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Palladium-Catalyzed Methylene C(sp^3)–H Arylation of Adamantyl Scaffold

Ye-Xing Lao,[ab] Jia-Qiang Wu,[a] Yunyun Chen,[a] Shang-Shi Zhang,[a] Qingjiang Li,[a] Honggen Wang*[a]

[a] *School of Pharmaceutical Sciences, Sun Yat-sen University, Guangzhou 510006, China*

[b] *PET/CT Center, The First Affiliated Hospital of Guangzhou Medical University, Guangzhou 510120, China*

**Email: wanghg3@mail.sysu.edu.cn*

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1. General Information

Unless otherwise noted, all reactions were carried out under an atmosphere of nitrogen in flame dried glassware. If reaction was not carried out at room temperature, reaction temperatures are reported as the temperature of the bath surrounding the vessel unless otherwise stated. The dry solvents used were purified by standard distillation procedures and stored over molecular sieves under argon. Commercially available chemicals were obtained from Acros Organics, Aldrich Chemical Co., Alfa Aesar, Adamas, 3B Scientific Co., and TCI Shanghai and used as received unless otherwise stated.

Analytical thin layer chromatography was performed on Polygram SIL G/UV254 plates. Visualization was accomplished with short wave UV light, phosphomolybdic acid staining solutions or $KMnO_4$ staining solutions followed by heating. Flash chromatography was performed on silica gel (200-300 mesh) by standard technique.

^1H nuclear magnetic resonance (NMR) spectra were recorded with a Bruker AV 400 NMR spectrometer. ^{13}C NMR spectra were recorded with a 100 MHz spectrometer. Chemical shifts (δ) are given in ppm relative to TMS. The residual solvent signals were used as references and the chemical shifts were converted to the TMS scale ($CDCl_3$: δ_H = 7.26 ppm, δ_C = 77.16 ppm; DMSO-d6: δ_H = 2.50 ppm, δ_C = 39.52 ppm). Multiplicities are reported using the following abbreviations: s = singlet, d = doublet, t = triplet, hept = heptet, m = multiplet, br = broad resonance. The sevent C-F bonds of the directing group *N*-arylamide (CONHAr) moiety appeared as complex set of short multiplets in the ^{13}C NMR spectra. Their chemical shifts are not assigned in the subsequent experimental section.

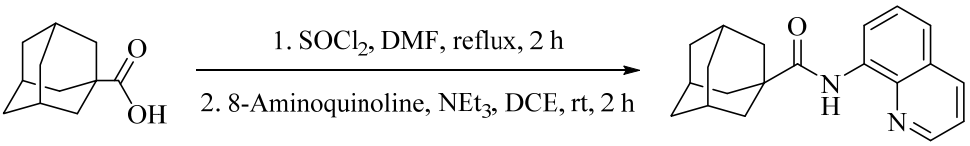
High-resolution mass spectra (HRMS) were recorded with a BRUKER VPEXII spectrometer.

No attempts were made to optimize yields for substrate synthesis.

2. Experimental Procedures and Compound Characterizations

2.1 Substrate Preparation

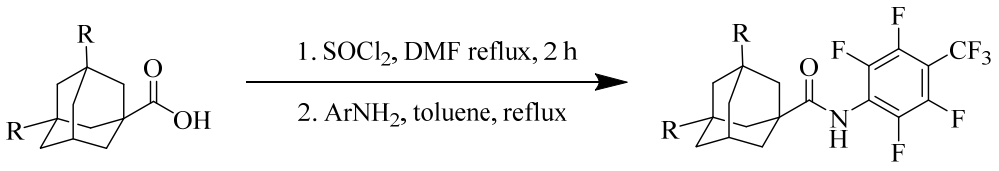
Preparation of (3*R*,5*R*,7*R*)-*N*-(quinolin-8-yl)adamantane-1-carboxamide (4)



S-a **4**

To a stirred solution of 1-adamantane carboxylic acid (**S-a**) (1.84 g, 10.2 mmol) in thionyl chloride was added a drop of DMF at rt, then the solution was refluxed for 2 h. The reaction mixture was then cooled to room temperature and removal of the excess of thionyl chloride under vacuum. After that, the corresponding crude acid chloride in dichloroethane was added dropwise to a stirred solution of 8-Aminoquinoline (1.2 g) and triethylamine (1.3 mL) in dichloroethane (40 mL) at rt. After stirring at room temperature for 2 h, the reaction mixture was washed successively with water, saturated aqueous $NaHCO_3$ and brine. The organic layer was dried over Na_2SO_4 and purified by flash column chromatography on silica gel using petroleum ether/EtOAc as the eluent to obtained compound **4** (1.5 g, 48%). R_F (petroleum ether/EtOAc 8:1): 0.49. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 10.21 (br s, 1H), 8.81 (d, J = 12.0 Hz, 1H), 8.80 (d, J = 12.0 Hz, 1H), 8.06 (d, J = 8.1 Hz, 1H), 7.56–7.27 (m, 3H), 2.09 (s, 9H), 1.76 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.7, 148.1, 138.8, 136.2, 134.6, 127.8, 127.4, 121.5, 121.2, 116.26, 42.2, 39.3, 36.5, 28.2; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{20}H_{22}N_2O$: 307.1805, found 307.1816.

General Procedure for the Preparation of Amides 6a and 6b

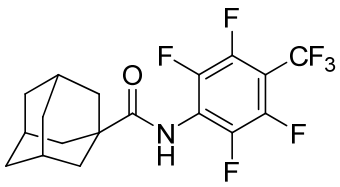


S-a, R = H
S-b, R = Me

6a, R = H
6b, R = Me

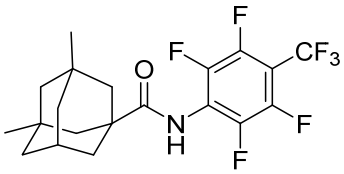
Amides **6** was synthesized according to a modified procedure reported by E. J. Yoo.[1] To a stirred solution of carboxylic acid (**S**, 1-4 equiv **)** in thionyl chloride was added a drop of DMF, and the solution was heated at reflux for 2 h. Removal of the excess of thionyl chloride under vacuum gave the crude acid chloride. The acid chloride was dissolved in toluene and added to a vigorously stirring solution of 2,3,5,6-tetrafluoro-4-(trifluoromethyl)aniline (1 equiv) in toluene. The reaction mixture was refluxed for 12 h, and then cooled to room temperature. Removed of toluene under vacuum gave the crude product. The pure product **6** was recrystallized from petroleum ether. The yield of the products were calculated based on 2,3,5,6-tetrafluoro-4-(trifluoromethyl)aniline.

(3*R*,5*R*,7*R*)-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1--carboxamide (6a)



Compound **6a** was obtained (2.9 g, 73%) from compound **S-a** (40.8 mmol, 7.4 g) and 2,3,5,6-tetrafluoro-4-(trifluoromethyl)aniline (10 mmol, 2.4 g). $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.45. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.10 (br s, 1H), 2.13 (s, 3H), 2.00 (d, J = 2.5 Hz, 6H), 1.78 (q, J = 12.5 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.9, 41.9, 39.3, 36.4, 28.1; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{18}H_{16}F_7NO$: 396.1193, found 396.1214.

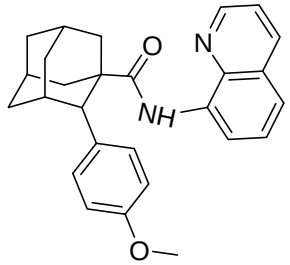
(1*R*,3*R*,5*S*,7*R*)-3,5-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)-adamantane-1-carboxamide (6b)



Compound **6b** was obtained (3.9 g, 64%) from compound **S-b** (28.8 mmol, 6.0 g) and 2,3,5,6-tetrafluoro-4-(trifluoromethyl)aniline (14.4 mmol, 3.4 g). R_F (petroleum ether/EtOAc 8:1): 0.57. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.15 (br s, 1H), 2.21 (dt, J = 6.2, 3.1 Hz, 1H), 1.82 (d, J = 2.6 Hz, 2H), 1.61 (q, J = 12.5 Hz, 4H), 1.47–1.35 (m, 4H), 1.28–1.16 (m, 2H), 0.90 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.9, 50.5, 45.3, 43.8, 42.6, 37.9, 31.3, 30.4, 29.3; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{20}H_{20}F_7NO$: 424.1506, found 424.1528.

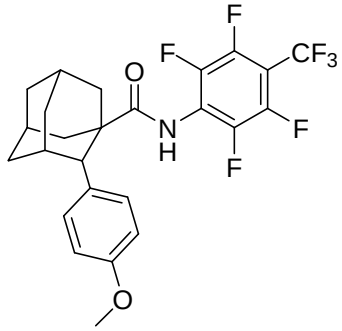
2.2 Pd(II)-Catalyzed Arylation of Methylene C(sp^3)–H Bonds

C-H Arylation for the Synthesis of (*1R,2S,3R,5R,7S*)-2-(4-methoxyphenyl)-*N*--(quinolin-8-yl)adamantane-1-carboxamide (5)



To a 10 mL sealed tube, were added substrate **3** (0.65 mmol, 1.0 equiv), $Pd(OAc)_2$ (10 mol %), *p*-iodoanisole (3.0 equiv), AgOAc (2.0 equiv) and *t*-Amyl-OH (0.5 mL). Then the reaction mixture was stirred vigorously at 140 °C for 24 h. After cooled down to room temperature, the reaction mixture was then purified by flash column chromatography on silica gel using EtOAc/petroleum ether as the eluent to give the desired product (8 mg, 3%). $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.43. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 10.18 (s, 1H), 8.85–8.73 (m, 1H), 8.68 (dd, J = 7.1, 1.4 Hz, 1H), 8.10 (d, J = 8.2 Hz, 1H), 7.51–7.37 (m, 3H), 7.33 (d, J = 8.7 Hz, 2H), 6.69 (d, J = 8.7 Hz, 2H), 3.64 (s, 3H), 3.60 (s, 1H), 2.79 (d, J = 12.2 Hz, 1H), 2.33–2.21 (m, 4H), 2.16 (s, 2H), 2.08–1.97 (m, 2H), 1.83 (s, 3H), 1.55 (d, J = 12.7 Hz, 1H); ^{13}C **NMR** (101 MHz, $CDCl_3$) δ 176.0, 157.3, 148.1, 138.8, 136.2, 135.4, 134.6, 129.4, 127.9, 127.4, 121.5, 121.1, 116.3, 113.4, 55.0, 50.8, 45.5, 44.7, 39.2, 37.3, 35.9, 33.8, 30.4, 28.5, 27.9; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{27}H_{28}N_2O_2$: 413.2224, found 413.2222.

C-H Arylation for the Synthesis of (1*R*,2*S*,3*R*,5*R*,7*S*)-2-(4-methoxyphenyl)-*N*-(2-,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7a)



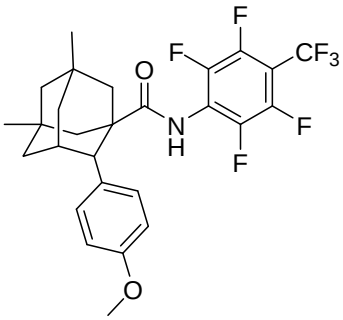
To a 10 mL sealed tube, were added substrate **6a** (0.1 mmol, 1.0 equiv), $Pd(OAc)_2$ (10 mol %), *p*-iodoanisole (5.0 equiv), PPh_3 (50 mol %), CsF (3.0 equiv), and *t*-Amyl-OH (0.2 mL). Then the reaction mixture was stirred vigorously at 120 °C for 24 h. After cooled down

to room temperature, the reaction mixture was then purified by flash column chromatography on silica gel using EtOAc/petroleum ether as the eluent to give the desired product **7a** (27mg, 53%). $\boldsymbol{R}_{\mathbf{F}}$ (petroleum ether/EtOAc 8:1): 0.40. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.28 (d, J = 8.7 Hz, 2H), 7.04 (br s, 1H), 6.83 (d, J = 8.3 Hz, 2H), 3.78 (s, 3H), 3.38 (s, 1H), 2.59 (d, J = 11.8 Hz, 1H), 2.26–1.97 (m, 8H), 1.81 (s, 3H), 1.54 (d, J = 12.7 Hz, 1H);^{13}C **NMR** (100 MHz, $CDCl_3$) δ 175.5, 158.1, 134.1, 129.5, 113.9, 55.4, 51.0, 44.6, 39.2, 37.0, 35.9, 33.8, 30.2, 29.8, 28.4, 27.7; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{25}H_{22}F_7NO_2$: 502.1612, found 502.1629.

General Procedure for the Synthesis of Arylation Product 7b-7r

To a 10 mL sealed tube, were added substrate **6** (0.1 mmol, 1.0 equiv), $Pd(TFA)_2$ (10 mol %), aryl halide (5.0 equiv), PPh_3 (50 mol %), CsF (3.0 equiv) and *n*-hexane (0.2 mL). Then the reaction mixture was stirred vigorously at 120 °C for 24 h. After cooled down to room temperature, the reaction mixture was then purified by flash column chromatography on silica gel using EtOAc/petroleum ether as the eluent to give the desired product **7b-7r**.

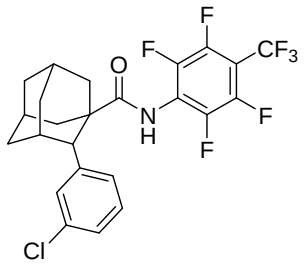
(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(4-methoxyphenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7b)



Isolated yield was 53%. $\boldsymbol{R}_{\mathbf{F}}$ (petroleum ether/EtOAc 8:1): 0.48. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.25 (d, J = 9.0 Hz, 2H), 6.98 (br s, 1H), 6.83 (d, J = 8.6 Hz, 2H), 3.78 (s, 3H), 3.21 (s, 1H), 2.33 (d, J = 2.3 Hz, 1H), 2.21 (d, J = 12.8 Hz, 1H), 1.83 (d, J = 12.4 Hz, 1H), 1.80–1.71 (m, 2H), 1.69–1.58 (m, 2H), 1.49 (d, J = 12.9 Hz, 1H), 1.28 (s, 2H), 1.16 (d, J = 13.1 Hz, 1H), 0.95 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz,

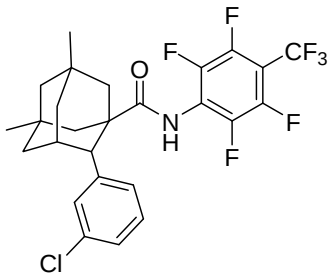
$CDCl_3$) δ 175.4, 158.1, 133.7, 129.5, 113.9, 55.3, 51.1, 50.5, 49.7, 47.0, 45.2, 40.1, 37.3, 36.6, 31.6, 31.0, 30.5, 29.9; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{27}H_{26}F_7NO_2$: 530.1925, found 530.1959.

(1*R*,2*S*,3*R*,5*R*,7*S*)-2-(3-chlorophenyl)-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)-phenyl)adamantane-1-carboxamide (7c)



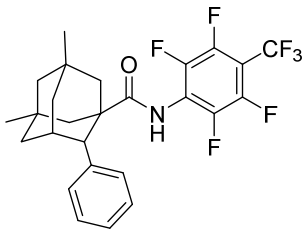
Isolated yield was 41%. $\boldsymbol{R}_\mathbf{F}$ (petroleum ether/EtOAc 8:1): 0.48. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.34 (s, 1H), 7.25–7.12 (m, 3H), 7.06 (s, 1H), 3.43 (s, 1H), 2.61 (d, J = 12.4 Hz, 1H), 2.28 (s, 1H), 2.18 (s, 4H), 2.04 (q, J = 13.0 Hz, 3H), 1.82 (s, 2H), 1.74 (d, J = 13.2 Hz, 1H), 1.58 (s, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.0, 144.4, 134.4, 129.7, 128.6, 126.7, 126.5, 51.2, 45.0, 44.6, 39.0, 36. 9, 35.8, 33.9, 30.2, 28.2, 27.5; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{24}H_{19}ClF_7NO$: 506.1116, found 506.1139.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(3-chlorophenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7d)



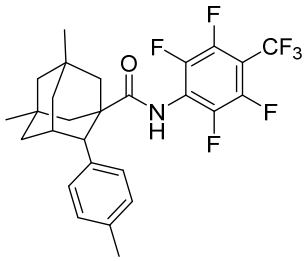
Isolated yield was 66%. $\boldsymbol{R}_\mathbf{F}$ (petroleum ether/EtOAc 8:1): 0.54. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.31 (s, 1H), 7.24–7.16 (m, 3H), 7.02 (s, 1H), 3.27 (s, 1H), 2.37 (d, J = 2.4 Hz, 1H), 2.22 (d, J = 12.6 Hz, 1H), 1.84 (d, J = 12.4 Hz, 1H), 1.76 (d, J = 12.6 Hz, 2H), 1.63 (t, J = 11.8 Hz, 2H), 1.43 (d, J = 12.9 Hz, 1H), 1.29 (s, 2H), 1.19 (d, J = 13.1 Hz, 1H), 0.97 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.8, 144.0, 134.5, 129.7, 128.7, 126.8, 126.5, 51.0, 50.4, 50.1, 46.9, 45.2, 40.4, 37.2, 36.7, 31.6, 31.1, 30.5, 29.8; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{26}H_{23}ClF_7NO$: 534.1429, found 534.1461.

(1*S*,2*S*,3*S*,5*R*,7*S*)-5,7-dimethyl-2-phenyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)-phenyl)adamantane-1-carboxamide (7e)



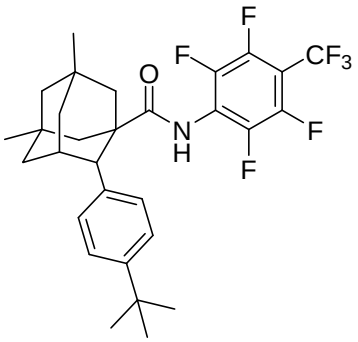
Isolated yield was 72%. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.50. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.39–7.27 (m, 4H), 7.24–7.18 (m, 1H), 6.97 (br s, 1H), 3.26 (s, 1H), 2.39 (d, J = 2.6 Hz, 1H), 2.25 (d, J = 12.8 Hz, 1H), 1.87–1.74 (m, 3H), 1.70–1.58 (m, 2H), 1.47 (d, J = 13.0 Hz, 1H), 1.29 (s, 2H), 1.16 (d, J = 13.1 Hz, 1H), 0.96 (s, 3H), 0.95 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.2, 141.7, 128.6, 128.5, 126.6, 51.1, 50.6, 50.5, 47.0, 45.3, 40.3, 37.4, 36.7, 31.7, 31.0, 30.5, 29.9; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{26}H_{24}F_7NO$: 500.1819, found 500.1835.

(1*S*,2*S*,3*S*,5*R*,7*S*)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)-2-(p-tolyl)adamantane-1-carboxamide (7f)



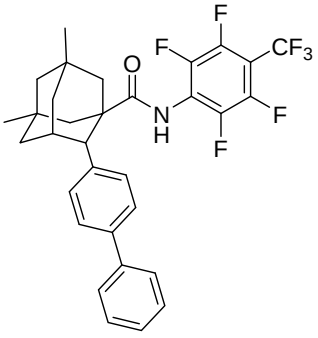
Isolated yield was 62%. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.59. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.21 (d, J = 7.9 Hz, 2H), 7.10 (d, J = 7.9 Hz, 2H), 6.99 (br s, 1H), 3.22 (s, 1H), 2.36 (d, J = 2.2 Hz, 1H), 2.31 (s, 3H), 2.23 (d, J = 13.1 Hz, 1H), 1.78 (dd, J = 25.3, 11.2 Hz, 3H), 1.69–1.59 (m, 2H), 1.51–1.39 (m, 2H), 1.26 (s, 1H), 1.15 (d, J = 13.1 Hz, 1H), 0.95 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.3, 138.6, 136.2, 129.3, 128.3, 51.1, 50.6, 50.1, 47.0, 45.3, 40.3, 37.4, 36.7, 31.7, 31.0, 30.5, 29.9, 21.0; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{27}H_{26}F_7NO$: 514.1975, found 514.1989.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(4-(tert-butyl)phenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4--(trifluoromethyl)phenyl)adamantane-1-carboxamide (7g)



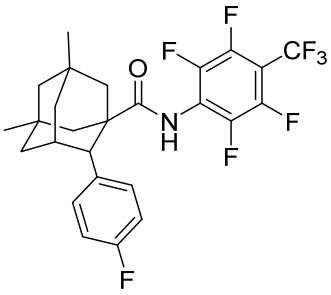
Isolated yield was 50%. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.56. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.30 (d, J = 8.5 Hz, 2H), 7.26 (d, J = 8.4 Hz, 2H), 6.92 (br s, 1H), 3.21 (s, 1H), 2.36 (d, J = 2.6 Hz, 1H), 2.23 (d, J = 12.9 Hz, 1H), 1.86 (d, J = 12.3 Hz, 1H), 1.83–1.72 (m, 2H), 1.70–1.53 (m, 5H), 1.29 (s, 9H), 1.18 (d, J = 13.2 Hz, 1H), 0.97 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.3, 149.5, 138.6, 128.3, 125.6, 51.2, 50.4, 50.3, 47.3, 45.4, 40.4, 37.1, 36.9, 34.5, 31.7, 31.4, 31.1, 30.6, 30.0; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{30}H_{32}F_7NO$: 556.2445, found 556.2467.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-([1,1'-biphenyl]-4-yl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4--(trifluoromethyl)phenyl)adamantane-1-carboxamide (7h)



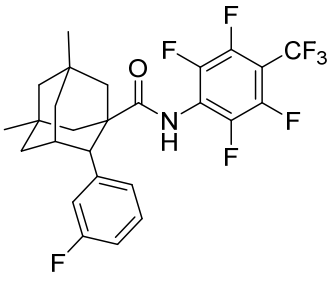
Isolated yield was 50%. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.52. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.58 (d, J = 7.8 Hz, 2H), 7.53 (d, J = 8.1 Hz, 2H), 7.47–7.38 (m, 4H), 7.37–7.31 (m, 1H), 7.08 (br s, 1H), 3.33 (s, 1H), 2.44 (d, J = 2.3 Hz, 1H), 2.30 (d, J = 12.6 Hz, 1H), 1.87 (d, J = 12.4 Hz, 1H), 1.81 (d, J = 13.4 Hz, 2H), 1.71–1.61 (m, 2H), 1.53 (d, J = 13.1 Hz, 1H), 1.31 (s, 2H), 1.20 (d, J = 13.7 Hz, 1H), 0.98 (s, 3H), 0.96 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.2, 140.8, 140.7, 139.4, 128.9, 128.9, 127.4, 127.2, 127.1, 51.0, 50.5, 50.1, 47.0, 45.2, 40.3, 37.3, 36.8, 31.6, 31.1, 30.5, 29.9; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{32}H_{28}F_7NO$: 576.2132, found 576.2154.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(4-fluorophenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7i)



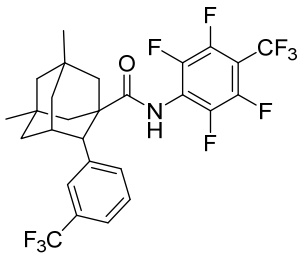
Isolated yield was 39%. $\boldsymbol{R}_{\mathbf{F}}$ (petroleum ether/EtOAc 8:1): 0.49. White solid (22 mg, 39%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.29 (dd, J = 8.4, 5.4 Hz, 2H), 7.03 (br s, 1H), 6.97 (t, J = 8.6 Hz, 2H), 3.26 (s, 1H), 2.33 (d, J = 2.3 Hz, 1H), 2.20 (d, J = 12.4 Hz, 1H), 1.84 (d, J = 12.2 Hz, 1H), 1.75 (d, J = 12.3 Hz, 2H), 1.67–1.57 (m, 2H), 1.45 (d, J = 13.8 Hz, 1H), 1.29 (s, 2H), 1.17 (d, J = 13.3 Hz, 1H), 0.96 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.0, 161.4 (d, , $J_{C\text{-}F}$ = 245.6 Hz), 137.5 (d, $J_{C\text{-}F}$ = 3.2 Hz), 130.0 (d, $J_{C\text{-}F}$ = 7.7 Hz), 115.4 (d, $J_{C\text{-}F}$ = 21.0 Hz), 51.0, 50.4, 49.8, 47.0, 45.2, 40.2, 37.3, 36.6, 31.6, 31.0, 30.5, 29.7; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{26}H_{23}F_8NO$: 518.1725, found 518.1756.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(3-fluorophenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7j)



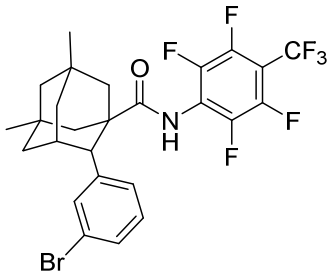
Isolated yield was 64%. $\boldsymbol{R}_{\mathbf{F}}$ (petroleum ether/EtOAc 8:1): 0.41. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.26–7.20 (m, 1H), 7.12 (s, 1H), 7.07 (d, J = 7.9 Hz, 1H), 7.03 (dd, J = 10.8, 2.0 Hz, 1H), 6.89 (td, J = 8.3, 2.2 Hz, 1H), 3.28 (s, 1H), 2.36 (dd, J = 5.5, 2.8 Hz, 1H), 2.21 (d, J = 12.7 Hz, 1H), 1.83 (d, J = 12.5 Hz, 1H), 1.74 (d, J = 12.3 Hz, 2H), 1.65–1.59 (m, 2H), 1.42 (s, 1H), 1.28 (d, J = 5.8 Hz, 2H), 1.18 (d, J = 13.2 Hz, 1H), 0.95 (s, 3H), 0.93 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 176.0, 162.9 (d, $J_{C\text{-}F}$ = 245.4 Hz), 144.5 (d, $J_{C\text{-}F}$ = 6.7 Hz), 129.9 (d, $J_{C\text{-}F}$ = 8.4 Hz), 124.1 (d, $J_{C\text{-}F}$ = 2.2 Hz), 115.5 (d, $J_{C\text{-}F}$ = 21.9 Hz), 113.5 (d, $J_{C\text{-}F}$ = 20.9 Hz), 51.0, 50.4, 50.1, 47.0, 45.2, 40.3, 37.2, 36.7, 31.6, 31.0, 30.5, 29.8; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{26}H_{23}F_8NO$: 518.1725, found 518.1742.

