

Chiral *N*-*tert*-Butanesulfinyl α,β -Unsaturated Ketimine: A Simple and Highly Effective Olefin/Sulfinimide Hybrid Ligand for Asymmetric 1,4-Additions

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General procedure for the synthesis of chiral olefin/sulfinamide ligands 4. To a solution of (*R*)-*tert*-butanesulfinamide (0.727 g, 6.0 mmol) in THF (12.0 mL) under argon was added α,β -unsaturated ketone or aldehyde (6.6 mmol), and then Ti(OEt)₄ (2.5 mL, 12.0 mmol) was added. The resulting mixture was heated at 80 °C overnight before cooled to room temperature. Brine (12.0 mL) was then added and the mixture was stirred at room temperature for 5 min before filtered through celite. The filter cake was washed with ethyl acetate and the aqueous layer was extracted with ethyl acetate twice. The combined organic layer was washed with brine, dried over Na₂SO₄, filtered, and concentrated under vacuum to give the crude product. The residue was then purified by flash chromatography on silica gel (hexanes/ethyl acetate = 10/1 to 5/1, v/v) to afford the corresponding products **4**.

(*R*)-*N*-[(*E*)-1,3-diphenylprop-2-enylidene]-*tert*-butanesulfinamide (4a**):** 71% yield, yellow solid; $[\alpha]_{\text{D}}^{20} = -378.3$ (*c* 0.95, CHCl₃); ¹H NMR (400 MHz, CDCl₃): δ 8.07 (d, *J* = 16.0 Hz, 1H), 7.75-7.57 (m, 2H), 7.56-7.41 (m, 5H), 7.40-7.31 (m, 3H), 6.90 (d, *J* = 16.0 Hz, 1H), 1.34 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 175.1, 143.6, 138.5, 135.0, 130.5, 129.9, 129.0, 128.6, 128.1, 127.8, 122.2, 58.1, 22.6.

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(*R*)-*N*-[(*E*)-1,3-bis(*p*-tolyl)prop-2-enylidene]-*tert*-butanesulfinamide (4b**):** 57% yield, yellow oil; $[\alpha]_{\text{D}}^{20} = -390.7$ (*c* 0.89, CHCl₃); IR (film): 1538, 1088 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 7.97 (d, *J* = 13.6 Hz, 1H), 7.66-7.45 (m, 2H), 7.29-7.17 (m, 2H), 7.16-7.06 (m, 2H), 6.89 (d, *J* = 16.0 Hz, 1H), 2.40 (s, 3H), 2.33 (s, 3H), 1.32 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 175.8, 143.9, 141.1, 140.4, 136.1, 132.6, 129.6, 129.4, 129.0, 128.1, 121.6, 58.0, 22.7, 21.5, 21.5; HRMS (EI) calcd for C₂₁H₂₅NOS (M): 339.1657; Found: 339.1661.

(*R*)-*N*-[(*E*)-1,3-bis(3-chlorophenyl)prop-2-enylidene]-*tert*-butanesulfinamide (4c**):** 89% yield, yellow oil; $[\alpha]_{\text{D}}^{20} = -300.7$ (*c* 1.00, CHCl₃); IR (film): 1473, 1275, 1074 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 8.12 (d, *J* = 14.4 Hz, 1H), 7.73-7.08 (m, 8H), 6.78 (d, *J* = 16.4 Hz, 1H), 1.34 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 172.8, 142.1, 140.1, 136.8, 134.8, 134.4, 130.6, 130.0, 129.9, 129.6, 128.9, 127.8, 127.2, 126.1, 123.2, 58.8, 22.8; HRMS (EI) calcd for C₁₉H₁₉NOSCl₂ (M): 379.0564; Found: 379.0569.

(*R*)-*N*-[(*E*)-1-phenyl-3-(*p*-tolyl)prop-2-enylidene]-*tert*-butanesulfinamide (4d**):** 63% yield, yellow solid; mp 79-81 °C; $[\alpha]_{\text{D}}^{20} = -395.7$ (*c* 1.00, CHCl₃); IR (film): 1540, 1069 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 8.02 (d, *J* = 15.2 Hz, 1H), 7.74-7.33 (m, 7H), 7.17 (d, *J* = 17.6 Hz, 2H), 6.88 (d, *J* = 16.0 Hz, 1H), 2.36 (s, 3H), 1.34 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 175.9, 144.4, 140.7, 139.0, 132.6, 130.7, 129.8, 129.4, 128.4, 128.3, 121.6, 58.3, 22.9, 21.6; Anal. Calcd for C₂₀H₂₃NOS: C, 73.81; H, 7.12; N, 4.30. Found: C, 73.88; H, 7.16; N, 4.21.

(*R*)-*N*-[(*E*)-3-(4-nitrophenyl)-1-phenylprop-2-enylidene]-*tert*-butanesulfinamide (4e**):** 83% yield, orange solid; mp 42-45 °C; $[\alpha]_{\text{D}}^{20} = -388.7$ (*c* 1.00, CHCl₃); IR (film): 1519, 1344, 1089 cm⁻¹; ¹H NMR

(400 MHz, CDCl₃): δ 8.29 (d, J = 16.0 Hz, 1H), 8.21 (d, J = 8.8 Hz, 2H), 7.64 (d, J = 8.8 Hz, 4H), 7.57-7.42 (m, 3H), 6.90 (d, J = 16.0 Hz, 1H), 1.36 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 173.7, 148.3, 141.7, 140.0, 138.4, 131.1, 129.2, 128.6, 126.7, 124.2, 59.2, 23.0; HRMS (EI) calcd for C₁₉H₂₀N₂O₃S (M): 356.1195; Found: 356.1190.

(R)-N-[(E)-3-(naphthalen-1-yl)-1-phenylprop-2-enylidene]-tert-butanesulfinamide (4f): 77% yield, yellow solid; mp 99-101 °C; $[\alpha]_{\text{D}}^{20}$ = -332.2 (c 1.00, CHCl₃); IR (film): 1607, 1540, 1069 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 8.10 (d, J = 14.8 Hz, 1H), 7.95-7.64 (m, 7H), 7.61-7.43 (m, 6H), 1.37 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 175.7, 140.8, 133.9, 132.7, 131.6, 131.1, 130.5, 129.6, 129.0, 128.6, 127.0, 126.3, 125.9, 125.5, 123.2, 58.5, 23.0; Anal. Calcd for C₂₃H₂₃NOS: C, 76.42; H, 6.41; N, 3.87. Found: C, 76.52; H, 6.48; N, 3.68.

(R)-N-[(E)-3-phenylprop-2-enylidene]-tert-butanesulfinamide (4g): 98% yield, light yellow solid; $[\alpha]_{\text{D}}^{20}$ = -333.5 (c 1.00, CHCl₃); ¹H NMR (400 MHz, CDCl₃): δ 8.38 (d, J = 9.2 Hz, 1H), 7.59-7.48 (m, 2H), 7.45-7.33 (m, 3H), 7.24 (d, J = 16.0 Hz, 1H), 7.08 (dd, J = 16.0, 9.2 Hz, 1H), 1.24 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 164.0, 146.5, 135.3, 130.4, 129.2, 128.1, 125.8, 57.8, 22.7.

H. K. Chang, D. Y. Jung, M. K. Kim and Y. H. Kim, *Synlett*, 2005, 304.

(R)-N-[(E)-1-methyl-3-phenylprop-2-enylidene]-tert-butanesulfinamide (4h): 85% yield, orange solid; $[\alpha]_{\text{D}}^{20}$ = -173.6 (c 1.00, CHCl₃); ¹H NMR (400 MHz, CDCl₃): δ 7.94 (d, J = 16.4 Hz, 0.3H), 7.48 (d, J = 6.4 Hz, 2H), 7.39-7.27 (m, 3H), 7.23 (d, J = 16.4 Hz, 0.7 H), 7.12 (d, J = 16.4 Hz, 0.3H), 6.80 (d, J = 16.4 Hz, 0.7H), 2.50 (s, 2.1H), 2.37 (s, 0.9H), 1.27 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 175.9, 173.6, 140.6, 138.8, 134.7, 134.6, 129.7, 129.6, 129.4, 128.4, 127.6, 127.4, 121.7, 57.1, 56.5, 23.9, 22.1, 18.4.

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(R)-N-[(E)-1-phenylprop-2-enylidene]-tert-butanesulfinamide (4i): 53% yield, orange oil; $[\alpha]_{\text{D}}^{20}$ = -123.2 (c 0.94, CHCl₃); IR (film): 1550, 1075 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 7.76-7.33 (m, 6H), 5.92 (d, J = 11.2 Hz, 1H), 5.61 (d, J = 17.6 Hz, 1H), 1.32 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 175.5, 137.9, 131.7, 131.1, 129.3, 128.9, 128.3, 58.2, 22.7; HRMS (EI) calcd for C₁₃H₁₇NOS (M): 235.1031; Found: 235.1034.

(R)-N-[(1E,4E)-1,5-diphenylpenta-1,4-dien-3-ylidene]-tert-butanesulfinamide (4j): 67% yield, yellow solid; mp 135-138 °C; $[\alpha]_{\text{D}}^{20}$ = -296.6 (c 0.90, CHCl₃); IR (film): 1559, 1067 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 7.92 (d, J = 13.2 Hz, 1H), 7.65-7.45 (m, 5H), 7.45-7.32 (m, 6H), 7.32-7.07 (m, 2H), 1.34 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 170.8, 140.3, 135.6, 130.0, 129.1, 128.2, 124.8, 58.7, 23.0; Anal. Calcd for C₂₁H₂₃NOS: C, 74.74; H, 6.87; N, 4.15. Found: C, 74.58; H, 7.00; N, 4.10.

(R)-N-[(E)-2-benzylidenecyclohexylidene]-tert-butanesulfinamide (4k): 63% yield, yellow oil; $[\alpha]_D^{20} = +118.4$ (*c* 1.06, CHCl₃); IR (film): 1261, 1275, 1066 cm⁻¹; ¹H NMR (400 MHz, CDCl₃): δ 7.42-7.21 (m, 6H), 3.16-3.01 (m, 1H), 2.98-2.86 (m, 1H), 2.85-2.64 (m, 2H), 1.94-1.74 (m, 2H), 1.74-1.59 (m, 2H), 1.30 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 183.1, 138.4, 136.4, 132.9, 130.1, 128.4, 128.1, 57.0, 34.4, 29.2, 24.1, 22.6; Anal. Calcd for C₁₇H₂₃NOS: C, 70.54; H, 8.01; N, 4.84. Found: C, 70.37; H, 7.96; N, 4.63.

(R)-N-(cyclohex-2-en-ylidene)-tert-butanesulfinamide (4l): 65% yield, yellow oil; $[\alpha]_D^{20} = -331.9$ (*c* 0.75, CHCl₃); ¹H NMR (400 MHz, CDCl₃): δ 7.07 (d, *J* = 10.0 Hz, 0.4H), 6.68-6.55 (m, 1H), 6.18 (d, *J* = 10.0 Hz, 0.6H), 3.09-2.93 (m, 0.6H), 2.87-2.73 (m, 0.6H), 2.58-2.51 (m, 0.8H), 2.34-2.19 (m, 2H), 1.99-1.75 (m, 2H), 1.21 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 177.9, 175.7, 146.0, 144.9, 130.4, 123.1, 56.9, 56.5, 36.1, 30.9, 26.0, 25.2, 22.5, 22.3, 22.2, 21.9.

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General procedure for 4a/Rh-catalyzed asymmetric 1,4-additions (Table 2): To a dried Schlenk flask charged with [RhCl(C₂H₄)₂]₂ (0.0023 g, 0.006 mmol, 1.5 mol %), and ligand **4a** (0.0045 g, 0.0144 mmol, 3.6 mol %) was added CH₃OH (0.50 mL) under argon. The resulting mixture was stirred at room temperature for 15 min before heated to 30 °C. Then K₃PO₄·3H₂O (0.030 mmol, 0.008 g, 7.5 mol %), arylboronic acid **6** (0.60 mmol), enone **5** (0.4 mmol) and CH₃OH (1.0 mL) was added sequentially. After stirring at 30 °C for 5 h, the reaction mixture was concentrated under reduced pressure, and the crude residue was purified by flash chromatography on silica gel (hexanes/ethyl ether) to afford the desired product **7**.

(S)-3-Phenylcyclohexanone (Table 2, entry 1): light yellow oil; $[\alpha]_D^{20} = -21.8$ (*c* 0.89, CHCl₃) (96% ee) [lit.: $[\alpha]_D^{20} = -21.0$ (*c* 0.96, CHCl₃) (97% ee) for *S*-isomer]; ¹H NMR (400 MHz, CDCl₃): δ 7.38-7.29 (m, 2H), 7.27-7.19 (m, 3H), 3.08-2.94 (m, 1H), 2.66-2.31 (m, 4H), 2.20-2.04 (m, 2H), 1.93-1.71 (m, 2H); ¹³C NMR (100 MHz, CDCl₃): δ 211.2, 144.5, 128.9, 126.9, 126.8, 49.1, 44.9, 41.4, 33.0, 25.7.

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(S)-3-*p*-Tolylcyclohexanone (Table 2, entry 2): light yellow solid; $[\alpha]_D^{20} = -17.8$ (*c* 0.85, CHCl₃) (96% ee) [lit.: $[\alpha]_D^{20} = -17.0$ (*c* 0.95, CHCl₃) (97% ee) for *S*-isomer]; ¹H NMR (400 MHz, CDCl₃): δ 7.15 (d, *J* = 13.2 Hz, 2H), 7.13 (d, *J* = 13.2 Hz, 2H), 3.04-2.92 (m, 1H), 2.63-2.36 (m, 4H), 2.34 (s, 1H), 2.20-2.03 (m, 2H), 1.90-1.70 (m, 2H); ¹³C NMR (100 MHz, CDCl₃): δ 211.2, 141.6, 136.4, 129.5, 126.6, 49.2, 44.5, 41.3, 33.1, 25.7, 21.1.

Y. Takaya, M. Ogasawara and T. Hayashi, *J. Am. Chem. Soc.*, 1998, **120**, 5579.

(S)-3-(Biphenyl-4-yl)cyclohexanone (Table 2, entry 3): white solid; $[\alpha]_{\text{D}}^{20} = -8.8$ (c 1.00, CHCl_3) (98% ee) [lit.: $[\alpha]_{\text{D}}^{25} = -5.5$ (c 0.50, CHCl_3) (93% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.57 (t, $J = 8.0$ Hz, 4H), 7.43 (t, $J = 7.2$ Hz, 2H), 7.36-7.27 (m, 3H), 3.13-2.97 (m, 1H), 2.68-2.33 (m, 4H), 2.21-2.08 (m, 2H), 1.93-1.73 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.1, 143.6, 141.0, 139.9, 129.0, 127.6, 127.4, 127.2, 49.1, 44.6, 41.4, 33.0, 25.7.

T. Zhang and M. Shi, *Chem.-Eur. J.*, 2008, **14**, 3759.

(S)-3-(4-Fluorophenyl)cyclohexanone (Table 2, entry 4): colorless oil; $[\alpha]_{\text{D}}^{20} = -17.5$ (c 0.61, CHCl_3) (96% ee) [lit.: $[\alpha]_{\text{D}}^{20} = +14.3$ (c 1.20, CHCl_3) (98% ee) for *R*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.22-7.13 (m, 2H), 7.05-6.95 (m, 2H), 3.06-2.92 (m, 1H), 2.61-2.30 (m, 4H), 2.18-2.02 (m, 2H), 1.88-1.70 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 210.7, 161.7 (d, $J_{\text{C-F}} = 243.4$ Hz), 140.2 (d, $J_{\text{C-F}} = 3.1$ Hz), 128.1 (d, $J_{\text{C-F}} = 7.8$ Hz), 115.6 (d, $J_{\text{C-F}} = 20.9$ Hz), 49.2, 44.1, 41.2, 33.1, 25.5.

M. Pucheault, S. Darses and J. P. Genêt, *Eur. J. Org. Chem.*, 2002, 3552.

(S)-3-[4-(Trifluoromethyl)phenyl]cyclohexanone (Table 2, entry 5): light yellow solid; $[\alpha]_{\text{D}}^{20} = -25.7$ (c 0.98, CHCl_3) (96% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -11.0$ (c 0.97, CHCl_3) (99% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.58 (d, $J = 8.4$ Hz, 2H), 7.33 (d, $J = 8.4$ Hz, 2H), 3.12-3.02 (m, 1H), 2.64-2.31 (m, 4H), 2.19-2.03 (m, 2H), 1.93-1.69 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 210.3, 148.4, 129.2 (q, $J_{\text{C-F}} = 32.4$ Hz), 127.2, 125.8 (q, $J_{\text{C-F}} = 3.9$ Hz), 124.3 (q, $J_{\text{C-F}} = 270.4$ Hz), 123.0, 48.7, 44.7, 41.3, 32.7, 25.6.

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(S)-3-(4-Acetylphenyl)cyclohexanone (Table 2, entry 6): white solid; $[\alpha]_{\text{D}}^{20} = -7.3$ (c 0.74, CHCl_3) (94% ee) [lit.: $[\alpha]_{\text{D}}^{32} = -7.8$ (c 1.02, CHCl_3) (97% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.90 (d, $J = 8.4$ Hz, 2H), 7.30 (d, $J = 8.0$ Hz, 2H), 3.11-2.98 (m, 1H), 2.60-2.32 (m, 6H), 2.58 (s, 3H), 2.19-2.03 (m, 2H), 1.92-1.78 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 210.4, 197.7, 149.8, 135.9, 129.0, 127.0, 48.5, 44.8, 41.2, 32.6, 26.7, 25.5.

C. Defieber, J.-F. Paquin, S. Serna and E. M. Carreira, *Org. Lett.*, 2004, **6**, 3873.

(S)-3-[4-(Hydroxymethyl)phenyl]cyclohexanone (Table 2, entry 7): colorless oil; $[\alpha]_{\text{D}}^{20} = -11.4$ (c 0.86, CHCl_3) (95% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -18.8$ (c 0.97, CHCl_3) (92% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.32 (d, $J = 8.0$ Hz, 2H), 7.20 (d, $J = 8.0$ Hz, 2H), 4.66 (s, 2H), 3.05-2.94 (m, 1H), 2.60-2.31 (m, 4H), 2.17-2.03 (m, 3H), 1.90-1.67 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.4, 143.9, 139.6, 127.6, 126.9, 65.1, 49.1, 44.6, 41.3, 32.9, 25.7.

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(S)-3-(1-Naphthyl)cyclohexanone (Table 2, entry 8): white solid; $[\alpha]_{\text{D}}^{20} = -56.0$ (c 1.00, CHCl_3) (95% ee) [lit.: $[\alpha]_{\text{D}} = +45.8$ (c 1.5, CHCl_3) (98% ee) for *R*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 8.05 (d, $J =$

8.4 Hz, 1H), 7.88 (d, $J = 8.8$ Hz, 1H), 7.76 (d, $J = 8.0$ Hz, 1H), 7.58-7.44 (m, 3H), 7.40 (d, $J = 7.2$ Hz, 1H), 3.93-3.80 (m, 1H), 2.83-2.41 (m, 4H), 2.30-2.14 (m, 2H), 2.08-1.85 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.3, 140.2, 134.2, 131.1, 129.3, 127.4, 126.4, 125.8, 125.7, 122.9, 122.6, 48.7, 41.6, 39.6, 32.5, 25.8.

C. S. Cho, S. Motofusa, K. Ohe, S. Uemura and S. C. Shim, *J. Org. Chem.*, 1995, **60**, 883.

(S)-3-(2-Naphthyl)cyclohexanone (Table 2, entry 9): white solid; $[\alpha]_{\text{D}}^{20} = -8.1$ (c 1.08, CHCl_3) (92% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -8.3$ (c 0.89, CHCl_3) (99% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.87-7.78 (m, 3H), 7.65 (s, 1H), 7.52-7.41 (m, 2H), 7.37 (dd, $J = 8.4, 1.6$ Hz, 1H), 3.25-3.12 (m, 1H), 2.74-2.59 (m, 2H), 2.55-2.36 (m, 2H), 2.24-2.12 (m, 2H), 2.04-1.76 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.0, 141.9, 133.7, 132.6, 128.5, 127.9, 127.8, 126.4, 125.8, 125.5, 124.9, 49.0, 45.0, 41.4, 32.9, 25.7.

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(S)-3-*o*-Methoxyphenylcyclohexanone (Table 2, entry 10): colorless oil; $[\alpha]_{\text{D}}^{20} = -37.8$ (c 0.63, CHCl_3) (92% ee) [lit.: $[\alpha]_{\text{D}}^{32} = -36.3$ (c 1.02, CHCl_3) (94% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.25-7.14 (m, 2H), 6.94 (dd, $J = 8.0, 7.2$ Hz, 1H), 6.87 (d, $J = 8.0$ Hz, 1H), 3.82 (s, 3H), 3.49-3.35 (m, 1H), 2.63-2.31 (m, 4H), 2.18-1.98 (m, 2H), 1.94-1.71 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.8, 156.9, 132.7, 127.7, 126.7, 120.9, 110.8, 55.4, 47.8, 41.6, 38.2, 31.2, 25.8.

C. Defieber, J.-F. Paquin, S. Serna and E. M. Carreira, *Org. Lett.*, 2004, **6**, 3873.

(S)-3-*o*-Tolylcyclohexanone (Table 2, entry 11): colorless oil; $[\alpha]_{\text{D}}^{20} = -40.8$ (c 1.16, CHCl_3) (90% ee) [lit.: $[\alpha]_{\text{D}} = -15.0$ (c 0.87, CHCl_3) (95% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.24-7.07 (m, 4H), 3.24-3.15 (m, 1H), 2.52-2.31 (m, 4H), 2.31 (s, 3H), 2.18-2.11 (m, 1H), 2.03-1.95 (m, 1H), 1.88-1.72 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.6, 142.4, 135.1, 130.7, 126.5, 126.4, 125.2, 48.4, 41.4, 40.4, 32.1, 25.8, 19.3.

Y. Ma, C. Song, C. Ma, Z. Sun, Q. Chai and M. B. Andrus, *Angew. Chem., Int. Ed.*, 2003, **42**, 5871.

(S)-3-(2-Chlorophenyl)cyclohexanone (Table 2, entry 12): colorless oil; $[\alpha]_{\text{D}}^{20} = -41.4$ (c 1.07, CHCl_3) (94% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -21.5$ (c 1.3, CHCl_3) (64% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.35 (d, $J = 8.0$ Hz, 1H), 7.30-7.22 (m, 2H), 7.19-7.12 (m, 1H), 3.58-3.43 (m, 1H), 2.65-2.56 (m, 1H), 2.53-2.31 (m, 3H), 2.19-2.01 (m, 2H), 1.91-1.72 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 210.5, 141.4, 133.6, 130.0, 127.9, 127.4, 127.1, 47.4, 41.4, 40.7, 31.4, 25.4.

X. Hu, M. Zhuang, Z. Cao and H. Du, *Org. Lett.*, 2009, **11**, 4744.

(S)-3-*m*-Tolylcyclohexanone (Table 2, entry 13): colorless oil; $[\alpha]_{\text{D}}^{20} = -19.6$ (c 1.10, CHCl_3) (96% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -15.6$ (c 0.95, CHCl_3) (82% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.26-7.17 (m, 1H), 7.07-6.95 (m, 3H), 3.01-2.88 (m, 1H), 2.62-2.29 (m, 4H), 2.34 (s, 3H), 2.18-2.00 (m, 2H), 1.90-1.68

(m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.1, 144.5, 138.3, 128.7, 127.5, 127.4, 123.7, 49.1, 44.8, 41.3, 32.9, 25.7, 21.6.

X. Hu, M. Zhuang, Z. Cao and H. Du, *Org. Lett.*, 2009, **11**, 4744.

(S)-3-(3-Fluorophenyl)cyclohexanone (Table 2, entry 14): colorless oil; $[\alpha]_{\text{D}}^{20} = -18.9$ (*c* 0.85, CHCl_3) (96% ee); ^1H NMR (400 MHz, CDCl_3): δ 7.33-7.23 (m, 1H), 6.99 (d, *J* = 8.0 Hz, 1H), 6.96-6.88 (m, 2H), 3.06-2.95 (m, 1H), 2.64-2.31 (m, 4H), 2.19-2.04 (m, 2H), 1.89- 1.70 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 210.5, 163.2 (d, $J_{\text{C-F}} = 244.6$ Hz), 140.1 (d, $J_{\text{C-F}} = 6.8$ Hz), 130.3 (d, $J_{\text{C-F}} = 8.3$ Hz), 113.8 (d, $J_{\text{C-F}} = 6.2$ Hz), 113.6 (d, $J_{\text{C-F}} = 6.7$ Hz), 48.9, 44.6, 41.3, 32.8, 25.6.

J.-G. Boiteau, R. Imbos, A. J. Minnaard and B. L. Feringa, *Org. Lett.*, 2003, **5**, 681.

(S)-3-(3,5-Dimethylphenyl)cyclohexanone (Table 2, entry 15): colorless oil; $[\alpha]_{\text{D}}^{20} = -17.5$ (*c* 1.10, CHCl_3) (97% ee) [lit.: $[\alpha]_{\text{D}}^{25} = +14.3$ (*c* 1.60, CHCl_3) (96% ee) for *R*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 6.88 (s, 1H), 6.84 (s, 2H), 2.99-2.86 (m, 1H), 2.61-2.33 (m, 4H), 2.31 (s, 6H), 2.20-2.01 (m, 2H), 1.91-1.69 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 211.3, 144.6, 138.4, 128.5, 124.6, 49.2, 44.9, 41.4, 33.1, 25.8, 21.5.

F. Lang, D. Li, J. Chen, J. Chen, L. Li, L. Cun, J. Zhu, J. Deng and J. Liao, *Adv. Synth. Catal.*, 2010, **352**, 843.

(S)-3-(2,4-Dimethoxyphenyl)cyclohexanone (Table 2, entry 16): colorless oil; $[\alpha]_{\text{D}}^{20} = -40.7$ (*c* 0.55, CHCl_3) (90% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -25.4$ (*c* 0.97, CHCl_3) (87% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.06 (d, *J* = 9.2 Hz, 1H), 6.46 (d, *J* = 9.6 Hz, 1H), 6.45 (s, 1H), 3.79 (s, 6H), 3.36-3.25 (m, 1H), 2.59-2.30 (m, 4H), 2.14-1.96 (m, 2H), 1.89-1.70 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3): δ 212.0, 157.9, 127.1, 125.3, 104.2, 98.9, 55.5, 55.4, 48.0, 41.6, 37.8, 31.4, 25.7.

Q. Li, Z. Dong and Z.-X. Yu, *Org. Lett.*, 2011, **13**, 1122.

(S)-3-Phenylcyclopentanone (Table 2, entry 17): colorless oil; $[\alpha]_{\text{D}}^{20} = -86.6$ (*c* 0.94, CHCl_3) (91% ee) [lit.: $[\alpha]_{\text{D}}^{20} = -73.8$ (*c* 0.82, CHCl_3) (97% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.38-7.30 (m, 2H), 7.29-7.21 (m, 3H), 3.48-3.34 (m, 1H), 2.66 (dd, *J* = 18.4, 8.0 Hz, 1H), 2.52-2.39 (m, 2H), 2.39-2.23 (m, 2H), 2.06-1.92 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ 218.5, 143.2, 128.9, 126.9, 46.0, 42.4, 39.0, 31.4.

Y. Takaya, M. Ogasawara and T. Hayashi, *J. Am. Chem. Soc.*, 1998, **120**, 5579.

(S)-3-*p*-Tolylcyclopentanone (Table 2, entry 18): colorless oil; $[\alpha]_{\text{D}}^{20} = -78.6$ (*c* 1.03, CHCl_3) (89% ee) [lit.: $[\alpha]_{\text{D}}^{24} = -81.0$ (*c* 1.16, CHCl_3) (93% ee) for *S*-isomer]; ^1H NMR (400 MHz, CDCl_3): δ 7.16 (s, 4H), 3.46-3.31 (m, 1H), 2.66 (dd, *J* = 18.4, 7.6 Hz, 1H), 2.52-2.23 (m, 4H), 2.35 (s, 3H), 2.04-1.89 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3): δ 218.7, 140.2, 136.5, 129.5, 126.8, 46.1, 42.0, 39.0, 31.5, 21.1.

Y. Takaya, M. Ogasawara, and T. Hayashi, *Tetrahedron Lett.*, 1999, **40**, 6957.

(S)-4-Phenyltetrahydro-2H-pyran-2-one (Table 2, entry 19): colorless oil; $[\alpha]_{\text{D}}^{20} = -4.2$ (*c* 0.90, CHCl₃) (97% ee) [lit.: $[\alpha]_{\text{D}}^{25} = +4.0$ (*c* 2.70, CHCl₃) (98% ee) for *S*-isomer]; ¹H NMR (400 MHz, CDCl₃): δ 7.40-7.32 (m, 2H), 7.31-7.24 (m, 1H), 7.23-7.17 (m, 2H), 4.56-4.46 (m, 1H), 4.44-4.34 (m, 1H), 3.30-3.18 (m, 1H), 2.98-2.86 (m, 1H), 2.64 (dd, *J* = 17.6, 10.4 Hz, 1H), 2.24-2.13 (m, 1H), 2.11-1.97 (m, 1H); ¹³C NMR (100 MHz, CDCl₃): δ 170.9, 143.0, 129.2, 127.4, 126.7, 68.8, 37.7, 37.6, 30.5.

Y. Takaya, T. Senda, H. Kurushima, M. Ogasawara and T. Hayashi, *Tetrahedron: Asymmetry*, 1999, **10**, 4047.

(S)-4-Phenylheptan-2-one (Table 2, entry 20): colorless oil; $[\alpha]_{\text{D}}^{20} = +21.2$ (*c* 1.20, CHCl₃) (60% ee) [lit.: $[\alpha]_{\text{D}}^{23} = -37.0$ (*c* 1.01, CHCl₃) (75% ee) for *R*-isomer]; ¹H NMR (400 MHz, CDCl₃): δ 7.31-7.23 (m, 2H), 7.21-7.14 (m, 3H), 3.16-3.09 (m, 1H), 2.73-2.67 (m, 2H), 2.00 (s, 3H), 1.62-1.51 (m, 2H), 1.21-1.11 (m, 2H), 0.84 (t, *J* = 7.2 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 208.1, 144.8, 128.6, 127.7, 126.5, 51.1, 41.3, 38.9, 30.8, 20.7, 14.1.

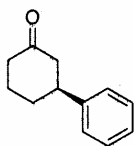
S. Oi, A. Taira, Y. Honma and Y. Inoue, *Org. Lett.*, 2003, **5**, 97.

(S)-4-Phenylnonan-2-one (Table 2, entry 21): colorless oil; $[\alpha]_{\text{D}}^{20} = -79.5$ (*c* 0.79, CHCl₃) (60% ee) [lit.: $[\alpha]_{\text{D}} = -17.0$ (*c* 1.26, CHCl₃) (92% ee)]; ¹H NMR (400 MHz, CDCl₃): δ 7.28 (t, *J* = 8.0 Hz, 2H), 7.22-7.12 (m, 3H), 3.16-3.05 (m, 1H), 2.78-2.63 (m, 2H), 2.00 (s, 3H), 1.67-1.58 (m, 2H), 1.27-1.05 (m, 6H), 0.89-0.75 (m, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 208.2, 144.8, 128.6, 127.6, 126.5, 51.1, 41.5, 36.6, 31.9, 30.8, 27.2, 22.7, 14.2.

