Supporting Information

Acid-Catalyzed Three-Component Addition of Carbonyl Compounds with 1,2,3-Triazoles and Indoles

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1. General information

All reactions were carried out under air atmosphere unless otherwise noted. Column chromatography was performed using aluminum oxide (neutral) (200-300 mesh). ^{1}H NMR and ^{13}C NMR spectra were recorded on Bruker-AV (400 and 100 MHz, respectively) instrument internally referenced to tetramethylsilane (TMS), chloroform or DMSO signals. Mass spectra were measured on Agilent 5975 GC-MS instrument (EI). High-resolution mass spectra (HRMS) were performed on FTMS ICR MS BRUKER 7T or Agilent 6230 TOF L C/MS. The structures of known compounds were further corroborated by comparing their ^{1}H NMR, ^{13}C NMR data and MS data with those of literature. Melting points were measured with a YUHUA X-5 melting point instrument and were uncorrected. Most reagents were obtained from commercial suppliers and used without further purification.

2. General procedure for 4-phenyl-1-tosyl-1*H*-1,2,3-triazole

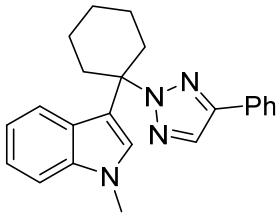
To a stirred solution of phenylacetylene (112 mg, 1.1 mmol), 4-methylbenzenesulfonyl azide (197 mg, 1 mmol), and 2-aminophenol (5.5 mg, 0.05 mmol) in MeCN (1 mL) was added $Cu(OAc)_2 \cdot H_2O$ (20 mg, 0.1 mmol) at room temperature. After **2a** was exhausted (ca. 6 h, monitored by TLC), the solvent was removed off in vacuum. The residue was purified by chromatography (silica gel, 10% EtOAc in PE) to give desired product 4-phenyl-1-tosyl-1H-1,2,3-triazole as a colorless solid. ^{1}H NMR δ 8.32 (s, 1H), 8.03-8.00 (m, 2H), 7.84-7.80 (m, 2H), 7.42-7.36 (m, 5H), 2.43 (s, 3H); ^{13}C NMR δ 147.5,133.2,130.6 (2C),129.2 (2C),129.1 (2C),129.0, 128.8 (2C), 126.2 (2C), 119.1, 22.0.

3. General procedure (4a)

A 10 mL oven-dried reaction vessel was charged with $TsOH \cdot H_2O$ (3 mg, 0.02 mmol), H_2O (10 μL, 0.5 mmol), 1-methyl-1H-indole (**1a**, 25 μL, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol), 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol) and 1,2-dichlorobenzene (1 mL) under air. The sealed reaction vessel was stirred at 60 ºC for 28 h. After cooling to room temperature, the reaction was diluted with ethyl acetate (5 mL) and washed with saturated sodium chloride solution. The organic layer was separated, and the aqueous layer was extracted with ethyl acetate for three times. The combined organic layer was dried over magnesium sulfate and the volatiles were removed under reduced pressure. The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4a** as yellow oil (33.8 mg, 75% yield).

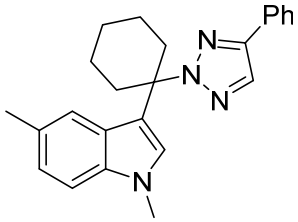
4. Characterization data of products

1-Methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4a)



^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (s, 1H), 7.86 – 7.76 (m, 2H), 7.56 – 7.49 (m, 1H), 7.41 (dd, J = 8.2, 6.9 Hz, 2H), 7.32 (dd, J = 7.9, 3.4 Hz, 2H), 7.20 (s, 1H), 7.09 – 7.01 (m, 1H), 6.93 – 6.84 (m, 1H), 3.69 (s, 3H), 3.16 – 3.04 (m, 2H), 2.35 (s, 2H), 1.72 – 1.58 (m, 2H), 1.42 (d, J = 6.9 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.4, 137.4, 131.1, 131.0, 129.4, 128.7, 127.0, 126.0, 125.3, 121.5, 120.4, 119.4, 119.2, 110.3, 67.0, 36.1, 32.8, 25.1, 22.5; HRMS (ESI) m/z calcd. for $C_{23}H_{24}N_4^+$ $(M+Na)^+$ 379.1899, found 379.1895.

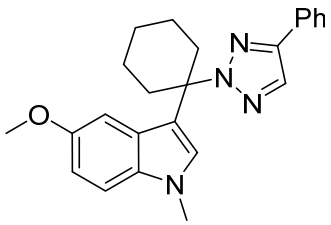
1,5-Dimethyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4b)



The reaction was conducted with 1,5-dimethyl-1H-indole (**1b**, 29.1 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4b** as yellow oil (34.8 mg, 47% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.25 (s, 1H), 7.89 – 7.83 (m, 2H), 7.43 (t, J = 7.3 Hz, 2H), 7.34 (d, J = 7.4 Hz, 1H), 7.23 (d, J = 15.1 Hz, 2H), 6.92 (d, J = 2.6 Hz, 1H), 6.73 – 6.67 (m, 1H), 3.68 (d, J = 6.1 Hz, 3H), 3.59 (d, J = 4.7 Hz, 3H), 3.14 (d, J = 13.6 Hz, 2H), 2.28 (d, J = 13.9 Hz, 2H), 1.81 – 1.65 (m, 2H), 1.58 (s, 1H), 1.43 (d, J = 7.9 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.3, 135.9, 131.2, 131.1, 129.4, 128.7, 127.5, 127.0, 126.0, 123.1, 120.2, 110.1, 67.1, 36.0, 32.8, 25.1, 22.5，21.8; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4^+$ $(M+Na)^+$ 393.2055, found 393.2102.

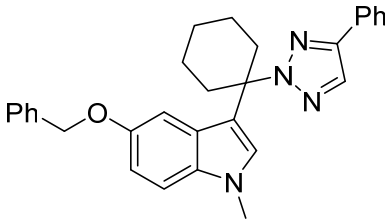
5-Methoxy-1-methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4c)



The reaction was conducted with 5-methoxy-1-methyl-1H-indole (**1c**, 32.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 10:1) to yield the desired product **4c** as yellow oil (58.7 mg, 76% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (d, J = 8.2 Hz, 2H), 7.96 (d, J = 8.3 Hz, 1H), 7.68 (s, 1H), 7.34 (d, J = 8.2 Hz, 2H), 7.30 (d, J = 7.7 Hz, 1H), 2.97 (d, J = 13.3, 6.7 Hz, 1H), 2.49 (s, 3H), 1.29 (d, J = 6.9 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.3, 152.2, 151.9, 135.3, 134.9, 131.1, 127.9, 127.5, 127.1, 122.4, 121.3, 34.1, 23.8, 21.5; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4O^+$ $(M+Na)^+$ 409.2004, found 409.2003.

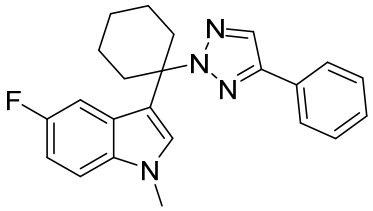
1-Methyl-5-phenoxy-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4d)



The reaction was conducted with 5-(benzyloxy)-1-methyl-1H-indole (**1d**, 47.4 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 10:1) to yield the desired product **4d** as white solid (75.8 mg, 82% yield), mp = 180-181 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.23 (s, 1H), 7.92 – 7.82 (m, 2H), 7.42 (t, J = 7.5 Hz, 2H), 7.35 – 7.30 (m, 5H), 7.02 (d, J = 2.3 Hz, 1H), 6.83 – 6.73 (m, 1H), 4.88 (d, J = 2.0 Hz, 2H), 3.67 (d, J = 2.8 Hz, 3H), 3.10 (d, J = 13.3 Hz, 2H), 2.29 (d, J = 12.9 Hz, 2H), 1.67 (s, 2H), 1.57 (s, 1H), 1.48 – 1.37 (m, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 152.31, 146.32, 137.93, 132.87, 131.24, 130.98, 129.45, 128.76, 128.08, 127.98, 127.44, 125.96, 125.52, 112.16, 111.04, 104.02, 70.15, 66.99, 36.02, 32.99, 25.16, 22.47. ^{13}C NMR (101 MHz, DMSO-d_6) δ 153.4, 146.3, 132.7, 131.2, 131.0, 129.4, 128.7, 127.4, 125.9, 125.6, 119.1, 111.4, 111.0, 102.2, 67.0, 55.5, 36.1, 33.0, 25.2, 22.5; HRMS (ESI) m/z calcd for $C_{30}H_{30}N_4O^+$ $(M+Na)^+$ 485.2317, found 485.2316.

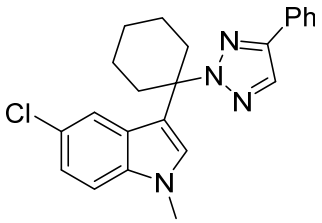
5-Fluoro-1-methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4e)



The reaction was conducted with 5-fluoro-1-methyl-1H-indole (**1e**, 29.8 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4e** as yellow oil (64.3 mg, 86% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.16 (s, 1H), 7.73 (d, J = 7.7 Hz, 2H), 7.34 (t, J = 7.6 Hz, 2H), 7.29 – 7.22 (m, 3H), 7.13 – 7.08 (m, 1H), 6.82 (t, J = 9.0 Hz, 1H), 3.62 (s, 3H), 2.99 (d, J = 13.3 Hz, 2H), 2.21 (t, J = 11.6 Hz, 2H), 1.56 (d, J = 12.3 Hz, 2H), 1.45 (s, 1H), 1.32 (d, J = 8.9 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 155.9 (d, J =232.3 Hz), 146.6, 134.2, 131.2, 130.9, 130.7, 129.5, 129.0. 128.8, 126.0, 119.4, 111.7(d, J =9.9 Hz), 109.9(d, J =26.2 Hz), 105.2(d, J =24.6 Hz), 66.8, 36.0, 33.2, 25.1, 22.5; HRMS (ESI) m/z calcd for $C_{23}H_{23}FN_4^+$ $(M+K)^+$ 413.1544, found 413.1549.

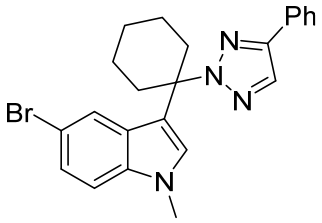
5-Chloro-1-methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4f)



The reaction was conducted with 5-chloro-1-methyl-1H-indole (**1f**, 33.0 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4f** as white solid (56.3 mg, 72% yield), mp = 147-148 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.17 (s, 1H), 7.77 – 7.70 (m, 2H), 7.46 (d, J = 2.1 Hz, 1H), 7.34 (t, J = 7.5 Hz, 2H), 7.30 – 7.21 (m, 3H), 6.97 (dd, J = 8.7, 2.0 Hz, 1H), 3.62 (s, 3H), 3.01 (d, J = 13.5 Hz, 2H), 2.19 (d, J = 12.2 Hz, 2H), 1.56 (s, 2H), 1.45 (s, 1H), 1.31 (t, J = 8.6 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.6, 136.0, 131.3, 130.9, 129.5, 128.9, 128.8, 126.2, 126.1, 124.0, 121.5, 119.6, 119.1, 112.1, 66.7, 36.0, 33.1, 25.1, 22.4.

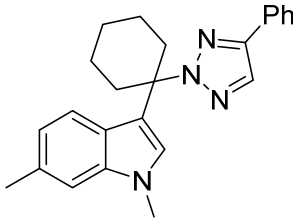
5-Bromo-1-methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4g)



The reaction was conducted with 5-bromo-1-methyl-1H-indole (**1g**, 42.0 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4g** as white solid (67.7 mg, 78% yield), mp = 180-181 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.25 (s, 1H), 7.86 – 7.79 (m, 2H), 7.71 (d, J = 2.0 Hz, 1H), 7.43 (t, J = 7.6 Hz, 2H), 7.38-7.31 (m, 3H), 7.17 (dd, J = 8.7, 1.9 Hz, 1H), 3.70 (s, 3H), 3.10 (d, J = 13.6 Hz, 2H), 2.35 – 2.24 (m, 2H), 1.70-1.62 (m, 2H), 1.54 (s, 1H), 1.40 (s, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.6, 136.1, 131.3, 130.8, 129.4, 128.8, 128.7, 126.9, 126.0, 124.0, 122.7, 119.0, 112.6, 112.1, 66.7, 36.0, 33.1, 25.1, 22.4; HRMS (ESI) m/z calcd for $C_{23}H_{23}BrN_4^+$ $(M+Na)^+$ 457.1004, found 457.1000.

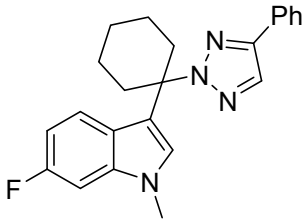
1,6-Dimethyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4h)



The reaction was conducted with 1,6-dimethyl-1H-indole (**1h**, 29.0 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4h** as yellow oil (48.8 mg, 66% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.12 (s, 1H), 7.72 (d, J = 7.6 Hz, 2H), 7.33 (td, J = 8.0, 4.0 Hz, 3H), 7.23 (t, J = 7.4 Hz, 1H), 7.02 (d, J = 2.4 Hz, 2H), 3.56 (s, 3H), 3.05 – 2.96 (m, 2H), 2.23 (s, 5H), 1.60 – 1.53 (m, 2H), 1.45 (s, 1H), 1.33 (d, J = 7.9 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.4, 137.8, 131.0, 130.0, 131.7, 129.4, 128.7, 126.3, 126.0, 123.3, 121.0, 120.1, 119.3, 110.1, 67.0, 36.1, 32.7, 25.2, 22.5, 21.8; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4^+$ $(M+Na)^+$ 393.2055, found 393.2054.

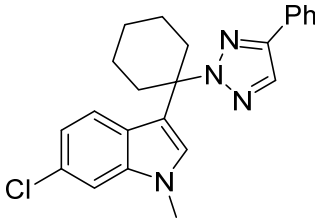
6-Fluoro-1-methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4i)



The reaction was conducted with 6-fluoro-1-methyl-1H-indole (**1i**, 29.8 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4i** as white solid (62.1 mg, 83% yield), mp = 123-124 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.14 (q, J = 2.5, 2.0 Hz, 1H), 7.79 – 7.69 (m, 2H), 7.39 (td, J = 5.9, 3.2 Hz, 1H), 7.36 – 7.28 (m, 2H), 7.27 – 7.20 (m, 1H), 7.18 – 7.07 (m, 2H), 3.58 (q, J = 3.0, 2.3 Hz, 3H), 3.01 (t, J = 10.4 Hz, 2H), 2.21 (d, J = 12.8 Hz, 2H), 1.60 – 1.51 (m, 2H), 1.45 (s, 1H), 1.32 (s, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 158.0(d, J = 236.2 Hz), 146.5, 131.2, 130.9, 129.4, 128.7, 127.7, 127.6, 126.0, 122.0, 121.5 (d, J = 9.9 Hz), 119.7, 107.8 (d, J = 24.3 Hz), 96.8 (d, J = 25.9 Hz), 66.8, 36.1, 33.0, 25.1, 22.4; HRMS (ESI) m/z calcd for $C_{23}H_{23}FN_4^+$ $(M+Na)^+$ 397.1804, found 397.1811.

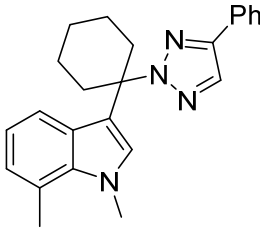
6-Chloro-1-methyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4j)



The reaction was conducted with 6-chloro-1-methyl-1H-indole (**1j**, 33.0 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4j** as white solid (56.2 mg, 72% yield), mp = 154-155 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.14 (s, 1H), 7.76 – 7.68 (m, 2H), 7.43 – 7.37 (m, 2H), 7.33 (t, J = 7.6 Hz, 2H), 7.27 – 7.17 (m, 2H), 6.82 (dd, J = 8.6, 2.0 Hz, 1H), 3.60 (s, 3H), 3.05 – 2.92 (m, 2H), 2.21 (d, J = 11.5 Hz, 2H), 1.56 (s, 2H), 1.45 (s, 1H), 1.31 (s, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.6, 138.0, 131.3, 130.9, 129.5, 128.8, 128.2, 126.7, 126.1, 124.1, 121.7, 119.7, 119.6, 110.4, 66.8, 36.1, 33.1, 25.1, 22.5; HRMS (ESI) m/z calcd for $C_{23}H_{23}ClN_4^+$ $(M+Na)^+$ 413.1509, found 413.1508.

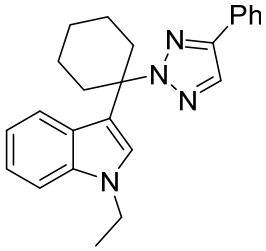
1,7-Dimethyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4k)



The reaction was conducted with 1,7-dimethyl-1H-indole (**1k**, 29.0 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4k** as yellow oil (44.4 mg, 60% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.13 (d, J = 1.2 Hz, 1H), 7.77 – 7.68 (m, 2H), 7.36 – 7.31 (m, 2H), 7.27 – 7.18 (m, 2H), 7.05 (s, 1H), 6.62 (s, 1H), 3.89 (s, 3H), 2.97 (d, J = 13.6 Hz, 2H), 2.55 (s, 3H), 2.29 – 2.20 (m, 2H), 1.57 (s, 2H), 1.46 (s, 1H), 1.33 (s, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.4, 136.0, 131.0, 129.4, 128.7, 126.5, 126.0, 124.0, 121.9, 119.4, 118.8, 118.4, 67.0, 36.9, 36.1, 25.2, 22.5, 19.8; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4^+$ $(M+Na)^+$ 393.2055, found 393.2081.

1-Ethyl-3-(1-(4-phenyl-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4l)

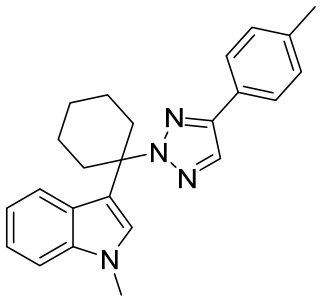


The reaction was conducted with 1-ethyl-1H-indole (**1l**, 29.0 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4l** as yellow oil (60.0 mg, 81% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.14 (s, 1H), 7.73 (d, J = 7.5 Hz, 2H), 7.42 (d, J = 8.1 Hz, 1H), 7.33 (t, J = 7.5 Hz, 2H), 7.28 – 7.19 (m, 3H), 6.94 (t, J = 7.6 Hz, 1H), 6.78 (t, J = 7.6 Hz, 1H), 4.02 (q, J = 7.2 Hz, 2H), 3.05 (d, J = 13.5 Hz, 2H), 2.22 (d, J = 12.3 Hz, 2H), 1.57 (s, 2H), 1.46 (s, 1H), 1.32 (s, 3H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.5, 136.5, 131.1, 131.0, 129.5, 128.7, 126.1, 125.5, 125.4, 121.5, 120.6, 119.7, 119.2, 110.4, 67.1, 40.7, 36.2, 25.2, 22.5, 15.9; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4^+$ $(M+Na)^+$ 393.2055, found

393.2073.

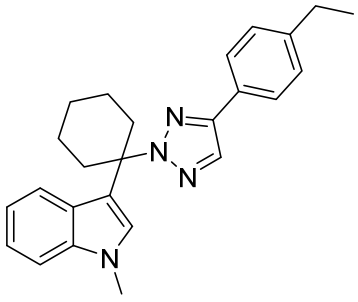
1-Methyl-3-(1-(4-(p-tolyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4m)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(p-tolyl)-1-tosyl-1H-1,2,3-triazole (**3m**, 62.6 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4l** as yellow oil (45.9 mg, 62% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.08 (s, 1H), 7.63 – 7.59 (m, 2H), 7.42 (d, J = 8.1 Hz, 1H), 7.24 (d, J = 8.2 Hz, 1H), 7.14 (d, J = 8.2 Hz, 3H), 6.96 (t, J = 7.6 Hz, 1H), 6.79 (t, J = 7.6 Hz, 1H), 3.61 (s, 3H), 3.05 – 2.96 (m, 2H), 2.28 (d, J = 23.1 Hz, 2H), 2.21 (s, 3H), 1.56 (d, J = 10.7 Hz, 2H), 1.46 (s, 1H), 1.33 (d, J = 8.1 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.5, 138.0, 137.4, 130.8, 130.0, 125.9, 121.5, 120.4, 119.2, 110.4, 66.9, 36.1, 32.8, 25.2, 22.5, 21.3; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4^+$ $(M+Na)^+$ 393.2055, found 393.2056.

3-(1-(4-(4-Ethylphenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4n)

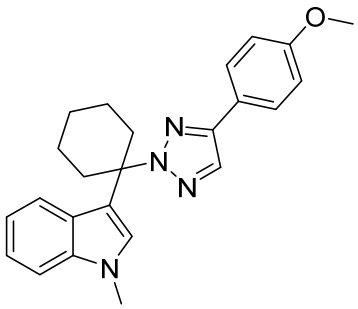


The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(4-ethylphenyl)-1-tosyl-1H-1,2,3-triazole (**3n**, 65.4 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4l** as yellow oil (41.5 mg, 54% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.09 (s, 1H), 7.64 (d, J = 8.0 Hz, 2H), 7.42 (d, J = 8.2 Hz, 1H), 7.23 (d, J = 8.2 Hz, 1H), 7.17 – 7.10 (m, 3H), 6.96 (t, J = 7.6 Hz, 1H), 6.79 (t, J = 7.5 Hz, 1H), 3.60 (s, 3H), 3.06 – 2.95 (m,

2H), 2.50 (q, J = 7.6 Hz, 2H), 2.25 (t, J = 11.7 Hz, 2H), 1.61 – 1.52 (m, 2H), 1.46 (s, 1H), 1.32 (s, 3H), 1.07 (t, J = 7.6 Hz, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.5, 144.4, 137.4, 130.8, 128. 8, 128.5, 127.0, 126.0, 125.4, 121.5, 120.4, 119.5, 119.2, 110.4, 66.9, 36.2, 32.8, 28.5, 25.2, 22.5, 16.0. HRMS (ESI) m/z calcd for $C_{25}H_{28}N_4^+$ $(M+Na)^+$ 407.2212, found 407.2220.

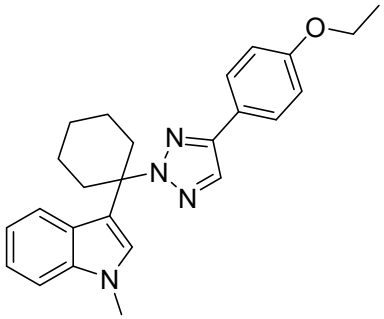
3-(1-(4-(4-Methoxyphenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4o)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(4-methoxyphenyl)-1-tosyl-1H-1,2,3-triazole (**3o**, 65.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 10:1) to yield the desired product **4o** as yellow oil (35.5 mg, 46% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.05 (s, 1H), 7.66 (d, J = 8.8 Hz, 2H), 7.43 (d, J = 8.1 Hz, 1H), 7.25 (d, J = 8.3 Hz, 1H), 7.13 (s, 1H), 6.97 (t, J = 7.6 Hz, 1H), 6.91 (d, J = 8.4 Hz, 2H), 6.80 (t, J = 7.5 Hz, 1H), 3.68 (s, 3H), 3.63 (s, 3H), 3.01 (d, J = 13.5 Hz, 2H), 2.25 (d, J = 11.9 Hz, 2H), 1.57 (d, J = 10.4 Hz, 2H), 1.47 (s, 1H), 1.35 (d, J = 8.1 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.4, 137.4, 131.6, 130.4, 127.4, 125.4, 123.6, 121.5, 120.8, 120.5, 119.8, 119.2, 114.9, 110.4, 66.8, 55.7, 36.2, 32.9, 25.2, 22.5; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4O^+$ $(M+Na)^+$ 409.2004, found 409.2010.

3-(1-(4-(4-Ethoxyphenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4p)

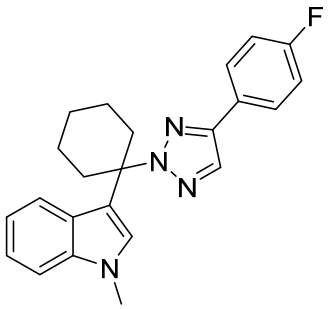


The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4

mmol) and 4-(4-ethoxyphenyl)-1-tosyl-1H-1,2,3-triazole (**3p**, 68.6 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 10:1) to yield the desired product **4p** as white solid (44.0 mg, 55% yield), mp = 190-191 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.09 (s, 1H), 7.64 (d, J = 8.0 Hz, 2H), 7.42 (d, J = 8.2 Hz, 1H), 7.23 (d, J = 8.2 Hz, 1H), 7.17 – 7.10 (m, 3H), 6.96 (t, J = 7.6 Hz, 1H), 6.79 (t, J = 7.5 Hz, 1H), 3.60 (s, 3H), 3.06 – 2.95 (m, 2H), 2.50 (q, J = 7.6 Hz, 2H), 2.25 (t, J = 11.7 Hz, 2H), 1.61 – 1.52 (m, 2H), 1.46 (s, 1H), 1.32 (s, 3H), 1.07 (t, J = 7.6 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.5, 144.4, 137.4, 130.8, 128.8, 128.5, 127.0, 126.0, 125.4, 121.5, 120.4, 119.5, 119.2, 110.4, 66.9, 36.2, 32.8, 28.5, 25.2, 22.5, 16.0; HRMS (ESI) m/z calcd for $C_{25}H_{28}N_4O^+$ $(M+Na)^+$ 423.2161, found 423.2173.

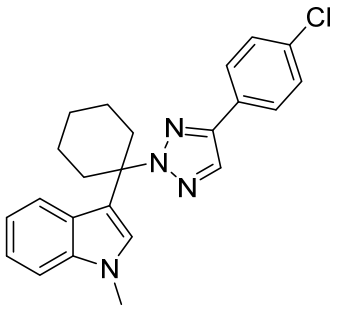
3-(1-(4-(4-Fluorophenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4q)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(4-fluorophenyl)-1-tosyl-1H-1,2,3-triazole (**3q**, 63.4 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4q** as yellow oil (48.6 mg, 65% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.20 (s, 1H), 7.85 (dd, J = 8.4, 5.5 Hz, 2H), 7.50 (d, J = 8.0 Hz, 1H), 7.32 (d, J = 8.3 Hz, 1H), 7.25 (td, J = 8.8, 1.6 Hz, 2H), 7.20 (s, 1H), 7.04 (t, J = 7.6 Hz, 1H), 6.88 (t, J = 7.6 Hz, 1H), 3.70 (s, 3H), 3.13 – 3.04 (m, 2H), 2.36 (q, J = 8.5 Hz, 2H), 1.68 – 1.63 (m, 2H), 1.54 (s, 1H), 1.42 (d, J = 8.0 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ161.2 (d, J = 245.8 Hz), 145.6, 137.4, 131.0, 130.5, 128.1(d, J = 8.3 Hz), 127.5(d, J = 3.1 Hz), 127.4, 127.0, 125.3, 121.5, 120.3, 119.2, 116.5, (d, J = 21.8 Hz), 110.4, 36.1, 32.8, 25.1, 22.5; HRMS (ESI) m/z calcd for $C_{23}H_{23}FN_4^+$ $(M+Na)^+$ 397.1804, found 397.1810.

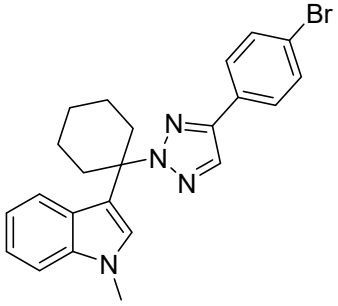
3-(1-(4-(4-Chlorophenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4r)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(4-chlorophenyl)-1-tosyl-1H-1,2,3-triazole (**3r**, 66.6 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4r** as white solid (65.5 mg, 84% yield), mp = 178-179 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.21 – 8.14 (m, 1H), 7.75 (d, J = 8.4 Hz, 2H), 7.40 (t, J = 8.6 Hz, 3H), 7.23 (d, J = 8.2 Hz, 1H), 7.13 (s, 1H), 6.96 (t, J = 7.6 Hz, 1H), 6.79 (t, J = 7.6 Hz, 1H), 3.61 (s, 3H), 3.00 (d, J = 13.6 Hz, 2H), 2.26 (dt, J = 12.5, 6.5 Hz, 2H), 1.62 – 1.53 (m, 2H), 1.45 (s, 1H), 1.39 – 1.27 (m, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 145.4, 137.4, 133.2, 131.3, 129.5, 127.7, 127.1, 125.3, 121.6, 120.4, 119.8, 119.3, 110.4, 67.2, 36.1, 32.9, 25.2, 22.5; HRMS (ESI) m/z calcd for $C_{23}H_{23}ClN_4^+$ $(M+Na)^+$ 413.1509, found 413.1509.

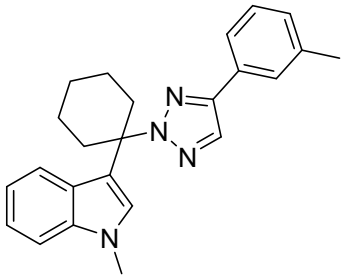
3-(1-(4-(4-Bromophenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4s)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(4-bromophenyl)-1-tosyl-1H-1,2,3-triazole (**3s**, 75.4 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4r** as white solid (61.6 mg, 71% yield), mp = 202-203 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.23 (s, 1H), 7.73 (d, J = 8.5 Hz, 2H), 7.58 (d, J = 8.6 Hz, 2H), 6.84 (t, J = 7.6 Hz, 1H), 3.66 (s, 3H), 3.05 (d, J = 14.0 Hz, 2H), 2.32 (t, J = 12.2 Hz, 2H), 1.63 (s, 1H), 1.50 (s, 1H), 1.37 (s, 2H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 145.5, 137.4, 132.4, 131.3, 130.2, 128.0, 127.1, 125.3, 121.7, 121.5, 120.3, 119.3, 119.2, 110.4, 67.2, 36.1, 32.9, 25.2, 22.4.

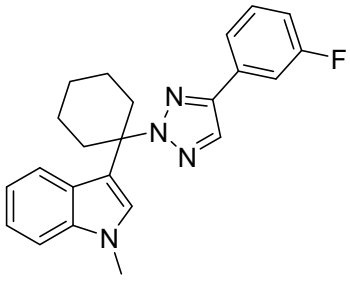
1-Methyl-3-(1-(4-(m-tolyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1H-indole (4t)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(m-tolyl)-1-tosyl-1H-1,2,3-triazole (**3t**, 62.6 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4t** as yellow oil (44.4 mg, 60% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.12 (s, 1H), 7.57 – 7.49 (m, 2H), 7.40 (d, J = 8.1 Hz, 1H), 7.25 – 7.18 (m, 2H), 7.12 (s, 1H), 7.04 (d, J = 7.6 Hz, 1H), 7.00 – 6.92 (m, 1H), 6.79 (t, J = 7.5 Hz, 1H), 3.61 (s, 3H), 3.07 – 2.94 (m, 2H), 2.23 (s, 5H), 1.63 – 1.53 (m, 2H), 1.51 – 1.44 (m, 1H), 1.33 (s, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 146.6, 138.6, 137.4, 131.1, 130.9, 129.3, 127.0, 126.5, 125.3, 123.2, 121.5, 120.4, 119.5, 119.2, 110.4, 67.0, 36.2, 32.8, 25.2, 22.5, 21.5; HRMS (ESI) m/z calcd for $C_{24}H_{26}N_4^+$ $(M+Na)^+$ 393.2055, found 393.2072.

3-(1-(4-(3-Fluorophenyl)-2H-1,2,3-triazol-2-yl) cyclohexyl)-1-methyl-1H-indole (4u)

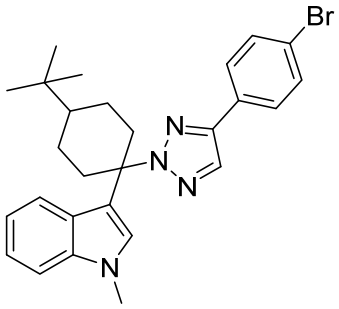


The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclohexanone (**2a**, 42 μL, 0.4 mmol) and 4-(3-fluorophenyl)-1-tosyl-1H-1,2,3-triazole (**3u**, 63.4 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4u** as yellow oil (46.4 mg, 62% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (s, 1H), 7.59 (d, J = 7.9 Hz, 2H), 7.42 (d, J = 8.1 Hz, 1H), 7.24 (d, J = 8.3 Hz, 1H), 7.14 (s, 1H), 7.07 (t, J = 8.6 Hz, 1H), 6.99 – 6.94 (m, 1H), 6.83 – 6.77 (m, 1H), 3.61 (s, 3H), 3.00 (d, J = 13.5 Hz, 2H), 2.25 (d, J = 12.5 Hz, 2H), 1.57 (s, 2H), 1.45 (s, 1H), 1.33 (d, J = 7.6 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ161.9(d, J = 244.2 Hz), 145.4, 137.4, 133.4 (d, J = 8.5 Hz), 131.6, 127.1, 125.3, 122.1,

122.0, 121.6, 120.3, 119.3, 115.5 (d, J = 21.2 Hz), 112.7 (d, J = 22.9 Hz), 110.4, 67.3, 36.1, 32.8, 25.2, 22.5; HRMS (ESI) m/z calcd for $C_{23}H_{23}N_4^+$ $(M+Na)^+$ 397.1804, found 397.1814.

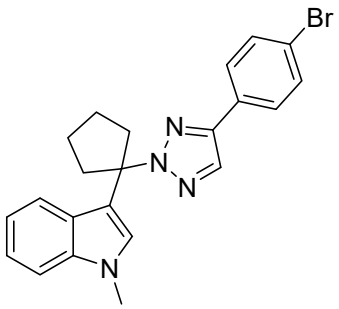
3-(1-(4-(4-Bromophenyl)-2H-1,2,3-triazol-2-yl)-4-(tert-butyl) cyclohexyl)-1-methyl-1H-indole (4v)



The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), 4-(tert-butyl)cyclohexan-1-one (**2b**, 68 μL, 0.4 mmol) and 4-(4-bromophenyl)-1-tosyl-1H-1,2,3-triazole (**3v**, 75.4 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **4v** as white solid (53.9 mg, 55% yield), mp = 209-210 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.20 (s, 1H), 7.69 (d, J = 8.5 Hz, 2H), 7.54 (d, J = 8.6 Hz, 2H), 7.38 (d, J = 8.1 Hz, 1H), 7.23 (d, J = 8.2 Hz, 1H), 7.06 (s, 1H), 6.99-6.92 (m, 1H), 6.78 (dd, J = 8.3, 7.1 Hz, 1H), 3.60 (s, 3H), 2.07 (t, J = 13.1 Hz, 2H), 1.65 (d, J = 12.8 Hz, 2H), 1.15 (d, J = 14.1 Hz, 2H), 0.99 (q, J = 12.7 Hz, 2H), 0.83-0.69 (m, 1H), 0.65 (s, 9H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 145.5, 137.4, 132.4, 131.3, 130.2, 128.0, 126.3, 125.3, 121.8, 121.6, 120.2, 120.2, 119.2, 110.4, 66.7, 46.6, 36.4, 32.8, 32.6, 27.7, 23.2; HRMS (ESI) m/z calcd for $C_{27}H_{31}BrN_4^+$ $(M+Na)^+$ 513.1630, found 513.1626.