(1*S*,2*S*,3*S*,5*R*,7*S*)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)-2-(3-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7k)



Isolated yield was 45%. $\boldsymbol{R}_{\mathbf{F}}$ (petroleum ether/EtOAc 8:1): 0.55. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.56 (s, 1H), 7.51 (d, J = 7.8 Hz, 1H), 7.47 (d, J = 7.7 Hz, 1H), 7.44–7.37 (m, 1H), 7.08 (s, 1H), 3.37 (s, 1H), 2.39 (dd, J = 5.4, 2.7 Hz, 1H), 2.24 (d, J = 12.6 Hz, 1H), 1.86 (d, J = 12.6 Hz, 1H), 1.82–1.73 (m, 2H), 1.71–1.57 (m, 2H), 1.44–1.34 (m, 1H), 1.31 (d, J = 5.4 Hz, 2H), 1.20 (d, J = 13.2 Hz, 1H), 0.97 (s, 3H), 0.96 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.7, 142.9, 131.6, 130.8 (q, $J_{C\text{-}F}$ = 32.0 Hz), 128.9, 125.2 (q, $J_{C\text{-}F}$ = 3.7 Hz), 124.2 (q, $J_{C\text{-}F}$ = 272.3 Hz), 123.4 (q, $J_{C\text{-}F}$ = 3.7 Hz), 51.0, 50.4, 50.2, 46.8, 45.1, 40.4, 37.2, 36.6, 31.6, 31.1, 30.5, 29.8; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{27}H_{23}F_{10}NO$: 568.1693, found 568.1717.

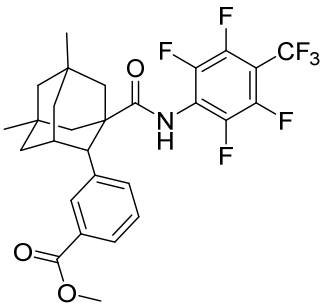
(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(3-bromophenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7l)



Isolated yield was 65%. $\boldsymbol{R}_{\mathbf{F}}$ (petroleum ether/EtOAc 8:1): 0.54. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.46 (s, 1H), 7.34 (d, J = 7.9 Hz, 1H), 7.25 (d, J = 6.1 Hz, 1H), 7.15 (t, J = 7.9 Hz, 1H), 7.04 (s, 1H), 3.26 (s, 1H), 2.37 (d, J = 2.5 Hz, 1H), 2.21 (d, J = 12.6 Hz, 1H), 1.83 (d, J = 12.4 Hz, 1H), 1.76 (d, J = 12.6 Hz, 2H), 1.66–1.58 (m, 2H), 1.42 (d, J = 11.6 Hz, 1H), 1.29 (d, J = 1.7 Hz, 2H), 1.18 (d, J = 13.2 Hz, 1H), 0.96 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.7, 144.3, 131.7, 130.0, 129.7, 126.9, 122.8, 51.0, 50.5, 50.1, 46.9,

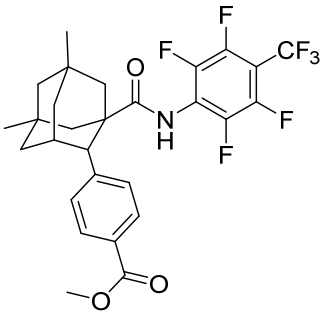
45.2, 40.4, 37.2, 36.7, 31.6, 31.1, 30.5, 29.8; **HRMS** (ESI) $[M+Na]^+$ calculated for $C_{26}H_{23}BrF_7NO$: 600.0743, found 600.0771.

methyl 3-((1*S*,2*S*,3*S*,5*R*,7*S*)-5,7-dimethyl-1-((2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)carbamoyl)adamantan-2-yl)benzoate (7m)



Isolated yield was 54%. R_F (petroleum ether/EtOAc 8:1): 0.41. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.03 (s, 1H), 7.87 (d, J = 7.7 Hz, 1H), 7.52 (d, J = 7.8 Hz, 1H), 7.36 (t, J = 7.8 Hz, 1H), 7.08 (br s, 1H), 3.90 (s, 3H), 3.36 (s, 1H), 2.40 (d, J = 2.2 Hz, 1H), 2.29 (d, J = 12.6 Hz, 1H), 1.87 (d, J = 12.3 Hz, 1H), 1.79 (d, J = 12.3 Hz, 2H), 1.69–1.59 (m, 2H), 1.41 (d, J = 12.4 Hz, 1H), 1.30 (s, 2H), 1.18 (d, J = 13.4 Hz, 1H), 0.97 (s, 3H), 0.95 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 174.8 167.2, 142.3, 132.9, 130.4, 129.7, 128.6, 127.7, 52.3, 51.0, 50.4, 50.2, 46.8, 45.1, 40.4, 37.2, 36.6, 31.6, 31.1, 30.5, 29.8; **HRMS** (ESI) $[M+Na]^+$ calculated for $C_{28}H_{26}F_7NO_3$: 580.1693, found 580.1708.

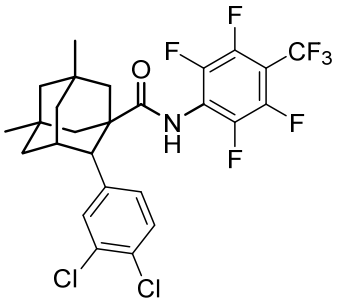
methyl 4-((1*S*,2*S*,3*S*,5*R*,7*S*)-5,7-dimethyl-1-((2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)carbamoyl)adamantan-2-yl)benzoate (7n)



Isolated yield was 40%. R_F (petroleum ether/EtOAc 8:1):0.28. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.91 (d, J = 8.2 Hz, 2H), 7.37 (d, J = 8.2 Hz, 2H), 7.29 (s, 1H), 3.89 (s, 3H), 3.37 (s, 1H), 2.39 (s, 1H), 2.24 (d, J = 12.7 Hz, 1H), 1.84 (d, J = 12.3 Hz, 1H), 1.76 (d, J = 12.6 Hz, 2H), 1.69–1.58 (m, 2H), 1.37–1.26 (m, 3H), 1.15 (d, J = 13.1 Hz, 1H), 0.94 (s, 3H), 0.93 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.0, 167.1, 147.5, 129.7, 128.4, 128.2, 52.2, 50.9, 50.4, 50.2, 46.7, 45.1, 40.3, 37.3, 36.6, 31.6,

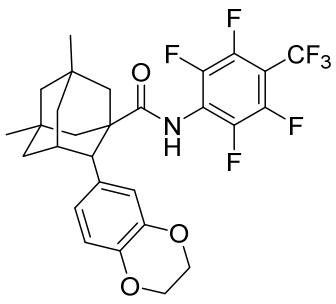
31.0, 30.4, 29.8; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{28}H_{26}F_7NO_3$: 558.1874, found 558.1905.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(3,4-dichlorophenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4--(trifluoromethyl)phenyl)adamantane-1-carboxamide (7o)



Isolated yield was 36%. R_F (petroleum ether/EtOAc 16:1): 0.20. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.41 (d, J = 1.6 Hz, 1H), 7.34 (d, J = 8.4 Hz, 1H), 7.20–7.11 (m, 1H), 7.01 (s, 1H), 3.26 (s, 1H), 2.35 (d, J = 2.5 Hz, 1H), 2.19 (d, J = 12.6 Hz, 1H), 1.83 (d, J = 12.5 Hz, 1H), 1.79–1.69 (m, 2H), 1.68–1.58 (m, 2H), 1.39 (d, J = 13.3 Hz, 1H), 1.34–1.28 (m, 2H), 1.20 (d, J = 13.2 Hz, 1H), 0.97 (s, 3H), 0.95 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.5, 142.3, 132.6, 130.6, 130.5, 130.3, 127.8, 50.9, 50.3, 49.5, 46.8, 45.0, 40.3, 37.0, 36.6, 31.6, 31.1, 30.5, 29.8; **HRMS** (ESI) $[M+Na]^+$ calculated for $C_{26}H_{22}Cl_2F_7NO$: 590.0859, found 590.0867.

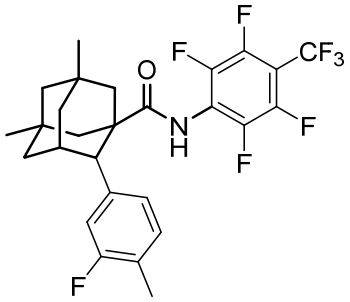
(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-5,7-dimethyl-*N*-(2,3,5,6-tetrafluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7p)



Isolated yield was 36%. R_F (petroleum ether/EtOAc 8:1):0.31. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 6.96 (s, 1H), 6.86 (s, 1H), 6.78 (s, 2H), 4.23 (s, 4H), 3.15 (s, 1H), 2.30 (d, J = 2.4 Hz, 1H), 2.20 (d, J = 12.7 Hz, 1H), 1.83 (d, J = 12.2 Hz, 1H), 1.78–1.79 (m, 2H), 1.68–1.58 (m, 2H), 1.53 (s, 1H), 1.27 (s, 2H), 1.17 (d, J = 13.0 Hz, 1H), 0.96 (s,

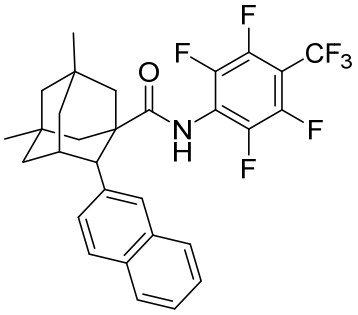
3H), 0.93 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 175.1, 143.5 142.2, 135.1 121.7 117.4, 117.3 64.5, 64.5 51.1, 50.4, 50.0, 47.2, 45.3, 40.2, 37.2, 36.7, 31.6, 31.0, 30.5, 29.9; **HRMS** (ESI) [M+H] + calculated for $C_{28}H_{26}F_7NO_3$: 558.1874, found 558.1853.

(1*S*,2*S*,3*S*,5*R*,7*S*)-2-(3-fluoro-4-methylphenyl)-5,7-dimethyl-*N*-(2,3,5,6-tetra-fluoro-4-(trifluoromethyl)phenyl)adamantane-1-carboxamide (7q)



The yield based on ^{1}H NMR was 53%. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.42. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.08 (t, J = 8.2 Hz, 1H), 7.00 (br s, 1H), 7.00–6.94 (m, 2H), 3.24 (s, 1H), 2.35 (d, J = 2.6 Hz, 1H), 2.29–2.17 (m, 4H), 1.83 (d, J = 12.2 Hz, 1H), 1.75 (d, J = 12.7 Hz, 2H), 1.67–1.58 (m, 2H), 1.45 (d, J = 13.2 Hz, 1H), 1.29 (s, 2H), 1.17 (d, J = 13.1 Hz, 1H), 0.96 (s, 3H), 0.94 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 174.9, 161.3 (d, J = 244.2 Hz), 141.5 (d, J = 6.7 Hz), 131.4 (d, J = 5.6 Hz), 123.8 (d, J = 3.1 Hz), 123.0 (d, J = 17.2 Hz), 115.1 (d, J = 22.9 Hz), 51.0, 50.4, 49.9, 47.0, 45.1, 40.3, 37.2, 36.7, 31.6, 31.1, 30.5, 29.9, 14.2 (d, J = 3.1 Hz); **HRMS** (ESI) $[M+H]^+$ calculated for $C_{27}H_{25}F_8NO$: 532.1881, found 532.1894.

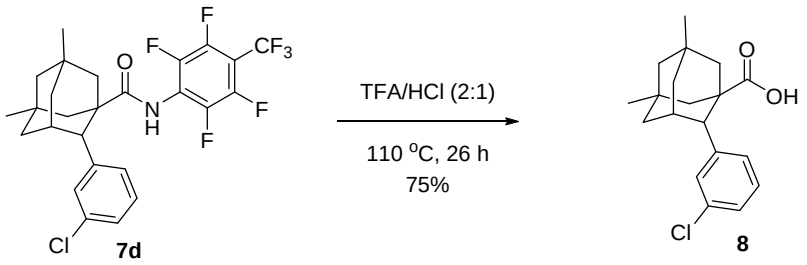
(1*S*,2*S*,3*S*,5*R*,7*S*)-5,7-dimethyl-2-(naphthalen-2-yl)-*N*-(2,3,5,6-tetrafluoro-4-(tri-fluoromethyl)phenyl)adamantane-1-carboxamide (7r)



Isolated yield was 27%. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1):0.51. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.81–7.73 (m, 4H), 7.50–7.40 (m, 3H), 7.10 (br s, 1H), 3.45 (s, 1H), 2.54 (d, J = 2.7 Hz, 1H), 2.40 (d, J = 12.8 Hz, 1H), 1.91–1.80 (m, 3H), 1.72 (dd, J = 12.4, 2.3 Hz, 1H), 1.66 (dd, J = 12.4, 2.7 Hz, 1H), 1.43 (s, 1H), 1.32 (s, 2H), 1.16 (d, J = 13.1 Hz, 1H), 0.97 (s, 3H), 0.96 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ

175.3, 139.0, 133.4, 132.1, 128.3, 128.0, 127.5, 127.1, 126.7, 126.3, 125.9, 51.1, 50.8, 50.2, 47.0, 45.3, 40.4, 37.2, 36.7, 31.7, 31.1, 30.5, 29.9; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{30}H_{26}F_7NO$: 550.1975, found 550.2001.

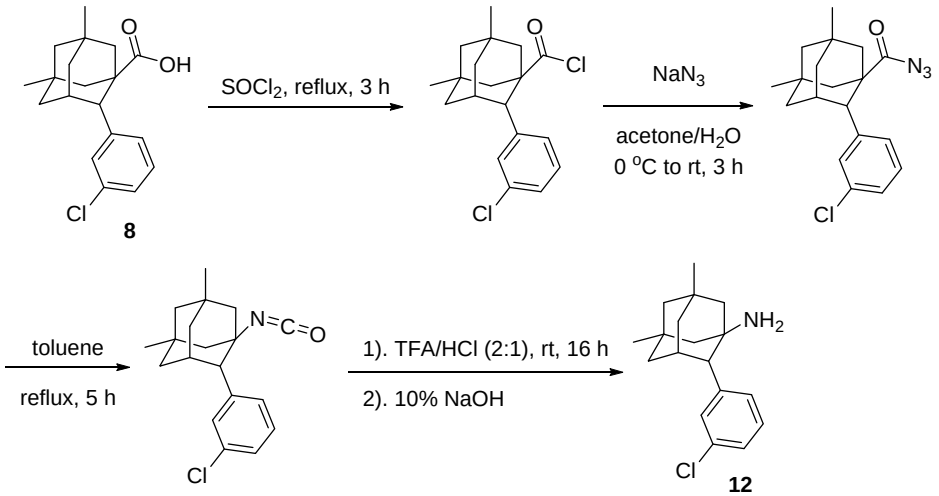
2.3 Cleavage of the Directing Group



The product **8** was synthesized according to a modified procedure reported by E. J. Yoo.[1]

To a 10 mL sealed tube, were added substrate **7d** (200 mg, 0.37 mmol) and the mixed solution of trifluoroacetic acid with concentrated HCl (v/v 2:1, 6 mL). The reaction mixture was heated at 110 °C for 26 h. After cooled down to room temperature, the reaction mixture was diluted with H_2O (10 mL) and extracted with diethyl ether (10 mL x 3). The combined organic extracts were washed with 1% Na_2CO_3 and water, dried over Na_2SO_4, filtered, concentrated under vacuum, purified by column chromatography to give the product **8** (88 mg, 75%). $\boldsymbol{R_F}$ (petroleum ether/EtOAc 8:1): 0.28. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.24 (s, 1H), 7.13 (s, 3H), 3.20 (s, 1H), 2.25 (d, J = 2.5 Hz, 1H), 2.13–2.01 (m, 1H), 1.73 (dd, J = 22.3, 12.4 Hz, 2H), 1.61 (d, J = 13.4 Hz, 1H), 1.56–1.46 (m, 2H), 1.32–1.26 (m, 1H), 1.20 (s, 2H), 1.06 (d, J = 13.0 Hz, 1H), 0.88 (s, 3H), 0.88 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 182.2 145.4 134.1, 129.4, 128.7, 126.2 126.2, 51.1 49.6, 49.3, 45.3, 45.2 39.8, 37.0, 36.7, 31.3, 30.7, 30.5, 29.9; **HRMS** (ESI) $[M+Na]^+$ calculated for $C_{19}H_{23}ClO_2$: 341.1279, found 341.1276.

2.4 Transformation of compound 8 to an Amantadine Analogue 12



overall yield: 76%

The amantadine **12** was synthesized according to a modified procedure reported by Sasaki, T.[2]

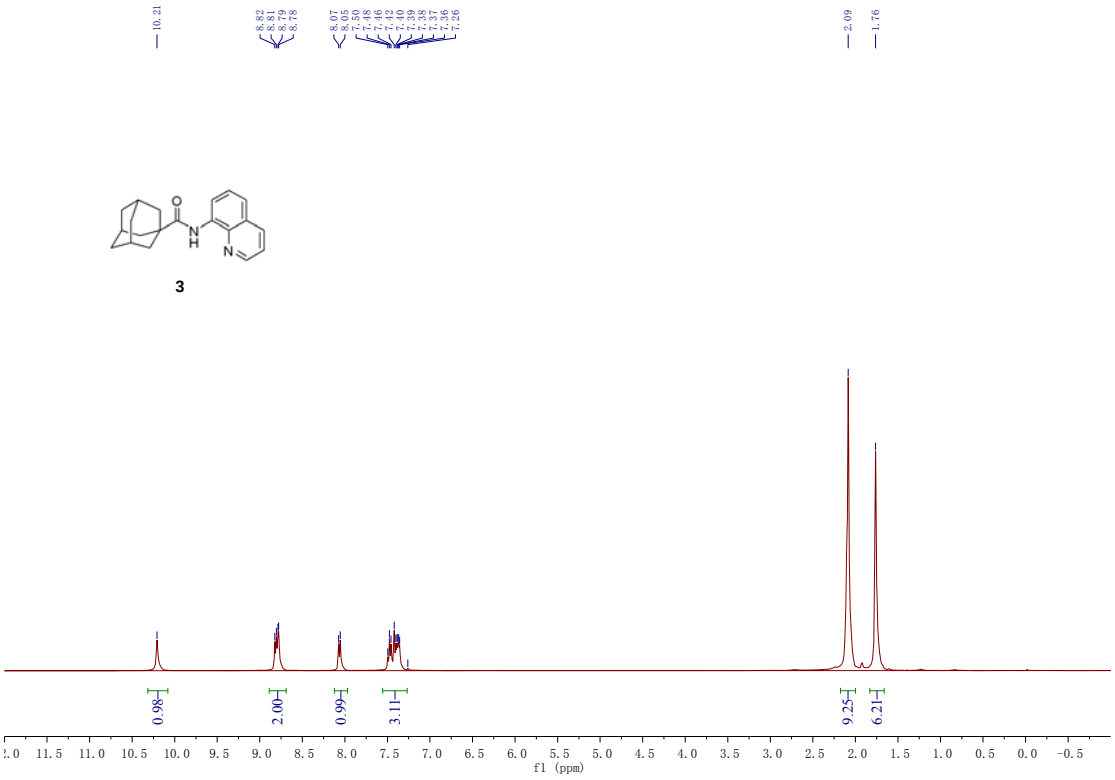
To a 10 mL round flask, were added compound **8** (96 mg, 0.3 mmol) and 3 mL thionyl chloride, then the solution was heated at reflux for 3 h. Removal of the excess of thonyl chloride under vacuum to give the crude acid chloride. The acid chloride was dissolved in acetone (2 mL) and added to a stirred and ice cooled solution of sodium azide (65 mg, 1.0 mmol) in water (2 mL). After being stirred for 3 h at room temperature, the reaction mixture was diluted with water (2 mL) and extracted with ether (3 x 10 mL). The combined extracts were washed successively with 5% aqueous sodium hydrogen carbonate and water. Removal of the solvent under vacuum to give the crude acid azide. To a refluxing toluene (6 mL), was added the azide in toluene (6 mL) and the refluxing mixture was stirred for another 5 h. Remove of the solvent under vacuum to give the crude isocyanate. The crude isocyanate was dissolved in TFA/HCl (2:1 mixture, 6 mL) and the solution was stirred at room temperature for 16 h. The reaction mixture was concentrated under vacuum, dissolved in methanol (5

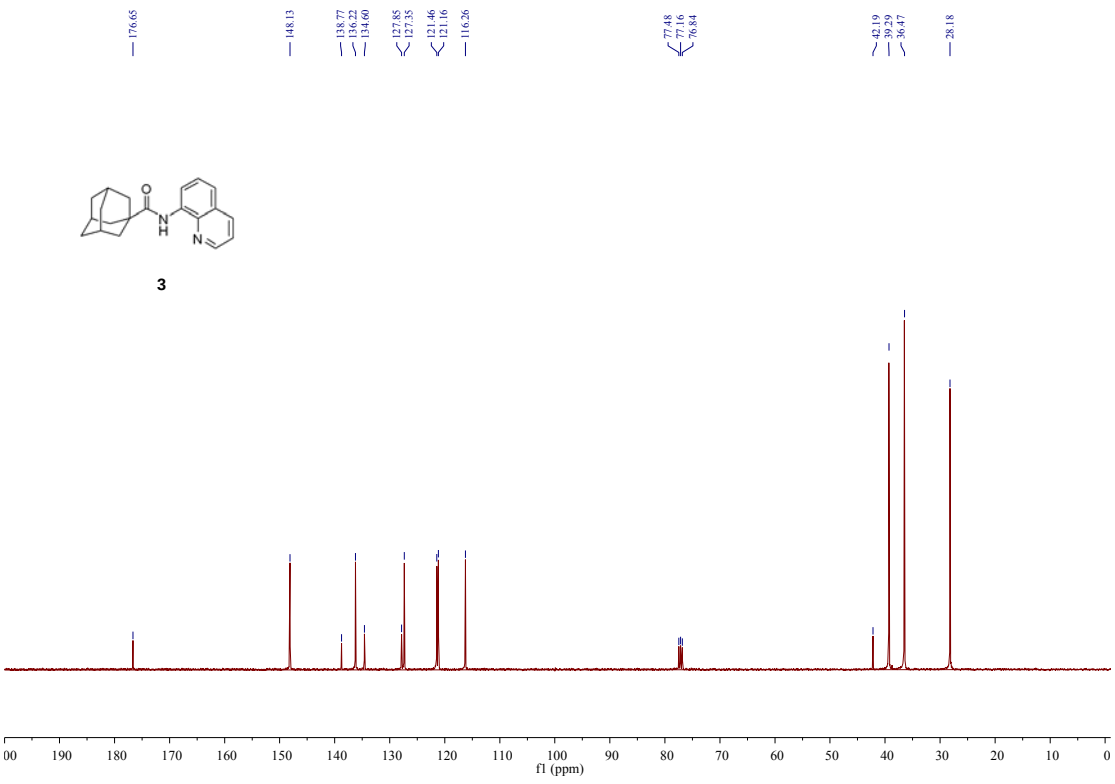
mL), and was added dropwise to a 10% sodium hydroxide solution. After being stirred at room temperature for 1.5 h, the solution was extracted with ether (3 x 10 mL). The combined extracts were washed successively with 5% aqueous sodium hydrogen carbonate and water. Removal of the solvent under vacuum to give the crude product. The product **12** (66 mg, 76%) was obtained by column chromatography purification on silica gel. $\boldsymbol{R_F}$ (petroleum ether/EtOAc 1:1):0.37. **^{1}H NMR** (400 MHz, DMSO) δ 7.50 (s, 1H), 7.46 (d, J = 7.8 Hz, 1H), 7.31 (t, J = 7.8 Hz, 1H), 7.24 (d, J = 8.7 Hz, 1H), 2.86 (br s, 2H), 2.69 (s, 1H), 2.09 (d, J = 2.3 Hz, 1H), 1.85–1.73 (m, 1H), 1.59–1.45 (m, 2H), 1.43–1.34 (m, 2H), 1.23 (s, 1H), 1.17–1.10 (m, 2H), 1.07 (d, J = 12.7 Hz, 2H), 0.87 (s, 3H), 0.84 (s, 3H); **^{13}C NMR** (100 MHz, DMSO) δ 146.0, 132.33, 130.0, 129.5, 128.1, 125.5, 55.6, 54.8, 51.1, 50.9, 47.0, 44.9, 36.8, 36.8, 32.8, 32.0, 30.1, 29.7; **HRMS** (ESI) $[M+H]^+$ calculated for $C_{18}H_{24}ClN$: 290.1670, found 290.1663.

