Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

Title: Greener Approach for the Synthesis of Substituted Alkenes by Direct Coupling of Alcohols with Styrenes using Recyclable Bronsted Acidic $[NMP]^+HSO_4^-$ Ionic Liquid

Kishor V. Wagh and Bhalchandra M. Bhanage*

Department of Chemistry, Institute of Chemical Technology (Autonomous), Matunga, Mumbai 400 019, India.

* Corresponding author. Tel.: + 91- 22 3361 1111/2222; Fax: +91- 22 2414 5614.

E-mail address: bhalchandra_bhanage@yahoo.com, bm.bhanage@ictmumbai.edu.in. (B. M. Bhanage)

Characterization of compounds:

1) (E)-prop-2-ene-1,1,3-triyltribenzene

(Table 2 entry 1)

White solid, ^{1}H NMR (200 MHz, $CDCl_3$, ppm) δ =7.41-7.24 (m, 15H), 6.69 (dd, 1H, *J*=16 Hz, *J*=8Hz), 6.36 (d, 1H, *J*=16), 4.91 (d, 1H, *J*=8Hz). ^{13}C (50 MHz, $CDCl_3$, ppm) 143.54, 137.29, 132.60, 131.43, 128.66, 128.47, 127.30, 126.43, 126.31, 54.20. GC-MS (EI) m/z (%) = 270 (58.7) $[M]^+$, 271 (13.6), 270 (58.7), 255 (12.8), 193 (21.9), 192 (100), 191 (40.1), 179 (35.8), 178 (40.2), 167 (11.0), 165 (30.4), 152 (10.5), 115 (35.8), 91 (26.9), 77 (6.8), 65 (7.9), 51 (7.3).

2) (E)-(3-(4-(tert-butyl)phenyl)prop-2-ene-1,1-diyl)dibenzene

(Table 2 entry 4)

White Solid, ^{1}H NMR (400 MHz, $CDCl_3$, ppm) δ = 7.34-7.30 (m, 8H), 7.27-7.23 (m, 6H), 6.66 (dd, *J*=16 Hz , *J*=8 Hz, 1H), 6.35 (d, *J*=16 Hz 1H), 4.91 (d, *J*=8Hz 1H), 1.33 (s, 9H). ^{13}C (100 MHz, $CDCl_3$, ppm) 150.51, 143.75, 134.59, 131.94, 131.23, 128.80, 128.56, 126.50, 126.12, 125.56, 54.27, 34.65, 31.41. GC-MS (EI) m/z (%) = 326 (25.3) $[M]^+$, 327 (6.3),

326 (25.3), 311 (14.7), 270 (22.2), 269 (100), 193 (10.5), 192 (29.7), 191 (60.5), 179 (6.9), 178 (15.1), 165 (12.9), 141 (5.8), 115 (26.3), 102 (14.5), 91 (48.1), 57 (28.3), 41 (13.5).

3) (E)-(3-(4-methoxyphenyl)prop-2-ene-1,1-diyl)dibenzene

(Table 2 entry 5)

White Solid, ^{1}H NMR (400 MHz, $CDCl_3$, ppm) δ = 7.37-7.33 (m, 6 H), 7.26-7.24 (m, 6H), 6.87(d, 2H, *J*=12 Hz), 6.57(dd, 1H, *J*=16 Hz, *J*=8Hz), 6.33 (d, 1H, *J*=16Hz), 4.91(d, *J*=8 Hz ,1H), 3.84 (s, 3H); ^{13}C (100 MHz, $CDCl_3$, ppm)159.01, 143.78, 130.80, 130.47, 130.10, 128.68, 128.46, 127.45, 126.39, 113.94, 55.31, 54.20; GC-MS (EI) m/z (%) = 300 (100) $[M]^+$, 301(25.2), 300(100), 269(23.2), 222(21.4), 221(38.6), 220(14.3), 209(26.5), 193(13.0), 192(62.0), 190(46.5), 178(18.7), 177(31.0), 165(34.9), 152(15.9), 145(10.4), 121(32.3), 115(39.4), 91(37.7), 77(14.9), 65(7.4), 51(6.8), 43(13.1).

4) (E)-(3-(4-bromophenyl)prop-2-ene-1,1-diyl)dibenzene

(Table 2 entry 7)

Colourless Oil, ^{1}H NMR (400 MHz, $CDCl_3$, ppm) δ = 7.45 (d, 2H, *J*=8Hz), 7.36 (t, 4H, *J*=8 Hz), 7.29-7.26(m, 8H), 6.71 (dd, *J*=16 Hz, *J*=8 Hz, 1H), 6.32 (d, *J*=16 Hz 1H), 4.92 (d, *J*=7.6Hz 1H). ^{13}C (100 MHz, $CDCl_3$, ppm) 143.24, 136.21,

