Electronic Supplementary Material (ESI) for Green Chemistry.

Supporting Information

Regioselective and Stereoselective Sulfonylation of Alkynylcarbonyl Compounds in Water

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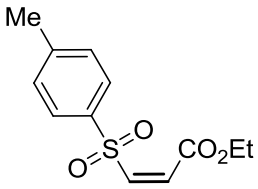
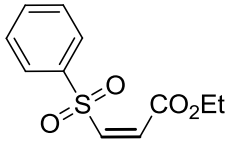
(*Z*)-ethyl 3-tosylacrylate (3aa)[1]



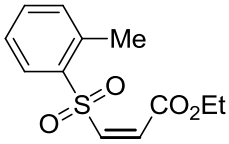
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.0 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 2H), 6.52 (d, *J* = 11.6 Hz, 1H), 6.27 (d, *J* = 11.6 Hz, 1H), 4.32 (q, *J* = 7.2 Hz, 2H), 2.45 (s, 3H), 1.35 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 164.1, 145.2, 136.5, 135.4, 131.4, 130.0, 128.3, 62.2, 21.7, 14.0.

(*Z*)-ethyl 3-(phenylsulfonyl)acrylate (3ba)[1]



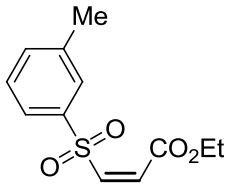
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 (d, *J* = 8.0 Hz, 2H), 7.70 – 7.66 (m, 1H), 7.62 – 7.57 (m, 2H), 6.56 (d, *J* = 11.6 Hz, 1H), 6.53 (d, *J* = 11.2 Hz, 1H), 4.38 (q, *J* = 6.8 Hz, 2H), 1.41 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.1, 139.6, 135.3, 134.2, 132.1, 129.5, 128.4, 62.3, 14.1.

(*Z*)-ethyl 3-(phenylsulfonyl)acrylate (3ca)



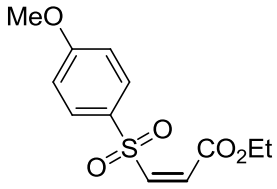
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (d, *J* = 7.6 Hz, 1H), 7.52 (t, *J* = 7.2 Hz, 1H), 7.38(t, *J* = 7.6 Hz, 1H), 7.32 (d, *J* = 7.6 Hz, 1H), 6.61 (d, *J* = 12.0 Hz, 1H), 6.51 (d, *J* = 11.6 Hz, 1H), 4.28 (q, *J* = 6.8 Hz, 2H), 2.65 (s, 3H), 1.33 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.6, 138.4, 137.8, 135.6, 134.0, 132.6, 131.6, 129.7, 126.5, 62.1, 20.3, 13.9. IR: 2971, 1730, 1336, 1144, 730, 705. MS (ESI, m/z) 277 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{14}NaO_4S]^+$ (M + Na^+) 277.0505, found 277.0501.

(*Z*)-ethyl 3-(m-tolylsulfonyl)acrylate (3da)



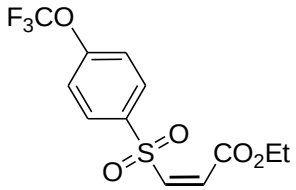
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 – 7.77 (m, 2H), 7.46 – 7.2 (m, 2H), 6.52 (d, *J* = 11.2 Hz, 1H), 6.48 (d, *J* = 11.6 Hz, 1H), 4.35 (q, *J* = 7.2 Hz, 2H), 2.44 (s, 3H), 1.38 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 138.6, 138.3, 134.1, 133.8, 130.7, 128.2, 127.4, 124.3, 61.1, 20.3, 13.0. IR: 2978, 1723, 1344, 1142, 732, 702. MS (ESI, m/z) 277 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{14}NaO_4S]^+$ (M + Na^+) 277.0505, found 277.0511.

(*Z*)-ethyl 3-(4-methoxyphenylsulfonyl)acrylate (3ea)[1]



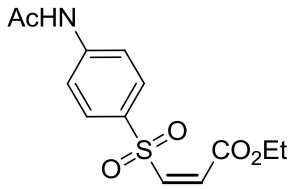
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 9.2 Hz, 2H), 6.95 (d, *J* = 8.8 Hz, 2H), 6.44 (d, *J* = 11.6 Hz, 1H), 6.37 (d, *J* = 11.6 Hz, 1H), 4.29 (q, *J* = 7.2 Hz, 2H), 3.81 (s, 3H), 1.32 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 164.2, 164.1, 135.7, 130.9, 130.6, 114.6, 62.1, 55.7, 14.0.

(*Z*)-ethyl 3-(4-(trifluoromethoxy)phenylsulfonyl)acrylate (3fa)



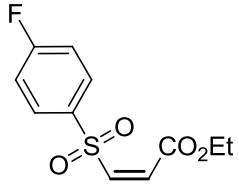
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.4 Hz, 2H), 7.85(d, *J* = 8.4 Hz, 2H), 6.62 (d, *J* = 11.6 Hz, 1H), 6.57 (d, *J* = 11.6 Hz, 1H), 4.37 (q, *J* = 7.2 Hz, 2H), 1.39 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.7, 142.9, 135.6 (d, *J* = 32.6 Hz), 134.5, 133.5, 128.9, 126.4(q, *J* = 3.8 Hz), 123.0 (d, *J* = 271.8 Hz), 62.3, 13.9. IR: 2986, 1734, 1322, 1152, 733, 701. MS (ESI, m/z) 347 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{11}NaF_3O_5S]^+$ (M + Na^+) 347.0171, found 347.0177.

(*Z*)-ethyl 3-(4-acetamidophenylsulfonyl)acrylate (3ga)[2]



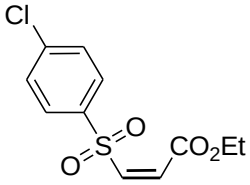
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.4 Hz, 2H), 7.70 (d, *J* = 8.8 Hz, 2H), 7.57 (s, 1H), 6.45 (d, *J* = 11.2 Hz, 1H), 6.41 (d, *J* = 11.6 Hz, 1H), 4.29 (q, *J* = 6.8 Hz, 2H), 2.15 (s, 3H), 1.31 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 168.7, 164.1, 143.3, 135.4, 133.9, 131.6, 129.7, 119.4, 62.1, 24.7, 13.9.

(*Z*)-ethyl 3-(4-fluorophenylsulfonyl)acrylate (3ha)[1]



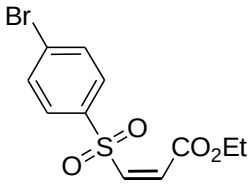
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 – 7.93 (m, 2H), 7.18 (d, *J* = 8.0 Hz 2H), 6.45 (s, 2H), 4.30 (q, *J* = 7.2 Hz, 2H), 1.32 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.1 (d, *J* = 271.2 Hz), 163.9, 135.5 (d, *J* = 3.7 Hz), 135.2, 132.2, 131.3(d, *J* = 9.4 Hz), 116.7 (d, *J* = 22.6 Hz), 62.3, 14.0.

(*Z*)-ethyl 3-(4-chlorophenylsulfonyl)acrylate (3ia)[2]



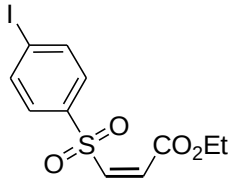
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.4 Hz, 2H), 7.48 (d, *J* = 8.8 Hz 2H), 6.46 (s, 2H), 4.29 (q, *J* = 7.2 Hz, 2H), 1.32 (t, *J* =6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.9, 140.9, 138.0, 135.0, 132.5, 129.8, 129.7, 62.3, 14.0.

(*Z*)-ethyl 3-(4-bromophenylsulfonyl)acrylate (3ja)[1]



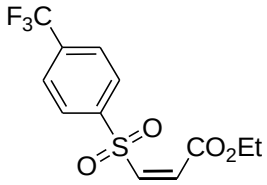
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 8.4 Hz, 2H), 7.64 (d, *J* = 8.4 Hz, 2H), 6.46 (s, 2H), 4.29 (q, *J* = 7.2 Hz, 2H), 1.31 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.8, 138.5, 135.0, 132.6, 132.5, 129.8, 129.5, 62.3, 14.0.

(*Z*)-ethyl 3-(4-iodophenylsulfonyl)acrylate (3ka)



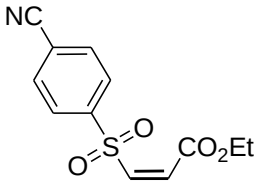
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.8 Hz, 2H), 7.71 (d, *J* = 8.4 Hz, 2H), 6.56 (d, *J* =11.2 Hz, 1H), 6.52 (d, *J* = 11.6 Hz, 1H), 4.36 (q, *J* = 7.2 Hz, 2H), 1.38 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.8, 139.0, 138.6, 134.8, 132.5, 129.5, 102.2, 62.2, 13.9. MS (ESI, m/z) 367 (M + H^+); HRESIMS Calcd for $[C_{11}H_{12}IO_4S]^+$ (M + H^+) 366.9495, found 366.9494.

(*Z*)-ethyl 3-(4-(trifluoromethyl)phenylsulfonyl)acrylate (3la)



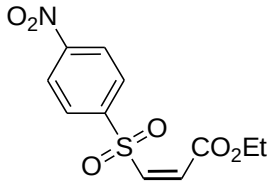
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.4 Hz, 2H), 7.85 (d, *J* = 8.4 Hz, 2H), 6.63 (d, *J* = 11.6 Hz, 1H), 6.58 (d, *J* = 11.6 Hz, 1H), 4.37(q, *J* = 7.2 Hz, 2H), 1.39(t, *J* = 6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.8, 142.9, 135.5 (t, *J* = 32.7 Hz), 134.5, 133.5, 128.8, 126.4 (d, *J* = 3.8 Hz), 123.0 (d, *J* = 271.8 Hz), 62.3, 13.9. IR: 2956, 1733, 1322, 1151, 735, 701. MS (ESI, m/z) 331 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{11}NaF_3O_4S]^+$ (M + Na^+) 331.0222, found 331.0228.

(*Z*)-ethyl 3-(4-cyanophenylsulfonyl)acrylate (3ma)



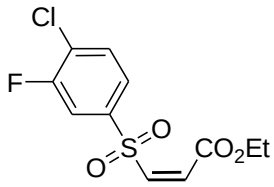
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, *J* = 8.8 Hz, 2H), 7.80 (d, *J* = 8.8 Hz, 2H), 6.56 (d, *J* = 11.2 Hz, 1H), 6.49 (d, *J* = 11.6 Hz, 1H), 4.30 (q, *J* = 7.2 Hz, 2H), 1.31 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.5, 143.6, 134.5, 134.0, 133.0, 128.9, 117.7, 117.0, 62.4, 13.9. IR: 2987, 1735, 1326, 1150, 740, 702. MS (ESI, m/z) 288 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{11}NaNO_4S]^+$ (M + Na^+) 288.0301, found 288.0309.

(*Z*)-ethyl 3-(4-nitrophenylsulfonyl)acrylate (3na)[3]



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34 (d, *J* = 8.8 Hz, 2H), 8.16 (d, *J* = 8.8 Hz, 2H), 6.57 (d, *J* = 11.6 Hz, 1H), 6.51 (d, *J* = 11.2 Hz, 1H), 4.31 (q, *J* = 7.2 Hz, 2H), 1.32 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4, 151.0, 145.2, 134.5, 134.3, 129.8, 124.4, 62.5, 13.8. IR: 2983, 1734, 1325, 1153, 742, 704.

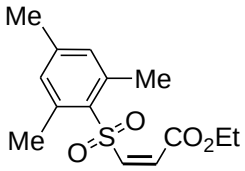
(*Z*)-ethyl 3-(4-chloro-3-fluorophenylsulfonyl)acrylate (3oa)



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 – 8.10 (m, 1H), 7.96 – 7.92 (m, 1H), 7.35 (t, *J* = 8.4 Hz, 1H), 6.60 (d, *J* = 11.6 Hz, 1H), 6.55 (d, *J* = 11.6 Hz, 1H), 4.37 (q, *J* = 7.2 Hz, 2H), 1.40 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.7, 161.6 (d, *J* = 1032.4 Hz), 136.5 (d, *J* = 15.2 Hz), 134.7, 133.2, 131.4, 129.1 (d, *J* = 36.4 Hz), 122.8 (d, *J* = 72.8 Hz), 117.7 (d, *J* = 91.2 Hz), 62.3, 14.0. δ IR: 2985, 1733, 1322, 1152, 740,

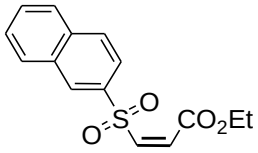
705. MS (ESI, m/z) 315 (M + Na^+); HRESIMS Calcd for $[C_{11}H_{10}NaClFO_4S]^+$ (M + Na^+) 314.9865, found 314.9866.

(*Z*)-ethyl 3-(mesitylsulfonyl)acrylate (3pa)



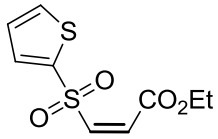
^{1}H NMR (400 MHz, $CDCl_3$) δ 6.89 (s, 2H), 6.59 (d, *J* = 12.0 Hz, 1H), 6.35 (d, *J* = 12.0 Hz, 1H), 4.14 (q, *J* = 7.2 Hz, 2H), 2.57 (s, 6H), 2.23 (s, 3H), 1.22 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 163.7, 143.9, 140.4, 138.4, 133.8, 132.3, 129.7, 62.1, 22.8, 21.2, 14.1. IR: 2925, 1724, 1305, 1146, 732, 704. MS (ESI, m/z) 305 (M + Na^+); HRESIMS Calcd for $[C_{14}H_{18}NaO_4S]^+$ (M + Na^+) 305.0818, found 305.0825.

(*Z*)-ethyl 3-(naphthalen-2-ylsulfonyl)acrylate (3qa)[1]



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (s, 1H), 7.95 – 7.85 (m, 4H), 7.63 – 7.55 (m, 2H), 6.52 (d, *J* = 11.6 Hz, 1H), 6.45 (d, *J* = 11.6 Hz, 1H), 4.32 (q, *J* = 7.2 Hz, 2H), 1.34 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.0, 136.3, 135.5, 135.2, 132.2, 131.9, 130.2, 129.7, 129.6, 129.5, 128.0, 127.7, 122.7, 62.2, 13.9.

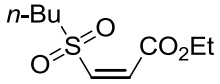
(*Z*)-ethyl 3-(thiophen-2-ylsulfonyl)acrylate (3ra)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 3.6 Hz, 1H), 7.74 (d, *J* = 5.6 Hz, 1H), 7.17 (t, *J* = 4.4 Hz, 1H), 6.64 (d, *J* = 11.6 Hz, 1H), 6.48 (d, *J* = 11.2 Hz, 1H), 4.37 (q, *J* = 7.2 Hz, 2H), 1.39 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ163.8, 140.7,

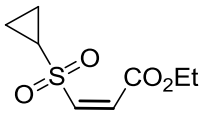
135.9, 135.2, 135.2, 131.6, 128.3, 62.4, 14.1. IR: 2924, 1726, 1319, 1144, 734, 701. MS (ESI, m/z) 269 (M + Na^+); HRESIMS Calcd for $[C_9H_{10}NaO_4S_2]^+$ (M + Na^+) 268.9913, found 268.9916.

(*Z*)-ethyl 3-(butylsulfonyl)acrylate (3sa)



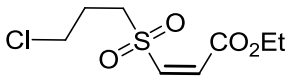
^{1}H NMR (400 MHz, $CDCl_3$) δ 6.59 (d, *J* = 11.2 Hz, 1H), 6.54 (d, *J* = 11.6 Hz, 1H), 4.26 (q, *J* = 7.6 Hz, 2H), 3.18 (t, *J* = 8.0 Hz, 2H), 1.81 – 1.73 (m, 2H), 1.48 – 1.39 (m, 2H), 1.30 (t, *J* = 7.2 Hz, 3H), 0.92 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4, 135.9, 134.1, 62.1, 55.1, 23.8, 21.6, 13.8, 13.4. IR: 2972, 1647, 1304, 1153, 739, 702. MS (ESI, m/z) 243 (M + Na^+); HRESIMS Calcd for $[C_9H_{16}NaO_4S]^+$ (M + Na^+) 243.0662, found 243.0672.

(*Z*)-ethyl 3-(cyclopropylsulfonyl)acrylate (3ta)



^{1}H NMR (400 MHz, $CDCl_3$) δ 6.54(d, *J* = 11.6 Hz, 1H), 6.49(d, *J* = 11.6 Hz, 1H), 4.24(q, *J* = 7.2 Hz, 2H), 2.70 – 2.62 (m, 1H), 1.32 – 1.18 (m, 5H), 1.04 – 0.97 (m, 2H).^{13}C NMR (100 MHz, $CDCl_3$) δ 163.7, 135.9, 132.6, 62.2, 31.4, 13.9, 5.3. IR: 2924, 1726, 1319, 1144, 736, 701. MS (ESI, m/z) 227 (M + Na^+); HRESIMS Calcd for $[C_8H_{12}NaO_4S]^+$ (M + Na^+) 227.0349, found 227.0357.

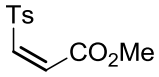
(*Z*)-ethyl 3-(3-chloropropylsulfonyl)acrylate (3ua)



^{1}H NMR (400 MHz, $CDCl_3$) δ 6.65(d, *J* = 12.0 Hz, 1H), 6.59(d, *J* = 11.6 Hz, 1H), 4.32(q, *J* = 7.2 Hz, 2H), 3.69(t, *J* = 6.4 Hz, 2H), 3.43(t, *J* = 7.6 Hz, 2 H), 1.35(t, *J* = 7.2 Hz, 3H), 1.31 – 1.24(m, 2H).^{13}C NMR (100 MHz, $CDCl_3$) δ 163.3, 135.7, 134.8, 62.4, 52.7, 42.7, 25.2, 13.9. IR: 2964, 1733, 1316, 112

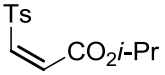
9, 735, 702. MS (ESI, m/z) 263 (M + Na^+); HRESIMS Calcd for [$C_8H_{13}NaClO_4S$]$^+$ (M + Na^+) 263.0115, found 263.0123.

(*Z*)-methyl 3-tosylacrylate (3ab)[2]



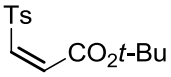
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.0 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 6.53 (d, *J* = 11.6 Hz, 1H), 6.47 (d, *J* = 11.6 Hz, 1H), 3.88 (d, *J* = 1.7 Hz, 3H), 2.44 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.6, 145.4, 136.5, 136.0, 131.1, 130.1, 128.4, 52.9, 21.8.

(*Z*)-isopropyl 3-tosylacrylate (3ac)



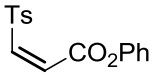
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (d, *J* = 8.4 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 2H), 6.48 (d, *J* = 11.6 Hz, 1H), 6.44 (d, *J* = 11.6 Hz, 1H), 5.28 – 5.19 (m, 1H), 2.45 (s, 3H), 1.38 (s, 3H), 1.37 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.6, 145.1, 136.6, 134.9, 131.8, 129.9, 128.3, 70.3, 21.7, 21.6. IR: 2924, 1722, 1308, 1142, 738, 706. MS (ESI, m/z) 291 (M + Na^+); HRESIMS Calcd for [$C_{13}H_{16}NaO_4S$]$^+$ (M + Na^+) 291.0662, found 291.0667.

(*Z*)-tert-butyl 3-tosylacrylate (3ad)



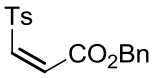
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 8.0 Hz, 2H), 7.28 (d, *J* = 8.4 Hz, 2H), 6.34 (s, 2H), 2.37 (s, 3H), 1.52 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 145.0, 136.7, 133.6, 132.5, 129.9, 128.1, 83.9, 28.0, 21.83. IR: 2925, 1724, 1307, 1147, 731, 701. MS (ESI, m/z) 305 (M + Na^+); HRESIMS Calcd for [$C_{14}H_{18}NaO_4S$]$^+$ (M + Na^+) 305.0818, found 305.0825.

(*Z*)-phenyl 3-tosylacrylate (3ae)



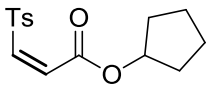
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.4 Hz, 2H), 7.46-7.42 (m, 2H), 7.38 – 7.28 (m, 5H), 6.68 (d, *J* = 11.6 Hz, 1H), 6.65 (d, *J* = 11.6 Hz, 1H), 2.44 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 150.2, 145.6, 136.4, 130.7, 130.2, 129.8, 129.6, 128.6, 126.6, 121.7, 21.9. IR: 2923, 1731, 1307, 1141, 733, 710. MS (ESI, m/z) 325 (M + Na^+); HRESIMS Calcd for $[C_{16}H_{14}NaO_4S]^+$ (M + Na^+) 325.0505, found 325.0511.

(*Z*)-benzyl 3-tosylacrylate (3af)



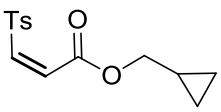
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, *J* = 8.4 Hz, 2H), 7.39 – 7.28 (m, 5H), 7.20 (d, *J* = 6.8 Hz, 2H), 6.47 (d, *J* = 11.2 Hz, 1H), 6.42 (d, *J* = 11.6 Hz, 1H), 5.25 (s, 2H), 2.36 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.9, 145.2, 136.4, 135.9, 134.8, 131.0, 129.9, 128.9, 128.7, 128.6, 128.3, 68.0, 21.7. IR: 2920, 1732, 1305, 1143, 734, 713. MS (ESI, m/z) 362 (M + Na^+); HRESIMS Calcd for $[C_{17}H_{16}NaO_4S]^+$ (M + Na^+) 362.0662, found 362.0668.

(*Z*)-cyclopentyl 3-tosylacrylate (3ag)



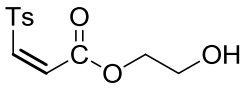
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.0 Hz, 2H), 7.35 (d, *J* = 8.4 Hz, 2H), 6.47 (d, *J* = 11.6 Hz, 1H), 6.44 (d, *J* = 11.2 Hz, 1H), 5.40 – 5.35 (m, 1H), 2.45 (s, 3H), 1.95 – 1.90 (m, 4H), 1.82 – 1.77 (m, 2H), 1.68 – 1.61 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.9, 145.1, 136.6, 134.9, 131.8, 129.9, 128.3, 79.6, 32.4, 23.7, 21.7. IR: 2973, 1742, 1319, 1149, 738, 702. MS (ESI, m/z) 317 (M + Na^+); HRESIMS Calcd for $[C_{15}H_{18}NaO_4S]^+$ (M + Na^+) 317.0818, found 317.0820.

(*Z*)-cyclopropylmethyl 3-tosylacrylate (3ah)



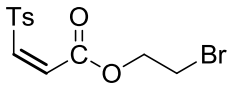
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.0 Hz, 2H), 7.36 (d, *J* = 8.0 Hz, 2H), 6.52 (d, *J* = 11.2 Hz, 1H), 6.49 (d, *J* = 11.6 Hz, 1H), 4.13 (d, *J* = 7.6 Hz, 2H), 2.45 (s, 3H), 1.30 – 1.20 (m, 1H), 0.65 (q, *J* = 5.6 Hz, 2H), 0.37 (q, *J* = 4.8 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.2, 145.2, 136.6, 135.4, 131.4, 139.9, 128.4, 71.1, 21.7, 9.52, 3.53. IR:2924, 1726, 1319, 1144, 701. MS (ESI, m/z) 303 (M + Na^+); HRESIMS Calcd for $[C_{14}H_{16}NaO_4S]^+$ (M + Na^+) 303.0662, found 303.0670.

(*Z*)-2-hydroxyethyl 3-tosylacrylate (3ai)



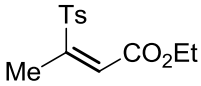
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.4 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 2H), 6.54 (d, *J* = 11.6 Hz, 1H), 6.50 (d, *J* = 11.6 Hz, 1H), 4.47 (t, *J* = 4.4 Hz, 2H), 3.95 (t, *J* = 4.0 Hz, 2H), 2.87 (s, 1H), 2.46 (s, 3H) .^{13}C NMR (100 MHz, $CDCl_3$) δ 164.2, 145.6, 136.0, 135.3, 130.8, 130.1, 128.2, 68.1, 60.7, 21.7. IR: 2971, 1749, 1312, 1145, 735, 706. MS (ESI, m/z) 293 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{14}NaO_5S]^+$ (M + Na^+) 293.0454, found 293.0458.

(*Z*)-2-bromoethyl 3-tosylacrylate (3aj)



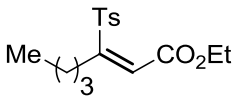
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.4 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 2H), 6.55 (d, *J* = 11.6 Hz, 1H), 6.50 (d, *J* = 11.6 Hz, 1H), 4.61 (t, *J* = 6.4 Hz, 2H), 3.63 (t, *J* = 6.4 Hz, 2H), 2.45 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.7, 145.4, 136.2, 135.9, 130.4, 130.1, 128.3, 65.1, 27.9, 21.7. IR: 2971, 1740, 1312, 1147, 738, 704. MS (ESI, m/z) 355 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{13}NaBrO_4S]^+$ (M + Na^+) 354.9610, found 354.9618.

(*Z*)-ethyl 3-tosylbut-2-enoate (3al)



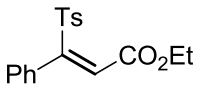
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.4 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 6.26 (s, 1H), 4.35 (q, *J* = 7.2 Hz, 2H), 2.44 (s, 3H), 1.96 (s, 3H), 1.38 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 165.1, 145.1, 142.4, 135.3, 129.9, 128.8, 128.6, 61.9, 21.7, 17.9, 14.0. IR: 2977, 1720, 1344, 1145, 733, 707. MS (ESI, m/z) 291 (M + Na^+); HRESIMS Calcd for $[C_{13}H_{16}NaO_4S]^+$ (M + Na^+) 291.0662, found 291.0665.

(*Z*)-ethyl 3-tosylhept-2-enoate (3am)



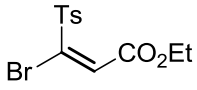
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.6 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 6.25 (s, 1H), 3.89 (s, 3H), 2.45 (s, 3H), 2.24 (t, *J* = 7.6 Hz, 2H), 1.45-1.38 (m, 2H), 1.25-1.21 (m, 4H), 0.83 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.3, 147.1, 145.0, 135.7, 129.9, 128.5, 127.4, 52.7, 30.9, 30.2, 27.3, 22.2, 21.7, 13.8. IR: 2978, 1721, 1343, 1143, 735, 709. MS (ESI, m/z) 305 (M + Na^+); HRESIMS Calcd for $[C_{16}H_{22}NaO_4S]^+$ (M + Na^+) 305.0818, found 305.0810.

(*Z*)-ethyl 3-phenyl-3-tosylacrylate (3an)[4]



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.4 Hz, 2H), 7.36-7.31 (m, 1H), 7.27-7.26 (m, 4H), 7.20 (d, *J* = 8.0 Hz, 2H), 6.39 (s, 1H), 4.42 (q, *J* = 7.2 Hz ,2H), 2.37 (s, 3H), 1.44 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 165.1, 146.2, 144.8, 135.5, 132.3, 130.4, 129.6, 129.6, 129.5, 128.7, 128.2, 62.1, 21.6, 14.0.