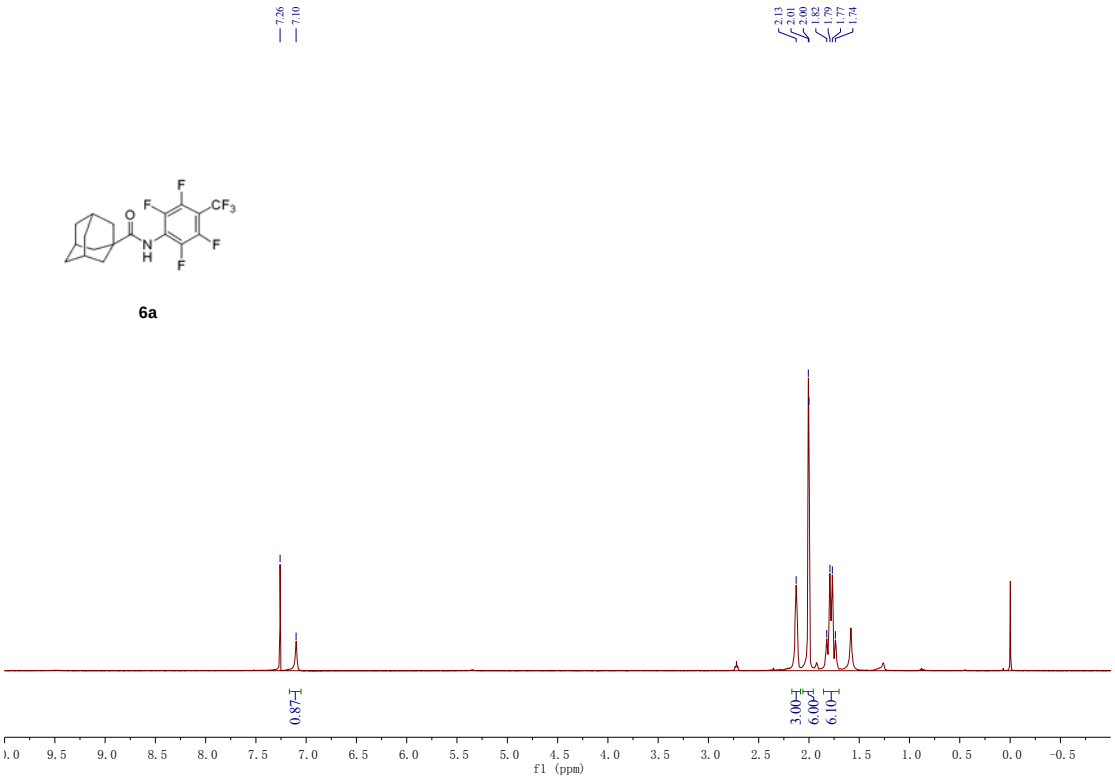
3. References

1. E. J. Yoo, S. Ma, T. S. Mei, K. S. Chan and J. Q. Yu, *J. Am. Chem. Soc.* , 2011, **133**, 7652-7655.
2. T. Sasaki, S. Eguchi and T. Okano, *Synthesis*, 1980, **1980**, 472-475.

4. ^{1}H and ^{13}C NMR Spectra



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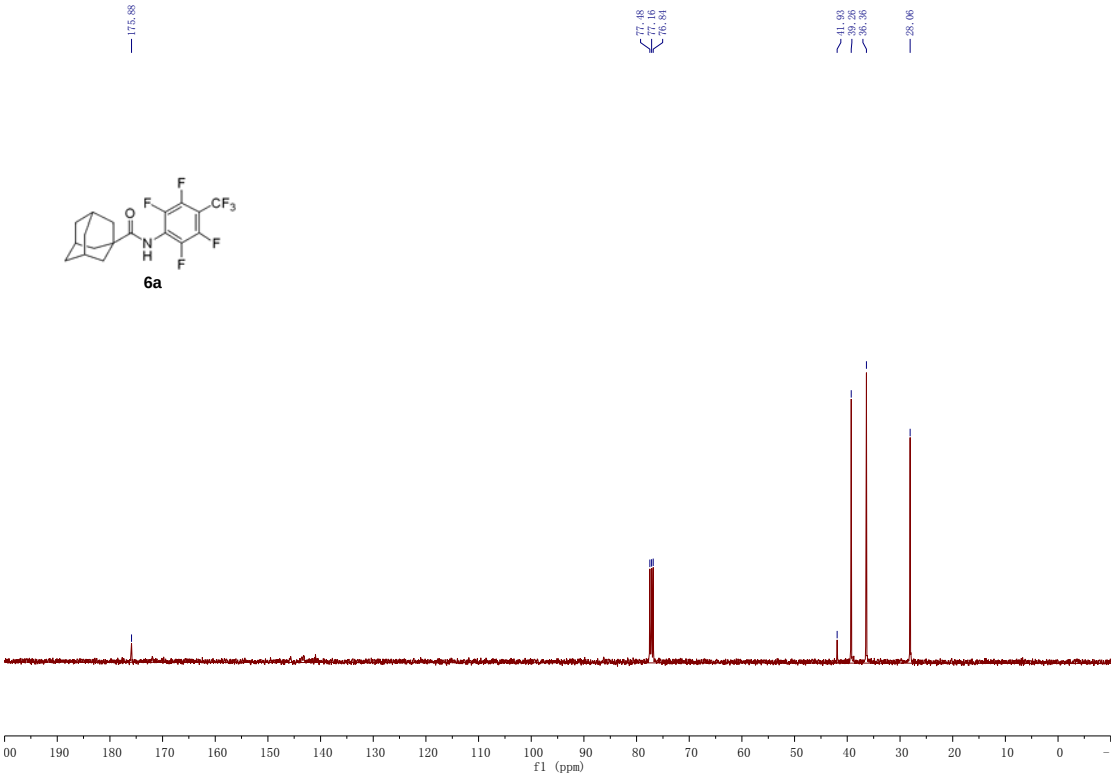
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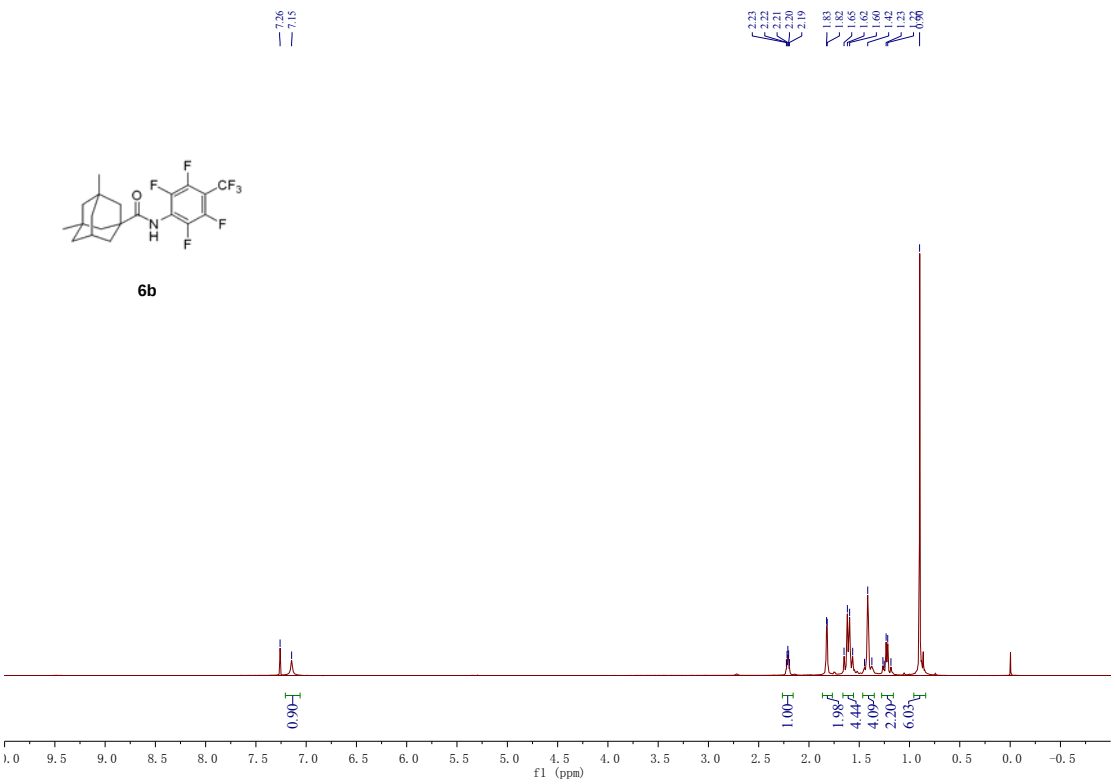
6a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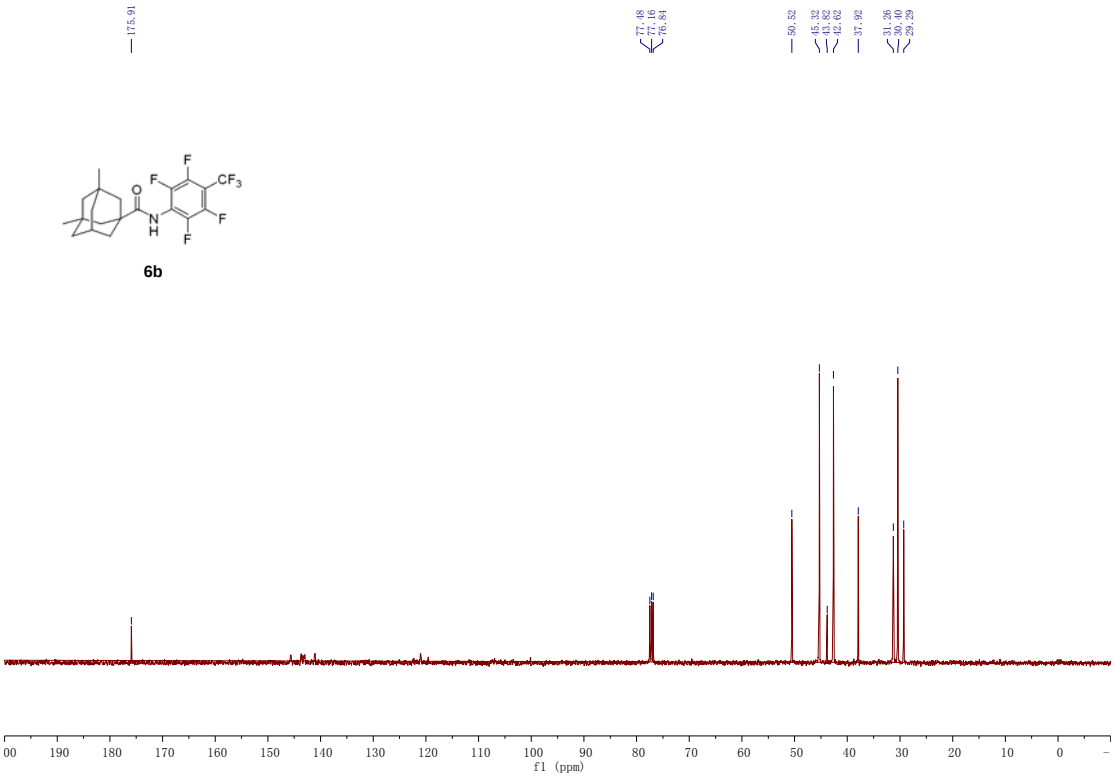
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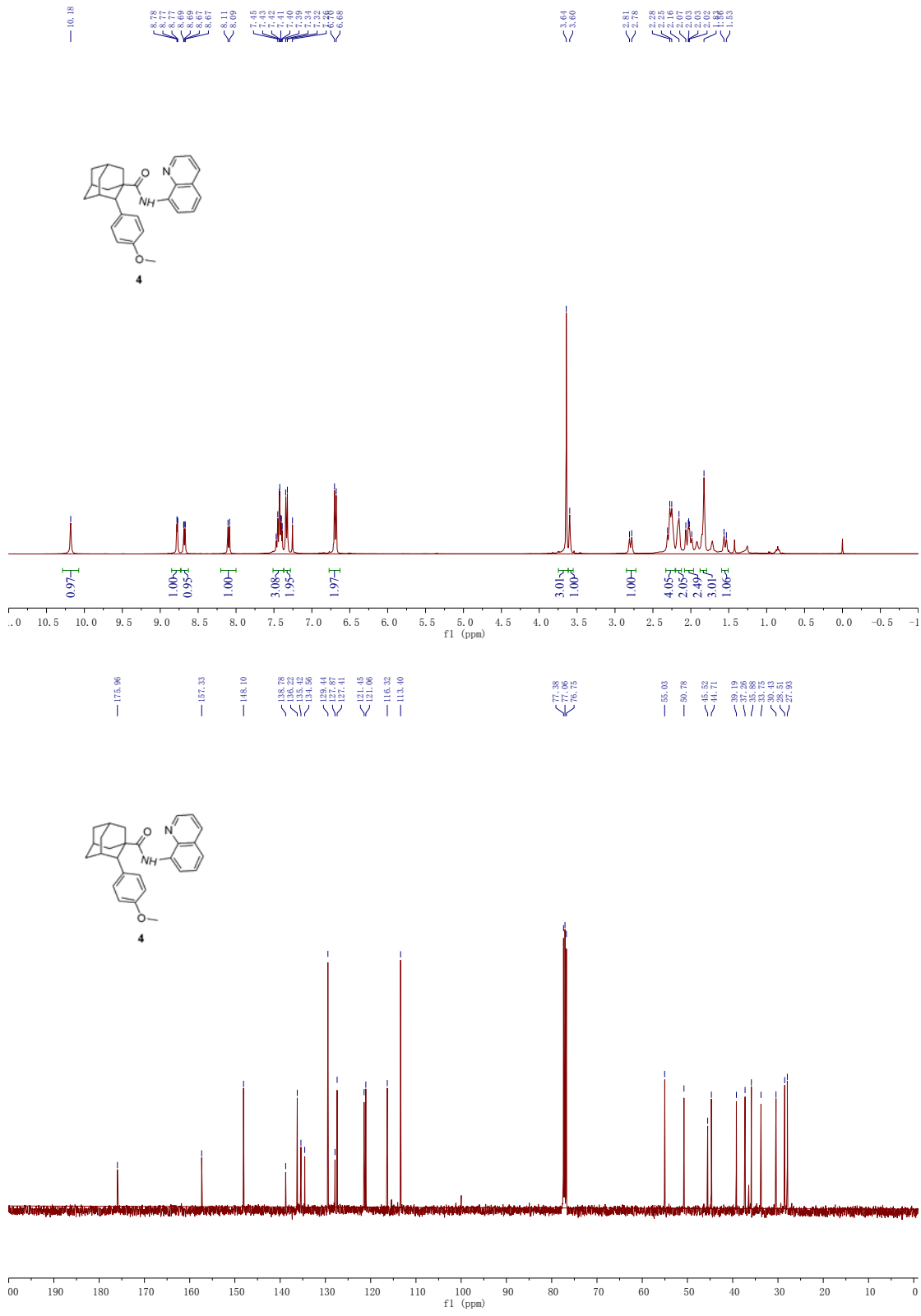
F
f1 (ppm)