3-(1-(4-(4-Bromophenyl)-2H-1,2,3-triazol-2-yl) cyclopentyl)-1-methyl-1H-indole (4w)

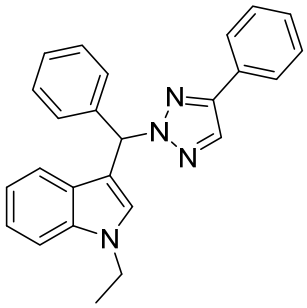


The reaction was conducted with 1-methyl-1H-indole (**1a**, 26.2 mg, 0.2 mmol), cyclopentanone (**2c**, 36 μL, 0.4 mmol) and 4-(4-bromophenyl)-1-tosyl-1H-1,2,3-triazole (**3w**, 75.4 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired

product **4w** as yellow oil (27.7 mg, 33% yield).

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.12 (s, 1H), 7.65 (dd, J = 9.0, 2.4 Hz, 2H), 7.52 (dd, J = 8.5, 1.3 Hz, 2H), 7.40 – 7.30 (m, 2H), 7.25 (d, J = 8.2 Hz, 1H), 6.98 (t, J = 7.6 Hz, 1H), 6.82 (t, J = 7.5 Hz, 1H), 3.63 (s, 3H), 3.14 (d, J = 5.7 Hz, 2H), 2.39 – 2.29 (m, 2H), 1.74 (s, 2H), 1.54 (d, J = 7.2 Hz, 2H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 145.7, 137.5, 132.4, 131.5, 130.2, 128.0, 127.5, 126.0, 121.8, 121.7, 120.2, 119.4, 117.1, 110.4, 75.3, 38.3, 32.9, 23.0.

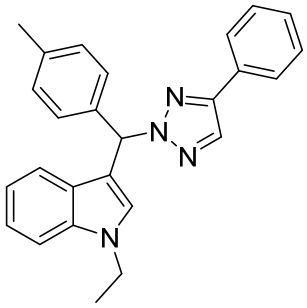
1-Ethyl-3-(phenyl(4-phenyl-2H-1,2,3-triazol-2-yl) methyl)-1H-indole (5a)



The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), benzaldehyde (**2d**, 40 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5a** as white solid (51.4 mg, 68% yield), mp = 160-161 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.29 (s, 1H), 7.82 (d, J = 7.5 Hz, 2H), 7.46 – 7.39 (m, 6H), 7.35 (dt, J = 13.8, 7.3 Hz, 4H), 7.24 (d, J = 8.0 Hz, 1H), 7.16 – 7.08 (m, 2H), 6.95 (t, J = 7.5 Hz, 1H), 3.75 (s, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 147.3, 139.7, 137.3, 131.9, 130.5, 130.0, 129.4, 128.9, 128.9, 128.3, 127.9, 126.6, 126.1, 122.1, 119.7, 119.4, 112.8, 110.4, 65.8, 32.9; HRMS (ESI) m/z calcd for $C_{25}H_{22}N_4^+$ $(M+Na)^+$ 401.1742, found 401.1735.

1-Ethyl-3-((4-phenyl-2H-1,2,3-triazol-2-yl) (p-tolyl) methyl)-1H-indole (5b)

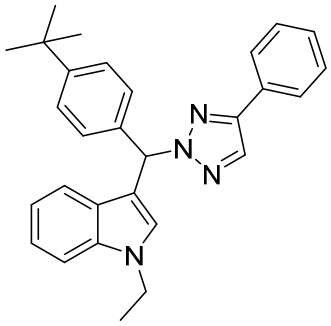


The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 4-methylbenzaldehyde (**2e**, 48 μL,

0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5b** as white solid (44.7 mg, 57% yield), mp = 161-162 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.18 (s, 1H), 7.72 (dd, J = 8.2, 1.4 Hz, 2H), 7.38 – 7.31 (m, 3H), 7.27 – 7.20 (m, 4H), 7.13 (d, J = 8.0 Hz, 1H), 7.10 – 7.06 (m, 3H), 7.03 (t, J = 7.1 Hz, 1H), 4.08 (q, J = 7.2 Hz, 2H), 2.18 (s, 3H), 1.20 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 147.3, 137.7, 136.8, 136.4, 131.9, 130.6, 129.6, 129.5, 129.0, 128.4, 128.0, 126.8, 126.1, 122.1, 119.7, 119.7, 113.1, 110.5, 65.9, 40.9, 21.2, 16.0; HRMS (ESI) m/z calcd for $C_{26}H_{24}N_4^+$ $(M+Na)^+$ 415.1899, found 415.1909.

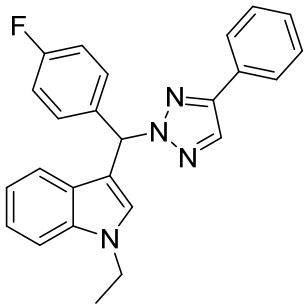
3-((4-(tert-Butyl) phenyl) (4-phenyl-2H-1,2,3-triazol-2-yl) methyl)-1-ethyl-1H-indole (5c)



The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 4-(tert-butyl) benzaldehyde (**2f**, 67 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5c** as white solid (26.0 mg, 30% yield), mp = 173-174 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.18 (s, 1H), 7.72 (d, J = 7.6 Hz, 2H), 7.34 (q, J = 7.8 Hz, 3H), 7.27 (d, J = 9.2 Hz, 5H), 7.19 (d, J = 8.0 Hz, 1H), 7.13 (s, 1H), 7.03 (t, J = 7.6 Hz, 1H), 6.85 (t, J = 7.5 Hz, 1H), 4.08 (q, J = 7.2 Hz, 2H), 1.20 (t, J = 7.2 Hz, 3H), 1.14 (s, 9H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 150.8, 147.3, 136.8, 136.4, 131.9, 130.6, 129.5, 129.0, 128.3, 127.8, 126.1, 125.8, 122.1, 119.7, 112.9, 110.5, 65.8, 40.9, 34.8, 31.6, 16.0; HRMS (ESI) m/z calcd for $C_{29}H_{30}N_4^+$ $(M+Na)^+$ 457.2368, found 457.2377.

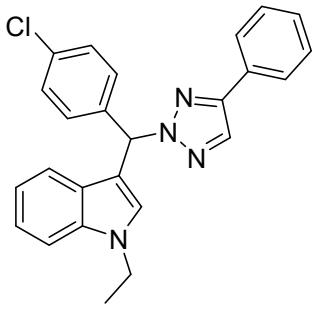
1-Ethyl-3-((4-fluorophenyl) (4-phenyl-2H-1,2,3-triazol-2-yl) methyl)-1H-indole (5d)



The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 4-fluorobenzaldehyde (**2g**, 44 μL, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5d** as white solid (38.0 mg, 48% yield), m.p. = 178-179 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (s, 1H), 7.79 – 7.70 (m, 2H), 7.39 (dd, J = 16.5, 8.5, 3.9 Hz, 5H), 7.28 (d, J = 7.2 Hz, 1H), 7.17 – 7.11 (m, 3H), 7.09 (s, 1H), 7.04 (d, J = 7.7 Hz, 1H), 6.87 (t, J = 7.5 Hz, 1H), 4.10 (q, J = 7.1 Hz, 2H), 1.23 (t, J = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ161.0(d, J = 245.1 Hz), 147.4, 145.1, 136.4, 135.9, 132.1, 130.2(d, J = 8.4 Hz),129.5, 129.0, 128.3, 126.1, 122.1, 119.7(d, J = 11.1 Hz), 116.2, 115.9(d, J = 21.6 Hz), 112.9, 110.6, 65.2, 40.9, 16.0; HRMS (ESI) m/z calcd for $C_{25}H_{21}FN_4^+$ $(M+Na)^+$ 419.1648, found 419.1660.

3-((4-Chlorophenyl) (4-phenyl-2H-1,2,3-triazol-2-yl) methyl) -1-ethyl-1H-indole (5e)

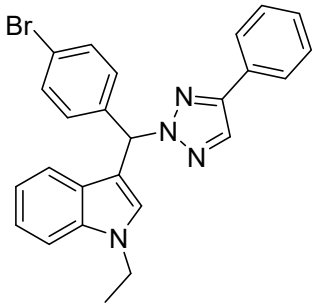


The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 4-chlorobenzaldehyde (**2h**, 56.0 mg, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5e** as white solid (42.8 mg, 52% yield), m.p. = 183-184 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (s, 1H), 7.75 – 7.70 (m, 2H), 7.35 (d, J = 6.1 Hz, 7H), 7.27 – 7.23 (m, 1H), 7.15 (d, J = 8.0 Hz, 1H), 7.10 (s, 1H), 7.04 (t, J = 7.6 Hz, 1H), 6.86 (t, J = 7.5 Hz, 1H), 4.08 (q, J = 7.2 Hz, 2H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 147.5, 138.7, 136.4, 133.1, 132.1, 130.5, 129.9,

129.5, 129.0, 128.5, 126.7, 126.2, 122.2, 119.8, 112.6, 110.6, 65.2, 40.9, 40.7, 16.0, 16.0; HRMS (ESI) m/z calcd for $C_{25}H_{21}ClN_4^+$ $(M+Na)^+$ 435.1352, found 435.1346.

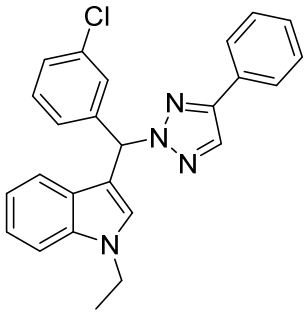
3-((4-Bromophenyl) (4-phenyl-2H-1,2,3-triazol-2-yl) methyl) -1-ethyl-1H-indole (5f)



The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 4-bromobenzaldehyde (**2i**, 73.6 mg, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5f** as white solid (42.8 mg, 47% yield), m.p. = 200-201 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (s, 1H), 7.75 – 7.70 (m, 2H), 7.49 (d, J = 8.5 Hz, 2H), 7.36 – 7.33 (m, 3H), 7.27 (d, J = 8.5 Hz, 3H), 7.15 (d, J = 8.0 Hz, 1H), 7.11 (s, 1H), 7.04 (t, J = 7.3 Hz, 1H), 6.86 (t, J = 7.5 Hz, 1H), 4.08 (q, J = 7.2 Hz, 2H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 147.5, 139.1, 136.4, 132.1, 132.0, 130.5, 130.2, 129.5, 129.0, 128.5, 126.7, 126.1, 122.1, 121.7, 119.8, 112.5, 110.6, 65.3, 40.9, 15.9; HRMS (ESI) m/z calcd for $C_{25}H_{21}BrN_4^+$ $(M+Na)^+$ 479.0847, found 479.0854.

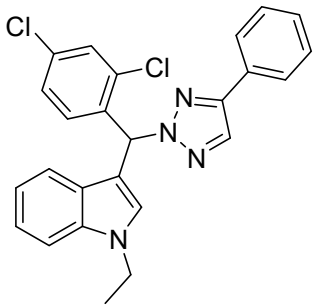
3-((3-Chlorophenyl) (4-phenyl-2H-1,2,3-triazol-2-yl) methyl) -1-ethyl-1H-indole (5g)



The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 3-chlorobenzaldehyde (**2j**, 56.0 mg, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5g** as white solid (43.6 mg, 53% yield), m.p. = 183-184 °C.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.24 (s, 1H), 7.73 (d, J = 7.7 Hz, 2H), 7.40 – 7.31 (m, 7H), 7.20 – 7.12 (m, 3H), 7.03 (d, J = 7.8 Hz, 1H), 6.87 (t, J = 7.5 Hz, 1H), 4.10 (q, J = 7.2 Hz, 2H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 147.5, 142.1, 136.4, 133.6, 132.3, 131.0, 130.4, 129.5, 129.1, 128.5, 128.5, 127.8, 126.7, 126.6, 126.1, 122.2, 119.8, 119.6, 112.3, 110.6, 65.2, 40.9, 16.0; HRMS (ESI) m/z calcd for $C_{25}H_{21}ClN_4^+$ $(M+Na)^+$ 435.1352, found 435.1364.

3-((2,4-Dichlorophenyl) (4-phenyl-2H-1,2,3-triazol-2-yl) methyl) -1-ethyl-1H-indole (5h)

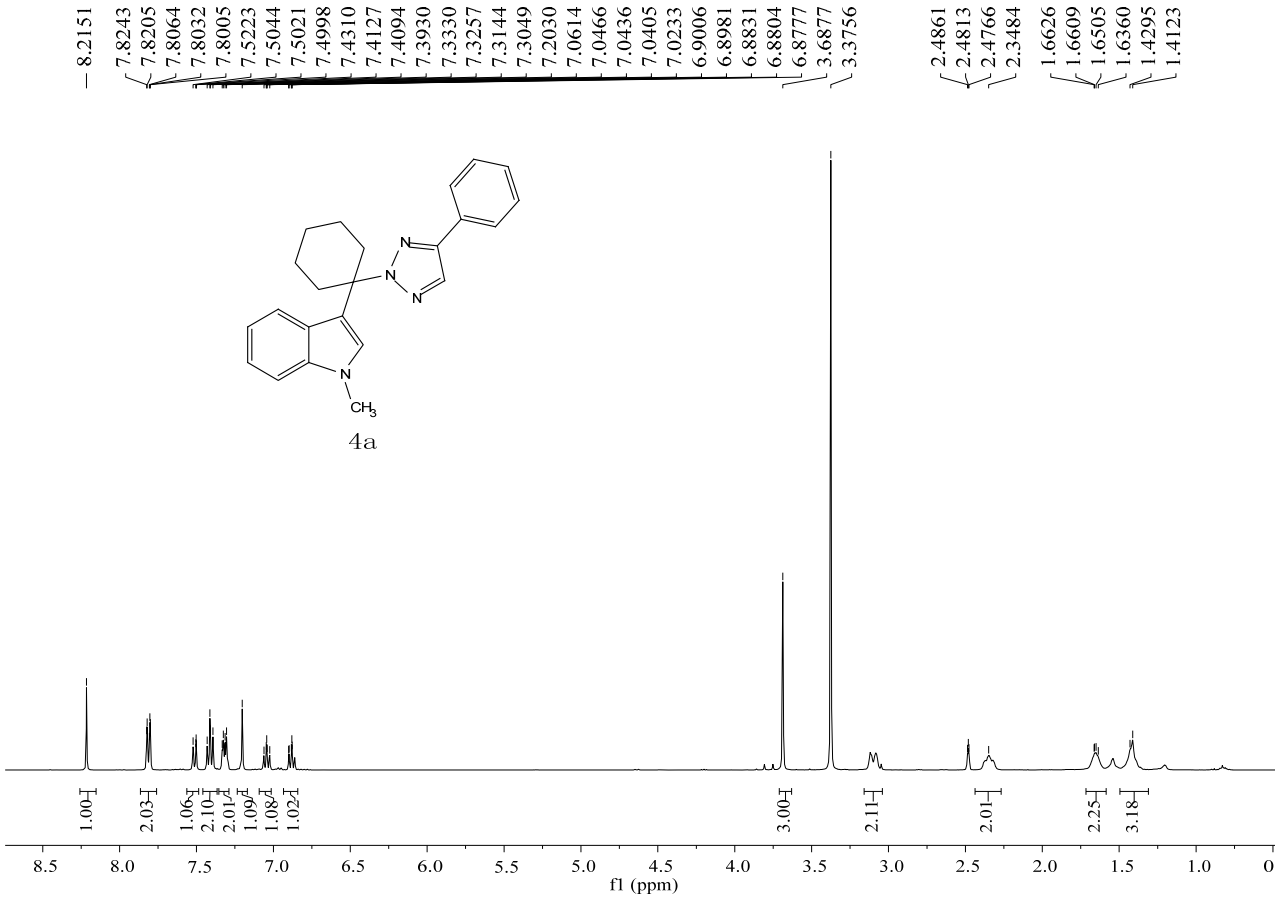


The reaction was conducted with 1-ethyl-1H-indole (**1b**, 29 μL, 0.2 mmol), 2,4-dichlorobenzaldehyde (**2k**, 69.6 mg, 0.4 mmol) and 4-phenyl-1-tosyl-1H-1,2,3-triazole (**3a**, 59.8 mg, 0.2 mmol). The residue was purified by aluminum oxide (neutral) (200-300 mesh) column (petroleum ether/ethyl acetate = 20:1) to yield the desired product **5h** as white solid (49.1 mg, 55% yield), m.p. = 220-221 °C. HRMS (ESI) m/z calcd for $C_{25}H_{20}Cl_2N_4^+$ $(M+Na)^+$ 469.0963, found 469.0967.

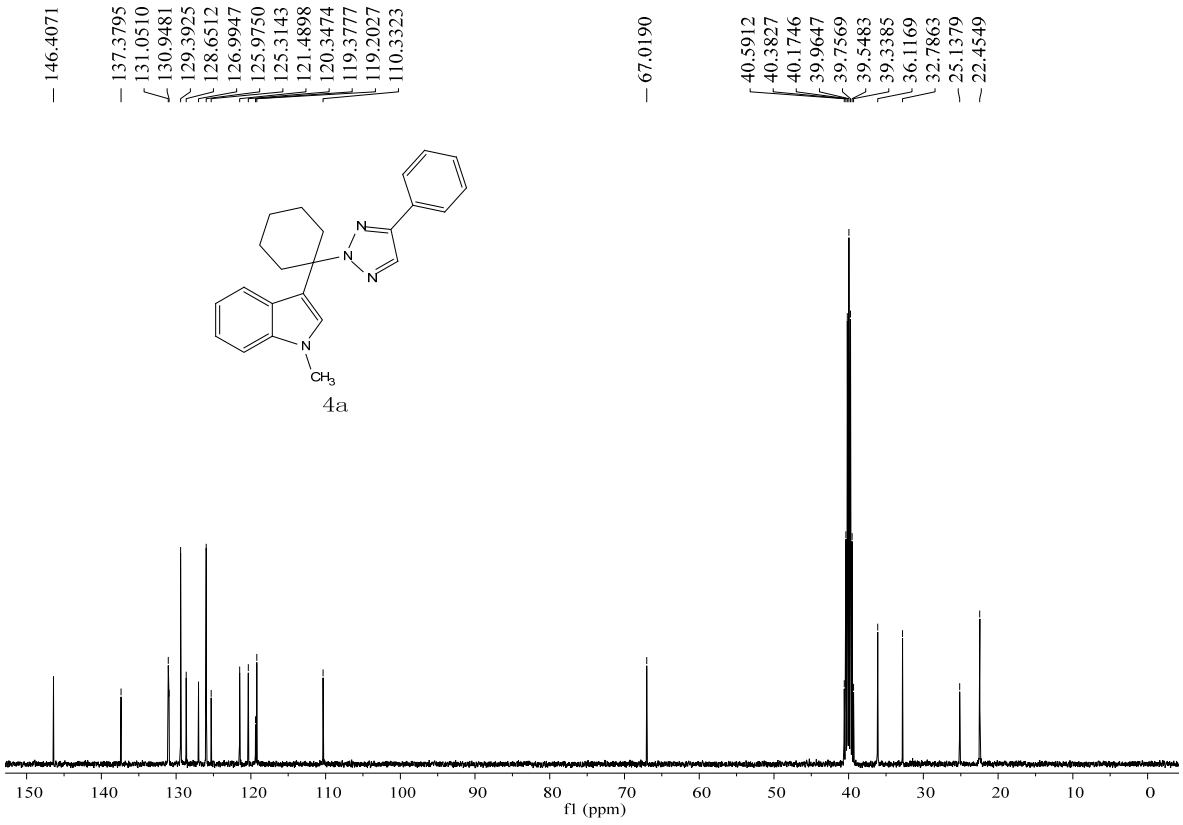
4. References

1 Y. T. Liu, X. Y. Wang, J. M. Xu, Q. Zhang, Y. Zhao and Y. F. Hu, *Tetrahedron*., 2011, **67**, 6294.

5. NMR spectra for products



4a



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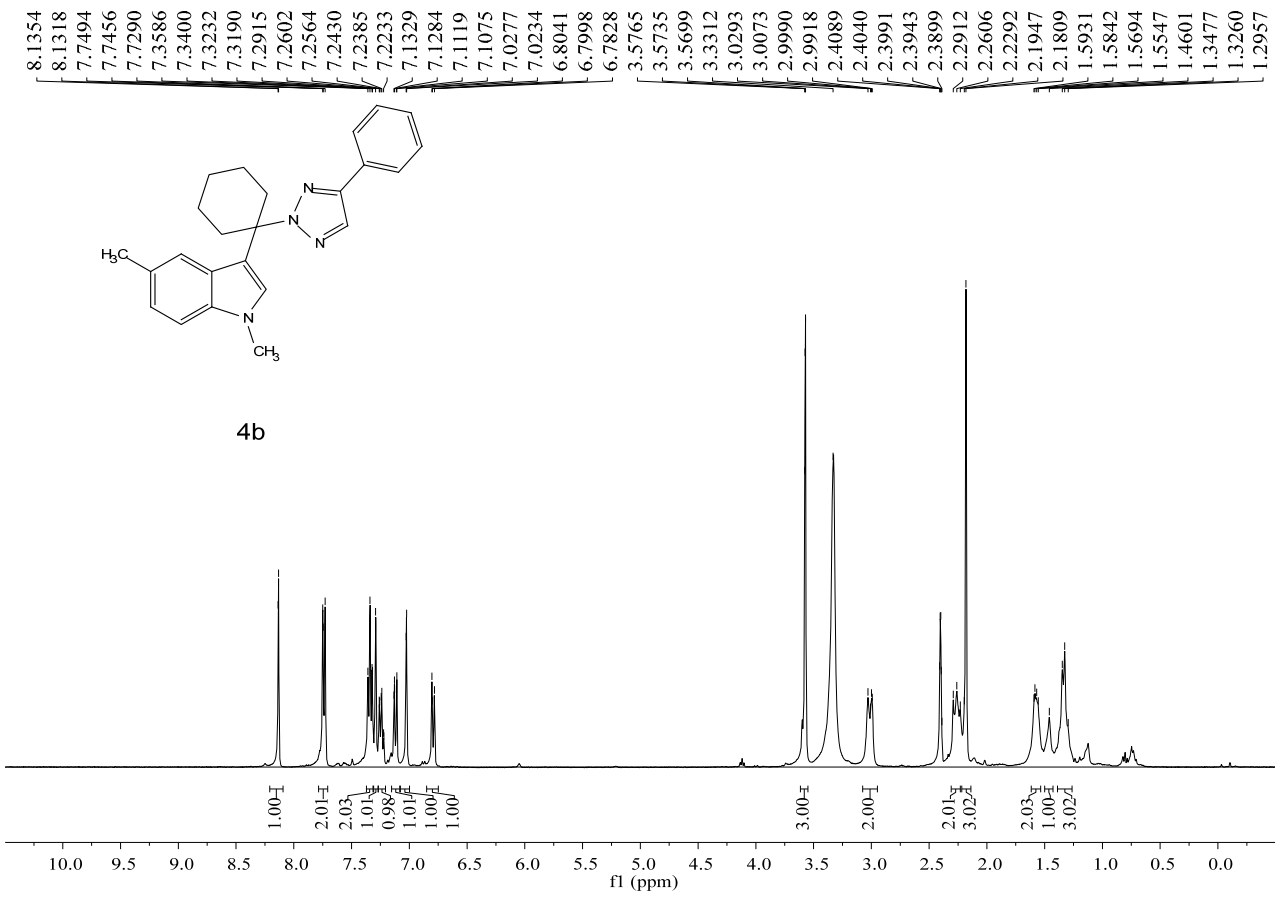
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7.2430
7.2385
7.2233
7.1329
7.1284
7.1119
7.1075
7.0277
7.0234
6.8041
6.7998
6.7828
3.5765
3.5735
3.5699
3.3312
3.0293
3.0073
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2.4040
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2.2912
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1.5842
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1.5547
1.4601
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1.3260
1.2957
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N
N
N
CH3
4b
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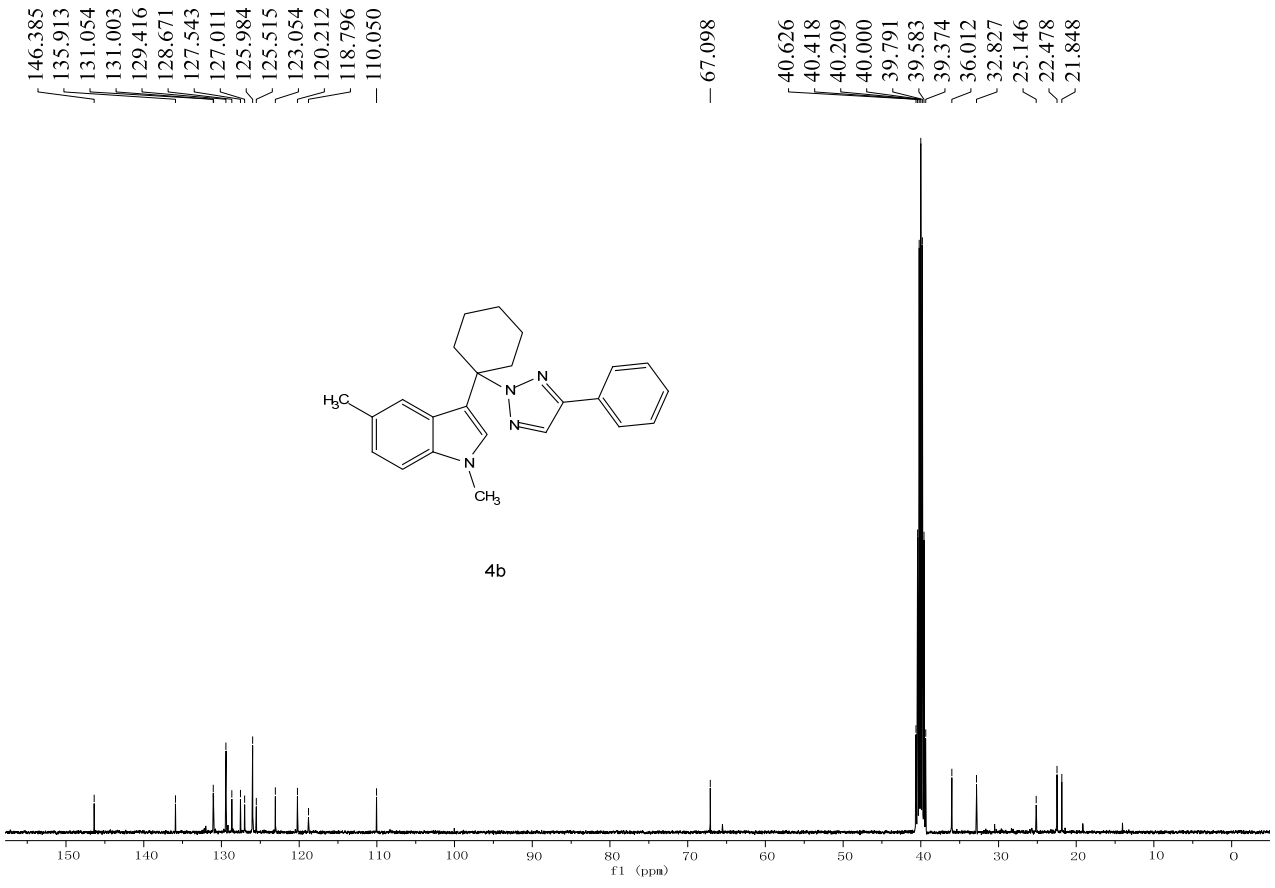
2.03
1.01
0.98
1.01
1.00
1.00
3.00
2.00
2.01
3.02
2.03
1.00
3.02
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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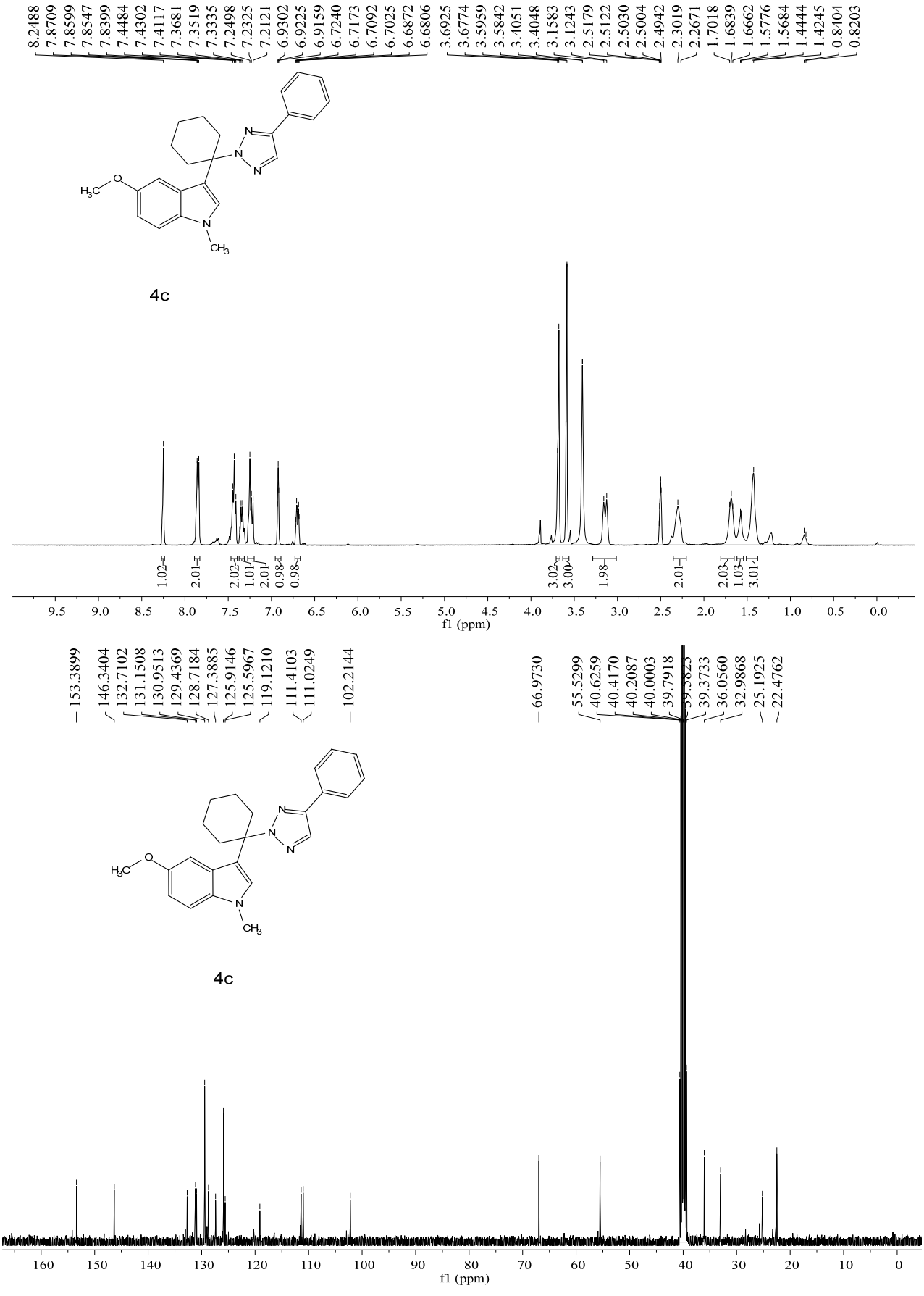
f1 (ppm)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2.03
1.03
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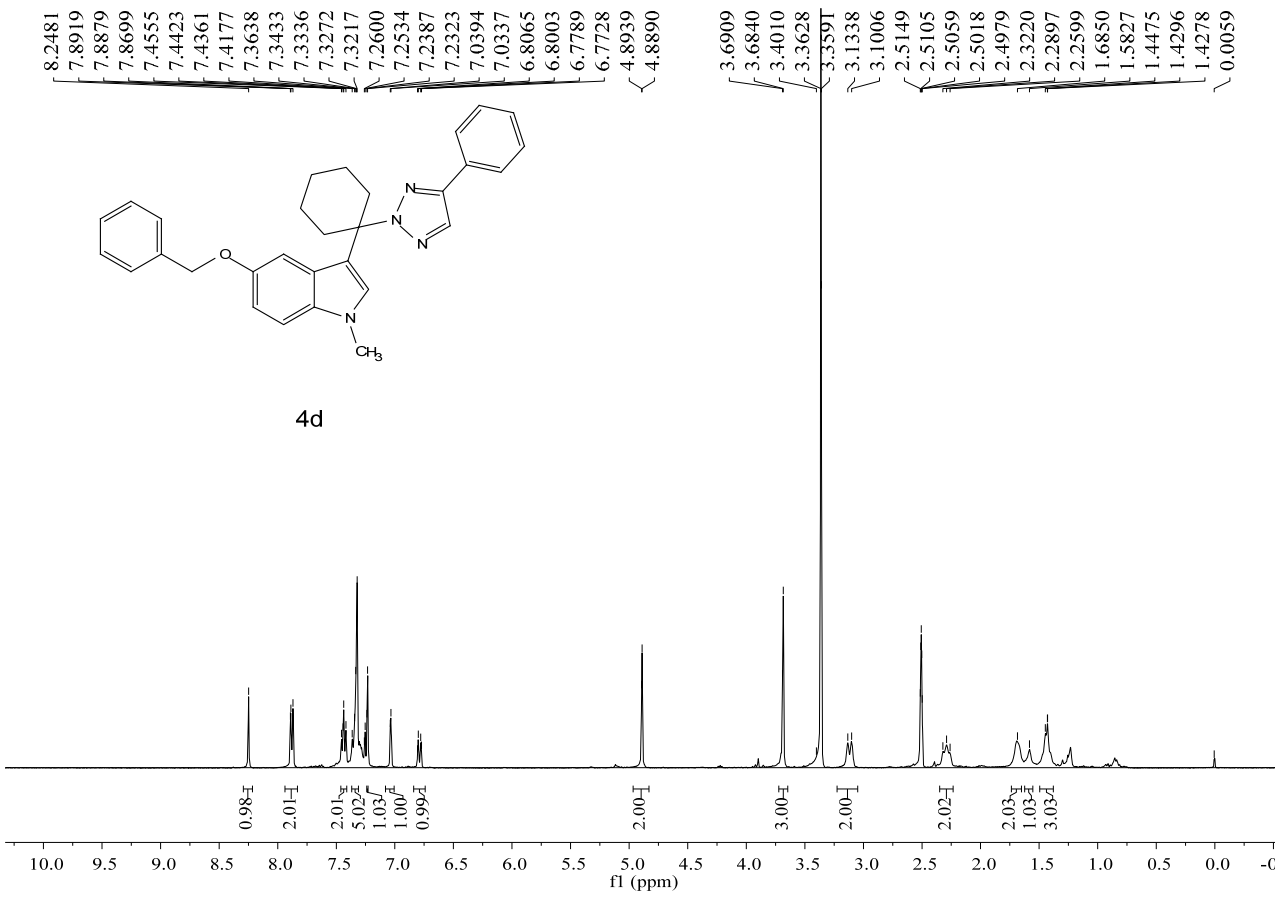
f1 (ppm)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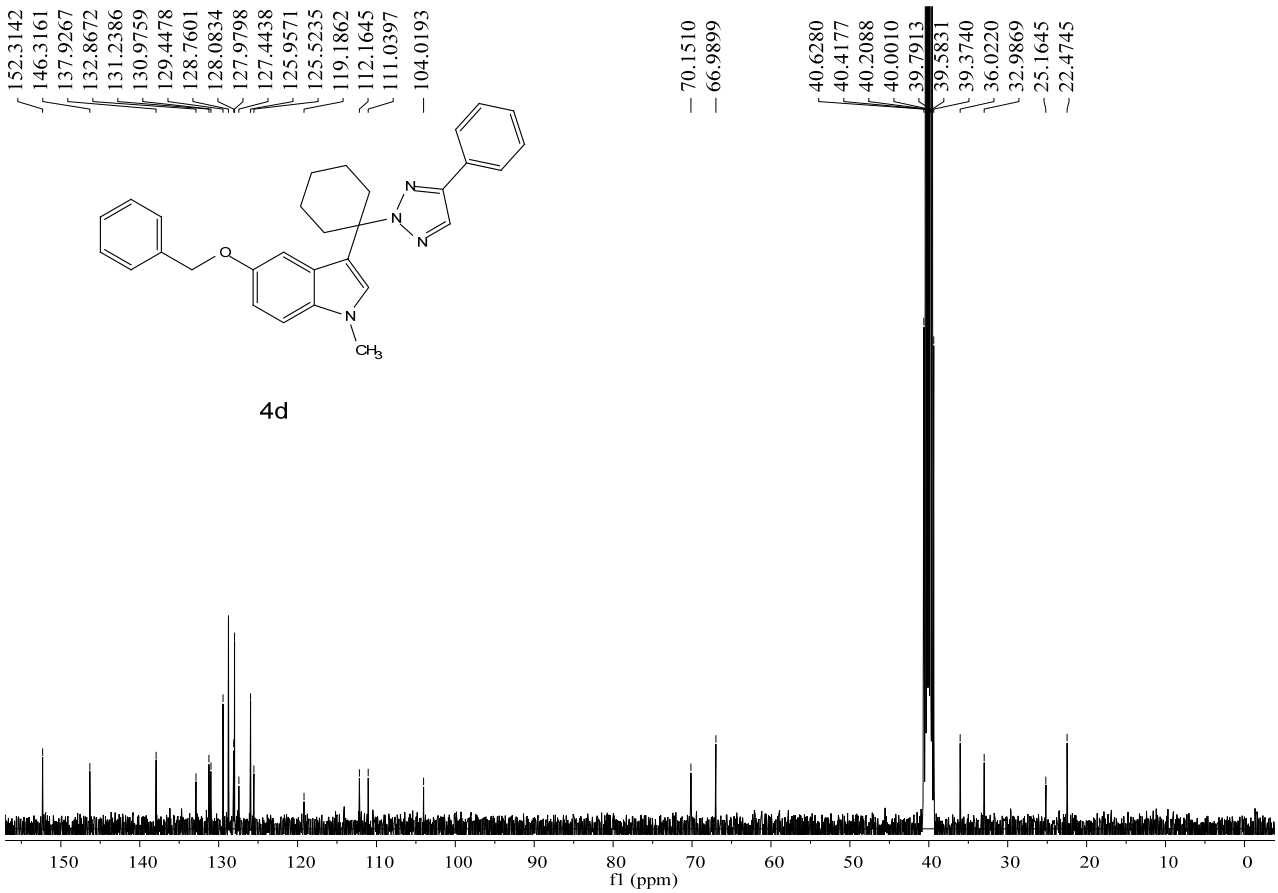
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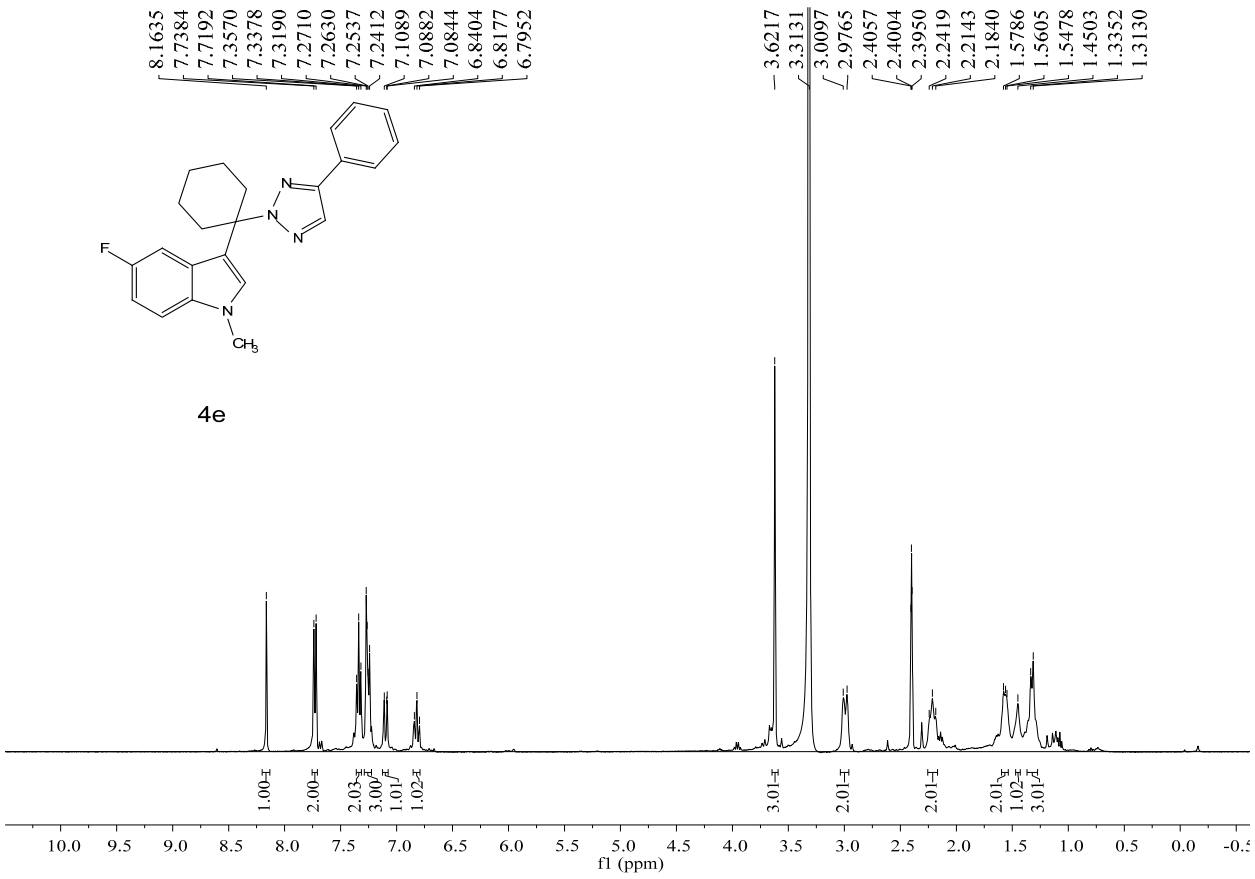
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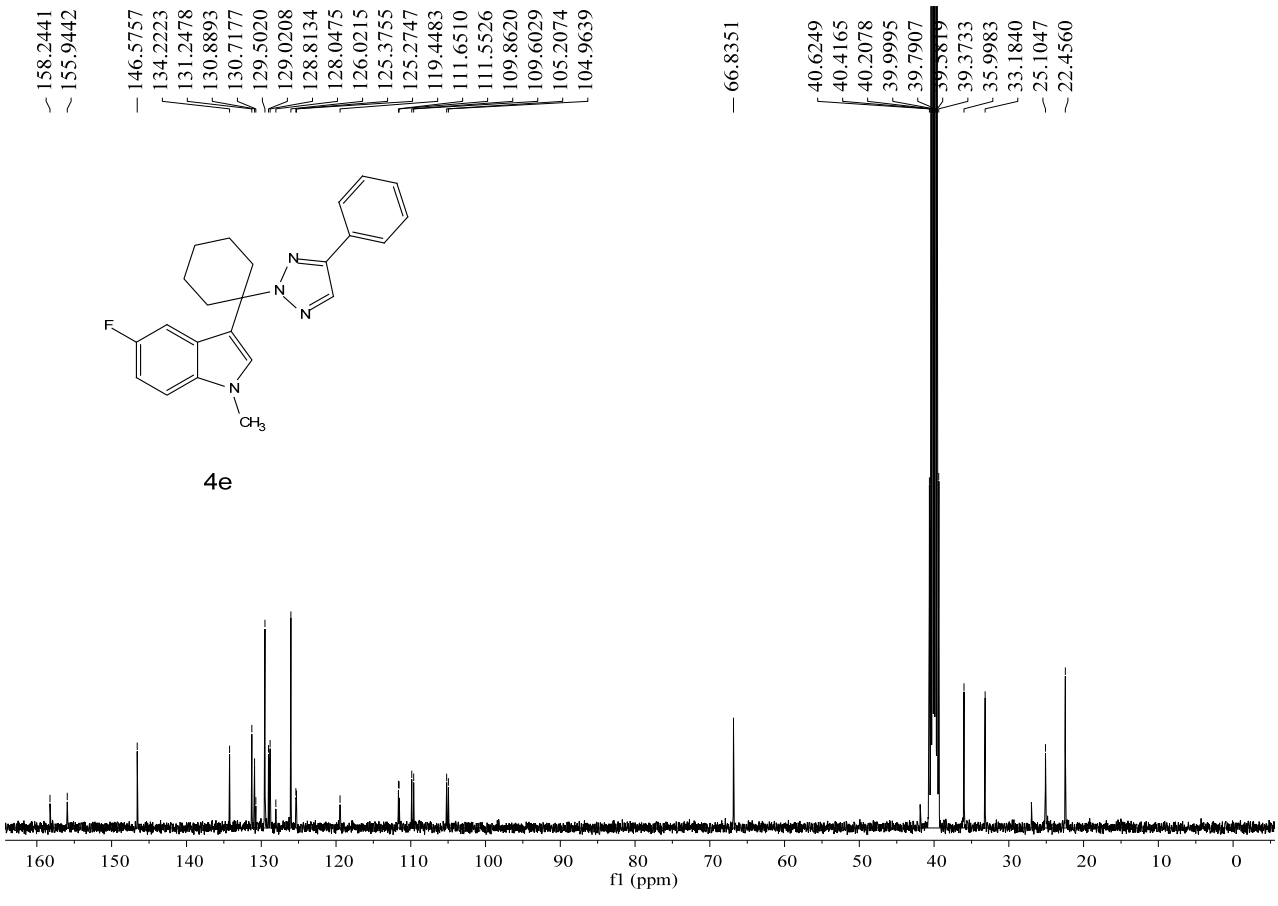
3.01
f1 (ppm)