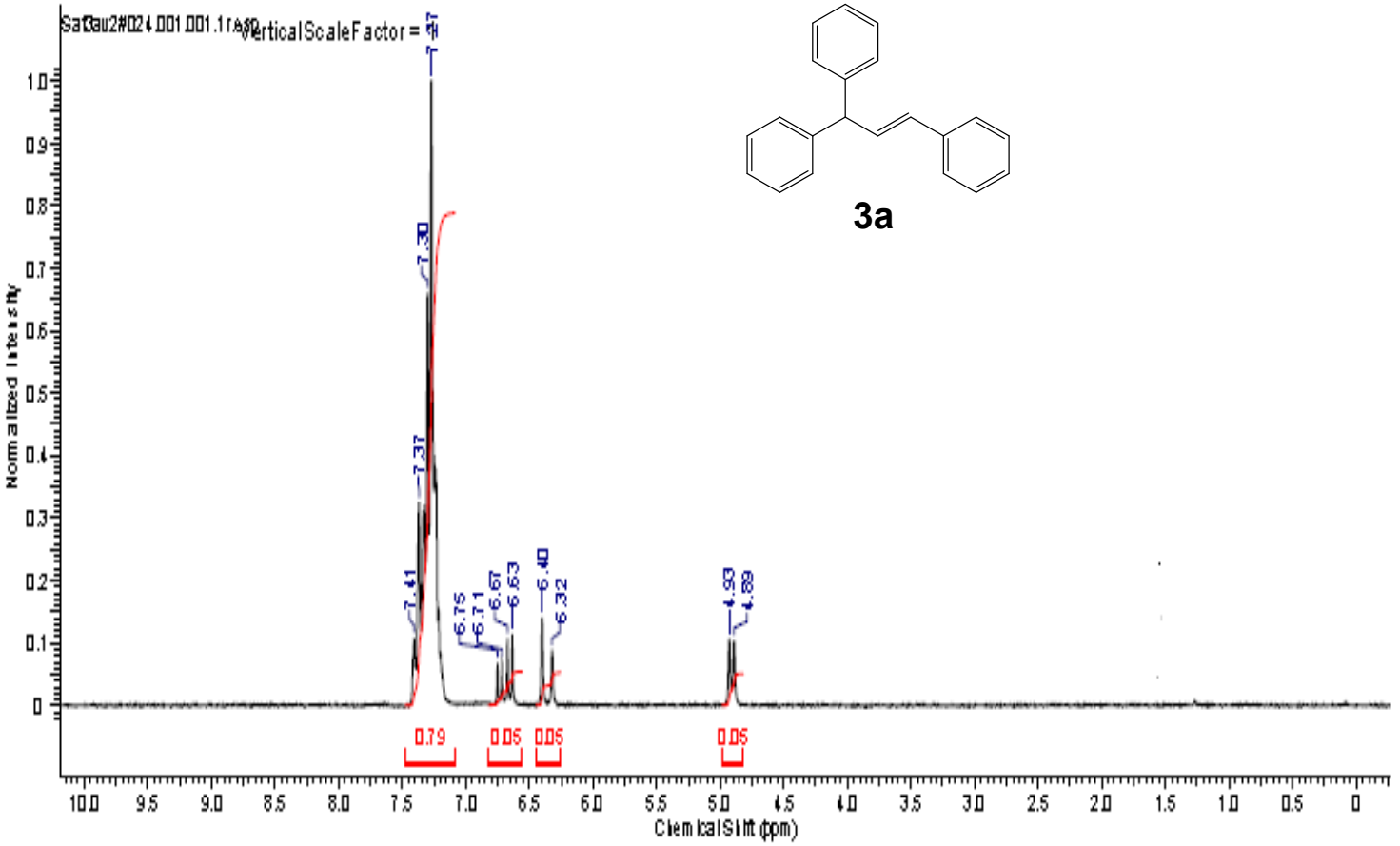
133.46, 131.61, 130.31, 128.64, 128.56, 127.86, 126.57, 121.03, 54.18. GC-MS (EI) m/z (%) = 348(8.7) $[M]^+$, 349 (27.6), 348 (8.7), 347 (27.6), 271 (20.4), 269 (54.0), 268 (12.5), 254 (11.8), 193 (12.0), 192 (66.6), 191 (100), 189 (22.6), 179 (28.8), 178 (45.0), 166 (11.2), 165 (39.7), 152 (11.0), 115 (20..7), 91 (38.5), 77 (8.2), 65 (6.4), 51 (9.4), 44 (5.6).

5) (E)-4-(3,3-diphenylprop-1-en-1-yl)phenyl acetate

(Table 2 entry 8)

