# Supporting Information for

## Syntheses of 4-Allyl-/4-allenyl-4-(arylthio)-1,4-dihydroisoquinolin-3-ones via Photochemical Doyle-Kirmse reaction

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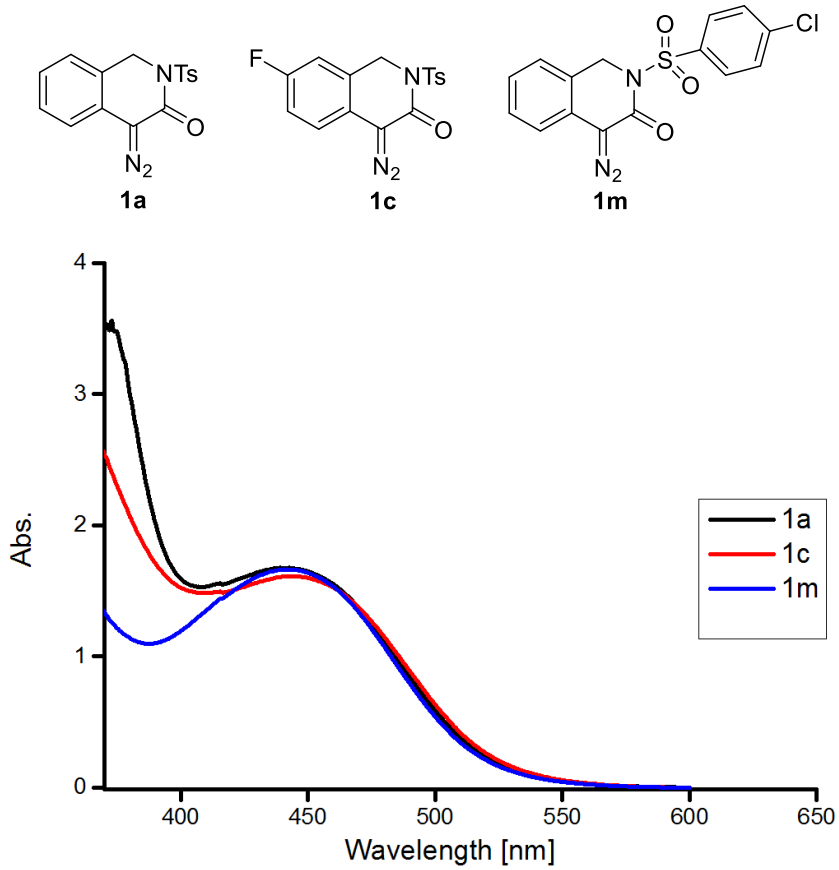
Content

**Figure S1. UV-Vis Absorbance Spectra of Diazo Compounds 1a, 1c and 1m in DCE (0.05 M)**




## General Information

Unless otherwise mentioned, solvent and reagent were purchased from commercial sources and used as received. $^{1}$H NMR spectra were obtained on 400 or 600 MHz in $CDCl_3$. The chemical shifts were quoted in parts per million (ppm) referenced to 0.0 ppm for tetramethylsilane as an internal standard. $^{13}$C NMR spectra were recorded on 100 or 150 MHz in $CDCl_3$. The chemical shifts were reported in ppm referenced to the internal solvent signals (77.0 ppm for $CDCl_3$). $^{13}C\{^{1}H\}$ for proton-decoupled carbon data was recorded. The following abbreviations were used to describe peak

patterns where appropriate: b = broad, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet. Coupling constants J were reported in hertz unit (Hz). Infrared spectra were obtained on an FTIR spectrometer. High-resolution mass spectra (HRMS) data were obtained by using ESI or EI ionization. Melting points were measured with SGW X-4 micro melting point apparatus. Flash column chromatography was performed employing 300-400 mesh silica gel. Thin layer chromatography (TLC) was performed on silica gel HSGF254. The photocatalytic reactions were carried out in a temperature controlled WATTCAS Parallel Light Reactor.

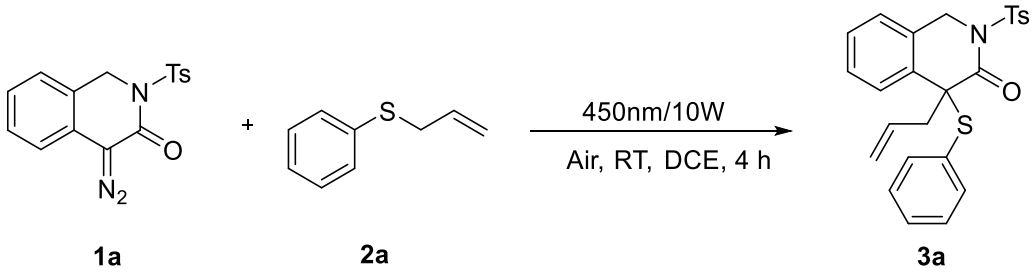
Substrates **1**, **2** and **4** were prepared according to the published procedures.[1,2]

**References:**

1. Z. M. Li, J. R. Chen, L. Wu, A. N. Ren, P. Lu and Y. G. Wang, *Org. Lett*., 2019, **22**, 26.

2. V. Pace, L. Castoldi and W. Holzer, *Tetrahedron Lett.*, 2012, **8**, 53, 967.

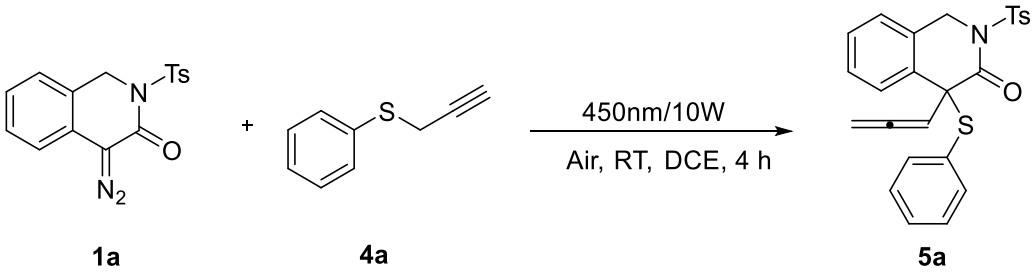
## General Procedure for the Synthesis of 3




**1a** **2a** **3a**

To a quartz test tube equipped with a magnetic stirring bar was added sequentially **1a** (0.1 mmol), **2a** (1.0 mmol) and DCE (0.5 mL). The reaction was irradiated with blue light (450 nm/10 W) from the photocatalytic reactor. The temperature was set to ambient and cooling was realized with a fan. Upon completion, the solvent was evaporated in vacuum. The residue was purified by column chromatography on silica (petroleum ether/ ethyl acetate/ dichloromethane = 25:1:2, v/v) to give the product **3a**.

## Typical Procedure for the Synthesis of 5a

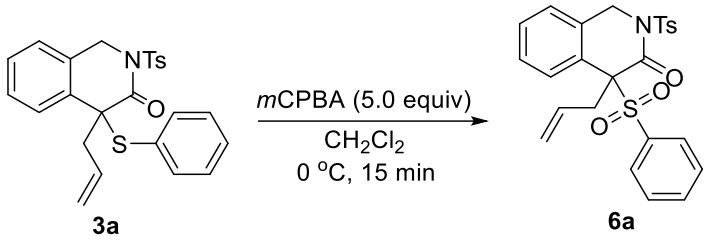



**1a** **4a** **5a**

To a quartz test tube equipped with a magnetic stirring bar was added sequentially **1a** (0.1 mmol), **4a** (1.0 mmol) and DCE (0.5 mL). The reaction was irradiated with blue light (450 nm/10 W) from the photocatalytic reactor. The temperature was set to ambient and cooling was realized with a fan. Upon completion, the solvent was evaporated in vacuum. The

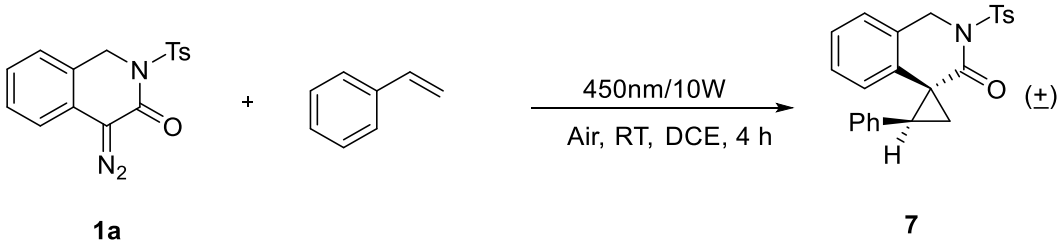
residue was purified by column chromatography on silica (petroleum ether/ ethyl acetate = 15 : 1, v/v) to give the product **5a**.

## Typical Procedure for the Synthesis of 6a




To an oven-dried flask equipped with a magnetic stirring bar were added **3a** (0.1 mmol), *m*CPBA (0.5 mmol), and dry $CH_2Cl_2$ (2 mL) under an air atmosphere. The reaction mixture was stirred at 0 $^0$C for 15 minutes, and then quenched with saturated $NaHCO_3$ (aq.). solution and extracted with EA. The combined organic layer was dried over $Na_2SO_4$ and concentrated under reduced pressure. The residure was purified by column chromatography on silica gel (PE/EA/DCM = 25 : 1 : 2 to 15 : 1 : 2, v/v) to give compound **6a**.

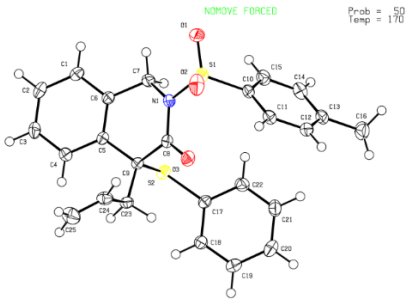
## Procedure for the Synthesis of 7

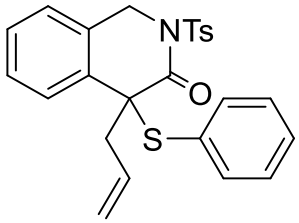



To a quartz test tube equipped with a magnetic stirring bar was added sequentially **1a** (0.1 mmol), styrene (1.0 mmol) and DCE (0.5 mL). The

reaction was irradiated with blue light (450 nm/10 W) from the photocatalytic reactor. The temperature was set to ambient and cooling was realized with a fan. Upon completion, the solvent was evaporated in vacuum. The residue was purified by column chromatography on silica (petroleum ether/ ethyl acetate/ dichloromethane = 15:1:2, v/v) to give the product **7**.

## The ORTEP and Crystal Parameters of 3a wherein thermal ellipsoids are drawn at 30% probability level




**3a**

Bond precision: C-C = 0.0018 A Wavelength=0.71073

Cell: a=9.009(2) b=9.253(3) c=13.987(4)
alpha=106.407(11) beta=94.581(11) gamma=91.510(13)
Temperature: 170 K

| | Calculated | Reported |
|---|---|---|
| Volume | 1113.5(5) | 1113.5(5) |
| Space group | P -1 | P -1 |
| Hall group | -P 1 | -P 1 |
| Moiety formula | C25 H23 N O3 S2 | C25 H23 N O3 S2 |
| Sum formula | C25 H23 N O3 S2 | C25 H23 N O3 S2 |
| Mr | 449.56 | 449.56 |
| Dx,g cm-3 | 1.341 | 1.341 |
| Z | 2 | 2 |
| Mu (mm-1) | 0.266 | 0.266 |
| F000 | 472.0 | 472.0 |
| F000' | 472.68 | |
| h,k,lmax | 11,11,17 | 11,11,17 |
| Nref | 4905 | 4900 |
| Tmin,Tmax | 0.920,0.948 | 0.697,0.746 |
| Tmin' | 0.901 | |

Correction method= # Reported T Limits: Tmin=0.697 Tmax=0.746
AbsCorr = MULTI-SCAN

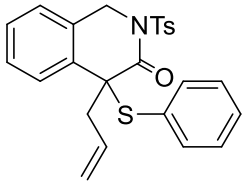
Data completeness= 0.999 Theta(max)= 27.093

R(reflections)= 0.0310( 4663) wR2(reflections)= 0.0827( 4900)

S = 1.058 Npar= 281

## Characterization Data for Products

### 4-allyl-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3a)




White solid; Yield 62% (28 mg); M.p. 193-194 °C.

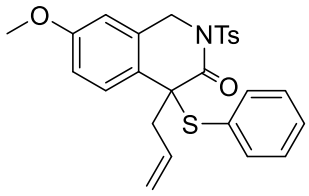
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.99 (d, *J* = 8.8 Hz, 2H), 7.46 (d, *J* = 8.0 Hz, 1H), 7.38 – 7.30 (m, 5H), 7.21 (d, *J* = 7.6 Hz, 1H), 7.10 – 7.05 (m, 2H), 6.87 (d, *J* = 6.8 Hz, 2H), 5.36 – 5.28 (m, 1H), 5.23 (d, *J* = 15.6 Hz, 1H), 4.97 (d, *J* = 16.8 Hz, 1H), 4.88 (d, *J* = 10.4 Hz, 1H), 4.65 (d, *J* = 15.2 Hz, 1H), 3.08 (dd, *J* = 14.8, 5.2 Hz, 1H), 2.96 (dd, *J* = 15.2, 8.0 Hz, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.2, 144.9, 137.4, 135.7, 132.6, 132.3, 130.0, 129.3, 129.2, 129.1, 128.6, 128.3, 128.1, 127.6, 126.0, 119.2, 57.6, 47.5, 38.8, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{23}NNaO_3S_2^+$ ([M+Na]$^+$): 472.1012; found: 472.1015.

**IR** (film); 2924, 2847, 1687, 1592, 1449, 1437, 1357, 1260, 1188, 1173, 1116, 1046, 983, 925, 817 cm$^{-1}$.

### 4-allyl-7-methoxy-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3b)




White solid; Yield 26% (13 mg); M.p. 189-190 °C.

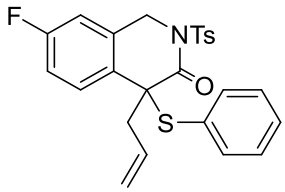
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.80 (d, *J* = 8.4 Hz, 2H), 7.28 – 7.26 (m, 1H), 7.25 – 7.24 (m, 1H), 7.16 – 7.14 (m, 2H), 7.03 (d, *J* = 8.4 Hz, 1H), 6.90 – 6.87 (m, 2H), 6.81 – 6.79 (m, 2H), 5.90 – 5.80 (m, 1H), 5.17 – 5.14 (m, 1H), 5.12 – 5.07 (m, 2H), 4.72 (s, 1H), 4.59 (d, *J* = 15.6 Hz, 1H), 3.85 (s, 3H), 3.51 (dt, *J* = 6.8, 1.2 Hz, 2H), 2.42 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 169.6, 159.3, 144.9, 135.8, 135.4, 133.3, 133.0, 132.7, 129.54, 129.51, 129.3, 128.4, 127.9, 125.9, 117.9, 114.3, 111.7, 55.5, 54.2, 48.3, 36.8, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{25}NNaO_4S_2^+$ ([M+Na]$^+$): 502.1117; found: 502.1118.

**IR** (film): 2923, 2843, 1687, 1611, 1505, 1353, 1171, 1142, 1034, 940, 815 cm$^{-1}$.

**4-allyl-7-fluoro-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3c)**




White solid; Yield 67% (31 mg); M.p. 169-170 ºC.

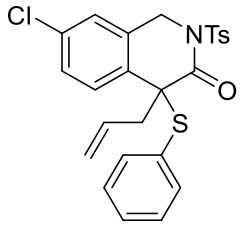
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.98 (d, *J* = 8.4, 2H), 7.44 – 7.40 (m, 1H), 7.37 (d, *J* = 8.4 Hz, 2H), 7.32 – 7.31 (m, 1H), 7.10 – 7.06 (m, 3H), 6.93 – 6.90 (m, 1H), 6.87 (d, *J* = 6.8, 2H), 5.33 – 5.23 (m, 1H), 5.18 (d, *J* = 15.6 Hz, 1H), 4.95 (d, *J* = 17.2 Hz, 1H), 4.88 (d, *J* = 10.4 Hz, 1H), 4.59 (d, *J* = 15.6 Hz, 1H), 3.12 – 3.07 (m, 1H), 2.91 (dd, *J* = 14.8 Hz, 8.0 Hz, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.9, 161.9 (d, *J* = 248.0 Hz), 145.1, 137.4, 135.5, 134.5 (d, *J* = 8.1 Hz), 132.4, 130.1, 129.9 (d, *J* = 8.5 Hz), 129.4, 129.2, 128.9, 128.7, 128.5 (d, *J* = 3.1 Hz), 119.4, 115.6 (d, *J* = 21.6 Hz), 112.8 (d, *J* = 22.4 Hz), 57.3, 47.1 (d, *J* = 2.2 Hz), 39.1, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}FNNaO_3S_2^+$ ([M+Na]$^+$): 490.0917; found: 490.0919.

**IR** (film): 3075, 2920, 1695, 1597, 1500, 1360, 1280, 1171, 1119, 1088, 958, 810 cm$^{-1}$.

**4-allyl-7-chloro-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one** (**3d**)




White solid; Yield 52% (25 mg); M.p. 191-192 °C.

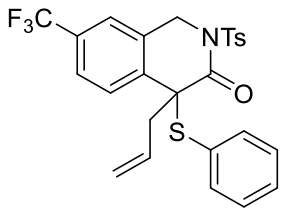
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.98 (d, *J* = 8.4 Hz, 2H), 7.39 – 7.30 (m, 5H), 7.21 (s, 1H), 7.11 – 7.07 (m, 2H), 6.88 (d, *J* = 6.4 Hz, 2H), 5.32 – 5.23 (m, 1H), 5.18 (d, *J* = 15.6 Hz, 1H), 4.95 (d, *J* = 17.2 Hz, 1H), 4.88 (d, *J* = 10.4 Hz, 1H), 4.58 (d, *J* = 15.6 Hz, 1H), 3.11 – 3.06 (m, 1H), 2.93 – 2.87 (m, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.7, 145.1, 126.0, 119.5, 137.4, 135.4, 134.1, 134.0, 132.2, 131.3, 130.2, 129.4, 129.2, 128.77, 128.76, 128.66, 128.5, 57.2, 46.9, 38.9, 21.8.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}ClNNaO_3S_2^+$ ($[M+Na]^+$): 506.0622; found: 506.0625.

**IR** (film): 3075, 2924, 1694, 1596, 1438, 1362, 1255, 1088, 971, 806 $cm^{-1}$.

## 4-allyl-4-(phenylthio)-2-tosyl-7-(trifluoromethyl)-1,4-dihydroisoquinolin-3(*2H*)-one (3e)




White solid; Yield 40% (21 mg); M.p. 142-143 °C.

**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.99 (d, *J* = 8.4 Hz, 2H), 7.62 – 7.55 (m, 2H), 7.47 (s, 1H), 7.38 (d, *J* = 8.4 Hz, 2H), 7.36 – 7.32 (m, 1H), 7.11 – 7.07 (m, 2H), 6.89 – 6.87 (m, 2H), 5.31 – 5.21 (m, 2H), 4.96 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.89 (d, *J* = 10.0 Hz, 1H), 4.62 (d, *J* = 15.6 Hz, 1H), 3.14 (ddt, *J* = 14.4, 5.2, 1.6 Hz, 1H), 2.94 (dd, *J* = 14.8, 8.0 Hz, 1H), 2.49 (s, 3H).

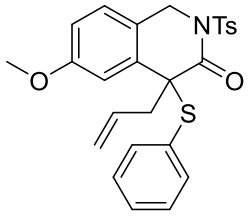
**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.5, 145.2, 137.4, 136.9, 135.4, 133.03, 132.02, 130.27 (q, *J* = 32.6 Hz), 130.33, 129.4, 129.2, 128.8, 128.43, 128.41, 125.0 (q, *J* = 3.4 Hz), 123.1 (q, *J* = 2.9 Hz), 123.6 (q, *J* = 270.8 Hz), 119.7, 57.4, 47.1, 38.9, 21.8.

**$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -62.745.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{22}F_3NNaO_3S_2^+$ ($[M+Na]^+$): 540.0885; found: 540.0886.

**IR** (film): 3075, 2922, 1694, 1596, 1438, 1362, 1255, 1088, 971, 806 $cm^{-1}$.

## 4-allyl-6-methoxy-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3f)




White solid; Yield 43% (21 mg); M.p. 196-197 ºC.

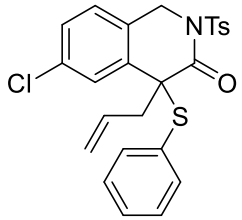
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.0 Hz, 2H), 7.27 – 7.22 (m, 1H), 7.06 (d, *J* = 8.8 Hz, 1H), 7.03 – 6.99 (m, 2H), 6.88 (d, *J* = 2.4 Hz, 1H), 6.82 – 6.78 (m, 3H), 5.30 – 5.22 (m, 1H), 5.12 (d, *J* = 14.8 Hz, 1H), 4.91 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.83 (d, *J* = 10.4 Hz, 1H), 4.56 (d, *J* = 15.2 Hz, 1H), 3.74 (s, 3H), 2.98 (ddt, *J* = 14.8, 5.6, 1.6 Hz, 1H), 2.83 (dd, *J* = 14.8, 8.0 Hz, 1H), 2.42 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.0, 159.4, 144.9, 137.4, 135.7, 133.9, 132.7, 130.0, 129.3, 129.2, 129.0, 128.6, 127.2, 124.6, 119.1, 114.1, 112.8, 57.7, 55.4, 47.0, 38.8, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{25}NNaO_4S_2^+$ ($[M+Na]^+$): 502.1117; found: 502.1120.

**IR** (film): 3445, 2963, 1693, 1616, 1507, 1471, 1357, 1260, 1187, 1088, 924, 817 $cm^{-1}$.

## 4-allyl-6-chloro-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3g)




White solid; Yield 59% (29 mg); M.p. 152-153 °C.

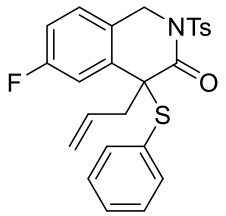
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.90 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 2.0 Hz, 1H), 7.30 (d, *J* = 8.4 Hz, 2H), 7.28 – 7.24 (m, 1H), 7.21 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.07 (d, *J* = 8.4 Hz, 1H), 7.04 – 7.00 (m, 2H), 6.84 – 6.76 (dd, *J* = 8.0, 1.2 Hz, 2H), 5.26 – 5.16 (m, 1H), 5.12 (d, *J* = 15.6 Hz, 1H), 4.90 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.83 (dd, *J* = 10.4, 1.2 Hz, 1H), 4.48 (d, *J* = 15.6 Hz, 1H), 3.01 (ddt, *J* = 14.8, 5.6, 1.6 Hz, 1H), 2.80 (dd, *J* = 14.8, 7.6 Hz, 1H), 2.42 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.6, 145.1, 137.4, 135.4, 134.7, 134.2, 132.0, 130.7, 130.2, 129.4, 129.2, 128.8, 128.6, 128.3, 127.8, 127.4, 119.7, 57.3, 47.0, 38.8, 21.8.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}ClNNaO_3S_2^+$ ($[M+Na]^+$): 506.0622; found: 506.0625.

**IR** (film): 3419, 2924, 1749, 1688, 1595, 1454, 1357, 1260, 1171, 1088, 935, 808 $cm^{-1}$.

**4-allyl-6-fluoro-4-(phenylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3h)**




White solid; Yield 60% (28 mg); M.p. 175-176 °C.

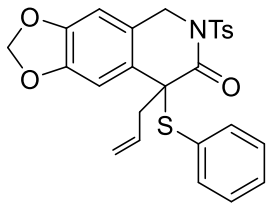
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.98 (d, *J* = 8.4 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.35 – 7.30 (m, 1H), 7.19 – 7.12 (m, 2H), 7.10 – 7.06 (m, 2H), 7.04 – 6.99 (m, 1H), 6.89 – 6.86 (m, 2H), 5.35 – 5.24 (m, 1H), 5.20 (d, *J* = 15.2 Hz, 1H), 5.00 – 4.95 (m, 1H), 4.90 (d, *J* = 10.0 Hz, 1H), 4.56 (d, *J* = 15.2, 1H), 3.11 – 3.06 (m, 1H), 2.85 (dd, *J* = 14.8, 8.0 Hz, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.6, 162.4 (d, *J* = 245.3 Hz), 145.0, 137.4, 135.5, 135.2 (d, *J* = 7.8 Hz), 132.1, 130.2, 129.4, 129.2, 128.7, 128.6, 128.1 (d, *J* = 2.9 Hz), 127.8 (d, *J* = 8.3 Hz), 119.6, 115.5 (d, *J* = 22.0 Hz), 114.5 (d, *J* =23.5 Hz), 57.5 (d, *J* = 1.8 Hz), 46.9, 38.9, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}FNNaO_3S_2^+$ ([M+Na]$^+$): 490.0917; found: 490.0919.

**IR** (film): 3079, 2963, 1704, 1689, 1613, 1596, 1506, 1438, 1260, 1173, 1113, 931, 818 cm$^{-1}$.

## 8-allyl-8-(phenylthio)-6-tosyl-5,8-dihydro-[1,3]dioxolo[4,5-g]isoquinolin-7(*6H*)-one (3i)




White solid; Yield 33% (16 mg); M.p. 187-188 °C.

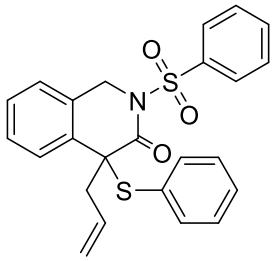
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.98 (d, *J* = 8.4 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.34 – 7.29 (m, 1H), 7.10 – 7.06 (m, 2H), 6.91 (s, 1H), 6.88 – 6.86 (m, 2H), 6.63 (s, 1H), 6.02 – 6.00 (m, 2H), 5.37 – 5.26 (m, 1H), 5.08 (d, *J* = 15.2 Hz, 1H), 4.97 (dd, *J* = 17.2, 1.2 Hz, 1H), 4.90 (dd, *J* = 10.4, 1.6 Hz, 1H), 4.51 (d, *J* = 15.2 Hz, 1H), 3.06 – 3.00 (m, 1H), 2.82 (dd, *J* = 14.8, 8.0 Hz, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.9, 148.0, 147.6, 144.9, 137.3, 135.6, 132.5, 129.9, 129.3, 129.19, 129.17, 128.6, 126.5, 125.9, 119.2, 107.3, 105.9, 101.6, 57.7, 47.3, 39.1, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{23}NNaO_5S_2^+$ ([M+Na]$^+$): 516.0910; found: 516.0910.

**IR** (film): 3059, 2963, 2922, 1694, 1596, 1505, 1488, 1359, 1261, 1171, 1089, 1035, 934, 800 cm$^{-1}$.

## 4-allyl-2-(phenylsulfonyl)-4-(phenylthio)-1,4-dihydroisoquinolin-3(*2H*)-one (3j)



White solid; Yield 60% (26 mg); M.p. 157-158 °C.

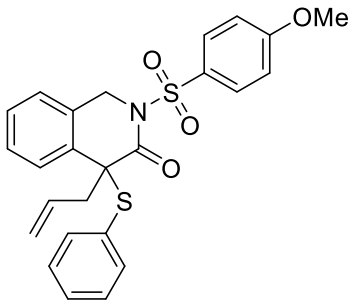
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 8.12 – 8.10 (m, 2H), 7.73 – 7.68 (m, 1H), 7.60 – 7.56 (m, 2H), 7.48 – 7.46 (m, 1H), 7.39 – 7.29 (m, 3H), 7.21 (d, *J* = 7.2 Hz, 1H), 7.10 – 7.06 (m, 2H), 6.88 – 6.86 (m, 2H), 5.35 – 5.23 (m, 2H), 4.96 (dd, *J* =1.6, 17.2 Hz, 1H), 4.86 (dd, *J* = 10.4, 1.2 Hz, 1H), 4.65 (d, *J* = 15.6 Hz, 1H), 3.08 (ddt, *J* = 14.8, 6.0, 1.6 Hz, 1H), 2.97 (dd, *J* = 14.4, 7.6 Hz, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.2, 138.6, 137.4, 133.8, 132.5, 132.4, 132.2, 130.0, 129.1, 128.9, 128.7, 128.3, 128.2, 127.6, 126.0, 119.3, 57.6, 47.5, 38.7.

**HRMS** (ESI-TOF) calcd for $C_{24}H_{21}NNaO_3S_2^+$ ([M+Na]$^+$): 458.0855; found: 458.0853.

**IR** (film): 3073, 2920, 1694, 1639, 1471, 1449, 1360, 1438, 1259, 1182, 1115, 1087, 917, 854 cm$^{-1}$.

## 4-allyl-2-((4-methoxyphenyl)sulfonyl)-4-(phenylthio)-1,4-dihydroisoquinolin-3(*2H*)-one (3k)



White solid; Yield 59% (27 mg); M.p. 205-206 °C.

**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 8.05 (d, *J* = 8.8 Hz, 2H), 7.46 (d, *J* = 8.0 Hz, 1H), 7.38 – 7.29 (m, 3H), 7.20 (d, *J* = 7.6 Hz, 1H), 7.11 – 7.07 (m, 2H), 7.03 (d, *J* = 8.8 Hz, 2H), 6.90 – 6.88 (m, 2H), 5.36 – 5.27 (m, 1H), 5.22 (d, *J* = 15.2 Hz, 1H), 4.98 (dd, *J* = 17.2, 1.6 Hz,

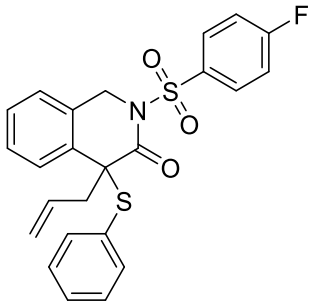
1H), 4.88 (dd, *J* = 10.4, 1.2 Hz, 1H), 4.61 (d, *J* = 15.2 Hz, 1H), 3.91 (s, 3H), 3.14 – 3.08 (m, 1H), 2.97 (dd, *J* = 14.8, 8.0 Hz, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.2, 163.9, 137.4, 132.59, 132.57, 132.4, 131.6, 130.0, 129.9, 129.0, 128.7, 128.2, 128.1, 127.6, 126.0, 119.2, 113.8, 57.6, 55.8, 47.4, 38.8.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{23}NNaO_4S_2^+$ ([M+Na]$^+$): 488.0961; found: 488.0963.

**IR** (film): 3076, 2976, 1682, 1591, 1497, 1448, 1355, 1262, 1216, 1160, 1115, 1088, 932, 837 cm$^{-1}$.

## 4-allyl-2-((4-fluorophenyl)sulfonyl)-4-(phenylthio)-1,4-dihydroisoquinolin-3(*2H*)-one (3l)




White solid; Yield 58% (26 mg); M.p. 182-183 $^o$C.

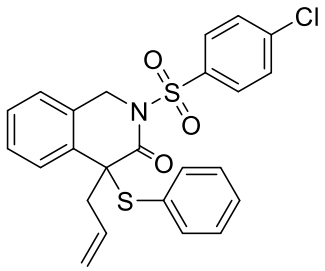
**$^1$H NMR** (400 MHz, Chloroform-d) δ 8.14 – 8.11 (m, 2H), 7.48 – 7.46 (m, 1H), 7.39 – 7.31 (m, 3H), 7.26 – 7.20 (m, 3H), 7.14 – 7.11 (m, 2H), 6.95 – 6.93 (m, 2H), 5.34 – 5.24 (m, 1H), 5.21 (d, *J* = 15.6 Hz, 1H), 4.95 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.87 (dd, *J* = 10.4, 1.6 Hz, 1H), 4.63 (d, *J* = 15.2 Hz, 1H), 3.13 – 3.07 (m, 1H), 2.99 (dd, *J* = 14.8, 7.6 Hz, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.3, 165.8 (d, *J* = 255.1 Hz), 137.3, 134.5 (d, *J* = 3.2 Hz), 132.4, 132.3 (d, *J* = 33.7 Hz), 132.2, 132.1, 130.1, 129.0, 128.7, 128.4, 128.2, 127.6, 126.0, 119.3, 115.9 (d, *J* = 22.7 Hz), 57.7, 47.5, 38.8.

**HRMS** (ESI-TOF) calcd for $C_{24}H_{20}FNNaO_3S_2^+$ ([M+Na]$^+$): 476.0761; found: 476.0763.

**IR** (film): 3070, 2925, 1687, 1587, 1492, 1362, 1261, 1179, 1159, 1086, 1046, 932, 848 cm$^{-1}$.

**4-allyl-2-((4-chlorophenyl)sulfonyl)-4-(phenylthio)-1,4-dihydroisoquinolin-3(*2H*)-one (3m)**




White solid; Yield 53% (25 mg); M.p. 184-185 ºC.

