Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry.

Supporting Information for:

Copper-catalyzed reaction of oximes with diisopropyl azodicarboxylate: An alternative method for the synthesis of oxime carbonates

Muhammad Usman, Zhi-Hui Ren, Yao-Yu Wang and Zheng-Hui Guan*

Key Laboratory of Synthetic and Natural Functional Molecule Chemistry of Ministry of Education, Department of Chemistry & Materials Science, Northwest University, Xi'an 710069, P. R. China

E-mail: guanzhh@nwu.edu.cn

CONTENTS

1. General information

[1]H, [13]C and [19]F NMR spectra were recorded at 400, 100 and 376 MHz respectively in CDCl3. Multiplicities were given as: s = singlet, d = doublet, dd = doublets of doublet, t = triplet, q = quartet and m = multiplet. Coupling constants, *J* were reported in Hertz unit (Hz). All products were further characterized by HRMS (ESI-TOF-Q). Flash column chromatography was performed with SiO_2 (Silicycle Silica Gel 60 (200-300 mesh)). Analytical thin layer chromatography (TLC) plates (silica gel GF254) were analyzed under UV light. All reactions were carried out under argon atmosphere in dried glassware with magnetic stirring. Solvents were distilled by standard methods. Reagents were purchased from commercial suppliers and used without further purification unless otherwise noted.

2. Synthesis of oximes

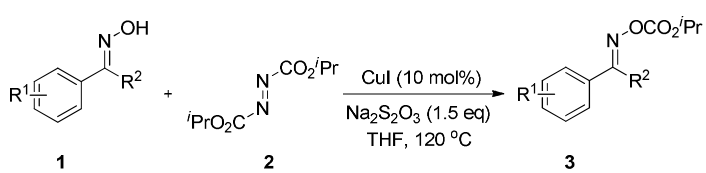
The ketoximes are very useful molecules, which can easily prepare from the corresponding ketones according to literature procdures[1-3] and can be used in the reaction without further purification.

(1) H. Zhao, C. P. Vandenbossche, S. G. Koenig, S. P. Singh and R. P. Bakale, *Org Lett.*, 2008, **10**, 505.

(2) G. Zhang, X. Wen, Y. Wang, W. Mo and C. Ding, *J. Org. Chem.*, 2011, **76**, 4665.

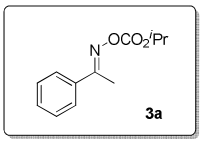
(3) P. C. Too, Y.-F. Wang and S. Chiba, *Org Lett.*, 2010, **12**, 5688.

3. Typical procedure for synthesis of oxime carbonates

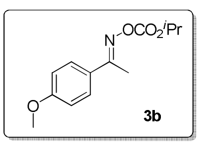


In a 10 mL round bottom flask, the mixture of ketoxime **1** (0.2 mmol), diisopropyl azodicarboxylate **2** (0.8 mmol), $Na_2S_2O_3$ (0.3 mmol, 74.4 mg) and CuI (10 mol%, 3.8 mg) was stirred in THF (2 mL) at 120 ^oC under Ar. When the reaction was completed (detected by TLC), the reaction mixture was cooled to room temperature. The reaction was quenched with H_2O (10 mL) and extracted with EtOAc (3 × 10 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and then evaporated under vacuum. The residue was purified by column chromatography on silica gel to afford the corresponding oxime carbonates **3** with hexane/ethyl acetate as the eluent.

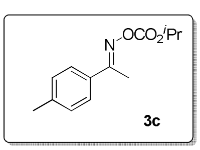
4. Characterization data of oxime carbonates.



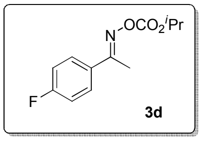
3a: Yield: 98% (43.3 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.74 (d, *J* = 6.8 Hz, 2 H), 7.44-7.38 (m, 3 H), 5.08-5.02 (m, 1 H), 2.40 (s, 3 H), 1.38 (d, *J* = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 162.2, 153.4, 134.6, 130.5, 128.5, 126.9, 72.8, 21.7, 14.3; HRMS Calcd (ESI) m/z for $C_{12}H_{15}NNaO_3$ $[M+Na]^+$ 244.0944, found 244.0938.



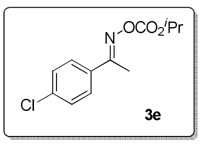
3b: Yield: 95% (47.7 mg), white solid, mp 53-55 ^{o}C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.71 (d, *J* = 7.6 Hz, 2 H), 6.91 (d, *J* = 7.6 Hz, 2 H), 5.06-5.03 (m, 1 H), 3.83 (s, 3 H), 2.36 (s, 3 H), 1.38 (d, *J* = 4.8 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.6, 161.4, 153.4, 128.4, 126.8, 113.8, 72.7, 55.3, 21.7, 14.0; HRMS Calcd (ESI) m/z for $C_{13}H_{17}NNaO_4$ $[M+Na]^+$ 274.1050, found 274.1040.



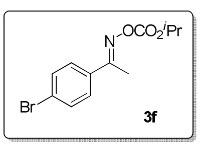
3c: Yield: 84% (39.5 mg), white solid, mp 49-51 ^{o}C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.64 (d, *J* = 8.4 Hz, 2 H), 7.20 (d, *J* = 8.4 Hz, 2 H), 5.06-5.03 (m, 1 H), 2.37 (s, 6 H), 1.38 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 162.1, 153.5, 140.8, 131.8, 129.3, 126.9, 72.8, 21.8, 21.4, 14.2; HRMS Calcd (ESI) m/z for $C_{13}H_{17}NNaO_3$ $[M+Na]^+$ 258.1101, found 258.1094.



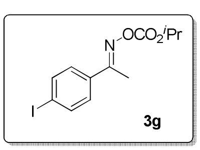
3d: Yield: 62% (29.7 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.77-7.73 (m, 2 H), 7.11-7.07 (m, 2 H), 5.08-5.02 (m, 1 H), 2.38 (s, 3 H), 1.38 (d, J = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 164.2 (d, J_{CF} = 249.4 Hz), 161.2, 153.4, 130.8 (d, J_{CF} = 3.3 Hz), 129.0 (d, J_{CF} = 8.5 Hz), 115.7 (d, J_{CF} = 21.7 Hz), 73.0, 21.8, 14.3; ^{19}F NMR ($CDCl_3$, 376 MHz) δ -109.8 (s, 1 F); HRMS Calcd (ESI) m/z for $C_{12}H_{14}FNNaO_3$ $[M+Na]^+$ 262.0850, found. 262.0845.



3e: Yield: 83% (42.5 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.70 (d, J = 8.4 Hz, 2 H), 7.38 (d, J = 8.4 Hz, 2 H), 5.10-5.02 (m, 1 H), 2.38 (s, 3 H), 1.38 (d, J = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.1, 153.3, 136.7, 133.1, 128.8, 128.3, 73.1, 21.8, 14.2; HRMS Calcd (ESI) m/z for $C_{12}H_{14}ClNNaO_3$ $[M+Na]^+$ 278.0554, found 278.0541.

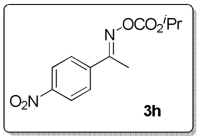


3f: Yield: 80% (48.1 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.66 (d, J = 8.8 Hz, 2 H), 7.53 (d, J = 8.8 Hz, 2 H), 5.08-5.02 (m, 1 H), 2.37 (s, 3 H), 1.38 (d, J = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.2, 153.3, 133.6, 131.8, 128.5, 125.1, 73.1, 21.8, 14.1; HRMS Calcd (ESI) m/z for $C_{12}H_{14}BrNNaO_3$ $[M+Na]^+$ 322.0049, found 322.0038.

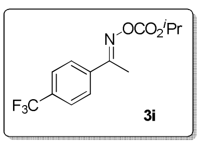


3g: Yield: 58% (40.1 mg), white solid, mp 63 ^{o}C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.74 (d, J = 8.4 Hz, 2 H), 7.48 (d, J = 8.4 Hz, 2 H), 5.08-5.01 (m, 1 H), 2.36 (s, 3 H), 1.38

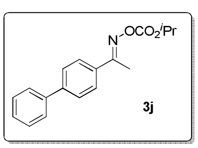
(d, J = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.3, 153.3, 137.7, 134.2, 128.6, 97.2, 73.1, 21.8, 14.1; HRMS Calcd (ESI) m/z for $C_{12}H_{14}INNaO_3$ $[M+Na]^+$ 369.9911, found 369.9898.



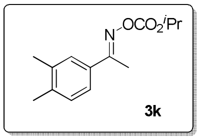
3h: Yield: 88% (46.9 mg), almost white solid, mp 101-103 ^{o}C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.26 (d, J = 9.2 Hz, 2 H), 7.94 (d, J = 8.8 Hz, 2 H), 5.10-5.04 (m, 1 H), 2.45 (s, 3 H), 1.40 (d, J = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 160.2, 153.0, 149.0, 140.7, 128.0, 123.7, 73.5, 21.7, 14.3; HRMS Calcd (ESI) m/z for $C_{12}H_{14}N_2NaO_5$ $[M+Na]^+$ 289.0795, found 289.0786.



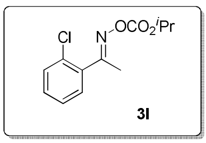
3i: Yield: 75% (43.5 mg), white solid, mp 57-59 ^{o}C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.87 (d, J = 8.0 Hz, 2 H), 7.67 (d, J = 8.4 Hz, 2 H), 5.09-5.05 (m, 1 H), 2.42 (s, 3 H), 1.39 (d, J = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 160.9, 153.2, 138.2, 132.3 (d, J_{CF} = 32.5 Hz), 127.4, 125.5 (q, J_{CF} = 3.6 Hz), 123.8 (d, J_{CF} = 270.7 Hz), 73.2, 21.7, 14.3; ^{19}F NMR ($CDCl_3$, 376 MHz): δ -62.9 (s, 3 F); HRMS Calcd (ESI) m/z for $C_{13}H_{14}F_3NNaO_3$ $[M+Na]^+$ 312.0818, found 312.0806.



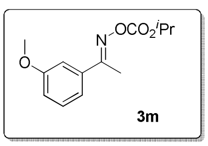
3j: Yield: 90% (53.5 mg), white solid, mp 144-146 ^{o}C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.83 (d, J = 8.4 Hz, 2 H), 7.62 (t, J = 8.4 Hz, 4 H), 7.45 (t, J = 7.2 Hz, 2 H), 7.36 (t, J = 7.2 Hz, 1 H), 5.10-5.03 (m, 1 H), 2.42 (s, 3 H), 1.39 (d, J = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.7, 153.4, 143.2, 140.0, 133.4, 128.8, 127.8, 127.4, 127.1, 127.0, 72.8, 21.7, 14.1; HRMS Calcd (ESI) m/z for $C_{18}H_{19}NNaO_3$ $[M+Na]^+$ 320.1257, found 320.1237.



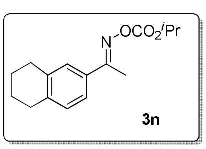
3k: Yield: 91% (45.4 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.55 (s, 1 H), 7.44 (dd, *J* = 7.6, 1.6 Hz, 1 H), 7.15 (d, *J* = 8.0 Hz, 1 H), 5.07-5.01 (m, 1 H), 2.36 (s, 3 H), 2.28 (s, 6 H), 1.37 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 162.3, 153.5, 139.5, 136.8, 132.2, 129.8, 128.0, 124.5, 72.7, 21.8, 19.7, 19.7, 14.2; HRMS Calcd (ESI) m/z for $C_{14}H_{19}NNaO_3$ $[M+Na]^+$ 272.1257, found 272.1250.



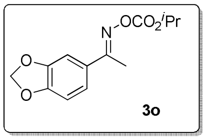
3l: Yield: 53% (26.9 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.42-7.29 (m, 4 H), 5.09-5.04 (m, 1 H), 2.39 (s, 3 H), 1.38 (d, *J* = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 163.8, 153.2, 135.1, 132.5, 130.8, 130.4, 130.0, 126.9, 73.1, 21.8, 17.9; HRMS Calcd (ESI) m/z for $C_{12}H_{14}ClNNaO_3$ $[M+Na]^+$ 278.0554, found 278.0540.



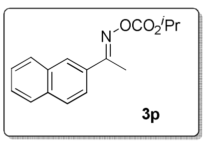
3m: Yield: 89% (44.9 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.31-7.27 (m, 3 H), 7.00-6.97 (m, 1 H), 5.07-5.03 (m, 1 H), 3.83 (s, 3 H), 2.37 (s, 3 H), 1.38 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 162.2, 159.7, 153.4, 136.1, 129.5, 119.5, 116.5, 112.1, 72.9, 55.4, 21.8, 14.4; HRMS Calcd (ESI) m/z for $C_{13}H_{17}NNaO_4$ $[M+Na]^+$ 274.1050, found .274.1043.



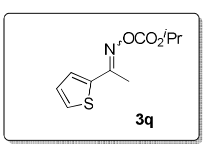
3o: Yield: 88% (48.6 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.47 (s, 1 H), 7.44 (d, *J* = 8.0 Hz, 1 H), 7.09 (d, *J* = 8.0 Hz, 1 H), 5.09-5.00 (m, 1 H), 2.78 (s, 4 H), 2.36 (s, 3 H), 1.80-1.78 (m, 4 H), 1.38 (d, *J* = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 162.3, 153.4, 140.0, 137.3, 131.6, 129.2, 127.5, 123.9, 72.7, 29.3, 29.2, 22.9, 22.9, 21.7, 14.2; HRMS Calcd (ESI) m/z for $C_{16}H_{21}NNaO_3$ $[M+Na]^+$ 298.1414, found 298.1402.



3p: Yield: 68% (36.1 mg), white solid, mp 100-102 °C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.31 (d, *J* = 1.6 Hz, 1 H), 7.22 (dd, *J* = 8.0, 1.6 Hz, 1 H), 6.82 (d, *J* = 8.0 Hz, 1 H), 6.00 (s, 2 H), 5.07-4.99 (m, 1 H), 2.34 (s, 3 H), 1.38 (d, *J* = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.5, 153.4, 149.7, 148.0, 128.7, 121.7, 108.1, 107.1, 101.6, 72.9, 21.8, 14.2; HRMS Calcd (ESI) m/z for $C_{13}H_{15}NNaO_5$ $[M+Na]^+$ 288.0842, found 288.0828.



3n: Yield: 89% (48.4 mg), white solid, mp 85-86 °C; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.14 (s, 1 H), 7.96 (dd, *J* = 8.8, 2.0 Hz, 1 H), 7.89-7.83 (m, 3 H), 7.52-7.50 (m, 2 H), 5.10-5.04 (m, 1 H), 2.50 (s, 3 H), 1.39 (d, *J* = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 161.9, 153.4, 134.2, 132.8, 132.0, 128.7, 128.2, 127.6, 127.3, 127.2, 126.5, 123.7, 72.9, 21.8, 14.1; HRMS Calcd (ESI) m/z for $C_{16}H_{17}NNaO_3$ $[M+Na]^+$ 294.1101, found 294.1088.



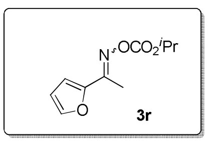
3q: Yield: 98% (44.6 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.65 (dd, *J* = 5.2, 1.2 Hz, 1 H), 7.60 (dd, *J* = 4.0, 1.2 Hz, 1 H), 7.42 (t, *J* = 3.6 Hz, 2 H) 7.15-7.13 (m, 1 H), 7.07-7.05 (m, 1 H), 5.11-5.00 (m, 2 H), 2.49 (s, 4 H), 2.41 (s, 2 H), 1.40-1.36 (m, 12 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 157.6, 153.1, 153.1, 137.7, 132.8, 132.4, 131.7, 129.2, 129.0, 127.2, 126.3, 73.1, 73.0, 21.8, 21.8, 20.0, 14.4; HRMS Calcd (ESI) m/z for $C_{10}H_{13}NNaO_3S$ $[M+Na]^+$ 250.0508, found .250.0502.

The isomers can be separated by careful chromatography on silica gel eluting with

12:1 hexane:ethyl acetate.

3q′: ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.44-7.41 (m, 2 H), 7.08-7.05 (m, 1 H), 5.07-5.00 (m, 1 H), 2.41 (s, 3 H), 1.37 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 157.6, 153.1, 137.7, 129.2, 129.0, 127.2, 73.1, 21.8, 14.4; HRMS Calcd (ESI) m/z for $C_{10}H_{13}NNaO_3S$ $[M+Na]^+$ 250.0508, found .250.0502.

3q″: ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.66 (d, *J* = 5.2 Hz, 1 H), 7.61-7.60 (m, 1 H), 7.15-7.13 (m, 1 H), 5.12-5.04 (m, 1 H), 2.49 (s, 3 H), 1.39 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 153.1, 153.1, 132.8, 132.4, 131.7, 126.3, 73.2, 21.8, 20.1; HRMS Calcd (ESI) m/z for $C_{10}H_{13}NNaO_3S$ $[M+Na]^+$ 250.0508, found .250.0502.



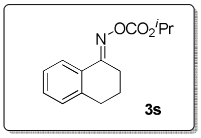
3r: Yield: 96% (40.5 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.54 (s, 2 H), 7.46 (d, *J* = 3.6 Hz, 1 H), 6.90 (d, *J* = 3.2 Hz, 1 H), 6.59-6.58 (m, 1 H), 6.49-6.48 (m, 1 H), 5.08-5.02 (m, 2 H), 2.40 (s, 3 H), 2.32 (s, 3 H), 1.37 (d, *J* = 6.4 Hz, 12 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 153.7, 153.3, 153.1, 150.3, 148.1, 145.0, 144.7, 144.1, 120.4, 113.1, 112.6, 111.7, 73.1, 72.9, 21.8, 21.8, 17.4, 13.0; HRMS Calcd (ESI) m/z for $C_{10}H_{13}NNaO_4$ $[M+Na]^+$ 234.0737, found .234.0739.

The isomers can be separated by careful chromatography on silica gel eluting with 12:1 hexane:ethyl acetate and can be differentiated by their different ^{1}H NMR signal patterns of the furan ring.

3r′: ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.54 (d, *J* = 1.6 Hz, 1 H), 7.46 (d, *J* = 3.6 Hz, 1 H), 6.59-6.58 (m, 1 H), 5.10-5.01 (m, 1 H), 2.40 (s, 3 H), 1.37 (d, *J* = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 153.4, 150.3, 144.7, 144.1, 120.4, 112.6, 72.9, 21.8, 17.5; HRMS Calcd (ESI) m/z for $C_{10}H_{13}NNaO_4$ $[M+Na]^+$ 234.0737, found .234.0733.

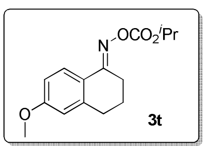
3r″: ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.53 (s, 1 H), 6.90 (d, *J* = 3.6 Hz, 1 H), 6.49-6.48 (m, 1 H), 5.09-5.00 (m, 1 H), 2.32 (s, 3 H), 1.37 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR

(CDCl$_3$, 100 MHz) δ 153.7, 153.1, 148.1, 145.0, 113.2, 111.7, 73.1, 21.8, 13.0; HRMS Calcd (ESI) m/z for $C_{10}H_{13}NNaO_4$ $[M+Na]^+$ 234.0737, found .234.0739.



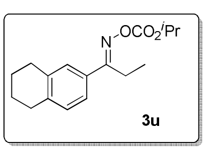
3s

3s: Yield: 88% (43.6 mg), transparent oil; ^{1}H NMR (CDCl$_3$, 400 MHz) δ 8.16 (d, *J* = 8.0 Hz, 1 H), 7.33 (td, *J* = 7.6, 1.6 Hz, 1 H), 7.23 (t, *J* = 8.0 Hz, 1 H), 7.17 (d, *J* = 7.6 Hz, 1 H), 5.09-5.00 (m, 1 H), 2.89 (t, *J* = 6.4 Hz, 2 H), 2.78 (t, *J* = 6.0 Hz, 2 H), 1.91-1.85 (m, 2 H), 1.38 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR (CDCl$_3$, 100 MHz) δ 161.0, 153.4, 140.7, 130.6, 128.7, 128.6, 126.5, 125.5, 72.7, 29.4, 25.4, 21.7, 21.1; HRMS Calcd (ESI) m/z for $C_{14}H_{17}NNaO_3$ $[M+Na]^+$ 270.1101, found 270.1088.



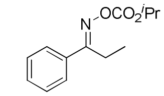
3t

3t: Yield: 77% (42.6 mg), white solid, mp 85-87 ^{o}C; ^{1}H NMR (CDCl$_3$, 400 MHz) δ 8.10 (d, *J* = 8.8 Hz, 1 H), 6.78 (dd, *J* = 8.8, 2.4 Hz, 1 H), 6.66 (d, *J* = 2.4 Hz, 1 H), 5.05-5.02 (m, 1 H), 3.82 (s, 3 H), 2.86 (t, *J* = 6.8 Hz, 2 H), 2.74 (t, *J* = 6.0 Hz, 2 H), 1.89-1.83 (m, 1 H), 1.37 (d, *J* = 6.0 Hz, 6 H); ^{13}C NMR (CDCl$_3$, 100 MHz) δ 161.4, 160.9, 153.6, 142.8, 127.4, 121.4, 113.0, 112.9, 72.7, 55.3, 29.8, 25.4, 21.8, 21.3; HRMS Calcd (ESI) m/z for $C_{15}H_{19}NNaO_4$ $[M+Na]^+$ 300.1206, found 300.1192.



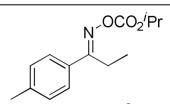
3u

3u: Yield: 82% (47.2 mg), transparent oil; ^{1}H NMR (CDCl$_3$, 100 MHz) δ 7.45 (s, 1 H), 7.42 (d, *J* = 8.0 Hz, 1 H), 7.09 (d, *J* = 8.0 Hz, 1 H), 5.07-5.01 (m, 1 H), 2.87-2.81 (m, 2 H), 2.78 (d, *J* = 2.8 Hz, 4 H), 1.81-1.78 (m, 4 H), 1.38 (d, *J* = 6.4 Hz, 6 H), 1.18 (t, *J* = 7.6 Hz, 3 H); ^{13}C NMR (CDCl$_3$, 100 MHz) δ 167.2, 153.6, 140.0, 137.4, 130.5, 129.3, 127.8, 124.1, 72.7, 29.3, 29.3, 23.0, 22.9, 21.8, 21.4, 11.4; HRMS Calcd (ESI) m/z for $C_{17}H_{23}NNaO_3$ $[M+Na]^+$ 312.1570, found 312.1550.



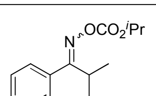
3v

3v: Yield: 77% (36.1 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.72 (d, *J* = 6.4 Hz, 2 H), 7.44-7.38 (m, 3 H), 5.08-5.02 (m, 1 H), 2.90-2.84 (m, 2 H), 1.38 (d, *J* = 6.4 Hz, 6 H), 1.19 (t, *J* = 7.6 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 167.2, 153.6, 133.7, 130.5, 128.6, 127.3, 72.9, 21.8, 21.6, 11.4; HRMS Calcd (ESI) m/z for $C_{13}H_{17}NNaO_3$ $[M+Na]^+$ 258.1101, found 258.1090.



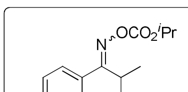
3w

3w: Yield: 79% (39.6 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.62 (d, *J* = 8.0 Hz, 2 H), 7.21 (d, *J* = 8.0 Hz, 2 H), 5.07-5.01 (m, 1 H), 2.87-2.82 (m, 2 H), 2.37 (s, 3 H), 1.38 (d, *J* = 6.0 Hz, 6 H), 1.18 (t, *J* = 7.6 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 167.0, 153.7, 140.7, 130.7, 129.3, 127.1, 72.8, 21.8, 21.4, 21.4, 11.4; HRMS Calcd (ESI) m/z for $C_{14}H_{19}NNaO_3$ $[M+Na]^+$ 272.1257, found 272.1242.



3x

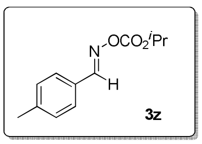
3x: Yield: 85% (42.3 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.44-7.35 (m, 8 H), 7.20-7.19 (m, 1 H), 7.18-7.17 (m, 1 H), 5.07-5.01 (m, 1 H), 4.94-4.88 (m, 1 H), 3.63-3.56 (m, 1 H), 3.03-2.96 (m, 1 H), 1.37 (d, *J* = 6.4 Hz, 7 H), 1.25 (d, *J* = 6.0 Hz, 6 H), 1.21 (d, *J* = 6.8 Hz, 7 H), 1.17 (d, *J* = 6.8 Hz, 4 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.9, 170.8, 153.8, 153.6, 133.6, 132.5, 129.4, 128.9, 128.2, 128.2, 127.0, 72.8, 72.6, 35.0, 29.5, 21.8, 21.7, 19.9, 19.6; HRMS Calcd (ESI) m/z for $C_{14}H_{19}NNaO_3$ $[M+Na]^+$ 272.1257, found 272.1245.



3y

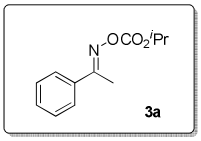
3y: Yield: 87% (46.0 mg), transparent oil; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.34 (d, *J* =

8.0 Hz, 2 H), 7.23-7.17 (m, 4 H), δ 7.09 (d, J = 8.0 Hz, 2 H), 5.06-5.00 (m, 1 H), 4.94-4.88 (m, 1 H), 3.60-3.53 (m, 1 H), 3.01-2.95 (m, 1 H), 2.37 (d, J = 5.6 Hz, 6 H), 1.36 (d, J = 6.4 Hz, 4 H), 1.26 (d, J = 6.4 Hz, 8 H), 1.21 (d, J = 7.2 Hz, 5 H), 1.17 (d, J = 6.8 Hz, 7 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.8, 170.8, 153.8, 153.6, 139.5, 138.9, 130.8, 129.6, 128.9, 128.9, 128.1, 127.0, 72.7, 72.5, 35.0, 29.6, 21.8, 21.7, 21.4, 21.3, 19.9, 19.6; HRMS Calcd (ESI) m/z for $C_{15}H_{21}NNaO_3$ $[M+Na]^+$ 286.1414, found 286.1400.

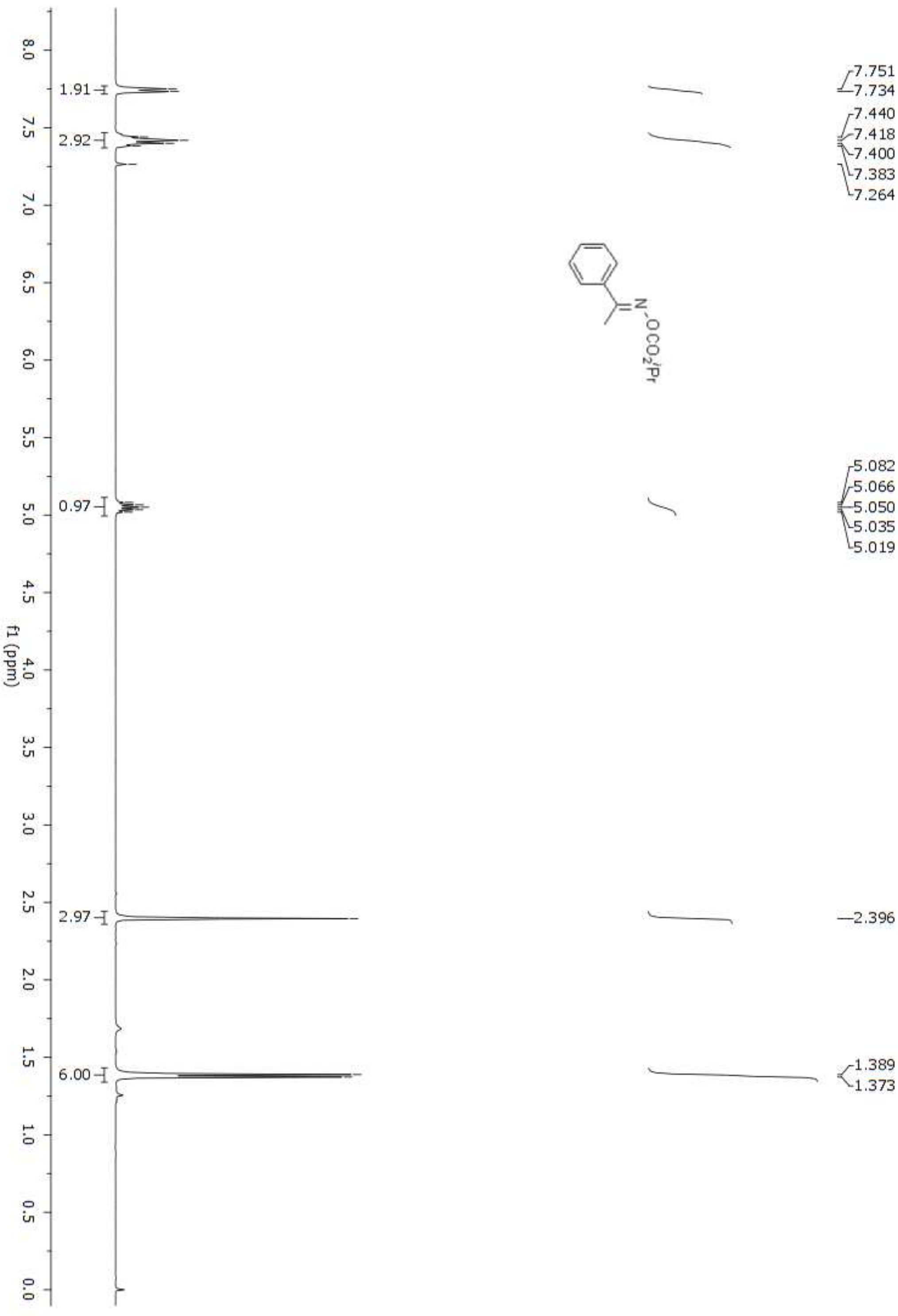


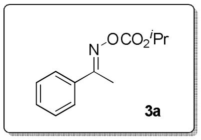
3z: Yield: 19% (43.1 mg), white solid, mp 74-76 ^oC; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 8.30 (s, 1 H), 7.62 (d, J = 8.0 Hz, 2 H), 7.23 (d, J = 8.0 Hz, 2 H), 5.07-5.01 (m, 1 H), 2.39 (s, 3 H), 1.38 (d, J = 6.4 Hz, 6 H); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 155.6, 153.3, 142.3, 129.6, 128.3, 127.1, 73.1, 21.8, 21.6; HRMS Calcd (ESI) m/z for $C_{12}H_{15}NNaO_3$ $[M+Na]^+$ 244.0944, found 244.0952.

