Supporting Information

Temperature-dependent synthesis of vinyl sulfones and β-hydroxy sulfones from *t*-butylsulfinamide and alkenes under aerobic conditions

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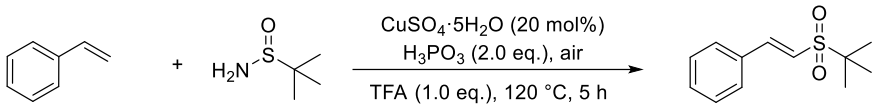
1. General information

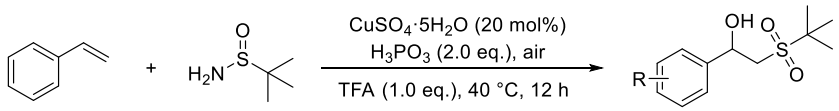
All the chemicals were obtained from Tianjin Kermel Chemical Reagent Co., Ltd. and used as received. All reactions were monitored by TLC and Silica gel was purchased from Qing Dao Hai Yang Chemical Industry Co. ^{1}H, ^{13}C NMR spectra were recorded on a Bruker Avance 400 MHz spectrometer operating at 400.13, 100.61 MHz, respectively. NMR spectra were recorded in $CDCl_3$ at room temperature (20 ± 2 °C). High resolution mass spectra (HRMS) of the products were obtained on a Bruker Daltonics micro TOF-QII spectrometer.

2. Experimental procedures for the synthesis of (E)-(2-(tert-butylsulfonyl)vinyl)benzene



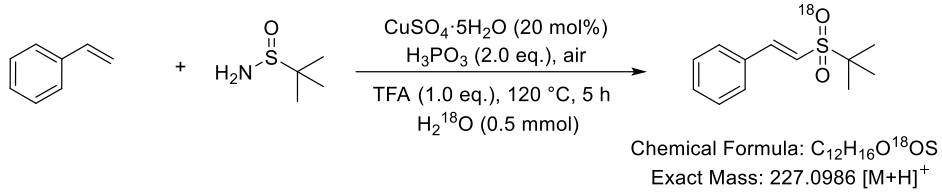
Styrene 0.5 mmol (0.051 g), tert-butyl sulfinamide 1.0 mmol (0.121 g), phosphorous acid 1.0 mmol (0.082 g), copper sulfate pentahydrate 0.1 mmol (0.25 g) and trifluoroacetic acid 0.5 mmol (0.057 g) were mixed in a 25 mL round-bottomed flask and refluxed at 120 °C for 5 h without solvent. The mixture was quenched with water (10 mL), extracted with CH_2Cl_2 (3 × 15 mL). The combined organic layers were washed with brine (15 mL) and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo. The crude product was purified by silica gel chromatography (petroleum ether : ethyl acetate = 20 : 1, v : v) to give the desired products.

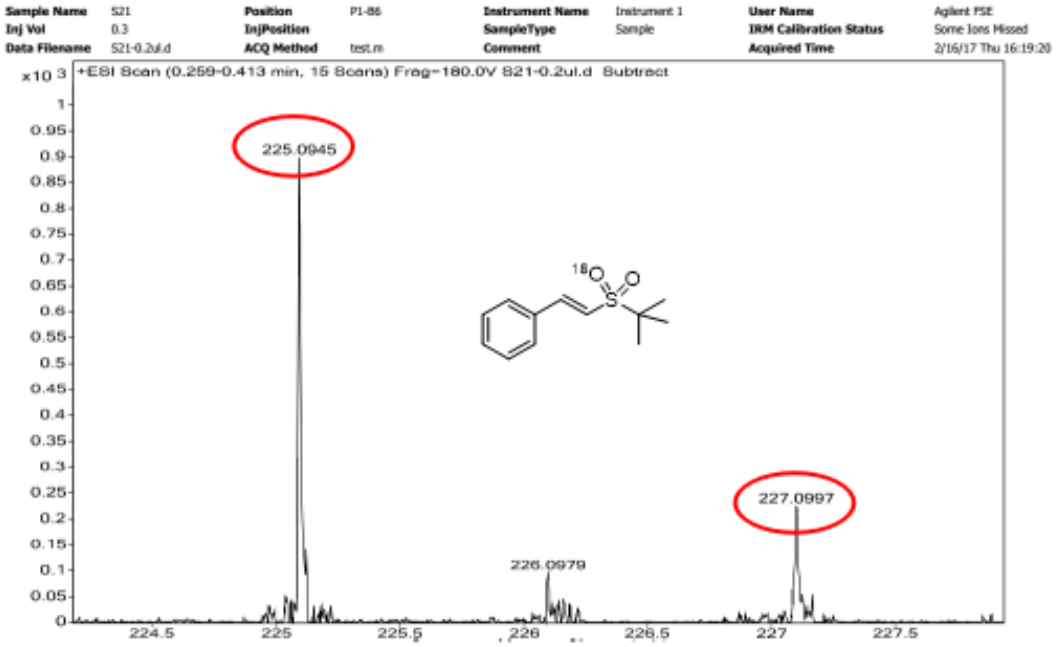
3. Experimental procedures for the synthesis of 2-(*tert*-butylsulfonyl)-1-phenylethan-1-ol



Styrene 0.5 mmol (0.051 g), tert-butyl sulfinamide 1.0 mmol (0.121 g), phosphorous acid 1.0 mmol (0.082 g), copper sulfate pentahydrate 0.1 mmol (0.25 g) and trifluoroacetic acid 0.5 mmol (0.057 g) were mixed in a 25 mL round-bottomed flask and stirred at 40 °C for 12 h without solvent. The mixture was diluted with water (10 mL), extracted with CH_2Cl_2 (3 × 15 mL). The combined organic layers were washed with brine (15 mL) and dried over anhydrous Na_2SO_4. After filtration, the solvent was evaporated in vacuo. The crude product was purified by silica gel chromatography (petroleum ether : ethyl acetate = 10 : 1, v : v) to give the desired products.

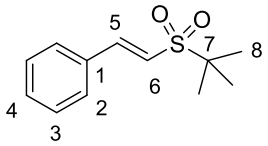
4. ^{18}O labeling experiment





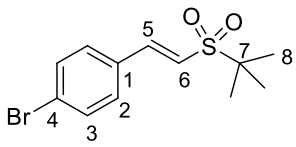
5. Characterization data for products (3a-3r)

(E)-(2-(tert-butylsulfonyl)vinyl)benzene (**3a**).



Yield 76%. White solid. M.p. 98-100 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm) 7.59 (d, J = 15.5 Hz, 1H, 5-H), 7.54-7.52 (m, 2H, 2-H), 7.44-7.42 (m, 3H, 3-H, 4-H), 6.84 (d, J = 15.5 Hz, 1H, 6-H), 1.42 (s, 9H, 8-H). ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 146.4 (5-C), 132.5 (1-C), 131.3 (4-C), 129.1 (3-C), 128.6 (2-C), 120.7 (6-C), 58.9 (7-C), 23.4 (8-C). HRMS: $C_{12}H_{16}O_2S$ $[M + H]^+$ 225.0949, found 225.0944.

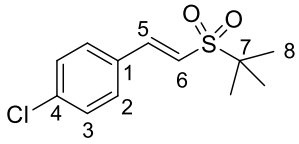
(E)-1-bromo-4-(2-(tert-butylsulfonyl)vinyl)benzene (**3b**).



Yield 64%. White solid. M.p. 86-89 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.56 (d, J = 8.4 Hz, 2H, 3-H), 7.52

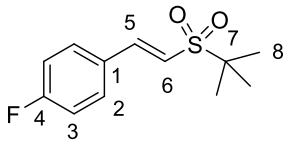
(d, J = 15.6 Hz, 1H, 5-H), 7.40 (d, J = 8.4 Hz, 2H, 2-H), 6.84 (d, J = 15.4 Hz, 1H, 6-H), 1.42 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 145.0 (5-C), 132.4 (3-C), 131.4 (1-C), 129.9 (2-C), 125.7 (4-C), 121.5 (6-C), 59.0 (7-C), 23.4 (8-C); HRMS: $C_{12}H_{15}BrO_2S$ $[M + H]^+$ 303.0054, found 303.0051.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-4-chlorobenzene (**3c**).



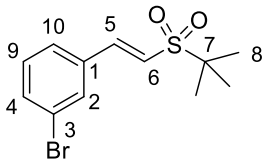
Yield 63%. White solid. M.p. 114-116 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.54 (d, J = 15.6 Hz, 1H, 5-H), 7.48-7.39 (m, 4H, 2-H, 3-H), 6.81 (d, J = 15.6 Hz, 1H, 6-H), 1.42 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 145.0 (5-C), 137.3 (4-C), 131.0 (1-C), 129.7 (2-C), 129.5 (3-C), 121.3 (6-C), 58.4 (7-C), 23.4 (8-C); HRMS: $C_{12}H_{15}ClO_2S$ $[M + H]^+$ 259.0560, found 259.0577.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-4-fluorobenzene (**3d**).



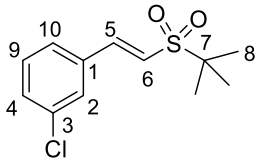
Yield 58%. White solid. M.p. 87-89 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.57-7.53 (m, 3H), 7.12 (m, 2H), 6.78 (d, J = 15.6 Hz, 1H), 1.42 (s, 9H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 164.4 (d, J = 251.4 Hz, 4-C), 145.1 (5-C), 130.6 (d, J = 8.7 Hz, 2-C), 128.8 (d, J = 3.2 Hz, 1-C), 120.4 (6-C), 116.3 (d, J = 21.9 Hz, 3-C), 58.9 (7-C), 23.4 (8-C); HRMS: $C_{12}H_{15}FO_2S$ $[M + H]^+$ 243.0855, found 243.0851.

(E)-1-bromo-3-(2-(tert-butylsulfonyl)vinyl)benzene (**3e**).



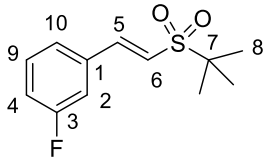
Yield 58%. White solid. M.p. 127-128 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.70 (m, 1H, 2-H), 7.61-7.58 (m, 1H, 4-H), 7.54 (d, J = 15.6 Hz, 1H, 5-H), 7.47 (d, J = 7.8 Hz, 1H, 10-H), 7.33 (m, 1H, 9-H), 6.86 (d, J = 15.6 Hz, 1H, 6-H), 1.42 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 144.7 (5-C), 134.5 (1-C), 134.1 (3-C), 131.1 (4-C), 130.7 (2-C), 127.2 (9-C), 123.2 (10-C), 122.3 (6-C), 59.0 (7-C), 23.4 (8-C); HRMS: $C_{12}H_{15}BrO_2S$ $[M + Na]^+$ 324.9874, found 324.9861.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-3-chlorobenzene (**3f**).



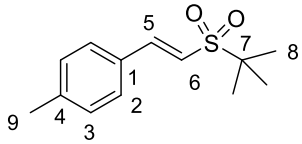
Yield 60%. White solid. M.p. 115-117 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.57-7.54 (m, 2H, 5-H, 2-H), 7.46-7.37 (m, 3H, 4-H, 9-H, 10-H), 6.87 (d, J = 15.6 Hz, 1H, 6-H), 1.45 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 144.8 (5-C), 135.2 (1-C), 134.2 (3-C), 131.1 (9-H), 130.4 (4-C), 128.1 (2-C), 126.8 (10-C), 122.3 (6-C), 59.0 (7-C), 23.4 (8-C); HRMS: $C_{12}H_{15}ClO_2S$ $[M + H]^+$ 259.0560, found 259.0556.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-3-fluorobenzene (**3g**).



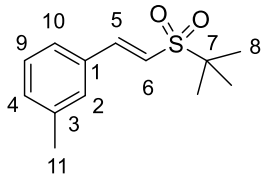
Yield 59%. White solid. M.p. 85-89 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.58 (d, J = 15.6 Hz, 1H, 5-H), 7.46-7.40 (m, 1H, 9-H), 7.33 (d, J = 7.6 Hz, 1H, 10-H), 7.25 (m, 1H, 4-H), 7.18 (m, 1H, 2-H), 6.86 (d, J = 15.6 Hz, 1H, 6-H), 1.45 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 164.2 (d, J = 246.4 Hz, 3-C), 145.0 (d, J = 2.6 Hz, 5-C), 134.6 (d, J = 7.6 Hz, 1-C), 130.8 (d, J = 8.2 Hz, 9-C), 124.6 (d, J = 2.8 Hz, 10-C), 122.2 (6-C), 118.2 (d, J = 21.2 Hz, 4-C), 114.8 (d, J = 22 Hz, 2-C), 59.0 (7-C), 23.4 (8-C); HRMS: $C_{12}H_{15}FO_2S$ $[M + H]^+$ 243.0855, found 243.0851.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-4-methylbenzene (**3h**).



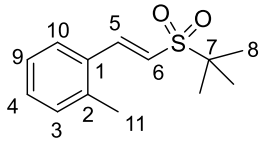
Yield 79%. White solid. M.p. 127-130 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.55 (d, J = 15.4 Hz, 1H, 5-H), 7.42 (d, J = 8.0 Hz, 2H), 7.23 (d, J = 8.0 Hz, 2H), 6.76 (d, J = 15.6 Hz, 1H), 2.39 (s, 3H), 1.42 (s, 9H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 146.5 (5-C), 141.9 (4-C), 129.8 (3-C), 129.8 (1-C), 128.6 (2-C), 119.4 (6-C), 58.9 (7-C), 23.4 (8-C), 21.5 (9-C); HRMS: $C_{13}H_{18}O_2S$ $[M + H]^+$ 239.1106, found 239.1104.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-3-methylbenzene (**3i**).



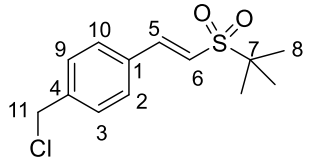
Yield 75%. White solid. M.p. 68-72 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.56 (d, J = 15.6 Hz, 1H, 5-H), 7.34-7.26 (m, 4H, 2-H, 4-H, 9-H, 10-H), 6.80 (d, J = 15.6 Hz, 1H, 6-H), 2.39 (s, 3H, 11-H), 1.42 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 146.6 (5-C), 138.9 (3-C), 132.5 (1-C), 132.1 (9-C), 129.1 (4-C), 129.0 (2-C), 125.8 (10-C), 120.4 (6-C), 58.9 (7-C), 23.4 (8-C), 21.3 (11-C); HRMS: $C_{13}H_{18}O_2S$ $[M + H]^+$ 239.1106, found 239.1105.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-2-methylbenzene (**3j**).



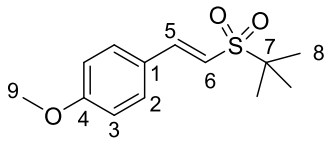
Yield 70%. White solid. M.p. 108-109 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.86 (d, J = 15.4 Hz, 1H, 5-H), 7.51 (m, 1H, 10-H), 7.34 (m, 1H, 9-H), 7.25, (m, 2H, 4-H, 3-H), 6.73 (d, J = 15.4 Hz, 1H, 6-H), 2.44 (s, 3H, 11-H), 1.43 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 144.5 (5-C), 138.0 (1-C), 131.7 (2-C), 131.1 (4-C), 131.0 (3-C), 126.9 (10-C), 126.6 (9-C), 121.7 (6-C) 58.9 (7-C), 23.4 (8-C), 21.3 (11-C); HRMS: $C_{13}H_{18}O_2S$ $[M + H]^+$ 239.1106, found 239.1112.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-4-(chloromethyl)benzene (**3k**).



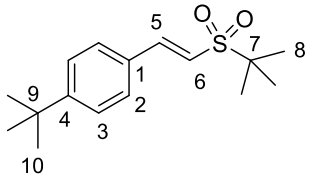
Yield 66%. White solid. M.p. 124-126 ℃. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.59 (d, *J* = 15.6 Hz, 1H,), 7.55 (d, *J* = 8.2 Hz, 2H, 2-H), 7.47 (d, *J* = 8.4 Hz, 2H), 6.85 (d, *J* = 15.6 Hz, 1H, 6-H), 1.42 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 145.6 (5-C), 140.6 (1-C), 129.3 (2-C), 128.9 (3-C), 121.3 (6-C), 58.5 (7-C), 23.4 (8-C), 18.4 (11-C); HRMS: $C_{13}H_{17}ClO_2S$ $[M + H]^+$ 273.0716, found 273.0711.

(E)-1-(2-(tert-butylsulfonyl)vinyl)-4-methoxybenzene (**3l**).



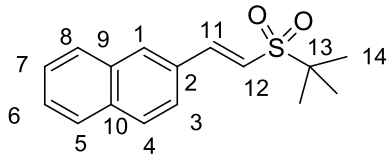
Yield 77%. White solid. M.p. 139-141 ℃. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.55-7.48 (m, 3H, 2-H, 5-H), 6.94 (d, *J* = 8.6 Hz, 2H, 3-H), 6.68 (d, *J* = 15.4 Hz, 1H, 6-H), 3.86 (s, 3H, 9-H), 1.42 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 162.1 (4-C), 146.1 (5-C), 130.3 (2-C), 125.2 (1-C), 117.7 (6-C), 114.5 (3-C), 58.9 (7-C), 55.5 (9-C), 23.5 (8-C); HRMS: $C_{13}H_{18}O_3S$ $[M + H]^+$ 255.1055, found 255.1055.

(E)-1-(tert-butyl)-4-(2-(tert-butylsulfonyl)vinyl)benzene (**3m**)



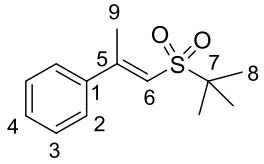
Yield 78%. White solid. M.p. 134-135 ℃. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.58 (d, *J* = 15.6 Hz, 1H, 5-H), 7.48 (m, 4H, 2-H, 3-H), 6.80 (d, *J* = 15.6 Hz, 1H, 6-H), 1.43 (s, 9H, 8-H),1.35 (s, 9H, 9-H) ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 155.0 (4-H), 146.4 (5-H), 129.8 (1-H), 128.4 (2-H), 126.3 (3-H), 119.6 (6-H), 58.9 (7-C), 35.0 (9-C), 31.1 (10-C), 23.4 (8-C); HRMS: $C_{16}H_{24}O_2S$ $[M + H]^+$ 281.1575, found 281.1582.

(E)-2-(2-(tert-butylsulfonyl)vinyl)naphthalene (**3n**).



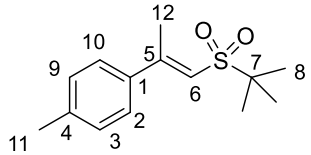
Yield 77%. White solid. M.p. 128-129 ℃. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.99 (s, 1H, 1-H), 7.90-7.87 (m, 3H, 8-H, 5-H, 4-H), 7.77 (d, *J* = 17.8 Hz, 1H, 11-H), 7.65 (dd, *J* = 1.6 Hz, *J* = 8.6 Hz, 1H, 3-H), 7.60-7.54 (m, 2H, 6-H, 7-H), 6.95 (d, *J* = 15.4 Hz, 1H, 12-H), 1.48 (s, 9H, 14-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 146.5 (5-C), 134.6 (13-C), 133.2 (1-C), 130.9 (3-C), 130.0 (4-C), 129.0 (12-C), 128.7 (14-C), 127.9 (10-C, 11-C), 127.1 (9-C), 123.4 (2-C), 120.7 (6-C), 59.0 (7-C), 23.5 (8-C); HRMS: $C_{16}H_{18}O_2S$ $[M + H]^+$ 275.1106, found 275.1106.

(E)-(1-(tert-butylsulfonyl)prop-1-en-2-yl)benzene (**3o**).



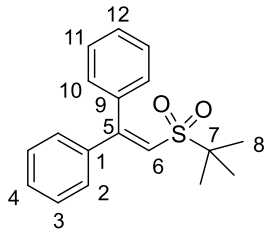
Yield 68%. White solid. M.p. 131-132 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.46-7.40 (m, 5H, 2-H, 3-H, 4-H), 6.38 (s, 1H, 6-H), 2.58 (s, 3H, 9-H), 1.44 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 156.8 (5-C), 141.0 (1-C), 129.8 (3-C), 128.8(4-C), 126.3 (2-C), 120.4 (6-C), 58.5 (7-C), 23.2 (8-C), 14.1 (9-C); HRMS: $C_{13}H_{18}O_2S$ [M + H]$^+$ 239.1106, found 239.1101.

(E)-1-(1-(tert-butylsulfonyl)prop-1-en-2-yl)-4-methylbenzene (**3p**).



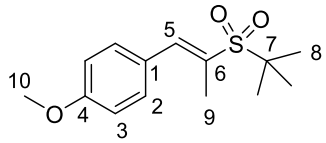
Yield 74%. White solid. M.p. 129-131 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.37 (d, J = 8.2 Hz, 2H, 3-H), 7.23 (d, J = 8.2 Hz, 2H, 2-H), 6.39 (d, J = 1.2 Hz, 1H, 6-H), 2.58 (d, J = 1.2 Hz, 3H, 12-H), 2.40 (s, 3H, 11-H) 1.45 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 156.6 (5-C), 140.1 (4-C), 137.9 (1-C), 129.5 (3-C), 126.3 (2-C), 119.5 (6-C), 60.0 (7-C), 23.2 (8-C), 21.2 (11-C), 17.1 (12-C); HRMS: $C_{14}H_{20}O_2S$ [M + H]$^+$ 253.1262, found 253.1259.

(2-(tert-butylsulfonyl)ethene-1,1-diyl)dibenzene (**3q**).



Yield 68%. White solid. M.p. 112-114 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.43-7.28 (m, 10H, 2-C, 3-C, 4-C), 6.77 (s, 1H, 6-C), 1.45 (s, 9H, 8-C), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 157.6 (5-C), 140.3 (9-C), 135.9 (1-C), 130.2 (12-C), 129.7 (11-C), 128.9 (4-C), 128.7 (3-C), 128.3 (10-C), 127.5 (2-C), 119.6 (6-C), 59.6 (7-C), 23.6 (8-C); HRMS: $C_{18}H_{20}O_2S$ [M + Na]$^+$ 323.1082, found 323.1084.

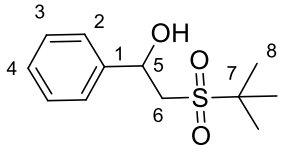
(E)-1-(2-(tert-butylsulfonyl)vinyl)-4-methoxybenzene (**3r**).



Yield 36%. White solid. M.p. 126-127 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ (ppm), 7.50 (s, 1H, 5-H), 7.44 (d, J = 8.6 Hz, 2H, 2-H), 6.96 (d, J = 8.6 Hz, 2H, 3-H), 3.86 (s, 3H, 10-H), 2.36 (d, J = 1.2 Hz, 3H, 9-H), 1.41 (s, 9H, 8-H), ^{13}C NMR ($CDCl_3$, 100 MHz): δ (ppm), 160.5 (4-C), 142.0 (5-C), 131.7 (2-C), 114.1 (3-C), 60.6 (10-C), 55.4 (7-C), 24.0 (8-C), 16.3 (9-C); HRMS: $C_{14}H_{20}O_3S$ [M + H]$^+$ 291.1031, found 291.1031.

