

Supporting Information

Stereoselective Nucleophilic Monofluoromethylation of *N*-(*tert*-Butanesulfinyl)imines Using Fluoromethyl Phenyl Sulfone

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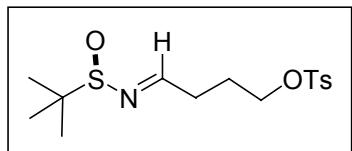
General:

Unless otherwise mentioned, solvents and reagent were purchased from commercial sources and used as received. THF was freshly distilled over sodium. Monofluoromethyl phenyl sulfone and *N*-*tert*-butanesulfinyl were prepared using known procedures.^[1,2] ¹H NMR spectra were recorded on Bruker 300 or Mercury 300 spectrometers with Me₄Si as internal standard. ¹⁹H NMR spectra were recorded on Bruker 300 or Mercury 300 spectrometers with CFCl₃ as external standard. ¹³C NMR spectra were recorded on Bruker 300 and DPX-400 spectrometers. Mass spectra were taken on a HP5989A spectrometer. High-resolution mass data were recorded on a high-resolution mass spectrometer in the EI, ESI or MALDI mode.

Preparation of **1l** and **1k**:

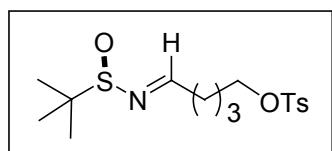
Under N₂ atmosphere, into a 10-mL Schlenk flask containing 4-oxobutyl 4'-methylbenzenesulfonate (703 mg, 2.9 mmol) and (*R*)-*tert*-butanesulfinamide (274 mg, 2.3 mmol) in 10 mL THF at r.t. was added Ti(OⁱPr)₄ (1.8 mL, 6.0 mmol). The reaction mixture was then stirred at this temperature for 5h, followed by adding a saturated aqueous NaCl solution (10 mL). The resulting suspension was filtered and the solid was washed with Et₂O. The filtrate was extracted with Et₂O (15 mL x 3), and the combined organic phase was dried over MgSO₄. After the removal of volatile solvents under vacuum, the crude product was further purified by silica gel column chromatography to give product **1k** as yellow oil, yield 87% (687 mg).

*(R)-4-(2-methylpropan-2-ylsulfinamido)butyl 4-methylbenzenesulfonate (**1k**)*



yellow oil; yield 87%; $[\alpha]^{20} -137.1$ ($c = 1.12$, CHCl_3); IR (film): 2962, 1625, 1361, 1177, 1082 cm^{-1} ; ^1H NMR: δ 8.01 (t, $J = 3.6$ Hz, 1H), 7.78 (d, $J = 7.8$ Hz, 2H), 7.35 (d, $J = 7.8$ Hz, 2H), 4.11 (t, $J = 6.0$ Hz, 2H), 2.54–2.59 (m, 2H), 2.45 (s, 3H), 1.97–2.06 (m, 2H), 1.15 (s, 9H); ^{13}C NMR: δ 167.42, 144.86, 132.91, 129.85, 127.79, 69.22, 56.56, 31.72, 24.41, 22.23, 21.55; EI (m/z, %) 346 ($M^+ + 1$, 2.4), 57 (100.0); HRMS (MALDI) calcd. for $\text{C}_{15}\text{H}_{24}\text{NO}_4\text{S}_2$ ($M^+ + \text{H}$): 346.11467; Found 346.11413.

*(R)-5-(2-methylpropan-2-ylsulfinamido)pentyl 4-methylbenzenesulfonate (**1l**)*



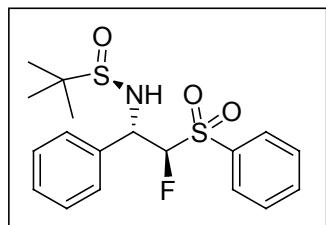
yellow oil; yield 86%; $[\alpha]^{20} -158.2$ ($c = 0.72$, CHCl_3); IR (film): 2959, 1623, 1360, 1189, 1176, 1082 cm^{-1} ; ^1H NMR: δ 8.01 (t, $J = 4.5$ Hz, 1H), 7.79 (d, $J = 8.1$ Hz, 2H), 7.35 (d, $J = 8.1$ Hz, 2H), 4.05 (t, $J = 5.4$ Hz, 2H), 2.47–2.51 (m, 2H), 2.45 (s, 3H), 1.66–1.75 (m, 4H), 1.17 (s, 9H); ^{13}C NMR: δ 168.41, 144.74, 132.99, 129.80, 127.76, 69.81, 56.50, 35.10, 28.22, 22.23, 21.52, 21.21; EI (m/z, %): 359 ($M^+ + 1$, 4.4), 57 (100.0); HRMS (MALDI): calcd. for $\text{C}_{16}\text{H}_{26}\text{NO}_4\text{S}_2$ ($M^+ + 1$): 360.13032; Found 360.12978.

Typical procedure for stereoselective nucleophilic monofluoromethylation using monofluoromethyl phenyl sulfone:

Under N_2 atmosphere, into a 20-mL Schlenk flask containing *N*-(*tert*-butanesulfinyl)aldimine (**1a**) (188 mg, 0.9 mmol) and $\text{PhSO}_2\text{CFH}_2$ (157 mg, 0.9 mmol) in 6ml THF at -78°C , was added a THF solution (0.94 mL) of $(\text{TMS})_2\text{NLi}$ (LHMDS, 1.0M, 0.95 mmol). The reaction mixture was then stirred at this temperature for 40 min, followed by adding a saturated aqueous NH_4Cl solution (10

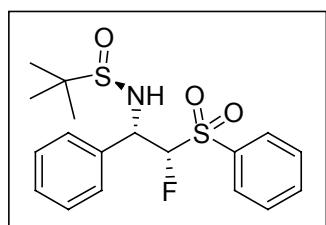
mL) at this temperature. The solution mixture was then extracted with EtOAc (15 mL \times 3), and the combined organic phase was dried over MgSO₄. After the removal of volatile solvents under vacuum, the crude product was further purified by silica gel column chromatography to give product **4a** (114mg) and **4a'** (228mg) respectively, overall yield 99%.

*(R)-N-[(1*S*,2*R*)-2-fluoro-1-phenyl-2-(phenylsulfonyl)ethyl]-2-methylpropane-2-sulfina-mide (**4a**)*



white solid. mp 137–139°C; $[\alpha]^{20} -34.8$ (c=0.70, CHCl₃); IR (film): 3217, 2959, 1448, 1329, 1153, 1067 cm⁻¹; ¹H NMR: δ 7.85 (d, *J*=7.8 Hz, 2H), 7.64–7.69 (m, 1H), 7.52 (t, *J*=7.5 Hz, 2H), 7.27–7.42 (m, 5H), 5.59 (dd, *J*=47.1, 6.3 Hz, 1H), 5.09–5.17 (m, 1H), 4.46 (d, *J*=5.1 Hz, 1H), 1.25 (s, 9H); ¹⁹F NMR: δ -180.20 (dd, *J*=46.3, 13.5 Hz, 1F); ¹³C NMR: δ 132.08, 130.70, 130.64, 125.42, 125.31, 125.21, 124.88, 97.96 (d, *J*=227.8 Hz), 54.54 (d, *J*=20.3 Hz), 52.86, 18.61; EI (m/z, %) 327 (M⁺-56, 1.2), 57 (100.0); EA calcd. for C₁₈H₂₂FNO₃S₂ C, 56.37; H, 5.78; N, 3.65; Found C, 56.60; H, 6.05; N, 3.58.

*(R)-N-[(1*S*, 2*S*)-2-fluoro-1-phenyl-2-(phenylsulfonyl)ethyl]-2-methylpropane-2-sulfinamide (**4a'**)*



white solid. mp 97–99 °C; $[\alpha]^{20} -3.71$ (c = 0.70, CHCl₃); IR (film): 3333, 2959, 1585, 1449, 1331, 1156, 1071 cm⁻¹; ¹H NMR: δ 7.89 (d, *J*=7.2 Hz, 2H), 7.66–7.71 (m, 1H), 7.53–7.58 (m, 2H), 7.33–7.44 (m, 5H), 5.17–5.33 (m, 2H), 4.29 (d, *J*=7.5 Hz, 1H),

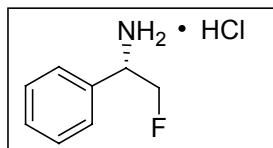
1.26 (s, 9H); ^{19}F NMR: δ –187.93 (dd, J = 45.2, 21.5 Hz, 1F); ^{13}C NMR: δ 136.69, 136.36, 134.69, 129.41, 129.07, 129.01, 127.95, 127.94, 102.87 (d, J = 228.4 Hz), 58.22 (d, J = 17.2 Hz), 52.14, 22.42; EI (m/z, %): 384(M^+ +1, 1.1), 327 (3.0), 141 (100.0); HRMS (MALDI): calcd. for $\text{C}_{22}\text{H}_{23}\text{F}_2\text{NO}_3\text{S}_2\text{Na}(\text{M}^++1)$: 384.11034; Found 384.10979.

Typical procedure for stereoselective nucleophilic monofluoromethylation and successive reductive desulfonylation and deprotection of the *tert*-butanesulfinyl group:

N-(*tert*-butanesulfinyl)aldimine (**1a**) (94 mg, 0.45 mmol) reacted with $\text{PhSO}_2\text{CFH}_2$ (78 mg, 0.45 mmol) affording the intermediate product **4** according to the procedure mentioned above without purification. Into a 10-mL flask containing **4** and Na_2HPO_4 (510mg, 3.6 mmol) in 5 mL anhydrous methanol at –20 °C, was added Na/Hg amalgam (10 wt. % Na in Hg, net sodium content 3.6 mmol). The reaction mixture was stirred at –20°C ~ –10°C for 1 h. The liquid phase was decanted, and most of the organic phase was removed under vacuum. Then 20 mL brine was added, followed by extracting with EtOAc.. The combined organic phase was dried over MgSO_4 , and the solvent was removed to give the intermediate product without further purification.

The intermediate product was dissolved in 5ml anhydrous methanol. Then 0.5 mL HCl/Dioxane (4N) was added. The reaction mixture was stirred at r.t. for 30min and was then concentrated to near dryness. Diethyl ether wad added to precipitate out the amine hydrochloride. The precipitate was then filtered off and washed with diethyl ether to provide pure amine hydrochloride **5a**, overall yield 77% (61mg).

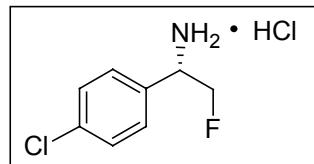
*(S)-2-fluoro-1-phenylethanamine hydrochloride (**5a**)*



[α]²⁰ 29.1 (c = 0.57, CH₃OH); IR (film): 2845, 1602, 1515, 1497, 1459, 1018 cm^{–1};

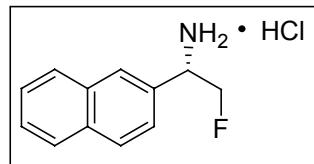
¹H NMR: δ 7.48–7.53(m, 5H), 4.70–4.91(m, 3H); ¹⁹F NMR: δ -225.04 (td, *J* = 44.0, 18.6 Hz, 1F); ¹³C NMR: δ 132.38 (d, *J* = 6.3 Hz), 129.52, 129.08, 127.28, 82.90 (d, *J* = 175.5 Hz), 54.78 (d, *J* = 18.9 Hz); ESI (m/z): 140 (M⁺-35); HRMS (EI): calcd. for C₇H₈N (M⁺-HCl-CFH₂): 106.06567; Found 106.06599.

(S)-1-(4-chlorophenyl)-2-fluoroethanamine hydrochloride (5b)



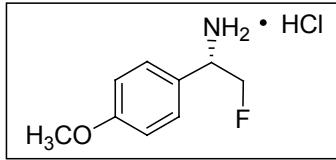
[α]²⁰ 26.3 (c = 1.00, CH₃OH); IR(film): 2870, 2025, 1591, 1536, 1492, 1008 cm⁻¹; ¹H NMR: δ 7.45–7.52 (m, 4H), 4.68–4.88 (m, 3H); ¹⁹F NMR: δ -226.44 (tm, *J* = 47.1 Hz, 1F); ¹³C NMR: δ 135.50, 131.23 (d, *J* = 6.1 Hz), 129.15, 129.12, 82.76 (d, *J* = 176.1 Hz), 54.08 (d, *J* = 19.2 Hz); EI (m/z, %) 173 (M⁺-HCl, 0.1), 140 (100.0), 77 (53.0); HRMS (EI) calcd. for C₈H₉ClFN (M⁺-HCl): 173.04076; Found 173.0400.

(S)-2-fluoro-1-(naphthalen-2-yl) ethanamine hydrochloride (5c)



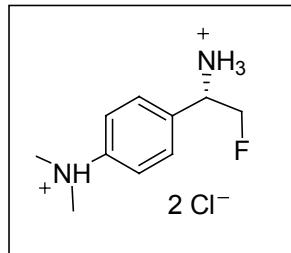
[α]²⁰ 33.9 (c = 0.88, CH₃OH); IR (film): 2879, 1603, 1513, 1402, 1025 cm⁻¹; ¹H NMR: δ 7.99 (d, *J* = 7.8 Hz, 2H), 7.91–7.94 (m, 2H), 7.54–7.59 (m, 3H), 4.76–4.79 (m, 3H); ¹⁹F NMR: δ -225.46 (tm, *J* = 46.2 Hz, 1F); ¹³C NMR: δ 137.72, 133.25, 129.67 (d, *J* = 6.2 Hz), 129.03, 127.84, 127.45, 127.08, 126.94, 126.68, 124.00, 83.02 (d, *J* = 176.2 Hz), 54.91 (d, *J* = 18.9 Hz); EI (m/z, %): 189 (M⁺-HCl, 5.5), 156 (100.0); HRMS(EI): calcd. for C₁₂H₁₂FN(M⁺-HCl): 189.09538; Found 189.0955.

(S)-2-fluoro-1-(4-methoxyphenyl) ethanamine hydrochloride (5d)



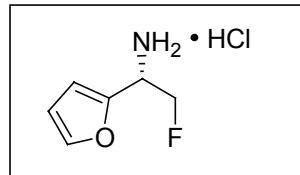
$[\alpha]^{20}$ 31.5 ($c = 0.66$, CH₃OH); IR (film): 2960, 2838, 1613, 1584, 1515, 1019 cm⁻¹; ¹H NMR: δ 7.40 (dd, $J = 6.9, 1.8$ Hz, 2H), 7.01(dd, $J = 6.9, 2.4$ Hz, 2H), 4.73 (dd, $J = 47.7, 6.6$ Hz, 2H), 4.62–4.67 (m, 1H), 3.81 (s, 3H); ¹⁹F NMR: δ -224.62 (td, $J = 47.9, 16.6$ Hz, 1F); ¹³C NMR: δ 160.93, 128.76, 124.07 (d, $J = 5.9$ Hz), 114.43, 82.98 (d, $J = 175.5$ Hz), 54.53, 54.34 (d, $J = 18.1$ Hz); ESI (m/z): 153.2 (M⁺-16); HRMS (EI) calcd. for C₈H₁₀NO(M⁺-HCl-CFH₂): 136.07624; Found 136.07644

(S)-4-(1-amino-2-fluoroethyl)-N,N-dimethylbenzenamine dihydrochloride (5e)



$[\alpha]^{20}$ 20.2 ($c = 0.81$, CH₃OH); IR (film): 3413, 2590, 1625, 1575, 1500, 1025 cm⁻¹; ¹H NMR: δ 7.71–7.80 (m, 4H), 4.70–4.92 (m, 3H), 3.29 (s, 6H); ¹⁹F NMR: δ -224.62 (td, $J = 47.6, 17.7$ Hz, 1F); ¹³C NMR: δ 143.94, 134.50 (d, $J = 5.0$ Hz), 129.83, 121.25, 82.75 (d, $J = 176.0$ Hz), 53.96 (d, $J = 19.1$ Hz), 45.65; EI (m/z, %): 182 (M⁺-HCl, 16.3), 149 (100.0); HRMS (EI): calcd. for C₈H₁₅FN (M⁺-HCl): 182.12193; Found 182.1221.

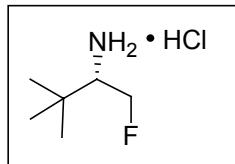
(S)-2-fluoro-1-(furan-2-yl)ethanamine hydrochloride (5f)



$[\alpha]^{20}$ 18.0 ($c = 0.93$, CH₃OH); ¹H NMR: δ 7.62–7.63(m, 1H), 6.64 (d, $J = 3.0$ Hz, 1H), 6.50–6.51(m, 1H), 4.86 (dd, $J = 46.8, 5.4$ Hz, 2H), 4.82–4.95(m, 1H); ¹⁹F NMR

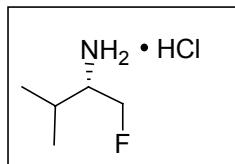
δ –228.92 (tm, J = 47.0 Hz, 1F); ^{13}C NMR: δ 145.59 (d, J = 8.1 Hz), 144.14, 110.69, 110.27 (d, J = 1.3 Hz), 81.1 (d, J = 174.7 Hz), 48.40 (d, J = 21.4 Hz); ESI (m/z): 130.2 ($\text{M}^+ - 35$); HRMS (EI): calcd. for $\text{C}_6\text{H}_8\text{FNO}$ ($\text{M}^+ - \text{HCl}$): 129.05899; Found 129.05951.

(S)-1-fluoro-3,3-dimethylbutan-2-amine hydrochloride (5g)



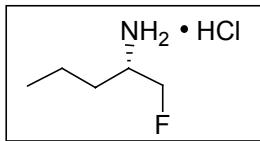
$[\alpha]^{20}$ 8.0 (c = 0.56, CH_3OH); IR (film): 2969, 1601, 1522, 1306, 1152, 1085, 1024 cm^{-1} ; ^1H NMR: δ 4.56–4.88 (m, 2H), 3.24–3.35 (m, 1H), 1.07 (s, 9H); ^{19}F NMR: δ –232.50 (td, J = 47.1, 20.3 Hz, 1F); ^{13}C NMR: δ 85.00 (d, J = 169.7 Hz), 63.52 (d, J = 15.7 Hz), 35.74 (d, J = 4.1 Hz), 29.24; EI (m/z, %): 119 ($\text{M}^+ - \text{HCl}$, 0.6), 104 (3.3), 63 (100.0); HRMS (EI): calcd. for $\text{C}_6\text{H}_{11}\text{FN}$ ($\text{M}^+ - \text{HCl-CH}_3$): 104.08755; Found 104.0880.

(S)-1-fluoro-3-methylbutane-2-amine hydrochloride (5h)



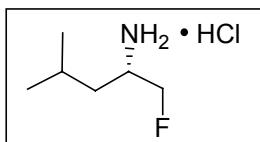
$[\alpha]^{20}$ 3.11 (c = 0.90, CH_3OH); IR (film): 2972, 2884, 1602, 1521, 1398, 1136, 1022 cm^{-1} ; ^1H NMR: δ 4.68 (dm, J = 47.1 Hz, 2H), 3.27–3.32 (m, 1H), 1.98–2.07 (m, 1H), 1.07 (d, J = 7.2 Hz, 3H), 1.05 (d, J = 6.6 Hz, 3H); ^{19}F NMR: δ –234.49 (td, J = 46.5, 22.2 Hz, 1F); ^{13}C NMR: δ 81.30 (d, J = 170.2 Hz), 56.71 (d, J = 17.4 Hz), 27.61 (d, J = 4.5 Hz), 17.73, 17.34; EI (m/z, %) 106 ($\text{M}^+ - 35$, 2.4), 62 (100.0); HRMS (EI): calcd. for $\text{C}_5\text{H}_{12}\text{FN}$ ($\text{M}^+ - \text{HCl}$): 105.09538; Found 105.09558.

(S)-1-fluoropentan-2-amine hydrochloride (5i)



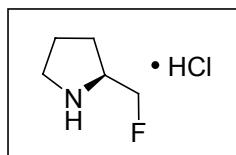
$[\alpha]^{20} 5.90$ ($c = 1.01$, CH₃OH); IR(film): 2968, 2880, 1602, 1515, 1471, 1023 cm⁻¹; ¹H NMR: δ 4.67 (ddd, $J = 46.8, 10.8, 3.0$ Hz, 1H), 4.52 (ddd, $J = 45.9, 10.8, 6.0$ Hz, 1H), 3.41–3.55 (m, 1H), 1.61–1.72 (m, 2H), 1.39–1.52 (m, 2H), 0.99 (t, $J = 6.9$ Hz, 3H); ¹⁹F NMR: δ -233.53 (td, $J = 48.5, 22.3$ Hz, 1F); ¹³C NMR: δ 82.13 (d, $J = 170.8$ Hz), 51.31 (d, $J = 18.3$ Hz), 30.23 (d, $J = 5.2$ Hz), 18.15, 12.65; EI (m/z, %) 106 (M⁺-35, 5.6), 62 (100.0); HRMS (EI): calcd. for C₅H₁₂FN (M⁺-HCl): 105.09538; Found 105.0956.

(S)-1-fluoro-4-methylpentan-2-amine hydrochloride (5j)



$[\alpha]^{20} 3.72$ ($c = 0.88$, CH₃OH); IR (film): 2966, 2875, 1599, 1516, 1471, 1029 cm⁻¹; ¹H NMR: δ 4.69 (ddd, $J = 46.8, 10.5, 3.0$ Hz, 1H), 4.53 (ddd, $J = 47.1, 11.1, 6.0$ Hz, 1H), 3.51–3.61 (m, 1H), 1.17–1.80 (m, 1H), 1.52–1.63 (m, 2H), 1.01 (dd, $J = 6.3, 1.2$ Hz, 6H); ¹⁹F NMR: δ -232.81 (td, $J = 46.8, 21.7$ Hz, 1F); ¹³C NMR: δ 82.30 (d, $J = 171.2$ Hz), 49.80 (d, $J = 18.6$ Hz), 36.98 (d, $J = 4.8$ Hz), 24.02, 21.38, 21.17; EI (m/z, %): 120 (M⁺-35, 3.5), 62 (100.0); HRMS (EI) calcd. for C₅H₁₁FN (M⁺-HCl-CH₃): 104.08755; Found 104.08782.

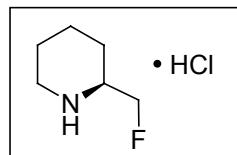
(S)-2-(fluoromethyl)pyrrolidine hydrochloride(5k)



$[\alpha]^{20} 8.40$ ($c = 0.80$, CH₃OH); IR (film): 2889, 2737, 1606, 1333, 1158, 996 cm⁻¹; ¹H NMR: δ 4.67–4.87 (m, 2H), 3.90–4.05 (m, 1H), 3.36 (t, $J = 6.9$ Hz, 2H), 2.02–2.27 (m, 3H), 1.77–1.90 (m, 1H); ¹⁹F NMR: δ -226.16 (td, $J = 47.4, 19.4$ Hz, 1F); ¹³C NMR:

δ 85.26 (d, J = 170.8 Hz), 63.31 (d, J = 17.8 Hz), 49.62, 28.75 (d, J = 4.3 Hz), 27.35; EI (m/z, %): 104 (M^+ -35, 44.8), 70 (100.0); HRMS (EI): calcd. for $C_5H_{10}FN$ (M^+ -HCl): 103.07973; Found 103.0800.