5. Copies of ^{1}H and ^{13}C NMR spectra

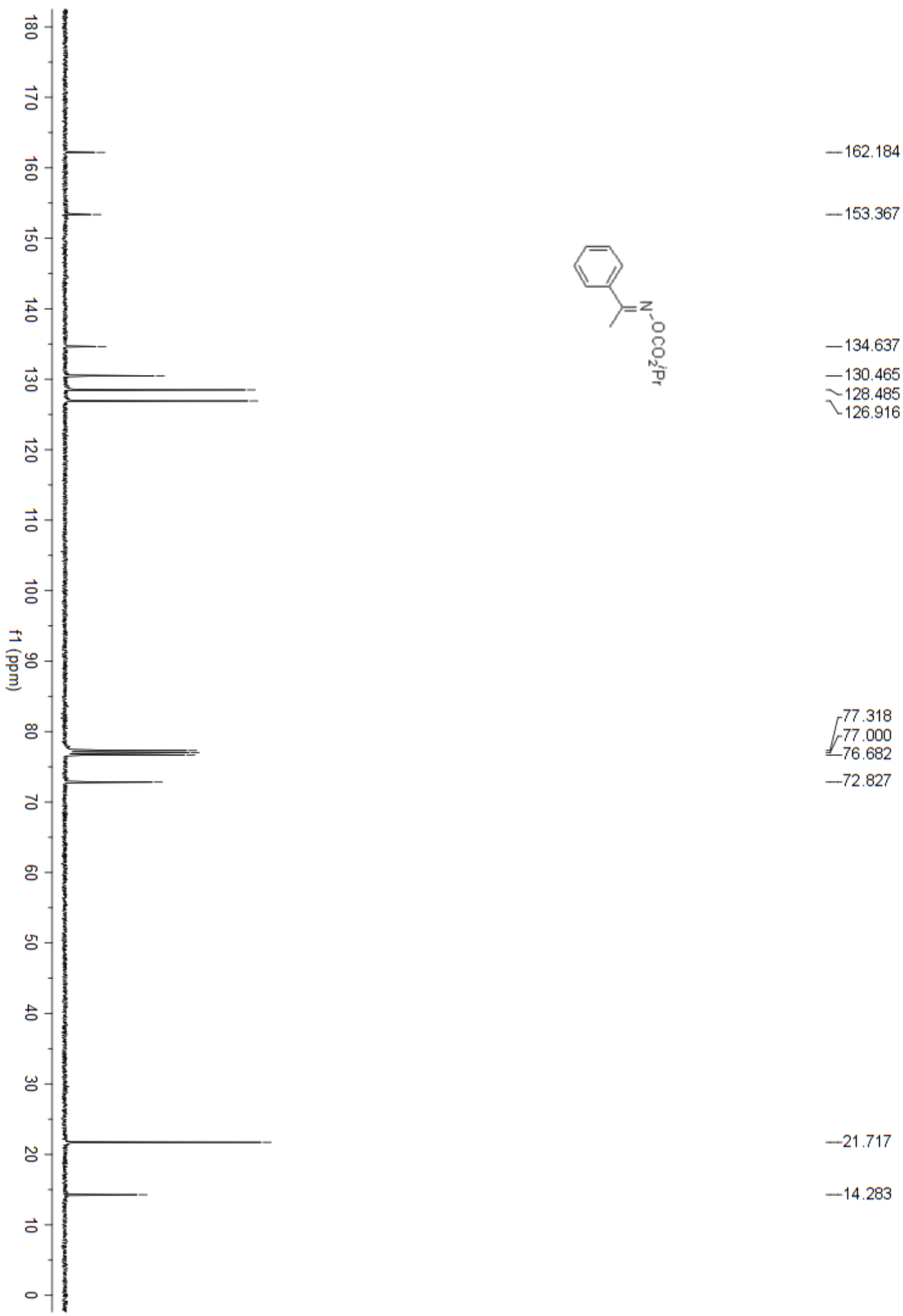


3a

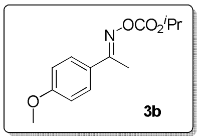


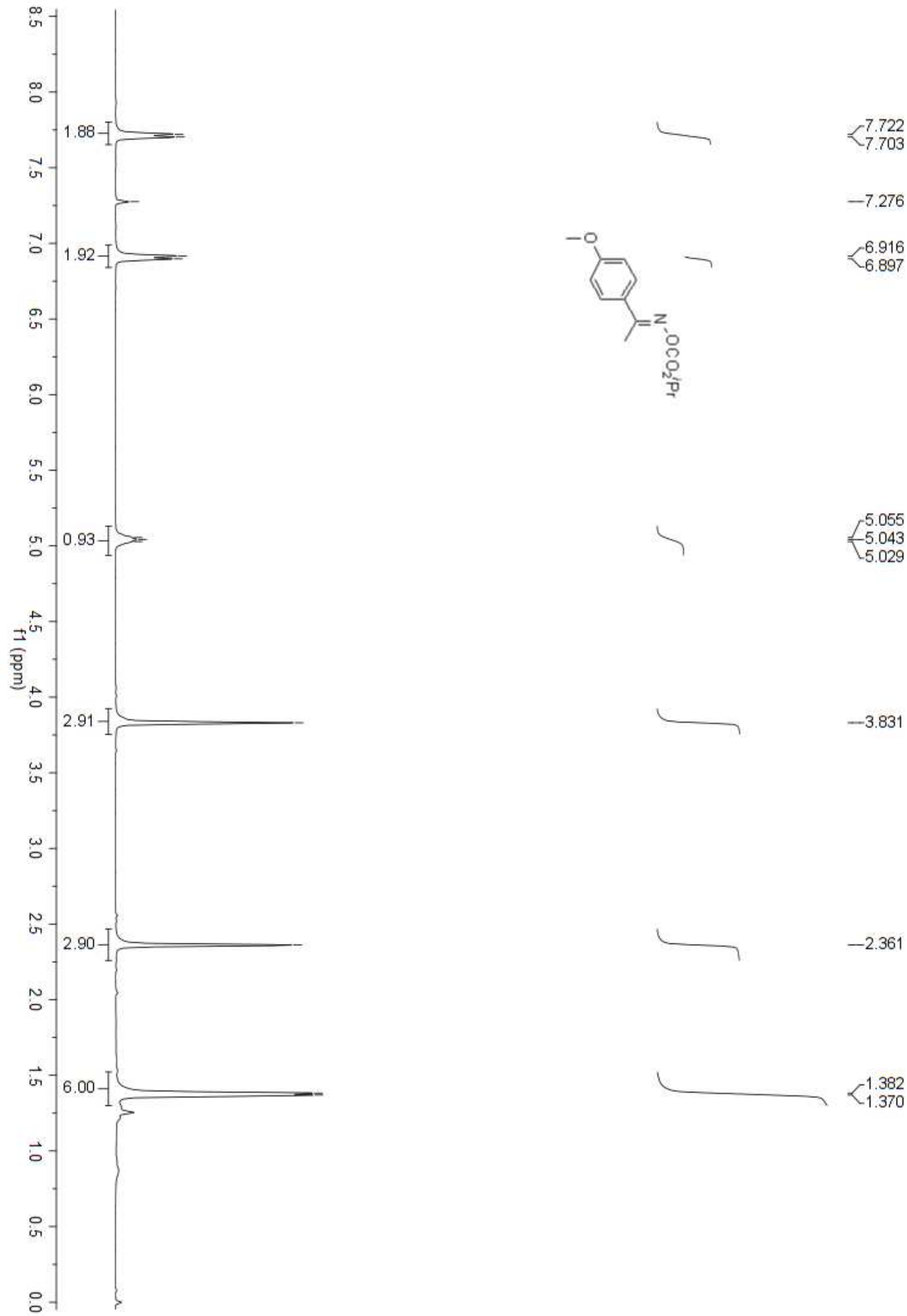


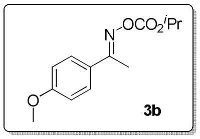
N
OCO2iPr
3a



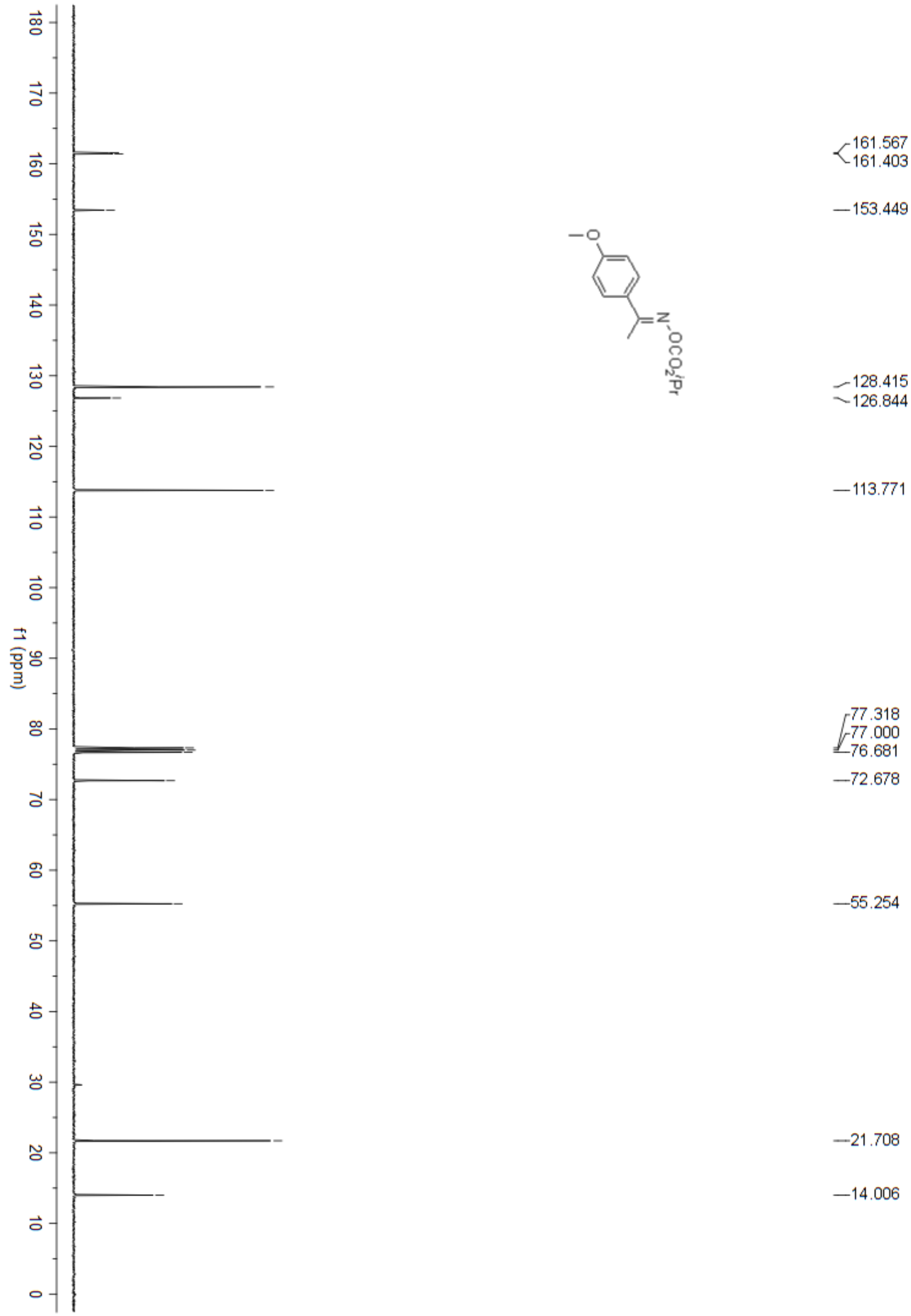
162.184
153.367
134.637
130.465
128.485
126.916
77.318
77.000
76.682
72.827
21.717
14.283
f1 (ppm)

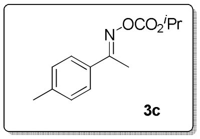

N
OCO2iPr
O
3b

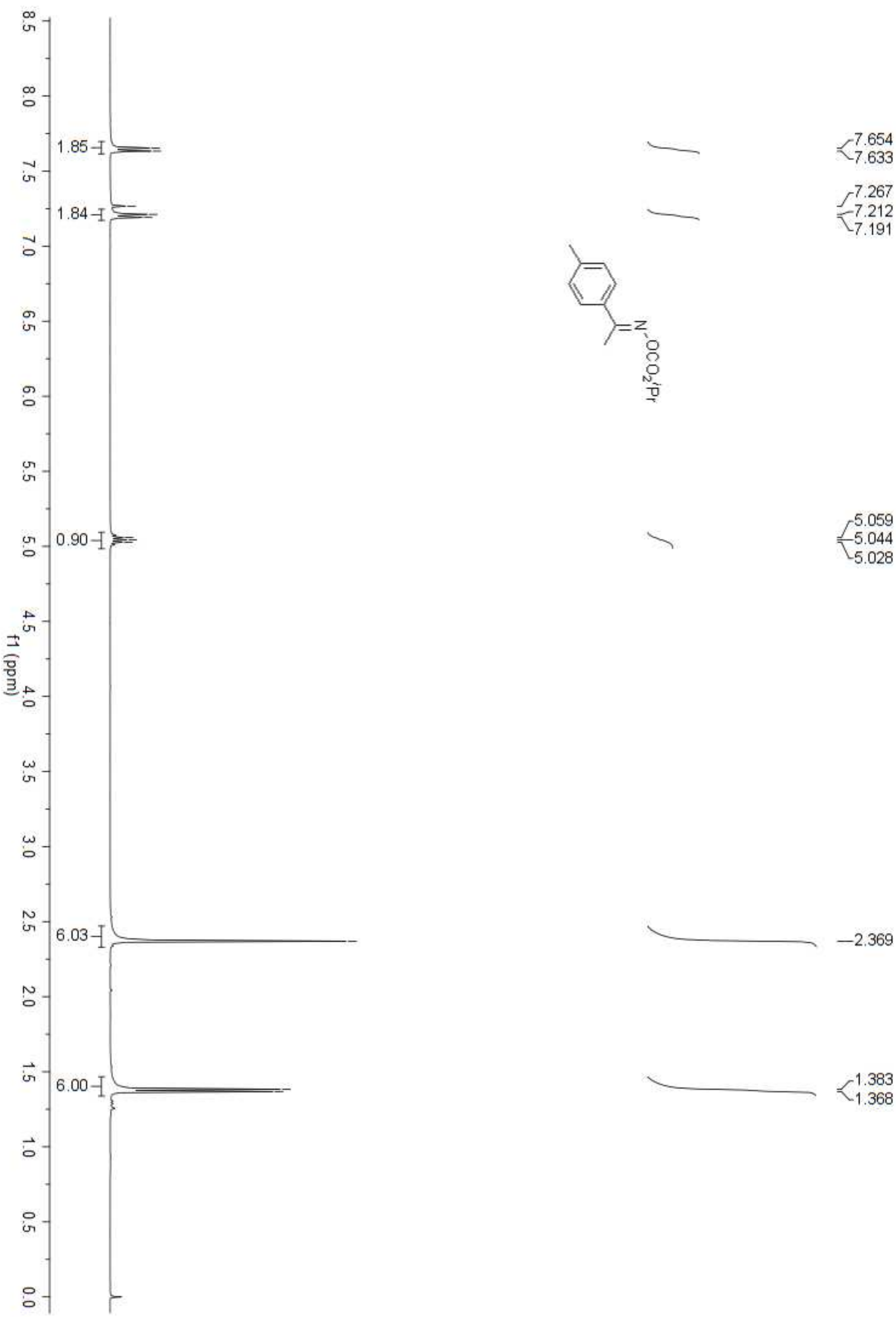

7.722
7.703
7.276
6.916
6.897
5.055
5.043
5.029
3.831
2.361
1.382
1.370
1.88
1.92
0.93
2.91
2.90
6.00
f1 (ppm)

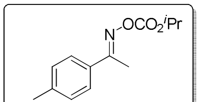


3b

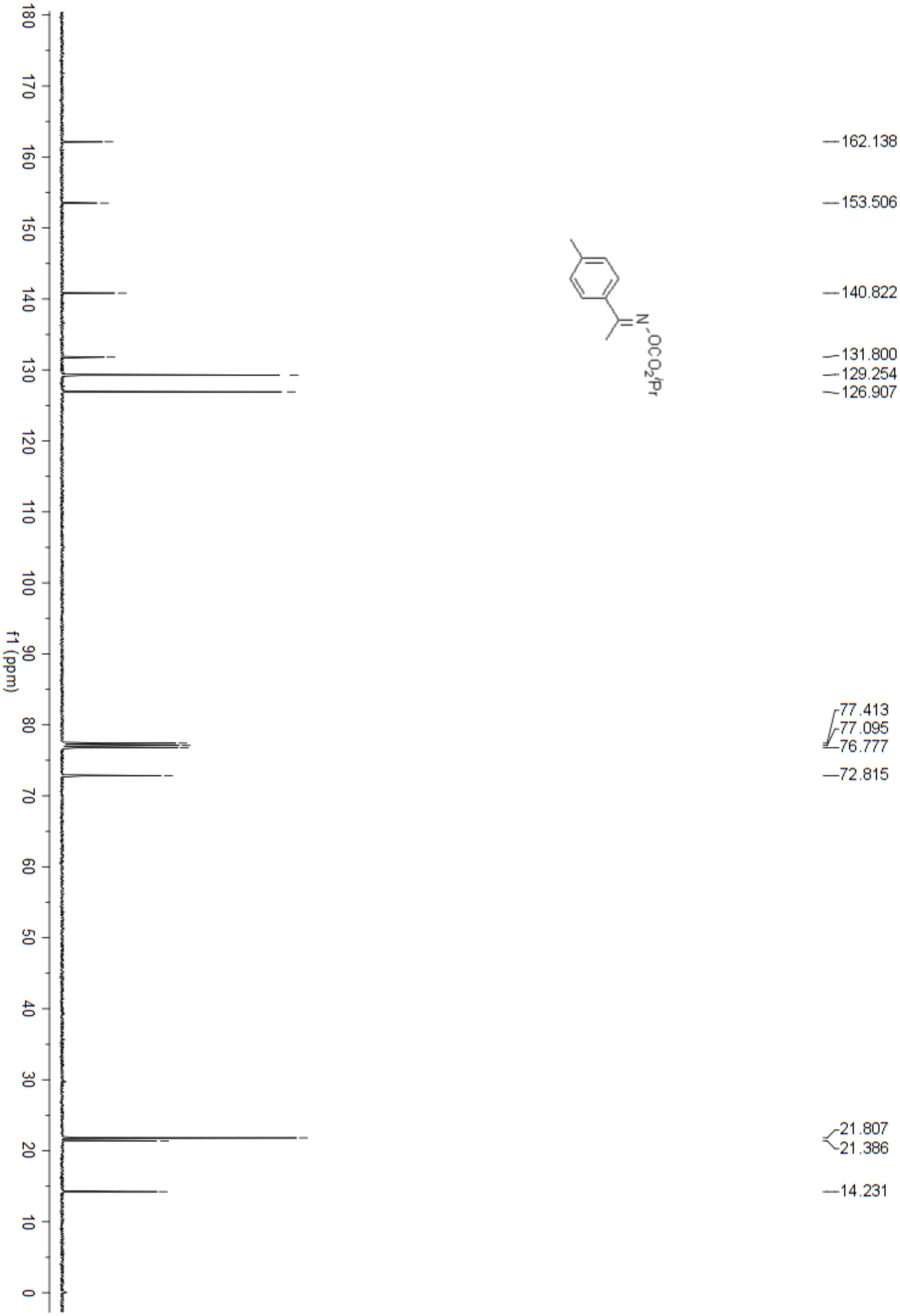

161.567
161.403
153.449
128.415
126.844
113.771
77.318
77.000
76.681
72.678
55.254
21.708
14.006
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

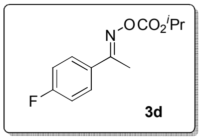

N
OCO2iPr
3c

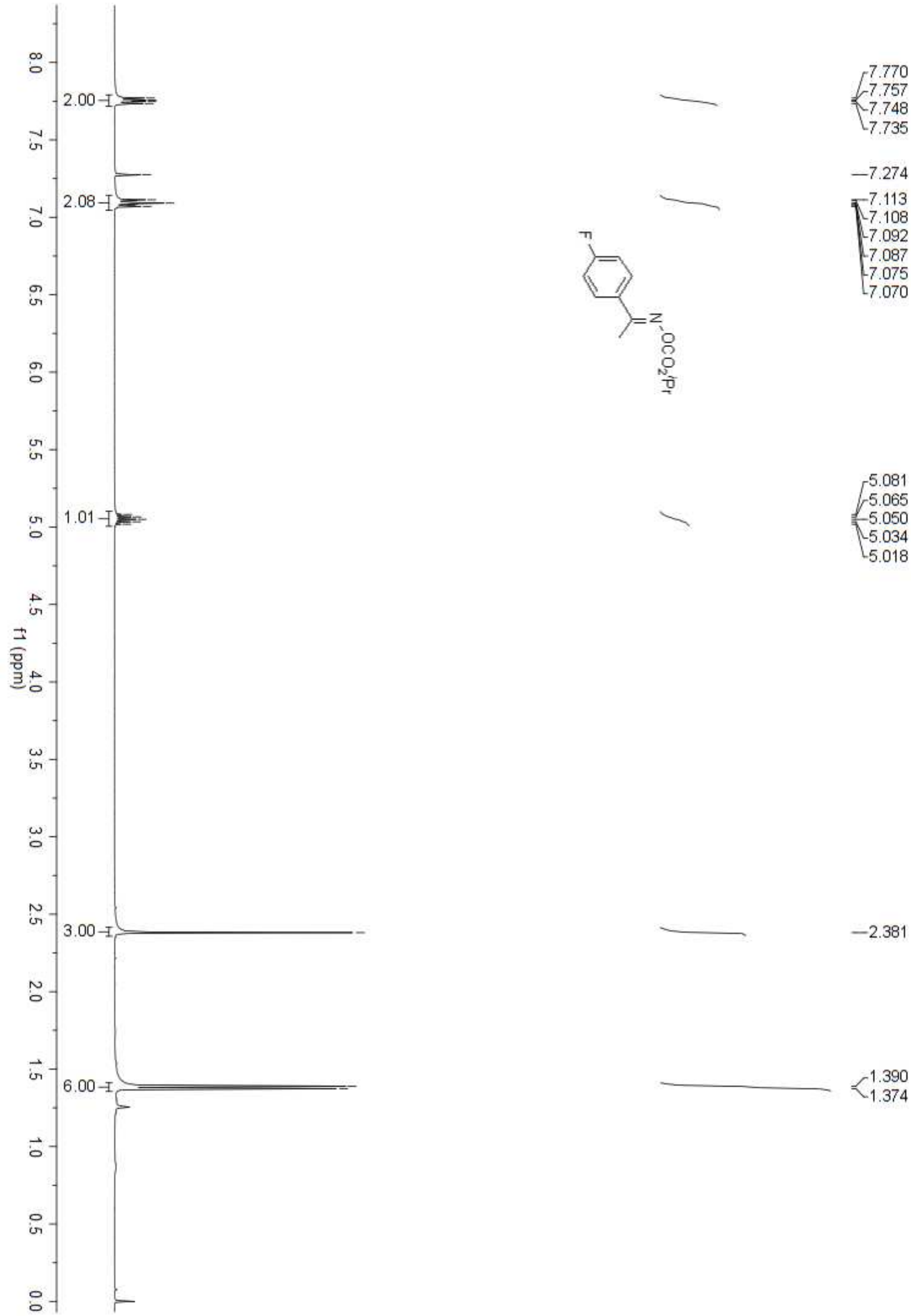

7.654
7.633
7.267
7.212
7.191
5.059
5.044
5.028
2.369
1.383
1.368
1.85
1.84
0.90
6.03
6.00
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

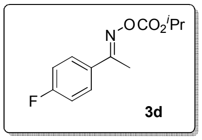

N
OCO2iPr

3c

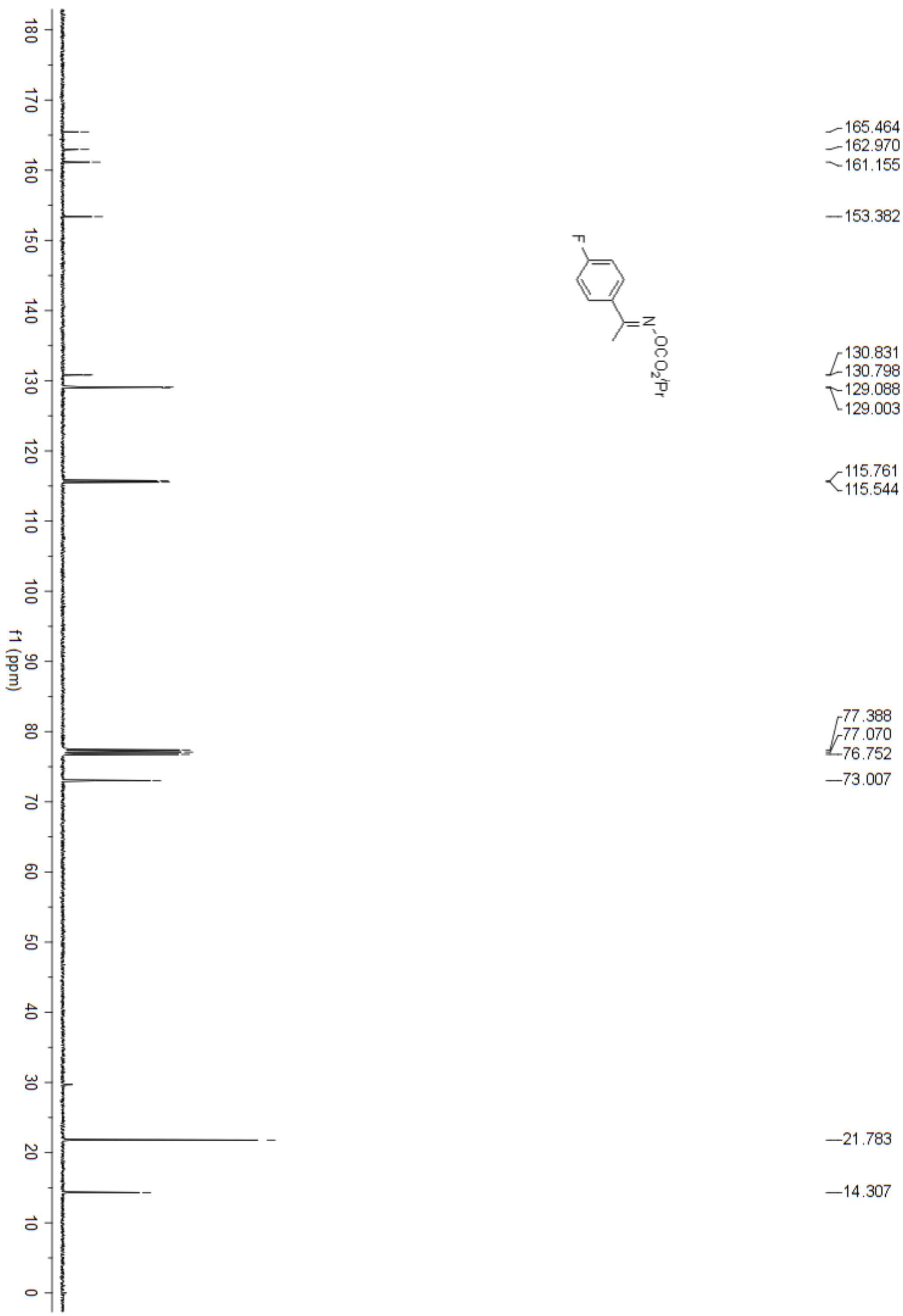

162.138
153.506
140.822
131.800
129.254
126.907
77.413
77.095
76.777
72.815
21.807
21.386
14.231
f1 (ppm)
OCO2iPr


N
OCO2iPr
F
3d





N
OCO2iPr
F
3d



165.464
162.970
161.155
153.382
130.831
130.798
129.088
129.003
115.761
115.544
77.388
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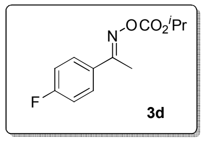
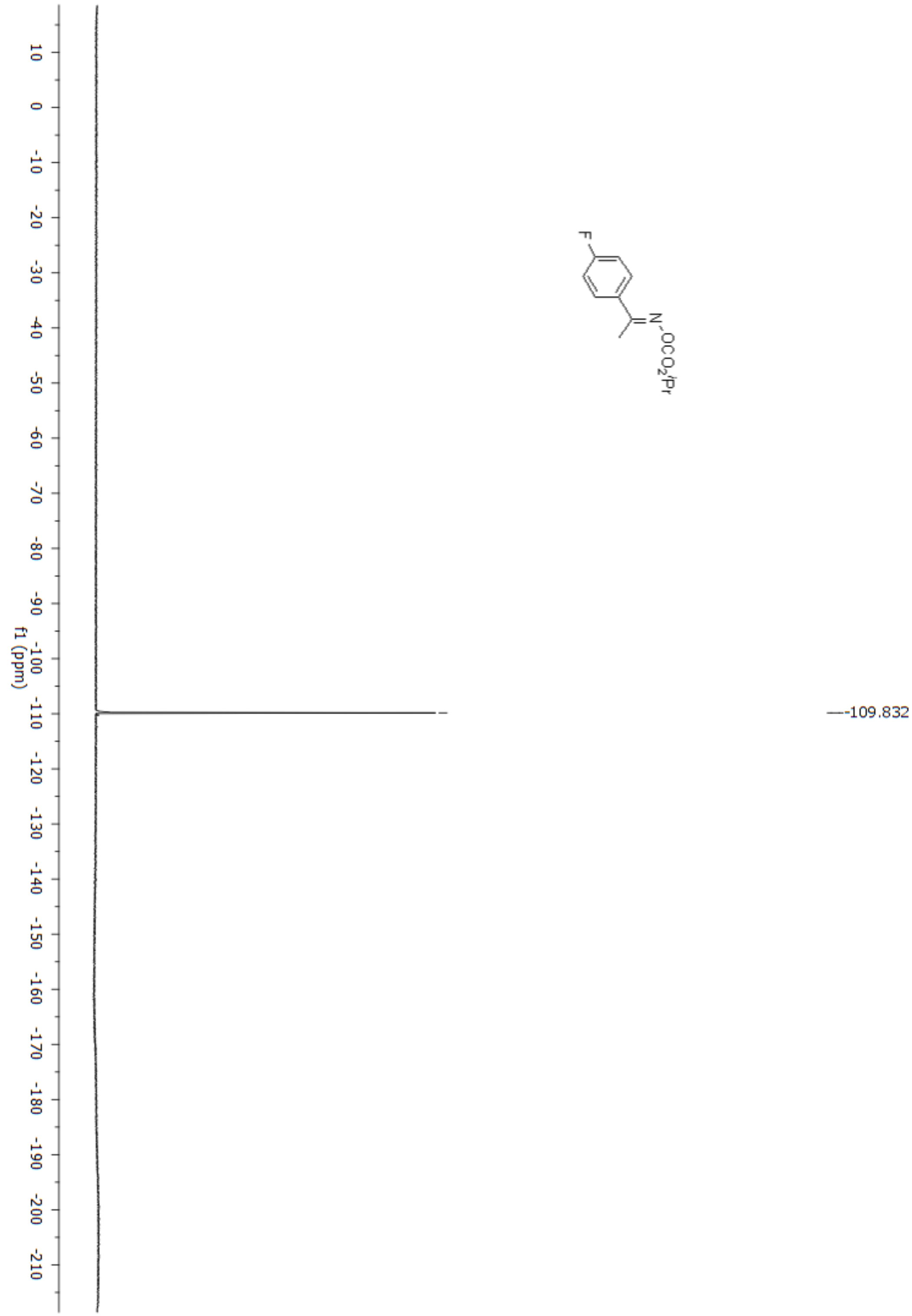
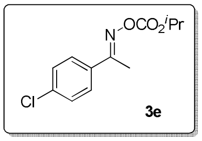
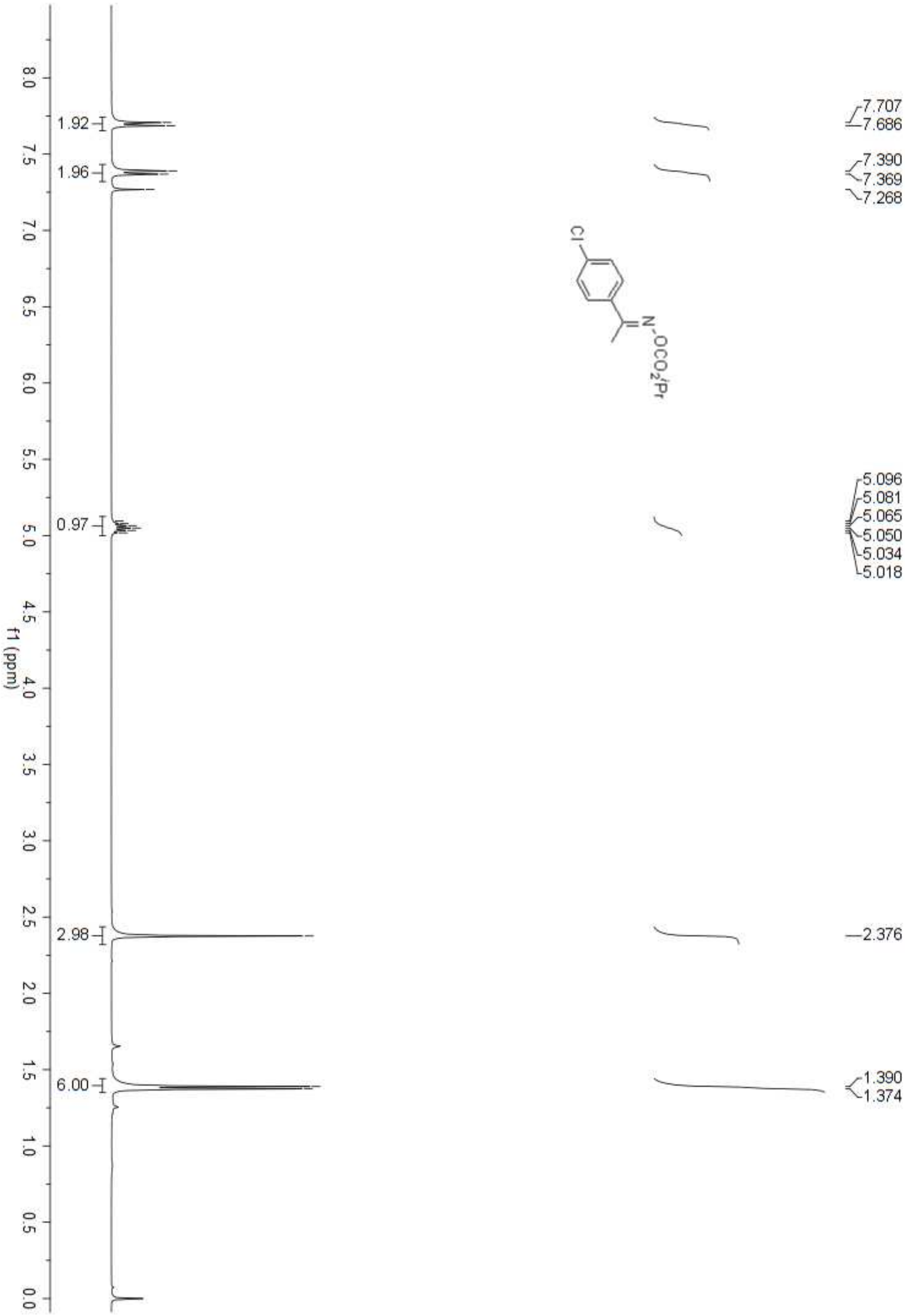
21.783
14.307
f1 (ppm)


N
OCO2iPr
F
3d


-109.832
f1 (ppm)


N
OCO2iPr
Cl

3e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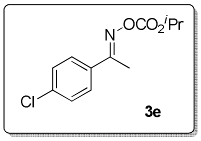
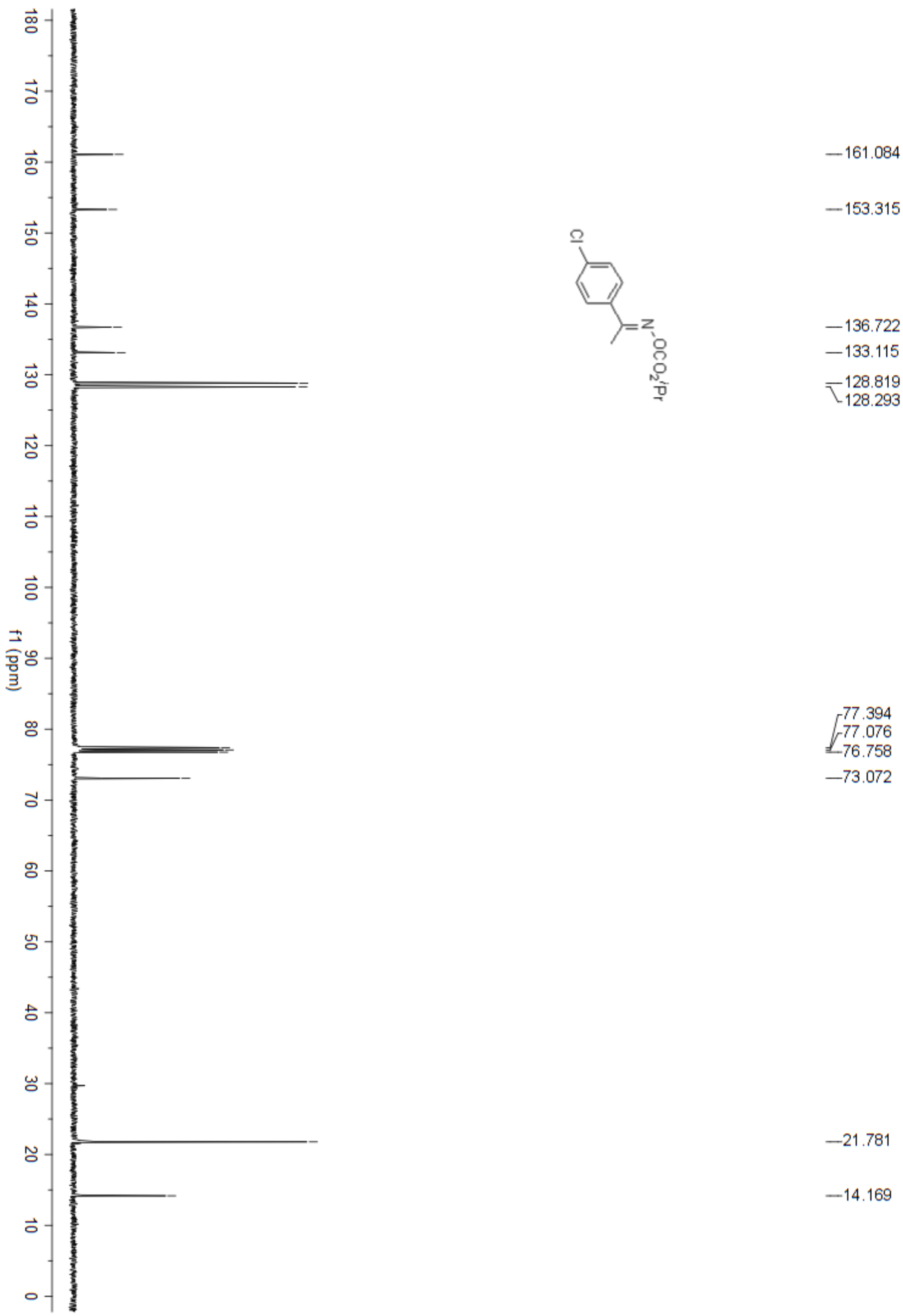
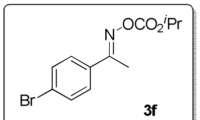
7.686
7.390
7.369
7.268
5.096
5.081
5.065
5.050
5.034
5.018
2.376
1.390
1.374
1.92
1.96
0.97
2.98
6.00
f1 (ppm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Cl
N
OCO2iPr

