

Poly(hydroxamic acid) Functionalized Copper Catalyzed C-N Bond Formation Reactions

Md. Shaharul Islam^a, Bablu Hira Mandal^{ab}, Tapan Kumar Biswas^{ac}, Md. Lutfor Rahman^{*d}, S. S. Rashid^a, Suat-Hian Tan^a and Shaheen M. Sarkar^{*a}

^aFaculty of Industrial Sciences and Technology, University Malaysia Pahang, Gambang 26300, Kuantan, Malaysia

^bDepartment of Chemistry, Jessore University of Science and Technology, Jessore 7408, Bangladesh

^cDepartment of Chemistry, University of Rajshahi, Rajshahi 6205, Bangladesh

^dFaculty of Science and Natural Resources, University Malaysia Sabah, Kotakinabalu 88400, Sabah, Malaysia

E-mail: sha_inha@yahoo.com

Supporting Information

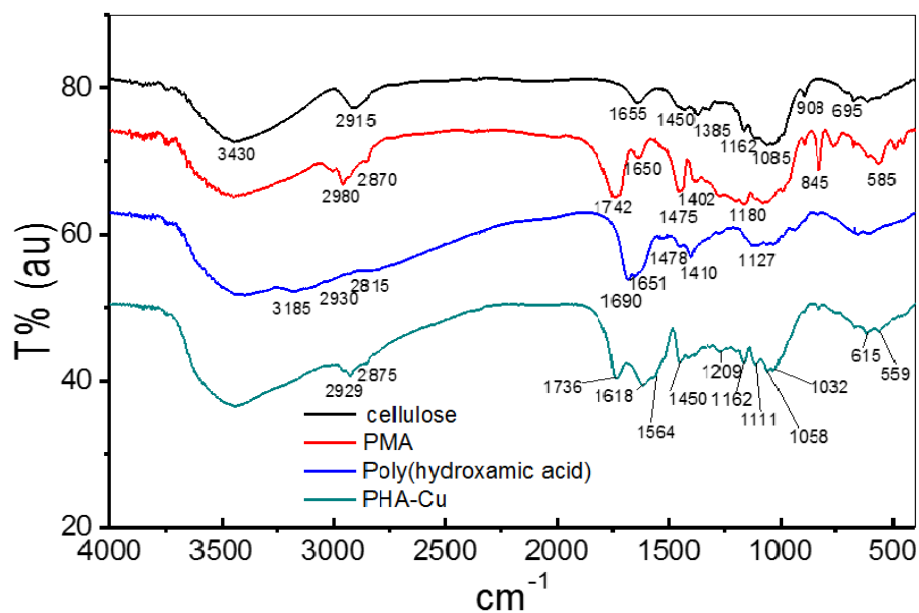


Figure 1. IR spectra of cellulose and modified cellulose.

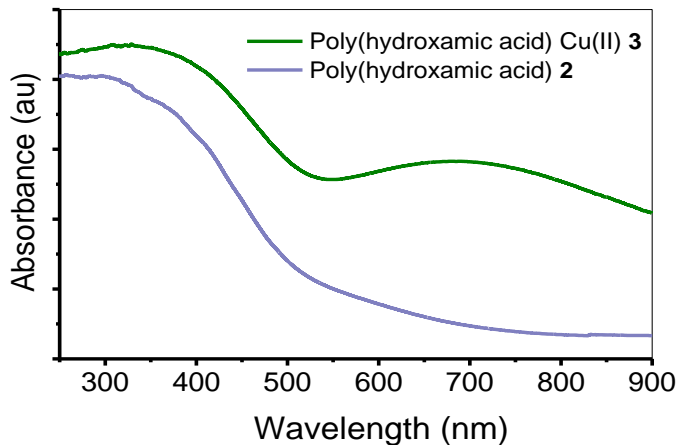
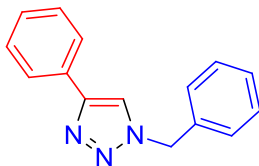
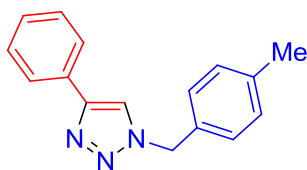


Figure 2. UV-vis of **3** and **2**

Characterization data

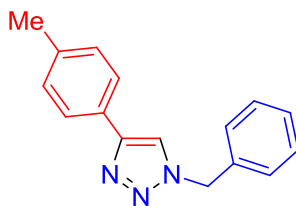


^1H NMR (500 MHz, CDCl_3) δ = 5.59 (s, 2 H), 7.26-7.37 (m, 3 H), 7.38-7.42 (m, 5 H), 7.66 (s, 1 H), 7.81 (d, J = 8.50 Hz, 2 H); ^{13}C NMR (125 MHz, CDCl_3) 54.40, 119.60, 125.84, 128.20, 129.13, 130.5, 134.82, 148.37; FTIR (cm^{-1}): 3122, 3053, 2925, 2858, 1481, 1457, 1434, 1336, 1226, 1196, 1077, 1053, 979, 913, 812, 769, 713, 708; MS-EI, m/z 235 (M^+).

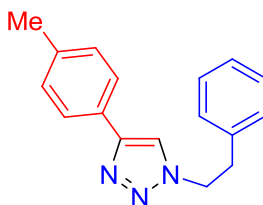


^1H NMR (500 MHz, CDCl_3) δ = 2.36 (s, 3 H), 5.52 (s, 2 H), 7.18-7.22 (m, 4 H), 7.31 (m, 1 H), 7.38 (dd, J = 1.85, 8.05 Hz, 2 H), 7.63 (s, 1 H), 7.80 (d, J = 8.05 Hz, 2 H); ^{13}C NMR (125 MHz, CDCl_3) 21.13, 54.01, 119.34, 125.65, 128.10, 128.75, 129.80, 131.61, 138.71, 148.12; FTIR (cm^{-1}): 3080, 2922, 2857, 1624, 1534, 1450, 1354, 1228, 1072, 1045, 976, 928, 836, 752, 687; MS-

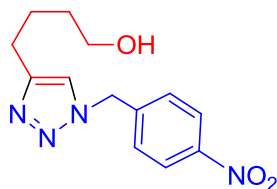
EI, m/z 249 (M^+).



^1H NMR (500 MHz, CDCl_3) δ = 2.36 (s, 3 H), 5.55 (s, 2 H), 7.19 (d, J = 8.0 Hz, 2 H), 7.27-7.30 (m, 2 H), 7.36-7.41 (m, 3 H), 7.61 (s, 1 H), 7.69 (d, J = 8.05 Hz, 2 H); ^{13}C NMR (125 MHz, CDCl_3) 21.24, 54.16, 119.10, 125.57, 127.69, 128.02, 128.17, 129.01, 129.42, 134.72, 137.97, 148.27; FTIR (cm^{-1}): 3145, 3027, 2928, 2853, 1745, 1499, 1452, 1356, 1211, 1136, 1057, 978, 828, 799, 726; MS-EI, m/z 249 (M^+).

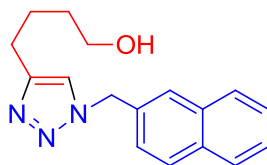


^1H NMR (500 MHz, CDCl_3) δ = 2.37 (s, 3 H), 3.24 (t, J = 7.45 Hz, 2 H), 4.62 (t, J = 7.45 Hz, 2 H), 7.12 (d, J = 6.9 Hz, 2 H), 7.22 (d, J = 7.45 Hz, 2 H), 7.28-7.31 (m, 3 H), 7.42 (s, 1 H), 7.67 (d, J = 8.0 Hz, 2 H); ^{13}C NMR (125 MHz, CDCl_3) 21.25, 36.0, 51.70, 119.54, 125.58, 127.10, 127.80, 128.71, 128.82, 137.90, 147.55; FTIR (cm^{-1}): 3110, 3025, 2932, 2860, 1644, 1492, 1459, 1363, 1219, 1085, 1043, 977, 912, 825, 726, 705; MS-EI, m/z 263 (M^+). Anal. Calcd for $\text{C}_{17}\text{H}_{17}\text{N}_3$: C, 77.54; H, 6.51; N, 15.96. Found: C, 77.54; H, 6.55; N, 15.99.

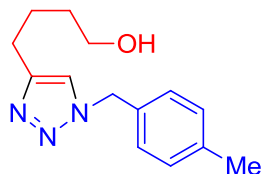


^1H NMR (500 MHz, CDCl_3) δ = 1.55-1.68 (m, 2 H), 1.69-1.74 (m, 2 H), 1.85 (bs, 1 H), 2.70 (t, J = 7.50 Hz, 2 H), 3.18 (t, J = 7.50 Hz, 2 H), 3.65 (t, J = 6.50 Hz, 2 H), 4.54 (t, J = 6.50 Hz, 2 H), 7.01 (s, 1 H), 7.10 (d, J = 7.0 Hz, 2 H), 7.24-7.31 (m, 3 H); ^{13}C NMR (125 MHz, CDCl_3) 25.12, 25.50, 31.91, 36.79, 51.46, 62.36, 121.06, 126.99, 128.66, 128.73, 137.16, 147.62; FTIR (cm^{-1}): 3367, 3136, 2929, 2854, 1556, 1454, 1427, 1379, 1213, 1128, 1059, 745, 708; MS-EI, m/z 245

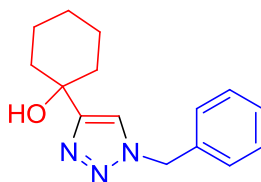
(M⁺). Anal. Calcd for C₁₄H₁₉N₃O: C, 68.54; H, 7.81; N, 17.13. Found: C, 68.28; H, 7.73; N, 16.98.



¹H NMR (500 MHz, CDCl₃) δ = 1.58-1.64 (m, 3 H), 1.70-1.76 (m, 2 H), 2.72 (t, *J* = 7.50 Hz, 2 H), 3.65 (t, *J* = 6.50 Hz, 2 H), 5.64 (s, 2 H), 7.22 (d, *J* = 8.50 Hz, 1 H), 7.33 (d, *J* = 8.50 Hz, 1 H), 7.50 (d, *J* = 8.5 Hz, 2 H), 7.73 (dd, *J* = 3.4, 6.45 Hz, 1 H), 7.81-7.85 (m, 3 H); ¹³C NMR (125 MHz, CDCl₃) 25.31, 25.46, 32.13, 54.22, 62.45, 120.65, 125.33, 126.62, 126.75, 127.21, 127.77, 129.11, 132.22, 133.20, 148.54; FTIR (cm⁻¹): 3446, 3395, 3116, 3053, 2935, 2853, 1645, 1546, 1516, 1467, 1339, 1213, 1136, 1058, 999, 864, 825, 784, 756; MS-EI, *m/z* 281 (M⁺). Anal. Calcd for C₁₇H₁₉N₃O: C, 72.57; H, 6.81; N, 14.94. Found: C, 72.56; H, 6.74; N, 14.92.

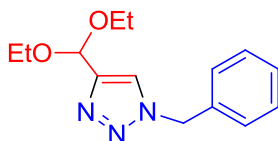


¹H NMR (500 MHz, CDCl₃) δ = 1.58-1.70 (m, 2 H), 1.71-1.76 (m, 2 H), 2.0 (bs, 1 H), 2.34 (s, 3 H), 2.71 (t, *J* = 7.5 Hz, 2 H), 3.65 (t, *J* = 7.0 Hz, 2 H), 5.43 (s, 2 H), 7.14-7.27 (m, 5 H); ¹³C NMR (125 MHz, CDCl₃) 21.10, 25.47, 32.11, 53.78, 62.13, 120.45, 128.01, 129.70, 131.80, 138.52, 148.37; FTIR (cm⁻¹): 3445, 3406, 3107, 3063, 2925, 2869, 1646, 1558, 1519, 1431, 1335, 1213, 1122, 1045, 990, 865, 778, 674; MS-EI, *m/z* 245 (M⁺). Anal. Calcd for C₁₄H₁₉N₃O: C, 68.54; H, 7.81; N, 17.13. Found: C, 68.53; H, 7.71; N, 17.08.

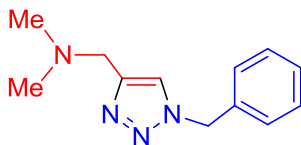


¹H NMR (500 MHz, CDCl₃) δ = 1.24-1.36 (m, 1 H), 1.53-2.04 (m, 9 H), 2.24 (bs, 1 H), 5.50 (d, *J* = 8.0 Hz, 2 H), 7.24 (d, *J* = 8.5 Hz, 2 H), 7.34-7.36 (m, 4 H); ¹³C NMR (125 MHz, CDCl₃) 21.91, 25.31, 38.07, 54.10, 69.54, 119.35, 128.08, 129.07, 134.64, 156.03; FTIR (cm⁻¹): 3393, 3136, 2931, 2855, 1643, 1492, 1456, 1347, 1251, 1216, 1157, 1054, 973, 907, 805, 728; MS-EI,

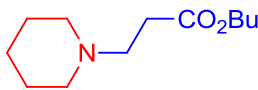
m/z 257 (M^+).



^1H NMR (500 MHz, CDCl_3) δ = 1.22 (t, J = 7.50 Hz, 6 H), 3.59 (q, J = 7.50 Hz, 2 H), 3.65 (q, J = 7.50 Hz, 2 H), 5.51 (s, 2 H), 5.70 (s, 1 H), 7.26 (dd, J = 7.40, 2.25 Hz, 2 H), 7.30-7.37 (m, 3 H), 7.50 (s, 1 H); ^{13}C NMR (125 MHz, CDCl_3) 15.10, 54.15, 61.64, 96.82, 121.77, 128.13, 128.72, 129.08, 134.46, 147.55; FTIR (cm^{-1}): 3136, 2973, 2883, 1695, 1533, 1456, 1387, 1223, 1153, 1125, 1056, 912, 798, 766, 728; MS-EI, m/z 216 ($[\text{M}-\text{OEt}]^+$).



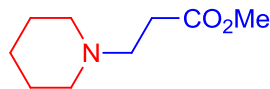
^1H NMR (500 MHz, CDCl_3) δ = 2.25 (s, 6 H), 3.58 (s, 2 H), 5.52 (s, 2 H), 7.26 (d, J = 7.4 Hz, 2 H), 7.34-7.37 (m, 3 H), 7.39 (s, 1 H); ^{13}C NMR (125 MHz, CDCl_3) 45.17, 54.10, 54.47, 122.20, 128.07, 128.67, 129.06, 134.67, 145.77; FTIR (cm^{-1}): 3138, 3077, 2949, 2864, 2827, 2773, 1647, 1453, 1329, 1256, 1217, 1177, 1122, 1046, 1213, 1176, 1124, 1042, 845, 801, 726; MS-EI, m/z 216 (M^+).



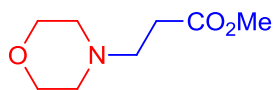
^1H NMR (500 MHz, CDCl_3): δ 4.04 (t, J = 6.63 Hz, 2H), 2.60 (t, J = 7.65 Hz, 2H), 2.44 (t, J = 7.65 Hz, 2H), 2.43-2.40 (m, 4H), 1.56-1.48 (m, 6H), 1.35-1.28 (m, 4H), 0.89 (t, J = 7.35 Hz, 3H). ^{13}C NMR (125 MHz, CDCl_3): δ 171.74, 63.19, 53.32, 53.25, 31.32, 29.70, 23.30, 18.13, 12.68. MS-EI, m/z 213 (M^+).



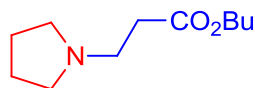
^1H NMR (500 MHz, CDCl_3): δ 3.63 (s, 3H), 2.75-2.71 (m, 2H), 2.41- 2.32 (m, 6H), 1.37-1.21 (m, 8H), 0.88 (t, J = 7.33 Hz, 6H). ^{13}C NMR (125 MHz, CDCl_3): δ 172.95, 53.40, 51.08, 49.15, 32.03, 29.05, 20.32, 20.24, 13.73. MS-EI, m/z 215 (M^+).



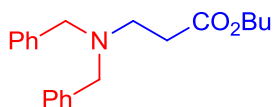
^1H NMR (500 MHz, CDCl_3): δ 3.64 (s, 3H), 2.62 (t, $J = 6.65$ Hz, 2H), 2.48 (t, $J = 7.50$ Hz, 2H), 2.37-2.34 (m, 4H), 1.561.51 (m, 4H), 1.42-1.36 (m, 2H). ^{13}C NMR (125 MHz, CDCl_3): δ 173.05, 54.12, 53.07, 51.48, 31.85, 25.74, 24.12. MS-EI, m/z 171 (M^+).



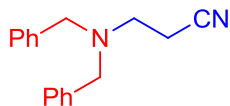
^1H NMR (500 MHz, CDCl_3): δ 3.70 (t, $J = 4.65$ Hz, 7H), 2.69-2.67 (m, 2H), 2.53-2.46 (m, 6H). ^{13}C NMR (125 MHz, CDCl_3): δ 172.27, 66.38, 53.50, 52.97, 51.12, 31.41. MS-EI, m/z 173 (M^+).



^1H NMR (500 MHz, CDCl_3): δ 4.06 (t, $J = 6.68$ Hz, 2H), 2.75 (t, $J = 7.58$ Hz, 2H), 2.48-2.46 (m, 6H), 1.74-1.72 (m, 4H), 1.54-1.51 (m, 2H), 1.33-1.30 (m, 2H), 0.91 (t, $J = 7.40$ Hz, 3H). ^{13}C NMR (125 MHz, CDCl_3): δ 171.19, 63.89, 53.65, 51.07, 33.86, 33.84, 30.34, 23.14, 18.79, 13.36. MS-EI, m/z 199 (M^+).

