

Supporting Information

## Organocatalytic Asymmetric Formal [3+2] Cycloaddition Reaction of Isocyanoacetates with Saccharin-Derived 1-Azadienes

Li Chang,<sup>†</sup> Guang-Yu Zhu,<sup>†</sup> Ting Yang,<sup>†</sup> Xiao-Li Zhao,<sup>‡</sup> Min Shi<sup>†,§</sup> and Mei-Xin Zhao<sup>\*,†</sup>

<sup>†</sup> Key Laboratory for Advanced Materials and Institute of Fine Chemicals, School of Chemistry & Molecular Engineering, East China University of Science and Technology, 130 Mei Long Road, Shanghai, 200237, P. R. China

E-mail: mxzhao@ecust.edu.cn

<sup>‡</sup> Shanghai Key Laboratory of Green Chemistry and Chemical Processes, Department of Chemistry, East China Normal University, 3663 North Zhongshan Road, Shanghai 200062, China

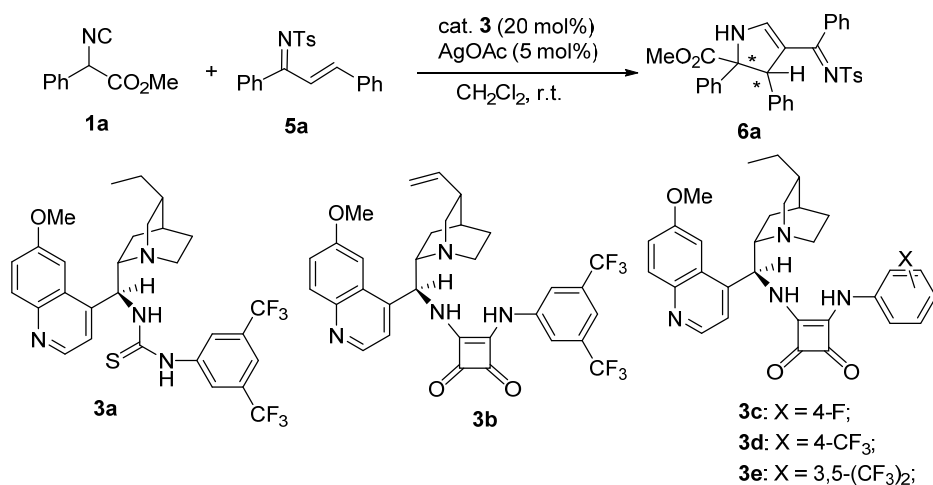
<sup>§</sup> State Key Laboratory of Organometallic Chemistry, Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences, 354 Fenglin Road, Shanghai 200032, P. R. China

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# 1. Optimization Reaction Conditions of Catalytic Asymmetric Formal [3+2] Cycloaddition Reaction of Isocyanoacetate **1a** with Chalcone-derived Tosylimine **5a**

Table S1 Catalysts screening and optimization reaction conditions<sup>[a]</sup>



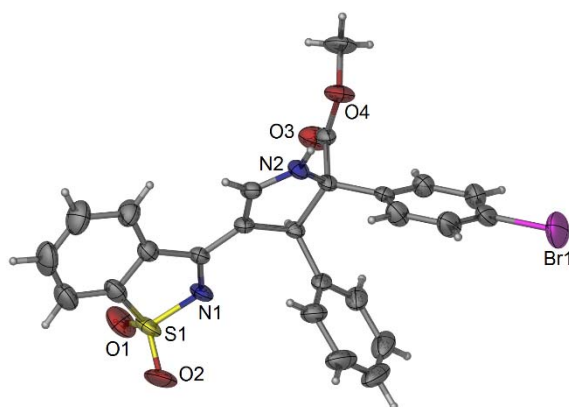
Entry	Catalyst	<i>t</i> (h)	<i>T</i> [°C]	Yield (%)	<i>d</i> <i>r</i> <sup>[b]</sup>	<i>ee</i> (%) <sup>[c]</sup>
1	<b>3a</b>	0.5	r.t.	99	0.9:1	25 (4)
2	<b>3b</b>	0.5	r.t.	99	2.6:1	63 (36)
3	<b>3c</b>	0.5	r.t.	99	2.1:1	39 (9)
4	<b>3d</b>	0.5	r.t.	99	2.1:1	42 (8)
5	<b>3e</b>	0.5	r.t.	99	1.8:1	65 (37)
6	<b>3e</b>	0.5	0	99	2.2:1	55 (24)
7	<b>3e</b>	0.5	40	99	2.6:1	60 (29)
8 <sup>[d]</sup>	<b>3e</b>	0.5	r.t.	99	3.1:1	67 (28)
9 <sup>[e]</sup>	<b>3e</b>	2	r.t.	99	2.1:1	58 (41)
10 <sup>[f]</sup>	<b>3e</b>	2	r.t.	99	2.2:1	80 (52)
11 <sup>[f]</sup>	<b>3e</b>	2	<b>10</b>	<b>99</b>	<b>4.2:1</b>	<b>81 (35)</b>
12 <sup>[f]</sup>	<b>3e</b>	2	0	99	2.1:1	74 (48)
13 <sup>[f]</sup>	<b>3e</b>	2	-20	99	3.0:1	59 (43)

[a] Unless otherwise noted, all of reactions were carried out with isocyanoacetate **1a** (0.12 mmol),  $\alpha$ ,  $\beta$ -unsaturated imine **5a** (0.10 mmol), AgOAc (5 mol%) and catalyst **3** (0.02 mmol) in 2.0 mL of CH<sub>2</sub>Cl<sub>2</sub>. The data in parentheses are the *ee* value for minor isomer. [b] Determined by <sup>1</sup>H NMR analysis for the pure product, the data in parenthesis was the *ee* for minor isomer. [c] Enantiomeric excesses were determined by chiral HPLC analysis. [d] 30 mg of 4Å molecular sieves was added. [e] **1a** was added dropwise. [f] **5a** was added dropwise.

## 2. X-Ray Crystal Data of Compound 4d

Table S2. Crystal data and structure refinement for **4d** (CCDC 2010595).

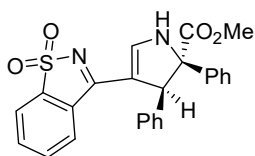
Empirical formula	C <sub>25</sub> H <sub>19</sub> BrN <sub>2</sub> O <sub>4</sub> S
Formula weight	523.39
Temperature	293(2) K
Wavelength	1.54184 Å
Crystal system	orthorhombic
Space group	P 21 21 21
Unit cell dimensions	a = 6.73540(10) Å      α = 90°. b = 18.2897(2) Å      β = 90°. c = 19.0257(2) Å      γ = 90°.
Volume	2343.75(5) Å <sup>3</sup>
Z	4
Density (calculated)	1.483 Mg/m <sup>3</sup>
Absorption coefficient	3.514 mm <sup>-1</sup>
F (000)	1064.0
Crystal size	0.43 x 0.37 x 0.35 mm <sup>3</sup>
Theta range for data collection	4.648 to 67.073°
Index ranges	-6 ≤ h ≤ 8, -16 ≤ k ≤ 21, -22 ≤ l ≤ 22
Reflections collected	23450
Independent reflections	4171 [R (int) = 0.0719]
Data / restraints / parameters	4171 / 0 / 300
Goodness-of-fit on F <sup>2</sup>	1.036
Final R indices [I > 2σ(I)]	R1 = 0.0488, wR2 = 0.1277
R indices (all data)	R1 = 0.0499, wR2 = 0.1286
Largest diff. peak and hole	1.077 and -0.832 e.Å <sup>-3</sup>



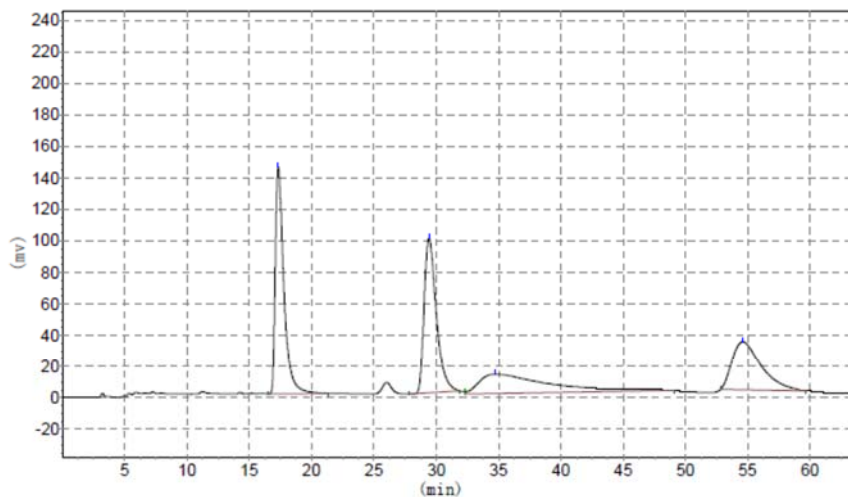
**Figure S1.** ORTEP plot of the X-ray crystal structure of **4d**. Displacement ellipsoids are drawn at the 50% probability level.

### 3. Copies of HPLC Analysis Spectra of Compounds 4

#### 4a (Table 3, entry 1)

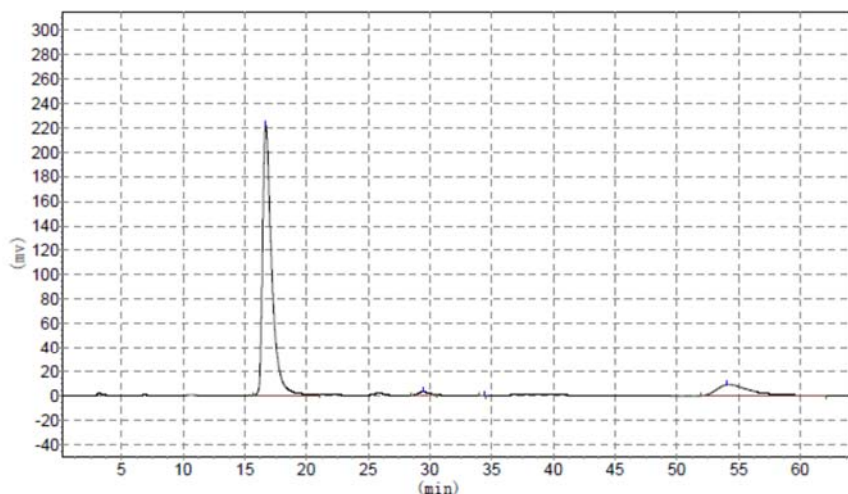


#### Racemic



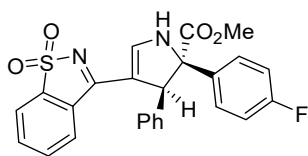
Peak	Retention time	Height	Area	Area %
1	17.320	144459.594	6955945.000	29.6249
2	29.422	98839.133	6728073.500	28.6544
3	34.737	12470.685	4815525.000	20.5090
4	54.575	30926.441	4980514.500	21.2117
Total		286695.853	23480058.000	100.0000

#### Chiral

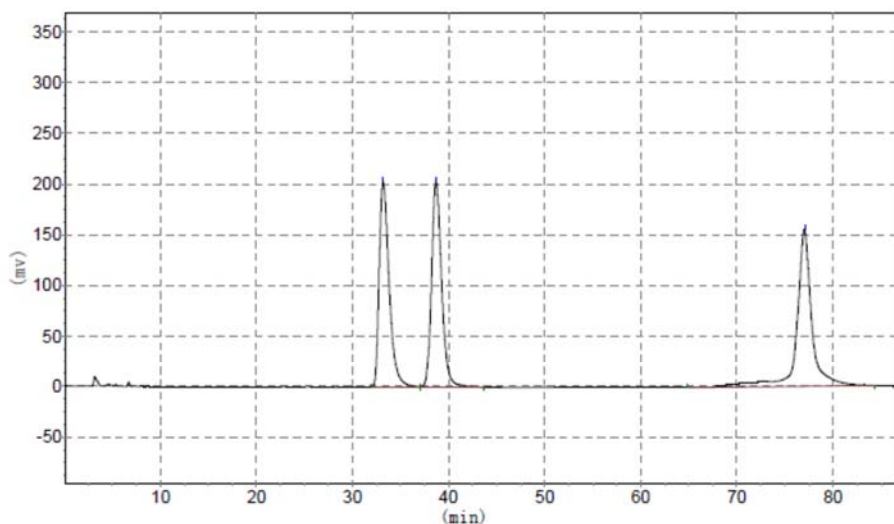


Peak	Retention time	Height	Area	Area%
1	16.708	222010.891	11511507.000	85.3617
2	29.460	3167.785	200083.656	1.4837
3	34.403	39.850	608.900	0.0045
4	54.102	9107.561	1773365.125	13.1501
Total		234326.086	13485564.681	100.0000

#### 4b (Table 3, entry 2)

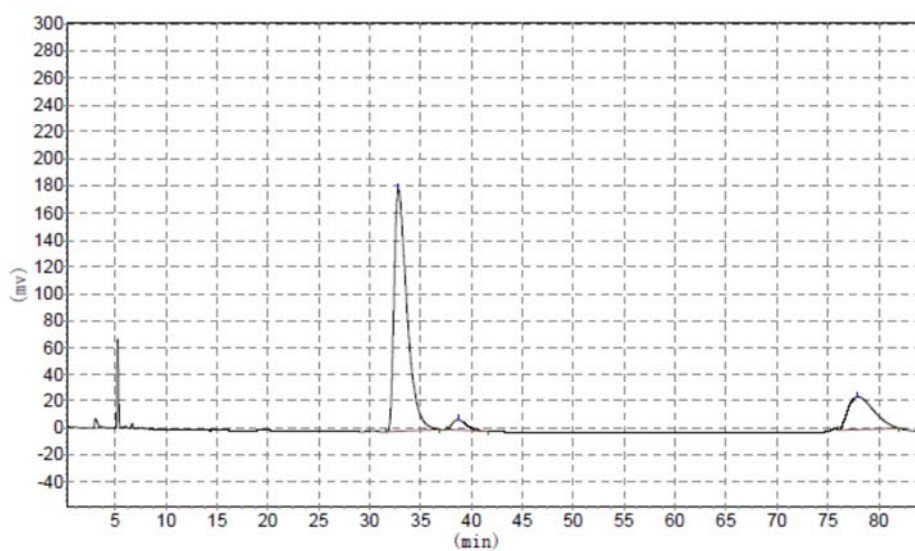


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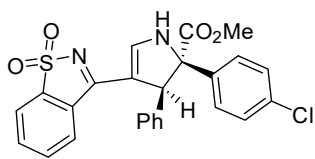
Peak	Retention time	Height	Area	Area%
1	33.198	203557.453	14832495.000	31.0386
2	38.698	204110.969	14984826.000	31.3573
3	77.032	156235.672	17969982.000	37.6041
<b>Total</b>		563904.094	47787303.000	100.0000

#### Chiral

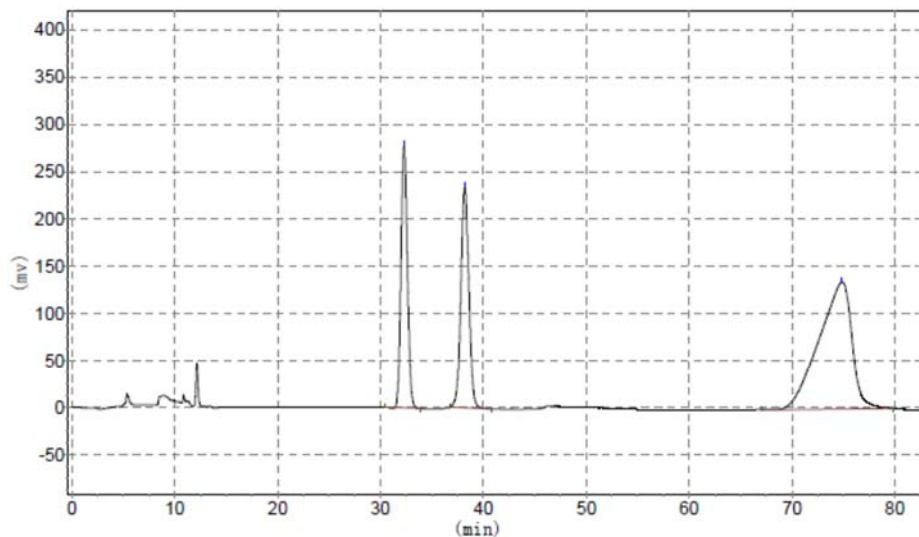


Peak	Retention time	Height	Area	Area%
1	32.840	180023.406	15921050.000	76.1714
2	38.693	7756.487	734860.813	3.5158
3	77.973	24342.518	4245689.500	20.3127
<b>Total</b>		212122.411	20901600.313	100.0000

#### 4c (Table 3, entry 3)

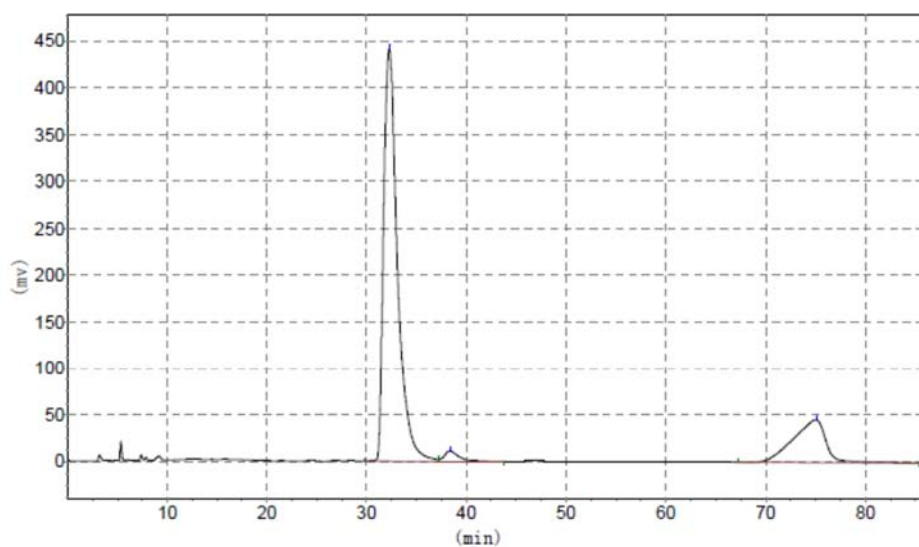


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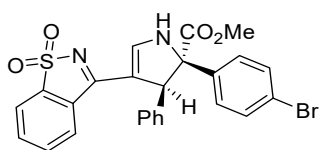
Peak	Retention time	Height	Area	Area%
1	32.283	277216.094	12126523.000	22.0311
2	38.180	233887.828	12719610.000	23.1086
3	74.867	135616.953	30196638.000	54.8603
<b>Total</b>		<b>646720.875</b>	<b>55042771.000</b>	<b>100.0000</b>

#### Chiral

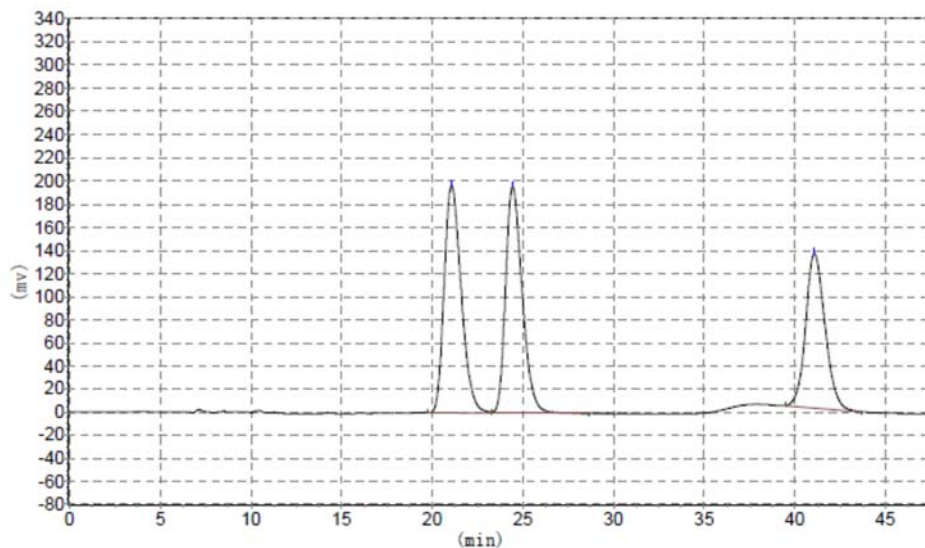


Peak	Retention time	Height	Area	Area%
1	32.265	441384.375	42698292.000	78.3683
2	38.332	11481.805	1318577.375	2.4201
3	75.065	45657.258	10467236.000	19.2115
<b>Total</b>		<b>498523.438</b>	<b>54484105.375</b>	<b>100.0000</b>

#### 4d (Table 3, entry 4)

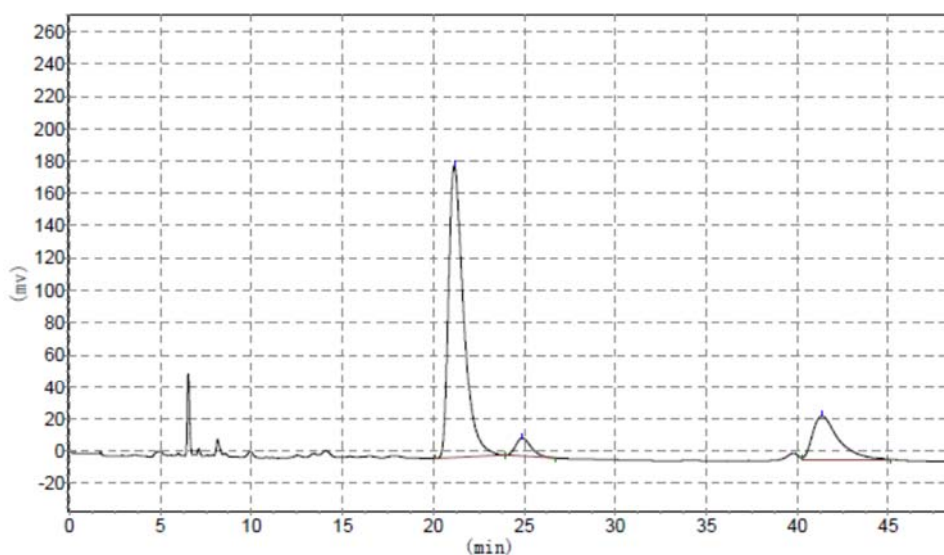


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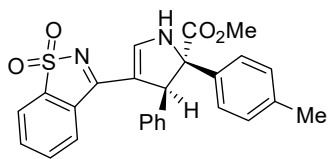
Peak	Retention time	Height	Area	Area%
1	21.068	196950.250	12906293.000	36.4017
2	24.440	195870.234	12527485.000	35.3333
3	41.077	134231.891	10021445.000	28.2651
<b>Total</b>		<b>527052.375</b>	<b>35455223.000</b>	<b>100.0000</b>

#### Chiral

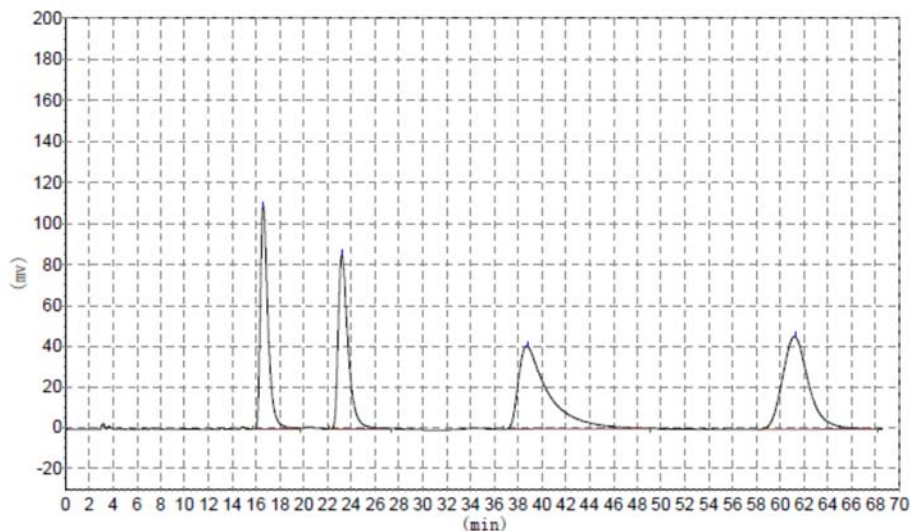


Peak	Retention time	Height	Area	Area%
1	21.143	181092.813	10386256.000	75.7206
2	24.880	11198.487	670833.688	4.8907
3	41.358	26753.791	2659457.750	19.3887
<b>Total</b>		<b>219045.091</b>	<b>13716547.438</b>	<b>100.0000</b>

#### 4e (Table 3, entry 5)

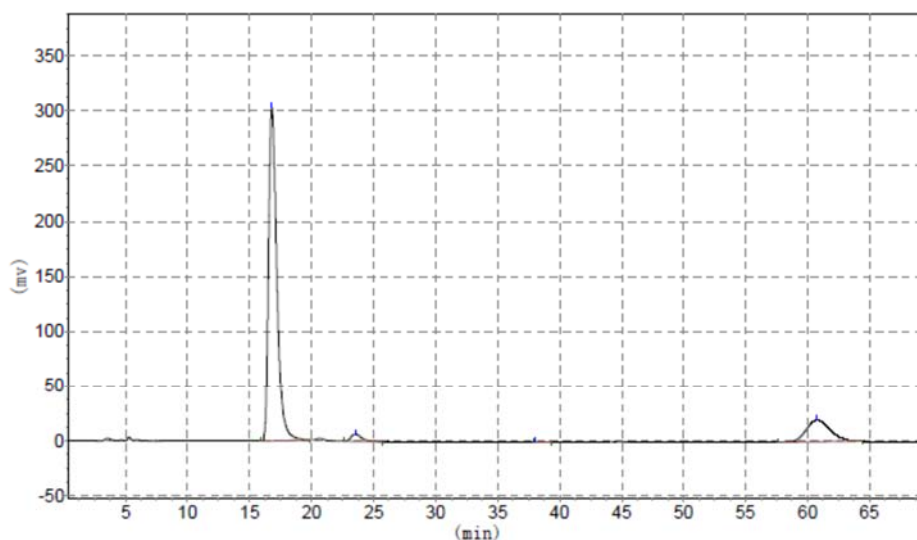


#### Racemic



Peak	Retention time	Height	Area	Area%
1	16.615	109378.844	4955883.500	20.2611
2	23.215	85759.695	5074097.500	20.7444
3	38.782	41492.289	7435519.000	30.3985
4	61.248	45931.684	6994635.000	28.5961
Total		282562.512	24460135.000	100.000

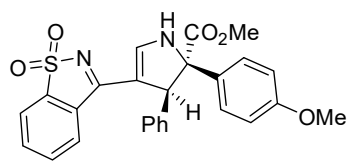
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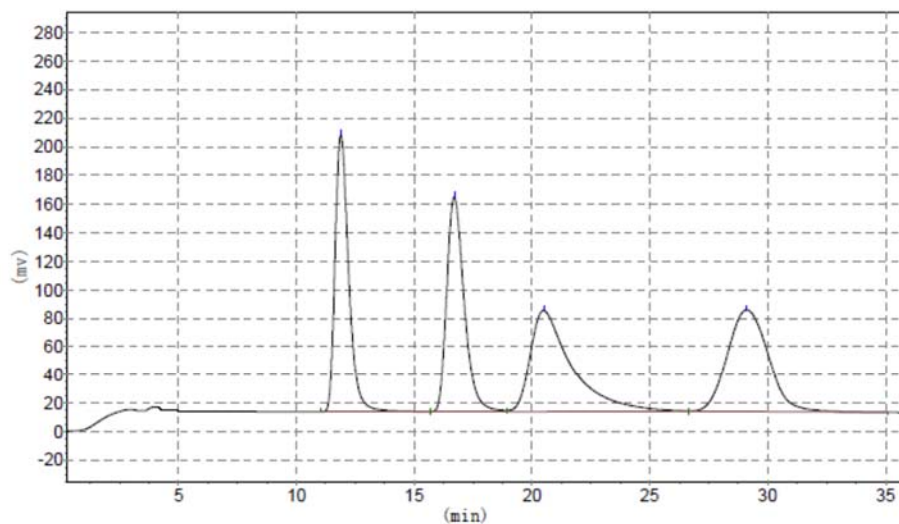
Peak	Retention time	Height	Area	Area%
1	16.802	302620.000	13695628.000	81.7622
2	23.530	6553.463	376609.250	2.2483
3	38.098	50.934	1762.601	0.0105
4	60.770	19639.793	2676559.000	15.9789
Total		328864.190	16750558.851	100.0000



**4f (Table 3, entry 6)**

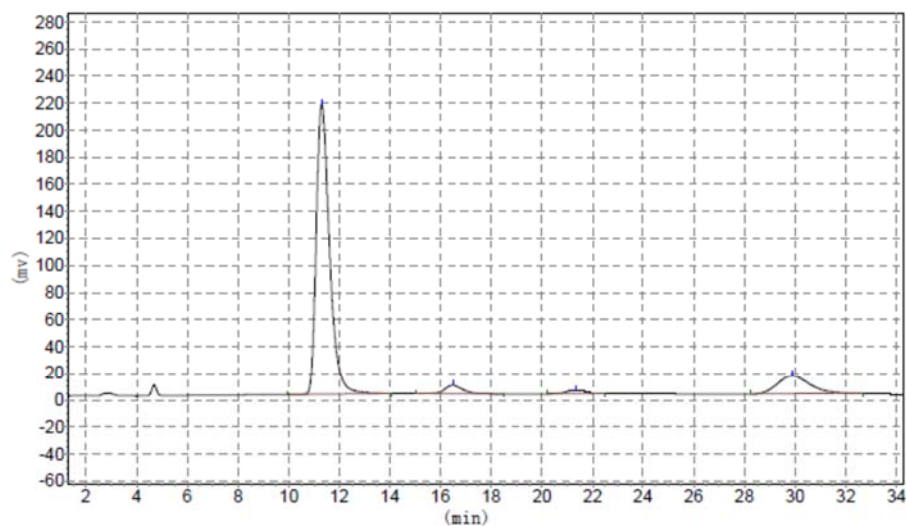


**Racemic**



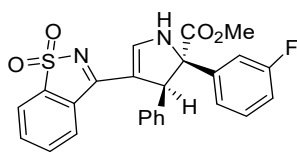
Peak	Retention time	Height	Area	Area%
1	11.878	194710.078	7842179.500	23.6974
2	16.693	151225.891	7822154.500	23.6369
3	20.483	71474.602	8730518.000	26.3818
4	29.110	71885.336	8698129.000	26.2839
<b>Total</b>		489295.906	33092981.000	100.0000

**Chiral**

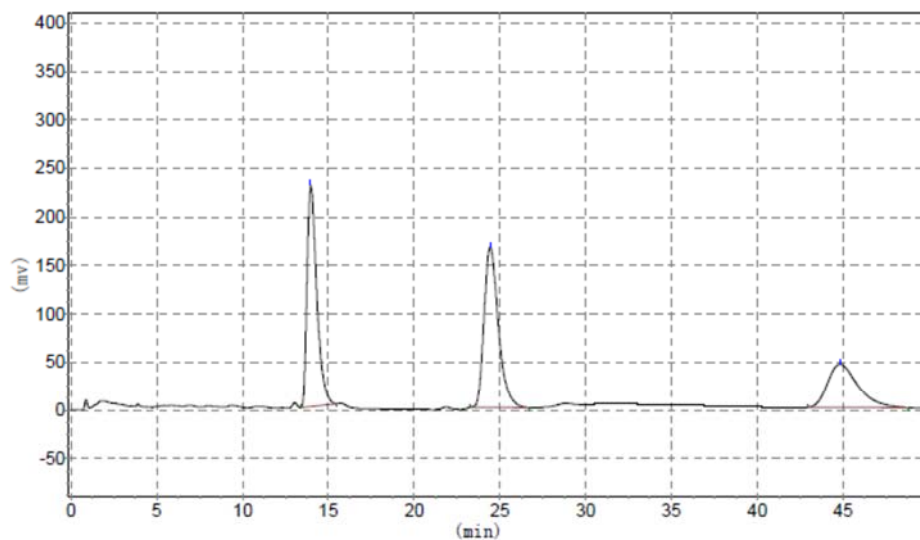


Peak	Retention time	Height	Area	Area%
1	11.307	215164.859	7801078.000	82.8532
2	16.473	6121.896	299016.125	3.1758
3	21.365	2431.196	133643.063	1.4194
4	29.878	13475.732	1181805.375	12.5516
<b>Total</b>		237193.683	9415542.563	100.0000

### 4g (Table 3, entry 7)

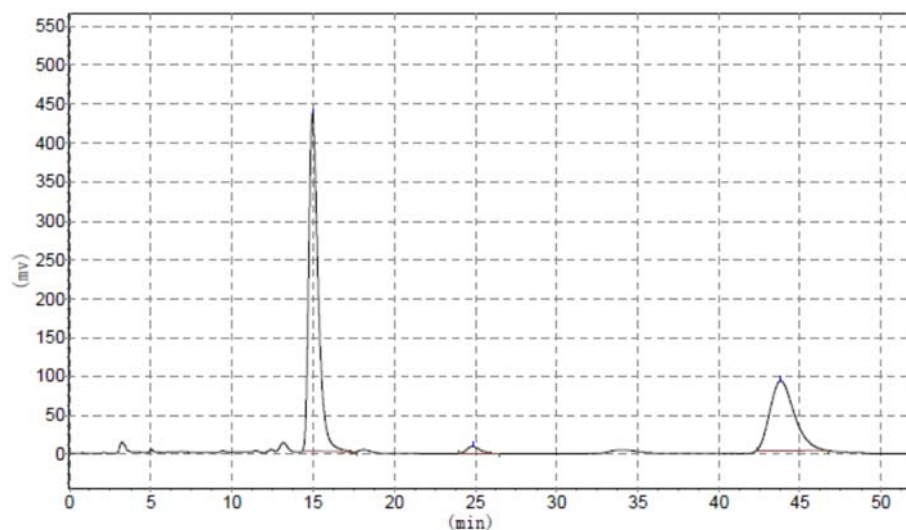


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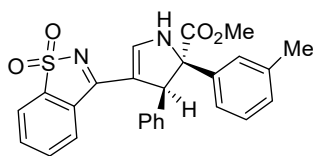
Peak	Retention time	Height	Area	Area%
1	13.980	228819.375	9059898.000	37.1878
2	24.438	166808.047	9706435.000	39.8417
3	44.820	45369.629	5596195.500	22.9705
<b>Total</b>		<b>440997.051</b>	<b>24362528.500</b>	<b>100.0000</b>

#### Chiral

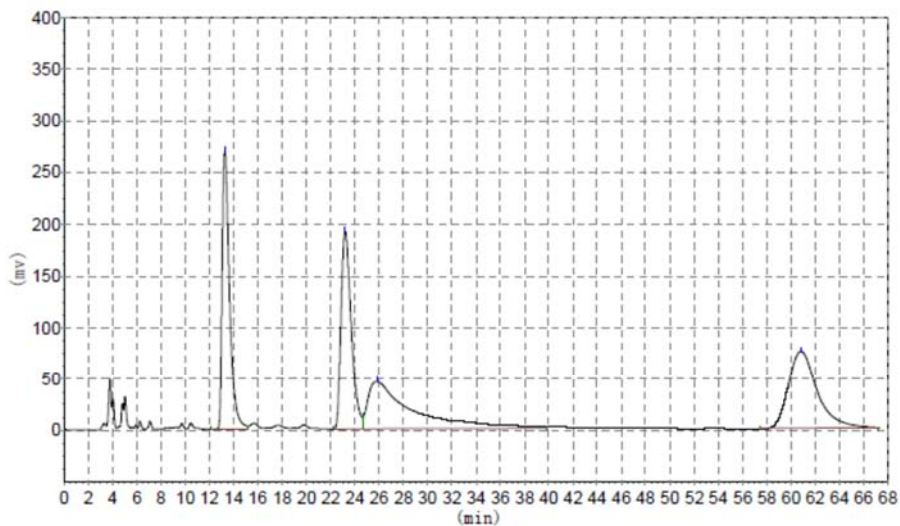


Peak	Retention time	Height	Area	Area%
1	14.955	434502.188	17442820.000	64.0665
2	24.823	8786.945	477696.906	1.7546
3	43.803	89388.383	9305614.000	34.1790
<b>Total</b>		<b>532677.516</b>	<b>27226130.906</b>	<b>100.0000</b>

#### 4h (Table 3, entry 8)

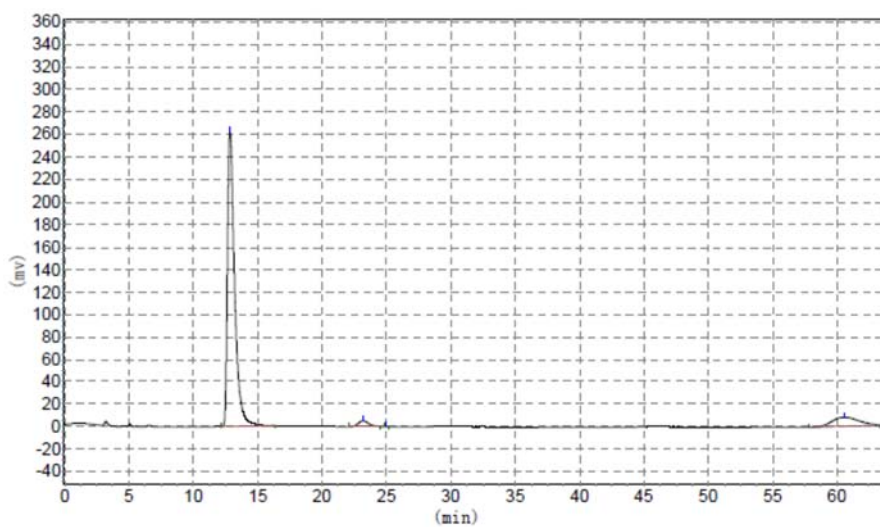


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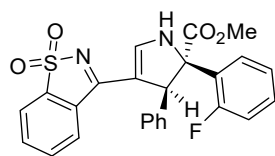
Peak	Retention time	Height	Area	Area%
1	13.265	270299.188	11481567.000	23.8575
2	23.215	192775.688	11405680.000	23.6998
3	25.815	46635.980	12638654.000	26.2618
4	60.882	75855.086	12599795.000	26.1810
Total		585565.941	48125696.000	100.0000