6b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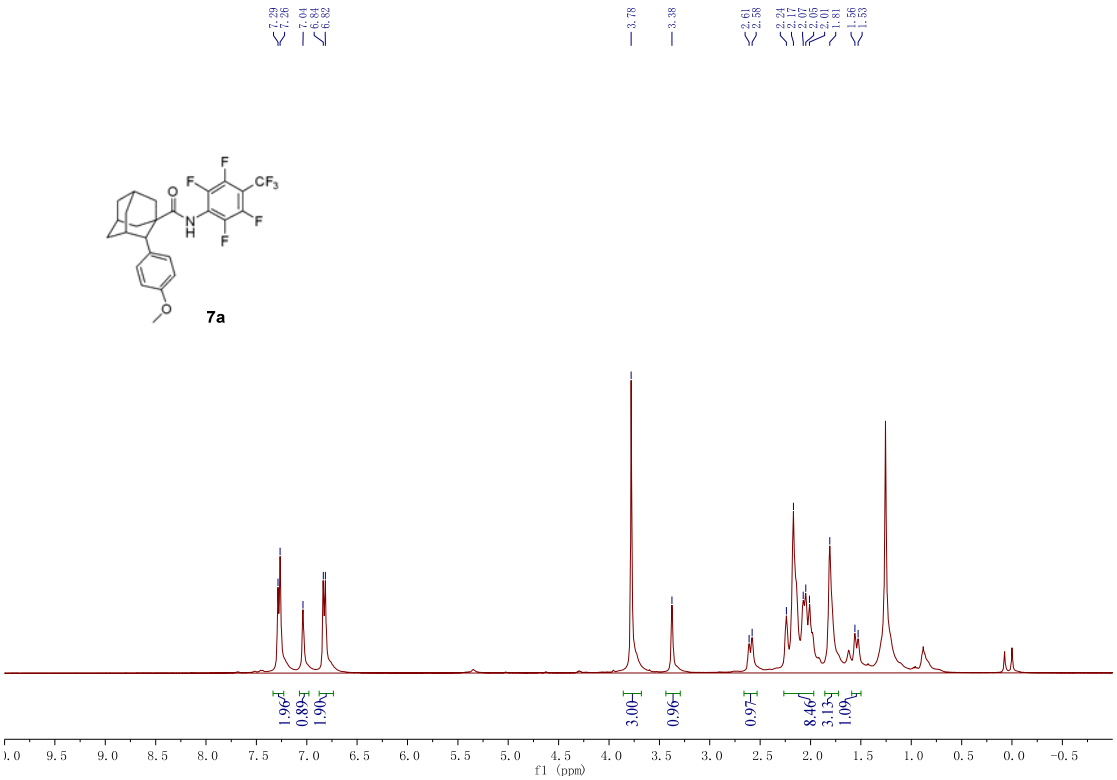
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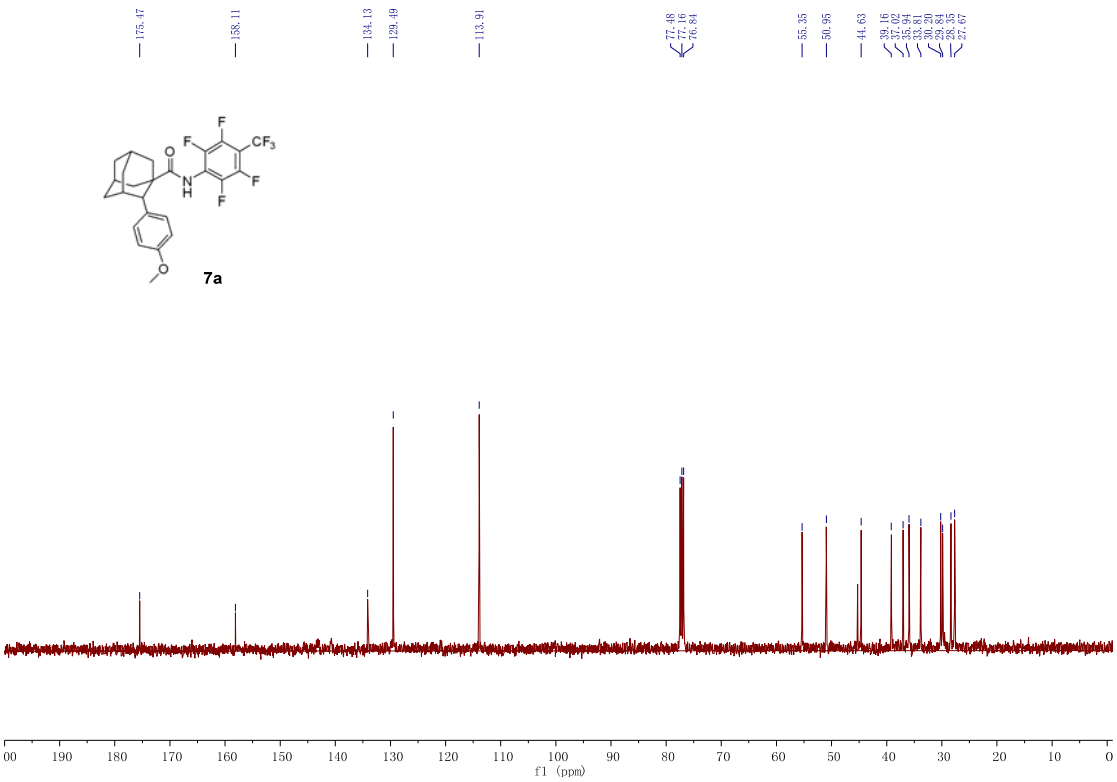
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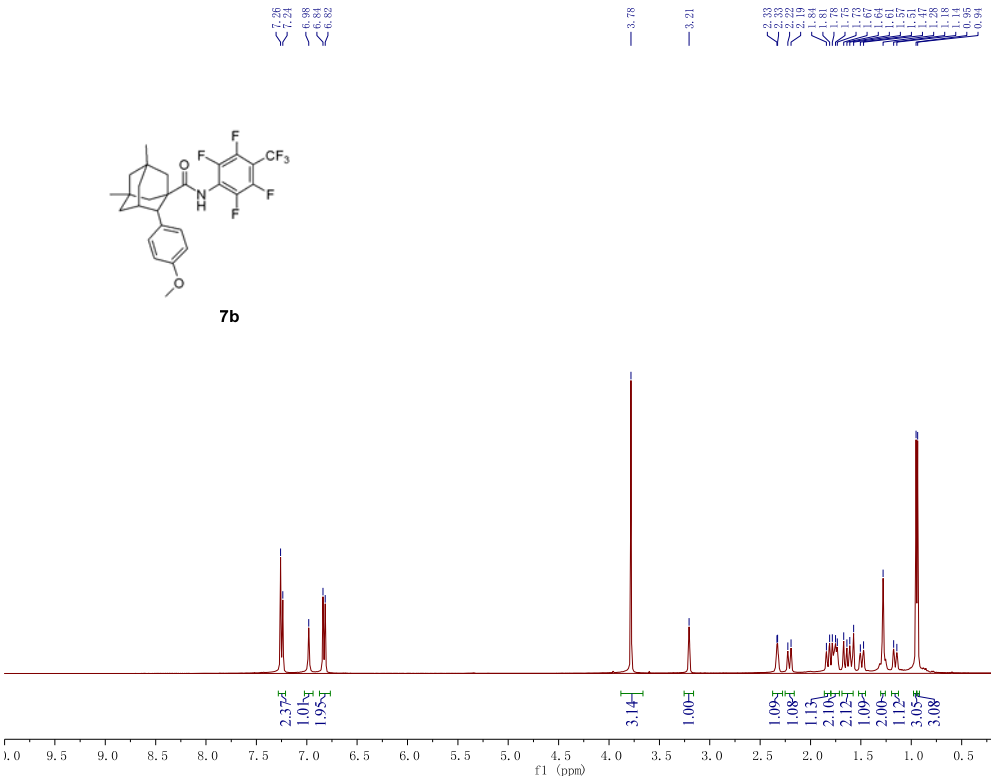
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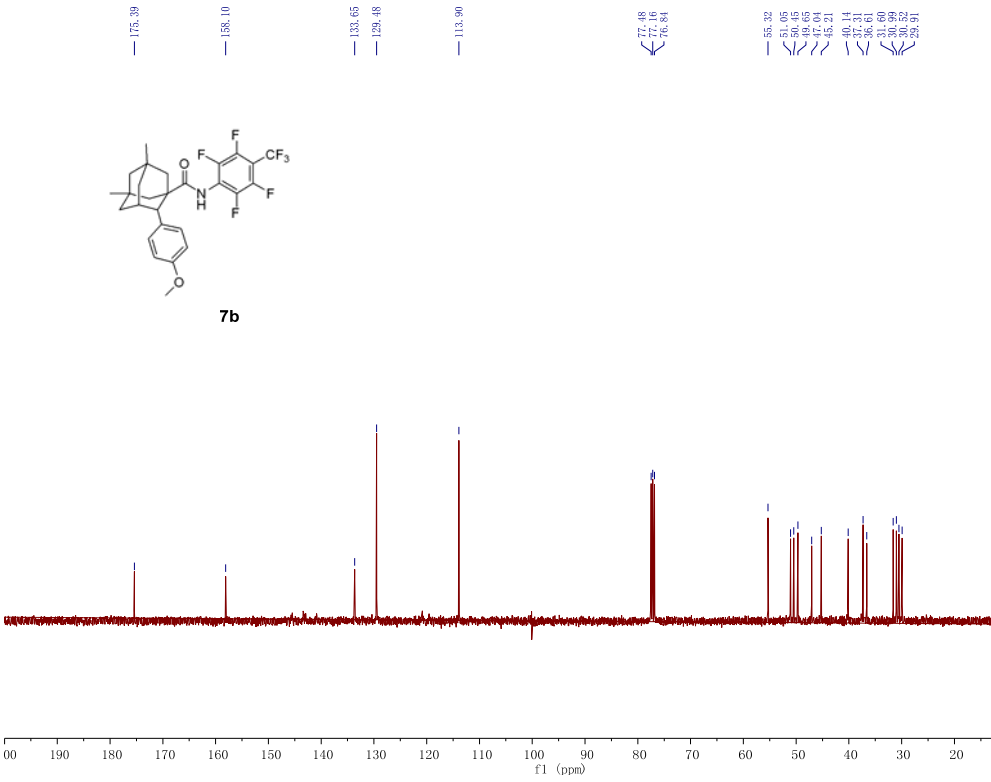
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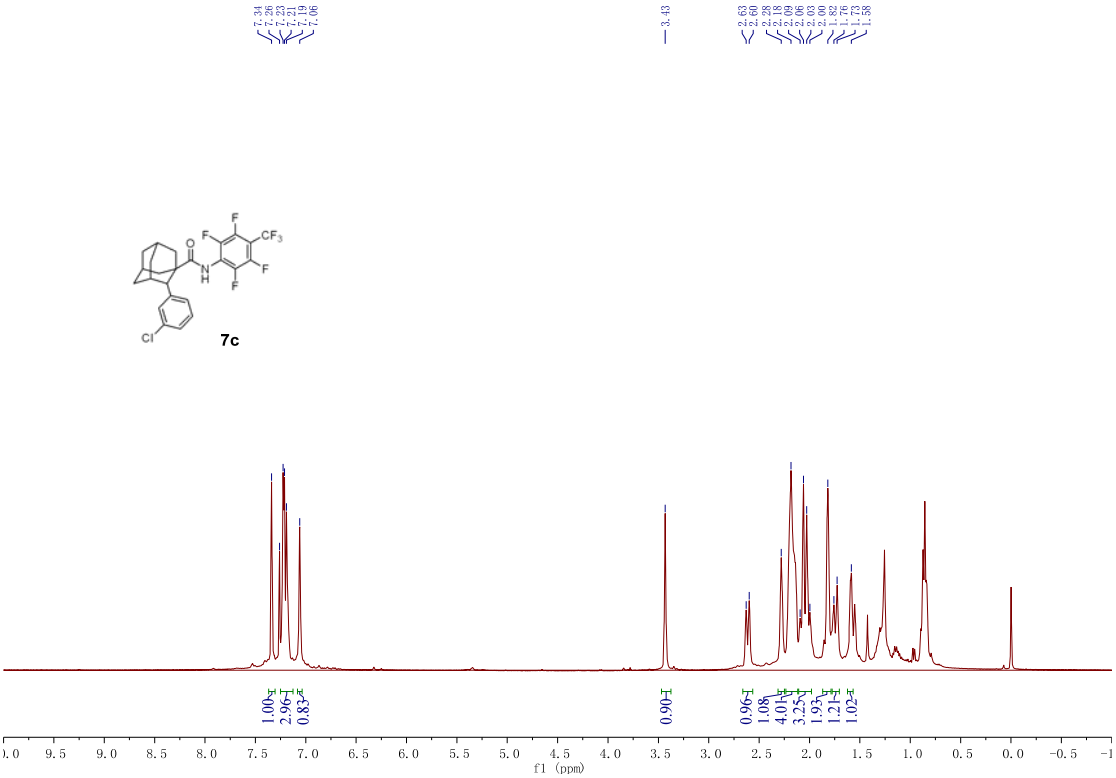
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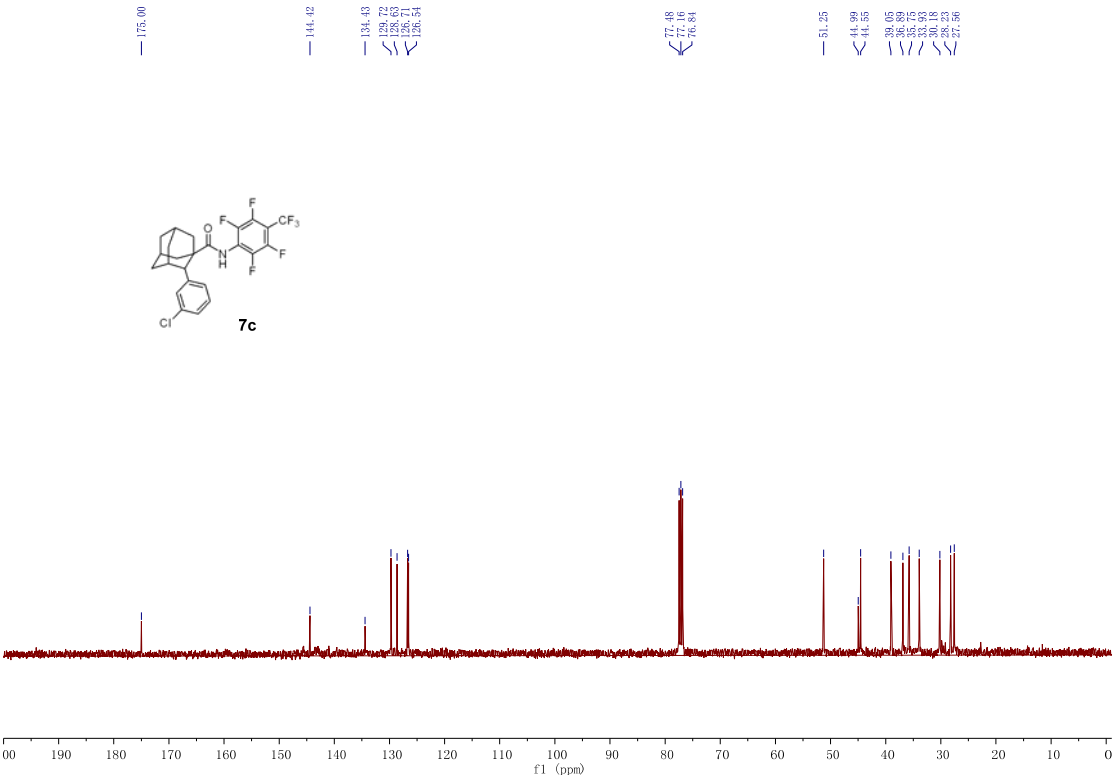
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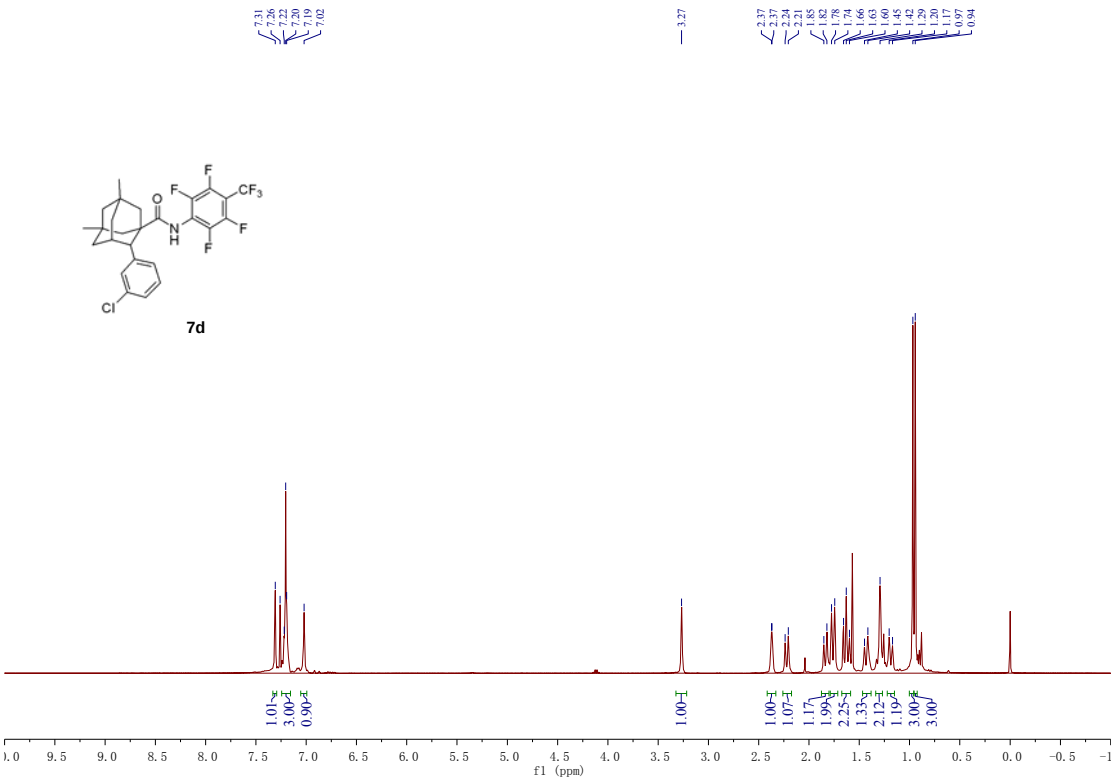
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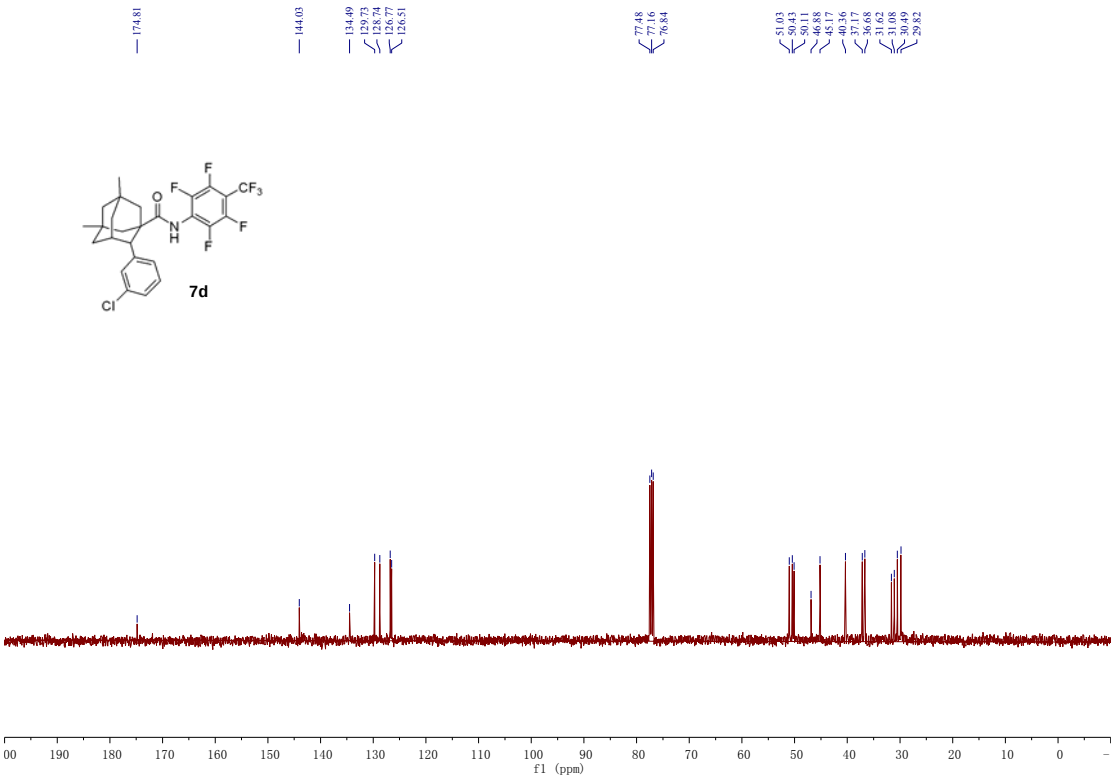
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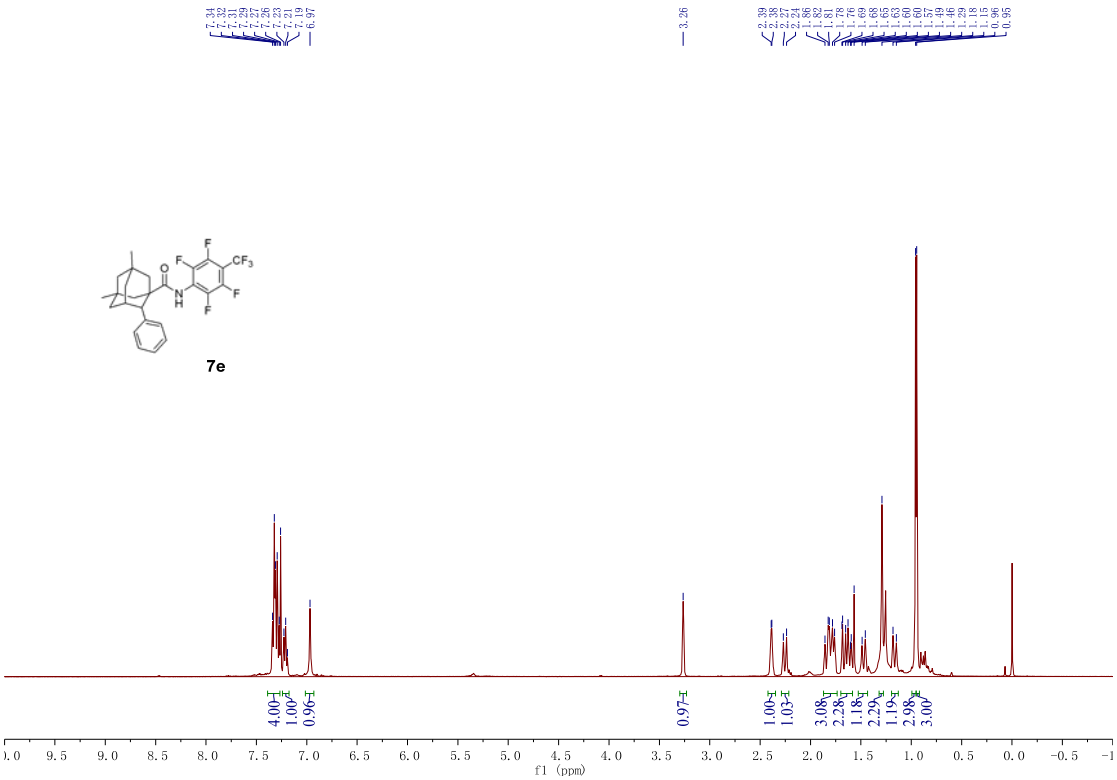
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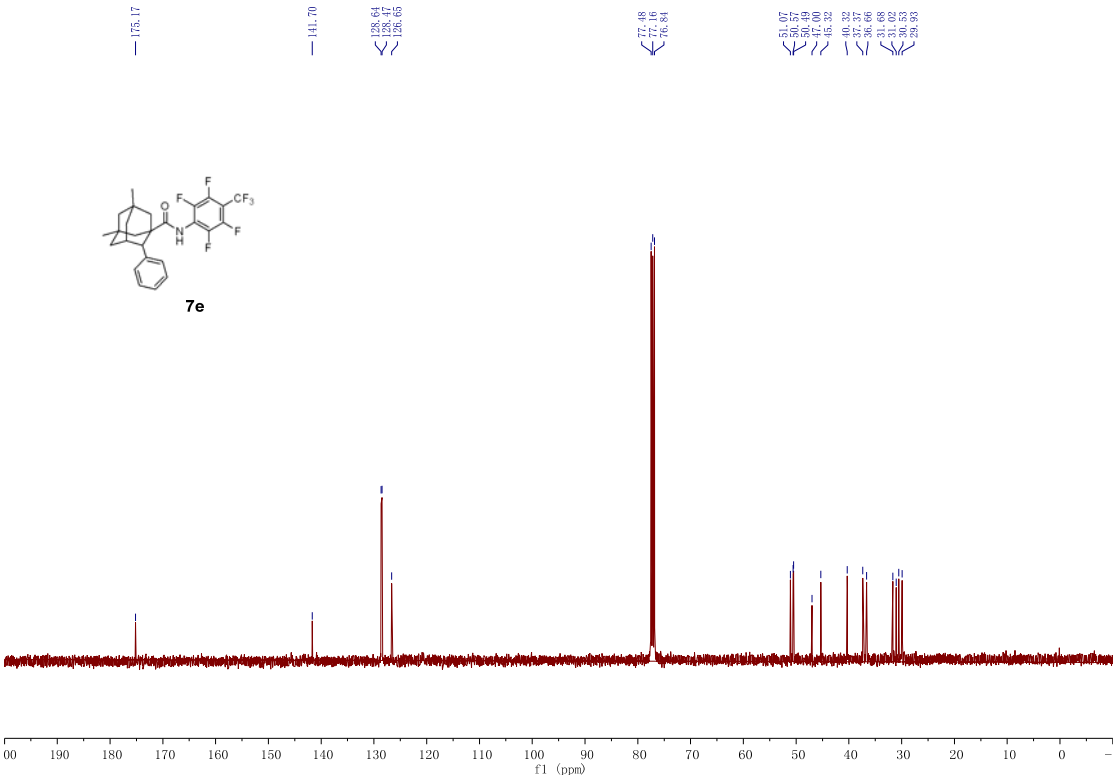
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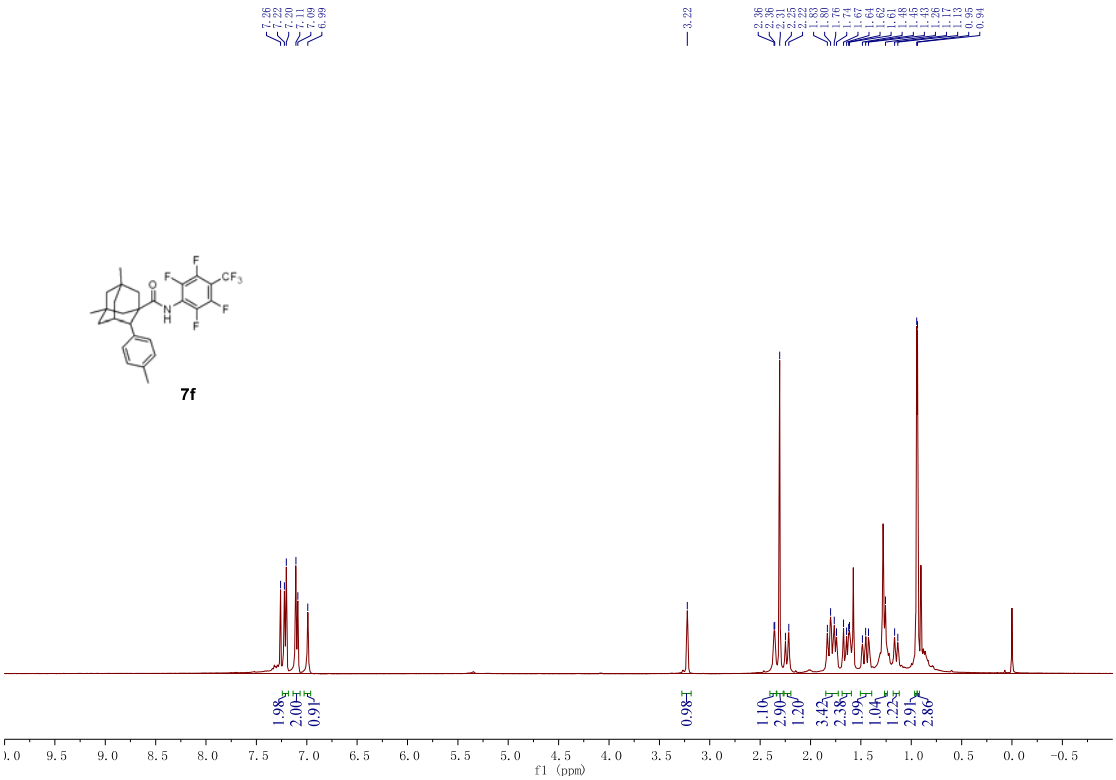
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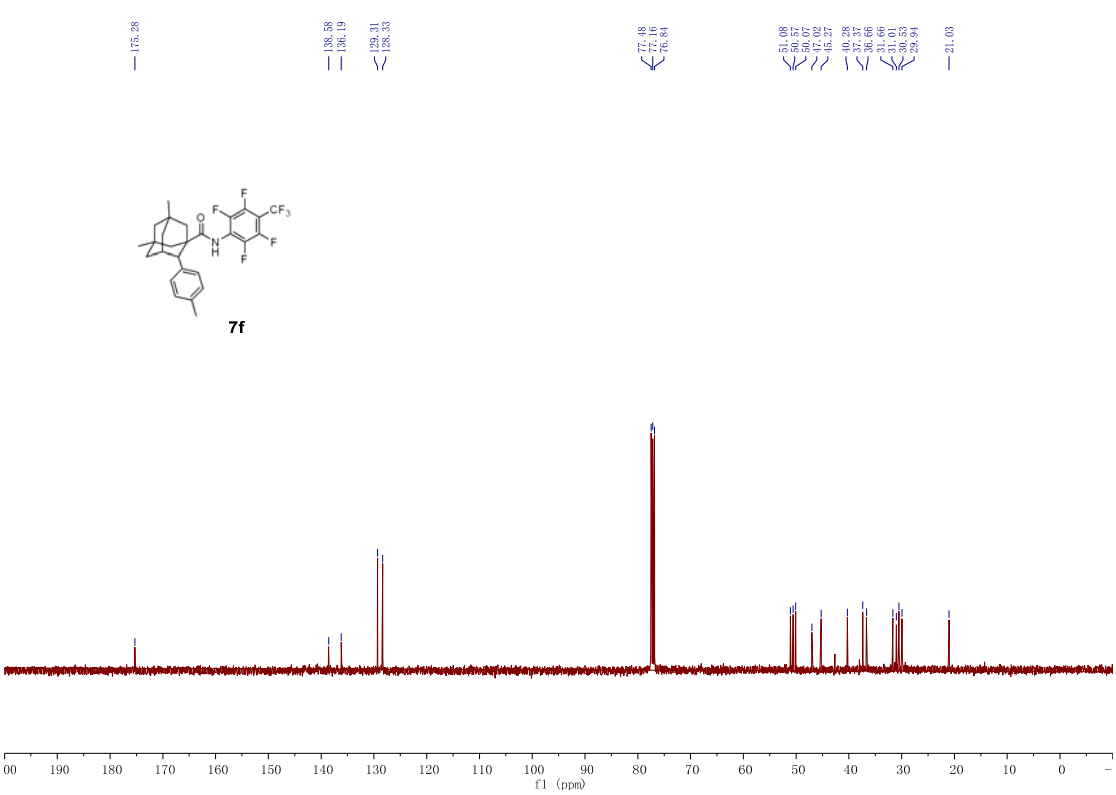
7f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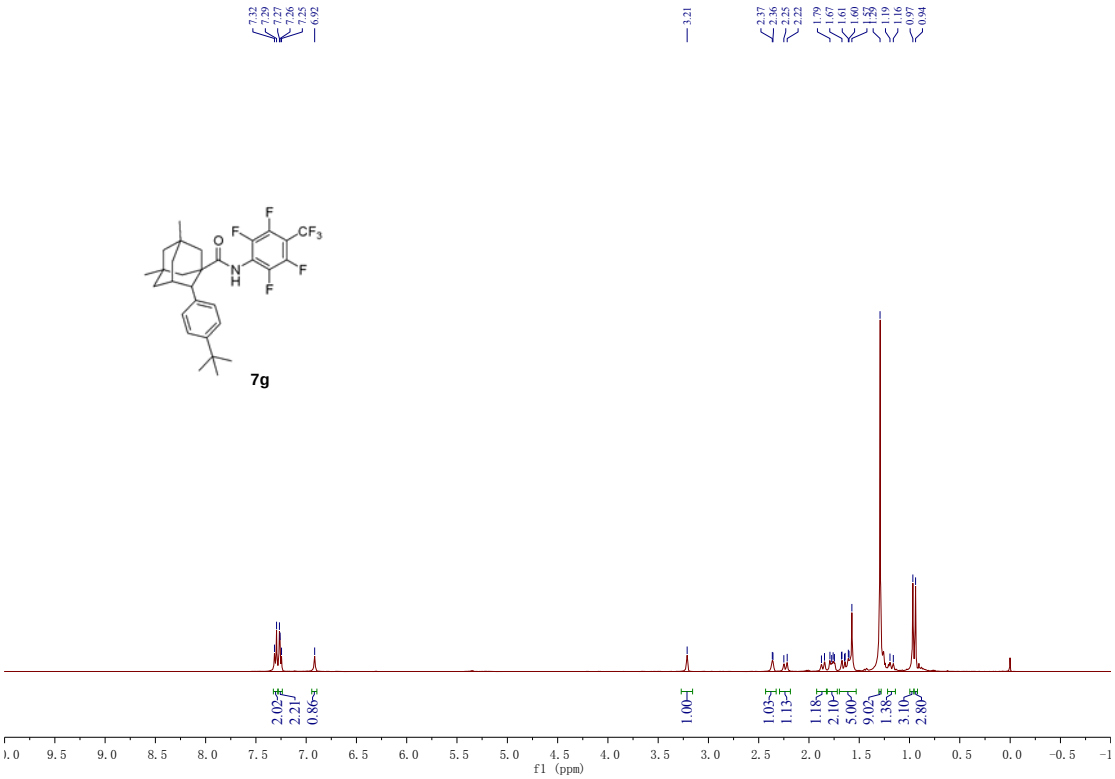
7f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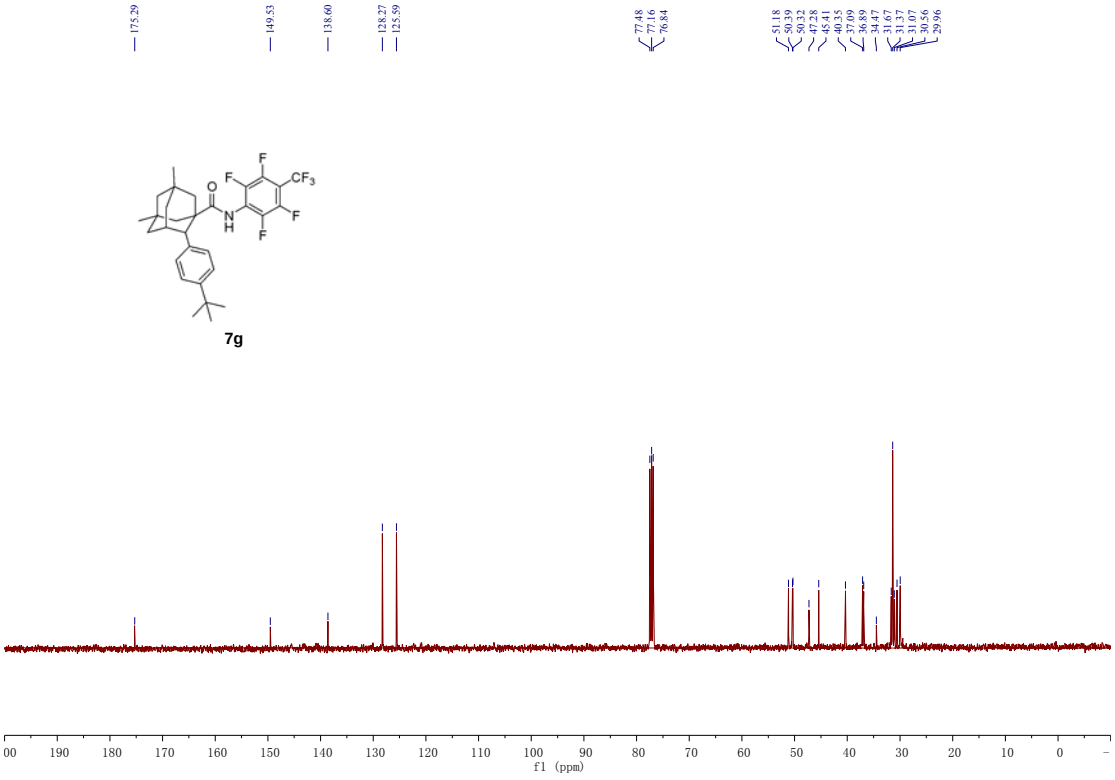
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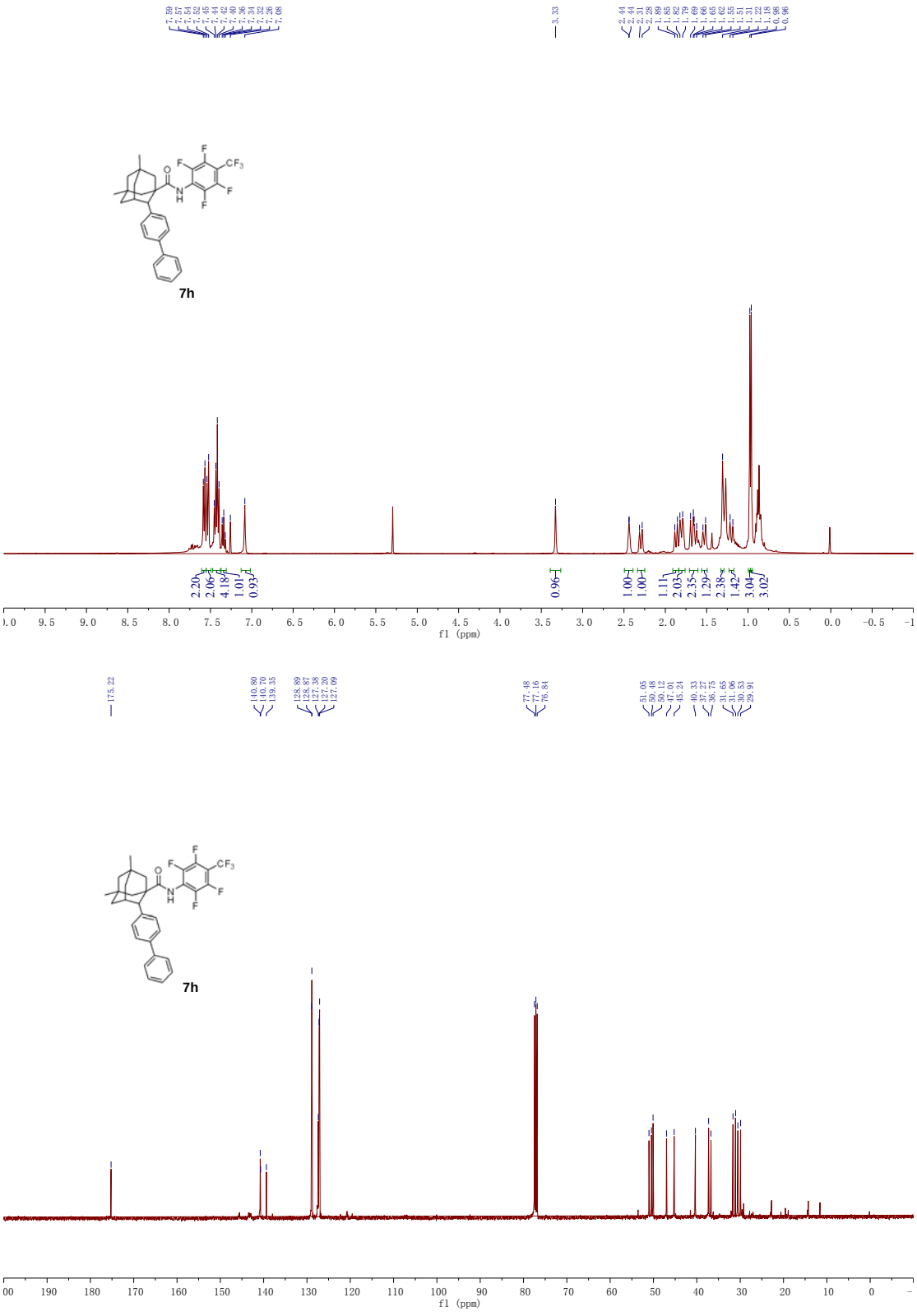
7h
f1 (ppm)
7h
f1 (ppm)