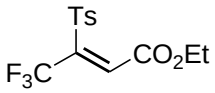
(*E*)-ethyl 3-bromo-3-tosylacrylate (3ao)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 8.0 Hz, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 6.72 (s, 1H), 4.35 (q, *J* = 7.2 Hz, 2H), 2.38 (s, 3H), 1.35 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.6, 144.6, 135.1, 132.5, 129.2, 12 7.2, 124.7, 62.5, 20.7, 12.8. IR: 2973, 1720, 1343, 1146, 738, 702. MS (ESI,

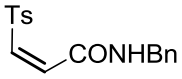
m/z) 355 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{13}NaBrO_4S]^+$ (M + Na^+) 354.9610, found 354.9613.

(Z)-ethyl 4,4,4-trifluoro-3-tosylbut-2-enoate (3ap)



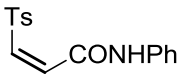
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.0 Hz, 2H), 7.38 (d, *J* = 7.5 Hz, 2H), 7.05 (s, 1H), 4.45 (q, *J* = 7.5 Hz, 2H), 2.47 (s, 3H), 1.43 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.8, 146.1, 136.1, 135.4, 135.3, 129.9, 128.9, 119.1, 62.8, 21.7, 13.8. IR: 2973, 1722, 1345, 1143, 734, 705. MS (ESI, m/z) 345 (M + Na^+); HRESIMS Calcd for $[C_{13}H_{13}F_3NaO_4S]^+$ (M + Na^+) 345.0379, found 345.0381.

(*Z*)-*N*-benzyl-3-tosylacrylamide (3ar)



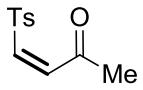
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.4 Hz, 2H), 7.33 – 7.24 (m, 7H), 6.80 (s, 1H), 6.46 (d, *J* = 12.0 Hz, 1H), 6.43 (d, *J* = 12.0 Hz, 1H), 4.49 (d, *J* = 5.6 Hz, 2H), 2.37 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 145.4, 137.1, 136.4, 134.8, 130.1, 128.9, 128.8, 128.2, 128.0, 127.8, 44.13, 21.72. IR: 2978,1721,1343,1143,709. MS (ESI, m/z) 338 (M + Na^+); HRESIMS Calcd for $[C_{17}H_{17}NaNO_3S]^+$ (M + Na^+) 338.0821, found 338.0822.

(*Z*)-N-phenyl-3-tosylacrylamide (3as)



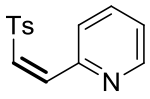
^{1}H NMR (400 MHz, $(CD_3)SO$) δ 10.38 (s, 1H), 7.83 (d, *J* = 8.0 Hz, 2H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.47 (d, *J* = 8.0 Hz, 2H), 7.34 (t, *J* = 8.0 Hz, 2H), 7.09 (t, *J* = 8.0 Hz, 1H), 7.01 (d, *J* = 8.0 Hz, 1H), 6.88 (d, *J* = 8.0 Hz, 1H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $(CD_3)SO$) δ 162.5, 145.1, 139.0, 137.4, 136.7, 133.5, 130.3, 129.2, 128.3, 124.2, 120.1, 21.6. IR: 2976, 1724, 1344, 1141, 732, 705. MS (ESI, m/z) 324 (M + Na^+); HRESIMS Calcd for $[C_{16}H_{15}NaNO_3S]^+$ (M + Na^+) 324.0665, found 324.0667.

(*Z*)-4-tosylbut-3-en-2-one (3at)[5]



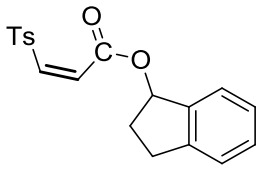
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, *J* = 8.4 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.05 (d, *J* = 15.2 Hz, 1H), 6.90 (d, *J* = 15.6 Hz, 1H), 2.40 (s, 3H), 2. 28 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.7, 141.3, 137.9, 135.6, 131.8, 130.3, 128.3, 29.0, 26.8.

(*Z*)-2-(2-tosylvinyl)pyridine (3au)



^{1}H NMR (400 MHz, $CDCl_3$) δ 8.59 (d, *J* = 4.8 Hz 1H), 7.83 (d, *J* = 8.0 Hz, 2H), 7.73 (t, *J* = 7.6 Hz 1H), 7.62 (d, *J* = 7.6 Hz 1H), 7.45 – 7.39 (m, 2 H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.30 – 7.26 (m, 1H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.1, 150.3, 144.6, 139.9, 137.3, 137.0, 132.2, 129.9, 1 27.9, 125.4, 124.9, 21.6. IR: 2973, 1723, 1343, 1146, 735, 703. MS (ESI, m/z) 282 (M + Na^+); HRESIMS Calcd for $[C_{14}H_{13}NaNO_2S]^+$ (M + Na^+) 282.0559, found 282.0563.

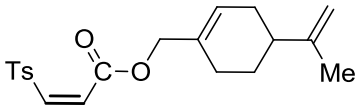
(*Z*)-2,3-dihydro-1H-inden-1-yl 3-tosylacrylate (4aa)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 8.4 Hz, 2H), 7.54 (d, *J* = 7.6 Hz, 1H), 7.34-7.33 (m, 2H), 7.29-7.27 (m, 3H), 6.49 (d, *J* = 11.6 Hz, 1H), 6.46 (d, *J* = 11.6 Hz, 1H), 6.42-6.40 (m, 1H), 3.22-3.14 (m, 1H), 3.22-3.14 (m, 1H), 2.97-2.90 (m, 1H), 2.61-2.52 (m, 1H), 2.43 (s, 3H), 2.42-2.34 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.1, 145.3, 145.1, 140.2, 136.8, 135.5, 131.6, 130.1, 129.5, 128.5, 127.0, 126.3, 125.0, 80.8, 32.1, 30.5, 21.8. IR: 2975, 1726, 1341, 1142, 739, 701. MS (ESI, m/z)

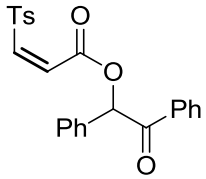
365 (M + Na^+); HRESIMS Calcd for $[C_{19}H_{18}NaO_4S]^+$ (M + Na^+) 365.0818, found 365.0820.

(*Z*)-(4-(prop-1-en-2-yl)cyclohex-1-enyl)methyl 3-tosylacrylate (4ab)



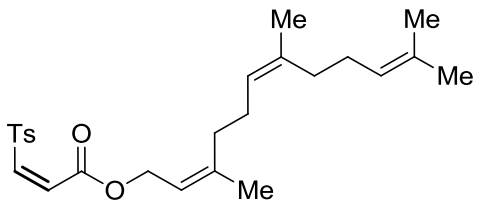
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.4 Hz, 2H), 7.35 (d, *J* = 8 Hz, 2H), 6.54 (d, *J* = 11.6 Hz, 1H), 6.49 (d, *J* = 11.6 Hz, 1H), 5.88 (s, 1H), 4.74-4.73 (m, 2H), 4.67 (s, 2H), 2.45 (s, 3H), 2.22-2.16 (m, 4H), 2.04-1.97 (m, 1H), 1.90-1.84 (m, 1H), 1.75 (s, 3H), 1.56-1.46 (m, 1H), 1.26 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.2, 149.6, 145.3, 136.5, 135.5, 132.0, 131.4, 130.0, 128.4, 127.6, 108.9, 70.3, 40.8, 30.6, 27.4, 26.5, 21.8, 20.9. IR: 2922, 1733, 1320, 1147, 731, 702. MS (ESI, m/z) 383 (M + Na^+); HRESIMS Calcd for $[C_{20}H_{24}NaO_4S]^+$ (M + Na^+) 383.1288, found 383.1389.

(*Z*)-2-oxo-1,2-diphenylethyl 3-tosylacrylate (4ac)



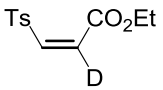
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.0 Hz, 2H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.50– 7.44 (m, 3H), 7.37– 7.30 (m, 5H), 7.09 (d, *J* = 8.0 Hz, 2H), 7.03 (s, 1H), 6.57 (d, *J* = 11.6 Hz, 1H), 7.61 (d, *J* = 11.6 Hz, 1H), 2.32 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 192.9, 163.3, 145.6, 136.1, 134.3, 133.6, 132.8, 130.5, 129.9, 129.7, 129.2, 129.2, 128.9, 128.8, 128.7, 128.3, 79.0, 21.7. IR:2915, 1603, 1264, 1155,741, 703. MS (ESI, m/z) 443 (M + Na^+); HRESIMS Calcd for $[C_{24}H_{20}NaO_5S]^+$ (M + Na^+) 443.0924, found 443.0934.

(*Z*)-((2*Z*,6*Z*)-3,7,11-trimethyldodeca-2,6,10-trienyl) 3-tosylacrylate (4ad)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 6.51 (d, *J* = 11.2 Hz, 1H), 6.46 (d, *J* = 11.6 Hz, 1H), 5.45 (t, *J* = 7.2 Hz, 1H), 5.13-5.07 (m, 2H), 4.83-4.79 (m, 2H), 2.45 (s, 3H), 2.17 – 1.95 (m, 8H), 1.76 (s, 3H), 1.68 (s, 6H), 1.57 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.1, 145.2, 143.8, 136.5, 135.7, 135.5, 131.4, 130.0, 128.4, 124.4, 124.3, 123.6, 117.3, 62.9, 39.7, 39.6, 26.6, 26.2, 26.1, 23.3, 17.7, 16.6, 16.0. IR: 2916, 1607, 1265, 1157, 738, 709. MS (ESI, m/z) 453 (M + Na^+); HRESIMS Calcd for $[C_{25}H_{34}NaO_4S]^+$ (M + Na^+) 453.2070, found 453.2077.

Deuterated -(Z)-ethyl 3-tosylacrylate



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, *J* = 8.0 Hz, 2H), 7.30 (d, *J* = 8.0 Hz, 2H), 6.45 (s, 1H), 4.30 (q, *J* = 7.2 Hz, 2H), 2.38 (s, 3H), 1.33 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.0, 145.2, 136.5, 135.4, 130.0, 128.3, 62.1, 21.7, 14.0. IR: 2926, 1725, 1306, 1144,732, 705. MS (ESI, m/z) 278 (M + Na^+); HRESIMS Calcd for $[C_{12}H_{13}DNaO_4S]^+$ (M + Na^+) 278.0568, found 278.0571.

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(2) Araviiskii, R. A.; Veksler, V. I.; Grinberg, G. E.; Mikhailets, G. A.; Mikhailova, V. N.; Mikhailova, M. A.; Yakovlev, V. V. *Pharm. Chem. J.* **1988**, *22*, 53-57.

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(4) Shi, W.; Zhang, B.; Liu, B.; Xu, F.; Xiao, F.; Zhang, J.; Zhang, S.; Wang, J. *Tetrahedron Lett.* **2004**, *45*, 4563-4566.

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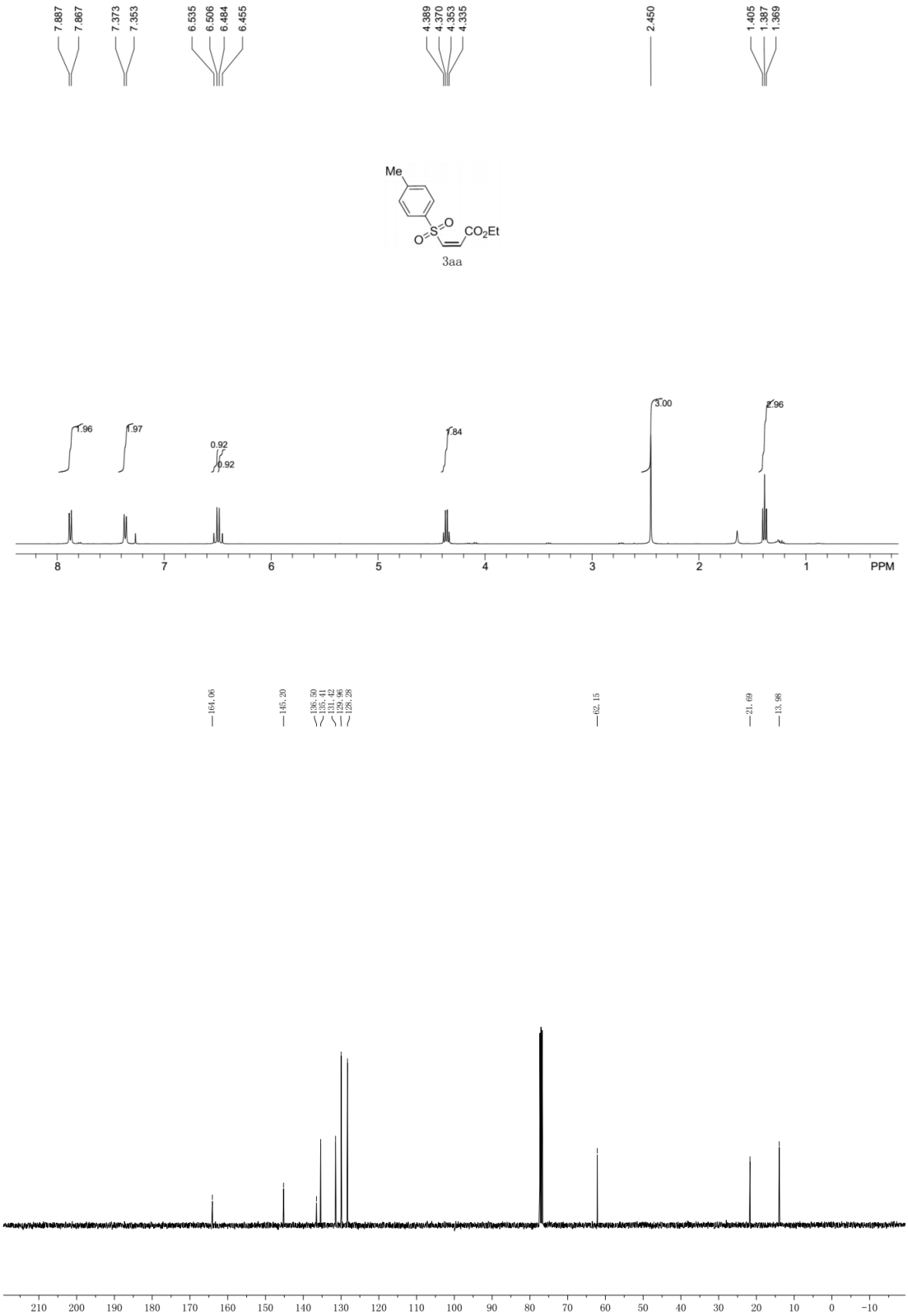
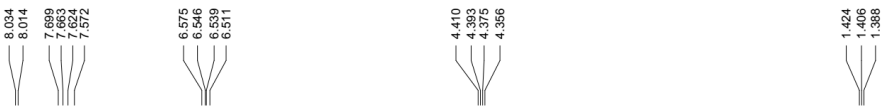
^{1}H and ^{13}C NMR spectra

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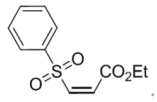
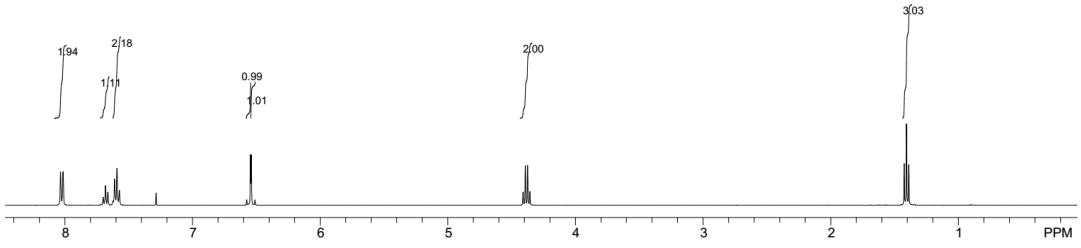
8.014
7.699
7.663
7.624
7.572
6.575
6.546
6.539
6.511
4.410
4.393
4.375
4.356
1.424
1.406
1.388


O
S
O
CO2Et

3ba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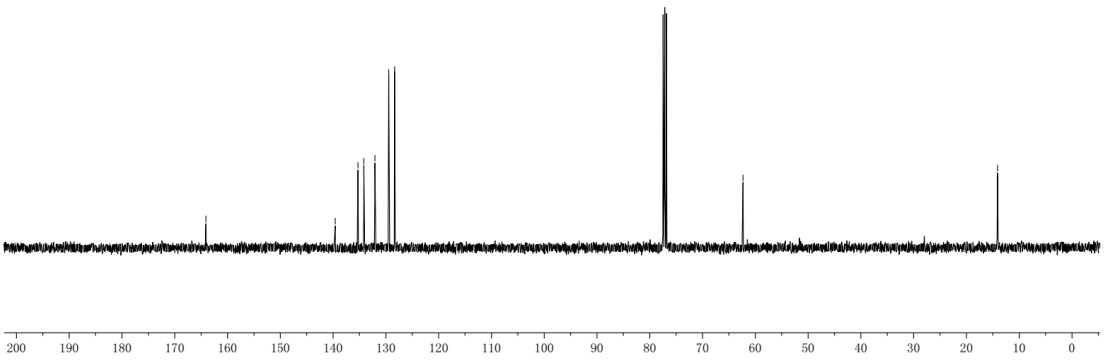
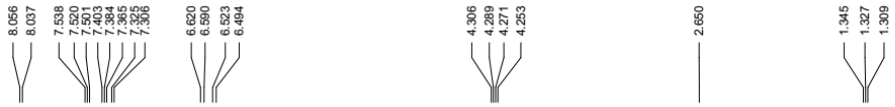
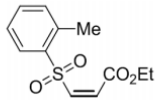
2.18
1.11
0.99
1.01
2.00
3.03
8
7
6
5
4
3
2
1
PPM

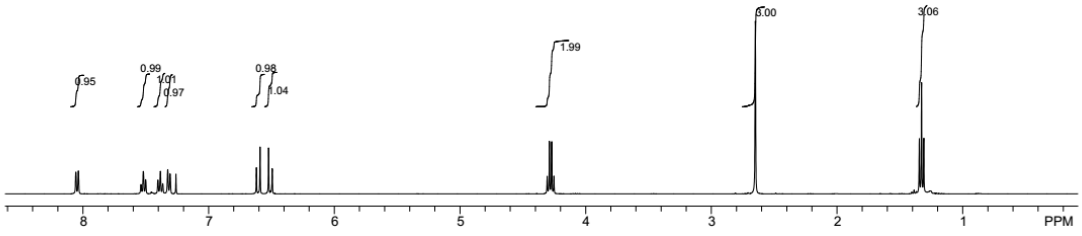

164.10
139.59
135.29
134.18
129.88
129.46
128.35
62.34
14.11


200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


8.056
8.037
7.538
7.520
7.501
7.403
7.384
7.365
7.325
7.306
6.620
6.590
6.523
6.494
4.306
4.289
4.271
4.253
2.650
1.345
1.327
1.309


Me
O
S
O
CO2Et

3ca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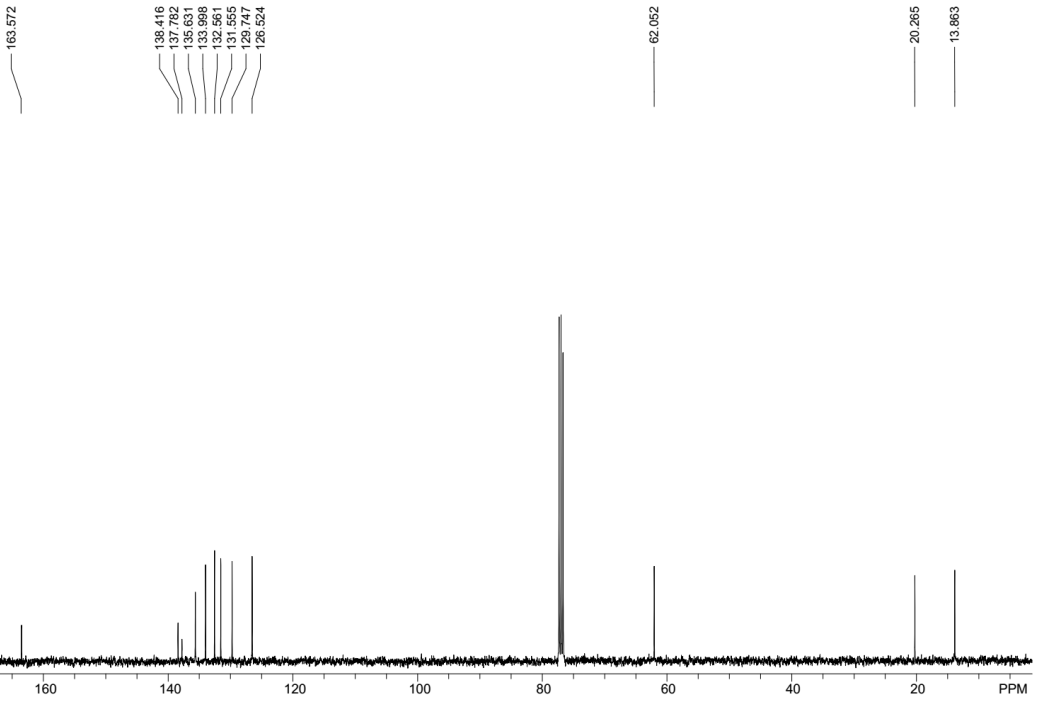
0.99
1.01
0.97
0.98
1.04
1.99
3.00
3.06
8
7
6
5
4
3
2
1
PPM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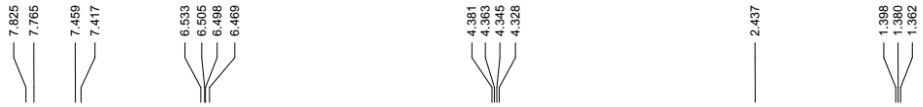
138.416
137.782
135.631
133.998
132.561
131.555
129.747
126.524
62.052
20.265
13.863
160
140
120
100
80
60
40
20
PPM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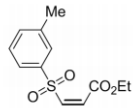
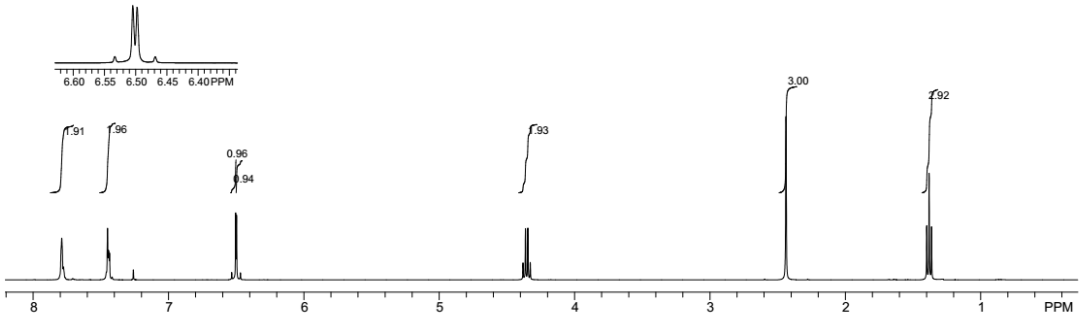
7.765
7.459
7.417
6.533
6.505
6.498
6.469
4.381
4.363
4.345
4.328
2.437
1.398
1.380
1.362


Me
O
S
O
CO2Et

3da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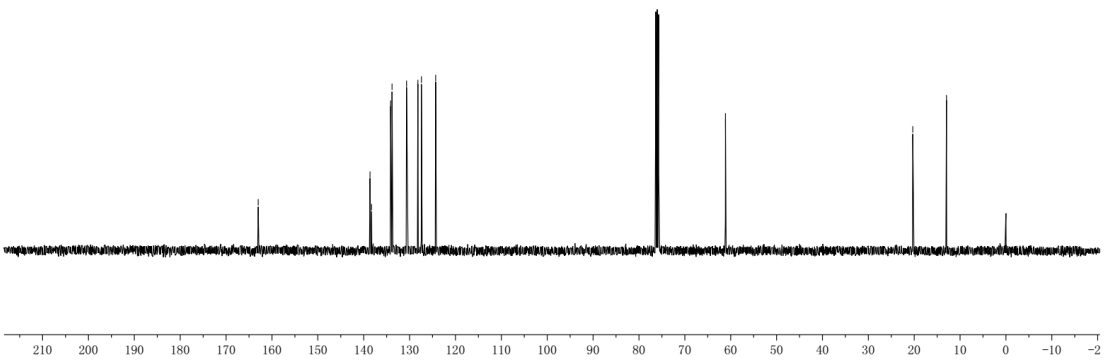
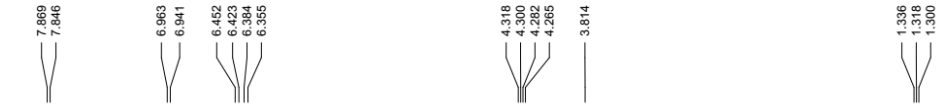
1.91
1.96
0.96
0.94
1.93
3.00
2.92
8
7
6
5
4
3
2
1
PPM


163.00
138.63
136.27
134.14
133.83
130.66
129.19
128.43
127.43
124.32
61.14
20.31
12.97


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−2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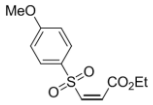
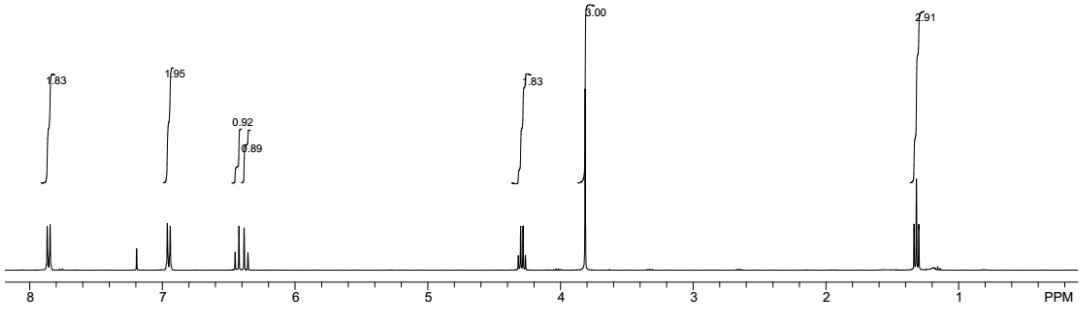
7.846
6.963
6.941
6.452
6.423
6.384
6.355
4.318
4.300
4.282
4.265
3.814
1.336
1.318
1.300


