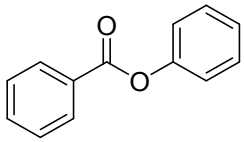
Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Typical reaction procedure for alkoxycarbonylation carbonylation reactions: $Pd(OAc)_2$ (3 mol %) and Xantphos (3 mol %) were transferred into an oven-dried tube which was filled with nitrogen. Toluene (2.0 mL), aryl halides (1.0 mmol), phenols (2.0 mmol) were added to the reaction tube. Then a mixture of formic acid (2.0 mmol) and acetic anhydride (2.0 mmol), which was stirred for 1.5 h at 30 °C, added dropwise to the reaction tube. After that, was added Et_3N (5.0 mmol). The mixture was stirred for 12 h at 80 °C. After the reaction was complete, the reaction mixture was filtered and concentrated, column chromatography on silica gel (petroleum ether/ethyl acetate 50:1).

Phenyl benzoate

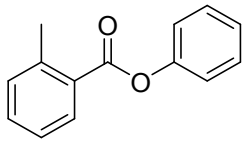


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.1 Hz, 2H), 7.62 (t, *J* = 7.3 Hz, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.28 (d, *J* = 7.3 Hz, 1H), 7.22 (d, *J* = 8.3 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.10, 150.89, 133.51, 130.09, 129.50, 129.42, 128.50, 125.81, 121.65.

GC-MS (EI, 70 eV): m/z(%)=198.0 ([M]+, 6), 198.0 (11), 105.0 (100), 77.0 (42), 51.0 (10).

Phenyl 2-methylbenzoate

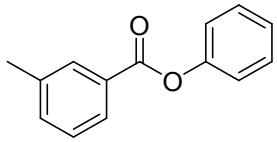


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 7.8 Hz, 1H), 7.53 – 7.40 (m, 3H), 7.36 – 7.27 (m, 3H), 7.23 (d, *J* = 7.9 Hz, 2H), 2.70 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.74, 150.87, 141.22, 132.64, 131.89, 131.09, 129.41, 128.50, 125.85, 125.74, 121.76, 21.88.

GC-MS (EI, 70 eV): m/z(%)=212.0 ([M]+, 5), 119.0 (100), 91.0 (48), 65.0 (20).

Phenyl 3-methylbenzoate

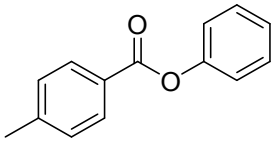


^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.1 Hz, 2H), 7.31 (dd, *J* = 15.4, 7.7 Hz, 4H), 7.15 (dd, *J* = 12.7, 5.3 Hz, 1H), 7.11 (d, *J* = 8.2 Hz, 2H), 2.33 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.24, 150.94, 138.31, 134.26, 130.58, 129.42, 129.39, 128.38, 127.24, 125.75, 121.65, 21.19.

GC-MS (EI, 70 eV): m/z(%)=212.0 ([M]+, 7), 212.0 (11), 119.1 (100), 91.1 (43), 65.0 (15).

Phenyl 4-methylbenzoate

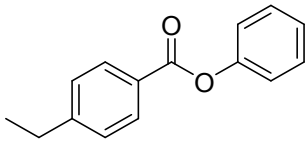


^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, *J* = 7.9 Hz, 2H), 7.29 (d, *J* = 7.6 Hz, 2H), 7.17 (d, *J* = 8.0 Hz, 2H), 7.10 (d, *J* = 8.2 Hz, 3H), 2.31 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.12, 150.95, 144.29, 130.11, 129.35, 129.19, 126.74, 125.68, 121.68, 21.63.

GC-MS (EI, 70 eV): m/z(%)=212.0 ([M]+, 6), 212.0 (15), 119.1 (100), 91.1 (79), 65.0 (39).

Phenyl 4-ethylbenzoate

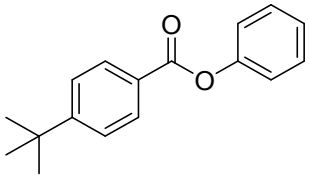


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.1 Hz, 2H), 7.43 (t, *J* = 7.8 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 7.28 (d, *J* = 7.4 Hz, 1H), 7.22 (d, *J* = 7.8 Hz, 2H), 2.75 (q, *J* = 7.6 Hz, 2H), 1.29 (t, *J* = 7.6 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.17, 150.98, 150.52, 130.27, 129.39, 128.05, 126.96, 125.72, 121.71, 28.98, 15.19.

GC-MS (EI, 70 eV): m/z(%)=226.0 ([M]+, 7), 226.0 (11), 133.0 (100), 105.0 (34), 77.0 (30).

Phenyl 4-(*tert*-butyl)benzoate

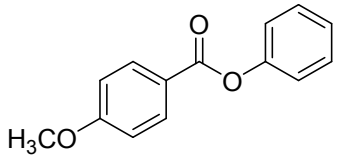


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.1 Hz, 2H), 7.40 (d, *J* = 8.3 Hz, 2H), 7.29 (t, *J* = 7.7 Hz, 2H), 7.14 (d, *J* = 7.5 Hz, 1H), 7.09 (d, *J* = 8.4 Hz, 2H), 1.25 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.04, 157.25, 150.96, 130.00, 129.35, 126.70, 125.67, 125.47, 121.69, 35.07, 31.02.

GC-MS (EI, 70 eV): m/z(%)=254.0 ([M]+, 5), 161.1 (100), 146.0 (33), 118.0 (30), 91.0 (28).

Phenyl 4-methoxybenzoate

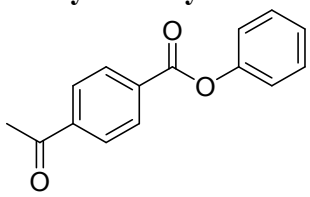


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.7 Hz, 2H), 7.40 (t, *J* = 7.8 Hz, 2H), 7.24 (dd, *J* = 12.5, 5.4 Hz, 1H), 7.19 (d, *J* = 8.1 Hz, 2H), 6.96 (d, *J* = 8.8 Hz, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.82, 163.82, 151.01, 132.20, 129.35, 125.63, 121.80, 121.73, 113.76, 55.41.

GC-MS (EI, 70 eV): m/z(%)=228.0 ([M]+, 8), 135.0 (100), 107.0 (20), 92.0 (32), 77.0 (36).

Phenyl 4-acetylbenzoate

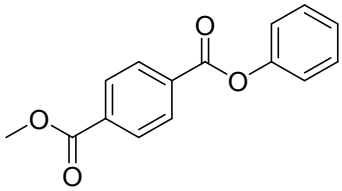


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, *J* = 8.2 Hz, 2H), 8.05 (d, *J* = 8.2 Hz, 2H), 7.42 (t, *J* = 7.8 Hz, 2H), 7.26 (dd, *J* = 13.6, 6.1 Hz, 1H), 7.21 (d, *J* = 8.1 Hz, 2H), 2.65 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.43, 164.29, 150.69, 140.66, 133.29, 130.38, 129.55, 128.32, 126.12, 121.53, 26.90.

GC-MS (EI, 70 eV): m/z(%)=240.0 ([M]+, 9), 240.0 (11), 147.0 (100), 119.0 (12), 91.0 (12).

Methyl phenyl terephthalate

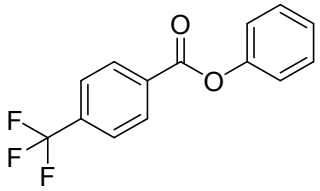


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.3 Hz, 2H), 8.17 (d, *J* = 8.3 Hz, 2H), 7.44 (t, *J* = 7.8 Hz, 2H), 7.31 – 7.21 (m, 3H), 3.96 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 166.11, 164.32, 150.71, 134.42, 133.30, 130.07, 129.66, 129.52, 126.07, 121.52, 52.46.

GC-MS (EI, 70 eV): m/z(%)=256.0 ([M]+, 9), 256.0 (10), 163.0 (100), 135.0 (11).

Phenyl 4-(trifluoromethyl)benzoate

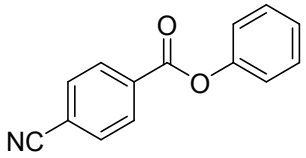


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 (d, *J* = 8.2 Hz, 2H), 7.76 (d, *J* = 8.2 Hz, 2H), 7.44 (t, *J* = 7.7 Hz, 2H), 7.29 (s, 1H), 7.22 (d, *J* = 7.9 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.01, 150.74, 135.03 (q, *J* = 32.33 Hz), 132.89, 130.58, 129.63, 126.25, 125.63 (q, *J* = 3.68 Hz), 123.62 (q, *J* = 273.60 Hz), 121.57.

GC-MS (EI, 70 eV): m/z(%)=266.0 ([M]+, 9), 266.0 (29), 247.0 (10), 174.0 (21), 173.0 (100), 145.0 (83).

Phenyl 4-cyanobenzoate

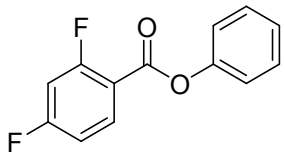


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, *J* = 8.2 Hz, 2H), 7.81 (d, *J* = 8.2 Hz, 2H), 7.45 (t, *J* = 7.8 Hz, 2H), 7.30 (t, *J* = 7.4 Hz, 1H), 7.21 (d, *J* = 8.0 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.55, 150.51, 133.40, 132.36, 130.60, 129.63, 126.33, 121.40, 117.82, 116.97.

GC-MS (EI, 70 eV): m/z(%)=223.0 ([M]+, 6), 233.0 (33), 130.0 (100), 102.0 (51).

Phenyl 2,4-difluorobenzoate

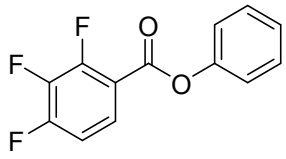


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (dd, *J* = 15.4, 8.1 Hz, 1H), 7.41 (t, *J* = 7.8 Hz, 2H), 7.26 (t, *J* = 7.4 Hz, 1H), 7.21 (d, *J* = 7.9 Hz, 2H), 7.03 – 6.88 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 167.49 (d, *J* = 12.60 Hz), 164.76 (dd, *J* = 12.44, 33.01 Hz), 162.00 (bdd), 150.55, 134.44 (dd, *J* = 1.84, 10.66 Hz), 129.56, 126.16, 121.67, 114.64 (dd, *J* = 3.65, 9.53 Hz), 111.87 (dd, *J* = 4.05, 21,63 Hz), 105.52 (t, *J* = 25.71).

GC-MS (EI, 70 eV): m/z(%)=234.0 ([M]+, 5), 234.0 (44), 141.1 (100), 113.0 (68), 63.0 (30).

Phenyl 2,3,4-trifluorobenzoate

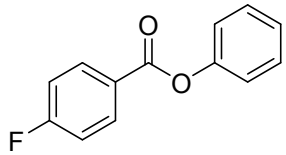


^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 – 7.84 (m, 1H), 7.43 (t, *J* = 7.8 Hz, 2H), 7.28 (t, *J* = 7.4 Hz, 1H), 7.22 (t, *J* = 6.6 Hz, 2H), 7.09 (q, *J* = 7.4 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 161.28 (bs), 155.80 (m), 153.37 (m), 150.77 (m), 150.38, 129.61, 126.79 (m), 126.33, 121.49, 115.85 (m), 112347 (dd, *J* = 4.05, 18.01 Hz).

GC-MS (EI, 70 eV): m/z(%)=252.0 ([M]+, 7), 252.0 (26), 159.0 (100), 131.0 (41), 81.0 (20).

Phenyl 4-fluorobenzoate

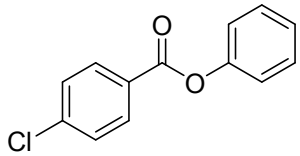


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (dd, *J* = 8.5, 5.7 Hz, 2H), 7.32 (t, *J* = 7.8 Hz, 2H), 7.16 (dd, *J* = 13.7, 6.3 Hz, 1H), 7.14 – 7.08 (m, 3H), 7.06 (d, *J* = 8.5 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 166.21 (d, *J* = 255.78 Hz), 164.80, 164.12, 150.77, 132.83 (d, *J* = 9.56 Hz), 129.45, 125.91, 121.59, 115.82 (d, *J* = 22.11 Hz).

GC-MS (EI, 70 eV): m/z(%)=216.0 ([M]+, 8), 216.0 (46), 123.0 (100), 95.0 (79), 75.0 (34).

Phenyl 4-chlorobenzoate

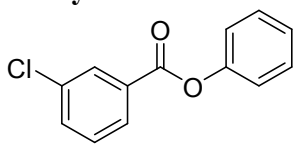


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 – 8.10 (m, 2H), 7.48 (t, *J* = 7.1 Hz, 2H), 7.46 – 7.39 (m, 2H), 7.33 – 7.27 (m, 1H), 7.24 – 7.17 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.33, 150.75, 140.11, 131.53, 129.53, 128.93, 128.01, 126.03, 121.59.

GC-MS (EI, 70 eV): m/z(%)=232.0 ([M]+, 7), 232.0 (14), 141.0 (65), 139.0 (100), 111.0 (50), 75.0 (15).

Phenyl 3-chlorobenzoate

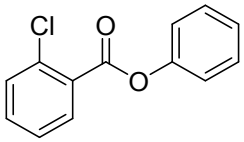


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 – 8.05 (m, 1H), 8.00 – 7.94 (m, 1H), 7.48 (ddd, *J* = 8.0, 2.0, 1.0 Hz, 1H), 7.33 (dt, *J* = 8.5, 6.5 Hz, 3H), 7.21 – 7.14 (m, 1H), 7.13 – 7.08 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.85, 150.63, 134.64, 133.49, 131.23, 130.06, 129.81, 129.47, 128.18, 126.01, 121.48.

GC-MS (EI, 70 eV): m/z(%)=232.0 ([M]+, 6), 232.0 (40), 139.0 (100), 141.0 (71), 111.0 (69), 75.0 (36).

Phenyl 2-chlorobenzoate

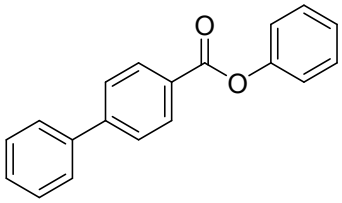


^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 7.7 Hz, 1H), 7.46 – 7.39 (m, 2H), 7.39 – 7.28 (m, 3H), 7.19 (dd, *J* = 15.3, 7.5 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.05, 150.65, 134.32, 133.12, 131.82, 131.29, 129.50, 129.35, 126.70, 126.07, 121.57.

GC-MS (EI, 70 eV): m/z(%)=232.0 ([M]+, 6), 232.0 (10), 141.0 (36), 139.0 (100), 111.0 (28), 75.0 (15).

Phenyl [1,1'-biphenyl]-4-carboxylate

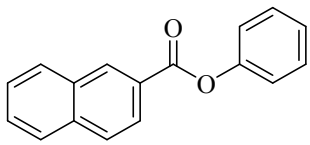


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 – 8.15 (m, 2H), 7.71 – 7.60 (m, 2H), 7.57 (d, *J* = 6.2 Hz, 2H), 7.46 – 7.30 (m, 5H), 7.18 (d, *J* = 12.2 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.05, 150.96, 146.28, 139.82, 130.67, 129.47, 128.95, 128.28, 128.23, 127.29, 127.20, 125.86, 121.71.

GC-MS (EI, 70 eV): m/z(%)=274.0 ([M]+, 6), 181.0 (100), 152.0 (41).

Phenyl 2-naphthoate

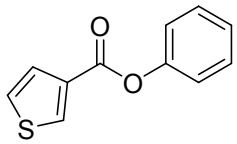


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.81 (s, 1H), 8.22 (d, *J* = 8.6 Hz, 1H), 8.01 (d, *J* = 8.1 Hz, 1H), 7.98 – 7.90 (m, 2H), 7.61 (dt, *J* = 14.9, 7.0 Hz, 2H), 7.47 (t, *J* = 7.8 Hz, 2H), 7.31 (t, *J* = 8.0 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.28, 151.00, 135.74, 132.43, 131.85, 129.46, 129.42, 128.55, 128.32, 127.77, 126.77, 126.71, 125.85, 125.39, 121.72.

GC-MS (EI, 70 eV): m/z(%)=248.0 ([M]+, 7), 248.0 (21), 155.0 (100), 127.0 (80).

Phenyl thiophene-3-carboxylate

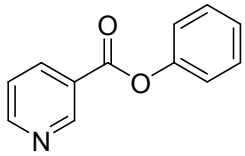


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, *J* = 2.1 Hz, 1H), 7.66 (d, *J* = 5.1 Hz, 1H), 7.41 (t, *J* = 7.7 Hz, 2H), 7.36 (dd, *J* = 4.6, 3.4 Hz, 1H), 7.28 – 7.23 (m, 1H), 7.20 (d, *J* = 7.8 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 161.00, 150.63, 133.96, 132.84, 130.12, 129.42, 128.52, 128.17, 126.32, 125.83, 121.65.

GC-MS (EI, 70 eV): m/z(%)=204.0 ([M]+, 5), 204.0 (30), 111.0 (100), 83.0 (26).

Phenyl nicotinate

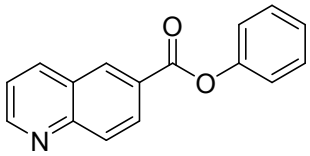


^{1}H NMR (400 MHz, $CDCl_3$) δ 9.40 (s, 1H), 8.85 (d, *J* = 4.7 Hz, 1H), 8.46 (d, *J* = 8.0 Hz, 1H), 7.54 – 7.39 (m, 3H), 7.32 – 7.17 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.60, 153.52, 150.92, 150.35, 137.71, 129.47, 126.12, 125.60, 123.47, 121.39.

GC-MS (EI, 70 eV): m/z(%)=199.0 ([M]+, 6), 199.0 (47), 106.0 (100), 78.0 (66), 51.0 (32).

Phenyl quinoline-6-carboxylate

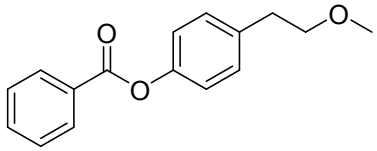


^{1}H NMR (400 MHz, $CDCl_3$) δ 9.06 (d, *J* = 3.6 Hz, 1H), 8.79 (s, 1H), 8.47 (d, *J* = 8.8 Hz, 1H), 8.36 (d, *J* = 8.3 Hz, 1H), 8.27 (d, *J* = 8.8 Hz, 1H), 7.54 (dd, *J* = 8.3, 4.3 Hz, 1H), 7.47 (t, *J* = 7.8 Hz, 2H), 7.30 (dd, *J* = 17.1, 7.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.56, 152.36, 150.82, 149.68, 137.97, 131.79, 129.60, 129.56, 129.46, 127.73, 127.47, 126.08, 122.01, 121.61.

GC-MS (EI, 70 eV): m/z(%)=249.0 ([M]+, 8), 249.0 (10), 156.0 (100), 128.0 (42), 101.0 (12).

4-(2-Methoxyethyl)phenyl benzoate

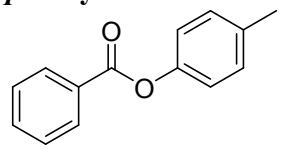


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 – 8.18 (m, 2H), 7.63 (dd, *J* = 10.5, 4.3 Hz, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 7.28 (t, *J* = 7.8 Hz, 2H), 7.15 (d, *J* = 8.5 Hz, 2H), 3.62 (t, *J* = 7.0 Hz, 2H), 3.37 (s, 3H), 2.91 (t, *J* = 7.0 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.17, 149.26, 136.58, 133.45, 130.06, 129.77, 129.54, 128.46, 121.44, 73.40, 58.58, 35.54.

GC-MS (EI, 70 eV): m/z(%)=256.0 ([M]+, 6), 256.0 (13), 105.0 (100), 77.0 (34).

***p*-Tolyl benzoate**

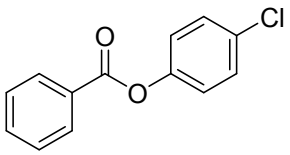


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 – 8.18 (m, 2H), 7.63 (dd, *J* = 10.5, 4.3 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H), 7.22 (d, *J* = 8.1 Hz, 2H), 7.09 (d, *J* = 8.4 Hz, 2H), 2.37 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.36, 148.68, 135.49, 133.47, 130.12, 129.97, 129.66, 128.51, 121.34, 20.88.

GC-MS (EI, 70 eV): m/z(%)=212.0 ([M]+, 4), 212.0 (24), 105.0 (100), 77.0 (49), 51.0 (10).

4-Chlorophenyl benzoate.

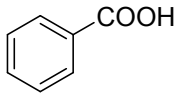


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 7.9 Hz, 2H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.52 (t, *J* = 7.7 Hz, 2H), 7.39 (d, *J* = 8.5 Hz, 2H), 7.18 (d, *J* = 8.6 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.82, 149.34, 133.70, 131.15, 130.10, 129.44, 129.09, 128.55, 123.03.

GC-MS (EI, 70 eV): m/z(%)=232.0 ([M]+, 5), 232.0 (26), 105.0 (100), 77.0 (68), 51.0 (28).

Benzoic acid

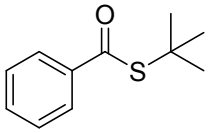


^{1}H NMR (400 MHz, $CDCl_3$) δ 13.03 (s, 1H), 8.14 (d, *J* = 8.3 Hz, 2H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.47 (t, *J* = 7.7 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 172.68, 133.80, 130.19, 129.30, 128.44.

GC-MS (EI, 70 eV): m/z(%)=122.0 ([M]+, 4), 122.0 (94), 105.0 (100), 77.0 (79), 51.0 (31).

***S*-(*tert*-Butyl) benzothioate**

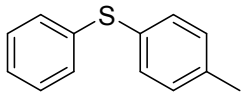


^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.2 Hz, 2H), 7.52 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.7 Hz, 2H), 1.58 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 192.81, 138.23, 132.86, 128.40, 126.90, 48.09, 29.96.

GC-MS (EI, 70 eV): m/z(%)=194.0 ([M]+, 8), 194.0 (33), 138.0 (46), 105.0 (100), 77.0 (49), 57.1 (30).