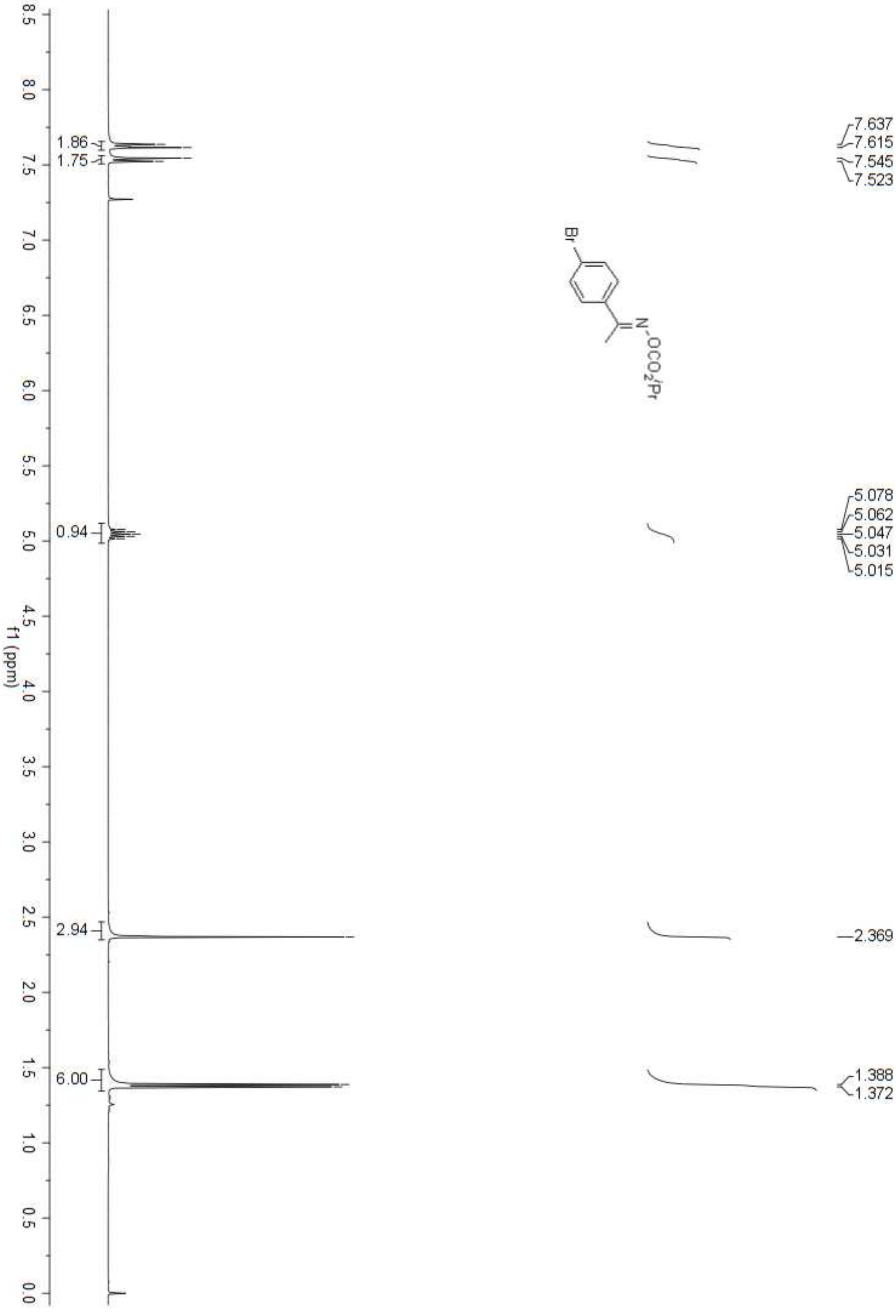

OCO2iPr
N
Cl
3e


161.084
153.315
136.722
133.115
128.819
128.293
77.394
77.076
76.758
73.072
21.781
14.169
f1 (ppm)

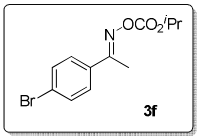


OCO2iPr
N
Br

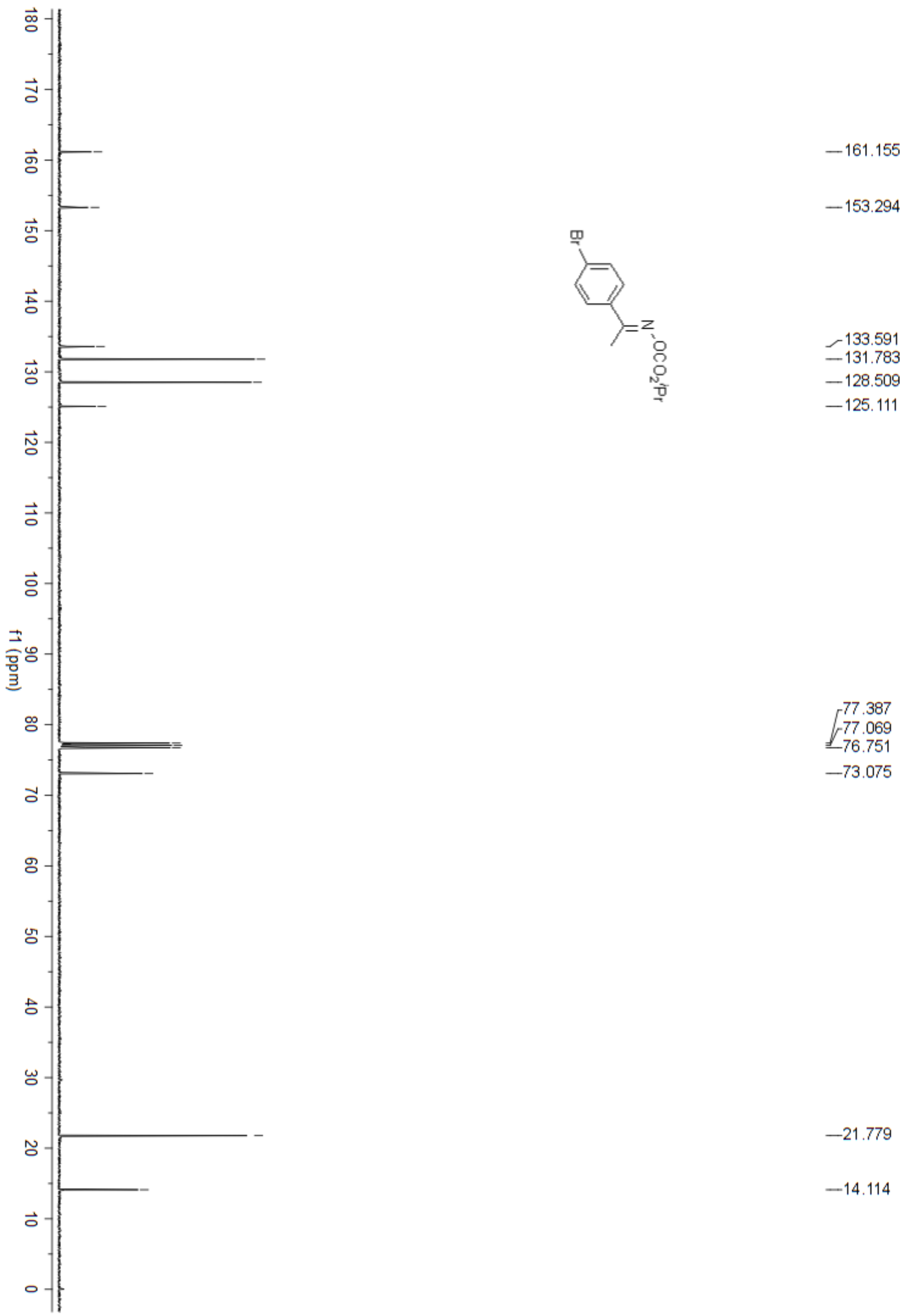
3f



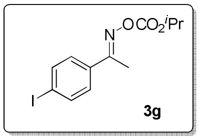
7.637
7.615
7.545
7.523
5.078
5.062
5.047
5.031
5.015
2.369
1.388
1.372
1.86
1.75
0.94
2.94
6.00
f1 (ppm)
Br
N
OCO2iPr

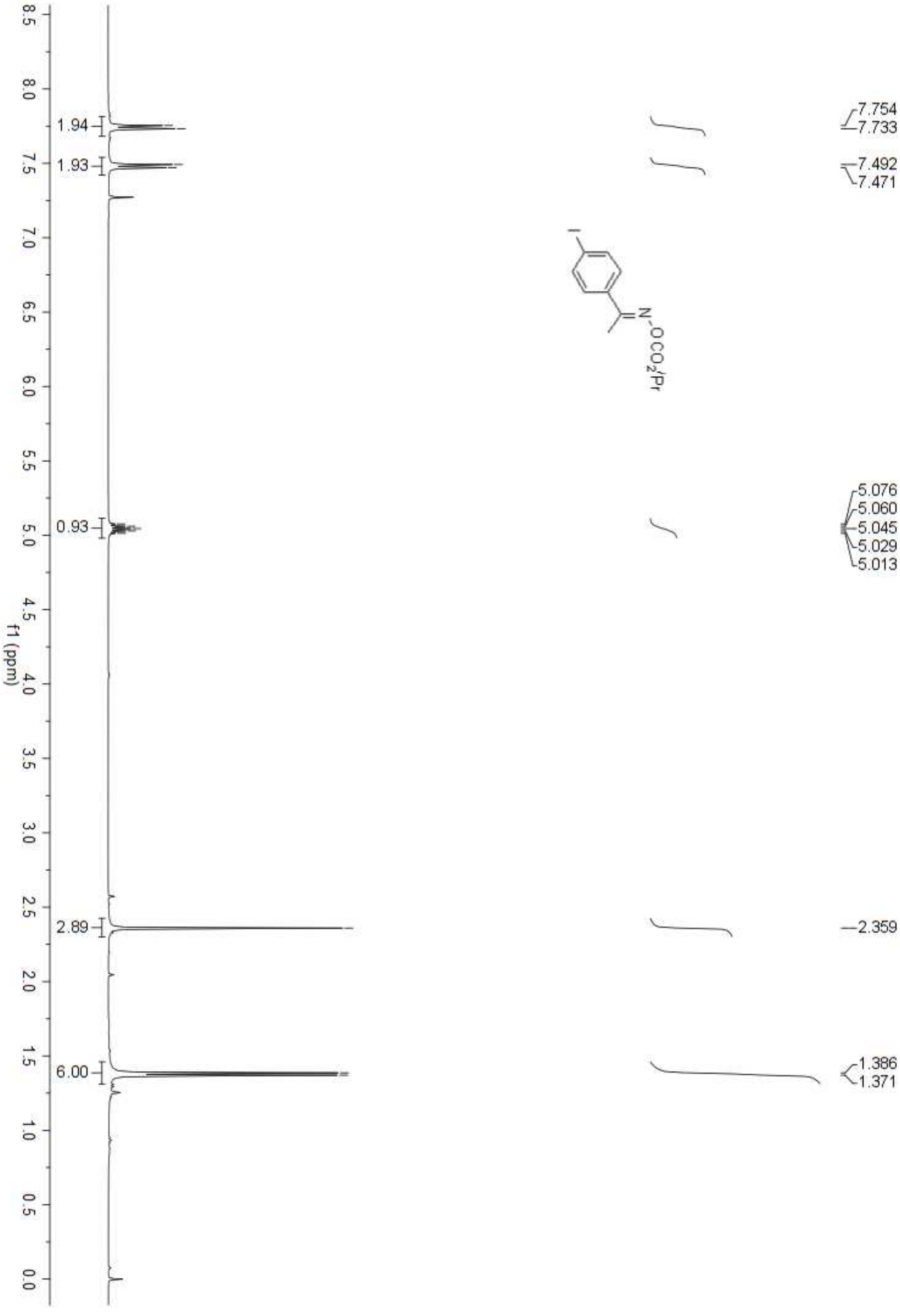


OCO2iPr
N
Br
3f



161.155
153.294
133.591
131.783
128.509
125.111
77.387
77.069
76.751
73.075
21.779
14.114
f1 (ppm)
Br
N
OCO2iPr

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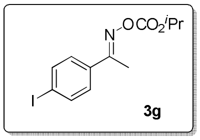
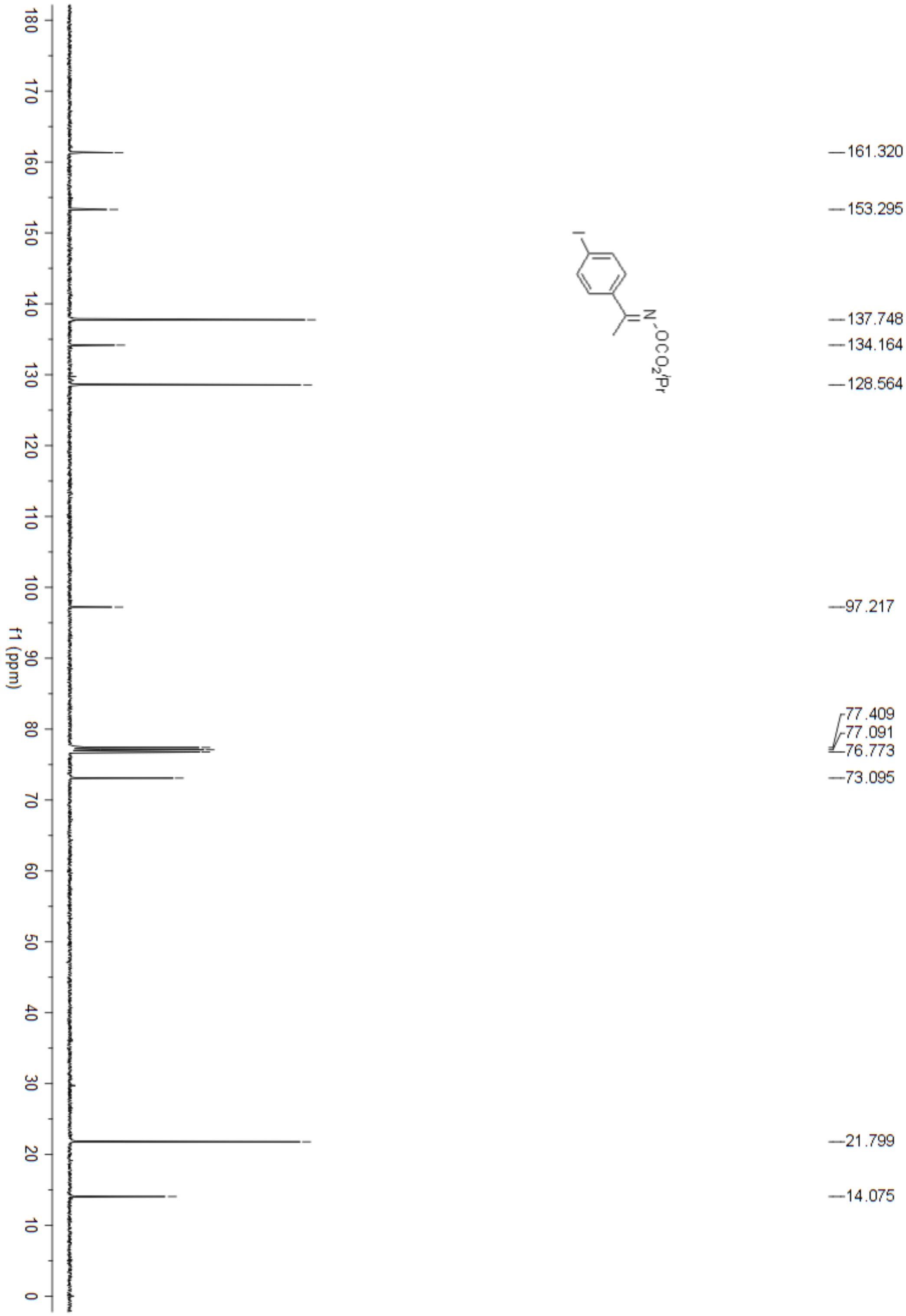
7.733
7.492
7.471
5.076
5.060
5.045
5.029
5.013
2.359
1.386
1.371
1.94
1.93
0.93
2.89
6.00
f1 (ppm)


N
OCO2iPr
I
3g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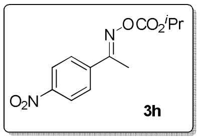
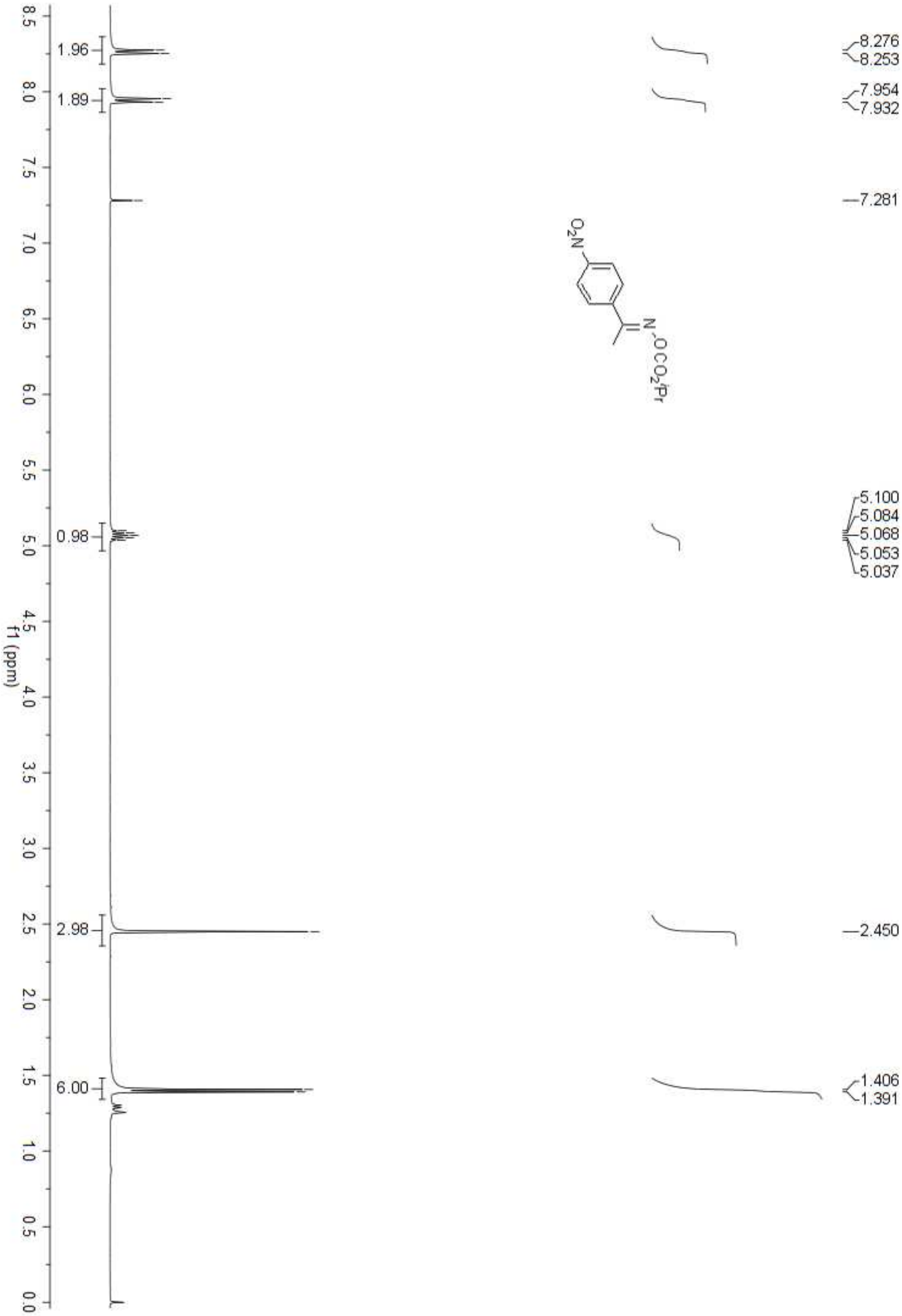
153.295
137.748
134.164
128.564
97.217
77.409
77.091
76.773
73.095
21.799
14.075
f1 (ppm)


O2N
N
OCO2iPr

3h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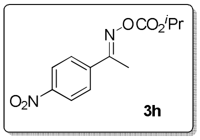
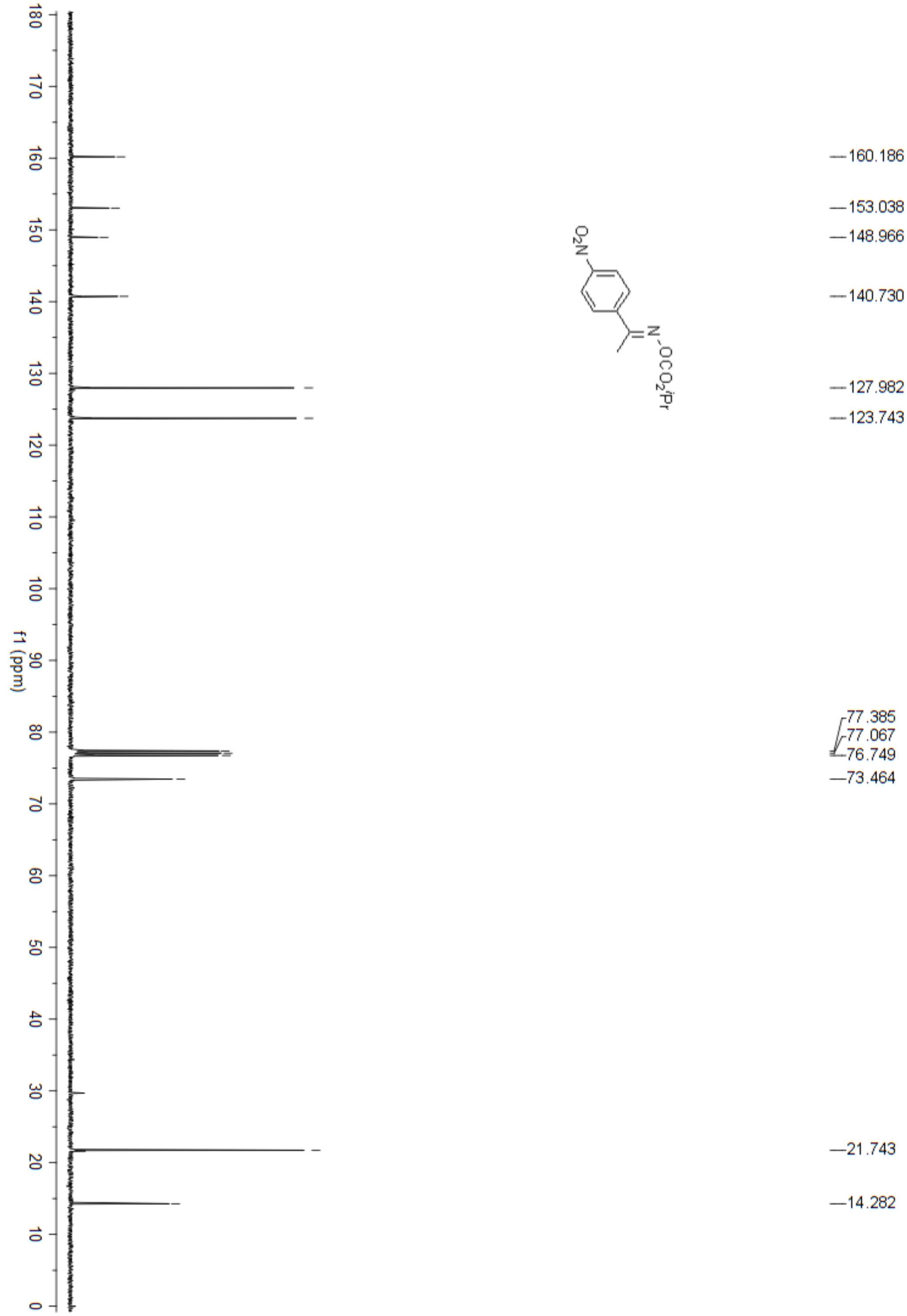
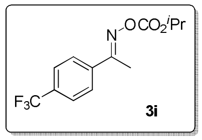
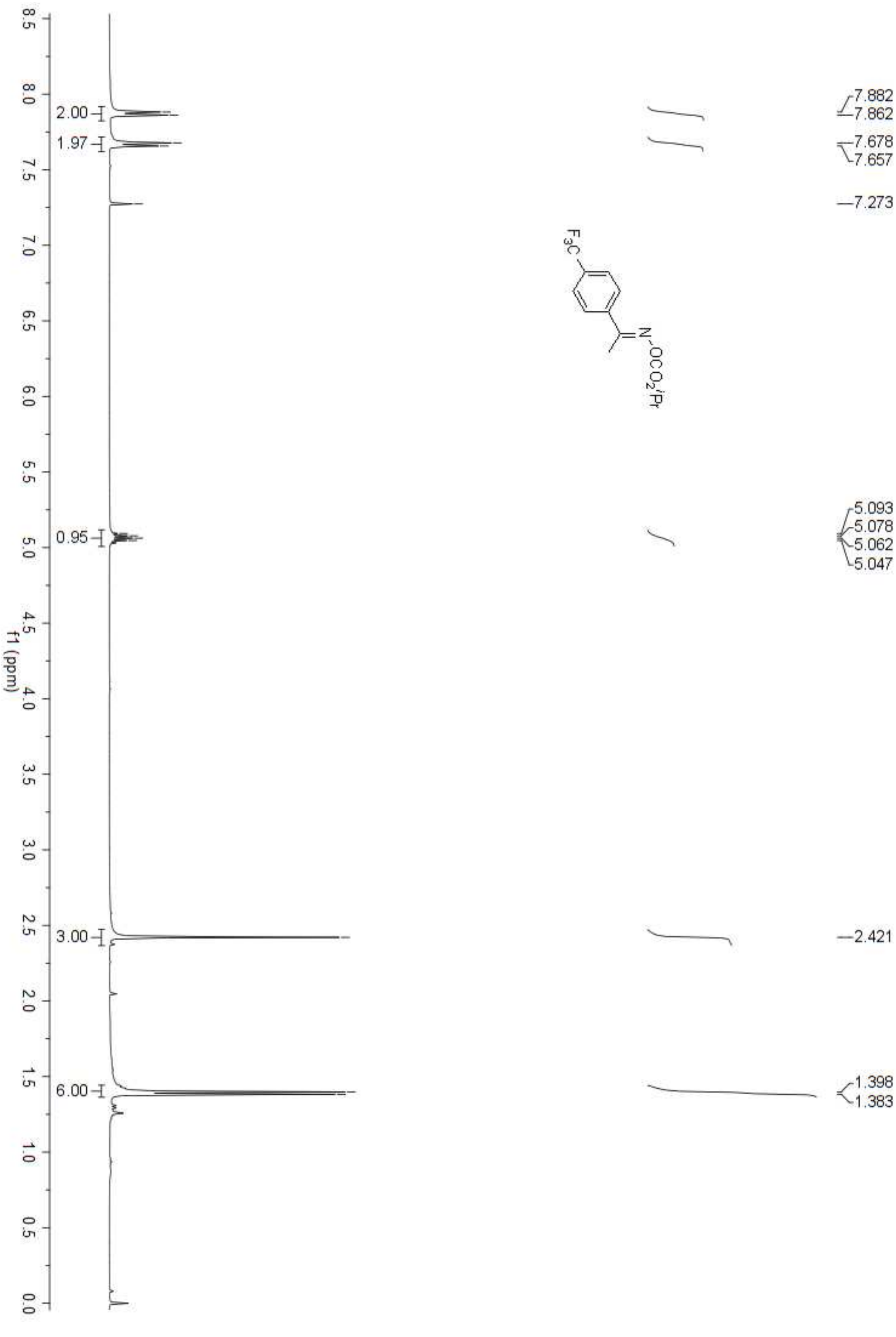
8.253
7.954
7.932
7.281
5.100
5.084
5.068
5.053
5.037
2.450
1.406
1.391
1.96
1.89
0.98
2.98
6.00
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

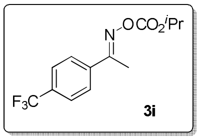

O2N
N
OCO2iPr

3h

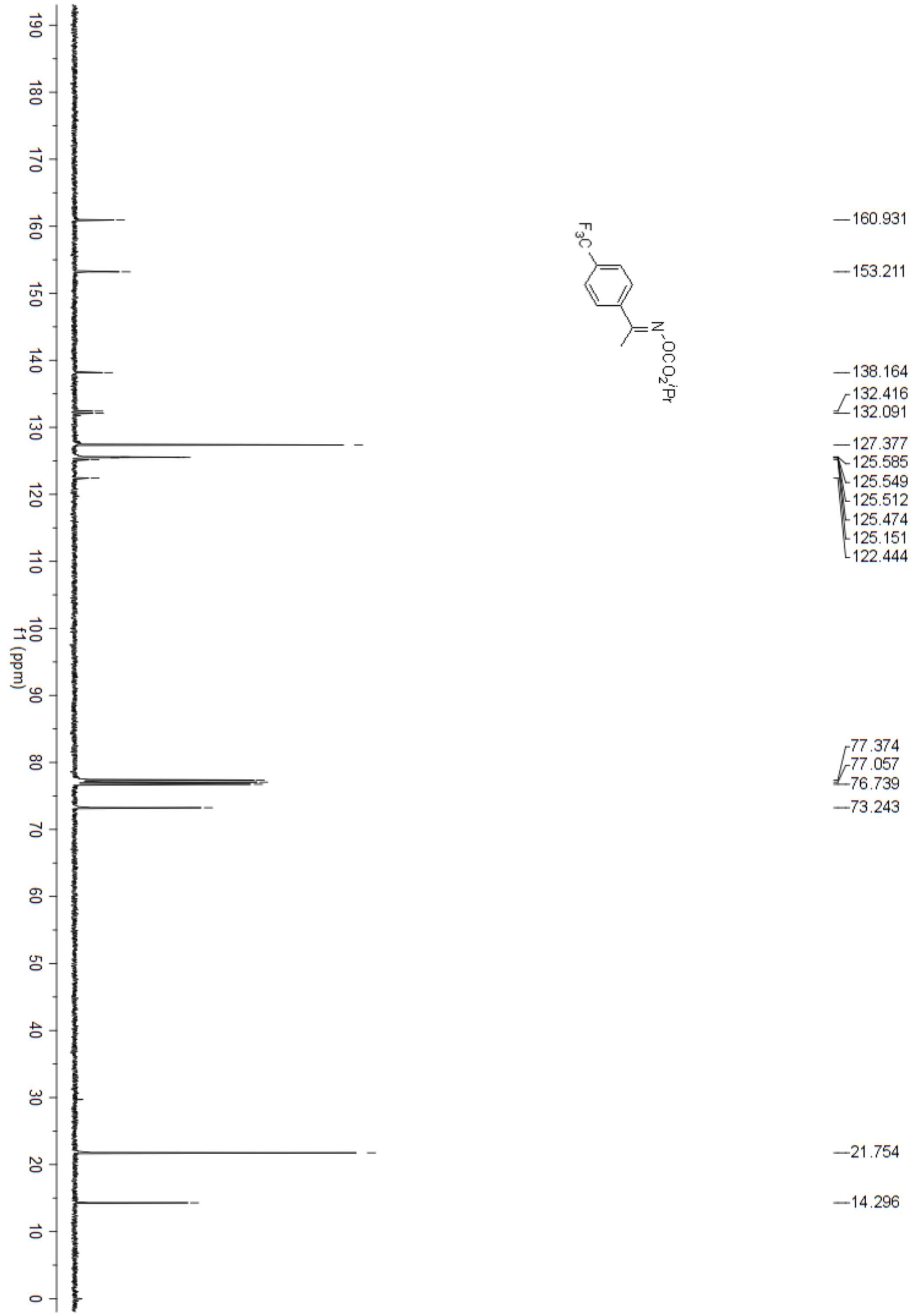

160.186
153.038
148.966
140.730
127.982
123.743
77.385
77.067
76.749
73.464
21.743
14.282
f1 (ppm)


N
OCO2iPr
F3C
3i

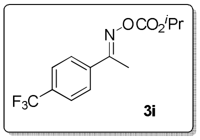

7.882
7.862
7.678
7.657
7.273
5.093
5.078
5.062
5.047
2.421
1.398
1.383
2.00
1.97
0.95
3.00
6.00
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
F3C
N
OCO2iPr

