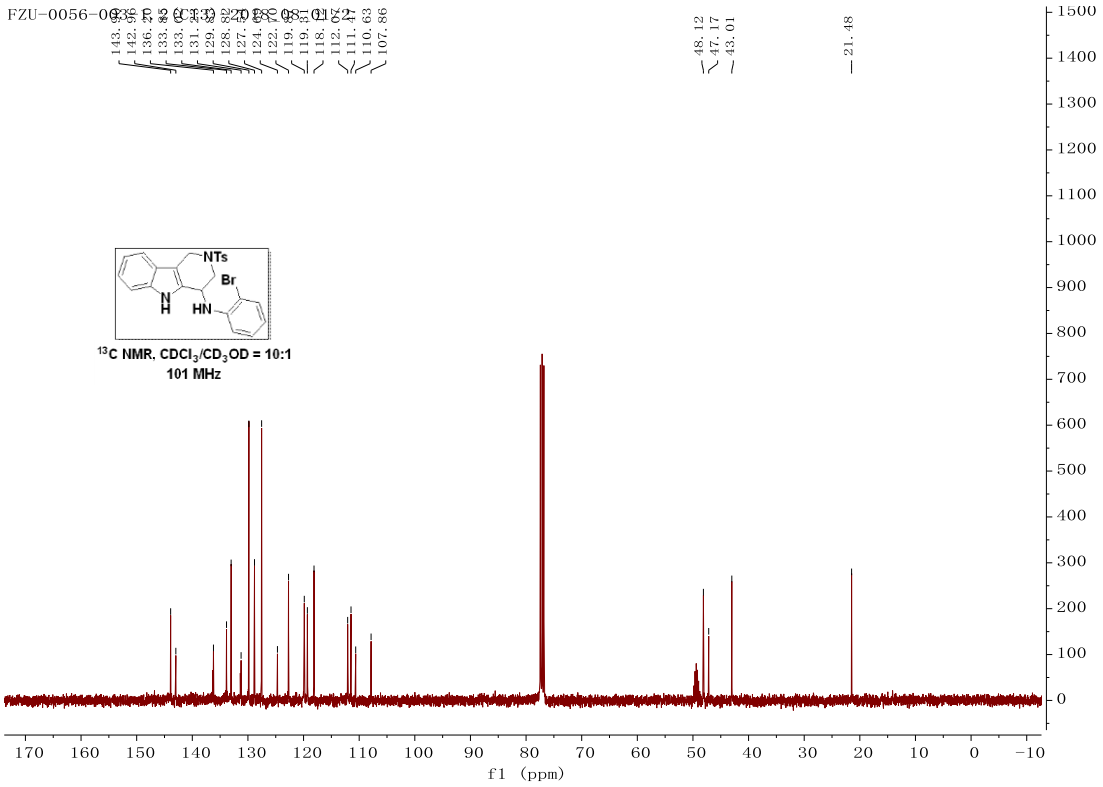
^{13}C NMR Spectrum of 3



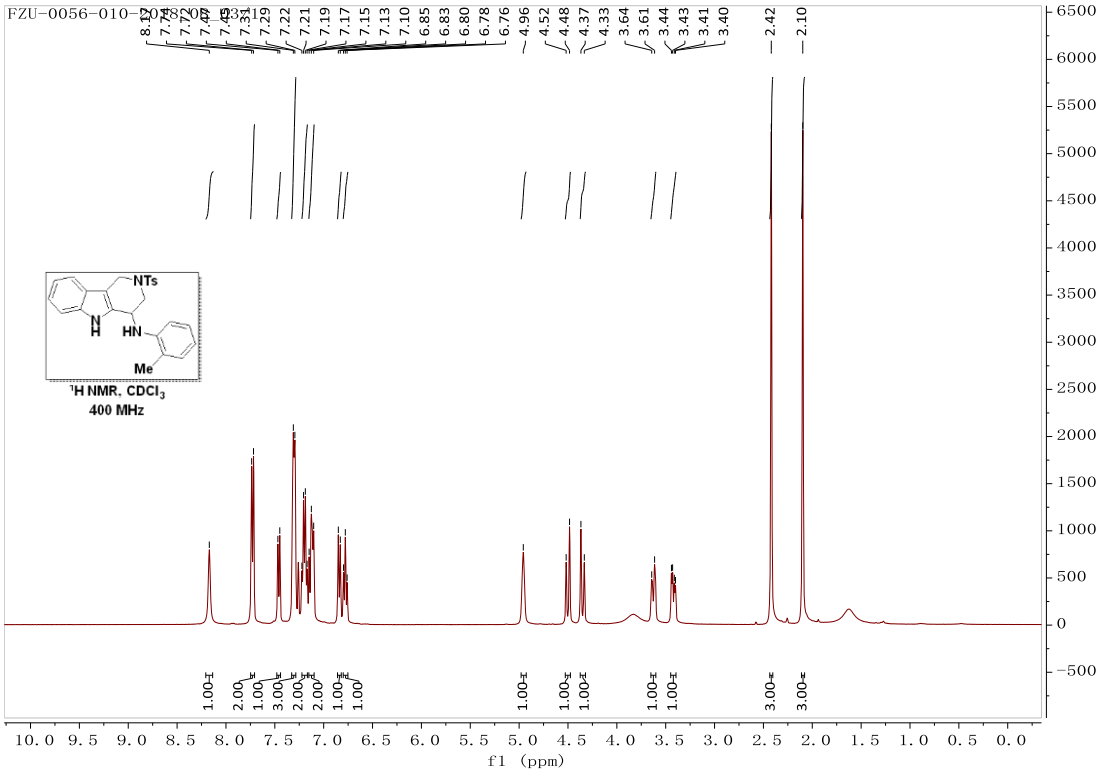
^{1}H NMR Spectrum of 4



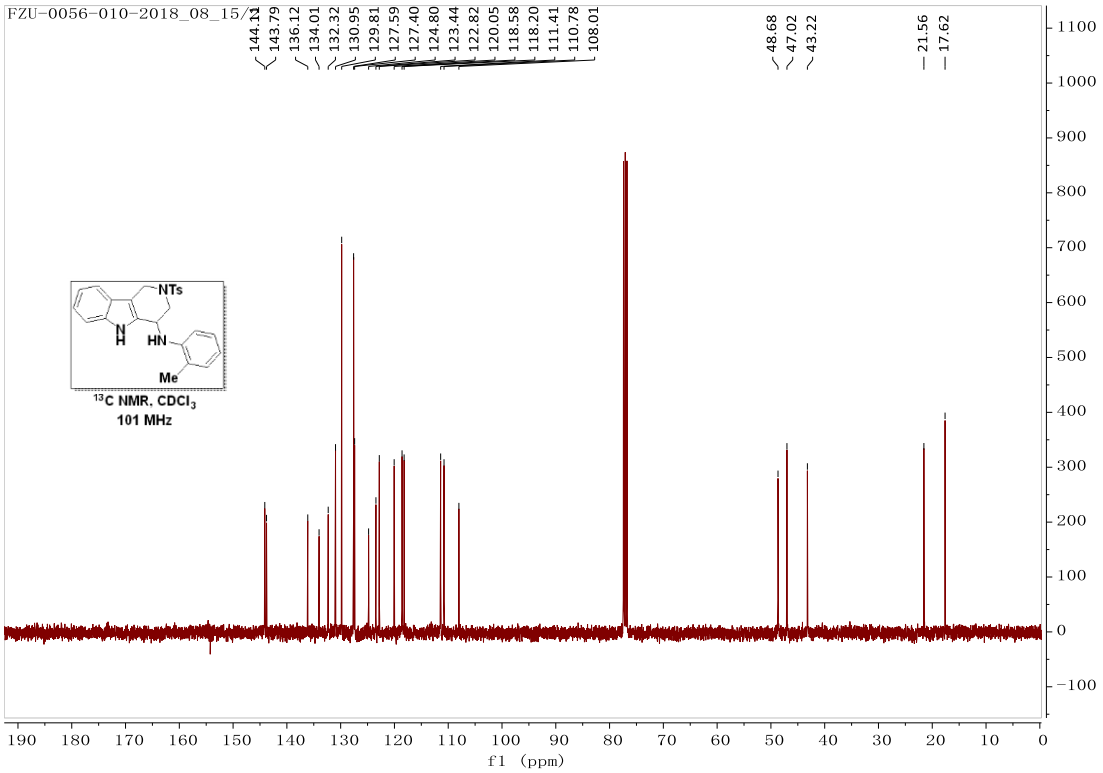
^{13}C NMR Spectrum of 4



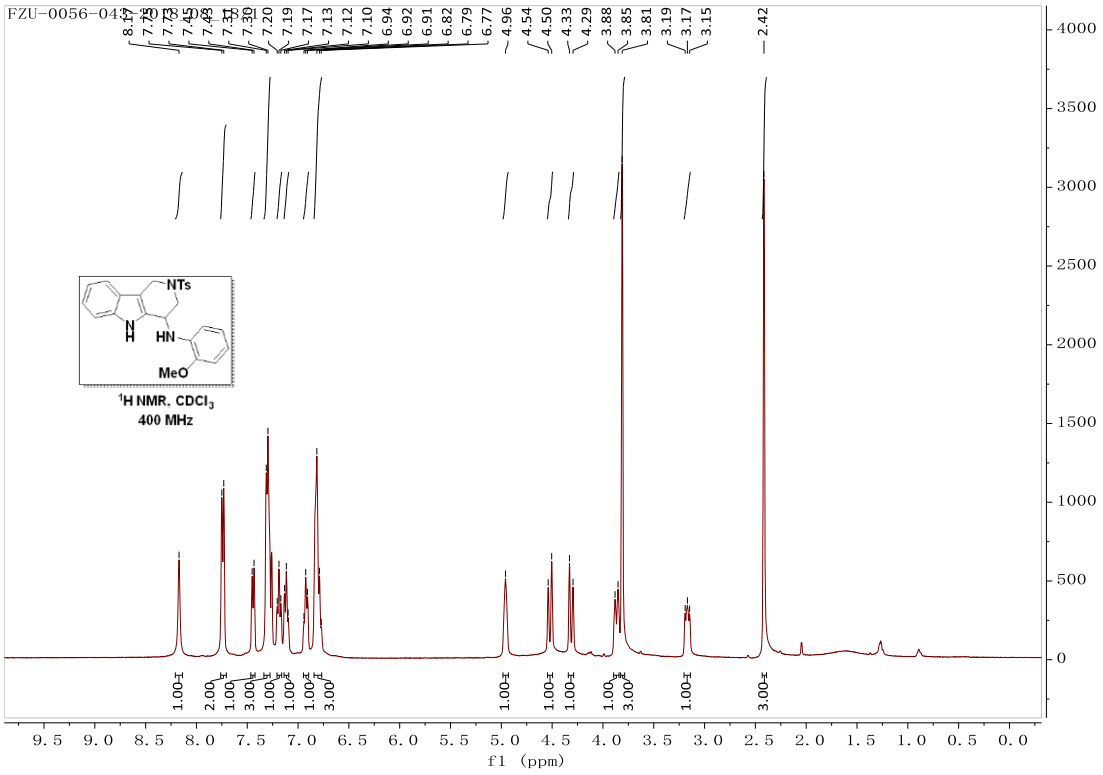
^{1}H NMR Spectrum of 5



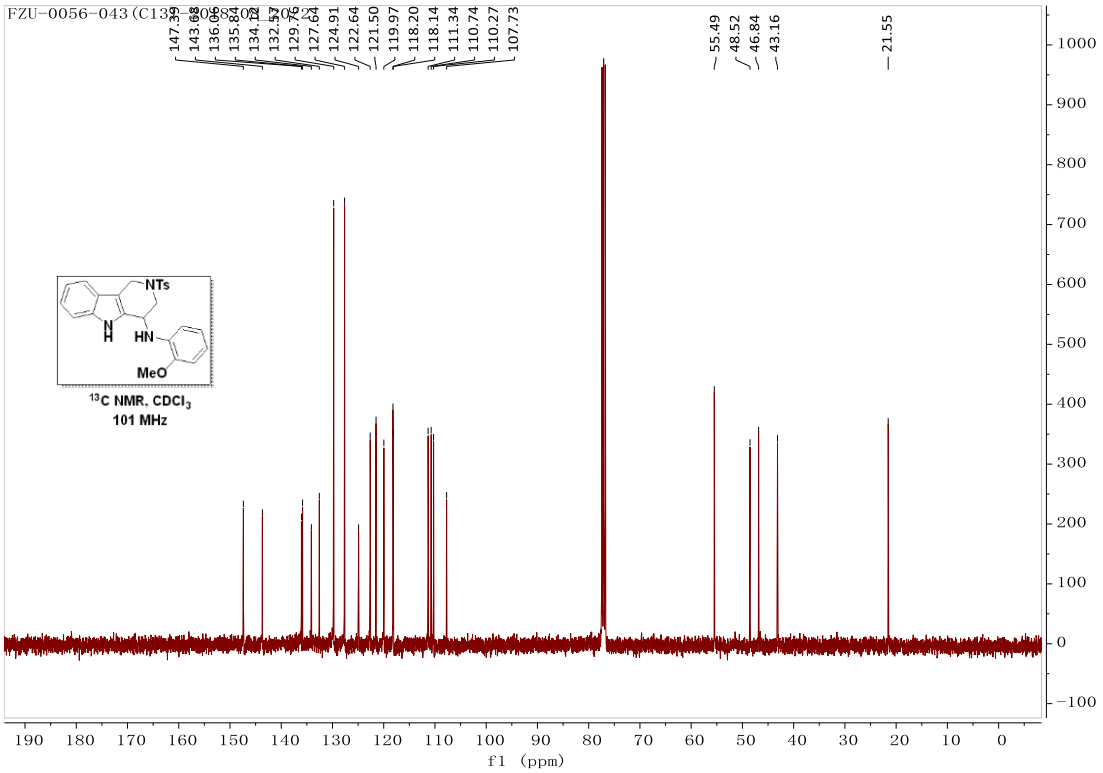
^{13}C NMR Spectrum of 5



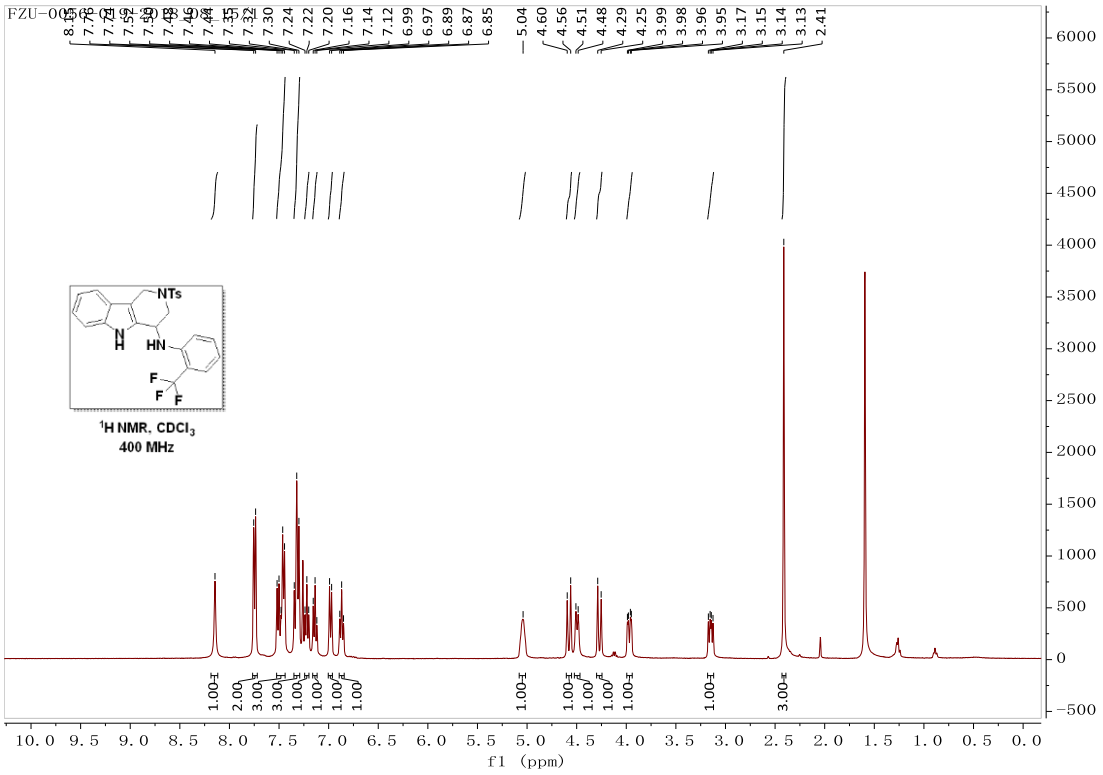
^{1}H NMR Spectrum of 6



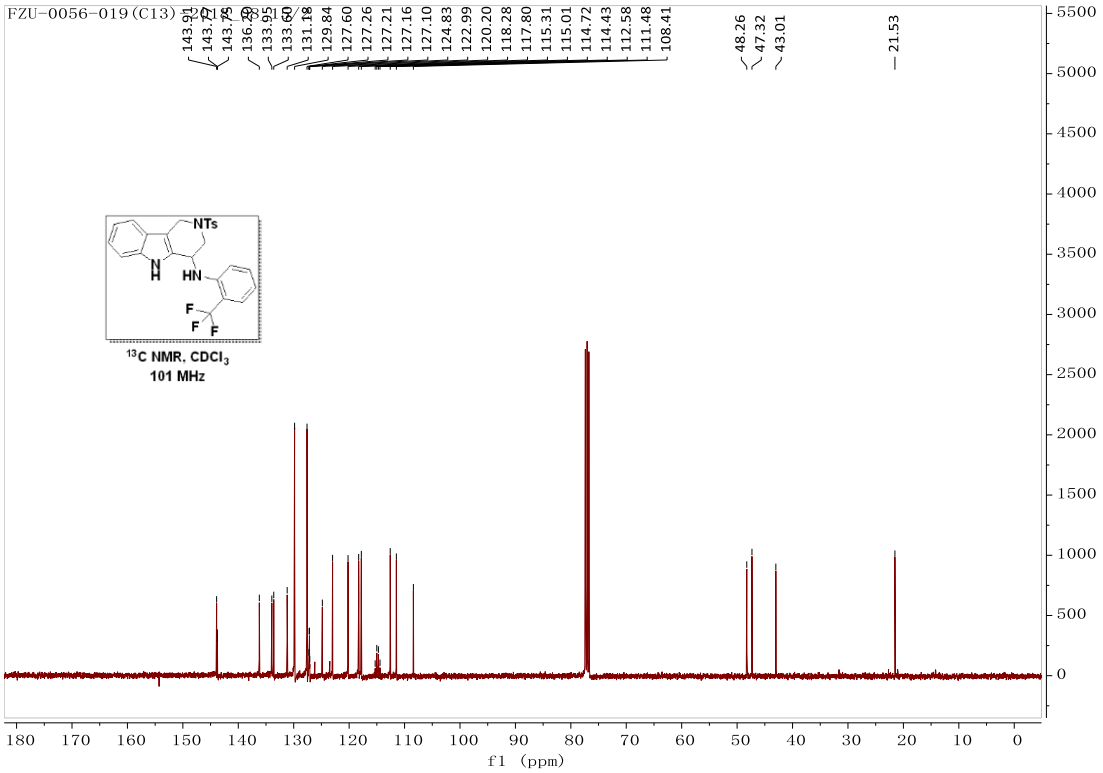
^{13}C NMR Spectrum of 6



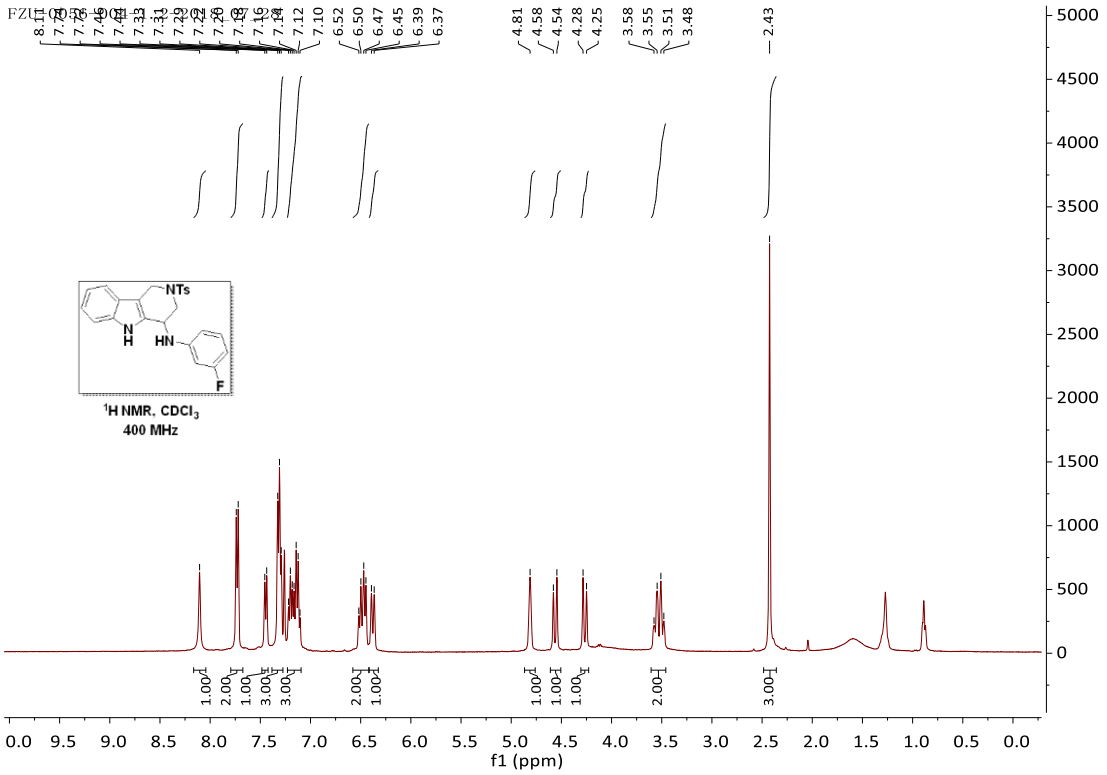
^{1}H NMR Spectrum of 7



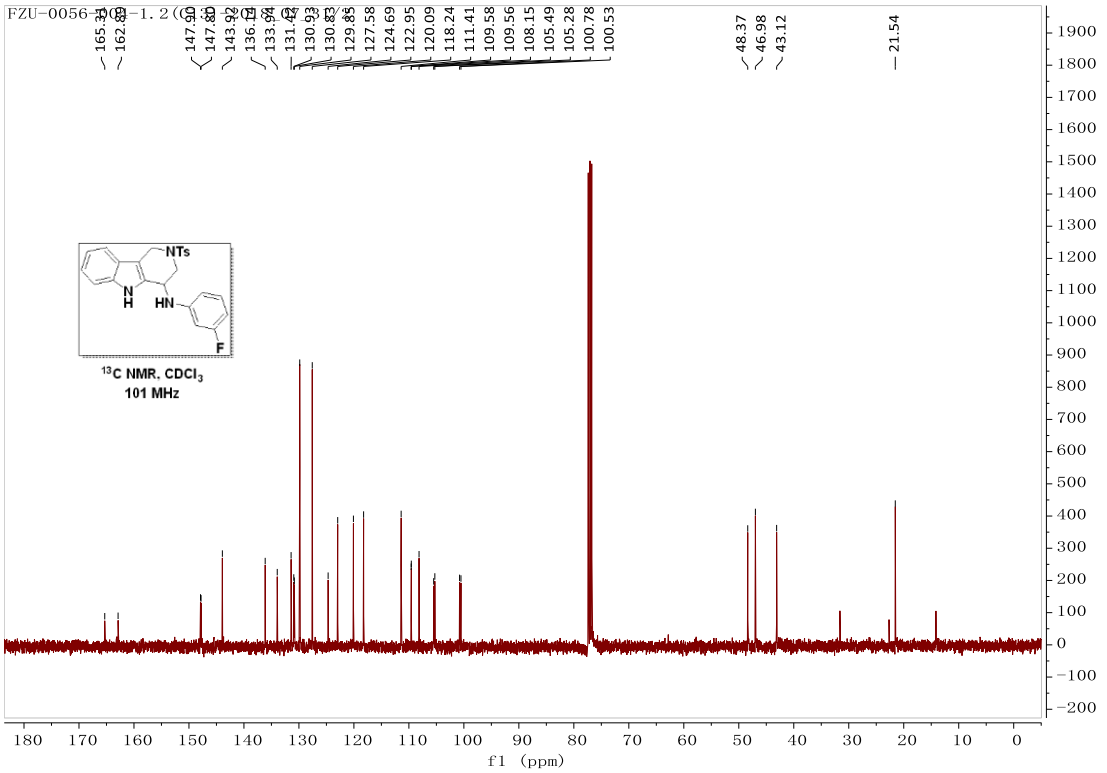
^{13}C NMR Spectrum of 7



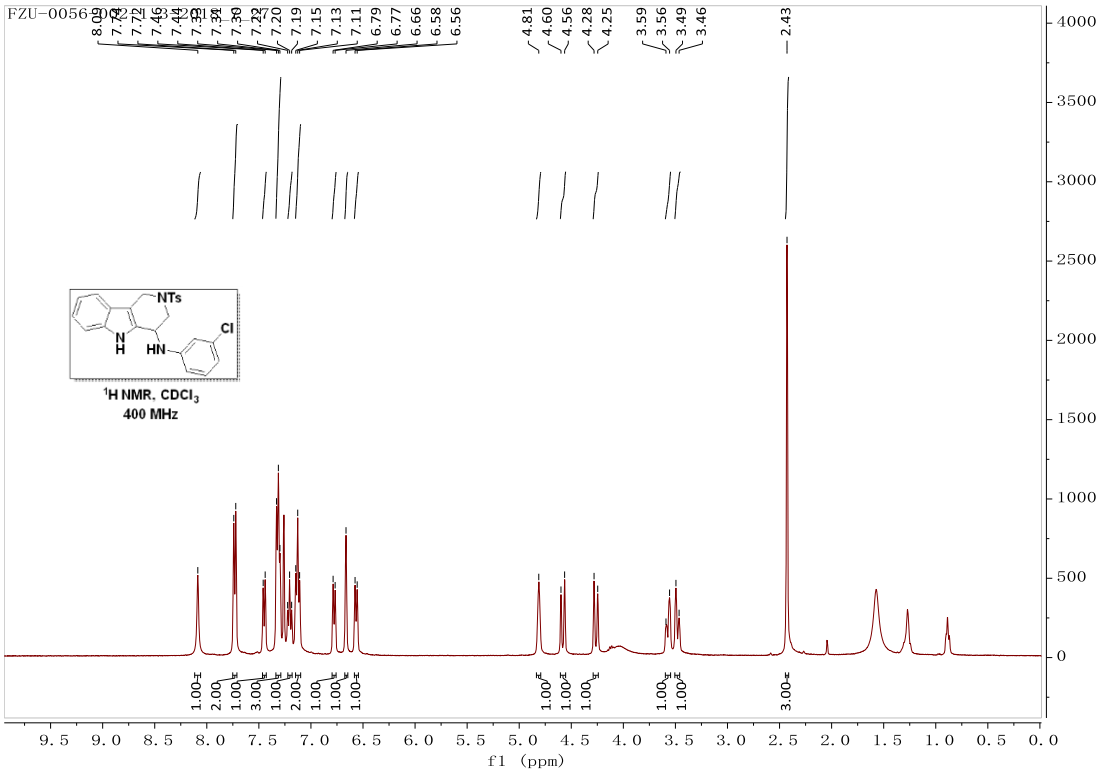
^{1}H NMR Spectrum of 8



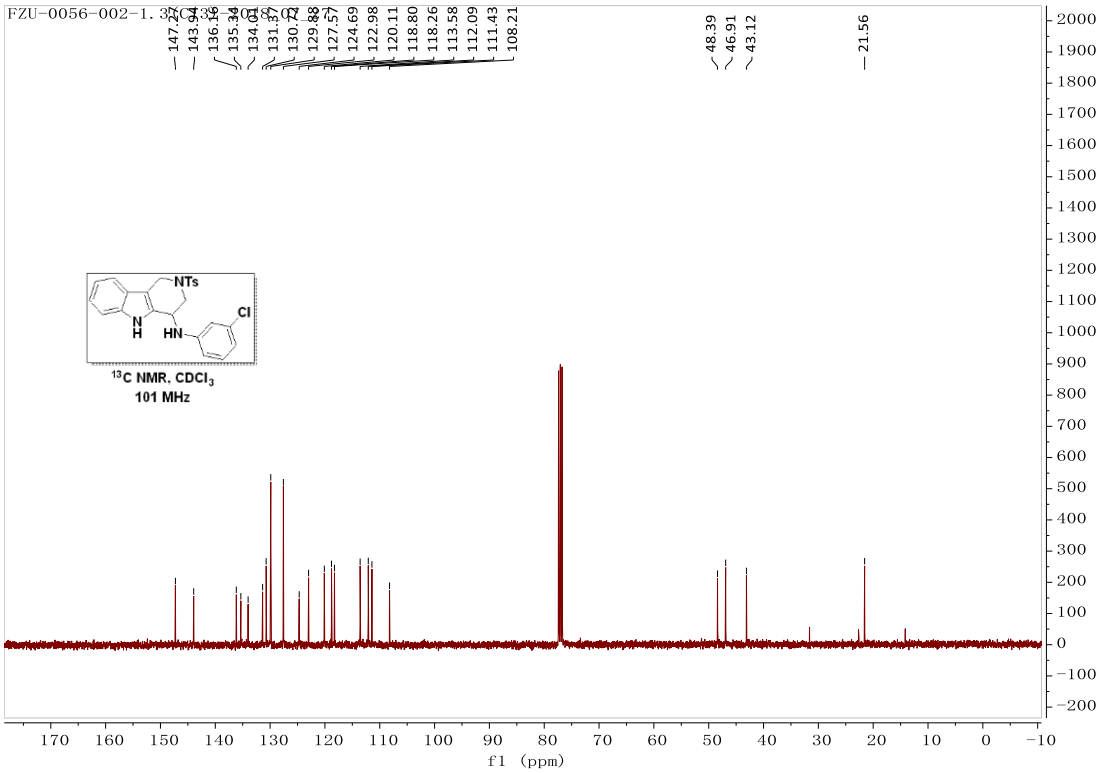
^{13}C NMR Spectrum of 8



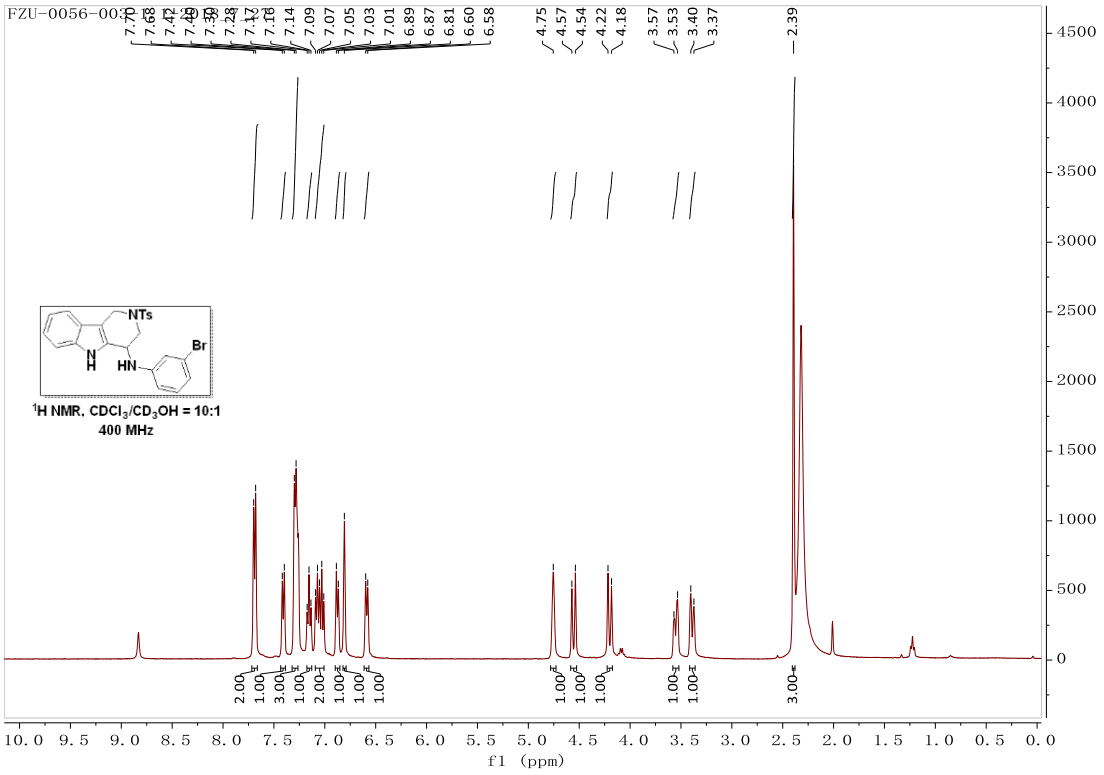
^{1}H NMR Spectrum of 9



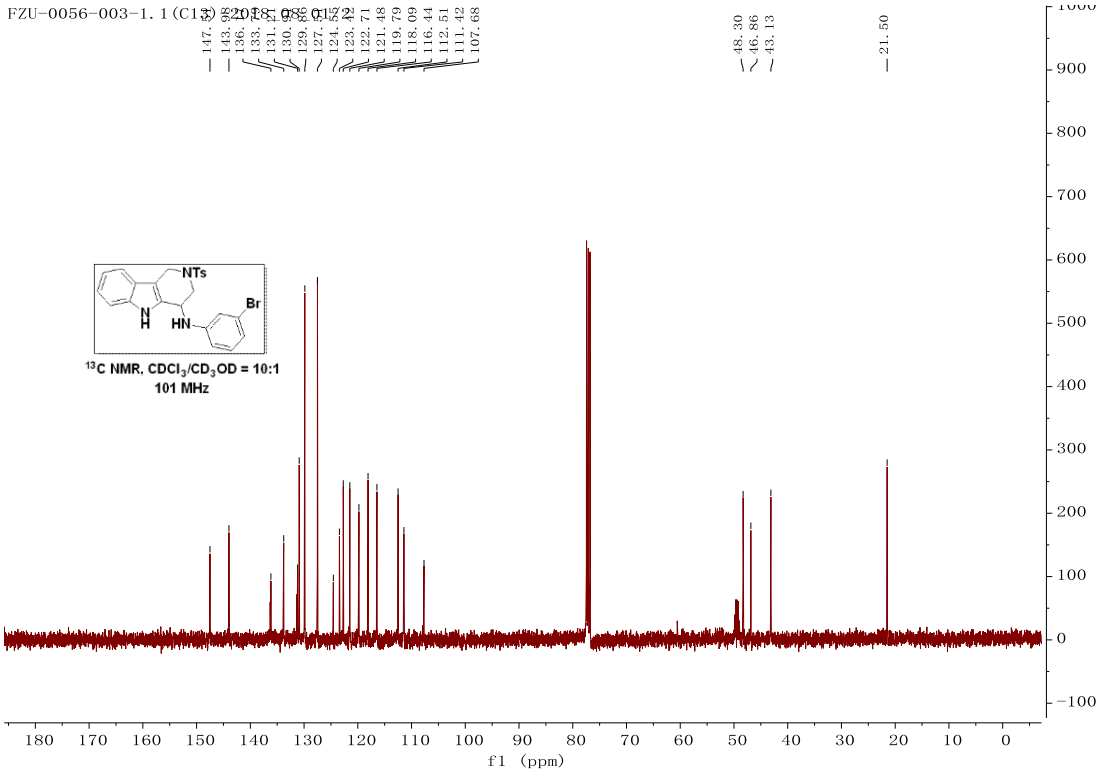
^{13}C NMR Spectrum of 9



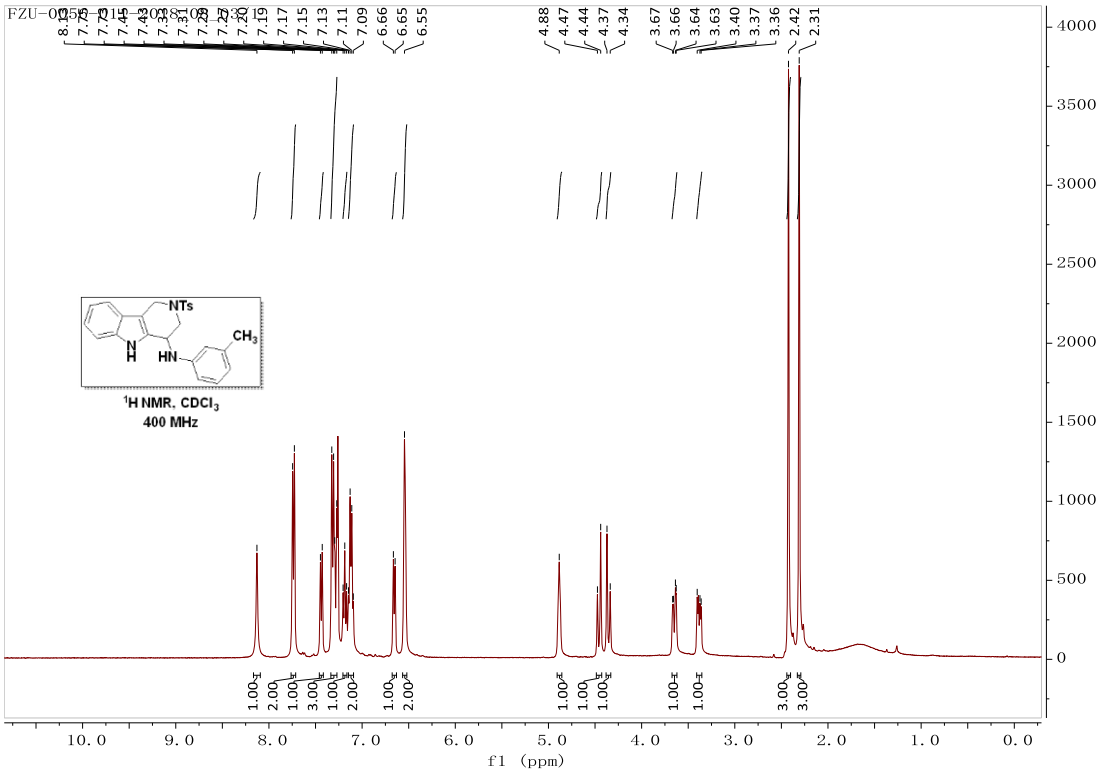
^{1}H NMR Spectrum of 10



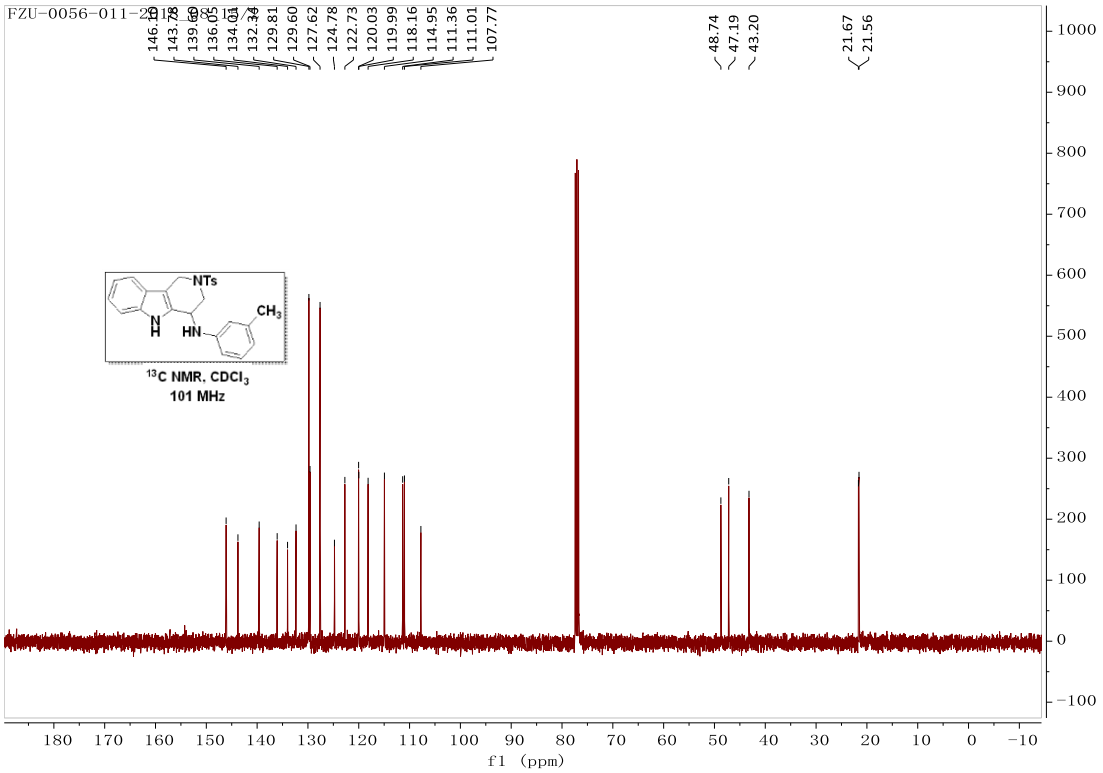
^{13}C NMR Spectrum of 10