4e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39.9995
39.7907
39.5819
39.3733
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33.1840
25.1047
22.4560
F
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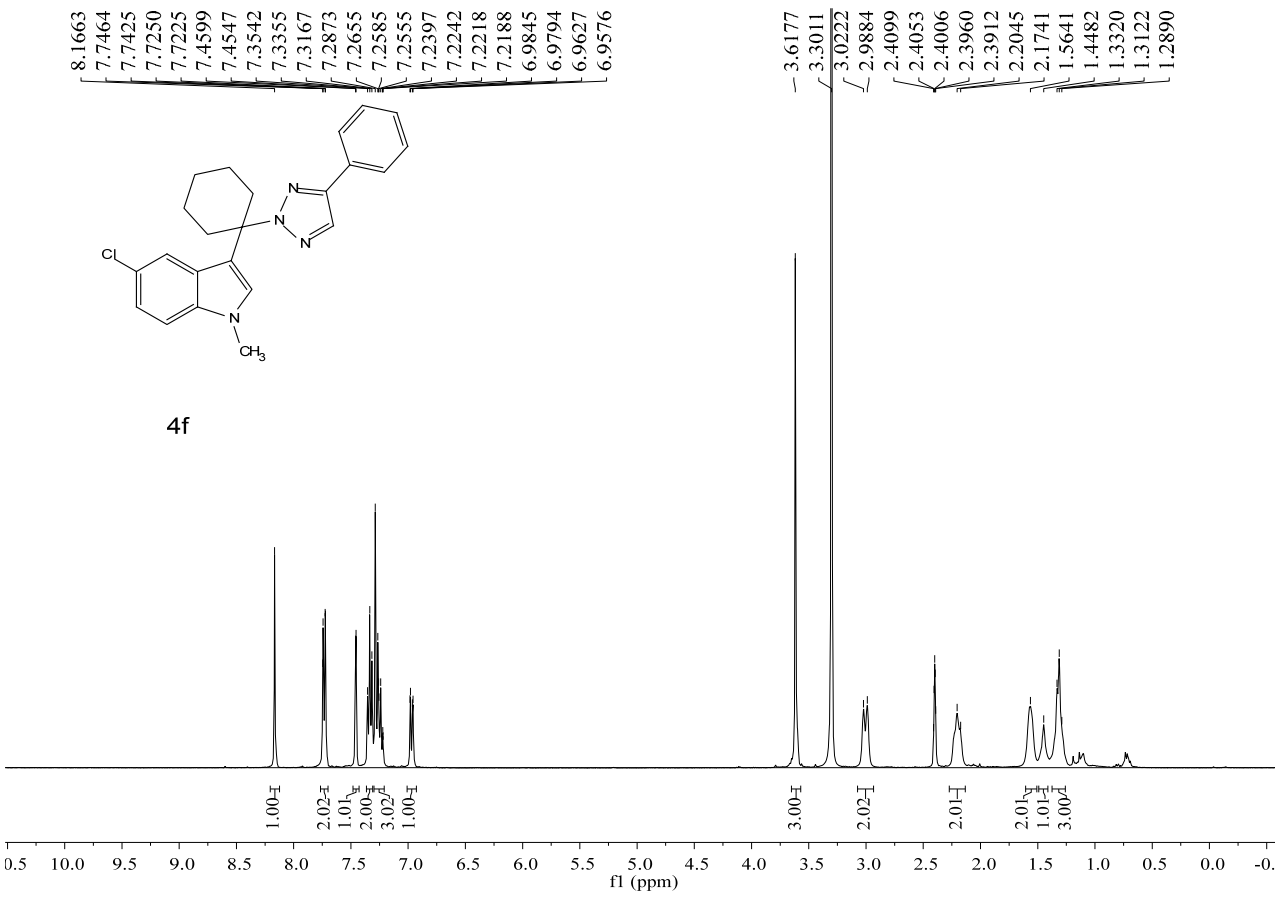
N
N
N
CH3
f1 (ppm)

4e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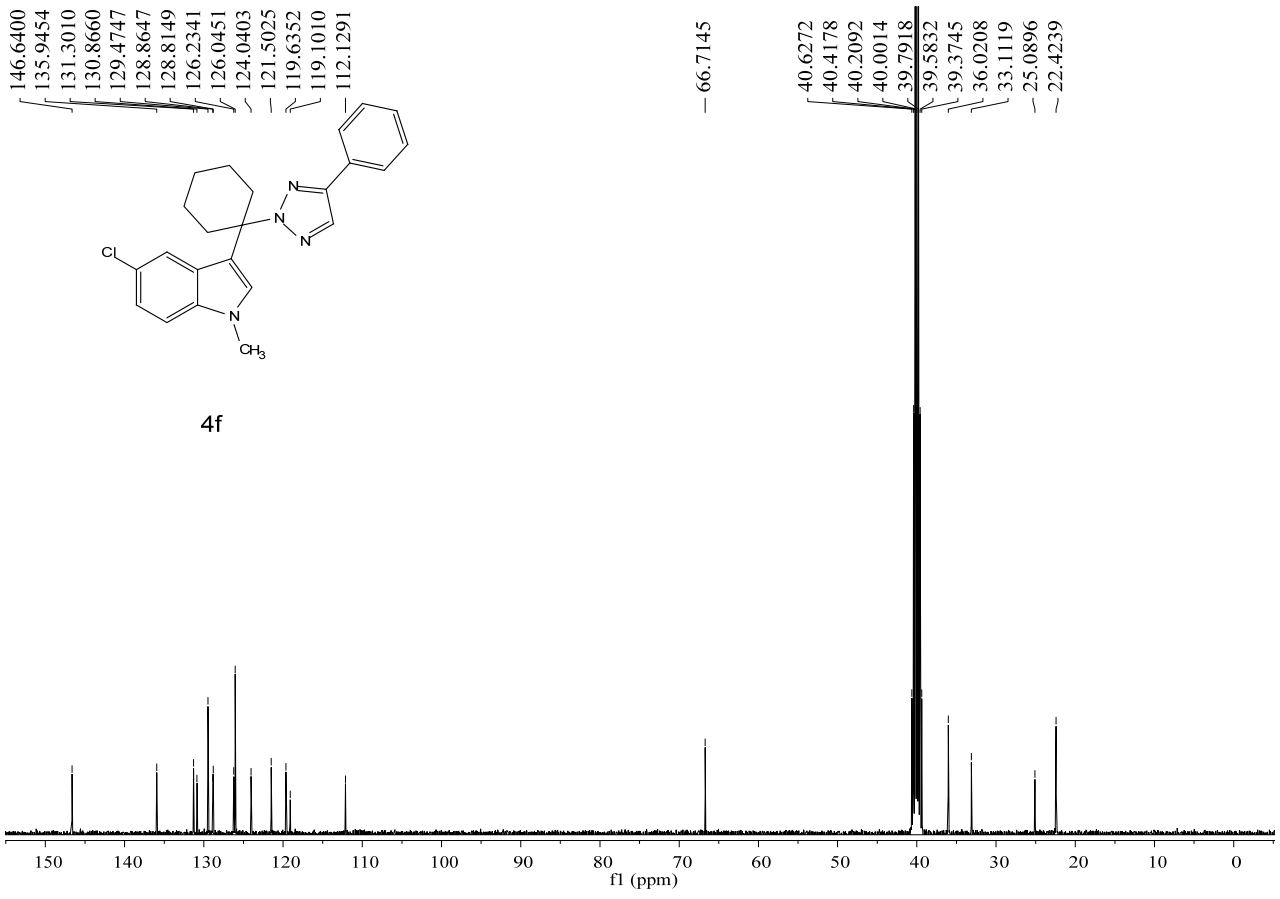
7.7225
7.4599
7.4547
7.3542
7.3355
7.3167
7.2873
7.2655
7.2585
7.2555
7.2397
7.2242
7.2218
7.2188
6.9845
6.9794
6.9627
6.9576
3.6177
3.3011
3.0222
2.9884
2.4099
2.4053
2.4006
2.3960
2.3912
2.2045
2.1741
1.5641
1.4482
1.3320
1.3122
1.2890
Cl
N
N
N
N
CH3
1.00
2.02
1.01
2.00
3.02
1.00
3.00
2.02
2.01
2.01
1.01
3.00
f1 (ppm)

4f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121.5025
119.6352
119.1010
112.1291
66.7145
40.6272
40.4178
40.2092
40.0014
39.7918
39.5832
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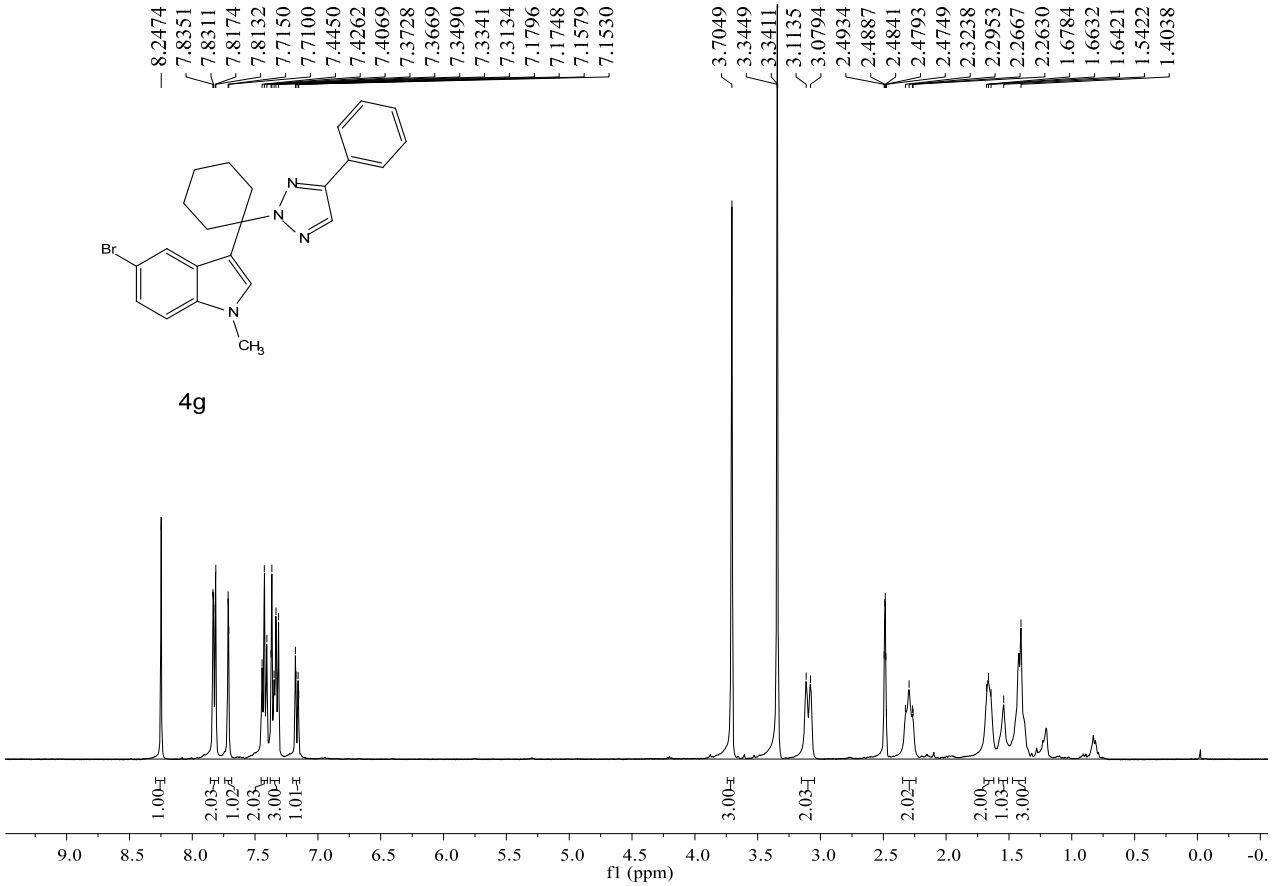
33.1119
25.0896
22.4239
Cl
N
N
N
N
CH3
f1 (ppm)