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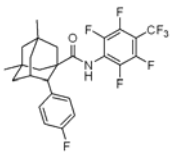

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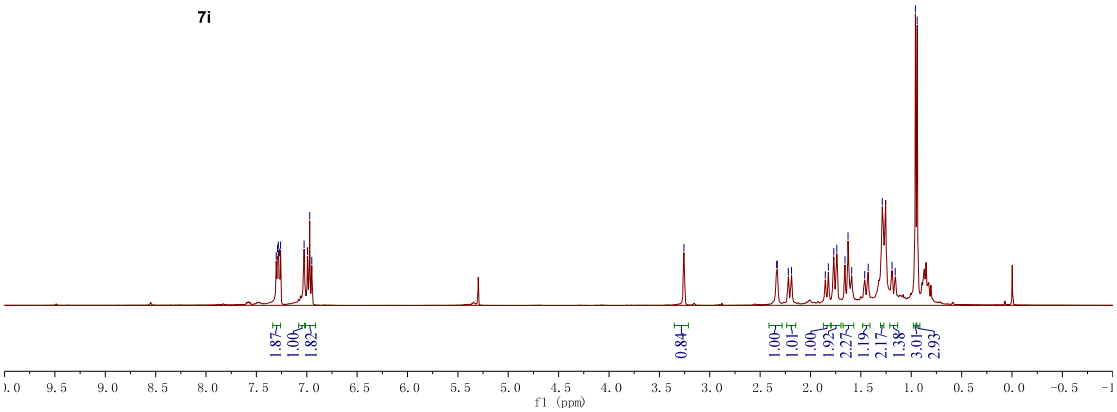
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f1 (ppm)


174.97
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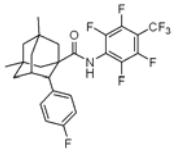

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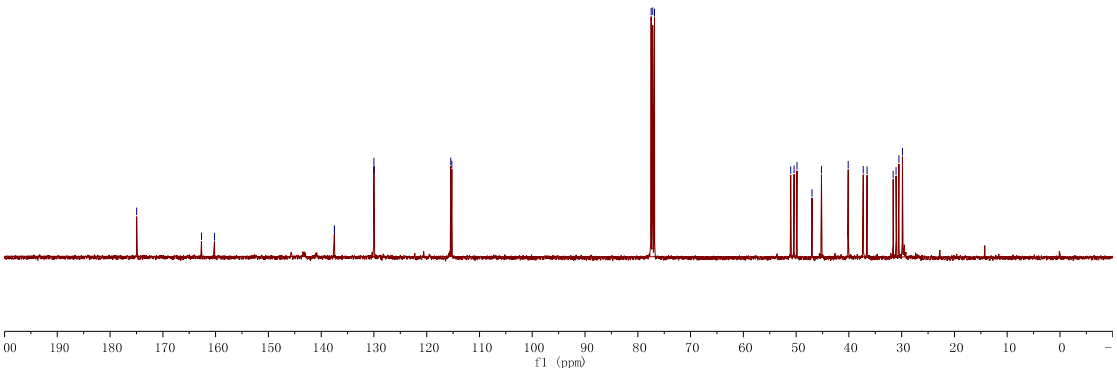
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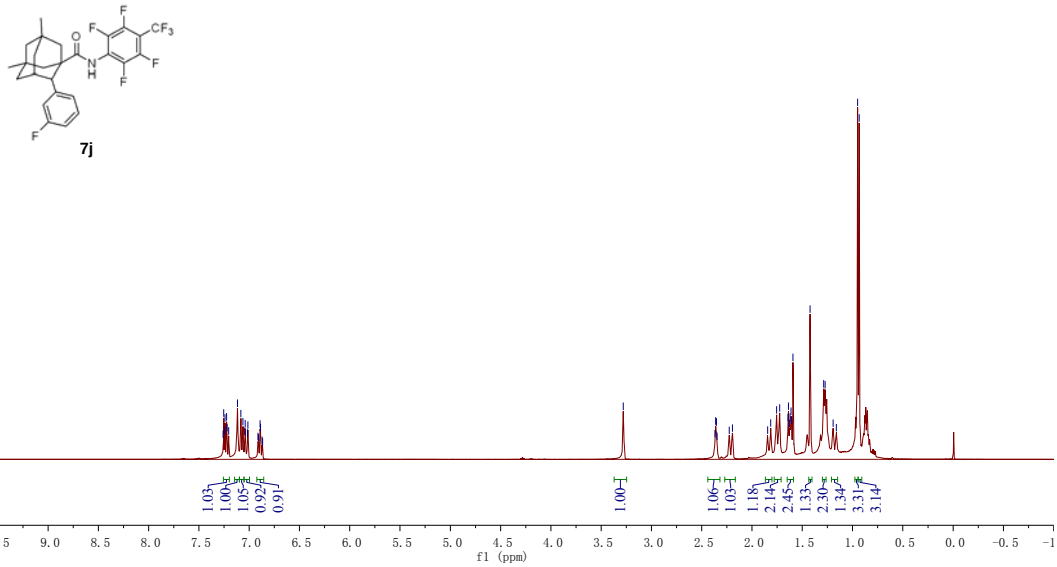
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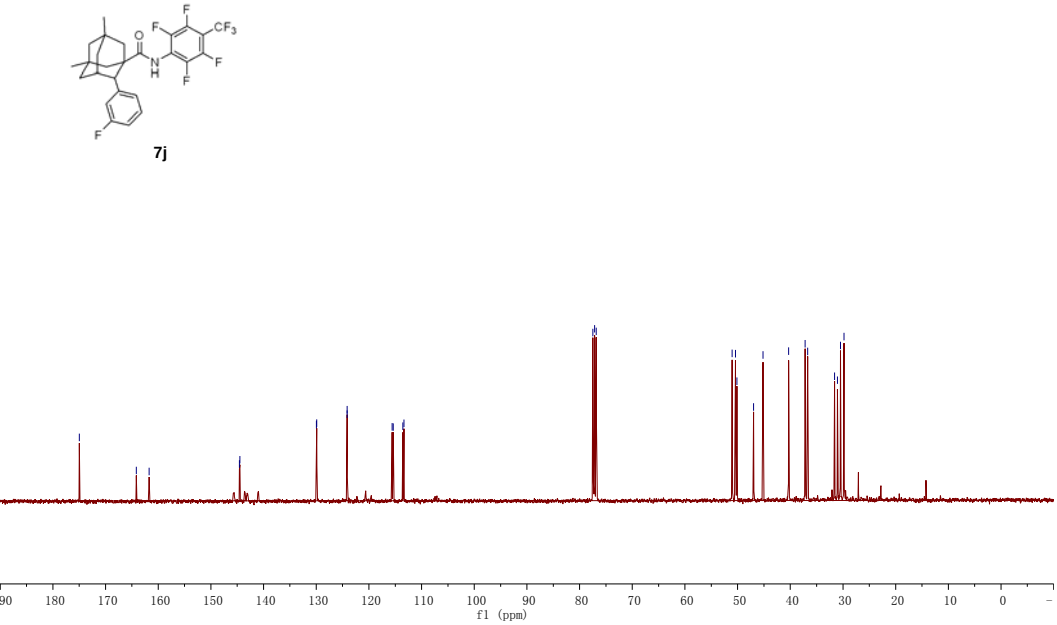
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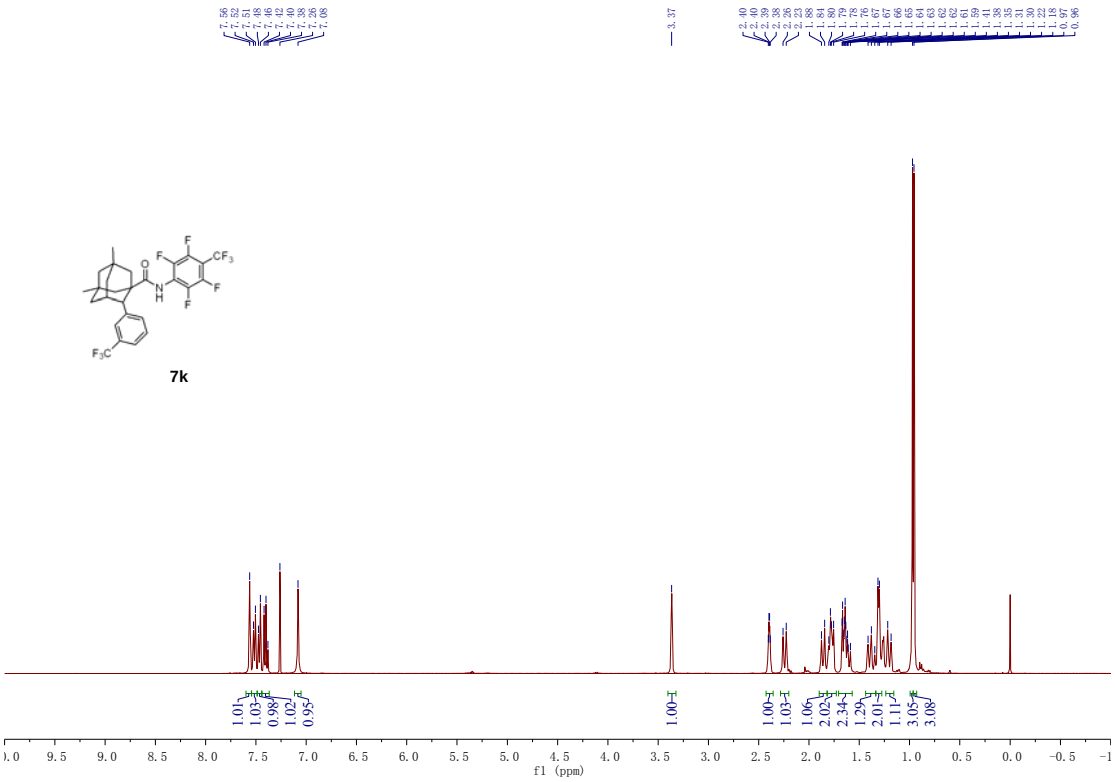
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2.39
2.38
2.25
2.23
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1.84
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1.79
1.78
1.76
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1.66
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1.64
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1.38
1.35
1.31
1.30
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0.96
7k
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1.03
0.98
1.02
0.95
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1.00
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2.02
2.34
1.29
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1.11
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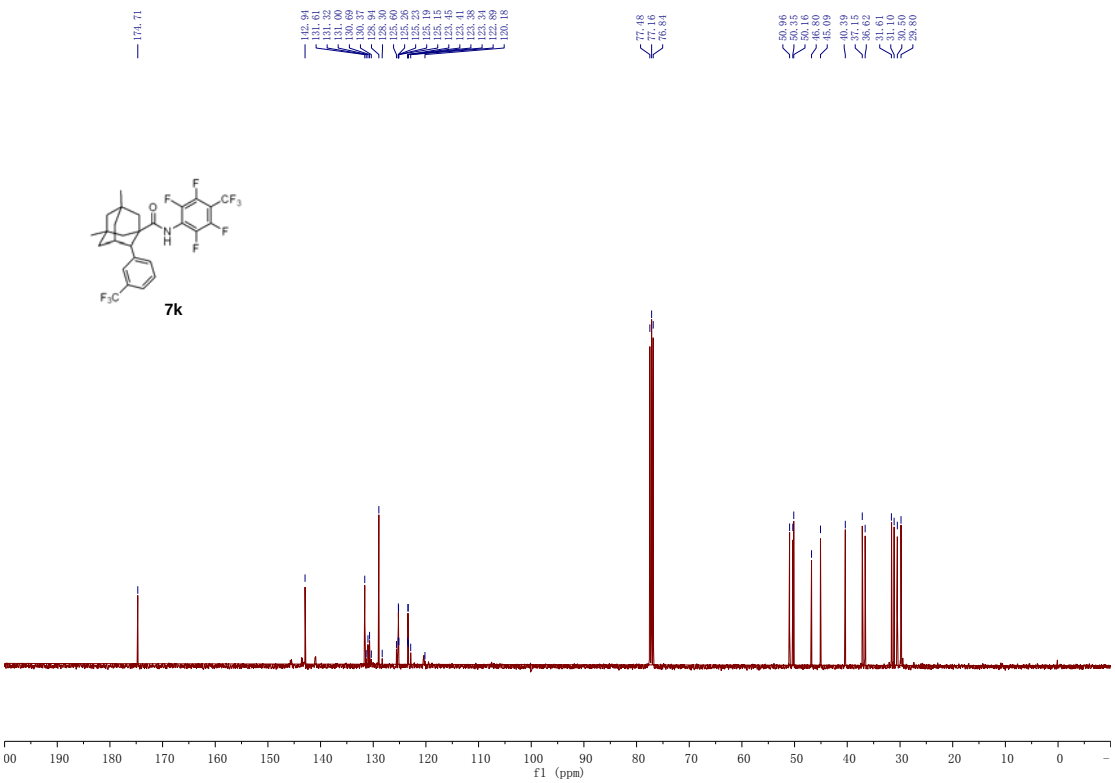
f1 (ppm)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125.15
123.45
123.41
123.38
123.34
122.89
120.18
77.48
77.16
76.84
50.96
50.35
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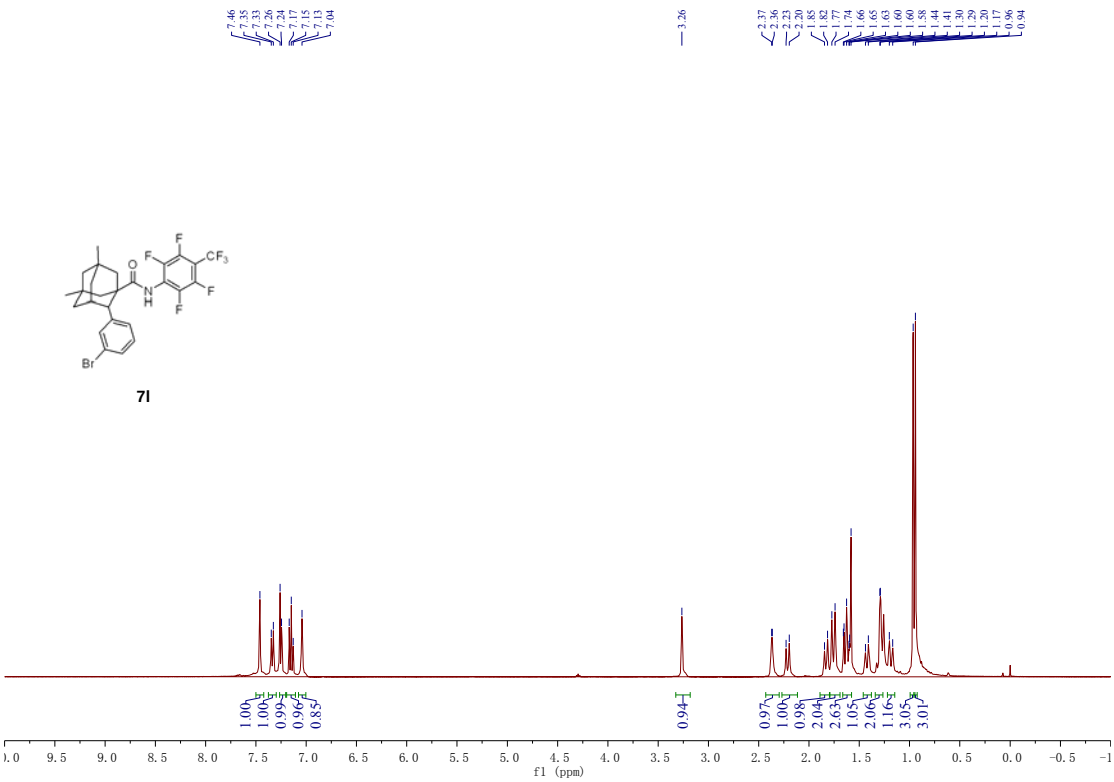
7k
f1 (ppm)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2.23
2.20
1.85
1.82
1.77
1.74
1.66
1.65
1.63
1.60
1.58
1.44
1.41
1.30
1.29
1.20
1.17
0.96
0.94
F
CF3
F
O
N
H
F
Br
1.00
1.00
0.99
0.96
0.85
0.94
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2.04
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1.05
2.06
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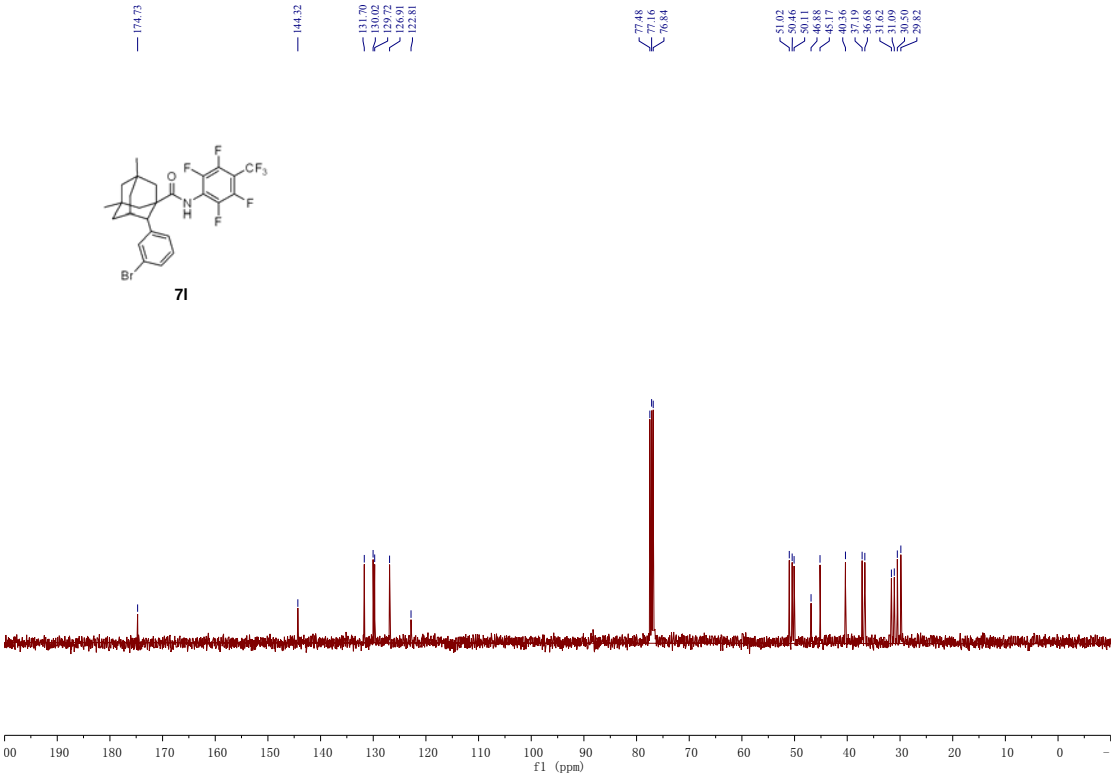
3.01
f1 (ppm)

7l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46.88
45.17
40.16
37.19
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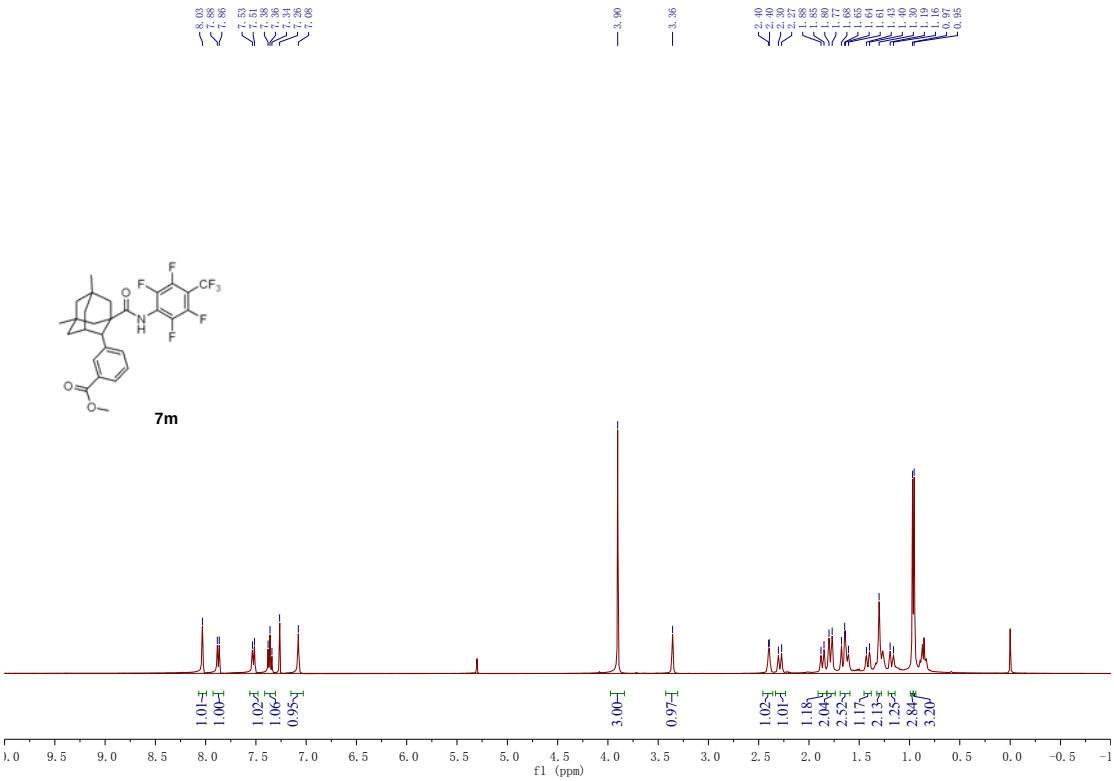
N
H
F
Br
f1 (ppm)