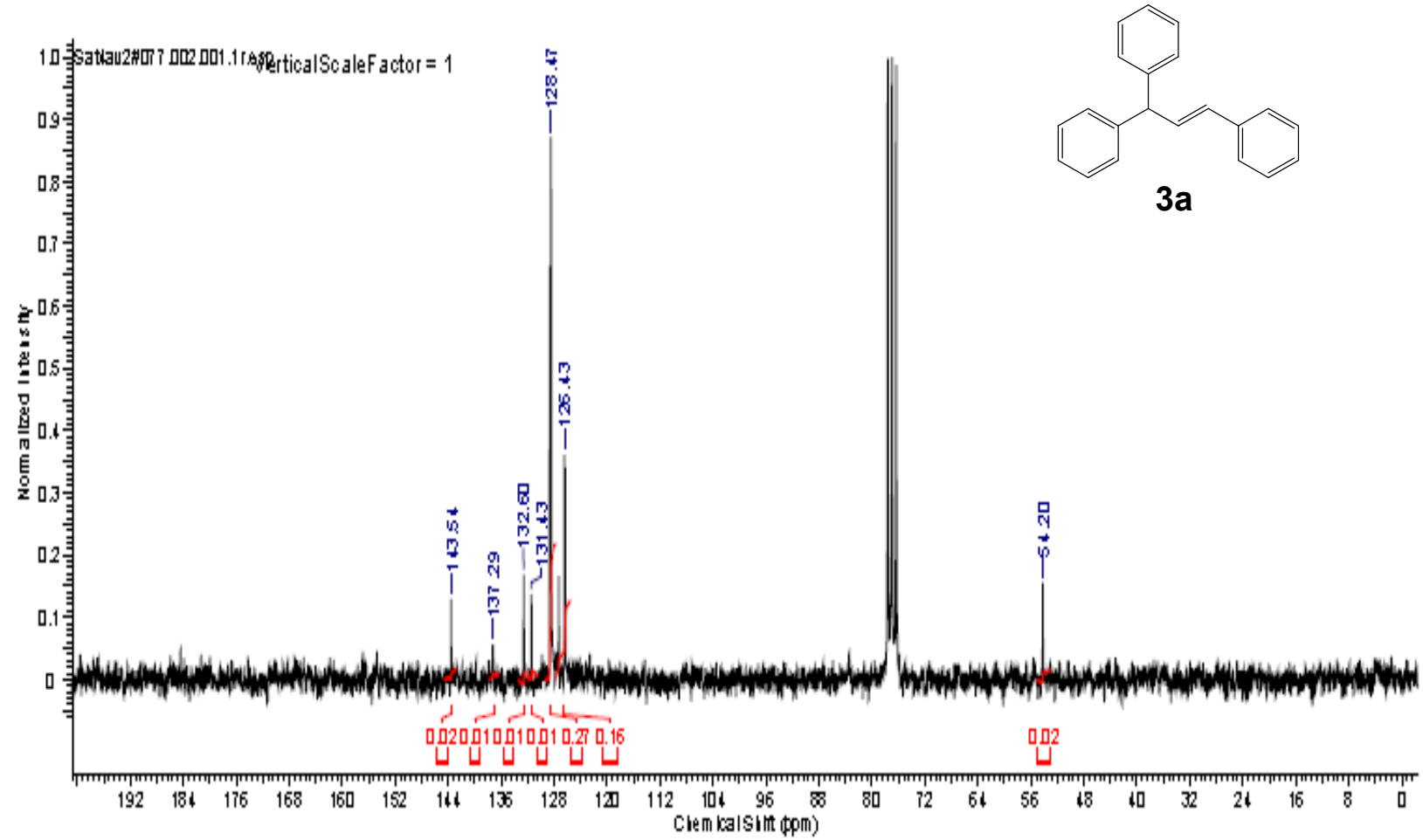
Yellow solid, ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ = 7.37 (d, 2H, *J*=5Hz), 7.32 (t, 4H, *J*=5 Hz), 7.26-7.22(m, 6H), 7.02(d, 2H, *J*=10 Hz), 6.63 (dd, *J* = 20 Hz , *J*=10 Hz, 1H), 6.32 (d, *J*=15 Hz 1H), 4.89 (d, *J*=5 Hz 1H), 2.29(S, 3H). ^{13}C (125 MHz, $CDCl_3$, ppm) 169.68, 149.99, 143.57, 135.28, 133.08, 130.62, 128.82, 128.68, 127.40, 126.66, 121.80, 54.29, 21.31. GC-MS (EI) m/z (%) = 328 (54.6) $[M]^+$, 329 (14.6), 328 (54.6), 287 (19.9), 286 (84.9), 285 (33.2), 269 (35.8), 268 (18.6), 209 (29.9), 208 (87.5), 206 (28.7), 195 (34.2), 193 (17.7), 192 (100), 179 (31.7), 178 (39.7), 167 (14.2), 166 (11.7), 165 (45.2), 152 (20.2), 131 (14.7), 115 (33.8), 107 (21.8), 91 (35.5), 77 (12.8), 43 (51.5).