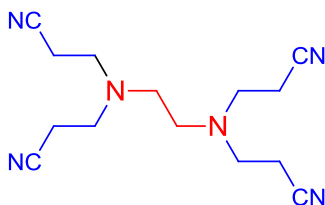


^1H NMR (500 MHz, CDCl_3): δ 7.45-7.38 (m, 8H), 7.32 (t, $J = 7.20$ Hz, 2H), 4.15 (t, $J = 6.75$ Hz, 2H), 3.68 (s, 4H), 2.94 (t, $J = 7.15$ Hz, 2H), 2.61 (t, $J = 7.15$ Hz, 2H), 1.66-1.62 (m, 2H), 1.47-1.42 (m, 2H), 1.03 (t, $J = 7.38$ Hz, 3H). ^{13}C NMR (125 MHz, CDCl_3): δ 172.31, 130.20, 128.66, 128.08, 126.82, 64.02, 57.95, 49.18, 32.71, 30.52, 19.03, 13.65. MS-EI, m/z 325 (M^+).

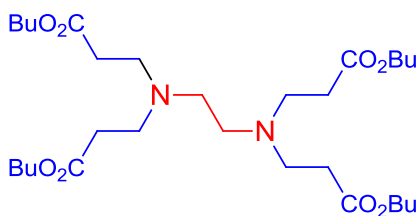


^1H NMR (500 MHz, CDCl_3): δ 7.33 (d, $J = 7.55$ Hz, 4H), 7.24 (t, $J = 7.40$ Hz, 4H), 7.17 (t, $J = 7.55$ Hz, 2H), 3.46 (s, 4H), 2.57 (t, $J = 6.80$ Hz, 2H), 2.18 (t, $J = 6.80$ Hz, 2H). ^{13}C NMR

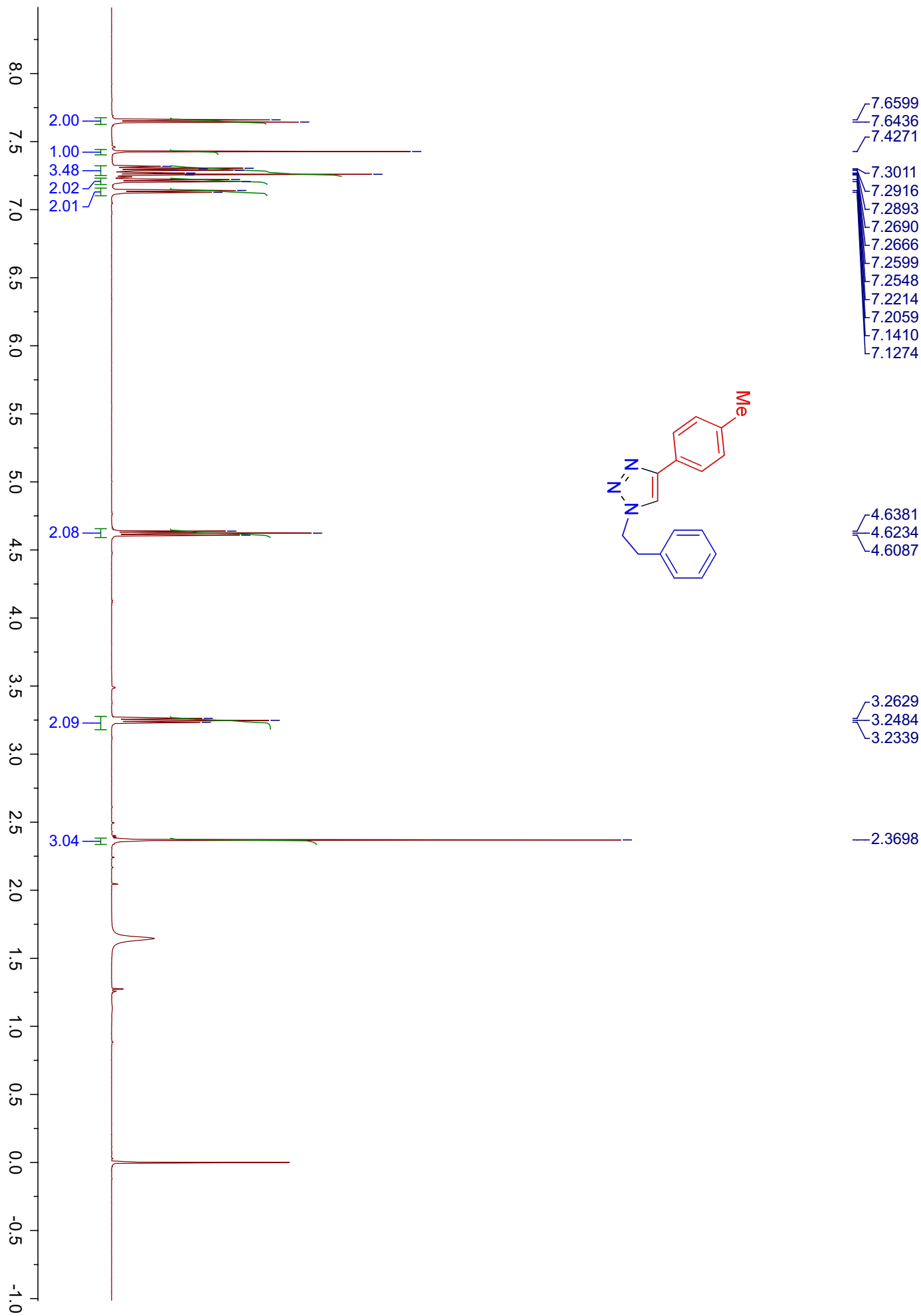
(125 MHz, CDCl₃): δ 138.49, 128.60, 128.30, 127.16, 118.75, 57.00, 48.56, 16.11. MS-EI, m/z 250 (M⁺).

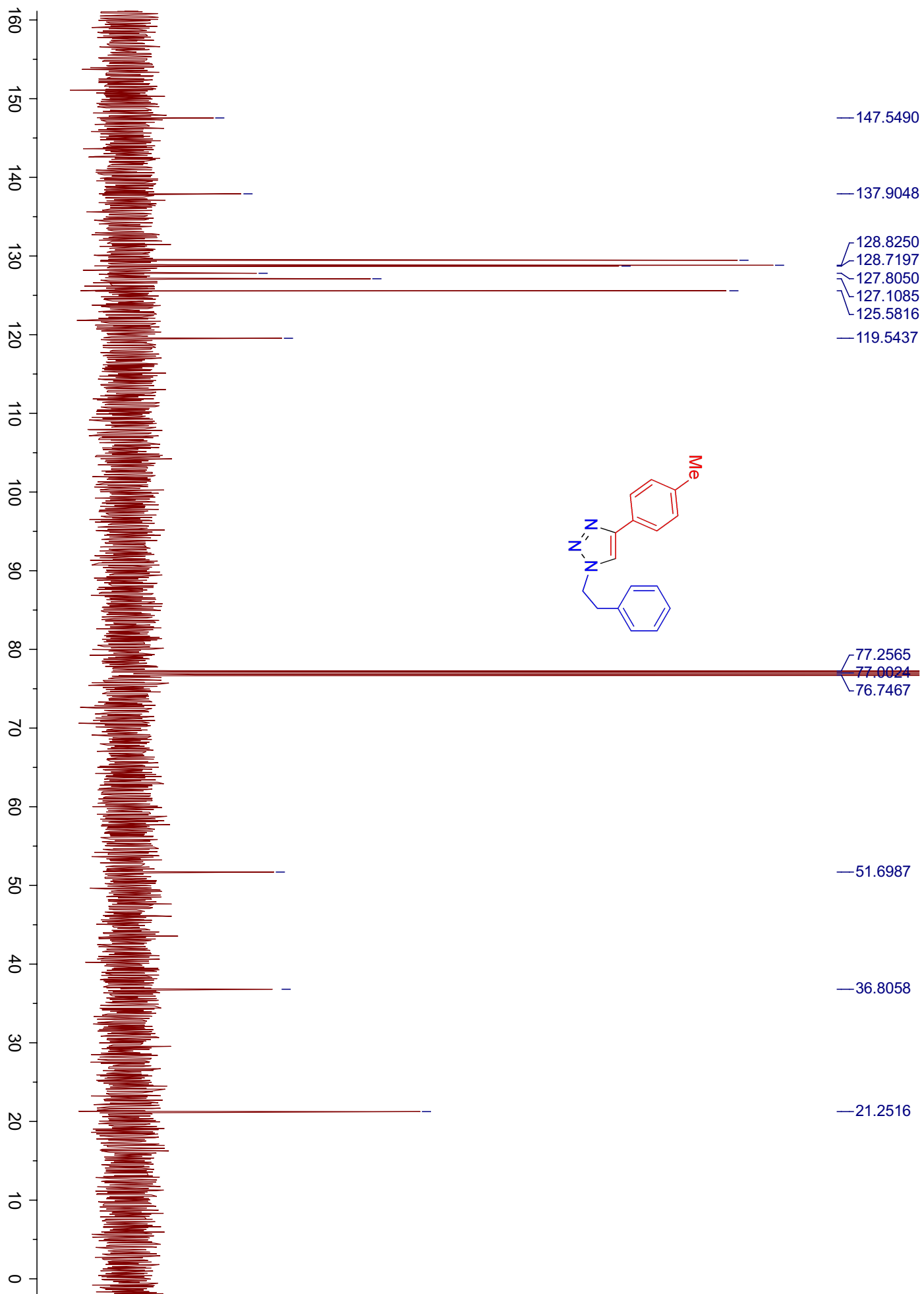


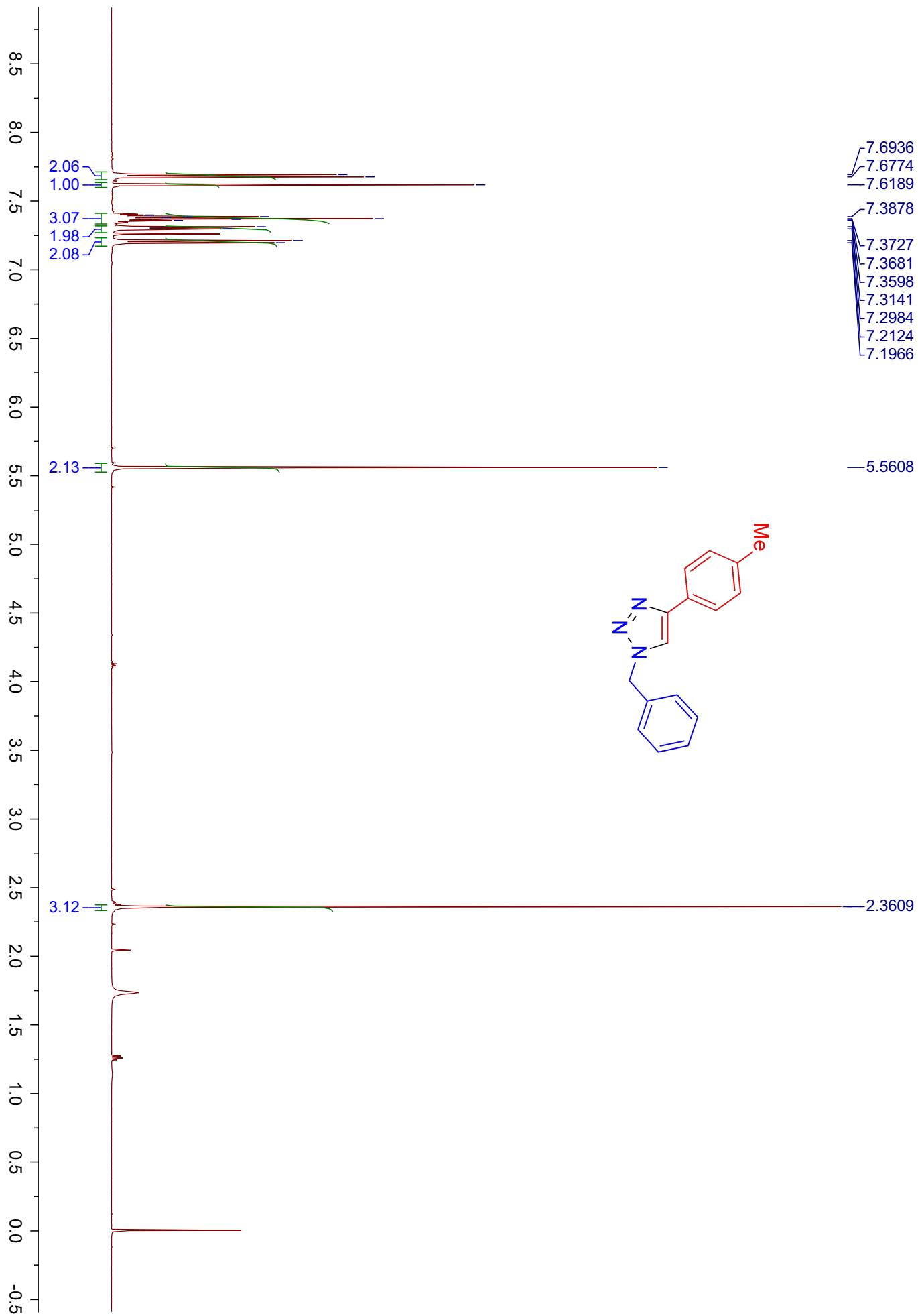
¹H NMR (500 MHz, CDCl₃): δ 2.80-2.75 (m, 4H), 2.71 (t, J = 6.5 Hz, 4H), 2.56-2.52 (m 4H), 2.42-2.39 (m, 8H). ¹³C NMR (125 MHz, CDCl₃): δ 118.62, 52.69, 49.03, 47.76, 46.15, 44.62, 44.38, 18.23, 18.06, 16.59. MS-EI, m/z 272 (M⁺).