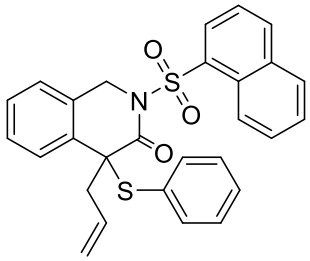
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 8.04 (d, *J* = 8.4 Hz, 2H), 7.54 (d, *J* = 8.8 Hz, 2H), 7.47 (d, *J* = 7.6 Hz, 1H), 7.40 – 7.31 (m, 3H), 7.22 (d, *J* = 7.2 Hz, 1H), 7.14 – 7.10 (m, 2H), 6.91 (d, *J* = 6.8 Hz, 2H), 5.35 – 5.27 (m, 1H), 5.22 (d, *J* = 15.2 Hz, 1H), 4.97 (d, *J* = 17.2 Hz, 1H), 4.89 (d, *J* = 10.4 Hz, 1H), 4.67 (d, *J* = 15.2 Hz, 1H), 3.11 – 3.06 (m, 1H), 3.02 – 2.97 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.2, 140.5, 137.3, 137.0, 132.4, 132.1, 130.7, 130.1, 129.0, 128.9, 128.7, 128.4, 128.2, 127.6, 126.1, 119.3, 57.6, 47.5, 38.7.

**HRMS** (ESI-TOF) calcd for $C_{24}H_{20}ClNNaO_3S_2^+$ ($[M+Na]^+$): 492.0465; found: 492.0467.

**IR** (film): 3067, 3006, 1686, 1438, 1361, 1182, 1115, 1085, 972, 824 $cm^{-1}$.

**4-allyl-2-(naphthalen-1-ylsulfonyl)-4-(phenylthio)-1,4-dihydroisoquinolin-3(*2H*)-one (3n)**




White solid; Yield 38% (18 mg); M.p. 184-185 ºC.

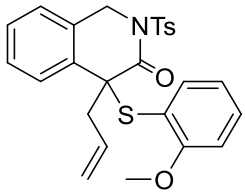
**$^1$H NMR** (400 MHz, Chloroform-d) δ 8.74 (s, 1H), 8.07 – 8.02 (m, 3H), 8.00 – 7.96 (m, 1H), 7.74 – 7.70 (m, 1H), 7.69 – 7.65 (m, 1H), 7.47 (dd, *J* = 7.2, 1.6 Hz, 1H), 7.40 – 7.32 (m, 2H), 7.273 – 7.269 (m, 1H), 7.15 – 7.10 (m, 1H), 6.68 – 6.63 (m, 4H), 5.38 – 5.27 (m, 2H), 4.95 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.84 (dd, *J* = 10.4, 1.6 Hz, 1H), 4.80 (d, *J* = 15.2 Hz, 1H), 3.06 – 2.92 (m, 2H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.1, 137.3, 135.4, 135.2, 132.55, 132.52, 132.3, 131.8, 131.6, 129.9, 129.8, 129.5, 128.9, 128.8, 128.44, 128.35, 128.2, 127.9, 127.6, 126.1, 123.3, 119.2, 57.4, 47.7, 38.6.

**HRMS** (ESI-TOF) calcd for $C_{28}H_{23}NNaO_3S_2^+$ ([M+Na]$^+$): 508.1012; found: 508.1011.

**IR** (film): 3060, 2920, 1692, 1590, 1453, 1354, 1261, 1172, 1114, 1088, 1071, 971, 859 cm$^{-1}$.

## 4-allyl-4-((2-methoxyphenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3o)




White solid; Yield 58% (28 mg); M.p. 169-170 ºC.

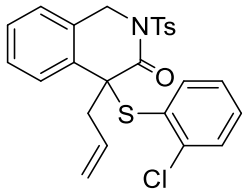
**$^1$H NMR** (400 MHz, Chloroform-d) δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.43 – 7.40 (m, 1H), 7.33 – 7.27 (m, 5H), 7.22 – 7.20 (m, 1H), 6.82 (dd, *J* = 7.6, 1.6 Hz, 1H), 6.77 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.64 (td, *J* = 7.6, 1.2 Hz, 1H), 5.27 (d, *J* = 15.2 Hz, 1H), 5.23 – 5.14 (m, 1H), 4.91 – 4.83 (m, 2H), 4.78 (d, *J* = 10.0 Hz, 1H), 3.71 (s, 3H), 3.17 – 3.12 (m, 1H), 3.10 – 3.04 (m, 1H), 2.44 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.1, 161.3, 144.7, 140.0, 135.8, 133.0, 132.7, 132.6, 132.3, 129.2, 128.9, 127.92, 127.87, 127.8, 125.8, 120.5, 118.9, 117.0, 110.8, 58.3, 55.6, 47.4, 38.6, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{25}NNaO_4S_2^+$ ([M+Na]$^+$): 502.1117; found: 502.1118.

**IR** (film): 3069, 2916, 1694, 1582, 1475, 1357, 1275, 1171, 1115, 1088, 913, 813 cm$^{-1}$.

**4-allyl-4-((2-chlorophenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3p)**




White solid; Yield 39% (18 mg); M.p. 179-180 ºC.

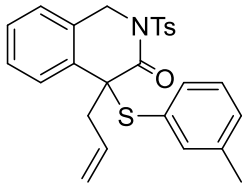
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.97 (d, *J* = 8.4 Hz, 2H), 7.49 – 7.47 (m, 1H), 7.36 – 7.33 (m, 5H), 7.29 – 7.27 (m, 1H), 7.25 – 7.22 (m, 1H), 6.96 – 6.91 (m, 1H), 6.81 (dd, *J* = 7.6, 1.6 Hz, 1H), 5.34 (d, *J* = 15.2 Hz, 1H), 5.29 – 5.20 (m, 1H), 4.98 – 4.93 (m, 2H), 4.86 (d, *J* = 10.0 Hz, 1H), 3.17 (dd, *J* = 14.8, 7.6 Hz, 1H), 3.06 – 3.04 (m, 1H), 2.47 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.6, 144.9, 141.0, 139.8, 135.6, 132.51, 132.48, 132.1, 131.3, 129.9, 129.3, 129.1, 128.5, 128.40, 128.38, 127.8, 126.9, 126.2, 119.4, 58.8, 47.4, 38.1, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}ClNNaO_3S_2^+$ ($[M+Na]^+$): 506.0622; found: 506.0626.

**IR** (film): 3071, 2921, 1694, 1449, 1360, 1261, 1187, 1172, 1115, 1088, 1036, 971, 853 $cm^{-1}$.

**4-allyl-4-(m-tolylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3q)**




White solid; Yield 61% (28 mg); M.p. 183-184 ºC.

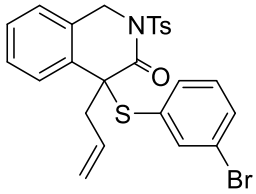
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.96 (d, *J* = 8.4 Hz, 2H), 7.44 (d, *J* = 8.0 Hz, 1H), 7.38 – 7.29 (m, 4H), 7.19 (d, *J* = 7.2 Hz, 1H), 7.14 (d, *J* = 7.2 Hz, 1H), 6.97 – 6.92 (m, 2H), 6.63 (d, *J* = 7.6 Hz, 1H), 5.34 – 5.17 (m, 1H), 5.19 (d, *J* = 15.2 Hz, 1H), 4.97 – 4.92(m, 1H), 4.85 (d, *J* = 10.4 Hz, 1H), 4.59 (d, *J* = 15.6 Hz, 1H), 3.13 – 3.07 (m, 1H), 2.95 (dd, *J* = 14.8, 7.6 Hz, 1H), 2.46 (s, 3H), 2.22 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.3, 144.8, 138.5, 138.1, 135.8, 134.3, 132.6, 132.4, 130.8, 129.3, 129.0, 128.7, 128.4, 128.2, 128.0, 127.6, 125.9, 119.1, 57.6, 47.5, 38.7, 21.7, 21.0.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{25}NNaO_3S_2^+$ ([M+Na]$^+$): 486.1168; found: 486.1170.

**IR** (film): 3075, 2922, 1694, 1594, 1453, 1359, 1259, 1187, 1172, 1116, 1089, 913, 813 cm$^{-1}$.

## 4-allyl-4-((3-bromophenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3r)




White solid; Yield 47% (25 mg); m.p. 165-166 ºC.

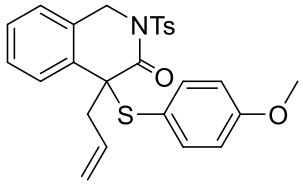
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.97 (d, *J* = 8.4 Hz, 2H), 7.45 – 7.43 (m, 2H), 7.37 – 7.32 (m, 4H), 7.24 (d, *J* = 7.2 Hz, 1H), 7.20 – 7.19 (m, 1H), 6.98 – 6.94 (m, 1H), 6.82 – 6.80 (m, 1H), 5.34 – 5.22 (m, 2H), 4.99 – 4.94 (m, 1H), 4.88 (d, *J* = 10.4 Hz, 1H), 4.71 (d, *J* = 15.2 Hz, 1H), 3.11 – 2.92 (m, 1H), 2.95 (dd, *J* = 14.4, 7.6 Hz, 1H), 2.46 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.0, 145.0, 139.5, 135.8, 135.5, 133.1, 132.22, 132.18, 132.1, 131.2, 129.9, 129.4, 129.0, 128.4, 128.36, 127.7, 126.1, 122.0, 119.5, 57.8, 47.5, 38.7, 21.8.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}BrNNaO_3S_2^+$ ([M+Na]$^+$): 550.0117; found: 550.0119.

**IR** (film): 3073, 2921, 1693, 1556, 1457, 1359, 1187, 1172, 1116, 972, 813 cm$^{-1}$.

## 4-allyl-4-((4-methoxyphenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3s)




White solid; Yield 52% (25 mg); M.p. 194-195 °C.

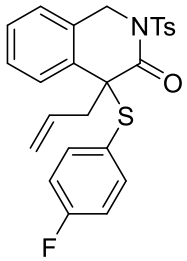
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.99 (d, *J* = 8.4 Hz, 2H), 7.44 (dd, *J* = 7.7, 1.6 Hz, 1H), 7.38 – 7.29 (m, 4H), 7.22 (dd, *J* = 7.6, 1.6 Hz, 1H), 6.82 – 6.78 (m, 2H), 6.61 – 6.57 (m, 2H), 5.36 – 5.23 (m, 2H), 4.97 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.87 (dd, *J* = 10.4, 1.2 Hz, 1H), 4.71 (d, *J* = 15.2 Hz, 1H), 3.78 (s, 3H), 3.06 (ddt, *J* = 14.8, 5.6, 2.0 Hz, 1H), 2.94 (dd, *J* = 14.4, 7.6 Hz, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.2, 161.1, 144.8, 139.0, 135.8, 132.7, 132.6, 132.3, 129.3, 129.2, 128.2, 128.0, 127.5, 126.1, 119.8, 119.0, 114.2, 57.6, 55.2, 47.5, 38.4, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{25}NNaO_4S_2^+$ ([M+Na]$^+$): 502.1117; found: 502.1121.

**IR** (film): 3011, 2925, 1693, 1590, 1492, 1359, 1289, 1251, 1172, 1140, 1088, 923, 827 $cm^{-1}$.

**4-allyl-4-((4-fluorophenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3t)**




White solid; Yield 49% (23 mg); M.p. 163-164 °C.

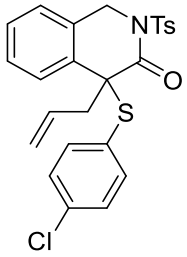
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.98 (d, *J* = 8.4 Hz, 2H), 7.46 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.39 – 7.31 (m, 4H), 7.25 – 7.23 (m, 1H), 6.90 – 6.86 (m, 2H), 6.79 – 6.75 (m, 2H), 5.35 – 5.24 (m, 2H), 4.96 (d, *J* = 17.2 Hz, 1H), 4.88 (d, *J* = 10.4 Hz, 1H), 4.74 (d, *J* = 15.6 Hz, 1H), 3.08 – 3.02 (m, 1H), 2.97 – 2.92 (m, 1H), 2.49 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.9, 163.9 (d, *J* = 250.0 Hz), 145.0, 139.4 (*J* = 8.6 Hz), 135.7, 132.3 (d, *J* = 16.7 Hz), 129.3, 129.2, 128.34, 128.28, 127.6, 126.1, 124.5 (d, *J* = 3.5 Hz), 119.3, 116.0, 115.8, 57.6, 47.5, 38.6, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}FNNaO_3S_2^+$ ([M+Na]$^+$): 490.0917; found: 490.0920.

**IR** (film): 3073, 2916, 1694, 1588, 1489, 1360, 1260, 1224, 1187, 1172, 1089, 914, 834 cm$^{-1}$.

**4-allyl-4-((4-chlorophenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3u)**




White solid; Yield 54% (26 mg); M.p. 174-175 ºC.

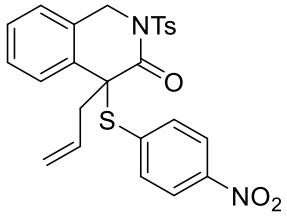
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.98 (d, *J* = 8.4 Hz, 2H), 7.46 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.39 – 7.32 (m, 4H), 7.25 (d, *J* = 6.8 Hz, 1H), 7.06 – 7.03 (m, 2H), 6.86 – 6.82 (m, 2H), 5.35 – 5.25 (m, 2H), 4.97 (dd, *J* = 17.2, 1.6 Hz, 1H), 4.88 (dd, *J* = 10.4, 1.6 Hz, 1H), 4.78 (d, *J* = 15.6 Hz, 1H), 3.05 (ddt, *J* = 14.8, 5.6, 1.6 Hz, 1H), 2.95 (dd, *J* = 14.4, 7.6 Hz, 1H), 2.50 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.8, 145.0, 138.5, 136.6, 135.6, 132.34, 132.25, 132.2, 129.3, 129.2, 128.9, 128.4, 128.3, 127.62, 127.58, 126.2, 119.4, 57.7, 47.5, 38.7, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}ClNNaO_3S_2^+$ ([M+Na]$^+$): 506.0622; found: 506.0622.

**IR** (film): 2923, 1694, 1571, 1492, 1474, 1359, 1262, 1188, 1172, 1091, 1014,929, 816 cm$^{-1}$.

**4-allyl-4-((4-nitrophenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3v)**




White solid; Yield 27% (13 mg); M.p.149-150 ºC.

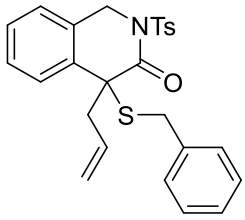
**$^1$H NMR** (400 MHz, Chloroform-d) δ 7.98 – 7.95 (m, 2H), 7.91 – 7.86 (m, 2H), 7.53 – 7.51 (m, 1H), 7.42 – 7.35 (m, 4H), 7.30 – 7.28 (m, 1H), 7.12 – 7.09 (m, 2H), 5.36 – 5.25 (m, 2H), 5.00 – 4.90 (m, 3H), 3.08 – 3.00 (m, 2H), 2.51 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.5, 148.2, 145.4, 138.0, 137.1, 135.4, 132.1, 131.8, 131.7, 129.4, 129.2, 128.7, 128.6, 127.7, 126.4, 123.4, 119.8, 58.6, 47.5, 39.3, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{22}N_2NaO_5S_2^+$ ([M+Na]$^+$): 517.0962; found: 517.0864.

**IR** (film): 3088, 2963, 1692, 1597, 1521, 1344, 1261, 1172, 1088, 854, 800 cm$^{-1}$.

**4-allyl-4-(benzylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3w)**




White solid; Yield 50% (23 mg); M.p.105-106 ºC.

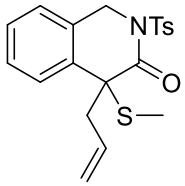
**$^1$H NMR** (400 MHz, Chloroform-d) δ 8.03 (d, *J* = 8.4 Hz, 2H), 7.45 – 7.42 (m, 1H), 7.37 – 7.31 (m, 4H), 7.29 – 7.27 (m, 1H), 7.23 – 7.16 (m, 3H), 6.98 – 6.95 (m, 2H), 5.49 – 5.41 (m, 1H), 5.31 (d, *J* = 14.8 Hz, 1H), 5.09 – 4.95 (m, 2H), 4.96 (d, *J* = 10.4 Hz, 1H), 3.57 (d, *J* = 11.6 Hz, 1H), 3.44 –3.38 (m, 1H), 3.10 (d, *J* = 11.6 Hz, 1H), 3.01 (dd, *J* = 15.2, 7.6 Hz, 1H), 2.41 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.6, 145.1, 135.55, 135.46, 132.8, 132.3, 131.8, 129.4, 129.1, 128.9, 128.4, 128.32, 128.28, 127.28, 127.25, 126.4, 119.1, 55.2, 47.7, 38.0, 34.8, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{25}NNaO_3S_2^+$ ([M+Na]$^+$): 486.1168; found: 486.1169.

**IR** (film): 3029, 2923, 1686, 1596, 1494, 1453, 1361, 1187, 1172, 1116, 1088, 972, 813 $cm^{-1}$.

**4-allyl-4-(methylthio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3x)**




White solid; Yield 59% (23 mg); M.p. 125-126 °C.

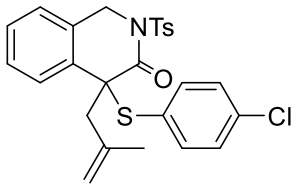
**$^1$H NMR** (400 MHz, Chloroform-d) δ 7.87 (d, *J* = 8.4 Hz, 2H), 7.37 – 7.34 (m, 1H), 7.28 – 7.38 (m, 1H), 7.26 – 7.19 (m, 4H), 5.41 – 5.31 (m, 1H), 5.21 (d, *J* = 15.2 Hz, 1H), 4.97 (d, *J* = 15.6 Hz, 2H), 4.89 – 4.86 (m, 1H), 3.25 – 3.20 (m, 1H), 2.83 (dd, *J* = 14.8, 7.6 Hz, 1H), 2.36 (s, 3H), 1.59 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.3, 144.9, 135.5, 132.83, 132.76, 131.9, 129.2, 128.6, 128.3, 128.2, 127.2, 126.4, 119.0, 53.4, 47.8, 36.9, 21.7, 12.9.

**HRMS** (ESI-TOF) calcd for $C_{20}H_{21}NNaO_3S_2^+$ ([M+Na]$^+$): 410.0855; found: 410.0857.

**IR** (film): 2921, 1689, 1596, 1493, 1452, 1358, 1260, 1187, 1172, 1117, 1089, 919, 813 $cm^{-1}$.

**4-((4-chlorophenyl)thio)-4-(2-methylallyl)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3y)**




White solid; Yield 37% (19 mg); M.p. 167-168 °C.

**$^1$H NMR** (400 MHz, Chloroform-d) δ 7.97 (d, *J* = 8.4 Hz, 2H), 7.42 – 7.40 (m, 1H), 7.37 – 7.30 (m, 4H), 7.22 – 7.20 (m, 1H), 7.04 (d, *J* = 8.4 Hz, 2H), 6.82 (d, *J* = 8.4 Hz, 2H),

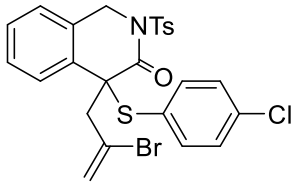
5.27 (d, *J* = 15.2 Hz, 1H), 4.69 (d, *J* = 15.2 Hz, 1H), 4.54 (d, *J* = 1.6 Hz, 1H), 4.11 (s, 1H), 3.11 (d, *J* = 16.0 Hz, 1H), 2.93 (d, *J* = 16.0 Hz, 1H), 2.49 (s, 3H), 1.34 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.1, 145.0, 139.9, 138.5, 136.6, 135.5, 132.5, 131.1, 129.24, 129.22, 128.8, 128.3, 128.2, 127.6, 127.5, 125.8, 114.5, 57.5, 47.5, 42.1, 23.5, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{24}ClNNaO_3S_2^+$ ([M+Na]$^+$): 520.0778; found:520.0782.

**IR** (film): 2922, 1694, 1596, 1572, 1474, 1453, 1360, 1261, 1187, 1171, 1144, 1124, 1092, 1014, 910, 814 cm$^{-1}$.

## 4-(2-bromoallyl)-4-((4-chlorophenyl)thio)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3z)




White solid; Yield 26% (15 mg); M.p. 183-184 $^o$C.

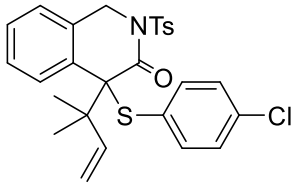
**$^1$H NMR** (400 MHz, Chloroform-d) δ 7.97 (d, *J* = 8.4 Hz, 2H), 7.41 – 7.34 (m, 5H), 7.25 – 7.24 (m, 1H), 7.08 (d, *J* = 8.4 Hz, 2H), 6.87 (d, *J* = 8.4 Hz, 2H), 5.30 (d, *J* = 15.6 Hz, 1H), 5.19 (dd, *J* = 3.2, 1.6 Hz, 1H), 4.85 – 4.81 (m, 2H), 3.55 (dt, *J* = 16.8, 2.0 Hz, 1H), 3.36 (d, *J* = 16.8 Hz, 1H), 2.48 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 166.2, 145.2, 138.6, 137.0, 135.2, 131.3, 131.2, 129.28, 129.25, 129.0, 128.6, 128.4, 127.3, 126.9, 126.6, 126.1, 120.2, 57.7, 47.5, 45.3, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{21}BrClNNaO_3S_2^+$ ([M+Na]$^+$): 583.9727; found: 583.9730.

**IR** (film): 2923, 1694, 1596, 1572, 1474, 1454, 1389, 1361, 1262, 1187, 1172, 1123, 1091, 1014, 909, 817 cm$^{-1}$.

**4-((4-chlorophenyl)thio)-4-(2-methylbut-3-en-2-yl)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (3A)**




White solid; Yield 41% (21 mg); M.p. 160-161 $^{o}$C.

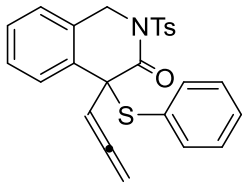
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.95 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.88 (d, *J* = 8.4 Hz, 2H), 7.32 – 7.28 (m, 3H), 7.26 – 7.23 (m, 1H), 7.11 (dd, *J* = 7.2, 1.2 Hz, 1H), 6.74 – 6.69 (m, 4H), 5.76 (dd, *J* = 17.2, 10.4 Hz, 1H), 5.06 (d, *J* = 16.4 Hz, 1H), 5.00 (dd, *J* = 10.4, 0.8 Hz, 1H), 4.85 – 4.78 (m, 2H), 2.48 (s, 3H), 1.21 (s, 3H), 1.16 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 167.5, 145.0, 141.8, 135.6, 135.0, 133.8, 132.6, 132.2, 130.8, 130.3, 129.12, 129.06, 128.3, 127.7, 126.6, 125.4, 115.1, 71.5, 48.9, 47.6, 24.4, 23.6, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{27}H_{26}ClNNaO_3S_2^+$ ([M+Na]$^+$): 534.0935; found: 534.0938.

**IR** (film): 2926, 1693, 1475, 1385, 1359, 1259, 1281, 1188, 1171, 1120, 1091, 1013, 916, 825 cm$^{-1}$.

**4-(phenylthio)-4-(propa-1,2-dien-1-yl)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (5a)**




Yellow solid; Yield 38% (17 mg); M.p. 140-141 $^{o}$C

**$^{1}$H NMR** (600 MHz, Chloroform-d) δ 7.95 (d, *J* = 8.4 Hz, 2H), 7.58 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.35 – 7.30 (m, 4H), 7.26 – 7.25 (m, 1H), 7.17 (d, *J* = 7.2 Hz, 1H), 7.06 – 7.04 (m,

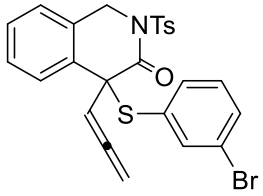
2H), 6.99 – 6.97 (m, 2H), 5.59 (t, *J* = 6.6 Hz, 1H), 5.16 (d, *J* = 15.6 Hz, 1H), 5.07 (dd, *J* = 6.6, 2.4 Hz, 2H), 4.56 (d, *J* = 15.6 Hz, 1H), 2.45 (s, 3H).

**$^{13}$C NMR** (150 MHz, Chloroform-d) δ 209.9, 167.4, 145.0, 136.3, 135.4, 133.8, 131.7, 130.2, 129.4, 129.3, 129.2, 128.5, 128.45, 128.42, 128.2, 125.8, 91.9, 80.4, 58.9, 47.9, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{21}NNaO_3S_2^+$ ([M+Na]$^+$): 470.0855; found: 470.0855.

**IR** (film): 2988, 2922, 1957, 1697, 1596, 1452, 1384, 1359, 1259, 1187, 1171, 1121, 1088, 938, 855 cm$^{-1}$.

## 4-((3-bromophenyl)thio)-4-(propa-1,2-dien-1-yl)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (5b)




Yellow solid; Yield 32% (17 mg); M.p. 146-147 ºC

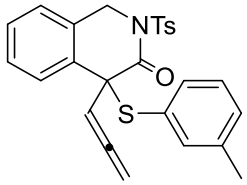
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.56 – 7.54 (m, 1H), 7.39 – 7.34 (m, 3H), 7.29 – 7.27 (m, 3H), 7.25 – 7.24 (m, 1H), 6.97 – 6.90 (m, 2H), 5.59 (t, *J* = 6.8 Hz, 1H), 5.22 (d, *J* = 15.6 Hz, 1H), 5.13 – 5.04 (m, 2H), 4.76 (d, *J* = 16.0 Hz, 1H), 2.43 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 210.0, 166.9, 145.1, 137.8, 135.2, 133.8, 133.3, 132.7, 132.1, 131.7, 129.8, 129.4, 129.0, 128.8, 128.4, 128.3, 126.0, 121.9, 91.5, 80.5, 59.2, 47.9, 21.7.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{20}BrNNaO_3S_2^+$ ([M+Na]$^+$): 547.9960; found: 547.9963.

**IR** (film): 2988, 1957, 1697, 1596, 1557, 1457, 1384, 1360, 1259, 1187, 1172, 1121, 1087, 909, 814 cm$^{-1}$.

**4-(propa-1,2-dien-1-yl)-4-(m-tolylthio)-2-tosyl-1,4-dihydroisoquinolin-3(2H)-one (5c)**




Yellow solid; Yield 34% (16 mg); M.p. 80-81 °C

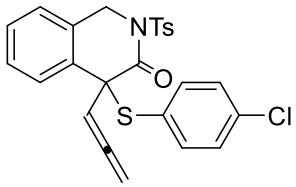
**$^{1}$H NMR** (600 MHz, Chloroform-d) δ 7.93 (d, *J* = 8.4 Hz, 2H), 7.57 (dd, *J* = 7.8, 1.2 Hz, 1H), 7.36 – 7.28 (m, 4H), 7.15 (d, *J* = 7.8 Hz, 1H), 7.09 (d, *J* = 7.2 Hz, 1H), 6.96 – 6.92 (m, 2H), 6.78 – 6.76 (m, 1H), 5.58 (t, *J* = 6.6 Hz, 1H), 5.11 – 5.07 (m, 3H), 4.46 (d, *J* = 15.6 Hz, 1H), 2.43 (s, 3H), 2.20 (s, 3H).

**$^{13}$C NMR** (150 MHz, Chloroform-d) δ 209.8, 167.5, 144.9, 138.3, 137.2, 135.5, 133.8, 133.3, 131.7, 130.3, 129.7, 129.3, 129.1, 128.5, 128.33, 128.26, 128.1, 125.6, 91.9, 80.3, 58.7, 47.9, 21.7, 21.0.

**HRMS** (ESI-TOF) calcd for $C_{26}H_{23}NNaO_3S_2^+$ ($[M+Na]^+$):484.1012; found: 484.1015.

**IR** (film): 2922, 1957, 1698, 1594, 1453, 1359, 1281, 1259, 1187, 1172, 1122, 1088, 1019, 939, 852 $cm^{-1}$.

**4-((4-chlorophenyl)thio)-4-(propa-1,2-dien-1-yl)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (5d)**




Yellow solid; Yield 36% (17 mg); M.p. 131-132 °C

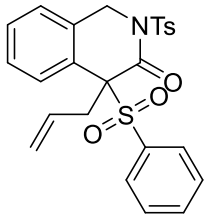
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.93 (d, *J* = 8.4 Hz, 2H), 7.58 – 7.56 (m, 1H), 7.37 – 7.35 (m, 2H), 7.31 (d, *J* = 8.4 Hz, 2H), 7.25 – 7.24 (m, 1H), 7.01 (d, *J* = 8.8 Hz, 2H), 6.95 (d, *J* = 8.4 Hz, 2H), 5.59 (t, *J* = 6.8 Hz, 1H), 5.26 (d, *J* = 15.6 Hz, 1H), 5.13 – 5.03 (m, 2H), 4.81 (d, *J* = 15.6 Hz, 1H), 2.47 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 210.0, 166.9, 145.3, 136.9, 135.7, 135.2, 133.5, 131.7, 129.3, 129.2, 128.8, 128.72, 128.69, 128.4, 128.3, 126.0, 91.6, 80.5, 59.2, 47.8, 21.8.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{20}ClNNaO_3S_2^+$ ([M+Na]$^+$):504.0465; found: 504.0468.

**IR** (film): 2924, 1958, 1696, 1596, 1572, 1475, 1360, 1261, 1187, 1171, 1121, 1091, 1013, 938, 816 cm$^{-1}$.

## 4-allyl-4-(phenylsulfonyl)-2-tosyl-1,4-dihydroisoquinolin-3(*2H*)-one (6a)




White solid; Yield 52% (25 mg); M.p. 236-237 ºC.

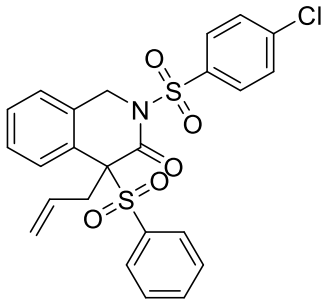
**$^{1}$H NMR** (600 MHz, Chloroform-d) δ 8.00 (d, *J* = 8.4 Hz, 2H), 7.61 (t, *J* = 7.8 Hz, 1H), 7.48 – 7.45 (m, 2H), 7.43 – 7.41 (m, 3H), 7.32 – 7.29 (m, 3H), 7.16 (d, *J* = 7.8 Hz, 2H), 5.29 (d, *J* = 15.0 Hz, 1H), 5.18 – 5.11 (m, 1H), 4.97 (dd, *J* = 16.8, 1.2 Hz, 1H), 4.91 (d, *J* = 15.0 Hz, 1H), 4.87 (dd, *J* = 10.2, 1.2 Hz, 1H), 3.10 (d, *J* = 6.6 Hz, 2H), 2.52 (s, 3H).

**$^{13}$C NMR** (150 MHz, Chloroform-d) δ 163.2, 145.3, 135.2, 134.7, 134.4, 133.8, 130.8, 130.5, 129.8, 129.7, 129.5, 129.3, 128.5, 127.8, 126.4, 124.4, 120.8, 76.6, 48.9, 35.0, 21.8.

**HRMS** (ESI-TOF) calcd for $C_{25}H_{23}NNaO_5S_2^+$ ([M+Na]$^+$): 504.0910; found: 504.0910.

**IR** (film): 2923, 2856, 1688, 1397, 1362, 1306, 1189, 1174, 1146, 1080, 931 cm$^{-1}$.

## 4-allyl-2-((4-chlorophenyl)sulfonyl)-4-(phenylsulfonyl)-1,4-dihydroisoquinolin-3(*2H*)-one (6b)




White solid; Yield 58% (29 mg); M.p. 209-210 ºC.

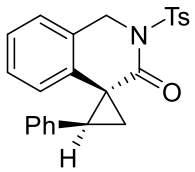
**$^{1}$H NMR** (600 MHz, Chloroform-d) δ 8.06 (d, *J* = 8.4 Hz, 2H), 7.65 – 7.63 (m, 1H), 7.59 (d, *J* = 7.8 Hz, 2H), 7.49 – 7.41 (m, 3H), 7.38 – 7.32 (m, 3H), 7.19 (d, *J* = 7.8 Hz, 2H), 5.28 (d, *J* = 15.0 Hz, 1H), 5.18 – 5.11 (m, 1H), 4.98 – 4.94 (m, 2H), 4.89 (d, *J* = 10.2 Hz, 1H), 3.13 – 3.07 (m, 2H).

**$^{13}$C NMR** (150 MHz, Chloroform-d) δ 163.5, 140.9, 136.4, 134.62, 134.61, 133.5, 131.0, 130.8, 130.4, 129.8, 129.6, 129.0, 128.7, 128.0, 126.4, 124.3, 121.0, 76.7, 49.0, 35.0.

**HRMS** (ESI-TOF) calcd for $C_{24}H_{20}ClNNaO_5S_2^+$ ([M+Na]$^+$): 524.0364; found: 524.0367.

**IR** (film): 3094, 2927, 1688, 1583, 1476, 1447, 1397, 1371, 1308, 1183, 1145, 1115, 1082, 1047, 1014, 932, 826 cm$^{-1}$.