Table 2 entry 1, ^{1}H NMR



3a

Table 2 entry 1, ^{13}C NMR



3a

Table 2 entry 1, ^{13}C NMR

3a

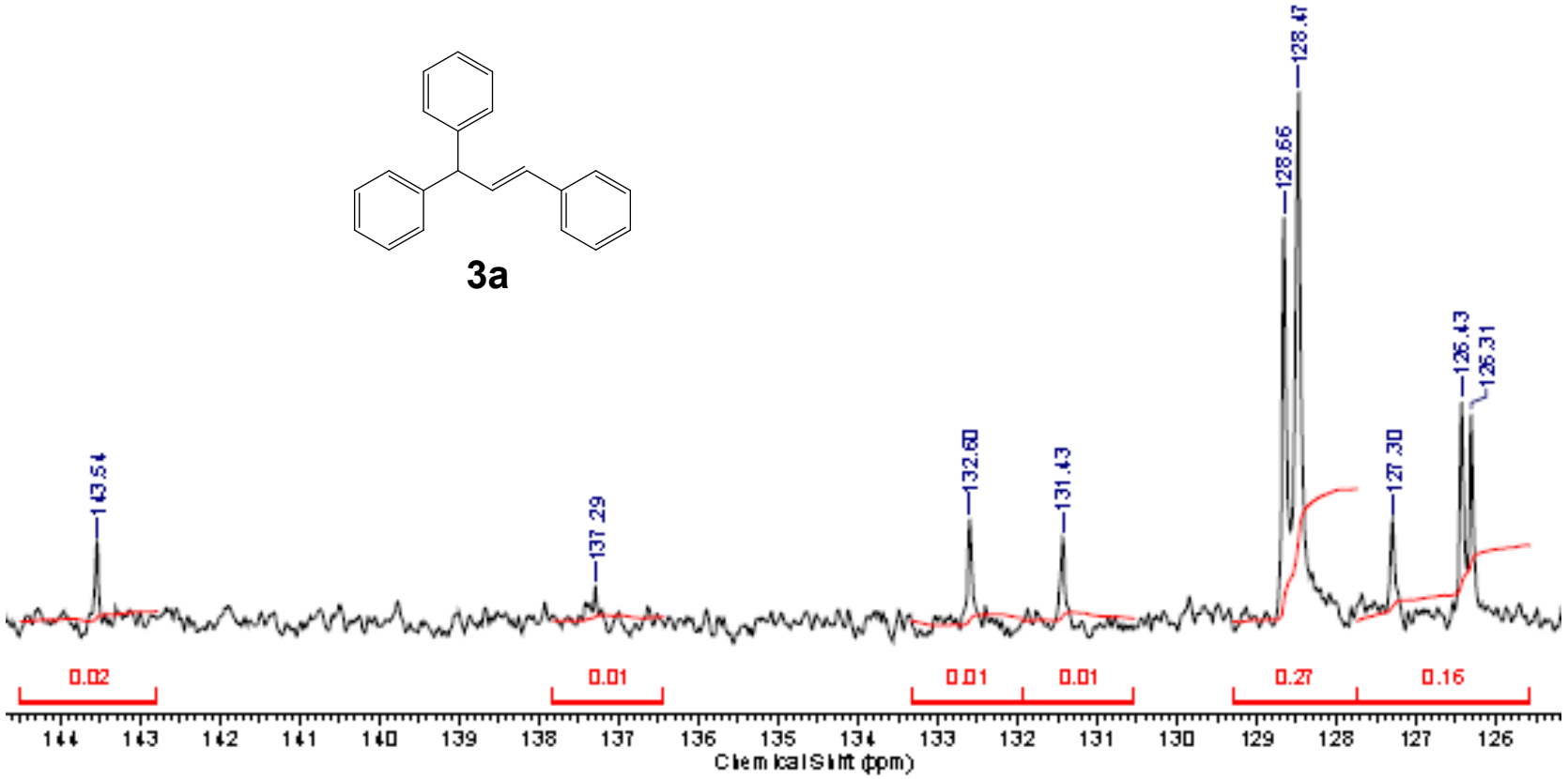