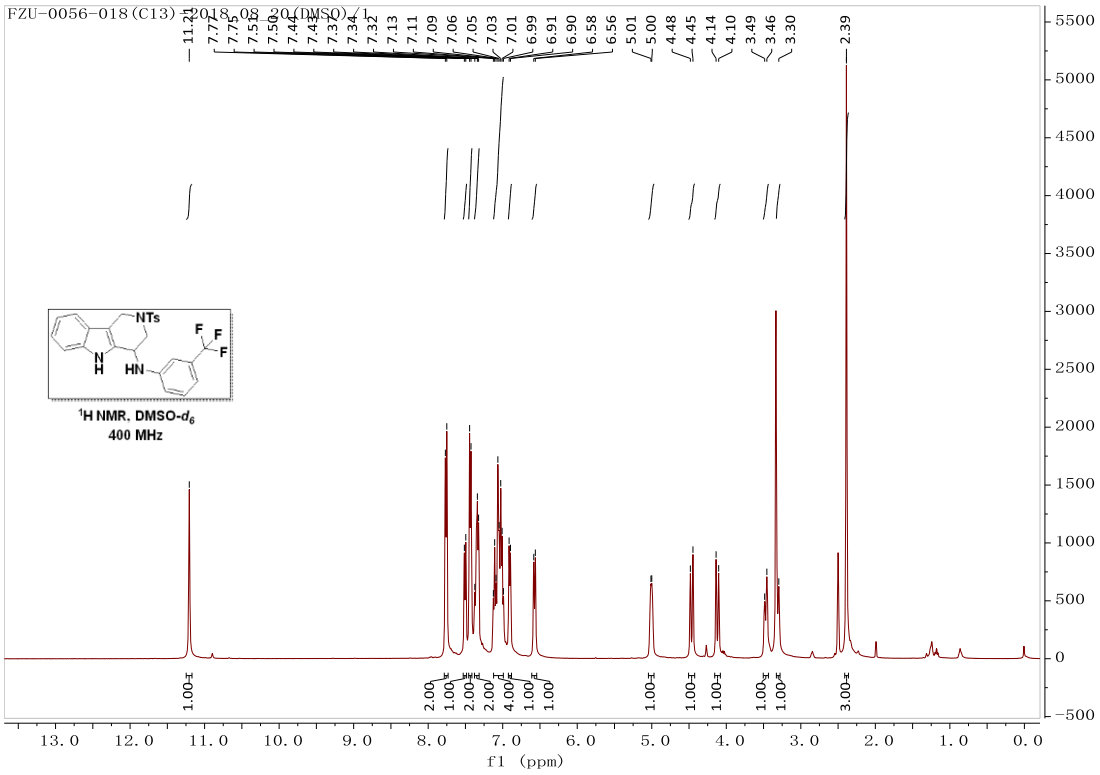
^{1}H NMR Spectrum of 11



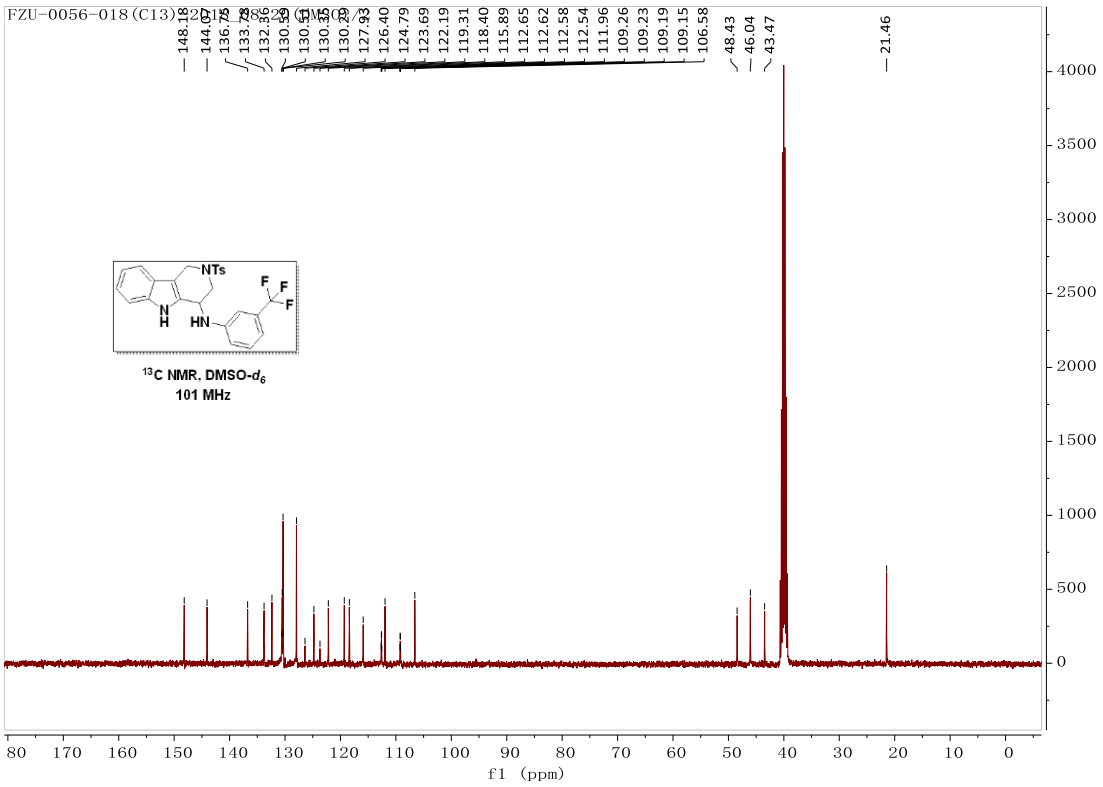
^{13}C NMR Spectrum of 11



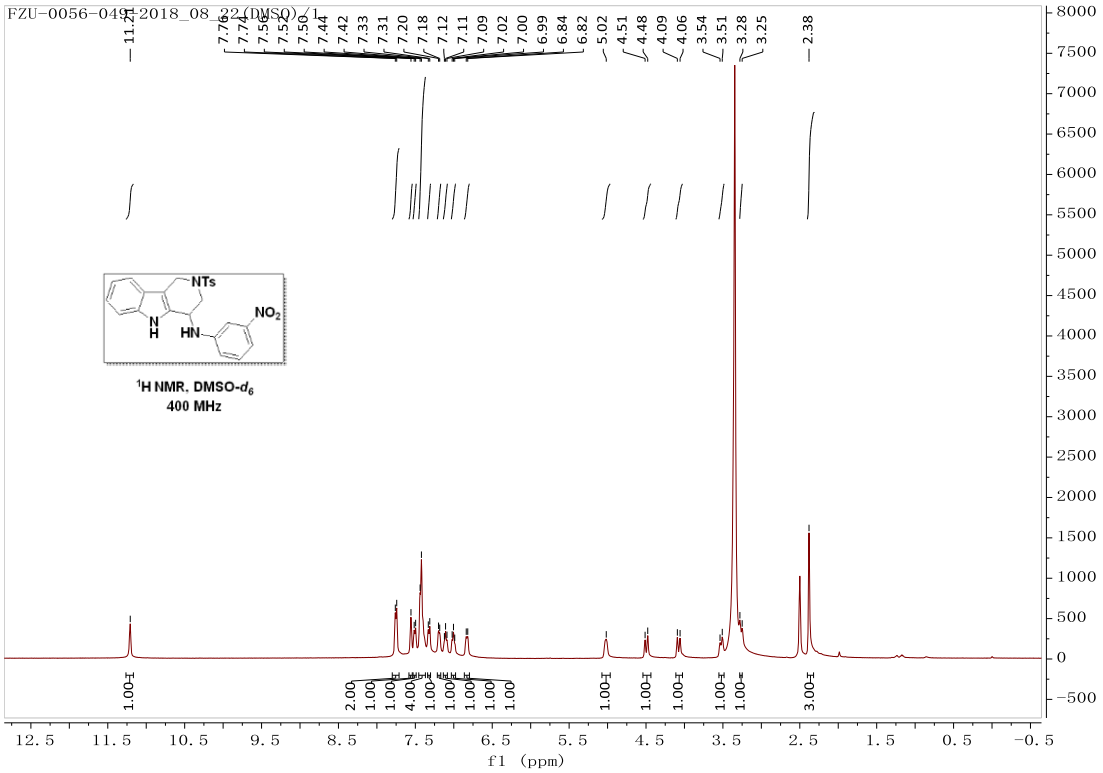
^{1}H NMR Spectrum of 12



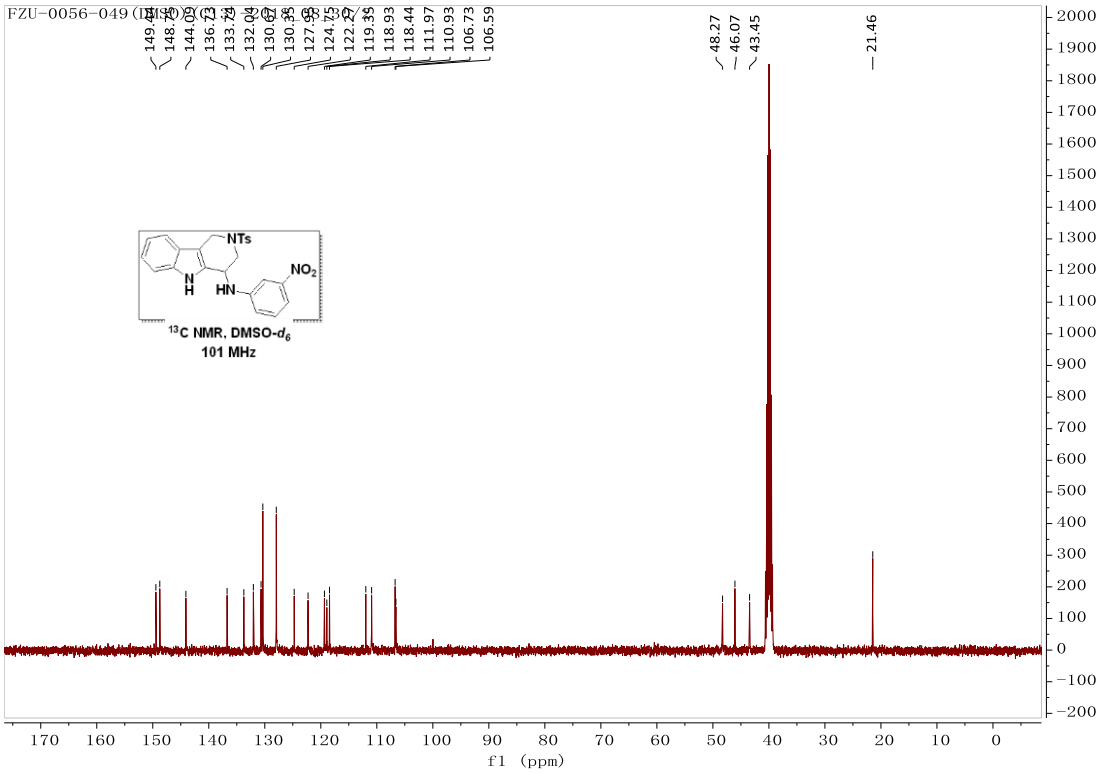
^{13}C NMR Spectrum of 12



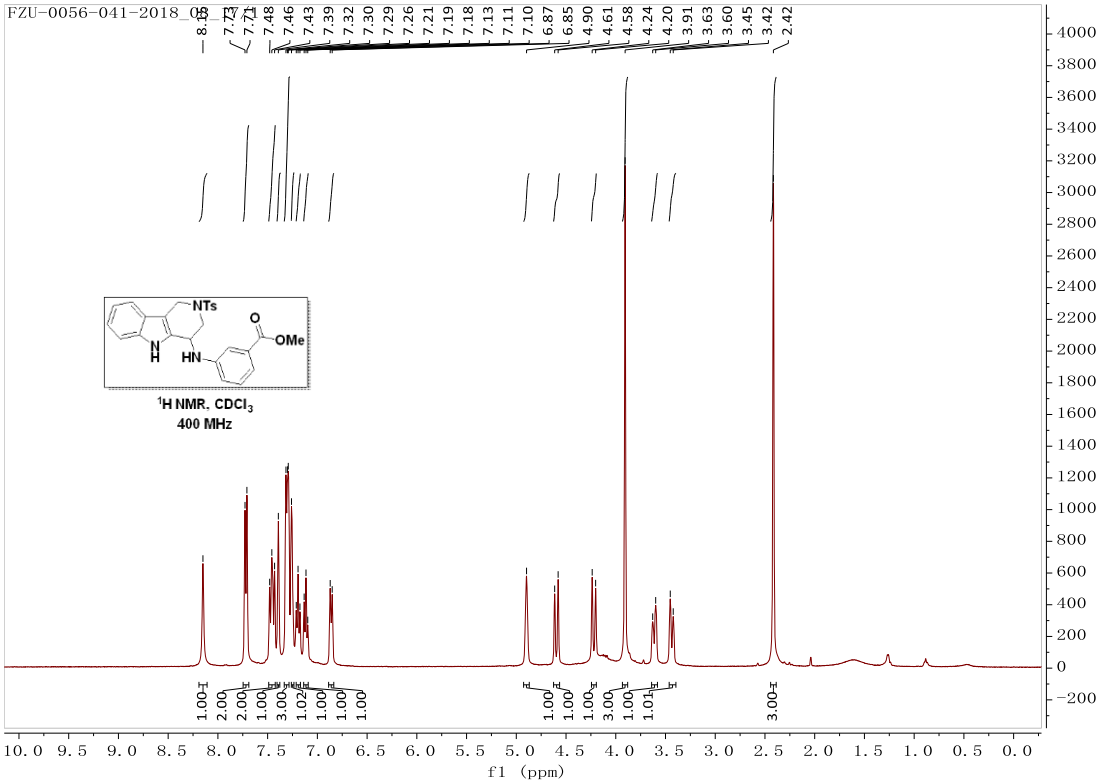
^{1}H NMR Spectrum of 13



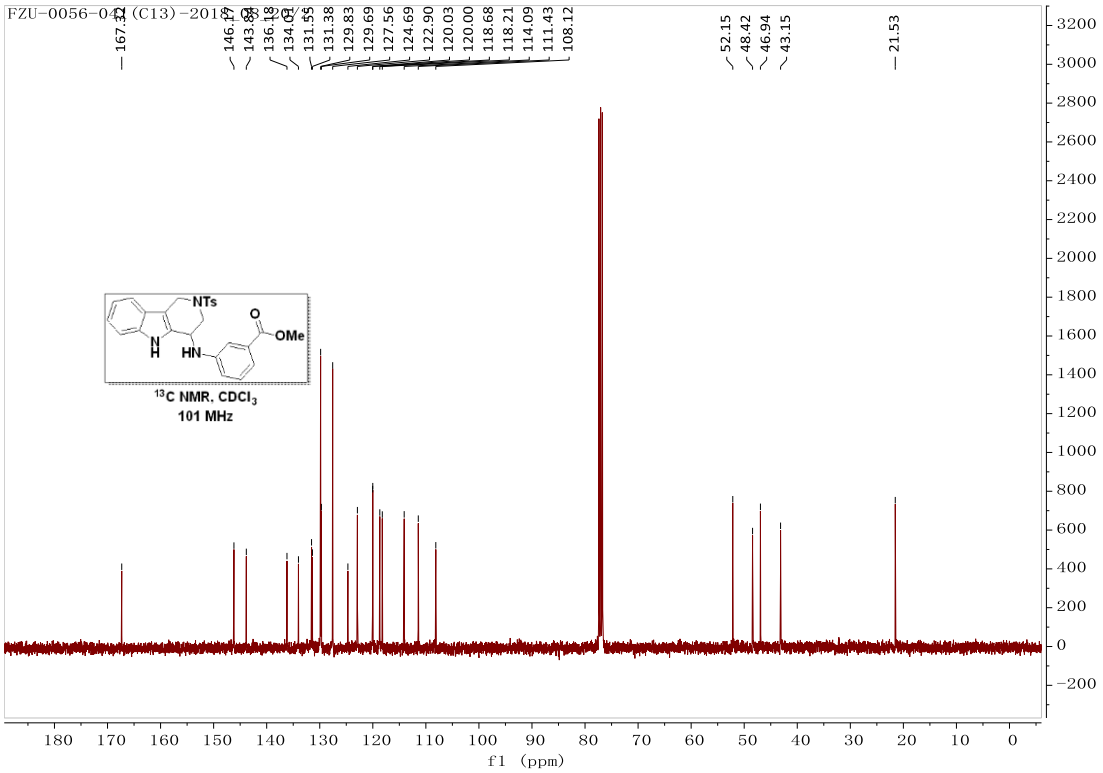
^{13}C NMR Spectrum of 13



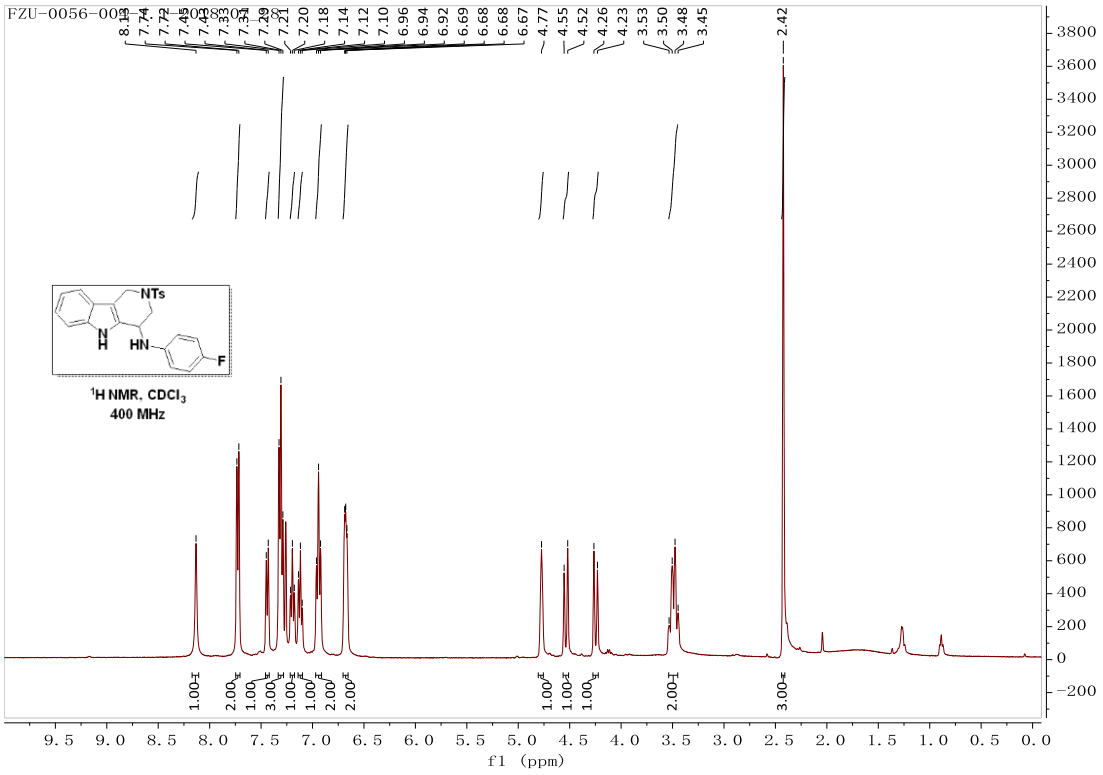
^{1}H NMR Spectrum of 14



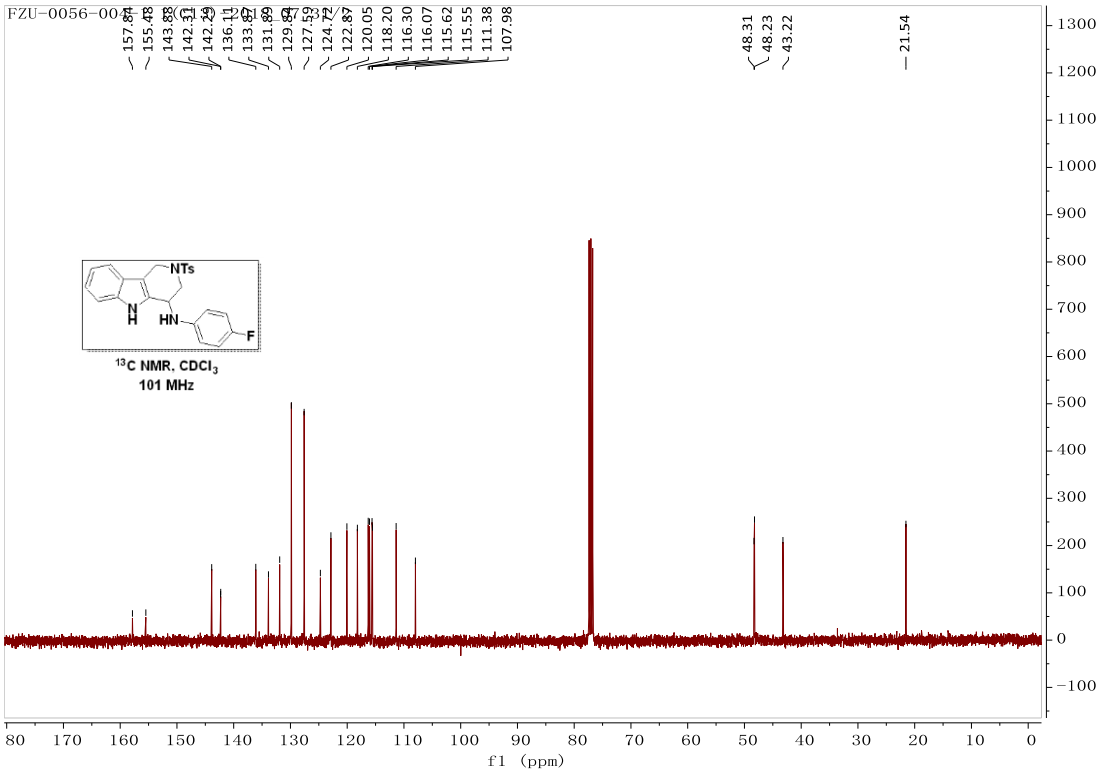
^{13}C NMR Spectrum of 14



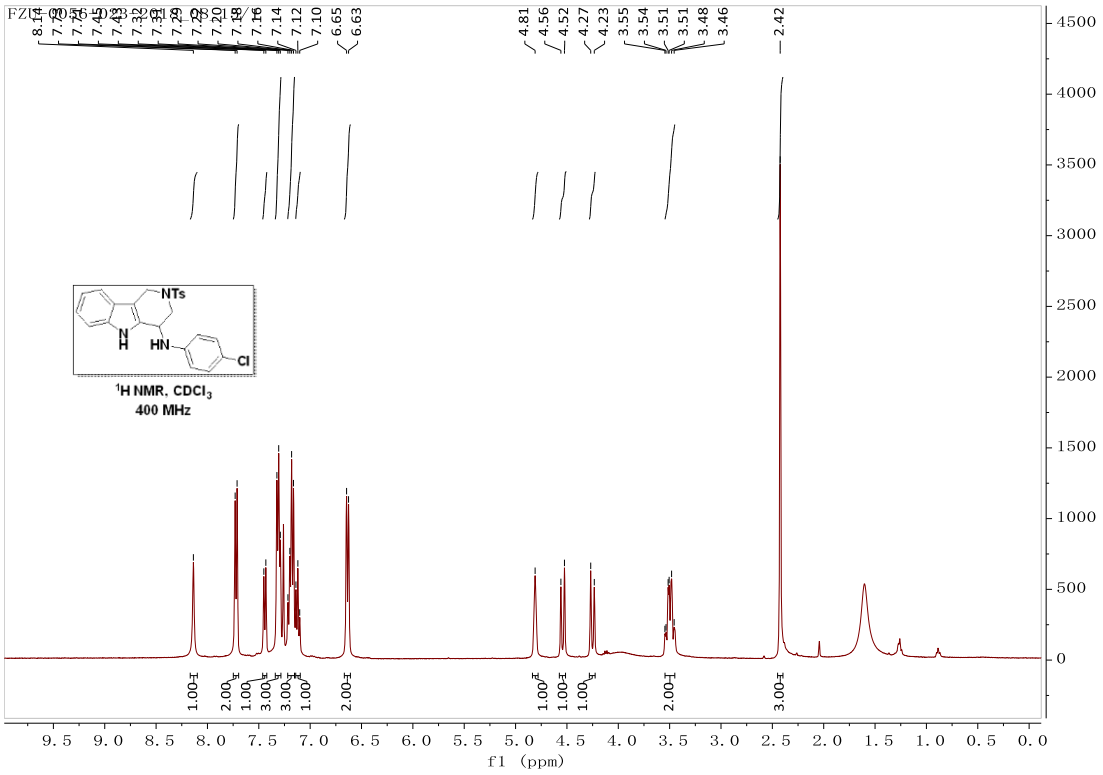
^{1}H NMR Spectrum of 15



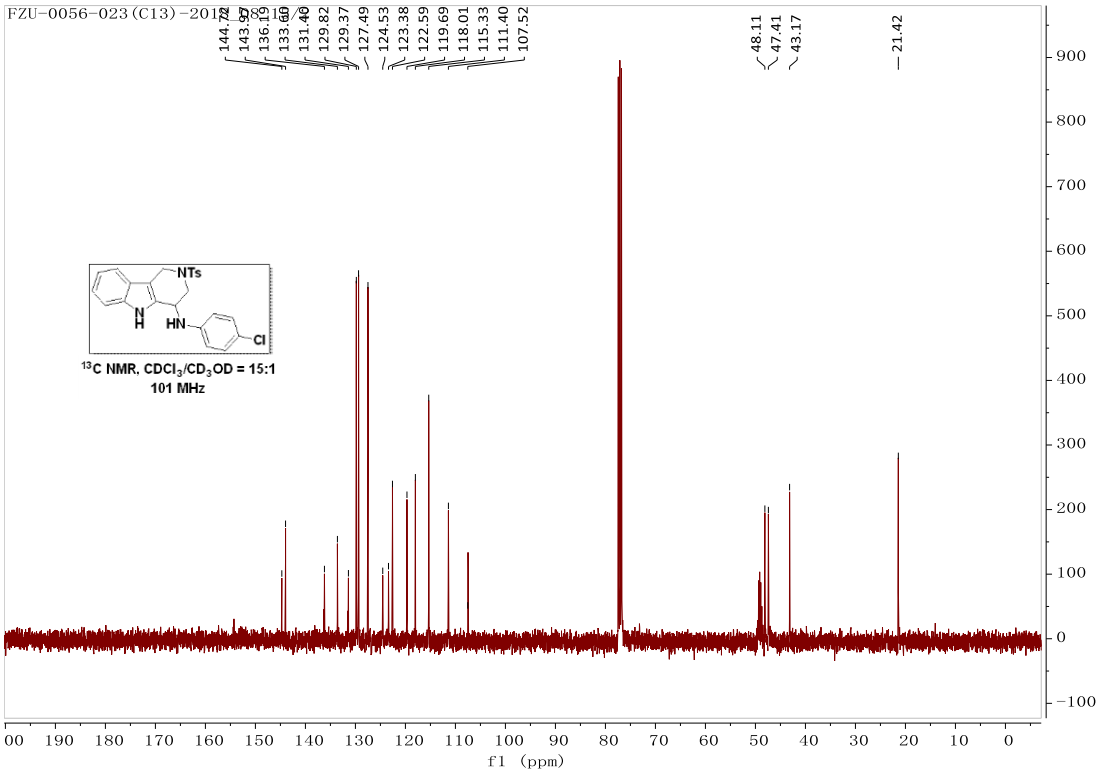
^{13}C NMR Spectrum of 15



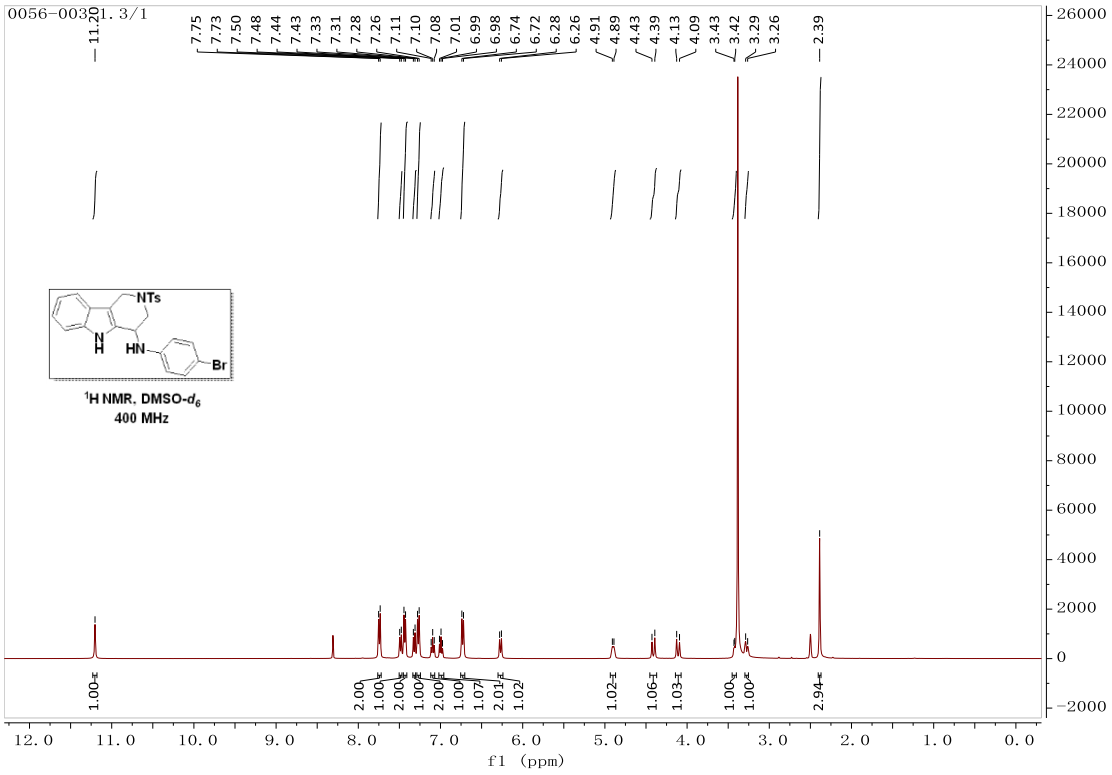
^{1}H NMR Spectrum of 16



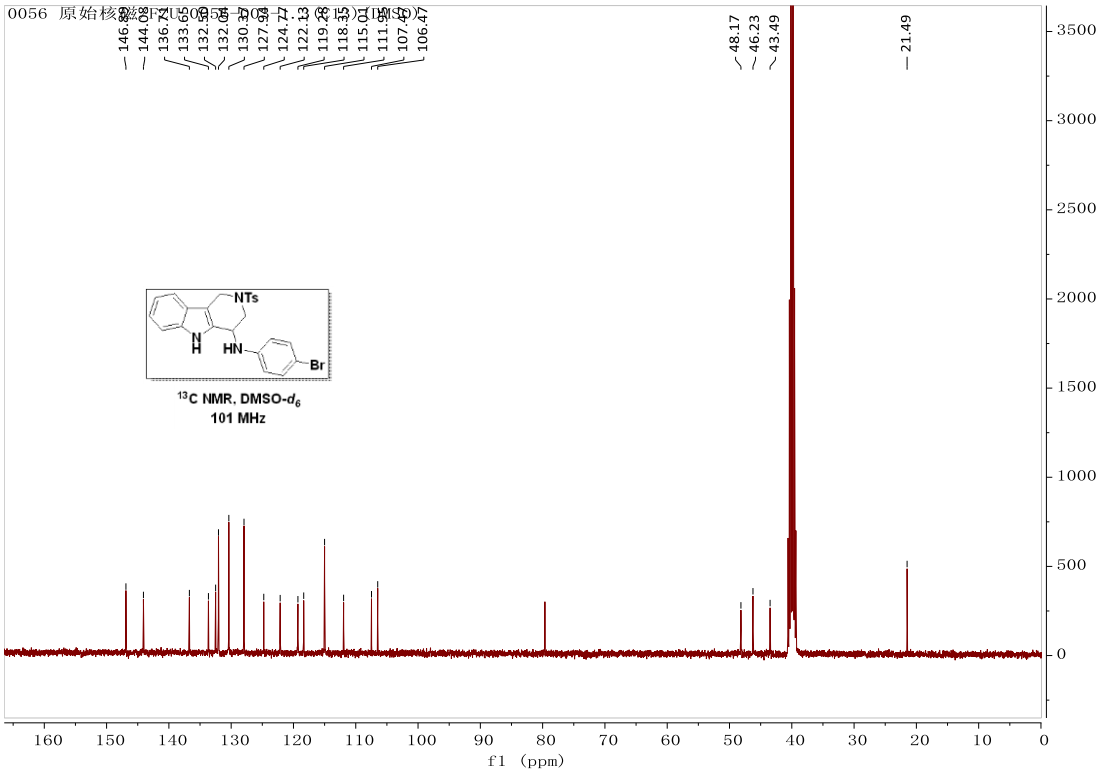
^{13}C NMR Spectrum of 16



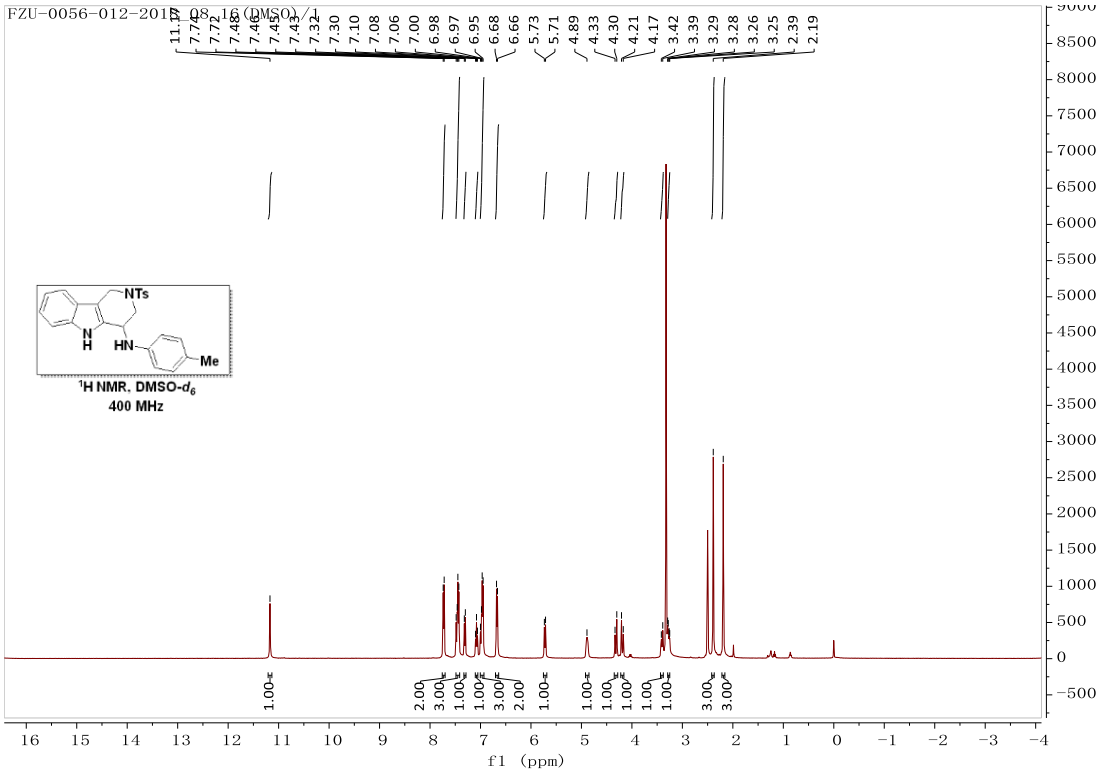
^{1}H NMR Spectrum of 17



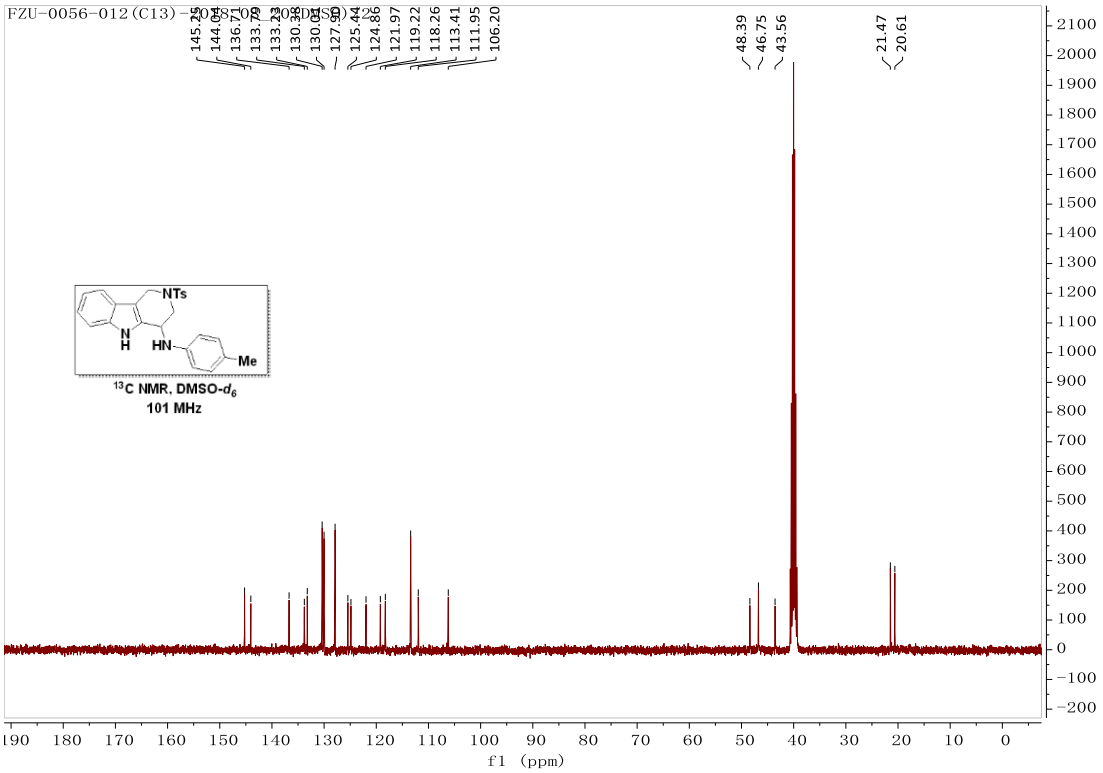
^{13}C NMR Spectrum of 17



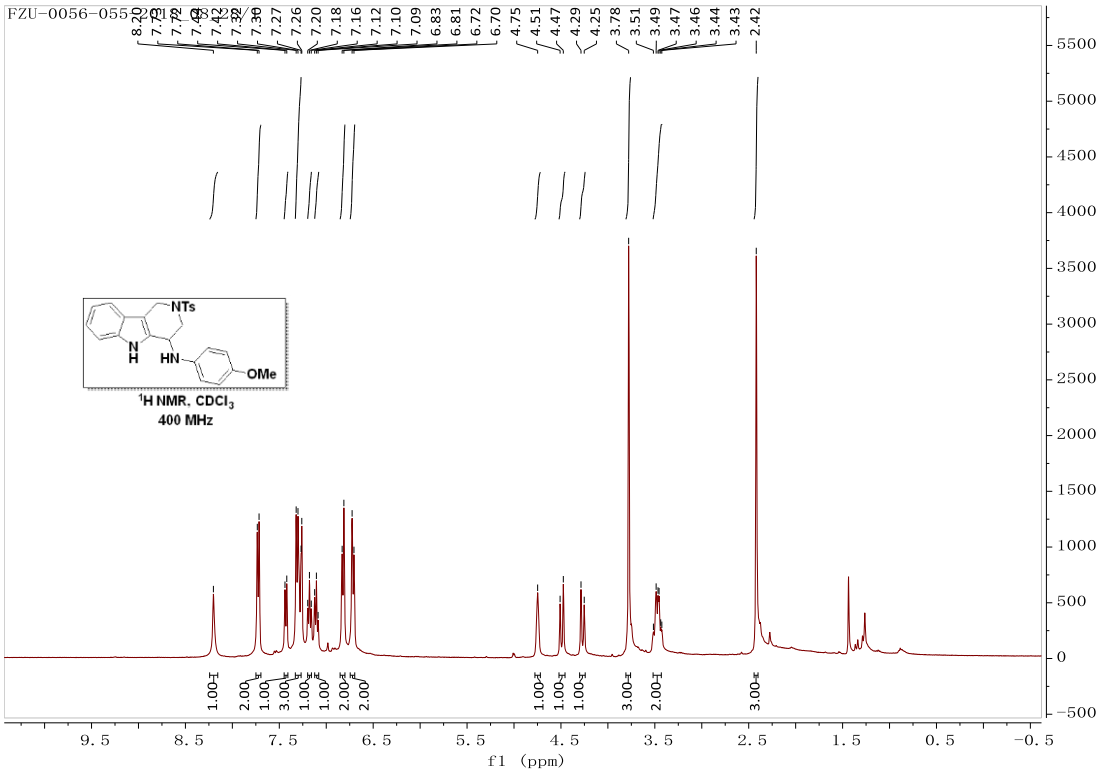