Y. Takaya, M. Ogasawara and T. Hayashi, *J. Am. Chem. Soc.*, 1998, **120**, 5579.

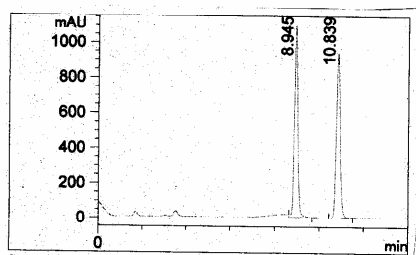
The chromatograms for determination of the enantiomeric excess

Table 2, entry 1



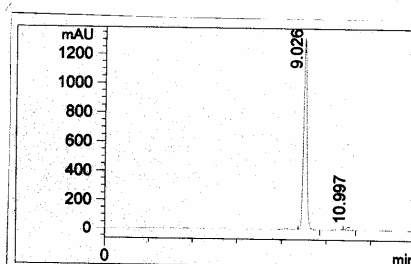
HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (99/1); Flow rate: 1.0 mL/min; Detection: UV 210 nm

Racemic



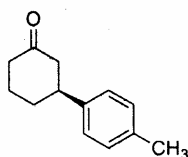
Peak #	RT [min]	Area %	Area
1	8.945	50.781	1.151e4
2	10.839	49.219	1.116e4

Chiral



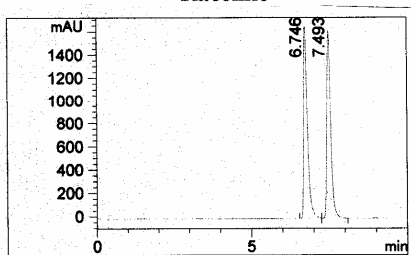
Peak #	RT [min]	Area %	Area
1	9.026	98.173	1.354e4
2	10.997	1.827	251.912

Table 2, entry 2



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (97/3); Flow rate: 1.0 mL/min; Detection: UV 214 nm

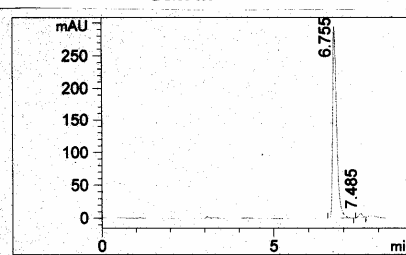
Racemic



Signal 1: VWD1 A, Wavelength=21

Peak #	RT [min]	Area %	Area
1	6.746	50.023	1.402e4
2	7.493	49.977	1.401e4

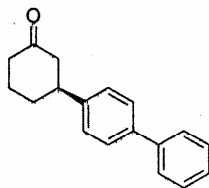
Chiral



Signal 1: VWD1 A, Wavelength=21

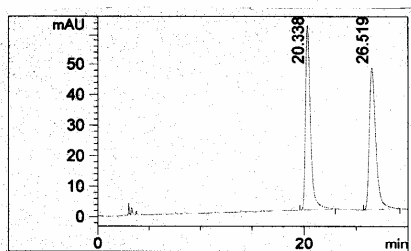
Peak #	RT [min]	Area %	Area
1	6.755	98.135	2.331e3
2	7.485	1.865	44.289

Table 2, entry 3



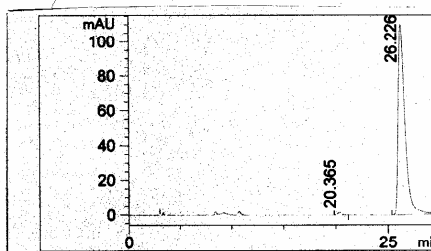
HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
Eluent: Hexanes/IPA (98/2); **Flow rate:** 1.0 mL/min; **Detection:** UV 211 nm

Racemic



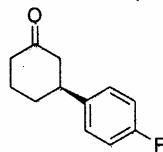
Peak #	RT [min]	Area %	Area
1	20.338	50.157	2.029e3
2	26.519	49.843	2.016e3

Chiral



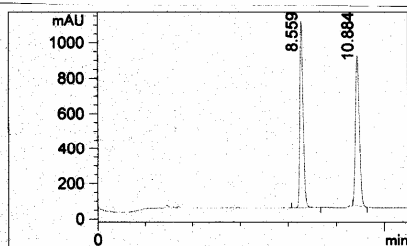
Peak #	RT [min]	Area %	Area
1	20.365	0.923	46.347
2	26.226	99.077	4.974e3

Table 2, entry 4



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
Eluent: Hexanes/IPA (97/3); **Flow rate:** 1.0 mL/min; **Detection:** UV 214 nm

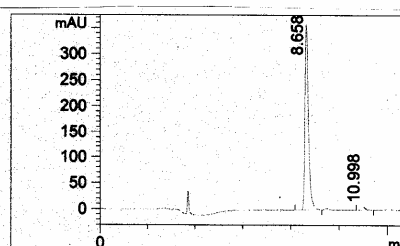
Racemic



Signal 1: VWD1 A, Wavelength=2

Peak #	RT [min]	Area %	Area
1	8.559	50.793	9.996e3
2	10.884	49.207	9.684e3

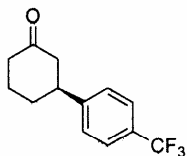
Chiral



Signal 1: VWD1 A, Wavelength=2

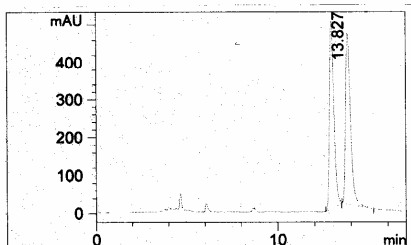
Peak #	RT [min]	Area %	Area
1	8.658	98.058	3.651e3
2	10.998	1.942	72.312

Table 2, entry 5



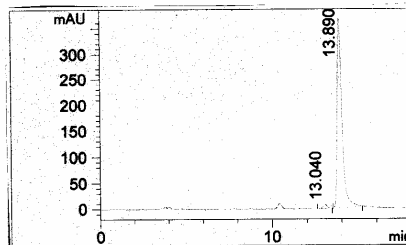
HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (99/1); Flow rate: 1.0 mL/min; Detection: UV 218 nm

Racemic



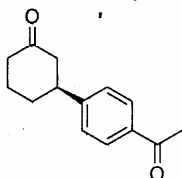
Peak #	RT [min]	Area %	Area
1	12.944	49.099	8.314e3
2	13.827	50.901	8.619e3

Chiral



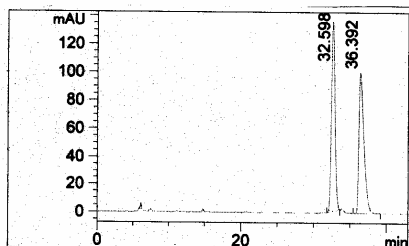
Peak #	RT [min]	Area %	Area
1	13.040	1.908	137.551
2	13.890	98.092	7.072e3

Table 2, entry 6



HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (90/10); Flow rate: 0.8 mL/min; Detection: UV 210 nm

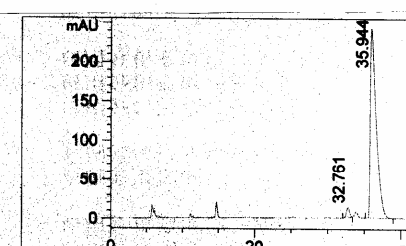
Racemic



Signal 1: VWD1 A, Wavelength=21

Peak #	RT [min]	Area %	Area
1	32.598	49.258	4.636e3
2	36.392	50.742	4.776e3

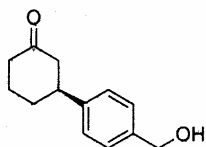
Chiral



Signal 1: VWD1 A, Wavelength=21

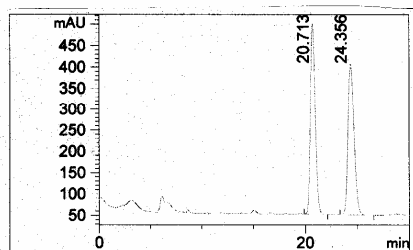
Peak #	RT [min]	Area %	Area
1	32.761	2.749	382.443
2	35.944	97.251	1.353e4

Table 2, entry 7



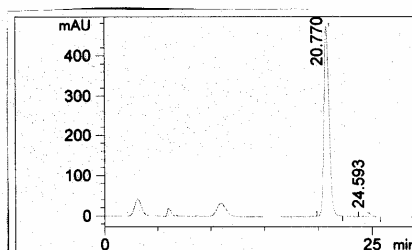
HPLC Conditions: Column: Chiralpak AS-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (60/40); Flow rate: 0.5 mL/min; Detection: UV 210 nm

Racemic



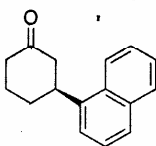
Peak #	RT [min]	Area %	Area
1	20.713	50.005	1.443e4
2	24.356	49.995	1.443e4

Chiral



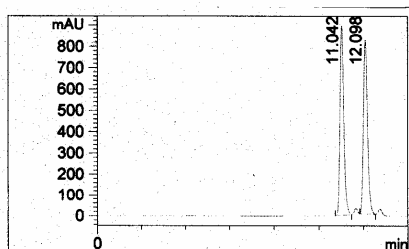
Peak #	RT [min]	Area %	Area
1	20.770	97.703	1.555e4
2	24.593	2.297	365.480

Table 2, entry 8



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (95/5); Flow rate: 0.7 mL/min; Detection: UV 222 nm

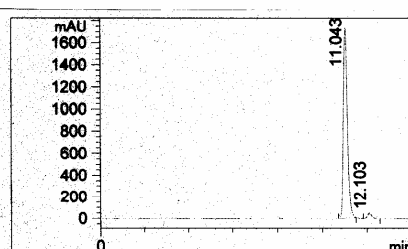
Racemic



Signal 1: VWD1 A, Wavelength=222

Peak #	RT [min]	Area %	Area
1	11.042	50.293	1.070e4
2	12.098	49.707	1.058e4

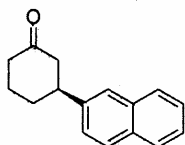
Chiral



Signal 1: VWD1 A, Wavelength=222

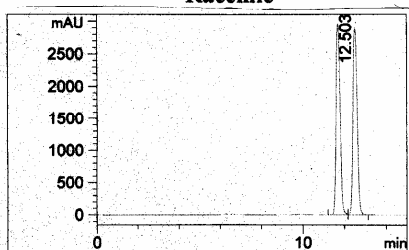
Peak #	RT [min]	Area %	Area
1	11.043	97.198	2.159e4
2	12.103	2.802	622.485

Table 2, entry 9



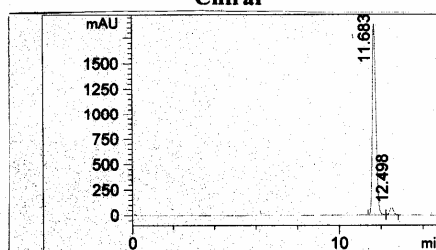
HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (85/15); Flow rate: 0.5 mL/min; Detection: UV 221 nm

Racemic



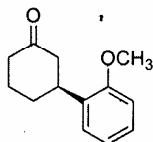
Peak #	RT [min]	Area %	Area
1	11.689	49.542	4.016e4
2	12.503	50.458	4.090e4

Chiral



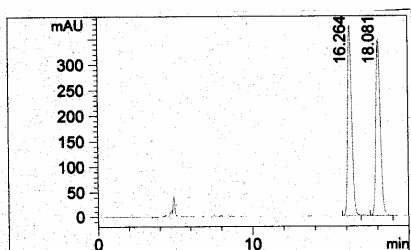
Peak #	RT [min]	Area %	Area
1	11.683	95.994	2.240e4
2	12.498	4.006	934.688

Table 2, entry 10



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (99/1); Flow rate: 0.7 mL/min; Detection: UV 217 nm

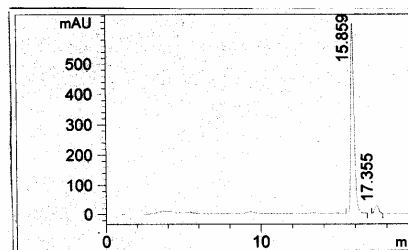
Racemic



Signal 1: VWD1 A, Wavelength=21

Peak #	RT [min]	Area %	Area
1	16.264	49.472	6.805e3
2	18.081	50.528	6.950e3

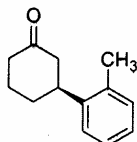
Chiral



Signal 1: VWD1 A, Wavelength=21

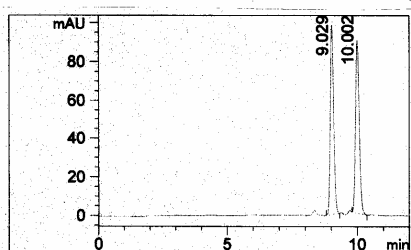
Peak #	RT [min]	Area %	Area
1	15.859	95.640	9.361e3
2	17.355	4.360	426.786

Table 2, entry 11



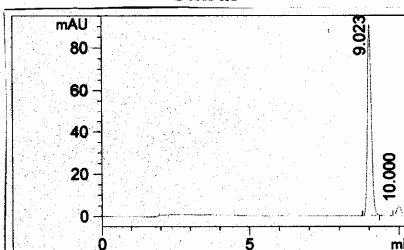
HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (85/15); Flow rate: 0.5 mL/min; Detection: UV 254 nm

Racemic



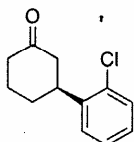
Peak #	RT [min]	Area %	Area
1	9.029	49.693	885.172
2	10.002	50.307	896.126

Chiral



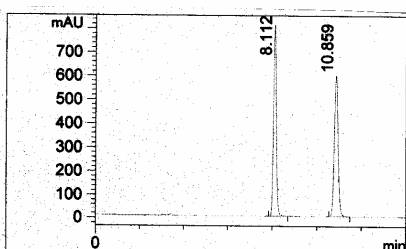
Peak #	RT [min]	Area %	Area
1	9.023	94.381	812.544
2	10.000	5.619	48.376

Table 2, entry 12



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (97/3); Flow rate: 1.0 mL/min; Detection: UV 214 nm

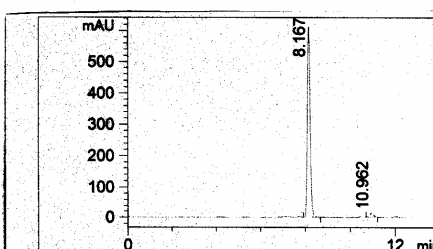
Racemic



Signal 1: VWD1 A, Wavelength=214

Peak #	RT [min]	Area %	Area
1	8.112	49.970	7.031e3
2	10.859	50.030	7.040e3

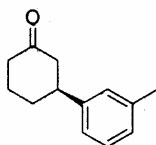
Chiral



Signal 1: VWD1 A, Wavelength=214

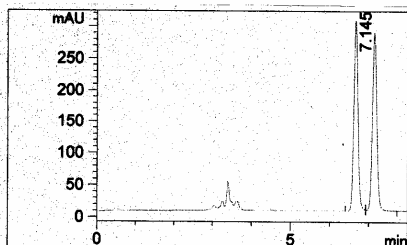
Peak #	RT [min]	Area %	Area
1	8.167	97.171	5.341e3
2	10.962	2.829	155.495

Table 2, entry 13



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (97/3); Flow rate: 1.0 mL/min; Detection: UV 212 nm

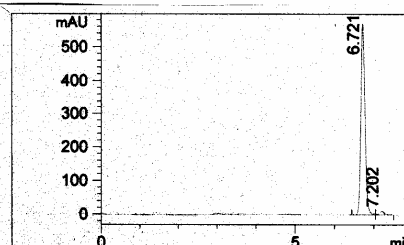
Racemic



Signal 1: VWD1 A, Wavelength=212

Peak #	RT [min]	Area %	Area
1	6.666	49.668	2.182e3
2	7.145	50.332	2.212e3

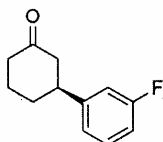
Chiral



Signal 1: VWD1 A, Wavelength=212

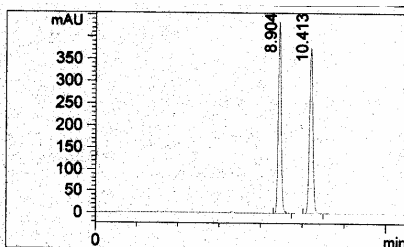
Peak #	RT [min]	Area %	Area
1	6.721	97.964	4.163e3
2	7.202	2.036	86.533

Table 2, entry 14



HPLC Conditions: Column: Chiralpak AD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (97/3); Flow rate: 1.0 mL/min; Detection: UV 214 nm

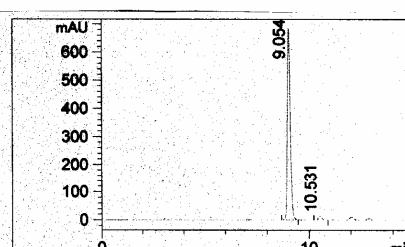
Racemic



Signal 1: VWD1 A, Wavelength=214

Peak #	RT [min]	Area %	Area
1	8.904	49.860	4.258e3
2	10.413	50.140	4.282e3

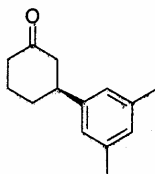
Chiral



Signal 1: VWD1 A, Wavelength=214

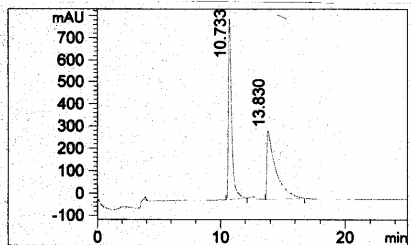
Peak #	RT [min]	Area %	Area
1	9.054	97.873	6.710e3
2	10.531	2.127	145.841

Table 2, entry 15



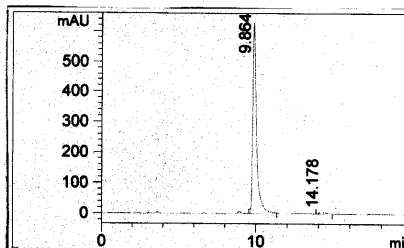
HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
Eluent: Hexanes/IPA (99/1); **Flow rate:** 1.0 mL/min; **Detection:** UV 208 nm

Racemic



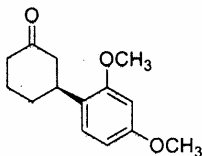
Peak #	RT [min]	Area %	Area
1	10.733	49.583	1.472e4
2	13.830	50.417	1.497e4

Chiral



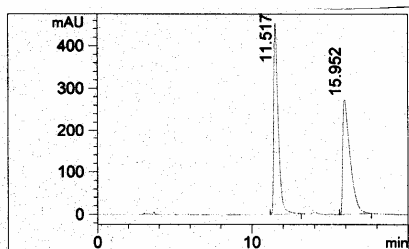
Peak #	RT [min]	Area %	Area
1	9.864	98.445	1.051e4
2	14.178	1.555	166.006

Table 2, entry 16



HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
Eluent: Hexanes/IPA (95/5); **Flow rate:** 1.0 mL/min; **Detection:** UV 228 nm

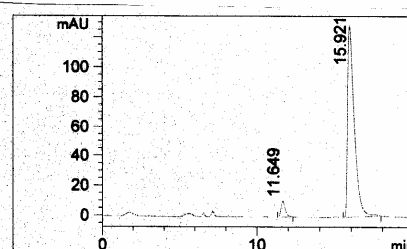
Racemic



Signal 1: VWD1 A, Wavelength=228 nm

Peak #	RT [min]	Area %	Area
1	11.517	50.168	8.905e3
2	15.952	49.832	8.845e3

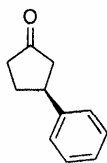
Chiral



Signal 1: VWD1 A, Wavelength=228 nm

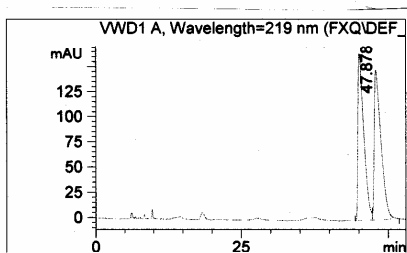
Peak #	RT [min]	Area %	Area
1	11.649	4.891	196.077
2	15.921	95.109	3.813e3

Table 2, entry 17



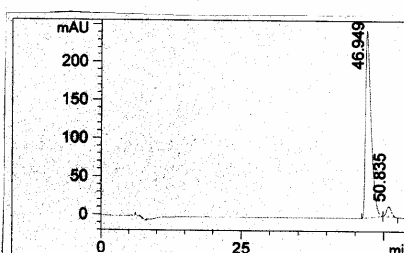
HPLC Conditions: Column: Chiralcel OB-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (99/1); Flow rate: 0.5 mL/min; Detection: UV 219 nm

Racemic



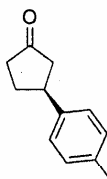
Peak #	RT [min]	Area %	Area
1	45.057	49.343	1.150e4
2	47.878	50.657	1.181e4

Chiral



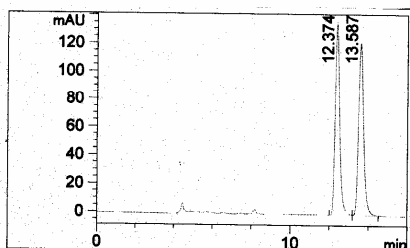
Peak #	RT [min]	Area %	Area
1	46.949	95.282	1.652e4
2	50.835	4.718	818.266

Table 2, entry 18



HPLC Conditions: Column: Chiralcel OB-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (90/10); Flow rate: 0.7 mL/min; Detection: UV 219 nm

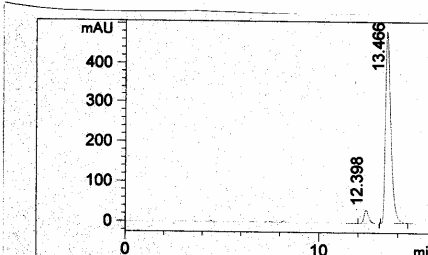
Racemic



Signal 1: VWD1 A, Wavelength=21

Peak #	RT [min]	Area %	Area
1	12.374	49.730	2.191e3
2	13.587	50.270	2.215e3

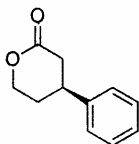
Chiral



Signal 1: VWD1 A, Wavelength=21

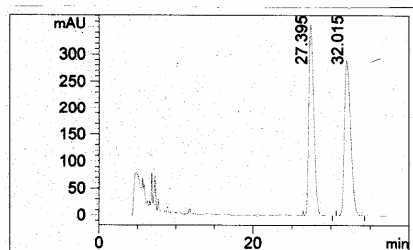
Peak #	RT [min]	Area %	Area
1	12.398	5.400	521.603
2	13.466	94.600	9.138e3

Table 2, entry 19



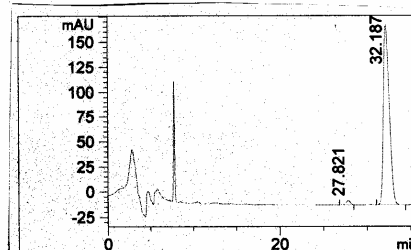
HPLC Conditions: Column: Chiralpak AS-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (60/40); Flow rate: 0.6 mL/min; Detection: UV 214 nm

Racemic



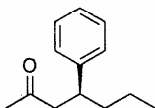
Peak #	RT [min]	Area %	Area
1	27.395	49.791	1.587e4
2	32.015	50.209	1.600e4

Chiral



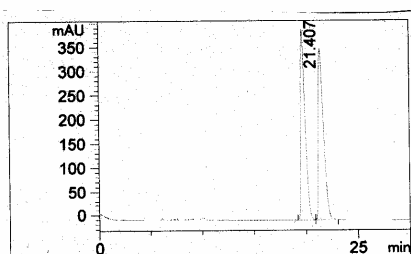
Peak #	RT [min]	Area %	Area
1	27.821	1.628	140.761
2	32.187	98.372	8.505e3

Table 2, entry 20



HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
 Eluent: Hexanes/IPA (99.5/0.5); Flow rate: 0.5 mL/min; Detection: UV 216 nm

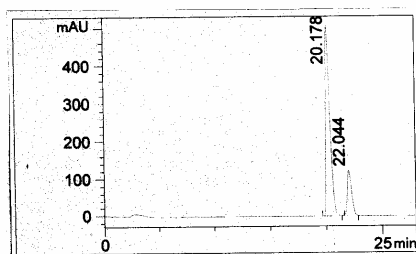
Racemic



Signal 1: VWD1 A, Wavelength=21

Peak #	RT [min]	Area %	Area
1	19.702	49.450	1.227e4
2	21.407	50.550	1.254e4

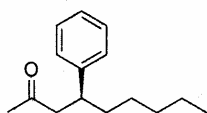
Chiral



Signal 1: VWD1 A, Wavelength=21

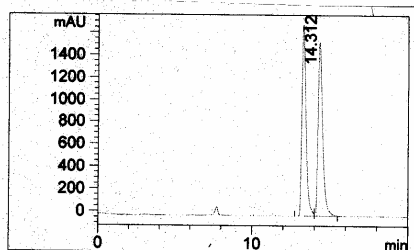
Peak #	RT [min]	Area %	Area
1	20.178	80.235	1.323e4
2	22.044	19.765	3.259e3

Table 2, entry 21



HPLC Conditions: Column: Chiralcel OD-H, Daicel Chemical Industries, Ltd.,
Eluent: Hexanes/IPA (99/1); Flow rate: 0.5 mL/min; Detection: UV 211 nm

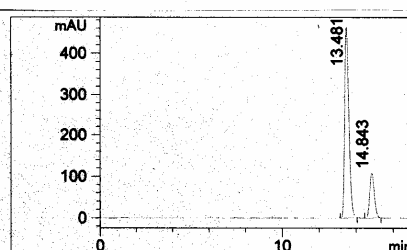
Racemic



Signal 1: VWD1 A, Wavelength=211

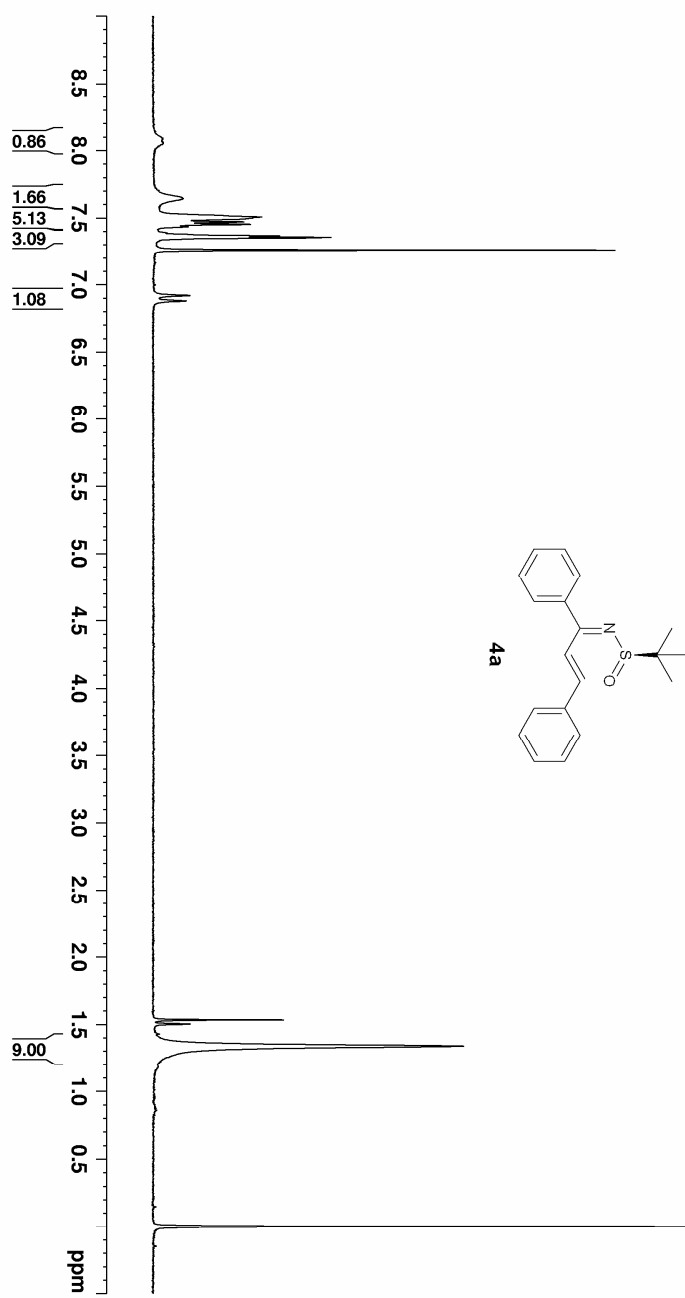
Peak #	RT [min]	Area %	Area
1	13.267	49.507	3.131e4
2	14.312	50.493	3.193e4