Table 2 entry 4, ^{1}H NMR

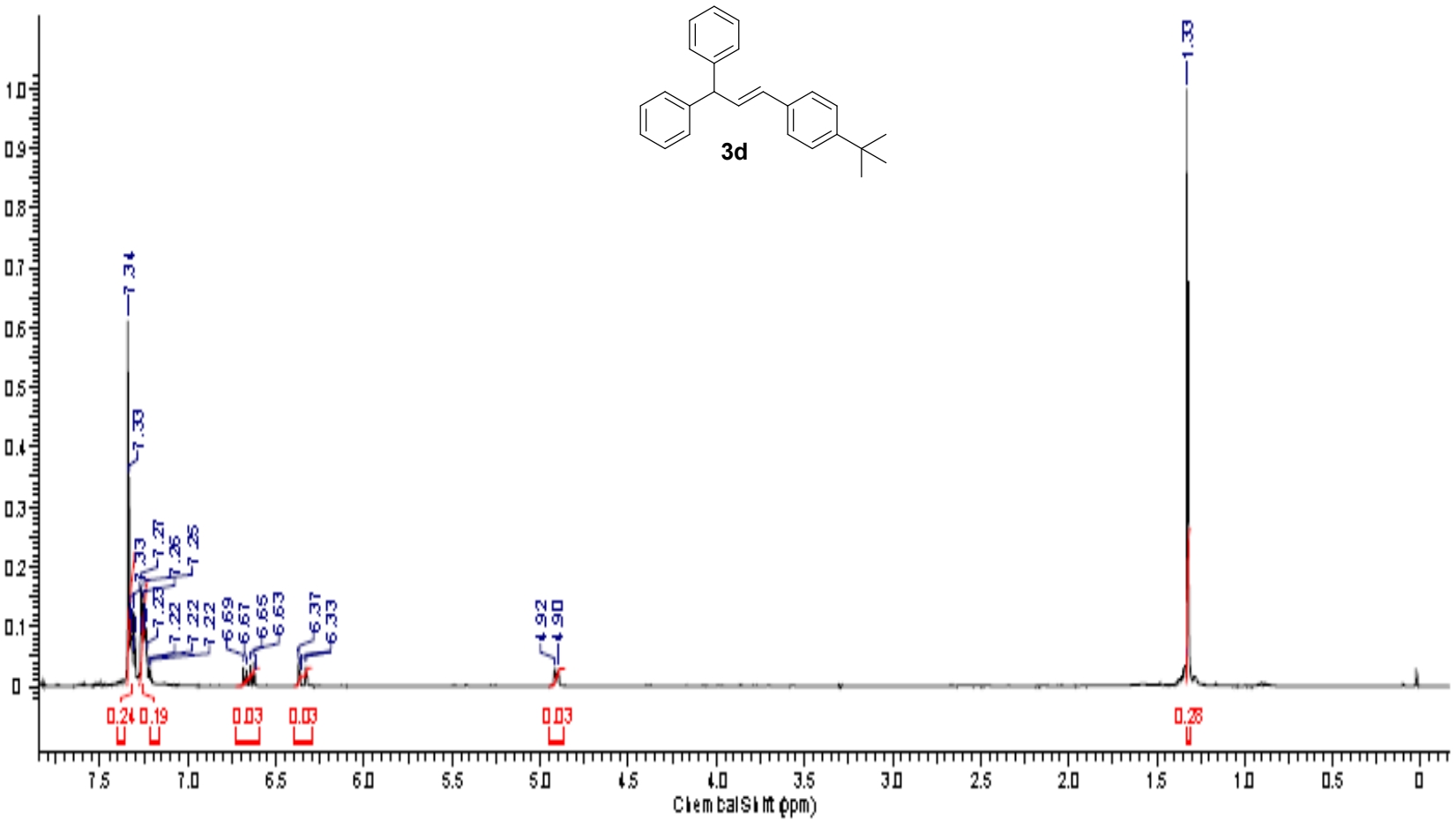


Table 2 entry 4, ^{13}C NMR

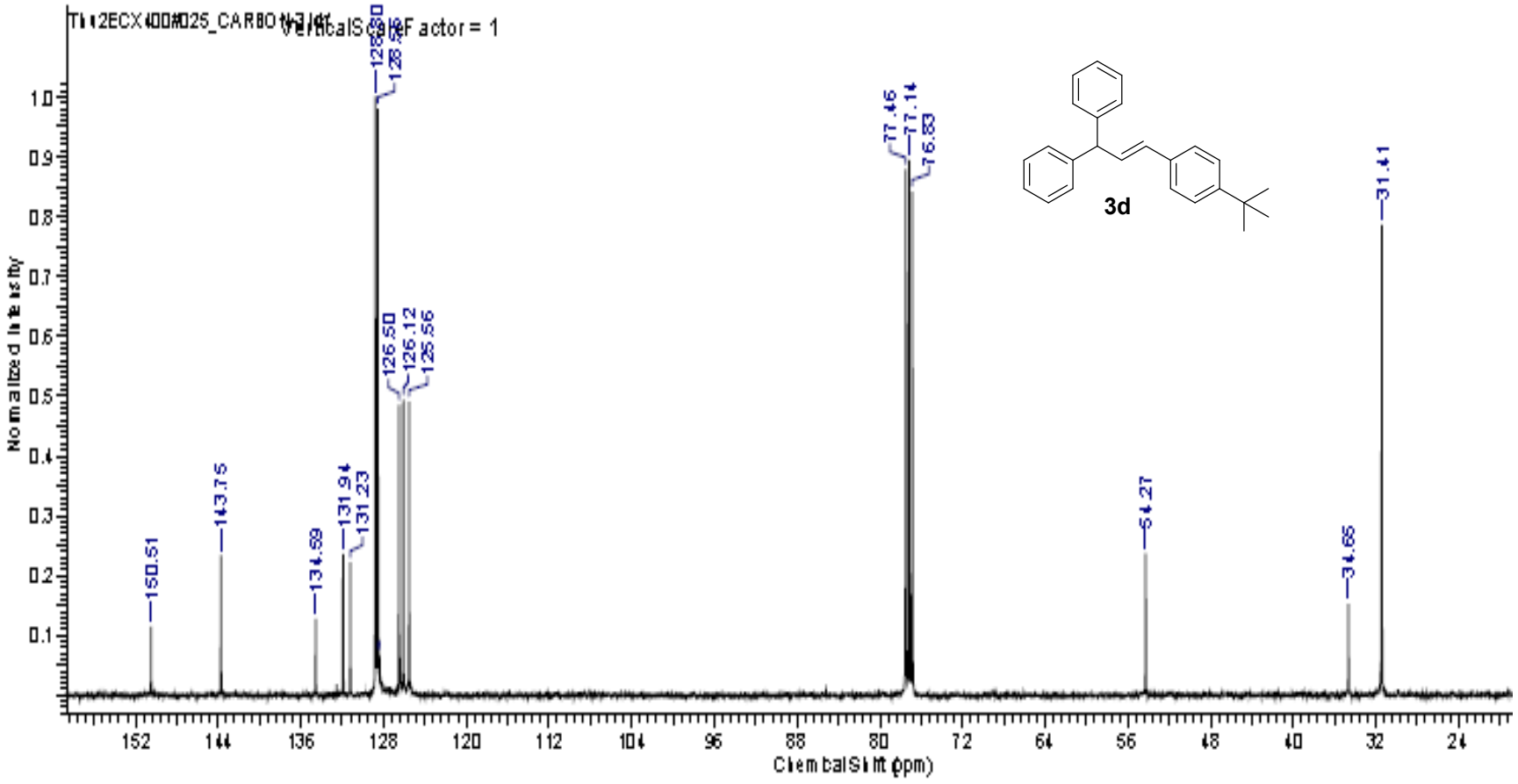