## (1R,2S)-2-phenyl-2'-tosyl-1',2'-dihydro-3'H-spiro[cyclopropane-1,4'-isoquinolin]-3'-one (7)




White solid; Yield 45% (18 mg); M.p. 157-158 ºC.

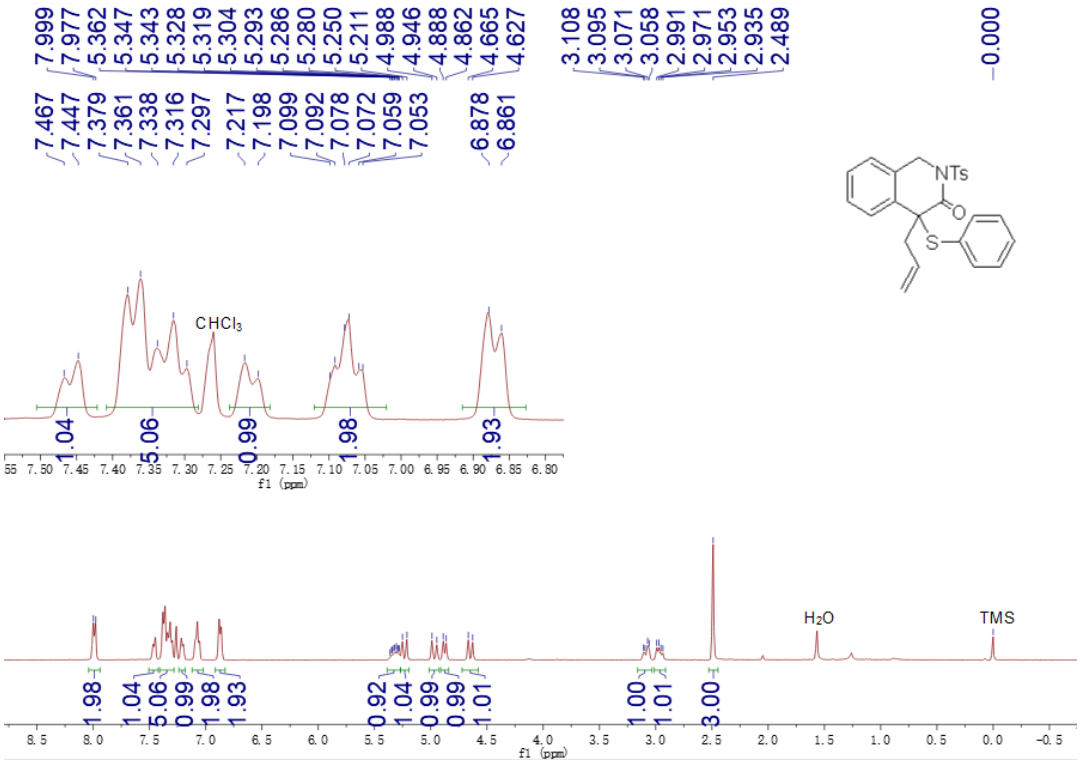
**$^{1}$H NMR** (400 MHz, Chloroform-d) δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.31 (d, *J* = 8.0 Hz, 2H), 7.17 (d, *J* = 7.6 Hz, 1H), 7.10 – 7.00 (m, 5H), 6.93 – 6.90 (m, 2H), 6.66 (d, *J* = 8.0 Hz, 1H), 5.41 (d, *J* = 14.8 Hz, 1H), 4.71 (d, *J* = 14.4 Hz, 1H), 2.85 (dd, *J* = 9.2, 7.2 Hz, 1H), 2.41 (s, 3H), 2.39 – 2.37 (m, 1H), 2.08 (dd, *J* = 7.2, 5.6 Hz, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-d) δ 171.0, 144.8, 135.7, 134.3, 132.9, 130.9, 129.4, 129.0, 128.4, 128.0, 127.4, 127.0, 126.7, 125.6, 125.1, 47.8, 37.7, 36.2, 21.6, 14.0.

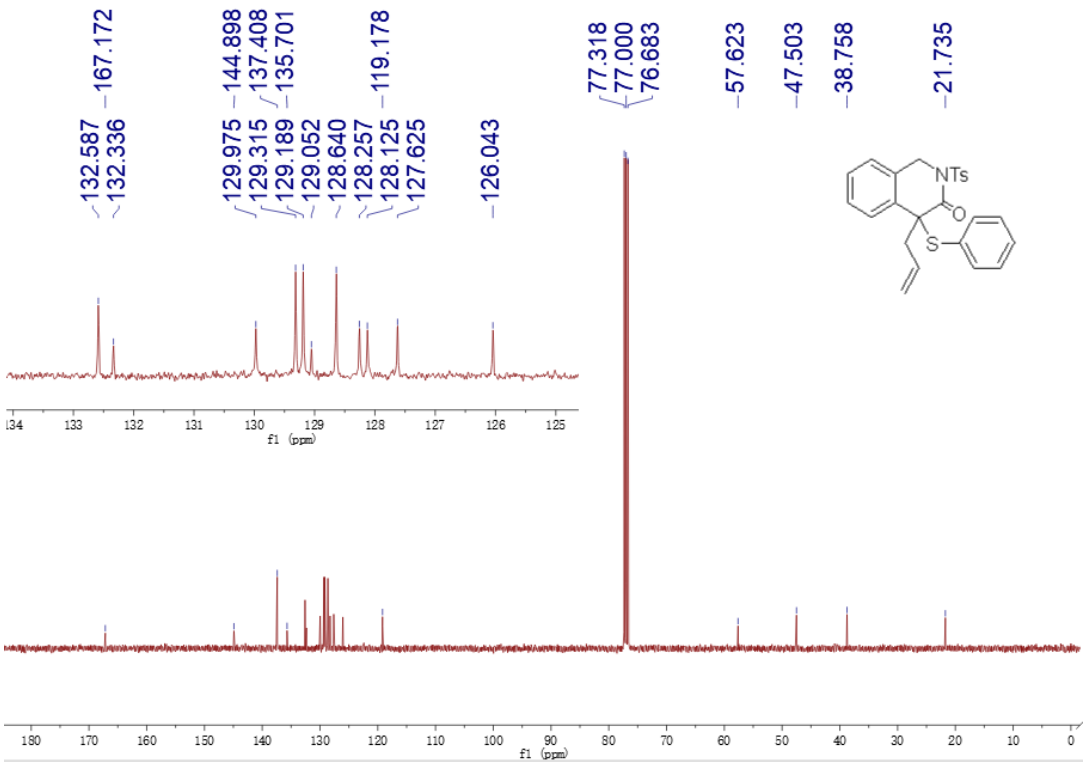
**HRMS** (ESI-TOF) calcd for $C_{24}H_{21}NNaO_3S^+$ ($[M+Na]^+$): 426.1134; found: 426.1136.

**IR** (film): 2955, 2924, 2851, 1689, 1459, 1379, 1260, 1172, 1117, 1087, 817 $cm^{-1}$.

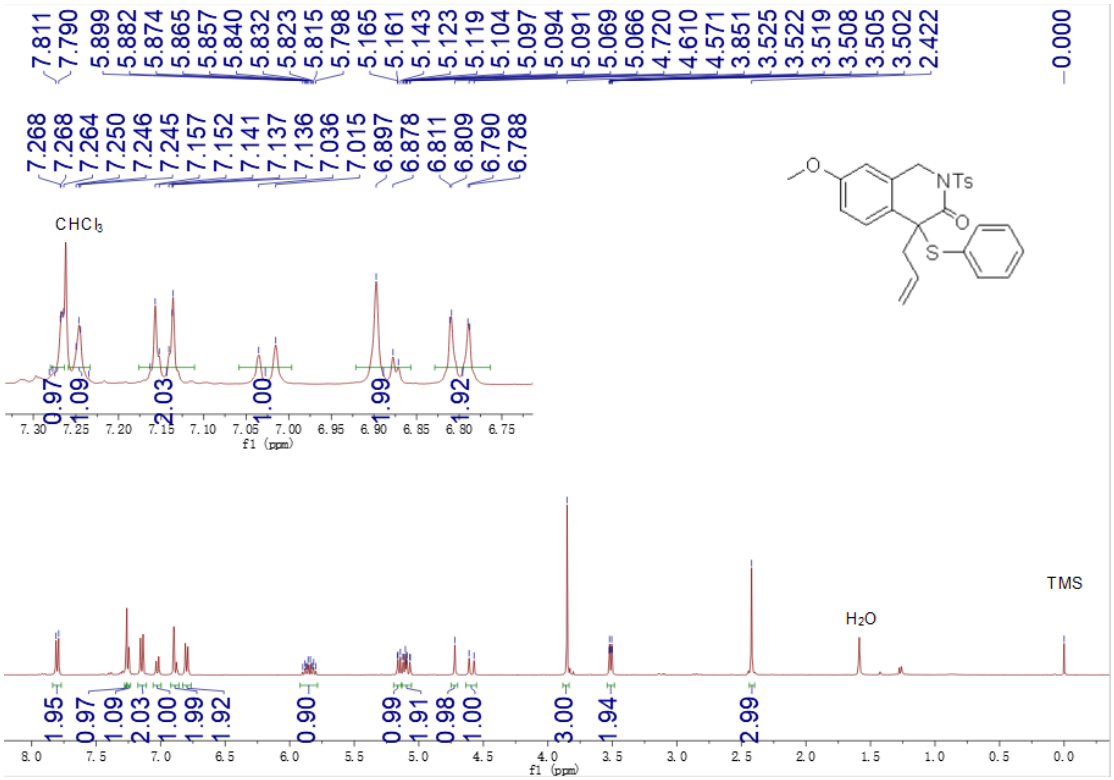
## Copies of NMR Spectra



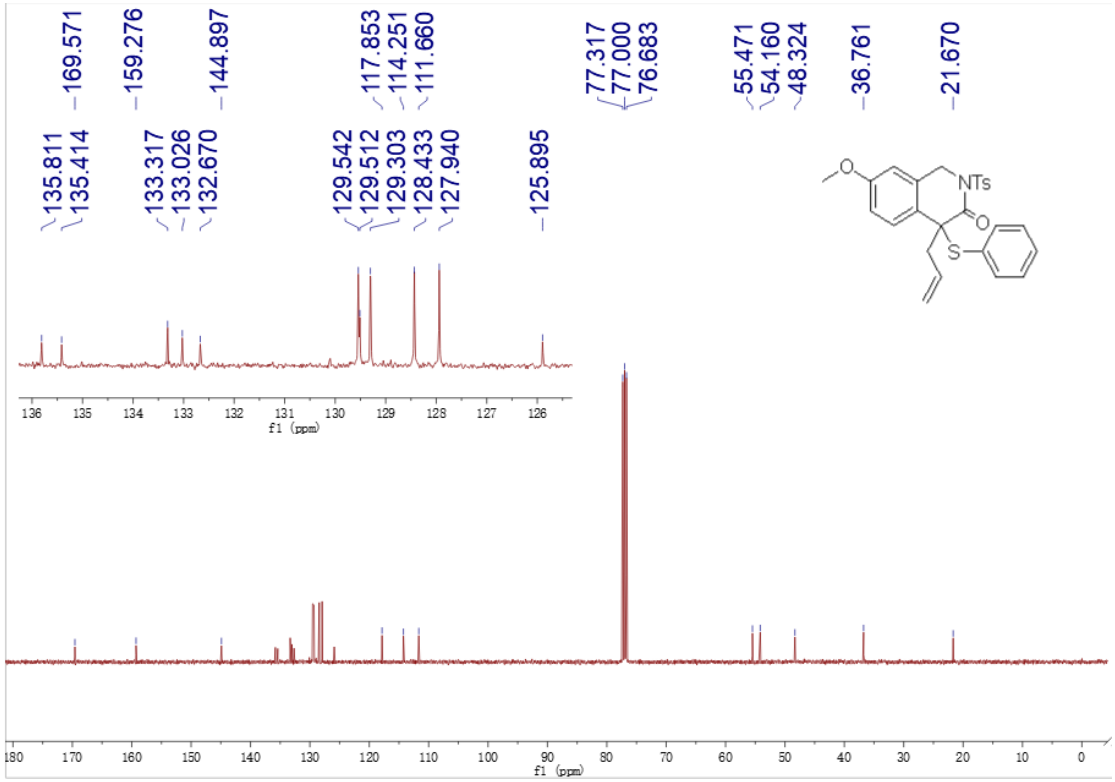

$^{1}$H NMR of **3a** ($CDCl_3$, 400 MHz)



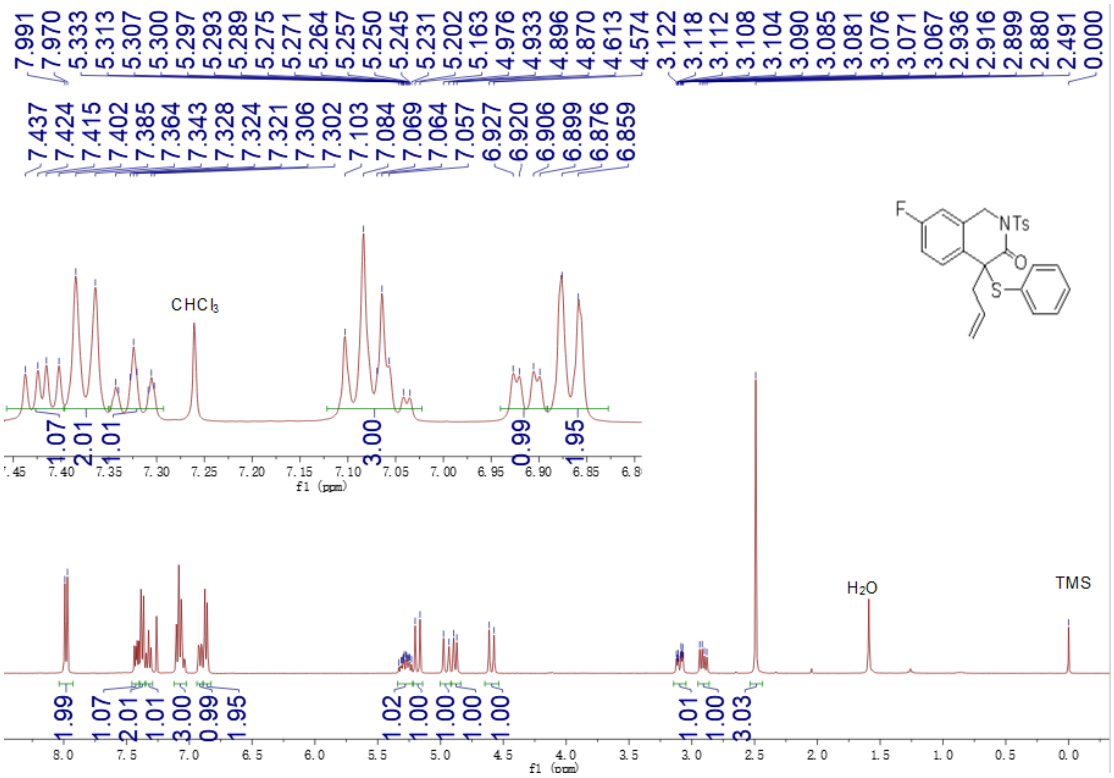

$^{13}$C{$^{1}$H} NMR of **3a** ($CDCl_3$, 100 MHz)



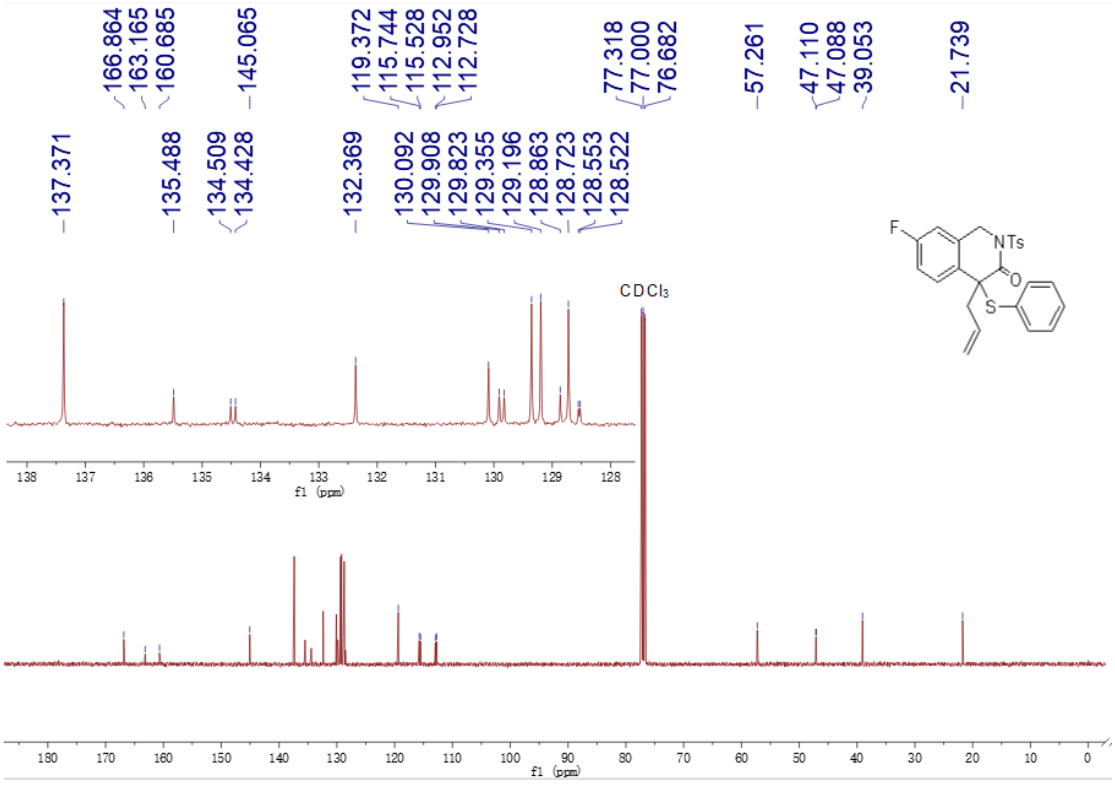

$^{1}$H NMR of **3b** ($CDCl_3$, 400 MHz)



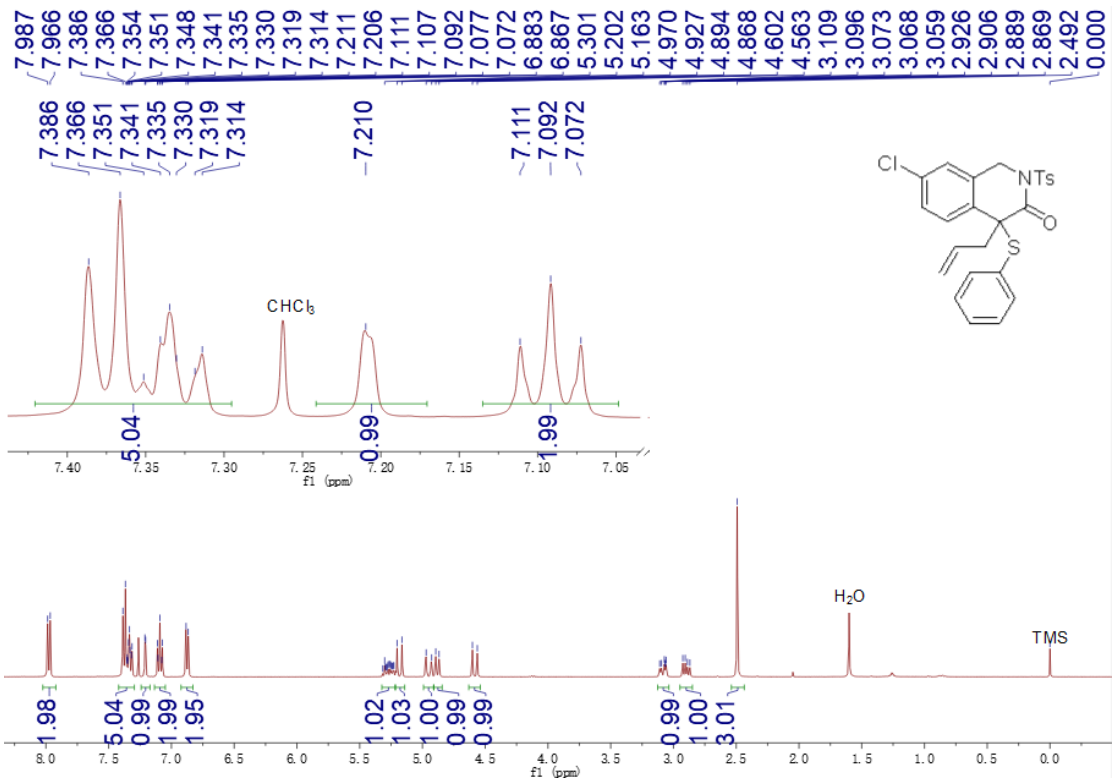

$^{13}C\{^{1}H\}$ NMR of **3b** ($CDCl_3$, 100 MHz)



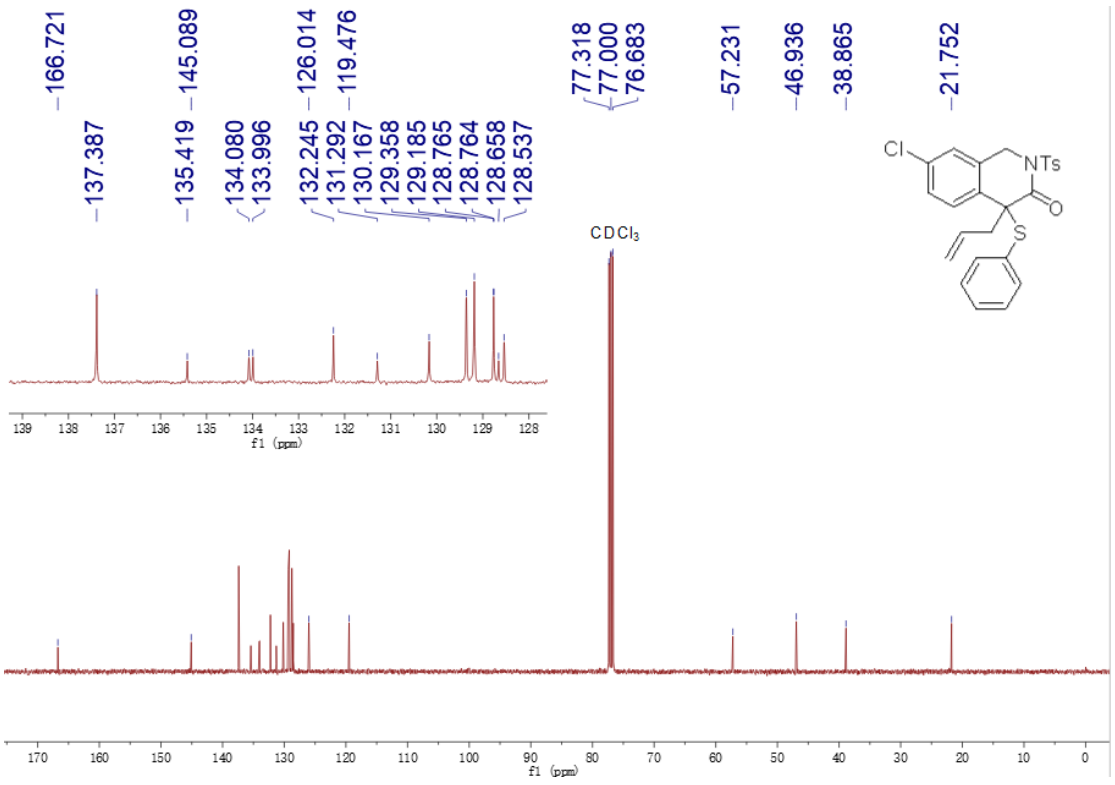

$^{1}$H NMR of **3c** ($CDCl_3$, 400 MHz)



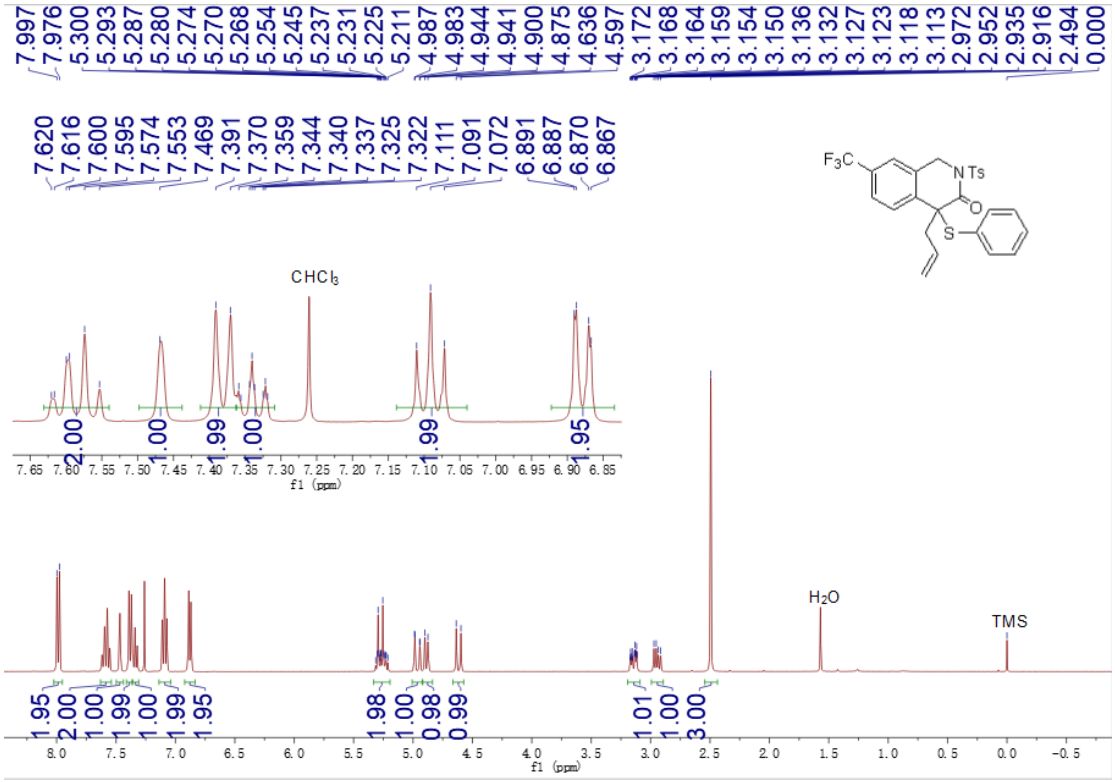

$^{13}C\{^{1}H\}$ NMR of **3c** ($CDCl_3$, 100 MHz)



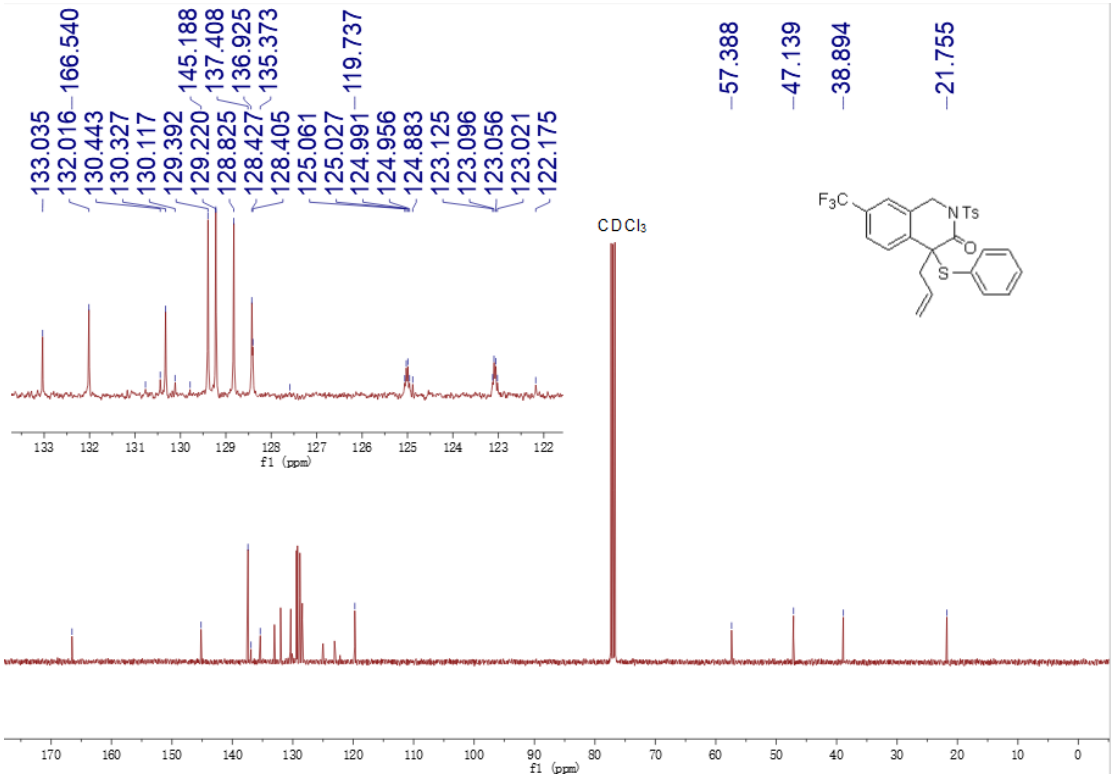

$^{1}$H NMR of **3d** ($CDCl_3$, 400 MHz)



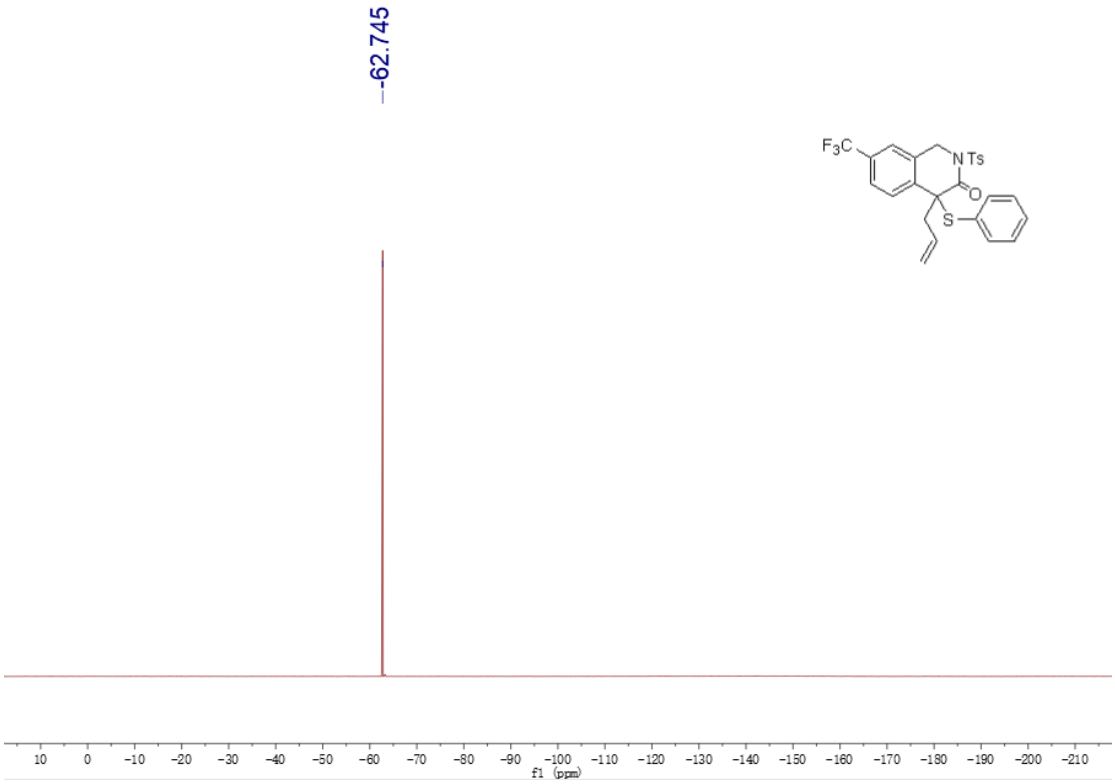

$^{13}$C{$^{1}$H} NMR of **3d** ($CDCl_3$, 100 MHz)



