

Supporting Information

**Divergent Synthesis of Bis(indolyl)methanes via Fe^{III}-Catalyzed Regioselective
Dehydrogenative Coupling Reactions: A Biomimetic Approach to 6,6'-bis-
(debromo)-Gelliusine F**

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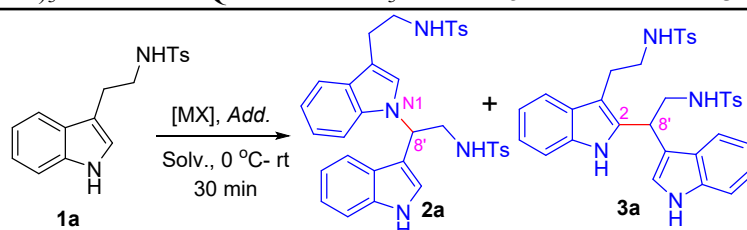
#These authors contribute equally to this work.

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Table S1. Reaction Development and Optimizations

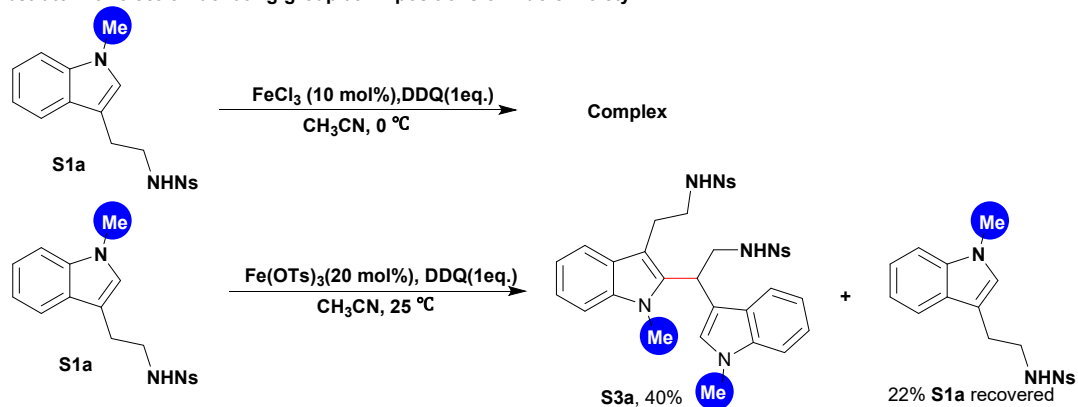
Entry	[MX]	Add.	Solv.	Temp. (°C)	Conv. (%) ^f	Yield (%) ^g	Ratio (2a : 3a) ^h
1 ^a	FeCl ₃	DDQ	CH ₂ Cl ₂	0	100	29	4.0: 1
2 ^a	FeCl ₃	DDQ	Toluene	0	NR	--	--
3 ^a	FeCl ₃	DDQ	Acetone	0	88	48	1.5: 1
4 ^a	FeCl ₃	DDQ	EtOH	0	100	27	1.2: 1
5 ^a	FeCl ₃	Benzoquinone	CH ₃ CN	0	NR	--	--
6 ^a	FeCl ₃	Benzoyl peroxide	CH ₃ CN	0	NR	--	--
7 ^a	FeCl ₃	Oxone	CH ₃ CN	0	NR	--	--
8 ^a	FeCl ₃	H ₂ O ₂	CH ₃ CN	0	100	0	--
9 ^a	FeCl ₃ ^c	DDQ	CH ₃ CN	0	100	20	3:1
10 ^a	FeCl ₃ ^d	DDQ	CH ₃ CN	0	100	58	19: 1
11 ^a	FeCl ₃	DDQ ^e	CH ₃ CN	0	100	71	6.5: 1
12 ^a	ZnFe ₂ O ₄	DDQ	CH ₃ CN	0	100	56	2.2:1
13 ^a	Fe ₃ O ₄	DDQ	CH ₃ CN	0	100	76	1.7:1
14 ^b	Fe(NO ₃) ₃	DDQ	CH ₃ CN	25	88	20	1: 4.3
15 ^b	Fe(ClO ₄) ₃	DDQ	CH ₃ CN	25	91	36	1: 1.1
16 ^b	Zn(OTf) ₂	DDQ	CH ₃ CN	25	100	63	2.9: 1
17 ^b	Fe(OTs) ₃	DDQ	CH ₂ Cl ₂	25	100	52	1.1: 1
18 ^b	Fe(OTs) ₃	DDQ	Toluene	25	100	37	6.9: 1
19 ^b	Fe(OTs) ₃	DDQ	Acetone	25	100	63	1.2: 1
20 ^b	Fe(OTs) ₃	DDQ	EtOH	25	100	30	1: 4.0
21 ^b	Fe(OTs) ₃ ^c	DDQ	CH ₃ CN	25	98	70	1: 4.4
22 ^b	Fe(OTs) ₃ ^d	DDQ	CH ₃ CN	25	93	42	1: 7
23 ^b	Fe(OTs) ₃	DDQ ^e	CH ₃ CN	25	66	34	1: 3



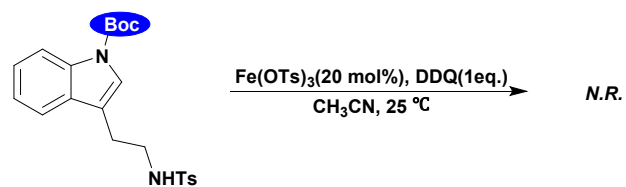
^a Reaction conditions: **1a**/catalyst/DDQ = 0.1:0.01:0.1 (mmol), in the indicated solvent (0.1 M) under air at the specified temperature for 30 min unless otherwise noted; ^b Reaction conditions: **1a**/catalyst/DDQ = 0.1:0.02:0.1 (mmol), in the indicated solvent (1.0 mL) under air at 0 °C for 30 min unless otherwise noted; ^c 5 mol% of ferric salt was used; ^d 20 mol% of ferric salt was used; ^e 0.5 equiv. of DDQ was used; ^f The conversions were determined by the HPLC analysis; ^g The isolated yields of **2a** and **3a** were reported; ^h The ratios of **2a**:**3a** were determined by ¹H-NMR analysis of the crude reaction mixtures; NR, no reaction; DDQ, 2,3-dichloro-5,6-dicyano-benzoquinone.

Table S1. Control experiments

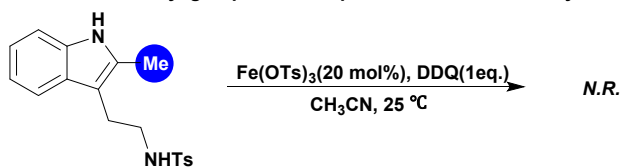
a. Substrate with electron-donating group at N1 positions of indole moiety



b. Substrate with electron-withdrawing group at N1 positions of indole moiety



c. Substrate with a Methyl group at the C2 positions of indole moiety

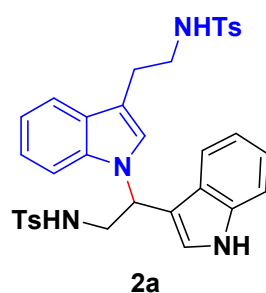


1. General information.

All reactions were performed under air using flame-dried glassware unless otherwise noted. All reagents were commercially available and used without further purification unless otherwise indicated. Analytical thin-layer chromatography (TLC) was carried out on precoated 0.25 mm thick silica gel GF254 plates. Visualization of the developed chromatogram was performed by a UV light or by a solution of 10% EtOH-H₂SO₄, or KMnO₄, followed by heating. All compounds were purified by silica gel flash column chromatography using silica gel (300–400 mesh). Solvents for extraction and flash column chromatography were reagent grade. Yields reported were for isolated, spectroscopically pure compounds. ¹H and ¹³C-NMR experiments were performed on a Bruker AM-400, DRX-500 and DRX-600 NMR spectrometer at ambient temperature. The residual solvent protons (¹H) or carbons (¹³C) were used as internal standards. ¹H-NMR data are presented as follows: chemical shift in ppm downfield from tetramethylsilane (multiplicity, coupling constant and integration). The following abbreviations are used in reporting NMR data: s, singlet; br s, broad singlet; d, doublet; t, triplet; q, quartet; dd, doublet of doublets; dt, doublet of triplets; m, multiplet and combinations thereof. ¹³C-NMR spectra with proton decoupling were described with the aid of an APT sequence. ESI-MS and HR-ESI-MS were taken on API STAR Pulsar at Central South University.

2. General procedure for the synthesis of compounds 2a-2j, 3k and 3l.

To a solution of compound **1** (0.1 mmol, 1.0 equiv.) in CH₃CN (1.0 mL) at 0 °C under air was added FeCl₃ (0.01 mmol, 0.1 equiv.) in one portion. The mixture was stirred at 0 °C for 10 min, which was followed by the addition of DDQ (0.1 mmol, 1.0 equiv.). The resulting mixture was stirred at 0 °C for another 30 min. The reaction was quenched with the saturated aqueous Na₂S₂O₃ solution (20 mL) upon the completion as indicated by TLC. The aqueous phase was extracted with ethyl acetate (10 mL* 3). The combined organic layers were washed with saturated aqueous NaHCO₃ solution, brine and dried over Na₂SO₄. Then the solvent was removed under reduced pressure. The residue was purified by silica gel column chromatography to give **2**.



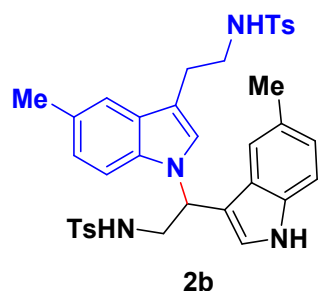
N-(2-(1-(1-*H*-indol-3-yl)-2-((4-methyl phenyl) sulfonamido) ethyl)-1*H*-indol-3-yl) ethyl)-4-methylbenzenesulfonamide (**2a**)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purified by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.5: 1). the title compound was obtained as a light-yellow solid (21.4 mg of **2a** and **3a** was obtained from 31.4 mg starting material, 68% yield, ratio (**2a**: **3a**= 10: 1)), m.p.: 95~ 98 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 11.14 (d, *J* = 2.6 Hz, 1H), 7.87 (dd, *J* = 6.0 Hz, 1H), 7.63 (dd, *J* = 8.3, 6.7 Hz, 4H), 7.58 (dd, *J* = 5.9 Hz, 1H), 7.52 – 7.47 (m, 2H), 7.35 – 7.27 (m, 6H), 7.14 – 7.09 (m, 2H), 7.06 (s, 1H), 7.05 – 7.00 (m, 1H), 6.97 (dd, *J* = 7.5 Hz, 1H), 6.85 (dd, *J* = 7.5 Hz, 1H), 5.85 (dd, *J* = 7.2 Hz, 1H), 3.56 (dd, *J* = 7.2 Hz, 2H), 2.93 (dd, *J* = 7.3 Hz, 2H), 2.74 – 2.62 (m, 2H), 2.34 (s, 3H), 2.34 (s, 3H).

¹³C NMR (126 MHz, DMSO) δ_C 142.7, 142.5, 137.8, 137.5, 136.1, 136.1, 129.6 (2C), 129.6 (2C), 127.4, 126.5 (2C), 126.4 (2C), 125.9, 123.9, 123.6, 121.4, 121.2, 118.9, 118.6, 118.3, 118.0, 112.0, 111.6, 110.9, 109.8, 52.1, 45.9, 43.3, 25.4, 20.9, 20.9.

HR-ESI-MS(*m/z*): calcd. for C₃₄H₃₄N₄O₄S₂ [M+H]⁺, 627.2094, found 627.2091.



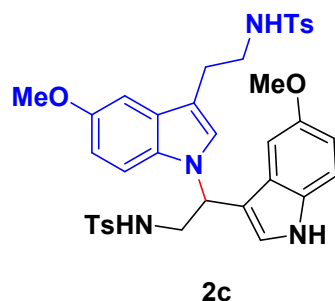
4-methyl-*N*-(2-(5-methyl-1-(1-(5-methyl-1*H*-indol-3-yl)-2-((4-methylphenyl)sulfonamido) ethyl)-1*H*-indol-3-yl) ethyl) benzene sulfonamide (2b)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.5: 1). the title compound was obtained as a yellow solid (137.9 mg of **2b** and **3b** was obtained from 328.4 mg starting material, 42% yield, ratio (**2b**: **3b** > 19:1)). The reaction was also performed at 1.05 gram-scale, which gave the coupling products in 49% yield and ratio of **2b**: **3b** >19:1, m.p.: 106~ 108 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 11.00 (d, *J* = 2.8 Hz, 1H), 7.86 (dd, *J* = 6.0 Hz, 1H), 7.67 – 7.62 (m, 4H), 7.60 (dd, *J* = 5.8 Hz, 1H), 7.38 (d, *J* = 2.7 Hz, 1H), 7.35 (d, *J* = 8.4 Hz, 1H), 7.34 – 7.29 (m, 4H), 7.22 (d, *J* = 8.2 Hz, 1H), 7.08 (s, 1H), 7.03 (s, 1H), 6.95 – 6.89 (m, 2H), 6.86 (dd, *J* = 8.3, 1.8 Hz, 1H), 5.77 (dd, *J* = 7.2 Hz, 1H), 3.57 – 3.48 (m, 2H), 2.96 – 2.89 (m, 2H), 2.73 – 2.59 (m, 2H), 2.35 (s, 3H), 2.34 (s, 3H), 2.34 (s, 3H), 2.22 (s, 3H).

¹³C NMR (151 MHz, DMSO) δ_C 142.6, 142.5, 137.7, 137.4, 134.5, 134.5, 129.6 (4C), 127.7, 127.3, 127.1, 126.5 (2C), 126.4 (2C), 126.2, 124.1, 123.7, 123.0, 122.6, 117.9, 117.6, 111.5, 111.3, 110.2, 109.6, 52.2, 45.9, 43.3, 25.4, 21.2, 21.1, 20.9.

HR-ESI-MS(*m/z*): calcd. for C₃₆H₃₈N₄O₄S₂ [M+H]⁺, 655.2407, found 655.2413.



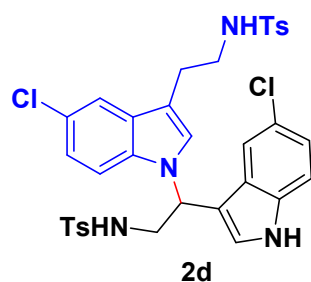
***N*-(2-(5-methoxy-1-(1-(5-methoxy-1*H*-indol-3-yl)-2-((4-methylphenyl)sulfonamido) ethyl)-1*H*-indol-3-yl) ethyl)-4-methylbenzenesulfonamide (2c)**

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.5: 1). the title compound was obtained as a white solid (102.9 mg of **2c** and **3c** was obtained from 294.0 mg starting material, 35% yield, ratio (**2c**: **3c** = 3.3 :1)), m.p.: 102~ 109 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 10.96 (d, *J* = 2.7 Hz, 1H), 7.87 (s, 1H), 7.68 – 7.60 (m, 5H), 7.37 (d, *J* = 2.7 Hz, 1H), 7.35 – 7.29 (m, 5H), 7.21 (d, *J* = 8.7 Hz, 1H), 7.08 (s, 1H), 6.82 (d, *J* = 2.6 Hz, 1H), 6.73 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.67 (dd, *J* = 8.7, 2.4 Hz, 1H), 6.53 (d, *J* = 2.6 Hz, 1H), 5.72 (dd, *J* = 7.2 Hz, 1H), 3.72 (s, 3H), 3.57 (d, *J* = 4.3 Hz, 2H), 3.54 (s, 3H), 2.93 (dd, *J* = 7.6, 4.7 Hz, 2H), 2.68 (m, 2H), 2.34 (s, 3H), 2.34 (s, 3H).

¹³C NMR (126 MHz, DMSO) δ_C 153.2, 153.1, 142.6, 142.5, 137.8, 137.5, 131.4, 131.2, 129.6 (4C), 127.8, 126.5 (2C), 126.4 (2C), 126.3, 124.7, 123.9, 112.2, 112.0, 111.2, 111.0, 110.6, 110.5, 100.3, 100.1, 55.4, 55.1, 52.6, 45.7, 43.2, 25.4, 20.9.

HR-ESI-MS(*m/z*): calcd. for C₃₆H₃₈N₄O₆S₂ [M+H]⁺, 687.2306, found 687.2311.

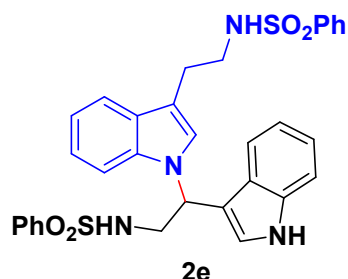


***N*-(2-(5-chloro-1-(1-(5-chloro-1*H*-indol-3-yl)-2-((4-methylphenyl)sulfonamido)ethyl)-1*H*-indol-3-yl)ethyl)-4-methylbenzenesulfonamide (2d)**

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.0: 1). the title compound was obtained as a yellow solid (220.0 mg of **2d** and **3d** was obtained from 347.5 mg starting material, 63% yield, ratio (**2d**: **3d** = 7.0: 1)), m.p.: 225~ 227 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 11.39 (d, *J* = 2.7 Hz, 1H), 7.88 (t, *J* = 6.0 Hz, 1H), 7.64 (d, *J* = 8.2 Hz, 2H), 7.62 – 7.56 (m, 4H), 7.49 (d, *J* = 8.9 Hz, 1H), 7.37 – 7.33 (m, 2H), 7.31 (d, *J* = 8.2 Hz, 2H), 7.27 (d, *J* = 8.2 Hz, 2H), 7.21 (s, 1H), 7.09 (dd, *J* = 8.7, 2.3 Hz, 1H), 7.06 (d, *J* = 2.1 Hz, 1H), 7.04 (dd, *J* = 8.5, 2.1 Hz, 1H), 5.81 (dd, *J* = 7.2 Hz, 1H), 3.59 (dd, *J* = 6.4 Hz, 2H), 2.98 – 2.86 (m, 2H), 2.75 – 2.60 (m, 2H), 2.34 (s, 3H), 2.33 (s, 3H).

^{13}C NMR (126 MHz, DMSO) δ_{C} 142.6, 142.5, 137.7, 137.5, 134.6, 134.5, 129.6 (2C), 129.5 (2C), 128.6, 126.9, 126.5 (2C), 126.3 (2C), 125.9, 125.6, 123.6, 123.4, 121.5, 121.1, 117.6, 117.2, 113.3, 111.7, 111.5, 111.0, 52.4, 45.7, 43.2, 25.1, 20.9.
HR-ESI-MS(m/z): calcd. for $\text{C}_{34}\text{H}_{32}\text{Cl}_2\text{N}_4\text{O}_4\text{S}_2$ $[\text{M}+\text{H}]^+$, 695.1315, found 695.1310.



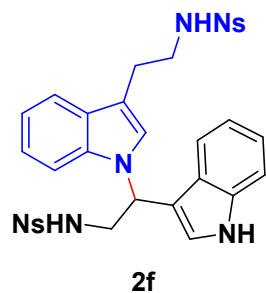
***N*-(2-(1*H*-indol-3-yl)-2-(3-(2-(phenylsulfonamido)ethyl)-1*H*-indol-1-yl)ethyl) benzene sulfonamide (2e)**

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 1.5:1). the title compound was obtained as a brown solid (168.4 mg of **2e** and **3e** was obtained from 300.0 mg starting material, 56% yield, ratio (**2e**: **3e** > 19: 1)), m.p.: 76~ 79 °C.

^1H NMR (600 MHz, DMSO- d_6) δ_{H} 11.15 (d, $J = 2.6$ Hz, 1H), 7.96 (dd, $J = 6.1$ Hz, 1H), 7.79 – 7.74 (m, 4H), 7.70 (dd, $J = 5.8$ Hz, 1H), 7.62 – 7.58 (m, 3H), 7.56 – 7.51 (m, 4H), 7.49 (d, $J = 2.5$ Hz, 1H), 7.35 (d, $J = 8.0$ Hz, 1H), 7.33 (d, $J = 8.3$ Hz, 1H), 7.14 (d, $J = 8.0$ Hz, 1H), 7.11 (dd, $J = 7.7$ Hz, 1H), 7.09 (s, 1H), 7.03 (dd, $J = 7.6$ Hz, 1H), 6.98 (dd, $J = 7.5$ Hz, 1H), 6.86 (dd, $J = 7.5$ Hz, 1H), 5.87 (dd, $J = 7.2$ Hz, 1H), 3.61 (dd, $J = 10.2, 4.4$ Hz, 2H), 2.96 (ddd, $J = 13.6, 6.2$ Hz, 2H), 2.76 – 2.62 (m, 2H).

^{13}C NMR (151 MHz, DMSO) δ_{C} 140.7, 140.4, 136.2, 136.1, 132.4, 132.3, 129.2 (2C), 129.2 (2C), 127.4, 126.4 (2C), 126.4 (2C), 125.9, 123.9, 123.7, 121.4, 121.2, 118.9, 118.6, 118.3, 118.0, 112.0, 111.6, 110.9, 109.8, 52.2, 45.9, 43.3, 25.5.

HR-ESI-MS(m/z): calcd. for $\text{C}_{32}\text{H}_{30}\text{N}_4\text{O}_4\text{S}_2$ $[\text{M}+\text{H}]^+$, 599.1781, found 599.1784.



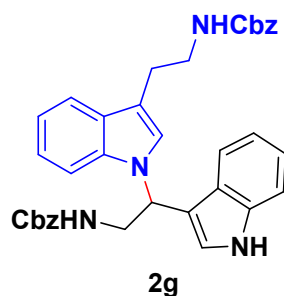
***N*-(2-(1-(1-(1*H*-indol-3-yl)-2-((4-nitrophenyl)sulfonamido)ethyl)-1*H*-indol-3-yl)ethyl)-4-nitrobenzenesulfonamide (2f)**

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a yellow solid (71 mg of **2f** and **3f** was obtained from 140 mg starting material, 51% yield, ratio (**2f**: **3f** = 3.6: 1)), m.p.: 221~224 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 11.15 (d, *J* = 2.7 Hz, 1H), 8.41 (s, 1H), 8.26 – 8.23 (m, 2H), 8.11 (d, *J* = 8.8 Hz, 3H), 7.93 (d, *J* = 8.8 Hz, 2H), 7.81 (d, *J* = 8.8 Hz, 2H), 7.51 (d, *J* = 2.6 Hz, 1H), 7.43 (d, *J* = 8.3 Hz, 1H), 7.30 (d, *J* = 8.1 Hz, 1H), 7.23 (d, *J* = 7.9 Hz, 1H), 7.18 (s, 1H), 7.14 (d, *J* = 8.0 Hz, 1H), 7.03 (dd, *J* = 7.8 Hz, 1H), 7.00 (dd, *J* = 7.5 Hz, 1H), 6.88 (dd, *J* = 7.4 Hz, 1H), 6.84 (dd, *J* = 7.5 Hz, 1H), 5.82 – 5.79 (m, 1H), 3.79 (t, *J* = 7.0 Hz, 2H), 3.04 (t, *J* = 7.7 Hz, 2H), 2.73 – 2.67 (m, 2H).

¹³C NMR (126 MHz, DMSO) δ_C 149.3, 148.9, 146.1, 146.0, 136.0, 135.9, 127.9 (2C), 127.3, 127.3 (2C), 125.8, 124.5 (2C), 124.2, 124.1 (2C), 123.8, 121.4, 121.1, 118.9, 118.6, 118.2, 118.0, 111.9, 111.6, 110.8, 109.7, 52.1, 46.0, 43.1, 25.4.

HR-ESI-MS(*m/z*): calcd. for C₃₂H₂₈N₆O₈S₂ [M+NH₄]⁺, 706.1748, found 706.1739.



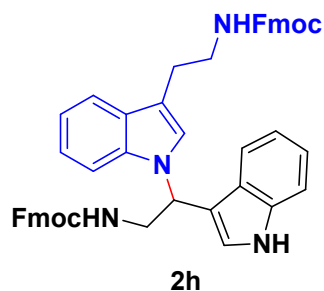
benzyl(2-(1-(2-(((benzyloxy)carbonyl)amino)-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl)ethyl)carbamate (2g)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 4: 1). the title compound was obtained as a yellow solid (39 mg of **2g** and **3g** was obtained from 58.9 mg starting material, 66% yield, ratio (**2g**: **3g** =2: 1)), m.p.: 70~73°C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 11.16 (s, 1H), 7.59 – 7.54 (m, 2H), 7.53 – 7.48 (m, 2H), 7.33 (ddd, *J* = 25.3, 13.8, 7.1 Hz, 11H), 7.22 (d, *J* = 6.9 Hz, 2H), 7.18 (s, 1H), 7.12 (dd, *J* = 7.7 Hz, 1H), 7.04 (dd, *J* = 7.5 Hz, 1H), 7.01 (dd, *J* = 7.5 Hz, 1H), 6.87 (dd, *J* = 7.3 Hz, 1H), 6.00 (dd, *J* = 6.7 Hz, 1H), 5.04 – 4.91 (m, 4H), 3.97 – 3.79 (m, 2H), 3.26 – 3.18 (m, 2H), 2.76 (ddd, *J* = 14.9, 7.3 Hz, 2H).

^{13}C NMR (151 MHz, DMSO) δ_{C} 156.4, 156.1, 137.3, 137.0, 136.5, 136.2, 128.4 (2C), 128.3 (2C), 127.8 (3C), 127.7, 127.7, 127.6 (2C), 126.2, 123.7, 123.5, 121.4, 121.1, 118.9, 118.6, 118.5, 118.2, 112.4, 111.6, 111.5, 109.7, 65.3, 65.2, 51.1, 44.4, 41.1, 25.6.

HR-ESI-MS(m/z): calcd. for $\text{C}_{36}\text{H}_{34}\text{N}_4\text{O}_4$ $[\text{M}+\text{H}]^+$, 587.2653, found 587.2642.