Table 2 entry 5, ^{1}H NMR

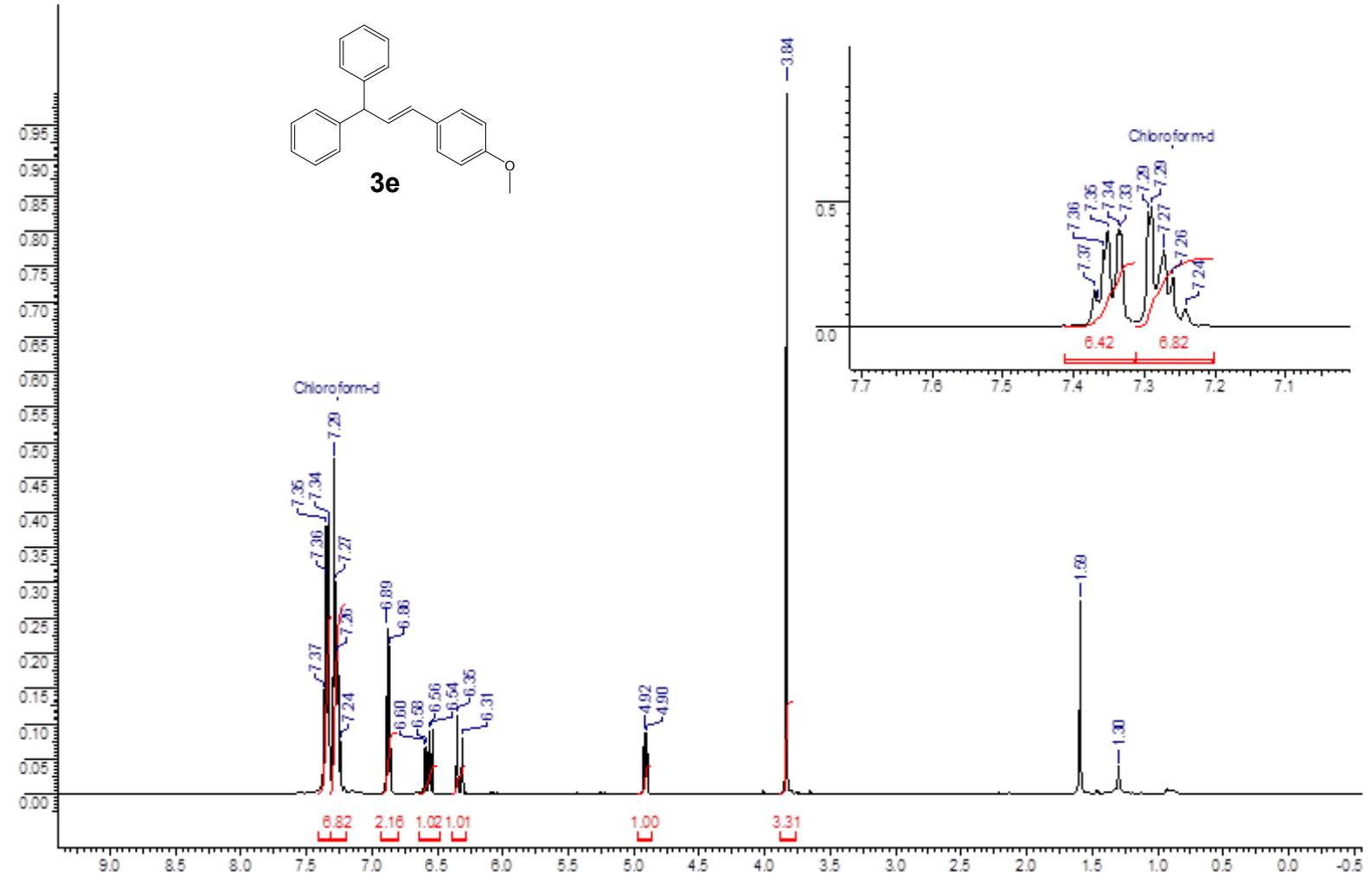


Table 2 entry 5, ^{13}C NMR

