

Supporting Information for:

Copper-Catalyzed Mannich-Type Oxidative β -Functionalization of Tertiary Amines

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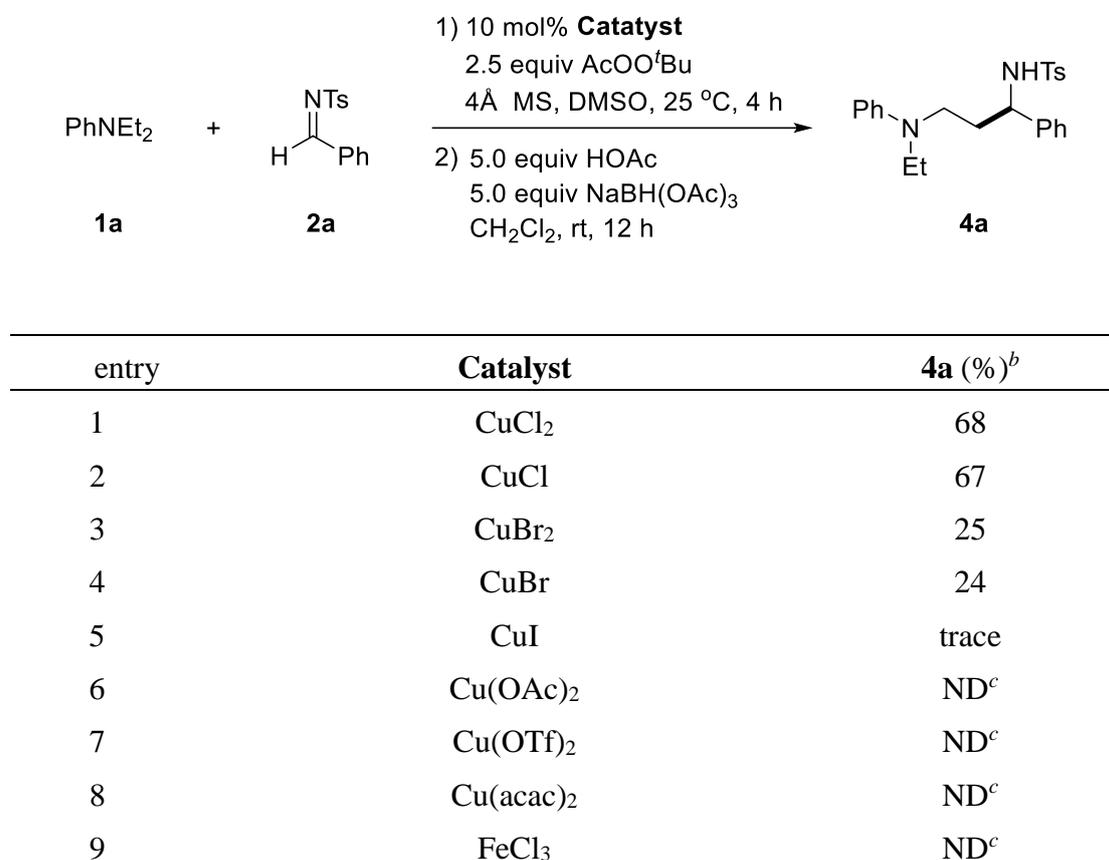
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1. General Information

Unless otherwise noted, all solvents used in the reactions were distilled from appropriate drying agent prior to use.¹ Copper (II) chloride (Sigma-Aldrich) were used without further purification. Imines²⁻⁵ and amines⁶⁻⁹ were synthesized according to the literature procedures. Melting points were measured on a RY-I apparatus and uncorrected. ¹H NMR and ¹³C NMR spectra were recorded with a Bruker AV 400 spectrometer at 400 MHz (¹H NMR) and 101 MHz (¹³C NMR). Chemical shifts for ¹H NMR spectra were reported in ppm down field from internal Me₄Si (δ 0.0) and relative to the signal of chloroform-*d* (δ 7.26, singlet). Chemical shifts for ¹³C NMR spectra were reported in ppm relative to the signal of chloroform-*d* (δ 77.00, triplet). Multiplicities were given as: s (singlet); brs (broad singlet); d (doublet); t (triplet); q (quartet); dd (doublets of doublet); m (multiplets) and etc. HRMS were recorded on an IonSpec FT-ICR mass spectrometer with ESI resource. NMR yield was calculated by ¹H NMR of crude product using an internal standard (1,3,5-trimethoxybenzene).

2. Optimization of the Reaction Conditions

Table S1. Evaluation of catalysts^a



10	CoBr ₂	ND ^c
11	NiCl ₂	ND ^c

^a Reaction conditions: **1a** (1.0 mmol, 5.0 equiv), **2a** (0.2 mmol, 1.0 equiv), metal catalyst (10 mol%), AcOO^tBu (2.5 equiv), 4Å MS (50 mg) and DMSO (2.0 mL) at 25 °C for 4 h; ^b Determined by ¹H NMR using 1,3,5-trimethoxybenzene as an internal standard; ^c ND = not detected.

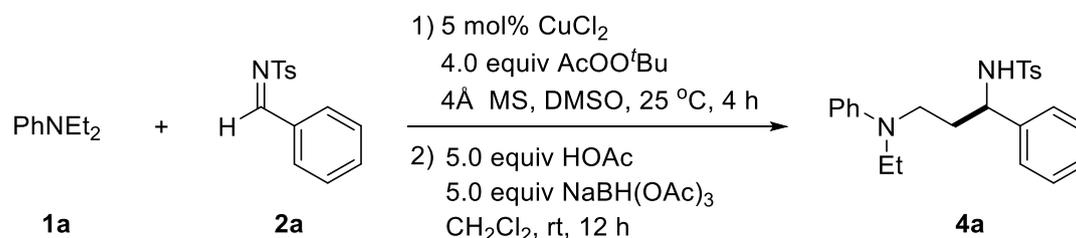
Table S2. Evaluation of Solvent^a

entry	solvent	4a (%) ^b
1	DMSO	68
2	DMF	18
3	THF	trace
4	1,4-dioxane	trace
5	DCM	ND ^c
6	DCE	ND ^c
7	toluene	ND ^c

^a Reaction conditions: **1a** (1.0 mmol, 5.0 equiv), **2a** (0.2 mmol, 1.0 equiv), CuCl₂ (10 mol%), AcOO^tBu (2.5 equiv), 4Å MS (50 mg) and solvent (2.0 mL) at 25 °C for 4 h; ^b Determined by ¹H NMR using 1,3,5-trimethoxybenzene as an internal standard; ^c ND = not detected.

3. Typical Procedure for Oxidative β-Functionaliation of Amines

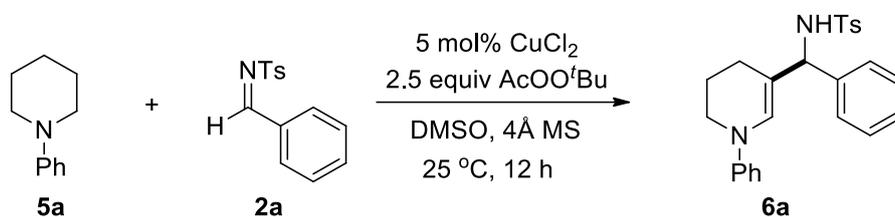
3.1 Typical Procedure for Oxidative β-Functionaliation of Acyclic Amines with Imines



CuCl₂ (1.4 mg, 0.01 mmol, 5 mol%), *N*-benzylidene-4-methylbenzenesulfonamide (**2a**) (51.9 mg, 0.2 mmol) and 4Å MS (50 mg) were introduced into an oven-dried 25 mL Schlenk tube under argon atmosphere. PhNEt₂ (**1a**) (255 μL, 1.6 mmol), DMSO (2 mL) and 50% AcOO^tBu (212 mg, 0.8

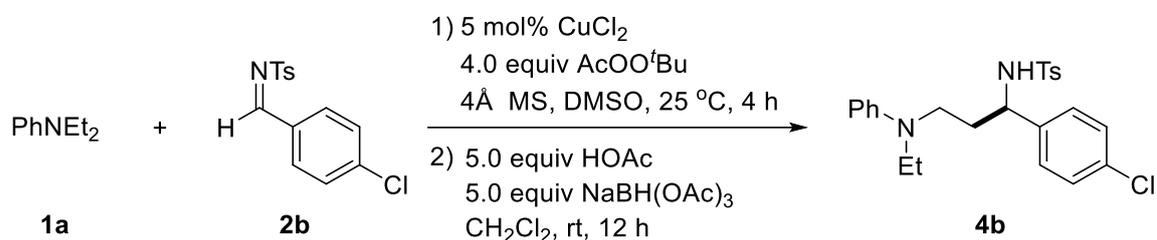
mmol) were successively added via syringes at room temperature, and the reaction mixture was stirred at 25 °C for 4 h. CH₂Cl₂ (1 mL), NaBH(OAc)₃ (212 mg, 1.0 mmol) and HOAc (60 μL, 1.0 mmol) were then added successively under argon atmosphere. After the mixture was stirred at room temperature for another 12 h, the mixture was diluted with CH₂Cl₂, quenched with 1N NaOH and then extracted with CH₂Cl₂ (3 × 5 mL). The combined organic phase was dried over anhydrous Na₂SO₄. After the desiccant was filtered off, the filtrate was concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (PE/EA = 5:1 to 3:1) to give **4a** as yellow oil.

3.2 Typical Procedure for Oxidative β-Functionaliation of Cyclic Amines with Imines



CuCl₂ (1.4 mg, 0.01 mmol, 5 mol%), *N*-benzylidene-4-methylbenzenesulfonamide (**2a**) (51.9 mg, 0.2 mmol) and 4Å MS (50 mg) were introduced into an oven-dried 25 mL Schlenk tube under argon atmosphere. *N*-phenyl piperidine **5a** (162 mg, 1.0 mmol), DMSO (2 mL) and 50% AcOO^tBu (132 mg, 0.5 mmol) were successively added via syringes at room temperature, and the reaction mixture was stirred at 25 °C for 12 h. Then the mixture was directly purified by column chromatography on silica gel (PE/EA = 5:1 to 3:1) to give **6a** as yellow oil.

3.3 Gram-Scale Experiment for **4b**

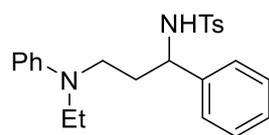


CuCl₂ (10.8 mg, 0.08 mmol, 2 mol%), *N*-(4-chlorobenzylidene)-4-methylbenzenesulfonamide (**2b**) (1.2 g, 4.0 mmol) and 4Å MS (1.0 g) were introduced into an oven-dried 250 mL Schlenk tube under argon atmosphere. PhNEt₂ (**1a**) (5.1 mL, 32.0 mmol), DMSO (40 mL) and 50% AcOO^tBu (4.2 g,

16.0 mmol) were successively added via syringes at room temperature, and the reaction mixture was stirred at 25 °C for 4 h. CH₂Cl₂ (20 mL), NaBH(OAc)₃ (4.2 g, 20.0 mmol) and HOAc (1.2 mL, 20 mmol) were then added successively under argon atmosphere. After the mixture was stirred at room temperature for another 12 h, the mixture was diluted with CH₂Cl₂, quenched with 1N NaOH and then extracted with CH₂Cl₂ (3 × 30 mL). The combined organic phase was dried over anhydrous Na₂SO₄. After the desiccant was filtered off, the filtrate was concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (PE/EA = 5:1 to 3:1) to give **4b** as brown oil.

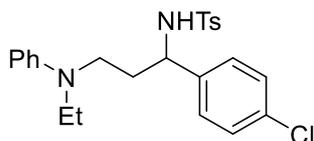
4. Analytical Data of Products

N-(3-(ethyl(phenyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (**4a**)



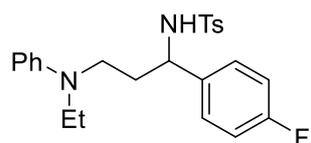
Yellow oil, 67.1 mg, 82% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.49 (d, *J* = 8.2 Hz, 2H), 7.22–7.12 (m, 5H), 7.10–7.01 (m, 4H), 6.70 (t, *J* = 7.3 Hz, 1H), 6.60 (d, *J* = 8.0 Hz, 2H), 5.82–5.69 (m, 1H), 4.37 (q, *J* = 7.2 Hz, 1H), 3.33–3.20 (m, 3H), 3.16–3.06 (m, 1H), 2.34 (s, 3H), 2.05–1.85 (m, 2H), 1.03 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (101 MHz, CDCl₃): δ 147.5, 142.9, 140.4, 137.4, 129.24, 129.20, 128.5, 127.4, 127.0, 126.4, 116.8, 113.5, 56.9, 47.1, 45.9, 34.5, 21.4, 11.8; ESI-HRMS calcd for [C₂₄H₂₉N₂O₂S, M + H]⁺: 409.1950, Found: 409.1953.

N-(1-(4-chlorophenyl)-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (**4b**)



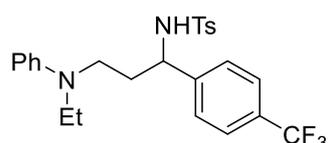
[Gram-scale experiment] brown oil, 1.45 g, 85% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.48 (d, *J* = 8.3 Hz, 2H), 7.22–7.15 (m, 2H), 7.12–7.05 (m, 4H), 6.98 (d, *J* = 8.5 Hz, 2H), 6.72 (t, *J* = 7.3 Hz, 1H), 6.61 (d, *J* = 8.0 Hz, 2H), 6.15 (d, *J* = 7.5 Hz, 1H), 4.36 (dd, *J* = 14.1, 7.3 Hz, 1H), 3.32–3.18 (m, 3H), 3.16–3.05 (m, 1H), 2.36 (s, 3H), 2.00–1.80 (m, 2H), 1.02 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (101 MHz, CDCl₃): δ 147.5, 143.2, 139.0, 137.3, 133.1, 129.3, 129.2, 128.5, 127.9, 126.9, 117.0, 113.7, 56.4, 47.1, 46.0, 34.3, 21.4, 11.8; ESI-HRMS calcd for [C₂₄H₂₈ClN₂O₂S, M + H]⁺: 443.1560, Found: 443.1562.

N-(3-(ethyl(phenyl)amino)-1-(4-fluorophenyl)propyl)-4-methylbenzenesulfonamide (**4c**)



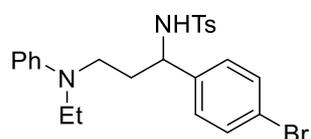
Yellow oil, 69.1 mg, 81% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.48 (d, $J = 7.7$ Hz, 2H), 7.18 (t, $J = 7.6$ Hz, 2H), 7.11–6.99 (m, 4H), 6.83 (t, $J = 8.4$ Hz, 2H), 6.72 (t, $J = 7.2$ Hz, 1H), 6.61 (d, $J = 8.1$ Hz, 2H), 5.99 (d, $J = 7.1$ Hz, 1H), 4.37 (q, $J = 6.9$ Hz, 1H), 3.33–3.16 (m, 3H), 3.16–3.03 (m, 1H), 2.35 (s, 3H), 2.02–1.80 (m, 2H), 1.02 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 162.0 (d, $J_{\text{CF}} = 246.4$ Hz), 147.6, 143.1, 137.5, 136.4 (d, $J_{\text{CF}} = 2.0$ Hz), 129.3, 129.2, 128.2 (d, $J_{\text{CF}} = 8.1$ Hz), 127.0, 117.1, 115.2 (d, $J_{\text{CF}} = 22.2$ Hz), 113.8, 56.3, 47.2, 46.0, 34.5, 21.4, 11.8; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{28}\text{FN}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 427.1856, Found: 427.1857.

***N*-(3-(ethyl(phenyl)amino)-1-(4-(trifluoromethyl)phenyl)propyl)-4-methylbenzenesulfonamide (4d)**



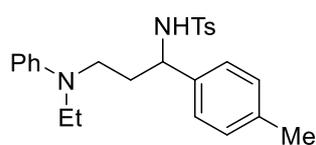
Brown oil, 89.7 mg, 94% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.42 (d, $J = 8.3$ Hz, 2H), 7.35 (d, $J = 8.1$ Hz, 2H), 7.23–7.12 (m, 4H), 7.01 (d, $J = 8.1$ Hz, 2H), 6.75 (t, $J = 7.3$ Hz, 1H), 6.65 (d, $J = 8.0$ Hz, 2H), 6.23 (d, $J = 7.3$ Hz, 1H), 4.47 (dd, $J = 13.8, 7.3$ Hz, 1H), 3.37–3.21 (m, 3H), 3.21–3.07 (m, 1H), 2.31 (s, 3H), 2.02–1.82 (m, 2H), 1.03 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.5, 144.5, 143.3, 137.2, 129.5 (q, $J_{\text{CF}} = 32.3$ Hz), 129.29, 129.26, 126.94, 126.93, 125.3 (q, $J_{\text{CF}} = 3.4$ Hz), 123.9 (q, $J_{\text{CF}} = 273.7$ Hz), 117.6, 114.3, 56.8, 47.3, 46.4, 34.3, 21.2, 11.7; ESI-HRMS calcd for $[\text{C}_{25}\text{H}_{28}\text{F}_3\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 477.1824, Found: 477.1822.

***N*-(1-(4-bromophenyl)-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4e)**



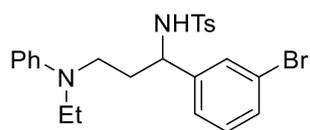
Brown oil, 85.8 mg, 88% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.47 (d, $J = 8.3$ Hz, 2H), 7.24 (d, $J = 8.4$ Hz, 2H), 7.19 (dd, $J = 8.6, 7.4$ Hz, 2H), 7.07 (d, $J = 8.1$ Hz, 2H), 6.92 (d, $J = 8.4$ Hz, 2H), 6.72 (t, $J = 7.3$ Hz, 1H), 6.61 (d, $J = 8.0$ Hz, 2H), 6.16 (d, $J = 7.5$ Hz, 1H), 4.35 (q, $J = 7.3$ Hz, 1H), 3.34–3.18 (m, 3H), 3.17–3.04 (m, 1H), 2.37 (s, 3H), 2.01–1.79 (m, 2H), 1.02 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.5, 143.2, 139.5, 137.3, 131.4, 129.3, 129.2, 128.3, 126.9, 121.2, 117.1, 113.8, 56.4, 47.1, 46.0, 34.2, 21.4, 11.8; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{28}\text{BrN}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 487.1055, Found: 487.1056.

***N*-(3-(ethyl(phenyl)amino)-1-(*p*-tolyl)propyl)-4-methylbenzenesulfonamide (4f)**



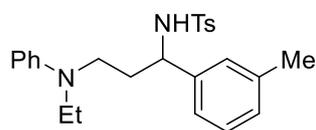
Brown oil, 59.2 mg, 70% yield, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.48 (d, $J = 8.2$ Hz, 2H), 7.18 (dd, $J = 8.3, 7.5$ Hz, 2H), 7.07 (d, $J = 7.8$ Hz, 2H), 6.95 (dd, $J = 18.8, 8.0$ Hz, 4H), 6.71 (d, $J = 7.2$ Hz, 1H), 6.60 (d, $J = 8.2$ Hz, 2H), 5.54–5.43 (m, 1H), 4.32 (q, $J = 7.0$ Hz, 1H), 3.33–3.16 (m, 3H), 3.15–3.05 (m, 1H), 2.35 (s, 3H), 2.28 (s, 3H), 2.05–1.83 (m, 2H), 1.03 (t, $J = 7.0$ Hz, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 147.6, 142.9, 137.5, 137.4, 137.2, 129.24, 129.21, 129.1, 127.0, 126.4, 116.8, 113.6, 56.7, 47.2, 45.9, 34.4, 21.4, 21.0, 11.9; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{31}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 423.2106, Found: 423.2109.

***N*-(1-(3-bromophenyl)-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4g)**



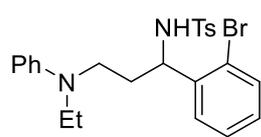
Brown oil, 88.7 mg, 91% yield, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.46 (d, $J = 7.9$ Hz, 2H), 7.25–7.21 (m, 1H), 7.18 (t, $J = 8.0$ Hz, 2H), 7.06 (d, $J = 8.1$ Hz, 2H), 7.03–7.00 (m, 2H), 6.71 (t, $J = 7.3$ Hz, 1H), 6.61 (d, $J = 8.1$ Hz, 2H), 6.11–5.95 (m, 1H), 4.33 (dd, $J = 13.9, 7.4$ Hz, 1H), 3.33–3.20 (m, 3H), 3.18–3.06 (m, 1H), 2.34 (s, 3H), 1.99–1.79 (m, 2H), 1.02 (t, $J = 7.0$ Hz, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 147.5, 143.2, 142.7, 137.2, 130.4, 130.0, 129.7, 129.3, 129.2, 126.9, 125.1, 122.4, 117.1, 113.8, 56.5, 47.2, 46.1, 34.4, 21.4, 11.8; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{28}\text{BrN}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 487.1055, Found: 487.1051.

***N*-(3-(ethyl(phenyl)amino)-1-(*m*-tolyl)propyl)-4-methylbenzenesulfonamide (4h)**



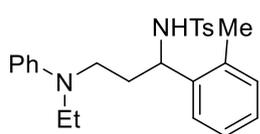
Brown oil, 69.0 mg, 81% yield, $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.47 (d, $J = 7.3$ Hz, 2H), 7.18 (t, $J = 7.1$ Hz, 2H), 7.07 (d, $J = 7.5$ Hz, 3H), 6.95 (d, $J = 7.4$ Hz, 1H), 6.85 (d, $J = 7.4$ Hz, 1H), 6.78–6.65 (m, 2H), 6.60 (d, $J = 7.9$ Hz, 2H), 5.48–5.37 (m, 1H), 4.32 (q, $J = 6.9$ Hz, 1H), 3.36–3.20 (m, 3H), 3.19–3.07 (m, 1H), 2.34 (s, 3H), 2.18 (s, 3H), 2.06–1.85 (m, 2H), 1.05 (t, $J = 6.9$ Hz, 3H); $^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 147.7, 142.9, 140.3, 138.1, 137.6, 129.3, 129.2, 128.5, 128.2, 127.3, 127.1, 123.5, 116.9, 113.7, 57.0, 47.3, 46.0, 34.5, 21.4, 21.2, 11.9; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{31}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 423.2106, Found: 423.2105.

***N*-(1-(2-bromophenyl)-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4i)**



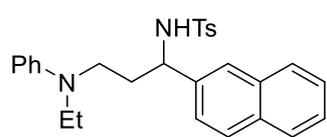
Brown oil, 90.0 mg, 92% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.54 (d, $J = 8.3$ Hz, 2H), 7.36 (dd, $J = 7.9, 1.0$ Hz, 1H), 7.23–7.14 (m, 3H), 7.13–7.02 (m, 3H), 6.99 (td, $J = 7.9, 1.7$ Hz, 1H), 6.73 (t, $J = 7.3$ Hz, 1H), 6.66 (d, $J = 8.0$ Hz, 2H), 6.19 (d, $J = 7.6$ Hz, 1H), 4.81 (dd, $J = 13.3, 7.8$ Hz, 1H), 3.39–3.24 (m, 3H), 3.24–3.13 (m, 1H), 2.32 (s, 3H), 2.01–1.81 (m, 2H), 1.05 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.5, 143.1, 139.7, 136.9, 132.9, 129.24, 129.23, 128.6, 128.2, 127.5, 127.0, 122.2, 117.3, 114.1, 56.4, 47.3, 46.3, 33.5, 21.4, 11.8; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{28}\text{BrN}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 487.1055, Found: 487.1056.

***N*-(3-(ethyl(phenyl)amino)-1-(*o*-tolyl)propyl)-4-methylbenzenesulfonamide (4j)**



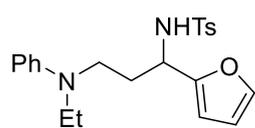
Brown oil, 62.5 mg, 74% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.47 (d, $J = 7.3$ Hz, 2H), 7.17 (t, $J = 7.2$ Hz, 2H), 7.07–6.92 (m, 6H), 6.69 (t, $J = 7.2$ Hz, 1H), 6.59 (d, $J = 8.0$ Hz, 2H), 5.69–5.54 (m, 1H), 4.67 (q, $J = 7.0$ Hz, 1H), 3.38–3.24 (m, 3H), 3.22–3.09 (m, 1H), 2.32 (s, 3H), 2.15 (s, 3H), 1.98–1.85 (m, 2H), 1.05 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.6, 142.9, 138.7, 137.4, 134.6, 130.4, 129.19, 129.16, 127.1, 126.8, 126.3, 125.5, 116.8, 113.5, 52.6, 47.2, 46.0, 34.4, 21.4, 19.0, 11.9; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{31}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 423.2106, Found: 423.2103.

***N*-(3-(ethyl(phenyl)amino)-1-(naphthalen-2-yl)propyl)-4-methylbenzenesulfonamide (4k)**



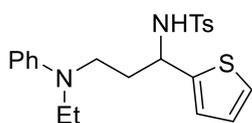
Brown oil, 67.4 mg, 81% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.79–7.71 (m, 1H), 7.63 (t, $J = 7.4$ Hz, 2H), 7.42 (dd, $J = 15.1, 6.9$ Hz, 5H), 7.18 (t, $J = 7.9$ Hz, 3H), 6.87 (d, $J = 7.8$ Hz, 2H), 6.71 (t, $J = 7.2$ Hz, 1H), 6.63 (d, $J = 8.1$ Hz, 2H), 5.82–5.68 (m, 1H), 4.55 (q, $J = 6.9$ Hz, 1H), 3.38–3.21 (m, 3H), 3.22–3.06 (m, 1H), 2.14 (s, 3H), 2.10–1.94 (m, 2H), 1.03 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.6, 142.9, 137.4, 137.3, 132.9, 132.7, 129.2, 129.1, 128.5, 127.8, 127.5, 127.0, 126.2, 126.0, 125.9, 123.9, 117.0, 113.8, 57.2, 47.3, 46.0, 34.3, 21.2, 11.9; ESI-HRMS calcd for $[\text{C}_{28}\text{H}_{31}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 459.2106, Found: 459.2108.

***N*-(3-(ethyl(phenyl)amino)-1-(furan-2-yl)propyl)-4-methylbenzenesulfonamide (4l)**



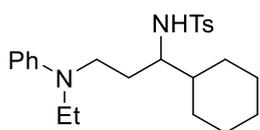
Brown oil, 23.1 mg, 29% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.55 (d, $J = 8.3$ Hz, 2H), 7.23–7.12 (m, 5H), 6.71 (t, $J = 7.3$ Hz, 1H), 6.63 (d, $J = 8.2$ Hz, 2H), 6.14 (dd, $J = 3.2, 1.9$ Hz, 1H), 5.95 (d, $J = 3.2$ Hz, 1H), 5.25 (d, $J = 5.8$ Hz, 1H), 4.48 (dd, $J = 15.3, 7.0$ Hz, 1H), 3.36–3.25 (m, 3H), 3.23–3.11 (m, 1H), 2.37 (s, 3H), 2.03–1.95 (m, 2H), 1.06 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 152.7, 147.6, 143.1, 142.0, 137.5, 129.4, 129.3, 127.0, 116.8, 113.4, 110.2, 107.2, 50.4, 46.9, 46.0, 32.1, 21.5, 12.0; ESI-HRMS calcd for $[\text{C}_{22}\text{H}_{27}\text{N}_2\text{O}_3\text{S}, \text{M} + \text{H}]^+$: 399.1742, Found: 399.1743.

***N*-(3-(ethyl(phenyl)amino)-1-(thiophen-2-yl)propyl)-4-methylbenzenesulfonamide (4m)**



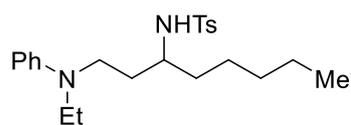
Brown oil, 44.8 mg, 54% yield, ^1H NMR (400 MHz, CDCl_3): δ : 7.54 (d, $J = 8.2$ Hz, 2H), 7.23–7.18 (m, 2H), 7.16–7.10 (m, 3H), 6.81 (dd, $J = 5.0, 3.6$ Hz, 1H), 6.76–6.70 (m, 2H), 6.66 (d, $J = 8.1$ Hz, 2H), 5.38 (d, $J = 7.5$ Hz, 1H), 4.69 (q, $J = 6.9$ Hz, 1H), 3.34–3.26 (m, 3H), 3.25–3.16 (m, 1H), 2.37 (s, 3H), 2.03 (q, $J = 6.9$ Hz, 2H), 1.05 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.6, 144.5, 143.2, 137.5, 129.4, 129.3, 127.0, 126.7, 125.1, 124.9, 117.1, 113.9, 52.5, 47.1, 46.2, 34.9, 21.5, 11.8; ESI-HRMS calcd for $[\text{C}_{22}\text{H}_{27}\text{N}_2\text{O}_2\text{S}_2, \text{M} + \text{H}]^+$: 415.1514, Found: 415.1508.

***N*-(1-cyclohexyl-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4n)**



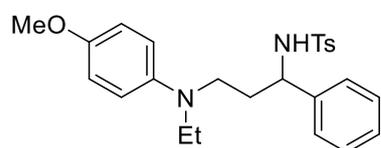
3s, yellow oil, 43.7 mg, 52% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.69 (d, $J = 8.0$ Hz, 2H), 7.23 (d, $J = 7.9$ Hz, 2H), 7.16 (t, $J = 7.9$ Hz, 2H), 6.66 (t, $J = 7.2$ Hz, 1H), 6.55 (d, $J = 8.1$ Hz, 2H), 4.63 (d, $J = 8.9$ Hz, 1H), 3.24–3.16 (m, 2H), 3.13–3.02 (m, 2H), 2.41 (s, 1H), 2.38 (s, 3H), 1.74–1.63 (m, 4H), 1.50 (d, $J = 12.2$ Hz, 2H), 1.38–1.27 (m, 2H), 1.09–1.05 (m, 2H), 1.01 (t, $J = 7.1$ Hz, 3H), 0.96–0.81 (m, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.6, 143.2, 138.5, 129.6, 129.3, 127.0, 116.3, 112.8, 57.6, 47.4, 45.6, 41.9, 29.1, 28.62, 28.59, 26.3, 26.2, 26.1, 21.5, 12.1; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{35}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 415.2419, Found: 415.2418.