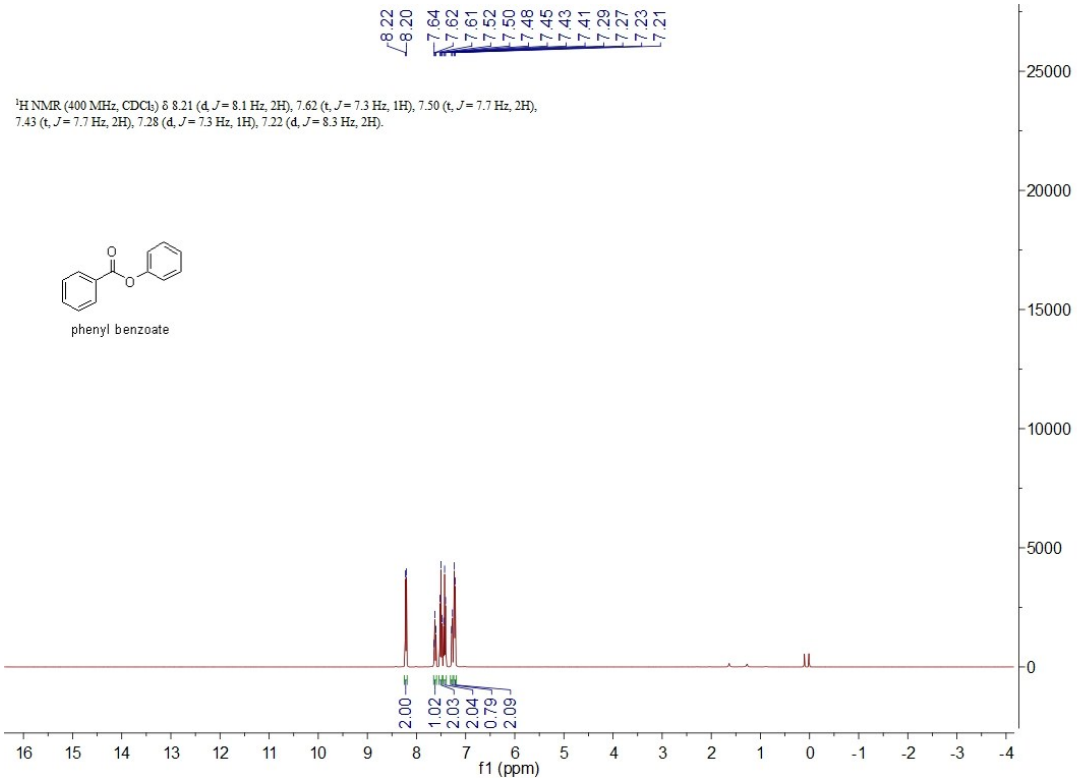
Phenyl(*p*-tolyl)sulfane



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.0 Hz, 2H), 7.26 (d, *J* = 4.4 Hz, 4H), 7.14 (s, 1H), 7.12 (d, *J* = 6.5 Hz, 2H), 2.34 (s, 3H).

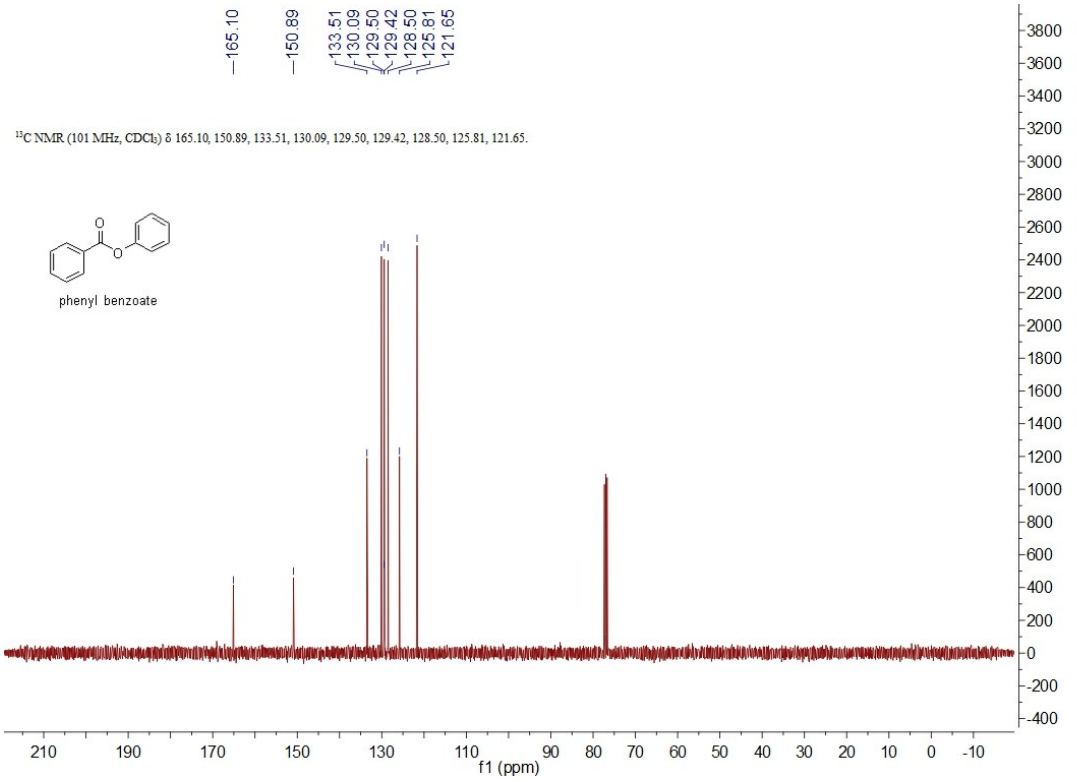
^{13}C NMR (101 MHz, $CDCl_3$) δ 137.58, 137.10, 132.25, 131.25, 130.04, 129.75, 129.02, 126.38, 21.11.

GC-MS (EI, 70 eV): m/z(%)=200.0 ([M]+, 12), 201.0 (18), 200.0 (100), 199.0 (36), 185.0 (46), 184.0 (45), 91.0 (26).



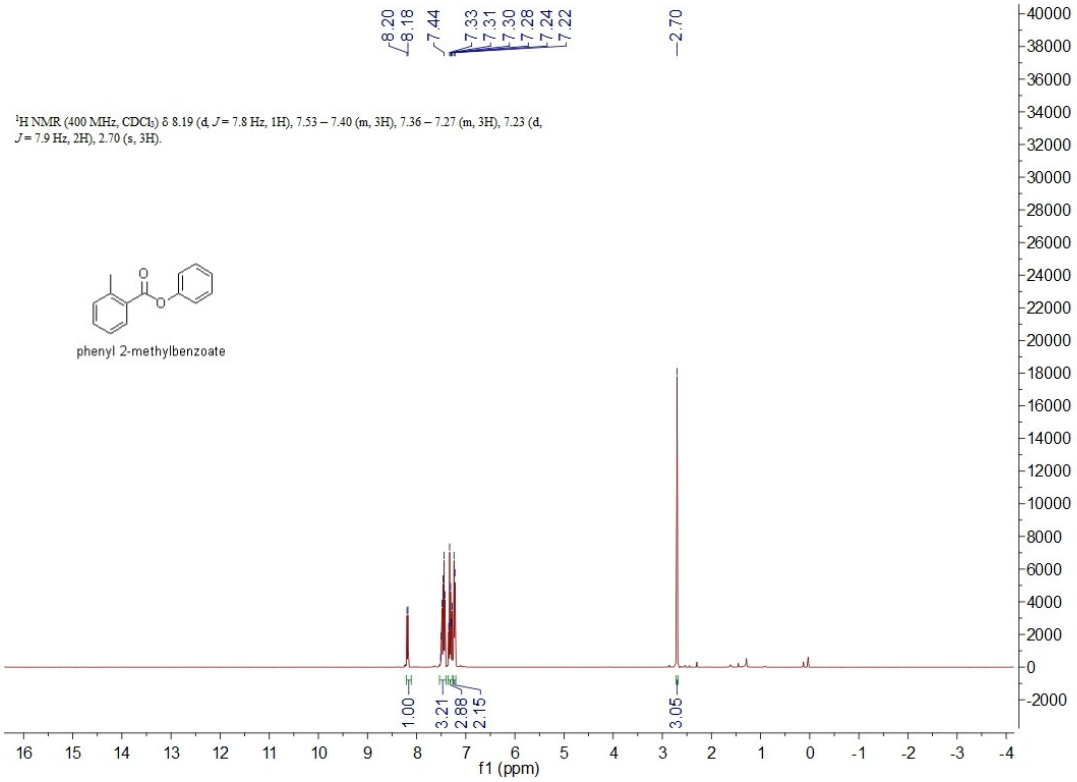
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, J = 8.1 Hz, 2H), 7.62 (t, J = 7.3 Hz, 1H), 7.50 (t, J = 7.7 Hz, 2H), 7.43 (t, J = 7.7 Hz, 2H), 7.28 (d, J = 7.3 Hz, 1H), 7.22 (d, J = 8.3 Hz, 2H).

phenyl benzoate



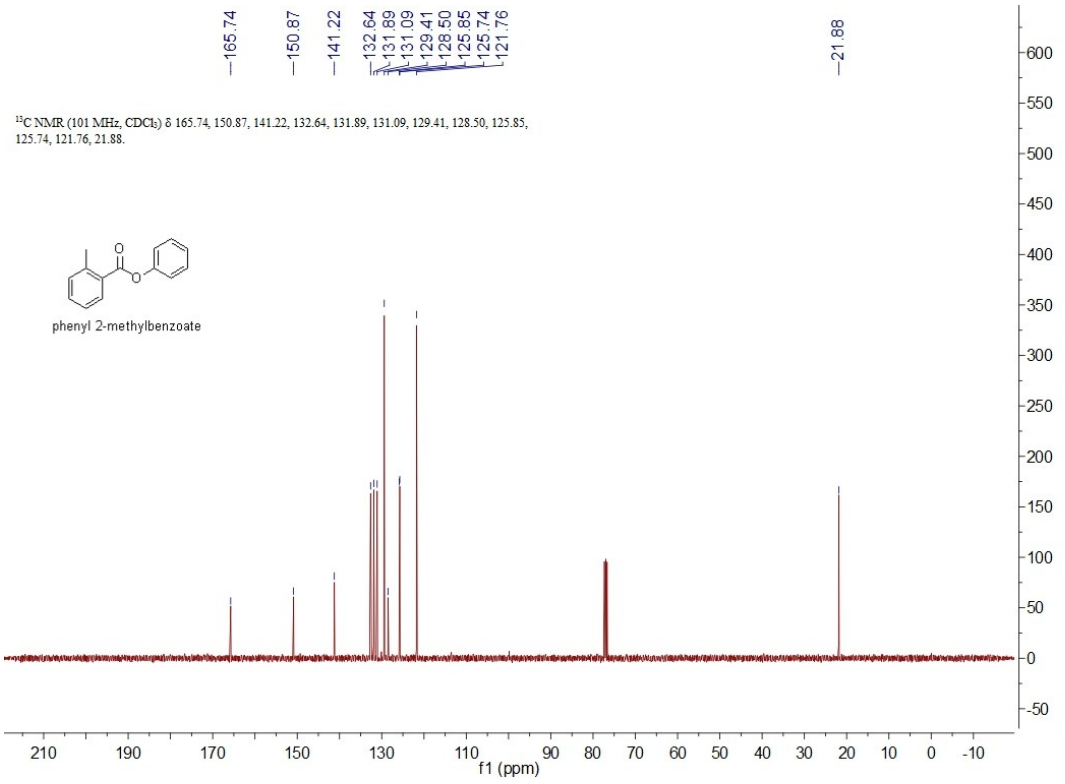
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.10, 150.89, 133.51, 130.09, 129.50, 129.42, 128.50, 125.81, 121.65.

phenyl benzoate



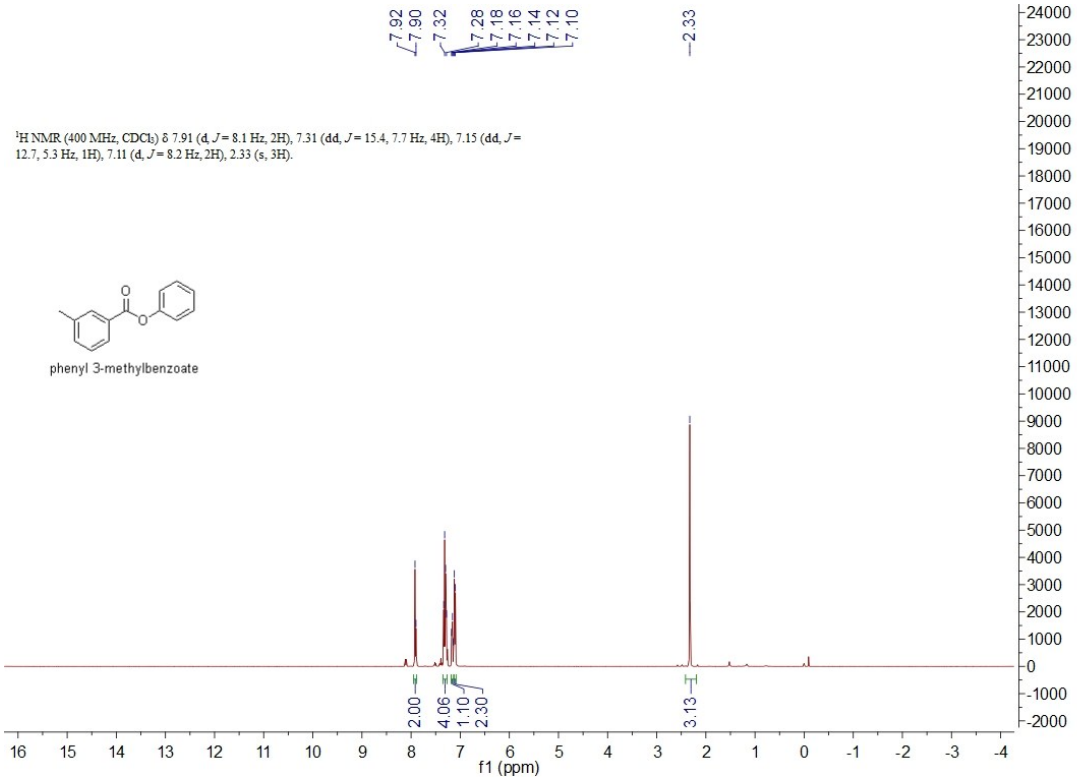
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, J = 7.8 Hz, 1H), 7.53 – 7.40 (m, 3H), 7.36 – 7.27 (m, 3H), 7.23 (d, J = 7.9 Hz, 2H), 2.70 (s, 3H).

phenyl 2-methylbenzoate



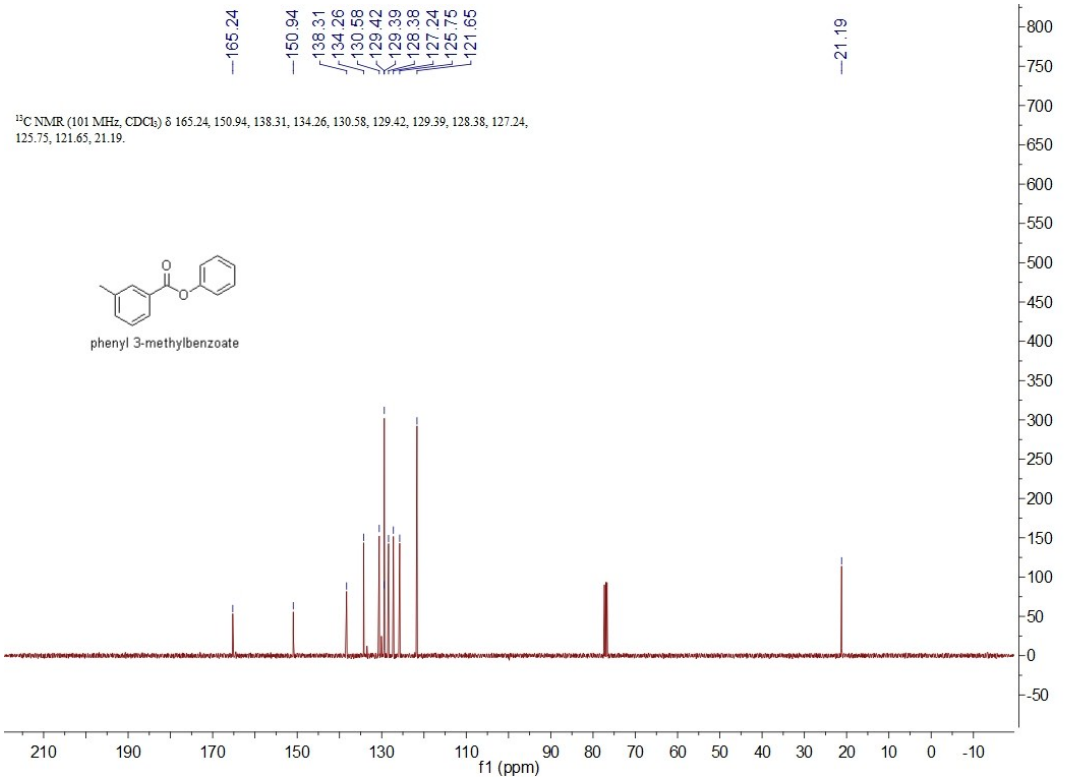
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.74, 150.87, 141.22, 132.64, 131.89, 131.09, 129.41, 128.50, 125.85, 125.74, 121.76, 21.88.

phenyl 2-methylbenzoate



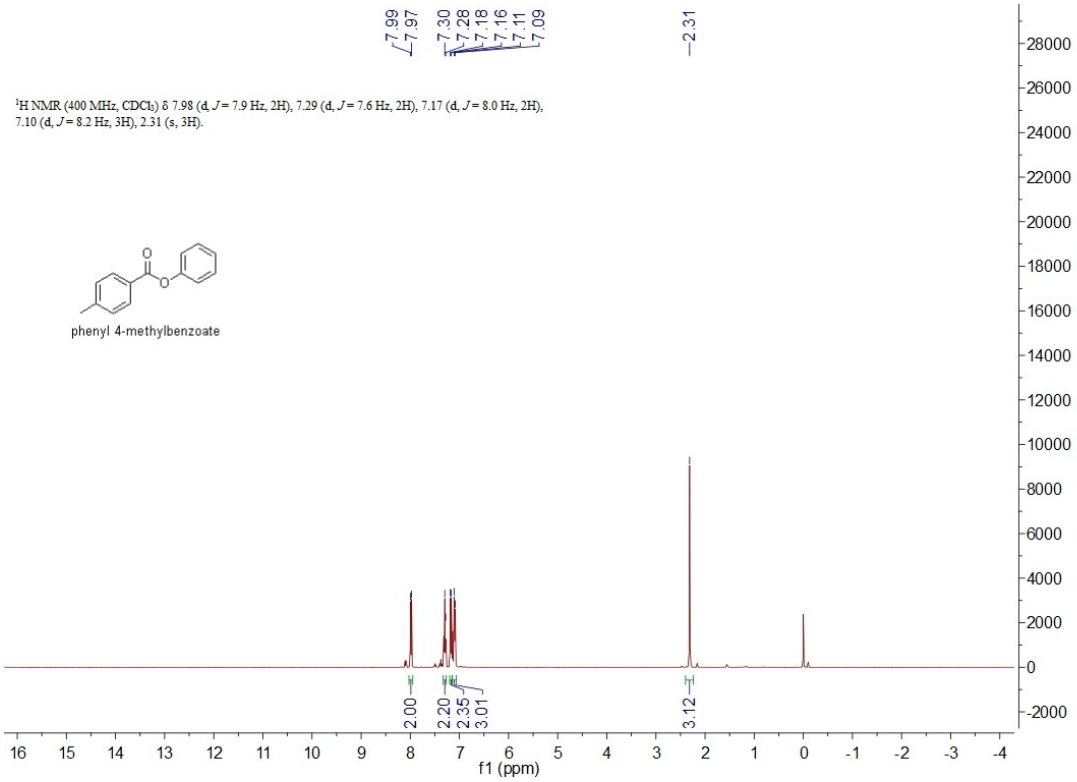
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, J = 8.1 Hz, 2H), 7.31 (dd, J = 15.4, 7.7 Hz, 4H), 7.15 (dd, J = 12.7, 5.3 Hz, 1H), 7.11 (d, J = 8.2 Hz, 2H), 2.33 (s, 3H).

phenyl 3-methylbenzoate



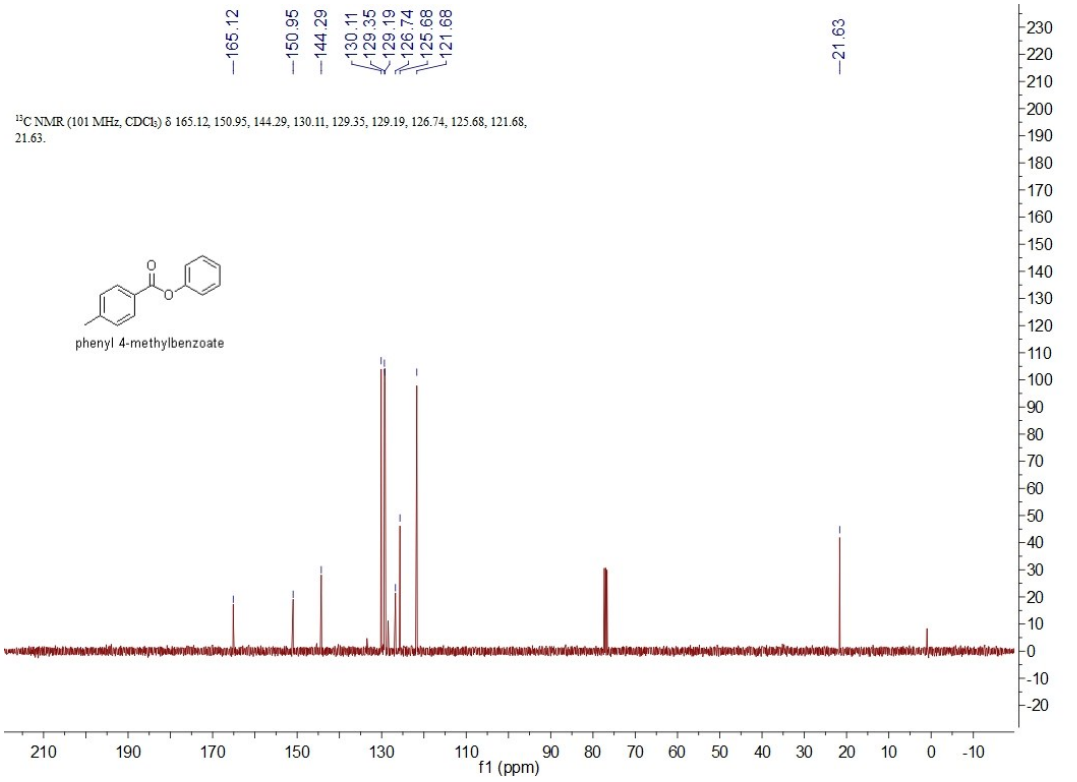
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.24, 150.94, 138.31, 134.26, 130.58, 129.42, 129.39, 128.38, 127.24, 125.75, 121.65, 21.19.

phenyl 3-methylbenzoate



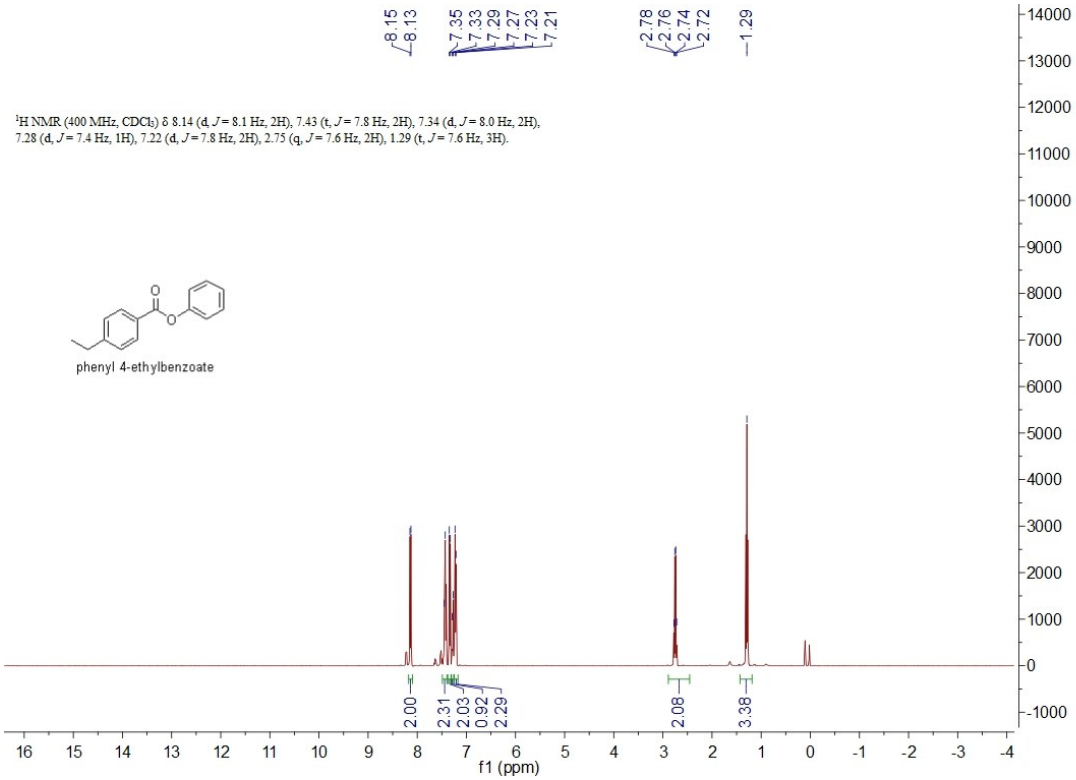
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, J = 7.9 Hz, 2H), 7.29 (d, J = 7.6 Hz, 2H), 7.17 (d, J = 8.0 Hz, 2H), 7.10 (d, J = 8.2 Hz, 3H), 2.31 (s, 3H).

