Electronic Supplementary Material (ESI) for Green Chemistry.

Supplementary Information

CO_2-Mediated Isomerization of Enamides

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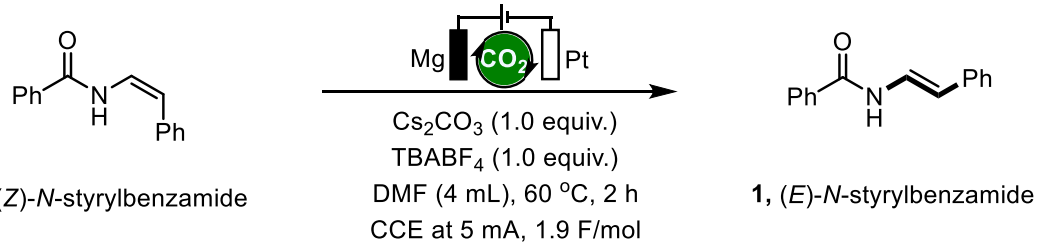
General Remarks

The reactions were carried out in undivided electrochemical cells (15 mL) using pre-dried glassware, if not noted otherwise. The substrates were obtained from commercial sources (J&K Scientific, Bidepharm, Energy Chemical) or synthesized according to literature methods.[1-2] Solvents were obtained from commercial sources. Magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm, 99.95%; obtained from Bochuang scientific research metal materials, Guangdong, China) and Platinum electrodes (0.25 mm × 10 mm × 15 mm, 99.9%; obtained from Chuxi, Shanghai, China) were connected using stainless steel adapters. Electrocatalysis was conducted using an HSPY-36-03 potentiostat in constant current mode. Cyclic Voltammetry studies were performed using a Shanghai Chenhua CHI760E workstation. Yields refer to isolated compounds, estimated to be >95% purity as determined by ^{1}H NMR. Flash chromatography was performed using Silica gel (200 – 300 mesh) purchased from Qingdao Haiyang Chemical Co., China. NMR spectra were recorded on Bruker AVANCE AV 400 or 600 in the solvent indicated; using $CDCl_3$ or DMSO-d_6 as the solvent with tetramethylsilane (TMS) as the internal standard at room temperature, chemical shifts (δ) are given in ppm relative to the residual solvent peak, coupling constants (J) are reported in Hertz (Hz). Multiplicities are recorded as: s = singlet, d = doublet, t = triplet, q = quadruplet, dd = doublet of doublets, m = multiplet. The High-resolution mass spectrometry (HRMS) data were collected on a Micro TOF mass spectrometer with ESI mass analyzer. Melting points were recorded on Shanghai ShenGuang WRS–2 apparatus. Visualization was achieved under a UV lamp (254 nm and 365 nm).

Optimization of the Reaction Conditions[a]

Table S1:



1a, (*Z*)-*N*-styrylbenzamide

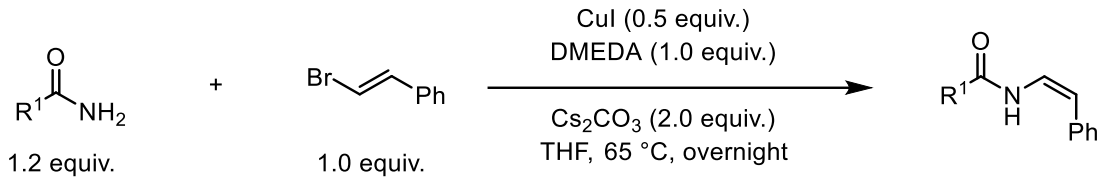
1, (*E*)-*N*-styrylbenzamide

Entry	Alteration	(**1a**+**1**) Yield (%)[b]	**1**-*E*
1	None	99	98
2	Fe(+) instead of Mg(+)	90	90
3	CF(-) instead of Pt (-)	62	62
3	DMA/MeCN/NMP instead of DMF	85/-/-	85/76/83
4	TBAI/TBAClO$_4$ instead of TBABF$_4$	94/-	94/59
4	Li_2CO_3/Na_2CO_3/K_2CO_3 instead of Cs_2CO_3	90/88/93	trace/27/87
5	0.5 equiv. of Cs_2CO_3	94	89
6	40 °C/50 °C/70 °C/80 °C	81/85/97/99	68/85/98/99
6	No Cs_2CO_3	79	23
7	No current	90	89
8	No CO_2	97	16
9	No current and CO_2	90	<10

[a] Reaction conditions: undivided cell, **1** (0.2 mmol), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), TBABF$_4$ (0.2 mmol, 1.0 equiv.) in DMF (4.0 mL), 60 °C, 2 h, under CO_2 (1 atm), Mg plate as the anode, and platinum plate as the cathode, CCE = 5.0 mA. [b] Yield of isolated products. CCE = constant current electrolysis;DMA = *N*, *N*-Dimethylacetamide; DMF = *N*, *N*-dimethylformamide; NMP = 1-Methyl-2-pyrrolidinone; MeCN = Acetonitrile; TBABF$_4$ = tetrabutylammonium tetrafluoroborate; TBAI = tetrabutylammonium iodide; TBAClO$_4$ = tetrabutylammonium perchlorate.

Synthesis of starting materials

General procedure for the preparation of substrates



Method A: A 100 mL schlenk flask was charged with amide (1.2 equiv.), copper(I) iodide (0.5 equiv.), and Cs_2CO_3 (2.0 equiv.). The flask was backfilled with argon, and closed with a rubber bung. Vinyl bromide (1.0 equiv.) and *N*,*N*-dimethylethylenediamine (1.0 equiv.) in dry and degassed THF (25 mL) were next added. The mixture was stirred at 65 °C overnight. The reaction mixture was cooled to room temperature, filtered, the solution layer was extracted with EtOAc and concentrated under vacuo. The crude residue was purified by flash chromatography on silica gel to give the desired enamides (**1a**-**21a**). Physical and spectral data were in accordance with literature data.[1]

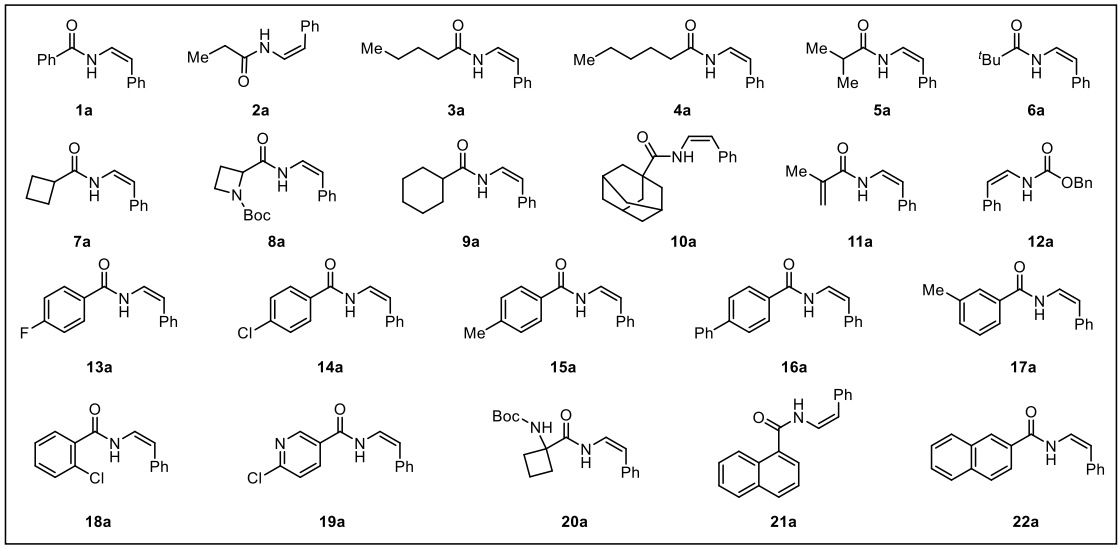
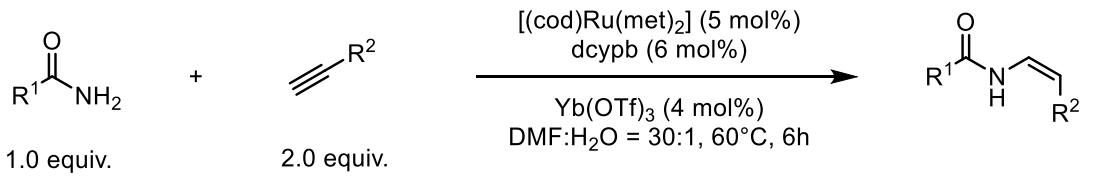


Figure S1: Starting materials synthesized according to **Method A**.



Method B: A dried 100 mL schlenk flask was charged with the amide (1.0 equiv.), bis(2-methallyl)-cycloocta-1,5-diene-ruthenium (II) (5 mol%), 1,4-bis(dicyclohexylphosphino)butane (6 mol%) and ytterbium triflate (4 mol%) and flushed with argon. Subsequently, dry DMF (0.5 M), alkyne (2.0 equiv.) and water (0.017 M) were added via syringe. The resulting solution was stirred for 6 h at 60 °C, then poured into an aqueous sodium bicarbonate solution (30 mL). The resulting mixture was extracted three times with EtOAc (20 mL × 3), the combined organic layers were washed with water and brine, dried with anhydrous Na_2SO_4, filtered, and the volatiles were removed under vacuo. The residue was purified by column chromatography (silica gel, ethyl acetate/ petroleum ether) to yield the *Z*-enamides. Physical and spectral data were in accordance with literature data.[2]

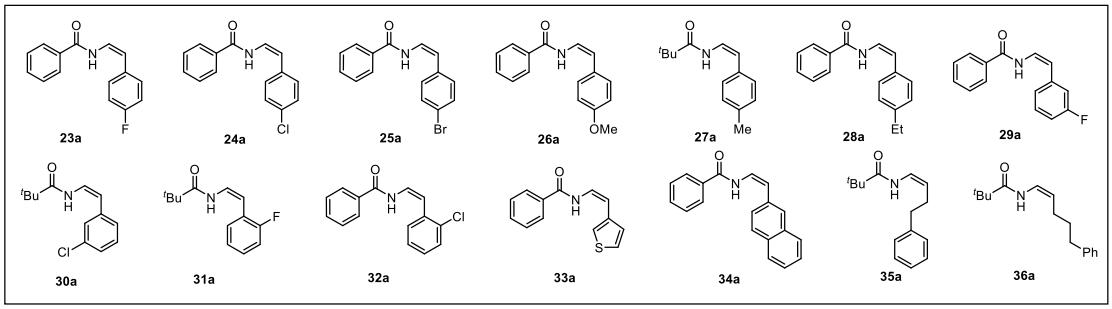
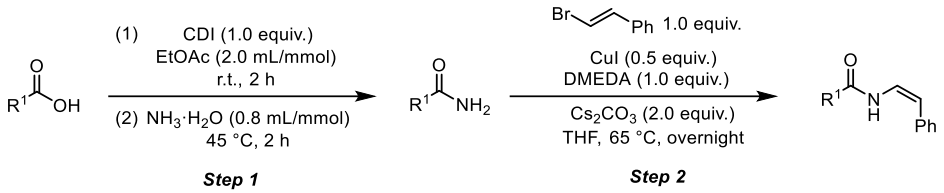


Figure S2: Starting materials synthesized according to **Method B**.



Method C:

Step1: A dried 50 mL round bottom flask was charged with the carboxylic acid (10 mmol, 1.0 equiv.) and 1,1'-carbonyldiimidazole (CDI) (10 mmol, 1.0 equiv.). Subsequently, EtOAc (2.0 mL/mmol) were added via syringe. The resulting solution was stirred for 2 h at room temperature, then, ammonium hydroxide (0.8 mL/mmol) was added slowly under vigorous stirring. The mixture stirred for 2 h at 45 °C. The

resulting mixture was extracted three times with EtOAc (20 mL × 3) the combined organic layers were washed with water and brine, dried with anhydrous Na_2SO_4, filtered, and the volatiles were removed under vacuo. The residue was used for step 2 without further purification.

Step2: see **Method A**.

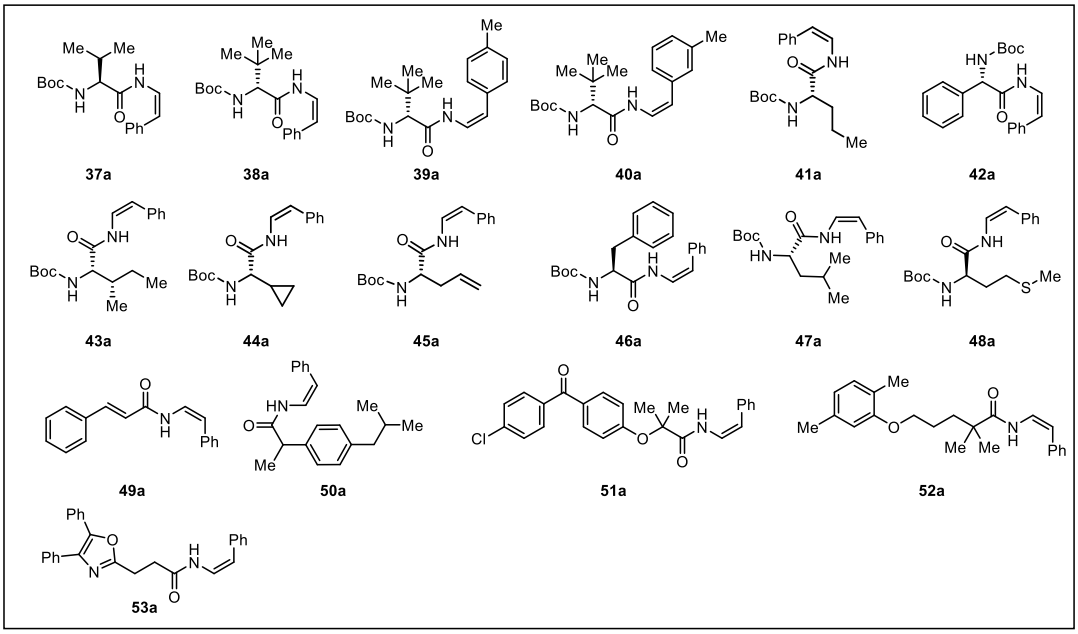
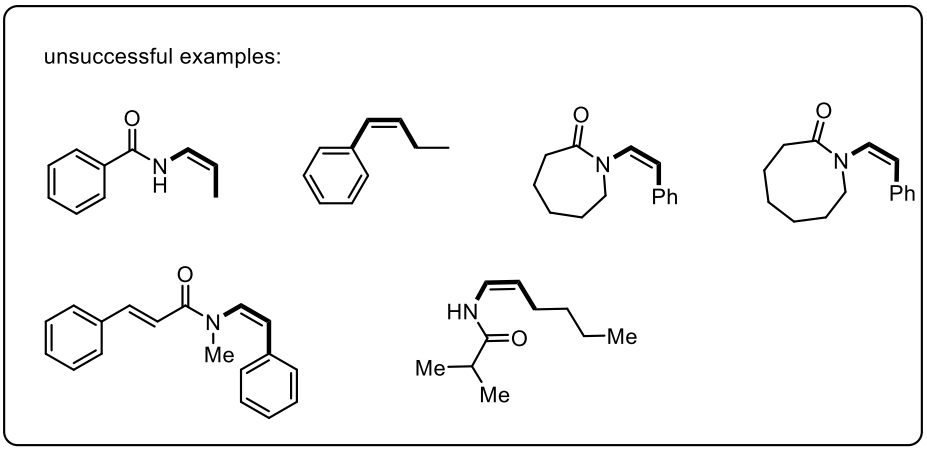


Figure S3: Starting materials synthesized according to **Method C**.



Graphical Guide

Pictures of the reaction setups

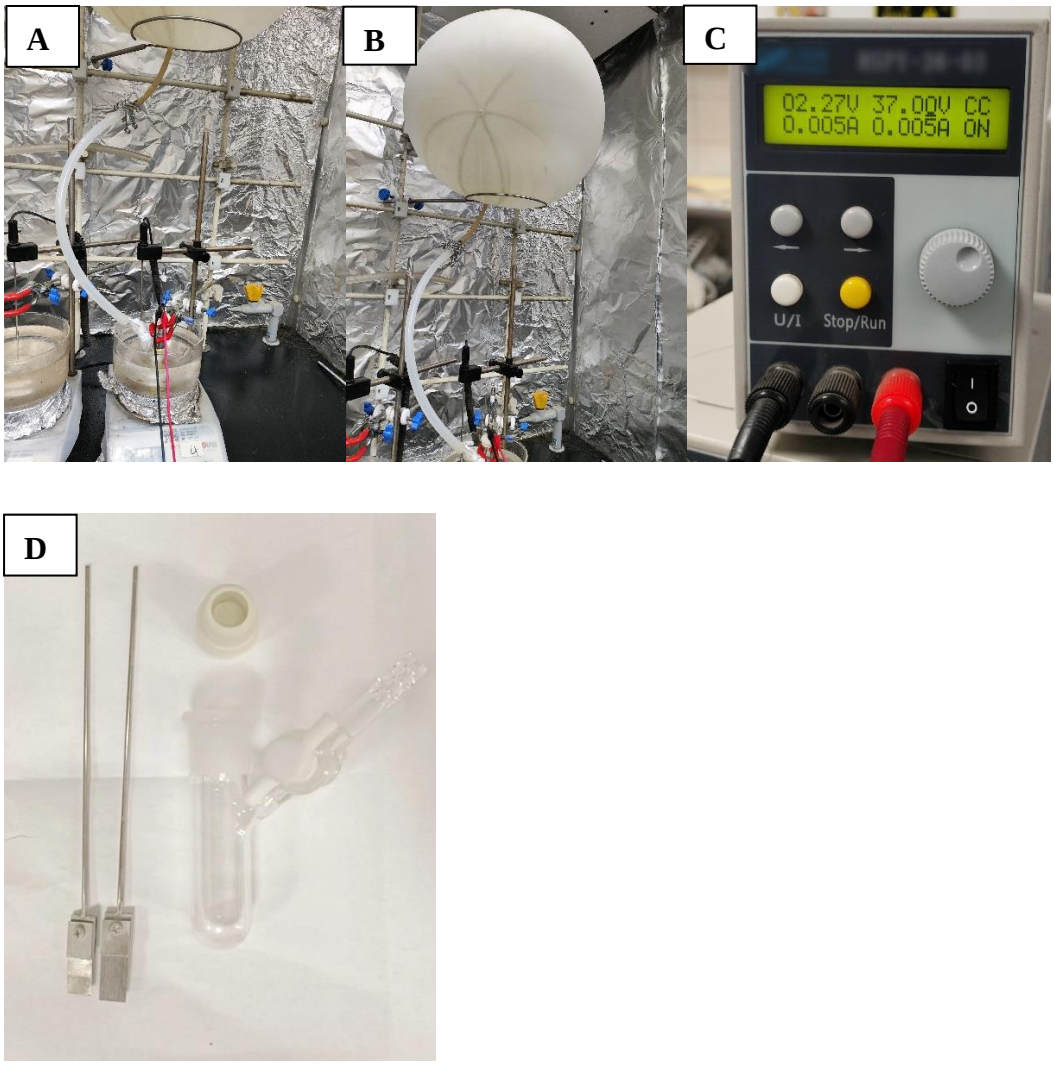
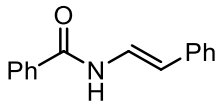


Figure S4. General reaction apparatus.

General Procedure

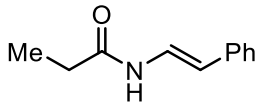
The reaction was carried out in an undivided cell with magnesium plates anodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum cathodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **1a** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 balloon at 60 ℃ with a constant current of 5.0 mA maintained for 2 h. After that, the reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The crude product was purified by column chromatography to furnish the desired product.

Characterization Data of Products



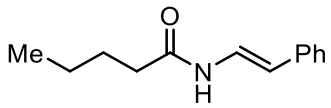
(*E*)-*N*-Styrylbenzamide (1)

Compound **1** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **1** (43.9 mg, 98 %) as a pale-yellow solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.64 (d, J = 9.2 Hz, 1H), 7.98 (d, J = 6.8 Hz, 2H), 7.74 – 7.45 (m, 4H), 7.40 (d, J = 8.0 Hz, 2H), 7.32 (t, J = 7.6 Hz, 2H), 7.18 (t, J = 7.2 Hz, 1H), 6.48 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.5, 137.1, 133.8, 132.4, 129.2, 129.0, 128.1, 126.7, 125.7, 124.6, 113.4. Spectroscopic data match those previously reported in the literature.[1]



(*E*)-*N*-Styrylpropionamide (2)

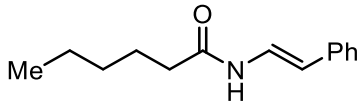
Compound **2** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **2** (29.8 mg, 85%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 (d, J = 10.0 Hz, 1H), 7.54 (dd, J = 14.8, 10.8 Hz, 1H), 7.31 – 7.23 (m, 4H), 7.19 – 7.13 (m, 1H), 6.10 (d, J = 14.4 Hz, 1H), 2.33 (q, J = 7.2 Hz, 2H), 1.22 (t, J = 7.6 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 171.4, 136.2, 128.7, 126.6, 125.5, 122.8, 112.4, 29.7, 9.6. Spectroscopic data match those previously reported in the literature.[1]



***(E)*-*N*-Styrylpentanamide (3)**

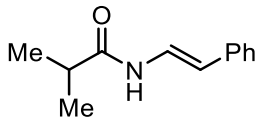
Compound **3** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 15:1) yielded **3** (29.7 mg, 73%) as a white solid. M.p.: 100 – 101 °C. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.59 – 7.46 (m, 2H), 7.32 – 7.23 (m, 4H), 7.16 (m, 1H), 6.09 (d, J = 14.0 Hz, 1H), 2.30 (t, J = 7.6

Hz, 2H), 1.68 (p, *J* = 7.6 Hz, 2H), 1.43 – 1.34 (m, 2H), 0.93 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 170.7, 136.1, 128.7, 126.6, 125.5, 122.7, 112.4, 36.5, 27.6, 22.4, 13.8. HRMS (ESI, m/z): Calculated $C_{13}H_{17}NO$ $[M+H]^+$: 204.1388, found 204.1390.



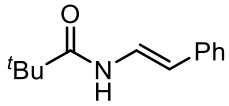
***(E)*-*N*-Styrylhexanamide (4)**

Compound **4** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **4** (34.3 mg, 79%) as a white solid. M.p.: 95– 96 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (dd, *J* = 14.4, 10.8 Hz, 1H), 7.48 – 7.39 (d, *J* = 9.2 Hz, 1H), 7.34 – 7.23 (m, 4H), 7.17 (t, *J* = 7.2 Hz, 1H), 6.09 (d, *J* = 14.4 Hz, 1H), 2.29 (t, *J* = 7.6 Hz, 2H), 1.70 (m, 2H), 1.40 – 1.27 (m, 4H), 0.91 (t, *J* = 6.4 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 170.7, 136.1, 128.7, 126.6, 125.5, 122.7, 112.4, 36.8, 31.4, 25.2, 22.4, 13.9. HRMS (ESI, m/z): Calculated $C_{14}H_{19}NO$ $[M+H]^+$: 218.1545, found 218.1549.



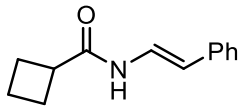
(*E*)-*N*-Styrylisobutyramide (5)

Compound **5** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **5** (34.1 mg, 90%) as a yellow solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.81 (d, *J* = 10.4 Hz, 1H), 7.54 (dd, *J* = 14.8, 10.8 Hz, 1H), 7.32 – 7.22 (m, 4H), 7.15 (t, *J* = 7.2 Hz, 1H), 6.15 (d, *J* = 14.8 Hz, 1H), 2.49 (m, 1H), 1.22 (d, *J* = 6.8 Hz, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 174.8, 136.2, 128.7, 126.6, 125.5, 122.9, 112.7, 35.7, 19.5. Spectroscopic data match those previously reported in the literature.[2]



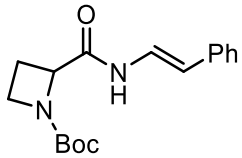
***(E)*-*N*-Styrylpivalamide (6)**

Compound **6** as prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 15:1) yielded **6** (39.8 mg, 98%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (dd, *J* = 14.0, 10.4 Hz, 1H), 7.46 (d, *J* = 10.0 Hz, 1H), 7.27 (m, 4H), 7.19 – 7.13 (m, 1H), 6.13 (d, *J* = 14.4 Hz, 1H), 1.27 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 175.7, 136.2, 128.7, 126.6, 125.5, 123.2, 112.6, 38.9, 27.5. Spectroscopic data match those previously reported in the literature.[2]



***(E)-N*-Styrylcyclobutanecarboxamide (7)**

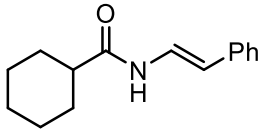
Compound **7** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **7** (34.6 mg, 86%) as a white solid. M.p.: 126 – 127 °C. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (dd, *J* = 14.0, 10.8 Hz, 1H), 7.44 (d, *J* = 10.0 Hz, 1H), 7.32 – 7.24 (m, 4H), 7.13 – 7.19 (m, 1H), 6.10 (d, *J* = 14.4 Hz, 1H), 3.10 (p, *J* = 8.4 Hz, 1H), 2.41 – 2.31 (m, 2H), 2.24 – 2.15 (m, 2H), 2.05 – 1.87 (m, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 172.5, 136.2, 128.7, 126.6, 125.5, 122.8, 112.4, 39.9, 25.6, 18.2. HRMS (ESI, m/z): Calculated $C_{13}H_{15}NO$ $[M+H]^+$: 202.1232, found 202.1235.



***tert*-Butyl *(E)*-2-(styrylcarbamoyl)azetidine-1-carboxylate (8)**

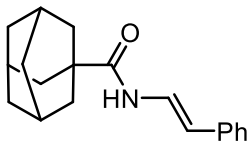
Compound **8** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **8** (49.0 mg, 81%) as a white solid. M.p.: 121 – 123 °C. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.50 (dd, *J* = 14.8, 10.8 Hz, 1H), 7.39 – 7.24 (m, 4H), 7.13 – 7.21 (m, 1H), 6.17 (d, *J* = 14.4 Hz, 1H), 4.75 (t, *J* = 8.0 Hz, 1H), 3.94 (q, *J* = 8.0 Hz, 1H), 3.76 – 3.86 (m, 1H), 2.65- 2.30 (m, 2H), 1.49 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.1, 136.2, 128.7, 126.7, 125.6, 122.2, 113.8, 81.4, 62.1, 47.3, 28.3. HRMS (ESI, m/z): Calculated $C_{17}H_{22}N_2O_3$

[M+Na]$^+$: 325.1528, found 325.1522.



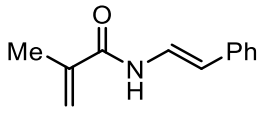
***(E)-N*-Styrylcyclohexanecarboxamide (9)**

Compound **9** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **9** (36.7 mg, 80%) as a yellow solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (dd, *J* = 14.4, 10.8 Hz, 1H), 7.34 – 7.25 (m, 5H), 7.20 – 7.14 (m, 1H), 6.09 (d, *J* = 14.4 Hz, 1H), 2.17 (tt, *J* = 11.6, 3.6 Hz, 1H), 1.87 - 1.96 (m, 2H), 1.79 – 1.86 (m, 2H), 1.66 – 1.73 (m, 1H), 1.55 – 1.45 (m, 2H), 1.35 – 1.23 (m, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 173.4, 136.2, 128.7, 126.6, 125.5, 122.9, 112.3, 45.5, 29.5, 25.7, 25.6. Spectroscopic data match those previously reported in the literature.[2]



***(E)-N*-Styryladamantane-1-carboxamide (10)**

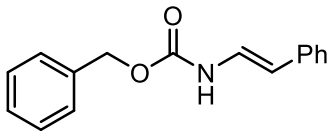
Compound **10** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **10** (54.6 mg, 97%) as a white solid. M.p.: 173 – 174 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.51 (m, 2H), 7.33 – 7.21 (m, 4H), 7.10 – 7.18 (m, 1H), 6.15 (d, *J* = 14.4 Hz, 1H), 2.07 (s, 3H), 1.93 (s, 6H), 1.66 – 1.80 (m, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 175.4, 136.3, 128.7, 126.5, 125.5, 123.2, 112.6, 40.8, 39.1, 36.4, 28.0. HRMS (ESI, m/z): Calculated $C_{19}H_{23}NO$ [M+H]$^+$: 282.1858, found 282.1861.



***(E)-N*-Styrylmethacrylamide (11)**

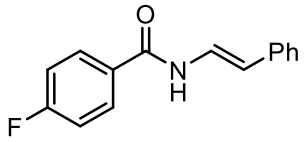
Compound **11** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 15:1) yielded **11** (30.7 mg, 82 %) as a white solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.70 (d, *J* = 10.8 Hz, 1H),

7.59 (dd, *J* = 14.8, 10.8 Hz, 1H), 7.37 – 7.26 (m, 4H), 7.13 – 7.22 (m, 1H), 6.19 (d, *J* = 14.8 Hz, 1H), 5.82 (s, 1H), 5.48 (s, 1H), 2.04 (s, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 165.3, 139.4, 136.0, 128.7, 126.8, 125.6, 122.8, 120.9, 113.5, 18.6. Spectroscopic data match those previously reported in the literature.[3]



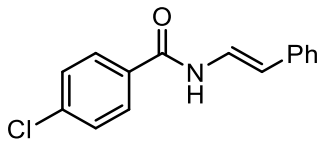
Benzyl *(E)*-styrylcarbamate (12)

Compound **12** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **12** (36.0 mg, 71%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 – 7.45 (m, 5H), 7.28 – 7.34 (m, 5H), 7.18 – 7.24 (m, 1H), 6.84 (d, *J* = 10.8 Hz, 1H), 6.01 (d, *J* = 14.4 Hz, 1H), 5.23 (s, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 153.6, 136.2, 135.9, 128.7, 128.7, 128.5, 128.4, 126.4, 125.4, 124.0, 111.0, 67.5. Spectroscopic data match those previously reported in the literature.[4]



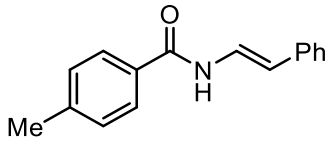
***(E)*-4-Fluoro-*N*-styrylbenzamide (13)**

Compound **13** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **13** (45.8 mg, 95%) as a yellow solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.67 (d, *J* = 10.0 Hz, 1H), 8.01 – 8.10 (m, 2H), 7.65 (dd, *J* = 14.8, 9.6 Hz, 1H), 7.42 – 7.35 (m, 4H),7.32 (t, *J* = 8.0 Hz, 1H), 7.22 – 7.13 (m, 1H), 6.47 (d, *J* = 14.4 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 166.0, 163.5 ($^{1}J_{C\text{-}F}$= 248.1 Hz), 163.5, 137.0, 130.9, 130.8 ($^{3}J_{C\text{-}F}$= 9.2 Hz), 130.3, 130.3 ($^{4}J_{C\text{-}F}$= 3.1 Hz), 129.2, 126.8, 125.7, 124.6, 116.1, 115.8 ($^{2}J_{C\text{-}F}$= 21.9 Hz), 113.5. ^{19}F NMR (375 MHz, Chloroform-*d*) δ -103.45. Spectroscopic data match those previously reported in the literature.[5]



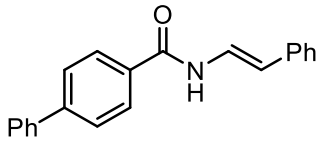
(*E*)-4-Chloro-*N*-styrylbenzamide (14)

Compound **14** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **14** (50.0 mg, 97%) as a yellow solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.72 (d, J = 9.6 Hz, 1H), 8.04 – 7.97 (m, 2H), 7.69 – 7.59 (m, 3H), 7.37 – 7.43 (m, 2H), 7.31 (t, J = 7.6 Hz, 2H), 7.21 – 7.15 (m, 1H), 6.48 (d, J = 14.4 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 163.5, 137.2, 136.9, 132.5, 130.0, 129.2, 129.1, 126.8, 125.8, 124.5, 113.8. Spectroscopic data match those previously reported in the literature.[6]



(*E*)-4-Methyl-*N*-styrylbenzamide (15)

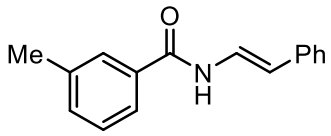
Compound **15** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **15** (44.6 mg, 94%) as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.56 (d, J = 10.0 Hz, 1H), 7.89 (d, J = 8.4 Hz, 2H), 7.65 (dd, J = 14.4, 10.0 Hz, 1H), 7.41 – 7.28 (m, 6H), 7.13 – 7.21 (m, 1H), 6.45 (d, J = 14.8 Hz, 1H), 2.38 (s, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.4, 142.5, 137.1, 131.0, 129.5, 129.2, 128.2, 126.7, 125.7, 124.7, 113.1, 21.5. Spectroscopic data match those previously reported in the literature.[7]



(*E*)-*N*-Styryl-[1,1'-biphenyl]-4-carboxamide (16)

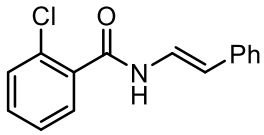
Compound **16** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **16** (47.9 mg, 80%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.35 (d, J = 10.0 Hz, 1H), 7.75 (d, J = 8.4 Hz, 2H), 7.59 (d, J = 8.4 Hz, 2H), 7.52 (d, J = 6.8 Hz, 2H), 7.41 – 7.26

(m, 7H), 7.24 – 7.18 (m, 1H), 7.18 – 7.10 (m, 1H), 5.82 (d, *J* = 9.6 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 164.1, 145.0, 139.8, 135.9, 132.0, 129.3, 129.0, 128.2, 127.9, 127.7, 127.5, 127.2, 127.1, 122.5, 111.0. Spectroscopic data match those previously reported in the literature.[7]



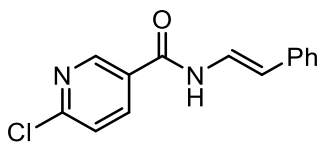
***(E)*-3-Methyl-*N*-styrylbenzamide (17)**

Compound **17** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **17** (45.6 mg, 96%) as a white solid. M.p.: 128 – 131 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.49 (d, *J* = 10.4 Hz, 1H), 7.78 – 7.61 (m, 3H), 7.32 – 7.22 (m, 6H), 7.12 – 7.19 (m, 1H), 6.31 (d, *J* = 14.8 Hz, 1H), 2.35 (s, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 165.0, 138.7, 136.1, 133.4, 132.9, 128.7, 128.6, 128.1, 126.7, 125.7, 124.2, 123.2, 113.8, 21.4. HRMS (ESI, m/z): Calculated $C_{16}H_{15}NO$ $[M+Na]^+$: 260.1051, found 260.1047.



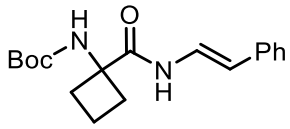
***(E)*-2-Chloro-*N*-styrylbenzamide (18)**

Compound **18** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **18** (36.1 mg, 70%) as a yellow solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.54 (d, *J* = 11.2 Hz, 1H), 7.81 (d, *J* = 7.2 Hz, 1H), 7.42 – 7.32 (m, 7H), 7.28 – 7.14 (m, 2H), 5.93 (d, *J* = 9.6 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 163.5, 135.4, 133.4, 132.2, 131.3, 130.6, 130.5, 129.1, 128.0, 127.4, 127.2, 121.8, 111.8. Spectroscopic data match those previously reported in the literature.[7]



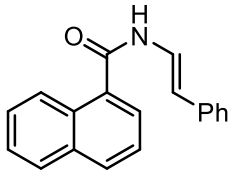
***(E)*-6-Chloro-*N*-styrylnicotinamide (19)**

Compound **19** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 5:1) yielded **19** (46.0 mg, 89%) as a pale-yellow solid. M.p.: 188 – 190 ℃. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.86 (d, J = 9.6 Hz, 1H), 8.96 (d, J = 2.8 Hz, 1H), 8.36 (dd, J = 8.0, 2.4 Hz, 1H), 7.70 (d, J = 8.4 Hz 2H), 7.64 (dd, J = 14.8, 10.0 Hz, 1H), 7.41 (d, J = 7.2 Hz, 2H), 7.31 (t, J = 8.0 Hz, 2H), 7.16 – 7.21 (m, 1H), 6.48 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 162.0, 153.5, 149.8, 139.4, 136.7, 129.2, 128.9, 127.0, 125.9, 124.7, 124.0, 114.4. HRMS (ESI, m/z): Calculated $C_{14}H_{11}N_2O^{35}Cl$ $[M+H]^+$: 259.0638, found 259.0636.



***tert*-Butyl (*E*)-(1-(styrylcarbamoyl)cyclobutyl)carbamate (20)**

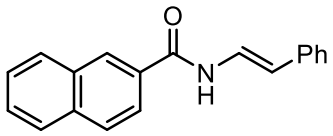
Compound **20** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **20** (58.2 mg, 88%) as a pale-yellow solid. M.p.: 158 – 162 ℃. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.99 (s, 1H), 7.62 – 7.43 (m, 1H), 7.36 – 7.22 (m, 4H), 7.16 (t, J = 7.2 Hz, 1H), 6.13 (d, J = 14.4 Hz, 1H), 2.82 – 2.63 (m, 2H), 2.28 – 1.83 (m, 4H), 1.45 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-d) δ 171.3, 155.5, 136.3, 128.6, 126.5, 125.5, 123.1, 113.0, 81.1, 59.1, 30.9, 28.3, 15.2. HRMS (ESI, m/z): Calculated $C_{18}H_{24}N_2O_3$ $[M+Na]^+$: 339.1685, found 339.1682.



(E)-N-Styryl-1-naphthamide (21)

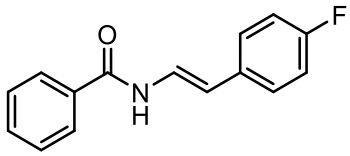
Compound **21** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **21** (54.1 mg, 99%) as a white solid. M.p.: 177 – 178 ℃. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.86 (d, J = 10.0 Hz, 1H), 8.32 – 8.23 (m, 1H), 8.10 (d, J = 8.4 Hz, 1H), 8.06-7.99 (m, 1H), 7.81 – 7.70 (m, 2H), 7.65 – 7.57 (m, 3H), 7.43 (d, J = 7.6 Hz, 2H), 7.33 (t, J = 7.6 Hz, 2H),

7.20 (t, J = 7.6 Hz, 1H), 6.40 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 166.6, 137.0, 133.8, 133.7, 131.1, 130.3, 129.2, 128.9, 127.6, 126.9, 126.8, 126.4, 125.8, 125.7, 125.4, 124.4, 113.5. HRMS (ESI, m/z): Calculated $C_{19}H_{15}NO$ $[M+H]^+$: 274.1232, found 274.1222.



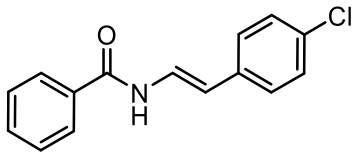
***(E)-N*-Styryl-2-naphthamide (22)**

Compound **22** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **22** (49.2 mg, 90%) as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.84 (d, J = 10.0 Hz, 1H), 8.62 (s, 1H), 8.12 – 8.00 (m, 4H), 7.74 (dd, J = 14.4, 10.0 Hz, 1H), 7.69 – 7.61 (m, 2H), 7.43 (d, J = 8.0 Hz, 2H), 7.33 (t, J = 8.0 Hz, 2H), 7.23 – 7.16 (m, 1H), 6.53 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.6, 137.1, 134.9, 132.6, 131.1, 129.5, 129.2, 128.7, 128.6, 128.5, 128.2, 127.4, 126.8, 125.8, 124.7, 113.5. Spectroscopic data match those previously reported in the literature.[8]



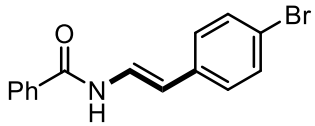
***(E)-N*-(4-Fluorostyryl) benzamide (23)**

Compound **23** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **23** (44.4 mg, 92%) as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.64 (d, J = 10.0 Hz, 1H), 7.98 (d, J = 7.2 Hz, 2H), 7.66 – 7.51 (m, 4H), 7.49 – 7.40 (m, 2H), 7.19 – 7.09 (m, 2H), 6.48 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.5, 162.5, 160.1 ($^1J_{C\text{-}F}$= 241.6 Hz), 133.8, 133.6, 133.6 ($^3J_{C\text{-}F}$= 3.0 Hz), 132.4, 128.9, 128.1, 127.5, 127.4, 124.6, 124.6 ($^4J_{C\text{-}F}$= 1.2 Hz), 116.1, 115.9 ($^2J_{C\text{-}F}$= 21.4 Hz), 112.4. ^{19}F NMR (375 MHz, DMSO-d_6) δ -116.24. Spectroscopic data match those previously reported in the literature.[9]



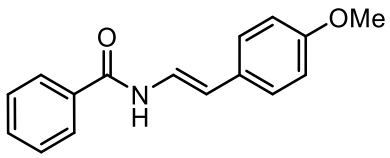
***(E)*-*N*-(4-Chlorostyryl) benzamide (24)**

Compound **24** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **24** (46.4 mg, 90%) as a light pink solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.55 (d, J = 10.0 Hz, 1H), 7.96 (d, J = 7.6 Hz, 2H), 7.63-7.48 (m, 5H), 7.39 – 7.29 (m, 2H), 6.52 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.4, 138.9, 133.9, 132.3, 128.9, 128.1, 127.2, 125.2, 124.6, 120.6, 108.7. Spectroscopic data match those previously reported in the literature.[10]



(*E*)-*N*-(4-bromostyryl) benzamide (25)

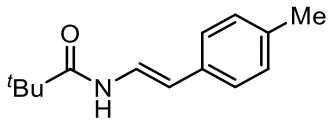
Compound **25** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 5:1) yielded **25** (51.4 mg, 85%) as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.70 (d, J = 9.6 Hz, 1H), 7.98 (d, J = 7.2 Hz, 2H), 7.70 (dd, J = 14.8, 9.6 Hz, 1H), 7.60 (t, J = 7.2 Hz, 1H), 7.54 (t, J = 7.6 Hz, 2H), 7.49 (d, J = 8.4 Hz, 2H), 7.38 (d, J = 8.4 Hz, 2H), 6.44 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.6, 136.5, 133.7, 132.5, 132.0, 129.0, 128.1, 127.7, 125.5, 119.3, 112.1. Spectroscopic data match those previously reported in the literature.[10]



(*E*)-*N*-(4-Methoxystyryl) benzamide (26)

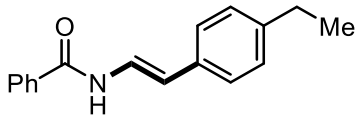
Compound **26** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 5:1) yielded **26** (40.5 mg, 80%) as a brown solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.31 (d, J = 11.2 Hz, 1H), 7.83

– 7.68 (m, 2H), 7.56 – 7.50 (m, 1H), 7.49 – 7.40 (m, 2H), 7.33 – 7.22 (m, 2H), 7.13 (dd, *J* = 10.8, 9.2 Hz, 1H), 7.01 – 6.89 (m, 2H), 5.84 (d, *J* = 9.2 Hz, 1H), 3.83 (s, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 164.3, 158.6, 133.5, 132.1, 129.1, 128.9, 128.1, 127.1, 121.4, 114.7, 110.8, 55.4. Spectroscopic data match those previously reported in the literature.[9]



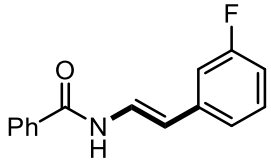
(*E*)-*N*-(4-Methylstyryl) pivalamide (27)

Compound **27** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **27** (39.1 mg, 90%) as a brown solid. M.p.: 150 – 153 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.55 – 7.40 (m, 2H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.09 (d, *J* = 8.0 Hz, 2H), 6.11 (d, *J* = 14.0 Hz, 1H), 2.31 (s, 3H), 1.26 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 175.7, 136.3, 133.3, 129.4, 125.4, 122.4, 112.6, 38.8, 27.5, 21.1. HRMS (ESI, m/z): Calculated $C_{14}H_{19}NO$ $[M+H]^+$: 218.1545, found 218.1555.



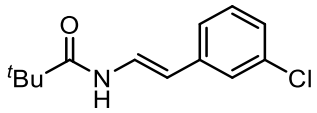
(*E*)-*N*-(4-ethylstyryl) benzamide (28)

Compound **28** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **28** (45.0 mg, 90%) as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.59 (d, J = 10.0 Hz, 1H), 7.98 (d, J = 7.6 Hz, 2H), 7.67 – 7.49 (m, 4H), 7.31 (d, J = 8.0 Hz, 2H), 7.15 (d, J = 7.8 Hz, 2H), 6.46 (d, J = 14.8 Hz, 1H), 2.58 (q, J = 7.6 Hz, 2H), 1.17 (t, J = 7.6 Hz, 3H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.4, 142.4, 134.5, 133.9, 132.3, 128.9, 128.6, 128.1, 125.7, 123.8, 113.4, 28.3, 16.0. Spectroscopic data match those previously reported in the literature.[9]



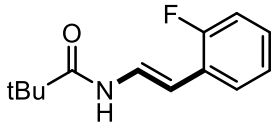
(*E*)-*N*-(3-fluorostyryl) benzamide (29)

Compound **29** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **29** (43.9 mg, 91%) as a white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.71 (d, J = 10.0 Hz, 1H), 7.99 (d, J = 7.6 Hz, 2H), 7.73 (dd, J = 14.8, 10.0 Hz, 1H), 7.65 – 7.48 (m, 3H), 7.39 – 7.18 (m, 3H), 7.03-6.92 (m, 1H), 6.47 (d, J = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.7, 164.4, 161.9($^{1}J_{C\text{-}F}$= 241.2 Hz), 139.9, 139.8, 133.7, 132.5, 131.0, 130.9 ($^{3}J_{C\text{-}F}$= 8.1 Hz), 129.0, 128.1, 126.1, 121.9, 121.9($^{4}J_{C\text{-}F}$= 2.4 Hz), 113.3, 113.1($^{2}J_{C\text{-}F}$= 21.1 Hz), 112.3, 112.2, 112.0. ^{19}F NMR (375 MHz, DMSO-d_6) δ -113.40.



(*E*)-*N*-(3-Chlorostyryl) pivalamide (30)

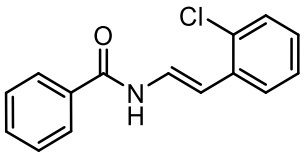
Compound **30** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **30** (45.2 mg, 95%) as a yellow solid. M.p.: 126 – 130 ℃. ^{1}H NMR (400 MHz, Chloroform-d) δ 7.60 – 7.46 (m, 2H), 7.28 – 7.24 (m, 1H), 7.21 – 7.16 (m, 2H), 7.14 – 7.08 (m, 1H), 6.06 (d, J = 14.0 Hz, 1H), 1.27 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-d) δ 175.9, 138.2, 134.6, 129.9, 126.4, 125.5, 124.4, 123.4, 111.1, 38.9, 27.4. HRMS (ESI, m/z): Calculated $C_{13}H_{16}NO^{35}Cl$ $[M+H]^+$: 238.0999, found 238.1001.



(*E*)-*N*-(2-fluorostyryl) pivalamide (31)

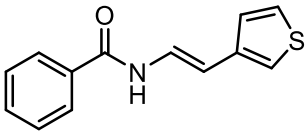
Compound **31** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **31** (35.4 mg, 80%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-d) δ 7.84 – 7.70 (m, 2H), 7.60 (t, J = 7.6 Hz, 1H), 7.36 – 7.28 (m, 1H), 7.27 – 7.15 (m, 2H), 6.45 (d, J = 14.0 Hz, 1H), 1.46 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-d) δ 175.8, 160.9, 158.4 (J = 246.3 Hz), 127.7, 127.6 (J = 8.0 Hz), 126.3, 126.2 (J = 3.0 Hz), 125.1, 125.0 (J = 5.0 Hz), 124.2, 124.2

(*J* = 3.0 Hz), 124.1, 124.0 (*J* = 13.0 Hz), 115.7, 115.5 (*J* = 8.0 Hz), 104.9, 104.9 (*J* = 7.0 Hz), 38.9, 27.4. ^{19}F NMR (375 MHz, Chloroform-*d*) δ -118.55.



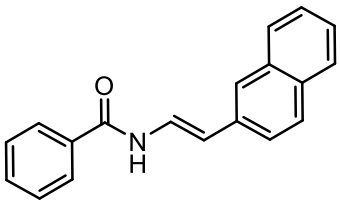
(*E*)-*N*-(2-Chlorostyryl) benzamide (32)

Compound **32** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **32** (44.8 mg, 87%) as a brown solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.44 (d, *J* = 11.2 Hz, 1H), 7.94 – 7.81 (m, 2H), 7.78 – 7.68 (m, 1H), 7.58 – 7.40 (m, 4H), 7.36 – 7.28 (m, 1H), 7.22 – 7.06 (m, 2H), 6.68 (d, *J* = 14.4 Hz, 1H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 164.8, 134.1, 133.2, 132.4, 132.3, 129.7, 128.8, 127.8, 127.3, 127.0, 125.8, 125.1, 109.8. Spectroscopic data match those previously reported in the literature.[1]



(*E*)-*N*-(2-(Thiophen-3-yl)vinyl) benzamide (33)

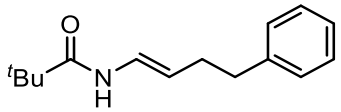
Compound **33** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **33** (43.1 mg, 94%) as white solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.54 (d, *J* = 10.0 Hz, 1H), 7.96 (d, *J* = 7.2 Hz, 2H), 7.62 – 7.49 (m, 5H), 7.40 – 7.29 (m, 2H), 6.52 (d, *J* = 14.4 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 164.4, 138.9, 133.9, 132.3, 128.9, 128.1, 127.2, 125.2, 124.6, 120.6, 108.7. Spectroscopic data match those previously reported in the literature.[11]



(*E*)-*N*-(2-(Naphthalen-2-yl)vinyl) benzamide (34)

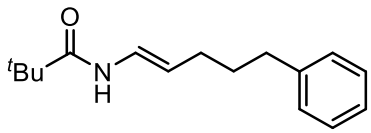
Compound **34** was prepared following the general procedure, purification by column

chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **34** (48.6 mg, 89%) as a pale yellow solid. M.p.: 183 – 184 ℃. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.77 (d, J = 9.6 Hz, 1H), 8.02 (d, J = 8.4 Hz, 2H), 7.90 – 7.79 (m, 5H), 7.69 (d, J = 8.8 Hz, 1H), 7.64 – 7.52 (m, 3H), 7.51 – 7.40 (m, 2H), 6.66 (d, J = 14.8 Hz, 1H). ^{13}C NMR (10 MHz, DMSO-d_6) δ 164.6, 134.7, 134.0, 133.8, 132.4, 132.3, 129.0, 128.7, 128.2, 128.0, 128.0, 126.8, 125.8, 125.2, 124.7, 123.6, 113.5. HRMS (ESI, m/z): Calculated $C_{19}H_{15}NO$ $[M+Na]^+$: 296.1051, found 296.1050.