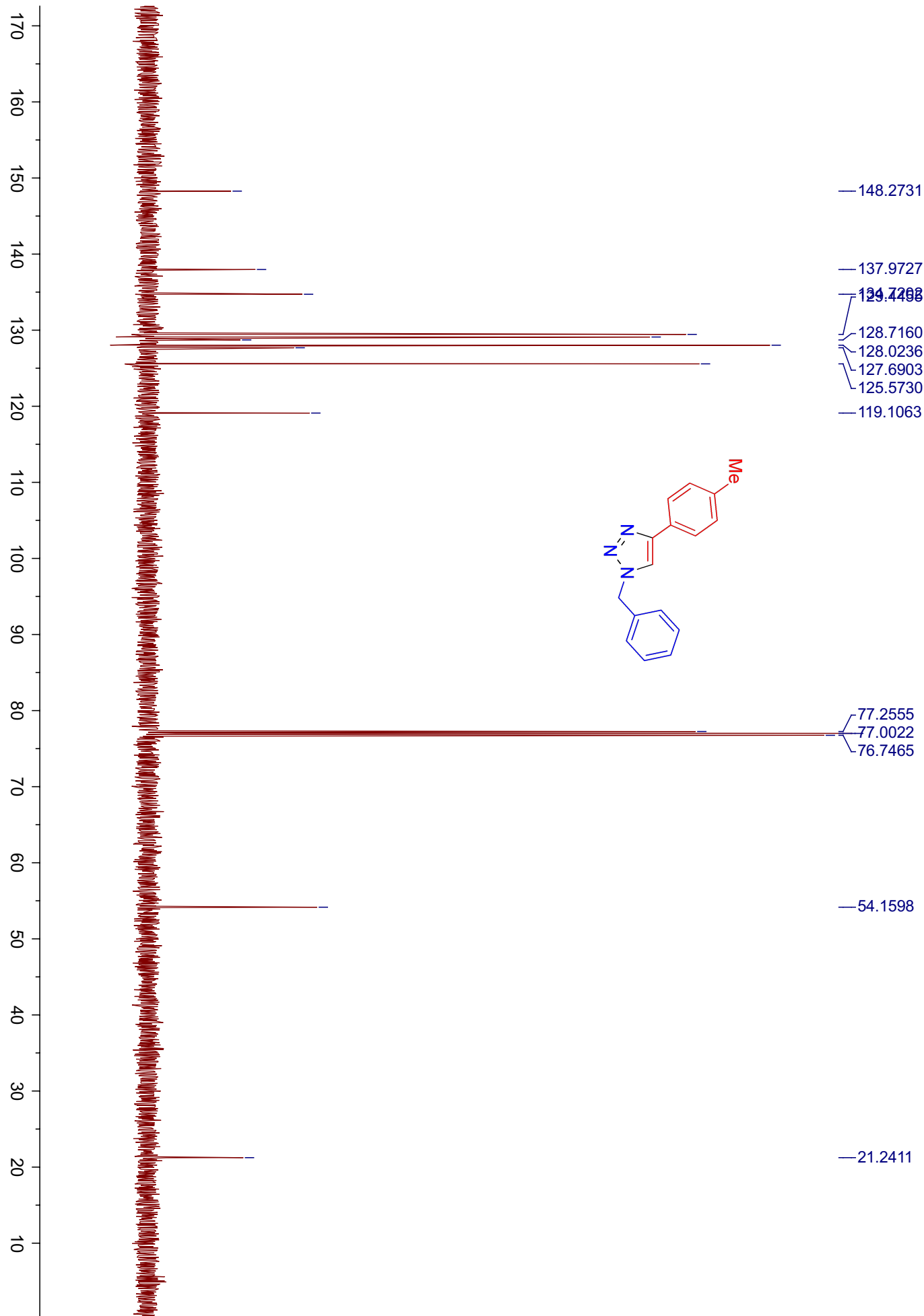


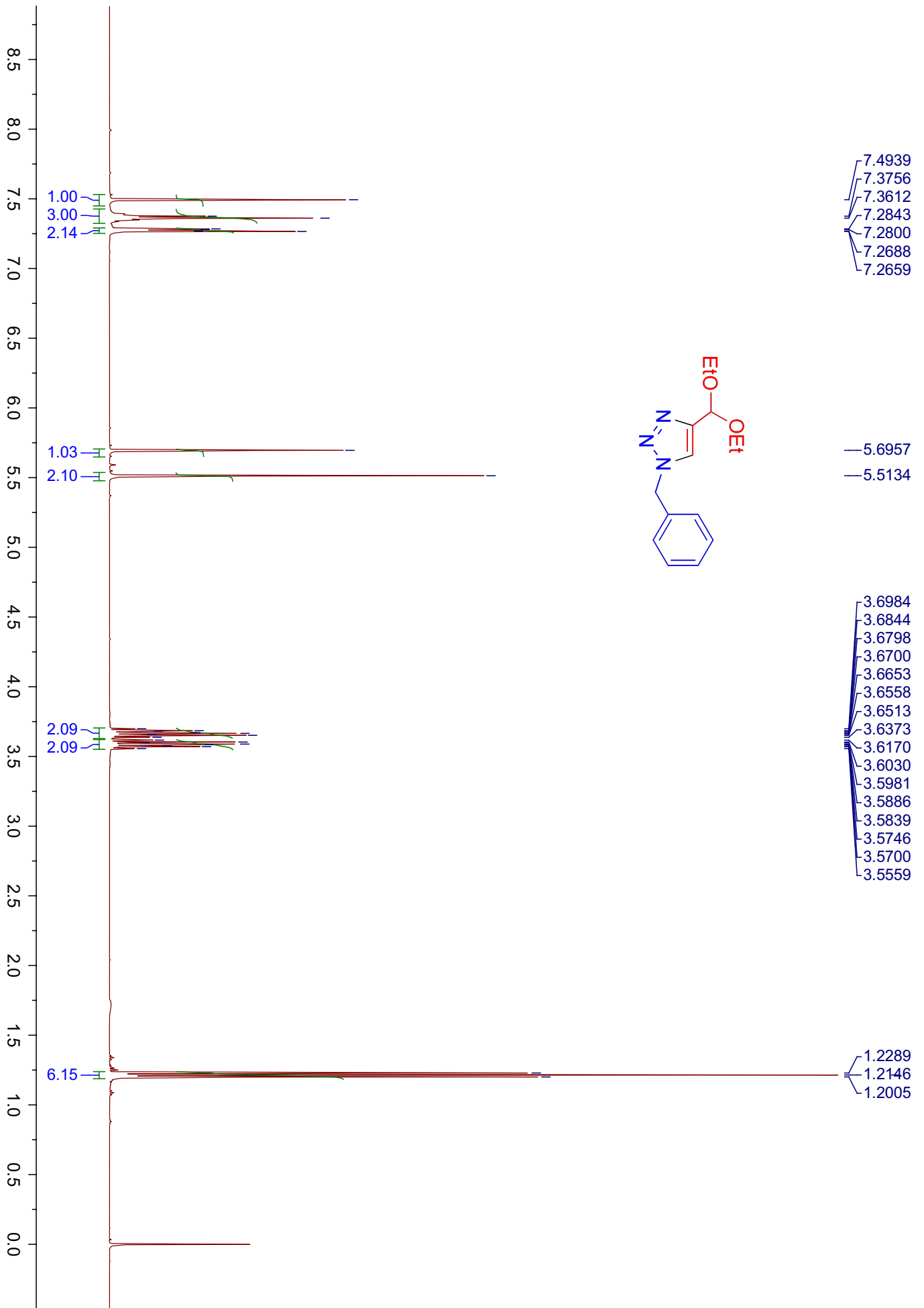
¹H NMR (500 MHz, CDCl₃): δ 3.97 (t, J = 6.70 Hz, 8H), 2.69 (t, J = 7.0 Hz, 8H), 2.43 (t, J = 6.71 Hz, 4H), 2.35 (t, J = 7.18 Hz, 8H), 1.52-1.47 (m, 8H), 1.31-1.25 (m, 8H), 0.85 (t, J = 7.40 Hz, 12H). ¹³C NMR (125 MHz, CDCl₃): δ 171.81, 63.49, 51.74, 49.29, 32.20, 30.14, 18.57, 13.09. MS-EI, m/z 572 (M⁺).

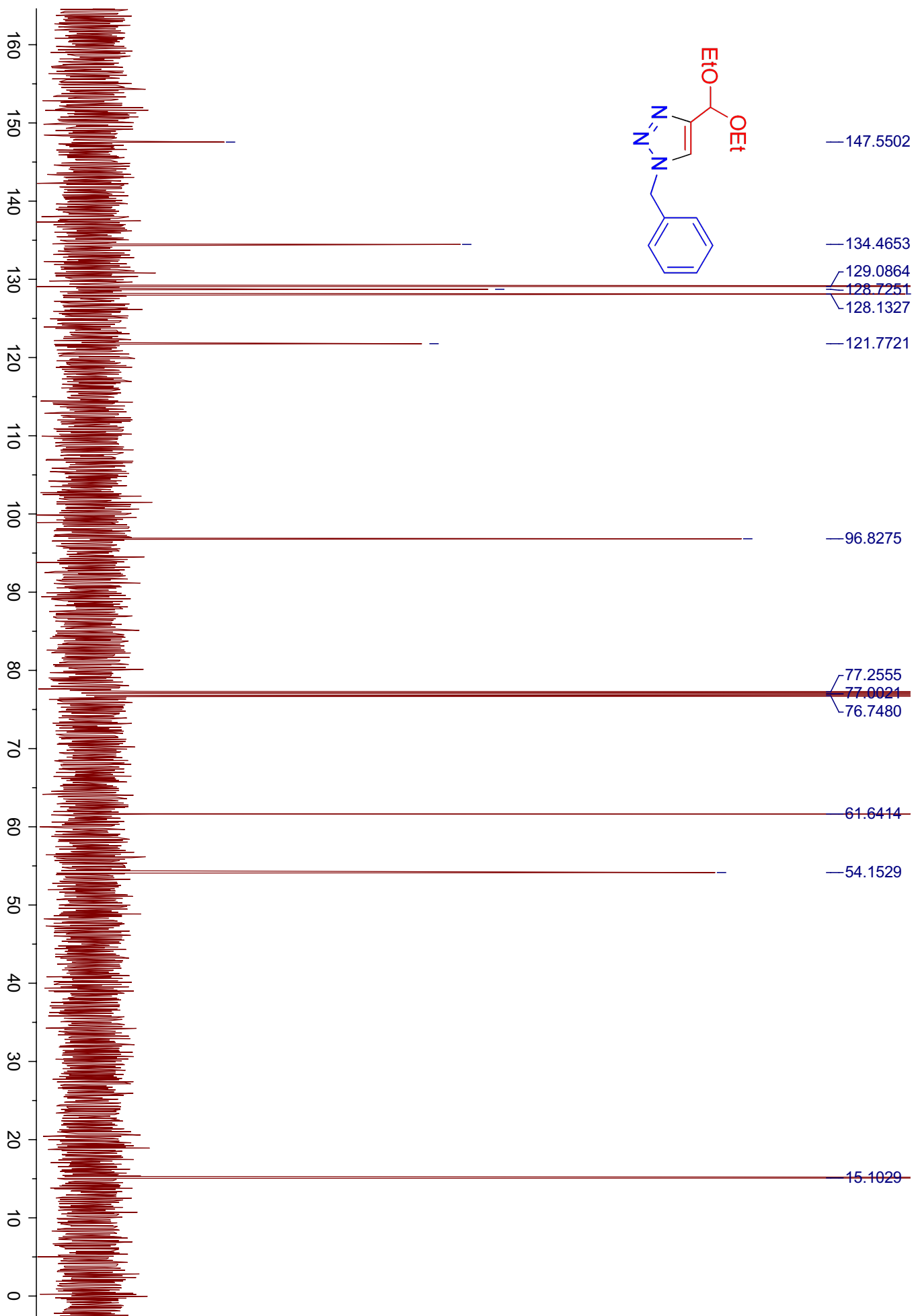


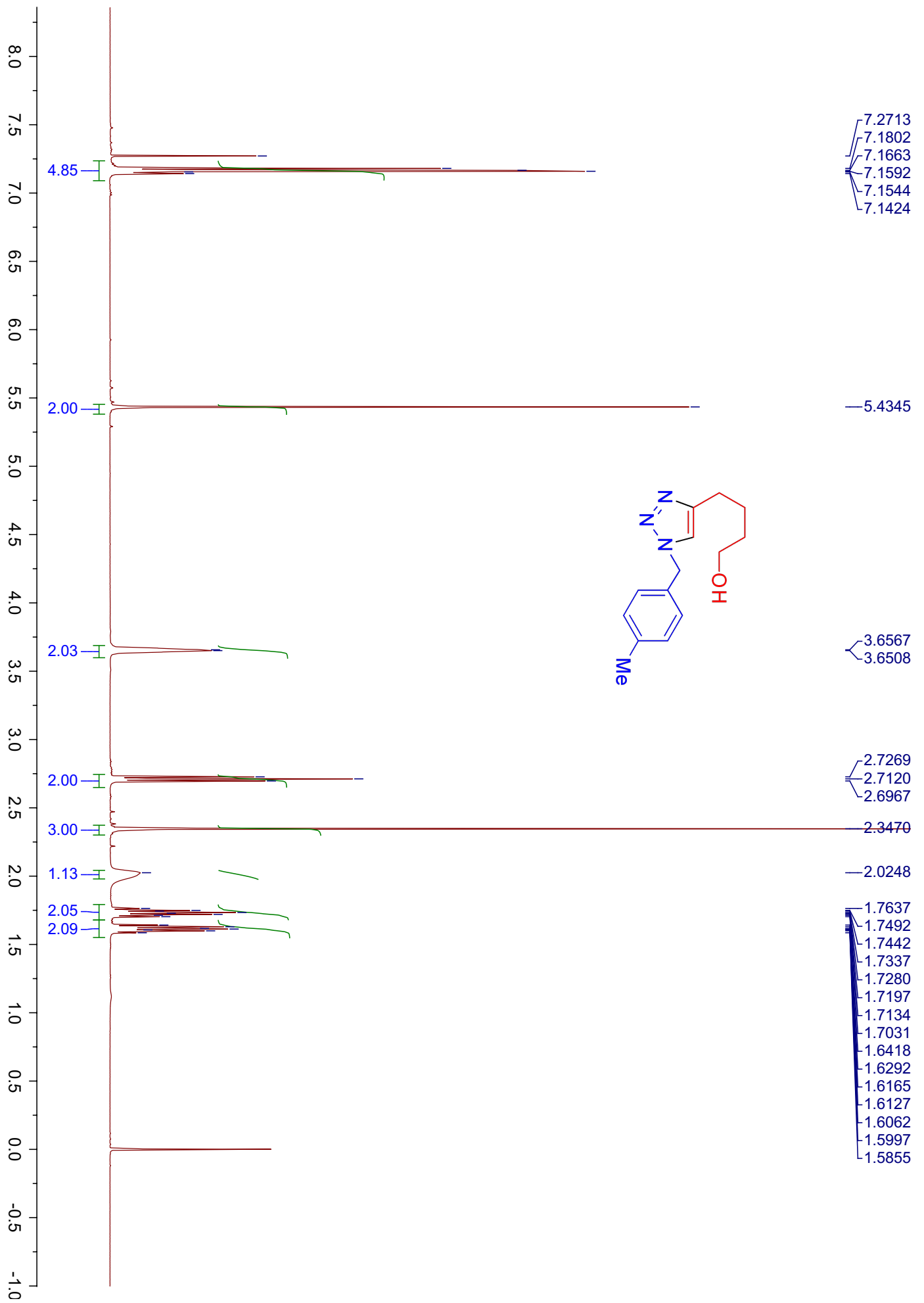


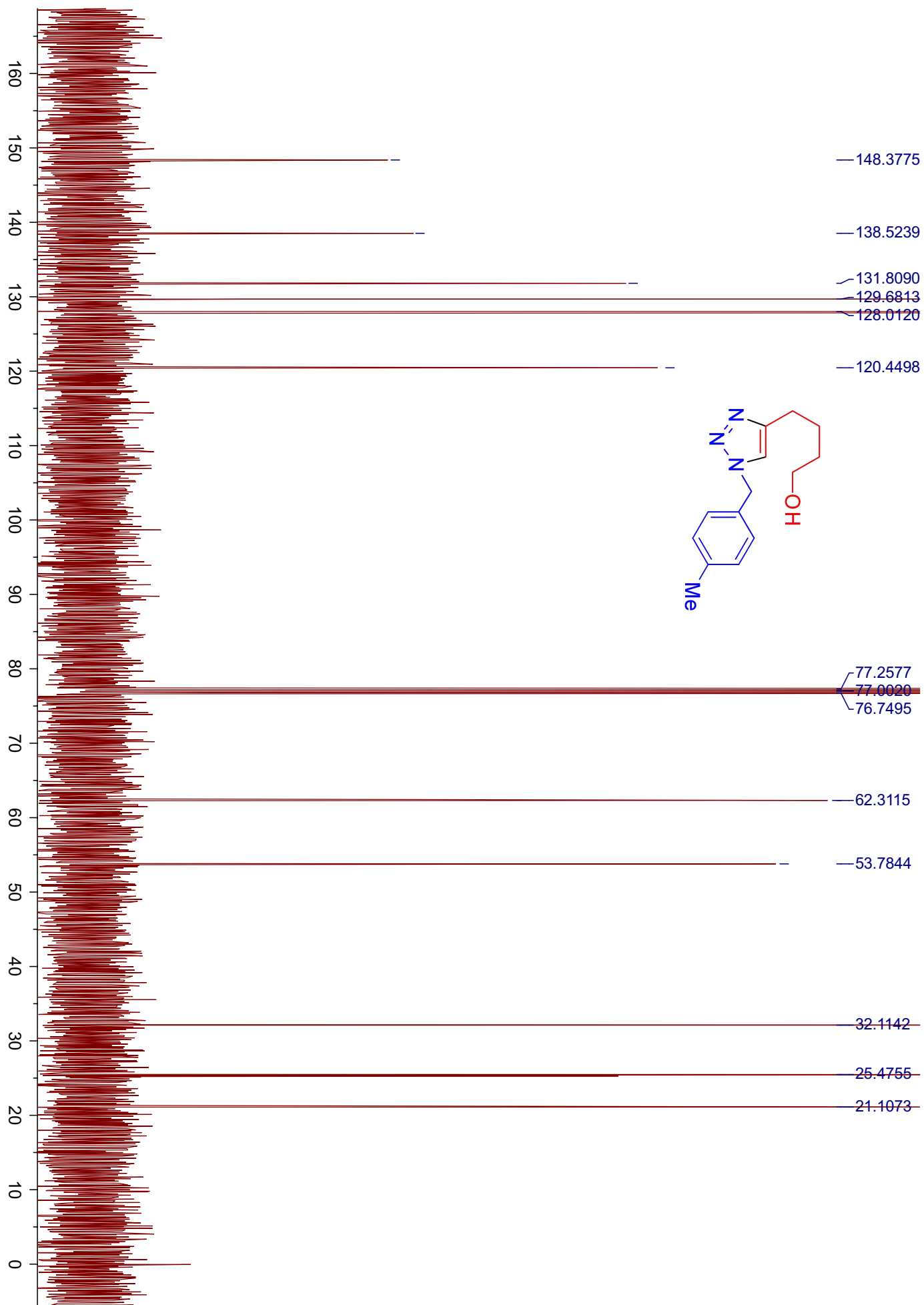


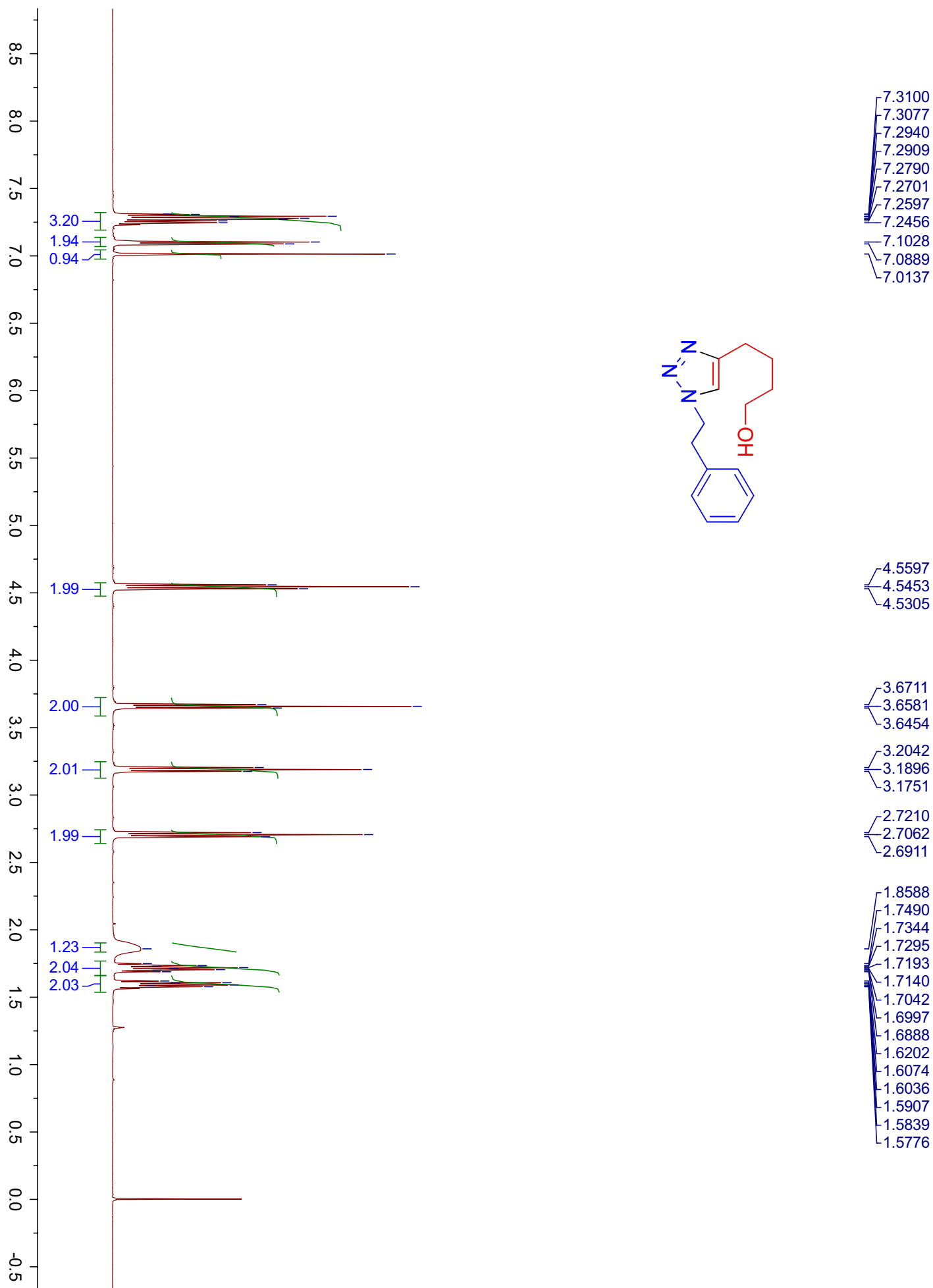
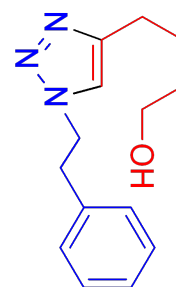