MeO
O
O
S
CO2Et

3ea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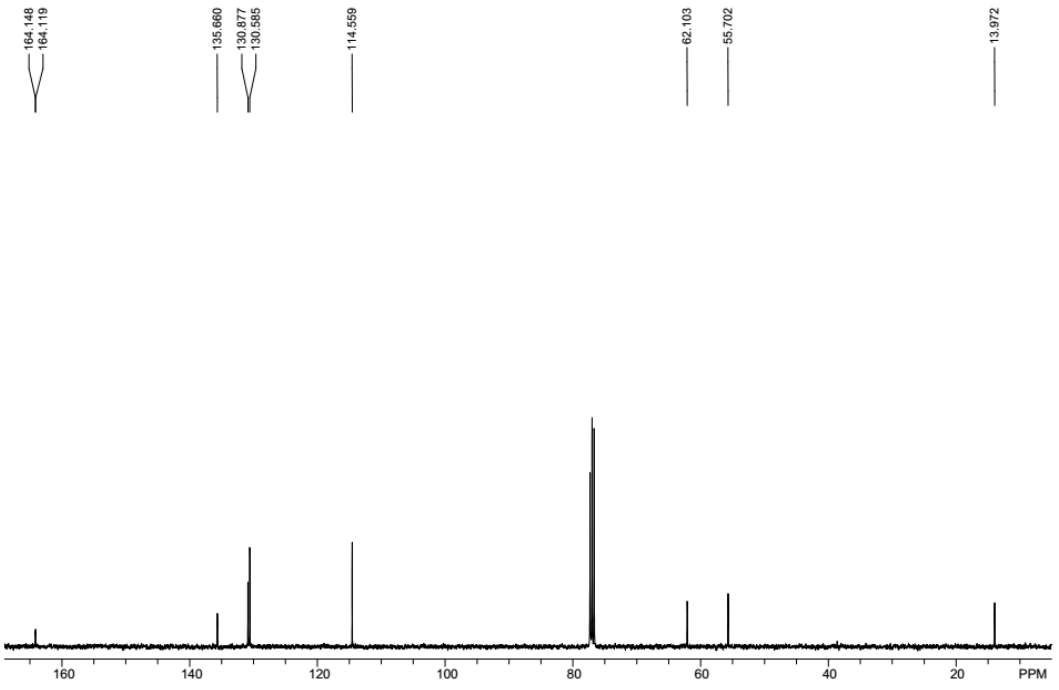
0.92
0.89
1.83
3.00
2.91
8
7
6
5
4
3
2
1
PPM


164.148
164.119
135.660
130.877
130.585
114.559
62.103
55.702
13.972
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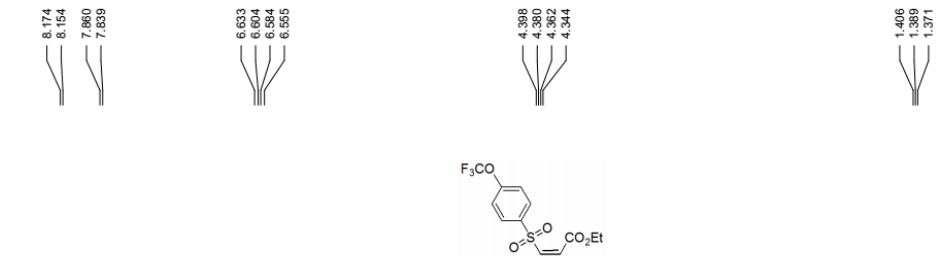
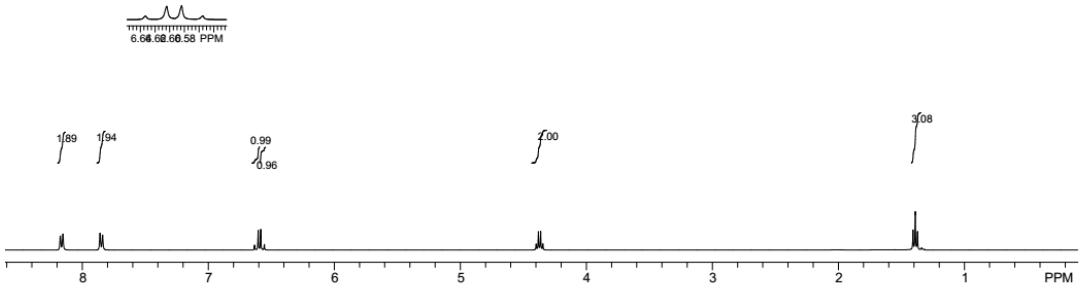
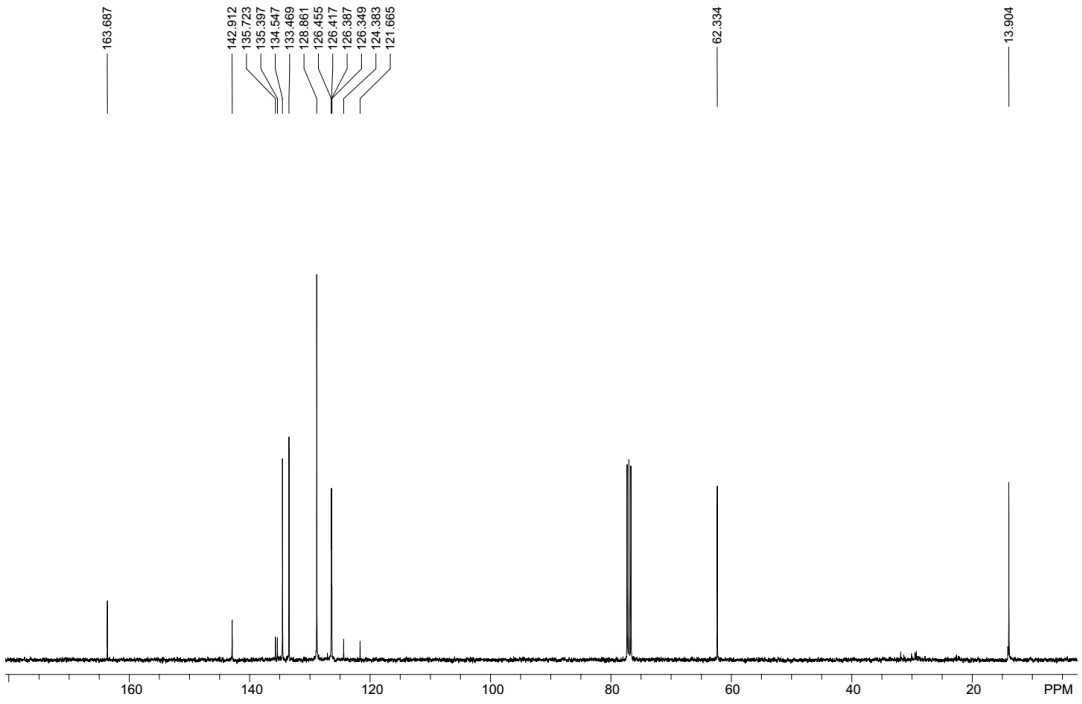
140
120
100
80
60
40
20
PPM


8.174
8.154
7.860
7.839
6.633
6.604
6.584
6.555
4.398
4.380
4.362
4.344
1.406
1.389
1.371
F3CO
O
S
O
CO2Et

3fa


6.64 6.62 6.60 6.58 PPM
1.89
1.94
0.99
0.96
2.00
3.08
8
7
6
5
4
3
2
1
PPM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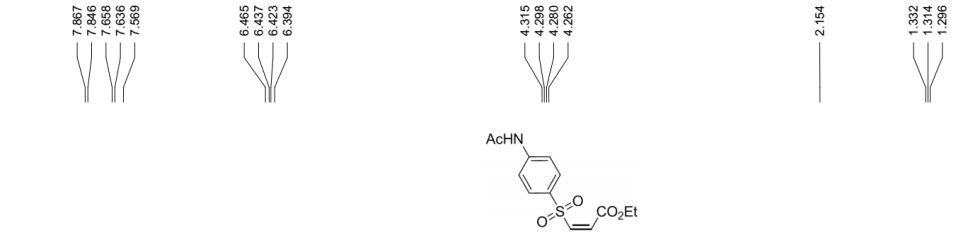
135.723
135.397
134.547
133.469
128.861
126.455
126.417
126.387
126.349
124.383
121.665
62.334
13.904
160
140
120
100
80
60
40
20
PPM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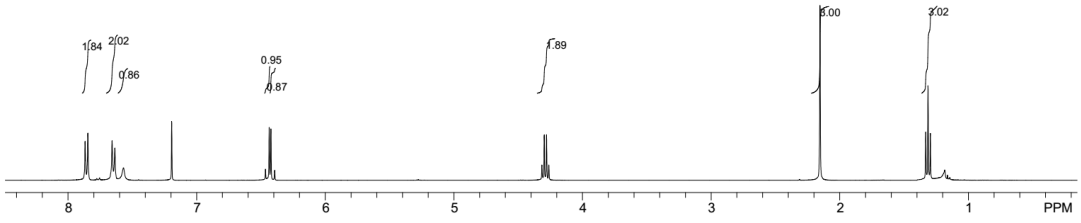
7.846
7.658
7.636
7.569
6.465
6.437
6.423
6.394
4.315
4.298
4.280
4.262
2.154
1.332
1.314
1.296
AcHN
O
S
O
CO2Et

3ga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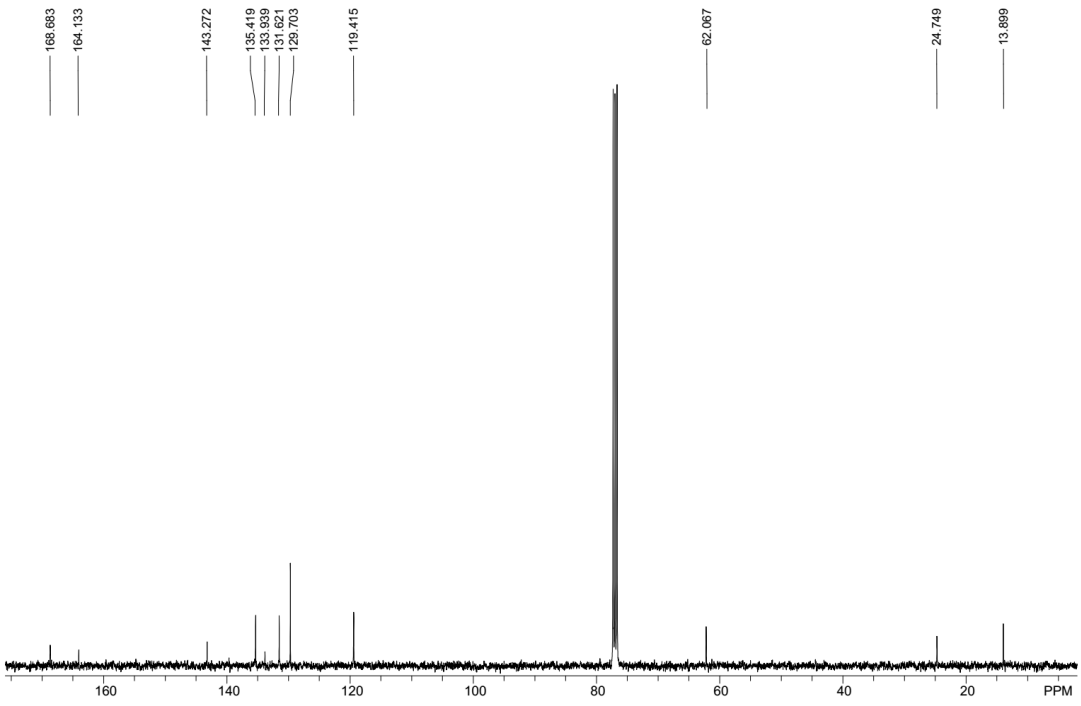
8
7
6
5
4
3
2
1
PPM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13.899
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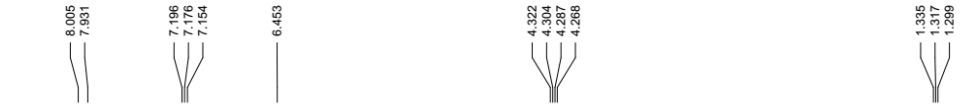
140
120
100
80
60
40
20
PPM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7.154
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4.322
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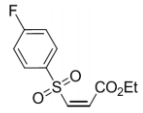
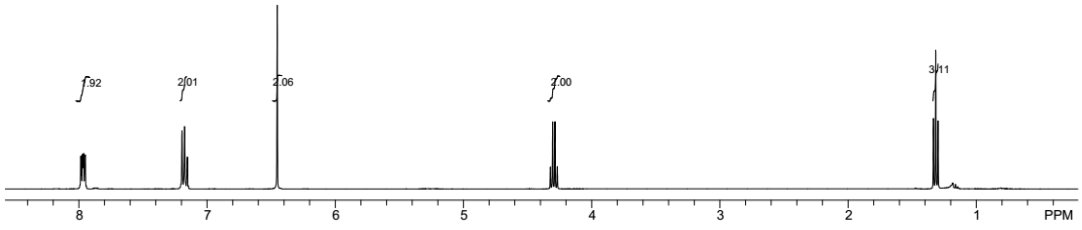
4.287
4.268
1.335
1.317
1.299


F
O
S
O
CO2Et

3ha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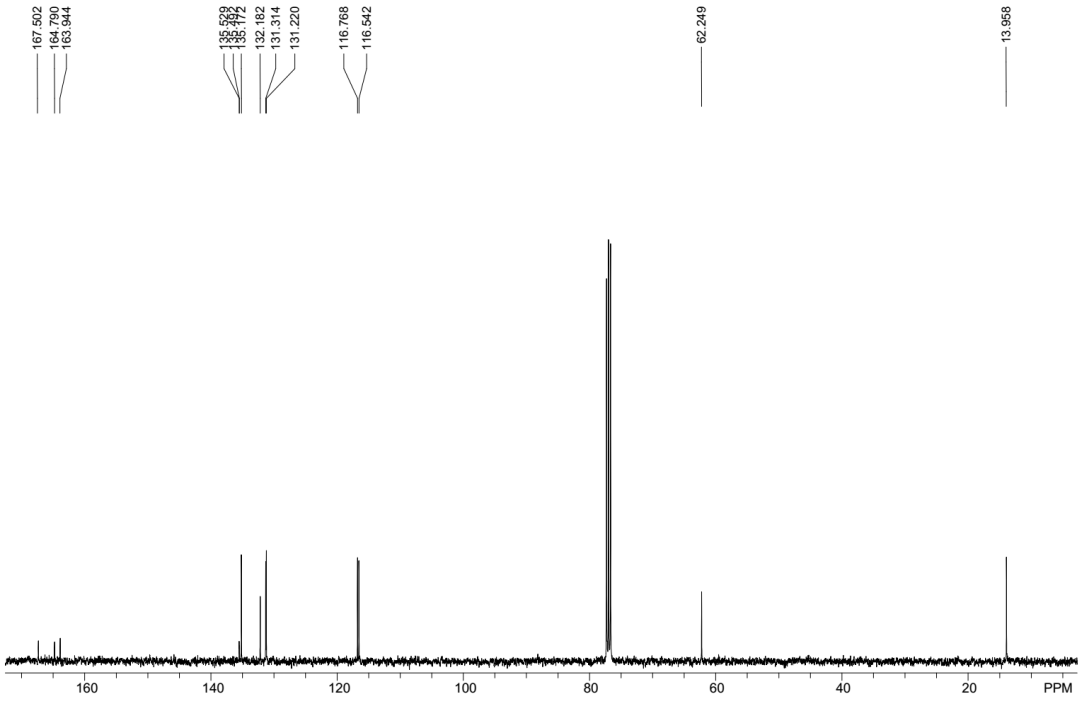
7.00
3.11
8
7
6
5
4
3
2
1
PPM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116.768
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13.958
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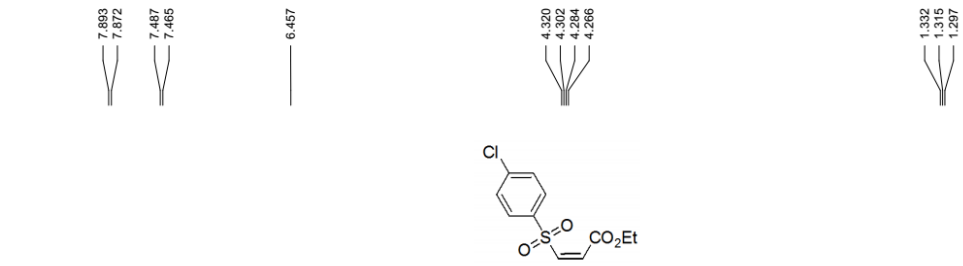
140
120
100
80
60
40
20
PPM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7.487
7.465
6.457
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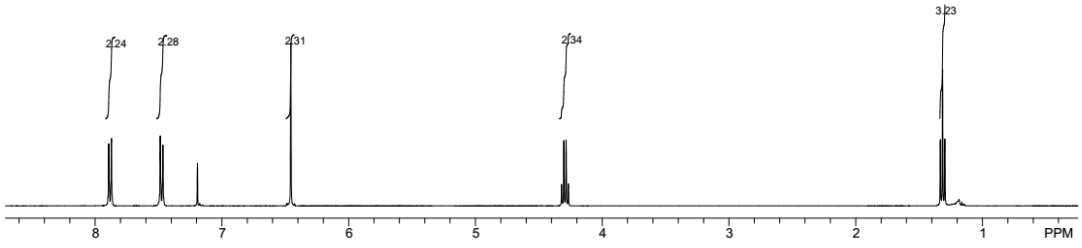
4.302
4.284
4.266
1.332
1.315
1.297
Cl
O
S
O
CO2Et

3ia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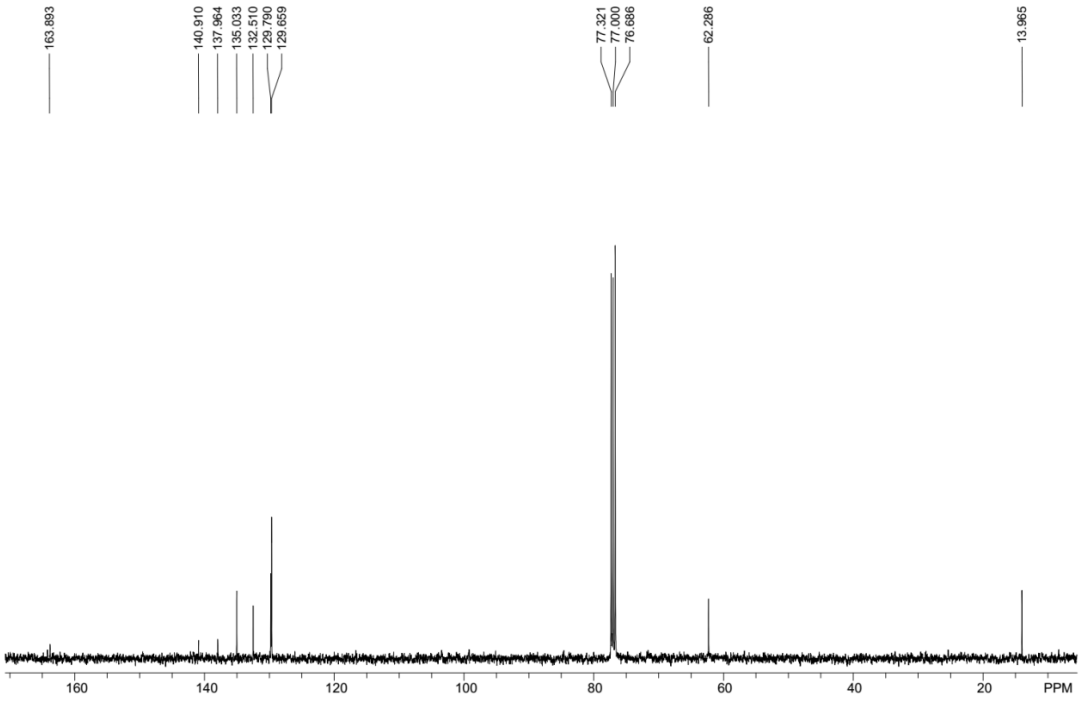
8
7
6
5
4
3
2
1
PPM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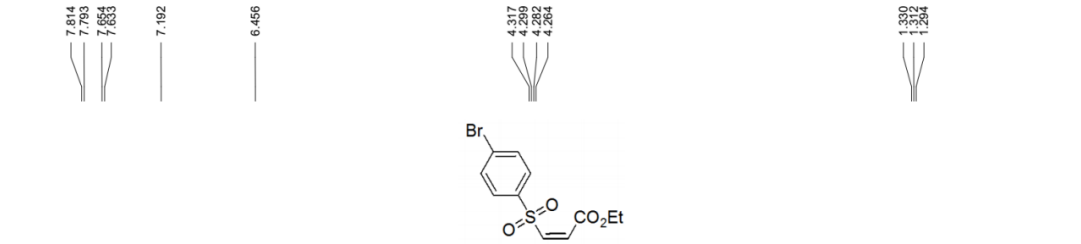
137.964
135.033
132.510
129.790
129.659
77.321
77.000
76.686
62.286
13.965
160
140
120
100
80
60
40
20
PPM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7.654
7.633
7.192
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4.282
4.264
1.330
1.312
1.294
Br
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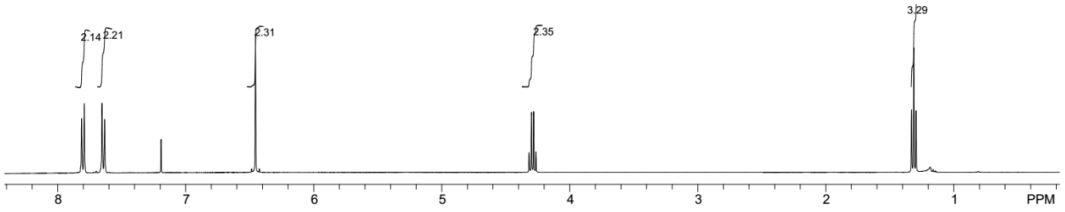
S
O
CO2Et

3ja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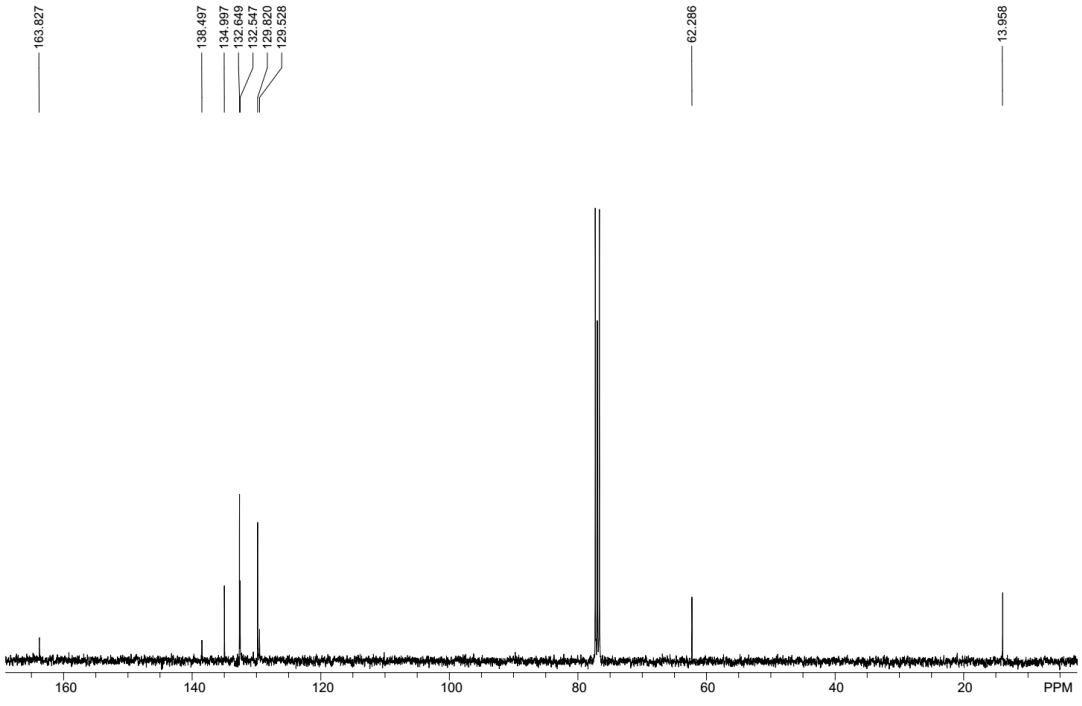
PPM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62.286
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60
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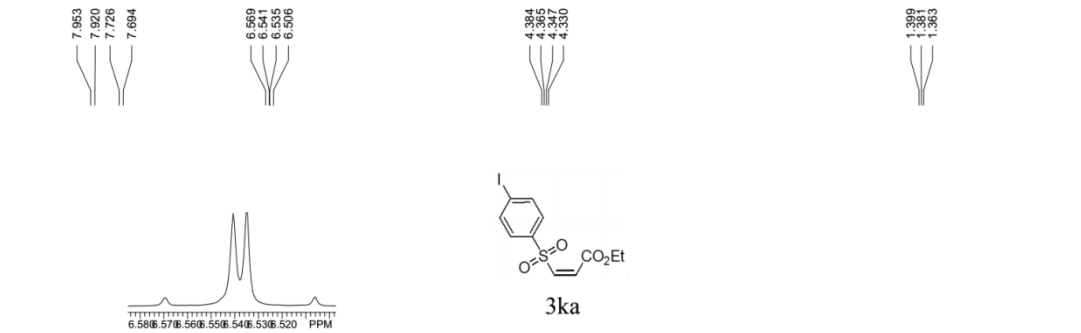
20
PPM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7.694
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6.506
4.384
4.365
4.347
4.330
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1.381
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I
O
S
O
CO2Et
6.580 6.570 6.560 6.550 6.540 6.530 6.520 PPM
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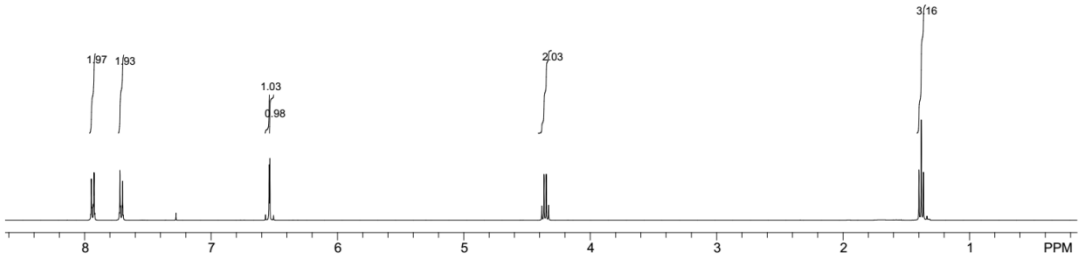
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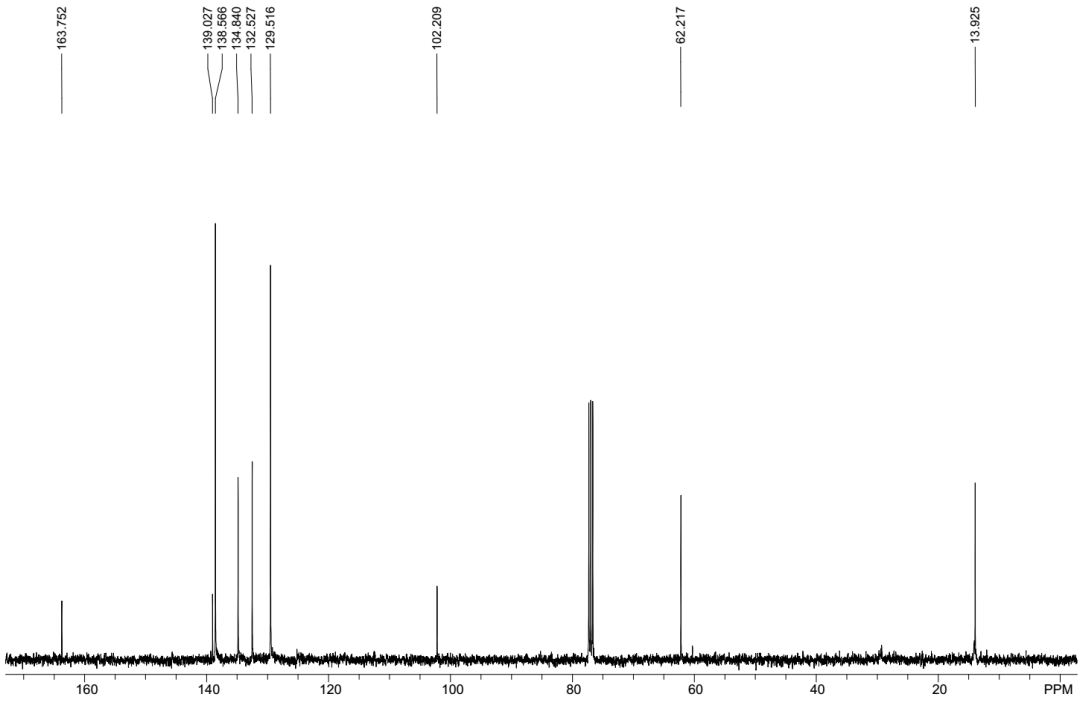
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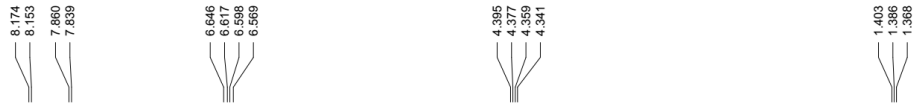
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6.598
6.569
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4.359
4.341
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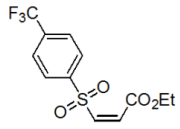
1.386
1.368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S
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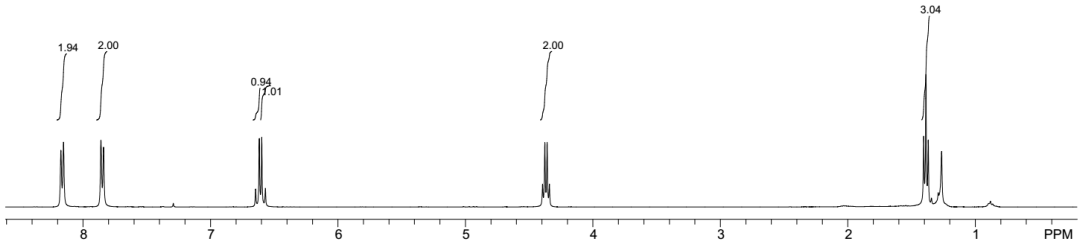
CO2Et