#### Chiral

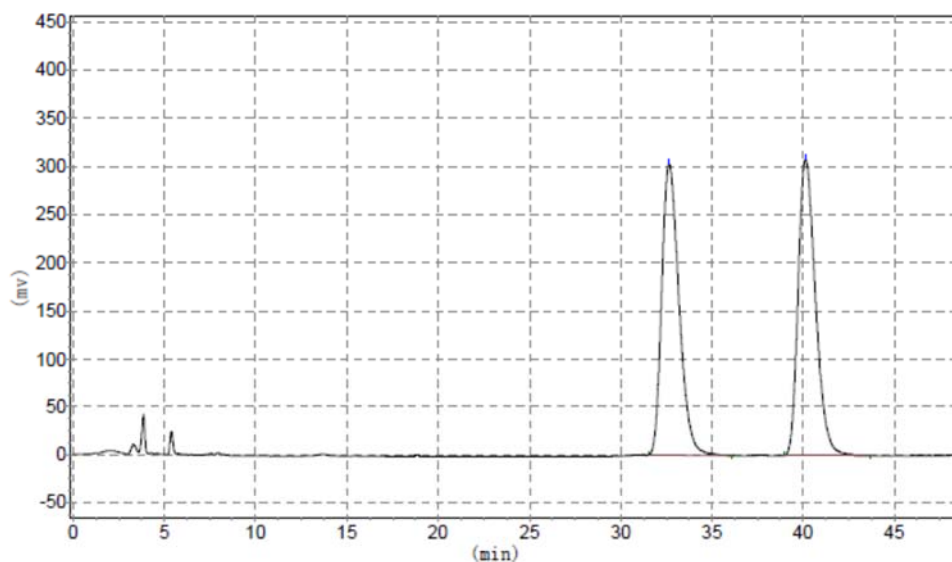


Peak	Retention time	Height	Area	Area%
1	12.855	261923.563	10136469.000	87.4364
2	23.182	5082.784	276807.250	2.3877
3	24.958	31.316	381.300	0.0033
4	60.577	8134.773	1179300.125	10.1726
Total		275172.436	11592957.675	100.0000

#### 4i (Table 3, entry 9)

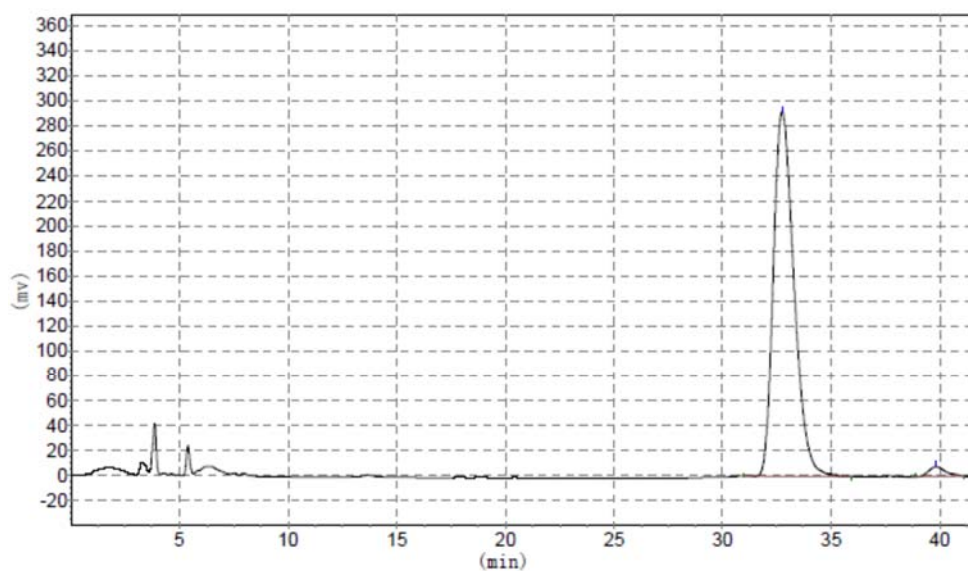


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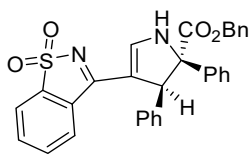
Peak	Retention time	Height	Area	Area%
1	32.657	303750.594	19968188.000	49.4168
2	40.140	308599.563	20439530.000	50.5832
<b>Total</b>		612350.156	40407718.000	100.0000

#### Chiral

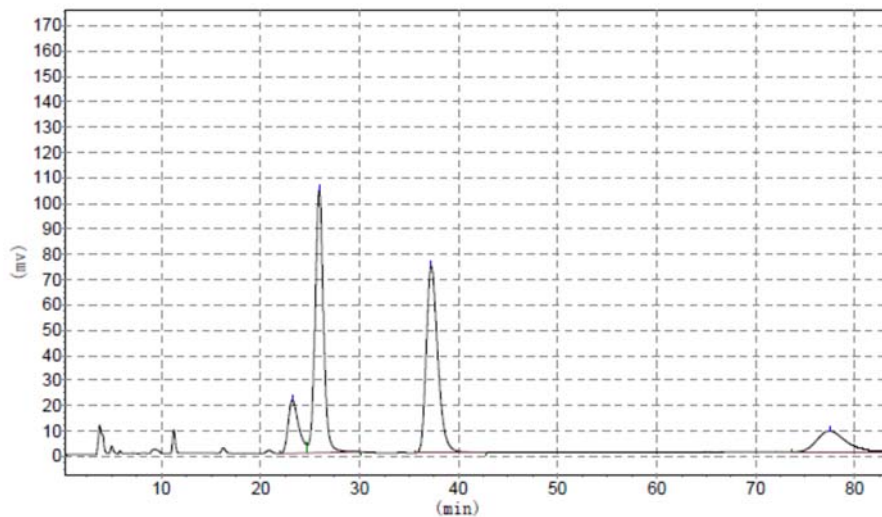


Peak	Retention time	Height	Area	Area%
1	32.737	291654.781	19232560.000	97.7878
2	39.832	8096.853	435087.594	2.2122
<b>Total</b>		299751.634	19667647.594	100.0000

#### 4k (Table 3, entry 11)

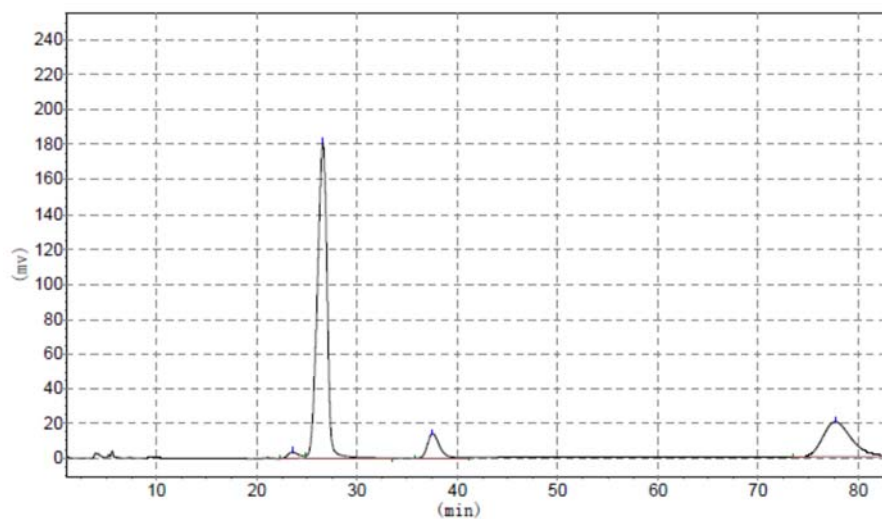


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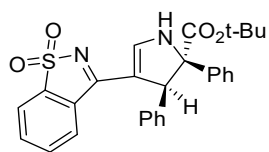
Peak	Retention time	Height	Area	Area%
1	23.228	20910.697	1542704.250	10.0240
2	25.948	104093.125	6131290.000	39.8394
3	37.250	74177.664	6023186.000	39.1369
4	77.453	8217.164	1692852.000	10.9997
<b>Total</b>		207398.650	15390032.250	100.0000

#### Chiral

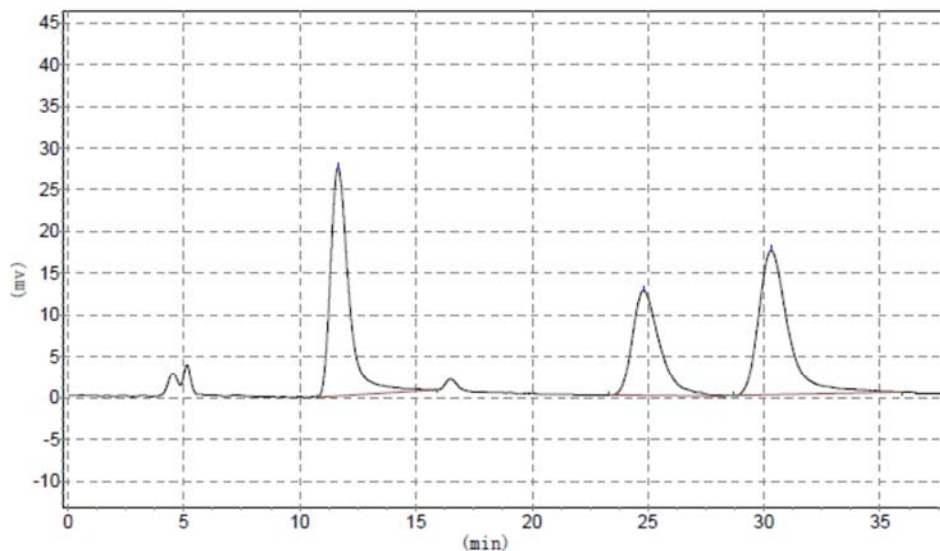


Peak	Retention time	Height	Area	Area%
1	23.532	3570.706	282637.406	1.5947
2	26.588	180916.906	12200495.000	68.8362
3	37.535	14089.200	1165943.250	6.5783
4	77.682	20132.754	4074880.750	22.9908
<b>Total</b>		218709.566	17723956.406	100.0000

4l (Table 3, entry 12)

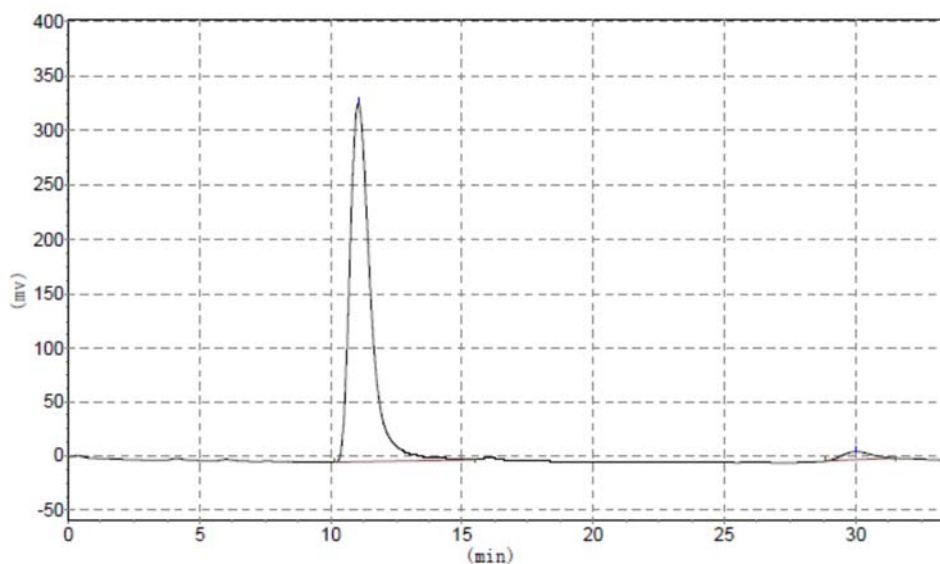


Racemic



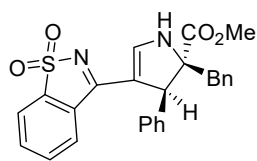
Peak	Retention time	Height	Area	Area%
1	11.645	27423.449	1522017.125	36.9237
2	24.813	12685.854	1039606.563	25.2206
3	30.307	17395.816	1560434.500	37.8557
<b>Total</b>		57505.120	4122058.188	100.0000

Chiral

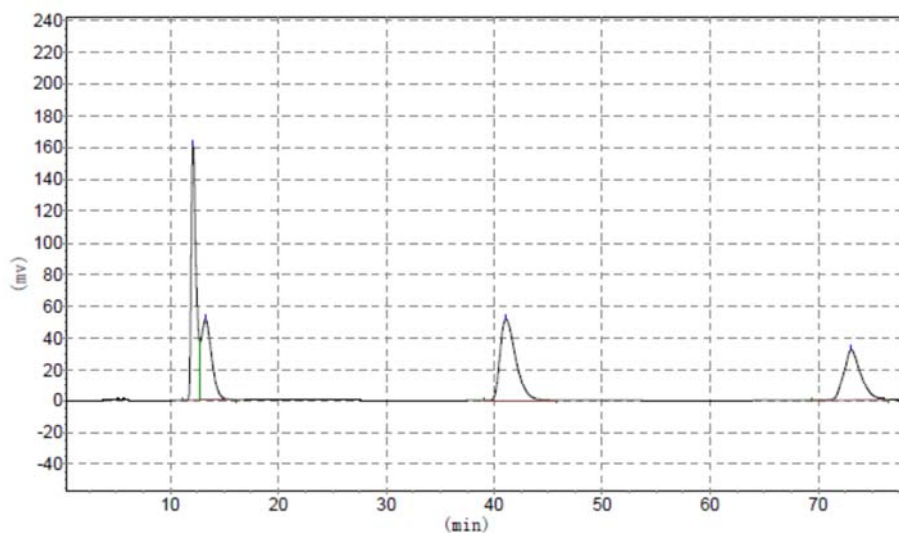


Peak	Retention time	Height	Area	Area%
1	11.045	330377.688	17988976.000	96.7999
2	30.018	7637.205	594700.000	3.2001
<b>Total</b>		338014.892	18583676.000	100.0000

#### 4m (Table 3, entry 13)

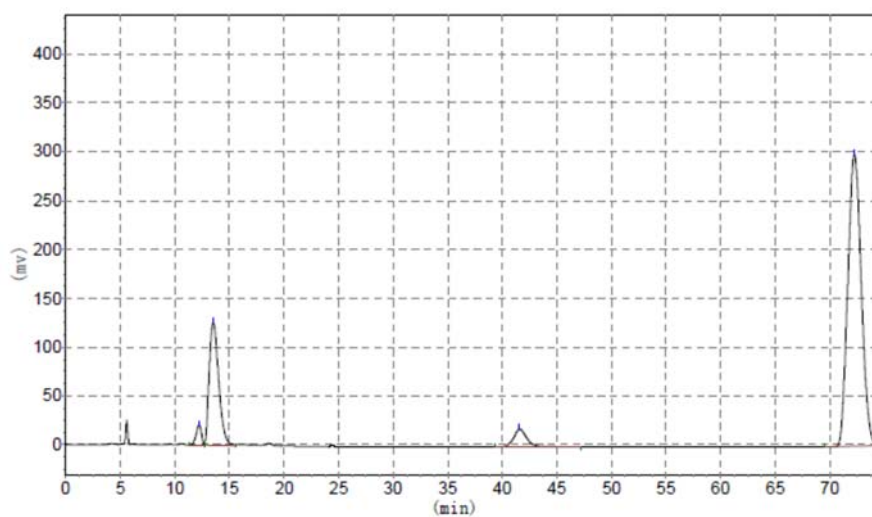


#### Racemic



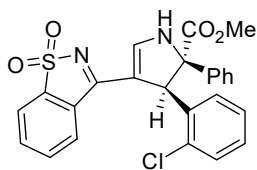
Peak	Retention time	Height	Area	Area%
1	12.090	161402.922	5310817.500	30.4710
2	13.237	51354.984	3383643.500	19.4138
3	41.088	51828.617	5216984.000	29.9326
4	73.078	32181.967	3517646.250	20.1826
<b>Total</b>		296768.490	17429091.250	100.0000

#### Chiral

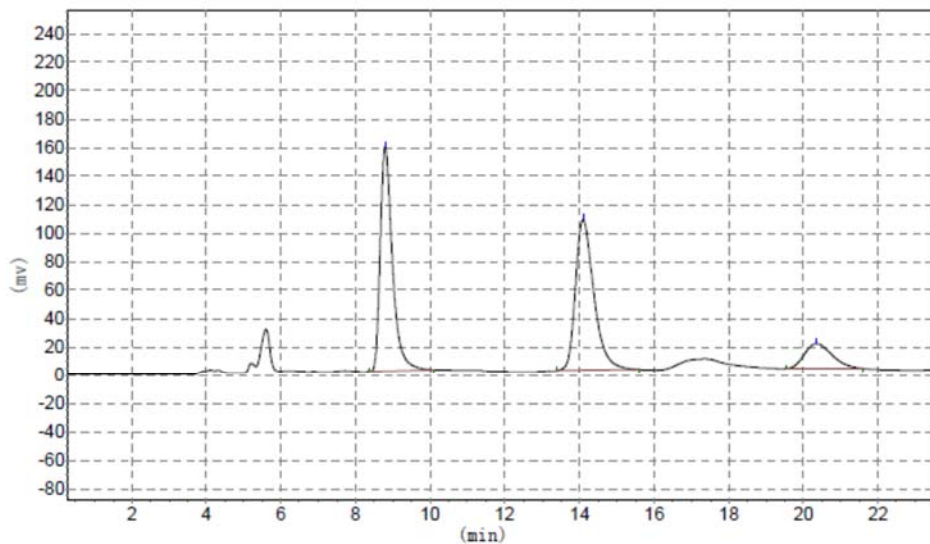


Peak	Retention time	Height	Area	Area%
1	12.212	20513.926	691226.375	1.9597
2	13.497	126119.852	7616079.500	21.5925
3	41.593	17859.039	1485583.375	4.2118
4	72.238	297892.031	25478998.000	72.2360
<b>Total</b>		462384.848	35271887.250	100.0000

### 4n (Table 4, entry 1)

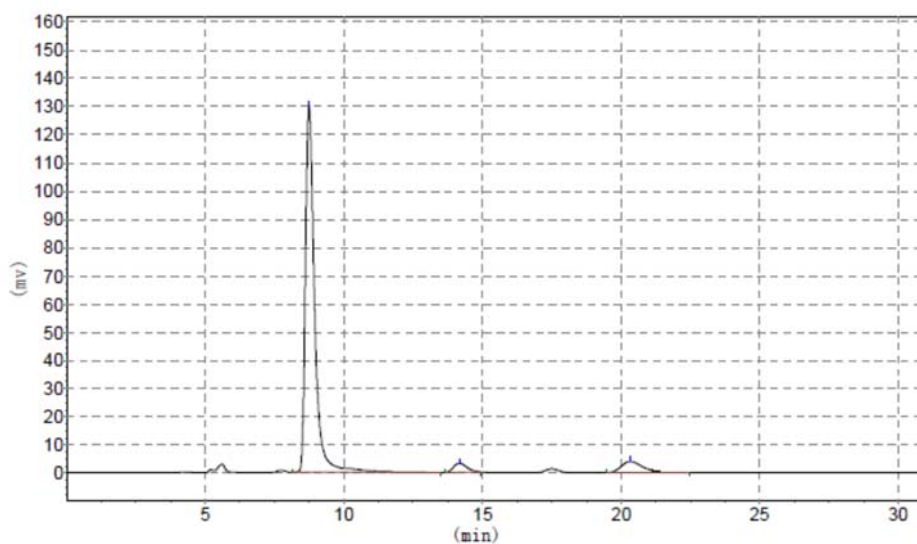


#### Racemic



Peak	Retention time	Height	Area	Area%
1	8.792	157742.156	3582106.000	43.9714
2	14.092	105834.430	3659770.250	44.9248
3	20.345	17628.172	904562.125	11.1038
<b>Total</b>		<b>281204.758</b>	<b>8146438.375</b>	<b>100.0000</b>

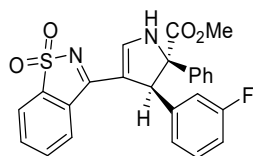
#### Chiral



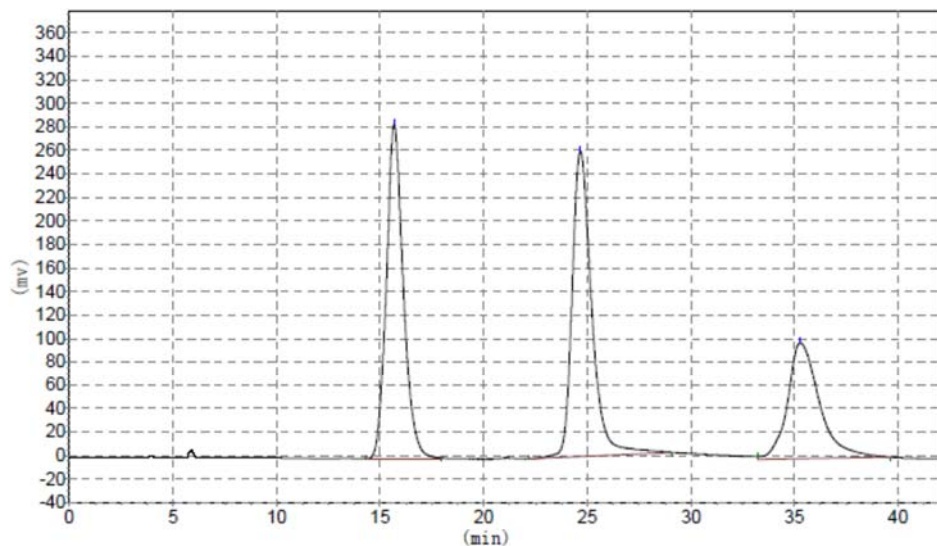
Peak	Retention time	Height	Area	Area%
1	8.740	130179.602	3035232.500	90.3376
2	14.165	3142.485	103617.398	3.0840
3	20.322	3998.549	221028.109	6.5785
<b>Total</b>		<b>137320.635</b>	<b>3359878.008</b>	<b>100.0000</b>



#### 4o (Table 4, entry 2)

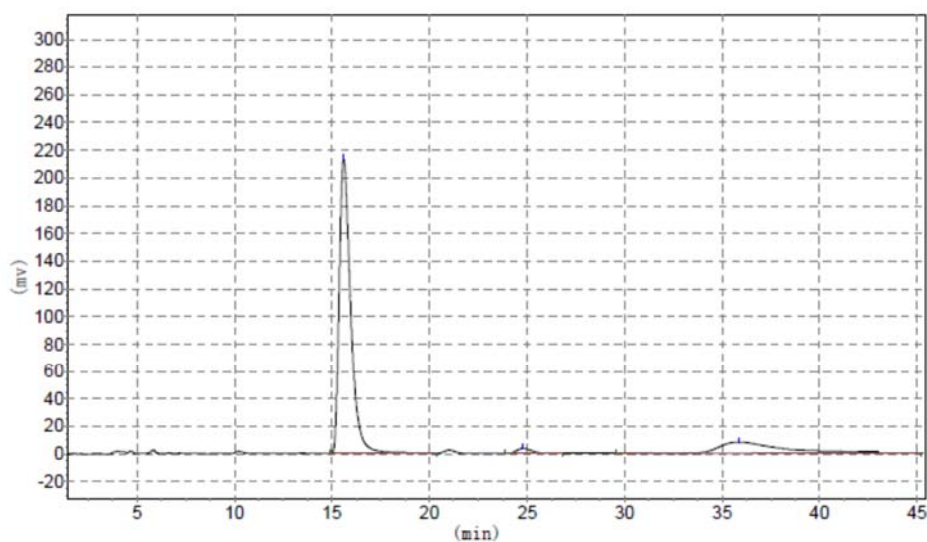


#### Racemic



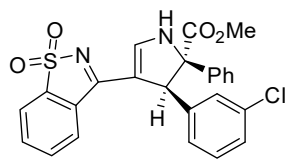
Peak	Retention time	Height	Area	Area%
1	15.673	285406.281	16221143.000	37.0300
2	24.660	260305.719	17044800.000	38.9103
3	35.290	99082.859	10539441.000	24.0597
<b>Total</b>		<b>644794.859</b>	<b>43805384.000</b>	<b>100.0000</b>

#### Chiral

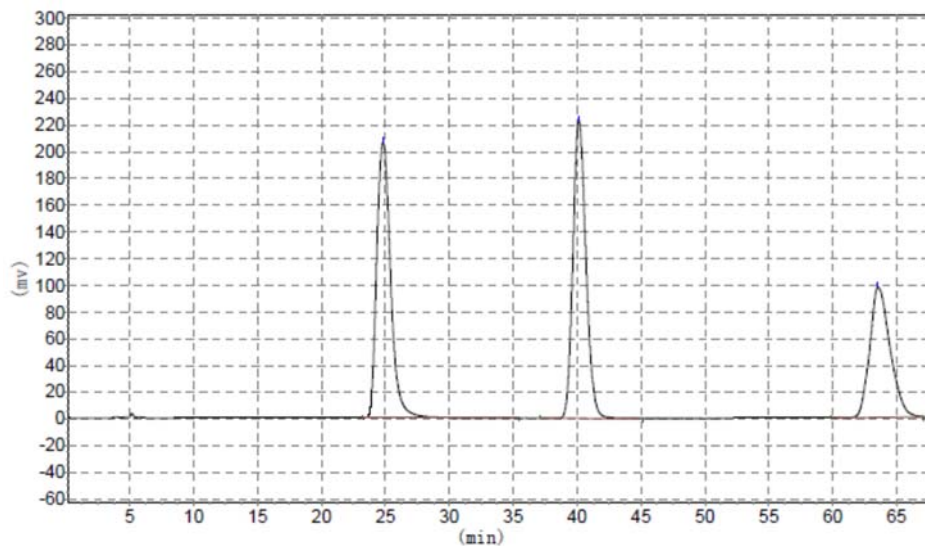


Peak	Retention time	Height	Area	Area%
1	15.592	213215.516	8755926.000	81.1981
2	24.790	3748.384	210882.281	1.9556
3	35.867	8195.339	1816604.125	16.8463
<b>Total</b>		<b>225159.238</b>	<b>10783412.406</b>	<b>100.0000</b>

### 4p (Table 4, entry 3)

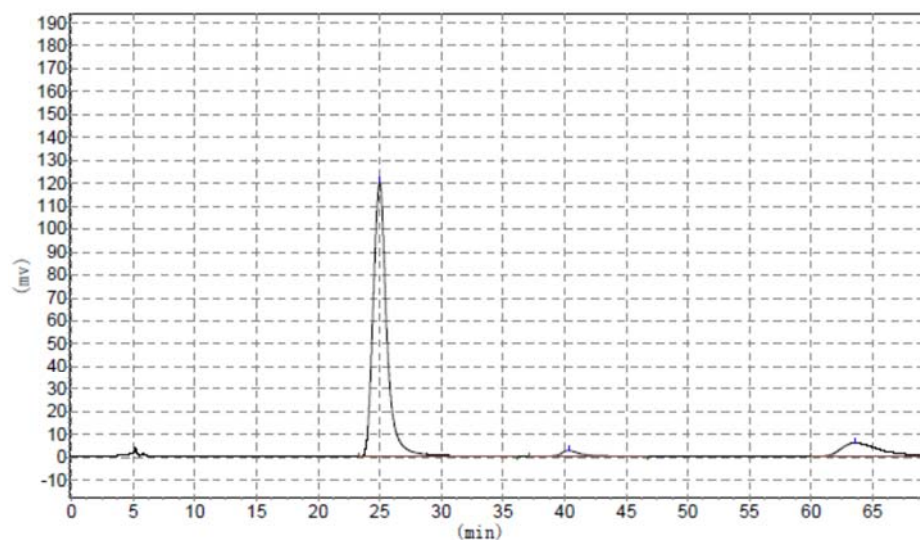


#### Racemic



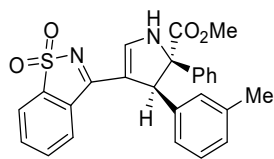
Peak	Retention time	Height	Area	Area%
1	24.825	206742.641	15763546.000	37.1447
2	40.140	223284.297	15807227.000	37.2476
3	63.557	97926.133	10867467.000	25.6077
<b>Total</b>		527953.070	42438240.000	100.0000

#### Chiral

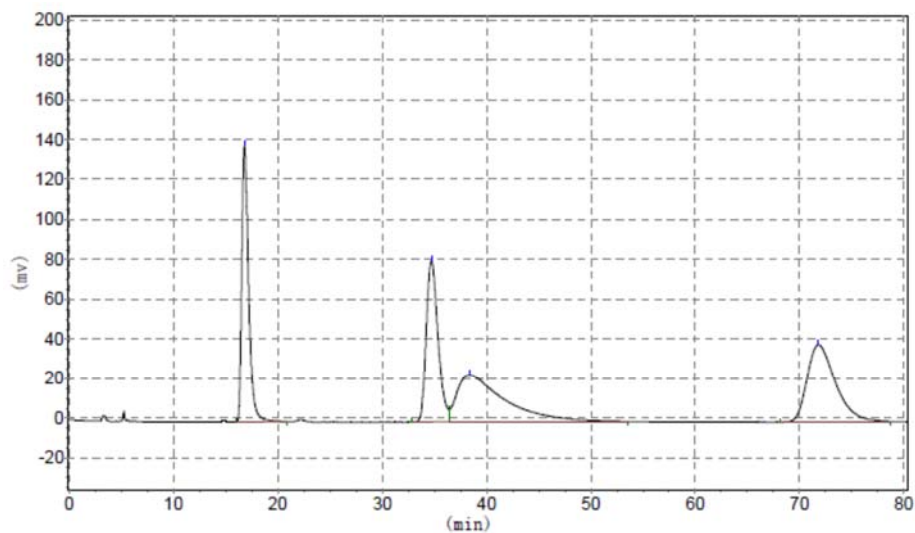


Peak	Retention time	Height	Area	Area%
1	24.998	119885.594	9201099.000	85.4607
2	40.332	2435.667	262005.406	2.4335
3	63.598	5846.000	1303361.500	12.1058
<b>Total</b>		128167.260	10766465.906	100.0000

**4q (Table 4, entry 4)**

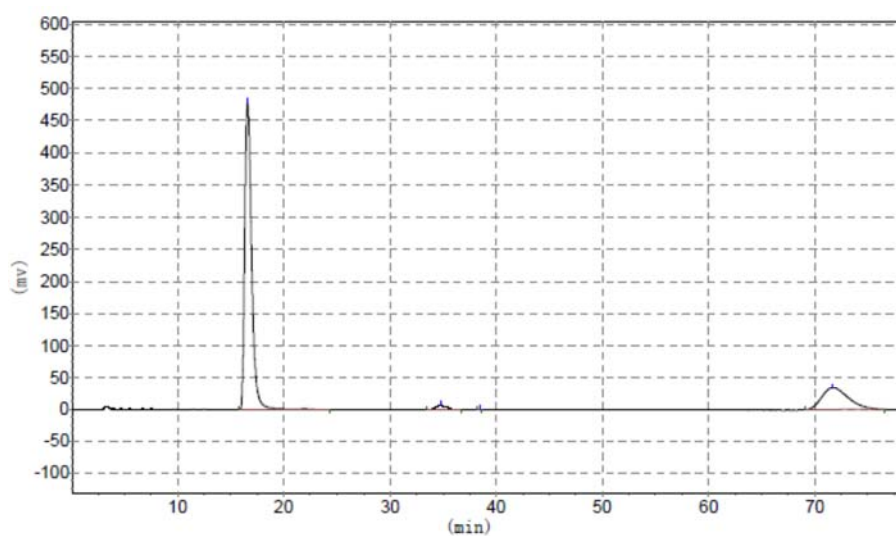


**Racemic**



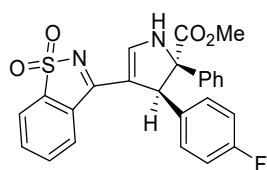
Peak	Retention time	Height	Area	Area%
1	16.788	138617.625	6356400.000	23.0090
2	34.708	81340.820	6364089.000	23.0368
3	38.348	23874.357	7608476.000	27.5413
4	71.793	39015.191	7296741.500	26.4129
<b>Total</b>		282847.994	27625706.500	100.0000

**Chiral**

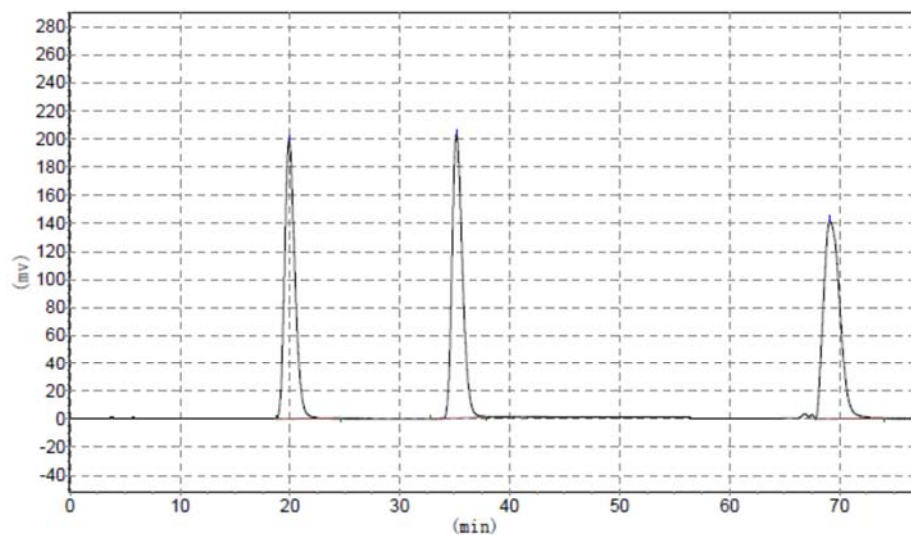


Peak	Retention time	Height	Area	Area%
1	16.583	478014.938	21671138.000	77.1799
2	34.733	5947.969	443781.813	1.5805
3	38.422	90.676	1055.800	0.0038
4	71.693	34259.816	5962764.500	21.2359
<b>Total</b>		518313.399	28078740.112	100.0000

#### 4r (Table 4, entry 5)

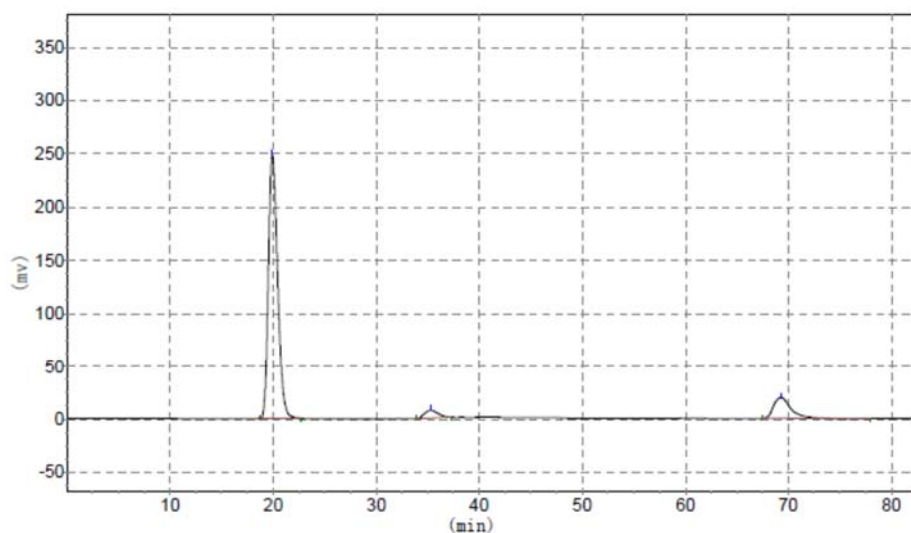


#### Racemic



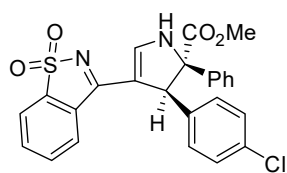
Peak	Retention time	Height	Area	Area%
1	19.925	198440.438	12911352.000	31.6712
2	35.155	202752.406	13288399.000	32.5961
3	69.113	141638.297	14567081.000	35.7327
<b>Total</b>		542831.141	40766832.000	100.0000

#### Chiral

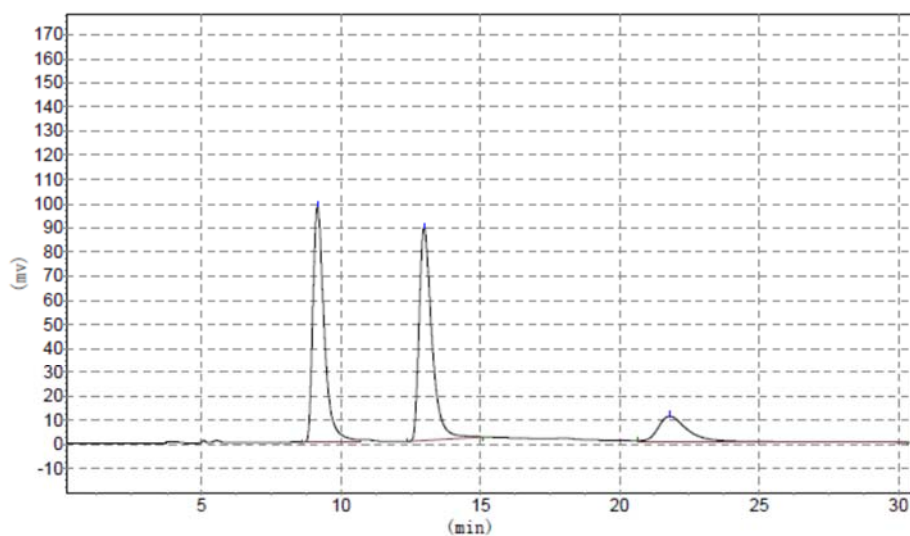


Peak	Retention time	Height	Area	Area%
1	19.920	248424.703	15545481.000	83.7164
2	35.272	7460.004	673762.688	3.6284
3	69.287	19828.586	2349978.000	12.6552
<b>Total</b>		275713.293	18569221.688	100.0000