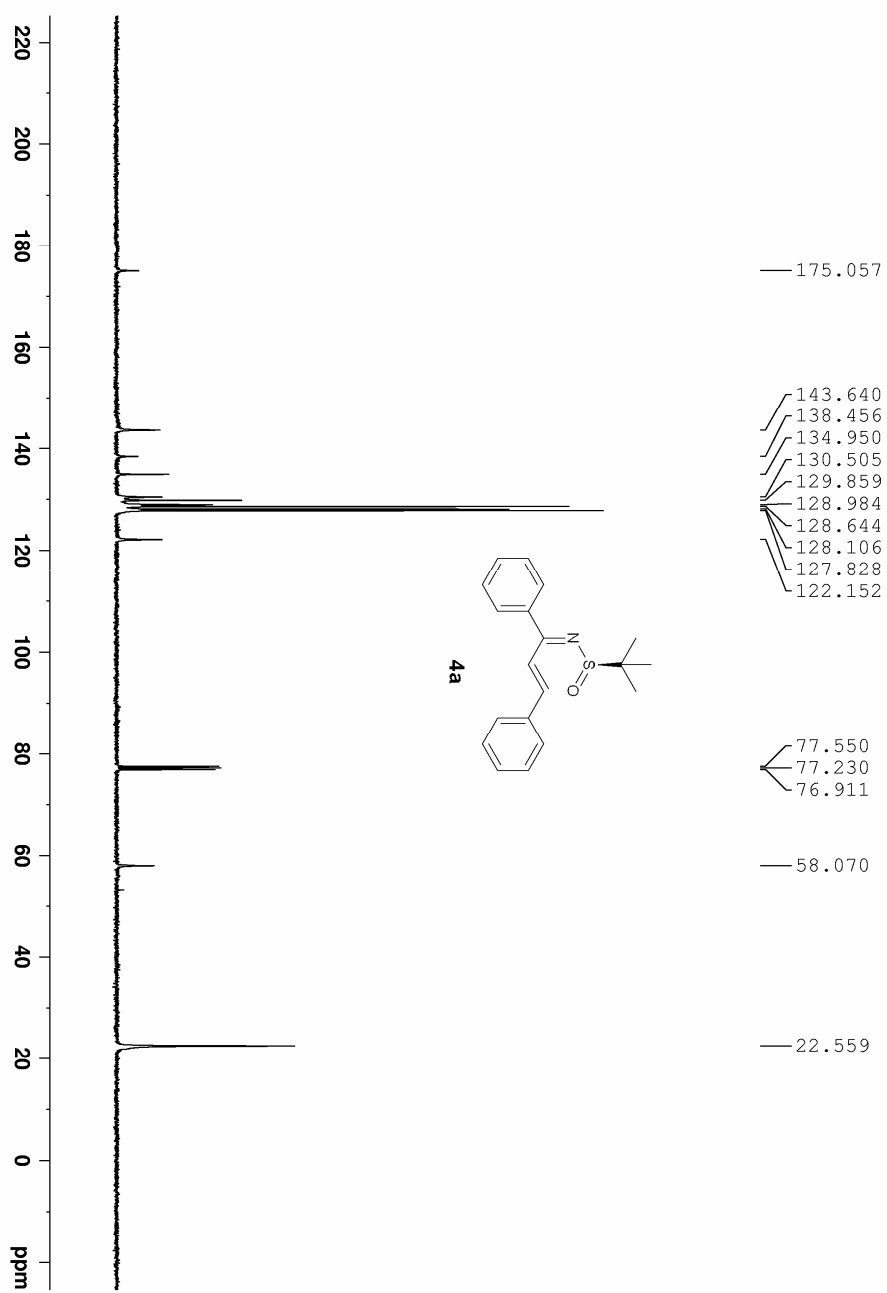
Chiral



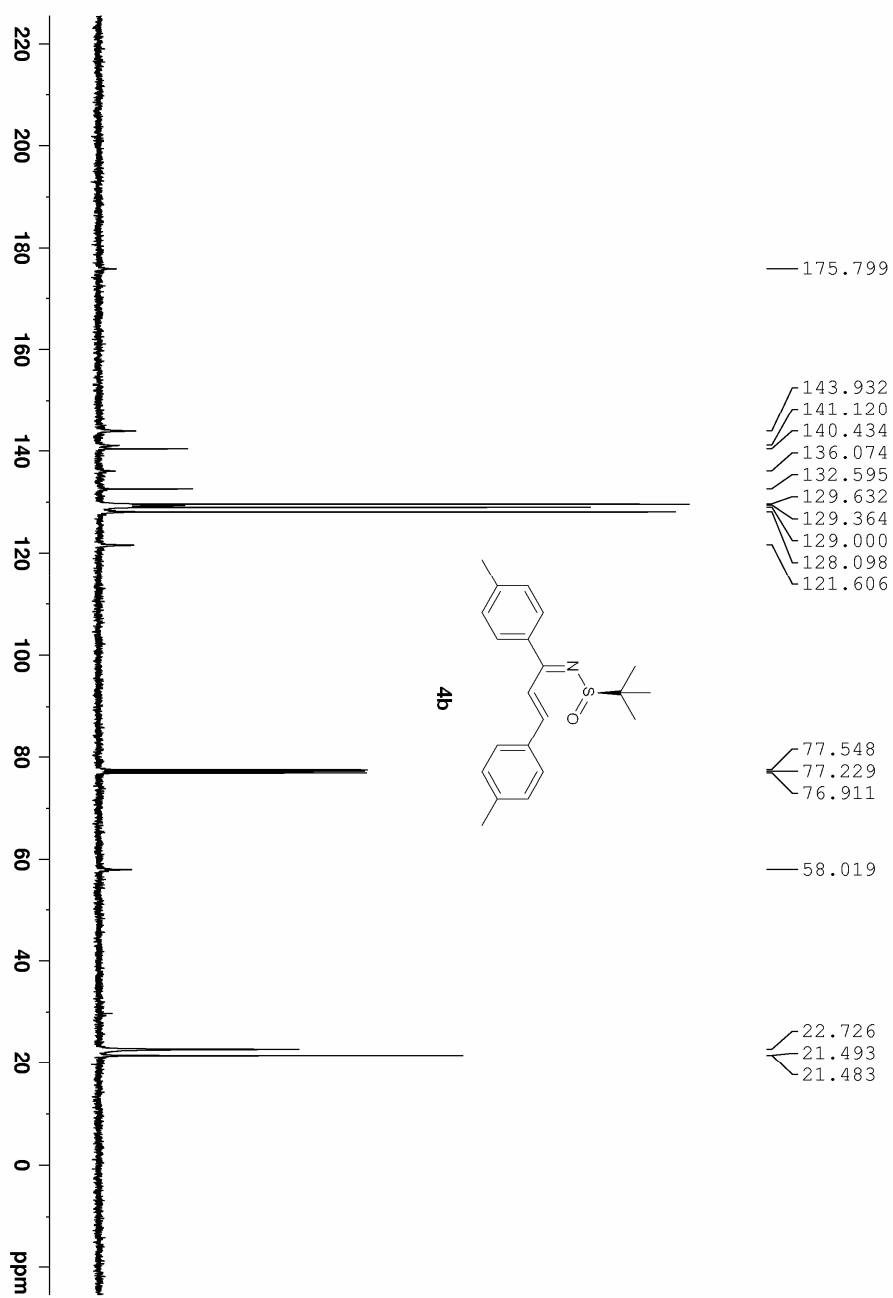
Signal 1: VWD1 A, Wavelength=211

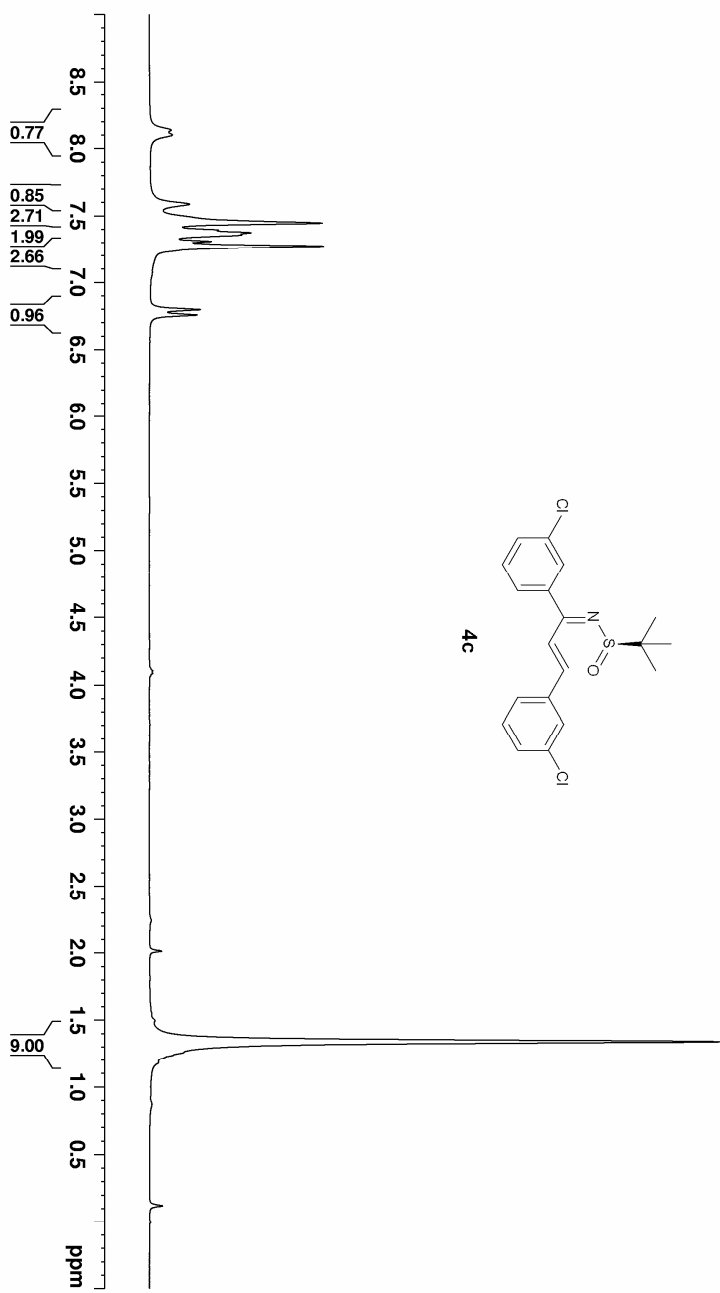
Peak #	RT [min]	Area %	Area
1	13.481	79.998	7.320e3
2	14.843	20.002	1.830e3