31a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8
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6
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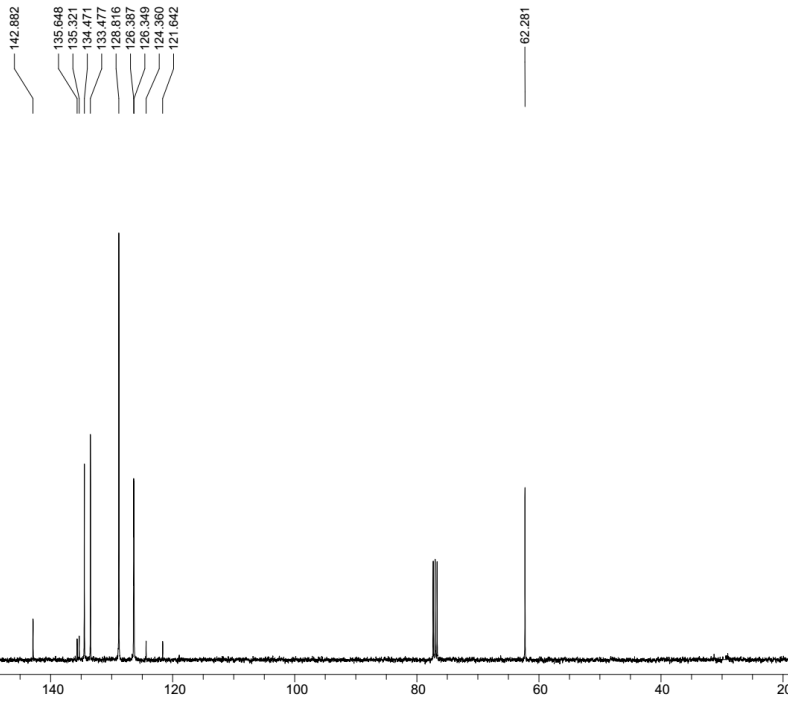
4
3
2
1
PPM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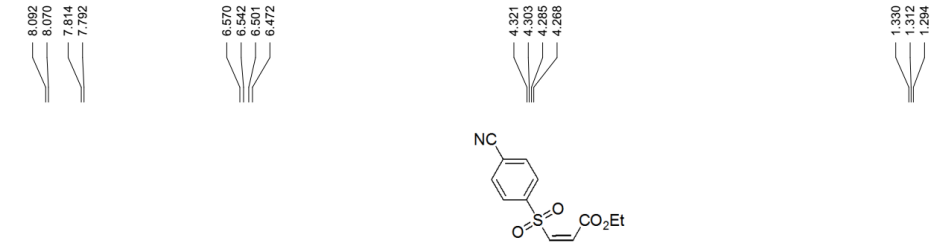
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7.792
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6.542
6.501
6.472
4.321
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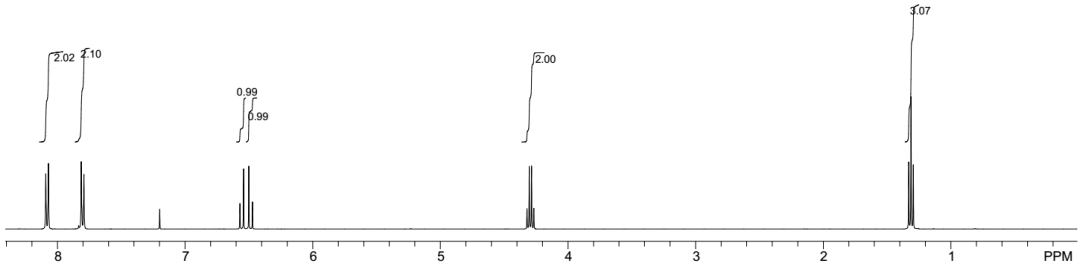
4.285
4.268
1.330
1.312
1.294
NC
O
S
O
O
CO2Et

3ma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0.99
2.00
3.07
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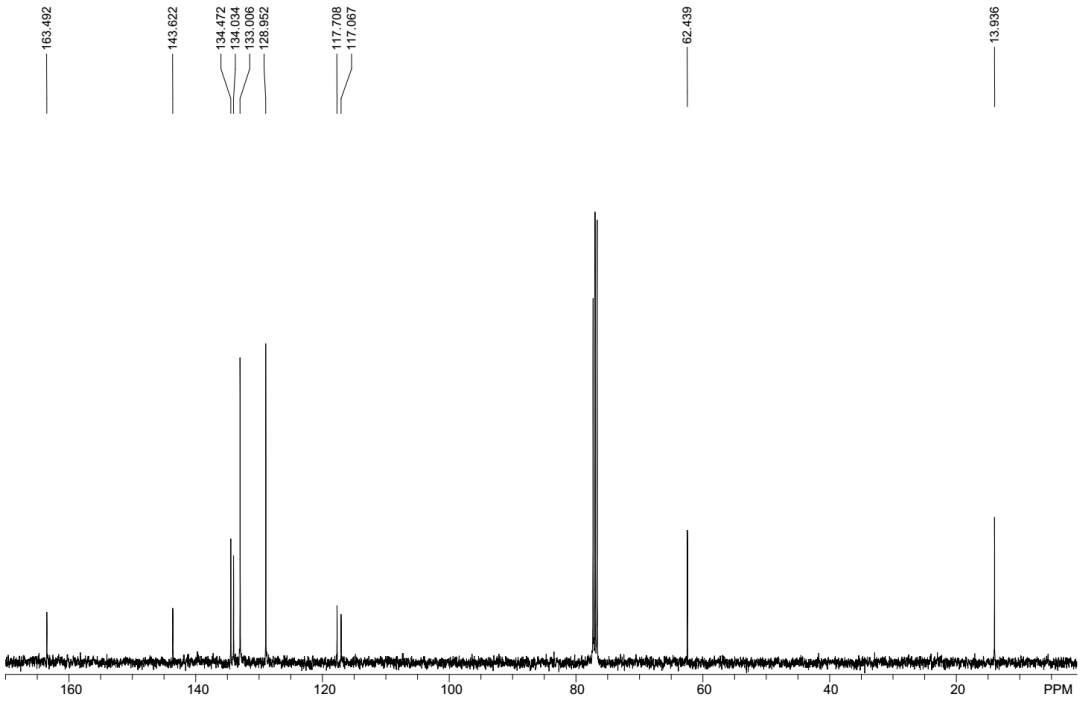
7
6
5
4
3
2
1
PPM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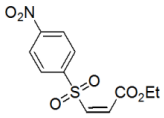
134.034
133.006
128.952
117.708
117.067
62.439
13.936
160
140
120
100
80
60
40
20
PPM


8.353
8.331
8.175
8.153
6.586
6.557
6.523
6.495
4.332
4.314
4.296
4.279
1.339
1.321
1.304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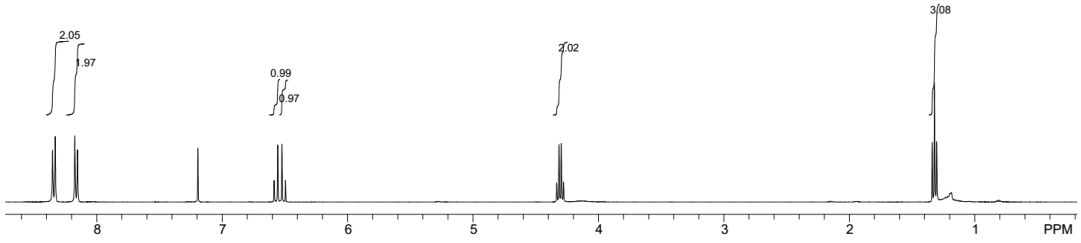
O
S
O
CO2Et

3na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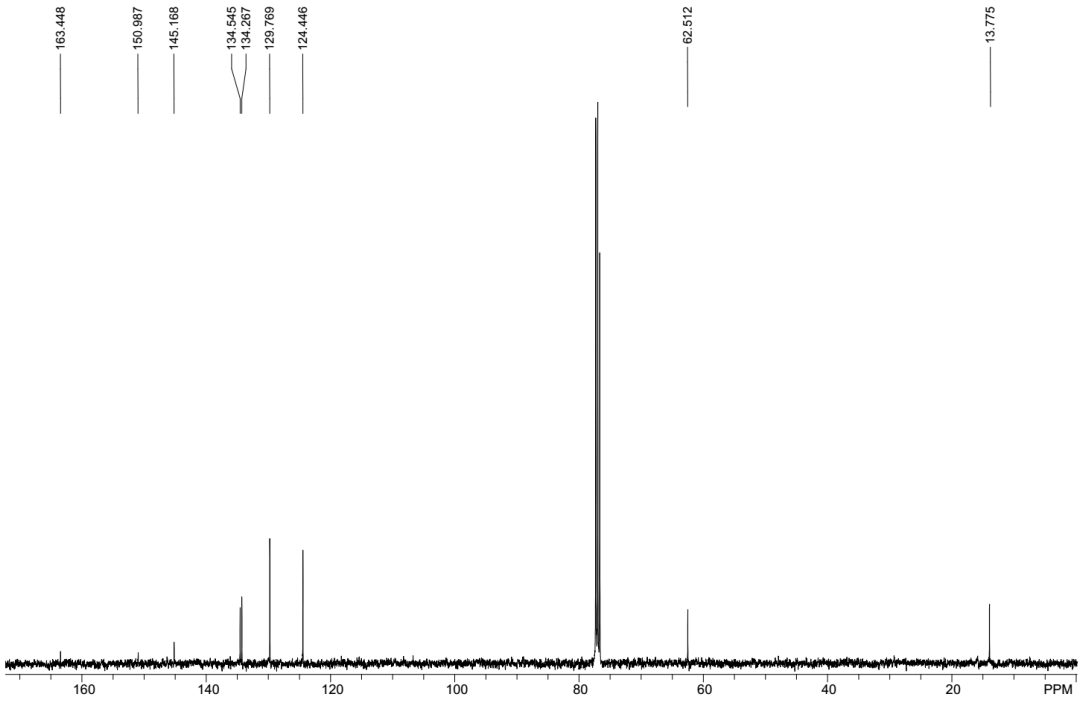
PPM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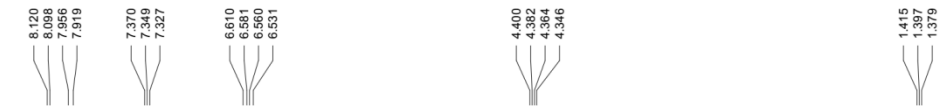
20
PPM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6.560
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4.364
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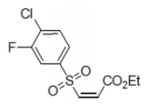
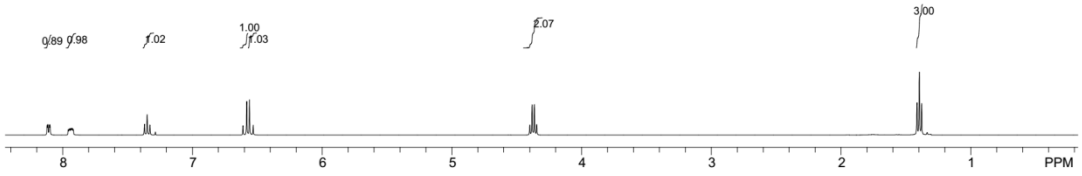
1.397
1.379


Cl
F
O
S
O
CO2Et

3oa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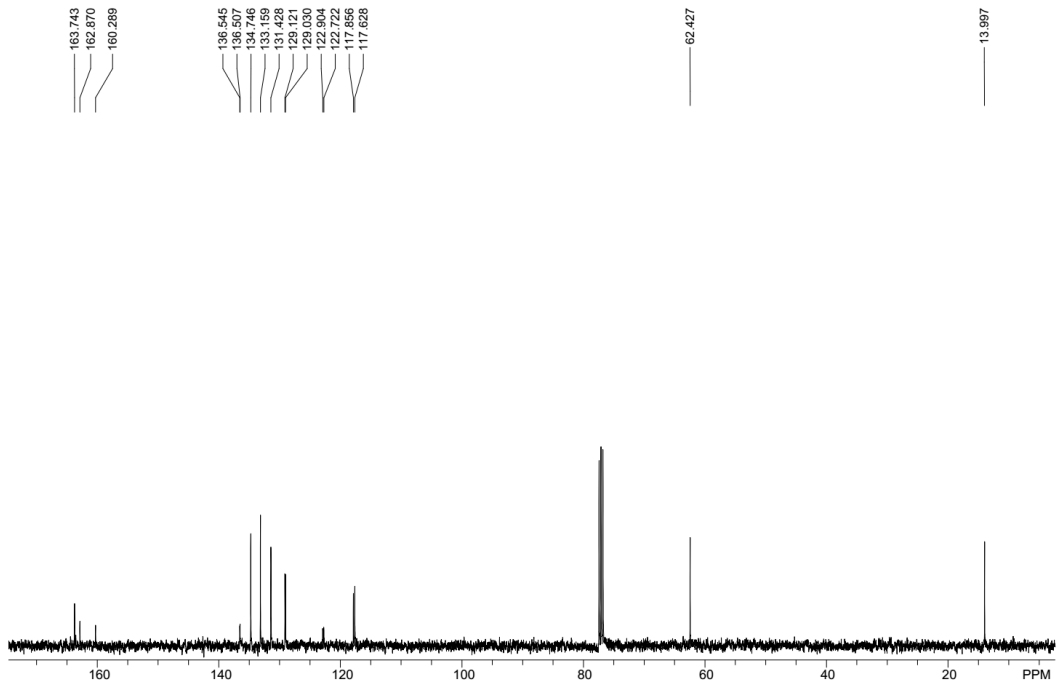
8
7
6
5
4
3
2
1
PPM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129.030
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20
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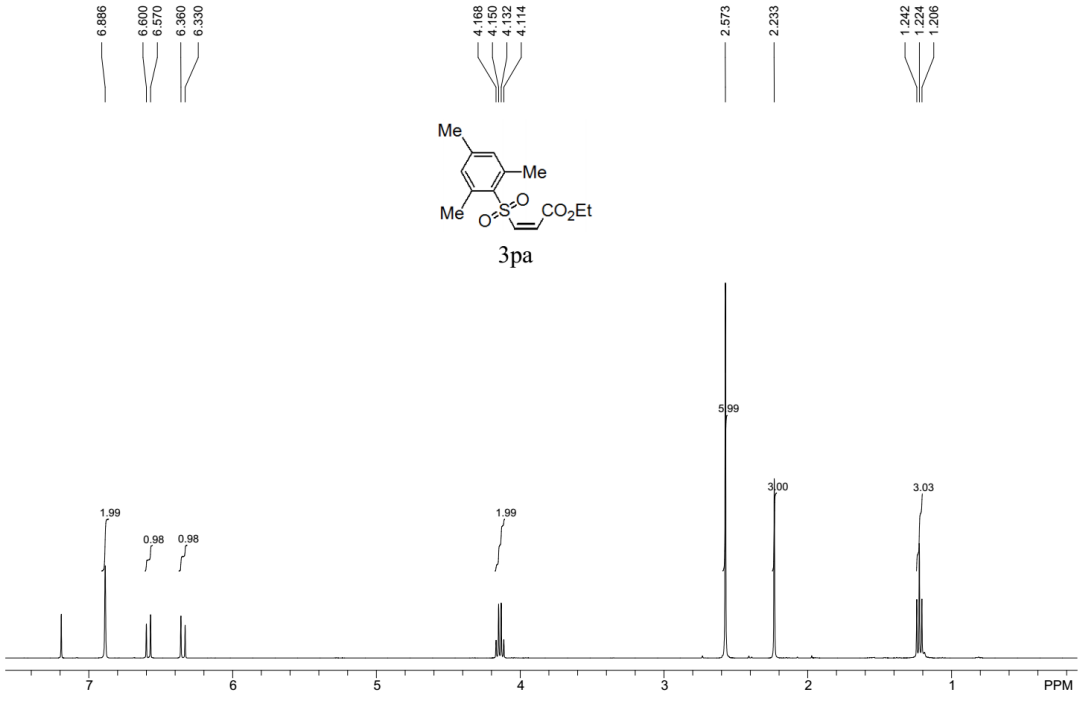
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4.150
4.132
4.114
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2.233
1.242
1.224
1.206
Me
Me
Me
O
S
O
CO2Et
1.99
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1.99
5.99
3.00
3.03
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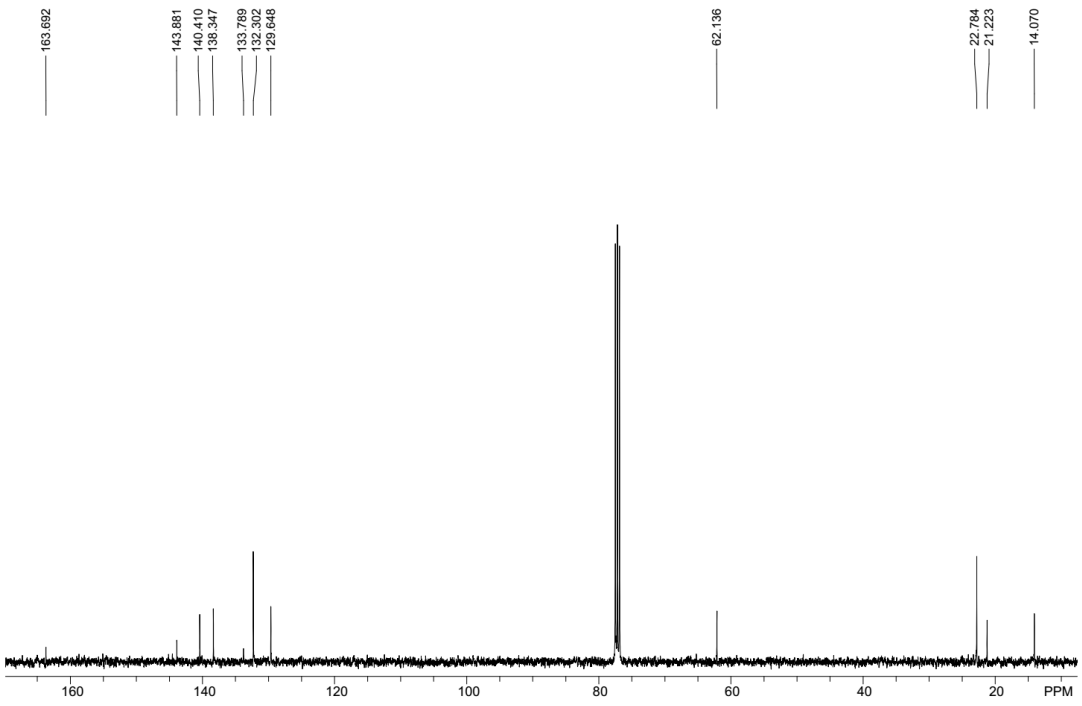
6
5
4
3
2
1
PPM

3pa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132.302
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62.136
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14.070
160
140
120
100
80
60
40
20
PPM


8.502
7.955
7.854
7.634
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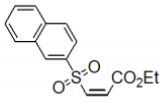
6.535
6.506
6.468
6.439
4.350
4.332
4.314
4.296
1.360
1.343
1.325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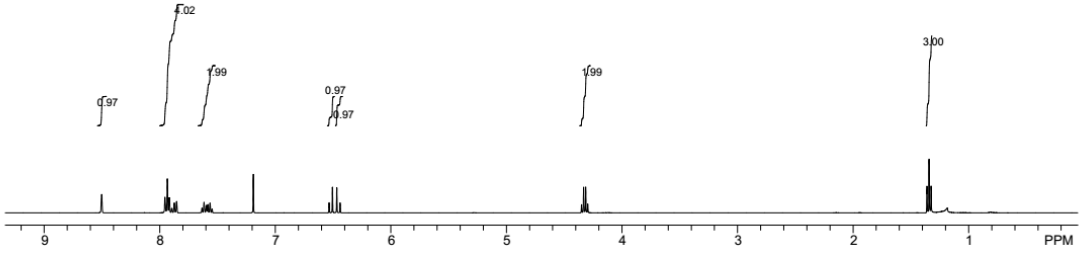
S
O
CO2Et

3qa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1.99
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9
8
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6
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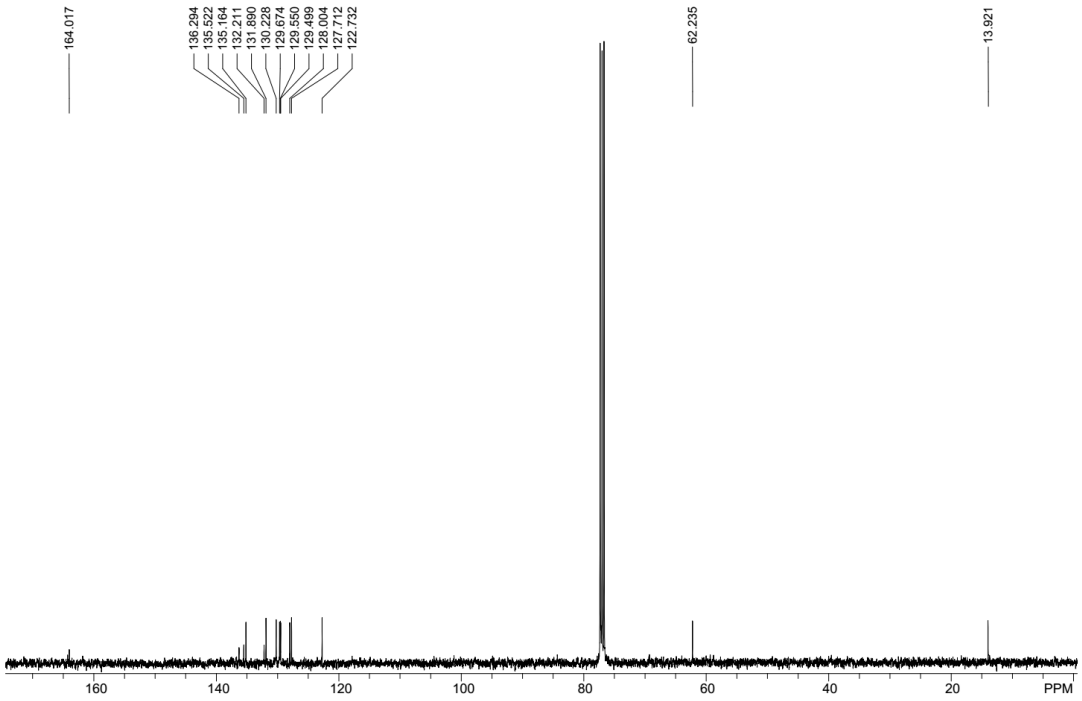
4
3
2
1
PPM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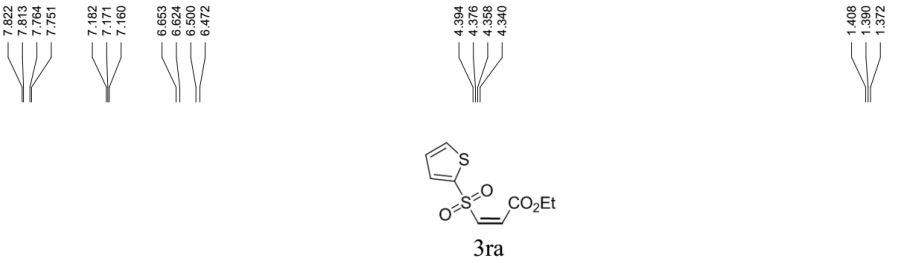
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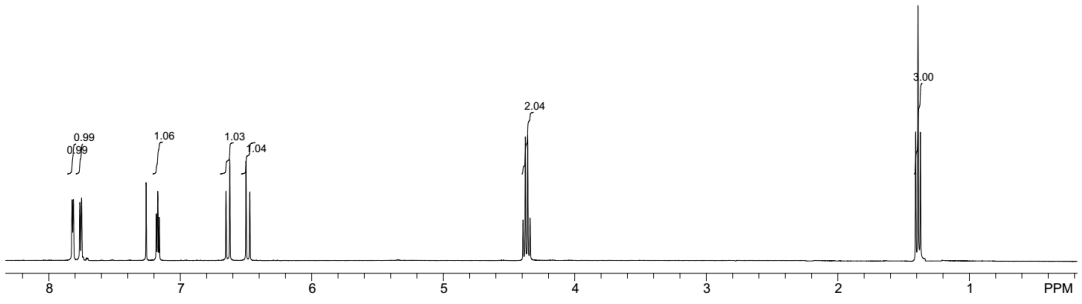
O
O
S
CO2Et