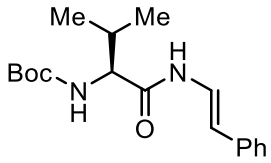
(*E*)-*N*-(4-Phenylbut-1-en-1-yl) pivalamide (35)

Compound **35** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **35** (33.8 mg, 73%) as a white solid. M.p.: 127 – 128 ℃. ^{1}H NMR (400 MHz, Chloroform-d) δ 7.35 – 7.29 (m, 2H), 7.25 – 7.19 (m, 3H), 7.14 (d, J = 10.4 Hz, 1H), 6.93-6.79 (m, 1H), 5.20 (dt, J = 14.4, 6.8 Hz, 1H), 2.78 – 2.68 (t, J = 8.0 Hz, 2H), 2.47 – 2.33 (m, 2H), 1.25 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-d) δ 175.5, 141.6, 128.4, 128.4, 125.9, 123.4, 111.9, 38.6, 36.4, 31.6, 27.4. HRMS (ESI, m/z): Calculated $C_{15}H_{21}NO$ $[M+Na]^+$: 254.1521, found 254.1516.



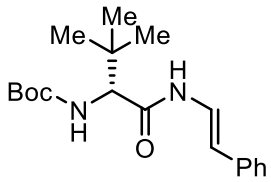
(*E*)-*N*-(5-Phenylpent-1-en-1-yl) pivalamide (36)

Compound **36** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 15:1) yielded **36** (24.5 mg, 50%) as a white solid. M.p.: 88 – 89 ℃. ^{1}H NMR (400 MHz, Chloroform-d) δ 7.28 (d, J = 2.0 Hz, 1H), 7.25 – 7.22 (m, 1H), 7.19 – 7.11 (m, 4H), 6.78 (dd, J = 14.0, 10.4 Hz, 1H), 5.17 (dt, J = 14.0, 7.2 Hz, 1H), 2.60 (t, J = 7.6 Hz, 2H), 2.05 (q, J = 6.8 Hz, 2H), 1.68 (p, J = 7.6 Hz, 2H), 1.21 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-d) δ 175.5, 142.3, 128.5, 128.3, 125.7, 123.3, 112.5, 38.6, 35.3, 31.6, 29.4, 27.5.



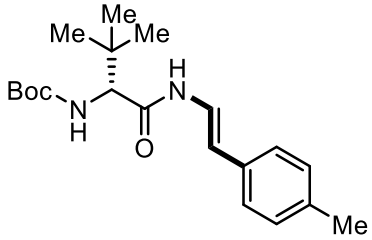
***tert*-Butyl (*S, E*)-(3-methyl-1-oxo-1-(styrylamino)butan-2-yl)carbamate (37)**

Compound **37** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **37** (59.9 mg, 94%) as a white solid. M.p.: 156 – 157 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.81 (d, *J* = 8.8 Hz, 1H), 7.43 (dd, *J* = 14.8, 10.8 Hz, 1H), 7.25 – 7.16 (m, 4H), 7.15 – 7.08 (m, 1H), 6.11 (d, *J* = 14.8 Hz, 1H), 5.42 (d, *J* = 8.8 Hz, 1H), 4.07 (t, *J* = 8.0 Hz, 1H), 2.20 – 2.07 (m, 1H), 1.47 (s, 9H), 1.01 (d, *J* = 6.8 Hz, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.8, 156.4, 136.1, 128.6, 126.6, 125.6, 122.4, 113.8, 60.4, 30.8, 28.4, 19.3, 18.4. HRMS (ESI, m/z): Calculated $C_{18}H_{26}N_2O_3$ $[M+Na]^+$: 341.1841, found 341.1840.



***tert*-Butyl (*R, E*)-(3,3-dimethyl-1-oxo-1-(styrylamino)butan-2-yl)carbamate (38)**

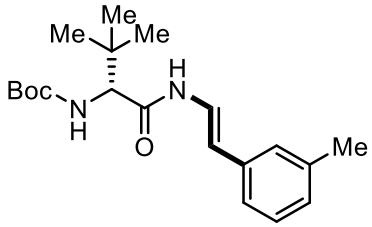
Compound **38** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **38** (63.2 mg, 95%) as a yellow liquid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.02 (d, *J* = 10.4 Hz, 1H), 7.39 (dd, *J* = 14.4, 10.8 Hz, 1H), 7.15 (d, *J* = 4.0 Hz, 4H), 7.09 (m, 1H), 6.06 (d, *J* = 14.8 Hz, 1H), 5.63 (d, *J* = 9.2 Hz, 1H), 4.09 (d, *J* = 9.2 Hz, 1H), 1.46 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.3, 156.6, 136.2, 128.5, 126.4, 125.6, 122.4, 113.8, 62.7, 34.4, 28.5, 26.6.



***tert*-Butyl (*R, E*)-(3,3-dimethyl-1-((4-methylstyryl)amino)-1-oxobutan-2-yl)**

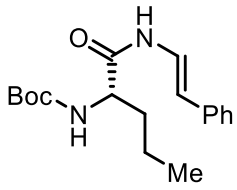
carbamate (39)

Compound **39** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **39** (61.0 mg, 88%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.99 (d, *J* = 9.6 Hz, 1H), 7.43 – 7.31 (m, 1H), 7.10 – 6.89 (m, 4H), 6.04 (d, *J* = 14.8 Hz, 1H), 5.67 (d, *J* = 8.0 Hz, 1H), 4.10 (d, *J* = 9.2 Hz, 1H), 2.26 (s, 3H), 1.45 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.2, 156.5, 136.0, 133.3, 129.2, 125.5, 121.6, 113.9, 62.6, 34.4, 28.5, 26.7, 21.1.



tert-Butyl (R, E)-(3, 3-dimethyl-1-((3-methylstyryl)amino)-1-oxobutan-2-yl) carbamate (40)

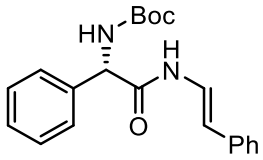
Compound **40** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **40** (62.4 mg, 90%) as a white solid. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.19 (d, *J* = 9.6 Hz, 1H), 7.51 – 7.37 (m, 1H), 7.09 – 6.88 (m, 4H), 6.07 (d, *J* = 14.8 Hz, 1H), 5.74 (d, *J* = 9.2 Hz, 1H), 4.16 (d, *J* = 6.8 Hz, 1H), 2.18 (s, 3H), 1.50 (s, 9H), 1.11 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.3, 156.6, 137.9, 136.1, 128.3, 127.2, 126.2, 122.8, 122.2, 113.9, 62.7, 34.4, 28.5, 26.7, 21.3.



***tert*-Butyl (*S, E*)-(1-oxo-1-(styrylamino)pentan-2-yl)carbamate (41)**

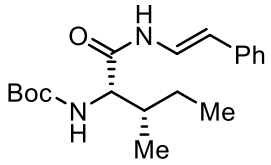
Compound **41** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **41** (58.6 mg, 92%) as a white solid. M.p.: 140 – 141 °C. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.78

(d, *J* = 8.8 Hz, 1H), 7.43 (dd, *J* = 12.0, 11.2 Hz, 1H), 7.26 – 7.19 (m, 4H), 7.17 – 7.11 (m, 1H), 6.12 (d, *J* = 14.4 Hz, 1H), 5.28 (d, *J* = 8.0 Hz, 1H), 4.30 – 4.17 (m, 1H), 1.87 – 1.77 (m, 1H), 1.69 – 1.58 (m, 1H), 1.47 (s, 9H), 1.44 – 1.36 (m, 2H), 0.94 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 170.2, 156.2, 136.1, 128.6, 126.6, 125.6, 122.5, 113.7, 54.5, 34.3, 28.4, 19.0, 13.7. HRMS (ESI, m/z): Calculated $C_{18}H_{26}N_2O_3$ $[M+Na]^+$: 341.1841, found 341.1843.



***tert*-Butyl (*S, E*)-(2-oxo-1-phenyl-2-(styrylamino)ethyl)carbamate (42)**

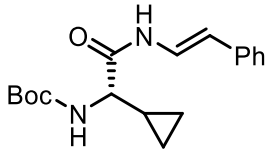
Compound **42** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **42** (63.4 mg, 90%) as a white solid. M.p.: 164 – 166 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.09 (s, 1H), 7.44 – 7.32 (m, 6H), 7.27 – 7.21 (m, 4H), 7.18 – 7.12 (m, 1H), 6.03 (d, *J* = 14.8 Hz, 1H), 5.83 (s, 1H), 5.33 (s, 1H), 1.44 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 167.8, 137.3, 135.8, 129.2, 128.7, 128.6, 127.4, 126.8, 125.6, 122.2, 114.1, 28.3. HRMS (ESI, m/z): Calculated $C_{21}H_{24}N_2O_3$ $[M+Na]^+$: 375.1685, found 375.1683.



***tert*-Butyl ((*2S,3S*)-3-methyl-1-oxo-1-(((*E*)-styryl)amino)pentan-2-yl)carbamate (43)**

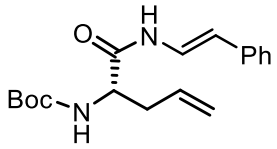
Compound **43** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **43** (60.5 mg, 91%) as a white solid. M.p.:140 – 141 ℃. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.24 (d, *J* = 9.6 Hz, 1H), 7.46 – 7.32 (m, 3H), 7.28 (t, *J* = 7.6 Hz, 2H), 7.15 (t, *J* = 7.2 Hz, 1H), 6.95 (d, *J* = 8.4 Hz, 1H), 6.22 (d, *J* = 14.7 Hz, 1H), 3.87 (t, *J* = 8.0 Hz, 1H), 1.80 – 1.66 (m, 1H), 1.52 – 1.42 (m, 1H), 1.39 (s, 9H), 1.23 – 1.07 (m, 1H), 0.89-0.78 (m, 6H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 170.5, 155.9, 136.9, 129.1, 126.6, 125.6, 123.8, 112.5,

78.5, 59.4, 36.6, 28.7, 25.1, 15.8, 11.3. HRMS (ESI, m/z): Calculated $C_{19}H_{28}N_2O_3$ $[M+H]^+$: 333.2178, found 333.2147.



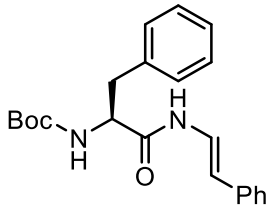
***tert*-Butyl (*S, E*)-(1-cyclopropyl-2-oxo-2-(styrylamino)ethyl)carbamate (44)**

Compound **44** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **44** (55.7 mg, 88%) a white solid. M.p.: 150 – 151 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.69 (d, *J* = 12.0 Hz, 1H), 7.49 – 7.38 (m, 1H), 7.29 – 7.19 (m, 4H), 7.18 – 7.12 (m, 1H), 6.12 (d, *J* = 14.4 Hz, 1H), 5.23 (d, *J* = 8.0 Hz, 1H), 4.21 (s, 1H), 1.90 – 1.78 (m, 2H), 1.69 – 1.58 (m, 1H), 1.47 (s, 9H), 1.44 – 1.35 (m, 2H), 0.95 (t, *J* = 7.6 Hz, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 170.2, 136.1, 128.6, 126.6, 125.6, 122.5, 113.7, 54.5, 34.3, 28.3, 19.0, 13.7. HRMS (ESI, m/z): Calculated $C_{18}H_{24}N_2O_3$ $[M+Na]^+$: 339.1685, found 339.1682.



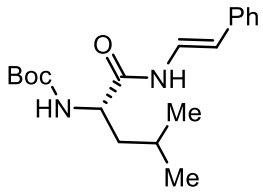
***tert*-Butyl (*S, E*)-(1-oxo-1-(styrylamino)pent-4-en-2-yl)carbamate (45)**

Compound **45** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **45** (59.5 mg, 94%) as a white solid. M.p.: 143 – 144 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.42 (s, 1H), 7.44 (dd, *J* = 14.4, 10.8 Hz, 1H), 7.31 – 7.22 (m, 4H), 7.20 – 7.14 (m, 1H), 6.13 (d, *J* = 14.4 Hz, 1H), 5.85 – 5.71 (m, 1H), 5.22 – 5.15 (m, 2H), 5.09 (s, 1H), 4.27 (s, 1H), 2.63 – 2.45 (m, 2H), 1.47 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.6, 156.2, 136.1, 132.8, 128.6, 126.6, 125.6, 122.4, 119.2, 114.0, 54.1, 36.8, 28.4. HRMS (ESI, m/z): Calculated $C_{18}H_{24}N_2O_3$ $[M+Na]^+$: 339.1685, found 339.1683.



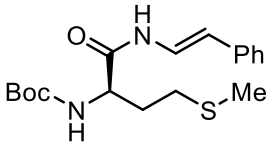
***tert*-Butyl (*S, E*)-(1-oxo-3-phenyl-1-(styrylamino)propan-2-yl)carbamate (46)**

Compound **46** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **46** (70.4 mg, 96%) as a yellow solid. M.p.: 156 – 157 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.42 (s, 1H), 7.40 (dd, *J* = 14.8, 10.4 Hz, 1H), 7.30 – 7.17 (m, 10H), 5.99 (d, *J* = 14.4 Hz, 1H), 5.36 (d, *J* = 8.4 Hz, 1H), 4.52 (s, 1H), 3.19 – 2.94 (m, 2H), 1.41 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.2, 155.9, 136.5, 136.0, 129.3, 128.7, 128.6, 127.1, 126.7, 125.6, 122.2, 114.1, 56.0, 38.6, 28.3. HRMS (ESI, m/z): Calculated $C_{22}H_{26}N_2O_3$ $[M+Na]^+$: 389.1841, found 389.1838.



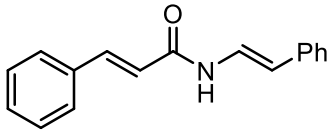
***tert*-Butyl (*S, E*)-(4-methyl-1-oxo-1-(styrylamino)pentan-2-yl)carbamate (47)**

Compound **47** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **47** (46.5 mg, 70%) as a white solid. M.p.: 135 – 137 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.27 (d, *J* = 9.6 Hz, 1H), 7.45 (dd, *J* = 14.0, 10.4 Hz 1H), 7.27 – 7.09 (m, 5H), 6.15 (d, *J* = 14.4 Hz, 1H), 5.52 (d, *J* = 8.0 Hz, 1H), 4.38 (dd, *J* = 15.6, 8.0 Hz, 1H), 1.83 – 1.73 (m, 1H), 1.72 – 1.61 (m, 2H), 1.49 (s, 9H), 0.99 (dd, *J* = 9.2, 6.4 Hz, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 170.9, 156.4, 136.2, 128.6, 126.5, 125.6, 122.7, 113.9, 53.3, 41.2, 28.4, 24.8, 23.0, 21.9. HRMS (ESI, m/z): Calculated $C_{19}H_{28}N_2O_3$ $[M+Na]^+$: 355.1998, found 355.1993.



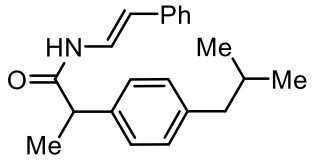
***tert*-Butyl (*R, E*)-(4-(methylthio)-1-oxo-1-(styrylamino)butan-2-yl)carbamate (48)**

Compound **48** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **48** (59.9 mg, 89%) as a pale-yellow solid. M.p.: 104 – 106 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.91 (d, *J* = 9.2 Hz, 1H), 7.47 (dd, *J* = 14.4, 10.8 Hz, 1H), 7.30 – 7.22 (m, 4H), 7.21 – 7.15 (m, 1H), 6.19 (d, *J* = 14.8 Hz, 1H), 5.58 (d, *J* = 8.0 Hz, 1H), 4.48 (d, *J* = 8.0 Hz, 1H), 2.63 (t, *J* = 7.2 Hz, 2H), 2.20 (m, 1H), 2.13 (s, 3H), 2.03 (m, 1H), 1.49 (s, 9H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.6, 156.2, 135.9, 128.6, 126.7, 125.6, 122.3, 114.1, 53.6, 31.5, 30.3, 28.4, 15.4. HRMS (ESI, m/z): Calculated $C_{18}H_{26}N_2O_3S$ $[M+Na]^+$: 373.1562, found 373.1558.



***N*-*((E)*-Styryl*)* cinnamamide (49)**

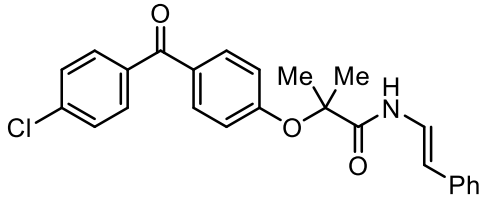
Compound **49** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **49** (44.9 mg, 90 %) as a yellow solid. ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.50 (d, *J* = 10.0 Hz, 1H), 7.68 – 7.53 (m, 4H), 7.37 – 7.48 (m, 5H), 7.30 (t, *J* = 7.6 Hz, 2H), 7.17 (t, *J* = 7.6 Hz, 1H), 6.73 (d, *J* = 16.0 Hz, 1H), 6.26 (d, *J* = 14.8 Hz, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 163.1, 141.1, 137.0, 135.1, 130.4, 129.5, 129.2, 128.3, 126.7, 125.7, 124.2, 121.3, 112.7. Spectroscopic data match those previously reported in the literature.[12]



(*E*)-2-(4-Isobutylphenyl)-*N*-styrylpropanamide (50)

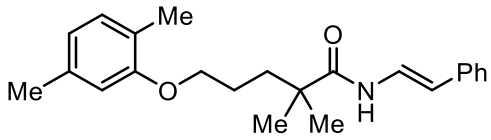
Compound **50** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **50** (43.0 mg, 70%) as a white solid. M.p.: 136 – 139 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.49 (dd, *J* = 14.8, 10.4 Hz, 1H), 7.32 (d, *J* = 10.8 Hz, 1H), 7.26 – 7.19 (m, 6H), 7.14 (d, *J* =

7.6 Hz, 3H), 5.95 (d, *J* = 14.8 Hz, 1H), 3.63 (q, *J* = 7.2 Hz, 1H), 2.46 (d, *J* = 7.2 Hz, 2H), 1.93 – 1.80 (m, 1H), 1.55 (d, *J* = 7.2 Hz, 3H), 0.90 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 171.9, 141.2, 137.7, 136.1, 129.9, 128.7, 127.5, 126.6, 125.5, 122.8, 112.8, 46.8, 45.0, 30.2, 22.4, 18.5. HRMS (ESI, m/z): Calculated $C_{21}H_{25}NO$ $[M+H]^+$: 308.2014, found 308.2010.



(*E*)-2-(4-(4-Chlorobenzoyl)phenoxy)-2-methyl-*N*-styrylpropanamide (51)

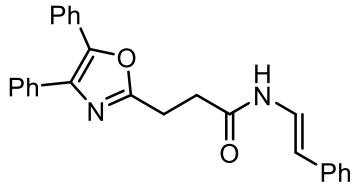
Compound **51** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **51** (67.2 mg, 80%) as a yellow solid. M.p.: 128 – 131 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.95 (d, *J* = 10.4 Hz, 1H), 7.72 (d, *J* = 8.4 Hz, 2H), 7.66 (d, *J* = 8.4 Hz, 2H), 7.58 (dd, *J* = 14.8, 10.8 Hz, 1H), 7.40 (d, *J* = 8.8 Hz, 2H), 7.29 – 7.18 (m, 4H), 7.15 – 7.09 (m, 1H), 7.00 (d, *J* = 8.8 Hz, 2H), 6.27 (d, *J* = 14.4 Hz, 1H), 1.66 (s, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 194.1, 171.8, 158.5, 138.6, 136.0, 132.0, 131.7, 131.2, 128.7, 128.6, 126.8, 125.6, 122.3, 119.8, 114.4, 81.8, 25.1. HRMS (ESI, m/z): Calculated $C_{25}H_{22}NO_3{}^{35}Cl$ $[M+Na]^+$: 442.1186, found 442.1186.



(*E*)-5-(2,5-Dimethylphenoxy)-2,2-dimethyl-*N*-styrylpentanamide (52)

Compound **52** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) yielded **52** (40.1 mg, 57%) as a pale-yellow solid. M.p.: 90 – 92 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.55 (d, *J* = 9.2 Hz, 2H), 7.31 – 7.22 (m, 4H), 7.18 – 7.12 (m, 1H), 6.99 (d, *J* = 7.2 Hz, 1H), 6.65 (d, *J* = 7.6 Hz, 1H), 6.60 (s, 1H), 6.14 – 6.06 (m, 1H), 3.91 (s, 2H), 2.28 (s, 3H), 2.18 (s, 3H), 1.77 (s, 4H), 1.28 (s, 6H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 175.0, 156.9, 136.6, 136.2, 130.4, 128.7, 126.6, 125.6, 123.5, 123.1, 120.9, 112.8, 112.2,

67.8, 42.2, 37.5, 25.5, 25.1, 21.5, 15.9. HRMS (ESI, m/z): Calculated $C_{23}H_{29}NO_2$ $[M+H]^+$: 352.2277, found 352.2274.

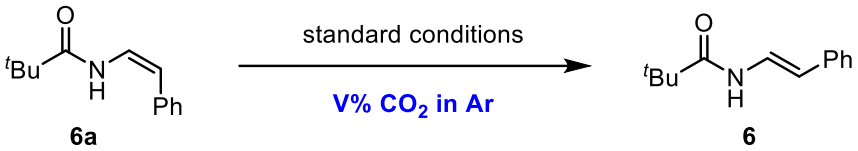


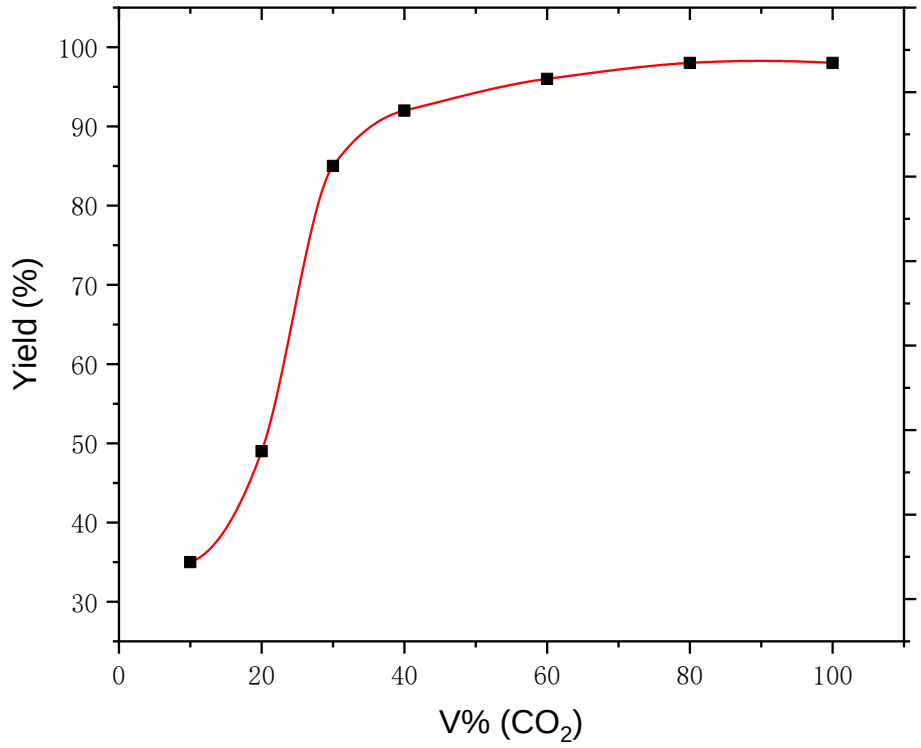
(*E*)-3-(4,5-Diphenyloxazol-2-yl)-*N*-styrylpropanamide (53)

Compound **53** was prepared following the general procedure, purification by column chromatography on silica gel (petroleum ether/EtOAc = 8:1) yielded **53** (45.0 mg, 60%) as a white solid. M.p.: 151 – 152 ℃. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.80 (d, *J* = 10.4 Hz, 1H), 7.66 – 7.61 (m, 2H), 7.58 – 7.49 (m, 3H), 7.40 – 7.31 (m, 6H), 7.27 – 7.22 (m, 4H), 7.18 – 7.11 (m, 1H), 6.05 (d, *J* = 14.8 Hz, 1H), 3.23 (t, *J* = 6.8 Hz, 2H), 2.86 (t, *J* = 6.8 Hz, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 169.0, 162.4, 145.7, 136.1, 134.8, 132.2, 128.7, 128.7, 128.3, 127.9, 126.6, 126.5, 125.6, 122.8, 112.9, 33.0, 23.9. HRMS (ESI, m/z): Calculated $C_{26}H_{22}N_2O_2$ $[M+Na]^+$: 417.1579, found 417.1575.

Mechanistic Studies

(a) Influence of the concentration of CO_2 atmosphere on reaction yield



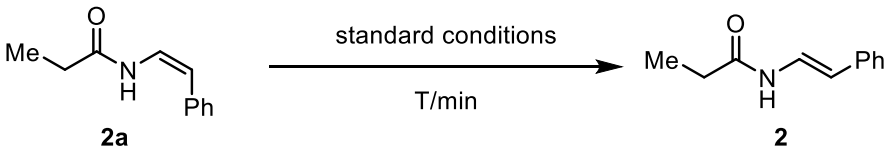


V% (CO_2)	10	20	30	40	60	80	100
Yield (%)	35	49	85	92	96	98	98

The reaction was carried out in an undivided cell with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **6a** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 (V% in Ar) flow (this procedure was repeated three times), and anhydrous DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 (V% in Ar) balloon at 60 ℃ with a constant current of 5.0 mA maintained for 2 h. After that, the reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried

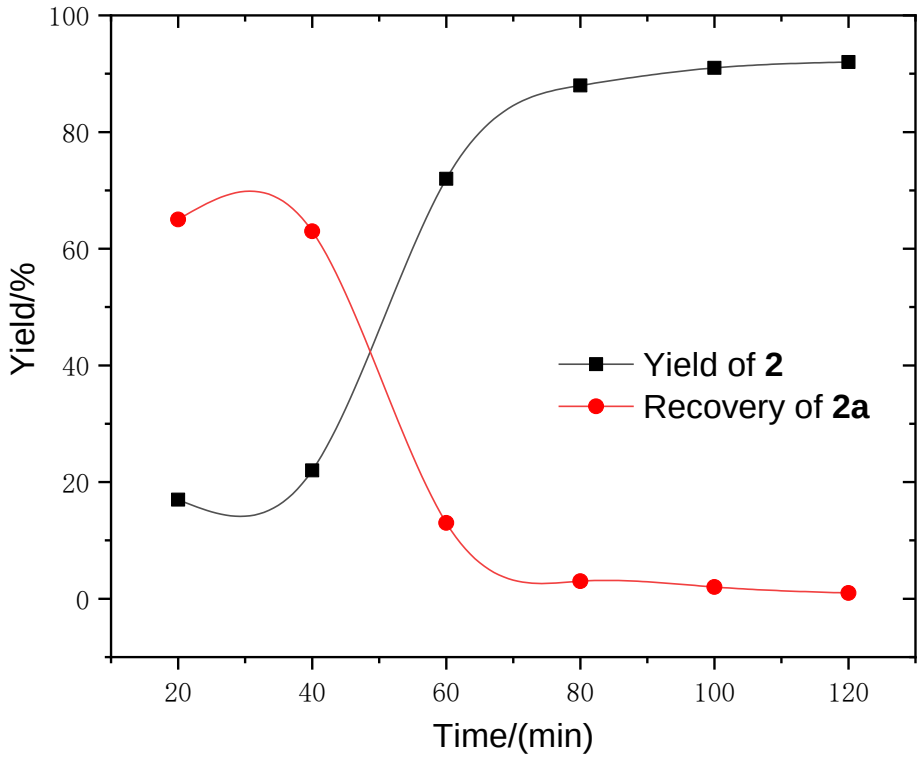
by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The residue was detected by ^{1}HNMR (0.2 mmol of dibromomethane was added as an internal standard) and the ^{1}HNMR yields were reported.

(b) Monitoring the reaction process of 2



2a **2**

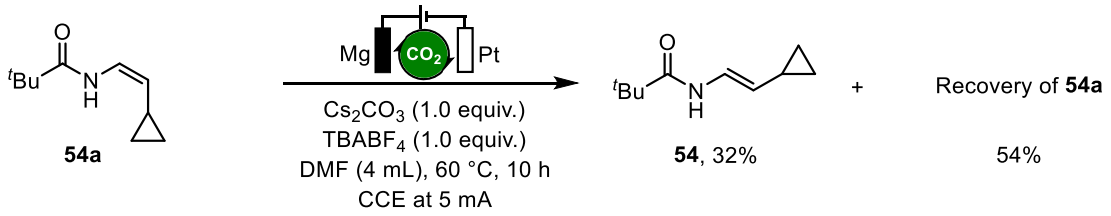
Time/min	20	40	60	80	100	120
2	17	22	72	88	91	92
2a	65	63	13	3	2	1



The reaction was carried out in six undivided cells with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm), respectively. To six 15.0 mL oven-dried undivided cells equipped with magnetic bars were added substrates *Z*-enamide **2a** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.), parallelly. Then the tubes were evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and anhydrous

DMF (4.0 mL) was added via a syringe. The electrocatalysis were performed under CO_2 balloon at 60 ℃ with a constant current of 5.0 mA. Six tubes maintained for incremental time, respectively. After that, every reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The residue was detected by ^{1}HNMR (0.2 mmol of dibromomethane was added as an internal standard) and the ^{1}HNMR yields were reported.

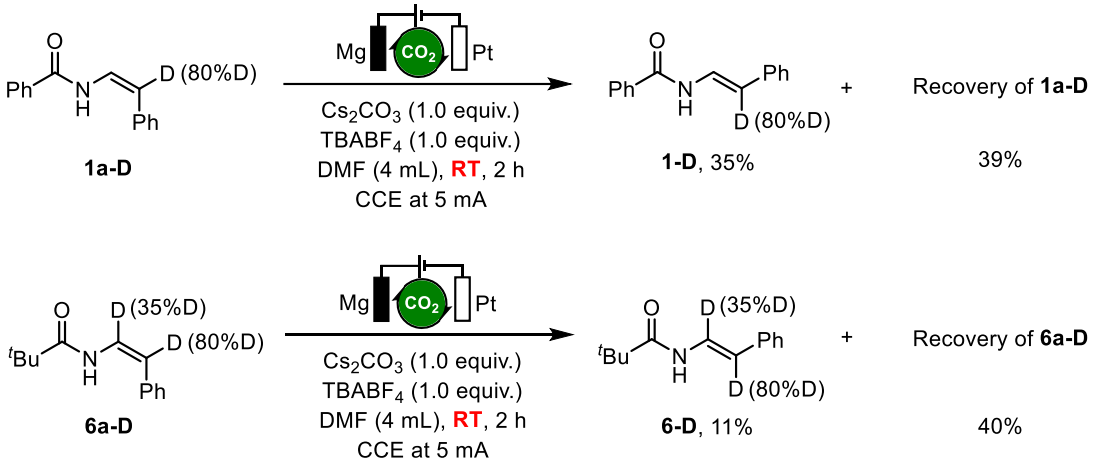
(d) Radical probe experiment



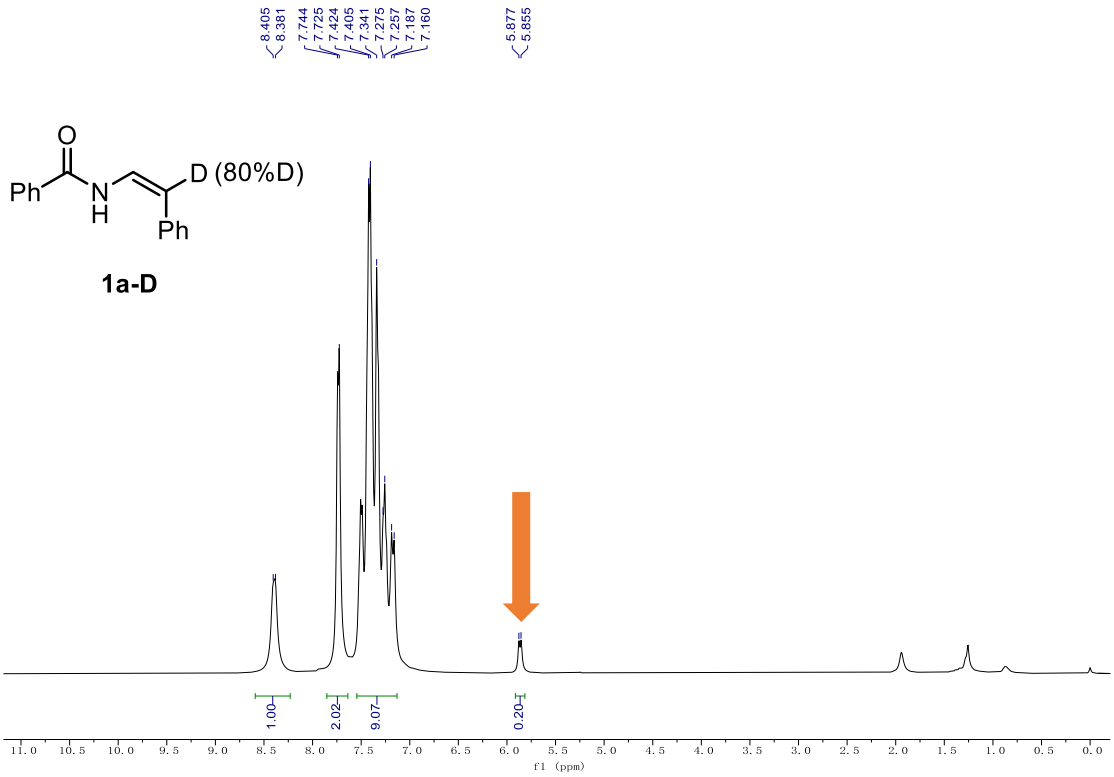
The reaction was carried out in an undivided cell with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **54a** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 balloon at 60 ℃ with a constant current of 5.0 mA maintained for 10 h. After that, the reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The crude product was purified by column chromatography to furnish the desired product **54** in 32% yield. ^{1}H NMR (400 MHz, Chloroform-d) δ 7.45 (d, J = 9.6 Hz, 1H), 6.52 (dd, J = 14.4, 10.0 Hz, 1H), 4.66 (dd, J = 14.0, 8.0 Hz, 1H), 1.08 – 0.99 (m, 1H), 0.92 (s, 9H), 0.39 – 0.32 (m, 2H), 0.01–0.05

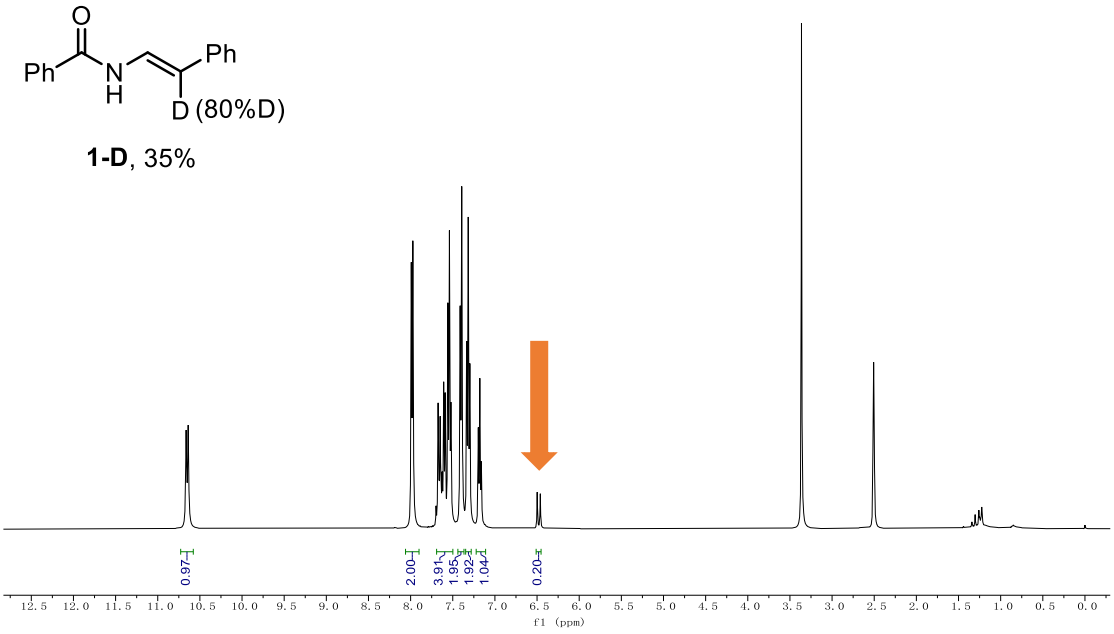
(m, 2H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ 175.4, 121.7, 116.7, 38.5, 27.3, 11.2, 6.3. HRMS (ESI, m/z): Calculated $C_{10}H_{17}NO$ $[M+H]^+$: 168.1388, found 168.1390.

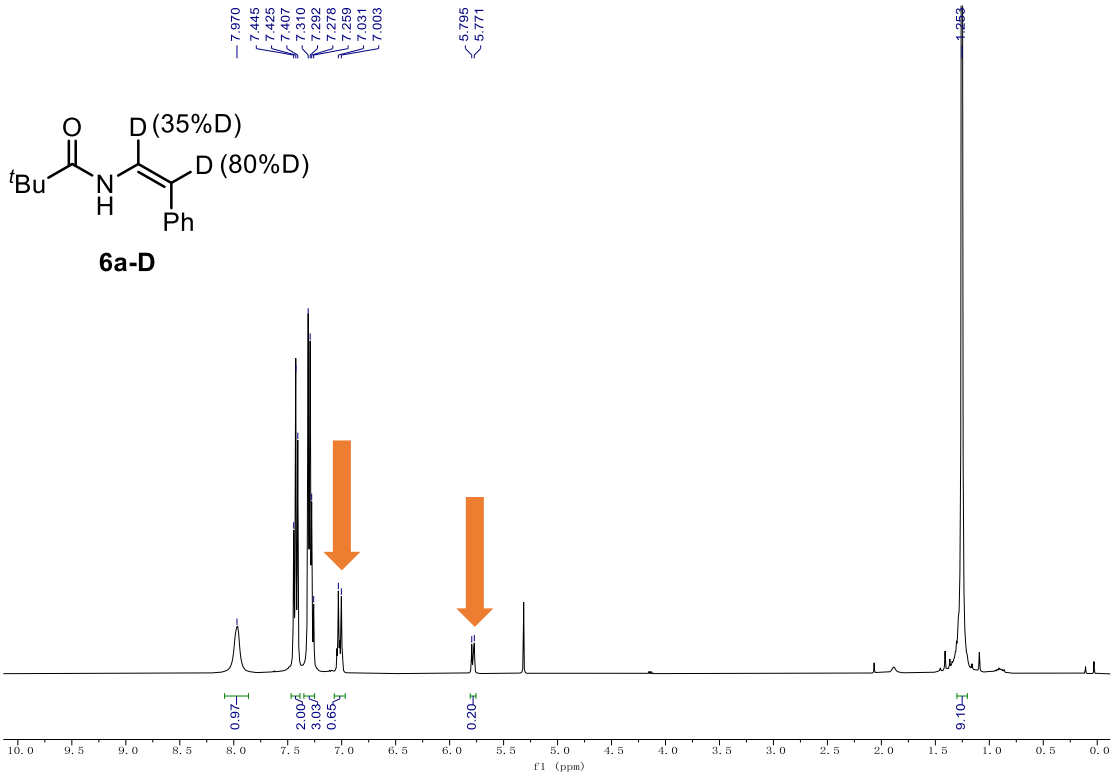
(e) Deuteration experiments at room temperature.



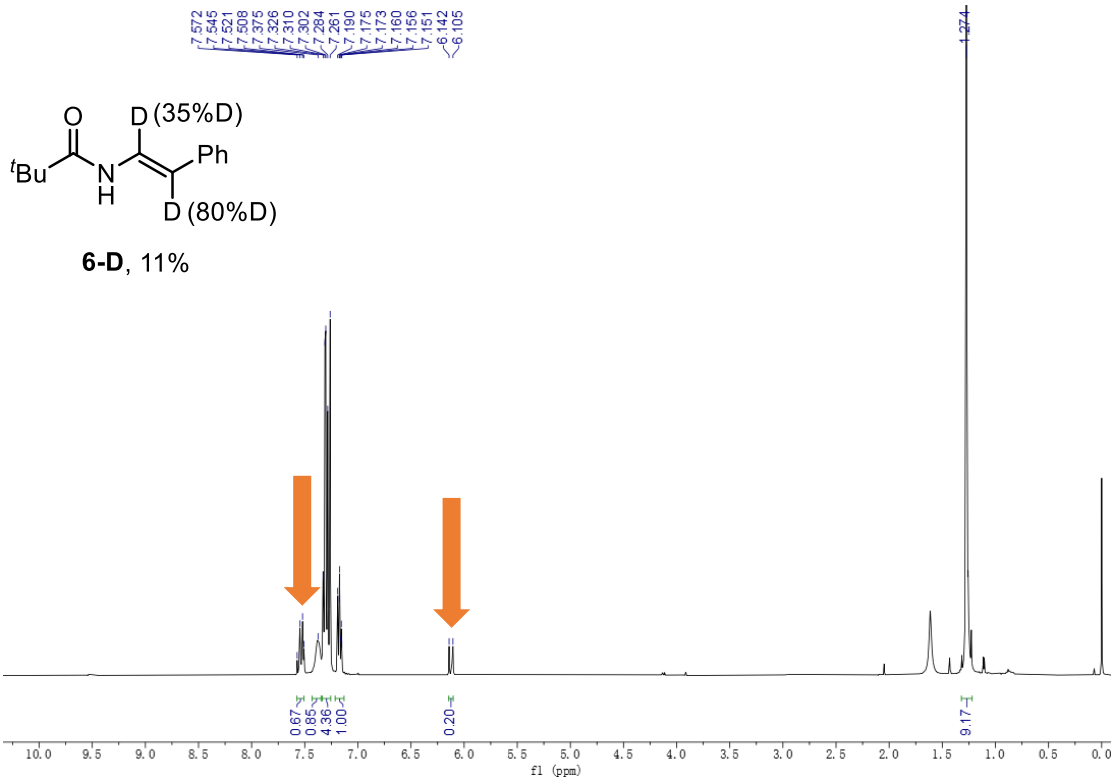
The reaction was carried out in an undivided cell with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **1a-D** or **6a-D** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 balloon at room temperature with a constant current of 5.0 mA maintained for 2 h. After that, the reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The crude product was purified by column chromatography to furnish the desired product **1-D** and **6-D** in 35% and 11% yield, respectively.


8.405
8.381
7.744
7.725
7.424
7.405
7.341
7.275
7.257
7.187
7.160
5.877
5.855
O
Ph
N
H
D (80%D)
Ph
1a-D
1.00
2.02
9.07
0.20
f1 (ppm)


O
Ph
N
H
Ph
D (80%D)
1-D, 35%
0.97
2.00
3.91
1.95
1.92
1.04
0.20
f1 (ppm)

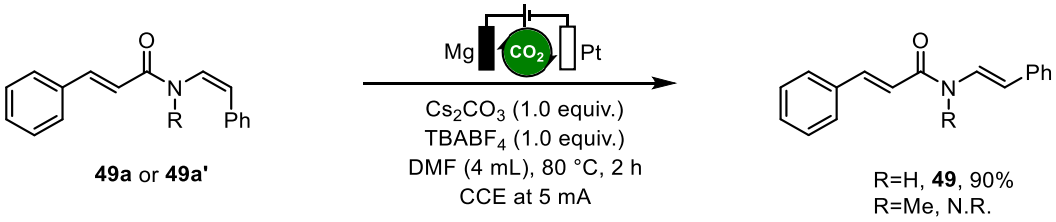


6a-D

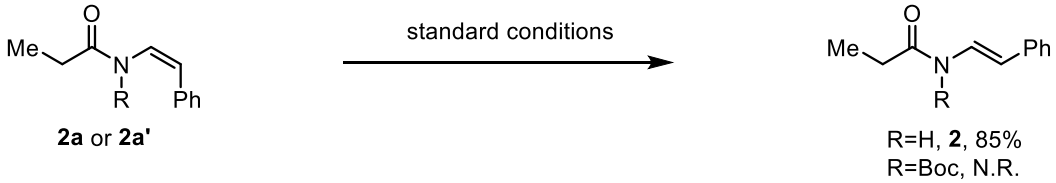


6-D, 11%

(f) Influence of *N*-protected groups



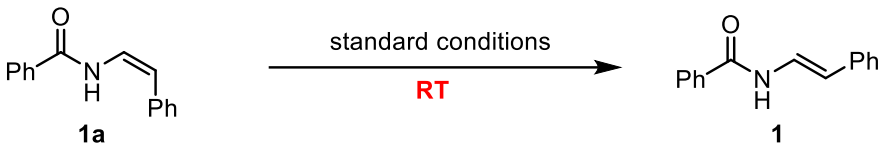
The reaction was carried out in an undivided cell with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **49a** and *N*-Me-protected **49a'** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 balloon at 80 °C with a constant current of 5.0 mA maintained for 2 h. After that, the reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The crude product was purified by column chromatography to furnish the desired product **49** in 90% and no target product was detected when using *N*-Me-protected **49a'** as starting material.



The reaction was carried out in an undivided cell with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **2a** and *N*-Boc-protected **2a'** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 balloon at 60 °C with a constant current of 5.0 mA maintained for 2 h. After that, the reaction mixture

was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The crude product was purified by column chromatography to furnish the desired product **2** in 85% and no target product was detected when using *N*-Boc-protected **2a'** as starting material.

(g) Control experiments at room temperature

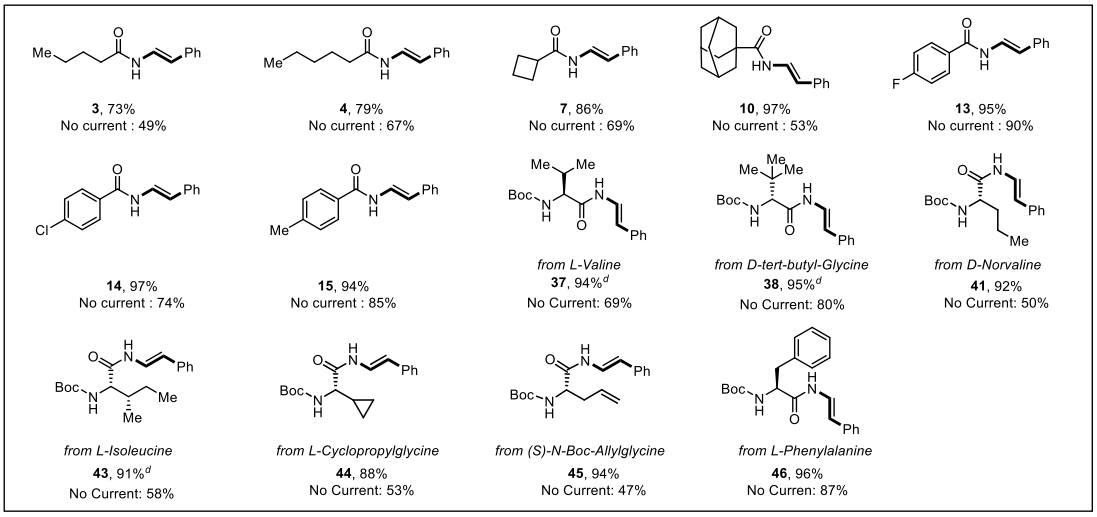


1a **1**

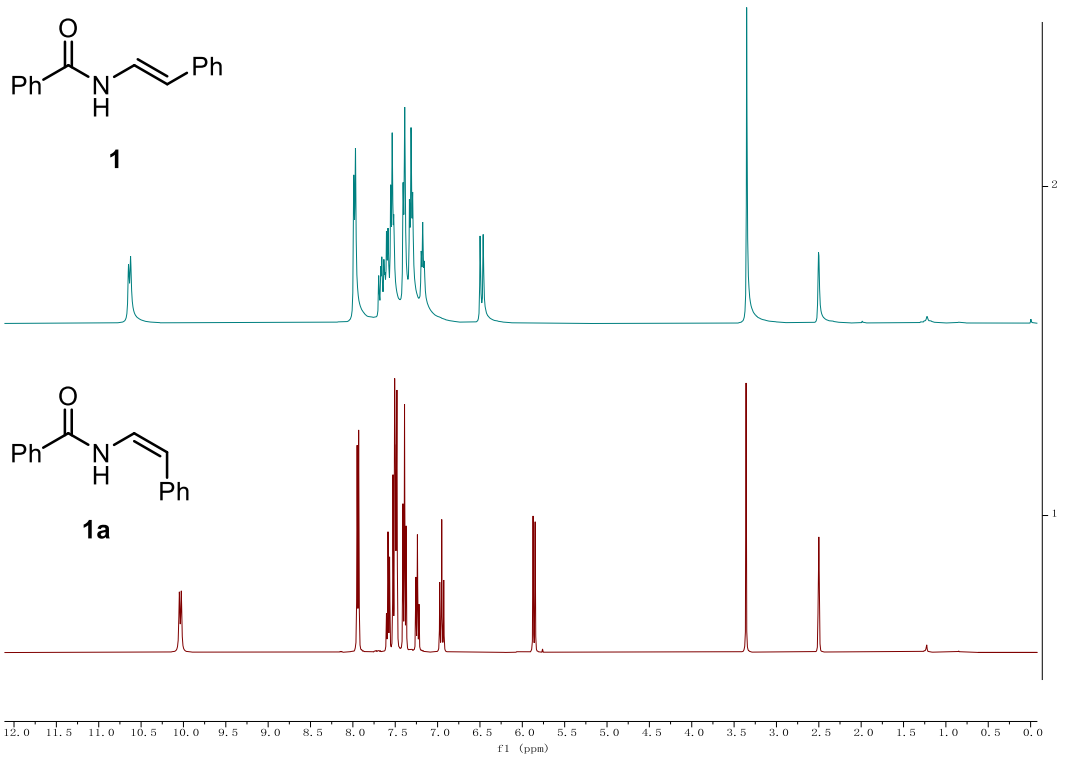
None	w/o CO_2	w/o current	w/o Cs_2CO_3
19%	N.R.	N.R.	N.R.