phenyl 4-methylbenzoate



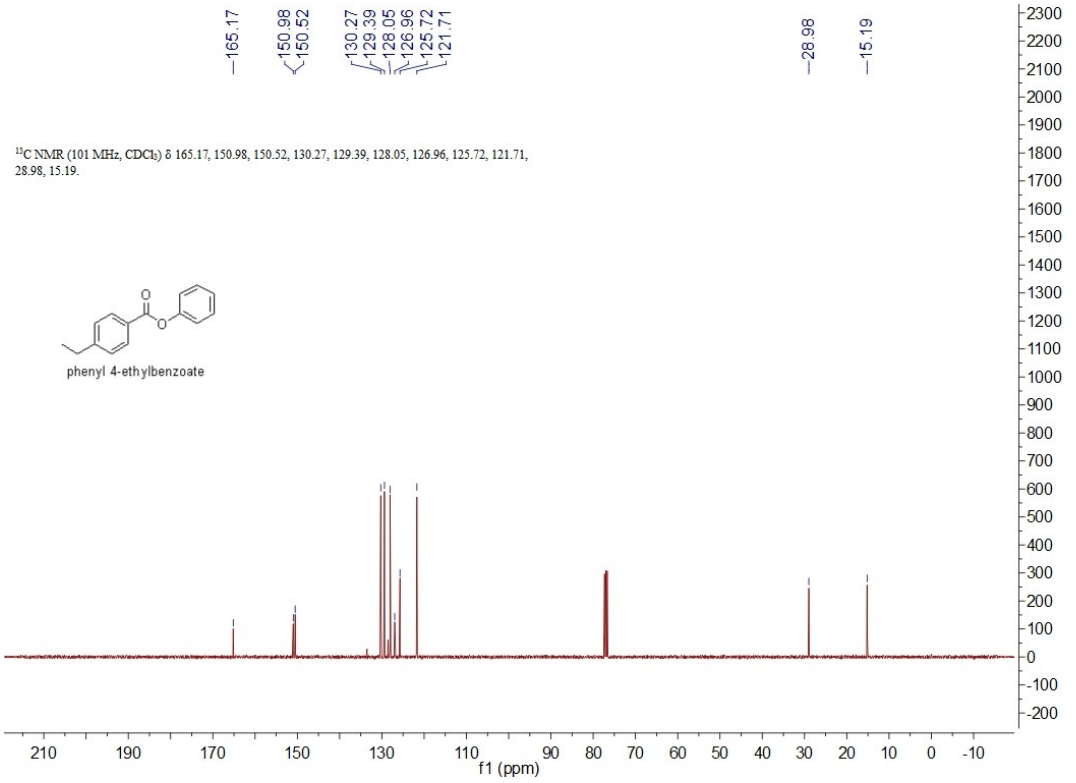
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.12, 150.95, 144.29, 130.11, 129.35, 129.19, 126.74, 125.68, 121.68, 21.63.

phenyl 4-methylbenzoate



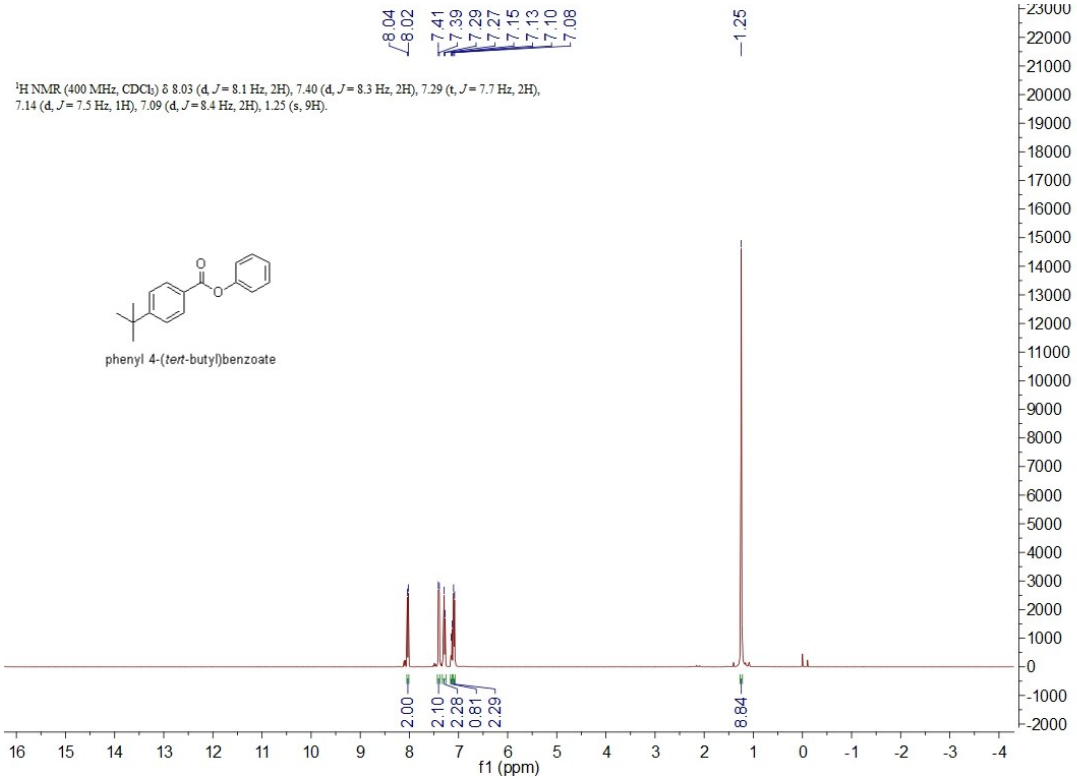
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, J = 8.1 Hz, 2H), 7.43 (t, J = 7.8 Hz, 2H), 7.34 (d, J = 8.0 Hz, 2H), 7.28 (d, J = 7.4 Hz, 1H), 7.22 (d, J = 7.8 Hz, 2H), 2.75 (q, J = 7.6 Hz, 2H), 1.29 (t, J = 7.6 Hz, 3H).

phenyl 4-ethylbenzoate



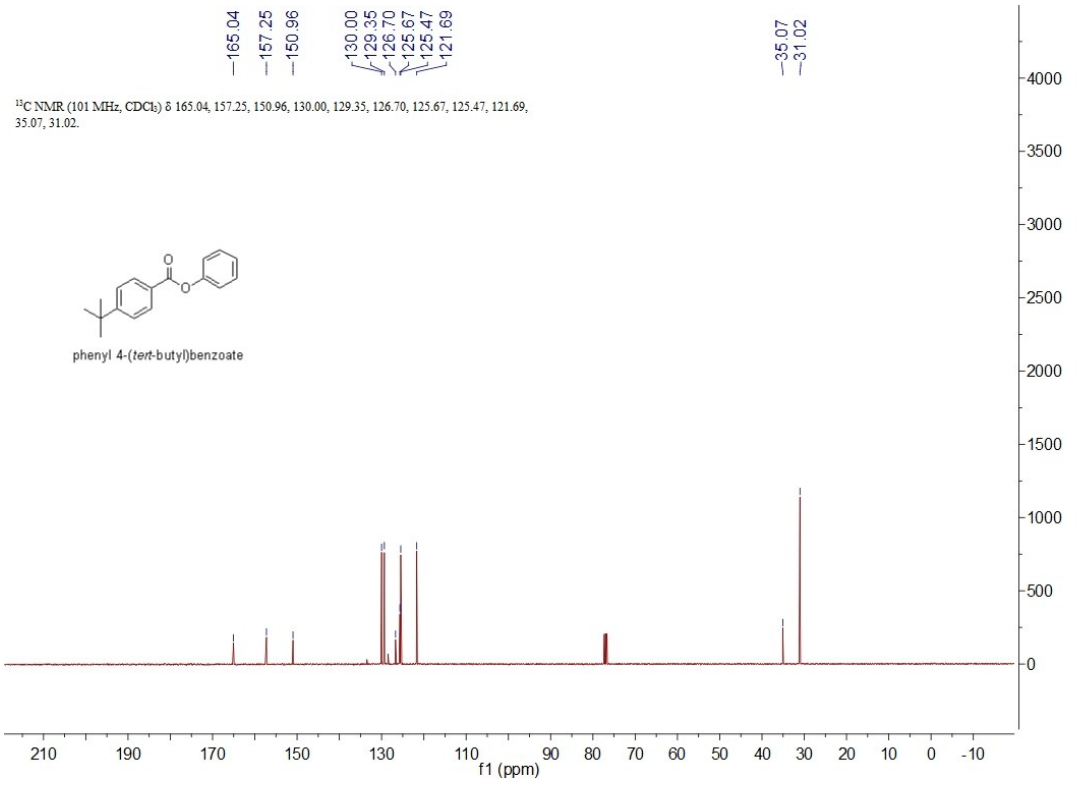
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.17, 150.98, 150.52, 130.27, 129.39, 128.05, 126.96, 125.72, 121.71, 28.98, 15.19.

phenyl 4-ethylbenzoate



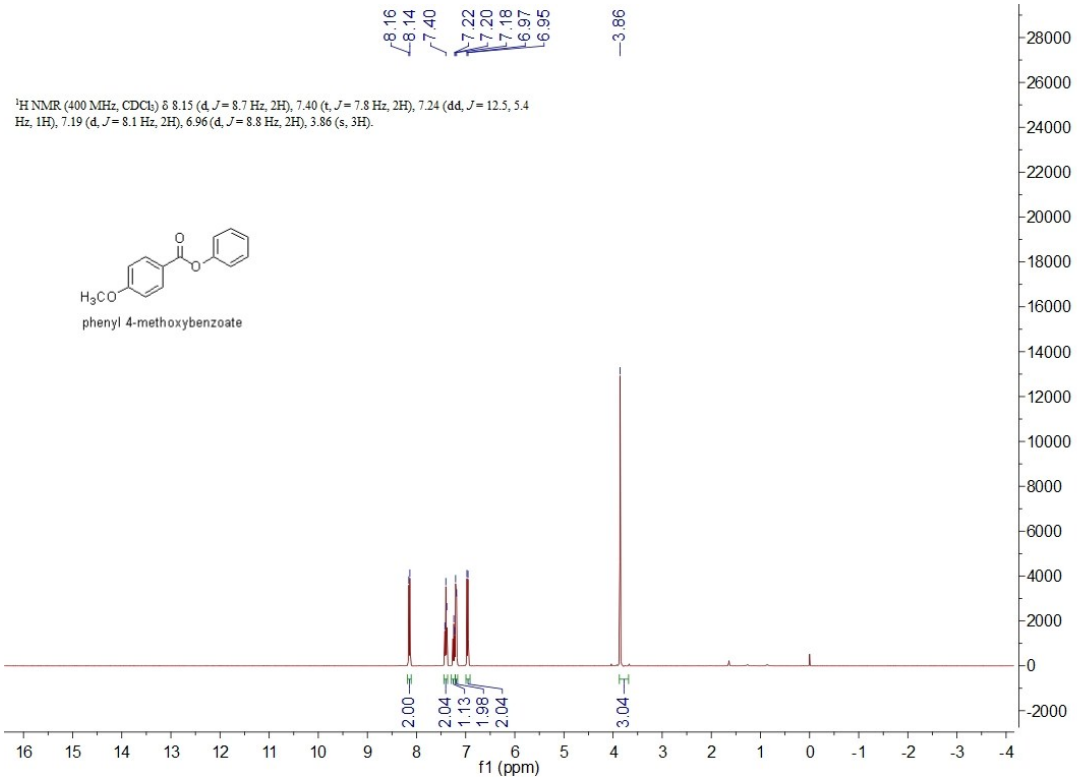
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, J = 8.1 Hz, 2H), 7.40 (d, J = 8.3 Hz, 2H), 7.29 (t, J = 7.7 Hz, 2H), 7.14 (d, J = 7.5 Hz, 1H), 7.09 (d, J = 8.4 Hz, 2H), 1.25 (s, 9H).

phenyl 4-(*tert*-butyl)benzoate



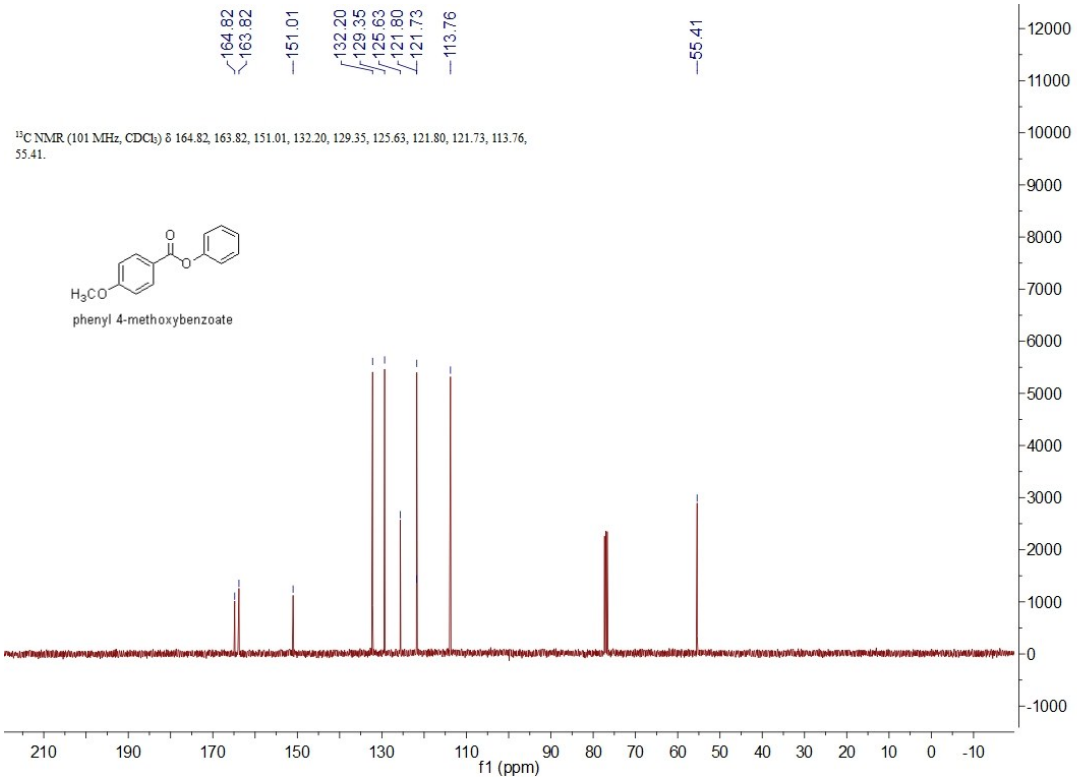
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.04, 157.25, 150.96, 130.00, 129.35, 126.70, 125.67, 125.47, 121.69, 35.07, 31.02.

phenyl 4-(*tert*-butyl)benzoate



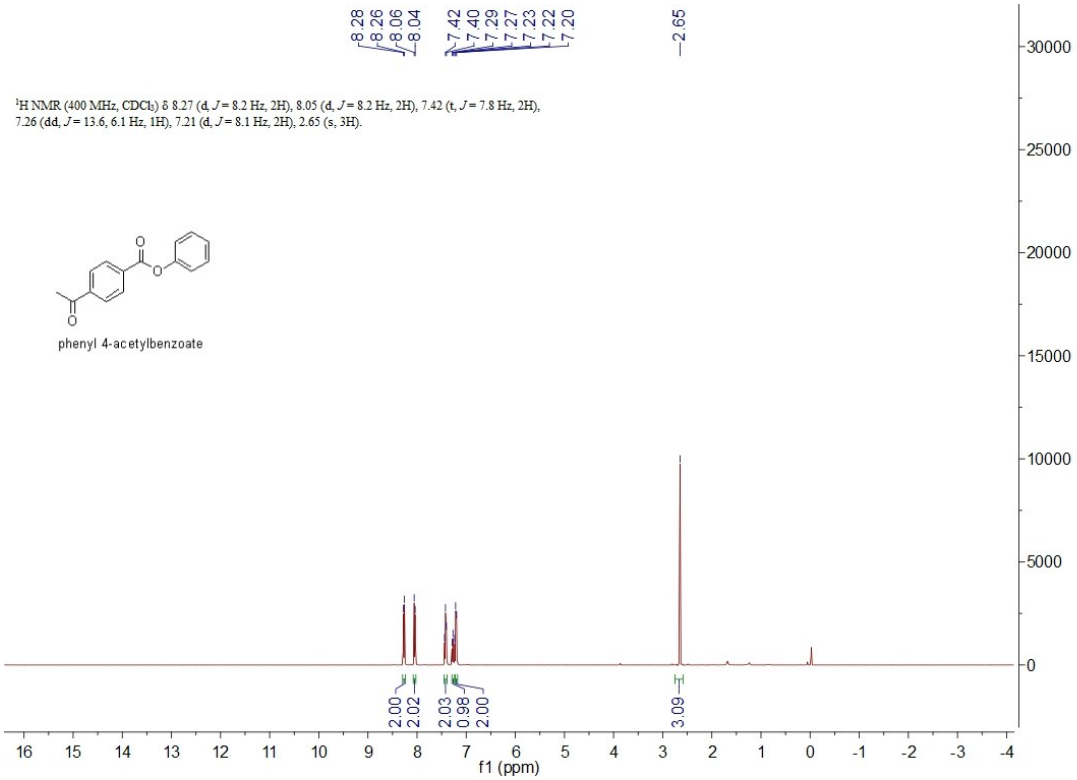
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, J = 8.7 Hz, 2H), 7.40 (t, J = 7.8 Hz, 2H), 7.24 (dd, J = 12.5, 5.4 Hz, 1H), 7.19 (d, J = 8.1 Hz, 2H), 6.96 (d, J = 8.8 Hz, 2H), 3.86 (s, 3H).

phenyl 4-methoxybenzoate



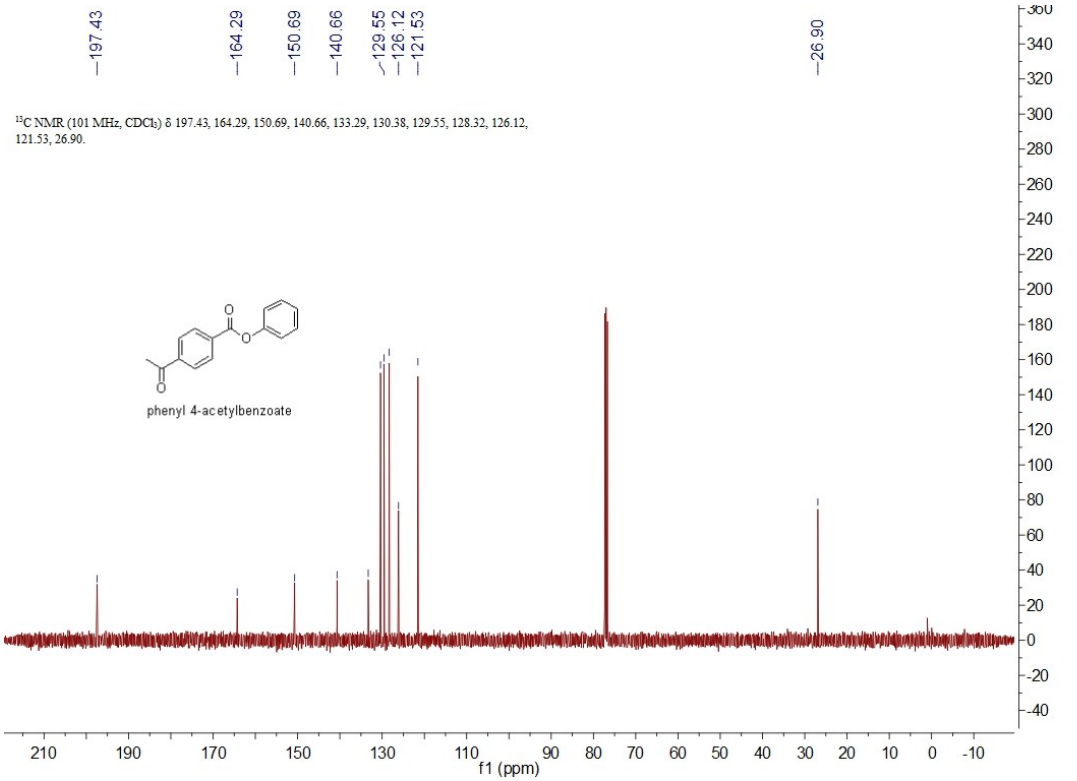
^{13}C NMR (101 MHz, $CDCl_3$) δ 164.82, 163.82, 151.01, 132.20, 129.35, 125.63, 121.80, 121.73, 113.76, 55.41.

phenyl 4-methoxybenzoate



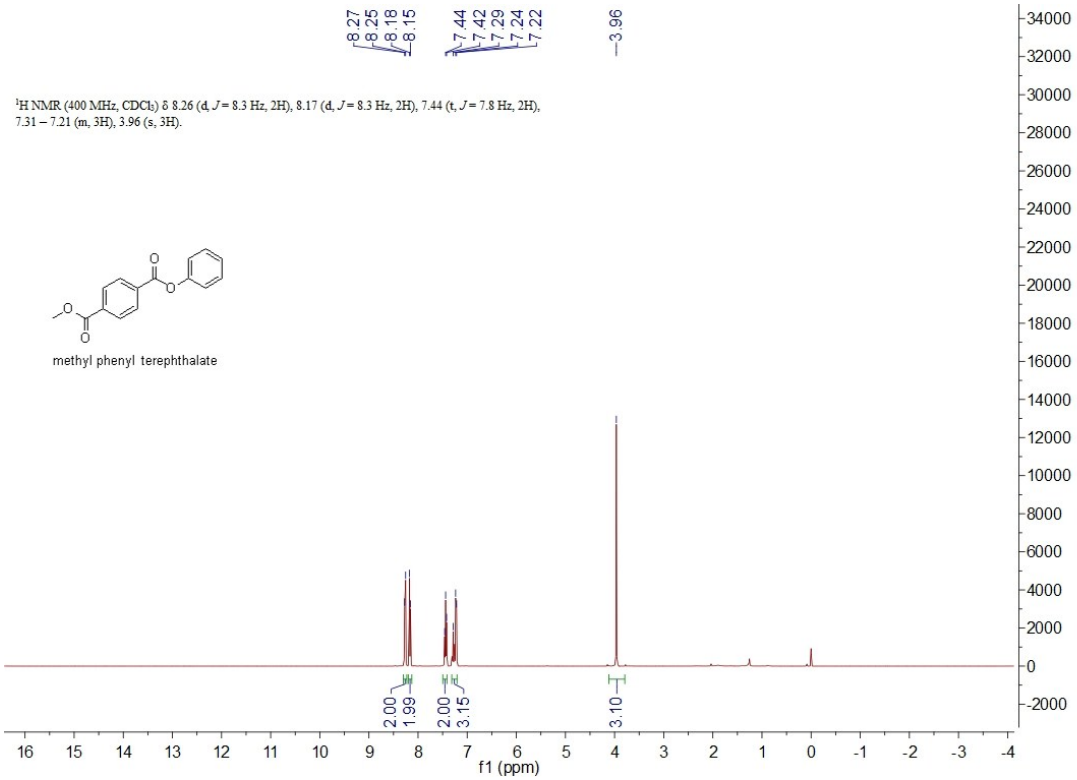
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 8.2 Hz, 2H), 8.05 (d, J = 8.2 Hz, 2H), 7.42 (t, J = 7.8 Hz, 2H), 7.26 (dd, J = 13.6, 6.1 Hz, 1H), 7.21 (d, J = 8.1 Hz, 2H), 2.65 (s, 3H).