3ra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2.04
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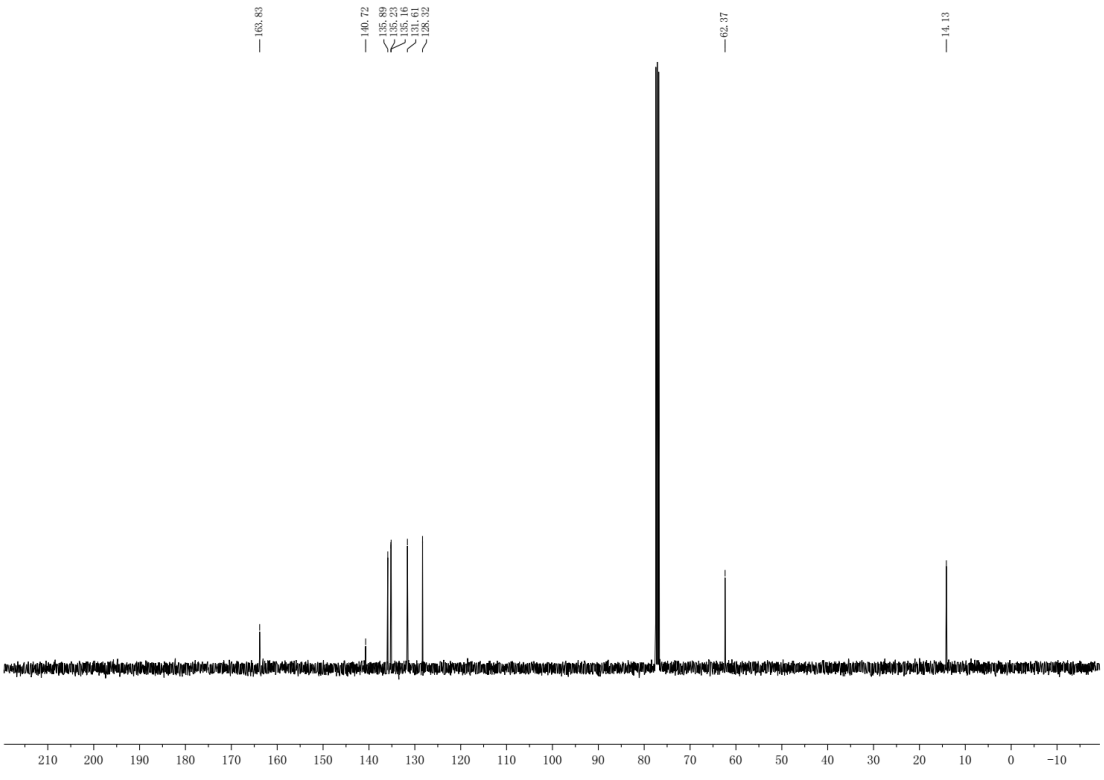
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200
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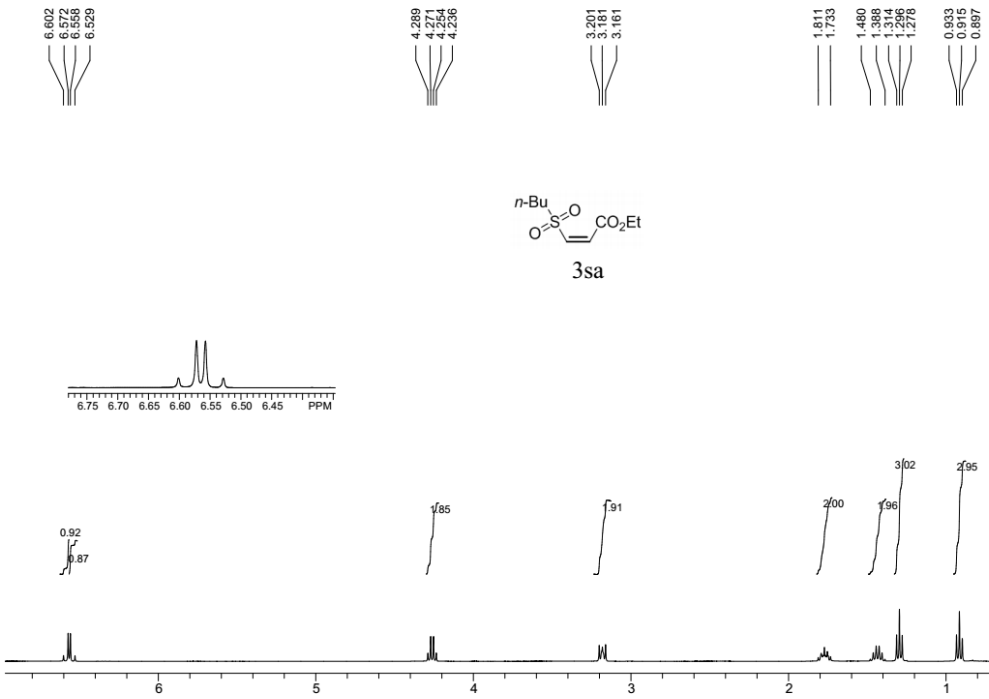
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4.236
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3.181
3.161
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1.733
1.480
1.388
1.314
1.296
1.278
0.933
0.915
0.897
n-Bu
O
S
O
CO2Et
3sa
6.75 6.70 6.65 6.60 6.55 6.50 6.45 PPM
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0.87
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1.91
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1.96
3.02
2.95
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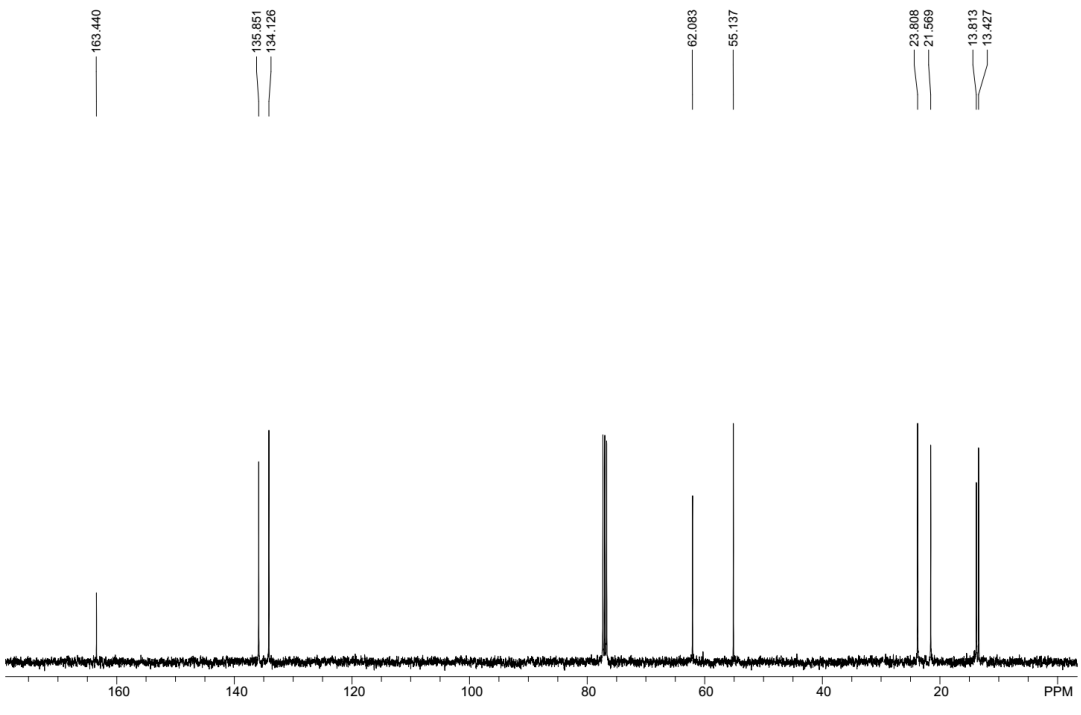
3
2
1
PPM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140
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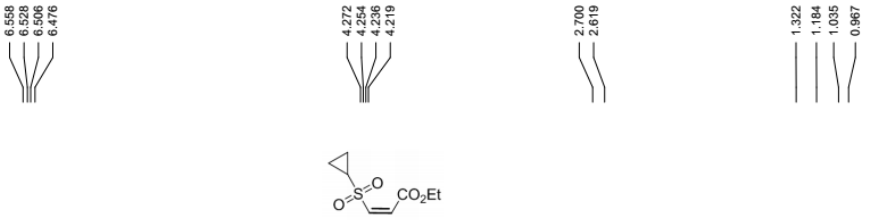
40
20
PPM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4.254
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1.035
0.967
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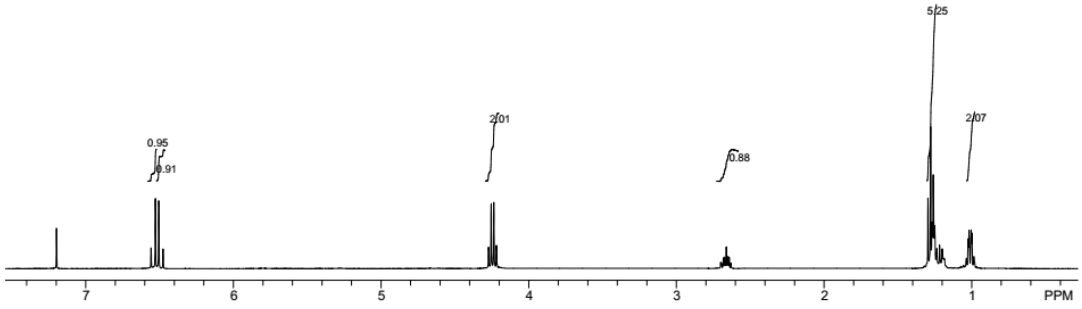
O
O
CO2Et

3ta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PPM


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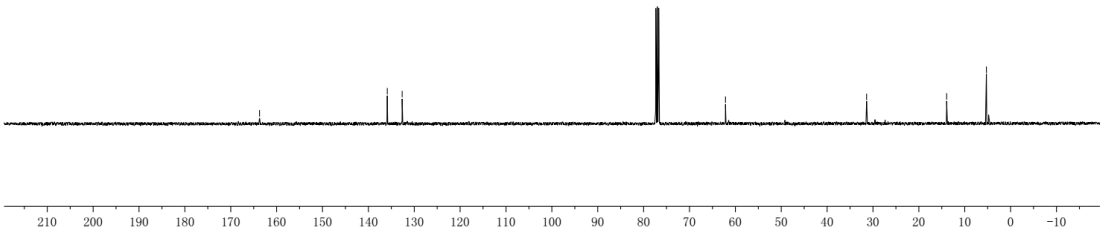
5.28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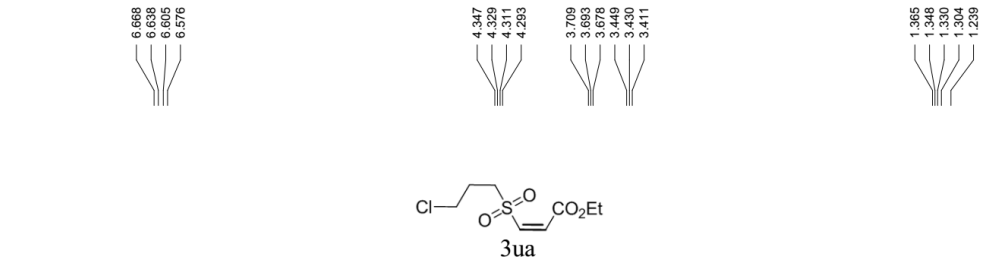
0
-10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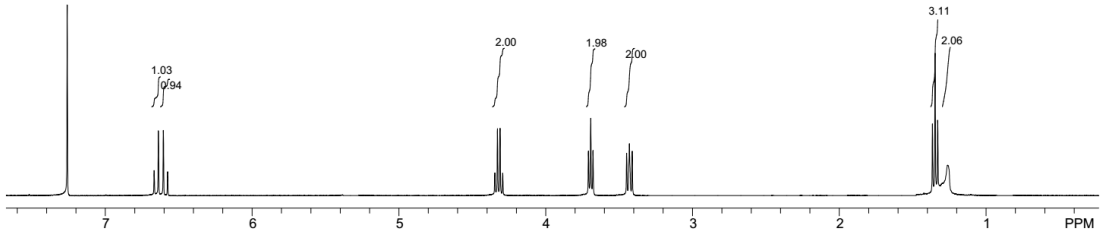
1.365
1.348
1.330
1.304
1.239

Cl
O
S
O
CO2Et

3ua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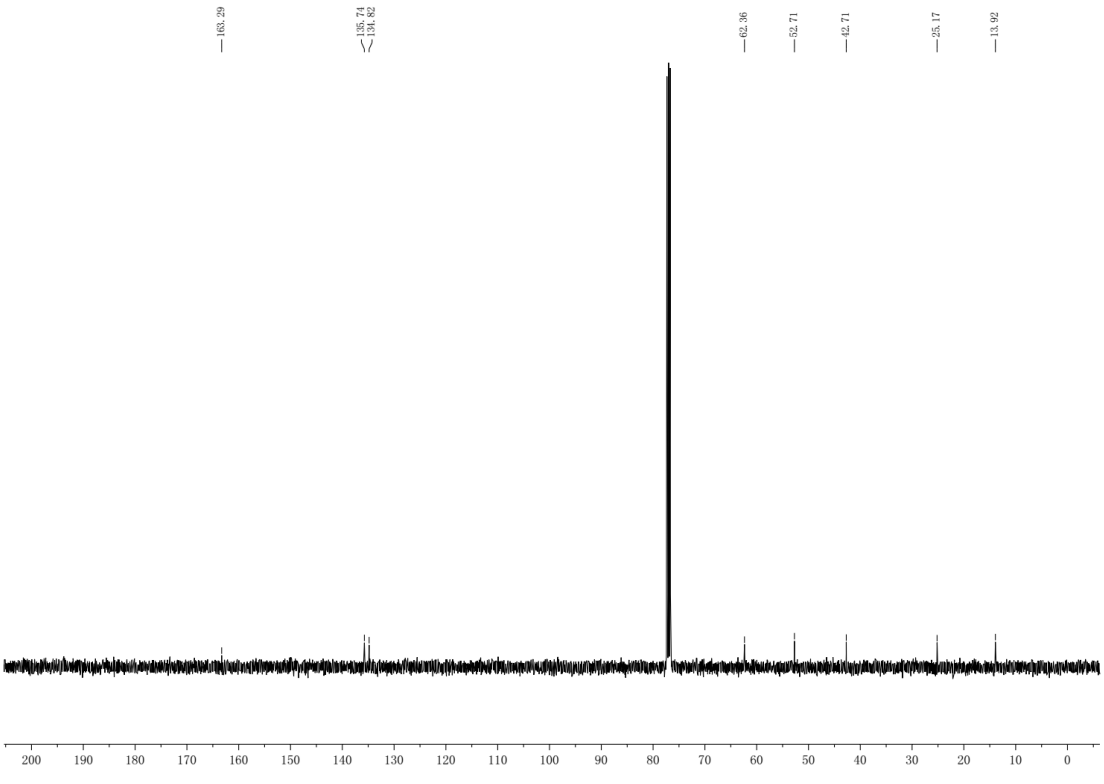
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100
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6.454
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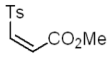
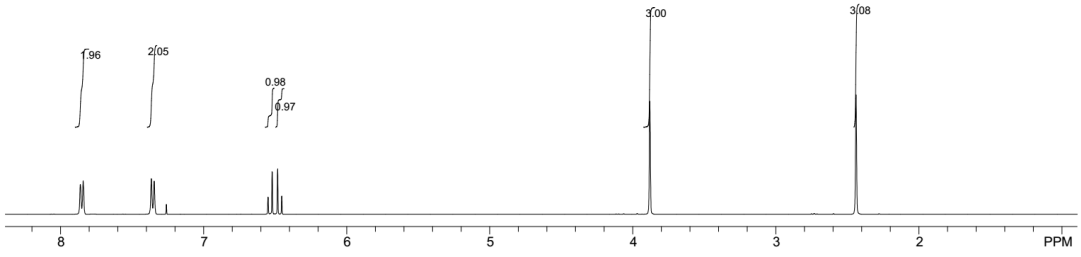
2.440


Ts
CO2Me

3ab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0.97
3.00
3.08
8
7
6
5
4
3
2
PPM


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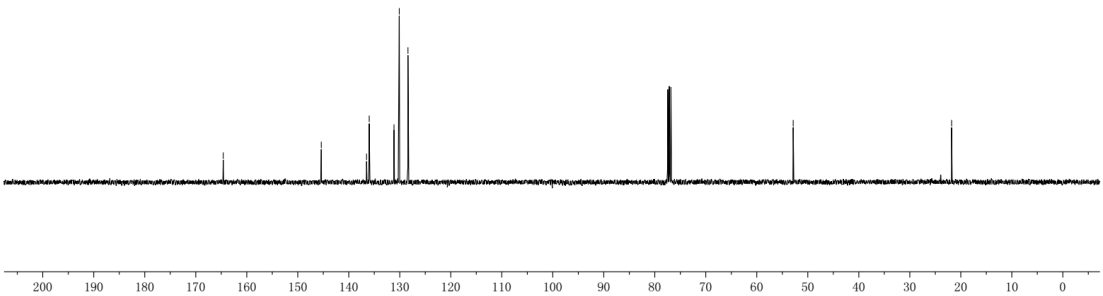
200
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180
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100
90
80
70
60
50
40
30
20
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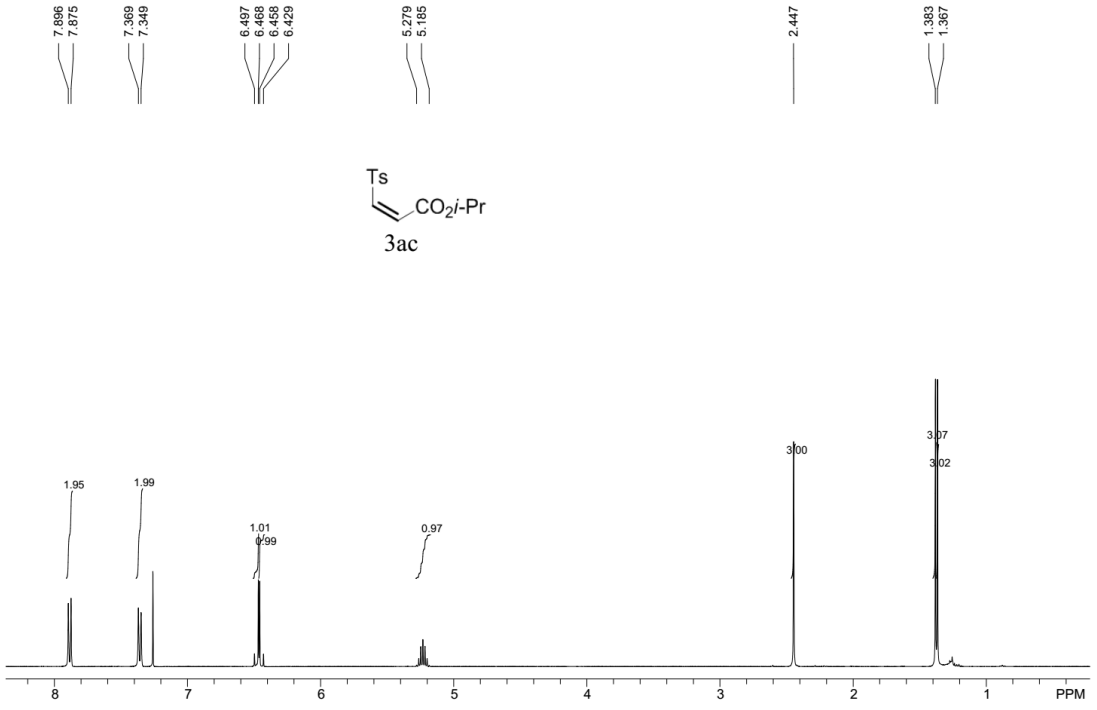
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6.429
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5.185
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1.367
Ts
CO2i-Pr
3ac
1.95
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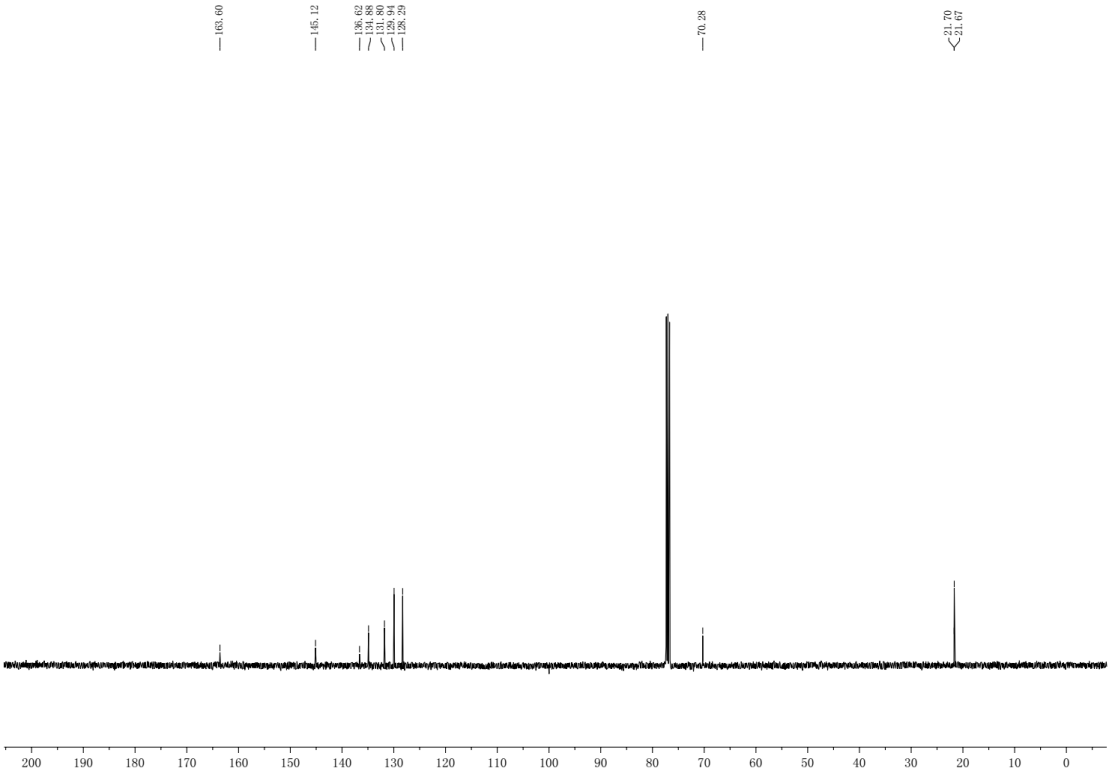
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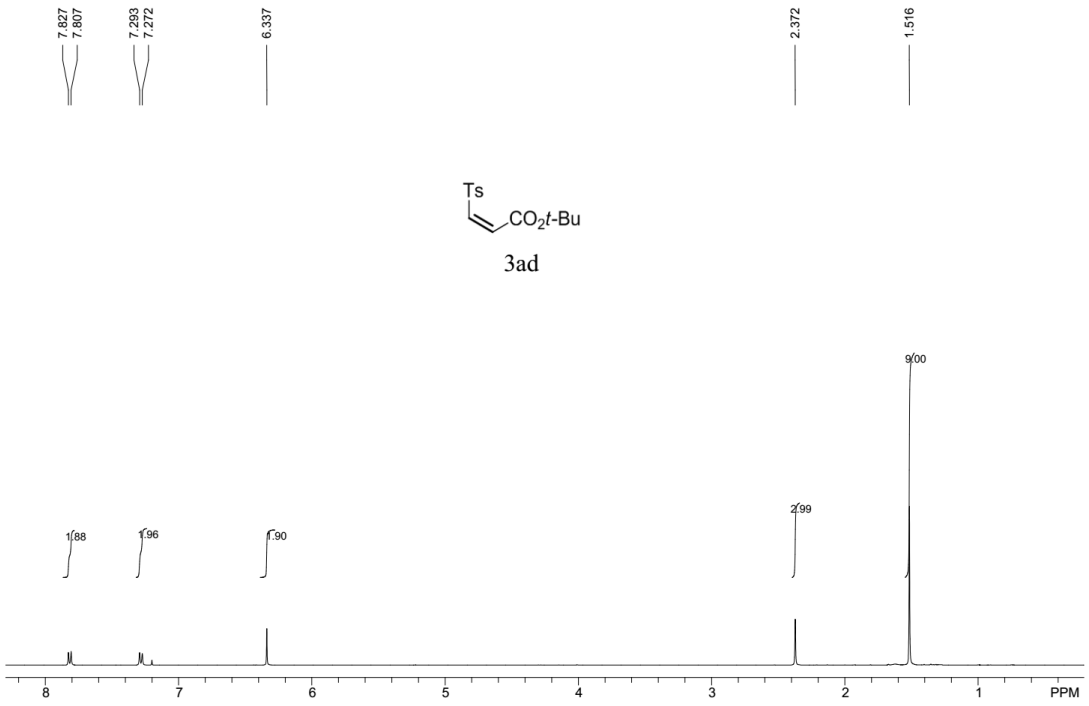
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Ts
CO2t-Bu
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1.96
1.90
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1
PPM