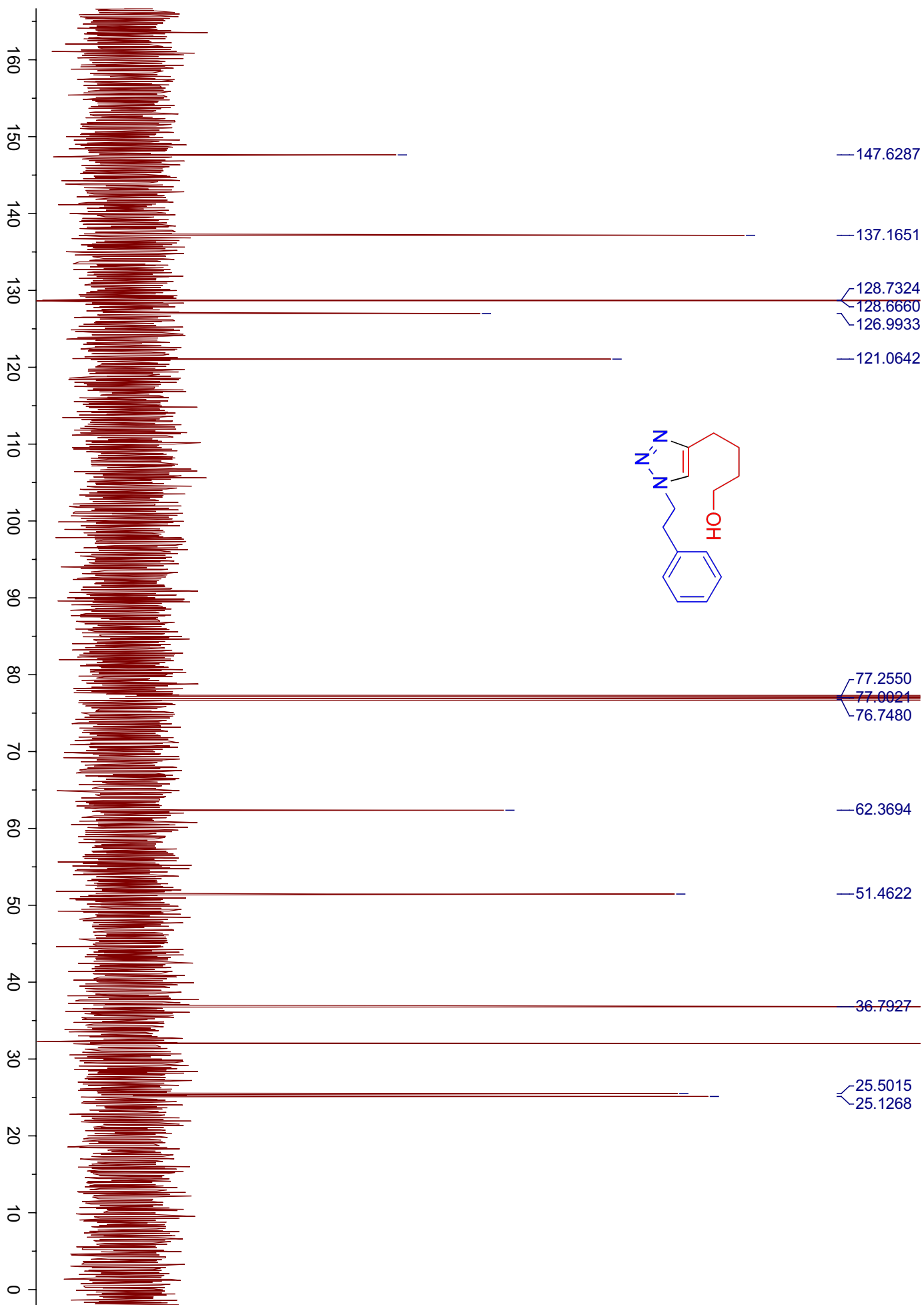


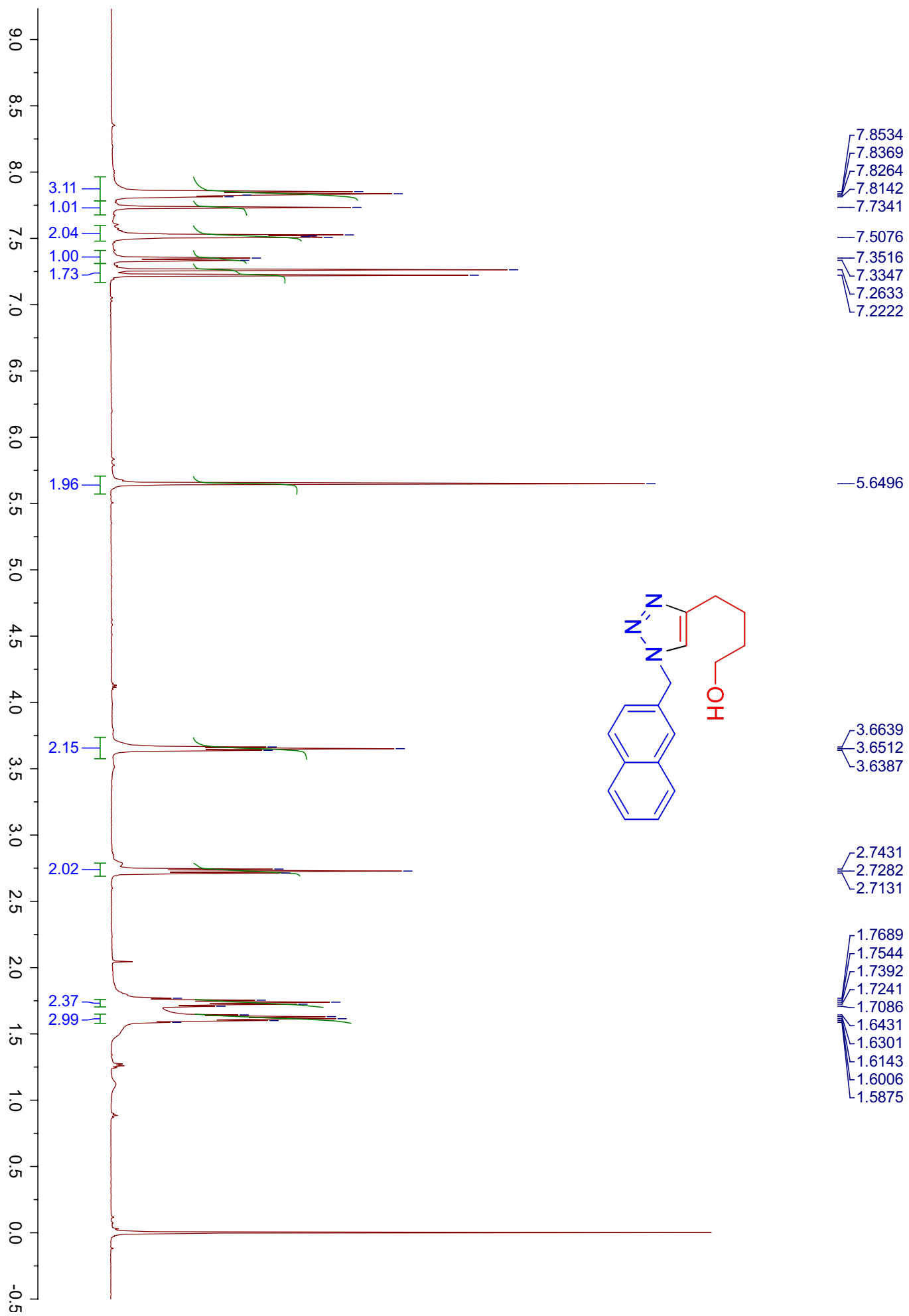


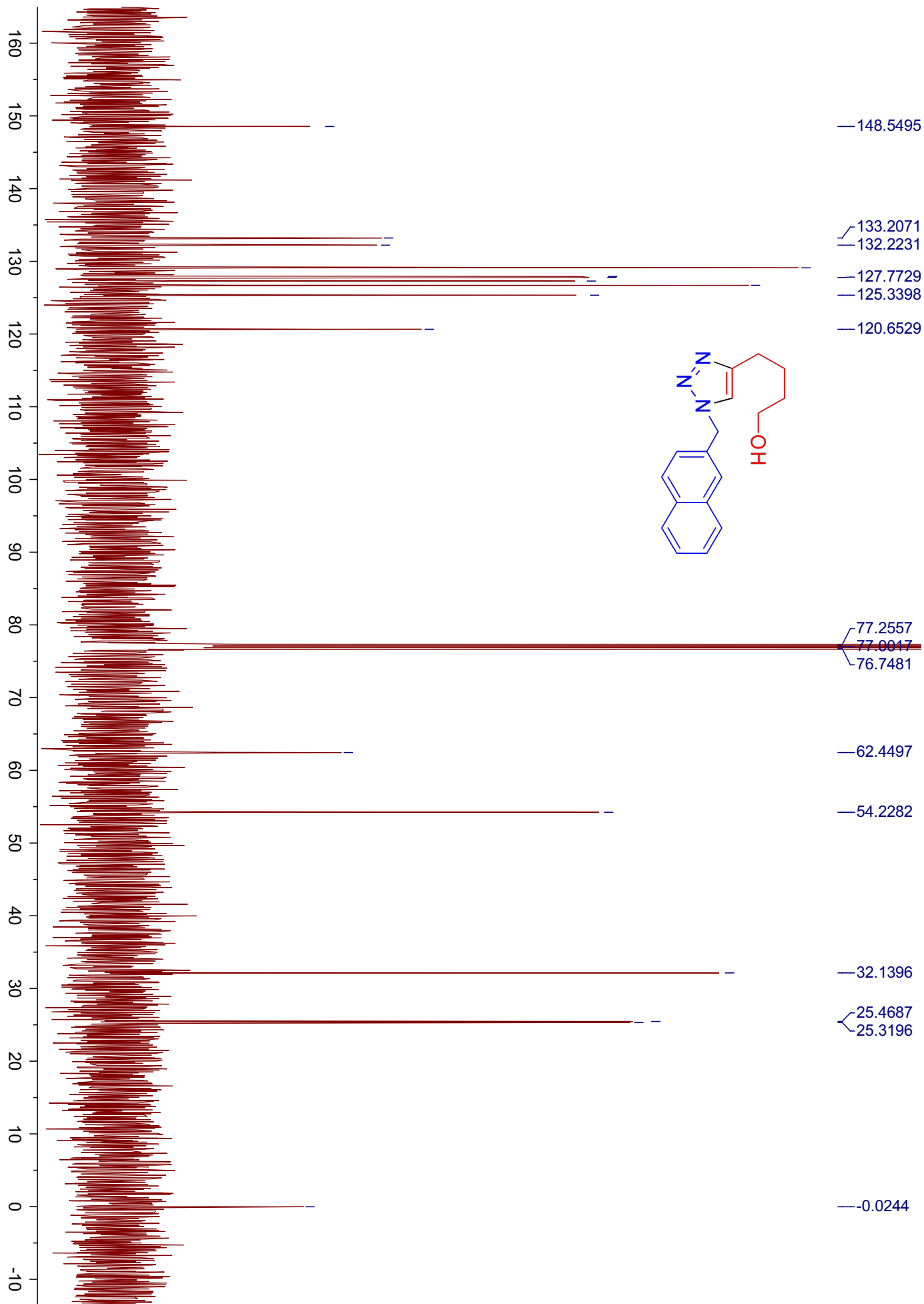


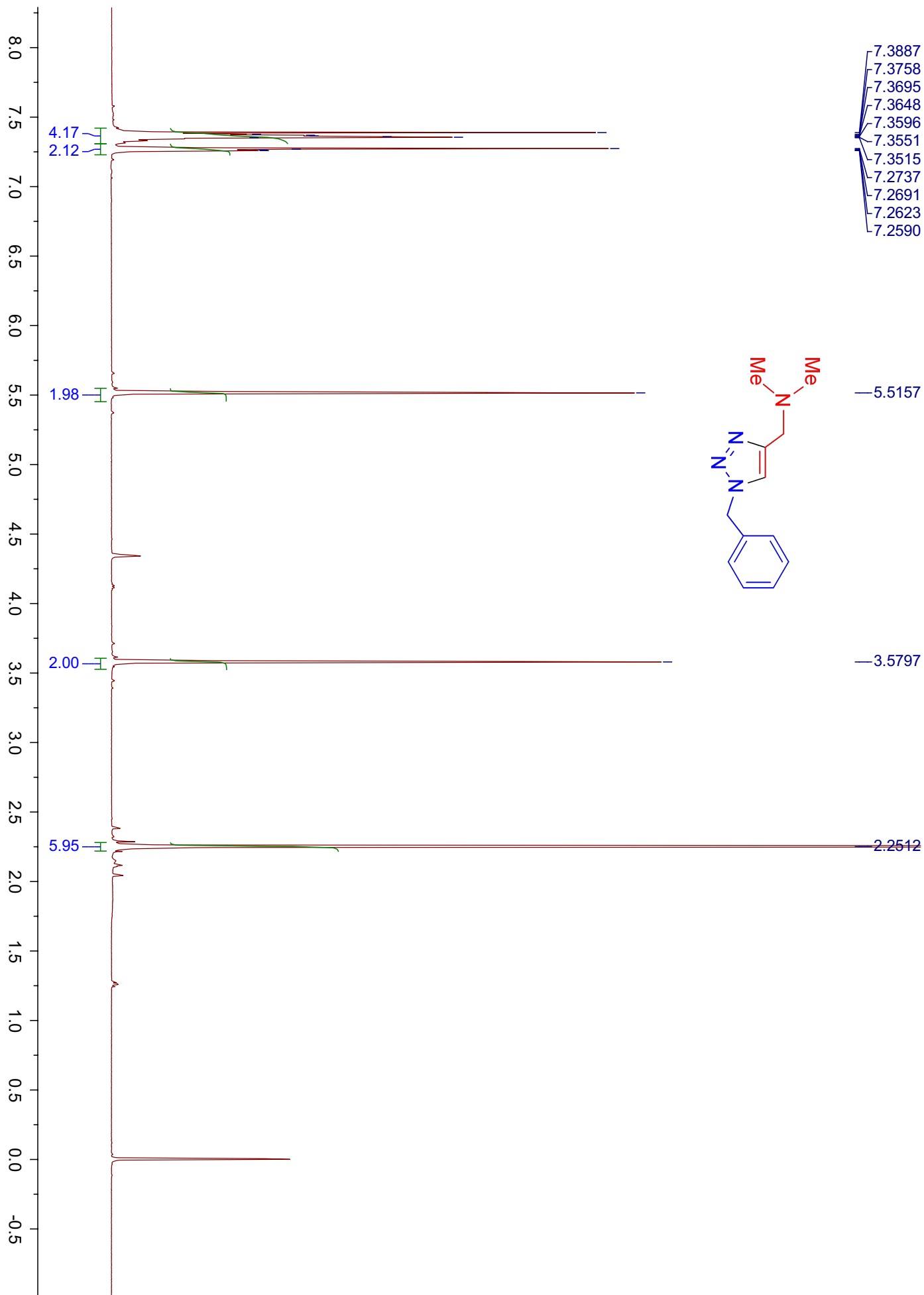


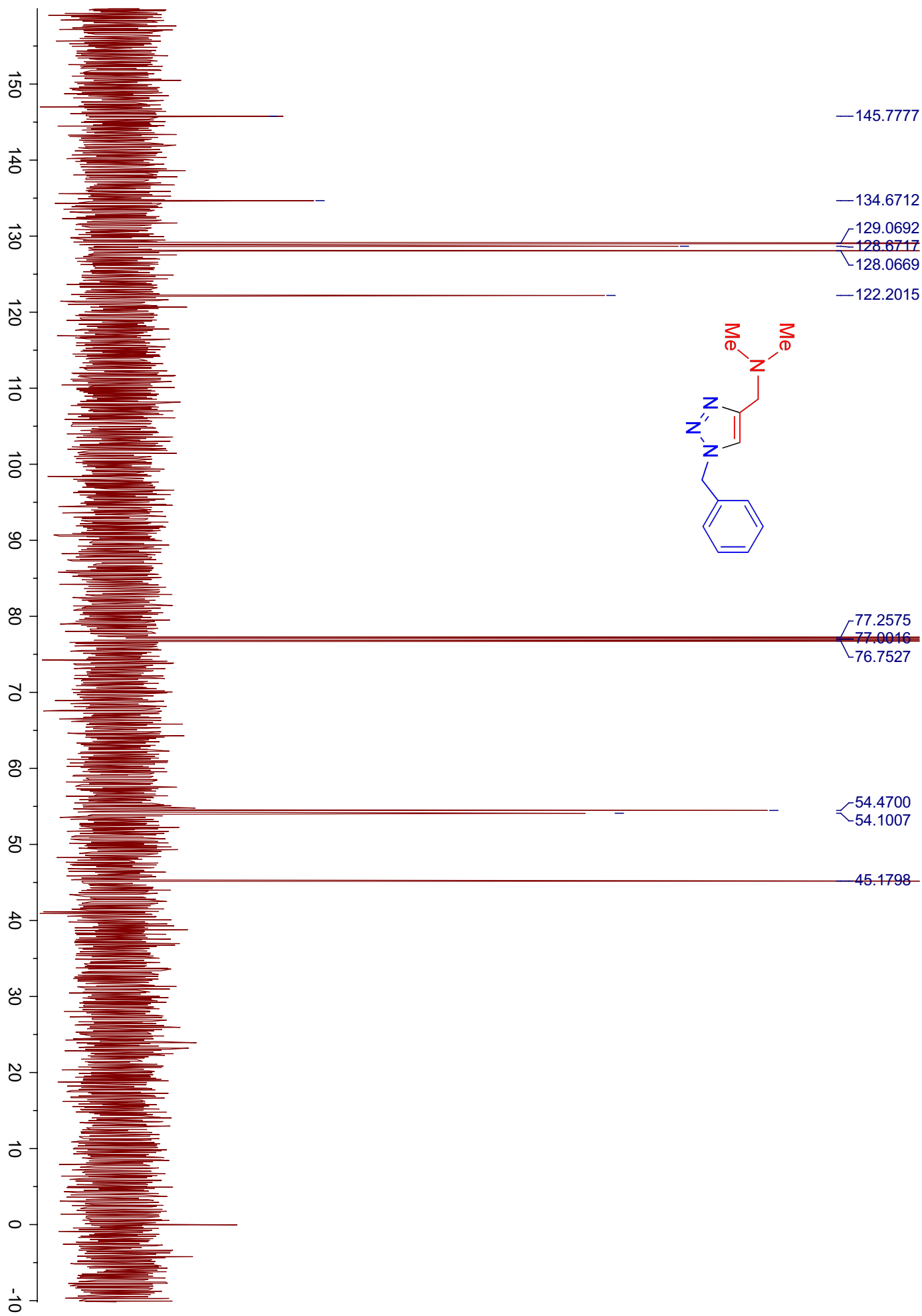
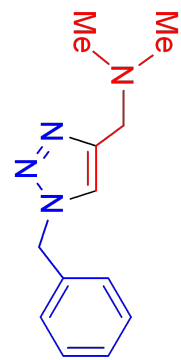