(S)-2-(fluoromethyl)piperidine hydrochloride (5l)

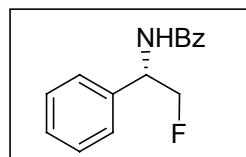


$[\alpha]^{20}$ 16.59 (c = 0.84, CH₃OH); IR (film): 2735, 2529, 1587, 1454, 1090, 1015 cm⁻¹; ¹H NMR: δ 4.34–4.69 (m, 2H), 3.35–3.40 (m, 2H), 2.90–2.98 (t, J = 12.0 Hz, 1H), 1.80–1.84 (m, 3H), 1.44–1.59 (m, 3H); ¹⁹F NMR: δ -229.27 (td, J = 45.9, 18.4 Hz, 1F); ¹³C NMR: δ 82.79 (d, J = 170.4 Hz), 56.21 (d, J = 18.7 Hz), 44.39, 23.41 (d, J = 5.6 Hz), 21.81, 21.27; EI (m/z, %): 117 (M^+ -HCl, 1.9), 84 (100.0); HRMS (EI): calcd. for C₆H₁₂FN (M^+ -HCl): 117.09538; Found 117.0952.

Procedure for Benzoylation of 5:

Under N₂ atmosphere, a mixture of amine chloride (**5a**) (0.2 mmol, 35 mg), PhCOCl (0.6 mmol, 84 mg), Et₃N (0.6 mmol, 61 mg) and K₂CO₃ (0.2 mmol, 28 mg) in 3mL dioxane was stirred at 55 °C for 7h. Removal of the solvents under reduced pressure and flash chromatography afforded **6a** as a white solid, yield 92% (45mg).

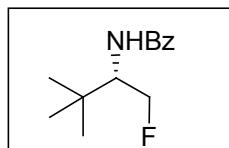
(S)-N-(2-fluoro-1-phenylethyl)benzamide (6a)



yield 92%; HPLC (Chiralpak AD-H column, 80:20 hexane/2-propanol; 0.7ml/min; 254nm; (*S*)-**6a**, t_r = 9.6 min, (*R*)-**6a**, t_r = 17.5 min); $[\alpha]^{20}$: -9.82 (c = 0.72, CHCl₃); white solid. Mp 132–134 °C. IR (film): 3331, 1637, 1532, 1292, 1012, 700 cm⁻¹; ¹H NMR: δ 7.80 (d, J = 7.2 Hz, 2H), 7.28–7.53 (m, 8H), 6.80 (d, J = 7.2 Hz, 1H), 5.46 (t,

$J = 25.8$ Hz, 1H), 4.78 (dd, $J = 48.0, 3.9$ Hz, 2H); ^{19}F NMR: $\delta = -227.28$ (td, $J = 46.6, 24.8$ Hz, 1F); ^{13}C NMR: $\delta = 167.24, 137.88, 134.06, 131.83, 128.93, 128.67, 128.16, 127.09, 127.07, 84.8$ (d, $J = 174.8$ Hz), 53.35 (d, $J = 19.5$ Hz); EI (m/z, %): 244 ($M^+ + 1$, 0.8), 223 (17.6), 105 (100.0); EA calcd. for $\text{C}_{15}\text{H}_{14}\text{FNO}$: C, 74.06; H, 5.80; N, 5.76; Found C, 73.97; H, 5.76; N, 5.76.

(S)-N-(1-fluoro-3,3-dimethylbutan-2-yl)benzamide (6g)

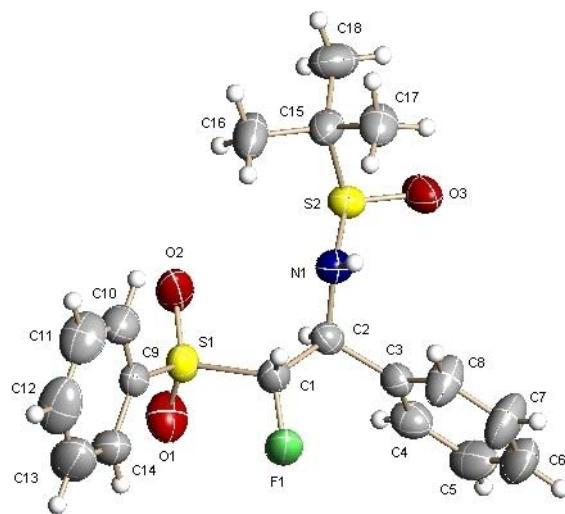
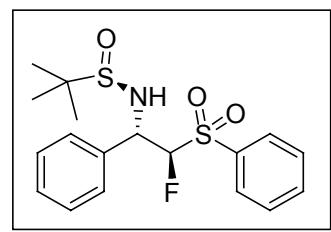


yield 89%; HPLC (Chiralpak OD column, 80:10 hexane/2-propanol; 0.7ml/min; 254nm; (*R*)-**6g**, $t_r = 12.0$ min, (*S*)-**6g**, $t_r = 13.7$ min); $[\alpha]^{20} = -46.15$ ($c = 0.54$, CHCl_3); white solid. Mp 97–98 °C. IR (film): 3327, 2966, 1638, 1544, 1352, 696 cm^{-1} ; ^1H NMR: $\delta = 7.72$ (dm, $J = 8.1$ Hz, 2H), 7.35–7.45 (m, 3H), 6.32 (d, $J = 8.1$ Hz, 1H), 4.38–4.77 (m, 2H), 4.10 (dm, $J = 32.7$ Hz, 1H), 1.00 (s, 9H); ^{19}F NMR: $\delta = -230.43$ (td, $J = 47.7, 32.1$ Hz, 1F); ^{13}C NMR: $\delta = 167.57, 134.62, 131.64, 128.69, 126.95, 83.44$ (d, $J = 170.2$ Hz), 56.66 (d, $J = 16.5$ Hz), 34.30 (d, $J = 20.9$ Hz), 27.19 (d, $J = 1.9$ Hz); EI (m/z, %): 223($M^+ + 40.8$), 41(100.0); HRMS (EI): calcd. for $\text{C}_{13}\text{H}_{18}\text{FNO}$ (M^+): 223.13724; Found 223.1376.

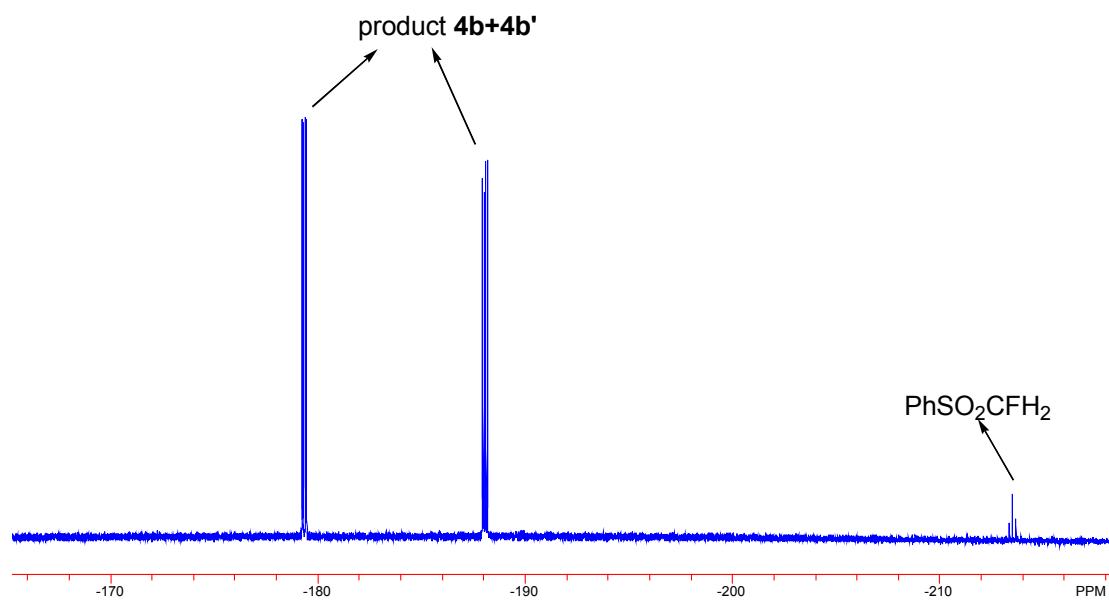
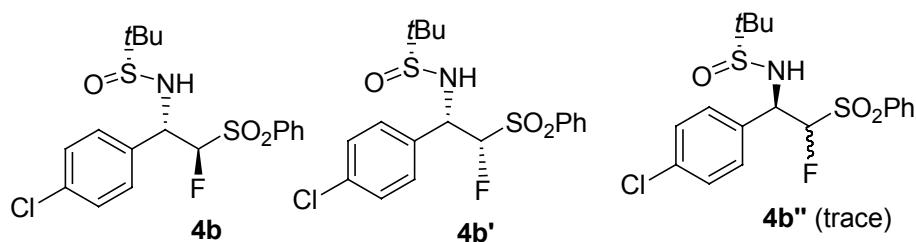
[1] Ellman, J. A.; Owens, T. D.; Tang, T. P. *Acc. Chem. Res.* **2002**, *35*, 984–995, and the references cited therein.

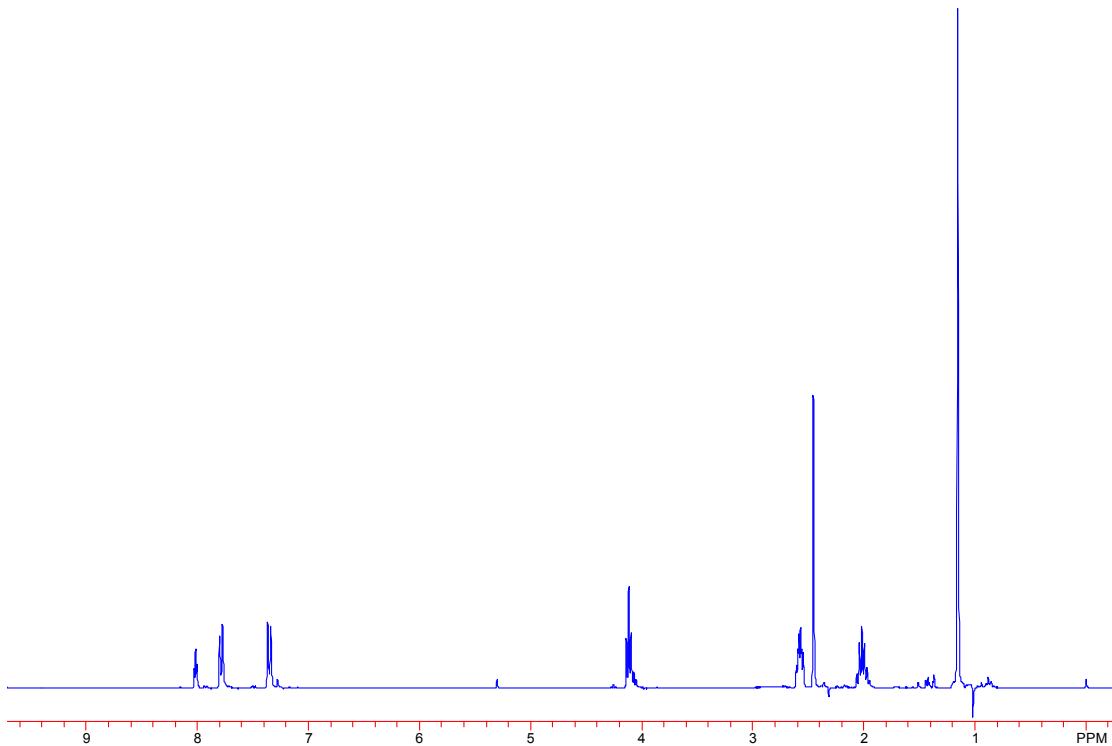
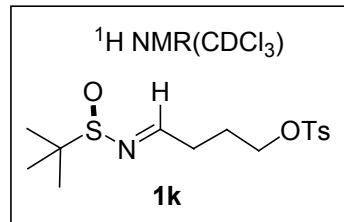
[2] Matthews, D. P.; Persichetti, R. A.; McCarthy, J. R. *Org. Prep. Proced. Int.* **1994**, *26*, 605–608; *Org. Syn.* **1995**, *72*, 209–215.

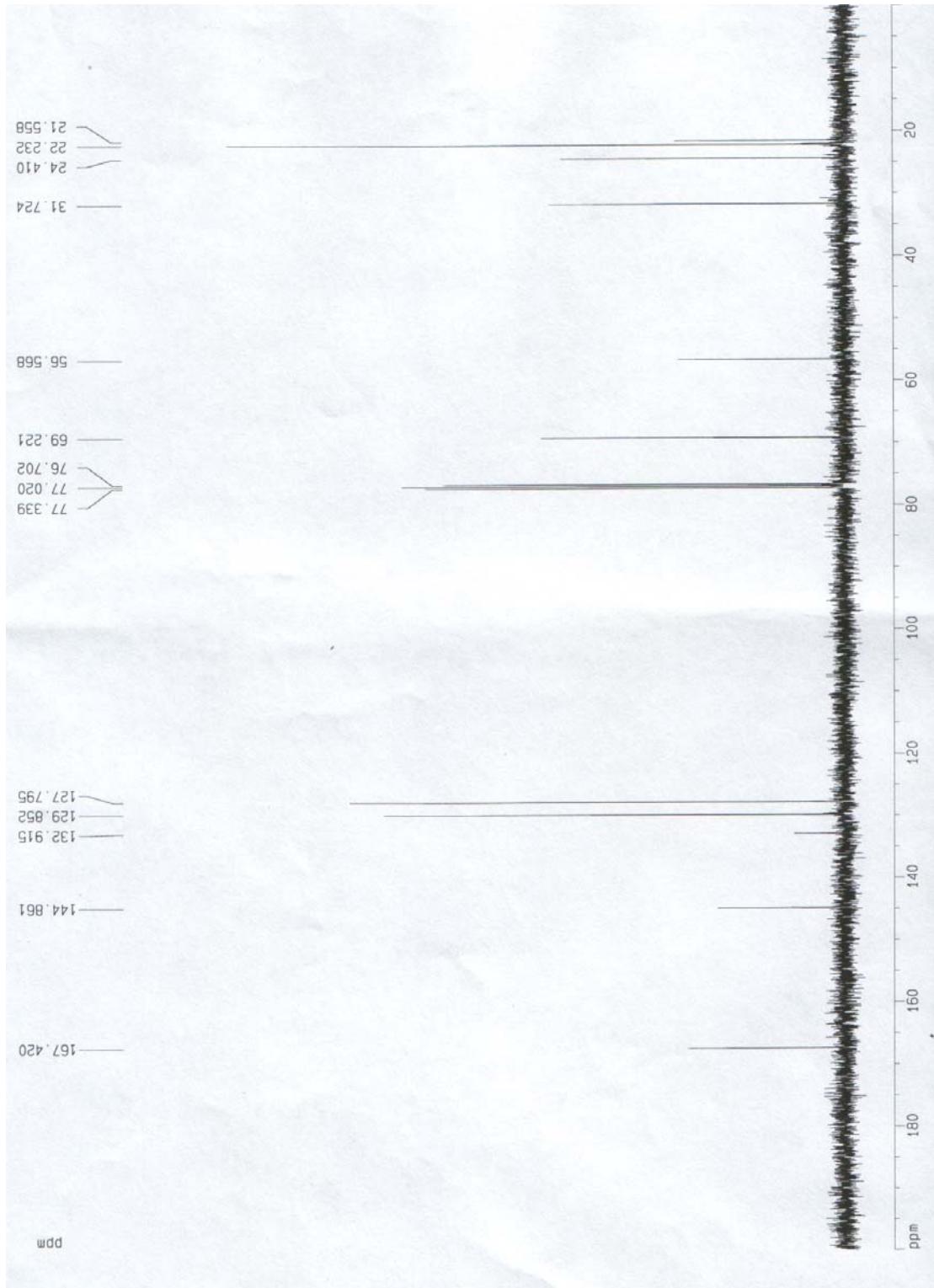
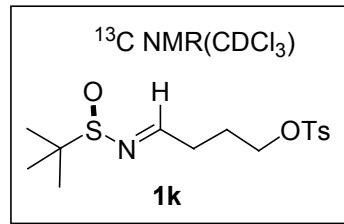
Determination of the absolute configuration of **4a** by X-ray analysis

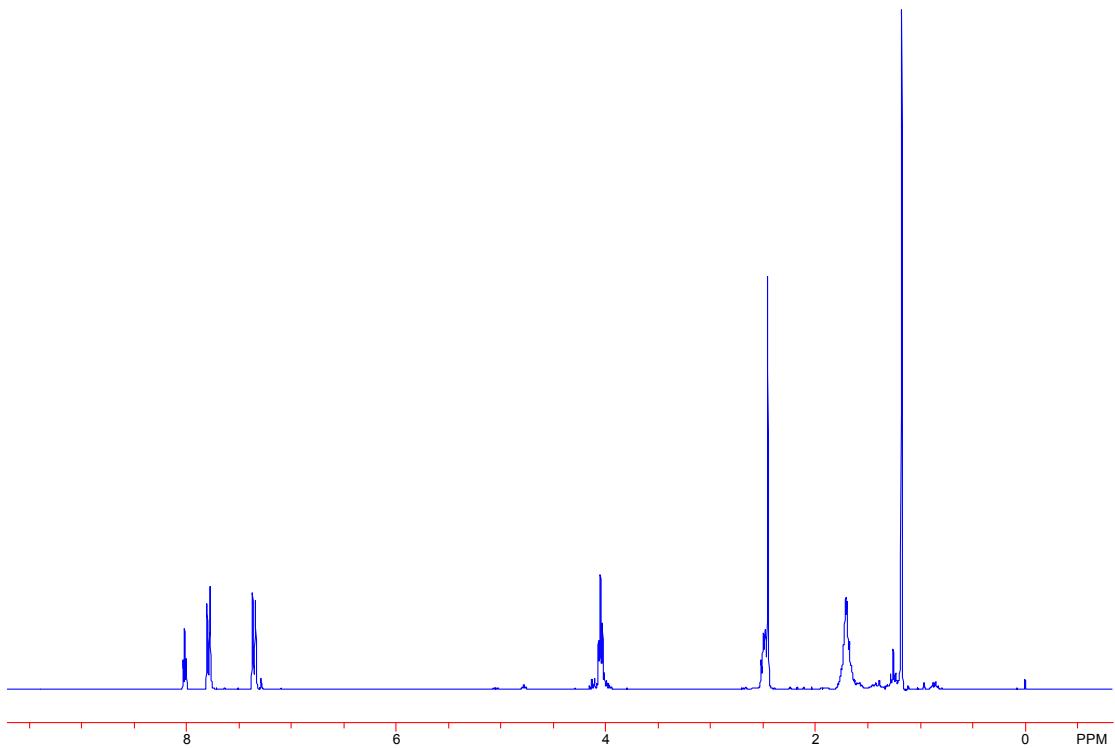
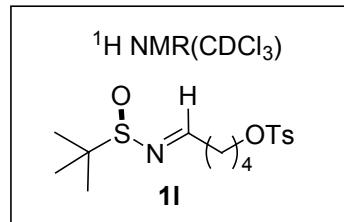


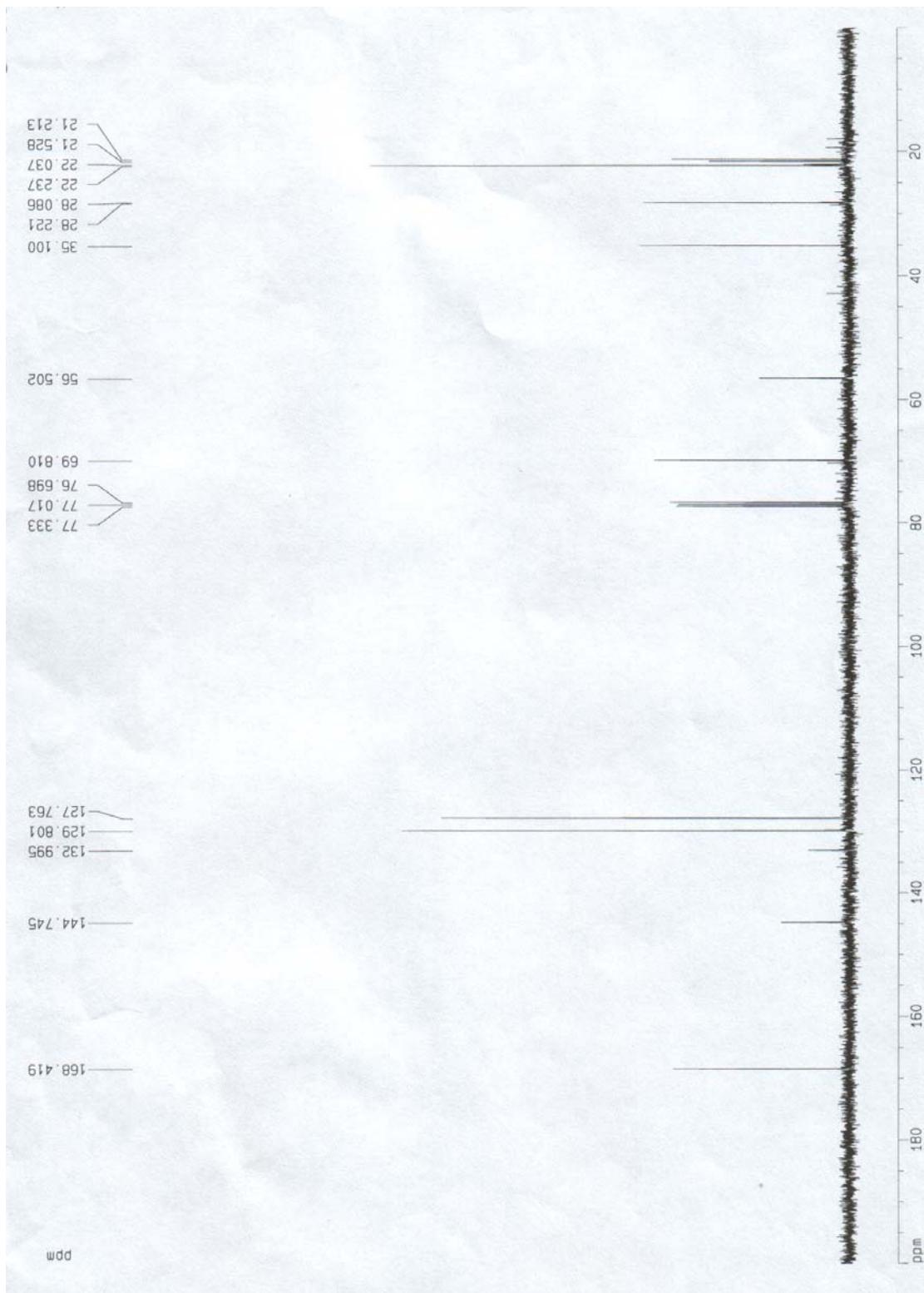
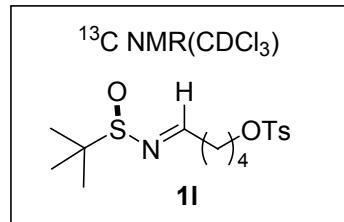
Example of determination of facial selectivity ratio and yield of **4** (the organic phase of the reaction mixture after saturated NH₄Cl water solution was added) by ¹⁹F NMR:

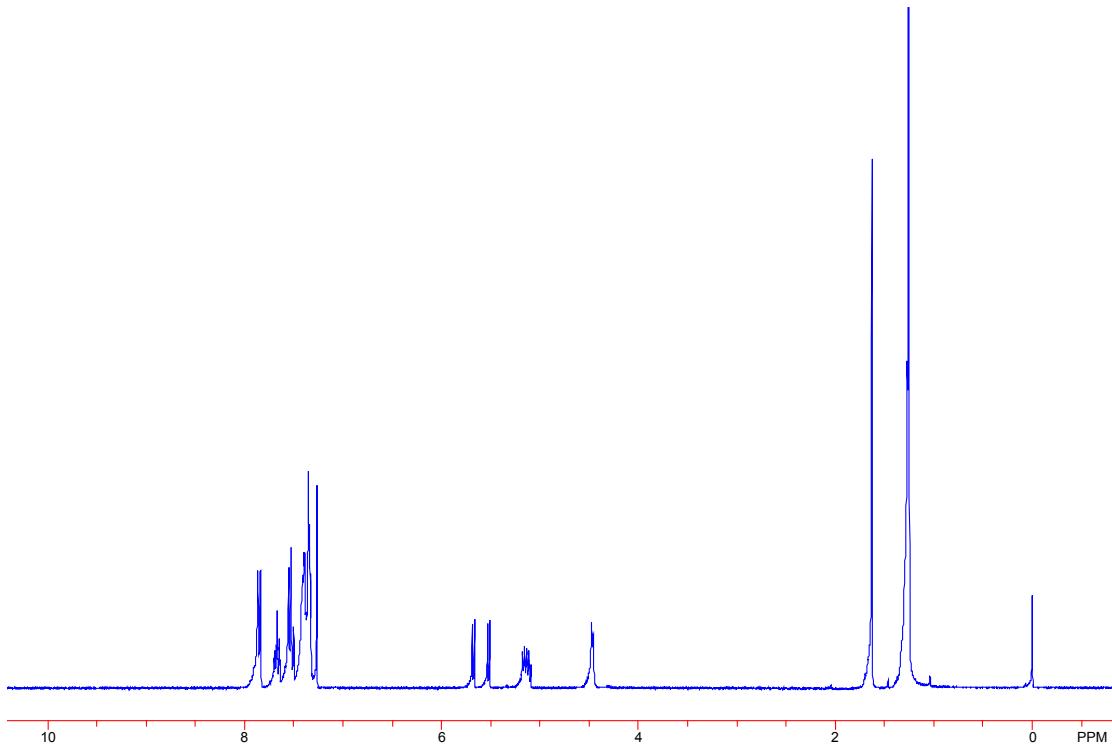
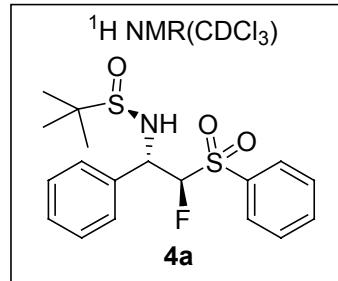


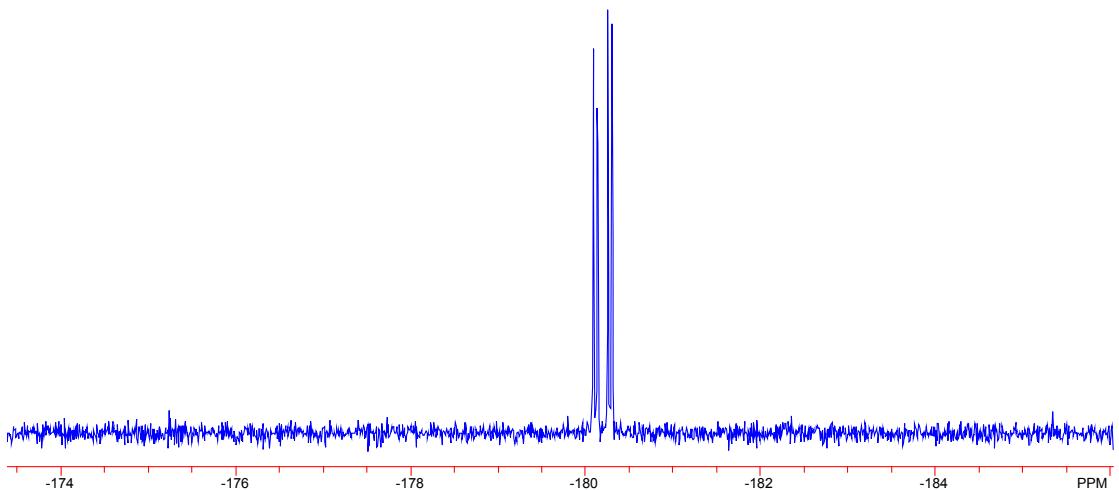
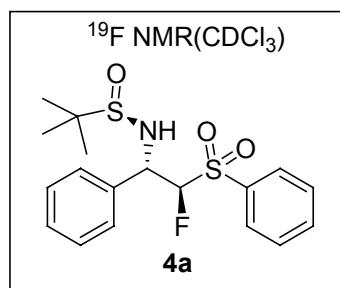


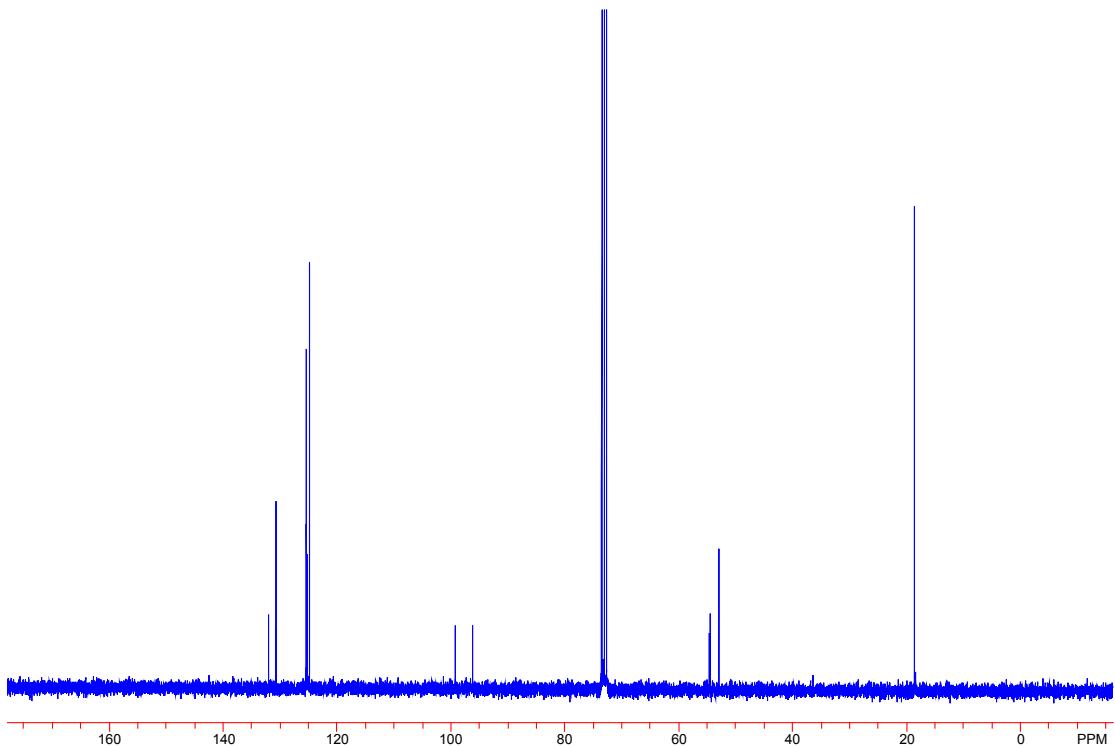
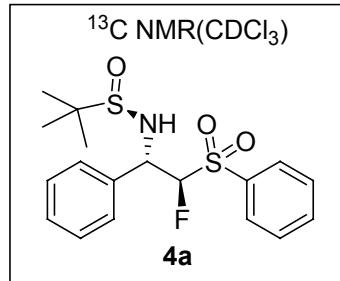


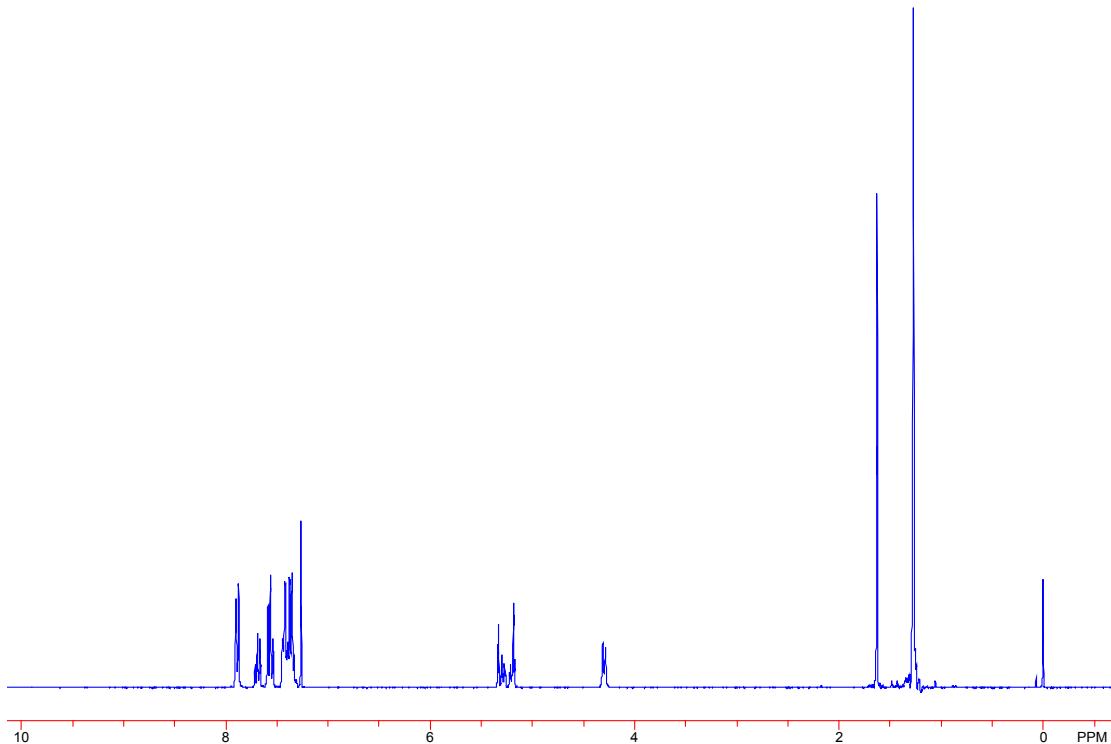
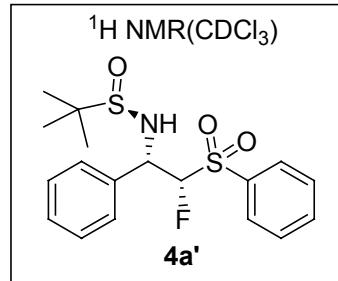


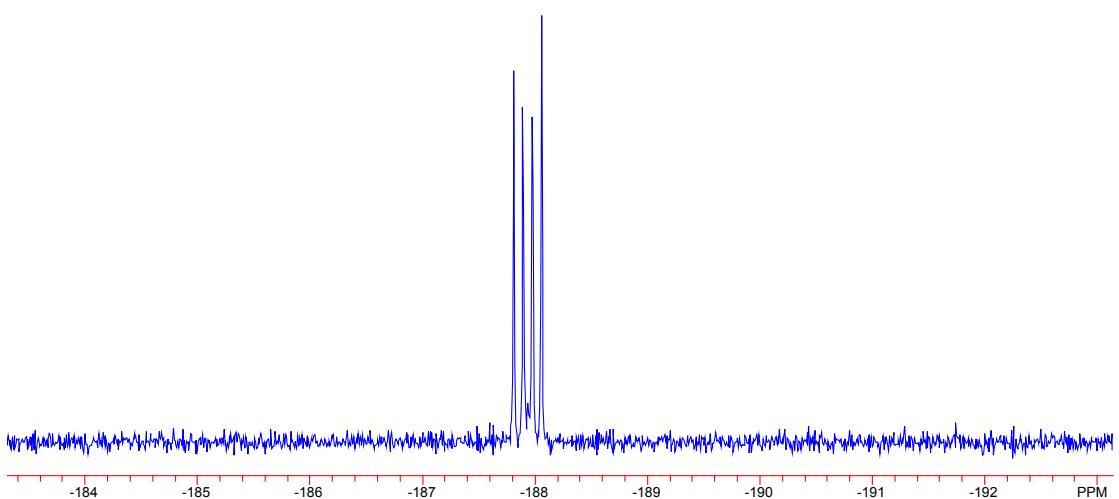
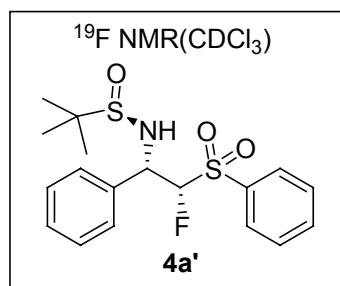


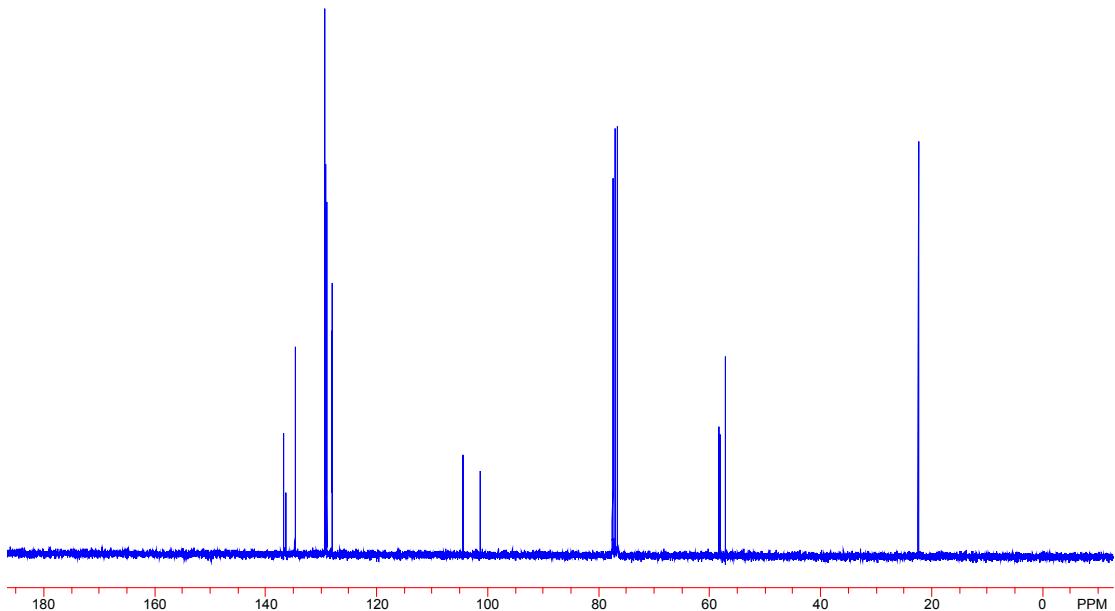
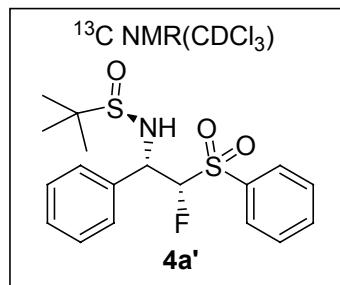


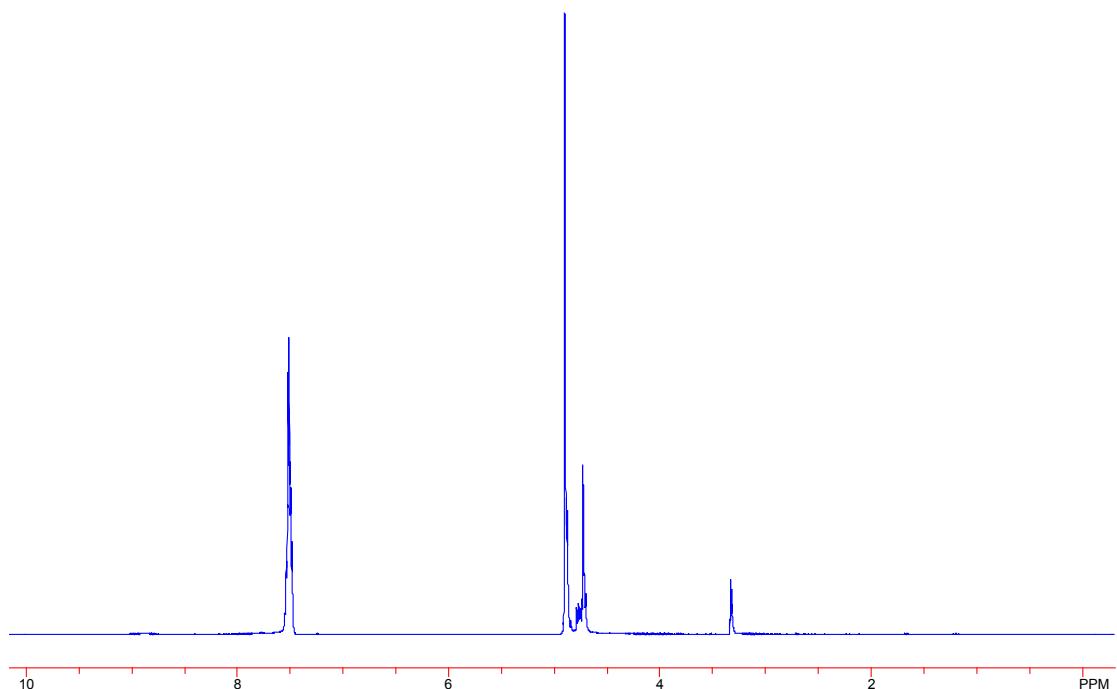
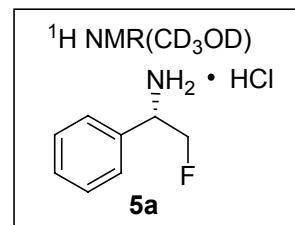


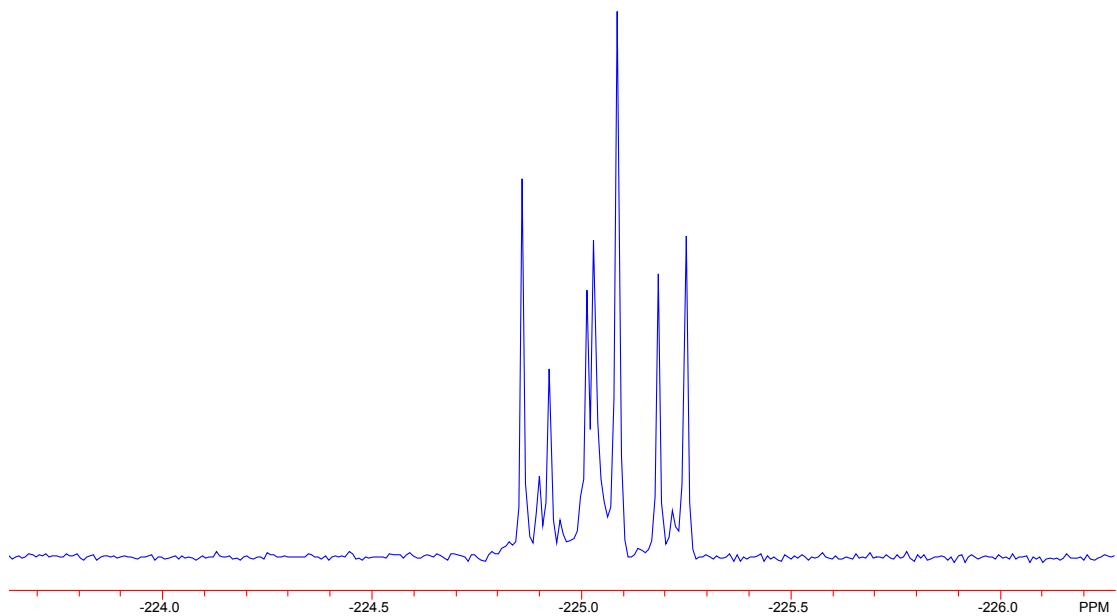
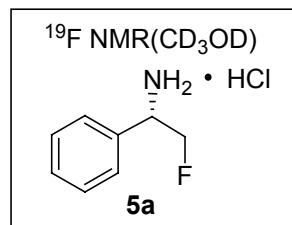