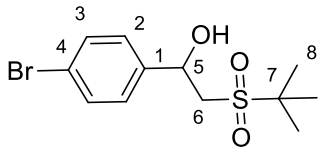
6. Characterization data for products (4a-4k)

2-(*tert*-butylsulfonyl)-1-phenylethan-1-ol (4a)



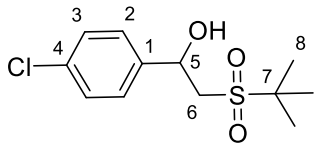
Yield 69%. White solid. M.p. 102-103 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.44 (s, 9H, 8-H), 3.12 (dd, *J* = 1.2 Hz, *J* = 13.2 Hz, 1H, 6-H), 3.33 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 6-H), 3.92 (d, *J* = 1.2 Hz, 1H, -OH), 5.54 (d, *J* = 10.0 Hz, 1H, 5-H), 7.34 (m, 1H, 4-H), 7.37-7.45 (m, 4H, 2, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.2 (8-C), 54.1 (6-C), 59.8 (7-C), 67.6 (6-C), 125.7 (2-C), 128.3 (4-C), 128.8 (3-C), 140.0 (1-C). HRMS: $C_{12}H_{18}O_3S$ [M + Na]$^+$: m/z 265.0869, Found 265.0869.

1-(4-bromophenyl)-2-(*tert*-butylsulfonyl)ethan-1-ol (4b)



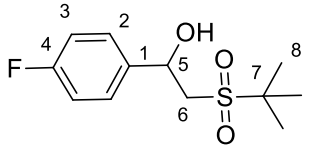
Yield 73%. White solid. M.p. 133-135 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.44 (s, 9H, 8-H), 3.07 (dd, *J* = 1.2 Hz, *J* = 9.2 Hz, 1H, 6-H), 3.26 (dd, *J* = 10.0 Hz, *J* = 13.2 Hz, 1H, 6-H), 3.97 (s, 1H, -OH), 5.50 (d, *J* = 10.0 Hz, 1H, 5-H), 7.31 (d, *J* = 8.4 Hz, 2H, 2-H), 7.53 (d, *J* = 8.4 Hz, 2H, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.1 (8-C), 53.8 (6-C), 60.0 (7-C), 67.0 (5-C), 122.2 (4-C), 127.5 (2-C), 131.2 (3-C), 140.1 (1-C). HRMS: $C_{12}H_{17}BrO_3S$ [M + Na]$^+$: m/z 342.9974, Found 342.9956.

2-(*tert*-butylsulfonyl)-1-(4-chlorophenyl)ethan-1-ol (4c)



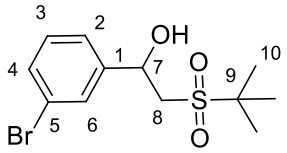
Yield 63%. White solid. M.p. 111-114 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.43 (s, 9H, 8-H), 3.07 (dd, *J* = 1.6 Hz, *J* = 13.6 Hz, 1H, 6-H), 3.29 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 6-H), 4.01 (d, *J* = 2.0 Hz, 1H, -OH), 5.48 (d, *J* = 10.0 Hz, 1H, 5-H), 7.33-7.38 (m, 4H, 2, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.1 (8-C), 53.9 (6-C), 59.9 (7-C), 67.0 (5-C), 127.2 (2-C), 128.9 (3-C), 134.0 (4-C), 149.7 (1-C). HRMS: $C_{12}H_{17}ClO_3S$ [M + Na]$^+$: m/z 299.0479, Found 342.9959.

2-(*tert*-butylsulfonyl)-1-(4-fluorophenyl)ethan-1-ol (4d)



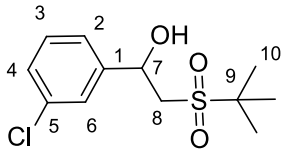
Yield 70%. White solid. M.p. 102-105 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.44 (s, 9H, 8-H), 3.08 (dd, *J* = 1.2 Hz, *J* = 9.2 Hz, 1H, 6-H), 3.29 (dd, *J* = 10.0 Hz, *J* = 13.2 Hz, 1H, 6-H), 3.98 (s, 1H, -OH), 5.51 (d, *J* = 9.6 Hz, 1H, 5-H), 7.07 (m, 2H, 2-H), 7.41 (m, 2H, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.1 (8-C), 54.0 (6-C), 59.9 (7-C), 67.0 (5-C), 115.7 (d, *J* = 31.7 Hz, 3-C), 127.5 (d, *J* = 9.4 Hz, 2-C), 136.9 (d, *J* = 3.7 Hz, 1-C), 161.7 (d, *J* = 251.8 Hz, 4-C). HRMS: $C_{12}H_{17}FO_3S$ [M + Na]$^+$: m/z 283.0775, Found 283.0776.

1-(3-bromophenyl)-2-(*tert*-butylsulfonyl)ethan-1-ol (4e)



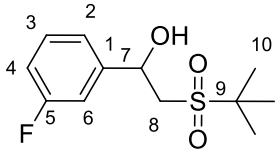
Yield 65%. White solid. M.p. 127-129 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.45 (s, 9H, 10-H), 3.09 (dd, *J* = 0.8 Hz, *J* = 13.6 Hz, 1H, 8-H), 3.26 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 8-H), 4.02 (d, 1H, *J* = 2.0 Hz, -OH), 5.49 (d, *J* = 10.4 Hz, 1H, 7-H), 7.27 (d, *J* = 8.0 Hz, 1H, 4-H), 7.35 (d, *J* = 7.6 Hz, 1H, 6-H), 7.46 (d, *J* =8.0 Hz, 1H, 2-H), 7.62 (s, 1H, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.1 (10-C), 53.9 (8-C), 59.9 (9-C), 66.9 (7-C), 122.9 (2-C), 124.4 (3-C), 128.9 (5-C), 130.4 (4-C), 131.4 (6-C), 143.3 (1-C). HRMS: $C_{12}H_{17}BrO_3S$ $[M + Na]^+$: m/z 342.9974, Found 342.9956.

2-(*tert*-butylsulfonyl)-1-(3-chlorophenyl)ethan-1-ol (4f)



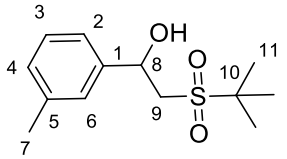
Yield 63%. White solid. M.p. 103-105 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.43 (s, 9H, 10-H), 3.10 (dd, *J* = 1.2 Hz, *J* = 13.6 Hz, 1H, 8-H), 3.26 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 8-H), 4.05 (d, 1H, *J* = 2.0 Hz, -OH), 5.48 (d, *J* = 10.4 Hz, 1H, 7-H), 7.26-7.31 (m, 3H, 2, 3, 4-H), 7.45 (s, 1H, 6-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.1 (10-C), 52.8 (8-C), 59.9 (9-C), 67.0 (7-C), 124.0 (2-C), 126.0 (3-C), 128.4 (5-C), 130.1 (4-C), 137.7 (6-C), 143.2 (1-C). HRMS: $C_{12}H_{17}ClO_3S$ $[M + Na]^+$: m/z 299.0479, Found 299.0454.

2-(*tert*-butylsulfonyl)-1-(3-fluorophenyl)ethan-1-ol (4g)



Yield 67%. White solid. M.p. 95-98 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.42 (s, 9H, 10-H), 3.11 (dd, *J* = 1.6 Hz, *J* = 13.6 Hz, 1H, 8-H), 3.31 (dd, *J* = 10.0 Hz, *J* = 13.2 Hz, 1H, 8-H), 4.06 (d, 1H, *J* = 2.0 Hz, -OH), 5.49 (d, *J* = 9.6 Hz, 1H, 7-H), 6.97-7.02 (m, 1H, 6-H), 7.17 (d, *J* = 7.6 Hz, 2H, 2, 4-H), 7.31 (t, 1H, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.1 (10-C), 53.8 (8-C), 59.9 (9-C), 67.0 (7-C), 112.8 (d, *J* = 22.1 Hz, 6-C), 115.1 (d, *J* = 20.9 Hz, 4-C), 121.4 (d, *J* = 9.2 Hz, 3-C), 130.4 (d, *J* = 8.2 Hz, 2-C), 143.8 (d, *J* = 7.0 Hz, 1-C), 164.1 (d, *J* = 24.5 Hz, 5-C). HRMS: $C_{12}H_{17}FO_3S$ $[M + Na]^+$: m/z 283.0775, Found 283.0773.

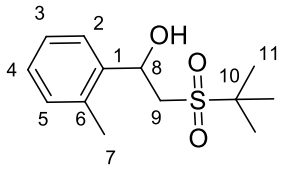
2-(*tert*-butylsulfonyl)-1-(*m*-tolyl)ethan-1-ol (4h)



Yield 65%. White solid. M.p. 89-90 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.44 (s, 9H, 10-H), 2.37 (s, 3H, 7-H), 3.11 (dd, *J* = 1.2 Hz, *J* = 13.6 Hz, 1H, 9-H), 3.31 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 9-H), 3.90 (d, *J* = 1.2 Hz, 1H, -OH), 5.50 (d, *J* = 10.4 Hz, 1H, 8-H), 7.14 (d, *J* = 7.6 Hz, 2H, 4-H), 7.21 (d, *J* = 7.6 Hz, 2H, 2-H), 7.25-7.30 (m, 2H, 6, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 21.4 (7-C), 23.2 (11-C), 54.1 (9-C), 59.8 (10-C), 67.6 (8-C),

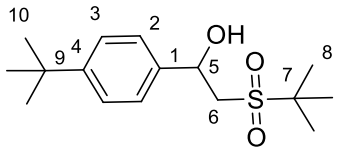
122.8 (2-C), 126.4 (4-C), 128.7 (3-C), 129.1 (6-C), 138.6 (5-C), 141.0 (1-C). HRMS: $C_{13}H_{20}O_3S$ [M + Na]$^+$: m/z 279.1025, Found 279.1209.

2-(*tert*-butylsulfonyl)-1-(*o*-tolyl)ethan-1-ol (4i)



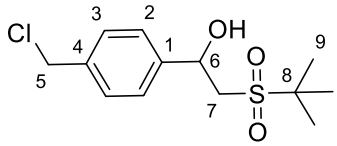
Yield 57%. White solid. M.p. 98-100 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.44 (s, 9H, 11-H), 2.36 (s, 3H, 7-H), 3.04 (d, *J* = 13.6 Hz, 1H, 9-H), 3.26 (dd, *J* = 10.0 Hz, *J* = 13.2 Hz, 1H, 9-H), 3.83 (s, 1H, -OH), 5.74 (d, *J* = 9.6 Hz, 1H, 8-H), 7.17 (d, *J* =7.2 Hz, 1H, 4-H), 7.21-7.30 (m, 2H, 2, 3-H), 7.60 (d, *J* = 7.2 Hz, 1H, 5-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 18.9 (7-C), 23.2 (11-C), 52.9 (9-C), 59.7 (10-C), 64.1 (8-C), 125.4 (2-C), 126.6 (3-C), 128.1 (5-C), 130.7 (4-C), 133.9 (6-C), 139.2 (1-C). HRMS: $C_{13}H_{20}O_3S$ [M + Na]$^+$: m/z 279.1025, Found 279.1026.

1-(4-(*tert*-butyl)phenyl)-2-(*tert*-butylsulfonyl)ethan-1-ol (4j)



Yield 57%. White solid. M.p. 100-103 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.31 (s, 9H, 10-H), 1.42 (s, 9H, 8-H), 3.12 (dd, *J* = 1.2 Hz, *J* = 13.2 Hz, 1H, 6-H), 3.34 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 6-H), 3.90 (d, *J* = 1.2 Hz, 1H, -OH), 5.49 (d, *J* = 10.4 Hz, 1H, 5-H), 7.35 (d, *J* = 8.4 Hz, 2H, 2-H), 7.40 (d, *J* = 8.4 Hz, 2H, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.2 (8-C), 31.3 (10-C), 34.6 (9-C), 54.0 (6-C), 59.8 (7-C), 67.4 (5-C), 125.4 (3-C), 125.7 (2-C), 138.1 (1-C), 151.4 (4-C). HRMS: $C_{16}H_{26}O_3S$ [M + Na]$^+$: m/z 321.1495, Found 321.1497.

2-(*tert*-butylsulfonyl)-1-(4-(chloromethyl)phenyl)ethan-1-ol (4k)



White solid. Yield 59%. M.p. 101-103 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm), 1.44 (s, 9H, 9-H), 3.10 (dd, *J* = 1.2 Hz, *J* = 13.2 Hz, 1H, 7-H), 3.30 (dd, *J* = 10.4 Hz, *J* = 13.6 Hz, 1H, 7-H), 3.96 (d, *J* = 1.6 Hz, 1H, -OH), 4.59 (s, 2H, 5-H), 5.53 (d, *J* = 10.4 Hz, 1H, 6-H), 7.40-7.45 (m, 4H, 2, 3-H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm), 23.2 (9-C), 45.8 (5-C), 54.0 (7-C), 59.9 (8-C), 67.3 (6-C), 126.2 (2-C), 129.1 (3-C), 137.6 (4-C), 141.4 (1-C). HRMS: $C_{13}H_{19}ClO_3S$ [M + Na]$^+$: m/z 313.0636, Found 313.0636.

7. ^{1}H NMR, ^{13}C NMR copies of products (3a-3r)