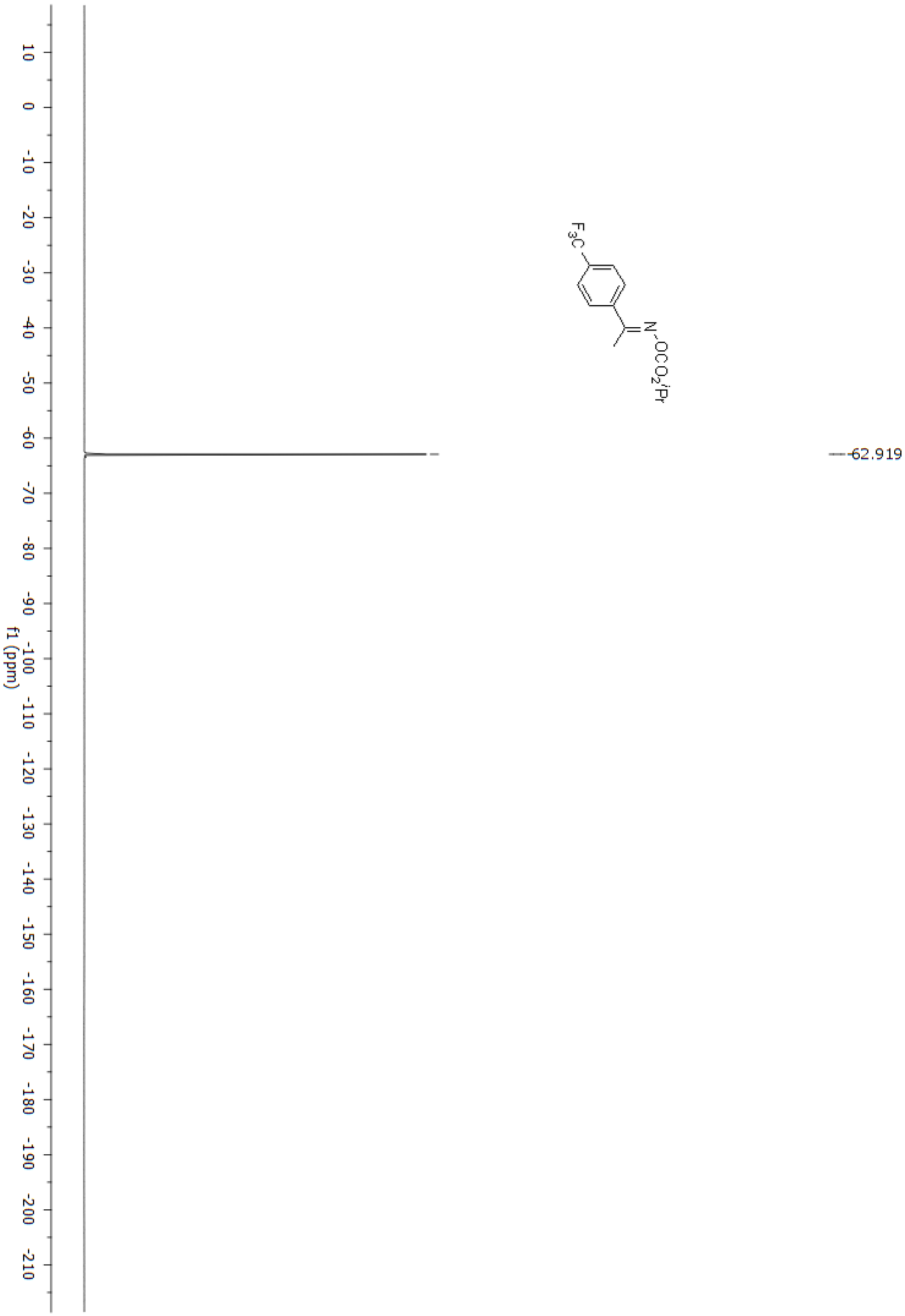


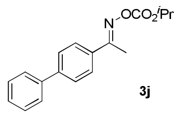
F3C
N
OCO2iPr
3i



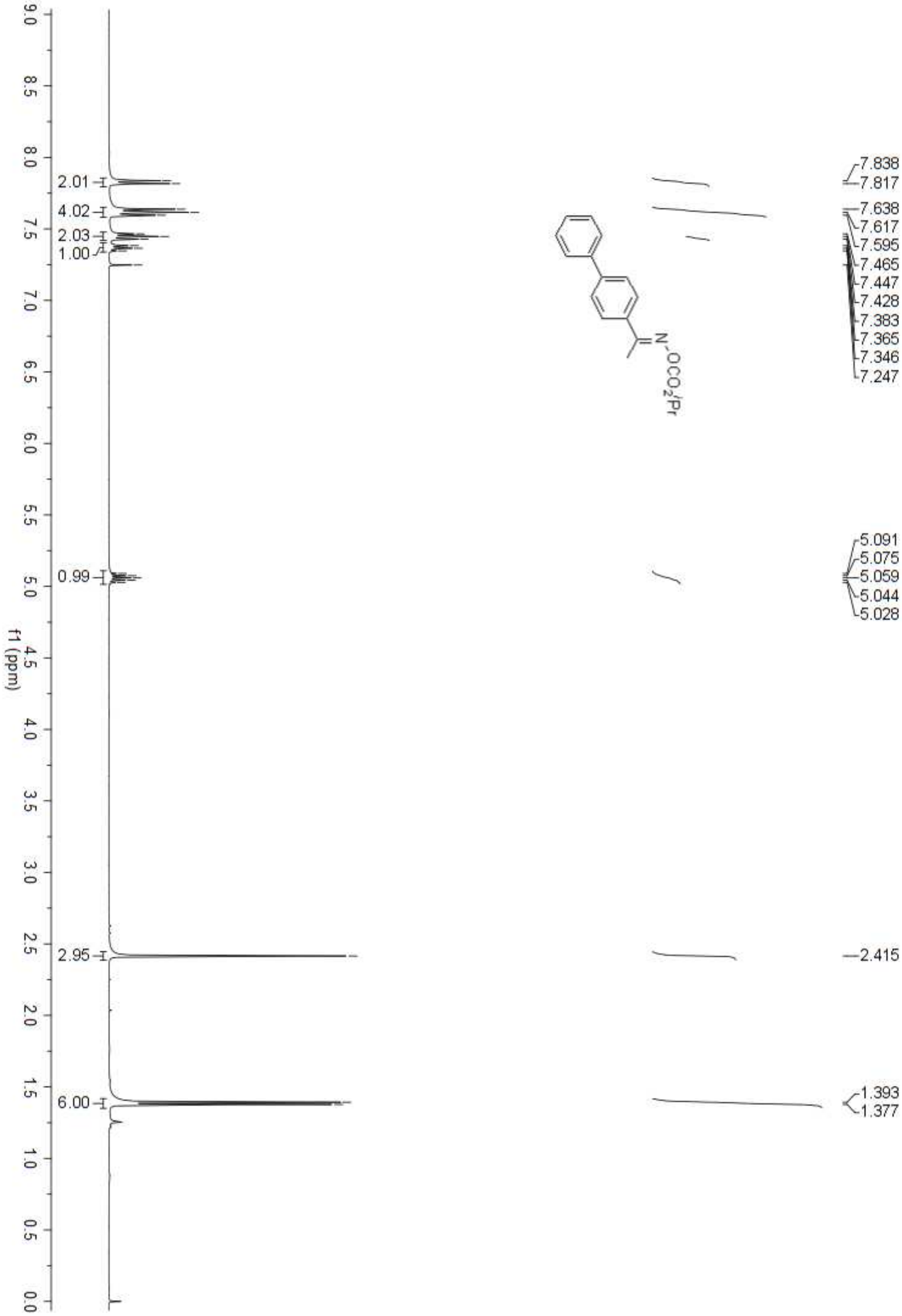
160.931
153.211
138.164
132.416
132.091
127.377
125.585
125.549
125.512
125.474
125.151
122.444
77.374
77.057
76.739
73.243
21.754
14.296
F3C
N
OCO2iPr
f1 (ppm)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

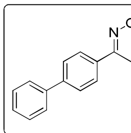

3i


f1 (ppm)
-62.919

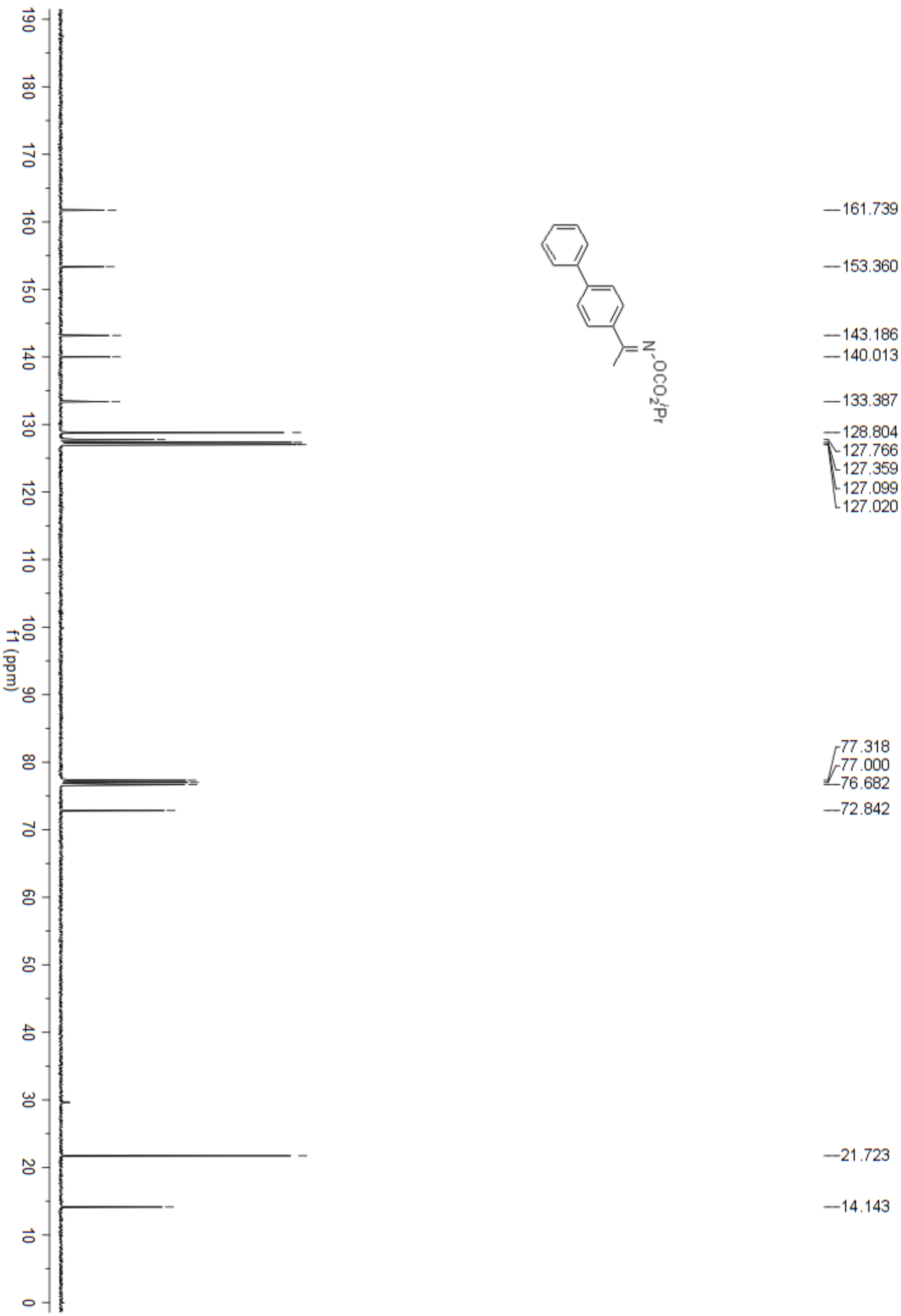

N
OCO2iPr

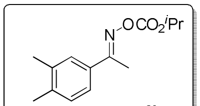
3j


f1 (ppm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2.01
4.02
2.03
1.00
0.99
2.95
6.00
7.838
7.817
7.638
7.617
7.595
7.465
7.447
7.428
7.383
7.365
7.346
7.247
5.091
5.075
5.059
5.044
5.028
2.415
1.393
1.377
N
OCO2iPr


N
OCO2iPr

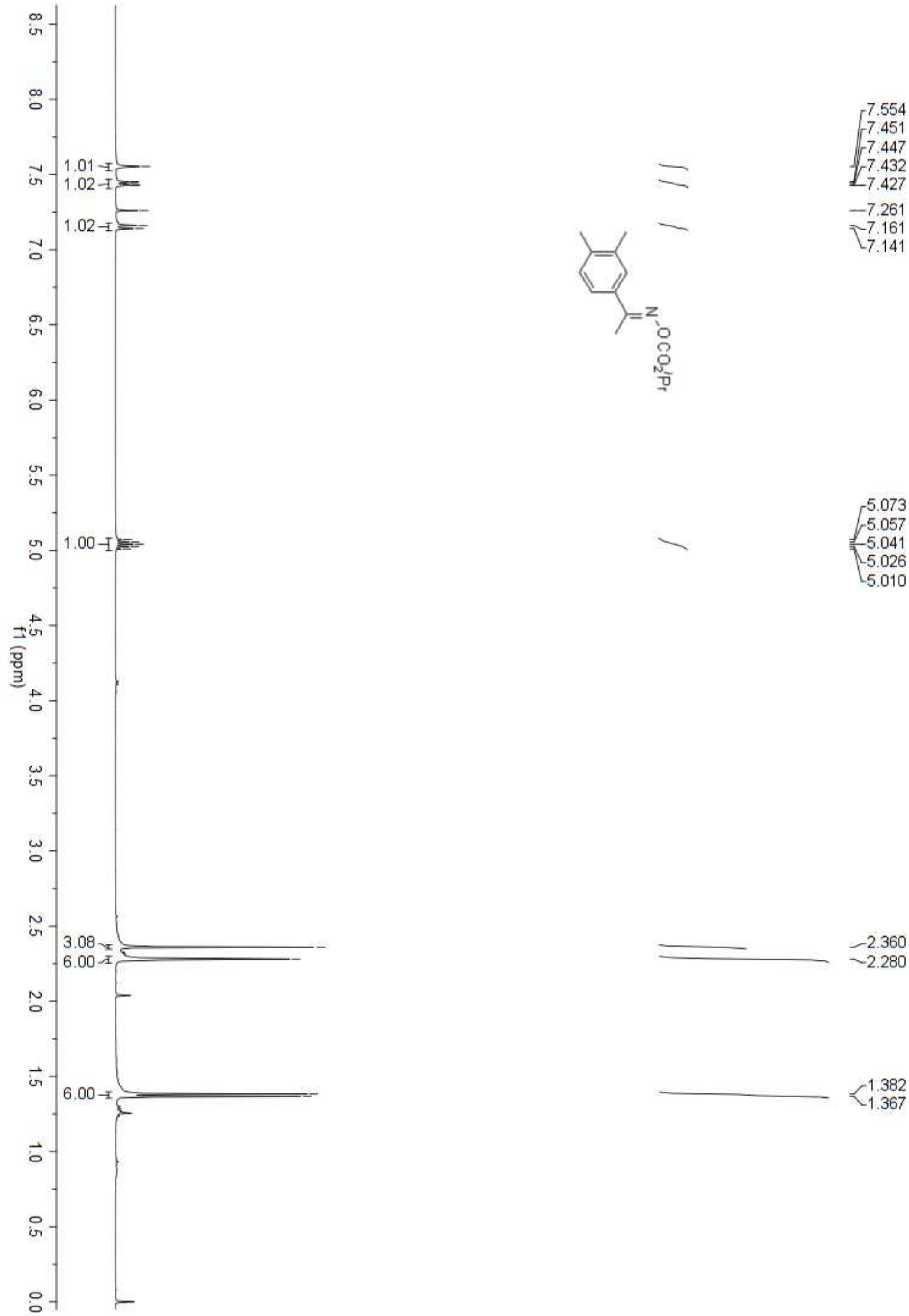
3j


161.739
153.360
143.186
140.013
133.387
128.804
127.766
127.359
127.099
127.020
77.318
77.000
76.682
72.842
21.723
14.143
f1 (ppm)

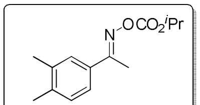


OCO2iPr
N

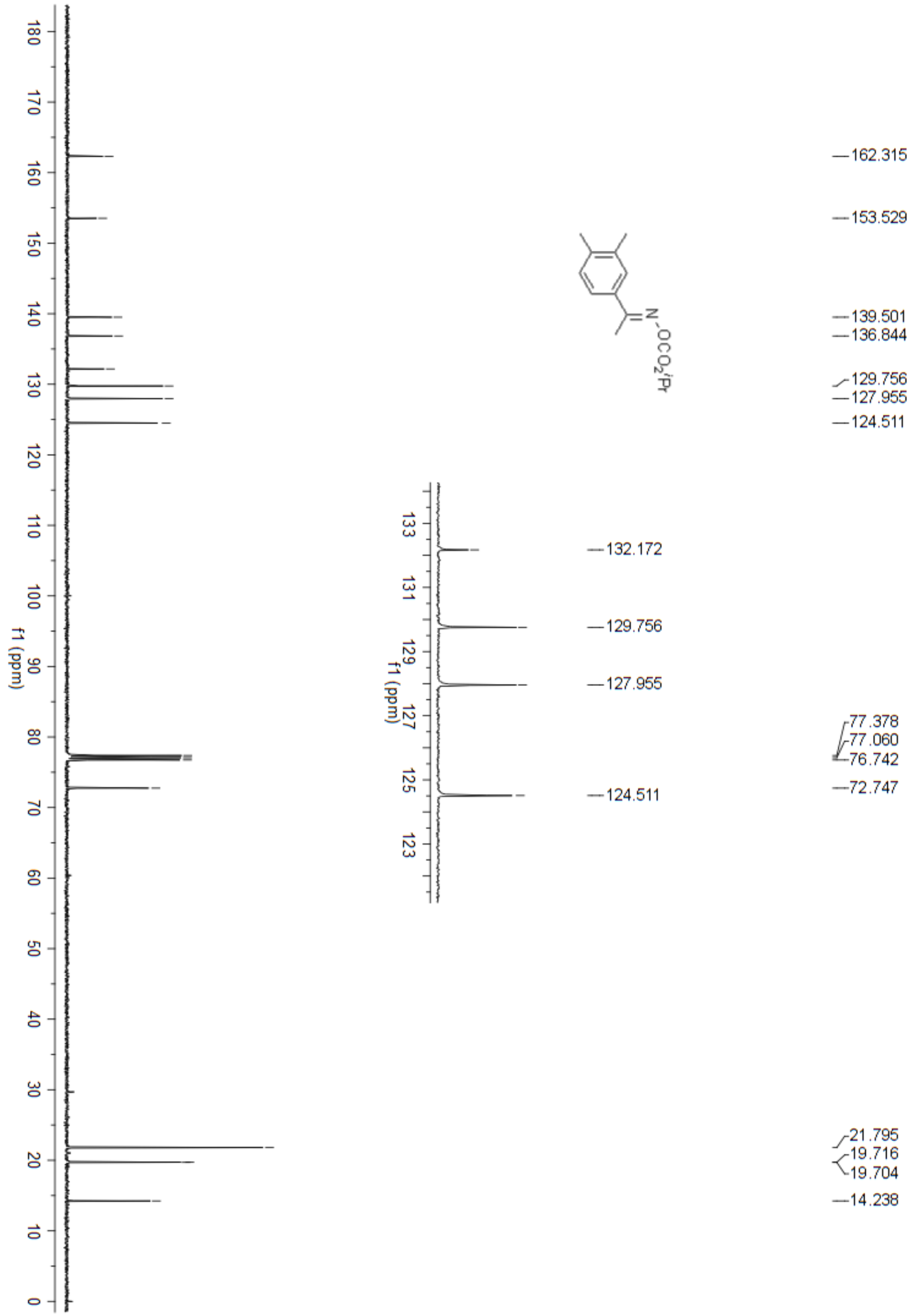
3k

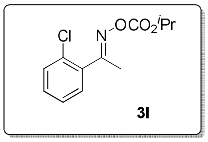


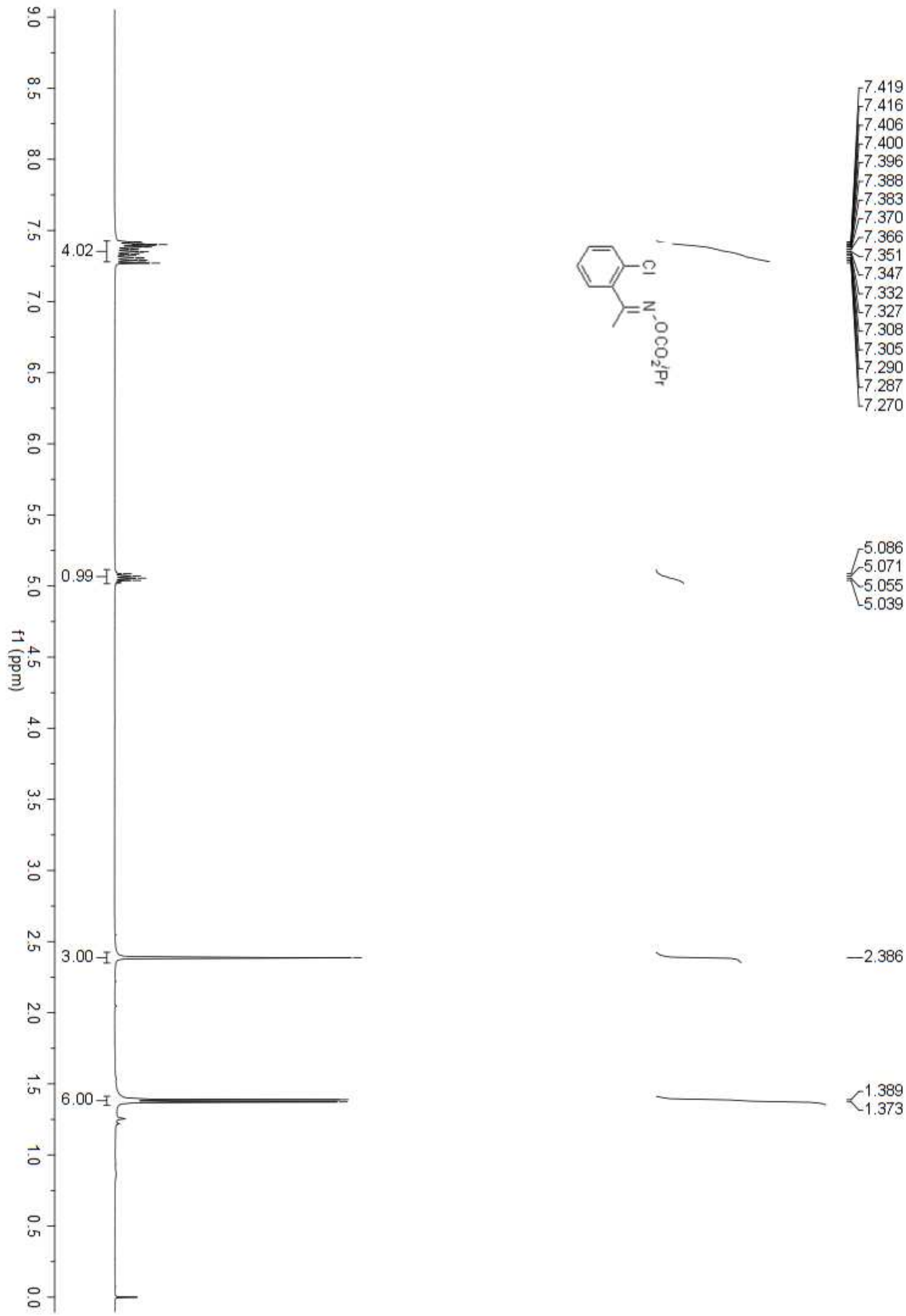
7.554
7.451
7.447
7.432
7.427
7.261
7.161
7.141
5.073
5.057
5.041
5.026
5.010
2.360
2.280
1.382
1.367
1.01
1.02
1.02
1.00
3.08
6.00
6.00
f1 (ppm)

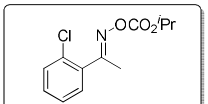

N
OCO2iPr

3k

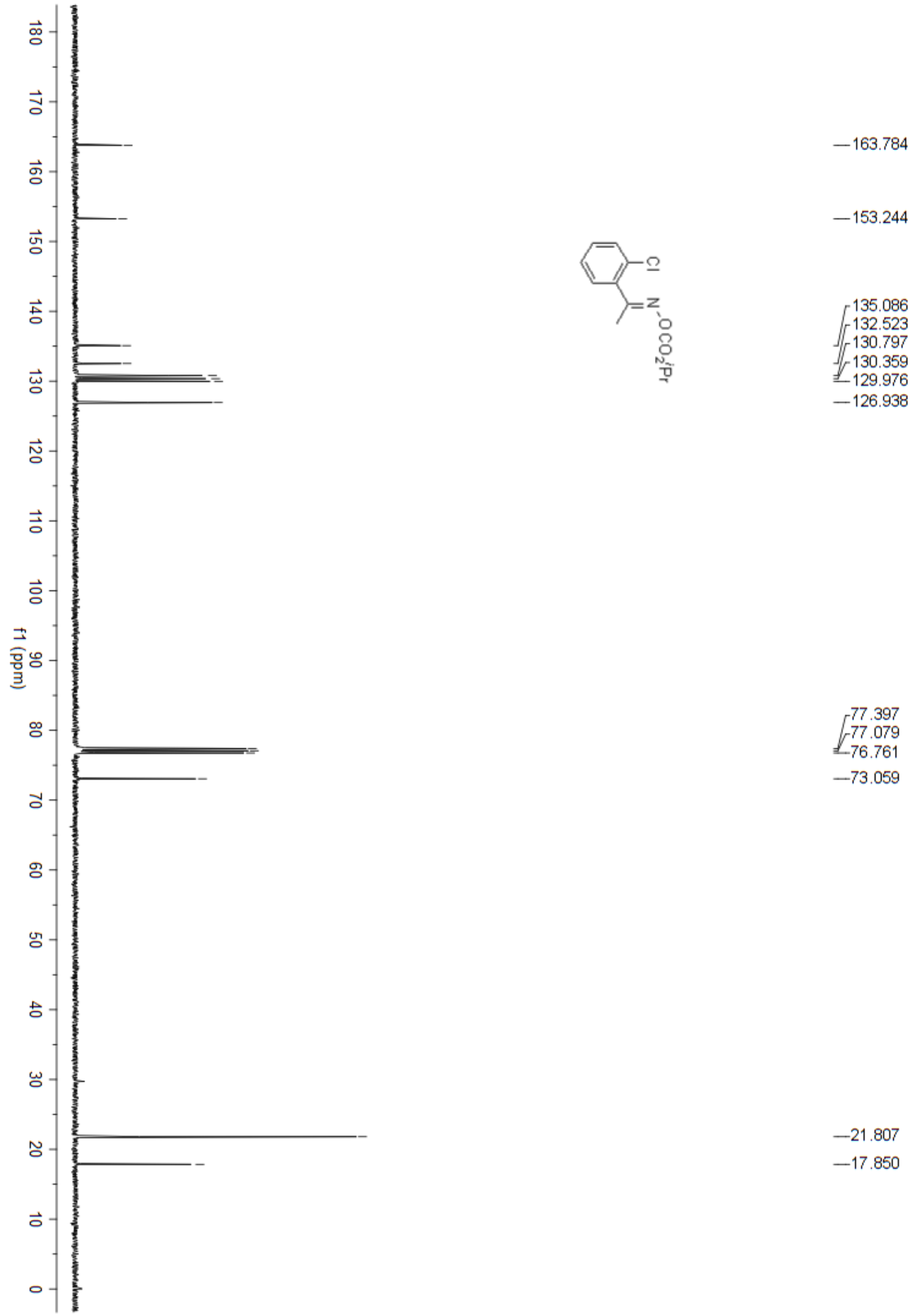

f1 (ppm)
162.315
153.529
139.501
136.844
129.756
127.955
124.511
132.172
129.756
127.955
124.511
77.378
77.060
76.742
72.747
21.795
19.716
19.704
14.238

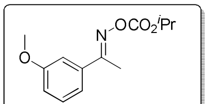

Cl
N
OCO$_2$^{i}Pr
3l


7.419
7.416
7.406
7.400
7.396
7.388
7.383
7.370
7.366
7.351
7.347
7.332
7.327
7.308
7.305
7.290
7.287
7.270
5.086
5.071
5.055
5.039
2.386
1.389
1.373
4.02
0.99
3.00
6.00
Cl
N
OCO$_2$^{i}Pr
f1 (ppm)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

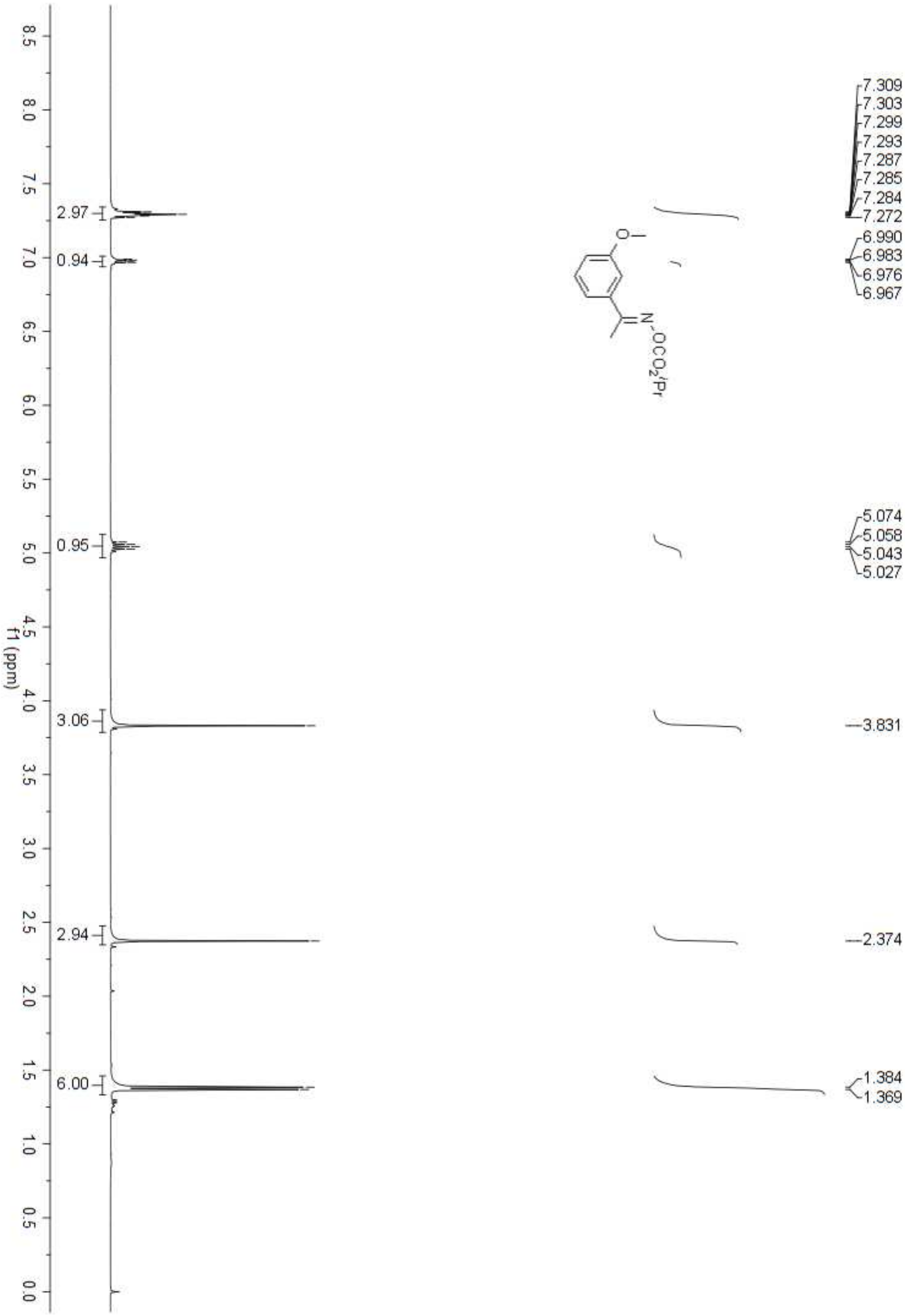

Cl
N
OCO2iPr

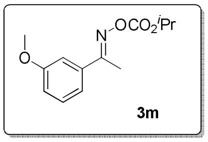
3l

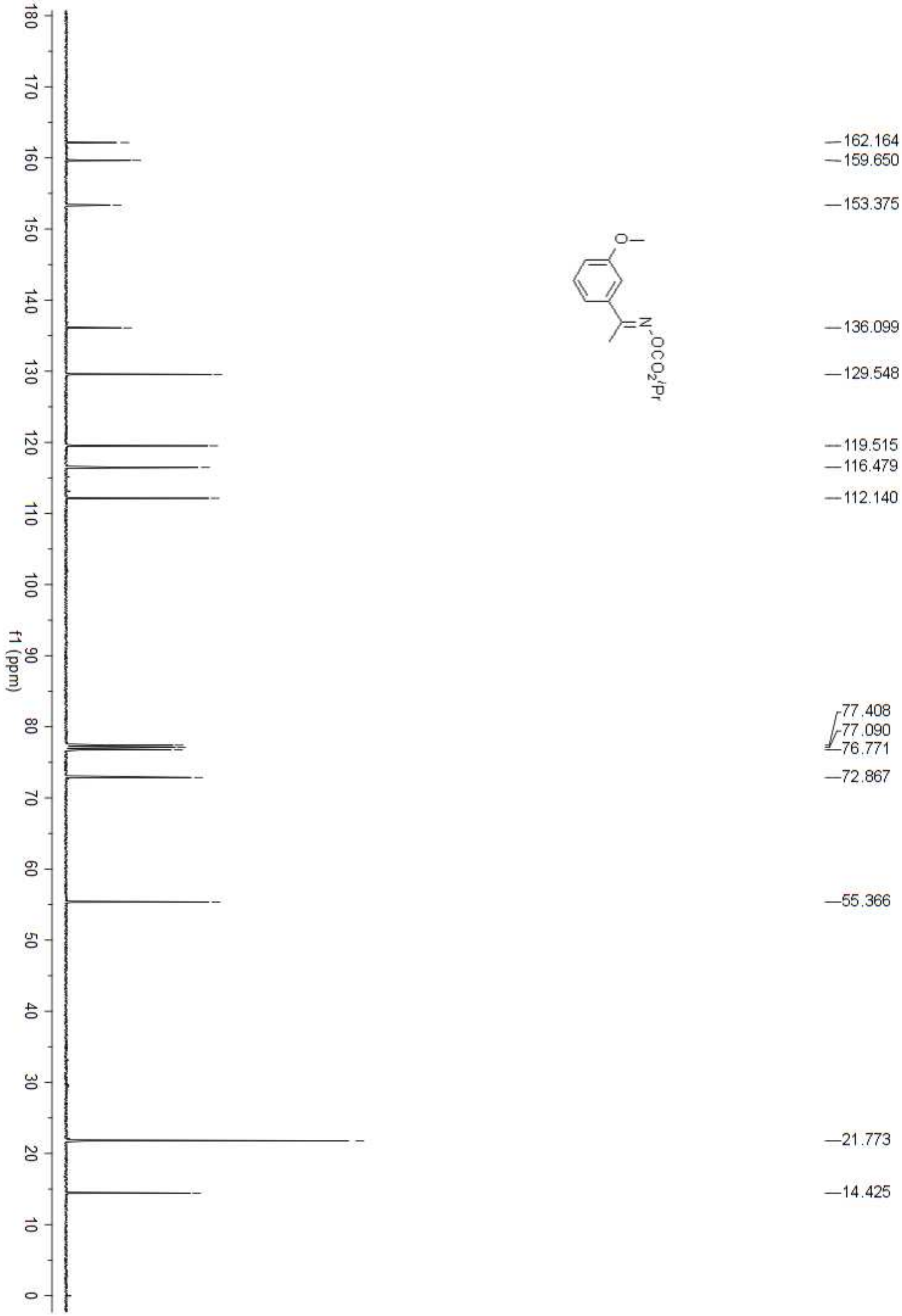

163.784
153.244
135.086
132.523
130.797
130.359
129.976
126.938
77.397
77.079
76.761
73.059
21.807
17.850
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