^{1}H NMR Spectrum of 18



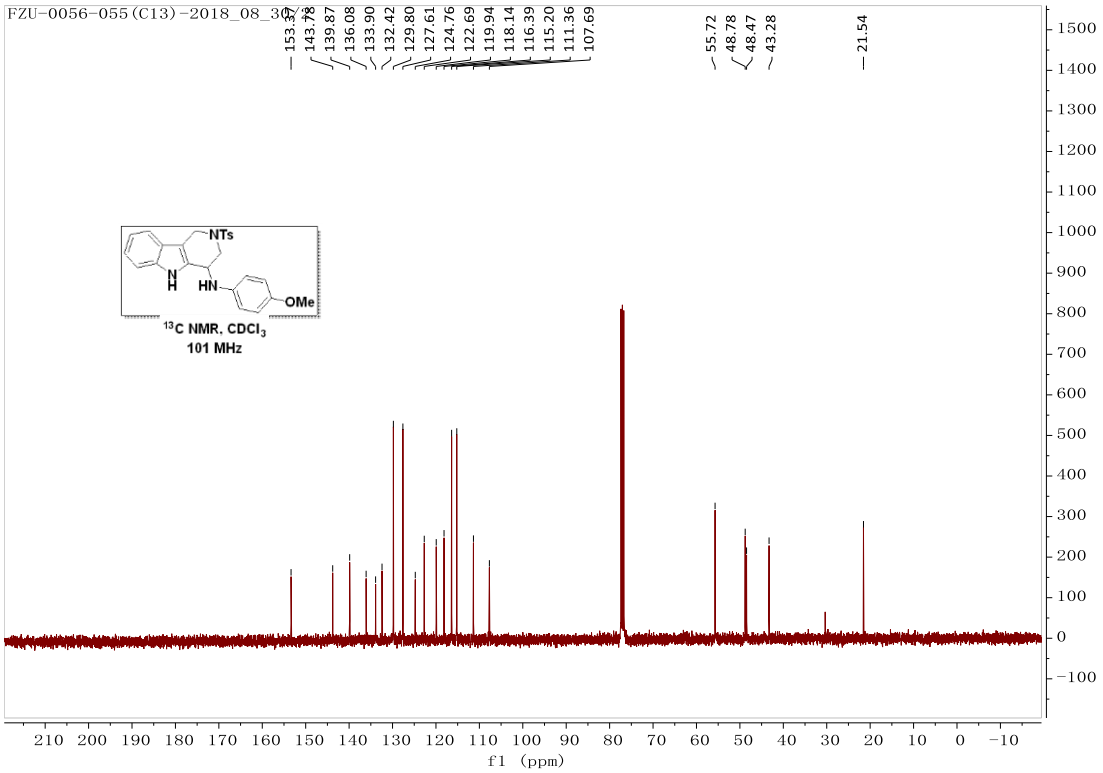
^{13}C NMR Spectrum of 18



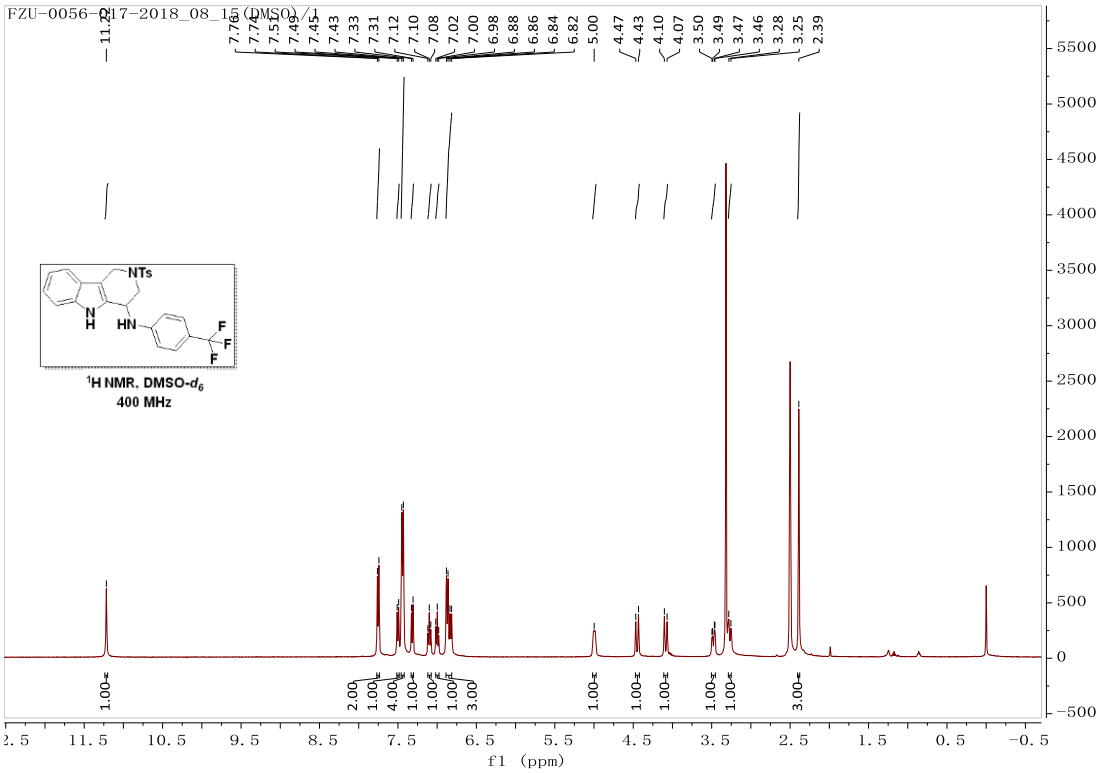
^{1}H NMR Spectrum of 19



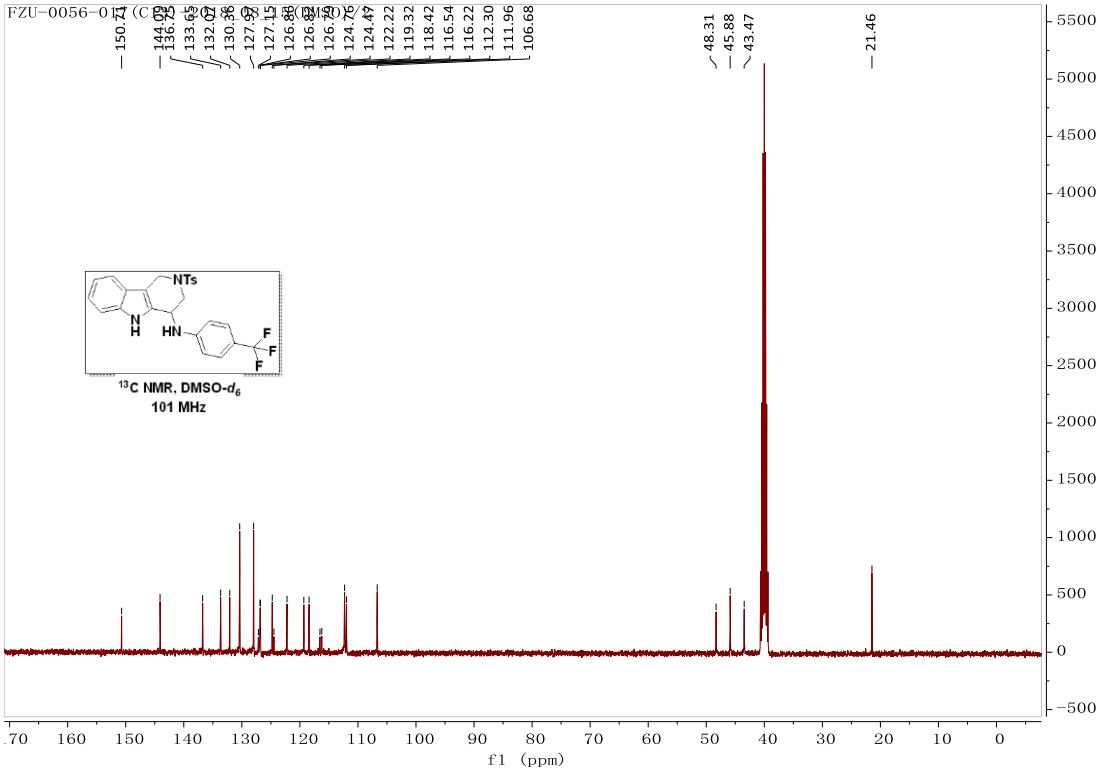
^{13}C NMR Spectrum of 19



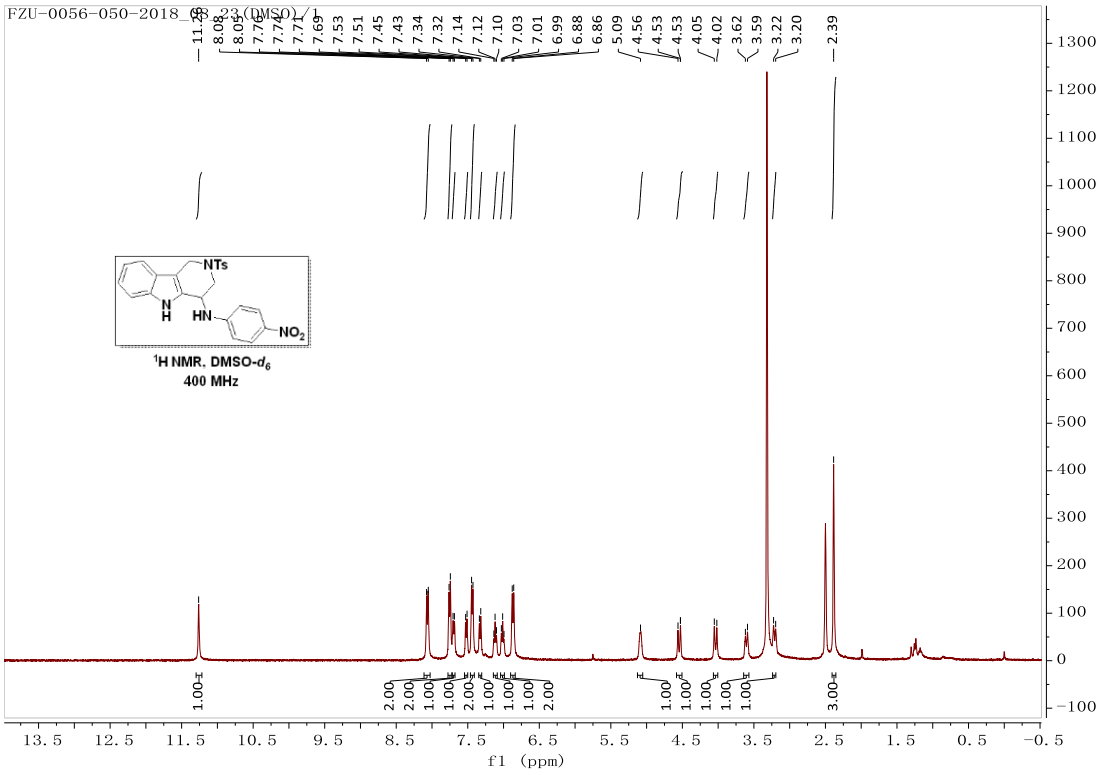
^{1}H NMR Spectrum of 20



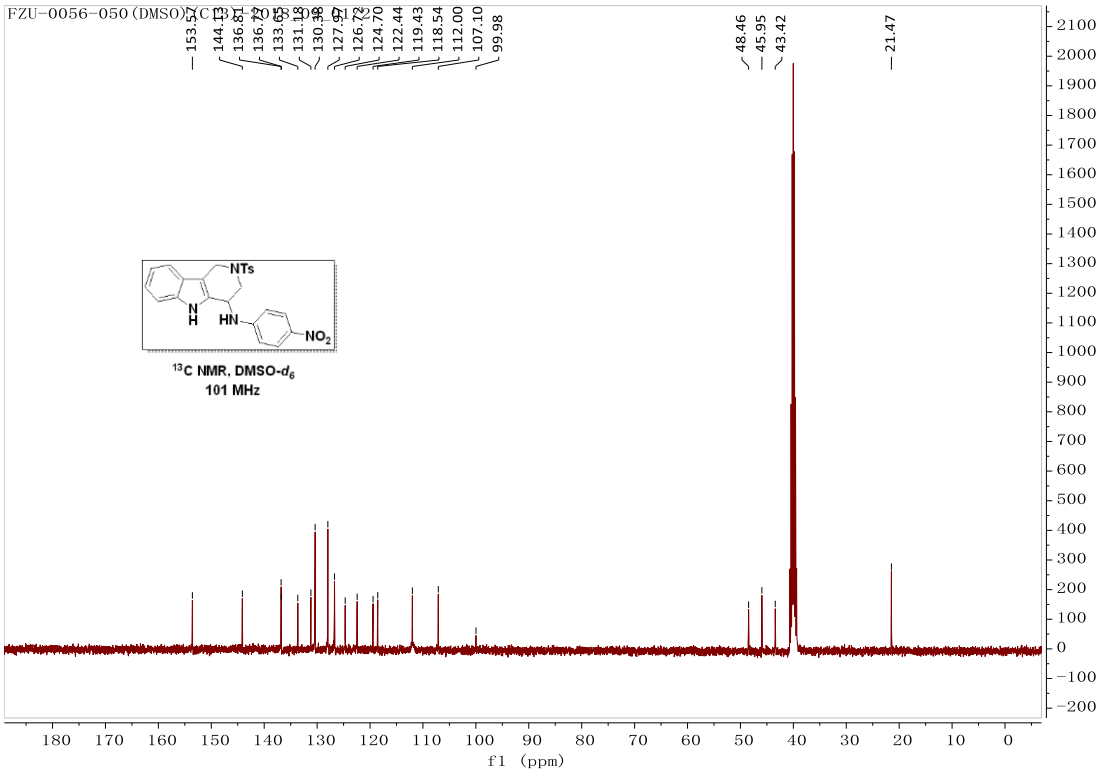
^{13}C NMR Spectrum of 20



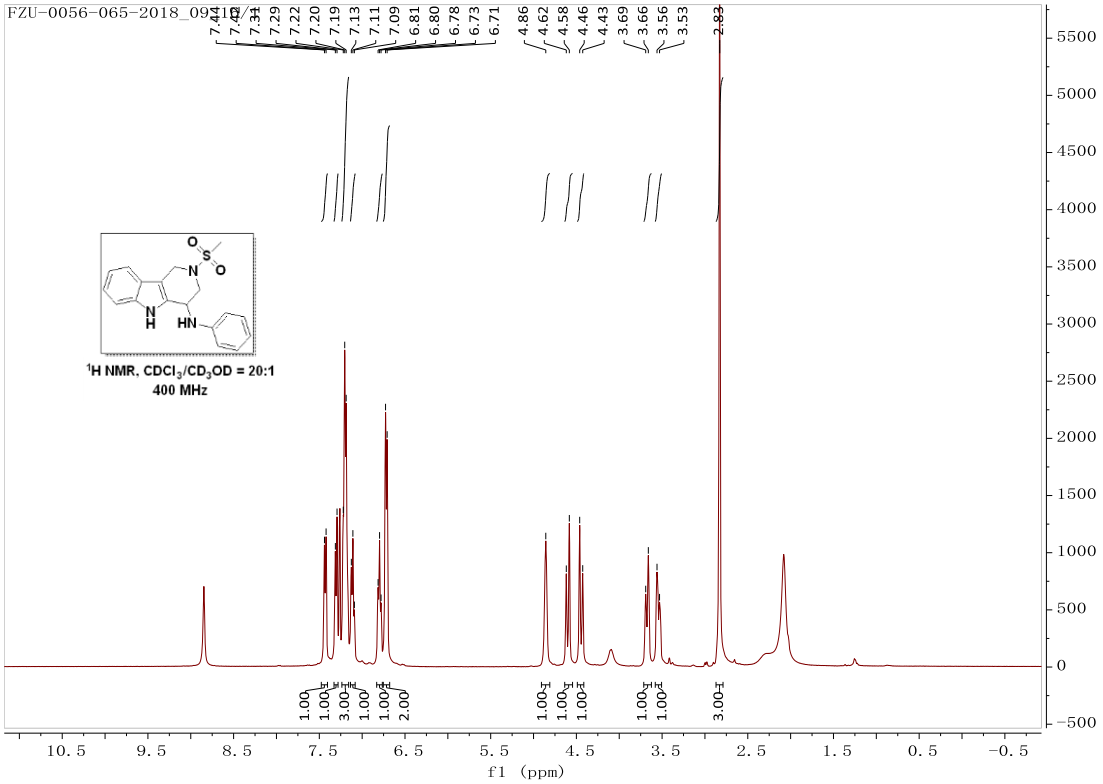
^{1}H NMR Spectrum of 21



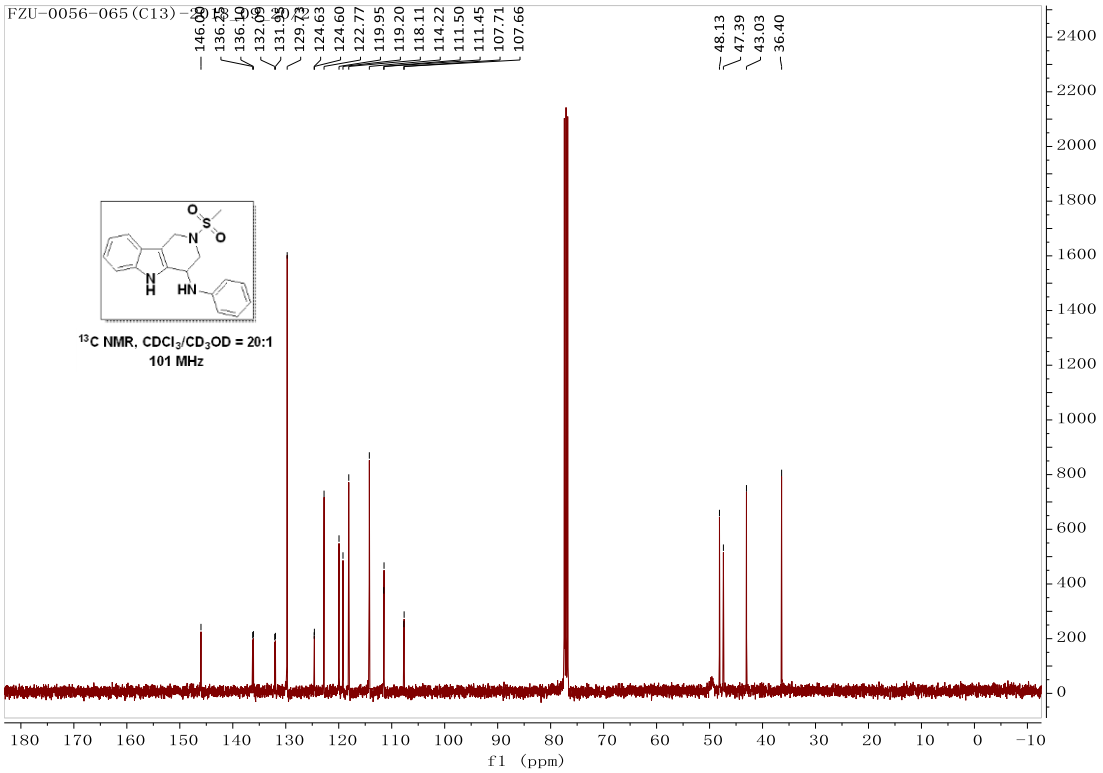
^{13}C NMR Spectrum of 21



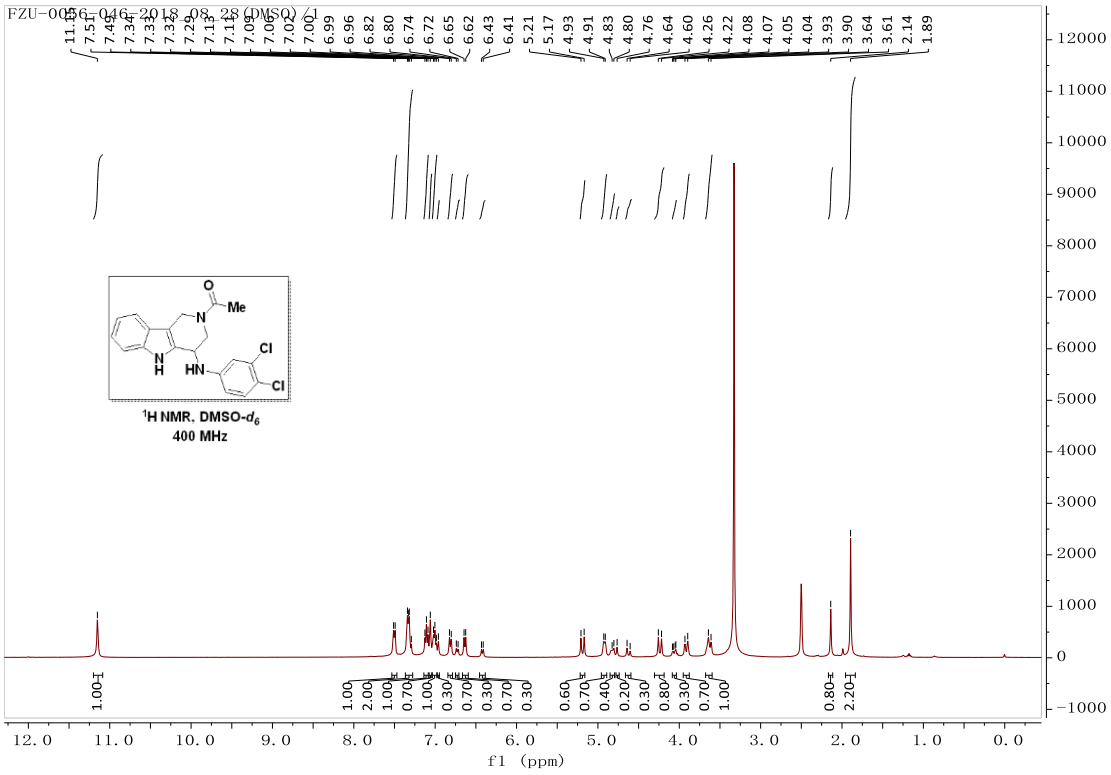
^{1}H NMR Spectrum of 22



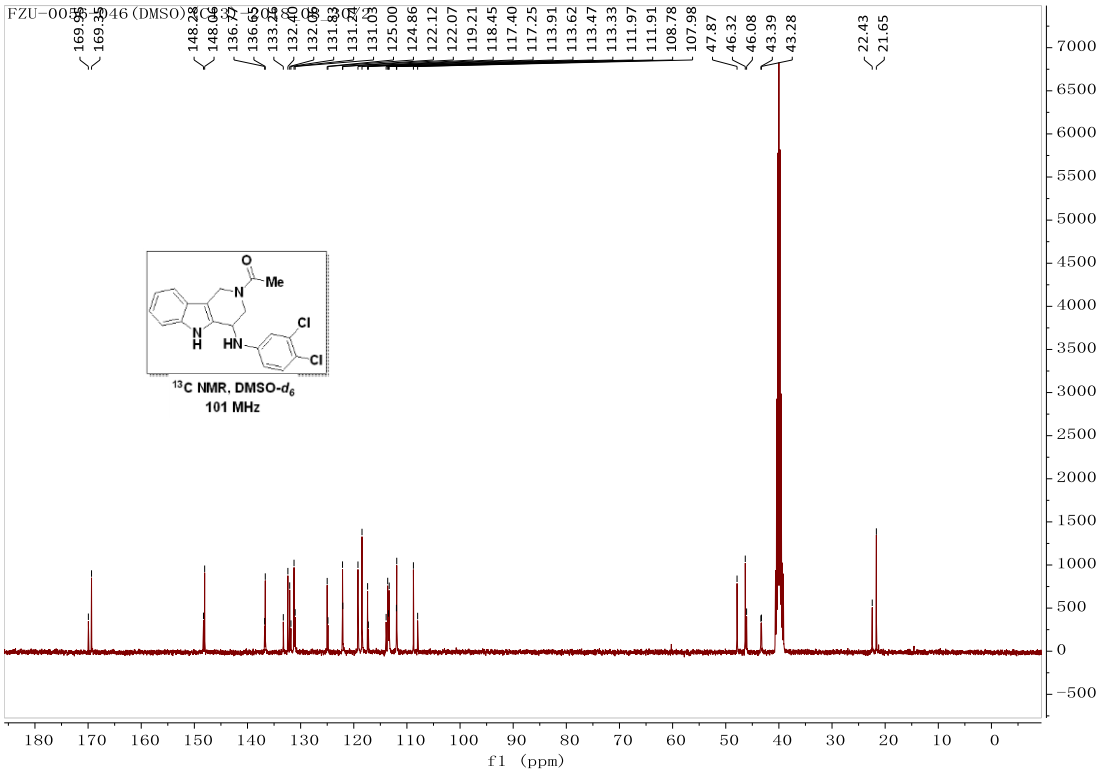
^{13}C NMR Spectrum of 22



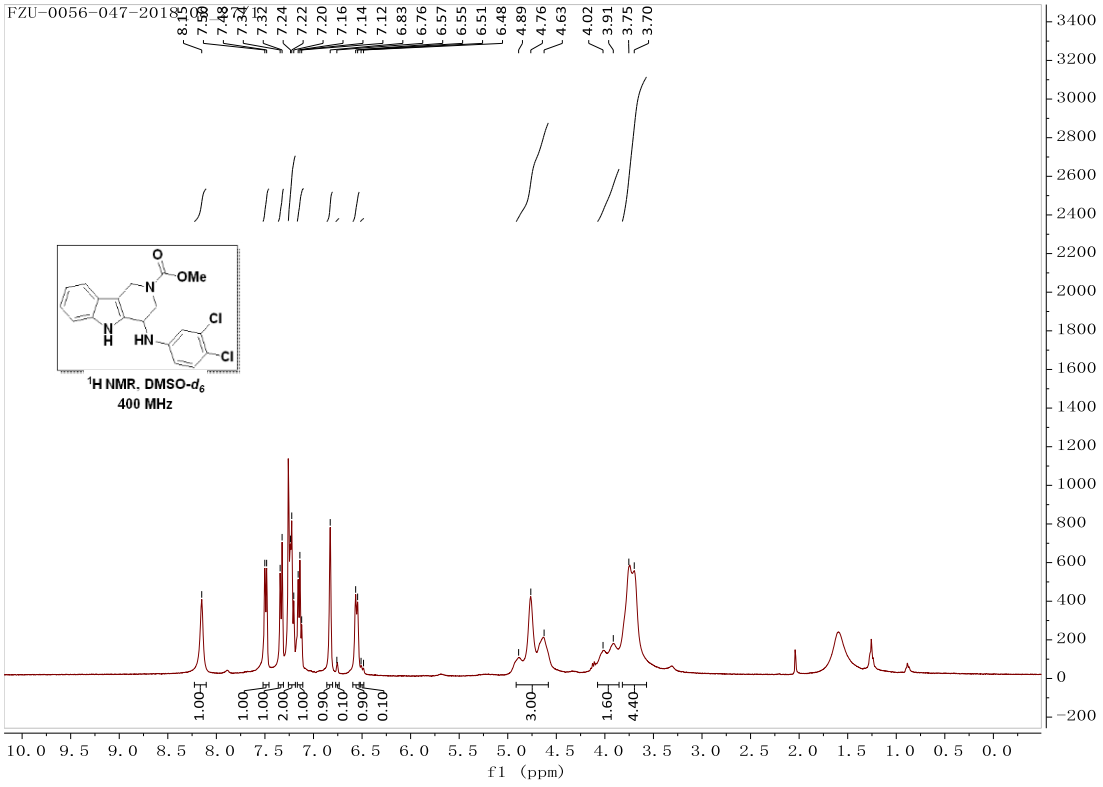
^{1}H NMR Spectrum of 23



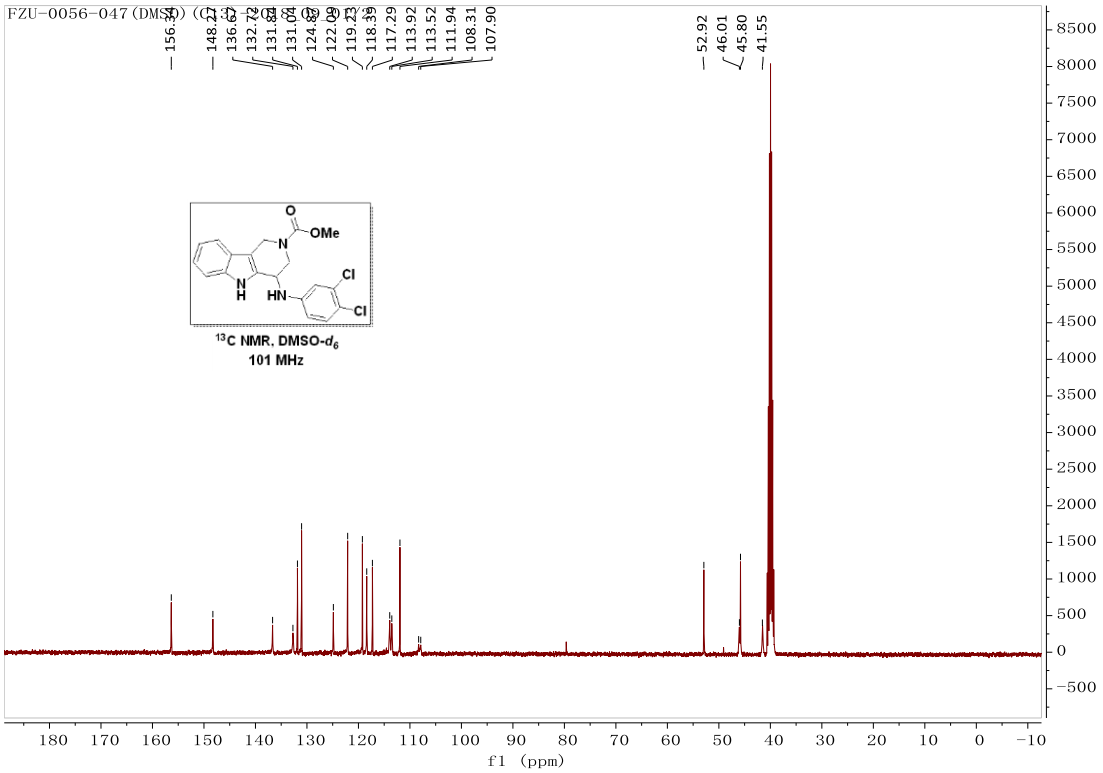
^{13}C NMR Spectrum of 23



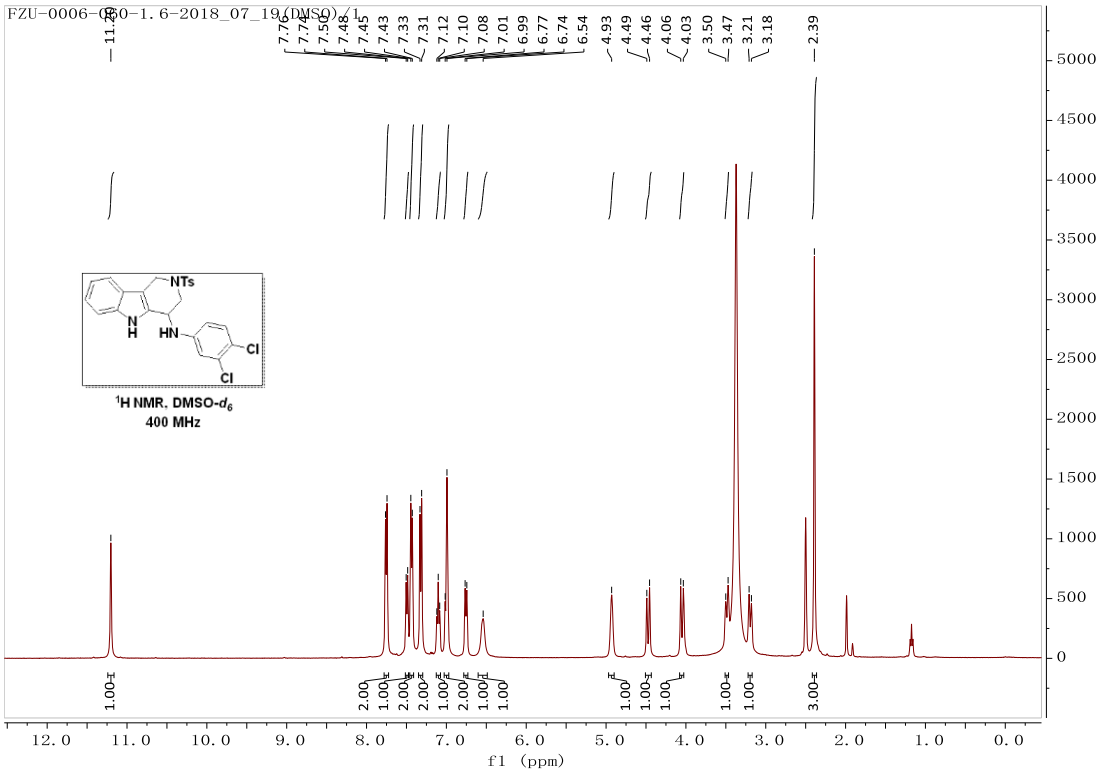
^{1}H NMR Spectrum of 24



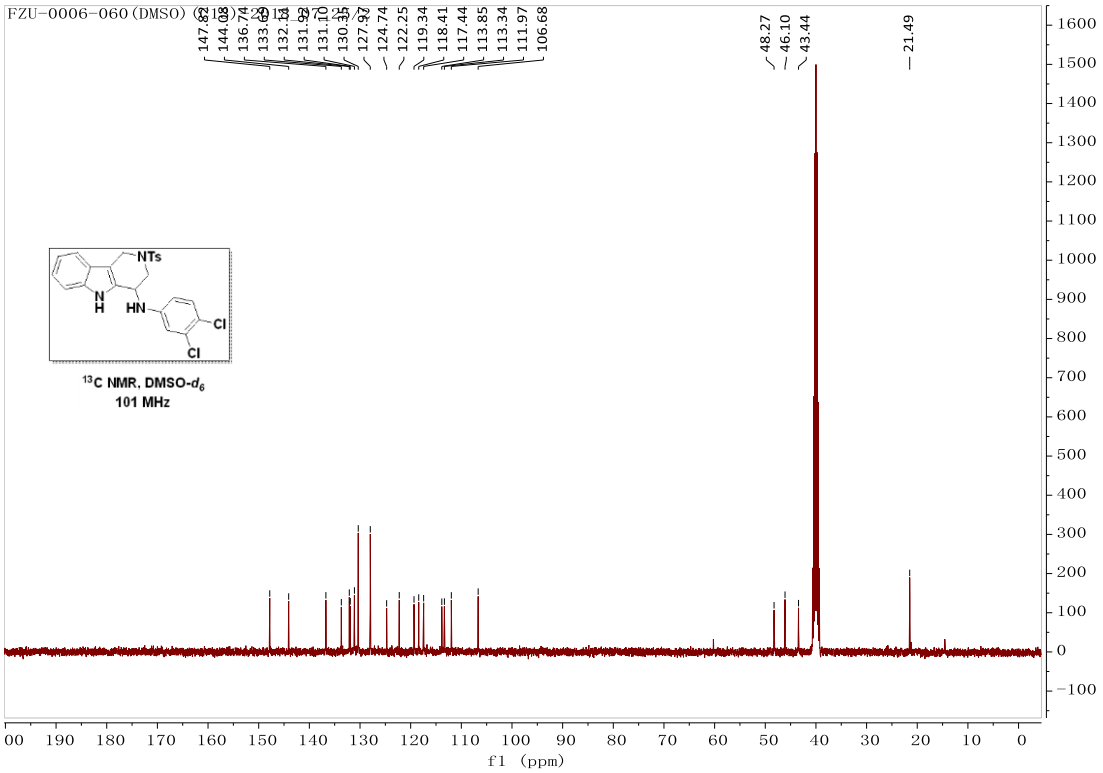
^{13}C NMR Spectrum of 24



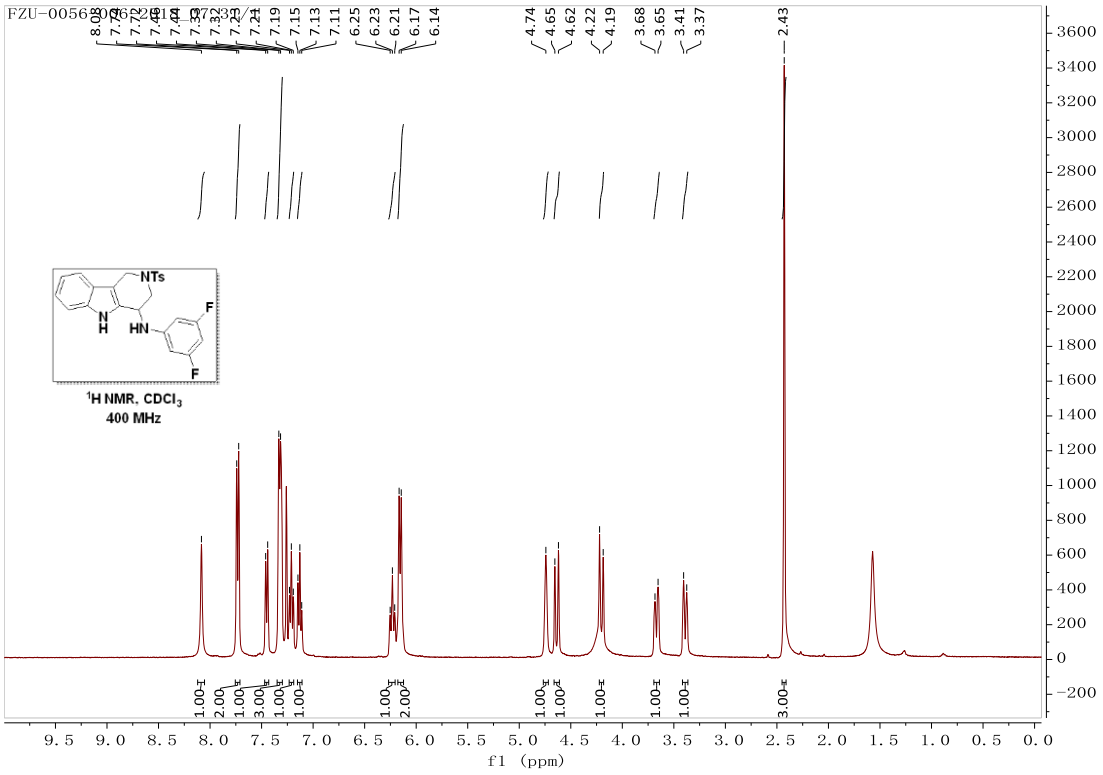
^{1}H NMR Spectrum of 25



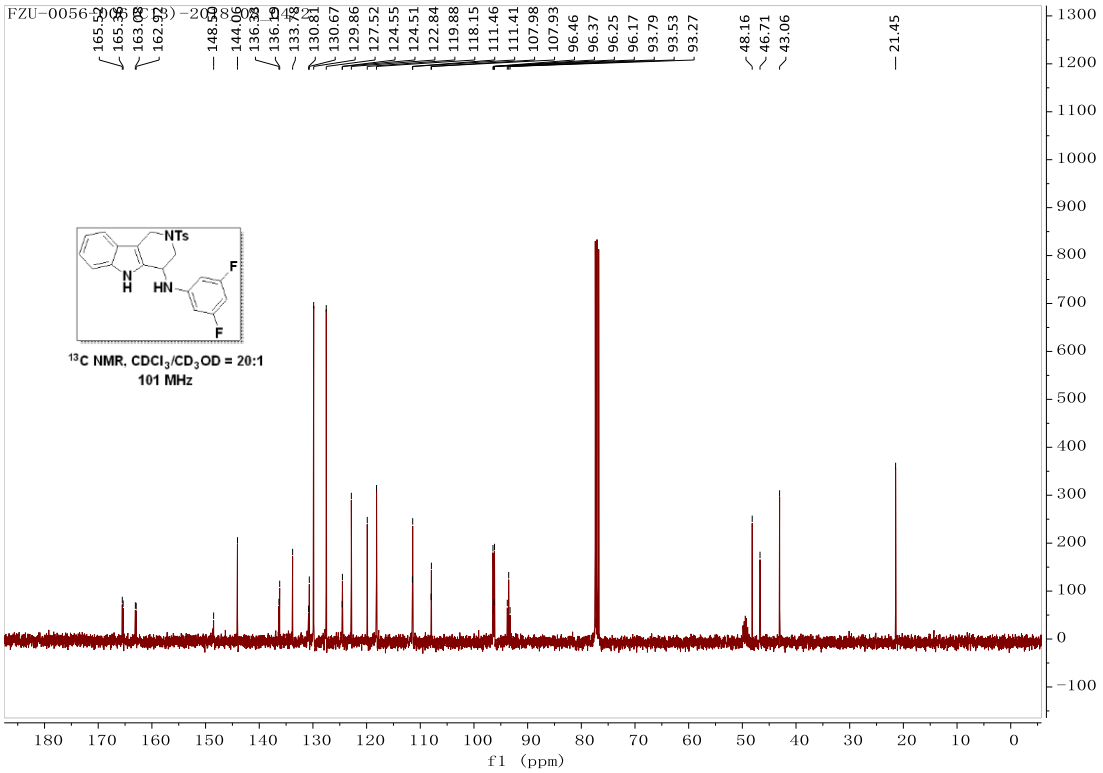