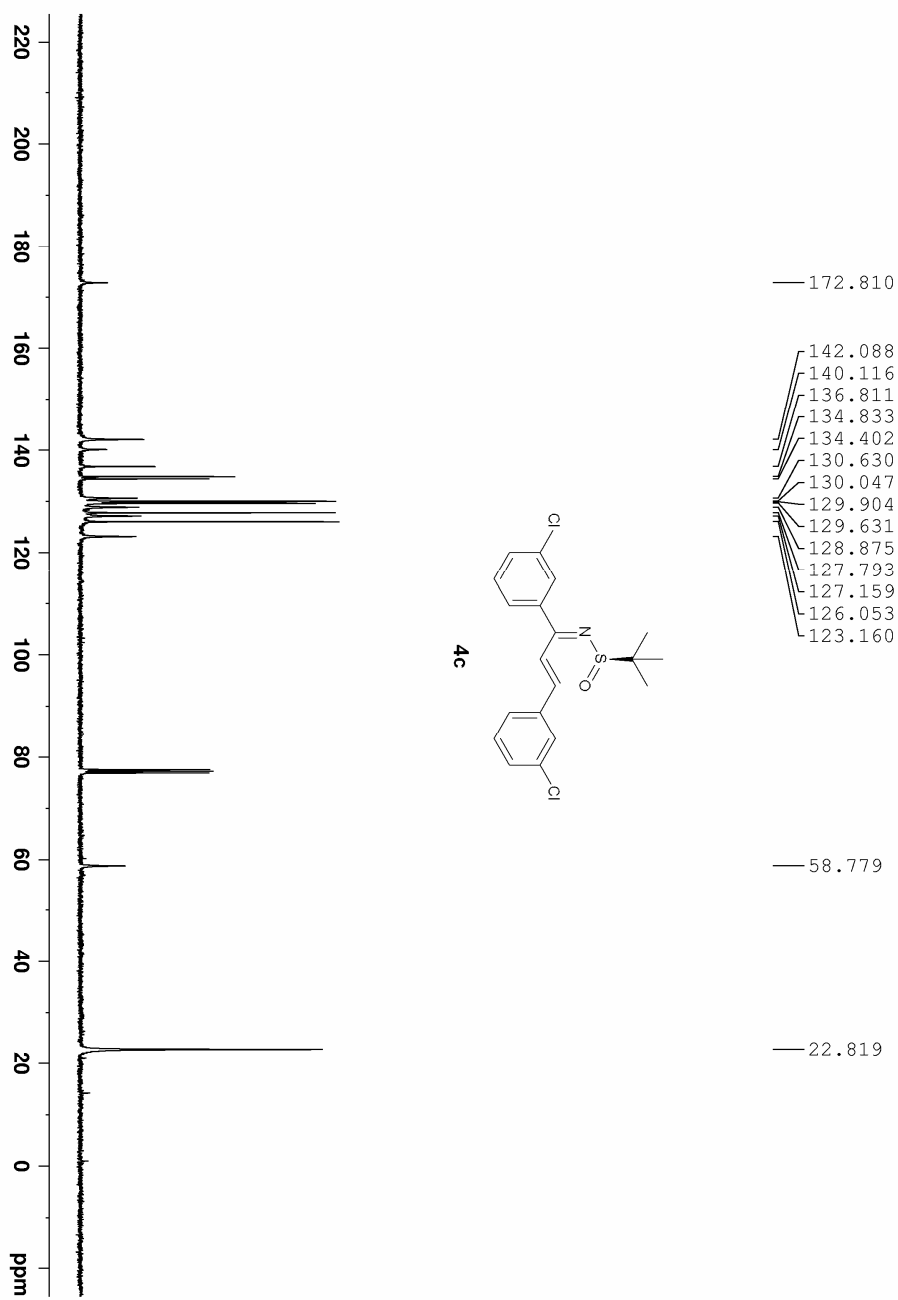


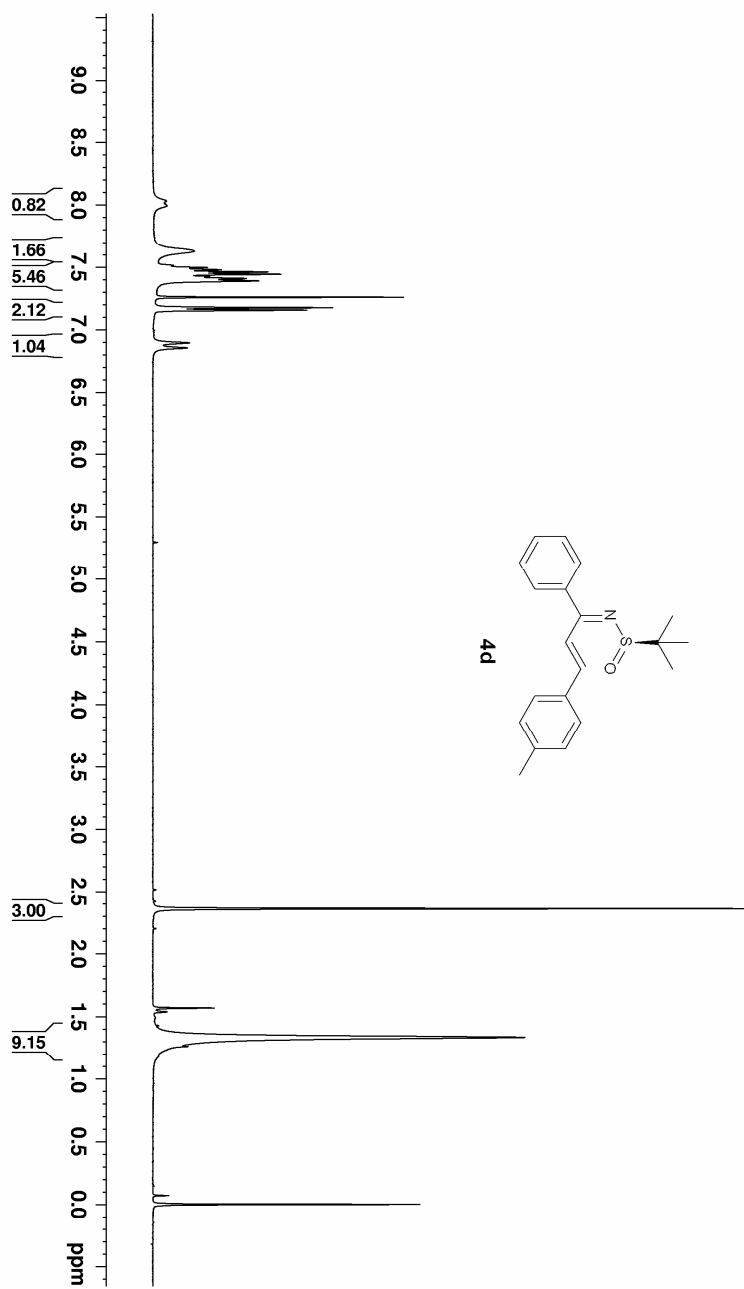


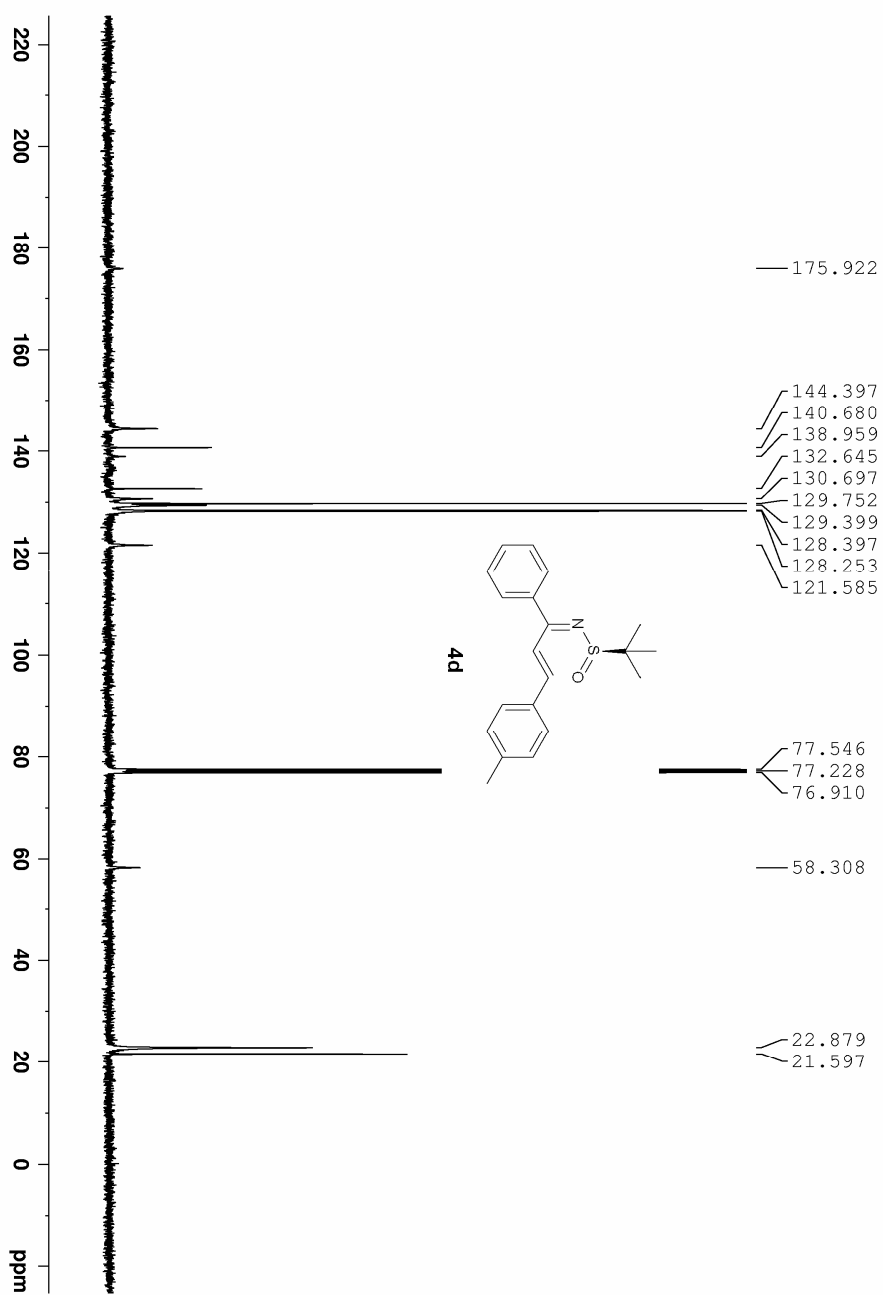


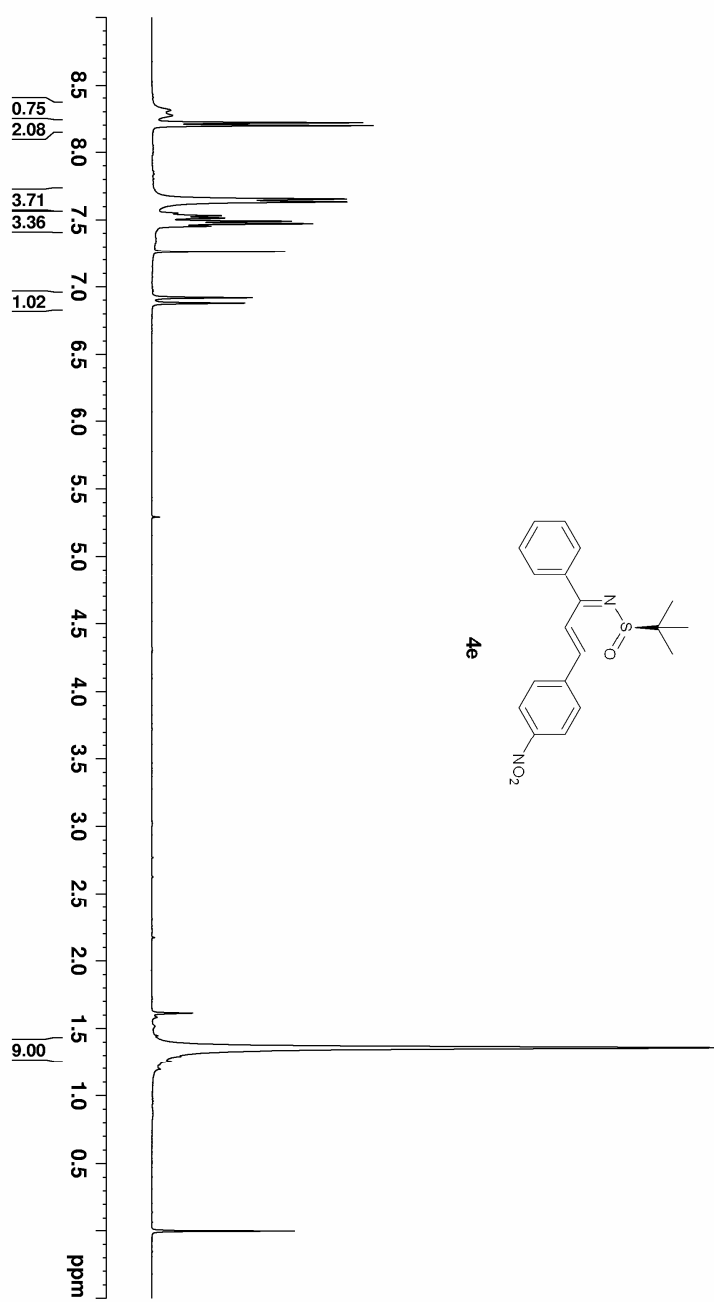


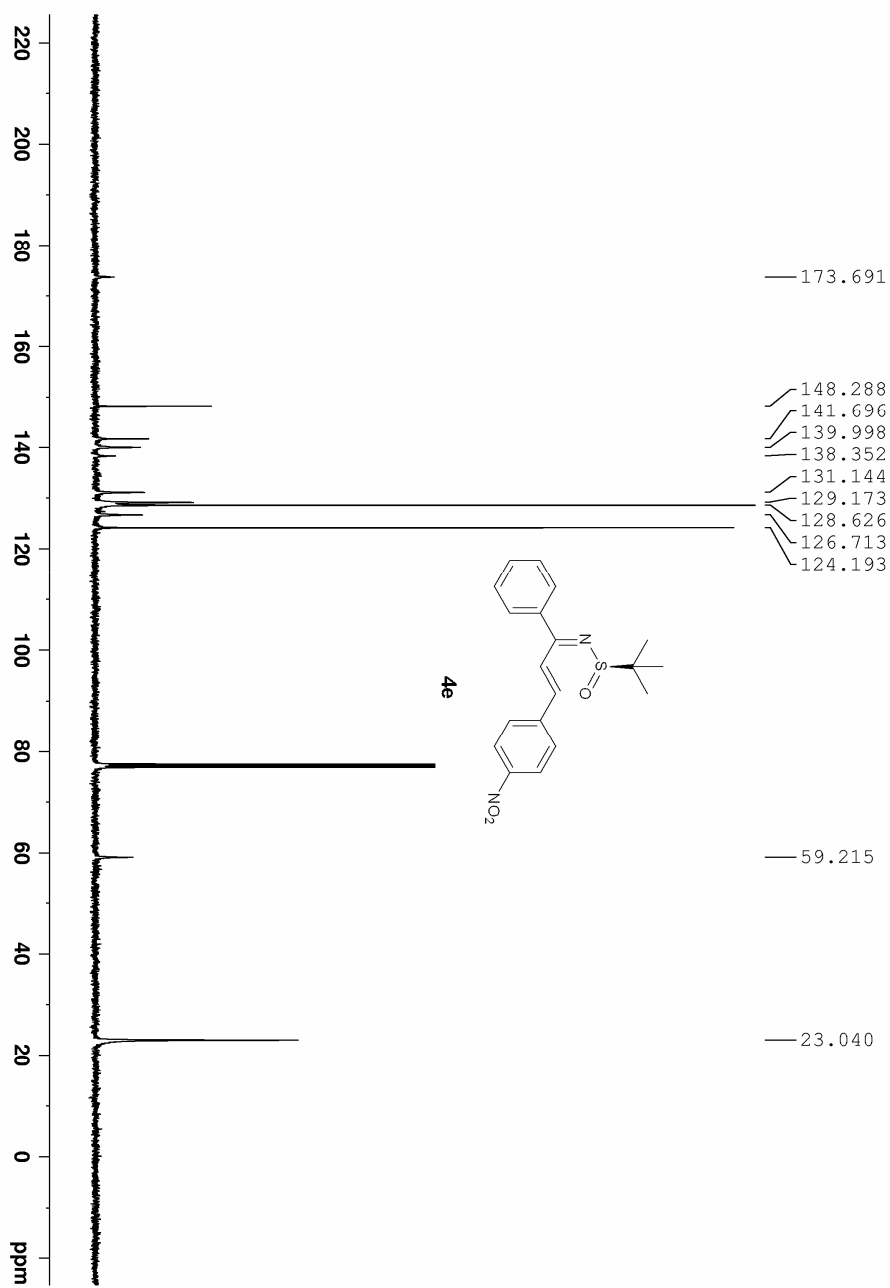


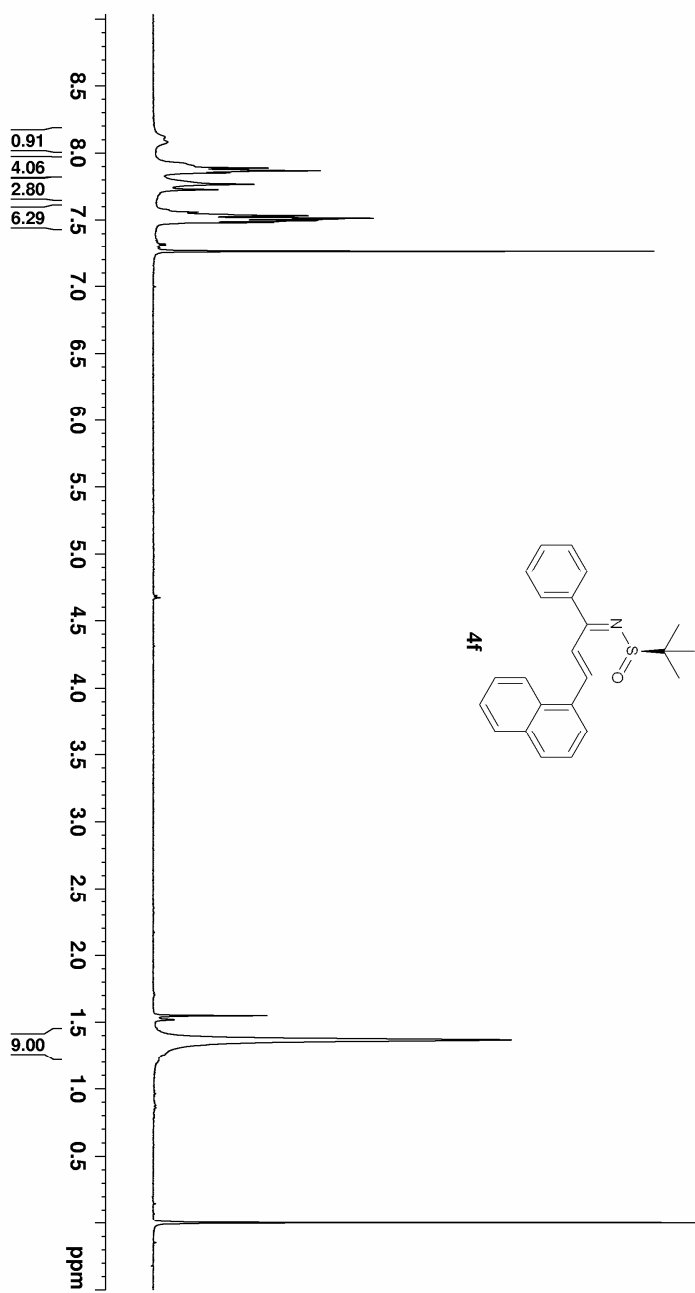


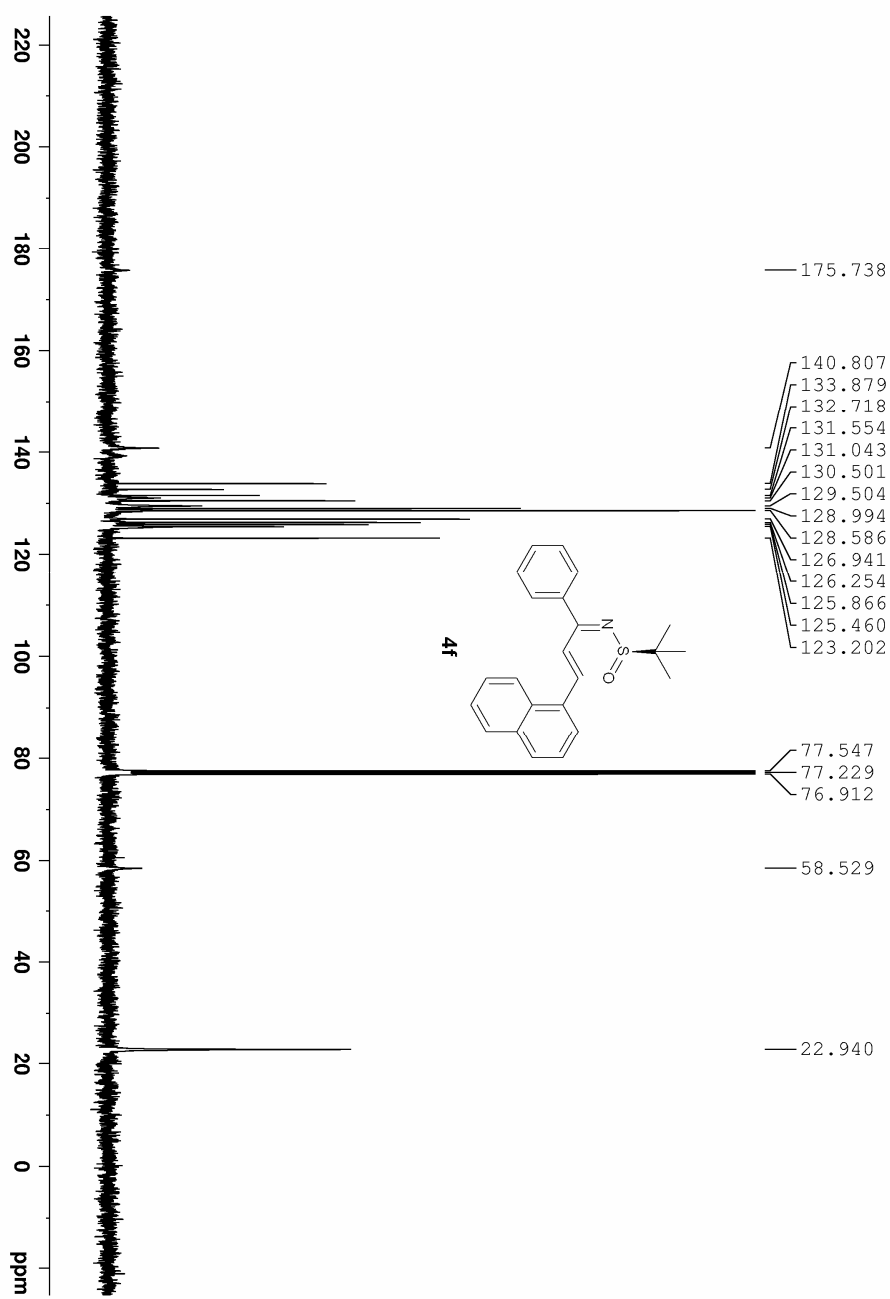


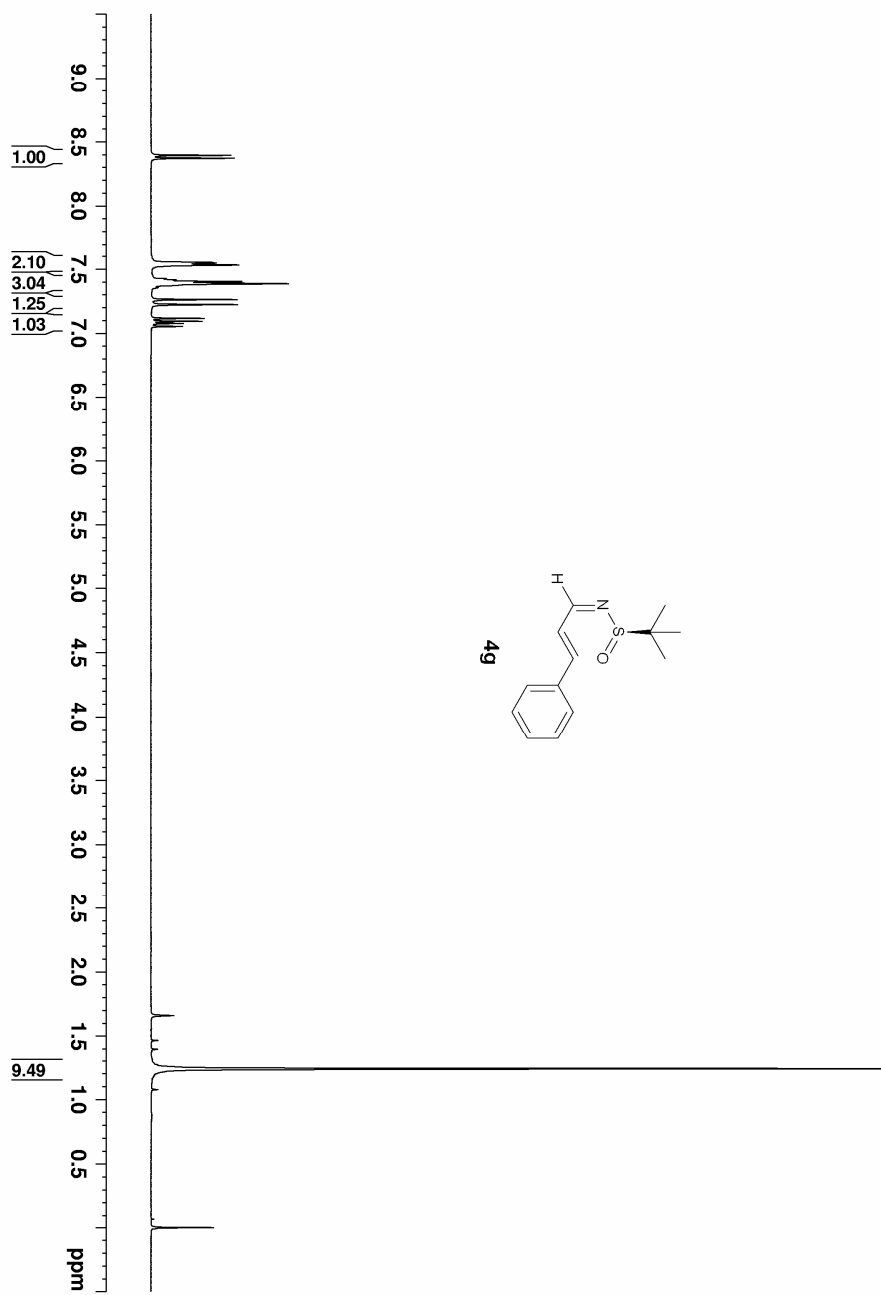


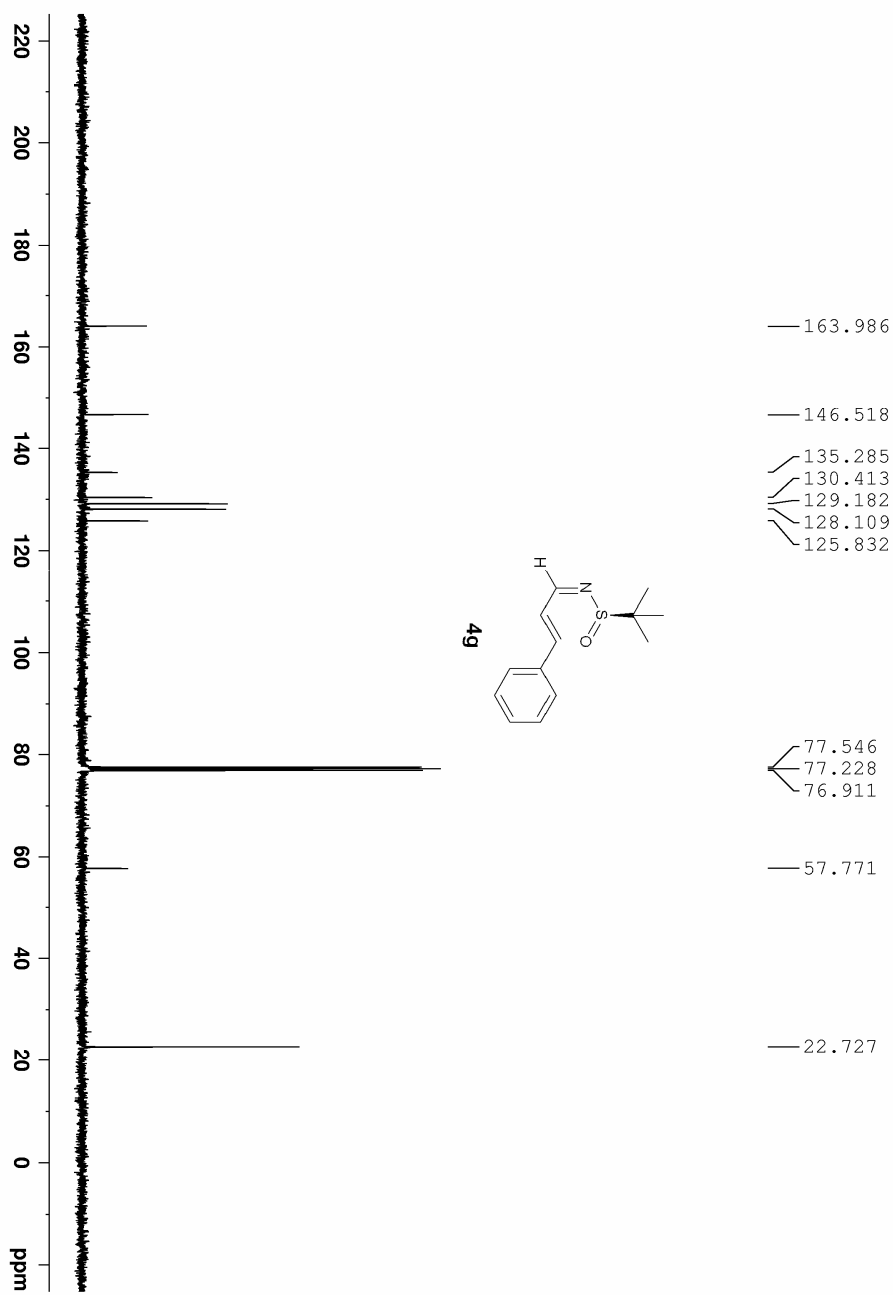


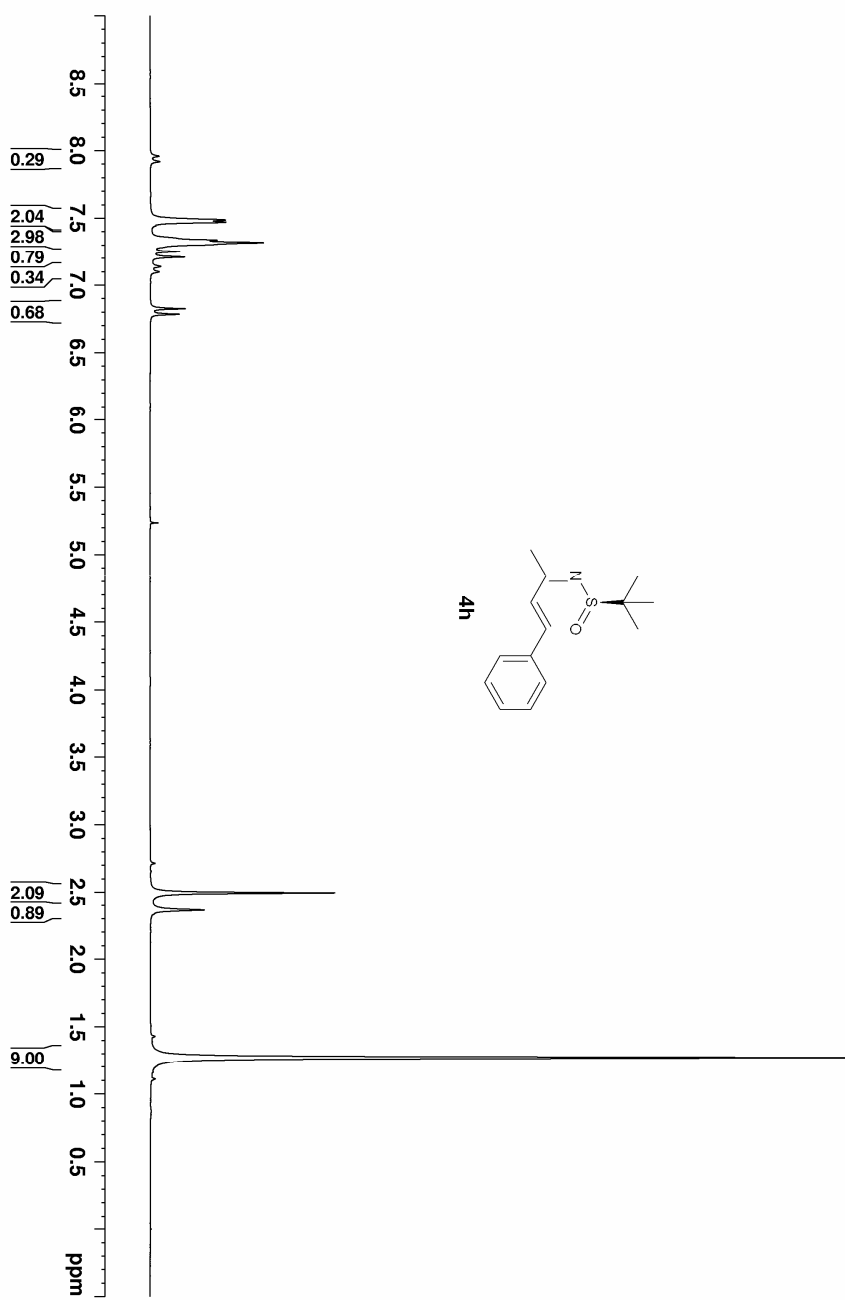


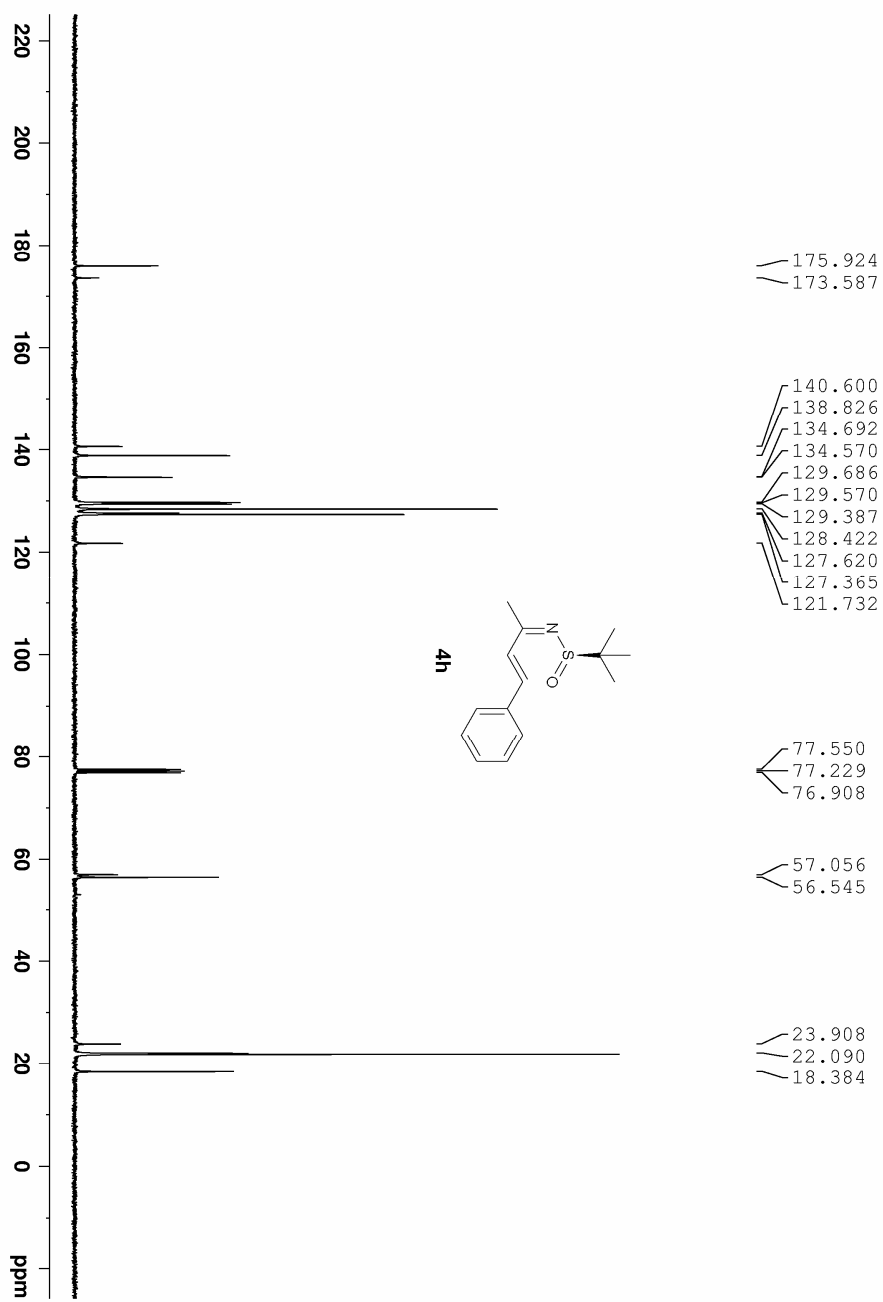


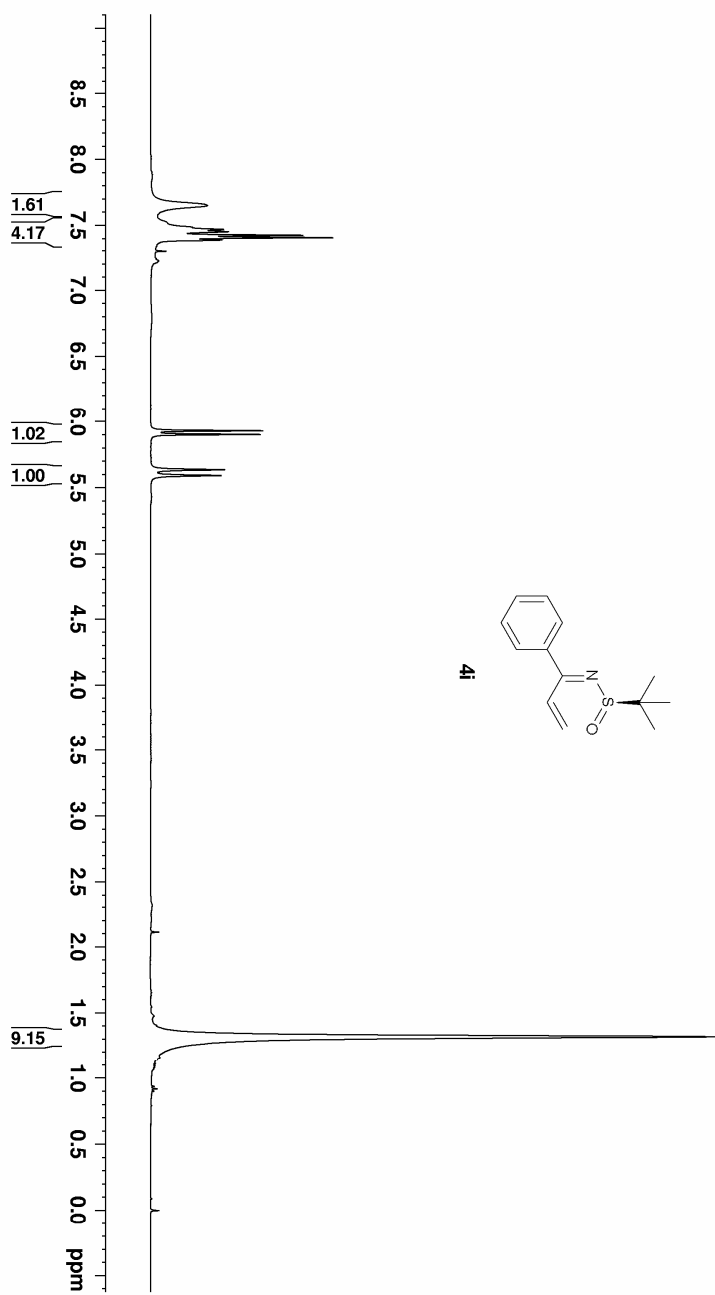


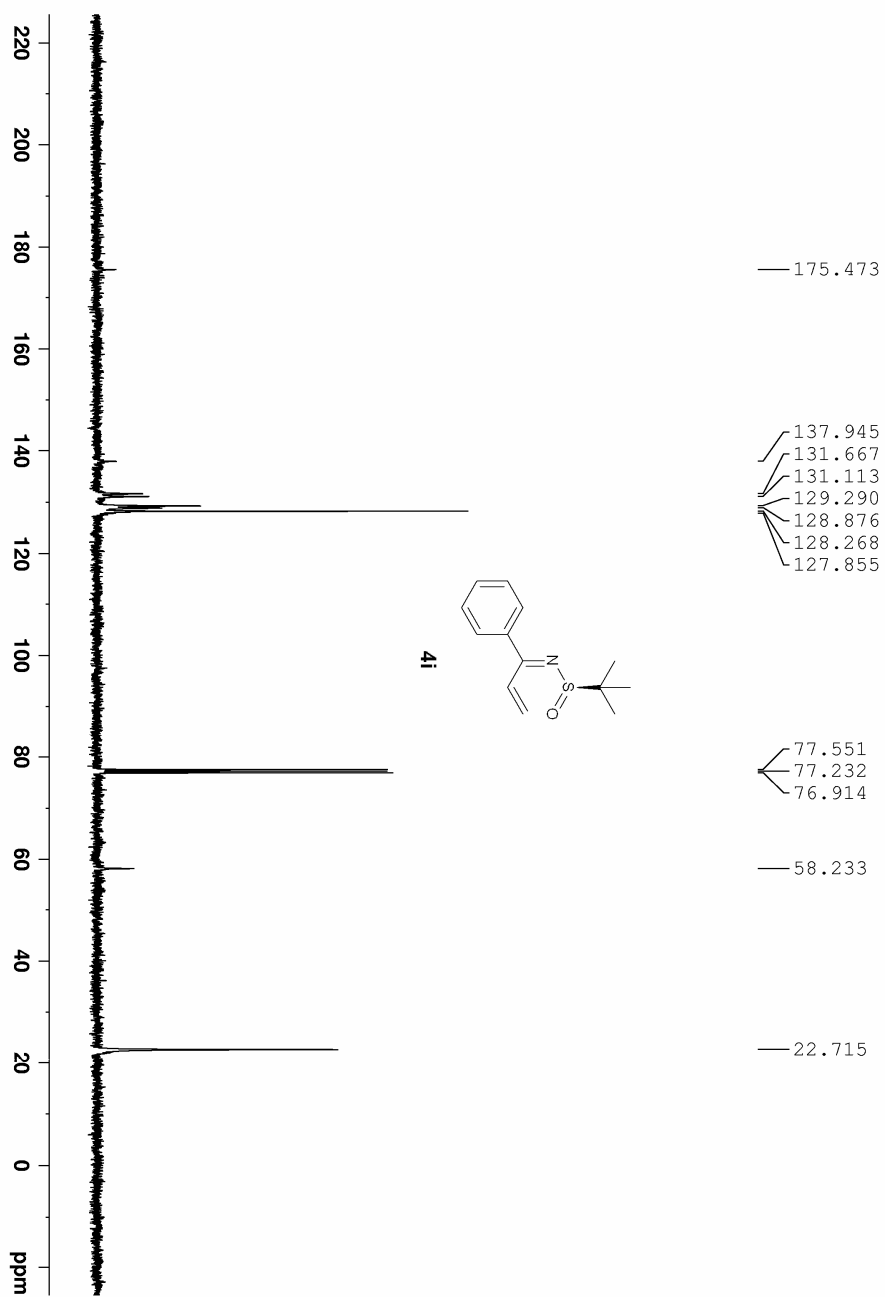


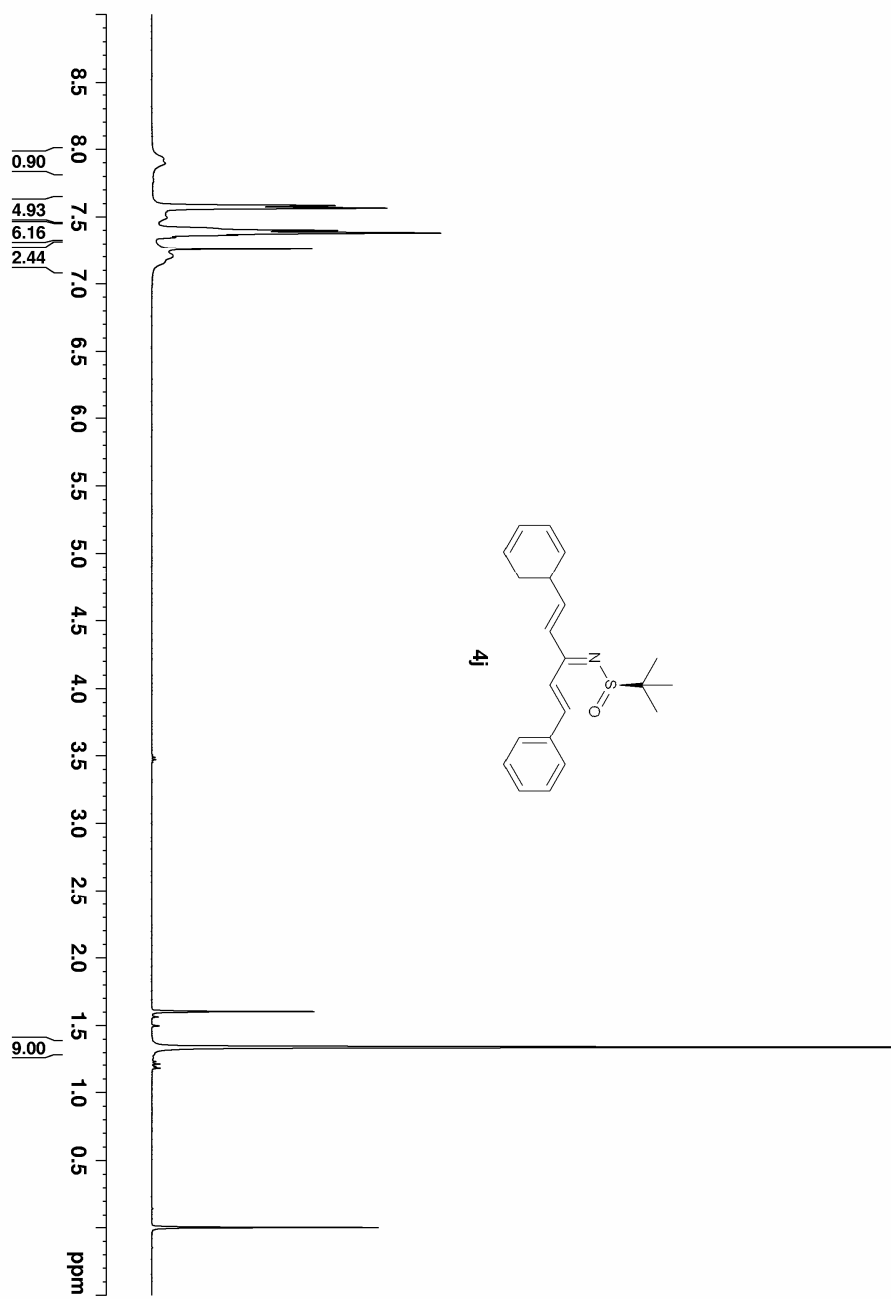


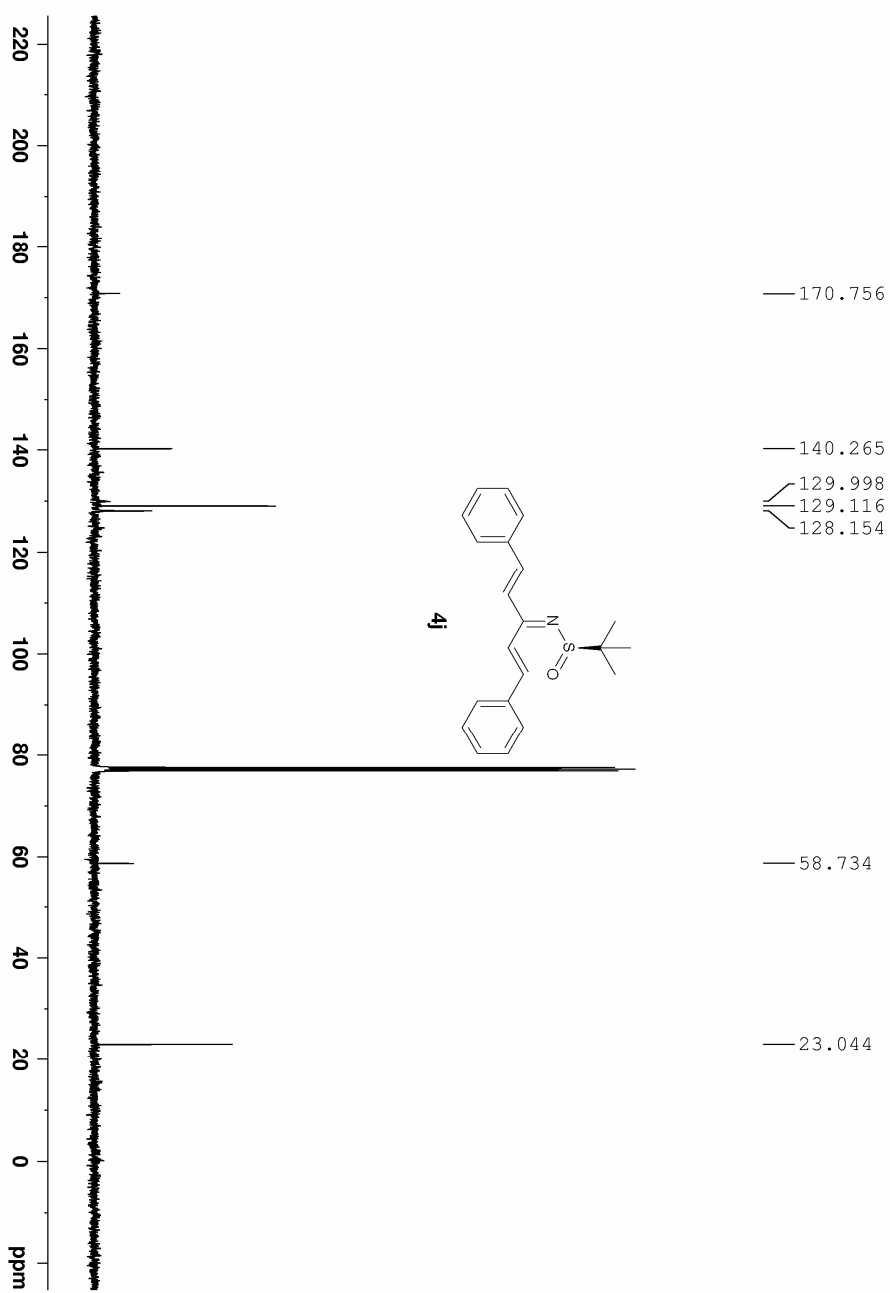