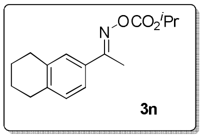

N
OCO2iPr
O

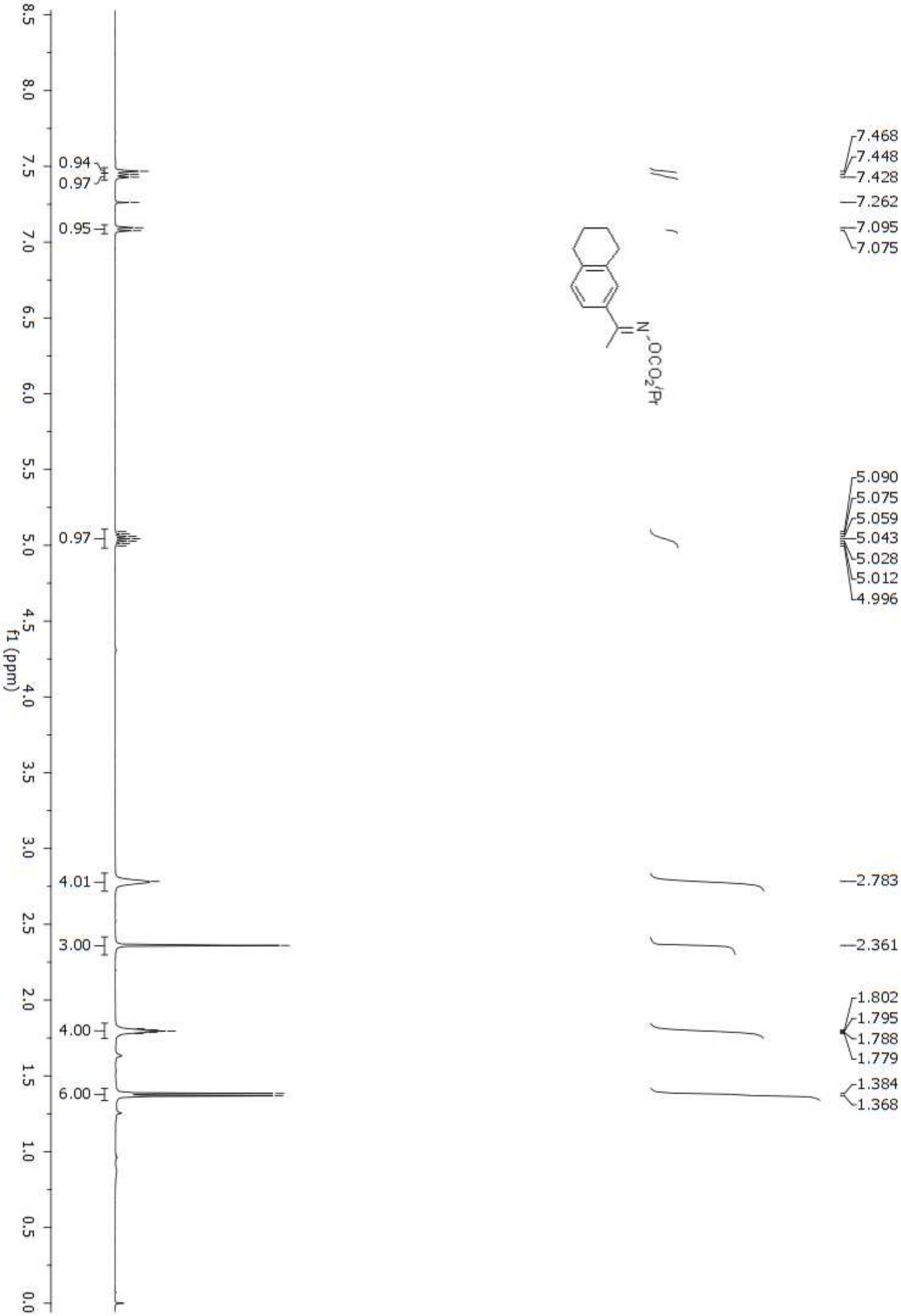
3m

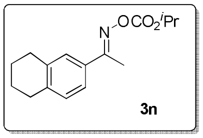

7.309
7.303
7.299
7.293
7.287
7.285
7.284
7.272
6.990
6.983
6.976
6.967
5.074
5.058
5.043
5.027
3.831
2.374
1.384
1.369
2.97
0.94
0.95
3.06
2.94
6.00
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


N
OCO2iPr
O
3m

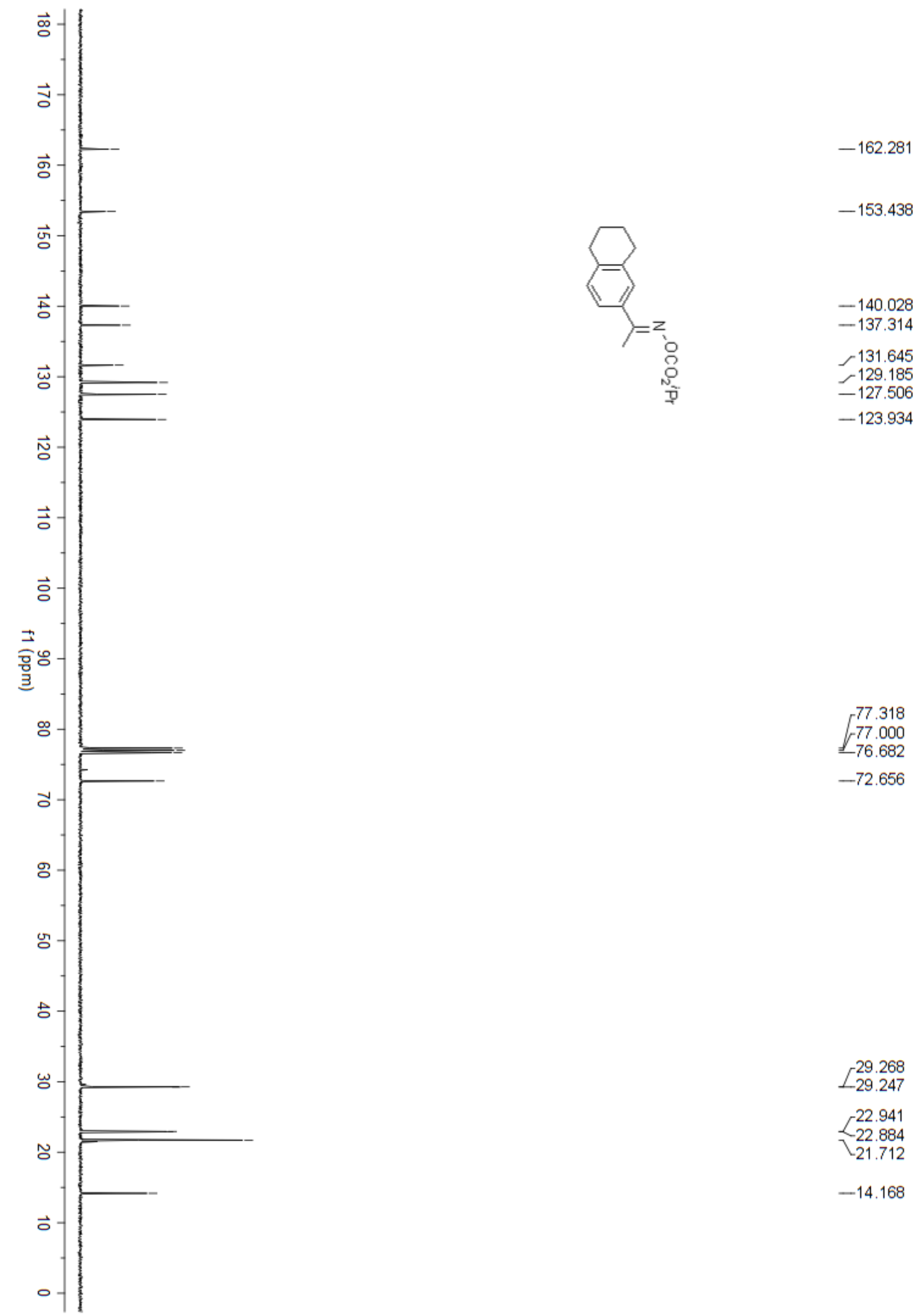

180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)
162.164
159.650
153.375
136.099
129.548
119.515
116.479
112.140
77.408
77.090
76.771
72.867
55.366
21.773
14.425
O
N
OCO2iPr


OCO2iPr
N
3n

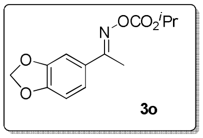

7.468
7.448
7.428
7.262
7.095
7.075
5.090
5.075
5.059
5.043
5.028
5.012
4.996
2.783
2.361
1.802
1.795
1.788
1.779
1.384
1.368
0.94
0.97
0.95
0.97
4.01
3.00
4.00
6.00
f1 (ppm)

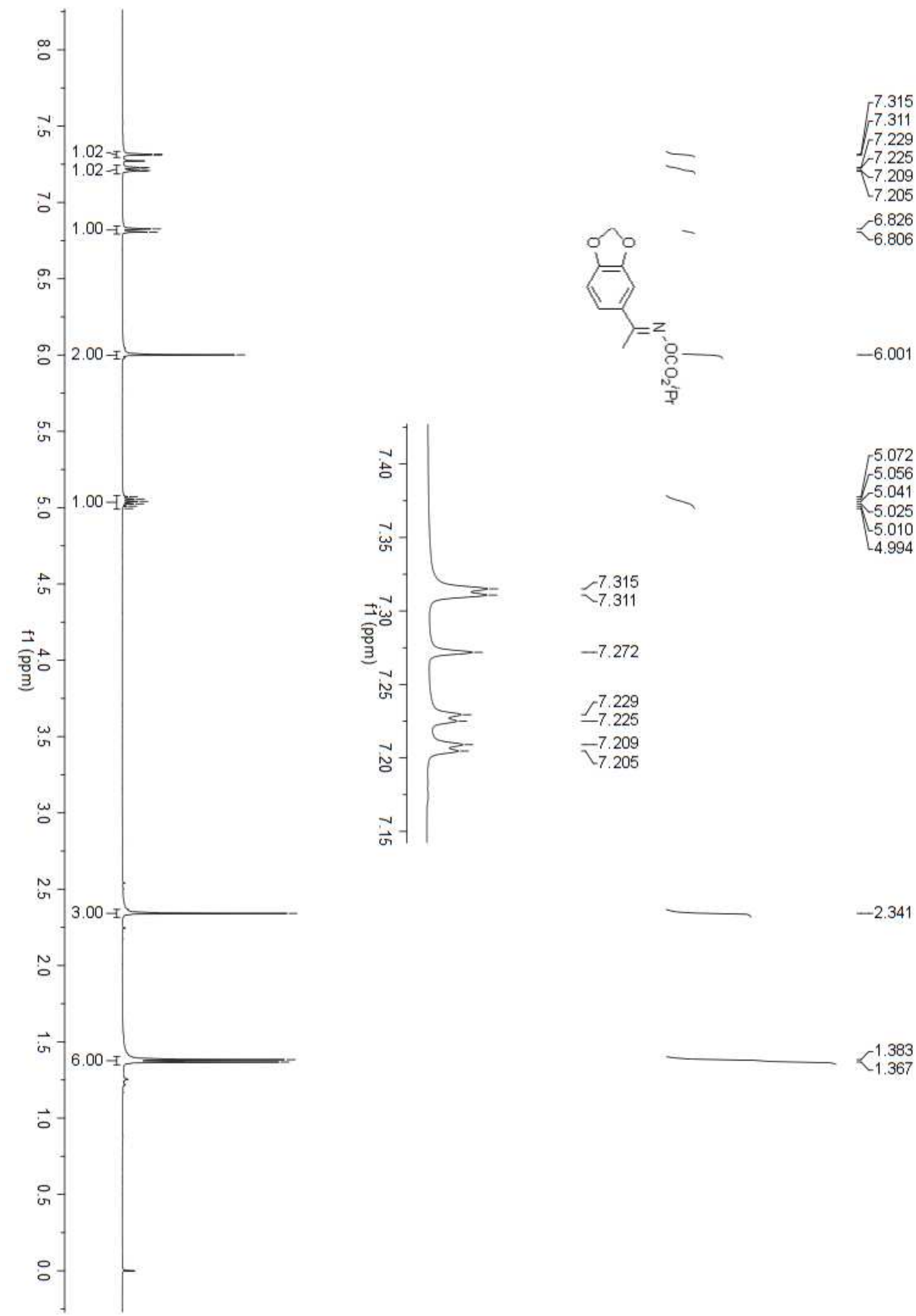


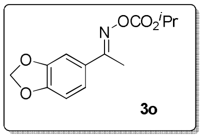
N
OCO2iPr
3n

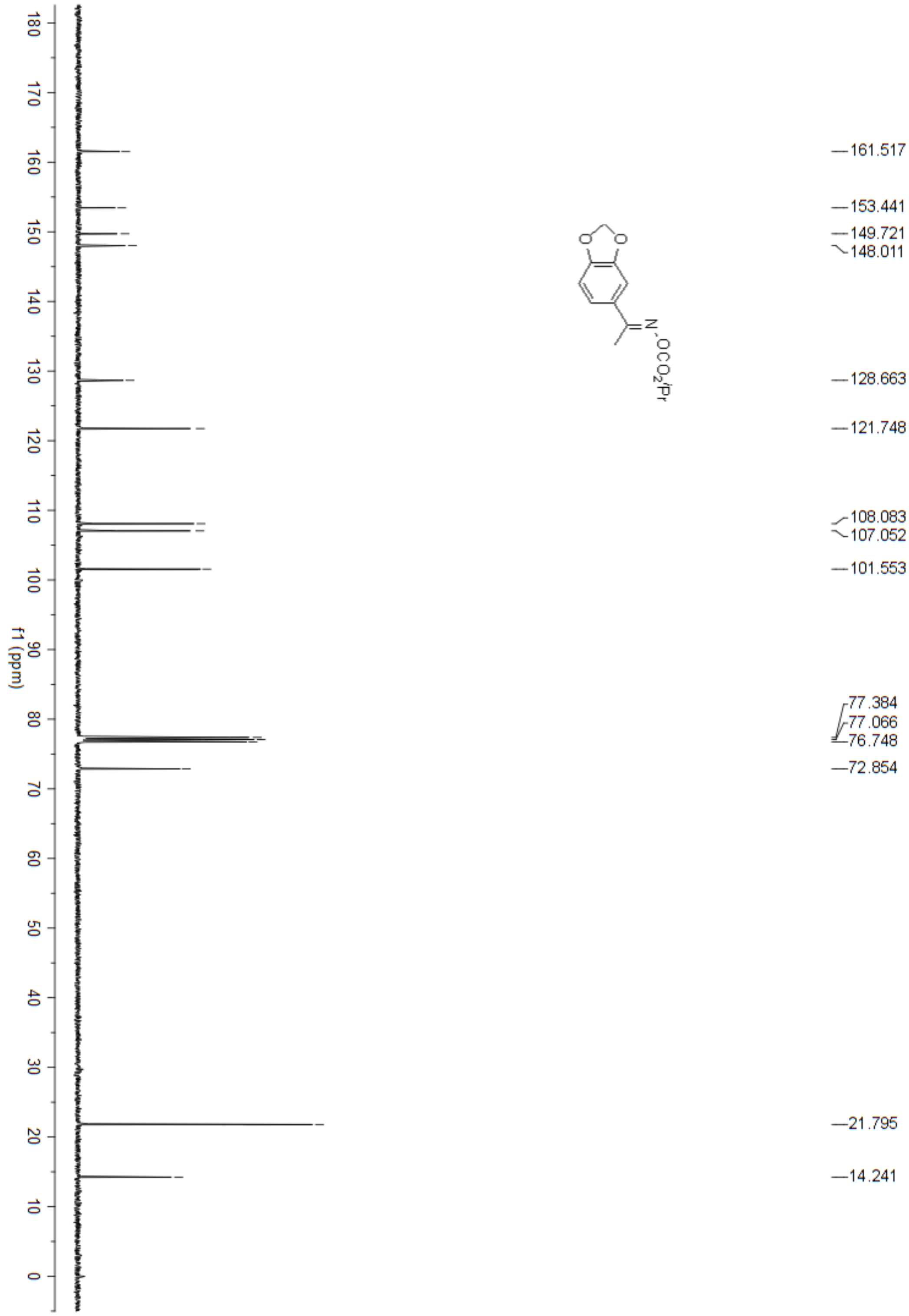


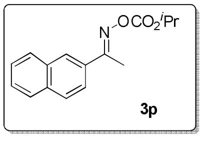
162.281
153.438
140.028
137.314
131.645
129.185
127.506
123.934
77.318
77.000
76.682
72.656
29.268
29.247
22.941
22.884
21.712
14.168
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
N
OCO2iPr

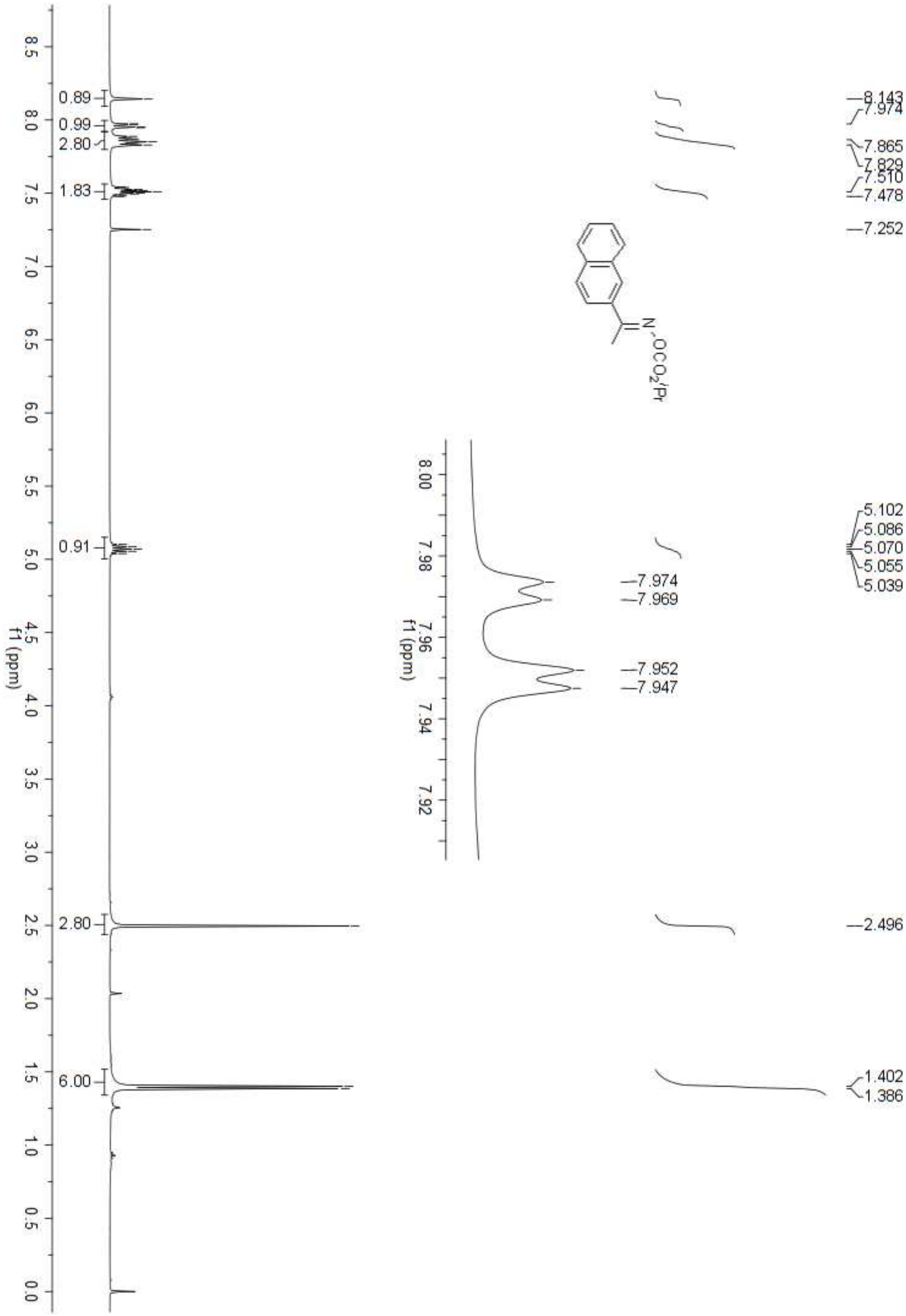

N
OCO2iPr
O
O
3o

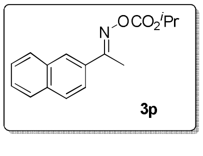

7.315
7.311
7.229
7.225
7.209
7.205
6.826
6.806
6.001
5.072
5.056
5.041
5.025
5.010
4.994
7.272
2.341
1.383
1.367
1.02
1.02
1.00
2.00
1.00
3.00
6.00
f1 (ppm)

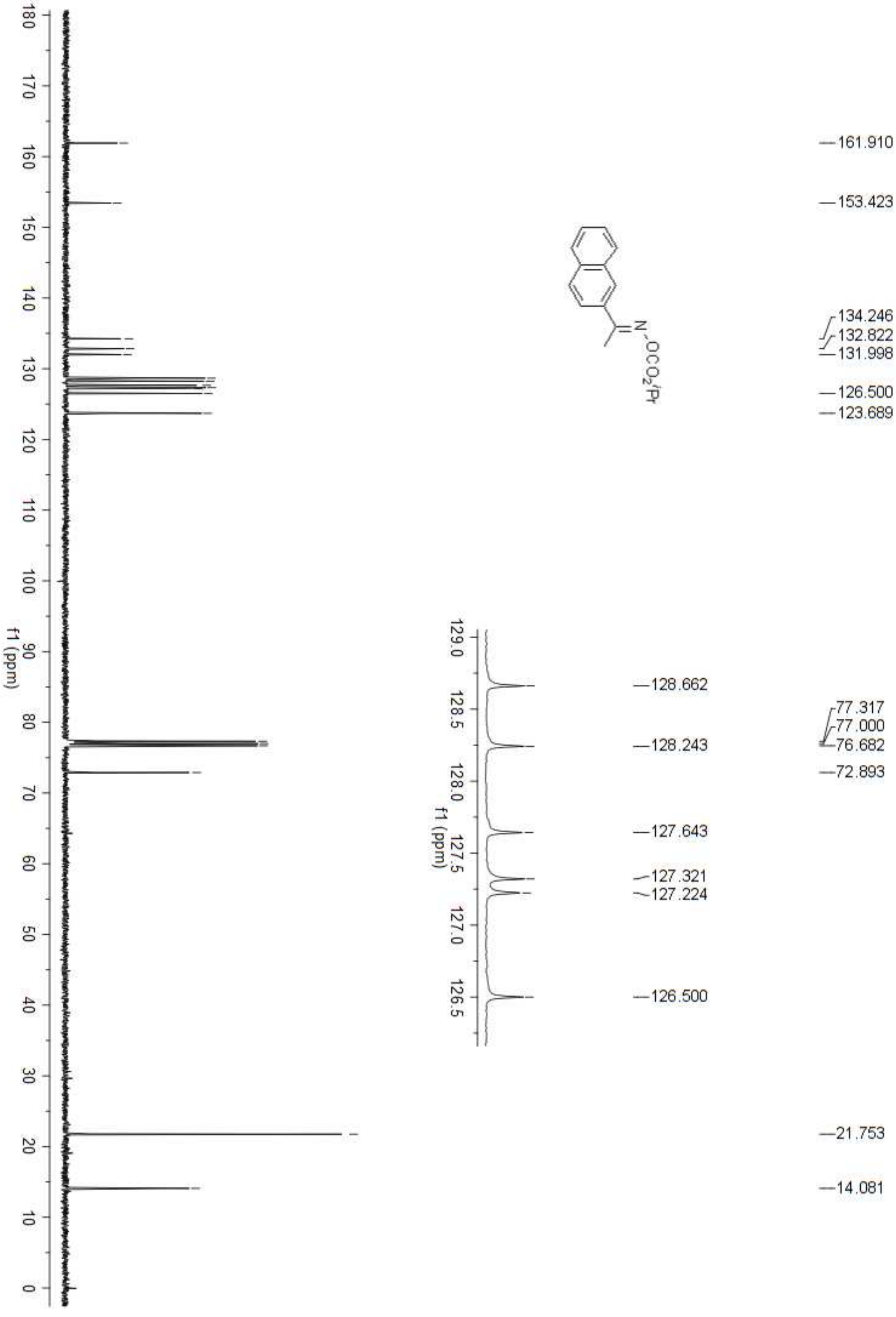

N
OCO2iPr
O
O
3o

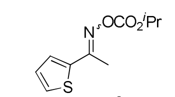

161.517
153.441
149.721
148.011
128.663
121.748
108.083
107.052
101.553
77.384
77.066
76.748
72.854
21.795
14.241
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


OCO2iPr
N
3p

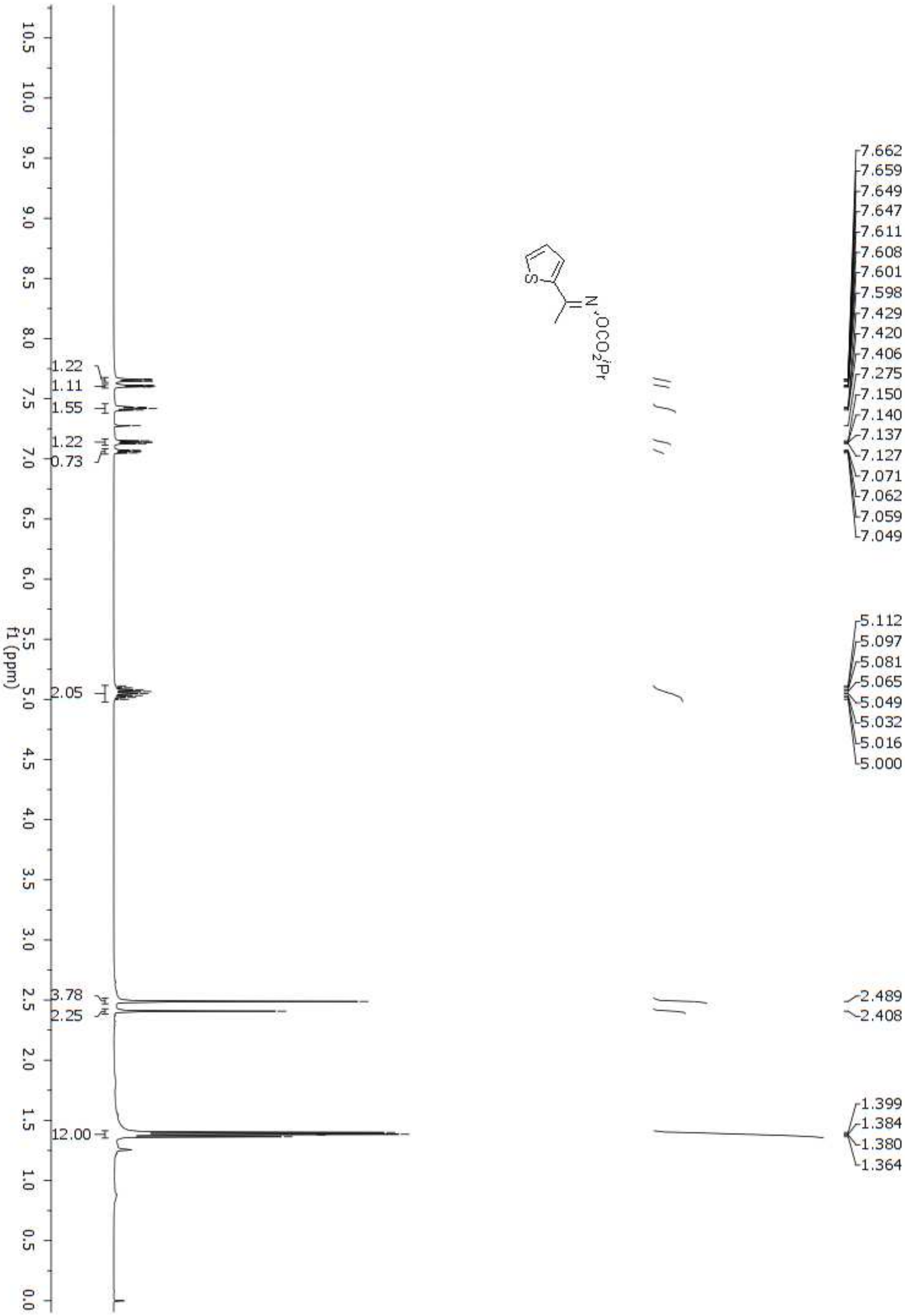

8.143
7.974
7.865
7.829
7.510
7.478
7.252
5.102
5.086
5.070
5.055
5.039
2.496
1.402
1.386
7.974
7.969
7.952
7.947
f1 (ppm)
0.89
0.99
2.80
1.83
0.91
2.80
6.00

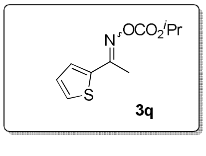

OCO2iPr
N
3p

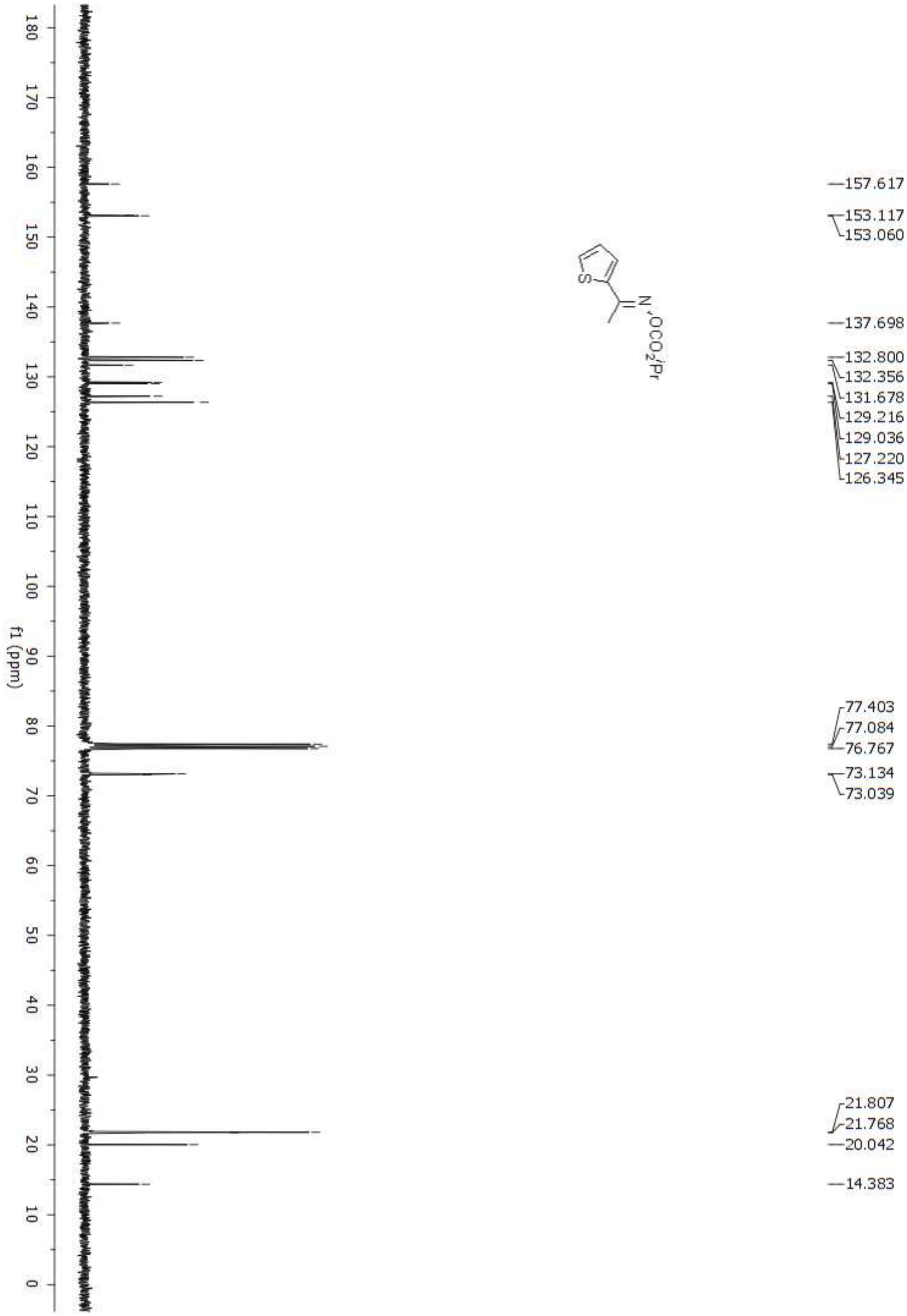

161.910
153.423
134.246
132.822
131.998
126.500
123.689
128.662
128.243
127.643
127.321
127.224
126.500
77.317
77.000
76.682
72.893
21.753
14.081
f1 (ppm)
N
OCO2iPr

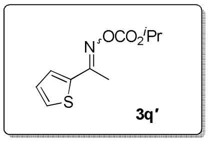

N
OCO2iPr
S

3q

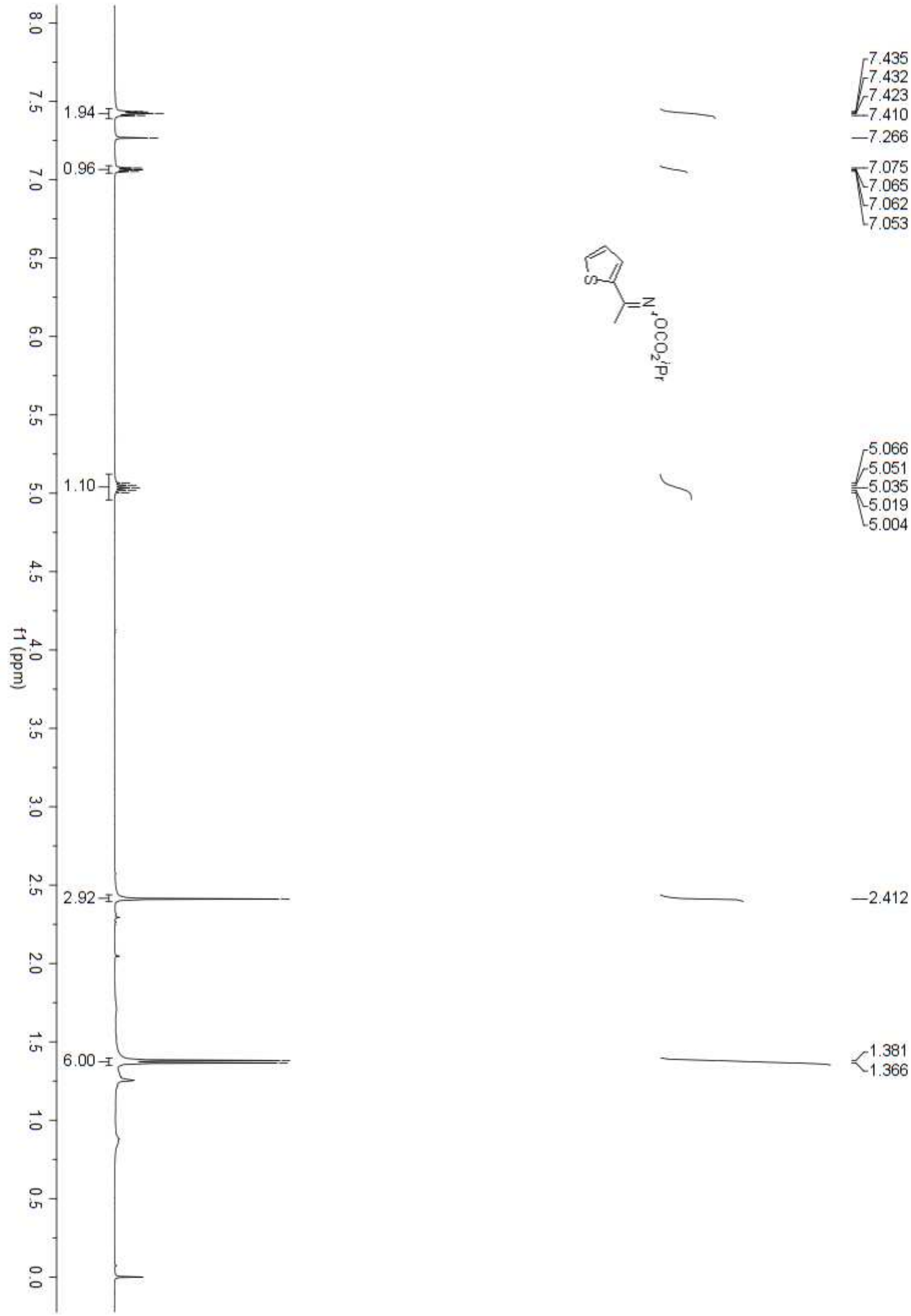

f1 (ppm)
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
1.22
1.11
1.55
1.22
0.73
2.05
3.78
2.25
12.00
7.662
7.659
7.649
7.647
7.611
7.608
7.601
7.598
7.429
7.420
7.406
7.275
7.150
7.140
7.137
7.127
7.071
7.062
7.059
7.049
5.112
5.097
5.081
5.065
5.049
5.032
5.016
5.000
2.489
2.408
1.399
1.384
1.380
1.364