phenyl 4-acetylbenzoate



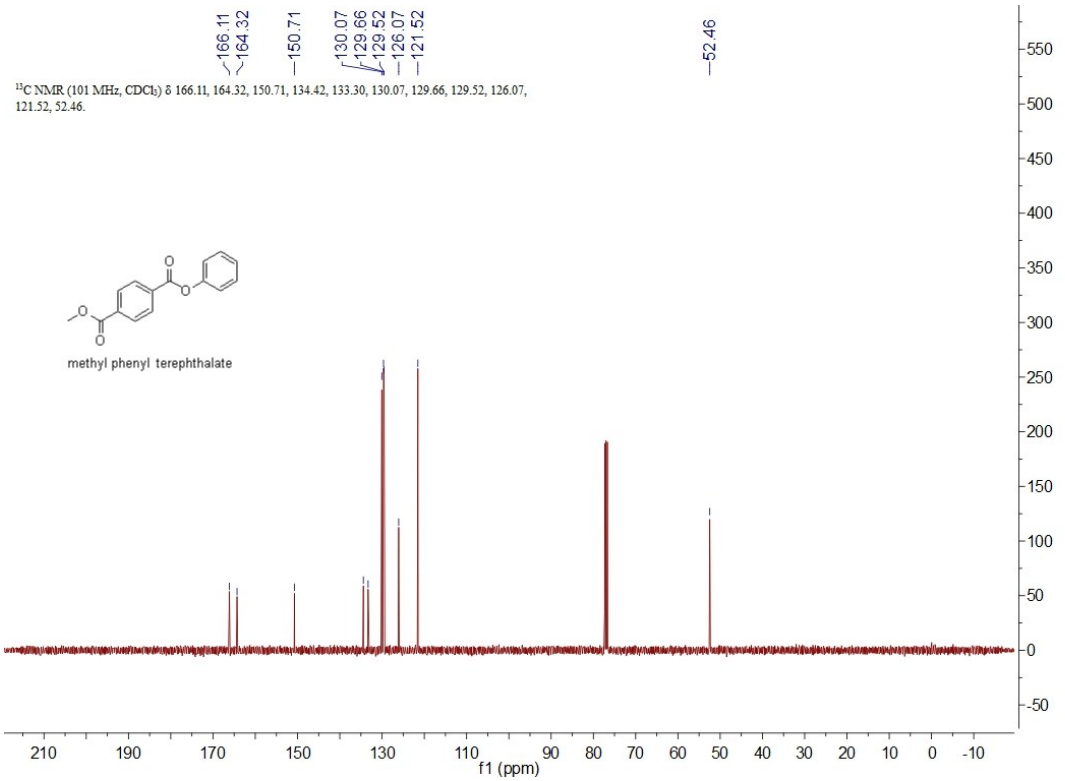
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.43, 164.29, 150.69, 140.66, 133.29, 130.38, 129.55, 128.32, 126.12, 121.53, 26.90.

phenyl 4-acetylbenzoate



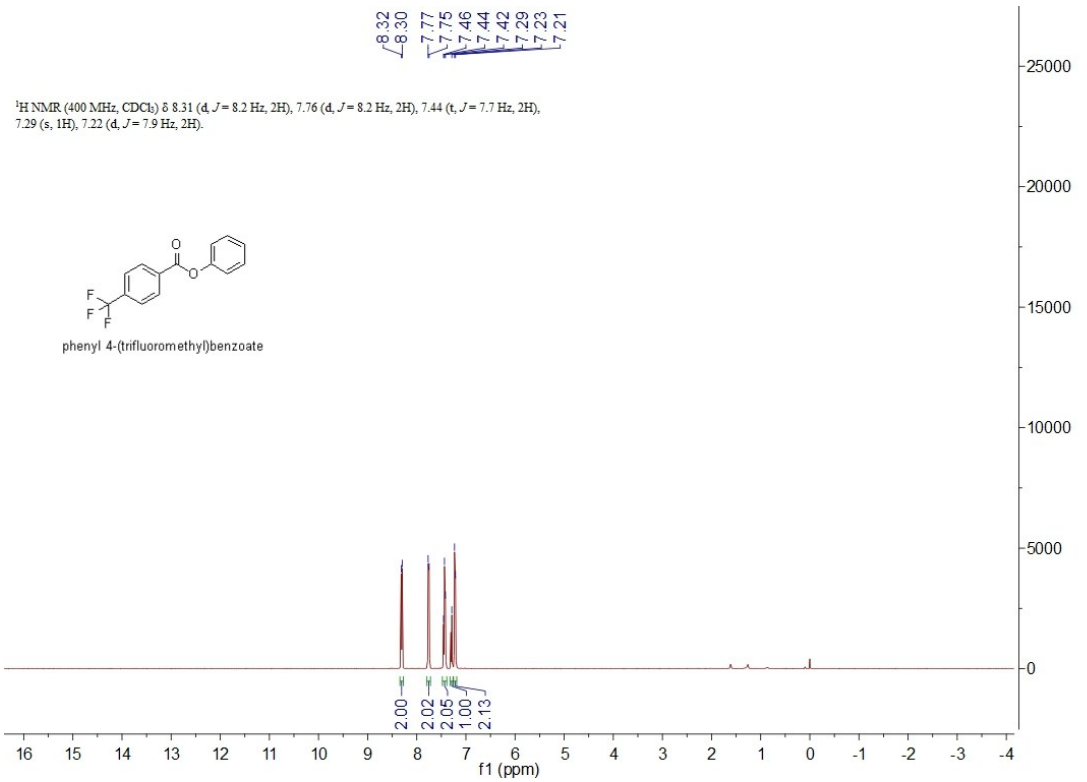
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (d, J = 8.3 Hz, 2H), 8.17 (d, J = 8.3 Hz, 2H), 7.44 (t, J = 7.8 Hz, 2H), 7.31 – 7.21 (m, 3H), 3.96 (s, 3H).

methyl phenyl terephthalate



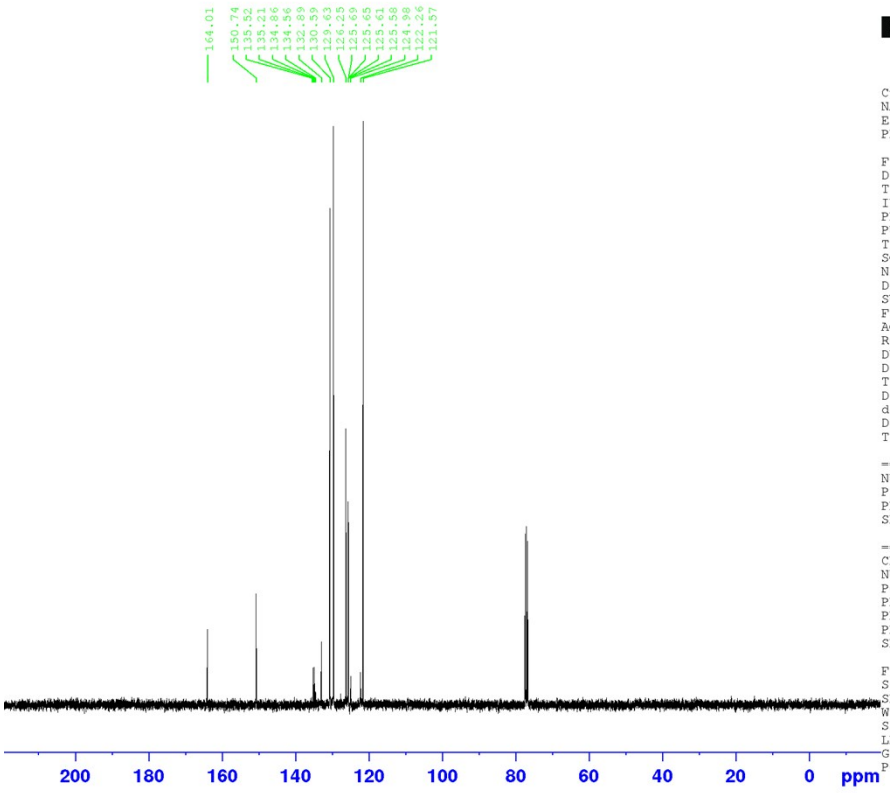
^{13}C NMR (101 MHz, $CDCl_3$) δ 166.11, 164.32, 150.71, 134.42, 133.30, 130.07, 129.66, 129.52, 126.07, 121.52, 52.46.

methyl phenyl terephthalate



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 (d, J = 8.2 Hz, 2H), 7.76 (d, J = 8.2 Hz, 2H), 7.44 (t, J = 7.7 Hz, 2H), 7.29 (s, 1H), 7.22 (d, J = 7.9 Hz, 2H).

phenyl 4-(trifluoromethyl)benzoate

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PROCNO                  1

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PL1               -3.00 dB
SFO1         100.6228298 MHz

======== CHANNEL f2 ========
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PL12              18.50 dB
PL13              18.50 dB
SFO2         400.1316005 MHz

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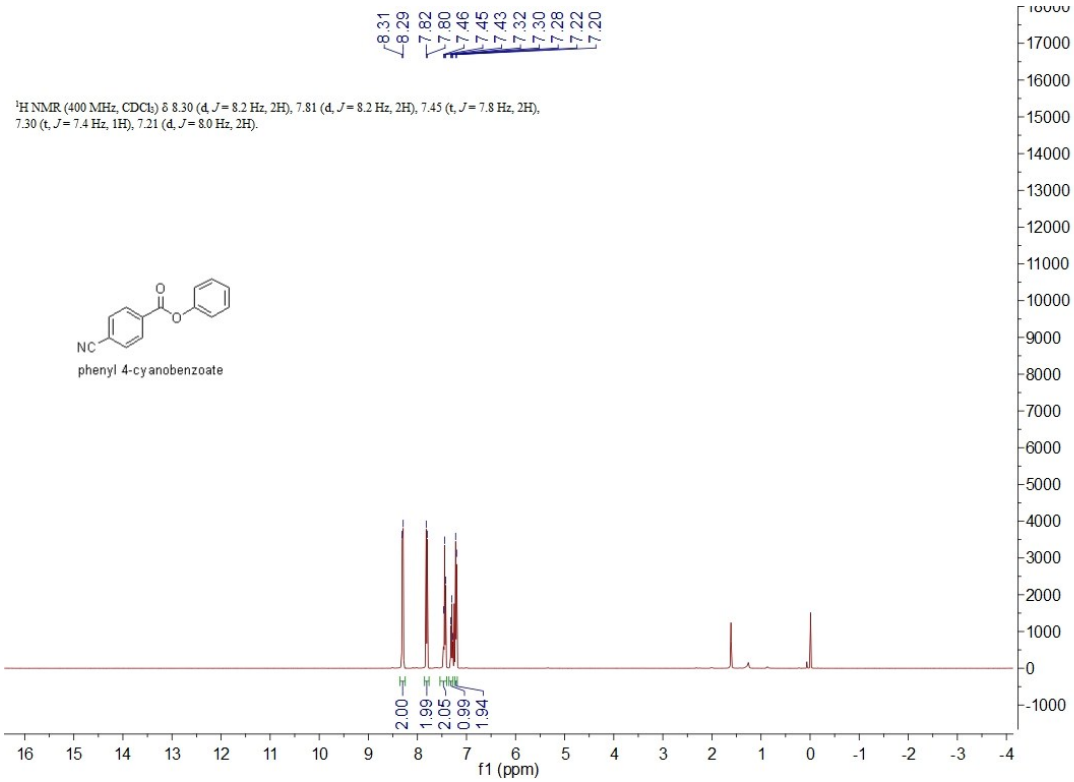
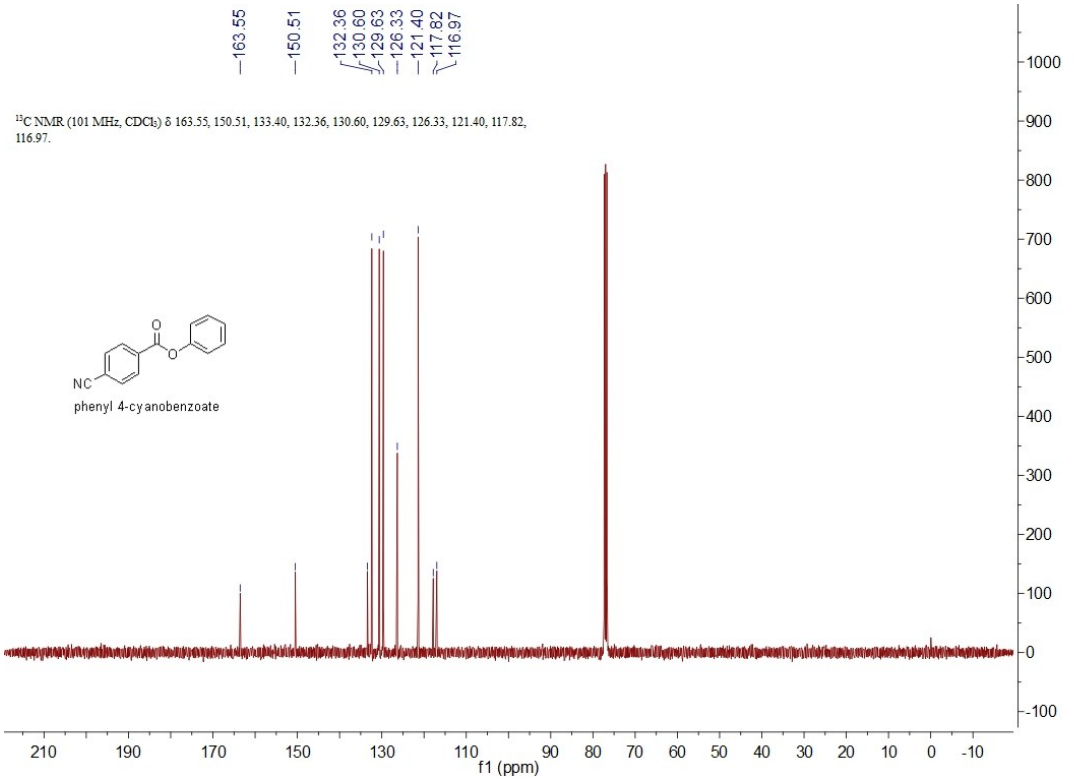

8.31
8.29
7.82
7.80
7.46
7.45
7.43
7.32
7.30
7.28
7.22
7.20
¹H NMR (400 MHz, CDCl₃) δ 8.30 (d, J = 8.2 Hz, 2H), 7.81 (d, J = 8.2 Hz, 2H), 7.45 (t, J = 7.8 Hz, 2H), 7.30 (t, J = 7.4 Hz, 1H), 7.21 (d, J = 8.0 Hz, 2H).
NC
O
O
phenyl 4-cyanobenzoate
2.00
1.99
2.05
0.99
1.94
f1 (ppm)


163.55
150.51
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117.82
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NC
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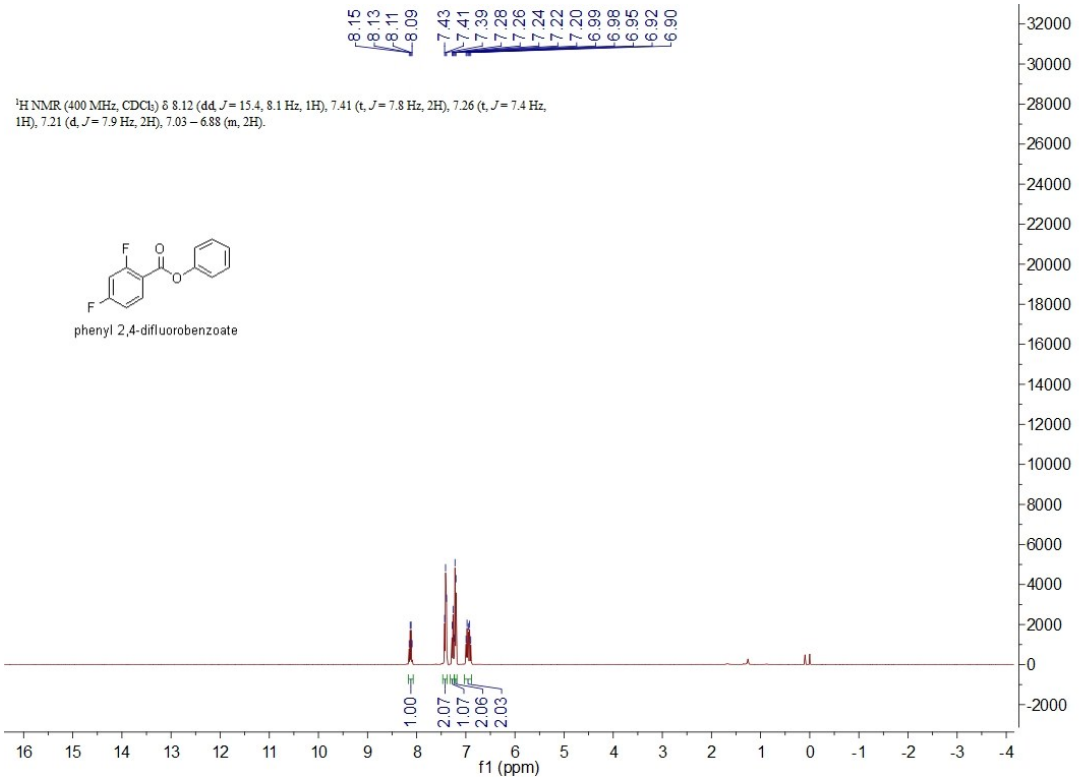
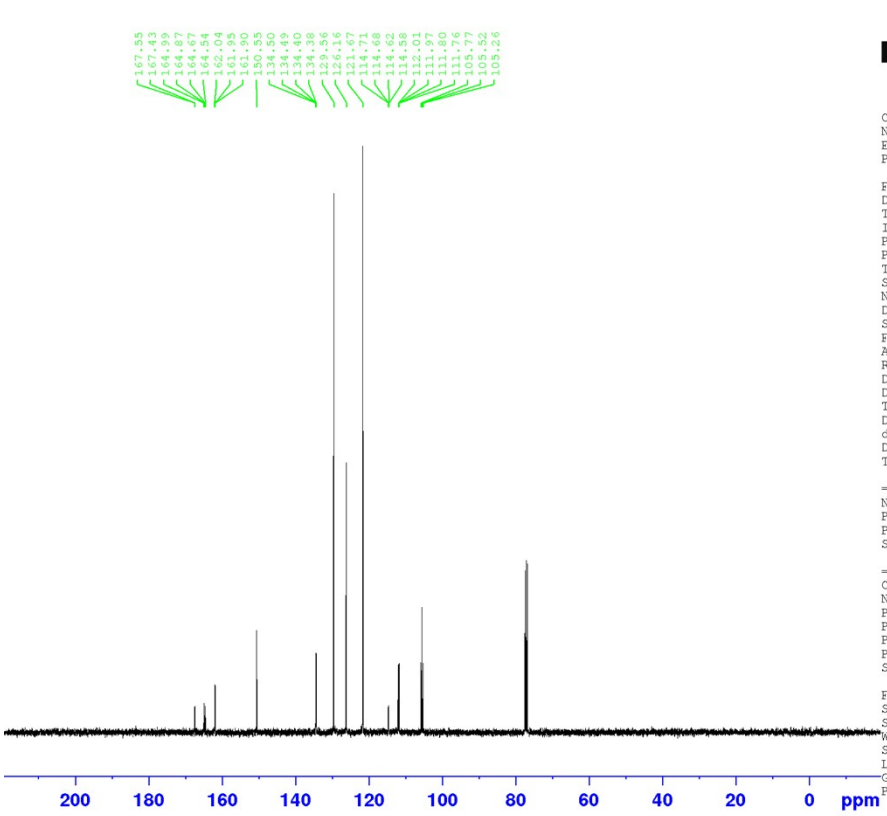
O
phenyl 4-cyanobenzoate
f1 (ppm)





BRUKER

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EXPNO                    2
PROCNO                   1

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Date_              20150910
Time                   2.37
INSTRUM               spect
PROBHD    5 mm PABBI 1H/
PULPROG              zgpg30
TD                    65536
SOLVENT               CDCl3
NS                      115
DS                        4
SWH               24038.461 Hz
FIDRES             0.366798 Hz
AQ                 1.3631488 sec
RG                      101
DW                   20.800 usec
DE                    6.00 usec
TE                   295.8 K
D1                2.00000000 sec
d11               0.03000000 sec
DELTA             1.89999998 sec
TD0                       1

======== CHANNEL f1 ========
NUC1                    13C
P1                   14.90 usec
PL1                  -3.00 dB
SFO1            100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2          waltz16
NUC2                    1H
PCPD2                80.00 usec
PL2                  -2.00 dB
PL12                 18.50 dB
PL13                 18.50 dB
SFO2            400.1316005 MHz