***N*-(1-(ethyl(phenyl)amino)octan-3-yl)-4-methylbenzenesulfonamide (4o)**



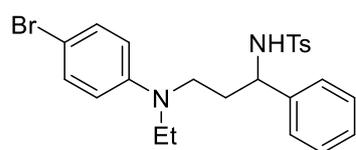
Brown oil, 36.3 mg, 45% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.73 (d, $J = 8.1$ Hz, 2H), 7.27 (s, 2H), 7.22 (t, $J = 7.9$ Hz, 2H), 6.71 (t, $J = 7.1$ Hz, 1H), 6.64 (d, $J = 8.2$ Hz, 2H), 4.64 (d, $J = 8.6$ Hz, 1H), 3.32–3.24 (m, 3H), 3.22–3.13 (m, 1H), 2.49–2.40 (m, 4H), 1.77–1.69 (m, 1H), 1.57–1.51 (m, 1H), 1.44–1.33 (m, 2H), 1.24–1.11 (m, 6H), 1.08 (t, $J = 7.0$ Hz, 3H), 0.84 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 147.7, 143.3, 138.2, 129.6, 129.3, 127.0, 116.4, 113.0, 52.9, 46.9, 45.6, 35.4, 32.3, 31.5, 25.0, 22.4, 21.5, 13.9, 12.0; ESI-HRMS calcd for $[\text{C}_{23}\text{H}_{35}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 403.2419, Found: 403.2418.

***N*-(3-(ethyl(4-methoxyphenyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4p)**



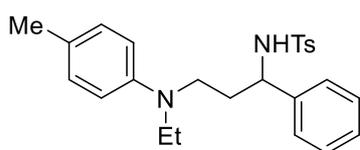
Brown oil, 49.0 mg, 55% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.44 (d, $J = 8.1$ Hz, 2H), 7.20–7.14 (m, 3H), 7.11–7.03 (m, 4H), 6.86–6.78 (m, 4H), 6.71 (d, $J = 3.8$ Hz, 1H), 4.41 (dd, $J = 12.1$, 6.0 Hz, 1H), 3.79 (s, 3H), 3.18–3.08 (m, 2H), 3.04 (t, $J = 6.2$ Hz, 2H), 2.34 (s, 3H), 1.90–1.72 (m, 2H), 0.97 (t, $J = 7.1$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 153.9, 142.7, 142.1, 140.9, 137.6, 129.2, 128.3, 127.2, 127.0, 126.5, 119.9, 114.6, 57.8, 55.6, 49.0, 48.8, 33.7, 21.4, 11.6; ESI-HRMS calcd for $[\text{C}_{25}\text{H}_{31}\text{N}_2\text{O}_3\text{S}, \text{M} + \text{H}]^+$: 439.2055, Found: 439.2057.

***N*-(3-((4-bromophenyl)(ethyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4q)**



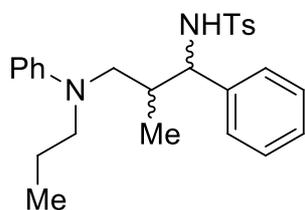
Brown oil, 78.0 mg, 80% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.49 (d, $J = 8.3$ Hz, 2H), 7.18–7.12 (m, 3H), 7.09–6.96 (m, 6H), 6.49–6.40 (m, 2H), 5.65 (d, $J = 7.7$ Hz, 1H), 4.34 (q, $J = 7.2$ Hz, 1H), 3.30–3.15 (m, 3H), 3.14–3.00 (m, 1H), 2.33 (s, 3H), 2.06–1.80 (m, 2H), 1.00 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 146.2, 143.1, 140.3, 137.5, 129.3, 129.0, 128.6, 127.7, 127.0, 126.4, 121.5, 114.5, 56.8, 47.3, 46.0, 34.5, 21.5, 11.8; ESI-HRMS calcd for $[\text{C}_{24}\text{H}_{28}\text{BrN}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 487.1055, Found: 487.1057.

***N*-(3-(ethyl(p-tolyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4r)**



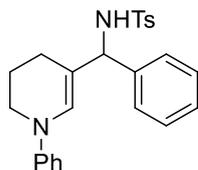
Brown oil, 64.4 mg, 76% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.46 (d, $J = 7.6$ Hz, 2H), 7.20–7.13 (m, 3H), 7.11–6.97 (m, 6H), 6.60 (d, $J = 8.5$ Hz, 2H), 6.03–5.89 (d, $J = 6.8$ Hz, 1H), 4.39 (q, $J = 6.8$ Hz, 1H), 3.30–3.12 (m, 3H), 3.12–3.02 (m, 1H), 2.34 (s, 3H), 2.26 (s, 3H), 1.97–1.81 (m, 2H), 1.00 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 145.6, 142.8, 140.6, 137.5, 129.8, 129.2, 128.4, 127.3, 127.2, 127.0, 126.5, 115.4, 57.3, 47.6, 46.9, 34.2, 21.4, 20.3, 11.7; ESI-HRMS calcd for $[\text{C}_{25}\text{H}_{31}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 423.2106, Found: 423.2104.

4-methyl-N-(2-methyl-1-phenyl-3-(phenylpropyl)amino)propylbenzenesulfonamide (4s)



Yellow oil, 41.8 mg, 48% yield, 1.1:1 dr. [for less polar diastereomer (minor)] ^1H NMR (400 MHz, CDCl_3): δ 7.34 (d, $J = 7.2$ Hz, 2H), 7.29–7.27 (m, 1H), 7.25–7.20 (m, 1H), 7.13–7.04 (m, 3H), 6.99 (d, $J = 7.6$ Hz, 2H), 6.93 (d, $J = 7.3$ Hz, 2H), 6.86–6.77 (m, 3H), 6.66 (d, $J = 3.7$ Hz, 1H), 4.17–4.05 (m, 1H), 3.36–3.21 (m, 3H), 3.17–3.07 (m, 1H), 2.30 (s, 3H), 2.15–2.07 (m, 1H), 1.54–1.46 (m, 2H), 0.88 (t, $J = 7.1$ Hz, 3H), 0.65 (d, $J = 6.7$ Hz, 3H); ^{13}C NMR (101 MHz, CDCl_3): δ 148.4, 142.6, 139.7, 137.7, 129.3, 129.0, 128.1, 127.4, 127.3, 127.1, 118.9, 116.5, 64.3, 57.3, 56.1, 36.3, 21.4, 19.2, 15.8, 11.6; ESI-HRMS calcd for $[\text{C}_{26}\text{H}_{33}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 437.2263, Found: 437.2260. [for more polar diastereomer (major)] ^1H NMR (400 MHz, CDCl_3): δ 7.43 (d, $J = 8.1$ Hz, 2H), 7.21–7.17 (m, 2H), 7.12–7.09 (m, 3H), 7.01 (d, $J = 8.4$ Hz, 2H), 6.94–6.89 (m, 2H), 6.72 (t, $J = 6.9$ Hz, 1H), 6.62 (d, $J = 8.6$ Hz, 2H), 5.55 (d, $J = 9.1$ Hz, 1H), 4.39 (dd, $J = 9.0, 5.0$ Hz, 1H), 3.29–3.23 (m, 2H), 3.18–3.10 (m, 1H), 3.02–2.94 (m, 1H), 2.30 (s, 3H), 2.24–2.16 (m, 1H), 1.48 (dd, $J = 14.8, 7.3$ Hz, 2H), 0.87–0.83 (m, 6H); ^{13}C NMR (101 MHz, CDCl_3): δ 148.1, 142.8, 139.3, 137.6, 129.2, 128.1, 127.0, 127.0, 126.8, 117.2, 114.4, 60.6, 55.3, 54.6, 37.5, 21.4, 19.4, 13.7, 11.5; ESI-HRMS calcd for $[\text{C}_{26}\text{H}_{33}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 437.2263, Found: 437.2260.

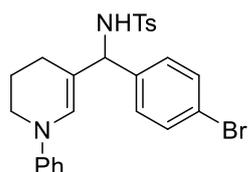
4-methyl-N-(phenyl(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)benzenesulfonamide (6a)



Yellow solid, mp: 143–144 °C, 66.5 mg, 79% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.72 (d, $J = 8.2$ Hz, 2H), 7.30–7.22 (m, 7H), 7.16 (d, $J = 8.1$ Hz, 2H), 6.88 (t, $J = 7.3$ Hz, 1H), 6.75 (d, $J = 8.0$ Hz, 2H), 6.38 (s, 1H), 5.26 (dd, $J = 13.1, 7.2$ Hz, 1H), 5.01 (d, $J = 7.3$ Hz, 1H), 3.38–3.27 (m, 1H), 3.25–3.14 (m, 1H), 2.34 (s, 3H), 1.84–1.73

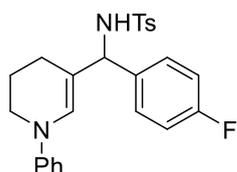
(m, 3H), 1.70–1.58 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ 146.3, 143.1, 139.7, 137.7, 129.2, 129.1, 129.0, 128.3, 127.4, 127.2, 126.7, 119.7, 114.8, 109.4, 62.3, 44.8, 21.7, 21.4, 21.0; ESI-HRMS calcd for $[\text{C}_{25}\text{H}_{27}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 419.1793, Found: 419.1788.

***N*-((4-bromophenyl)(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)-4-methylbenzenesulfonamide (6b)**



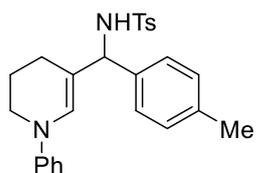
Yellow oil, 82.6 mg, 83% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.66 (d, J = 8.1 Hz, 2H), 7.35 (d, J = 8.4 Hz, 2H), 7.26–7.21 (m, 2H), 7.13 (dd, J = 13.5, 8.3 Hz, 4H), 6.87 (t, J = 7.3 Hz, 1H), 6.72 (d, J = 7.9 Hz, 2H), 6.31 (s, 1H), 5.33–5.17 (m, 1H), 4.92 (d, J = 7.3 Hz, 1H), 3.35–3.25 (m, 1H), 3.24–3.15 (m, 1H), 2.33 (s, 3H), 1.83–1.71 (m, 3H), 1.71–1.63 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ 146.2, 143.3, 138.8, 137.5, 131.4, 129.31, 129.29, 129.2, 128.6, 127.4, 121.1, 119.9, 115.0, 108.8, 61.9, 44.8, 21.7, 21.4, 21.0; ESI-HRMS calcd for $[\text{C}_{25}\text{H}_{24}\text{BrN}_2\text{O}_2\text{S}, \text{M} - \text{H}]^+$: 495.0742, Found: 495.0745.

***N*-((4-fluorophenyl)(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)-4-methylbenzenesulfonamide (6c)**



Yellow solid, mp: 148–150 °C, 70.5 mg, 81% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.68 (d, J = 7.6 Hz, 2H), 7.25–7.17 (m, 4H), 7.15 (d, J = 7.7 Hz, 2H), 6.92 (t, J = 8.3 Hz, 2H), 6.86 (t, J = 7.3 Hz, 1H), 6.72 (d, J = 7.8 Hz, 2H), 6.31 (s, 1H), 5.25 (d, J = 7.0 Hz, 1H), 4.95 (d, J = 7.2 Hz, 1H), 3.35–3.26 (m, 1H), 3.24–3.14 (m, 1H), 2.32 (s, 3H), 1.83–1.71 (m, 3H), 1.70–1.65 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ 161.9 (d, J_{CF} = 246.4 Hz), 146.2, 143.2, 137.6, 135.5 (d, J_{CF} = 3.0 Hz), 129.3, 129.19, 129.15, 128.5 (d, J_{CF} = 8.1 Hz), 127.4, 119.8, 115.1 (d, J_{CF} = 21.2 Hz), 114.9, 109.2, 61.7, 44.8, 21.7, 21.4, 21.0; ESI-HRMS calcd for $[\text{C}_{25}\text{H}_{26}\text{FN}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 437.1699, Found: 437.1689.

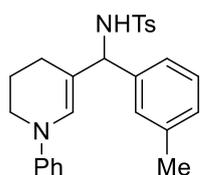
4-methyl-*N*-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(p-tolyl)methyl)benzenesulfonamide (6d)



Yellow oil, 68.0 mg, 79% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.68 (d, $J = 8.1$ Hz, 2H), 7.23 (d, $J = 7.6$ Hz, 2H), 7.15–7.09 (m, 4H), 7.07–7.03 (d, $J = 8.0$ Hz, 2H), 6.85 (t, $J = 7.3$ Hz, 1H), 6.73 (d, $J = 8.4$ Hz, 2H), 6.38 (s, 1H), 4.99 (t, $J = 7.2$ Hz, 1H), 4.93 (d, $J = 6.9$ Hz, 1H), 3.33–3.24 (m, 1H), 3.22–3.13 (m, 1H), 2.32 (s, 3H), 2.30 (s, 3H), 1.80–1.69 (m, 3H), 1.66–1.60 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ 146.4, 143.0, 137.8, 136.9, 136.7, 129.2, 129.1, 129.0, 128.9, 127.4, 126.7, 119.6, 114.9, 109.6, 62.1, 44.8, 26.9, 21.8, 21.4, 21.0; ESI-HRMS calcd for $[\text{C}_{26}\text{H}_{27}\text{N}_2\text{O}_2\text{S}, \text{M} - \text{H}]^+$: 431.1793, Found: 431.1796.

4-methyl-N-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(m-tolyl)methyl)benzenesulfonamide

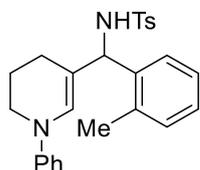
(6e)



Yellow oil, 61.0 mg, 73% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.68 (d, $J = 8.2$ Hz, 2H), 7.25–7.21 (m, 2H), 7.15–7.09 (m, 3H), 7.04–6.96 (m, 3H), 6.85 (t, $J = 7.3$ Hz, 1H), 6.73 (d, $J = 8.0$ Hz, 2H), 6.38 (s, 1H), 5.32–5.15 (m, 1H), 4.94 (d, $J = 7.2$ Hz, 1H), 3.34–3.24 (m, 1H), 3.22–3.11 (m, 1H), 2.31 (s, 3H), 2.24 (s, 3H), 1.83–1.70 (m, 3H), 1.67–1.55 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ 146.3, 143.0, 139.6, 137.9, 137.8, 129.2, 129.1, 128.8, 128.2, 127.9, 127.44, 127.41, 123.8, 119.6, 114.8, 109.6, 62.3, 44.7, 21.7, 21.4, 21.3, 21.0; ESI-HRMS calcd for $[\text{C}_{26}\text{H}_{29}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 433.1950, Found: 433.1939.

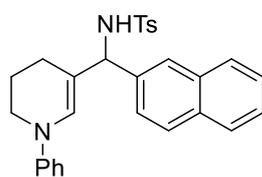
4-methyl-N-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(o-tolyl)methyl)benzenesulfonamide

(6f)



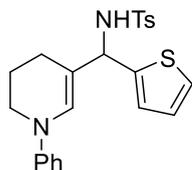
Yellow solid, mp: 134–136 °C, 57.0 mg, 66% yield, ^1H NMR (400 MHz, CDCl_3): δ 7.63 (d, $J = 8.2$ Hz, 2H), 7.23–7.18 (m, 2H), 7.17–7.02 (m, 6H), 6.83 (t, $J = 7.3$ Hz, 1H), 6.65 (d, $J = 7.9$ Hz, 2H), 6.22 (s, 1H), 5.16 (d, $J = 6.3$ Hz, 1H), 4.97–4.84 (m, 1H), 3.36–3.24 (m, 2H), 2.33 (s, 3H), 2.26 (s, 3H), 1.96–1.77 (m, 3H), 1.74–1.64 (m, 1H); ^{13}C NMR (101 MHz, CDCl_3): δ 146.4, 143.0, 137.8, 137.4, 135.4, 130.6, 129.3, 129.18, 129.15, 127.3, 127.1, 126.2, 125.8, 119.7, 115.0, 109.1, 58.8, 45.0, 22.3, 22.0, 21.5, 19.3; ESI-HRMS calcd for $[\text{C}_{26}\text{H}_{29}\text{N}_2\text{O}_2\text{S}, \text{M} + \text{H}]^+$: 433.1950, Found: 433.1941.

4-methyl-*N*-(naphthalen-2-yl(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)benzenesulfonamide (6g)



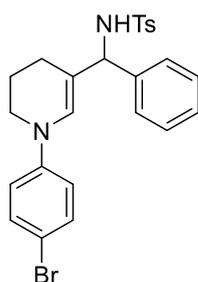
Yellow solid, mp: 152–154 °C, 76.5 mg, 81% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.82–7.75 (m, 1H), 7.74–7.66 (m, 4H), 7.63 (s, 1H), 7.48–7.41 (m, 2H), 7.32 (dd, *J* = 8.5, 1.6 Hz, 1H), 7.26–7.20 (m, 2H), 7.07 (d, *J* = 8.1 Hz, 2H), 6.86 (t, *J* = 7.3 Hz, 1H), 6.75 (d, *J* = 8.0 Hz, 2H), 6.45 (s, 1H), 5.26–5.18 (m, 1H), 5.14 (d, *J* = 7.2 Hz, 1H), 3.38–3.27 (m, 1H), 3.25–3.15 (m, 1H), 2.24 (s, 3H), 1.84–1.73 (m, 3H), 1.72–1.61 (m, 1H); ¹³C NMR (101 MHz, CDCl₃): δ 146.3, 143.1, 137.7, 136.9, 133.0, 132.6, 129.6, 129.16, 129.13, 128.1, 127.9, 127.5, 127.4, 126.1, 125.9, 125.5, 124.9, 119.8, 114.9, 109.5, 62.5, 44.8, 21.8, 21.3, 21.2; ESI-HRMS calcd for [C₂₉H₂₇N₂O₂S, M – H]⁺: 467.1793, Found: 467.1796.

4-methyl-*N*-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(thiophen-2-yl)methyl)benzenesulfonamide (6h)



Yellow oil, 43.3 mg, 51% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.72 (d, *J* = 8.2 Hz, 2H), 7.29–7.26 (m, 2H), 7.19–7.15 (m, 3H), 6.91–6.86 (m, 3H), 6.80–6.76 (m, 2H), 6.48 (s, 1H), 5.23 (d, *J* = 7.6 Hz, 1H), 5.06 (brs, 1H), 3.39–3.30 (m, 1H), 3.19–3.10 (m, 1H), 2.33 (s, 3H), 1.95–1.87 (m, 1H), 1.83–1.75 (m, 1H), 1.74–1.64 (m, 2H); ¹³C NMR (101 MHz, CDCl₃): δ 146.3, 144.9, 143.3, 137.8, 129.4, 129.3, 129.2, 127.5, 126.9, 125.0, 124.9, 120.0, 115.1, 108.9, 58.9, 44.9, 21.7, 21.5, 20.6; ESI-HRMS calcd for [C₂₃H₂₅N₂O₂S₂, M + H]⁺: 425.1357, Found: 425.1359.

***N*-((1-(4-bromophenyl)-1,4,5,6-tetrahydropyridin-3-yl)(phenyl)methyl)-4-methylbenzenesulfonamide (6i)**

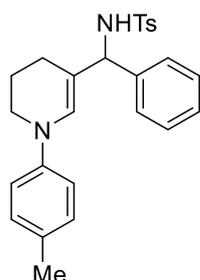


Yellow solid, mp: 155–156 °C, 93.3 mg, 93% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.68 (d, *J* = 6.6 Hz, 2H), 7.34–7.28 (m, 2H), 7.26–7.17 (m, 5H), 7.13 (d, *J* = 7.0 Hz, 2H), 6.64–6.55 (m, 2H), 6.31 (s, 1H), 5.27 (d, *J* = 7.0 Hz, 1H), 4.97 (d, *J* = 6.8 Hz, 1H), 3.31–3.20 (m, 1H), 3.20–3.08 (m, 1H), 2.32 (s, 3H), 1.82–1.71 (m, 3H), 1.69–1.58 (m, 1H); ¹³C NMR (101 MHz, CDCl₃): δ 145.3, 143.1, 139.5, 137.7, 131.9, 129.3, 128.4, 128.2, 127.4, 127.3, 126.7, 116.3, 111.7, 110.7, 62.2, 44.8,

21.7, 21.4, 21.1; ESI-HRMS calcd for [C₂₅H₂₆BrN₂O₂S, M – H]⁺: 497.0898, Found: 497.0898.

4-methyl-*N*-(phenyl(1-(*p*-tolyl)-1,4,5,6-tetrahydropyridin-3-yl)methyl)benzenesulfonamide

(6j)

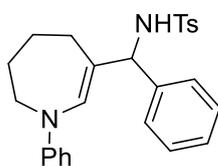


Brown oil, 58.8 mg, 68% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.69 (d, *J* = 8.1 Hz, 2H), 7.25–7.18 (m, 5H), 7.14 (d, *J* = 8.1 Hz, 2H), 7.05 (d, *J* = 8.3 Hz, 2H), 6.64 (d, *J* = 8.5 Hz, 2H), 6.32 (s, 1H), 5.09 (s, 1H), 4.98 (d, *J* = 7.1 Hz, 1H), 3.33–3.23 (m, 1H), 3.22–3.13 (m, 1H), 2.33 (s, 3H), 2.28 (s, 3H), 1.81–1.70 (m, 3H), 1.64–1.60 (m, 1H); ¹³C NMR (101 MHz, CDCl₃): δ 144.4, 143.0, 139.9,

137.9, 129.7, 129.6, 129.3, 129.2, 128.3, 127.5, 127.2, 126.8, 115.2, 108.8, 62.5, 45.1, 21.8, 21.4, 21.1, 20.4; ESI-HRMS calcd for [C₂₆H₂₉N₂O₂S, M + H]⁺: 433.1950, Found: 433.1948.

4-methyl-*N*-(phenyl(1-phenyl-4,5,6,7-tetrahydro-1H-azepin-3-yl)methyl)benzenesulfonamide

(6k)

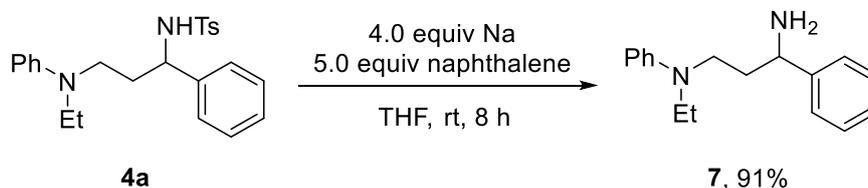


Yellow oil, 60.6 mg, 70% yield, ¹H NMR (400 MHz, CDCl₃): δ 7.73 (d, *J* = 8.2 Hz, 2H), 7.29–7.20 (m, 9H), 6.81 (t, *J* = 7.3 Hz, 1H), 6.69 (d, *J* = 8.1 Hz, 2H), 6.21 (s, 1H), 5.11–5.02 (m, 1H), 4.99 (d, *J* = 7.2 Hz, 1H), 3.60–3.45 (m, 2H), 2.37 (s, 3H), 1.94 (t, *J* = 5.7 Hz, 2H), 1.70–1.64 (m, 2H), 1.48–1.37 (m,

2H); ¹³C NMR (101 MHz, CDCl₃): δ 146.1, 143.3, 139.9, 137.7, 133.6, 129.5, 129.2, 128.5, 127.4, 127.3, 126.7, 122.5, 118.8, 113.9, 62.9, 48.0, 27.3, 26.7, 23.9, 21.5; ESI-HRMS calcd for [C₂₆H₂₉N₂O₂S, M + H]⁺: 433.1950, Found: 433.1948.

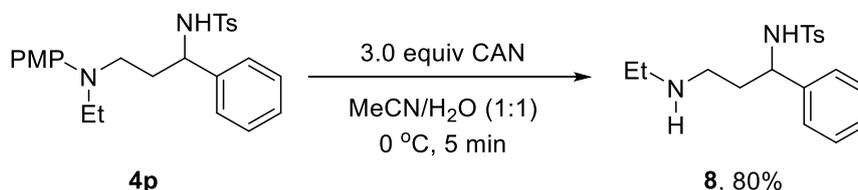
5. Transformations of the products

*N*¹-ethyl-*N*¹,3-diphenylpropane-1,3-diamine (**7**)



Sodium metal (22.3 mg, 0.97 mmol) and dry degassed THF (2 mL) was added into an oven-dried 25 mL Schlenk tube under argon atmosphere. Then a solution of naphthalene in dry THF (0.5 mL) was added. After the mixture was stirred for approximately 1 hour at room temperature, formation of the naphthalene anion radical was indicated by the intense green color observed. At this time, a solution of *N*-(3-(ethyl(phenyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (**4a**, 99.4 mg, 0.24 mmol) in dry THF (0.5 mL) was added and the mixture was stirred for another 8 hours at room temperature. The mixture was quenched by addition of a small amount of water and dried over anhydrous Na₂SO₄. After removal of solvent under reduced pressure, the crude product was purified by column chromatography on silica gel (CH₂Cl₂/MeOH = 20:1) to give **7** as light yellow oil, 56.0 mg, 91% yield. ¹H NMR (400 MHz, CDCl₃): δ 7.38–7.29 (m, 4H), 7.30–7.23 (m, 1H), 7.21–7.13 (m, 2H), 6.66–6.57 (m, 3H), 3.95 (t, *J* = 6.9 Hz, 1H), 3.38–3.25 (m, 3H), 3.24–3.13 (m, 1H), 2.15 (brs, 2H), 2.02–1.92 (m, 2H), 1.09 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (101 MHz, CDCl₃): δ 147.8, 145.6, 129.2, 128.6, 127.3, 126.2, 115.6, 112.1, 54.5, 47.5, 44.9, 36.3, 12.2; ESI-HRMS calcd for [C₁₇H₂₃N₂, M + H]⁺: 255.1861, Found: 255.1856.

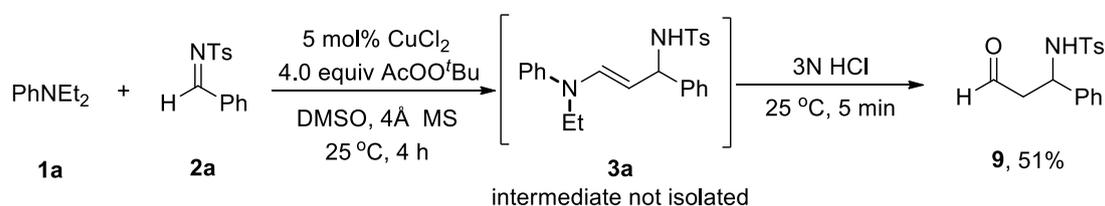
N-(3-(ethylamino)-1-phenylpropyl)-4-methylbenzenesulfonamide (**8**)



To *N*-(3-(ethyl(4-methoxyphenyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide **4p** (46.3 mg, 0.11 mmol) in acetonitrile/water (1:1, 2 mL) at 0 °C was added a solution of ceric ammonium nitrate (179 mg, 0.33 mmol) in acetonitrile/water (1:1, 2 mL) and the mixture was stirred at 0 °C for 5 min. After completion of the reaction, the mixture was diluted with water (10 mL) and ethyl acetate (10 mL). The aqueous phase was extracted with ethyl acetate (3 × 10 mL), diluted with

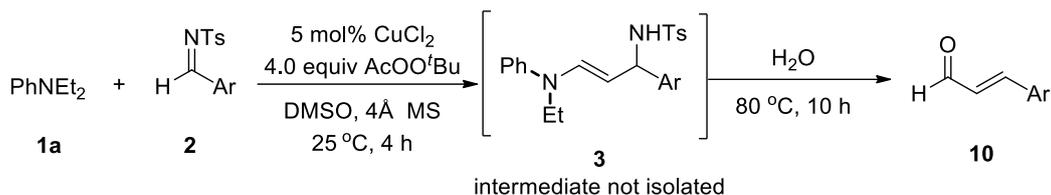
saturated sodium bicarbonate solution (10 mL) and further extracted with ethyl acetate (2 × 10 mL). The combined organic phase was dried over anhydrous MgSO₄, concentrated under reduced pressure and the residue was purified by column chromatography on silica gel (CH₂Cl₂/MeOH = 10:1) to give **8** as brown oil, 27.8 mg, 80% yield. ¹H NMR (400 MHz, CDCl₃): δ 7.43 (d, *J* = 8.2 Hz, 2H), 7.09–6.98 (m, 5H), 6.95 (d, *J* = 8.2 Hz, 2H), 6.79 (brs, 2H), 4.49–4.38 (m, 1H), 3.23–3.11 (m, 1H), 3.04–2.88 (m, 3H), 2.46–2.33 (m, 1H), 2.30–2.18 (m, 4H), 1.28 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (101 MHz, CDCl₃): δ 142.7, 139.3, 137.4, 129.1, 128.4, 127.4, 126.9, 126.5, 56.6, 45.2, 43.5, 33.5, 21.3, 11.3; ESI-HRMS calcd for [C₁₈H₂₅N₂O₂S, M + H]⁺: 333.1637, Found: 333.1636.

N-(1-(4-chlorophenyl)-3-oxopropyl)-4-methylbenzenesulfonamide (**9**)



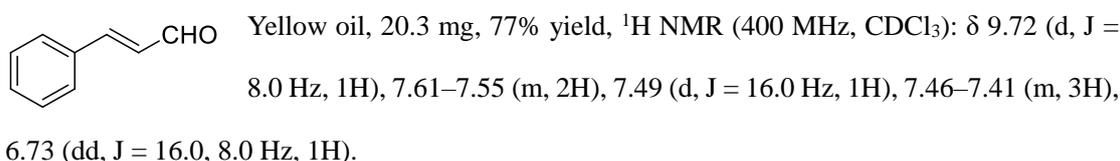
CuCl₂ (1.4 mg, 0.01 mmol, 5 mol%), *N*-benzylidene-4-methylbenzenesulfonamide (**2a**) (51.9 mg, 0.2 mmol) and 4Å MS (50 mg) were introduced into an oven-dried 25 mL Schlenk tube under argon atmosphere. PhNEt₂ (**1a**) (255 μL, 1.6 mmol), DMSO (2 mL) and 50% AcOO^tBu (212 mg, 0.8 mmol) were successively added via syringes at room temperature, and the reaction mixture was stirred at 25 °C for 4 h. CH₂Cl₂ (1 mL) and 3N HCl (~ 0.5 mL) were added and the mixture was stirred for about 5 min at 25 °C. The mixture was diluted with water (3 mL) and CH₂Cl₂ (3 mL), and the aqueous phase was separated and extracted with CH₂Cl₂ (2 × 5 mL). The combined organic phase was dried over anhydrous Na₂SO₄, concentrated under reduced pressure and the residue was purified by column chromatography on silica gel (PE/EA = 3:1 to 2:1) to give **9** as brown oil, 37.8 mg, 56% yield. ¹H NMR (400 MHz, CDCl₃): δ 9.63 (s, 1H), 7.61–7.54 (m, 2H), 7.20–7.13 (m, 5H), 7.09–7.02 (m, 2H), 5.45 (brs, 1H), 4.80 (q, *J* = 7.0 Hz, 1H), 3.06–2.97 (m, 1H), 2.94–2.83 (m, 1H), 2.37 (s, 3H).