7l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1.43
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1.39
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CF3
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O
O
7m
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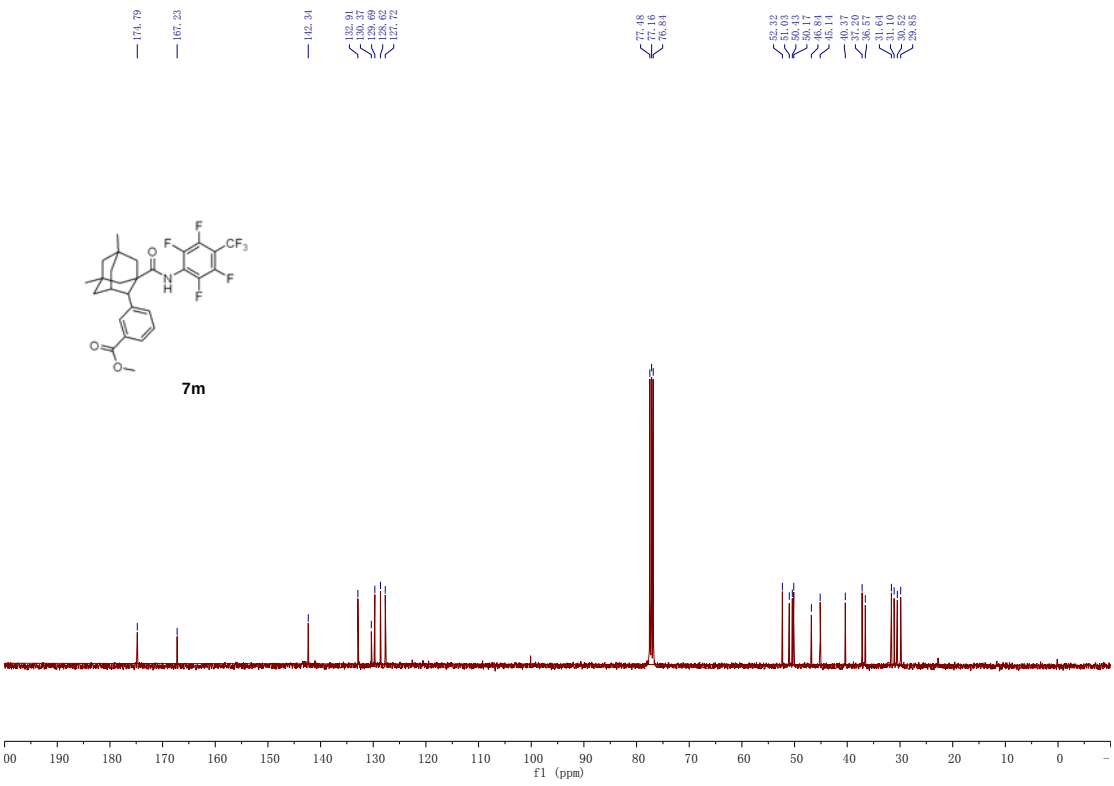
f1 (ppm)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51.03
50.43
50.17
45.84
45.14
40.37
37.00
36.57
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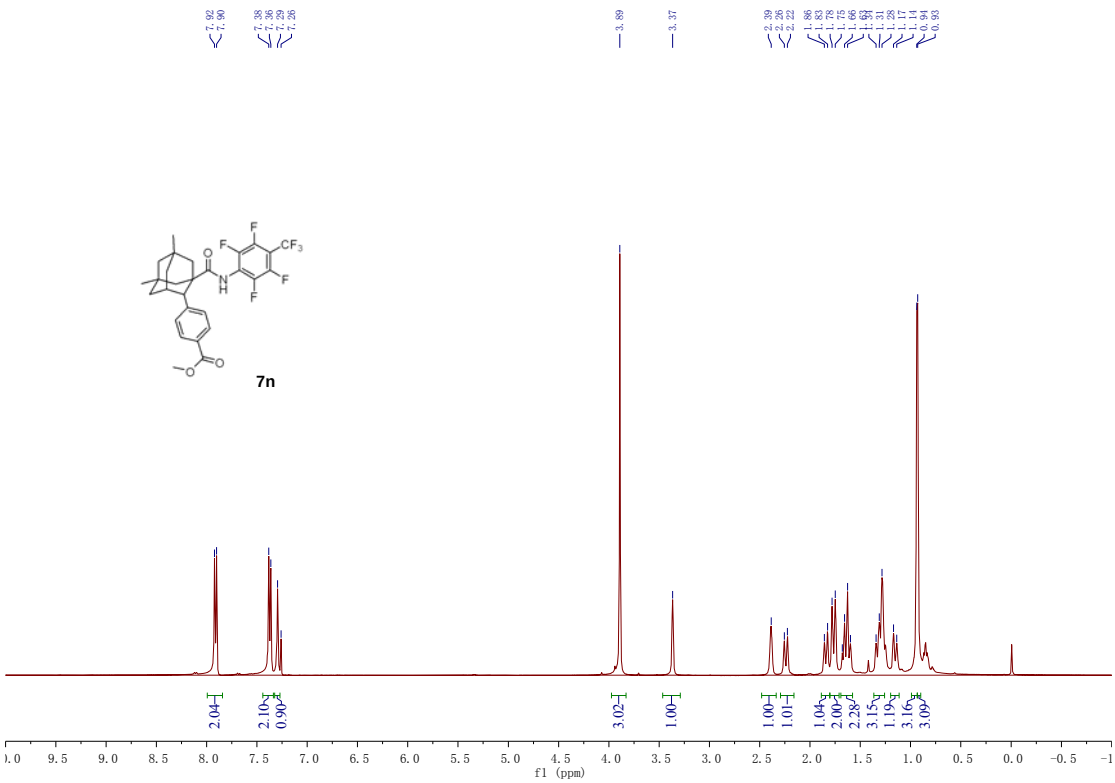
29.85
F
CF3
F
O
N
H
F
O
O
7m
f1 (ppm)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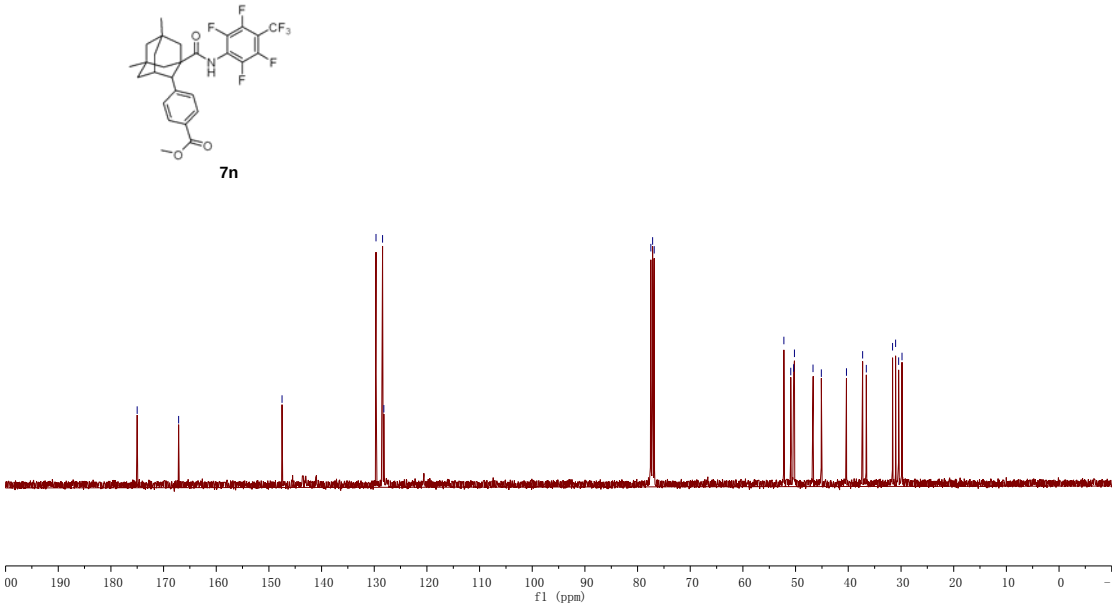
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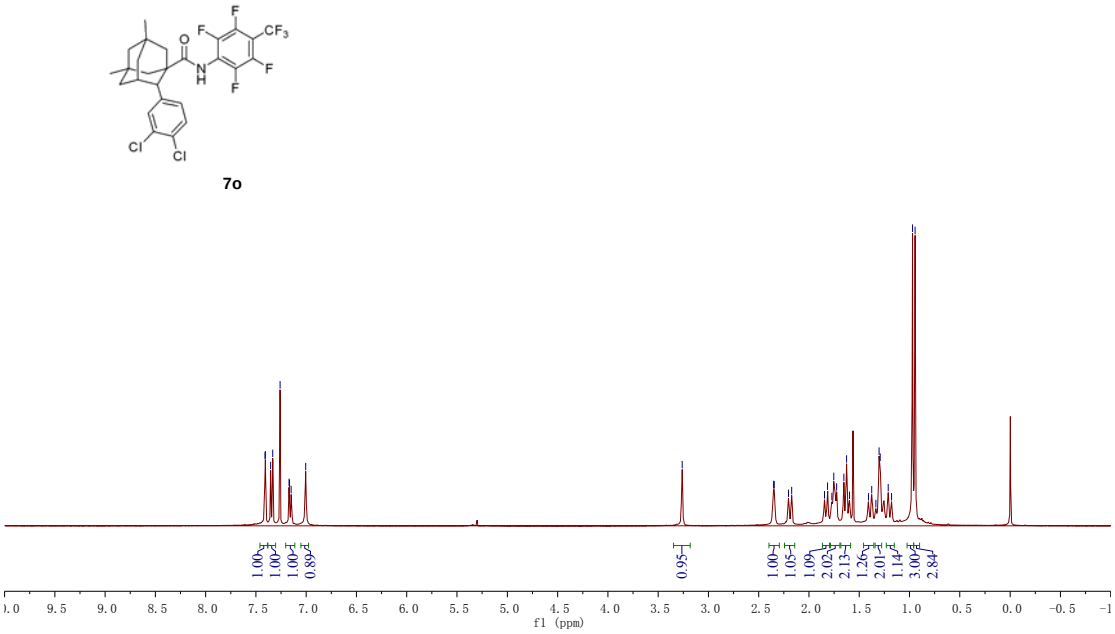
f1 (ppm)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1.77
1.75
1.72
1.65
1.63
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1.41
1.38
1.34
1.30
1.29
1.21
1.18
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0.95
F
F
CF3
O
N
H
F
F
Cl
Cl
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1.00
1.00
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0.95
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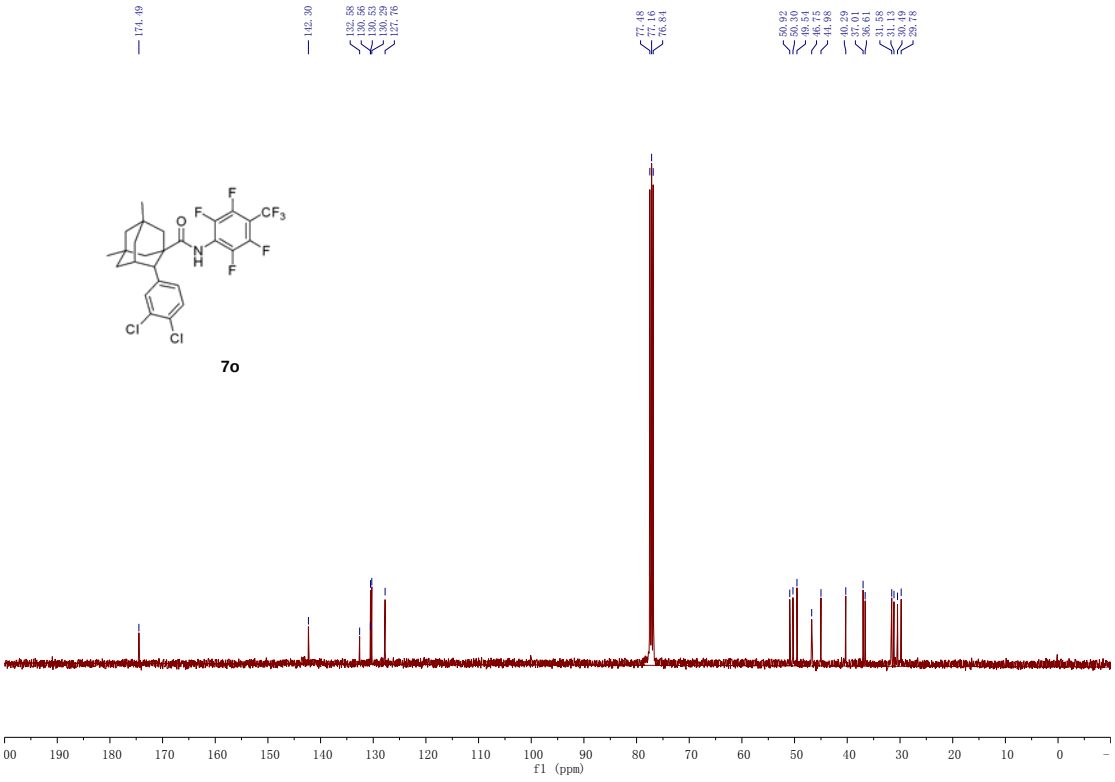
1.26
2.01
1.14
3.00
2.84
f1 (ppm)

7o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50.30
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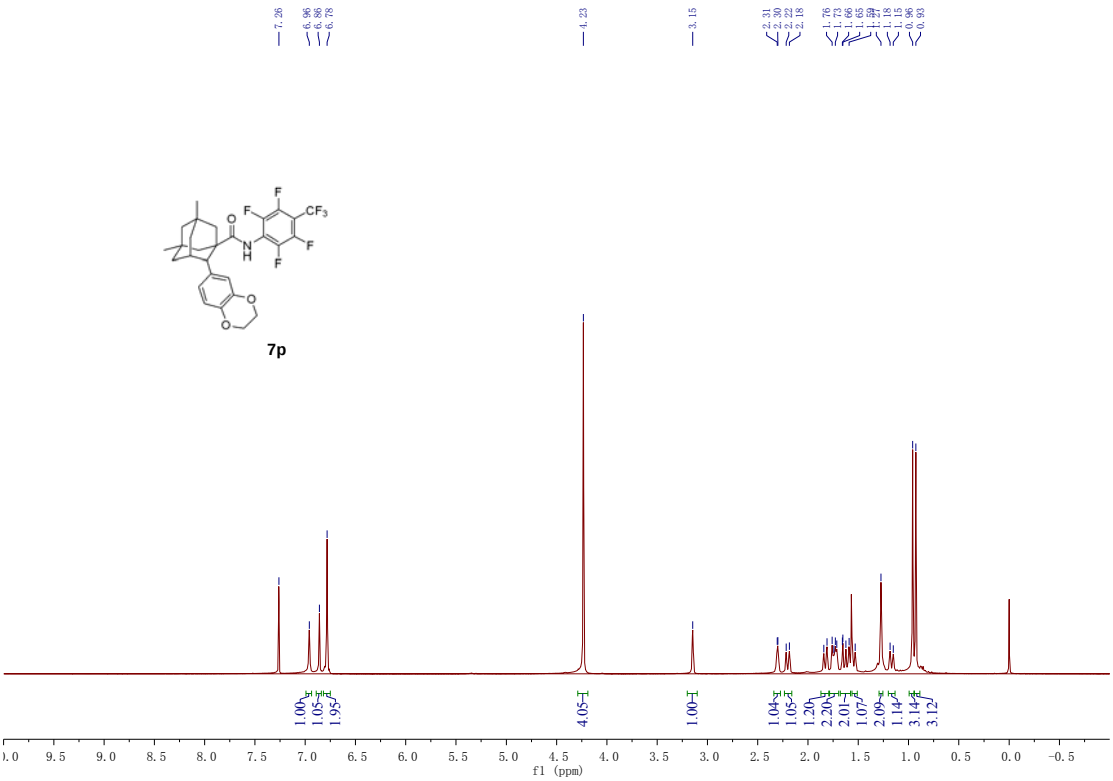
44.98
40.29
37.01
36.61
31.58
31.13
30.49
29.78
F
F
CF3
O
N
H
F
F
Cl
Cl
f1 (ppm)

7o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2.30
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2.18
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1.66
1.65
1.18
1.15
0.98
0.93
F
F
CF3
O
N
H
F
F
O
O
7p
1.00
1.05
1.95
4.05
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1.20
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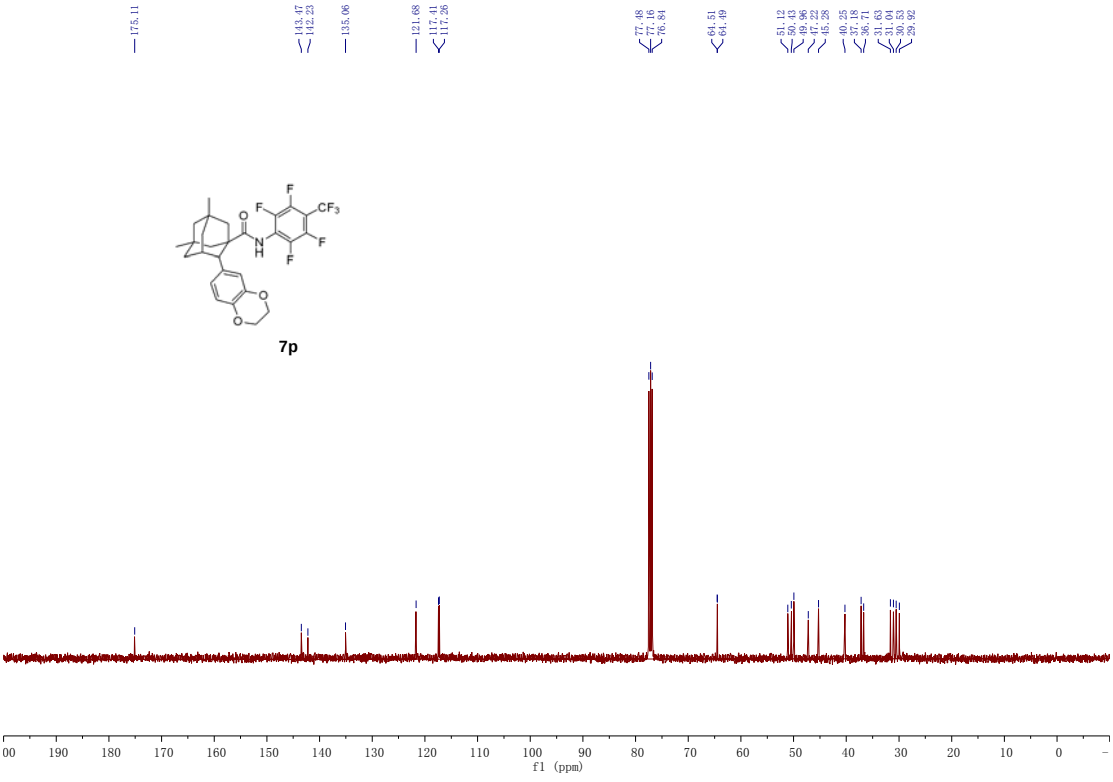
f1 (ppm)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77.16
76.84
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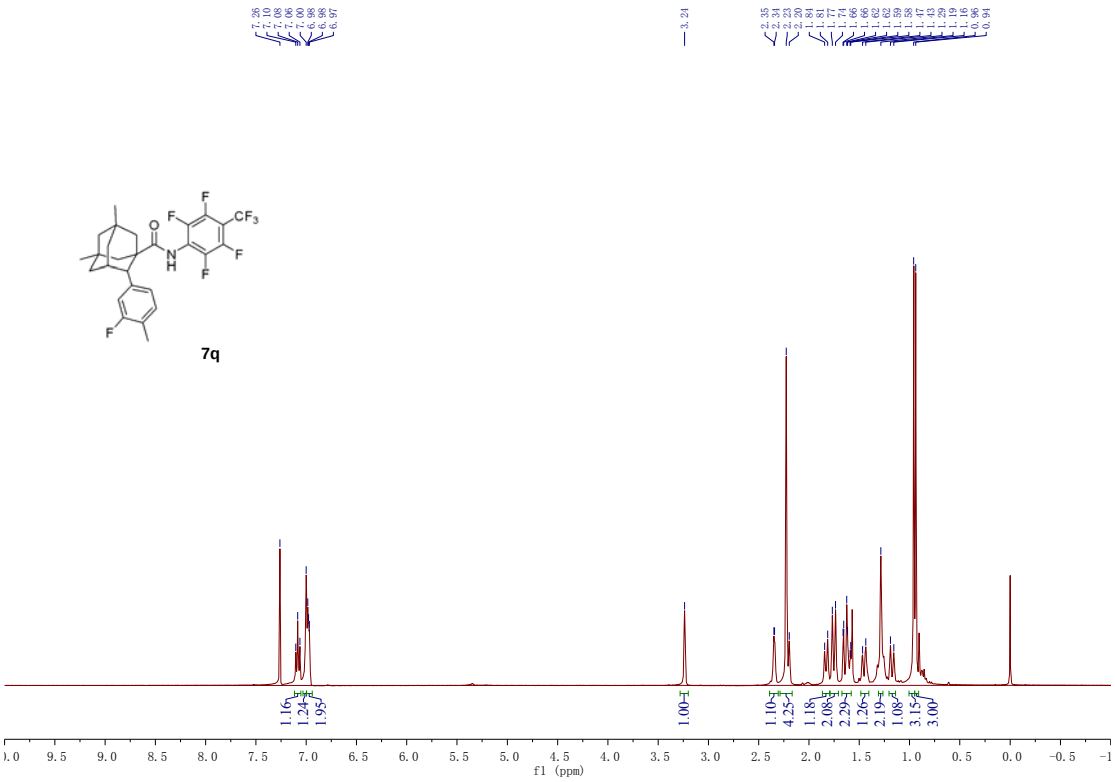
51.12
50.43
49.96
47.22
45.28
40.25
37.18
36.71
31.63
31.04
30.53
29.92
F
F
CF3
O
N
H
F
F
O
O
7p
f1 (ppm)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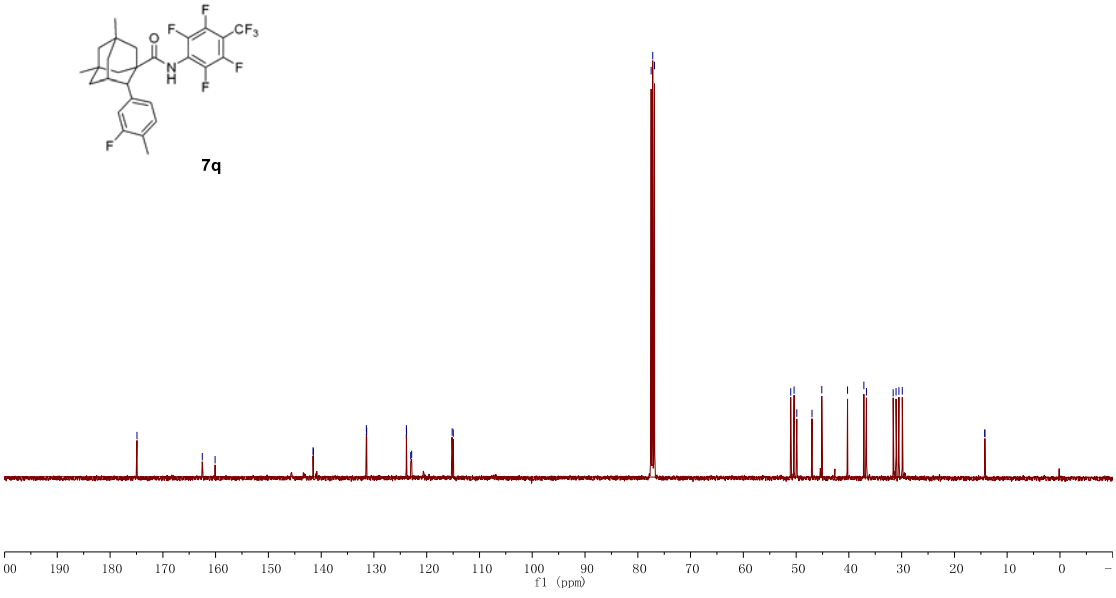
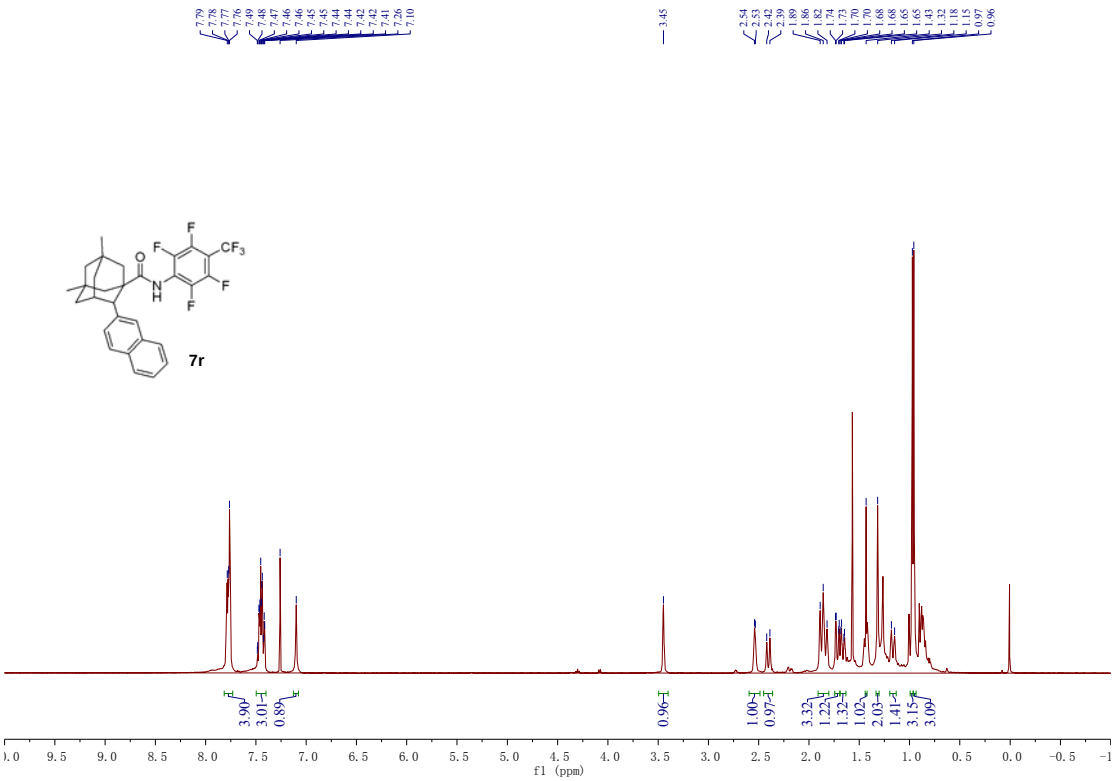
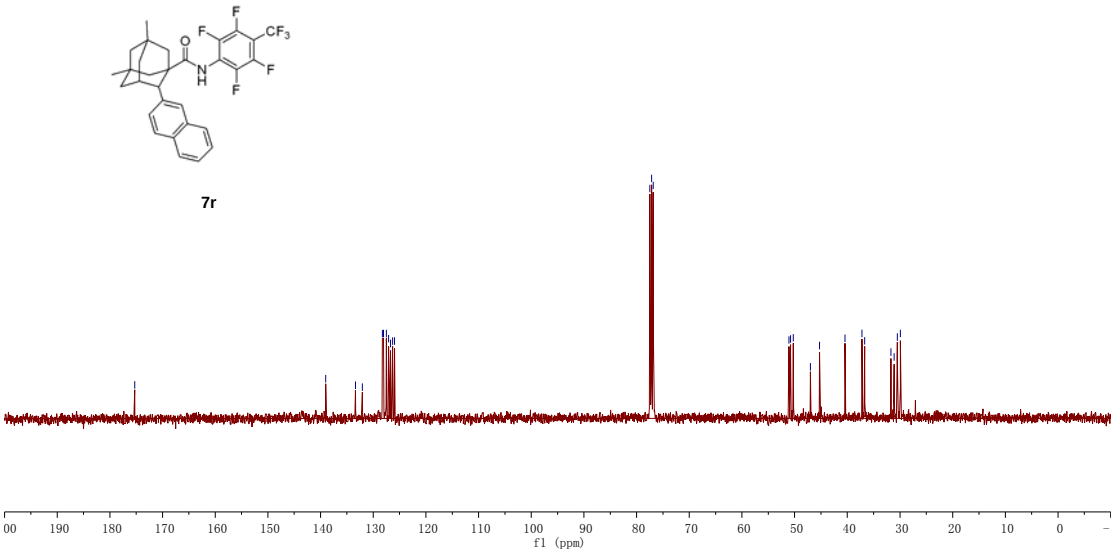
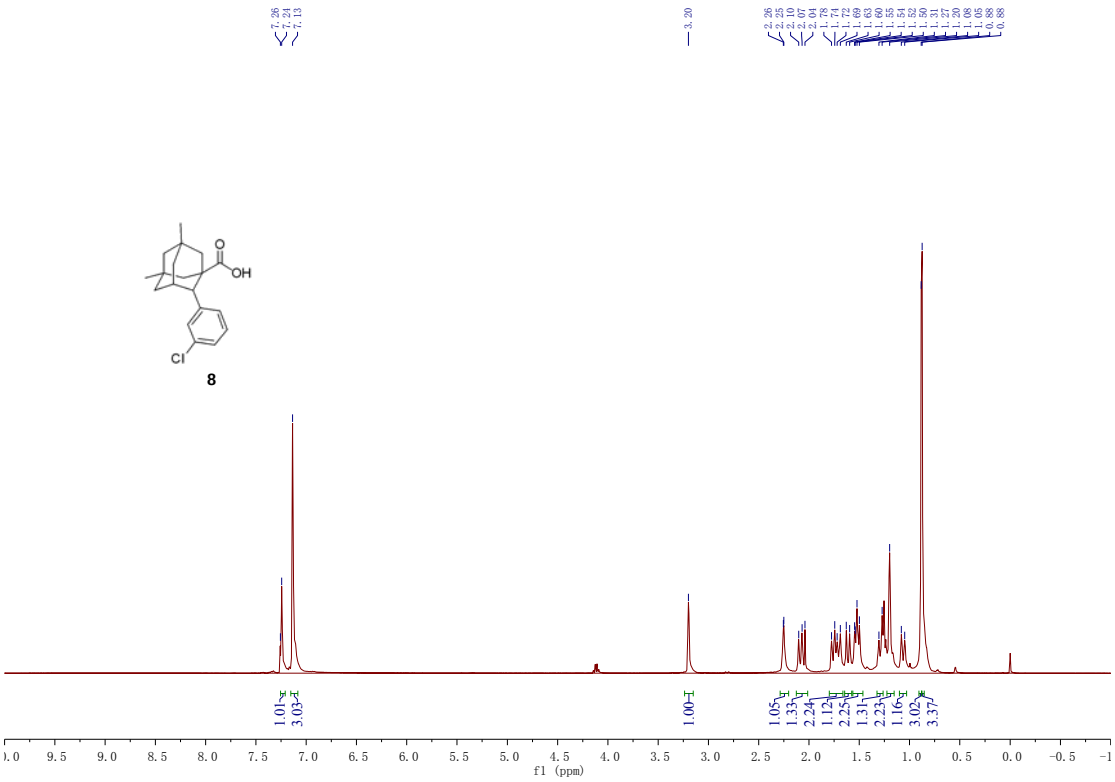
f1 (ppm)