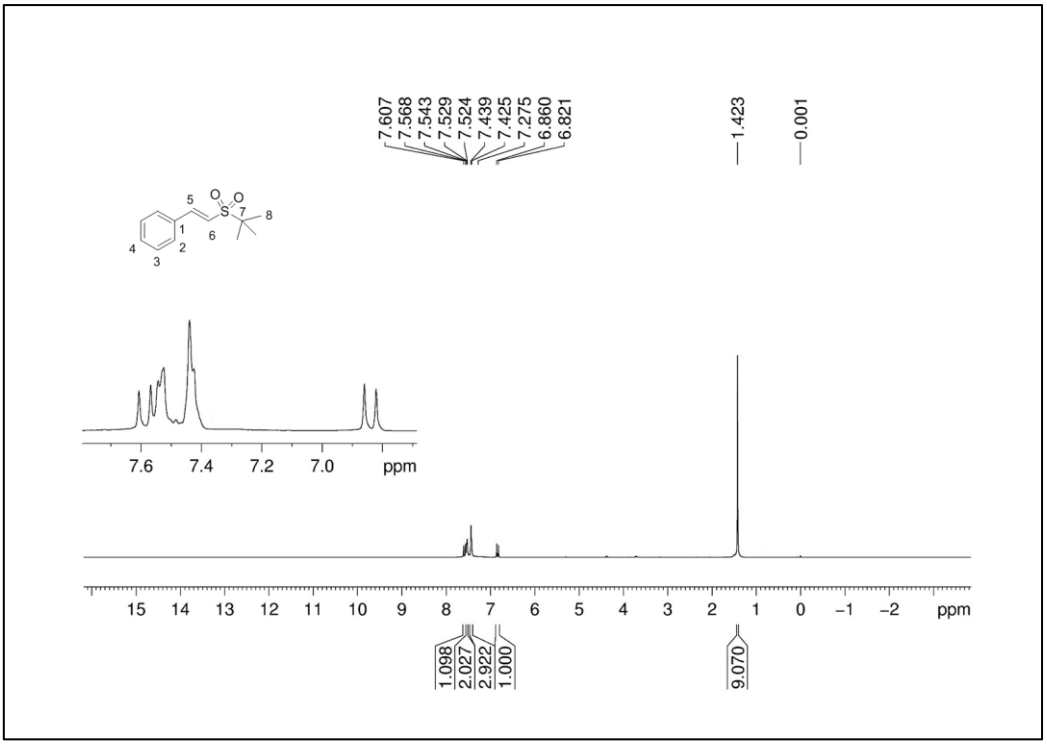


Fig.1 ^{1}H NMR spectrum of compound **3a**

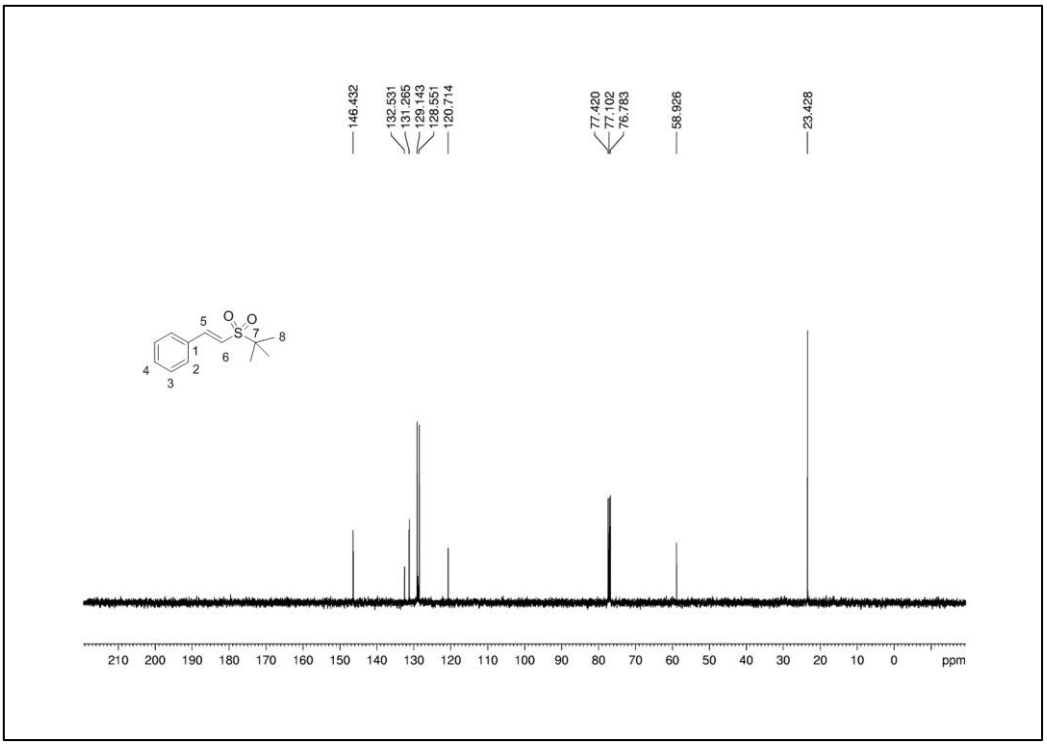


Fig.2 ^{13}C NMR spectrum of compound **3a**

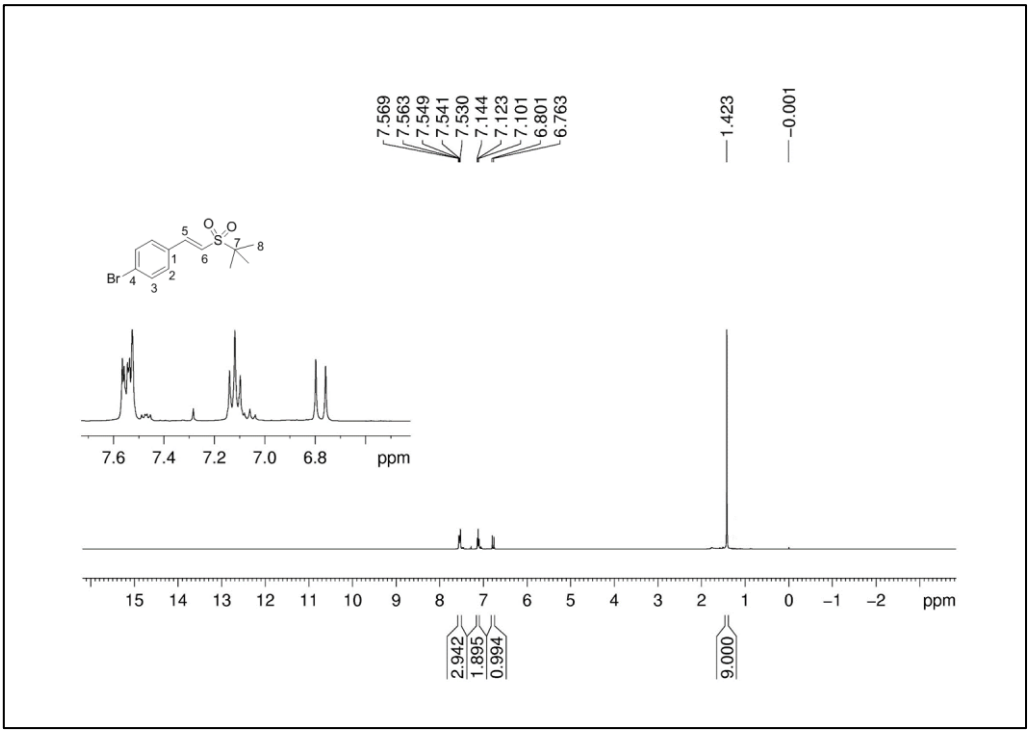


Fig.3 ^{1}H NMR spectrum of compound **3b**

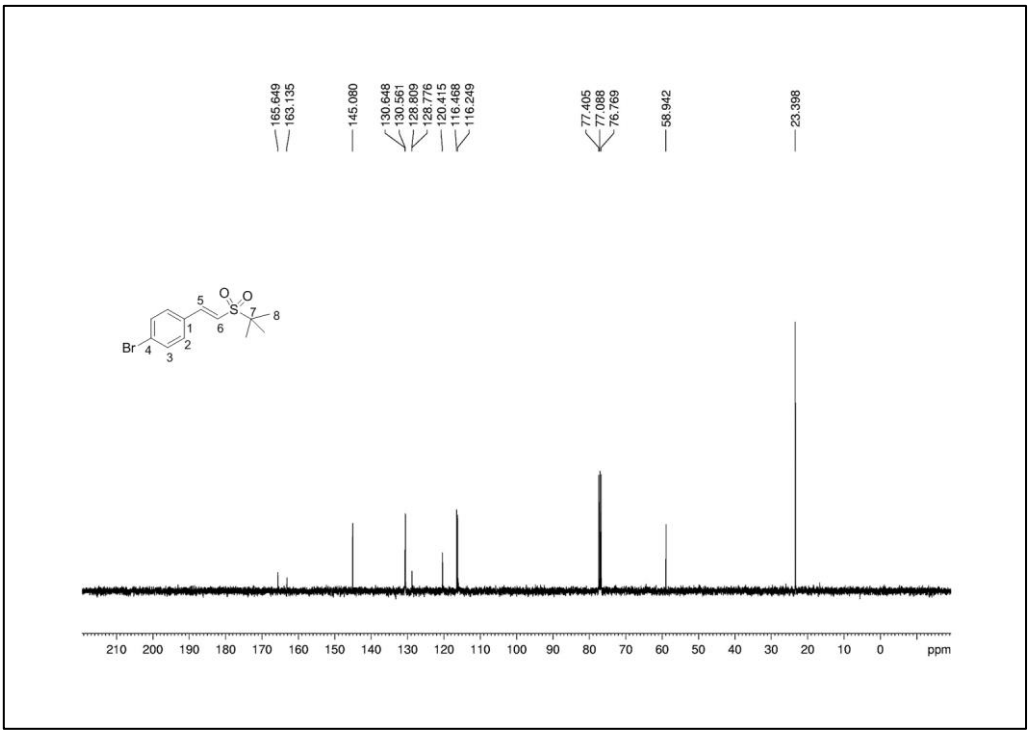


Fig.4 ^{13}C NMR spectrum of compound **3b**

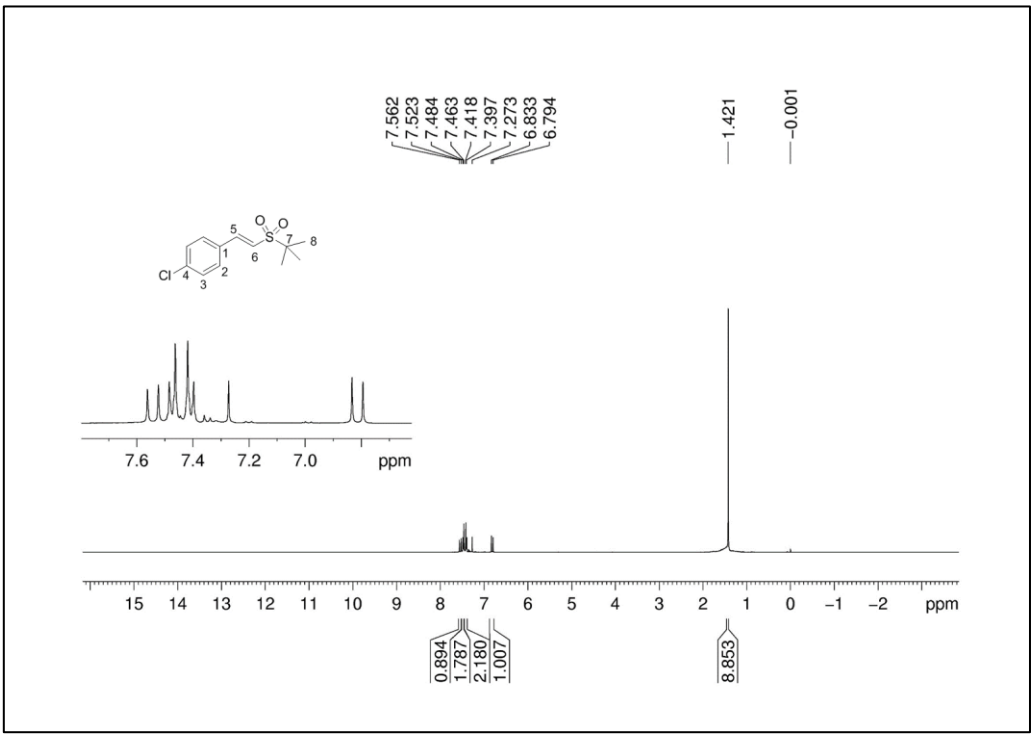


Fig.5 [1]H NMR spectrum of compound **3c**

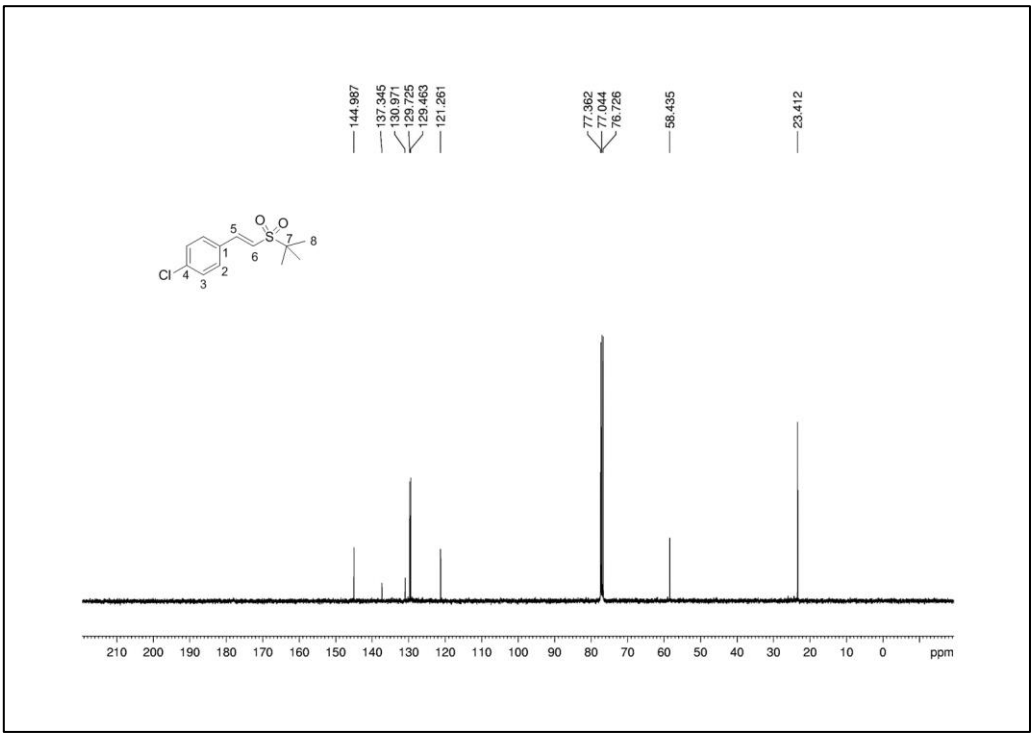


Fig.6 [13]C NMR spectrum of compound **3c**

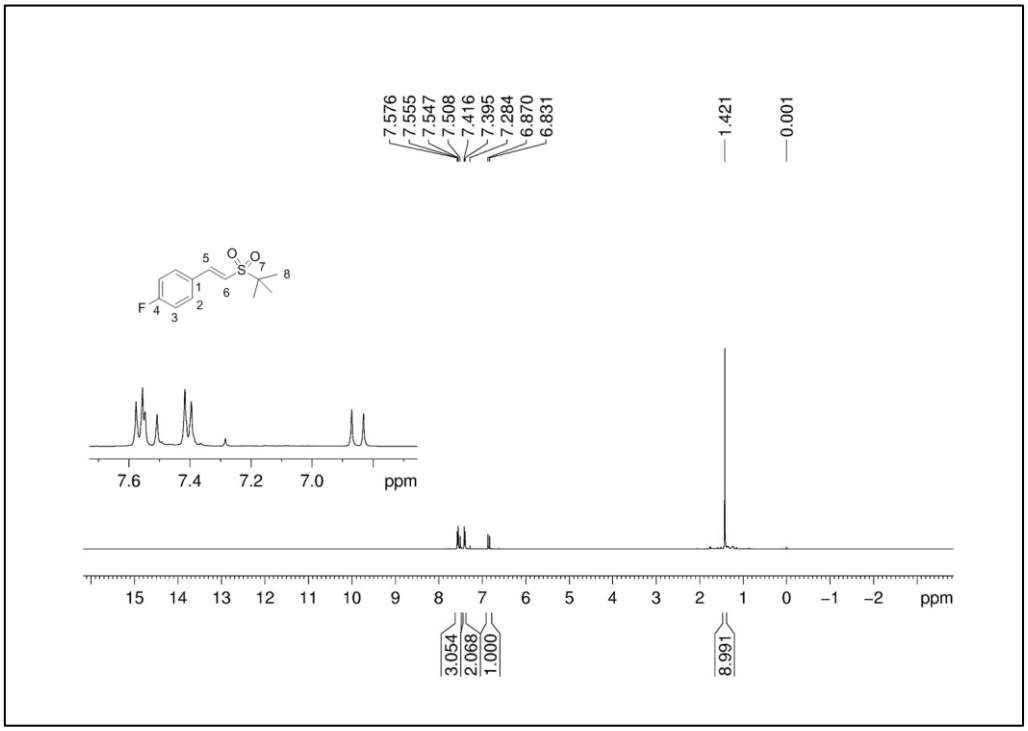


Fig.7 [1]H NMR spectrum of compound **3d**

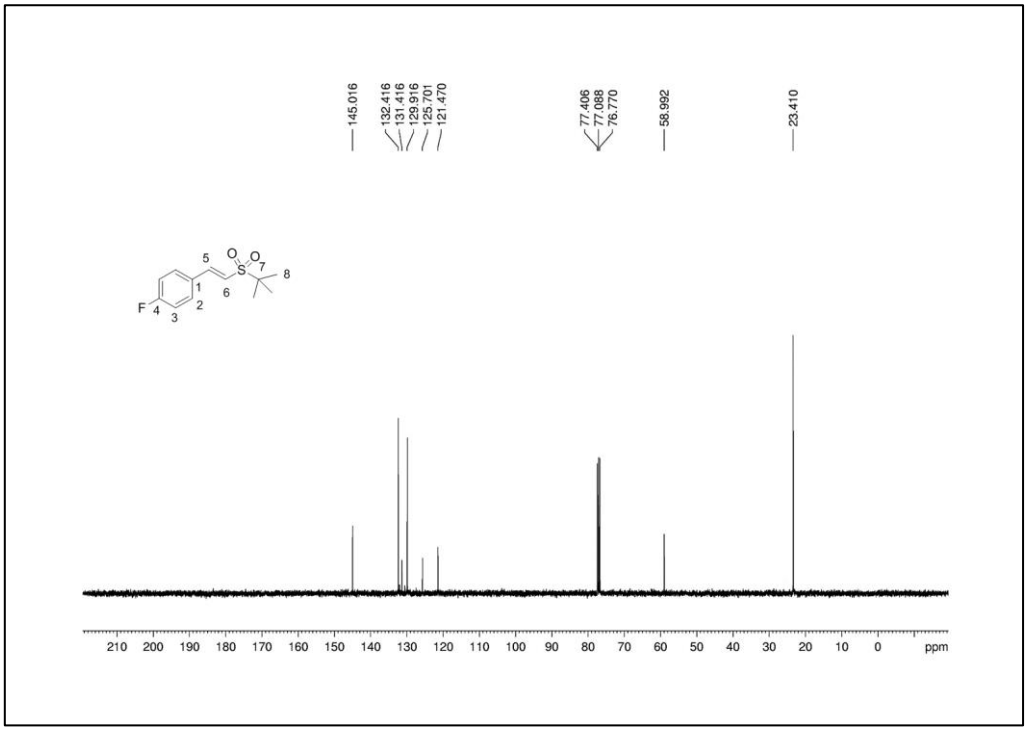


Fig.8 [13]C NMR spectrum of compound **3d**

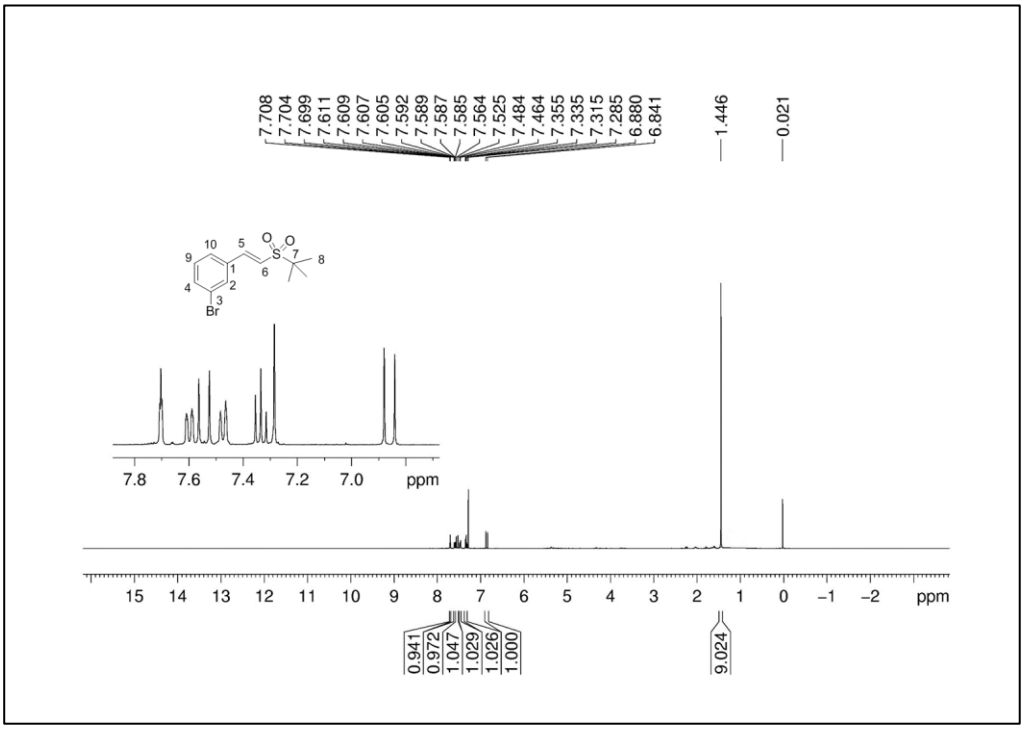


Fig.9 [1]H NMR spectrum of compound **3e**

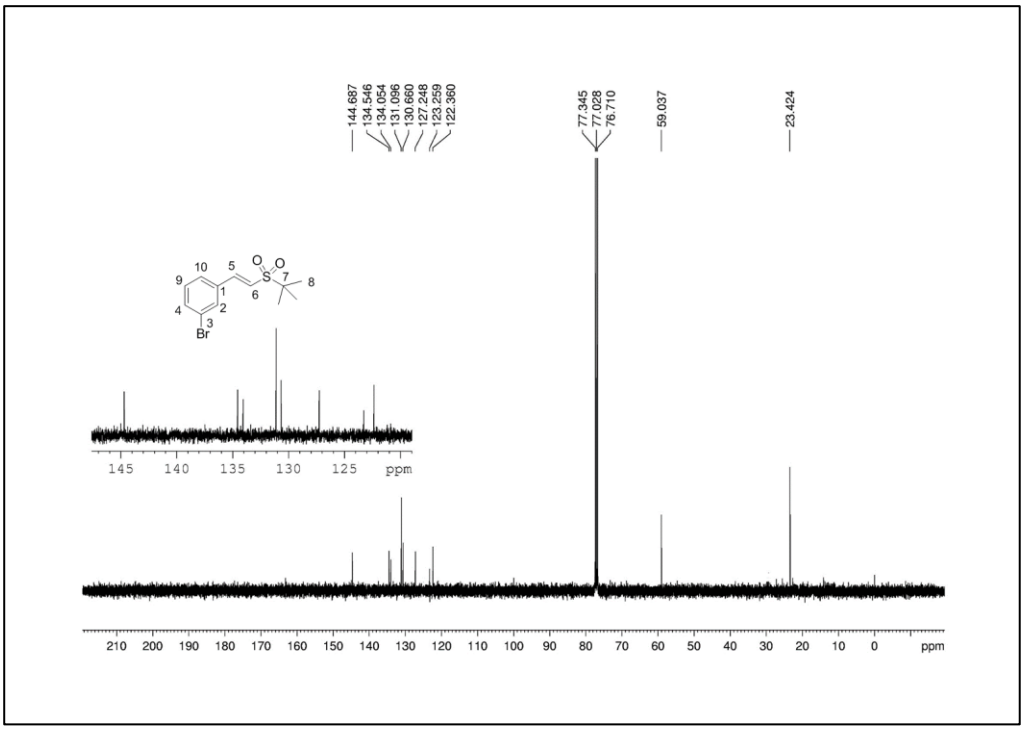