Typical procedure for producing E- α,β -unsaturated aldehydes (**10**)

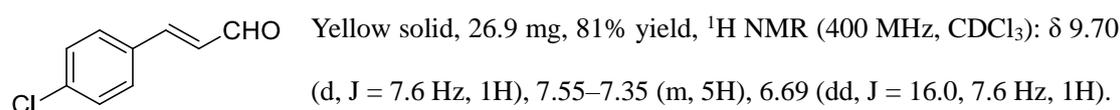


CuCl₂ (1.4 mg, 0.01 mmol, 5 mol%), *N*-benzylidene-4-methylbenzenesulfonamide (**2a**) (51.9 mg, 0.2 mmol) and 4Å MS (50 mg) were introduced into an oven-dried 25 mL Schlenk tube under argon atmosphere. PhNEt₂ (**1a**) (255 μ L, 1.6 mmol), DMSO (2 mL) and 50% AcOO^tBu (212 mg, 0.8 mmol) were successively added via syringes at room temperature, and the reaction mixture was stirred at 25 °C for 4 h. Then 3 mL water was added into the mixture and the mixture was stirred at 80 °C for about 10 hours. After completion of the reaction, the mixture was cooled to room temperature and extracted with CH₂Cl₂ (3 \times 5 mL). The combined organic phase was dried over anhydrous Na₂SO₄, concentrated under reduced pressure and the residue was purified by column chromatography on silica gel (PE/EA = 20:1) to give **10**.

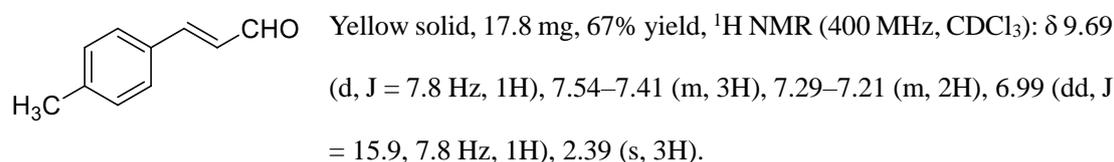
Cinnamaldehyde (**10a**)



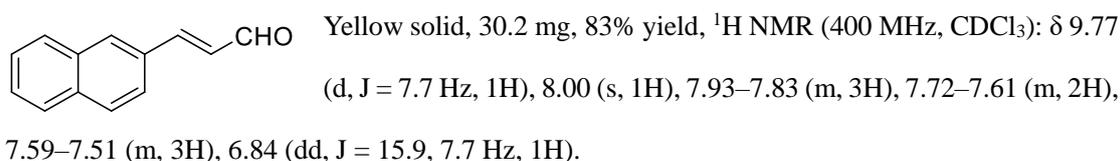
(*E*)-3-(4-chlorophenyl)acrylaldehyde (**10b**)



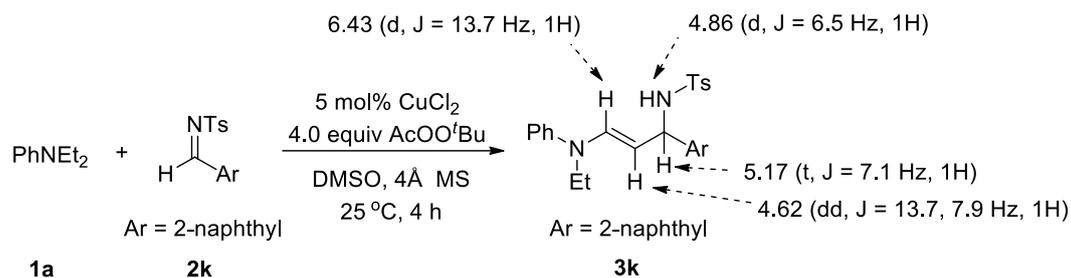
(*E*)-3-(*p*-tolyl)acrylaldehyde (**10c**)



(*E*)-3-(naphthalen-2-yl)acrylaldehyde (**10d**)



6. The ^1H NMR Spectra Evidence of the Enamine Intermediates



CuCl_2 (1.4 mg, 0.01 mmol), 4-methyl-*N*-(naphthalen-2-ylmethylene)benzenesulfonamide (**2k**) (61.9 mg, 0.2 mmol) and 4Å MS (50 mg) were introduced into an oven-dried 25 mL Schlenk tube under argon atmosphere. PhNEt_2 (**1a**) (225 μL , 1.6 mmol), DMSO (2 mL) and 50% AcOO^tBu (212 mg, 0.8 mmol) were successively added via syringes at room temperature. A little amount of the mixture was taken out intermediately via syringe and monitored by ^1H NMR in CDCl_3 (Figure S1, a). After stirring at 25 $^\circ\text{C}$ under argon atmosphere for 4 hours, a little amount of the mixture was taken out again via syringe and monitored by ^1H NMR in CDCl_3 (Figure S1, b). Then the reaction mixture was stirred in air for another 10 hours. A little amount of the mixture was taken out at this time and monitored by ^1H NMR in CDCl_3 (Figure S1, c).

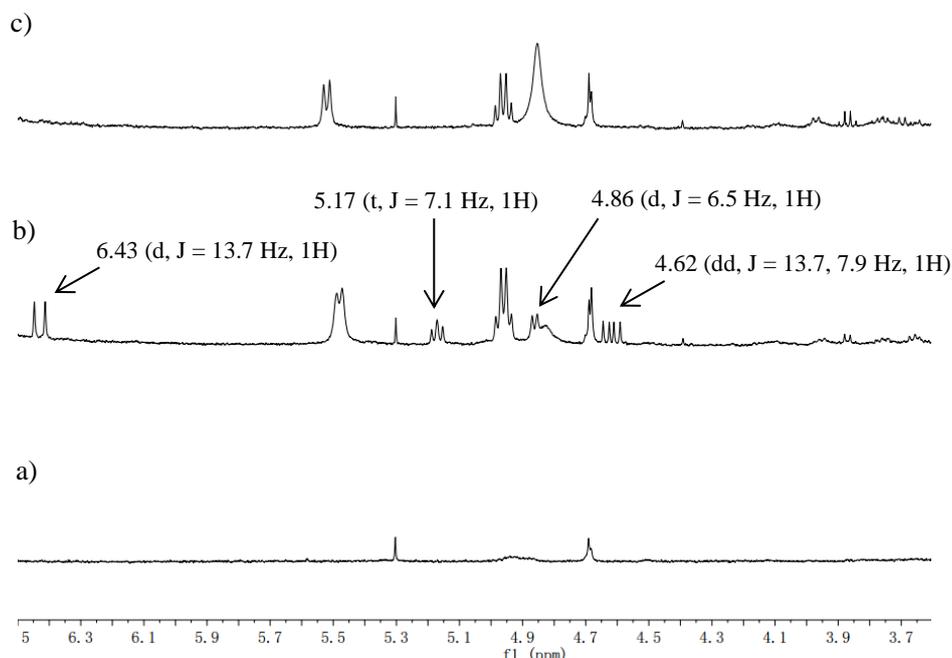
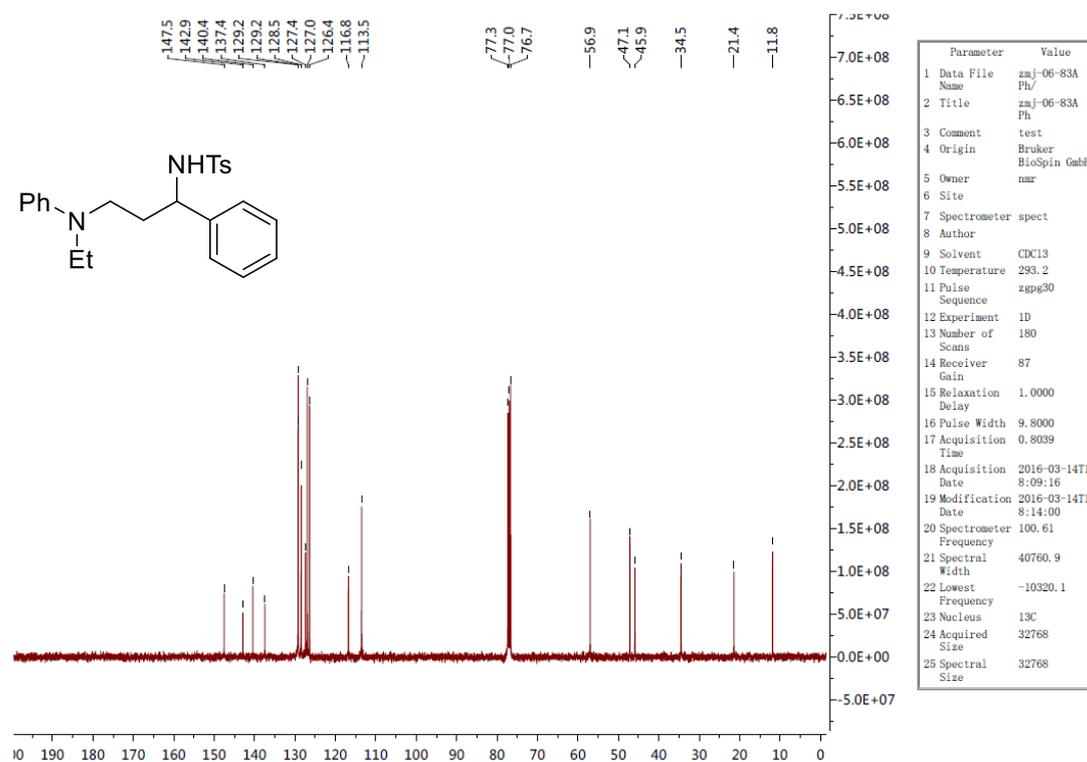
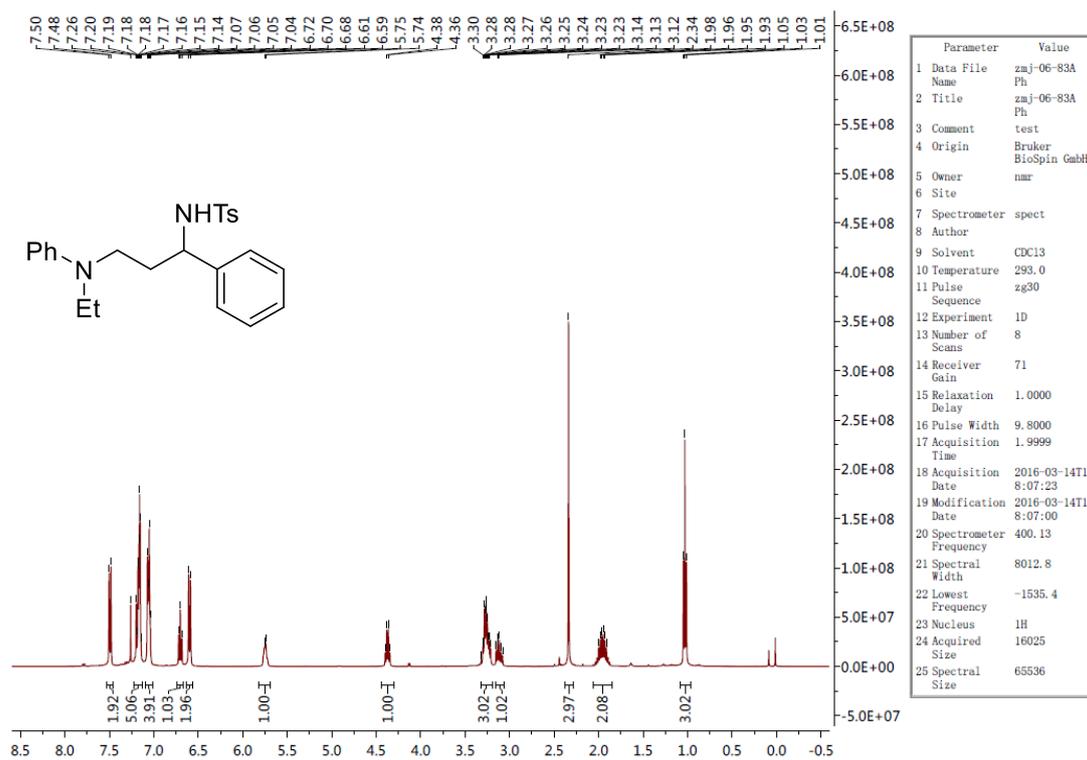


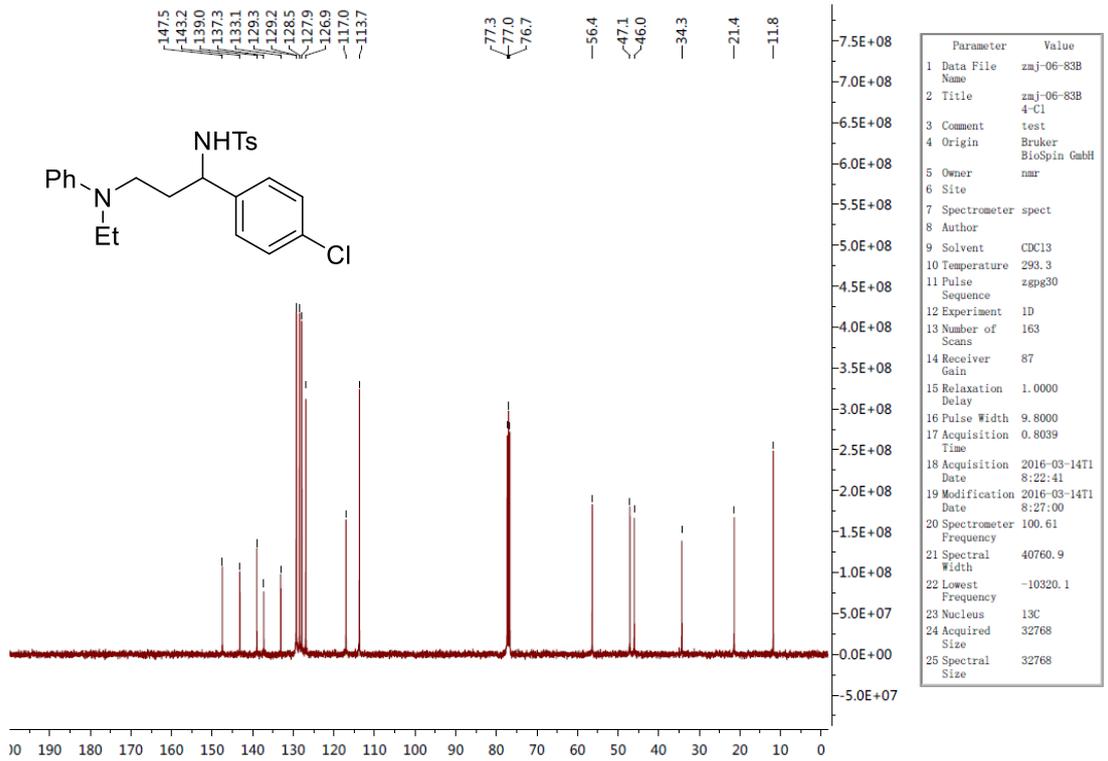
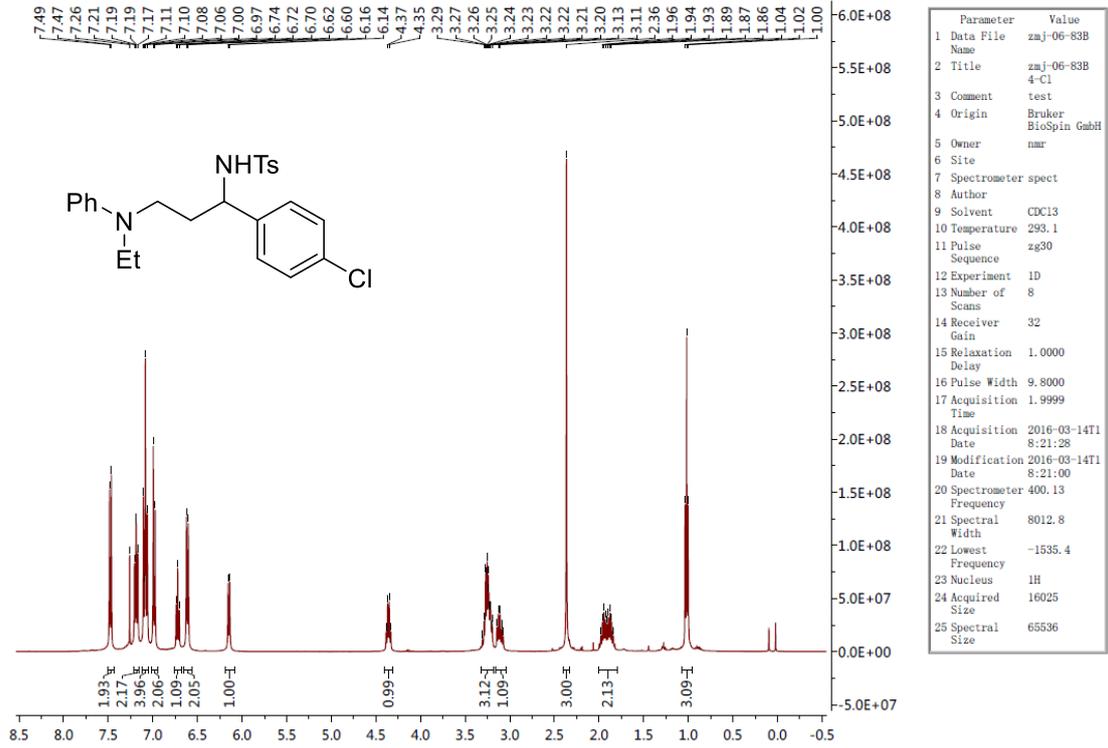
Figure S1. The ^1H NMR spectra evidence of the enamine intermediates. a) after 0 hour; b) after 4 hours, signals of enamine intermediate **4k** can be observed; c) after 14 hours, signals of enamine intermediate **4k** were disappeared due to hydrolysis in air.

8. NMR Spectra of Products

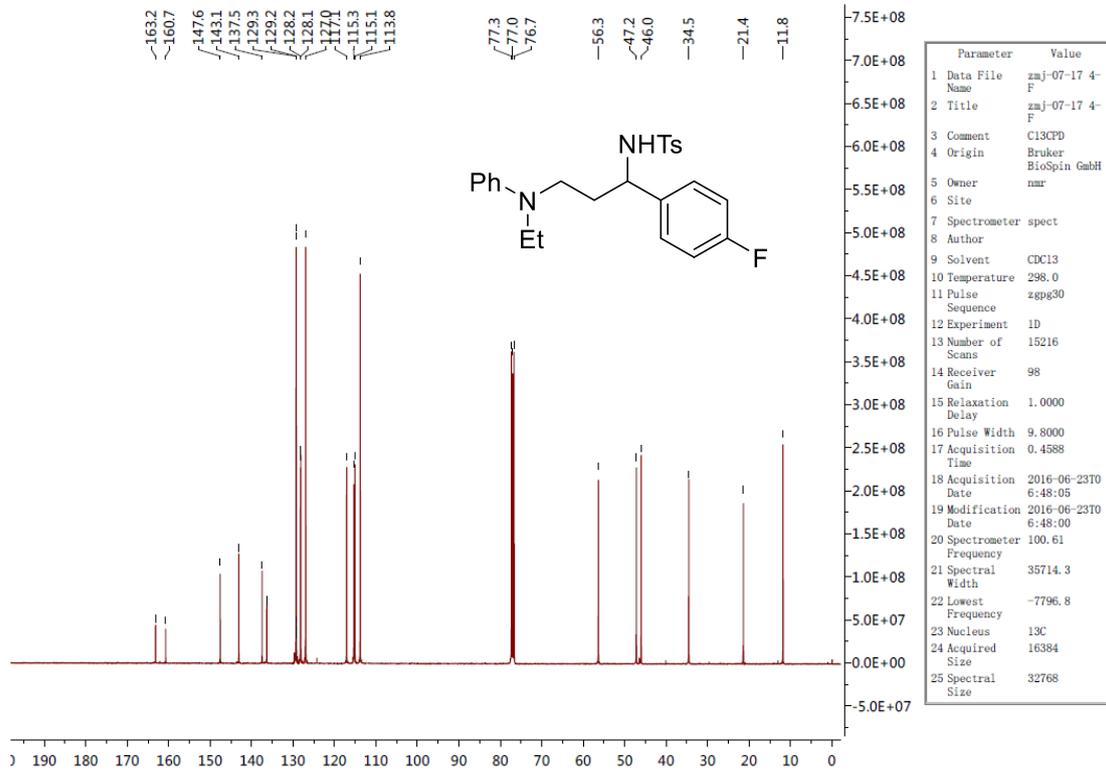
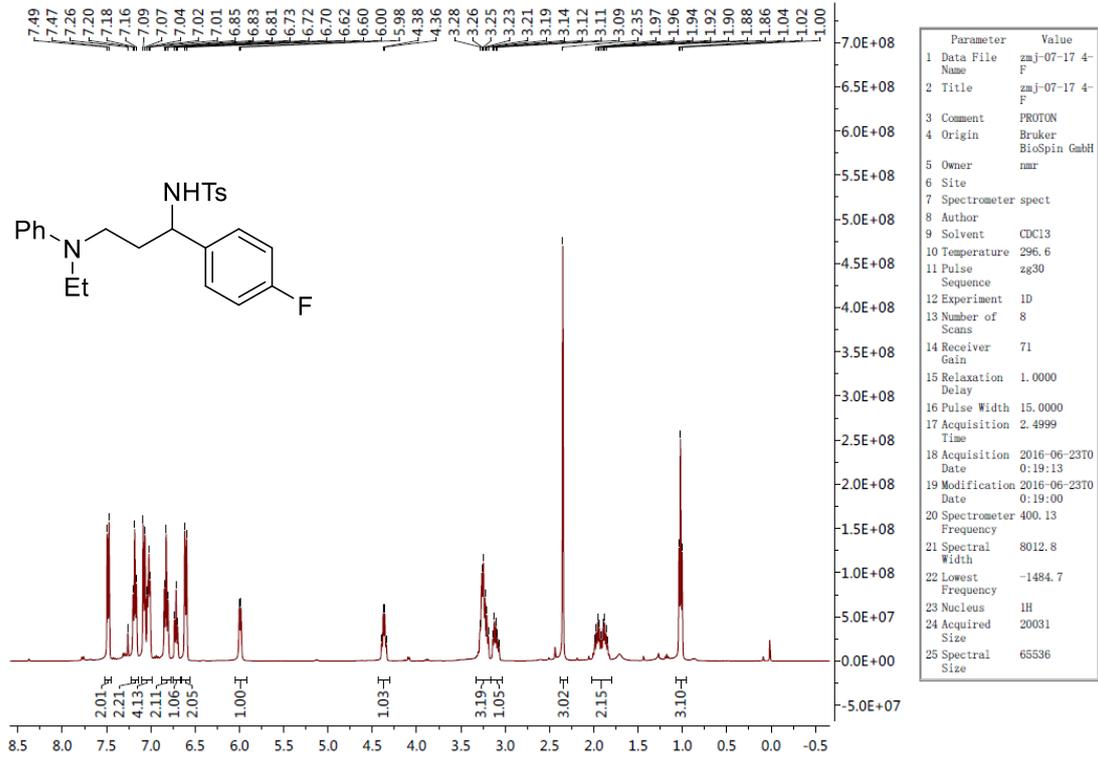
N-(3-(ethyl(phenyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4a)



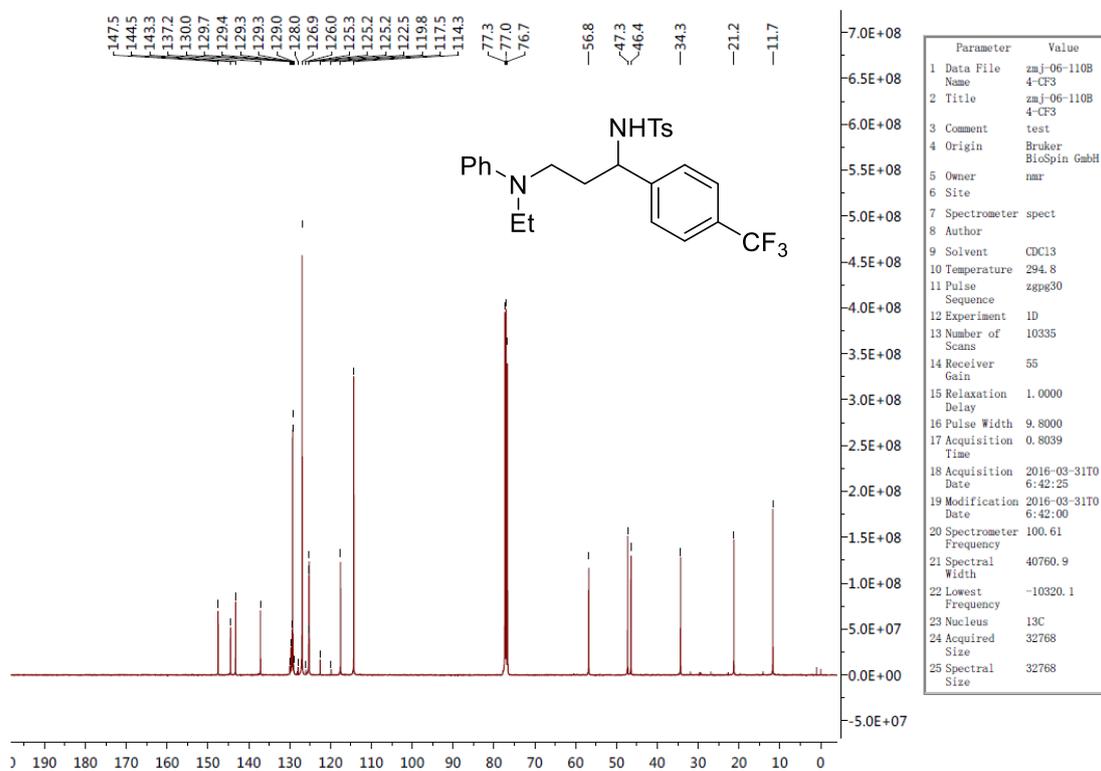
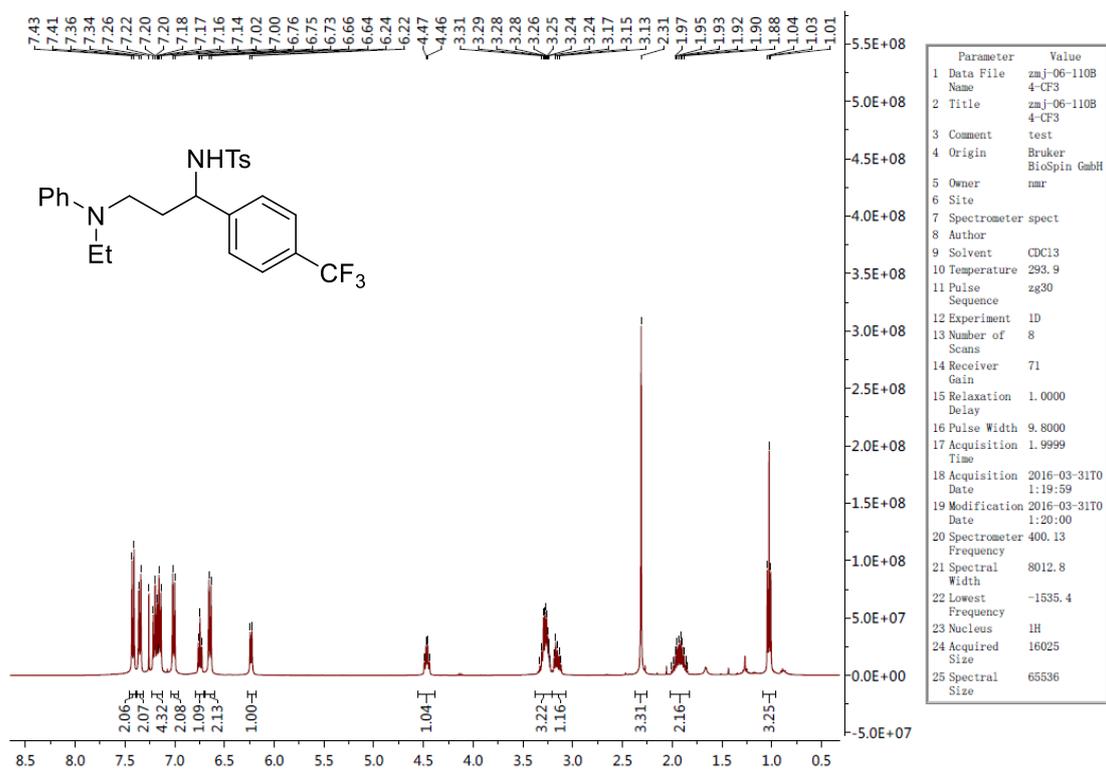
***N*--(4-chlorophenyl)-3-(ethyl(phenyl)amino)propyl-4-methylbenzenesulfonamide (4b)**