^{13}C NMR Spectrum of 25



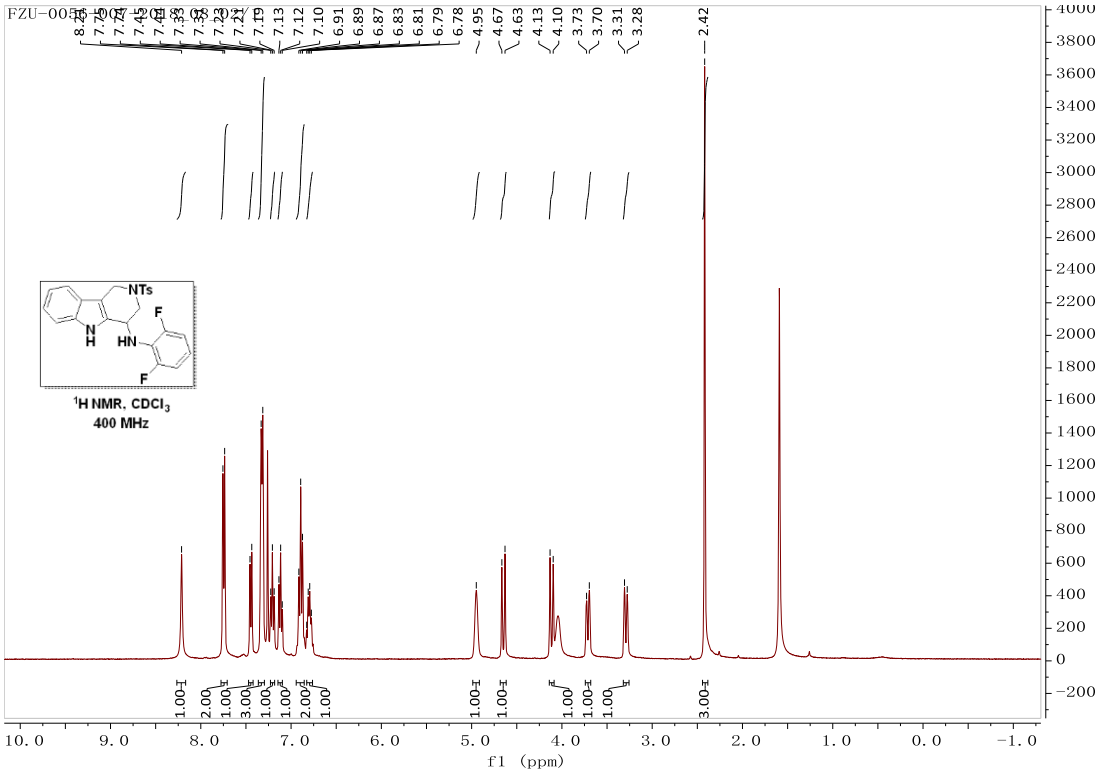
^{1}H NMR Spectrum of 26



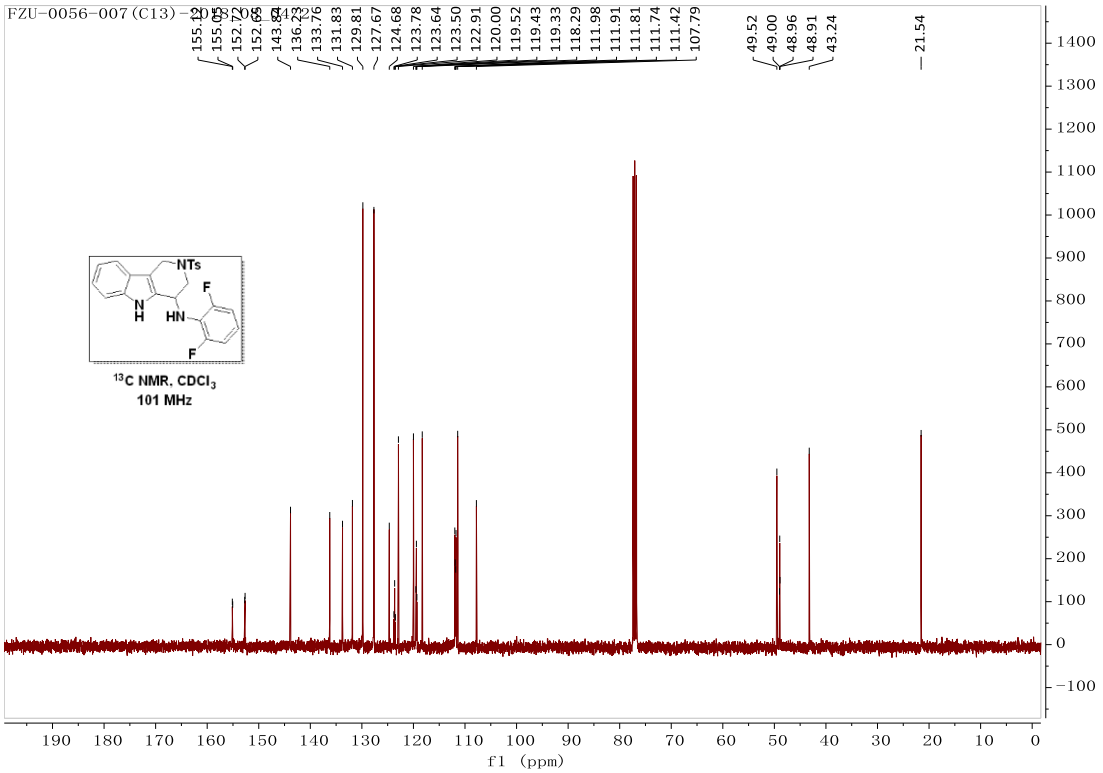
^{13}C NMR Spectrum of 26



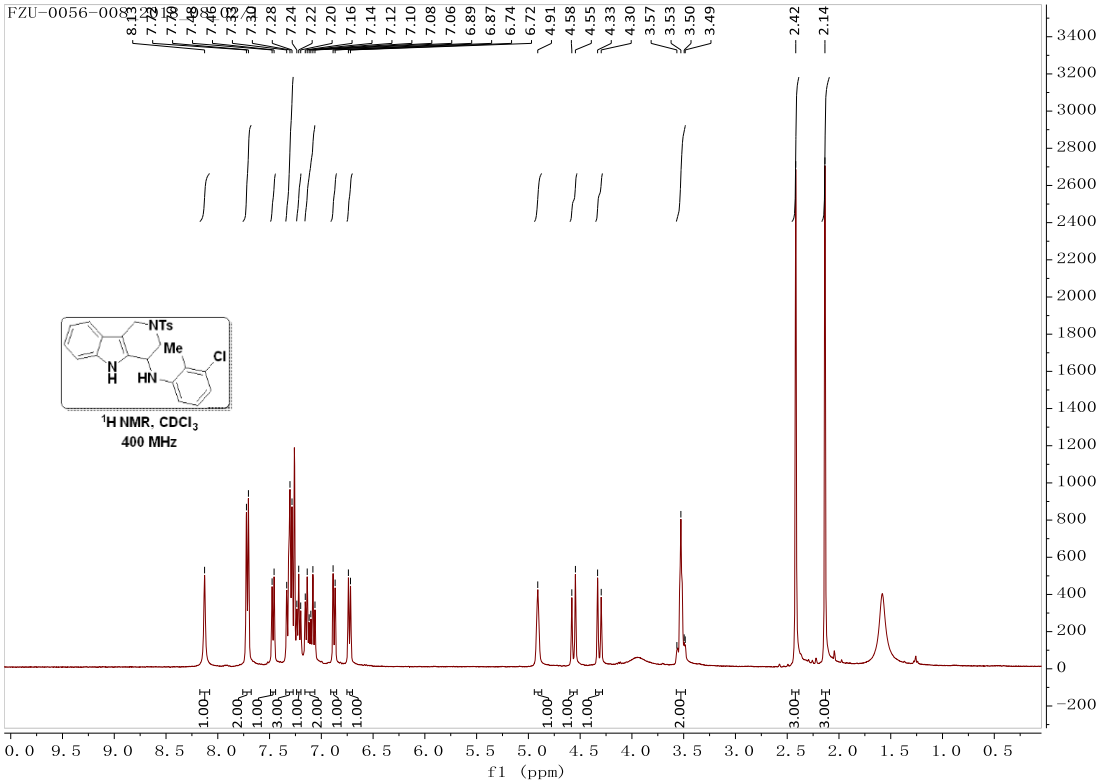
^{1}H NMR Spectrum of 27



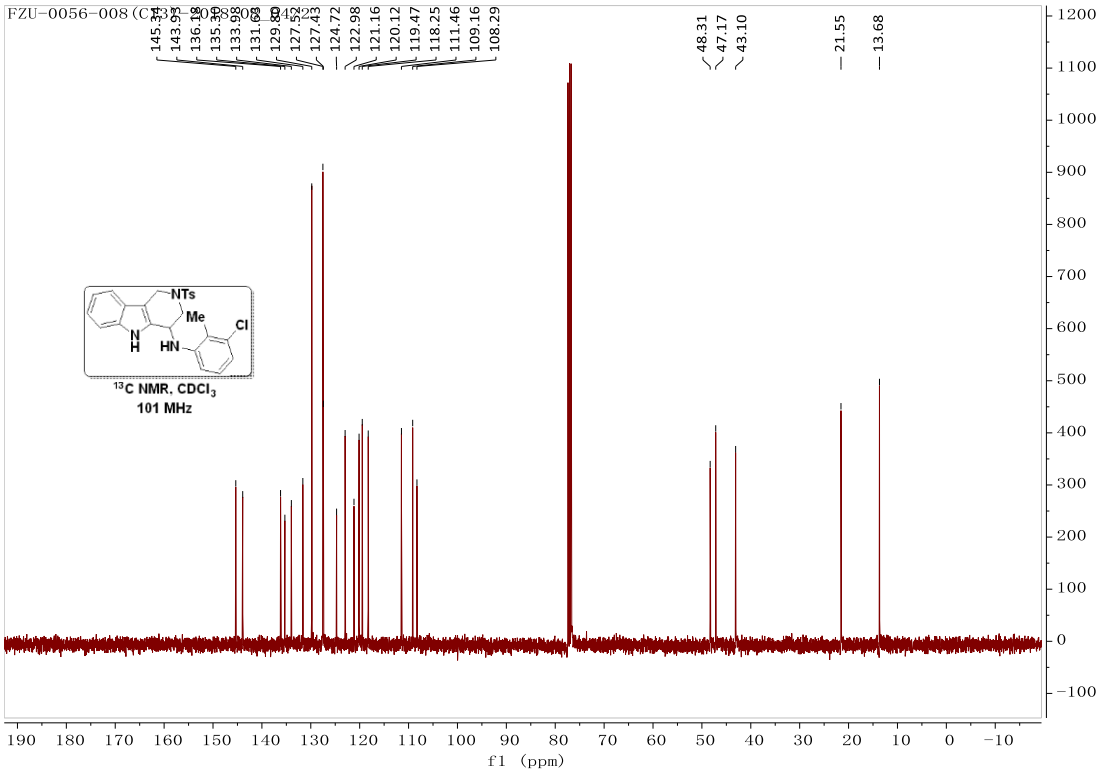
^{13}C NMR Spectrum of 27



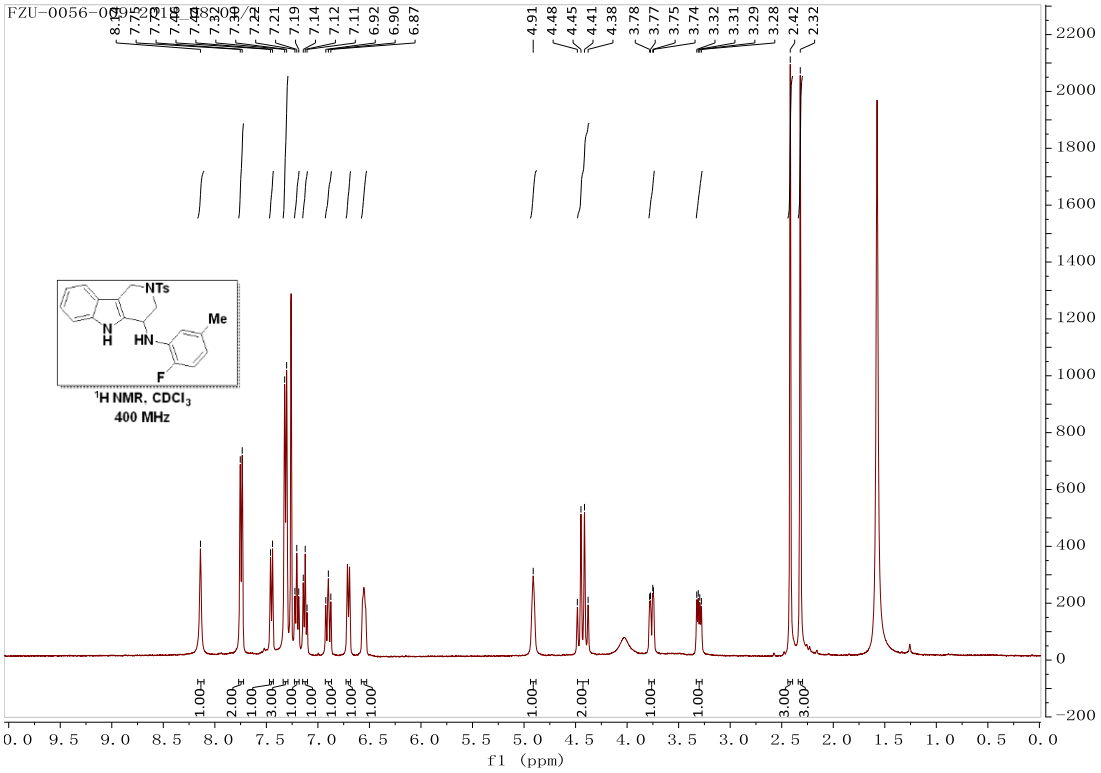
^{1}H NMR Spectrum of 28



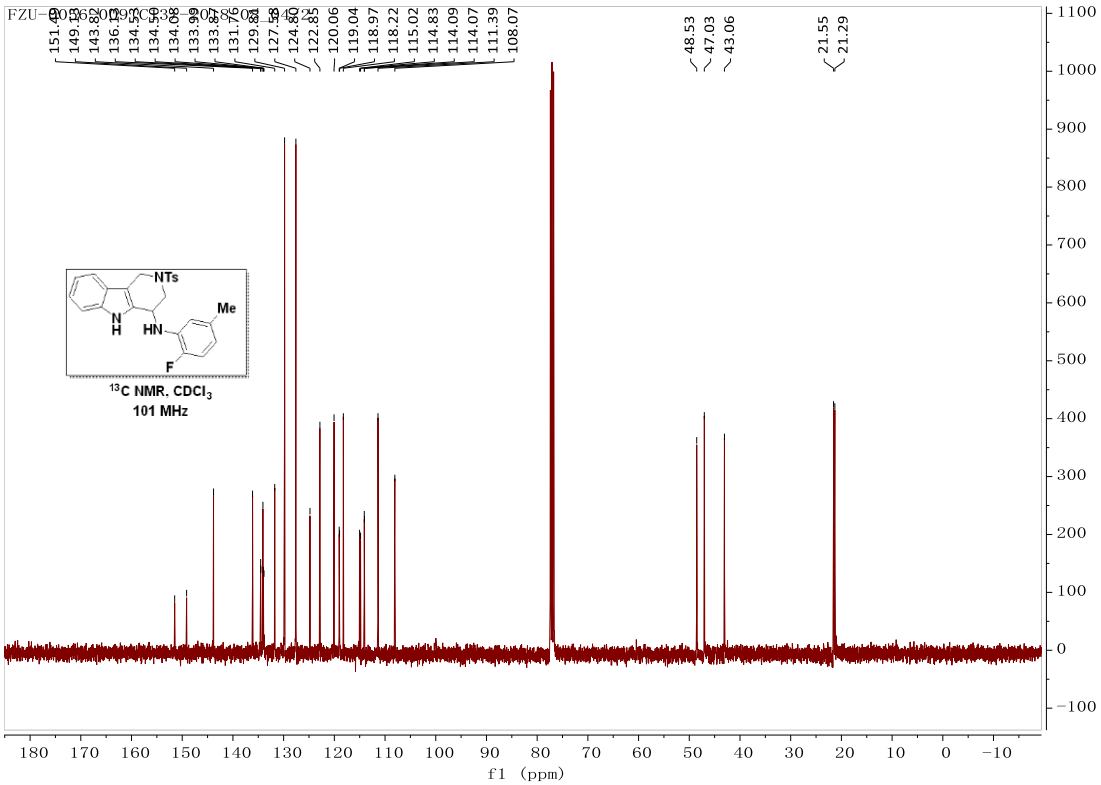
^{13}C NMR Spectrum of 28



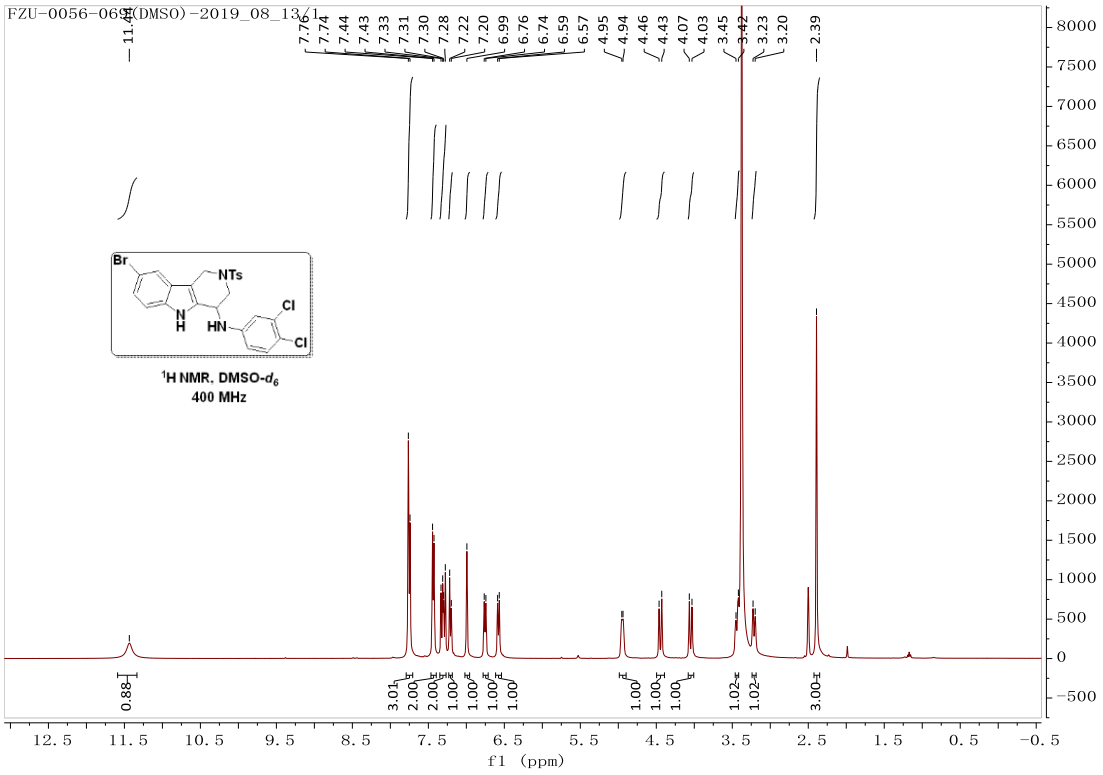
^{1}H NMR Spectrum of 29



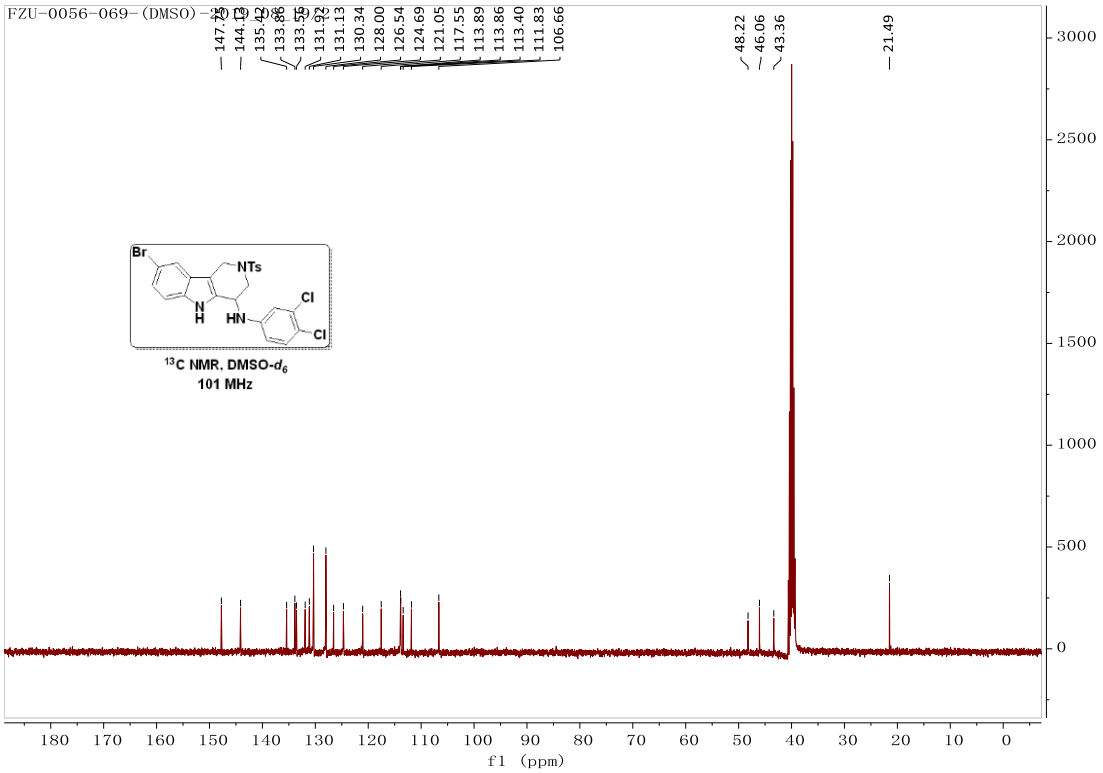
^{13}C NMR Spectrum of 29



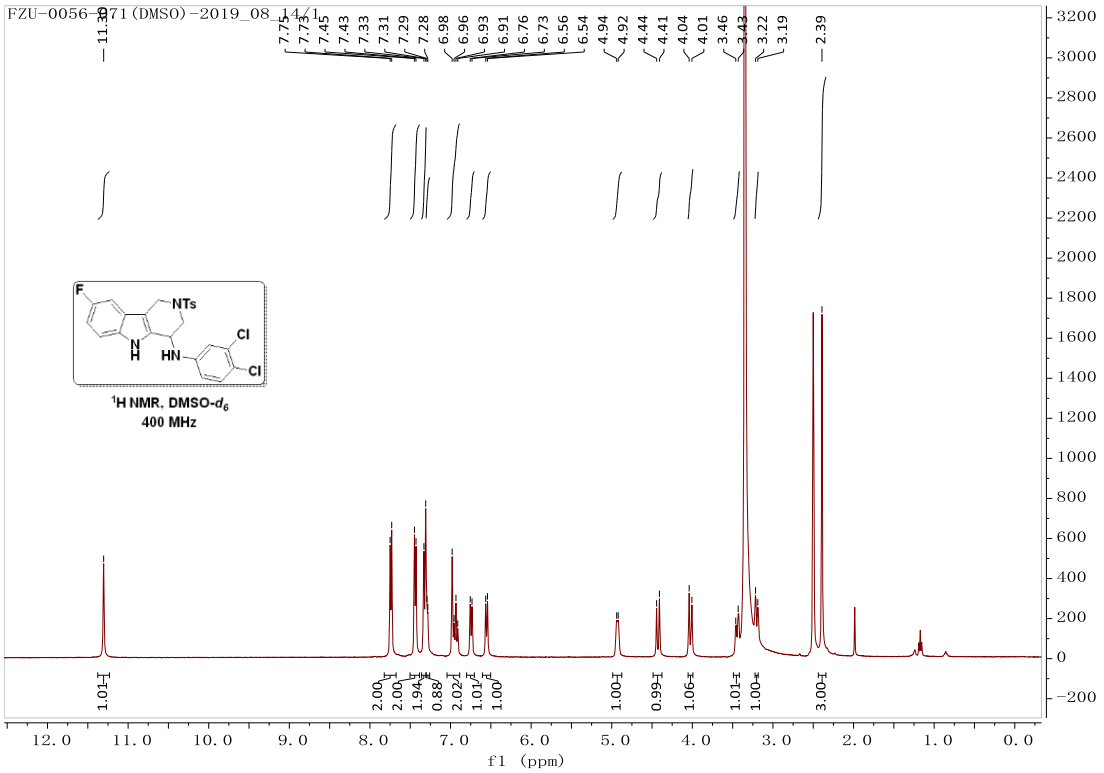
^{1}H NMR Spectrum of 30



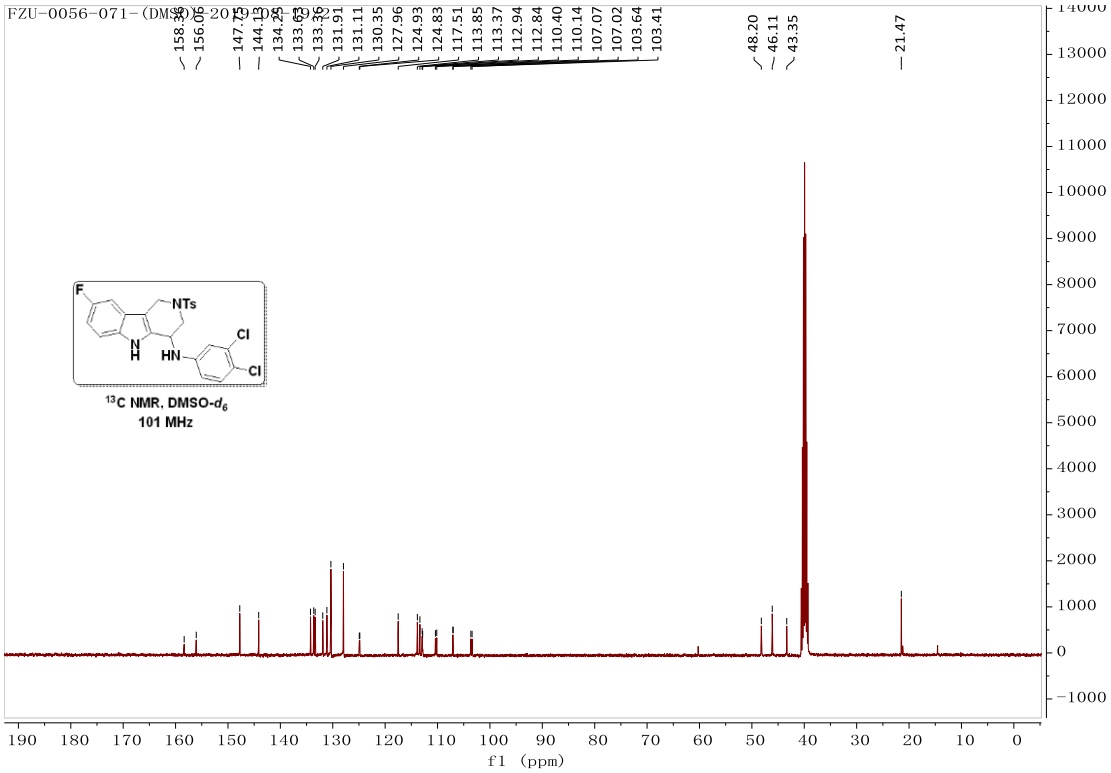
^{13}C NMR Spectrum of 30



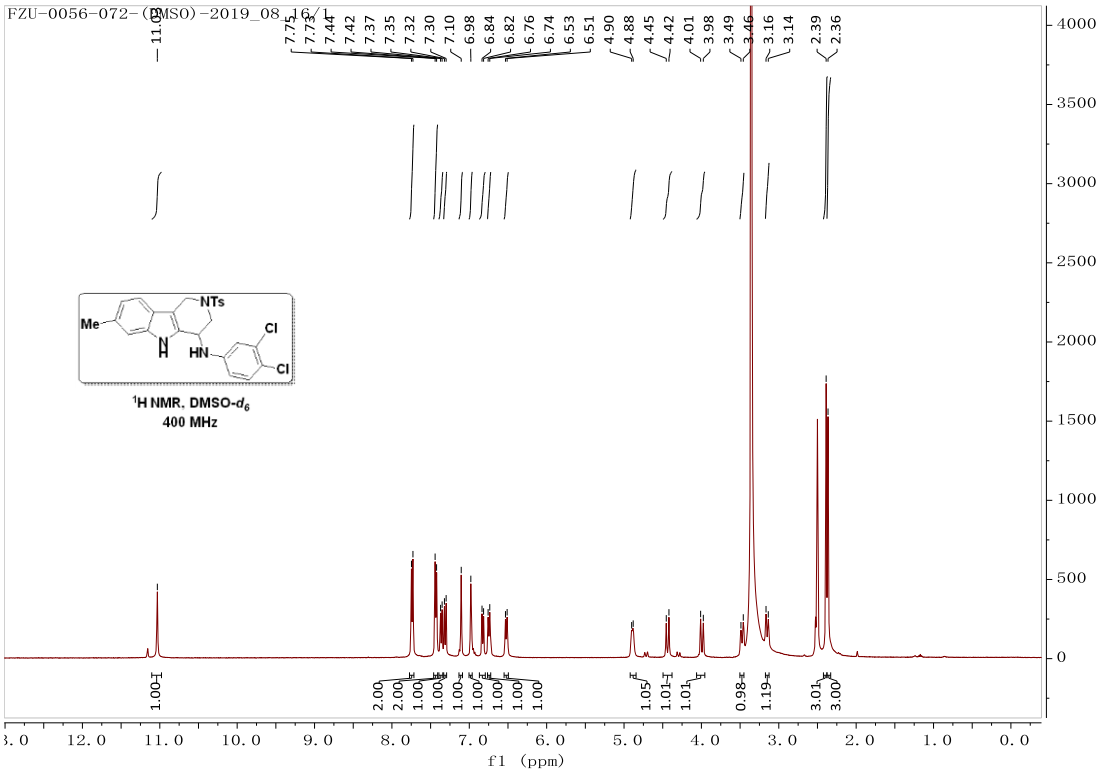
^{1}H NMR Spectrum of 31



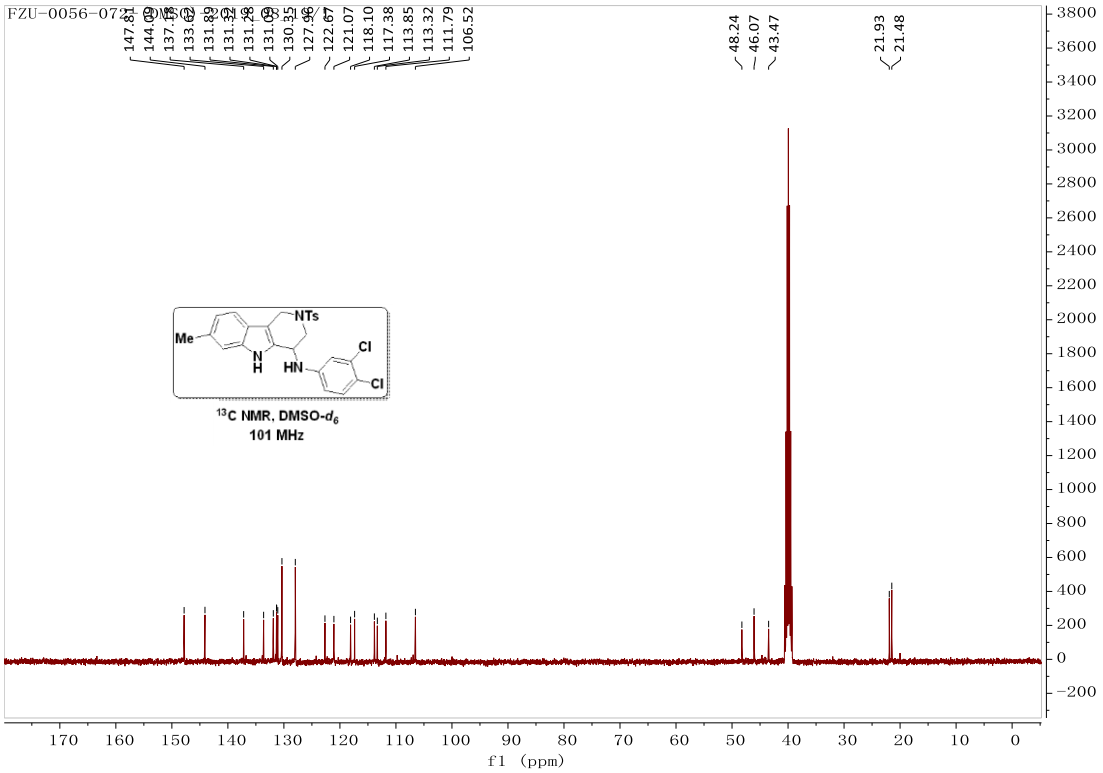
^{13}C NMR Spectrum of 31



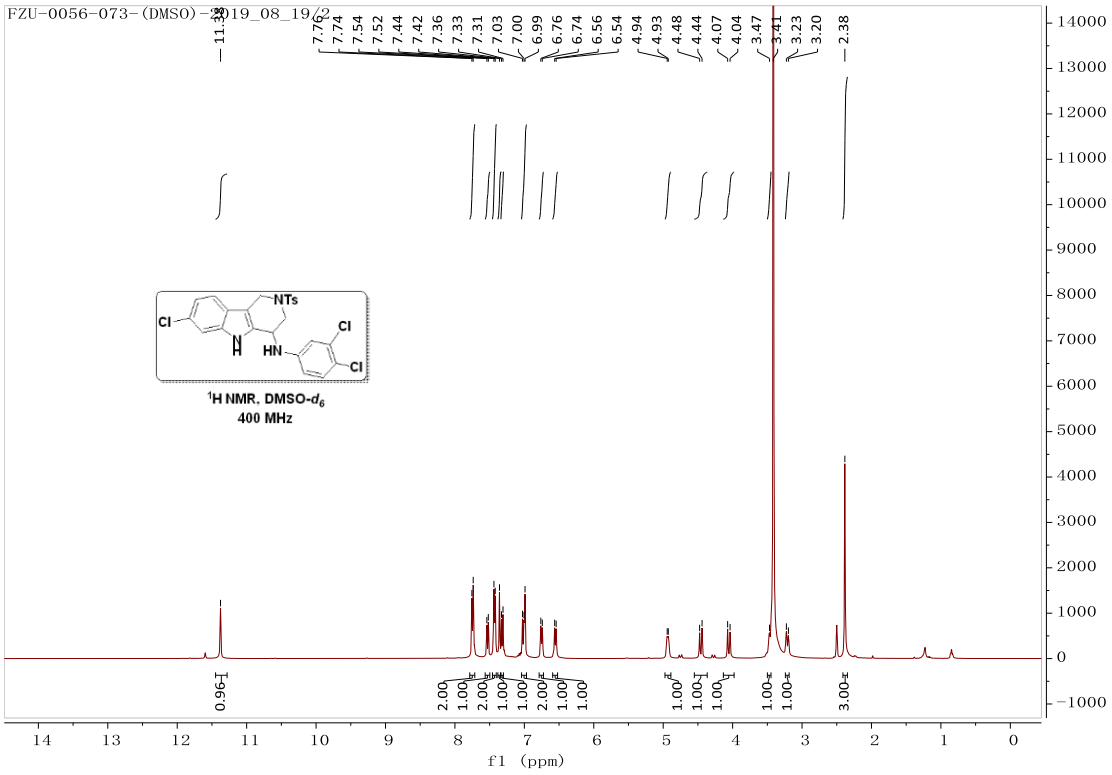
^{1}H NMR Spectrum of 32



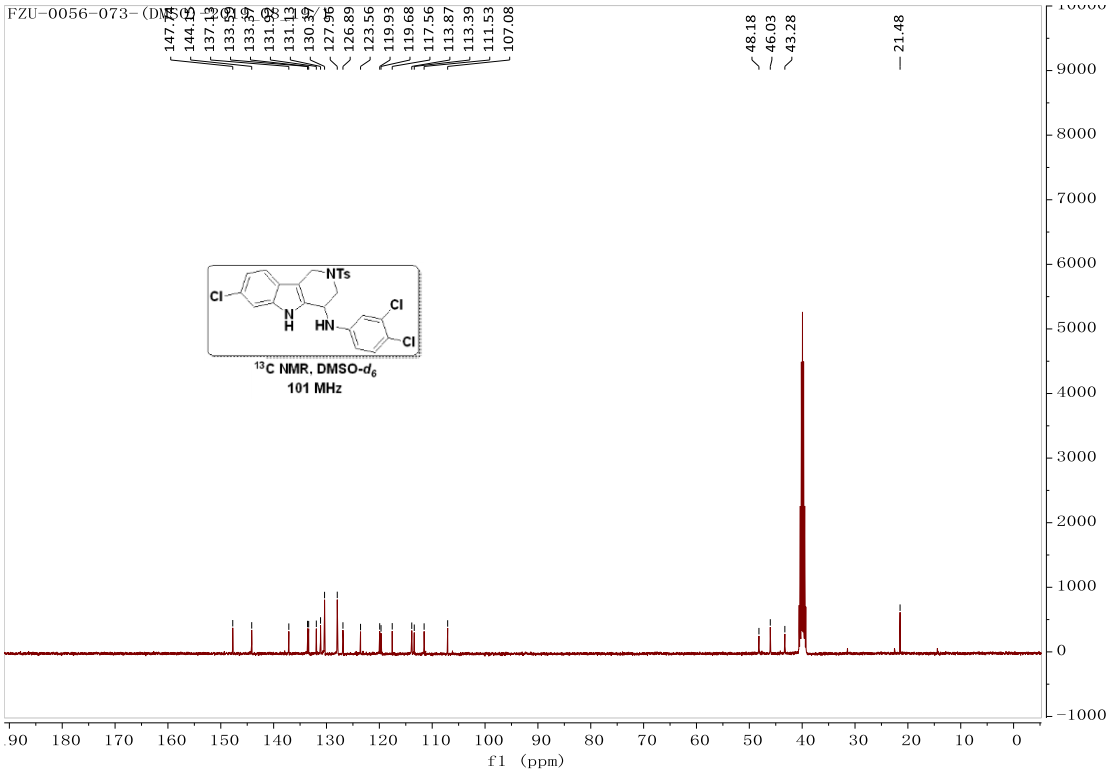
^{13}C NMR Spectrum of 32