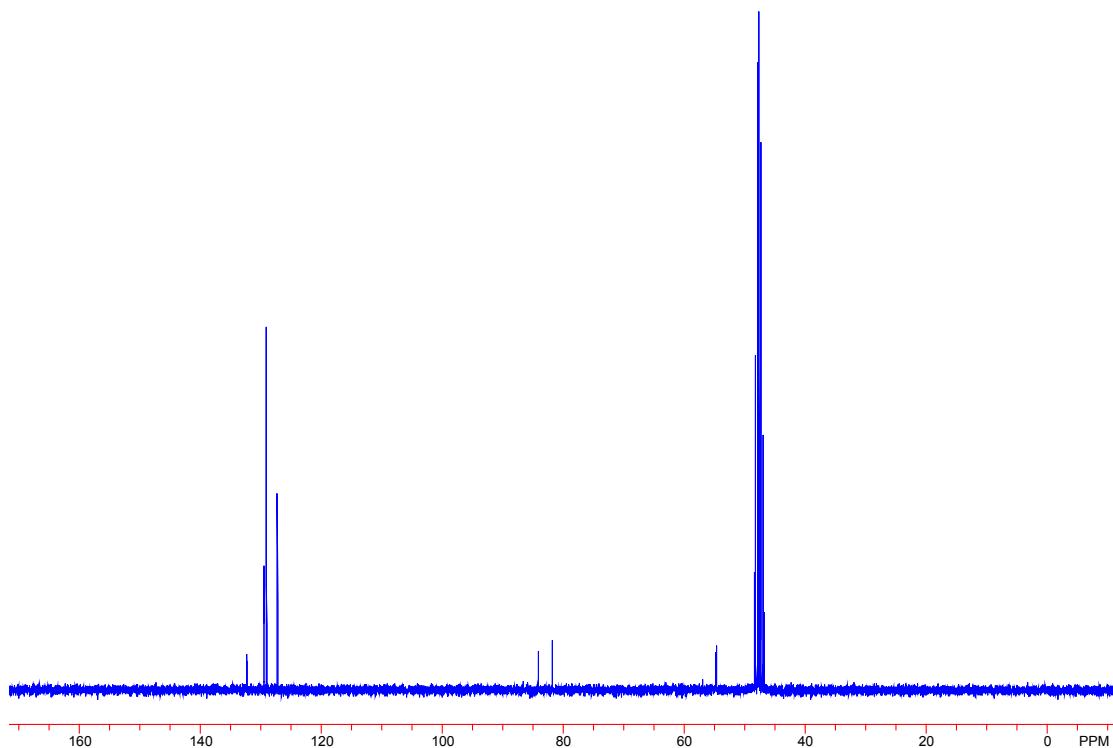
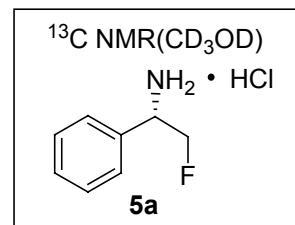


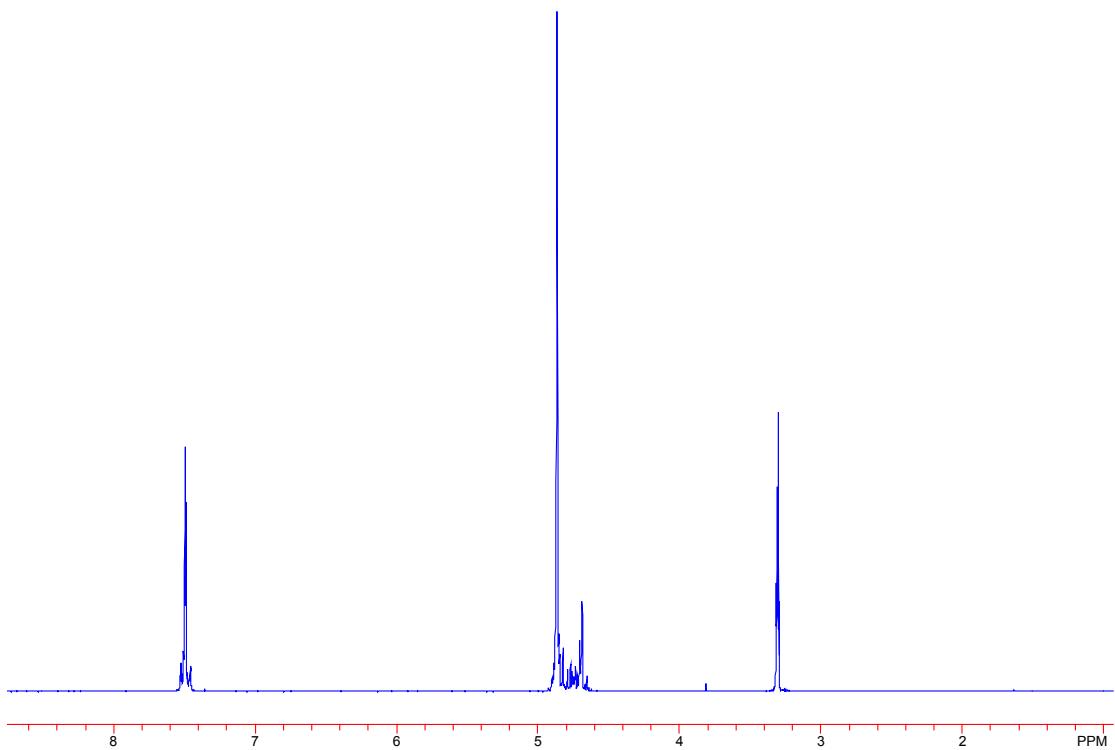
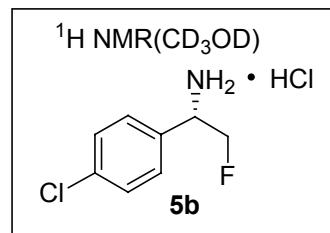


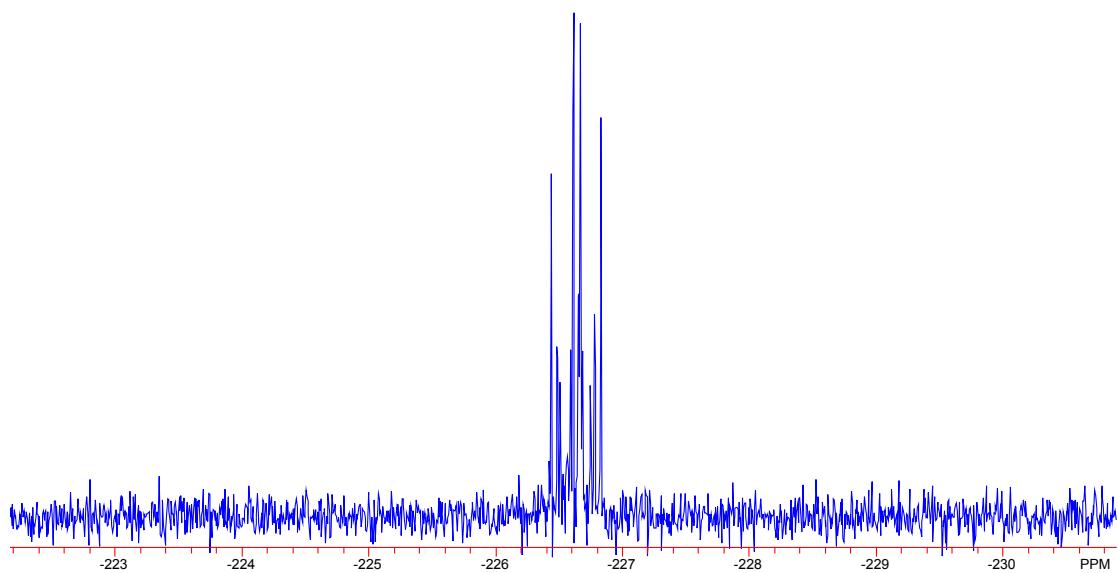
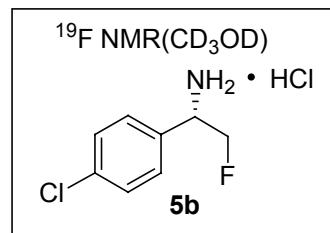


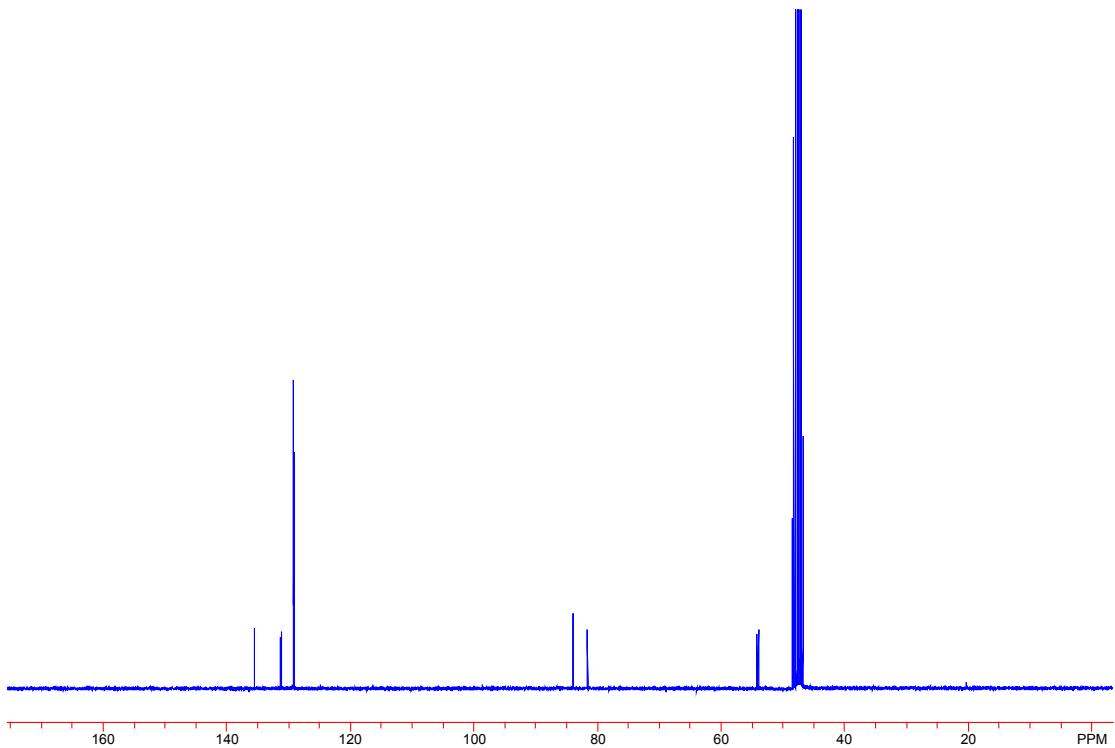
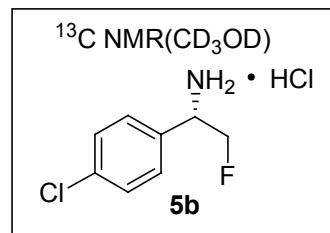


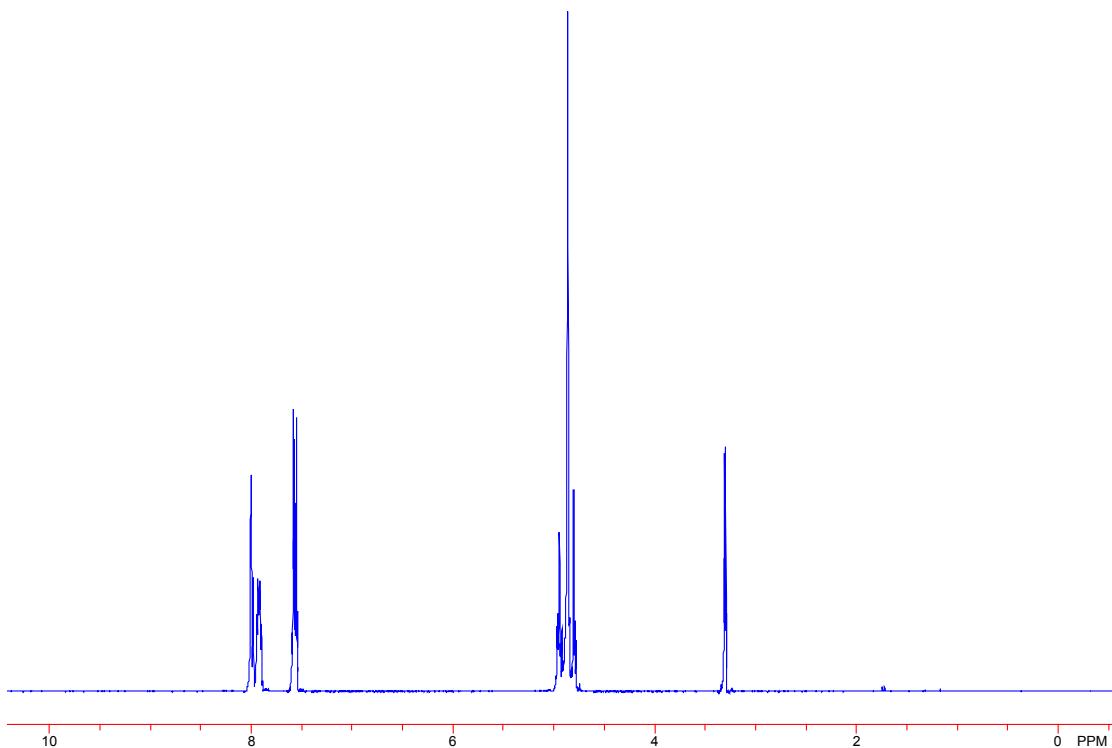
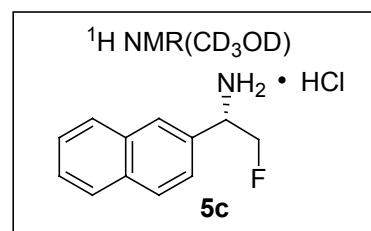


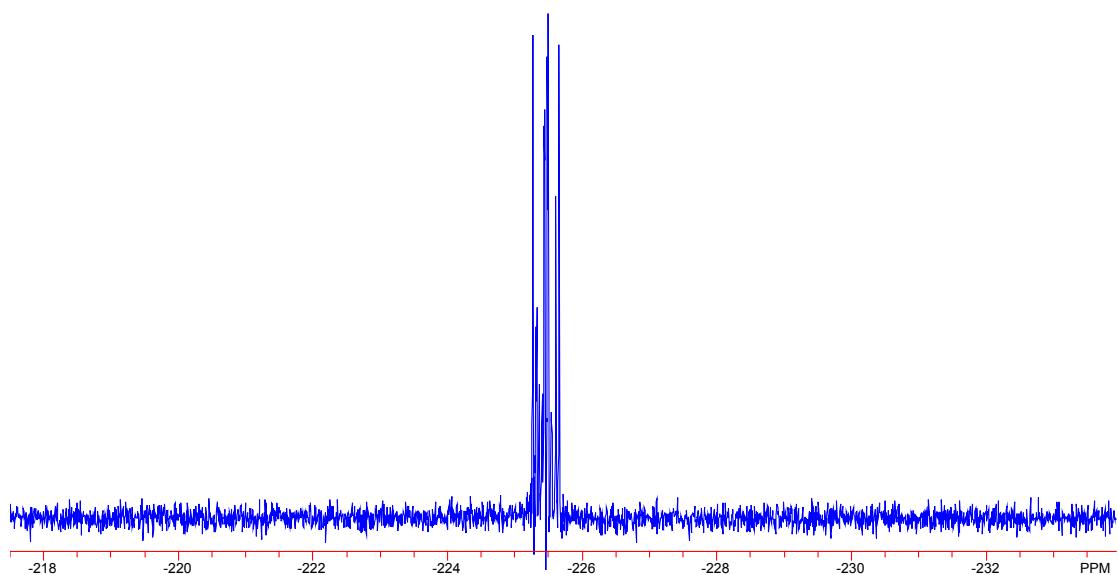
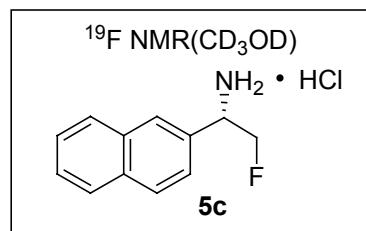


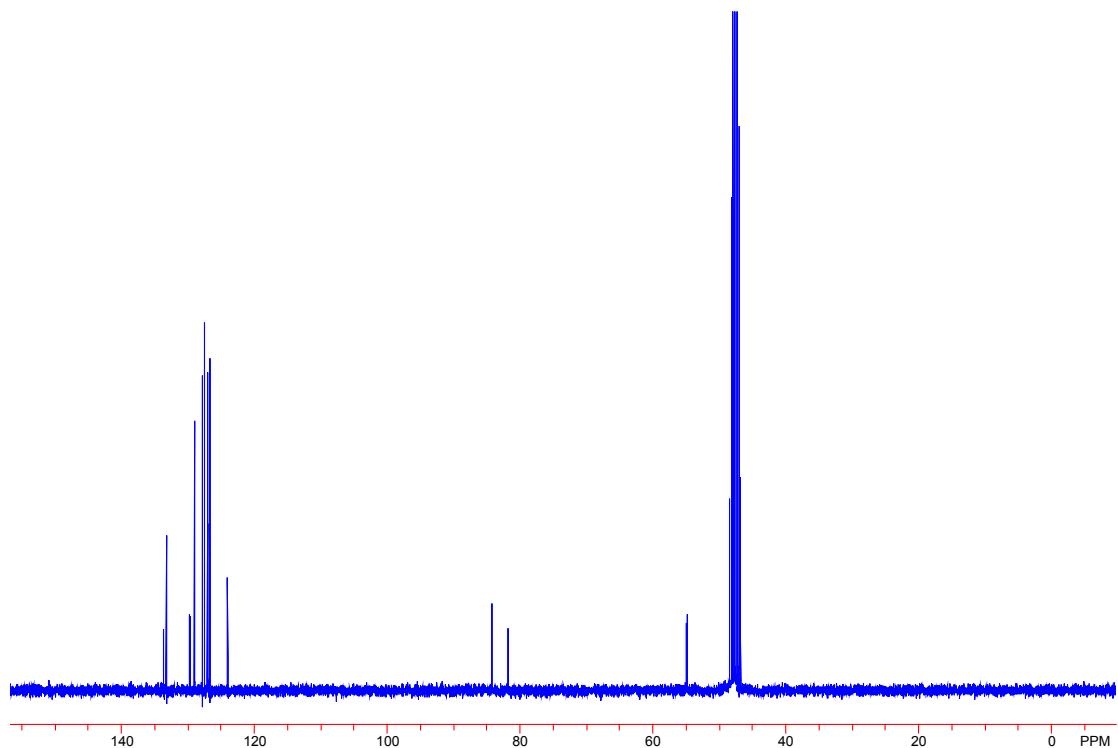
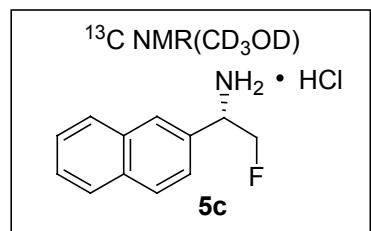


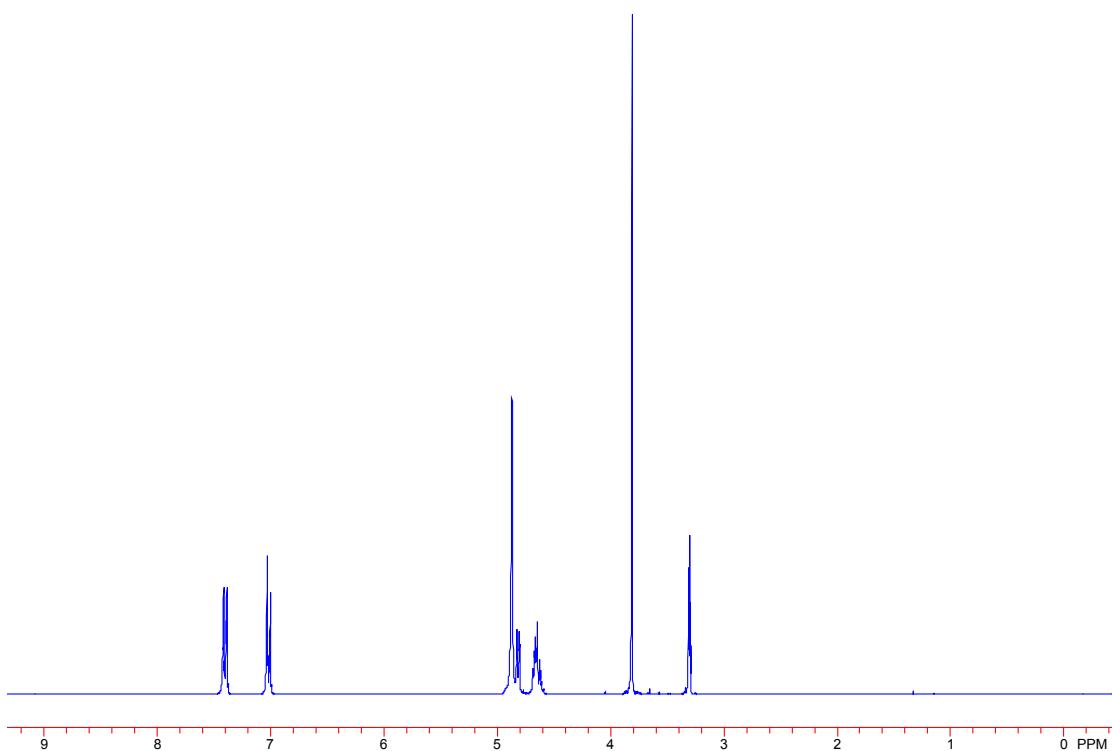
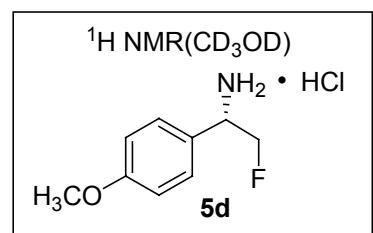


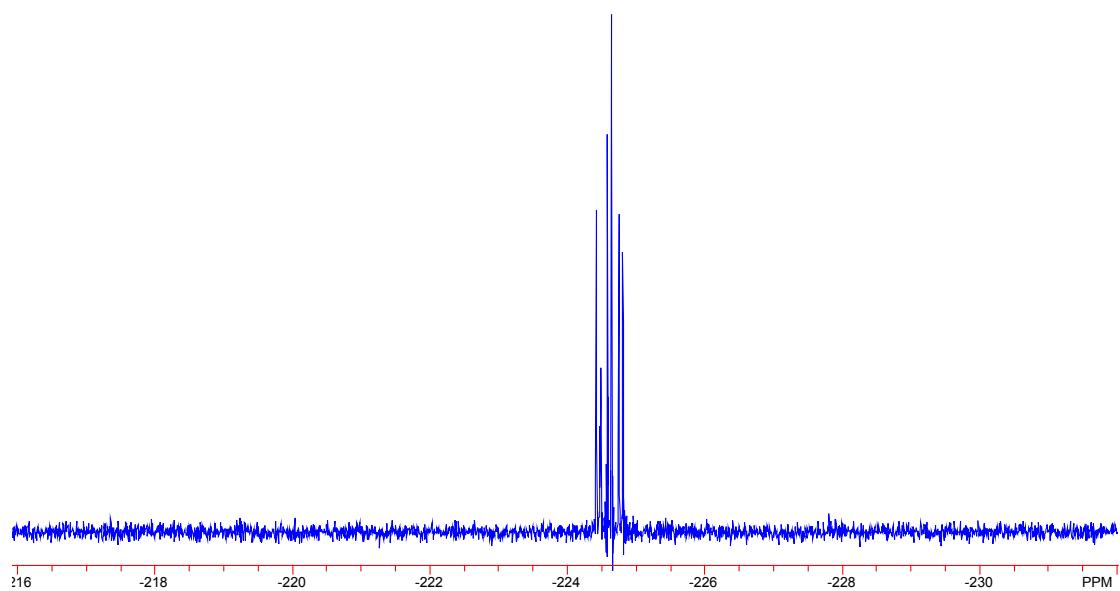
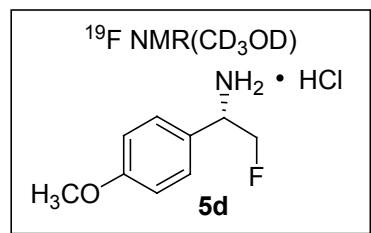