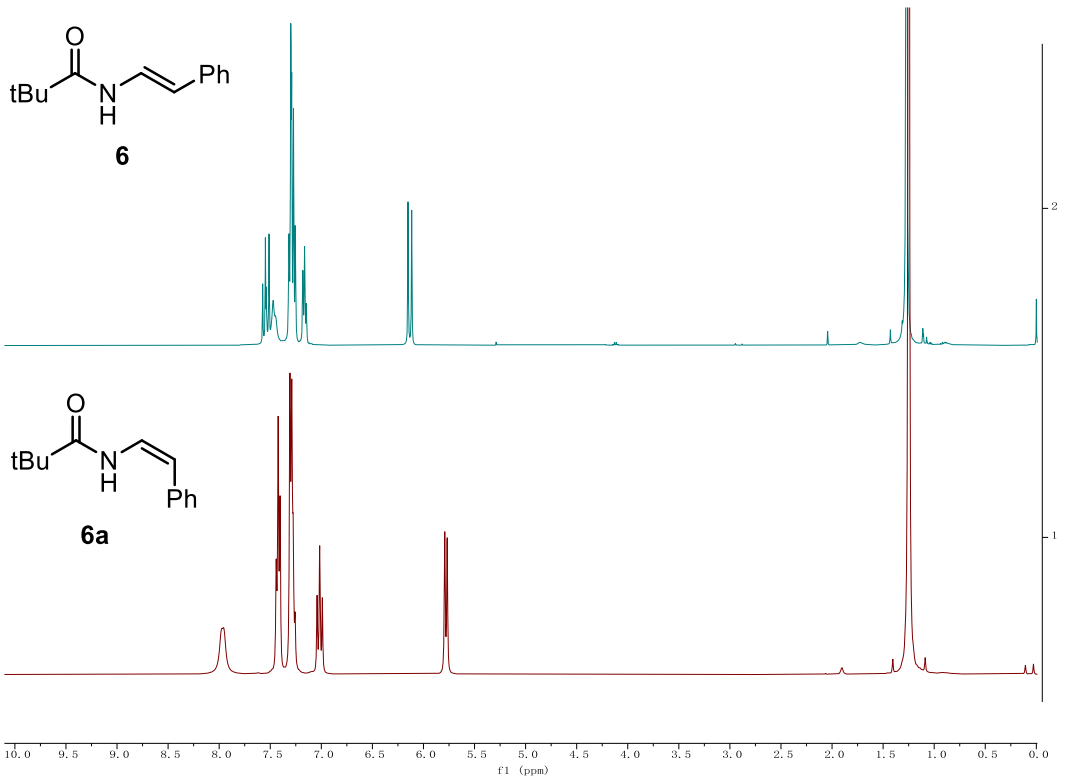
The reaction was carried out in an undivided cell with magnesium plates electrodes (0.1 mm × 10.0 mm × 20.0 mm) and platinum electrodes (0.25 mm × 10 mm × 15 mm). To a 15.0 mL oven-dried undivided cell equipped with a magnetic bar was added substrates *Z*-enamide **1a** (0.2 mmol, 1.0 equiv.), Cs_2CO_3 (0.2 mmol, 1.0 equiv.), $TBABF_4$ (0.2 mmol, 1.0 equiv.). Then the tube was evacuated and back-filled under CO_2 flow (this procedure was repeated three times), and DMF (4.0 mL) was added via a syringe. The electrocatalysis was performed under CO_2 balloon at room temperature with a constant current of 5.0 mA maintained for 2 h. After that, the reaction mixture was acidized with HCl aqueous (1.0 N, 5 mL). The aqueous layer was extracted with EtOAc (2 × 10 mL) and the combined organic phase was washed with brine, dried by anhydrous $MgSO_4$, filtered, and concentrated under vacuo. The crude product was purified by column chromatography to furnish the desired product.

(h) Control experiments with/without current on standard conditions



(i) The differences between *Z*-enaimdes and *E*-enamides by ^{1}H NMR spectrum (substrates 1 and 6 as examples)




O
tBu
N
H
Ph
6
O
tBu
N
H
Ph
6a
2
1
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

Cyclic Voltammetry Studies

The cyclic voltammetry was carried out with a Shanghai Chenhua CHI760E workstation. A glassy-carbon electrode (5 mm-diameter, disc-electrode) was used as the working electrode, a Pt plate was used as the auxiliary electrode and an $Ag/AgNO_3$ electrode was used as a reference electrode. The sample should be bubbled with Ar or CO_2 for 5 min before testing. The measurements were carried out at a scan rate of 100 mV s^{-1} in DMF/^{n}Bu_4NBF_4 (0.1 M).

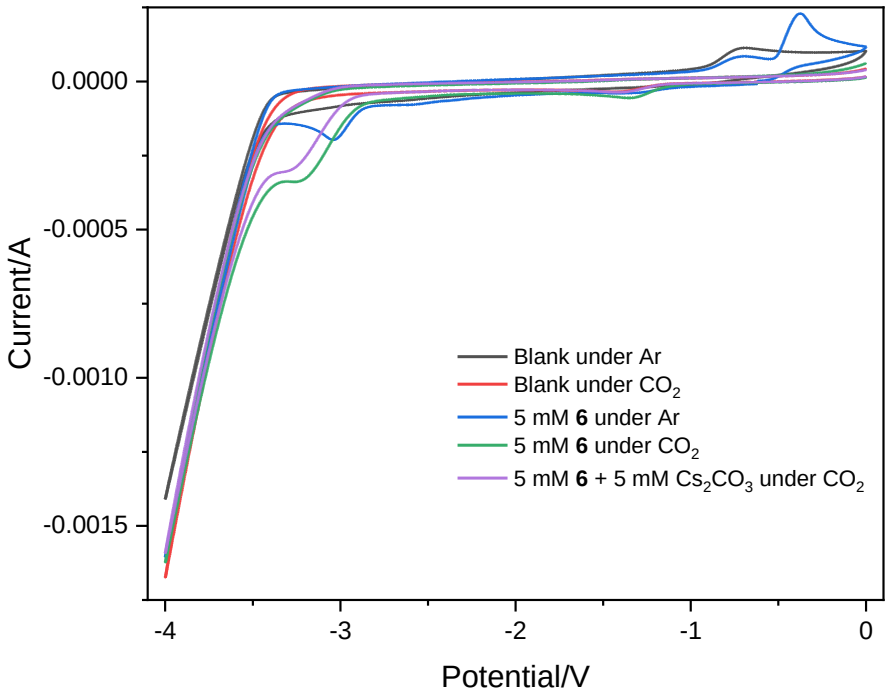


Figure S5. Cyclic voltammograms of **6** under Ar atmosphere (blue line), **6** under CO_2 atmosphere (green line), **6** with Cs_2CO_3 under CO_2 atmosphere (purple line) in DMF with ^{n}Bu_4NBF_4 (0.1 M).

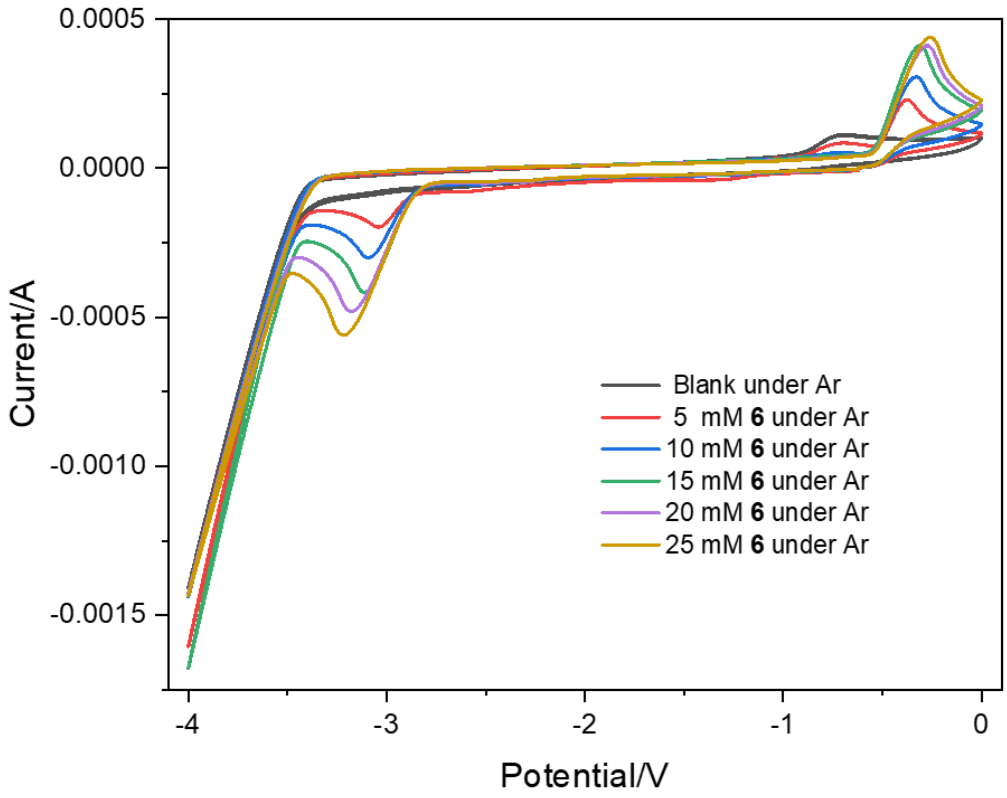


Figure S6. Cyclic voltammograms of different concentrations of **6** under Ar atmosphere in DMF with $^{n}Bu_4NBF_4$ (0.1 M).

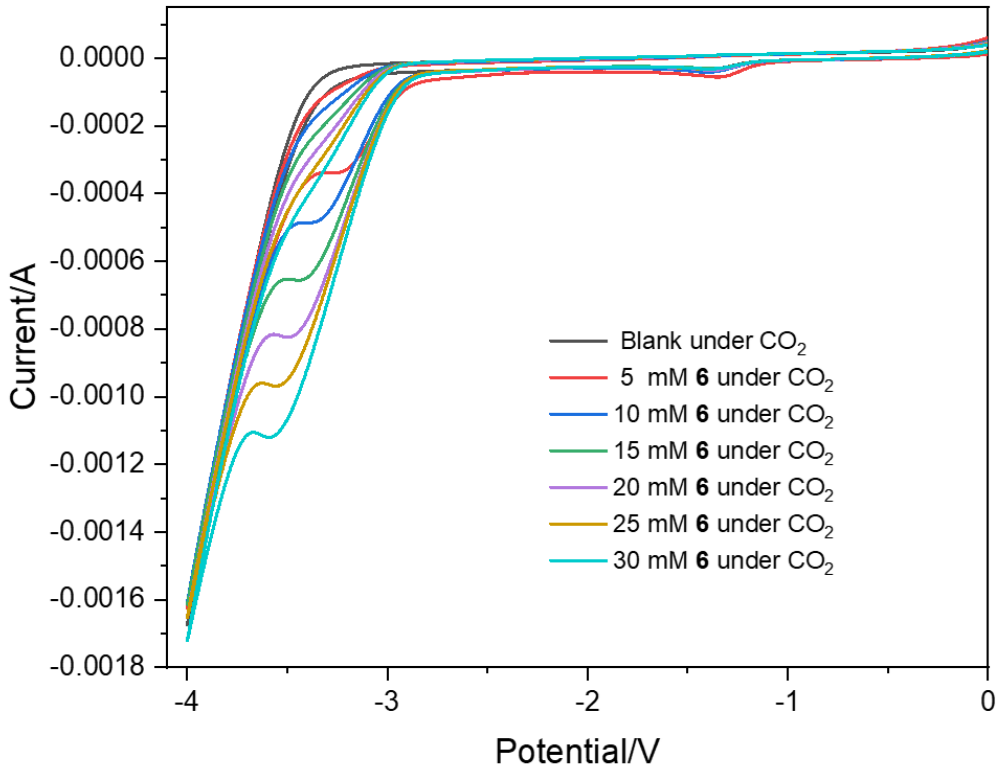


Figure S7. Cyclic voltammograms of different concentrations of **6** under CO_2 atmosphere in DMF with $^{n}Bu_4NBF_4$ (0.1 M).

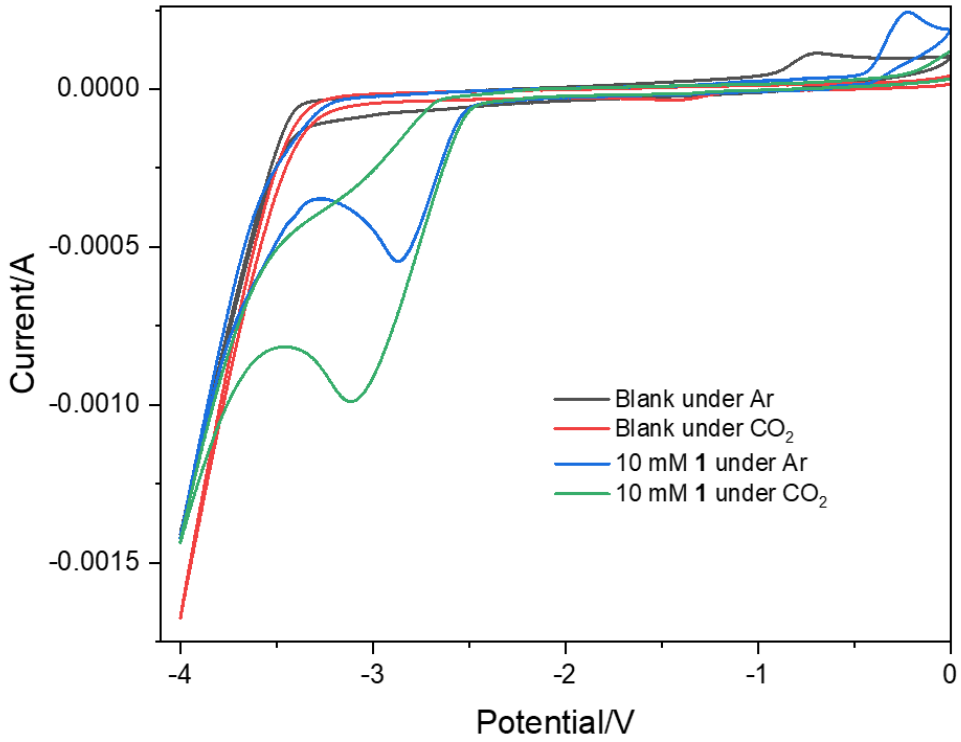


Figure S8. Cyclic voltammograms of **1** under Ar atmosphere (blue line), **1** under CO_2 atmosphere (green line) in DMF with $^{n}Bu_4NBF_4$ (0.1 M).

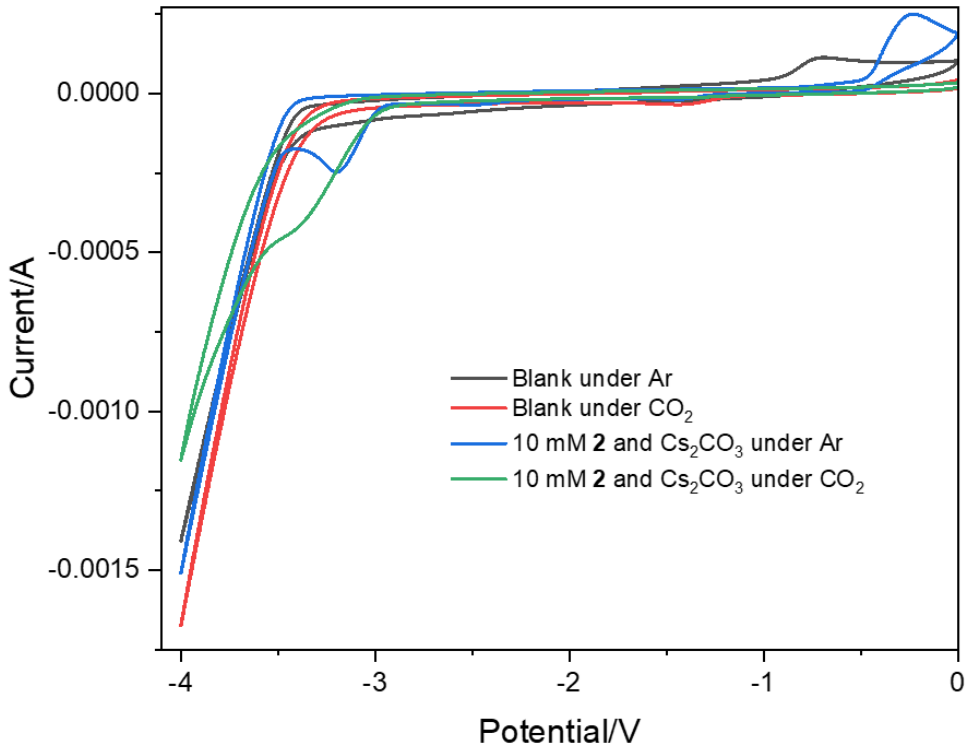


Figure S9. Cyclic voltammograms of **2** under Ar atmosphere (blue line), **2** under CO_2 atmosphere (green line) in DMF with $^{n}Bu_4NBF_4$ (0.1 M).

DFT Calculations

General Information of DFT Computational Studies

For single-point energy (SPE) calculation of optimized geometries:

- Calculation software: Gaussian 16, Rev. A 03 [13]
- DFT functional: M06-2X-D3 (Hybrid functional M06-2X[14] with dispersion-correction DFT-D3[15])
- Basis sets: ma-TZVP[16]
- Solvation model: SMD,[17] an implicit solvation model. The keyword scrf=solvent=N,N-dimethylformamide was input to set up solvent parameters.
- Other information: The keyword SCF=conver=6 was implemented to loosen the convergence criteria of SCF iterations, and reduce the running time. Other settings were kept default.

For geometry optimization and frequency analysis:

- Calculation software: Gaussian 16, Rev. A 03[13]
- DFT functional: M06-2X-D3 (Hybrid functional M06-2X[14] with dispersion-correction DFT-D3[15])
- Basis sets: def2-SVP[18]
- Solvation model: IEFPCM,[19] an implicit solvation model. The keyword scrf=solvent=N,N-dimethylformamide was input to set up solvent parameters.
- Other information: The keyword "Opt=(TS, CalcFC, NoEigen)" was implemented while searching transition states. Each intermediate does not have any imaginary frequency, and each transition state only has a sole imaginary frequency. Most other settings, like the accuracy of integration grids, and criteria of convergence, were kept default.

For the calculation of thermodynamic properties:

- Calculation software: Shermo 2.3,[20] the calculated harmonic frequencies

from frequency analysis are required for a certain geometry. Thermal corrections, including the thermal correction to Gibbs free energy (TCG), are the output.

- Environment parameters: T=333.15K and p=1 atm
- Treatment for low frequencies: Grimme's interpolation for entropy[21]
- Harmonic vibrational frequency scale factors for zero-point energy (ZPE), thermal energy (U), and entropy (S) were set to 0.977, 0.948, and 0.952, respectively. To see how these scale factors are obtained, please check the supporting information of Feng's work.[22]

  In this work, we adopted the same method[22] to calculate the harmonic vibrational frequency scale factors. The procedure and test sets remained the same, however, while performing geometry optimization to molecules in test sets, M06-2X/def2-SVP was applied instead. To check test sets and source codes, please access:

  https://github.com/TMSCN/Computational_Chemistry_Utils/tree/main/Scale_Factor_Generator

The level of DFT computation can be noted as SMD(DMF) / M06-2X-D3 / ma-TZVP // IEFPCM(DMF) / M06-2X-D3 / def2-SVP.

Computed Energies of Stationary Points

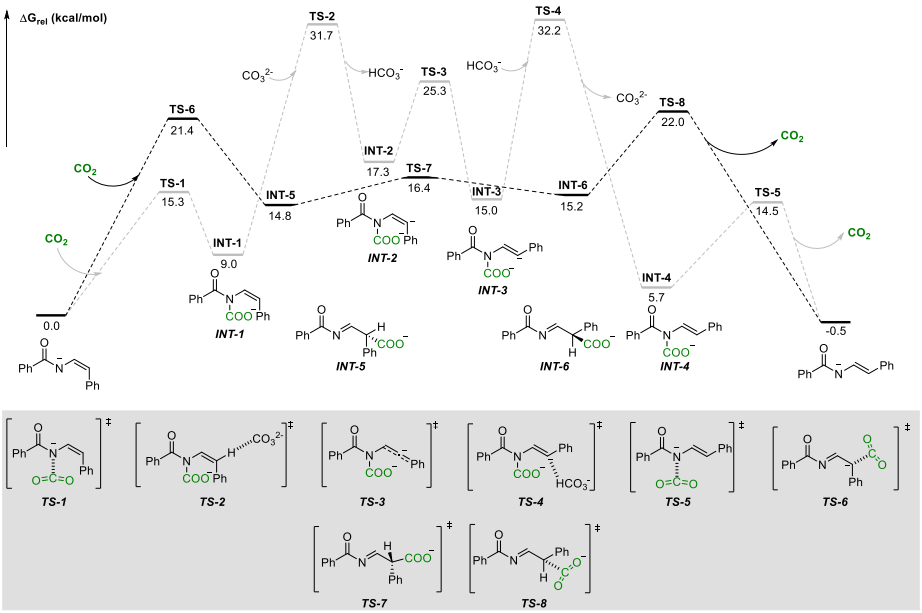


Table S2. Single-point energies (SPE) and thermal corrections to Gibbs free energies (TCG). 1 Hartree = 627.51 kcal/mol = 2625.5 kJ/mol.

Structures	SPE (Hartree)	TCG (Hartree)
1_Z	-709.396836	0.192354
1-_Z	-708.908438	0.179233
CO_2	-188.599399	-0.01184
CO_3_2-	-264.039294	-0.0126
1_E	-709.399010	0.191705
1-_E	-708.908813	0.178694
HCO_3-	-264.572060	-0.00265
INT-1	-897.517087	0.191063
INT-2	-896.967820	0.177695
INT-3	-896.969377	0.175525
INT-4	-897.521577	0.190089
INT-5	-897.506038	0.189153
INT-6	-897.504402	0.18809
TS-1	-897.504105	0.187999
TS-2	-1161.536706	0.194968
TS-3	-896.953289	0.17595
TS-4	-1161.536111	0.195011
TS-5	-897.504213	0.186686
TS-6	-897.493523	0.187232
TS-7	-897.504376	0.190084
TS-8	-897.492183	0.186773
TS-9	-708.844750	0.175379

Cartesian Coordinates of Stationary Points (Unit: Å)

1-_E

Charge = -1 Spin Multiplicity = 1

C	-4.63771146	-1.58977574	0.01832857
C	-3.30567953	-1.17800742	0.01223981
C	-2.98350922	0.18438335	-0.01722193
C	-4.01867044	1.12576033	-0.04046761
C	-5.35195264	0.71716665	-0.03445627
C	-5.66498776	-0.64321539	-0.00499865
H	-4.87869738	-2.65432366	0.04138088
H	-2.48682342	-1.89661630	0.03002122
H	-3.74952268	2.18243119	-0.06328043
H	-6.15130332	1.46046015	-0.05276601
H	-6.70771133	-0.96589783	-0.00021572
C	-1.54584831	0.67251946	-0.02471662
O	-1.35018829	1.90034282	-0.05154116
N	-0.62924480	-0.30803791	-0.00079753
C	0.66930785	0.09213476	-0.00670472
H	0.85663195	1.17680348	-0.03052350
C	1.73136415	-0.76126754	0.01478512
H	1.51633887	-1.83426601	0.03830698
C	3.14107460	-0.38219677	0.00950638
C	3.59418984	0.95586745	-0.01957302
C	4.12914270	-1.38890410	0.03448007
C	4.95173203	1.26026926	-0.02324991
H	2.86987521	1.77158868	-0.03965510
C	5.48819884	-1.08277924	0.03076286
H	3.81118625	-2.43419035	0.05727499
C	5.91377621	0.24609287	0.00184395
H	5.26468563	2.30628477	-0.04607543
H	6.22201241	-1.89126035	0.05067894
H	6.97709901	0.48982140	-0.00115515

1-_Z

Charge = -1 Spin Multiplicity = 1

C	3.71157654	-0.49925726	-0.64667160
C	2.43164139	-0.14327048	-0.22255636
C	2.25574075	0.85265838	0.74586749
C	3.38469278	1.48383401	1.28066386
C	4.66577318	1.13005345	0.85909078
C	4.83247098	0.13621288	-0.10720400
H	3.83760176	-1.27733105	-1.40189443

H	1.54852124	-0.63259519	-0.63324229
H	3.22819345	2.25675705	2.03399650
H	5.53836511	1.62974970	1.28409776
H	5.83386660	-0.14346784	-0.43943984
C	0.88286334	1.27291908	1.24181240
O	0.82919348	2.15963862	2.10957475
N	-0.14109978	0.61859278	0.66683861
C	-1.38186572	0.95642529	1.10719246
H	-1.43282726	1.71323077	1.90553339
C	-2.57956750	0.45940008	0.67420857
H	-3.47091997	0.85760730	1.16675556
C	-2.84083179	-0.53809308	-0.35978999
C	-1.83141683	-1.15899299	-1.12963695
C	-4.17577057	-0.91716813	-0.62197216
C	-2.15143043	-2.10518922	-2.10154072
H	-0.79887667	-0.87172427	-0.93798889
C	-4.49072861	-1.86260730	-1.59369006
H	-4.97768784	-0.45216232	-0.04262903
C	-3.47872506	-2.46721239	-2.34364129
H	-1.34942054	-2.56826386	-2.68099455
H	-5.53493603	-2.13081718	-1.76789021
H	-3.72172901	-3.20914483	-3.10600276

1_E

Charge = 0 Spin Multiplicity = 1

C	-7.44839569	1.55009501	0.80719862
C	-6.27016535	0.80511097	0.82299095
C	-6.10378799	-0.26157438	-0.06812788
C	-7.11776200	-0.56247024	-0.98451498
C	-8.29696880	0.17726983	-0.99322902
C	-8.46394742	1.23383490	-0.09560878
H	-7.56942497	2.38494420	1.49840503
H	-5.47625372	1.08684705	1.51707187
H	-6.96322896	-1.38543403	-1.68319773
H	-9.08812905	-0.06811113	-1.70285615
H	-9.38615658	1.81667683	-0.10382407
C	-4.85897639	-1.09655472	-0.12493305
O	-4.54933054	-1.72557445	-1.11984352
H	-4.44995383	-0.66227969	1.85139195
N	-4.09999024	-1.11952669	1.01686363
C	-2.90728464	-1.82414648	1.10070961
H	-2.63173626	-2.30146115	0.15926728

C	-2.16913260	-1.91216783	2.21915680
H	-2.52558056	-1.40843943	3.12315398
C	-0.89976158	-2.64105866	2.34882920
C	-0.28467118	-3.31384882	1.27707649
C	-0.26219039	-2.67219868	3.59993647
C	0.91722100	-3.99126702	1.45653532
H	-0.74668309	-3.30830363	0.28858330
C	0.94244439	-3.35058764	3.77935897
H	-0.72394215	-2.15448377	4.44358854
C	1.53881772	-4.01454207	2.70819519
H	1.37546239	-4.50587722	0.61030642
H	1.41656594	-3.35940082	4.76219450
H	2.48154590	-4.54627676	2.84424473

1_Z

Charge = 0 Spin Multiplicity = 1

C	2.99880946	-2.04783687	0.78695632
C	2.07487411	-1.00931486	0.68110975
C	2.45370210	0.21014601	0.10663571
C	3.76720577	0.38261450	-0.34473830
C	4.68636762	-0.65790239	-0.24493829
C	4.30223826	-1.87552574	0.32031583
H	2.69966017	-2.99241870	1.24258382
H	1.06946768	-1.15956548	1.07912881
H	4.04843551	1.34410971	-0.77559185
H	5.70600007	-0.51993994	-0.60692444
H	5.02233618	-2.69095780	0.40254536
C	1.52582496	1.38183887	-0.03143326
O	1.93813580	2.51625308	-0.18314772
N	0.18588507	1.09076264	0.00091615
C	-0.79099469	2.07831544	-0.02745765
H	-0.37761490	3.08614202	0.02120542
C	-2.11900061	1.87267438	-0.06925339
H	-2.74706633	2.76236577	0.00898874
C	-2.81582619	0.57517744	-0.14534896
C	-2.32502024	-0.50663373	-0.89778842
C	-4.03557811	0.41013952	0.53319965
C	-3.01087369	-1.72040401	-0.93697326
H	-1.41733605	-0.38907541	-1.49363051
C	-4.72039262	-0.80155751	0.49318948
H	-4.44253662	1.24719824	1.10451433
C	-4.20681336	-1.87581806	-0.23655579

H	-2.61248556	-2.54498115	-1.53028713
H	-5.66218608	-0.90872233	1.03385188
H	-4.74287971	-2.82535423	-0.26842402
H	-0.10479477	0.12247198	0.06868029

CO_2

Charge = 0 Spin Multiplicity = 1

C	-0.53841542	0.06153846	-0.00704824
O	-1.69452363	0.06153846	-0.00704824
O	0.61769279	0.06153846	-0.00704824

CO_3_2-

Charge = -2 Spin Multiplicity = 1

C	-4.33485909	1.66235897	-0.40597931
O	-3.69242930	2.78109323	-0.40597931
O	-5.62539401	1.66235899	-0.40597931
O	-3.69242934	0.54362468	-0.40597931

HCO_3-

Charge = -1 Spin Multiplicity = 1

C	-0.58295426	0.09719327	-0.15780655
O	-0.63989493	0.43277333	1.03754480
O	-1.16860979	-0.80391778	-0.76771144
O	0.28624600	0.85929784	-0.94987339
H	0.66449433	1.51552592	-0.35215531

INT-1

Charge = -1 Spin Multiplicity = 1

C	3.95106217	-1.59206342	1.07278644
C	2.78330662	-0.83911049	0.97403725
C	2.59428414	0.02104998	-0.11386909
C	3.59082744	0.13312672	-1.08689916
C	4.75041025	-0.63578177	-0.99835182
C	4.93217488	-1.49871838	0.08296036
H	4.09723763	-2.25570386	1.92637878
H	2.01755651	-0.91303731	1.74899297
H	3.44410566	0.82984568	-1.91350599
H	5.51734415	-0.55593865	-1.77023570
H	5.84242947	-2.09574864	0.15900111
C	1.41554367	0.95046430	-0.20174026
O	1.57465644	2.08520287	-0.62785053
N	0.20219309	0.52589211	0.28540729

C	-0.69722728	1.53111475	0.65778171
H	-0.20353321	2.44853025	0.98931035
C	-2.04262292	1.50084690	0.66945824
H	-2.51570876	2.37898543	1.11729666
C	-2.97976068	0.48551077	0.16491946
C	-2.66401796	-0.40104588	-0.87969348
C	-4.28125068	0.44517522	0.69392136
C	-3.60929541	-1.30765729	-1.35424250
H	-1.67080193	-0.38175936	-1.32846385
C	-5.22533024	-0.46459111	0.22235823
H	-4.55055066	1.14110160	1.49186497
C	-4.89208757	-1.34913857	-0.80426944
H	-3.34181792	-1.98625717	-2.16630654
H	-6.22710252	-0.47970619	0.65528620
H	-5.62927858	-2.06072799	-1.17945143
C	-0.10796618	-0.95179200	0.50586720
O	0.26404835	-1.67385768	-0.41765170
O	-0.67875373	-1.18949834	1.56584913

INT-2

Charge = -2 Spin Multiplicity = 1

C	-4.66608311	-0.46787914	1.65442799
C	-3.35866682	-0.60545362	1.19206222
C	-3.08886333	-0.56368455	-0.18083175
C	-4.14574060	-0.40278772	-1.08065990
C	-5.45195521	-0.24368958	-0.61847702
C	-5.71490597	-0.27810942	0.75156004
H	-4.86916729	-0.50899455	2.72600864
H	-2.53751357	-0.74710418	1.89803772
H	-3.92762800	-0.40616176	-2.14971010
H	-6.26818434	-0.10101772	-1.32880575
H	-6.73701003	-0.16342736	1.11661004
C	-1.71110378	-0.83458953	-0.74084216
O	-1.62567813	-1.51105820	-1.76767258
N	-0.63430899	-0.40077450	-0.05042586
C	0.66054348	-0.96580546	-0.38768085
H	0.57241090	-2.05363452	-0.52766591
C	1.81250196	-0.30270130	-0.53377639
C	1.89144093	1.13622723	-0.47253371
C	1.51088995	1.94988734	-1.57425524
C	2.44746687	1.82487116	0.63961353
C	1.66414808	3.33341967	-1.55821245

H	1.08393732	1.46325424	-2.45565102
C	2.58631494	3.20780997	0.65518664
H	2.75934318	1.23949450	1.50759986
C	2.20065046	3.98573968	-0.44376599
H	1.35165326	3.91599409	-2.42933867
H	3.00757622	3.69234891	1.54039061
H	2.31935020	5.07033263	-0.43158827
C	-0.73284655	0.65477648	1.01088203
O	-1.39590176	1.64783829	0.69479934
O	-0.15756727	0.37975791	2.06928196

INT-3

Charge = -2 Spin Multiplicity = 1

C	4.66627387	0.97757473	-0.65812618
C	3.29257245	0.74093264	-0.61308791
C	2.80687999	-0.50921924	-0.21120163
C	3.71556158	-1.51856965	0.12411101
C	5.08789660	-1.27679472	0.09634781
C	5.56691795	-0.02613120	-0.29753024
H	5.03639267	1.95270730	-0.97967848
H	2.59049196	1.52958345	-0.88857307
H	3.32499064	-2.49825033	0.40282087
H	5.78662993	-2.06758687	0.37479522
H	6.64106346	0.16438127	-0.32938614
C	1.33953154	-0.87335579	-0.23828089
O	1.03256347	-2.02691484	-0.55179994
N	0.43717803	0.09232008	0.03269115
C	-0.96013350	-0.17851293	-0.15585649
H	-1.10234317	-0.95366654	-0.92788012
C	-1.93774659	0.42131794	0.53278290
C	-3.30860556	0.11918719	0.19854236
C	-3.94272261	0.63011452	-0.96650665
C	-4.13253961	-0.66425396	1.05295301
C	-5.28229948	0.37510442	-1.25201271
H	-3.35071489	1.24376927	-1.65046851
C	-5.46584317	-0.92706133	0.75747526
H	-3.69017564	-1.06933969	1.96717054
C	-6.06382747	-0.40722301	-0.39706964
H	-5.72301967	0.78926916	-2.16297542
H	-6.05346661	-1.54599084	1.44085731
H	-7.11301787	-0.60537413	-0.62157041
C	0.81048771	1.36753605	0.74826259

O	1.31846655	1.19461837	1.85898144
O	0.58189069	2.40469149	0.11931089

INT-4

Charge = -1 Spin Multiplicity = 1

C	-4.72771012	-1.10950673	0.96098007
C	-3.37978326	-0.86999133	0.70251168
C	-3.00878414	0.09338623	-0.24272502
C	-3.99627548	0.82469310	-0.90883078
C	-5.34453163	0.57243582	-0.66202396
C	-5.71172386	-0.39494480	0.27452998
H	-5.01227042	-1.85660890	1.70336166
H	-2.61186309	-1.42886839	1.24106396
H	-3.69110308	1.59187758	-1.62172016
H	-6.11092771	1.13593332	-1.19625212
H	-6.76668844	-0.58897694	0.47487743
C	-1.57394692	0.47200188	-0.48052903
O	-1.28975730	1.62828963	-0.75099238
N	-0.61890937	-0.50553343	-0.29586205
C	0.70652708	-0.09814968	-0.18779754
H	0.80357601	0.98911506	-0.18028381
C	1.79177905	-0.89257354	-0.11745424
H	1.65975646	-1.97487491	-0.12214135
C	3.17367704	-0.40441161	-0.00593077
C	3.52045370	0.95756380	0.08222049
C	4.21890559	-1.34473881	0.01457359
C	4.85065322	1.35392350	0.18261673
H	2.74212371	1.72227909	0.07680810
C	5.55153907	-0.94841952	0.11527025
H	3.97309082	-2.40705966	-0.05121242
C	5.87670297	0.40503683	0.19968747
H	5.09002595	2.41673596	0.25034423
H	6.33999537	-1.70311379	0.12809285
H	6.91811057	0.72009672	0.27935878
C	-0.95497836	-1.98161136	-0.49210902
O	-0.46543932	-2.72744722	0.35490736
O	-1.65714955	-2.19462592	-1.47600628

INT-5

Charge = -1 Spin Multiplicity = 1

C	2.60612767	-1.19597858	1.77592558
C	1.78830690	-0.44270893	0.93152347

C	2.28633589	-0.02128634	-0.30844372
C	3.59031429	-0.35553435	-0.69459636
C	4.39588650	-1.11402148	0.14886673
C	3.90218567	-1.53514553	1.38669243
H	2.22623581	-1.52084321	2.74574827
H	0.77799835	-0.16608410	1.25023026
H	3.95375662	-0.01009927	-1.66330025
H	5.40988962	-1.37805818	-0.15486685
H	4.53292353	-2.12896805	2.05045387
C	1.47020360	0.81416118	-1.25278106
O	1.95028774	1.32221748	-2.24396739
N	0.11316018	0.88029278	-0.97497689
C	-0.40132560	1.74632231	-0.20648703
H	0.22619658	2.51601951	0.27828983
C	-1.84876826	1.79152184	0.16721470
H	-2.20916993	2.82263297	0.04043987
C	-2.72429907	0.84579957	-0.61710763
C	-3.68594658	1.32382993	-1.51213242
C	-2.59029799	-0.54035758	-0.45030473
C	-4.49824864	0.44108655	-2.22801494
H	-3.80084932	2.40153554	-1.65002849
C	-3.39669184	-1.42281224	-1.16501793
H	-1.84613714	-0.91104865	0.25758123
C	-4.35454227	-0.93499105	-2.05820268
H	-5.24559941	0.83248743	-2.92055546
H	-3.28044229	-2.49901218	-1.02407200
H	-4.98737772	-1.62660163	-2.61684003
C	-1.95479176	1.45205871	1.71040254
O	-1.05307146	0.70925801	2.15322232
O	-2.93574764	1.92000794	2.29960679

INT-6

Charge = -1 Spin Multiplicity = 1

C	-3.70420214	-0.99835189	1.68706655
C	-2.56503569	-0.58701086	0.99653904
C	-2.68058042	0.32589414	-0.05823475
C	-3.93933231	0.82598300	-0.41391600
C	-5.07489865	0.41378066	0.27682695
C	-4.95707235	-0.49920233	1.32834681
H	-3.61407100	-1.70864315	2.51003267
H	-1.57931817	-0.96286742	1.26977097
H	-4.00660789	1.53714389	-1.23819254

H	-6.05509968	0.80284944	-0.00206232
H	-5.84714784	-0.82186468	1.87098777
C	-1.48700700	0.78258595	-0.83729168
O	-1.56613428	1.63464689	-1.69603772
N	-0.27394778	0.17927030	-0.46644960
C	0.53716666	-0.11780215	-1.40480346
H	0.26258977	0.04511823	-2.46118590
C	1.89505324	-0.67420088	-1.15885901
H	2.04563272	-0.80211840	-0.07999714
C	2.04830939	-2.01076639	-1.85959161
C	2.14694614	-3.19639401	-1.12306812
C	2.07424120	-2.08215318	-3.26005606
C	2.27577020	-4.42755070	-1.76826859
H	2.12399798	-3.15248918	-0.03192531
C	2.19617919	-3.31190323	-3.90471965
H	2.01828768	-1.15340133	-3.83157017
C	2.29800807	-4.48980795	-3.16143425
H	2.35687519	-5.34211450	-1.17814308
H	2.21694786	-3.35116884	-4.99533606
H	2.39606564	-5.45184989	-3.66689117
C	2.98083820	0.33230400	-1.71923449
O	2.63329029	0.97891385	-2.72631211
O	4.06012974	0.33491460	-1.11509777

TS-1

Charge = -1 Spin Multiplicity = 1

C	3.88333984	-1.29617852	1.02490729
C	2.76060668	-0.47104443	0.95914821
C	2.57861686	0.39456737	-0.12432870
C	3.55057782	0.43833769	-1.12967685
C	4.66344714	-0.39945384	-1.07804991
C	4.83179861	-1.26961372	0.00110623
H	4.02030362	-1.96071434	1.87972695
H	2.02561138	-0.48018954	1.76667856
H	3.41714684	1.14203735	-1.95290754
H	5.40624875	-0.37020526	-1.87717341
H	5.70619501	-1.92097021	0.04823978
C	1.41938558	1.36292403	-0.19587318
O	1.64371045	2.49651460	-0.64250529
N	0.22632722	0.91193780	0.23167039
C	-0.70805199	1.87836042	0.51216926
H	-0.29866390	2.85863735	0.79860417

C	-2.06013527	1.76043115	0.53554762
H	-2.61171325	2.61456076	0.93777899
C	-2.88548476	0.63514390	0.08596202
C	-2.45494151	-0.28377012	-0.89045968
C	-4.19030641	0.48160554	0.59413447
C	-3.28014966	-1.32593328	-1.30964944
H	-1.46061262	-0.16937874	-1.32155031
C	-5.01553050	-0.55820728	0.17293811
H	-4.55403907	1.19455358	1.33818766
C	-4.56287567	-1.47475166	-0.77895419
H	-2.91837877	-2.02603212	-2.06557451
H	-6.01979974	-0.65479085	0.59020770
H	-5.20679013	-2.29123535	-1.10953860
C	-0.20765673	-1.11215200	0.83611755
O	0.16525465	-1.74378862	-0.08051365
O	-0.67122406	-0.92569757	1.89891184

TS-2

Charge = -3 Spin Multiplicity = 1

C	-4.75129700	-0.42906010	1.41255354
C	-3.40421110	-0.52168933	1.06887036
C	-3.02940889	-0.70201893	-0.26770586
C	-4.01915467	-0.80596354	-1.24829684
C	-5.36702057	-0.69204498	-0.90844648
C	-5.73566827	-0.50544506	0.42427869
H	-5.03628285	-0.29622626	2.45762824
H	-2.63449119	-0.45607092	1.84087803
H	-3.71709847	-0.97841421	-2.28244307
H	-6.13210600	-0.75771231	-1.68392504
H	-6.78989977	-0.42533975	0.69497722
C	-1.59513670	-0.94101907	-0.67499930
O	-1.36875541	-1.77730669	-1.54757386
N	-0.60908918	-0.29462178	-0.00261681
C	0.71496544	-0.84080027	-0.09381706
H	0.72295408	-1.93640675	-0.09688348
C	1.88245736	-0.18238530	-0.14115723
H	3.06952913	-0.95291699	-0.01617292
C	1.96934282	1.28051820	-0.24690672
C	1.25512749	2.02060556	-1.21262588
C	2.87284929	1.99913431	0.56568120
C	1.42451758	3.39779731	-1.34808615
H	0.55088289	1.49274704	-1.85981673

C	3.02983132	3.37795024	0.44569684
H	3.45977619	1.44386336	1.30186464
C	2.30729582	4.09002529	-0.51592910
H	0.85621671	3.93957773	-2.10800990
H	3.73019510	3.90250434	1.09994441
H	2.43678318	5.16876012	-0.62024670
C	-0.87814441	0.94486338	0.80490323
O	-1.62703424	1.75978873	0.25665436
O	-0.32889555	0.97269851	1.90883494
C	4.01439987	-2.84052116	0.34190933
O	5.06900204	-3.47305514	0.62604819
O	2.87328157	-3.37616985	0.22302364
O	4.12442838	-1.52170573	0.15245225

TS-3

Charge = -2 Spin Multiplicity = 1

C	-3.72241397	-1.57517846	-0.69666833
C	-2.60058078	-0.75016008	-0.76014291
C	-2.50588348	0.37298205	0.07006283
C	-3.55453871	0.66618537	0.94708036
C	-4.66836825	-0.16856752	1.02395287
C	-4.75496878	-1.29138498	0.19948793
H	-3.79260562	-2.44448920	-1.35265989
H	-1.79293484	-0.97510950	-1.45923682
H	-3.48180026	1.56210498	1.56509310
H	-5.47464792	0.06101024	1.72265010
H	-5.62943990	-1.94232477	0.25041329
C	-1.37155178	1.36667358	-0.02417496
O	-1.61804843	2.55815574	0.16736688
N	-0.14981144	0.90757890	-0.38038706
C	0.88093690	1.86165740	-0.71086480
H	0.42243105	2.80336264	-1.05212653
C	2.16912166	1.63757630	-0.61419315
C	3.51755920	1.46885046	-0.62635445
C	4.38071219	1.80590795	0.49412280
C	4.22192587	0.91528759	-1.77293009
C	5.74914540	1.60955056	0.45057836
H	3.92143462	2.22207666	1.39406900
C	5.59263100	0.73561703	-1.77556311
H	3.63198422	0.62685542	-2.64632861
C	6.40073573	1.07378370	-0.67450831
H	6.33871119	1.88493640	1.33145125

H	6.05672327	0.31151211	-2.67231728
H	7.48049399	0.92479233	-0.69183678
C	0.25238688	-0.54009002	-0.23925443
O	0.03996836	-1.01662336	0.87841715
O	0.72483258	-1.04914343	-1.25851081

TS-4

Charge = -3 Spin Multiplicity = 1

C	-5.18367473	-0.13370508	1.12057218
C	-3.82357444	-0.37572019	0.93341284
C	-3.32350601	-0.61967734	-0.35122760
C	-4.20489420	-0.63625054	-1.43683331
C	-5.56191684	-0.37649127	-1.25221038
C	-6.05468098	-0.12601782	0.02929786
H	-5.56688756	0.04970884	2.12580170
H	-3.14437592	-0.37457612	1.78784797
H	-3.80759301	-0.85684668	-2.42856756
H	-6.23798078	-0.37559046	-2.10887905
H	-7.11772166	0.07050573	0.17880678
C	-1.88446751	-0.99262146	-0.61506776
O	-1.64450624	-1.81444590	-1.49968721
N	-0.92393038	-0.44864923	0.17200322
C	0.39781129	-0.96017401	0.07342492
H	0.40076106	-2.00878740	-0.25718291
C	1.51714616	-0.25086368	0.29627449
H	1.73189659	1.12060262	0.47595523
C	2.79893875	-0.96552199	0.18383357
C	3.03126159	-2.25444585	0.70674444
C	3.88149269	-0.31420713	-0.45088325
C	4.27567102	-2.87509037	0.58451031
H	2.22016689	-2.76444932	1.23273307
C	5.11969464	-0.93996364	-0.57705743
H	3.68922622	0.68619476	-0.85606989
C	5.32840219	-2.22384148	-0.06037103
H	4.42639673	-3.87339293	1.00253974
H	5.93910168	-0.42196357	-1.08200361
H	6.30309652	-2.70684889	-0.15251910
C	-1.17291124	0.78375859	1.01686318
O	-1.62394127	1.74283641	0.38904736
O	-0.91920754	0.64190032	2.21495974
C	2.34744200	3.00715840	-0.40375795
O	2.50353899	4.25072479	-0.25944442

O	2.46020377	2.40422720	-1.51600531
O	2.06166472	2.28951183	0.68267543

TS-5

Charge = -1 Spin Multiplicity = 1

C	2.92939641	-2.81169470	0.36824942
C	1.76327342	-2.09434947	0.63302470
C	1.54551623	-0.84412047	0.04468156
C	2.50429314	-0.33379433	-0.83821146
C	3.66482929	-1.05433454	-1.11656176
C	3.88361247	-2.29265642	-0.50859065
H	3.09386360	-3.78065114	0.84309158
H	0.99749978	-2.49080816	1.30111023
H	2.32119242	0.63065136	-1.31486724
H	4.40215613	-0.65023640	-1.81255417
H	4.79453571	-2.85442847	-0.72265611
C	0.24641852	-0.11892911	0.33723886
O	-0.71070929	-0.79120089	0.74403590
C	-0.85388267	1.97457174	0.16884080
H	-0.62855436	3.02878989	-0.04416619
C	-2.15254684	1.65741475	0.43289697
C	-3.25752388	2.62149251	0.42631775
C	-3.13334791	3.97391562	0.04244687
C	-4.53796541	2.18577931	0.82356391
C	-4.22558751	4.83629440	0.06869000
H	-2.16832649	4.35980160	-0.28958656
C	-5.63221872	3.04795371	0.84715547
H	-4.66572675	1.14235046	1.12172642
C	-5.48522660	4.38370796	0.47137999
H	-4.09306484	5.87680729	-0.23488715
H	-6.60795296	2.67249786	1.16219305
H	-6.33884430	5.06285685	0.48761872
H	-2.40731949	0.62978831	0.68174345
N	0.27557053	1.20460940	0.10083120
C	2.02348104	2.46541302	0.61243794
O	1.80431899	3.37895375	-0.08727612
O	2.55543298	1.80584262	1.41895876

TS-6

Charge = -1 Spin Multiplicity = 1

C	-3.45840253	0.62940597	2.16056543
C	-2.47524845	0.41738872	1.19444557

C	-2.83651533	0.04387063	-0.10537778
C	-4.19003455	-0.11442574	-0.42580315
C	-5.17201259	0.09728872	0.53904101
C	-4.80654012	0.46963199	1.83493721
H	-3.17249206	0.92031848	3.17268210
H	-1.41786248	0.53815484	1.42940747
H	-4.45137041	-0.40588533	-1.44381847
H	-6.22540543	-0.02788168	0.28324881
H	-5.57454839	0.63539385	2.59244014
C	-1.80631724	-0.18843137	-1.18137583
O	-2.16555832	-0.51255662	-2.30648525
N	-0.50354026	-0.02262330	-0.76477424
C	0.40355712	0.02887069	-1.71195370
H	0.06418709	0.01975893	-2.76220396
C	1.80702624	0.02878582	-1.52878889
H	2.36528358	0.36955685	-2.40318954
C	2.48533450	0.26453774	-0.24158832
C	3.75475109	0.87135195	-0.24284591
C	1.94578875	-0.12726492	0.99792246
C	4.45290605	1.09705434	0.94125526
H	4.19510879	1.17469636	-1.19604449
C	2.64689695	0.09926614	2.18218867
H	0.97180455	-0.61127251	1.01233373
C	3.90026450	0.71368659	2.16489399
H	5.43376114	1.57532396	0.90848002
H	2.20820713	-0.21196948	3.13262992
H	4.44299883	0.88917929	3.09519854
C	1.96127328	-1.93060337	-1.94130480
O	1.79444968	-2.54181134	-0.92835920
O	2.20396037	-2.01861458	-3.11108947

TS-7

Charge = -1 Spin Multiplicity = 1

C	-4.75726301	0.37538041	0.49174782
C	-3.94212883	-0.71809515	0.21467289
C	-2.60689065	-0.52297830	-0.15778052
C	-2.09268416	0.77615895	-0.25591685
C	-2.91116691	1.86949600	0.02510342
C	-4.24097253	1.67040935	0.39795381
H	-5.79717083	0.22118795	0.78284021
H	-4.32112141	-1.73847559	0.28456201
H	-1.05491390	0.93395878	-0.55468013

H	-2.50829505	2.88040376	-0.04989027
H	-4.87932558	2.52812478	0.61593844
C	-1.76313275	-1.73838541	-0.41775998
O	-2.19844594	-2.86330032	-0.30611908
N	-0.47479390	-1.47689277	-0.86998707
C	0.50846934	-1.38292330	-0.07294675
H	0.40090241	-1.51936750	1.01752295
C	1.88381004	-1.01058852	-0.52566779
C	2.01912947	0.48265639	-0.26491518
C	1.85044238	1.39755558	-1.31153716
C	2.22879436	0.96977359	1.03260233
C	1.90084139	2.77116227	-1.07102208
H	1.67619061	1.02683987	-2.32428283
C	2.27585482	2.34280088	1.27282524
H	2.36041153	0.25121877	1.84385099
C	2.11175243	3.24838973	0.22328677
H	1.77385884	3.47106603	-1.89878558
H	2.44169448	2.70838059	2.28782619
H	2.14889139	4.32224391	0.41299456
C	2.99061597	-1.80949305	0.24217500
O	4.03148910	-2.02726666	-0.39500974
O	2.71872405	-2.10601109	1.42427871
H	1.97200782	-1.19064295	-1.60462836

TS-8

Charge = -1 Spin Multiplicity = 1

C	4.83949991	0.14313138	-1.60344746
C	3.54938017	-0.06044054	-1.11505896
C	3.32011411	-0.10774562	0.26511579
C	4.39438276	0.04887496	1.14866887
C	5.68387382	0.24761859	0.66078368
C	5.90768068	0.29532867	-0.71737525
H	5.01378952	0.18282922	-2.67995902
H	2.70019130	-0.18035198	-1.78732609
H	4.19476939	0.01147803	2.22030224
H	6.51820856	0.36669989	1.35393563
H	6.91722678	0.45232489	-1.10120363
C	1.93666723	-0.30589742	0.83039338
O	1.76489488	-0.27029002	2.04332695
N	0.96753688	-0.53851752	-0.11883496
C	-0.27753016	-0.47444082	0.29095864
H	-0.47287310	-0.19099471	1.34005581