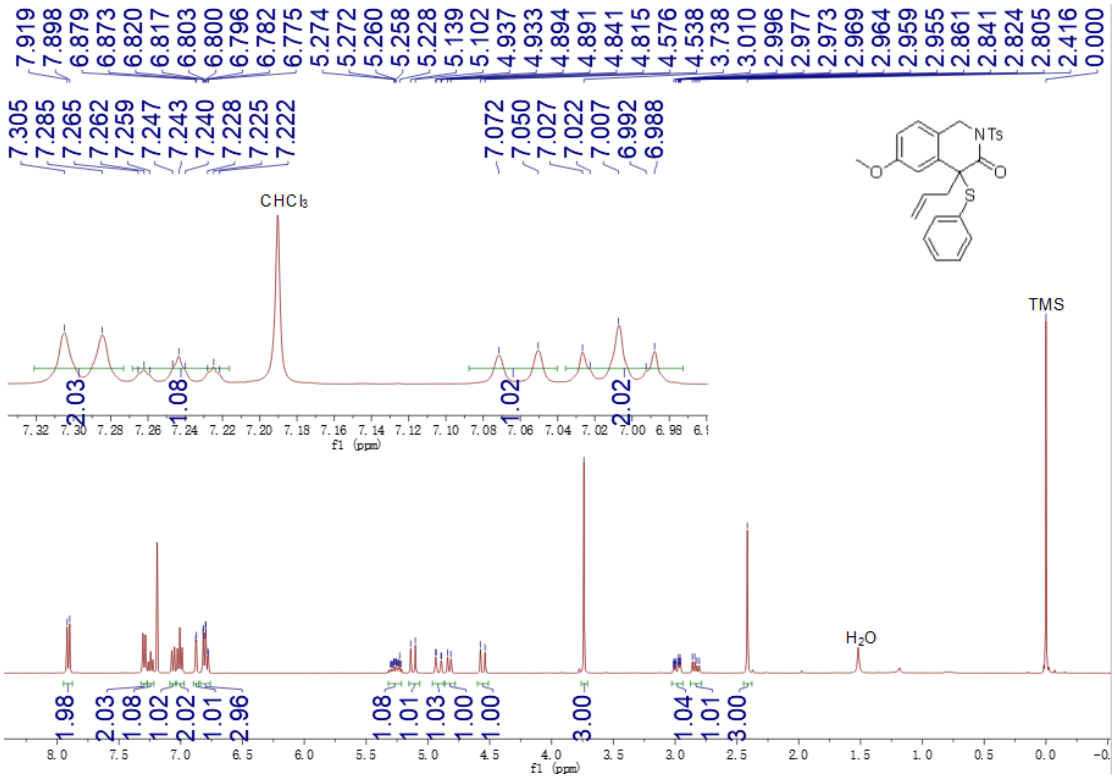

$^{1}$H NMR of **3e** ($CDCl_3$, 400 MHz)



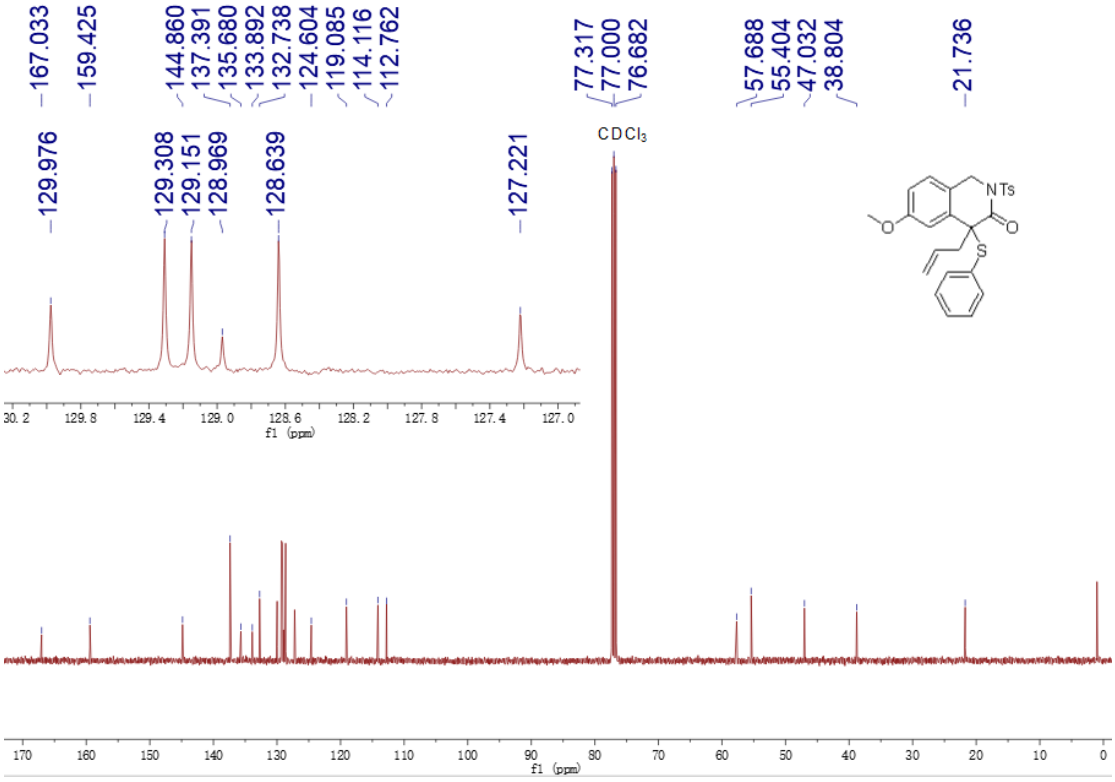

$^{13}$C{$^{1}$H} NMR of **3e** ($CDCl_3$, 100 MHz)



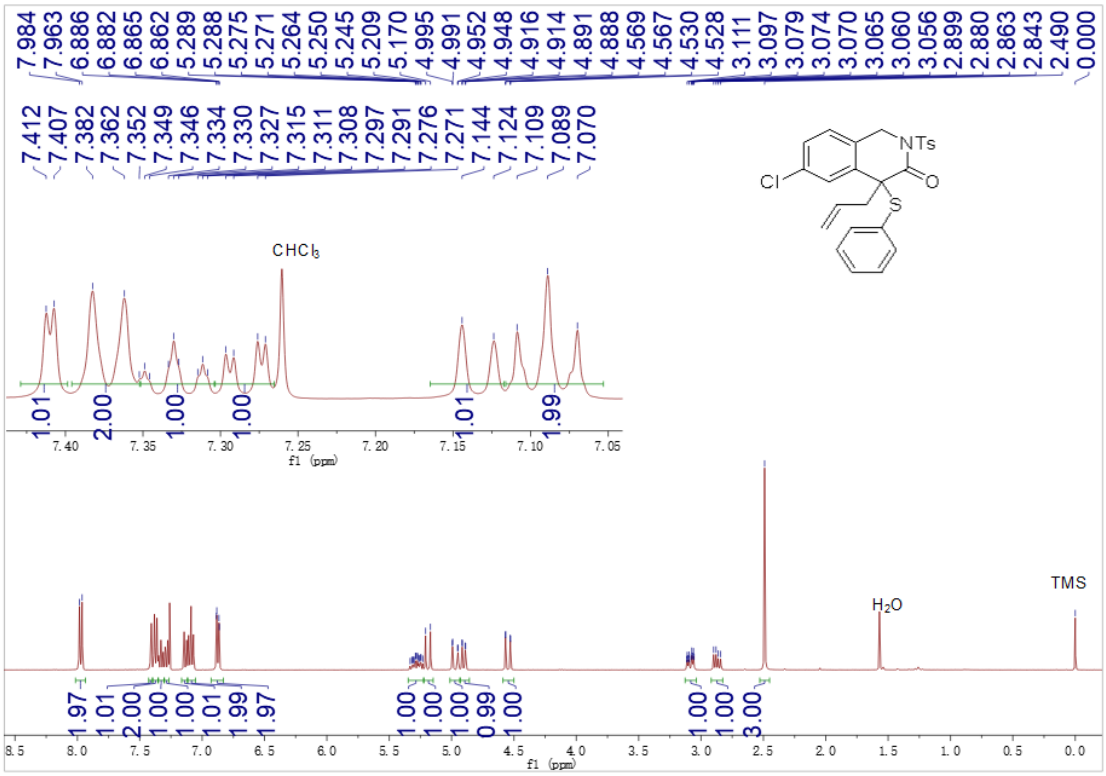

$^{19}$F NMR of **3e** ($CDCl_3$, 376 MHz)



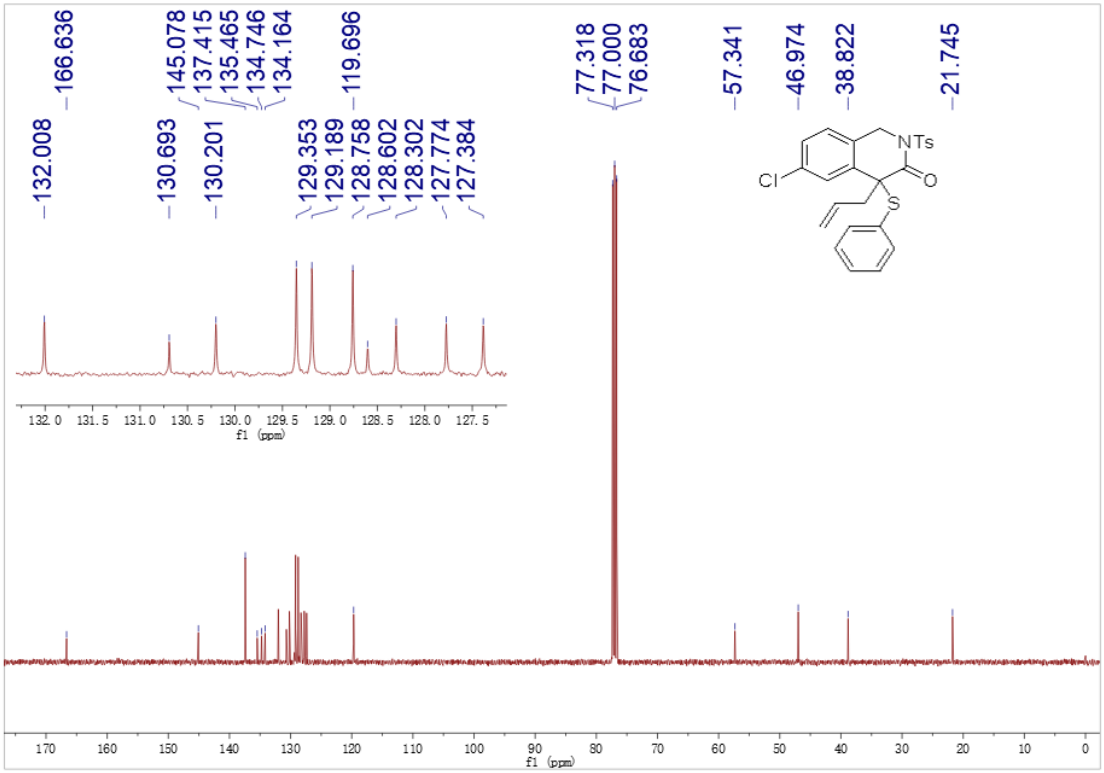

$^{1}$H NMR of **3f** ($CDCl_3$, 400 MHz)



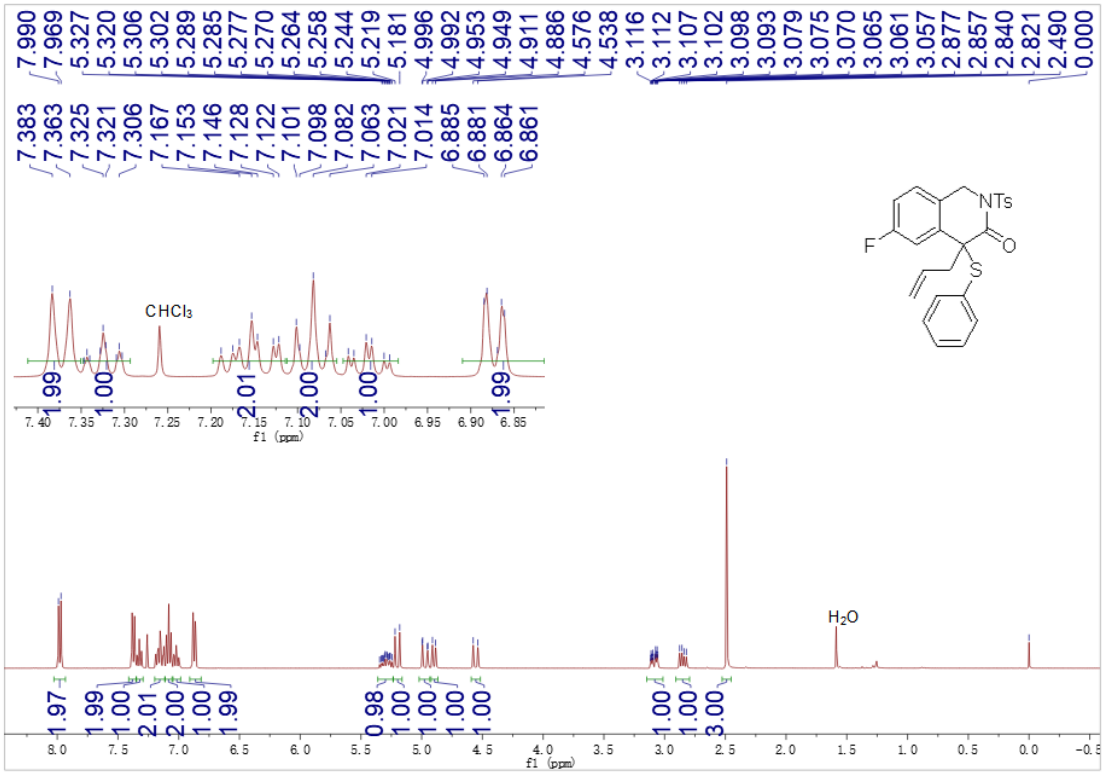

$^{13}C\{^{1}H\}$ NMR of **3f** ($CDCl_3$, 100 MHz)



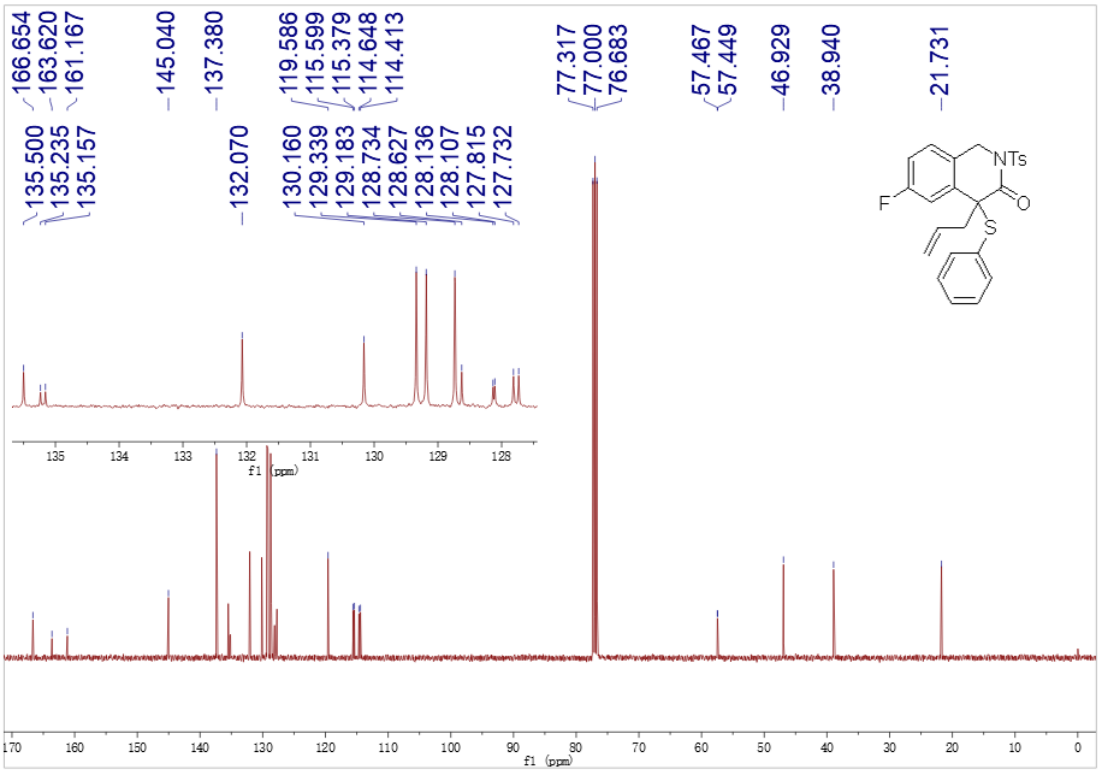

$^{1}$H NMR of **3g** ($CDCl_3$, 400 MHz)



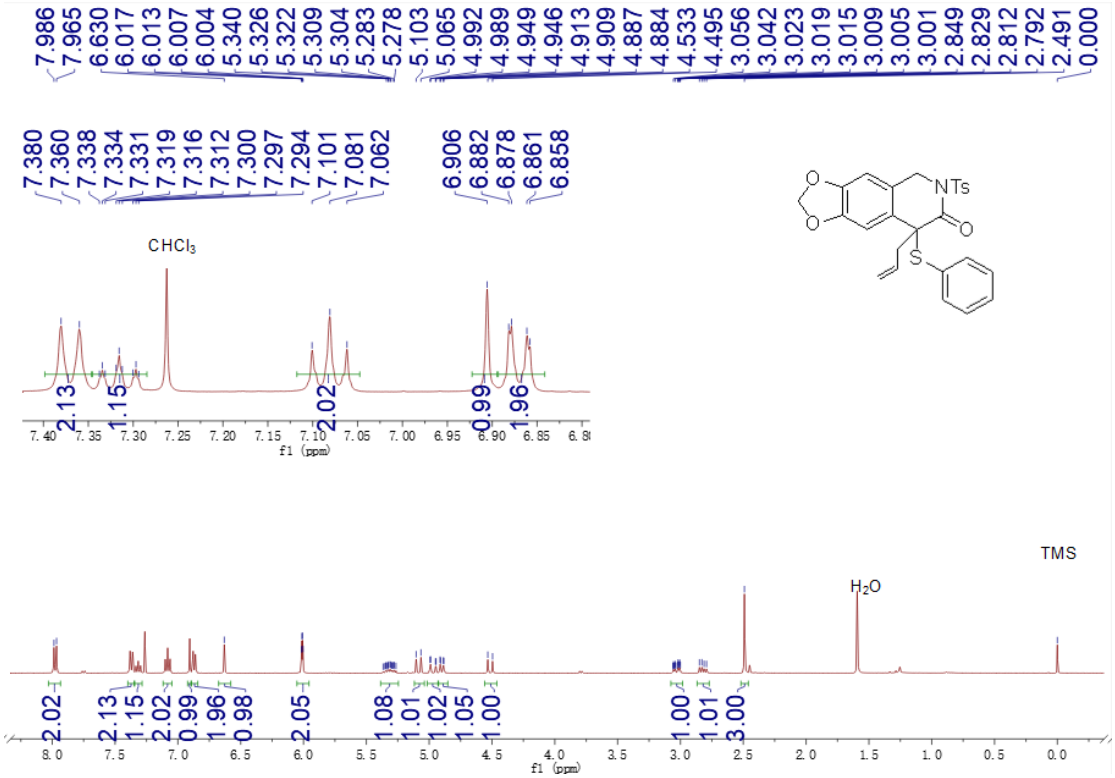

$^{13}$C{$^{1}$H} NMR of **3g** ($CDCl_3$, 100 MHz)



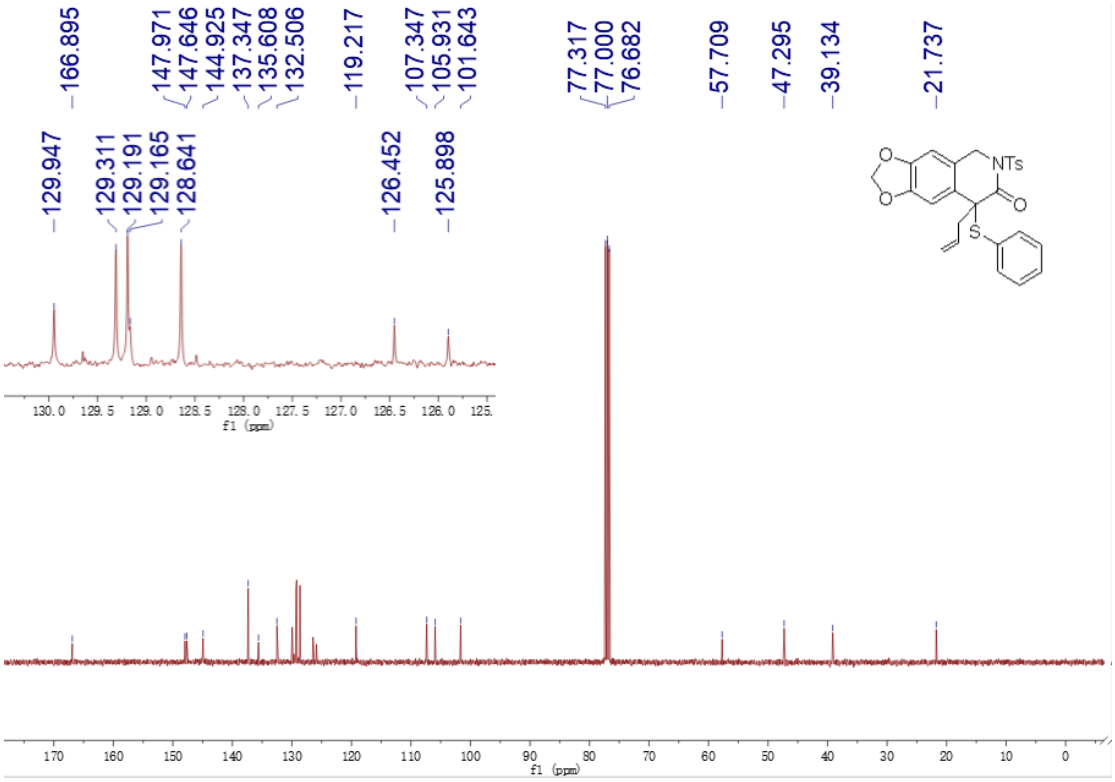

$^{1}$H NMR of **3h** ($CDCl_3$, 400 MHz)



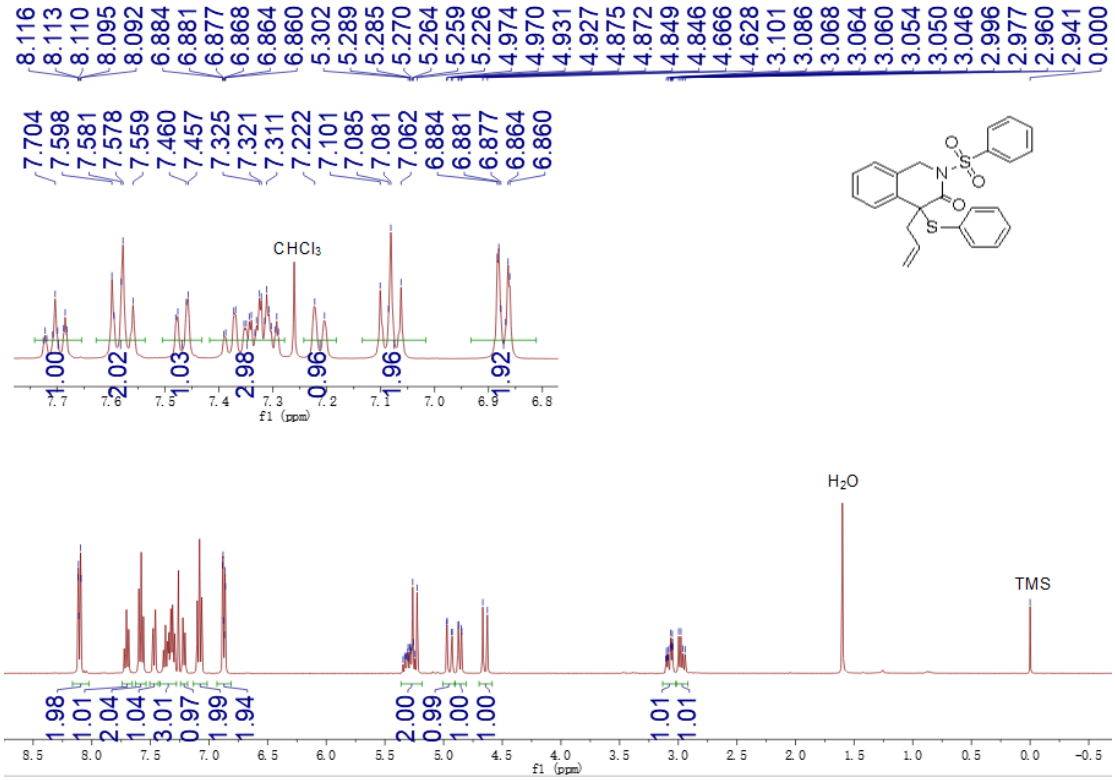

$^{13}$C{$^{1}$H} NMR of **3h** ($CDCl_3$, 100 MHz)



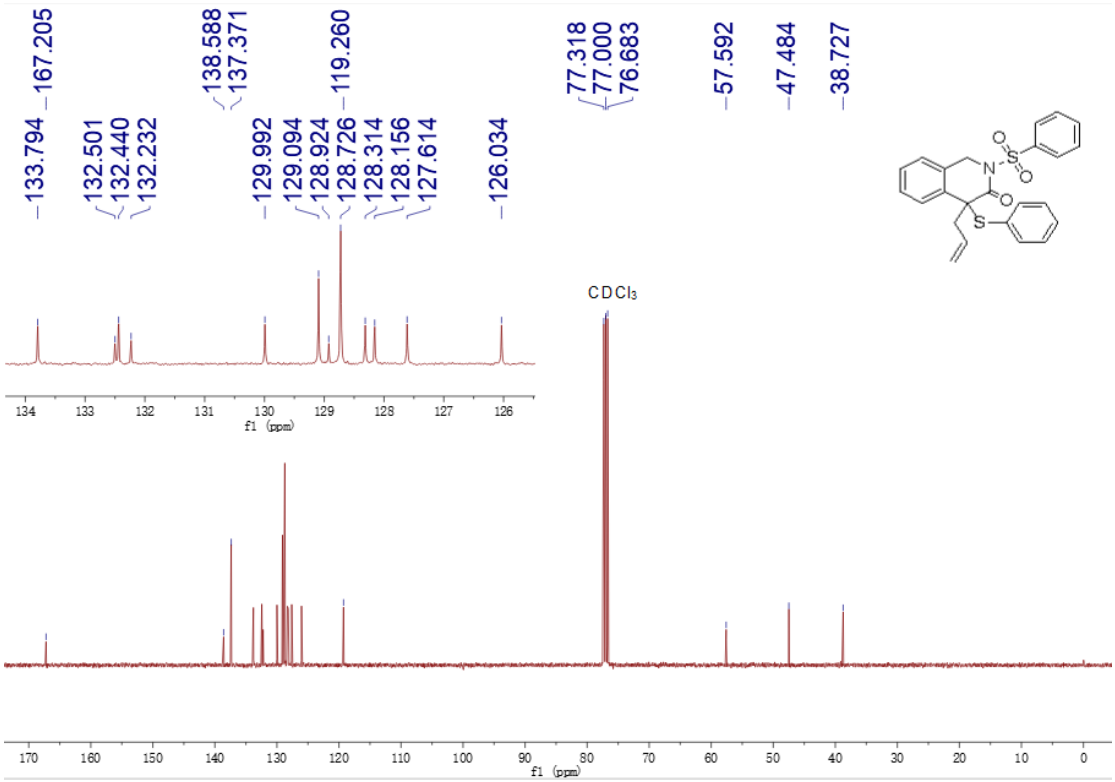

$^{1}$H NMR of **3i** ($CDCl_3$, 400 MHz)



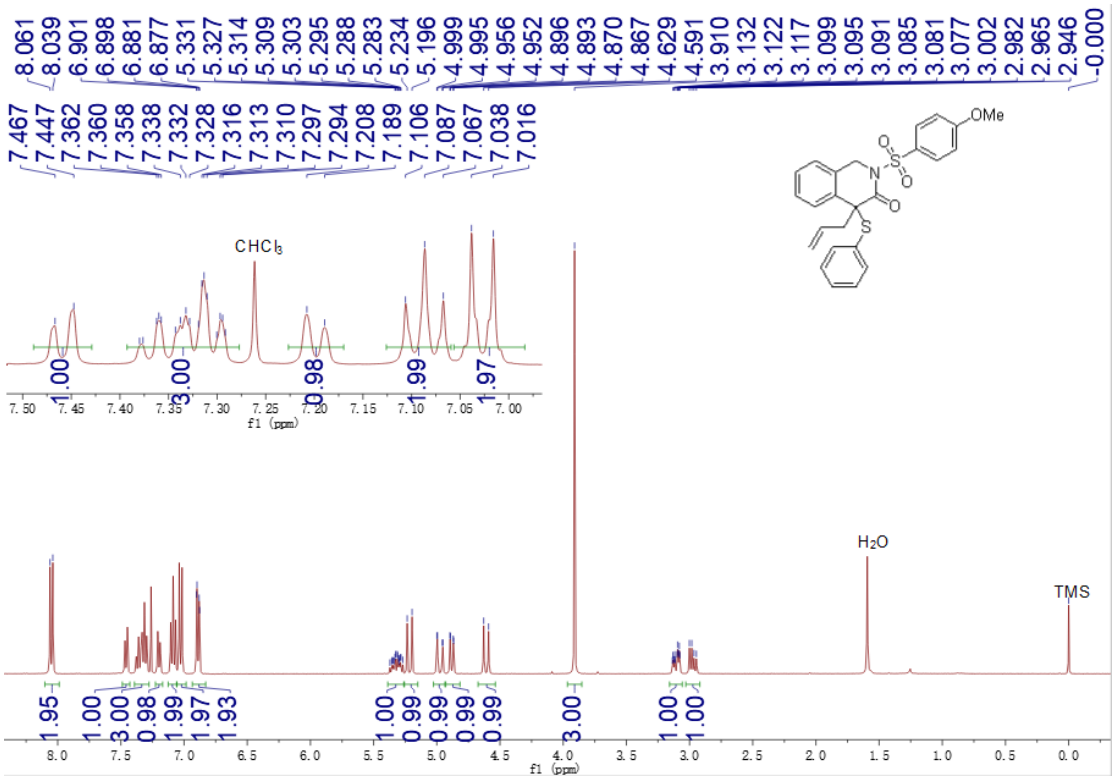

$^{13}$C{$^{1}$H} NMR of **3i** ($CDCl_3$, 100 MHz)



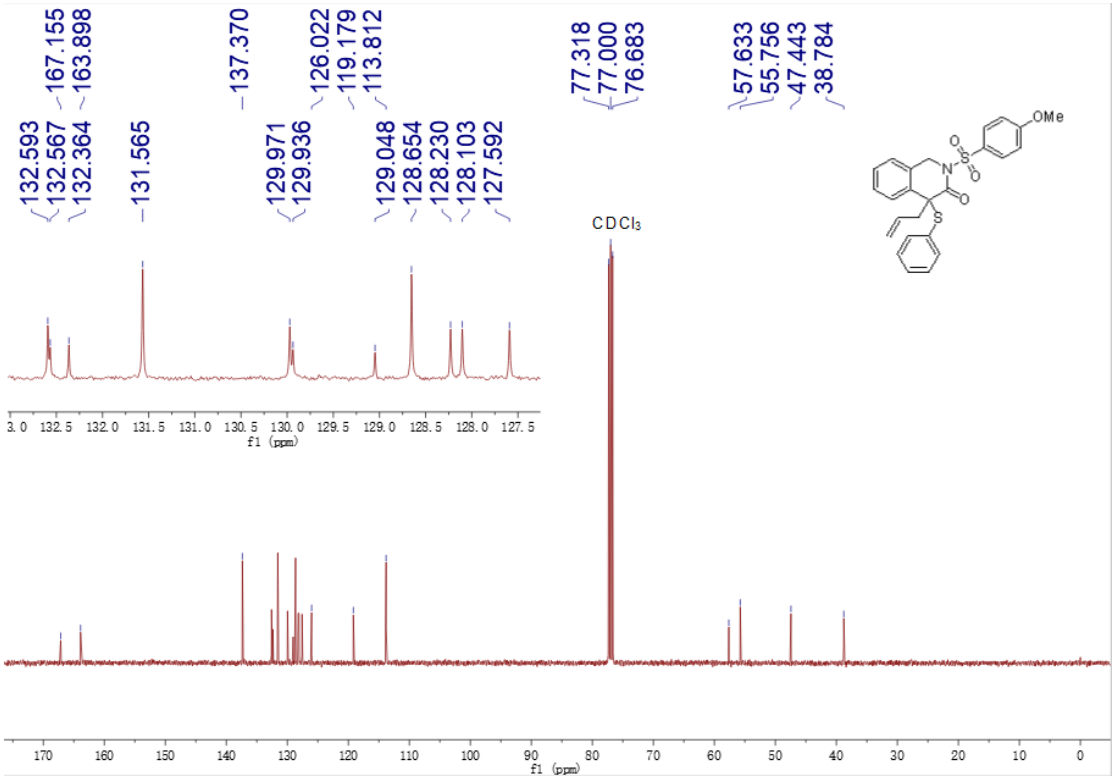

$^{1}$H NMR of **3j** ($CDCl_3$, 400 MHz)