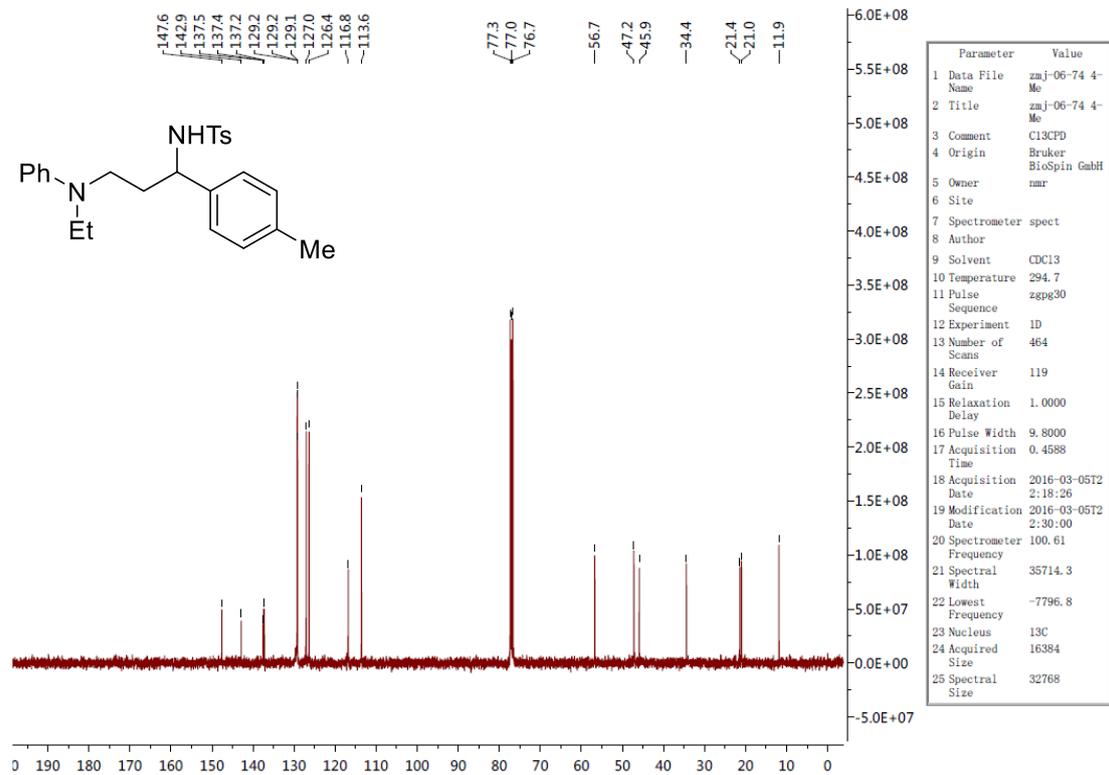
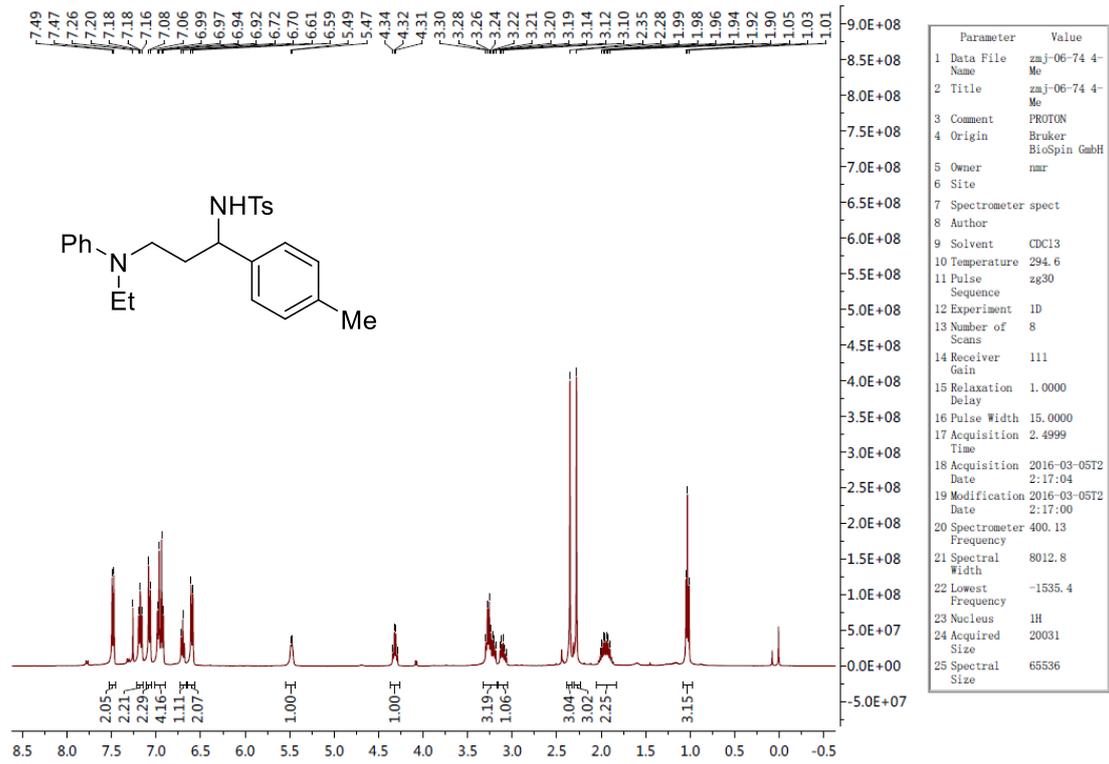
***N*-(3-(ethyl(phenyl)amino)-1-(4-fluorophenyl)propyl)-4-methylbenzenesulfonamide (4c)**



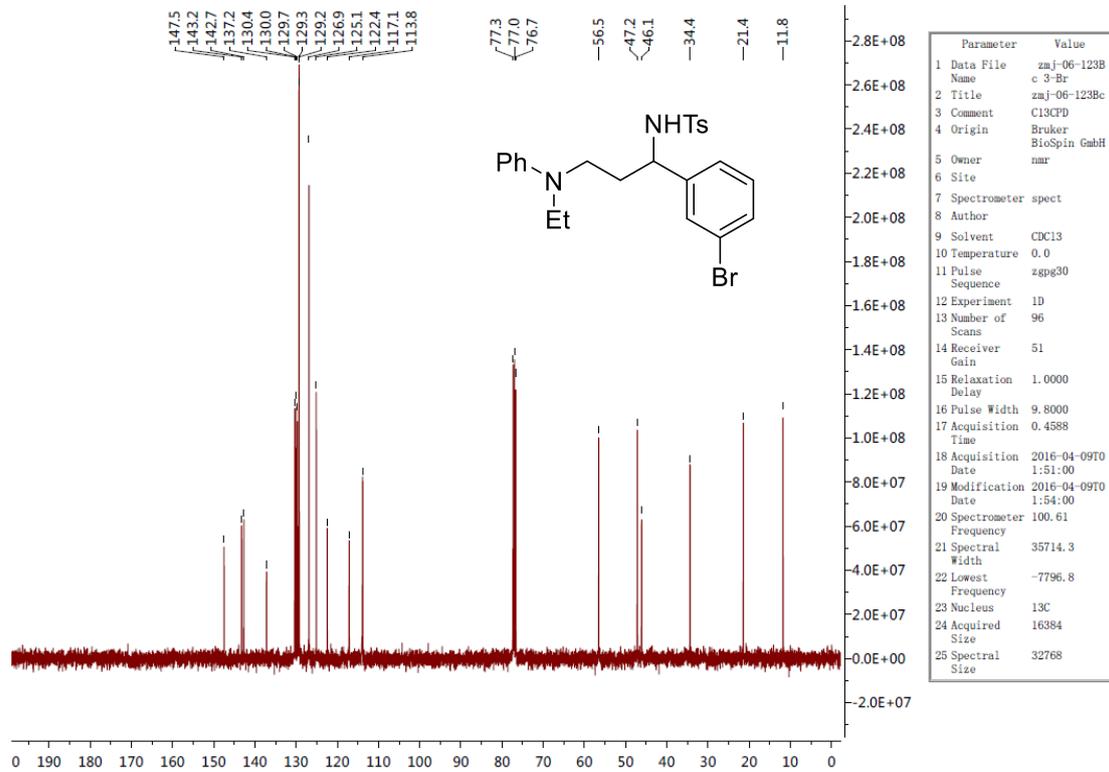
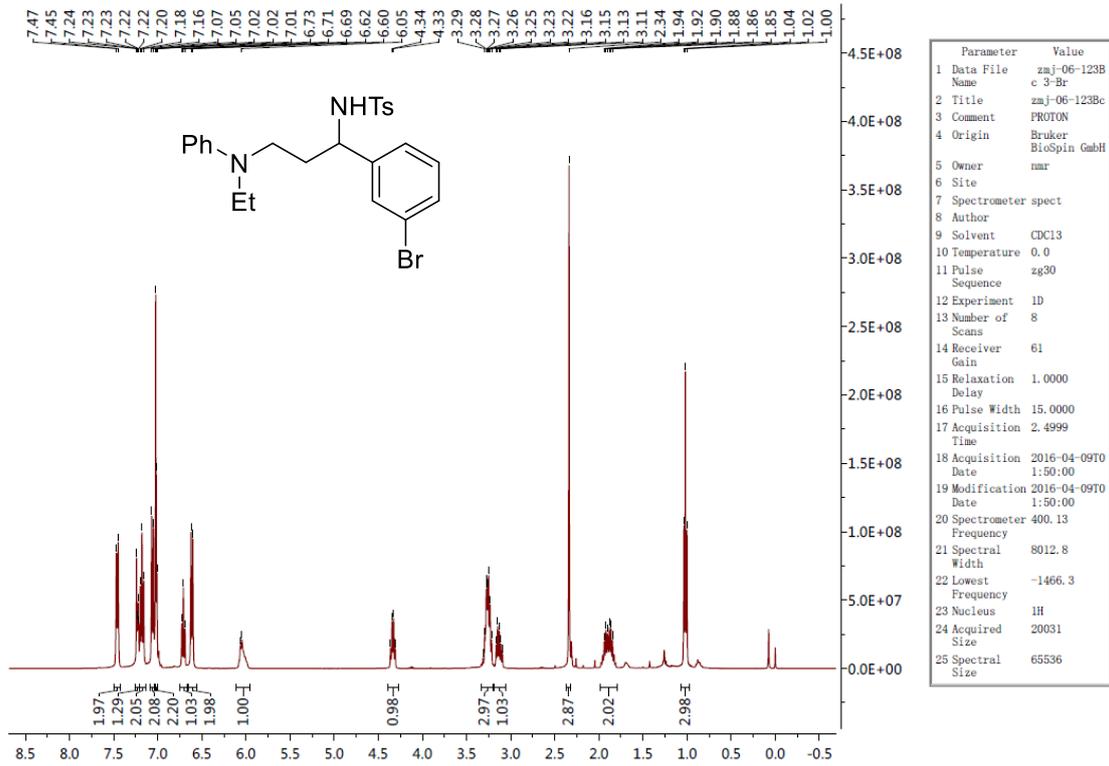
***N*-3-(ethyl(phenyl)amino)-1-(4-(trifluoromethyl)phenyl)propyl)-4-methylbenzenesulfonamide (4d)**



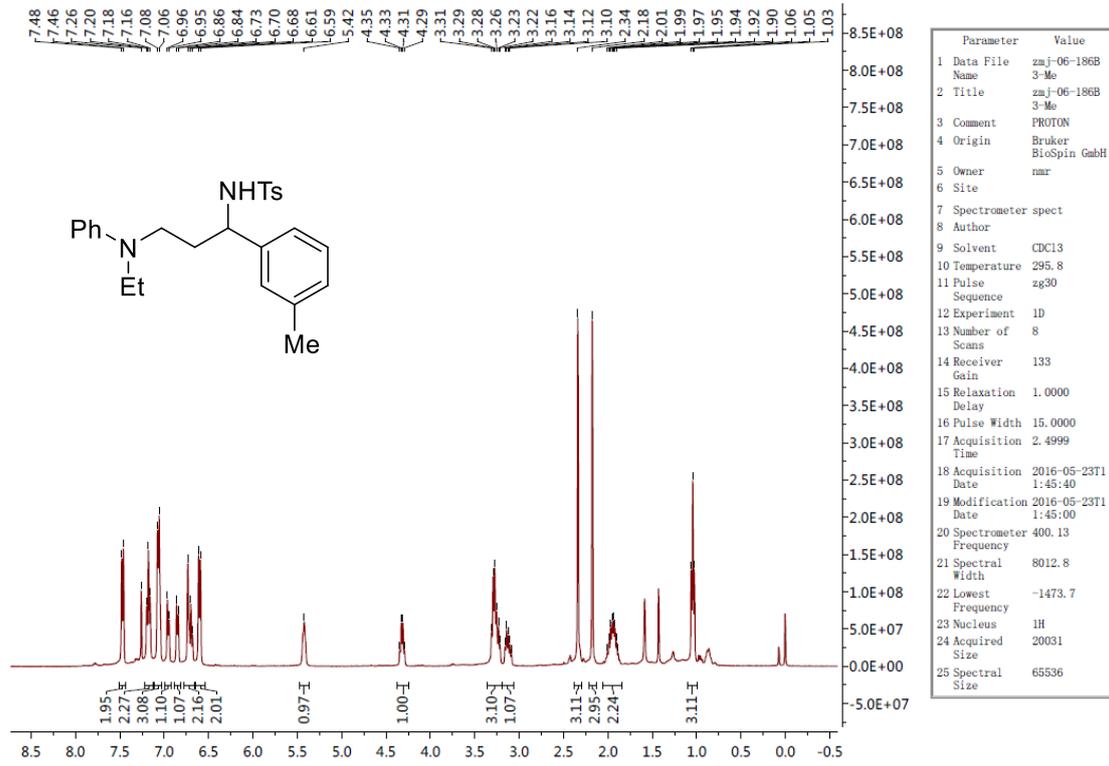
***N*-3-(ethyl(phenyl)amino)-1-(*p*-tolyl)propyl)-4-methylbenzenesulfonamide (4f)**



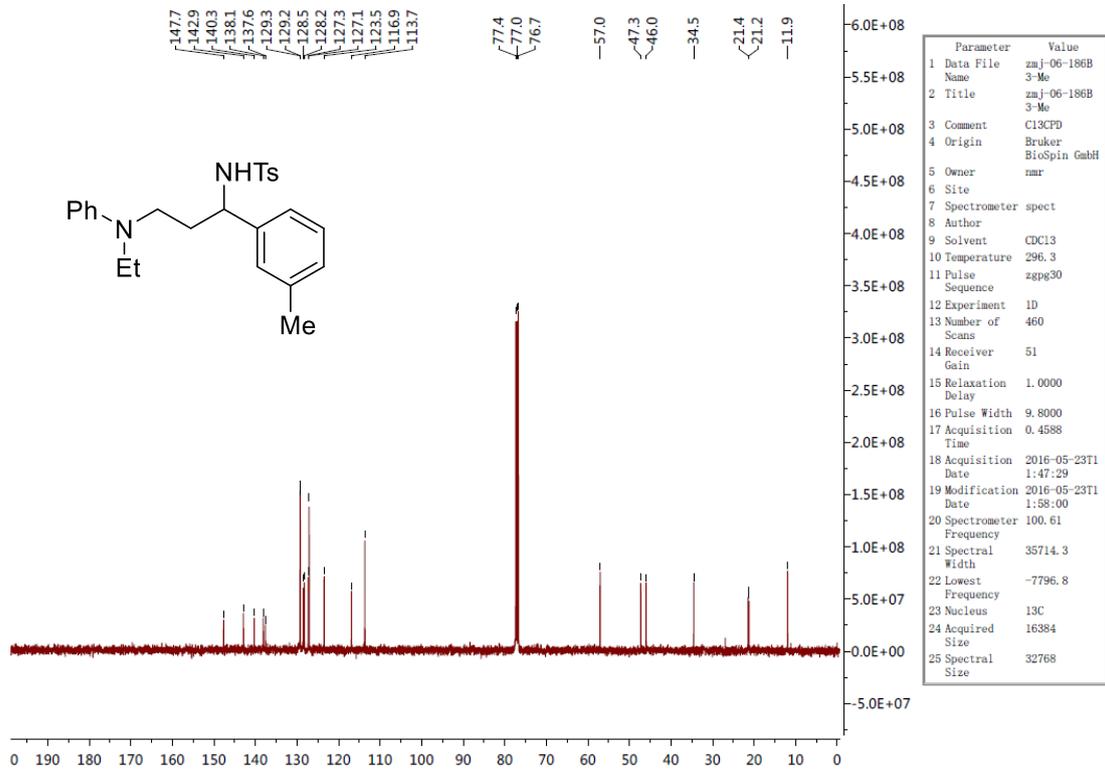
***N*-(1-(3-bromophenyl)-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4g)**



***N*-3-(ethyl(phenyl)amino)-1-(*m*-tolyl)propyl-4-methylbenzenesulfonamide (4h)**

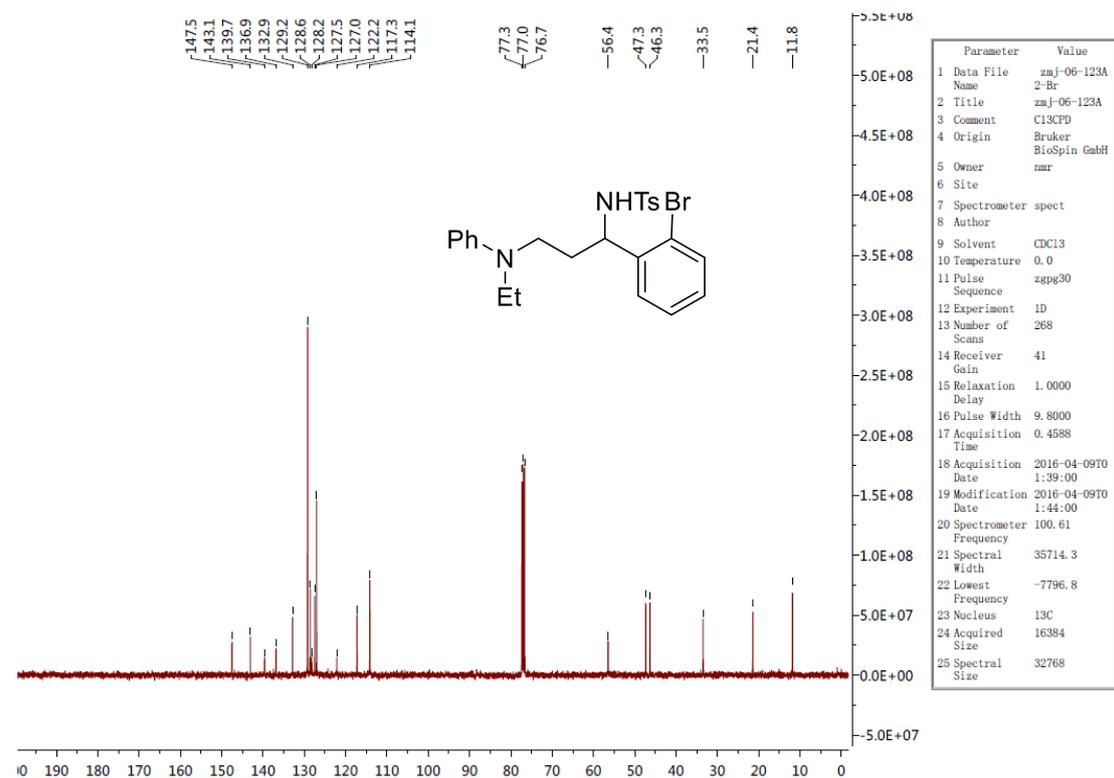
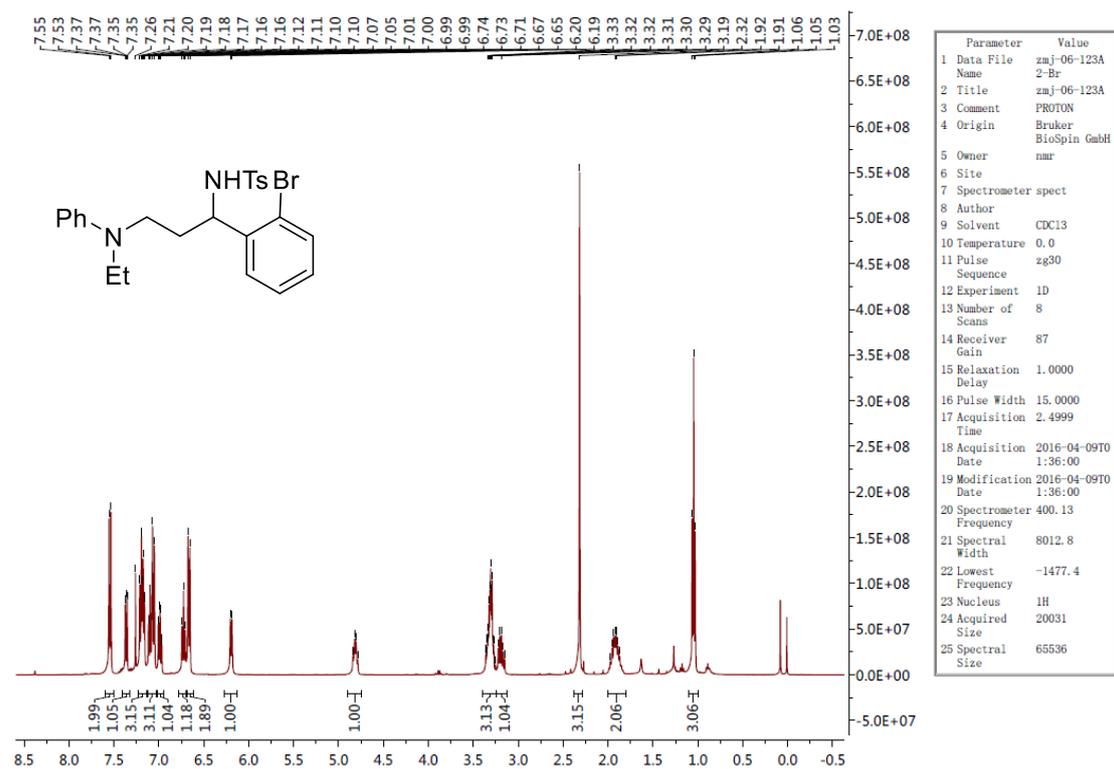


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9 Author	
10 Solvent	CDCl3
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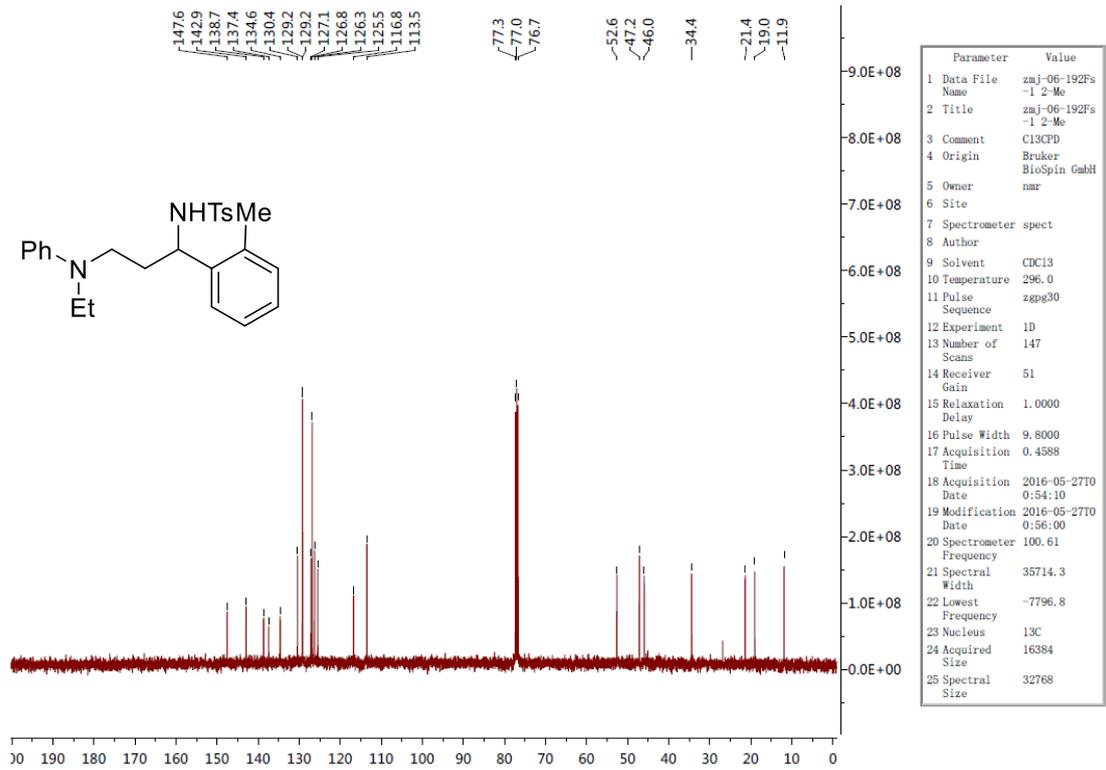
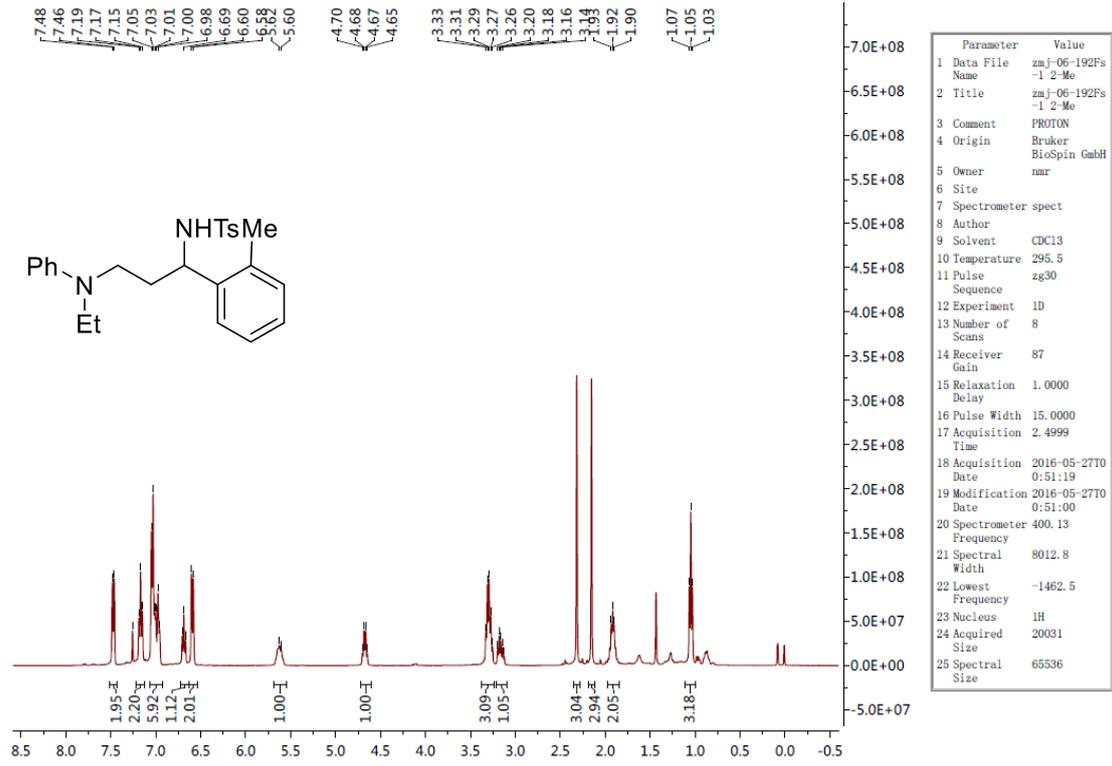


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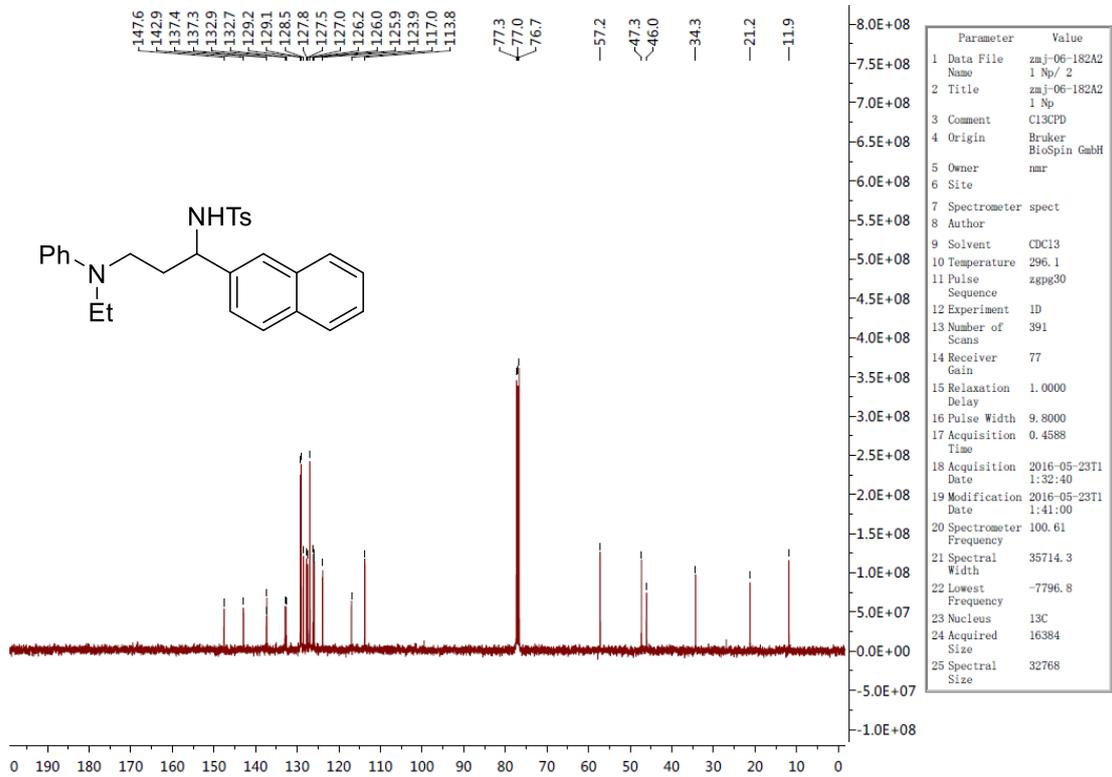
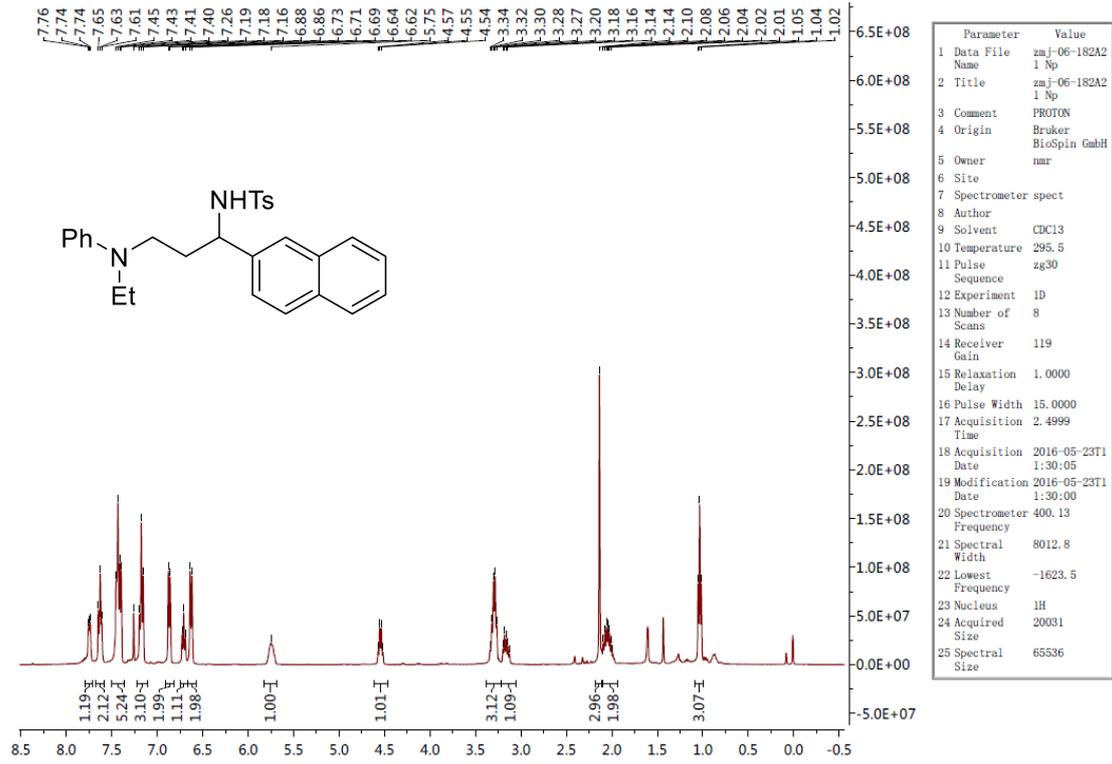
N-(1-(2-bromophenyl)-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4i)