Fig.10 [13]C NMR spectrum of compound **3e**

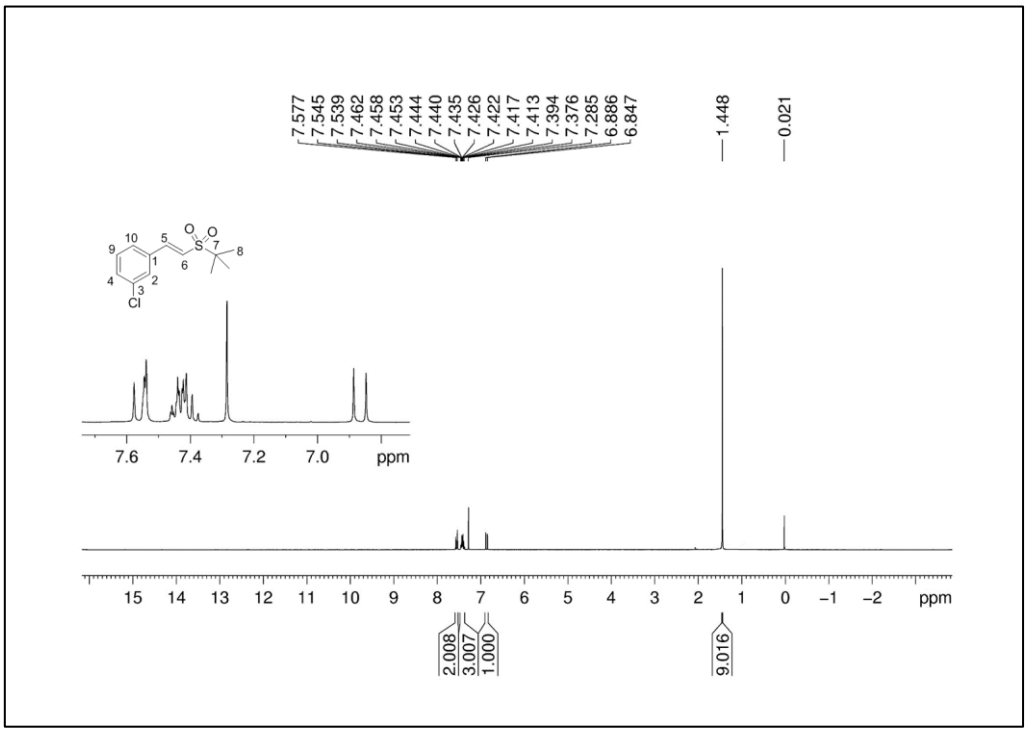


Fig.11 ^{1}H NMR spectrum of compound **3f**

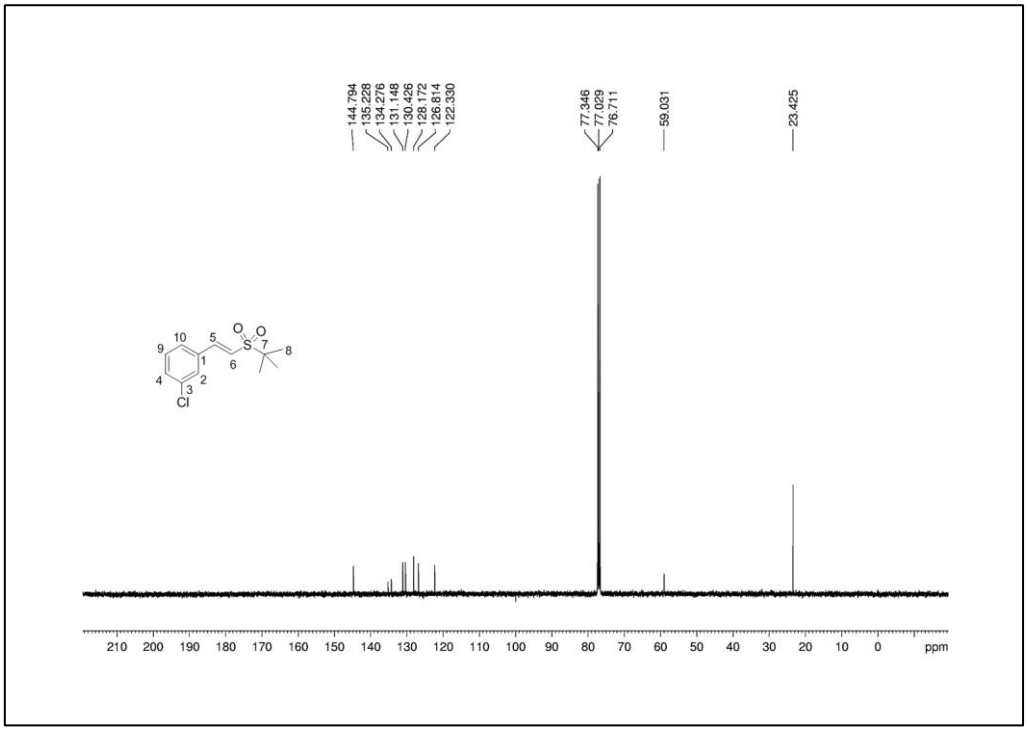


Fig.12 ^{13}C NMR spectrum of compound **3f**

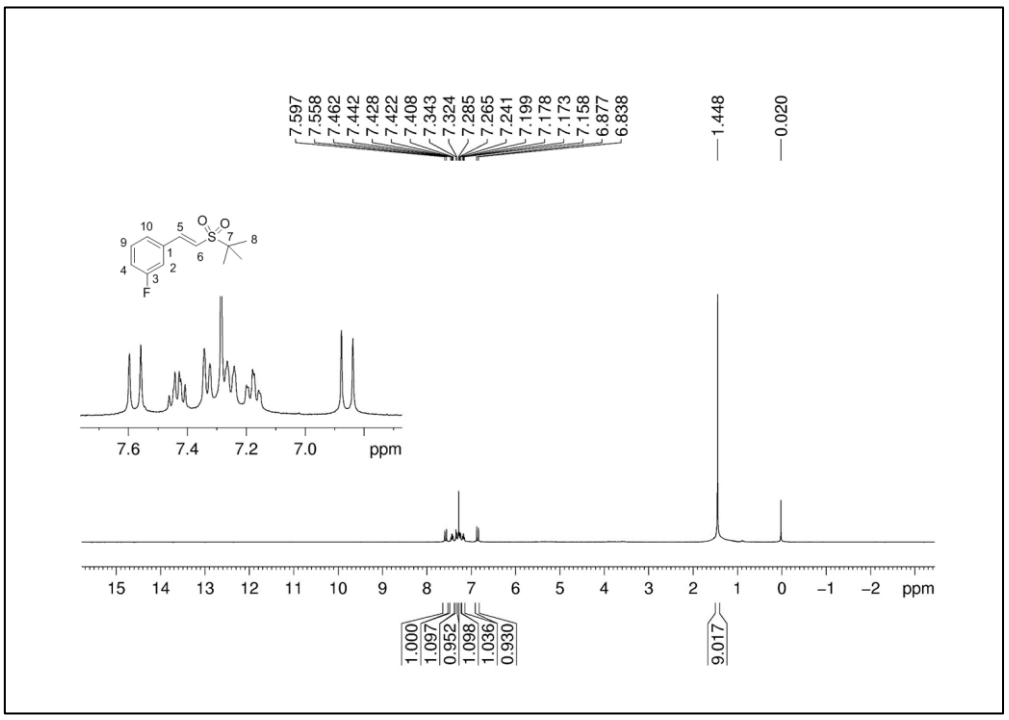


Fig.13 ^{1}H NMR spectrum of compound **3g**

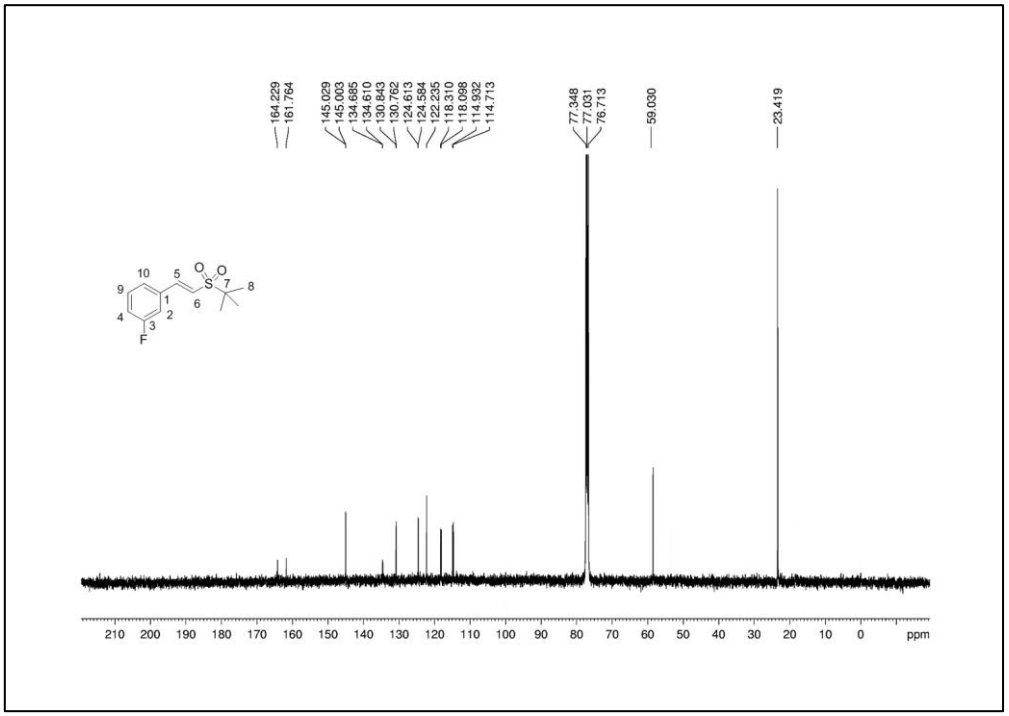


Fig.14 ^{13}C NMR spectrum of compound **3g**

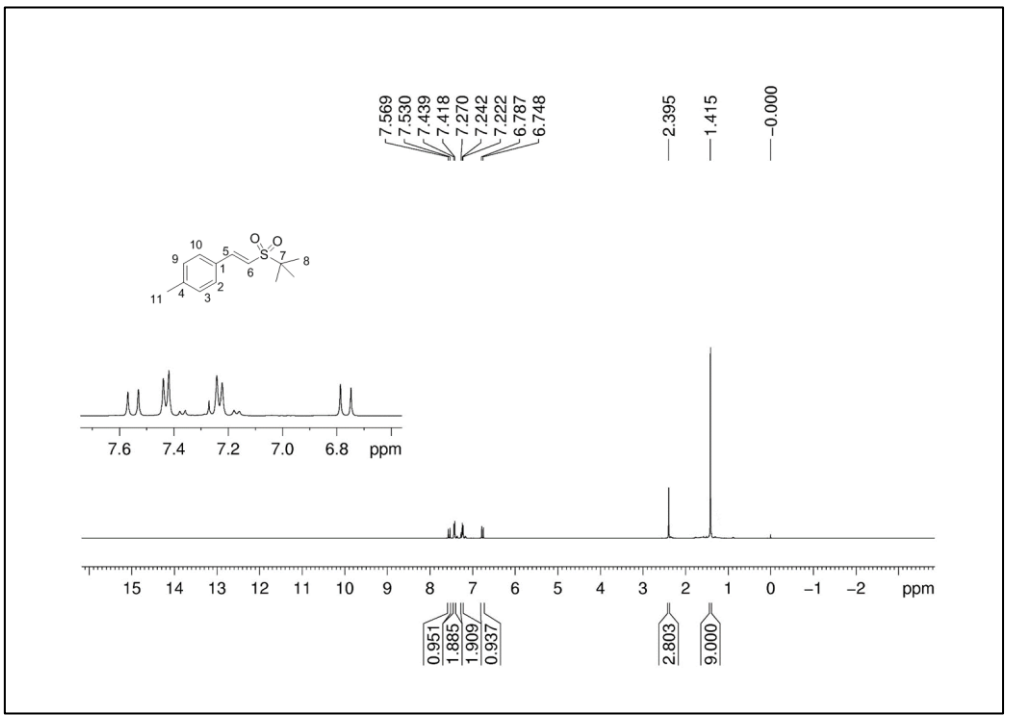


Fig.15 ^{1}H NMR spectrum of compound **3h**

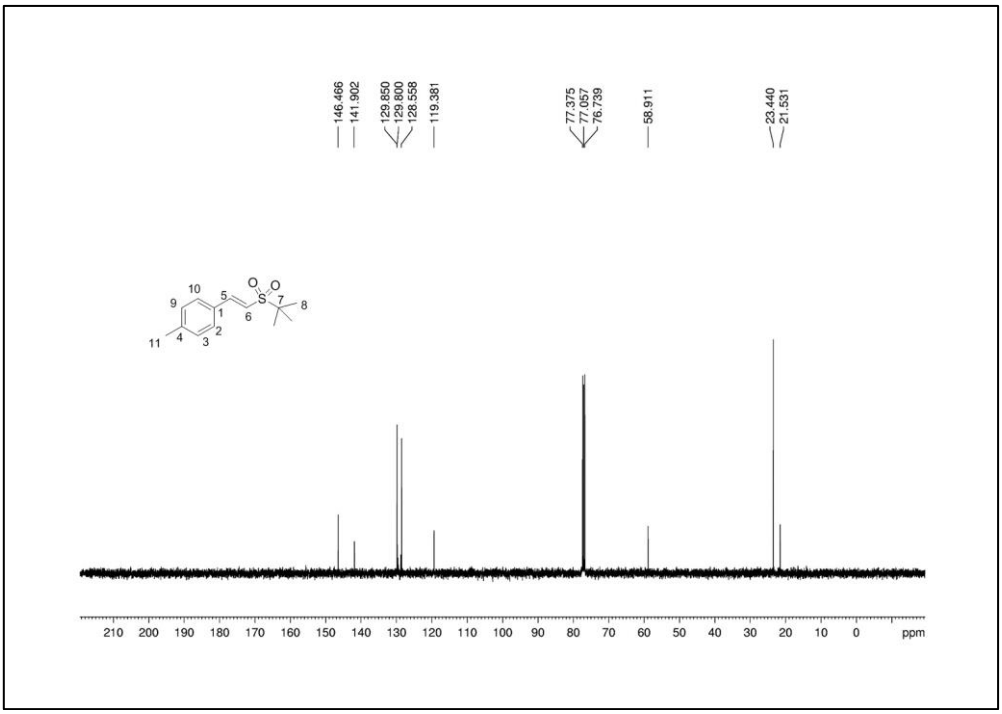


Fig.16 ^{13}C NMR spectrum of compound **3h**

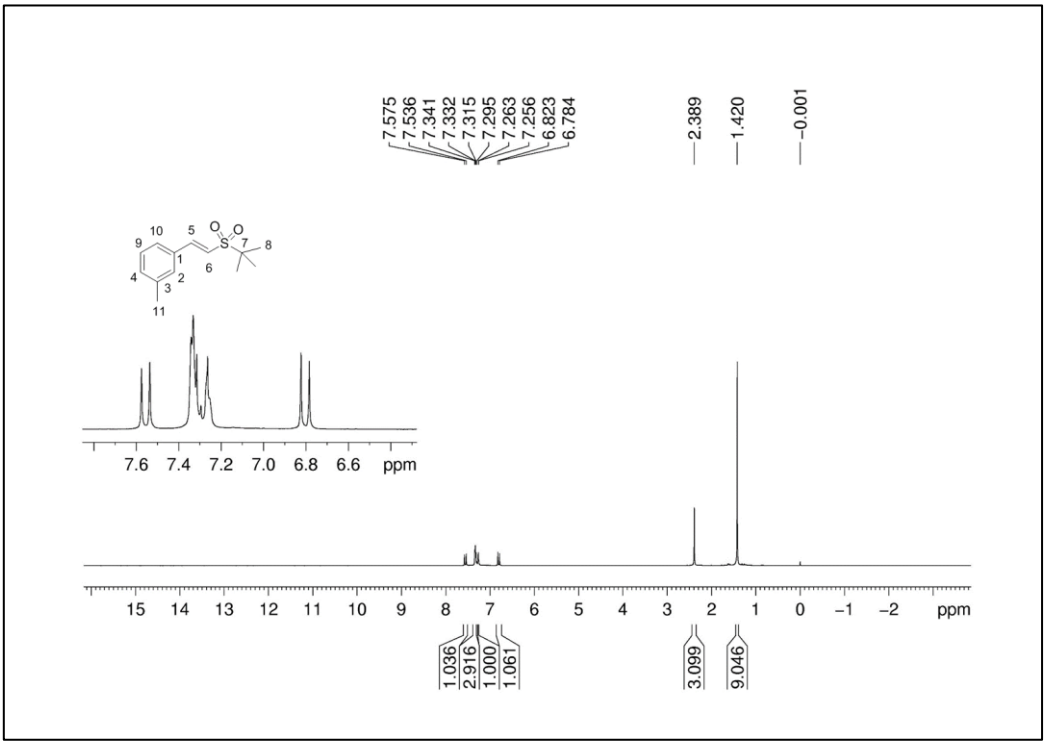


Fig.17 [1]H NMR spectrum of compound **3i**

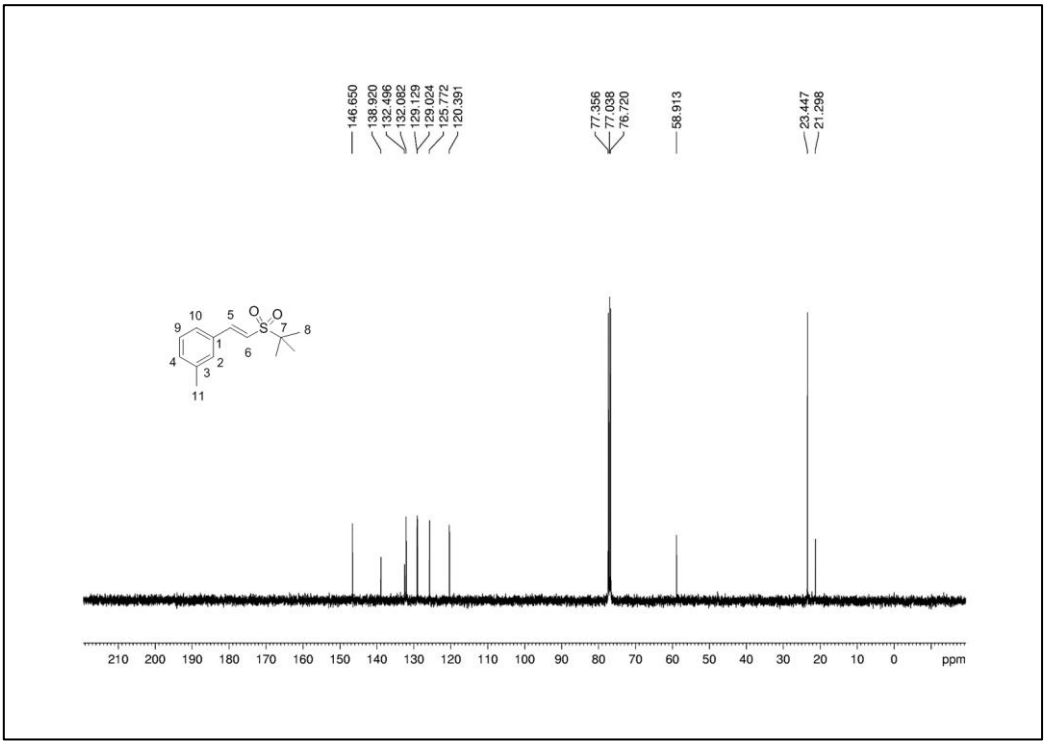


Fig.18 [13]C NMR spectrum of compound **3i**

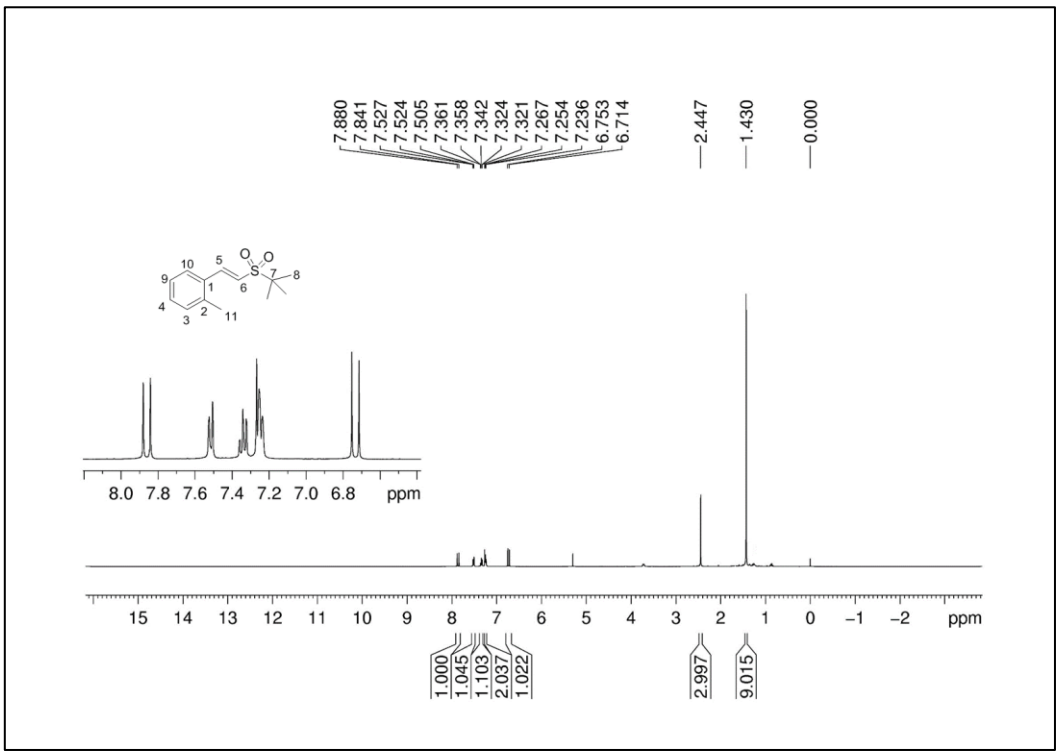