C	-1.38958540	-0.68293114	-0.55588098
H	-1.16040114	-1.20032017	-1.49201023
C	-2.73381880	-0.92898761	-0.00301179
C	-3.61700859	-1.79603916	-0.66872069
C	-3.19552653	-0.29470078	1.16444116
C	-4.90005411	-2.03835664	-0.18039147
H	-3.28229129	-2.29216362	-1.58294813
C	-4.47492471	-0.54199019	1.65685925
H	-2.54948334	0.41589690	1.68224554
C	-5.33652637	-1.41617221	0.98998892
H	-5.56205697	-2.72075905	-0.71708604
H	-4.80703197	-0.03903416	2.56725840
H	-6.33925690	-1.60526093	1.37624812
C	-1.40916899	1.18617575	-1.32435803
O	-2.21806458	1.83232322	-0.72771396
O	-0.61254686	1.18765474	-2.21499420

TS-9

Charge = -1 Spin Multiplicity = 1

C	3.03781693	-1.02809336	-1.48714598
C	2.16041792	-0.76879415	-0.43500592
C	2.53548979	0.11330770	0.58522859
C	3.79295320	0.72685504	0.54946544
C	4.66831574	0.46486688	-0.50083737
C	4.29015339	-0.41276586	-1.52022285
H	2.74485052	-1.71488102	-2.28240189
H	1.18183347	-1.24859456	-0.39436587
H	4.06420149	1.41041156	1.35513196
H	5.64767103	0.94468560	-0.52825184
H	4.97592032	-0.61806652	-2.34385975
C	1.61059368	0.44354024	1.71934628
O	1.94625593	1.17247294	2.63044381
N	0.37236222	-0.19053683	1.67245378
C	-0.69770706	0.51306012	1.66237282
H	-0.55613065	1.62052945	1.63312607
C	-2.05804863	-0.03664532	1.65035101
H	-2.58458939	-0.09322723	2.60729635
C	-2.74287941	-0.25647886	0.45448934
C	-2.14087281	-0.08416238	-0.84756352
C	-4.12200852	-0.68221960	0.41522575
C	-2.84107209	-0.31320702	-2.02313530
H	-1.09447077	0.22977907	-0.90774499
C	-4.79578628	-0.90813008	-0.77207279

H	-4.64309437	-0.83137037	1.36574814
C	-4.18022683	-0.73023537	-2.02408335
H	-2.32332849	-0.16274520	-2.97588684
H	-5.84030825	-1.23265220	-0.72723955
H	-4.71981244	-0.91122848	-2.95409028

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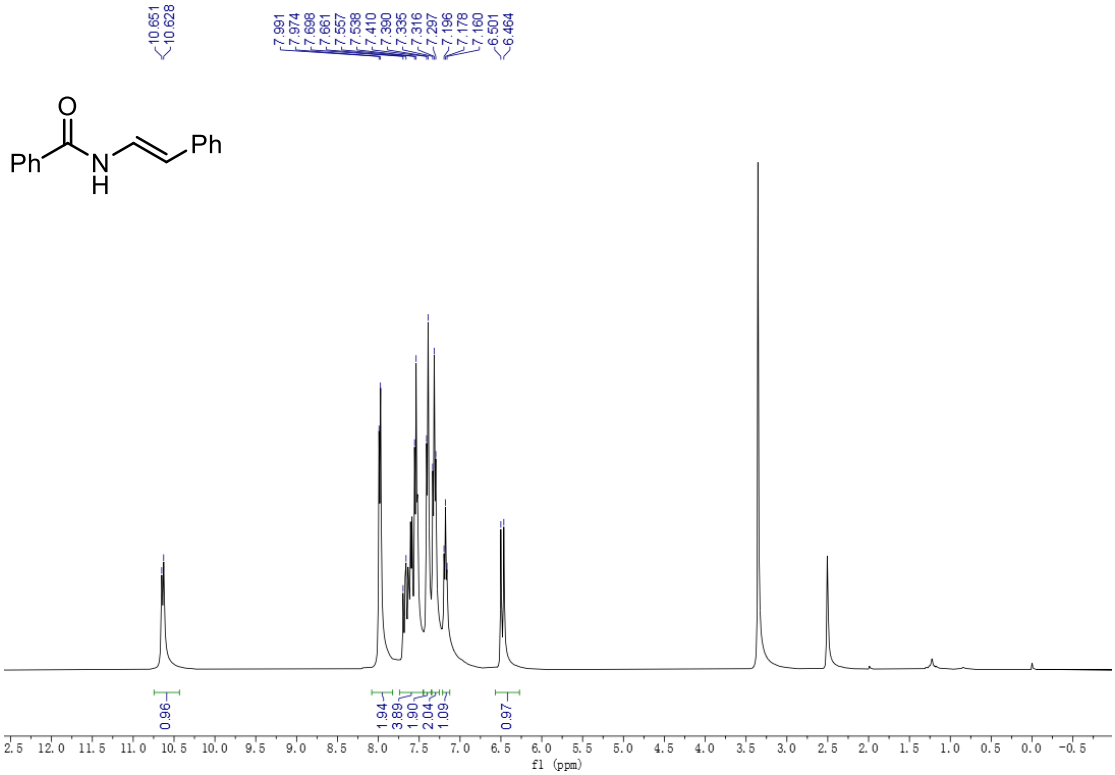
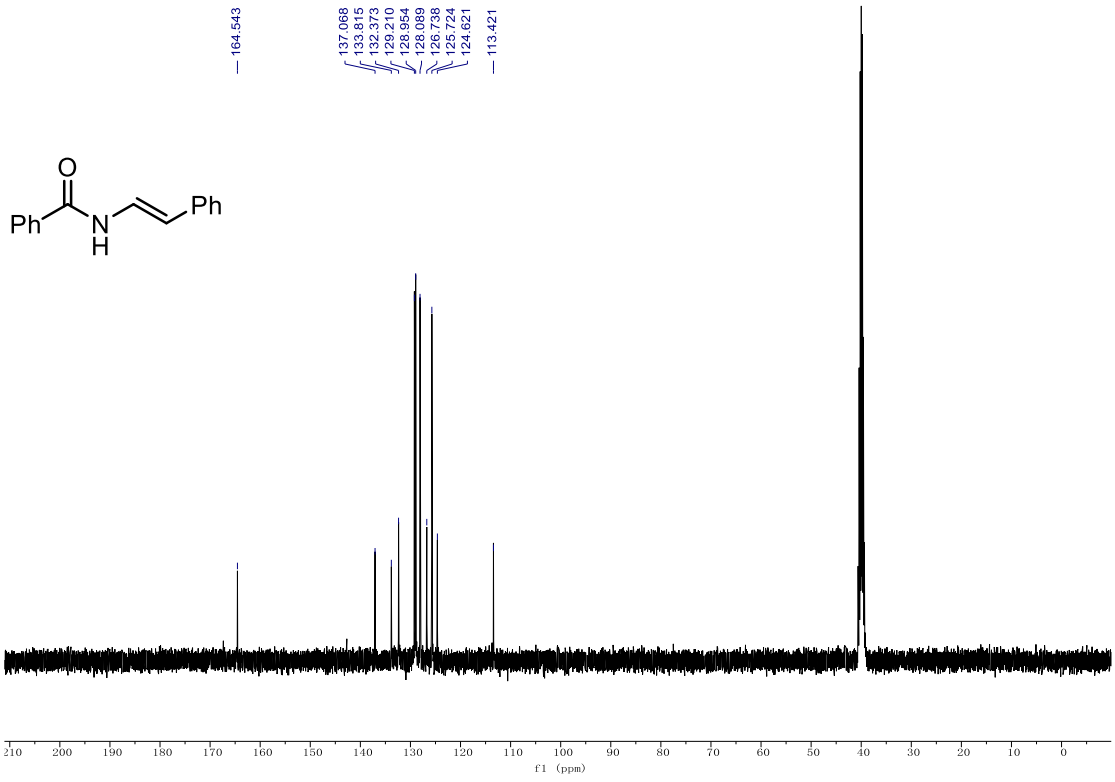
Copies of ^{1}H, ^{13}C and ^{19}F NMR Spectra for Compounds

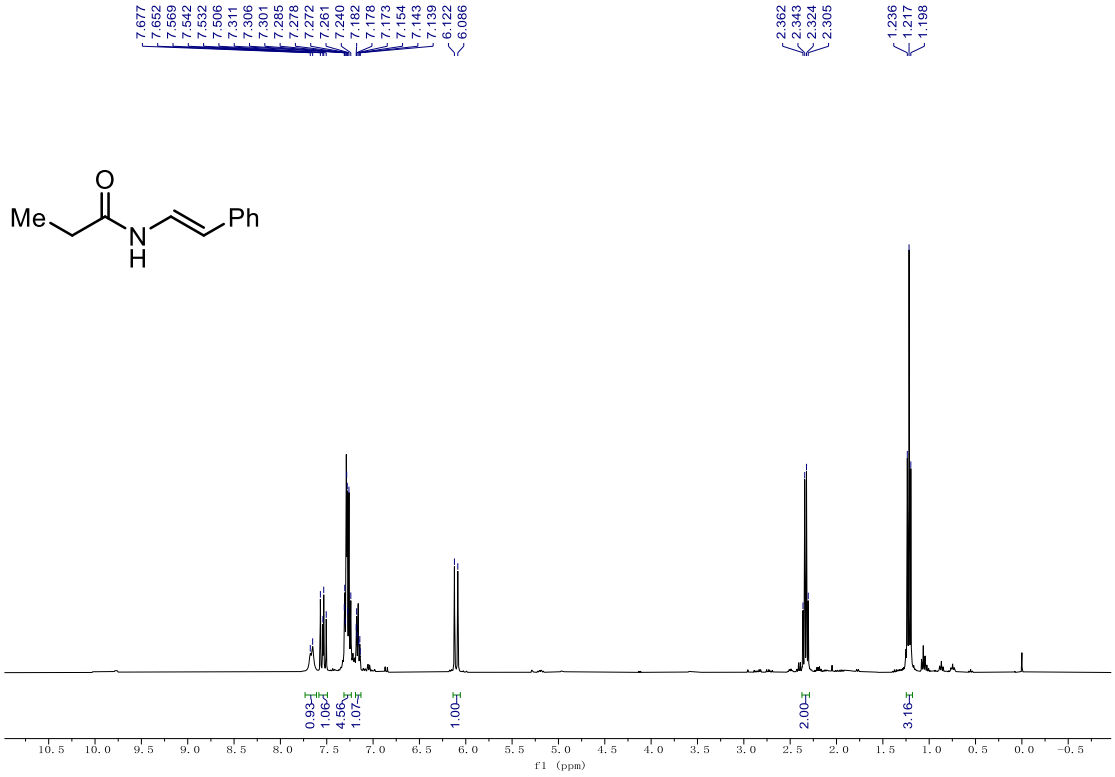
^{1}H NMR spectrum of **1** (**400 MHz, DMSO-*d*$_6$**)



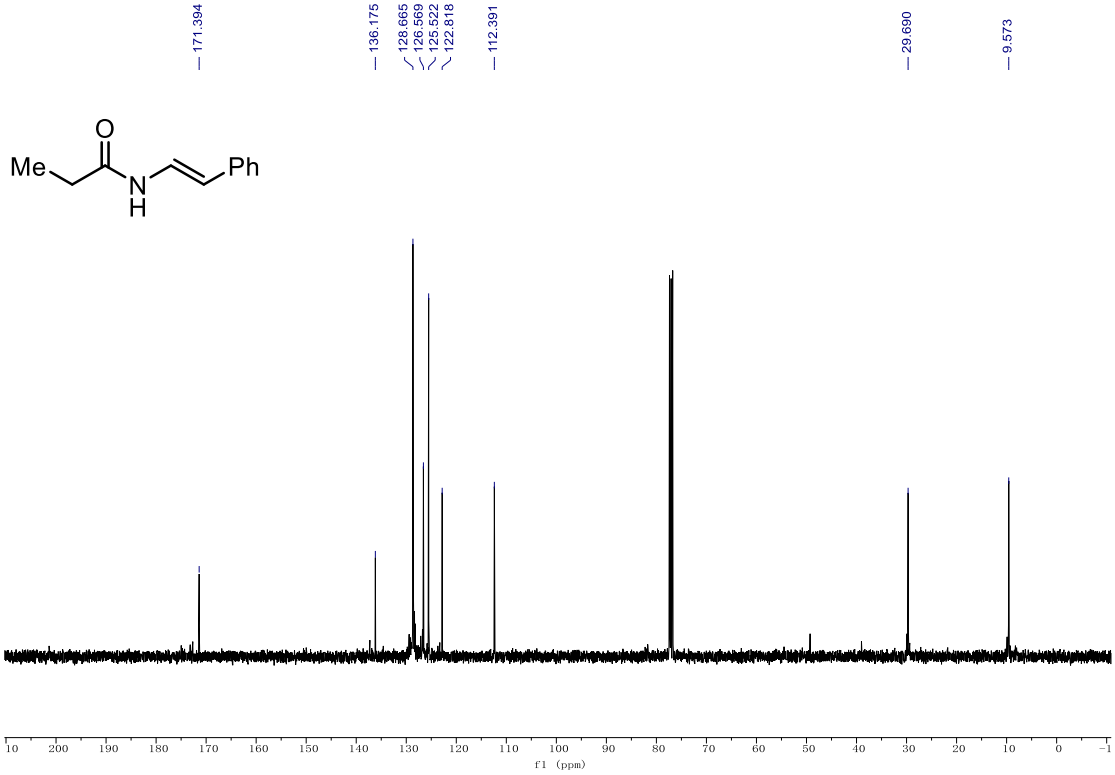
^{13}C NMR spectrum of **1** (**100 MHz, DMSO-*d*$_6$**)



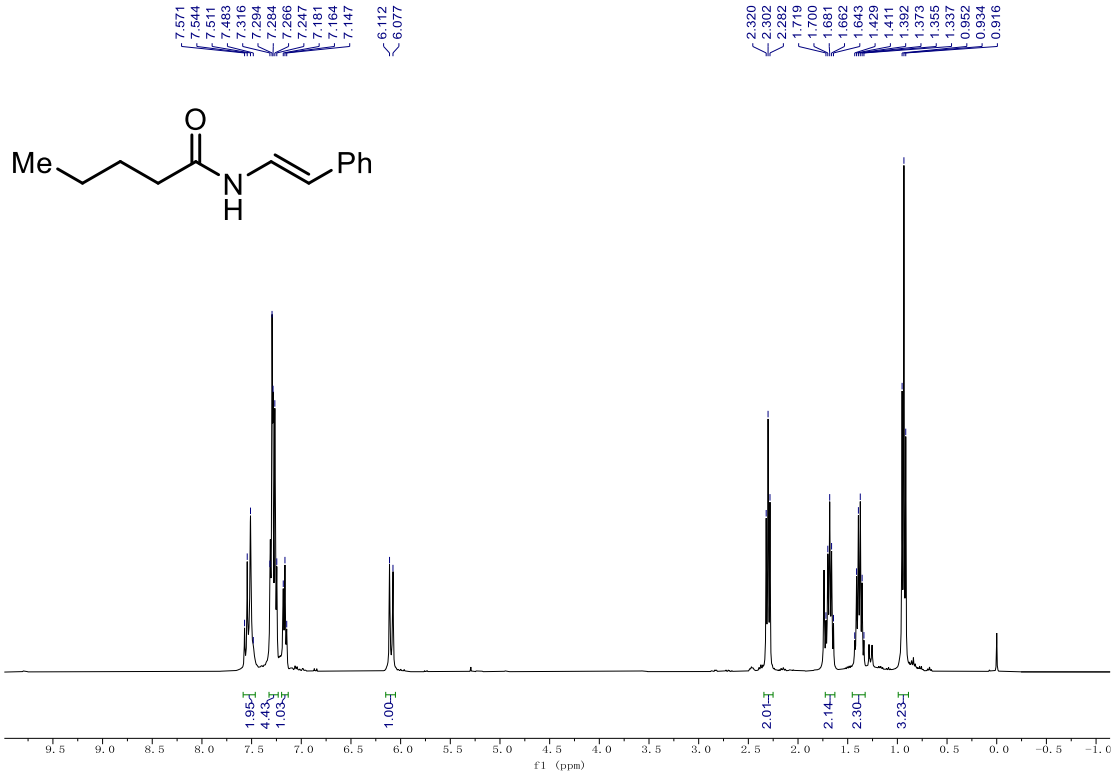
^{1}H NMR spectrum of **2** (**400 MHz, Chloroform-*d***)



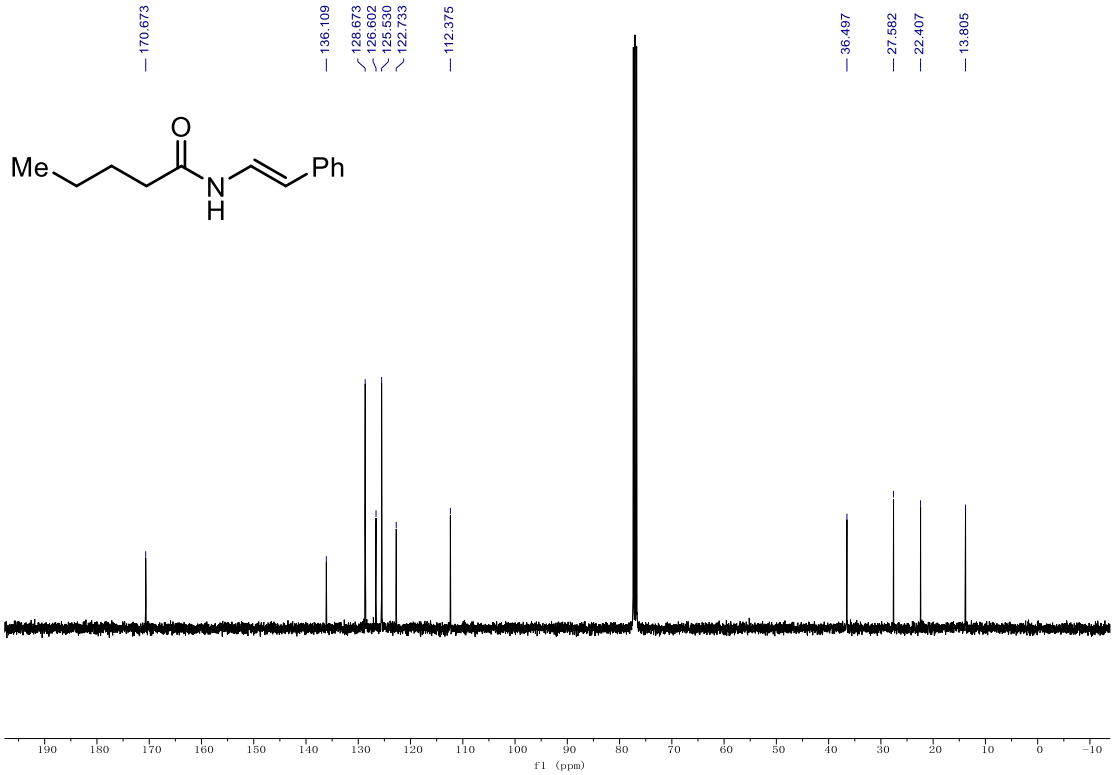
^{13}C NMR spectrum of **2** (**100 MHz, Chloroform-*d***)



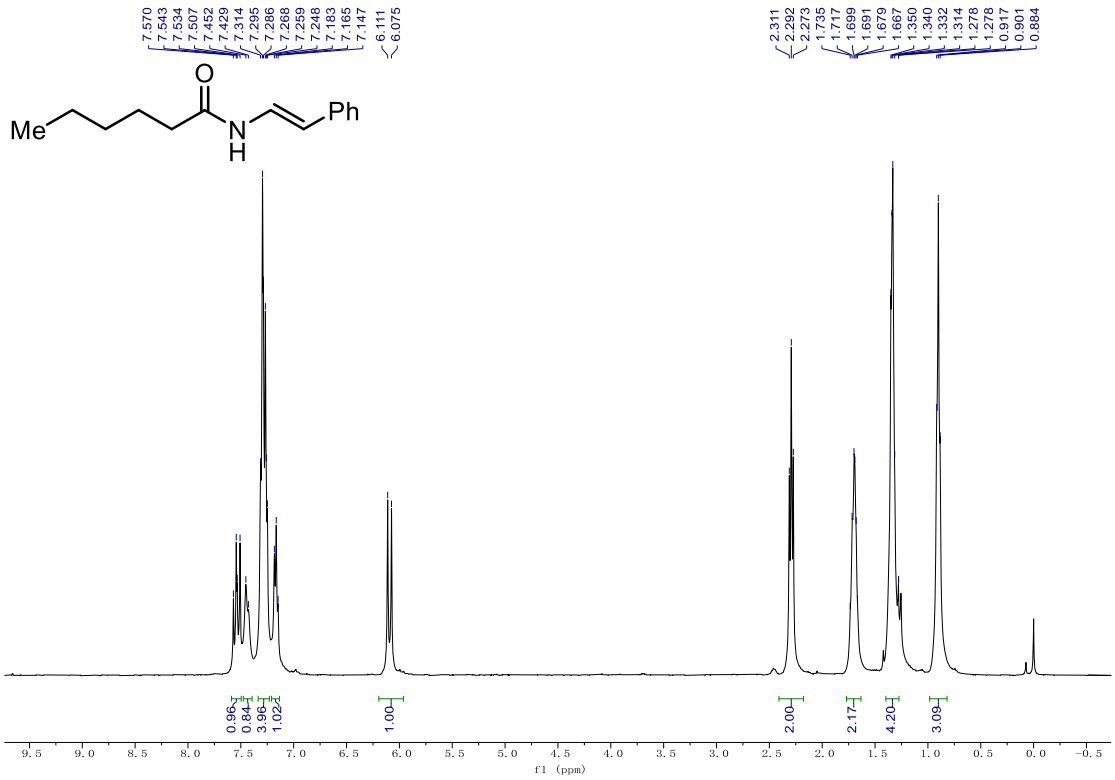
^{1}H NMR spectrum of **3** (**400 MHz, Chloroform-*d***)



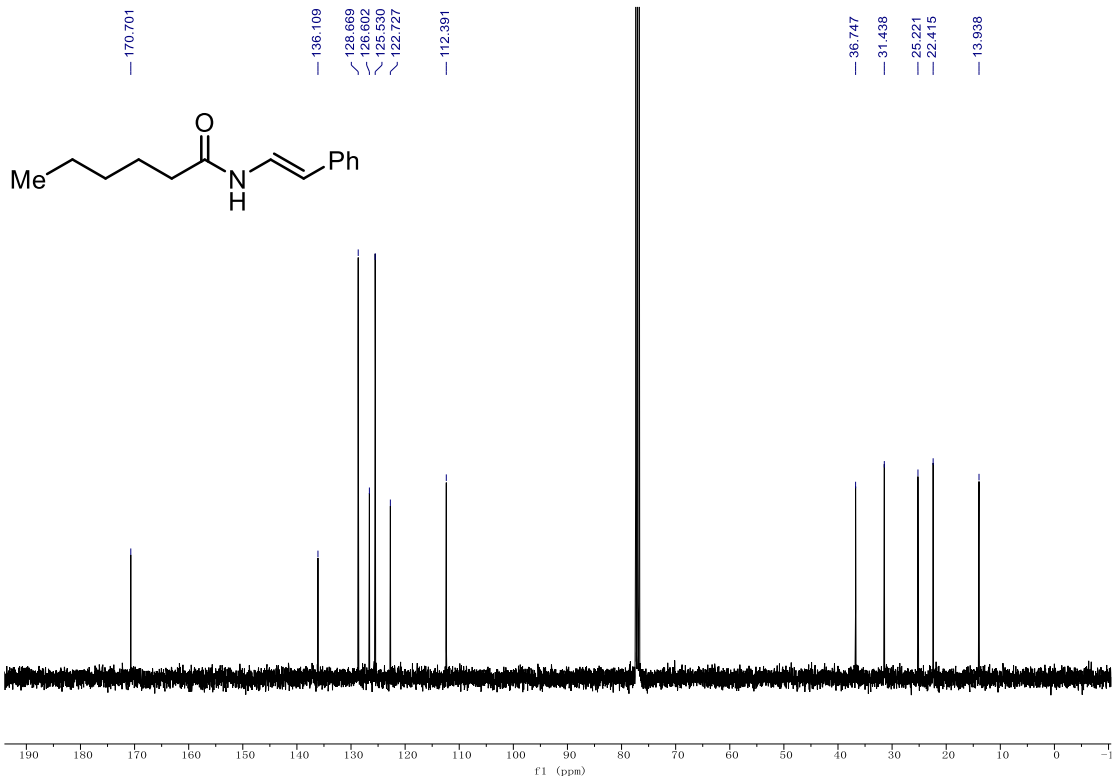
^{13}C NMR spectrum of **3** (**100 MHz, Chloroform-*d***)



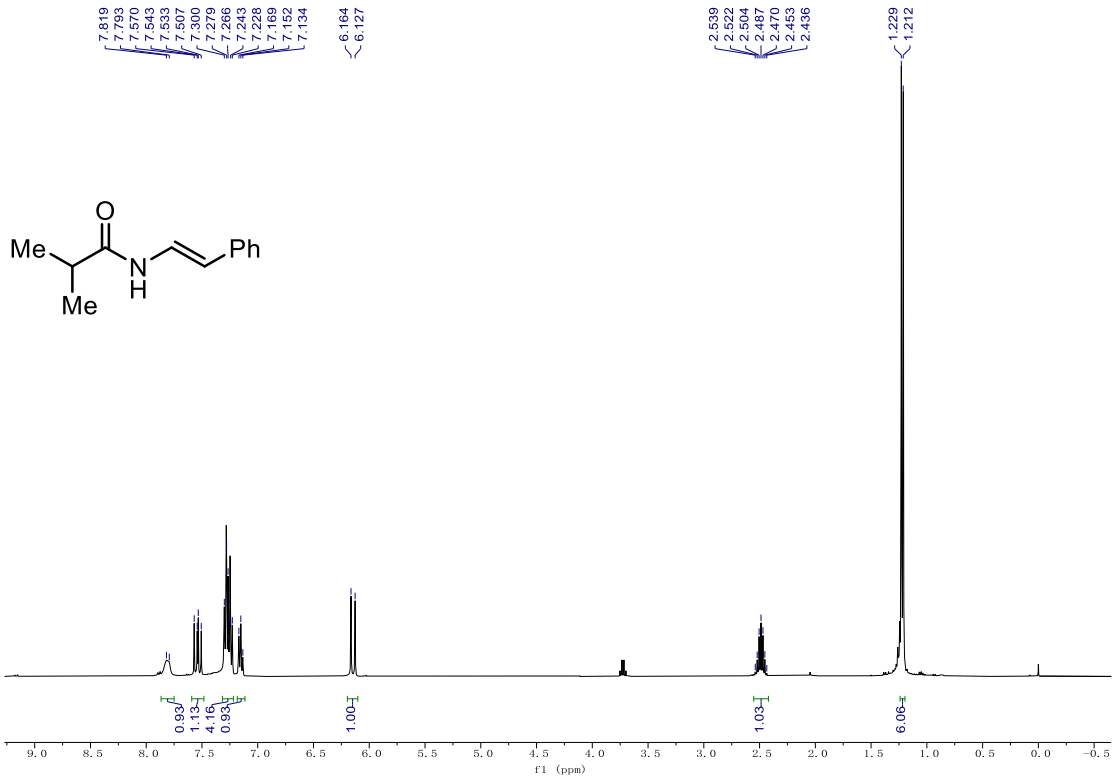
^{1}H NMR spectrum of **4** (**400 MHz, Chloroform-*d***)



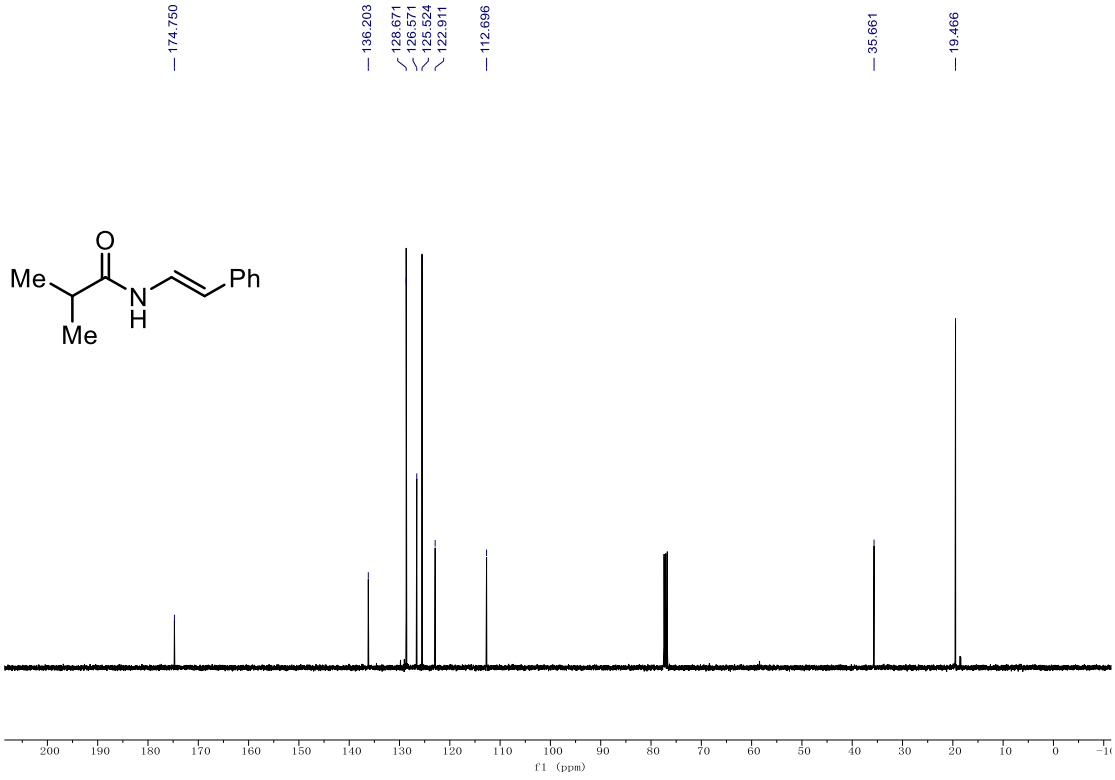
^{13}C NMR spectrum of **4** (**100 MHz, Chloroform-*d***)



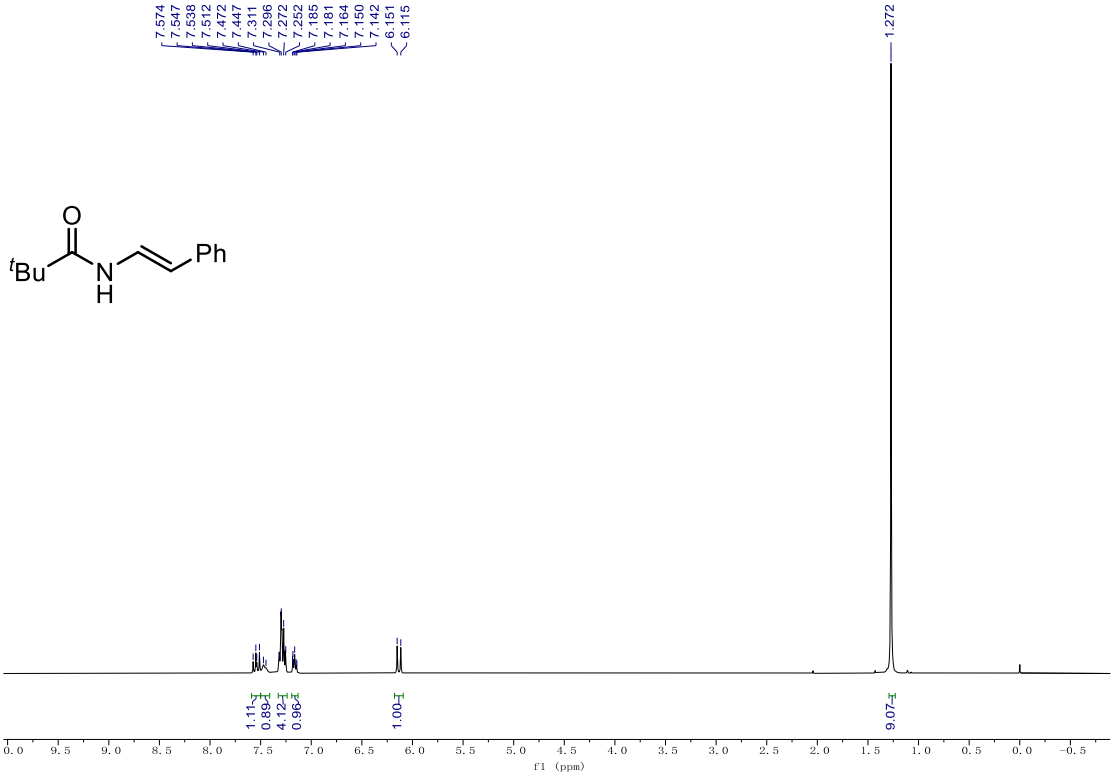
^{1}H NMR spectrum of **5 (400 MHz, Chloroform-*d*)**



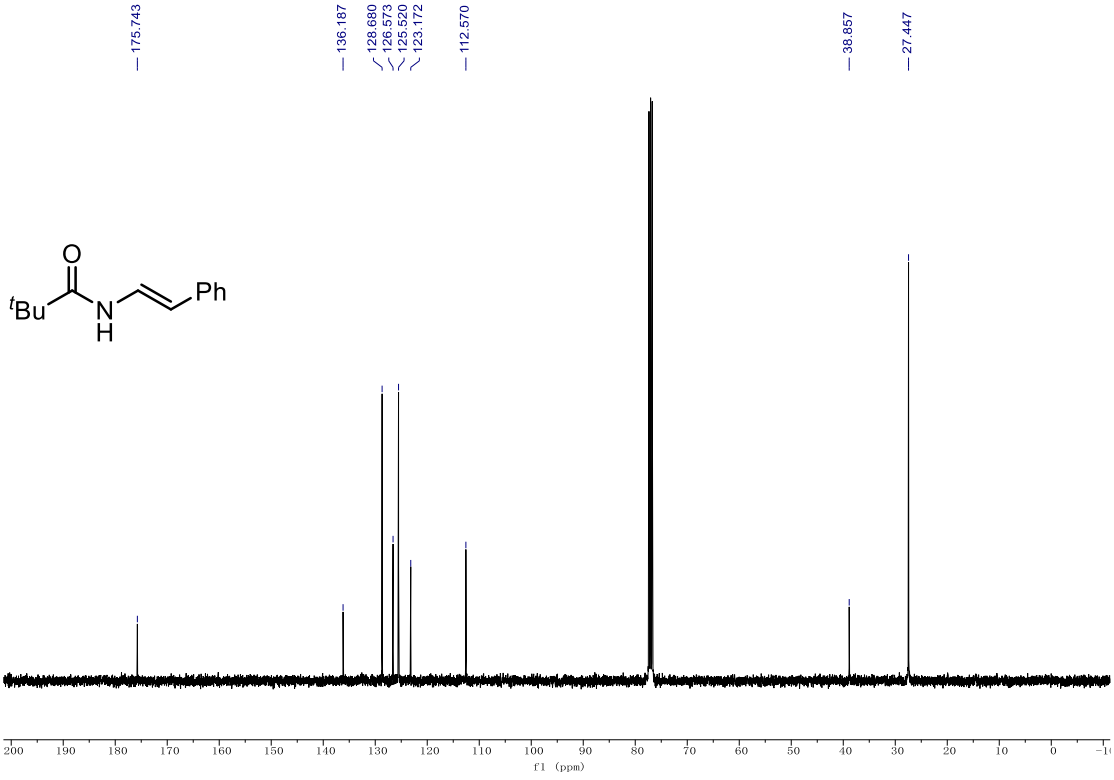
^{13}C NMR spectrum of **5** (**100 MHz, Chloroform-*d***)



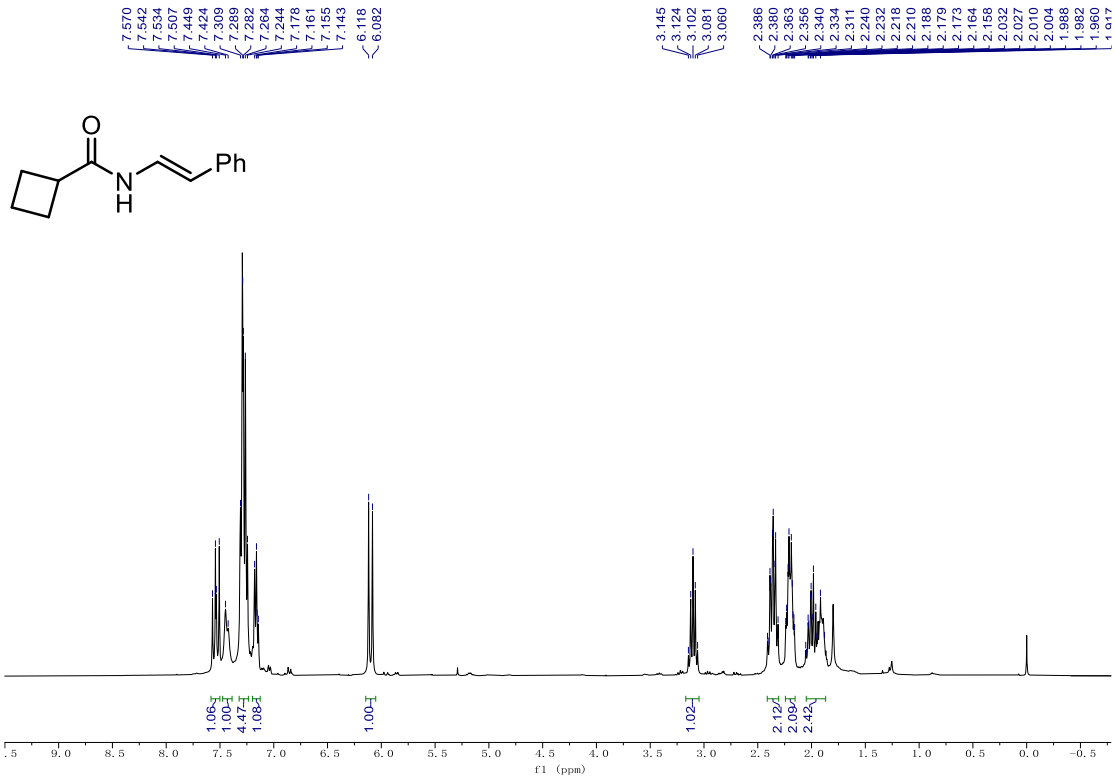
^{1}H NMR spectrum of **6** (**400 MHz, Chloroform-*d***)



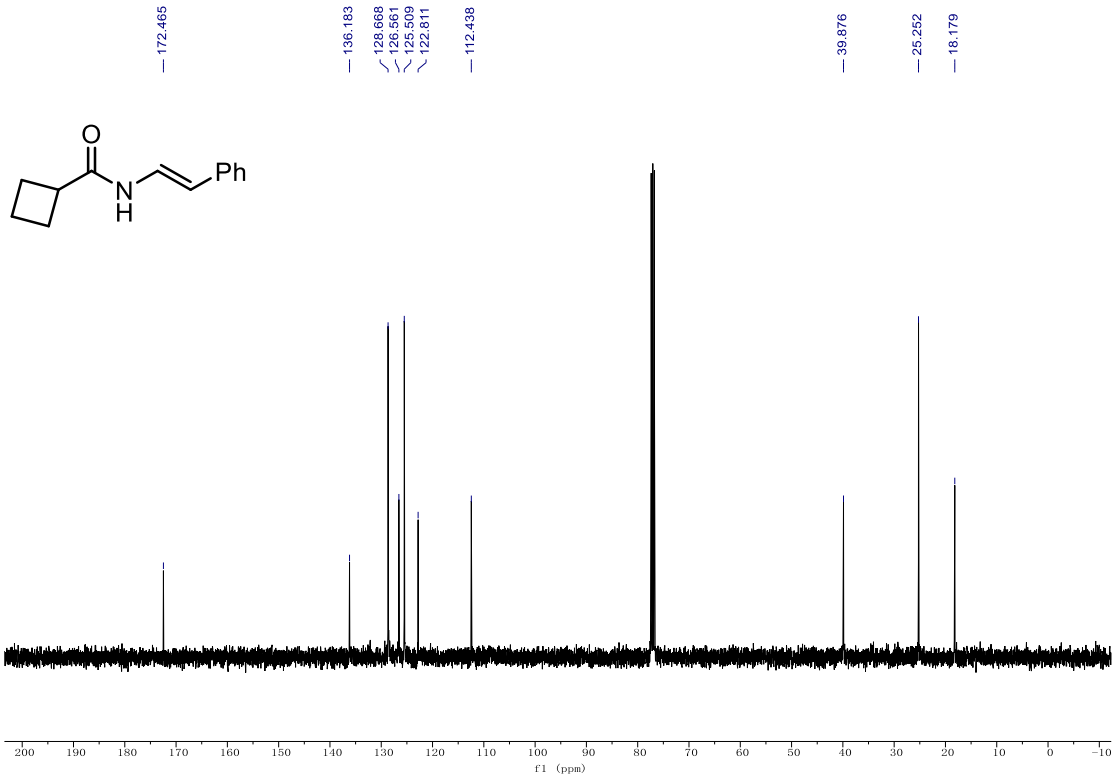
^{13}C NMR spectrum of **6** (**100 MHz, Chloroform-*d***)



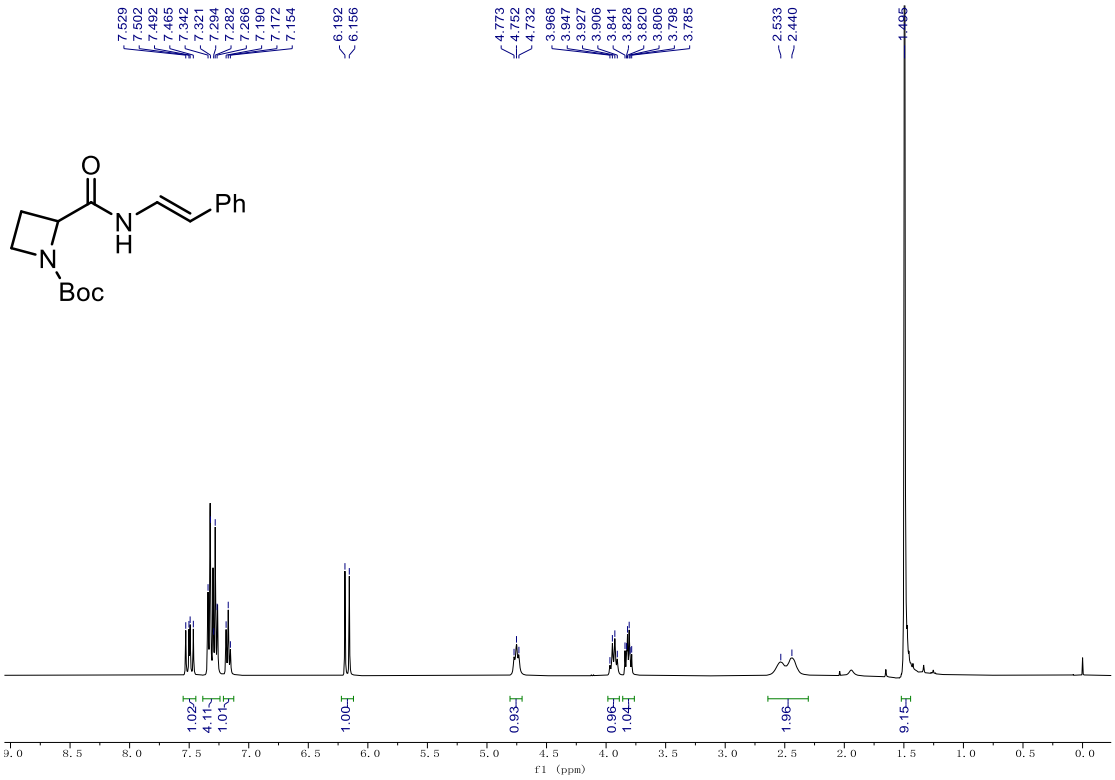
^{1}H NMR spectrum of **7** (**400 MHz, Chloroform-*d***)



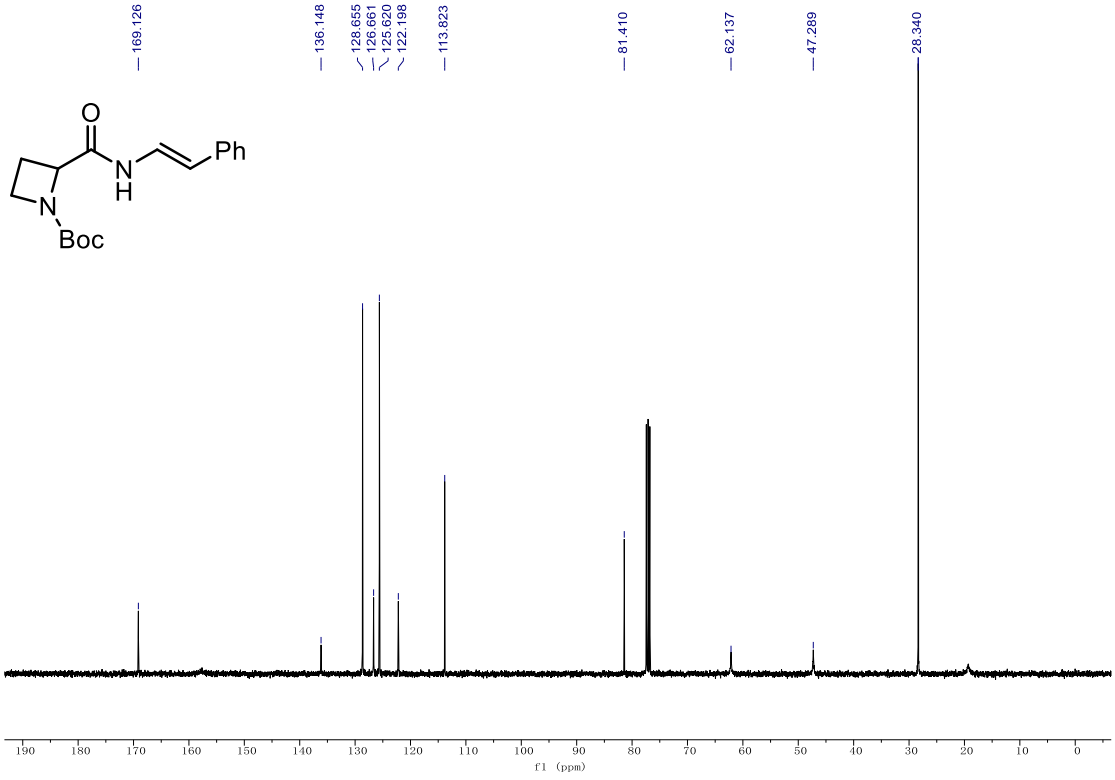
^{13}C NMR spectrum of **7** (**100 MHz, Chloroform-*d***)



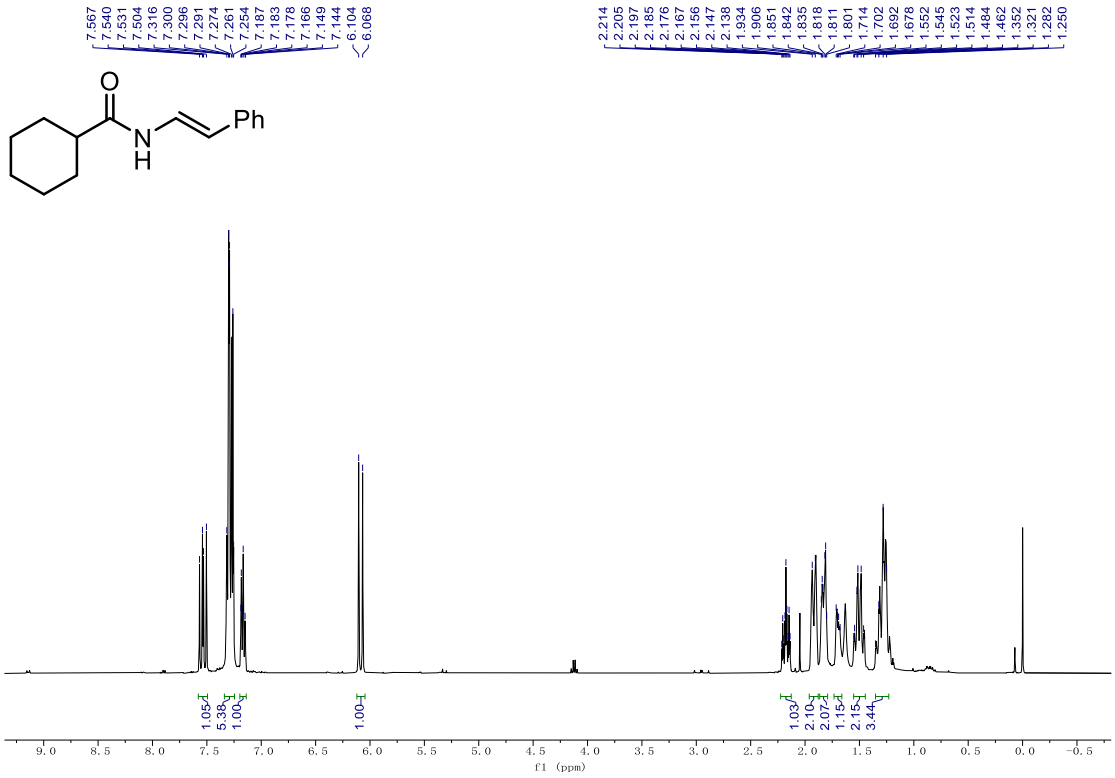
^{1}H NMR spectrum of **8** (**400 MHz, Chloroform-*d***)



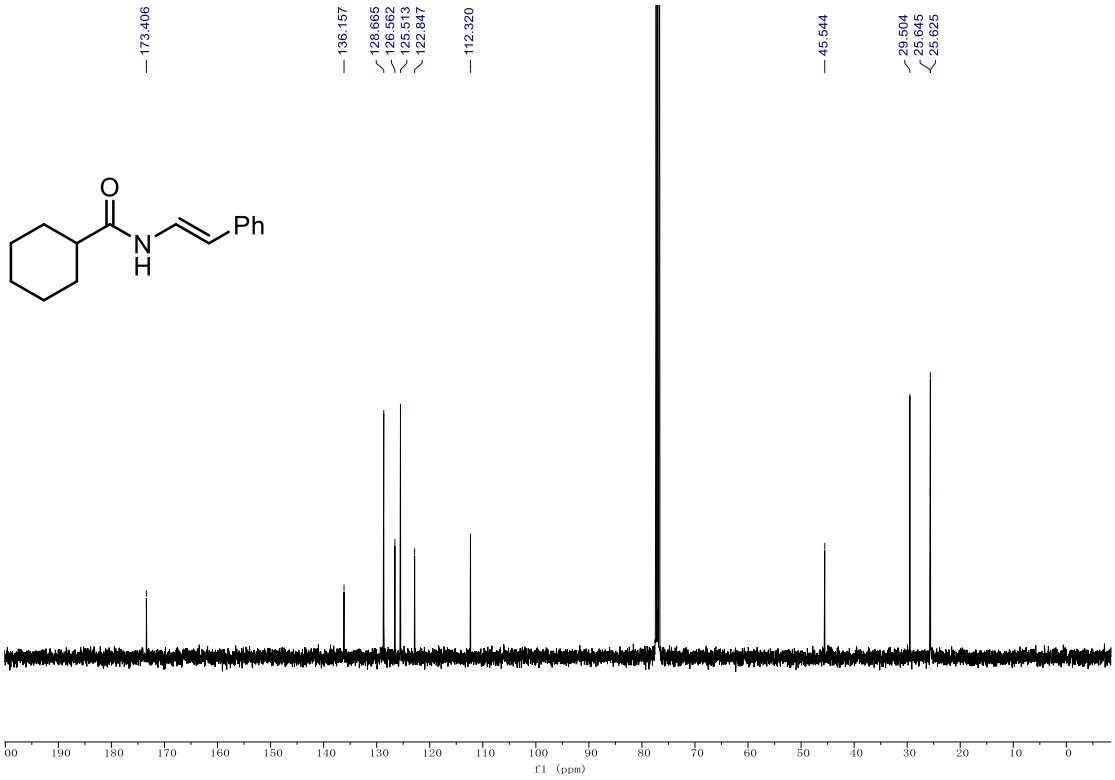
^{13}C NMR spectrum of **8** (**100 MHz, Chloroform-*d***)