F2 - Processing parameters
SI                      32768
SF              100.6127690 MHz
WDW                        EM
SSB       0
LB                    1.00 Hz
GB        0
PC                    1.40
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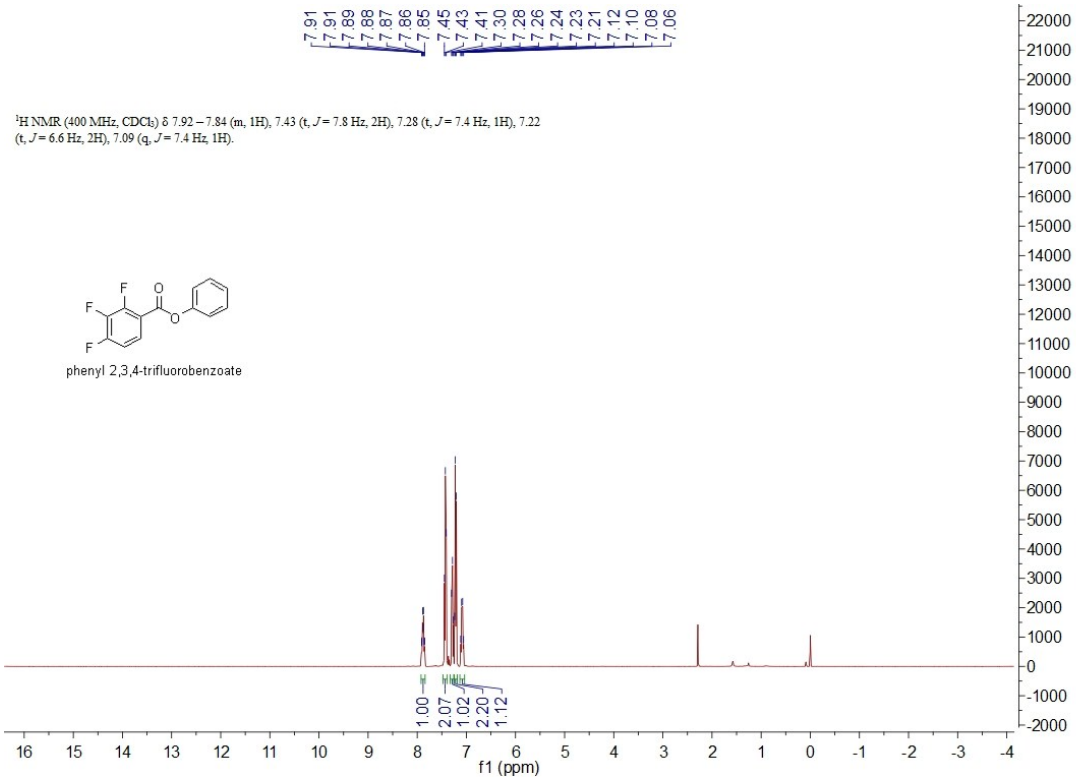
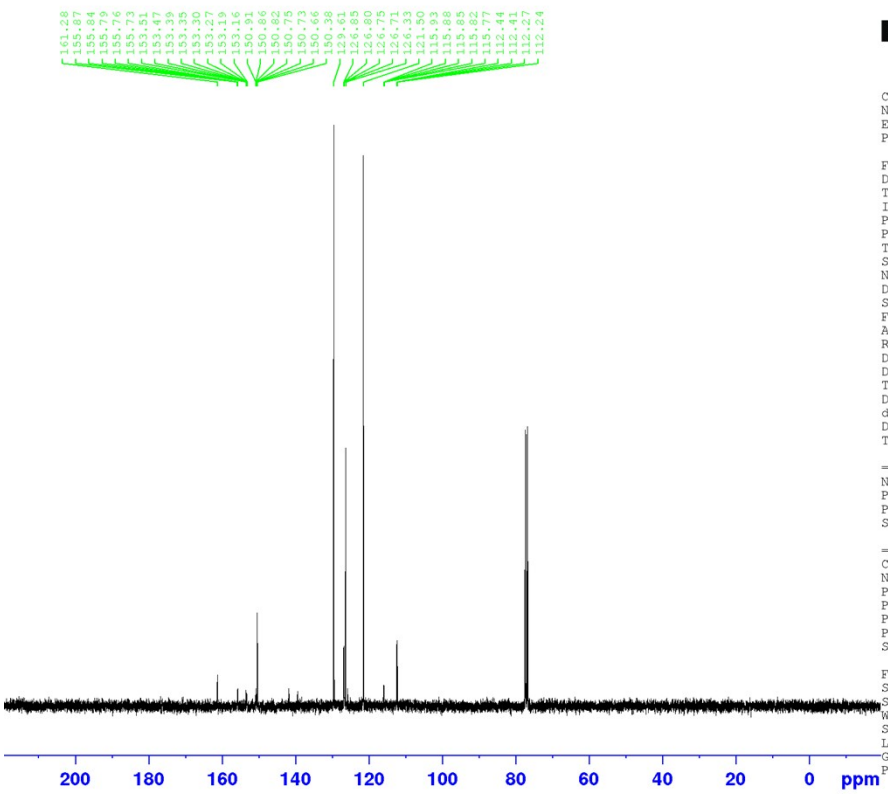


^{1}H NMR (400 MHz, CDCl$_3$) δ 7.92 – 7.84 (m, 1H), 7.43 (t, J = 7.8 Hz, 2H), 7.28 (t, J = 7.4 Hz, 1H), 7.22 (t, J = 6.6 Hz, 2H), 7.09 (q, J = 7.4 Hz, 1H).

phenyl 2,3,4-trifluorobenzoate



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Current Data Parameters
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EXPNO                      2
PROCNO                     1

F2 - Acquisition Parameters
Date_              20150921
Time                 10.41
INSTRUM              spect
PROBHD    5 mm PABBI 1H/
PULPROG           zgpg30
TD                 65536
SOLVENT            CDCl3
NS                    78
DS                     4
SWH             24038.461 Hz
FIDRES           0.366798 Hz
AQ               1.3631488 sec
RG                  90.5
DW                20.800 usec
DE                 6.00 usec
TE                297.5 K
D1             2.00000000 sec
d11            0.03000000 sec
DELTA          1.89999998 sec
TD0                    1

======== CHANNEL f1 ========
NUC1                  13C
P1                 14.90 usec
PL1                -3.00 dB
SFO1          100.6228298 MHz

======== CHANNEL f2 ========
CPDPRG[2          waltz16
NUC2                  1H
PCPD2              80.00 usec
PL2                -1.50 dB
PL12               17.91 dB
PL13               17.91 dB
SFO2          400.1316005 MHz

F2 - Processing parameters
SI                 32768
SF            100.6127690 MHz
WDW                   EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
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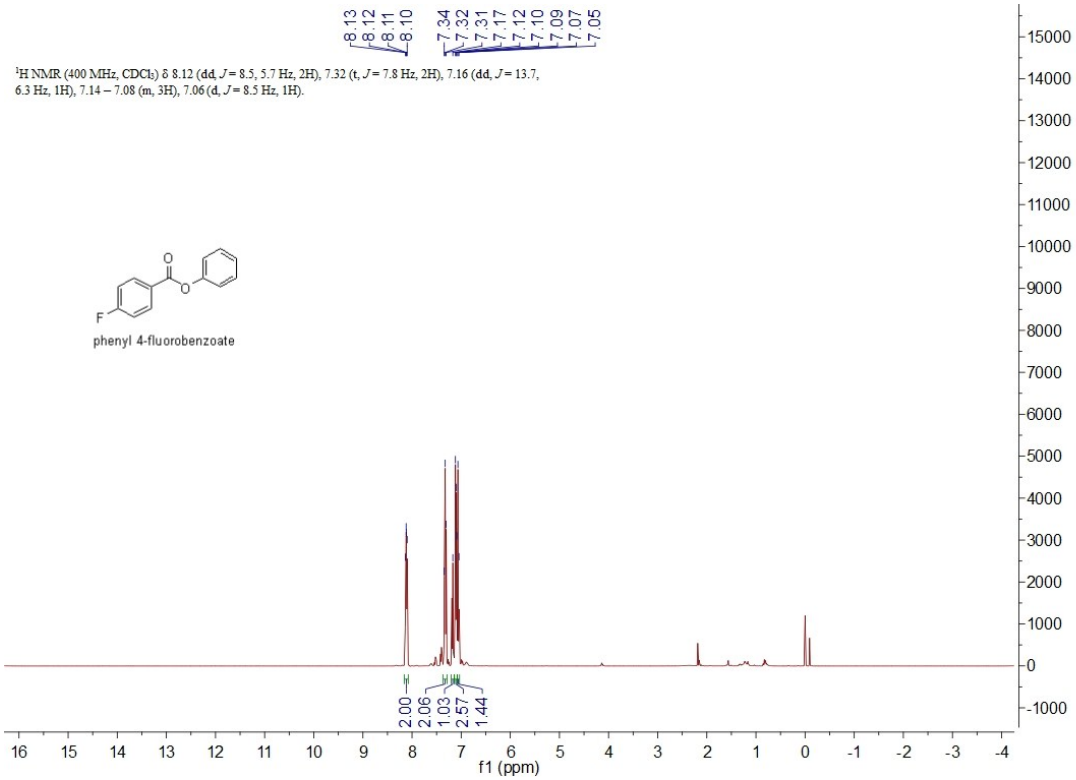
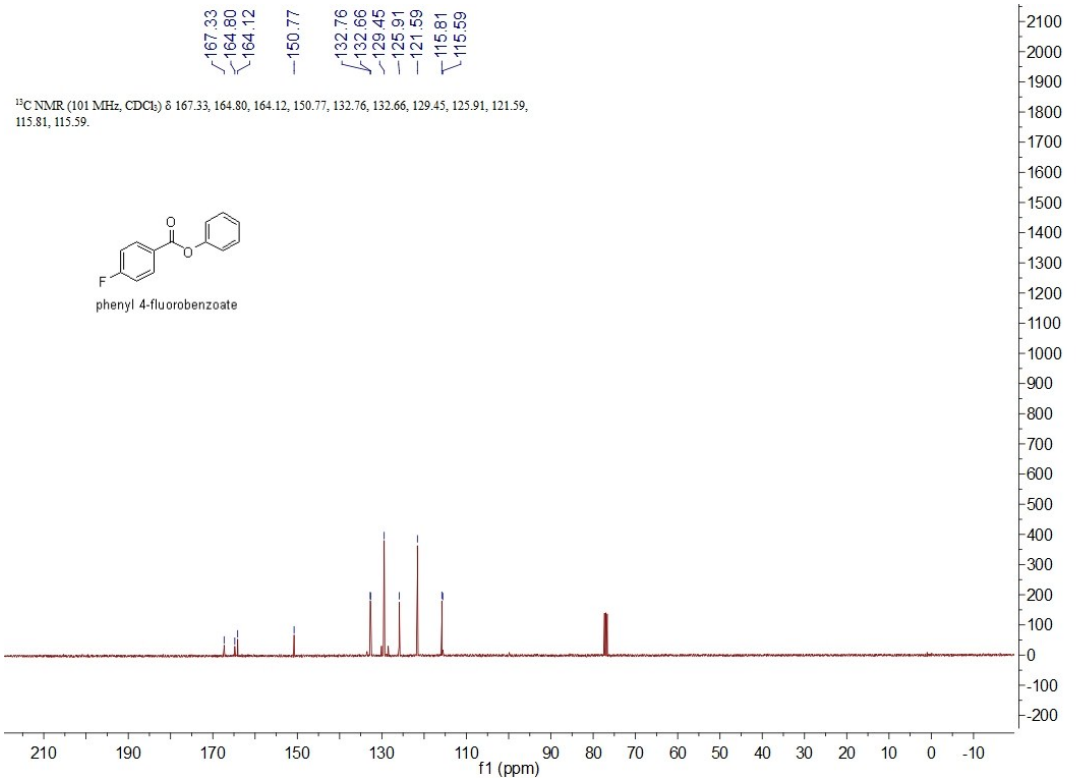


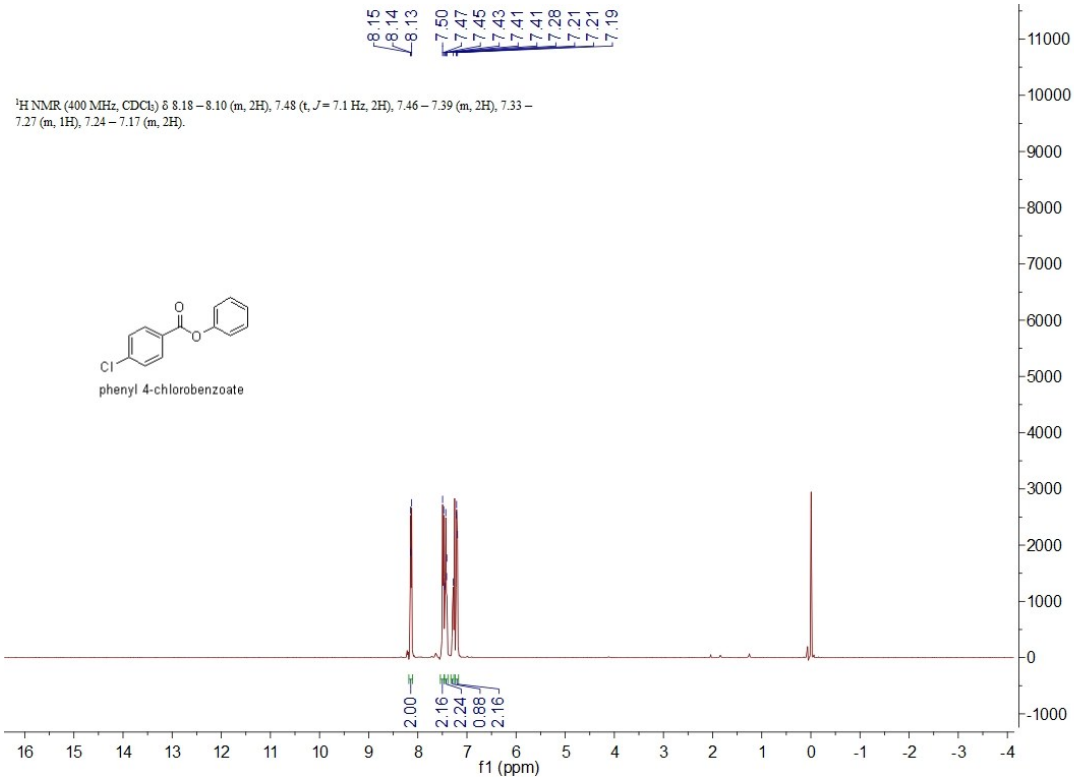
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (dd, J = 8.5, 5.7 Hz, 2H), 7.32 (t, J = 7.8 Hz, 2H), 7.16 (dd, J = 13.7, 6.3 Hz, 1H), 7.14 – 7.08 (m, 3H), 7.06 (d, J = 8.5 Hz, 1H).

phenyl 4-fluorobenzoate



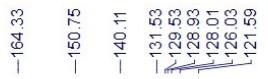
^{13}C NMR (101 MHz, $CDCl_3$) δ 167.33, 164.80, 164.12, 150.77, 132.76, 132.66, 129.45, 125.91, 121.59, 115.81, 115.59.

phenyl 4-fluorobenzoate

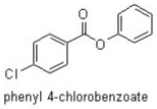


^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 – 8.10 (m, 2H), 7.48 (t, J = 7.1 Hz, 2H), 7.46 – 7.39 (m, 2H), 7.33 – 7.27 (m, 1H), 7.24 – 7.17 (m, 2H).

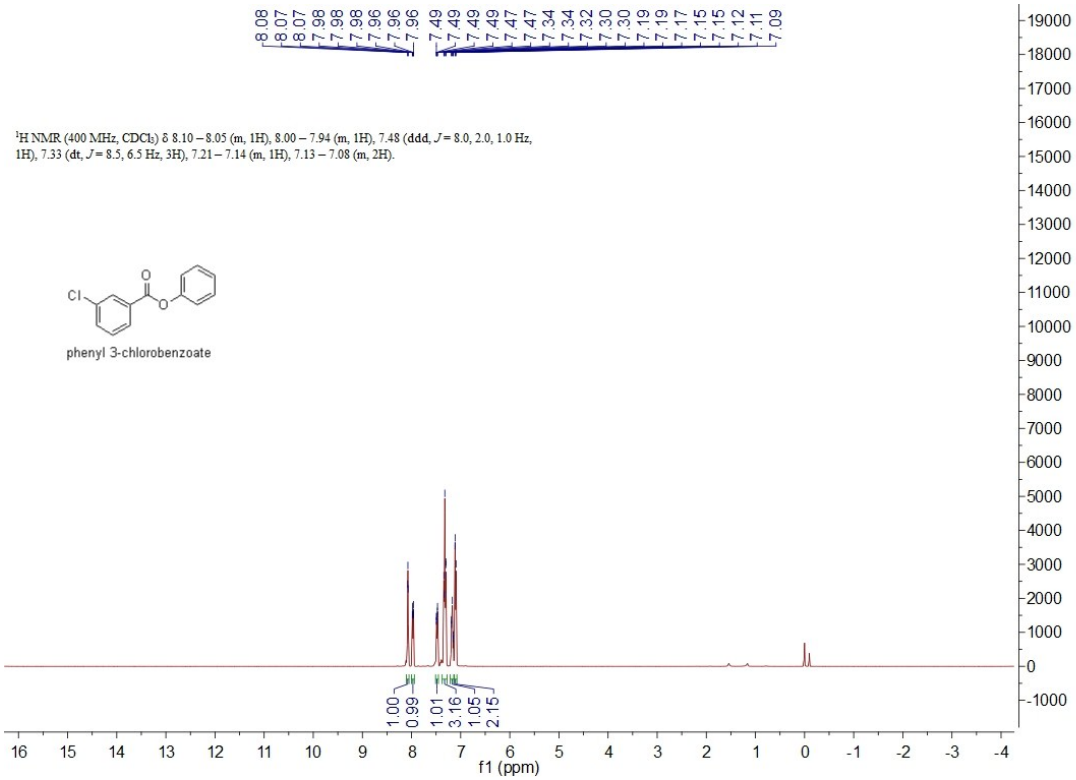
phenyl 4-chlorobenzoate

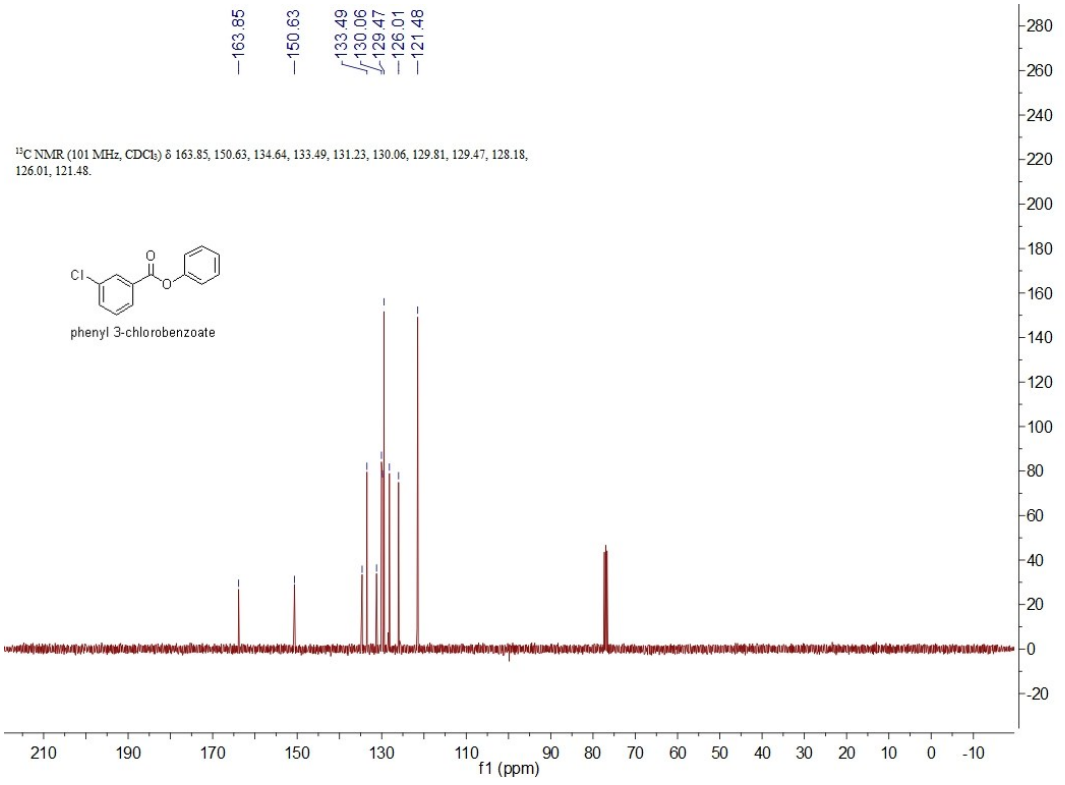


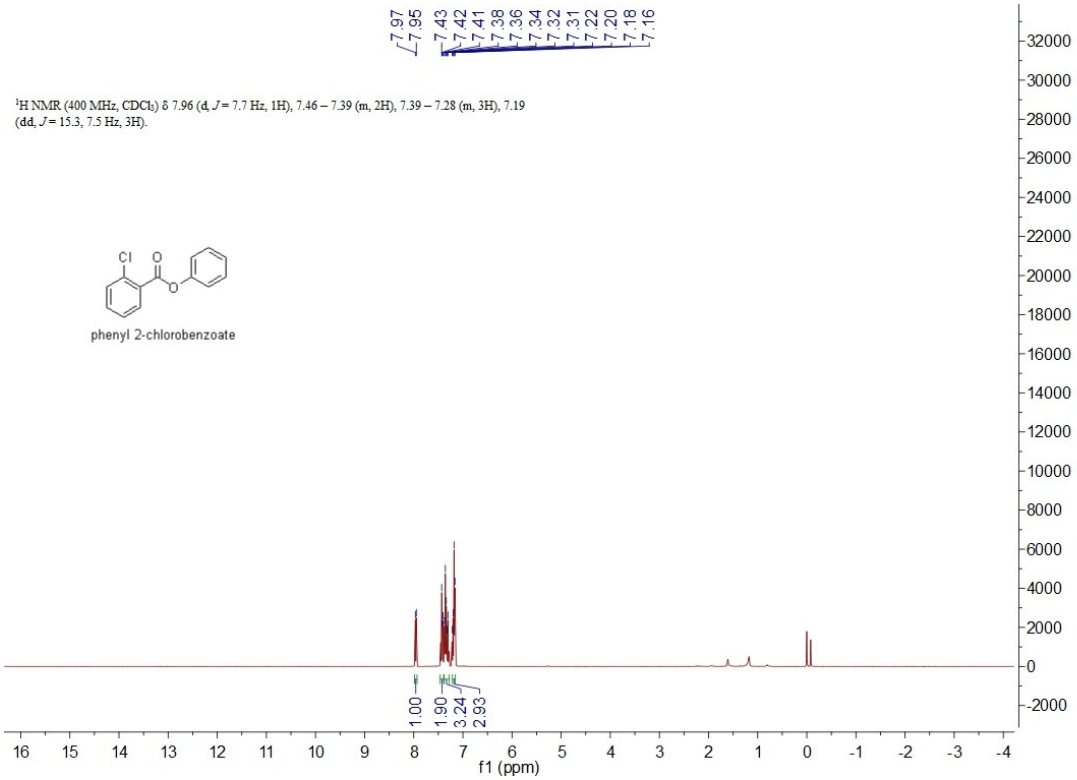
^{13}C NMR (101 MHz, $CDCl_3$) δ 164.33, 150.75, 140.11, 131.53, 129.53, 128.93, 128.01, 126.03, 121.59.