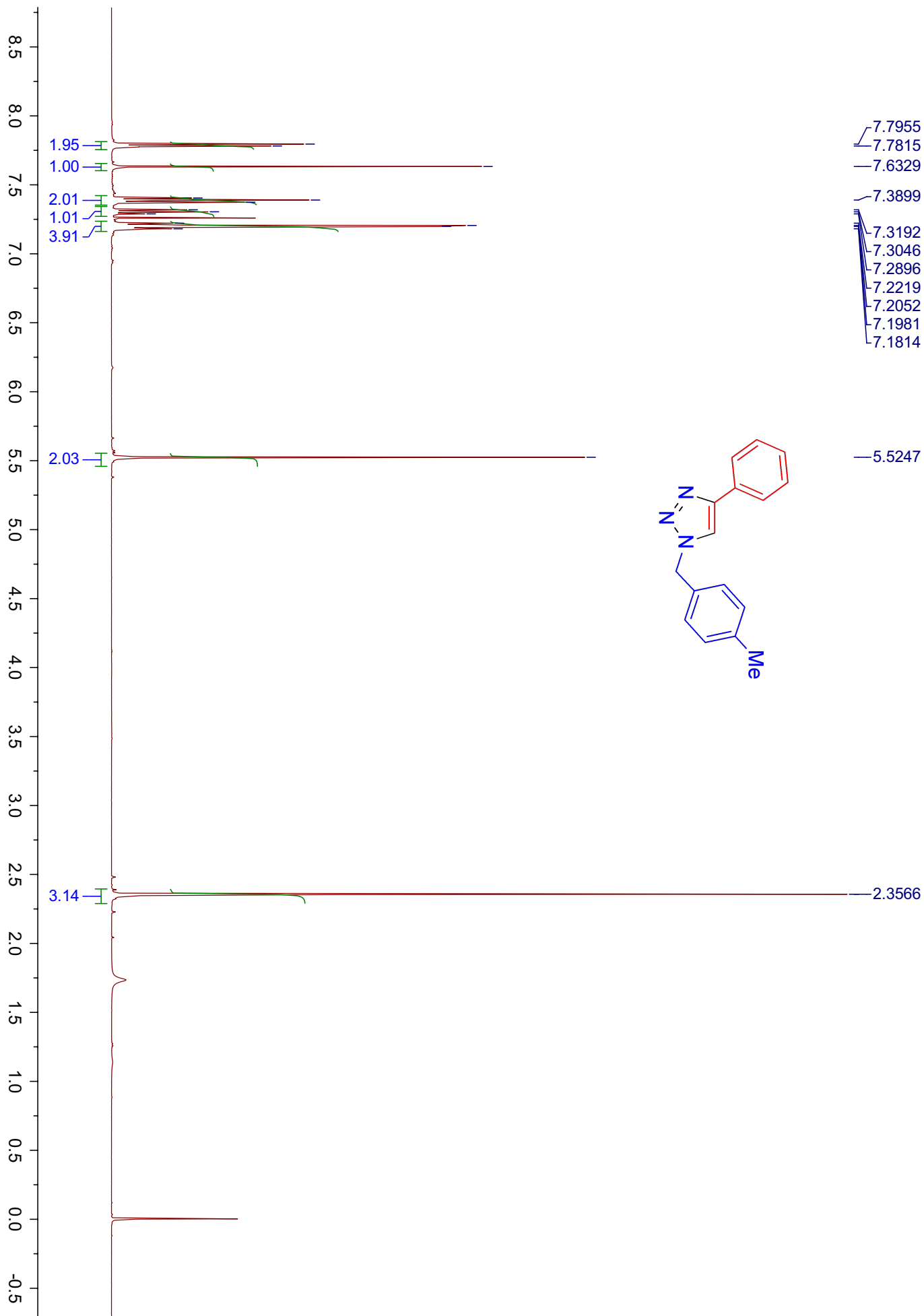


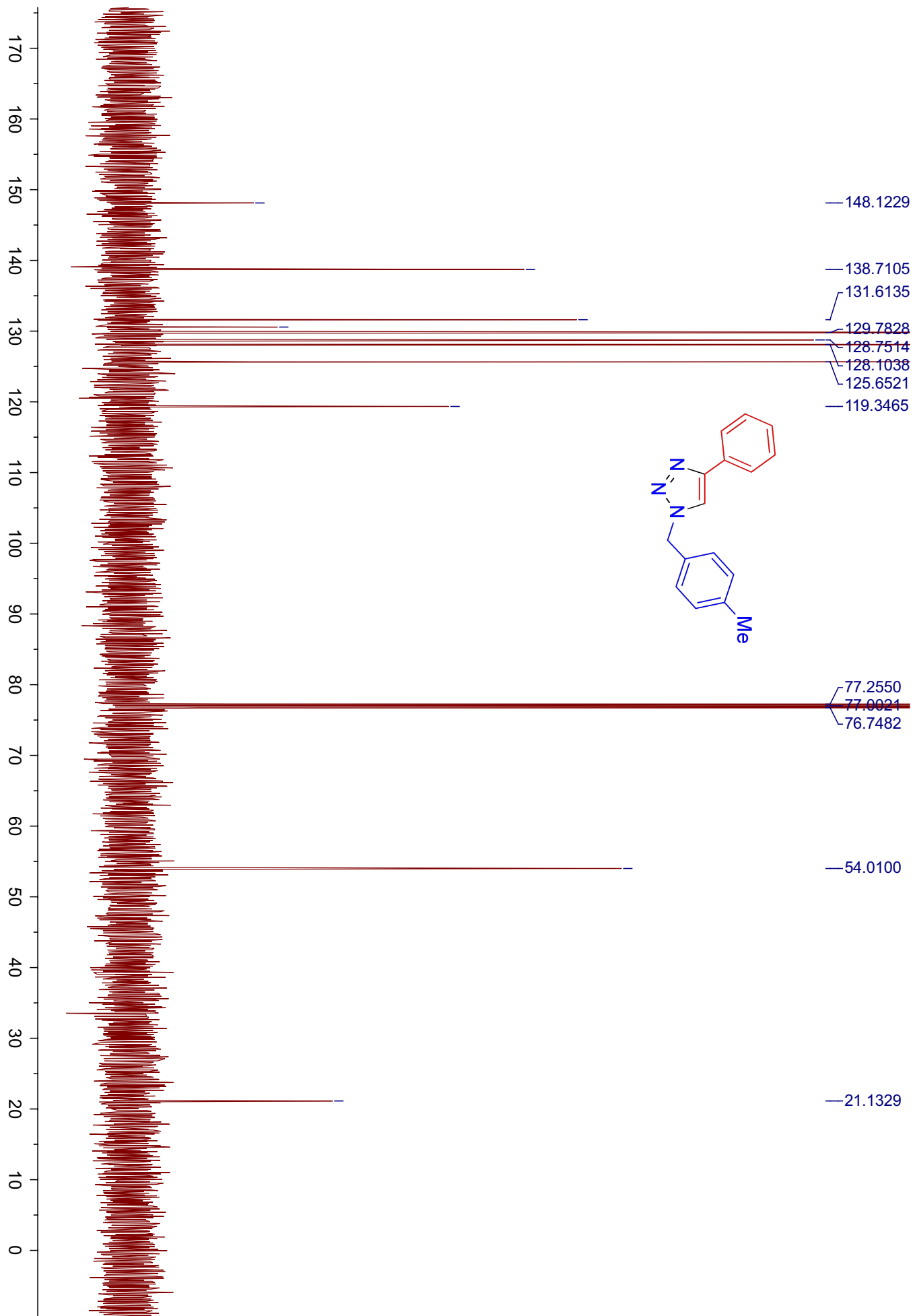


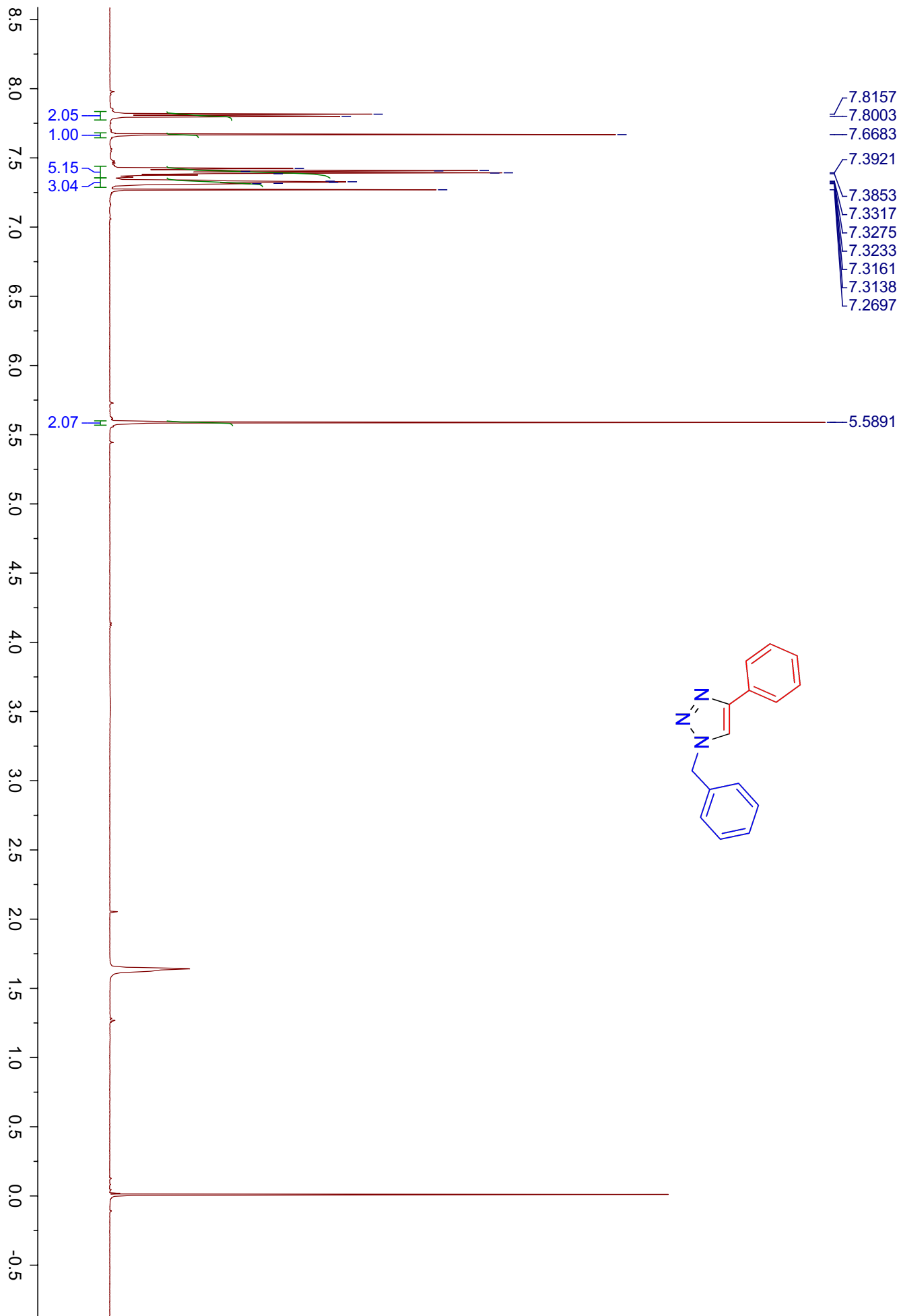


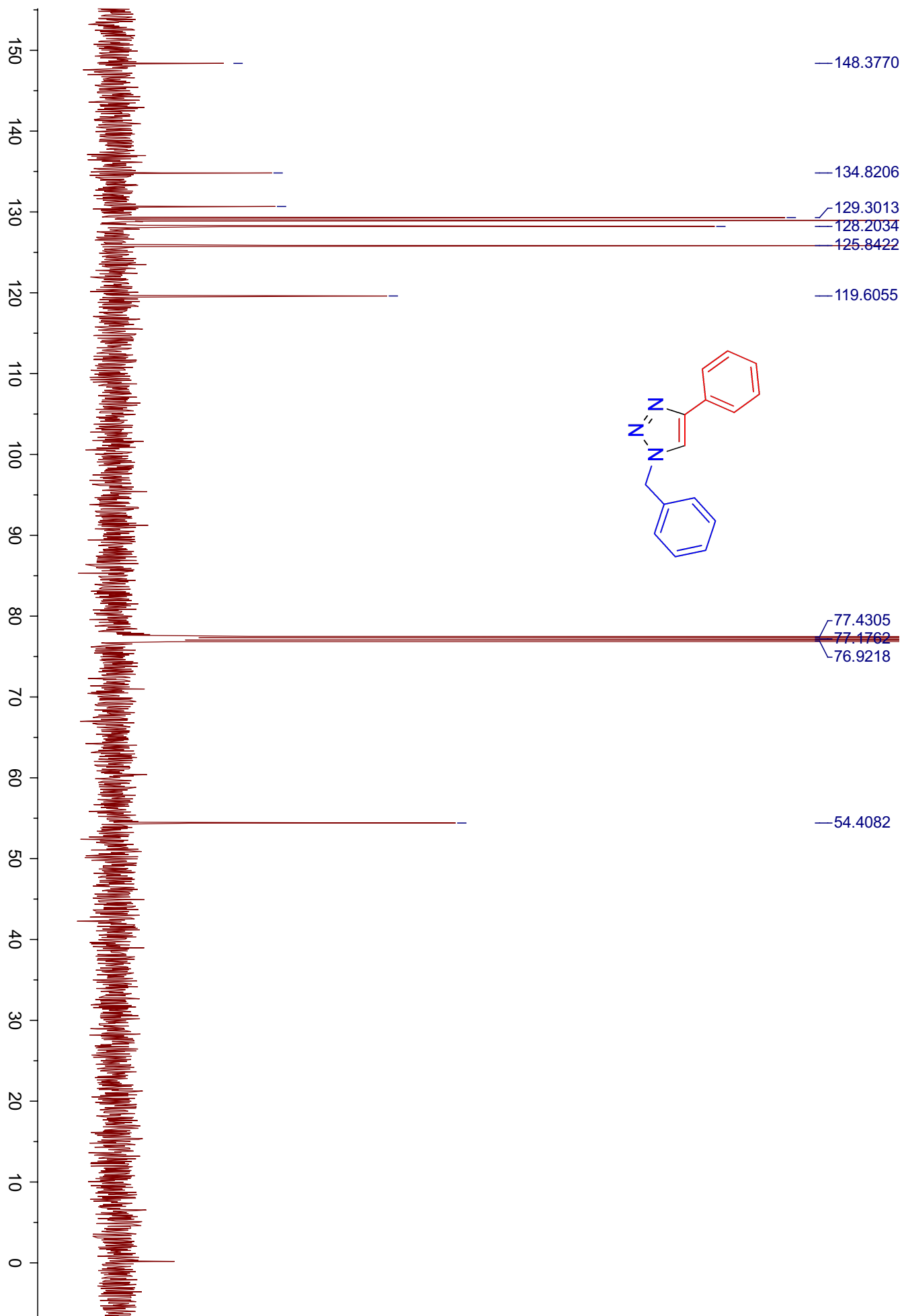


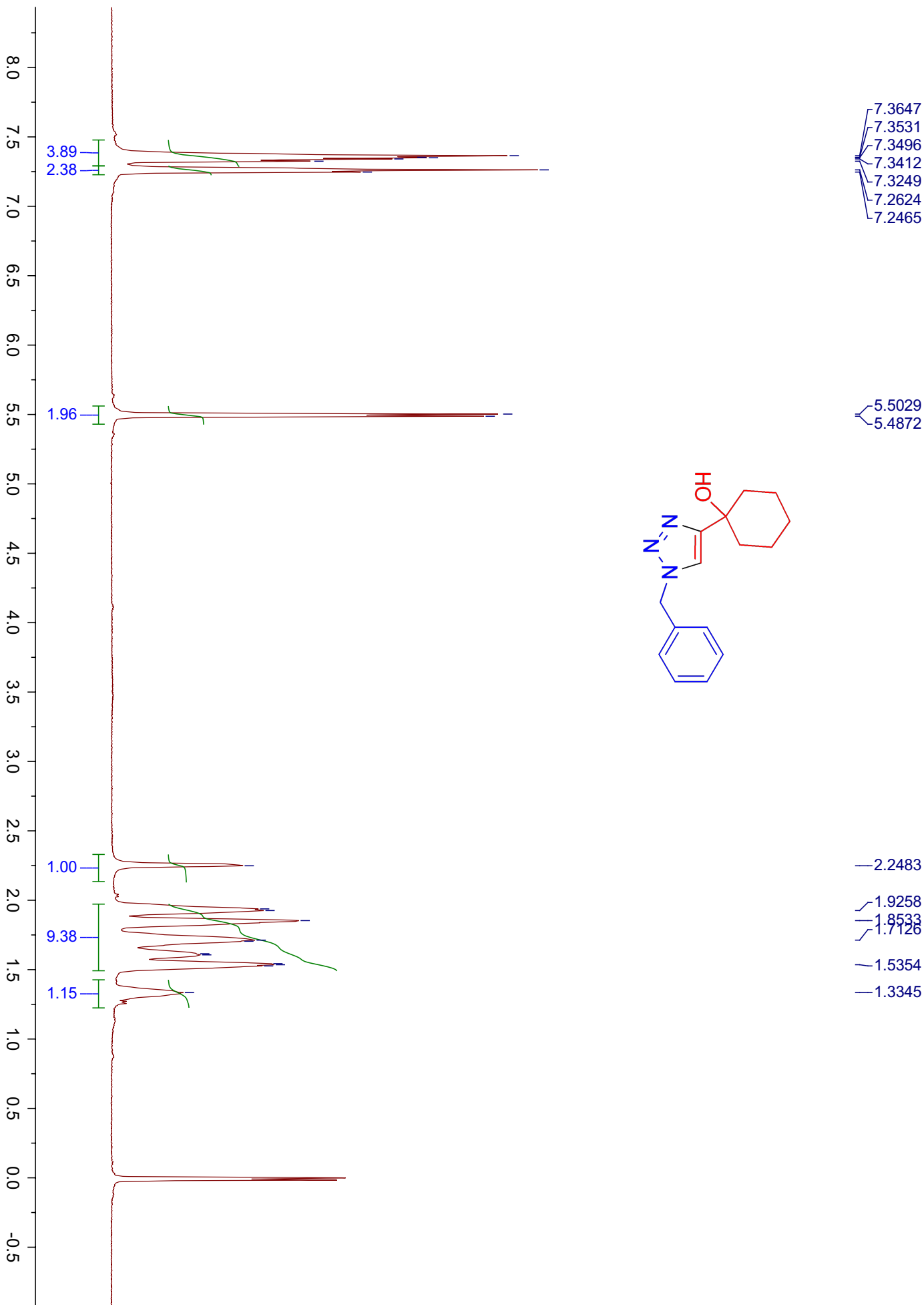