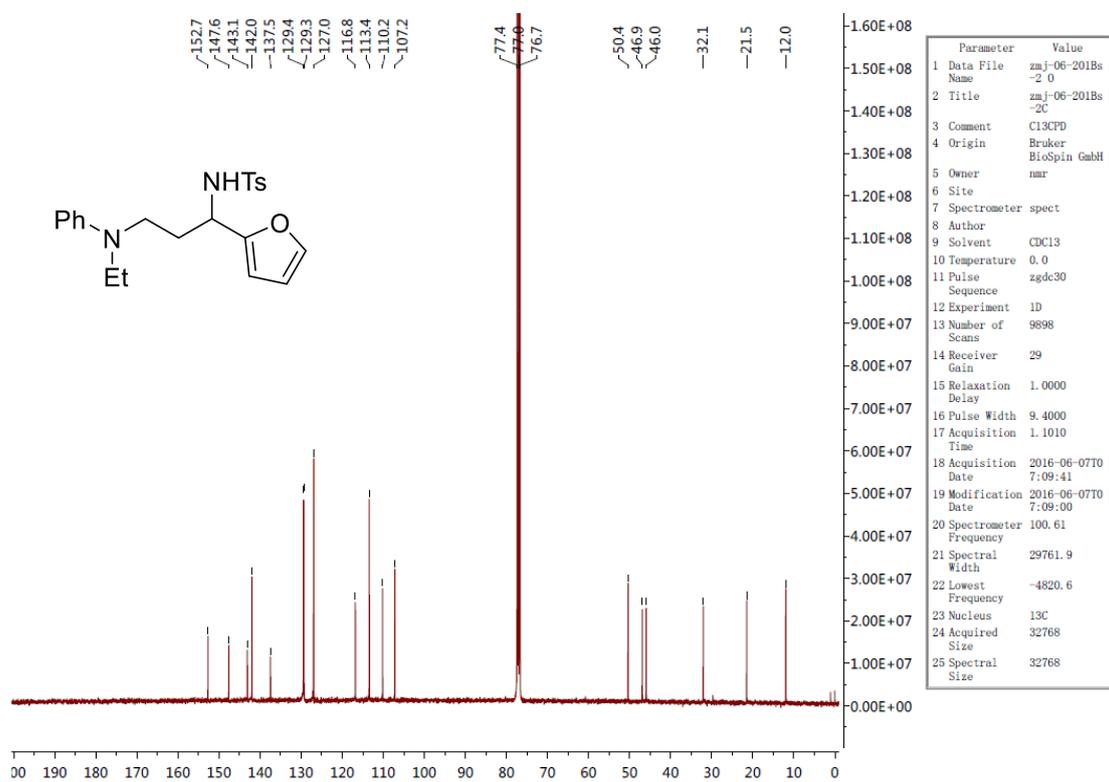
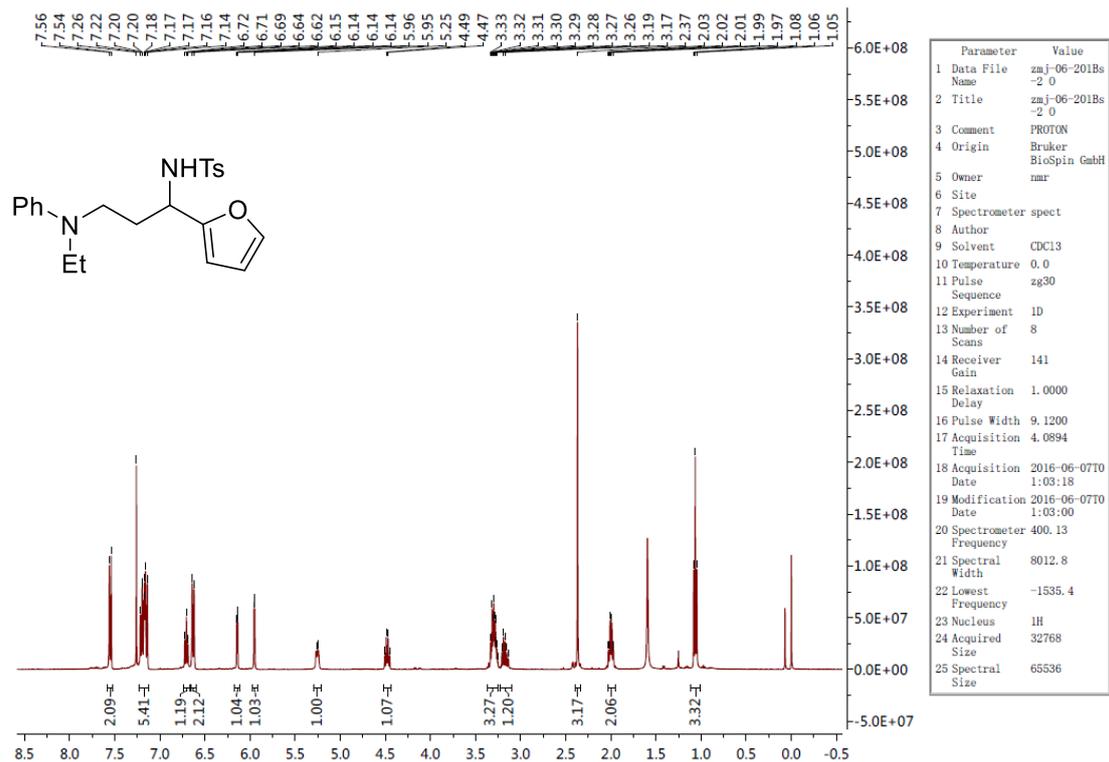
***N*-3-(ethyl(phenyl)amino)-1-(*o*-tolyl)propyl)-4-methylbenzenesulfonamide (4j)**



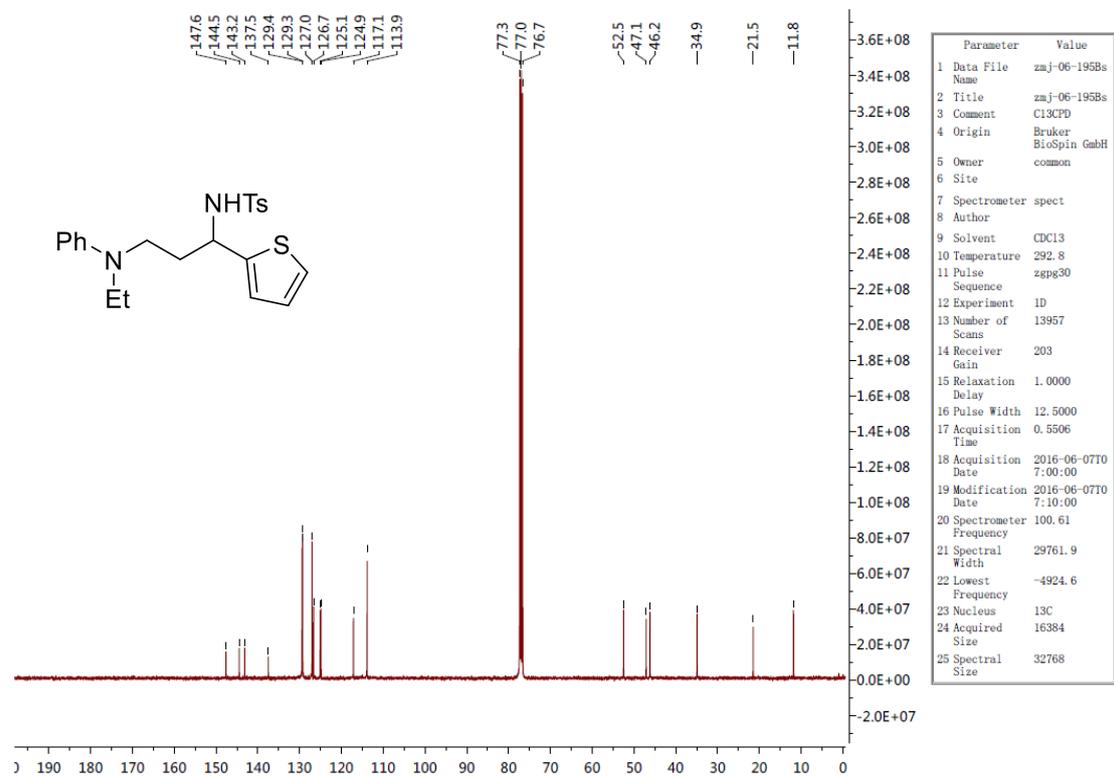
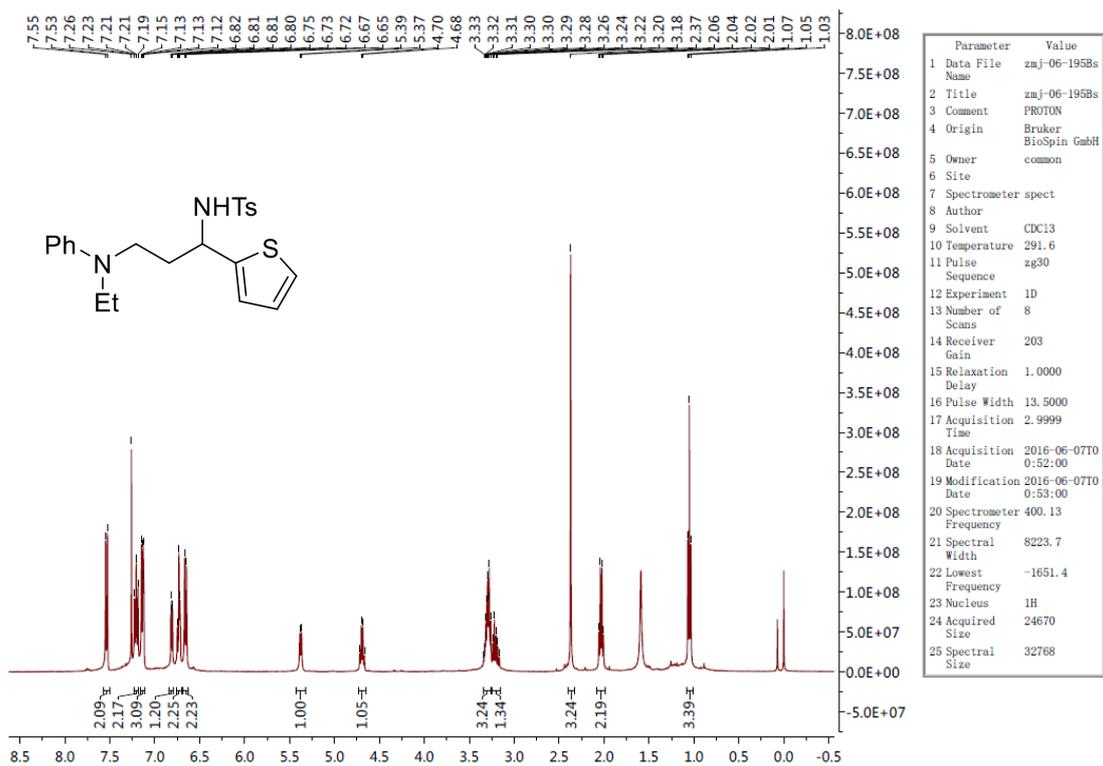
***N*-3-(ethyl(phenyl)amino)-1-(naphthalen-2-yl)propyl-4-methylbenzenesulfonamide (4k)**



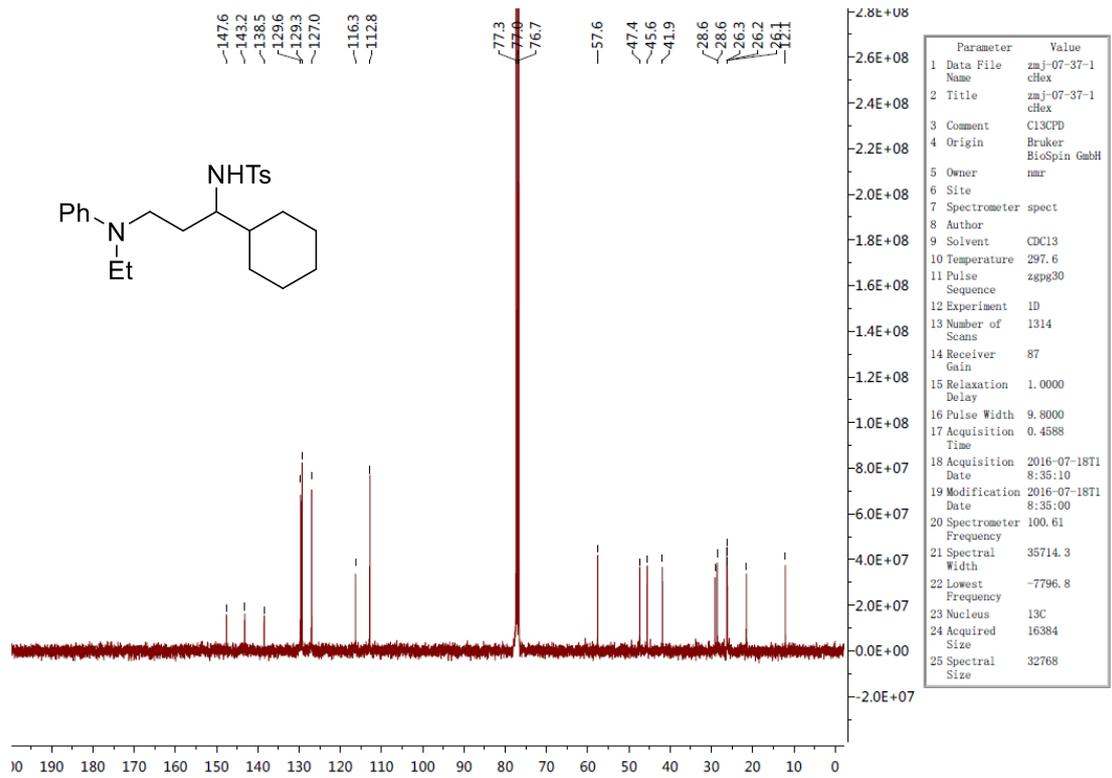
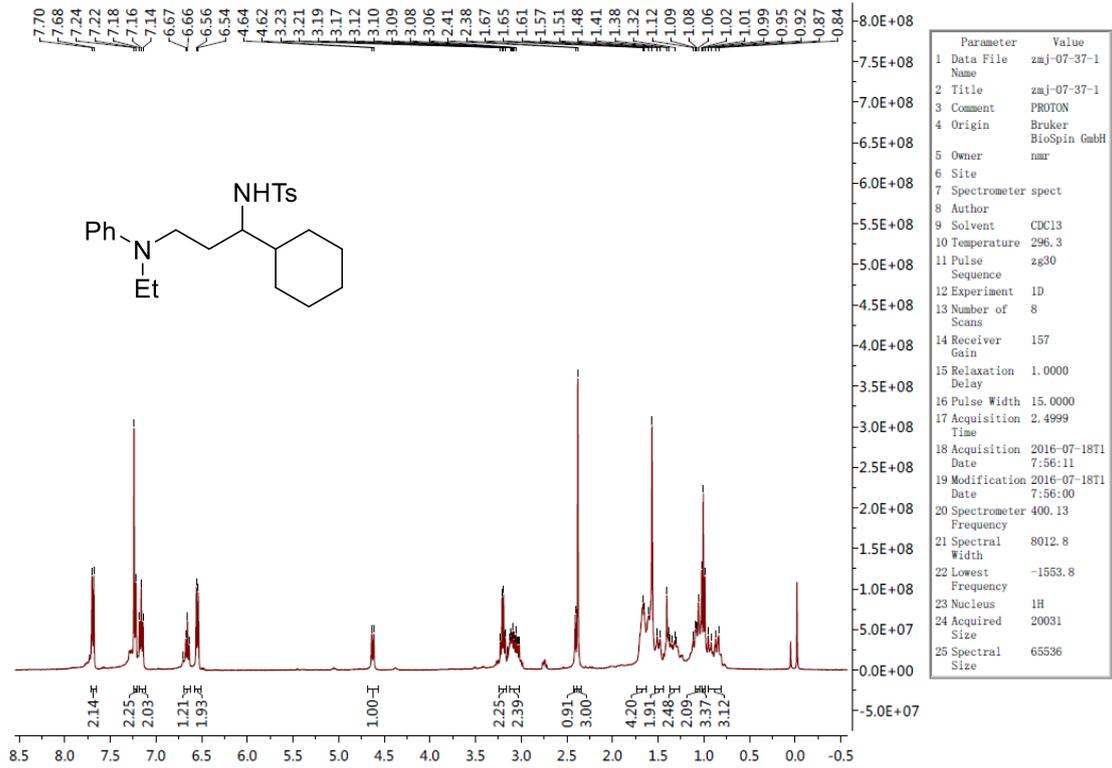
N-(3-(ethyl(phenyl)amino)-1-(furan-2-yl)propyl)-4-methylbenzenesulfonamide (4l)



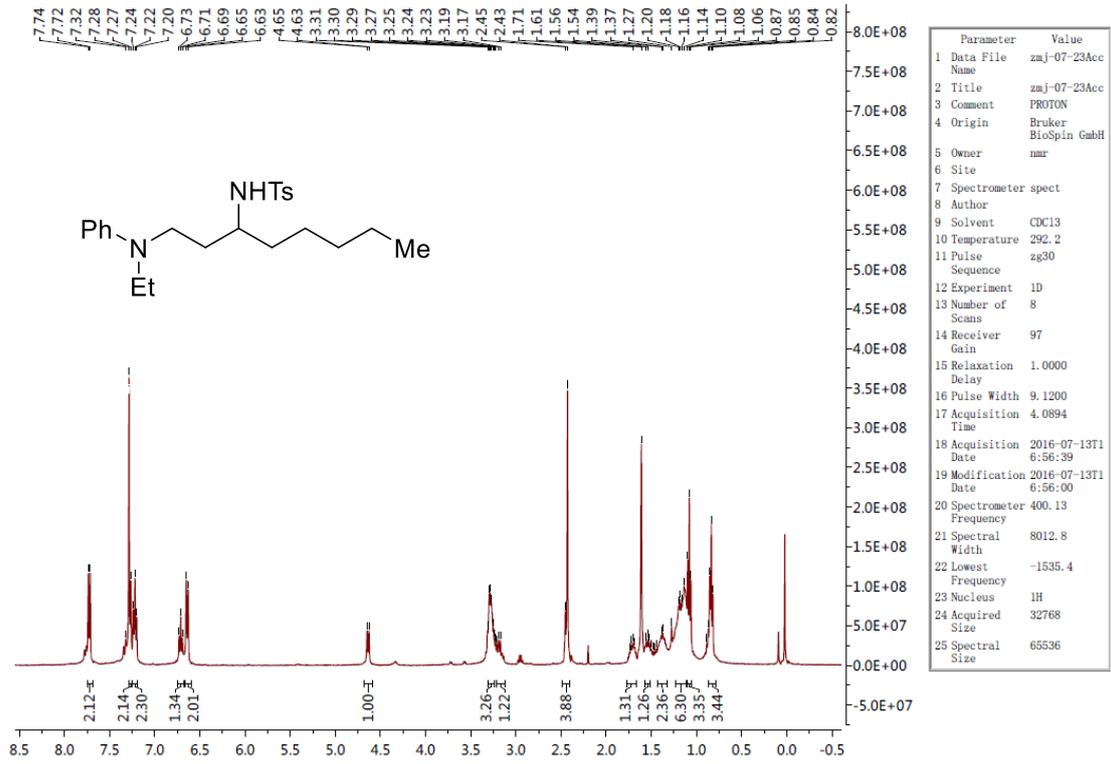
***N*-3-(ethyl(phenyl)amino)-1-(thiophen-2-yl)propyl-4-methylbenzenesulfonamide (4m)**



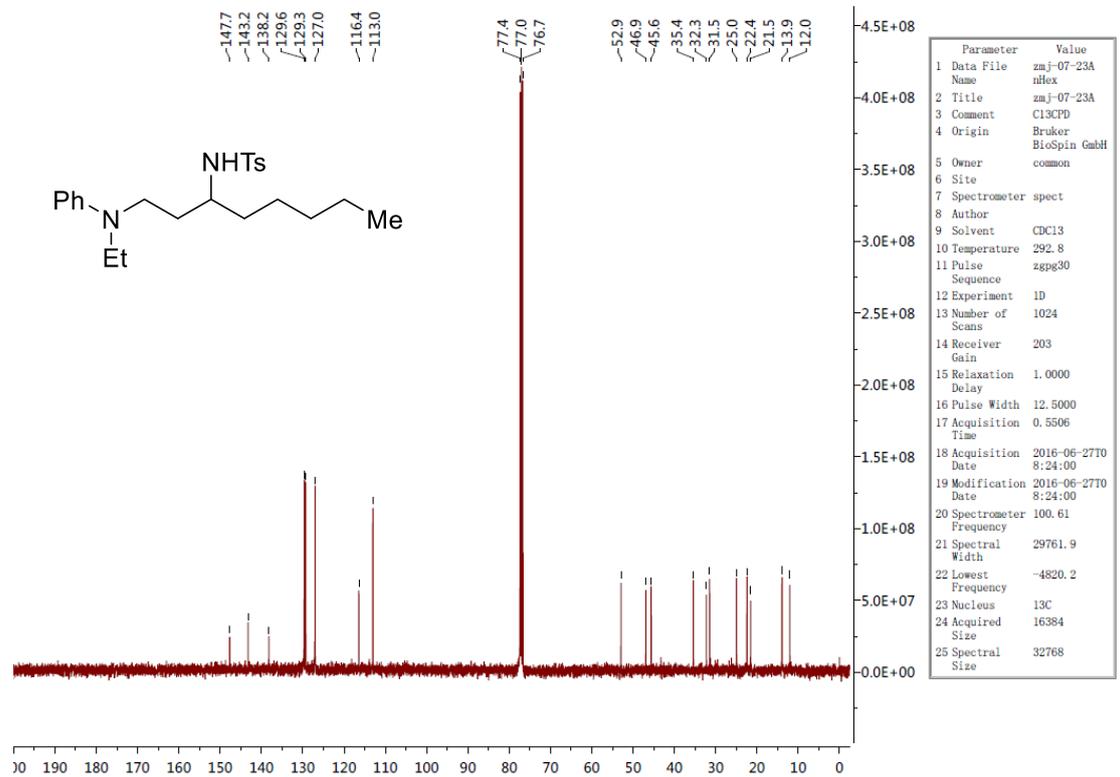
***N*-(1-cyclohexyl-3-(ethyl(phenyl)amino)propyl)-4-methylbenzenesulfonamide (4n)**



***N*-(1-(ethyl(phenyl)amino)octan-3-yl)-4-methylbenzenesulfonamide (4o)**

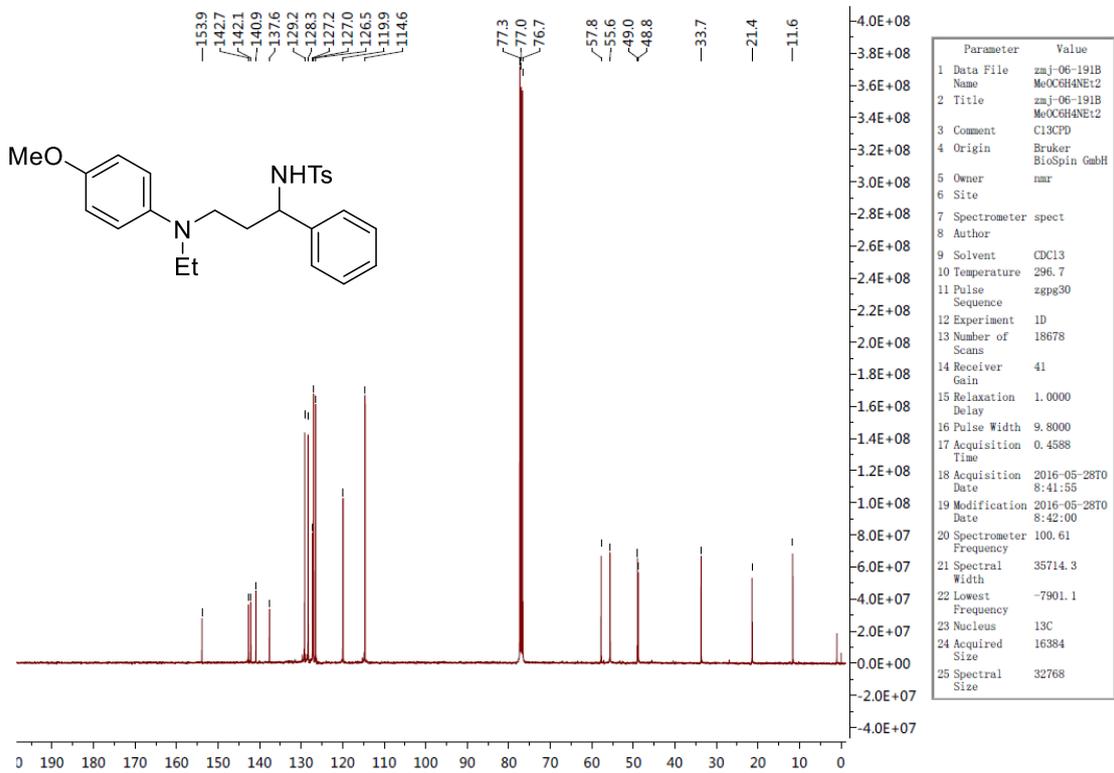
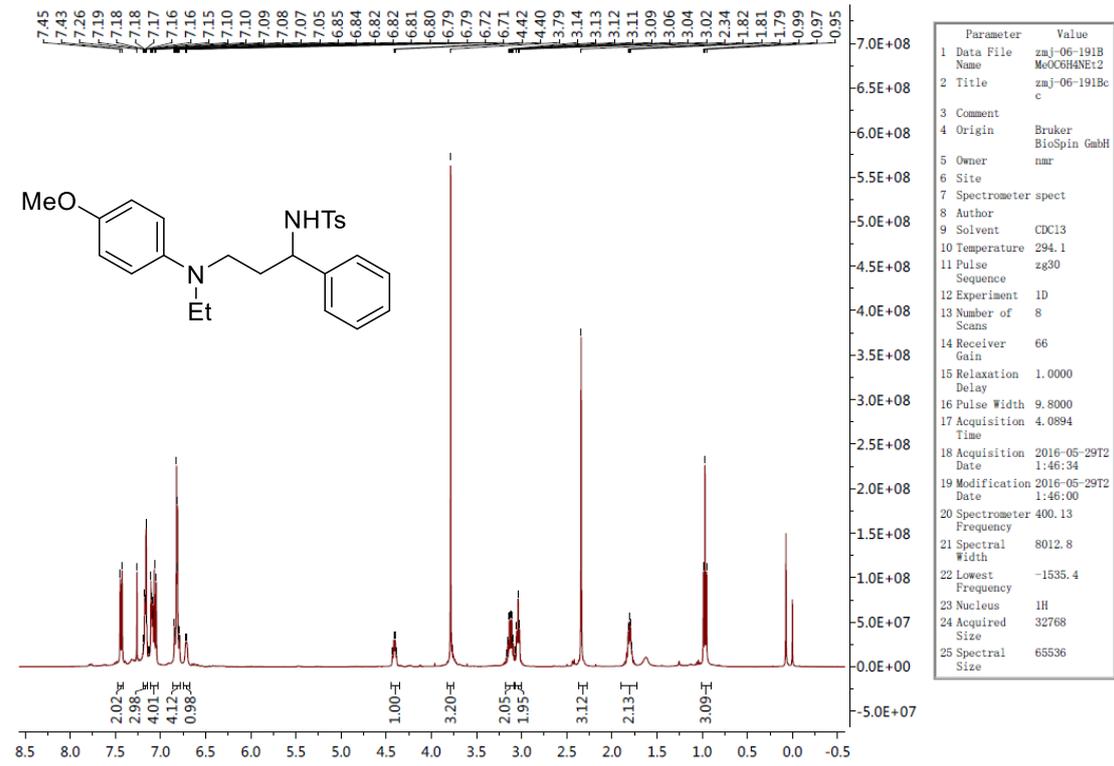