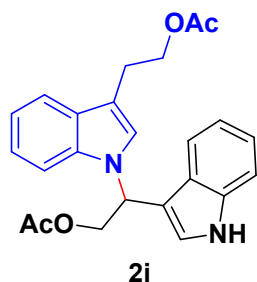
(9H-fluoren-9-yl)methyl (2-(1-(2-(((9H-fluoren-9-yl)methoxy)carbonyl)amino)-1-(1H-indol-3-yl)ethyl)-1H-indol-3-yl)ethyl)carbamate (2h)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a yellow solid (34 mg of **2h** and **3h** was obtained from 65.7 mg starting material, 44% yield, ratio (**2h**: **3h** =1: 1)), m.p.: 115~ 119 °C.

^1H NMR (500 MHz, DMSO- d_6) δ_{H} 11.17 (s, 1H), 7.88 (d, $J = 7.6$ Hz, 2H), 7.85 (d, $J = 7.2$ Hz, 2H), 7.67 (d, $J = 7.4$ Hz, 2H), 7.62 – 7.48 (m, 6H), 7.45 – 7.33 (m, 6H), 7.33 – 7.28 (m, 2H), 7.26 – 7.15 (m, 4H), 7.12 (dd, $J = 7.5$ Hz, 1H), 7.04 (dd, $J = 7.1$ Hz, 1H), 6.98 (dd, $J = 7.4$ Hz, 1H), 6.87 (dd, $J = 7.6$ Hz, 1H), 5.99 (dd, $J = 7.1$ Hz, 1H), 4.38 – 4.10 (m, 6H), 3.97 – 3.76 (m, 2H), 3.27 – 3.14 (m, 2H), 2.83 – 2.68 (m, 2H).

^{13}C NMR (126 MHz, DMSO) δ_{C} 156.3, 156.1, 143.9, 143.8, 140.7 (2C), 140.7 (2C), 136.4, 136.3, 127.7, 127.6 (2C), 127.6 (2C), 127.1, 127.0 (2C), 127.0 (2C), 126.2, 125.2 (2C), 125.1 (2C), 123.7, 123.5, 121.4, 121.1, 120.1 (2C), 120.1 (2C), 118.9, 118.6, 118.5, 118.2, 118.2, 112.4, 111.6, 111.5, 109.7, 65.4, 65.2, 51.3, 46.8, 46.6, 44.2, 41.1, 25.7.

HR-ESI-MS(m/z): calcd. for $\text{C}_{50}\text{H}_{42}\text{N}_4\text{O}_4$ $[\text{M}+\text{H}]^+$, 763.3279, found 763.3246.



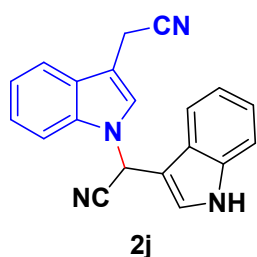
2-(1-(2-acetoxy-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl)ethyl acetate (2i)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 4: 1). the title compound was obtained as a yellow solid (43.7 mg of **2i** and **3i** was obtained from 93.0 mg starting material, 47% yield, ratio (**2i**: **3i** > 19:1)).

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 11.22 (s, 1H), 7.66 (dd, *J* = 8.4, 2.2 Hz, 1H), 7.61 (d, *J* = 2.8 Hz, 1H), 7.55 (dd, *J* = 8.0, 2.3 Hz, 1H), 7.38 (dd, *J* = 8.0, 2.3 Hz, 1H), 7.31 (d, *J* = 2.5 Hz, 1H), 7.28 – 7.23 (m, 1H), 7.19 – 7.11 (m, 1H), 7.09 – 7.03 (m, 1H), 7.03 (ddd, *J* = 7.4, 1.9 Hz, 1H), 6.89 (ddd, *J* = 7.9, 2.2 Hz, 1H), 6.20 (dd, *J* = 6.5 Hz, 1H), 4.98 – 4.77 (m, 2H), 4.19 (t, *J* = 7.1 Hz, 2H), 3.05 – 2.89 (m, 2H), 1.91 (s, 3H), 1.87 (s, 3H).

¹³C NMR (151 MHz, DMSO) δ_H 170.2, 170.1, 136.2, 136.1, 127.6, 125.9, 124.3, 123.6, 121.4, 121.1, 118.9, 118.6, 118.6, 118.2, 111.6, 110.9, 110.1, 109.9, 64.8, 63.7, 50.7, 24.2, 20.6, 20.5.

HR-ESI-MS(*m/z*): calcd. for C₂₄H₂₄N₂O₄ [M+Na]⁺, 427.1628, found 427.1637.



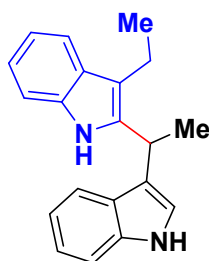
2-(3-(cyanomethyl)-1*H*-indol-1-yl)-2-(1*H*-indol-3-yl) acetonitrile (2j)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a light-yellow solid (82 mg of **2j** and **3j** was obtained from 200 mg starting material, 41% yield, ratio (**2j**: **3j** > 19:1)), m.p.: 60~ 64 °C.

$^1\text{H NMR}$ (500 MHz, $\text{DMSO-}d_6$) δ_{H} 11.57 (d, $J = 2.7$ Hz, 1H), 7.86 – 7.82 (m, 2H), 7.65 (d, $J = 7.9$ Hz, 1H), 7.63 (s, 1H), 7.46 (d, $J = 8.2$ Hz, 1H), 7.41 (s, 1H), 7.35 – 7.29 (m, 2H), 7.22 – 7.18 (m, 1H), 7.15 (ddd, $J = 8.2, 7.0, 1.4$ Hz, 1H), 7.00 (ddd, $J = 8.1, 7.0, 1.1$ Hz, 1H), 4.05 (d, $J = 0.9$ Hz, 2H).

$^{13}\text{C NMR}$ (126 MHz, DMSO) δ_{C} 136.7, 135.4, 127.0, 125.9, 125.0, 124.6, 122.9, 122.3, 120.5, 119.8, 119.1, 119.0, 117.9, 117.5, 112.3, 110.5, 106.2, 106.1, 43.4, 13.1.

HR-ESI-MS(m/z): calcd. for $\text{C}_{20}\text{H}_{14}\text{N}_4$ $[\text{M}+\text{Na}]^+$, 333.1111, found 333.1109.



3k

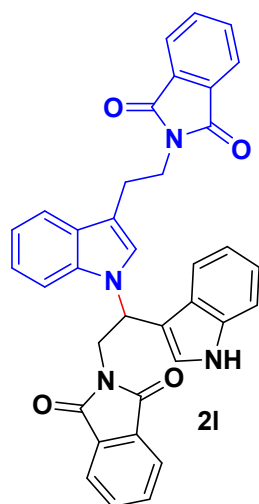
2-(1-(1H-indol-3-yl) ethyl)-3-ethyl-1H-indole (3k)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 6.0: 1). the title compound was obtained as yellow solid (80.0 mg of **2k** and **3k** was obtained from 145.0 mg starting material, 55% yield, ratio (**3k**: **2k** > 19:1)), m.p.: 60~ 67 °C.

$^1\text{H NMR}$ (500 MHz, $\text{DMSO-}d_6$) δ_{H} 10.88 (s, 1H), 10.40 (s, 1H), 7.41 (d, $J = 7.7$ Hz, 1H), 7.32 (d, $J = 8.1$ Hz, 1H), 7.29 (d, $J = 8.0$ Hz, 1H), 7.25 (d, $J = 1.9$ Hz, 1H), 7.20 (d, $J = 7.8$ Hz, 1H), 7.02 – 6.98 (m, 1H), 6.96 – 6.92 (m, 1H), 6.91 – 6.87 (m, 1H), 6.84 (dd, $J = 7.5$ Hz, 1H), 4.59 (q, $J = 7.1$ Hz, 1H), 2.79 (q, $J = 7.5$ Hz, 2H), 1.71 (d, $J = 7.2$ Hz, 3H), 1.15 (t, $J = 7.5$ Hz, 3H).

$^{13}\text{C NMR}$ (126 MHz, DMSO) δ_{C} 139.0, 136.3, 135.3, 127.7, 126.4, 122.0, 120.8, 119.8, 118.4, 118.1, 118.0, 117.8, 117.6, 111.3, 110.7, 110.5, 27.7, 21.0, 17.0, 15.9.

HR-ESI-MS(m/z): calcd. for $\text{C}_{10}\text{H}_{11}\text{N}$ $[\text{M}]^+$, 288.1626, found 288.1621.



2-(2-(1-(2-(1,3-dioxoisoindolin-2-yl)-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl) ethyl) isoindoline-1,3-dione (2I)

The reaction mixture was stirred at 0 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: Dichloromethane: ethyl acetate = 10: 20: 1). the title compound was obtained as a white solid (29.0 mg of **2I** and **3I** was obtained from 60.0 mg starting material, 50% yield, ratio (**2I**: **3I** = 1: 5)), m.p.: 270~ 274 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 11.25 (d, *J* = 2.7 Hz, 1H), 7.85 – 7.79 (m, 4H), 7.76 – 7.71 (m, 5H), 7.48 (d, *J* = 8.3 Hz, 2H), 7.36 (d, *J* = 8.1 Hz, 1H), 7.26 (s, 1H), 7.17 (d, *J* = 8.0 Hz, 1H), 7.04 (dd, *J* = 7.5 Hz, 1H), 6.99 (dd, *J* = 7.7 Hz, 1H), 6.91 (dd, *J* = 7.5 Hz, 1H), 6.84 (dd, *J* = 7.5 Hz, 1H), 6.26 (dd, *J* = 8.7, 6.2 Hz, 1H), 4.44 (ddd, *J* = 46.6, 14.0, 7.5 Hz, 2H), 3.73 (ddq, *J* = 20.8, 13.7, 7.0 Hz, 2H), 2.92 (q, *J* = 7.7, 6.8 Hz, 2H).

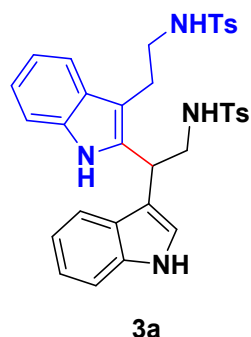
¹³C NMR (126 MHz, DMSO) δ_C 167.8 (2C), 167.5 (2C), 136.3, 136.2, 134.5 (2C), 134.3 (2C), 131.6 (2C), 131.1 (2C), 127.5, 126.0, 124.2, 123.8, 123.1 (2C), 123.0 (2C), 121.6, 121.3, 119.0, 118.7, 118.5, 118.0, 111.7, 111.2, 111.0, 109.2, 49.6, 41.2, 38.0, 23.8.

HR-ESI-MS(*m/z*): calcd. for C₃₆H₂₆N₄O₄ [M+H]⁺, 579.2027, found 579.2012.

3. General procedure for the synthesis of compounds 3a-3h, 3I-3o.

To a solution of **1** (0.1 mmol, 1.0 equiv.) in CH₃CN (1.0 mL) at 25 °C under air was added Fe(OTf)₃ (0.02 mmol, 0.2 equiv.) in one portion. The mixture was stirred at 25 °C for 10 min, which was followed by the addition of DDQ (0.1 mmol, 1.0 equiv.). The resulting mixture was stirred at 0 °C for another 30 min. Upon the completion as indicated by TLC, the reaction was quenched with the saturated aqueous Na₂SO₃

solution (20 mL). The aqueous phase was extracted with ethyl acetate (10 mL* 3). The combined organic layers were washed with saturated aqueous NaHCO₃ solution, brine and dried over Na₂SO₄. Then the solvent was removed under reduced pressure. The residue was purified by silica gel column chromatography to give **3**.



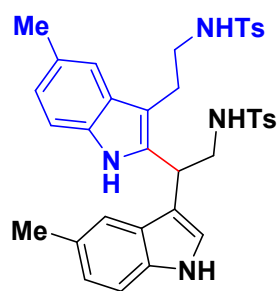
***N*-(2-(2-(1-(1*H*-indol-3-yl)-2-((4-methylphenyl)sulfonamido)ethyl)-1*H*-indol-3-yl)ethyl)-4-methylbenzenesulfonamide (**3a**)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a yellow solid (13.2 mg of **2a** and **3a** was obtained from 31.4 mg starting material, 42% yield, ratio (**3a**: **2a** = 7: 1)). The reaction was also run at 1.5 gram-scale, which gave the coupling product in 44% yield and **3a**: **2a** >19:1, m.p.:114~ 116 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 10.93 (d, *J* = 2.6 Hz, 1H), 10.68 (s, 1H), 7.73 (d, *J* = 5.9 Hz, 1H), 7.70 – 7.64 (m, 2H), 7.64 – 7.58 (m, 2H), 7.33 (d, *J* = 8.3 Hz, 2H), 7.32 – 7.29 (m, 1H), 7.27 (d, *J* = 8.3 Hz, 2H), 7.23 – 7.19 (m, 3H), 7.05 – 7.01 (m, 1H), 6.97 (ddd, *J* = 8.0, 7.5, 1.4 Hz, 1H), 6.91 – 6.85 (m, 2H), 4.57 – 4.51 (m, 1H), 3.44 (ddd, *J* = 13.0, 6.4 Hz, 1H), 3.36 – 3.33 (m, 1H), 2.93 – 2.73 (m, 4H), 2.34 (s, 3H), 2.33 (s, 3H).

¹³C NMR (126 MHz, DMSO) δ_C 142.6, 142.5, 137.8, 137.5, 136.1, 136.1, 129.6 (2C), 129.6 (2C), 127.4, 126.5 (2C), 126.4 (2C), 125.9, 123.9, 123.6, 121.4, 121.2, 118.9, 118.6, 118.3, 118.0, 112.0, 111.6, 110.9, 109.8, 52.1, 45.9, 43.3, 25.4, 20.9.

HR-ESI-MS(*m/z*): calcd. for C₃₄H₃₄N₄O₄S₂ [M+H]⁺, 627.2094, found 627.2077.



3b

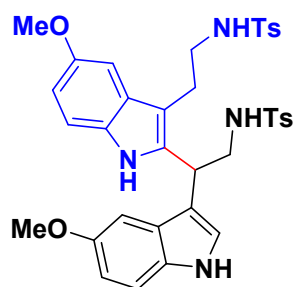
4-methyl-*N*-(2-(5-methyl-1*H*-indol-3-yl)-2-(5-methyl-3-(2-((4-methylphenyl)sulfonamido) ethyl)-1*H*-indol-2-yl)ethyl)benzene sulfonamide (3b)

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.5: 1). the title compound was obtained as a red solid (129.4 mg of **2b** and **3b** was obtained from 200 mg starting material, 65% yield, ratio (**3b**: **2b** > 19: 1)), m.p.:116~ 120 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 10.78 (d, *J* = 2.6 Hz, 1H), 10.52 (s, 1H), 7.74 – 7.70 (m, 2H), 7.68 (d, *J* = 8.2 Hz, 2H), 7.62 (d, *J* = 8.2 Hz, 2H), 7.34 (d, *J* = 8.1 Hz, 2H), 7.28 (d, *J* = 8.2 Hz, 2H), 7.19 (d, *J* = 8.2 Hz, 1H), 7.13 – 7.07 (m, 3H), 6.94 (s, 1H), 6.86 (d, *J* = 8.2 Hz, 1H), 6.79 (d, *J* = 8.4 Hz, 1H), 4.49 (dd, *J* = 7.7 Hz, 1H), 3.43 – 3.36 (m, 1H), 3.33 – 3.27 (m, 1H), 2.92 – 2.72 (m, 4H), 2.34 (s, 3H), 2.33 (s, 3H), 2.32 (s, 3H), 2.30 (s, 3H).

¹³C NMR (126 MHz, DMSO) δ_C 142.4, 142.4, 137.8, 137.6, 136.4, 134.3, 133.9, 129.5 (2C), 129.4 (2C), 127.8, 126.7, 126.5 (2C), 126.4, 126.4 (2C), 122.6, 122.6, 121.8, 117.5, 117.0, 113.3, 111.1, 110.6, 106.6, 46.6, 43.5, 34.3, 24.7, 21.2, 21.2, 20.9 (2C).

HR-ESI-MS(*m/z*): calcd. for C₃₆H₃₈N₄O₄S₂ [M+H]⁺, 655.2407, found 655.2413.



3c

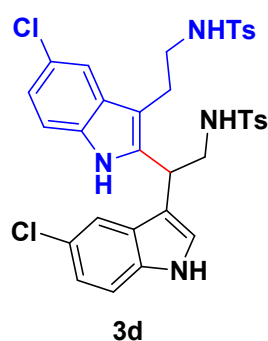
***N*-(2-(5-methoxy-1*H*-indol-3-yl)-2-(5-methoxy-3-(2-((4-methylphenyl)sulfonamido) ethyl)-1*H*-indol-2-yl) ethyl)-4-methylbenzenesulfonamide (3c)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2: 1). the title compound was obtained as a yellow solid (82.0 mg of **2c** and **3c** was obtained from 124.0 mg starting material, 66% yield, ratio (**3c**: **2c** = 3.0: 1)), m.p.:109~ 114 °C.

¹H NMR (400 MHz, DMSO-*d*₆) δ_H 10.77 (d, *J* = 2.7 Hz, 1H), 10.56 (s, 1H), 7.74 (q, *J* = 5.7, 5.3 Hz, 2H), 7.68 – 7.58 (m, 4H), 7.32 (d, *J* = 7.9 Hz, 2H), 7.28 (d, *J* = 8.1 Hz, 2H), 7.21 (d, *J* = 8.8 Hz, 1H), 7.13 – 7.07 (m, 2H), 6.75 (dd, *J* = 6.0, 2.4 Hz, 2H), 6.68 (dd, *J* = 8.7, 2.4 Hz, 1H), 6.63 (dd, *J* = 8.7, 2.4 Hz, 1H), 4.52 – 4.44 (m, 1H), 3.71 (s, 3H), 3.63 (s, 3H), 3.44 (dt, *J* = 12.8, 6.4 Hz, 1H), 3.34 – 3.27 (m, 1H), 2.91 – 2.74 (m, 4H), 2.33 (s, 6H).

¹³C NMR (126 MHz, DMSO) δ_C 153.0, 153.0, 142.5, 142.5, 137.8, 137.7, 137.0, 131.1, 130.7, 129.6 (2C), 129.5 (2C), 128.0, 126.6, 126.5 (2C), 126.4 (2C), 123.3, 113.6, 112.1, 111.6, 111.1, 110.2, 107.2, 99.9, 99.6, 55.3, 55.1, 46.5, 43.4, 34.7, 24.8, 20.9, 20.9.

HR-ESI-MS(*m/z*): calcd. for C₃₆H₃₈N₄O₆S₂ [M+H]⁺, 687.2306, found 687.2311.



***N*-(2-(5-chloro-1*H*-indol-3-yl)-2-(5-chloro-3-(2-((4-methylphenyl)sulfonamido)ethyl)-1*H*-indol-2-yl) ethyl)-4-methylbenzenesulfonamide (2n)**

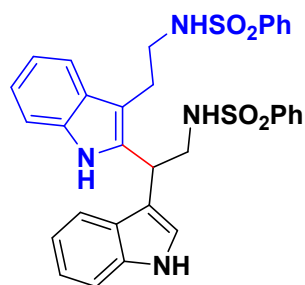
The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.5: 1). the title compound was obtained as a yellow solid (79.0 mg of **2d** and **3d** was obtained from 208.0 mg starting material, 38% yield, ratio (**3d**: **2d** = 7.0: 1)), m.p.:132~ 136 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 11.18 (d, *J* = 2.6 Hz, 1H), 10.96 (s, 1H), 7.75 (s, 1H), 7.67 (s, 1H), 7.63 (d, *J* = 8.2 Hz, 2H), 7.58 (d, *J* = 8.2 Hz, 2H), 7.34 (d, *J* = 8.6 Hz, 1H), 7.31 (d, *J* = 8.1 Hz, 2H), 7.27 (d, *J* = 1.7 Hz, 1H), 7.25 (s, 1H), 7.24 (d, *J* = 4.8 Hz, 2H), 7.22 (d, *J* = 5.3 Hz, 1H), 7.21 (s, 1H), 7.04 (dd, *J* = 8.6, 1.9 Hz, 1H), 6.98

(dd, $J = 8.6, 1.9$ Hz, 1H), 4.48 (dd, $J = 7.5$ Hz, 1H), 3.42 (ddd, $J = 11.6, 5.6$ Hz, 1H), 3.37 – 3.34 (m, 1H), 2.84 – 2.67 (m, 4H), 2.33 (s, 3H), 2.32 (s, 3H).

^{13}C NMR (151 MHz, DMSO) δ_{C} 142.5, 142.5, 137.9, 137.6, 137.6, 134.5, 134.0, 129.6 (2C), 129.5 (2C), 128.8, 127.3, 126.5 (2C), 126.3 (2C), 124.7, 123.2, 123.0, 121.1, 120.4, 117.2, 116.7, 113.3, 113.1, 112.4, 107.5, 46.4, 43.4, 34.4, 24.4, 21.0, 20.9.

HR-ESI-MS(m/z): calcd. for $\text{C}_{34}\text{H}_{32}\text{Cl}_2\text{N}_4\text{O}_4\text{S}_2$ $[\text{M}+\text{H}]^+$, 695.1315, found 695.1313.



3e

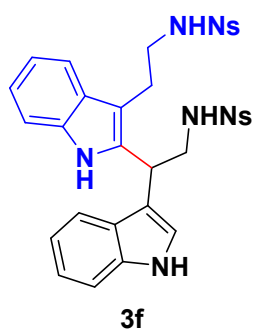
***N*-(2-(1*H*-indol-3-yl)-2-(3-(2-(phenylsulfonamido)ethyl)-1*H*-indol-2-yl)ethyl)benzene sulfonamide (3e)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2.5: 1). the title compound was obtained as a yellow solid (117.5 mg of **2e** and **3e** was obtained from 300.0 mg starting material, 39% yield, ratio (**3e**: **2e** > 19: 1)), m.p.: 87~ 92 °C.

^1H NMR (500 MHz, DMSO- d_6) δ_{H} 10.95 (d, $J = 2.5$ Hz, 1H), 10.72 (s, 1H), 7.87 – 7.82 (m, 2H), 7.80 – 7.77 (m, 2H), 7.76 – 7.73 (m, 2H), 7.63 – 7.50 (m, 4H), 7.50 (dd, $J = 7.6$ Hz, 2H), 7.35 (d, $J = 8.0$ Hz, 1H), 7.32 (d, $J = 8.1$ Hz, 1H), 7.26 – 7.19 (m, 3H), 7.03 (dd, $J = 7.5$ Hz, 1H), 6.99 – 6.96 (m, 1H), 6.93 – 6.87 (m, 2H), 4.57 (dd, $J = 7.6$ Hz, 1H), 3.48 (ddd, $J = 12.9, 6.6$ Hz, 1H), 3.42 – 3.36 (m, 1H), 2.97 – 2.76 (m, 4H).

^{13}C NMR (126 MHz, DMSO) δ_{C} 140.7, 140.5, 136.3, 135.9, 135.6, 132.3, 132.2, 129.2 (2C), 129.1 (2C), 127.6, 126.5 (2C), 126.4 (2C), 126.3, 122.6, 121.1, 120.4, 118.5, 118.2, 118.0, 117.4, 113.8, 111.4, 110.9, 107.2, 46.6, 43.6, 35.9, 24.9.

HR-ESI-MS(m/z): calcd. for $\text{C}_{32}\text{H}_{30}\text{N}_4\text{O}_4\text{S}_2$ $[\text{M}+\text{H}]^+$, 599.1781, found 599.1784.



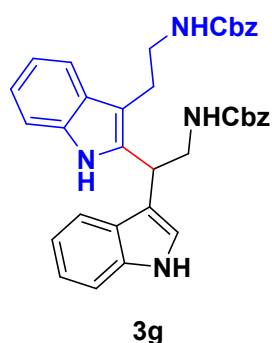
***N*-(2-(2-(1-(1*H*-indol-3-yl)-2-((4-nitrophenyl)sulfonamido)ethyl)-1*H*-indol-3-yl)ethyl)-4-nitrobenzenesulfonamide (3f)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 5: 1). the title compound was obtained as a yellow solid (83.0 mg of **2f** and **3f** was obtained from 159.6 mg starting material, 52% yield, ratio (**3f**: **2f** = 10: 1)), m.p.: 139~ 142 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 10.94 (s, 1H), 10.69 (s, 1H), 8.29 – 8.23 (m, 3H), 8.19 (s, 1H), 8.08 (d, *J* = 7.4 Hz, 2H), 7.90 (d, *J* = 7.5 Hz, 2H), 7.79 (d, *J* = 7.6 Hz, 2H), 7.31 (d, *J* = 7.8 Hz, 1H), 7.26 (d, *J* = 8.0 Hz, 1H), 7.23 (s, 1H), 7.21 (d, *J* = 7.8 Hz, 1H), 7.14 (d, *J* = 7.9 Hz, 1H), 6.98 (dd, *J* = 7.2 Hz, 1H), 6.93 (dd, *J* = 7.2 Hz, 1H), 6.87 – 6.82 (m, 2H), 4.53 – 4.49 (m, 1H), 3.60 (ddd, *J* = 14.8, 7.0 Hz, 2H), 2.98 – 2.78 (m, 4H).

¹³C NMR (126 MHz, DMSO) δ_C 149.3, 148.8, 146.3, 146.1, 136.1, 135.8, 135.4, 127.8 (2C), 127.5, 127.3 (2C), 126.1, 124.4 (2C), 124.0 (2C), 122.7, 121.0, 120.5, 118.4, 118.3, 117.8, 117.4, 113.5, 111.4, 110.9, 107.2, 46.6, 43.6, 34.3, 24.8.

HR-ESI-MS(*m/z*): calcd. for C₃₂H₂₈N₆O₈S₂ [M+H]⁺, 689.1483, found 689.1480.