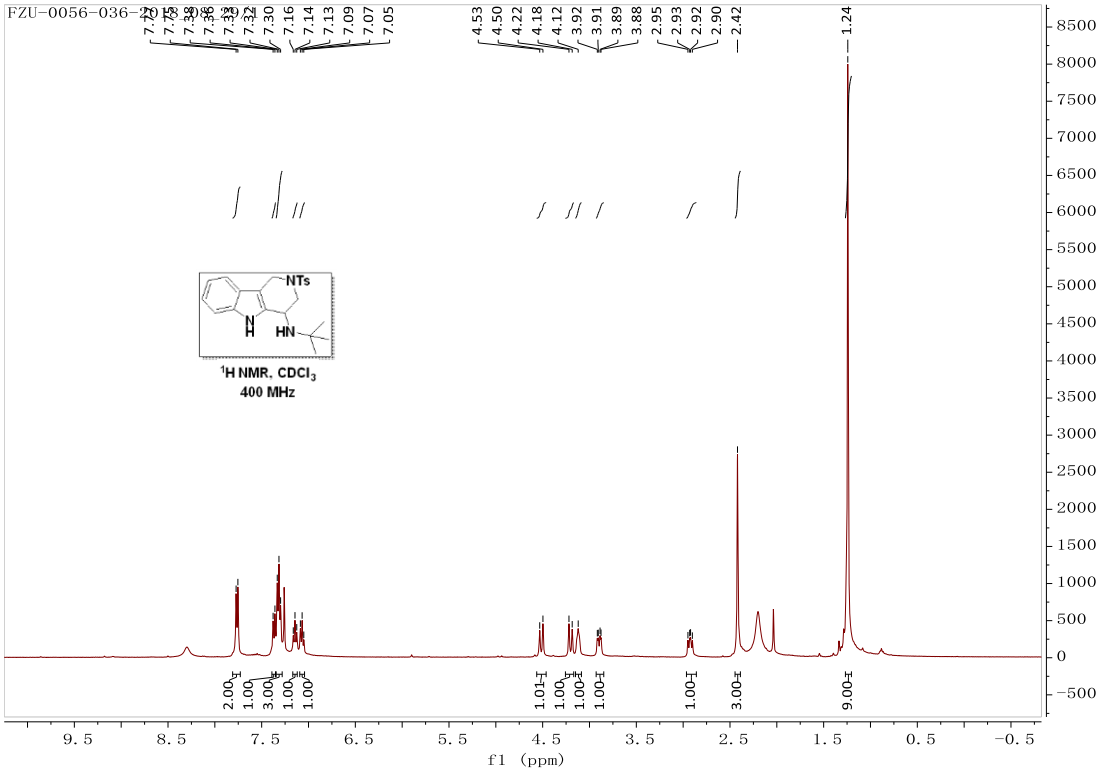
^{1}H NMR Spectrum of 33



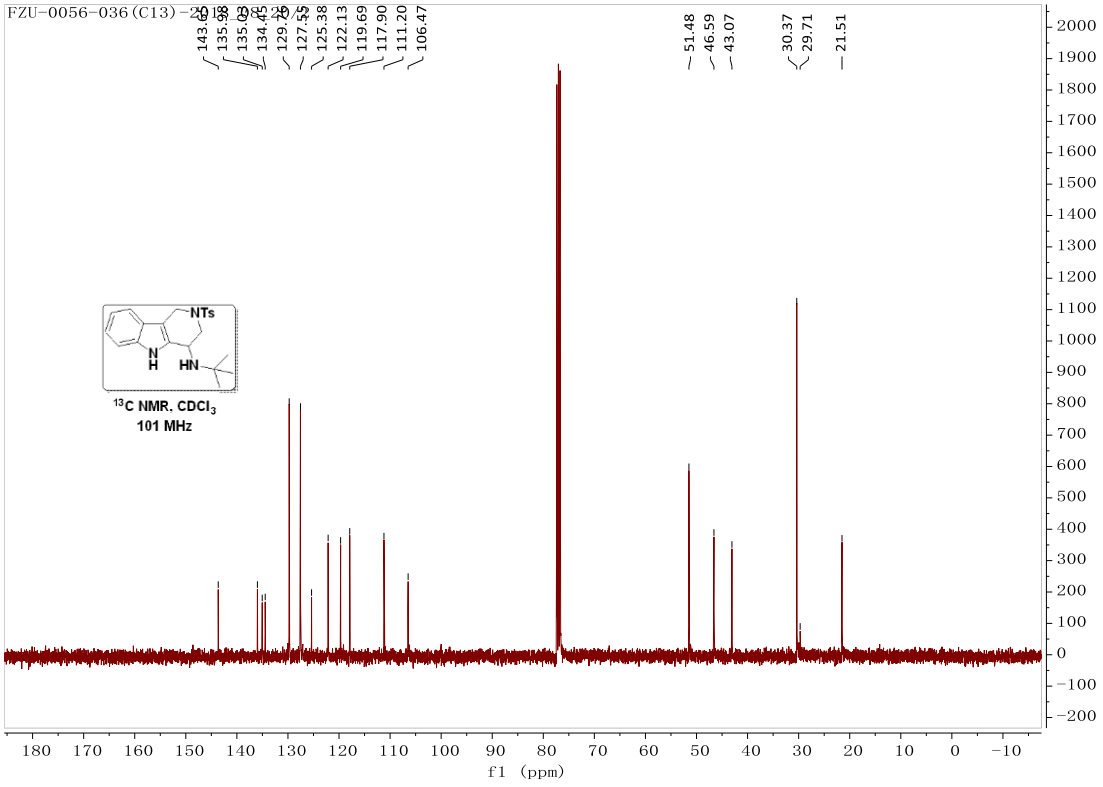
^{13}C NMR Spectrum of 33



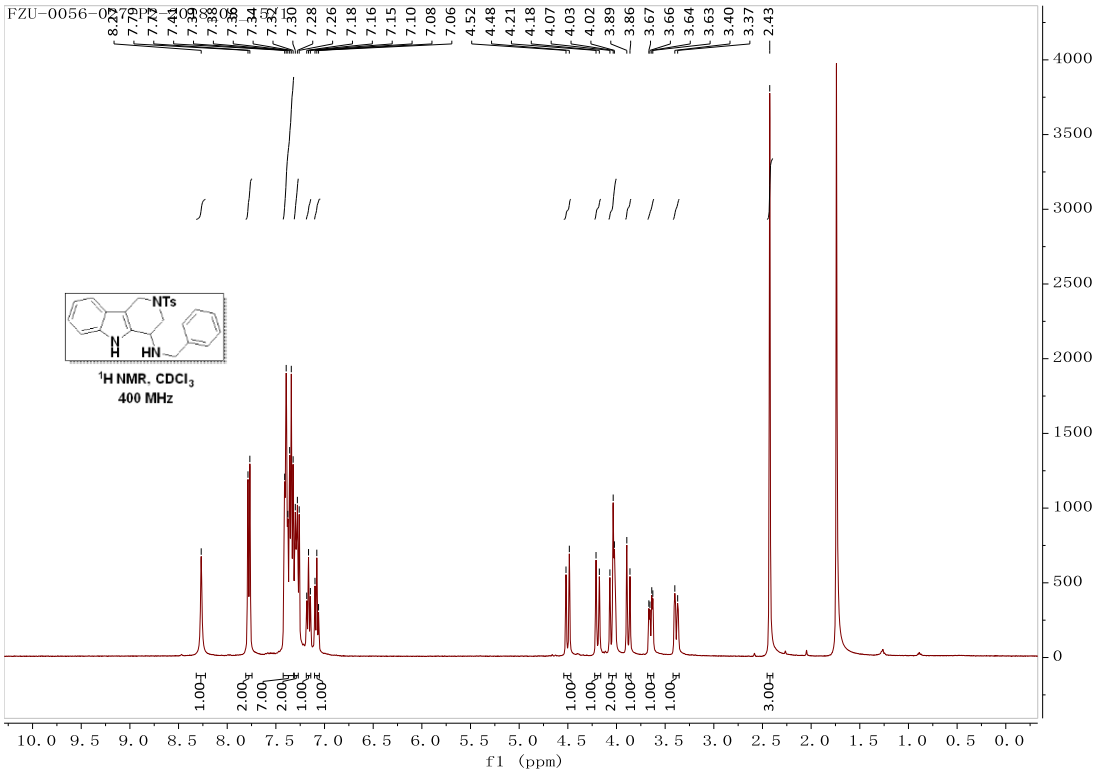
^{1}H NMR Spectrum of 34



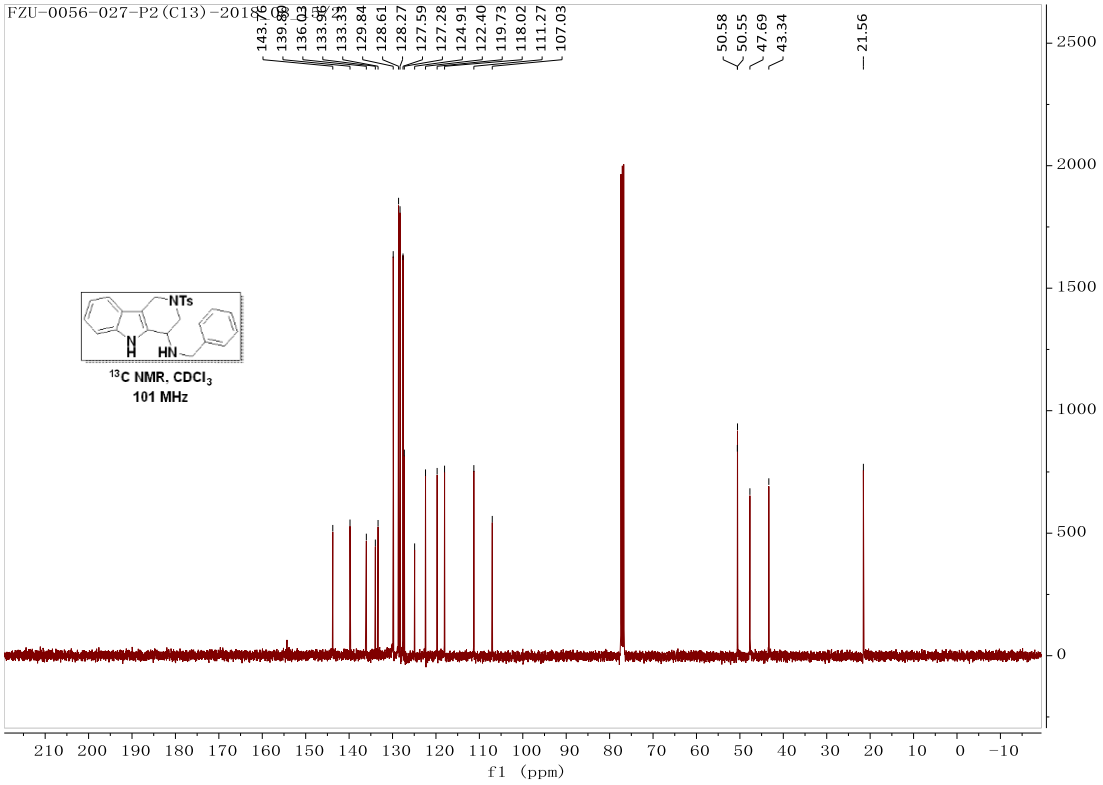
^{13}C NMR Spectrum of 34



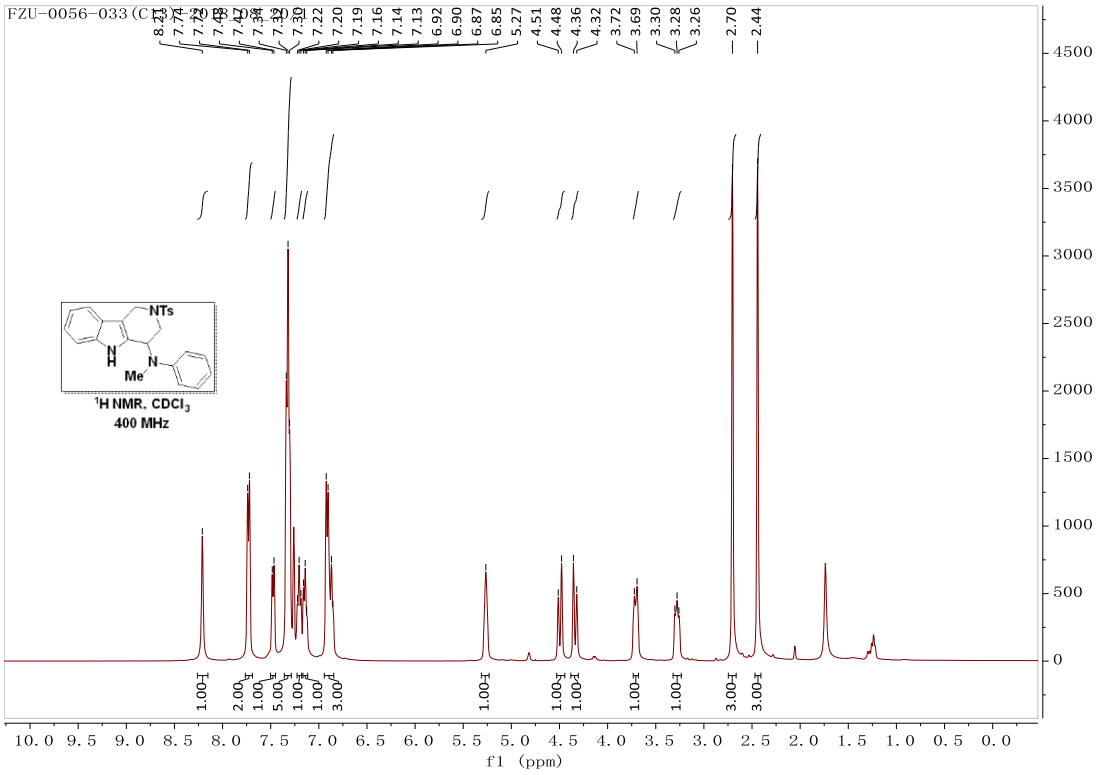
^{1}H NMR Spectrum of 35



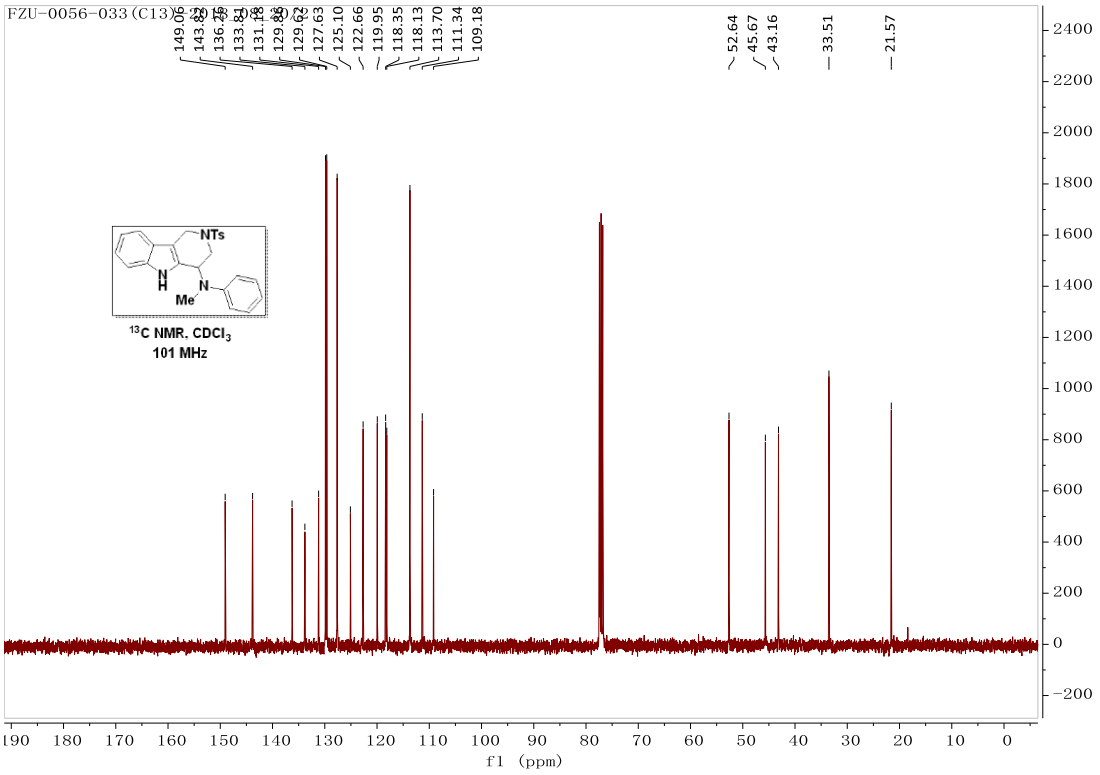
^{13}C NMR Spectrum of 35



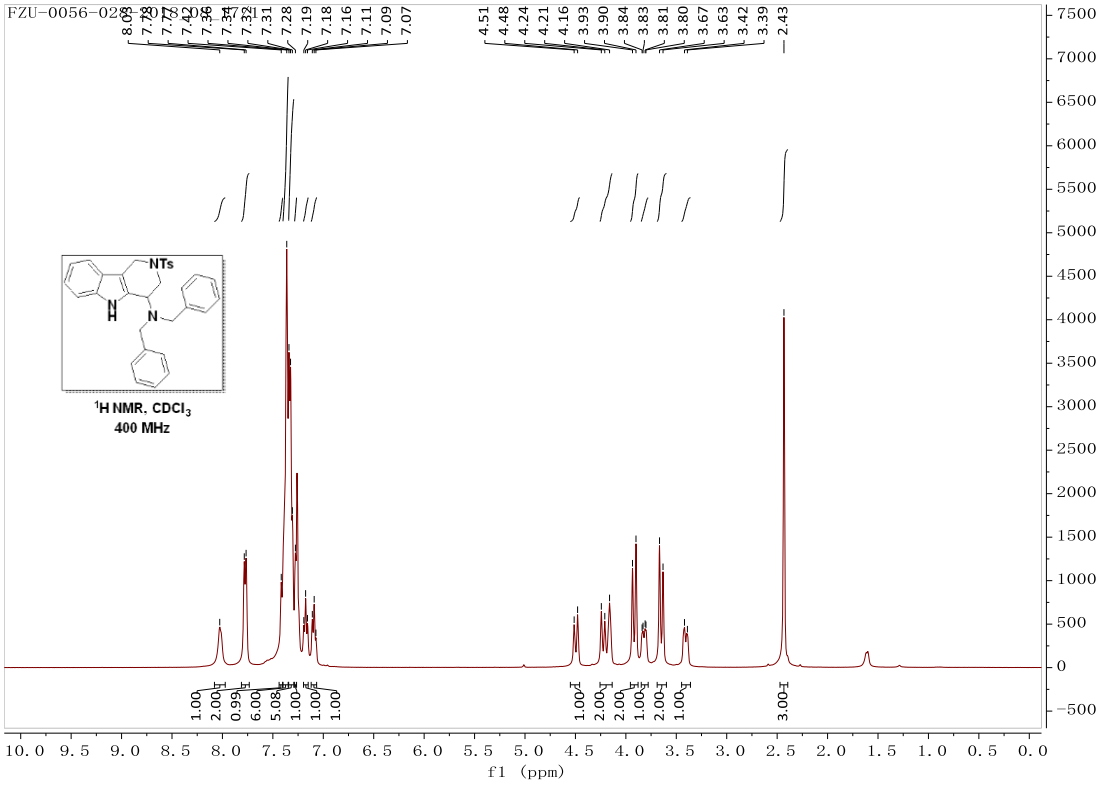
^{1}H NMR Spectrum of 36



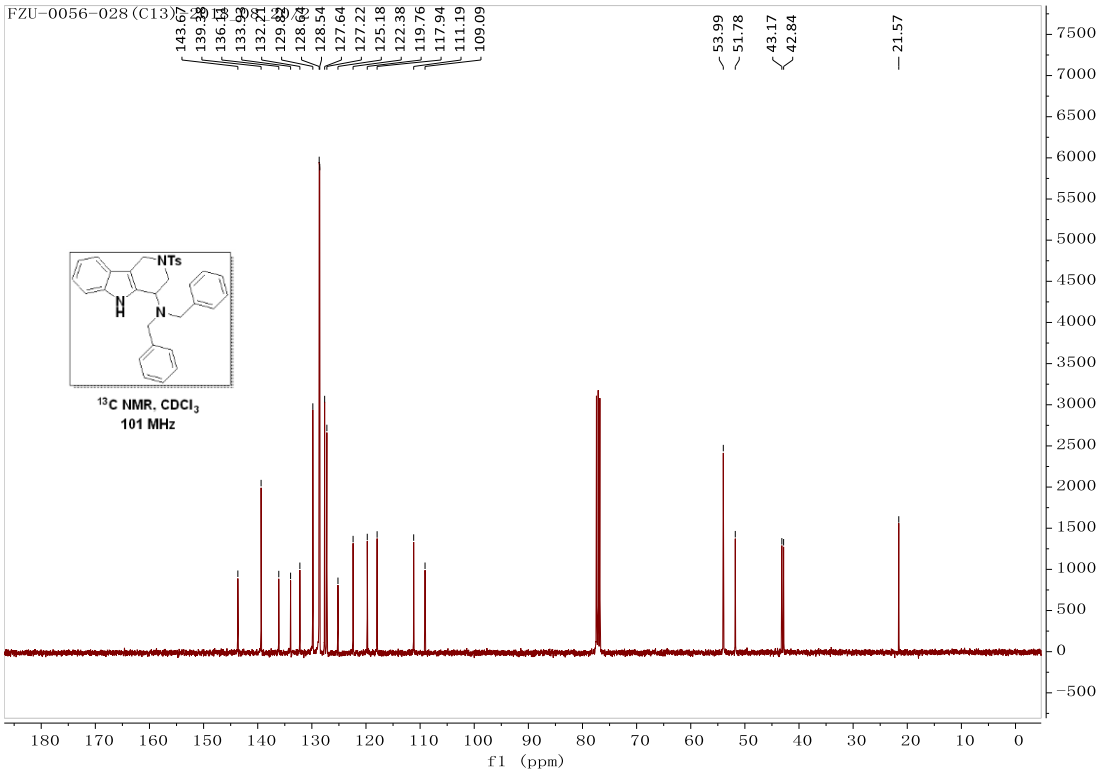
^{13}C NMR Spectrum of 36



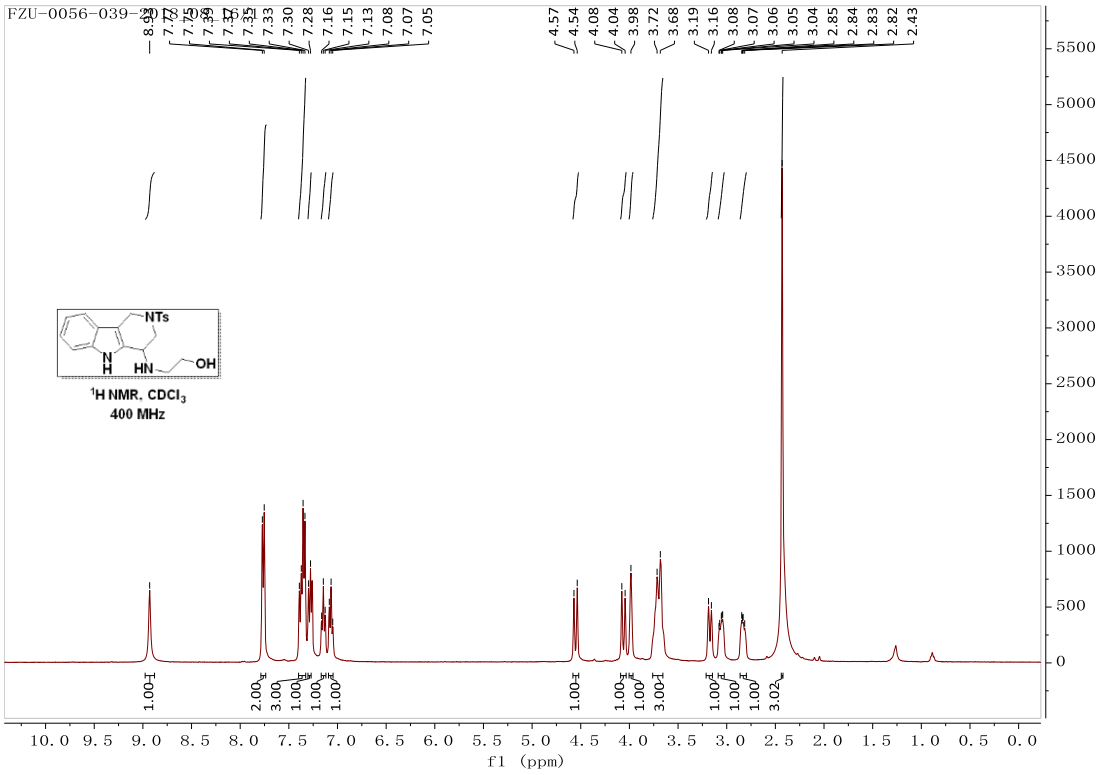
^{1}H NMR Spectrum of 37



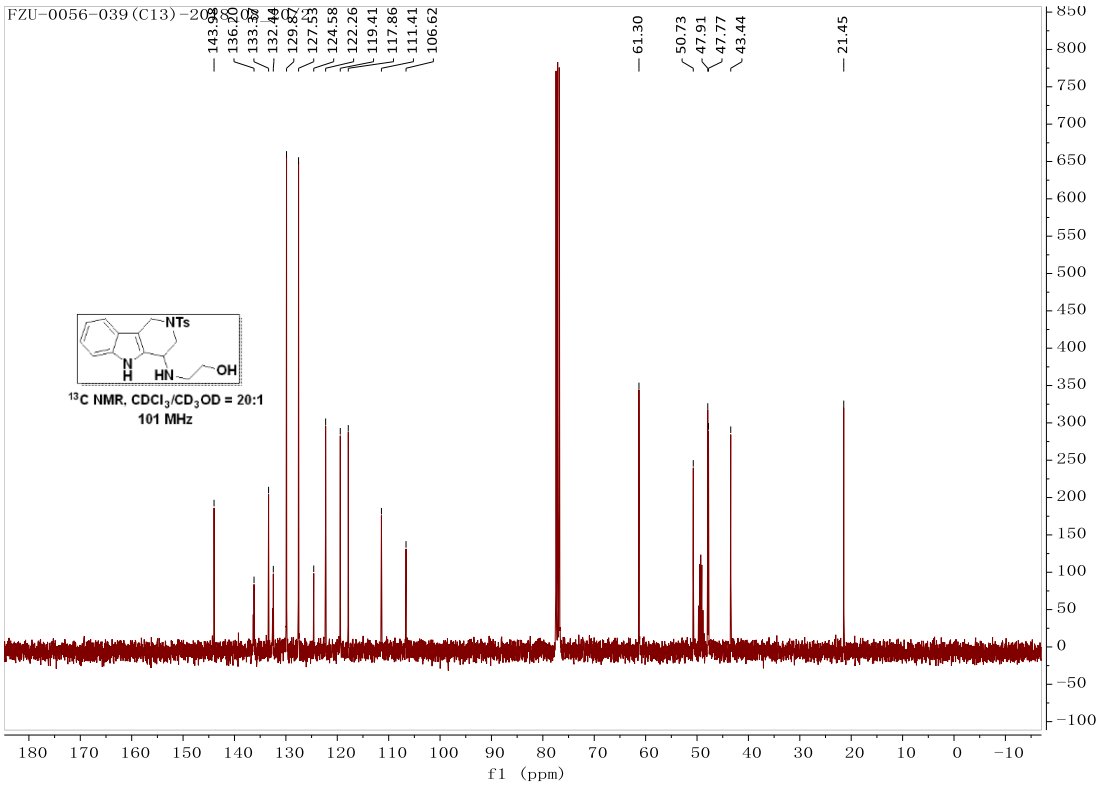
^{13}C NMR Spectrum of 37



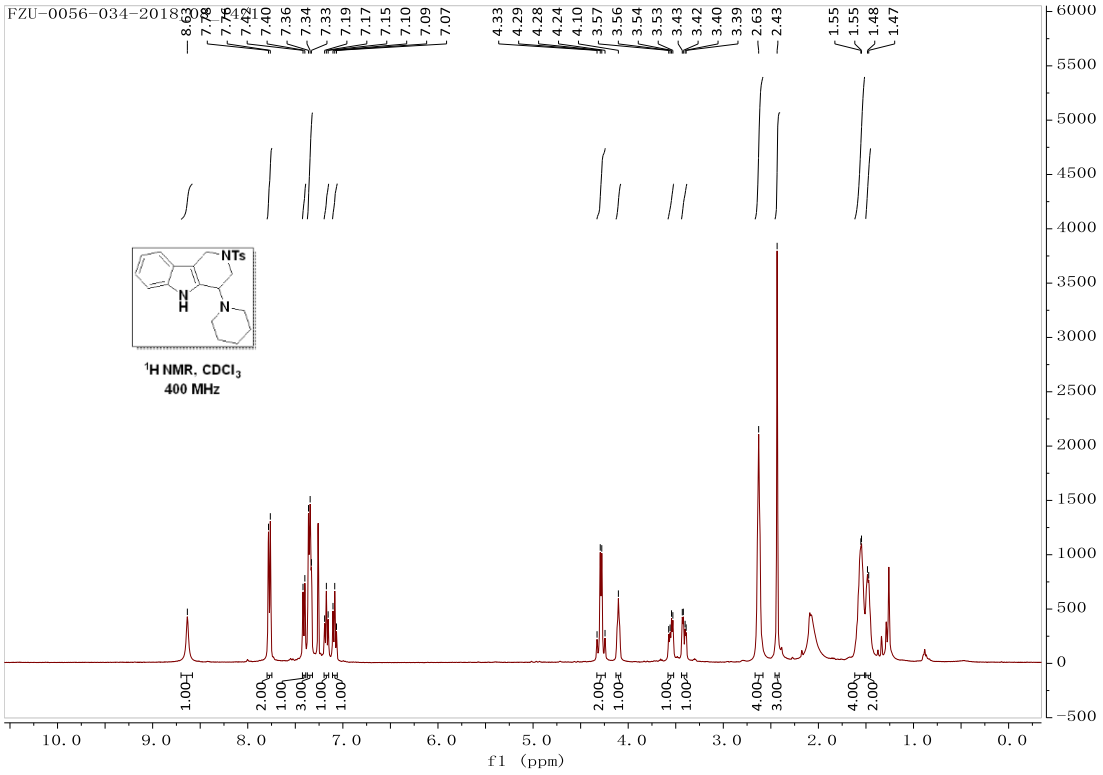
^{1}H NMR Spectrum of 38



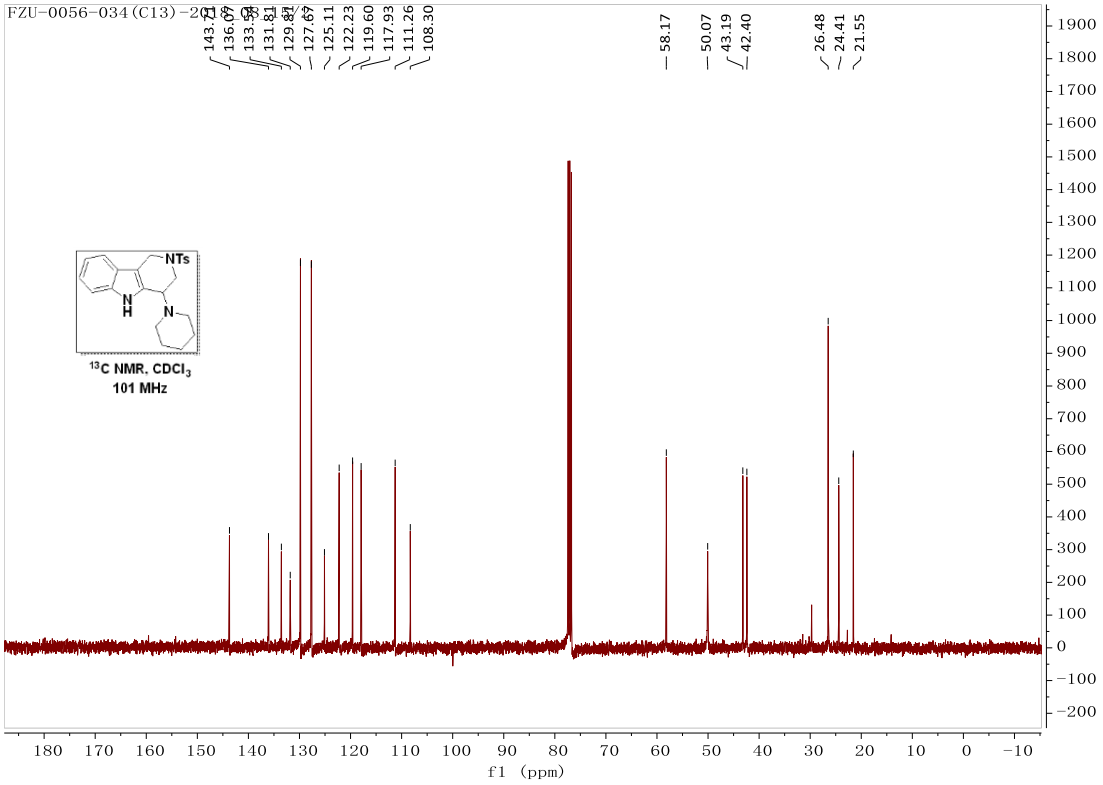
^{13}C NMR Spectrum of 38



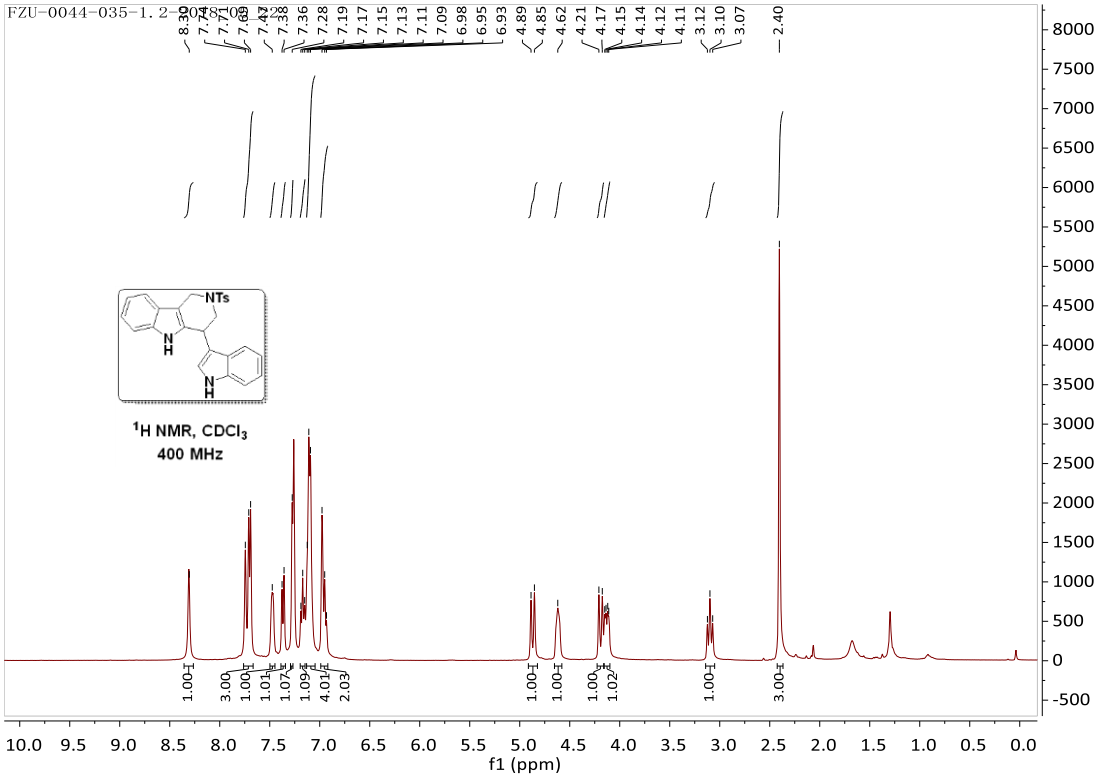
^{1}H NMR Spectrum of 39



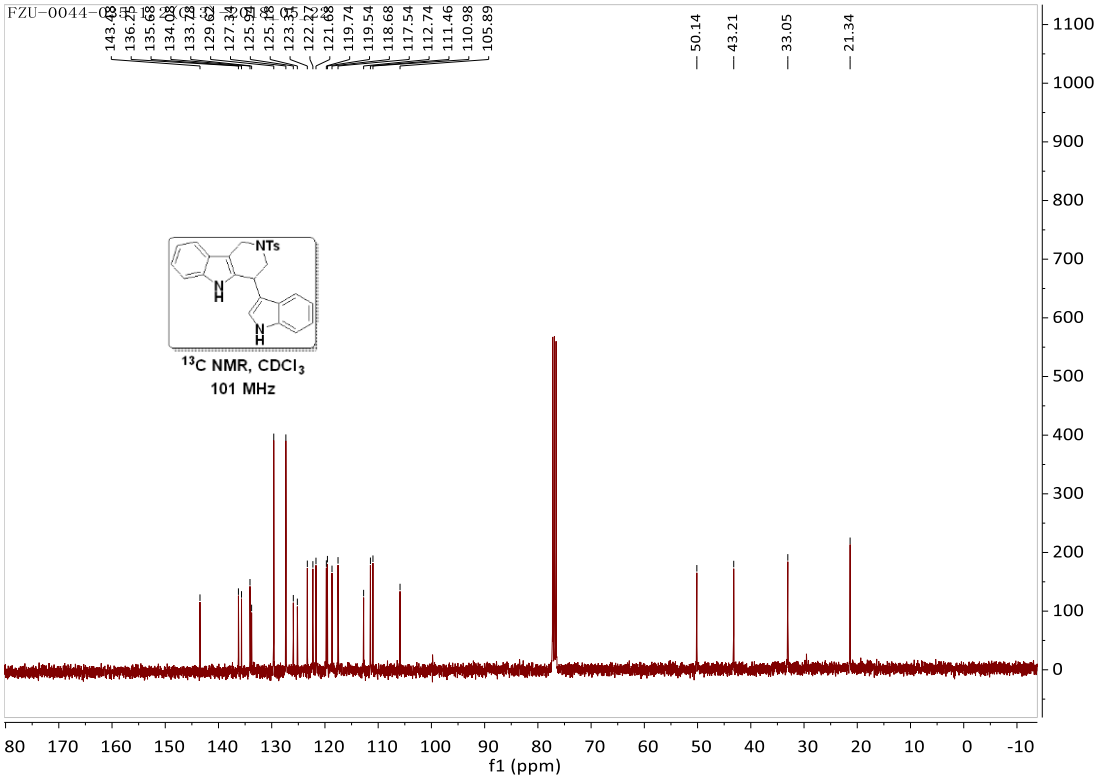
^{13}C NMR Spectrum of 39



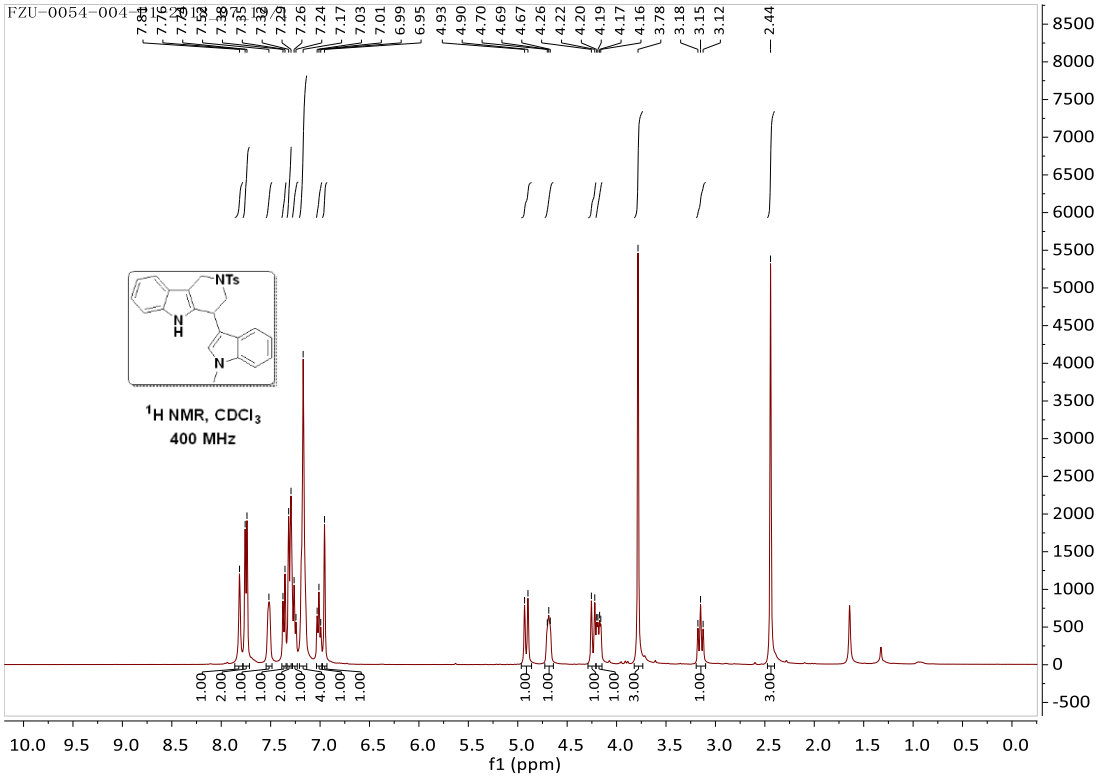
^{1}H NMR Spectrum of 40