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8 Author	
9 Solvent	CDCl3
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11 Pulse Sequence	zg30
12 Experiment	1D
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15 Relaxation Delay	1.0000
16 Pulse Width	9.1200
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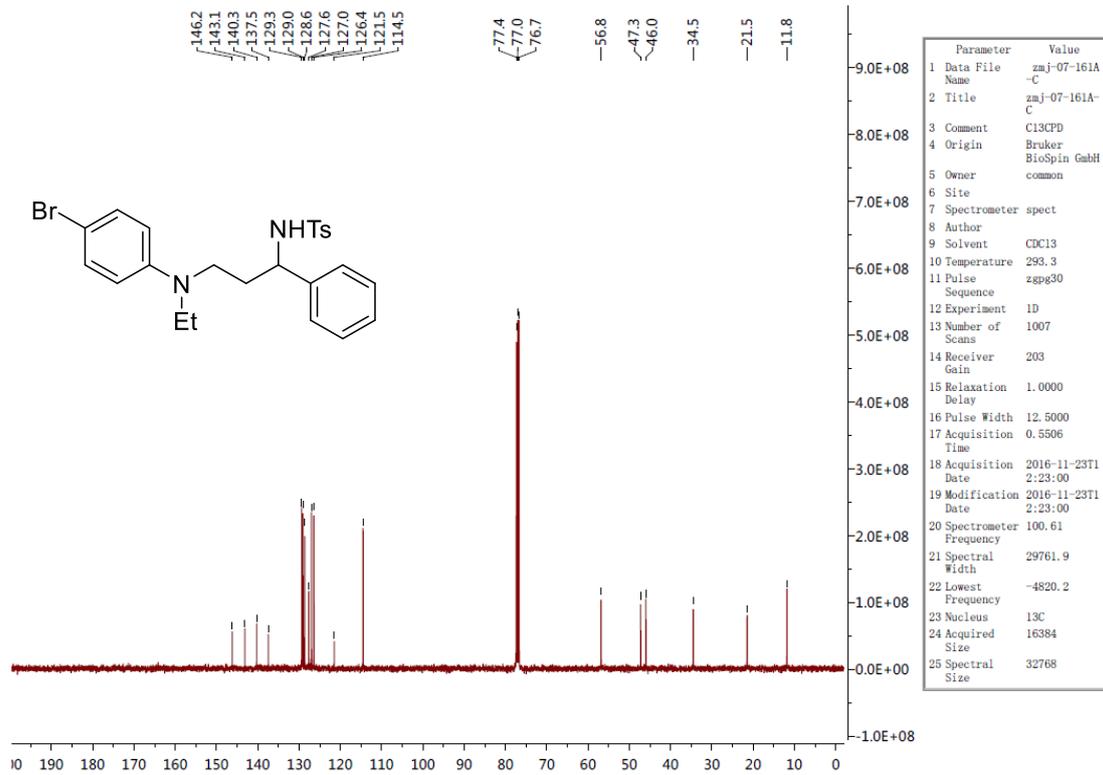
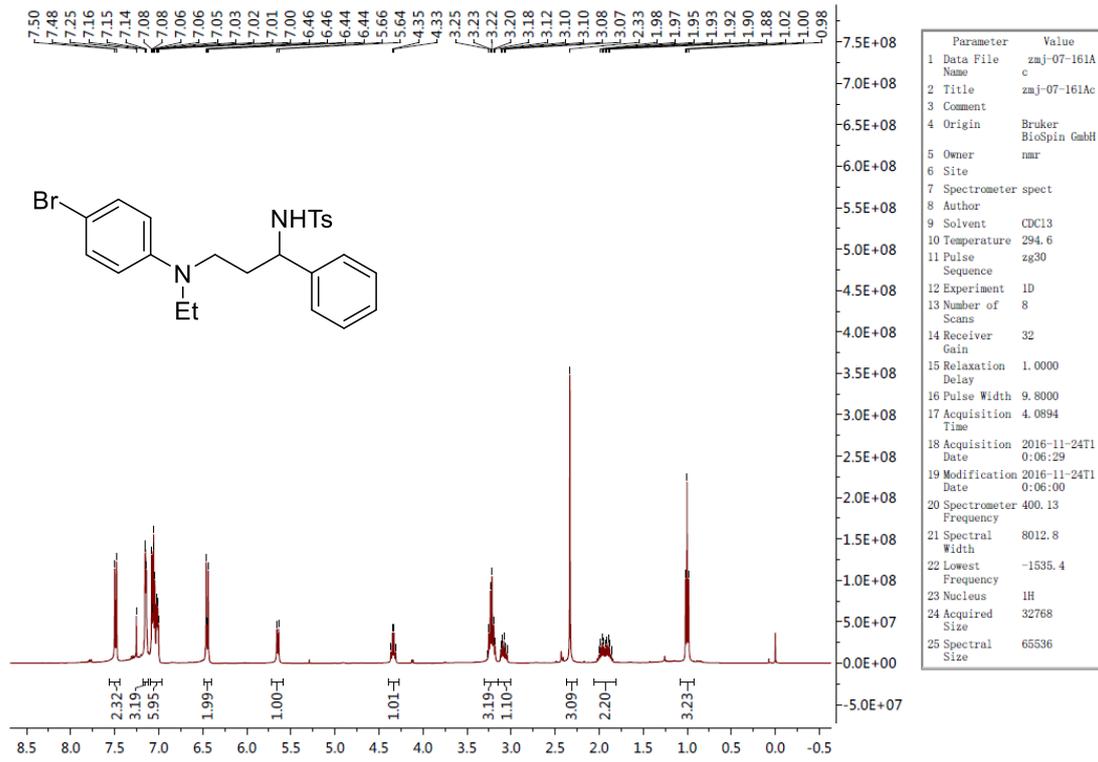


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8 Author	
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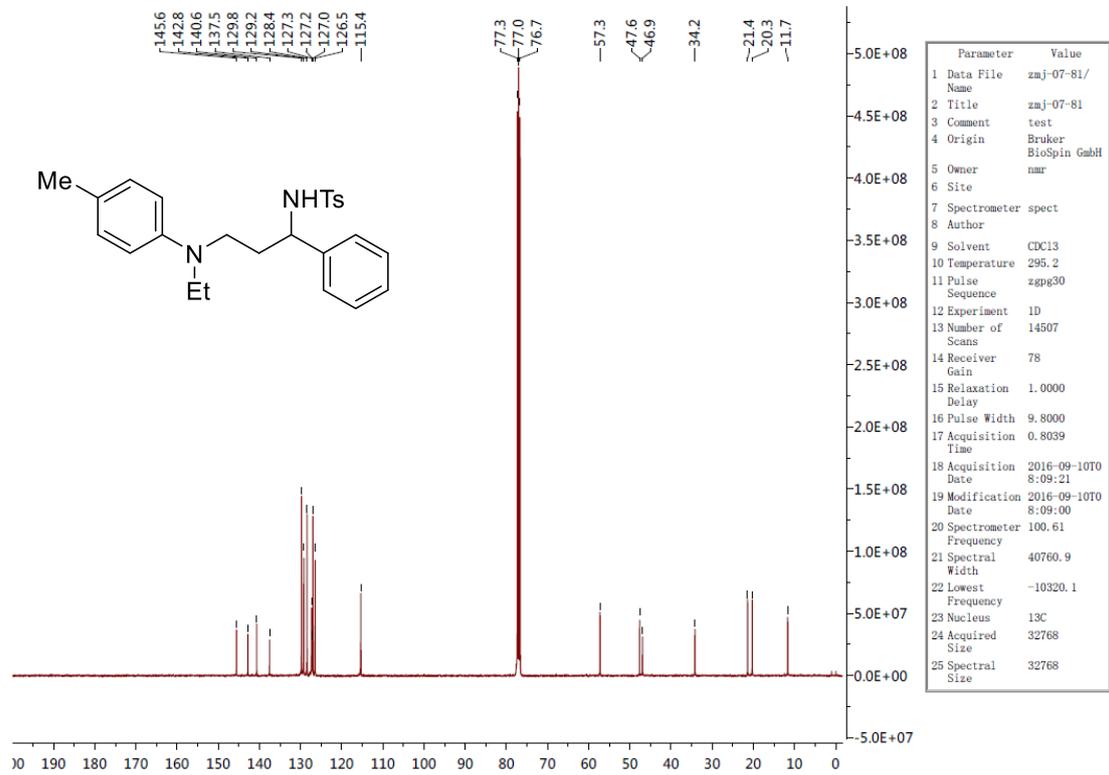
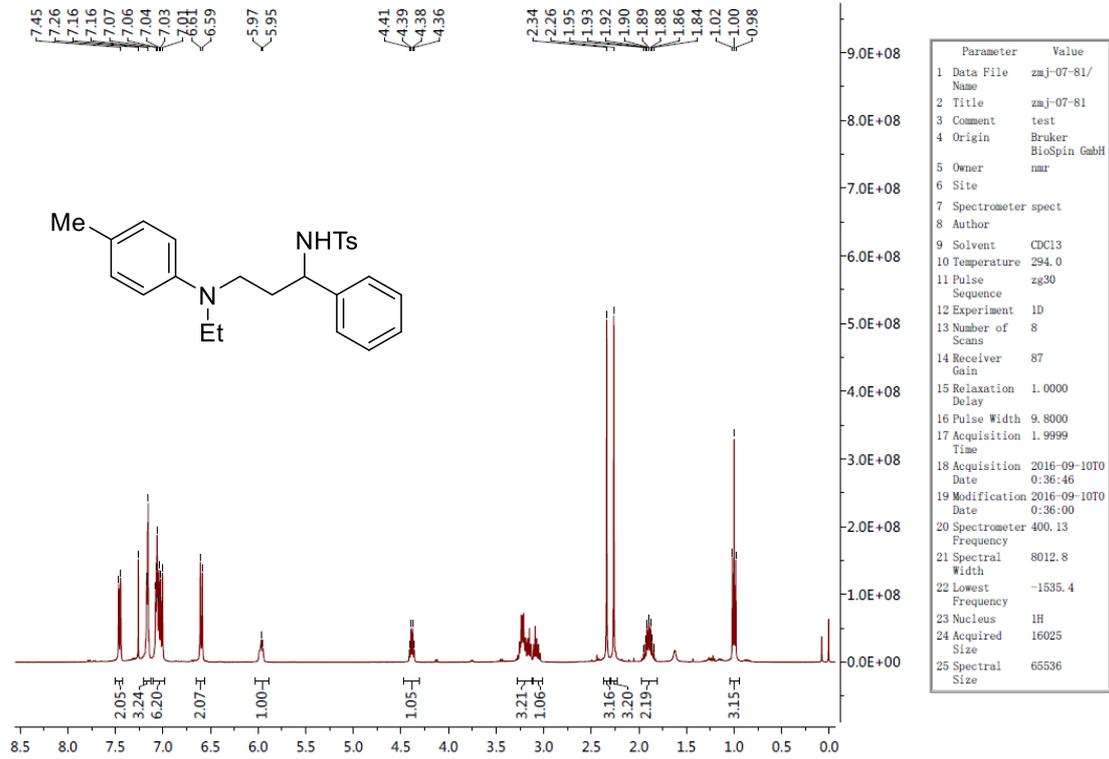
***N*-(3-(ethyl(4-methoxyphenyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4p)**



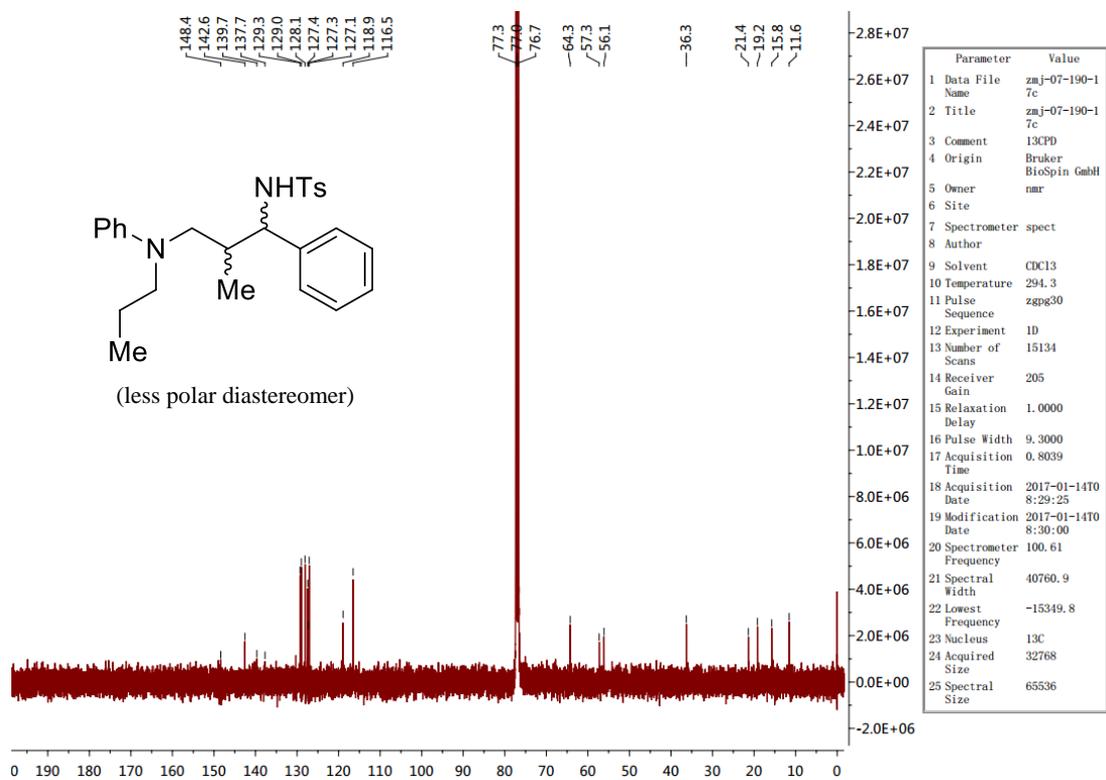
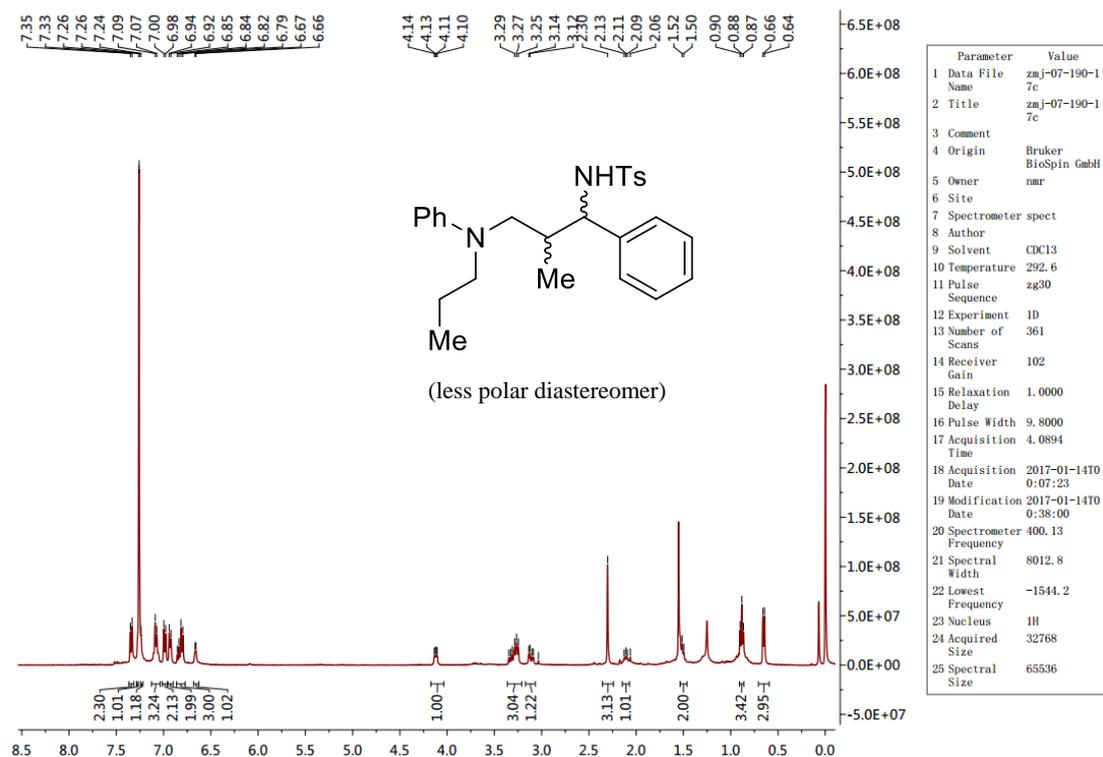
***N*-3-((4-bromophenyl)(ethylamino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4q)**

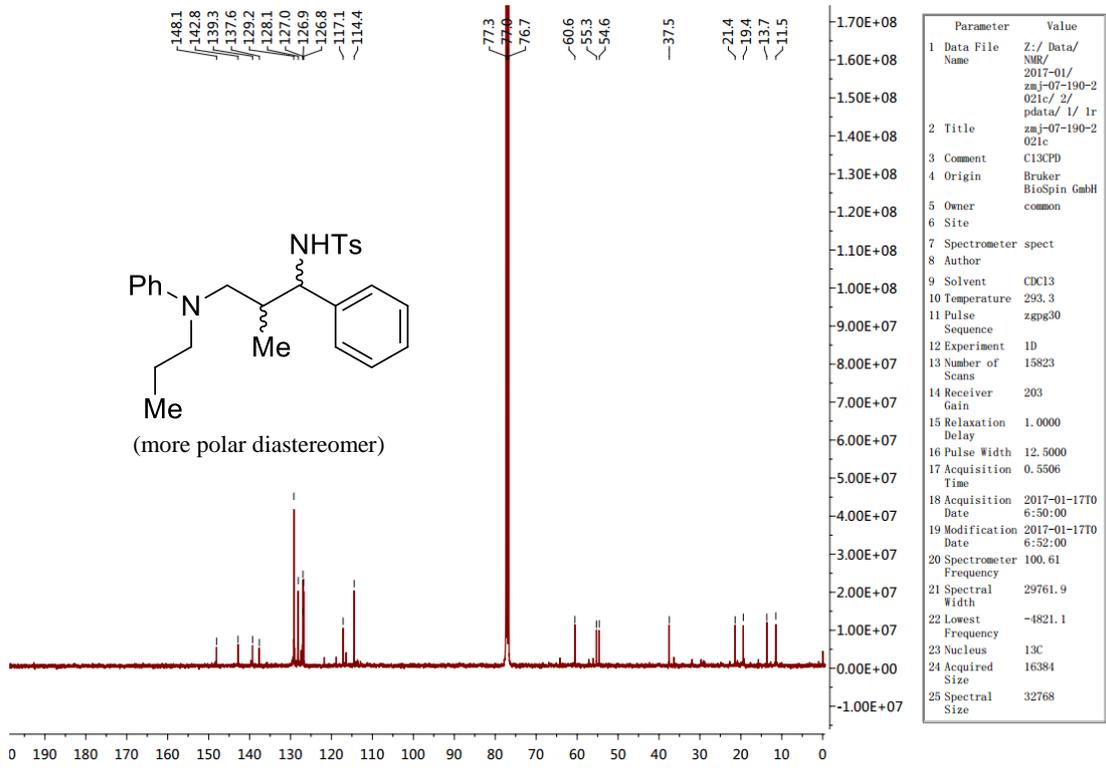
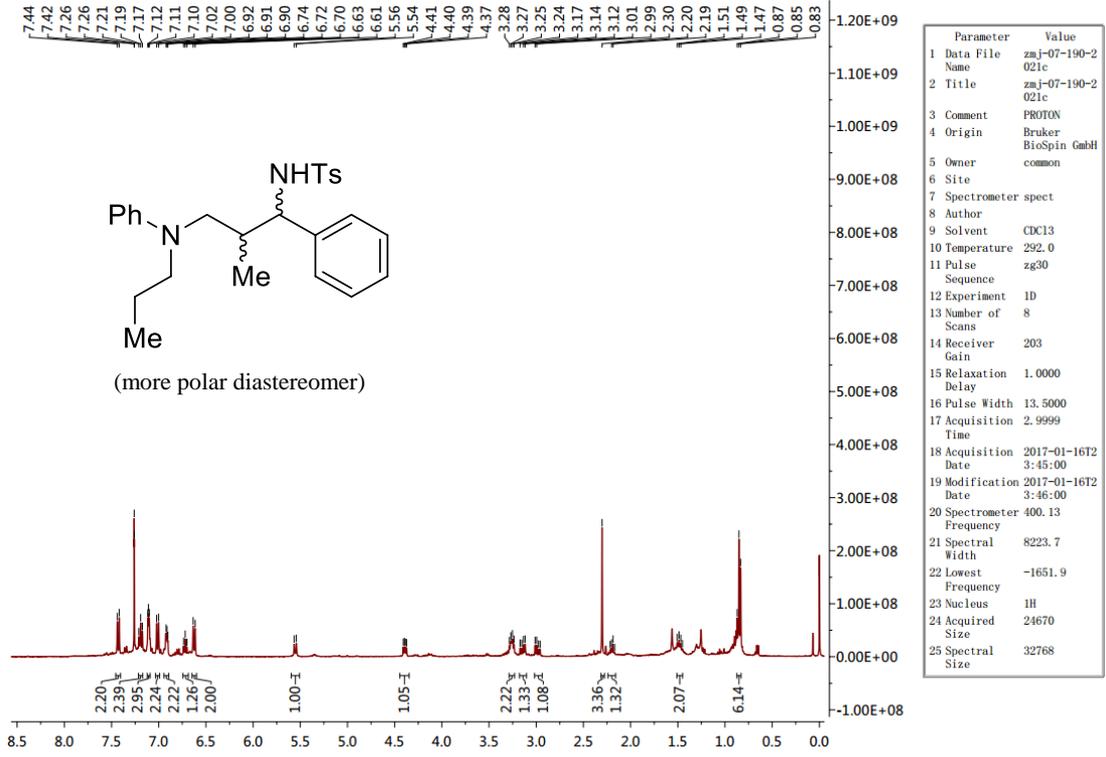


***N*-3-(ethyl(*p*-tolyl)amino)-1-phenylpropyl)-4-methylbenzenesulfonamide (4r)**

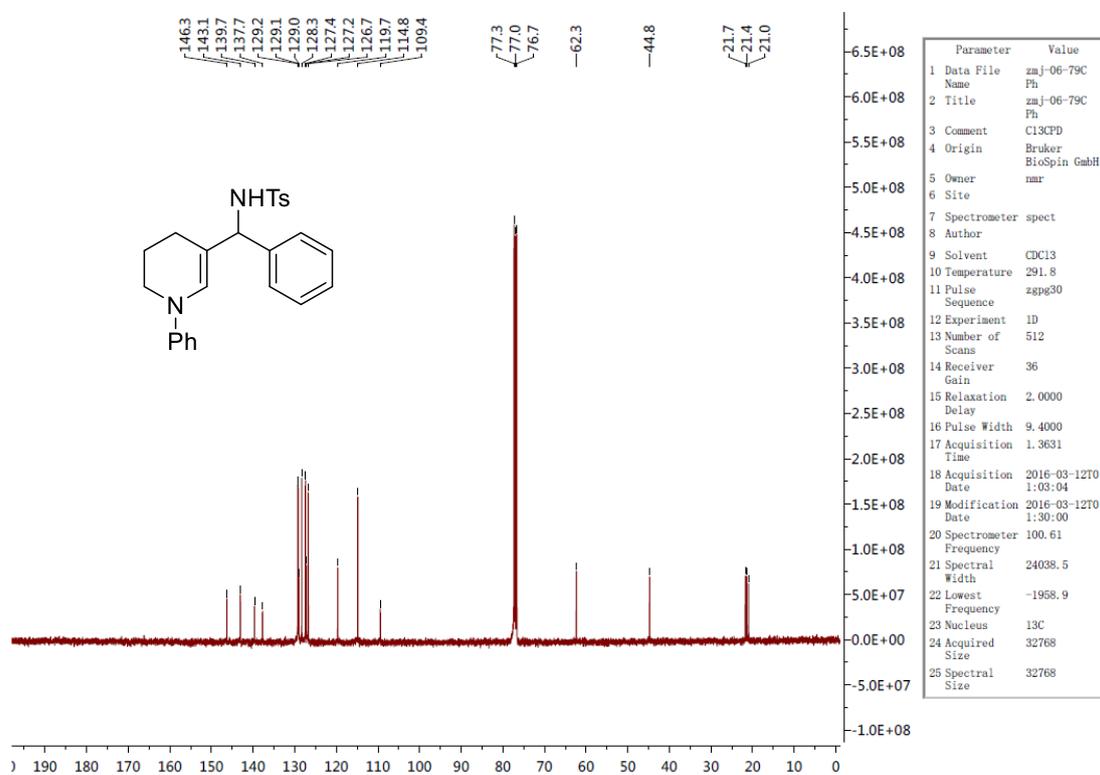
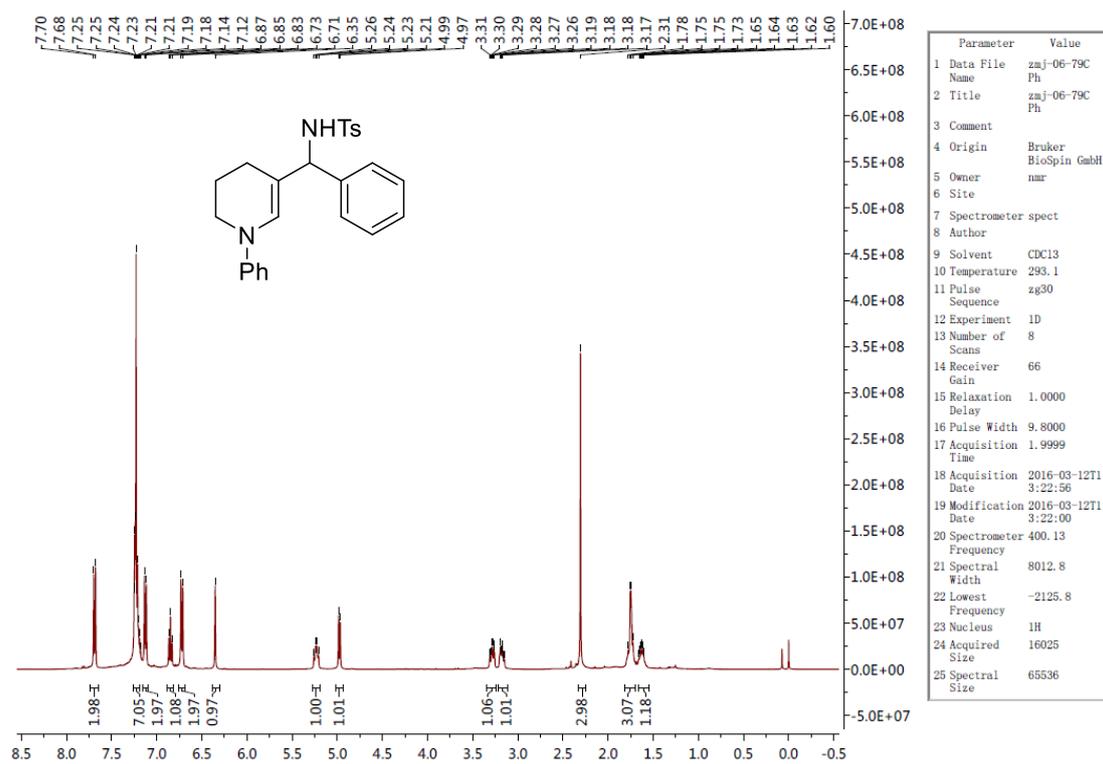


4-methyl-N-(2-methyl-1-phenyl-3-(phenyl(propyl)amino)propyl)benzenesulfonamide (4s)

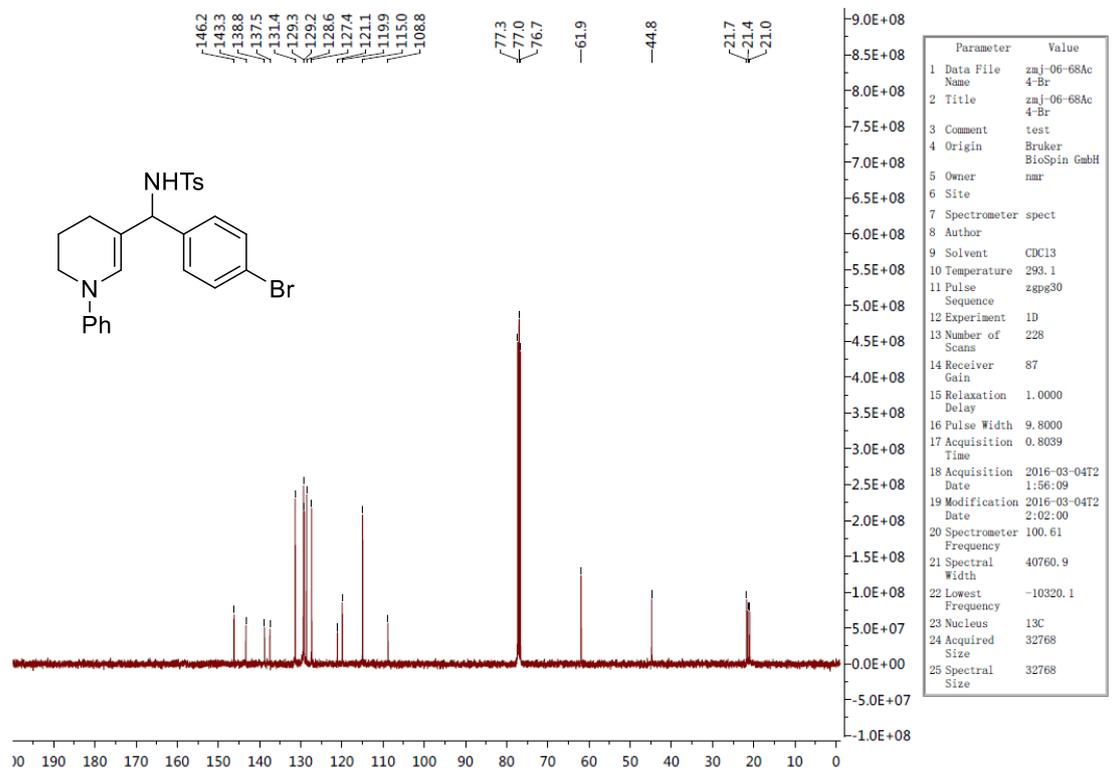
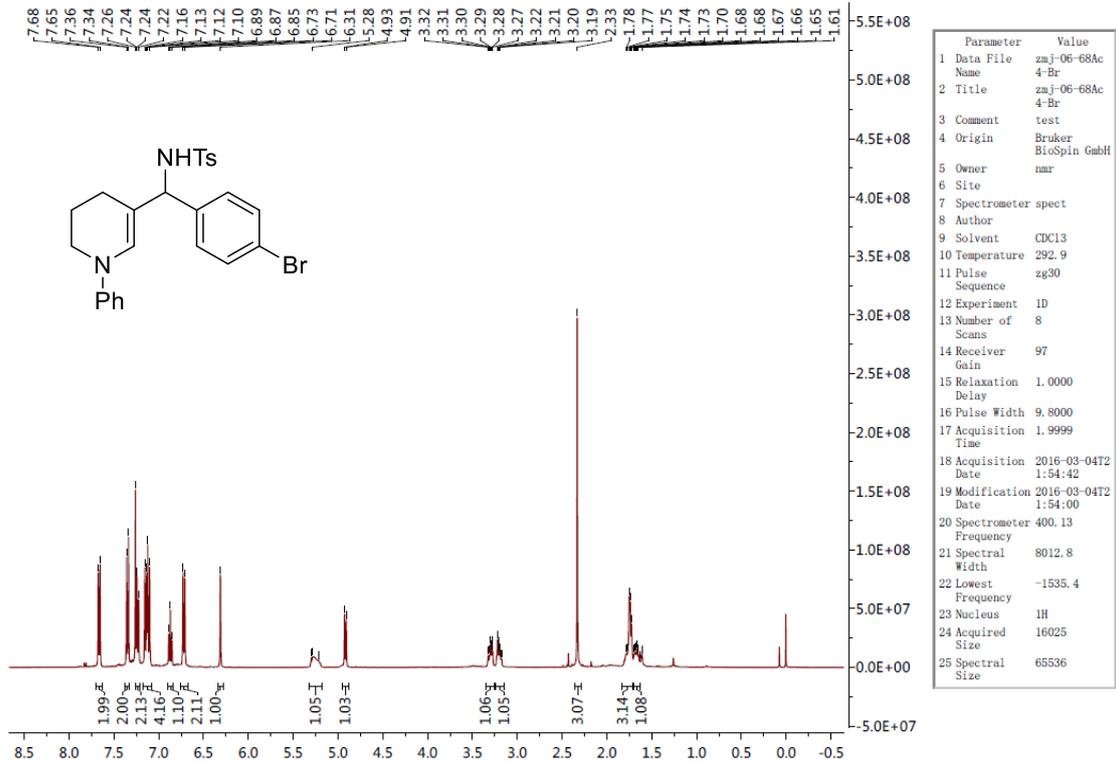