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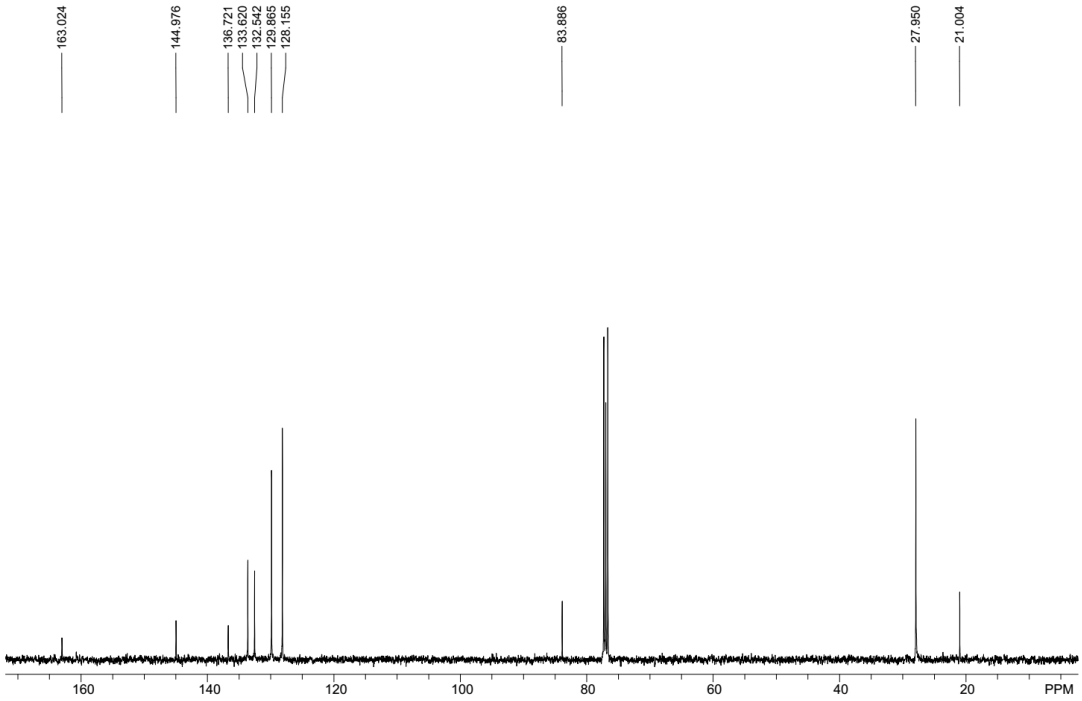
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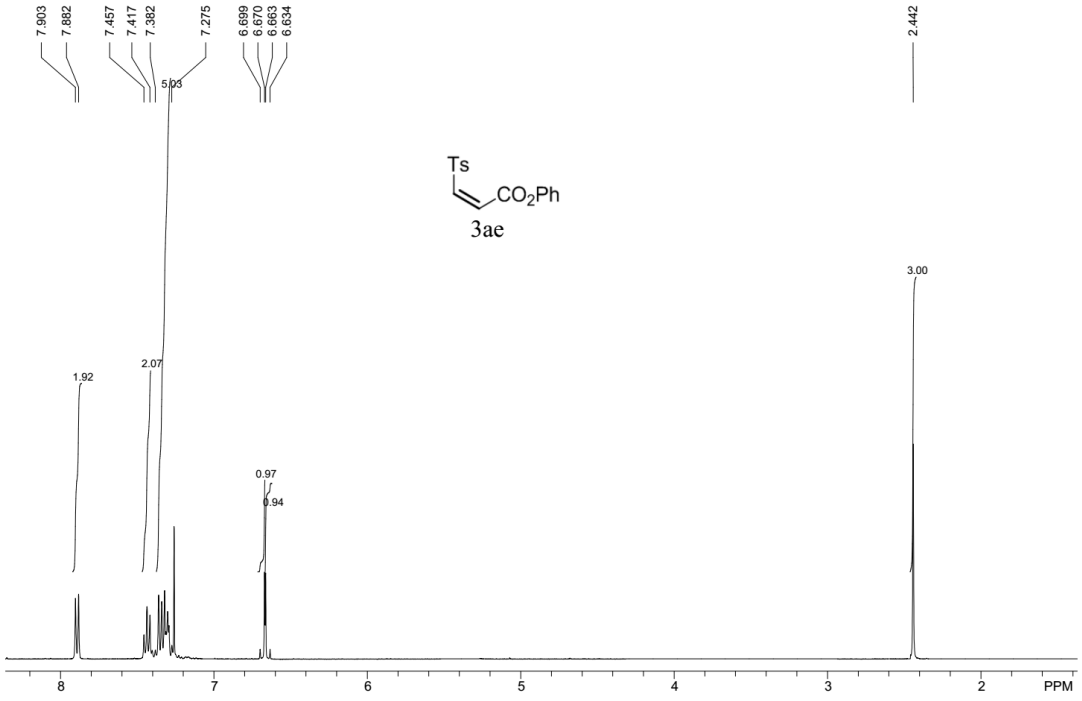
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6.670
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6.634
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2.442
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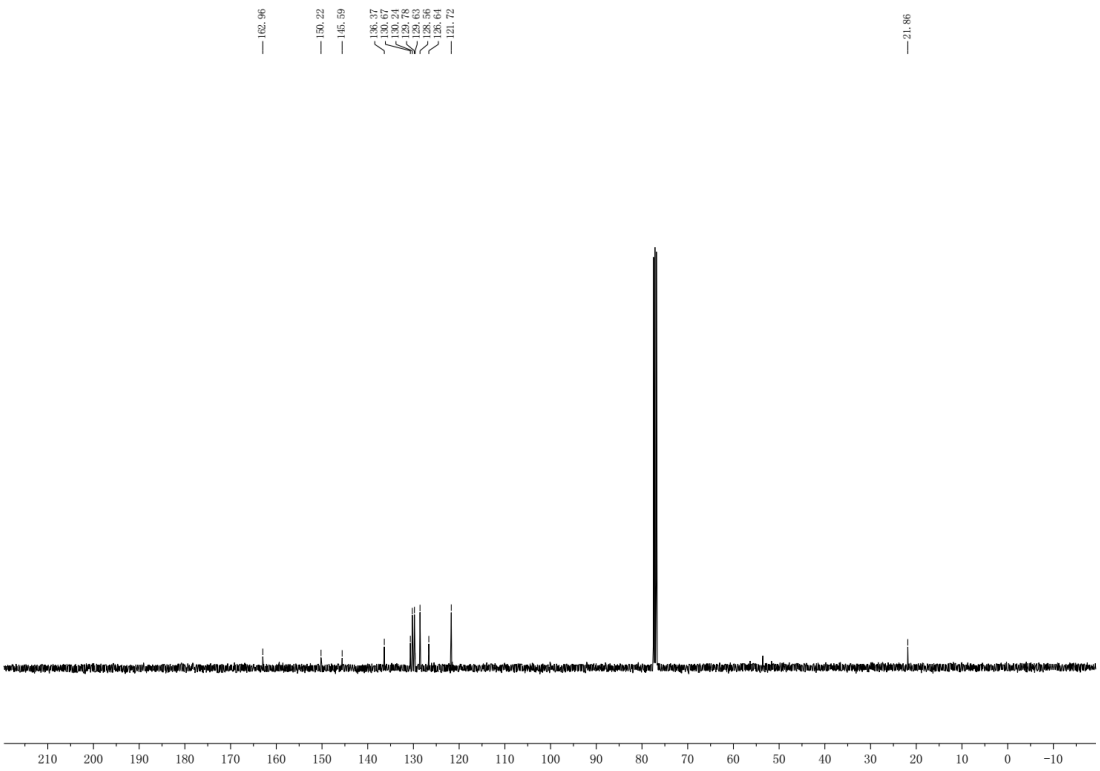
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129.45
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126.64
121.72
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200
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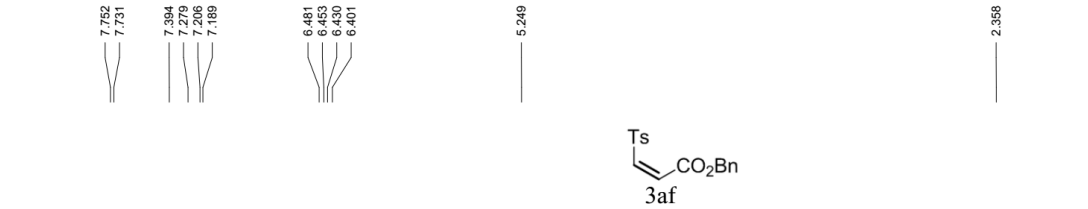
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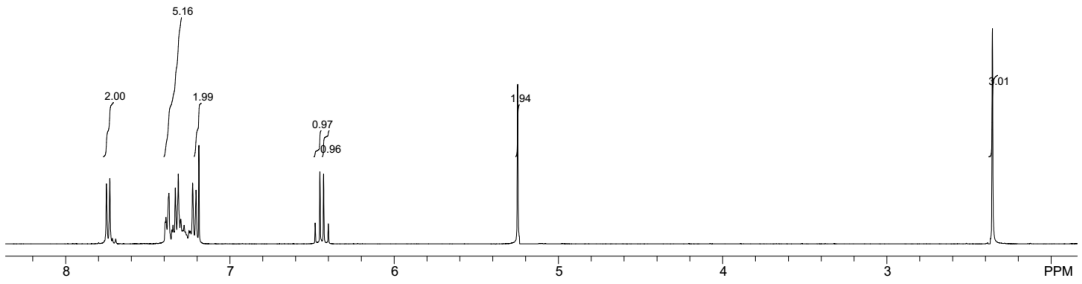
2.358

Ts
CO2Bn

3af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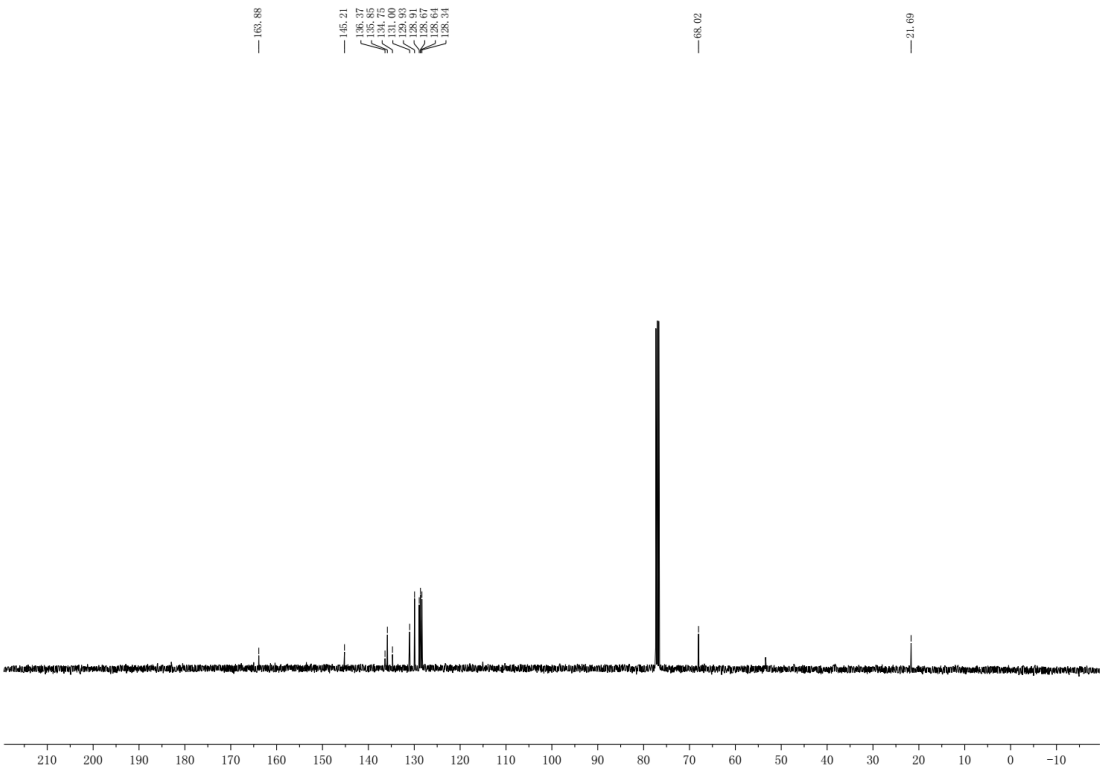
PPM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200
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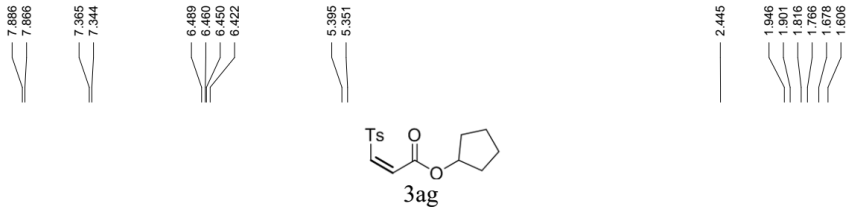
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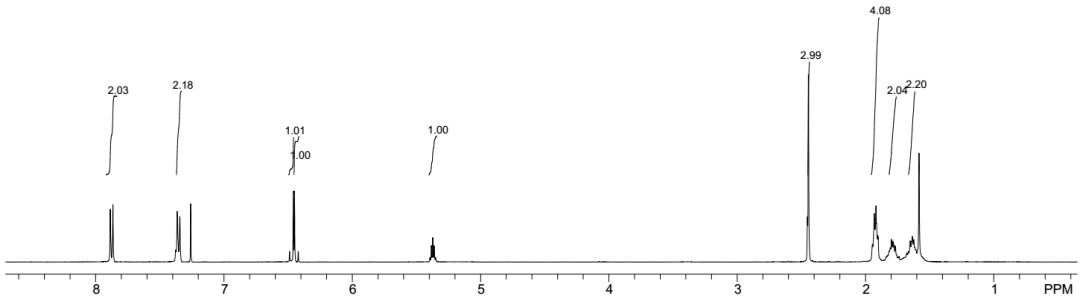
1.901
1.816
1.766
1.678
1.606

Ts
O
O

3ag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2.99
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2.04
2.20
8
7
6
5
4
3
2
1
PPM


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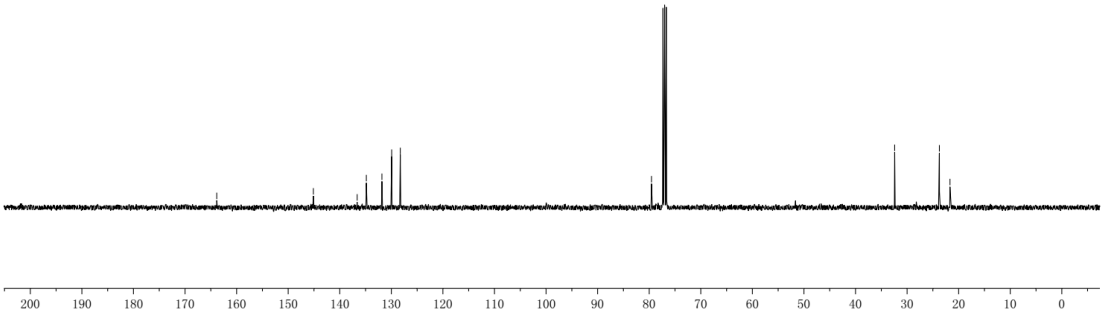
129.93
128.27
79.56
32.41
23.74
21.68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180
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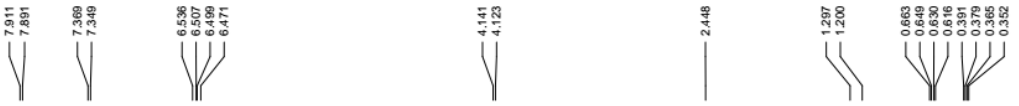
10
0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6.507
6.499
6.471
4.141
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1.200
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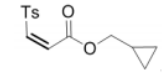
0.649
0.630
0.616
0.391
0.379
0.365
0.352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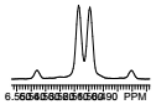
O
O

3ah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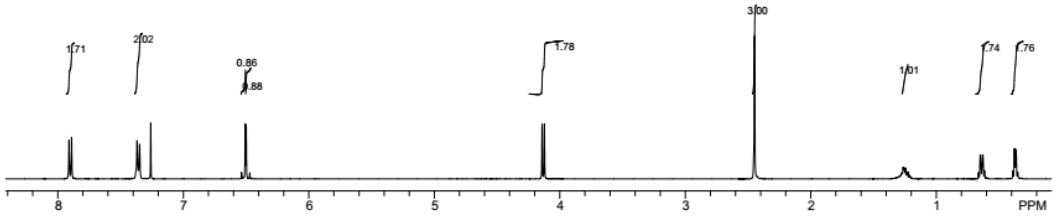
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3
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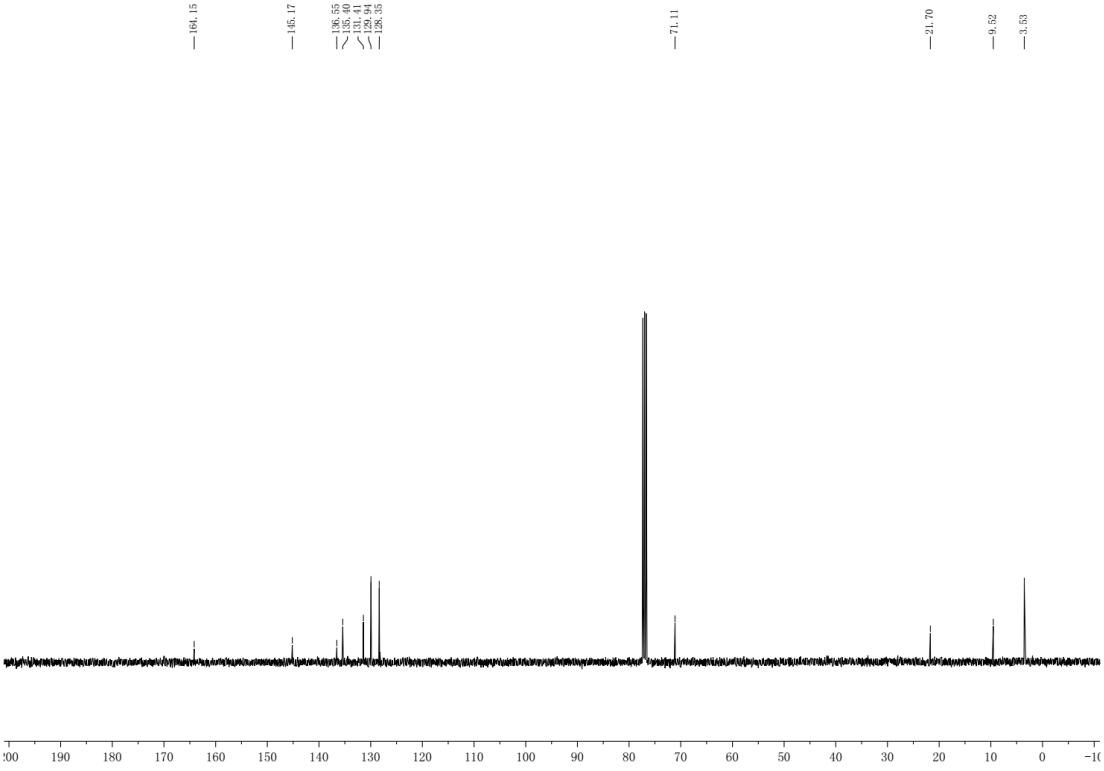
1
PPM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9.52
3.53
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190
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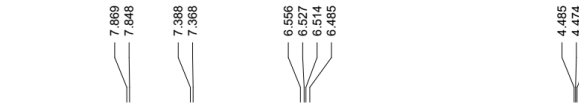
-10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6.485
4.485
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3.953
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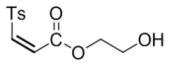
2.869
2.455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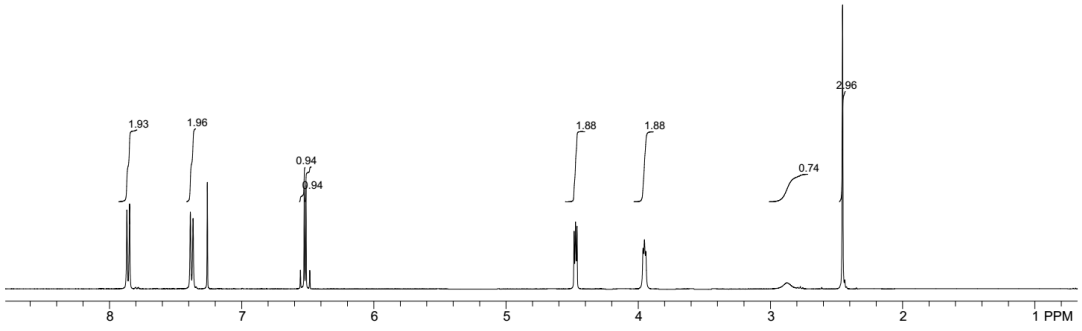
O
C
O
OH

3ai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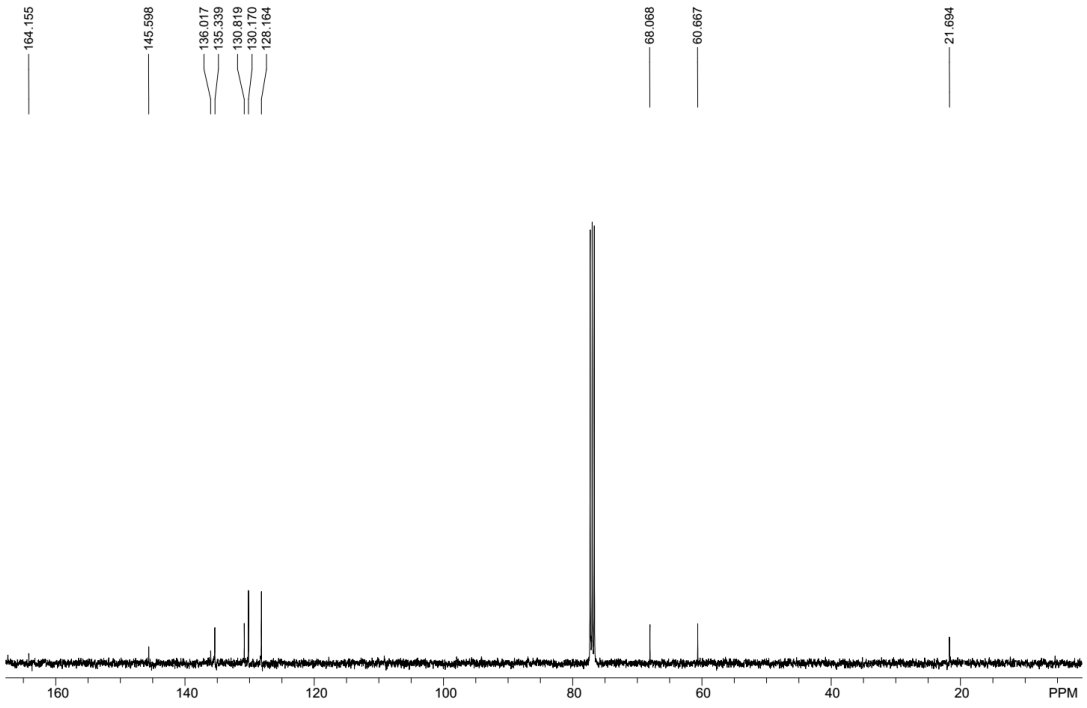
0.94
0.94
1.88
1.88
0.74
2.96
8
7
6
5
4
3
2
1 PPM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130.170
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21.694
160
140
120
100
80
60
40
20
PPM


7.882
7.861
7.380
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6.511
6.483
4.622
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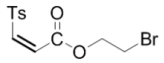
4.590
3.644
3.628
3.612
2.451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O
C
O
Br

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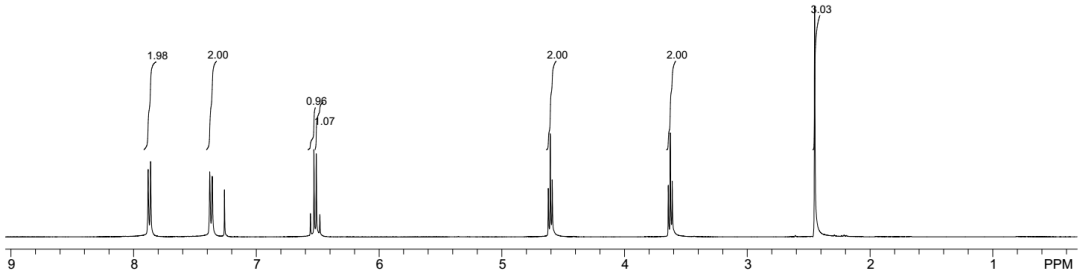
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2.00
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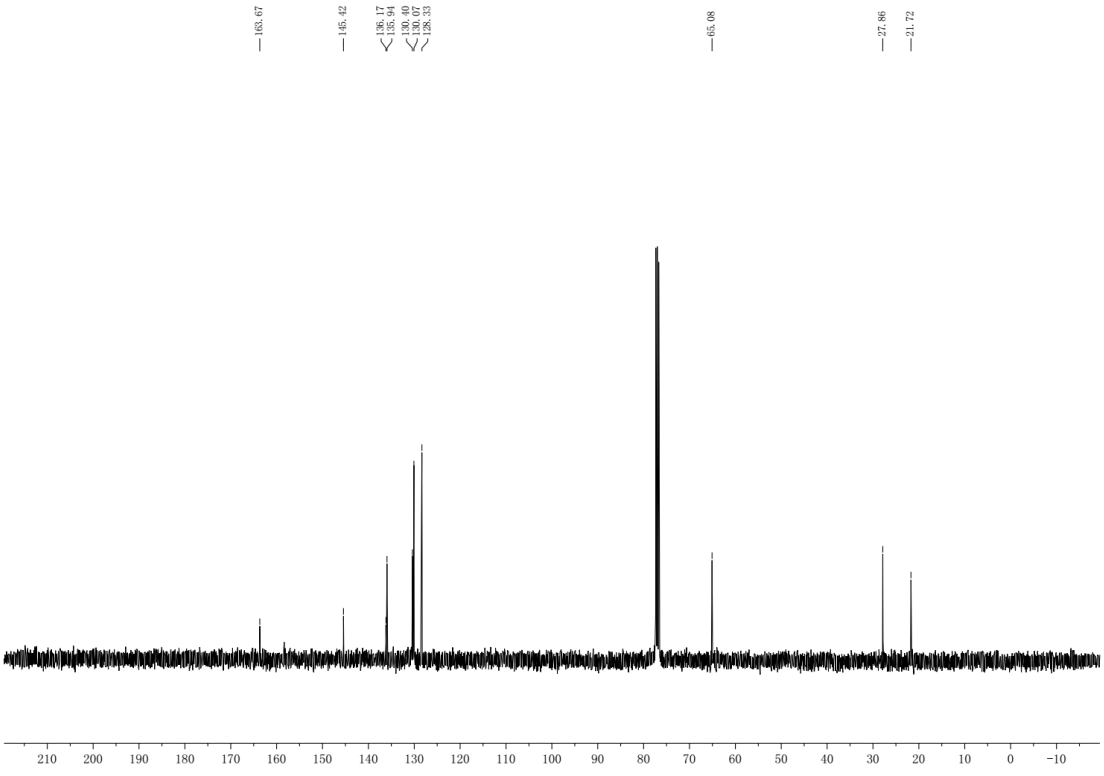
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27.86
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150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10


7.894
7.873
7.364
7.344
6.261
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4.357
4.339
4.321
2.442
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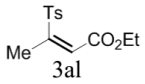
1.964
1.401
1.383
1.365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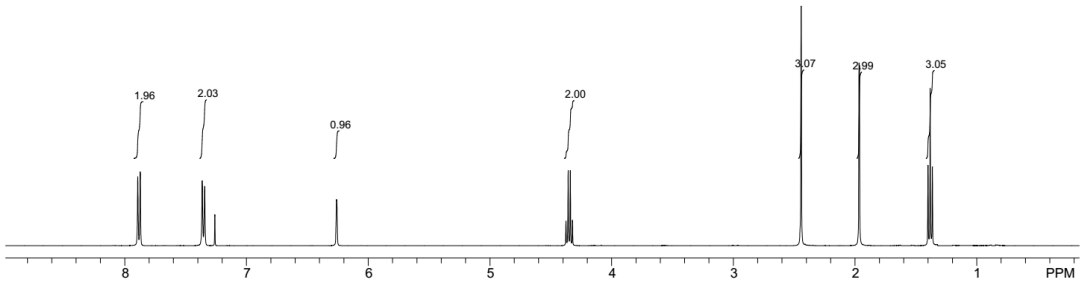
Me
CO2Et

3al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7
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5
4
3
2
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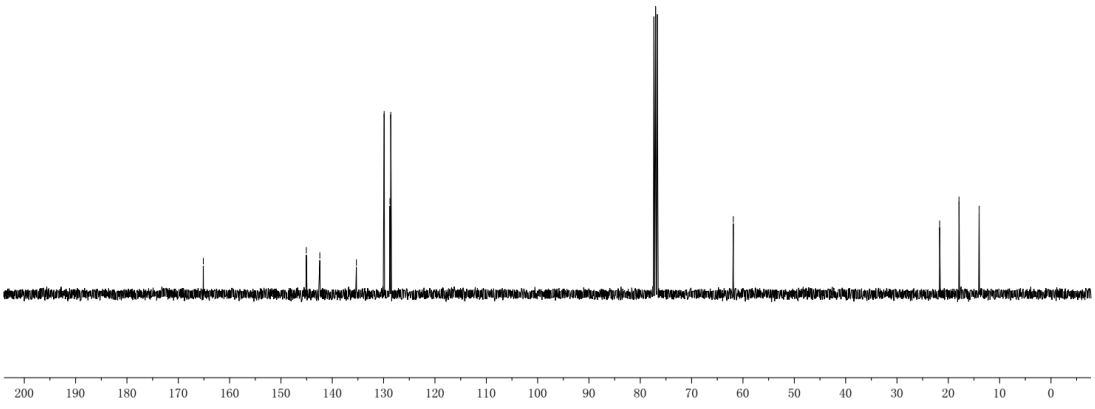
14.00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190
180
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150
140
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120
110
100
90
80
70
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50
40
30
20
10
0