Fig.19 ^{1}H NMR spectrum of compound **3j**

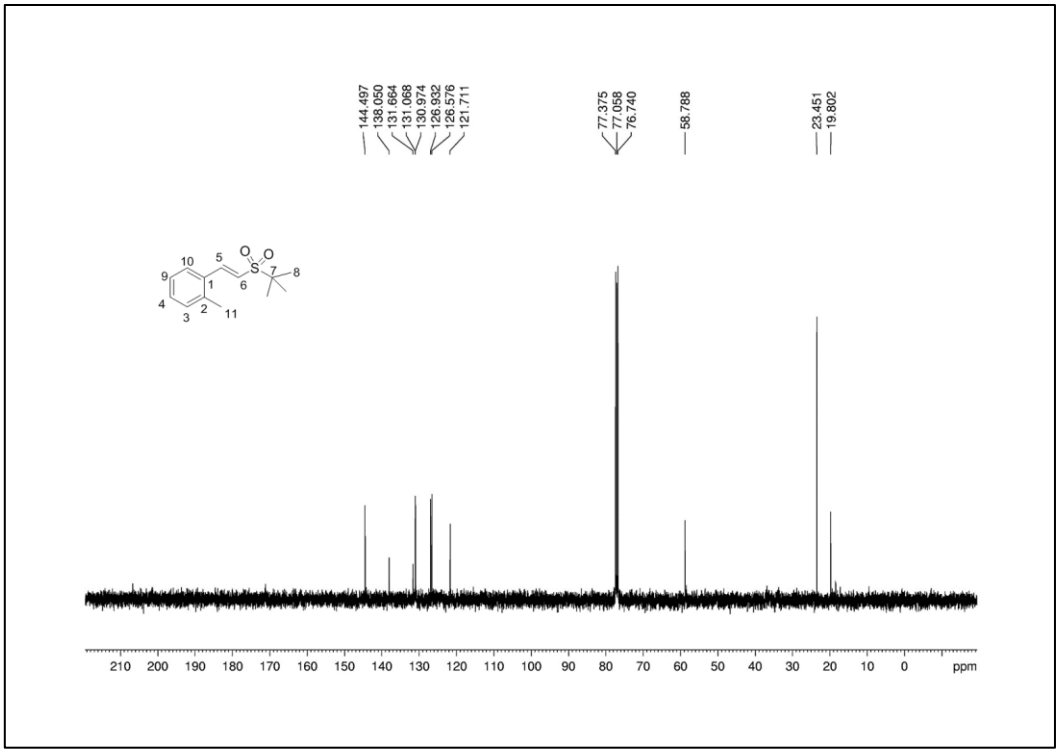


Fig.20 ^{13}C NMR spectrum of compound **3j**

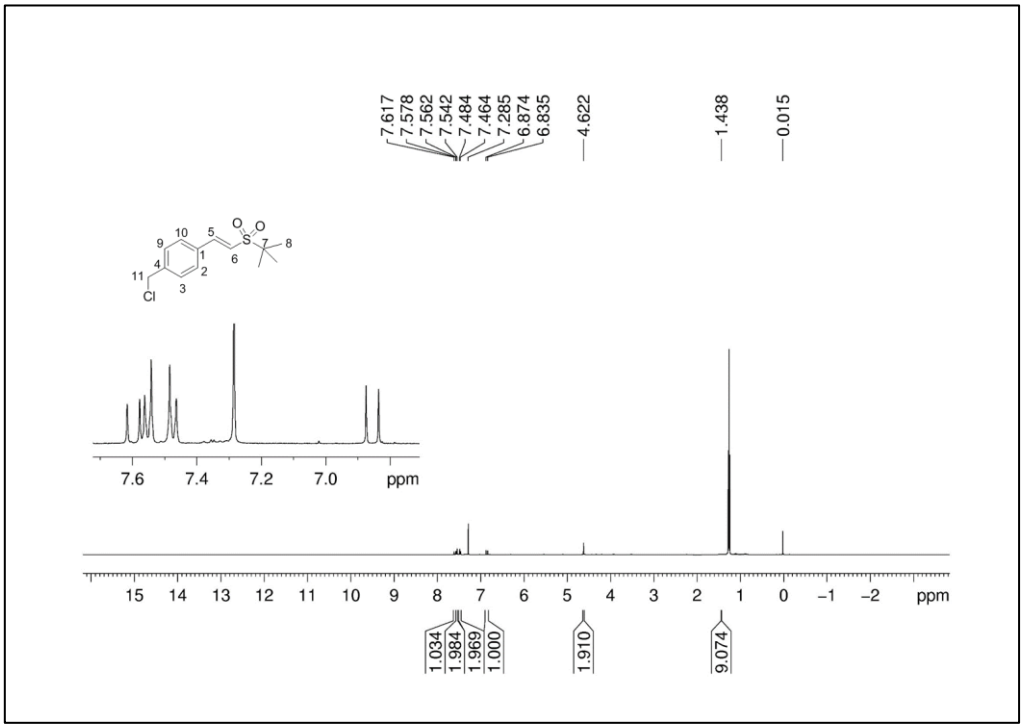


Fig.21 ^{1}H NMR spectrum of compound **3k**

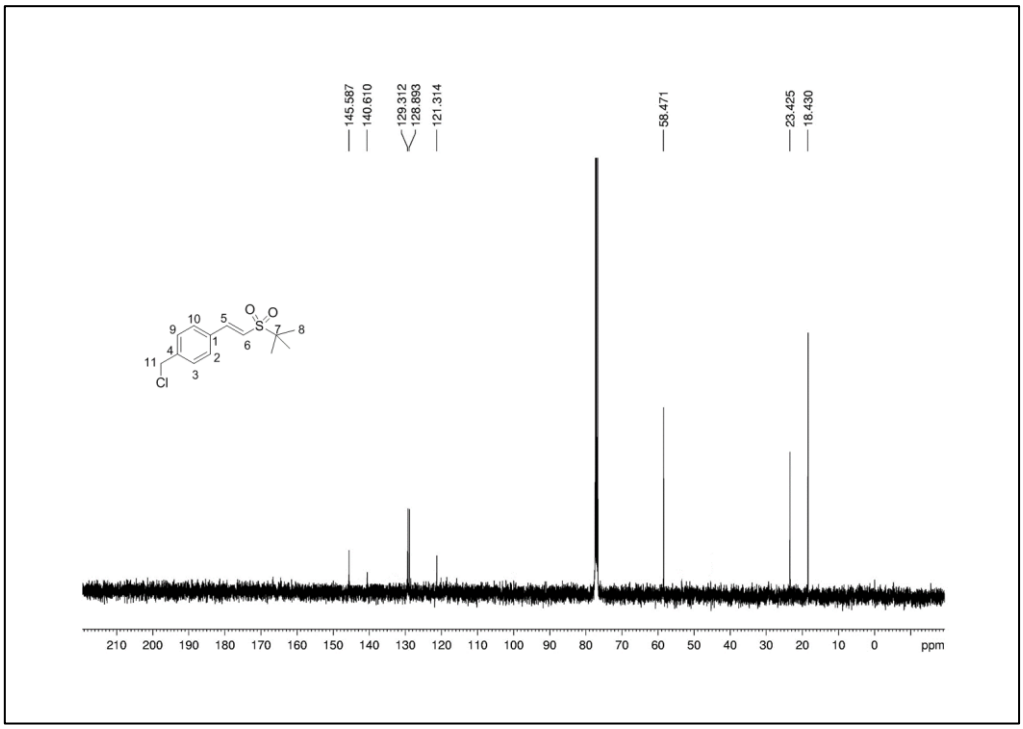


Fig.22 ^{13}C NMR spectrum of compound **3k**

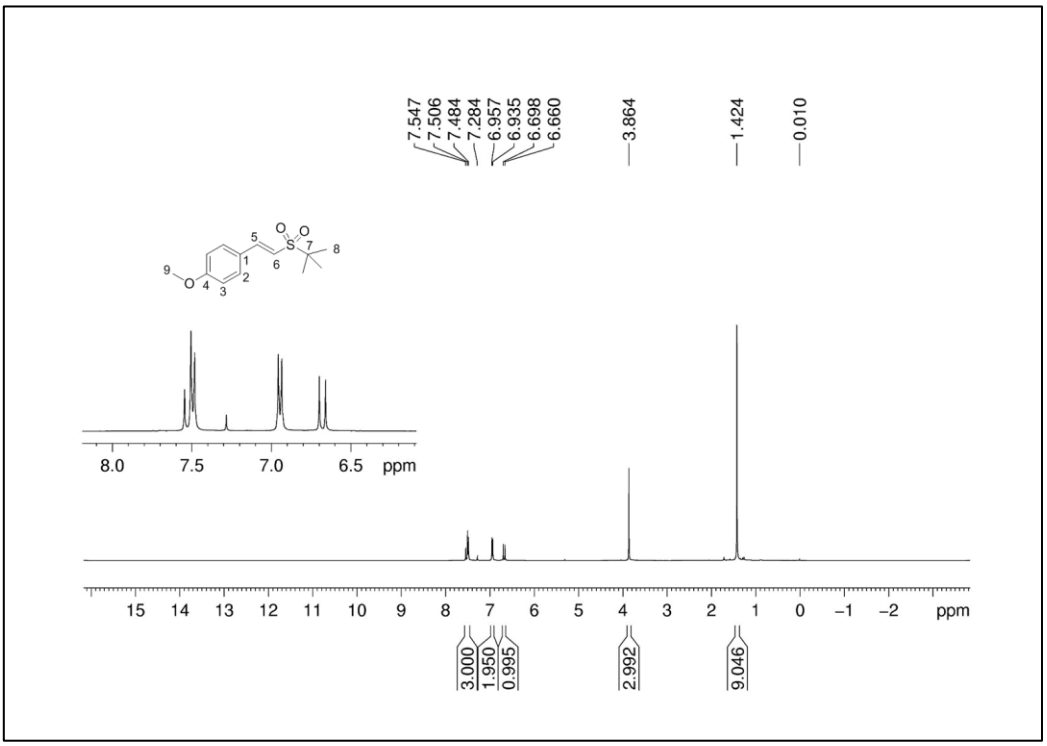


Fig.23 ^{1}H NMR spectrum of compound **3l**

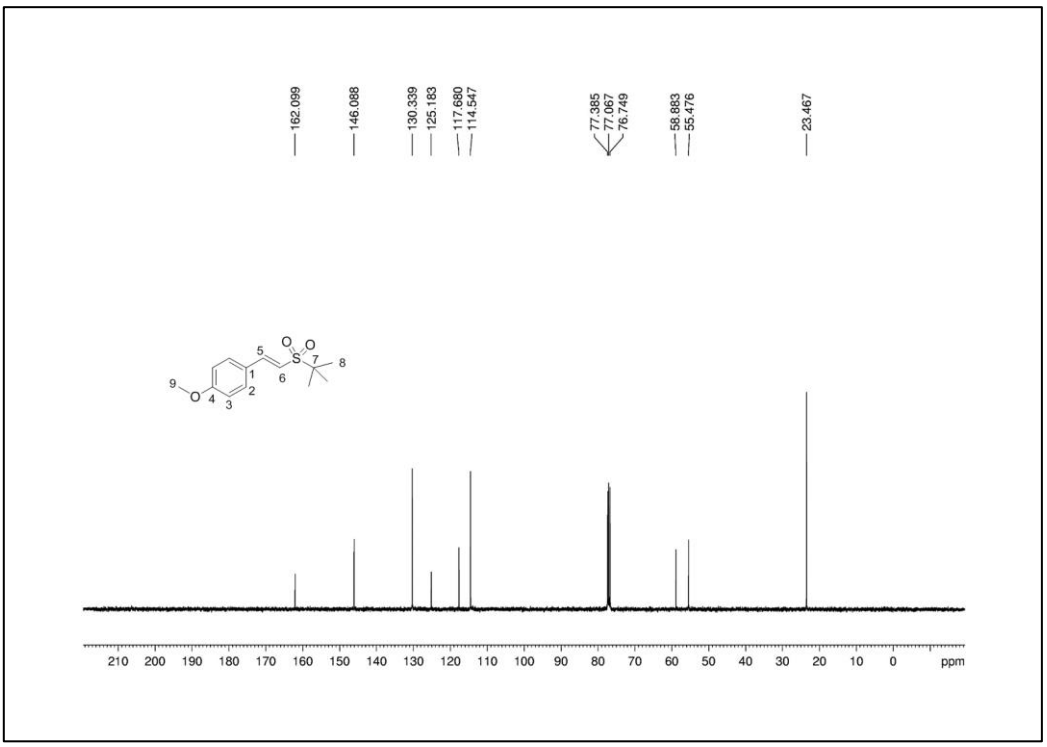


Fig.24 ^{13}C NMR spectrum of compound **3l**

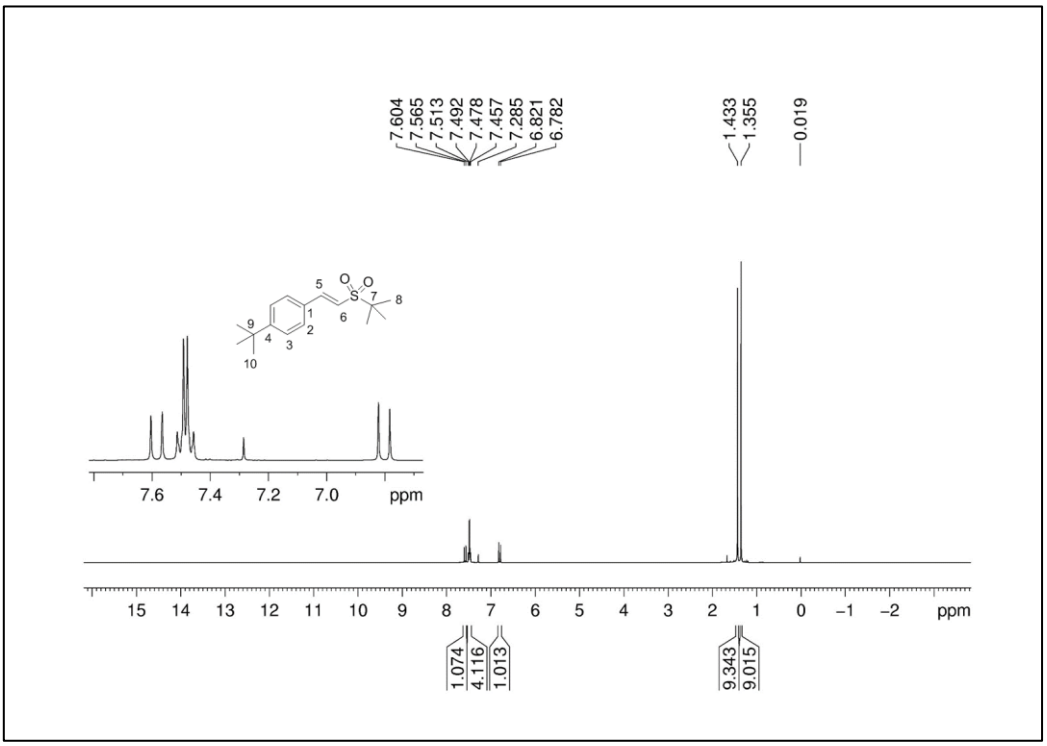


Fig.25 [1]H NMR spectrum of compound **3m**

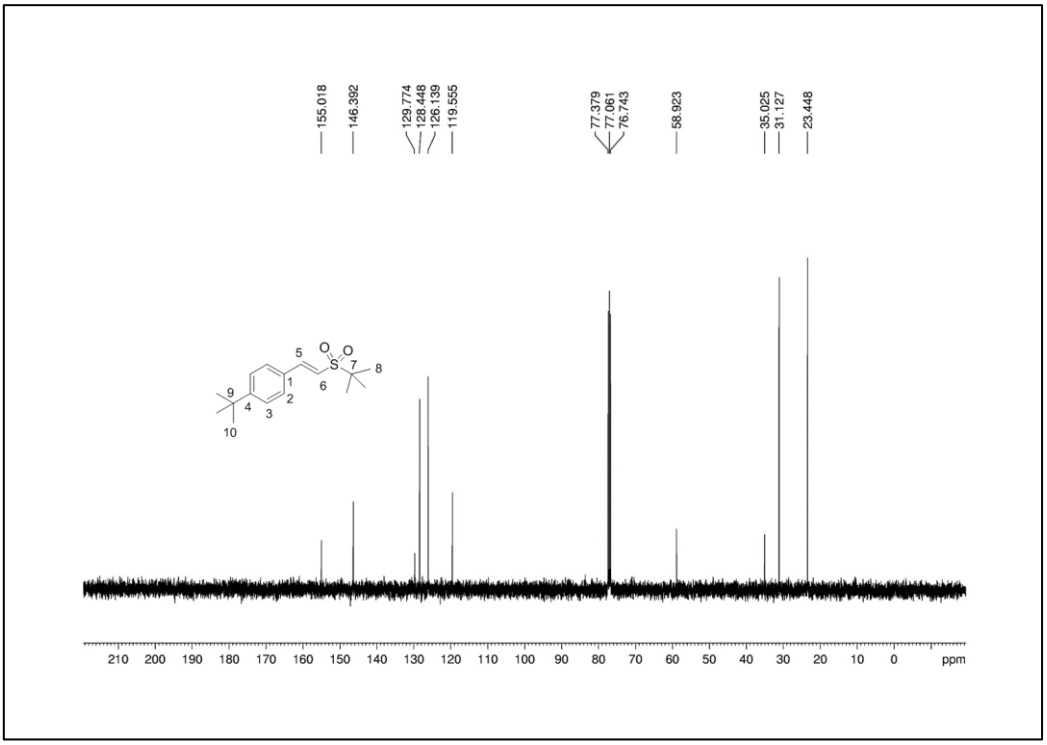


Fig.26 [13]C NMR spectrum of compound **3m**

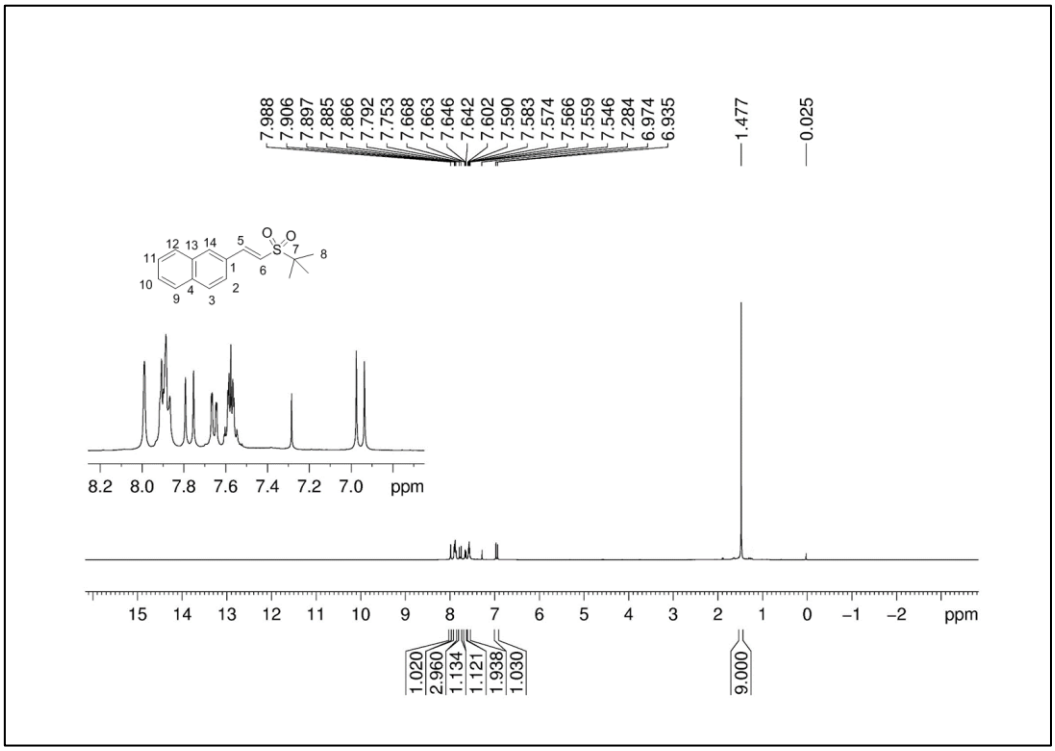


Fig.27 ^{1}H NMR spectrum of compound **3n**

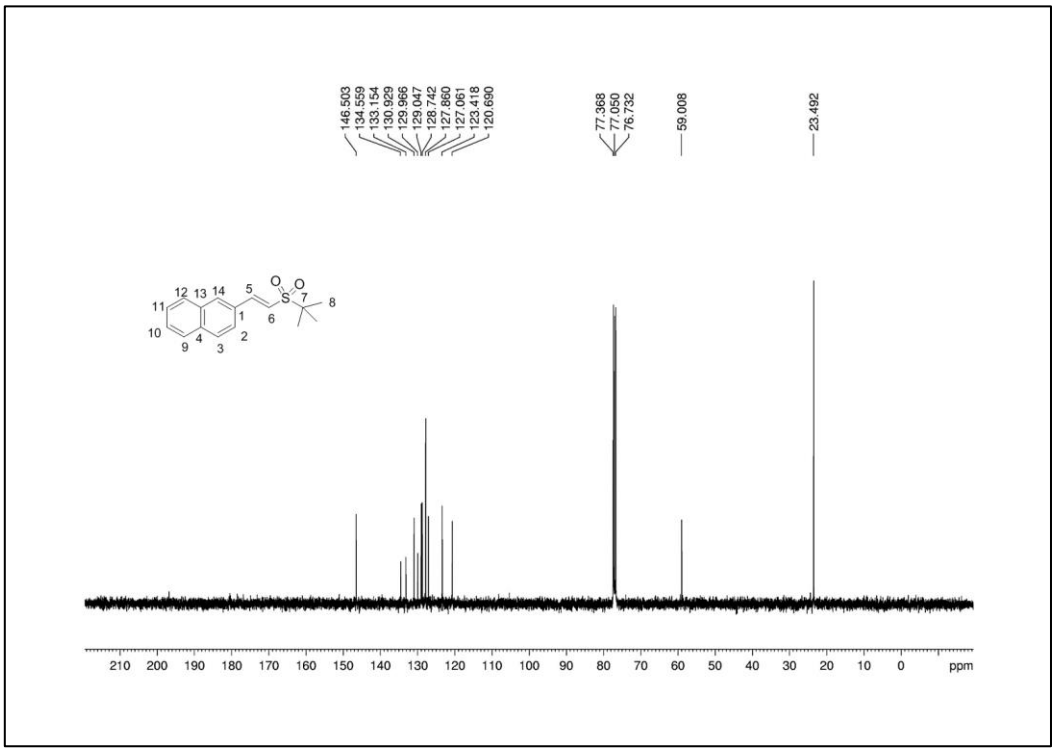