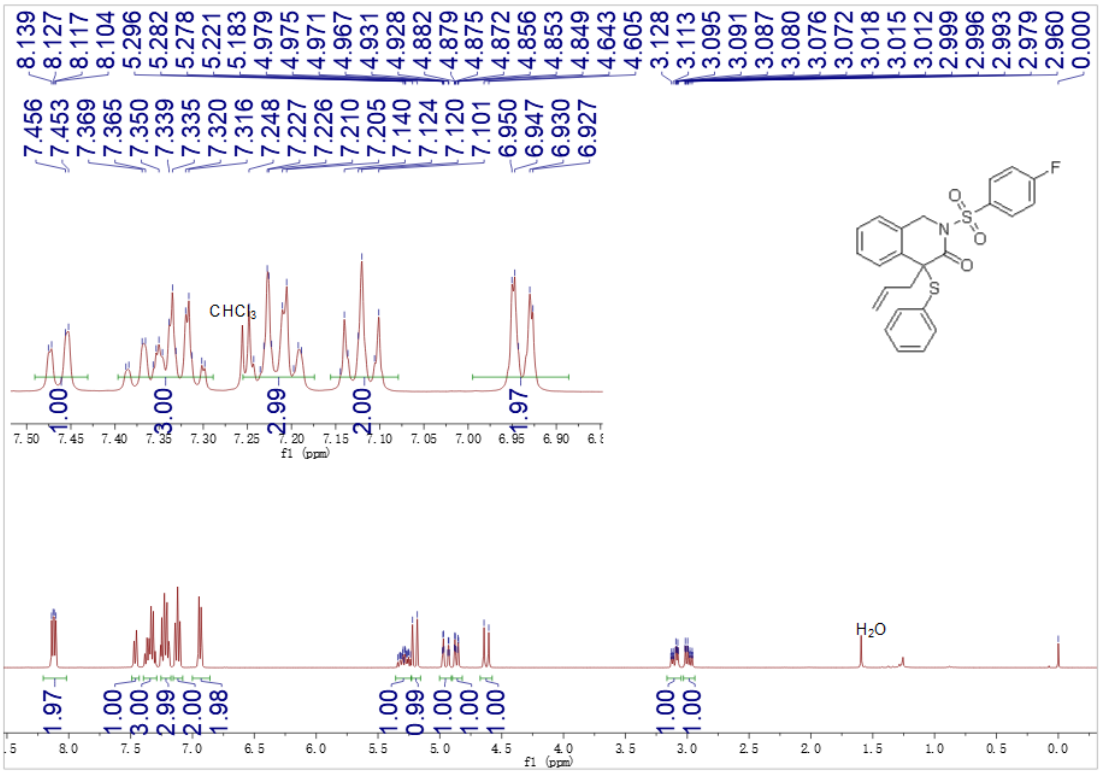

$^{13}$C{$^{1}$H} NMR of **3j** ($CDCl_3$, 100 MHz)



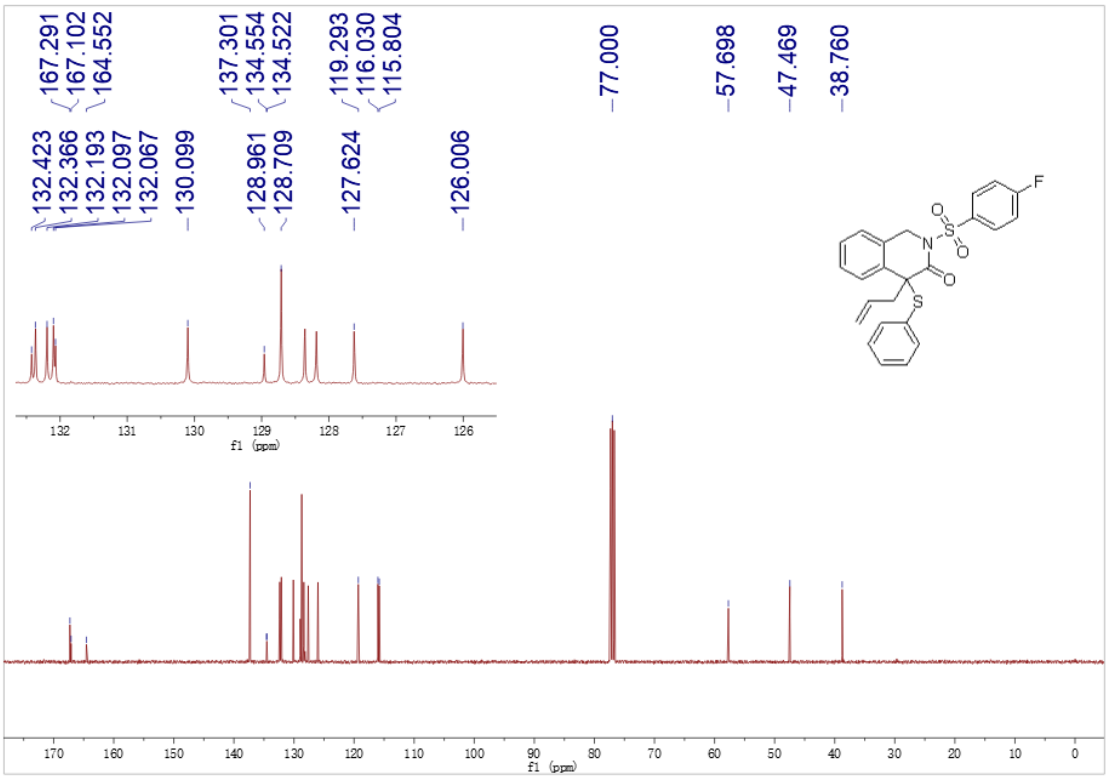

$^{1}$H NMR of **3k** ($CDCl_3$, 400 MHz)



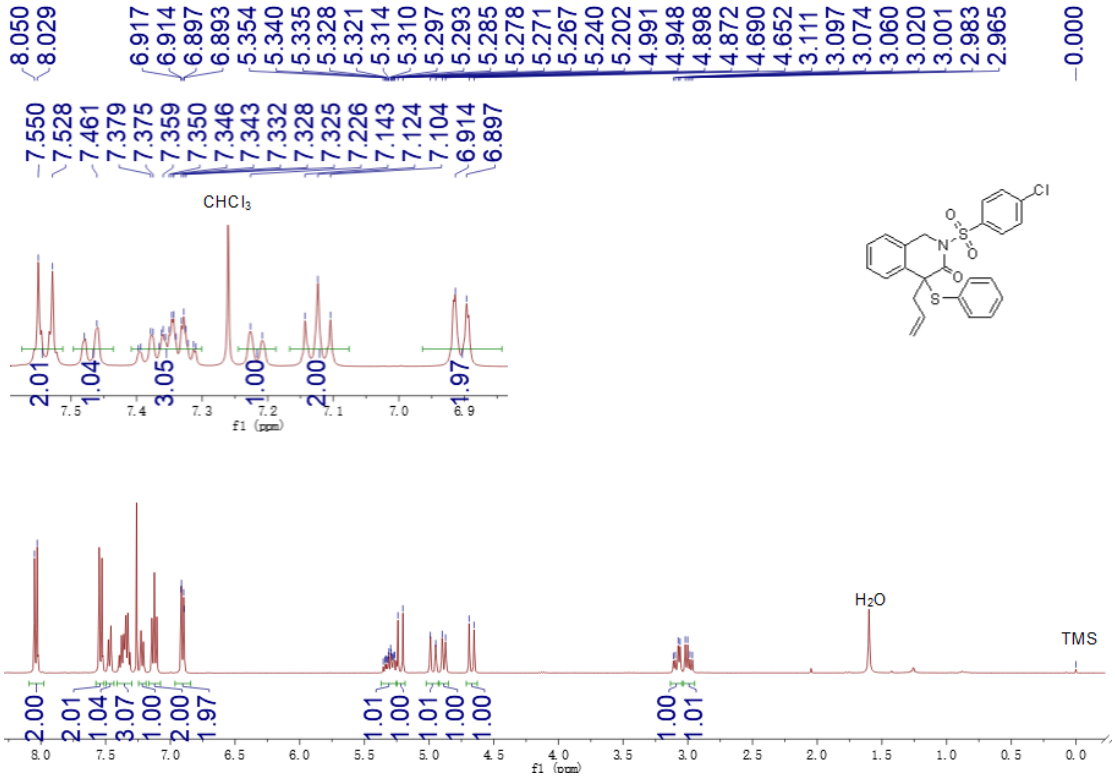

$^{13}$C{$^{1}$H} NMR of **3k** ($CDCl_3$, 100 MHz)



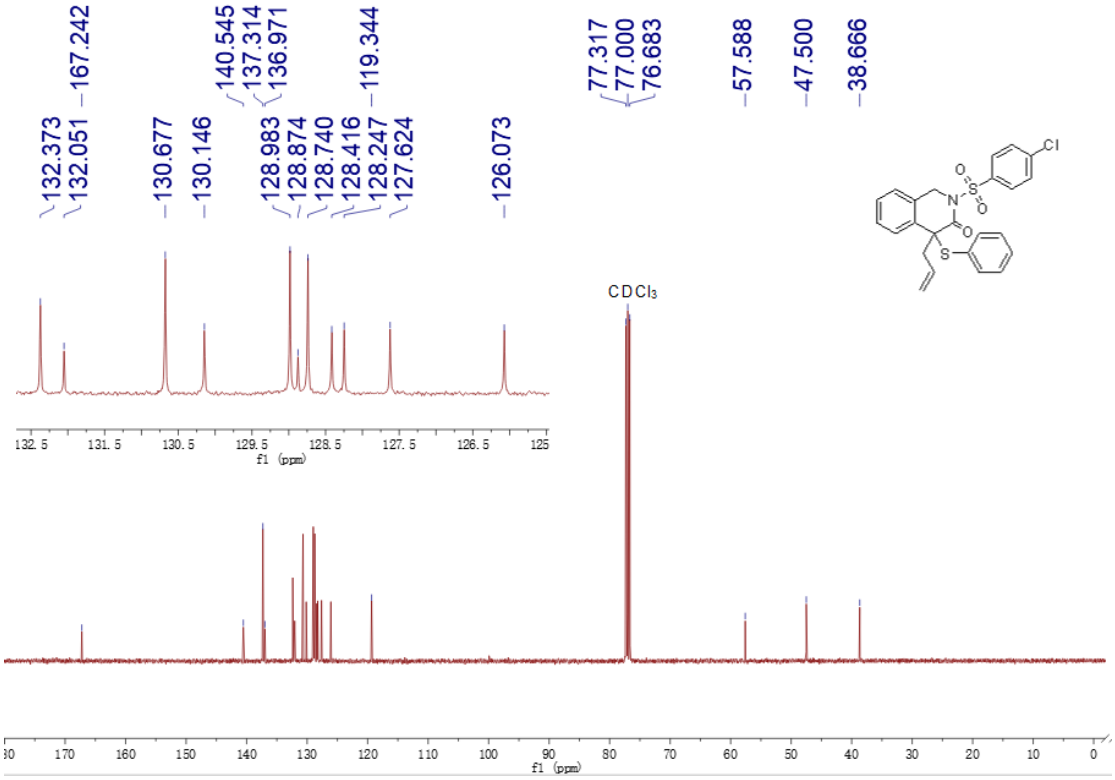

$^{1}$H NMR of **3l** ($CDCl_3$, 400 MHz)



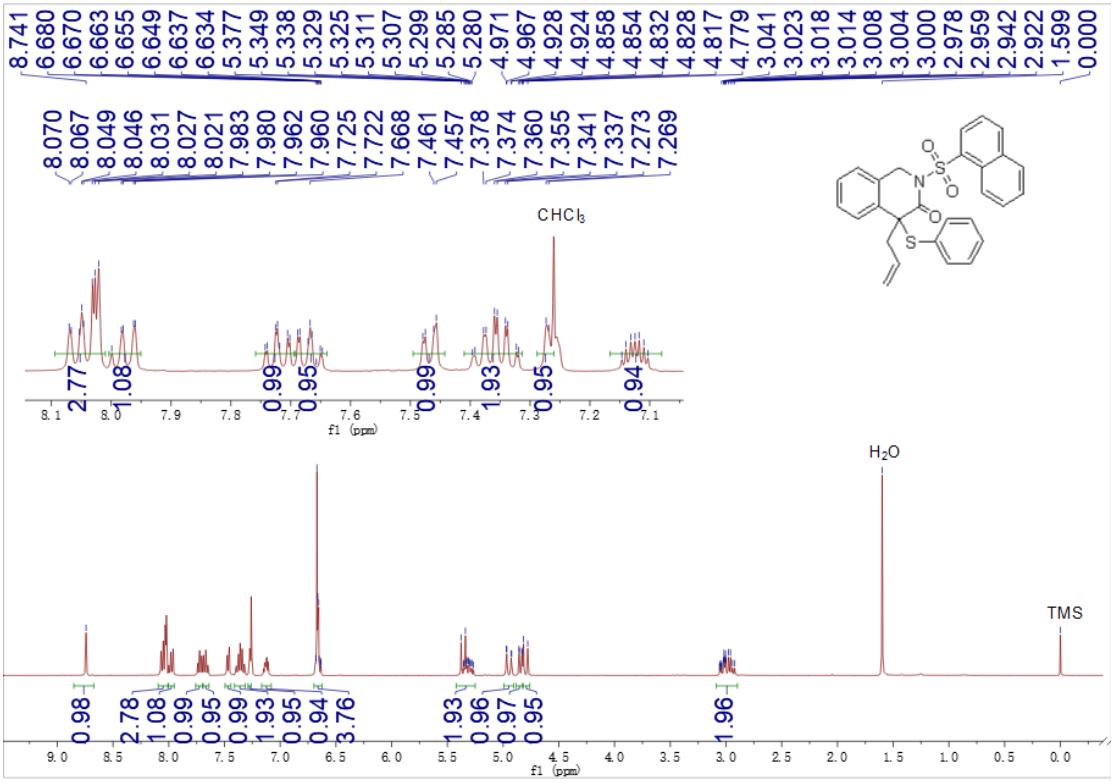

$^{13}C\{^{1}H\}$ NMR of **3l** ($CDCl_3$, 100 MHz)



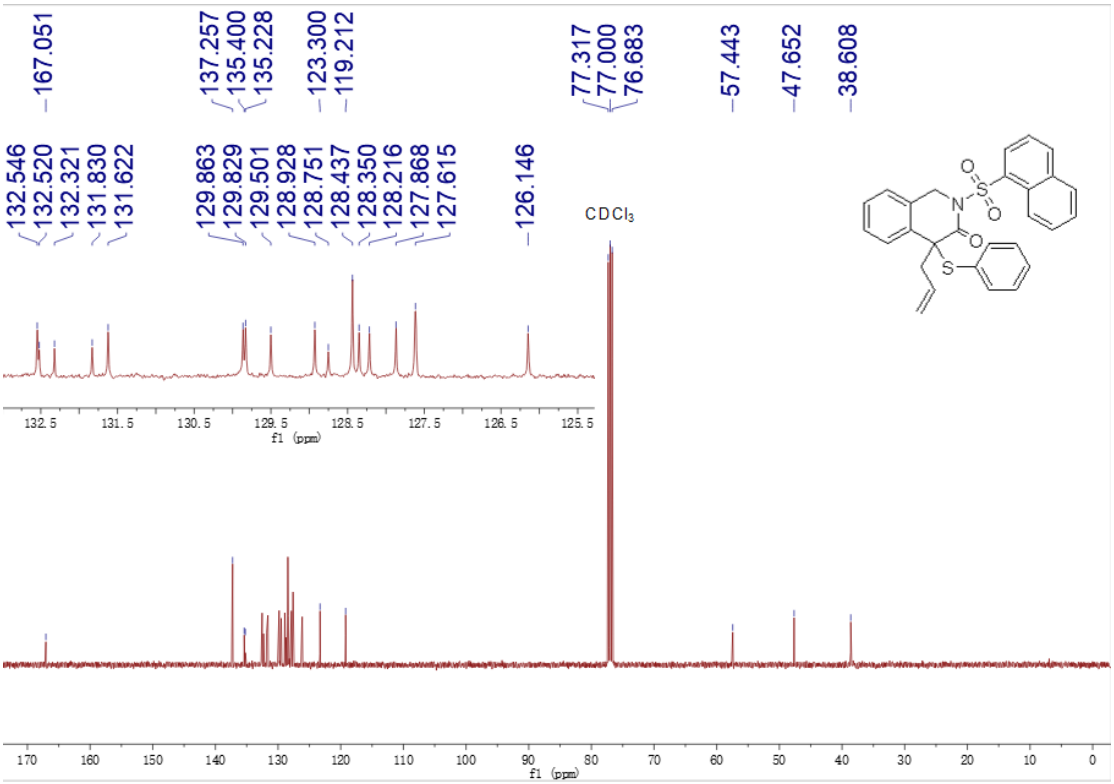

$^{1}$H NMR of **3m** ($CDCl_3$, 400 MHz)



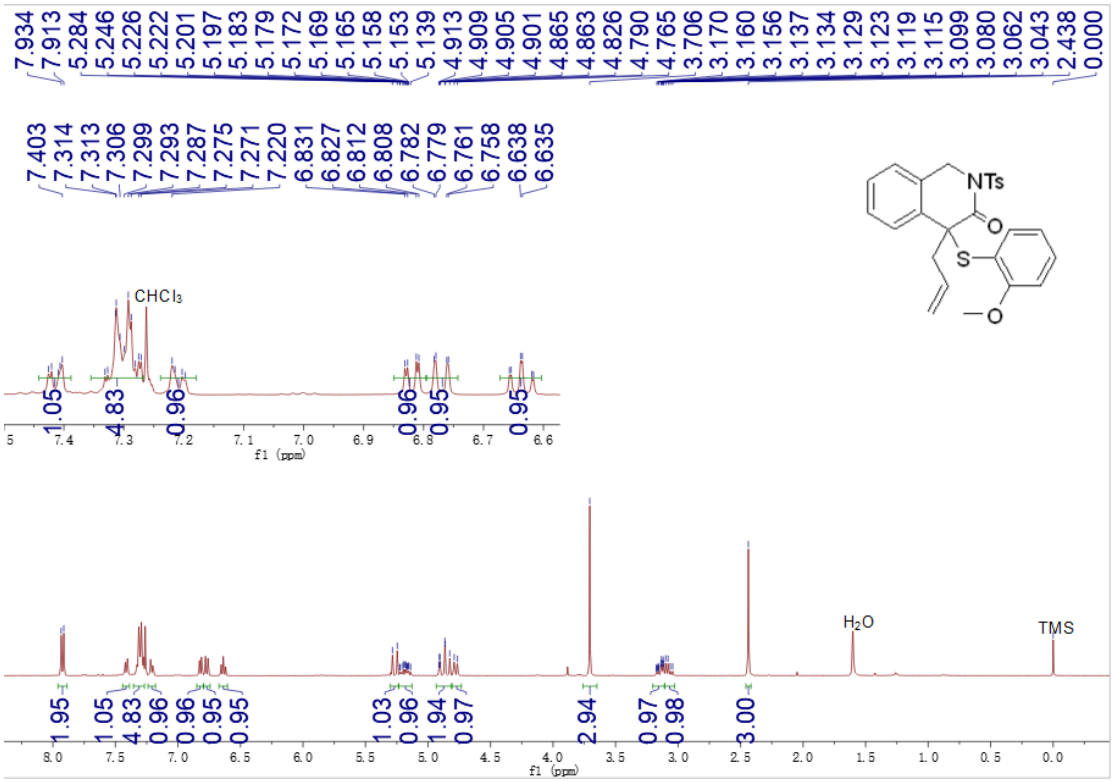

$^{13}$C{$^{1}$H} NMR of **3m** ($CDCl_3$, 100 MHz)



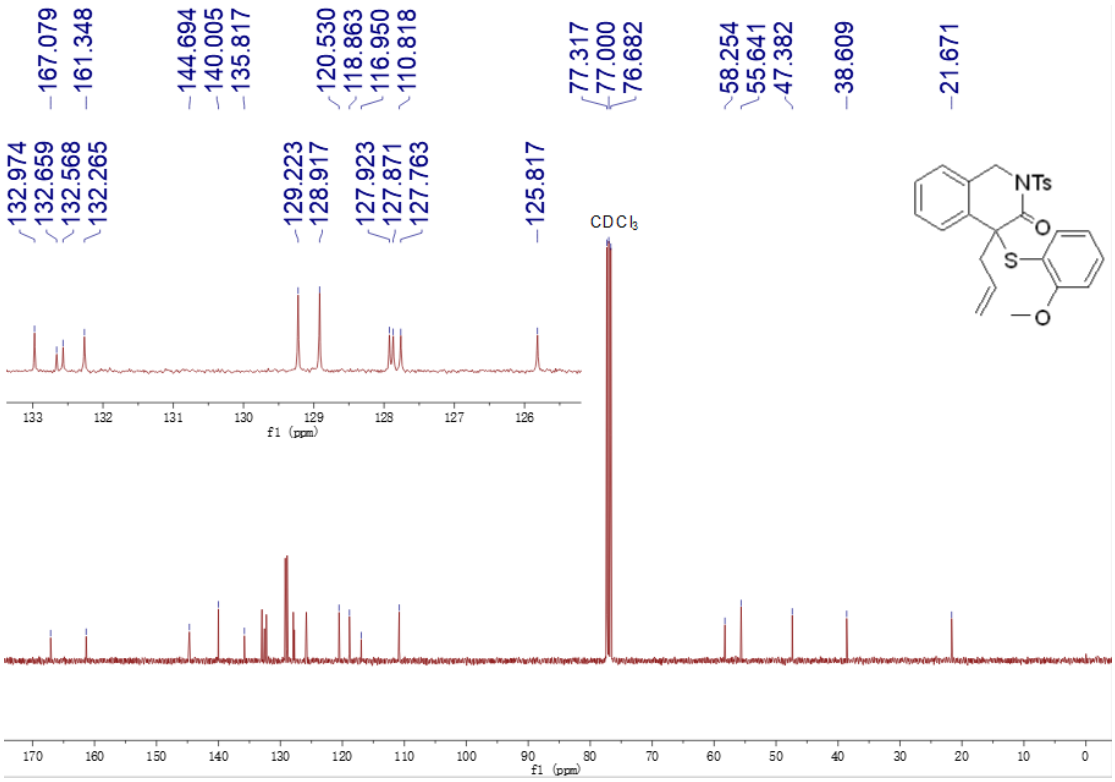

$^{1}$H NMR of **3n** ($CDCl_3$, 400 MHz)



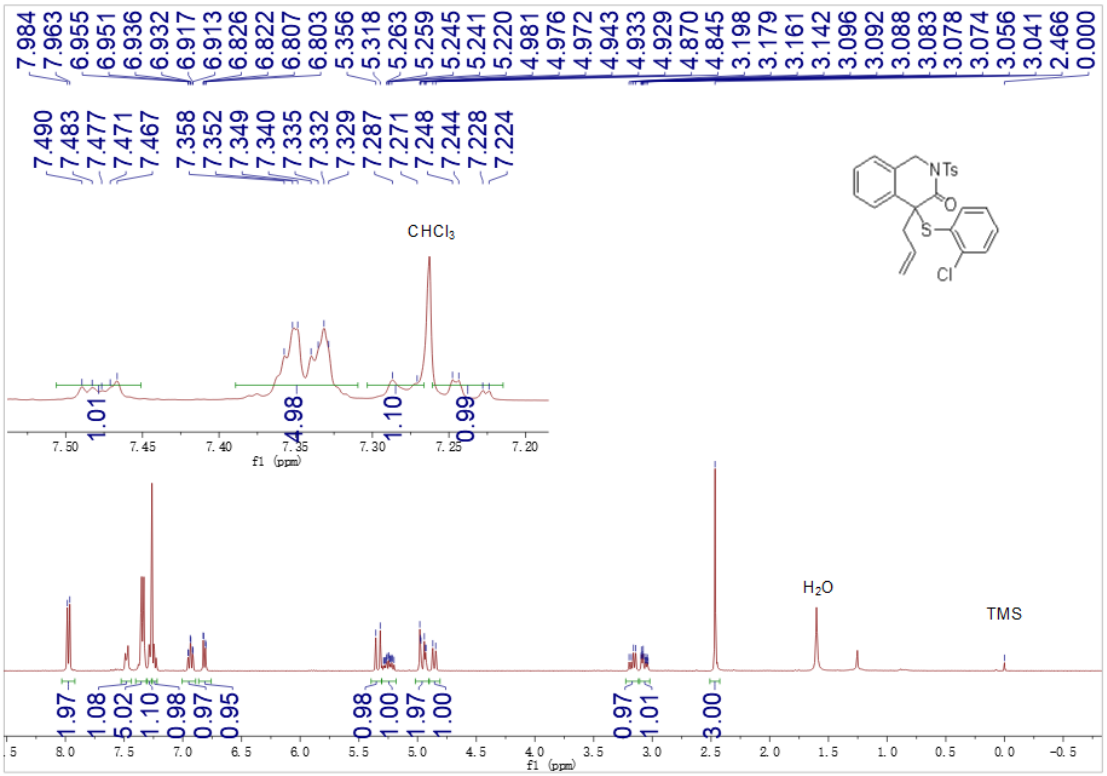

$^{13}C\{^{1}H\}$ NMR of **3n** ($CDCl_3$, 100 MHz)



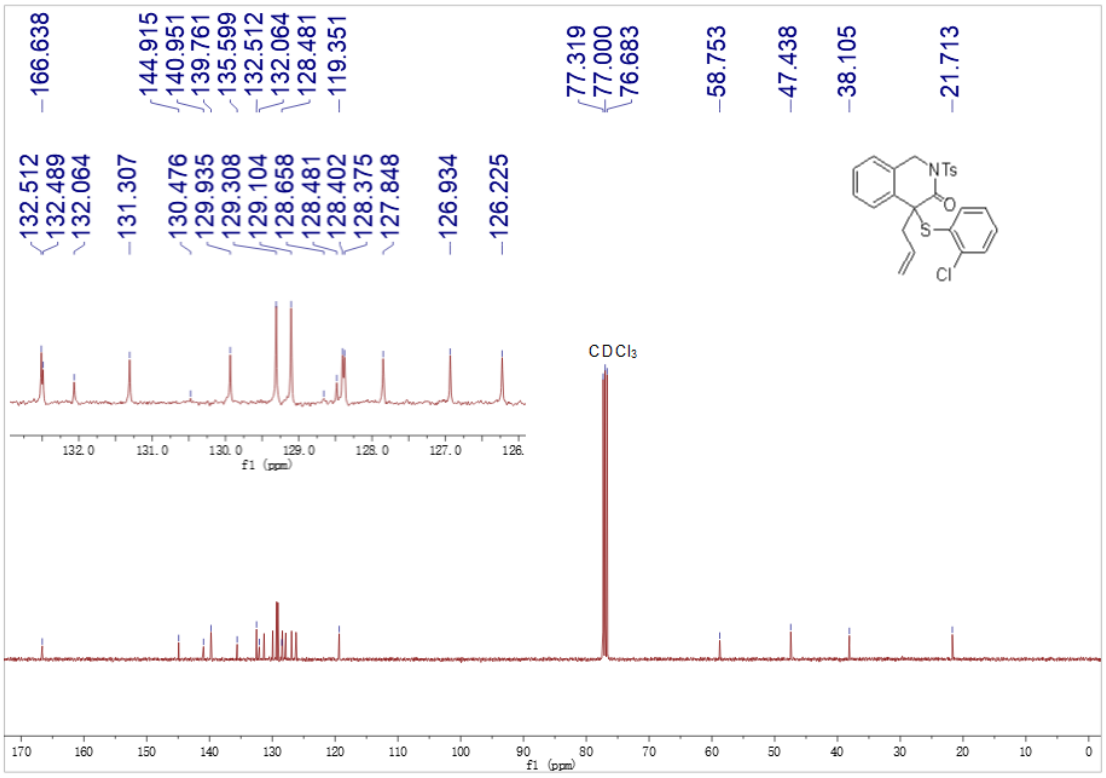

$^{1}$H NMR of **3o** ($CDCl_3$, 400 MHz)



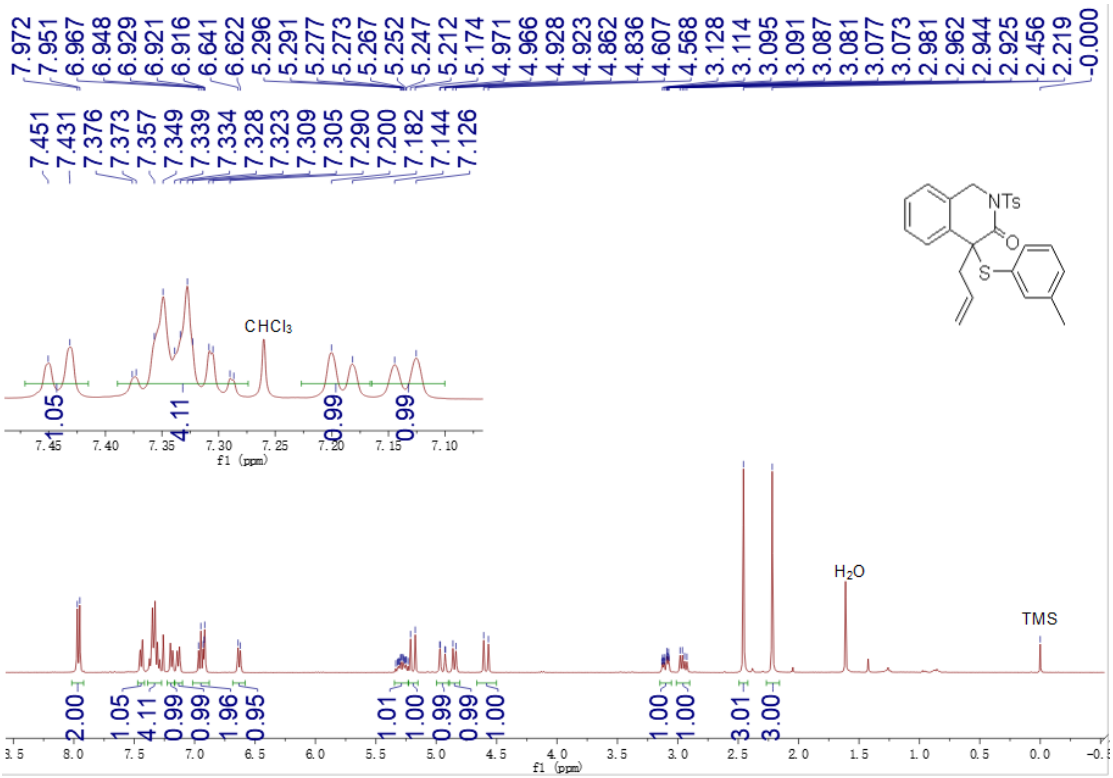

$^{13}$C{$^{1}$H} NMR of **3o** ($CDCl_3$, 100 MHz)



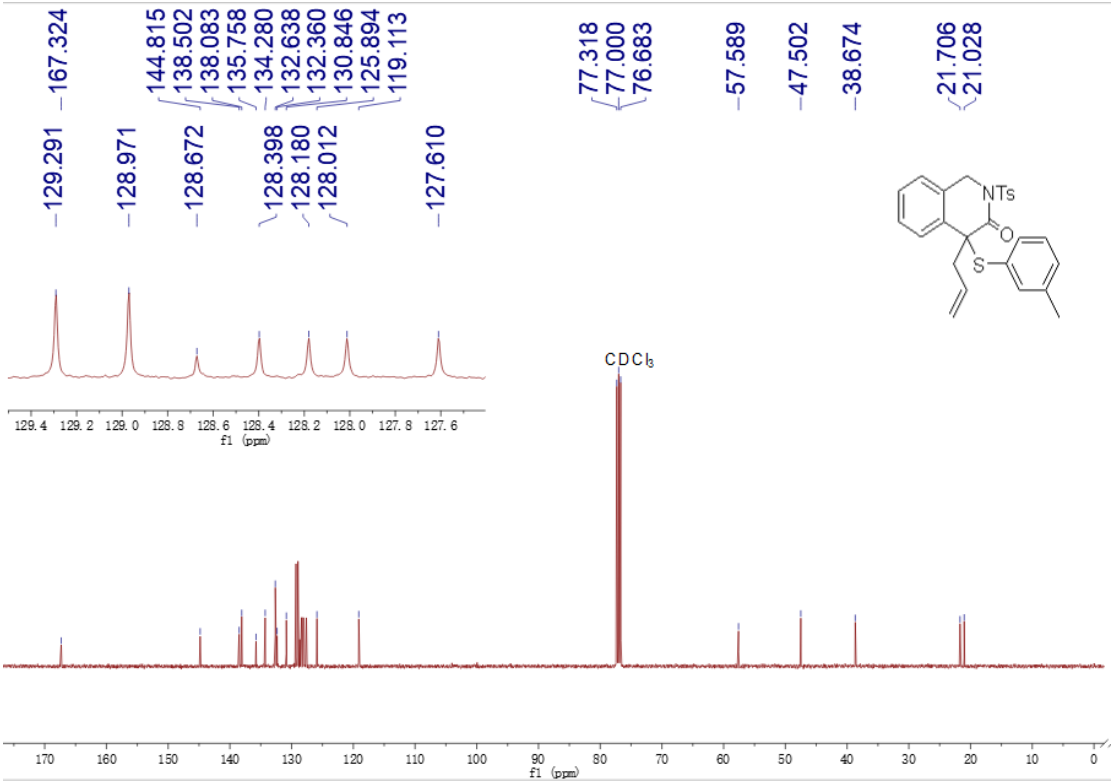

$^{1}$H NMR of **3p** ($CDCl_3$, 400 MHz)