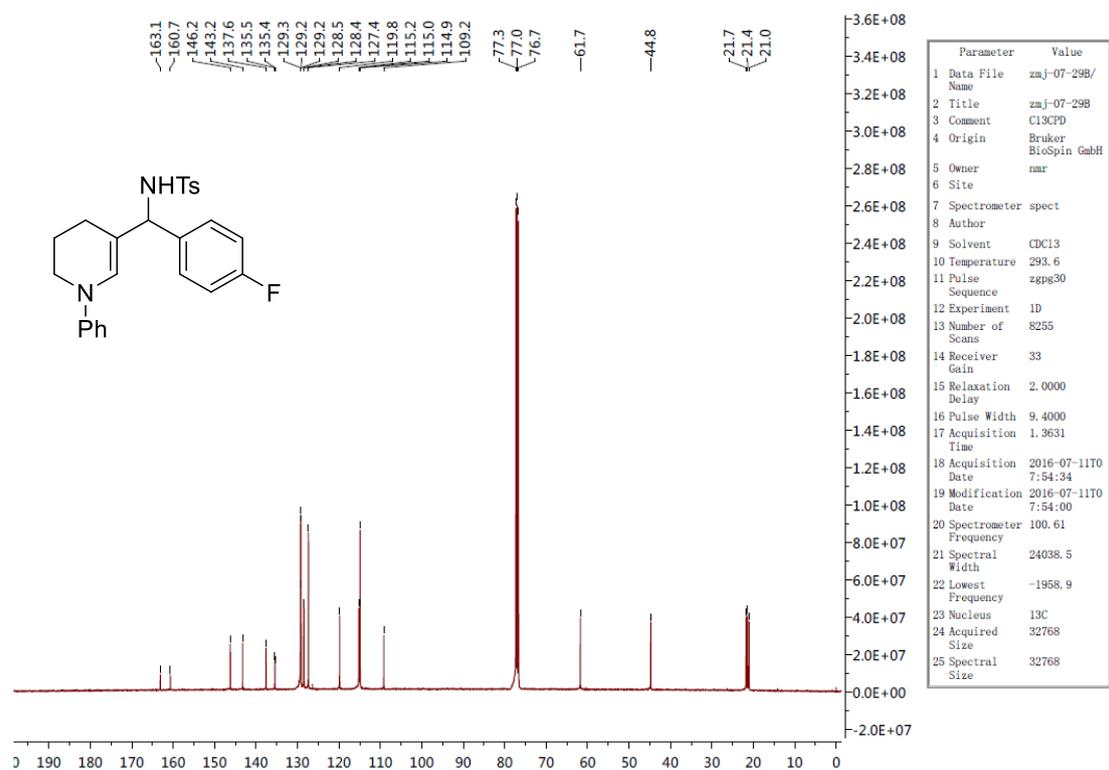
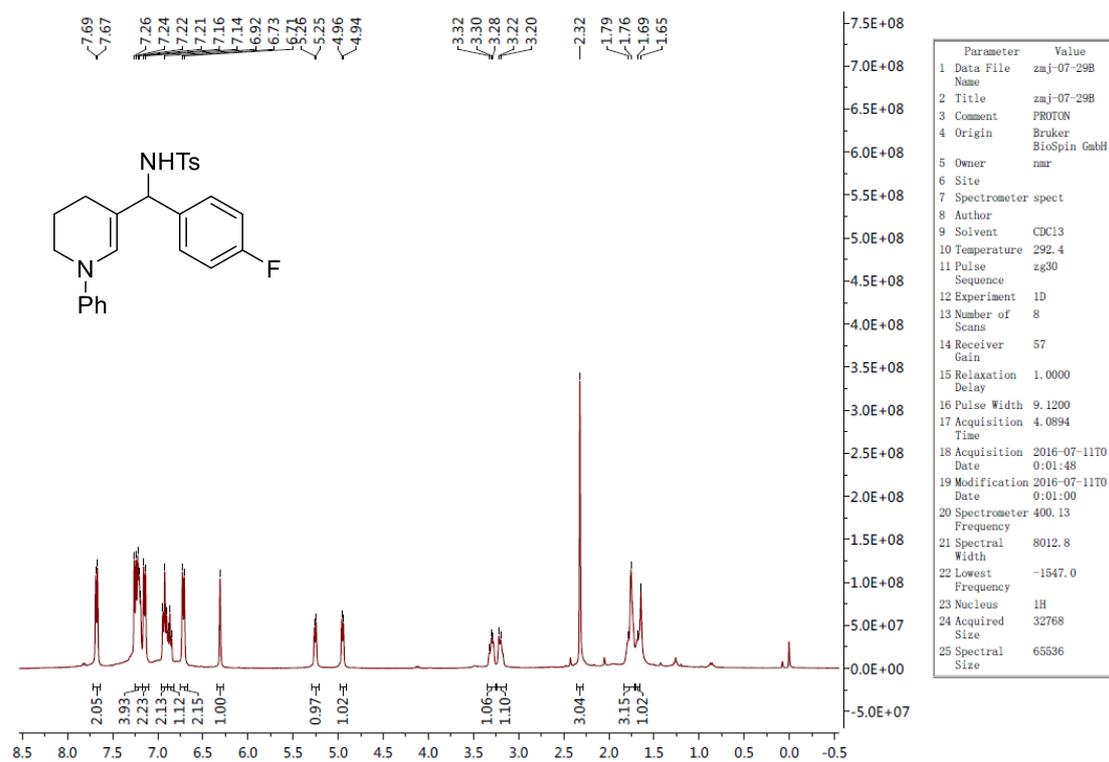
4-methyl-N-(phenyl(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)benzenesulfonamide (6a)



***N*-((4-bromophenyl)(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)-4-methylbenzenesulfonamide (6b)**

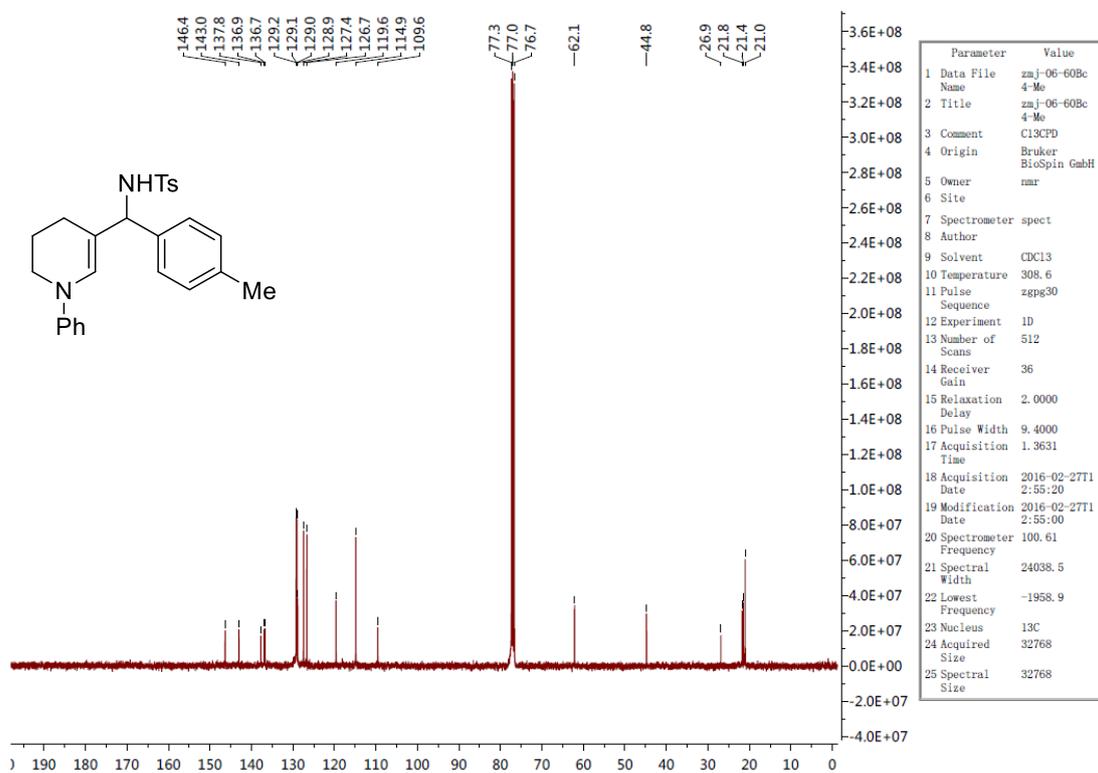
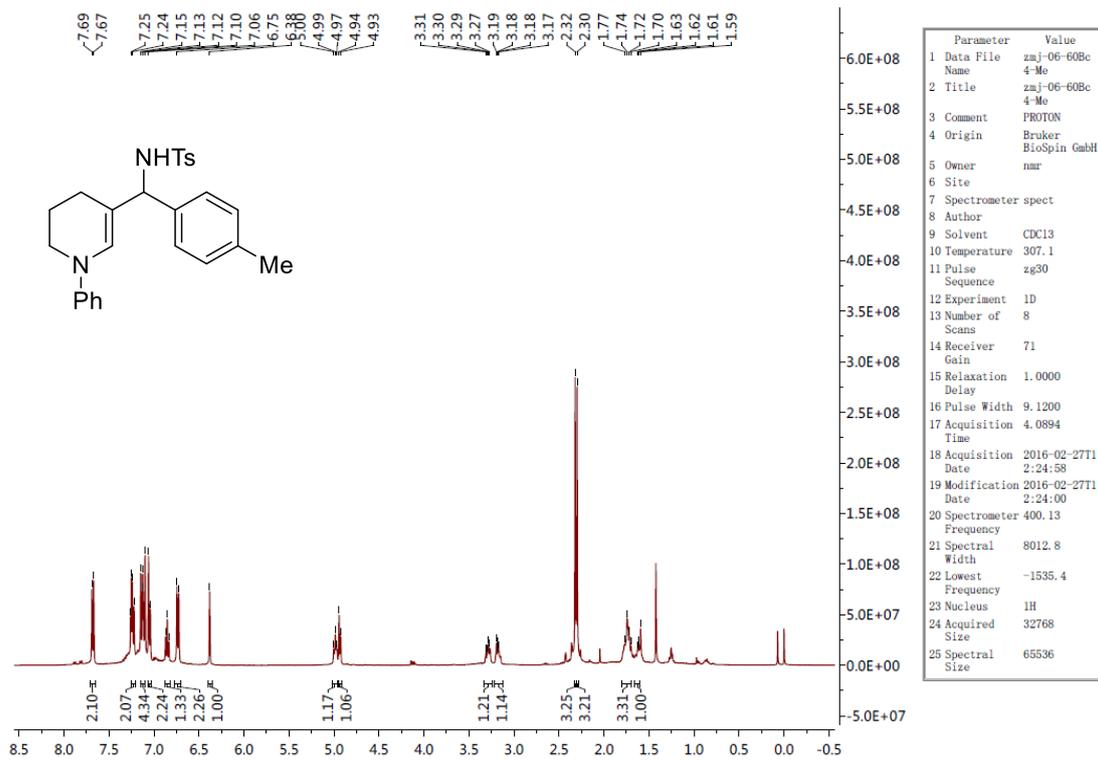


***N*-((4-fluorophenyl)(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)-4-methylbenzenesulfonamide (6c)**



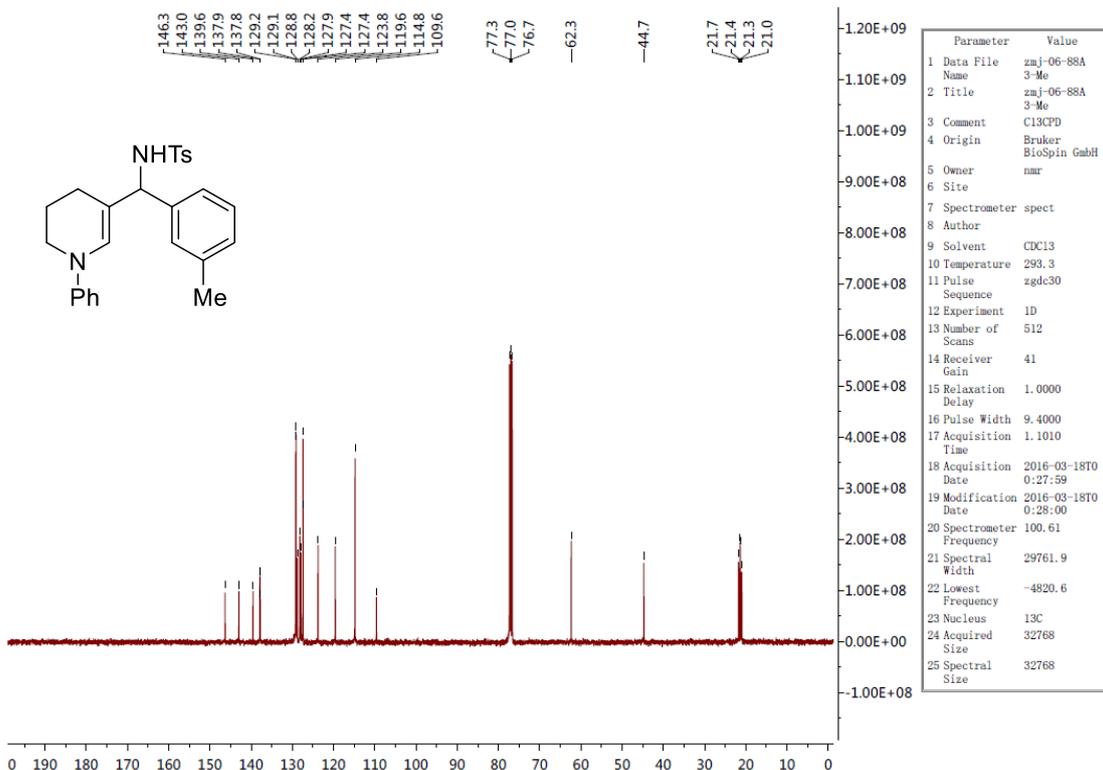
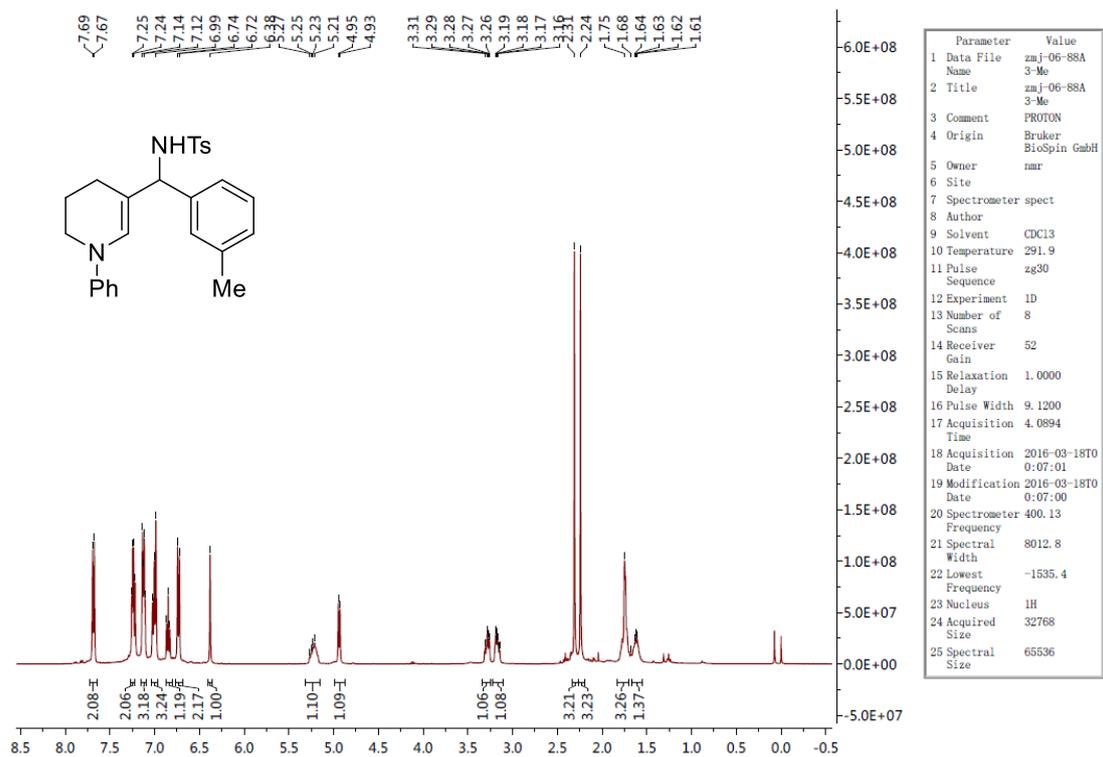
4-methyl-N-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(p-tolyl)methyl)benzenesulfonamide

(6d)



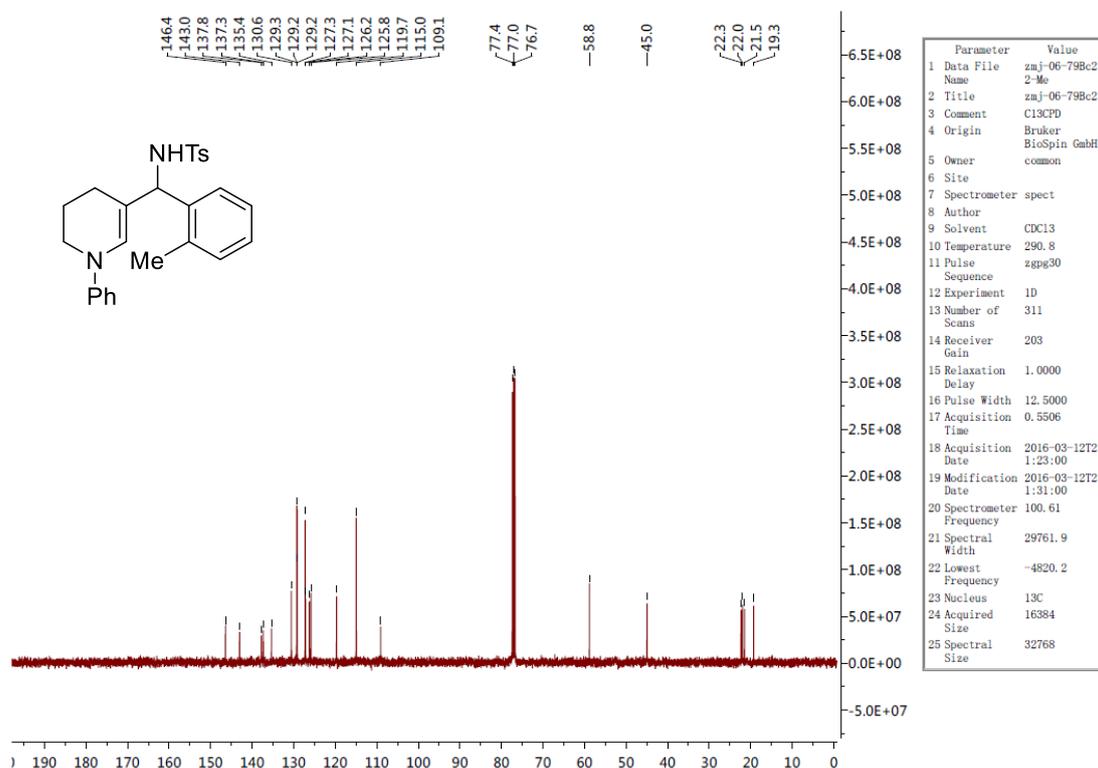
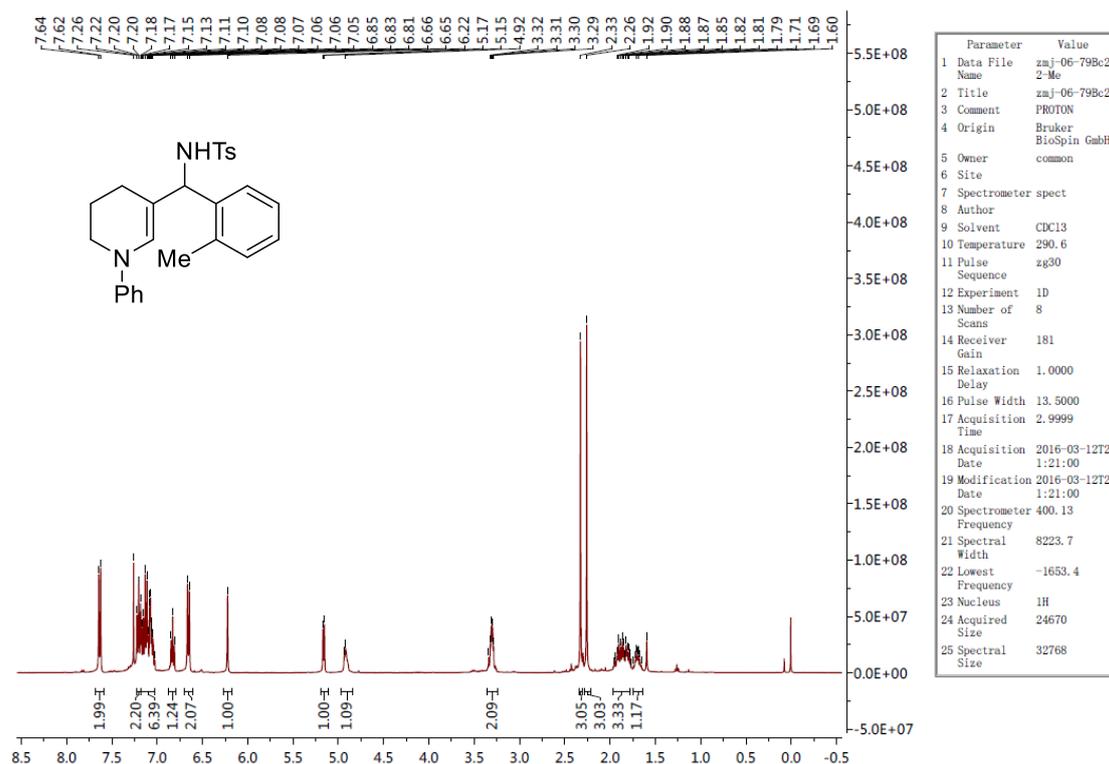
4-methyl-N-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(m-tolyl)methyl)benzenesulfonamide

(6e)

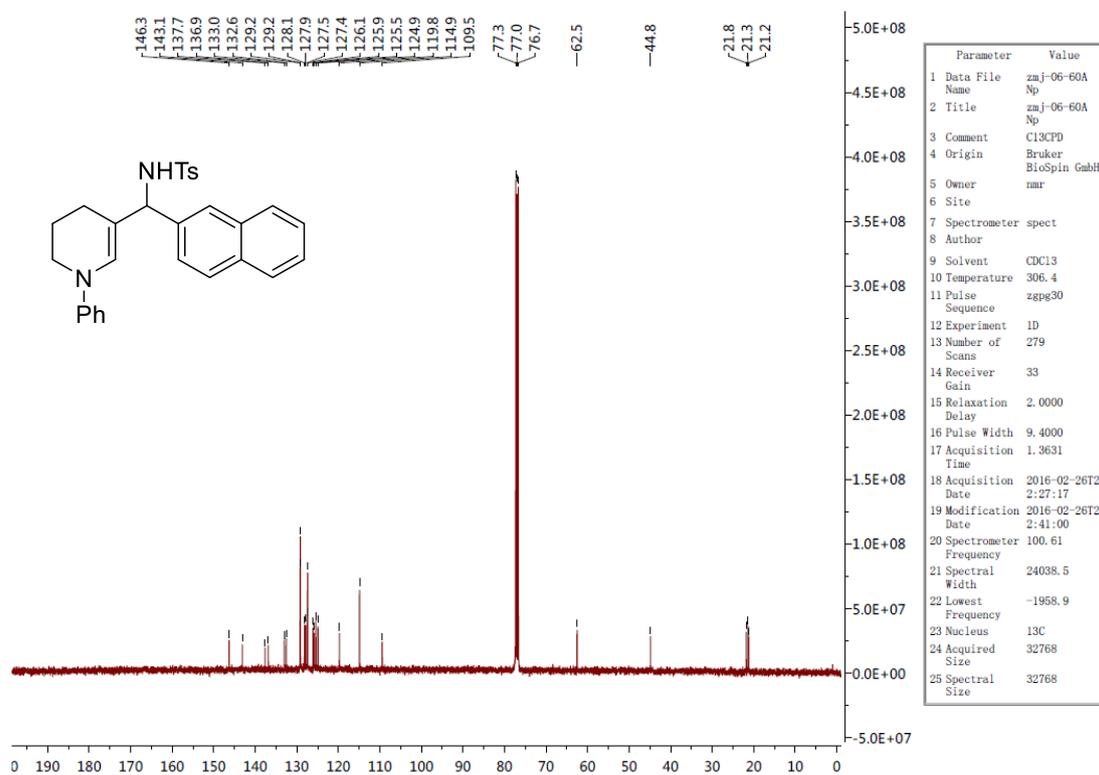
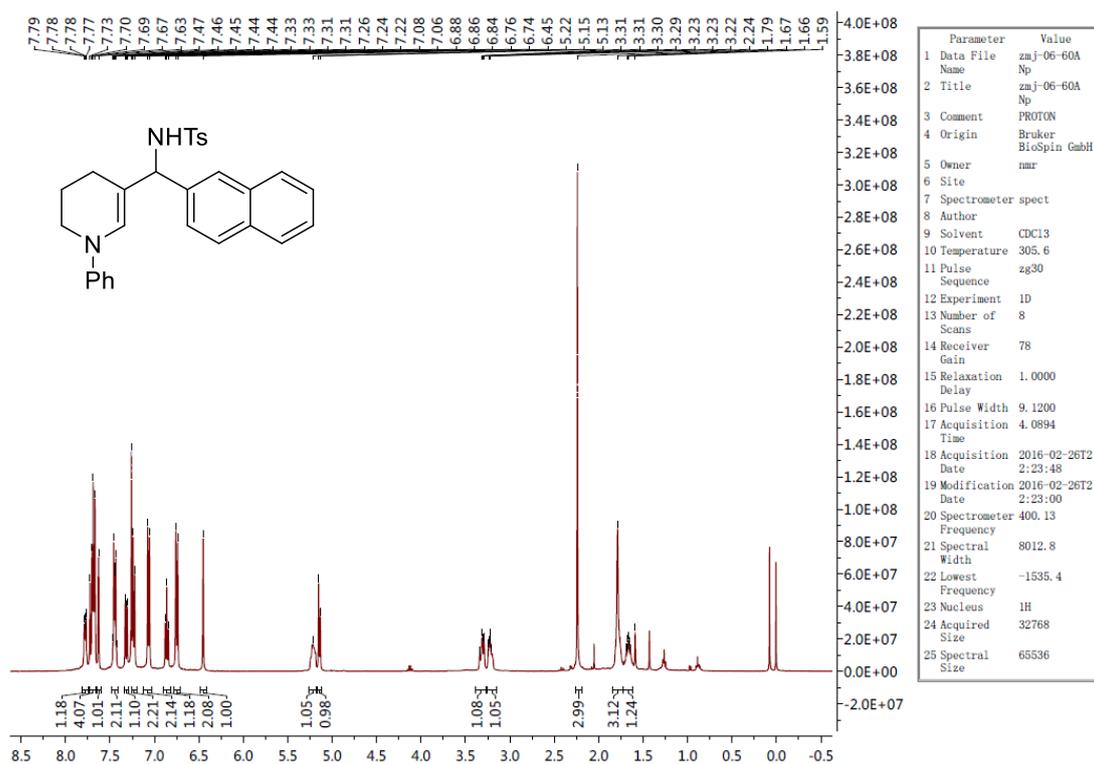


4-methyl-N-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(o-tolyl)methyl)benzenesulfonamide

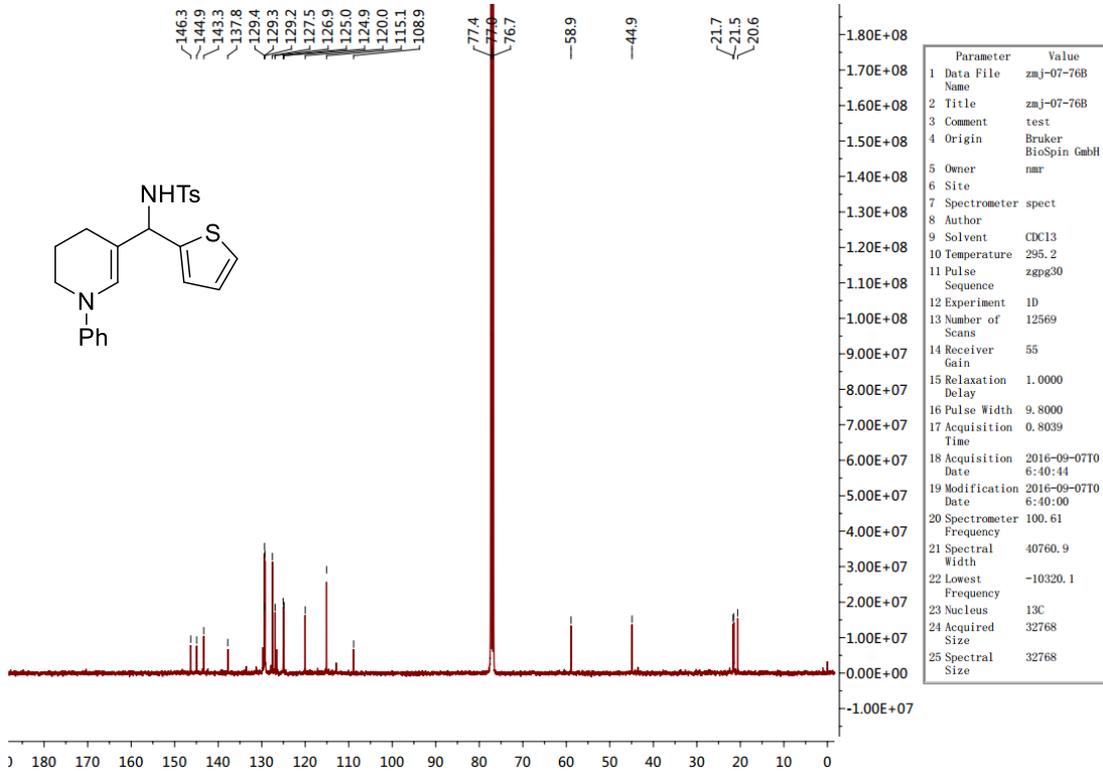
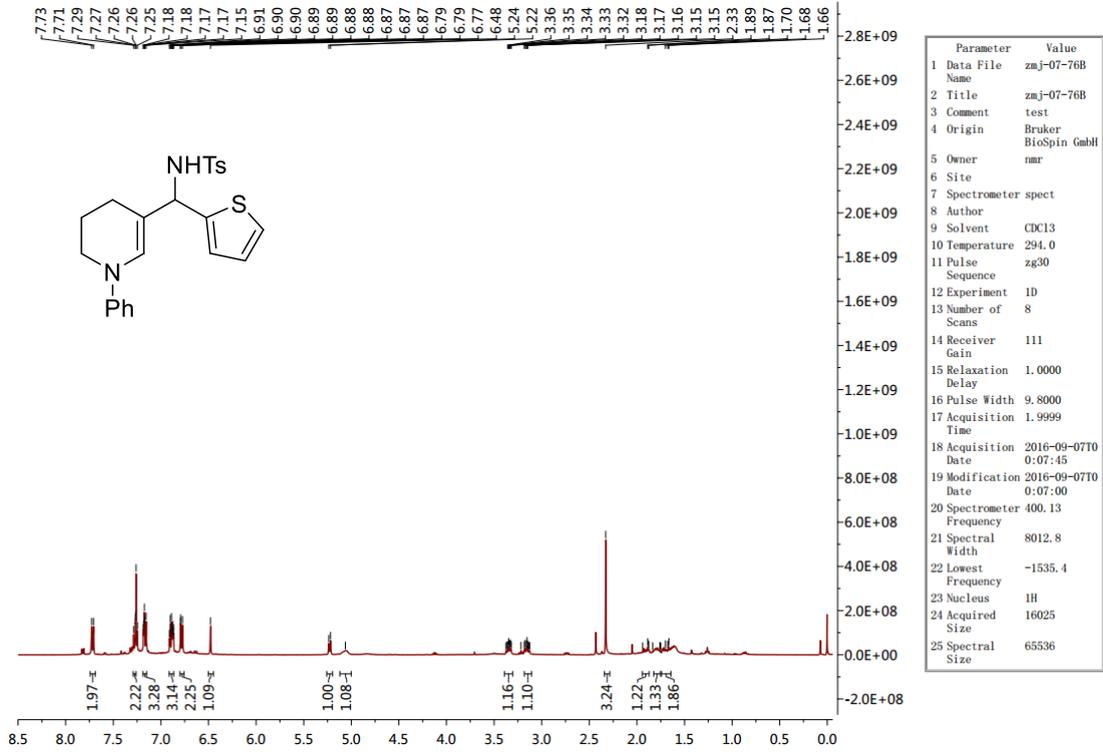
(6f)