4f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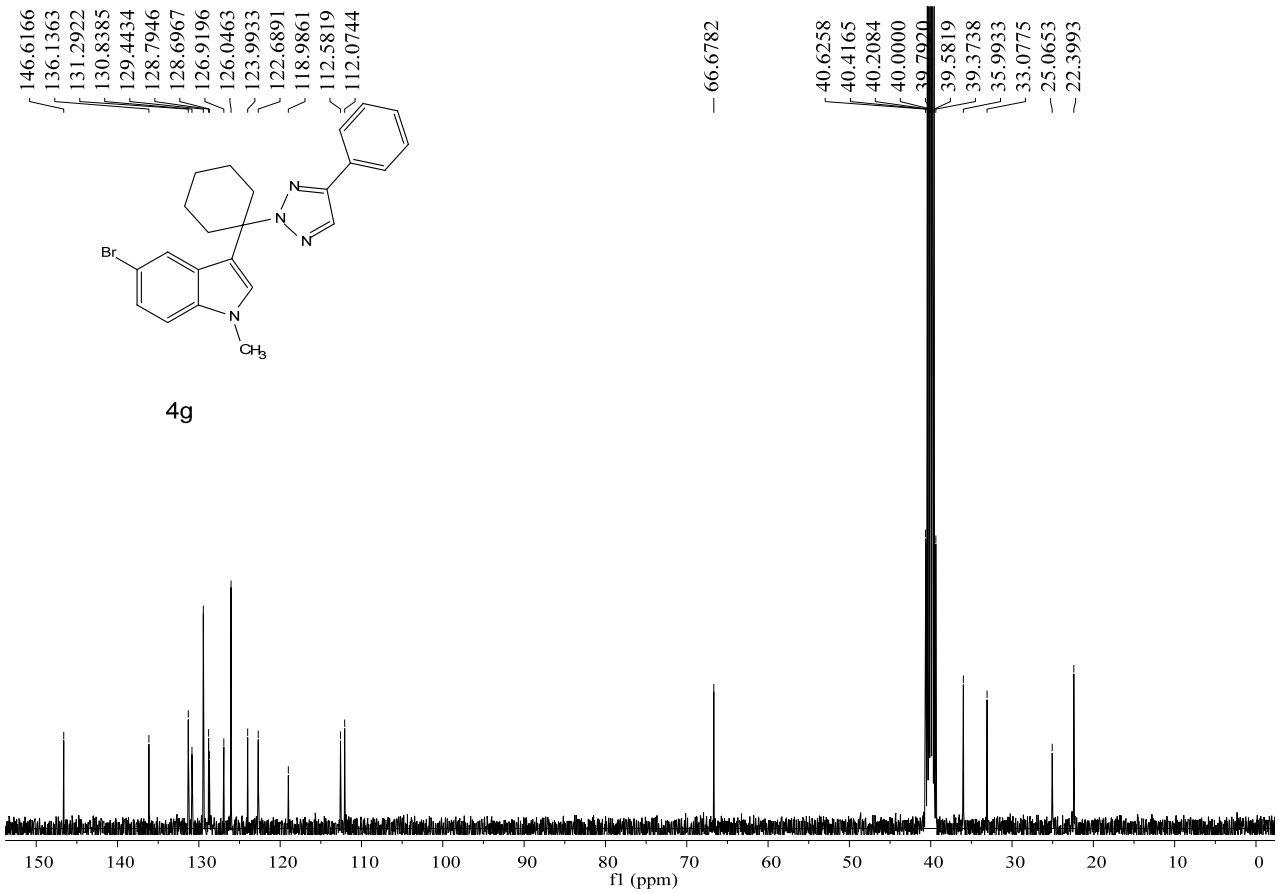
7.3728
7.3669
7.3490
7.3341
7.3134
7.1796
7.1748
7.1579
7.1530
3.7049
3.3449
3.3411
3.1135
3.0794
2.4934
2.4887
2.4841
2.4793
2.4749
2.3238
2.2953
2.2667
2.2630
1.6784
1.6632
1.6421
1.5422
1.4038
Br
N
N
N
CH3
4g
1.00
2.03
1.02
2.03
3.00
1.01
3.00
2.03
2.02
2.00
1.03
3.00
f1 (ppm)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118.9861
112.5819
112.0744
66.6782
40.6258
40.4165
40.2084
40.0000
39.7920
39.5819
39.3738
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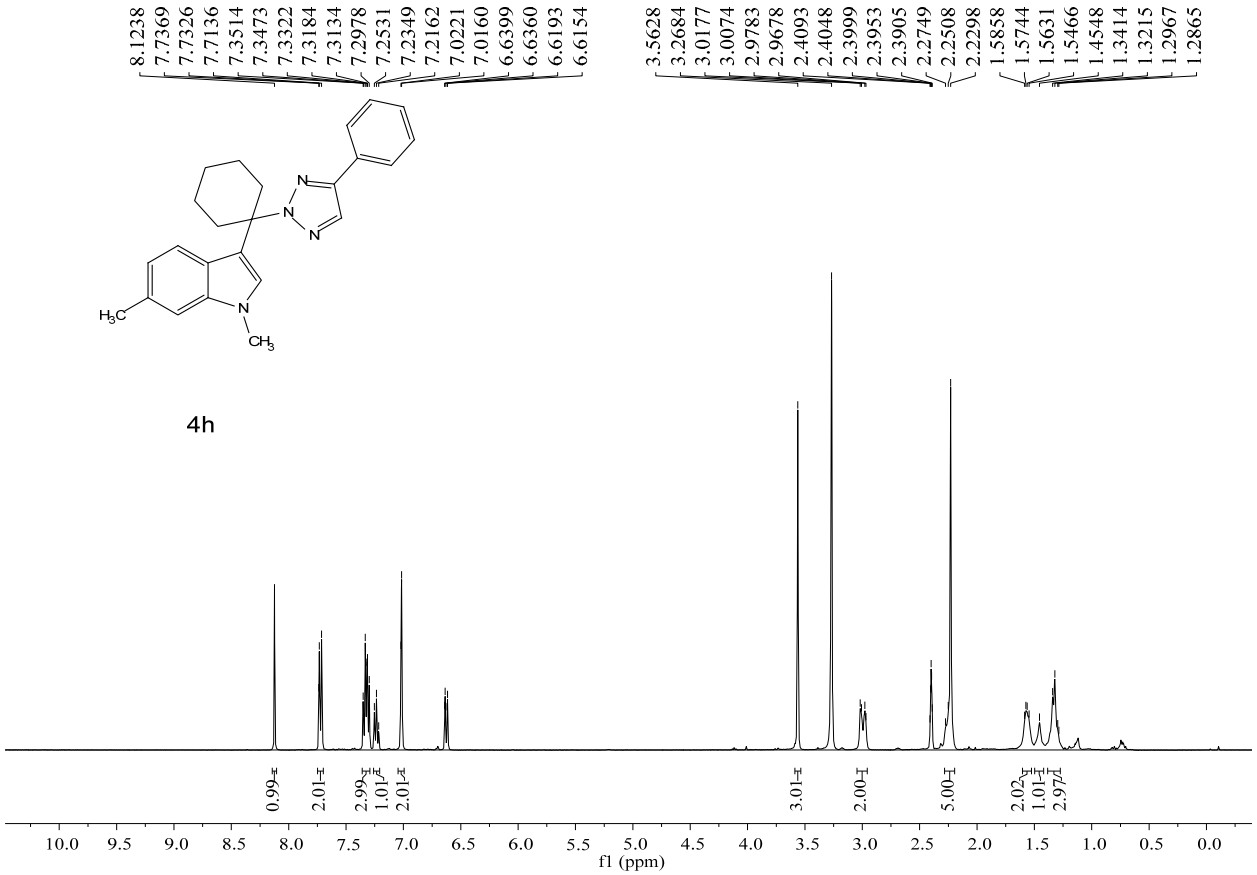
33.0775
25.0653
22.3993
Br
N
N
N
CH3
4g
f1 (ppm)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7.2531
7.2349
7.2162
7.0221
7.0160
6.6399
6.6360
6.6193
6.6154
3.5628
3.2684
3.0177
3.0074
2.9783
2.9678
2.4093
2.4048
2.3999
2.3953
2.3905
2.2749
2.2508
2.2298
1.5858
1.5744
1.5631
1.5466
1.4548
1.3414
1.3215
1.2967
1.2865
4h
0.99
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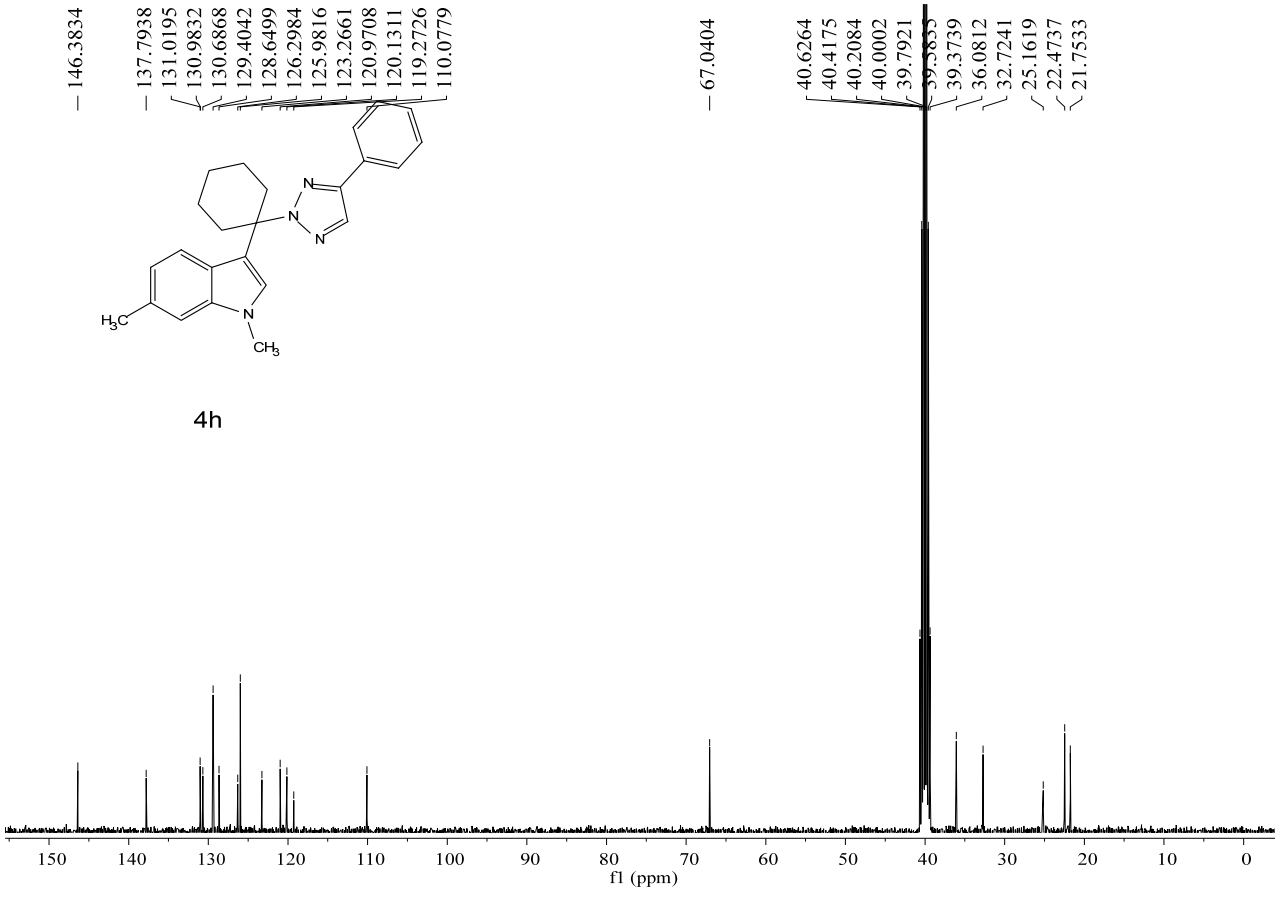
2.99
1.01
2.01
3.01
2.00
5.00
2.02
1.01
2.97
f1 (ppm)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130.6868
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128.6499
126.2984
125.9816
123.2661
120.9708
120.1311
119.2726
110.0779
67.0404
40.6264
40.4175
40.2084
40.0002
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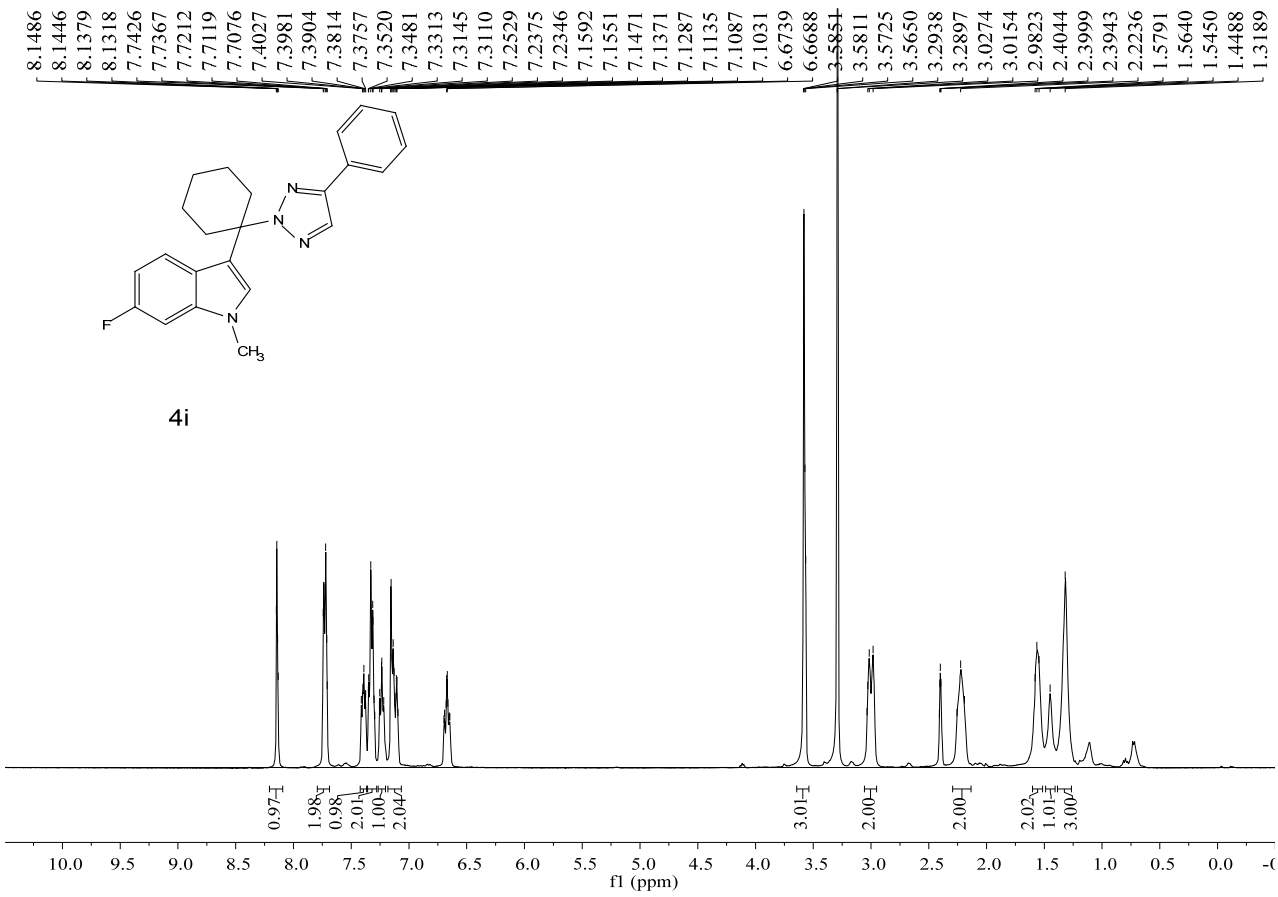
39.3739
36.0812
32.7241
25.1619
22.4737
21.7533
4h
f1 (ppm)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8.1379
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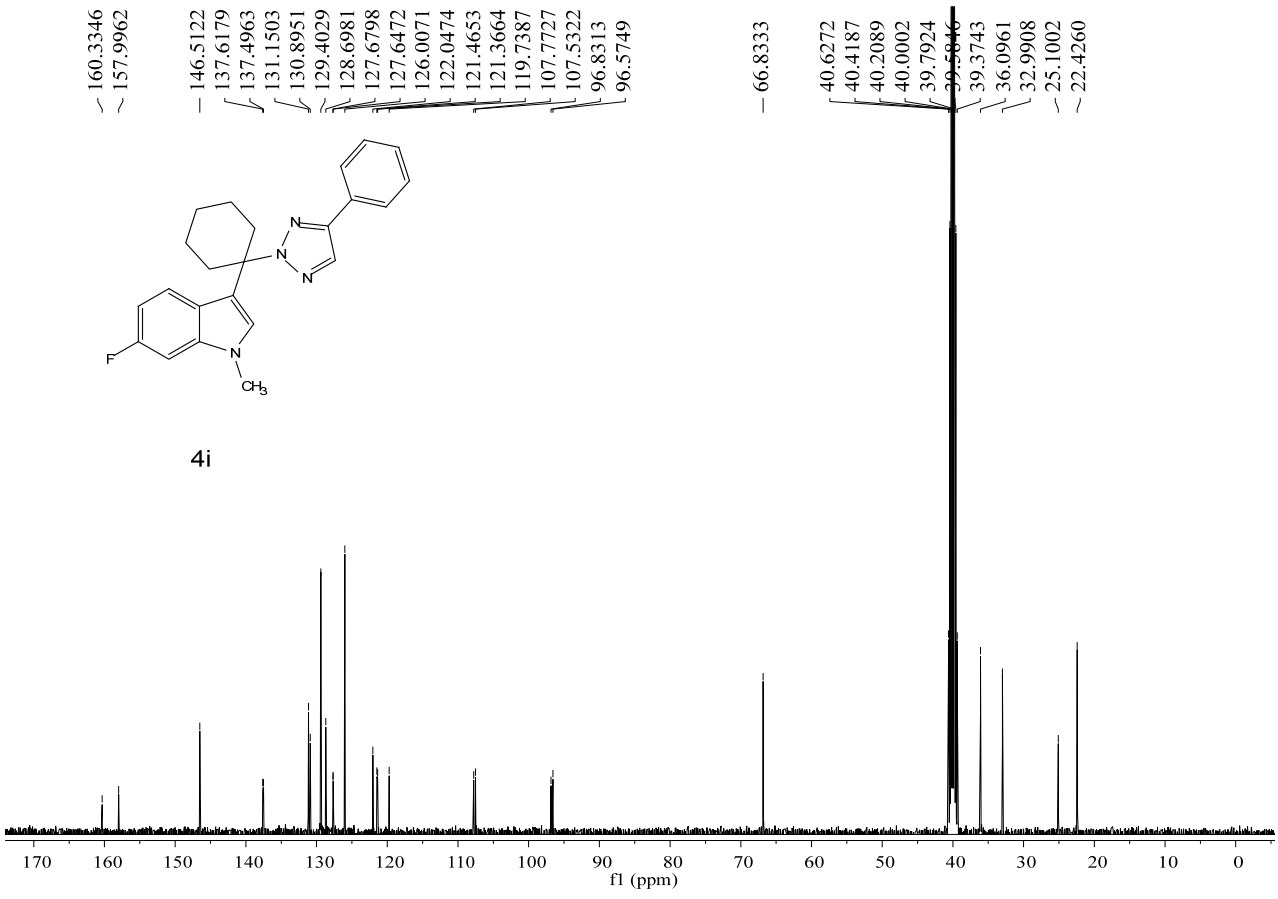
7.3981
7.3904
7.3814
7.3757
7.3520
7.3481
7.3313
7.3145
7.3110
7.2529
7.2375
7.2346
7.1592
7.1551
7.1471
7.1371
7.1287
7.1135
7.1087
7.1031
6.6739
6.6688
3.5851
3.5811
3.5725
3.5650
3.2938
3.2897
3.0274
3.0154
2.9823
2.4044
2.3999
2.3943
2.2236
1.5791
1.5640
1.5450
1.4488
1.3189
N
N
N
F
N
CH3
4i
0.97
1.98
0.98
2.01
1.00
2.04
3.01
2.00
2.00
2.02
1.01
3.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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126.0071
122.0474
121.4653
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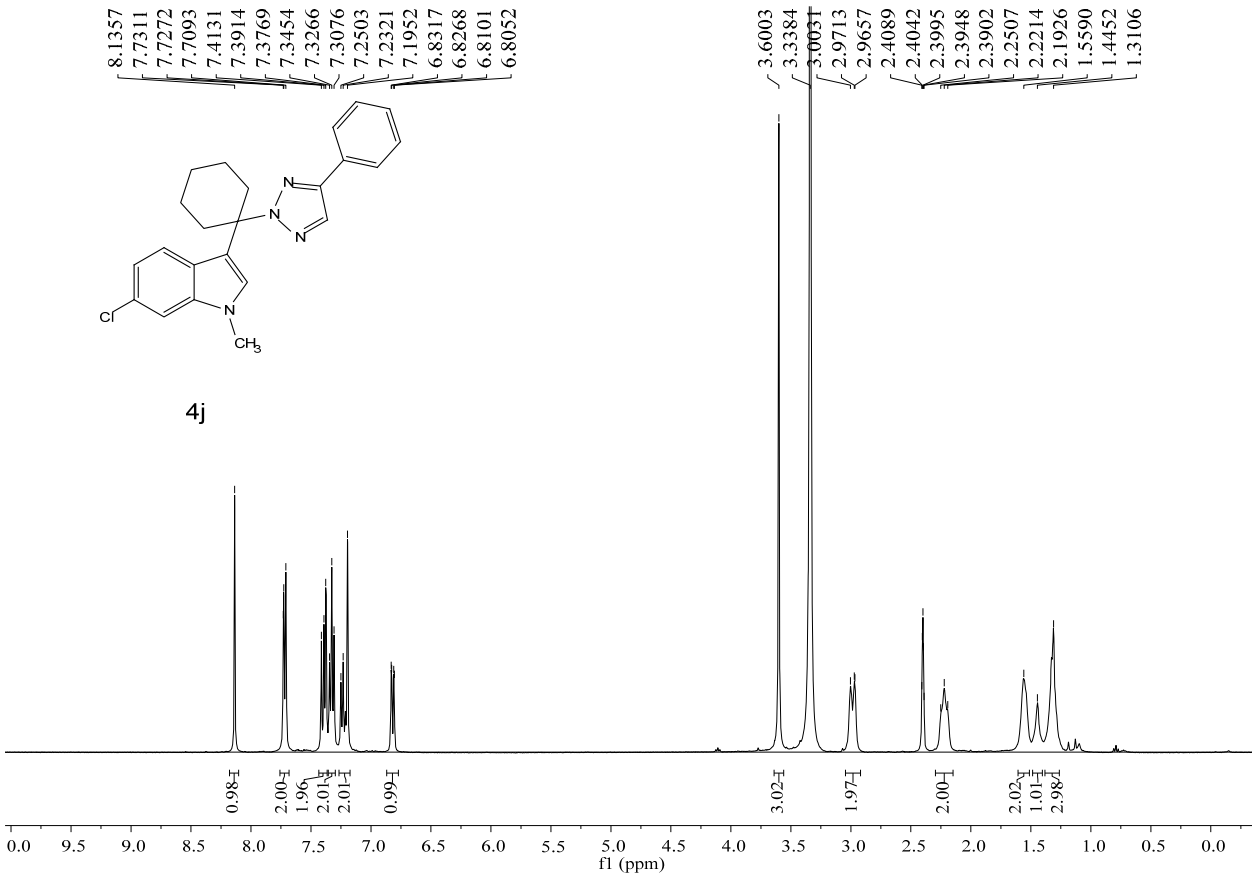
119.7387
107.7727
107.5322
96.8313
96.5749
66.8333
40.6272
40.4187
40.2089
40.0002
39.7924
39.5846
39.3743
36.0961
32.9908
25.1002
22.4260
N
N
N
F
N
CH3
4i
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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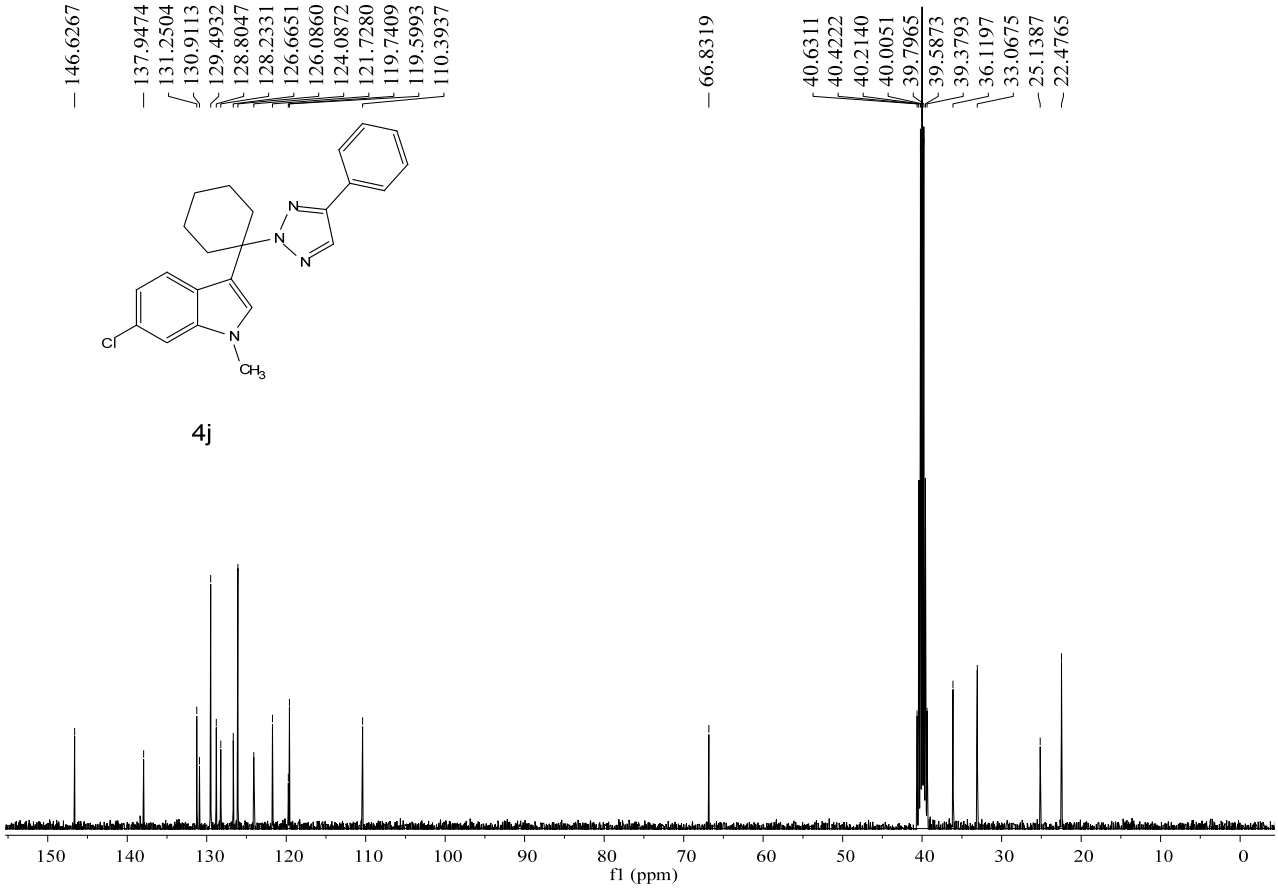
7.3266
7.3076
7.2503
7.2321
7.1952
6.8317
6.8268
6.8101
6.8052
3.6003
3.3384
3.0031
2.9713
2.9657
2.4089
2.4042
2.3995
2.3948
2.3902
2.2507
2.2214
2.1926
1.5590
1.4452
1.3106
Cl
N
CH3
0.98
2.00
1.96
2.01
2.01
0.99
3.02
1.97
2.00
2.02
1.01
2.98
f1 (ppm)

4j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128.8047
128.2331
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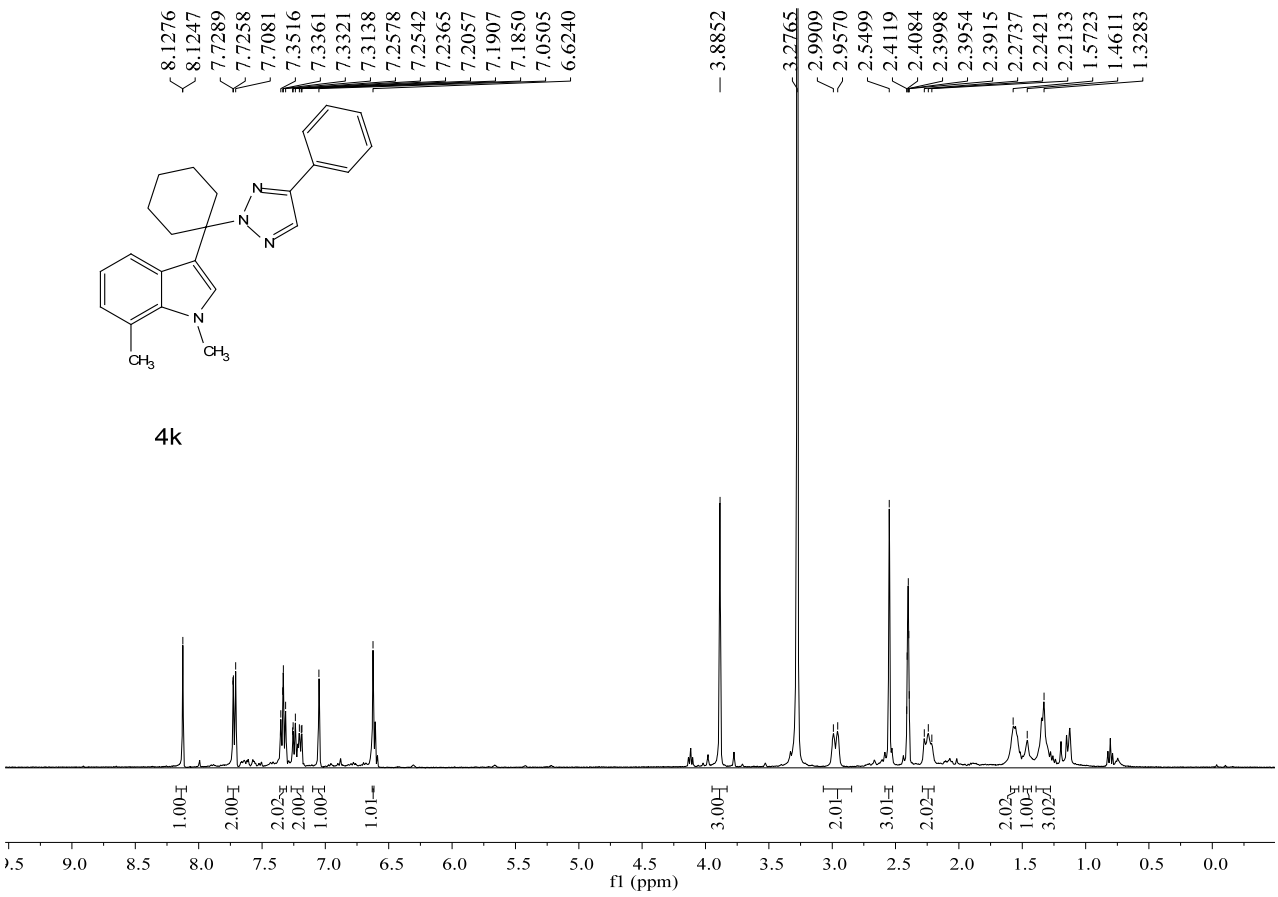
126.0860
124.0872
121.7280
119.7409
119.5993
110.3937
66.8319
40.6311
40.4222
40.2140
40.0051
39.7965
39.5873
39.3793
36.1197
33.0675
25.1387
22.4765
Cl
N
CH3
f1 (ppm)

4j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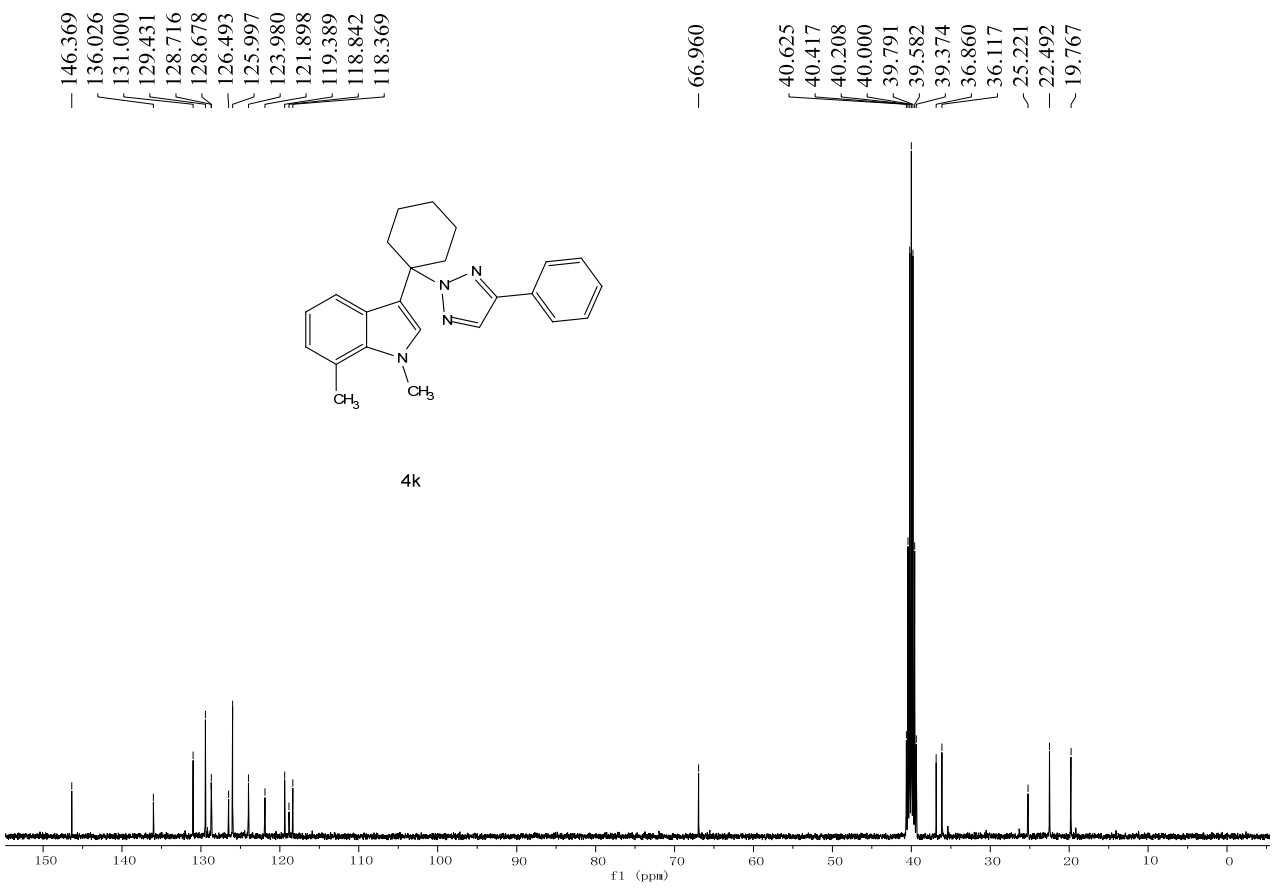
7.7081
7.3516
7.3361
7.3321
7.3138
7.2578
7.2542
7.2365
7.2057
7.1907
7.1850
7.0505
6.6240
3.8852
3.2765
2.9909
2.9570
2.5499
2.4119
2.4084
2.3998
2.3954
2.3915
2.2737
2.2421
2.2133
1.5723
1.4611
1.3283
1.00
2.00
2.02
2.00
1.00
1.01
3.00
2.01
3.01
2.02
2.02
1.00
3.02
f1 (ppm)

4k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125.997
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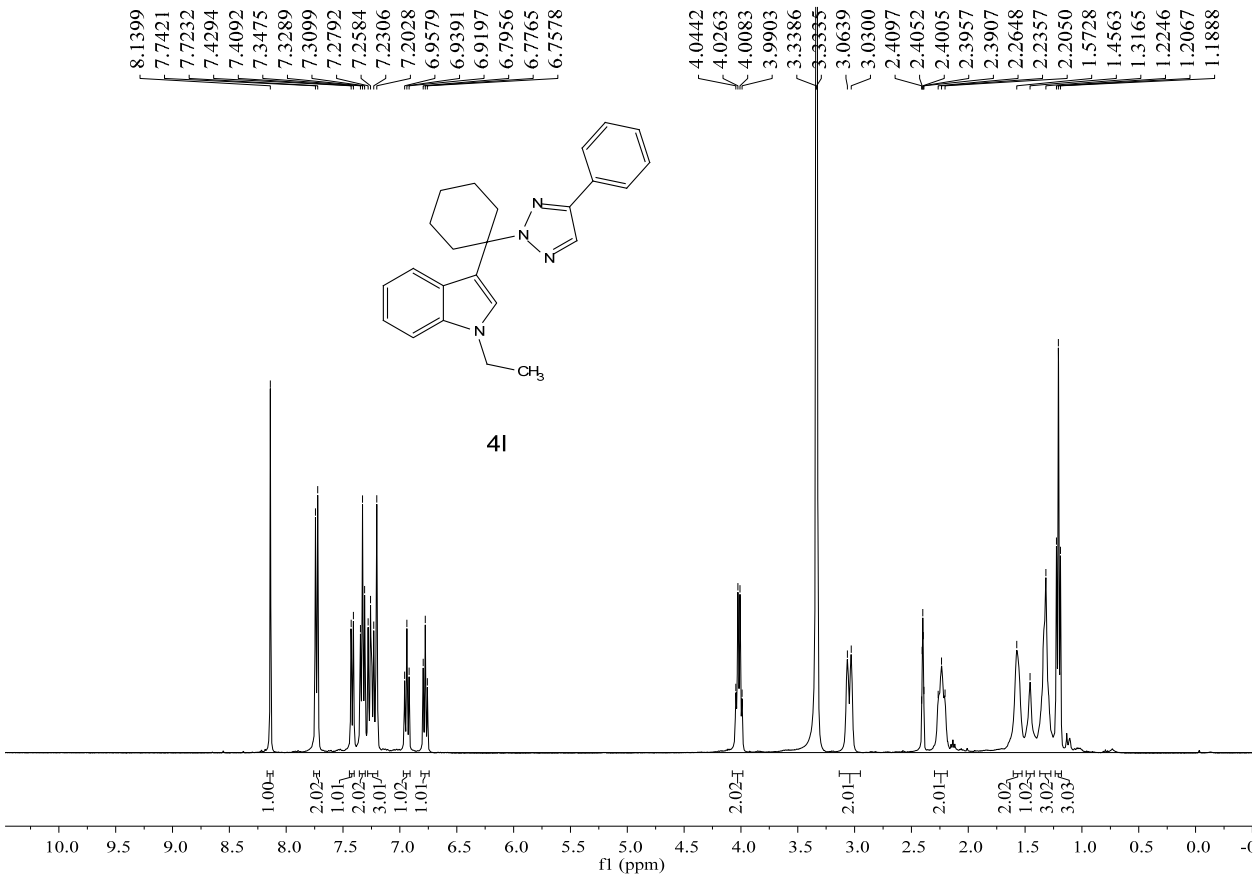
121.898
119.389
118.842
118.369
66.960
40.625
40.417
40.208
40.000
39.791
39.582
39.374
36.860
36.117
25.221
22.492
19.767
f1 (ppm)