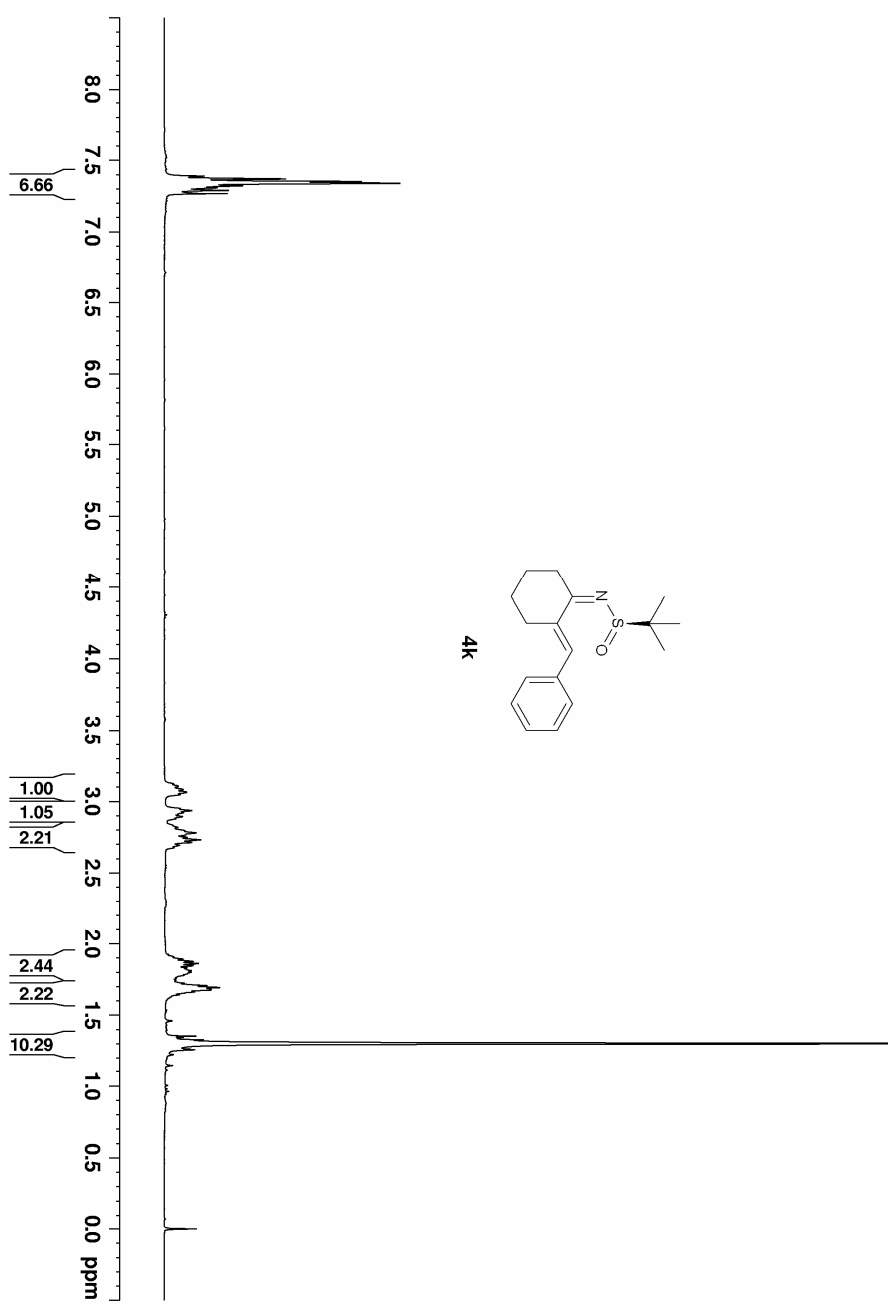


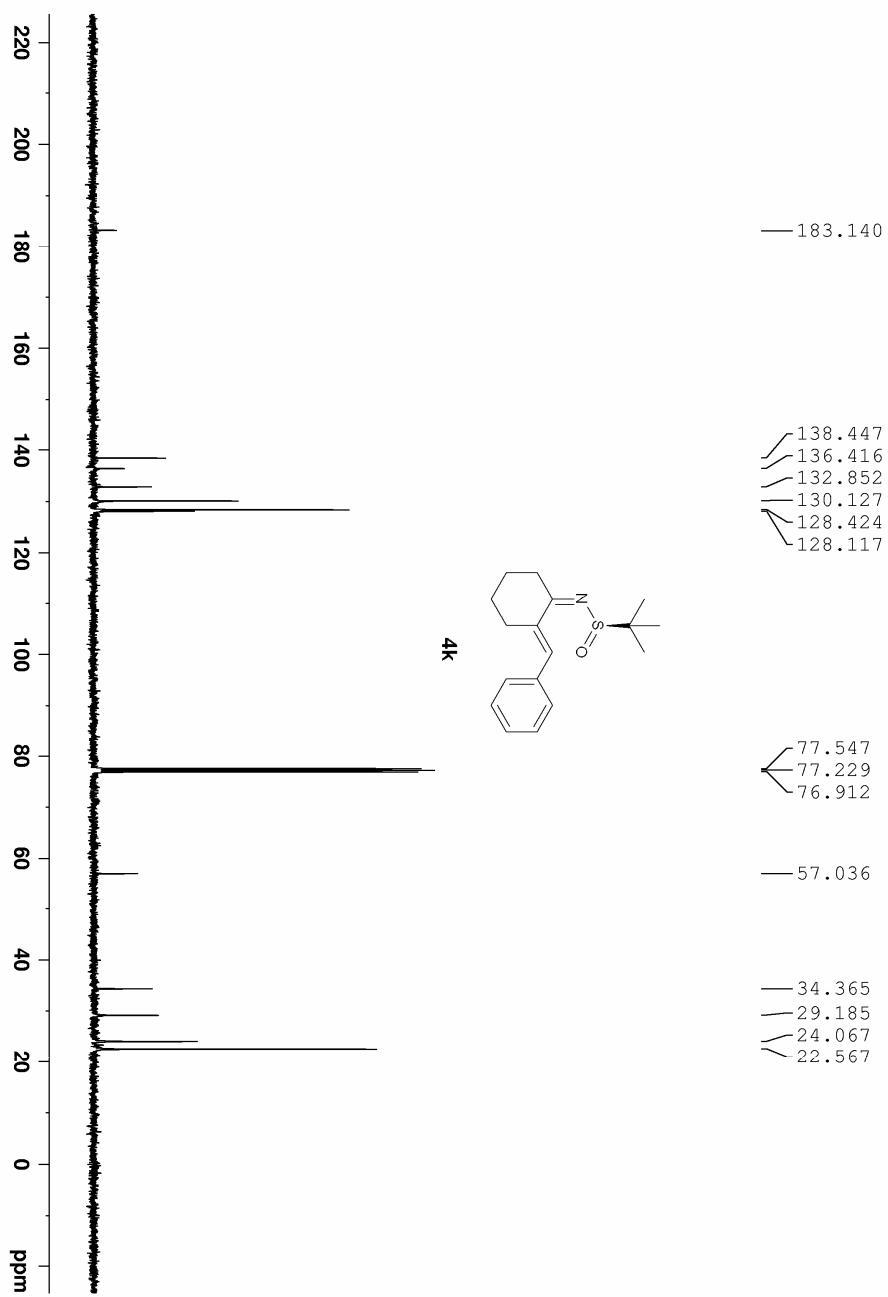


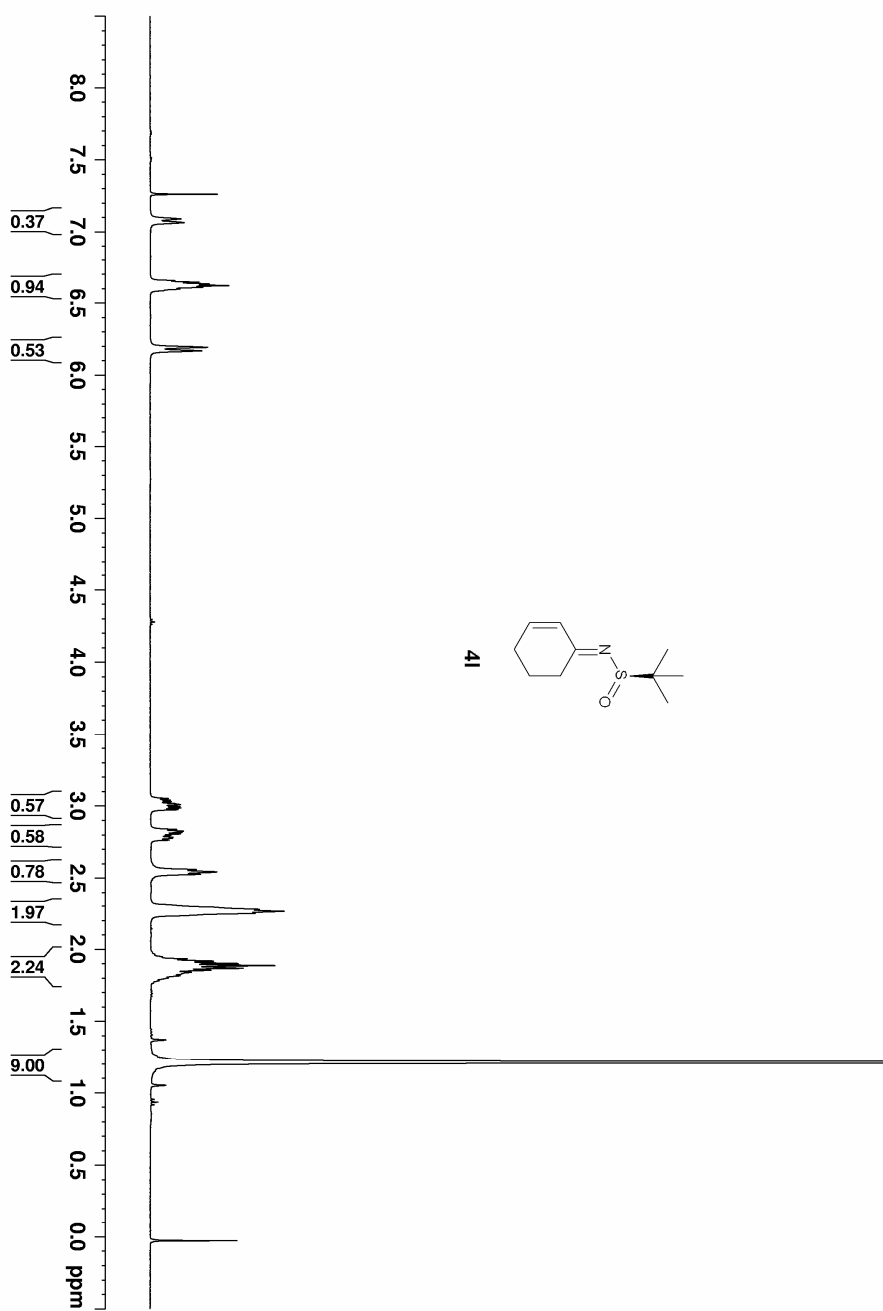


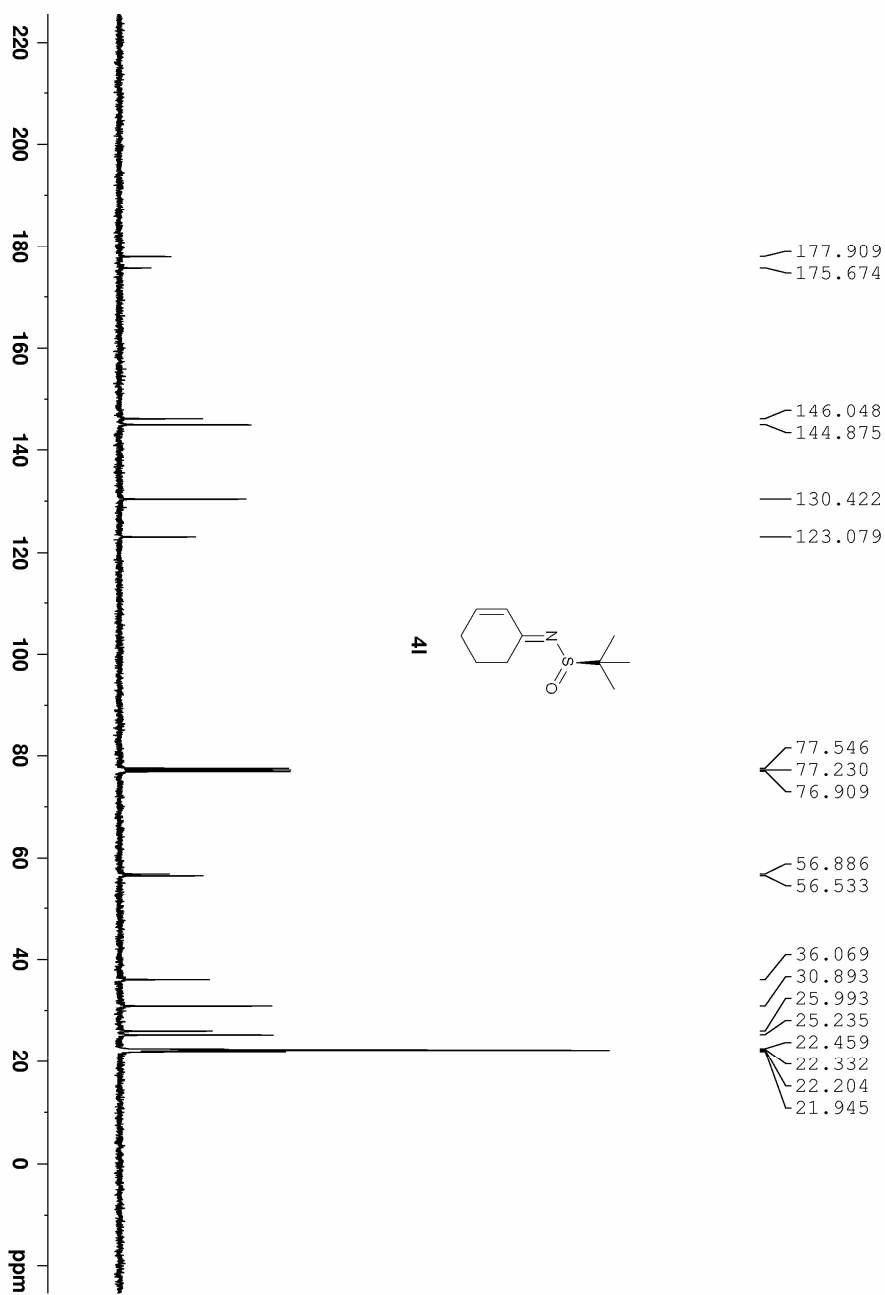


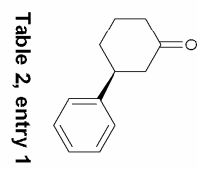
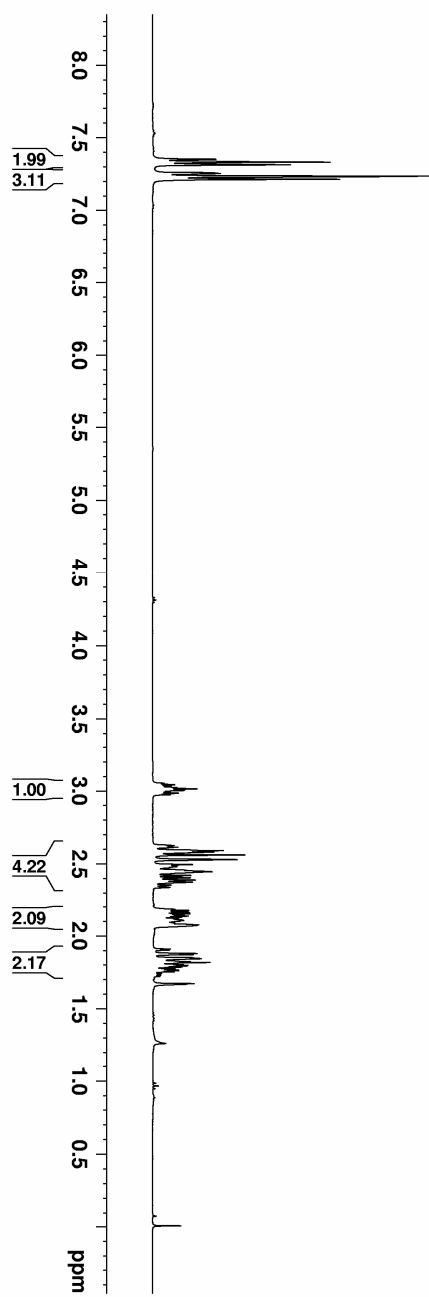


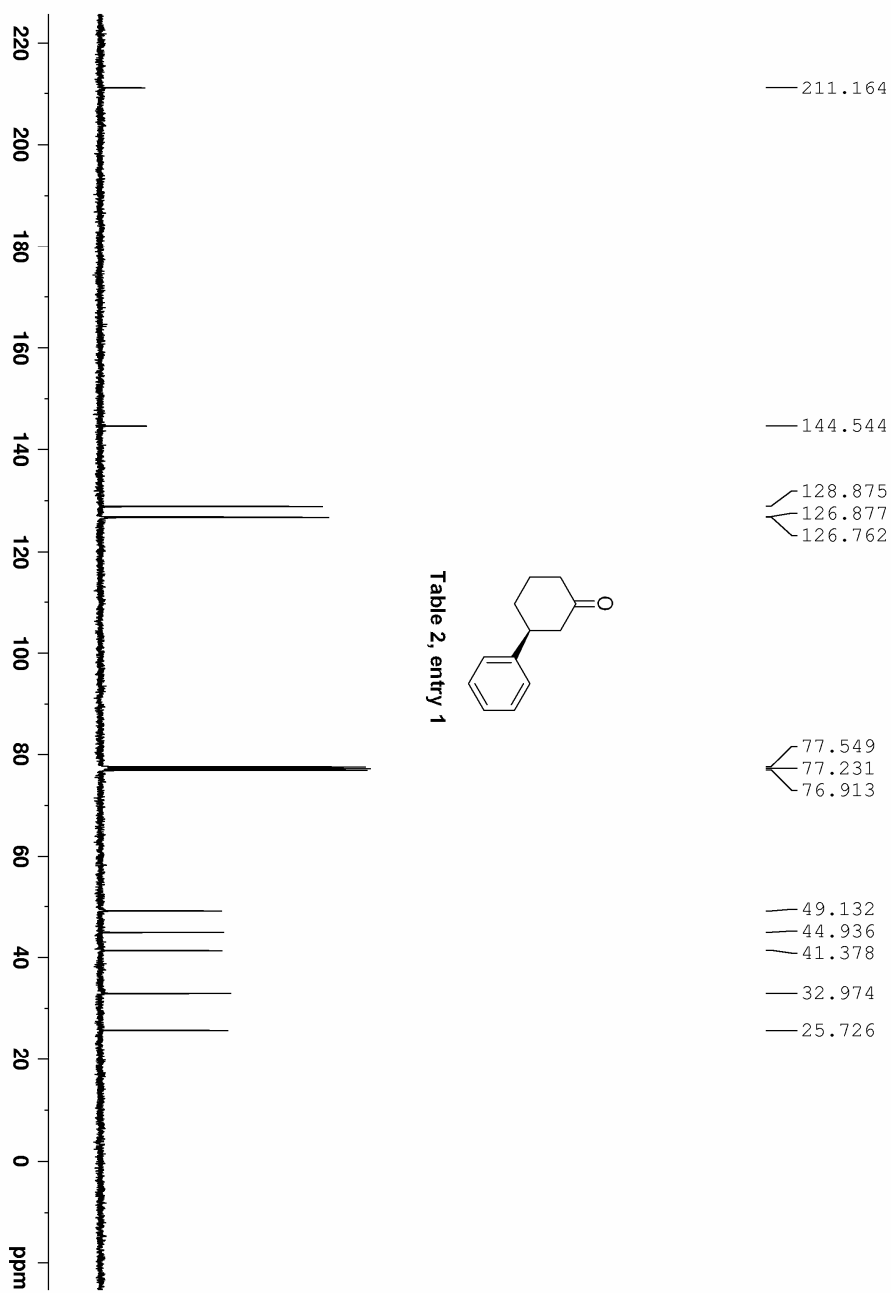


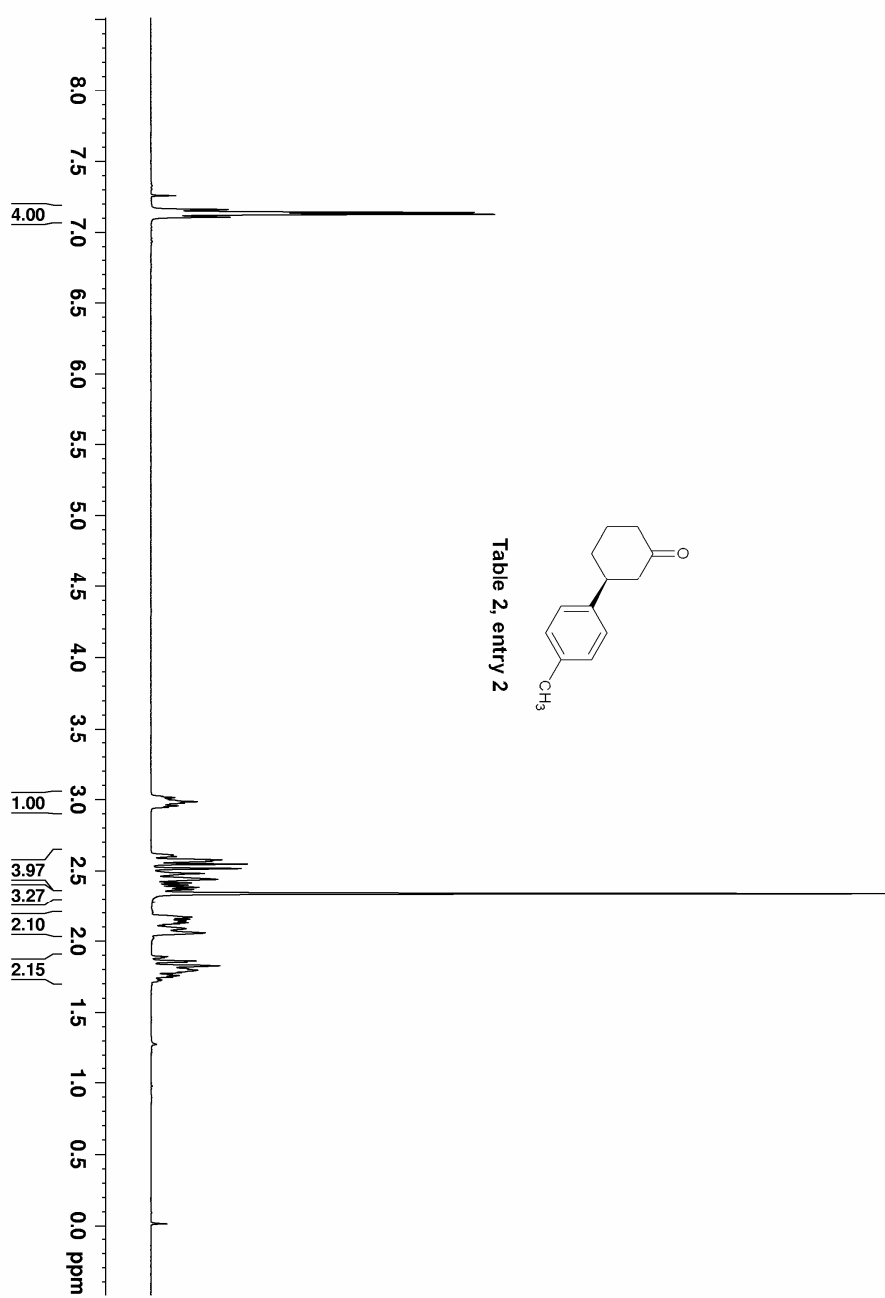


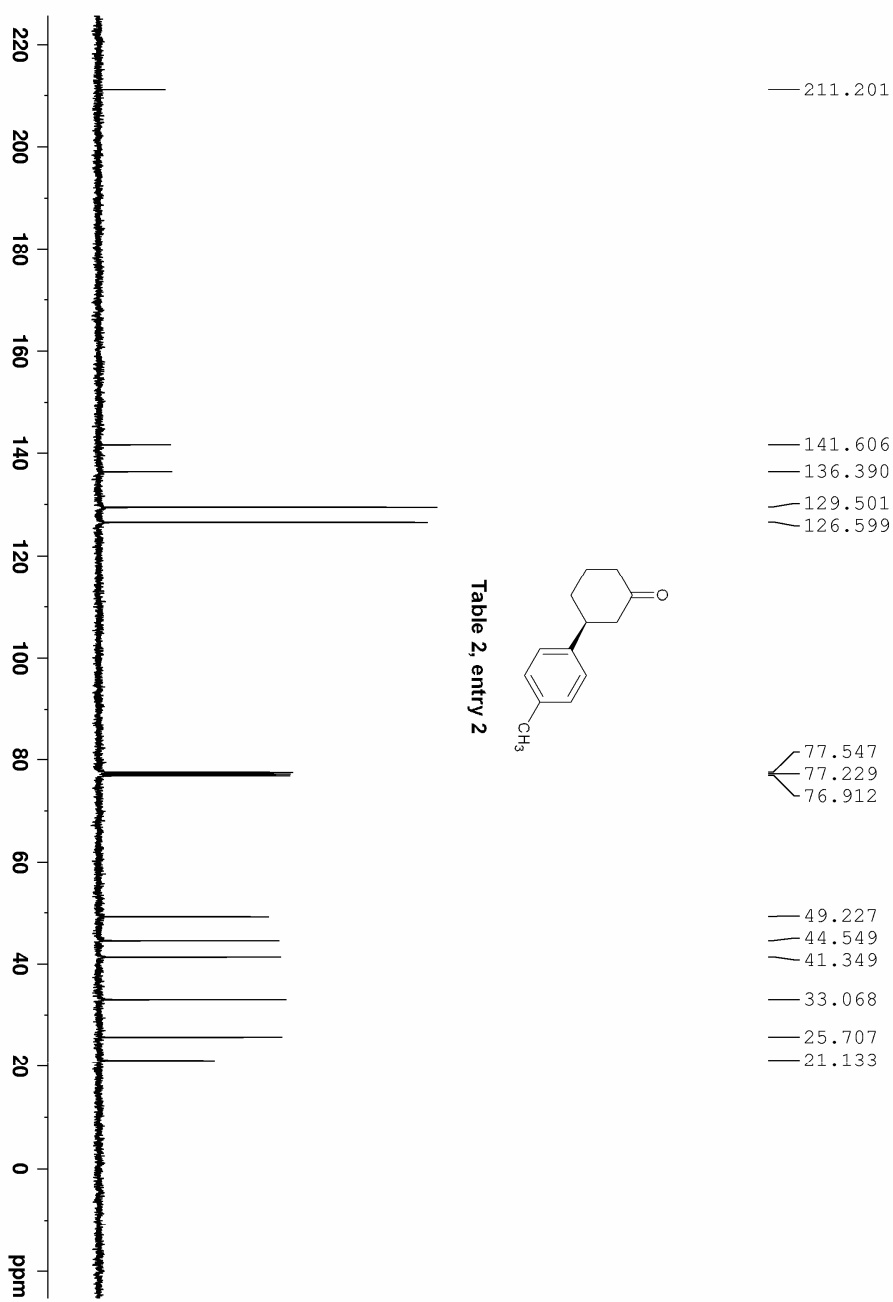












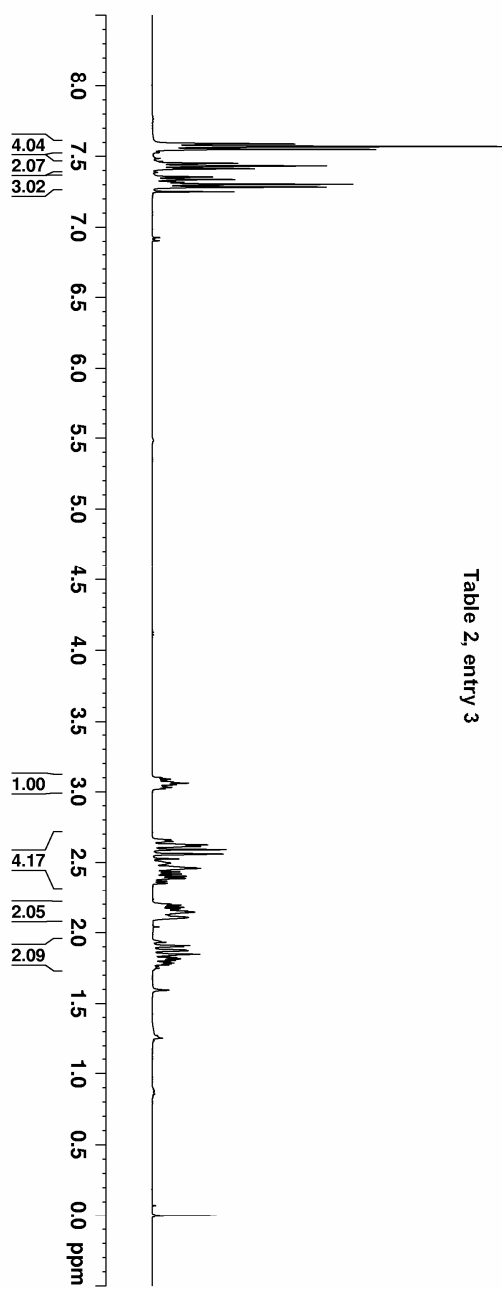
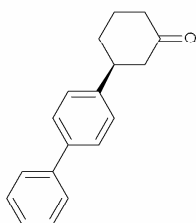
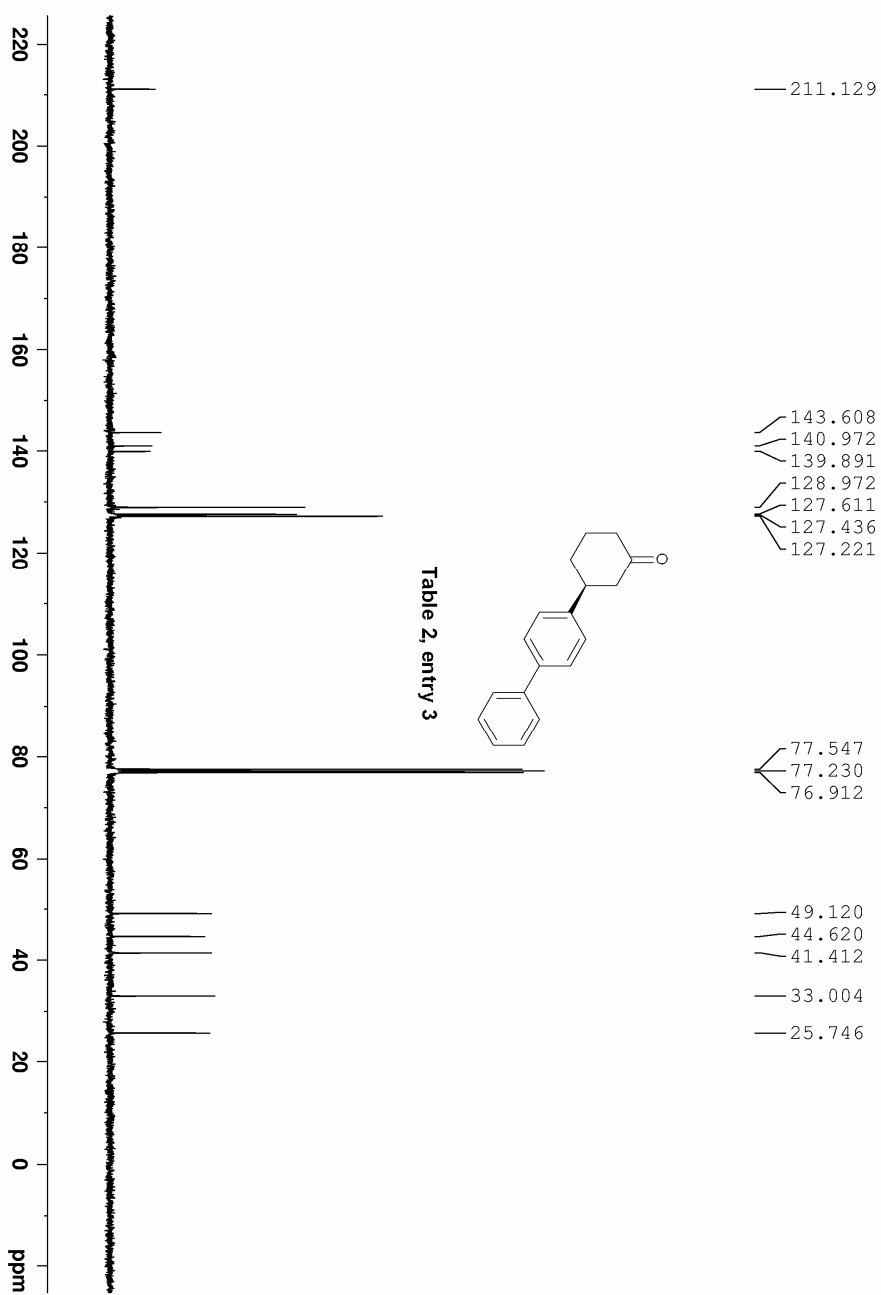
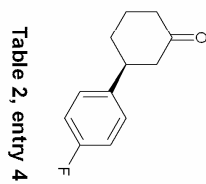
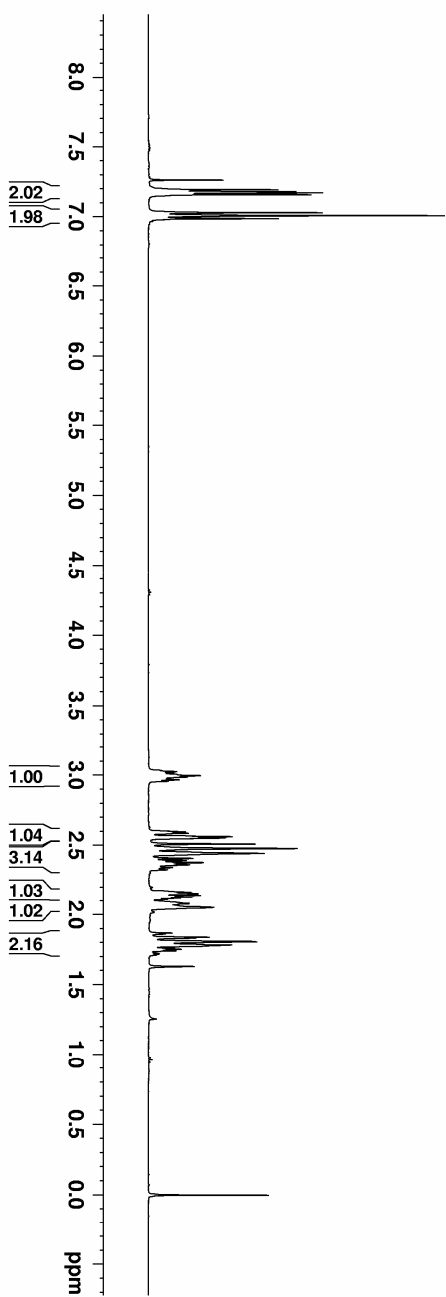
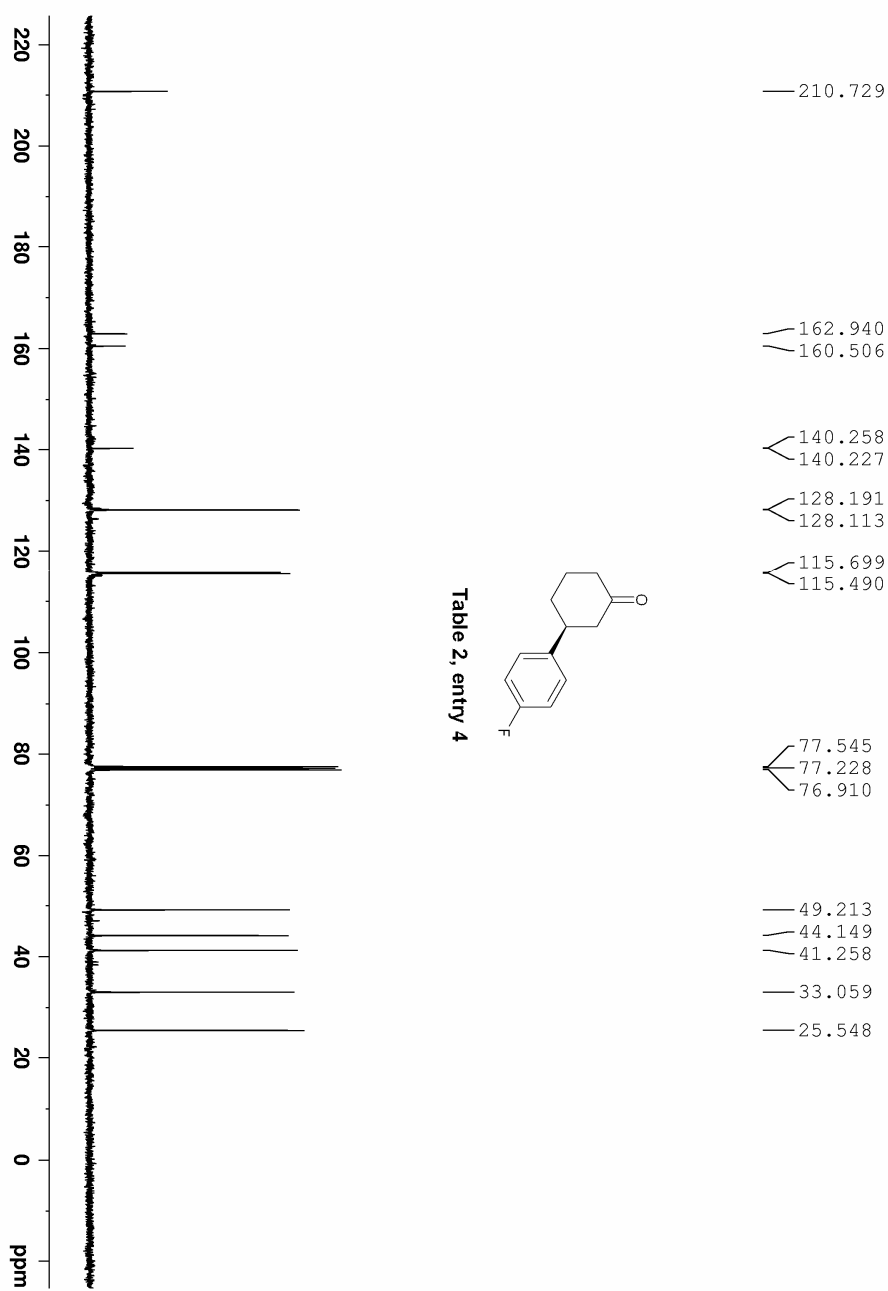