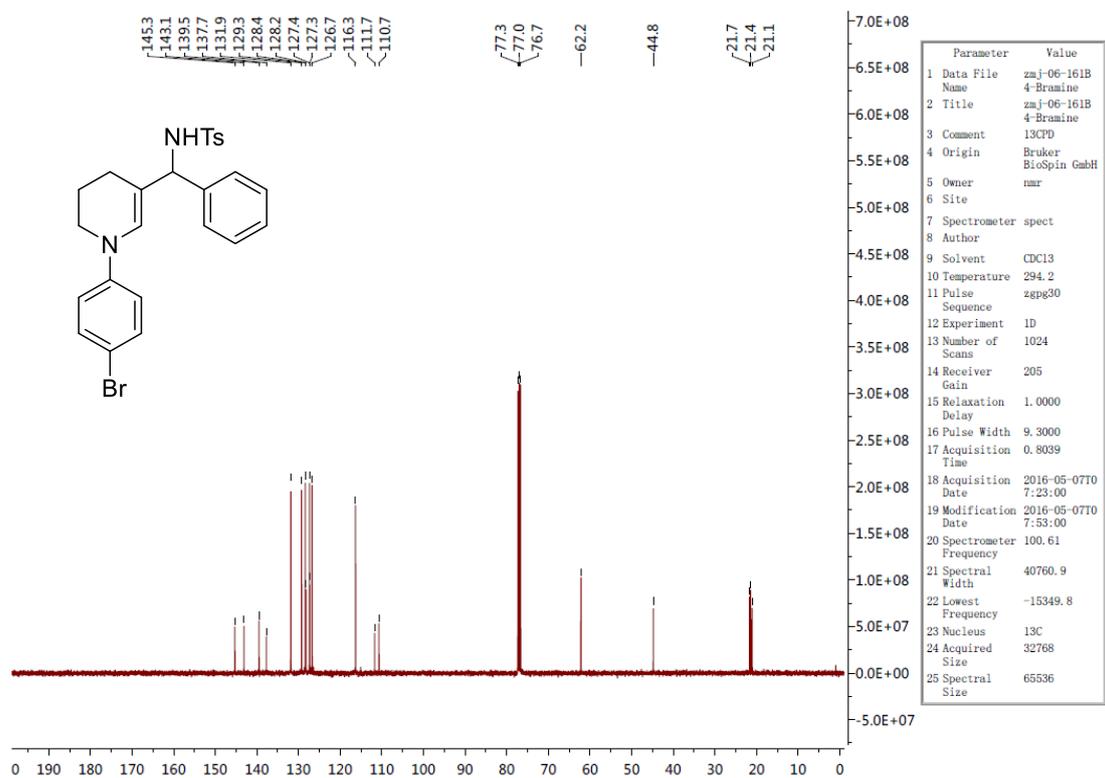
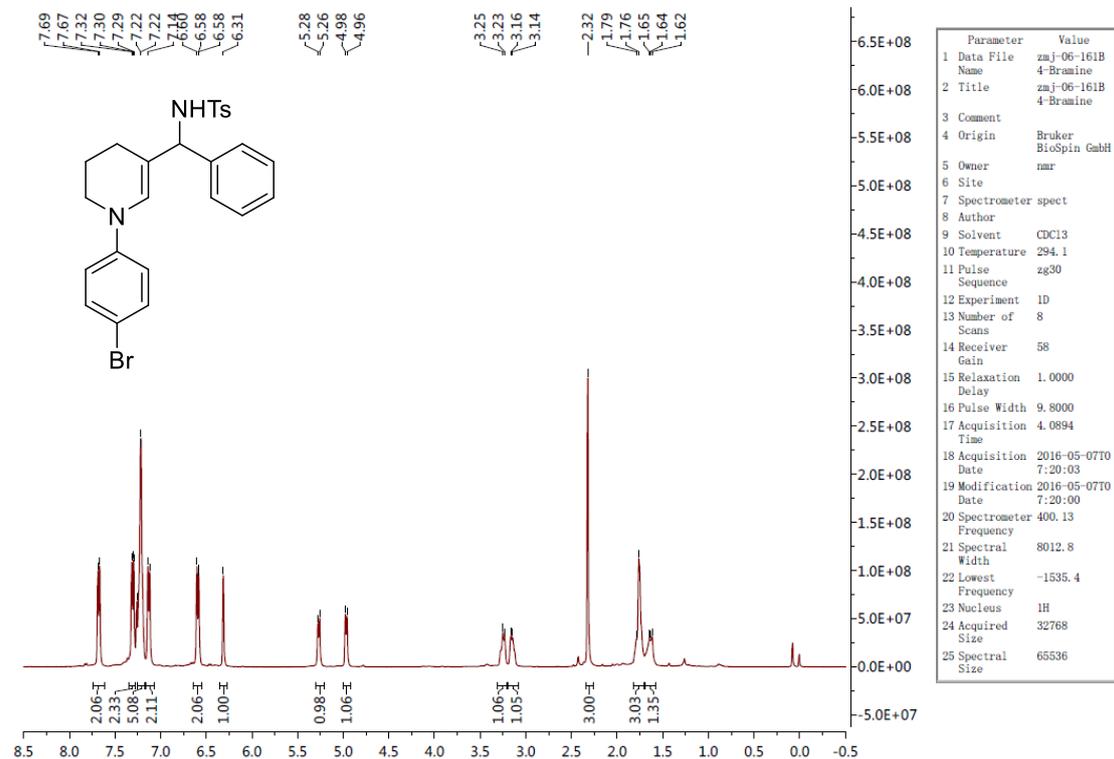
4-methyl-N-(naphthalen-2-yl(1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)methyl)benzenesulfonamide (6g)



4-methyl-N-((1-phenyl-1,4,5,6-tetrahydropyridin-3-yl)(thiophen-2-yl)methyl)benzenesulfonamide (6h)

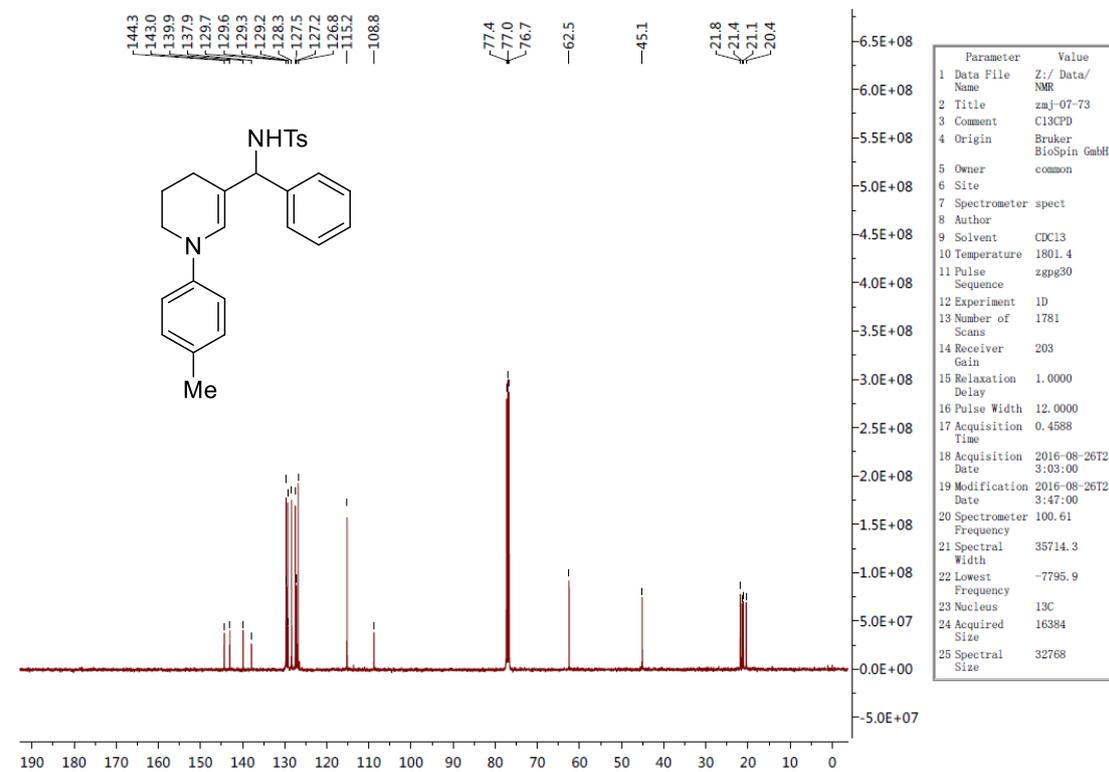
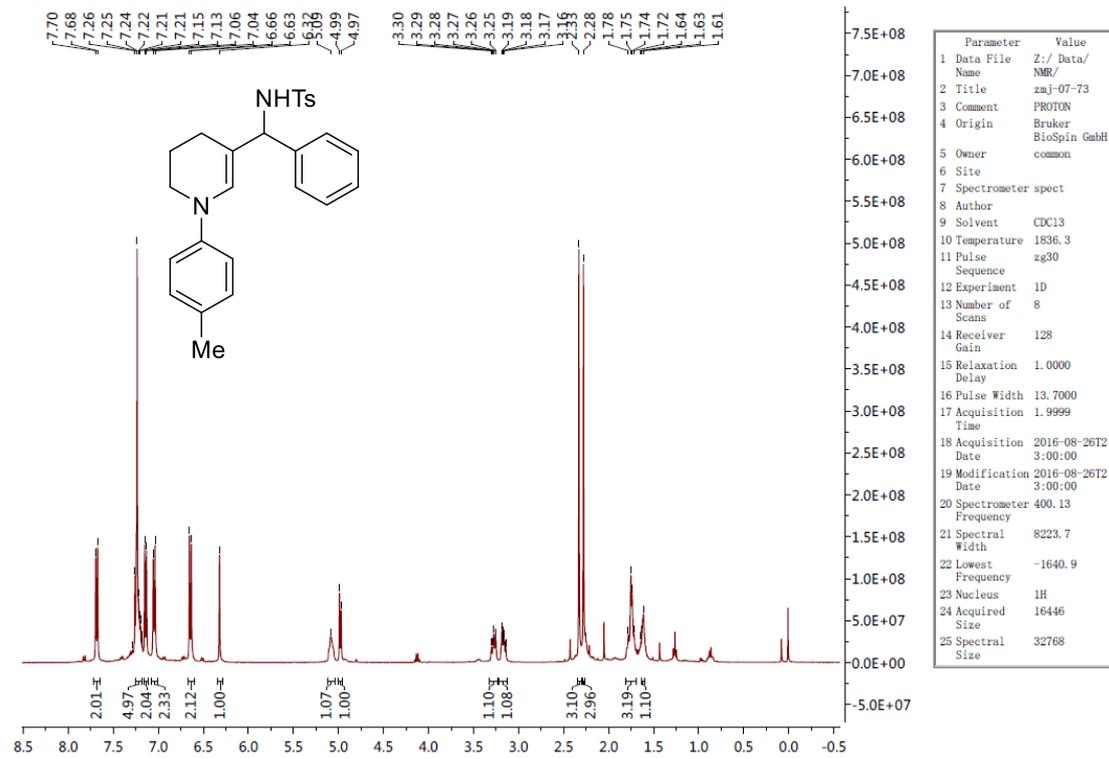


***N*-((1-(4-bromophenyl)-1,4,5,6-tetrahydropyridin-3-yl)(phenyl)methyl)-4-methylbenzenesulfonamide (6i)**



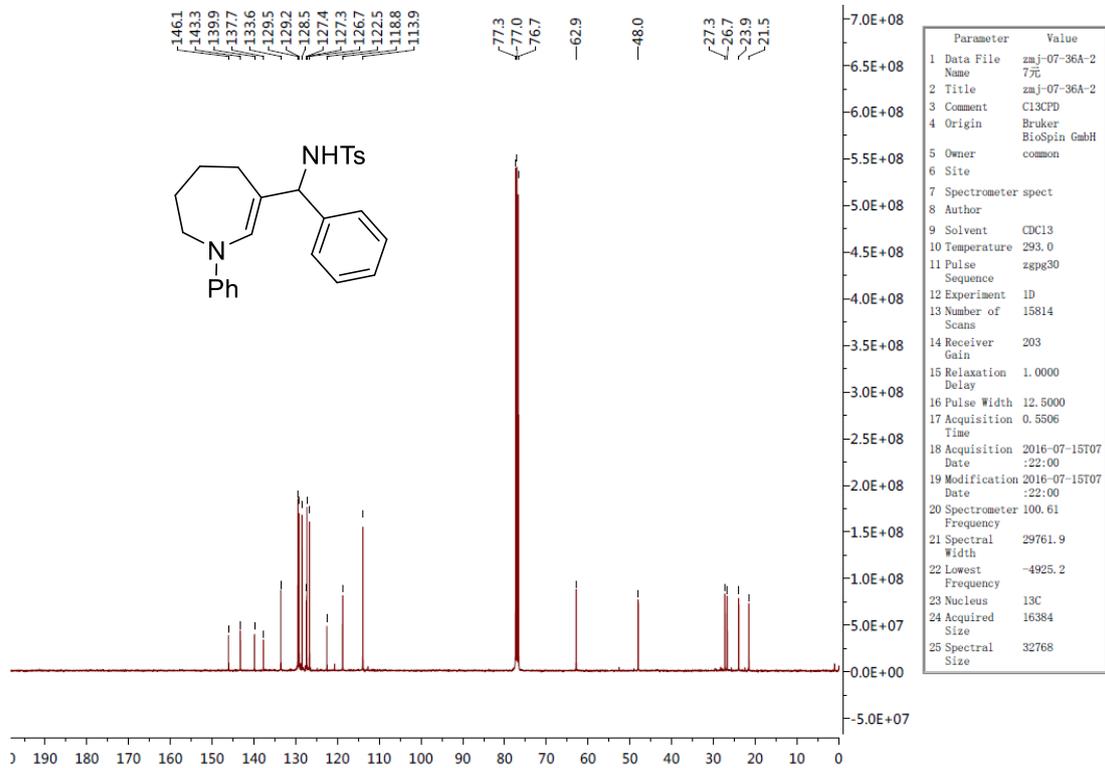
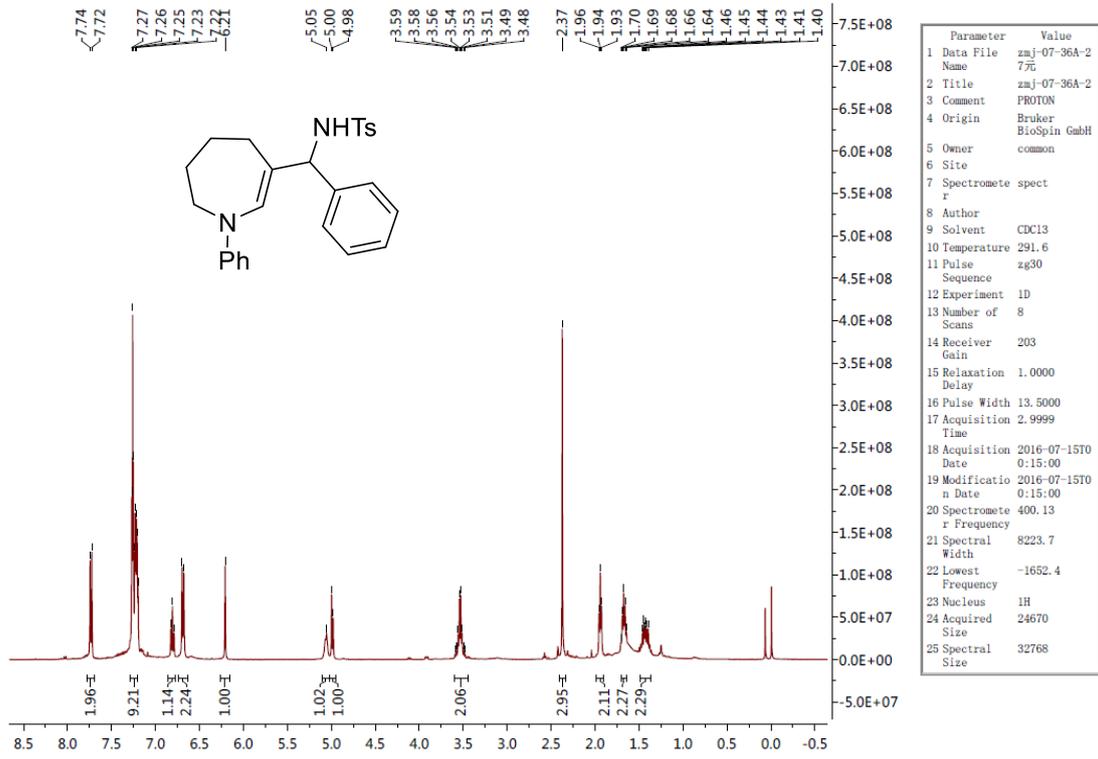
4-methyl-N-(phenyl(1-(p-tolyl)-1,4,5,6-tetrahydropyridin-3-yl)methyl)benzenesulfonamide

(6j)

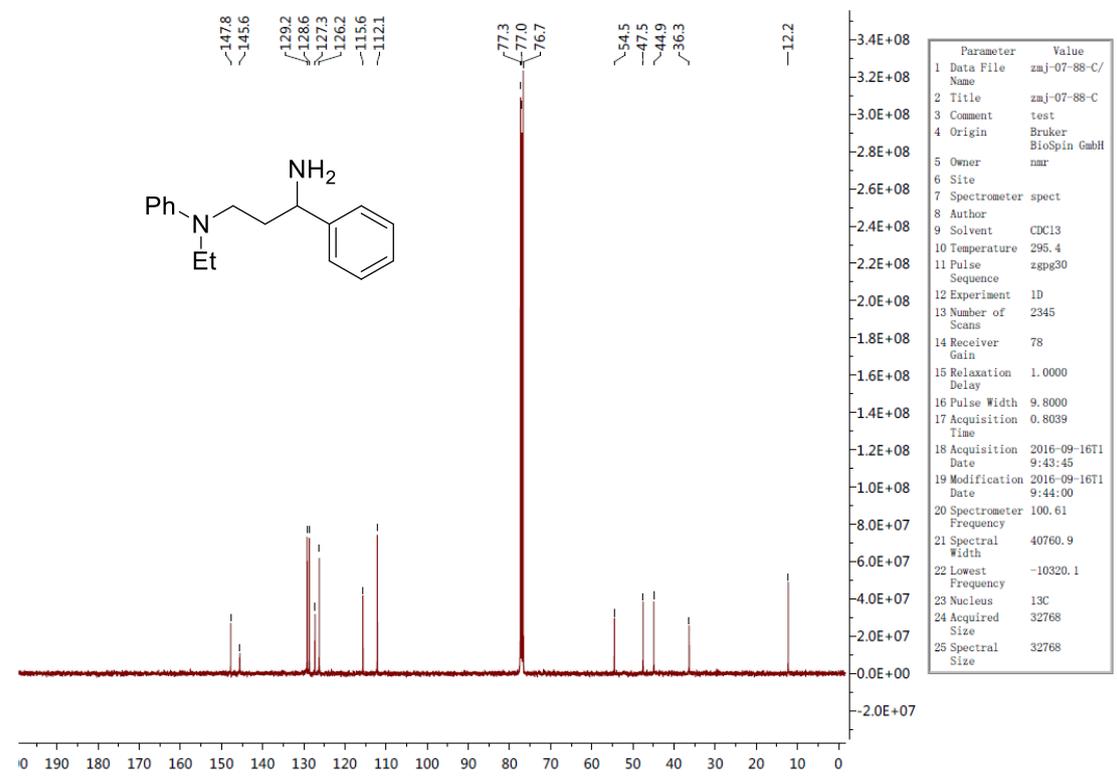
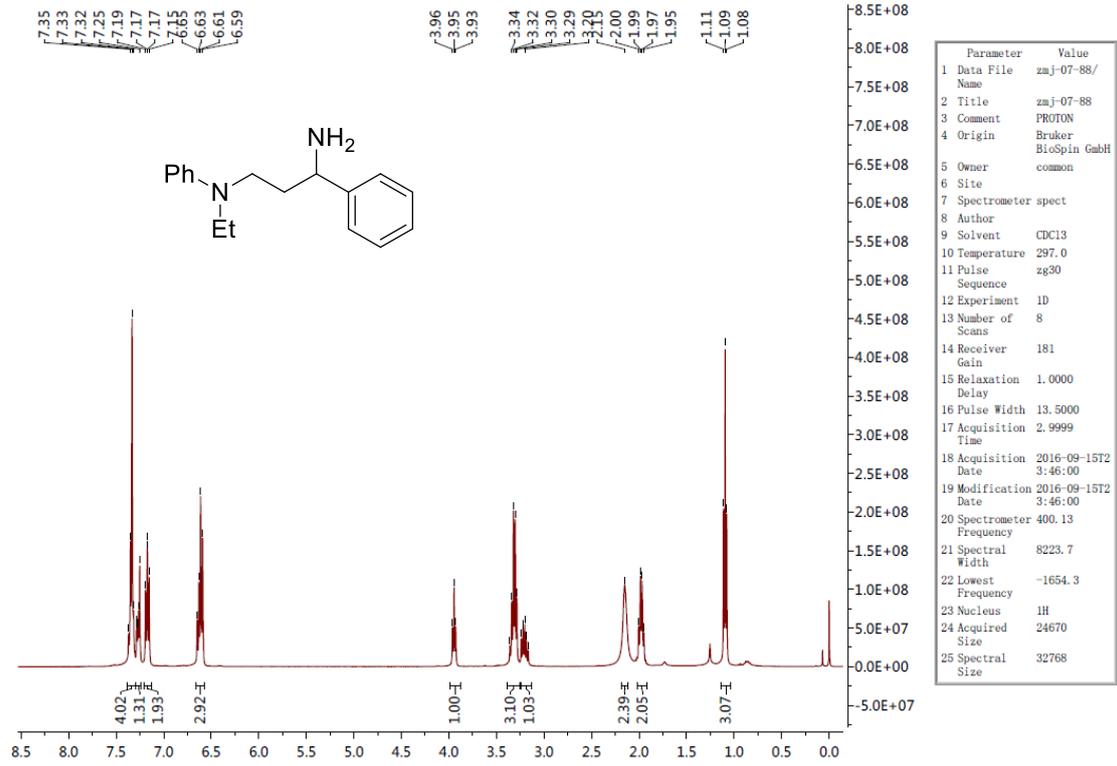


4-methyl-N-(phenyl(1-phenyl-4,5,6,7-tetrahydro-1H-azepin-3-yl)methyl)benzenesulfonamide

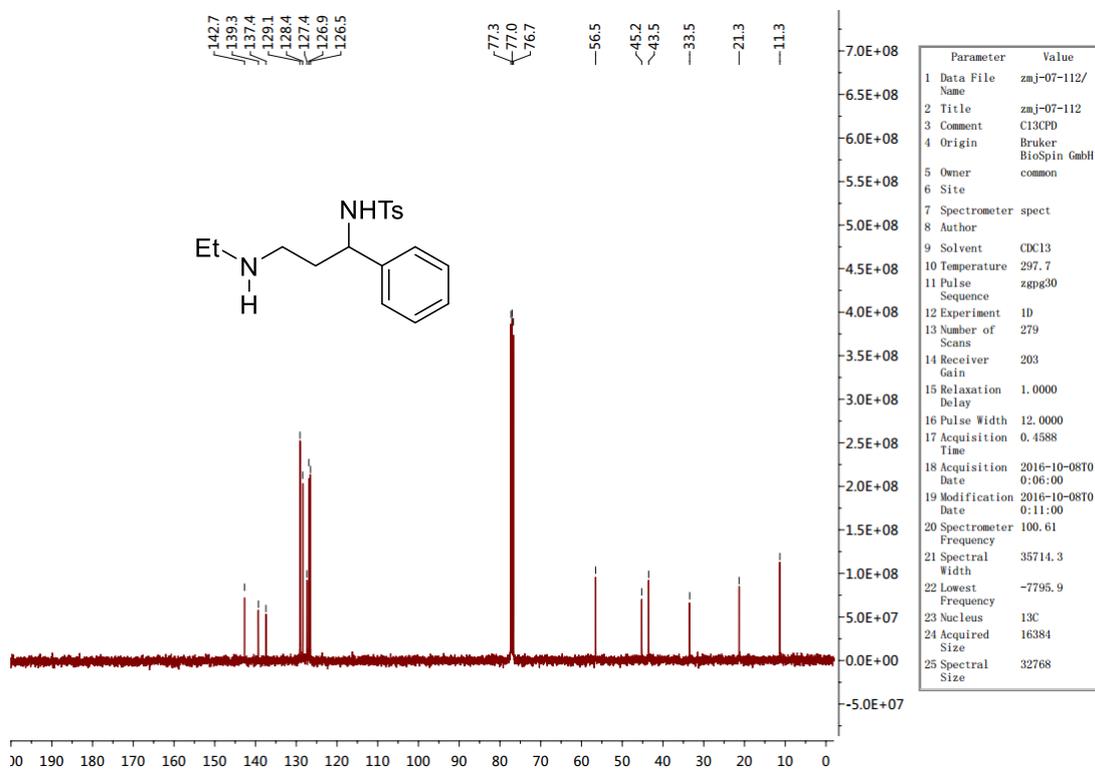
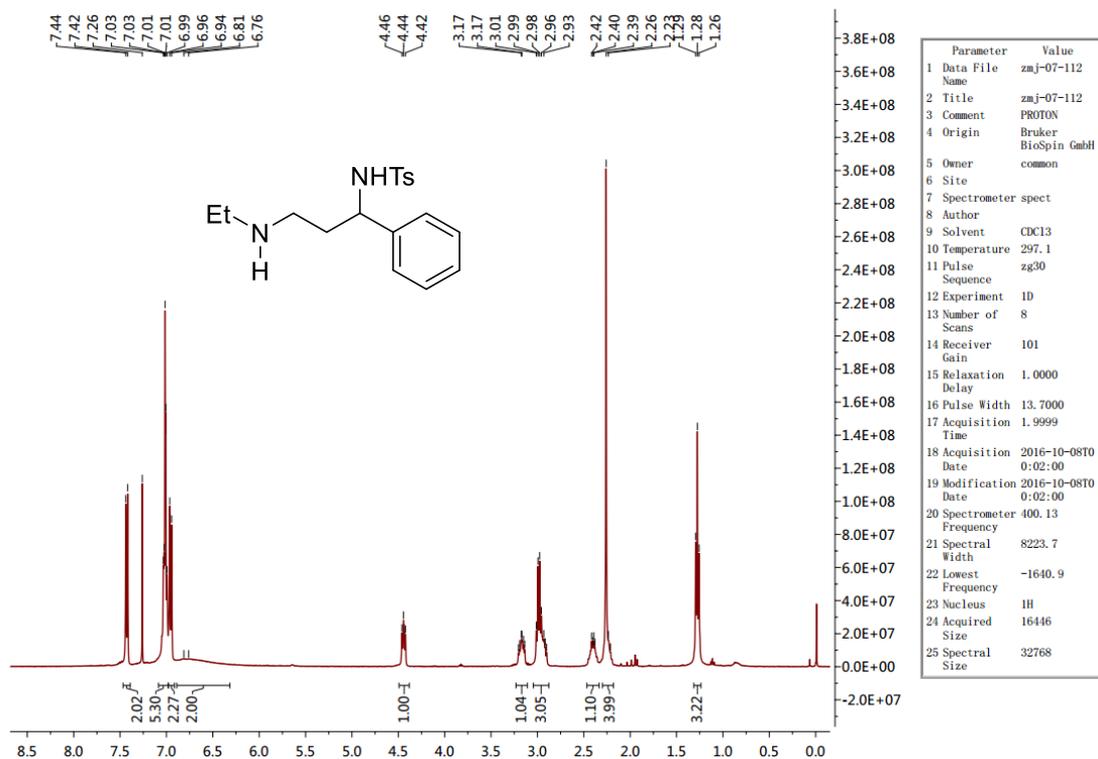
(6k)



N¹-ethyl-N¹,3-diphenylpropane-1,3-diamine (7)



***N*-(3-(ethylamino)-1-phenylpropyl)-4-methylbenzenesulfonamide (8)**



9. Reference

- (1) W. L. F. Armarego, C. L. L. Chai, *Purification of Laboratory chemicals-Six Edition*; Elsevier Inc., London, 2009.
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- (7) Y. H. Lv, Y. Y. Zheng, Y. Li, T. Xiong, J. P. Zhang, Q. Liu and Q. Zhang, *Chem. Commun.*, 2013, **49**, 8866.
- (8) Y. L. Wang, T. L. Liu, L. Y. Bu, J. F. Li, C. Yang, X. J. Li, Y. Yao and W. J. Yang, *J. Phys. Chem. C*, 2012, **116**, 15576.
- (9) N. Takasu, K. Oisaki and M. Kanai, *Org. Lett.*, 2013, **15**, 1918.