4k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7.3289
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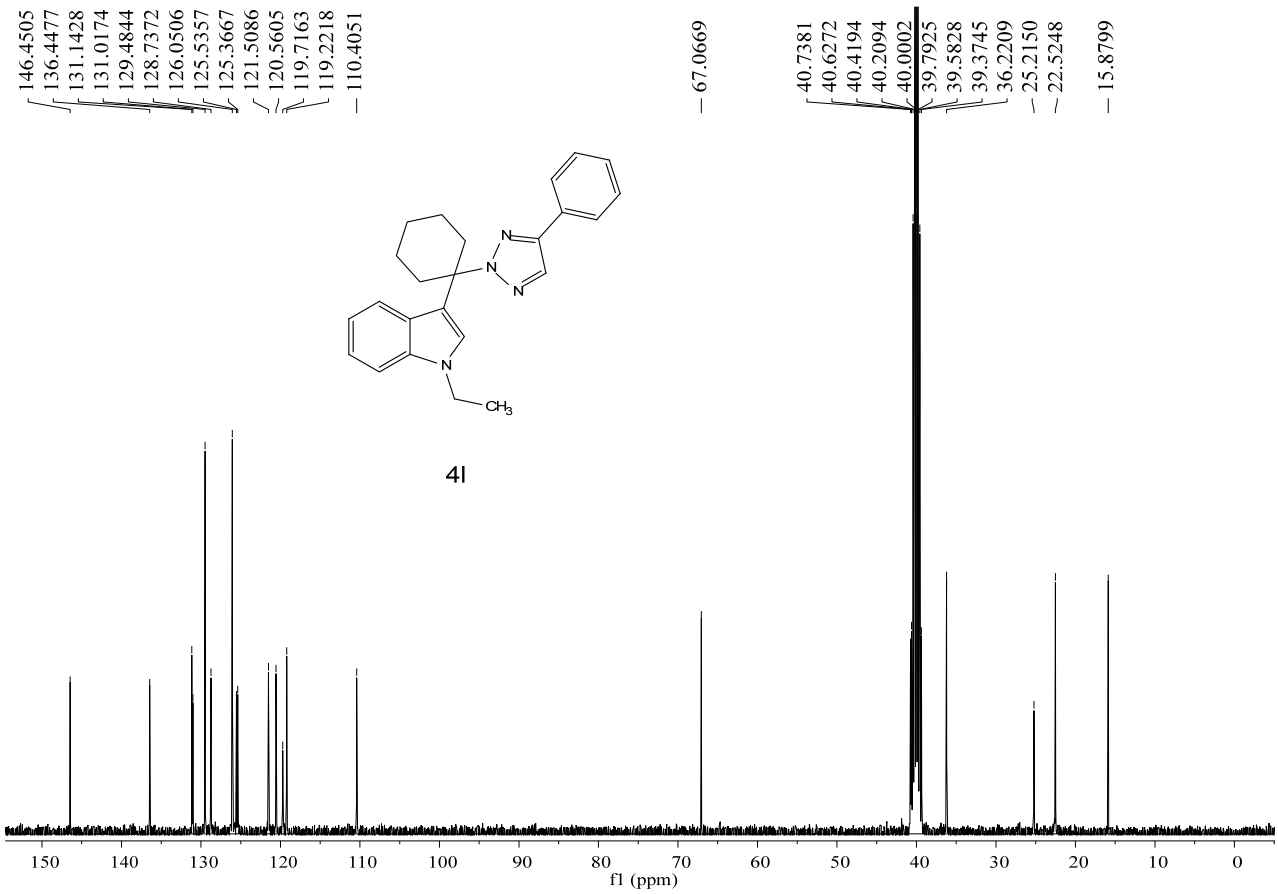
7.2792
7.2584
7.2306
7.2028
6.9579
6.9391
6.9197
6.7956
6.7765
6.7578
4.0442
4.0263
4.0083
3.9903
3.3386
3.3335
3.0639
3.0300
2.4097
2.4052
2.4005
2.3957
2.3907
2.2648
2.2357
2.2050
1.5728
1.4563
1.3165
1.2246
1.2067
1.1888
N
N
N
N
CH3
4l
1.00
2.02
1.01
2.02
3.01
1.02
1.01
2.02
2.01
2.01
2.02
1.02
3.02
3.03
f1 (ppm)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125.3667
121.5086
120.5605
119.7163
119.2218
110.4051
67.0669
40.7381
40.6272
40.4194
40.2094
40.0002
39.7925
39.5828
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25.2150
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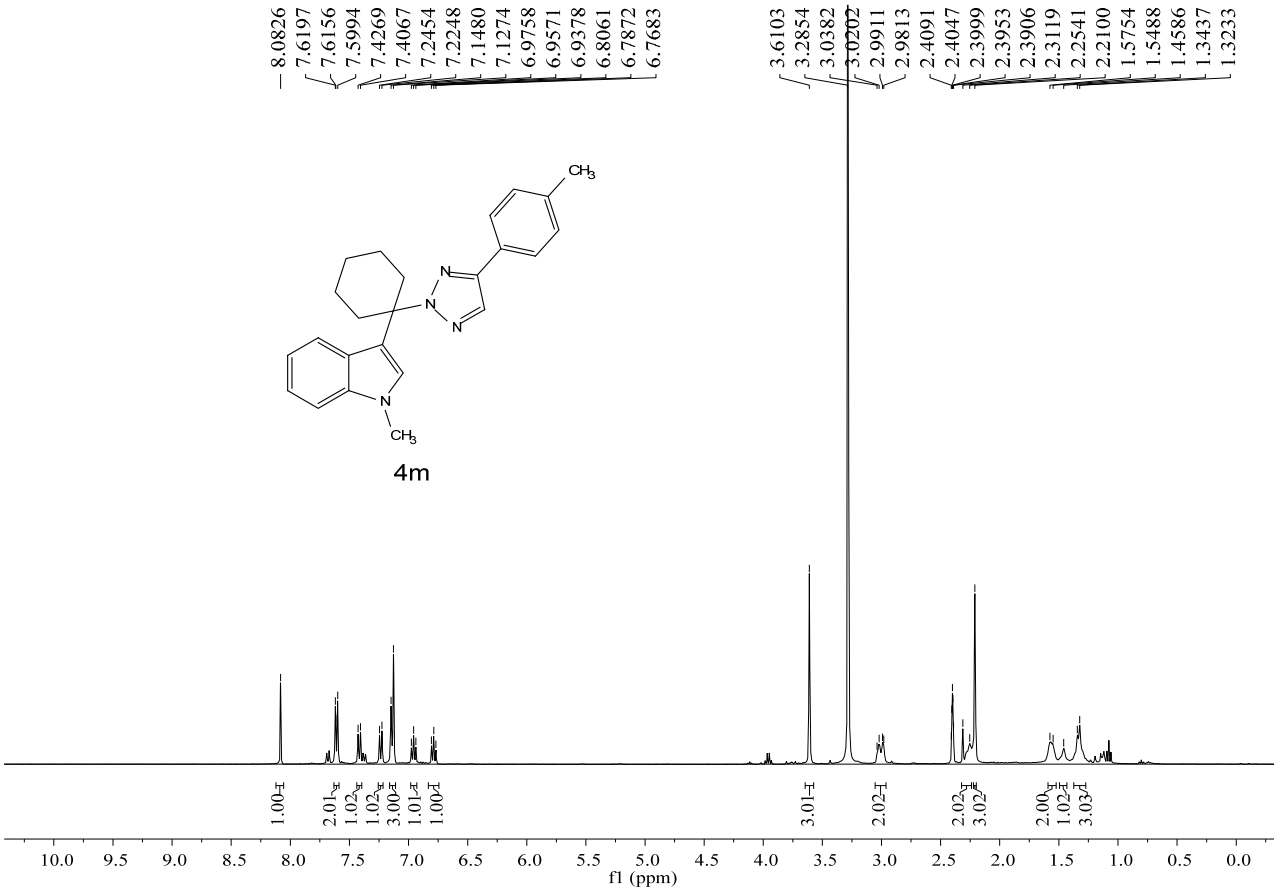
N
N
N
CH3
4l
f1 (ppm)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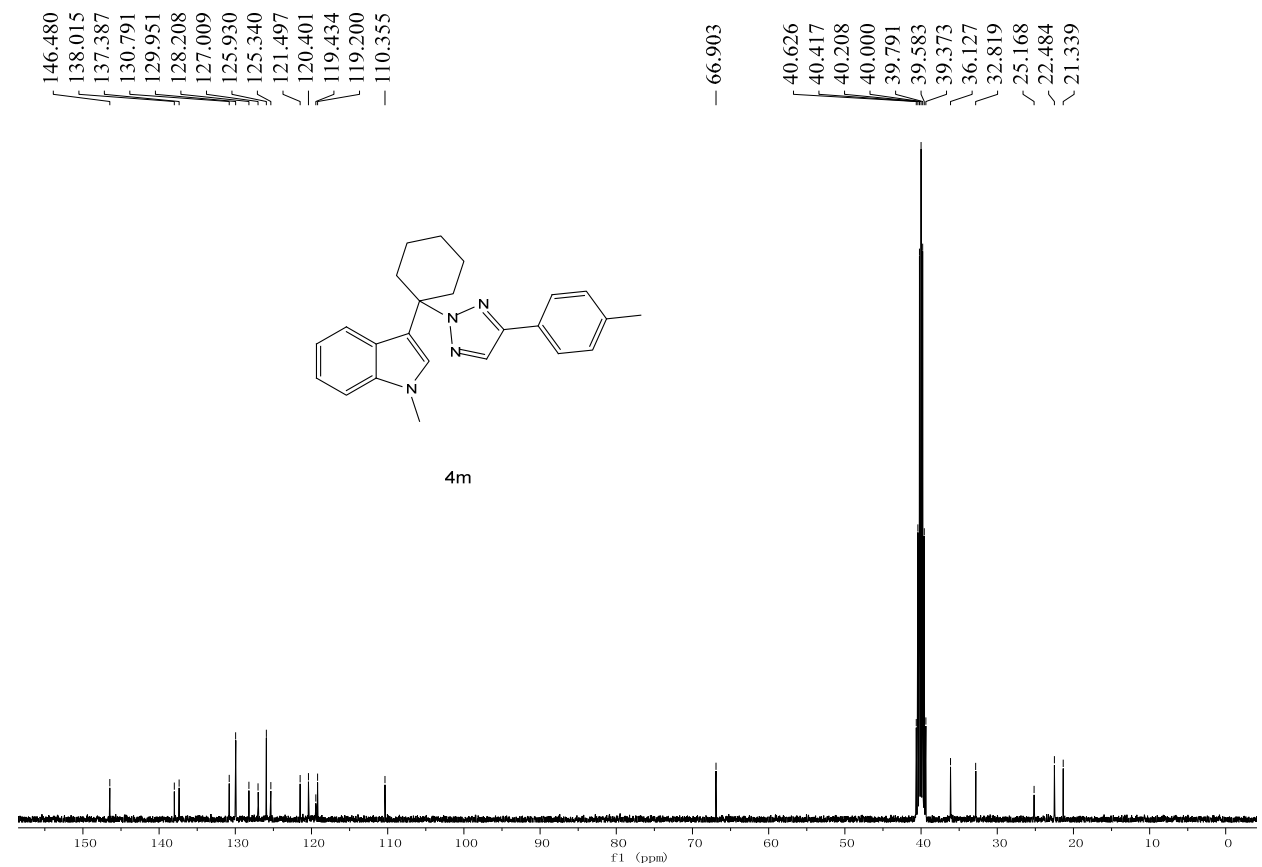
6.9571
6.9378
6.8061
6.7872
6.7683
3.6103
3.2854
3.0382
3.0202
2.9911
2.9813
2.4091
2.4047
2.3999
2.3953
2.3906
2.3119
2.2541
2.2100
1.5754
1.5488
1.4586
1.3437
1.3233
CH3
N
N
N
N
CH3
4m
1.00
2.01
1.02
1.02
3.00
1.01
1.00
3.01
2.02
2.02
3.02
2.00
1.02
3.03
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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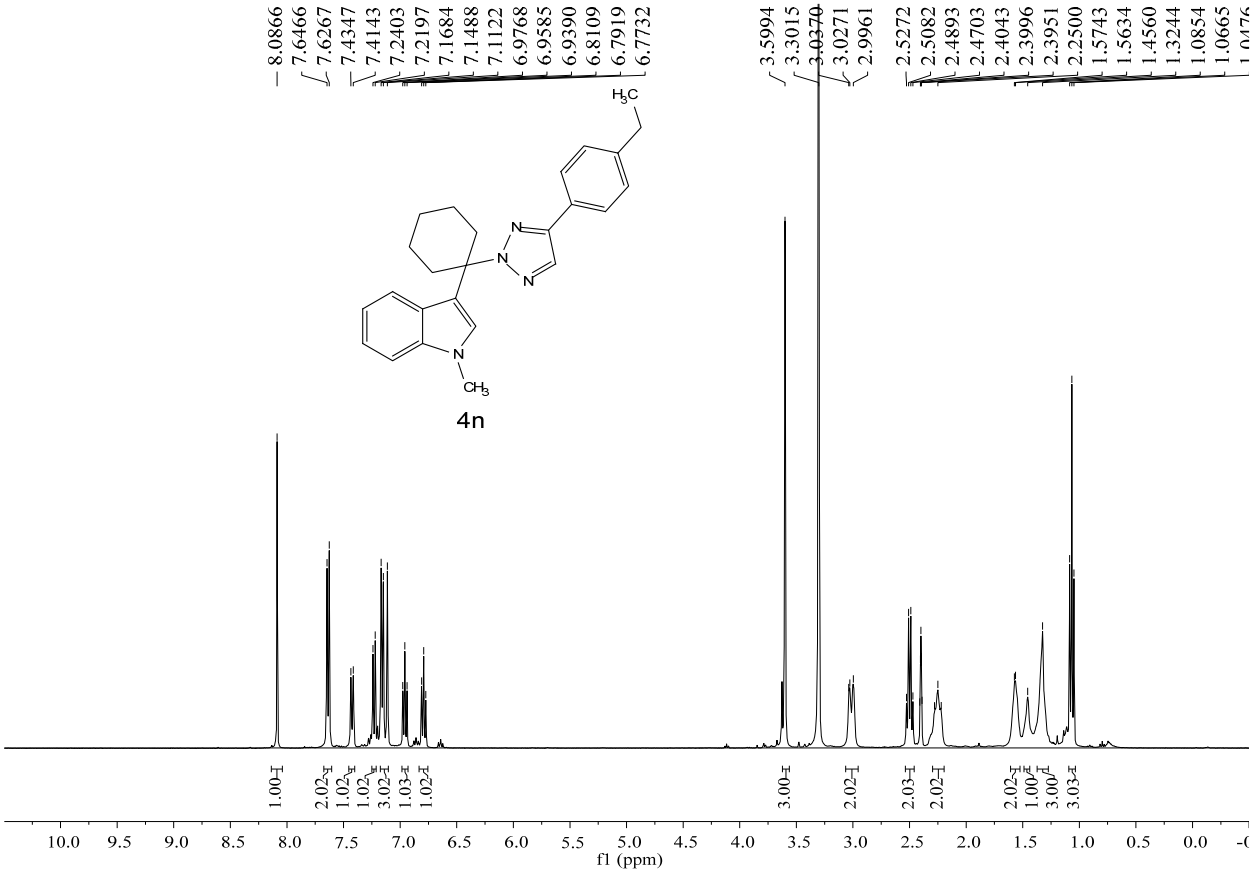
125.930
125.340
121.497
120.401
119.434
119.200
110.355
66.903
40.626
40.417
40.208
40.000
39.791
39.583
39.373
36.127
32.819
25.168
22.484
21.339
N
N
N
N
4m
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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7.4143
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7.2197
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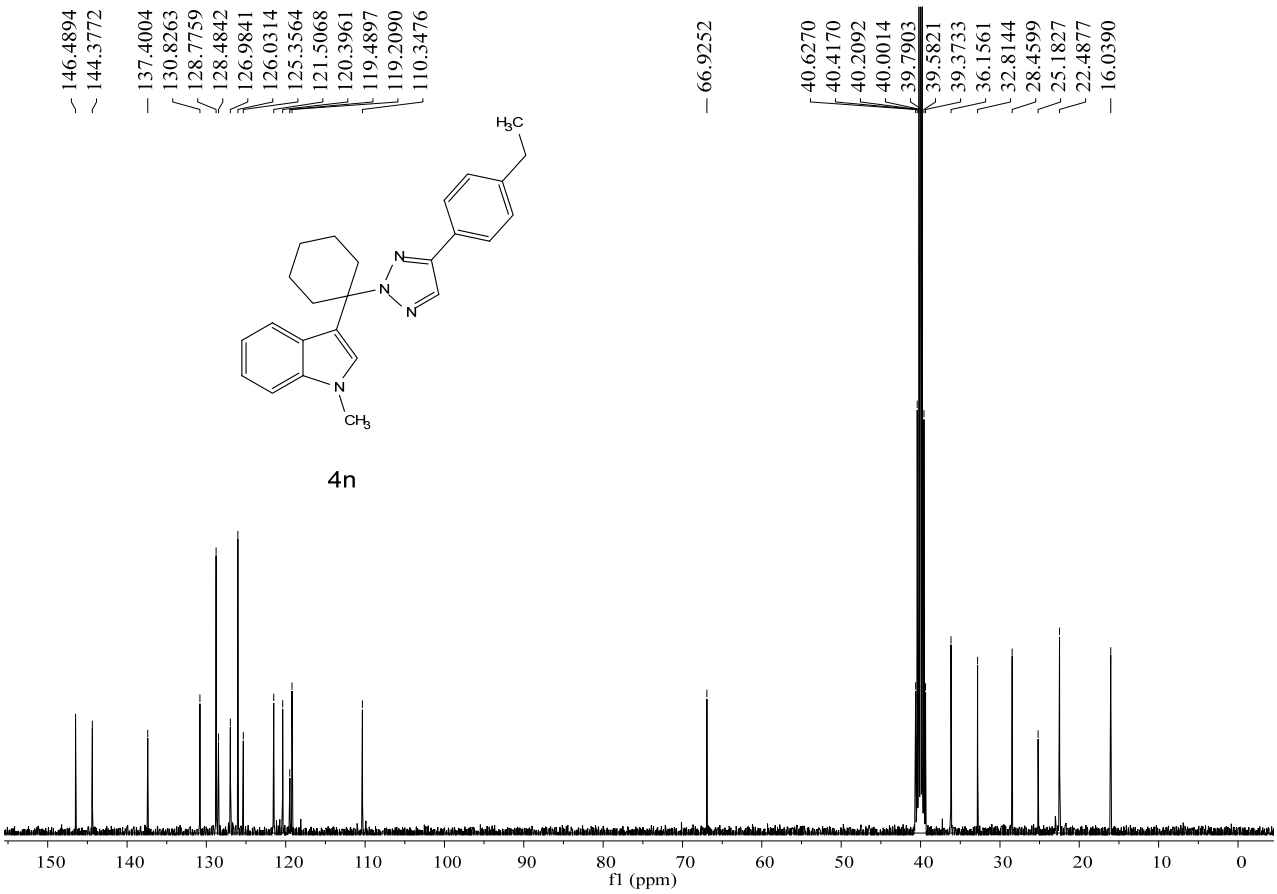
7.1488
7.1122
6.9768
6.9585
6.9390
6.8109
6.7919
6.7732
3.5994
3.3015
3.0370
3.0271
2.9961
2.5272
2.5082
2.4893
2.4703
2.4043
2.3996
2.3951
2.2500
1.5743
1.5634
1.4560
1.3244
1.0854
1.0665
1.00
2.02
1.02
1.02
3.02
1.03
1.02
3.00
2.02
2.03
2.02
2.02
1.00
3.00
3.03
H3C
N
N
N
N
CH3
f1 (ppm)

4n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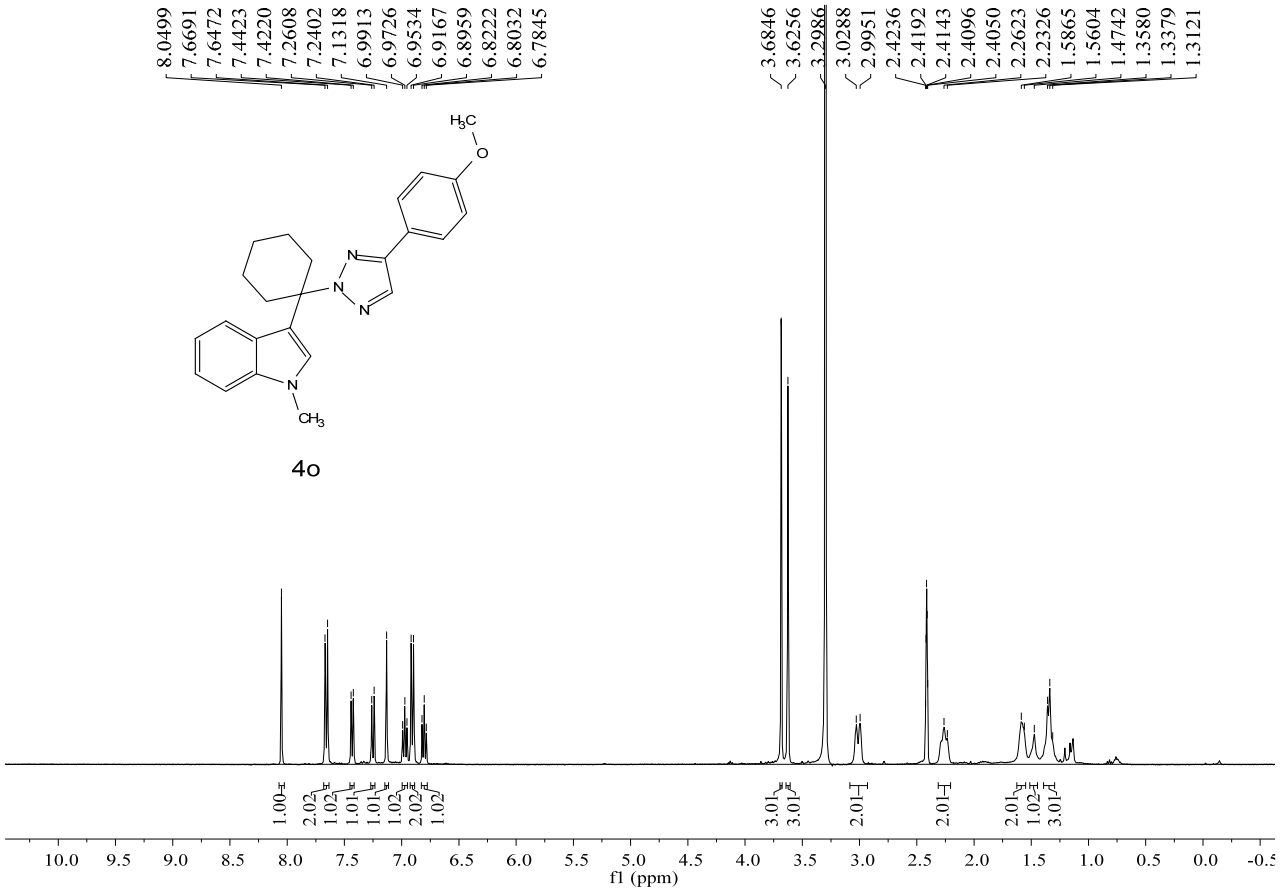
125.3564
121.5068
120.3961
119.4897
119.2090
110.3476
66.9252
40.6270
40.4170
40.2092
40.0014
39.7903
39.5821
39.3733
36.1561
32.8144
28.4599
25.1827
22.4877
16.0390
H3C
N
N
N
N
CH3
f1 (ppm)

4n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7.4220
7.2608
7.2402
7.1318
6.9913
6.9726
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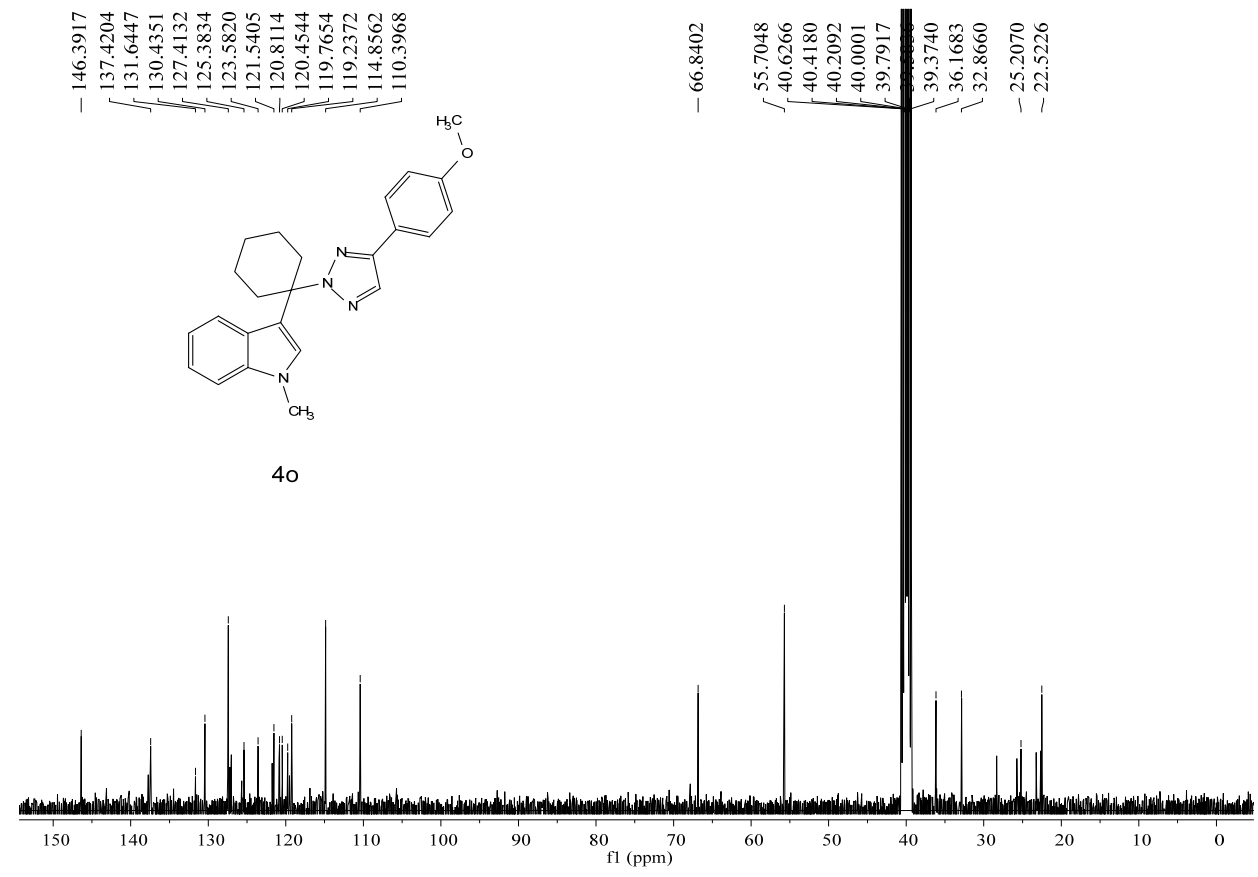
6.9167
6.8959
6.8222
6.8032
6.7845
3.6846
3.6256
3.2986
3.0288
2.9951
2.4236
2.4192
2.4143
2.4096
2.4050
2.2623
2.2326
1.5865
1.5604
1.4742
1.3580
1.3379
1.3121
H3C
O
N
N
N
N
CH3
1.00
2.02
1.02
1.01
1.01
1.02
2.02
1.02
3.01
3.01
2.01
2.01
2.01
1.02
3.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

4o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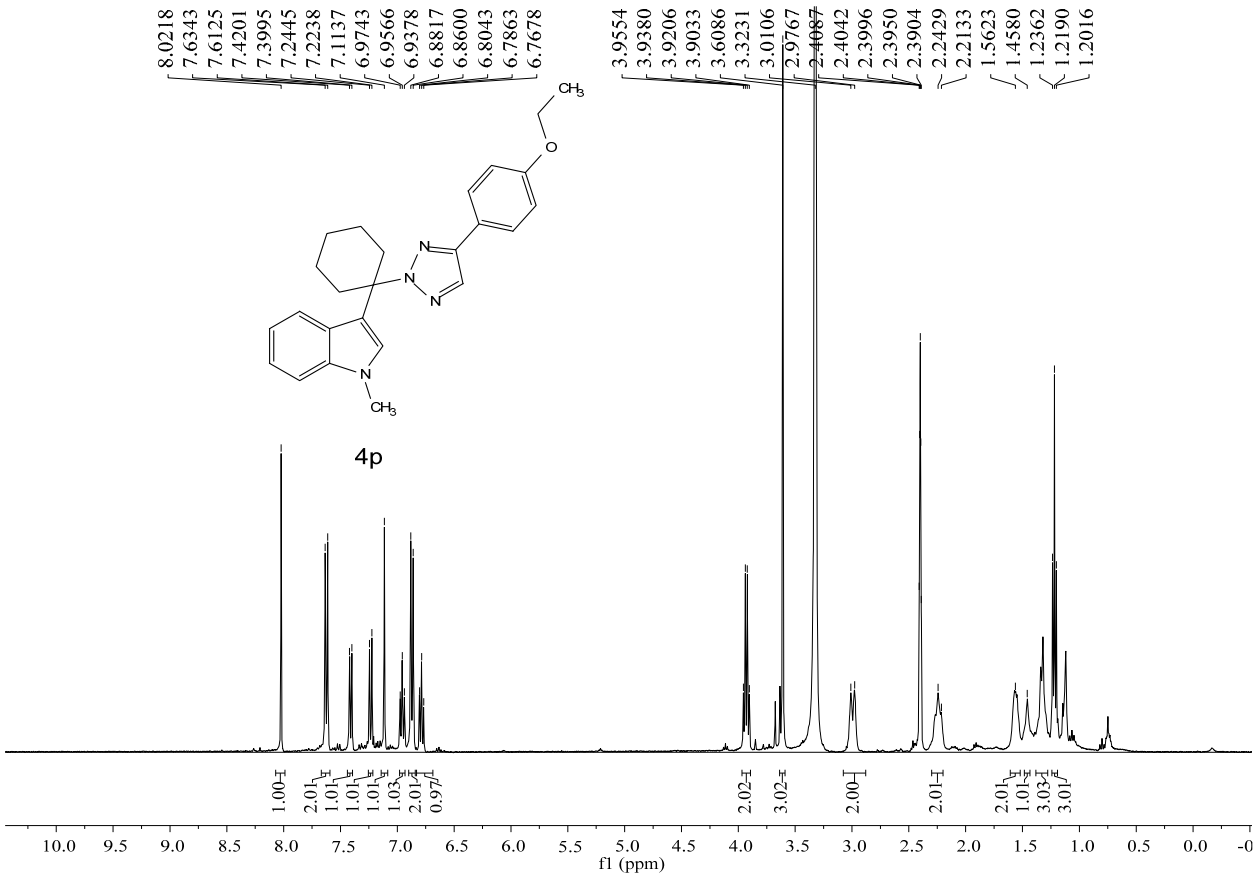
114.8562
110.3968
66.8402
55.7048
40.6266
40.4180
40.2092
40.0001
39.7917
39.3740
36.1683
32.8660
25.2070
22.5226
H3C
O
N
N
N
N
CH3
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

4o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7.2238
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6.9743
6.9566
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6.8817
6.8600
6.8043
6.7863
6.7678
3.9554
3.9380
3.9206
3.9033
3.6086
3.3231
3.0106
2.9767
2.4087
2.4042
2.3996
2.3950
2.3904
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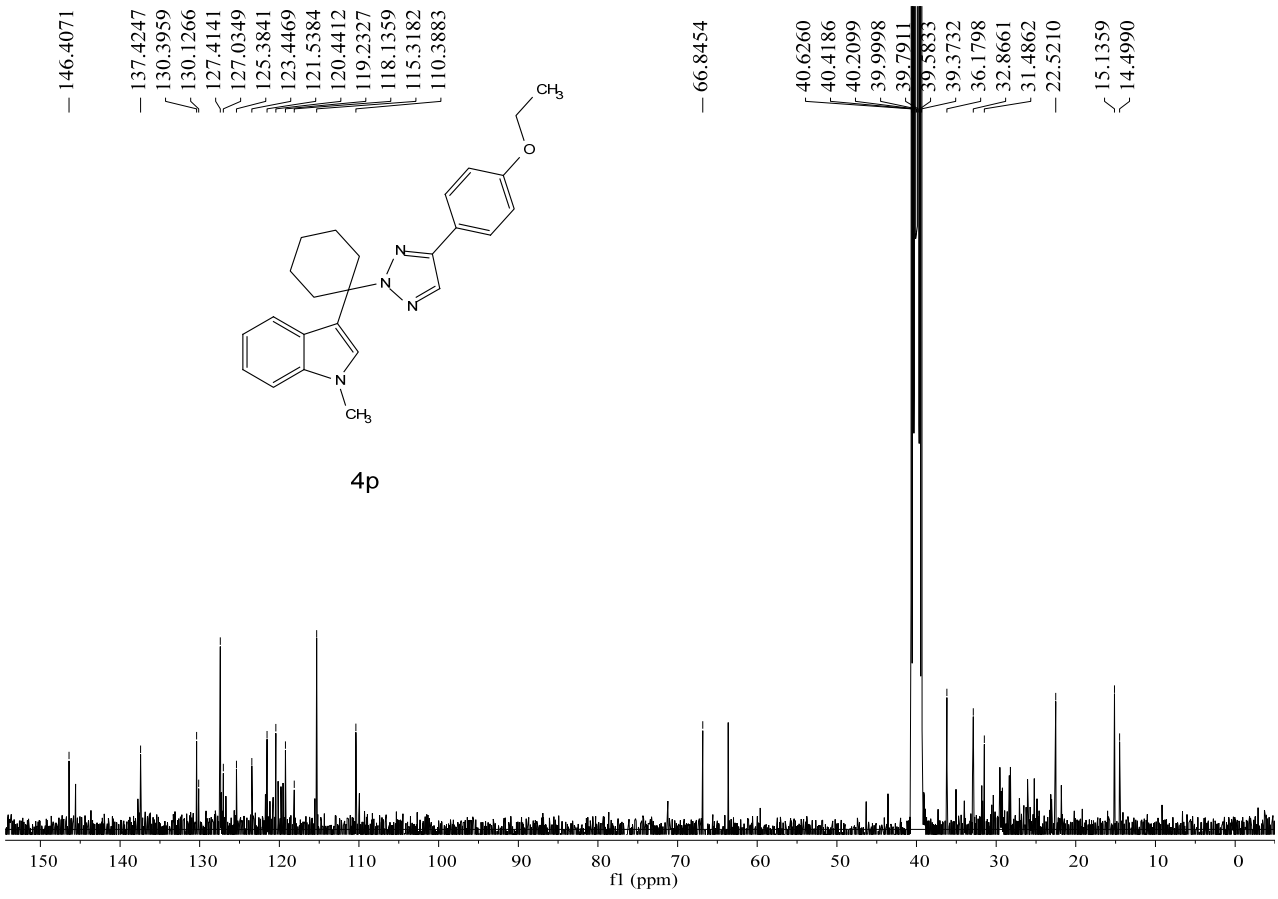
2.2133
1.5623
1.4580
1.2362
1.2190
1.2016
4p
f1 (ppm)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125.3841
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121.5384
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119.2327
118.1359
115.3182
110.3883
66.8454
40.6260
40.4186
40.2099
39.9998
39.7911
39.5833
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36.1798
32.8661
31.4862
22.5210
15.1359
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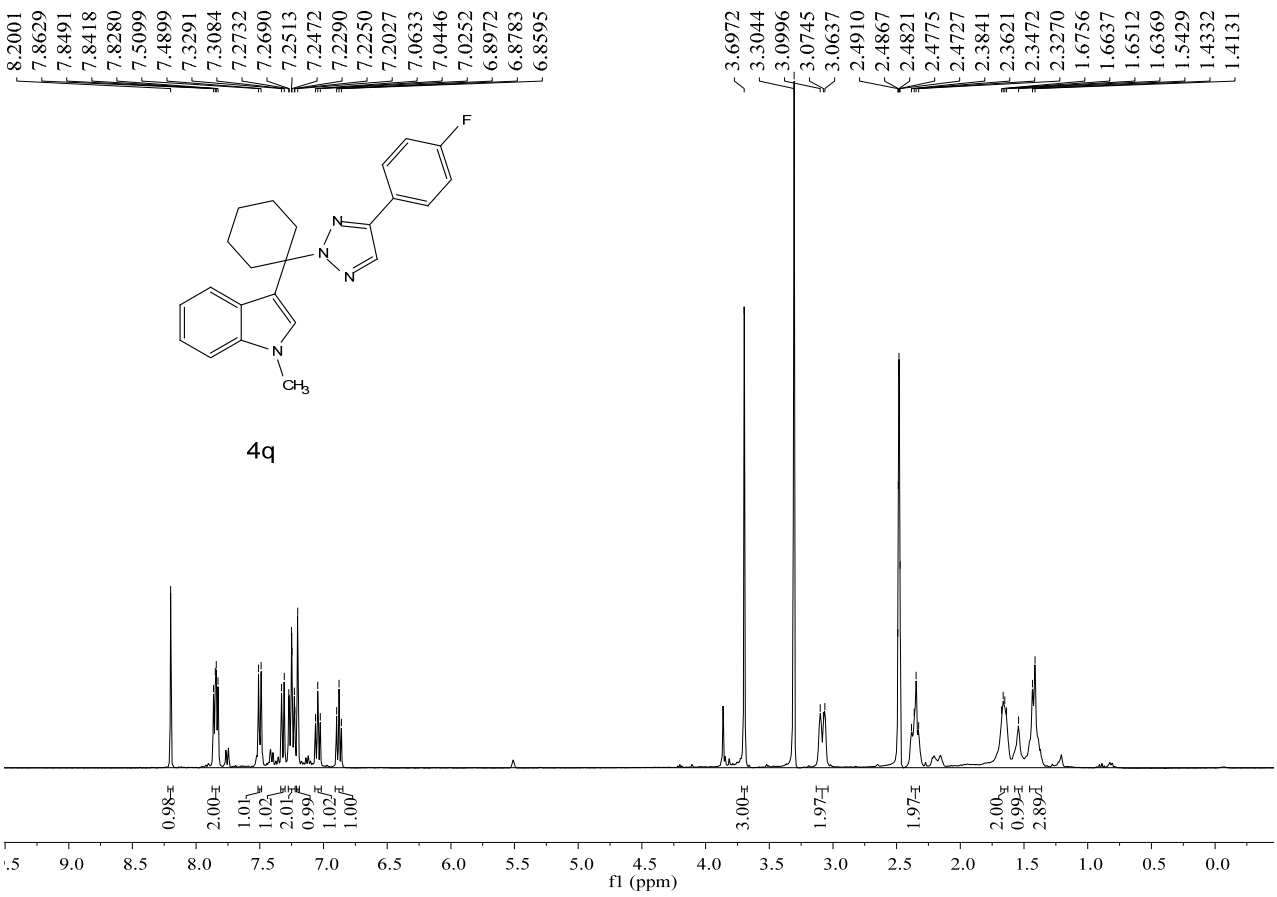
4p
f1 (ppm)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7.4899
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7.3084
7.2732
7.2690
7.2513
7.2472
7.2290
7.2250
7.2027
7.0633
7.0446
7.0252
6.8972
6.8783
6.8595
3.6972
3.3044
3.0996
3.0745
3.0637
2.4910
2.4867
2.4821
2.4775
2.4727
2.3841
2.3621
2.3472
2.3270
1.6756
1.6637
1.6512
1.6369
1.5429
1.4332
1.4131
F
N
N
N
N
CH3
0.98
2.00
1.01
1.02
2.01
0.99
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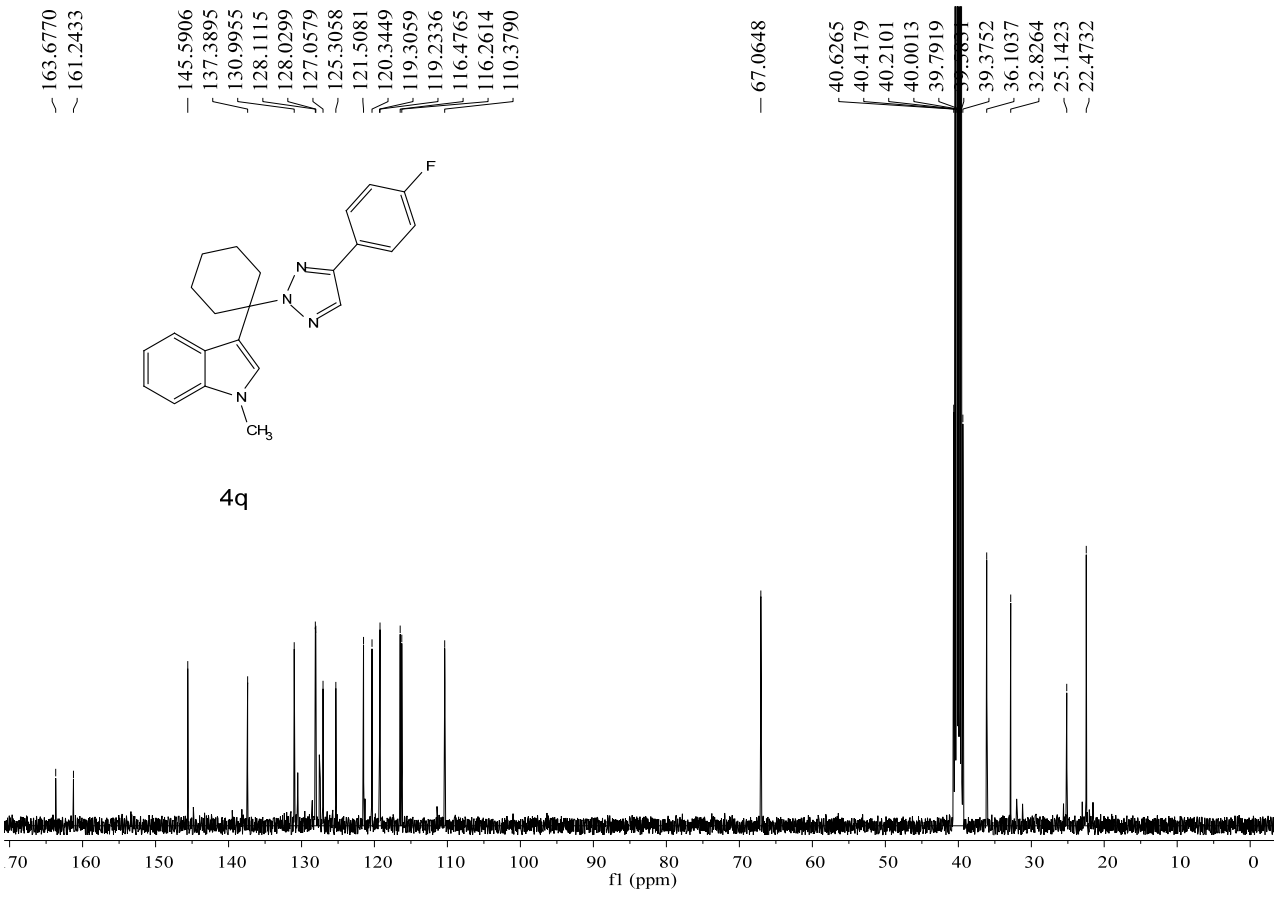
1.00
3.00
1.97
1.97
2.00
0.99
2.89
f1 (ppm)