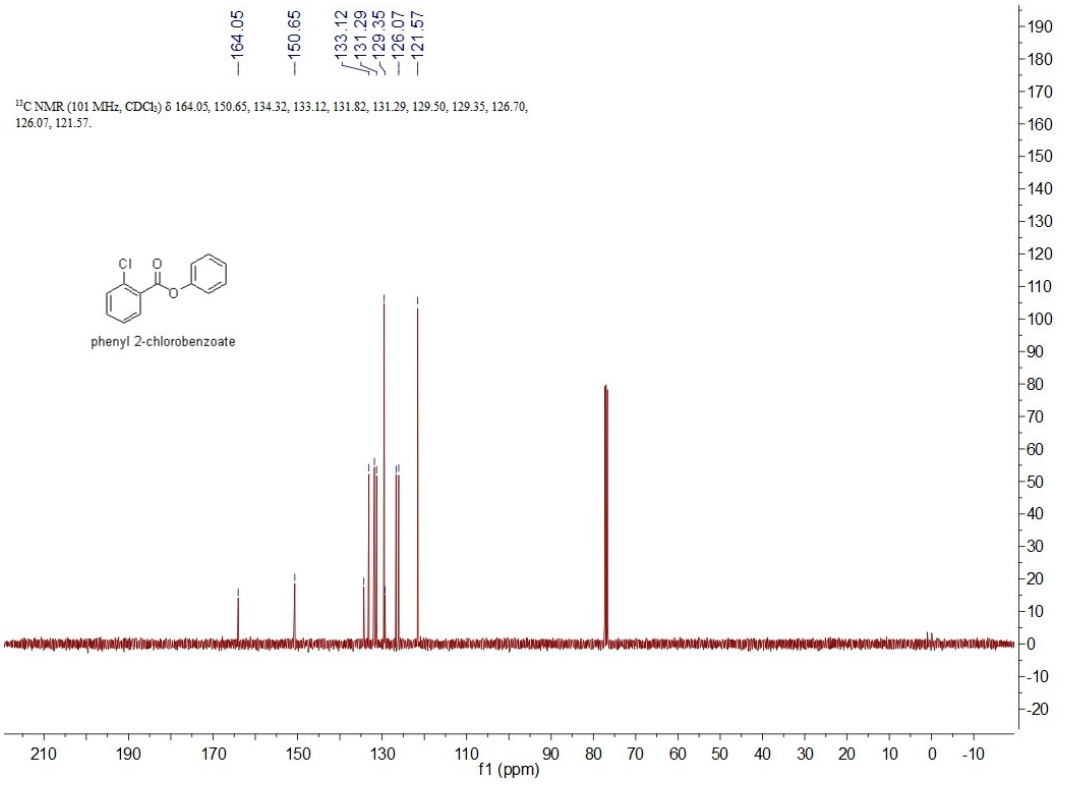


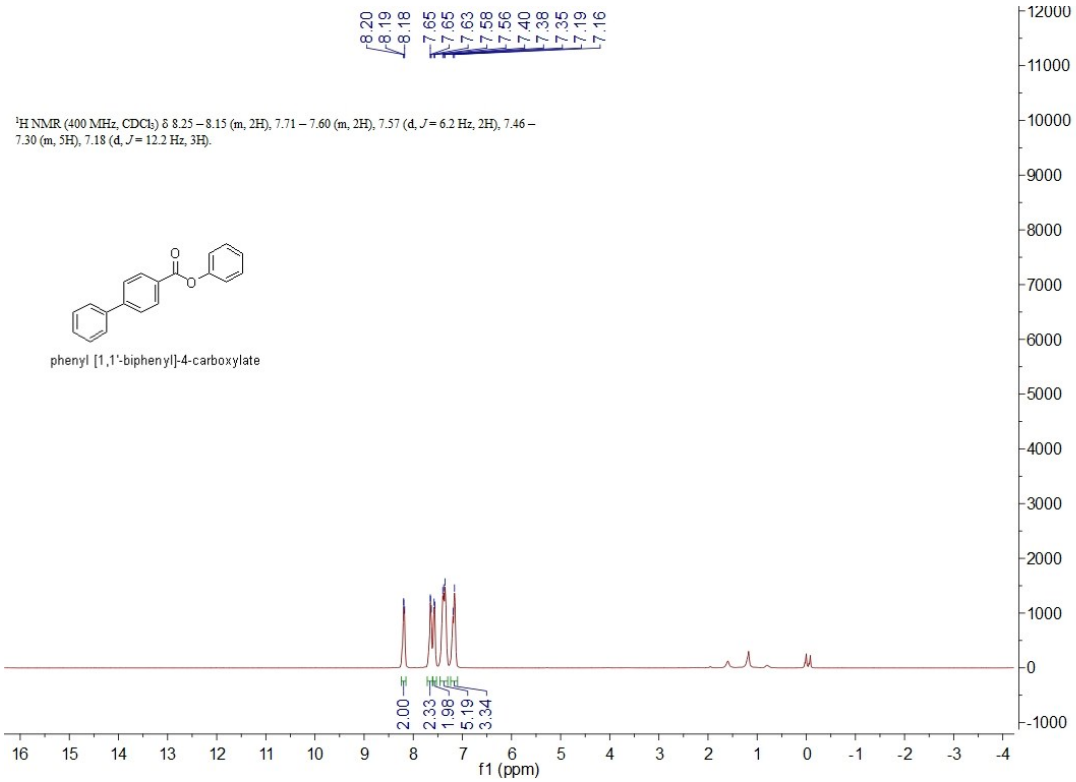
phenyl 4-chlorobenzoate

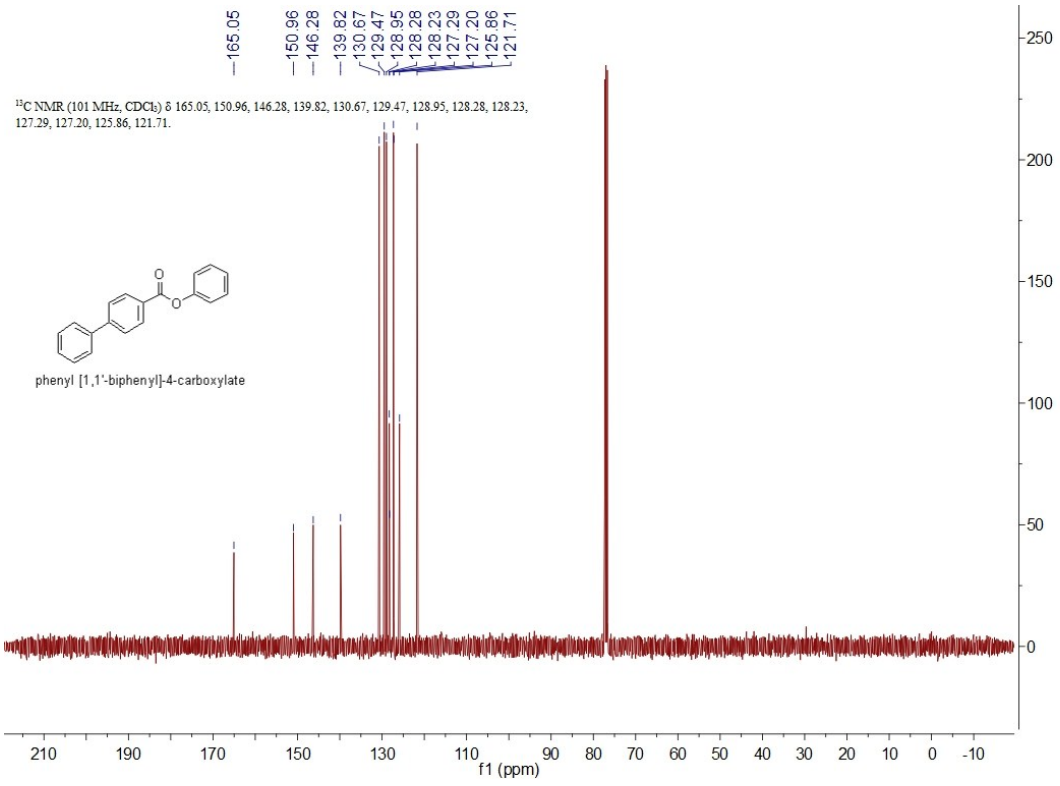

8.08
8.07
8.07
7.98
7.98
7.96
7.96
7.96
7.49
7.49
7.49
7.49
7.47
7.47
7.34
7.34
7.32
7.30
7.30
7.19
7.19
7.17
7.15
7.15
7.12
7.11
7.09
1H NMR (400 MHz, CDCl3) δ 8.10 – 8.05 (m, 1H), 8.00 – 7.94 (m, 1H), 7.48 (ddd, J = 8.0, 2.0, 1.0 Hz, 1H), 7.33 (dt, J = 8.5, 6.5 Hz, 3H), 7.21 – 7.14 (m, 1H), 7.13 – 7.08 (m, 2H).
Cl
O
O
phenyl 3-chlorobenzoate
1.00
0.99
1.01
3.16
1.05
2.15
f1 (ppm)

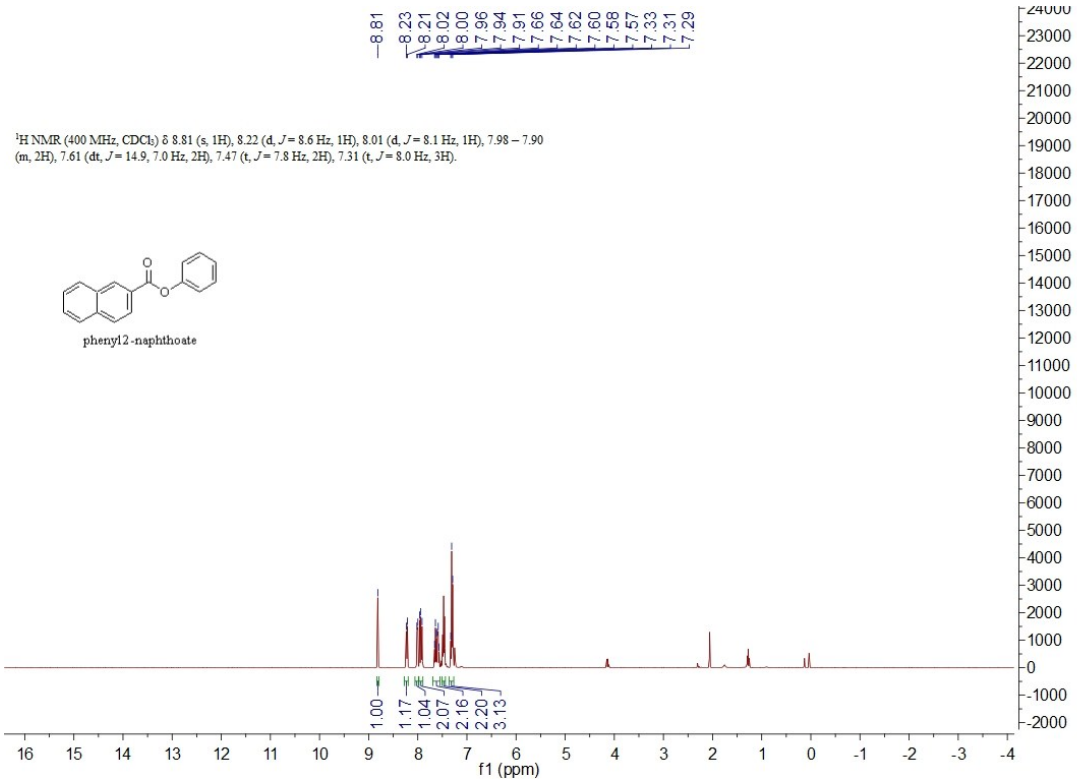

163.85
150.63
133.49
130.06
129.47
126.01
121.48
13C NMR (101 MHz, CDCl3) δ 163.85, 150.63, 134.64, 133.49, 131.23, 130.06, 129.81, 129.47, 128.18, 126.01, 121.48.
Cl
O
O
phenyl 3-chlorobenzoate
f1 (ppm)

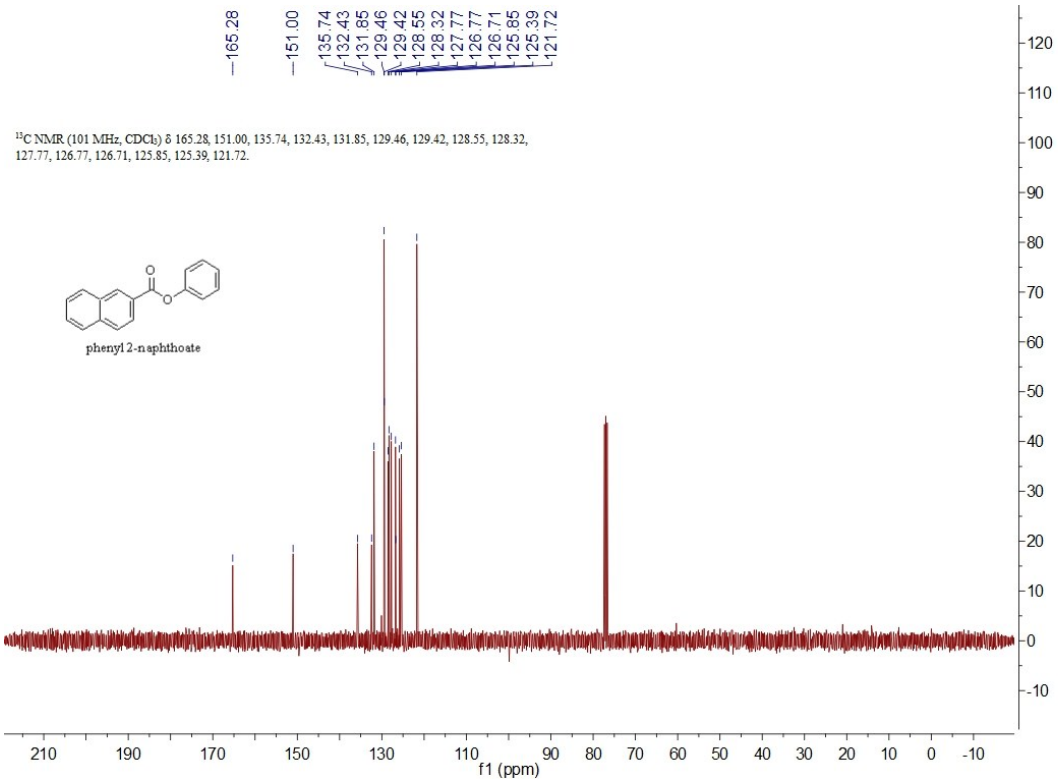

7.97
7.95
7.43
7.42
7.41
7.38
7.36
7.34
7.32
7.31
7.22
7.20
7.18
7.16
1H NMR (400 MHz, CDCl3) δ 7.96 (d, J = 7.7 Hz, 1H), 7.46 – 7.39 (m, 2H), 7.39 – 7.28 (m, 3H), 7.19 (dd, J = 15.3, 7.5 Hz, 3H).
Cl
O
O
phenyl 2-chlorobenzoate
1.00
1.90
3.24
2.93
f1 (ppm)

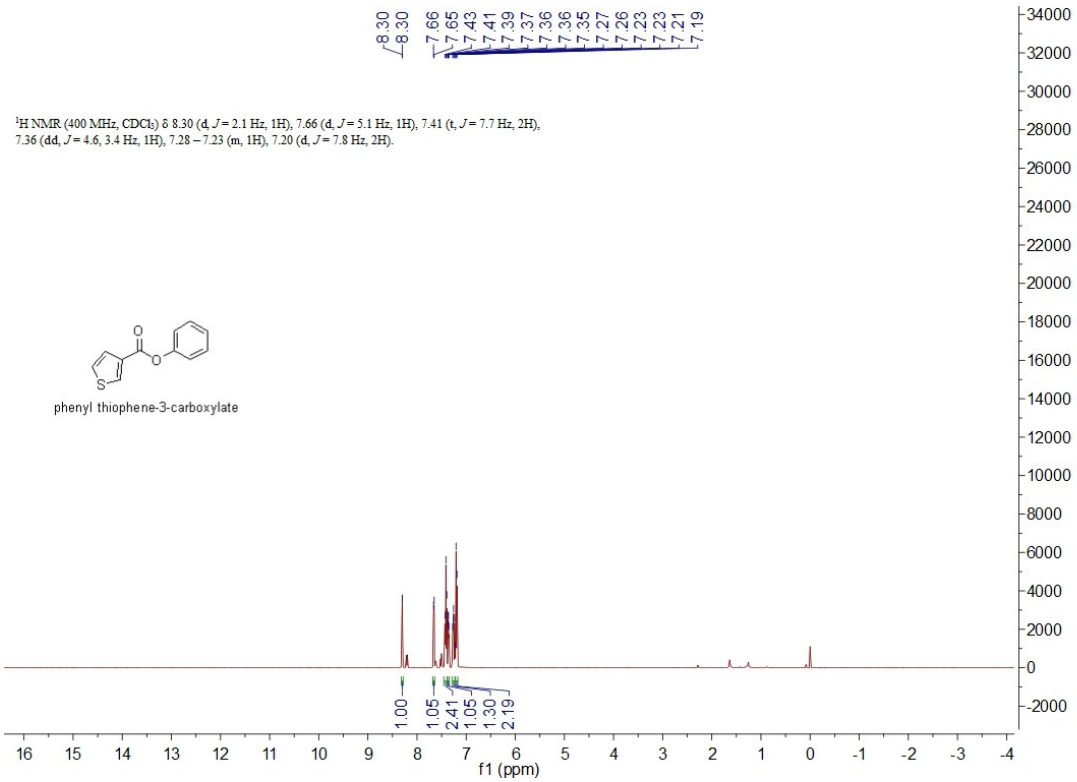

164.05
150.65
133.12
131.29
129.35
126.07
121.57
13C NMR (101 MHz, CDCl3) δ 164.05, 150.65, 134.32, 133.12, 131.82, 131.29, 129.50, 129.35, 126.70, 126.07, 121.57.
Cl
O
O
phenyl 2-chlorobenzoate
f1 (ppm)

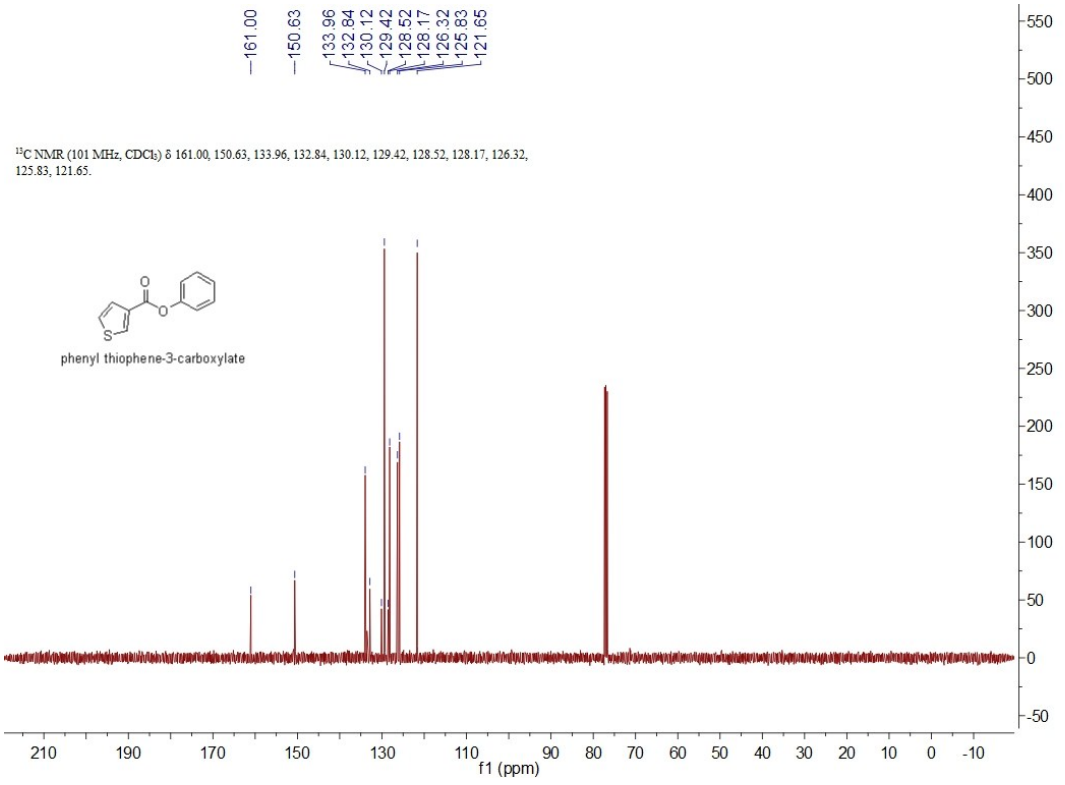

8.20
8.19
8.18
7.65
7.65
7.63
7.58
7.56
7.40
7.38
7.35
7.19
7.16
¹H NMR (400 MHz, CDCl₃) δ 8.25 – 8.15 (m, 2H), 7.71 – 7.60 (m, 2H), 7.57 (d, J = 6.2 Hz, 2H), 7.46 – 7.30 (m, 5H), 7.18 (d, J = 12.2 Hz, 3H).
phenyl [1,1'-biphenyl]-4-carboxylate
2.00
2.33
1.98
5.19
3.34
f1 (ppm)

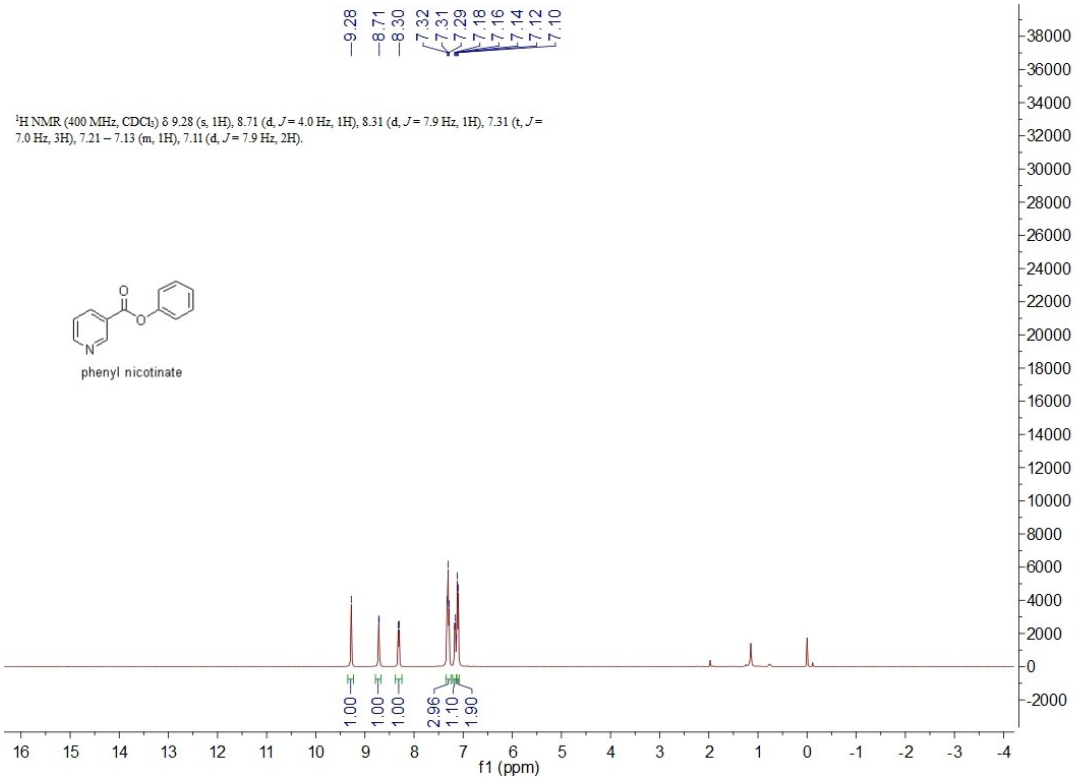

165.05
150.96
146.28
139.82
130.67
129.47
128.95
128.28
128.23
127.29
127.20
125.86
121.71
¹³C NMR (101 MHz, CDCl₃) δ 165.05, 150.96, 146.28, 139.82, 130.67, 129.47, 128.95, 128.28, 128.23, 127.29, 127.20, 125.86, 121.71.
phenyl [1,1'-biphenyl]-4-carboxylate
f1 (ppm)