7.882
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7.362
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6.249
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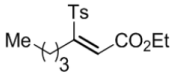
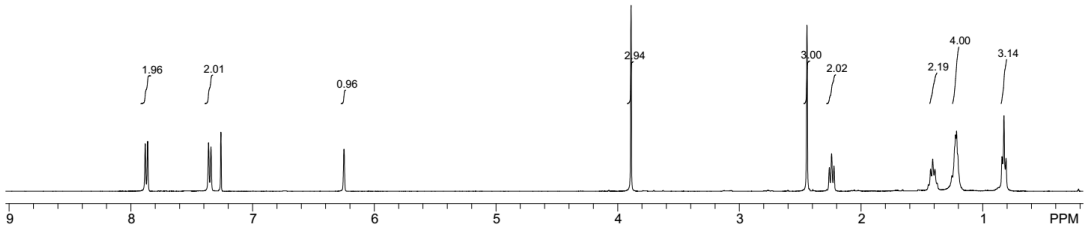

Ts
Me
3
CO2Et

3am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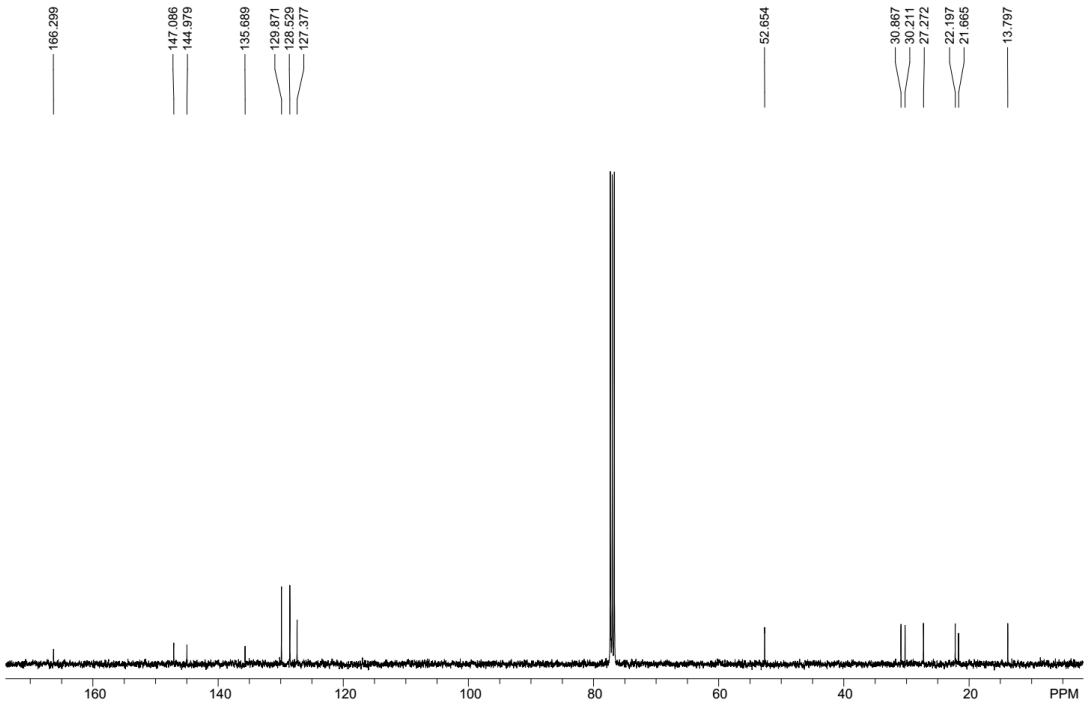
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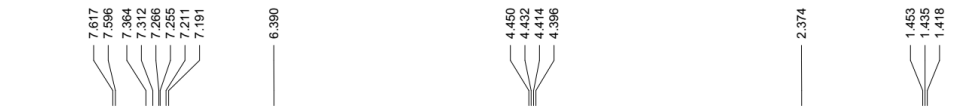
20
PPM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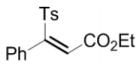
1.435
1.418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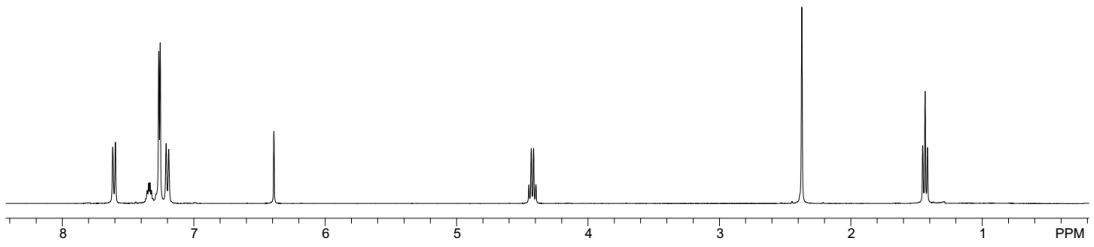
Ph
CO2Et

3an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7
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5
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3
2
1
PPM


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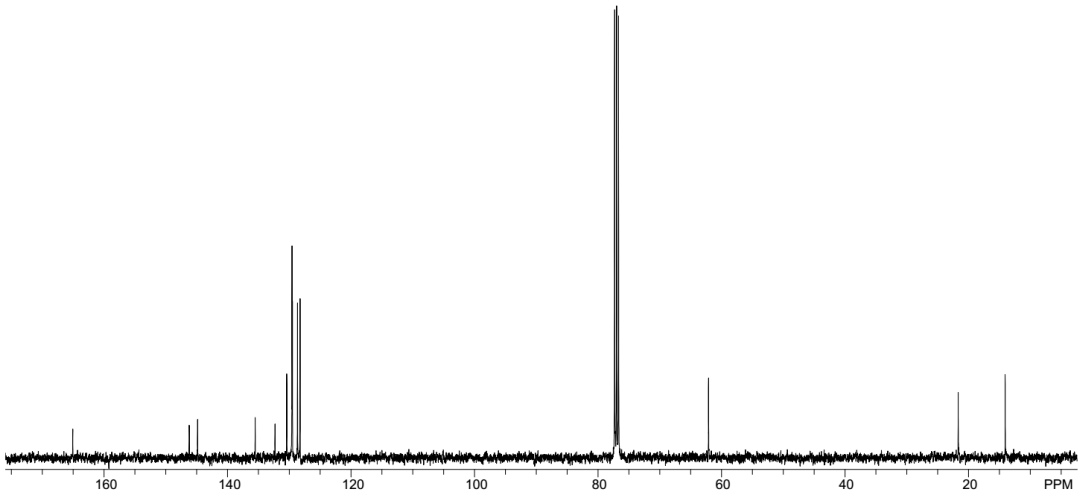
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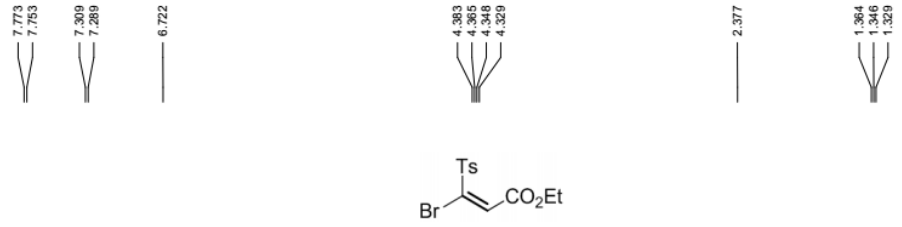
PPM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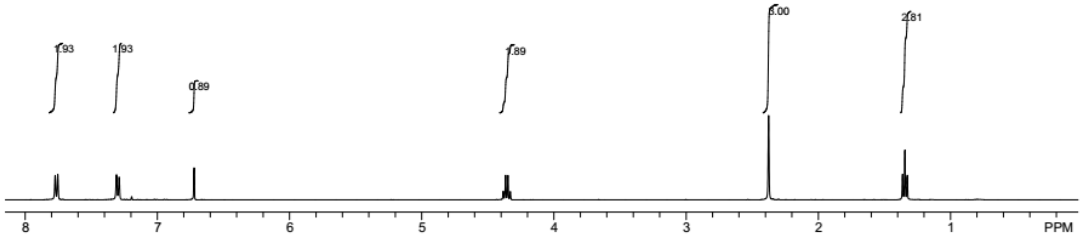
1.329

Ts
Br
CO2Et

3ao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7
6
5
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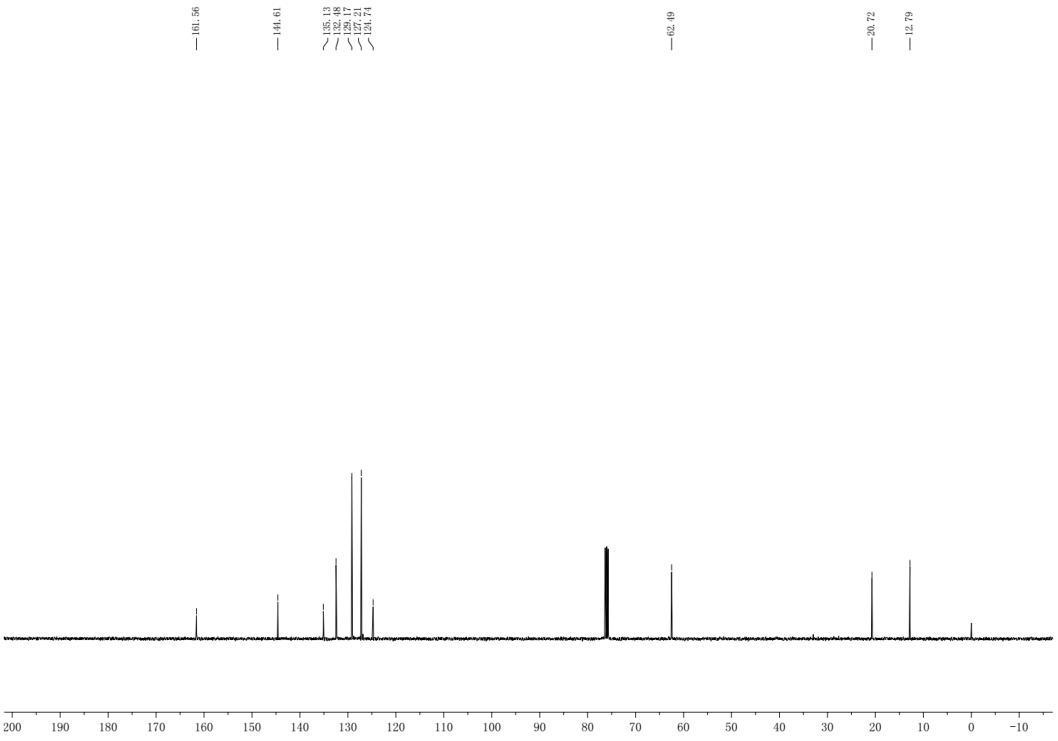
3
2
1
PPM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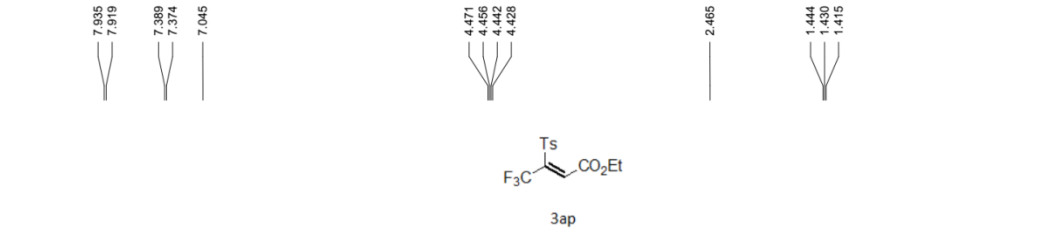
-10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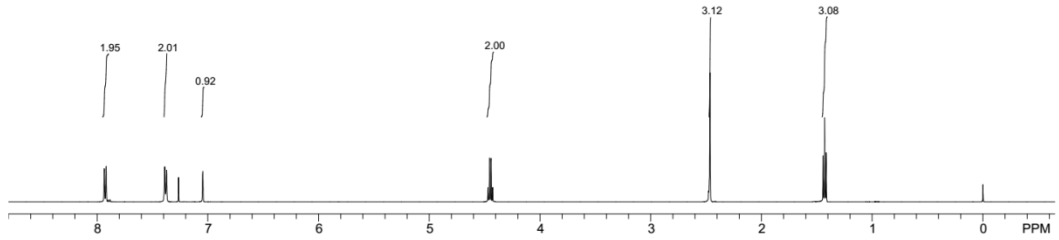
Ts
F3C
CO2Et

3ap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2.00
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3.08
8
7
6
5
4
3
2
1
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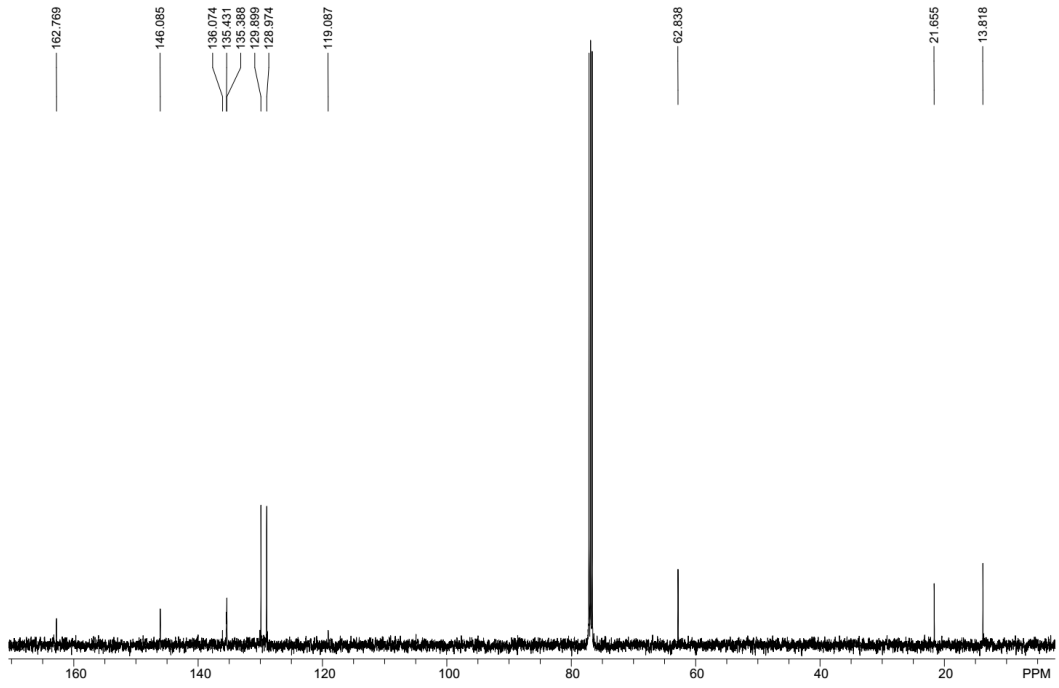
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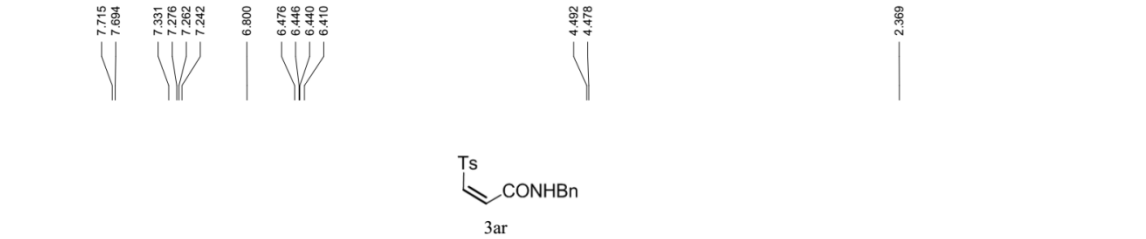
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6.476
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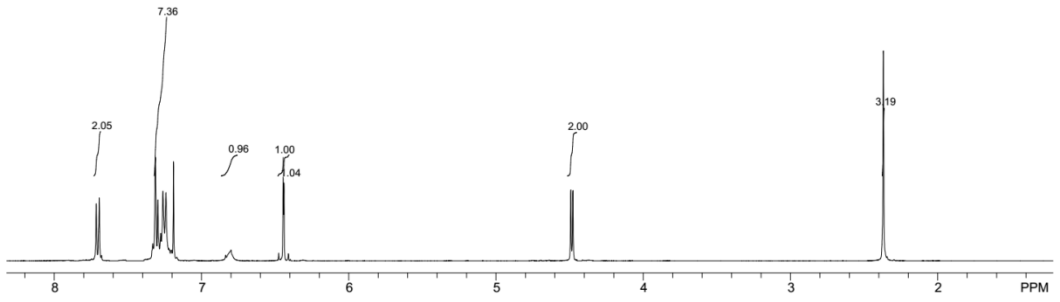
6.410
4.492
4.478
2.369

Ts
CONHBn

3ar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1.04
2.00
3.19
8
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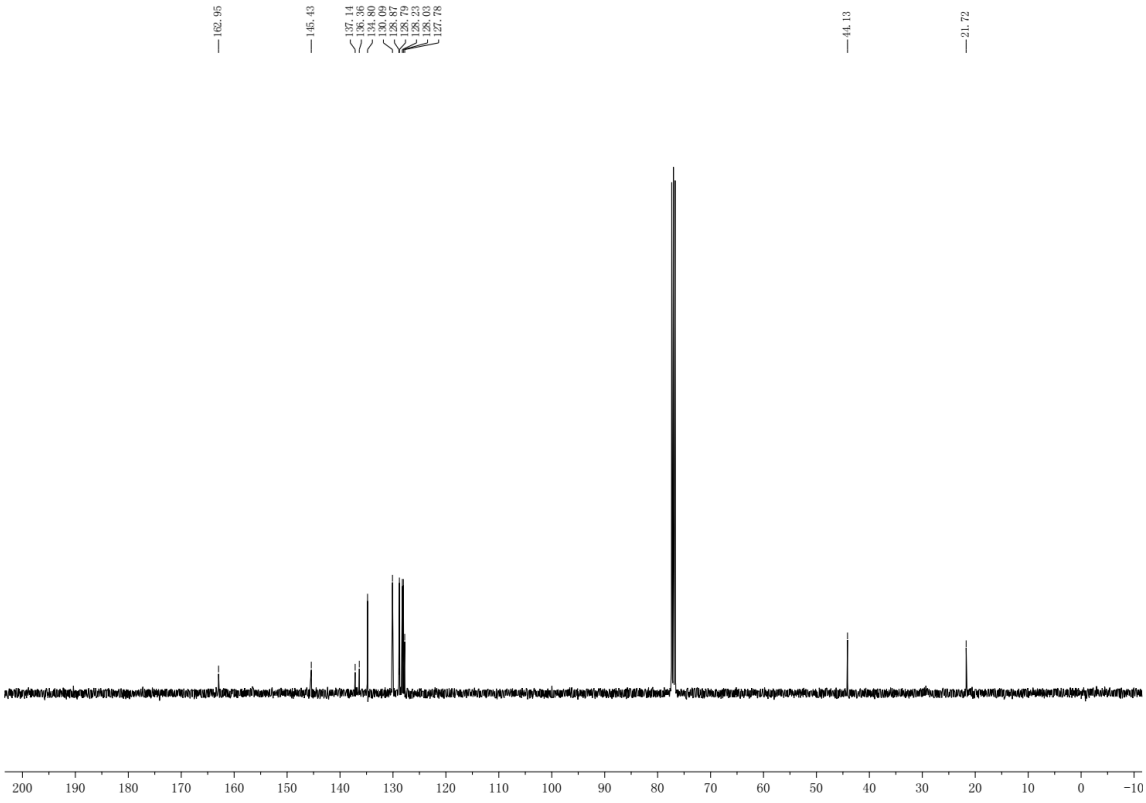
PPM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137.14
136.36
134.80
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128.87
128.79
128.23
128.03
127.78
44.13
21.72
200
190
180
170
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50
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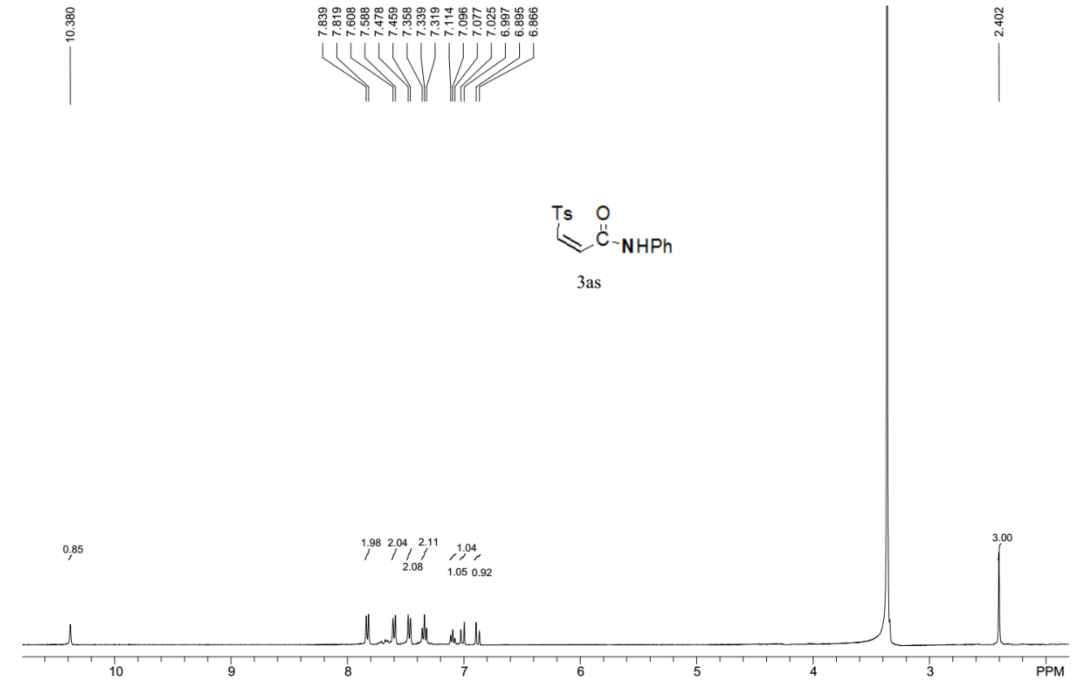
10
0
−10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7.478
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7.358
7.339
7.319
7.114
7.096
7.077
7.025
6.997
6.895
6.866
2.402
Ts
O
NHPh
3as
0.85
1.98
2.04
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1.04
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3
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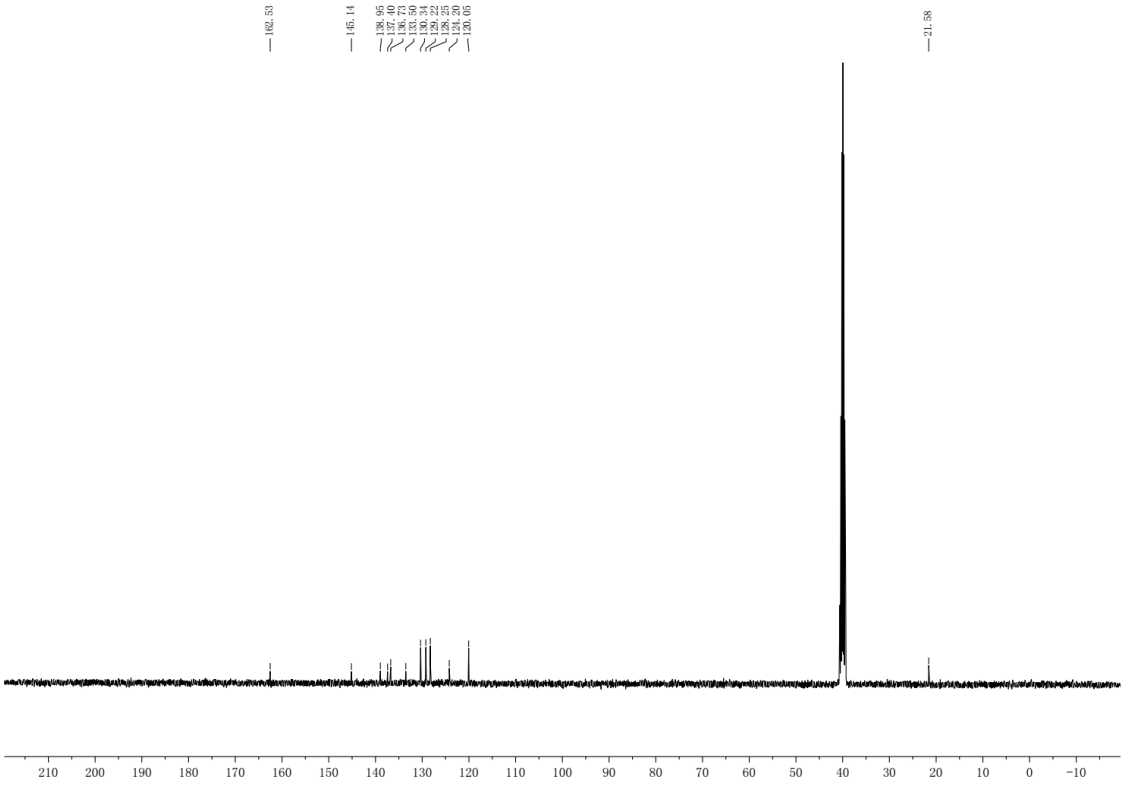
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200
190
180
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120
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30
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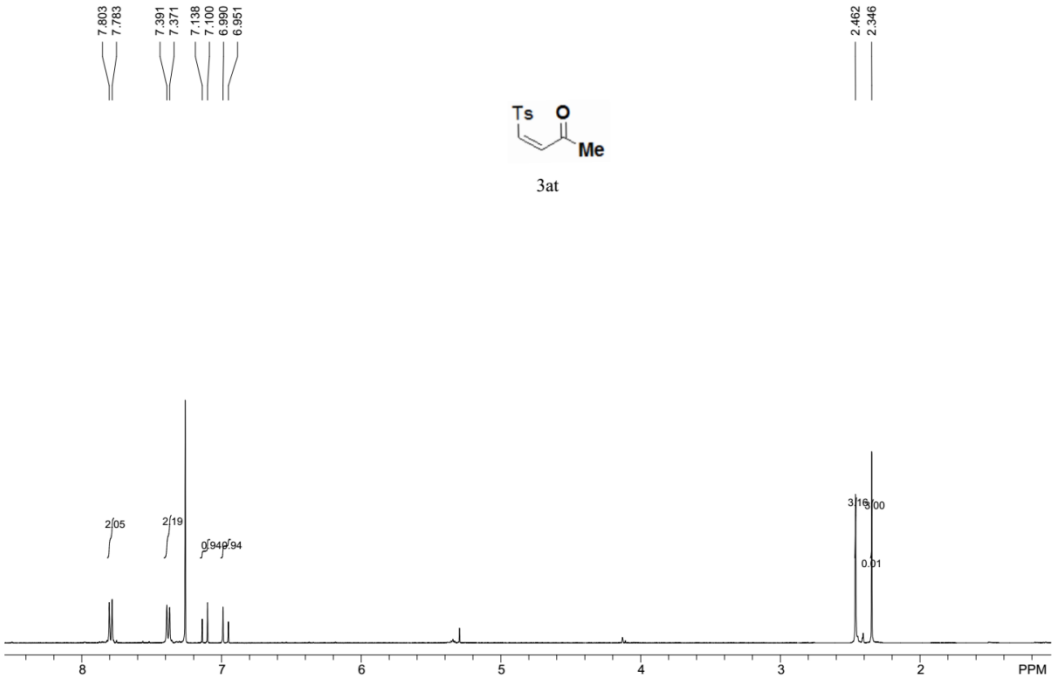
10
0
−10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7.138
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6.990
6.951
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2.346
Ts
O
Me
2.05
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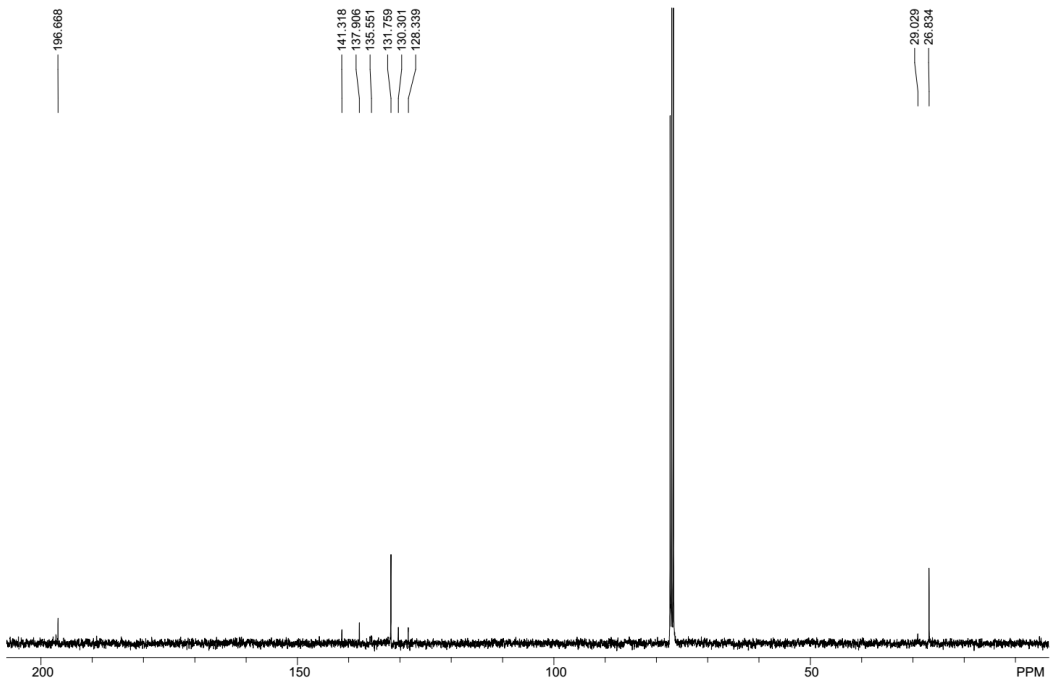
0.94
3.19
3.00
0.01
8
7
6
5
4
3
2
PPM