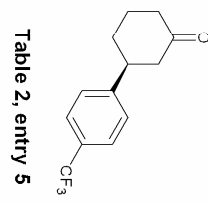
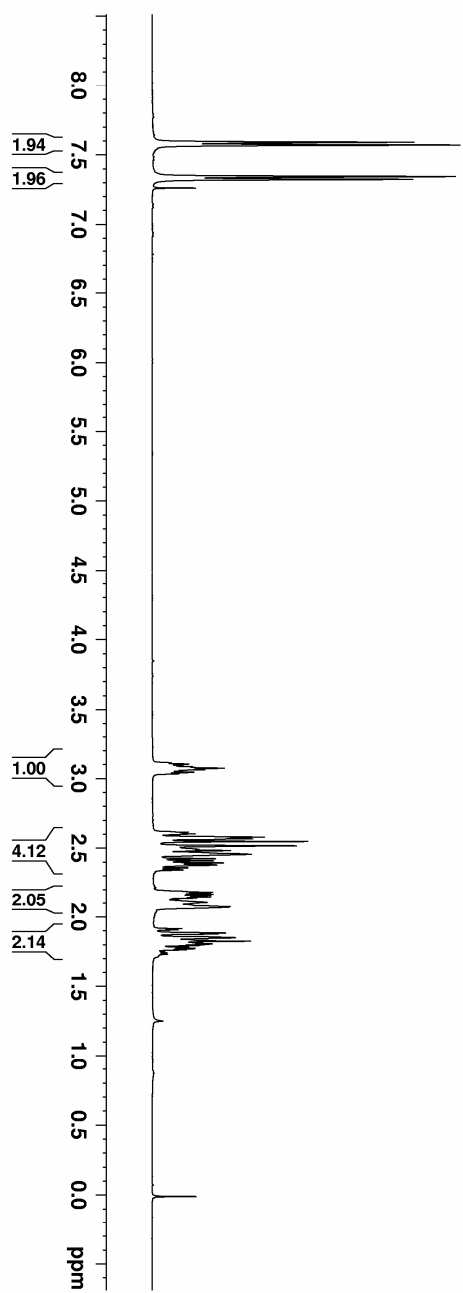
Table 2, entry 3

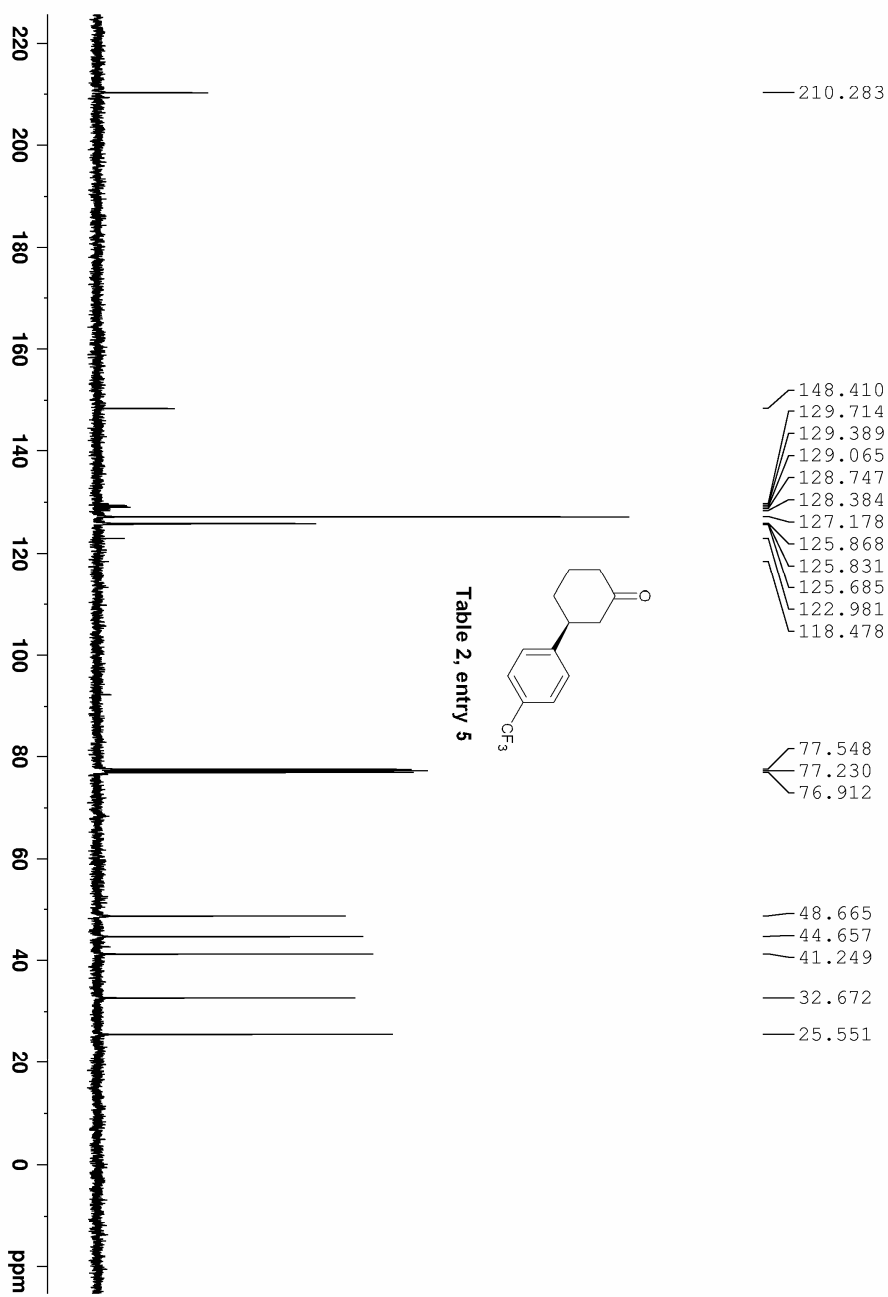


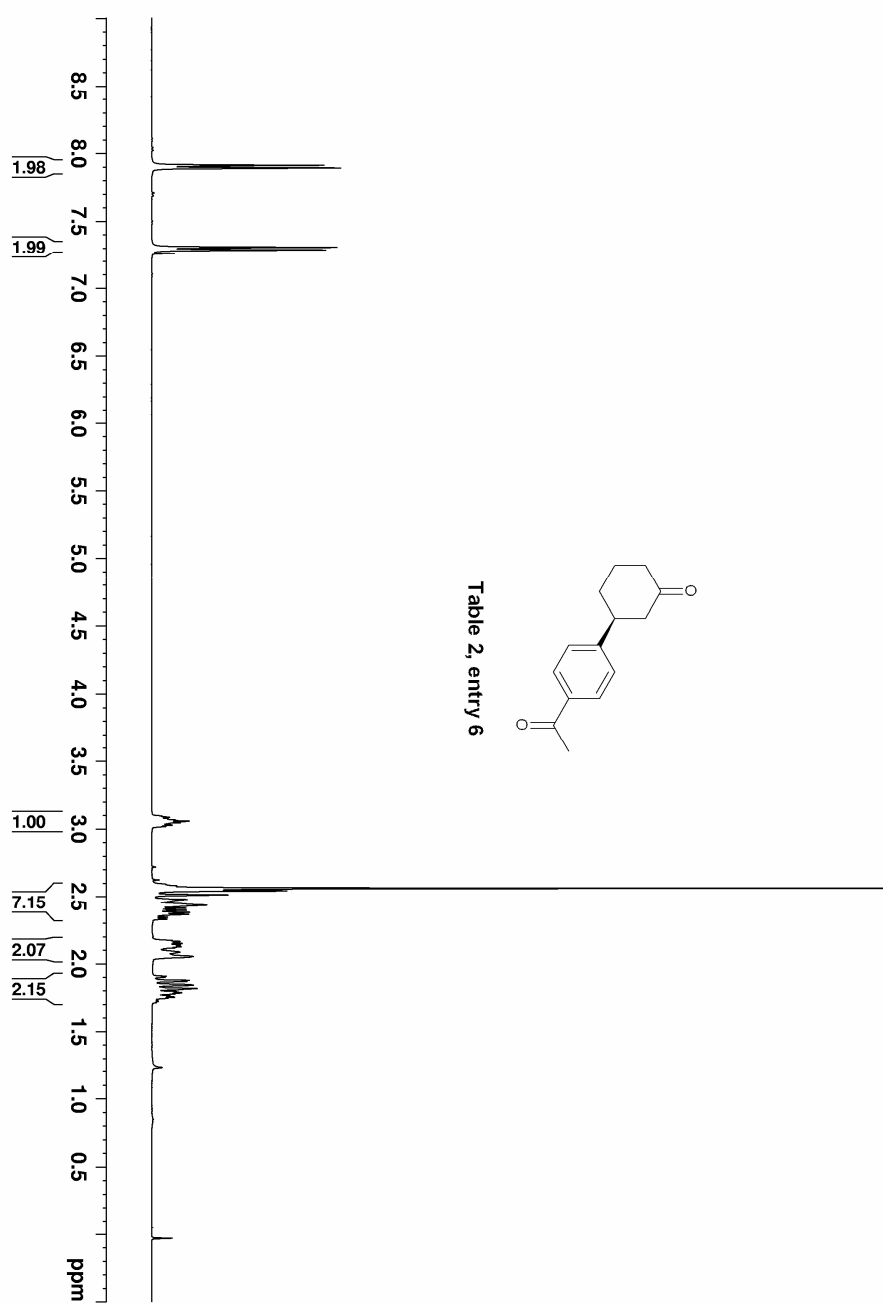


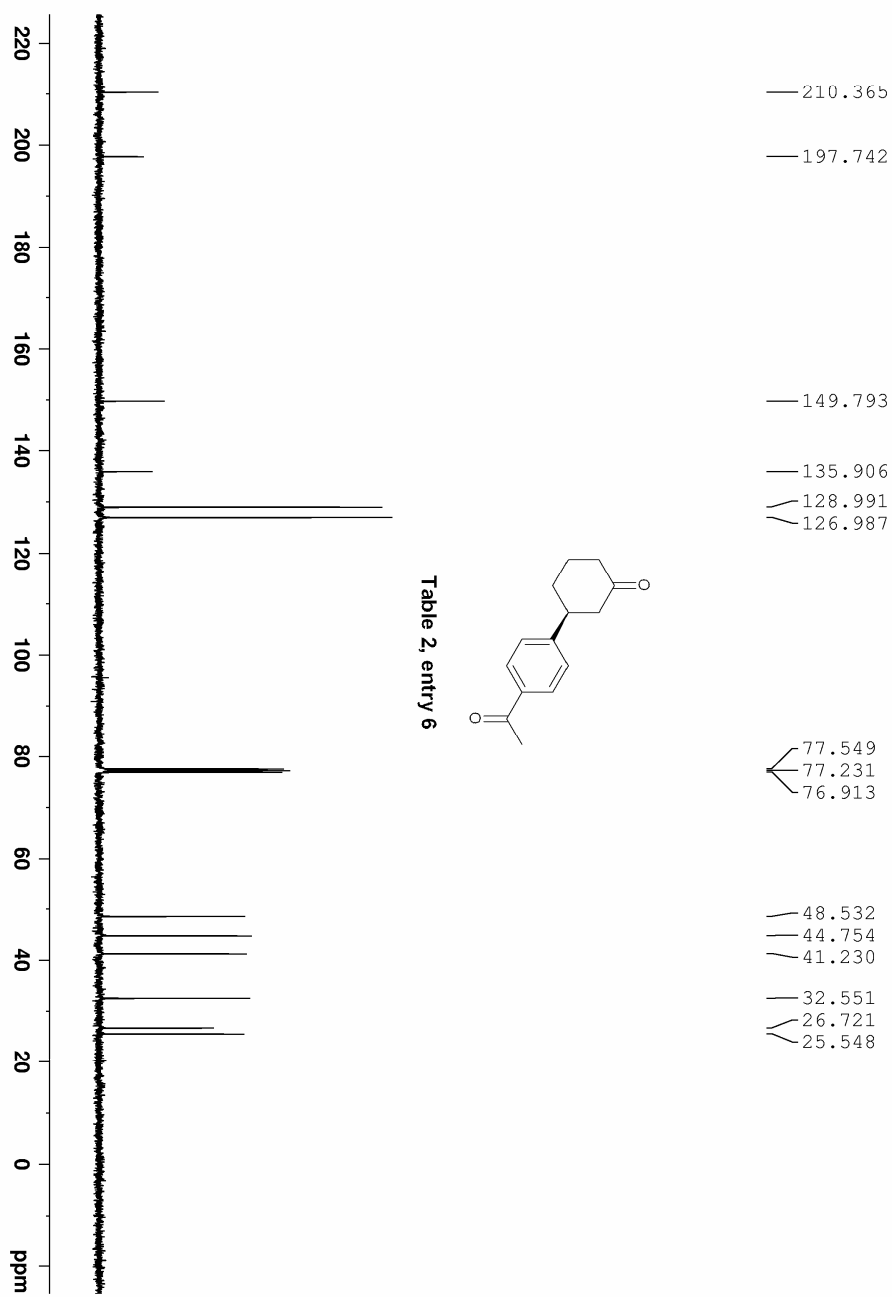


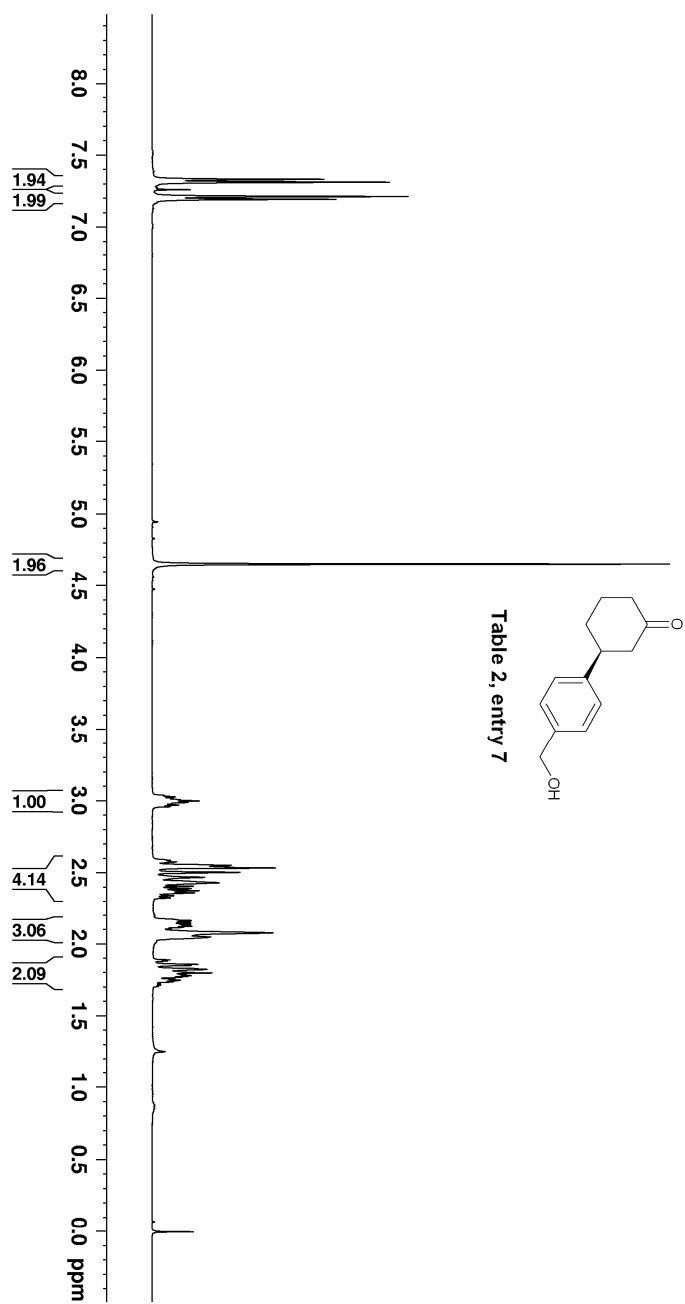


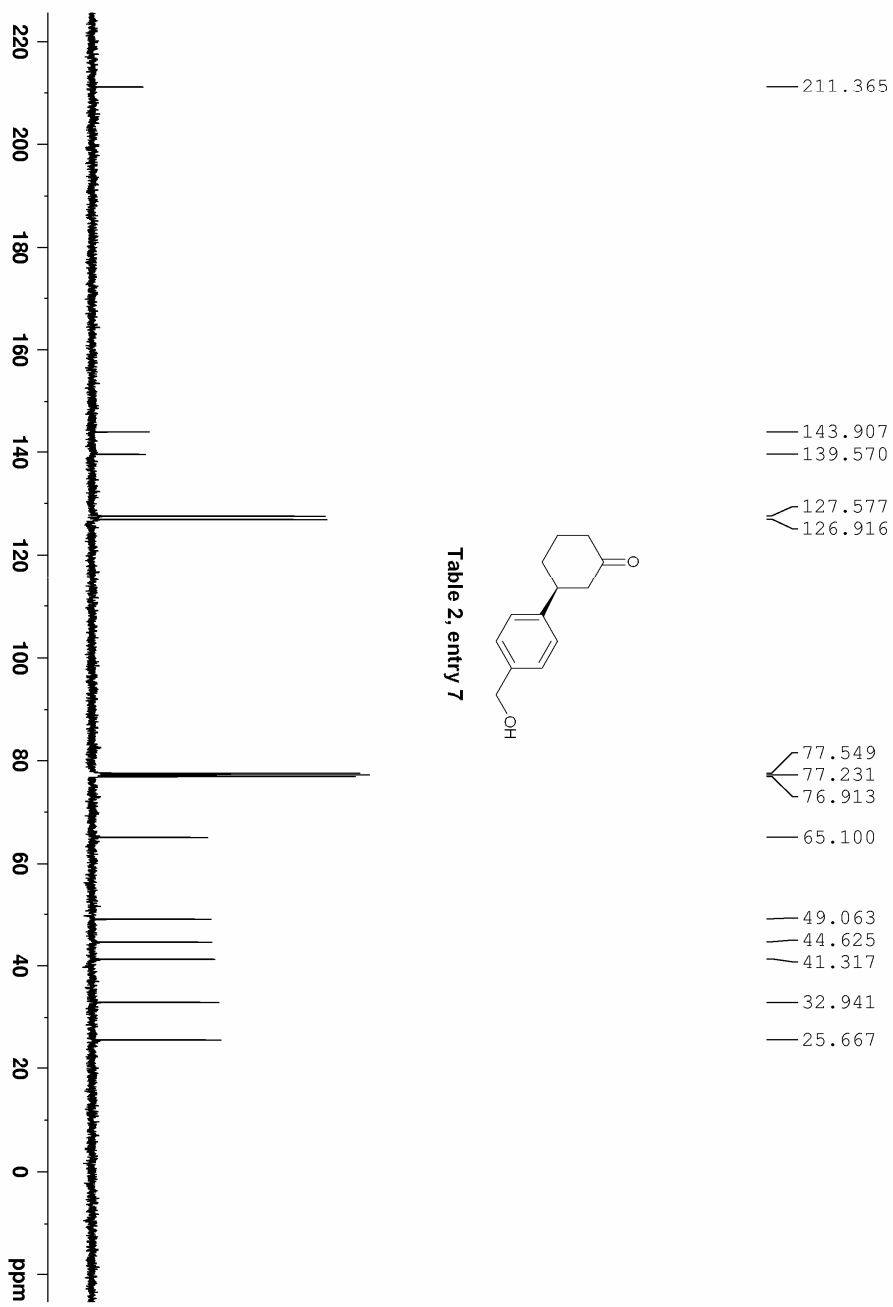


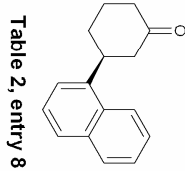
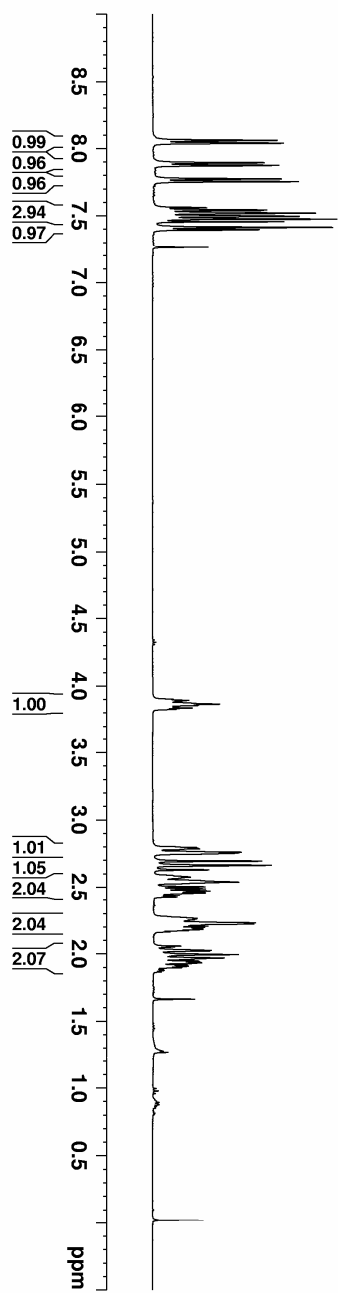