4q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120.3449
119.3059
119.2336
116.4765
116.2614
110.3790
67.0648
40.6265
40.4179
40.2101
40.0013
39.7919
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32.8264
25.1423
22.4732
F
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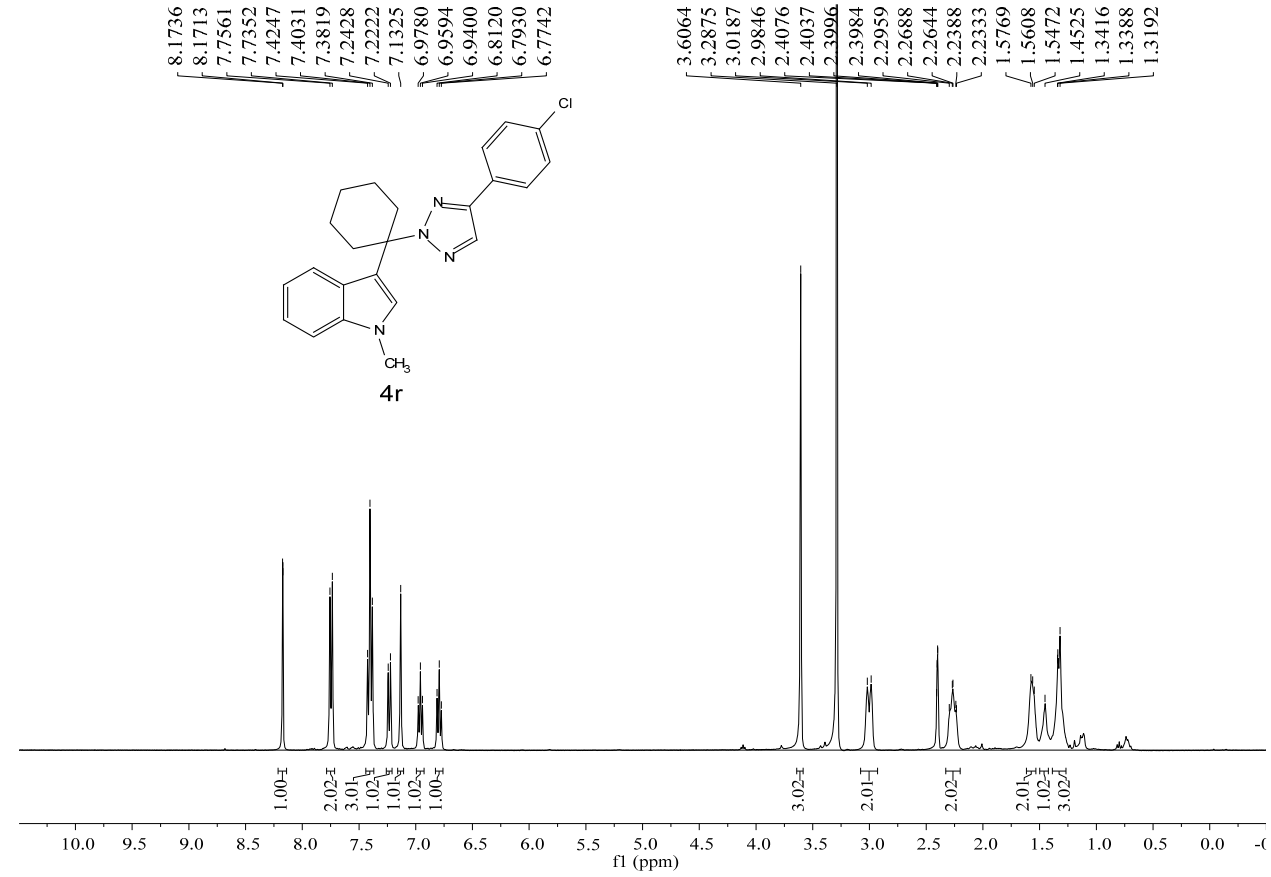
N
N
N
CH3
f1 (ppm)

4q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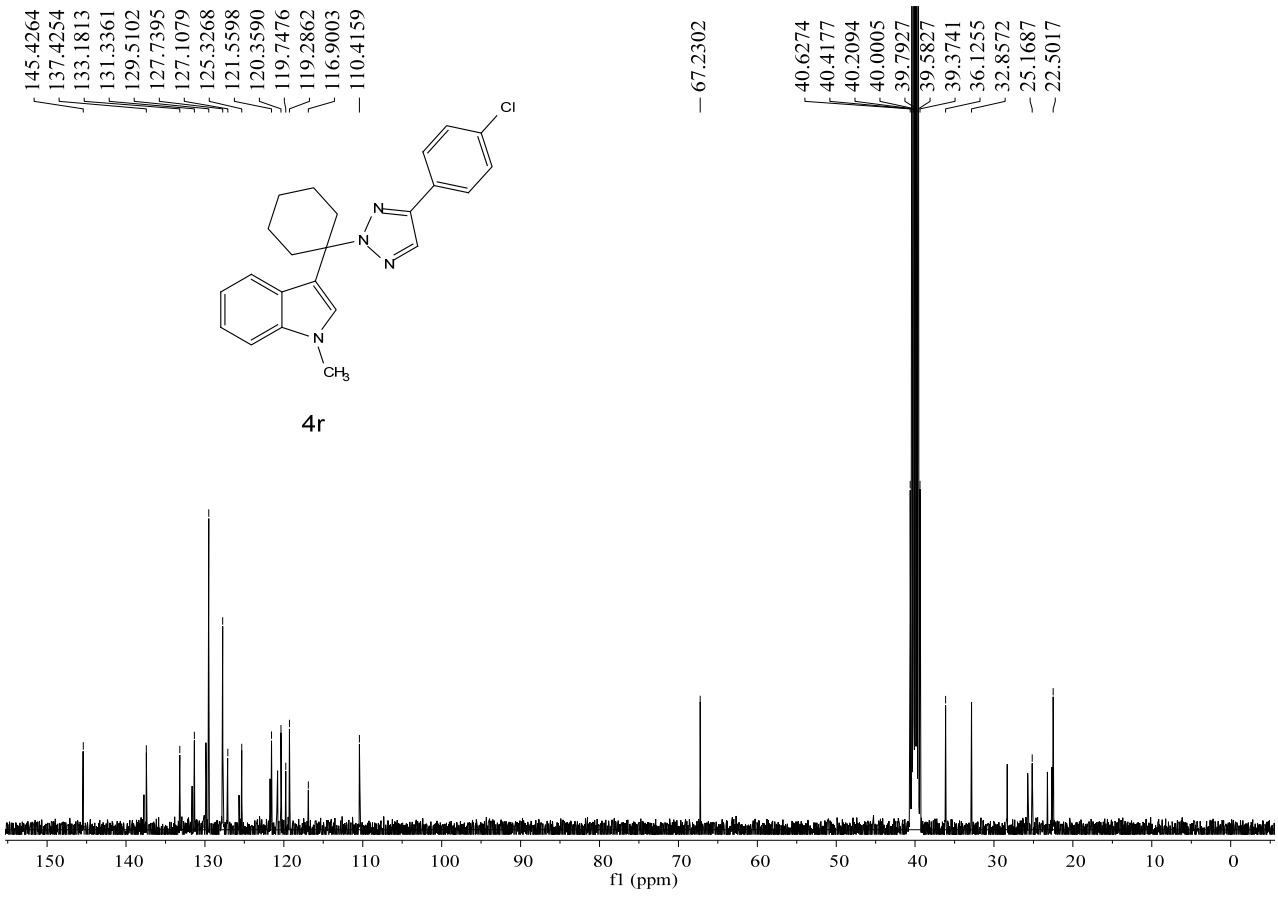
7.3819
7.2428
7.2222
7.1325
6.9780
6.9594
6.9400
6.8120
6.7930
6.7742
3.6064
3.2875
3.0187
2.9846
2.4076
2.4037
2.3996
2.3984
2.2959
2.2688
2.2644
2.2388
2.2333
1.5769
1.5608
1.5472
1.4525
1.3416
1.3388
1.3192
Cl
N
N
N
N
CH3
4r
1.00
2.02
3.01
1.02
1.01
1.02
1.00
3.02
2.01
2.02
2.01
1.02
3.02
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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119.2862
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67.2302
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39.5827
39.3741
36.1255
32.8572
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Cl
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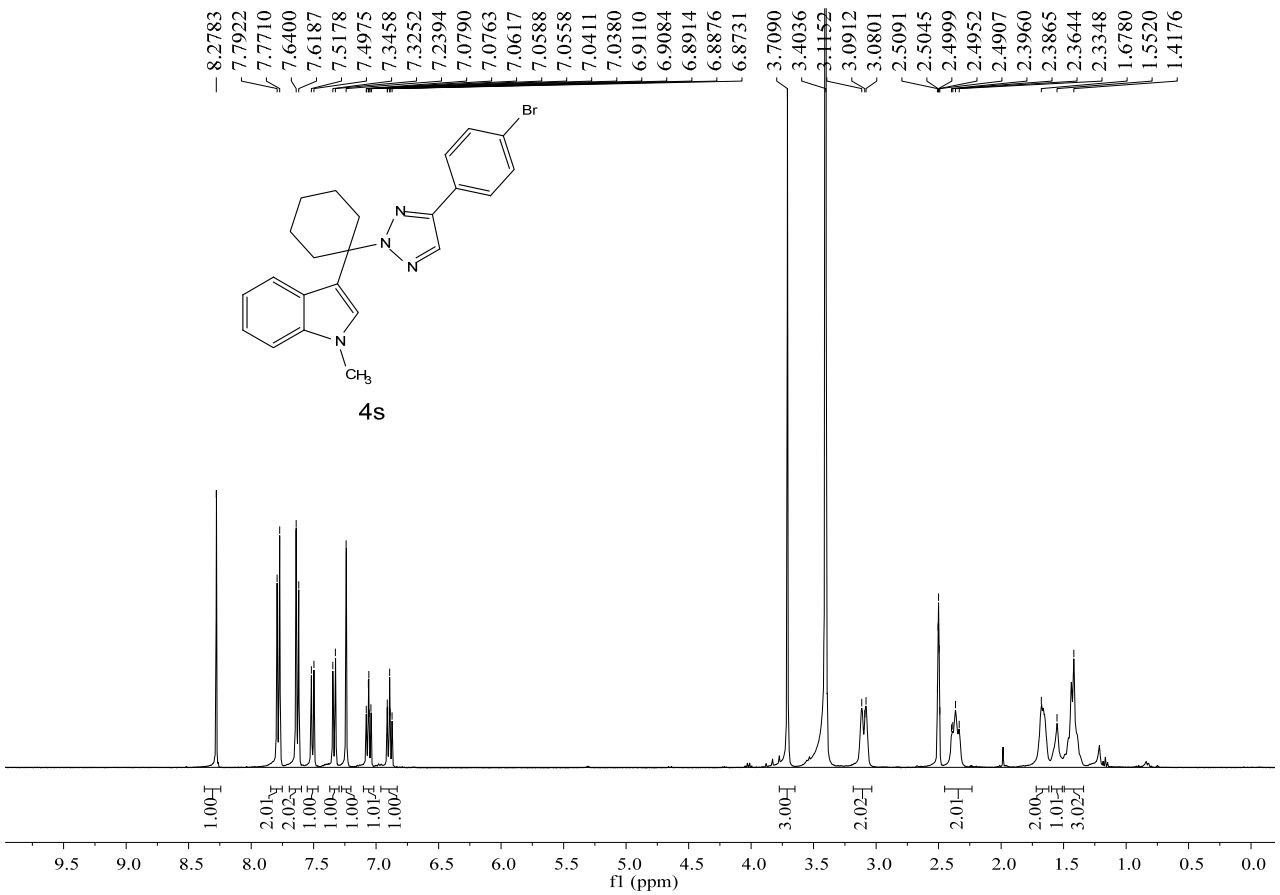
N
N
N
CH3
4r
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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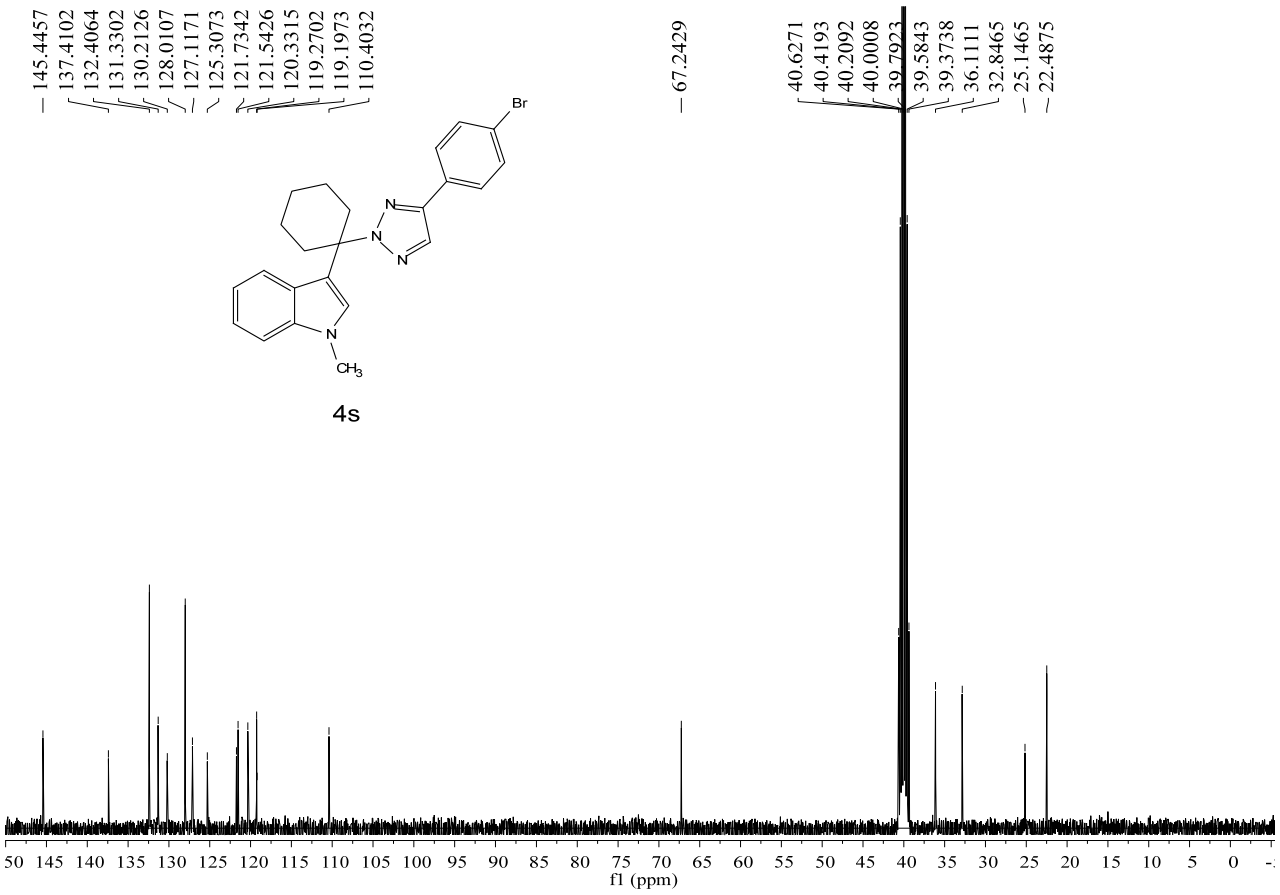
7.3252
7.2394
7.0790
7.0763
7.0617
7.0588
7.0558
7.0411
7.0380
6.9110
6.9084
6.8914
6.8876
6.8731
3.7090
3.4036
3.1152
3.0912
3.0801
2.5091
2.5045
2.4999
2.4952
2.4907
2.3960
2.3865
2.3644
2.3348
1.6780
1.5520
1.4176
Br
N
N
N
N
CH3
4s
1.00
2.01
2.02
1.00
1.00
1.01
1.00
3.00
2.02
2.01
2.00
1.01
3.02
f1 (ppm)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119.1973
110.4032
67.2429
40.6271
40.4193
40.2092
40.0008
39.7923
39.5843
39.3738
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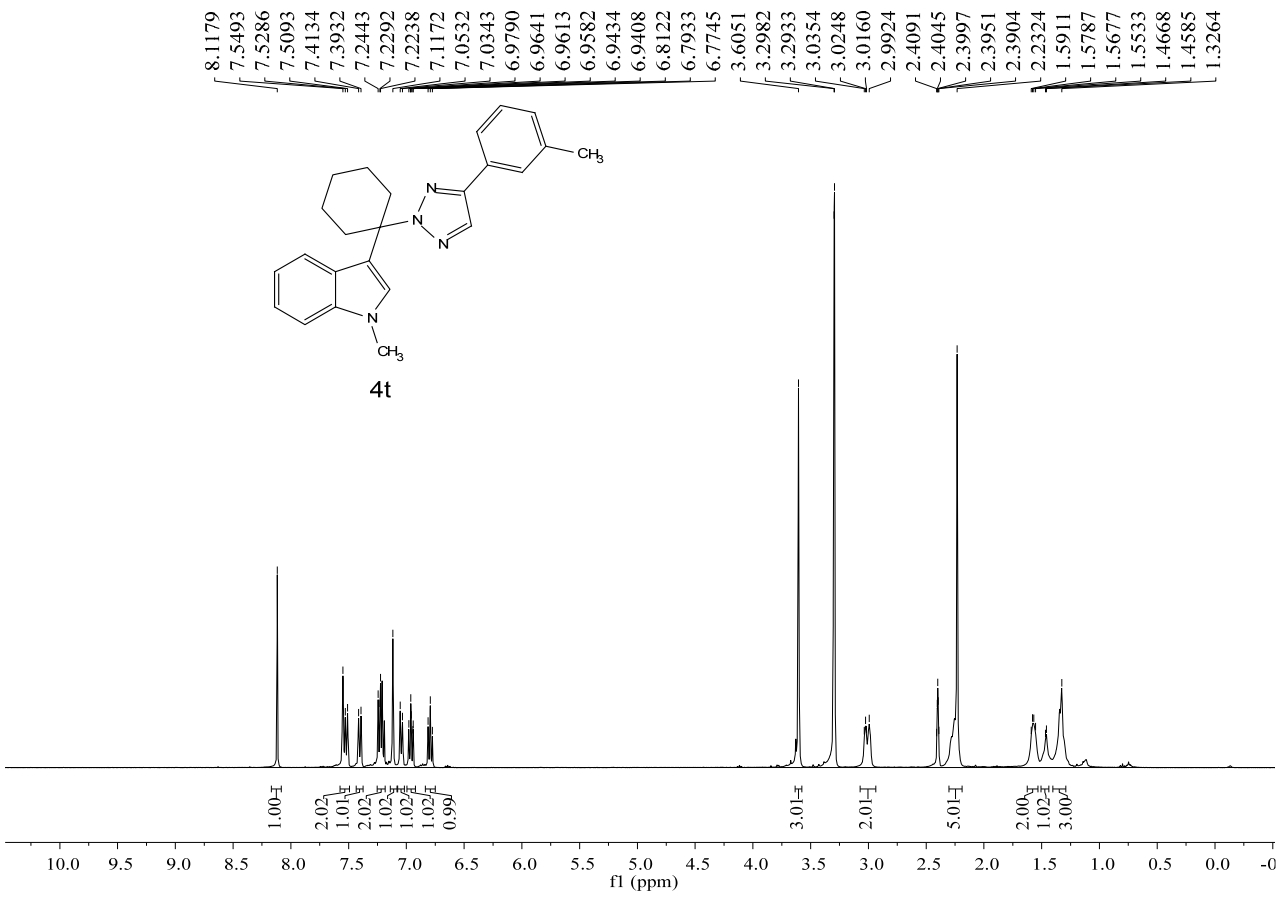
32.8465
25.1465
22.4875
Br
N
N
N
N
CH3
4s
f1 (ppm)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7.2238
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7.0532
7.0343
6.9790
6.9641
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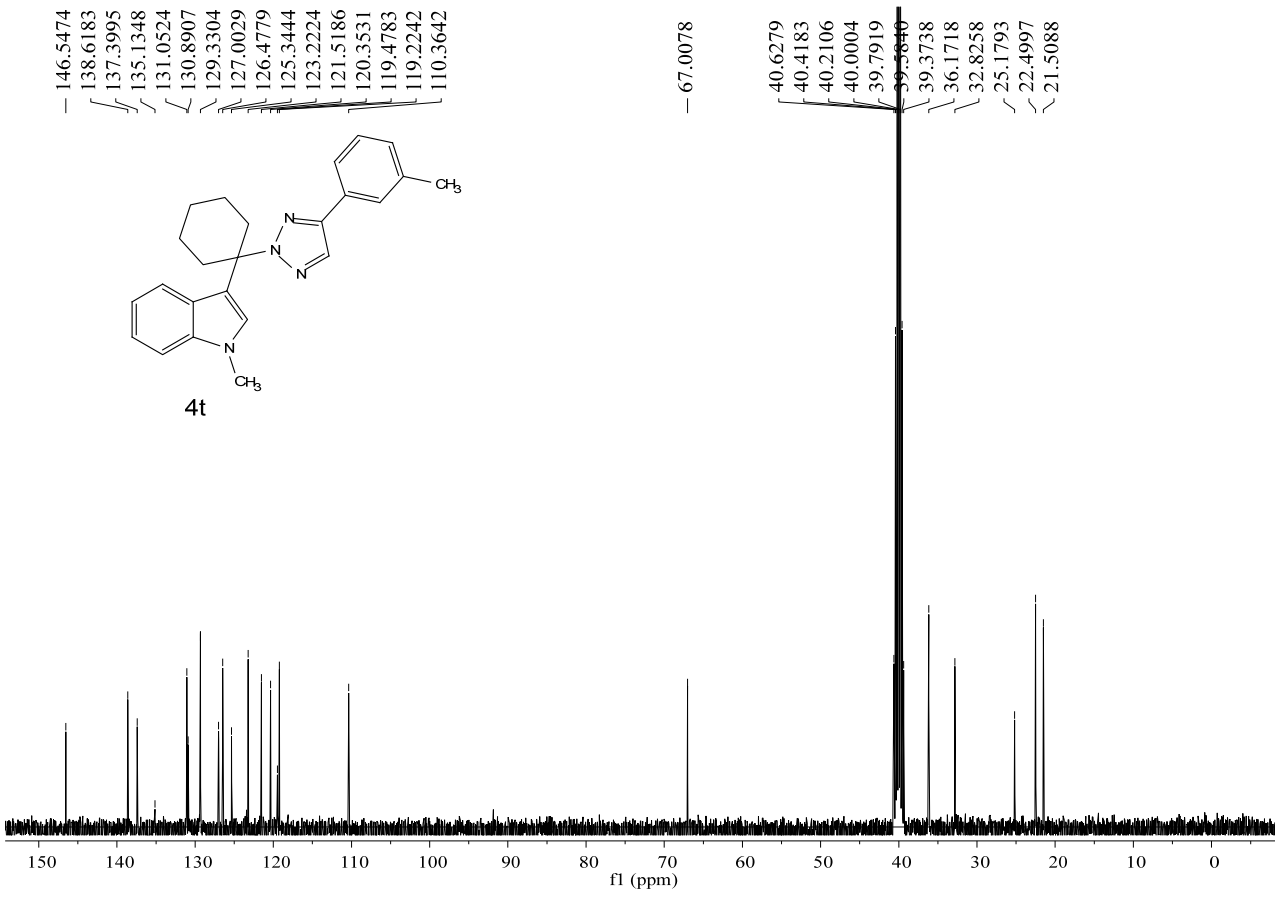
6.9582
6.9434
6.9408
6.8122
6.7933
6.7745
3.6051
3.2982
3.2933
3.0354
3.0248
3.0160
2.9924
2.4091
2.4045
2.3997
2.3951
2.3904
2.2324
1.5911
1.5787
1.5677
1.5533
1.4668
1.4585
1.3264
4t
1.00
2.02
1.01
2.02
1.02
1.02
1.02
0.99
3.01
2.01
5.01
2.00
1.02
3.00
f1 (ppm)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129.3304
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123.2224
121.5186
120.3531
119.4783
119.2242
110.3642
67.0078
40.6279
40.4183
40.2106
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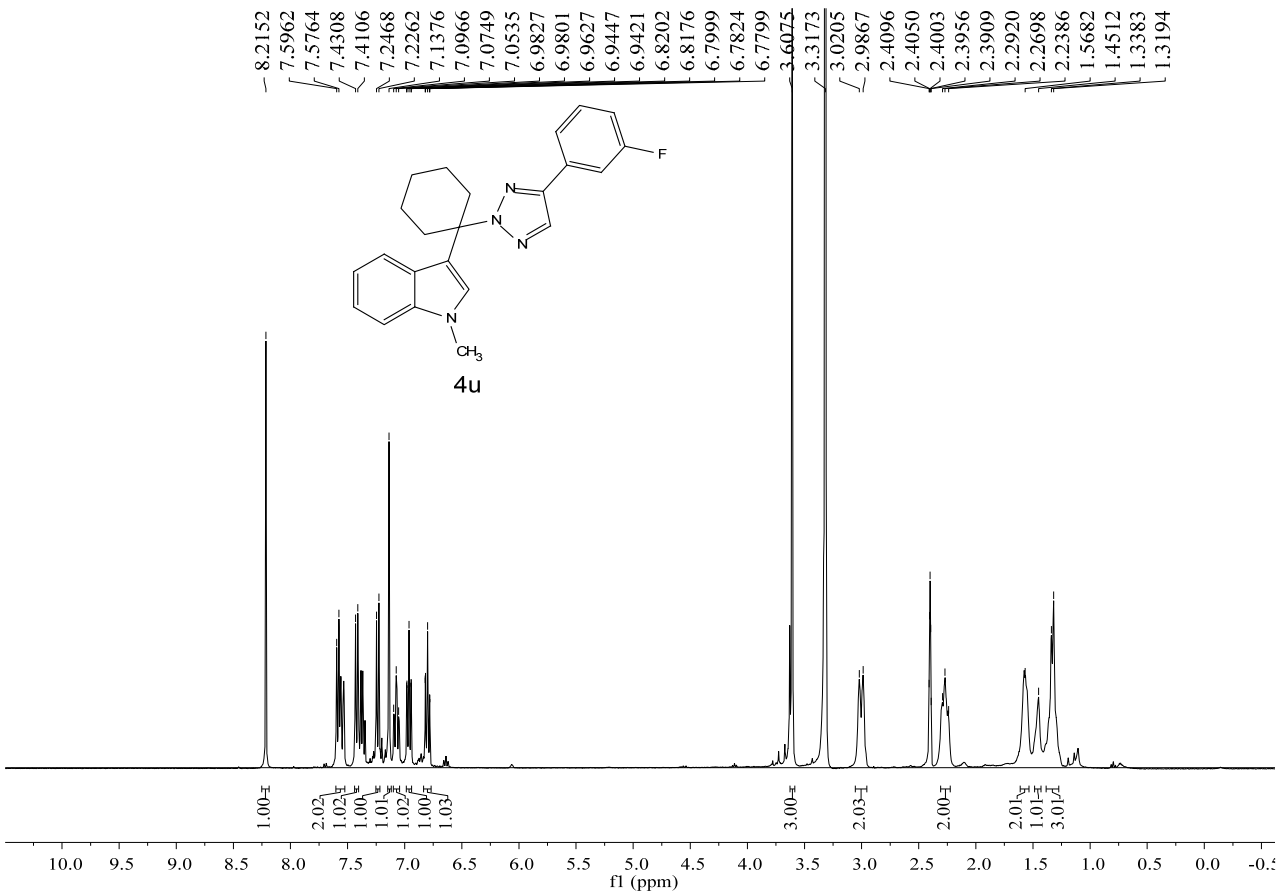
39.3738
36.1718
32.8258
25.1793
22.4997
21.5088
4t
f1 (ppm)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7.0535
6.9827
6.9801
6.9627
6.9447
6.9421
6.8202
6.8176
6.7999
6.7824
6.7799
3.6075
3.3173
3.0205
2.9867
2.4096
2.4050
2.4003
2.3956
2.3909
2.2920
2.2698
2.2386
1.5682
1.4512
1.3383
1.3194
F
N
N
N
N
CH3
4u
1.00
2.02
1.02
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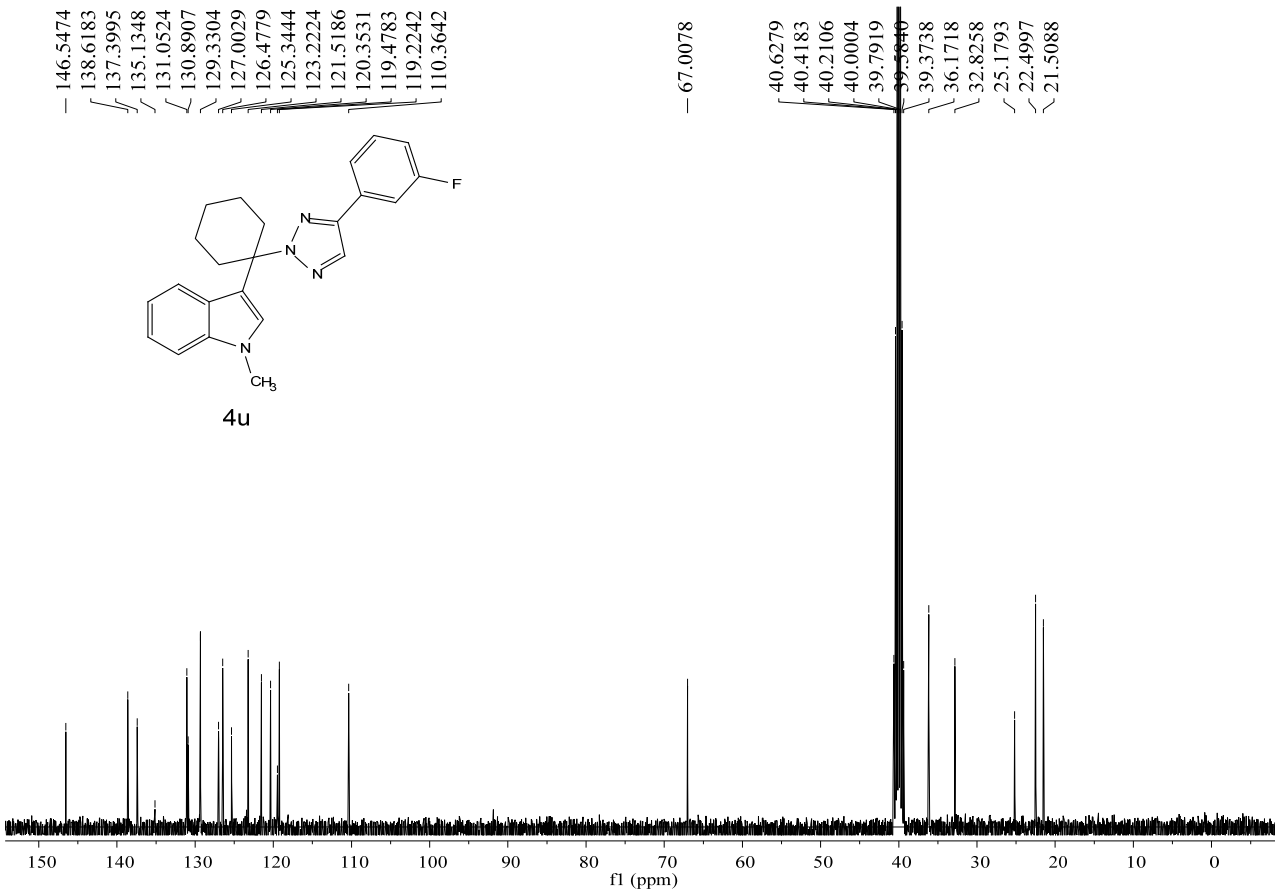
1.00
1.03
3.00
2.03
2.00
2.01
1.01
3.01
f1 (ppm)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135.1348
131.0524
130.8907
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126.4779
125.3444
123.2224
121.5186
120.3531
119.4783
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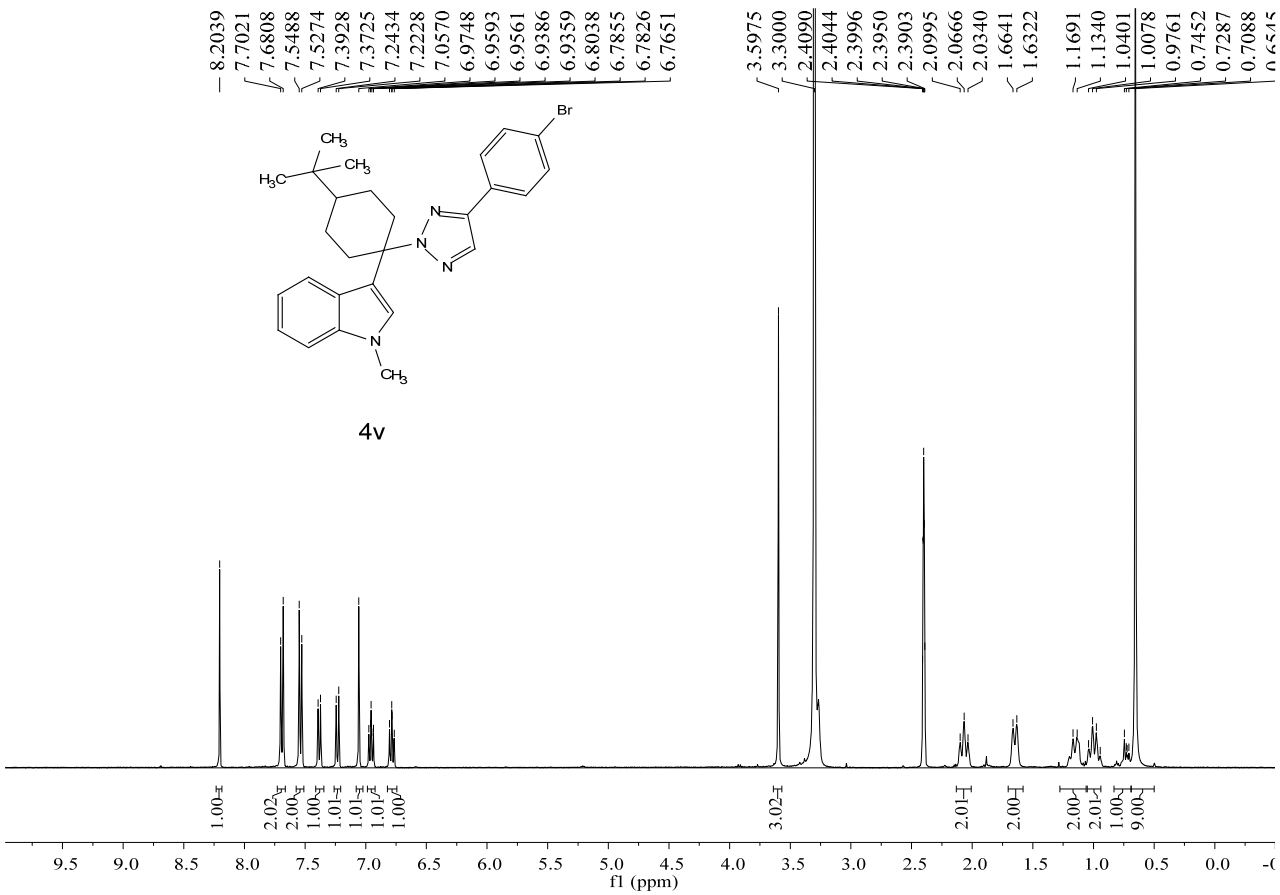
110.3642
67.0078
40.6279
40.4183
40.2106
40.0004
39.7919
39.3738
36.1718
32.8258
25.1793
22.4997
21.5088
F
N
N
N
N
CH3
4u
f1 (ppm)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7.2228
7.0570
6.9748
6.9593
6.9561
6.9386
6.9359
6.8038
6.7855
6.7826
6.7651
3.5975
3.3000
2.4090
2.4044
2.3996
2.3950
2.3903
2.0995
2.0666
2.0340
1.6641
1.6322
1.1691
1.1340
1.0401
1.0078
0.9761
0.7452
0.7287
0.7088
1.00
2.02
2.00
1.00
1.01
1.01
1.01
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3.02
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2.00
2.00
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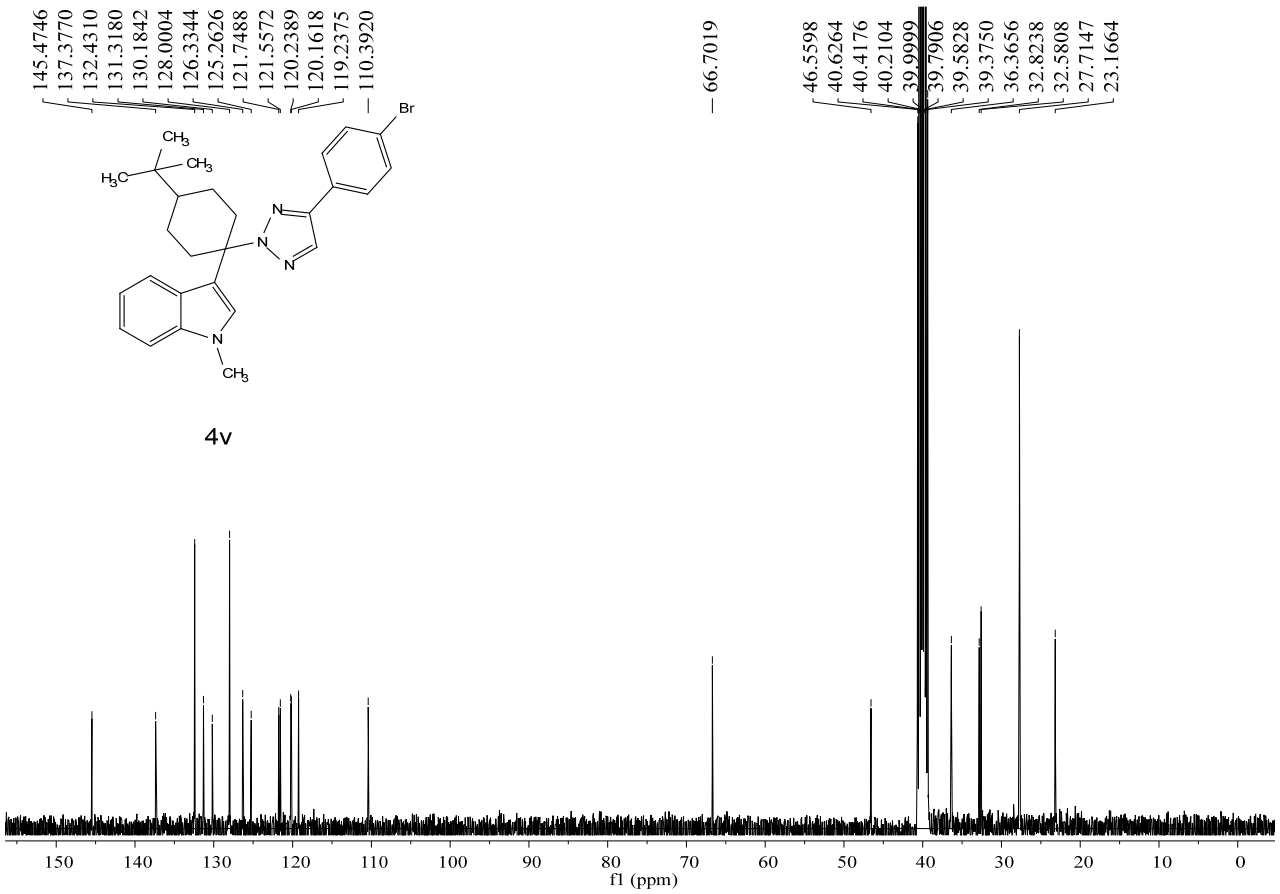
9.00
f1 (ppm)