Fig.28 ^{13}C NMR spectrum of compound **3n**

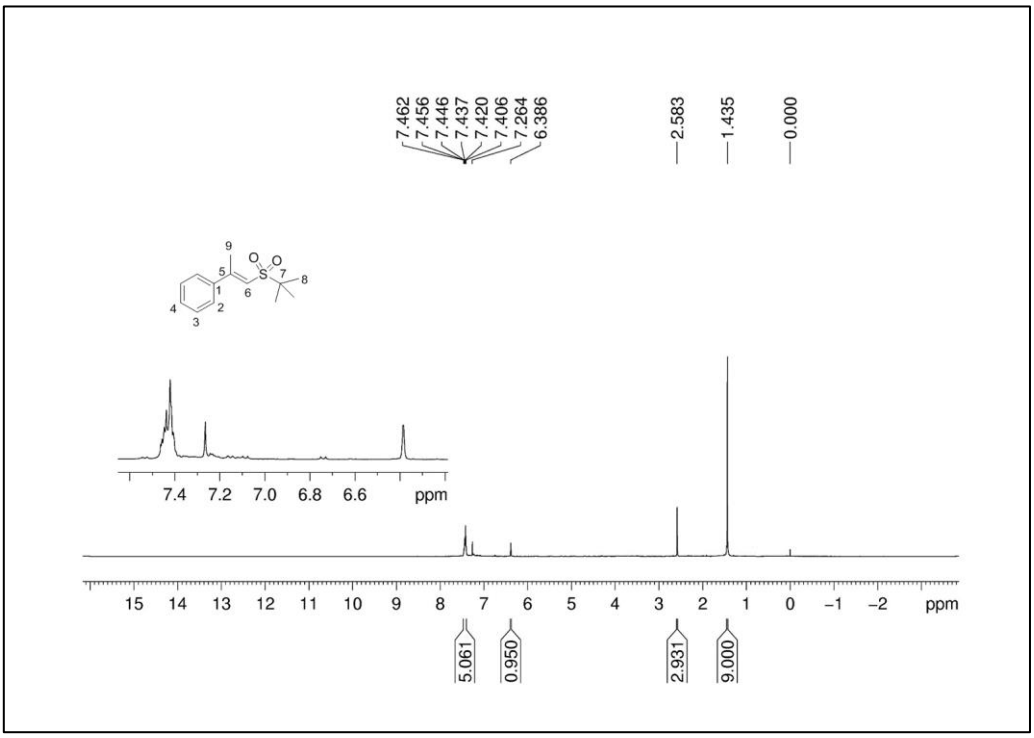


Fig.29 ^{1}H NMR spectrum of compound **3o**

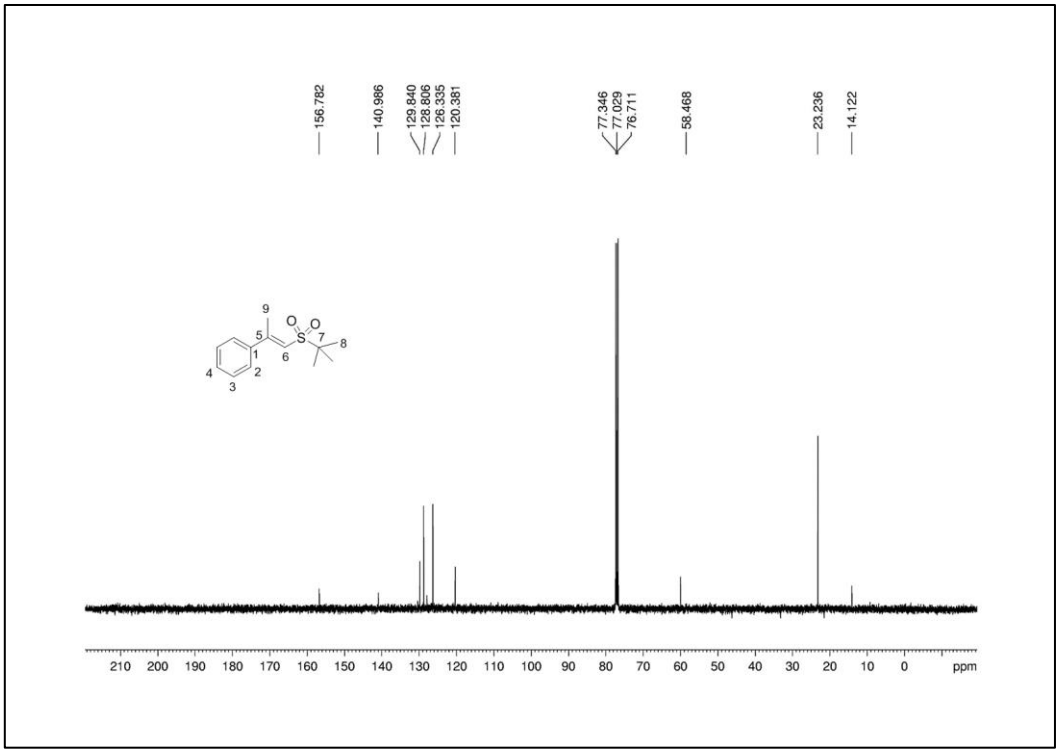


Fig.30 ^{13}C NMR spectrum of compound **3o**

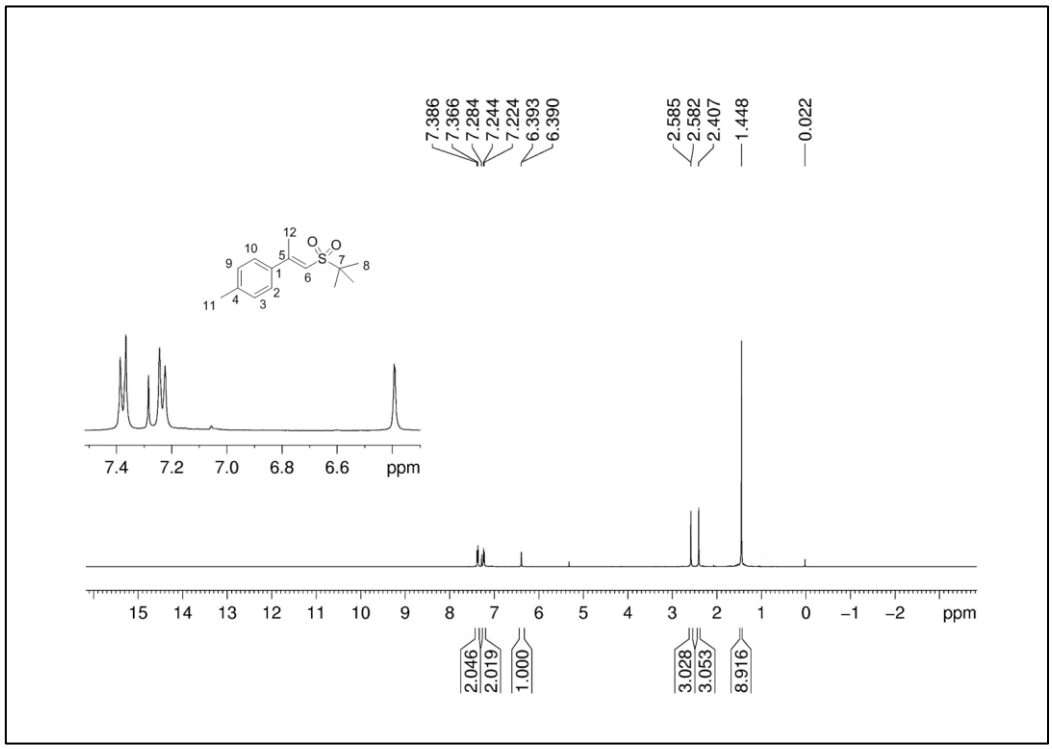


Fig.31 ^{1}H NMR spectrum of compound **3p**

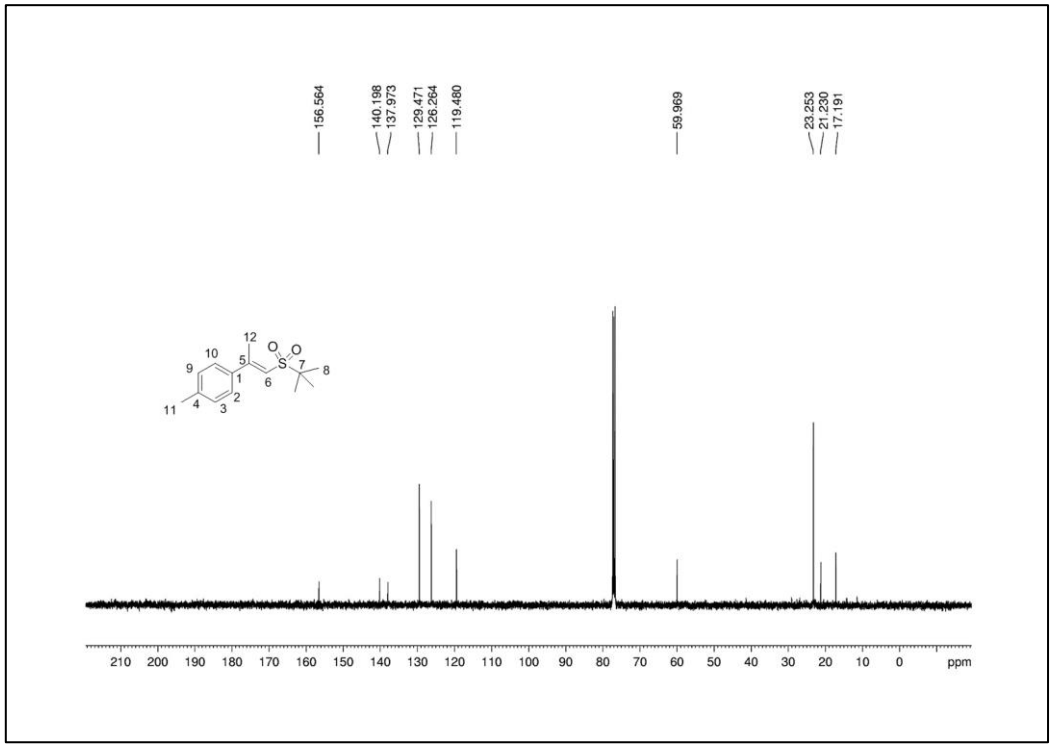


Fig.32 ^{13}C NMR spectrum of compound **3p**

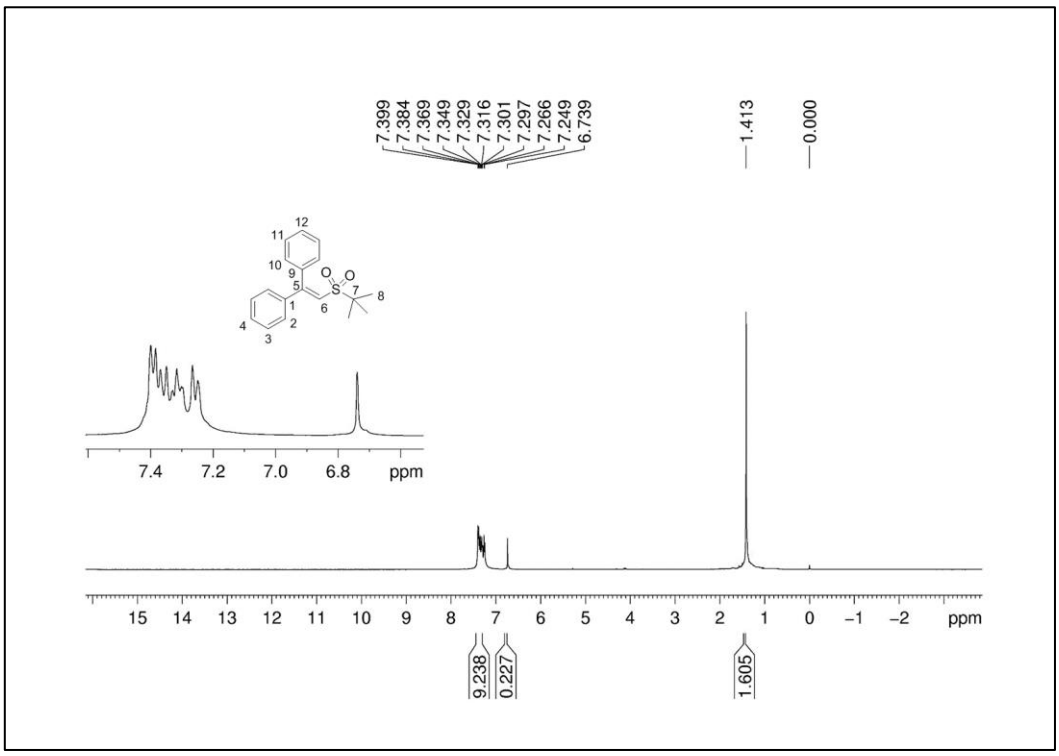


Fig.33 ^{1}H NMR spectrum of compound **3q**

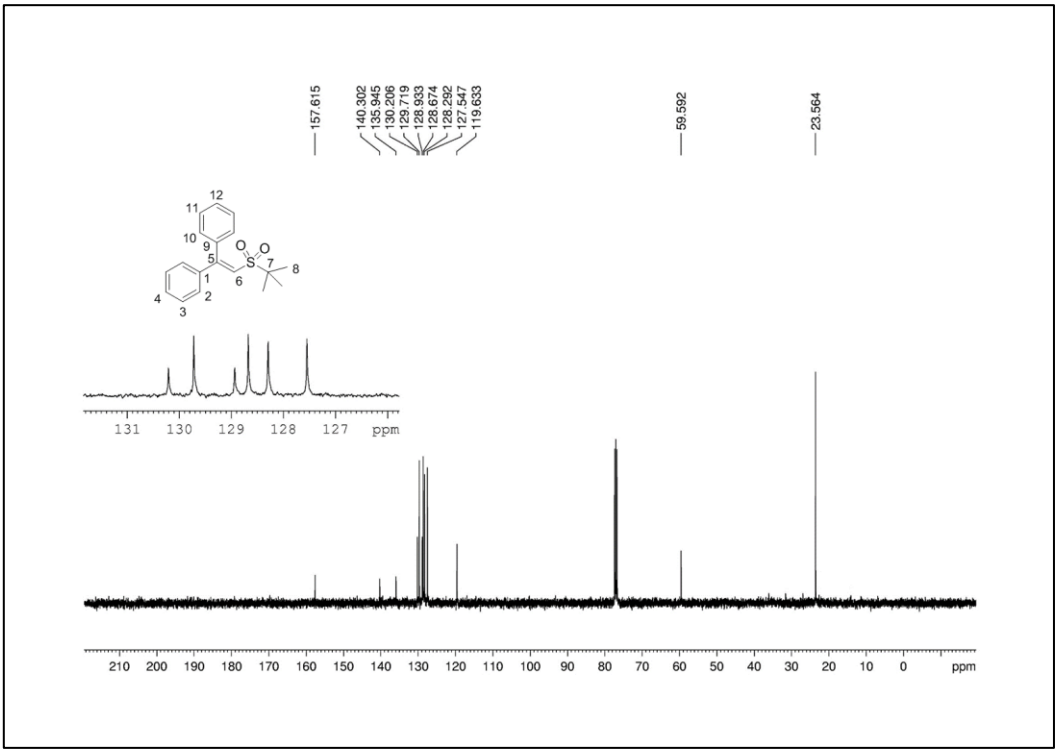


Fig.34 ^{13}C NMR spectrum of compound **3q**

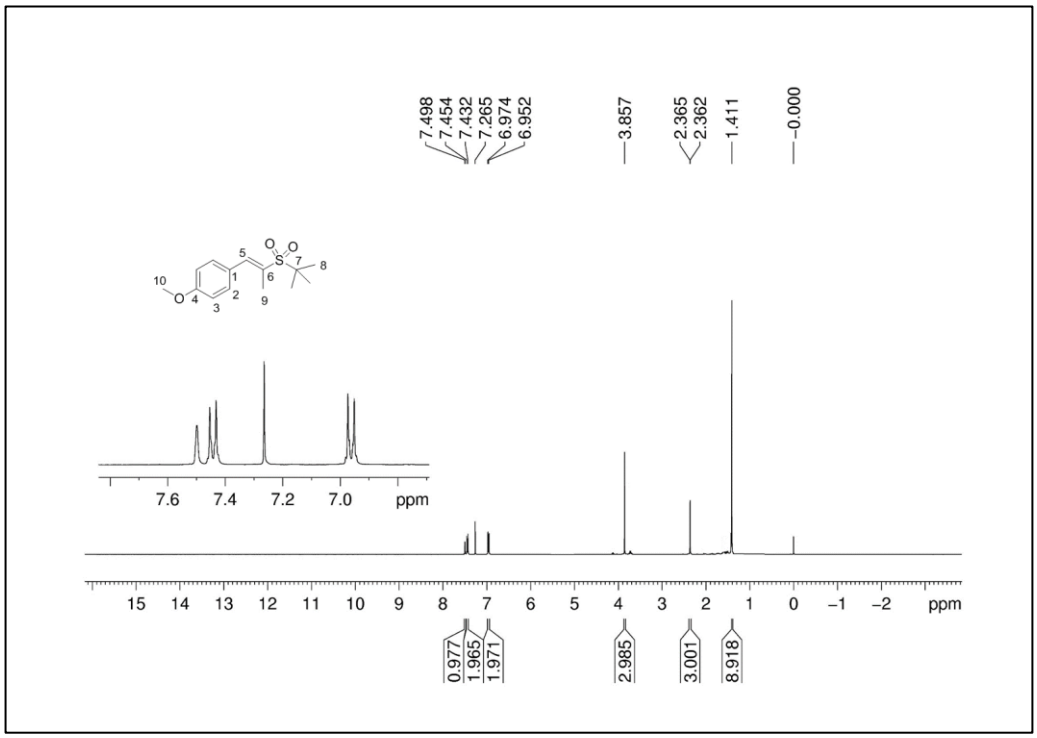


Fig.35 ^{1}H NMR spectrum of compound **3r**

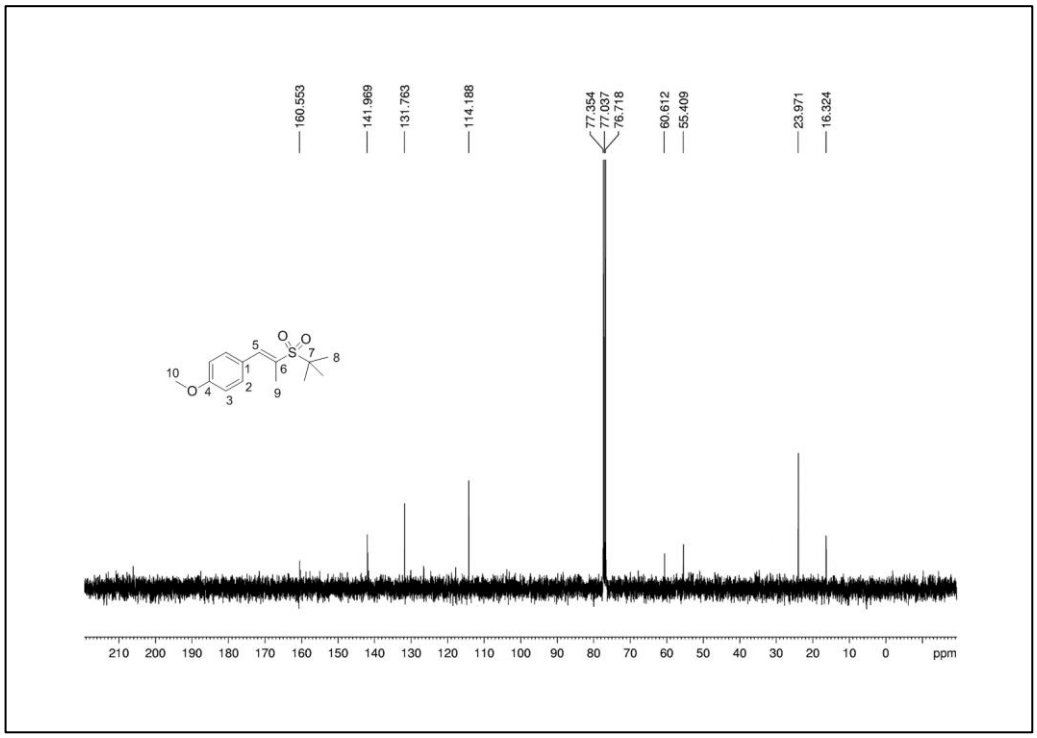


Fig.36 ^{13}C NMR spectrum of compound **3r**

8. ^{1}H NMR, ^{13}C NMR copies of products (4a-4k)