7q
f1 (ppm)


7r
f1 (ppm)


7r
f1 (ppm)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3.20
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2.10
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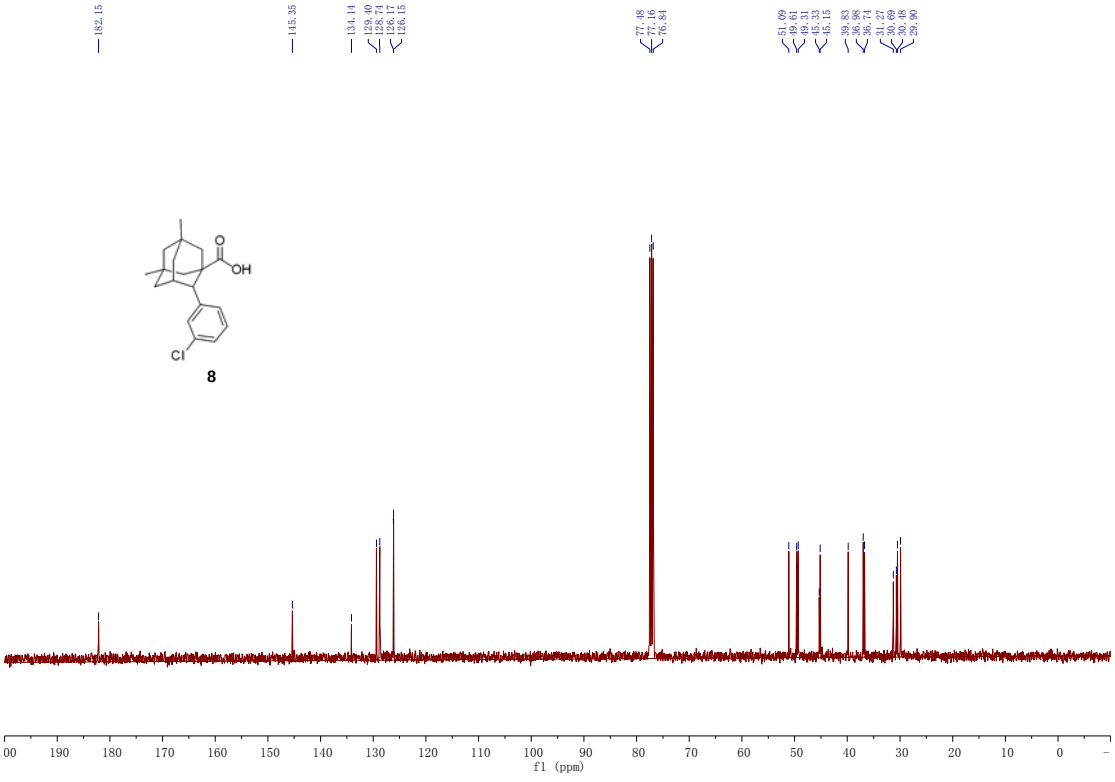
2.04
1.78
1.74
1.72
1.69
1.65
1.60
1.55
1.54
1.52
1.50
1.31
1.27
1.20
1.08
1.05
0.88
0.88
OH
Cl
8
1.01
3.03
1.00
1.05
1.33
2.24
1.12
2.25
1.31
2.23
1.16
3.02
3.37
f1 (ppm)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76.84
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49.31
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45.15
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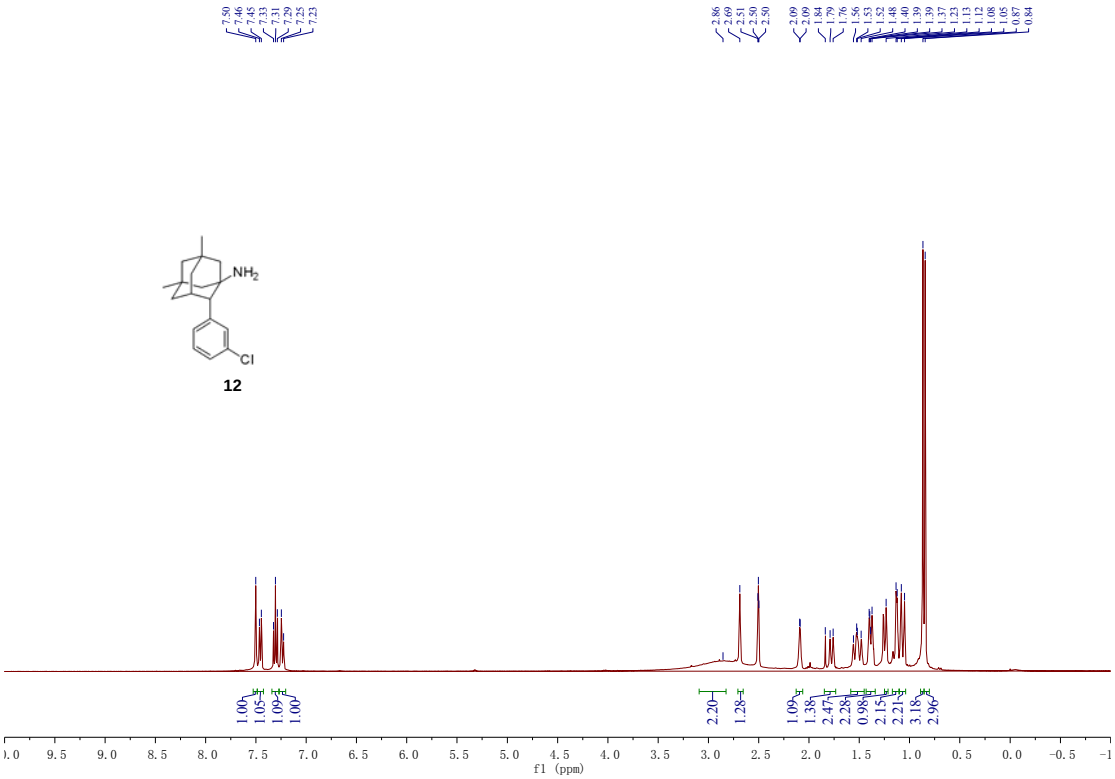
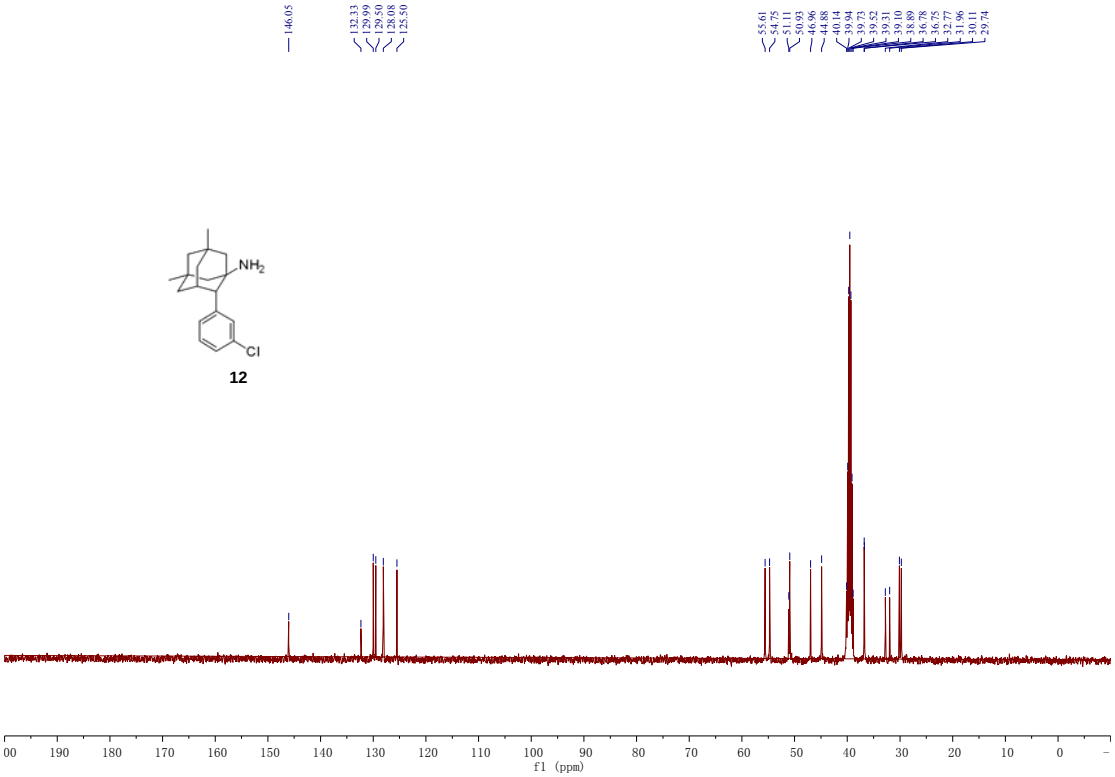
30.69
30.48
29.90
OH
Cl
8
f1 (ppm)


NH2
Cl
12
f1 (ppm)


NH2
Cl
12
f1 (ppm)

5. X-ray Crystallographic Data of Compound 7d

Crystal data for tmp: chemical formula weight = 533.90, M = 0.3 × 0.3 × 0.1 mm^3, colourless granular crystal, space group *Cc* (No. 9), V = 4727.22(8) Å^3, Z = 8, D_c = 1.500 g/cm^3, F_{000} = 2192, Xcalibur, Onyx, Nova, CuKα radiation, λ = 1.54184 Å, T = 100(2)K, $2\theta_{max}$ = 143.1°, 10465 reflections collected, 6282 unique (R_{int} = 0.0236).

The structure was solved and refined using the programs XS (Sheldrick, 2008) and XL (Sheldrick, 2008) respectively. The program X-Seed (Barbour, 1999) was used as an interface to the SHELX programs, and to prepare the figures. Final *GooF* = 1.041, *R1* = 0.0289, *wR2* = 0.0725, *R* indices based on 6078 reflections with I >2sigma(I) (refinement on F^2), 653 parameters, 2 restraints. Lp and absorption corrections applied, μ = 2.125 mm^{-1}. Crystallographic data are summarized in Table 1.

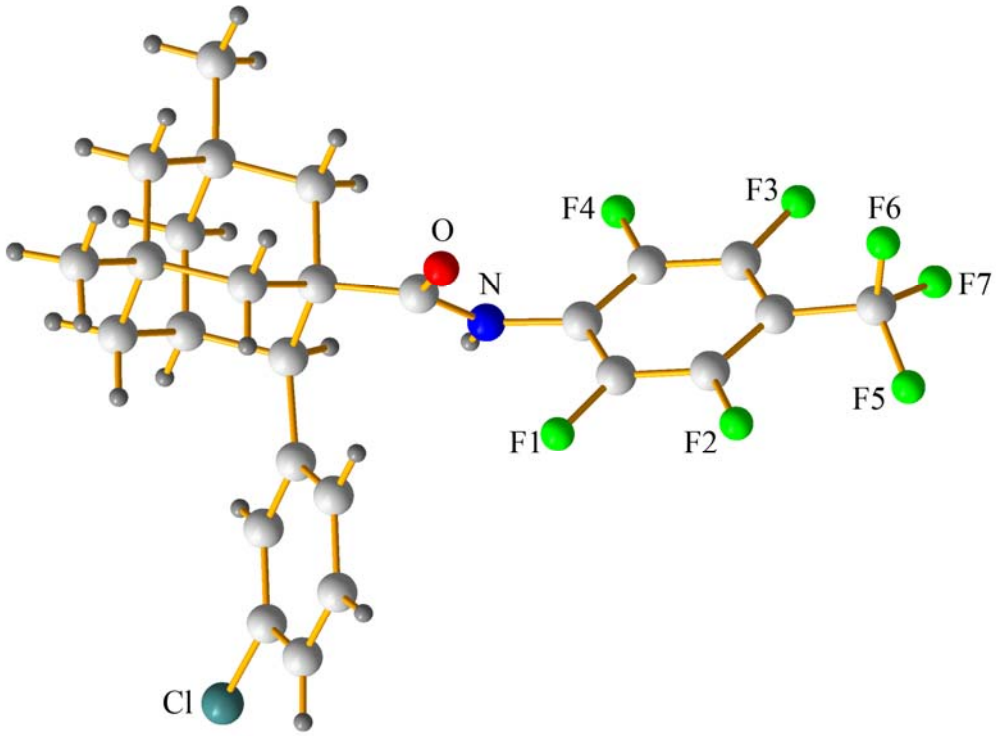


Table 1 Crystal data and structure refinement for lyx_2_141118.

Identification code	lyx_2_141118
Empirical formula	$C_{26}H_{23}NOClF_7$
Formula weight	533.90
Temperature/K	100(2)
Crystal system	monoclinic
Space group	Cc
a/Å	12.89225(14)
b/Å	15.11065(14)
c/Å	24.8076(3)
α/°	90.00
β/°	101.9969(10)
γ/°	90.00
Volume/Å^3	4727.22(8)
Z	8
ρ_{calc}g/cm^3	1.500
μ/mm^{-1}	2.125
F(000)	2192.0
Crystal size/mm^3	0.3 × 0.3 × 0.1
Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	7.28 to 143.12
Index ranges	-15 ≤ h ≤ 15, -18 ≤ k ≤ 12, -30 ≤ l ≤ 29
Reflections collected	10465
Independent reflections	6282 [R_{int} = 0.0236, R_{sigma} = 0.0332]
Data/restraints/parameters	6282/2/653
Goodness-of-fit on F^2	1.041

Final R indexes [I>=2σ (I)]	R_1 = 0.0289, wR_2 = 0.0725
Final R indexes [all data]	R_1 = 0.0304, wR_2 = 0.0738
Largest diff. peak/hole / e $Å^{-3}$	0.29/-0.28
Flack parameter	0.003(10)

Table 2 Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($Å^2 \times 10^3$) for lyx_2_141118. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
Cl2	-7396.4(4)	-3928.2(4)	-954.5(3)	33.68(13)
Cl1	-10987.8(8)	-1966.0(4)	-3239.9(3)	54.9(2)
F8	-6878.1(11)	-3999.6(9)	-2401.7(5)	28.5(3)
F1	-10096.4(10)	-5751.1(9)	-1295.7(6)	29.4(3)
F11	-4130.3(11)	-4013.1(9)	-3391.8(5)	29.9(3)
F9	-8207.4(11)	-4669.9(10)	-3262.9(6)	36.4(3)
O1	-10781.1(13)	-7001(1)	-2158.9(6)	26.1(3)
O2	-3529.9(12)	-4642.4(10)	-2315.0(6)	24.6(3)
F4	-13709.4(11)	-6531.2(10)	-1689.6(6)	32.2(3)
F10	-5444.5(12)	-4685.8(11)	-4258.0(6)	37.4(3)
F12	-7529.3(13)	-4433.7(12)	-4738.0(6)	45.0(4)
F3	-13588.6(11)	-6970.7(10)	-643.2(6)	34.0(3)
F5	-10973.5(14)	-6385.6(10)	534.0(6)	40.1(4)
N2	-4797.7(15)	-3596.2(12)	-2413.4(7)	22.1(4)
F14	-8617.7(12)	-4992.4(12)	-4291.8(7)	43.8(4)
F2	-9945.1(11)	-6209.2(11)	-251.7(6)	36.6(3)
N1	-11973.0(15)	-5949.0(12)	-2085.6(7)	22.9(4)
F6	-11347.1(18)	-7699.5(10)	256.2(7)	53.4(5)
C48	-5817.0(19)	-4546.5(15)	-3797.7(9)	27.0(5)
F13	-7359.5(18)	-5786.8(13)	-4478.8(9)	66.9(6)
C21	-10958.6(18)	-6061.7(14)	-1139.6(9)	23.7(4)
C46	-5457.9(18)	-4014.2(13)	-2860.6(9)	21.7(4)

C20	-11905.0(18)	-6142.4(13)	-1524.9(9)	21.5(4)
C51	-6510.7(18)	-4189.3(14)	-2854.4(9)	23.9(4)
F7	-12587.1(15)	-6794(2)	352.5(7)	75.8(7)
C10	-11604.2(18)	-6265.1(14)	-3004.7(9)	21.4(4)
C29	-4334.5(18)	-3669.1(14)	-1043.5(9)	22.6(4)
C49	-6875.6(19)	-4701.5(15)	-3797.5(10)	27.3(5)
C13	-12574.7(19)	-6870.9(14)	-3232.7(9)	25.4(5)
C15	-11868(2)	-7163.0(15)	-4077.9(10)	29.2(5)
C39	-2085.0(18)	-3786.8(14)	-1499.8(9)	23.1(4)
C45	-3813.5(17)	-3918.4(13)	-2175.5(9)	20.7(4)
C47	-5120.8(19)	-4208.4(15)	-3346.0(9)	25.0(4)
C22	-10887.3(19)	-6287.5(15)	-593.3(10)	26.4(5)
C35	-2848.5(18)	-2482.5(14)	-2060.9(9)	23.7(4)
C50	-7209.7(18)	-4527.4(15)	-3310.4(10)	26.6(5)
C6	-11361(2)	-3709.5(16)	-3153.8(11)	31.7(5)
C7	-11915.2(18)	-5303.3(14)	-3190.4(9)	23.4(4)
C43	-329.0(19)	-3678.3(16)	-838.9(11)	30.2(5)
C8	-12159(2)	-5303.5(15)	-3832.1(9)	28.3(5)
C25	-12781.3(18)	-6437.2(14)	-1334.1(9)	23.8(4)
C41	-1345.8(18)	-3183.1(15)	-1091.8(9)	24.3(4)
C28	-5432.0(18)	-3543.8(14)	-1107.9(9)	23.6(4)
C44	-1864(2)	-1036.4(16)	-1968.5(11)	32.4(5)
C18	-13789(2)	-7469.4(18)	-4072.6(11)	37.3(6)
C42	-1100.4(18)	-2357.5(15)	-1402.9(10)	26.0(4)
C14	-12843(2)	-6864.5(15)	-3863(1)	28.5(5)
C34	-3129.2(17)	-3317.8(13)	-1753.9(9)	20.8(4)

C32	-5581(2)	-4804.6(15)	-531.6(9)	28.3(5)
C40	-1923.5(18)	-2887.0(15)	-640.3(9)	24.8(4)
C1	-10668(3)	-3027.7(16)	-2968.2(12)	38.3(6)
C23	-11762.7(19)	-6581.5(15)	-401.8(9)	25.9(5)
C33	-3732.4(17)	-2984.1(14)	-1307.1(8)	21.0(4)
C11	-10657.2(18)	-6590.0(14)	-3238.6(9)	24.3(4)
C5	-11124.9(19)	-4576.0(14)	-2959.0(9)	26.0(5)
C12	-10908(2)	-6569.3(15)	-3871.2(9)	27.0(5)
C24	-12718.8(18)	-6657.4(15)	-789.8(10)	25.3(4)
C19	-11391.6(17)	-6419.6(13)	-2382.7(9)	21.1(4)
C37	-2683.1(19)	-1584.6(14)	-1200.8(10)	24.8(4)
C30	-3884(2)	-4389.6(15)	-724.2(10)	27.5(5)
C16	-13104(2)	-5909.9(16)	-4048.8(10)	29.7(5)
C9	-11196(2)	-5608.8(15)	-4050.9(10)	28.9(5)
C17	-9948(2)	-6885.2(16)	-4085.4(11)	33.4(5)
C36	-2958.1(18)	-2403.7(14)	-892.6(9)	24.6(4)
C4	-10195(2)	-4702.3(16)	-2564.3(10)	29.3(5)
C38	-2115.8(19)	-1857.2(14)	-1662.6(10)	25.0(4)
C3	-9518(2)	-4000.7(19)	-2378.9(11)	38.1(6)
C31	-4501(2)	-4943.8(15)	-470.7(10)	28.3(5)
C27	-6031.1(19)	-4104.3(15)	-856.0(9)	26.2(5)
C26	-11676(2)	-6869.6(18)	188.1(10)	33.3(5)
C2	-9738(3)	-3155.1(18)	-2585.3(12)	42.2(7)
C52	-7613(2)	-4990.1(17)	-4326.6(11)	34.7(5)