4v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120.1618
119.2375
110.3920
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46.5598
40.6264
40.4176
40.2104
39.9999
39.7906
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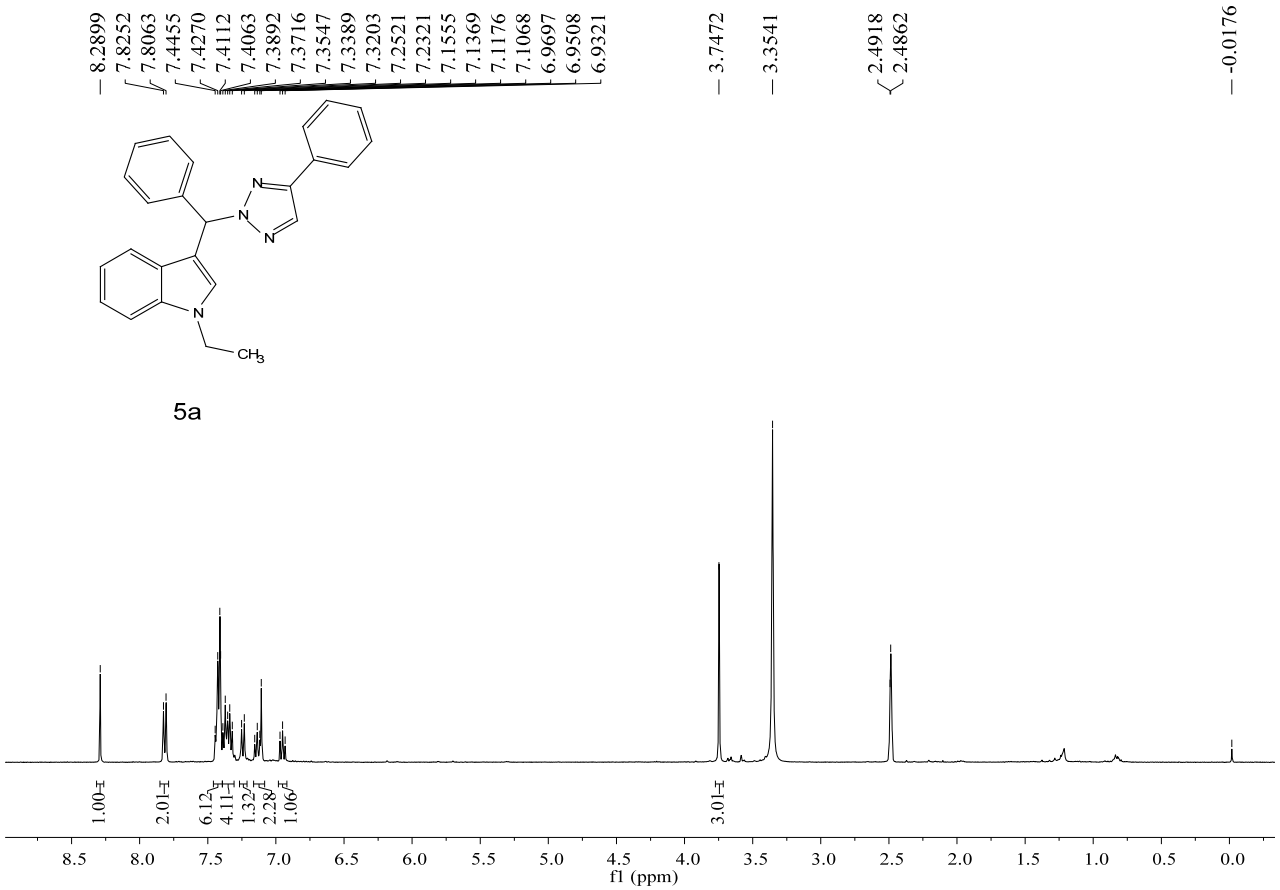
39.3750
36.3656
32.8238
32.5808
27.7147
23.1664
f1 (ppm)

4v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7.3203
7.2521
7.2321
7.1555
7.1369
7.1176
7.1068
6.9697
6.9508
6.9321
3.7472
3.3541
2.4918
2.4862
-0.0176
N
N
N
N
CH3
1.00
2.01
6.12
4.11
1.32
2.28
1.06
3.01
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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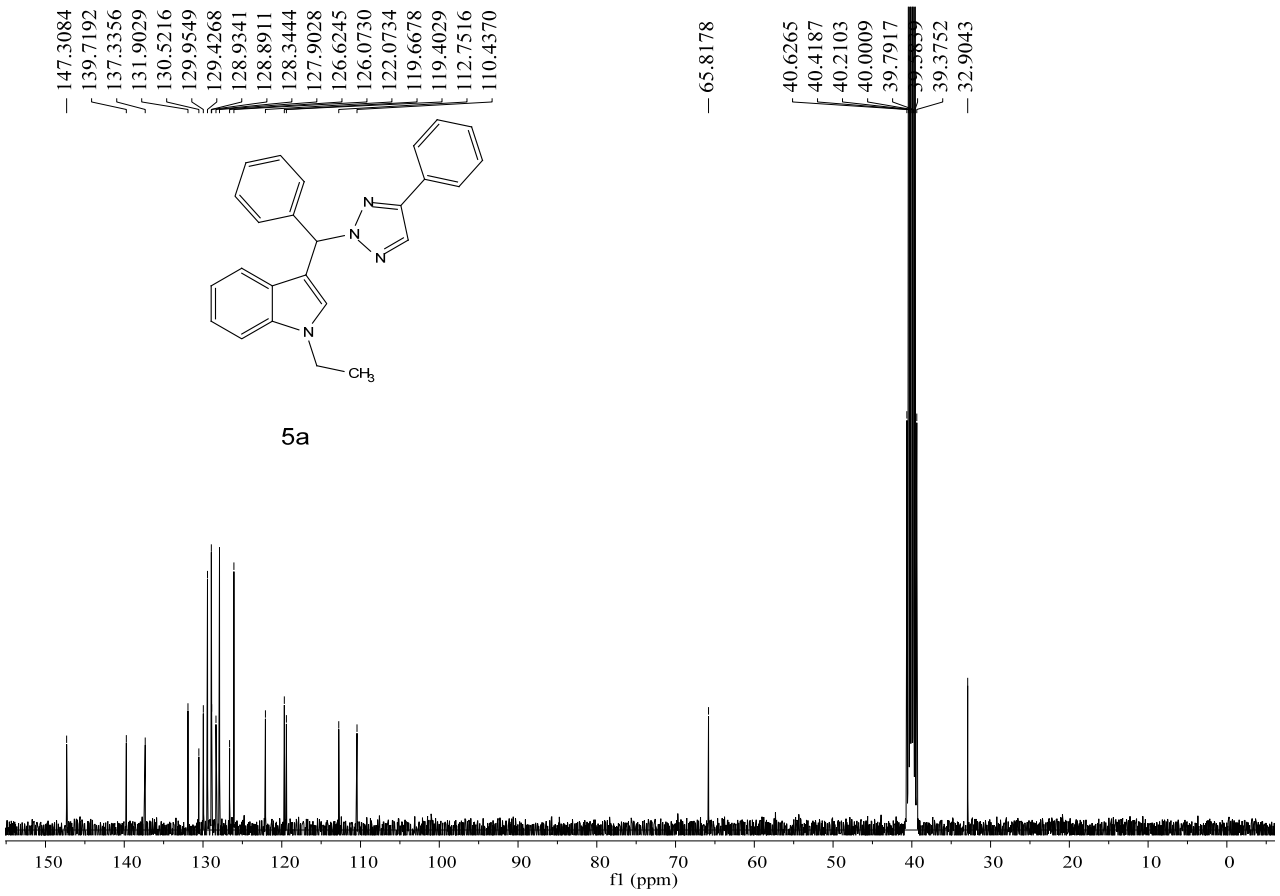
0.0
f1 (ppm)

5a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129.4268
128.9341
128.8911
128.3444
127.9028
126.6245
126.0730
122.0734
119.6678
119.4029
112.7516
110.4370
65.8178
40.6265
40.4187
40.2103
40.0009
39.7917
39.3752
32.9043
N
N
N
N
CH3
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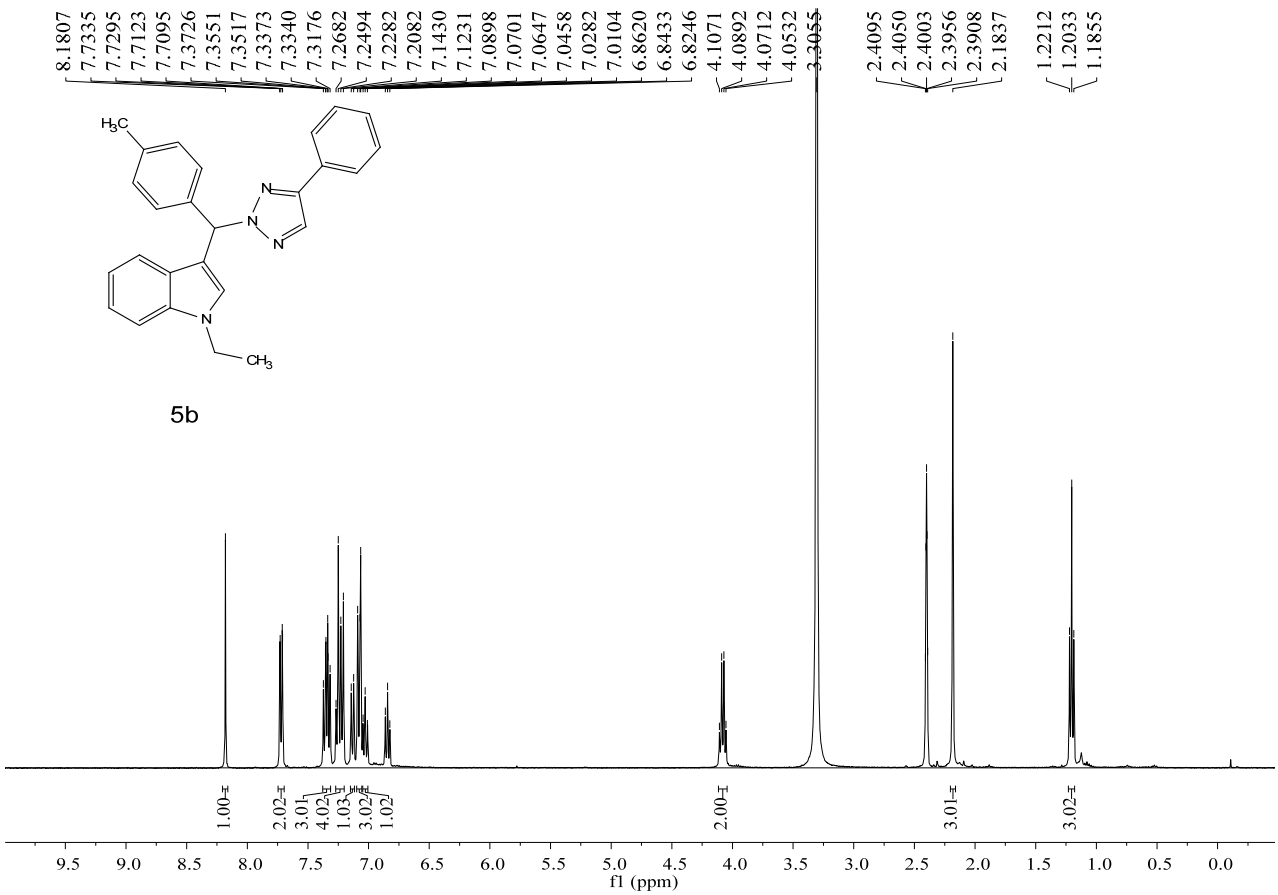
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

5a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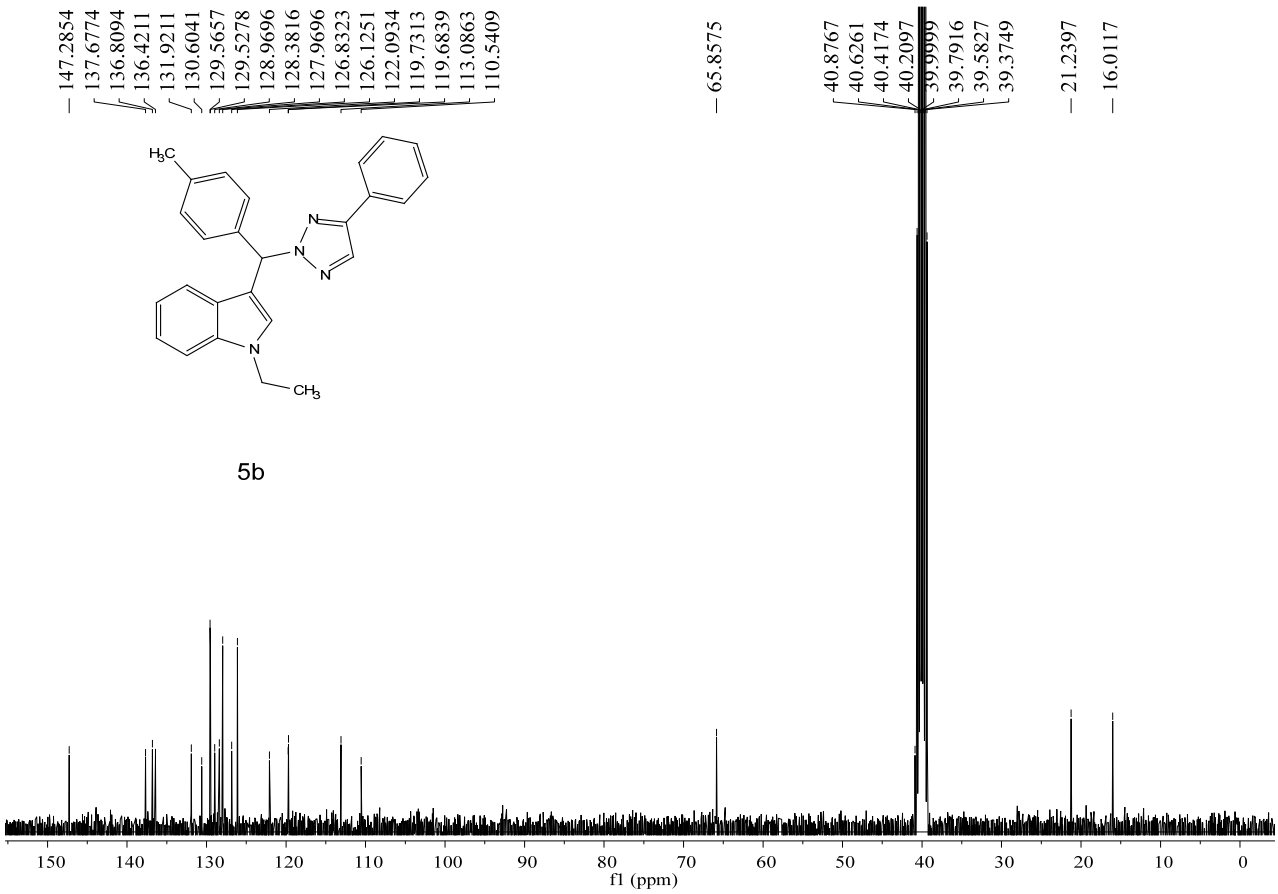
7.3176
7.2682
7.2494
7.2282
7.2082
7.1430
7.1231
7.0898
7.0701
7.0647
7.0458
7.0282
7.0104
6.8620
6.8433
6.8246
4.1071
4.0892
4.0712
4.0532
3.3055
2.4095
2.4050
2.4003
2.3956
2.3908
2.1837
1.2212
1.2033
1.1855
H3C
N
N
N
N
CH3
1.00
2.02
3.01
4.02
1.03
3.02
1.02
2.00
3.01
3.02
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

5b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126.8323
126.1251
122.0934
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113.0863
110.5409
65.8575
40.8767
40.6261
40.4174
40.2097
39.9999
39.7916
39.5827
39.3749
21.2397
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H3C
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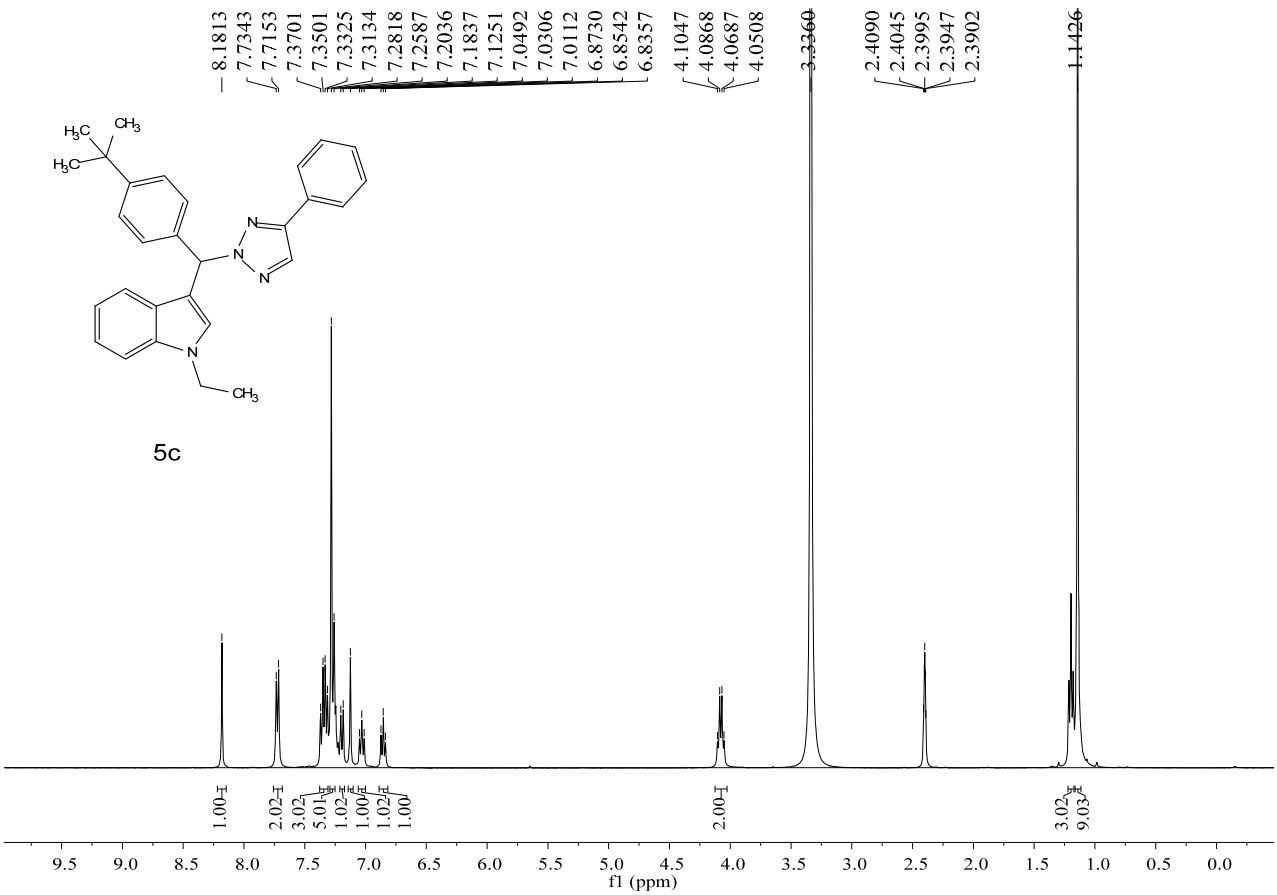
N
N
N
CH3
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

5b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7.3134
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7.2587
7.2036
7.1837
7.1251
7.0492
7.0306
7.0112
6.8730
6.8542
6.8357
4.1047
4.0868
4.0687
4.0508
3.3360
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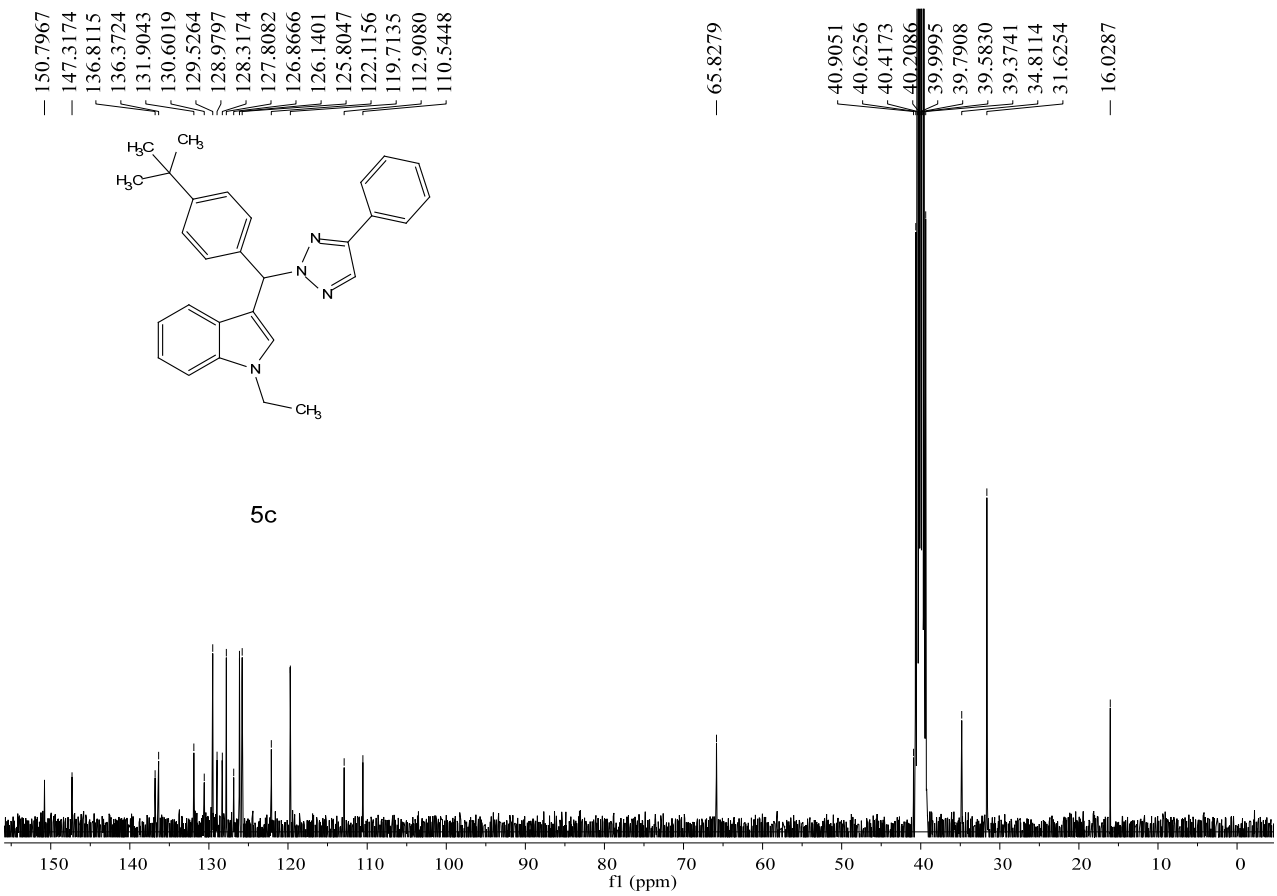
2.4045
2.3995
2.3947
2.3902
1.1426
1.00
2.02
3.02
5.01
1.02
1.00
1.02
1.00
2.00
3.02
9.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

5c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126.8666
126.1401
125.8047
122.1156
119.7135
112.9080
110.5448
65.8279
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40.6256
40.4173
40.2086
39.9995
39.7908
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34.8114
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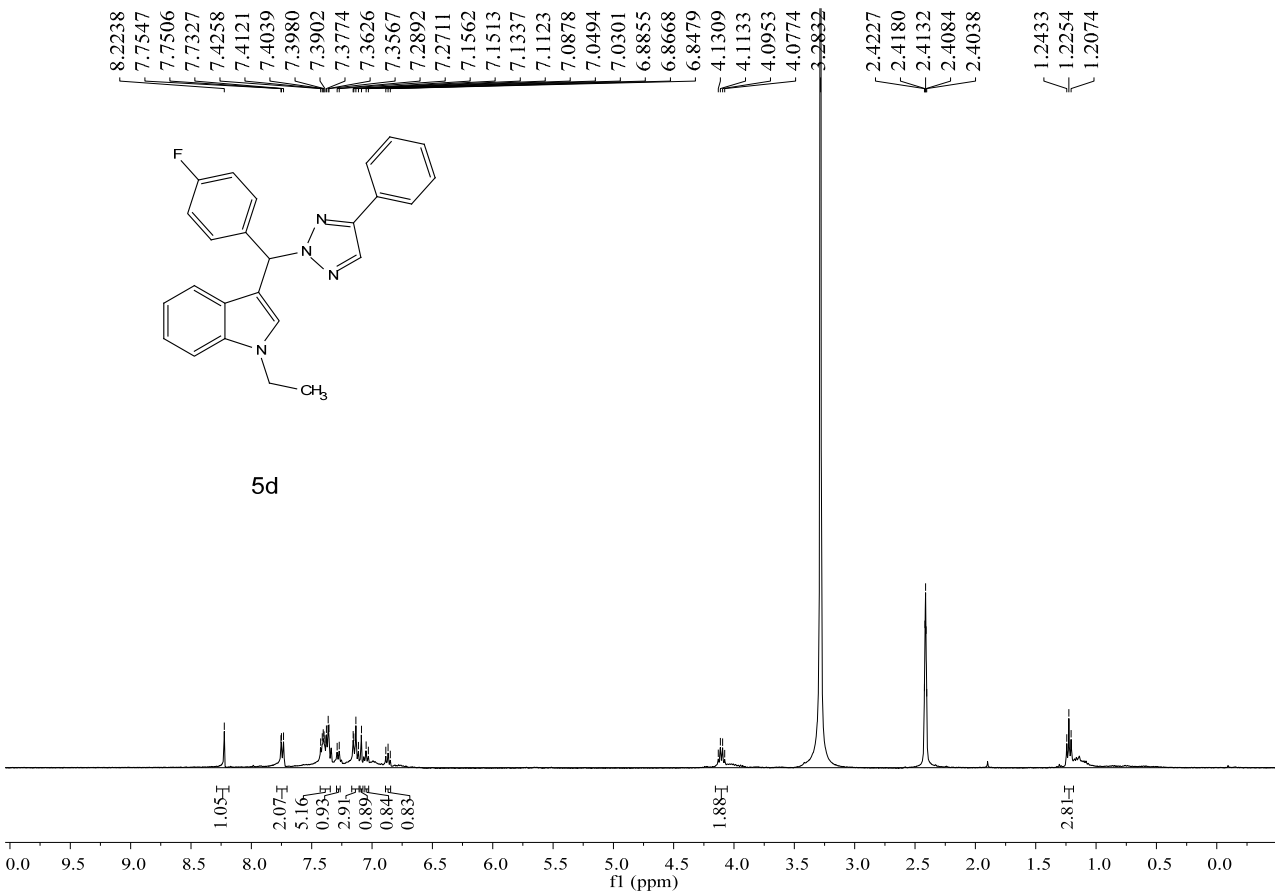
16.0287
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