### 4s (Table 4, entry 6)

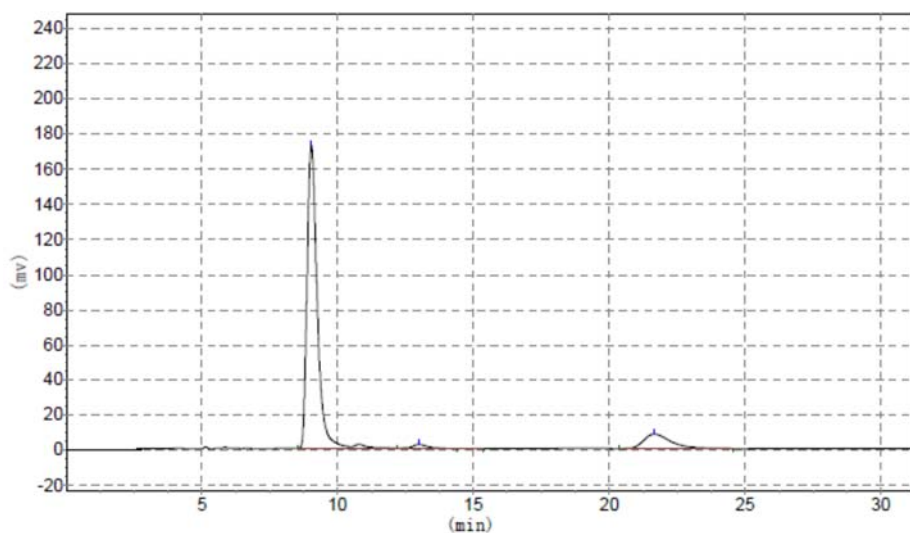


#### Racemic



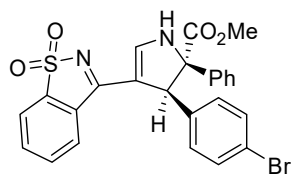
Peak	Retention time	Height	Area	Area%
1	9.150	98260.438	2802019.000	42.9699
2	12.977	88737.117	2829233.750	43.3872
3	21.790	10873.801	889637.250	13.6429
<b>Total</b>		<b>197871.355</b>	<b>6520890.000</b>	<b>100.0000</b>

#### Chiral

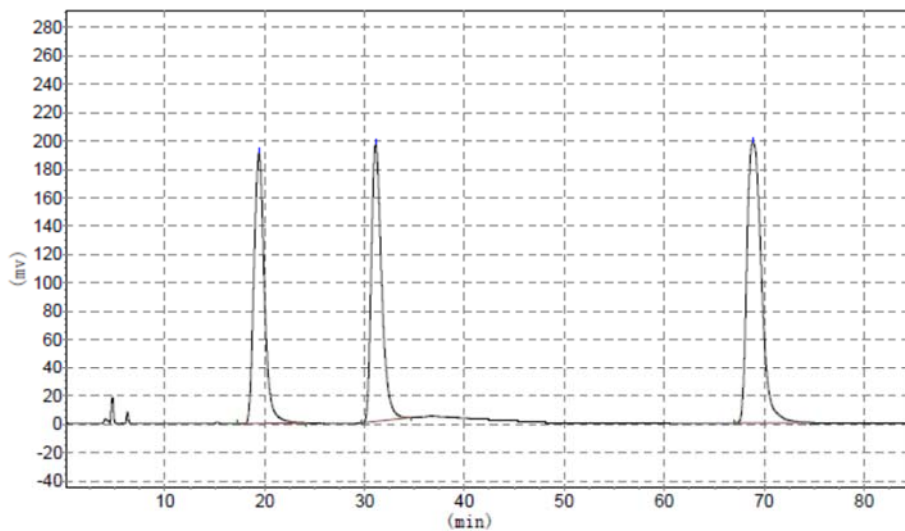


Peak	Retention time	Height	Area	Area%
1	9.032	172357.313	4605579.500	87.7901
2	12.998	2082.070	69249.352	1.3200
3	21.660	8210.159	571297.625	10.8899
<b>Total</b>		<b>182649.542</b>	<b>5246126.477</b>	<b>100.0000</b>

#### 4t (Table 4, entry 7)

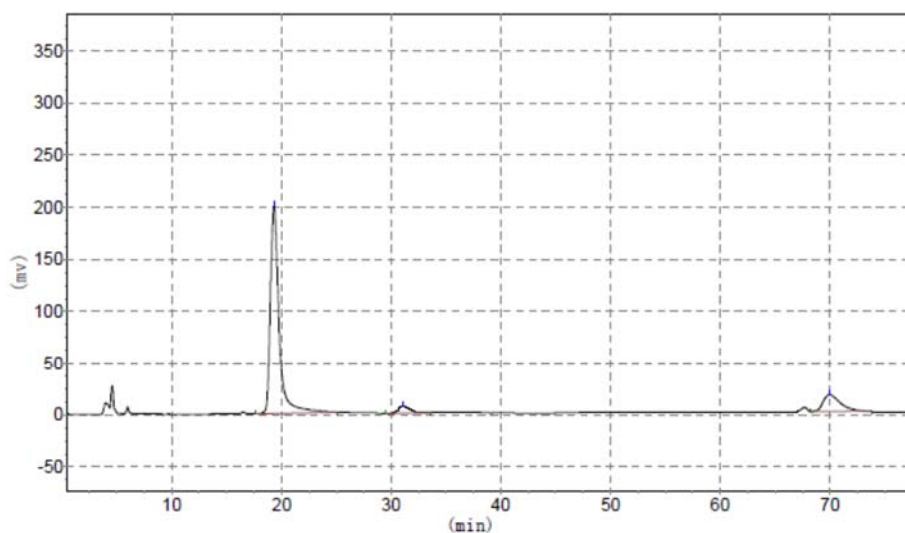


#### Racemic



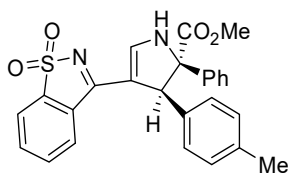
Peak	Retention time	Height	Area	Area%
1	19.420	191246.922	13886921.000	28.9673
2	31.107	195623.828	14031783.000	29.2695
3	68.903	198306.875	20021316.000	41.7633
<b>Total</b>		585177.625	47940020.000	100.0000

#### Chiral

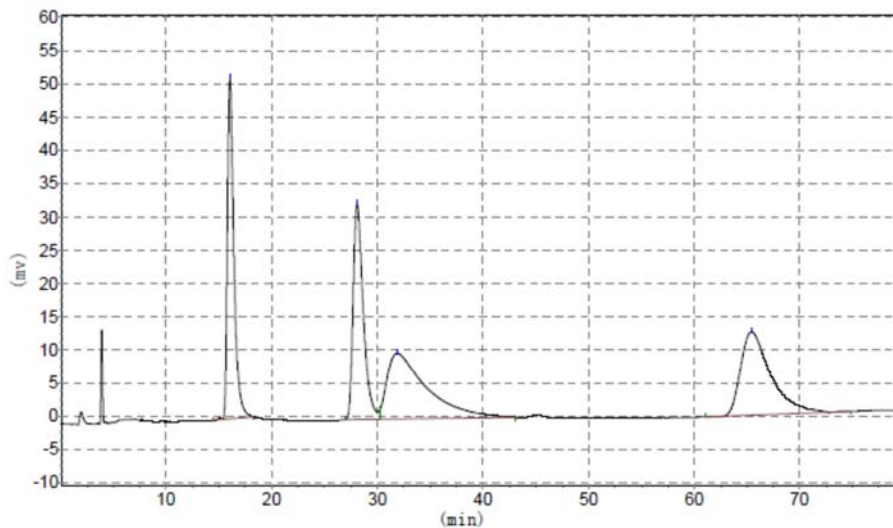


Peak	Retention time	Height	Area	Area%
1	19.312	200756.734	11070367.000	82.5288
2	31.108	6946.273	495897.813	3.6969
3	69.967	16300.468	1847674.125	13.7743
<b>Total</b>		224003.476	13413938.938	100.0000

4u (Table 4, entry 8)

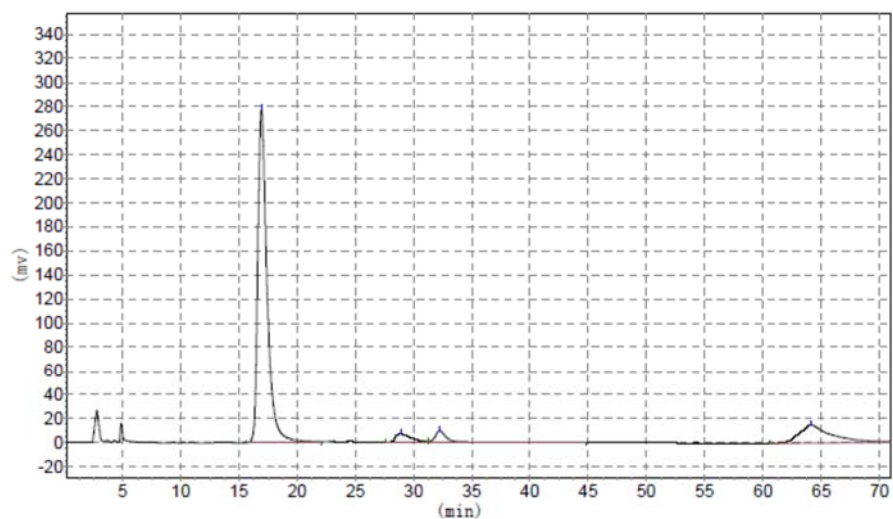


Racemic



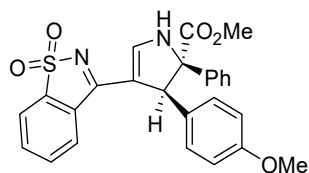
Peak	Retention time	Height	Area	Area%
1	16.067	51159.629	2191268.000	23.1218
2	28.097	32495.781	2185266.250	23.0585
3	31.883	9968.766	2581487.000	27.2393
4	65.392	12686.282	2519041.000	26.5804
<b>Total</b>		106310.458	9477062.250	100.0000

Chiral

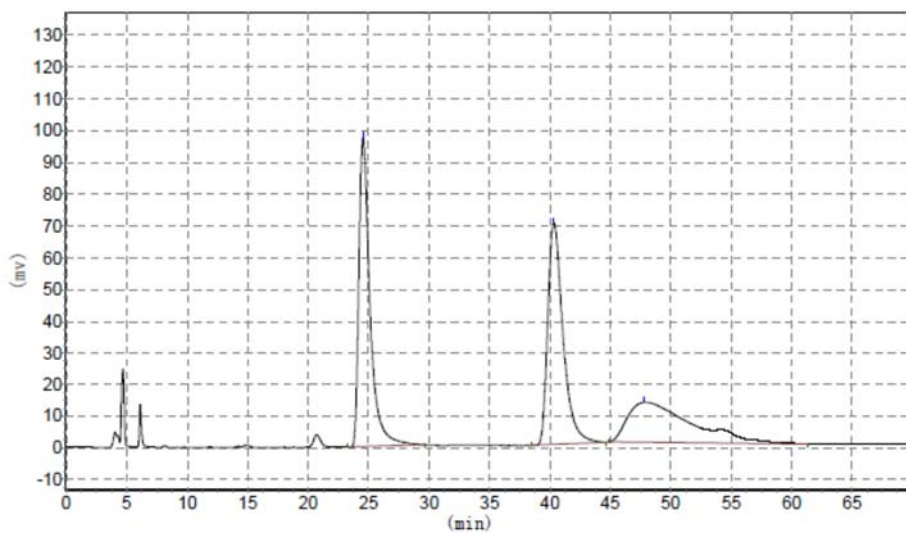


Peak	Retention time	Height	Area	Area%
1	16.925	277747.469	15378618.000	77.5485
2	28.852	7485.595	790429.875	3.9858
3	32.228	9891.167	815234.500	4.1109
4	64.097	15126.865	2846682.750	14.3547
<b>Total</b>		310251.096	19830965.125	100.0000

4v (Table 4, entry 9)

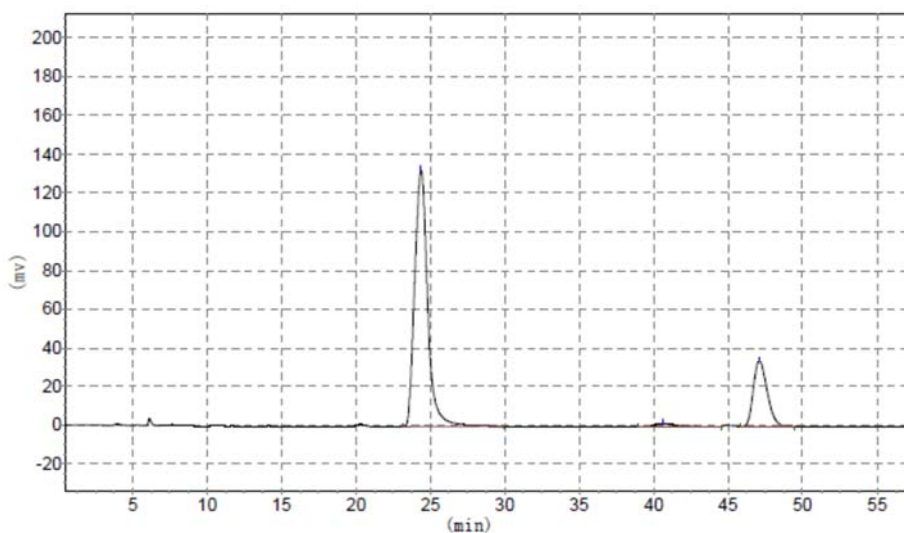


**Racemic**



Peak	Retention time	Height	Area	Area%
1	24.537	97539.234	6235758.000	36.6817
2	40.323	69938.875	6144945.500	36.1475
3	47.827	12599.236	4618935.500	27.1708
<b>Total</b>		180077.346	16999639.000	100.0000

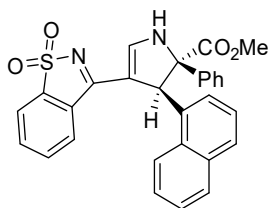
**Chiral**



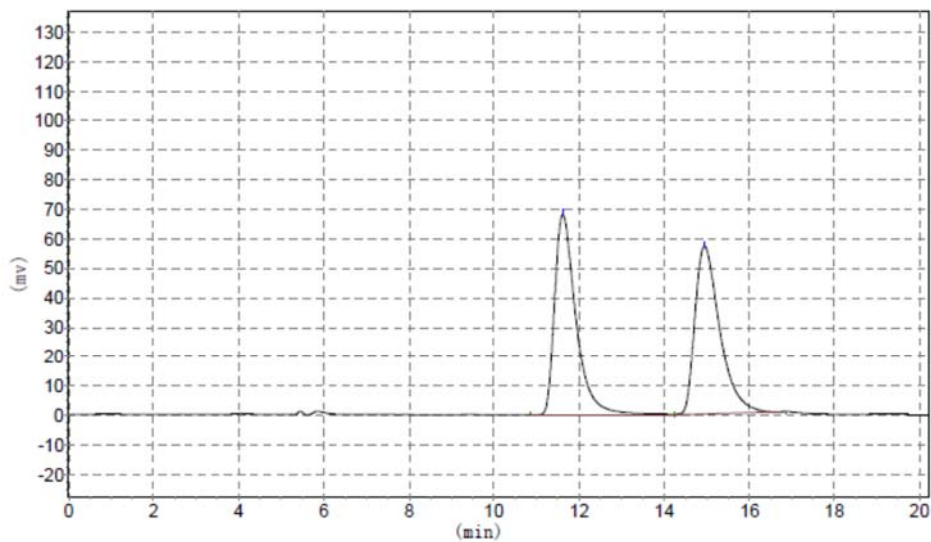
Peak	Retention time	Height	Area	Area%
1	24.377	132587.281	8046901.000	77.5030
2	40.613	1664.705	160210.563	1.5431
3	47.088	33887.980	2175585.500	20.9540
<b>总计</b>		168139.967	10382697.063	100.0000



#### 4w (Table 4, entry 10)

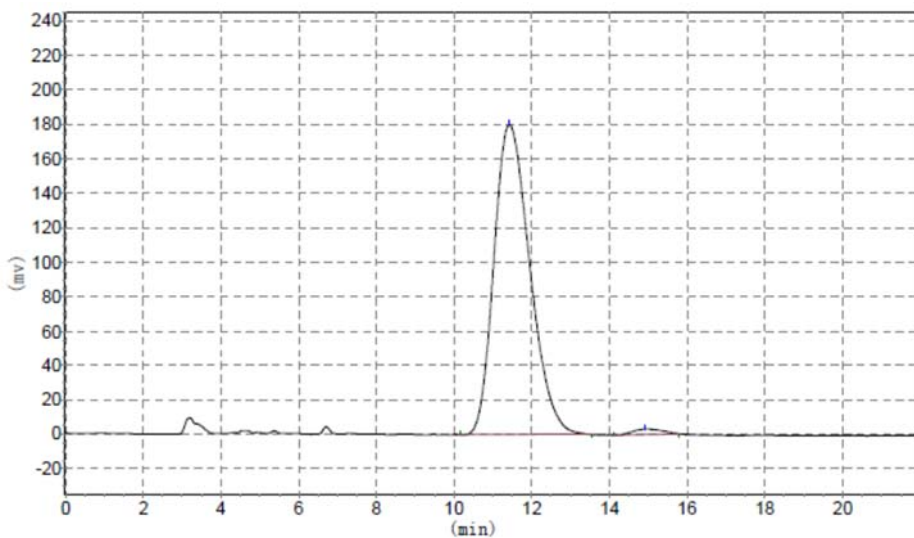


#### Racemic



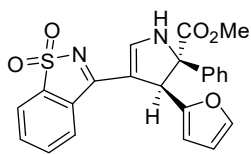
Peak	Retention time	Height	Area	Area%
1	11.613	68207.664	2398505.250	50.7458
2	14.947	57177.012	2328000.500	49.2542
<b>Total</b>		125384.676	4726505.750	100.0000

#### Chiral

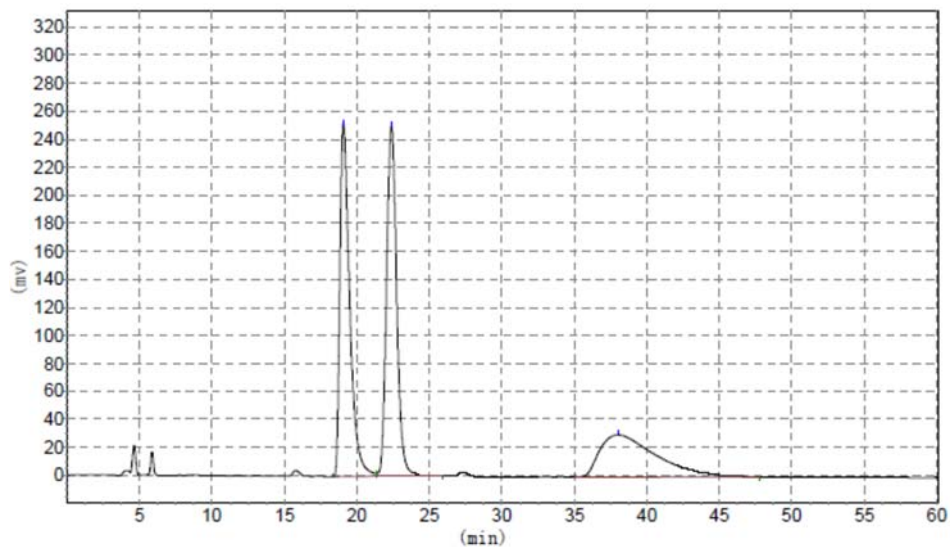


Peak	Retention time	Height	Area	Area%
1	11.422	180336.547	11554340.000	98.5142
2	14.917	3297.988	174267.797	1.4858
<b>Total</b>		183634.535	11728607.797	100.0000

### 4x (Table 4, entry 11)

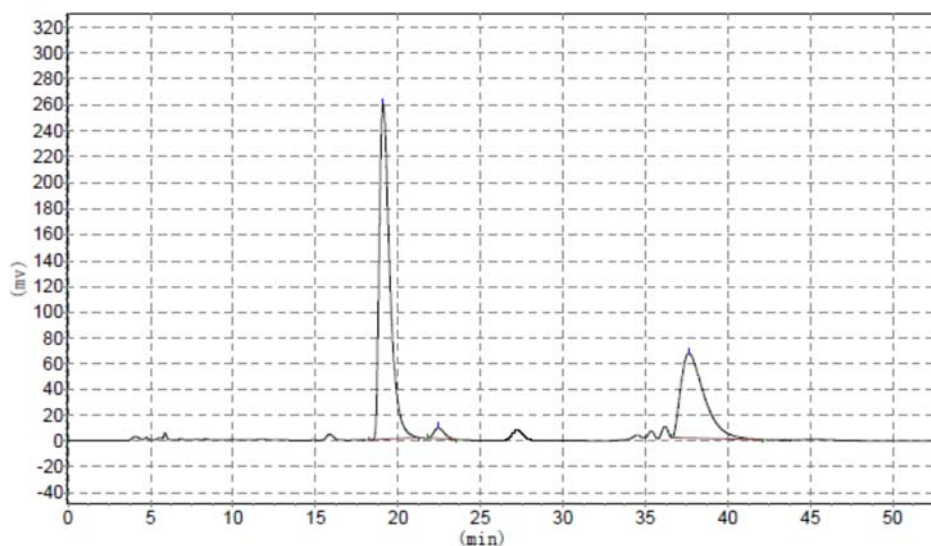


### Racemic



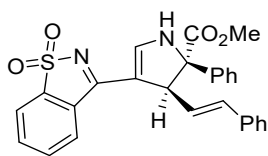
Peak	Retention time	Height	Area	Area%
1	19.098	251772.563	11986988.000	37.0855
2	22.398	250533.313	12249845.000	37.8987
3	38.032	30007.844	8085767.000	25.0158
<b>Total</b>		<b>532313.719</b>	<b>32322600.000</b>	<b>100.0000</b>

### Chiral

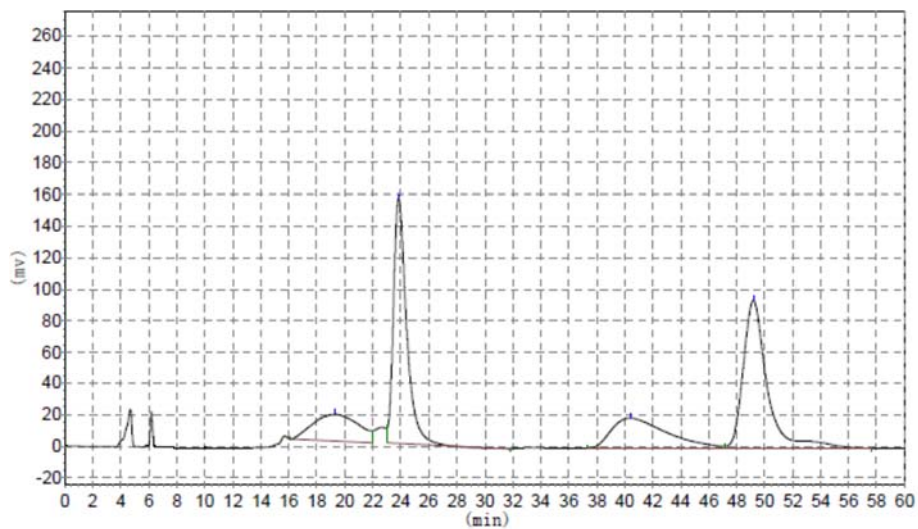


Peak	Retention time	Height	Area	Area%
1	19.100	259251.797	11509460.000	62.7137
2	22.452	8347.351	364916.406	1.9884
3	37.633	66356.953	6478016.000	35.2979
<b>Total</b>		<b>333956.101</b>	<b>18352392.406</b>	<b>100.0000</b>

4y (Table 4, entry 12)

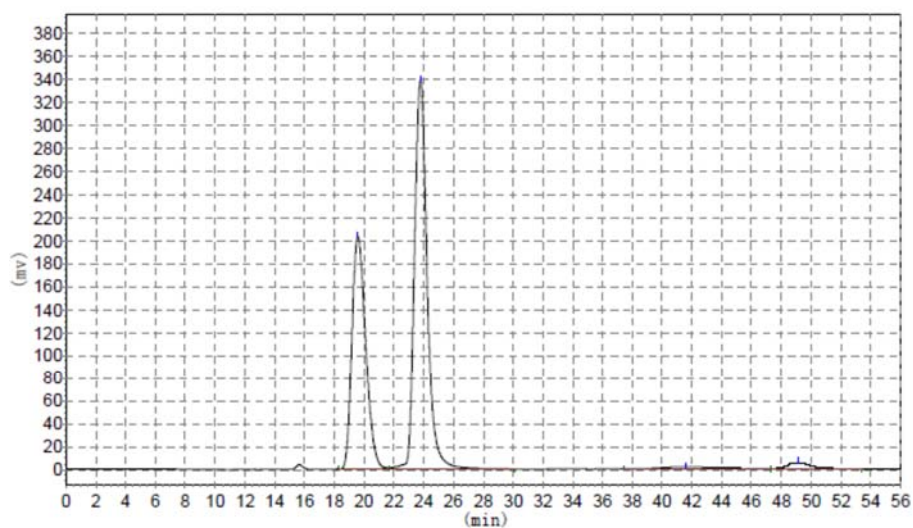


Racemic



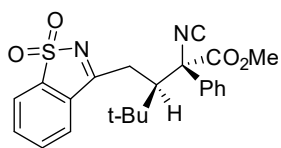
Peak	Retention time	Height	Area	Area%
1	19.332	21456.334	5414917.000	16.4350
2	23.865	158908.484	10942670.000	33.2126
3	40.398	19204.971	5337431.500	16.1999
4	49.198	93895.008	11252356.000	34.1525
<b>Total</b>		293464.797	32947374.500	100.0000

Chiral

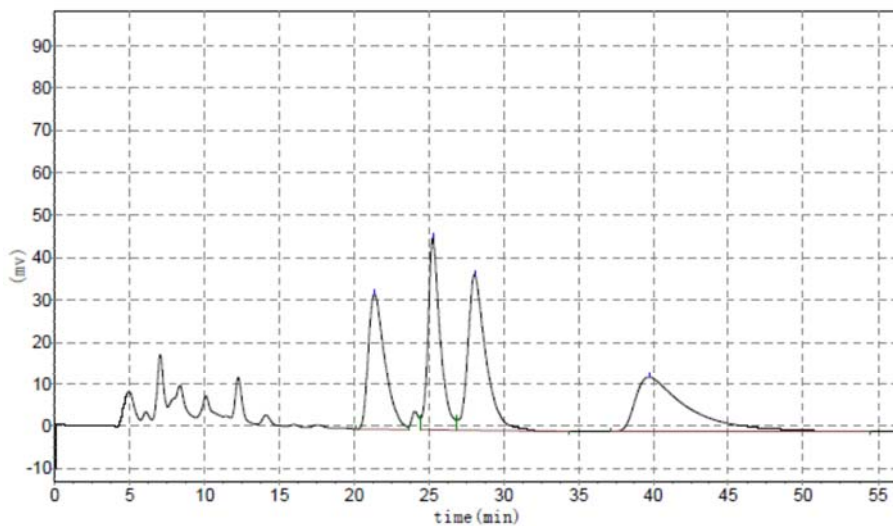


Peak	Retention time	Height	Area	Area%
1	19.598	203591.016	13118973.000	38.1022
2	23.798	338550.188	20067078.000	58.2820
3	41.598	1725.702	487348.750	1.4154
4	49.132	5627.227	631390.813	1.8338
<b>Total</b>		553658.592	34431009.664	100.0000

4z (Table 4, entry 13)

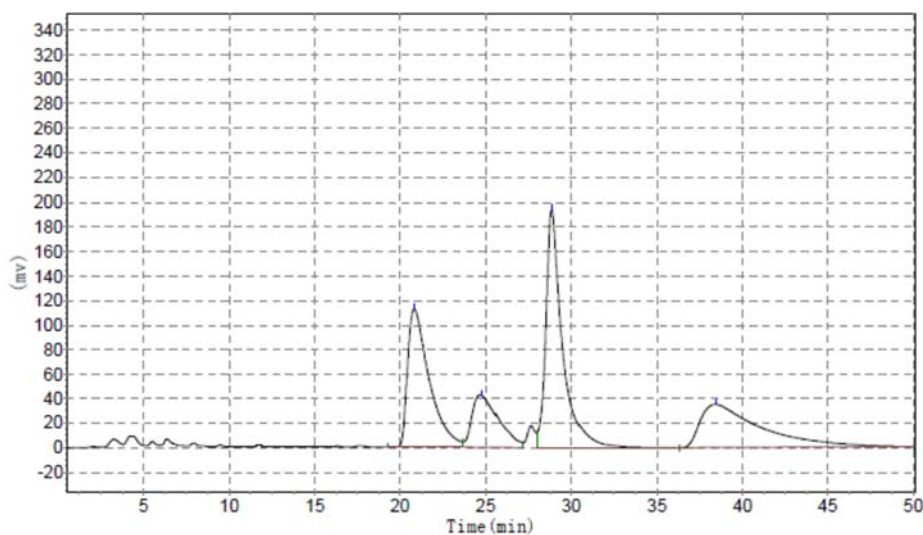


Racemic



Peak	Retention time	Height	Area	Area%
1	21.390	32231.285	2476681.500	22.1820
2	25.257	45553.855	2546036.750	22.8031
3	28.057	37019.855	3080149.750	27.5868
4	39.723	12814.225	3062430.250	27.4281
<b>Total</b>		127619.221	11165298.250	100.0000

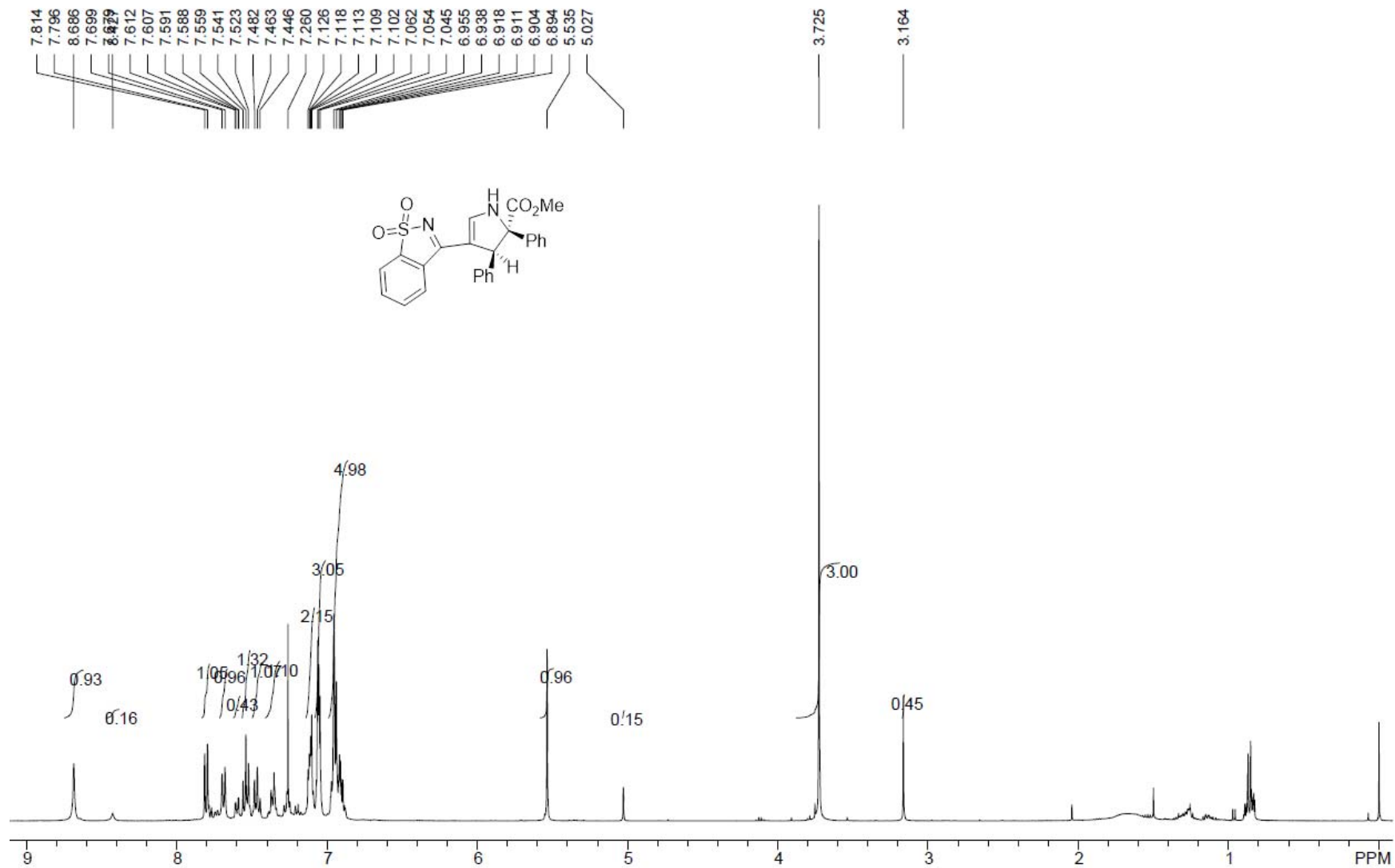
Chiral



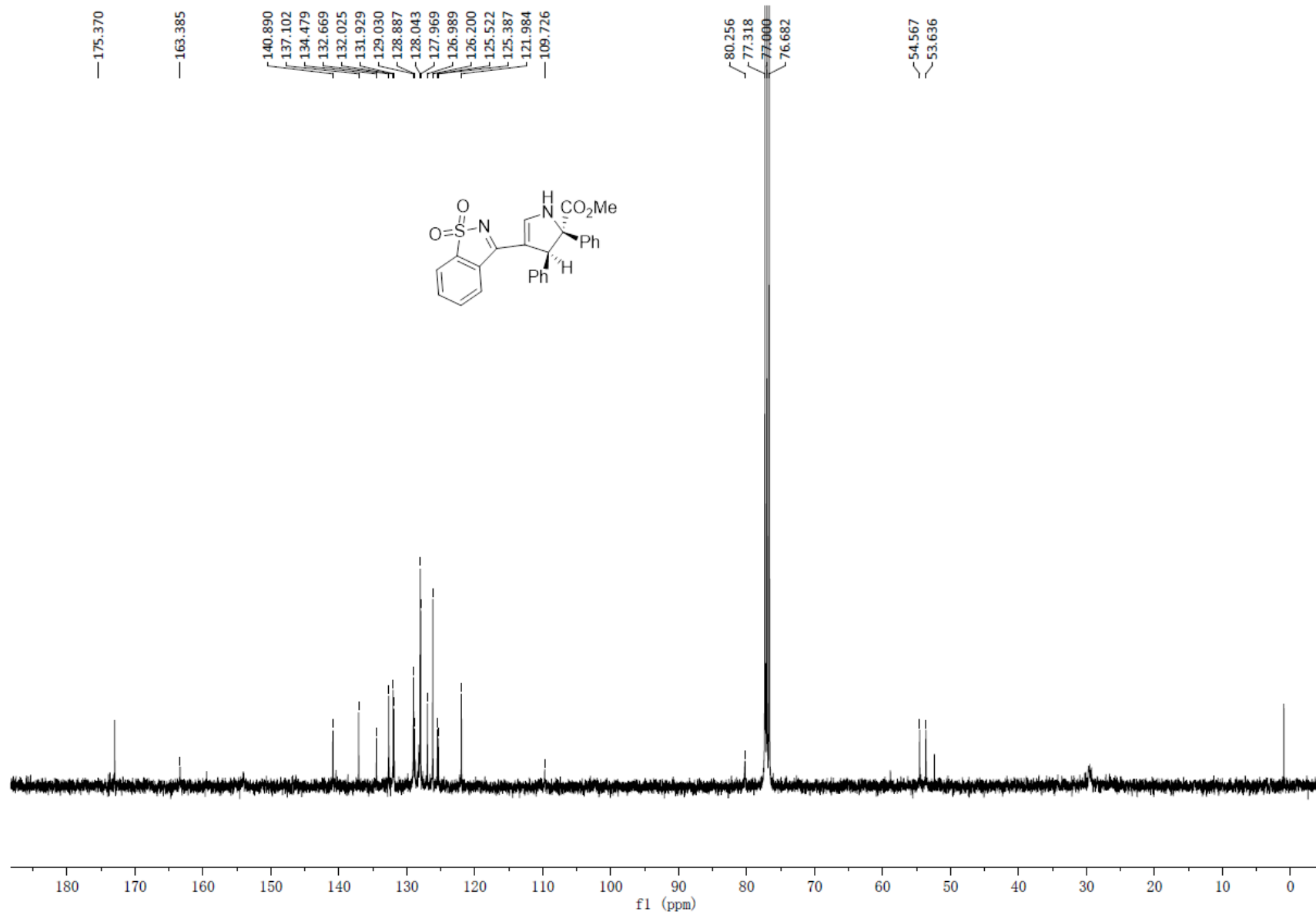
Peak	Retention time	Height	Area	Area%
1	20.832	113487.648	9987124.000	27.5604
2	24.732	42657.016	4620986.500	12.7521
3	28.865	193805.641	12980628.000	35.8213
4	38.465	34993.746	8648422.000	23.8662
<b>Total</b>		384944.051	36237160.500	100.0000