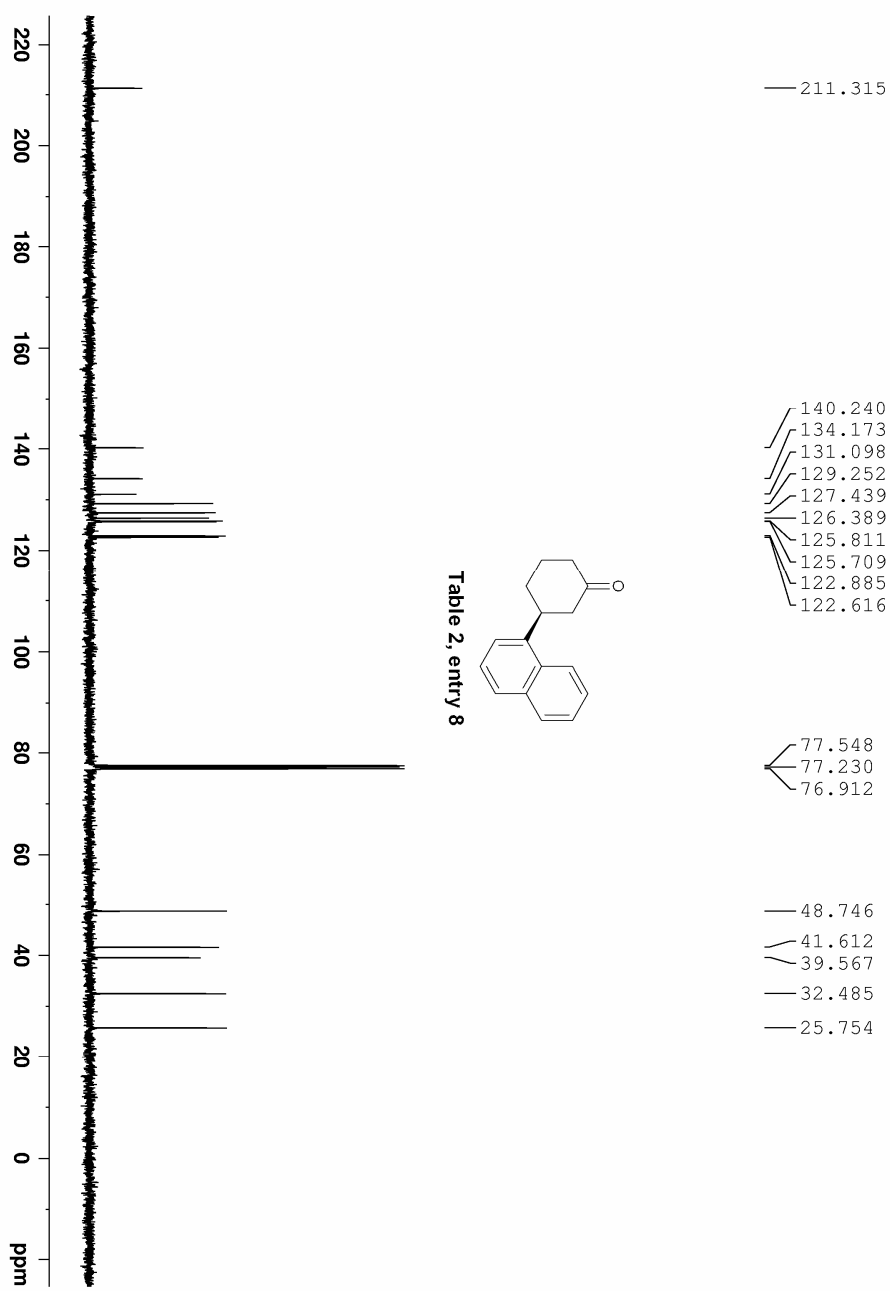












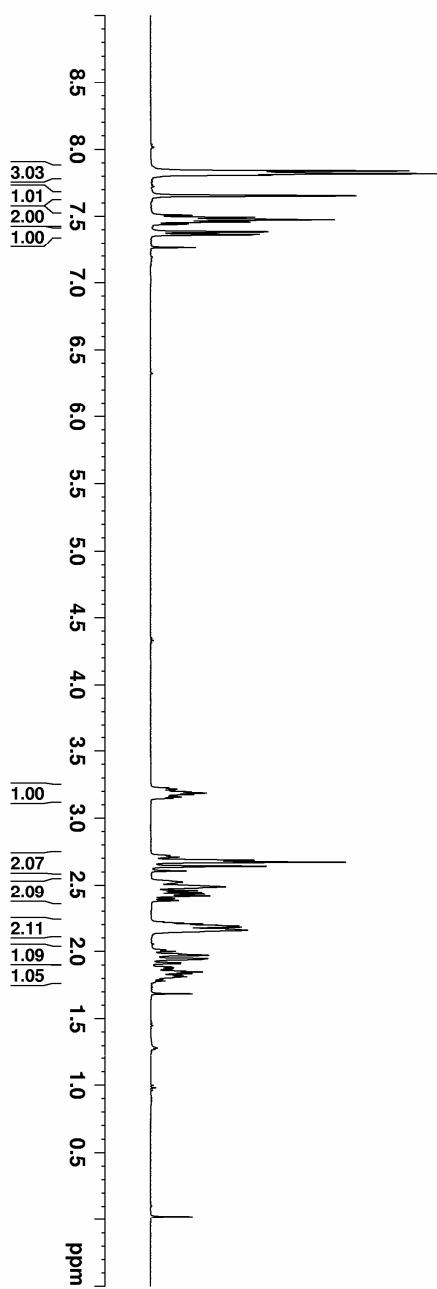
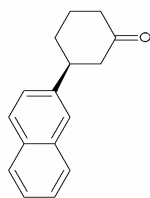
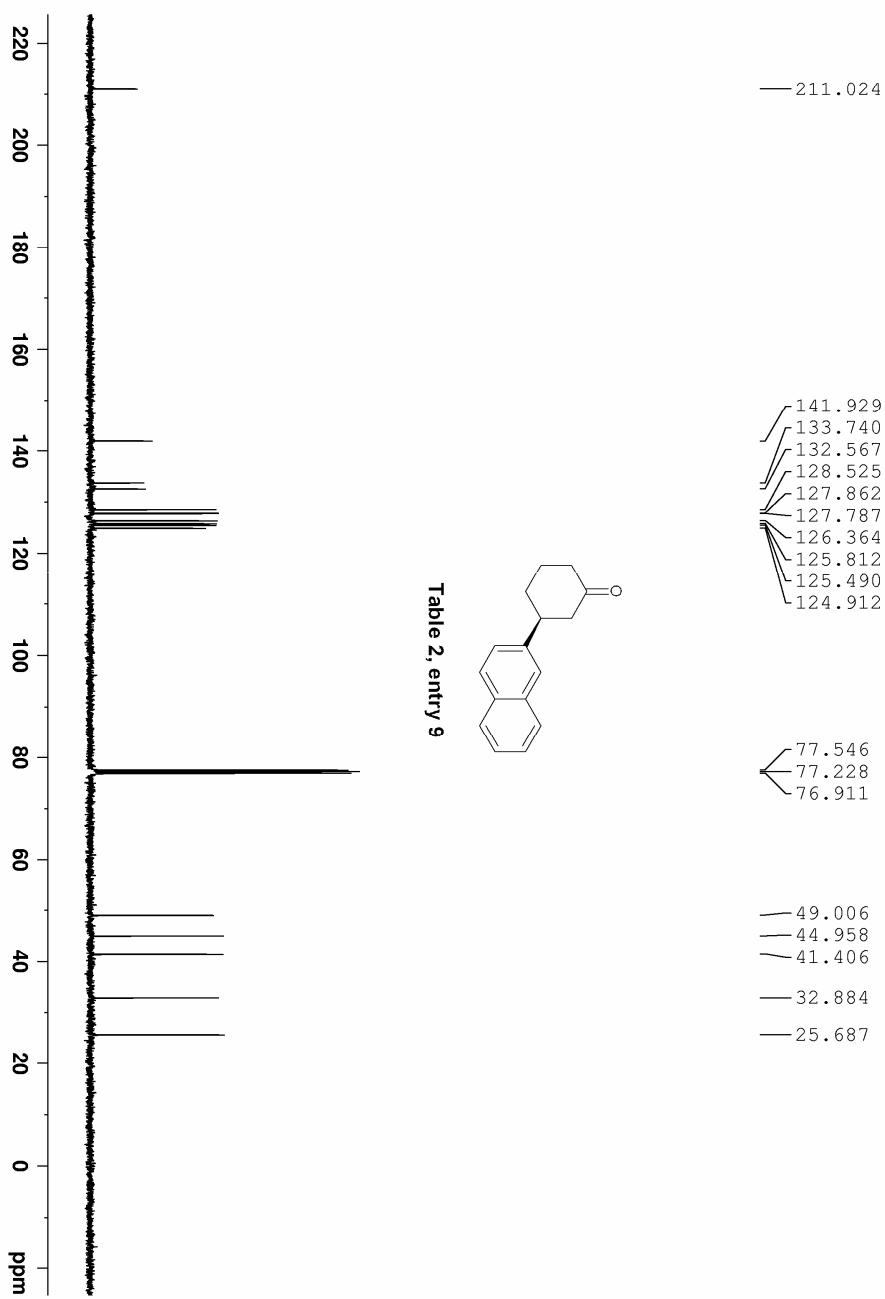
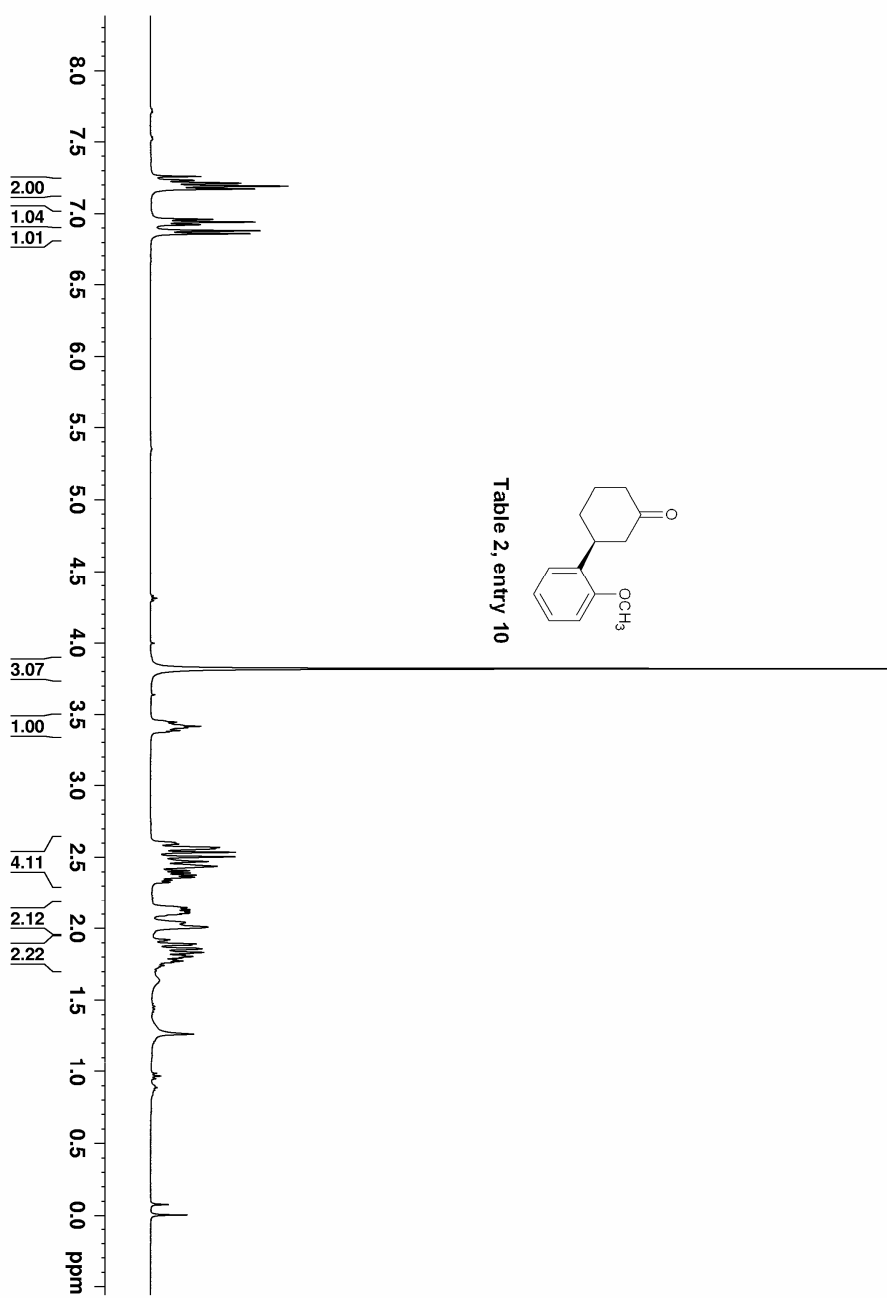
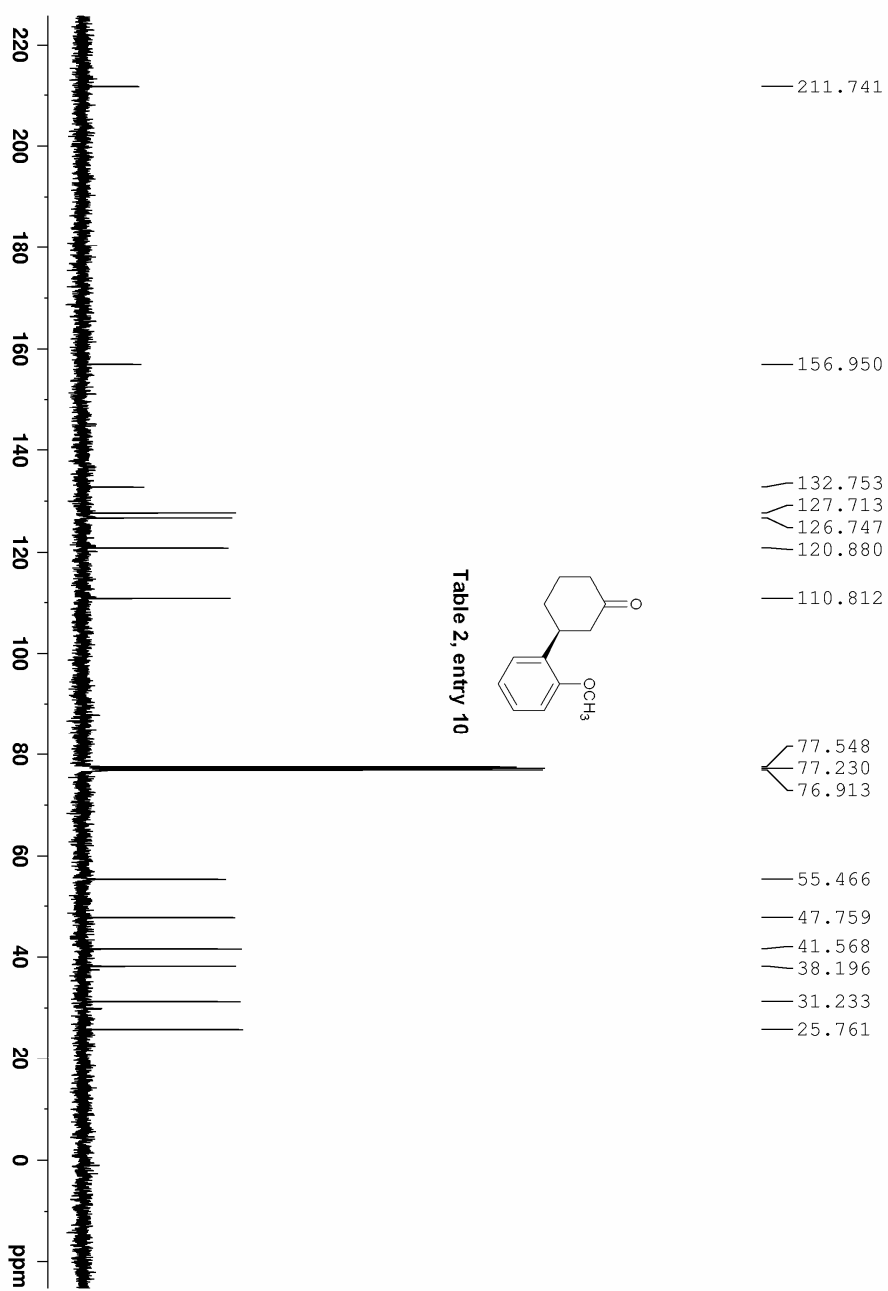


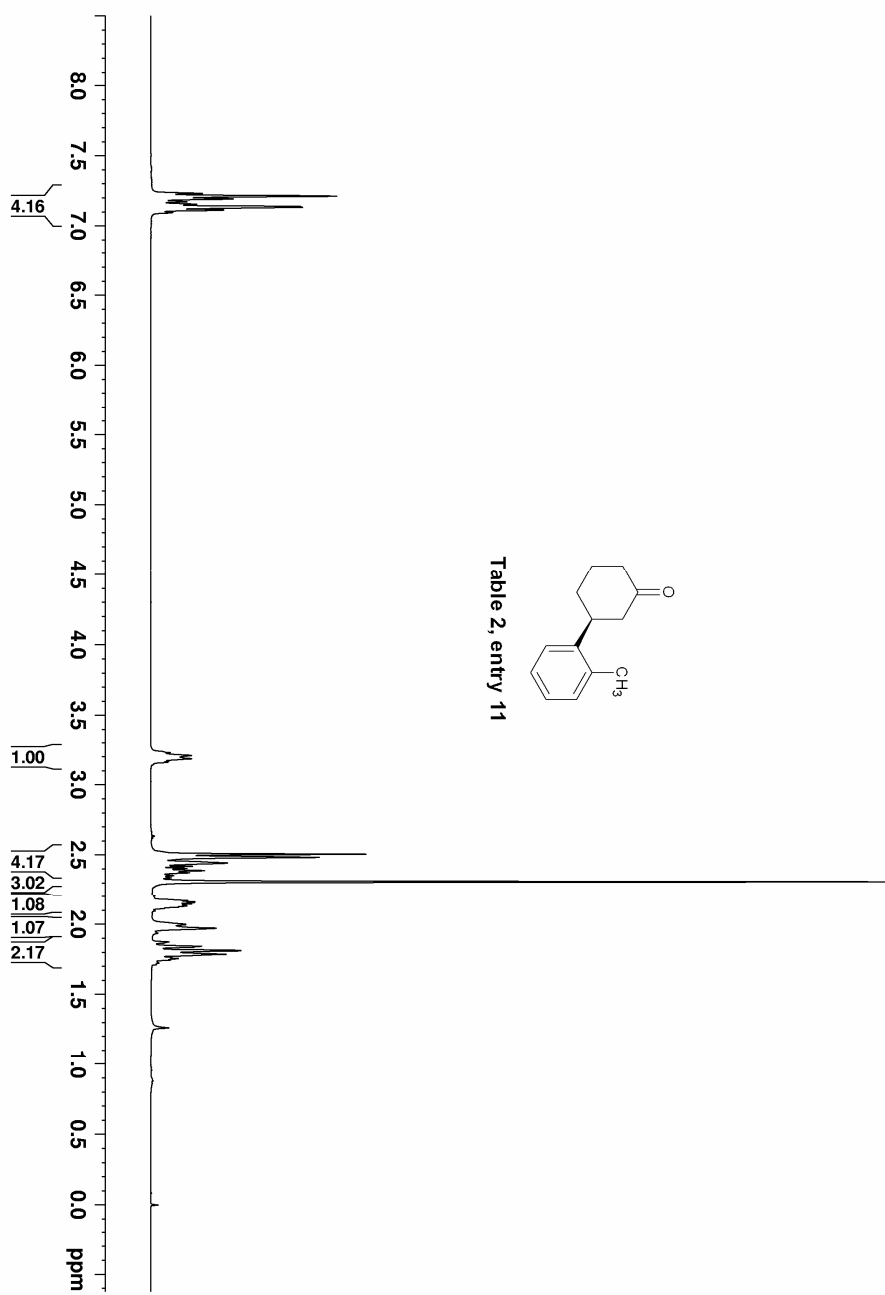
Table 2, entry 9

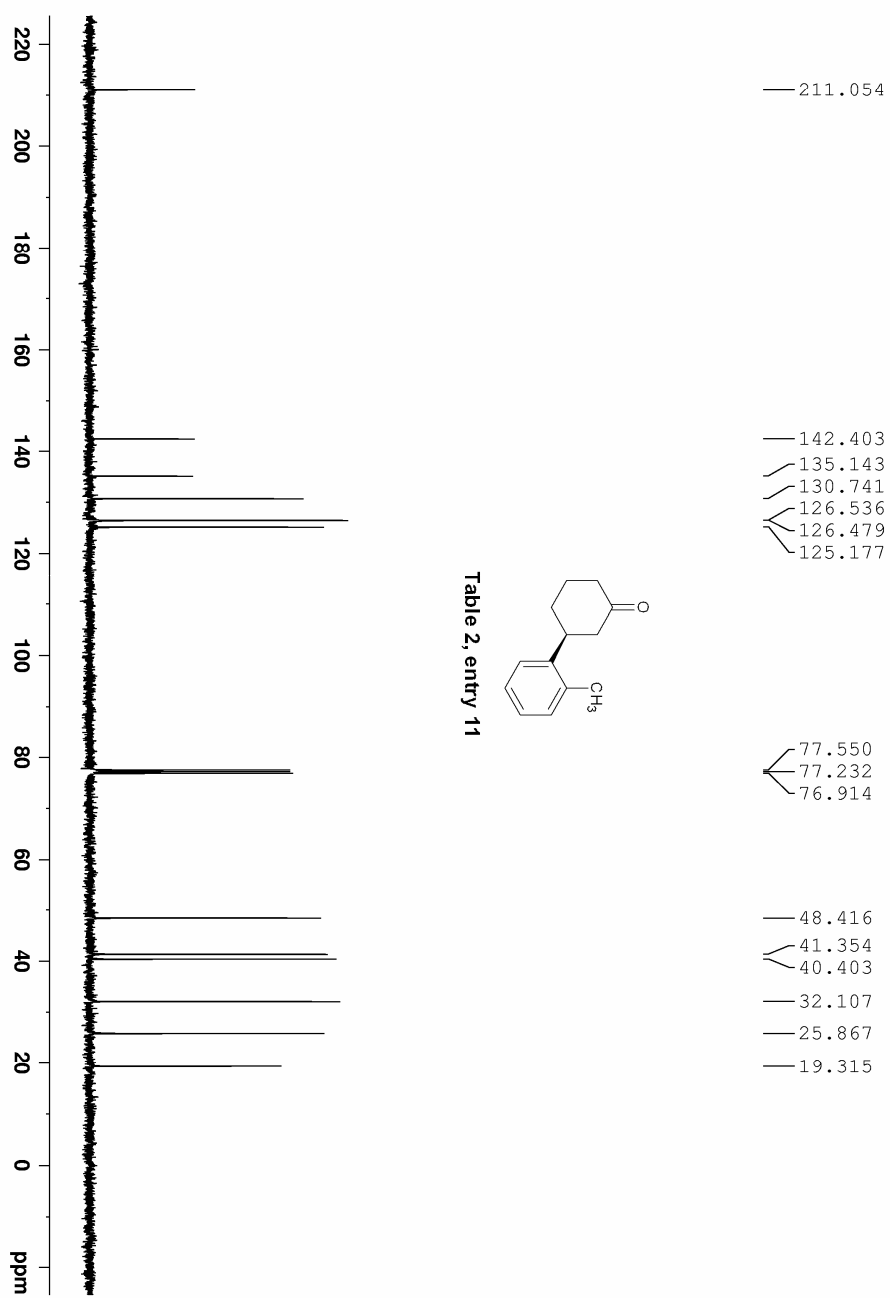












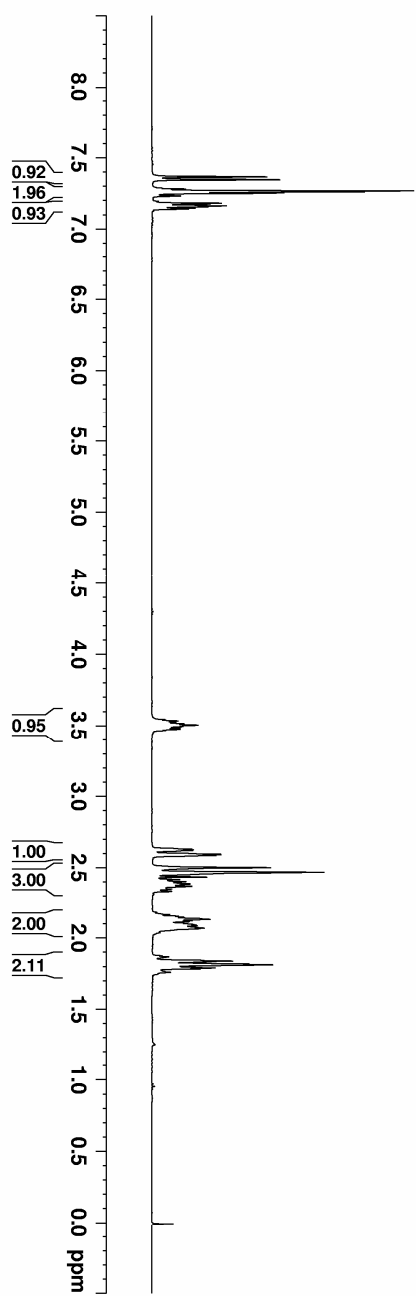
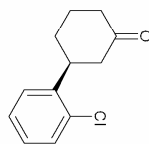
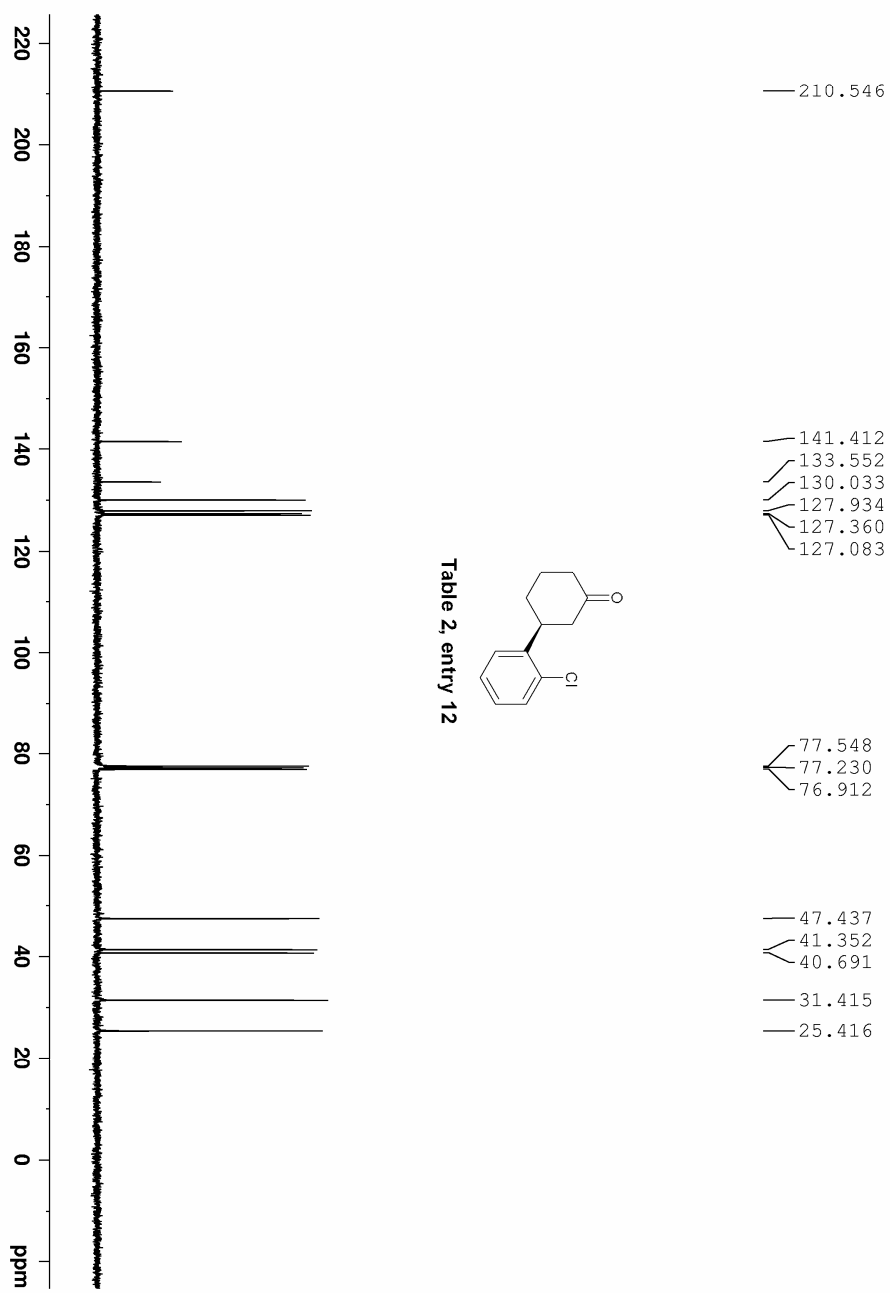
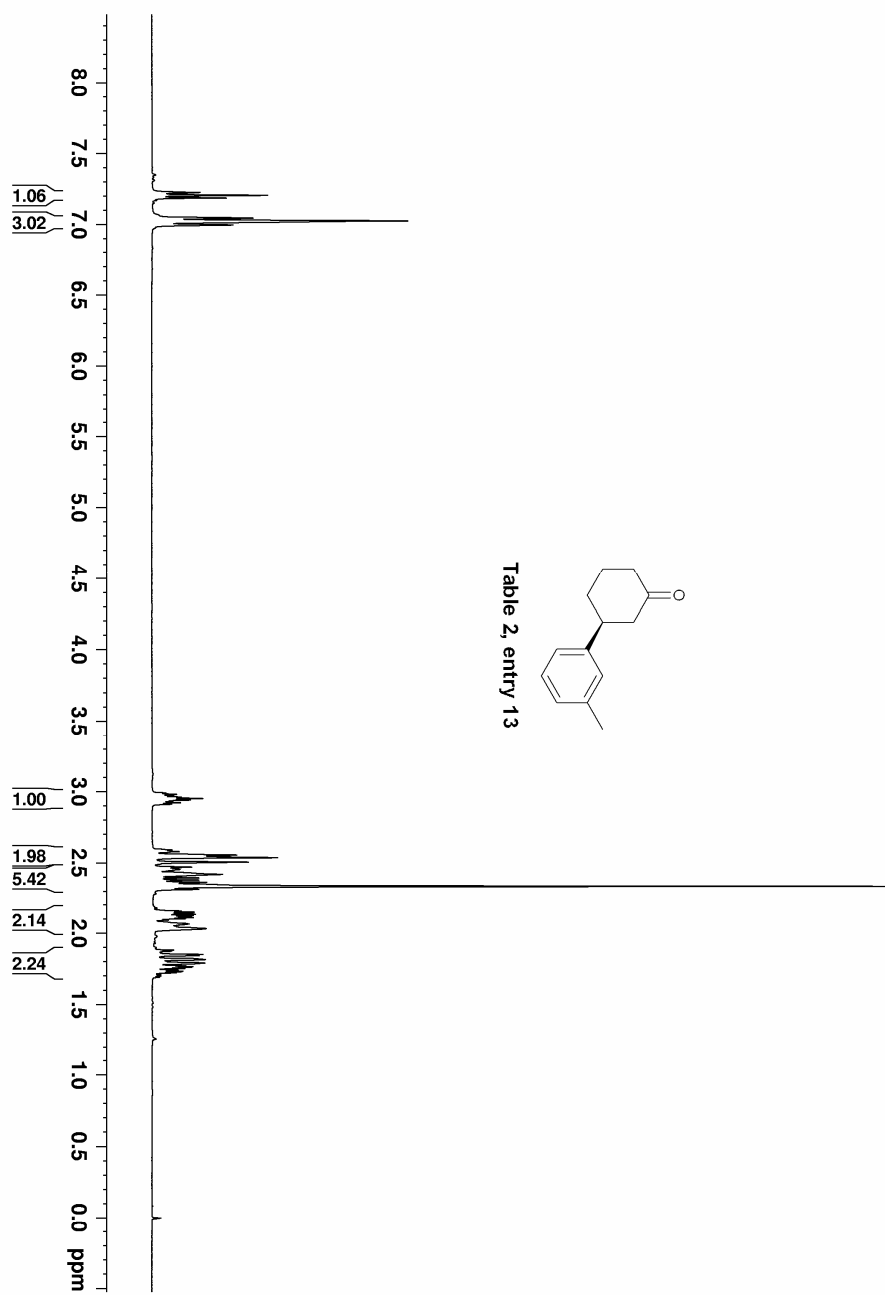
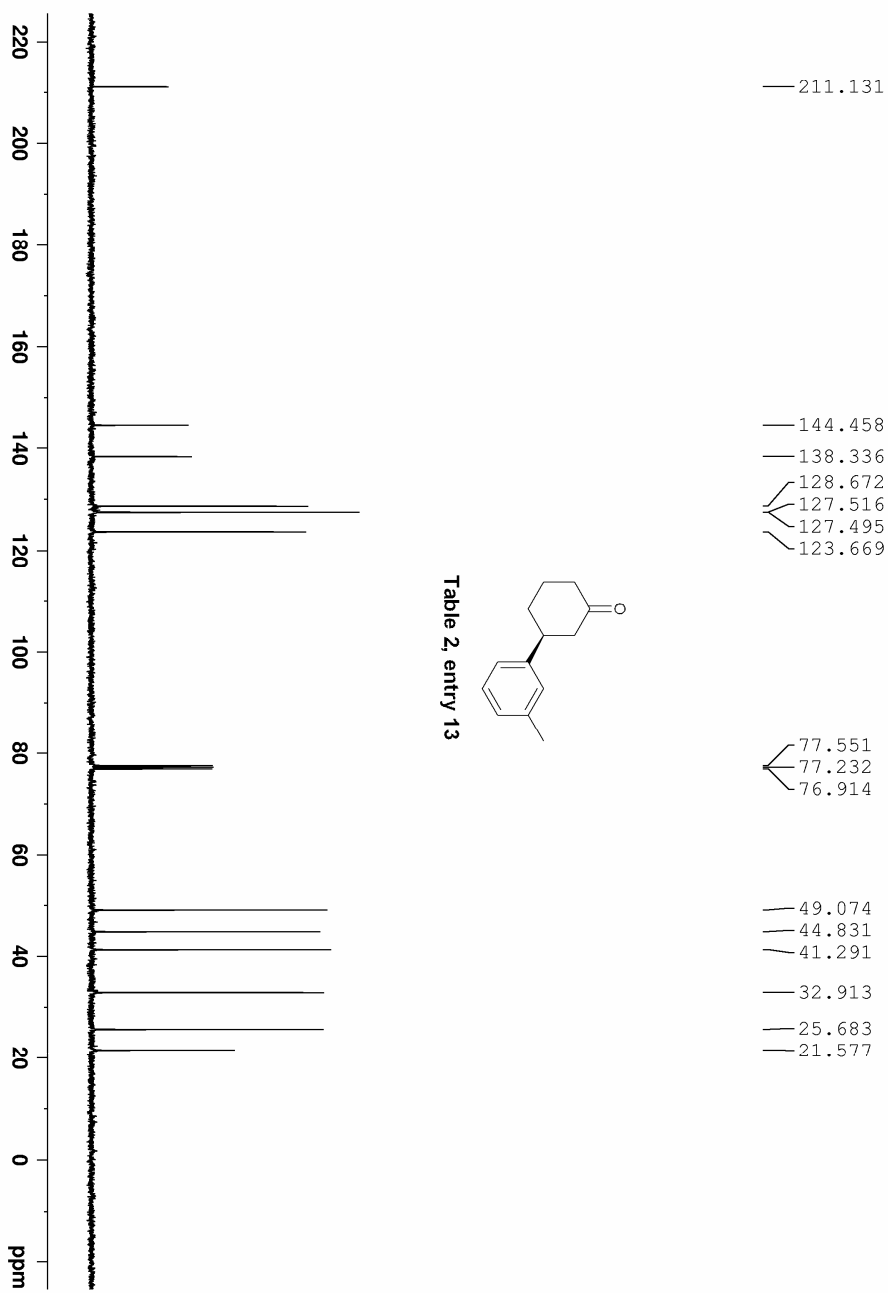