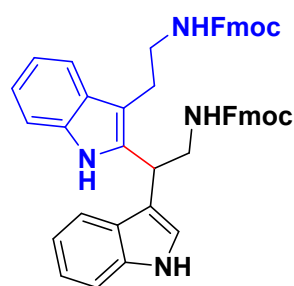
benzyl (2-(2-(2-(((benzyloxy)carbonyl)amino)-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl)ethyl)carbamate (3g)

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a white solid (40.0 mg of **2g** and **3g** was obtained from 58.9 mg starting material, 68% yield, ratio (**3g**: **2g** = 1: 2)), m.p.: 83~ 86 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 10.97 (s, 1H), 10.69 (s, 1H), 7.55 – 7.38 (m, 4H), 7.39 – 7.19 (m, 13H), 7.03 (dd, *J* = 7.5 Hz, 1H), 6.98 (dd, *J* = 7.5 Hz, 1H), 6.95 – 6.77 (m, 2H), 5.15 – 4.92 (m, 4H), 4.75 (dd, *J* = 8.3 Hz, 1H), 3.88 (ddd, *J* = 13.4, 6.4 Hz, 1H), 3.67 – 3.56 (m, 1H), 3.25 – 3.11 (m, 2H), 3.02 – 2.86 (m, 2H).

¹³C NMR (126 MHz, DMSO) δ_C 156.3, 156.2, 137.3, 137.2, 136.8, 136.0, 135.7, 128.4 (2C), 128.3 (2C), 128.1, 127.7 (2C), 127.7 (2C), 127.6, 126.8, 122.5, 121.0, 120.2, 118.4, 118.4, 118.0, 117.8, 114.2, 111.4, 110.9, 108.0, 65.1 (2C), 44.8, 41.7, 33.6, 24.9.

HR-ESI-MS(*m/z*): calcd. for C₃₆H₃₄N₄O₄ [M+H]⁺, 587.2653, found 587.2649.



3h

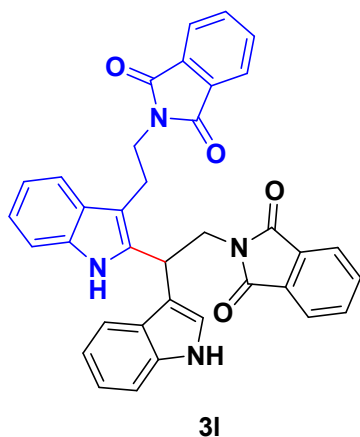
(9H-fluoren-9-yl)methyl (2-(2-(2-(((9H-fluoren-9-yl)methoxy)carbonyl)amino)-1-(1H-indol-3-yl)ethyl)-1H-indol-3-yl)ethyl)carbamate (3h)

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a white solid (110 mg of **2h** and **3h** was obtained from 191.2 mg starting material, 58% yield, ratio (**3h**: **2h** = 1: 2)), m.p.: 106~ 111 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_H 10.96 (s, 1H), 10.68 (s, 1H), 7.88 (d, *J* = 7.2 Hz, 2H), 7.83 (d, *J* = 6.9 Hz, 2H), 7.69 (d, *J* = 7.0 Hz, 2H), 7.62 – 7.59 (m, 1H), 7.58 (d, *J* = 7.1 Hz, 1H), 7.53 (d, *J* = 8.0 Hz, 1H), 7.51 – 7.46 (m, 3H), 7.42 – 7.38 (m, 2H), 7.36 – 7.29 (m, 6H), 7.24 (dd, *J* = 8.7 Hz, 2H), 7.18 (dd, *J* = 7.5 Hz, 1H), 7.03 (dd, *J* = 7.5 Hz, 1H), 6.98 (dd, *J* = 7.5 Hz, 1H), 6.94 – 6.90 (m, 2H), 4.76 (dd, *J* = 6.8 Hz, 1H), 4.35 – 4.30 (m, 1H), 4.28 (d, *J* = 7.1 Hz, 2H), 4.19 (d, *J* = 8.4 Hz, 2H), 4.15 (t, *J* = 6.8 Hz, 1H), 3.93 – 3.85 (m, 1H), 3.64 – 3.57 (m, 1H), 3.22 – 3.15 (m, 2H), 3.00 – 2.88 (m, 2H).

^{13}C NMR (151 MHz, DMSO) δ_{C} 156.3, 156.2, 144.0, 143.8, 142.6, 140.8, 140.7, 140.7, 139.4, 137.4, 136.8, 136.0, 135.7, 129.0, 128.1, 127.6, 127.6, 127.5, 127.3, 127.1, 127.0, 126.8, 125.2, 125.1, 122.5, 121.4, 121.0, 120.3, 120.1, 120.1, 118.4, 118.4, 118.1, 117.8, 114.3, 111.4, 110.9, 109.8, 108.0, 65.5, 65.3, 46.8, 46.6, 44.7, 41.7, 33.7, 25.0.

HR-ESI-MS(m/z): calcd. for $\text{C}_{50}\text{H}_{42}\text{N}_4\text{O}_4$ $[\text{M}+\text{H}]^+$, 763.3279, found 763.3266.



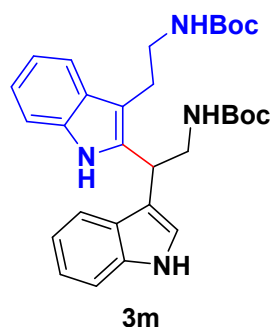
2-(2-(2-(2-(1,3-dioxoisindolin-2-yl)-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl) ethyl) isoindoline-1,3-dione (31)

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 3: 1). the title compound was obtained as a white solid (201 mg of **21** and **31** was obtained from 300 mg starting material, 67% yield, ratio (**31**: **21** > 19: 1)), m.p.: 289~ 291 °C.

^1H NMR (400 MHz, DMSO- d_6) δ_{H} 11.02 (s, 1H), 10.94 (d, $J = 2.7$ Hz, 1H), 7.80 – 7.73 (m, 4H), 7.73 – 7.68 (m, 4H), 7.59 (d, $J = 7.9$ Hz, 1H), 7.44 (d, $J = 7.8$ Hz, 1H), 7.42 (d, $J = 2.7$ Hz, 1H), 7.30 (d, $J = 8.1$ Hz, 1H), 7.25 (d, $J = 8.1$ Hz, 1H), 7.04 – 6.96 (m, 2H), 6.94 – 6.85 (m, 2H), 5.10 (dd, $J = 7.9$ Hz, 1H), 4.39 (dd, $J = 13.5, 7.2$ Hz, 1H), 4.29 (dd, $J = 13.6, 8.7$ Hz, 1H), 3.72 (ddd, $J = 13.3, 9.0, 7.1$ Hz, 1H), 3.60 (ddd, $J = 13.7, 9.3, 5.0$ Hz, 1H), 3.05 (ddd, $J = 13.7, 9.3, 7.2$ Hz, 1H), 2.93 (ddd, $J = 13.9, 9.2, 4.9$ Hz, 1H).

^{13}C NMR (101 MHz, DMSO) δ_{C} 167.8 (2C), 167.7 (2C), 135.9 (2C), 135.8, 134.5 (2C), 134.1 (2C), 131.5 (2C), 131.3 (2C), 127.5, 126.5, 123.1 (2C), 122.8, 122.7 (2C), 121.1, 120.7, 118.6, 118.3, 118.0, 117.6, 112.9, 111.5, 111.1, 107.3, 42.1, 38.2, 32.0, 23.0.

HR-ESI-MS(m/z): calcd. for $\text{C}_{36}\text{H}_{26}\text{N}_4\text{O}_4$ $[\text{M}+\text{H}]^+$, 579.2027, found 579.2028.



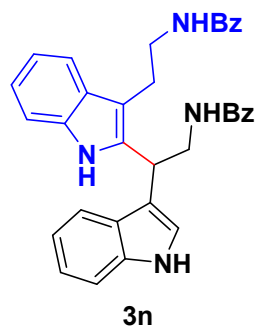
***tert*-butyl(2-(2-(2-((*tert*-butoxycarbonyl)amino)-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl)ethyl)carbamate (**3m**)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 4: 1). the title compound was obtained as a white solid (74 mg of **2m** and **3m** was obtained from 200 mg starting material, 37% yield, ratio (**3m**: **2m** > 19: 1)), m.p.: 106~ 110 °C.

¹H NMR (500 MHz, DMSO-*d*₆) δ_H 10.93 (s, 1H), 10.58 (s, 1H), 7.50 (d, *J* = 7.9 Hz, 1H), 7.46 (d, *J* = 7.7 Hz, 1H), 7.33 – 7.30 (m, 2H), 7.23 (d, *J* = 7.9 Hz, 1H), 7.03 (t, *J* = 7.5 Hz, 1H), 6.97 (t, *J* = 7.4 Hz, 1H), 6.91 (td, *J* = 7.2, 2.2 Hz, 2H), 6.88 (s, 1H), 6.86 (s, 1H), 4.70 (dd, *J* = 7.6 Hz, 1H), 3.80 (ddd, *J* = 12.9, 6.3 Hz, 1H), 3.54 – 3.45 (m, 1H), 3.19 – 3.04 (m, 2H), 2.95 – 2.82 (m, 2H), 1.39 (s, 9H), 1.34 (s, 9H).

¹³C NMR (151 MHz, DMSO) δ_C 155.7, 155.6, 136.9, 136.0, 135.7, 128.2, 126.8, 122.4, 121.0, 120.1, 118.5, 118.3, 117.9, 117.8, 114.4, 111.3, 110.8, 108.2, 77.6, 77.4, 44.4, 41.4, 33.6, 28.3 (3C), 28.2 (3C), 24.7.

HR-ESI-MS(*m/z*): calcd. for C₃₀H₃₈N₄O₄ [M+H]⁺, 519.2966, found 519.2972.



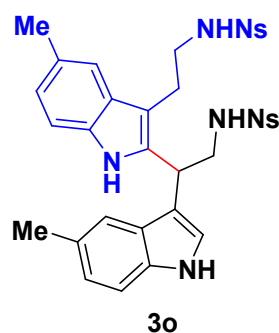
***N*-(2-(2-(2-benzamido-1-(1*H*-indol-3-yl)ethyl)-1*H*-indol-3-yl)ethyl)benzamide (**3n**)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 2: 1). the title compound was obtained as a yellow solid (68.0 mg of **2n** and **3n** was obtained from 158.0 mg starting material, 43% yield, ratio (**3n**: **2n** = 6: 1)), m.p.: 234~ 235 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_{H} 10.98 (d, *J* = 2.6 Hz, 1H), 10.70 (s, 1H), 8.67 (dd, *J* = 5.7 Hz, 1H), 8.64 (dd, *J* = 5.7 Hz, 1H), 7.86 (d, *J* = 7.3 Hz, 2H), 7.75 (d, *J* = 7.4 Hz, 2H), 7.59 (d, *J* = 8.0 Hz, 1H), 7.57 (d, *J* = 7.8 Hz, 1H), 7.51 (dd, *J* = 7.3 Hz, 1H), 7.47 – 7.42 (m, 4H), 7.38 (dd, *J* = 7.6 Hz, 2H), 7.33 (d, *J* = 8.1 Hz, 1H), 7.26 (d, *J* = 8.0 Hz, 1H), 7.03 (dd, *J* = 7.5 Hz, 1H), 6.98 (dd, *J* = 7.5 Hz, 1H), 6.94 – 6.87 (m, 2H), 5.01 (dd, *J* = 7.6 Hz, 1H), 4.24 (dd, *J* = 13.1, 6.7 Hz, 1H), 3.82 (ddd, *J* = 13.1, 8.1, 5.3 Hz, 1H), 3.52 – 3.42 (m, 2H), 3.13 – 2.98 (m, 2H).

¹³C NMR (151 MHz, DMSO) δ_{C} 166.7, 166.1, 137.0, 136.1, 135.7, 134.7, 134.7, 131.0, 128.2, 128.1, 127.2, 127.2, 126.9, 122.6, 121.0, 120.2, 118.6, 118.4, 118.0, 118.0, 114.4, 111.3, 110.9, 108.1, 44.0, 40.7, 33.5, 24.6.

HR-ESI-MS(*m/z*): calcd. for C₃₄H₃₀N₄O₂ [M+H]⁺, 527.2447, found 527.2444.



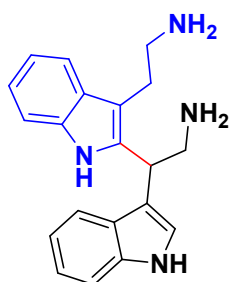
***N*-(2-(5-methyl-1*H*-indol-3-yl)-2-(5-methyl-3-(2-((4-nitrophenyl)sulfonamido)ethyl)-1*H*-indol-2-yl)ethyl)-4-nitrobenzenesulfonamide (3o)**

The reaction mixture was stirred at 25 °C for 30 min. the crude product was purification by silica gel flash column chromatography (petroleum ether: ethyl acetate = 4: 1). the title compound was obtained as a red solid (180.5 mg of **2o** and **3o** was obtained from 300 mg starting material, 60% yield, ratio (**3o**: **2o** > 19: 1)), m.p.: 127~ 130 °C.

¹H NMR (600 MHz, DMSO-*d*₆) δ_{H} 10.79 (s, 1H), 10.51 (s, 1H), 8.28 – 8.23 (m, 3H), 8.16 (s, 1H), 8.00 (d, *J* = 7.9 Hz, 2H), 7.90 (d, *J* = 8.0 Hz, 2H), 7.73 (d, *J* = 7.8 Hz, 2H), 7.17 – 7.12 (m, 2H), 7.10 (s, 1H), 7.00 (d, *J* = 8.1 Hz, 1H), 6.88 (s, 1H), 6.82 (d, *J* = 8.1 Hz, 1H), 6.72 (d, *J* = 8.1 Hz, 1H), 4.45 (dd, *J* = 7.2 Hz, 1H), 3.62 – 3.57 (m, 2H), 2.93 – 2.71 (m, 4H), 2.27 (s, 6H).

¹³C NMR (126 MHz, DMSO) δ_{C} 149.3, 148.6, 146.4, 146.1, 136.1, 134.2, 133.7, 127.9 (2C), 127.7, 127.1 (2C), 126.9, 126.6, 126.4, 124.4 (2C), 123.8 (2C), 122.8, 122.7, 122.0, 117.5, 117.0, 113.0, 111.1, 110.7, 106.7, 46.7, 43.6, 34.3, 24.7, 21.2, 21.2.

HR-ESI-MS(*m/z*): calcd. for C₃₄H₃₂N₆O₈S₂ [M+H]⁺, 717.1796, found 717.1796.



6,6'-Bis-(de bromo)-gelliusine F

To a solution of **3I** (87 mg, 0.15 mmol) in EtOH (2 mL) was added Hydrazine hydrate (0.56 mL, 80%, 0.9 mmol), which was stirred at room temperature for 4 h until the reaction was completed as indicated by TLC. The reaction mixture was filtered. The filtrate was concentrated under the reduced pressure. The residue was dissolved in water and ethyl acetate, which was charged with 1M aq. HCl solution to *pH* = 3, which was adjusted with 4% aq. NaOH solution to *pH* = 12 and extracted with ethyl acetate. The combined organic layers were washed with brine, dried over Na₂SO₄ and concentrated under vacuum. The crude product was purified with reverse column chromatography (C₁₈, MeOH/H₂O = 10%-70%) to give the title compound as a yellow solid (32 mg, 70% yield).

¹H NMR (400 MHz, DMSO-*d*₆) δ_{H} 10.98 (s, 1H), 10.66 (s, 1H), 7.49 (d, *J* = 7.9 Hz, 1H), 7.45 (d, *J* = 7.7 Hz, 1H), 7.33 (d, *J* = 8.1 Hz, 1H), 7.30 (s, 1H), 7.26 (d, *J* = 7.9 Hz, 1H), 7.03 (dd, *J* = 7.5 Hz, 1H), 6.97 (dd, *J* = 7.3 Hz, 1H), 6.94 – 6.87 (m, 2H), 4.56 (t, *J* = 7.2 Hz, 1H), 3.29 (d, *J* = 7.2 Hz, 2H), 2.94 (t, *J* = 6.8 Hz, 2H), 2.88 – 2.73 (m, 2H).

¹³C NMR (101 MHz, DMSO) δ_{C} 137.7, 136.0, 135.7, 128.1, 126.8, 122.2, 120.9, 120.1, 118.4, 118.3, 118.0, 117.8, 115.3, 111.4, 110.8, 108.6, 46.0, 42.5, 37.0, 27.5.

HR-EI-MS(*m/z*): calcd. for C₂₀H₂₂N₄ [M]⁺, 318.1846, found 318.1844.

Figure S1. The ^1H -NMR spectra copy of compound 2a.

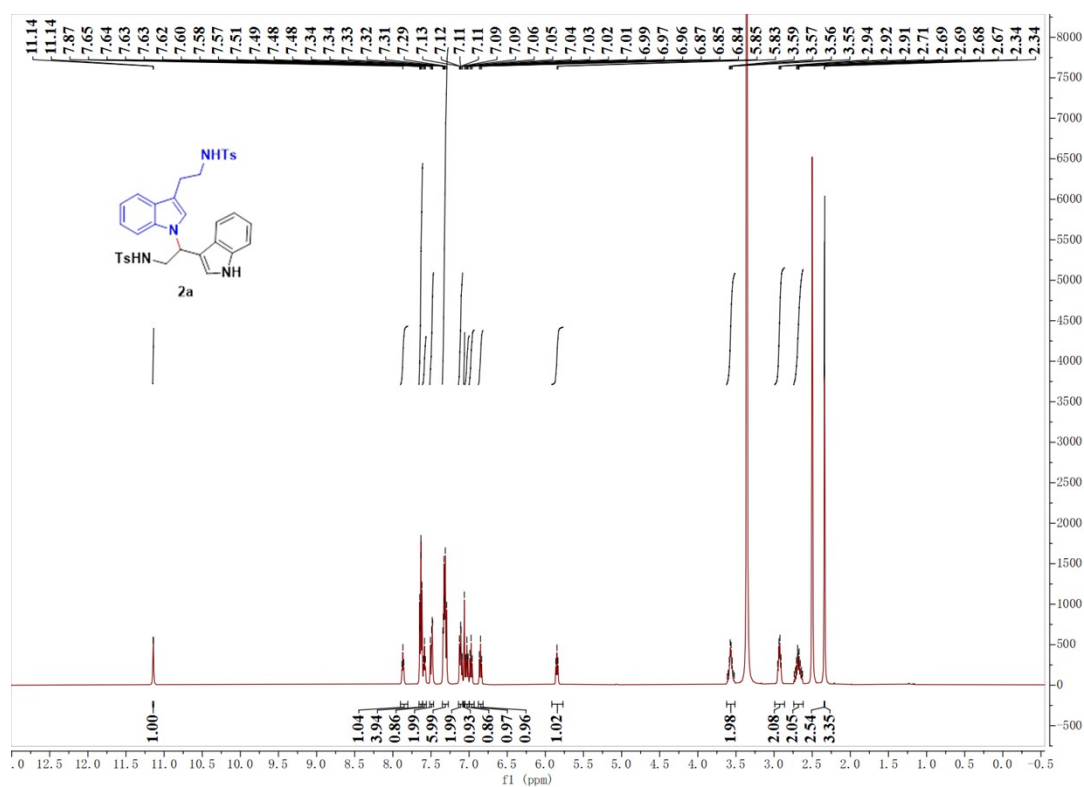


Figure S2. The ^{13}C -NMR spectra copy of compound 2a.

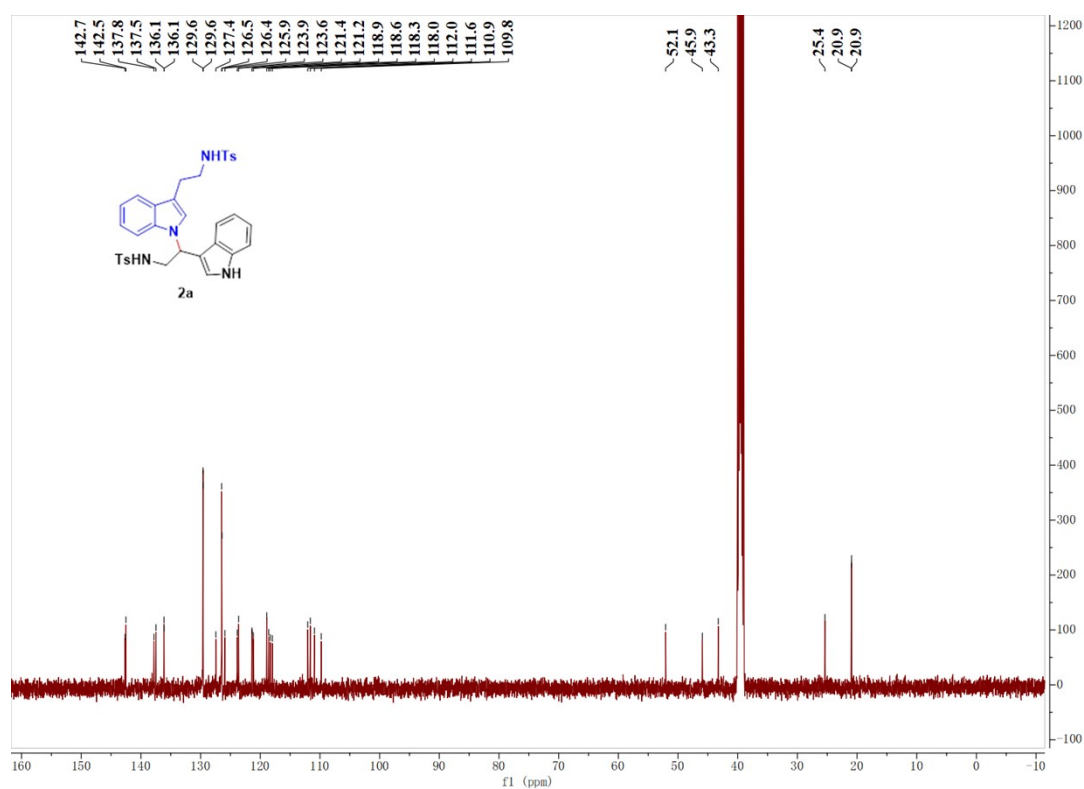


Figure S3. The ¹H-NMR spectra copy of compound 2b.

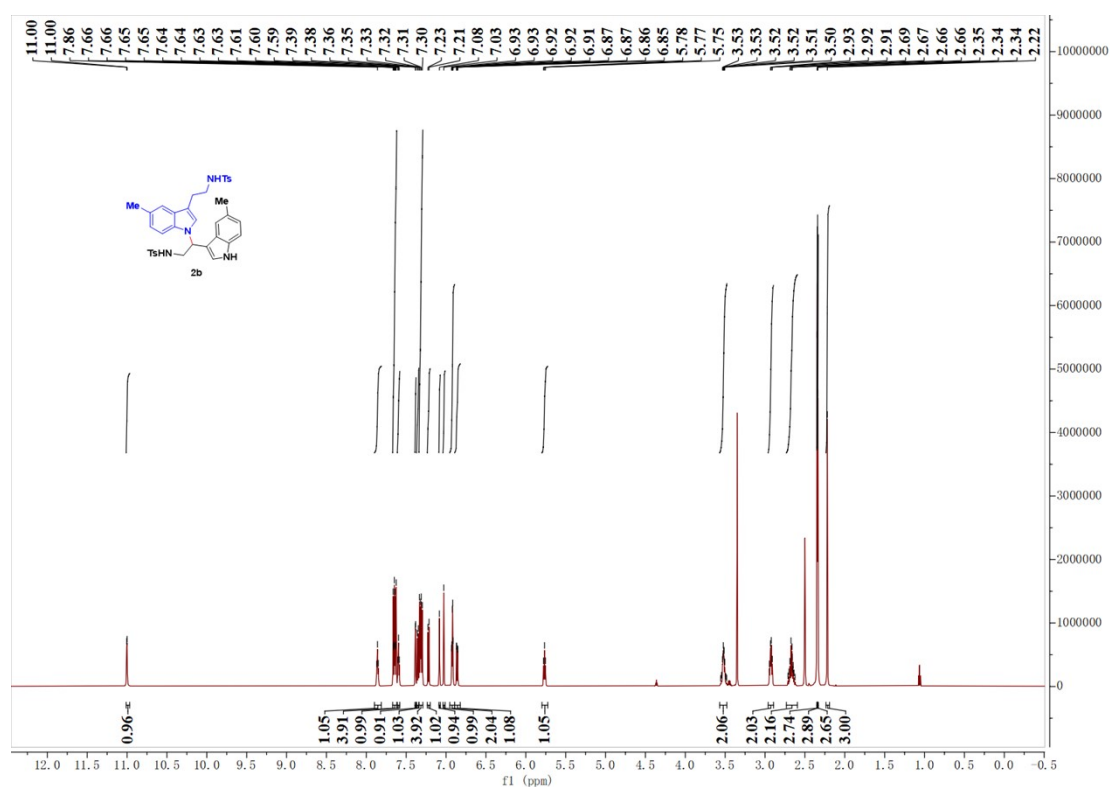


Figure S4. The ¹³C-NMR spectra copy of compound 2b.