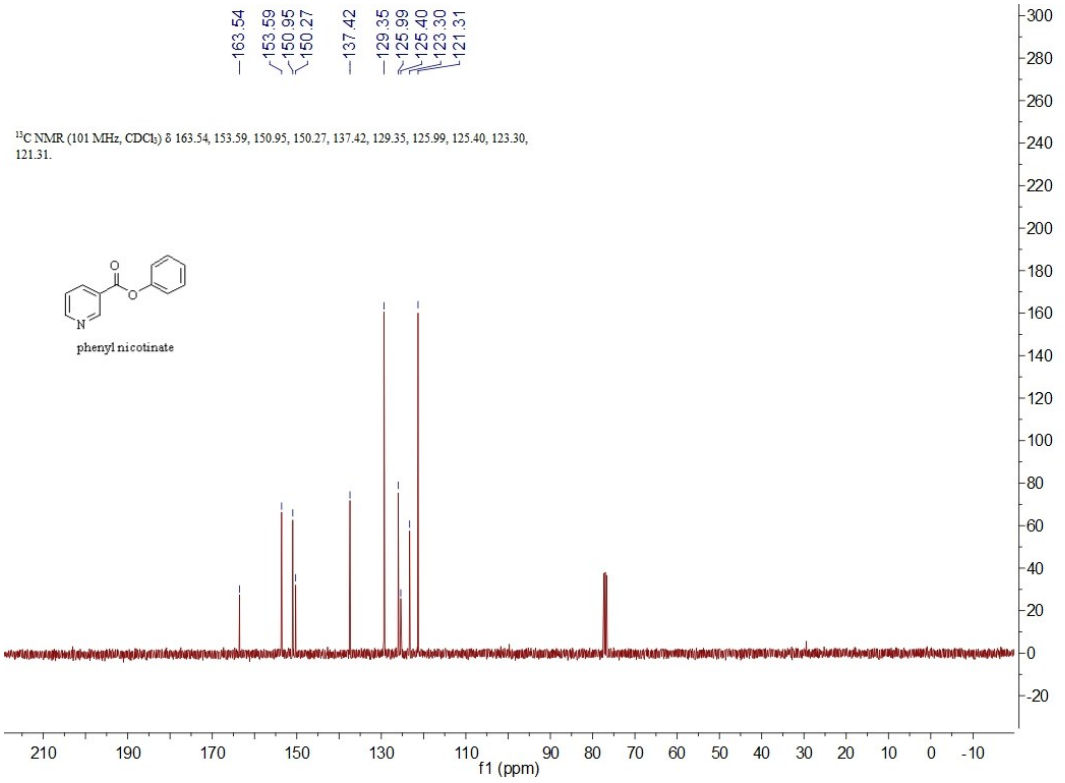

8.81
8.23
8.21
8.02
8.00
7.96
7.94
7.91
7.66
7.64
7.62
7.60
7.58
7.57
7.33
7.31
7.29
1H NMR (400 MHz, CDCl3) δ 8.81 (s, 1H), 8.22 (d, J = 8.6 Hz, 1H), 8.01 (d, J = 8.1 Hz, 1H), 7.98 – 7.90 (m, 2H), 7.61 (dt, J = 14.9, 7.0 Hz, 2H), 7.47 (t, J = 7.8 Hz, 2H), 7.31 (t, J = 8.0 Hz, 3H).
phenyl 2-naphthoate
1.00
1.17
1.04
2.07
2.16
2.20
3.13
f1 (ppm)

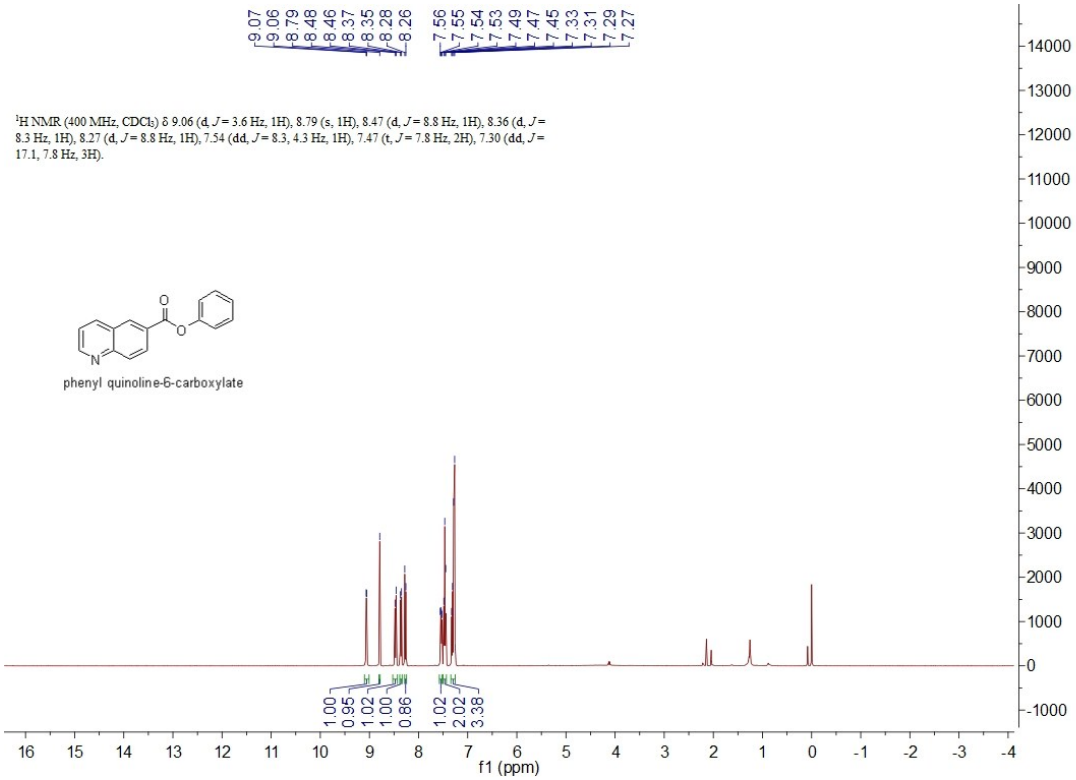

165.28
151.00
135.74
132.43
131.85
129.46
129.42
128.55
128.32
127.77
126.77
126.71
125.85
125.39
121.72
13C NMR (101 MHz, CDCl3) δ 165.28, 151.00, 135.74, 132.43, 131.85, 129.46, 129.42, 128.55, 128.32, 127.77, 126.77, 126.71, 125.85, 125.39, 121.72.
phenyl 2-naphthoate
f1 (ppm)


8.30
8.30
7.66
7.65
7.43
7.41
7.39
7.37
7.36
7.36
7.35
7.27
7.26
7.23
7.23
7.21
7.19
1H NMR (400 MHz, CDCl3) δ 8.30 (d, J = 2.1 Hz, 1H), 7.66 (d, J = 5.1 Hz, 1H), 7.41 (t, J = 7.7 Hz, 2H), 7.36 (dd, J = 4.6, 3.4 Hz, 1H), 7.28 – 7.23 (m, 1H), 7.20 (d, J = 7.8 Hz, 2H).
phenyl thiophene-3-carboxylate
1.00
1.05
2.41
1.05
1.30
2.19
f1 (ppm)


161.00
150.63
133.96
132.84
130.12
129.42
128.52
128.17
126.32
125.83
121.65
13C NMR (101 MHz, CDCl3) δ 161.00, 150.63, 133.96, 132.84, 130.12, 129.42, 128.52, 128.17, 126.32, 125.83, 121.65.
phenyl thiophene-3-carboxylate
f1 (ppm)

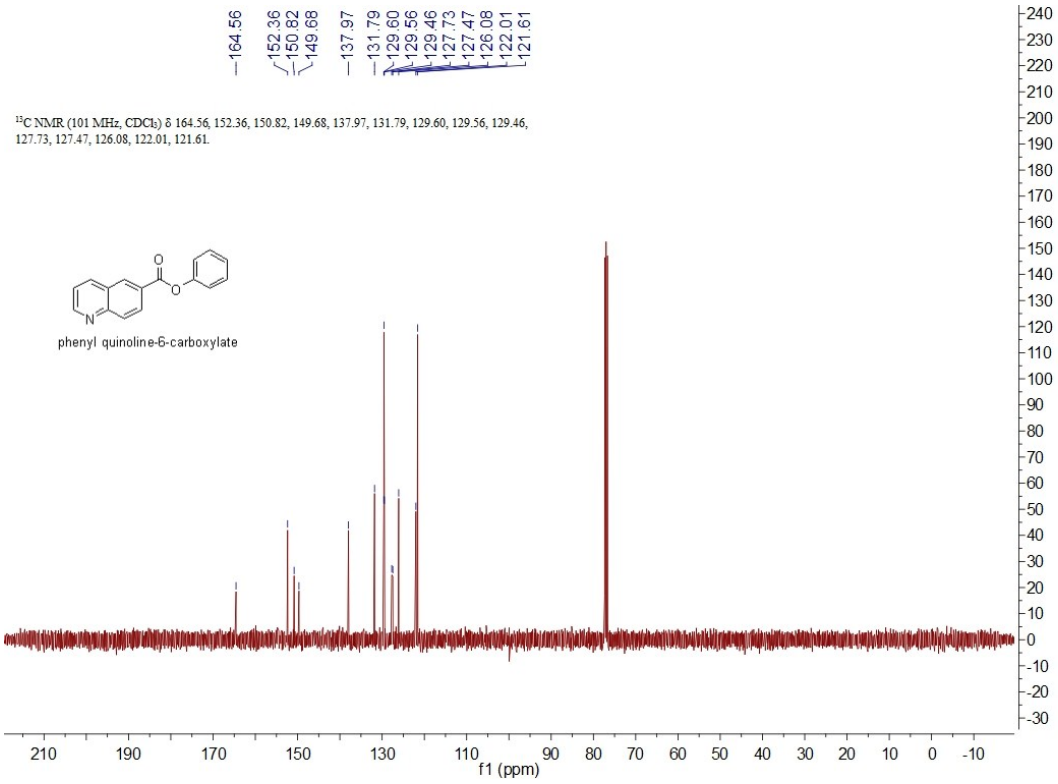

9.28
8.71
8.30
7.32
7.31
7.29
7.18
7.16
7.14
7.12
7.10
1H NMR (400 MHz, CDCl3) δ 9.28 (s, 1H), 8.71 (d, J = 4.0 Hz, 1H), 8.31 (d, J = 7.9 Hz, 1H), 7.31 (t, J = 7.0 Hz, 3H), 7.21 – 7.13 (m, 1H), 7.11 (d, J = 7.9 Hz, 2H).
phenyl nicotinate
1.00
1.00
1.00
2.96
1.10
1.90
f1 (ppm)


163.54
153.59
150.95
150.27
137.42
129.35
125.99
125.40
123.30
121.31
13C NMR (101 MHz, CDCl3) δ 163.54, 153.59, 150.95, 150.27, 137.42, 129.35, 125.99, 125.40, 123.30, 121.31.
phenyl nicotinate
f1 (ppm)



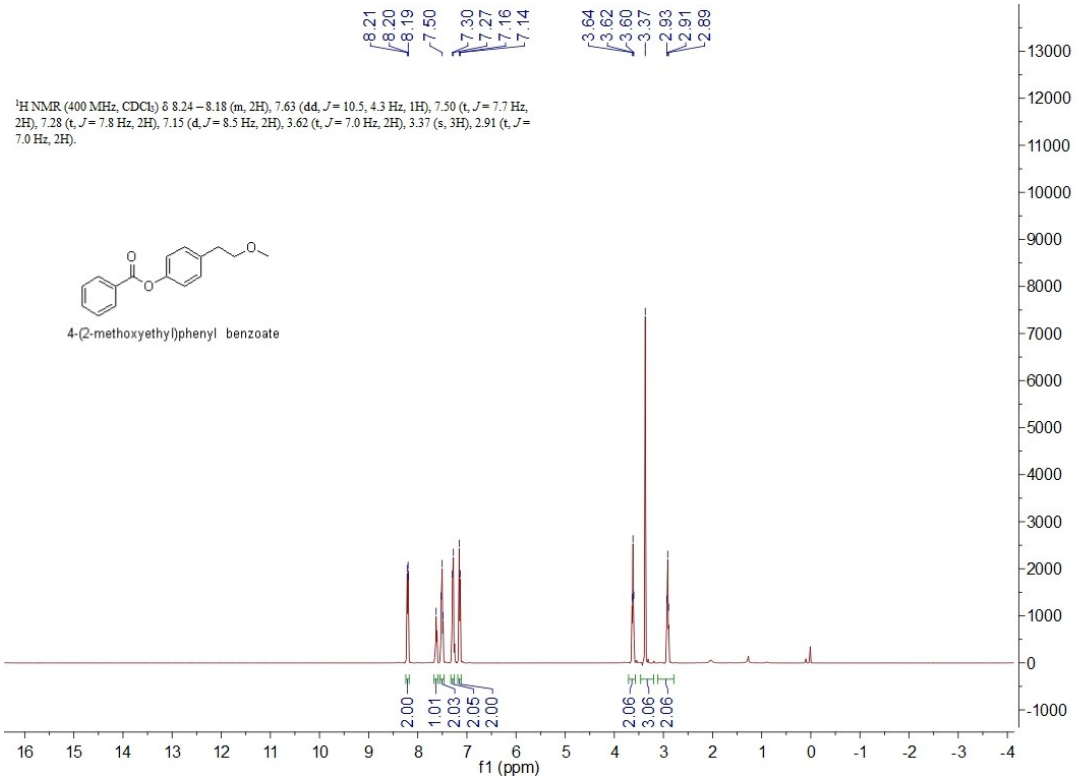
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.06 (d, J = 3.6 Hz, 1H), 8.79 (s, 1H), 8.47 (d, J = 8.8 Hz, 1H), 8.36 (d, J = 8.3 Hz, 1H), 8.27 (d, J = 8.8 Hz, 1H), 7.54 (dd, J = 8.3, 4.3 Hz, 1H), 7.47 (t, J = 7.8 Hz, 2H), 7.30 (dd, J = 17.1, 7.8 Hz, 3H).

phenyl quinoline-6-carboxylate



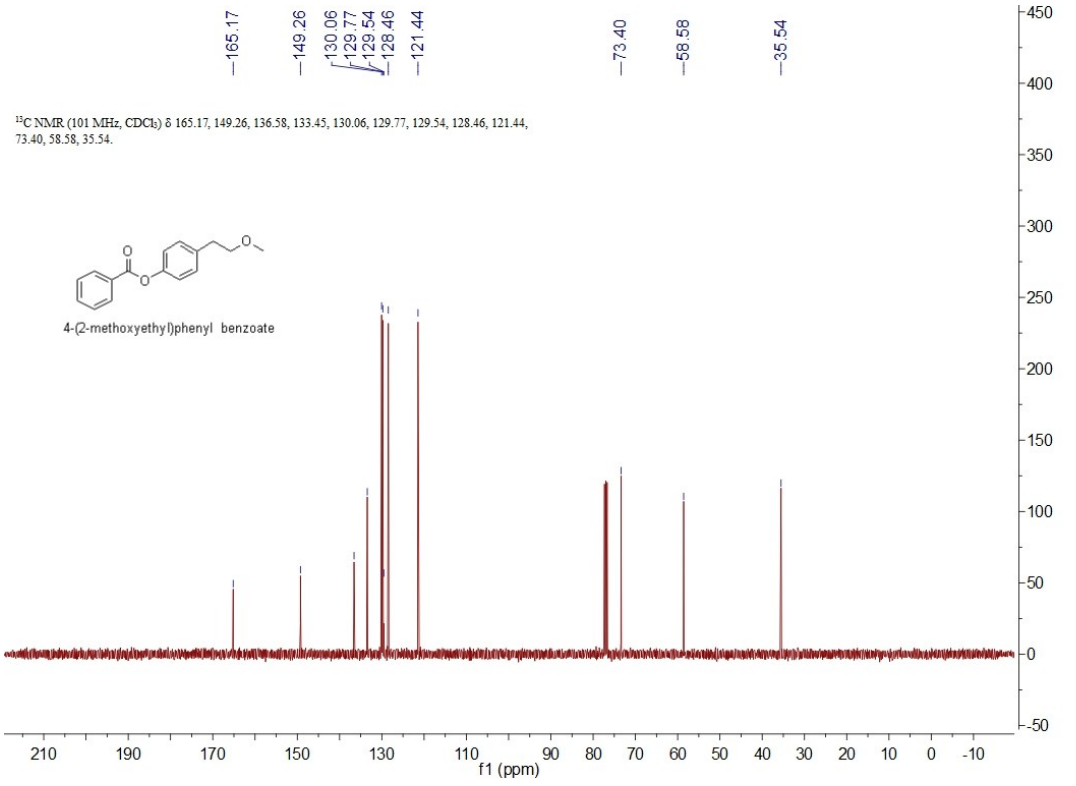
^{13}C NMR (101 MHz, $CDCl_3$) δ 164.56, 152.36, 150.82, 149.68, 137.97, 131.79, 129.60, 129.56, 129.46, 127.73, 127.47, 126.08, 122.01, 121.61.

phenyl quinoline-6-carboxylate



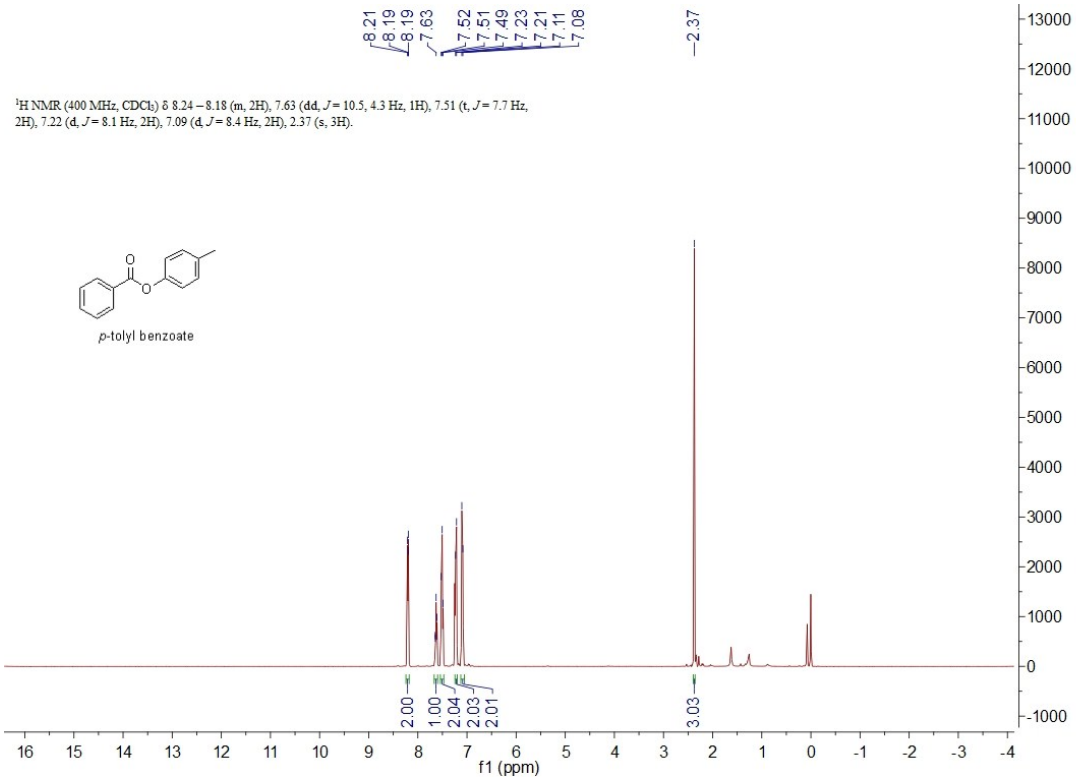
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 – 8.18 (m, 2H), 7.63 (dd, *J* = 10.5, 4.3 Hz, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 7.28 (t, *J* = 7.8 Hz, 2H), 7.15 (d, *J* = 8.5 Hz, 2H), 3.62 (t, *J* = 7.0 Hz, 2H), 3.37 (s, 3H), 2.91 (t, *J* = 7.0 Hz, 2H).

4-(2-methoxyethyl)phenyl benzoate



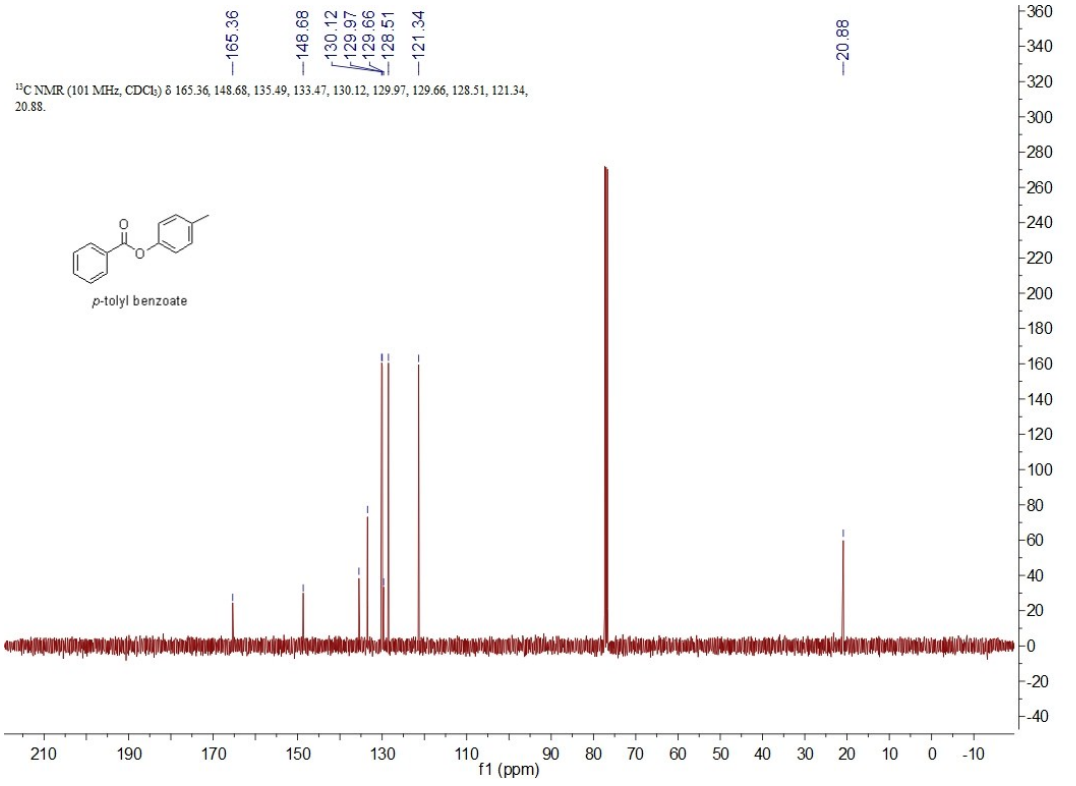
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.17, 149.26, 136.58, 133.45, 130.06, 129.77, 129.54, 128.46, 121.44, 73.40, 58.58, 35.54.