Table 2, entry 12









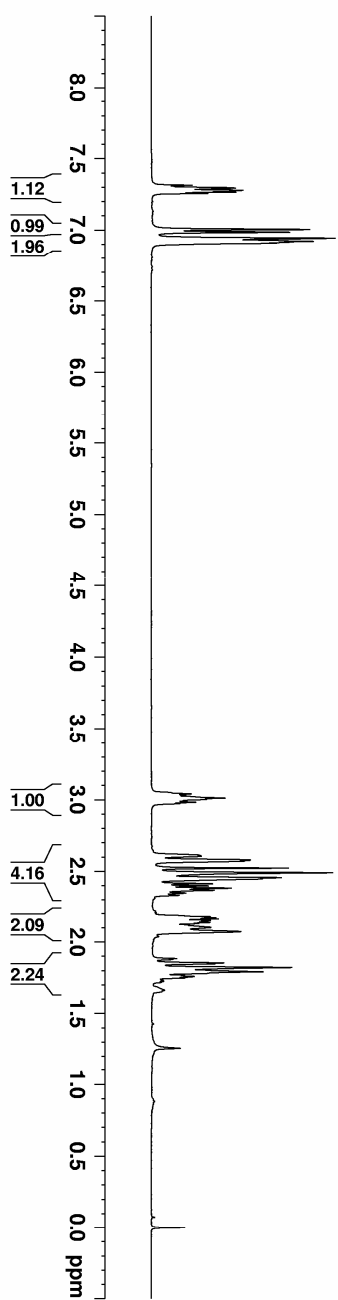
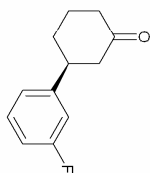
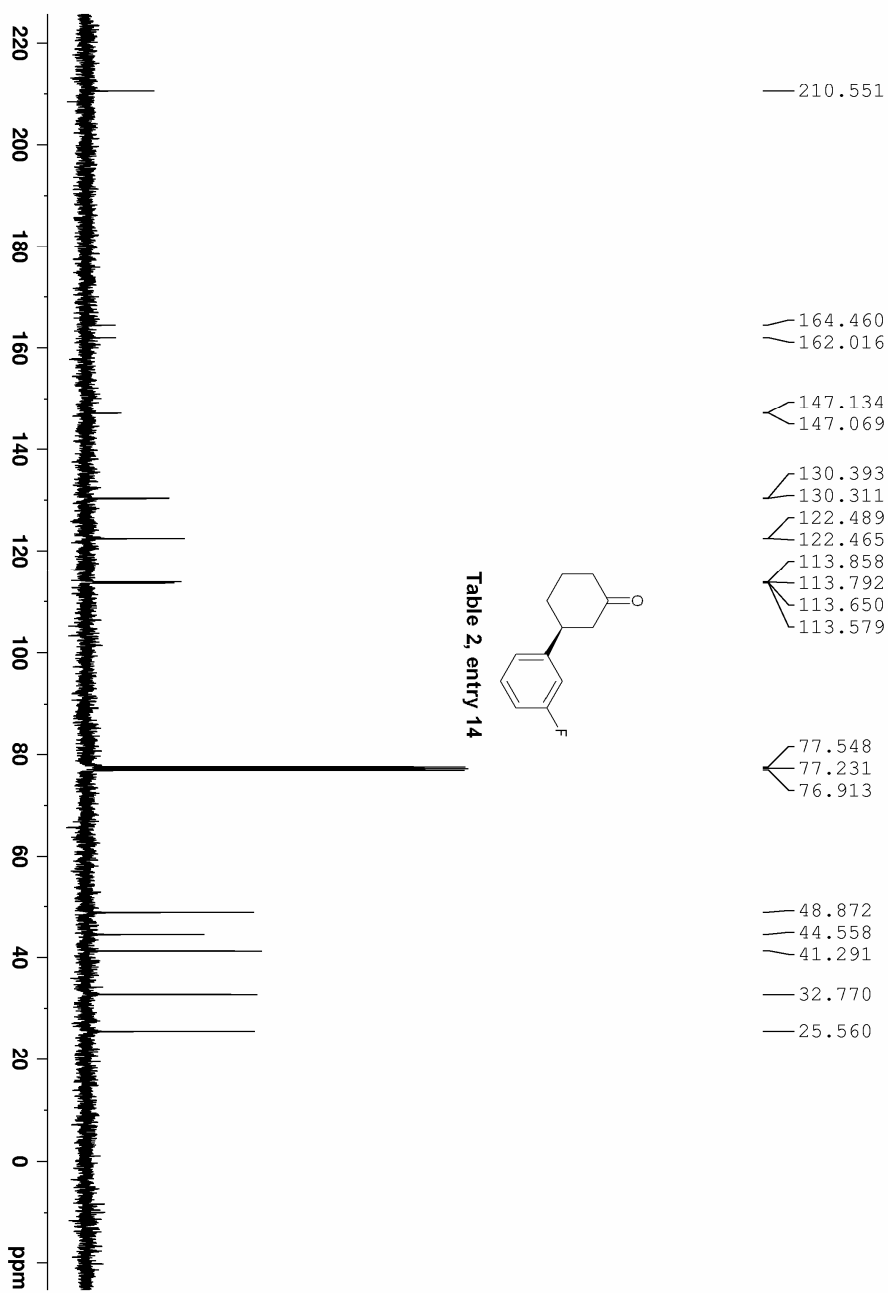
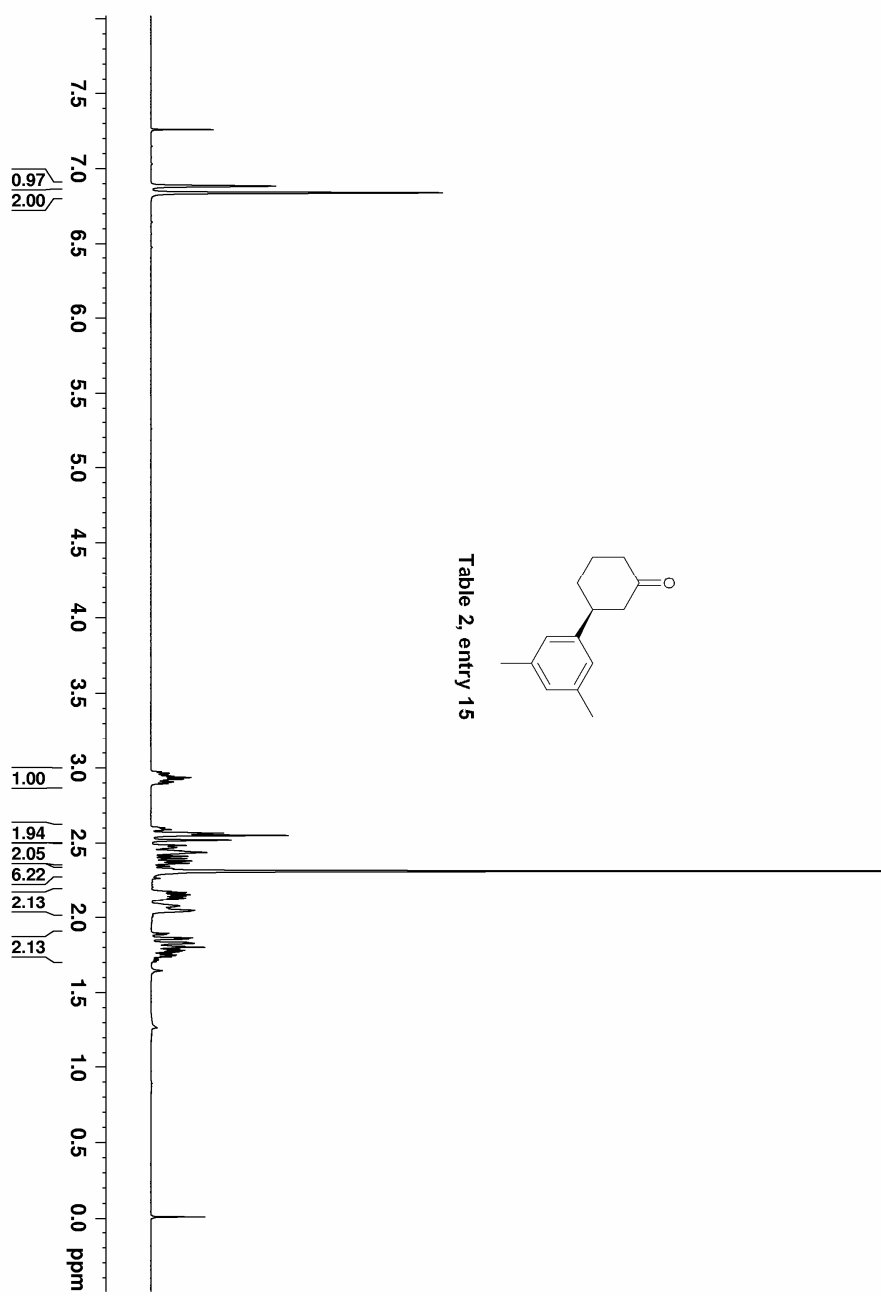
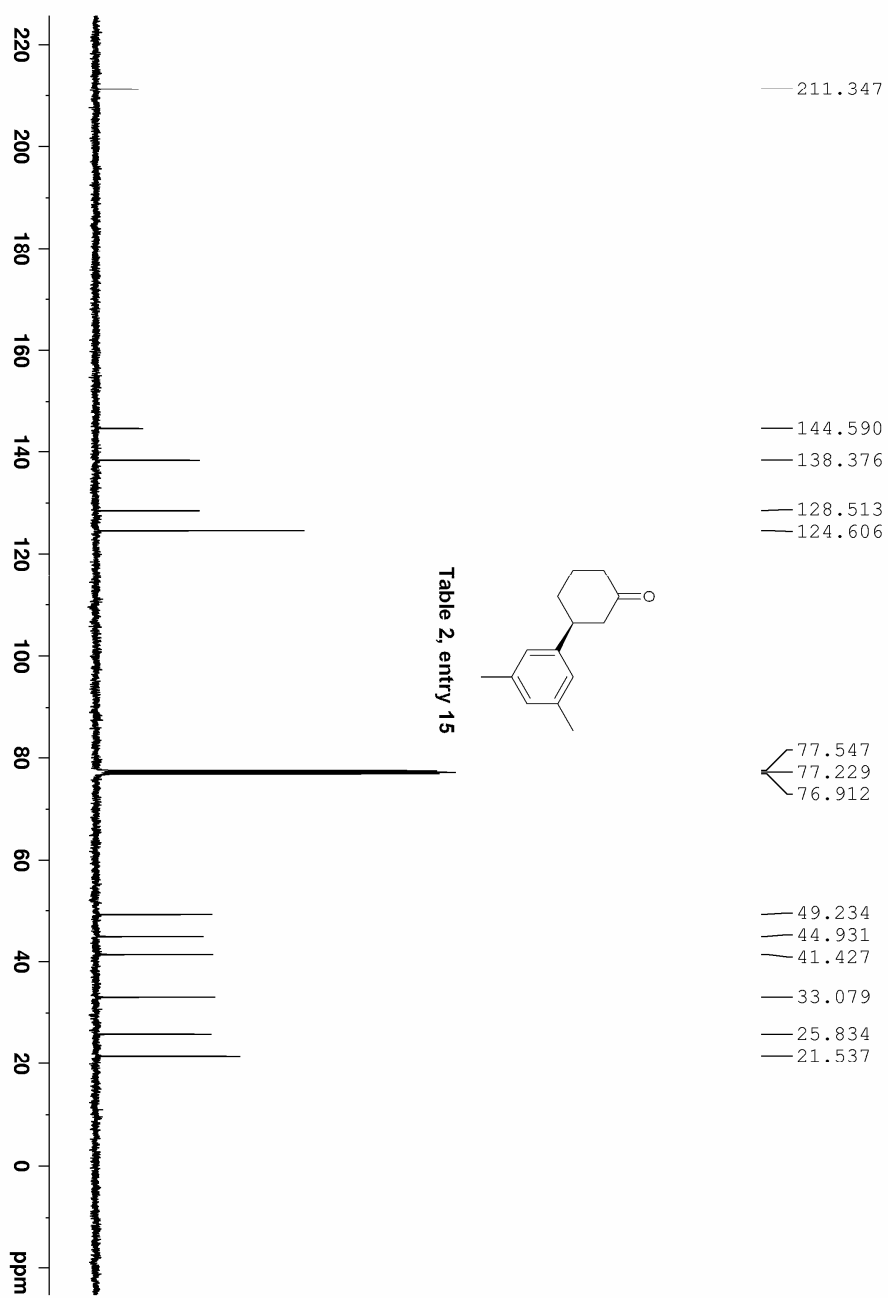


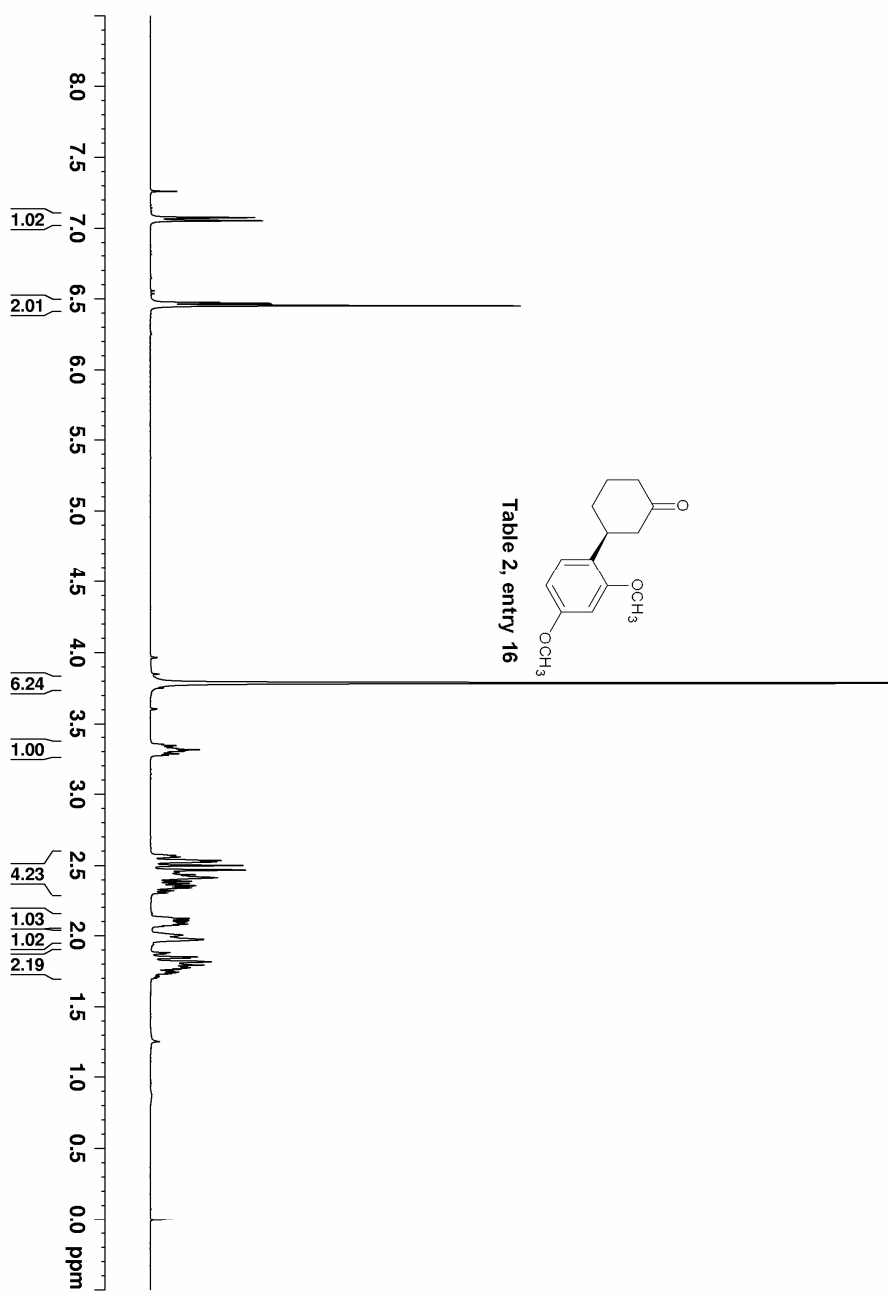
Table 2, entry 14

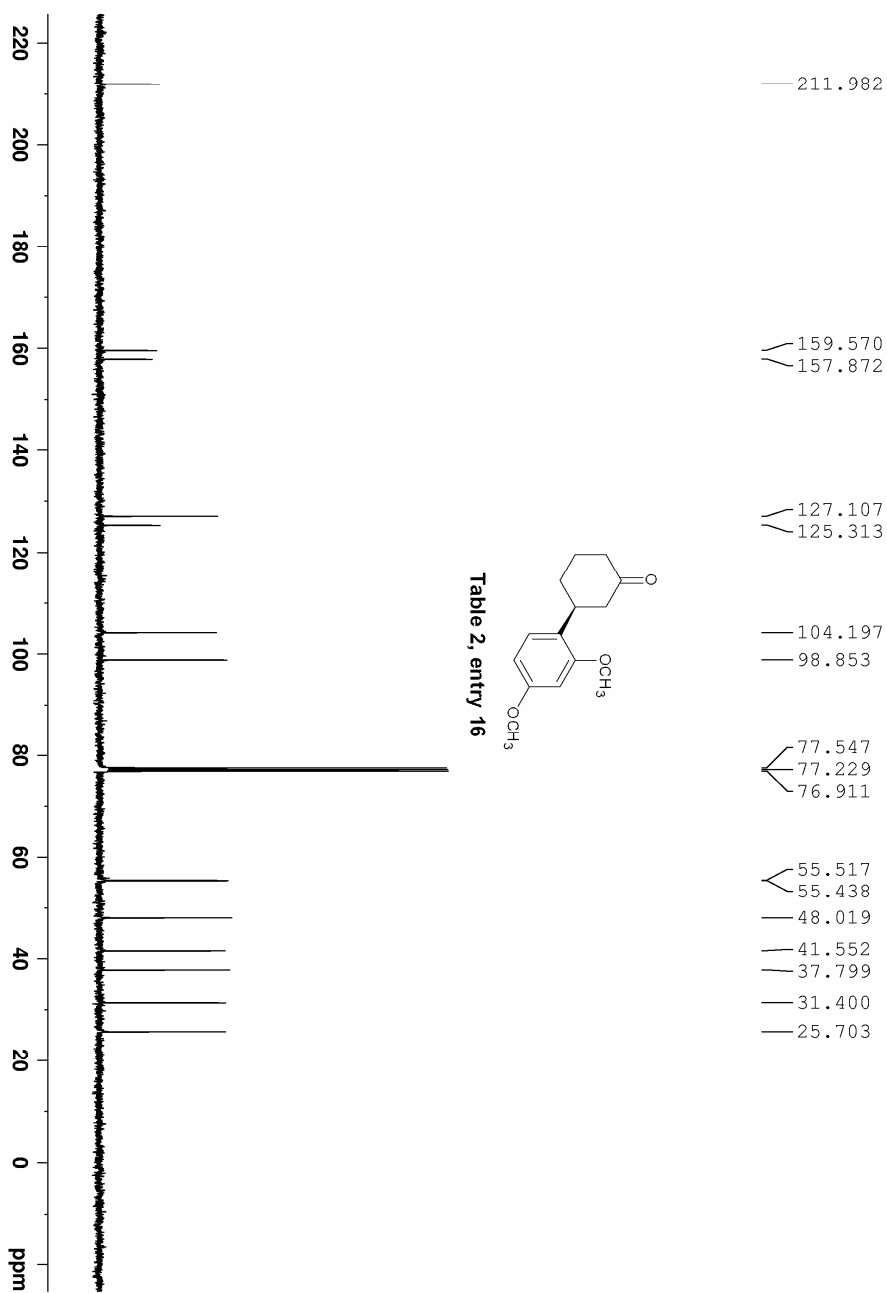


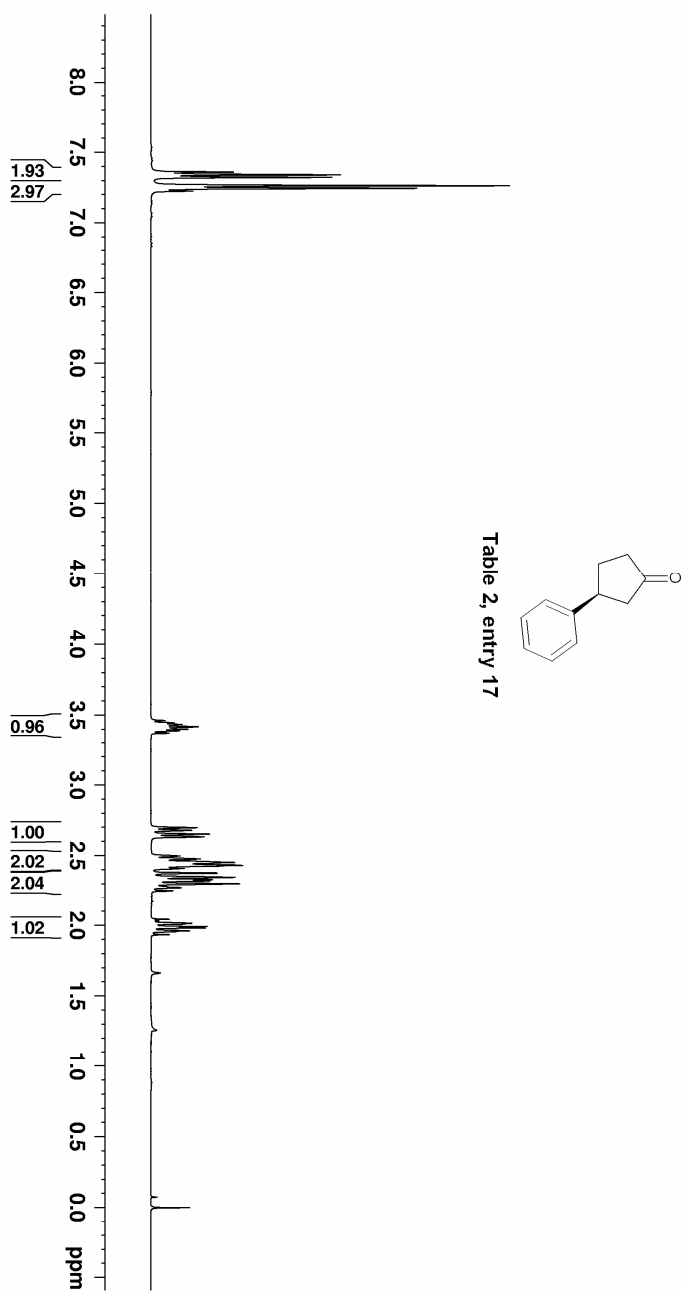


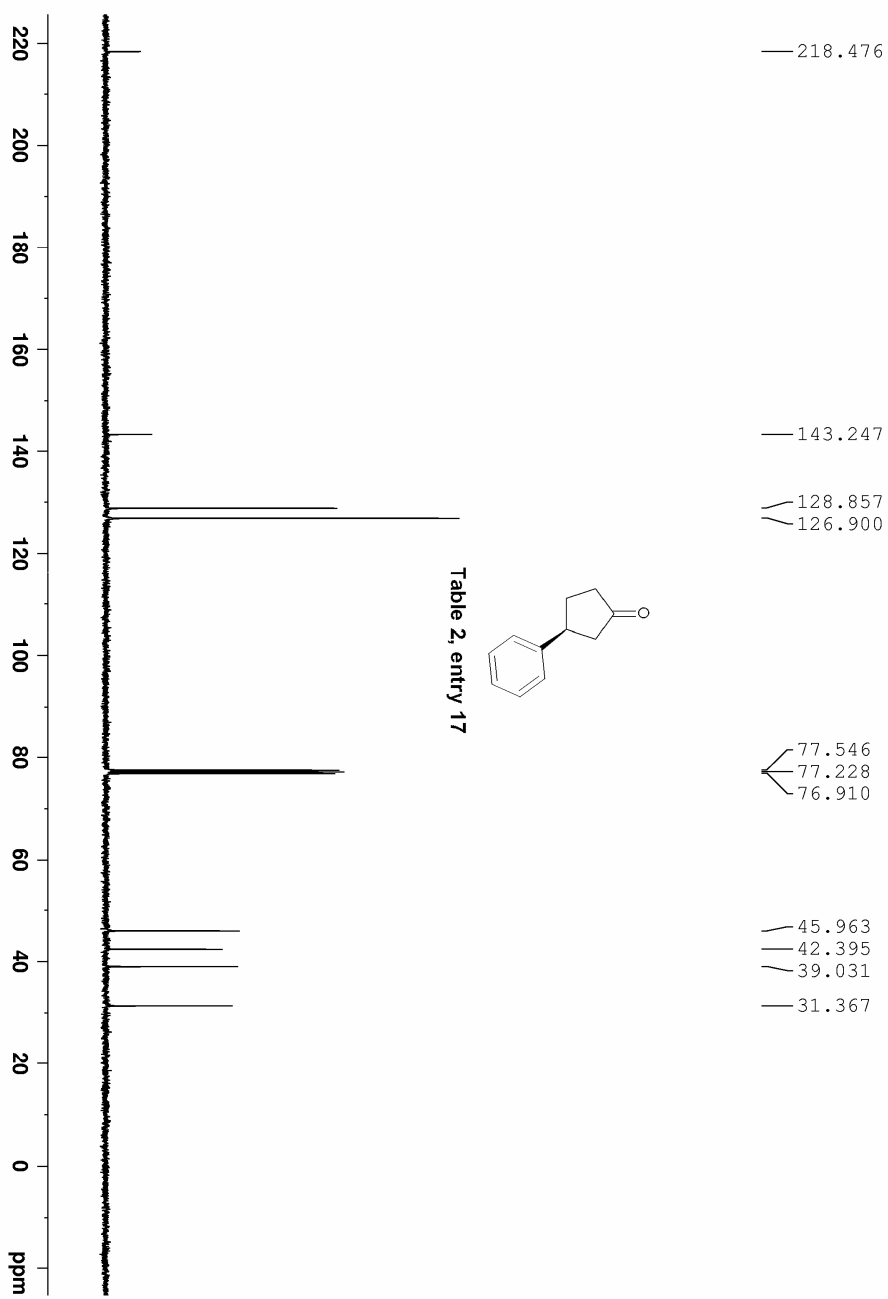


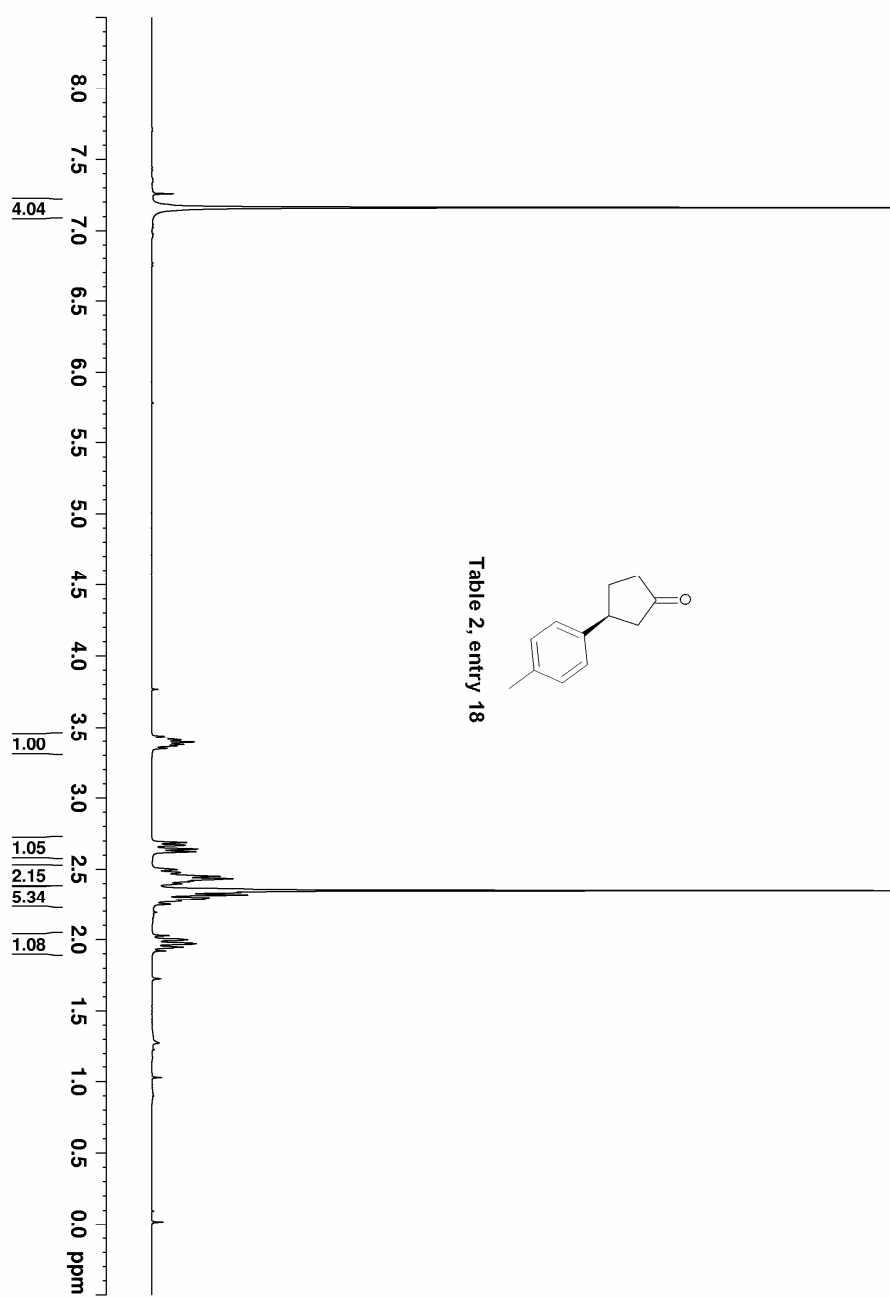


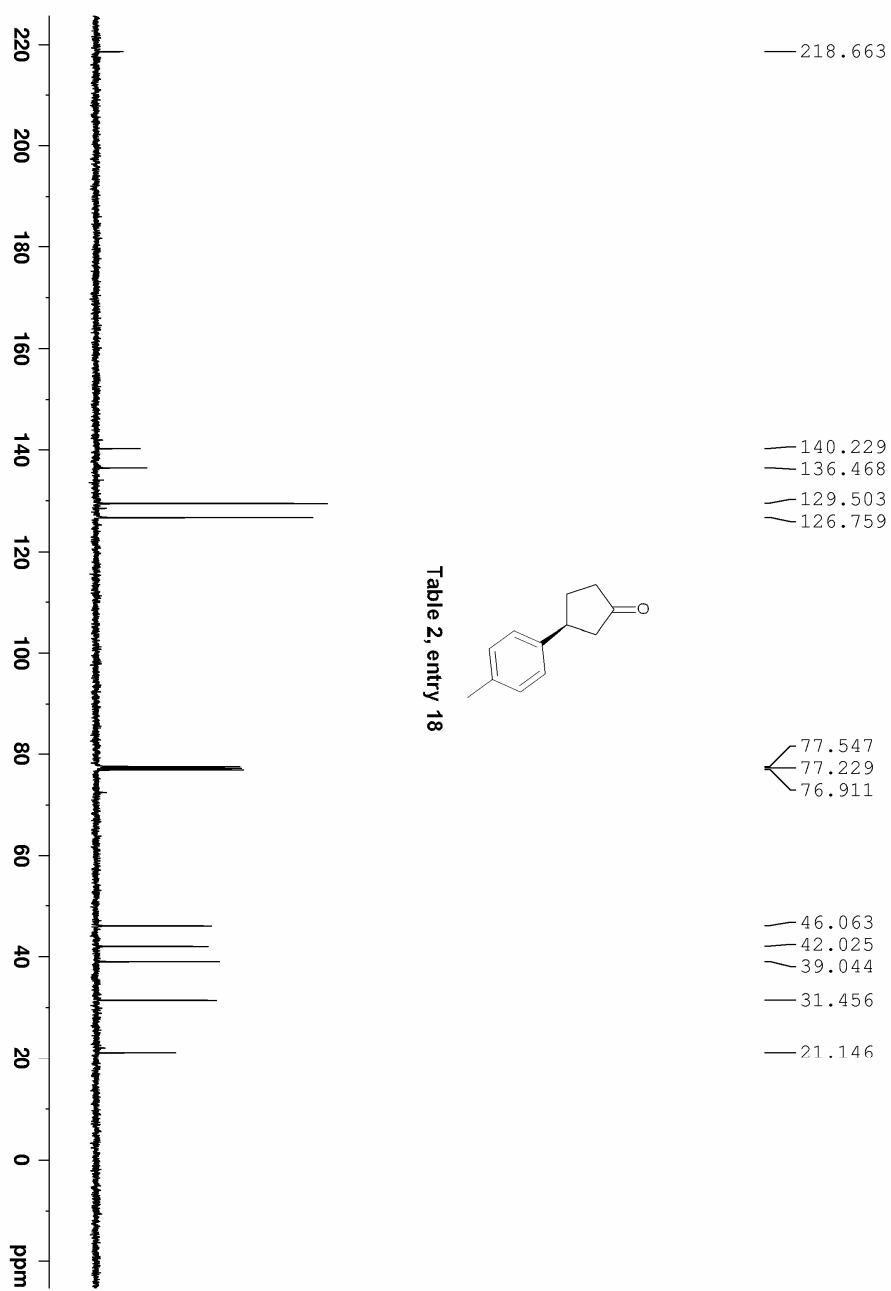












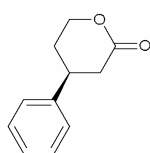
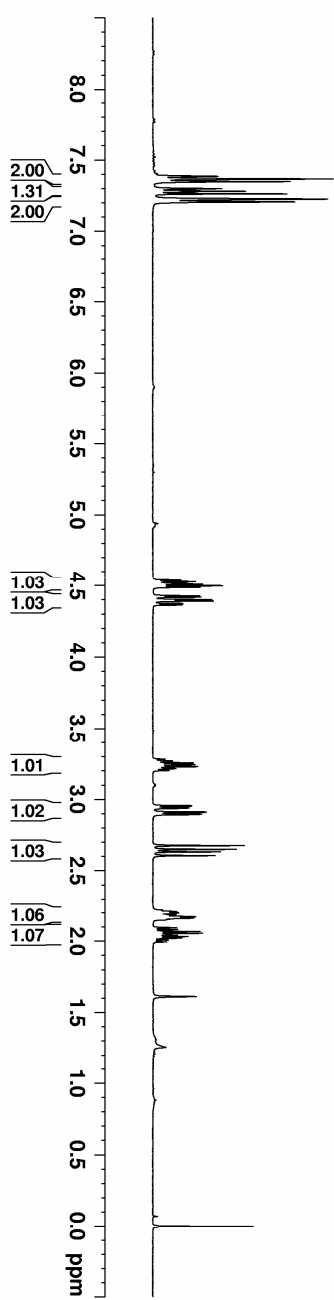


Table 2, entry 19