#### 4. Copies of NMR Spectra for the Compounds 4

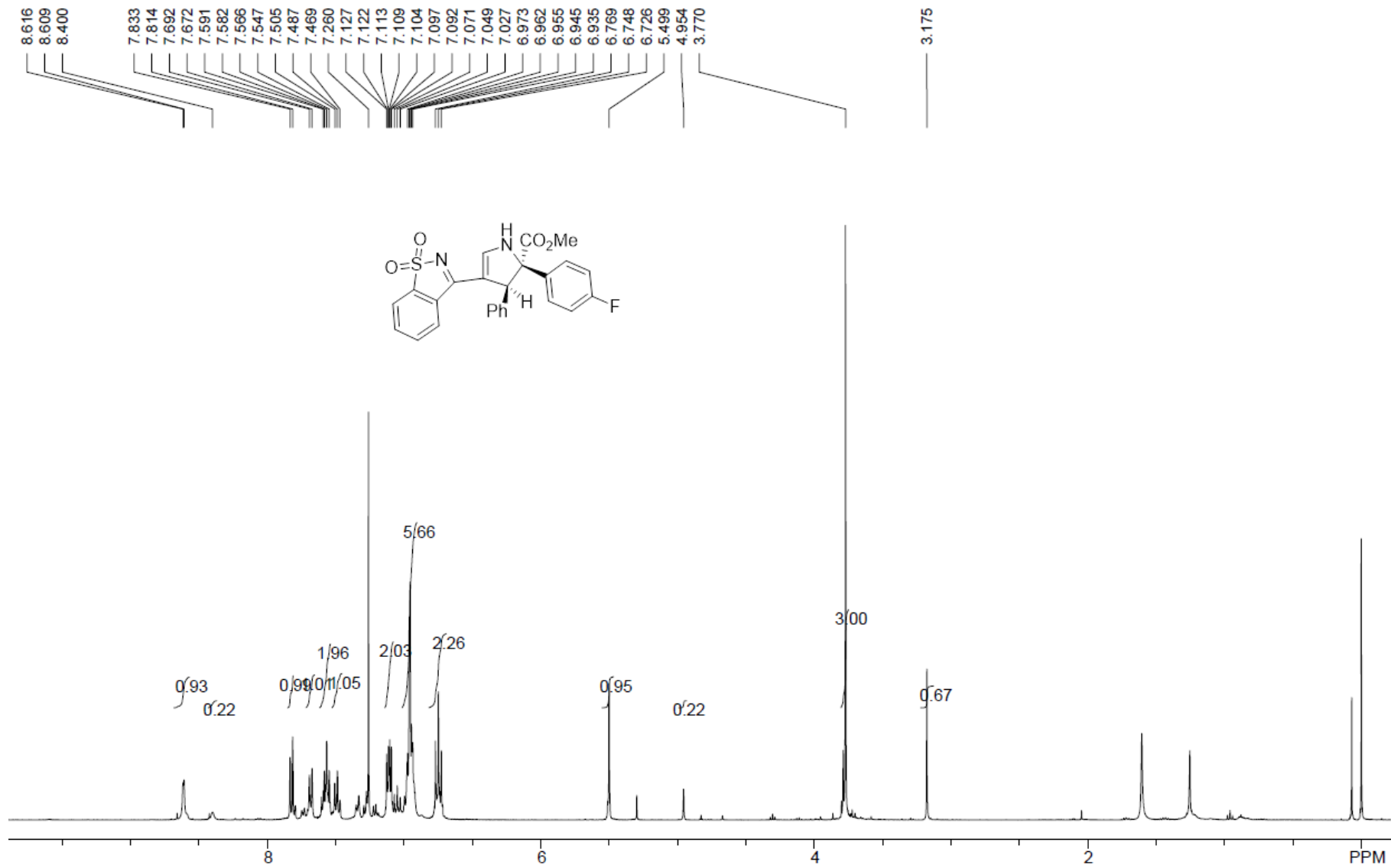
$^1\text{H}$  NMR of 4a



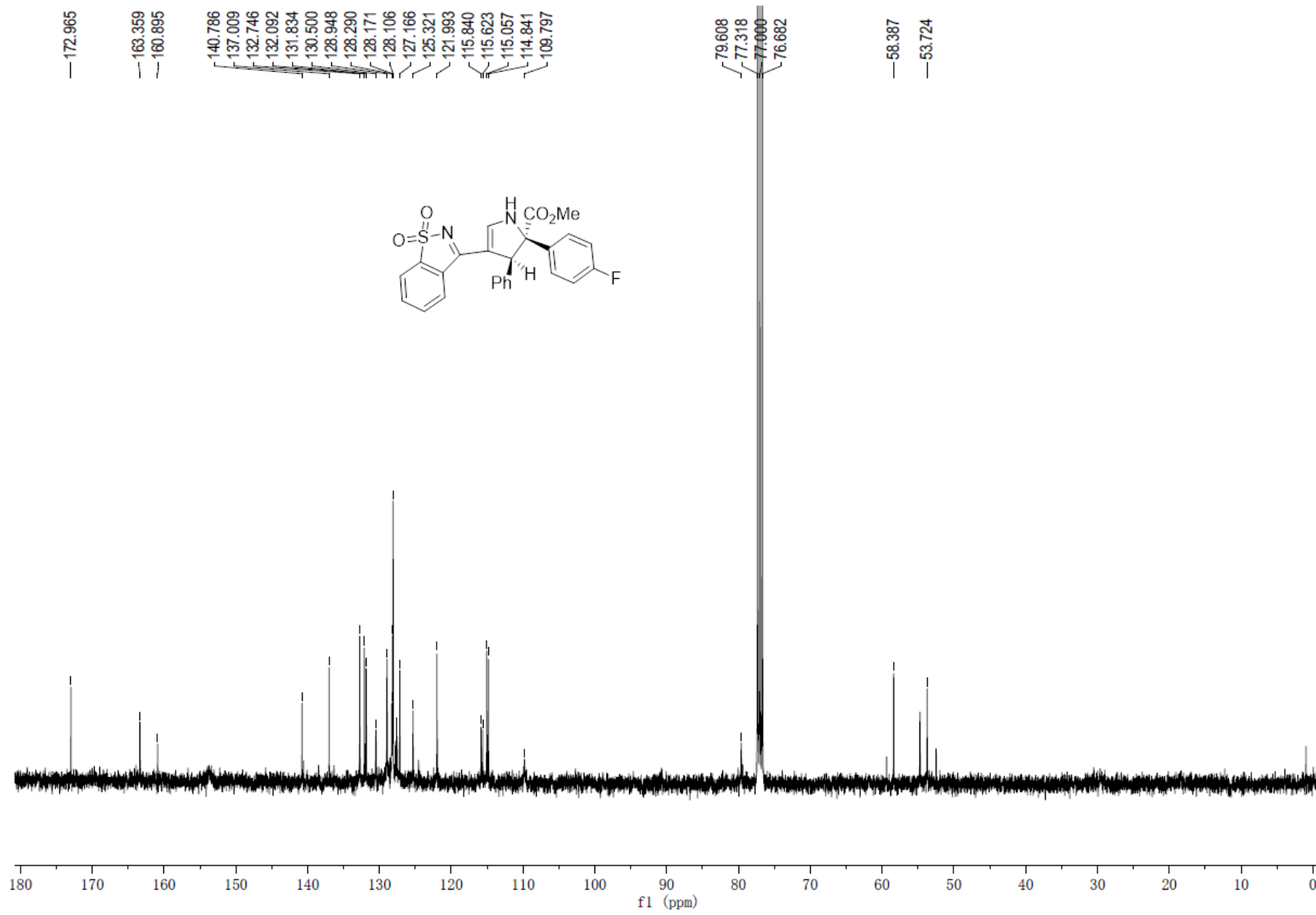
<sup>13</sup>C NMR of **4a**



<sup>1</sup>H NMR of **4b**



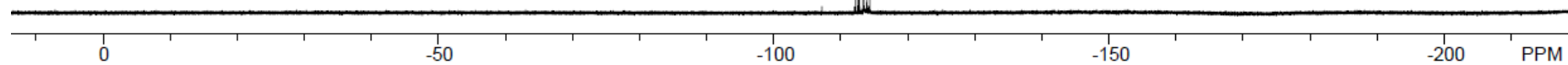
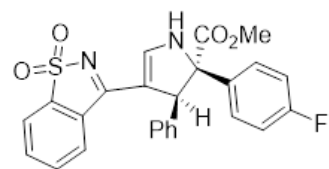
<sup>13</sup>C NMR of **4b**



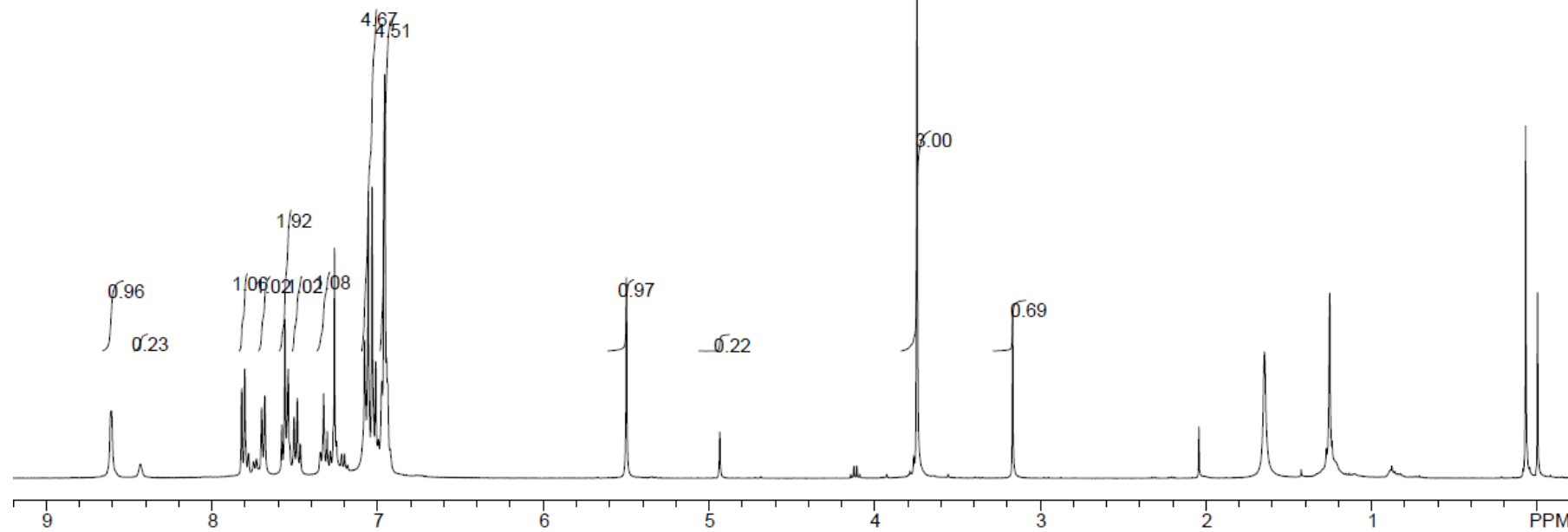
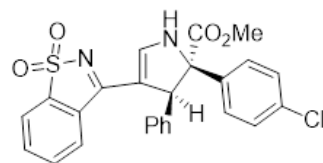
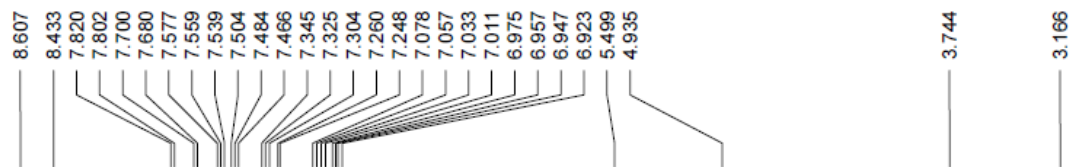


<sup>19</sup>F NMR of **4b**

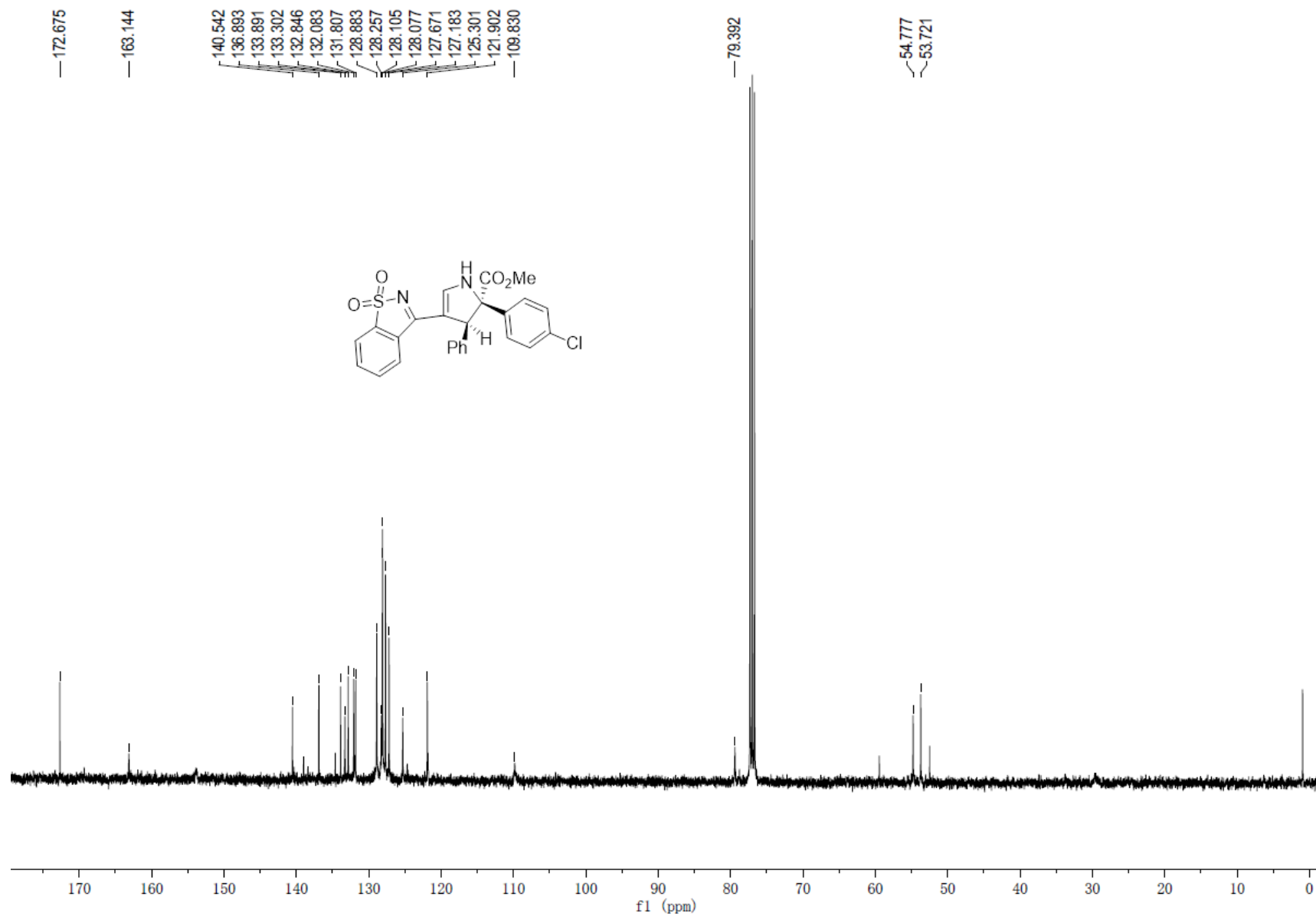
112.761  
113.424



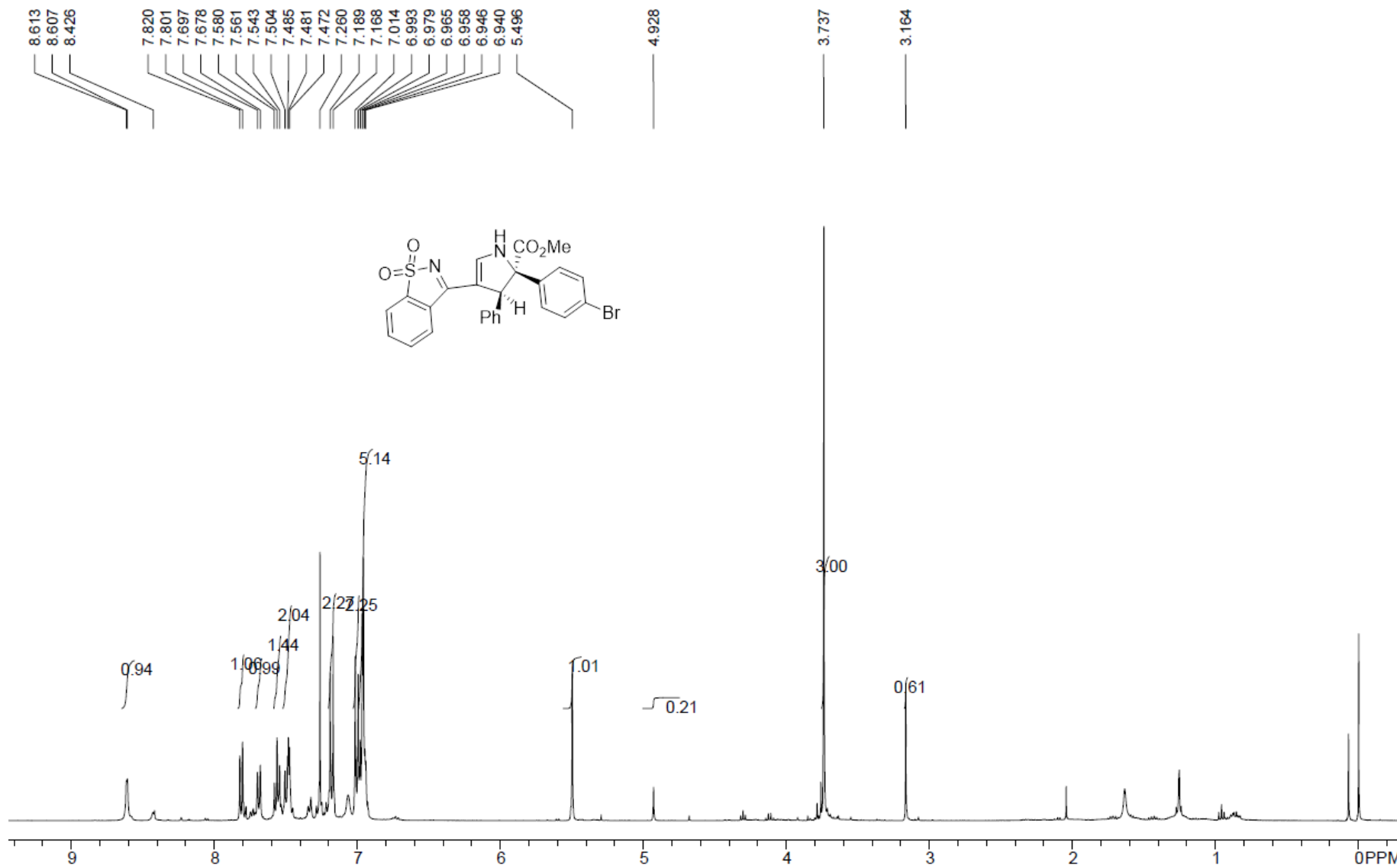
<sup>1</sup>H NMR of 4c



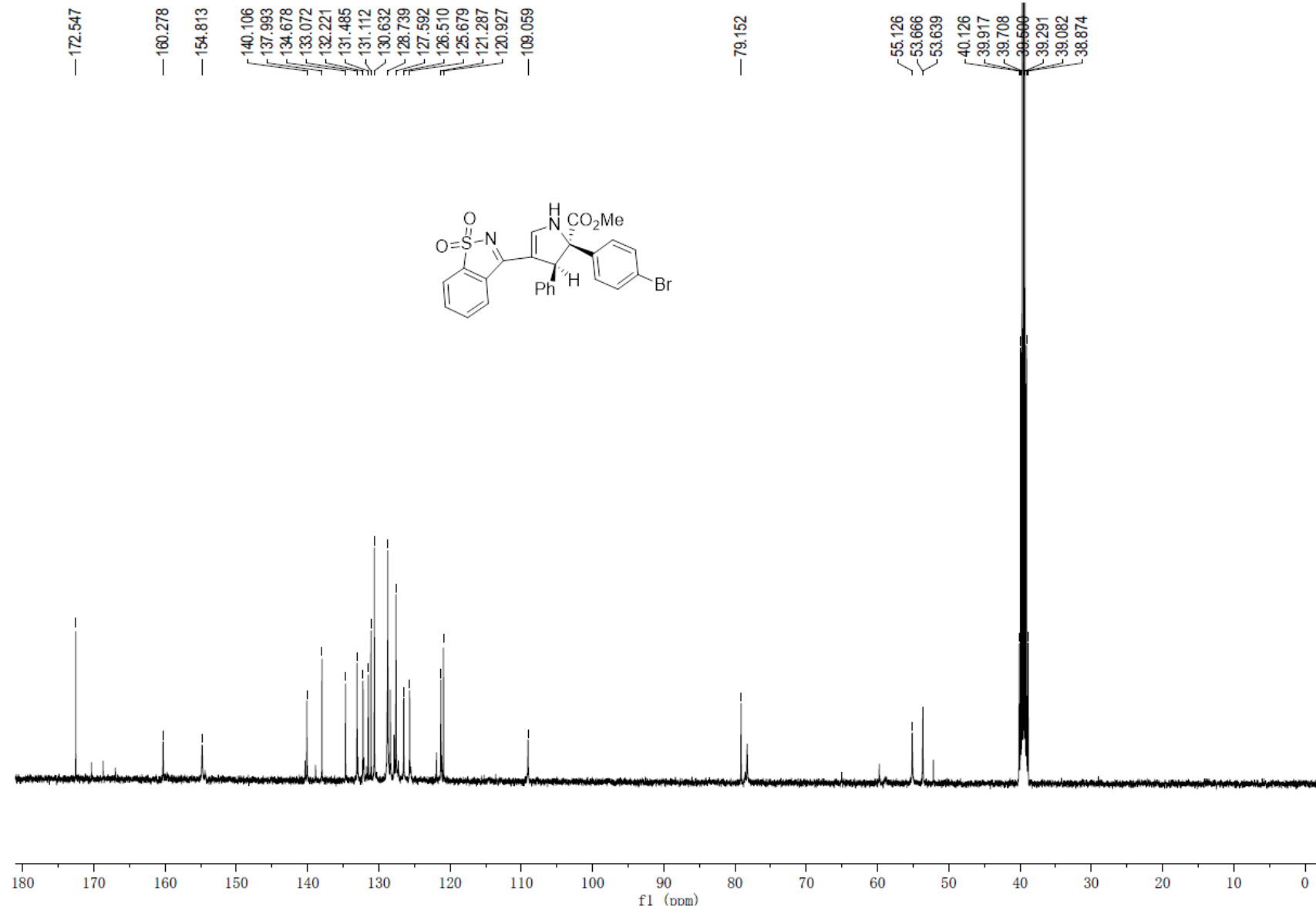
<sup>13</sup>C NMR of 4c



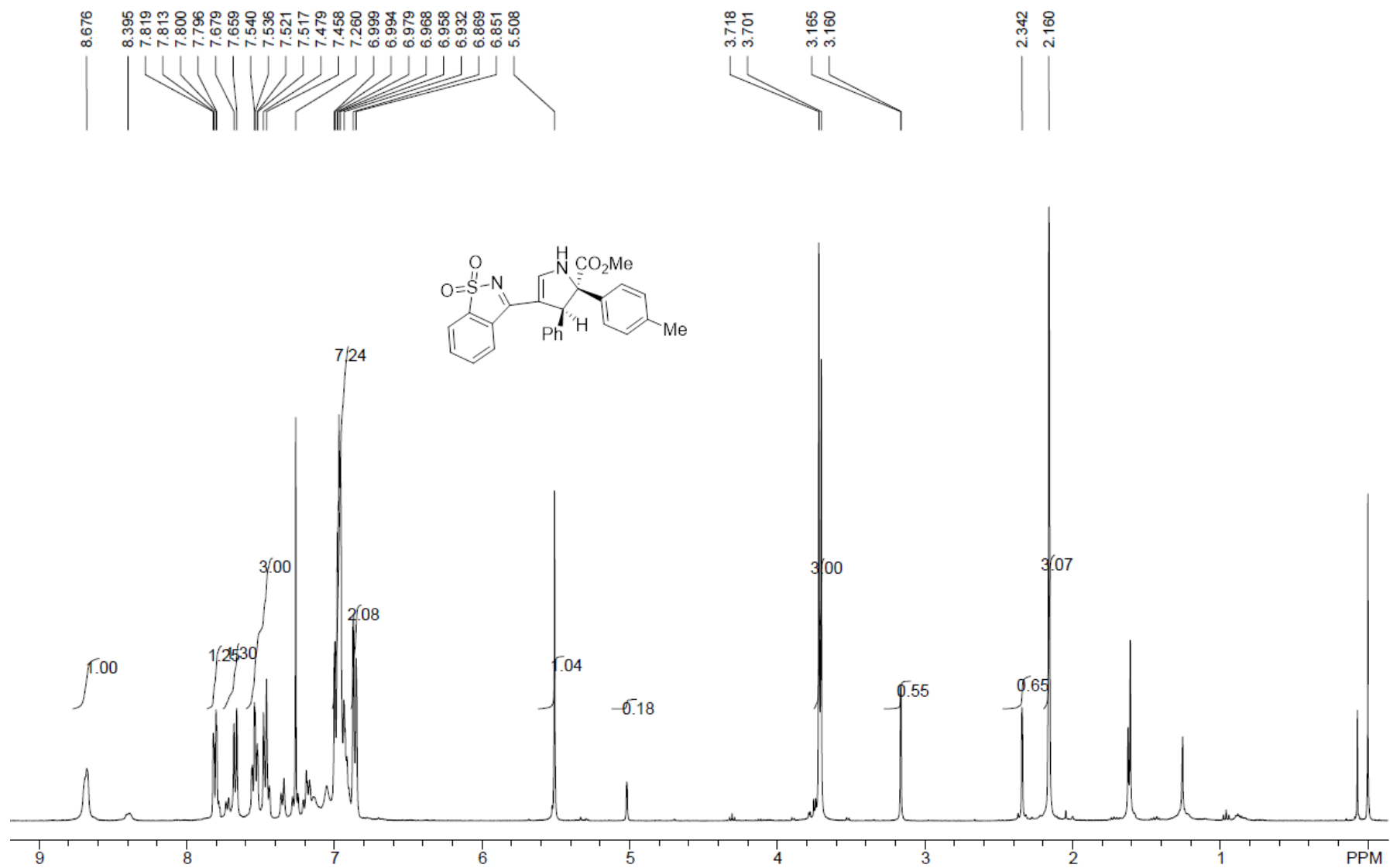
<sup>1</sup>H NMR of 4d



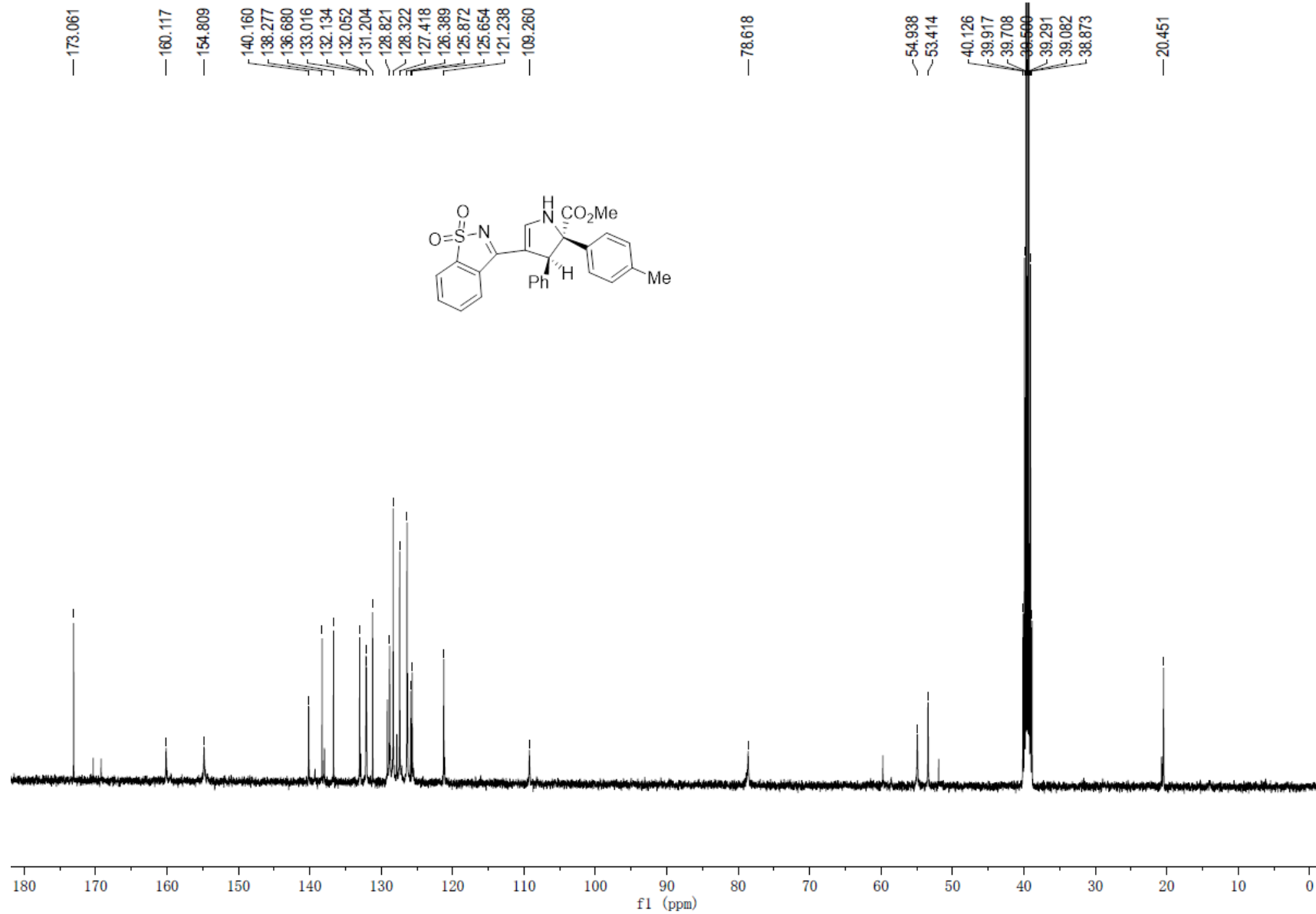
<sup>13</sup>C NMR of **4d**



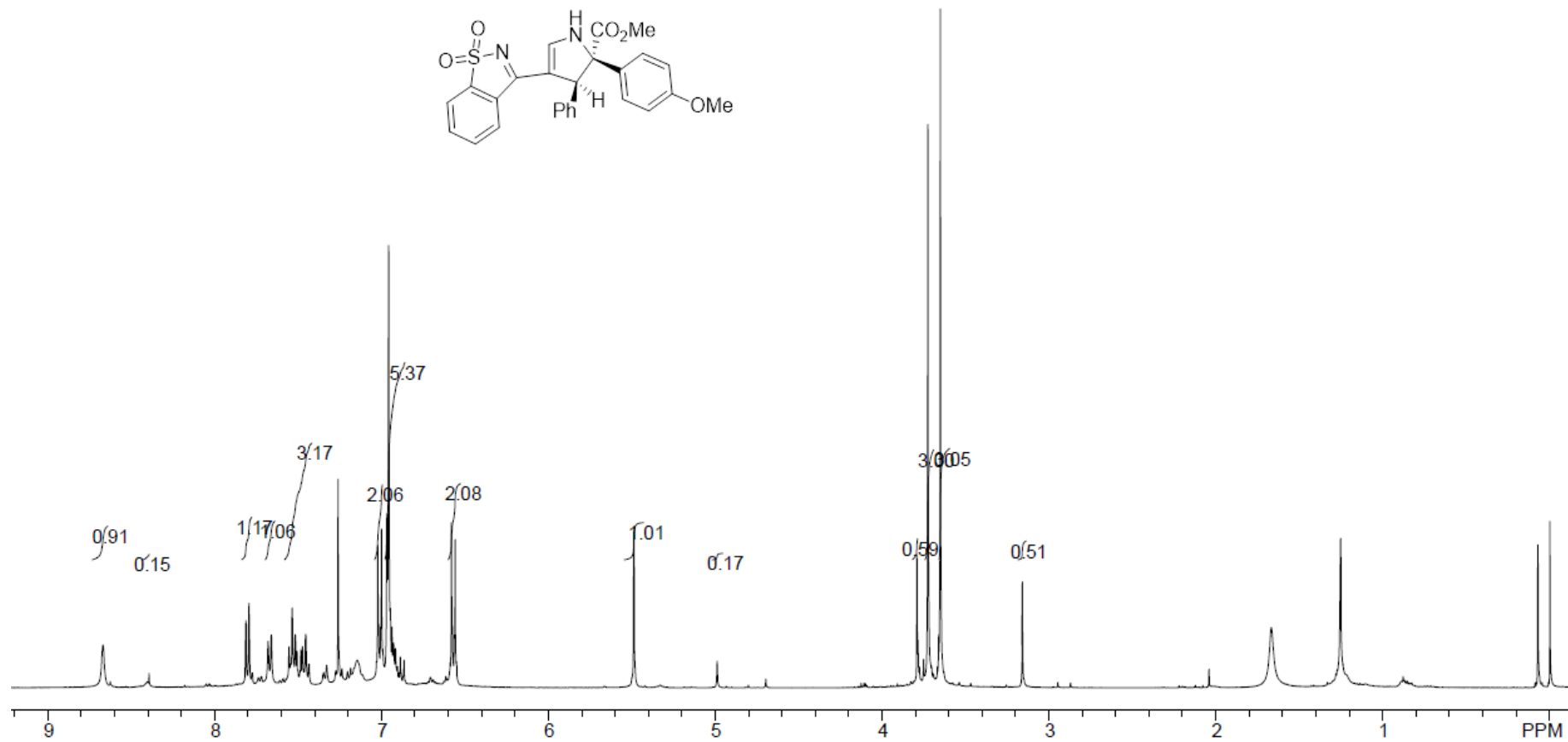
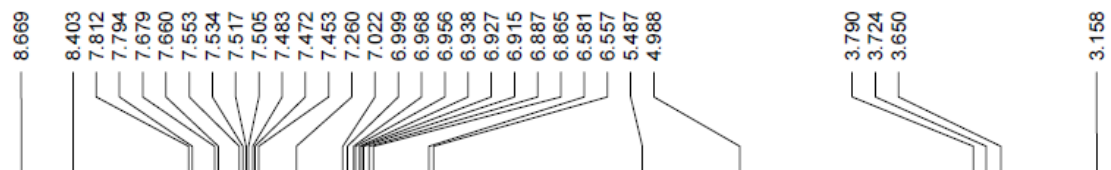
<sup>1</sup>H NMR of 4e