4-(2-methoxyethyl)phenyl benzoate



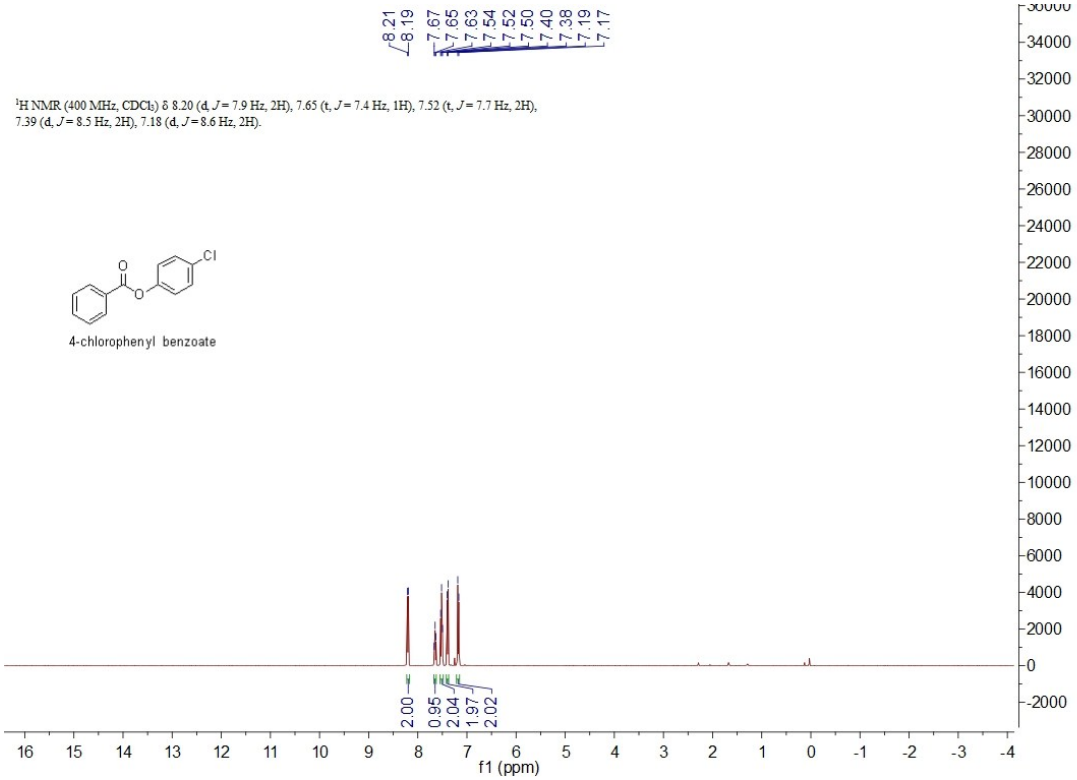
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 – 8.18 (m, 2H), 7.63 (dd, *J* = 10.5, 4.3 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H), 7.22 (d, *J* = 8.1 Hz, 2H), 7.09 (d, *J* = 8.4 Hz, 2H), 2.37 (s, 3H).

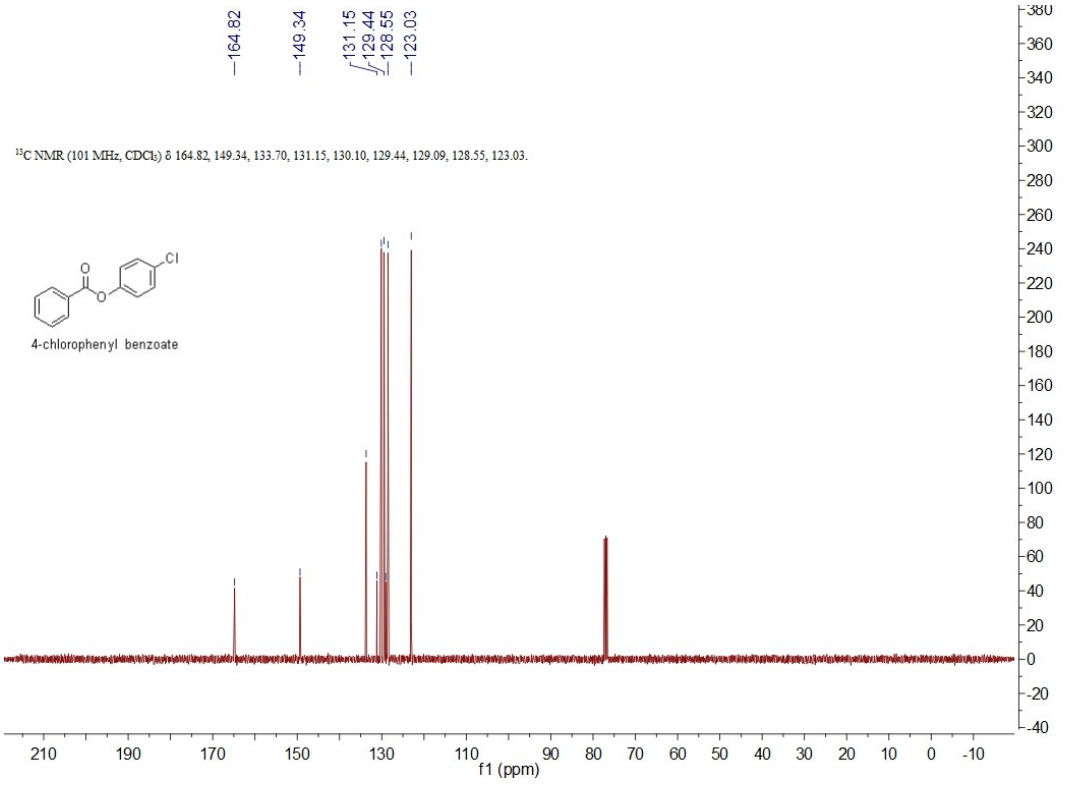
p-tolyl benzoate

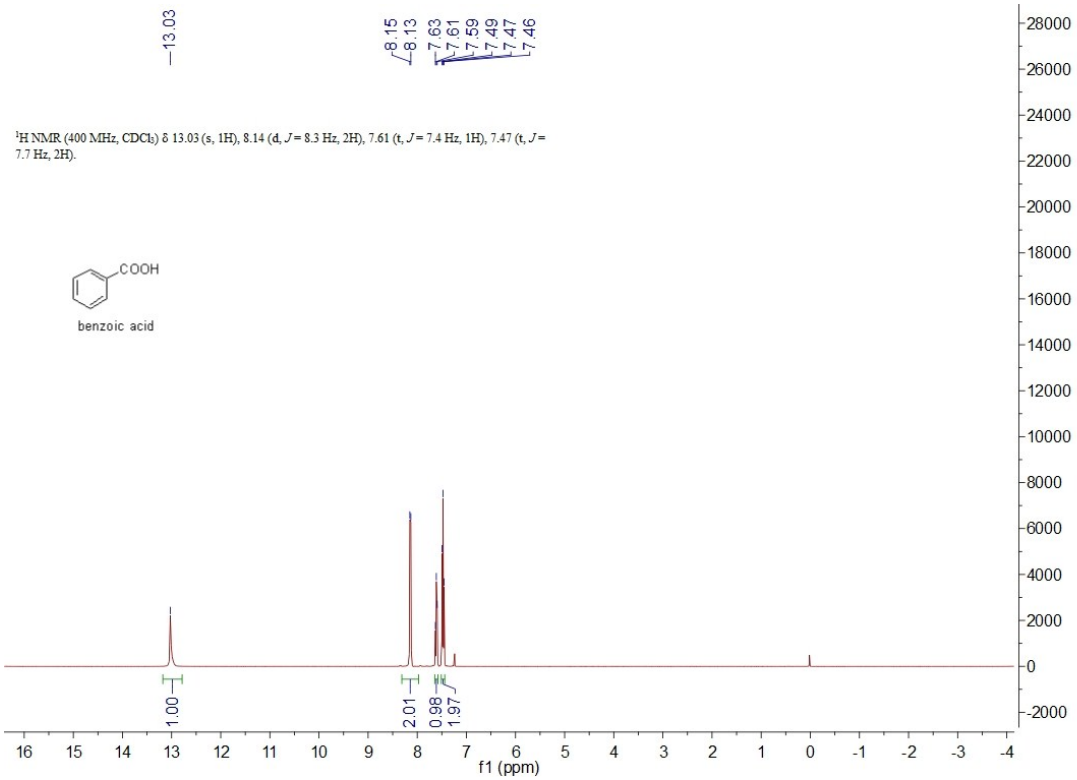


^{13}C NMR (101 MHz, $CDCl_3$) δ 165.36, 148.68, 135.49, 133.47, 130.12, 129.97, 129.66, 128.51, 121.34, 20.88.

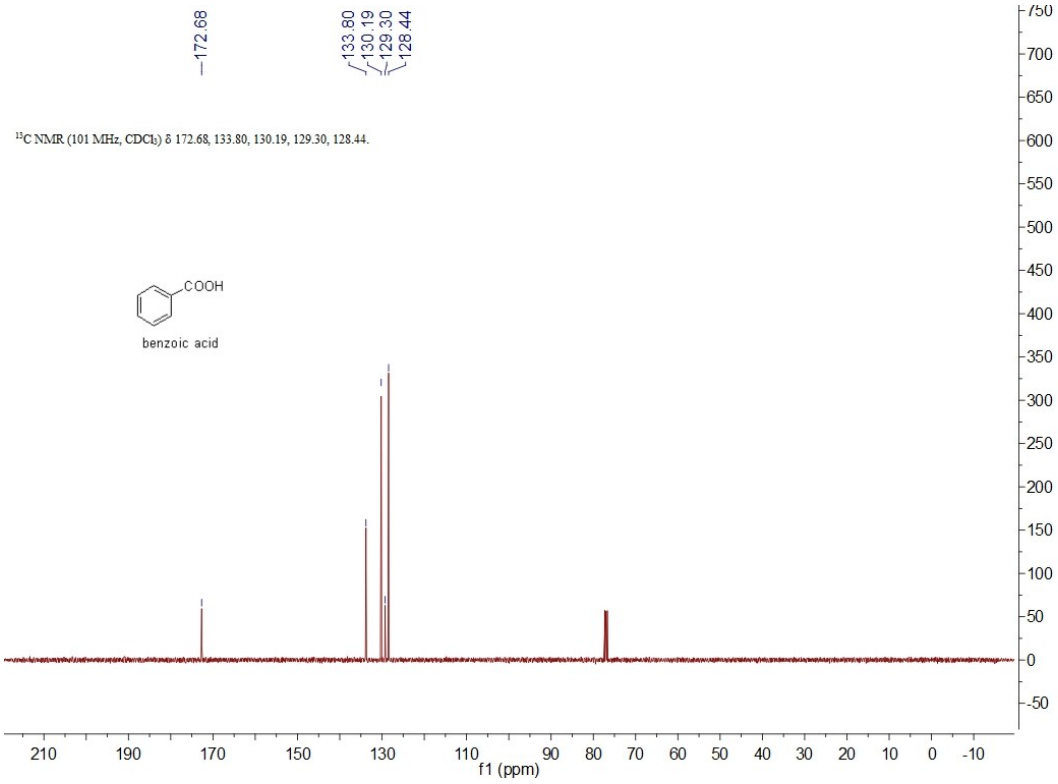
p-tolyl benzoate


8.21
8.19
7.67
7.65
7.63
7.54
7.52
7.50
7.40
7.38
7.19
7.17
¹H NMR (400 MHz, CDCl₃) δ 8.20 (d, J = 7.9 Hz, 2H), 7.65 (t, J = 7.4 Hz, 1H), 7.52 (t, J = 7.7 Hz, 2H), 7.39 (d, J = 8.5 Hz, 2H), 7.18 (d, J = 8.6 Hz, 2H).
Cl
4-chlorophenyl benzoate
2.00
0.95
2.04
1.97
2.02
f1 (ppm)

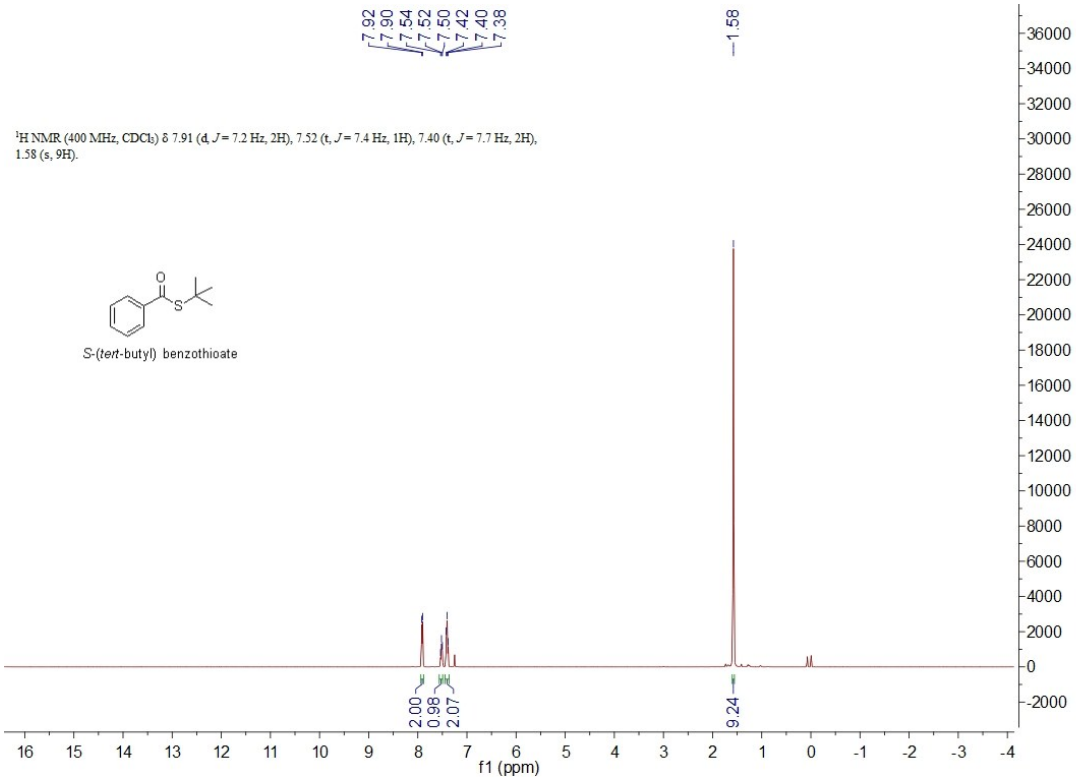

164.82
149.34
131.15
129.44
128.55
123.03
¹³C NMR (101 MHz, CDCl₃) δ 164.82, 149.34, 133.70, 131.15, 130.10, 129.44, 129.09, 128.55, 123.03.
Cl
4-chlorophenyl benzoate
f1 (ppm)

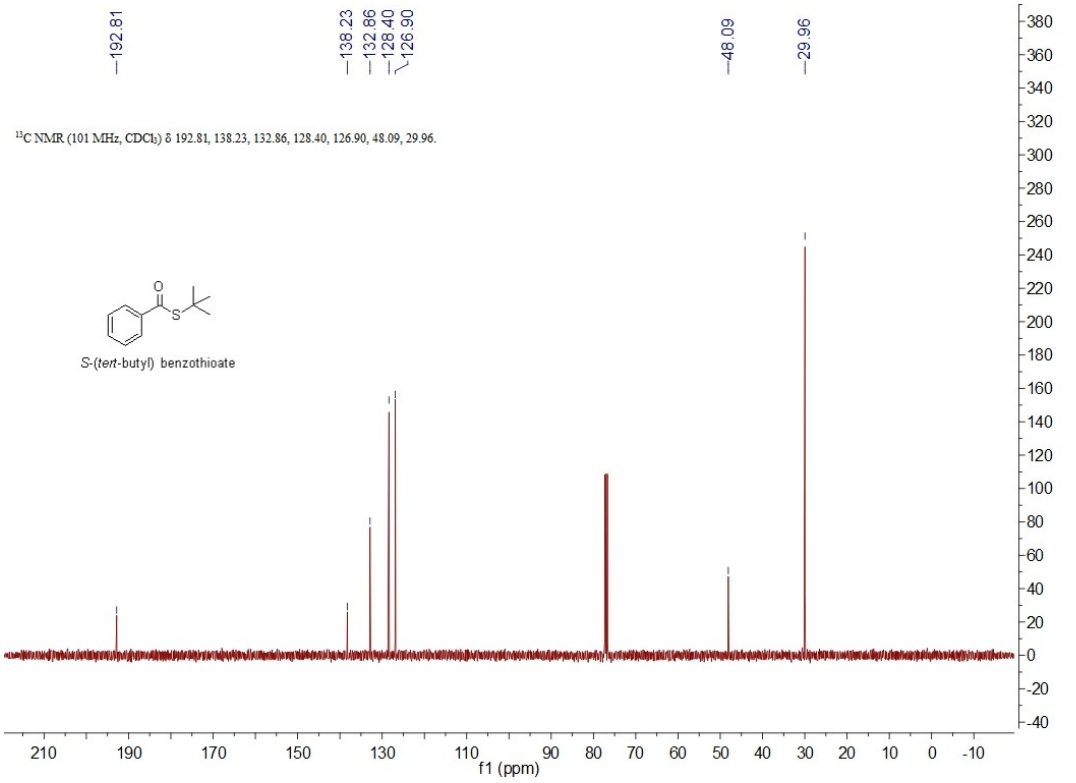


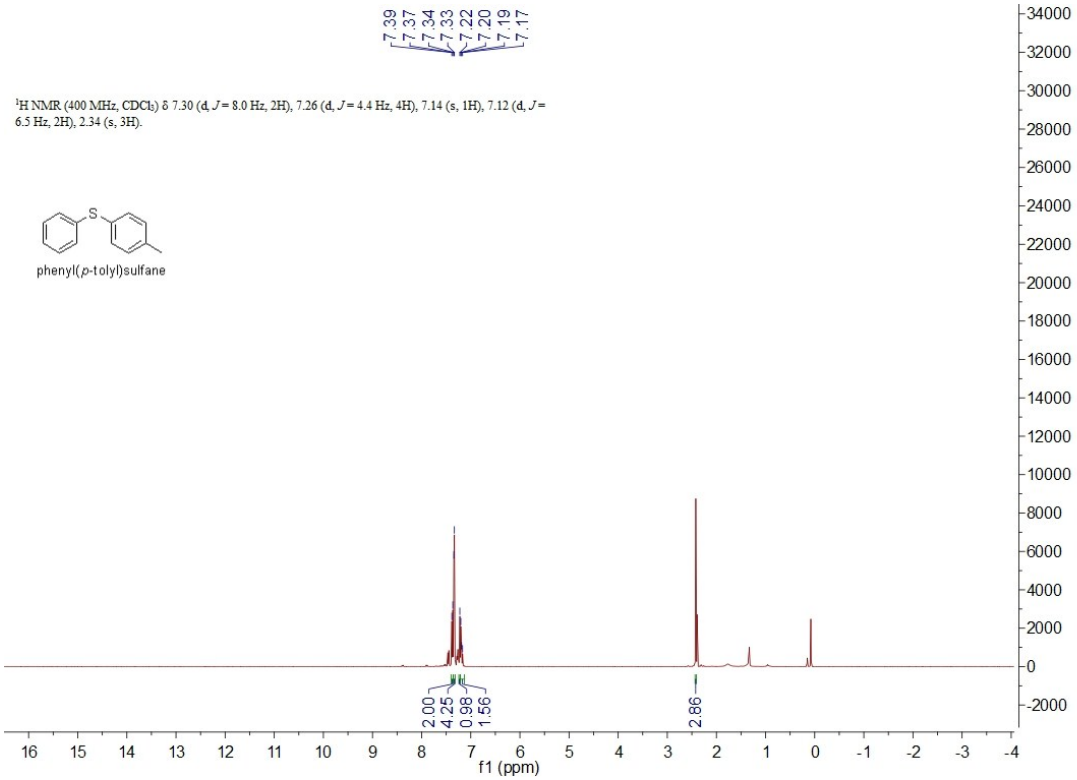
^{1}H NMR (400 MHz, $CDCl_3$) δ 13.03 (s, 1H), 8.14 (d, J = 8.3 Hz, 2H), 7.61 (t, J = 7.4 Hz, 1H), 7.47 (t, J = 7.7 Hz, 2H).



^{13}C NMR (101 MHz, $CDCl_3$) δ 172.68, 133.80, 130.19, 129.30, 128.44.

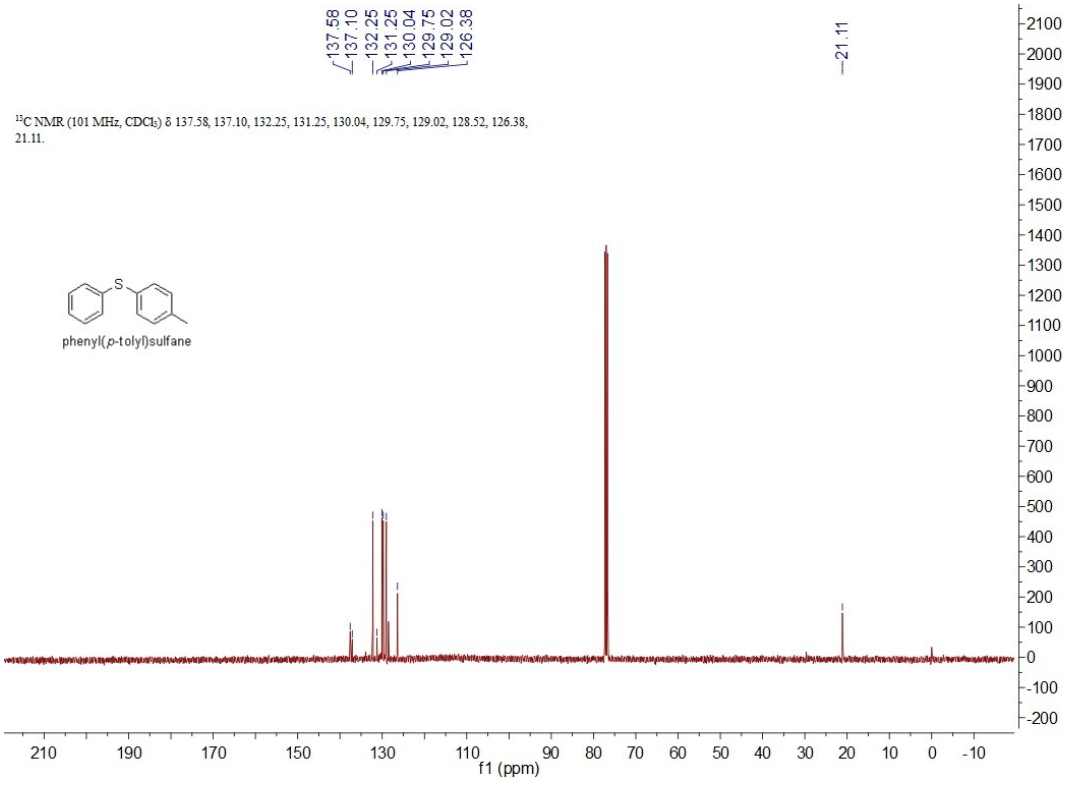

7.92
7.90
7.54
7.52
7.50
7.42
7.40
7.38
1.58
^{1}H NMR (400 MHz, CDCl$_3$) δ 7.91 (d, J = 7.2 Hz, 2H), 7.52 (t, J = 7.4 Hz, 1H), 7.40 (t, J = 7.7 Hz, 2H), 1.58 (s, 9H).
S-(tert-butyl) benzothioate
2.00
0.98
2.07
9.24
f1 (ppm)


192.81
138.23
132.86
128.40
126.90
48.09
29.96
^{13}C NMR (101 MHz, CDCl$_3$) δ 192.81, 138.23, 132.86, 128.40, 126.90, 48.09, 29.96.
S-(tert-butyl) benzothioate
f1 (ppm)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, J = 8.0 Hz, 2H), 7.26 (d, J = 4.4 Hz, 4H), 7.14 (s, 1H), 7.12 (d, J = 6.5 Hz, 2H), 2.34 (s, 3H).

phenyl(*p*-tolyl)sulfane



^{13}C NMR (101 MHz, $CDCl_3$) δ 137.58, 137.10, 132.25, 131.25, 130.04, 129.75, 129.02, 128.52, 126.38, 21.11.

phenyl(*p*-tolyl)sulfane