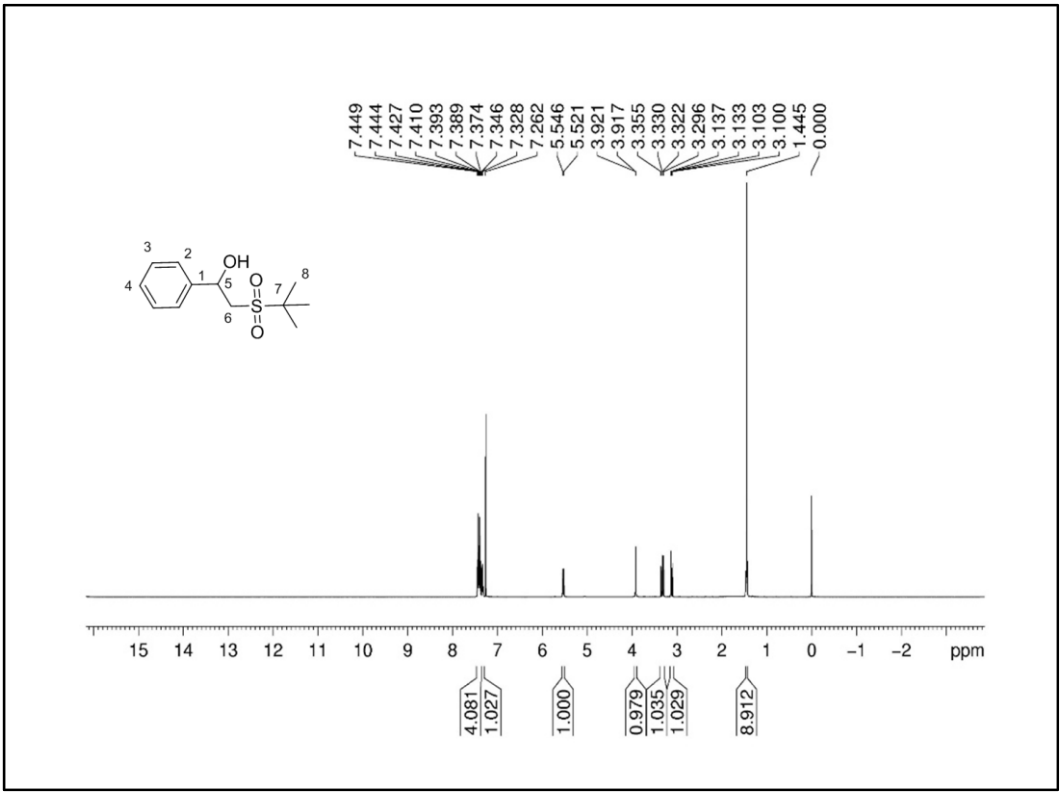


Fig.37 ^{1}H NMR spectrum of compound **4a**

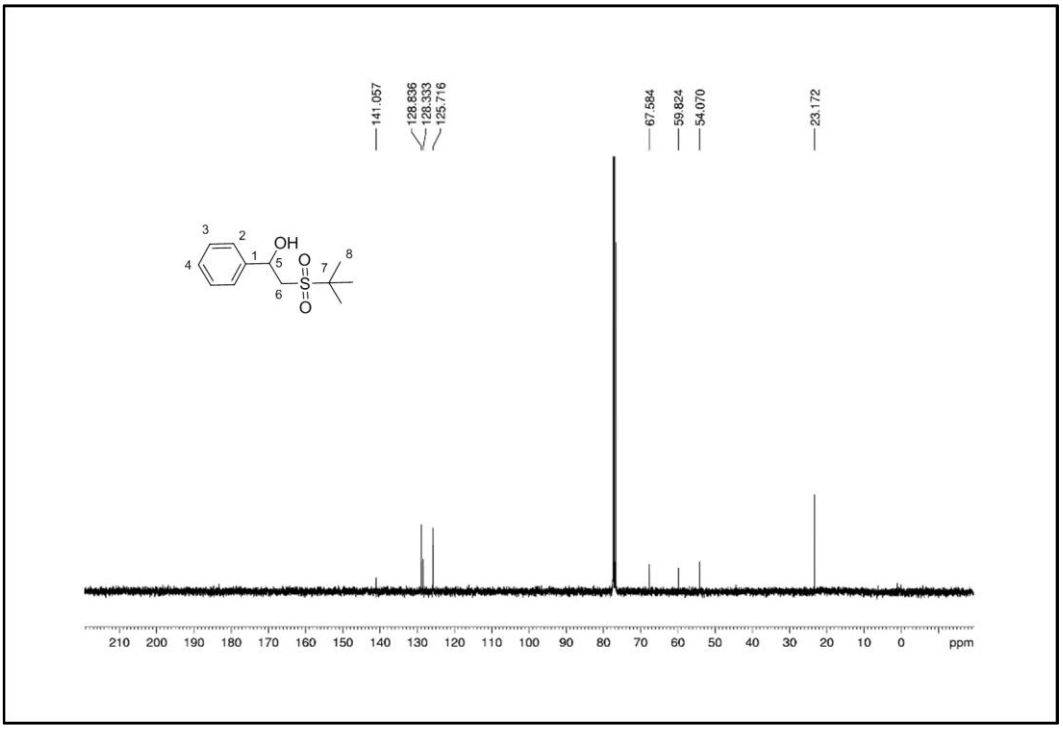


Fig.38 ^{13}C NMR spectrum of compound **4a**

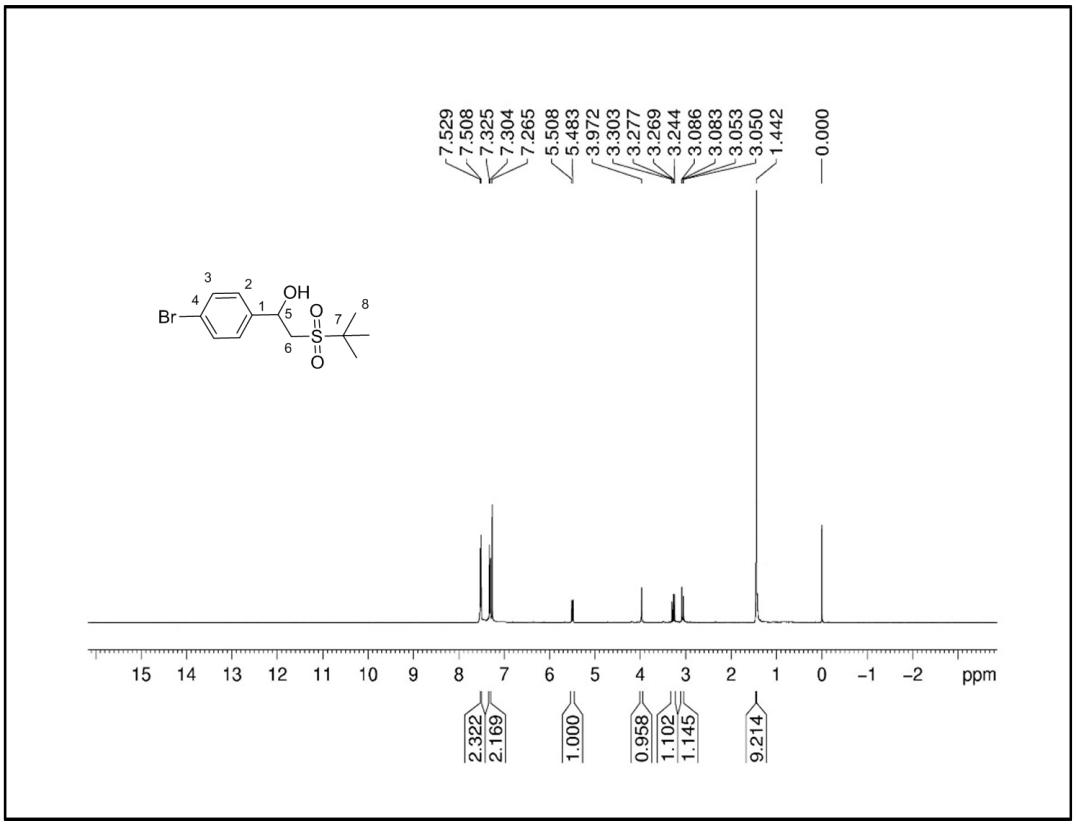


Fig.39 ^{1}H NMR spectrum of compound **4b**

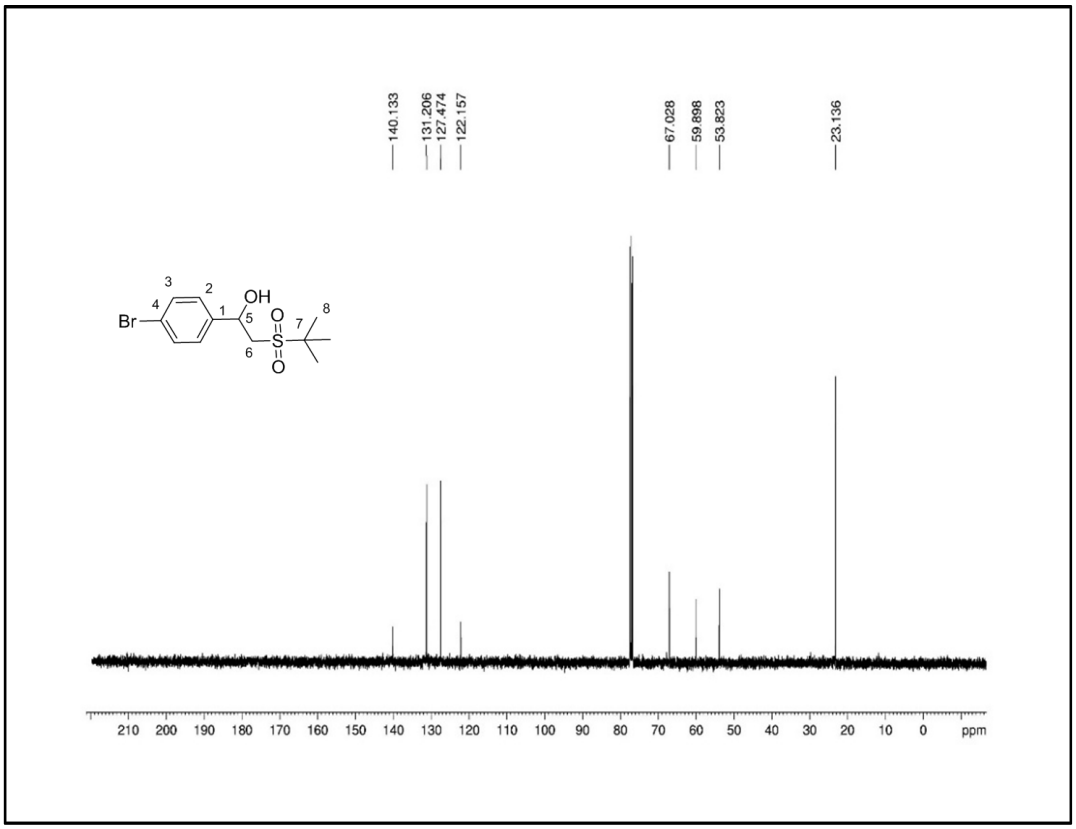


Fig.40 ^{13}C NMR spectrum of compound **4b**

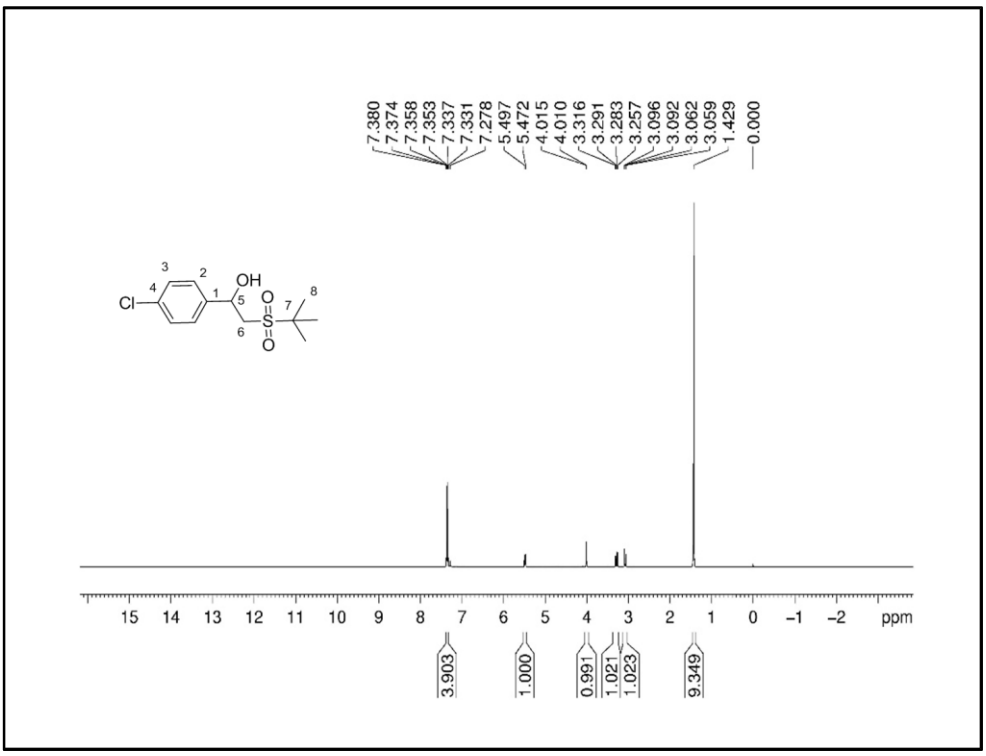


Fig.41 ^{1}H NMR spectrum of compound **4c**

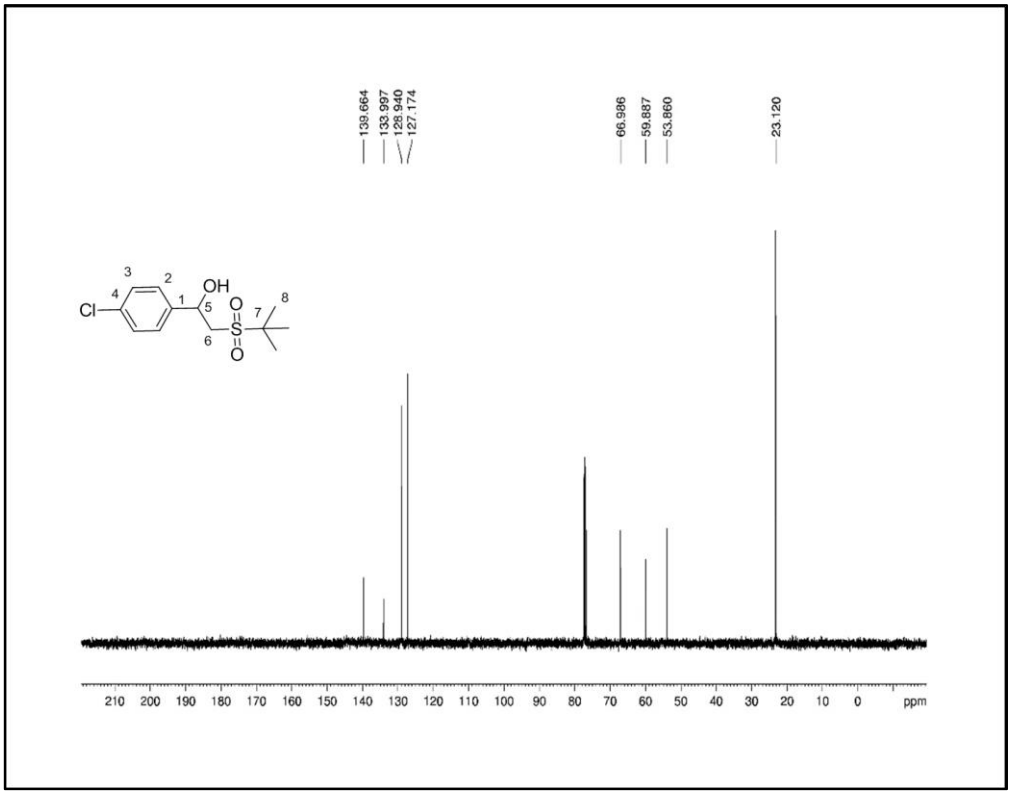


Fig.42 ^{13}C NMR spectrum of compound **4c**

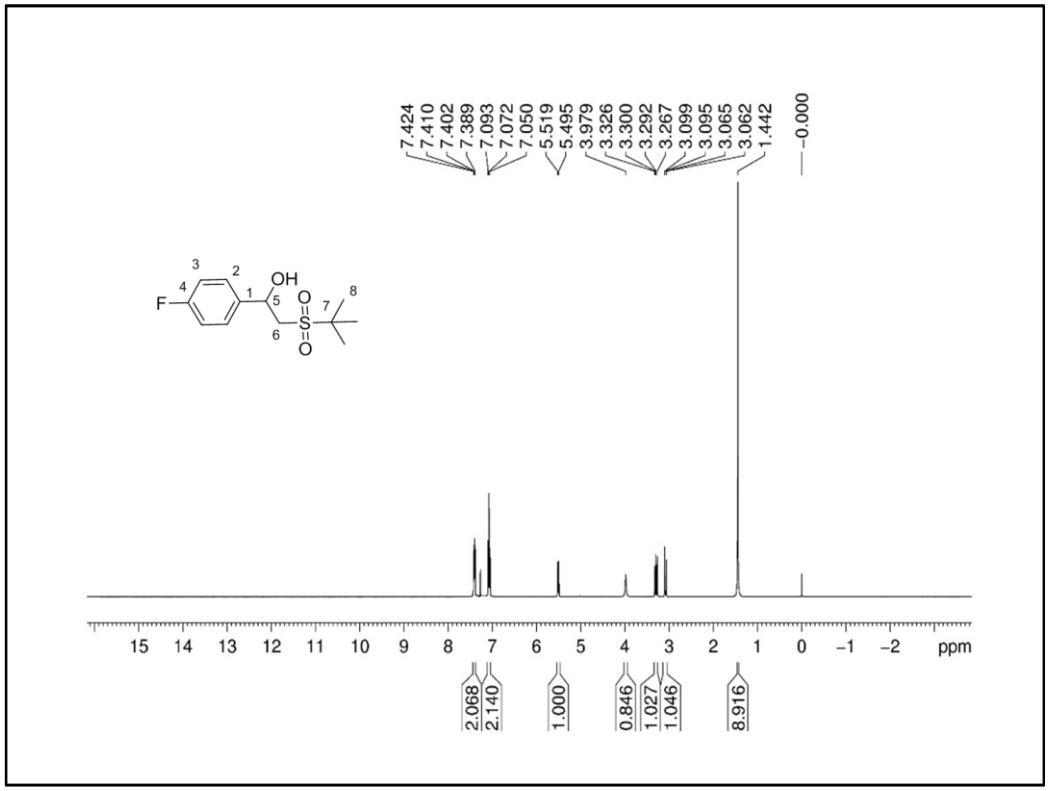


Fig.43 ^{1}H NMR spectrum of compound **4d**

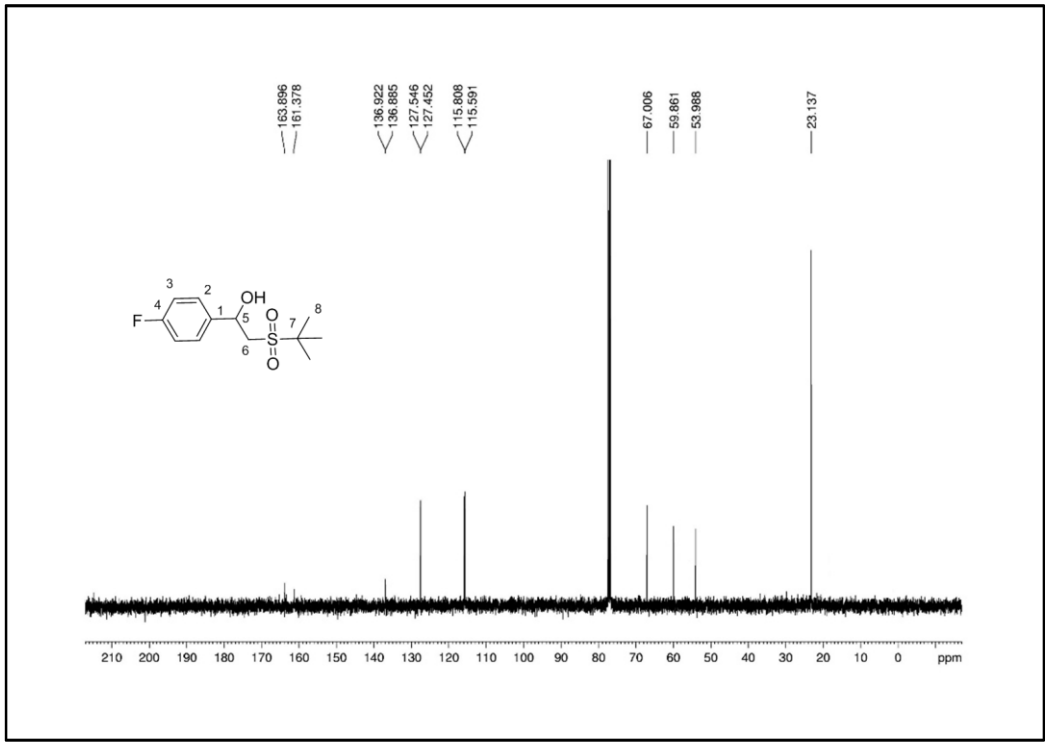


Fig.44 ^{13}C NMR spectrum of compound **4d**

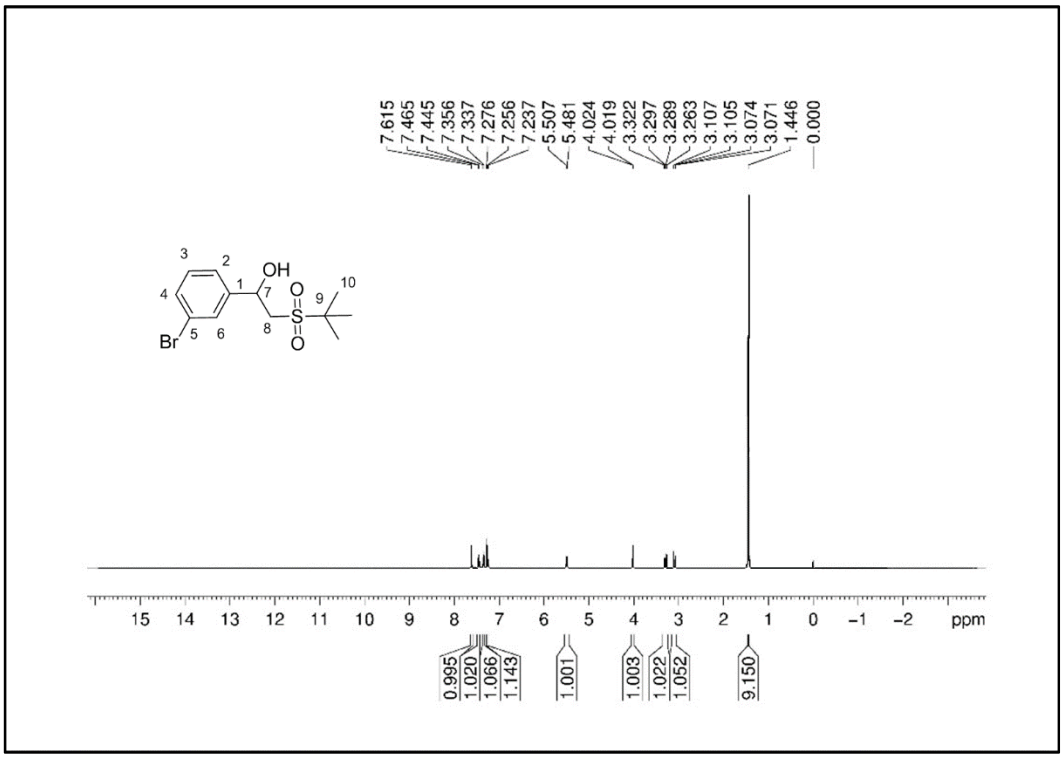


Fig.45 ^{1}H NMR spectrum of compound **4e**

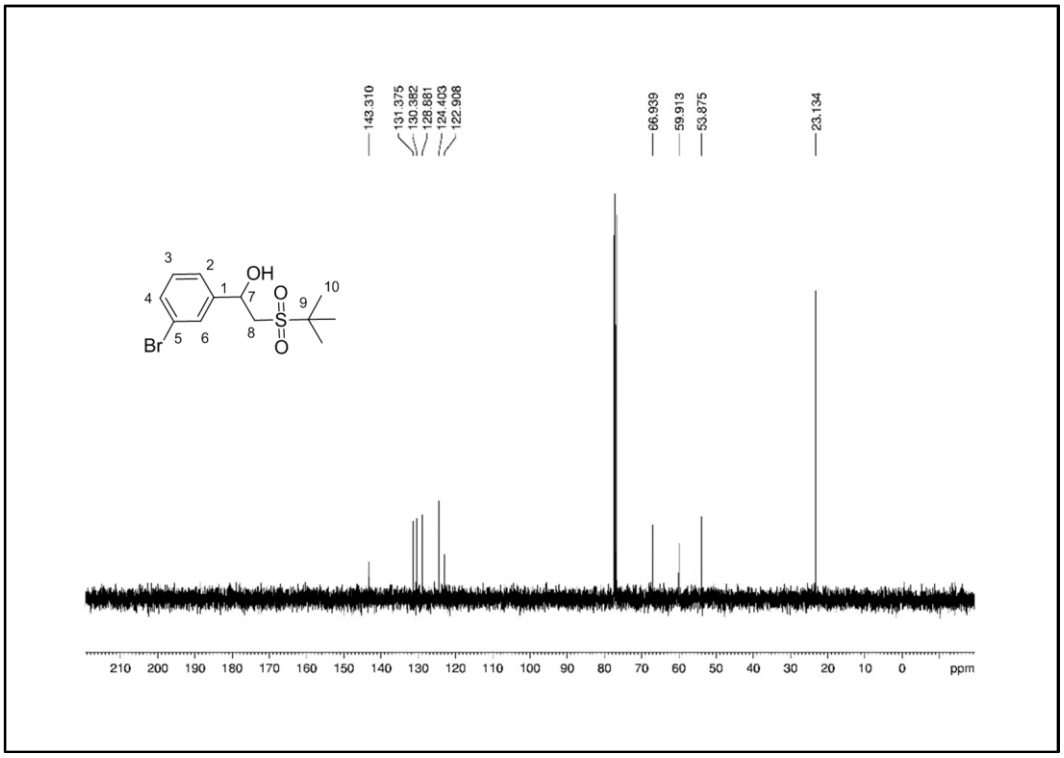


Fig.46 ^{13}C NMR spectrum of compound **4e**

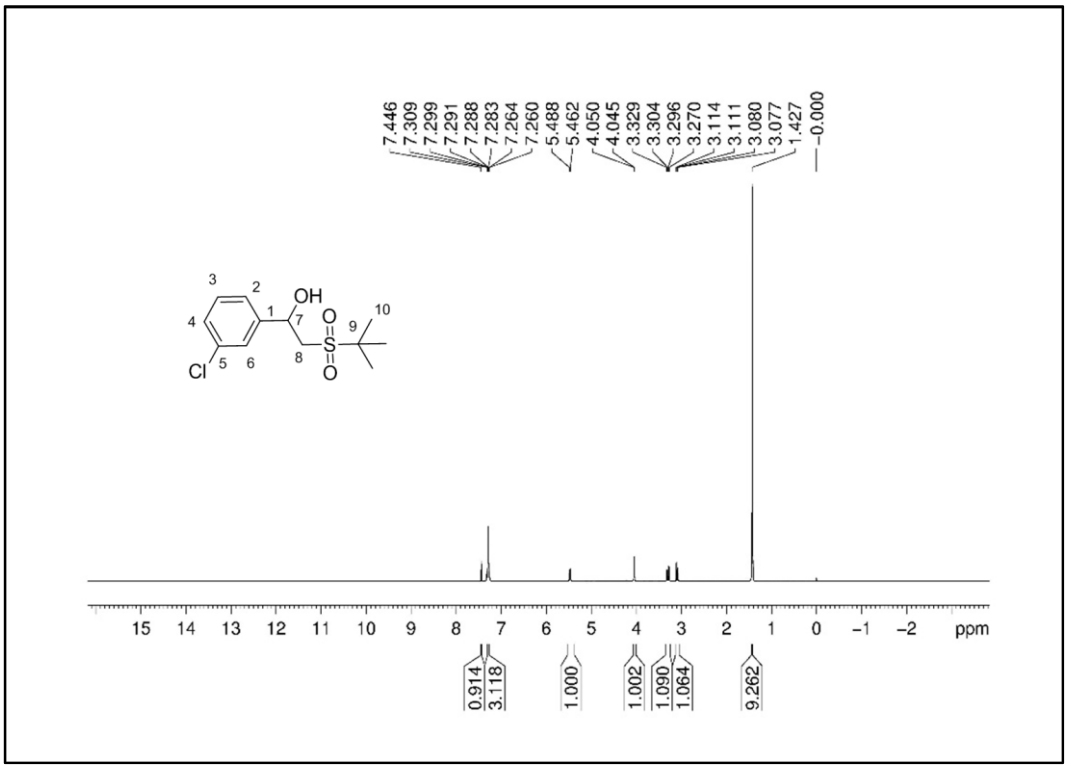


Fig.47 ^{1}H NMR spectrum of compound **4f**