<sup>13</sup>C NMR of **4e**

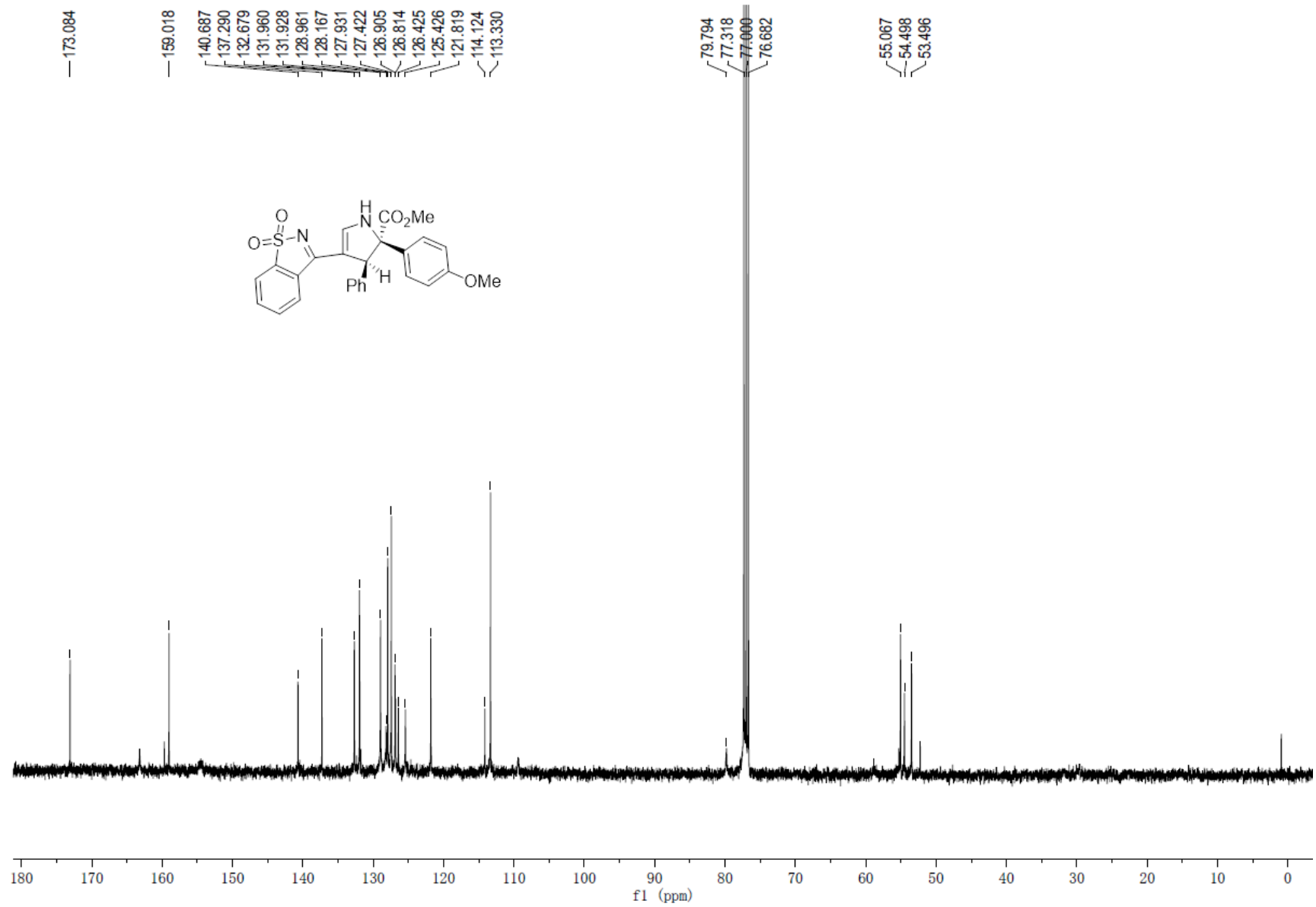


<sup>1</sup>H NMR of **4f**

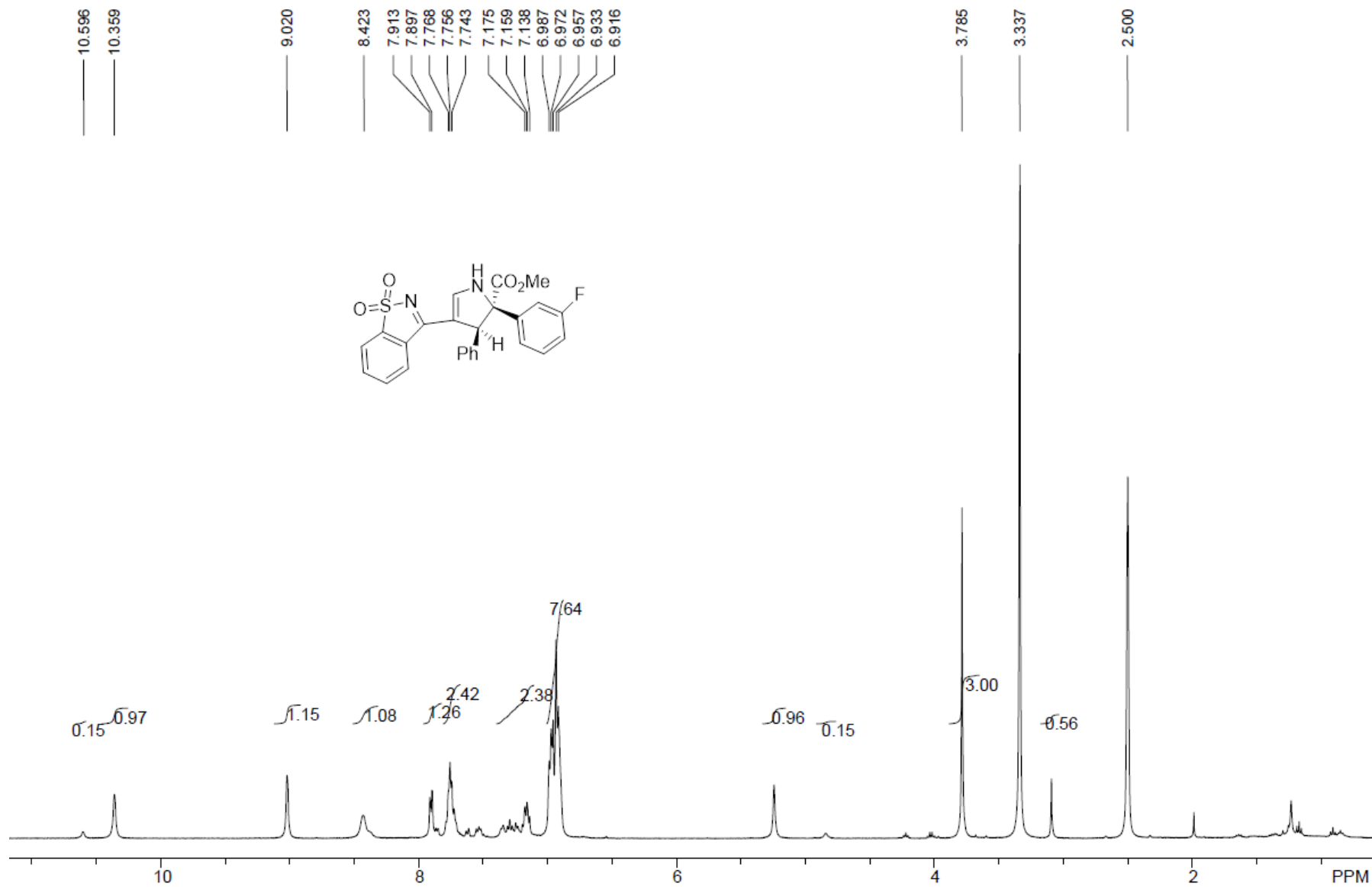




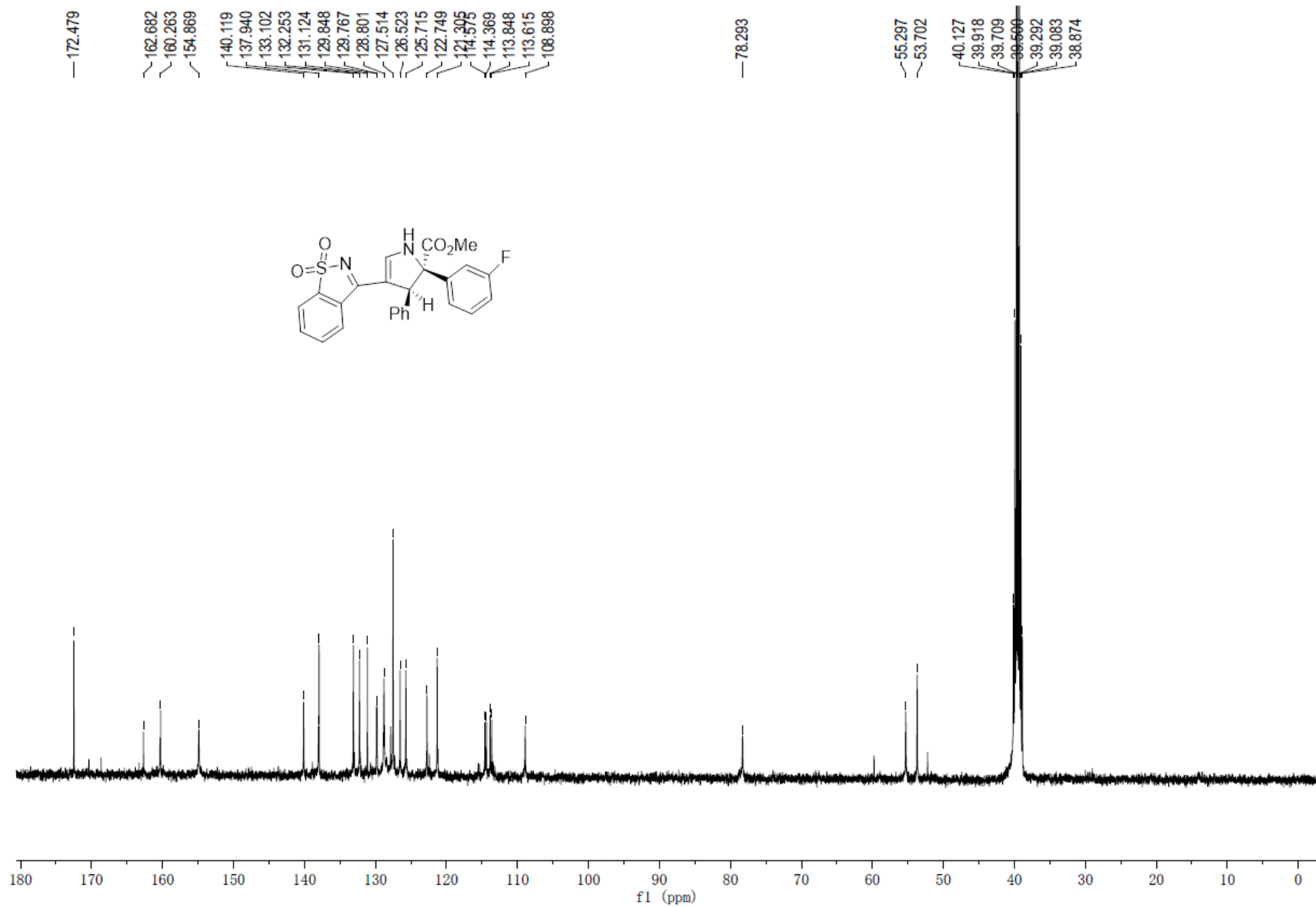
<sup>13</sup>C NMR of **4f**



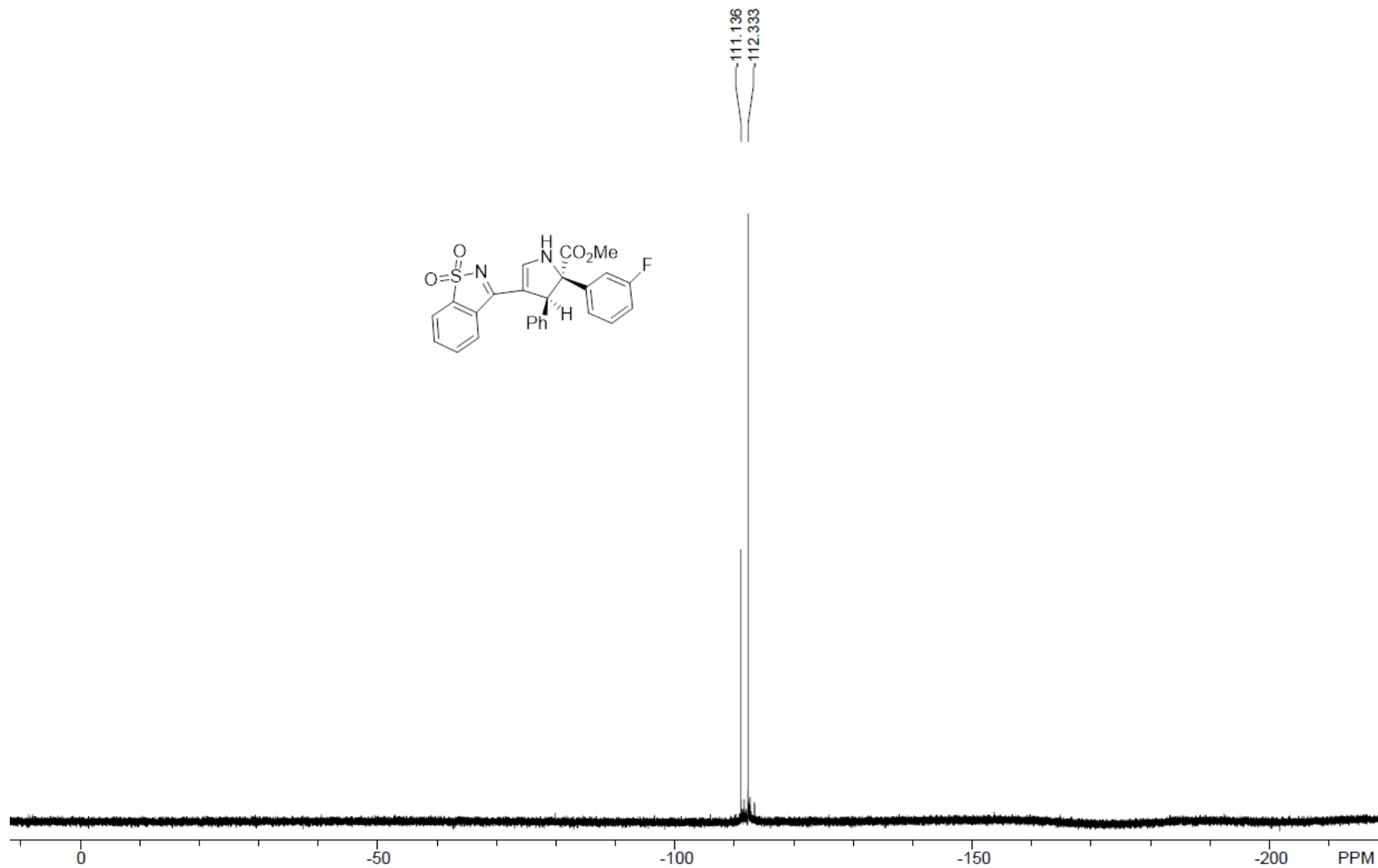
<sup>1</sup>H NMR of 4g



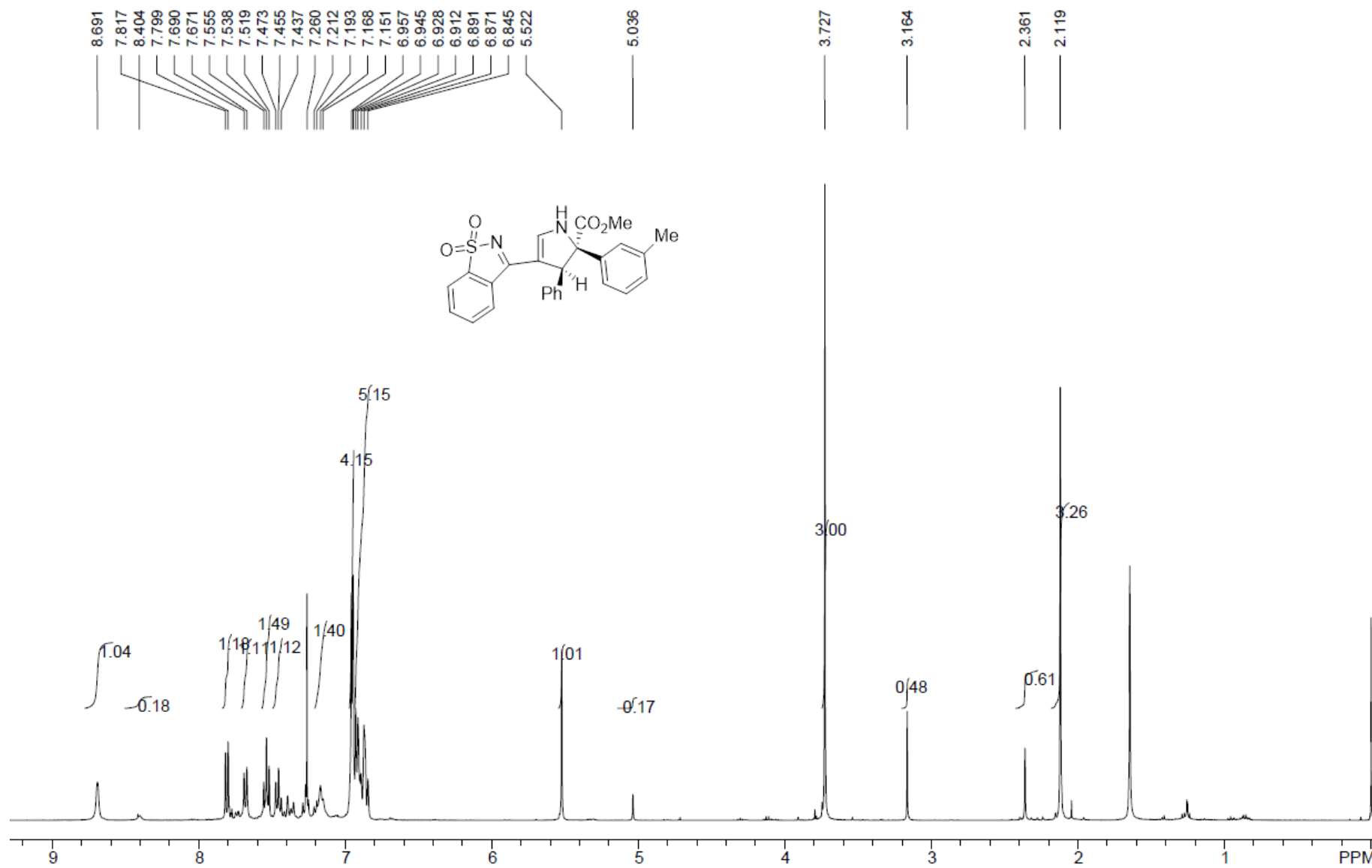
<sup>13</sup>C NMR of **4g**



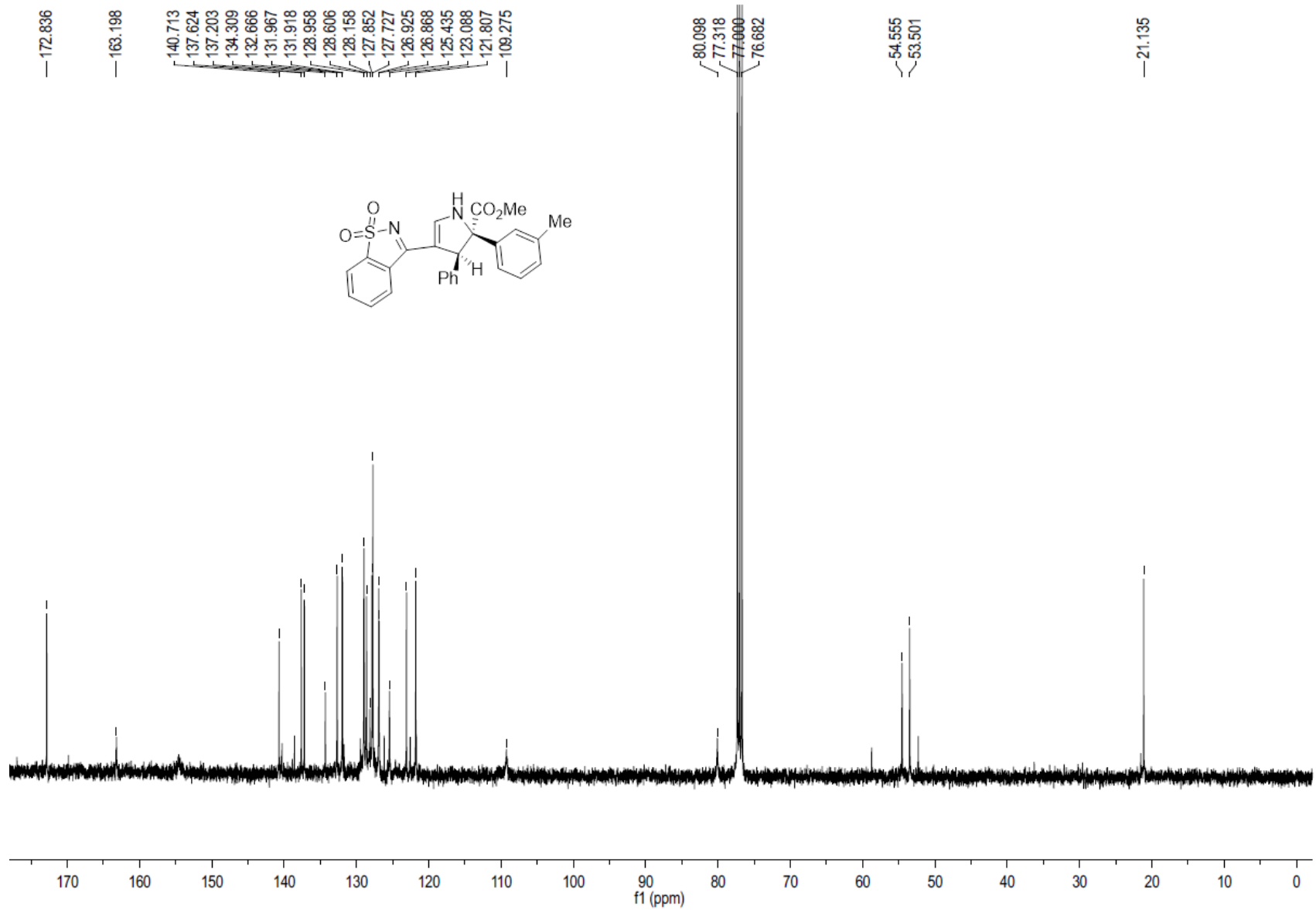
<sup>19</sup>F NMR of 4g



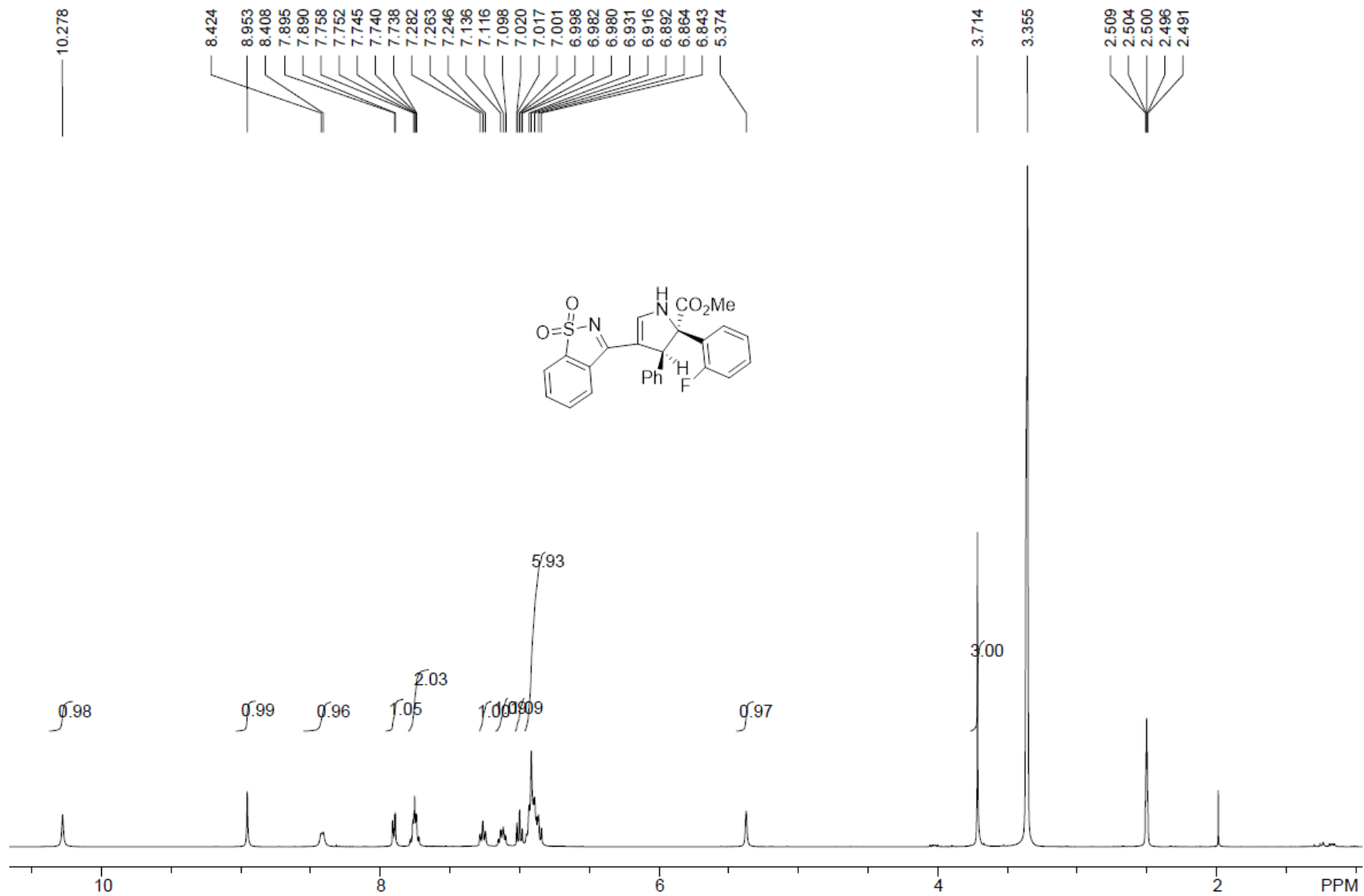
<sup>1</sup>H NMR of **4h**



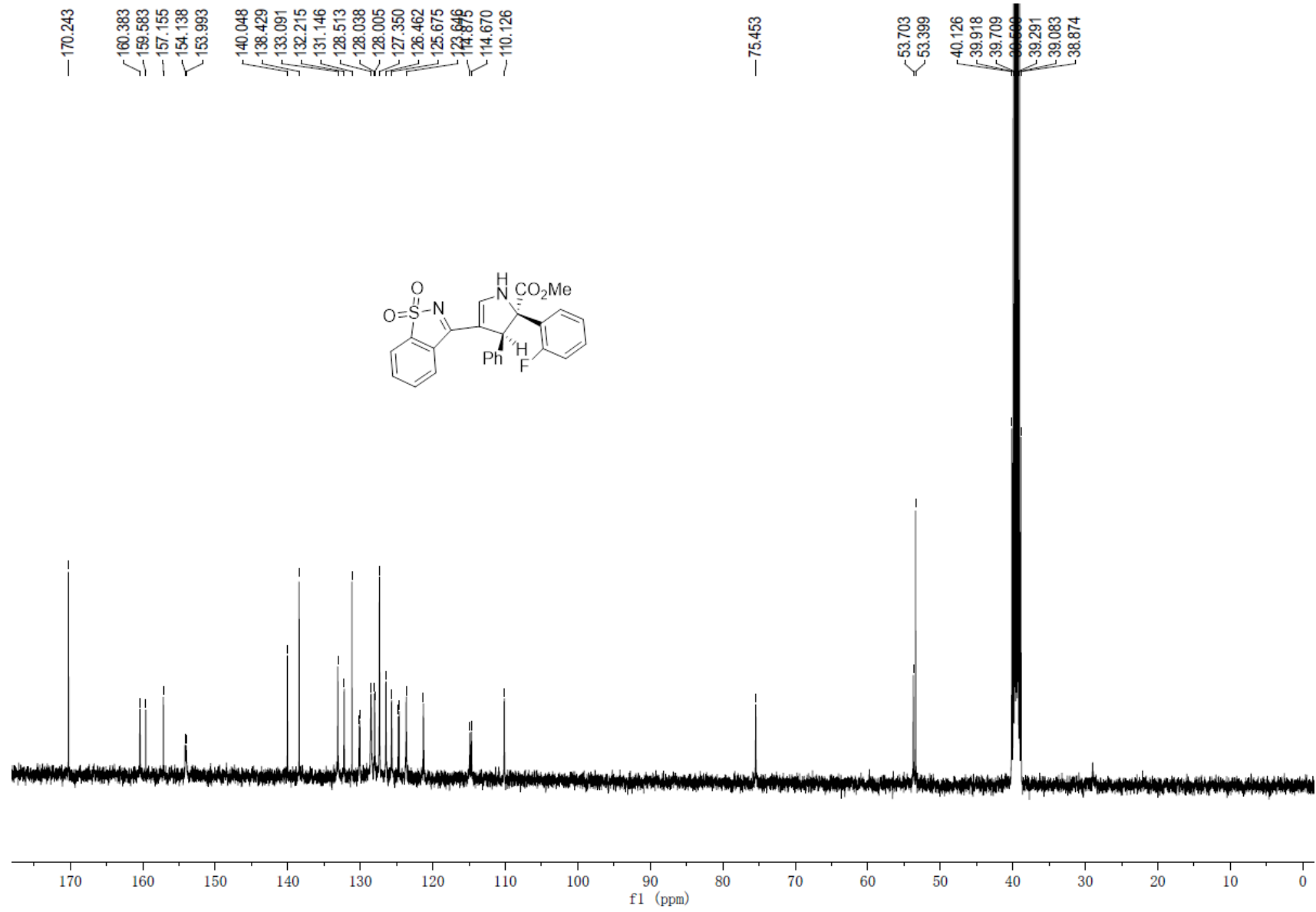
<sup>13</sup>C NMR of **4h**



<sup>1</sup>H NMR of 4i



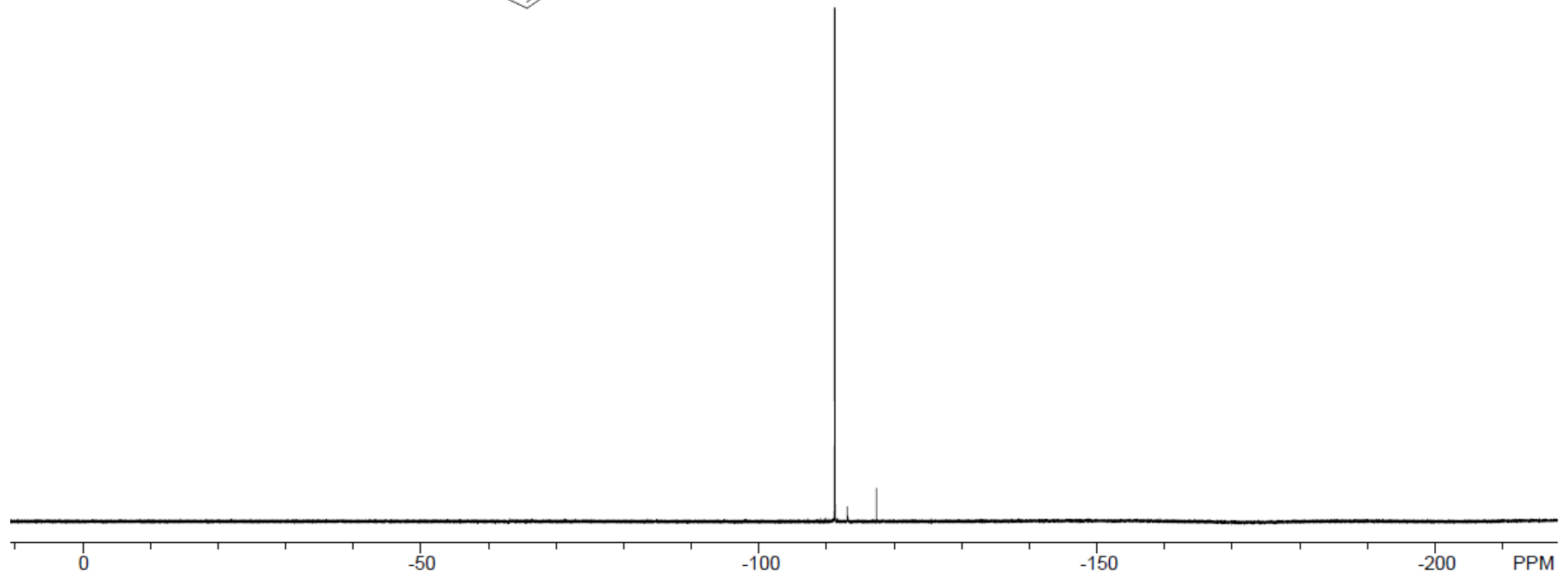
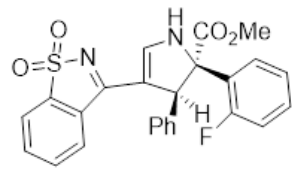
<sup>13</sup>C NMR of **4i**



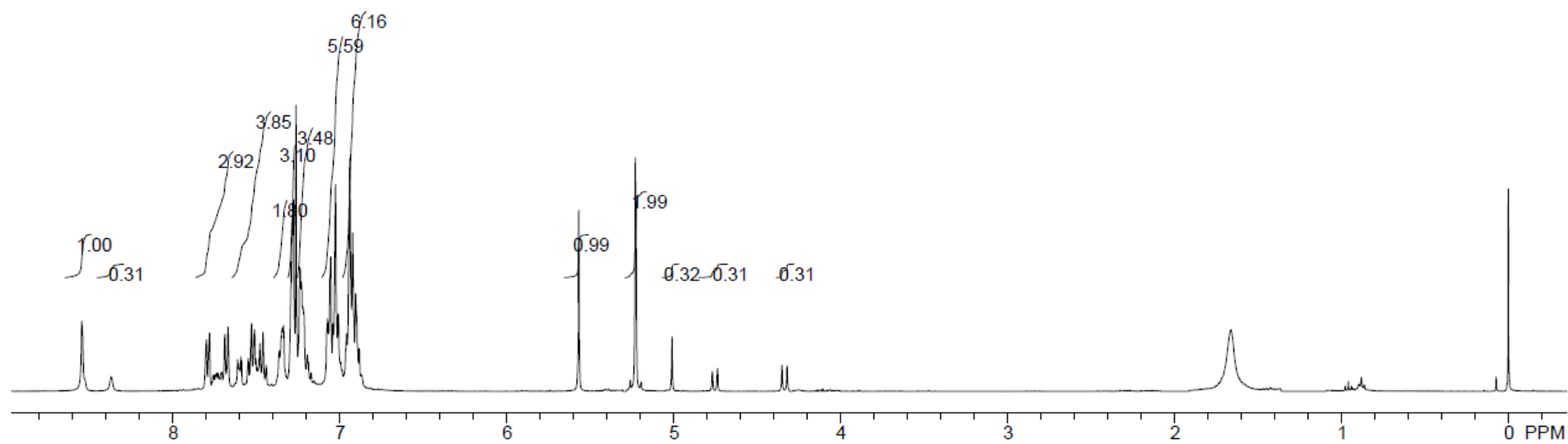
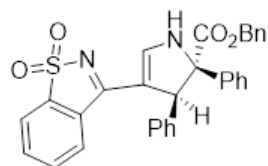
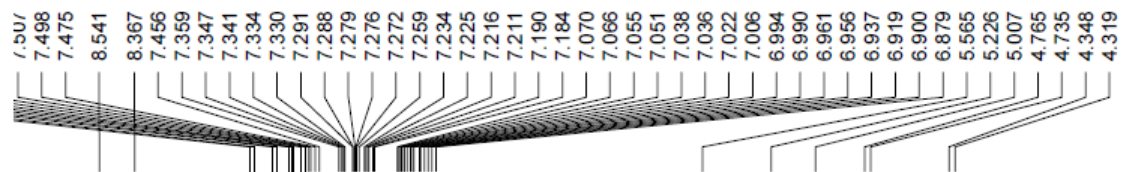