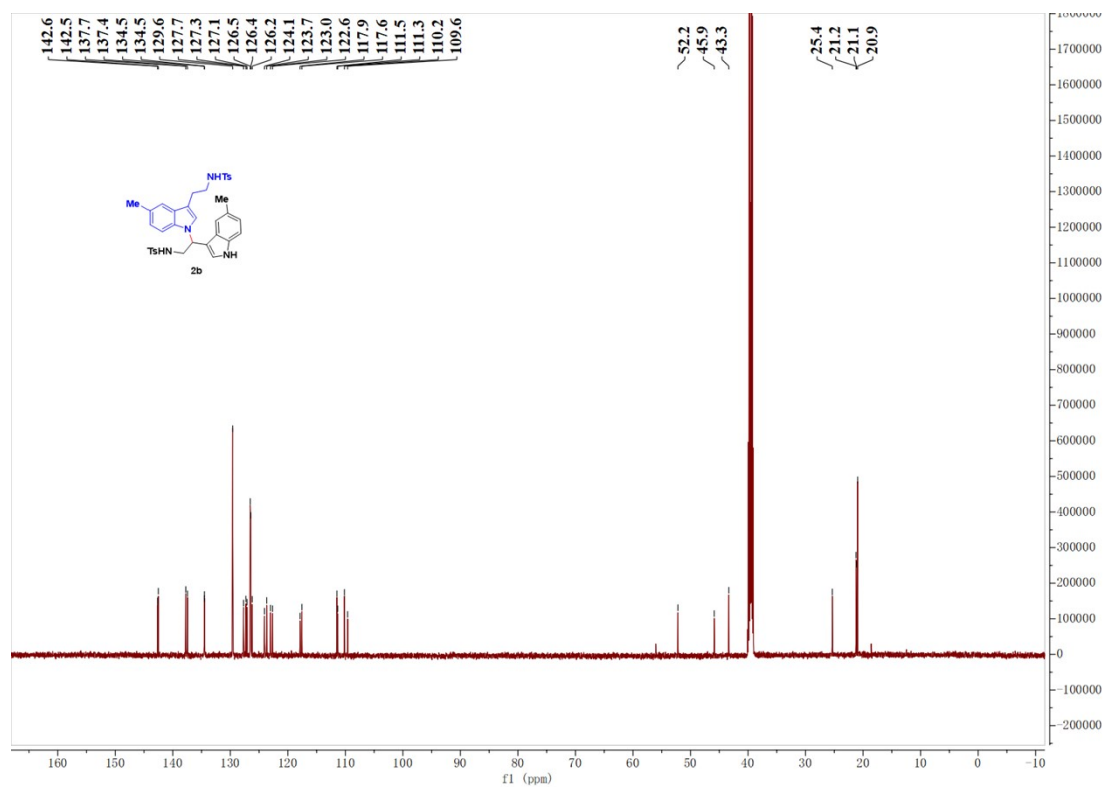


Figure S5. The $^1\text{H-NMR}$ spectra copy of compound 2c.

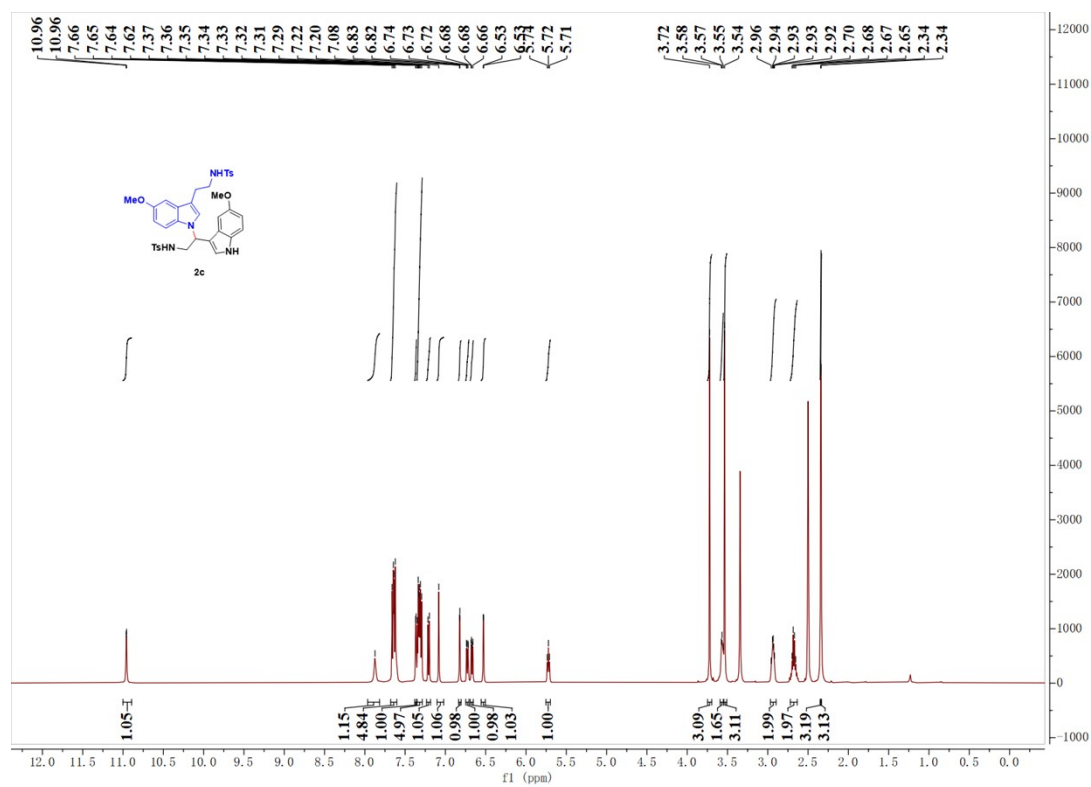


Figure S6. The $^{13}\text{C-NMR}$ spectra copy of compound 2c.

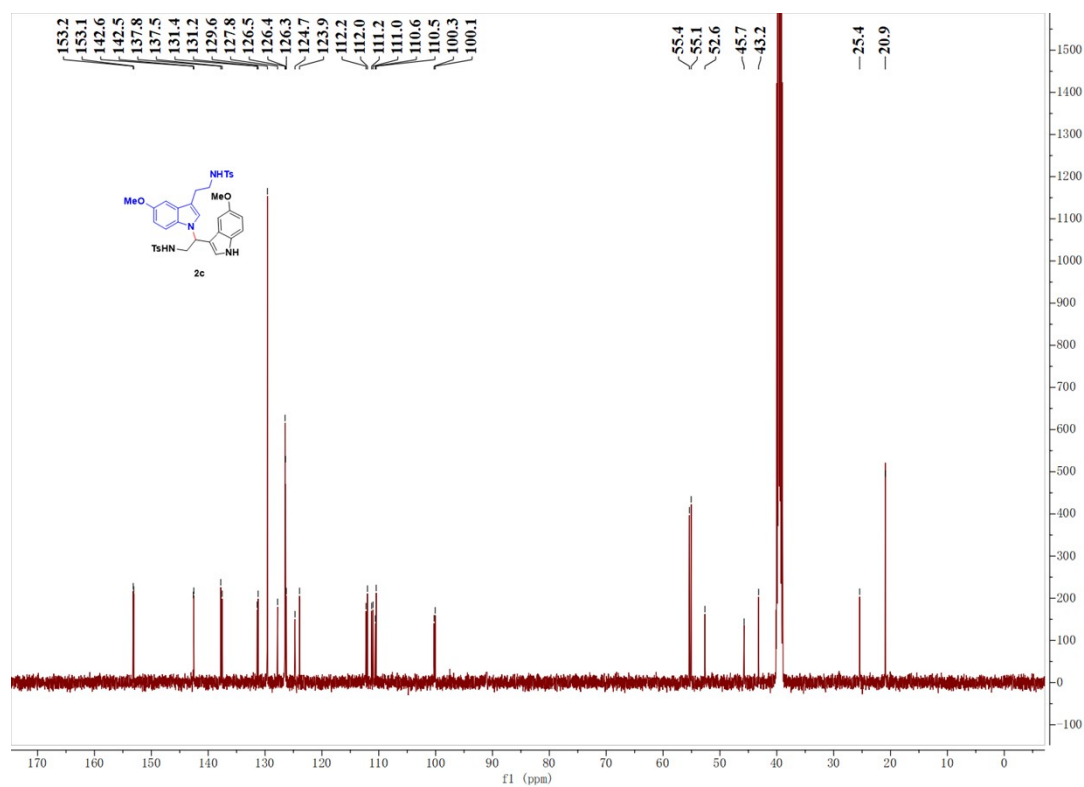


Figure S7. The ^1H -NMR spectra copy of compound 2d.

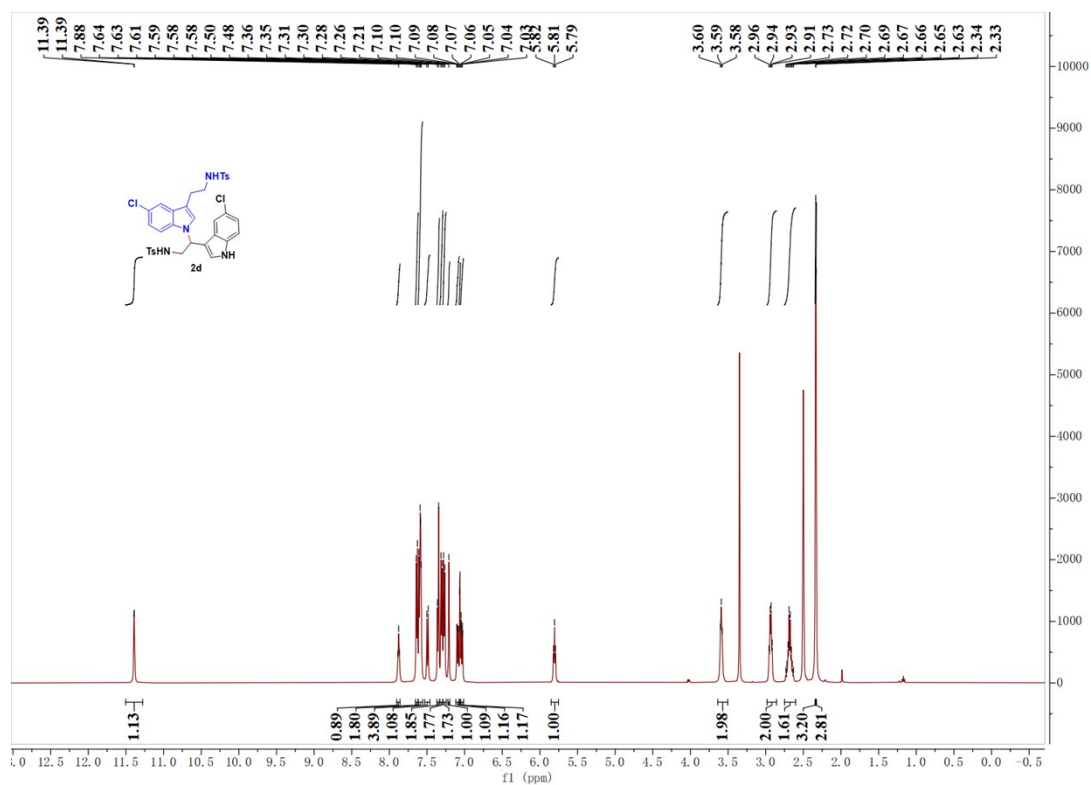


Figure S8. The ^{13}C -NMR spectra copy of compound 2d.

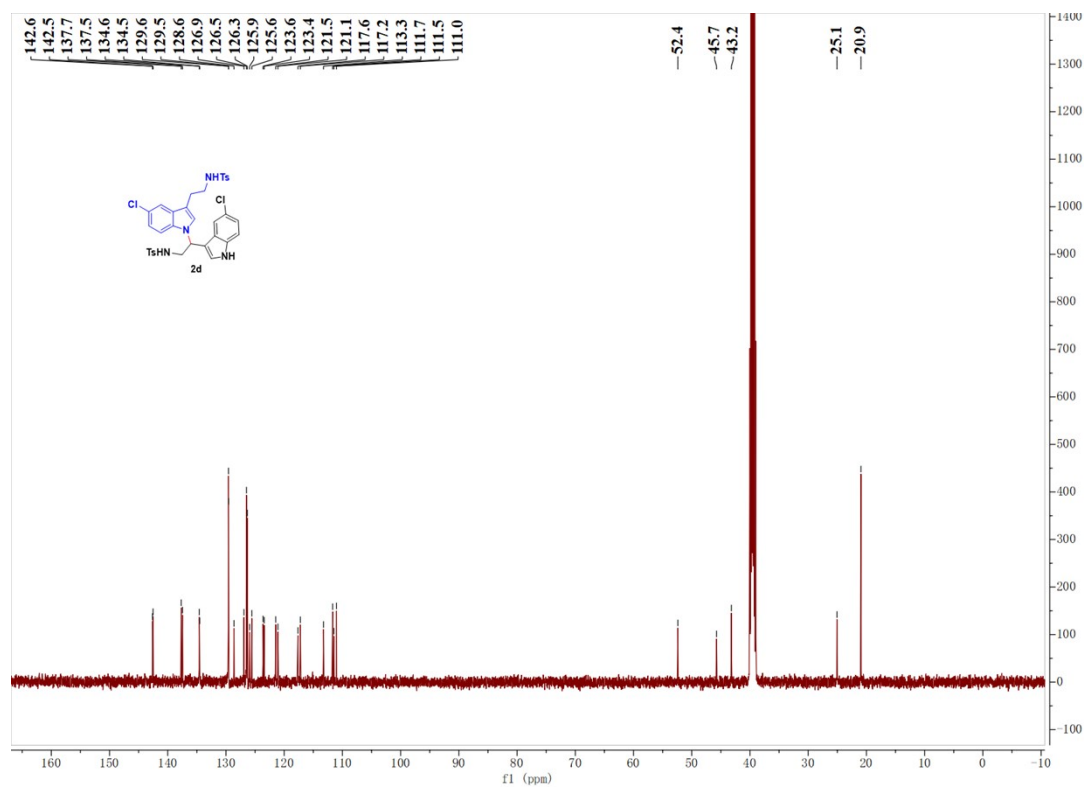


Figure S9. The $^1\text{H-NMR}$ spectra copy of compound 2e.

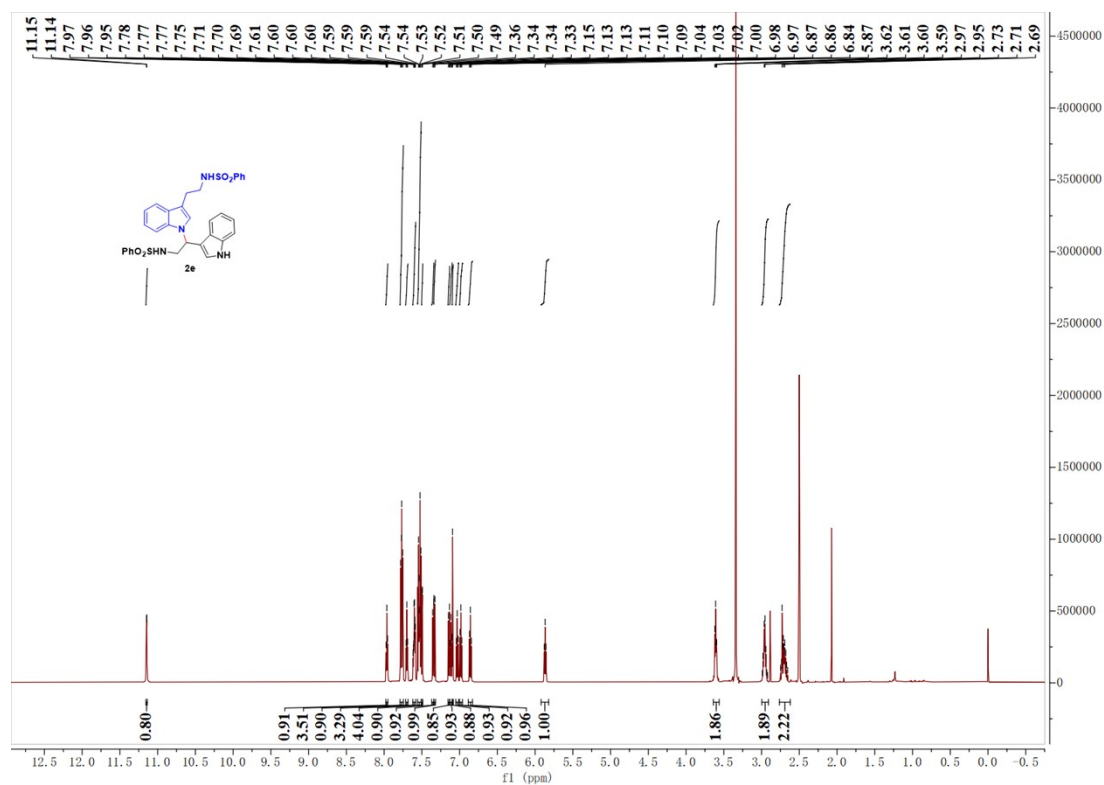


Figure S10. The $^{13}\text{C-NMR}$ spectra copy of compound 2e.

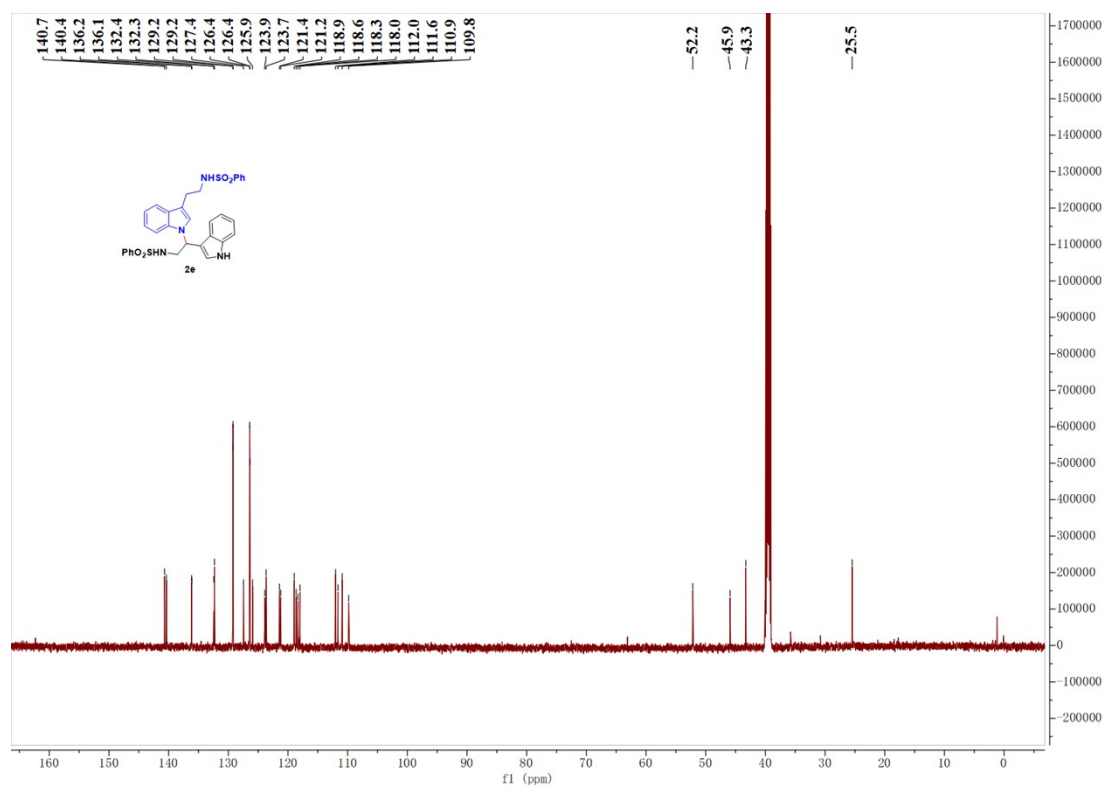


Figure S11. The ^1H -NMR spectra copy of compound 2f.

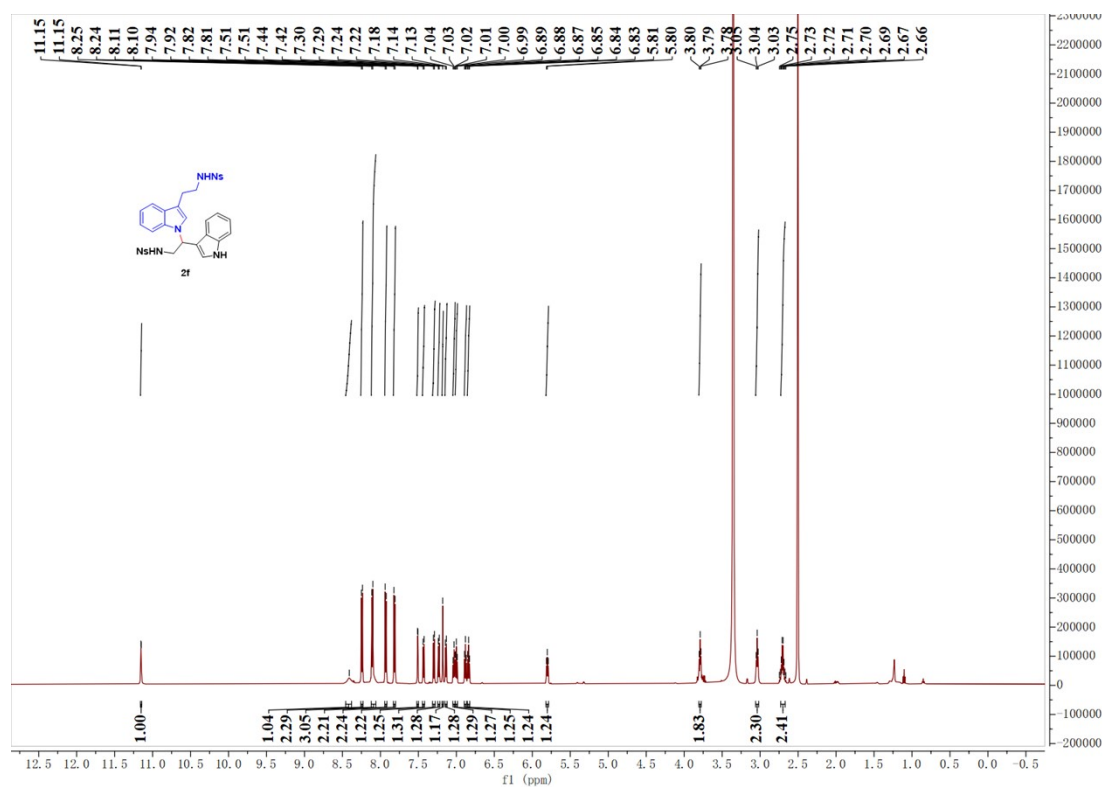


Figure S12. The ^{13}C -NMR spectra copy of compound 2f.

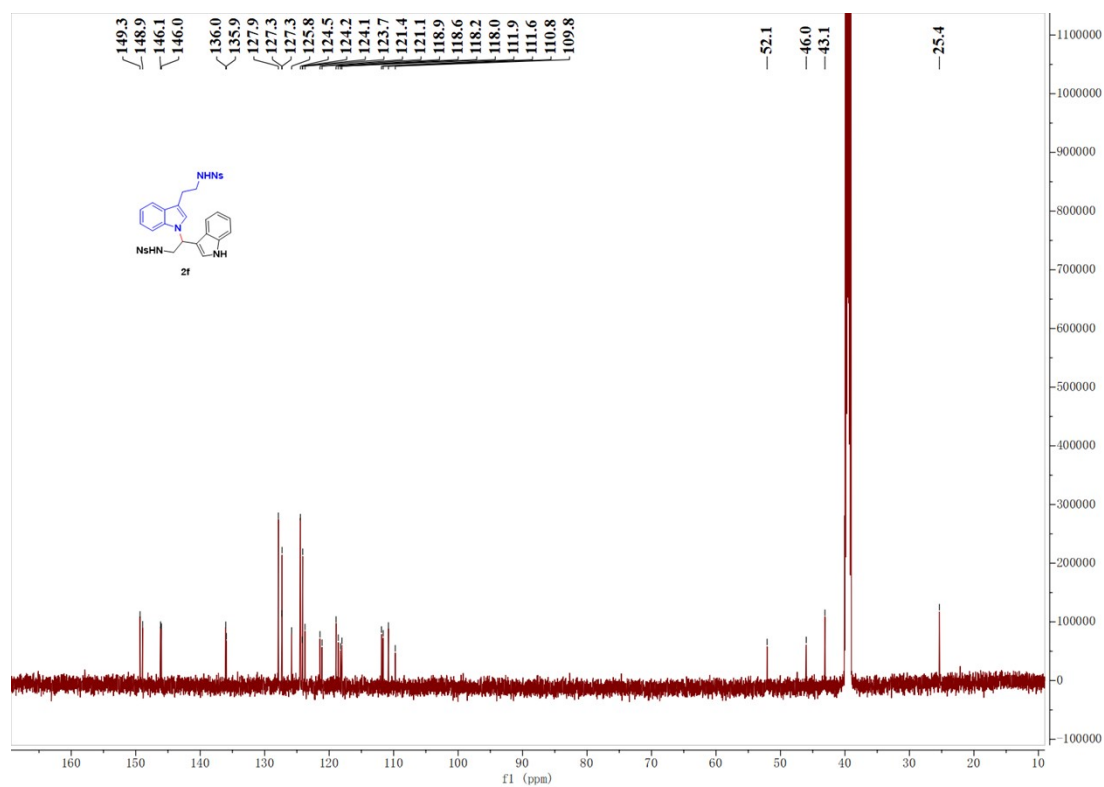


Figure S13. The ^1H -NMR spectra copy of compound 2g.