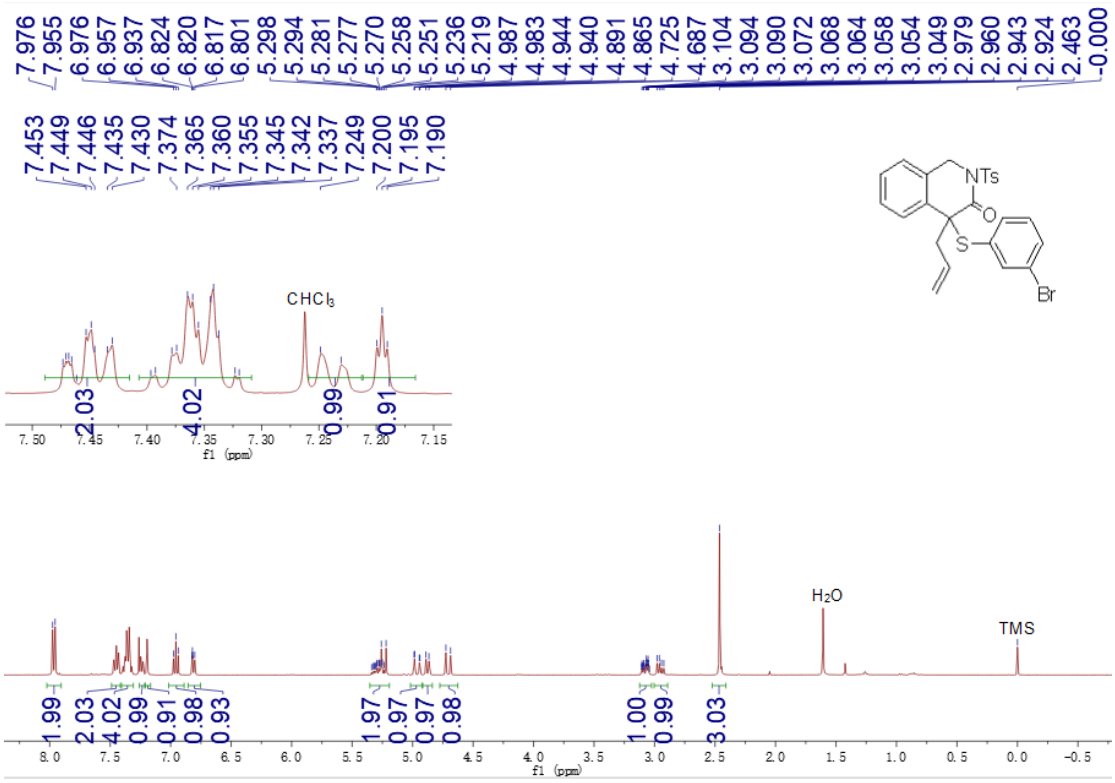

$^{13}C\{^{1}H\}$ NMR of **3p** ($CDCl_3$, 100 MHz)



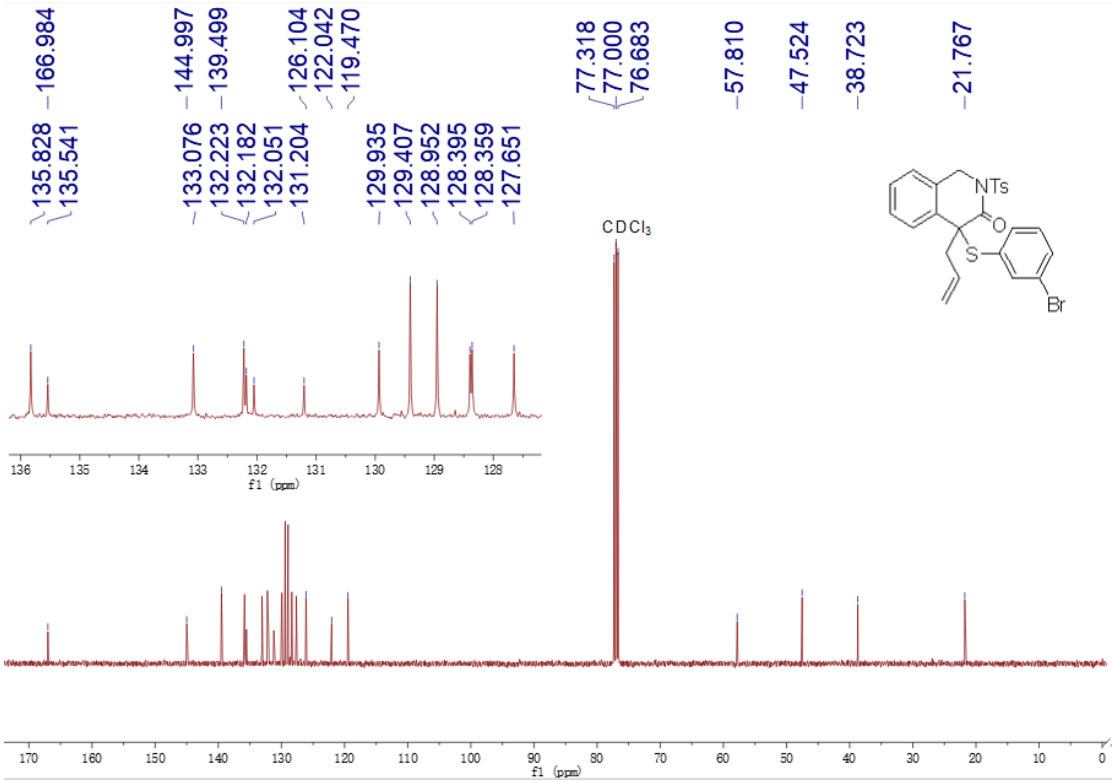

$^{1}$H NMR of **3q** ($CDCl_3$, 400 MHz)



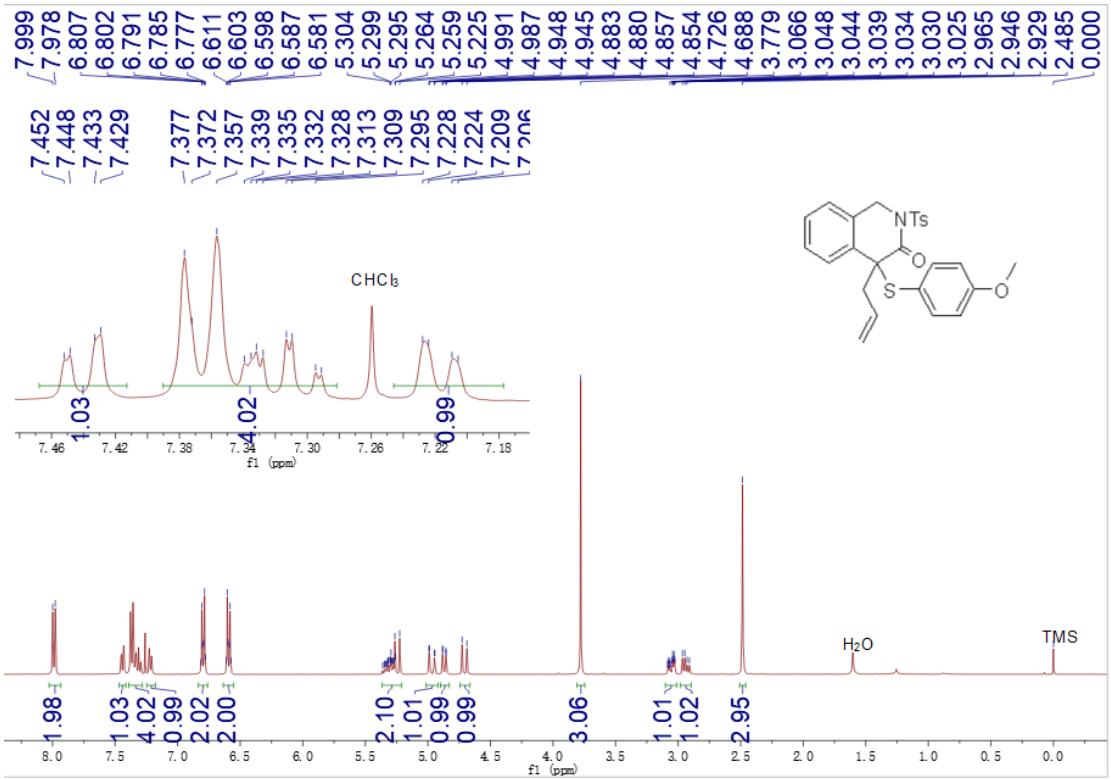

$^{13}$C{$^{1}$H} NMR of **3q** ($CDCl_3$, 100 MHz)



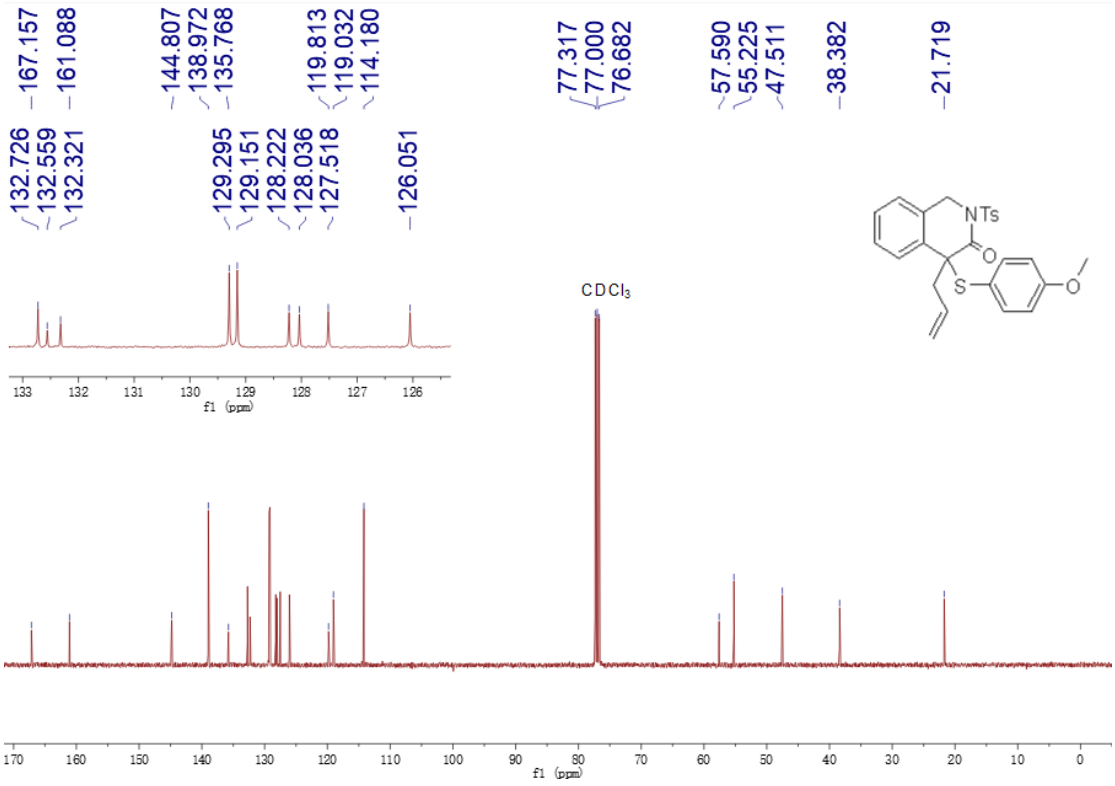

$^{1}$H NMR of **3r** ($CDCl_3$, 400 MHz)



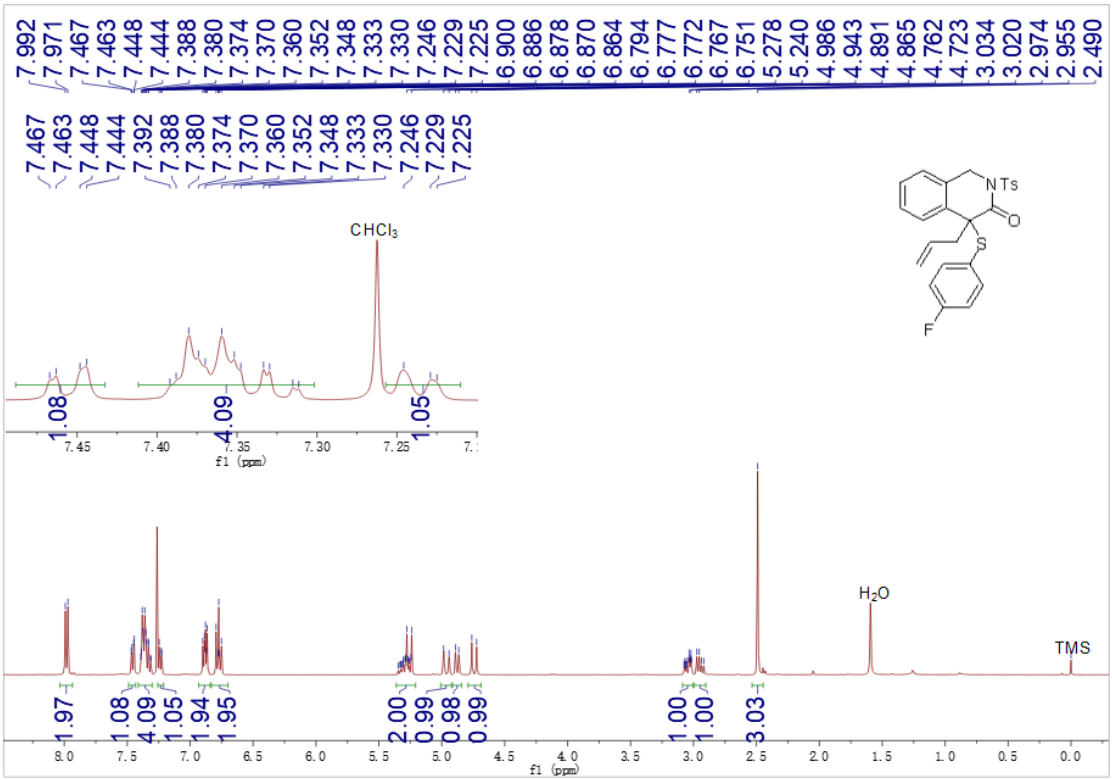

$^{13}C\{^{1}H\}$ NMR of **3r** ($CDCl_3$, 100 MHz)



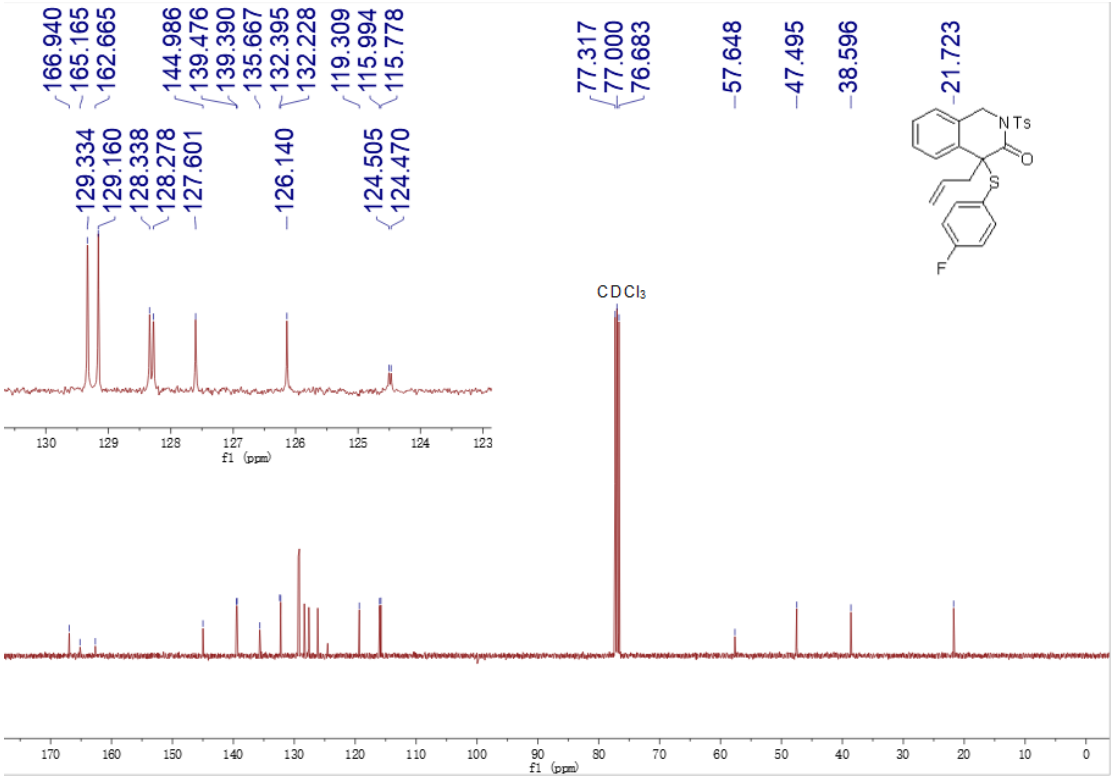

$^{1}$H NMR of **3s** ($CDCl_3$, 400 MHz)



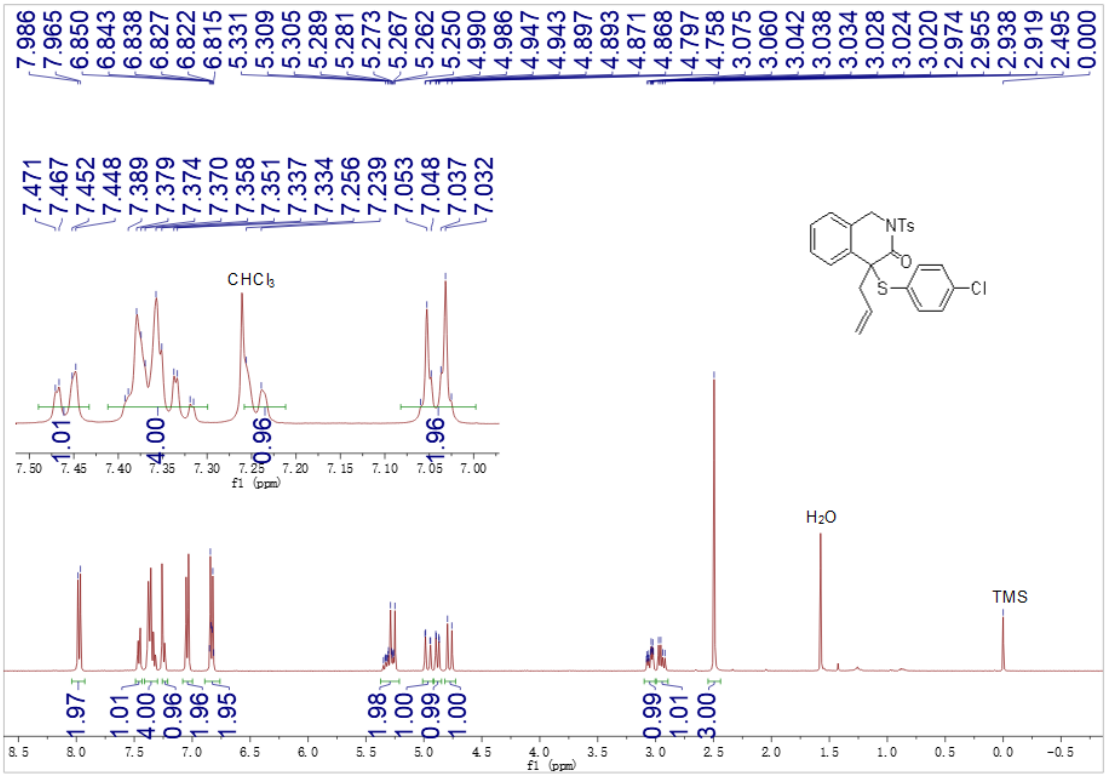

$^{13}$C{$^{1}$H} NMR of **3s** ($CDCl_3$, 100 MHz)



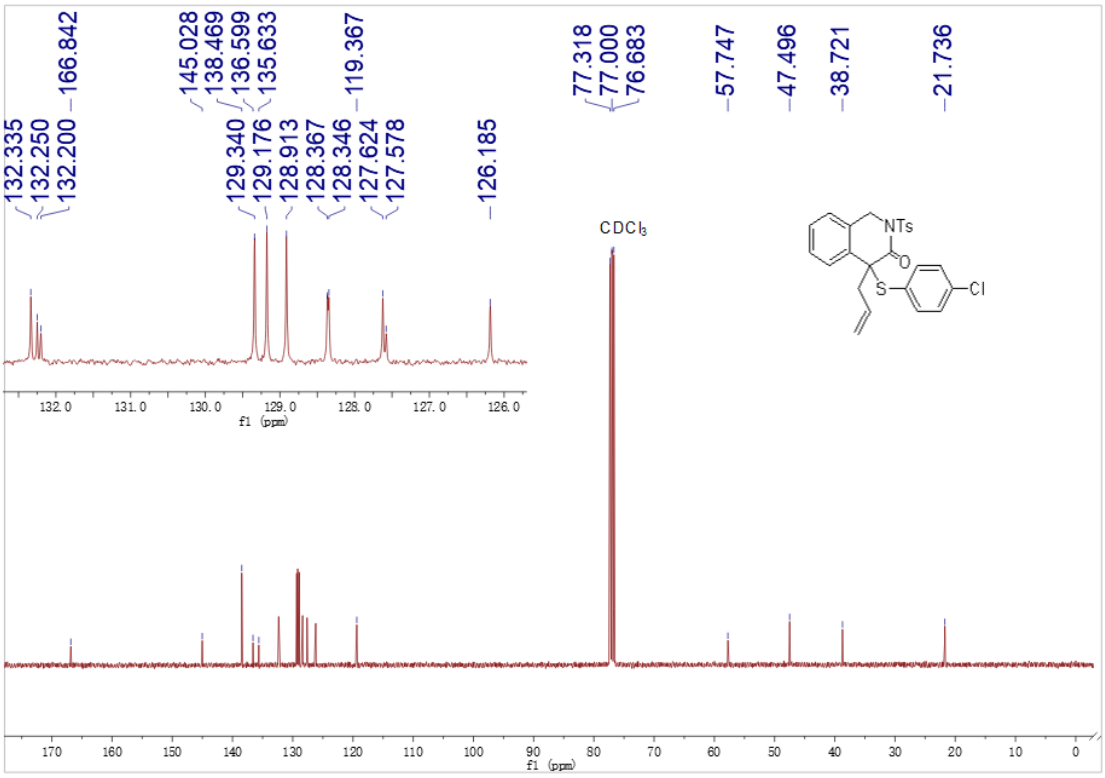

$^{1}$H NMR of **3t** ($CDCl_3$, 400 MHz)



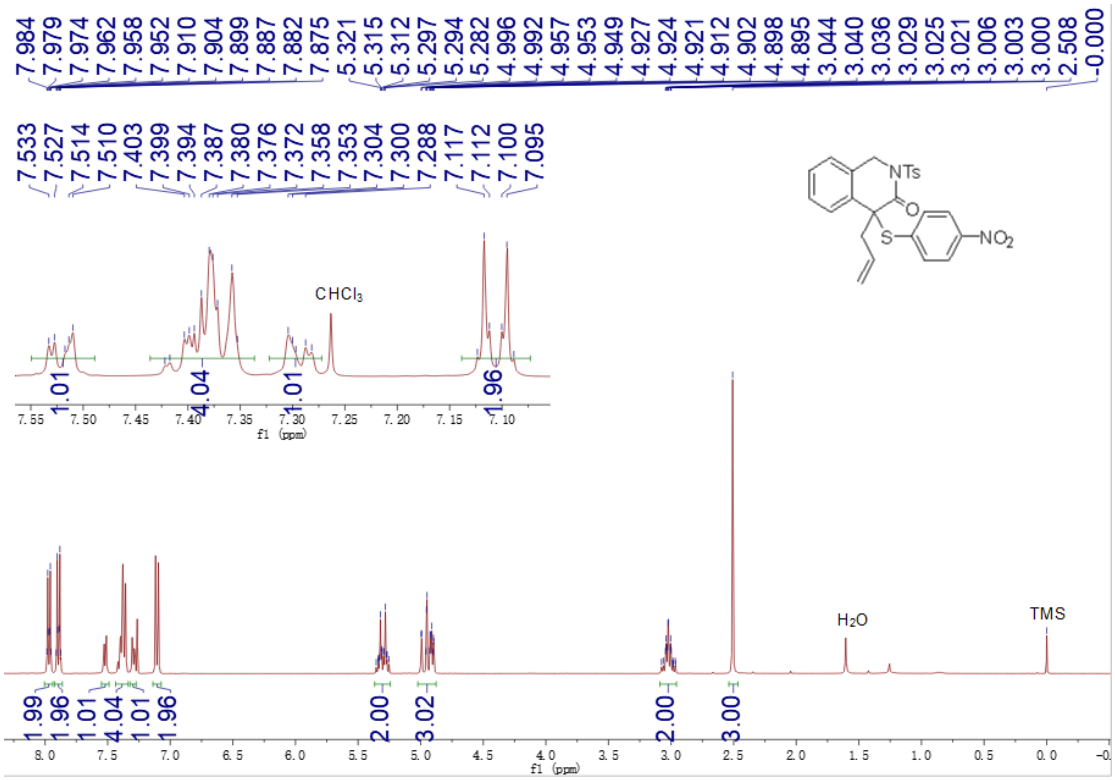

$^{13}C\{^{1}H\}$ NMR of **3t** ($CDCl_3$, 100 MHz)



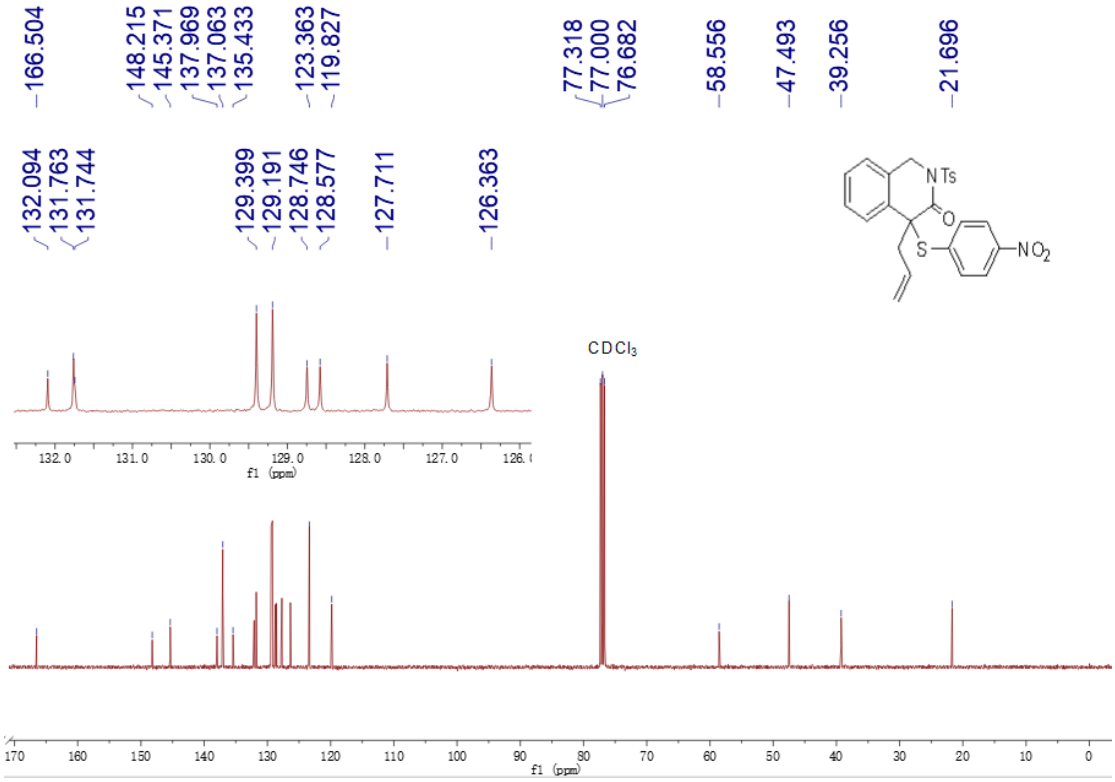

$^{1}$H NMR of **3u** ($CDCl_3$, 400 MHz)



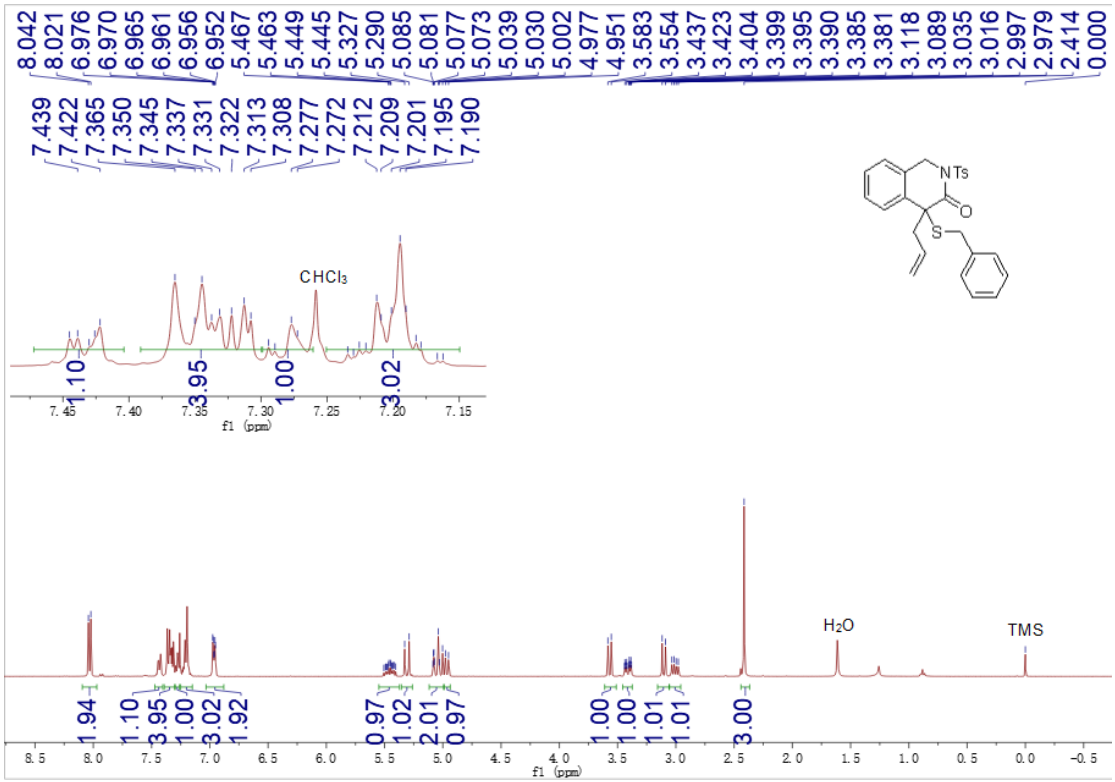

$^{13}$C{$^{1}$H} NMR of **3u** ($CDCl_3$, 100 MHz)



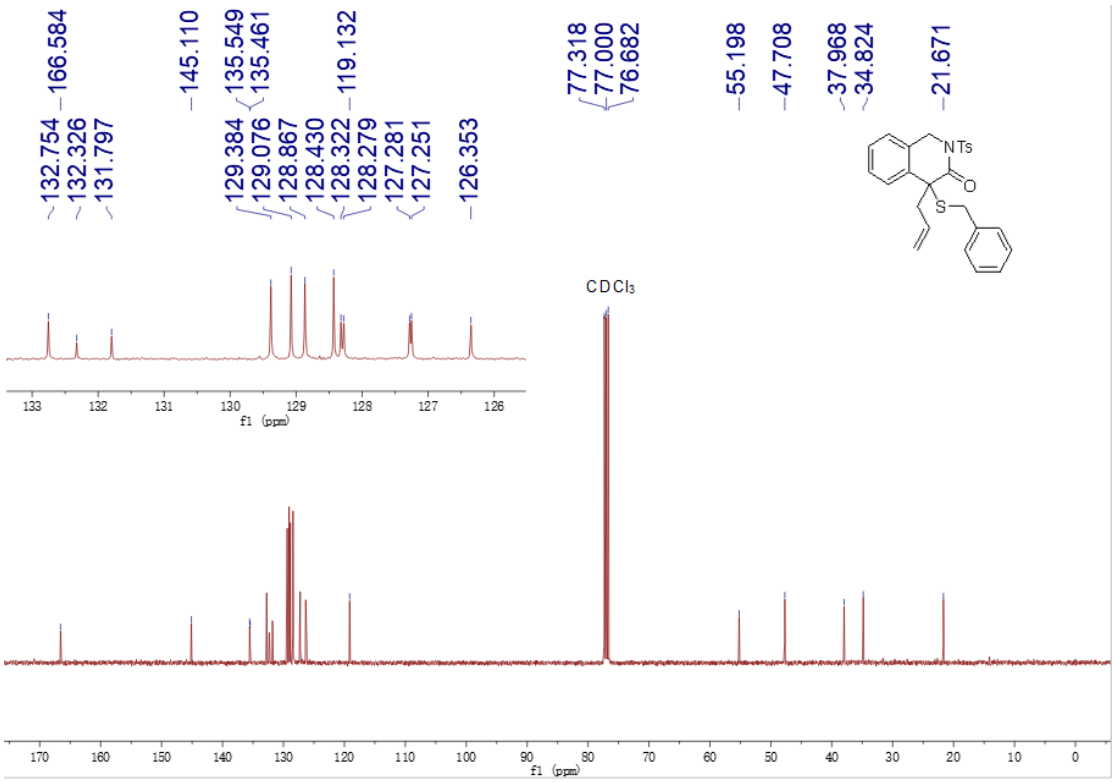

$^{1}$H NMR of **3v** ($CDCl_3$, 400 MHz)