<sup>19</sup>F NMR of **4i**

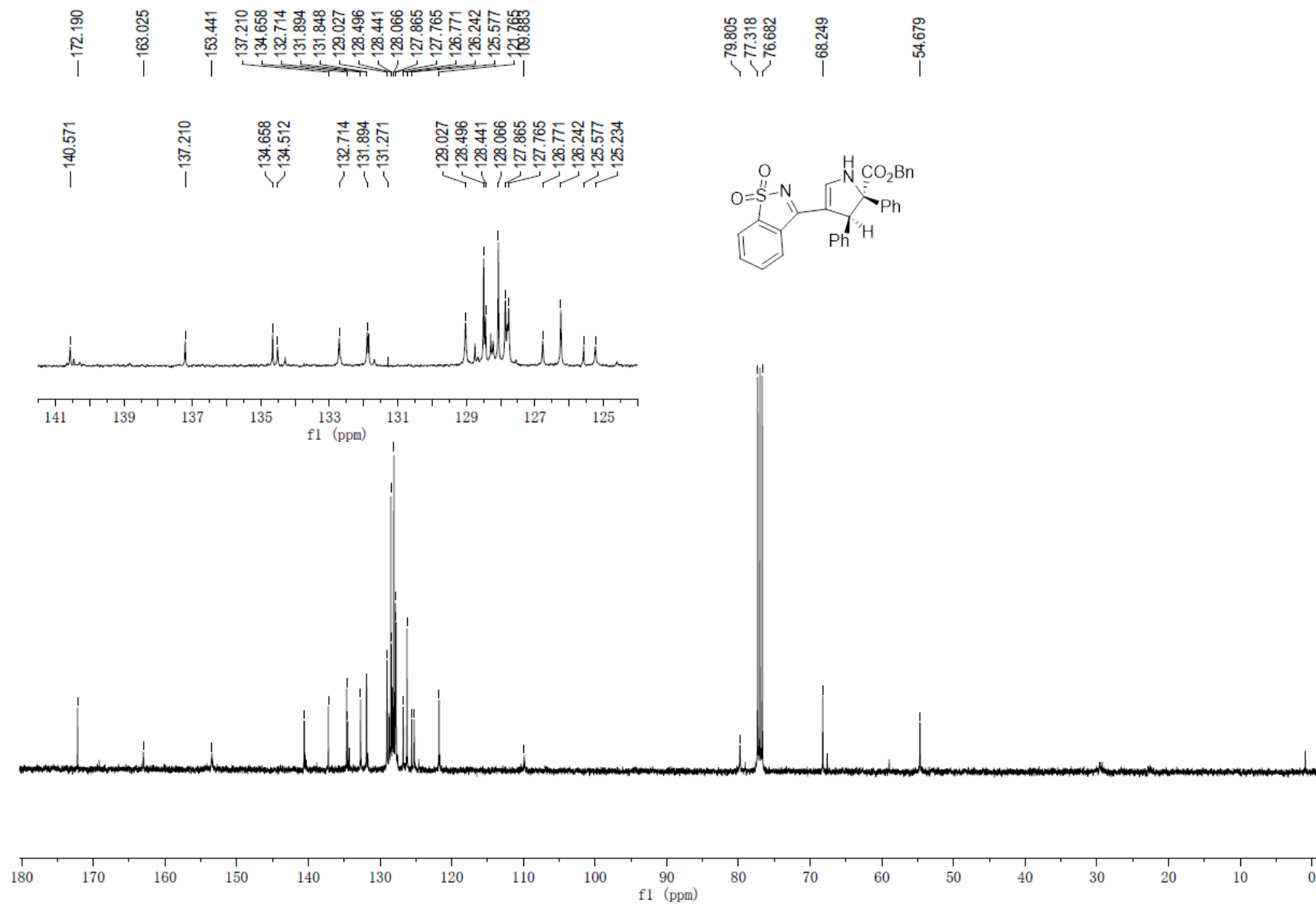
111.250



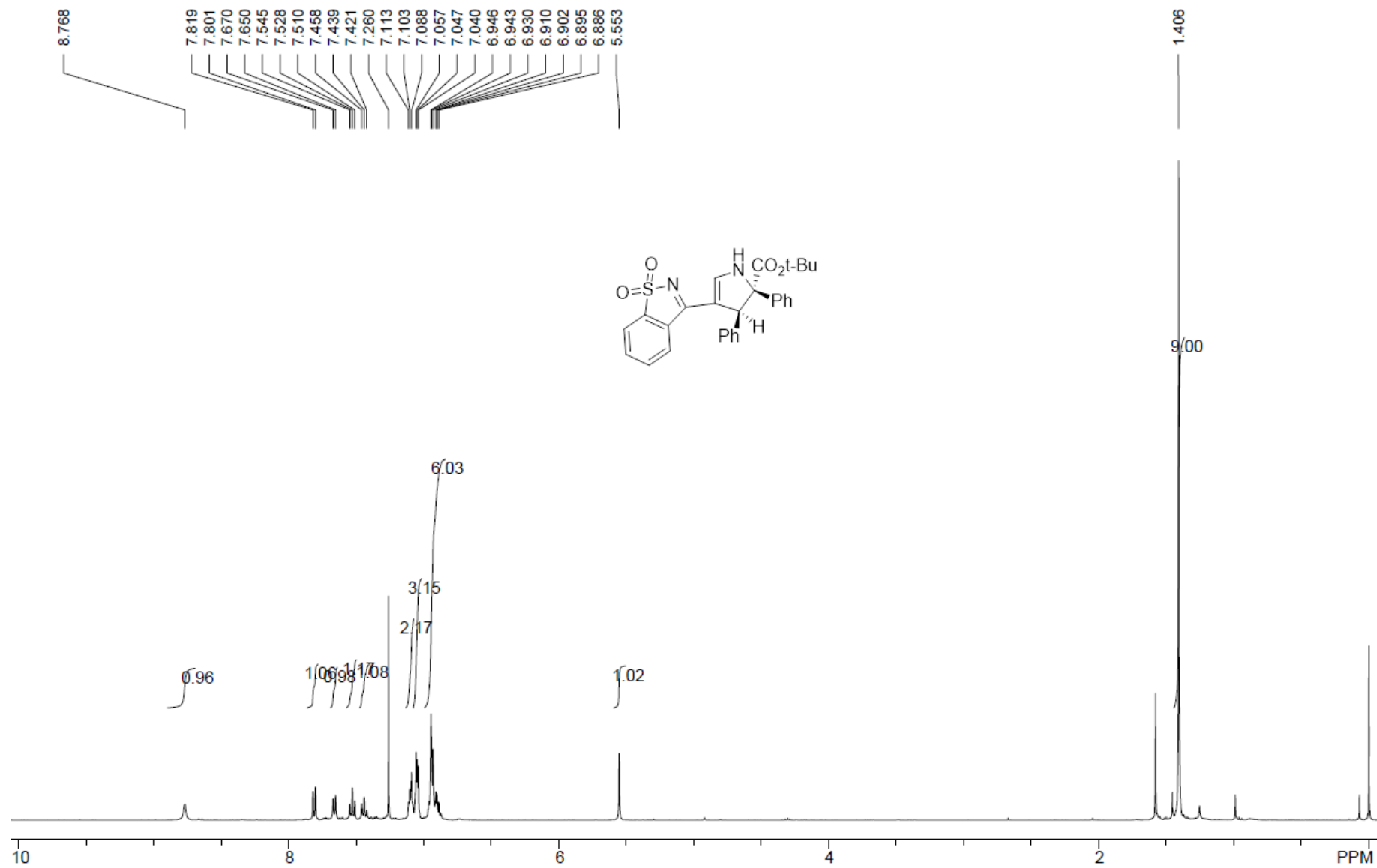
<sup>1</sup>H NMR of **4k**



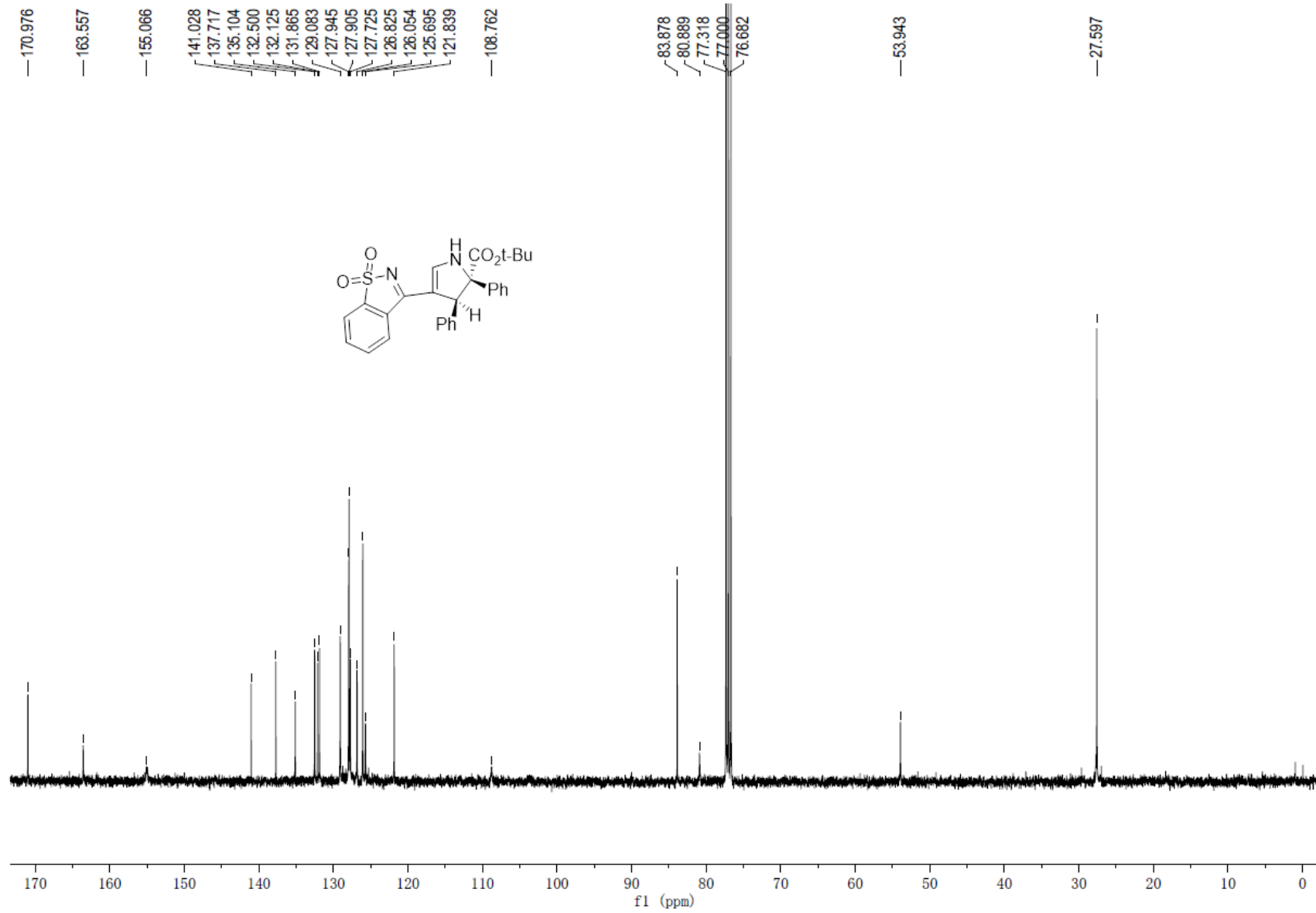
<sup>13</sup>C NMR of **4k**



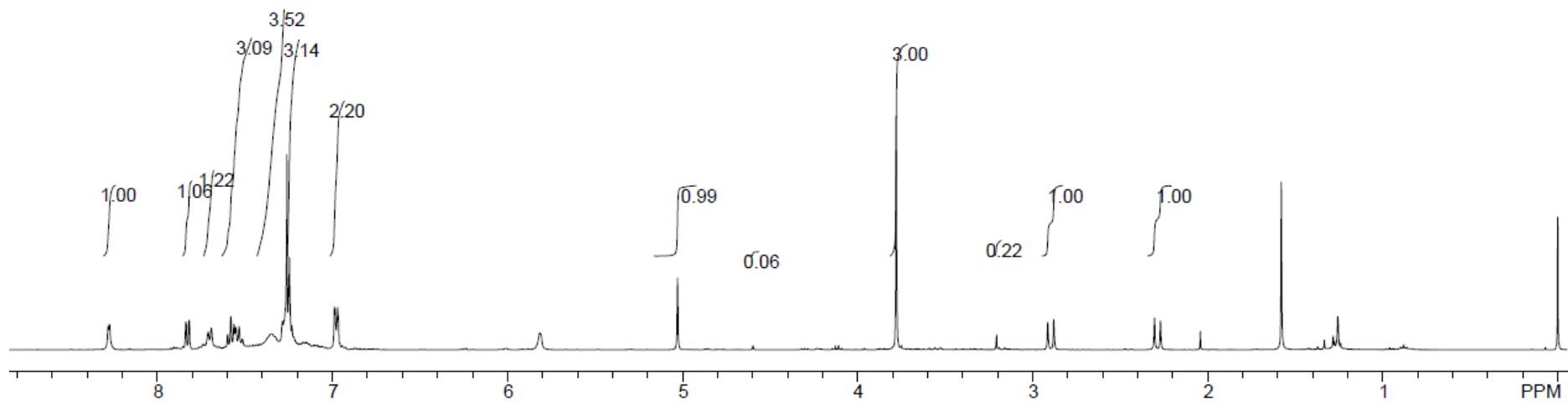
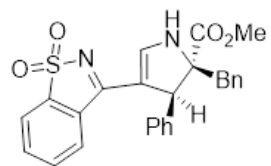
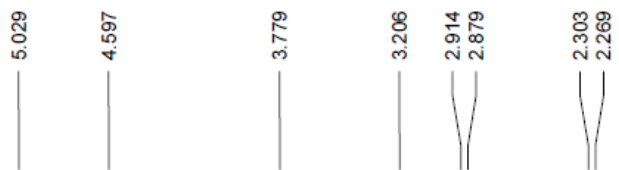
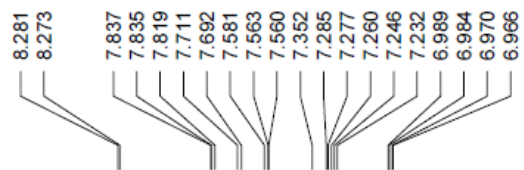
<sup>1</sup>H NMR of **4I**



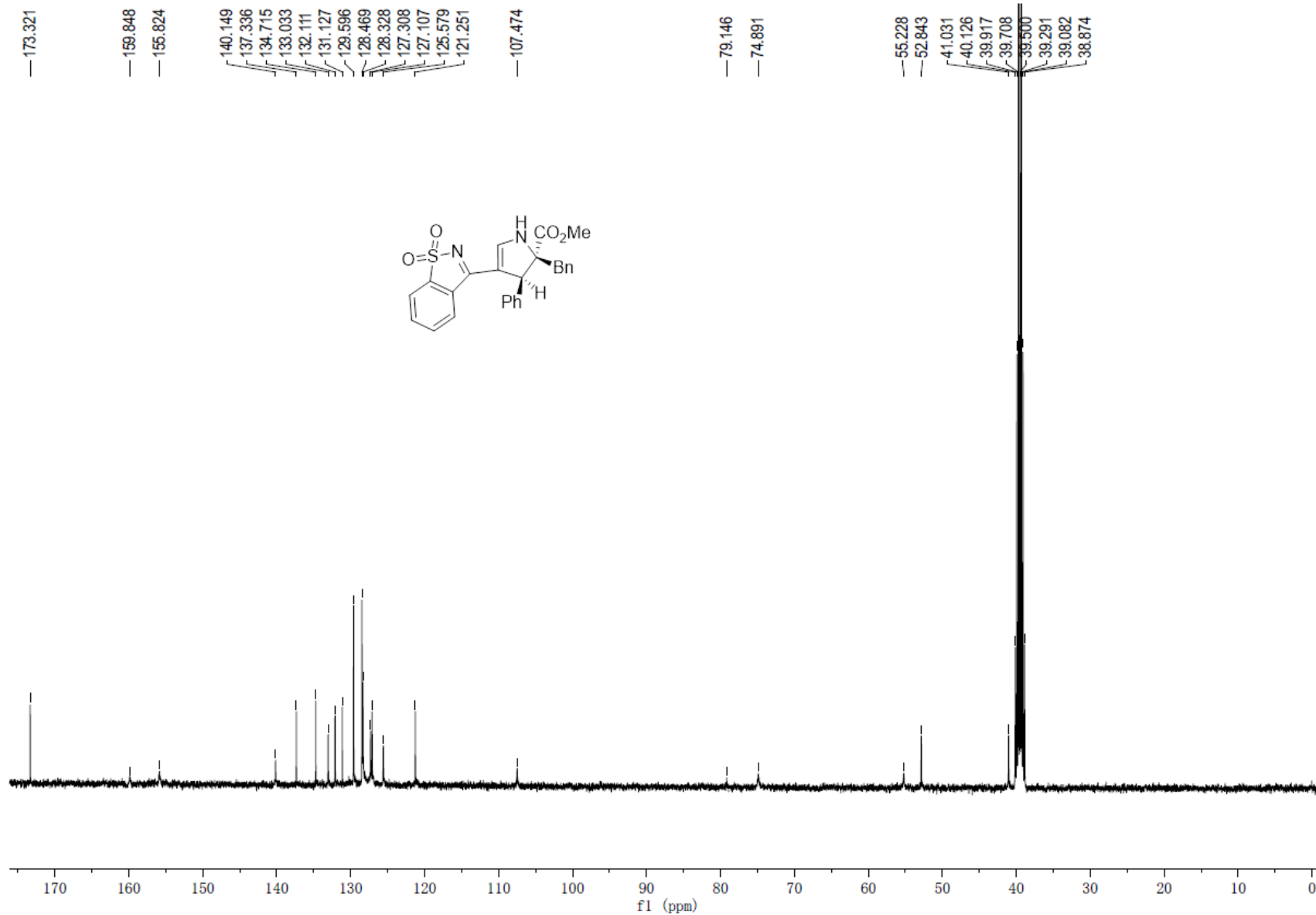
<sup>13</sup>C NMR of **4I**



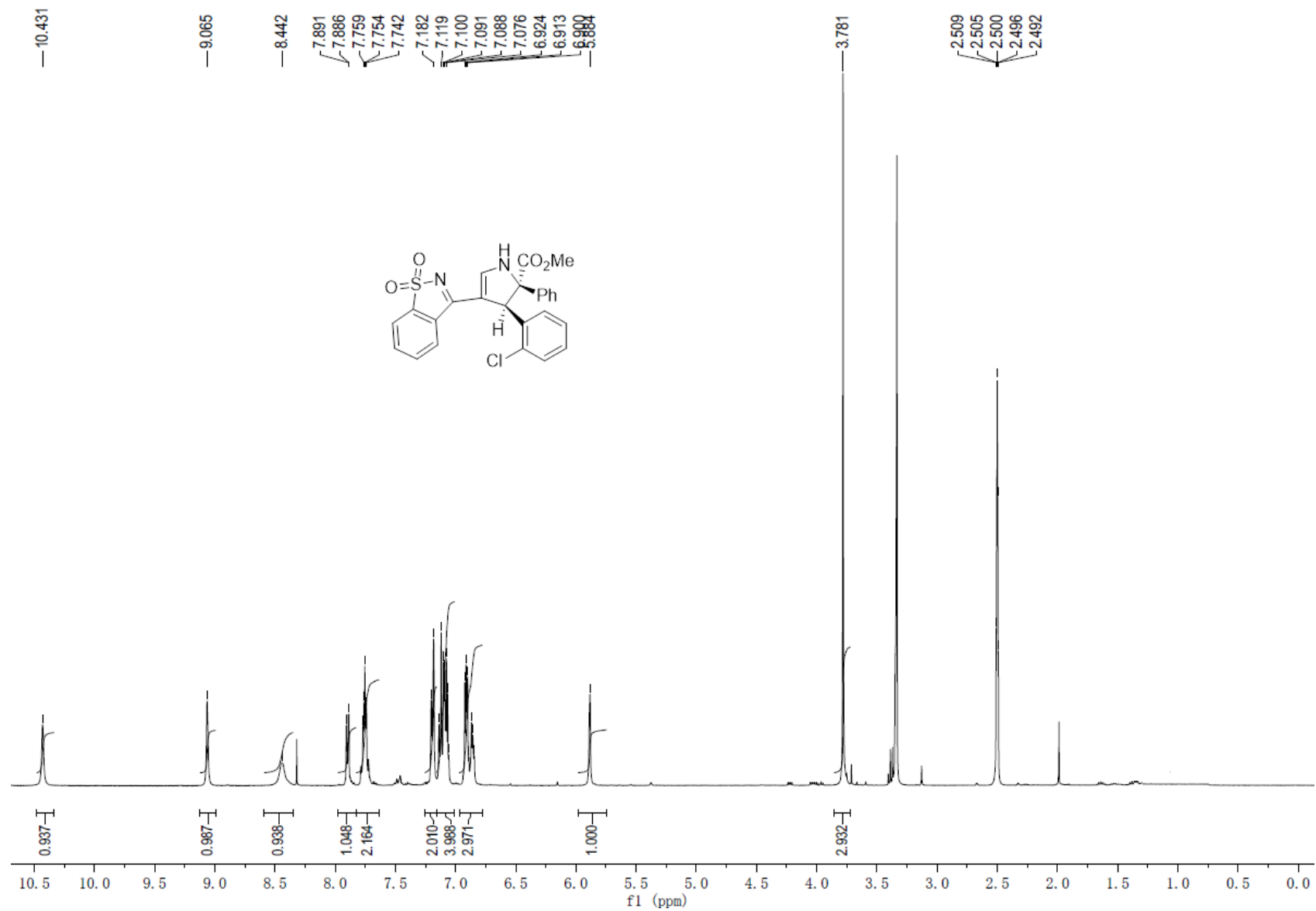
<sup>1</sup>H NMR of 4m



<sup>13</sup>C NMR of **4m**

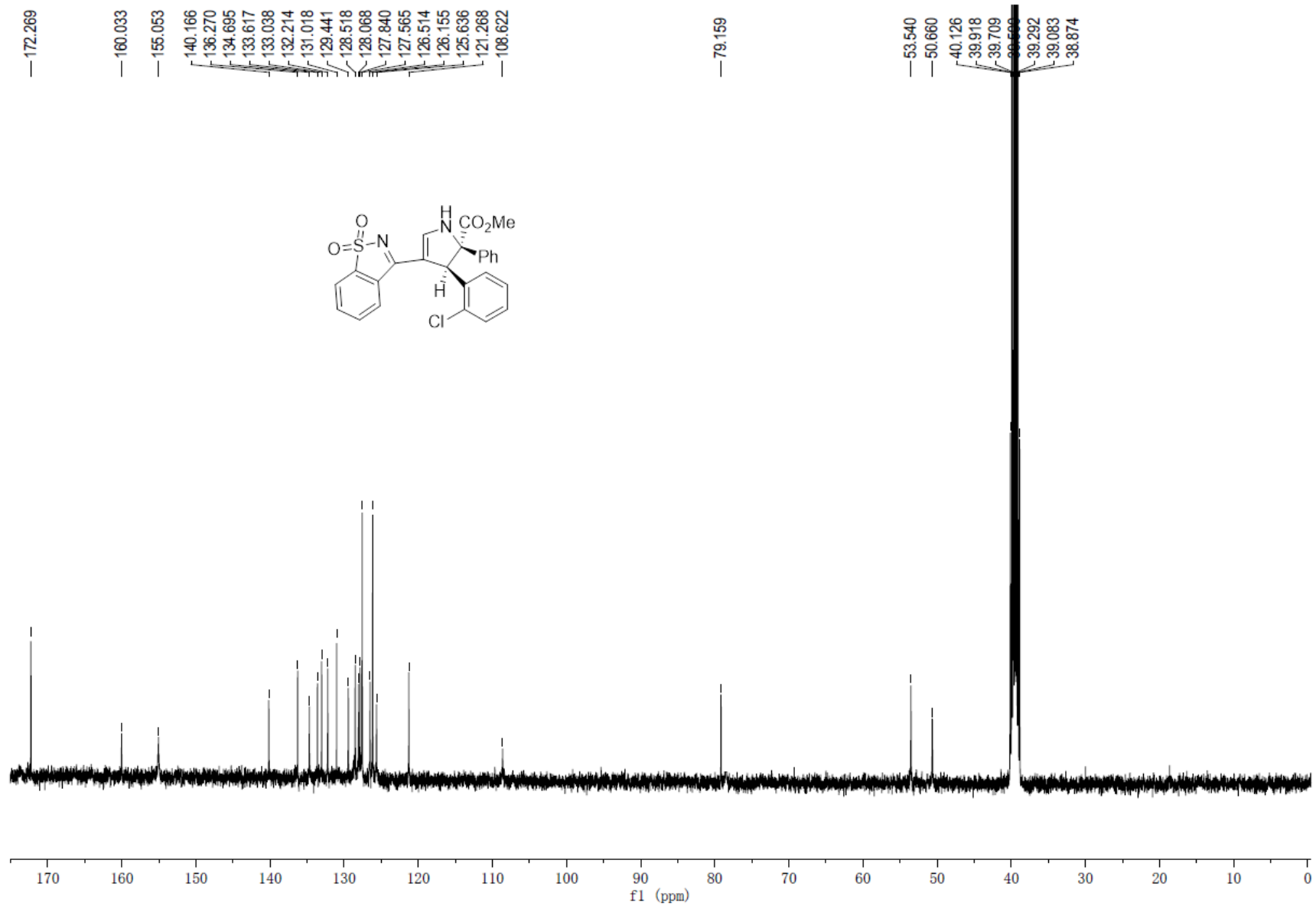


<sup>1</sup>H NMR of **4n**

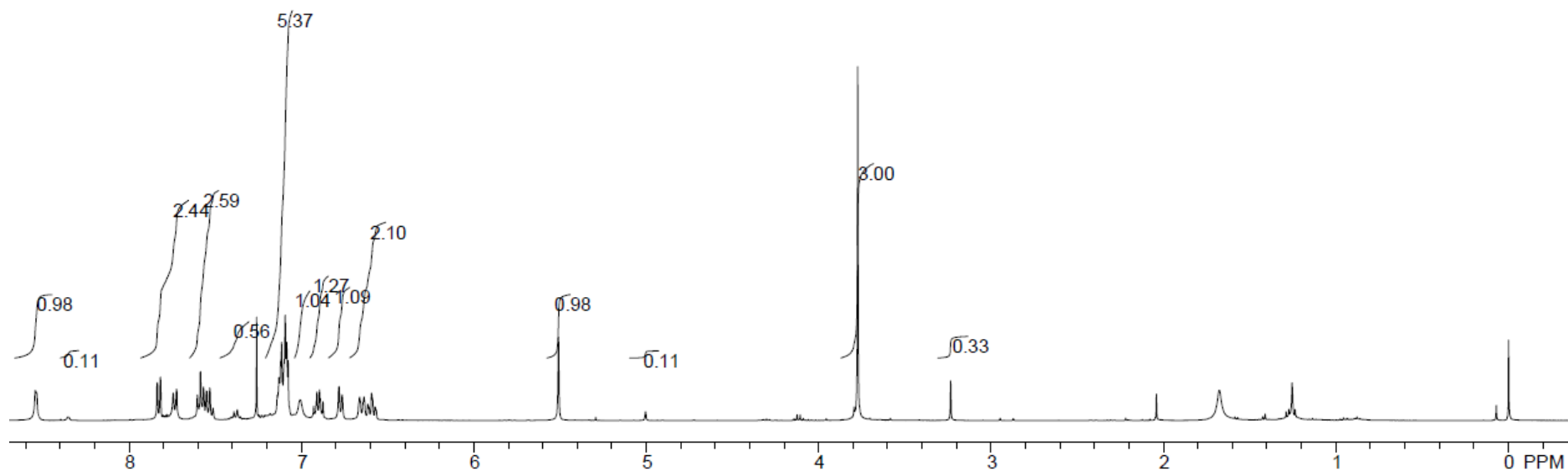
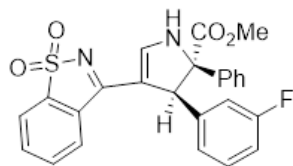
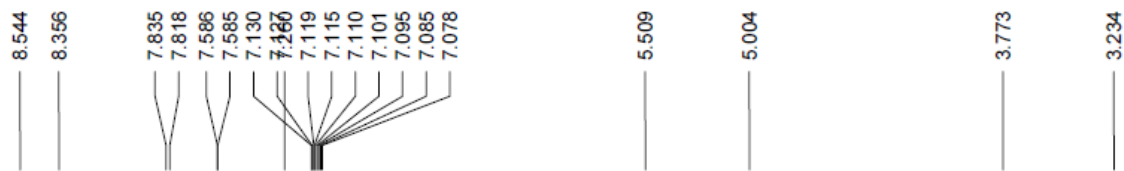




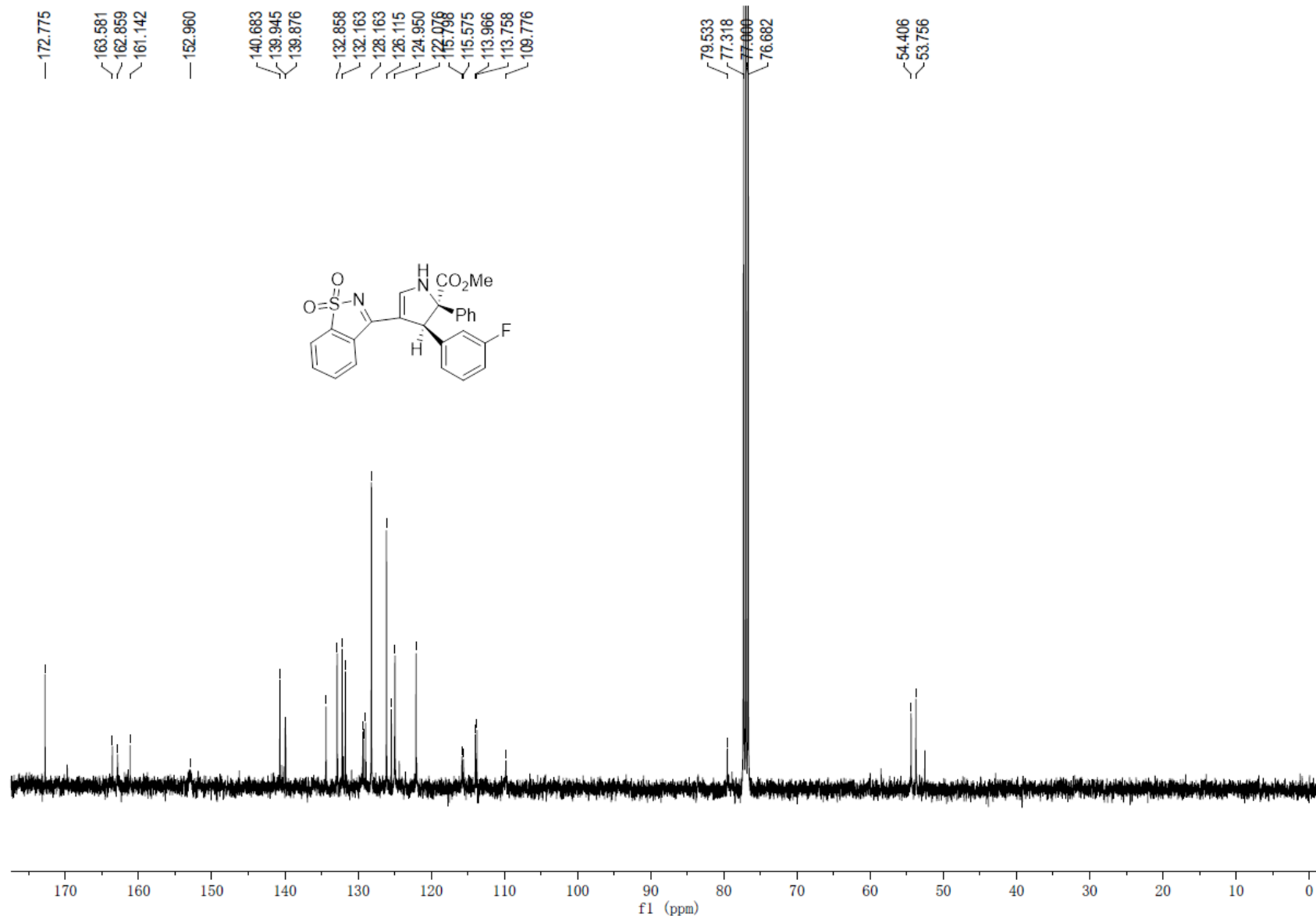
<sup>13</sup>C NMR of **4n**



<sup>1</sup>H NMR of **4o**

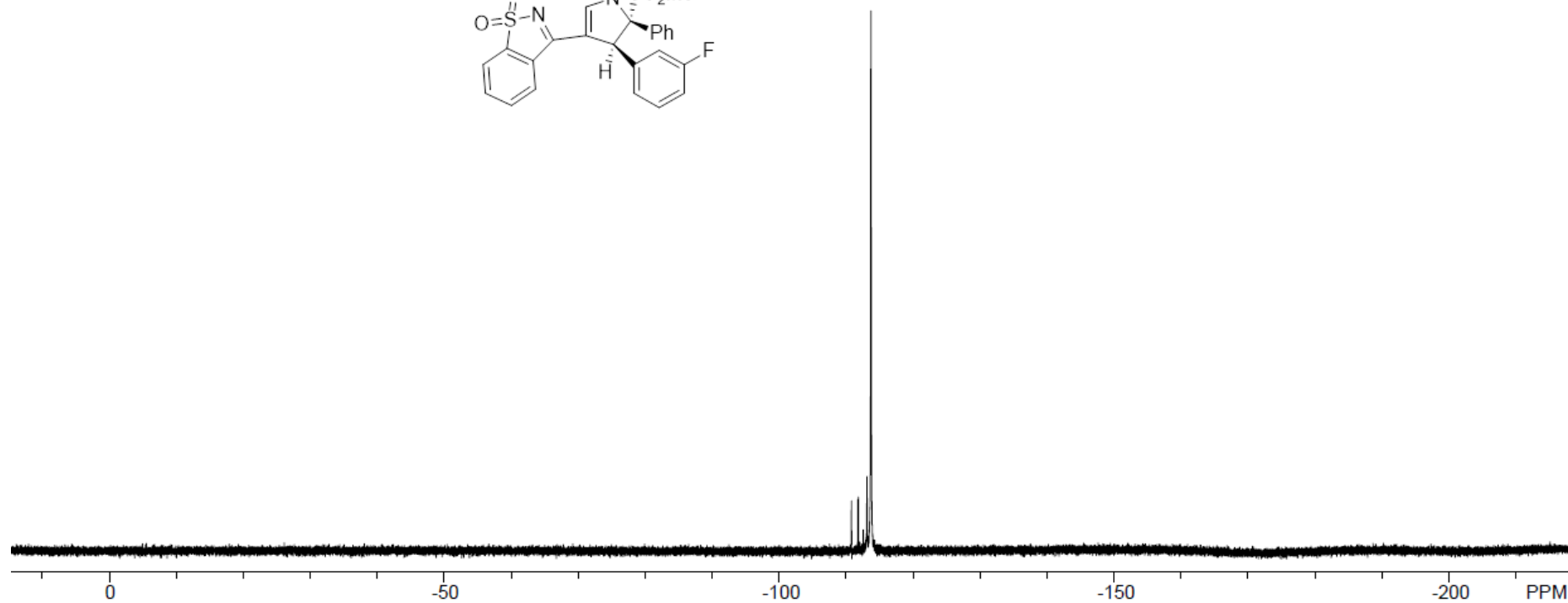
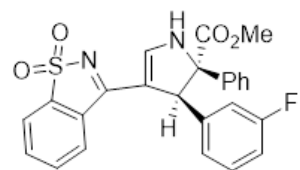


<sup>13</sup>C NMR of **40**

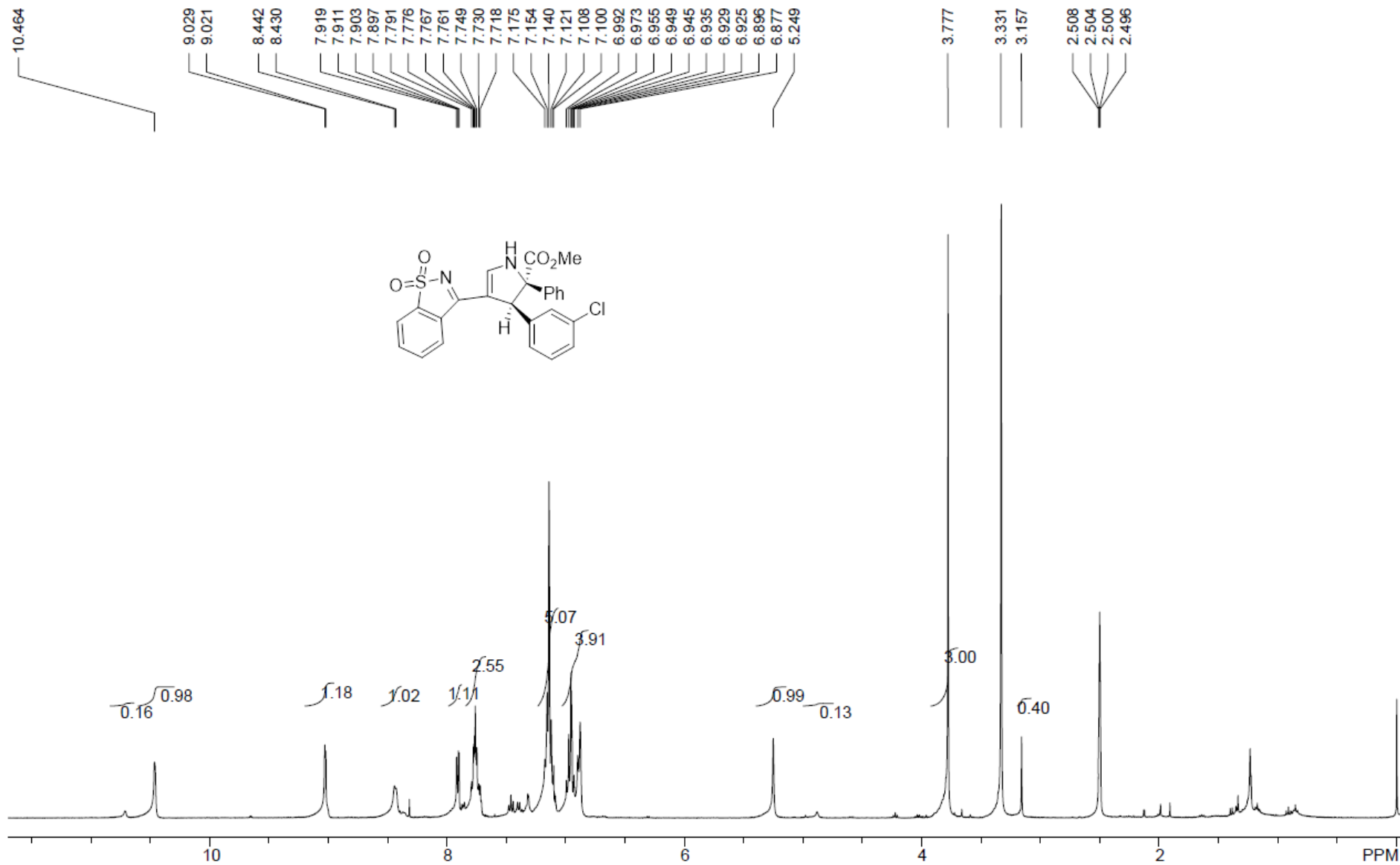


<sup>19</sup>F NMR of **4o**

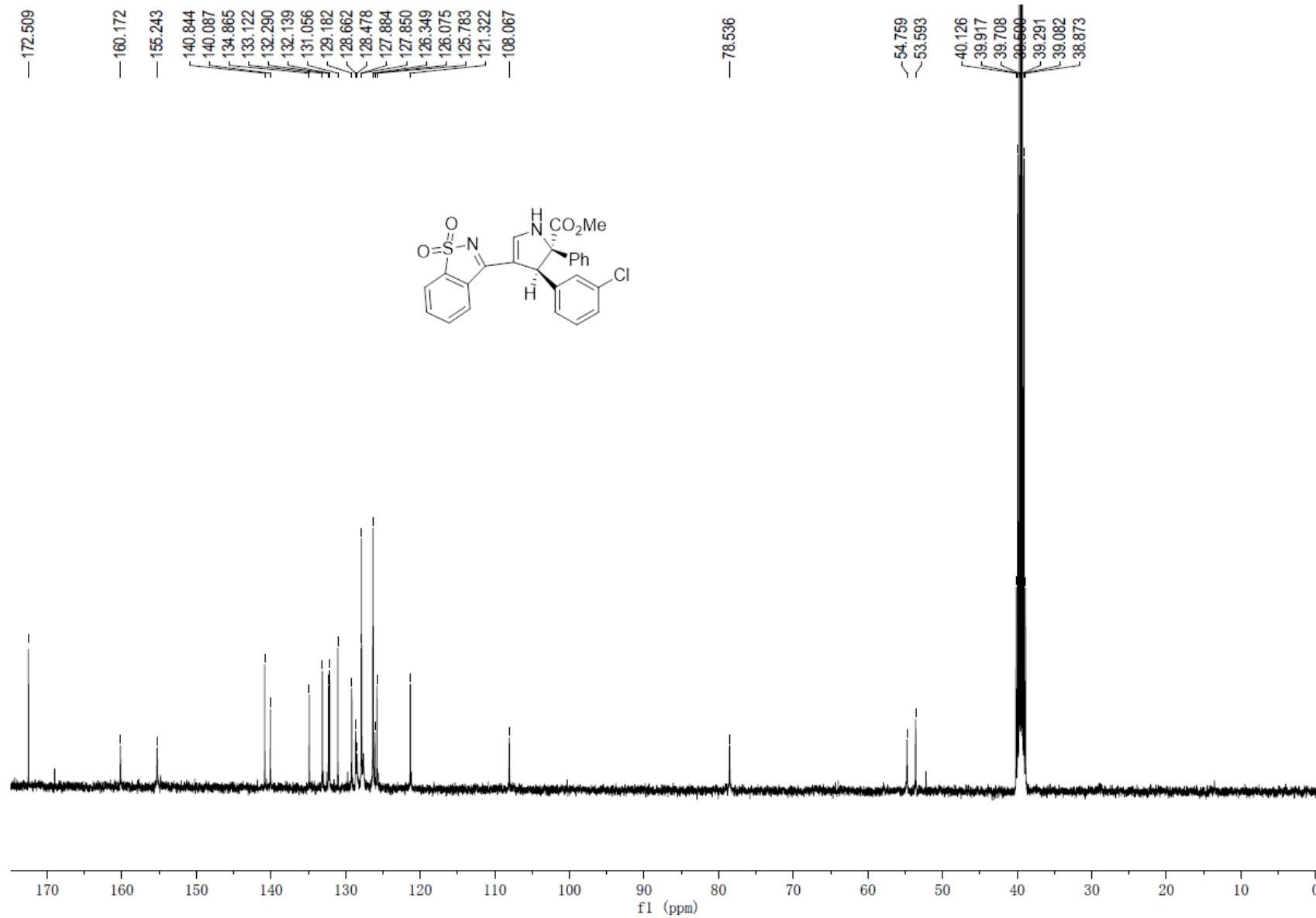
113.153  
113.756



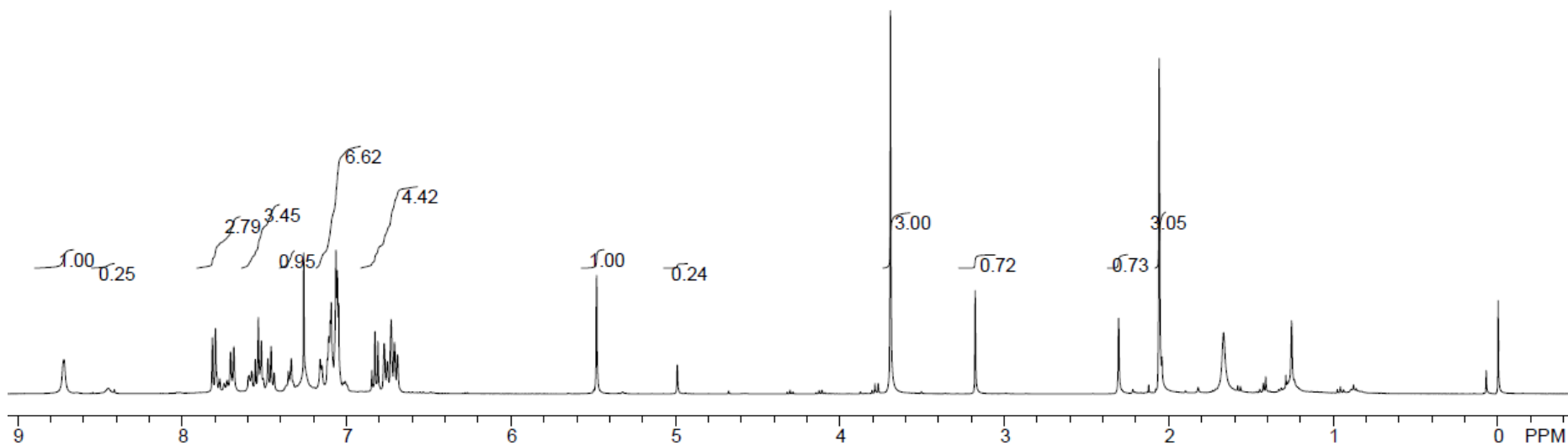
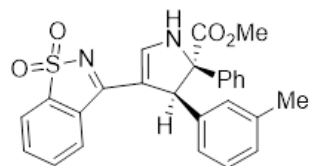
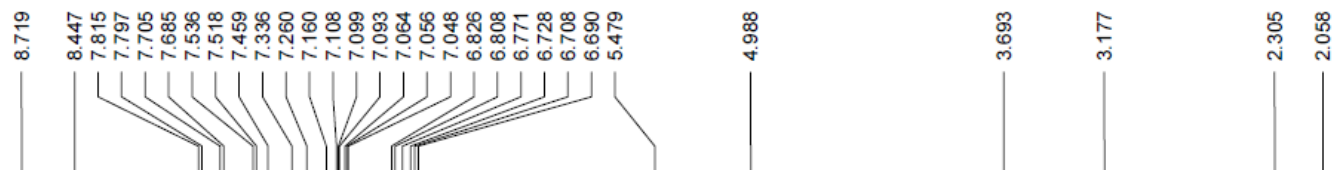
<sup>1</sup>H NMR of 4p