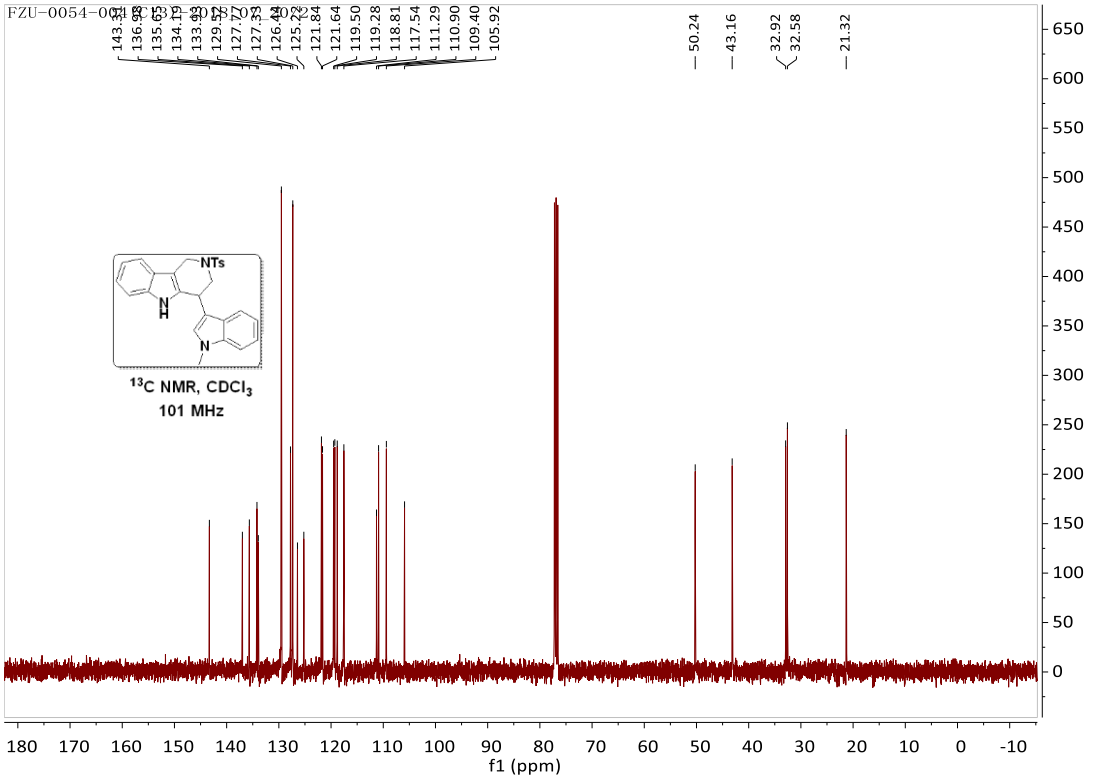
^{13}C NMR Spectrum of 40



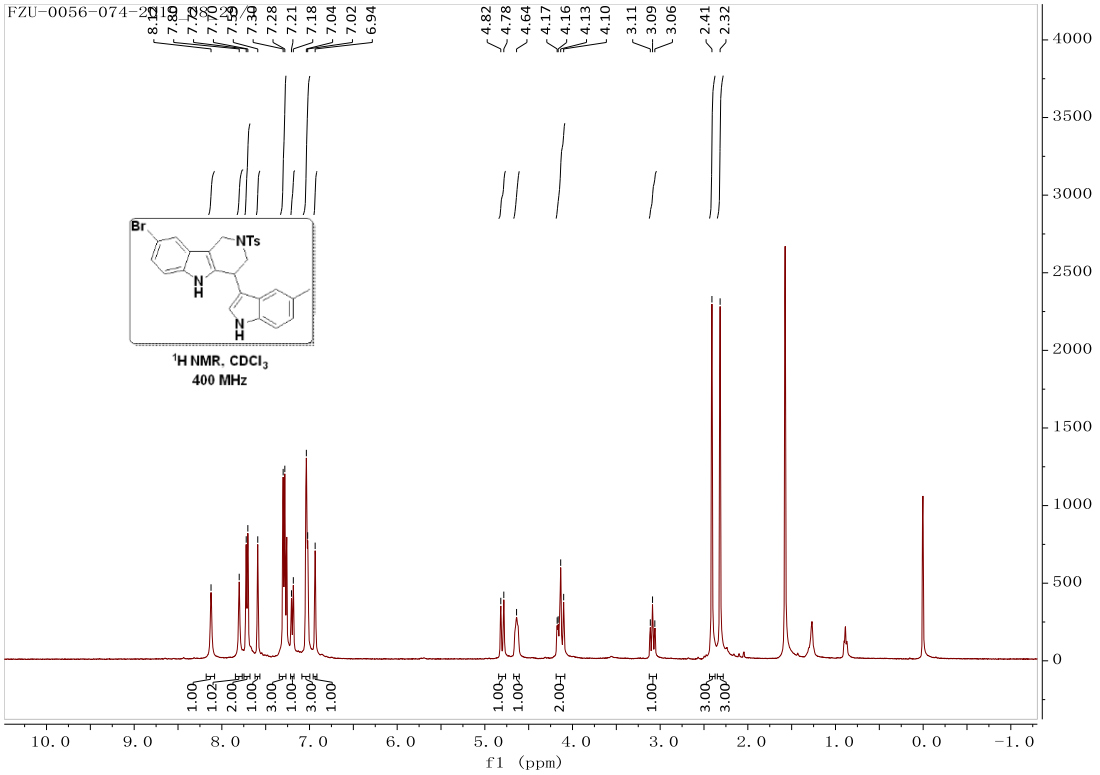
^{1}H NMR Spectrum of 41



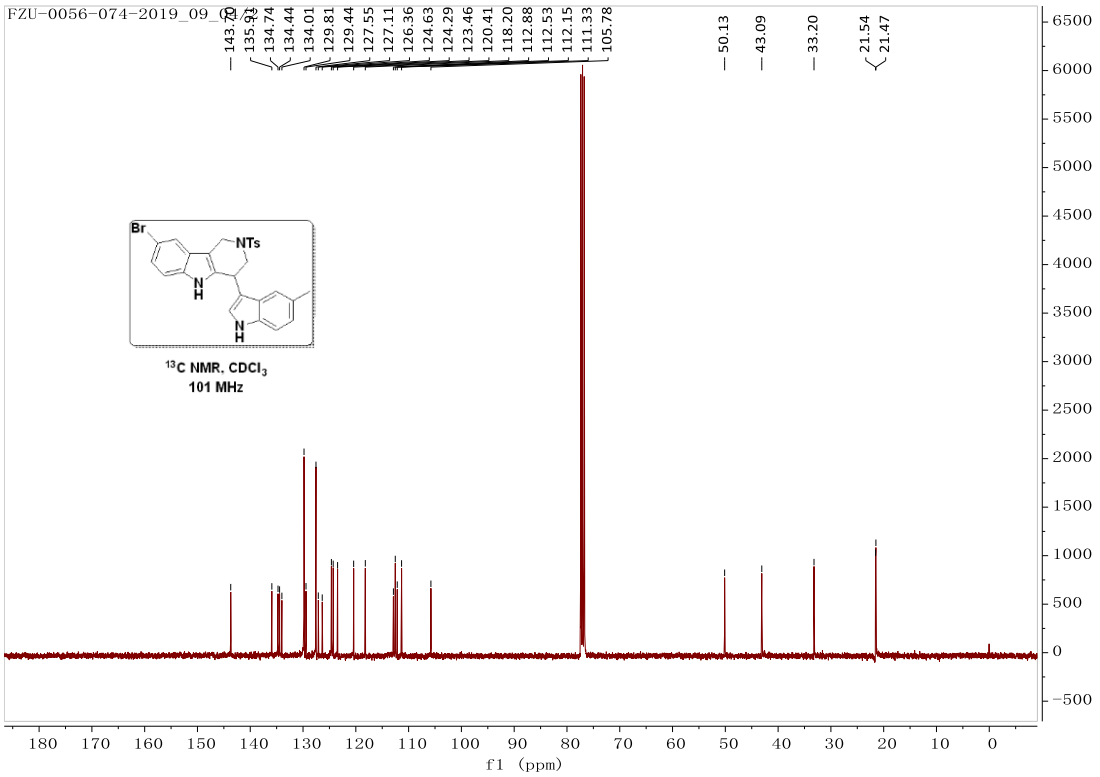
^{13}C NMR Spectrum of 41



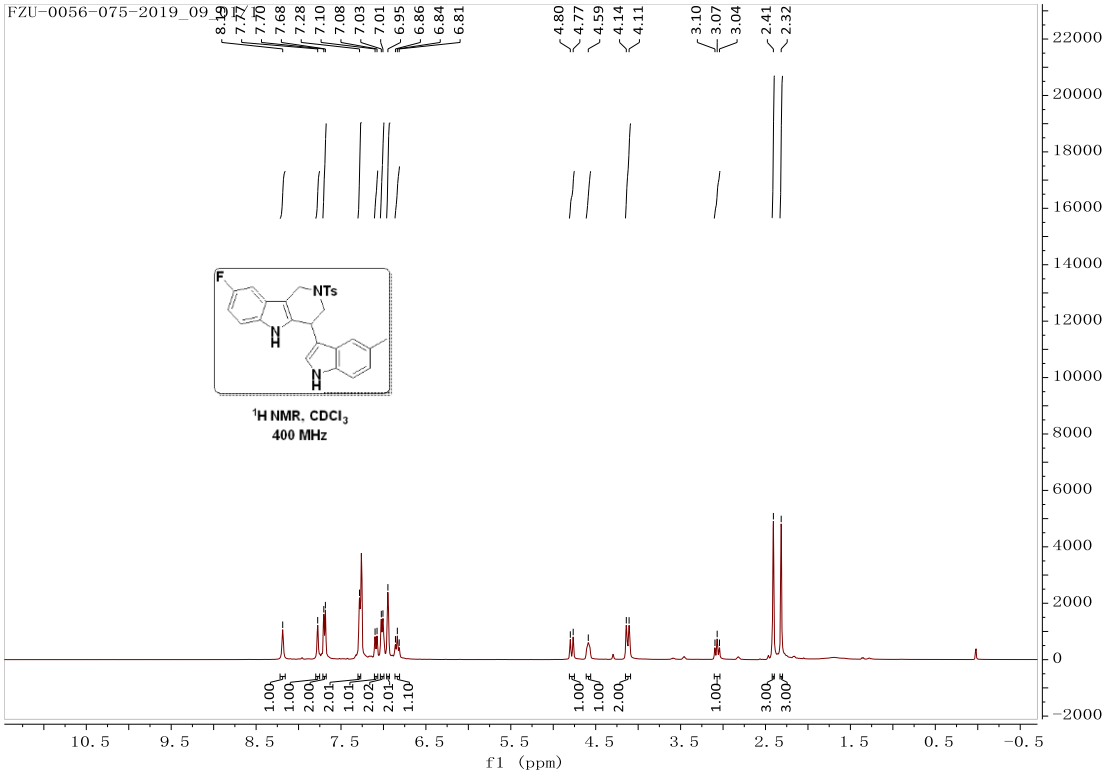
^{1}H NMR Spectrum of 42



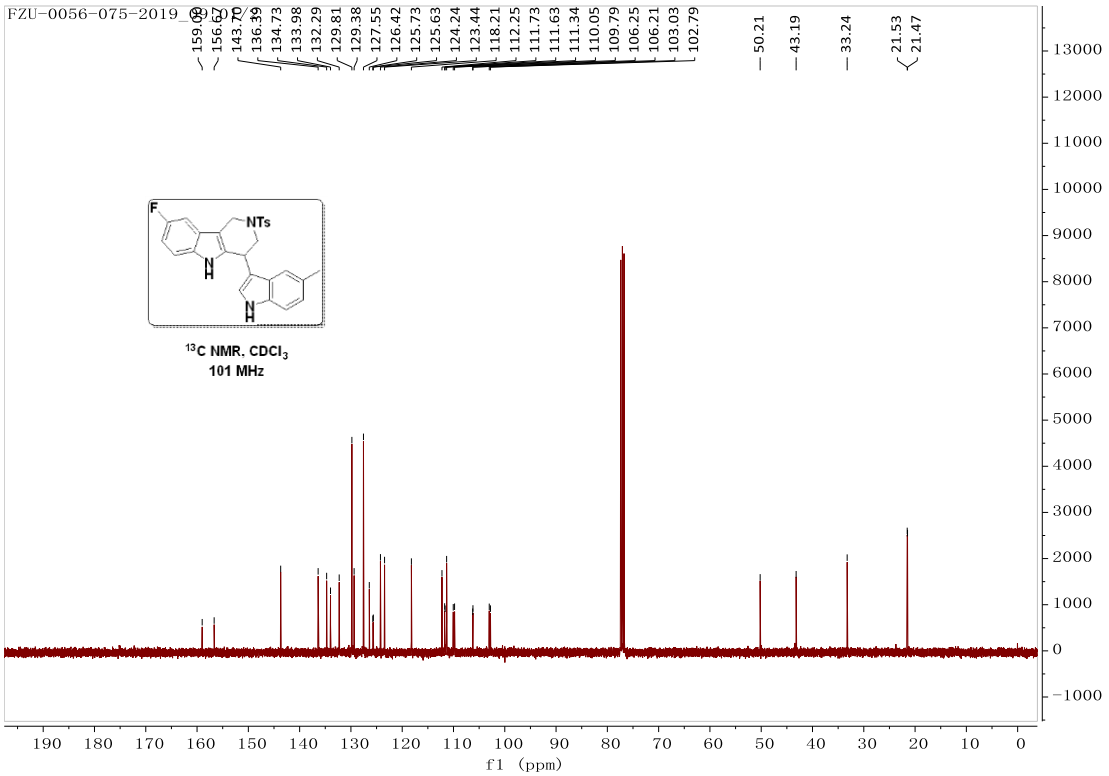
^{13}C NMR Spectrum of 42



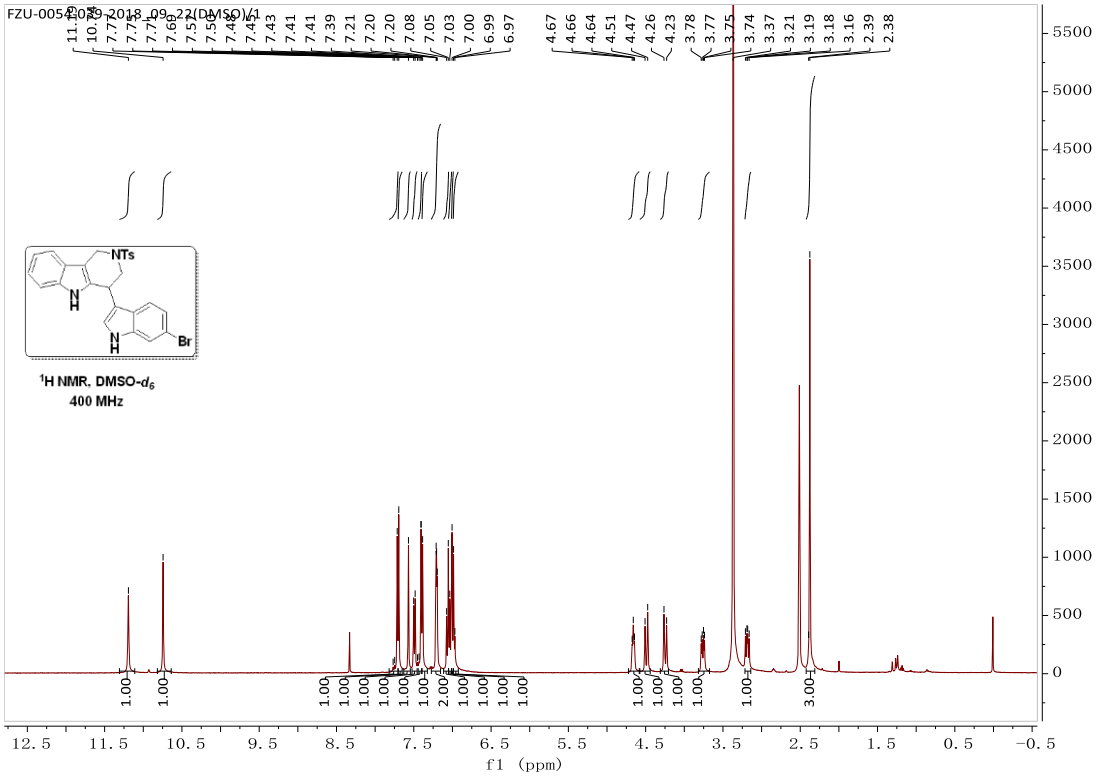
^{1}H NMR Spectrum of 43



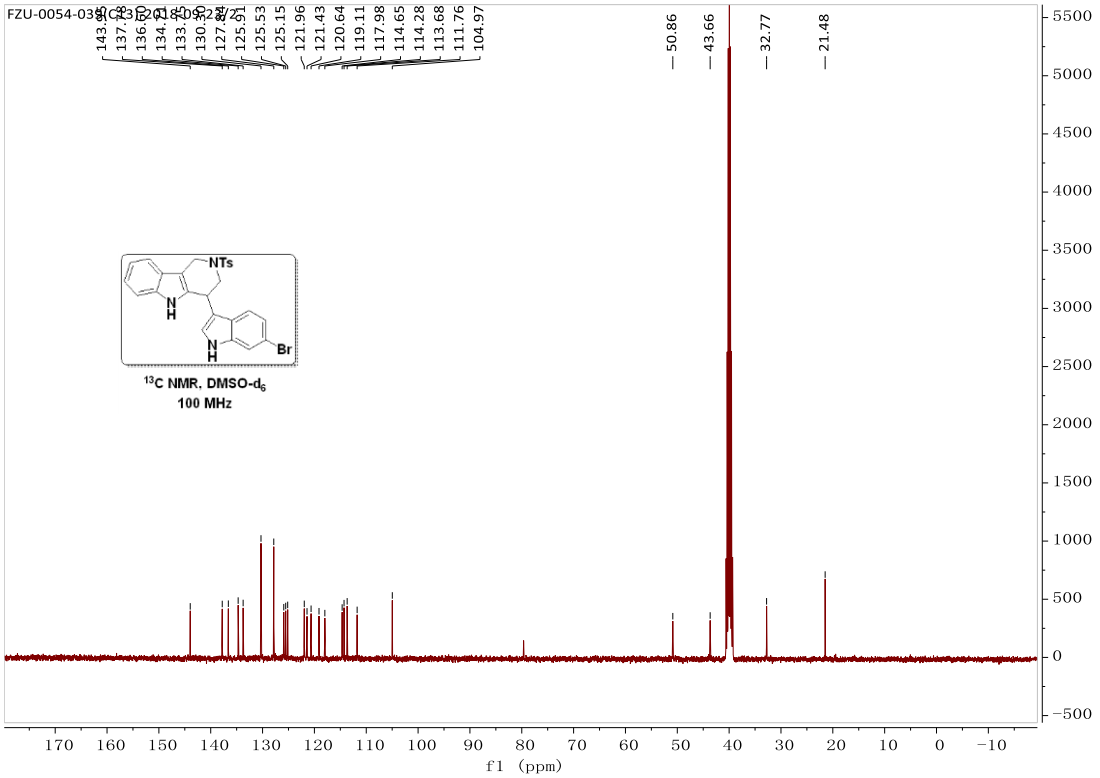
^{13}C NMR Spectrum of 43



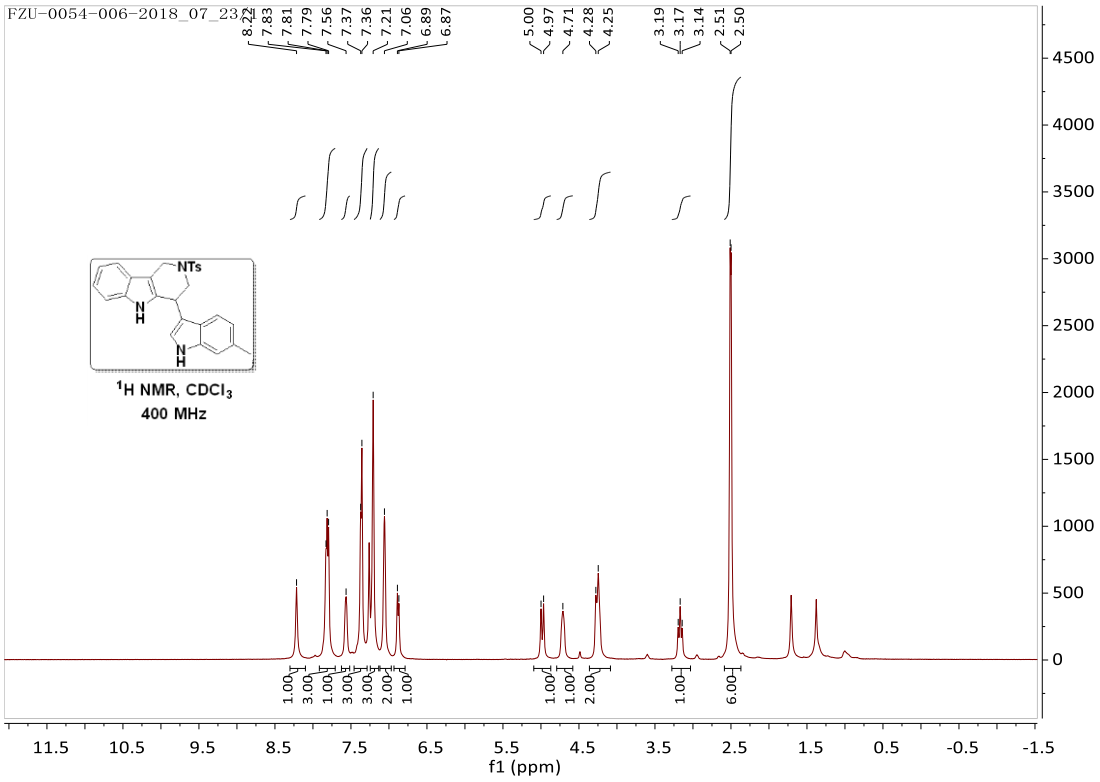
^{1}H NMR Spectrum of 44



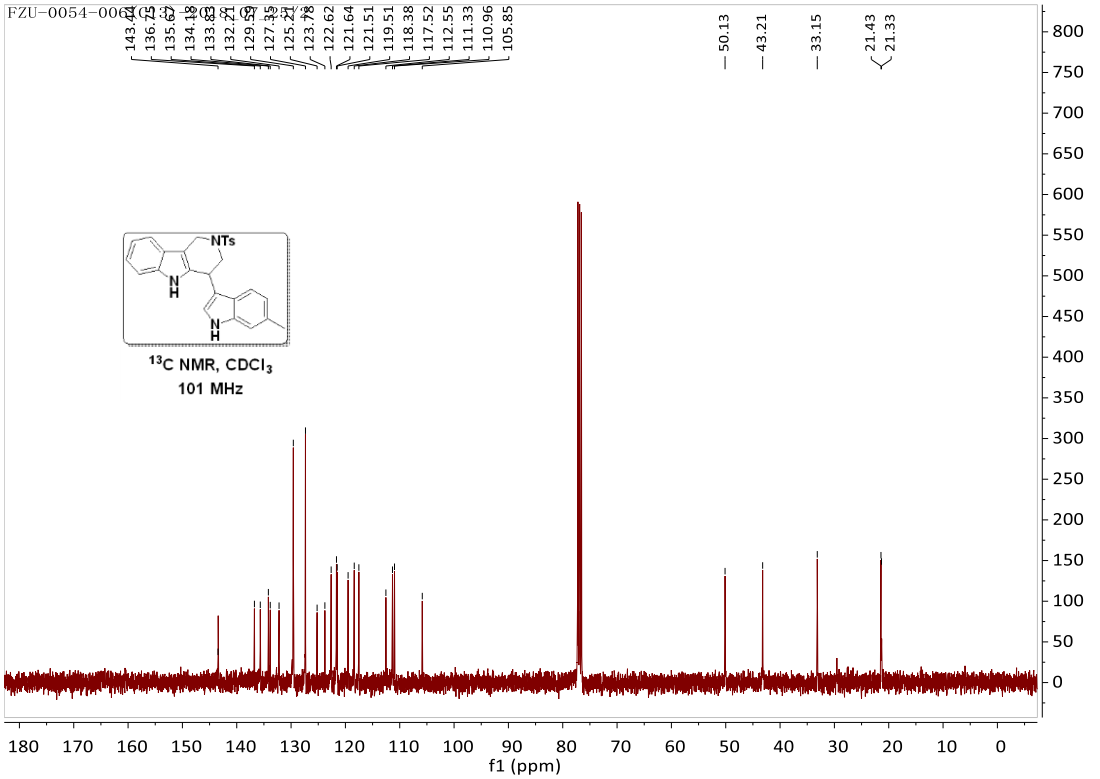
^{13}C NMR Spectrum of 44



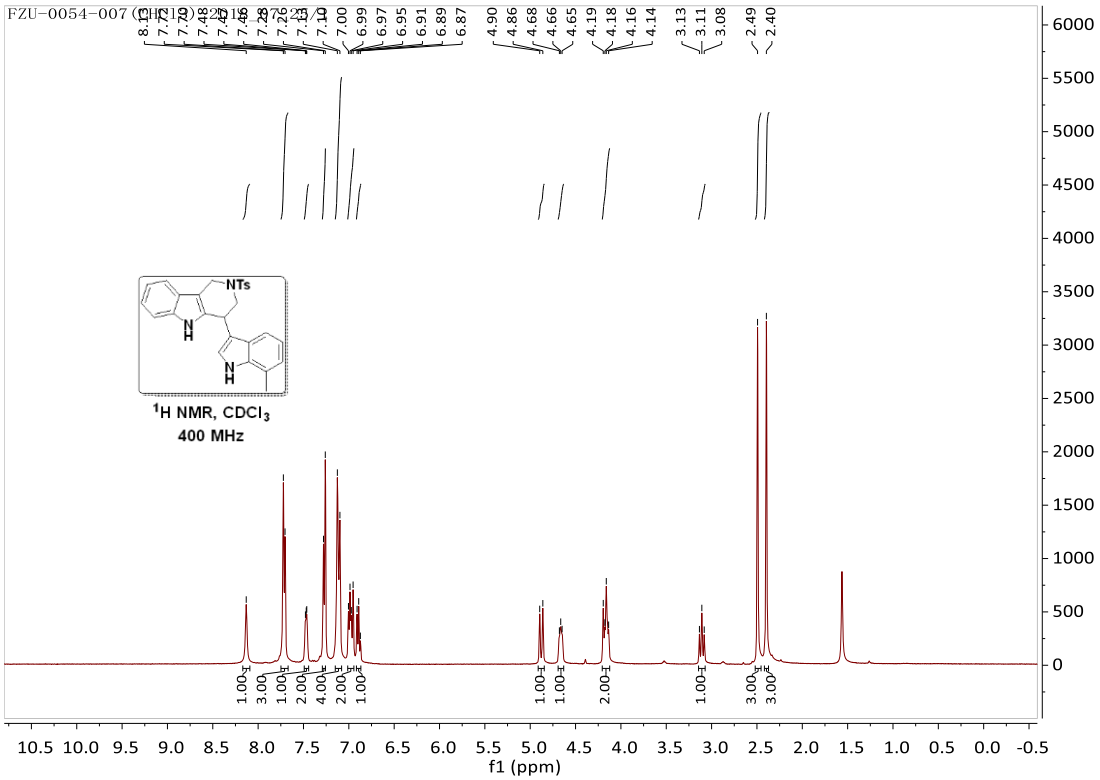
^{1}H NMR Spectrum of 45



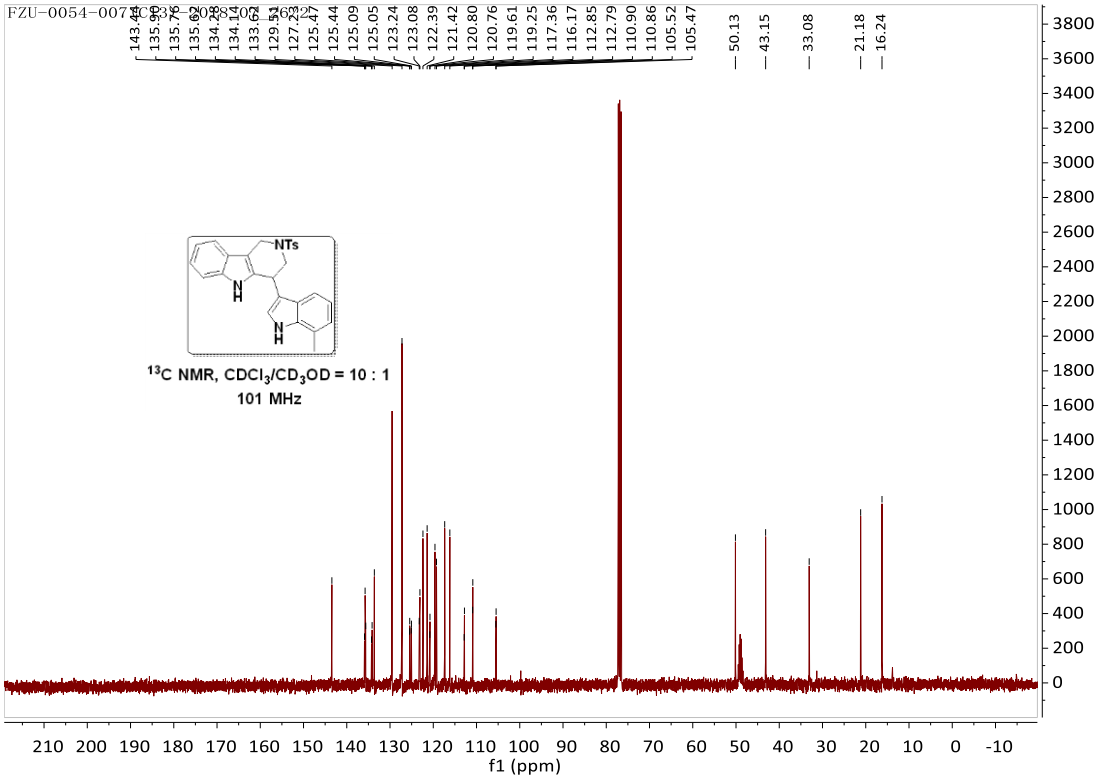
^{13}C NMR Spectrum of 45



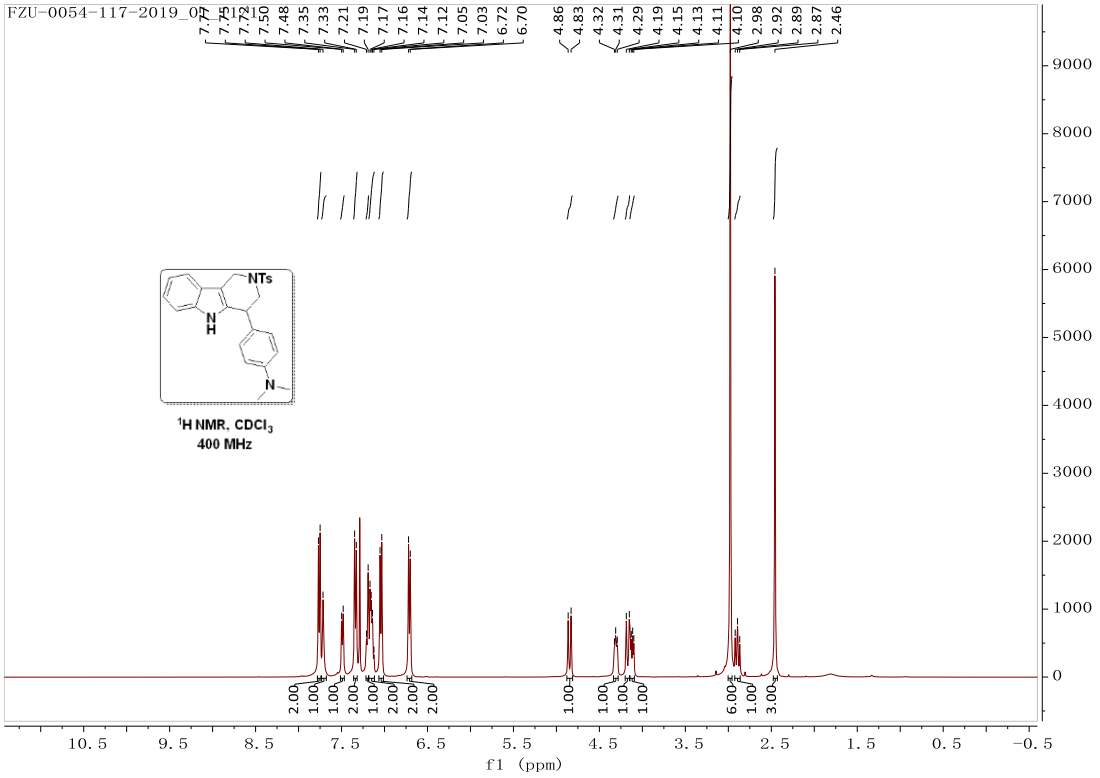
^{1}H NMR Spectrum of 46



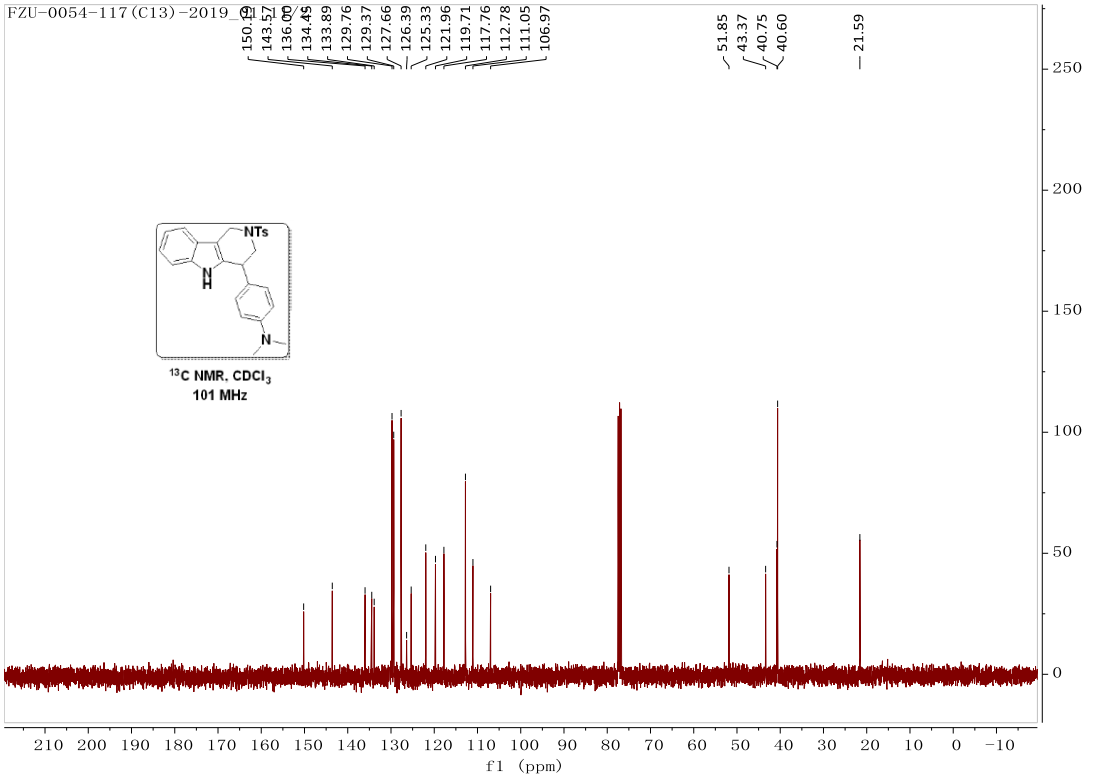
^{13}C NMR Spectrum of 46



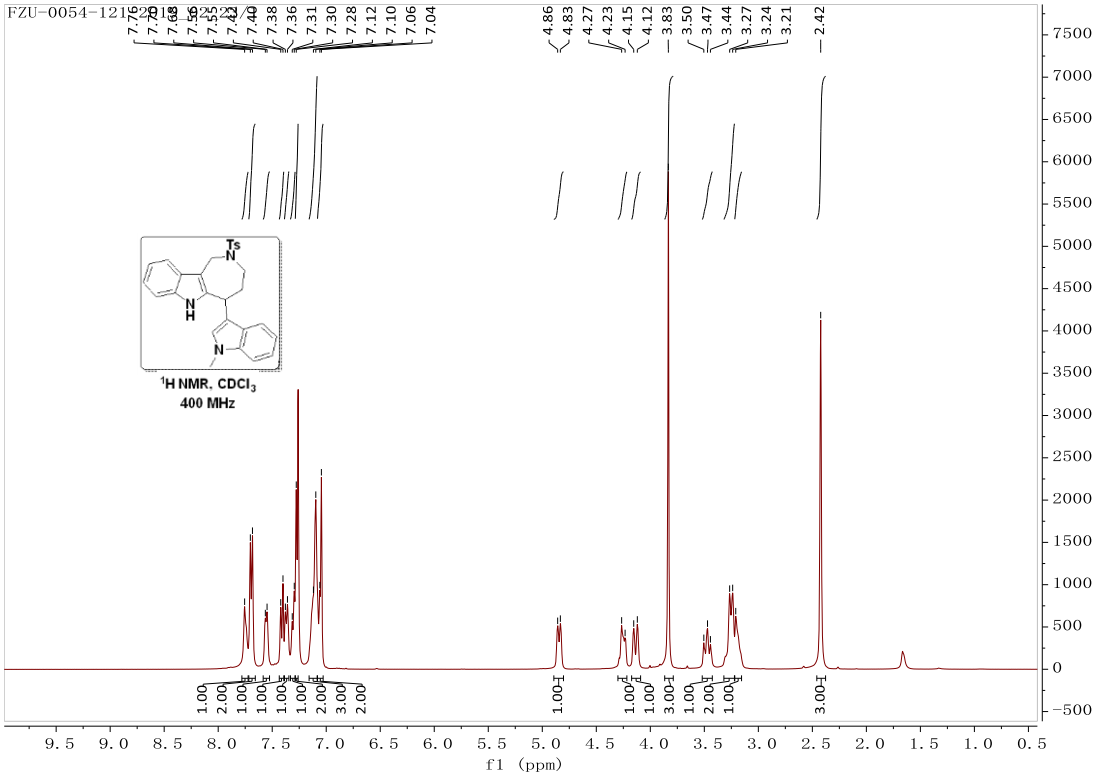
^{1}H NMR Spectrum of 47



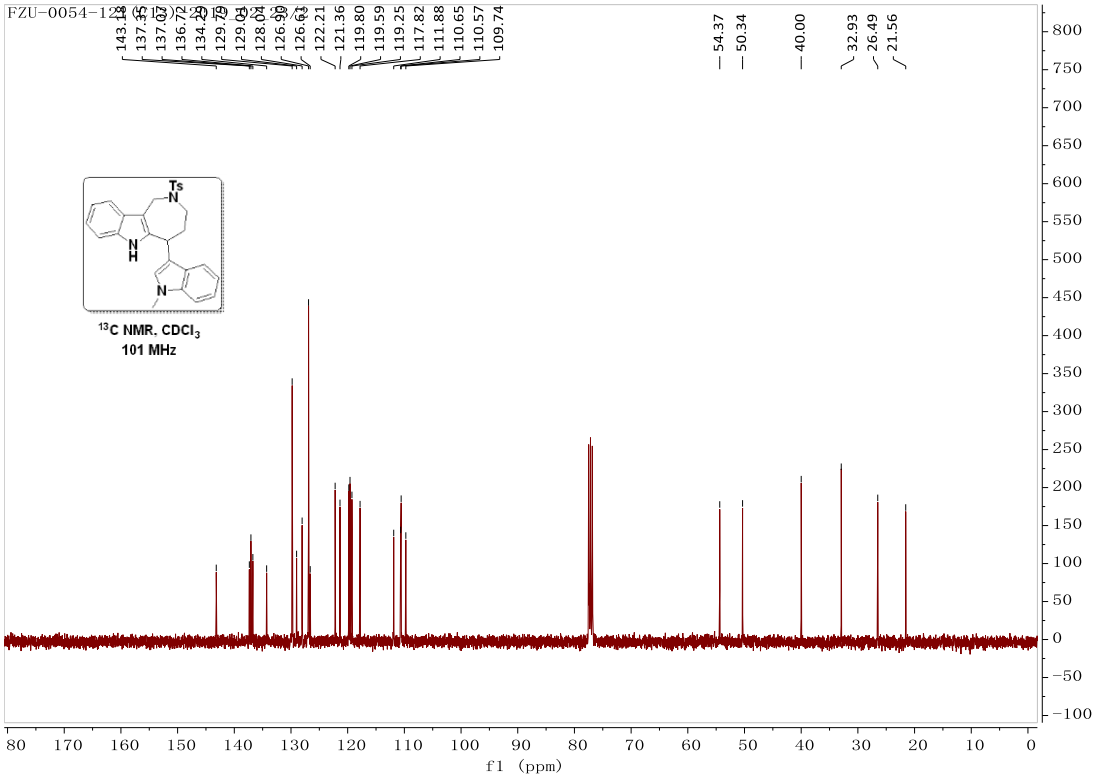