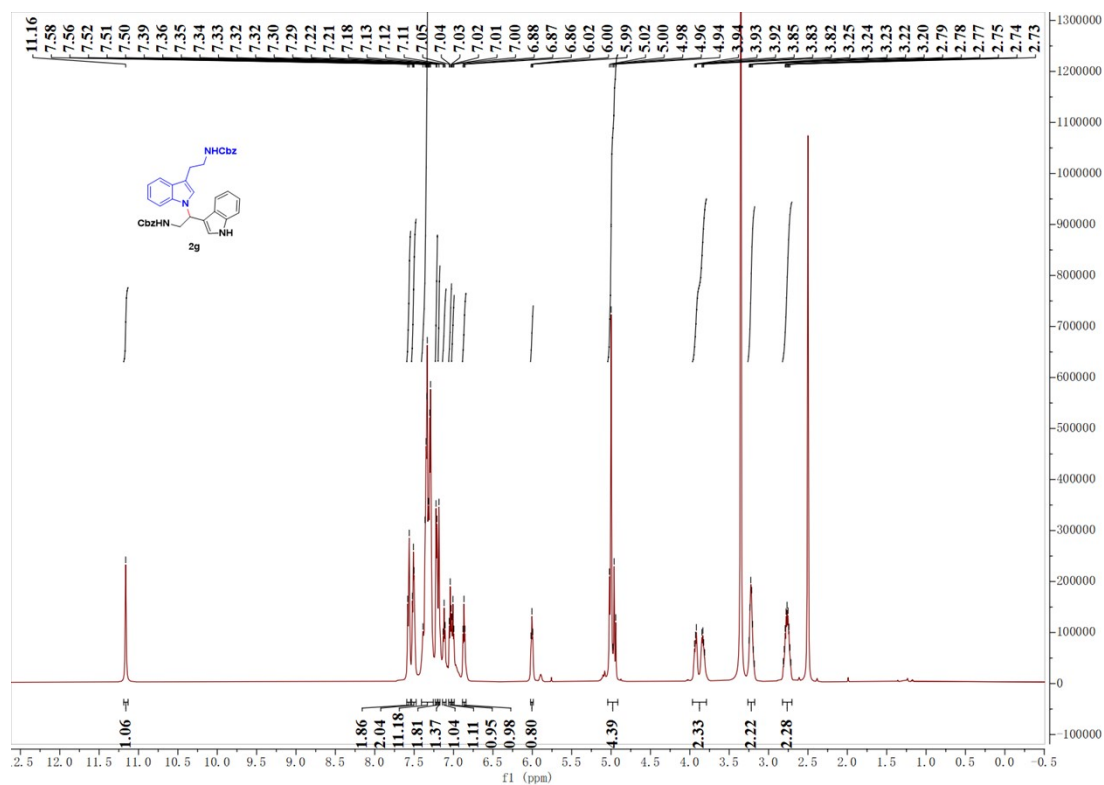


Figure S14. The ^{13}C -NMR spectra copy of compound 2g.

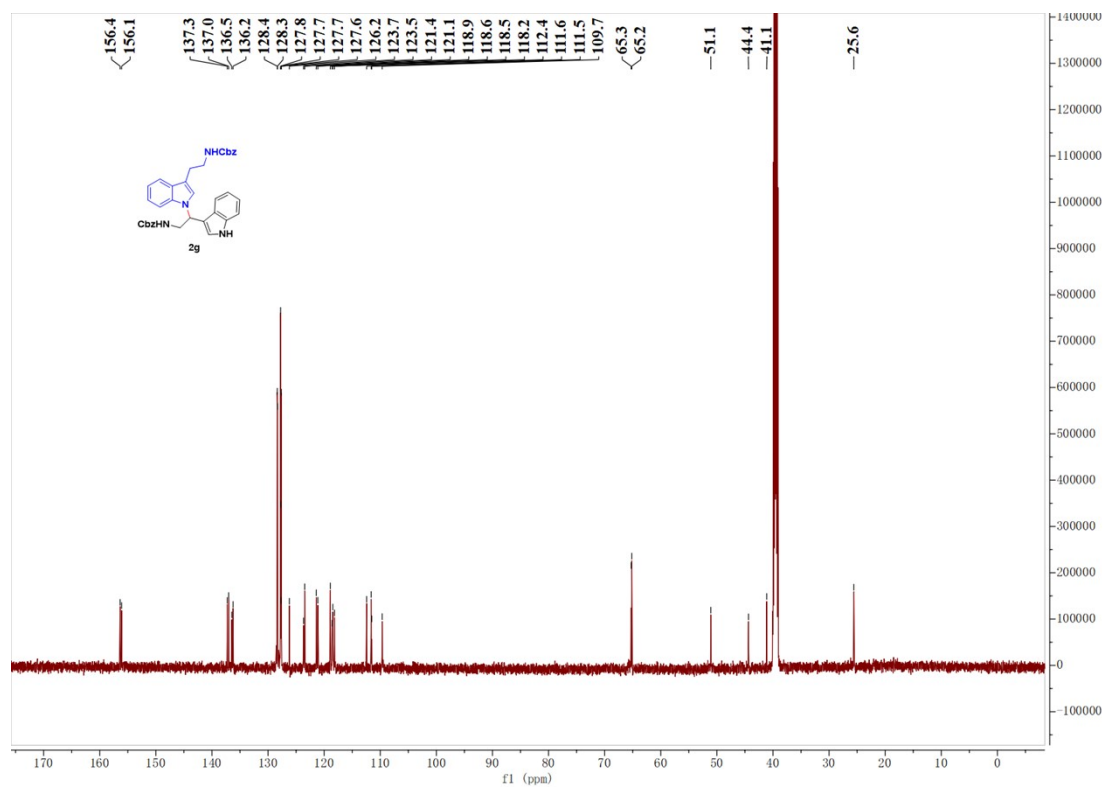


Figure S15. The $^1\text{H-NMR}$ spectra copy of compound 2h.

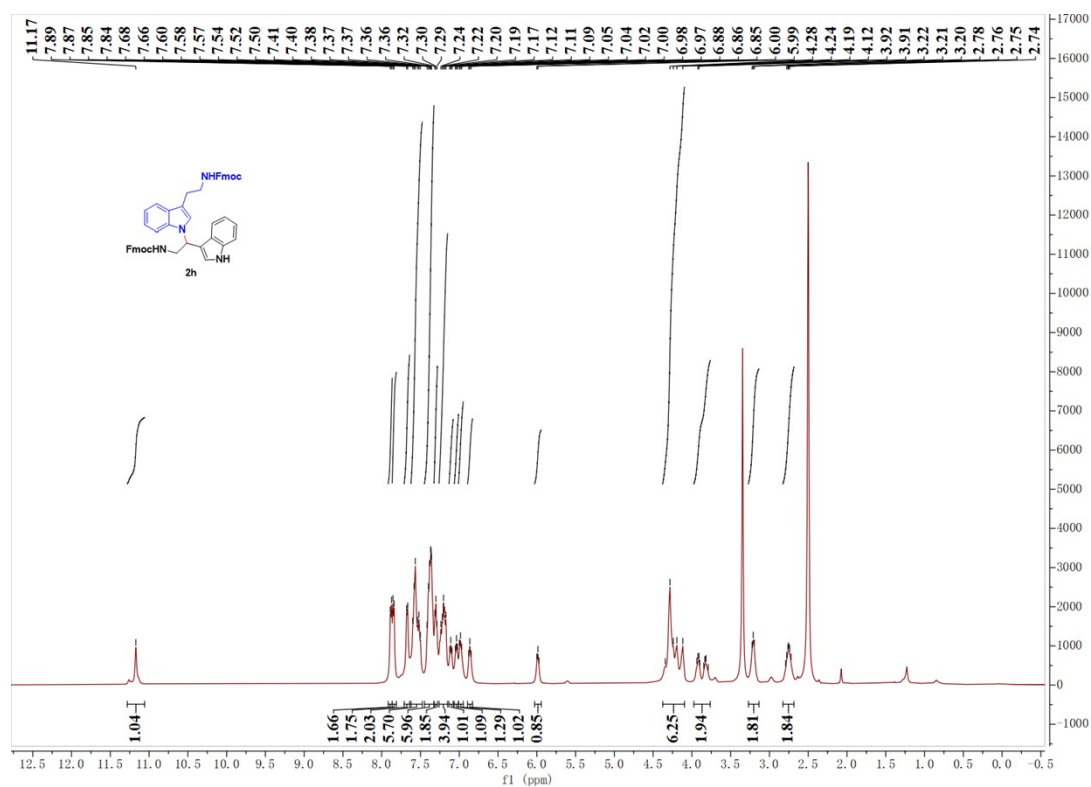


Figure S16. The $^{13}\text{C-NMR}$ spectra copy of compound 2h.

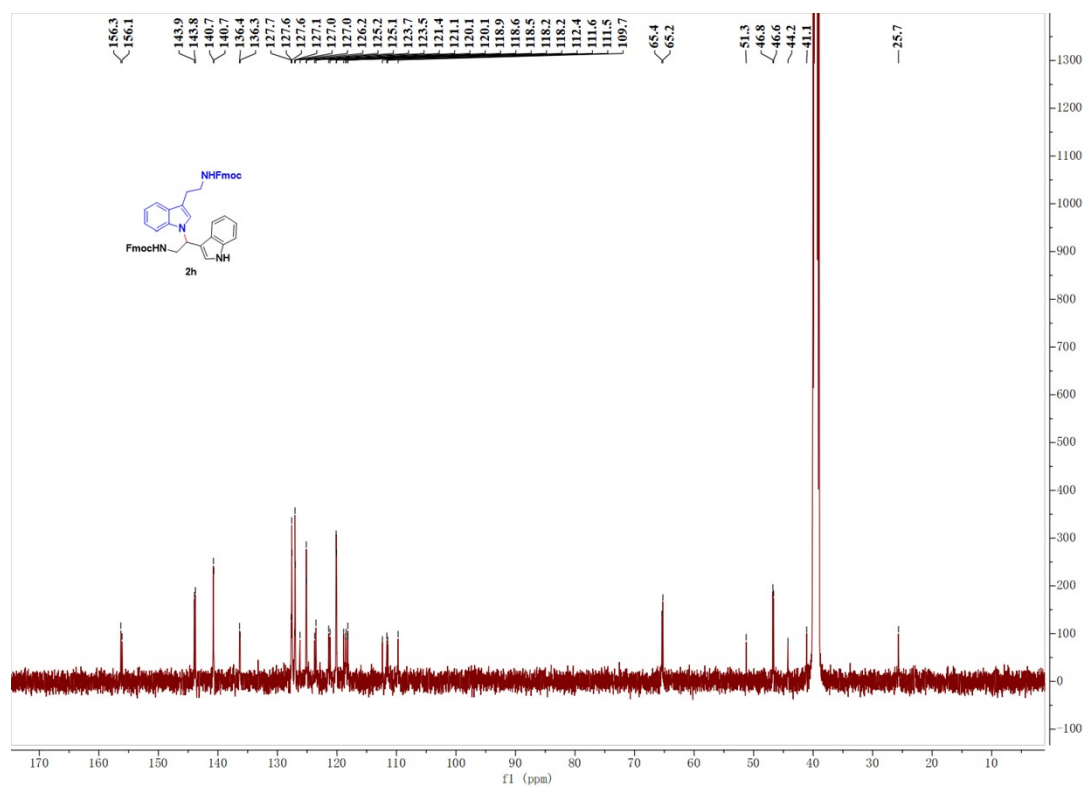


Figure S17. The ^1H -NMR spectra copy of compound 2i.

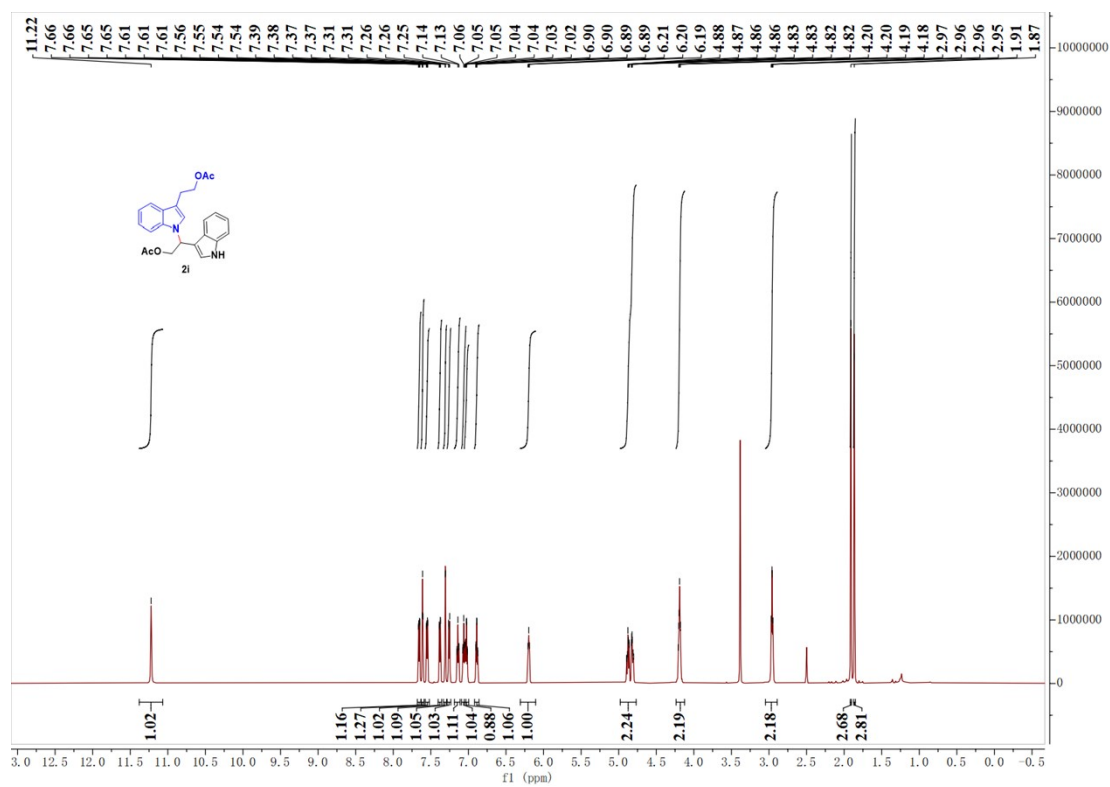


Figure S18. The ^{13}C -NMR spectra copy of compound 2i.

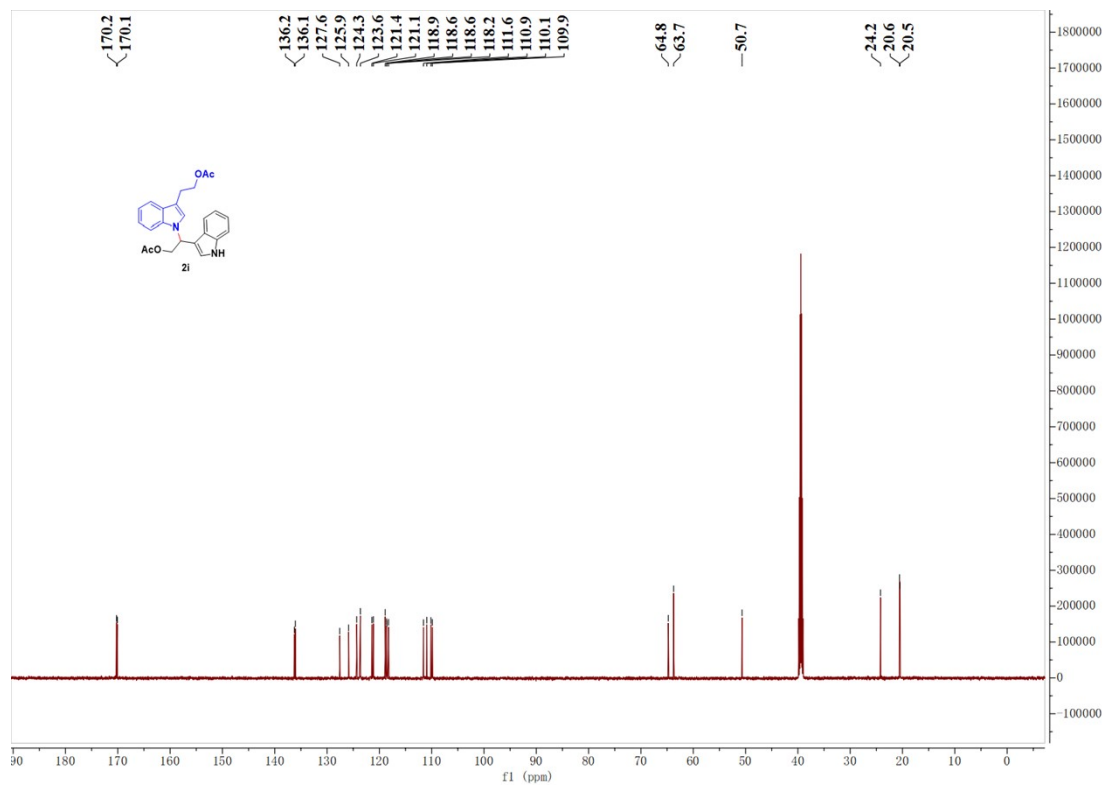


Figure S19. The ^1H -NMR spectra copy of compound 2j.

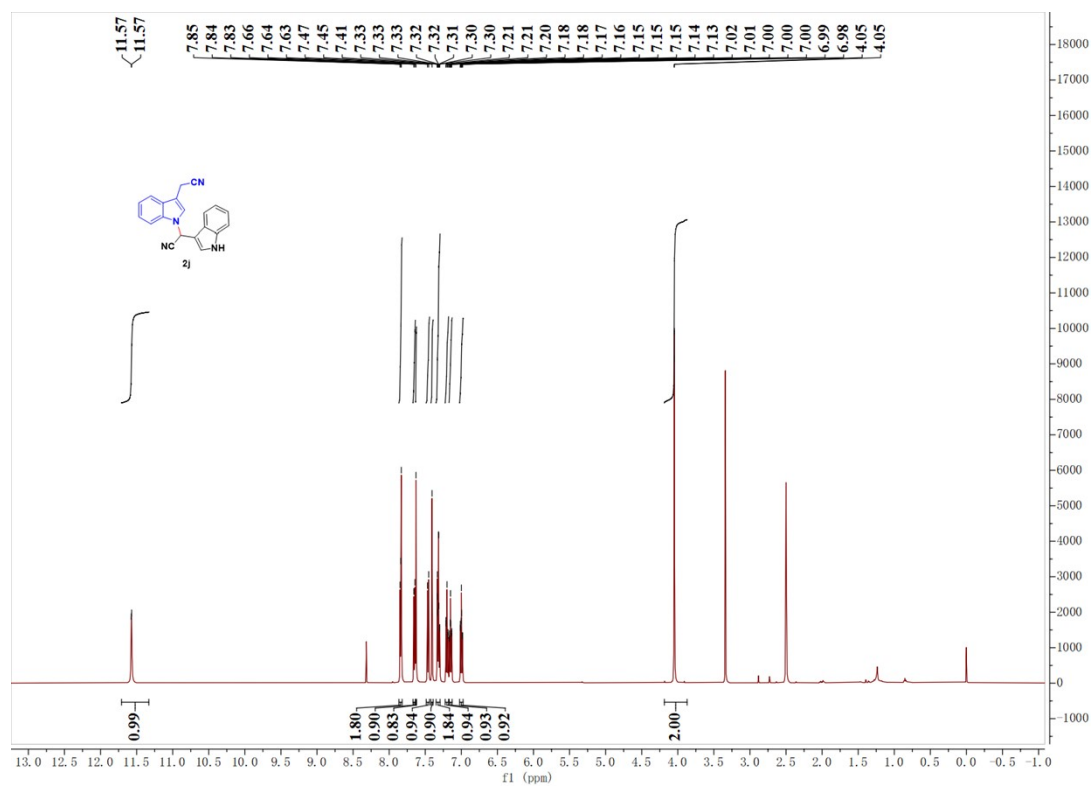


Figure S20. The ^{13}C -NMR spectra copy of compound 2j.

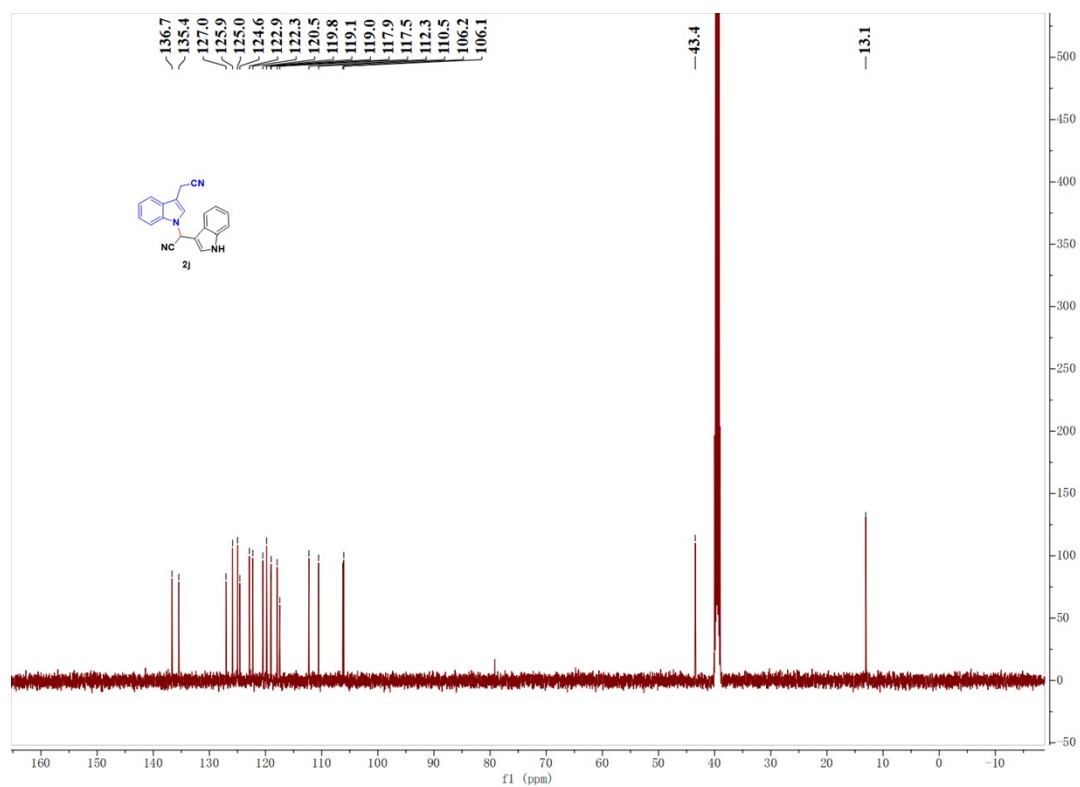


Figure S21. The ^1H -NMR spectra copy of compound 2l.

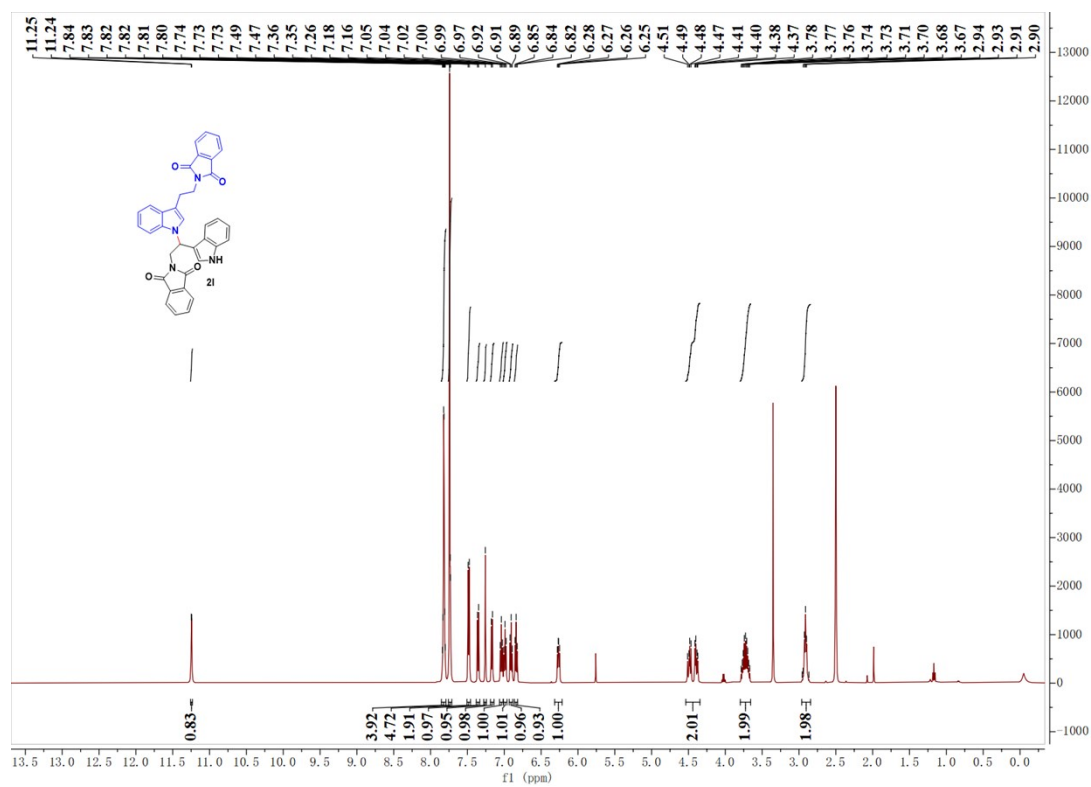


Figure S22. The ^{13}C -NMR spectra copy of compound 2l.

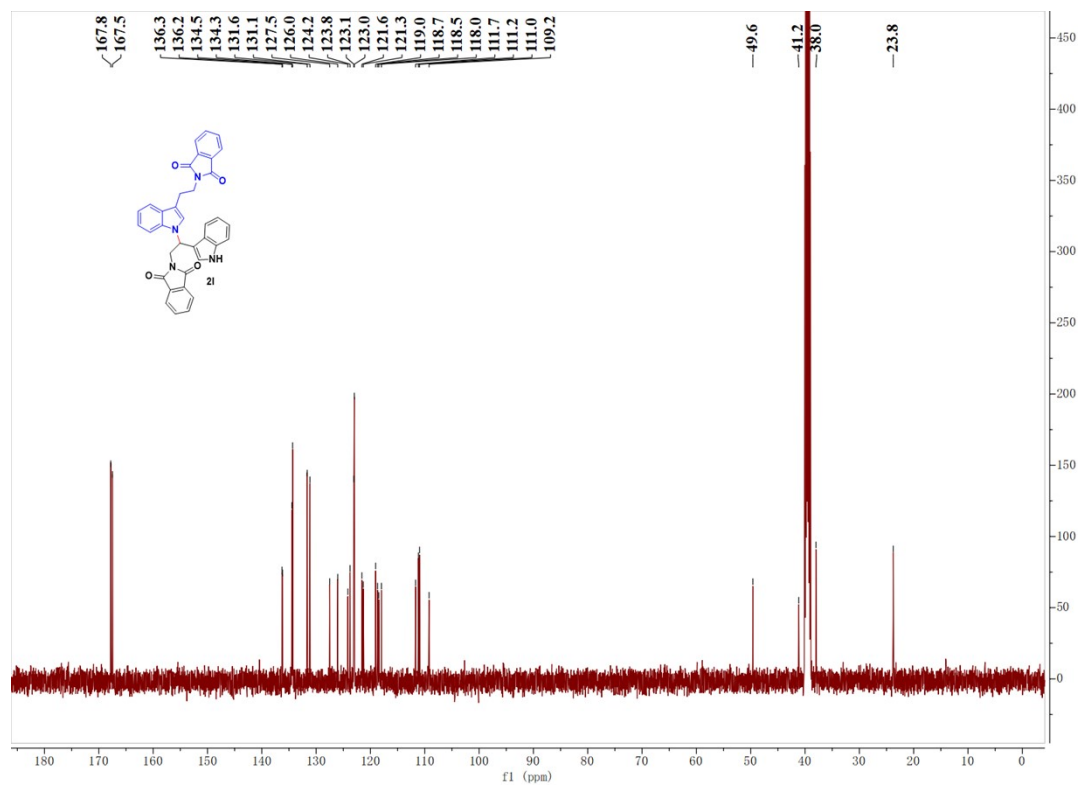


Figure S23. The ^1H -NMR spectra copy of compound 3a.