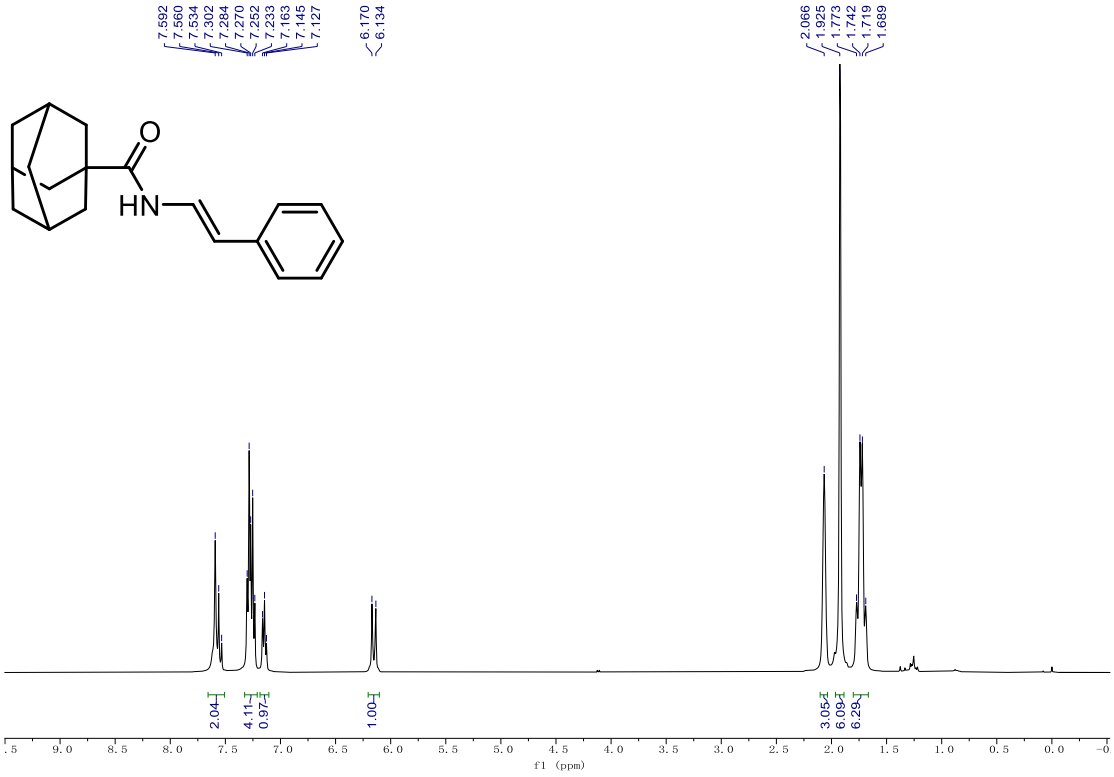
^{1}H NMR spectrum of **9** (**400 MHz, Chloroform-*d***)



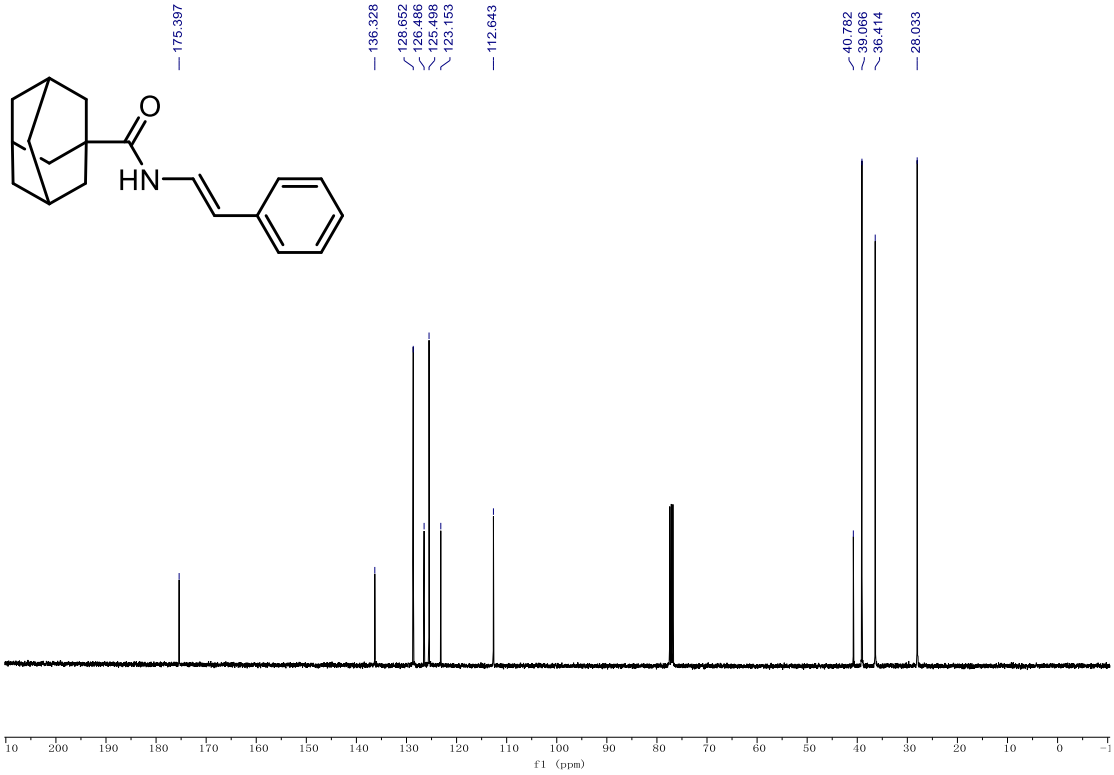
^{13}C NMR spectrum of **9** (**100 MHz, Chloroform-*d***)



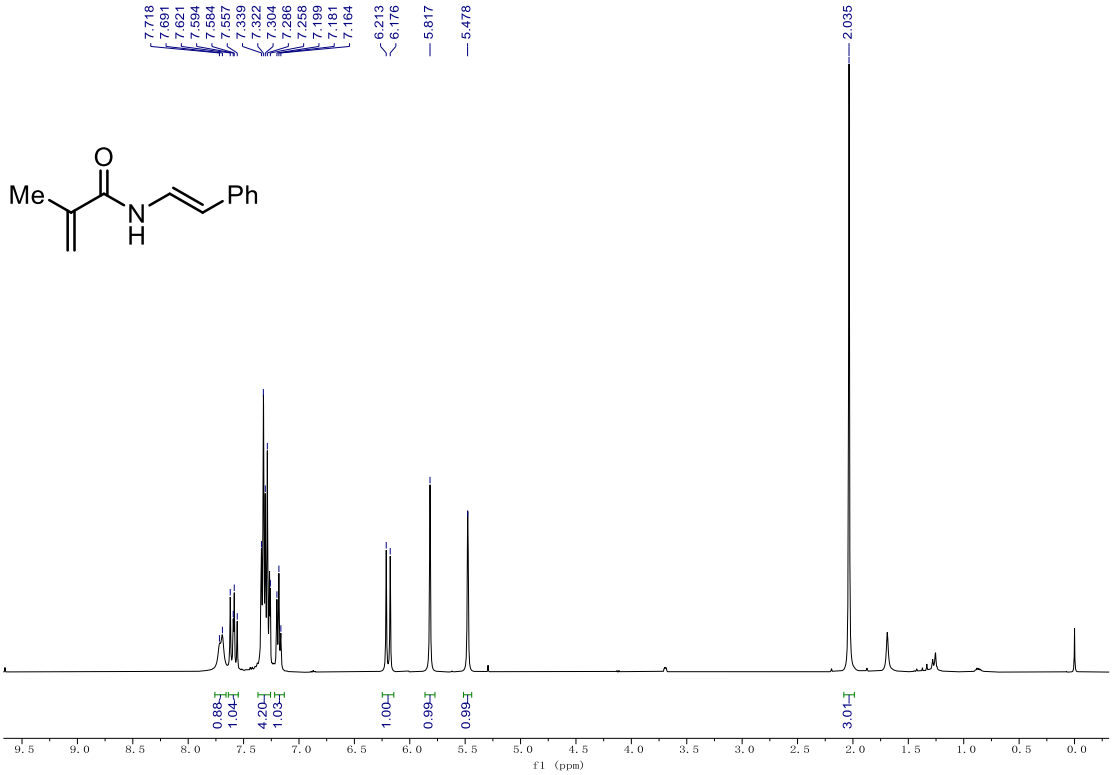
^{1}H NMR spectrum of **10** (**400 MHz, Chloroform-*d***)



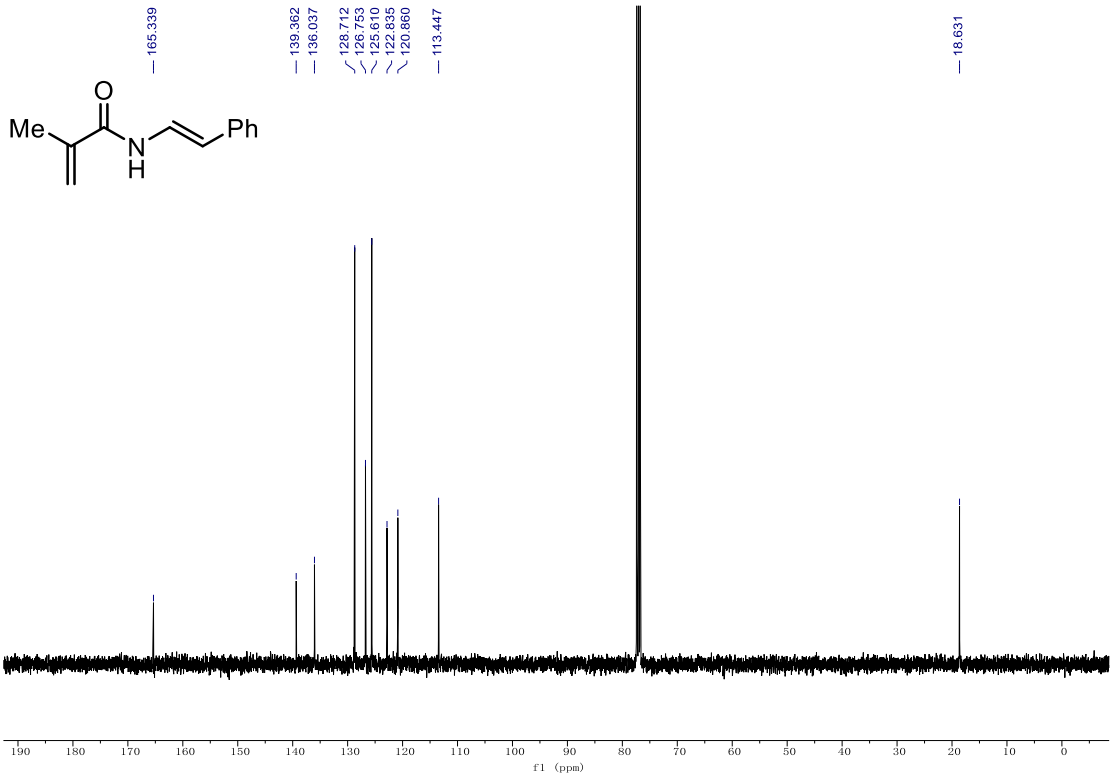
^{13}C NMR spectrum of **10** (**100 MHz, Chloroform-*d***)



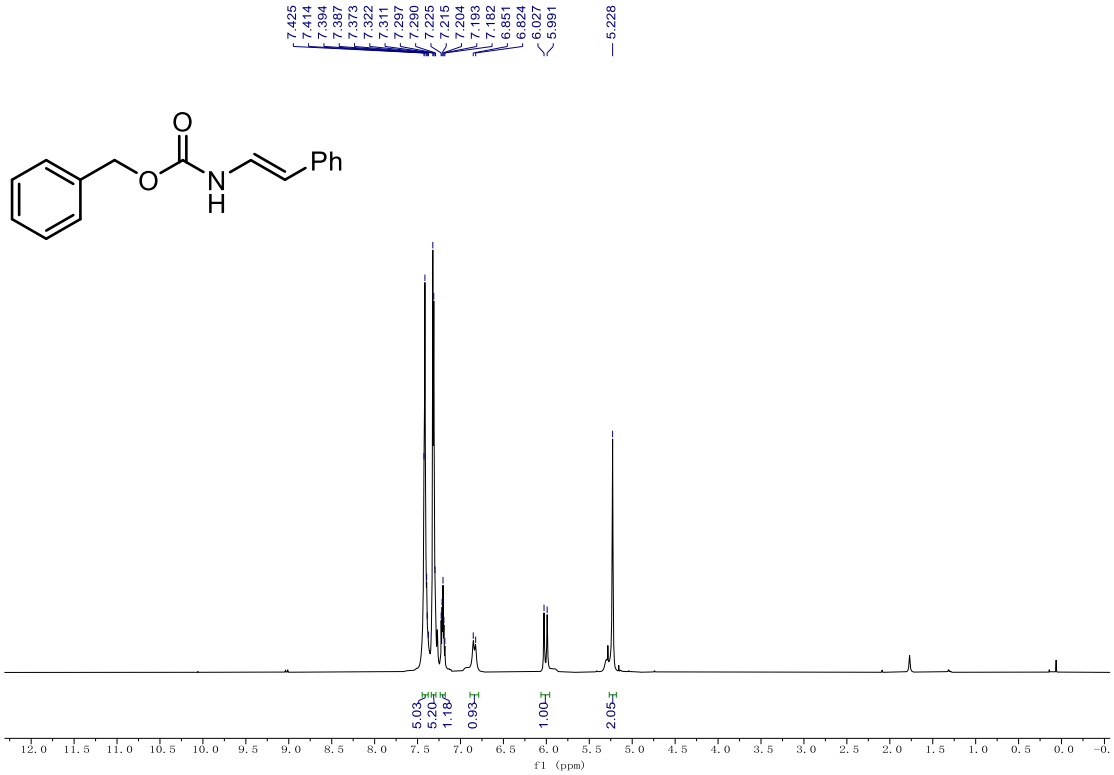
^{1}H NMR spectrum of **11** (**400 MHz, Chloroform-*d***)



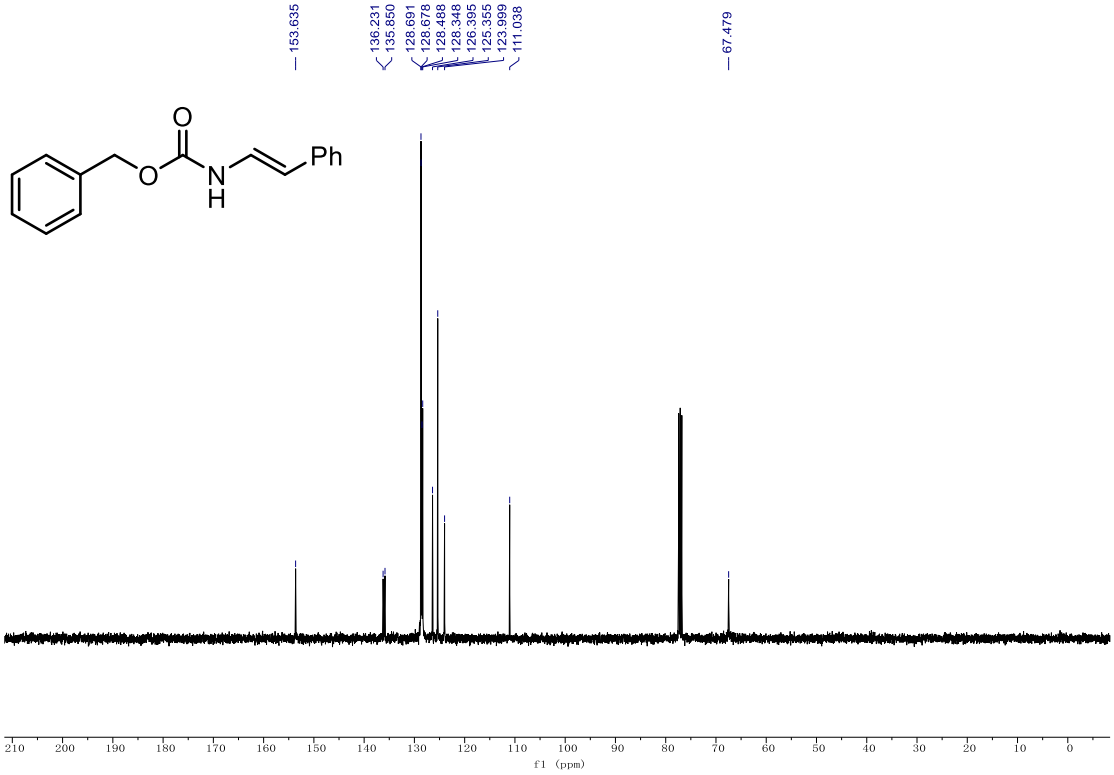
^{13}C NMR spectrum of **11** (**100 MHz, Chloroform-*d***)



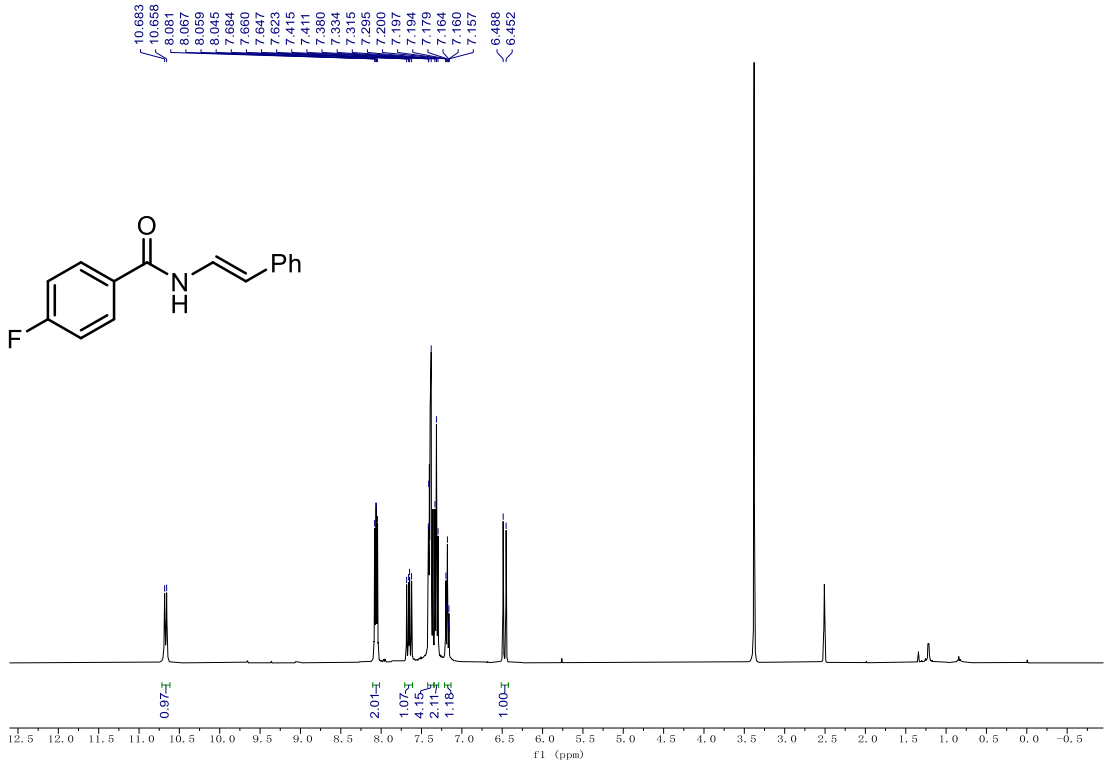
^{1}H NMR spectrum of **12** (**400 MHz, Chloroform-*d***)



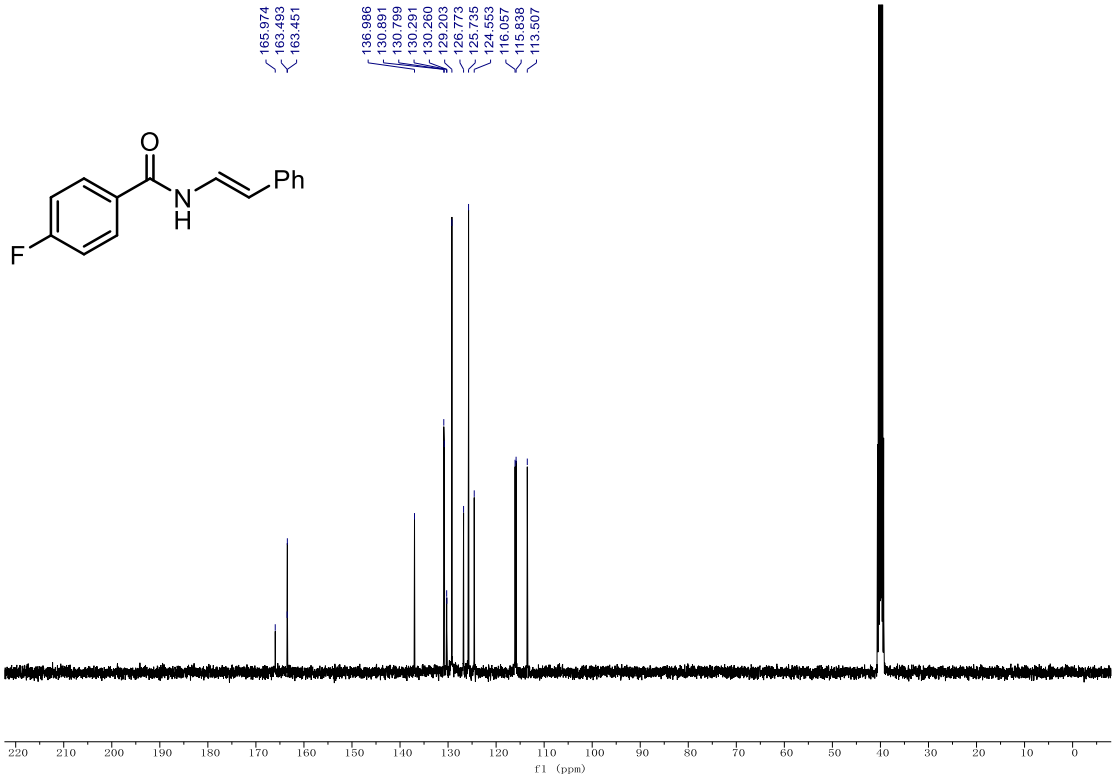
^{13}C NMR spectrum of **12** (**100 MHz, Chloroform-*d***)



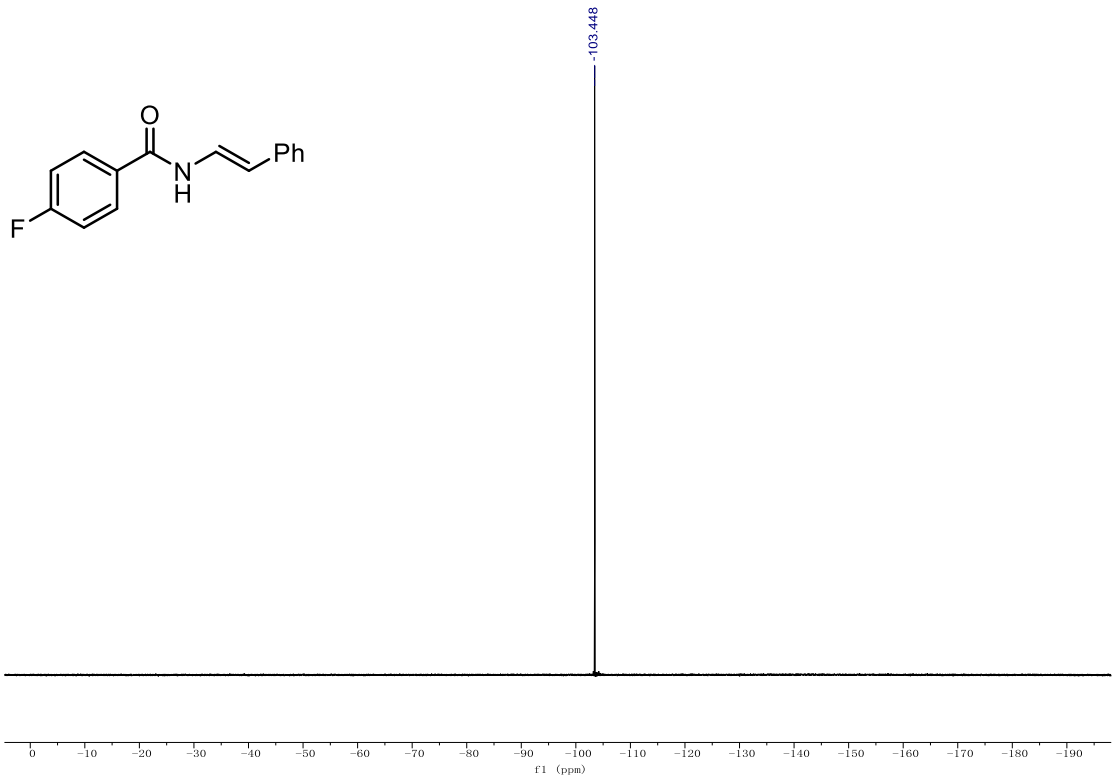
^{1}H NMR spectrum of **13** (**400 MHz, DMSO-*d*$_6$**)



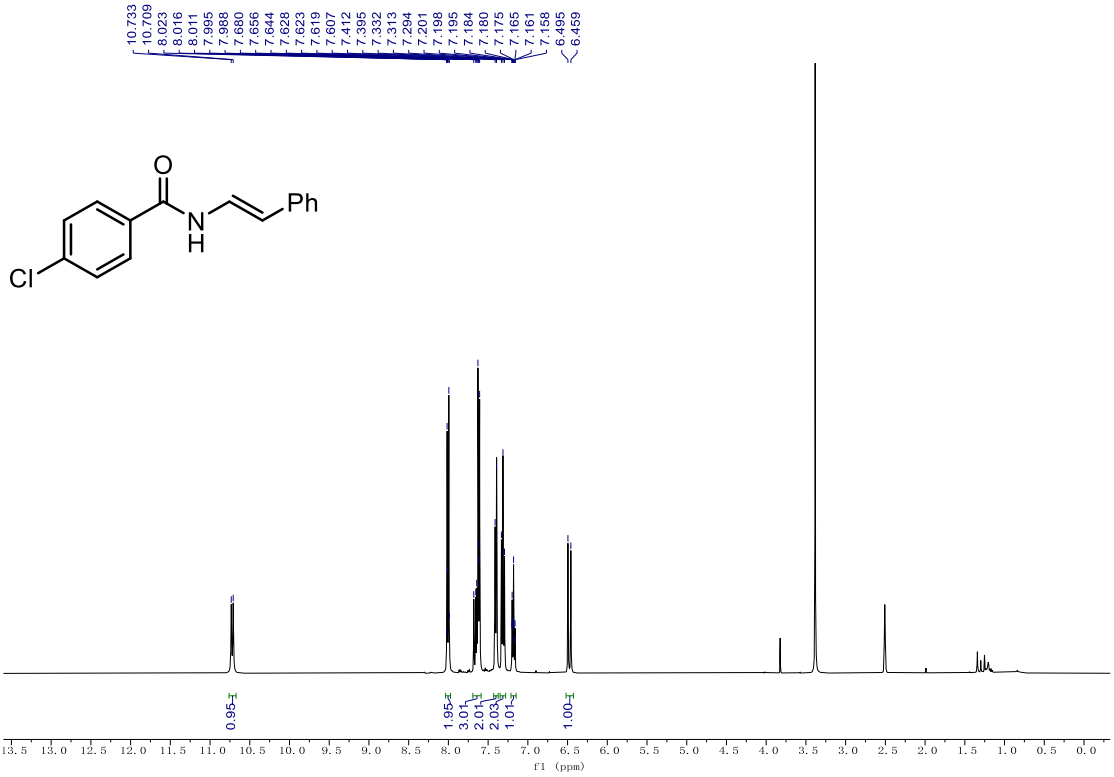
^{13}C NMR spectrum of **13** (**100 MHz, DMSO-*d*$_6$**)



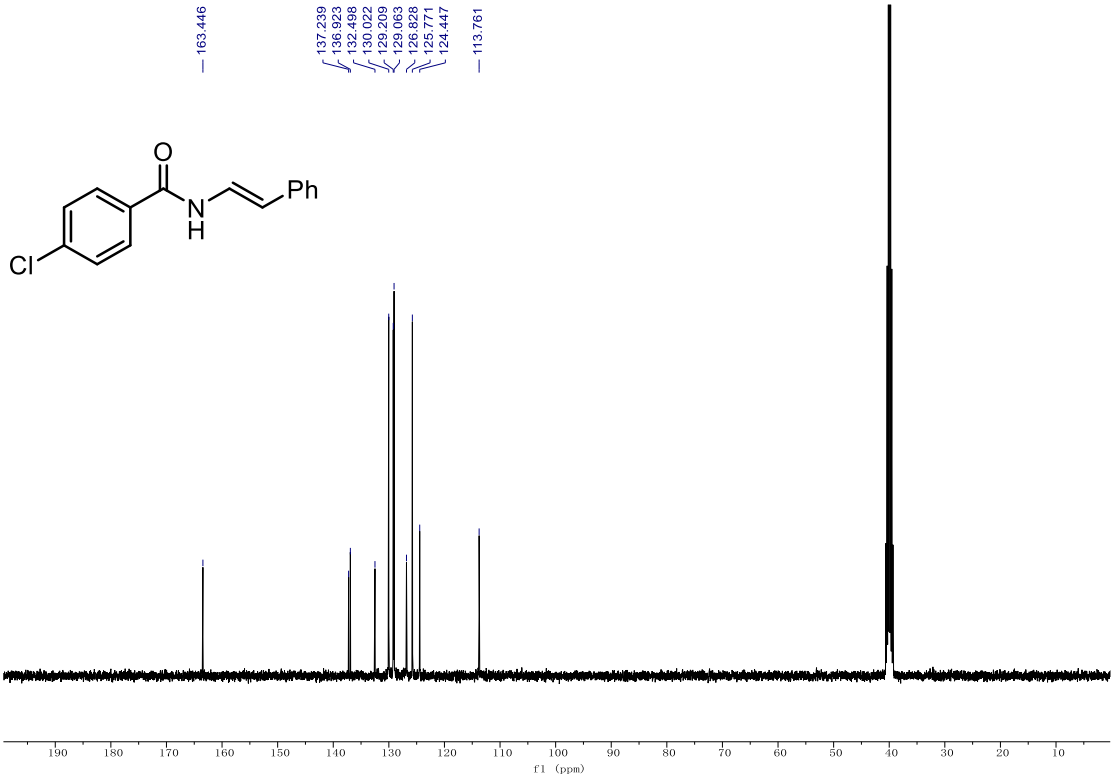
^{19}F NMR spectrum of **13** (**375 MHz DMSO-d_6**)



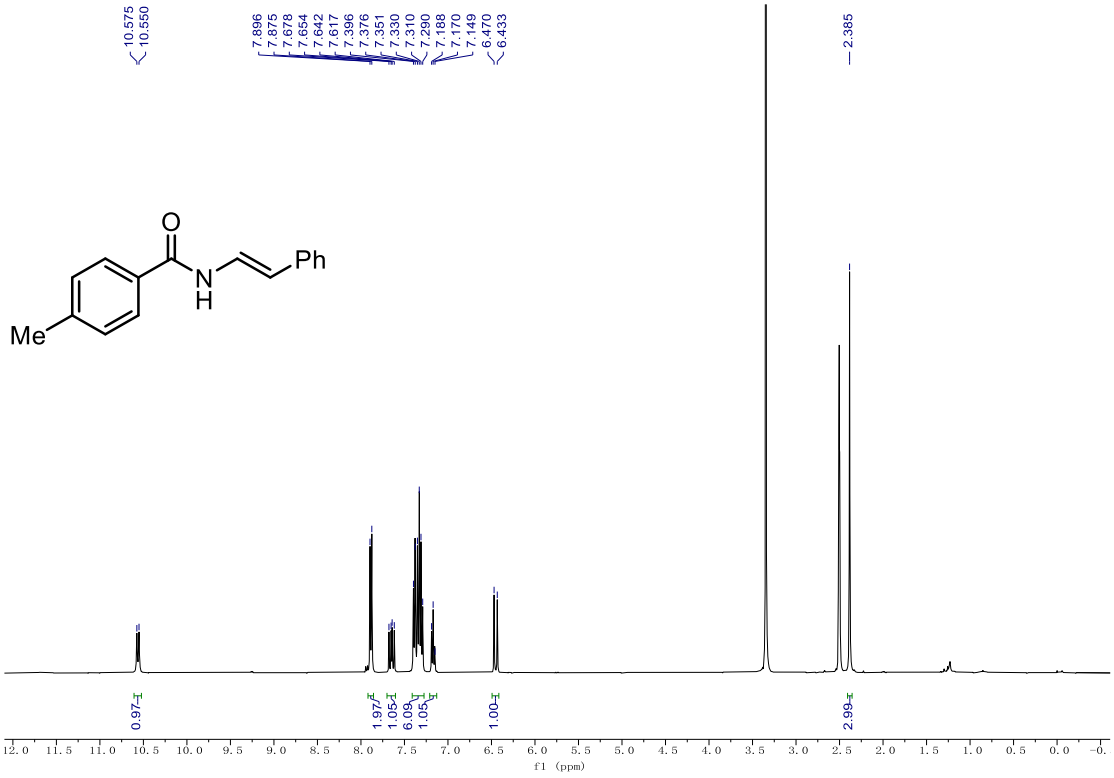
^{1}H NMR spectrum of **14** (**400 MHz, DMSO-*d*$_6$**)



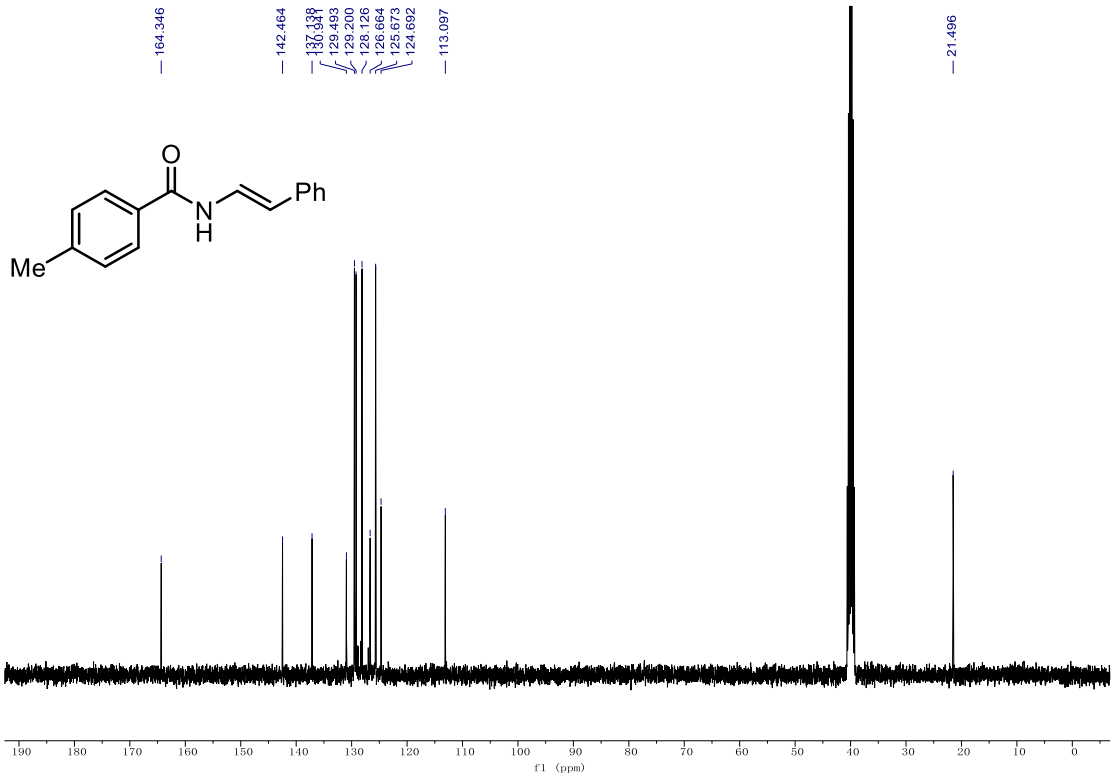
^{13}C NMR spectrum of **14** (**100 MHz, DMSO-*d*$_6$**)



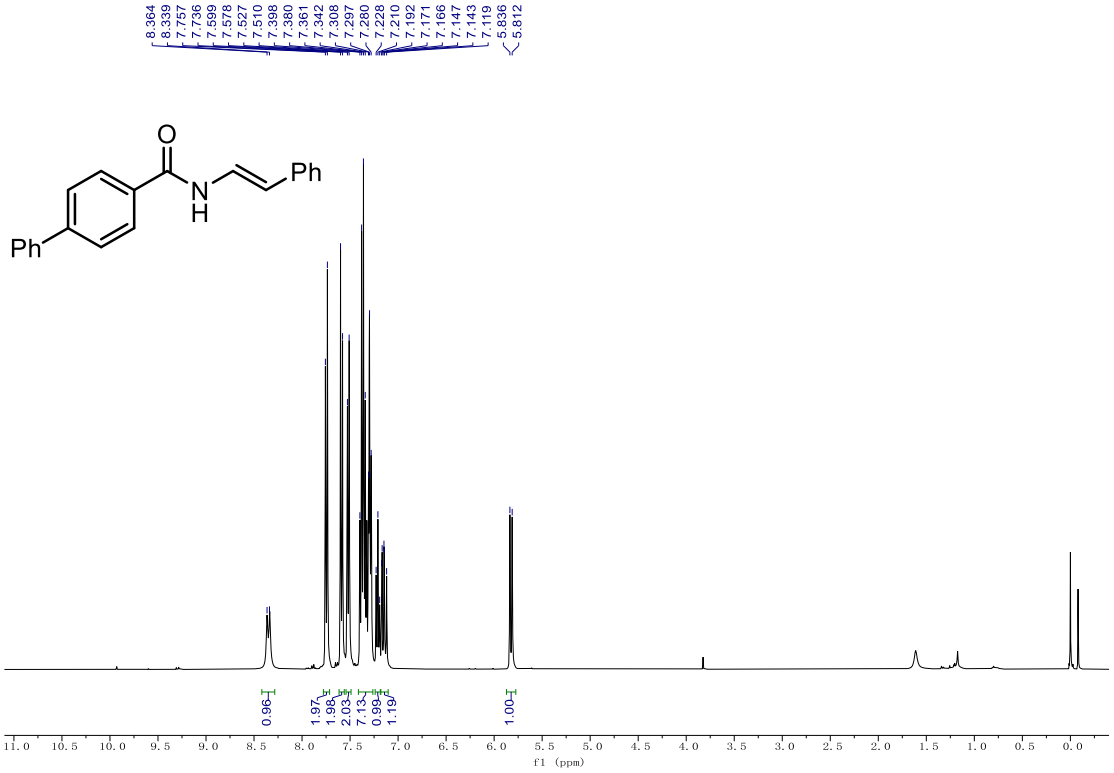
^{1}H NMR spectrum of **15** (**400 MHz, DMSO-*d*$_6$**)



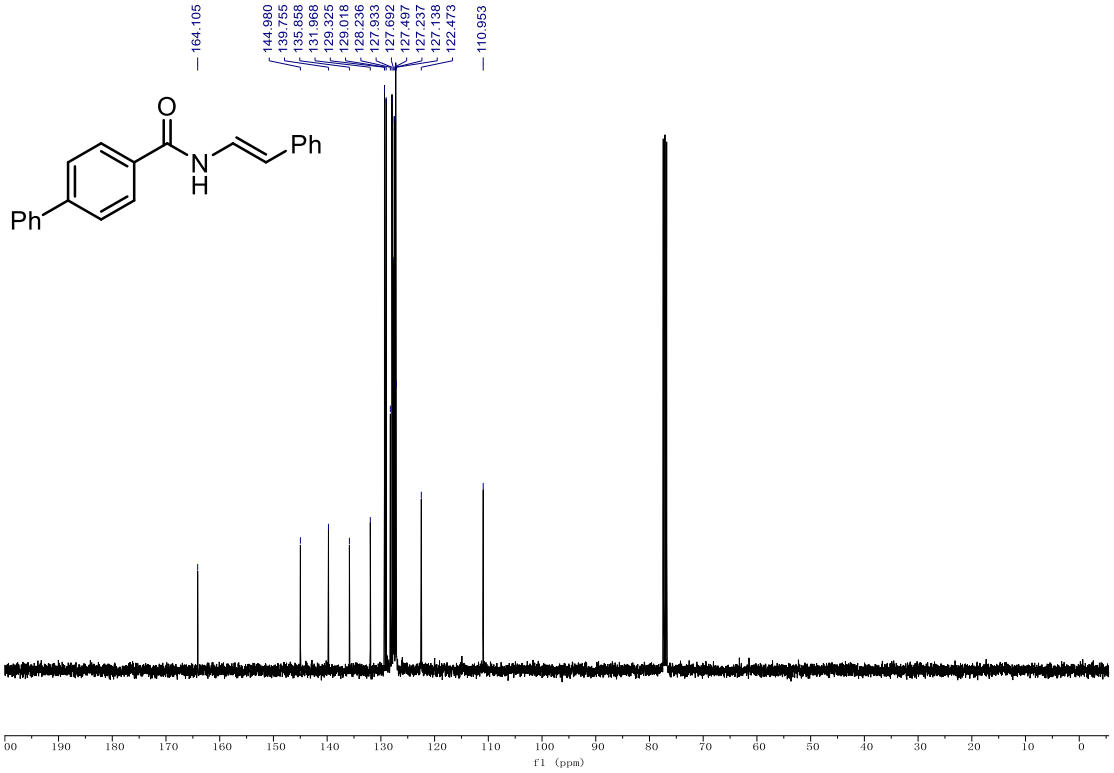
^{13}C NMR spectrum of **15** (**100 MHz, DMSO-*d*$_6$**)



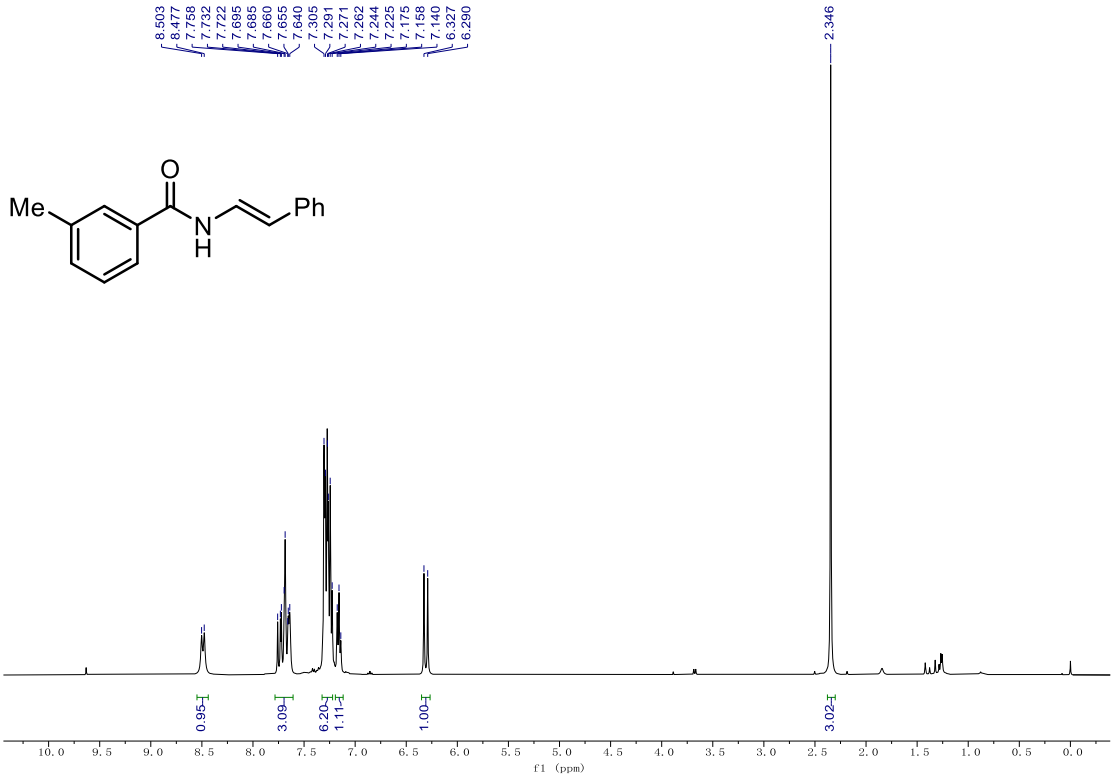
^{1}H NMR spectrum of **16** (**400 MHz, Chloroform-*d***)



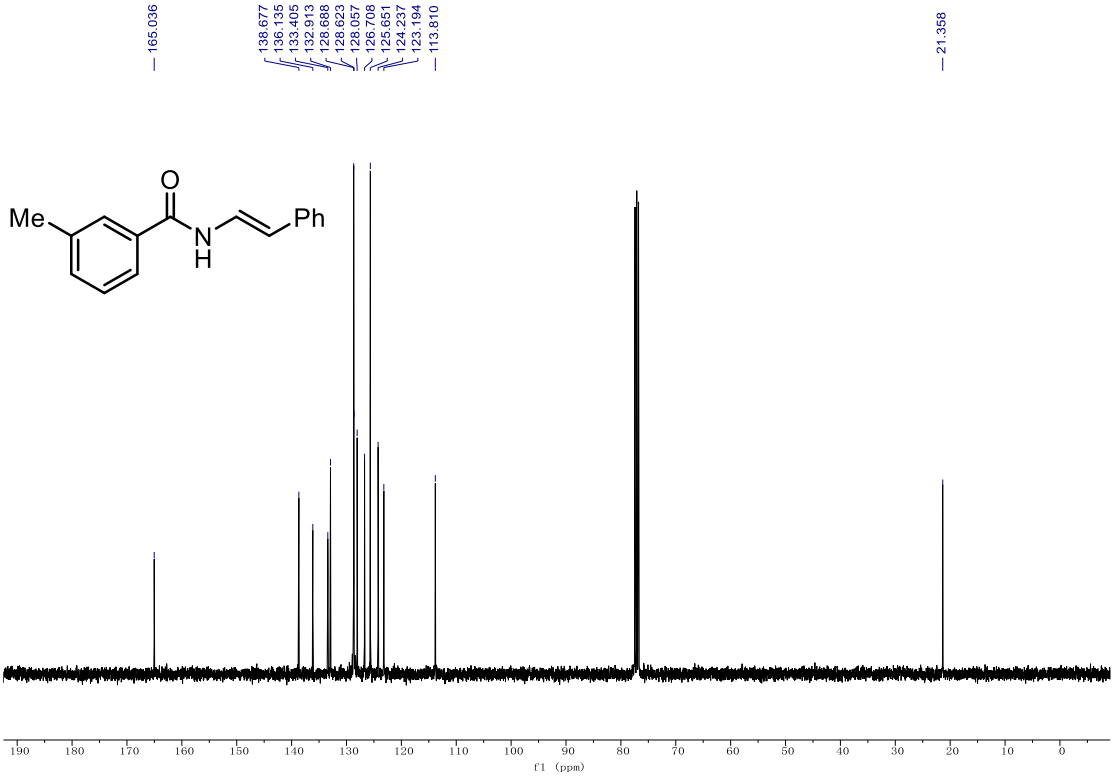
^{13}C NMR spectrum of **16** (**100 MHz, Chloroform-*d***)



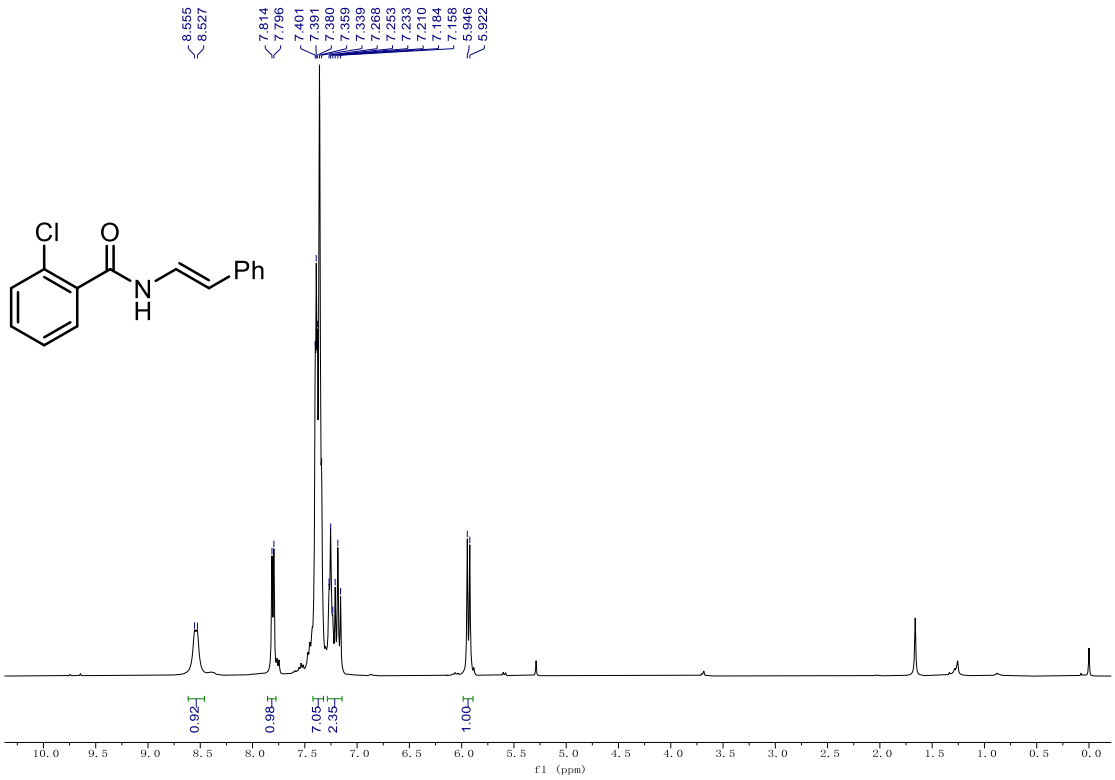
^{1}H NMR spectrum of **17** (**400 MHz, Chloroform-*d***)