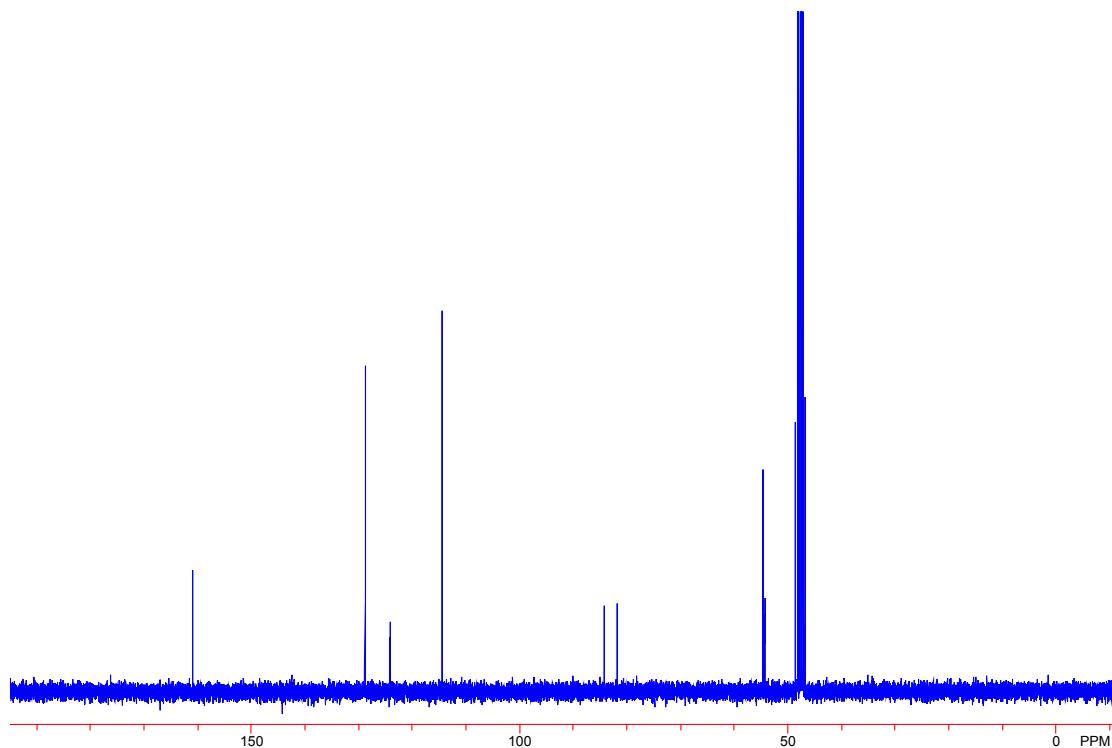
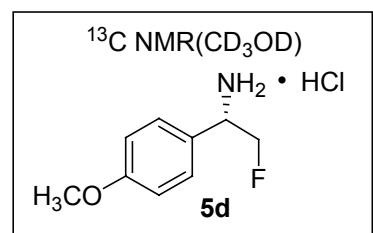


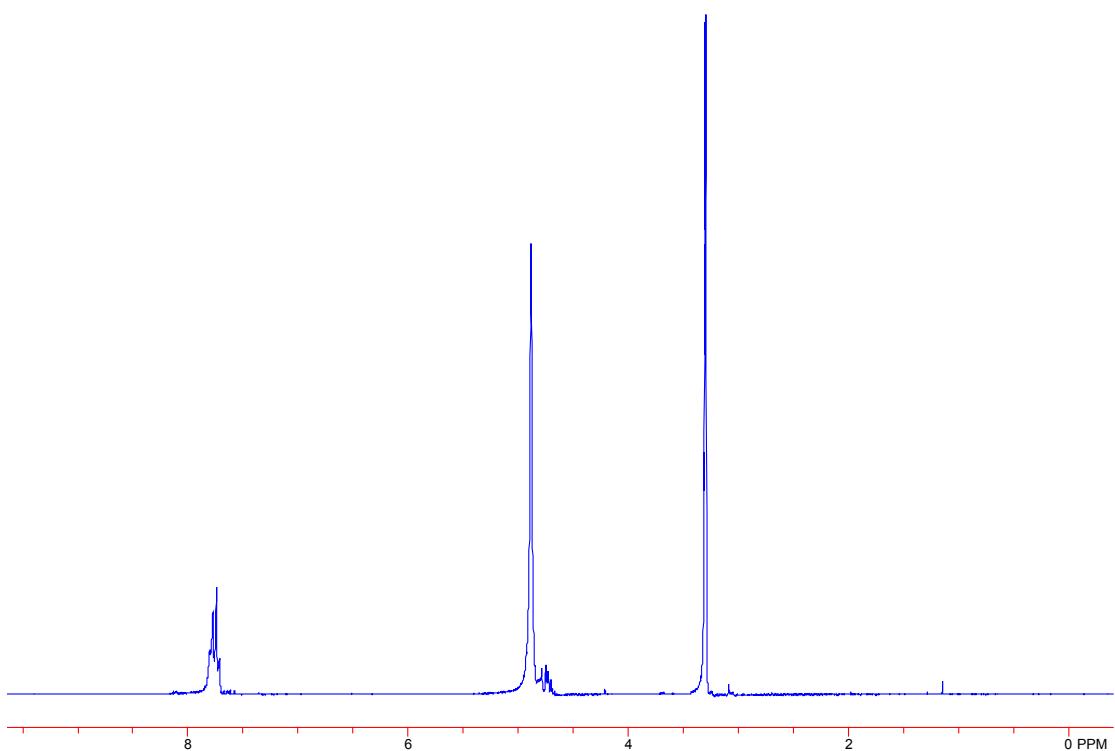
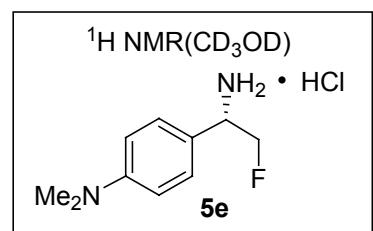


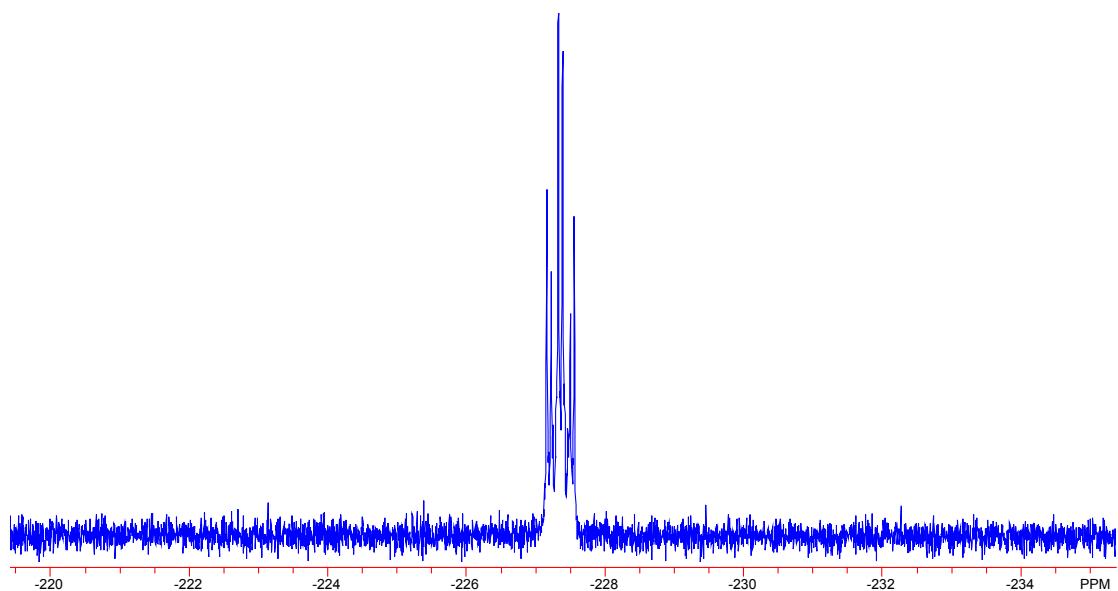
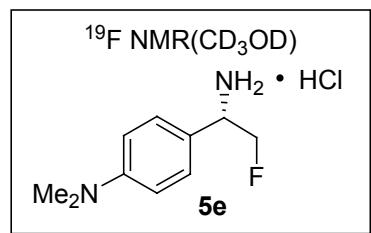


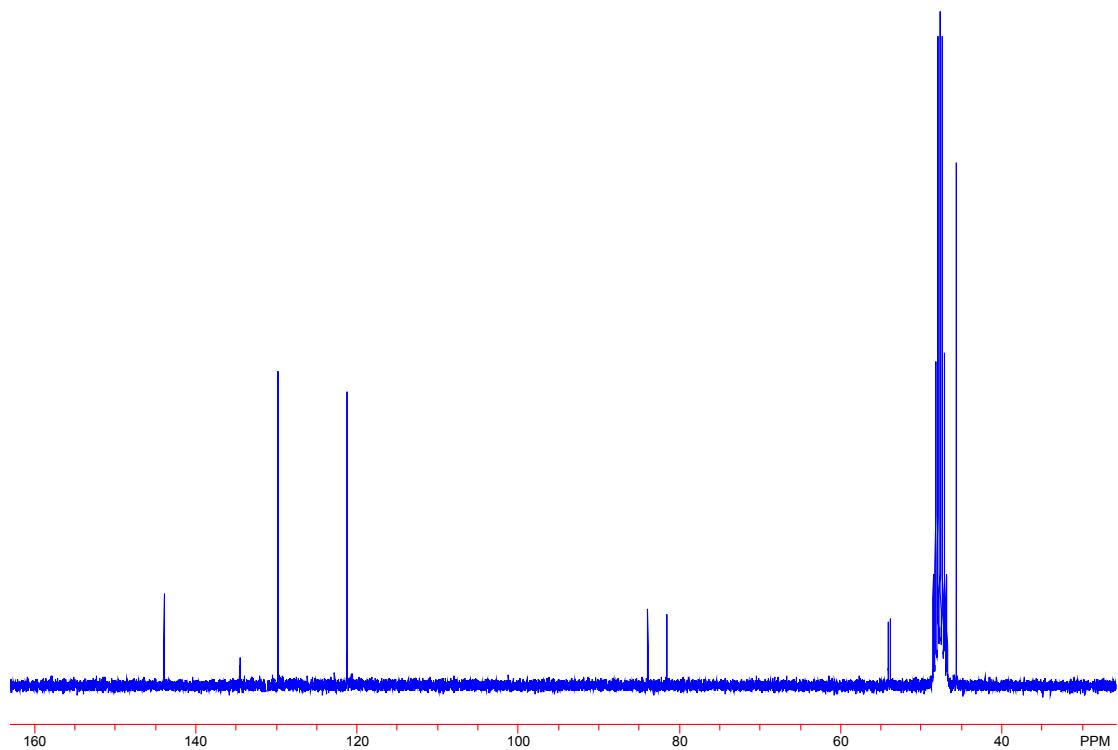
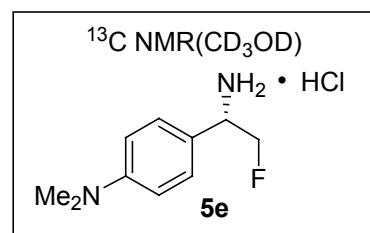


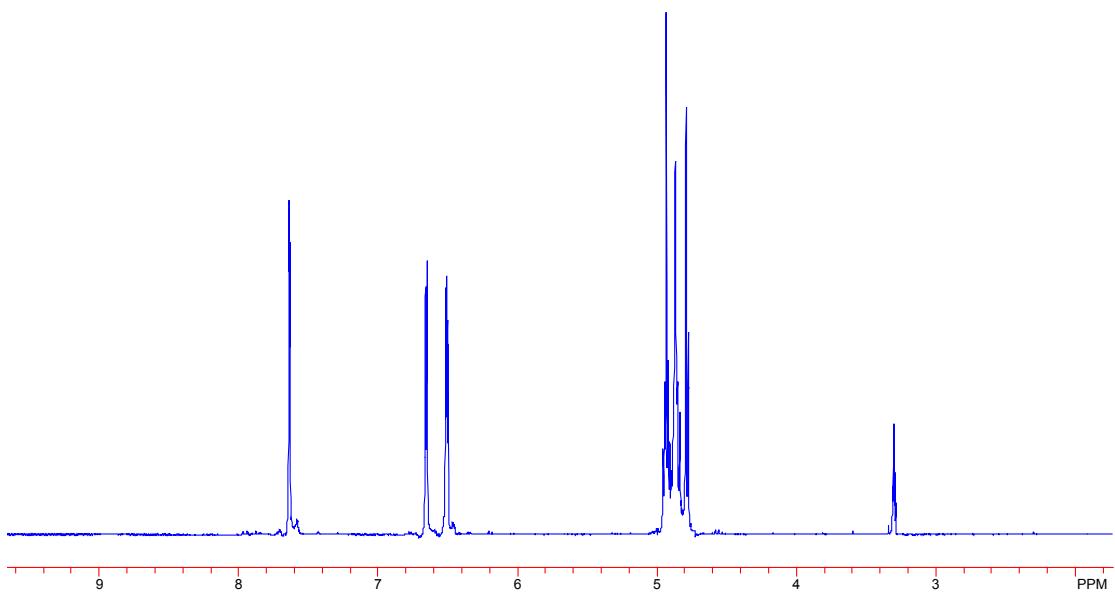
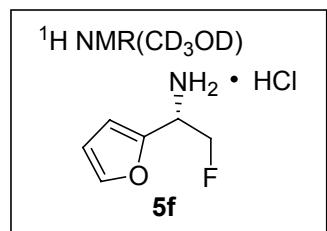


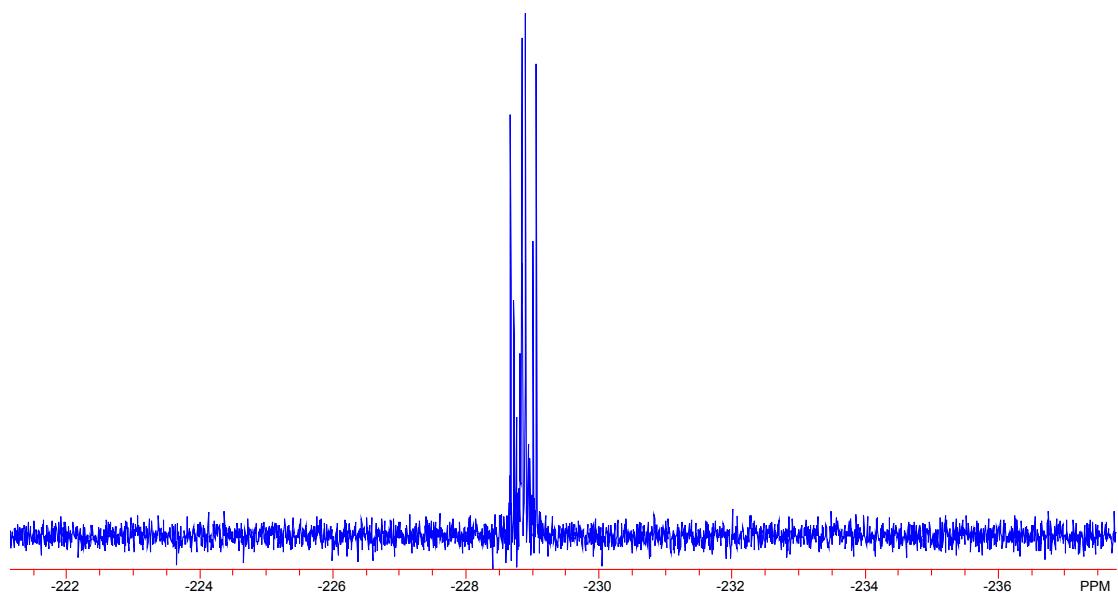
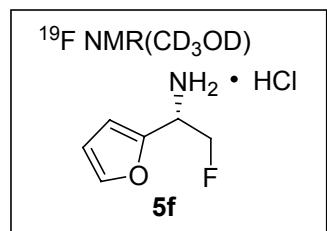


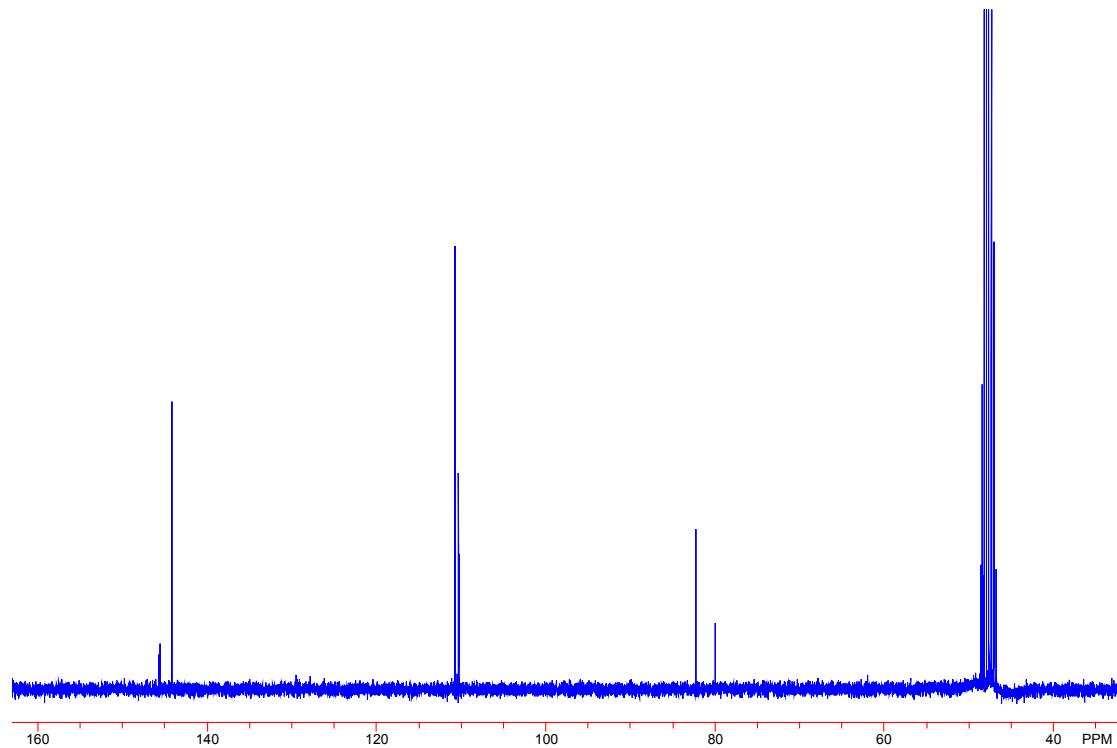
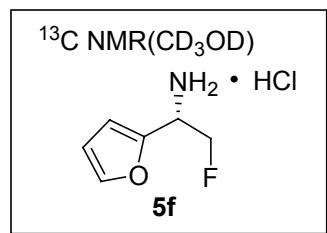


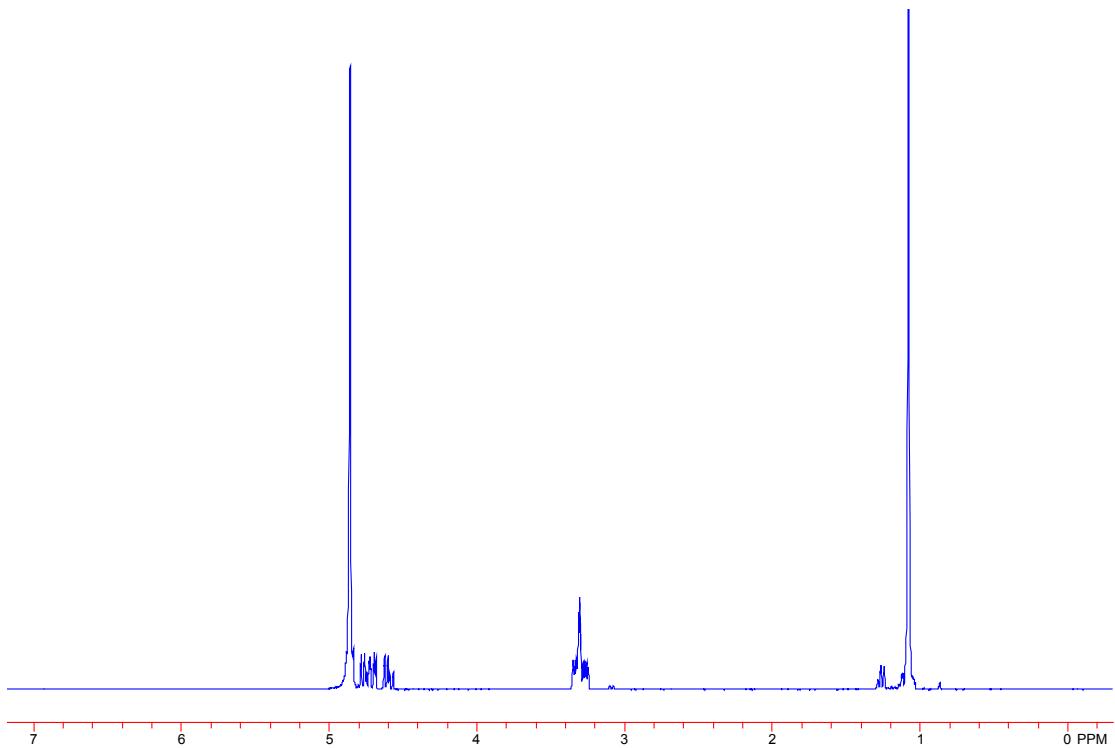
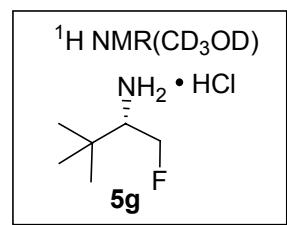