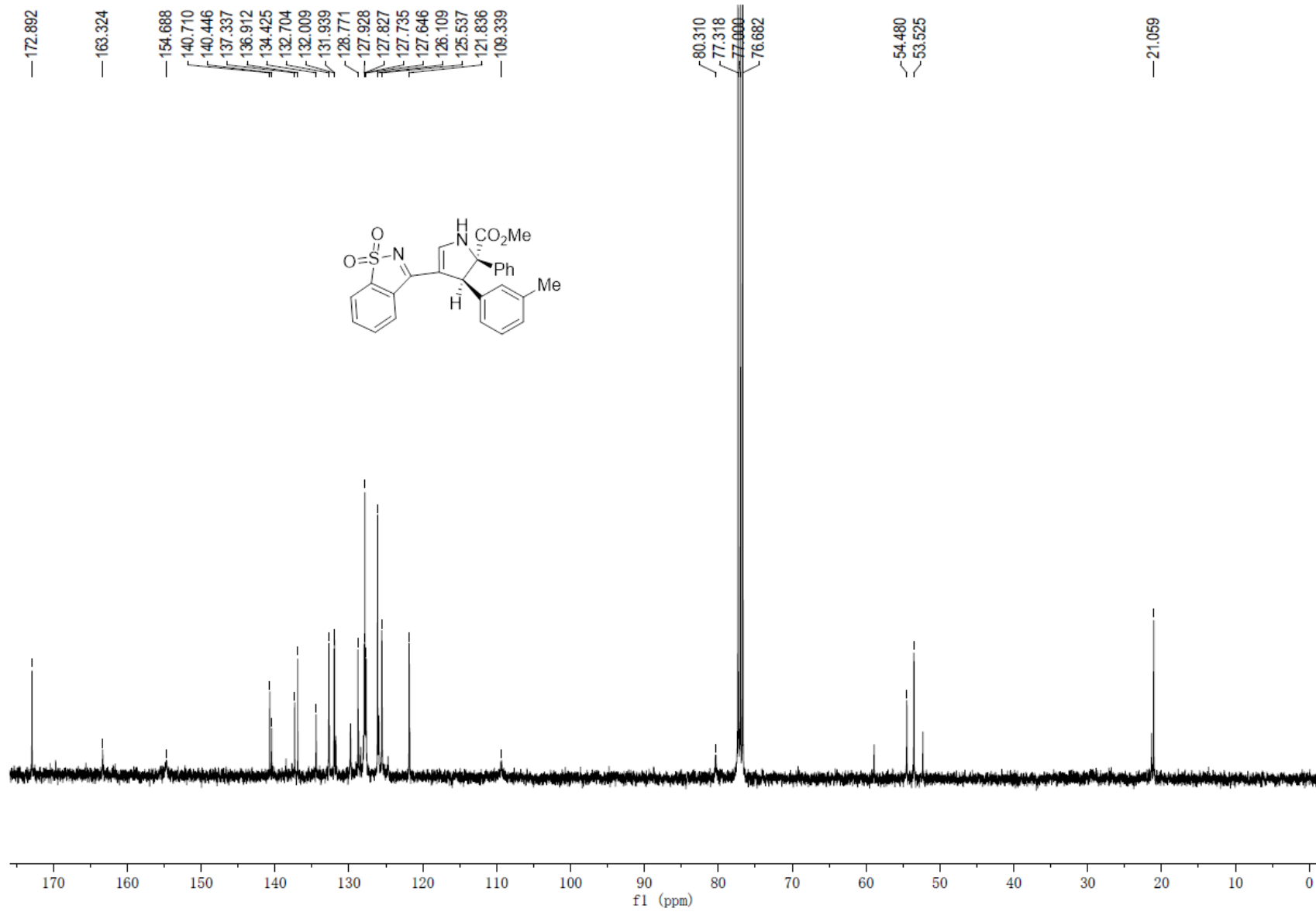
<sup>13</sup>C NMR of **4p**



<sup>1</sup>H NMR of **4q**

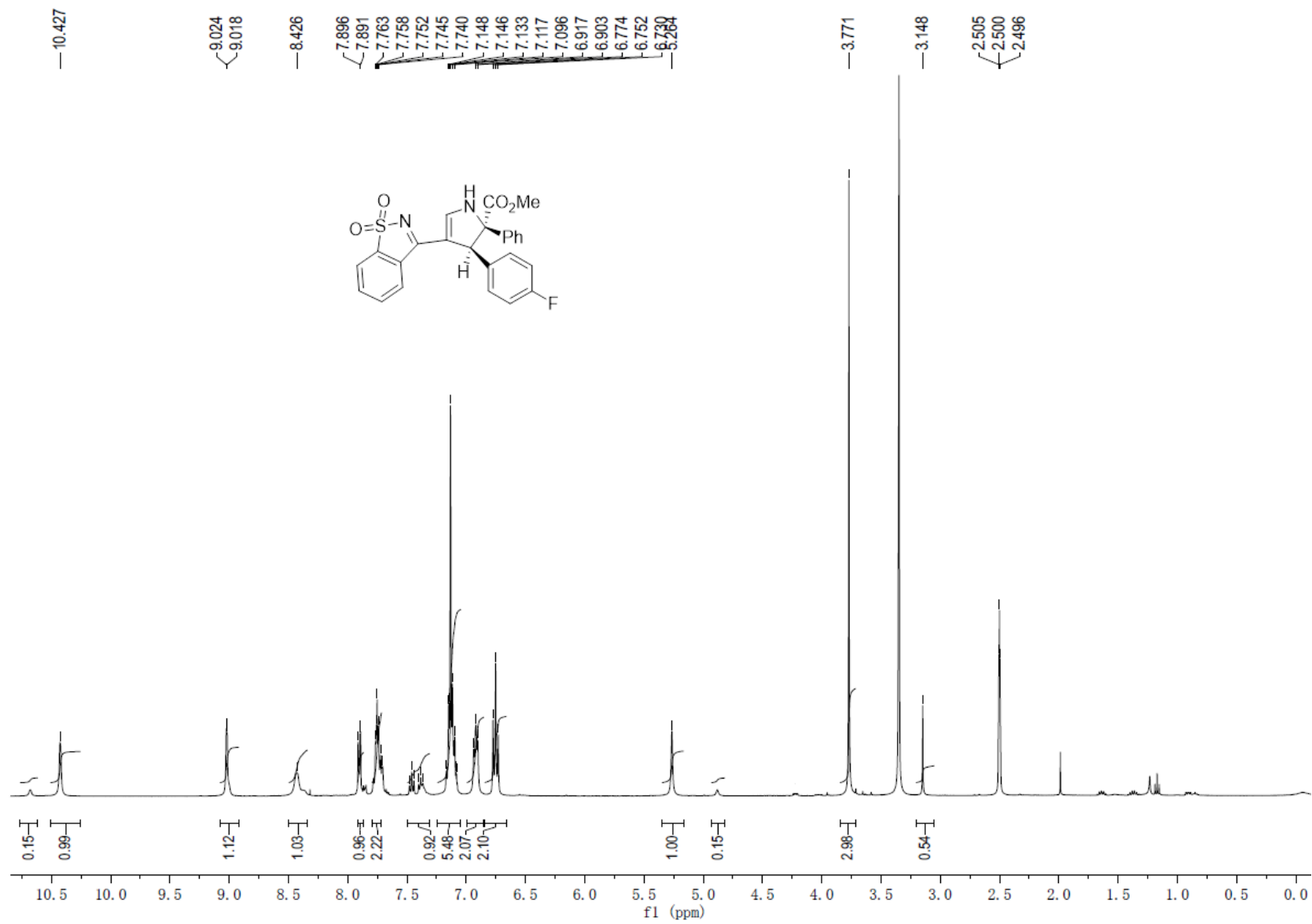


<sup>13</sup>C NMR of **4q**

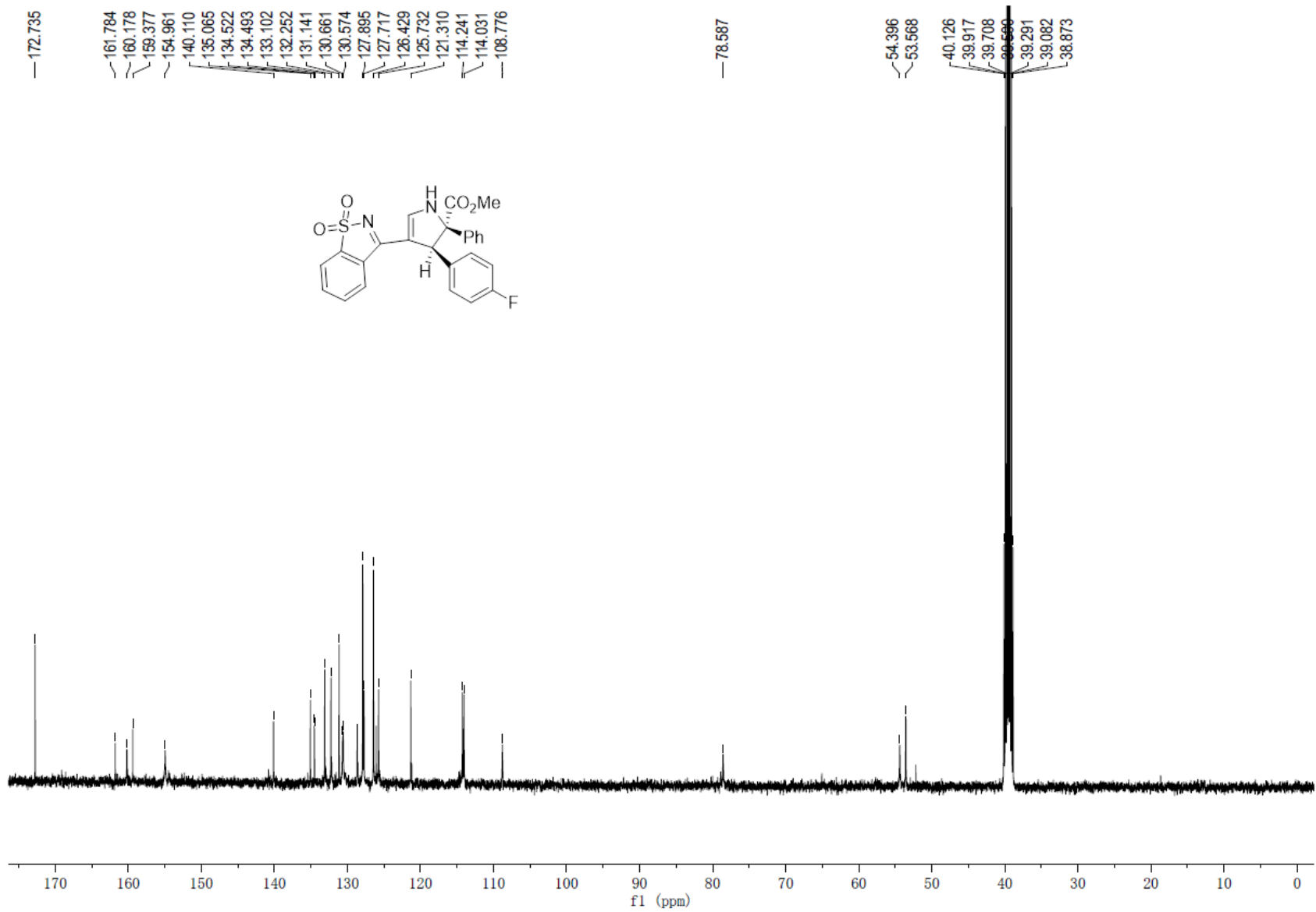




<sup>1</sup>H NMR of 4r

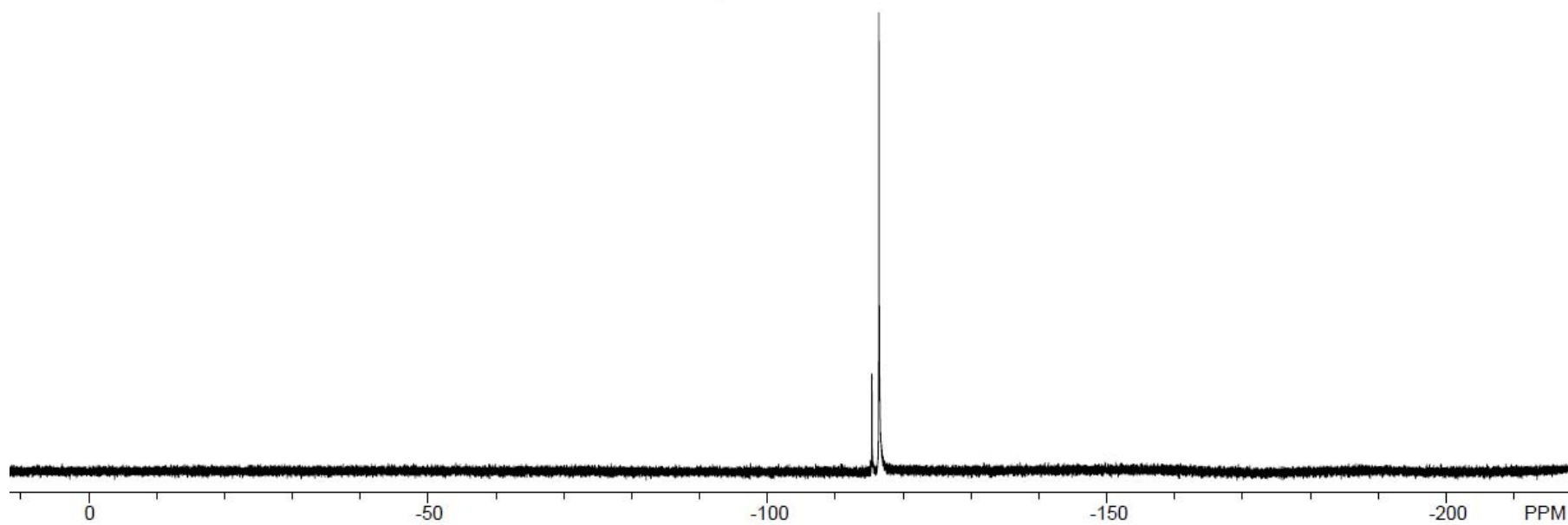
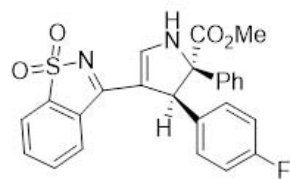