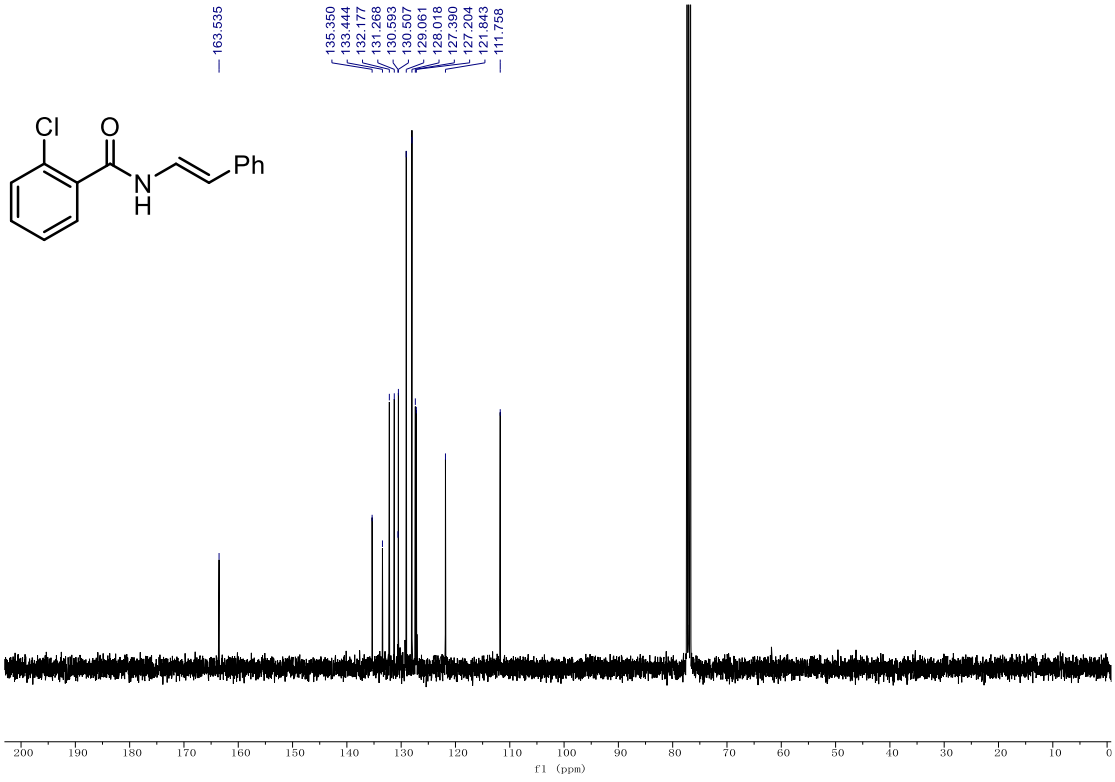
^{13}C NMR spectrum of **17** (**100 MHz, Chloroform-*d***)



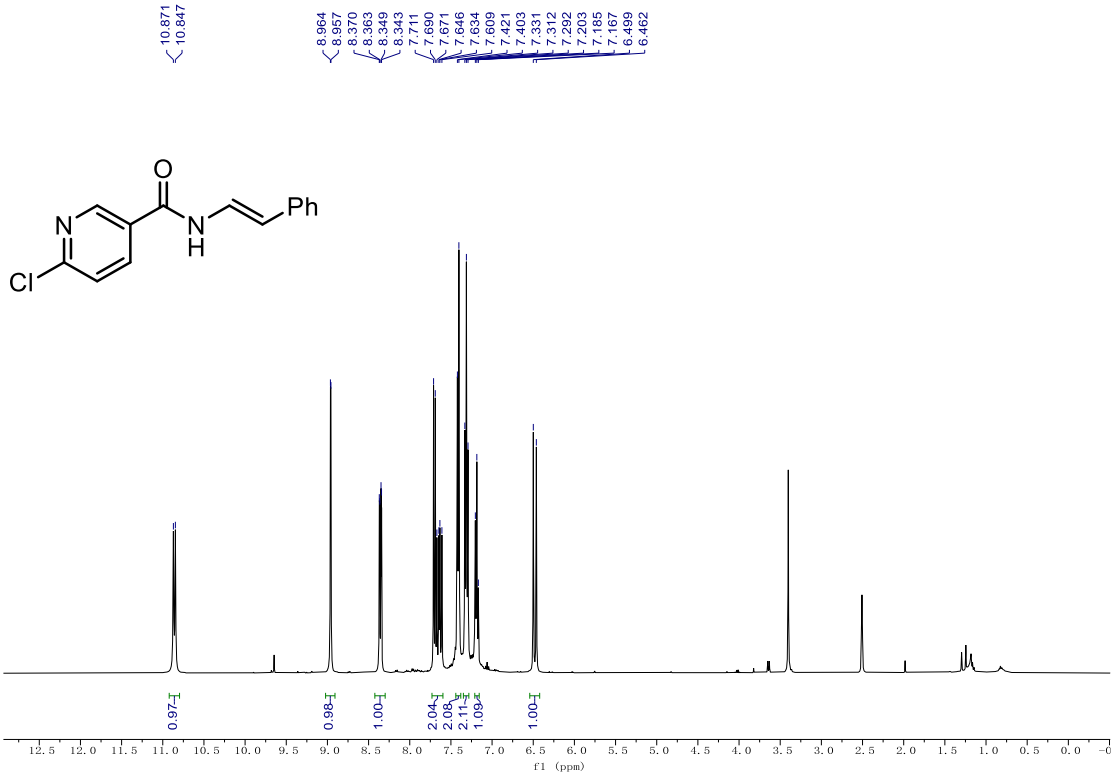
^{1}H NMR spectrum of **18** (**400 MHz, Chloroform-*d***)



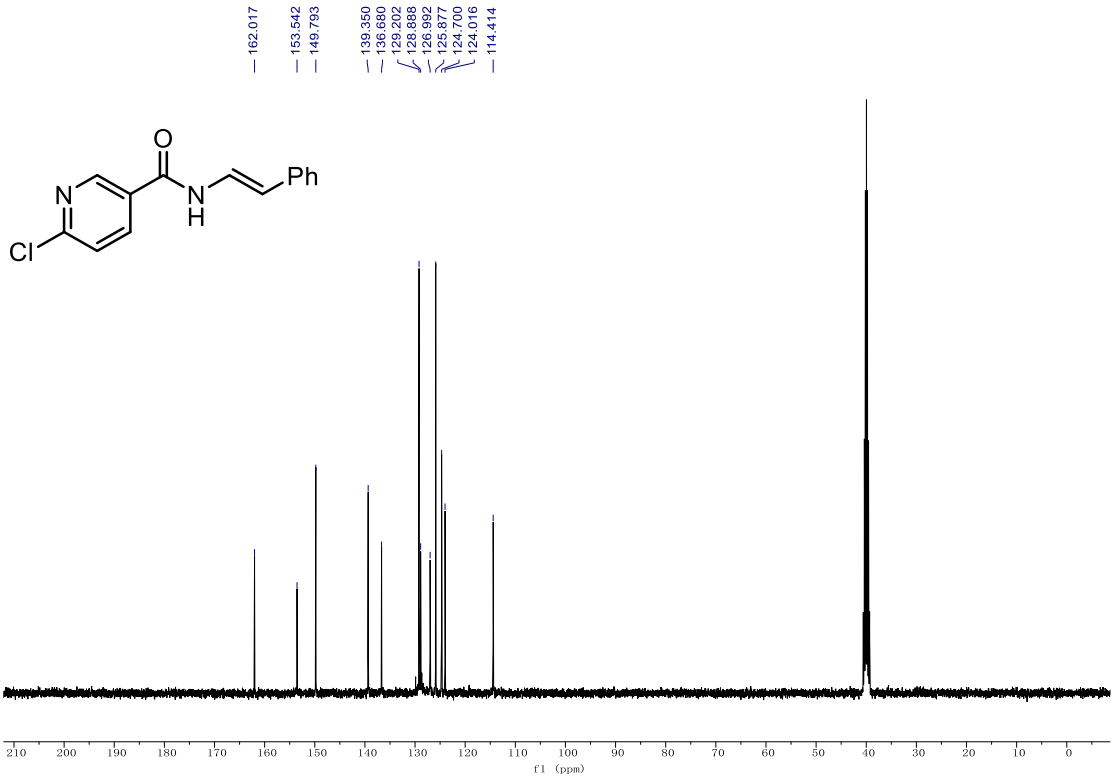
^{13}C NMR spectrum of **18** (**100 MHz, Chloroform-*d***)



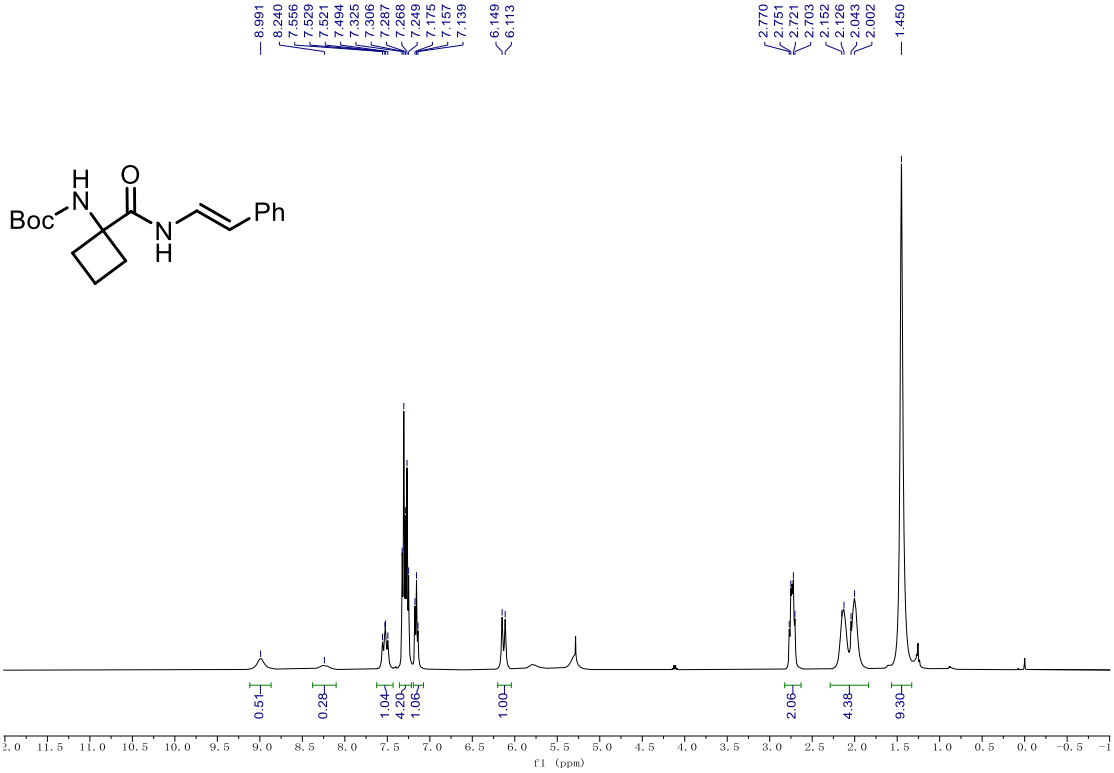
^{1}H NMR spectrum of **19** (**400 MHz, DMSO-*d*$_6$**)



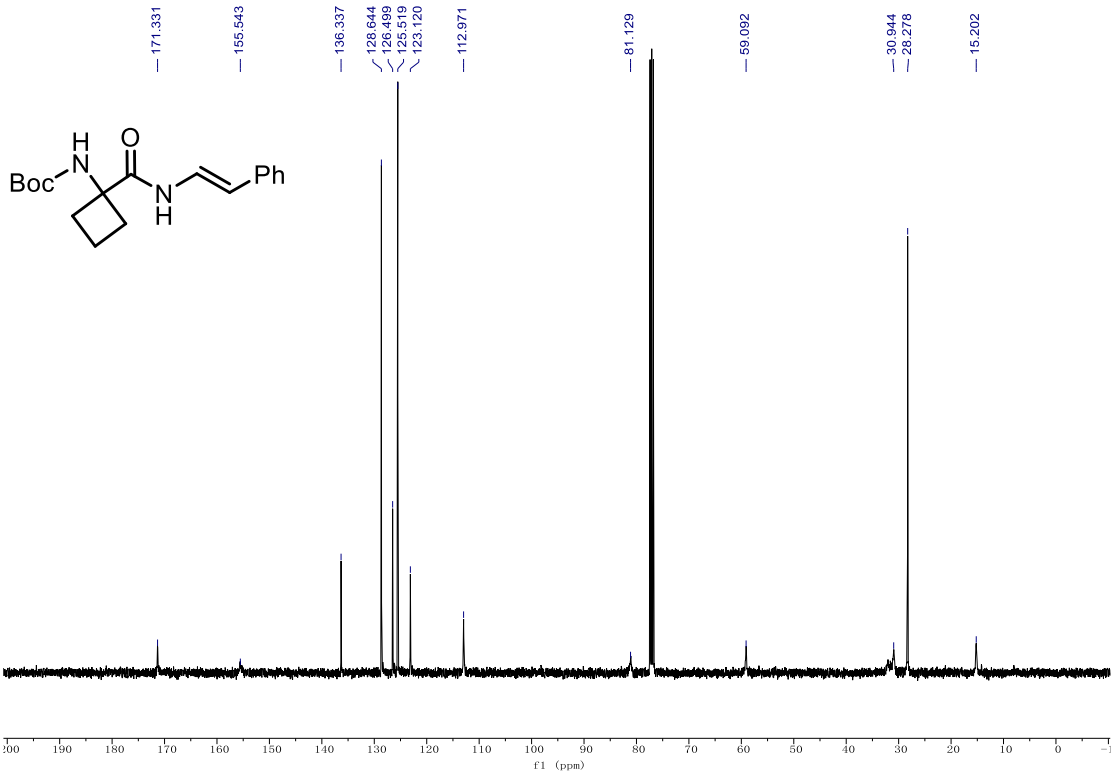
^{13}C NMR spectrum of **19** (**100 MHz, DMSO-*d*$_6$**)



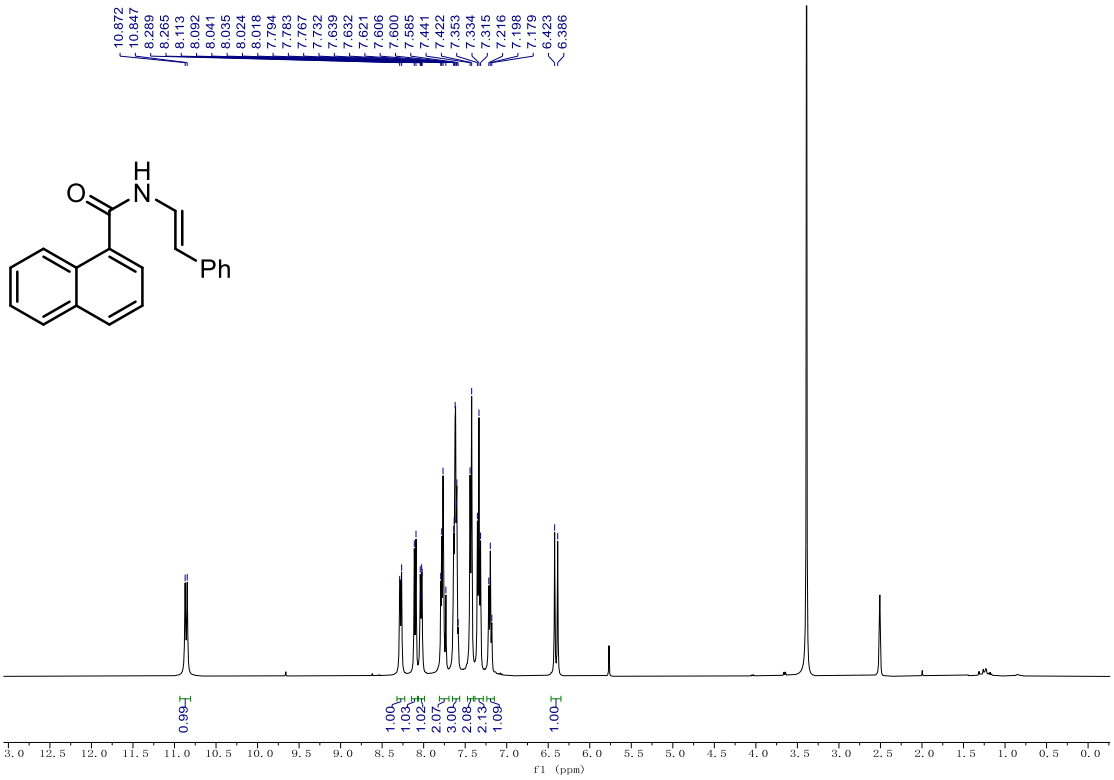
^{1}H NMR spectrum of **20** (**400 MHz, Chloroform-*d***)



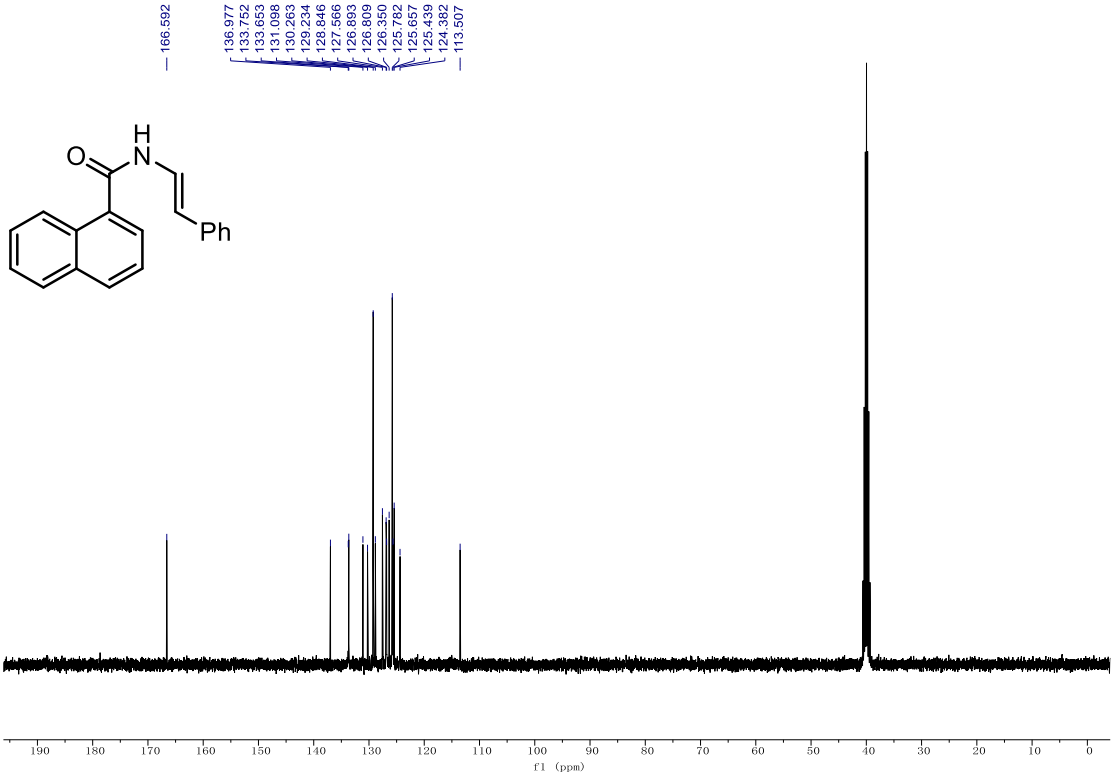
^{13}C NMR spectrum of **20** (**100 MHz, Chloroform-*d***)



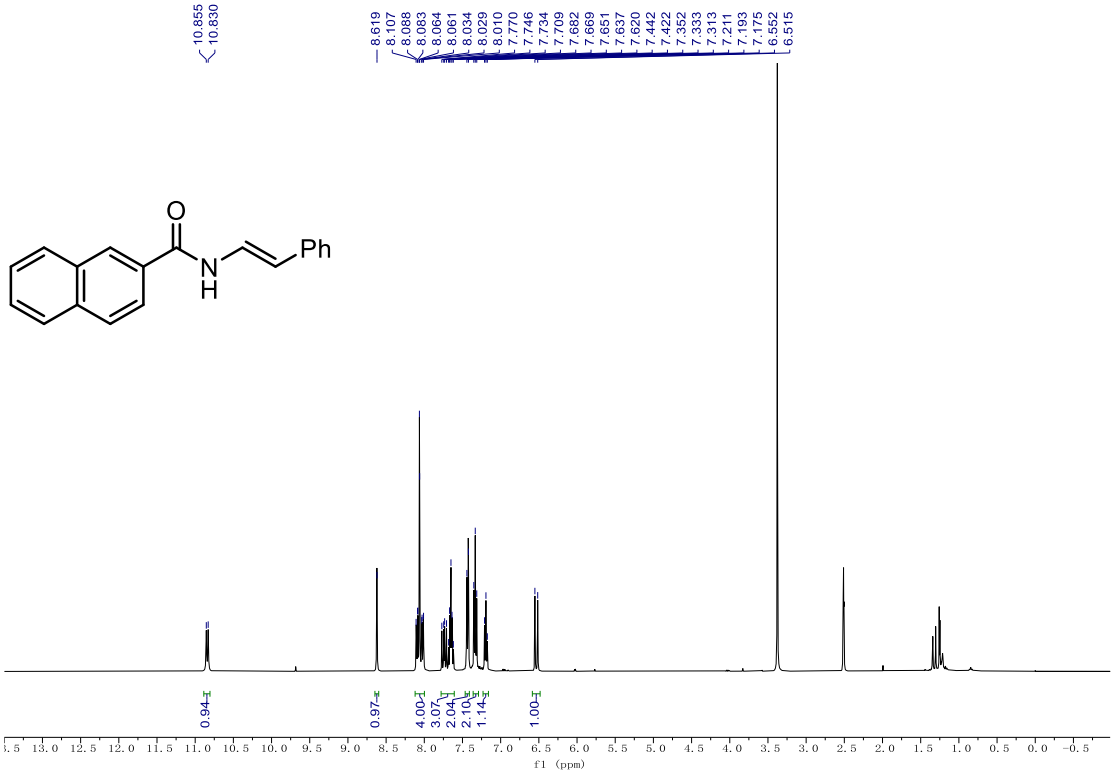
^{1}H NMR spectrum of **21** (**400 MHz, DMSO-*d*$_6$**)



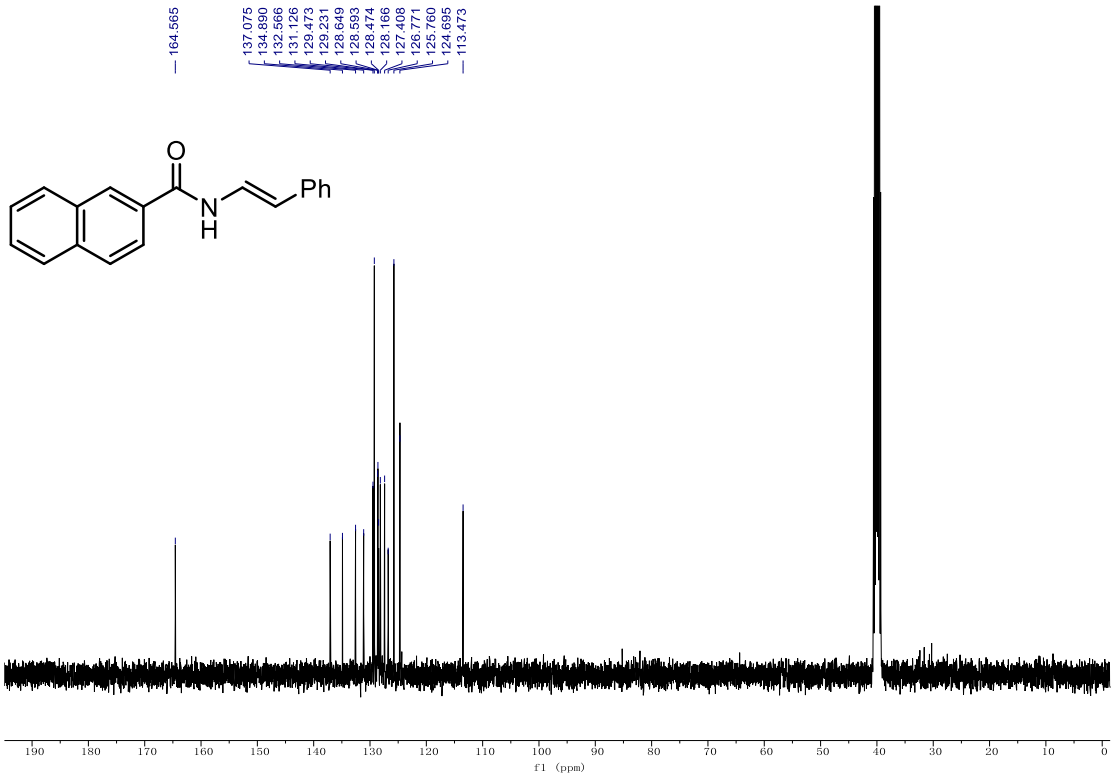
^{13}C NMR spectrum of **21** (**100 MHz, DMSO-*d*$_6$**)



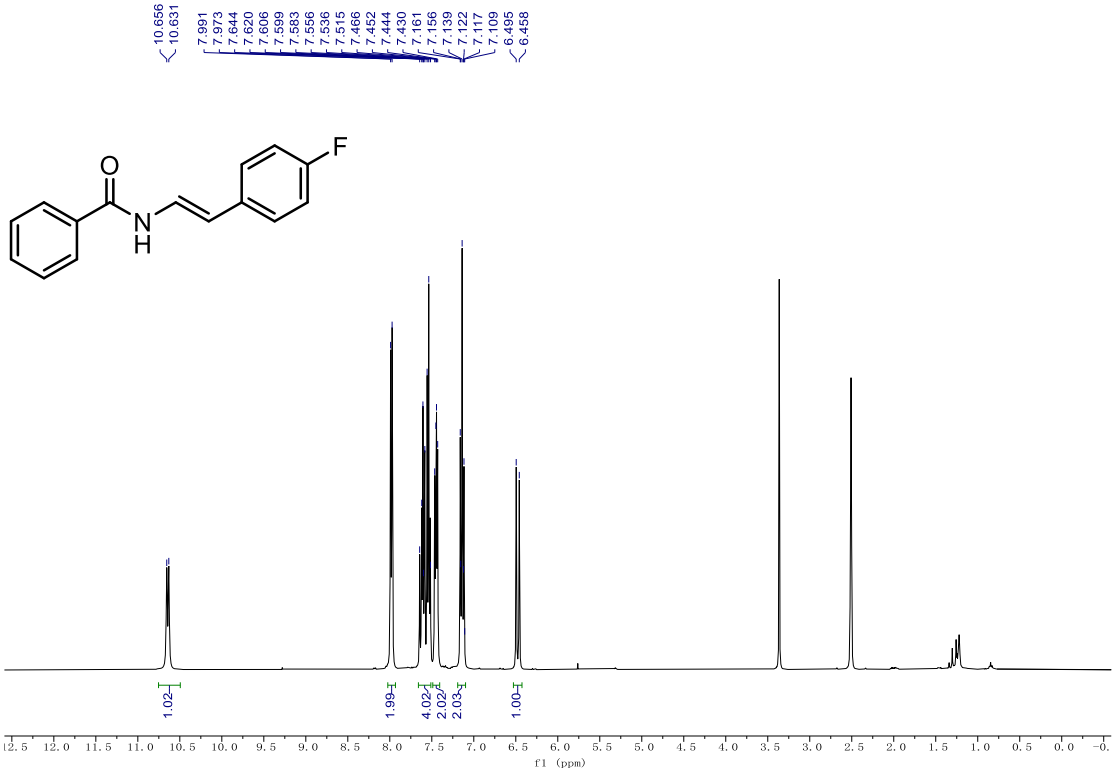
^{1}H NMR spectrum of **22** (**400 MHz, DMSO-*d*$_6$**)



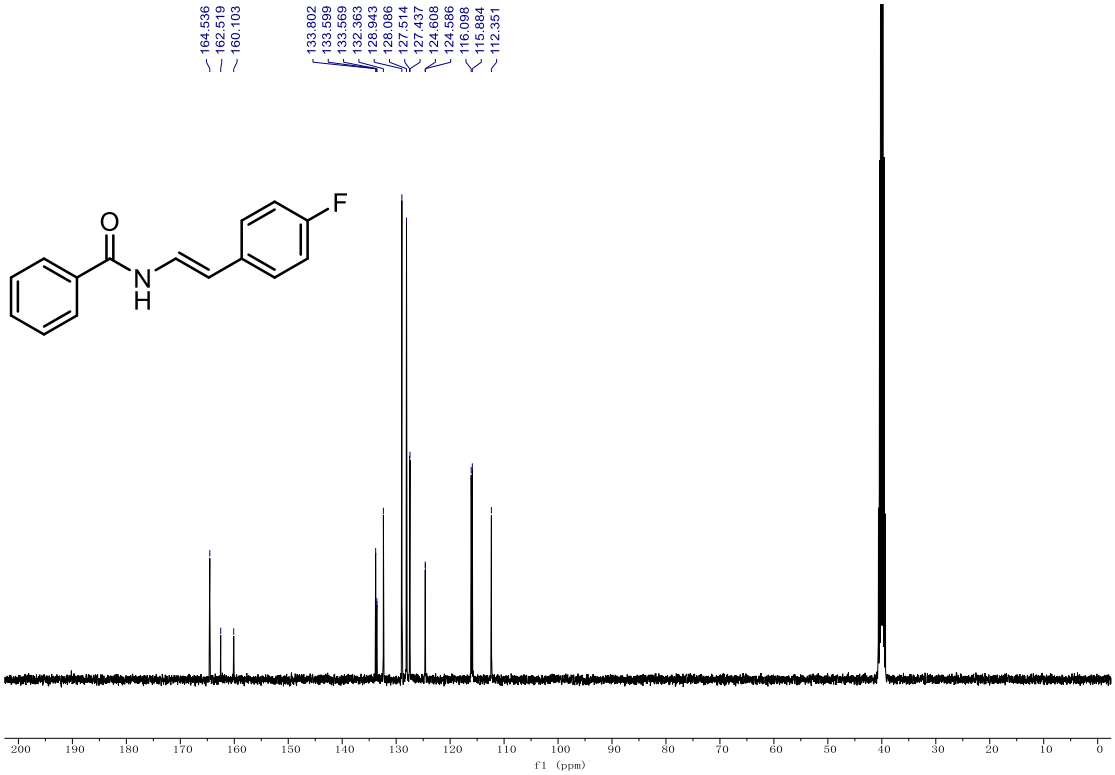
^{13}C NMR spectrum of **22** (**100 MHz, DMSO-*d*$_6$**)



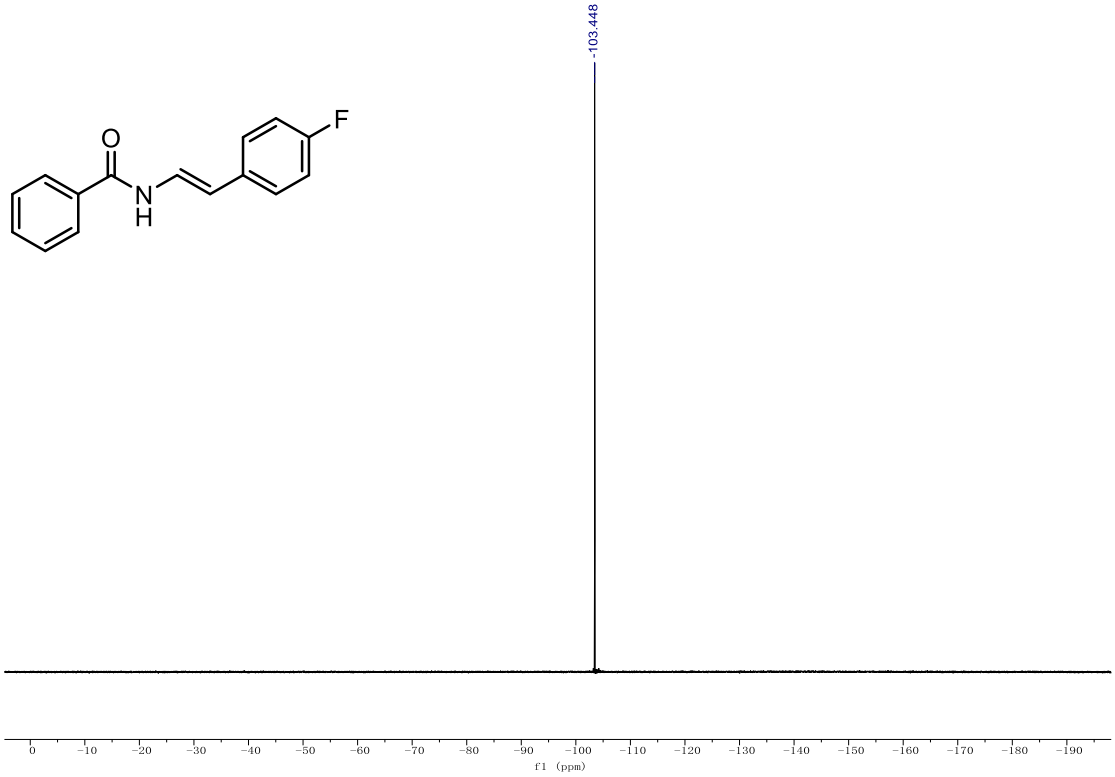
^{1}H NMR spectrum of **23** (**400 MHz, DMSO-*d*$_6$**)



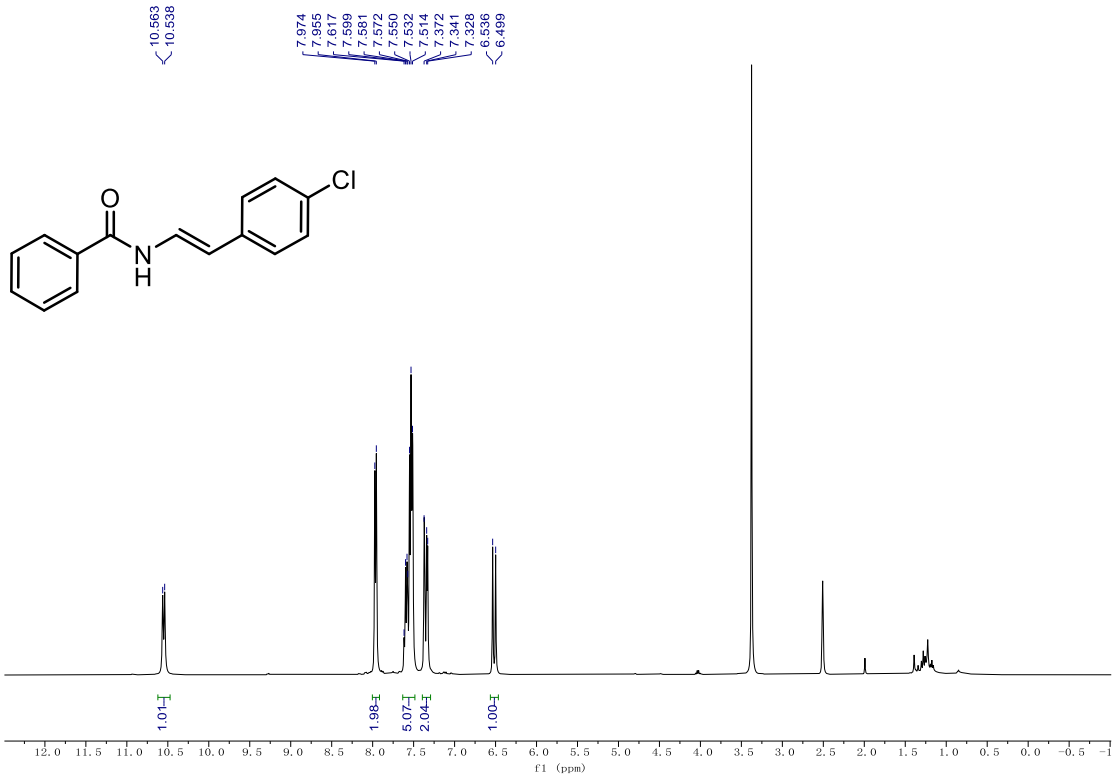
^{13}C NMR spectrum of **23** (**100 MHz, DMSO-*d*$_6$**)



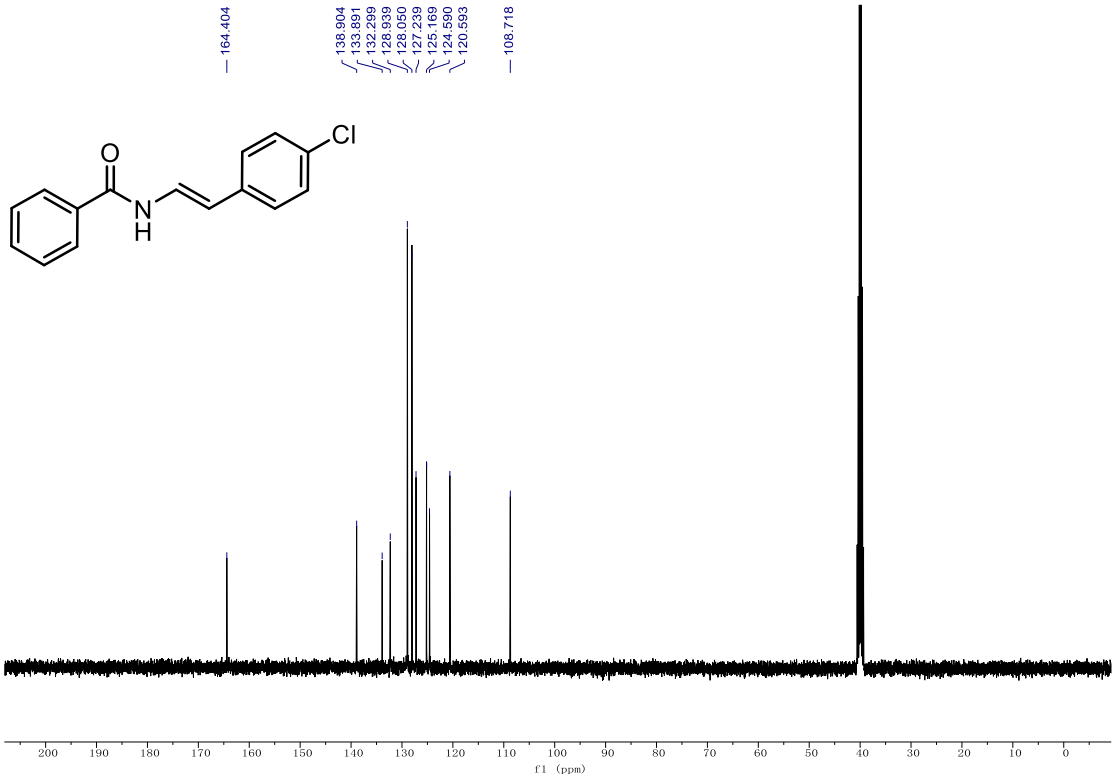
^{19}F NMR spectrum of **23** (**375 MHz DMSO-d_6**)



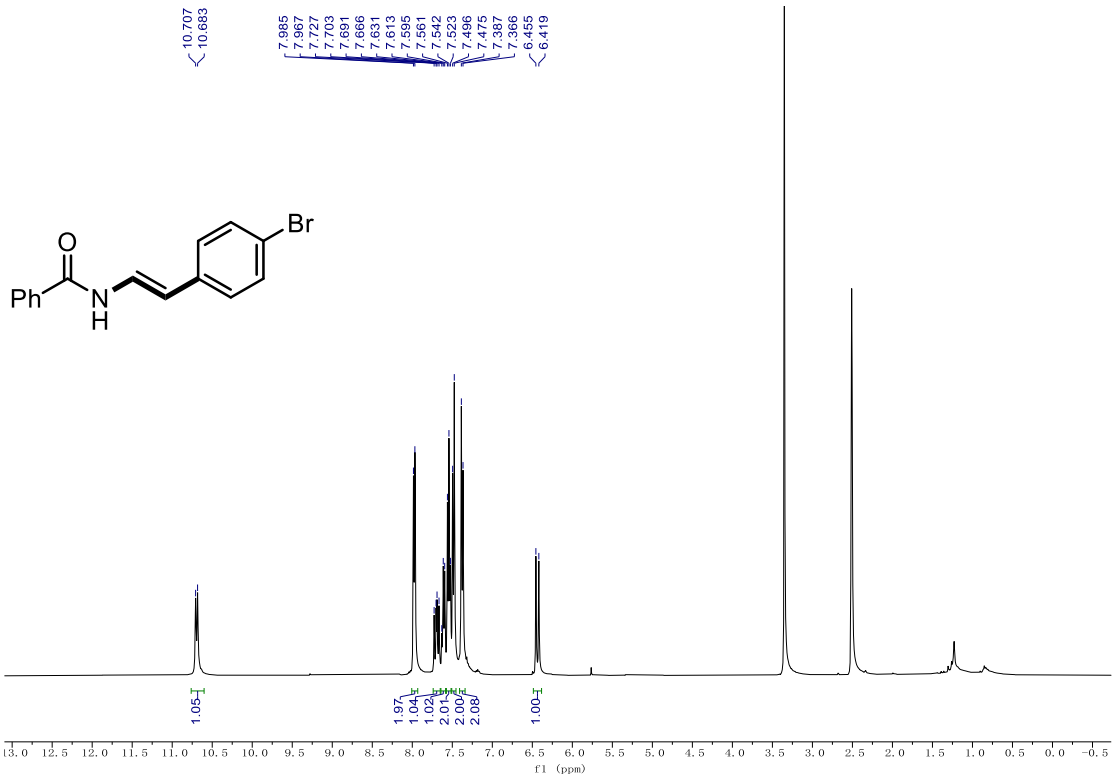
^{1}H NMR spectrum of **24** (**400 MHz, DMSO-*d*$_6$**)



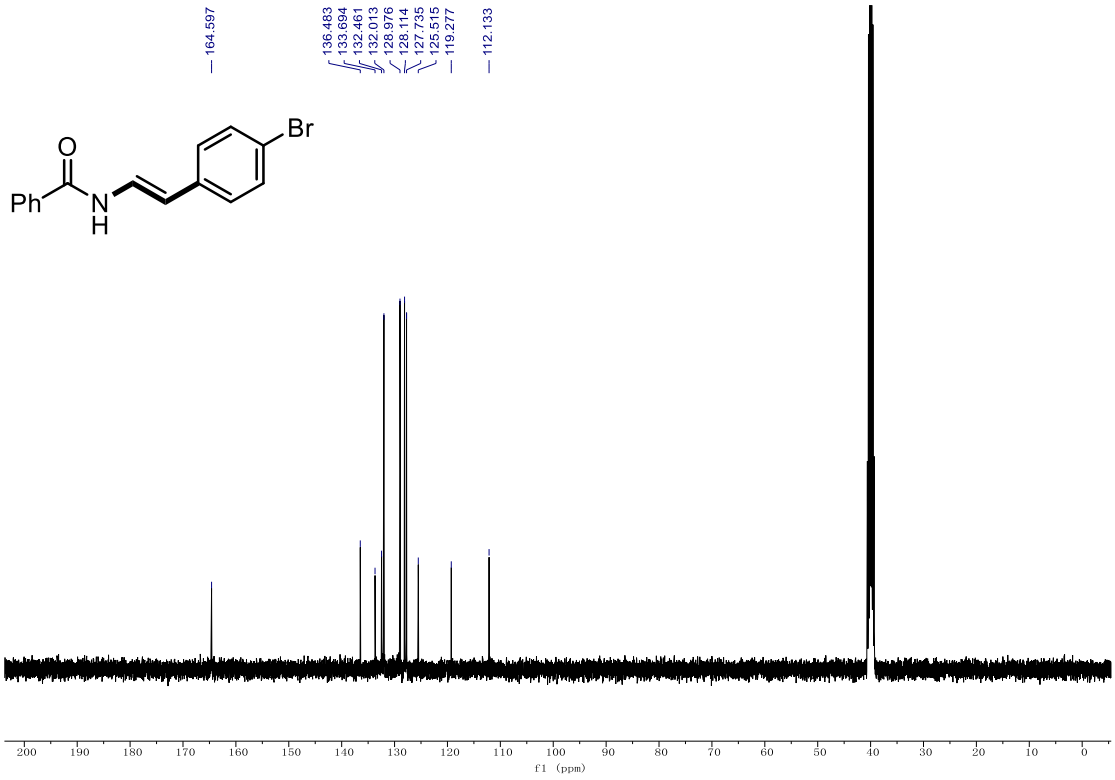
^{13}C NMR spectrum of **24** (**100 MHz, DMSO-*d*$_6$**)



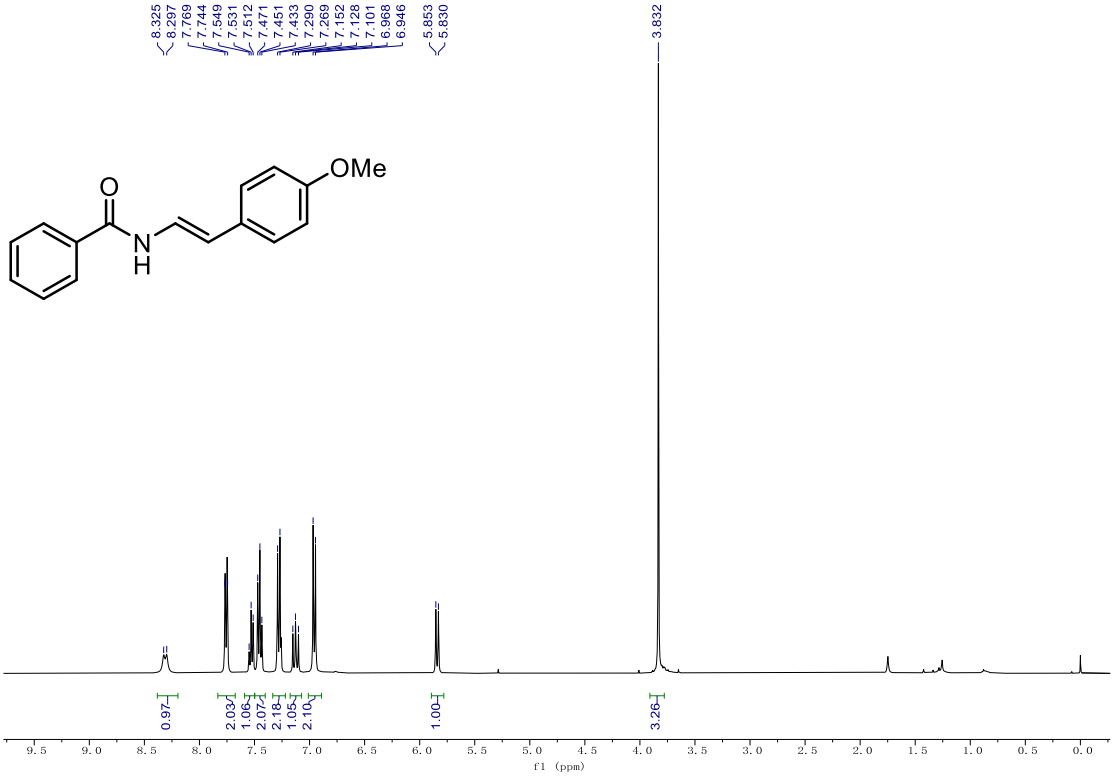
^{1}H NMR spectrum of **25** (**400 MHz, DMSO-*d*$_6$**)



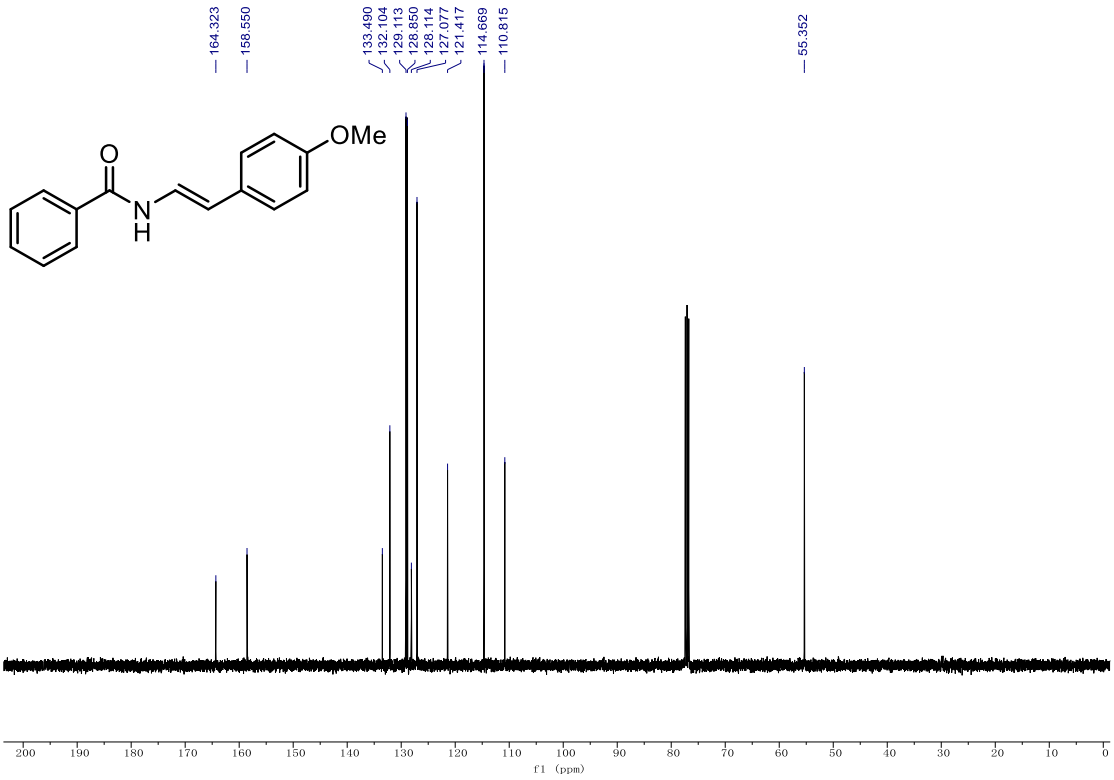
^{13}C NMR spectrum of **25** (**100 MHz, DMSO-*d*$_6$**)