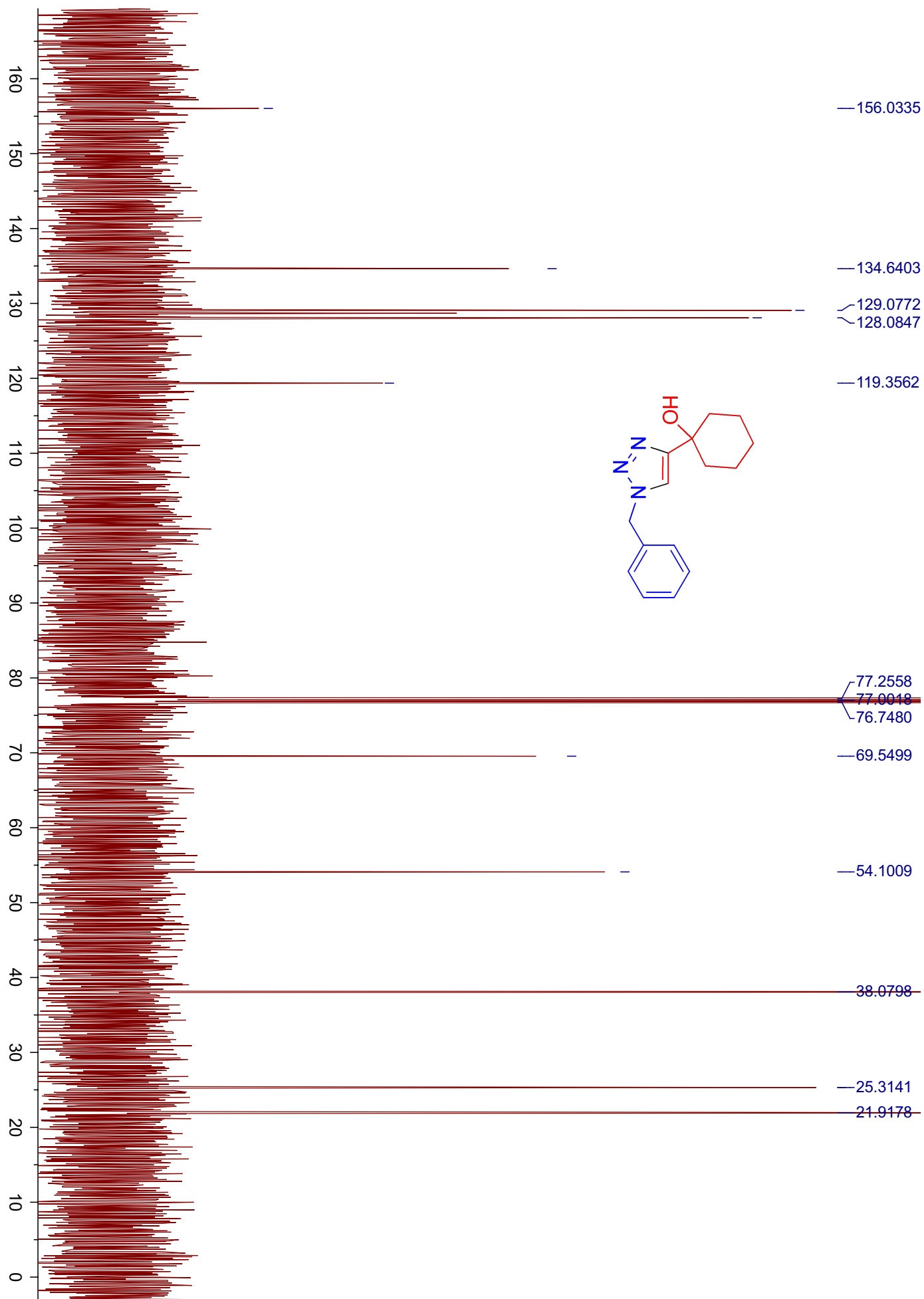


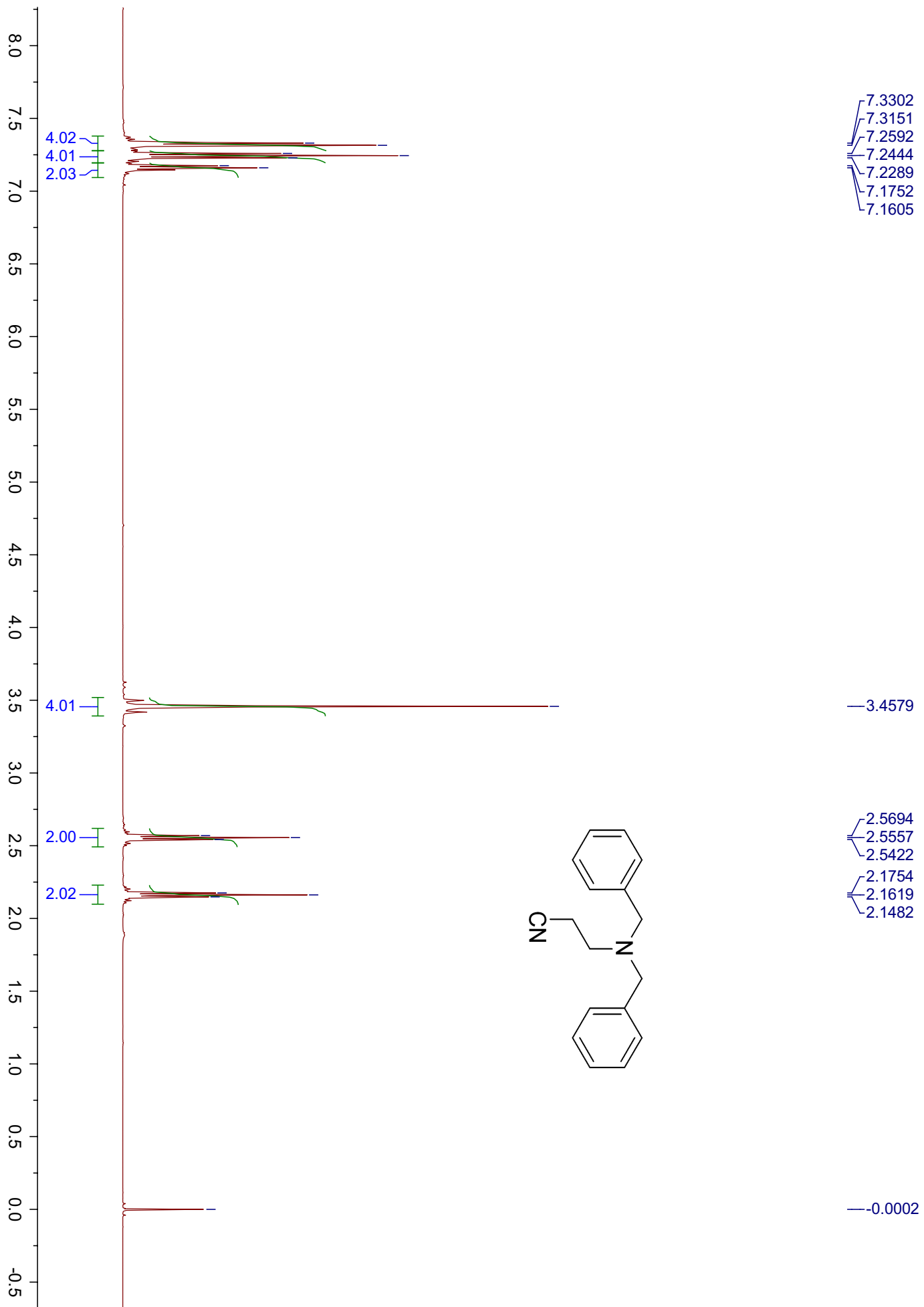


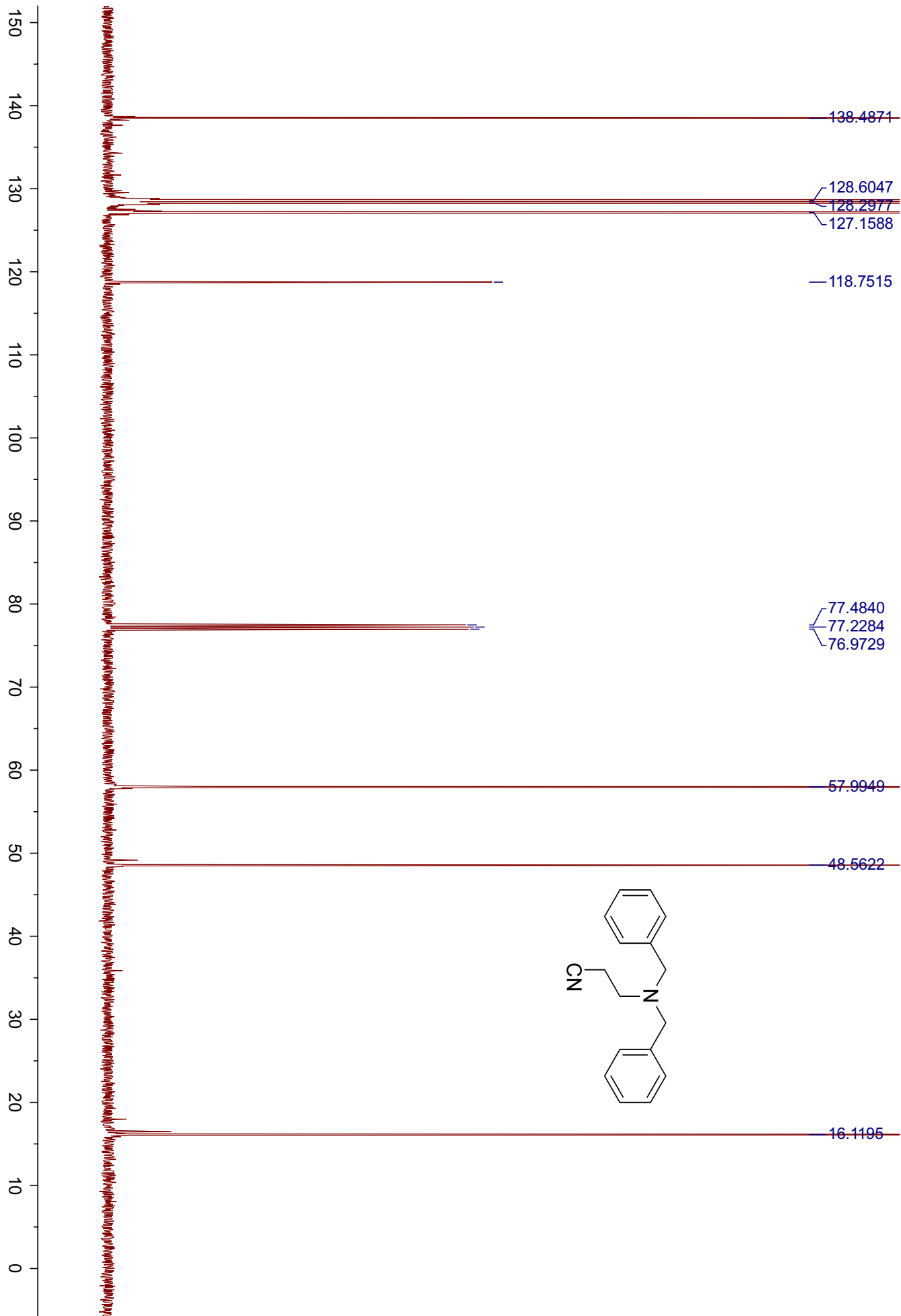


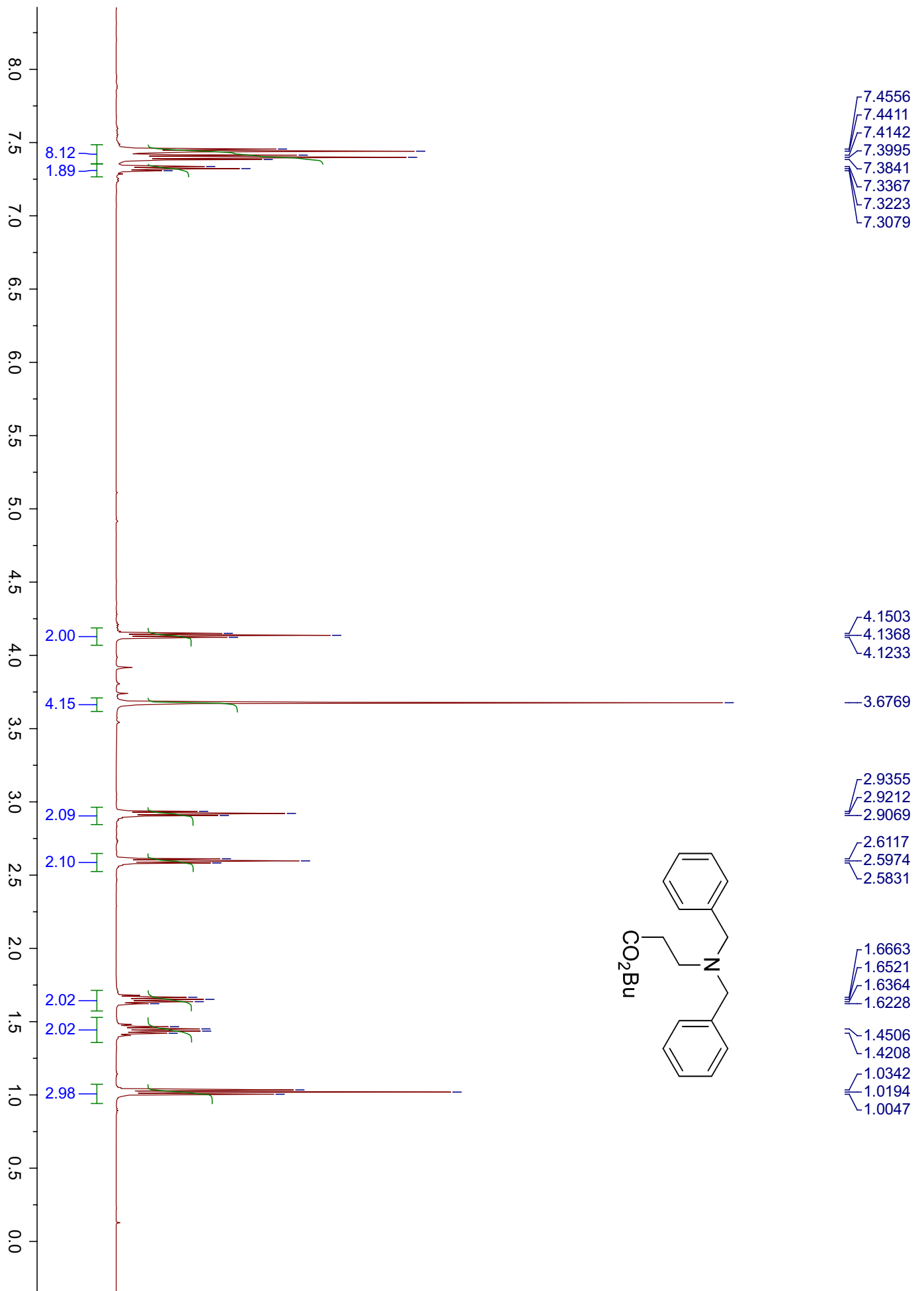


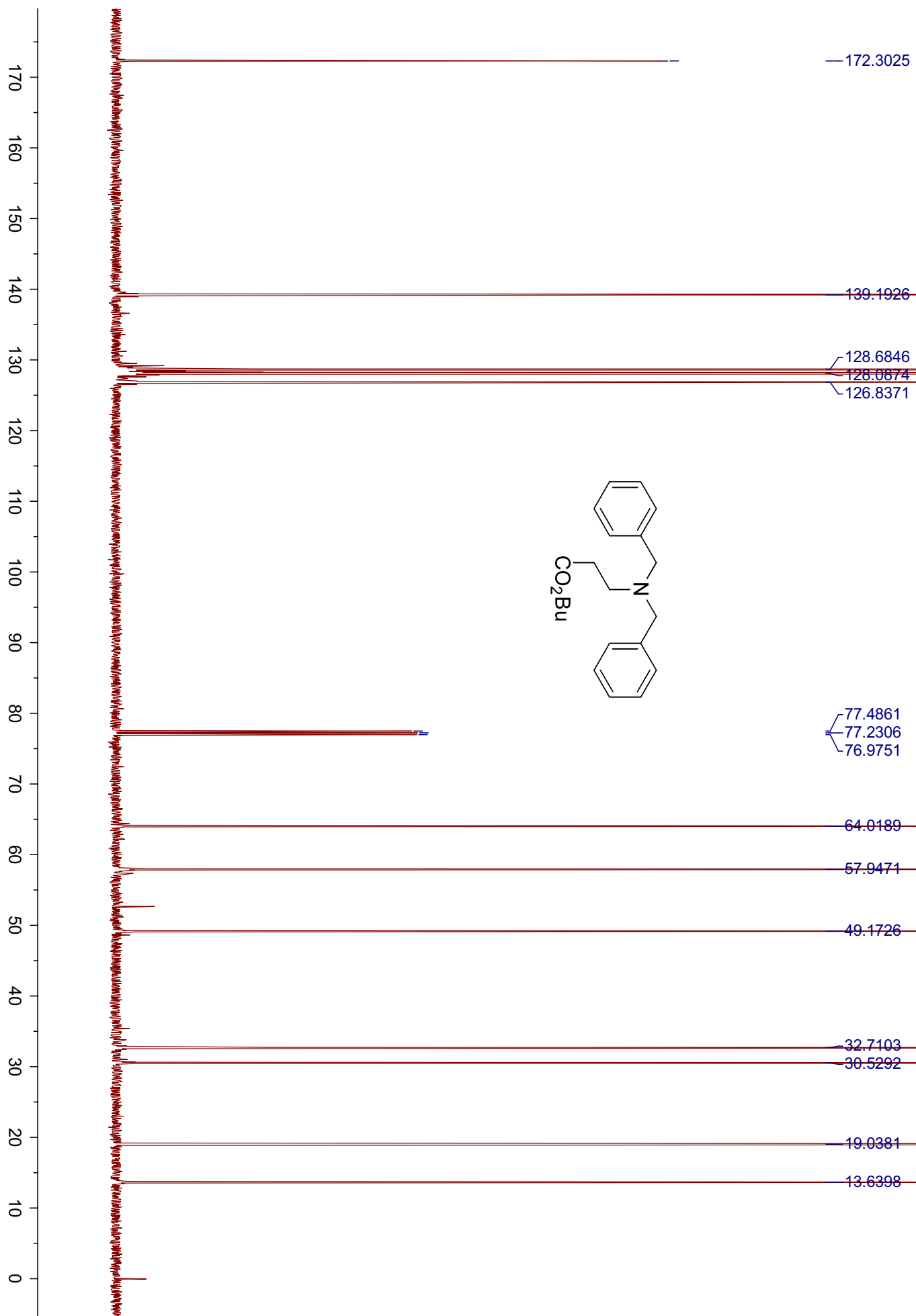