Table 3 Anisotropic Displacement Parameters ($Å^2×10^3$) for lyx_2_141118. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
Cl2	26.4(3)	36.6(3)	39.0(3)	-0.1(2)	9.1(2)	-2.6(2)
Cl1	97.6(6)	22.7(3)	55.8(4)	-1.2(3)	42.6(4)	-4.9(3)
F8	29.4(7)	34.4(7)	23.2(6)	-1.7(5)	9.2(5)	-0.2(6)
F1	23.4(7)	37.0(7)	28.5(7)	0.5(6)	7.1(5)	0.4(6)
F11	23.3(7)	40.5(7)	26.4(7)	0.1(5)	6.1(5)	4.2(6)
F9	28.8(7)	46.3(8)	34.9(7)	-5.6(6)	8.3(6)	-9.2(6)
O1	31.0(8)	25.6(7)	21.4(7)	1.3(6)	4.4(6)	10.4(7)
O2	26.5(8)	20.5(7)	25.4(7)	-2.7(6)	2.3(6)	6.5(6)
F4	26.5(7)	40.9(8)	27.1(7)	-0.9(6)	0.9(5)	-3.8(6)
F10	35.9(8)	54.9(9)	21.3(7)	-9.3(6)	5.9(5)	8.3(7)
F12	40.6(9)	65.8(10)	25.1(7)	1.4(7)	-0.9(6)	-3.7(8)
F3	32.4(8)	39.4(7)	32.3(7)	3.2(6)	11.9(6)	-7.4(6)
F5	59.3(10)	37.3(8)	20.9(7)	-3.7(6)	2.1(6)	-2.2(7)
N2	24.2(9)	19.9(8)	21.5(9)	-2.4(7)	3.0(7)	3.8(7)
F14	33.1(8)	58.1(10)	36.4(8)	-6.5(7)	-1.5(6)	-10.8(7)
F2	28.1(7)	55.1(9)	23.8(7)	-1.5(6)	-1.5(5)	1.8(6)
N1	28.8(10)	21.5(8)	18.7(8)	1.8(7)	5.7(7)	8.4(7)
F6	97.7(15)	29.2(7)	28.1(7)	6.1(6)	1.3(8)	-7.7(8)
C48	28.8(12)	28.0(11)	24.2(11)	-2.4(9)	5.5(9)	6.9(9)
F13	79.7(14)	46.5(10)	58.1(12)	-31.7(9)	-23.2(10)	19.5(9)
C21	24.2(11)	23.2(10)	24.0(11)	-0.1(8)	5.9(8)	3.3(8)
C46	24.6(11)	17.3(9)	22.6(10)	2.0(8)	3.6(8)	5.0(8)

C20	28.8(12)	16.6(9)	19.4(10)	-0.4(8)	5.5(8)	4.8(8)
C51	28.6(12)	20.8(9)	22.5(11)	0.4(8)	6.1(9)	1.7(9)
F7	40.6(10)	162(2)	27.6(8)	11.7(11)	13.5(7)	2.3(12)
C10	26.8(11)	20.1(9)	17.0(9)	0.3(8)	4.2(8)	3.0(8)
C29	27.2(11)	22.5(10)	18.4(9)	-4.7(8)	5.0(8)	0.8(9)
C49	31.0(12)	22.9(10)	26.8(11)	-2.5(9)	3.1(9)	1.3(9)
C13	30.8(12)	22.2(10)	23.2(11)	0.2(8)	5.2(9)	0.6(9)
C15	41.7(14)	24.3(10)	21.3(10)	-0.5(9)	5.6(9)	-0.1(10)
C39	23.5(11)	22.9(10)	22.9(10)	0.3(8)	5.0(8)	4.2(9)
C45	23.5(10)	20.2(10)	19.2(10)	2.1(8)	6.4(8)	2.3(8)
C47	25.5(11)	25.6(10)	23.7(11)	0.6(8)	4.5(8)	6.5(9)
C22	27.1(12)	27.1(11)	23.6(11)	-1.3(9)	2.1(9)	5.6(9)
C35	27.0(11)	22.5(10)	21.9(10)	1.6(8)	5.9(8)	1.8(9)
C50	25.0(12)	24.2(10)	30.3(12)	0.4(9)	4.8(9)	-0.6(9)
C6	45.4(15)	24.9(10)	29.0(12)	-1.7(9)	17.2(10)	-0.8(10)
C7	27.9(11)	21.2(10)	21.2(10)	1.2(8)	5.6(8)	3.6(9)
C43	24.1(11)	30.8(12)	33.4(12)	-2.4(10)	0.4(9)	3.2(9)
C8	40.2(13)	22.1(10)	22.0(11)	3.8(9)	5.4(9)	3.6(10)
C25	26.3(11)	20.6(10)	23.5(10)	-1.4(8)	2.8(9)	0.8(9)
C41	22.1(11)	25.2(11)	24.5(11)	-1.6(8)	2.2(8)	1.7(9)
C28	28.4(11)	20.5(10)	22.3(10)	-2.5(8)	6.4(8)	1.2(8)
C44	35.7(13)	28.3(11)	35.0(13)	1(1)	11.6(10)	-1.8(10)
C18	38.9(15)	39.3(13)	31.2(12)	-6.0(11)	1.5(10)	-4.8(11)
C42	24.6(11)	27.8(10)	26.6(11)	-1.8(9)	7.6(8)	-0.1(9)
C14	33.0(12)	26.4(11)	24.3(11)	-2.1(9)	1.8(9)	-2.0(9)
C34	23.2(10)	18.7(9)	20.1(9)	0.1(8)	3.8(8)	2.1(8)

C32	37.2(13)	26.1(11)	22.7(11)	-2.8(9)	8.3(9)	-7.4(10)
C40	27.4(11)	25.7(10)	20.5(10)	-0.7(8)	3.5(8)	-2.6(9)
C1	63.6(18)	24.1(11)	35.7(13)	-4.9(10)	29.5(13)	-6.9(11)
C23	31.3(12)	24.1(10)	21.3(10)	0.6(8)	3.6(9)	4.6(9)
C33	22.3(10)	20.5(9)	20(1)	0.6(8)	4.4(8)	3.2(8)
C11	27.7(11)	21.8(10)	23.7(11)	0.0(8)	6.1(8)	3.3(8)
C5	35.0(13)	22.9(10)	23.2(11)	-2.1(8)	13.0(9)	1.1(9)
C12	35.3(12)	23.6(11)	24.0(11)	0.9(9)	10.7(9)	1.3(9)
C24	27.8(12)	23.3(10)	26.2(11)	-1.1(8)	8.9(9)	-0.3(9)
C19	21.9(10)	19.0(9)	21.5(10)	-0.2(8)	2.7(8)	1.6(8)
C37	25.8(11)	20.7(10)	28.1(11)	-3.4(8)	6.1(9)	-1.5(9)
C30	31.3(12)	26.2(11)	24.6(10)	-1.6(9)	5.2(9)	1.5(9)
C16	33.9(13)	31.3(12)	21.6(11)	1.2(9)	0.7(9)	5.5(10)
C9	40.2(13)	24.8(11)	22.8(11)	2.2(9)	9.5(9)	-1.2(10)
C17	44.2(15)	30.3(11)	29.0(12)	-2.1(10)	15.1(11)	2.9(10)
C36	29.2(12)	24.2(10)	22.1(10)	-2.8(8)	8.8(9)	0.8(9)
C4	35.2(13)	30.0(12)	24.8(11)	-5.2(9)	10.8(9)	-1.4(10)
C38	25.3(11)	22.4(10)	27.7(11)	-1.4(9)	6.8(8)	0.7(9)
C3	36.8(14)	47.1(15)	32.9(13)	-12.7(11)	13.0(11)	-9.7(12)
C31	37.5(13)	23.1(10)	23.2(11)	1.4(9)	3.6(9)	-0.6(10)
C27	26.0(11)	27.0(11)	25.2(11)	-6.2(9)	4.4(9)	-4.8(9)
C26	36.6(13)	38.9(13)	25.2(12)	3.5(10)	7.9(10)	0.0(11)
C2	57.6(18)	36.9(13)	40.6(15)	-16.7(12)	29.6(13)	-18.8(13)
C52	36.4(14)	33.5(13)	31.5(12)	-6.8(10)	0.6(10)	3.9(10)

Table 4 Bond Lengths for lyx_2_141118.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
Cl2	C27	1.746(2)	C15	C14	1.532(4)
Cl1	C1	1.756(3)	C15	C12	1.529(4)
F8	C51	1.337(3)	C39	C41	1.538(3)
F1	C21	1.336(3)	C39	C34	1.536(3)
F11	C47	1.338(3)	C45	C34	1.521(3)
F9	C50	1.333(3)	C22	C23	1.386(3)
O1	C19	1.232(3)	C35	C34	1.555(3)
O2	C45	1.226(3)	C35	C38	1.541(3)
F4	C25	1.338(3)	C6	C1	1.379(4)
F10	C48	1.344(3)	C6	C5	1.407(3)
F12	C52	1.344(3)	C7	C8	1.557(3)
F3	C24	1.336(3)	C7	C5	1.527(3)
F5	C26	1.330(3)	C43	C41	1.527(3)
N2	C46	1.401(3)	C8	C16	1.529(4)
N2	C45	1.373(3)	C8	C9	1.526(4)
F14	C52	1.316(3)	C25	C24	1.377(3)
F2	C22	1.334(3)	C41	C42	1.534(3)
N1	C20	1.406(3)	C41	C40	1.535(3)
N1	C19	1.357(3)	C28	C27	1.380(3)
F6	C26	1.323(3)	C44	C38	1.524(3)
C48	C49	1.385(3)	C18	C14	1.526(4)
C48	C47	1.380(3)	C42	C38	1.533(3)
F13	C52	1.323(3)	C14	C16	1.530(3)
C21	C20	1.390(3)	C34	C33	1.564(3)

C21	C22	1.382(3)	C32	C31	1.384(4)
C46	C51	1.386(3)	C32	C27	1.382(4)
C46	C47	1.394(3)	C40	C36	1.535(3)
C20	C25	1.386(3)	C1	C2	1.380(5)
C51	C50	1.389(3)	C23	C24	1.402(3)
F7	C26	1.326(3)	C23	C26	1.509(3)
C10	C13	1.559(3)	C33	C36	1.548(3)
C10	C7	1.552(3)	C11	C12	1.535(3)
C10	C11	1.537(3)	C5	C4	1.394(4)
C10	C19	1.528(3)	C12	C9	1.541(3)
C29	C28	1.403(3)	C12	C17	1.521(3)
C29	C33	1.521(3)	C37	C36	1.535(3)
C29	C30	1.399(3)	C37	C38	1.538(3)
C49	C50	1.390(3)	C30	C31	1.392(4)
C49	C52	1.516(3)	C4	C3	1.390(4)
C13	C14	1.530(3)	C3	C2	1.384(4)

Table 5 Bond Angles for lyx_2_141118.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C45	N2	C46	122.40(17)	C18	C14	C16	110.6(2)
C19	N1	C20	120.04(18)	C16	C14	C15	108.5(2)
F10	C48	C49	120.0(2)	C39	C34	C35	107.59(18)
F10	C48	C47	117.4(2)	C39	C34	C33	112.36(17)
C47	C48	C49	122.5(2)	C45	C34	C39	109.92(17)
F1	C21	C20	119.7(2)	C45	C34	C35	107.96(17)
F1	C21	C22	118.8(2)	C45	C34	C33	112.14(17)
C22	C21	C20	121.5(2)	C35	C34	C33	106.62(16)
C51	C46	N2	120.83(19)	C27	C32	C31	118.1(2)
C51	C46	C47	116.8(2)	C41	C40	C36	110.69(18)
C47	C46	N2	122.1(2)	C6	C1	Cl1	118.1(2)
C21	C20	N1	121.8(2)	C6	C1	C2	122.4(2)
C25	C20	N1	121.1(2)	C2	C1	Cl1	119.5(2)
C25	C20	C21	117.0(2)	C22	C23	C24	117.0(2)
F8	C51	C46	119.15(19)	C22	C23	C26	121.6(2)
F8	C51	C50	118.7(2)	C24	C23	C26	121.3(2)
C46	C51	C50	122.1(2)	C29	C33	C34	117.31(17)
C7	C10	C13	107.70(17)	C29	C33	C36	114.59(17)
C11	C10	C13	108.42(17)	C36	C33	C34	107.85(17)
C11	C10	C7	111.32(17)	C12	C11	C10	111.38(19)
C19	C10	C13	103.81(17)	C6	C5	C7	117.4(2)
C19	C10	C7	115.08(17)	C4	C5	C6	117.5(2)
C19	C10	C11	110.03(17)	C4	C5	C7	125.1(2)
C28	C29	C33	116.87(19)	C15	C12	C11	108.32(18)

C30	C29	C28	117.3(2)	C15	C12	C9	109.0(2)
C30	C29	C33	125.7(2)	C11	C12	C9	107.56(18)
C48	C49	C50	116.9(2)	C17	C12	C15	111.1(2)
C48	C49	C52	119.3(2)	C17	C12	C11	109.7(2)
C50	C49	C52	123.8(2)	C17	C12	C9	111.07(19)
C14	C13	C10	111.18(18)	F3	C24	C25	118.1(2)
C12	C15	C14	112.13(19)	F3	C24	C23	120.7(2)
C34	C39	C41	111.52(17)	C25	C24	C23	121.2(2)
O2	C45	N2	119.9(2)	O1	C19	N1	120.16(19)
O2	C45	C34	124.21(19)	O1	C19	C10	121.85(19)
N2	C45	C34	115.88(17)	N1	C19	C10	117.72(18)
F11	C47	C48	118.9(2)	C36	C37	C38	110.49(17)
F11	C47	C46	120.1(2)	C31	C30	C29	121.0(2)
C48	C47	C46	120.8(2)	C8	C16	C14	110.5(2)
F2	C22	C21	117.9(2)	C8	C9	C12	110.32(19)
F2	C22	C23	120.6(2)	C40	C36	C33	112.77(18)
C21	C22	C23	121.5(2)	C37	C36	C40	108.40(19)
C38	C35	C34	110.96(17)	C37	C36	C33	108.04(18)
F9	C50	C51	117.5(2)	C3	C4	C5	121.2(2)
F9	C50	C49	121.7(2)	C44	C38	C35	110.2(2)
C51	C50	C49	120.8(2)	C44	C38	C42	111.0(2)
C1	C6	C5	120.1(3)	C44	C38	C37	109.67(18)
C10	C7	C8	106.75(17)	C42	C38	C35	108.86(18)
C5	C7	C10	116.83(18)	C42	C38	C37	108.41(19)
C5	C7	C8	111.20(18)	C37	C38	C35	108.59(18)
C16	C8	C7	109.66(19)	C2	C3	C4	121.1(3)

C9	C8	C7	110.91(19)	C32	C31	C30	121.0(2)
C9	C8	C16	109.94(19)	C28	C27	Cl2	119.06(18)
F4	C25	C20	119.3(2)	C28	C27	C32	121.8(2)
F4	C25	C24	118.9(2)	C32	C27	Cl2	119.16(18)
C24	C25	C20	121.8(2)	F5	C26	C23	111.7(2)
C43	C41	C39	109.97(18)	F6	C26	F5	106.3(2)
C43	C41	C42	110.86(19)	F6	C26	F7	108.8(2)
C43	C41	C40	110.39(19)	F6	C26	C23	110.8(2)
C42	C41	C39	108.40(18)	F7	C26	F5	106.4(2)
C42	C41	C40	108.19(18)	F7	C26	C23	112.5(2)
C40	C41	C39	108.97(18)	C1	C2	C3	117.7(2)
C27	C28	C29	120.8(2)	F12	C52	C49	110.1(2)
C38	C42	C41	111.41(19)	F14	C52	F12	106.7(2)
C13	C14	C15	109.0(2)	F14	C52	F13	108.7(2)
C13	C14	C16	107.62(19)	F14	C52	C49	113.1(2)
C18	C14	C13	109.8(2)	F13	C52	F12	106.8(2)
C18	C14	C15	111.1(2)	F13	C52	C49	111.2(2)

Table 6 Torsion Angles for lyx_2_141118.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
Cl1	C1	C2	C3	179.62(19)	C35	C34	C33	C29	165.23(18)
F8	C51	C50	F9	-2.1(3)	C35	C34	C33	C36	-63.6(2)
F8	C51	C50	C49	177.4(2)	C50	C49	C52	F12	124.2(2)
F1	C21	C20	N1	3.4(3)	C50	C49	C52	F14	5.1(3)
F1	C21	C20	C25	-177.66(18)	C50	C49	C52	F13	-117.6(3)
F1	C21	C22	F2	-2.1(3)	C6	C1	C2	C3	-1.1(4)
F1	C21	C22	C23	177.53(19)	C6	C5	C4	C3	-1.3(3)
O2	C45	C34	C39	-4.7(3)	C7	C10	C13	C14	62.6(2)
O2	C45	C34	C35	112.4(2)	C7	C10	C11	C12	-59.4(2)
O2	C45	C34	C33	-130.5(2)	C7	C10	C19	O1	-152.0(2)
F4	C25	C24	F3	1.1(3)	C7	C10	C19	N1	34.0(3)
F4	C25	C24	C23	179.2(2)	C7	C8	C16	C14	-62.3(2)
F10	C48	C49	C50	-178.8(2)	C7	C8	C9	C12	62.5(2)
F10	C48	C49	C52	-2.6(3)	C7	C5	C4	C3	179.7(2)
F10	C48	C47	F11	2.0(3)	C43	C41	C42	C38	179.59(19)
F10	C48	C47	C46	177.5(2)	C43	C41	C40	C36	-178.92(19)
N2	C46	C51	F8	-3.8(3)	C8	C7	C5	C6	52.8(3)
N2	C46	C51	C50	173.9(2)	C8	C7	C5	C4	-128.2(2)
N2	C46	C47	F11	1.5(3)	C41	C39	C34	C45	177.16(17)
N2	C46	C47	C48	-174.0(2)	C41	C39	C34	C35	59.8(2)
N2	C45	C34	C39	176.65(18)	C41	C39	C34	C33	-57.2(2)
N2	C45	C34	C35	-66.3(2)	C41	C42	C38	C35	-58.7(2)
N2	C45	C34	C33	50.9(2)	C41	C42	C38	C44	179.75(19)
F2	C22	C23	C24	-179.1(2)	C41	C42	C38	C37	59.2(2)

F2	C22	C23	C26	-3.3(3)	C41	C40	C36	C33	59.1(2)
N1	C20	C25	F4	-0.6(3)	C41	C40	C36	C37	-60.5(2)
N1	C20	C25	C24	177.8(2)	C28	C29	C33	C34	-119.8(2)
C48	C49	C50	F9	-178.7(2)	C28	C29	C33	C36	112.2(2)
C48	C49	C50	C51	1.8(3)	C28	C29	C30	C31	-1.6(3)
C48	C49	C52	F12	-51.7(3)	C18	C14	C16	C8	179.3(2)
C48	C49	C52	F14	-170.9(2)	C42	C41	C40	C36	59.6(2)
C48	C49	C52	F13	66.5(3)	C14	C15	C12	C11	58.9(2)
C21	C20	C25	F4	-179.59(19)	C14	C15	C12	C9	-57.9(2)
C21	C20	C25	C24	-1.2(3)	C14	C15	C12	C17	179.4(2)
C21	C22	C23	C24	1.3(3)	C34	C39	C41	C43	178.76(19)
C21	C22	C23	C26	177.0(2)	C34	C39	C41	C42	-59.9(2)
C46	N2	C45	O2	-7.7(3)	C34	C39	C41	C40	57.6(2)
C46	N2	C45	C34	170.99(19)	C34	C35	C38	C44	-179.10(19)
C46	C51	C50	F9	-179.8(2)	C34	C35	C38	C42	58.9(2)
C46	C51	C50	C49	-0.3(3)	C34	C35	C38	C37	-58.9(2)
C20	N1	C19	O1	-2.0(3)	C34	C33	C36	C40	-55.2(2)
C20	N1	C19	C10	172.11(19)	C34	C33	C36	C37	64.6(2)
C20	C21	C22	F2	178.6(2)	C40	C41	C42	C38	-59.2(2)
C20	C21	C22	C23	-1.8(3)	C1	C6	C5	C7	-178.7(2)
C20	C25	C24	F3	-177.29(19)	C1	C6	C5	C4	2.2(3)
C20	C25	C24	C23	0.8(3)	C33	C29	C28	C27	-176.27(19)
C51	C46	C47	F11	176.45(19)	C33	C29	C30	C31	175.6(2)
C51	C46	C47	C48	0.9(3)	C11	C10	C13	C14	-58.0(2)
C10	C13	C14	C15	57.5(2)	C11	C10	C7	C8	57.2(2)
C10	C13	C14	C18	179.51(19)	C11	C10	C7	C5	-67.9(2)

C10	C13	C14	C16	-60.0(2)	C11	C10	C19	O1	-25.3(3)
C10	C7	C8	C16	62.5(2)	C11	C10	C19	N1	160.73(19)
C10	C7	C8	C9	-59.1(2)	C11	C12	C9	C8	-59.9(3)
C10	C7	C5	C6	175.6(2)	C5	C6	C1	Cl1	178.29(18)
C10	C7	C5	C4	-5.3(3)	C5	C6	C1	C2	-1.0(4)
C10	C11	C12	C15	-59.2(2)	C5	C7	C8	C16	-169.00(18)
C10	C11	C12	C9	58.4(2)	C5	C7	C8	C9	69.4(2)
C10	C11	C12	C17	179.37(18)	C5	C4	C3	C2	-0.8(4)
C29	C28	C27	Cl2	-179.32(17)	C12	C15	C14	C13	-58.5(2)
C29	C28	C27	C32	0.2(3)	C12	C15	C14	C18	-179.7(2)
C29	C33	C36	C40	77.4(2)	C12	C15	C14	C16	58.4(3)
C29	C33	C36	C37	-162.77(18)	C24	C23	C26	F5	-148.9(2)
C29	C30	C31	C32	0.7(3)	C24	C23	C26	F6	92.8(3)
C49	C48	C47	F11	-174.9(2)	C24	C23	C26	F7	-29.2(4)
C49	C48	C47	C46	0.7(3)	C19	N1	C20	C21	61.6(3)
C13	C10	C7	C8	-61.5(2)	C19	N1	C20	C25	-117.3(2)
C13	C10	C7	C5	173.36(18)	C19	C10	C13	C14	-174.95(18)
C13	C10	C11	C12	58.9(2)	C19	C10	C7	C8	-176.72(19)
C13	C10	C19	O1	90.6(2)	C19	C10	C7	C5	58.1(3)
C13	C10	C19	N1	-83.4(2)	C19	C10	C11	C12	171.79(17)
C13	C14	C16	C8	59.3(3)	C30	C29	C28	C27	1.1(3)
C15	C14	C16	C8	-58.6(2)	C30	C29	C33	C34	63.1(3)
C15	C12	C9	C8	57.3(2)	C30	C29	C33	C36	-64.9(3)
C39	C41	C42	C38	58.8(2)	C16	C8	C9	C12	-59.0(3)
C39	C41	C40	C36	-58.1(2)	C9	C8	C16	C14	59.9(3)
C39	C34	C33	C29	-77.1(2)	C17	C12	C9	C8	-180.0(2)

C39	C34	C33	C36	54.0(2)	C36	C37	C38	C35	58.7(2)
C45	N2	C46	C51	130.7(2)	C36	C37	C38	C44	179.2(2)
C45	N2	C46	C47	-54.5(3)	C36	C37	C38	C42	-59.4(2)
C45	C34	C33	C29	47.3(2)	C4	C3	C2	C1	2.0(4)
C45	C34	C33	C36	178.45(17)	C38	C35	C34	C39	-59.1(2)
C47	C48	C49	C50	-2.0(3)	C38	C35	C34	C45	-177.72(18)
C47	C48	C49	C52	174.2(2)	C38	C35	C34	C33	61.6(2)
C47	C46	C51	F8	-178.80(19)	C38	C37	C36	C40	60.2(2)
C47	C46	C51	C50	-1.1(3)	C38	C37	C36	C33	-62.3(2)
C22	C21	C20	N1	-177.3(2)	C31	C32	C27	Cl2	178.43(17)
C22	C21	C20	C25	1.7(3)	C31	C32	C27	C28	-1.1(3)
C22	C23	C24	F3	177.22(19)	C27	C32	C31	C30	0.6(3)
C22	C23	C24	C25	-0.8(3)	C26	C23	C24	F3	1.5(3)
C22	C23	C26	F5	35.6(3)	C26	C23	C24	C25	-176.6(2)
C22	C23	C26	F6	-82.7(3)	C52	C49	C50	F9	5.3(4)
C22	C23	C26	F7	155.2(2)	C52	C49	C50	C51	-174.2(2)

Table 7 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for lyx_2_141118.

Atom	*x*	*y*	*z*	U(eq)
H2	-5017	-3120	-2283	27
H1	-12383	-5532	-2240	27
H13A	-12417	-7471	-3103	31
H13B	-13183	-6667	-3094	31
H15A	-11692	-7766	-3960	35
H15B	-12035	-7156	-4478	35
H39A	-1730	-3965	-1791	28
H39B	-2238	-4317	-1310	28
H35A	-2499	-2661	-2354	28
H35B	-3495	-2172	-2226	28
H6	-11986	-3596	-3408	38
H7	-12580	-5168	-3075	28
H43A	9	-3880	-1127	45
H43B	-498	-4177	-633	45
H43C	142	-3289	-597	45
H8	-12343	-4700	-3963	34
H28	-5759	-3078	-1323	28
H44A	-2511	-736	-2128	49
H44B	-1505	-1208	-2255	49
H44C	-1416	-648	-1715	49
H18A	-13625	-8058	-3936	56
H18B	-13941	-7476	-4468	56
H18C	-14397	-7254	-3945	56

H42A	-636	-1969	-1150	31
H42B	-732	-2532	-1690	31
H32	-5991	-5172	-359	34
H40A	-1467	-2496	-385	30
H40B	-2081	-3400	-436	30
H33	-4274	-2576	-1501	25
H11A	-10047	-6218	-3101	29
H11B	-10479	-7190	-3114	29
H37A	-2228	-1194	-945	30
H37B	-3327	-1265	-1358	30
H30	-3162	-4500	-681	33
H16A	-13279	-5885	-4448	36
H16B	-13715	-5708	-3912	36
H9A	-10599	-5224	-3911	35
H9B	-11351	-5572	-4450	35
H17A	-9345	-6526	-3931	50
H17B	-10092	-6838	-4480	50
H17C	-9801	-7491	-3980	50
H36	-3308	-2215	-597	30
H4	-10026	-5266	-2423	35
H3	-8908	-4101	-2112	46
H31	-4184	-5415	-257	34
H2A	-9274	-2689	-2470	51