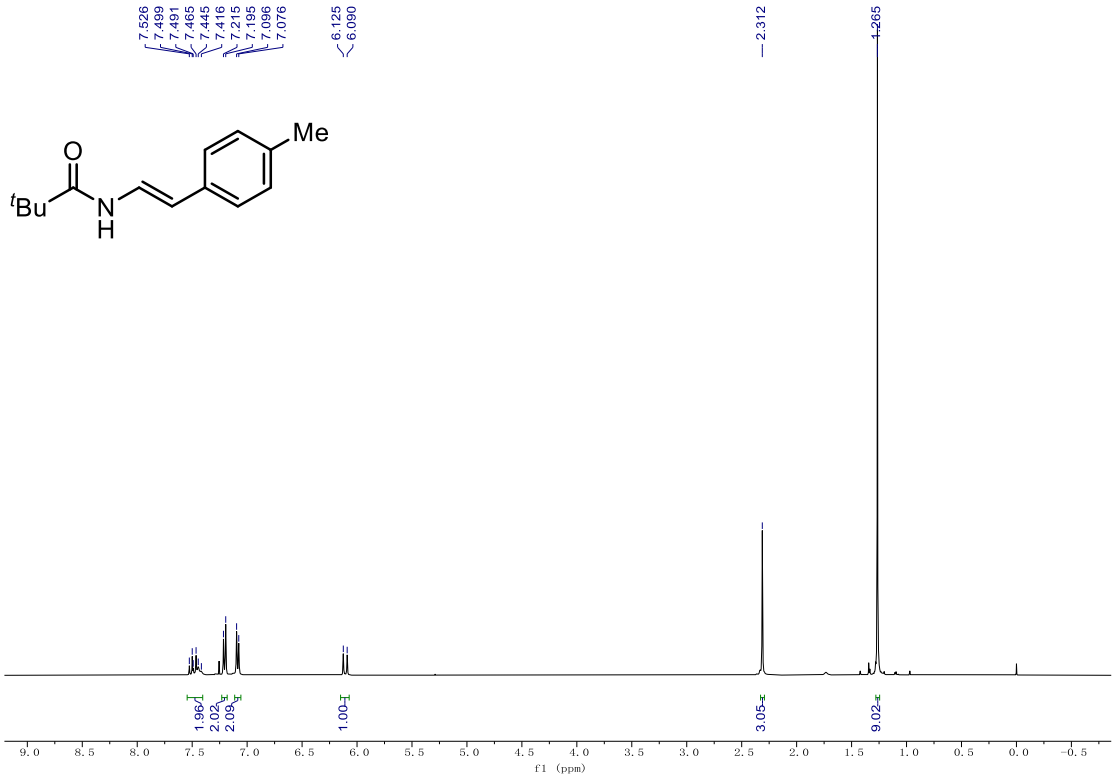
^{1}H NMR spectrum of **26** (**400 MHz, Chloroform-*d***)



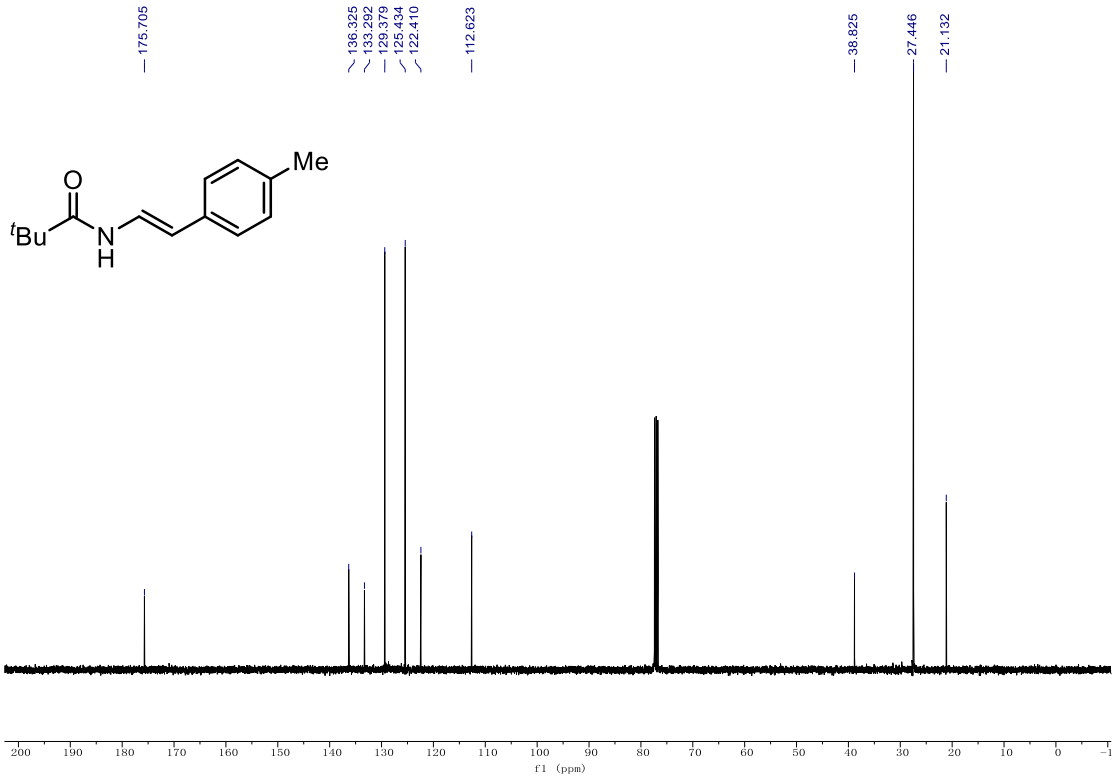
^{13}C NMR spectrum of **26** (**100 MHz, Chloroform-*d***)



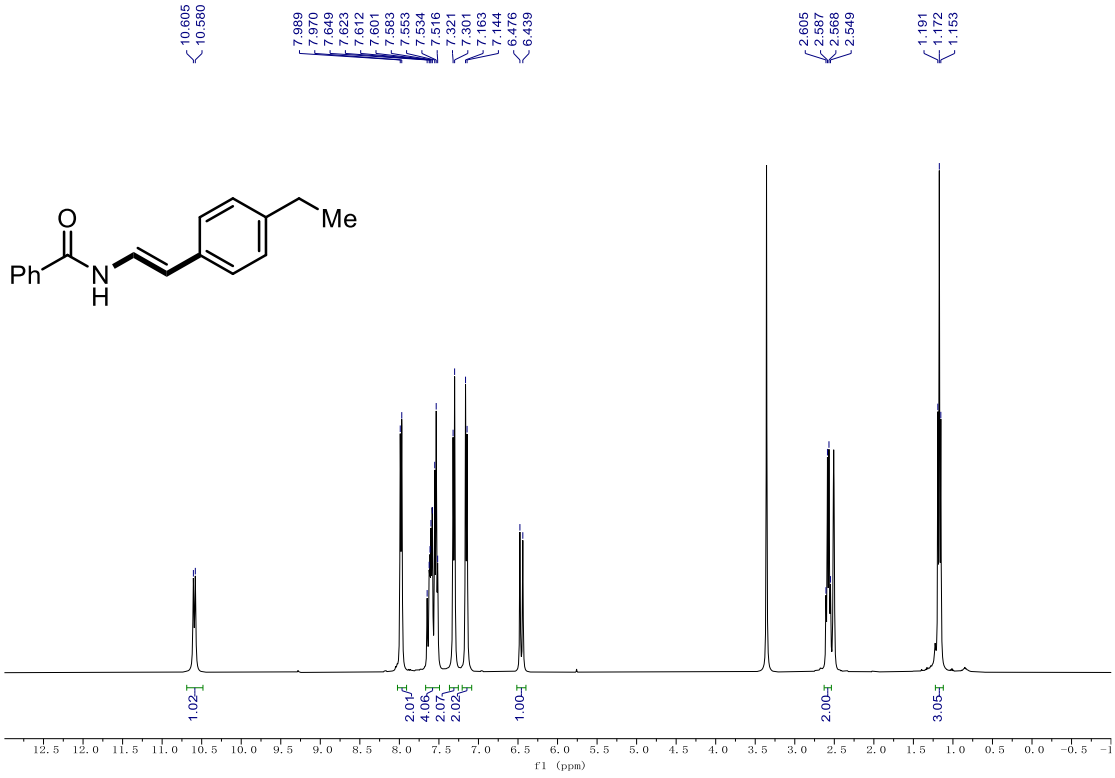
^{1}H NMR spectrum of **27** (**400 MHz, Chloroform-*d***)



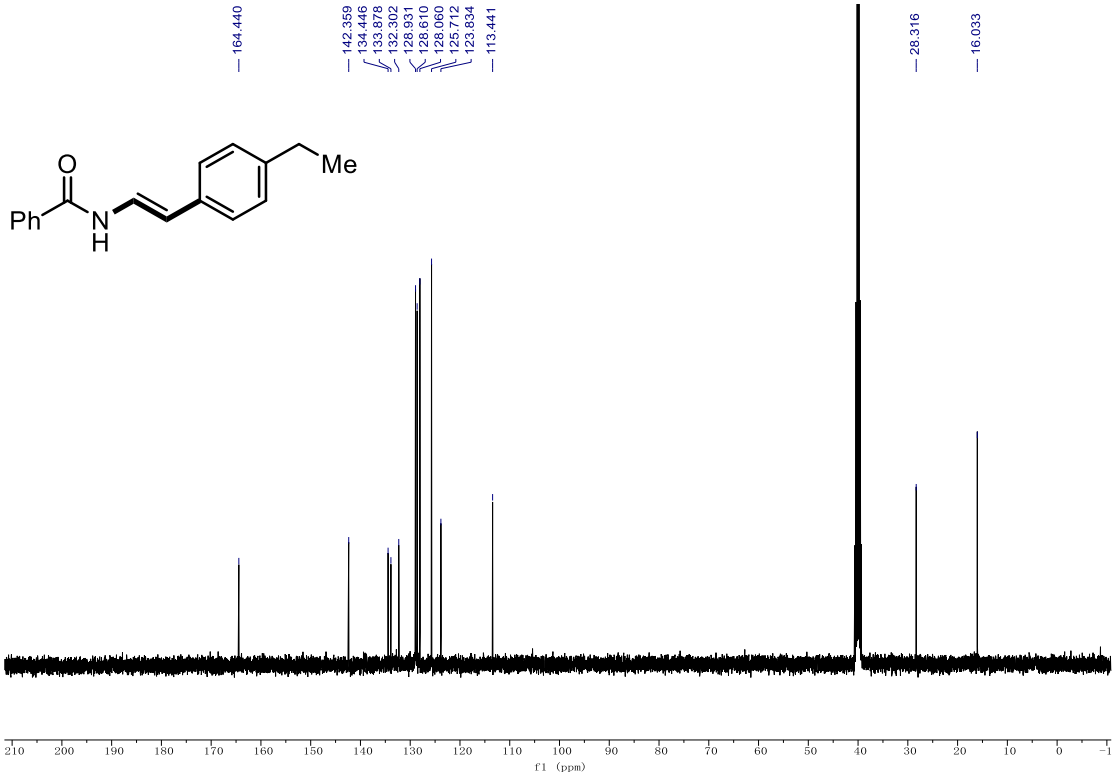
^{13}C NMR spectrum of **27** (**100 MHz, Chloroform-*d***)



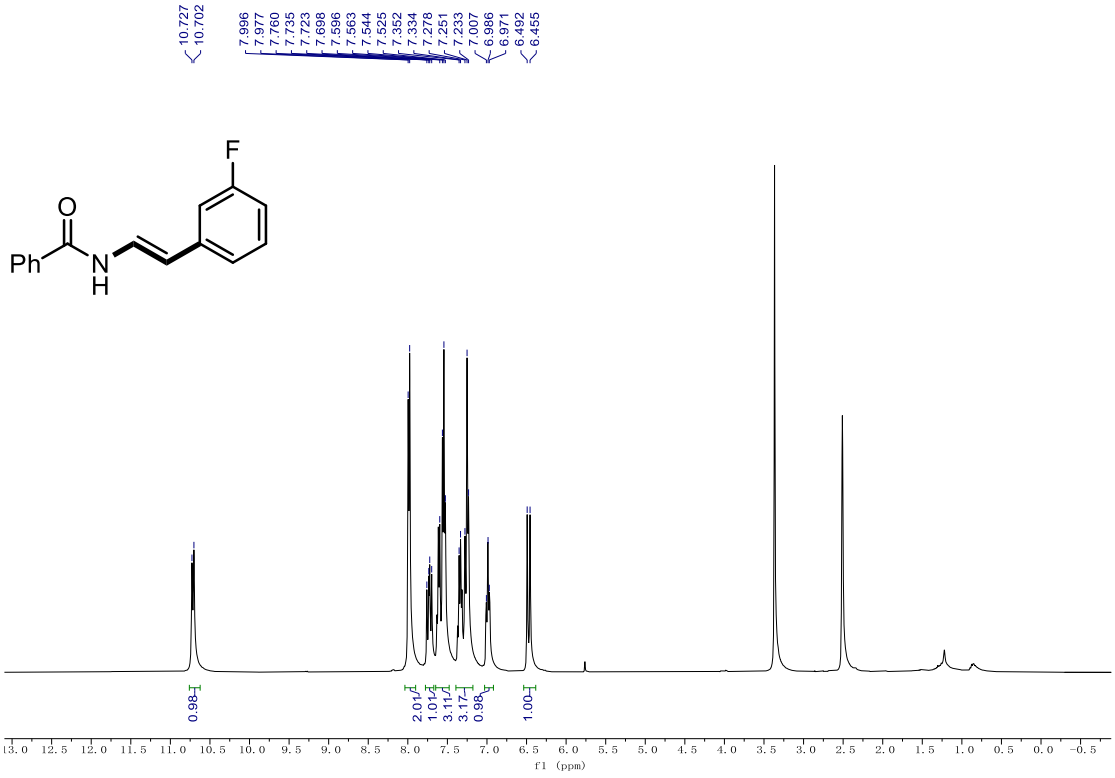
^{1}H NMR spectrum of **28** (**400 MHz, DMSO-*d*$_6$**)



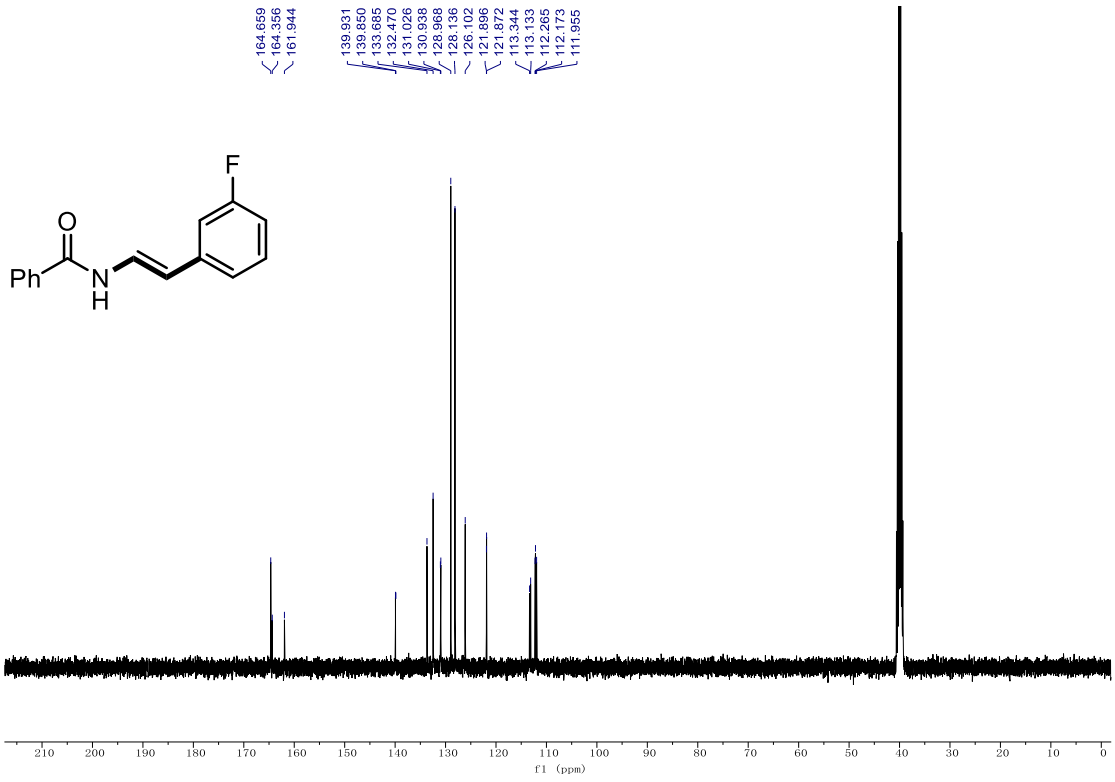
^{13}C NMR spectrum of **28** (**100 MHz, DMSO-*d*$_6$**)



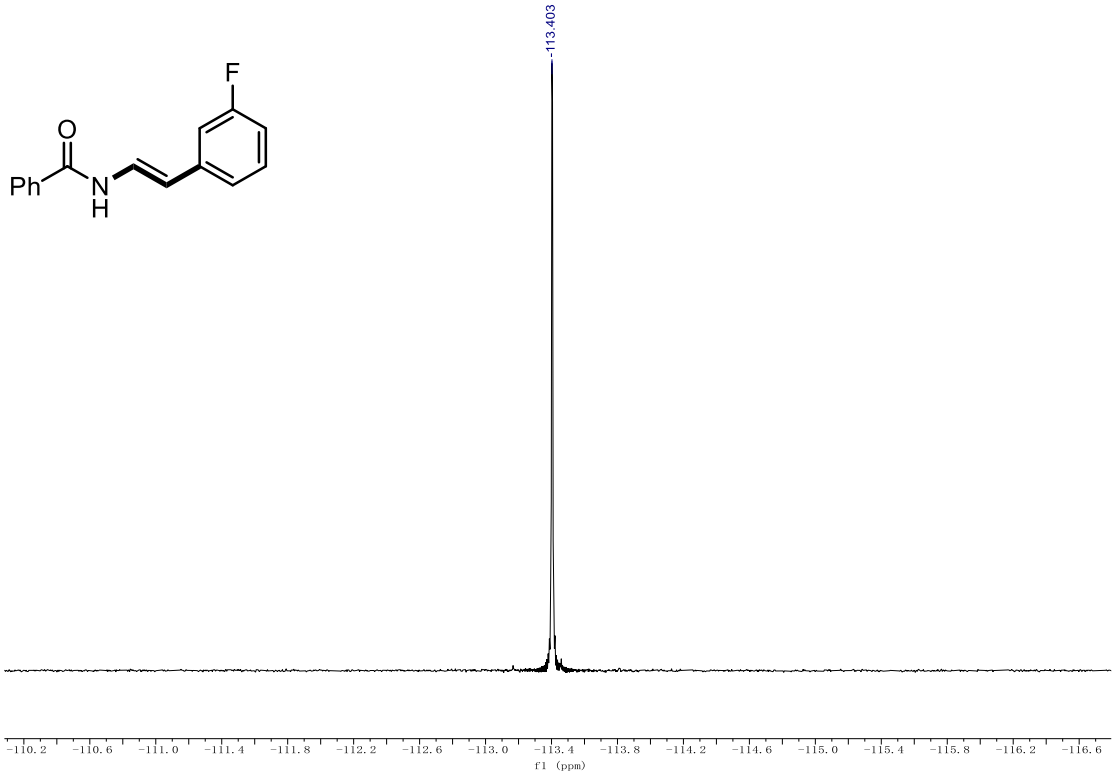
^{1}H NMR spectrum of **29** (**400 MHz, DMSO-*d*$_6$**)



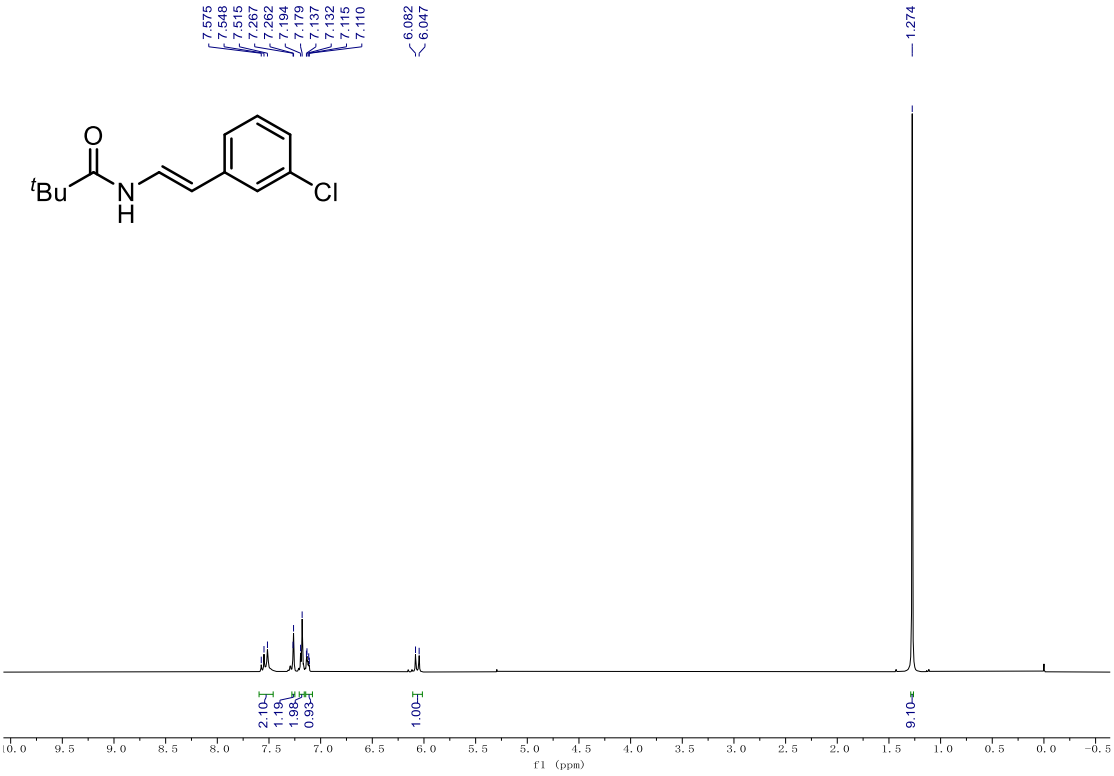
^{13}C NMR spectrum of **29** (**100 MHz, DMSO-*d*$_6$**)



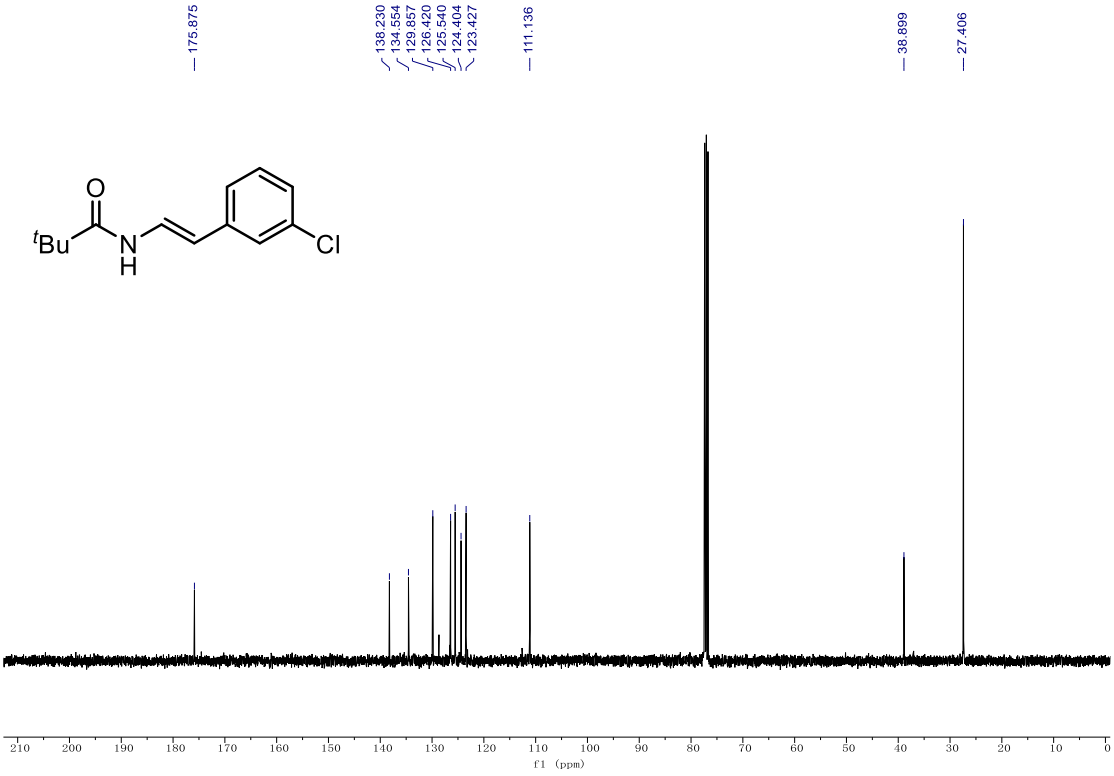
^{19}F NMR spectrum of **29** (**375 MHz DMSO-d_6**)



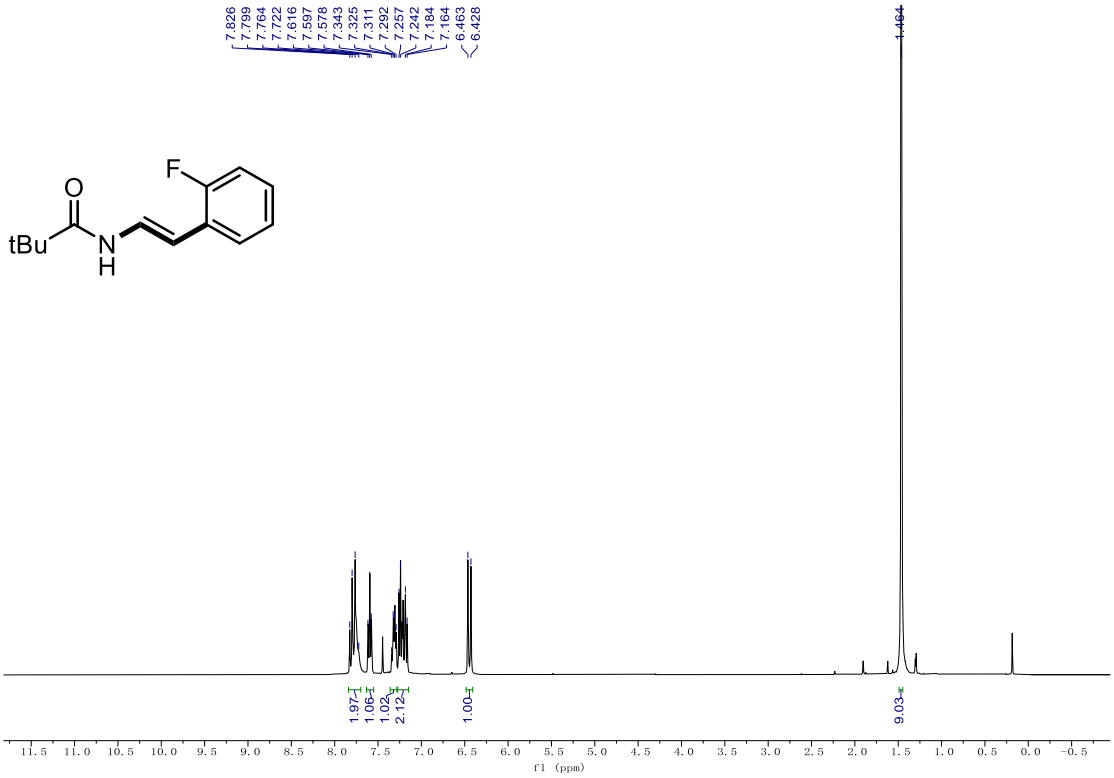
^{1}H NMR spectrum of **30** (**400 MHz, Chloroform-*d***)



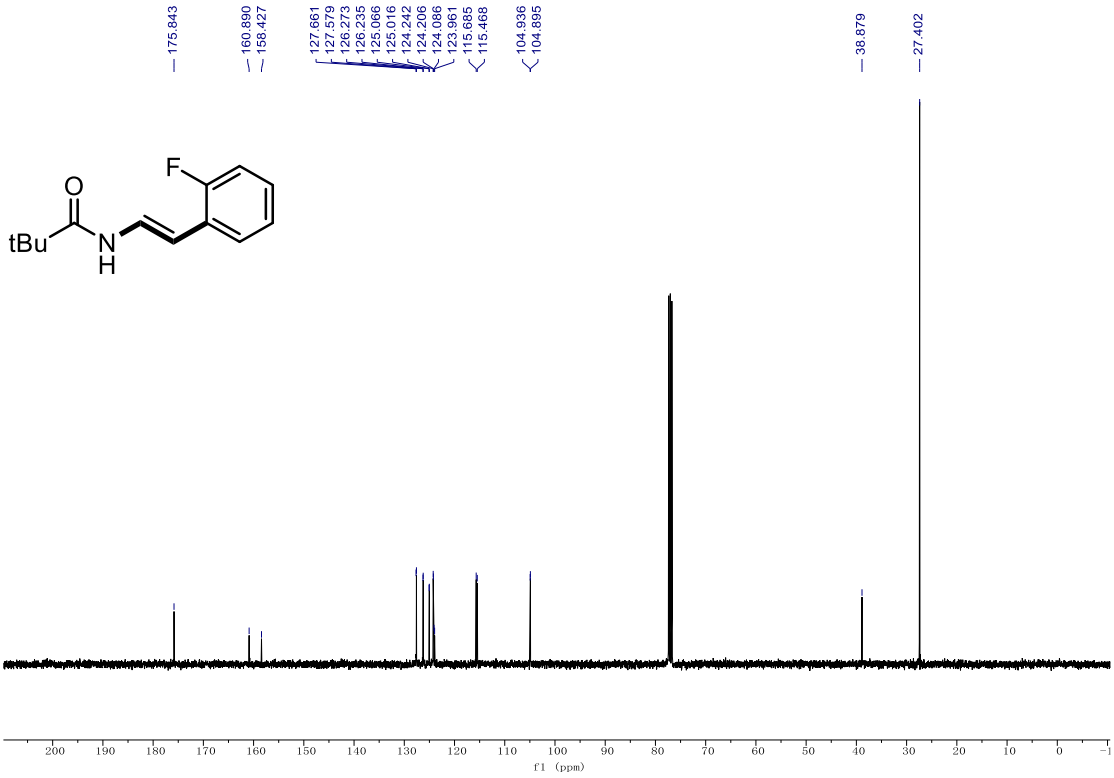
^{13}C NMR spectrum of **30** (**100 MHz, Chloroform-*d***)



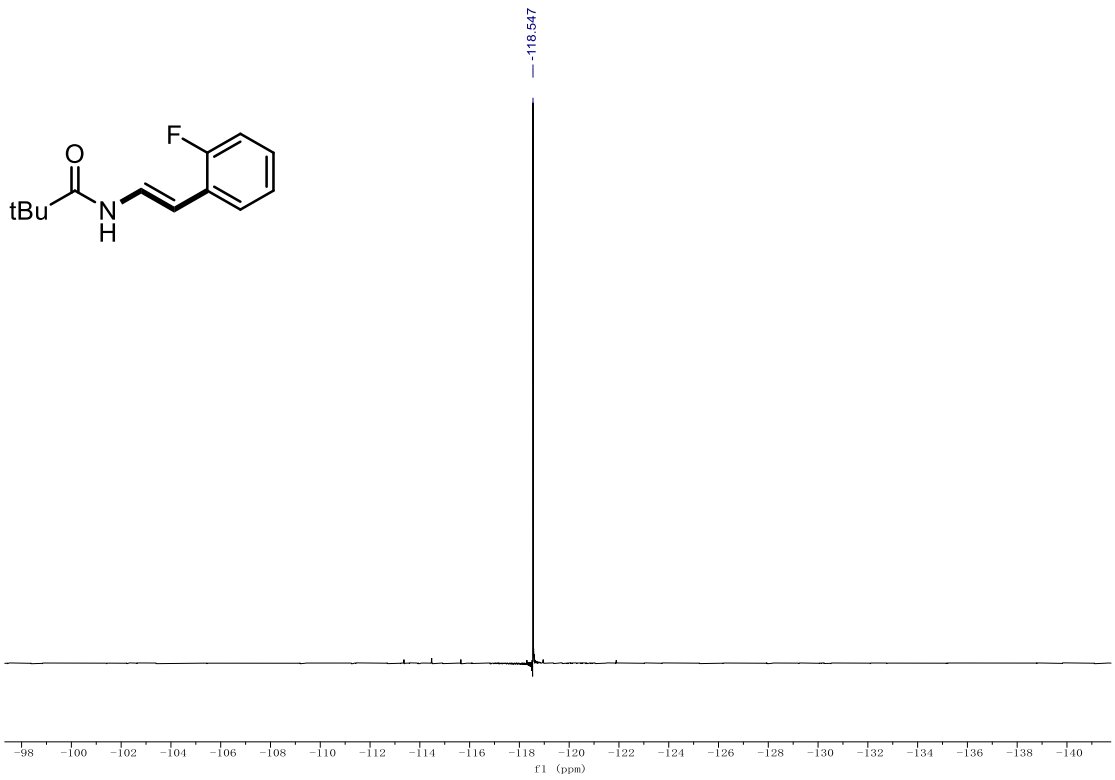
^{1}H NMR spectrum of **31** (**400 MHz, Chloroform-*d***)



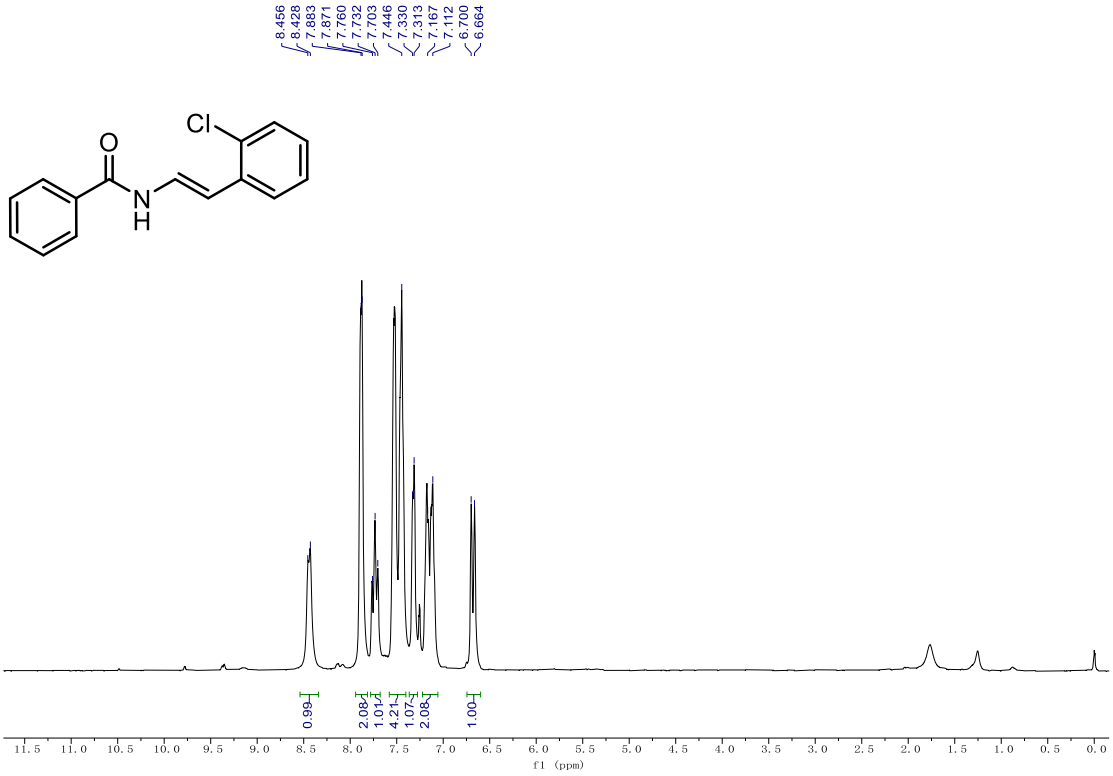
^{13}C NMR spectrum of **31** (**100 MHz, Chloroform-*d***)



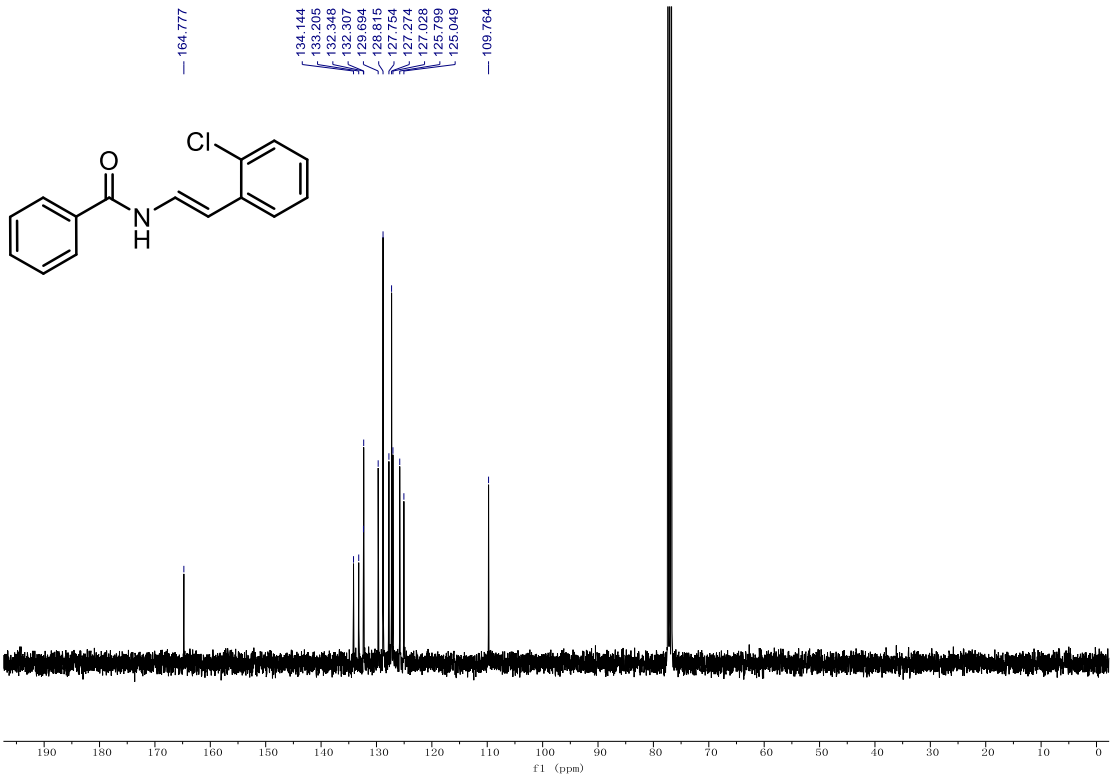
^{19}F NMR spectrum of **31** (**375 MHz Chloroform-*d***)



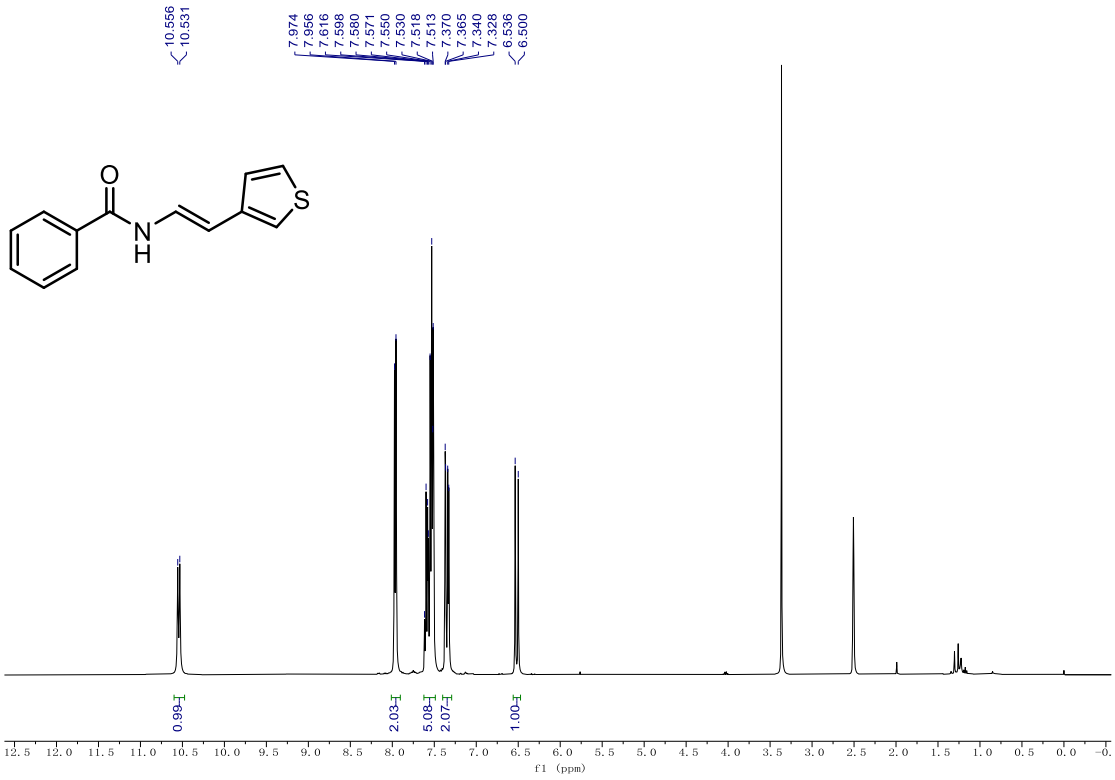
^{1}H NMR spectrum of **32** (**400 MHz, Chloroform-*d***)



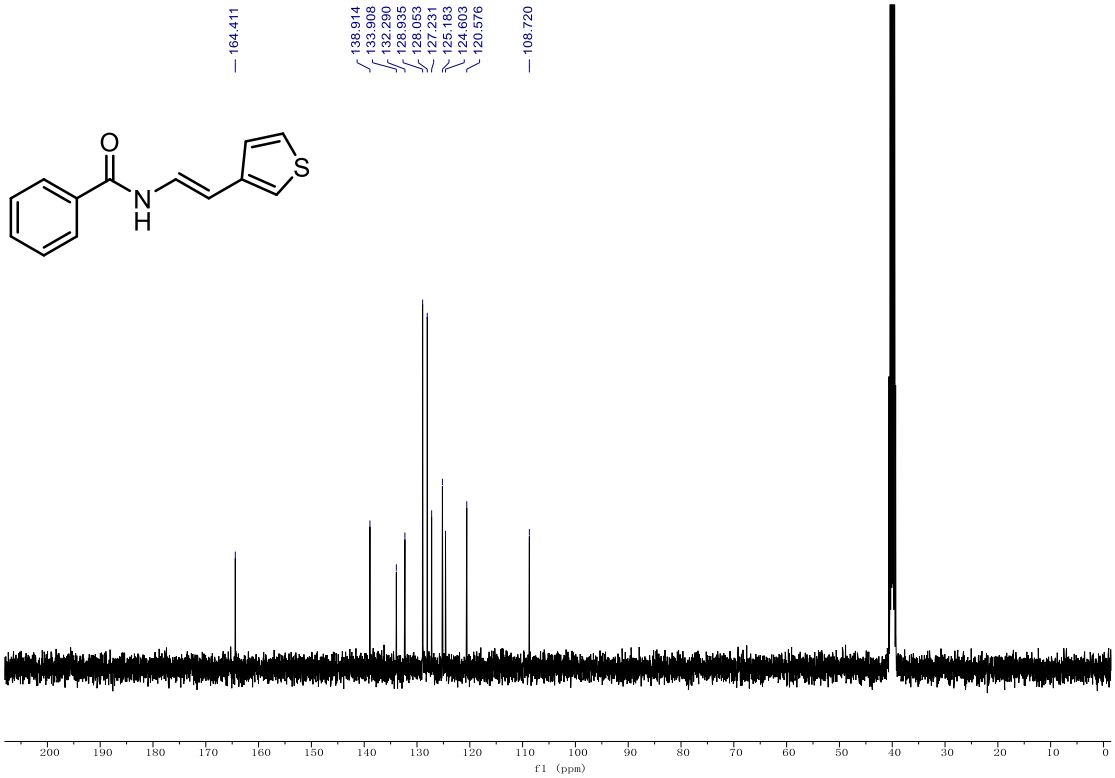
^{13}C NMR spectrum of **32** (**100 MHz, Chloroform-*d***)



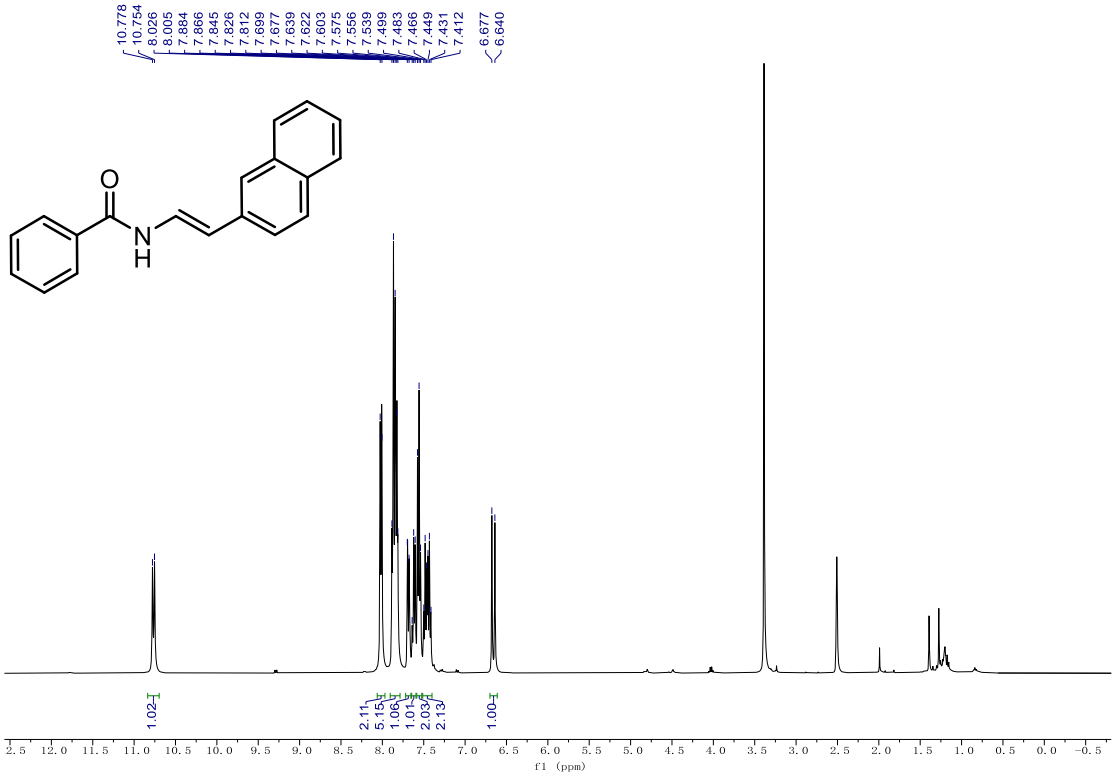
^{1}H NMR spectrum of **33** (**400 MHz, DMSO-*d*$_6$**)



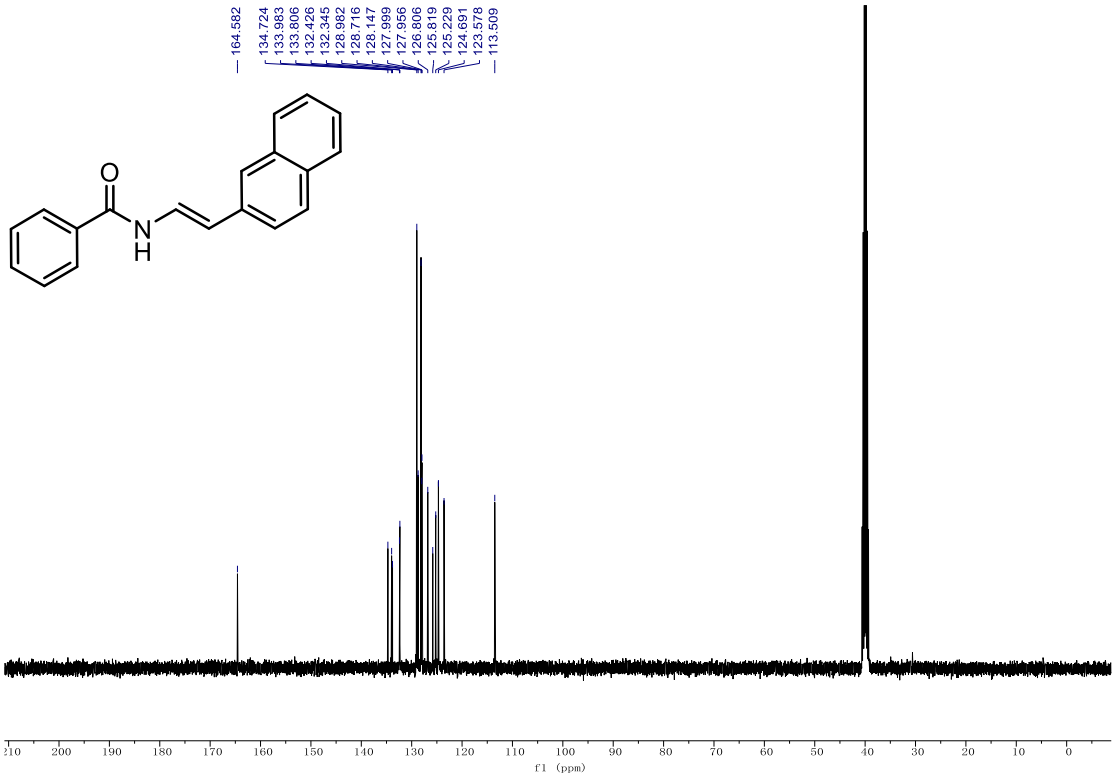
^{13}C NMR spectrum of **33** (**100 MHz, DMSO-*d*$_6$**)



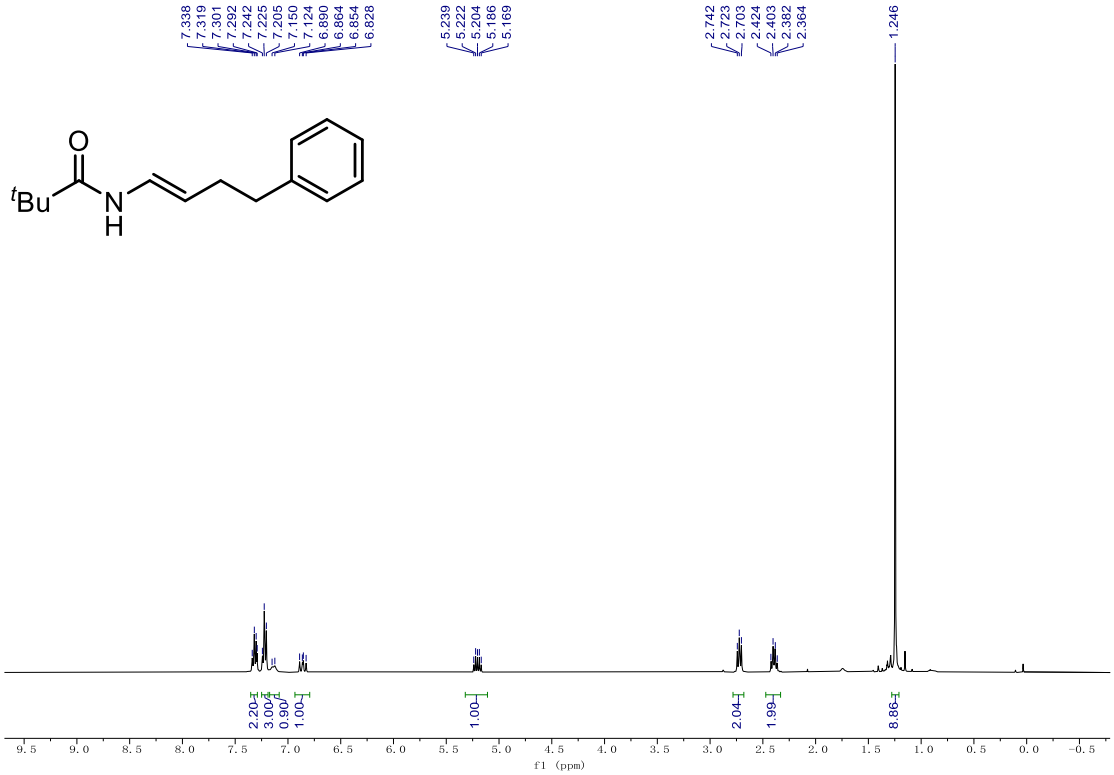
^{1}H NMR spectrum of **34** (**400 MHz, DMSO-*d*$_6$**)