<sup>13</sup>C NMR of **4r**

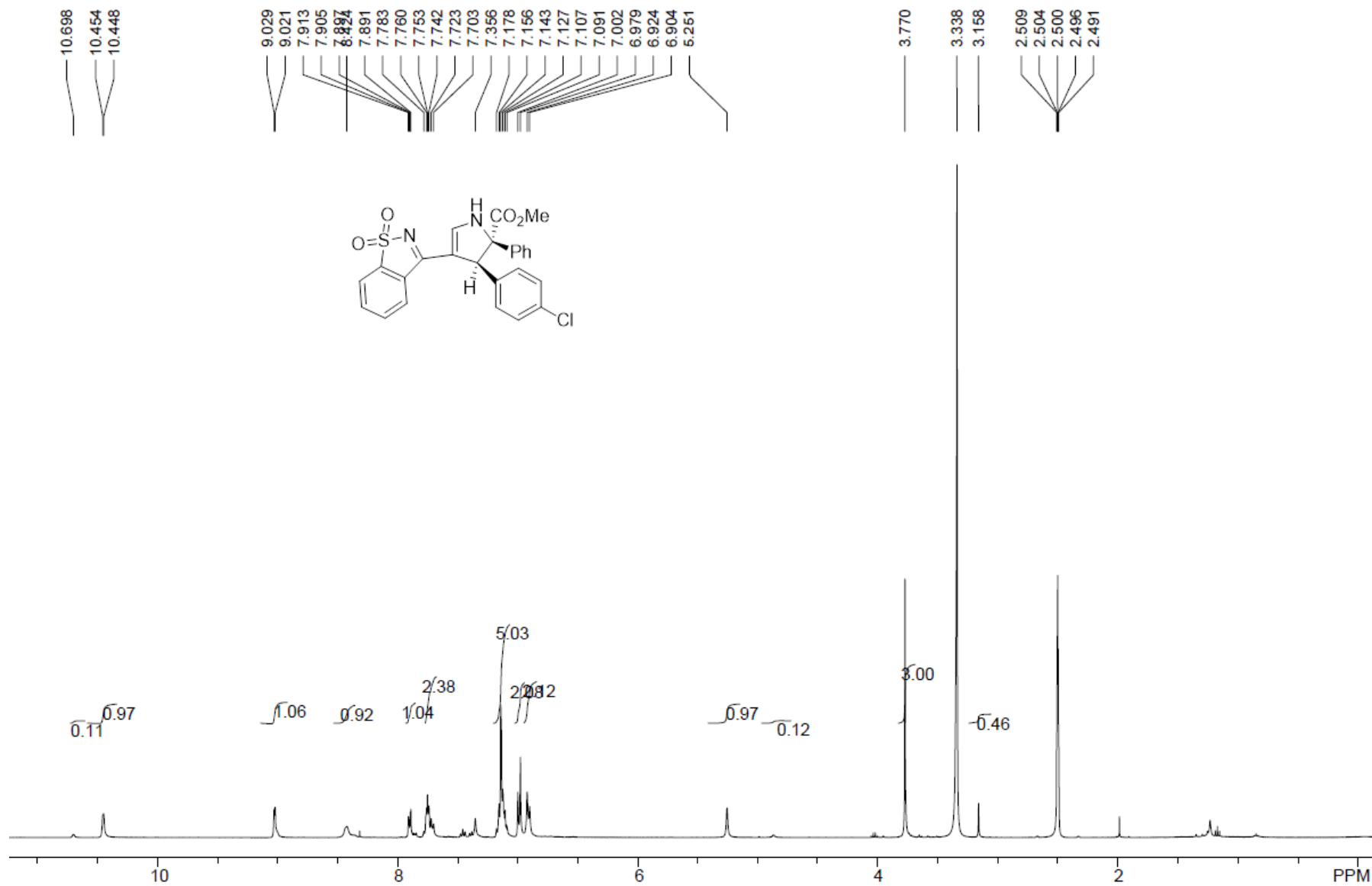


<sup>19</sup>F NMR of **4r**

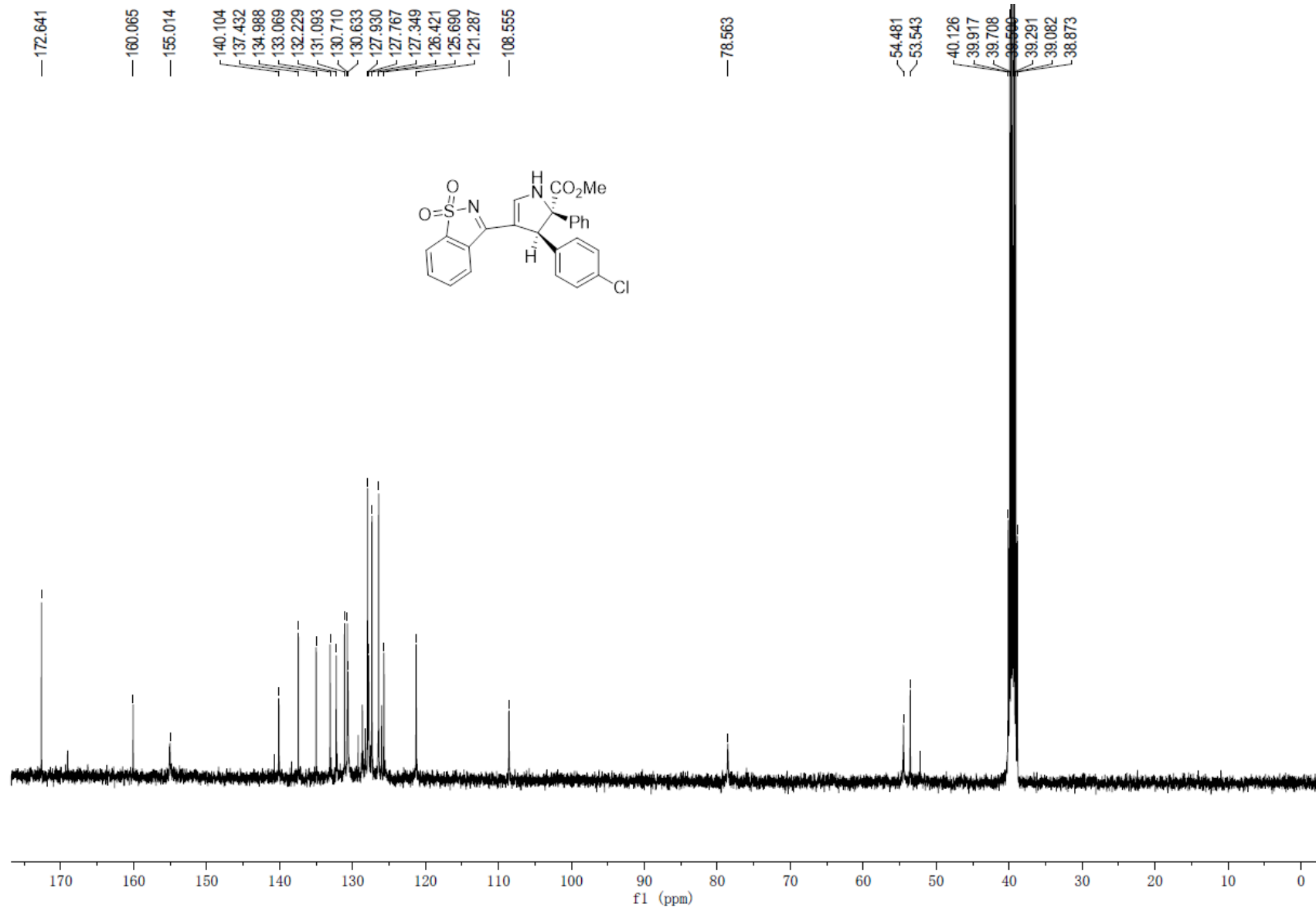
115.425  
116.461



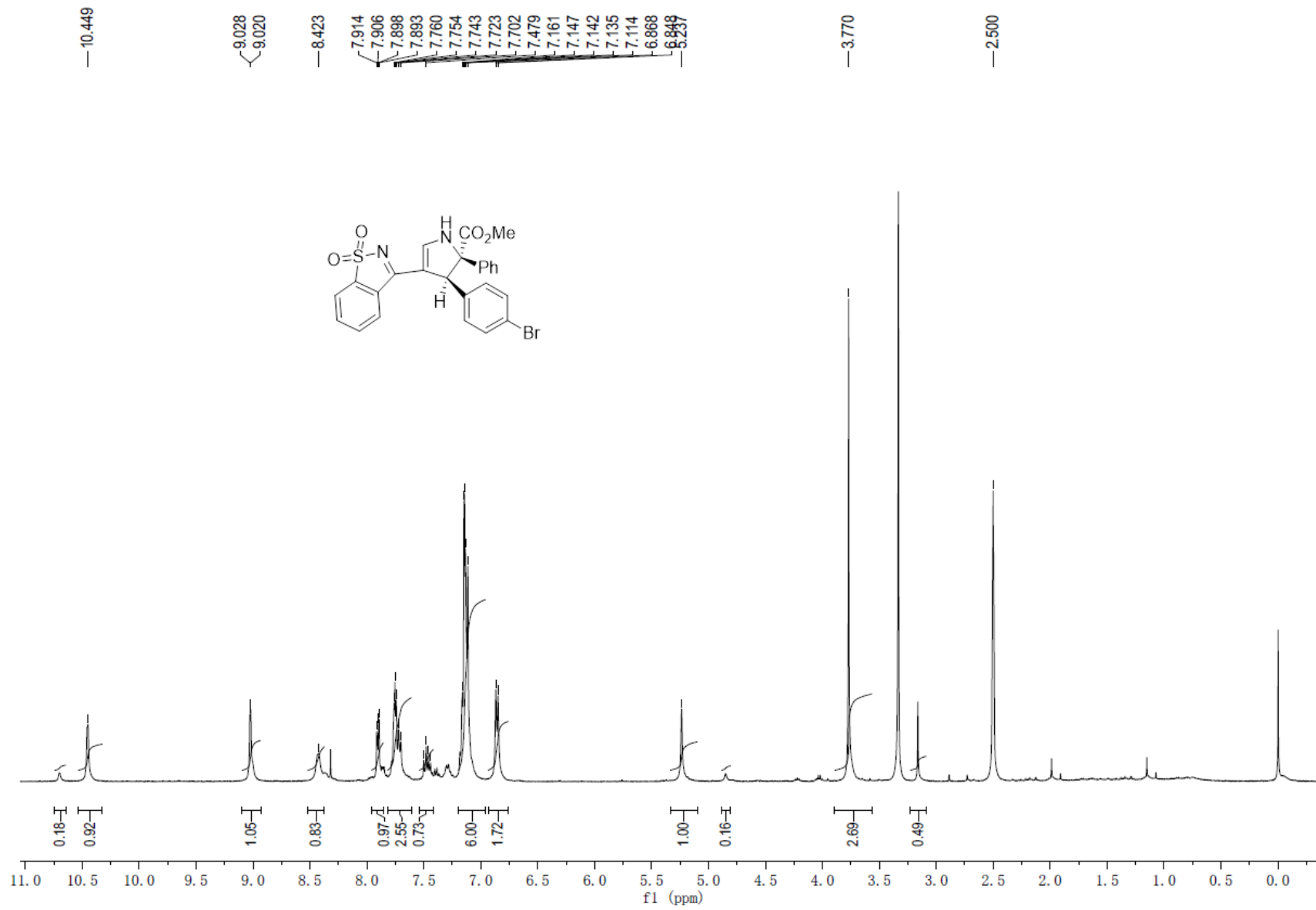
<sup>1</sup>H NMR of 4s



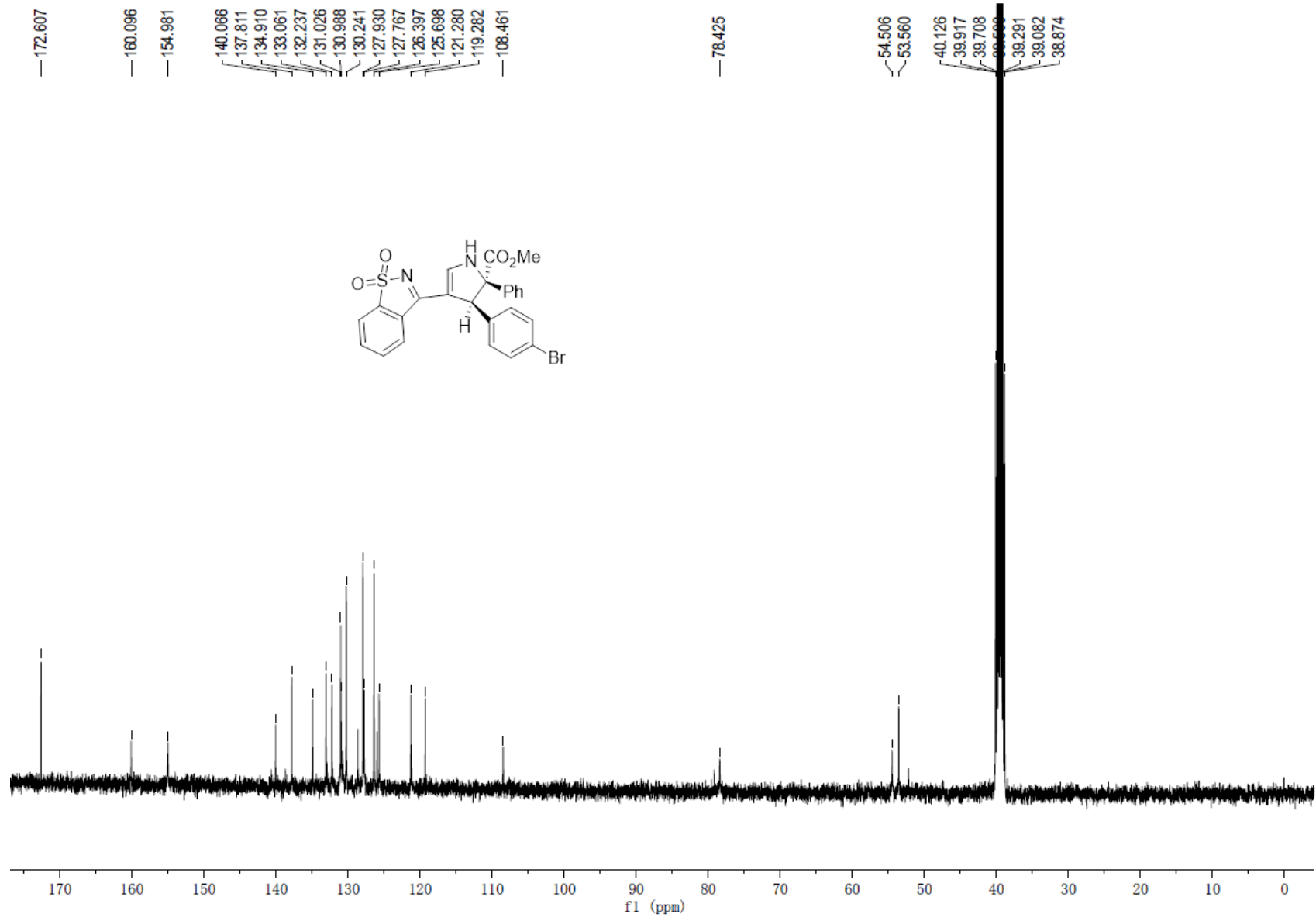
<sup>13</sup>C NMR of 4s



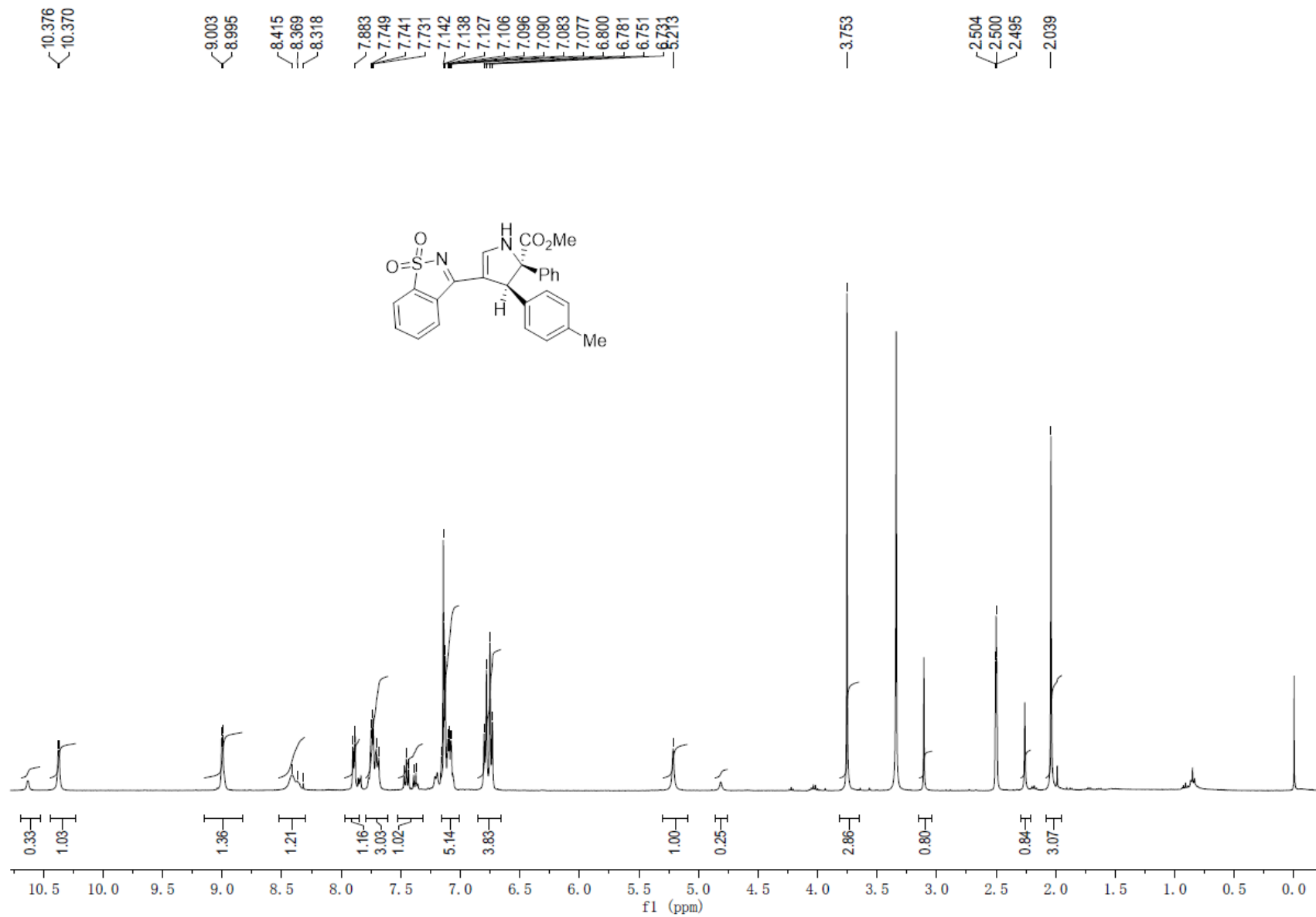
<sup>1</sup>H NMR of 4t



<sup>13</sup>C NMR of 4t

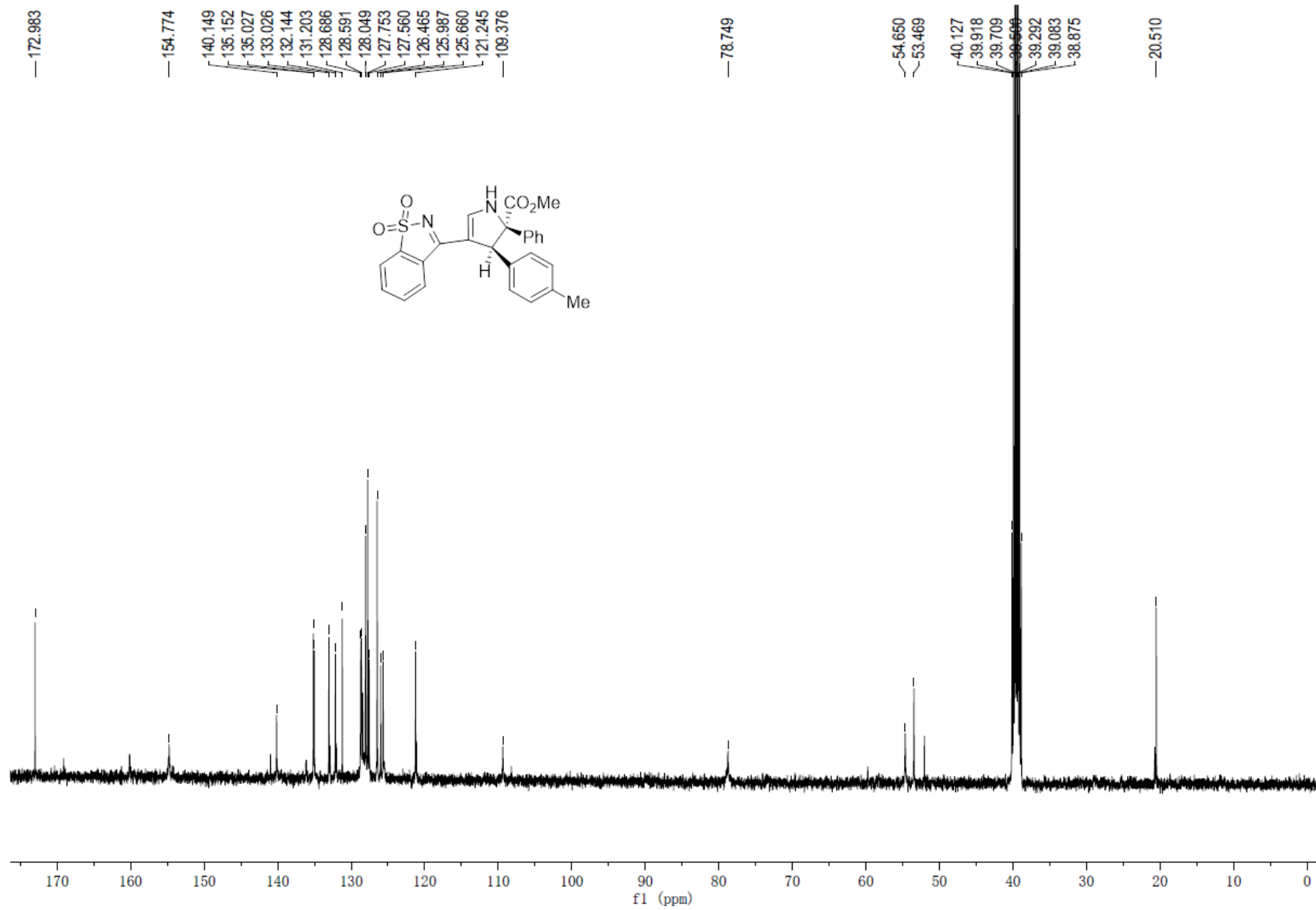


<sup>1</sup>H NMR of **4u**

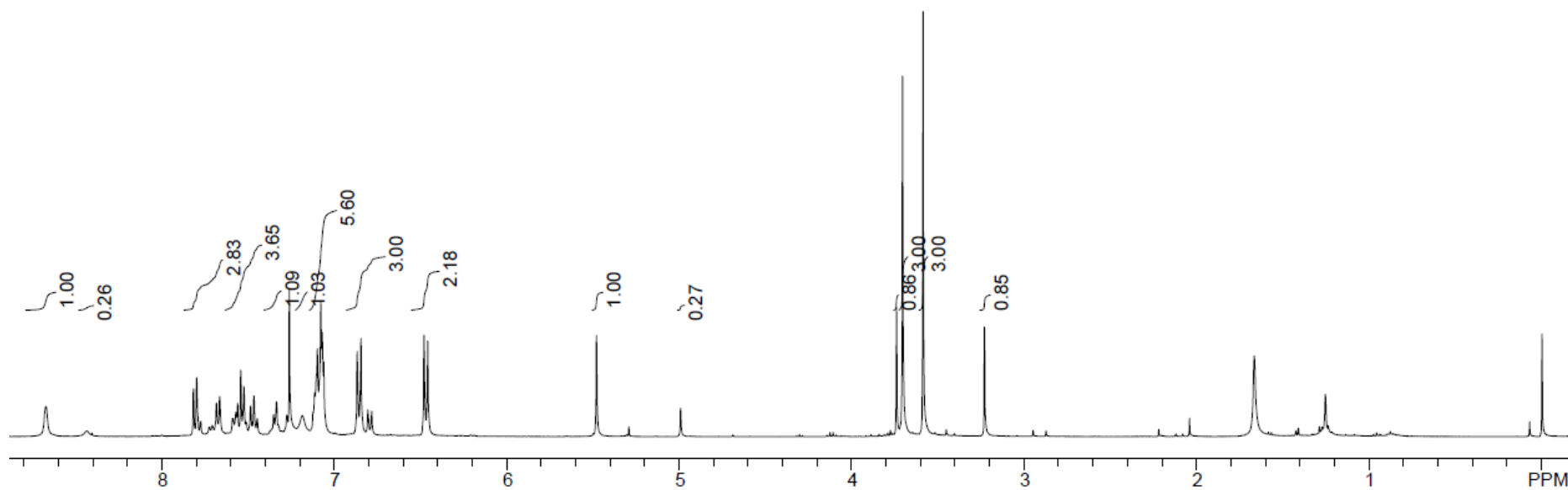
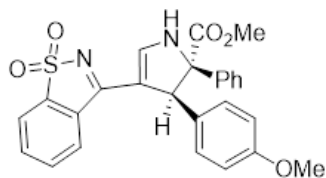
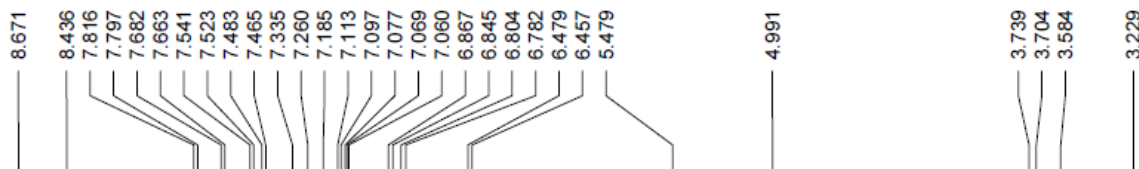




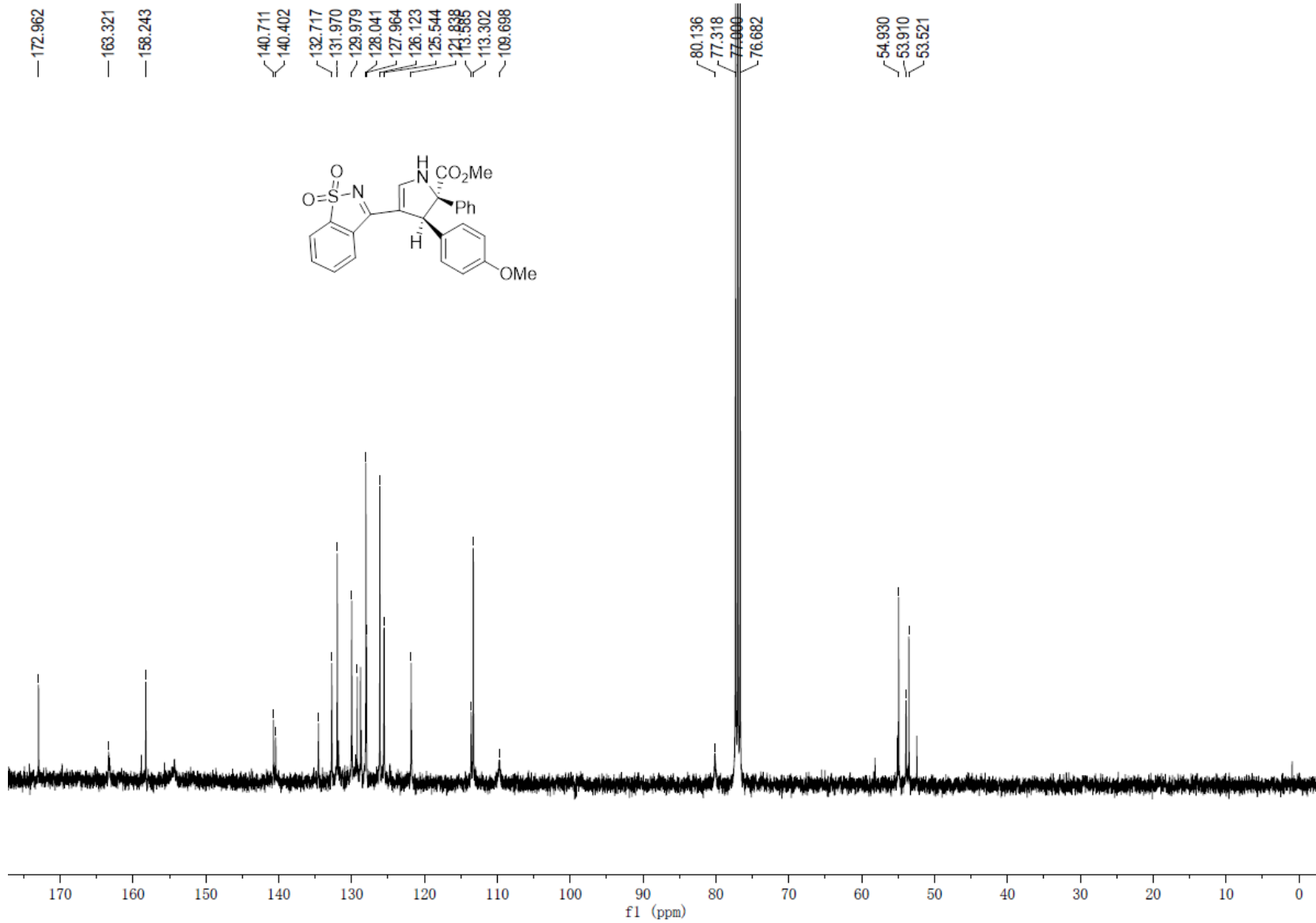
<sup>13</sup>C NMR of **4u**



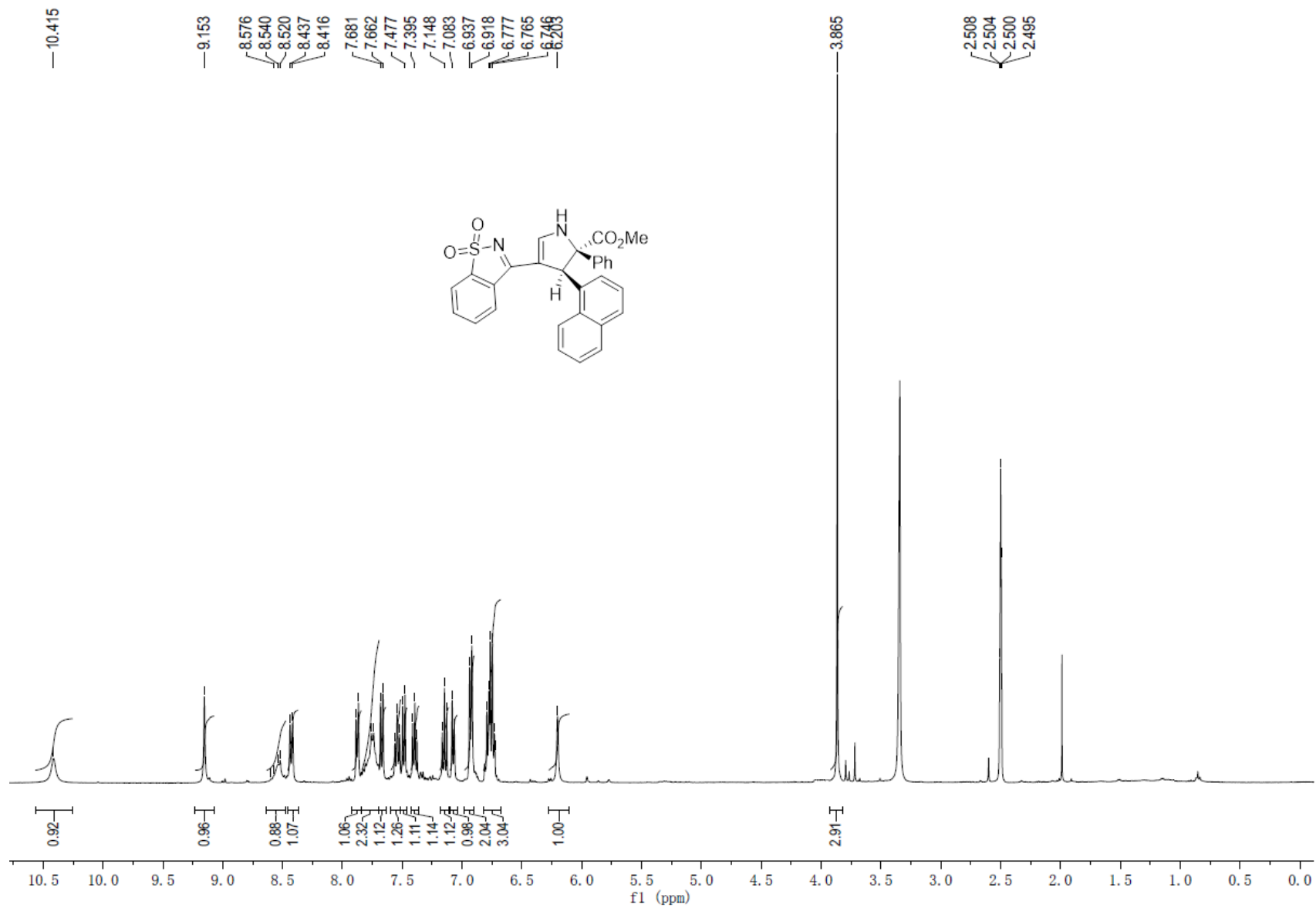
<sup>1</sup>H NMR of 4v



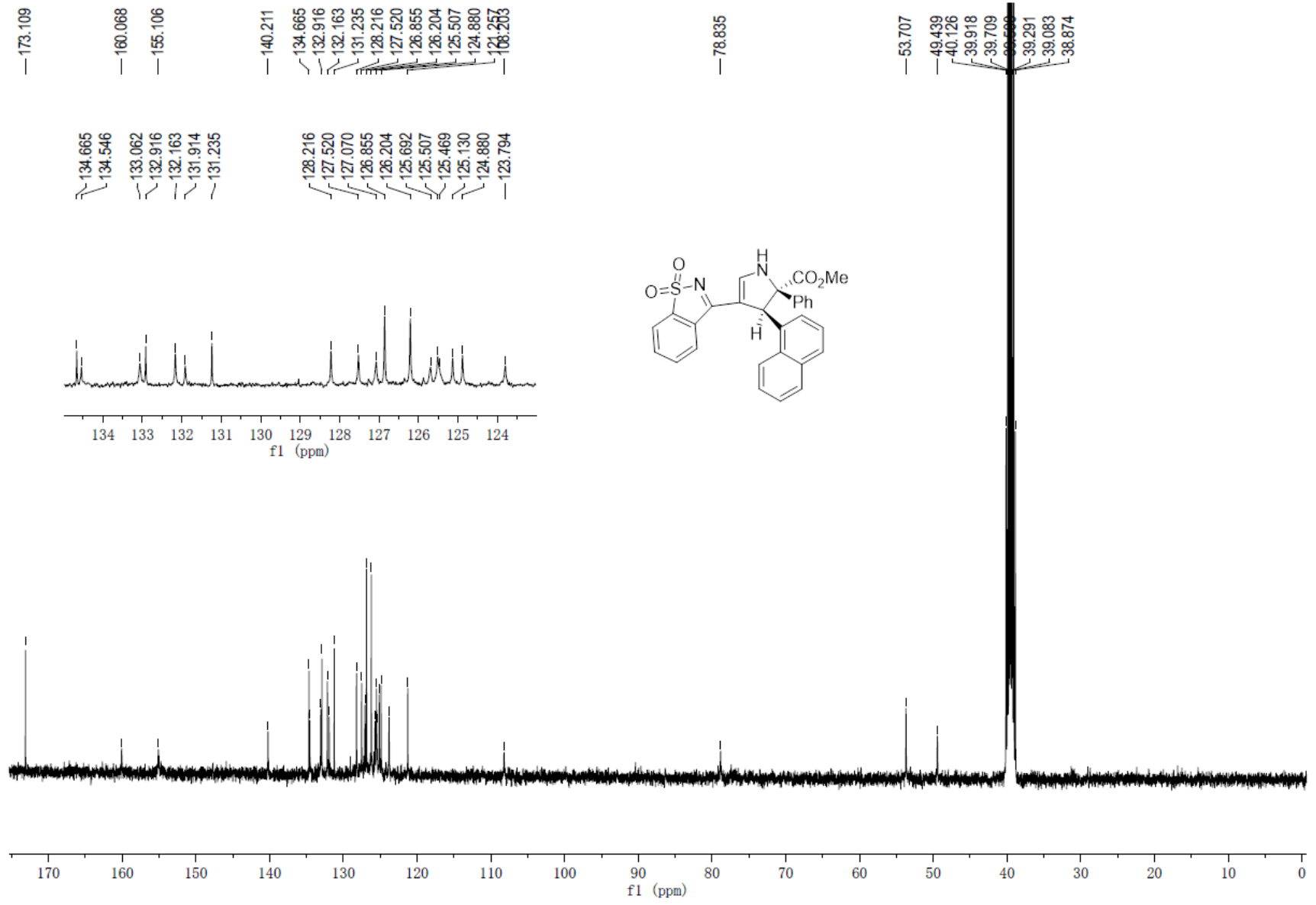
<sup>13</sup>C NMR of 4v



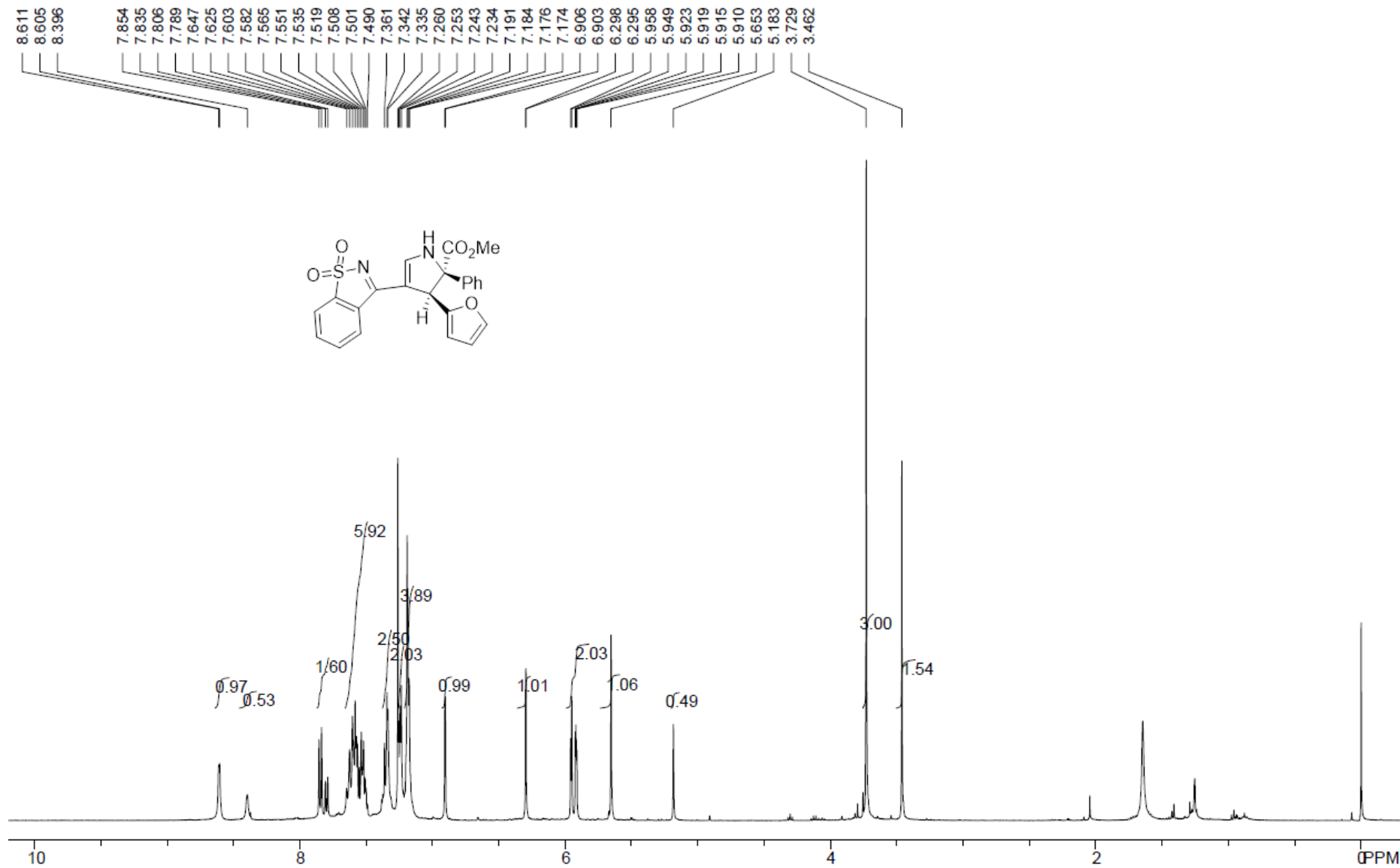
<sup>1</sup>H NMR of 4w



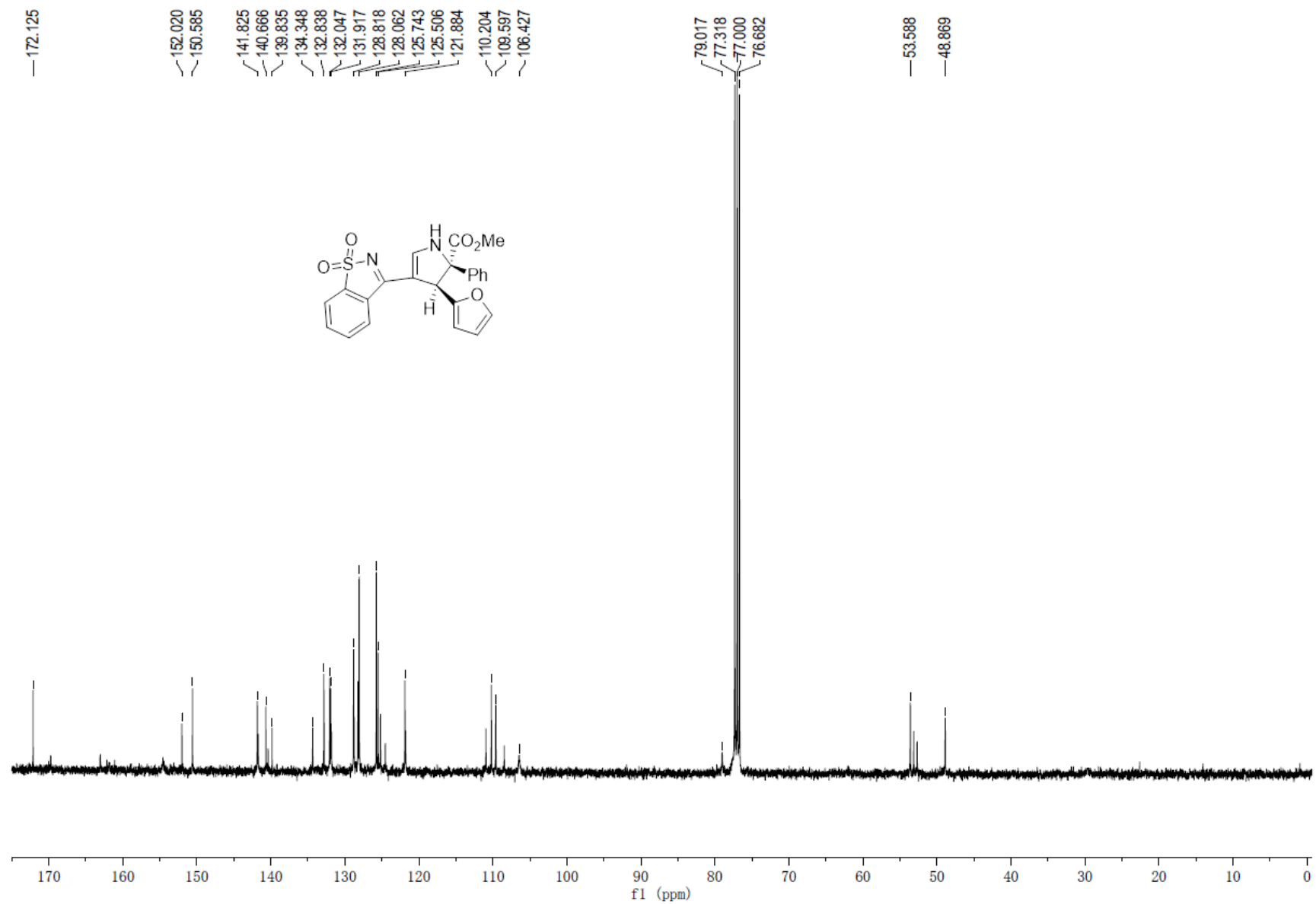
<sup>13</sup>C NMR of **4w**



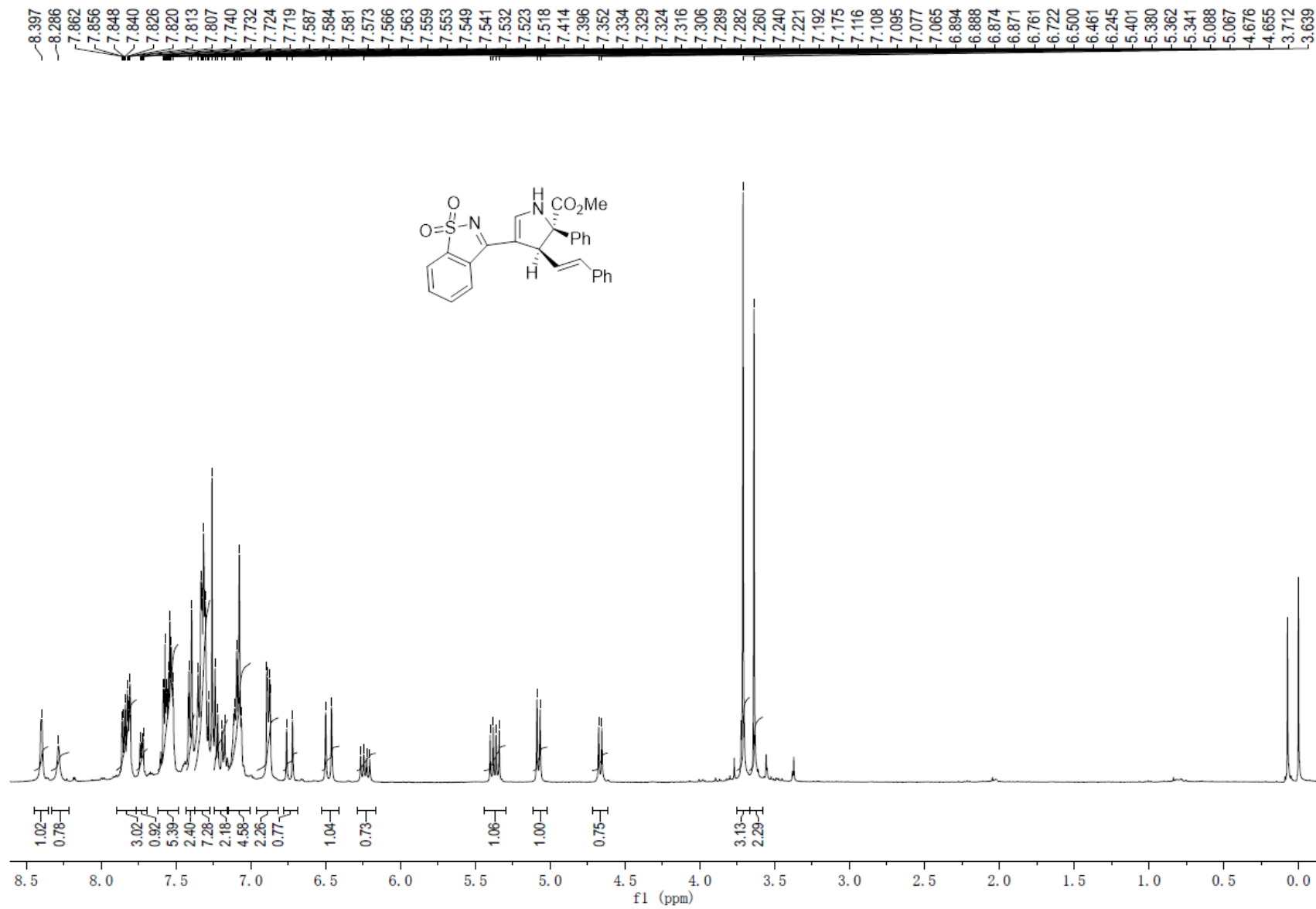
<sup>1</sup>H NMR of 4x



<sup>13</sup>C NMR of 4x

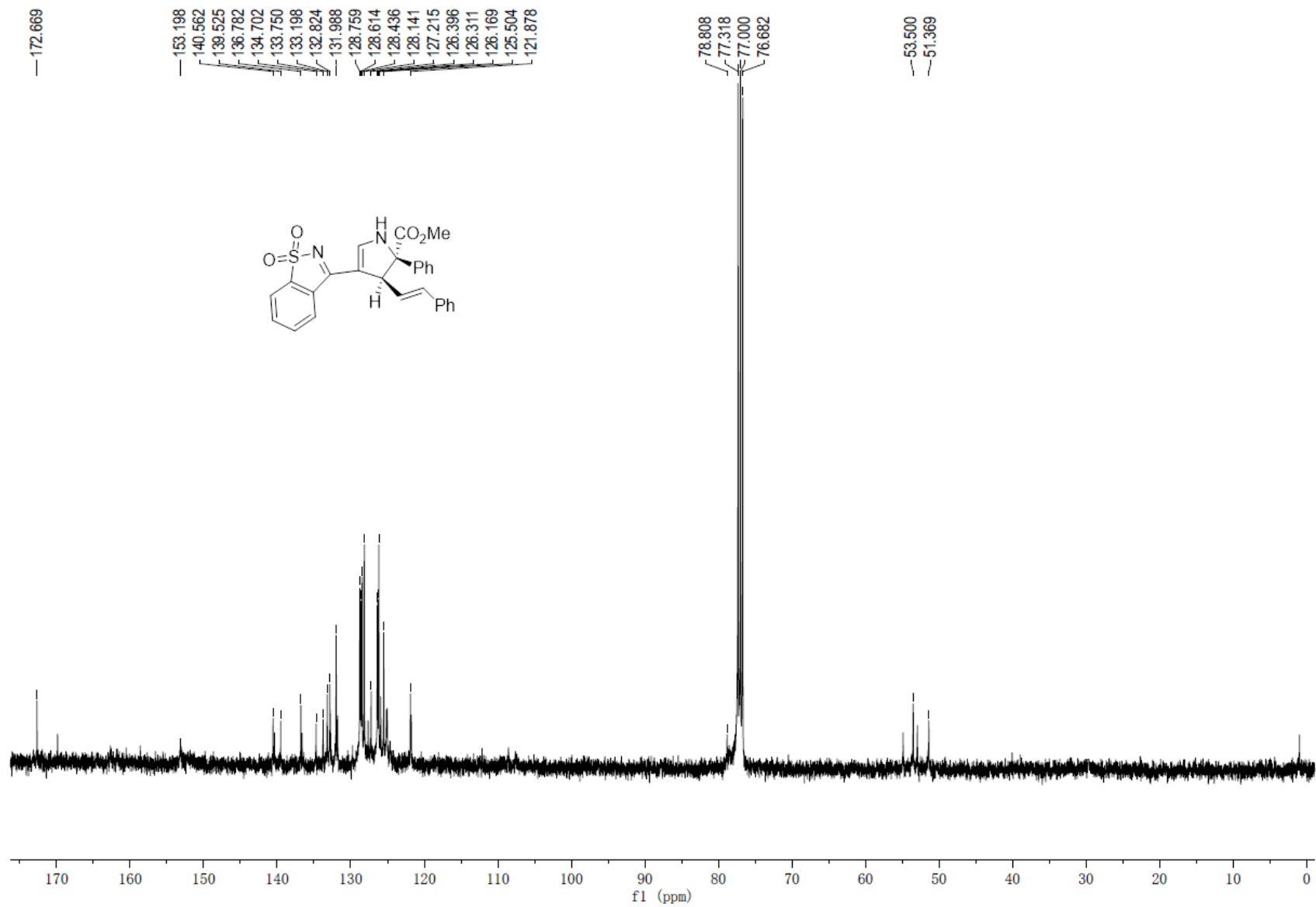


<sup>1</sup>H NMR of 4y





<sup>13</sup>C NMR of 4y



<sup>1</sup>H NMR of 4z

7.845  
7.827  
7.696  
7.667  
7.648  
7.624  
7.606  
7.467  
7.449  
7.430  
7.422  
7.403  
7.384  
7.260  
7.243  
7.210  
7.192  
7.187  
7.133  
7.115  
7.096  
7.064  
7.046  
7.027

5.291  
5.265  
5.249

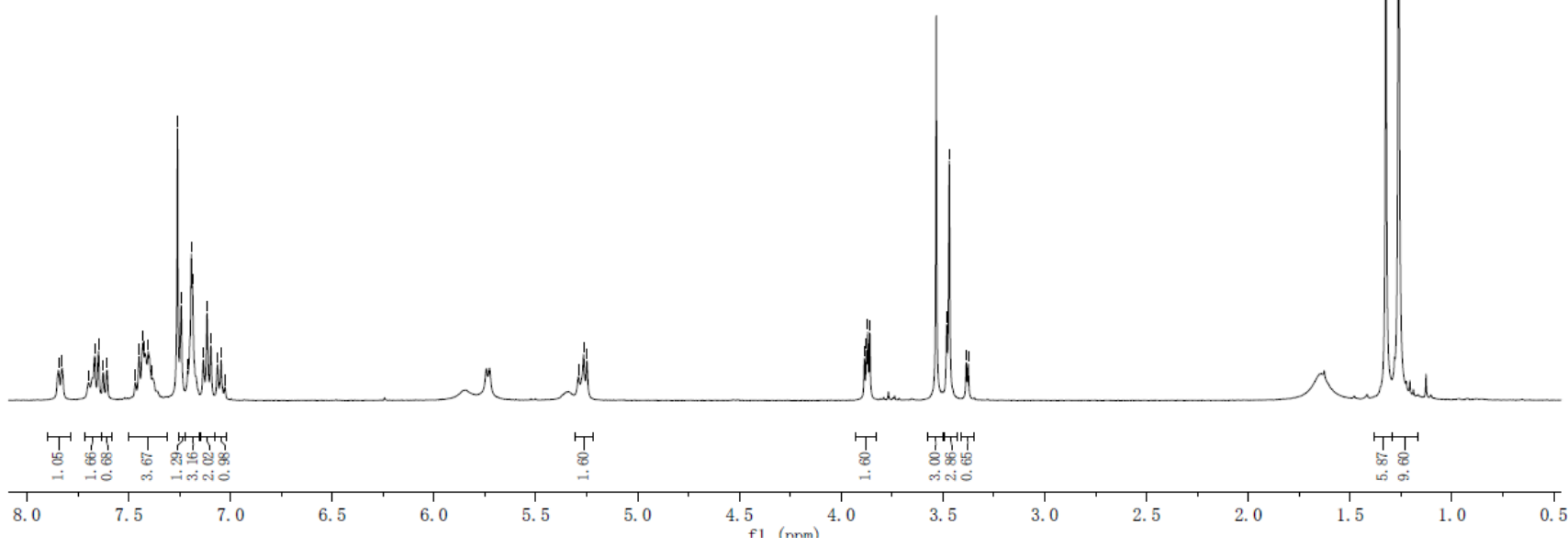
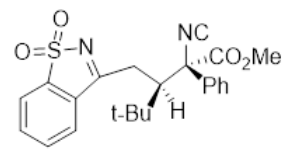
3.886  
3.876  
3.869  
3.859  
3.482  
3.469  
3.386  
3.376

1.324  
1.262

*Handwritten integration curves for the aromatic region (7.0-7.9 ppm).*

*Handwritten integration curve for the methine proton (5.2 ppm).*

*Handwritten integration curves for the methoxy and methyl groups (3.3-3.9 ppm).*



<sup>13</sup>C NMR of 4z