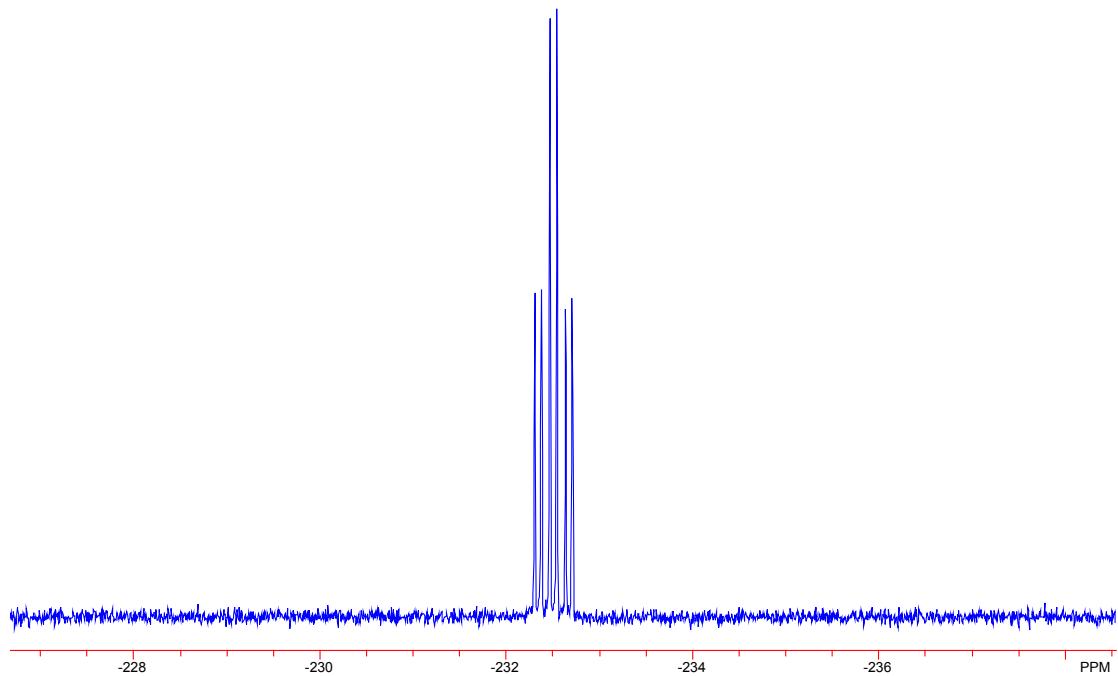
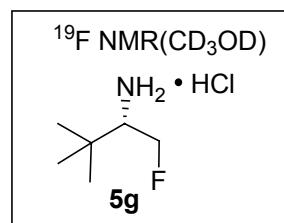


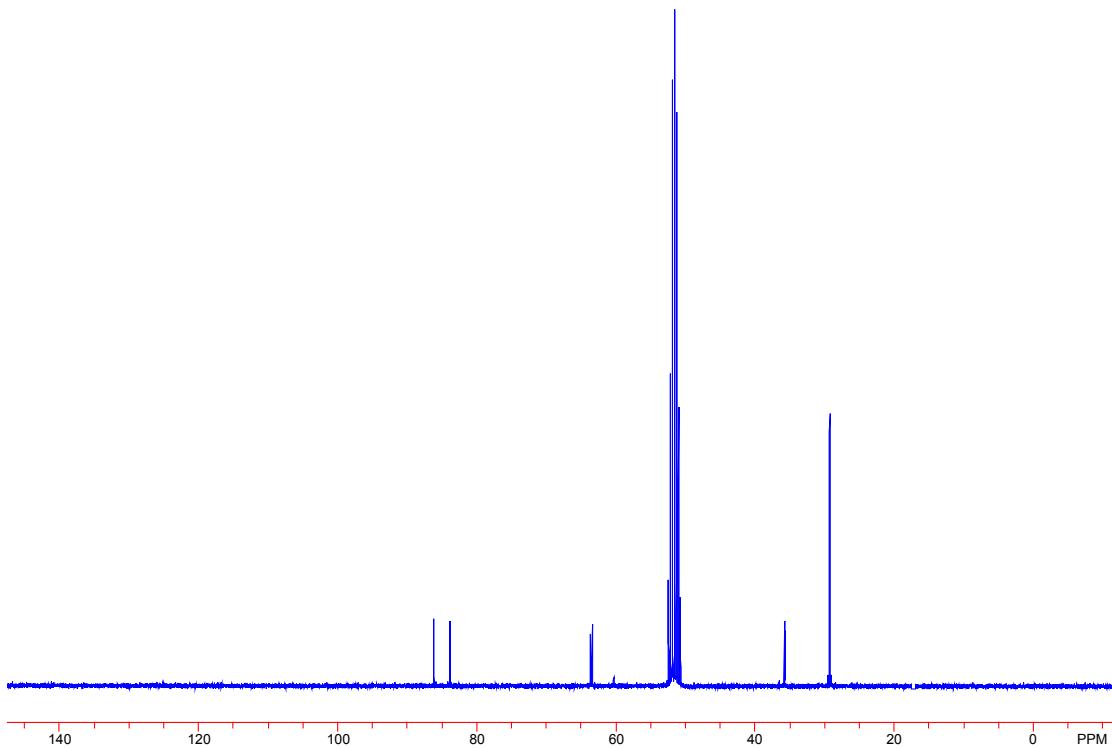
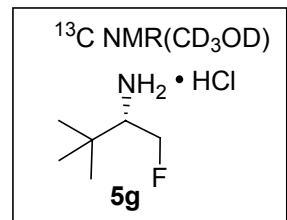


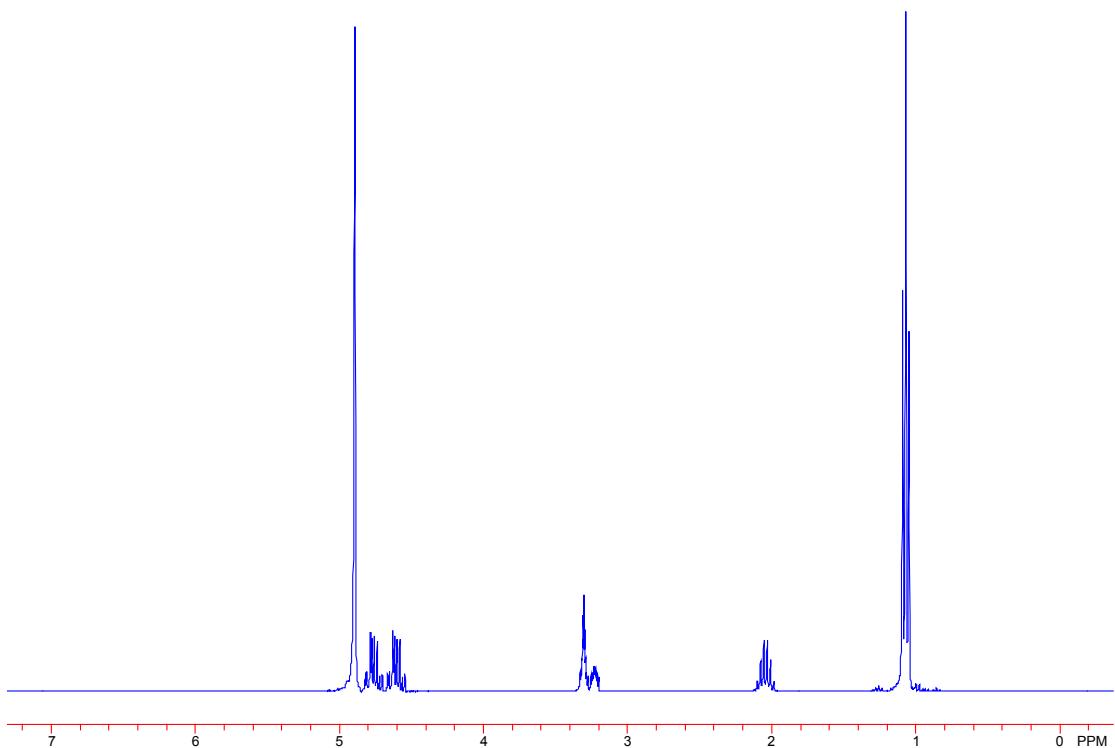
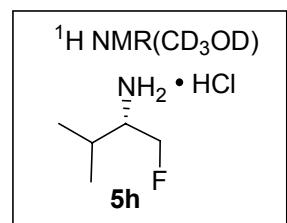


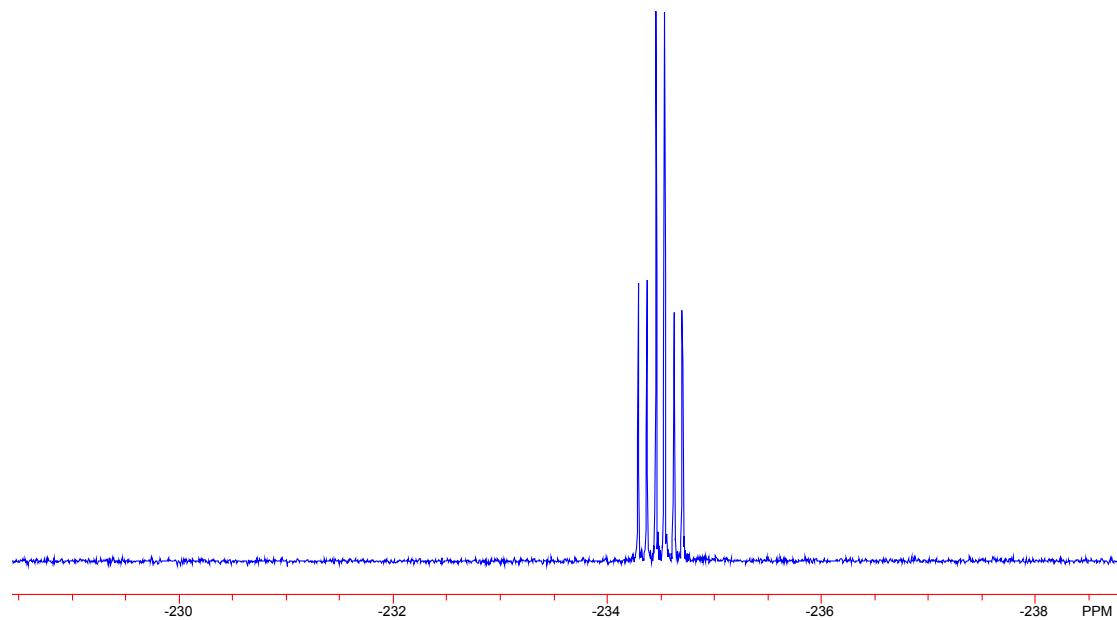
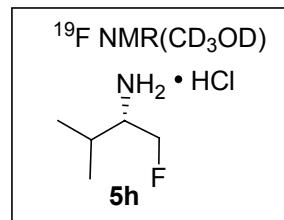


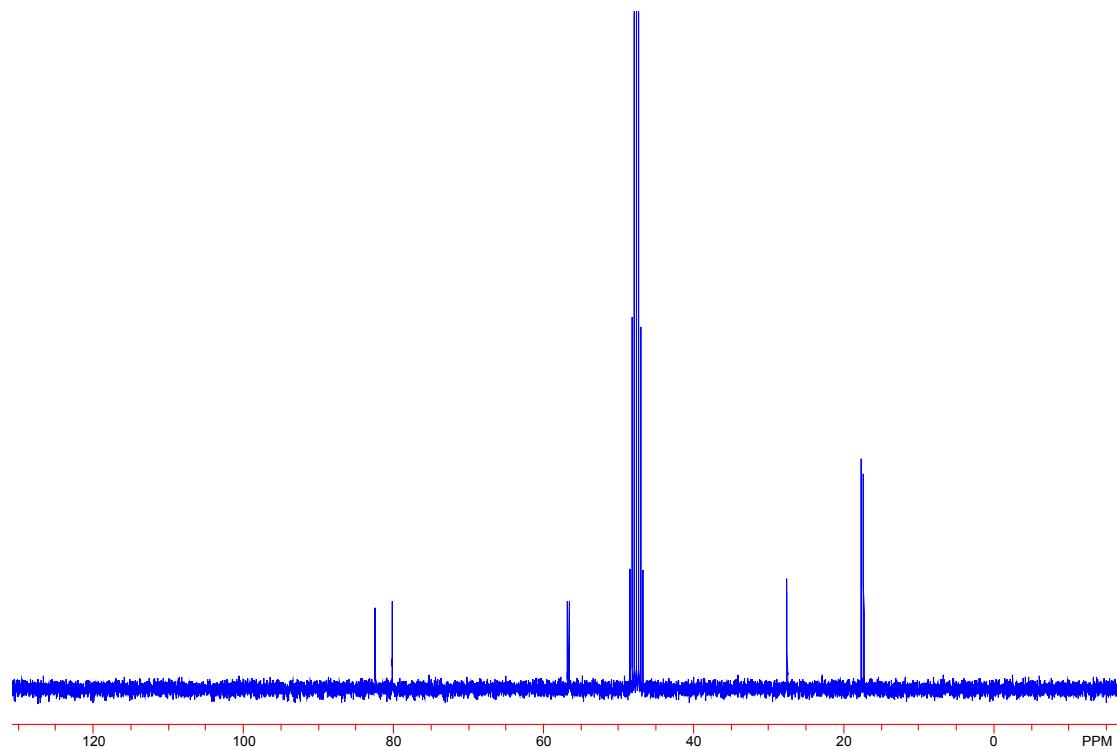
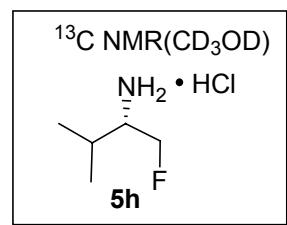


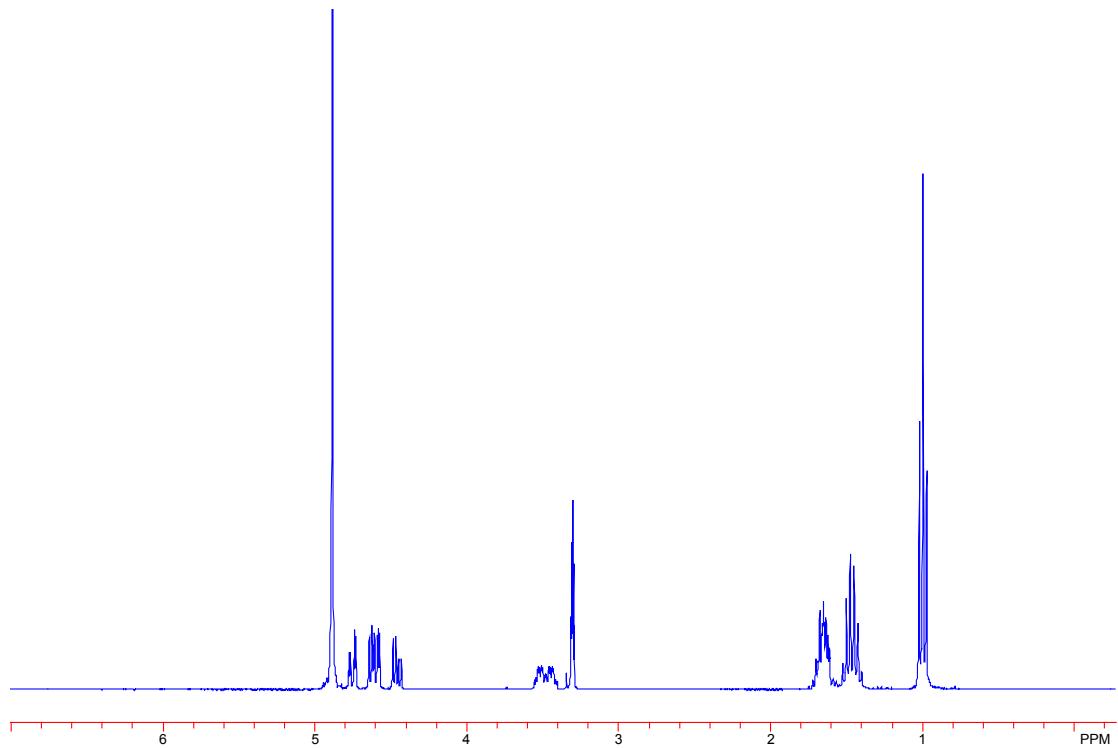
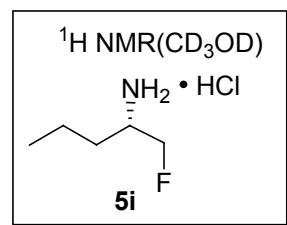


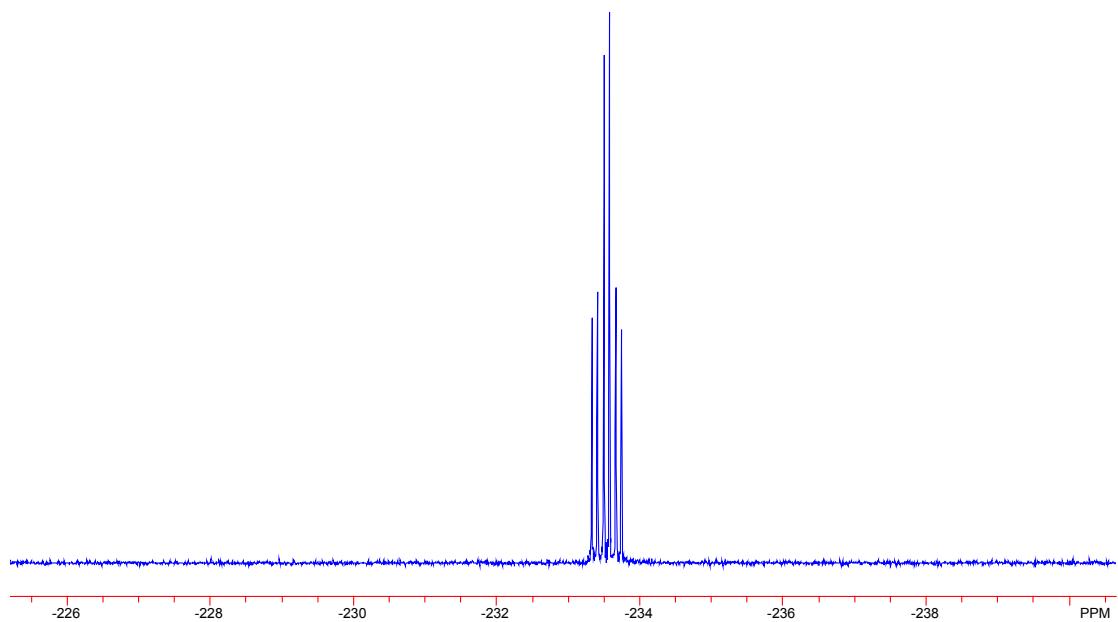
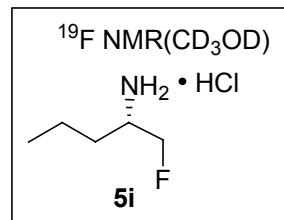


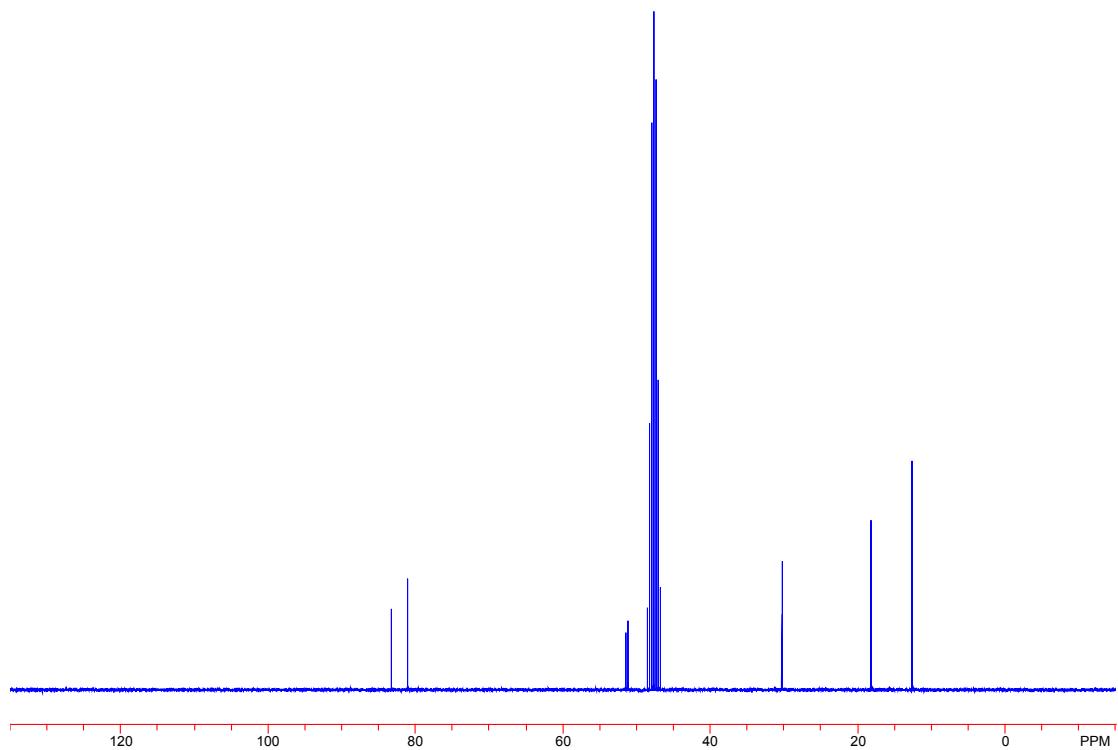
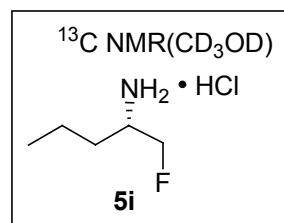


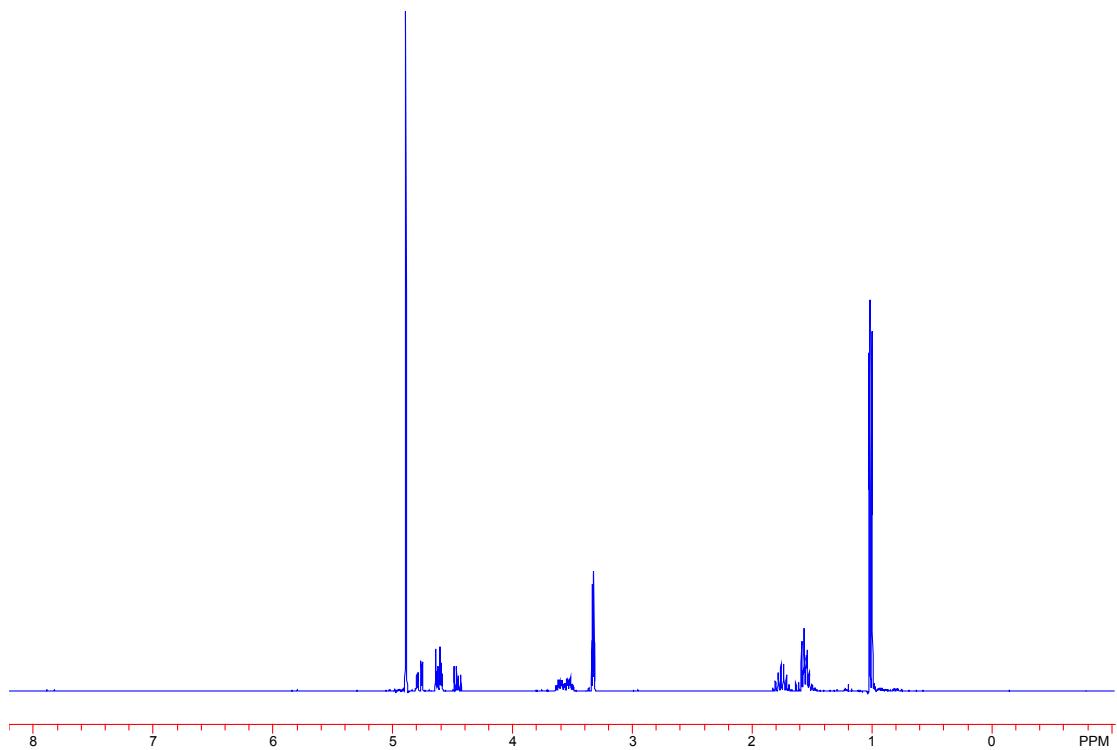
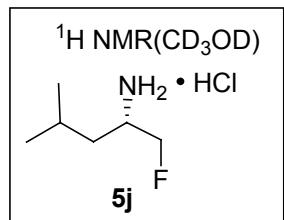