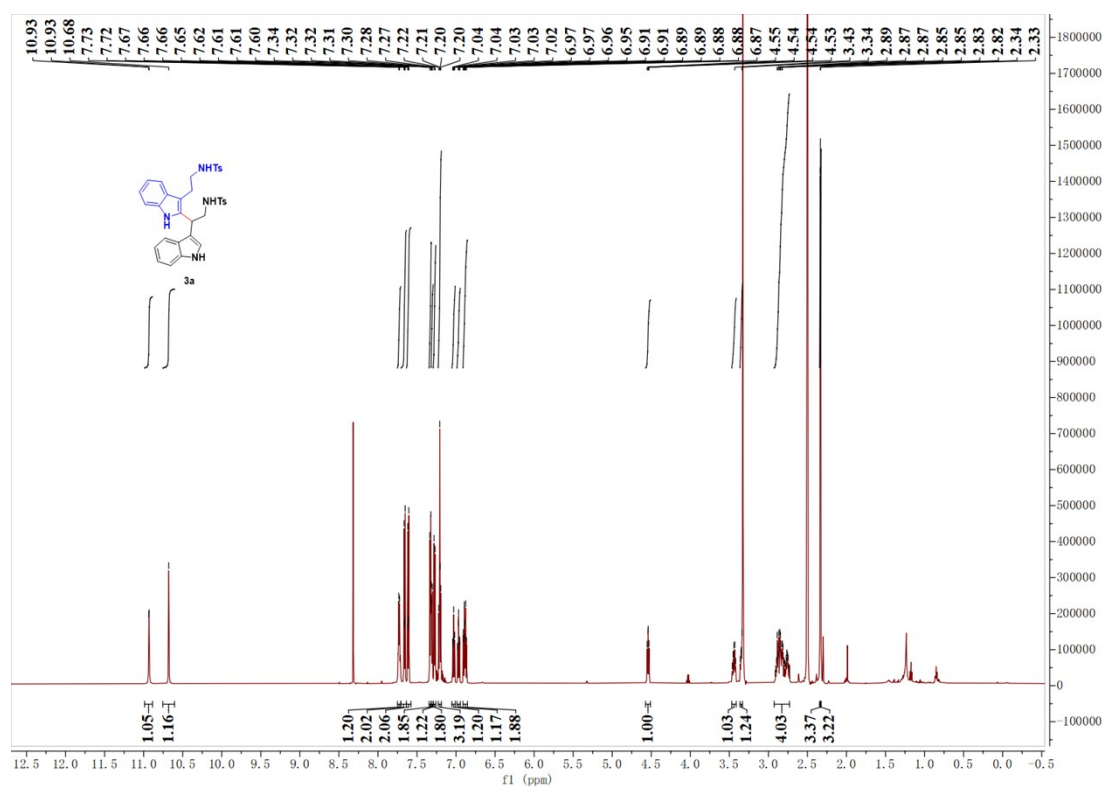


Figure S24. The ^{13}C -NMR spectra copy of compound 3a.

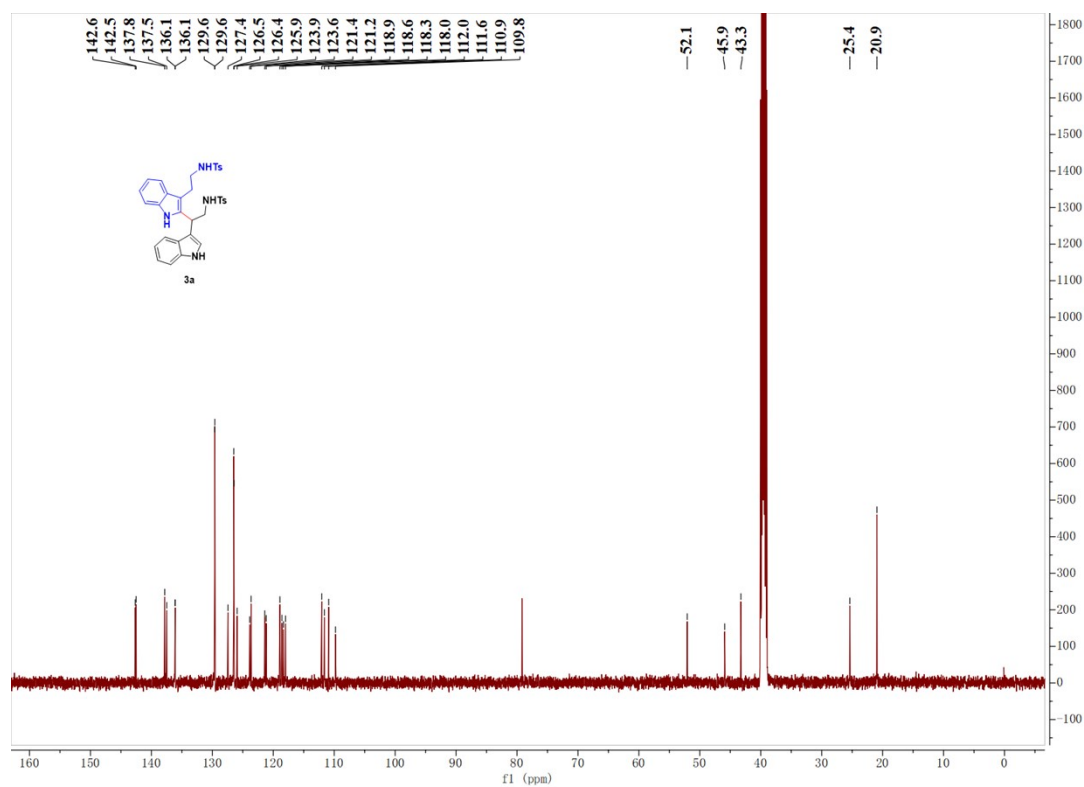


Figure S25. The ^1H -NMR spectra copy of compound 3b.

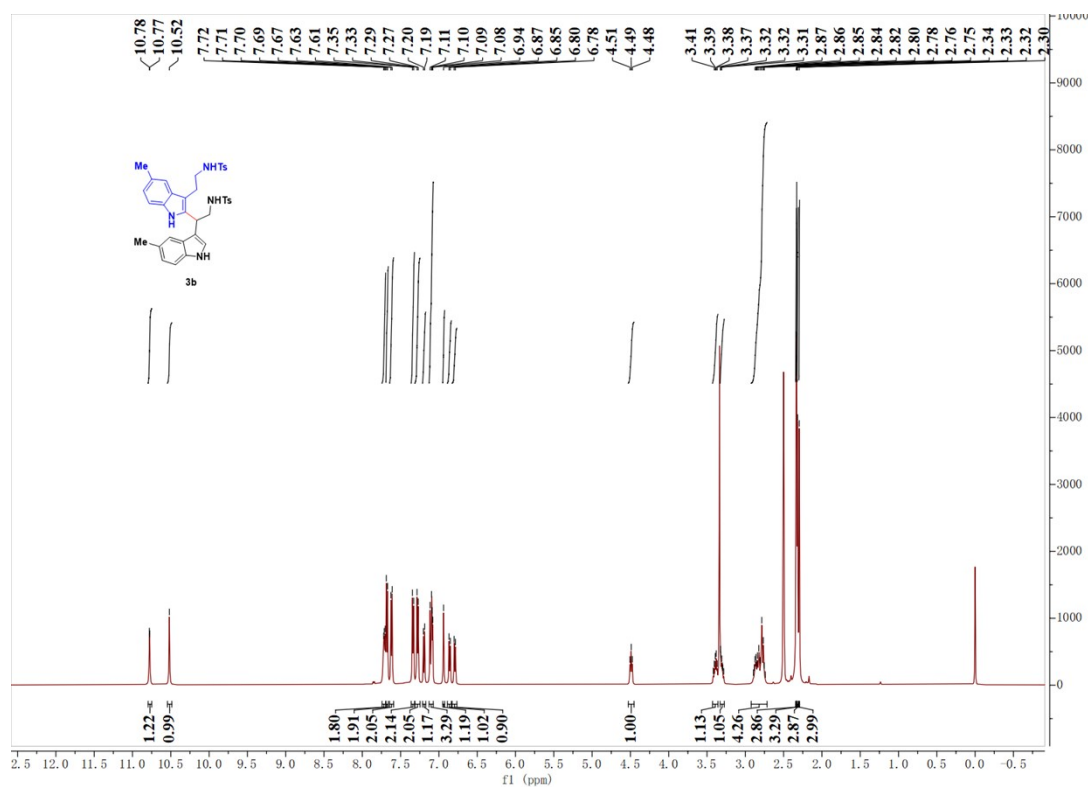


Figure S26. The ^{13}C -NMR spectra copy of compound 3b.

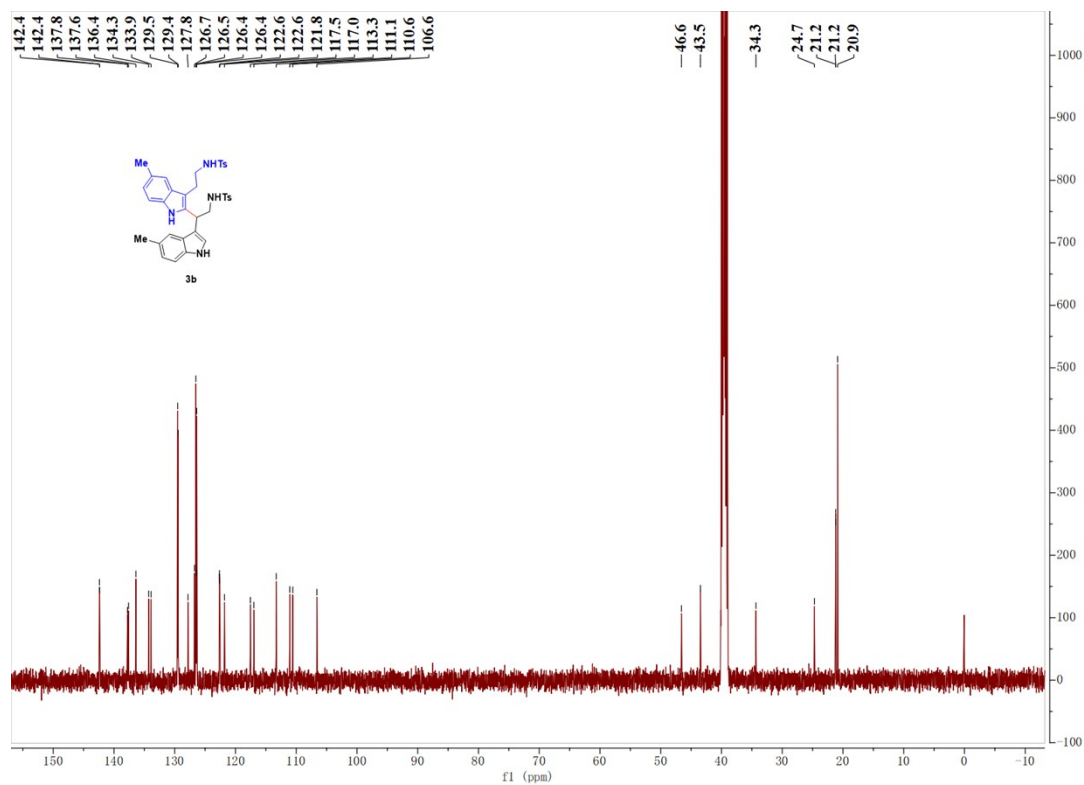


Figure S27. The ^1H -NMR spectra copy of compound 3c.

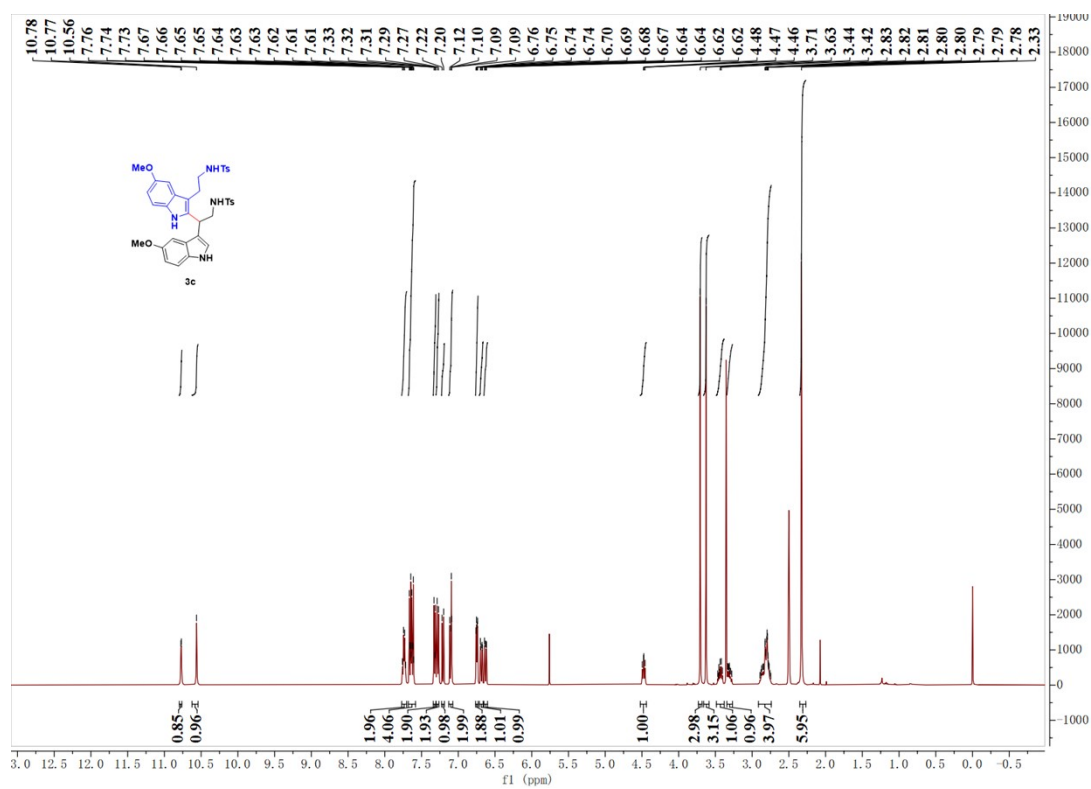


Figure S28. The ^{13}C -NMR spectra copy of compound 3c.

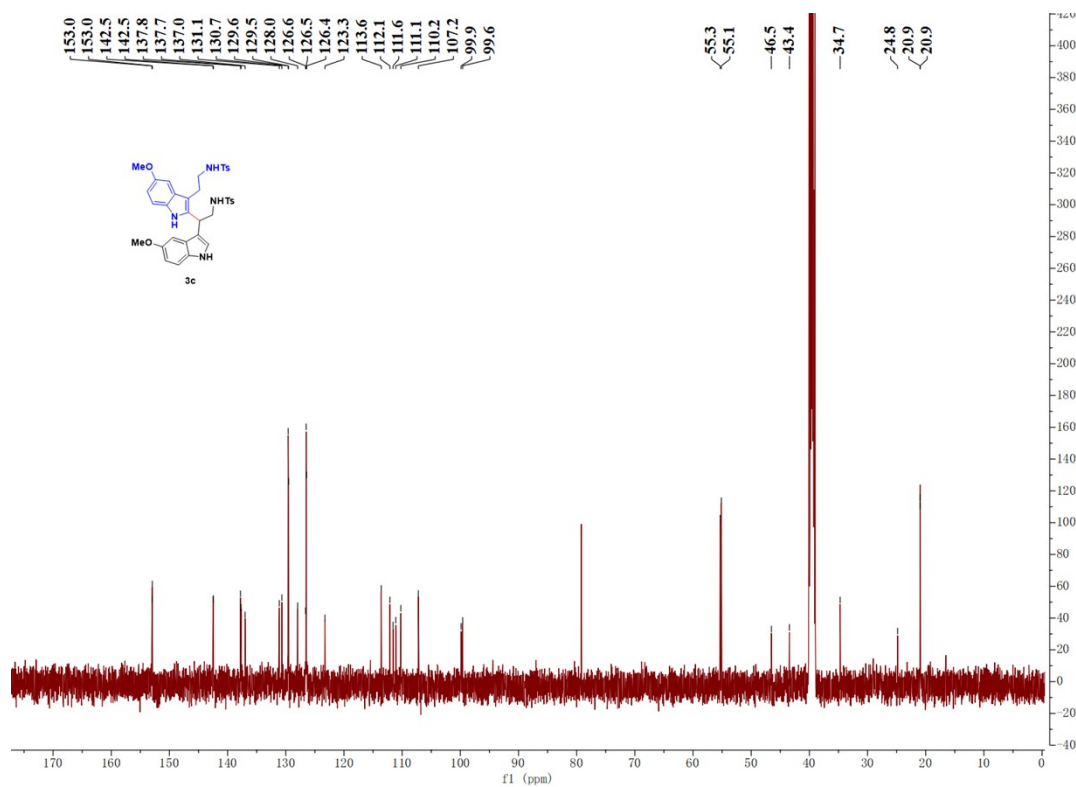


Figure S29. The ^1H -NMR spectra copy of compound 3d.

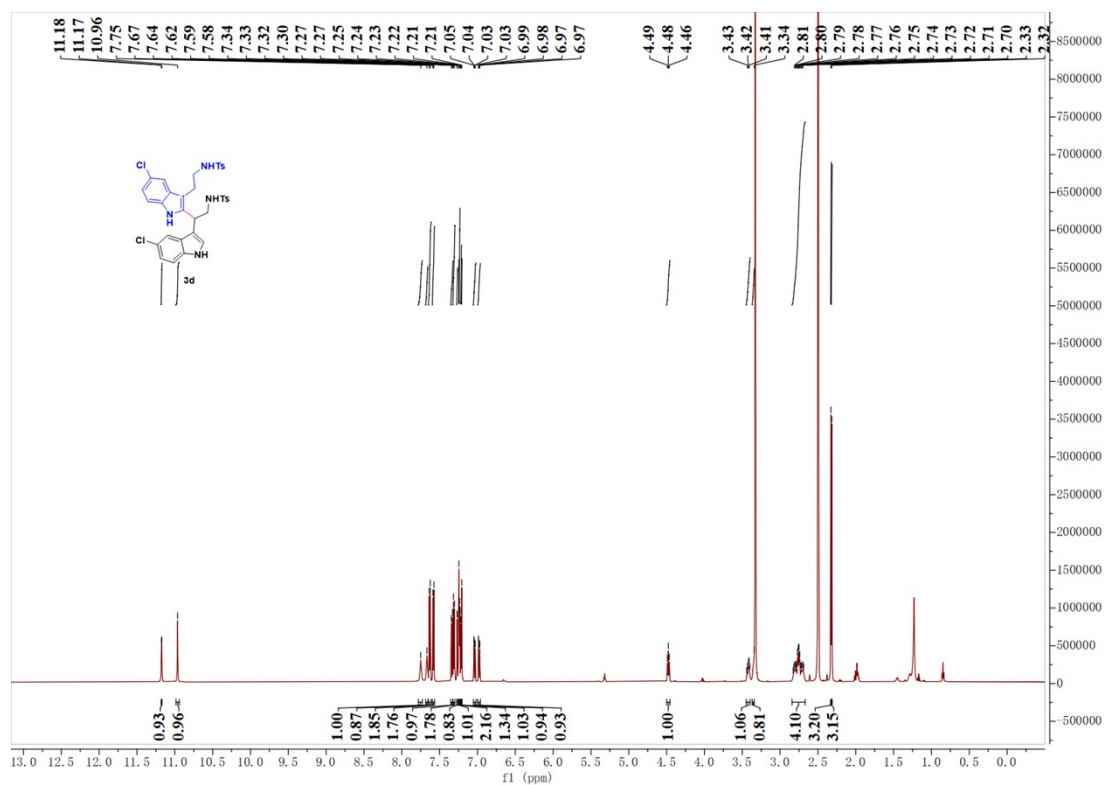


Figure S30. The ^{13}C -NMR spectra copy of compound 3d.

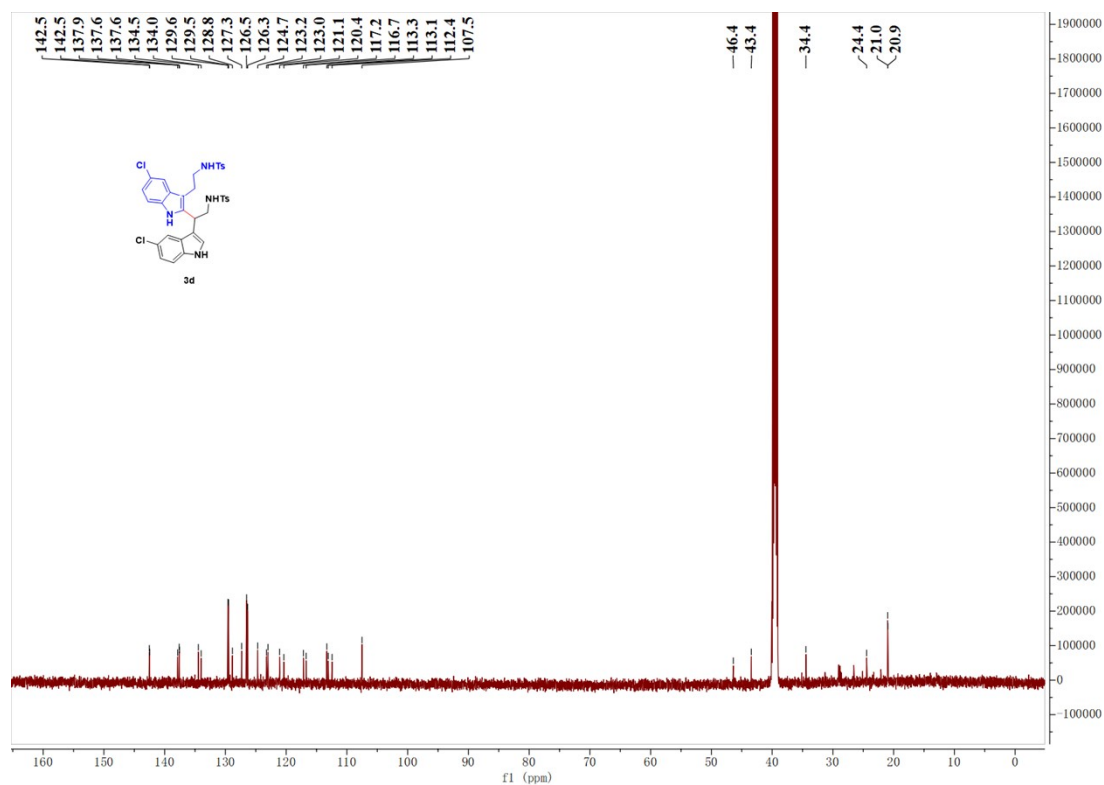


Figure S31. The $^1\text{H-NMR}$ spectra copy of compound 3e.

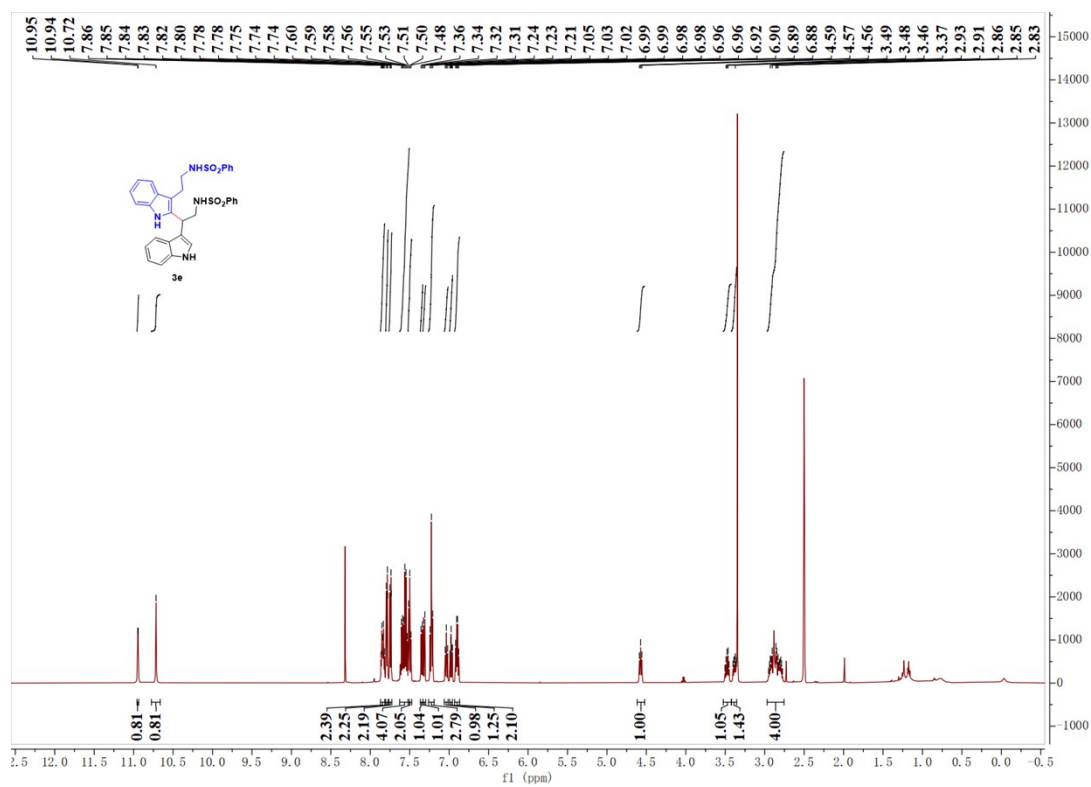


Figure S32. The $^{13}\text{C-NMR}$ spectra copy of compound 3e.