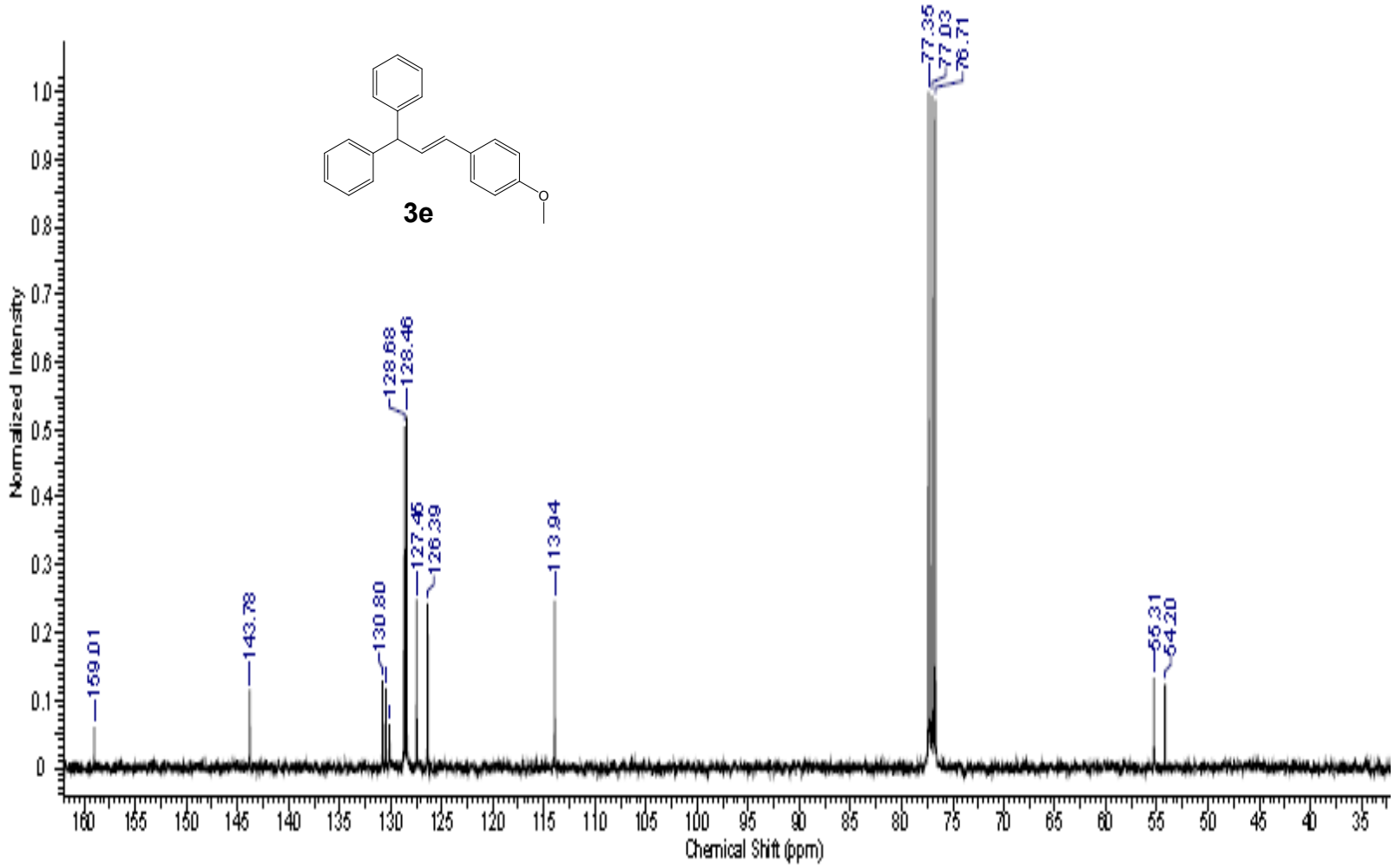


Table 2 entry 7, ^{1}H NMR

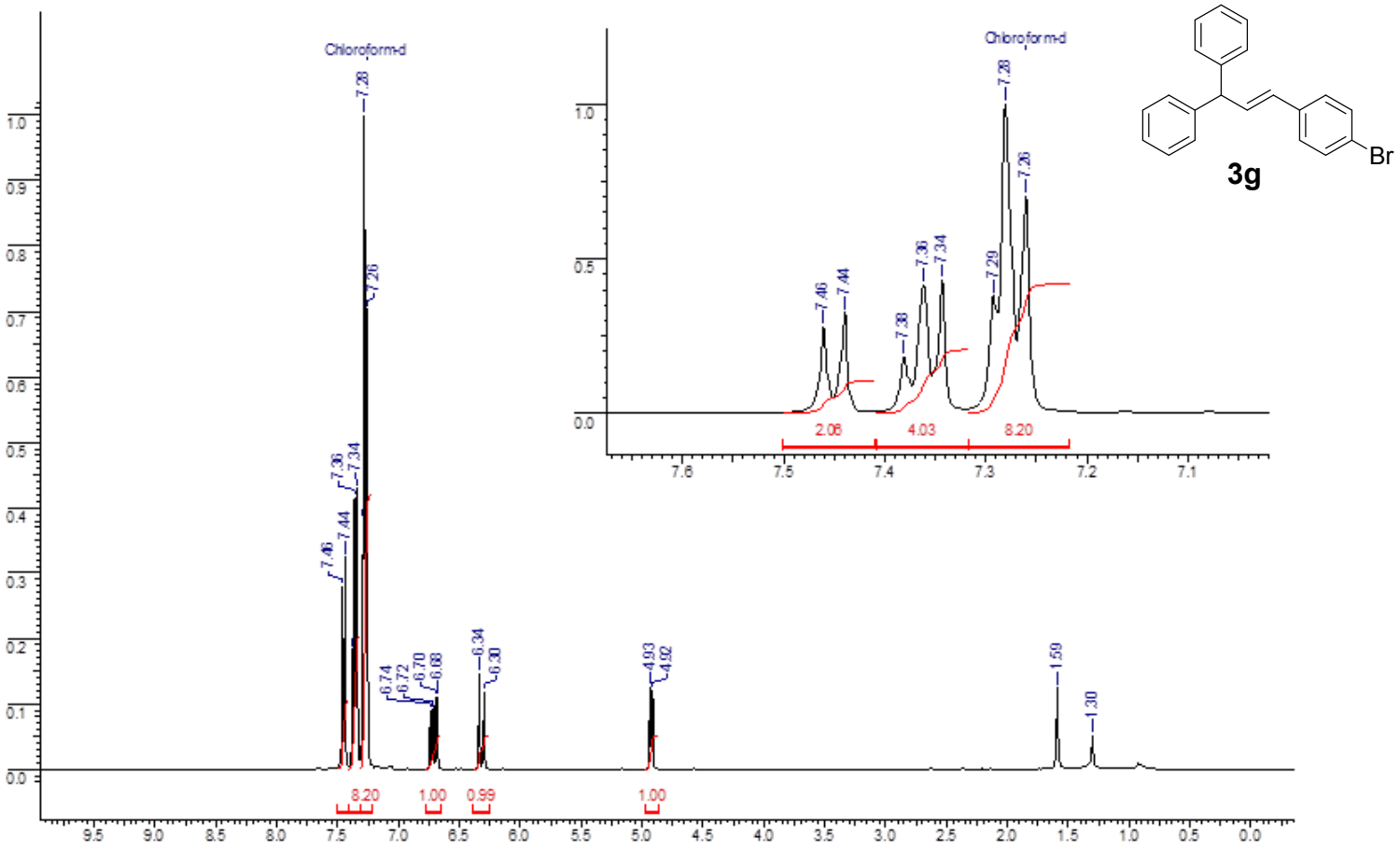


Table 2 entry 7, ^{13}C NMR