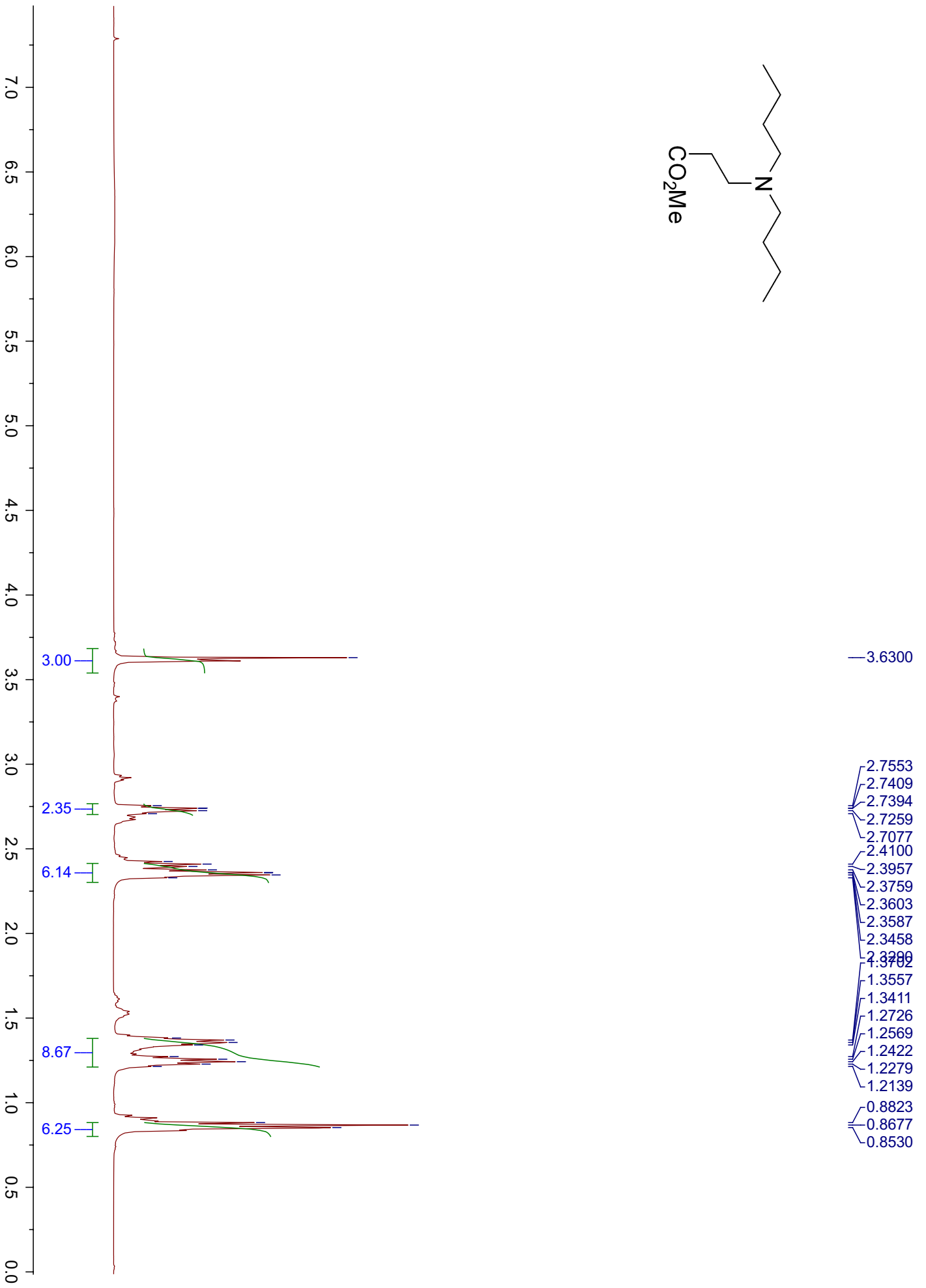
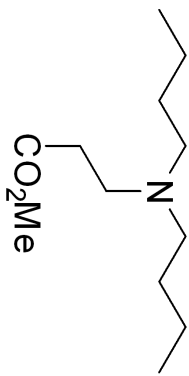


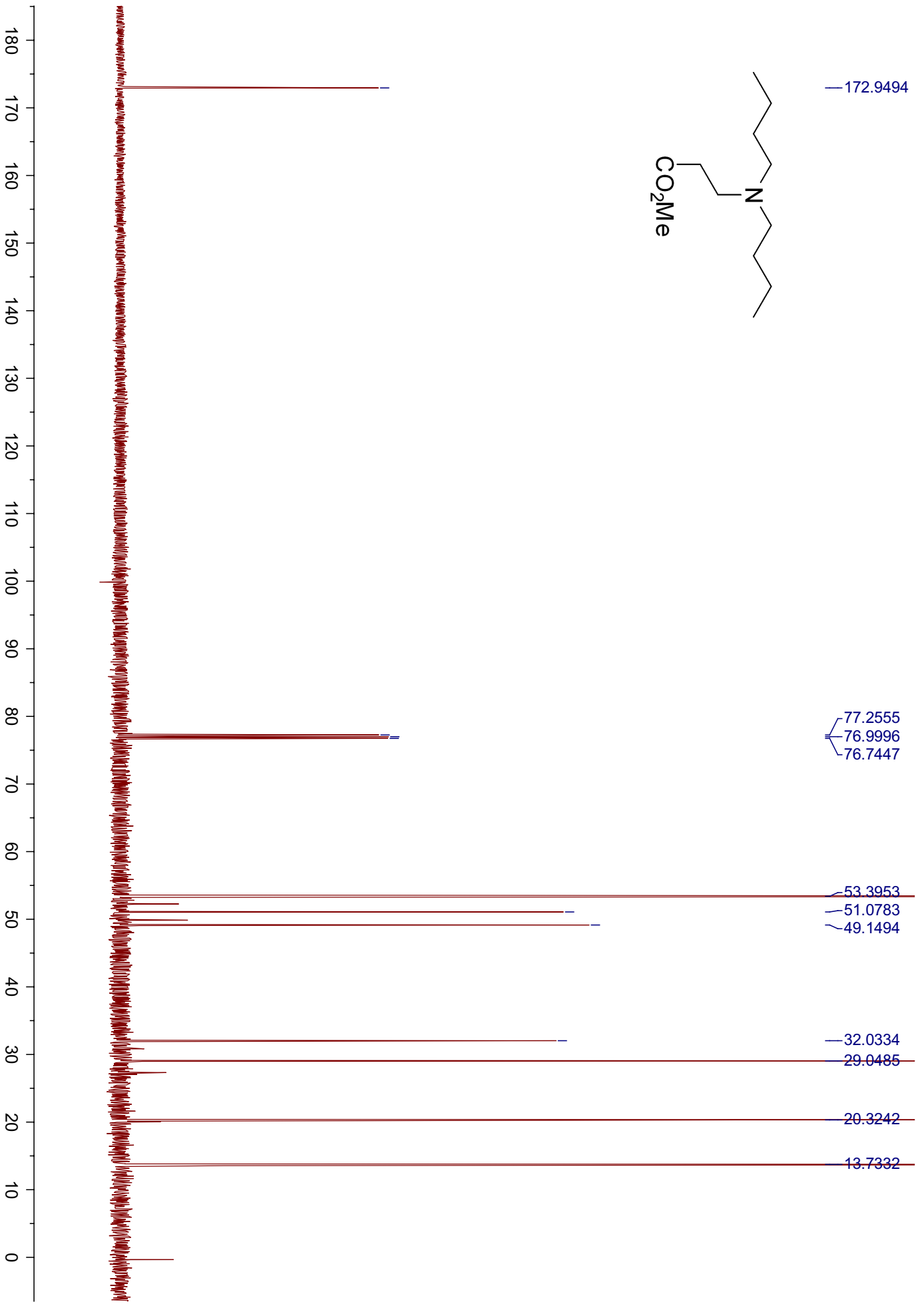


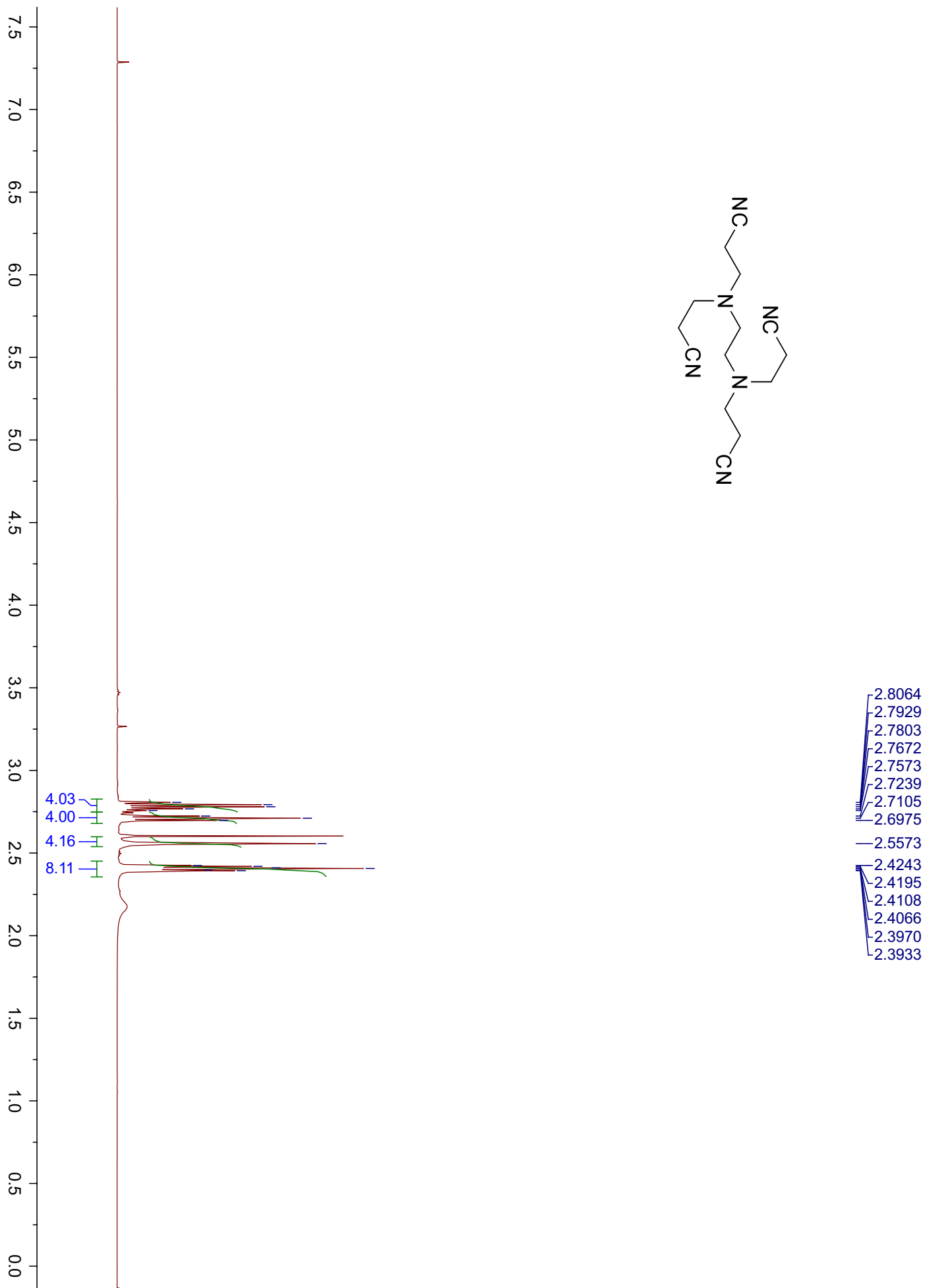
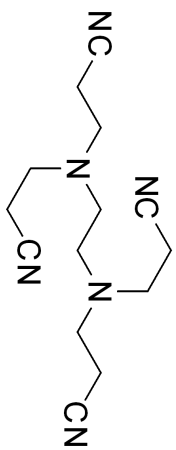