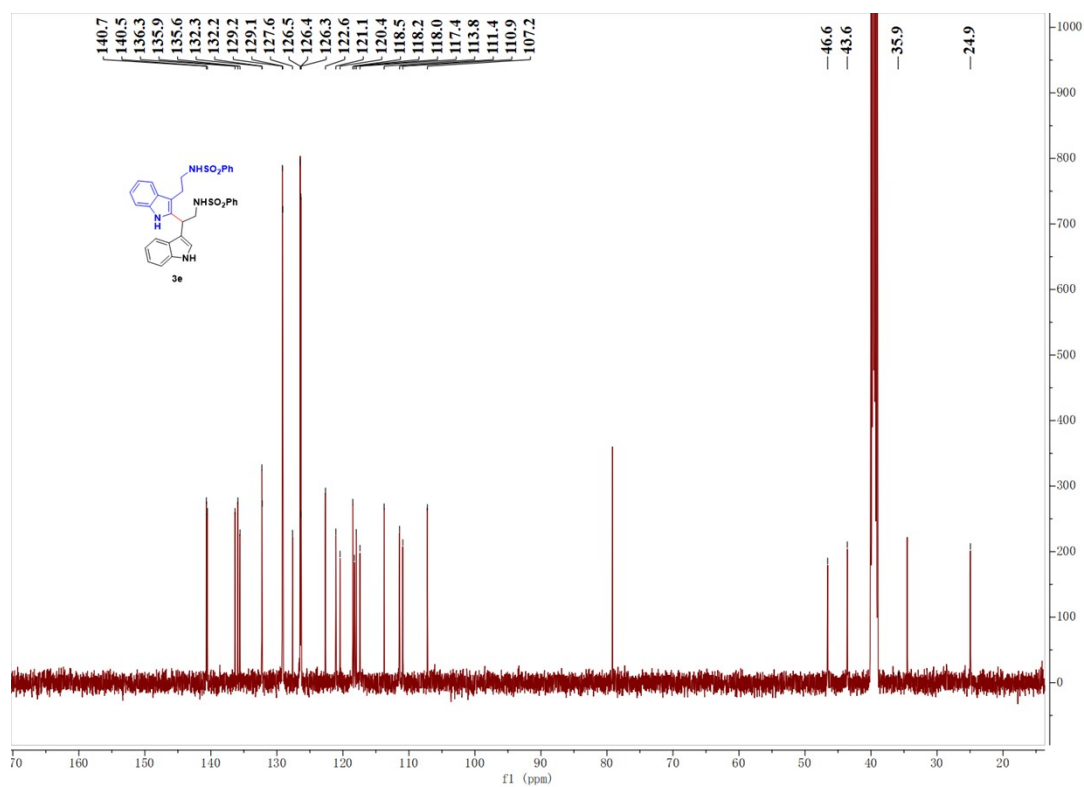


Figure S33. The ^1H -NMR spectra copy of compound 3f.

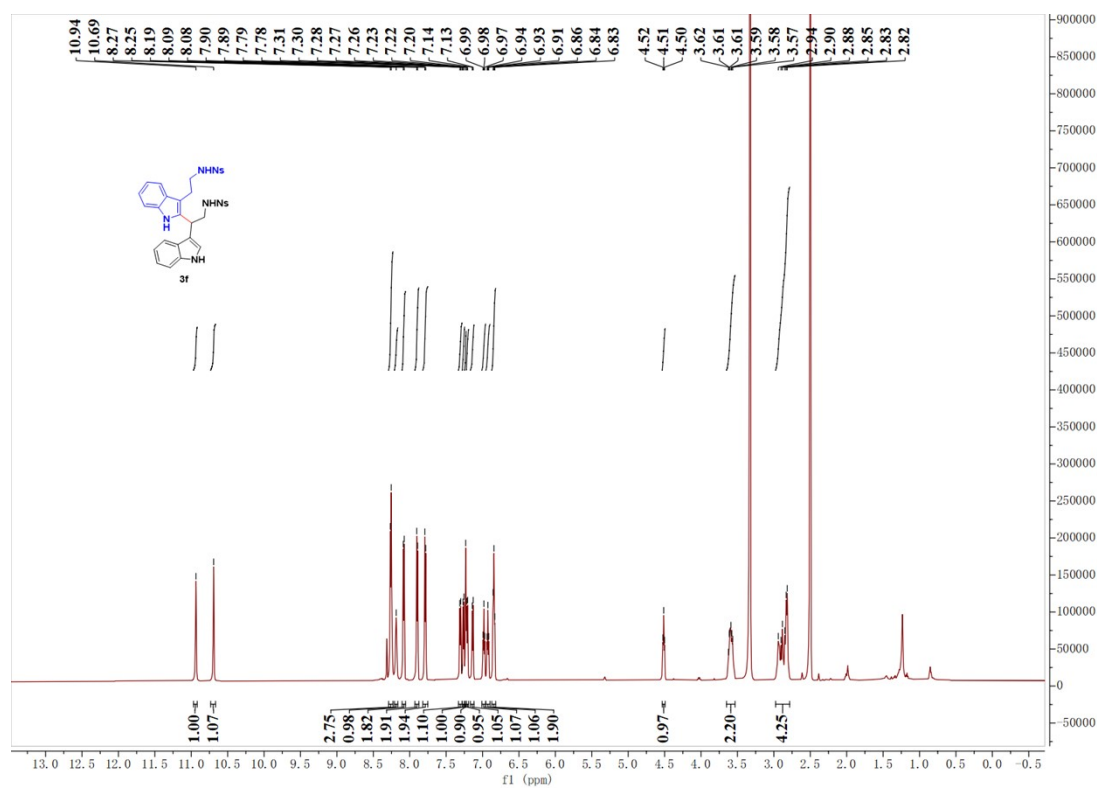


Figure S34. The ^{13}C -NMR spectra copy of compound 3f.

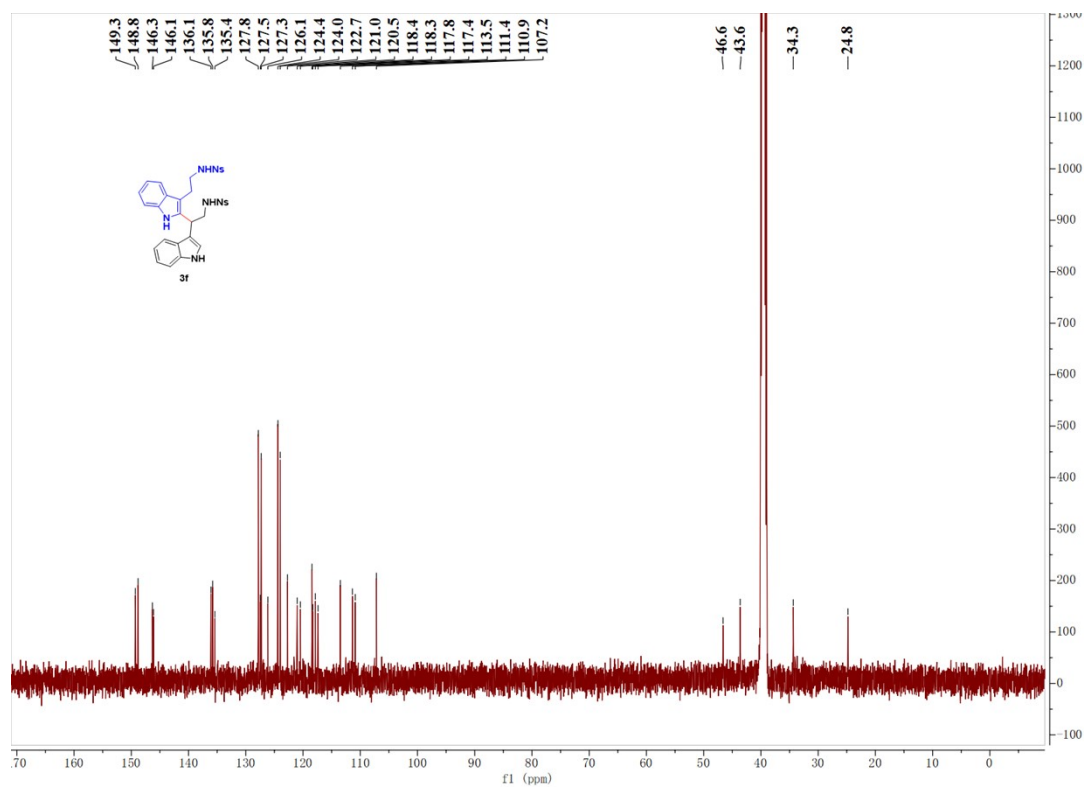


Figure S35. The $^1\text{H-NMR}$ spectra copy of compound 3g.

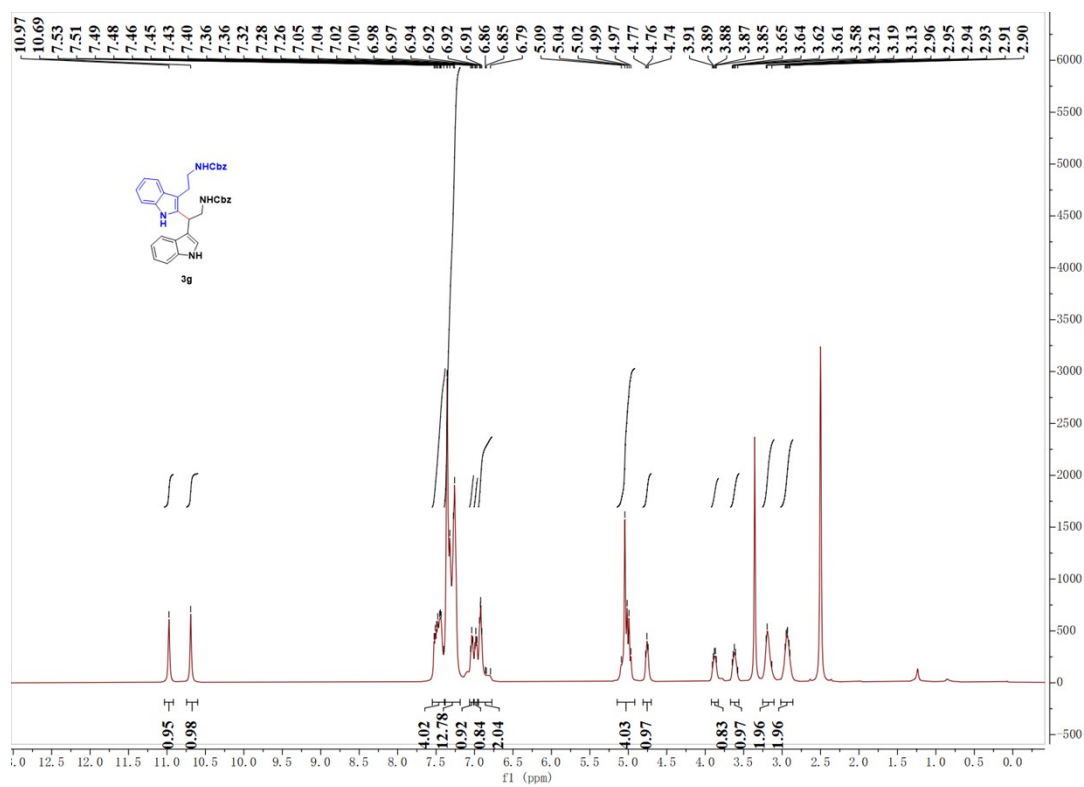


Figure S36. The $^{13}\text{C-NMR}$ spectra copy of compound 3g.

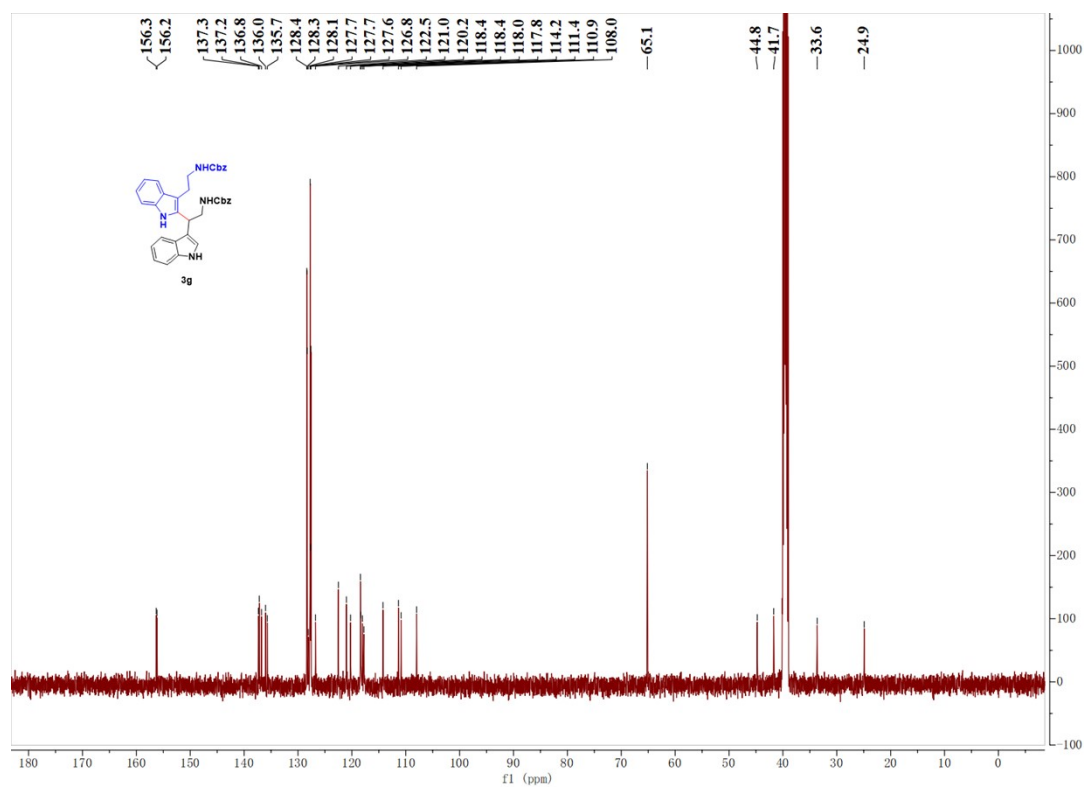


Figure S37. The ^1H -NMR spectra copy of compound 3h.

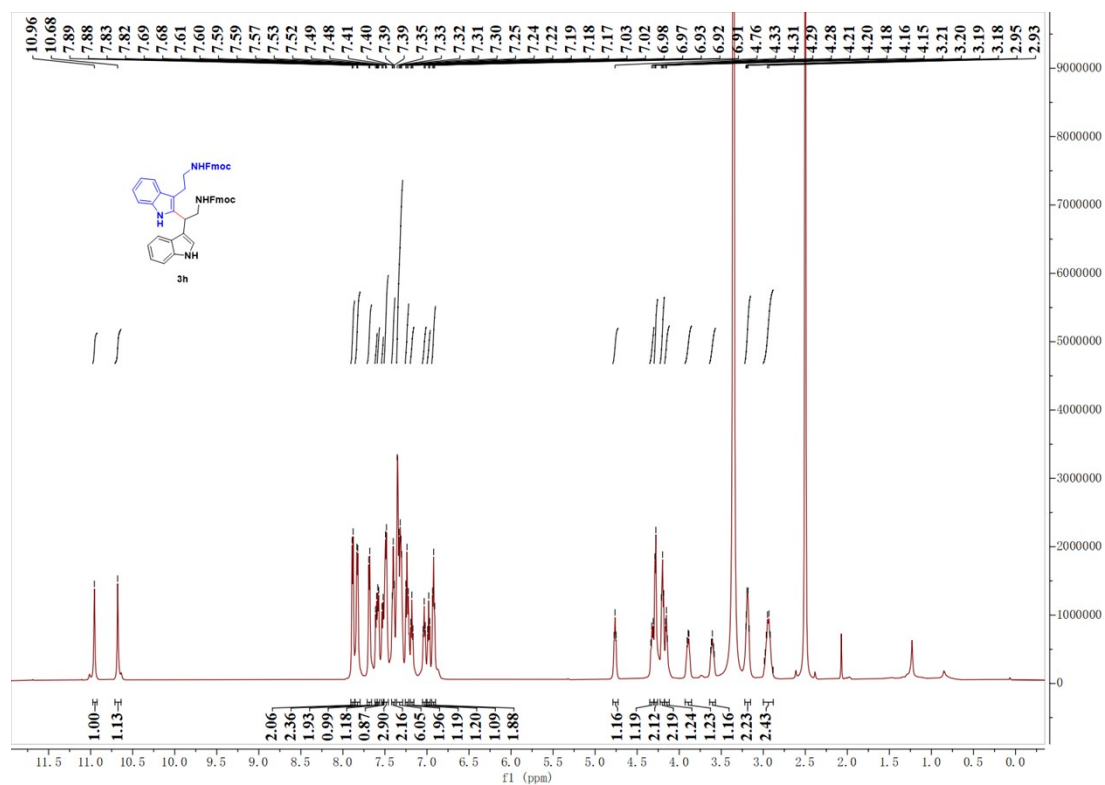


Figure S38. The ^{13}C -NMR spectra copy of compound 3h.

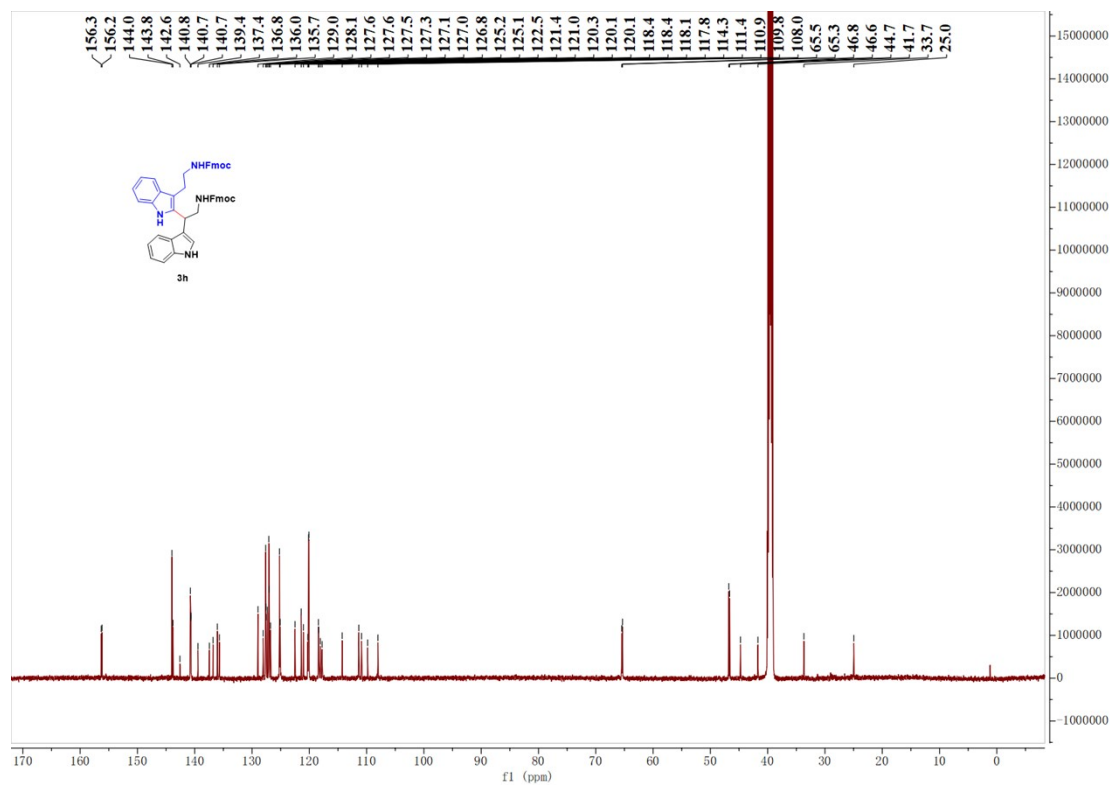


Figure S39. The ^1H -NMR spectra copy of compound 3k.

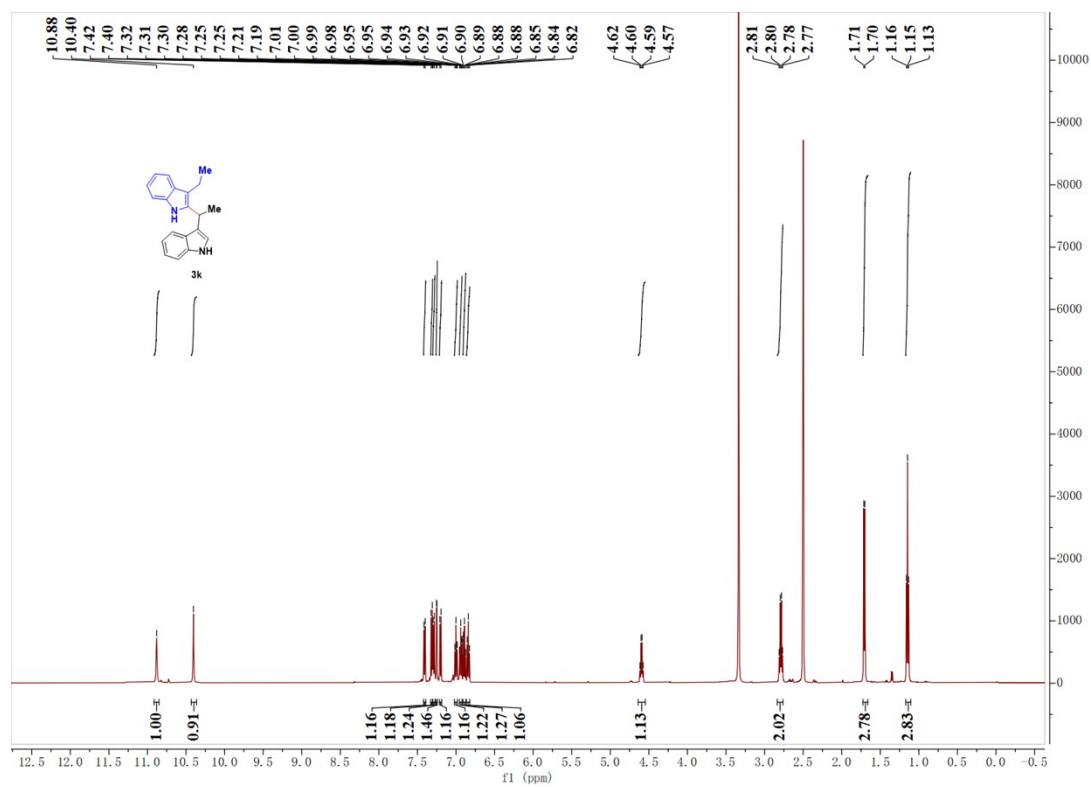


Figure S40. The ^{13}C -NMR spectra copy of compound 3k.

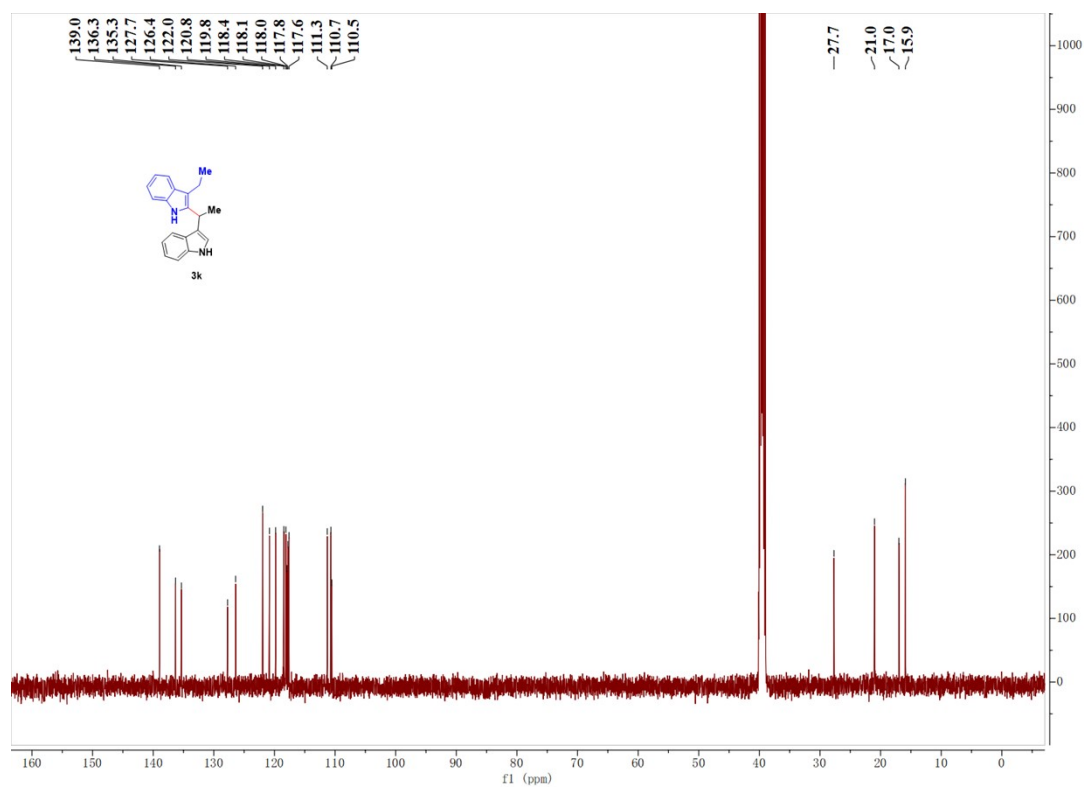


Figure S41. The $^1\text{H-NMR}$ spectra copy of compound 3l.