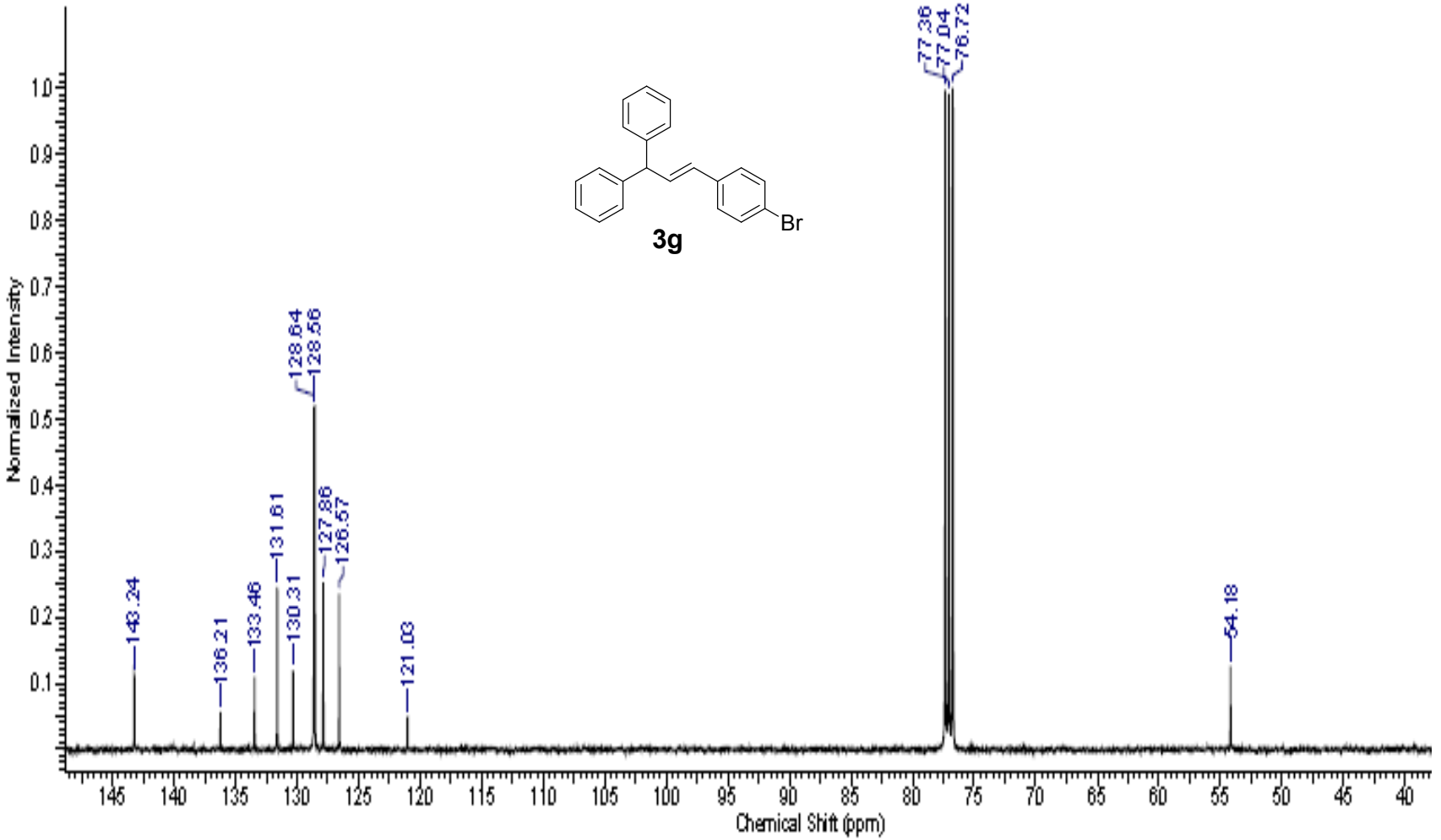


Table 2 entry 8, ^{1}H NMR

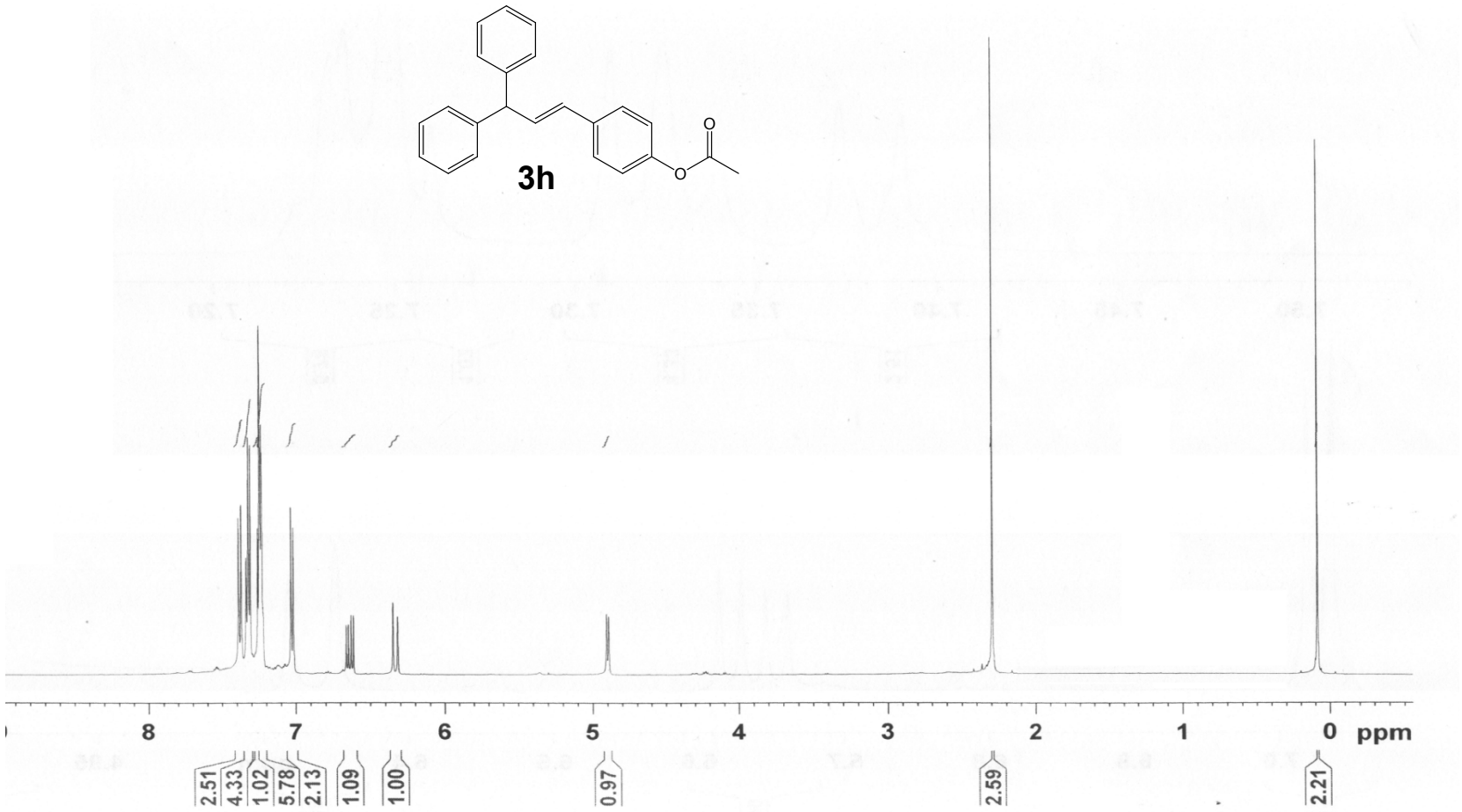


Table 2 entry 8, ^{13}C NMR