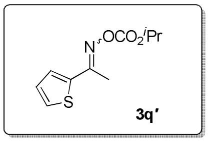

N
OCO2iPr
S
3q

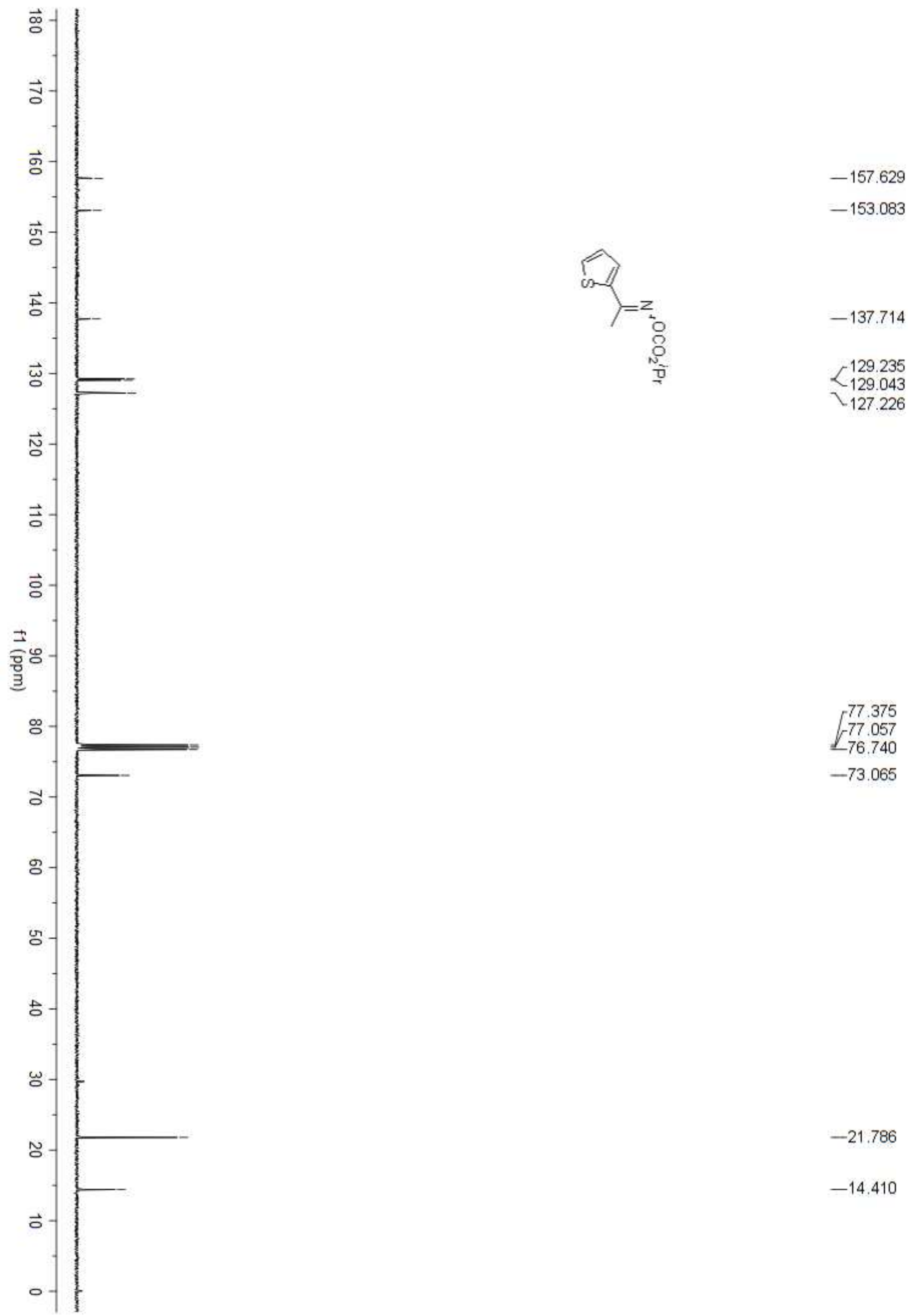

157.617
153.117
153.060
137.698
132.800
132.356
131.678
129.216
129.036
127.220
126.345
77.403
77.084
76.767
73.134
73.039
21.807
21.768
20.042
14.383
f1 (ppm)

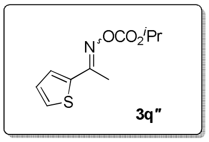

N
OCO2iPr
S

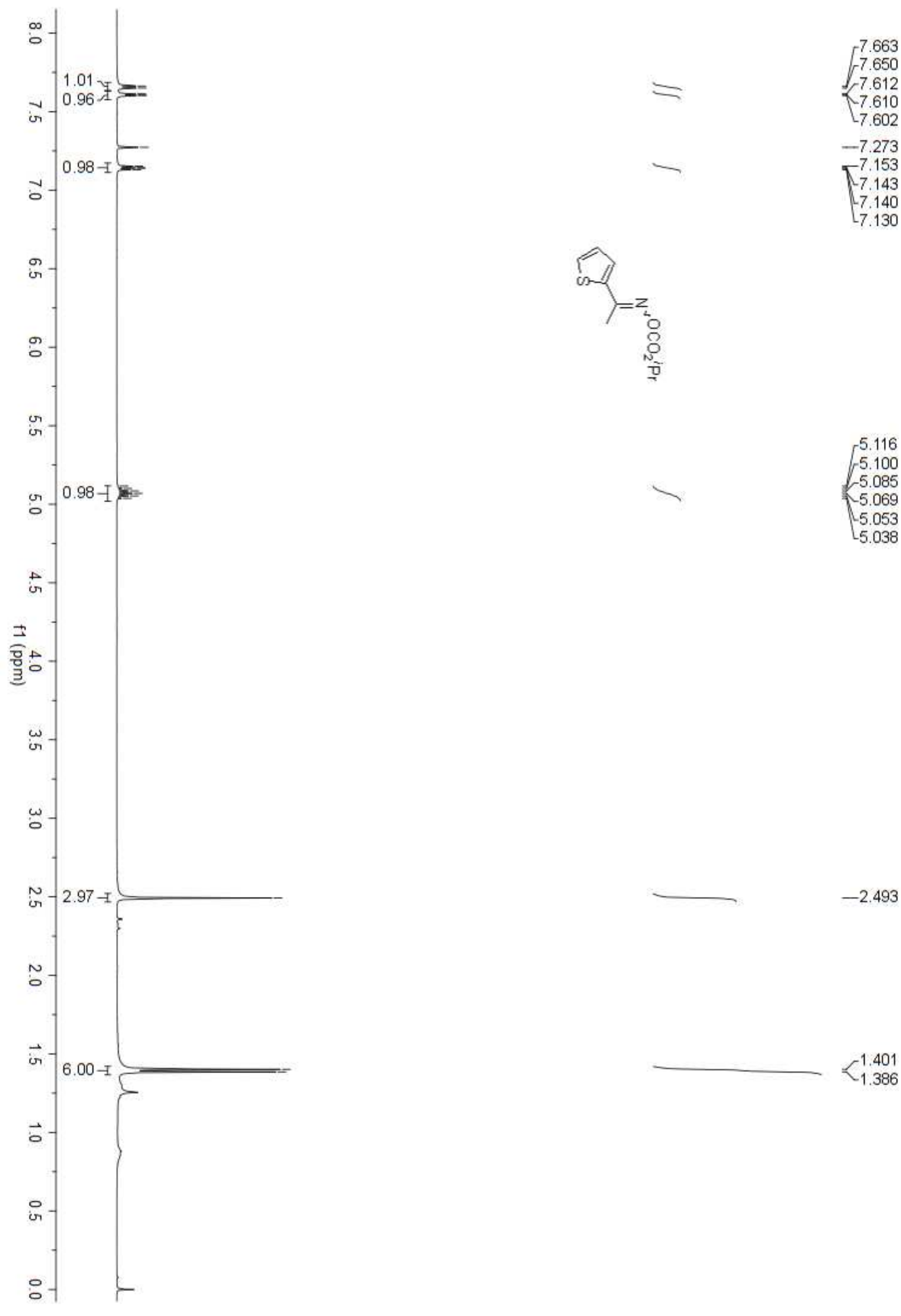
3q′

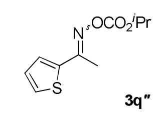

7.435
7.432
7.423
7.410
7.266
7.075
7.065
7.062
7.053
5.066
5.051
5.035
5.019
5.004
2.412
1.381
1.366
1.94
0.96
1.10
2.92
6.00
f1 (ppm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


N
OCO2iPr
S
3q′

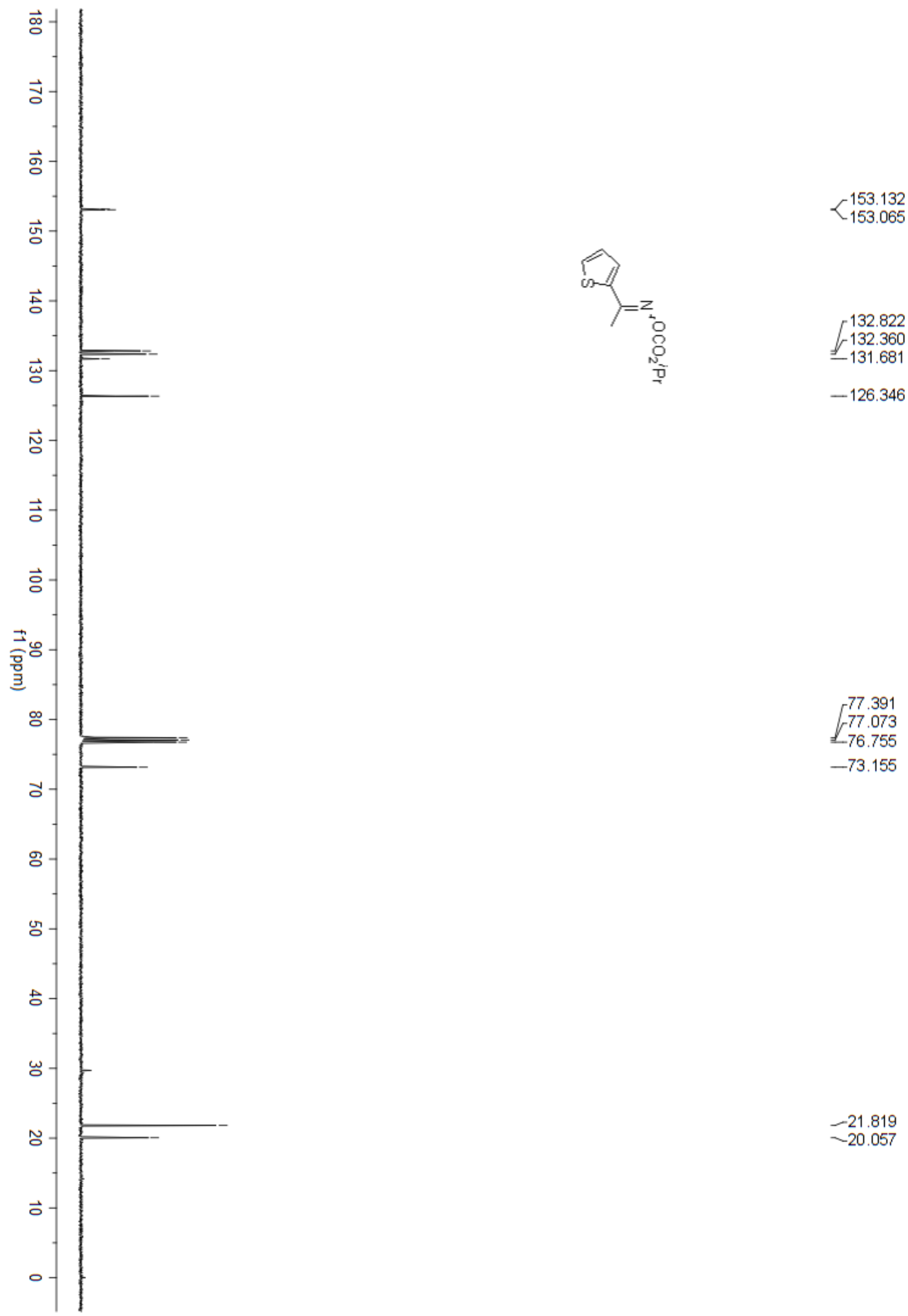

157.629
153.083
137.714
129.235
129.043
127.226
77.375
77.057
76.740
73.065
21.786
14.410
f1 (ppm)


N
OCO2iPr
S
3q″

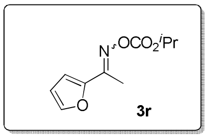

7.663
7.650
7.612
7.610
7.602
7.273
7.153
7.143
7.140
7.130
5.116
5.100
5.085
5.069
5.053
5.038
2.493
1.401
1.386
1.01
0.96
0.98
0.98
2.97
6.00
f1 (ppm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

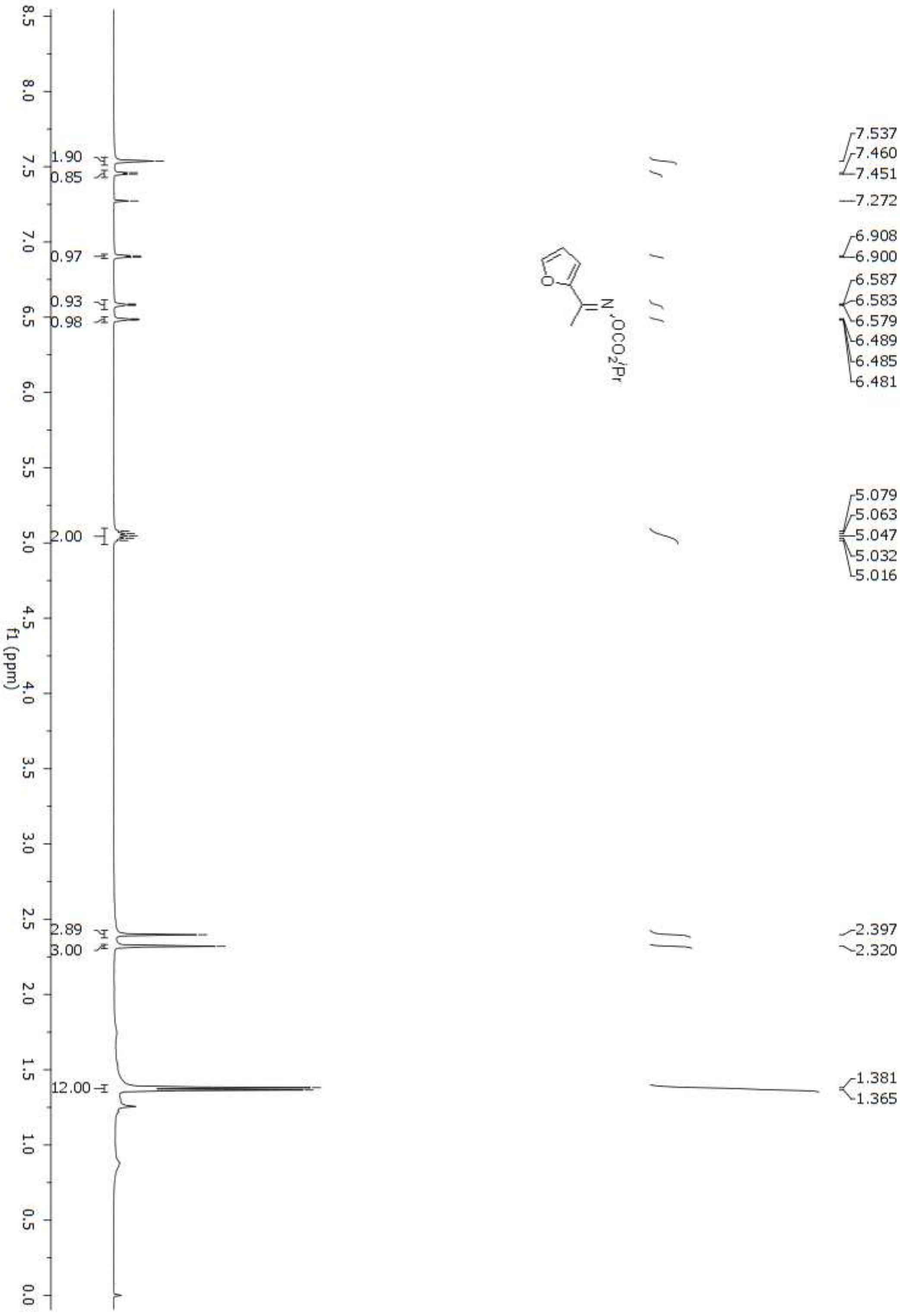


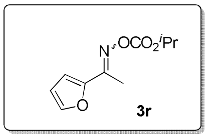
3q″

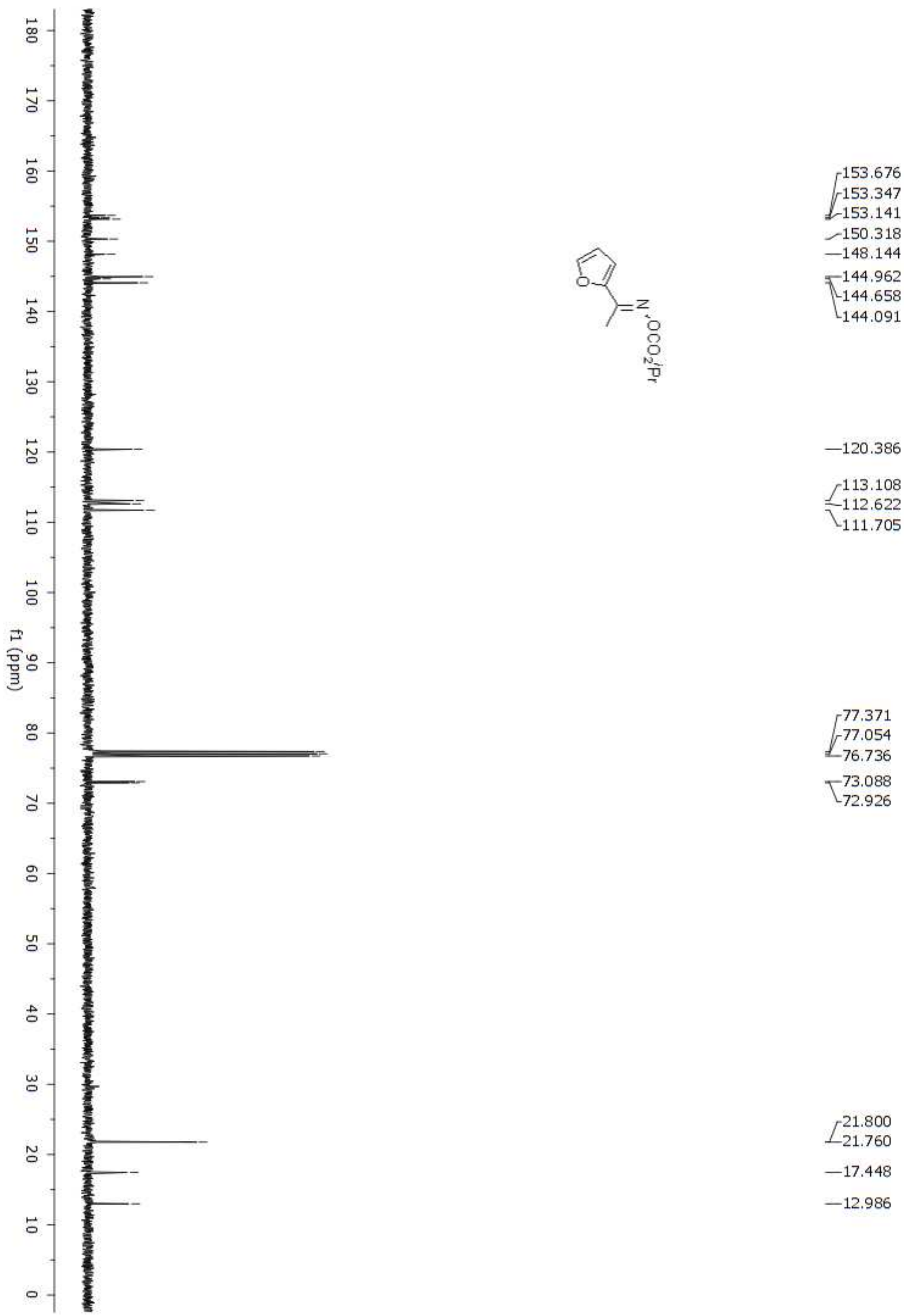


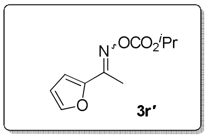
153.132
153.065
132.822
132.360
131.681
126.346
77.391
77.073
76.755
73.155
21.819
20.057
f1 (ppm)

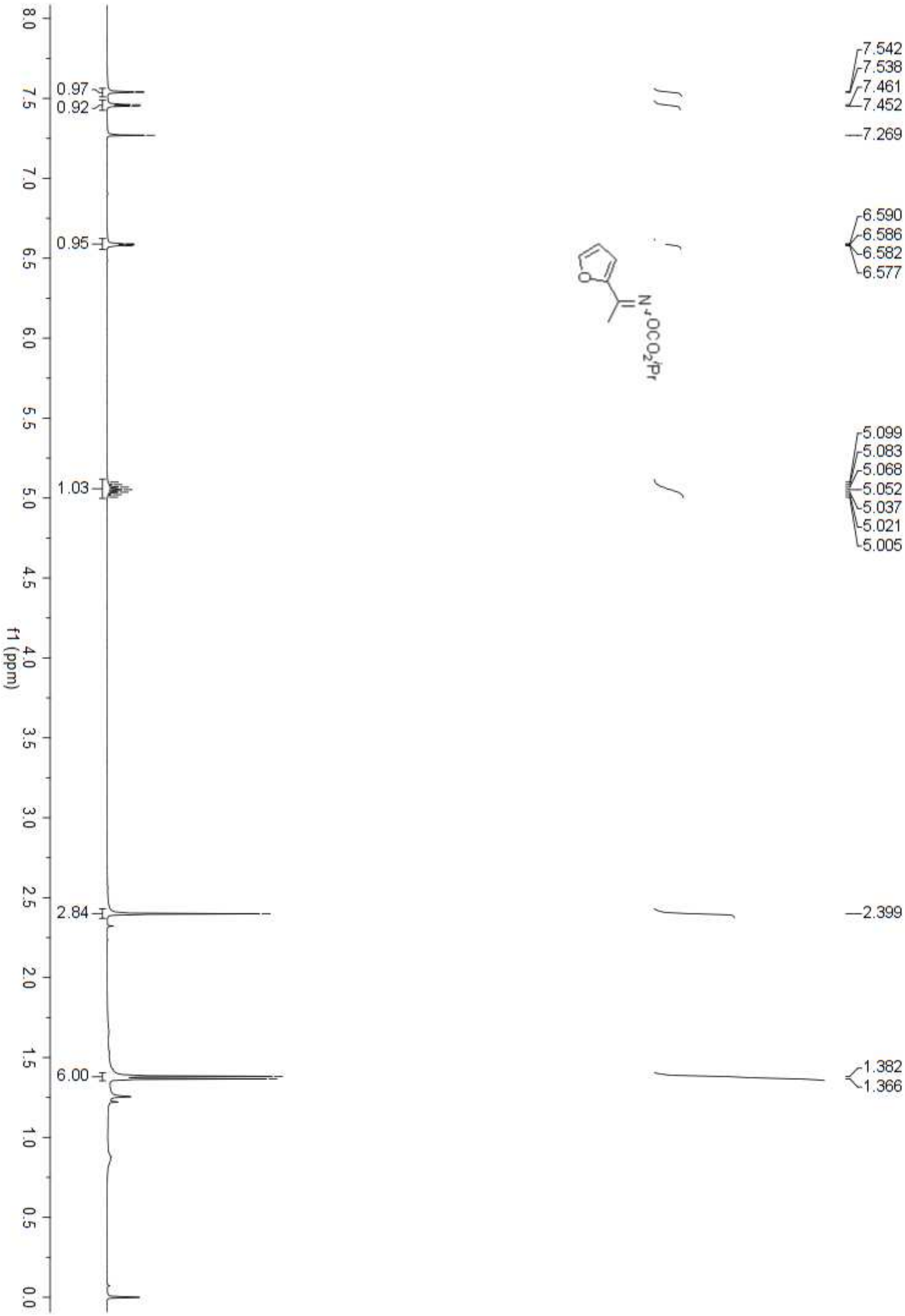

N
OCO2iPr
O
3r

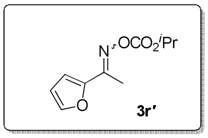

7.537
7.460
7.451
7.272
6.908
6.900
6.587
6.583
6.579
6.489
6.485
6.481
5.079
5.063
5.047
5.032
5.016
2.397
2.320
1.381
1.365
1.90
0.85
0.97
0.93
0.98
2.00
2.89
3.00
12.00
f1 (ppm)

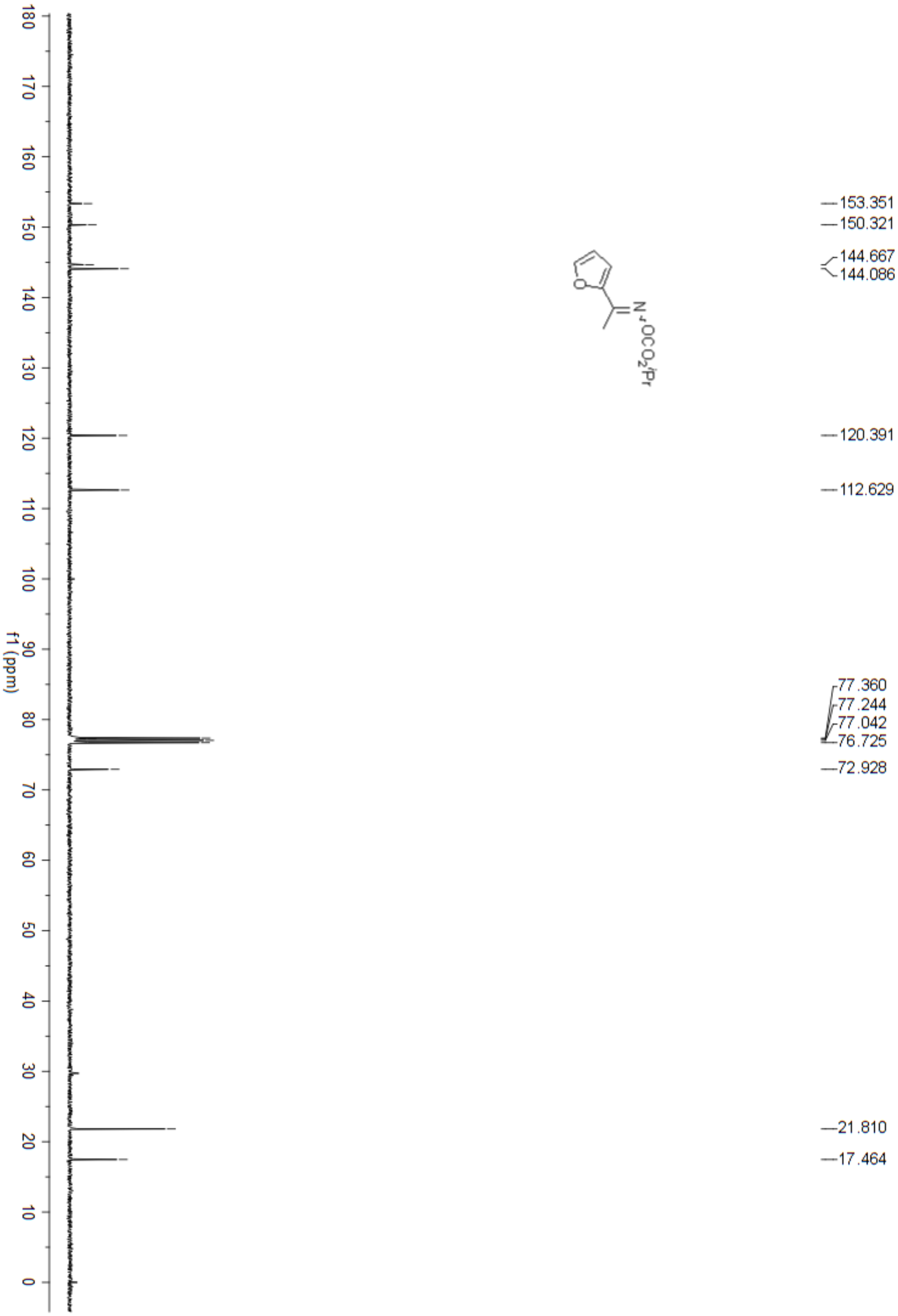

N OCO2iPr
O
3r

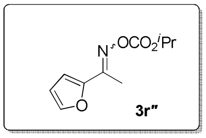

153.676
153.347
153.141
150.318
148.144
144.962
144.658
144.091
120.386
113.108
112.622
111.705
77.371
77.054
76.736
73.088
72.926
21.800
21.760
17.448
12.986
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

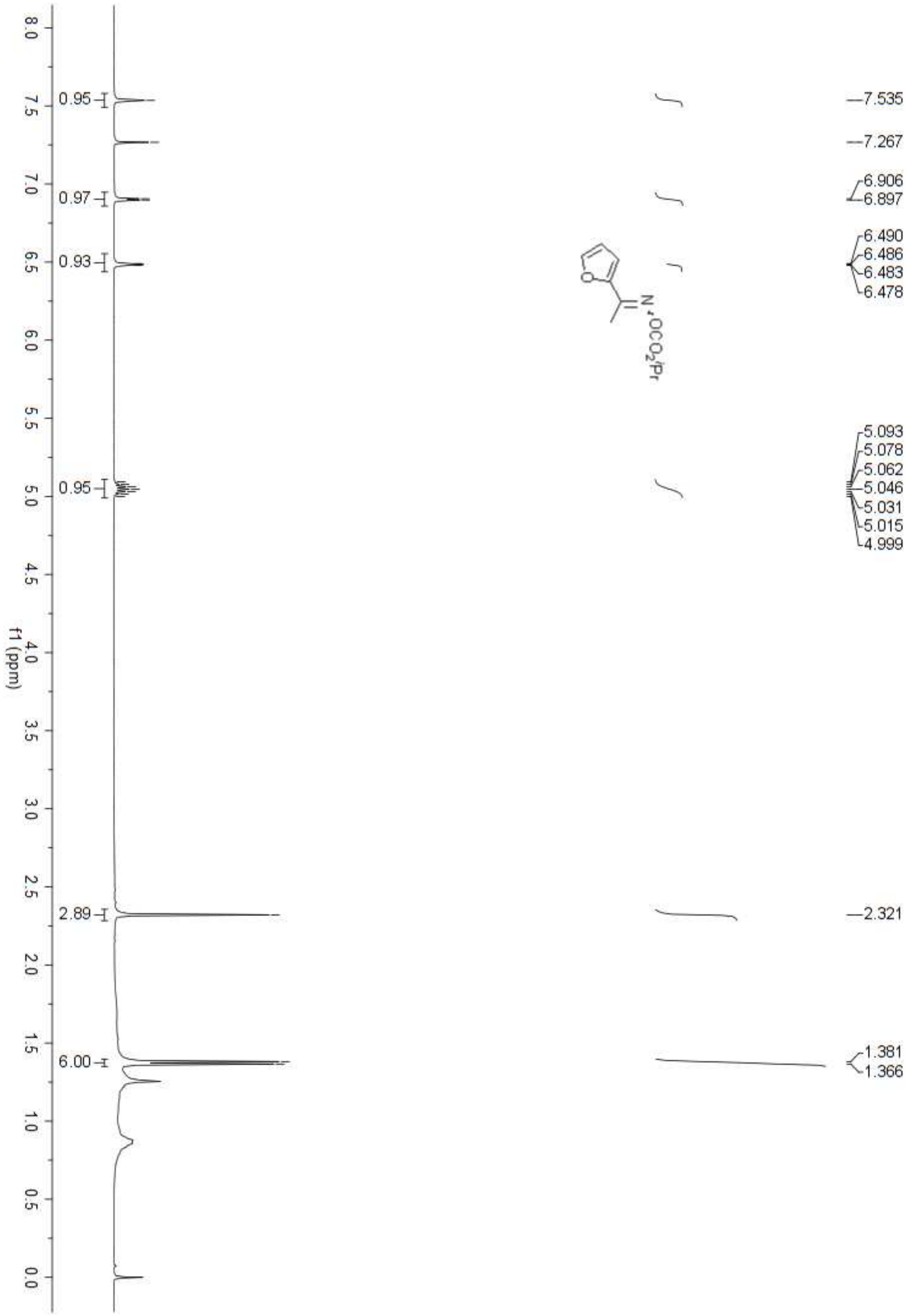

N OCO2iPr
O
3r′

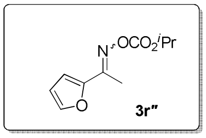

8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
0.97
0.92
0.95
1.03
2.84
6.00
7.542
7.538
7.461
7.452
7.269
6.590
6.586
6.582
6.577
5.099
5.083
5.068
5.052
5.037
5.021
5.005
2.399
1.382
1.366
N OCO2iPr
O