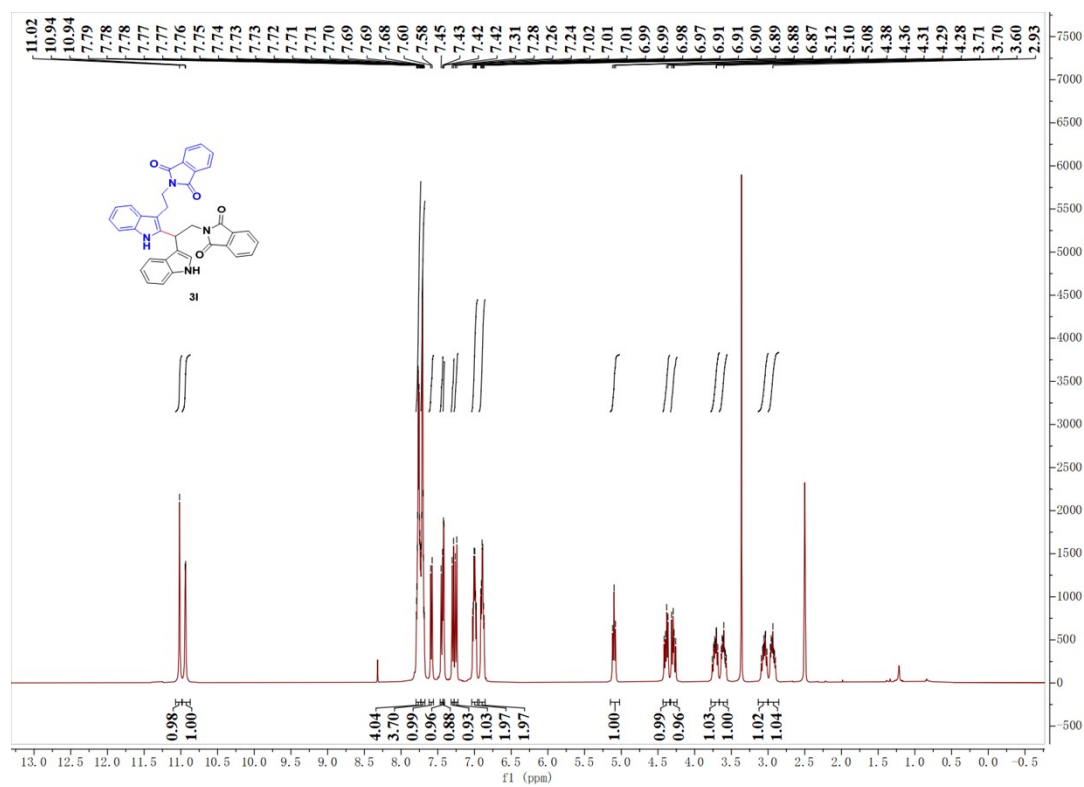


Figure S42. The $^{13}\text{C-NMR}$ spectra copy of compound 3l.

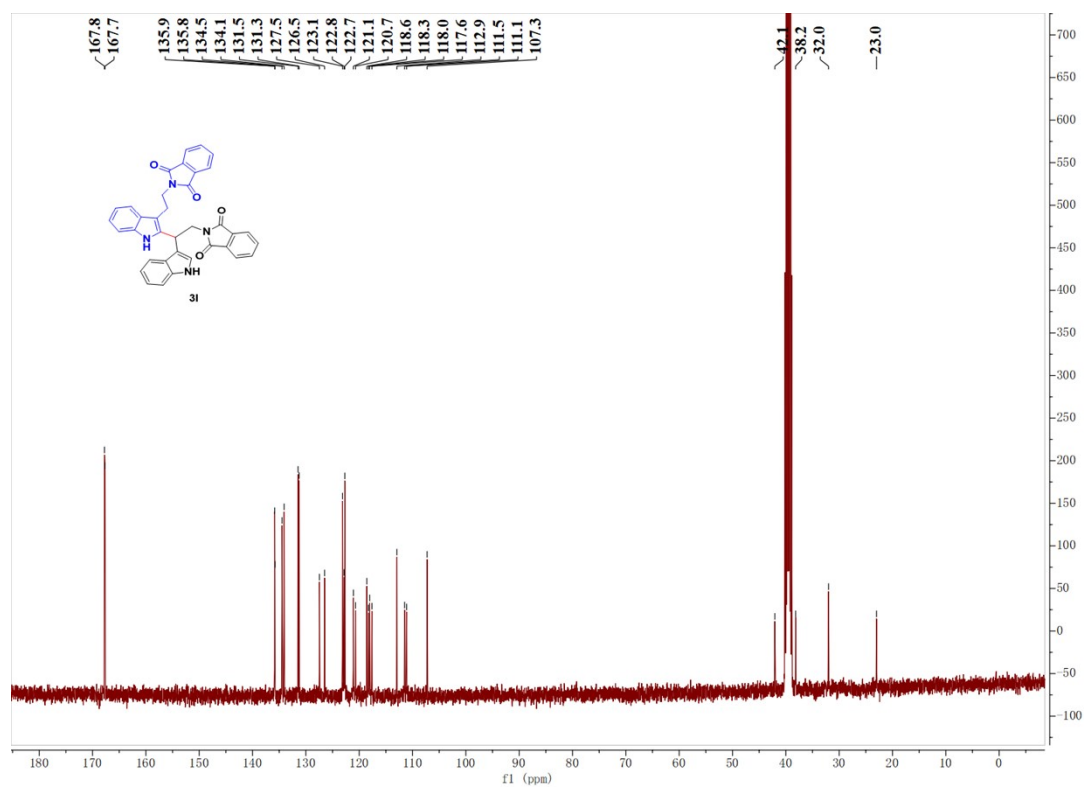


Figure S43. The ^1H -NMR spectra copy of compound 3m.

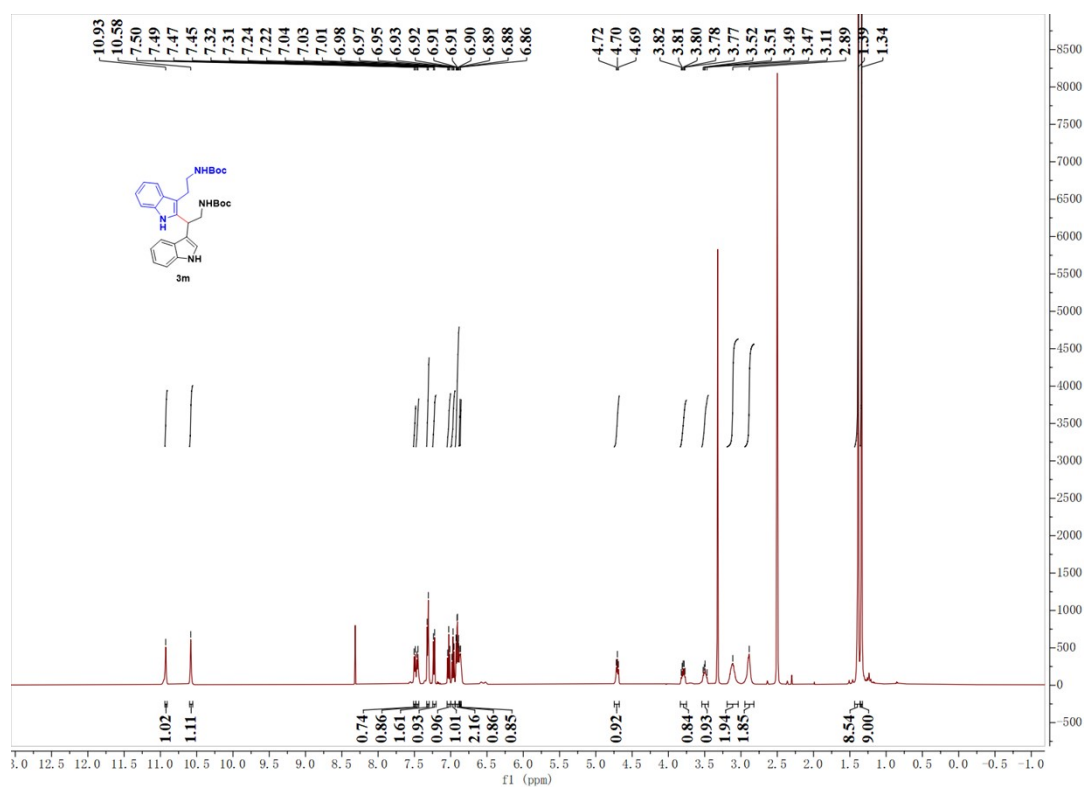


Figure S44. The ^{13}C -NMR spectra copy of compound 3m.

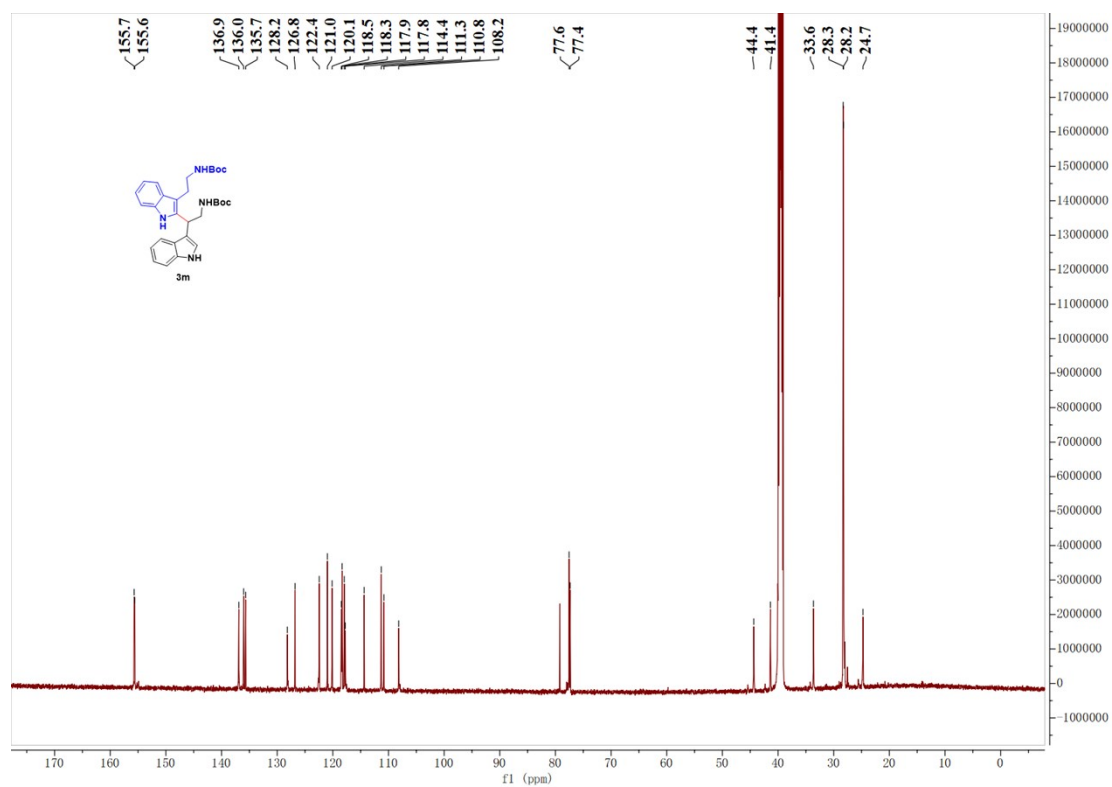


Figure S45. The ^1H -NMR spectra copy of compound 3n.

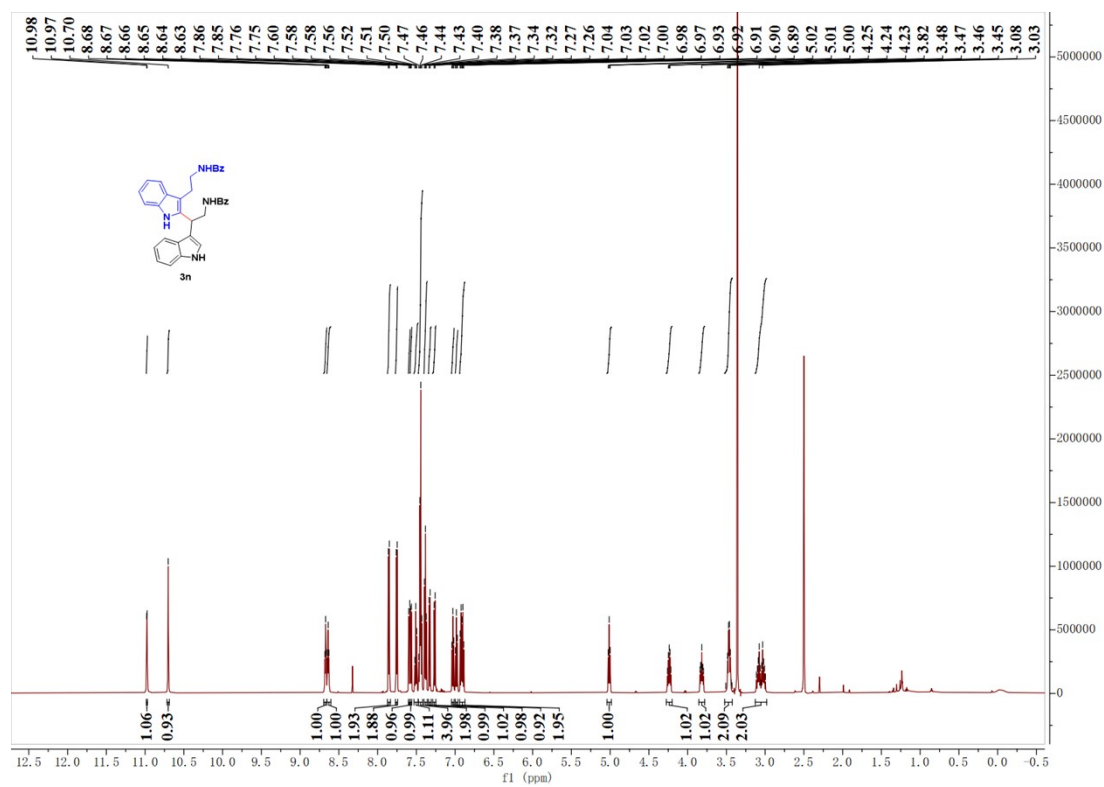


Figure S46. The ^{13}C -NMR spectra copy of compound 3n.

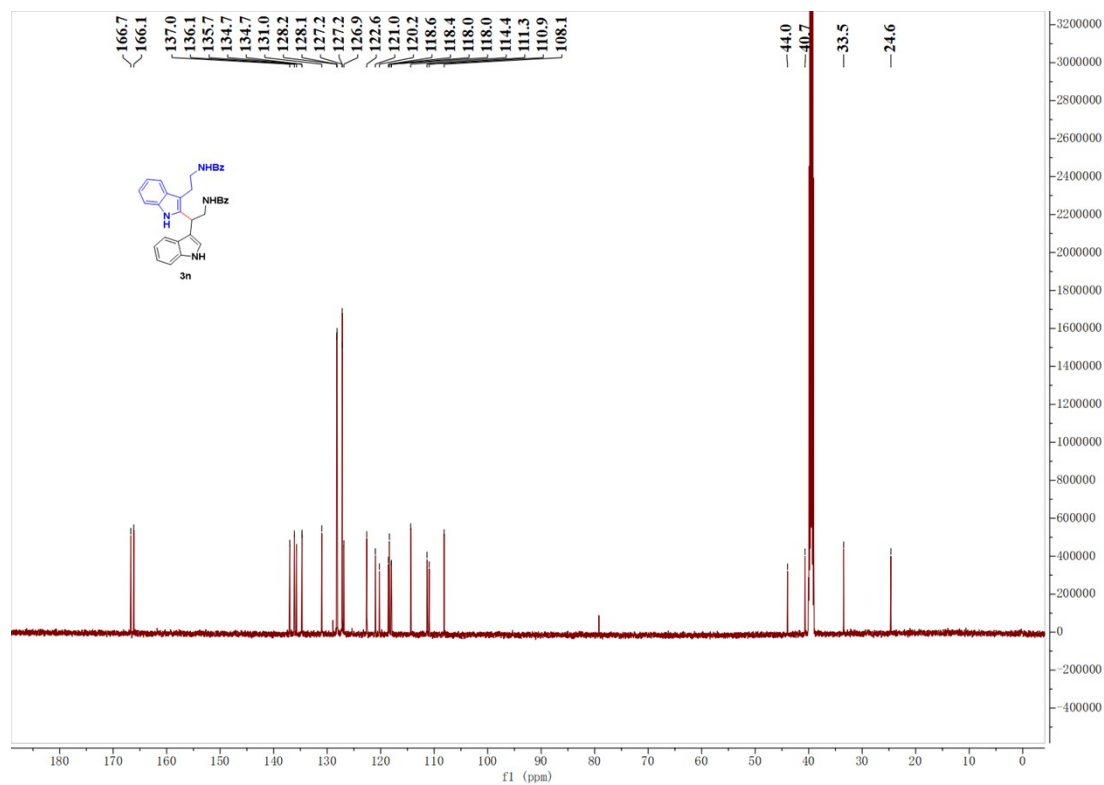


Figure S47. The ^1H -NMR spectra copy of compound 3o.

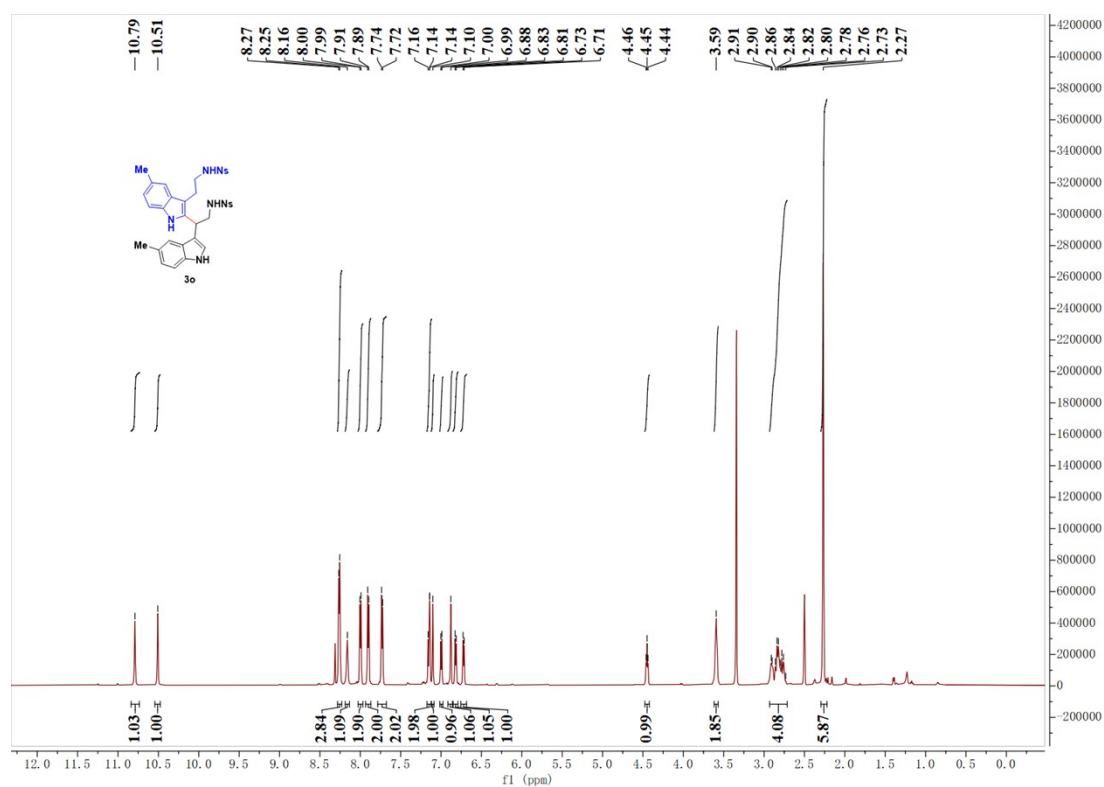


Figure S48. The ^{13}C -NMR spectra copy of compound 3o.

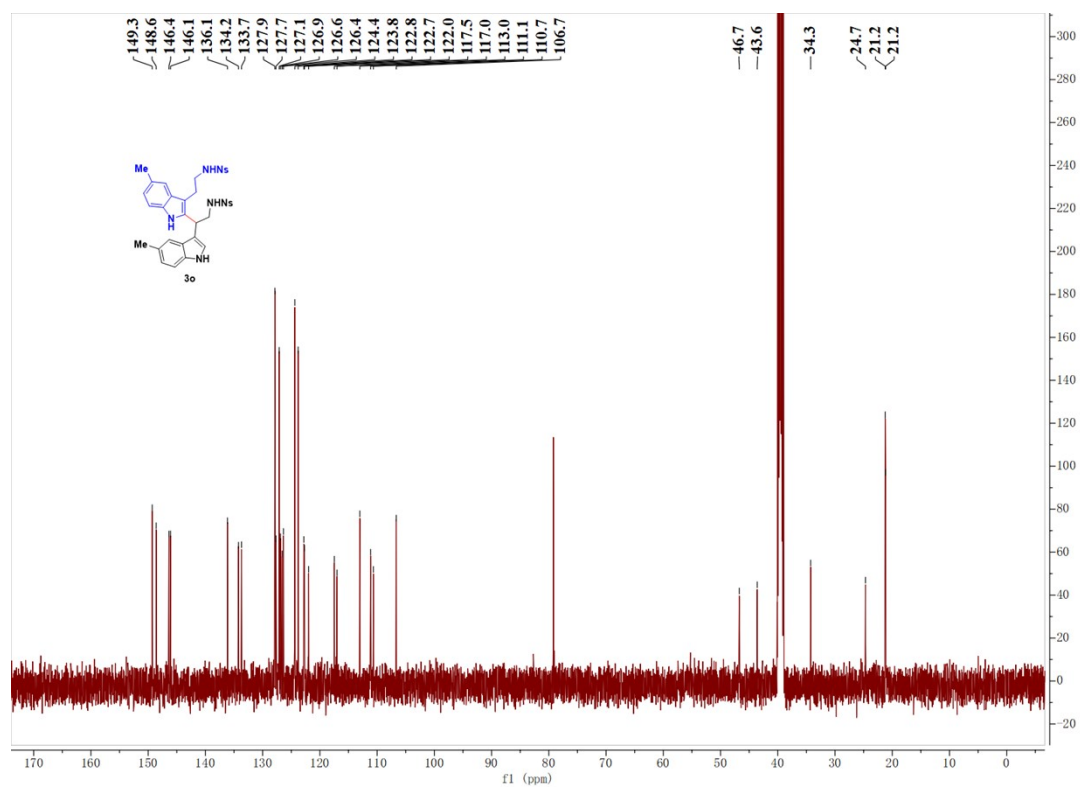


Figure S49. The $^1\text{H-NMR}$ spectra copy of 6,6'-bis-(debromo)-gelliusine F.

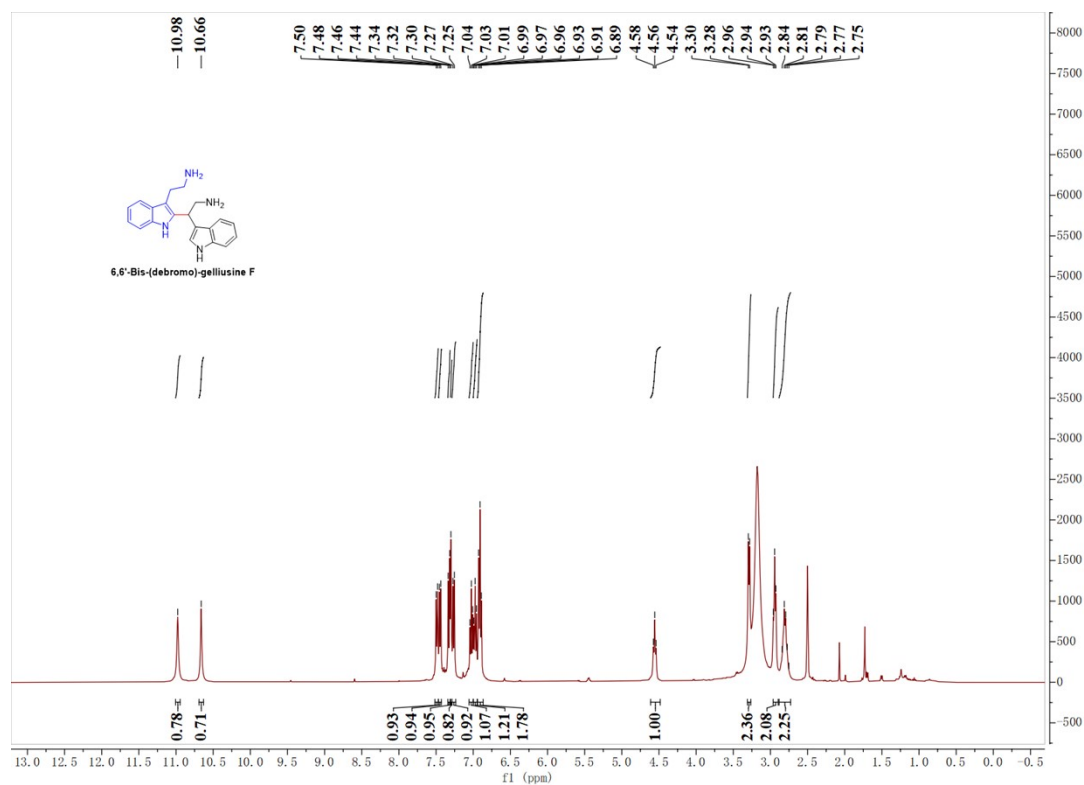


Figure S50. The $^{13}\text{C-NMR}$ spectra copy of 6,6'-bis-(debromo)-gelliusine F.