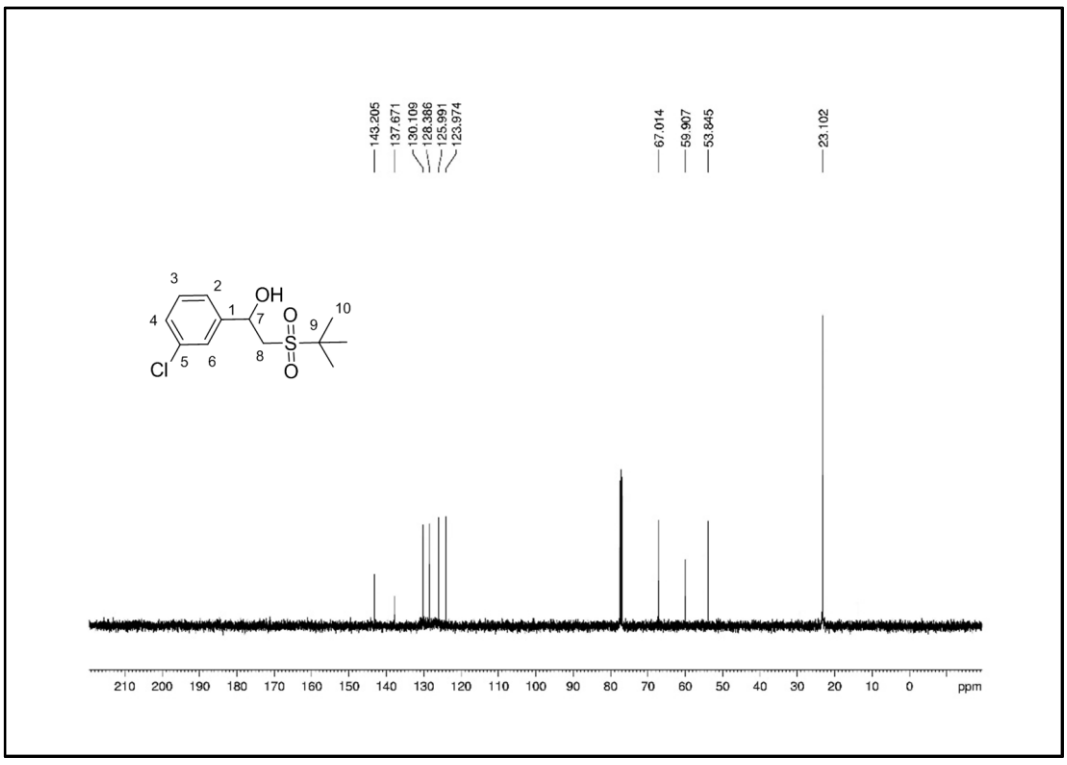


Fig.48 ^{13}C NMR spectrum of compound **4f**

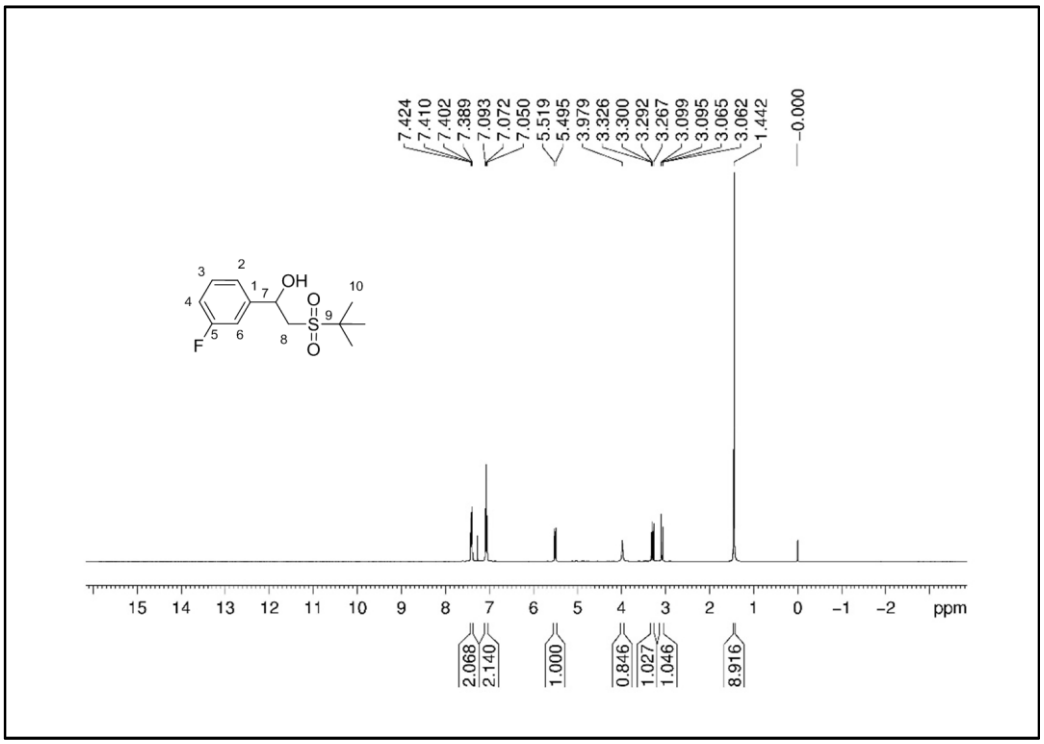


Fig.49 ^{1}H NMR spectrum of compound **4g**

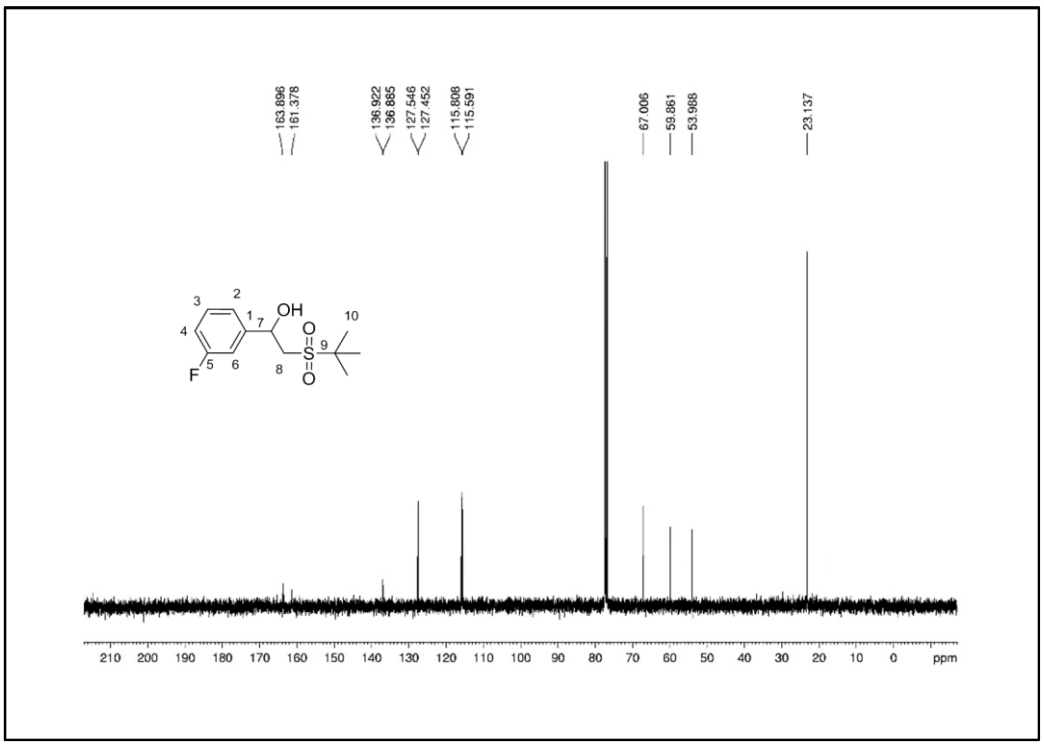


Fig.50 ^{13}C NMR spectrum of compound **4g**

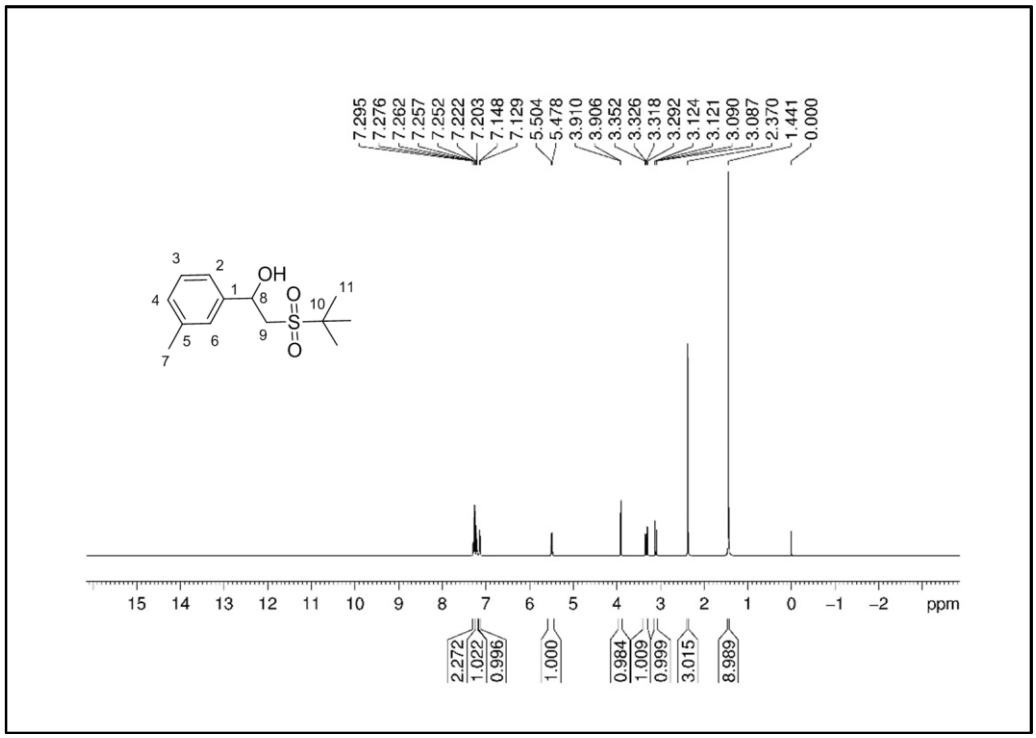


Fig.51 ^{1}H NMR spectrum of compound **4h**

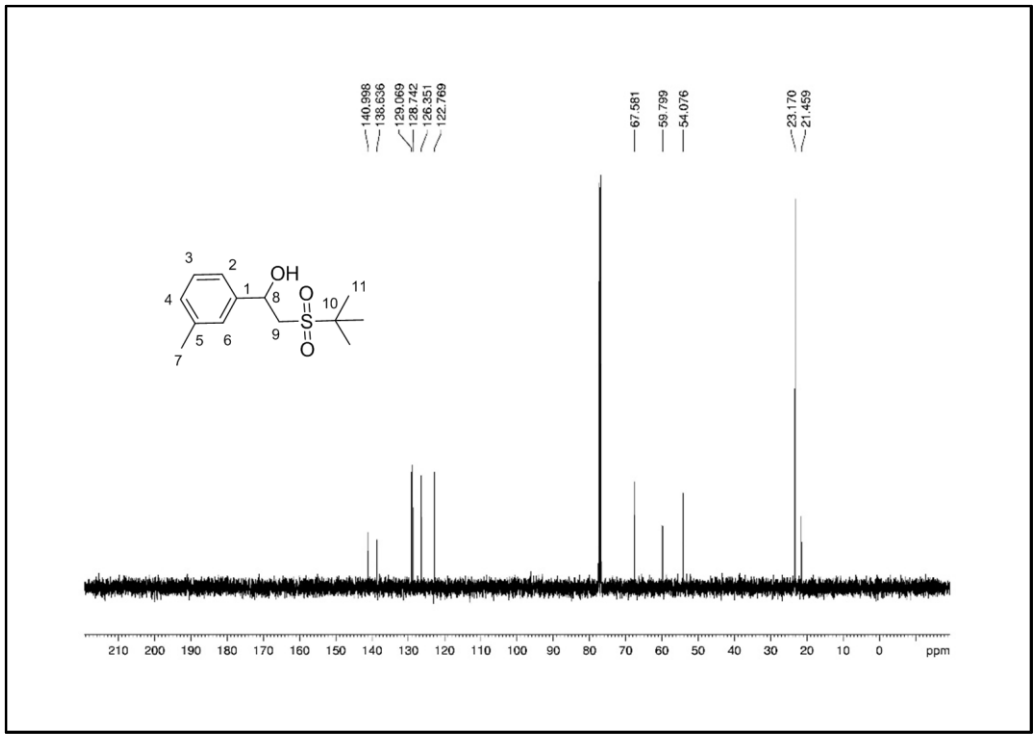


Fig.52 ^{13}C NMR spectrum of compound **4h**

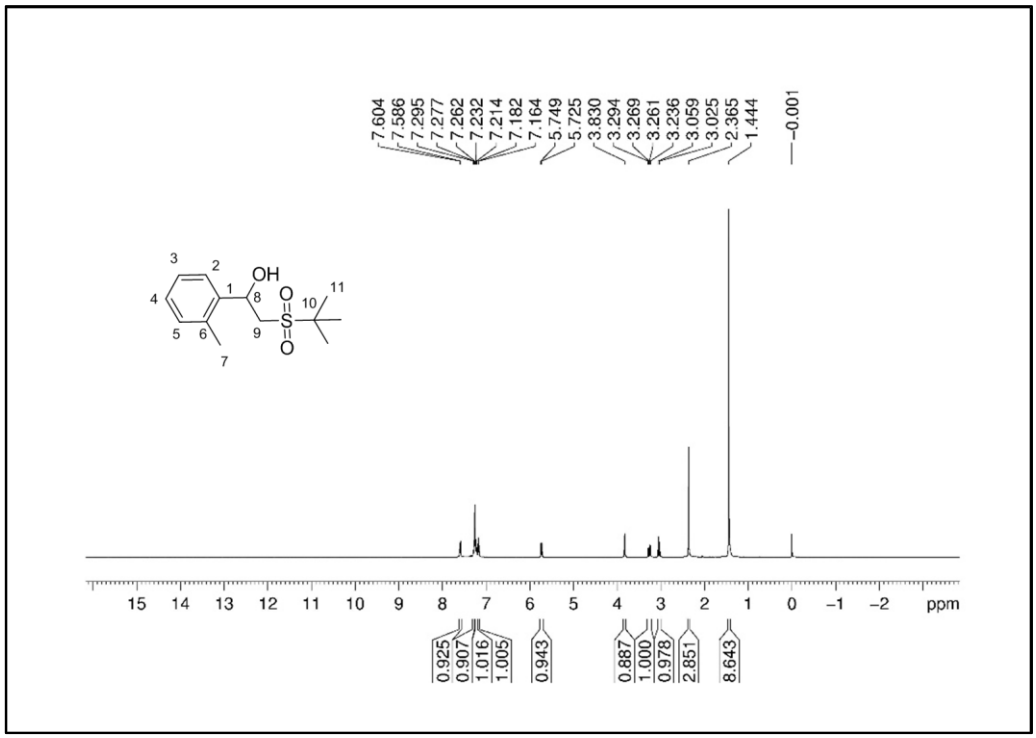


Fig.53 ^{1}H NMR spectrum of compound **4i**

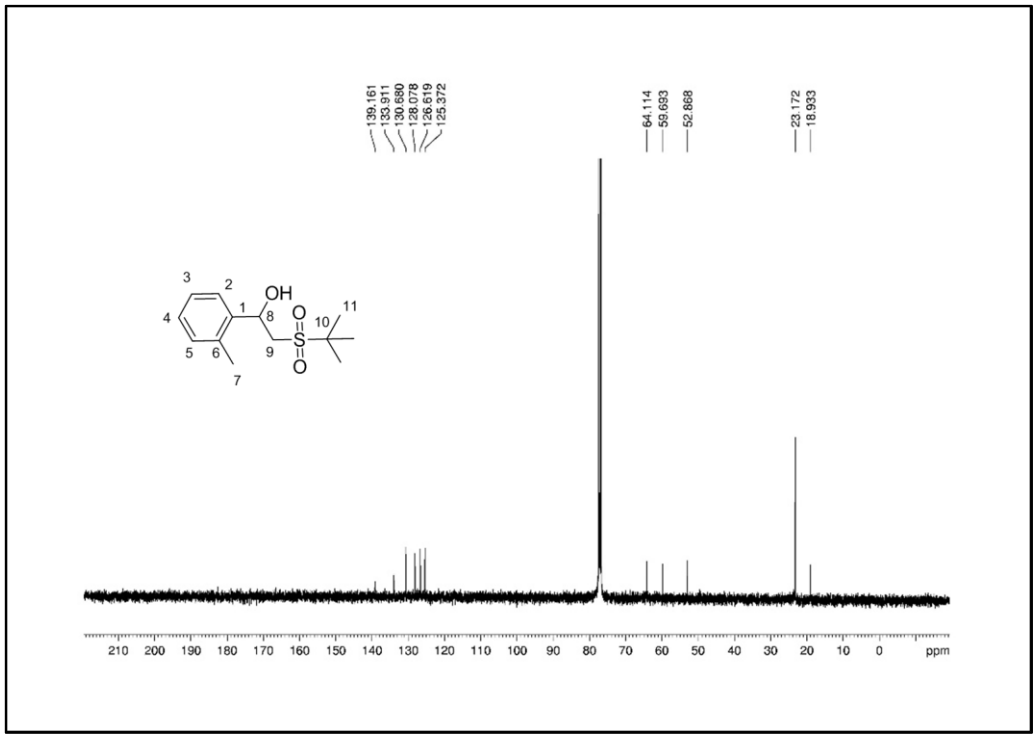


Fig.54 ^{13}C NMR spectrum of compound **4i**

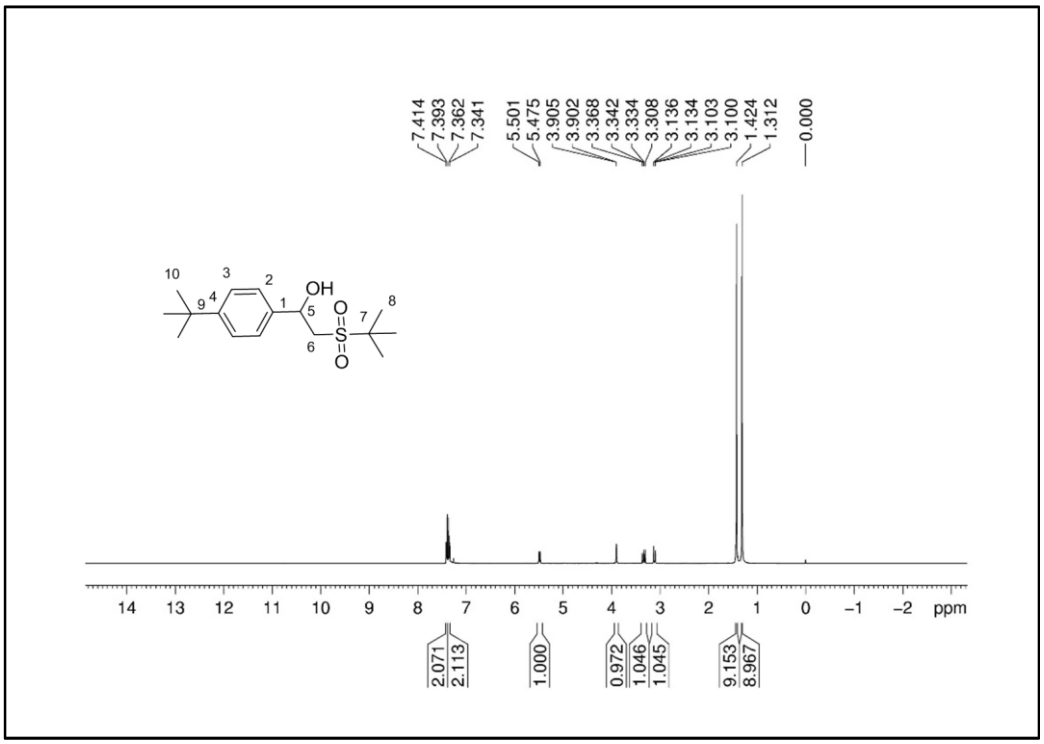


Fig.55 ^{1}H NMR spectrum of compound **4j**

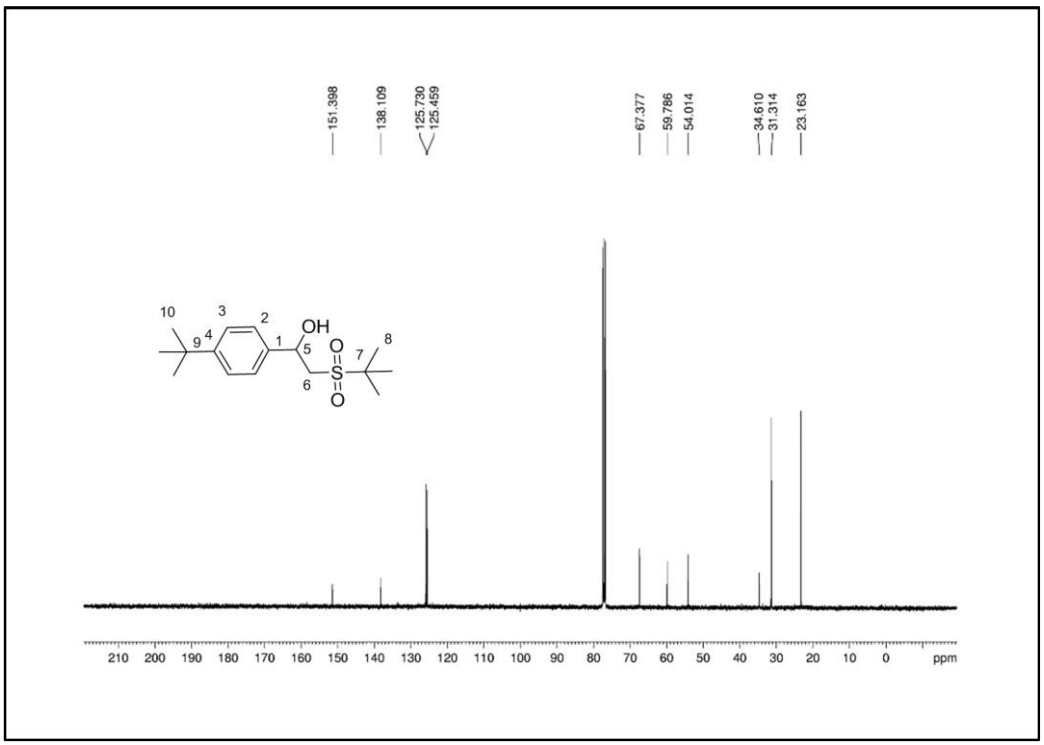


Fig.56 ^{13}C NMR spectrum of compound **4j**

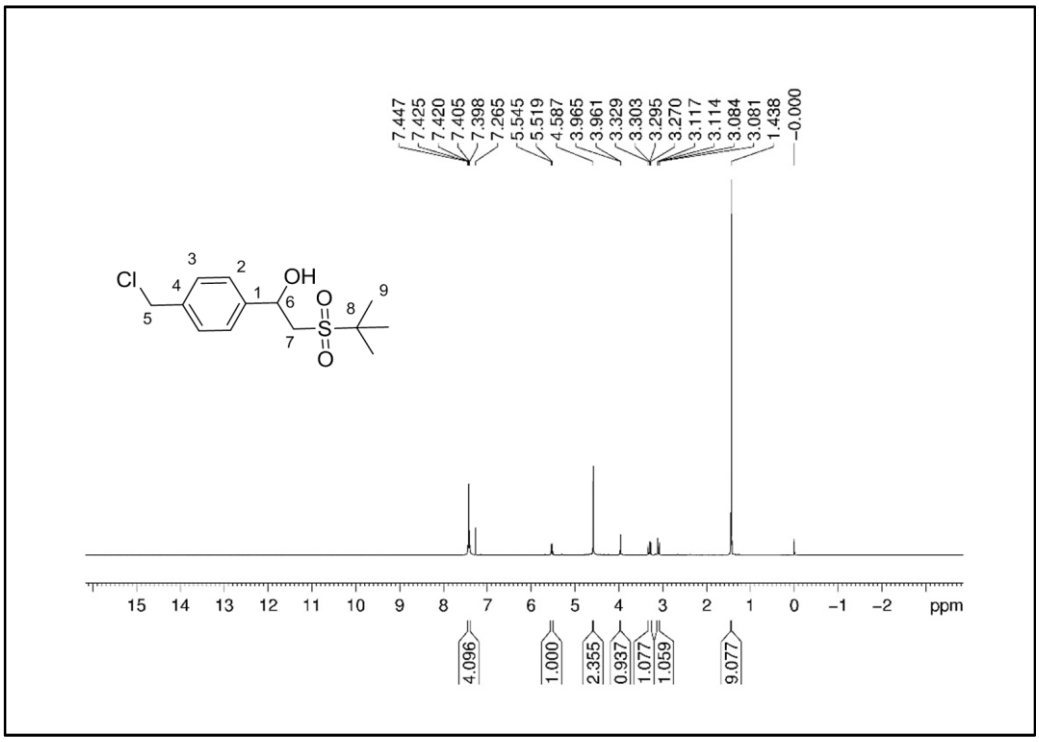


Fig.57 ^{1}H NMR spectrum of compound **4k**

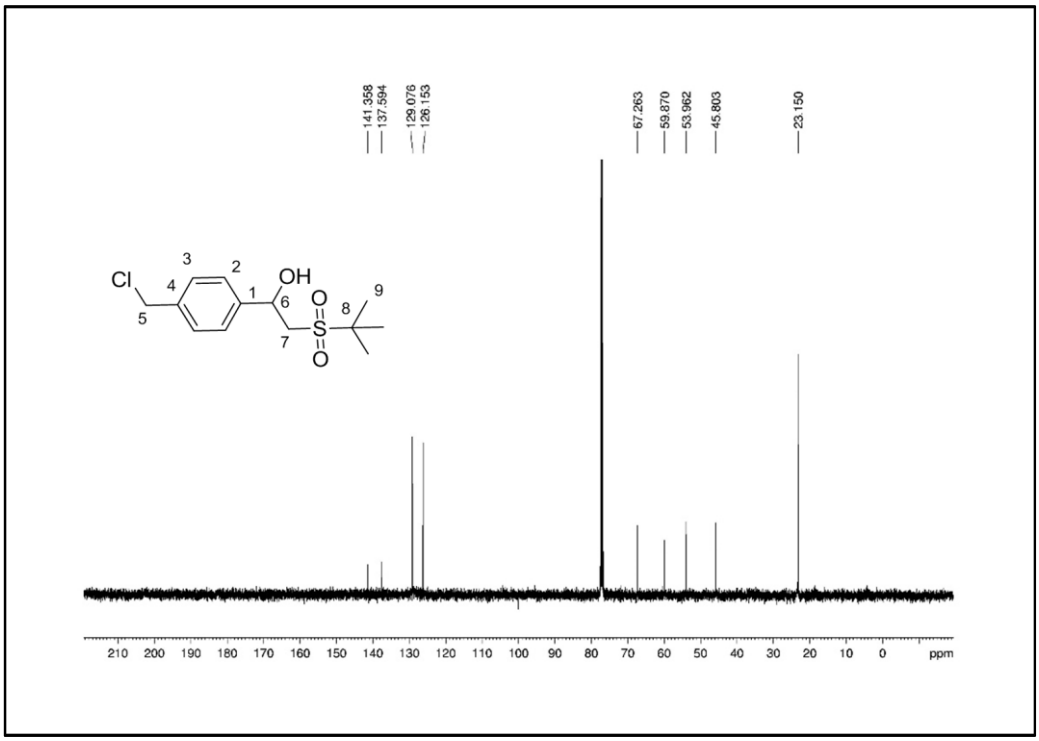


Fig.58 ^{13}C NMR spectrum of compound **4k**