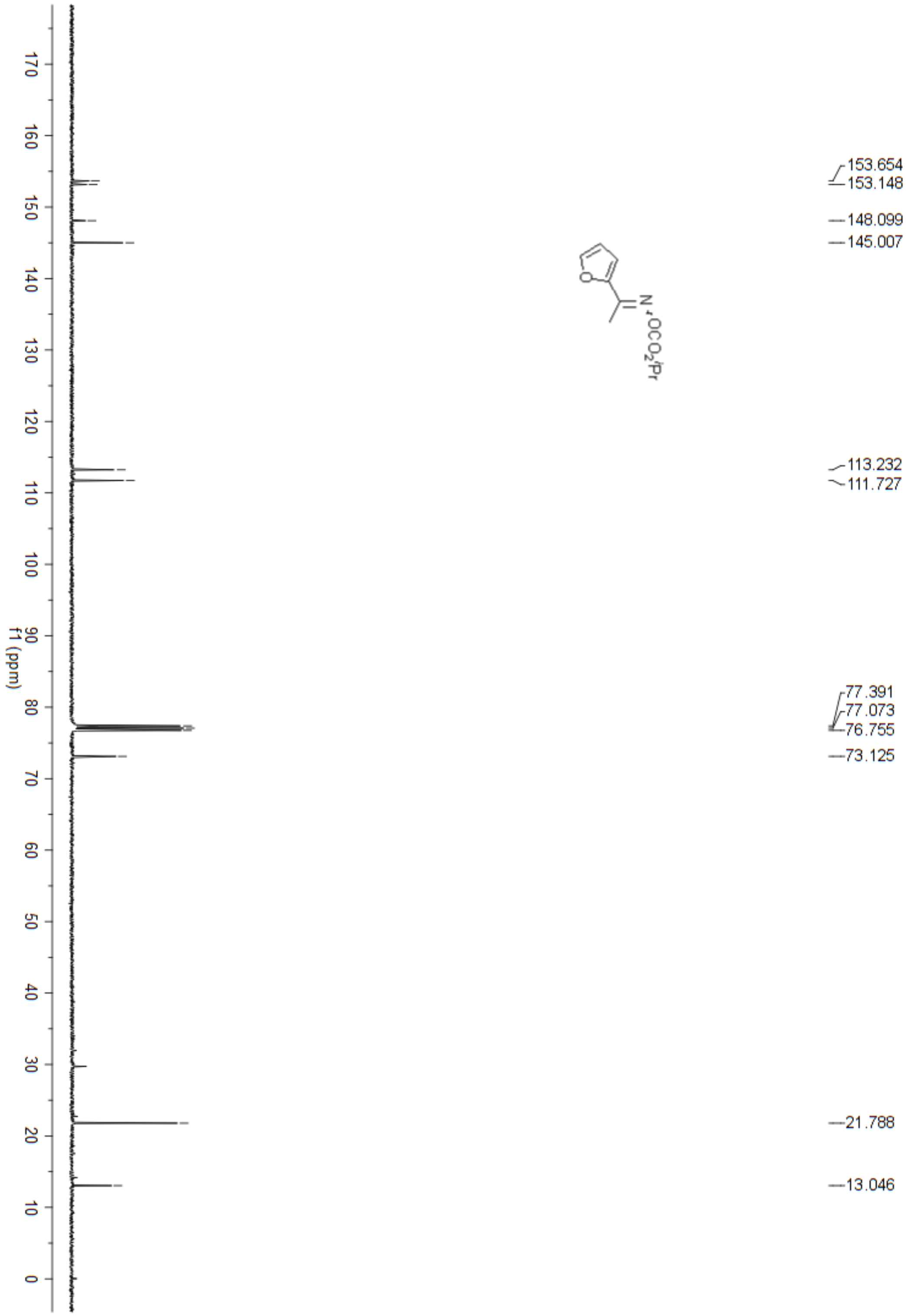

N-OCO2iPr
O
3r′

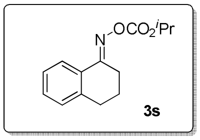

153.351
150.321
144.667
144.086
120.391
112.629
77.360
77.244
77.042
76.725
72.928
21.810
17.464
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

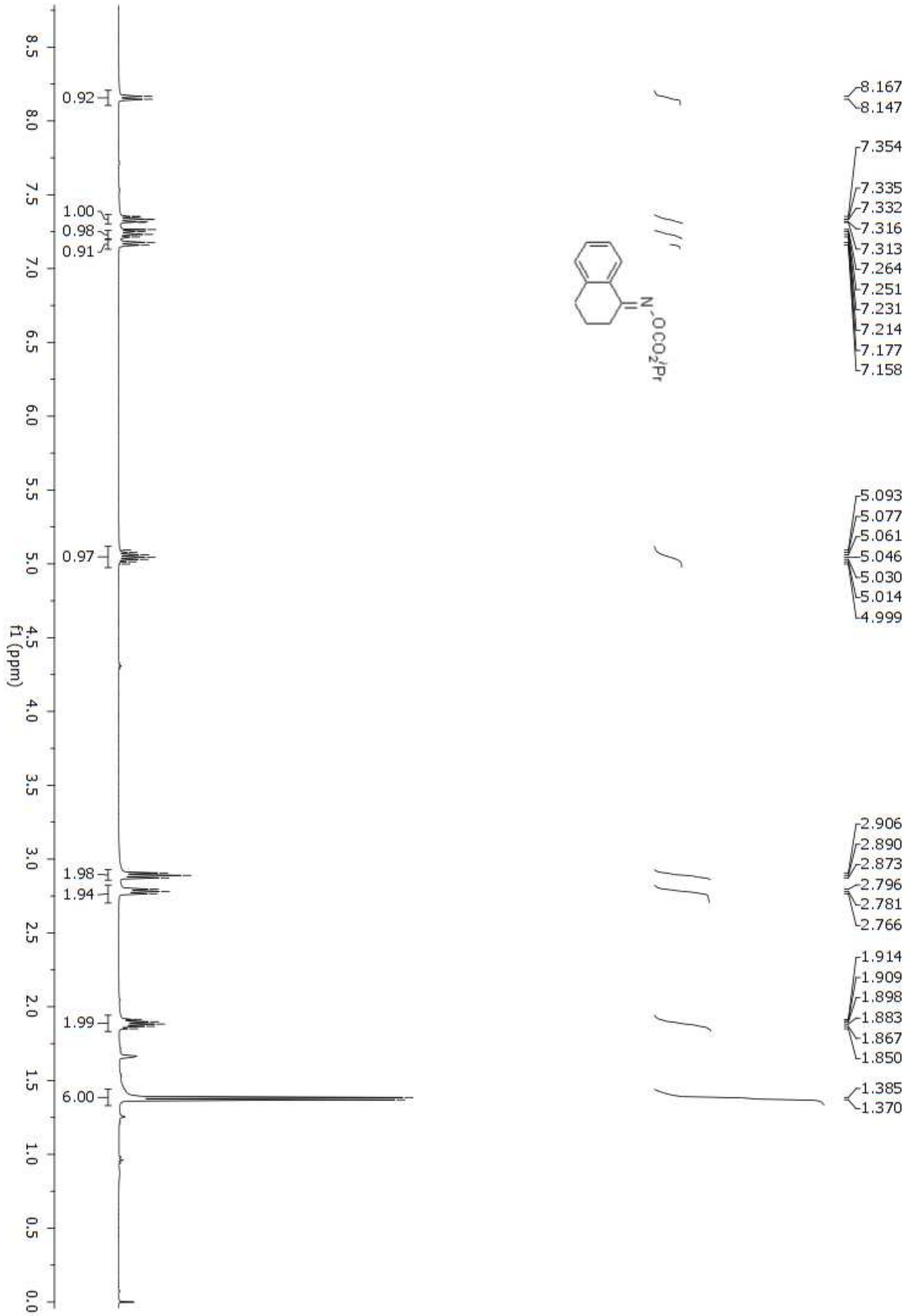

N
OCO2iPr
O
3r″

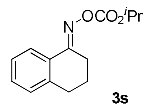

7.535
7.267
6.906
6.897
6.490
6.486
6.483
6.478
5.093
5.078
5.062
5.046
5.031
5.015
4.999
2.321
1.381
1.366
0.95
0.97
0.93
0.95
2.89
6.00
f1 (ppm)


N
OCO2iPr
O
3r″

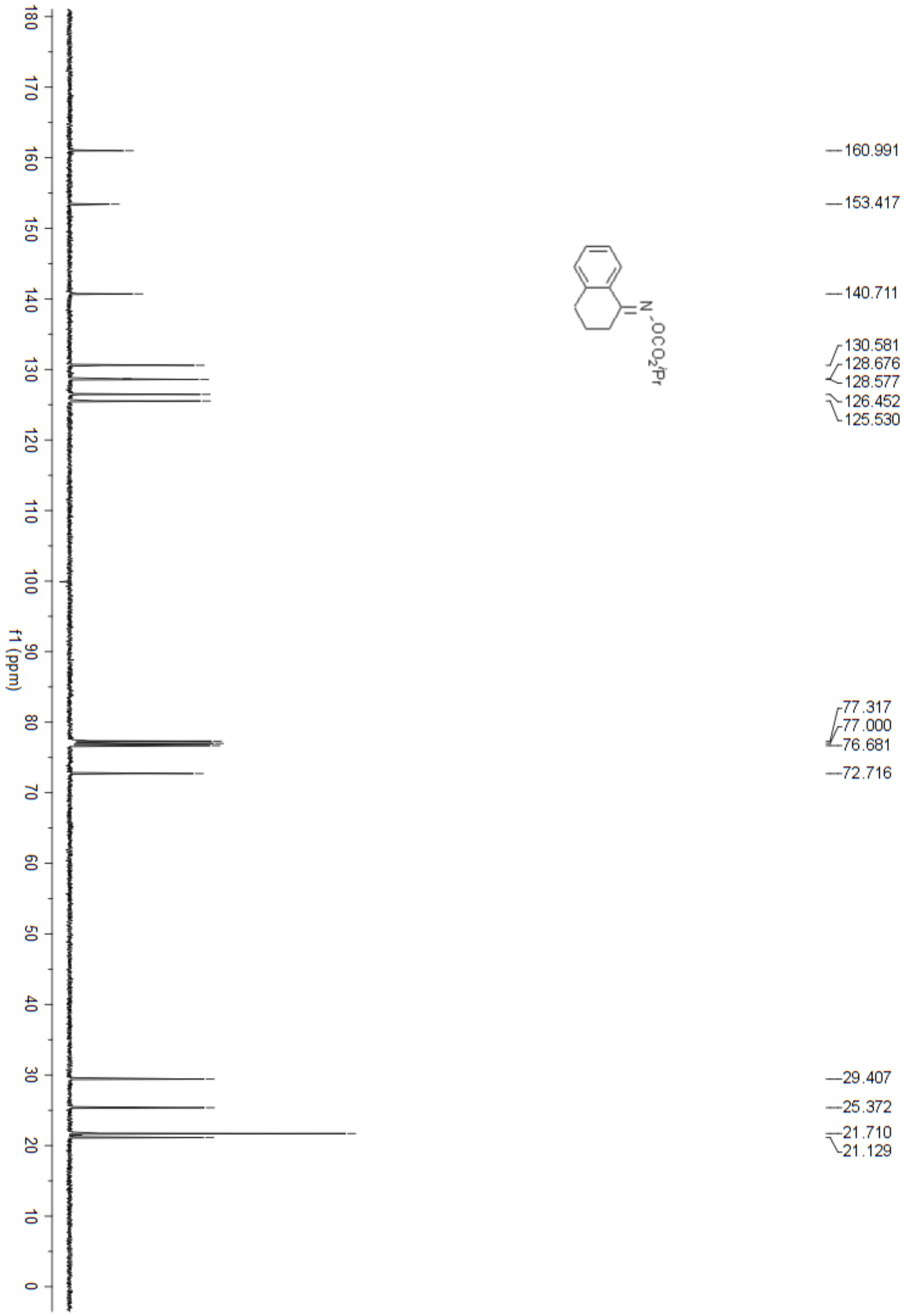

153.654
153.148
148.099
145.007
113.232
111.727
77.391
77.073
76.755
73.125
21.788
13.046
f1 (ppm)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

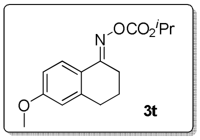

N
OCO2iPr
3s

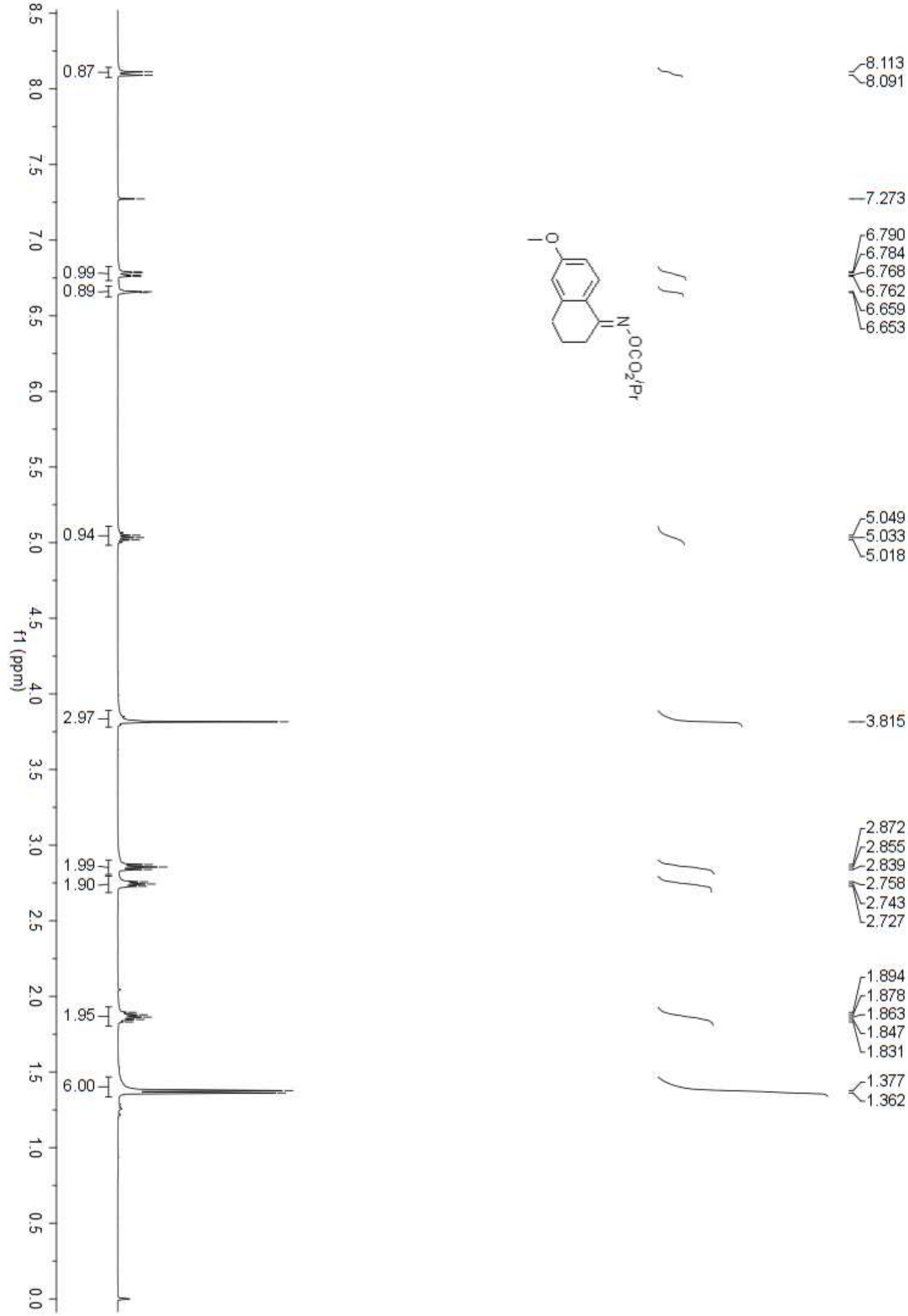

8.167
8.147
7.354
7.335
7.332
7.316
7.313
7.264
7.251
7.231
7.214
7.177
7.158
5.093
5.077
5.061
5.046
5.030
5.014
4.999
2.906
2.890
2.873
2.796
2.781
2.766
1.914
1.909
1.898
1.883
1.867
1.850
1.385
1.370
0.92
1.00
0.98
0.91
0.97
1.98
1.94
1.99
6.00
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
OCO2iPr

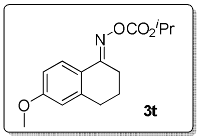

N
OCO2iPr

3s


160.991
153.417
140.711
130.581
128.676
128.577
126.452
125.530
77.317
77.000
76.681
72.716
29.407
25.372
21.710
21.129
f1 (ppm)

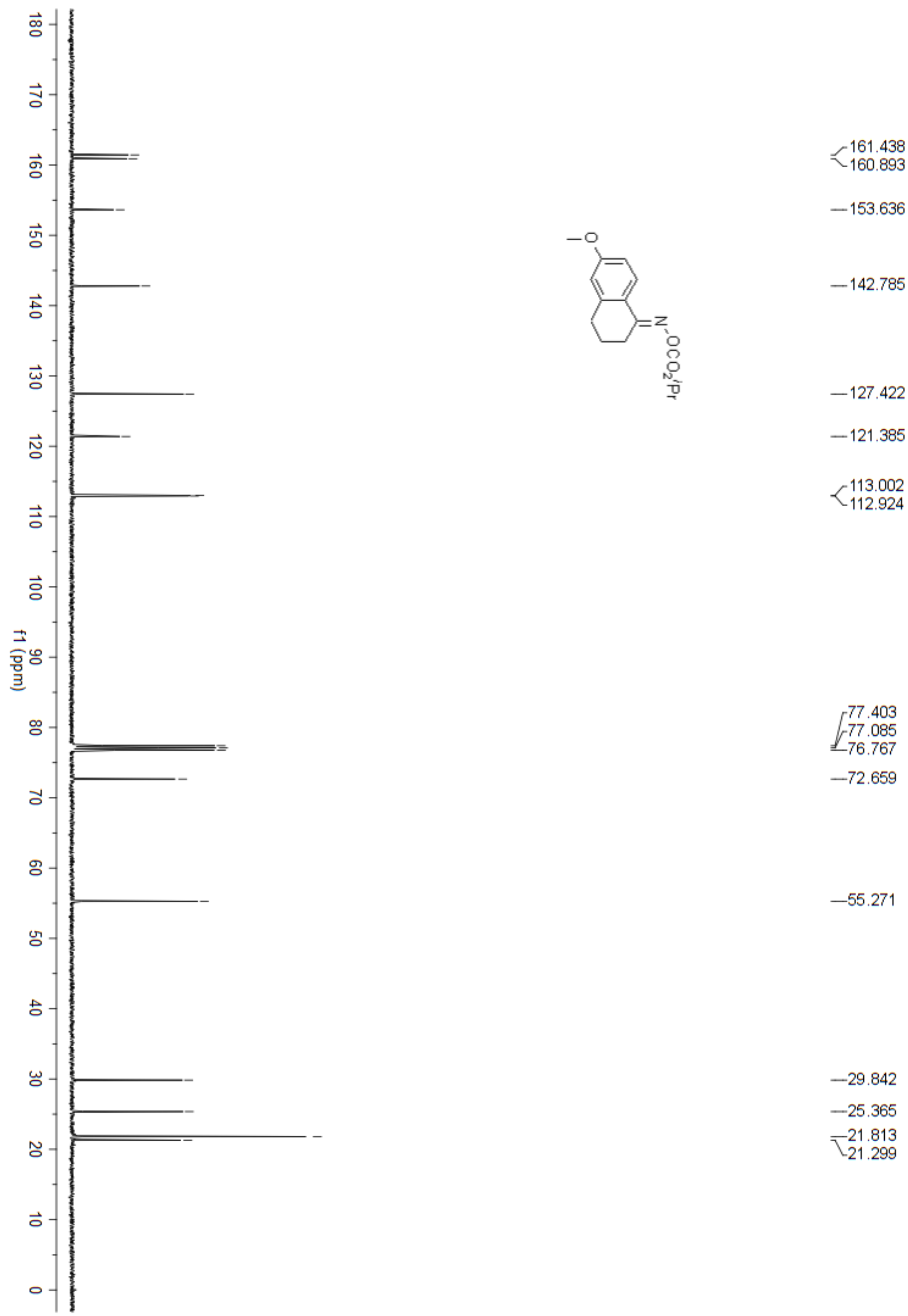

N
OCO2iPr
O
3t


f1 (ppm)
8.113
8.091
7.273
6.790
6.784
6.768
6.762
6.659
6.653
5.049
5.033
5.018
3.815
2.872
2.855
2.839
2.758
2.743
2.727
1.894
1.878
1.863
1.847
1.831
1.377
1.362
0.87
0.99
0.89
0.94
2.97
1.99
1.90
1.95
6.00

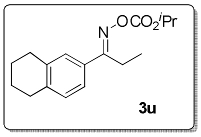


N
$OCO_2{}^iPr$
O

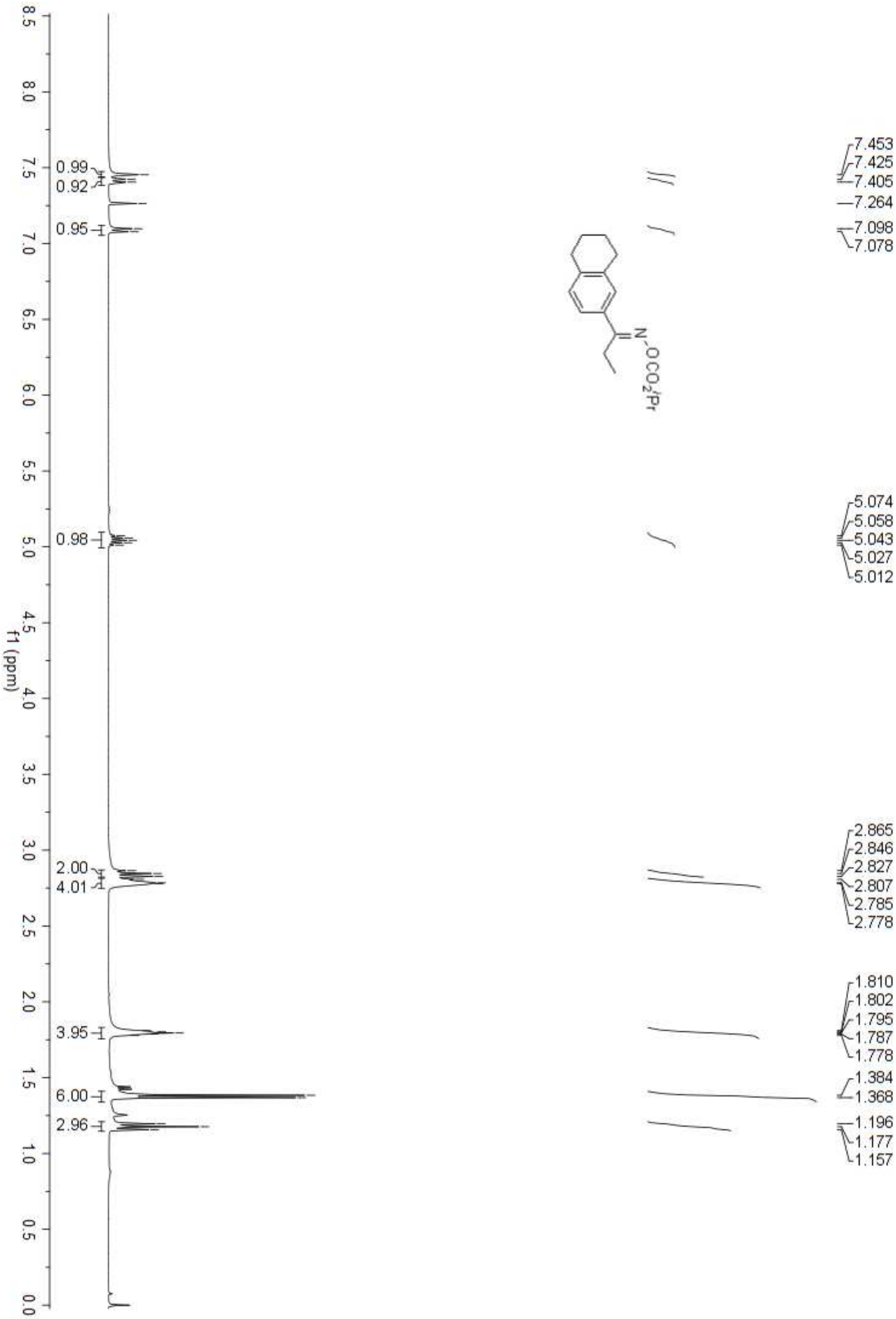
3t



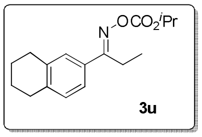
161.438
160.893
153.636
142.785
127.422
121.385
113.002
112.924
77.403
77.085
76.767
72.659
55.271
29.842
25.365
21.813
21.299
f1 (ppm)

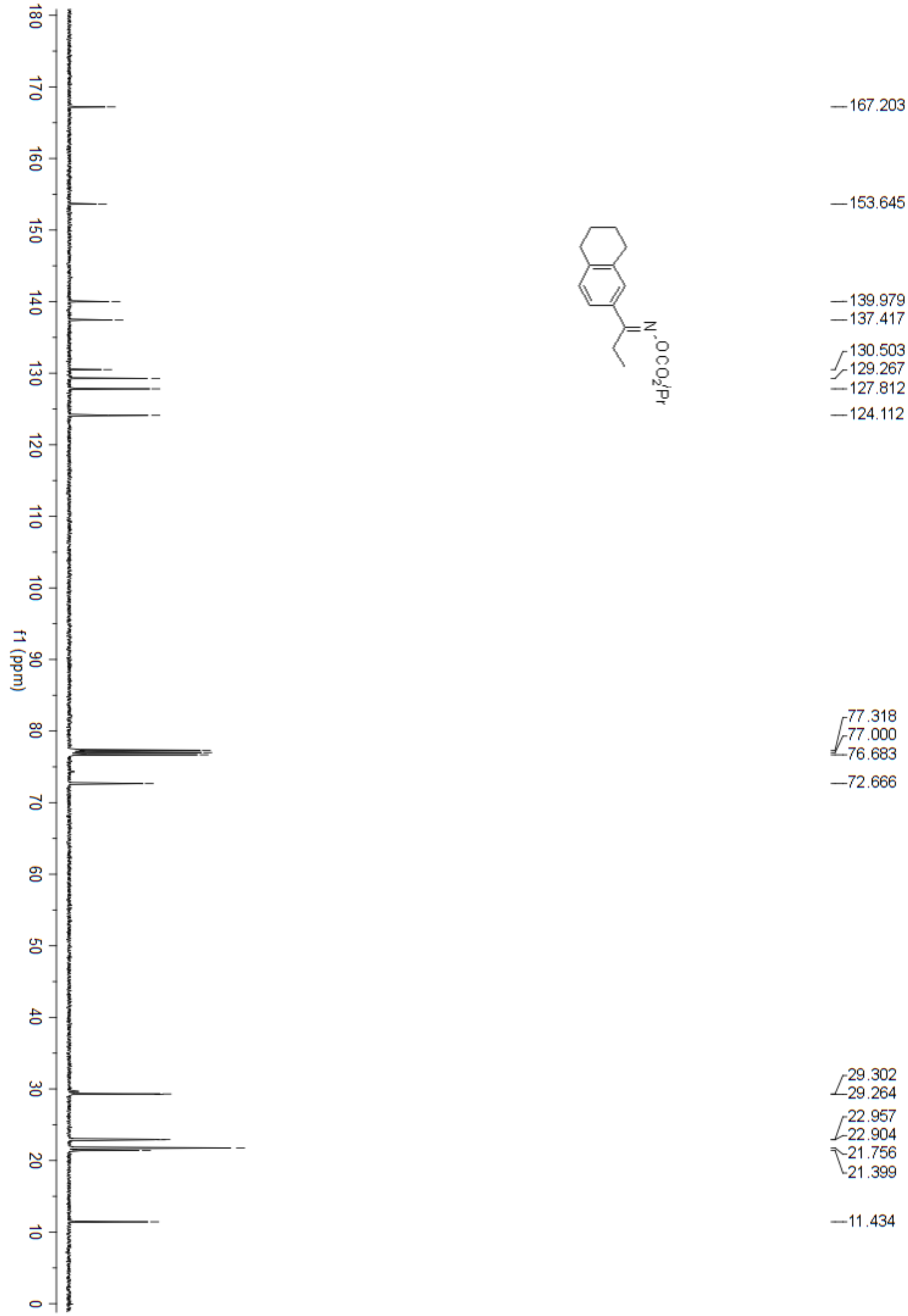


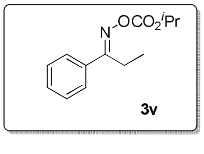
OCO2iPr
N
3u

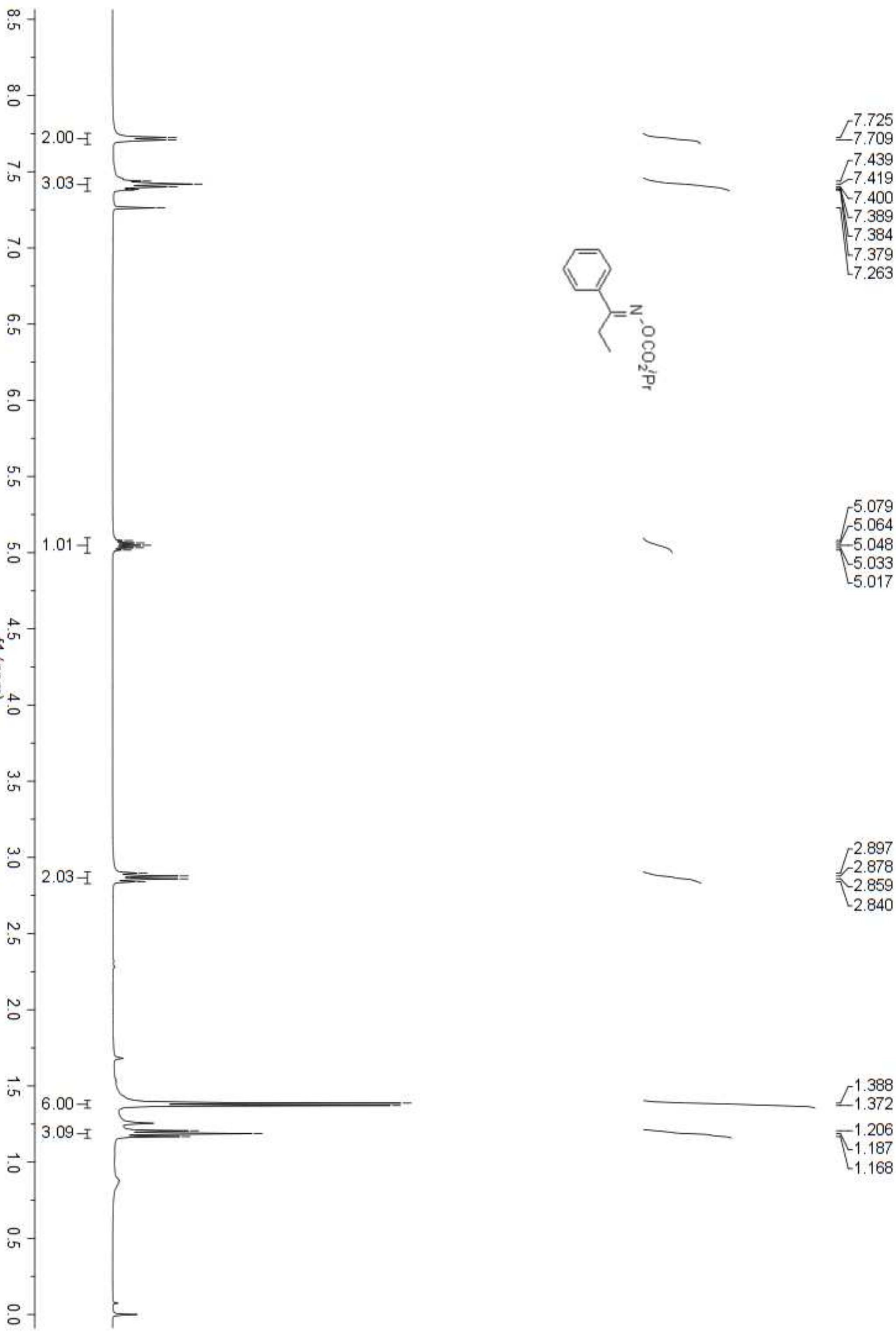


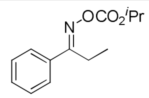
f1 (ppm)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.99
0.92
0.95
0.98
2.00
4.01
3.95
6.00
2.96
7.453
7.425
7.405
7.264
7.098
7.078
5.074
5.058
5.043
5.027
5.012
2.865
2.846
2.827
2.807
2.785
2.778
1.810
1.802
1.795
1.787
1.778
1.384
1.368
1.196
1.177
1.157
N
OCO2iPr


OCO2iPr
N
3u

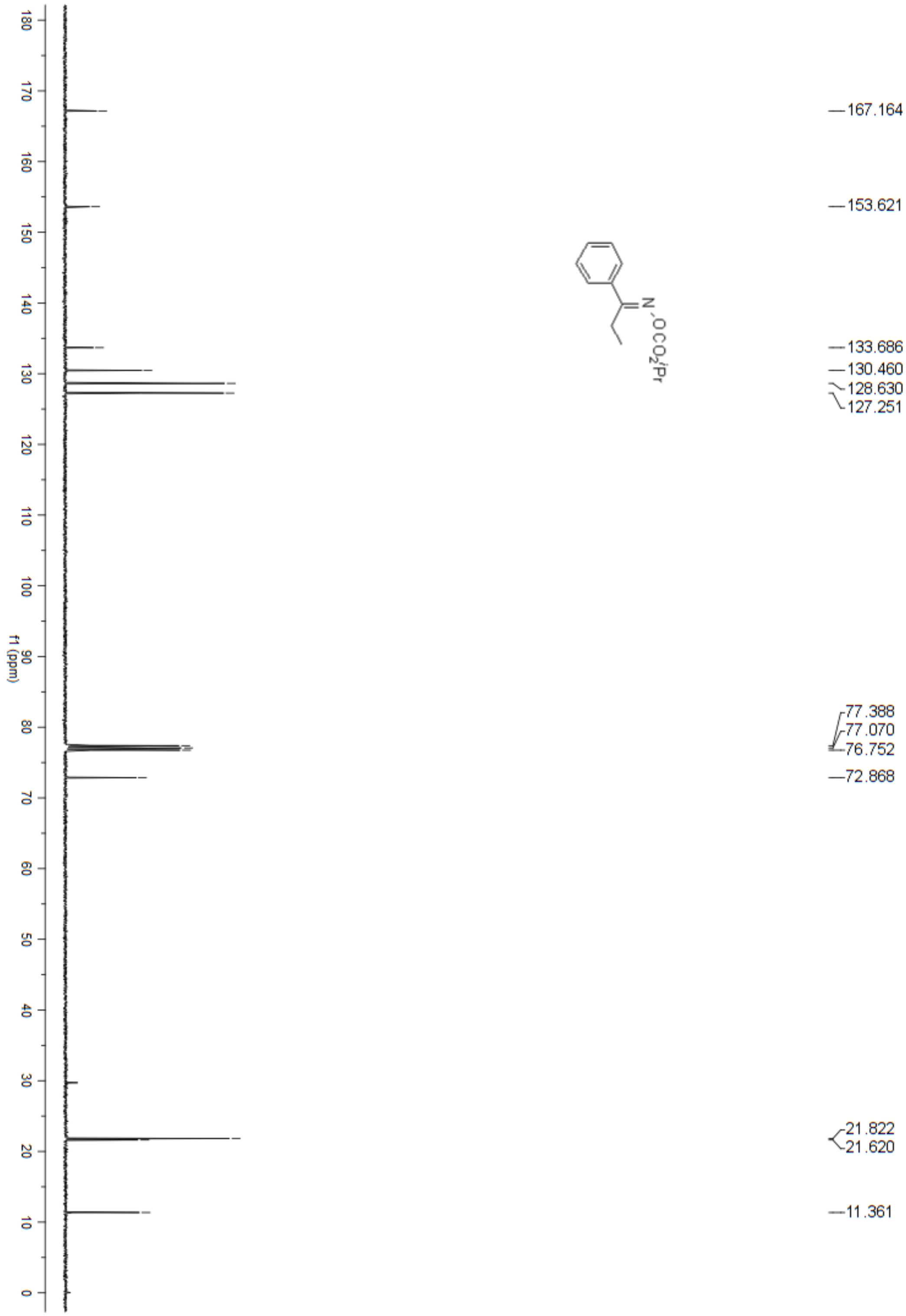

f1 (ppm)
167.203
153.645
139.979
137.417
130.503
129.267
127.812
124.112
77.318
77.000
76.683
72.666
29.302
29.264
22.957
22.904
21.756
21.399
11.434