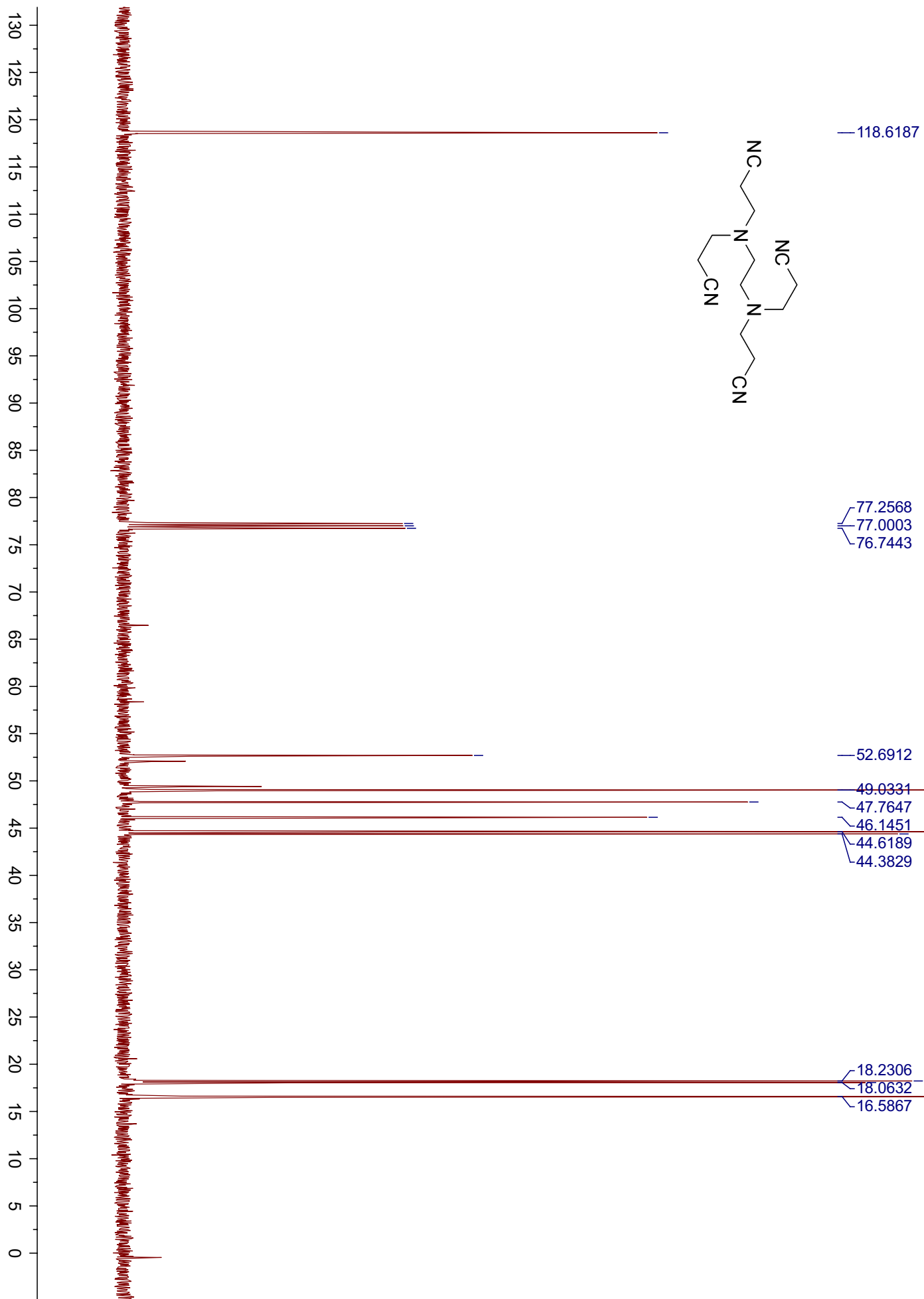
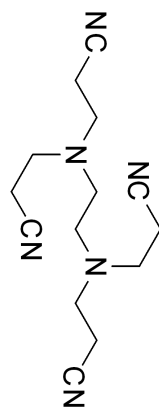


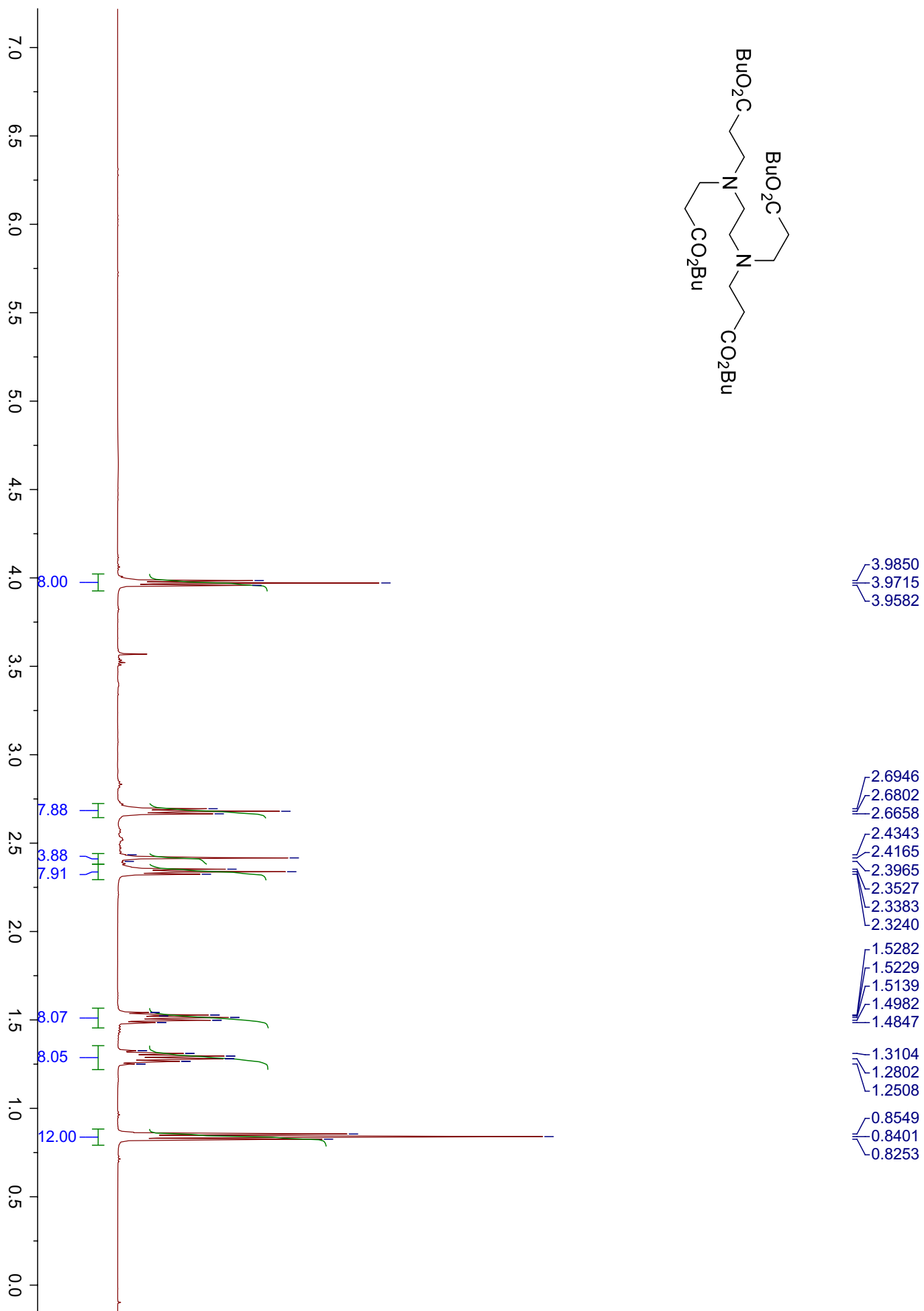
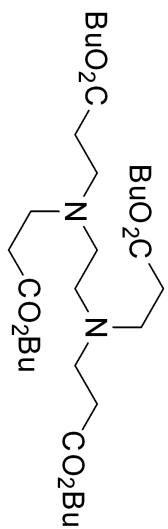


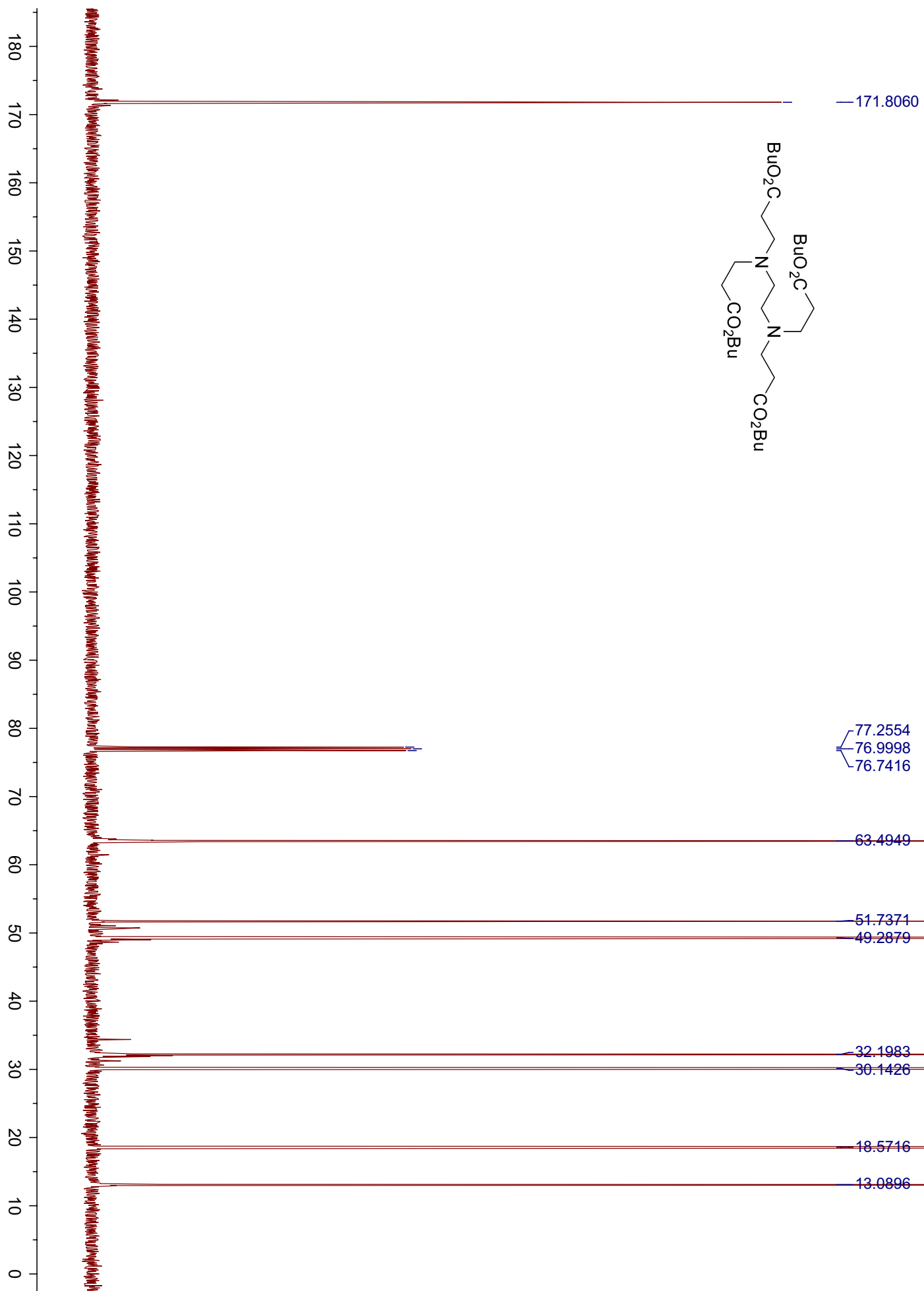


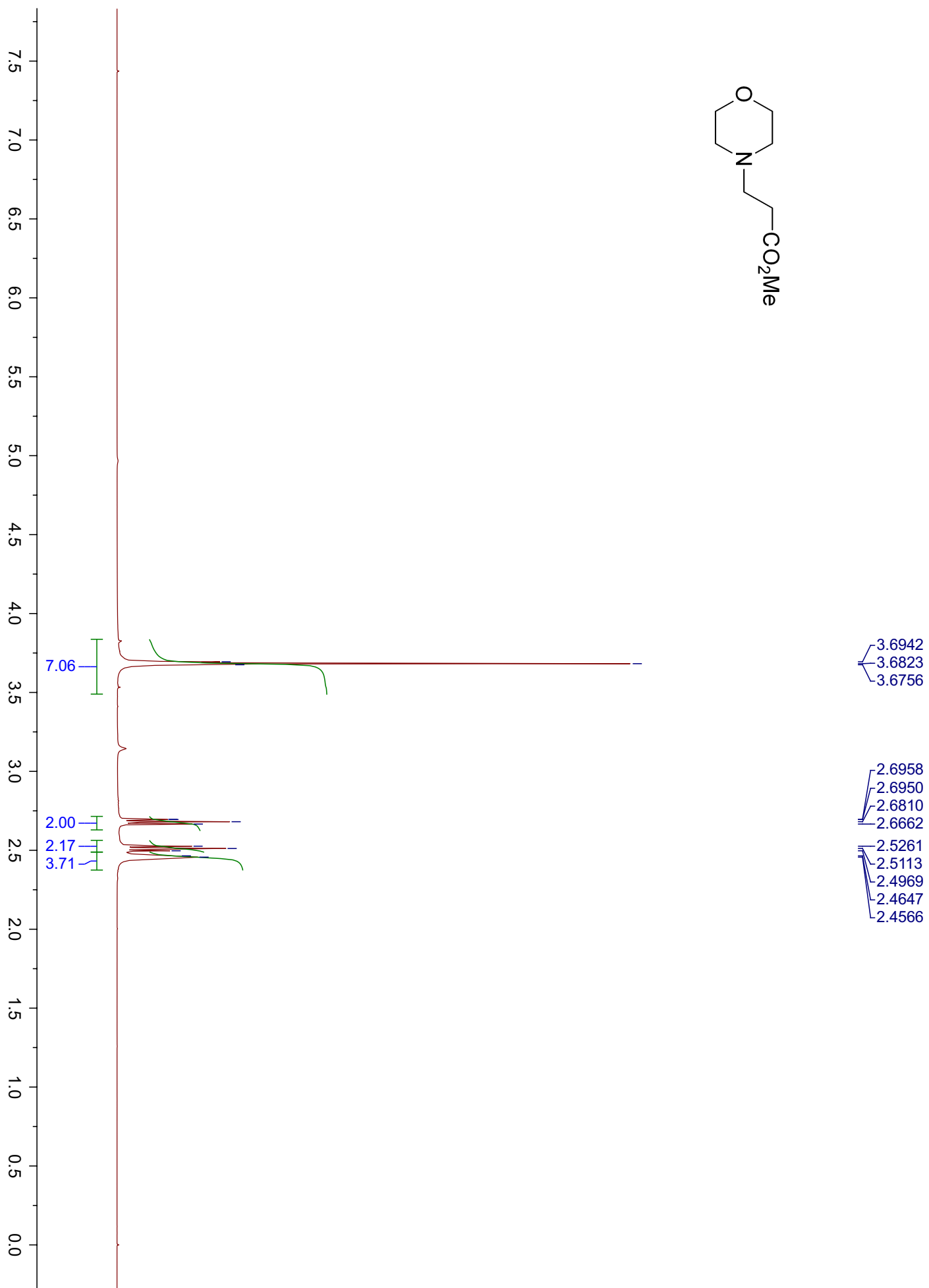
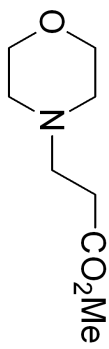


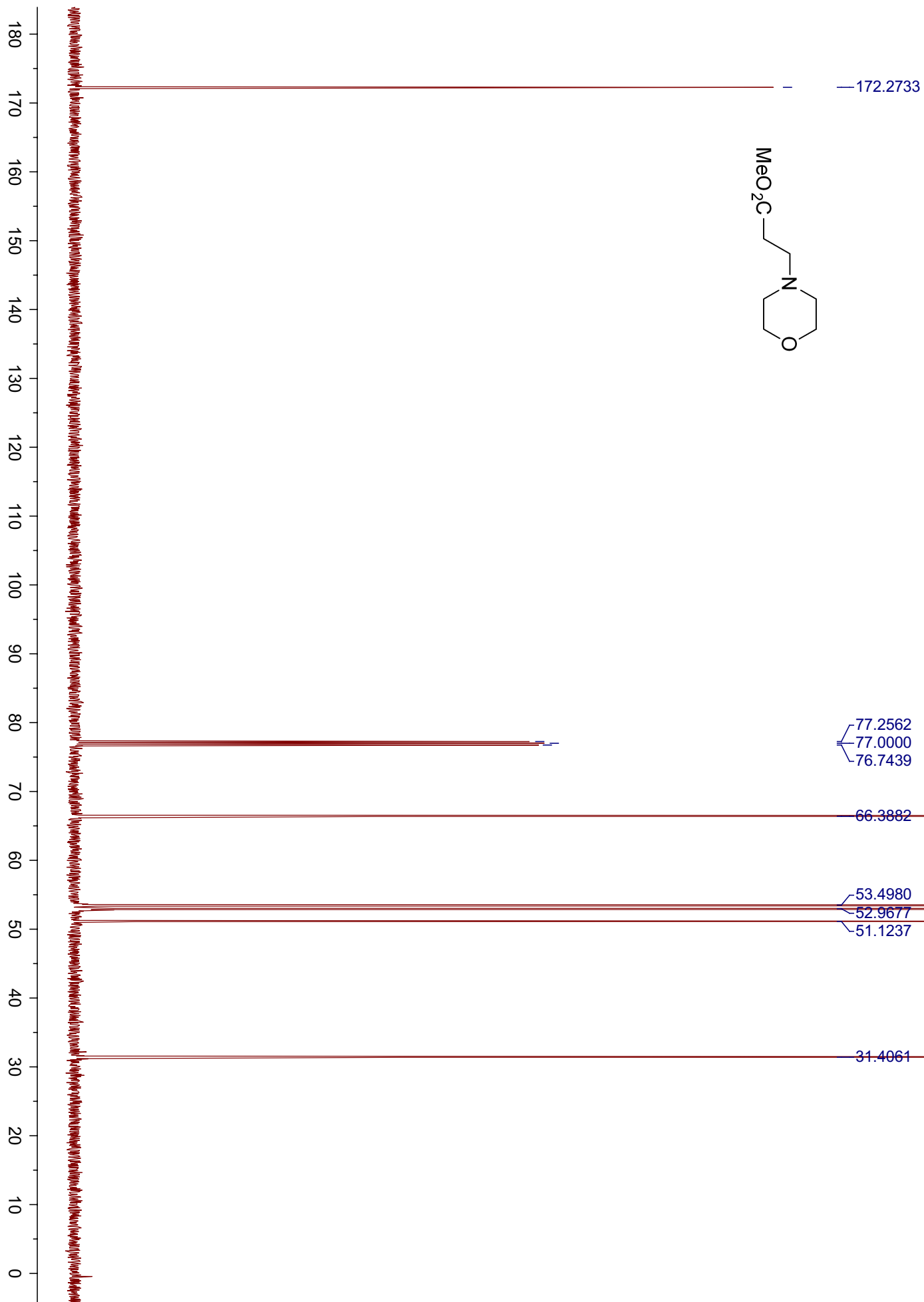


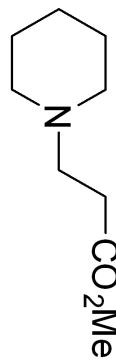












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