^{13}C NMR Spectrum of 47



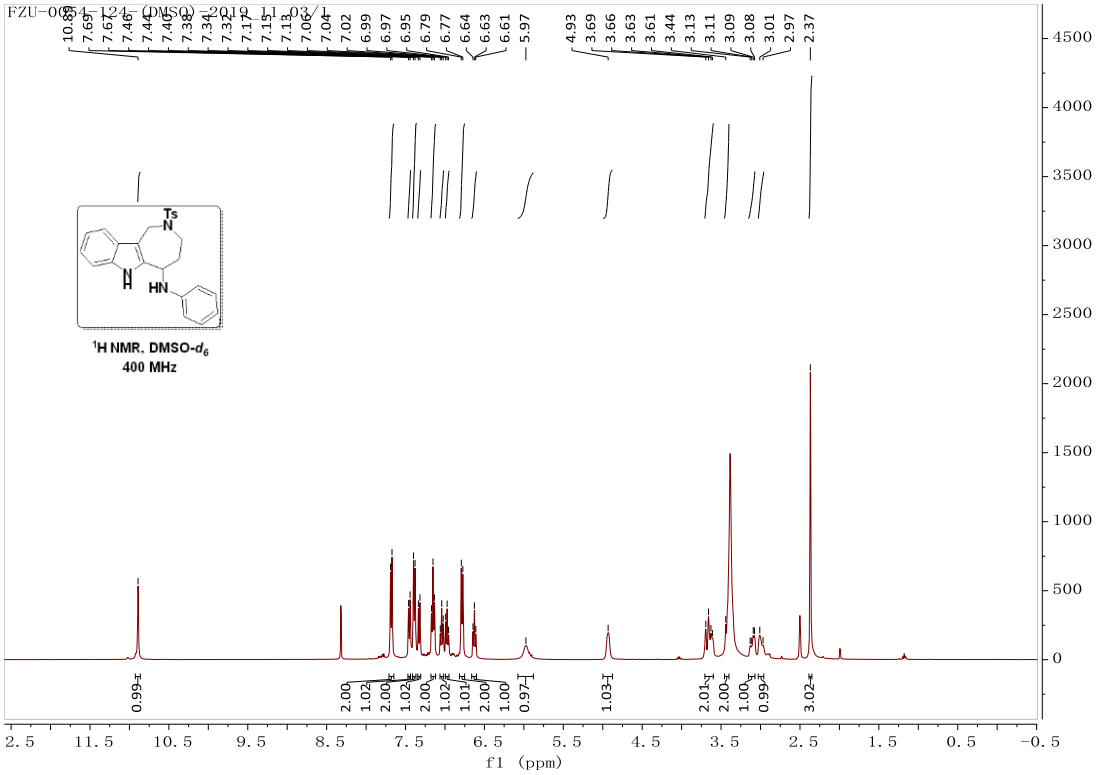
^{1}H NMR Spectrum of 48



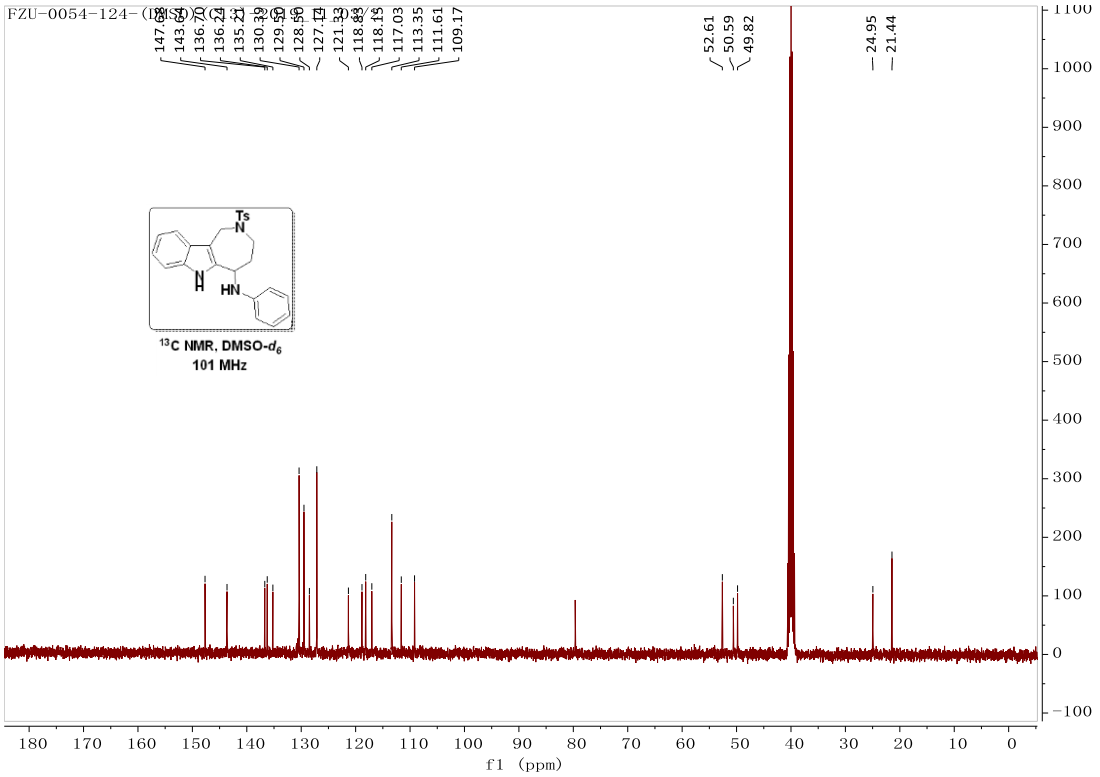
^{13}C NMR Spectrum of 48



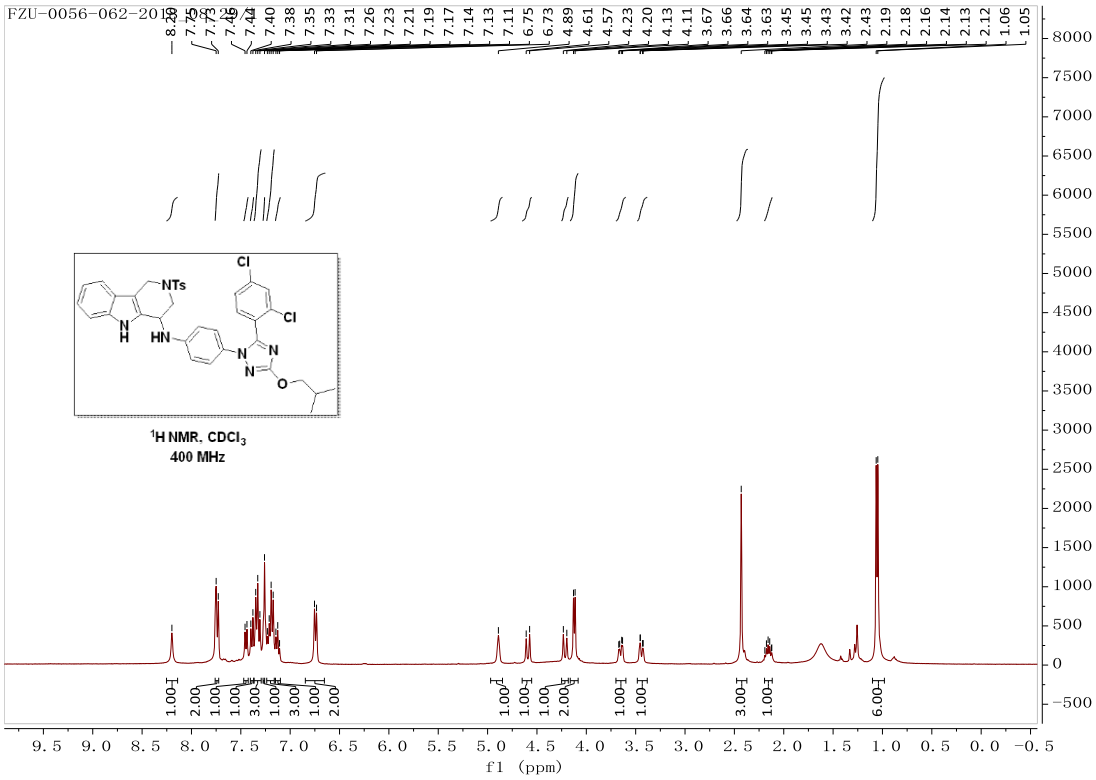
^{1}H NMR Spectrum of 49



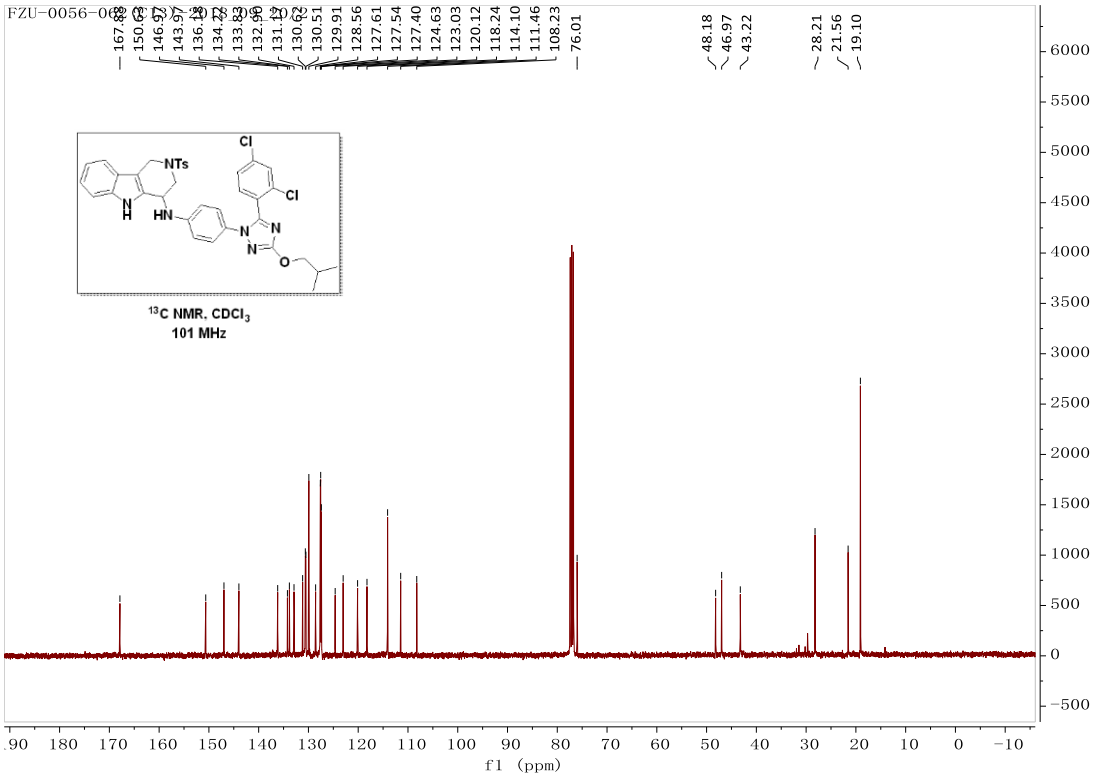
^{13}C NMR Spectrum of 49



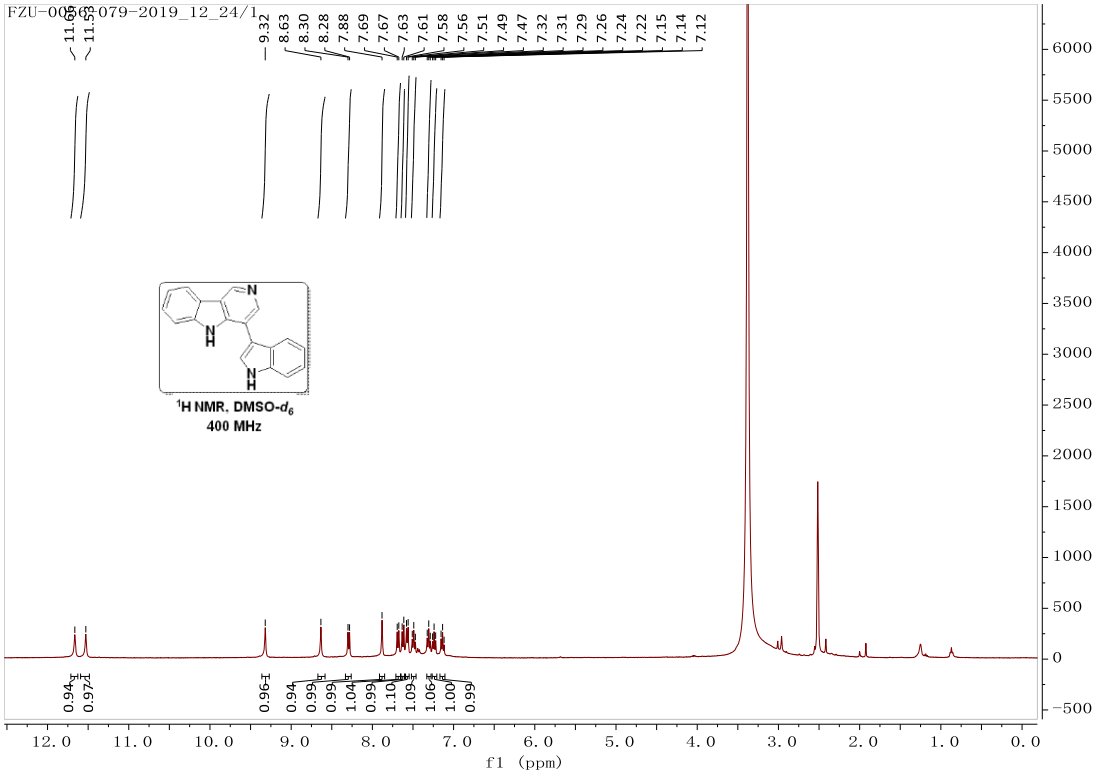
^{1}H NMR Spectrum of 50



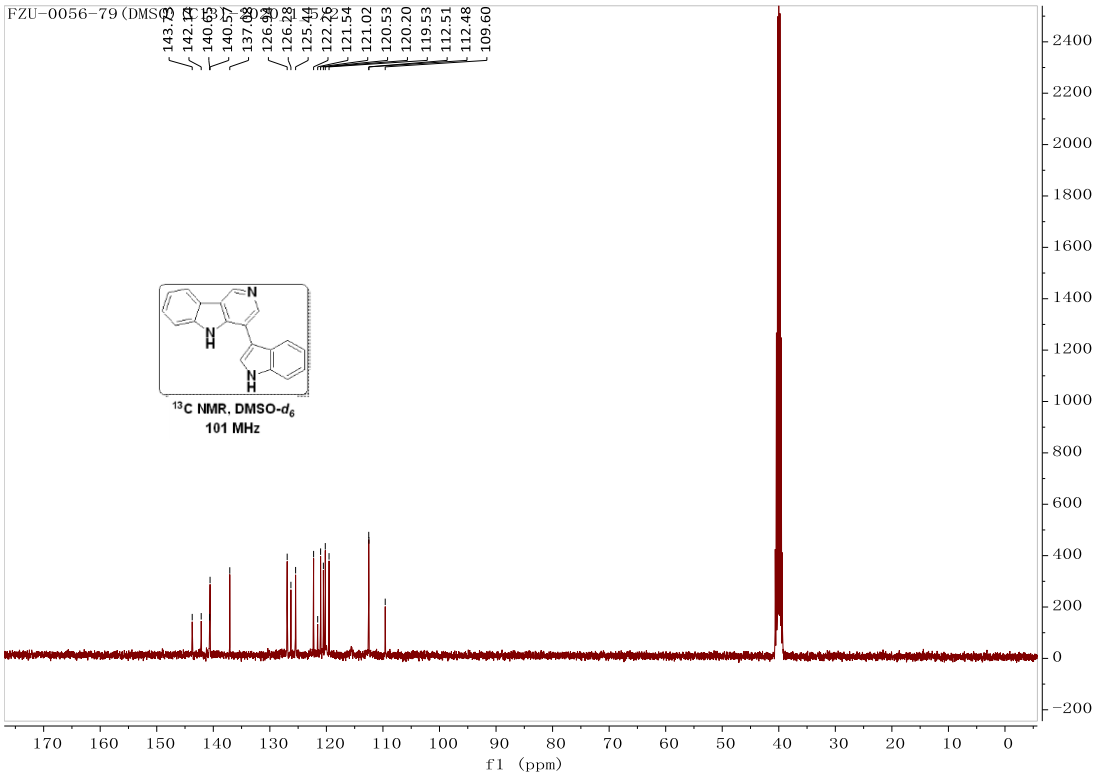
^{13}C NMR Spectrum of 50



^{1}H NMR Spectrum of 51

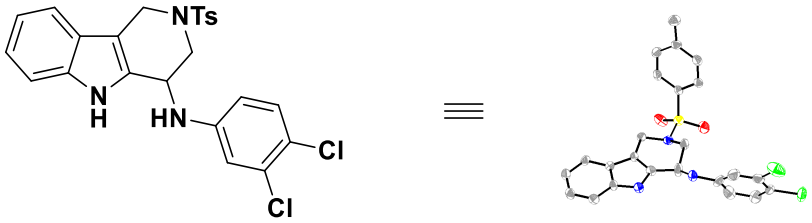


^{13}C NMR Spectrum of 51



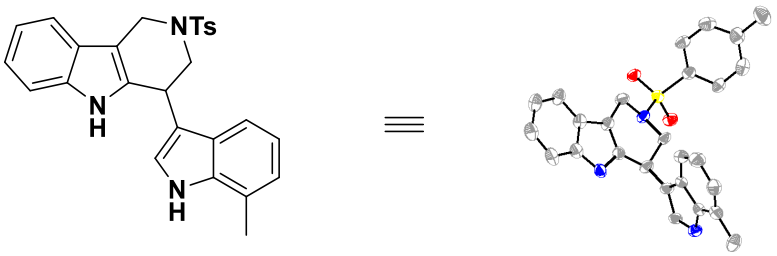
4. X-ray Crystal Structure Data

X-ray Crystal Structure Data for compound 25



Identification code	25	
Bond precision	C-C = 0.0088 Å Wavelength=0.71073	
Cell	a=11.0746(18) b=11.3733(17) c=17.772(2) alpha=90 beta=103.848(5) gamma=90	
Temperature	173 K	
	Calculated	Reported
Volume	2173.4(5)	2173.4(6)
Space group	P 21/c	P 21/c
Hall group	-P 2ybc	-P 2ybc
Moiety formula	C24 H21 Cl2 N3 O2 S	?
Sum formula	C24 H21 Cl2 N3 O2 S	C24 H21 Cl2 N3 O2 S