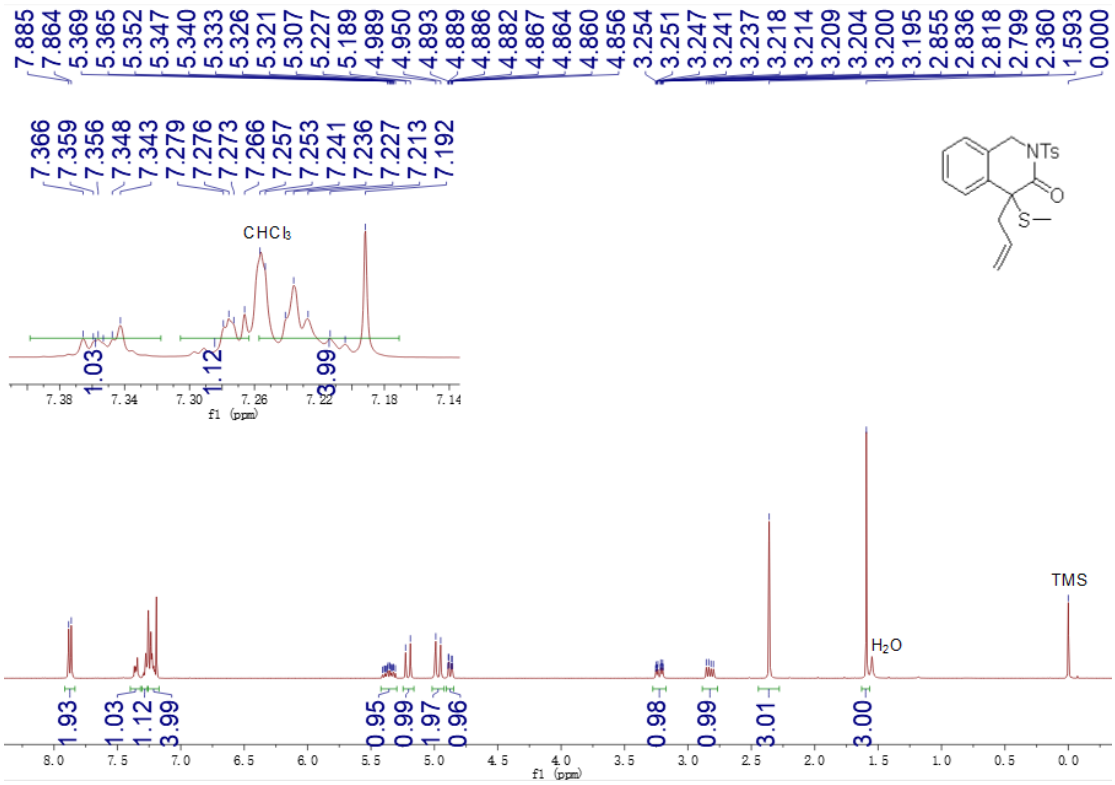

$^{13}$C{$^{1}$H} NMR of **3v** ($CDCl_3$, 100 MHz)



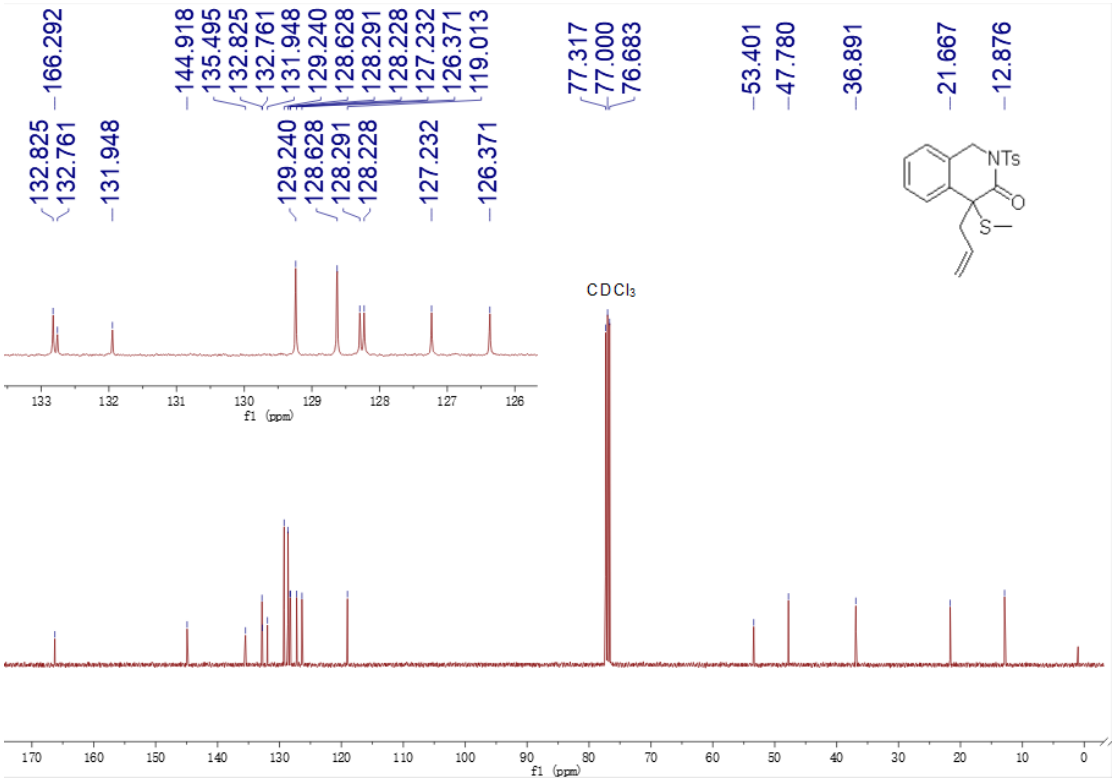

$^{1}$H NMR of **3w** ($CDCl_3$, 400 MHz)



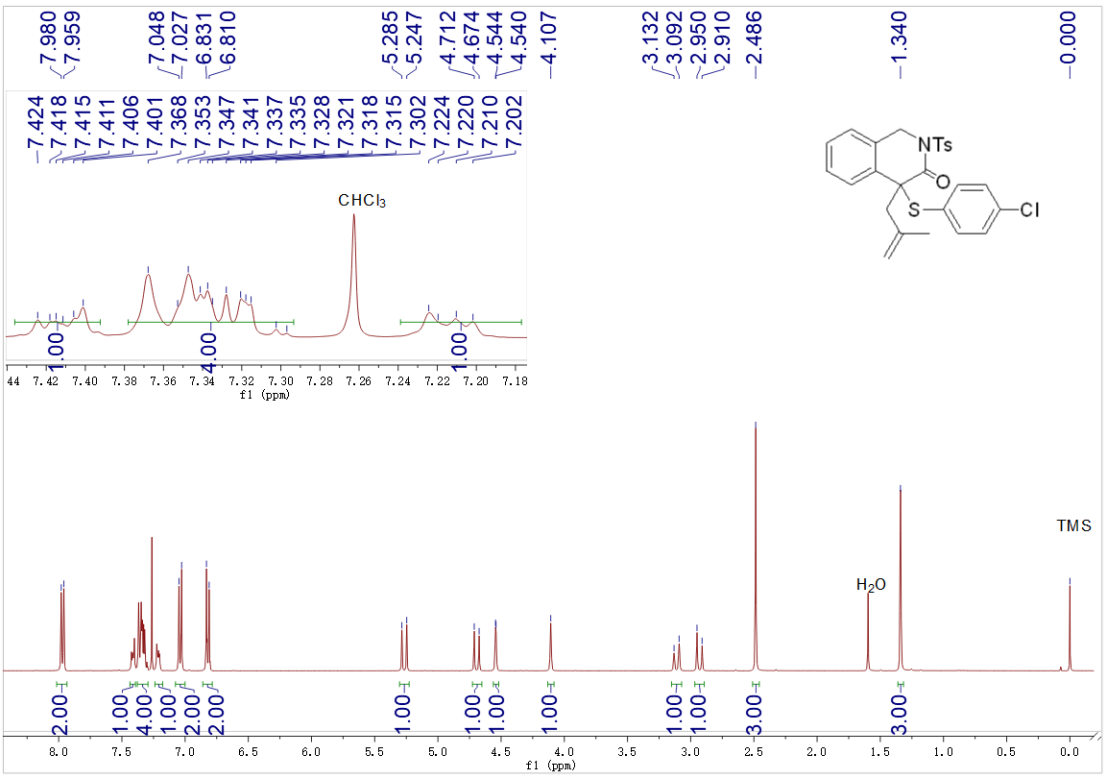

$^{13}$C{$^{1}$H} NMR of **3w** ($CDCl_3$, 100 MHz)



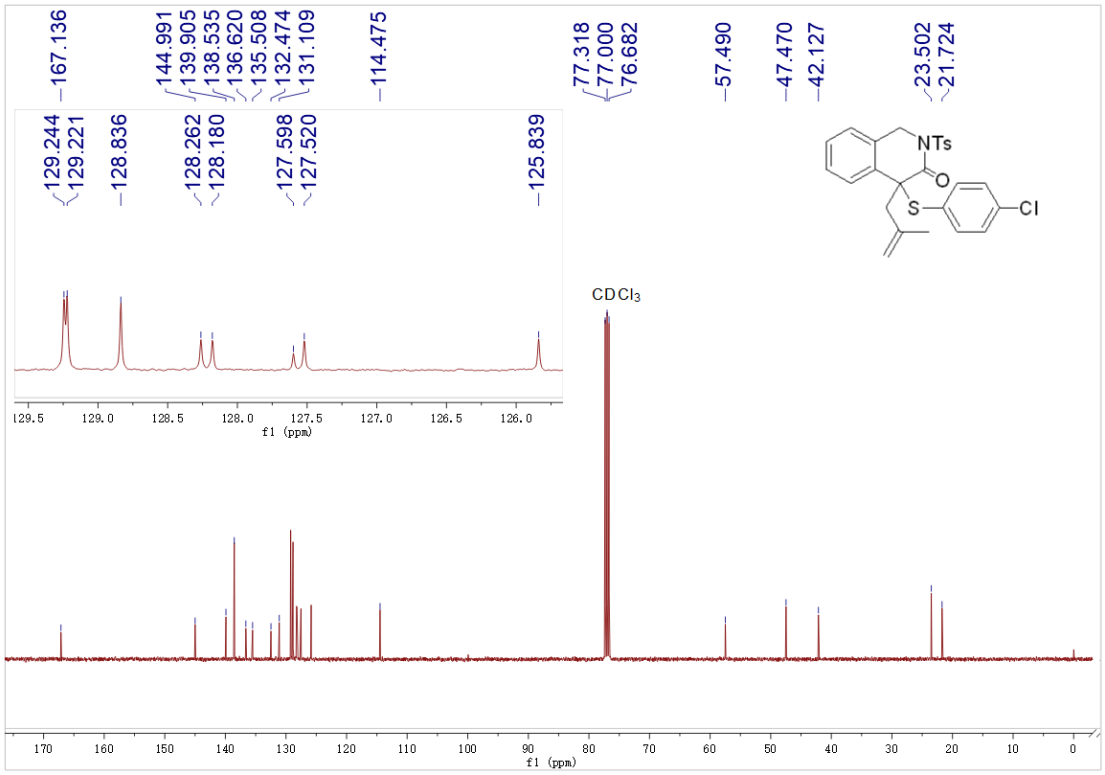

$^{1}$H NMR of **3x** ($CDCl_3$, 400 MHz)



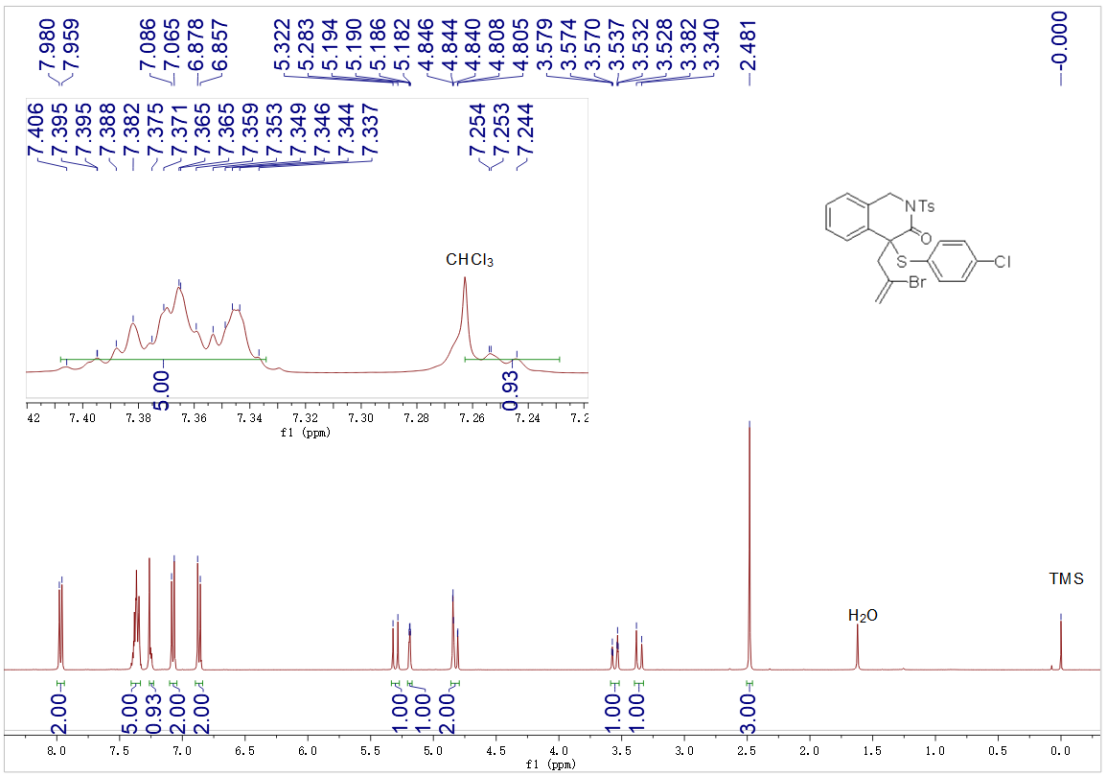

$^{13}$C{$^{1}$H} NMR of **3x** ($CDCl_3$, 100 MHz)



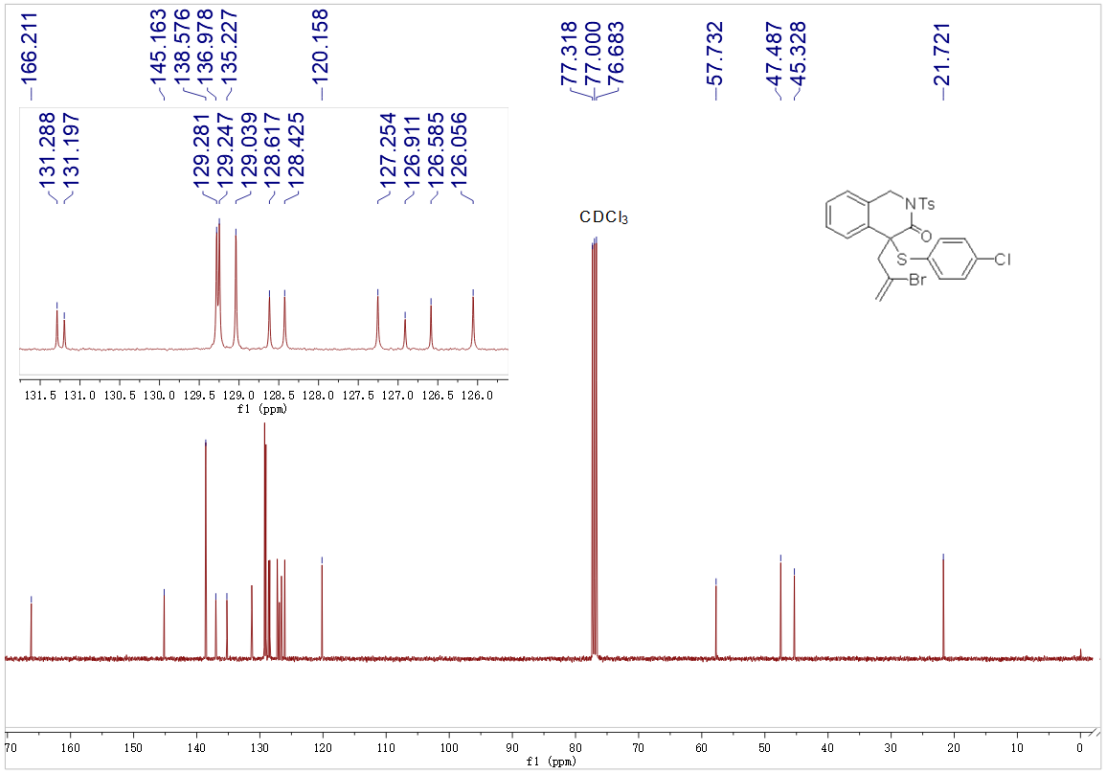

$^{1}$H NMR of **3y** ($CDCl_3$, 400 MHz)



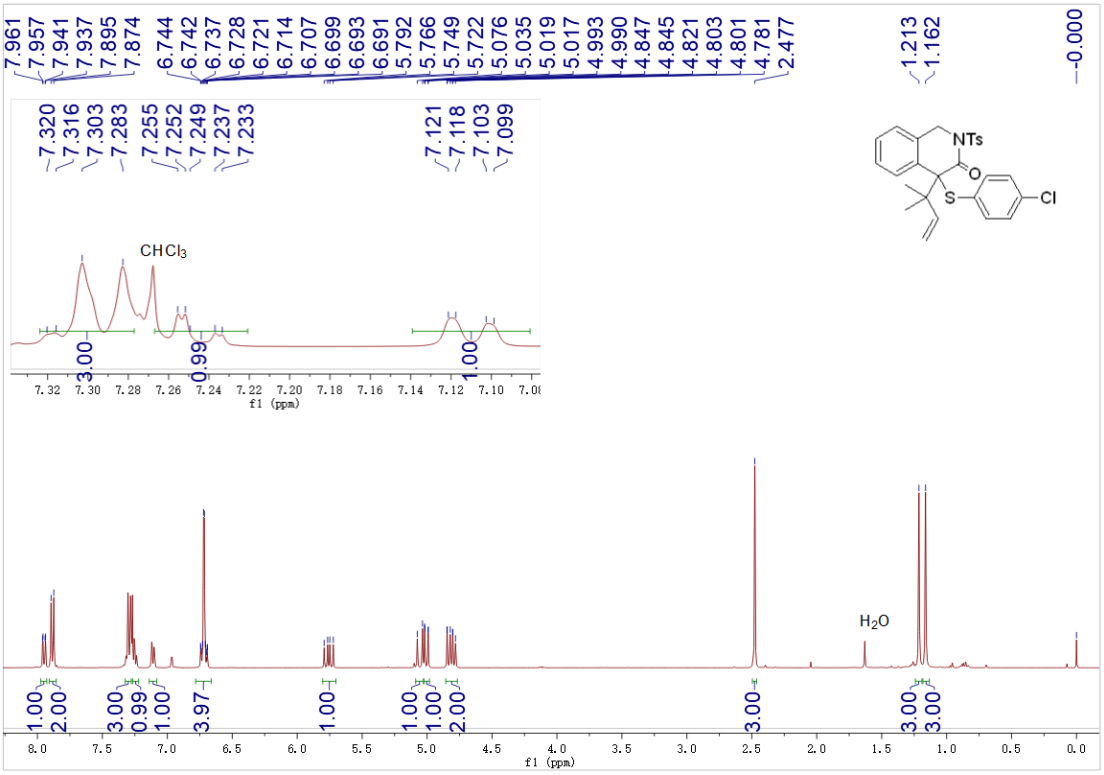

$^{13}$C{$^{1}$H} NMR of **3y** ($CDCl_3$, 100 MHz)



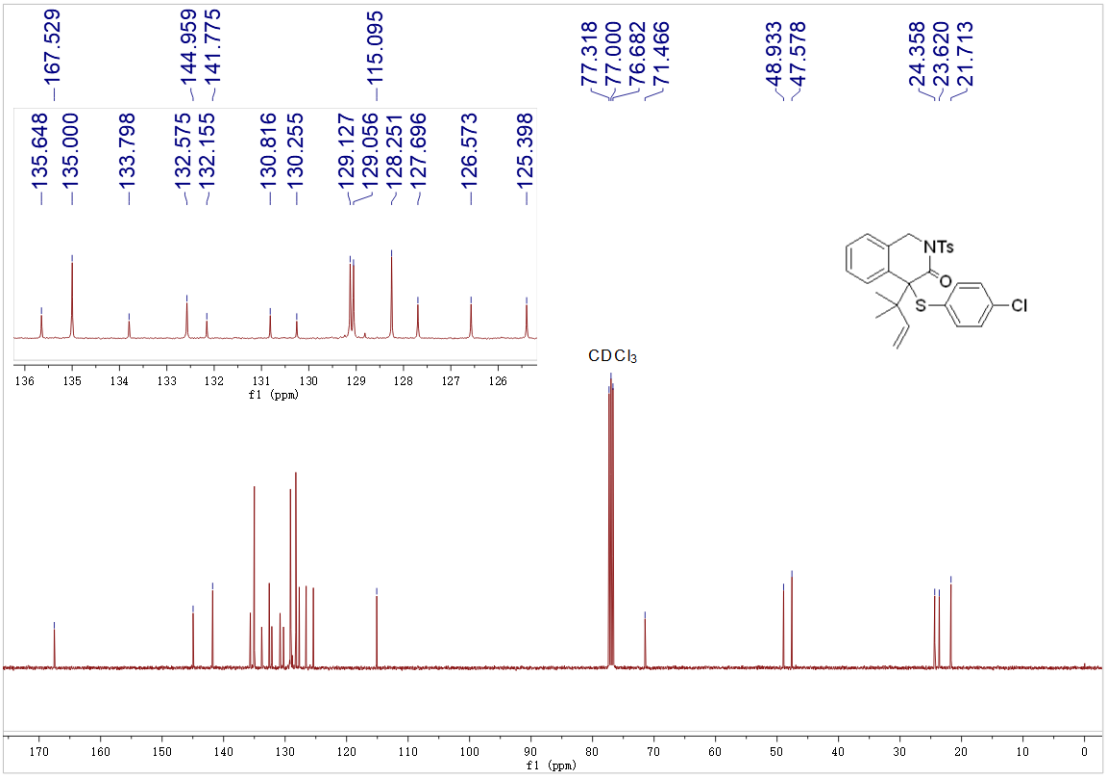

$^{1}$H NMR of **3z** ($CDCl_3$, 400 MHz)



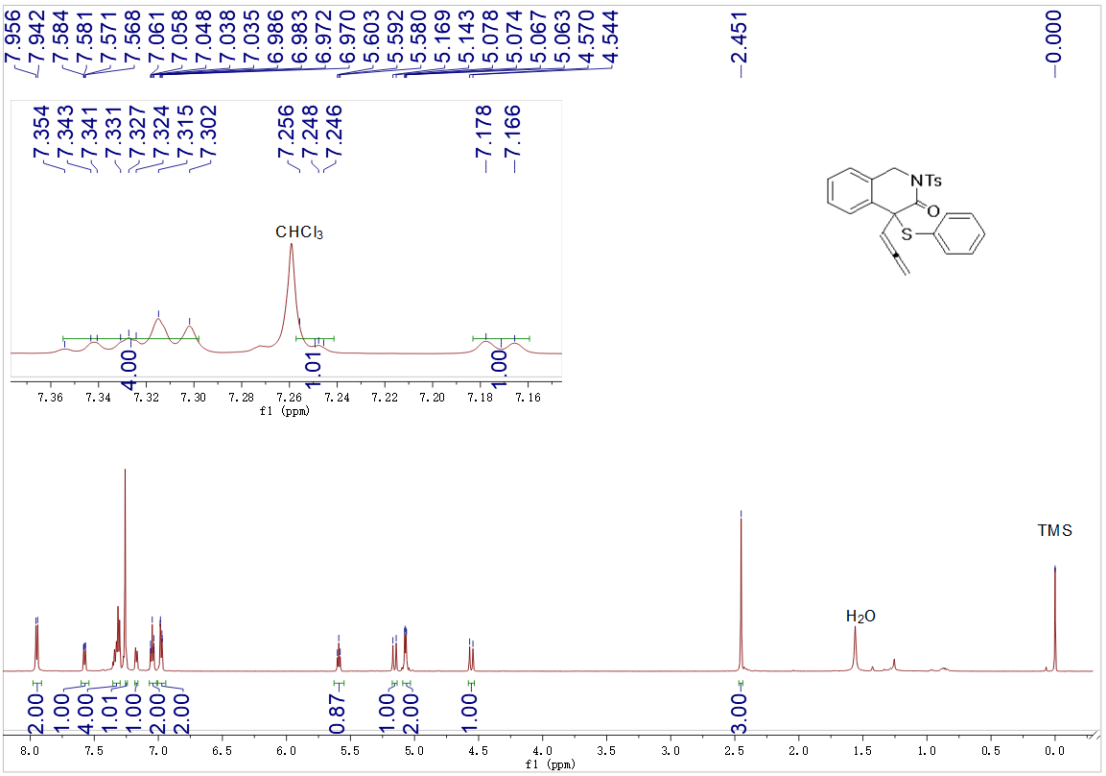

$^{13}$C{$^{1}$H} NMR of **3z** ($CDCl_3$, 100 MHz)



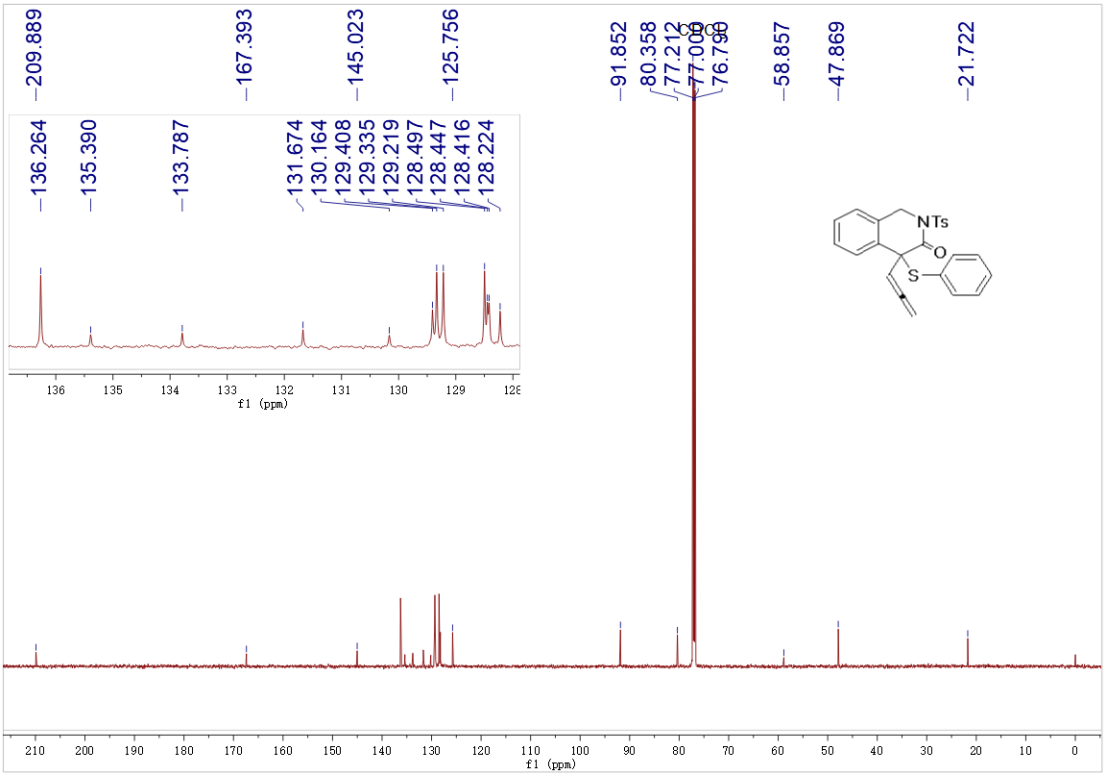

$^{1}$H NMR of **3A** ($CDCl_3$, 400 MHz)



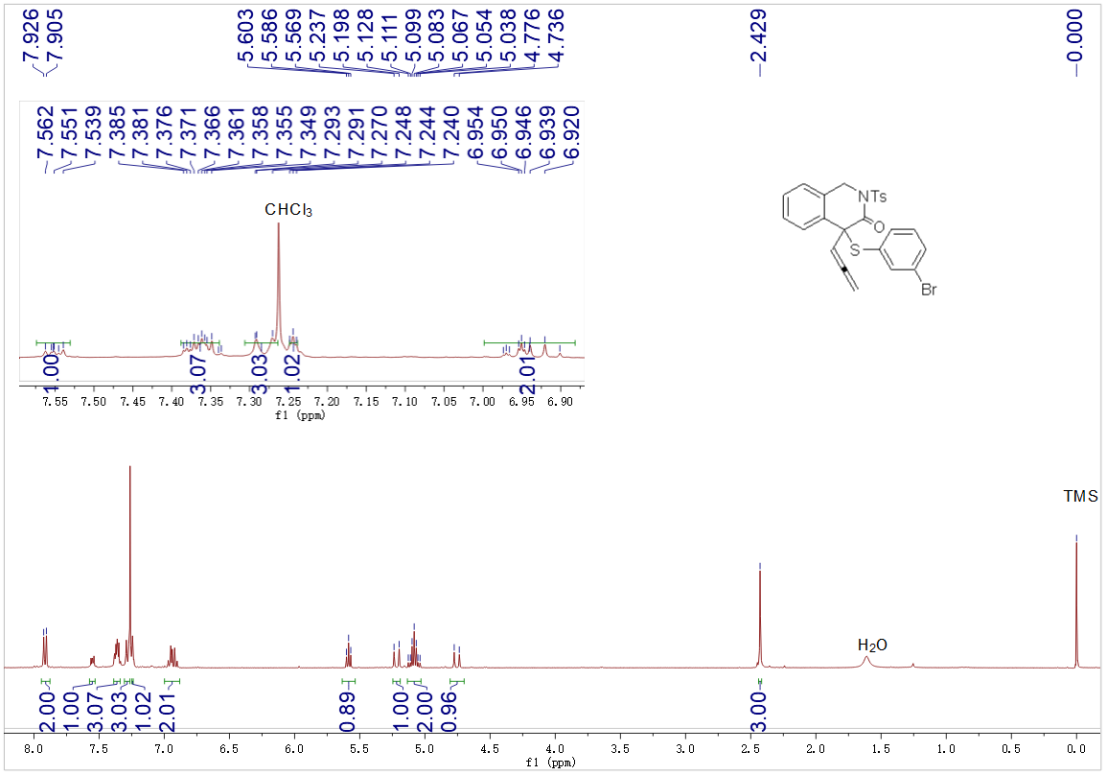

$^{13}$C{$^{1}$H} NMR of **3A** ($CDCl_3$, 100 MHz)