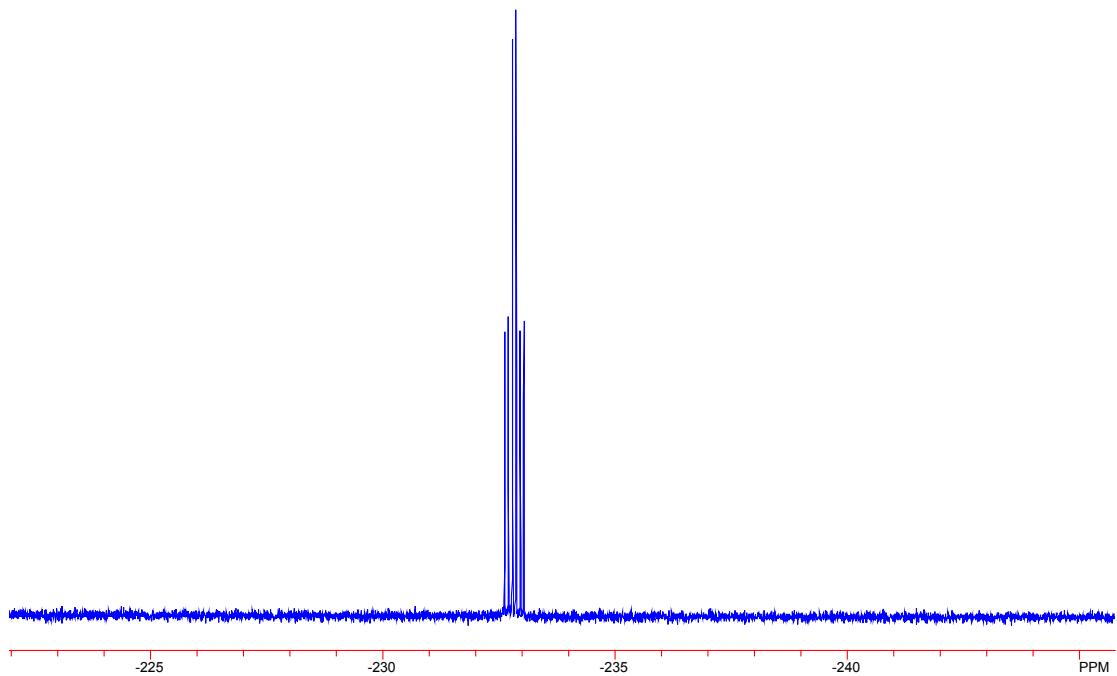
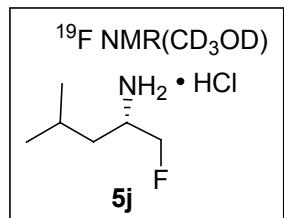


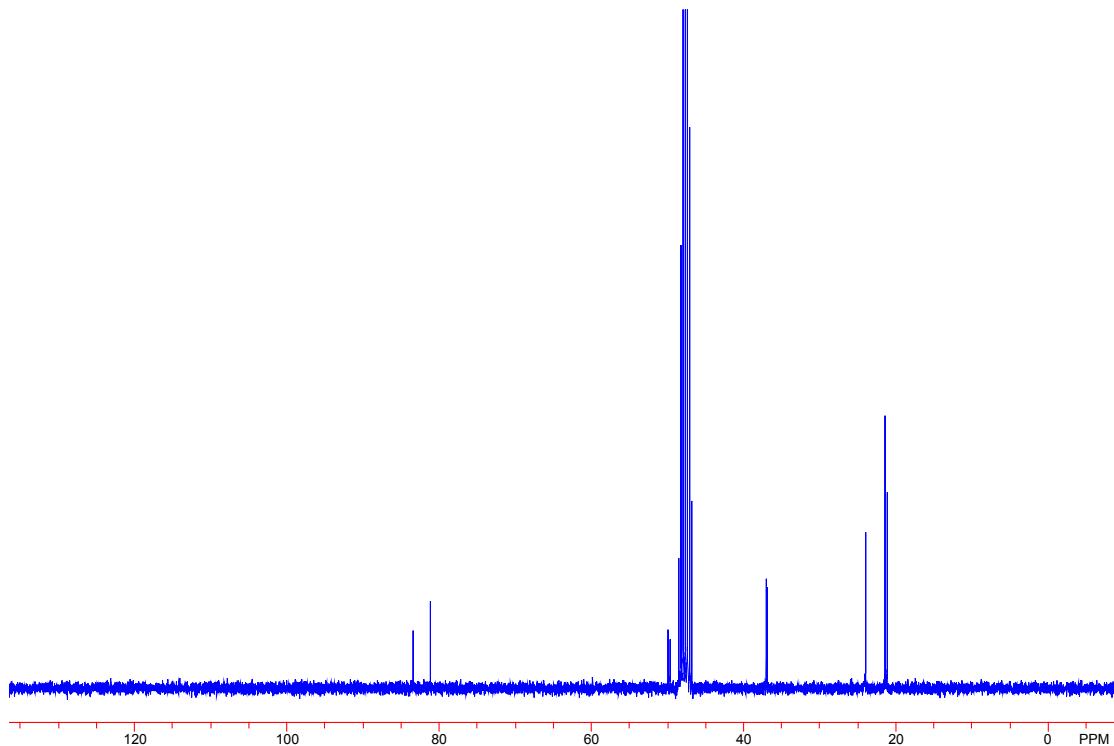
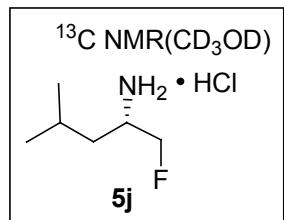


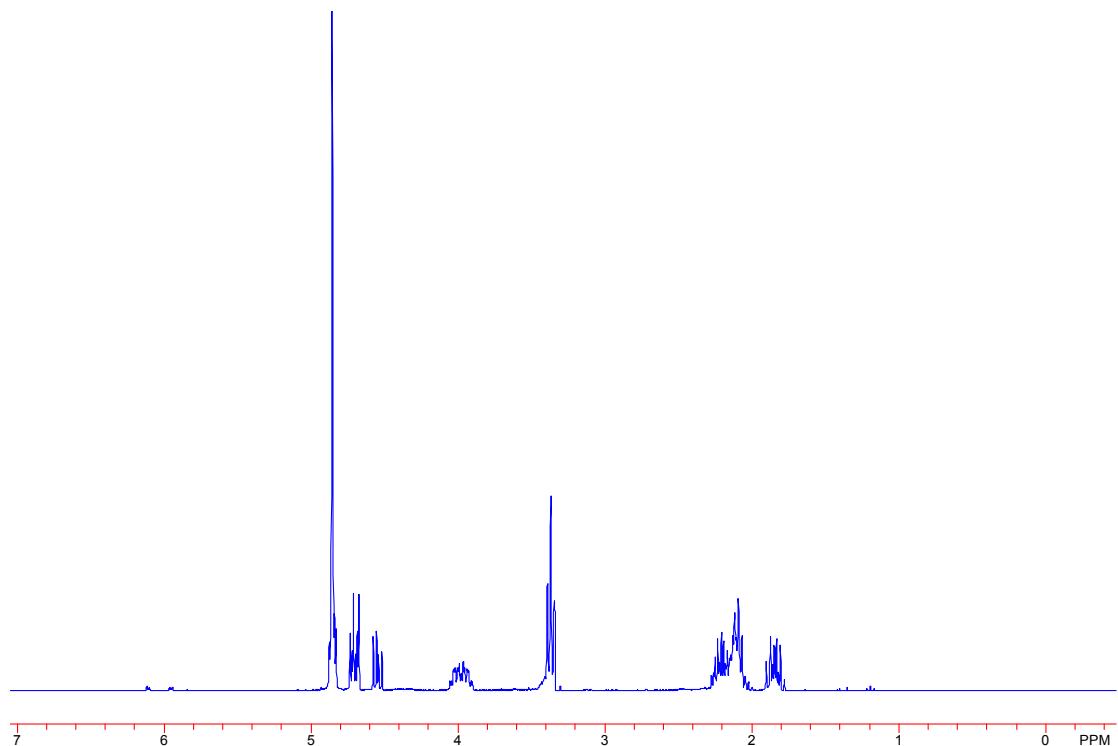
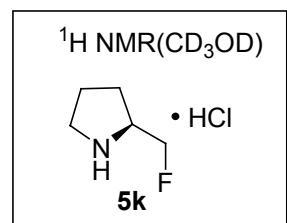


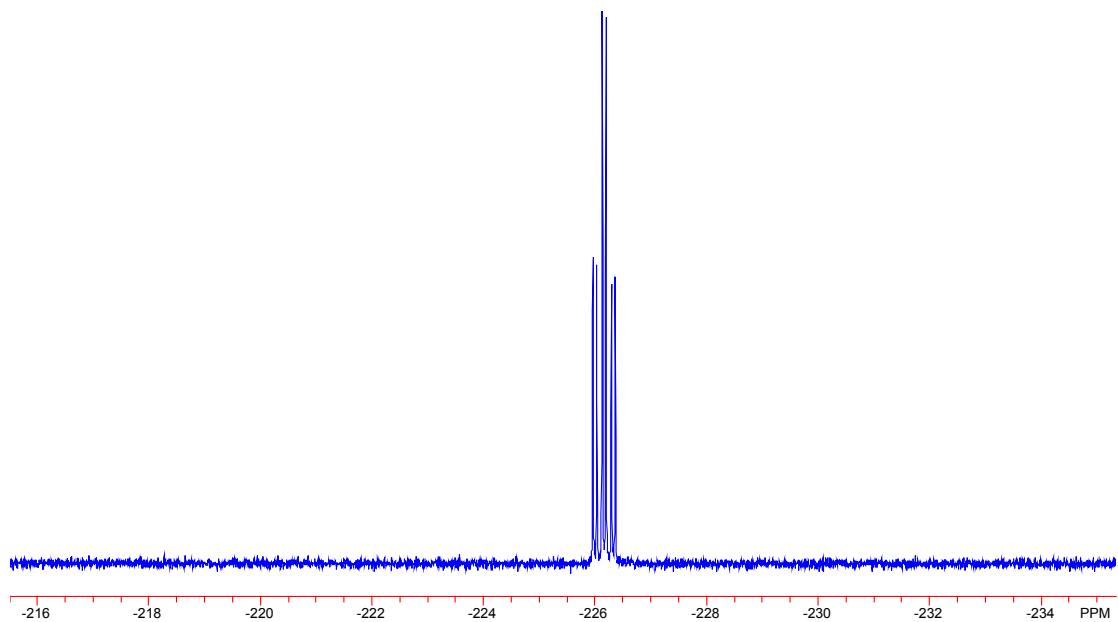
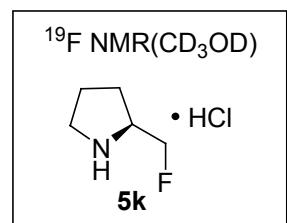


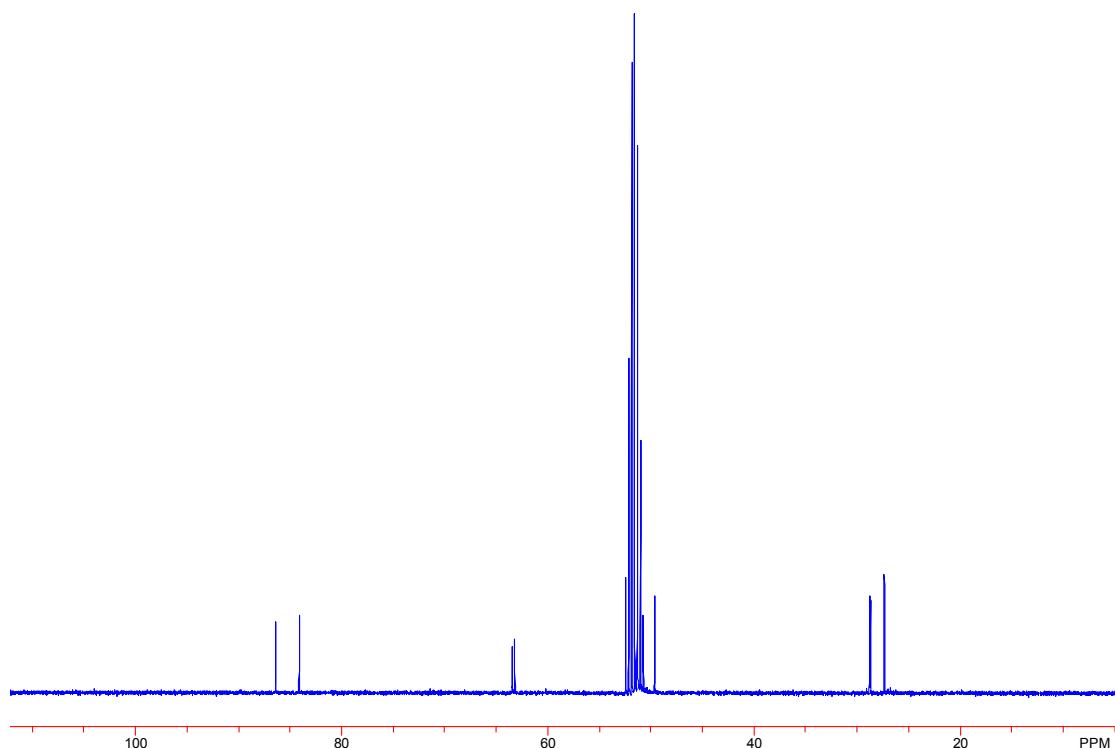
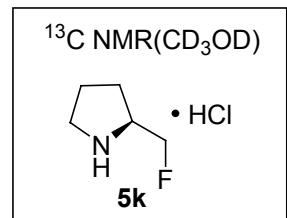


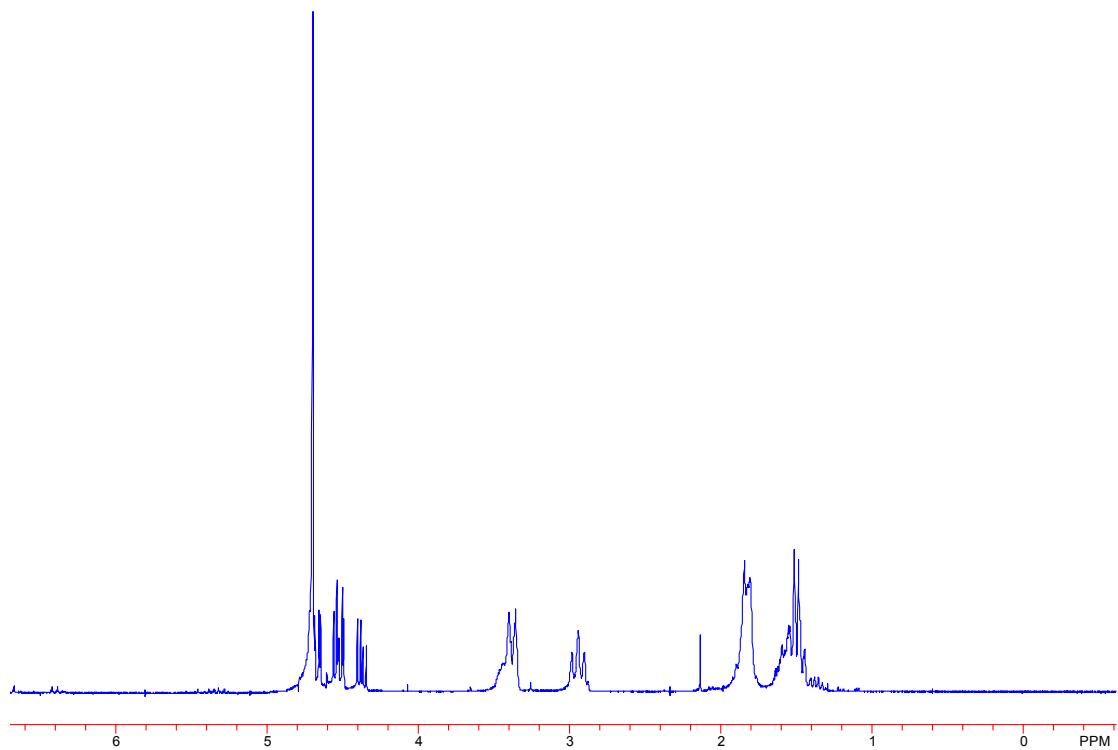
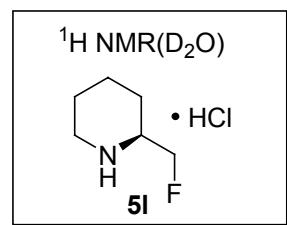


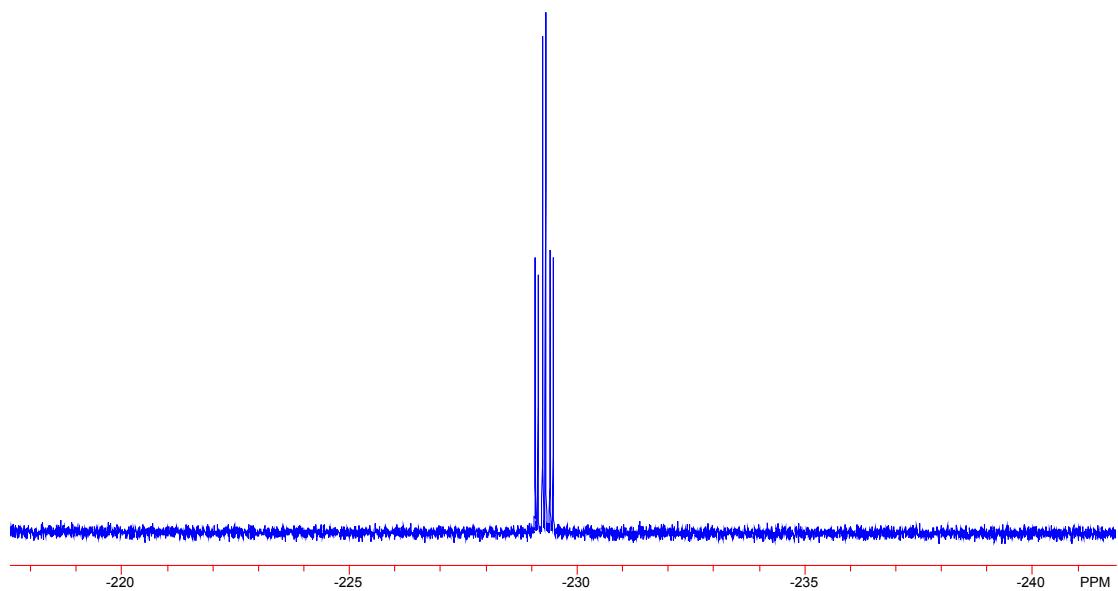
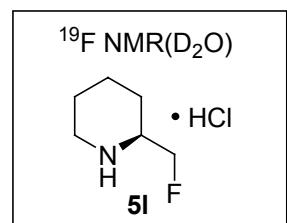


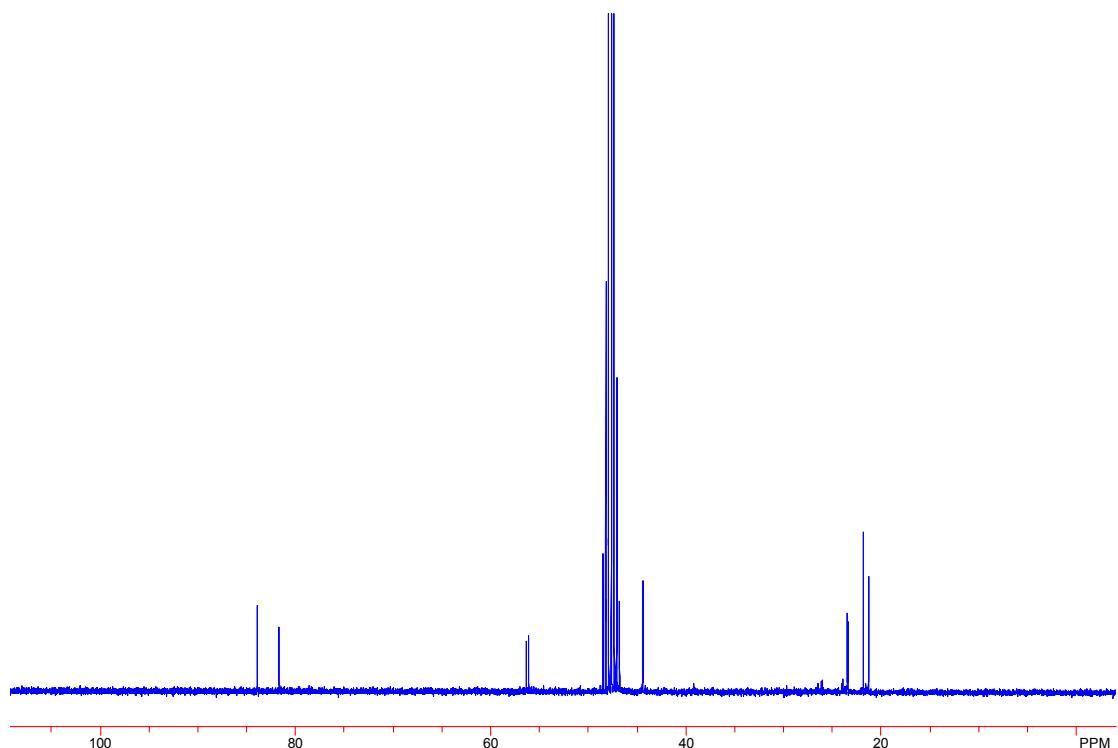
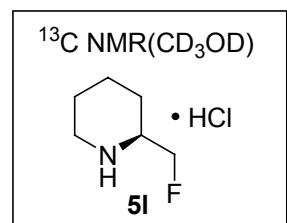