Mr	486.40	486.40
Dx, g cm-3	1.487	1.487
Z	4	4
Mu (mm-1)	0.423	0.423
F000	1008.0	1008.0
F000’	1010.02	/
h, k, lmax	13,13,21	13,13,21
Nref	3833	3832
Tmin, Tmax	0.911,0.932	/
Tmin’	0.911	/
Data Completeness	1.000	
Theta(max)	25.014	
R(reflections)	0.0873(2760)	
wR2(reflections)	0.1937(3832)	
S	1.075	
Npar	299	

X-ray Crystal Structure Data for compound 46



Identification code	46	
Bond precision	C-C = 0.0000 Å Wavelength=0.71073	
Cell	a=19.448(5) b=10.825(3) c=22.041(5) alpha=90 beta=90 gamma=90	
Temperature	296 K	
	Calculated	Reported
Volume	4640(2)	4640(2)
Space group	P n a 21	P n a 21
Hall group	P 2c -2n	P 2c -2n
Moiety formula	C27 H24 N3 O2 S	?
Sum formula	C27 H24 N3 O2 S	C27 H24 N3 O2 S
Mr	454.55	454.55
Dx, g cm-3	1.301	1.301
Z	8	8
Mu (mm-1)	0.169	0.169
F000	1912.0	1912.0
F000’	1913.70	/
h, k, lmax	23,13,26	23,13,26
Nref	8586[4413]	8352
Tmin, Tmax	0.967,0.967	0.459,0.745
Tmin’	0.967	/
Data Completeness	1.89/0.97	
Theta(max)	25.445	
R(reflections)	0.0675(5755)	
wR2(reflections)	0.1882(8352)	
S	1.023	
Npar	1175	