3at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150
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50
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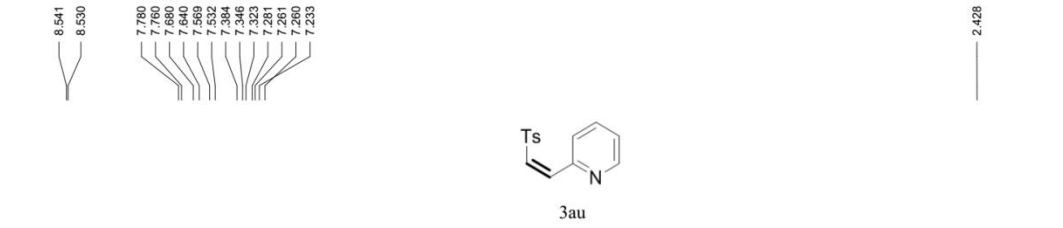
8.541
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7.640
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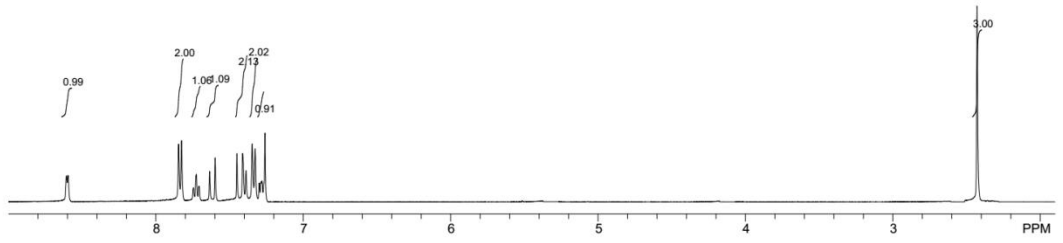
7.384
7.346
7.323
7.281
7.261
7.260
7.233
2.428
Ts
N

3au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1.09
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2.02
0.91
3.00
8
7
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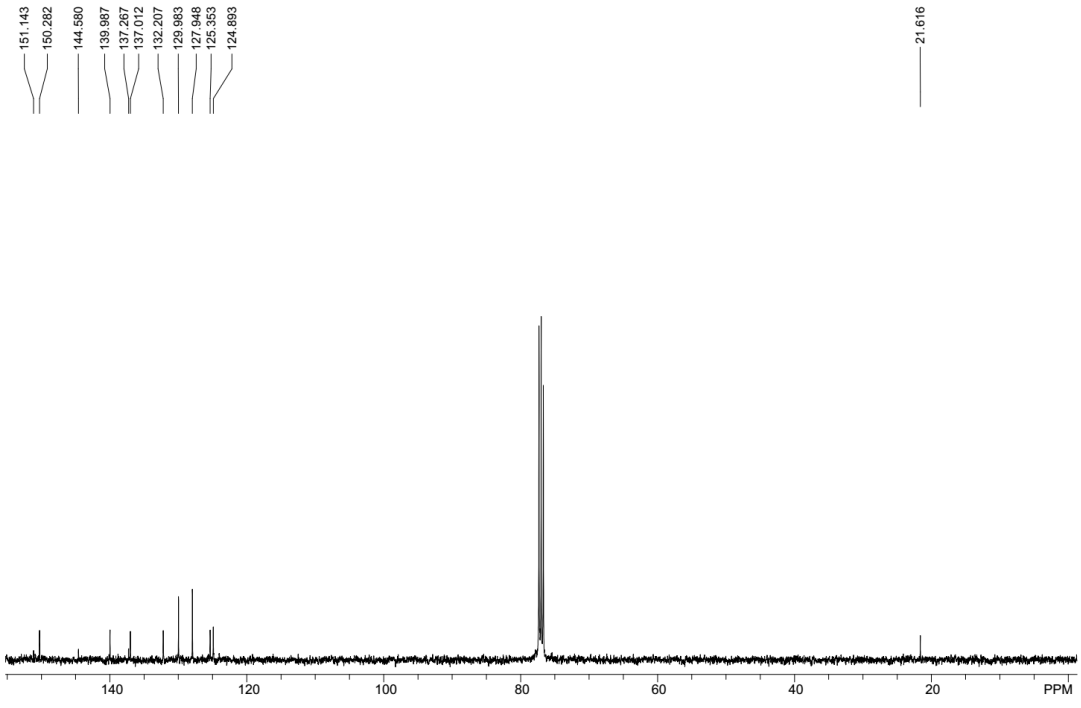
5
4
3
PPM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144.580
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137.267
137.012
132.207
129.983
127.948
125.353
124.893
21.616
140
120
100
80
60
40
20
PPM


7.818
7.797
7.546
7.527
7.343
7.326
7.294
7.274
6.507
6.478
6.472
6.443
6.421
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6.404
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2.899
2.611
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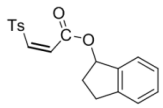
2.419
2.344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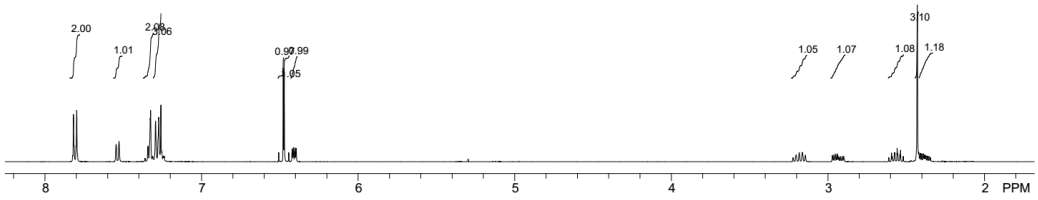
O
C
O

4aa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2.08
1.06
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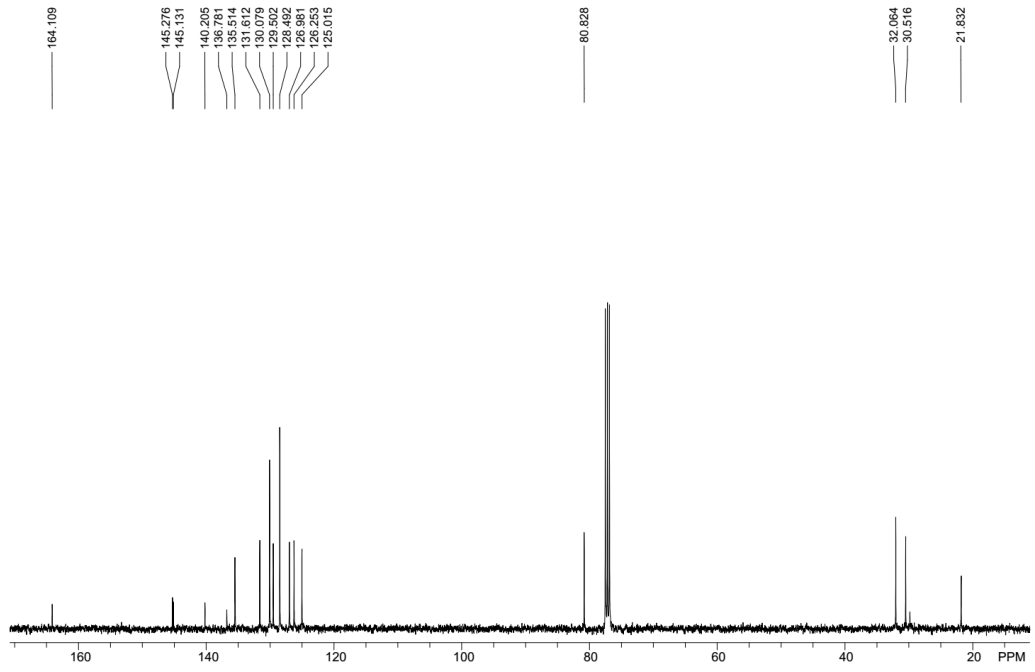
1.05
1.07
1.08
3.10
1.18
8
7
6
5
4
3
2
PPM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145.131
140.205
136.781
135.514
131.612
130.079
129.502
128.492
126.981
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80.828
32.064
30.516
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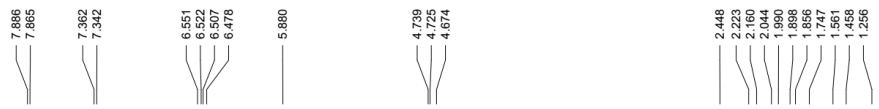
140
120
100
80
60
40
20
PPM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7.362
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6.522
6.507
6.478
5.880
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4.725
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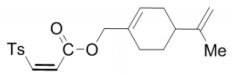
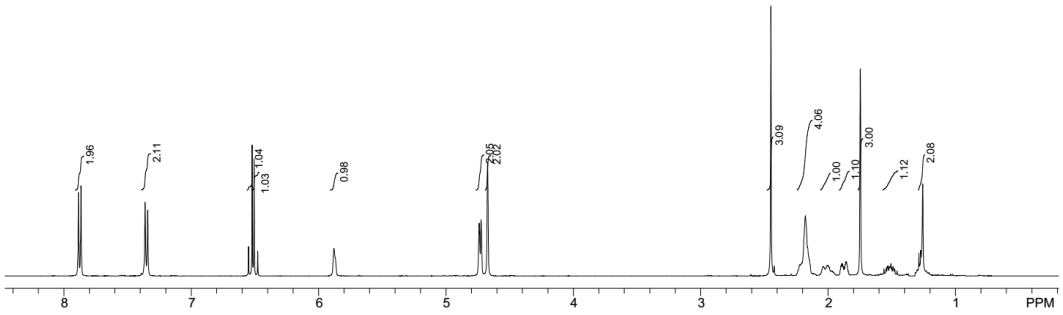
1.856
1.747
1.561
1.458
1.256


O
C
O
Ts
Me

4ab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0.98
2.02
2.02
3.09
4.06
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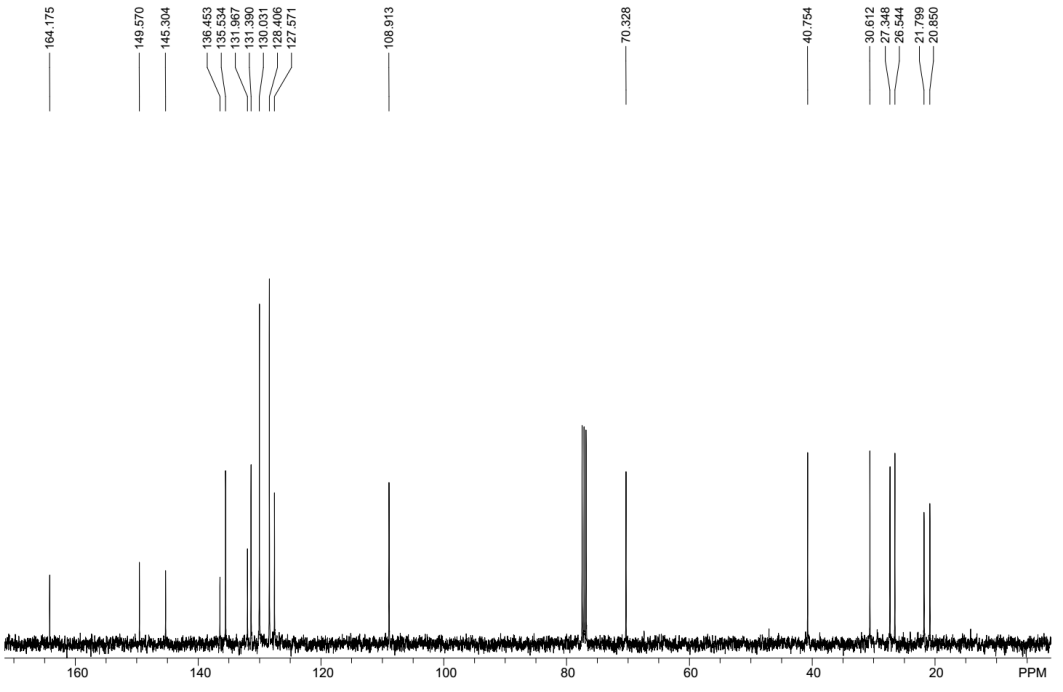
1.10
3.00
1.12
2.08
8
7
6
5
4
3
2
1
PPM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70.328
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27.348
26.544
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120
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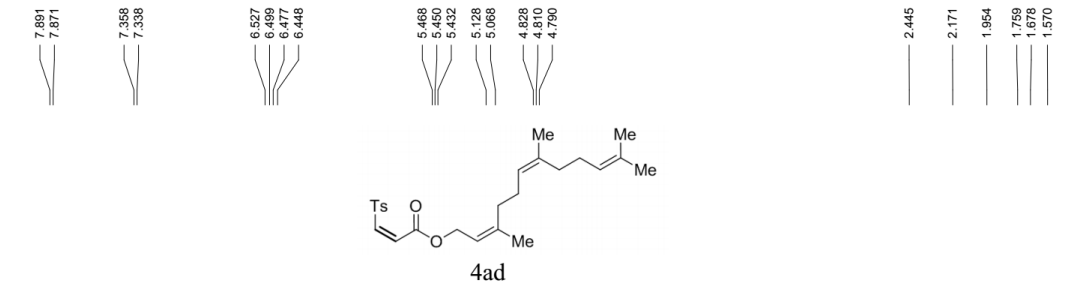
60
40
20
PPM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6.477
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5.450
5.432
5.128
5.068
4.828
4.810
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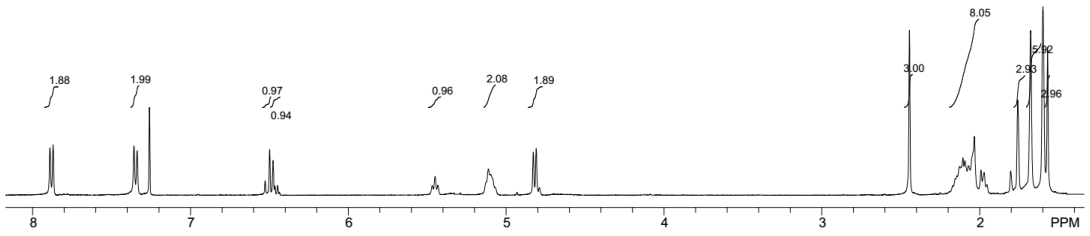
1.759
1.678
1.570
Me
Me
Me
Ts
O
O
Me

4ad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2.96
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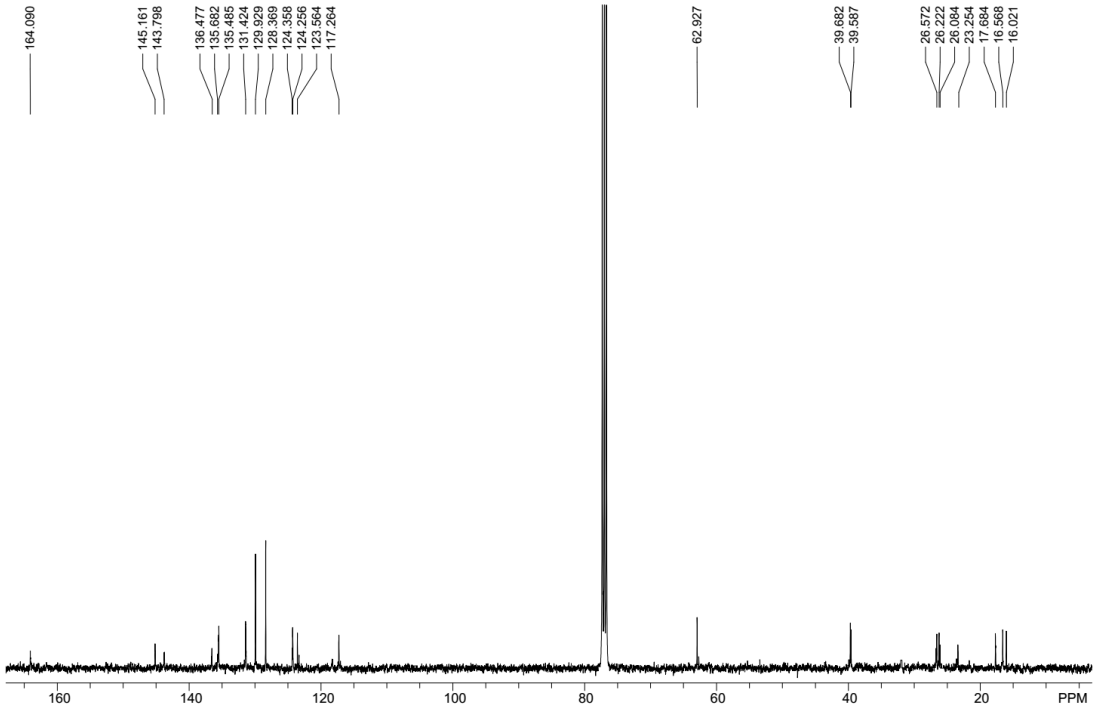
4
3
2
PPM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135.485
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117.264
62.927
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39.587
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20
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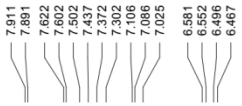
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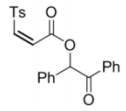
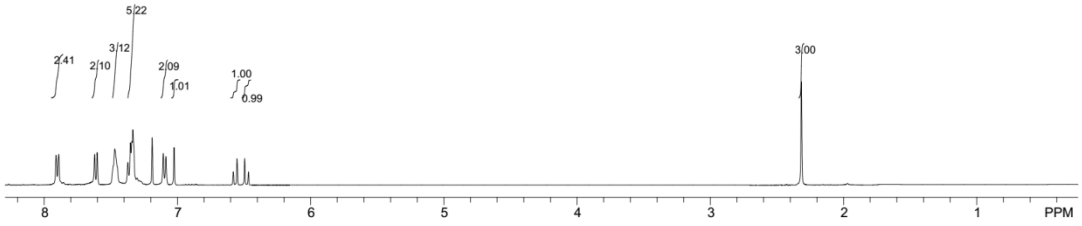
7.086
7.025
6.581
6.552
6.496
6.467


2.317


Ts
O
O
Ph
Ph
O

4ac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1
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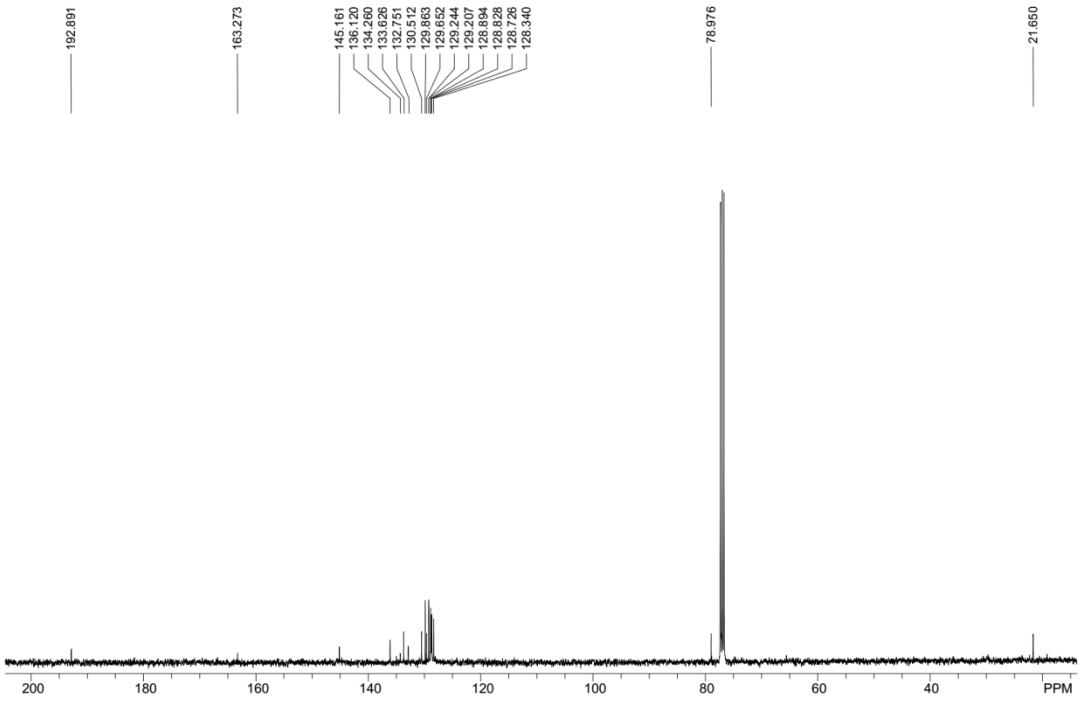
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133.626
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130.512
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129.652
129.244
129.207
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140
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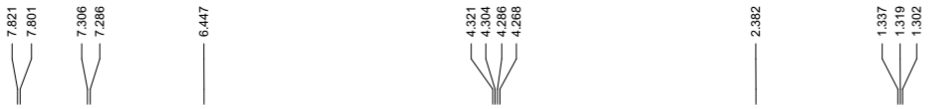
100
80
60
40
PPM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4.286
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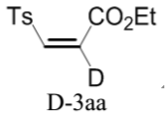
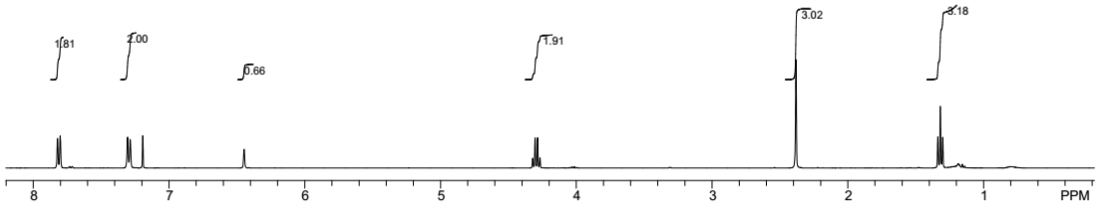
1.319
1.302


Ts
CO2Et
D

D-3aa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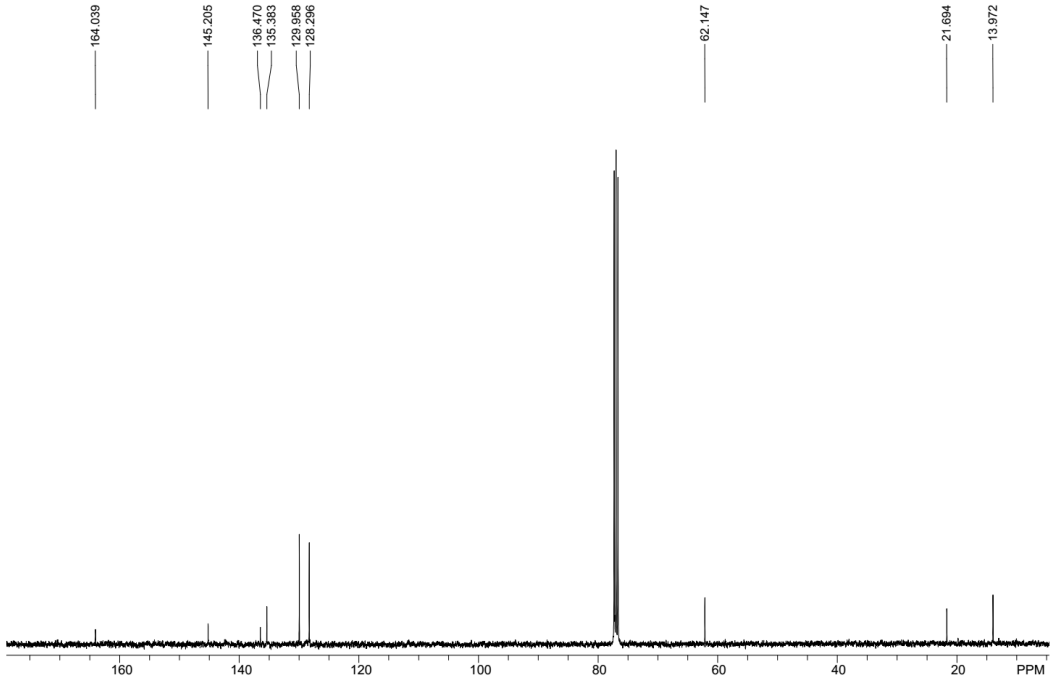
2
1
PPM


164.039
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160
140
120
100
80
60
40
20
PPM