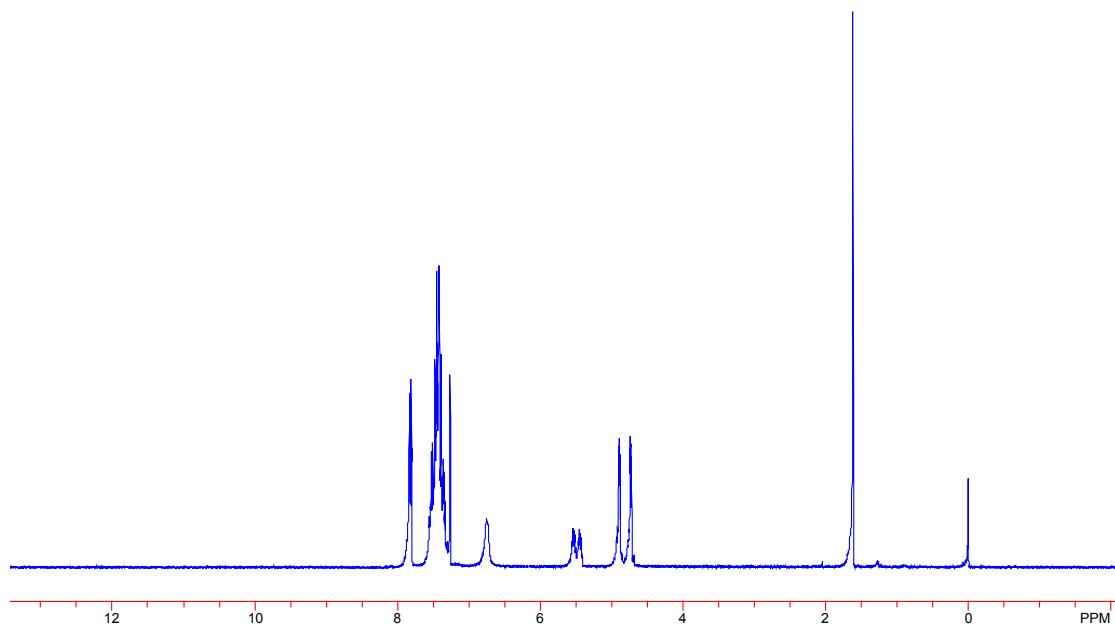
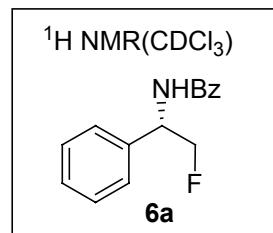




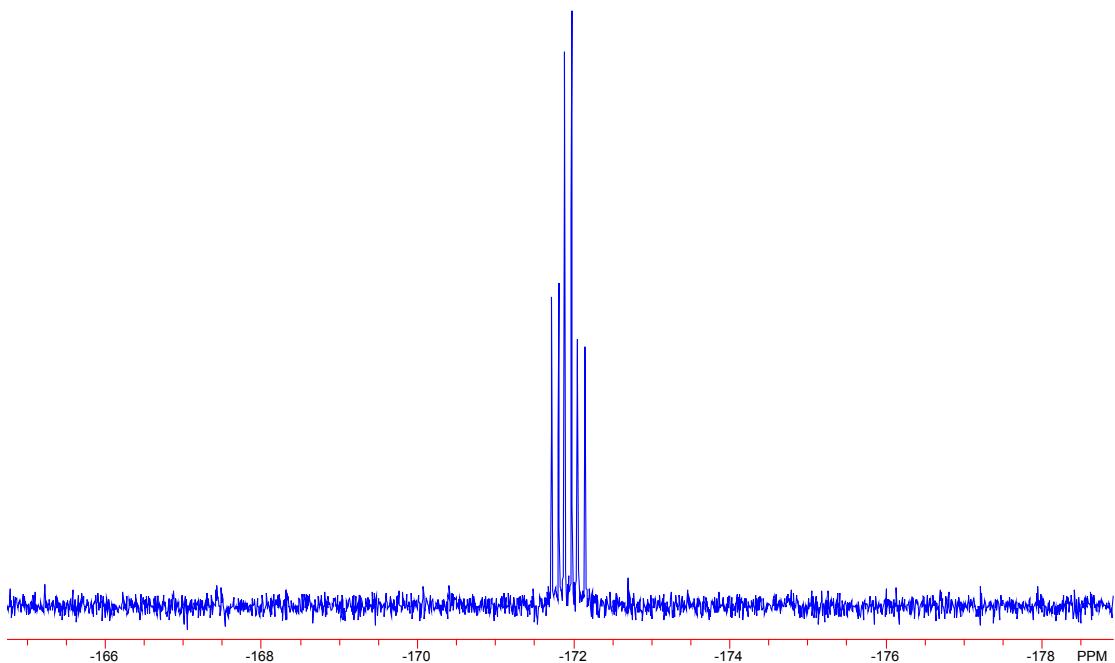
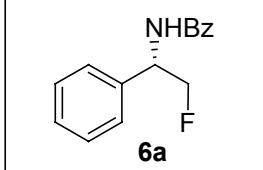


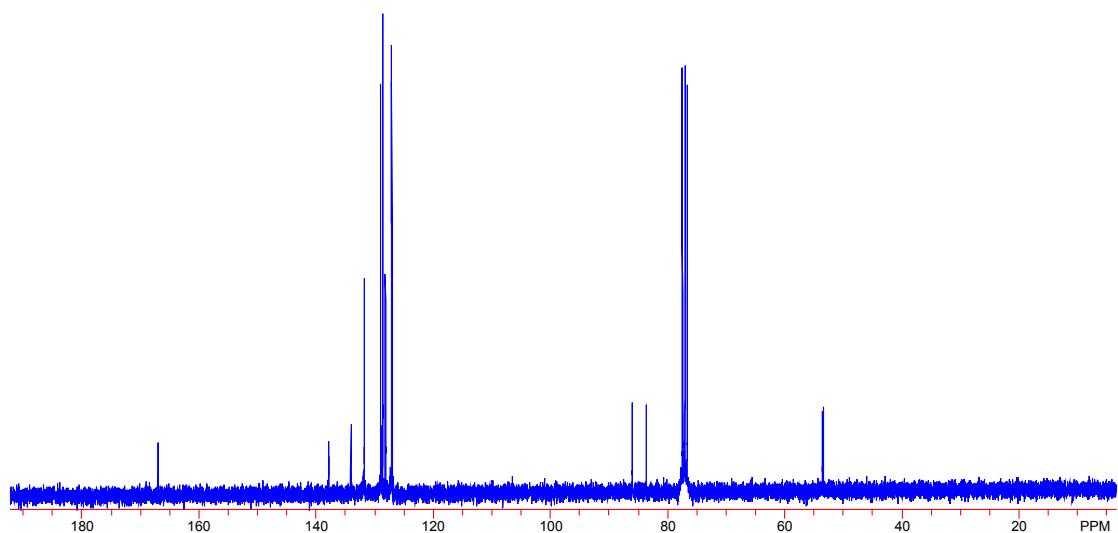
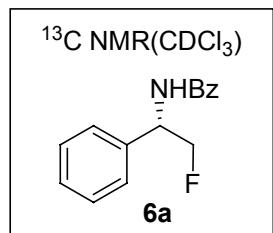


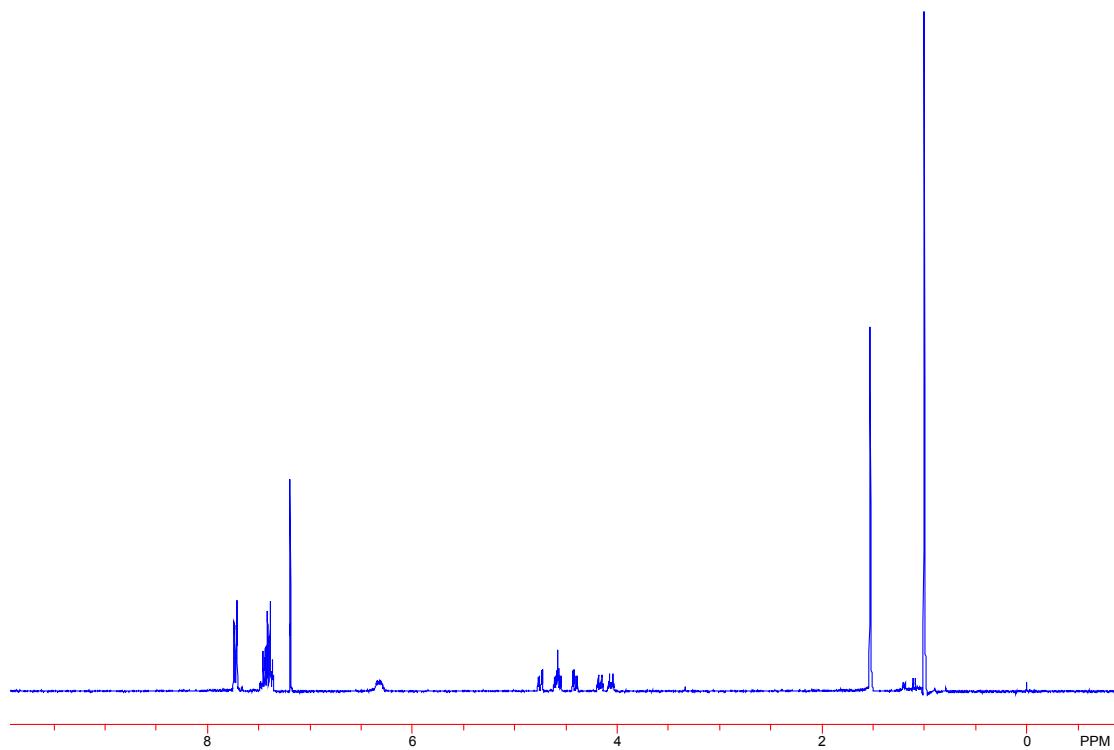
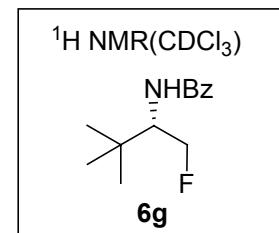


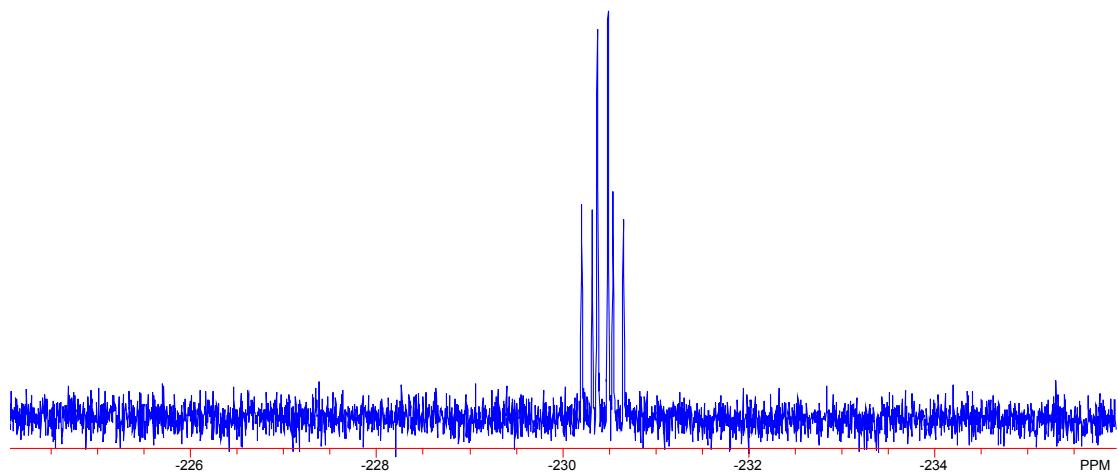
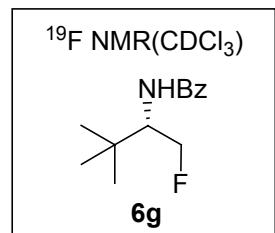


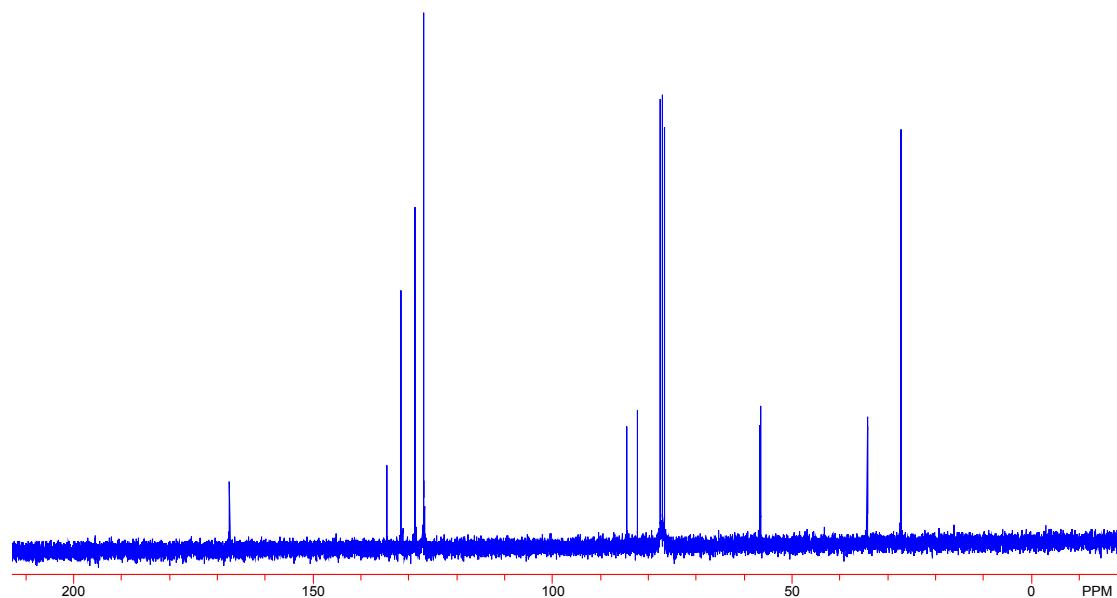
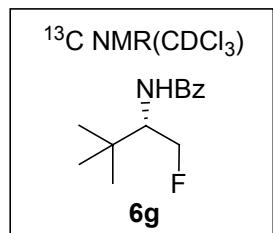
¹⁹F NMR(CDCl₃)





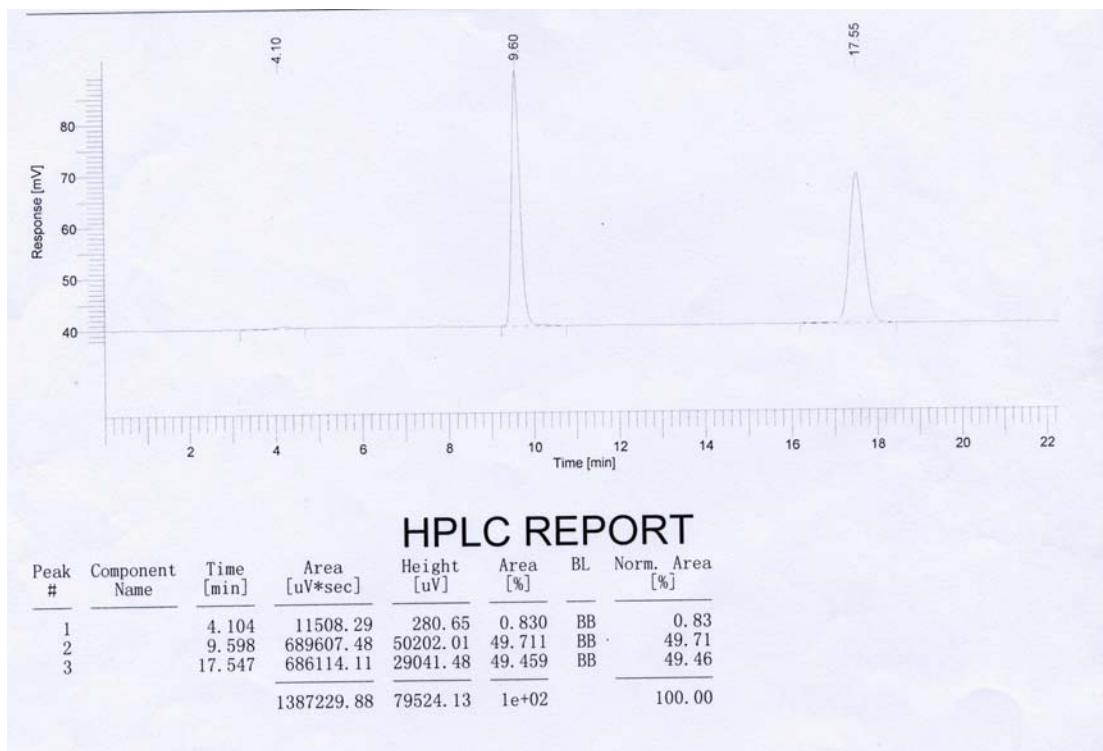


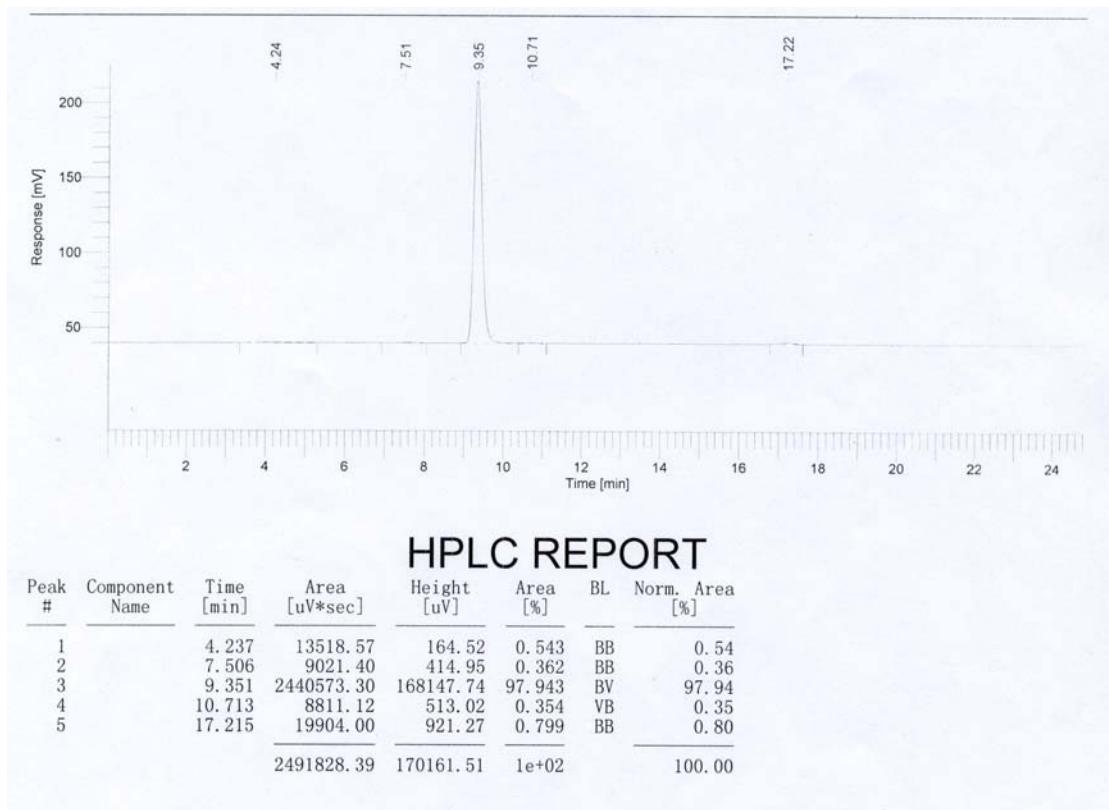




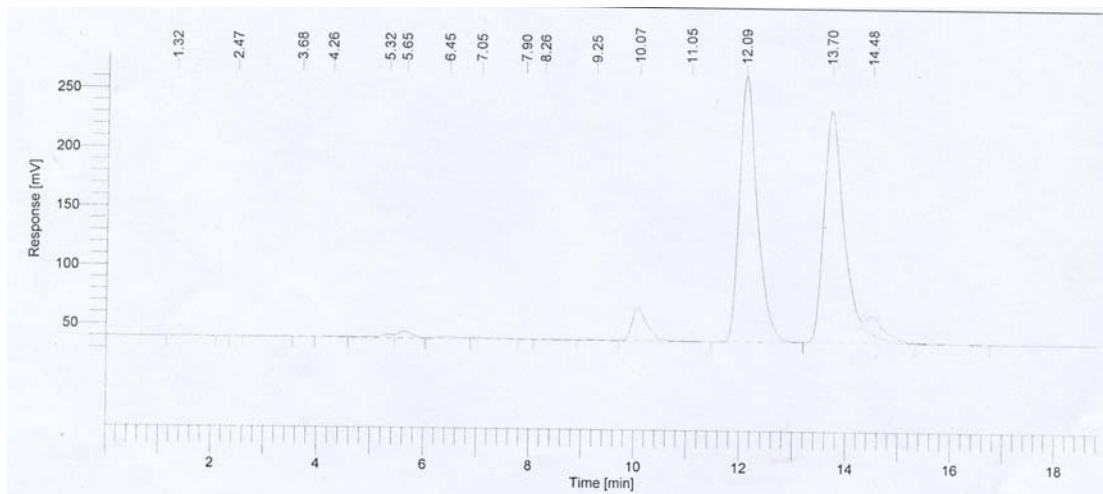
Determination of optical purity of **6** by chiral HPLC

6a





6g



HPLC REPORT

Peak #	Component Name	Time [min]	Area [uV*sec]	Height [uV]	Area [%]	BL	Norm. Area [%]
1		1. 322	2654. 31	61. 63	0. 022	BB	0. 02
2		2. 474	243. 25	31. 30	0. 002	BB	0. 00
3		3. 684	2475. 98	98. 03	0. 021	BV	0. 02
4		4. 260	11288. 42	364. 85	0. 095	VV	0. 10
5		5. 317	57950. 58	3141. 58	0. 488	VV	0. 49
6		5. 645	106568. 85	5742. 74	0. 898	VB	0. 90
7		6. 446	43300. 25	1420. 57	0. 365	BV	0. 36
8		7. 054	31594. 63	861. 62	0. 266	VV	0. 27
9		7. 902	6035. 33	358. 37	0. 051	VV	0. 05
10		8. 264	12409. 49	587. 28	0. 105	VV	0. 10
11		9. 249	9927. 50	383. 71	0. 084	VV	0. 08
12		10. 069	563926. 62	28080. 08	4. 753	VE	4. 75
13		11. 050	3567. 93	183. 04	0. 030	EB	0. 03
14		12. 089	5279627. 22	225774. 07	44. 499	BB	44. 50
15		13. 700	5367079. 04	196742. 16	45. 236	BE	45. 24
16		14. 479	366069. 40	13466. 43	3. 085	EB	3. 09
			11864718. 79	477297. 46	1e+02		100. 00