5c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7.3567
7.2892
7.2711
7.1562
7.1513
7.1337
7.1123
7.0878
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7.0301
6.8855
6.8668
6.8479
4.1309
4.1133
4.0953
4.0774
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2.4227
2.4180
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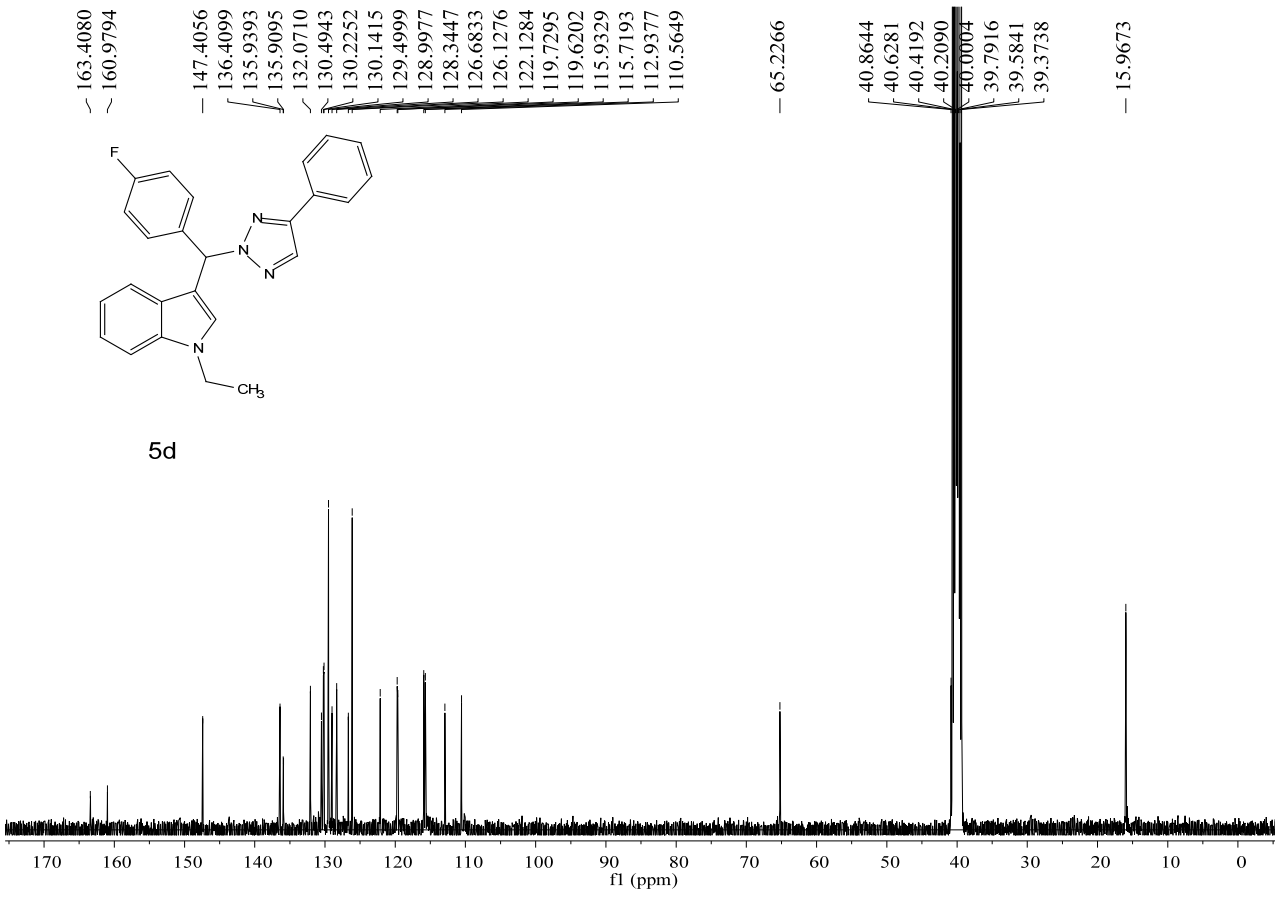
2.4038
1.2433
1.2254
1.2074
F
N
N
N
N
CH3
1.05
2.07
5.16
0.93
2.91
0.89
0.84
0.83
1.88
2.81
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

5d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132.0710
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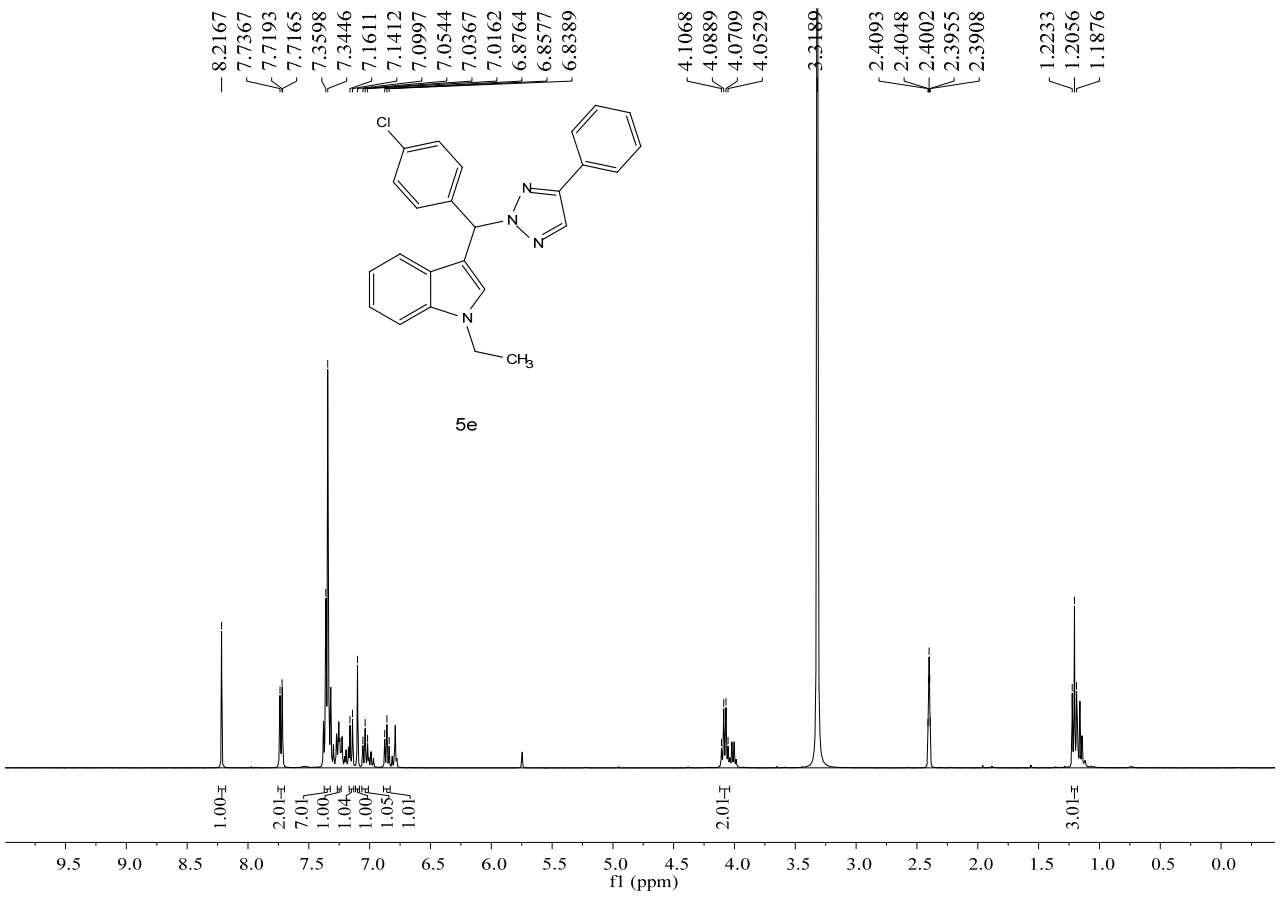
130.2252
130.1415
129.4999
128.9977
128.3447
126.6833
126.1276
122.1284
119.7295
119.6202
115.9329
115.7193
112.9377
110.5649
65.2266
40.8644
40.6281
40.4192
40.2090
40.0004
39.7916
39.5841
39.3738
15.9673
F
N
N
N
N
CH3
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

5d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7.7193
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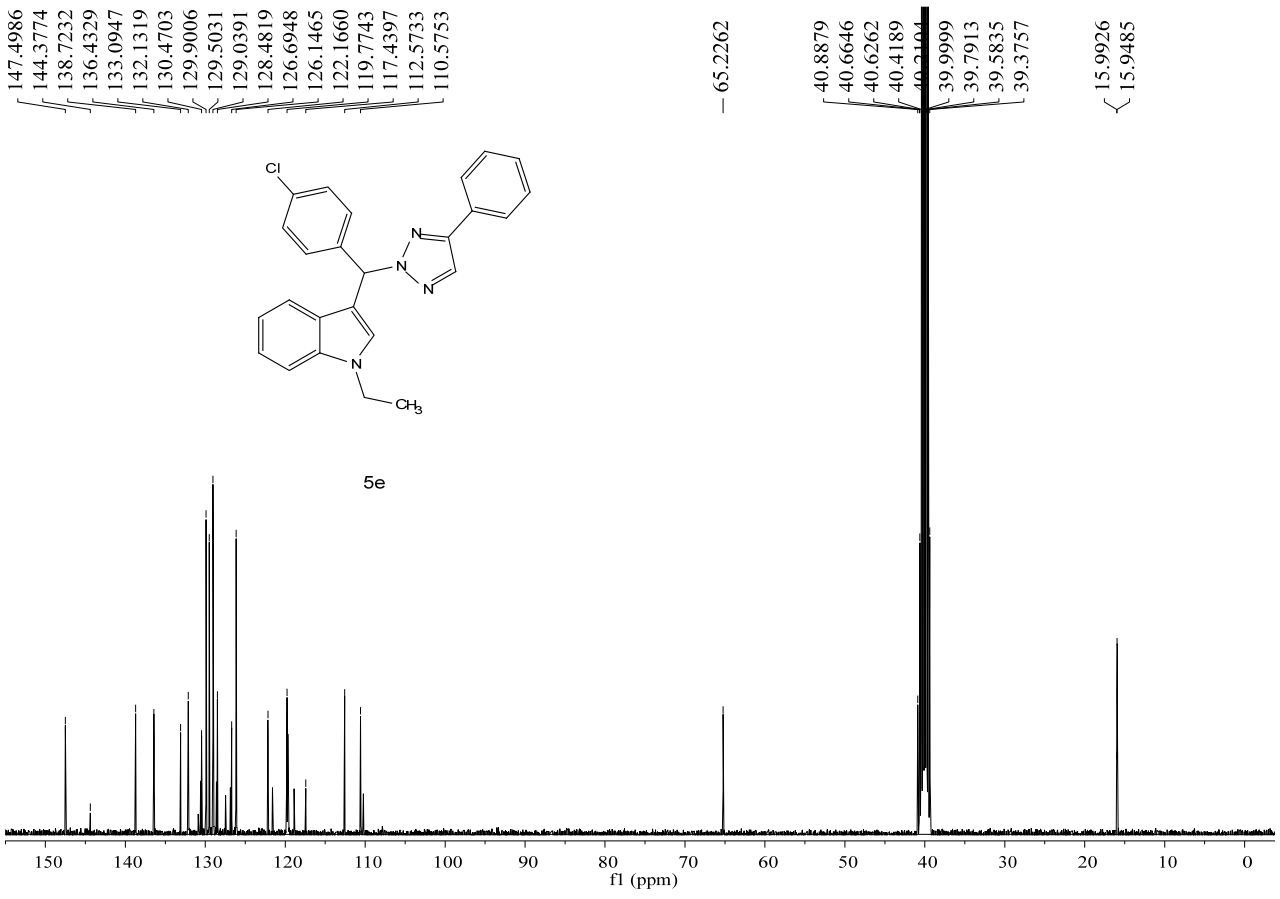
7.3598
7.3446
7.1611
7.1412
7.0997
7.0544
7.0367
7.0162
6.8764
6.8577
6.8389
4.1068
4.0889
4.0709
4.0529
3.3189
2.4093
2.4048
2.4002
2.3955
2.3908
1.2233
1.2056
1.1876
Cl
N
N
N
N
CH3
5e
1.00
2.01
7.01
1.00
1.04
1.00
1.05
1.01
2.01
3.01
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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138.7232
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133.0947
132.1319
130.4703
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128.4819
126.6948
126.1465
122.1660
119.7743
117.4397
112.5733
110.5753
65.2262
40.8879
40.6646
40.6262
40.4189
40.2104
39.9999
39.7913
39.5835
39.3757
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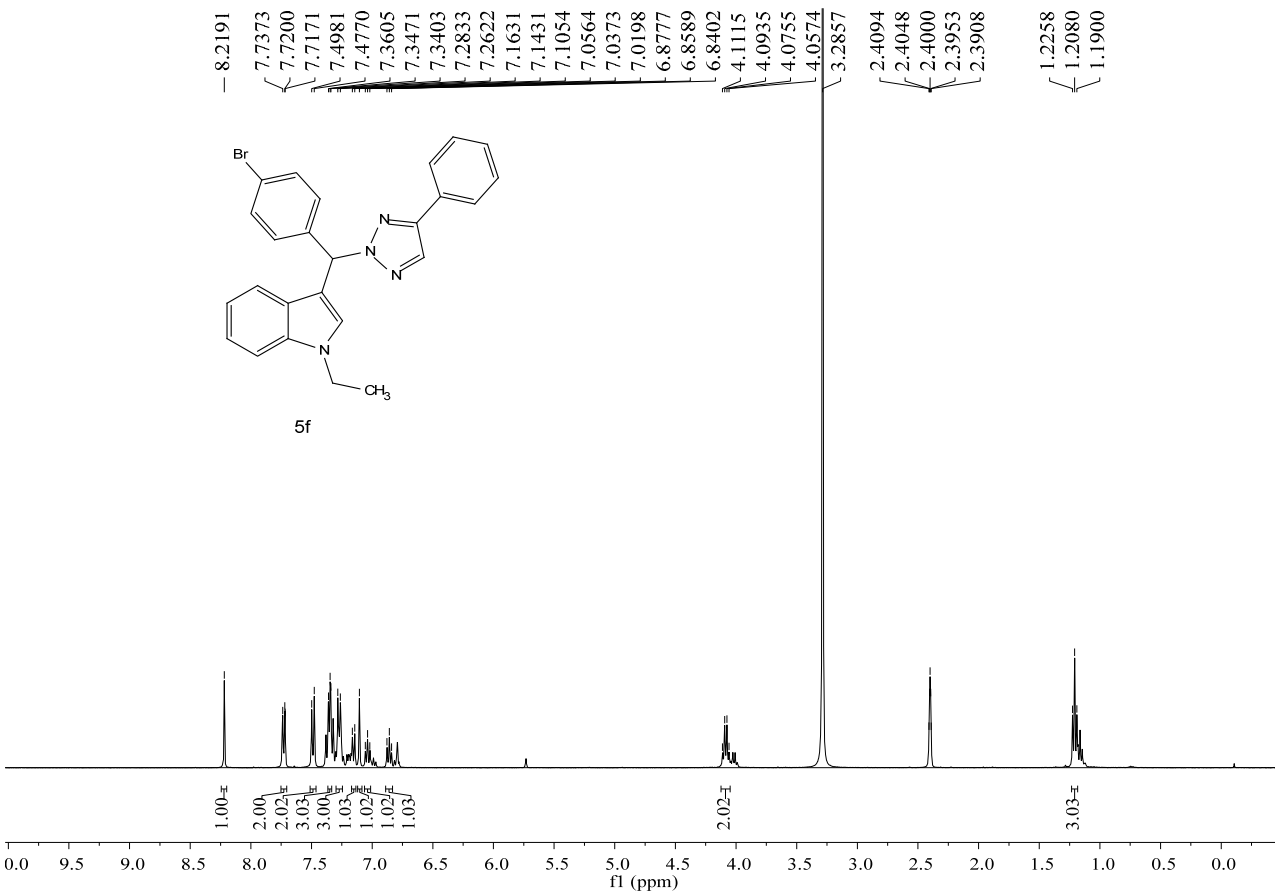
Cl
N
N
N
N
CH3
5e
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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7.7171
7.4981
7.4770
7.3605
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7.3403
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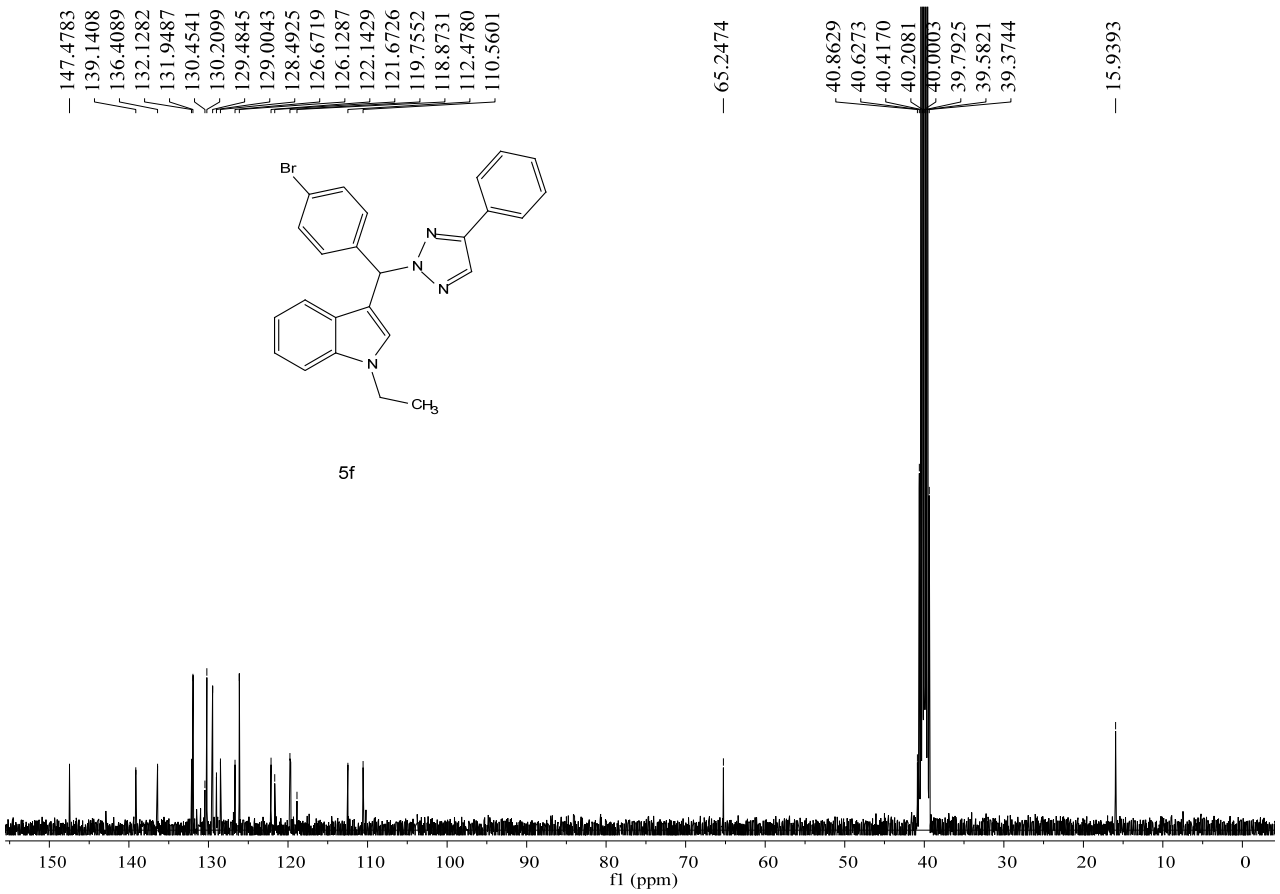
7.2622
7.1631
7.1431
7.1054
7.0564
7.0373
7.0198
6.8777
6.8589
6.8402
4.1115
4.0935
4.0755
4.0574
3.2857
2.4094
2.4048
2.4000
2.3953
2.3908
1.2258
1.2080
1.1900
Br
N
N
N
N
CH3
1.00
2.00
2.02
3.03
3.00
1.03
1.02
1.02
1.03
2.02
3.03
f1 (ppm)

5f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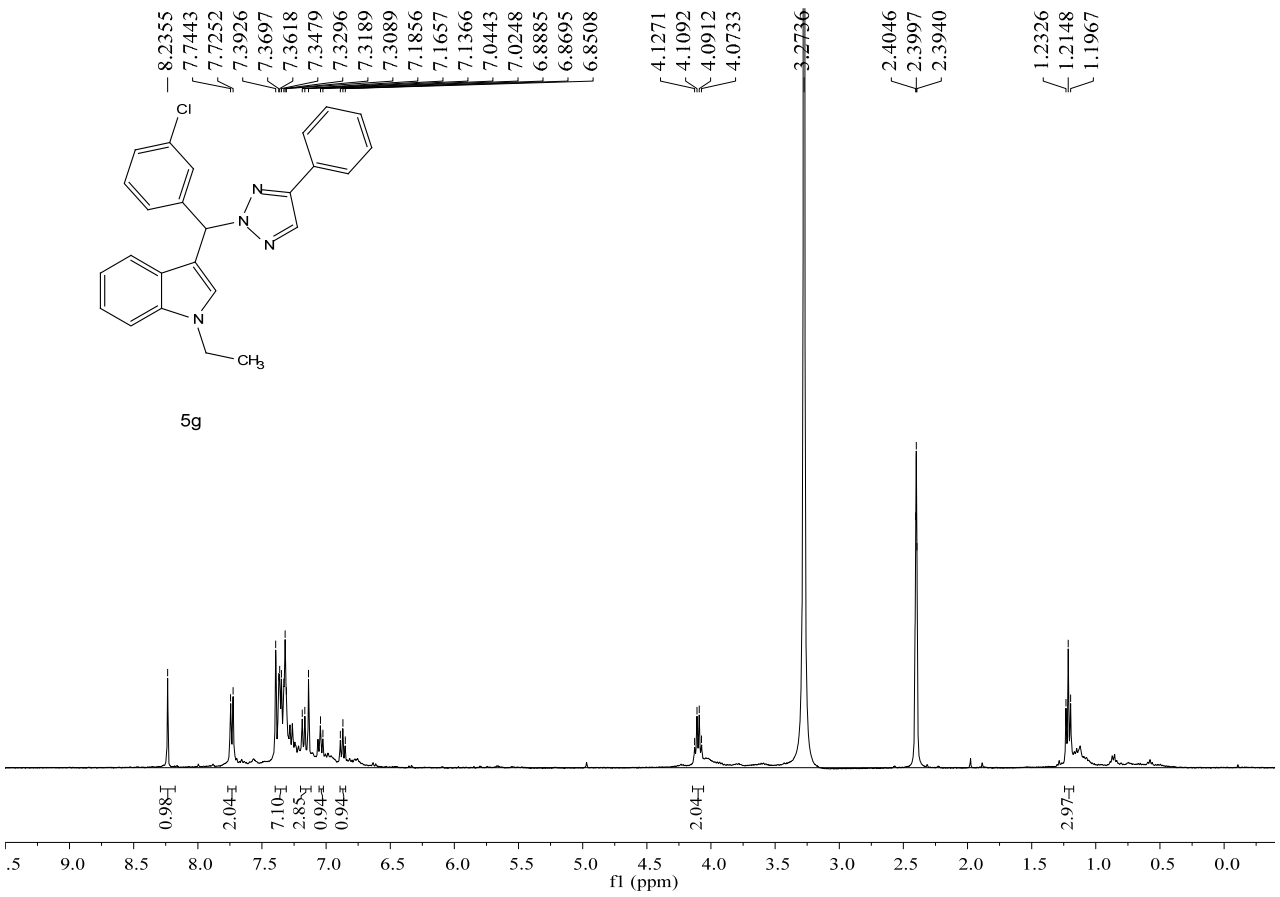
136.4089
132.1282
131.9487
130.4541
130.2099
129.4845
129.0043
128.4925
126.6719
126.1287
122.1429
121.6726
119.7552
118.8731
112.4780
110.5601
65.2474
40.8629
40.6273
40.4170
40.2081
40.0003
39.7925
39.5821
39.3744
15.9393
Br
N
N
N
N
CH3
f1 (ppm)

5f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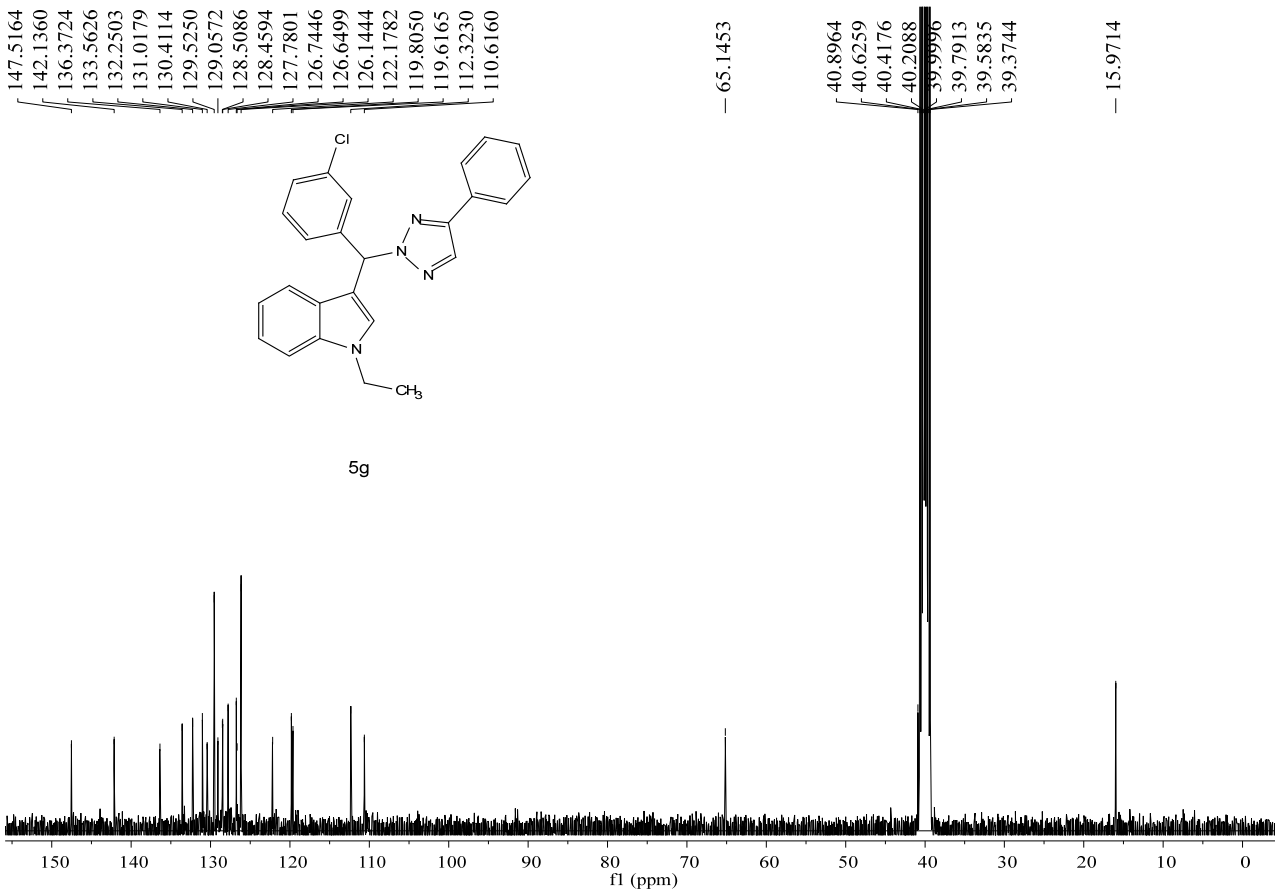
7.7252
7.3926
7.3697
7.3618
7.3479
7.3296
7.3189
7.3089
7.1856
7.1657
7.1366
7.0443
7.0248
6.8885
6.8695
6.8508
4.1271
4.1092
4.0912
4.0733
3.2736
2.4046
2.3997
2.3940
1.2326
1.2148
1.1967
Cl
N
N
N
N
CH3
5g
0.98
2.04
7.10
2.85
0.94
0.94
2.04
2.97
f1 (ppm)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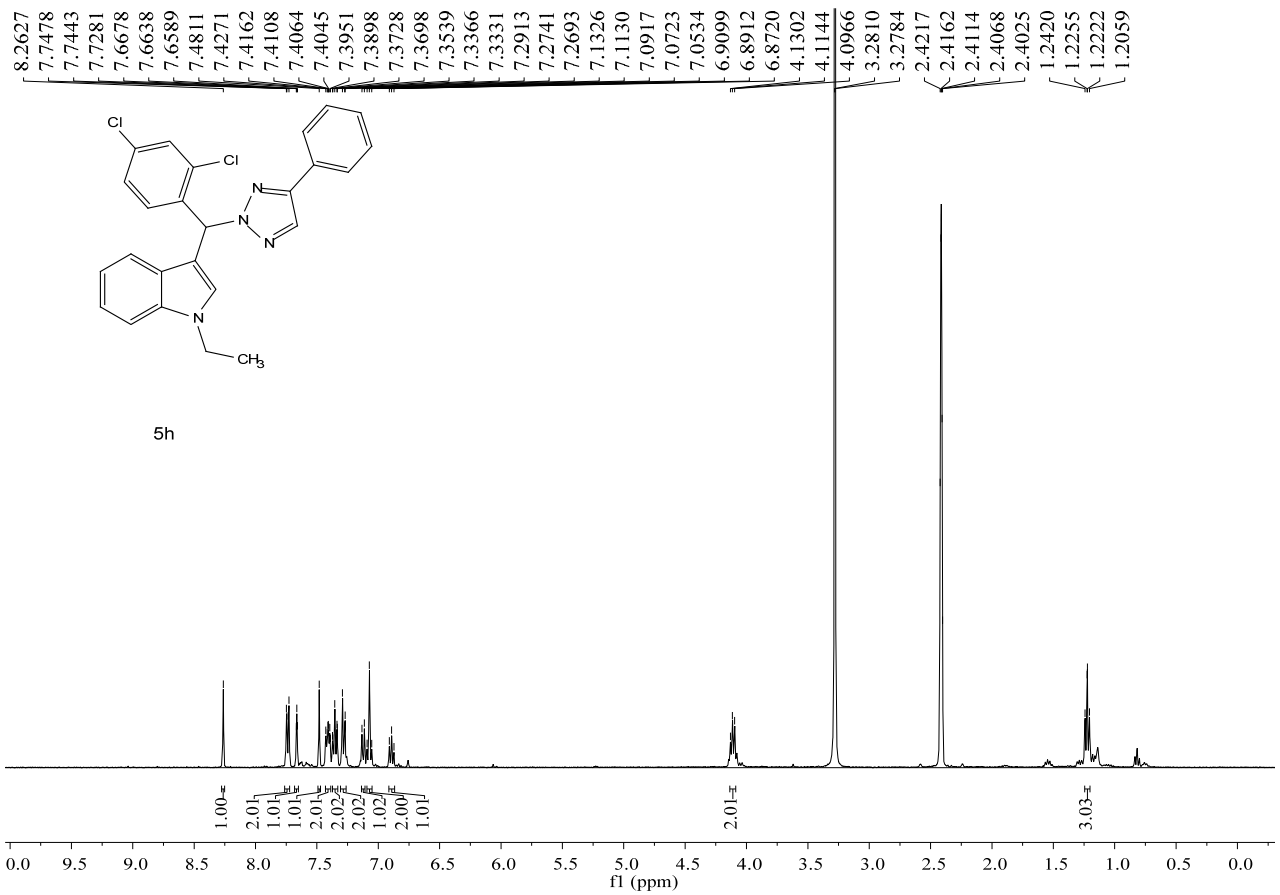
142.1360
136.3724
133.5626
132.2503
131.0179
130.4114
129.5250
129.0572
128.5086
128.4594
127.7801
126.7446
126.6499
126.1444
122.1782
119.8050
119.6165
112.3230
110.6160
65.1453
40.8964
40.6259
40.4176
40.2088
39.9996
39.7913
39.5835
39.3744
15.9714
Cl
N
N
N
N
CH3
5g
f1 (ppm)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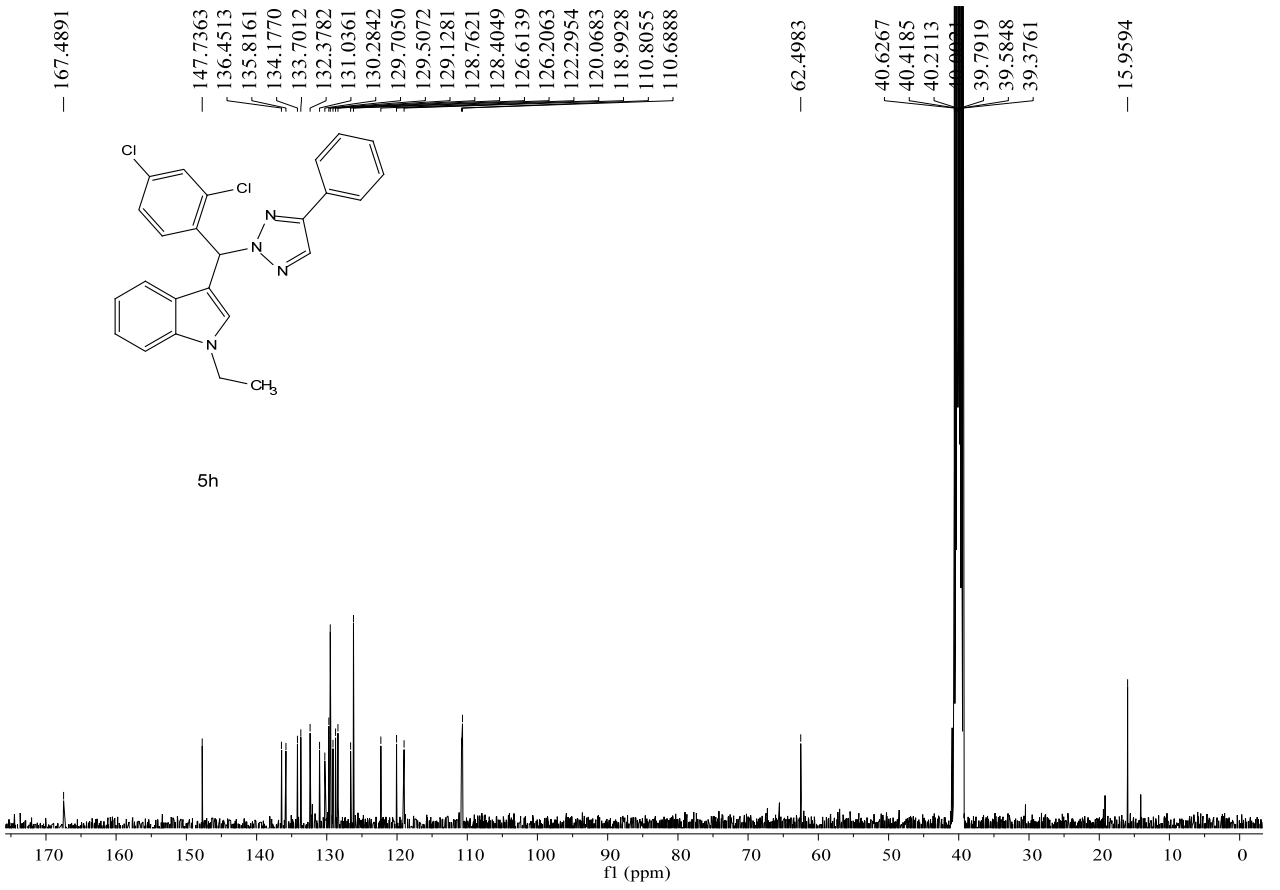
7.7443
7.7281
7.6678
7.6638
7.6589
7.4811
7.4271
7.4162
7.4108
7.4064
7.4045
7.3951
7.3898
7.3728
7.3698
7.3539
7.3366
7.3331
7.2913
7.2741
7.2693
7.1326
7.1130
7.0917
7.0723
7.0534
6.9099
6.8912
6.8720
4.1302
4.1144
4.0966
3.2810
3.2784
2.4217
2.4162
2.4114
2.4068
2.4025
1.2420
1.2255
1.2222
1.2059
Cl
Cl
N
N
N
N
CH3
1.00
2.01
1.01
1.01
2.01
2.02
2.02
1.02
2.00
1.01
2.01
3.03
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

5h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131.0361
130.2842
129.7050
129.5072
129.1281
128.7621
128.4049
126.6139
126.2063
122.2954
120.0683
118.9928
110.8055
110.6888
62.4983
40.6267
40.4185
40.2113
39.7919
39.5848
39.3761
15.9594
Cl
Cl
N
N
N
N
CH3
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

5h