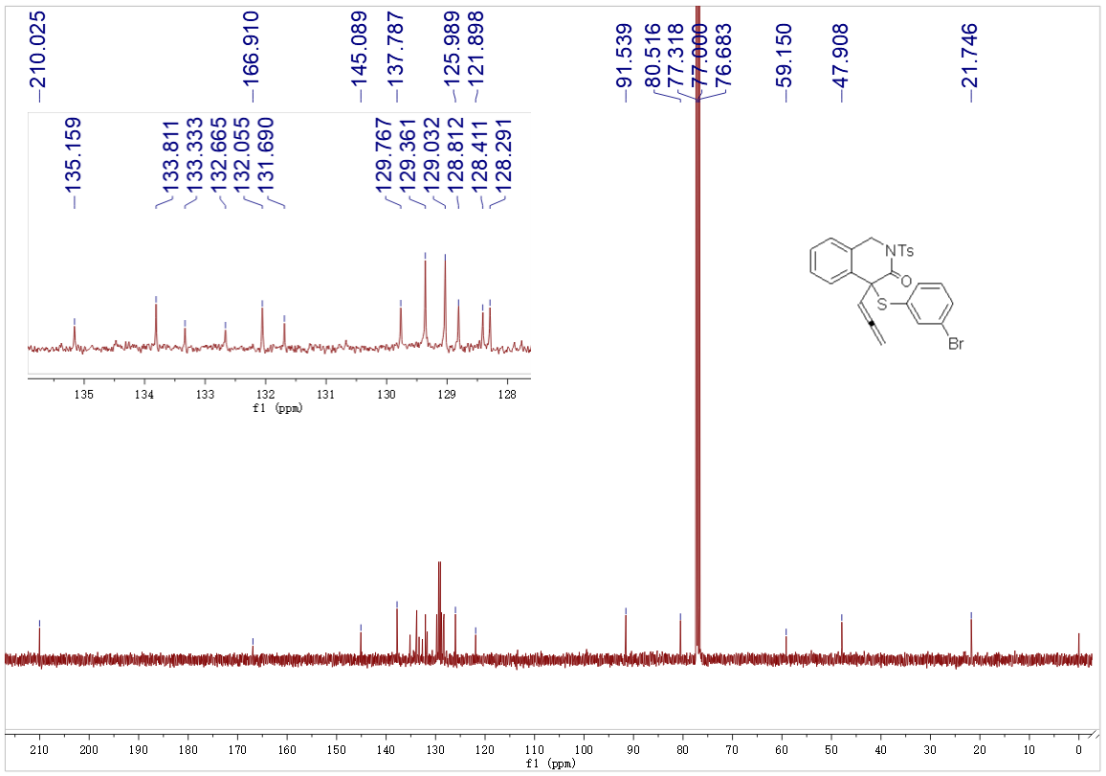

$^{1}$H NMR of **5a** ($CDCl_3$, 600 MHz)



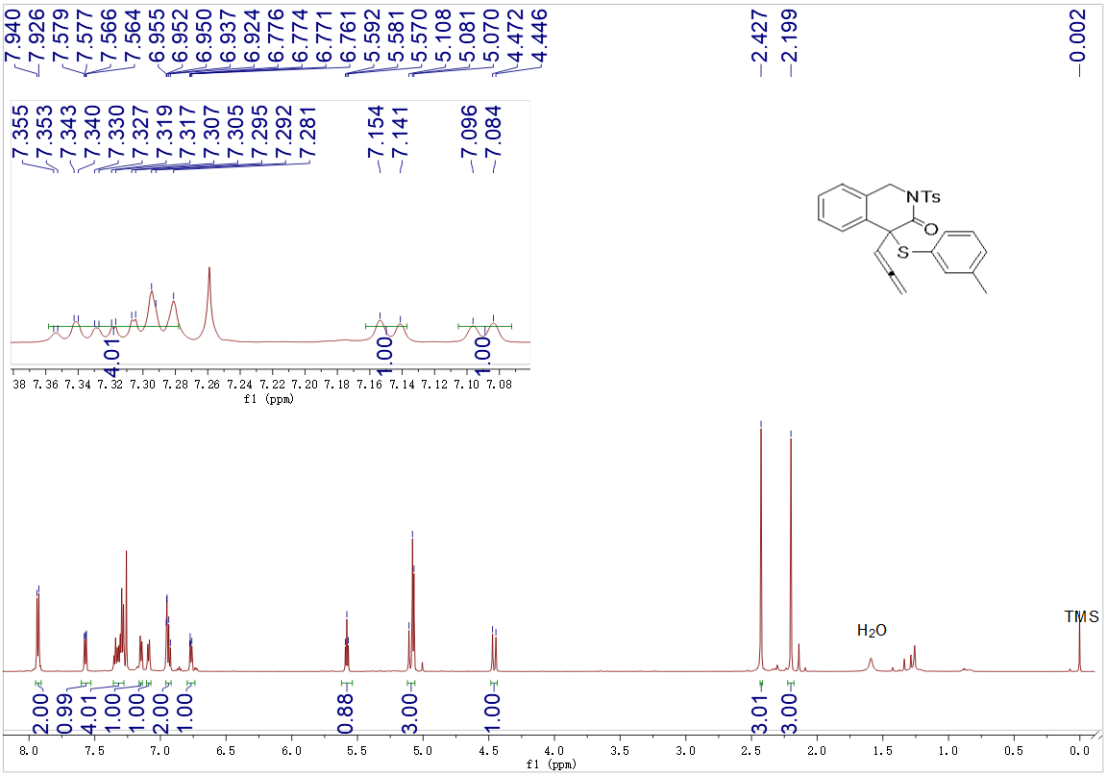

$^{13}$C{$^{1}$H} NMR of **5a** ($CDCl_3$, 150 MHz)



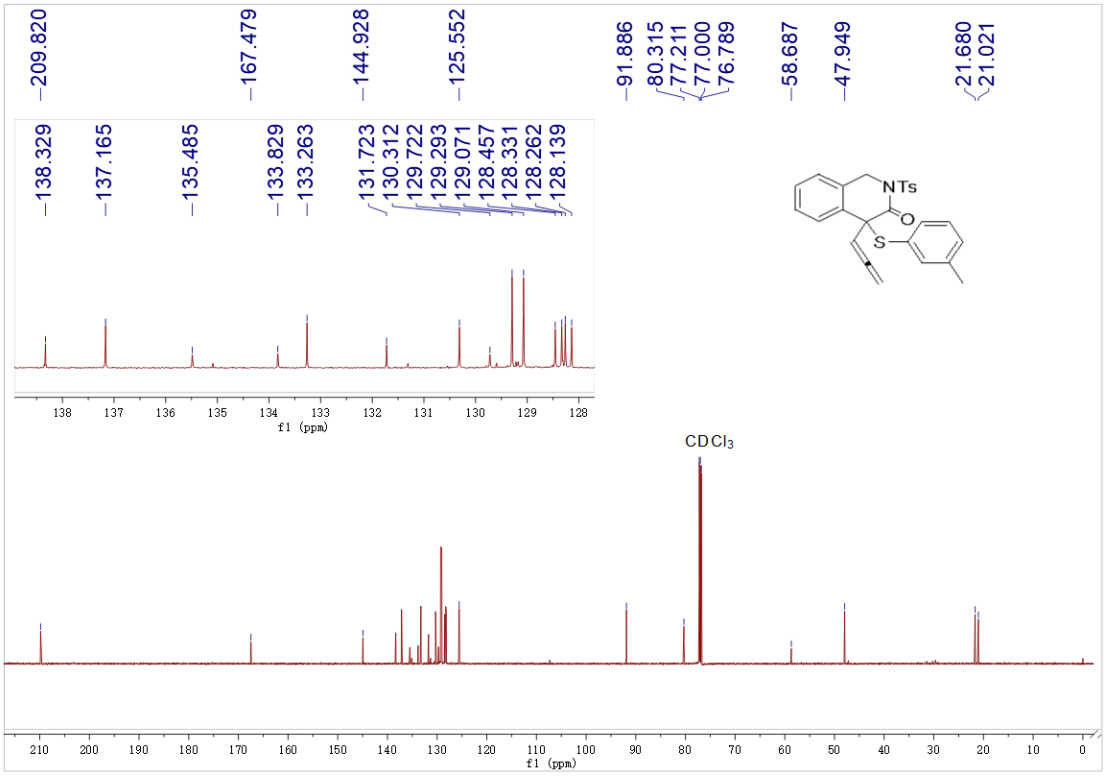

$^{1}$H NMR of **5b** ($CDCl_3$, 400 MHz)



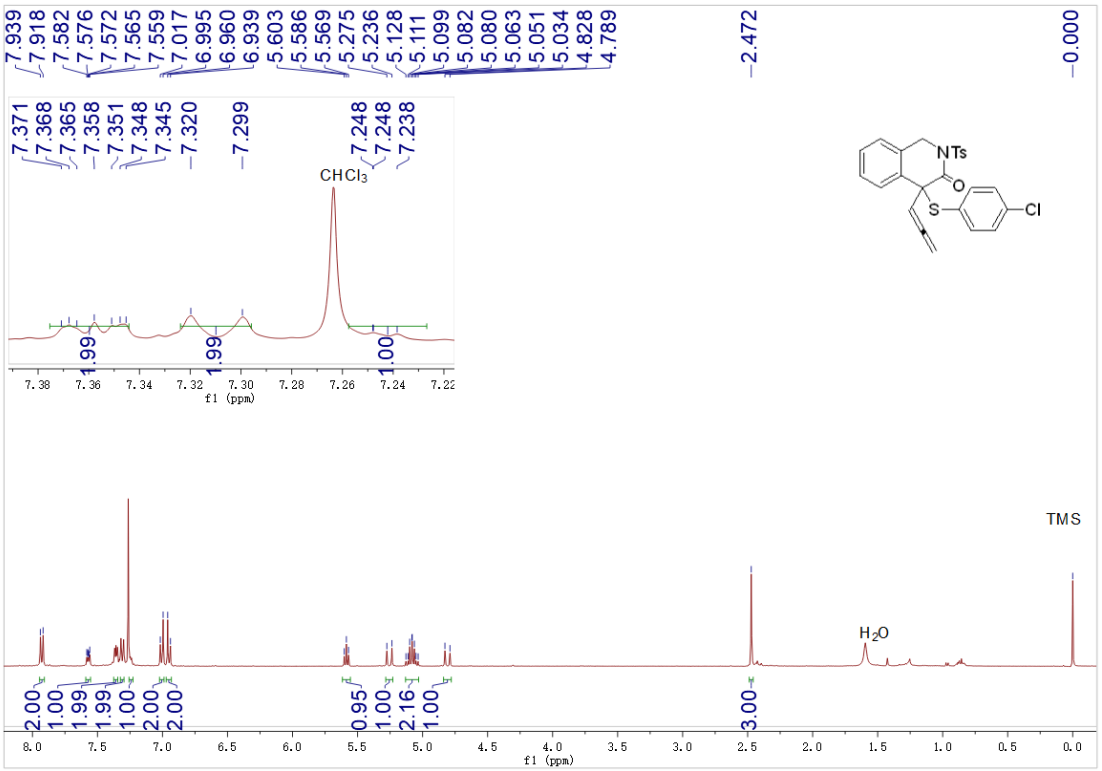

$^{13}$C{$^{1}$H} NMR of **5b** ($CDCl_3$, 100 MHz)



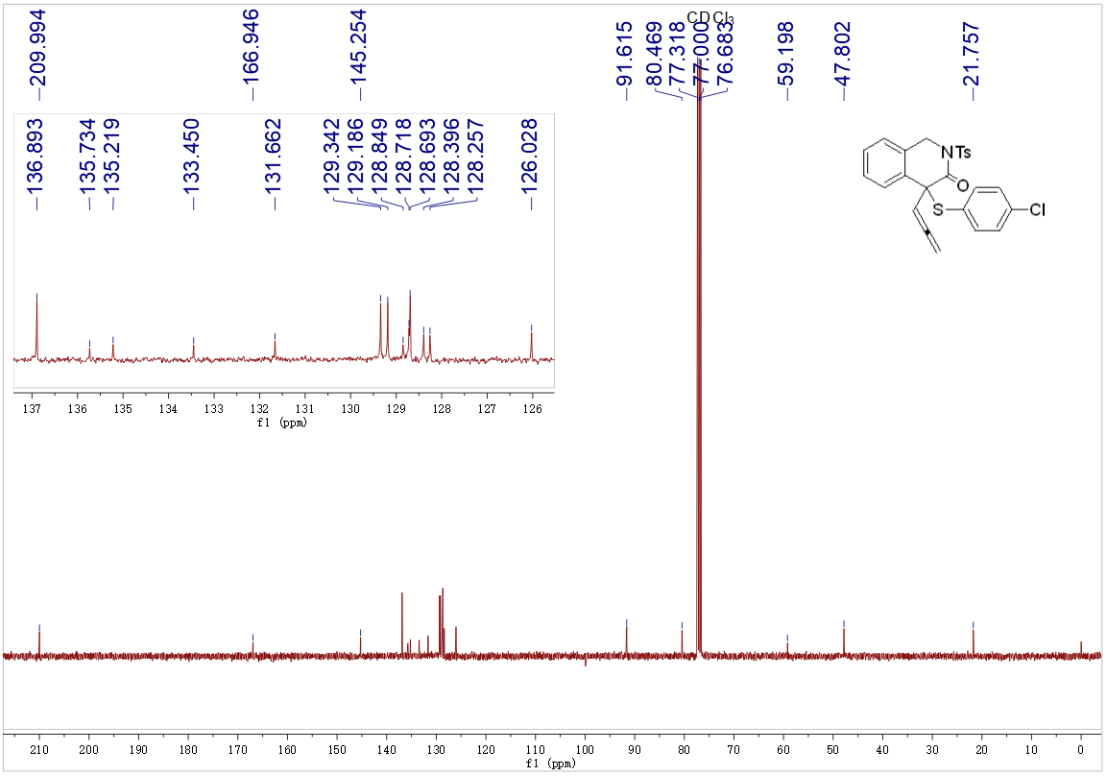

$^{1}$H NMR of **5c** ($CDCl_3$, 600 MHz)



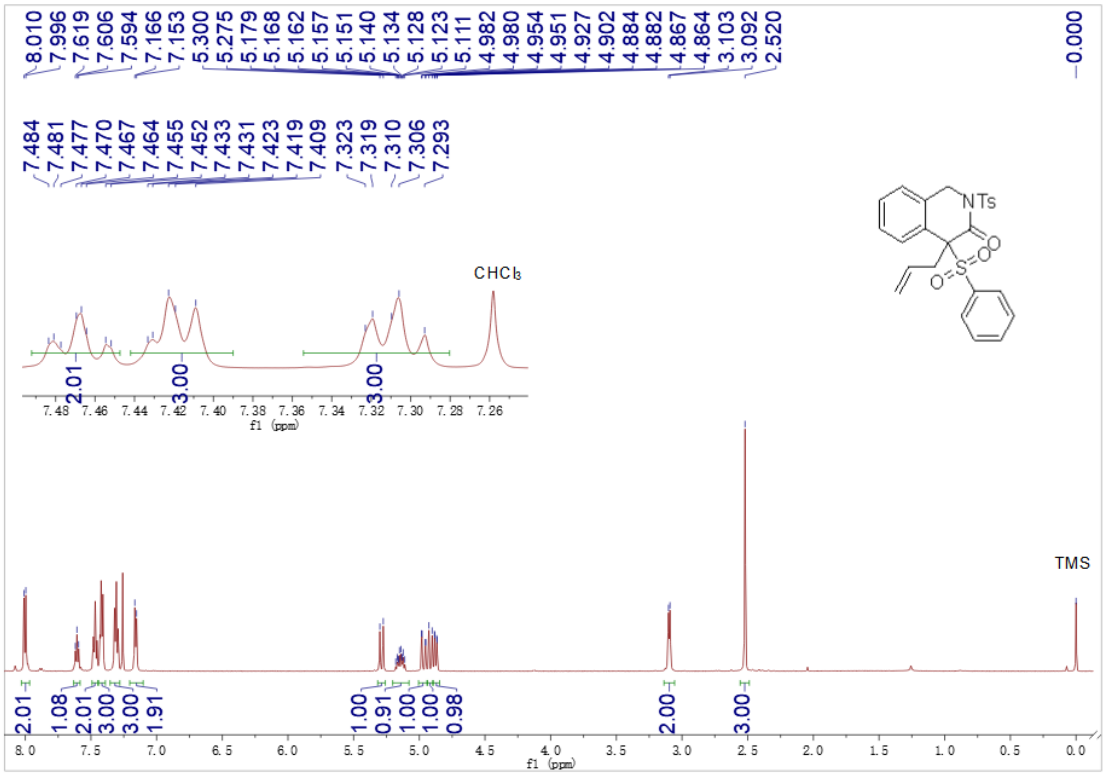

$^{13}$C{$^{1}$H} NMR of **5c** ($CDCl_3$, 150 MHz)



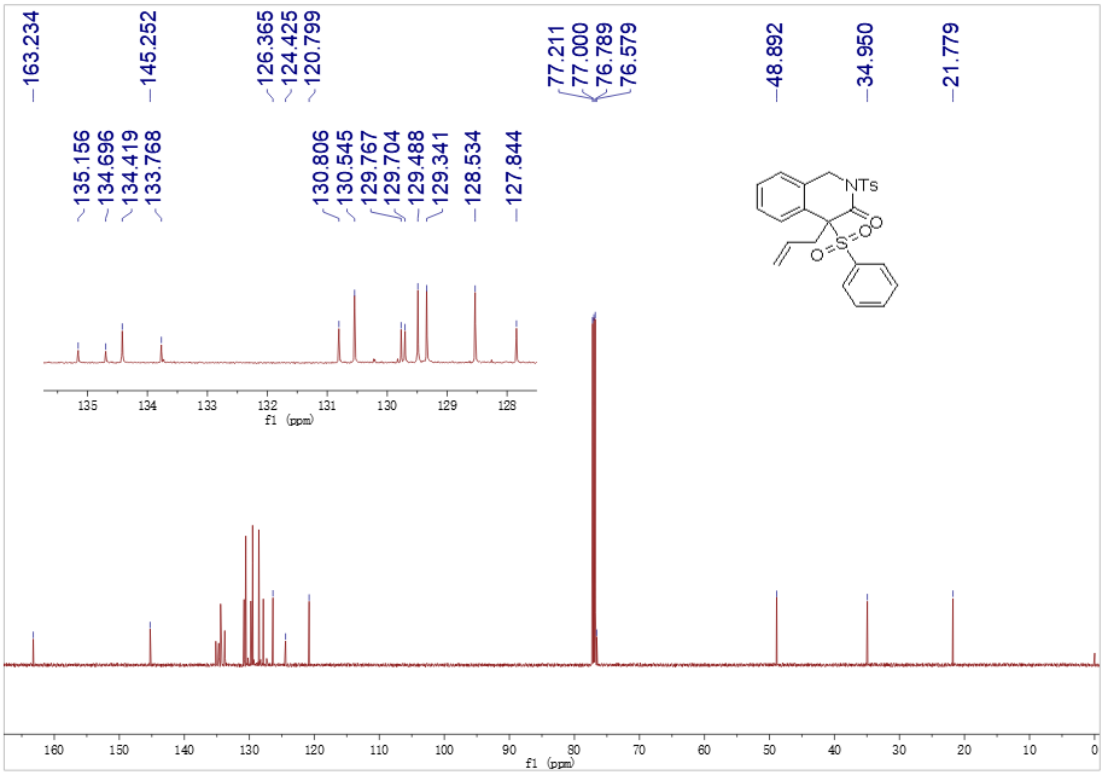

$^{1}$H NMR of **5d** ($CDCl_3$, 400 MHz)



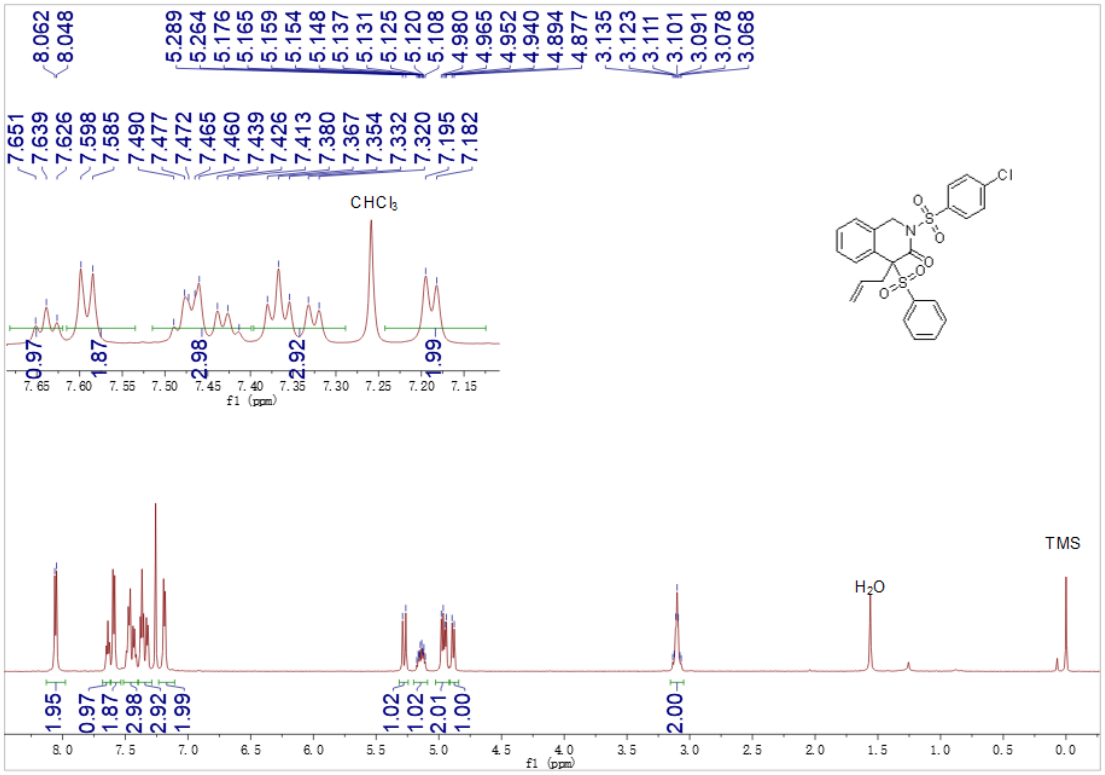

$^{13}$C{$^{1}$H} NMR of **5d** ($CDCl_3$, 100 MHz)



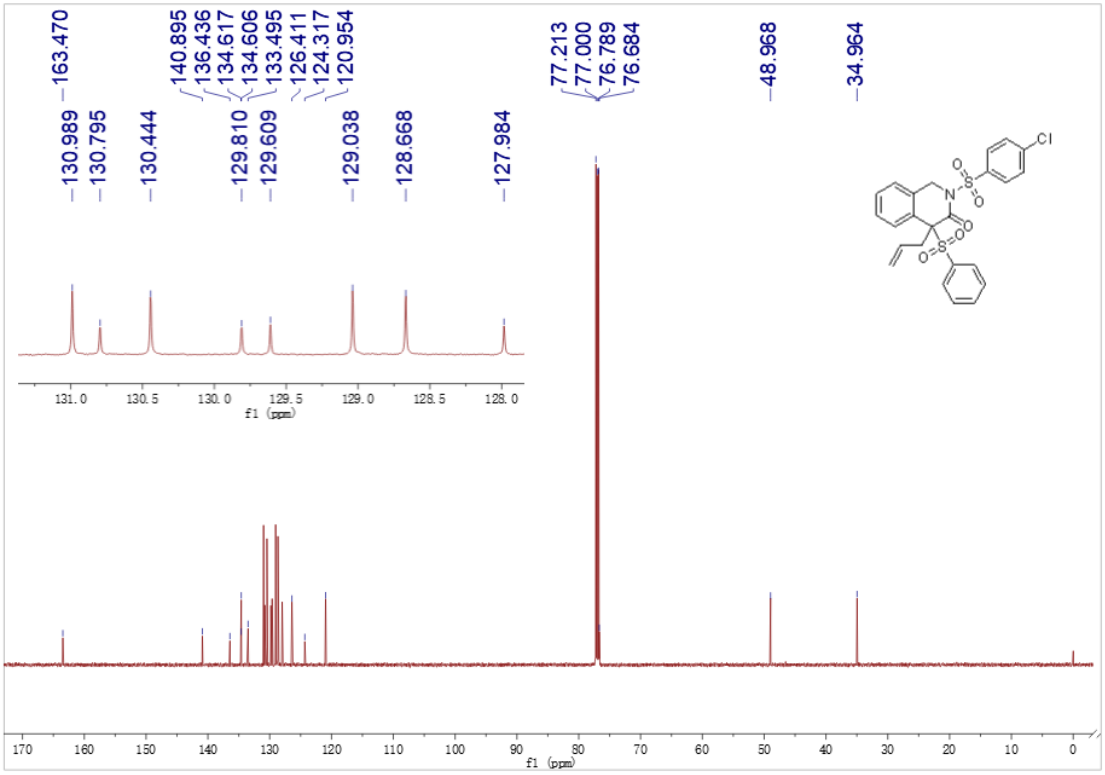

$^{1}$H NMR of **6a** ($CDCl_3$, 600 MHz)



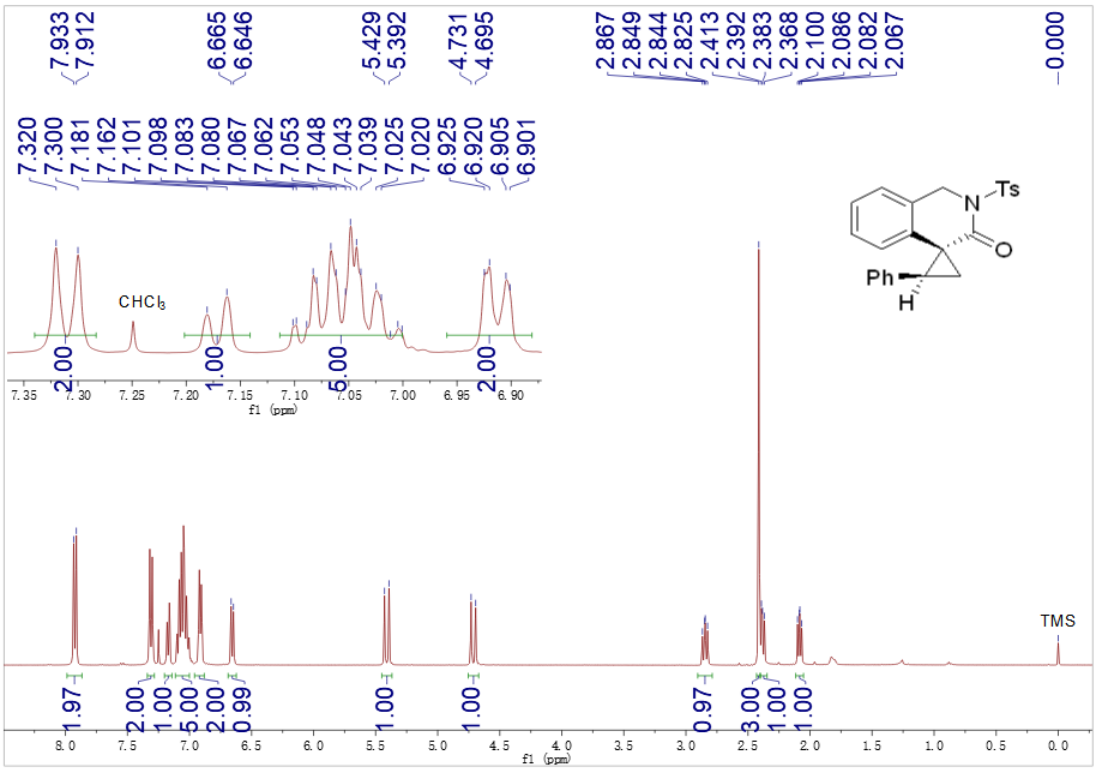

$^{13}$C{$^{1}$H} NMR of **6a** ($CDCl_3$, 150 MHz)



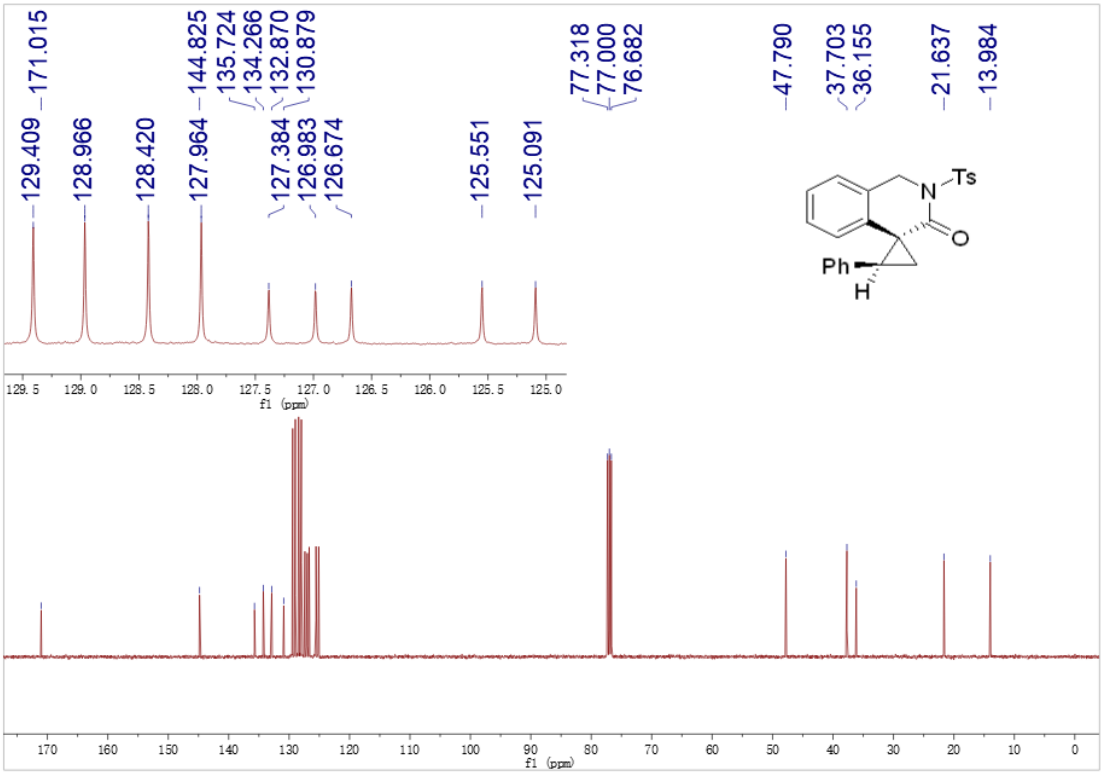

$^{1}$H NMR of **6b** ($CDCl_3$, 600 MHz)



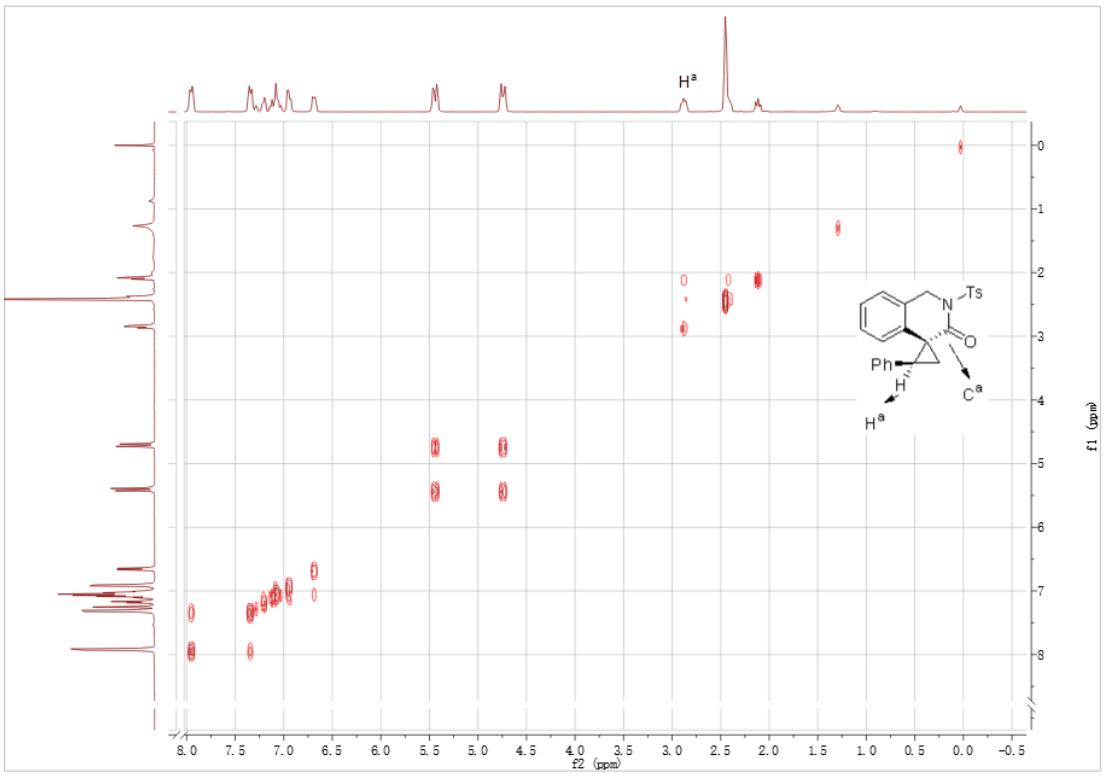

$^{13}$C{$^{1}$H} NMR of **6b** ($CDCl_3$, 150 MHz)




$^{1}$H NMR of **7** ($CDCl_3$, 400 MHz)




$^{13}$C{$^{1}$H} NMR of **7** ($CDCl_3$, 100 MHz)




$^{1}$H - $^{1}$H COSY NMR of **7** ($CDCl_3$, 400 MHz)


$^{1}$H - $^{13}$C HMBC NMR of **7** ($CDCl_3$, 100 MHz)