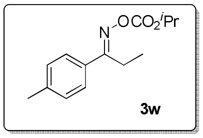

N
OCO2iPr
3v

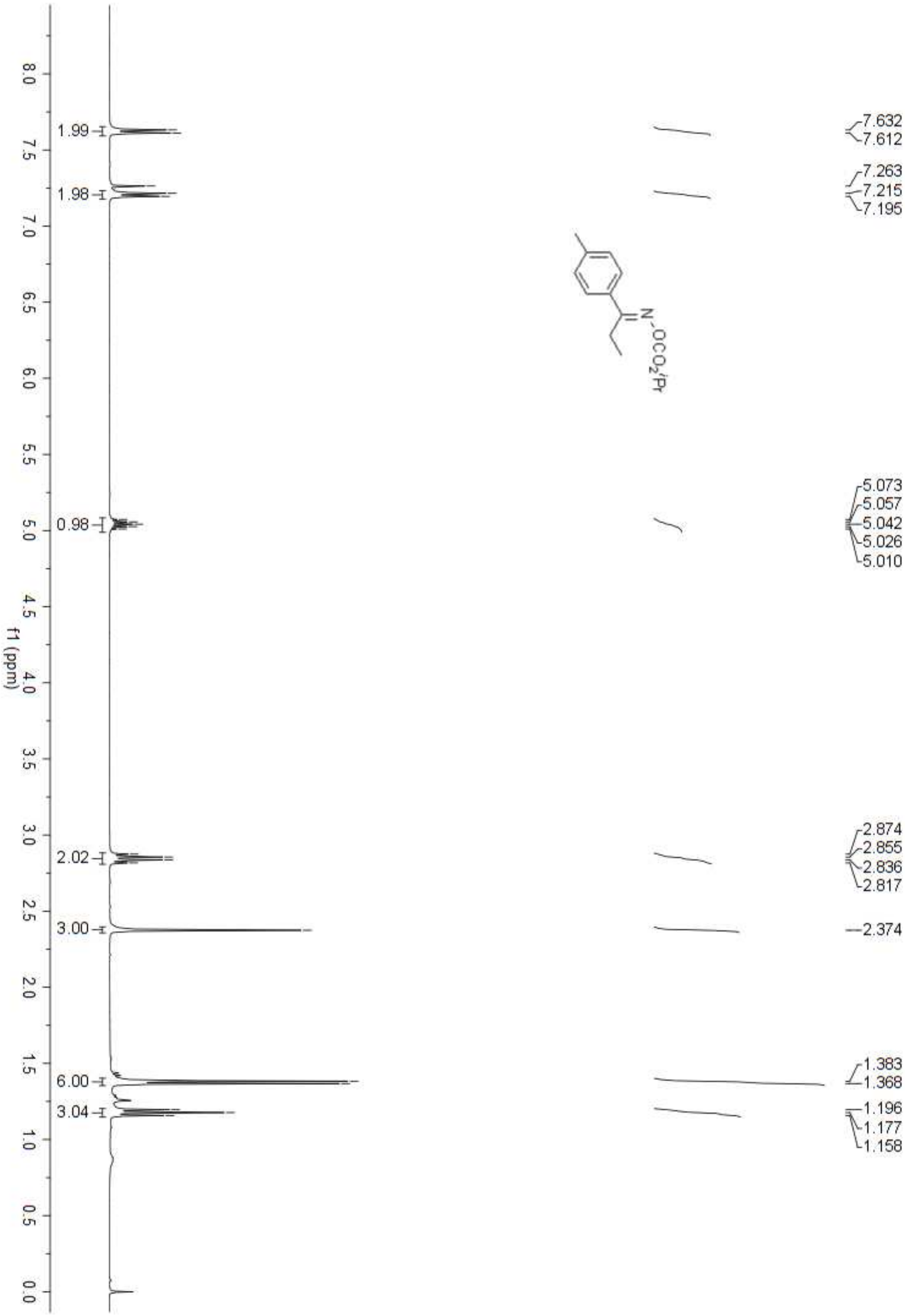

7.725
7.709
7.439
7.419
7.400
7.389
7.384
7.379
7.263
5.079
5.064
5.048
5.033
5.017
2.897
2.878
2.859
2.840
1.388
1.372
1.206
1.187
1.168
2.00
3.03
1.01
2.03
6.00
3.09
f1 (ppm)

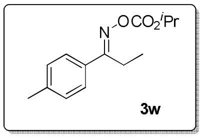

OCO2iPr
N

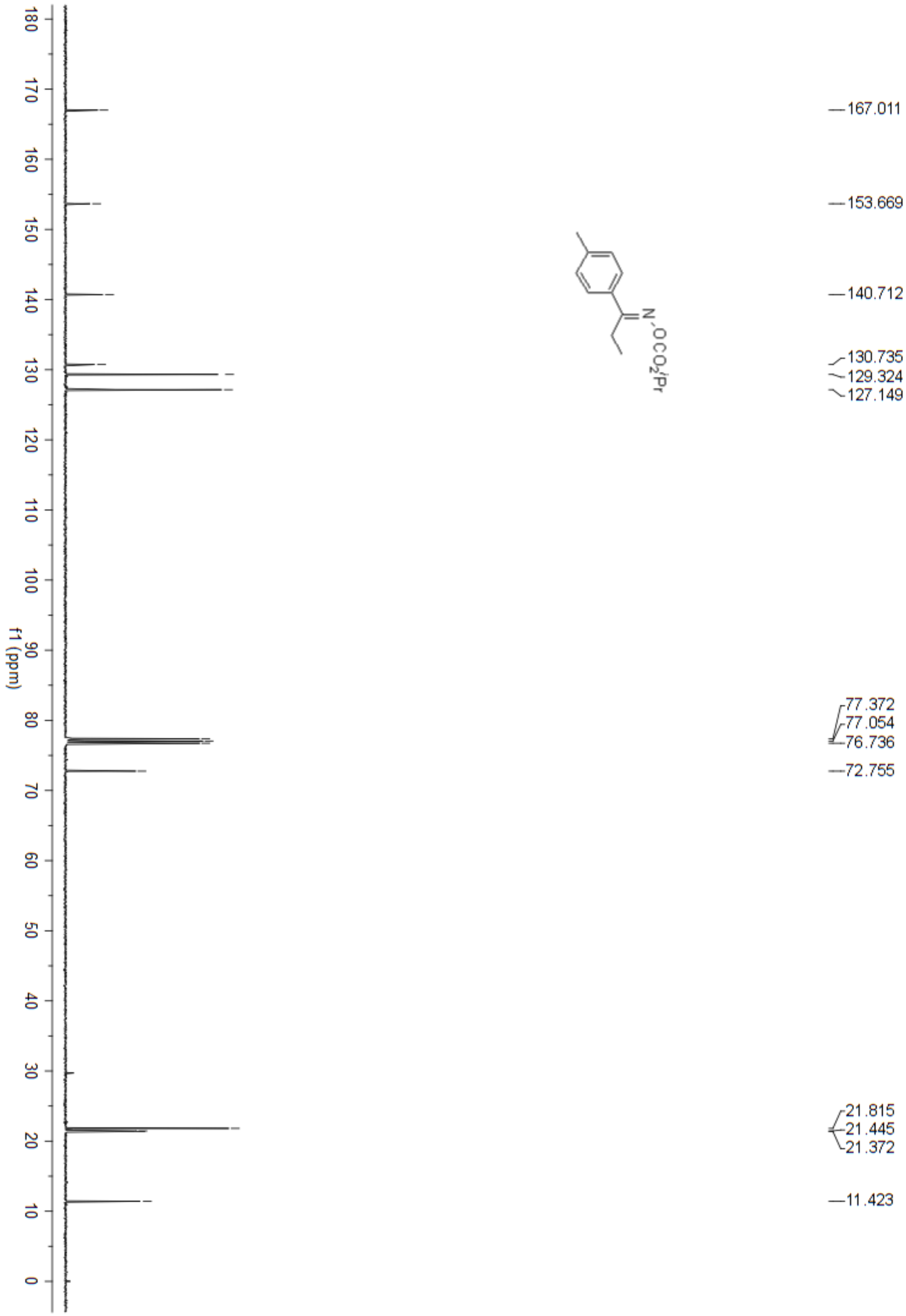
3v

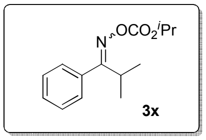

167.164
153.621
133.686
130.460
128.630
127.251
77.388
77.070
76.752
72.868
21.822
21.620
11.361
f1 (ppm)


N
OCO2iPr
3w

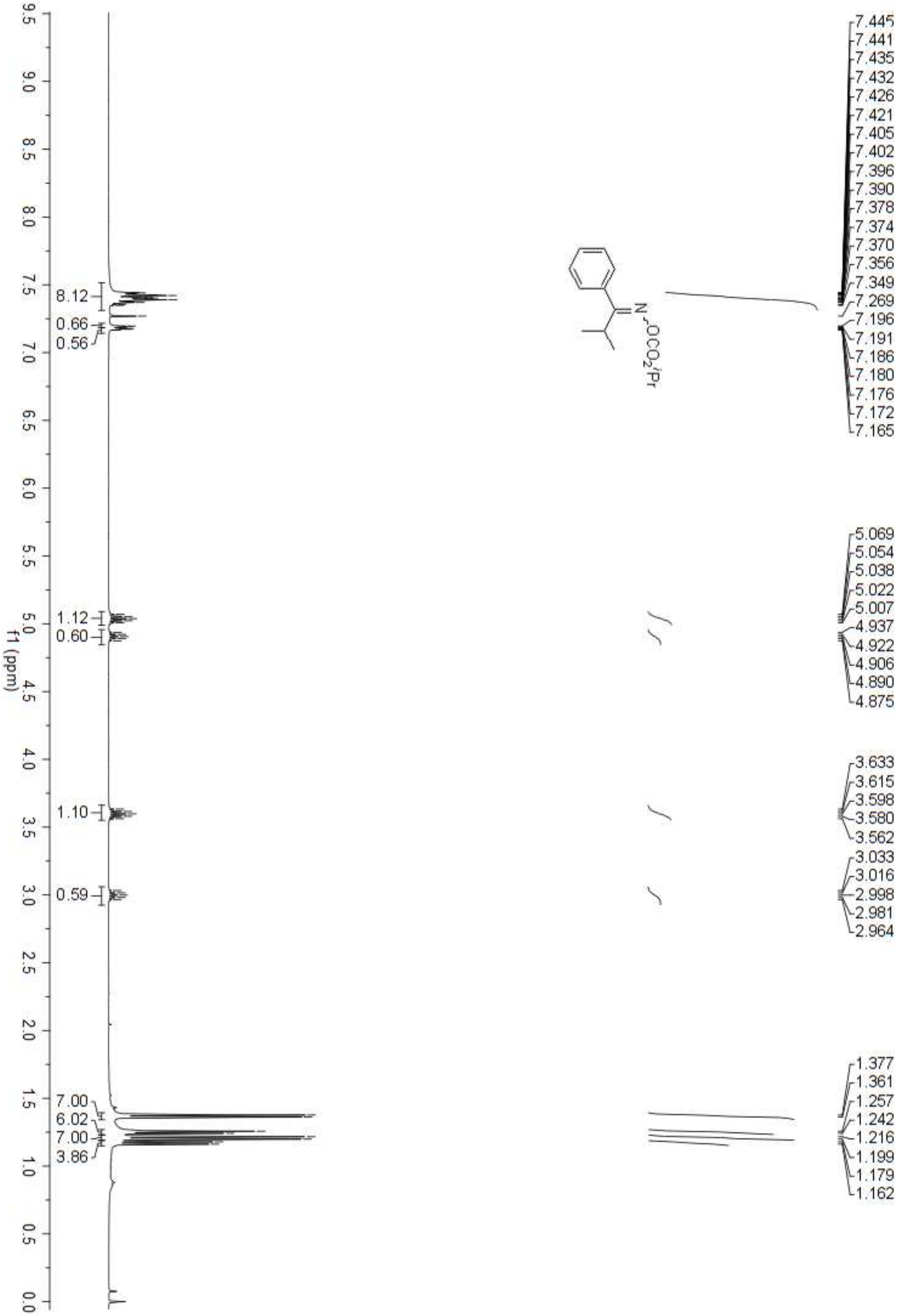

7.632
7.612
7.263
7.215
7.195
5.073
5.057
5.042
5.026
5.010
2.874
2.855
2.836
2.817
2.374
1.383
1.368
1.196
1.177
1.158
1.99
1.98
0.98
2.02
3.00
6.00
3.04
f1 (ppm)


OCO2iPr
N
3w

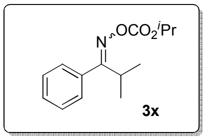

167.011
153.669
140.712
130.735
129.324
127.149
77.372
77.054
76.736
72.755
21.815
21.445
21.372
11.423
f1 (ppm)
OCO2iPr

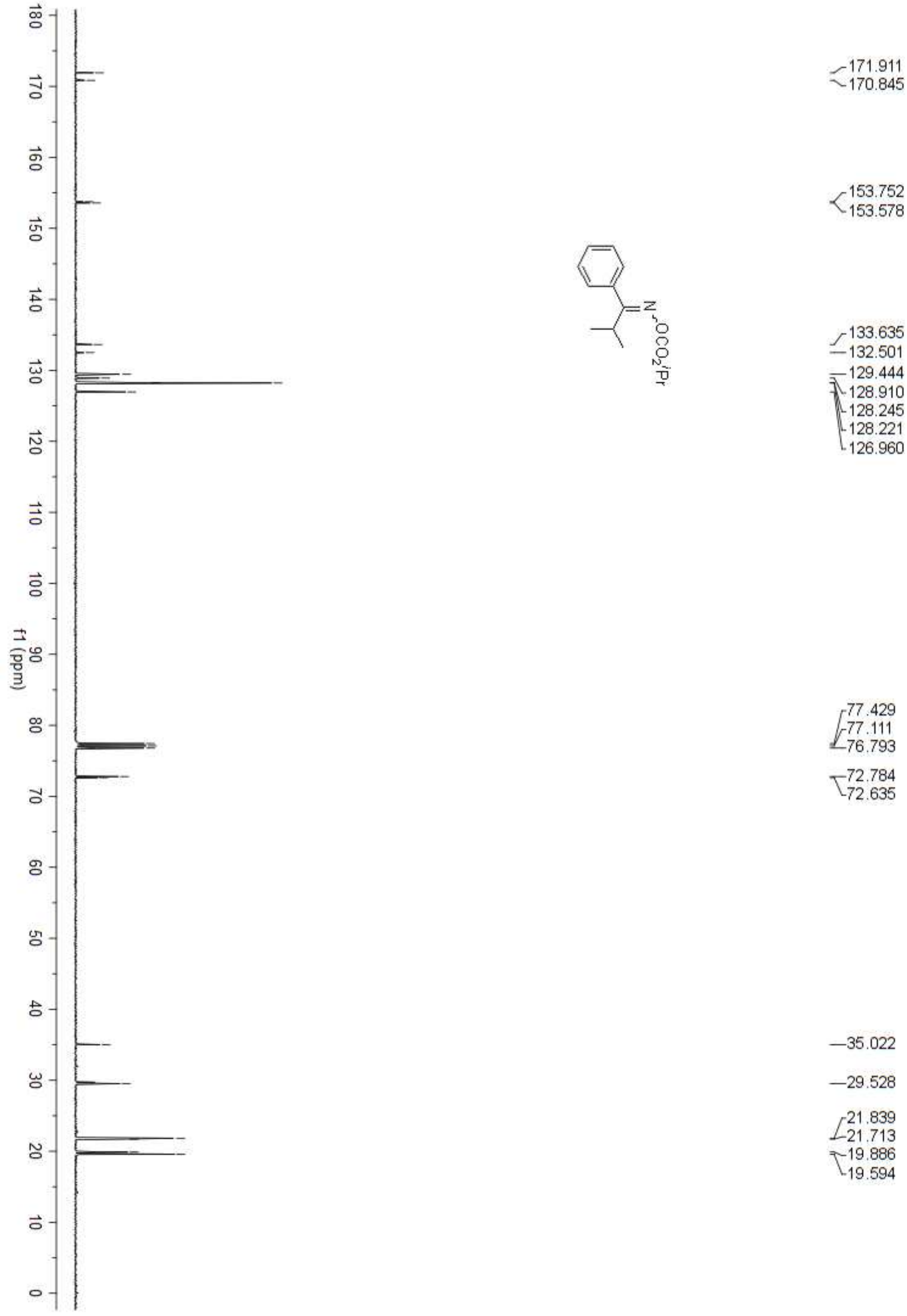


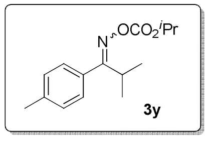
N OCO2iPr
3x



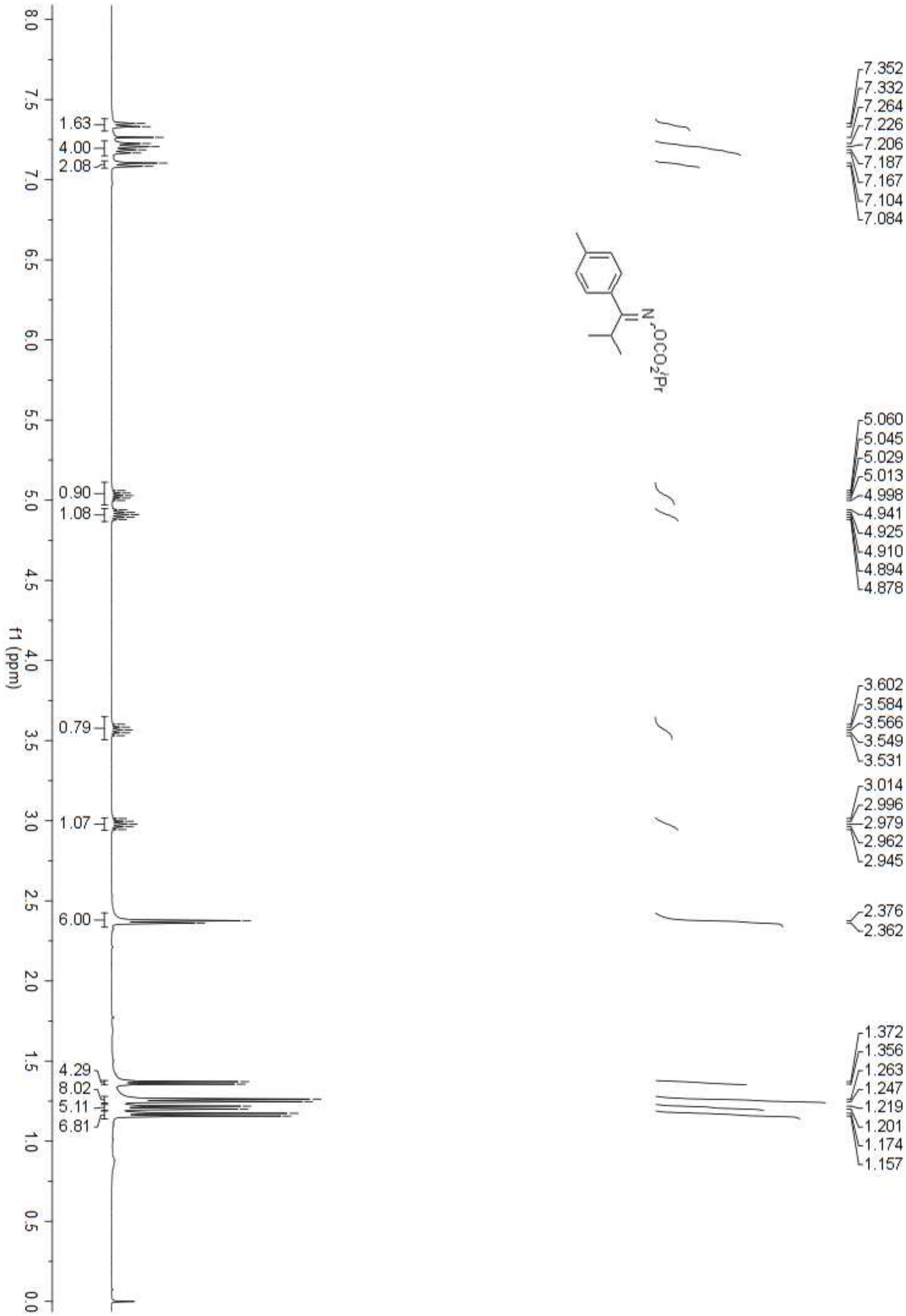
7.445
7.441
7.435
7.432
7.426
7.421
7.405
7.402
7.396
7.390
7.378
7.374
7.370
7.356
7.349
7.269
7.196
7.191
7.186
7.180
7.176
7.172
7.165
5.069
5.054
5.038
5.022
5.007
4.937
4.922
4.906
4.890
4.875
3.633
3.615
3.598
3.580
3.562
3.033
3.016
2.998
2.981
2.964
1.377
1.361
1.257
1.242
1.216
1.199
1.179
1.162
8.12
0.66
0.56
1.12
0.60
1.10
0.59
7.00
6.02
7.00
3.86
f1 (ppm)
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


N
OCO$_2$^{i}Pr
3x

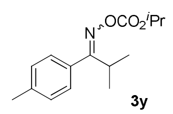

171.911
170.845
153.752
153.578
133.635
132.501
129.444
128.910
128.245
128.221
126.960
77.429
77.111
76.793
72.784
72.635
35.022
29.528
21.839
21.713
19.886
19.594
f1 (ppm)
N
OCO$_2$^{i}Pr



3y

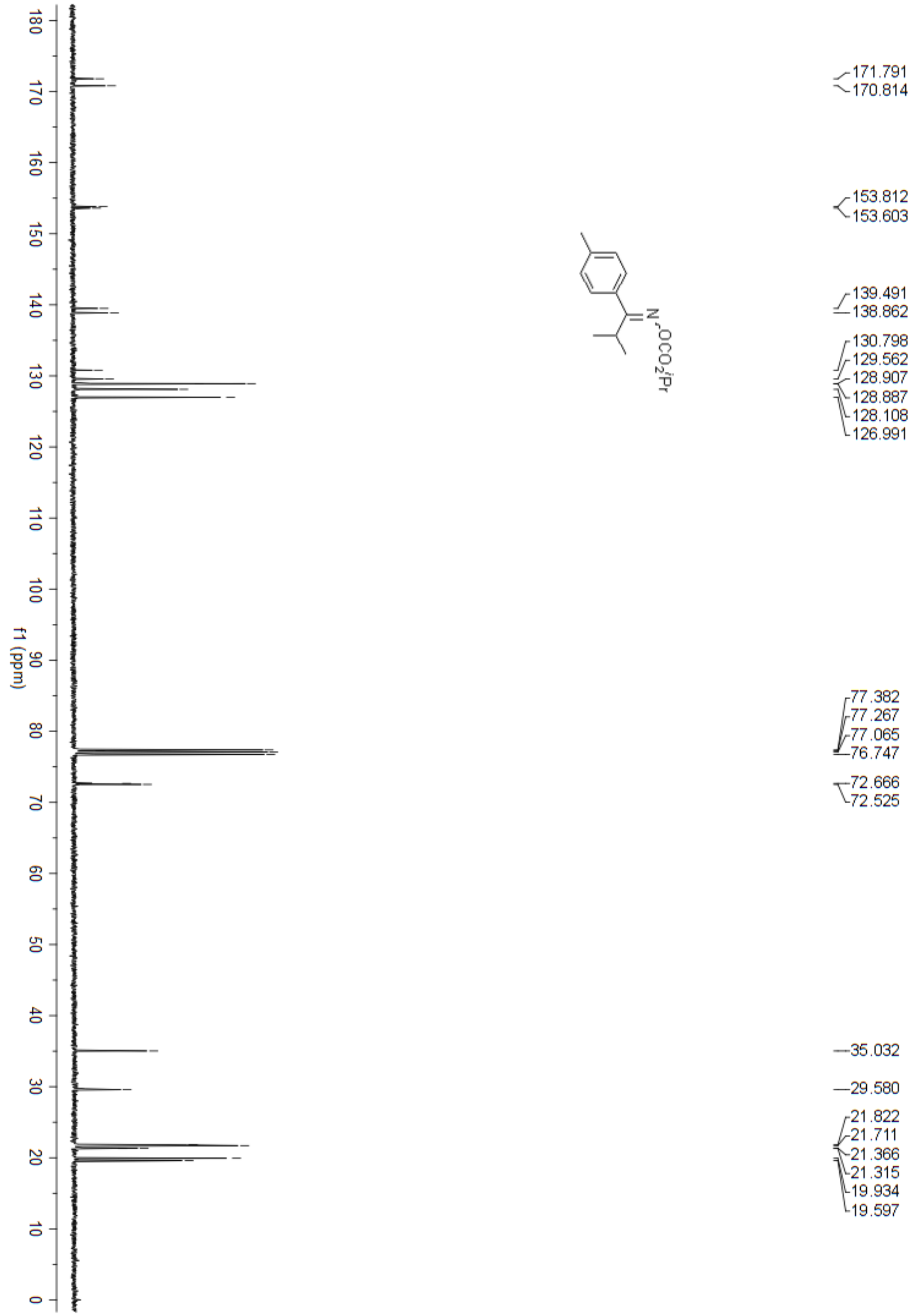


f1 (ppm)
7.352
7.332
7.264
7.226
7.206
7.187
7.167
7.104
7.084
5.060
5.045
5.029
5.013
4.998
4.941
4.925
4.910
4.894
4.878
3.602
3.584
3.566
3.549
3.531
3.014
2.996
2.979
2.962
2.945
2.376
2.362
1.372
1.356
1.263
1.247
1.219
1.201
1.174
1.157
1.63
4.00
2.08
0.90
1.08
0.79
1.07
6.00
4.29
8.02
5.11
6.81

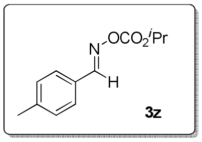


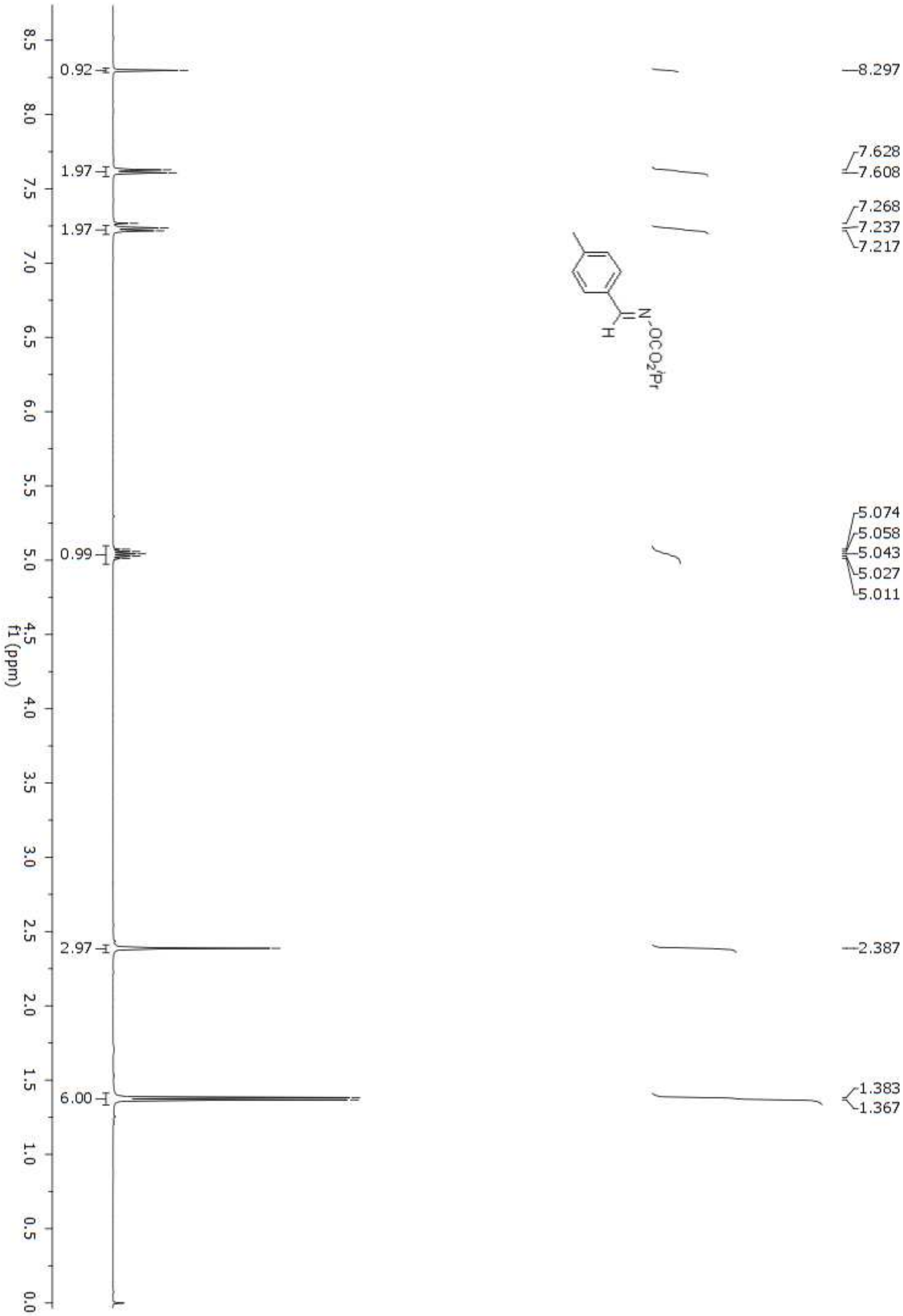
N
OCO$_2$^{i}Pr

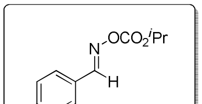
3y



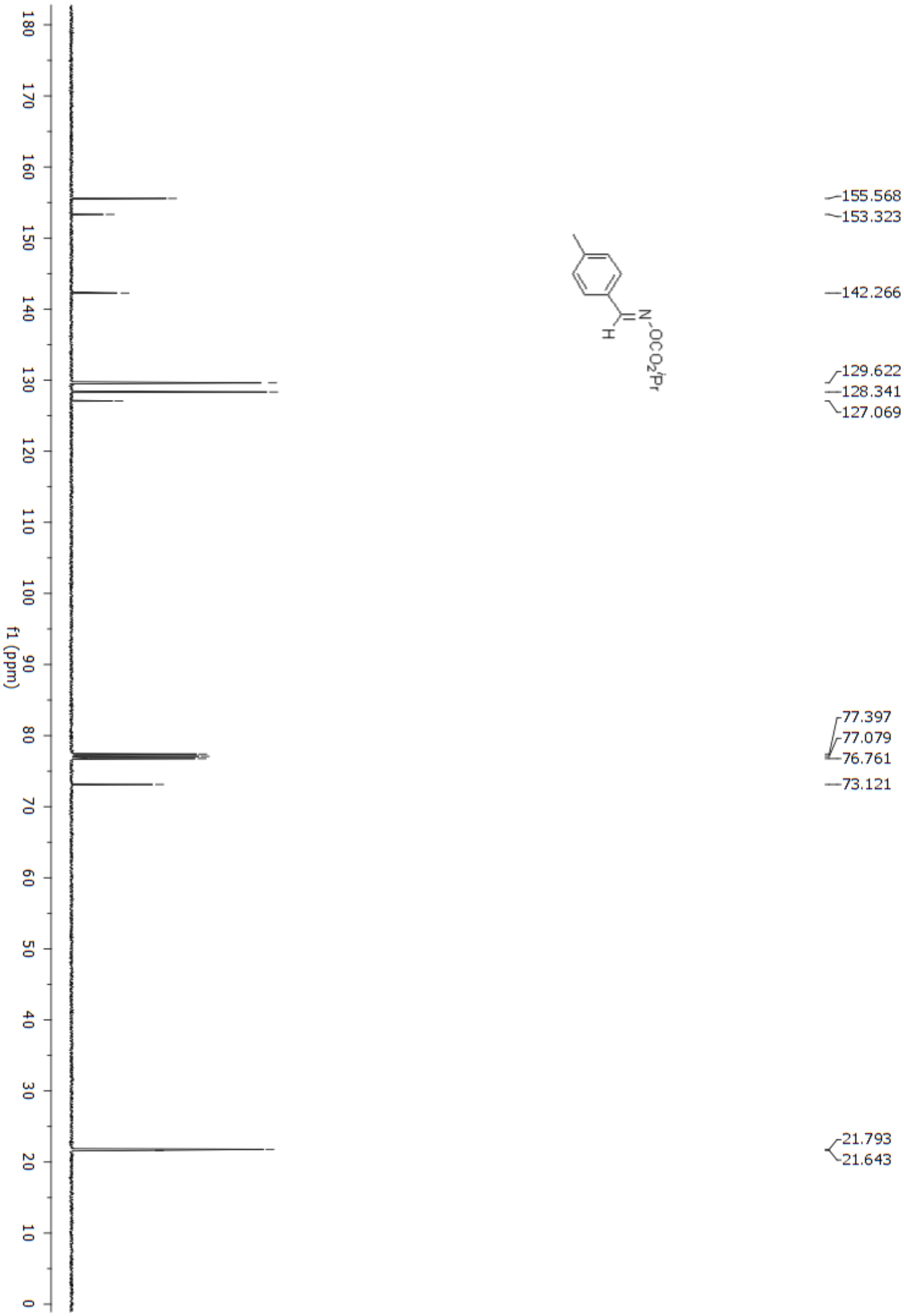
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
171.791
170.814
153.812
153.603
139.491
138.862
130.798
129.562
128.907
128.887
128.108
126.991
77.382
77.267
77.065
76.747
72.666
72.525
35.032
29.580
21.822
21.711
21.366
21.315
19.934
19.597
N
OCO$_2$^{i}Pr


N
OCO2iPr
H
3z


8.297
7.628
7.608
7.268
7.237
7.217
5.074
5.058
5.043
5.027
5.011
2.387
1.383
1.367
0.92
1.97
1.97
0.99
2.97
6.00
f1 (ppm)


N
OCO$_2$^{i}Pr
H

3z


155.568
153.323
142.266
129.622
128.341
127.069
77.397
77.079
76.761
73.121
21.793
21.643
f1 (ppm)