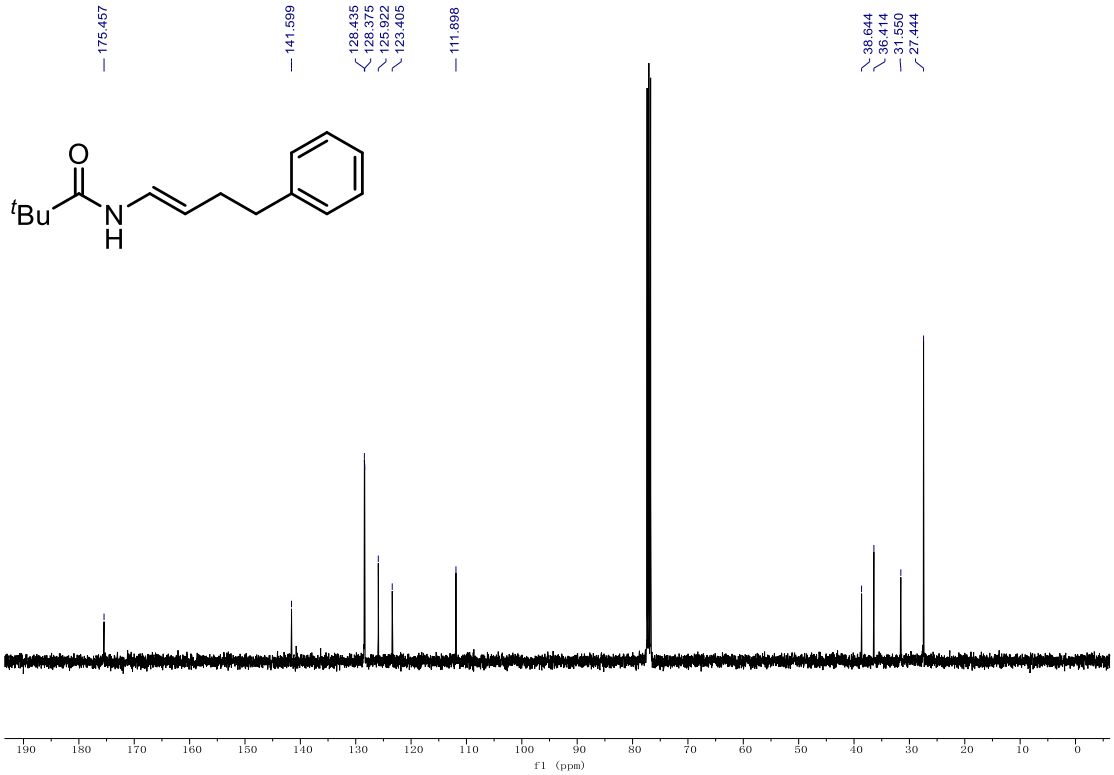
^{13}C NMR spectrum of **34** (**100 MHz, DMSO-*d*$_6$**)



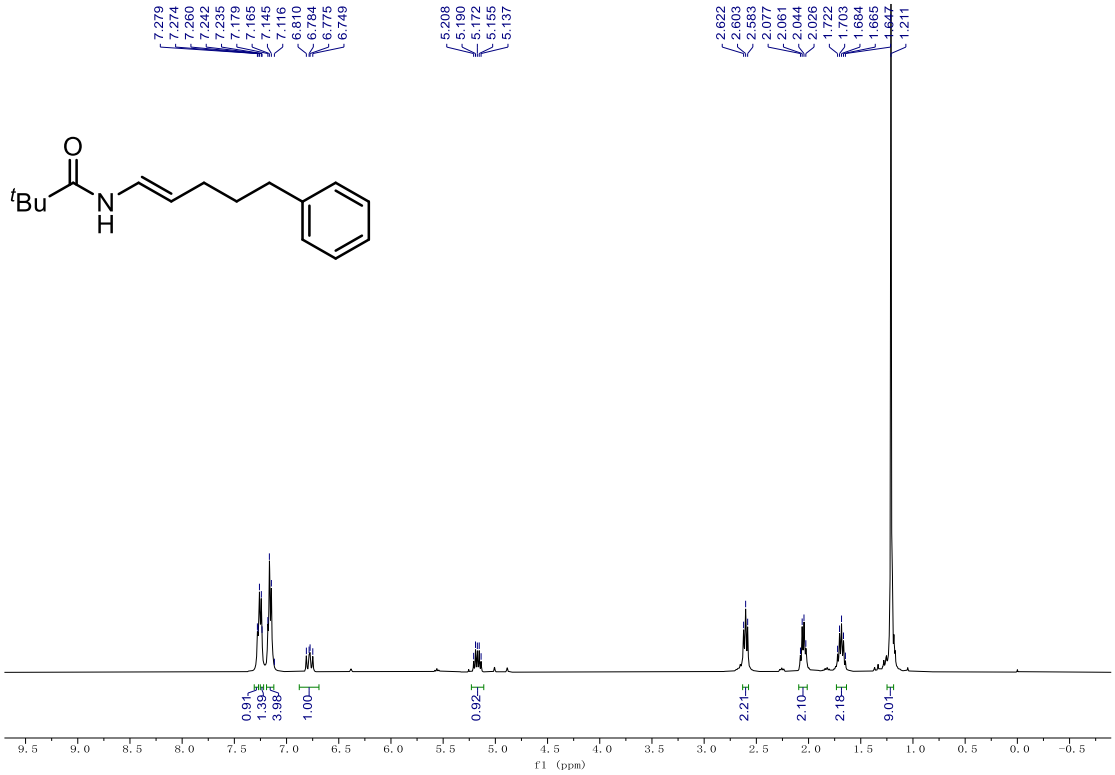
^{1}H NMR spectrum of **35** (**400 MHz, Chloroform-*d***)



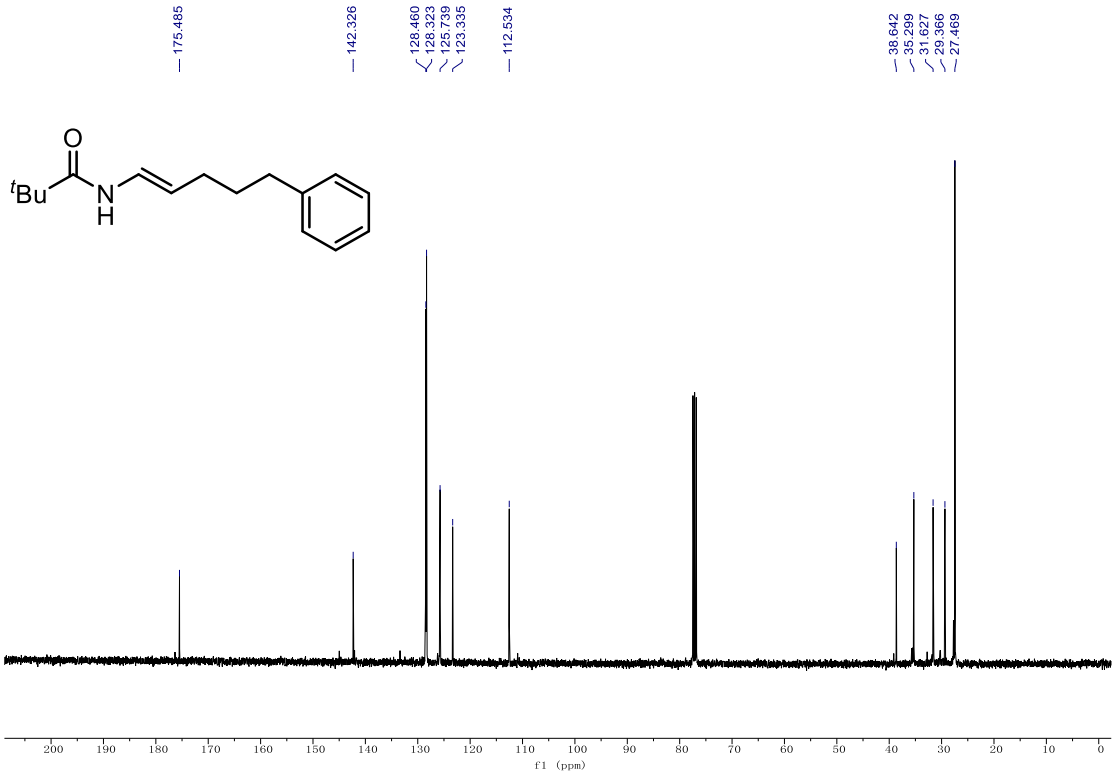
^{13}C NMR spectrum of **35** (**100 MHz, Chloroform-*d***)



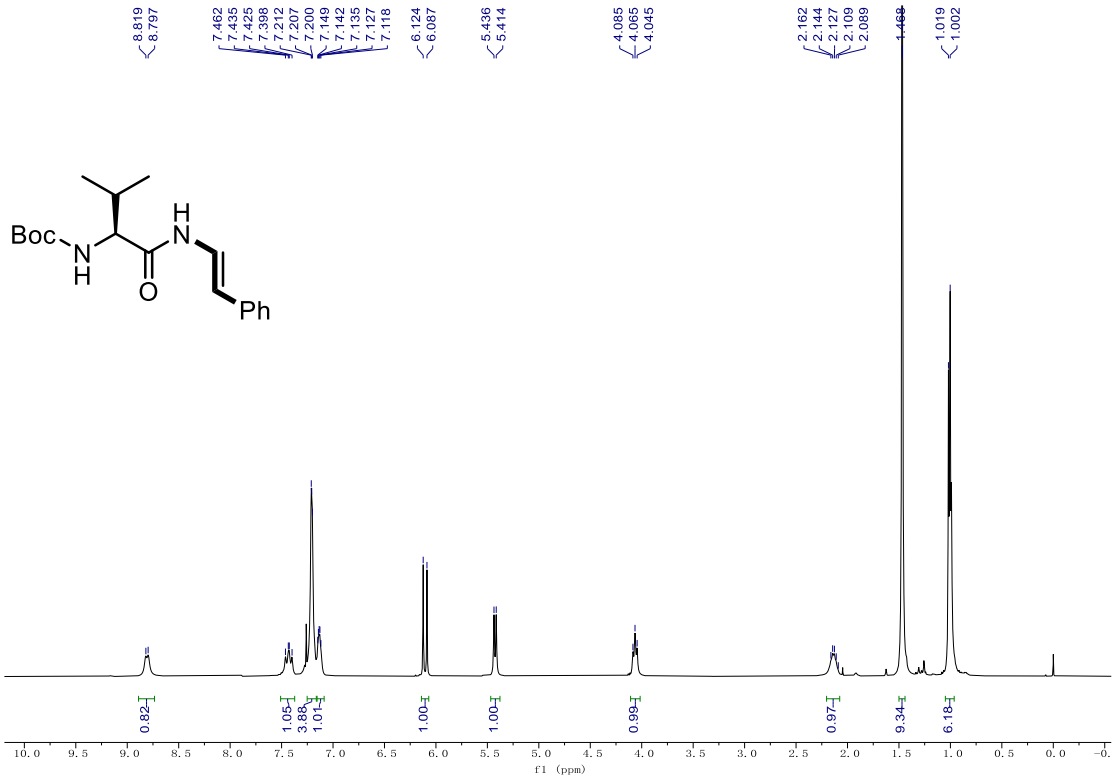
^{1}H NMR spectrum of **36** (**400 MHz, Chloroform-*d***)



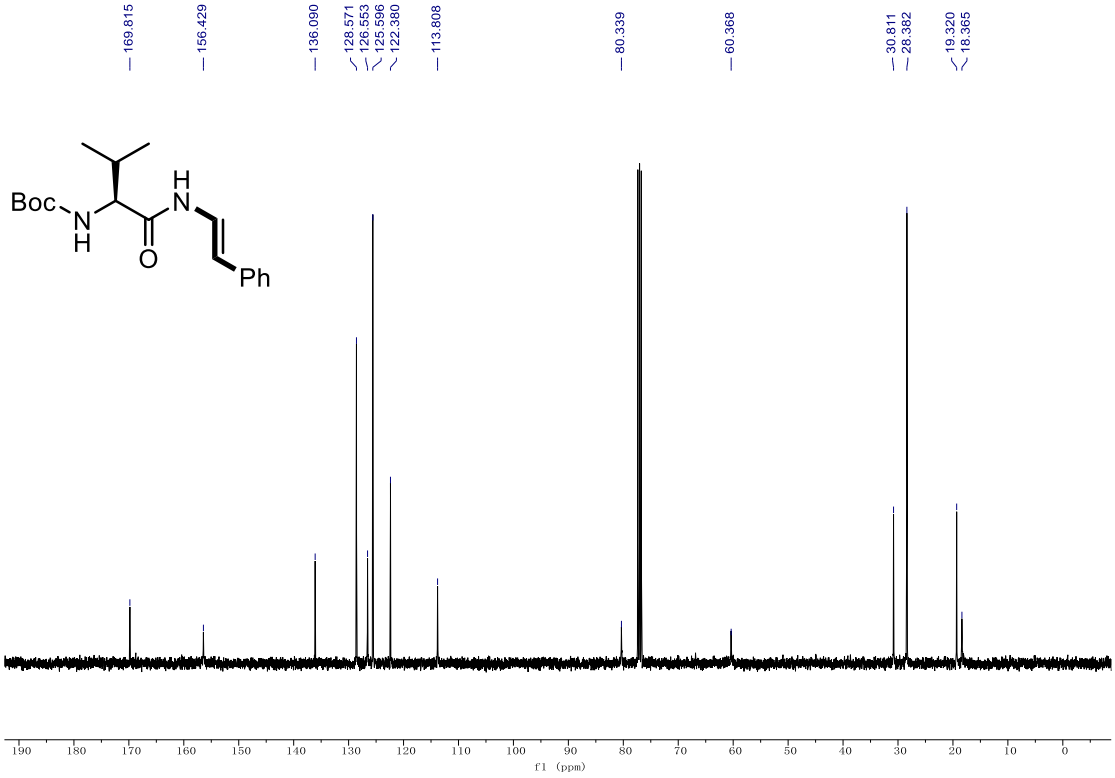
^{13}C NMR spectrum of **36** (**100 MHz, Chloroform-*d***)



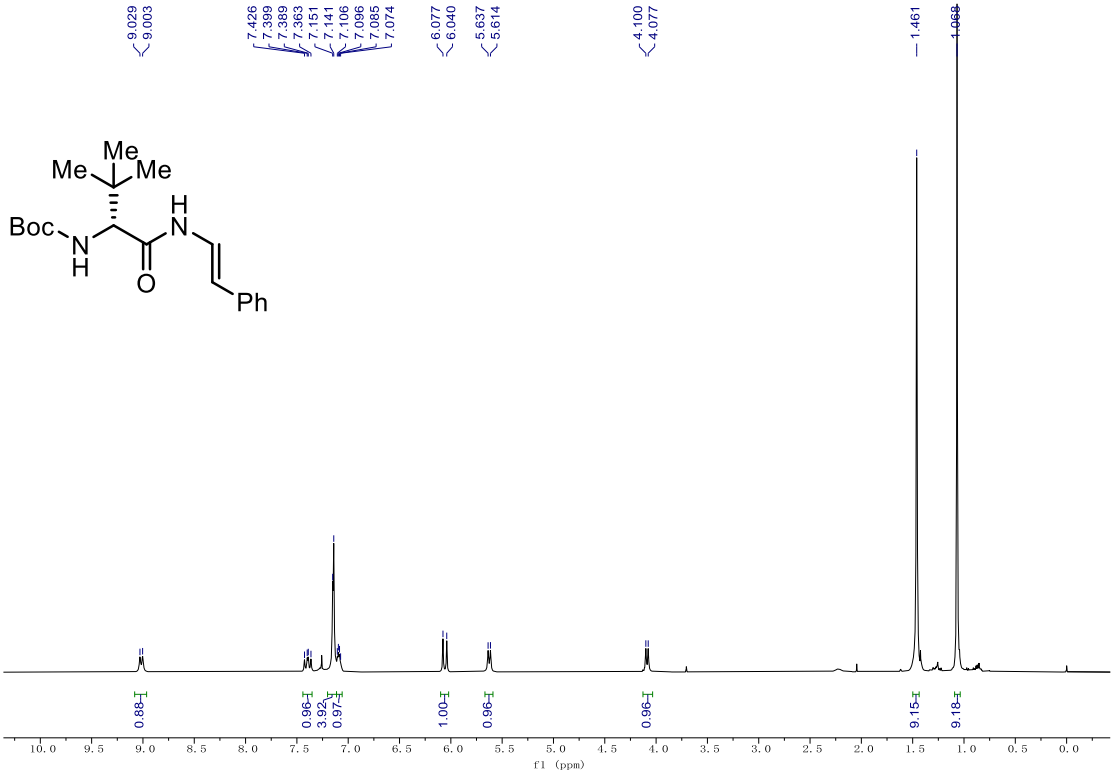
^{1}H NMR spectrum of **37** (**400 MHz, Chloroform-*d***)



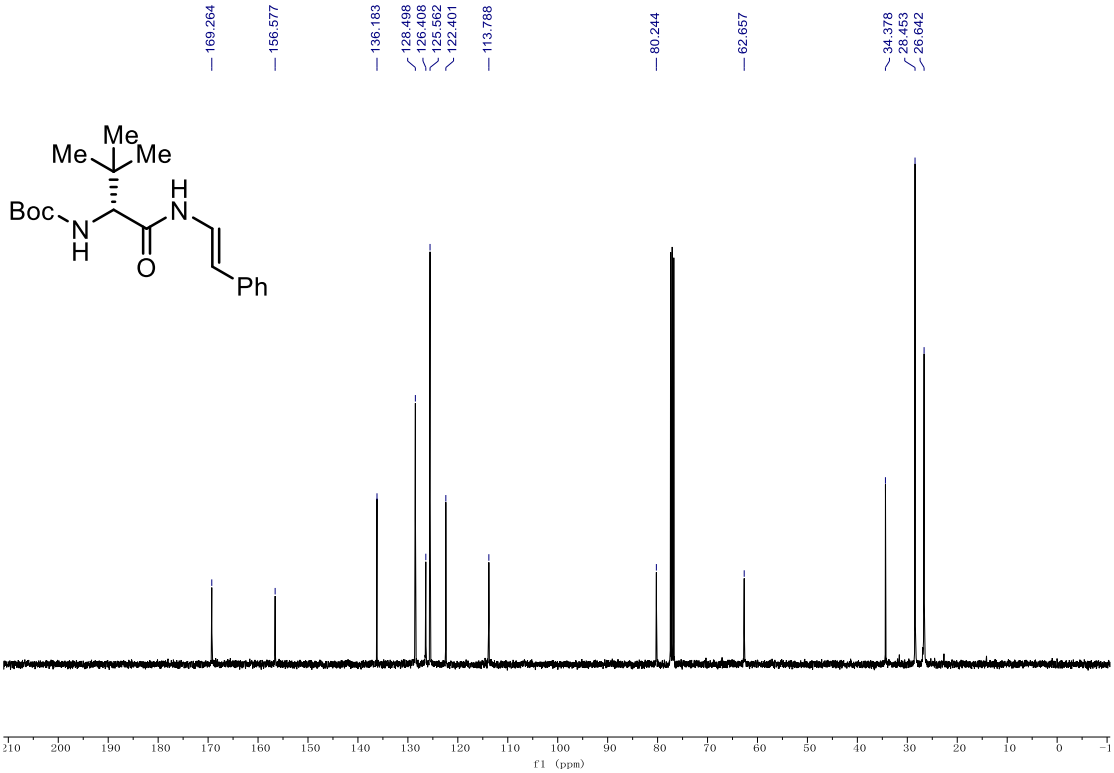
^{13}C NMR spectrum of **37** (**100 MHz, Chloroform-*d***)



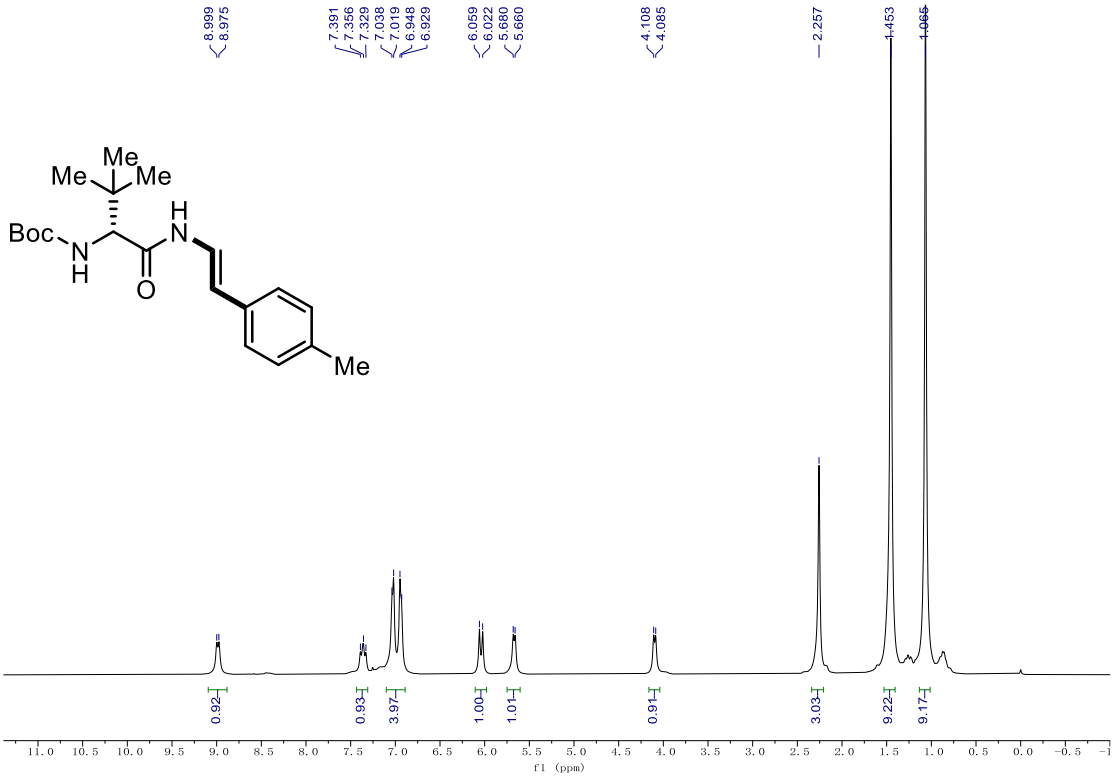
^{1}H NMR spectrum of **38** (**400 MHz, Chloroform-*d***)



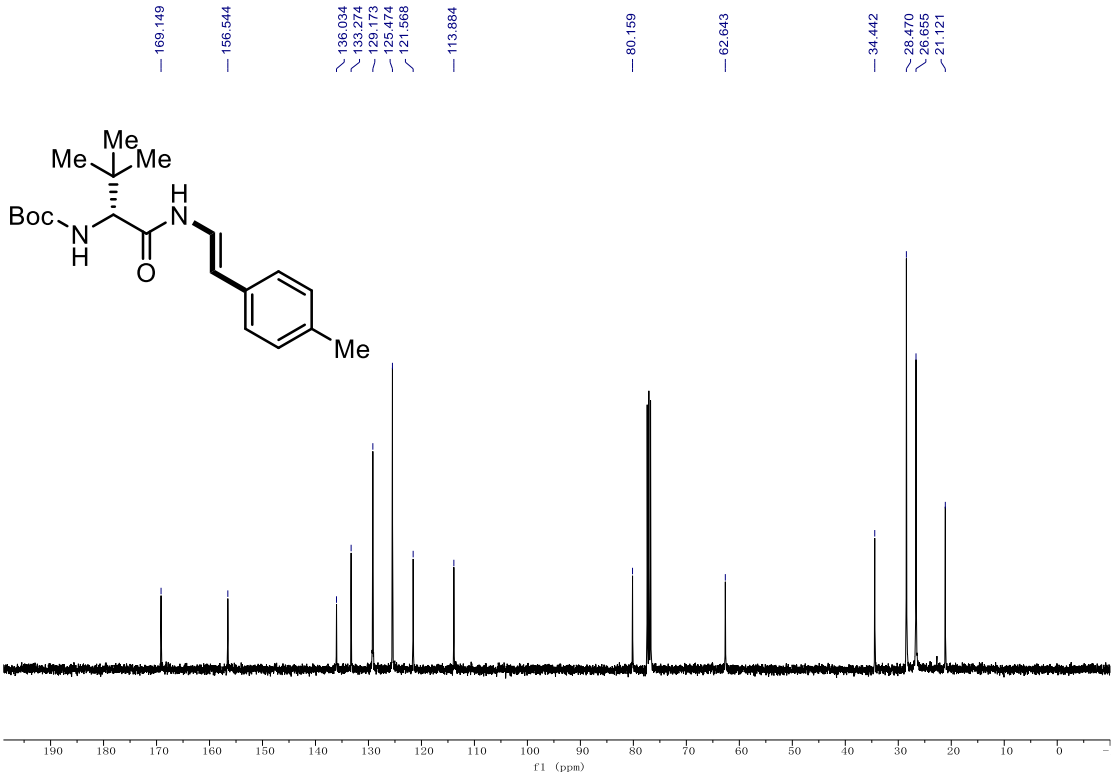
^{13}C NMR spectrum of **38** (**100 MHz, Chloroform-*d***)



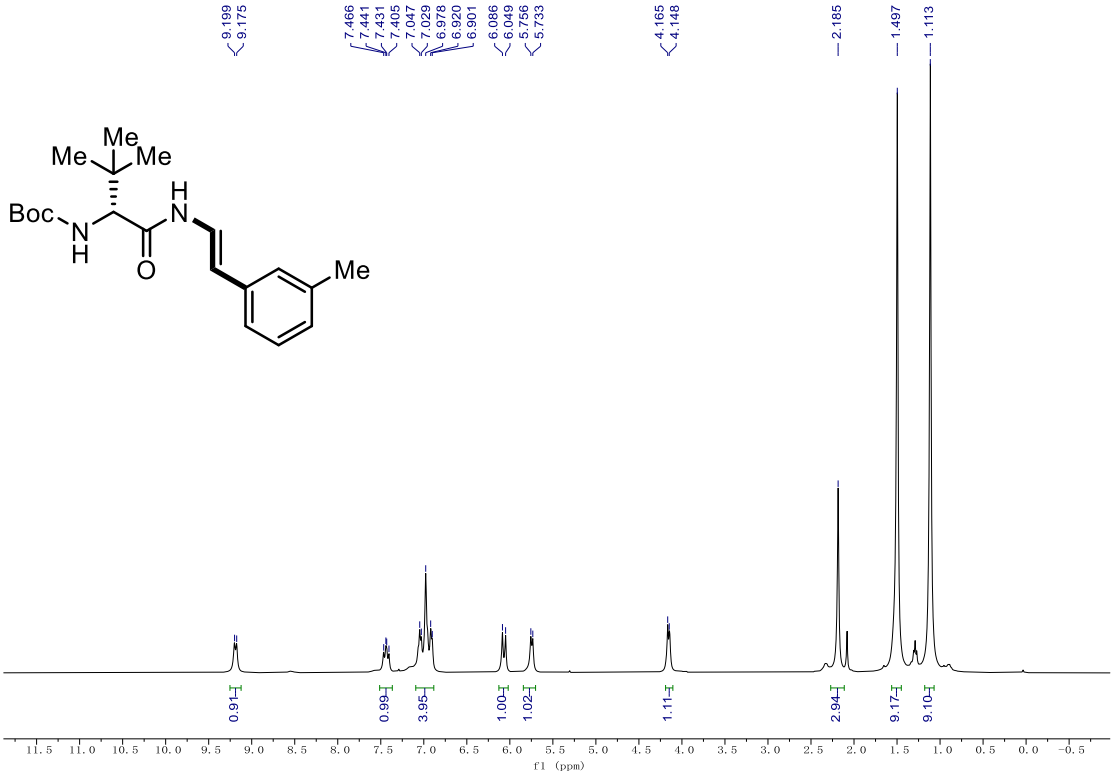
^{1}H NMR spectrum of **39** (**400 MHz, Chloroform-*d***)



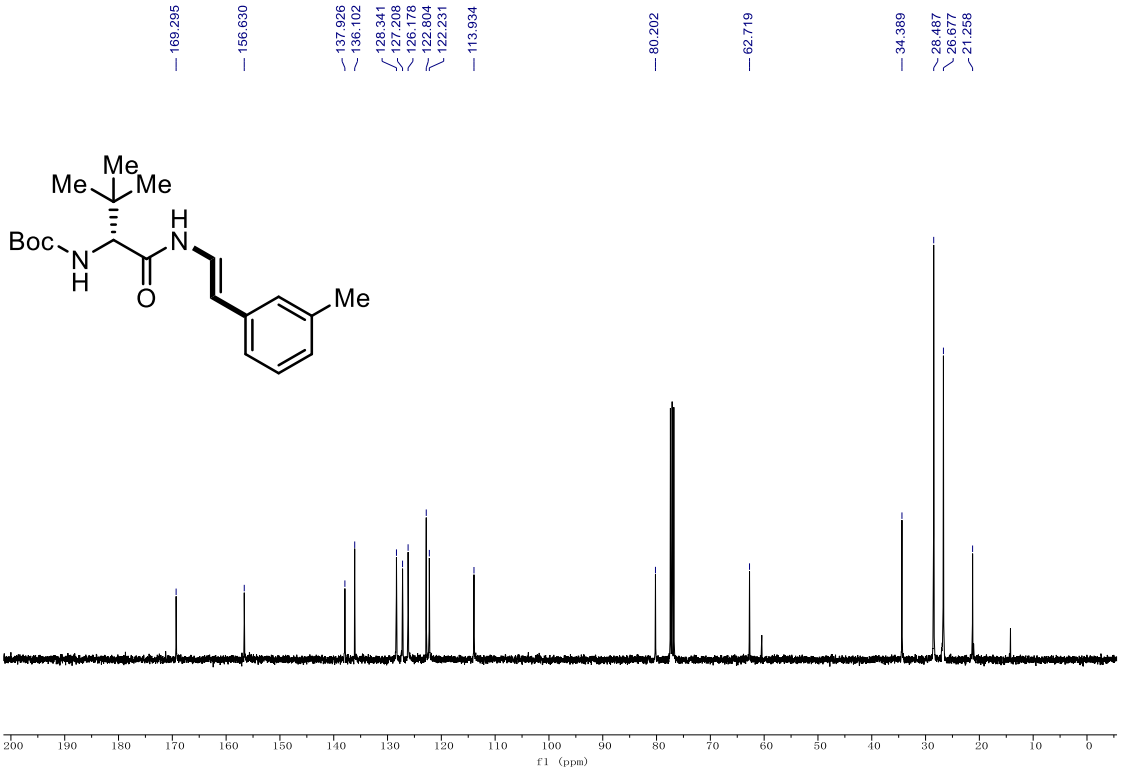
^{13}C NMR spectrum of **39** (**100 MHz, Chloroform-*d***)



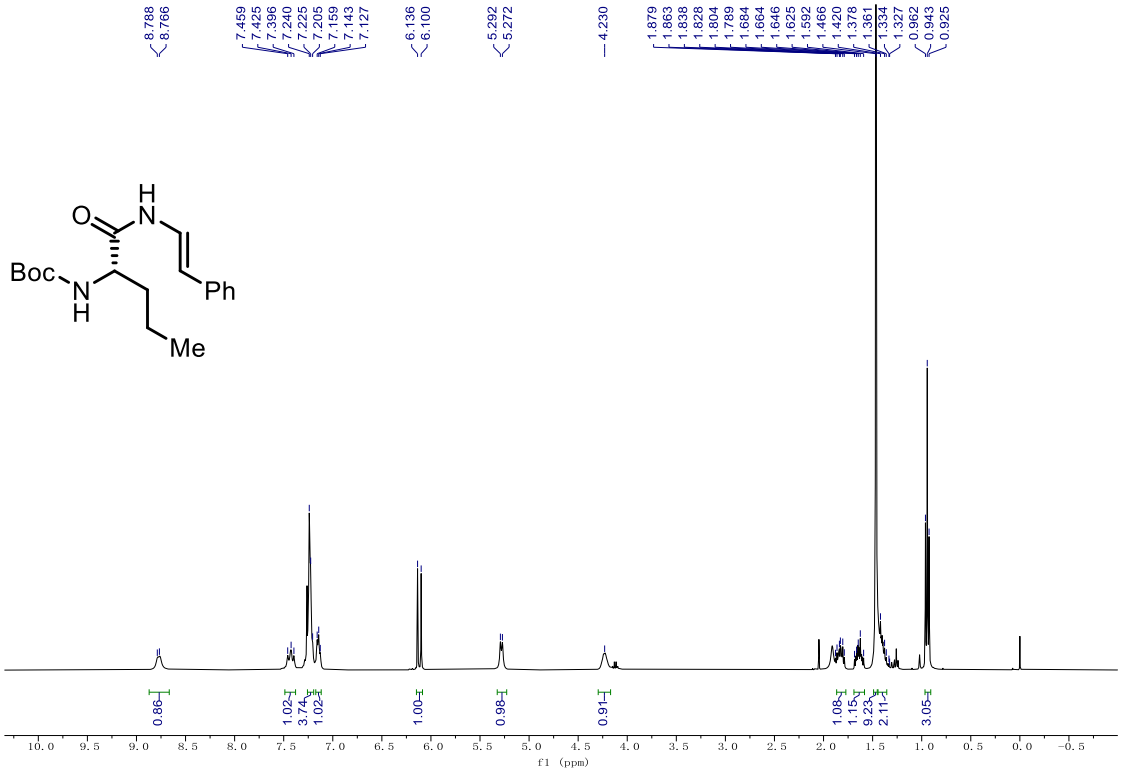
^{1}H NMR spectrum of **40** (**400 MHz, Chloroform-*d***)



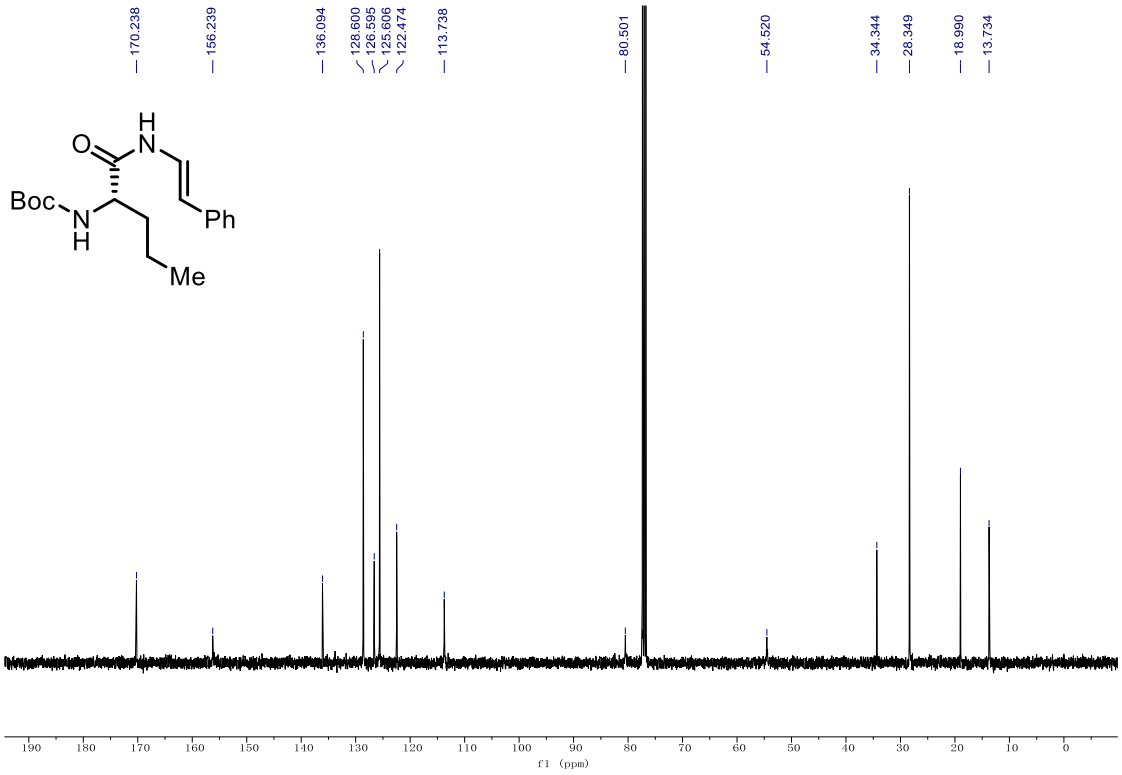
^{13}C NMR spectrum of **40** (**100 MHz, Chloroform-*d***)



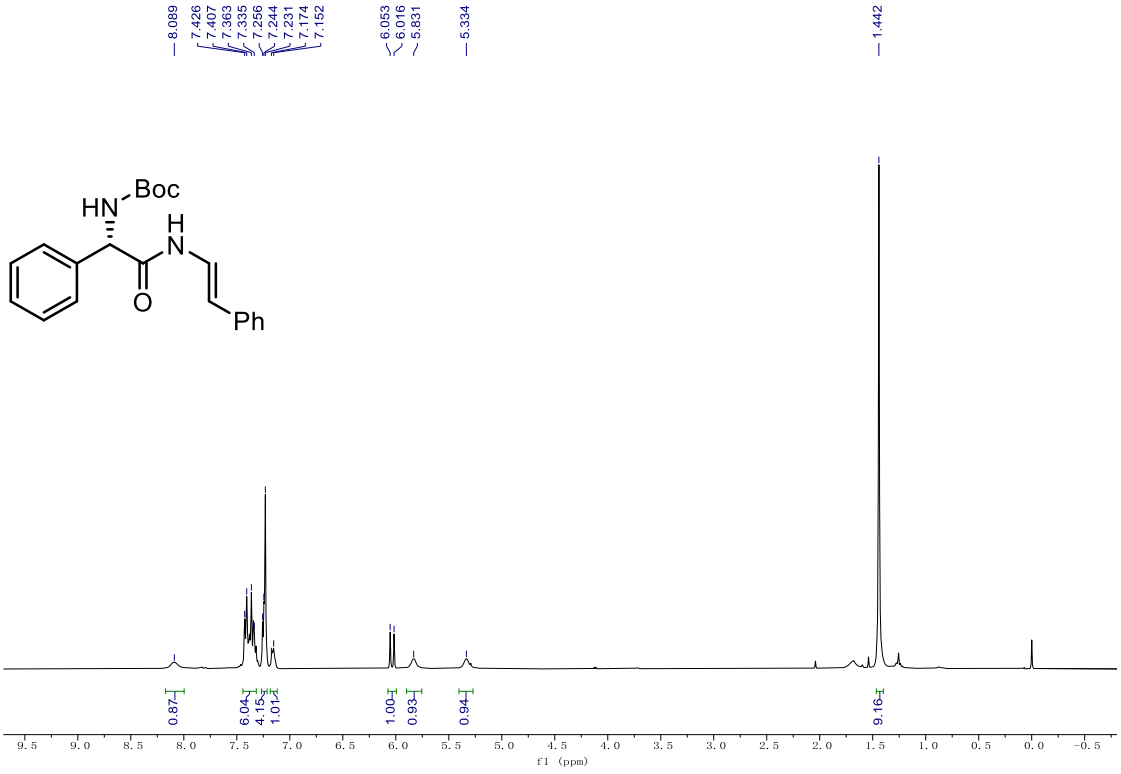
^{1}H NMR spectrum of **41** (**400 MHz, Chloroform-*d***)



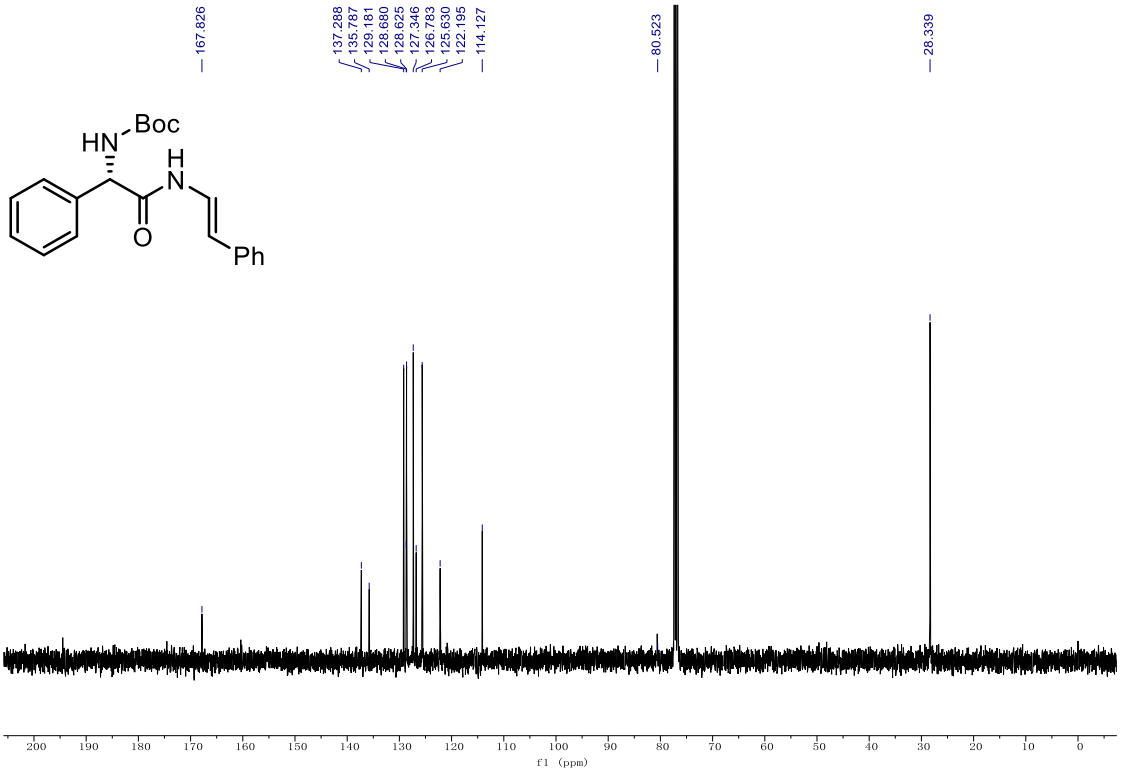
^{13}C NMR spectrum of **41** (**100 MHz, Chloroform-*d***)



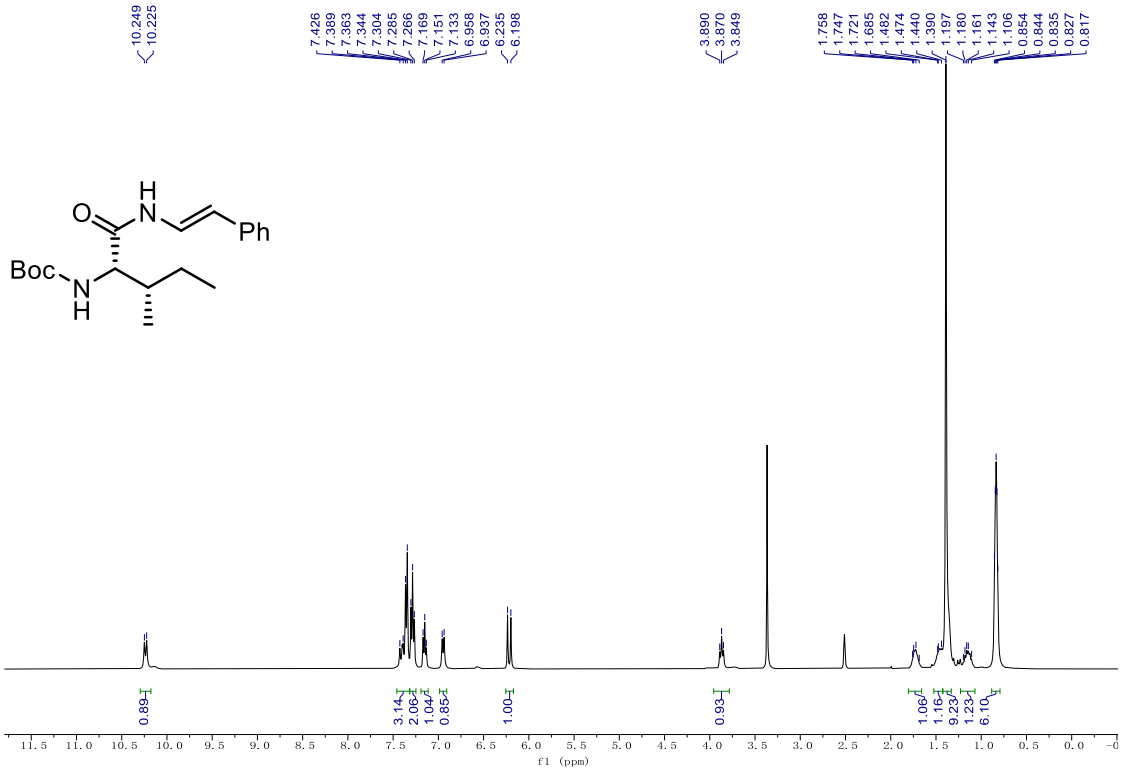
^{1}H NMR spectrum of **42** (**400 MHz, Chloroform-*d***)



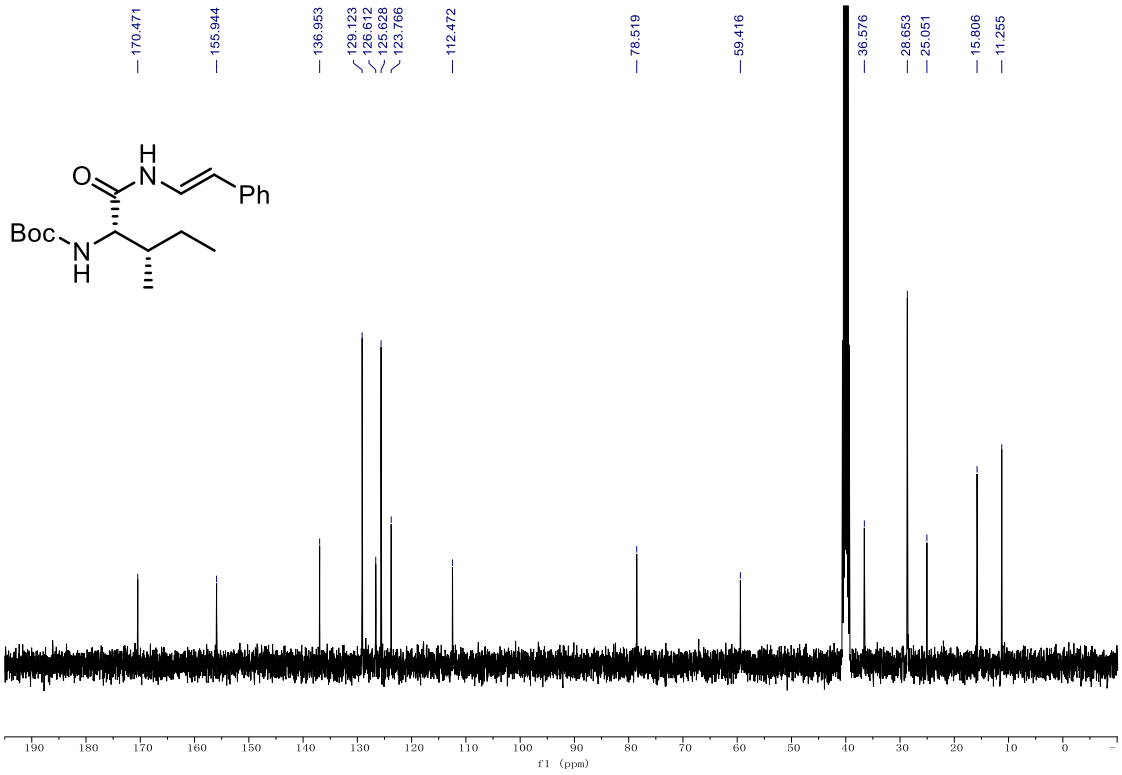
^{13}C NMR spectrum of **42** (**100 MHz, Chloroform-*d***)



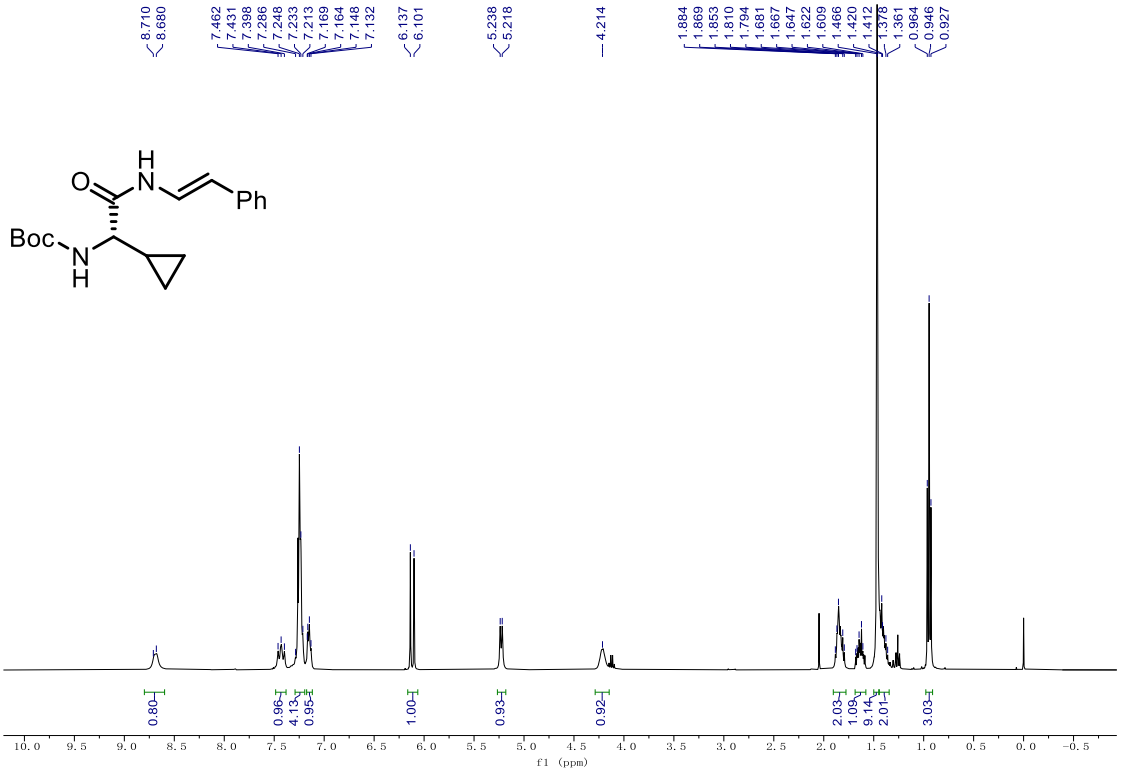
^{1}H NMR spectrum of **43** (**400 MHz, DMSO-*d*$_6$**)



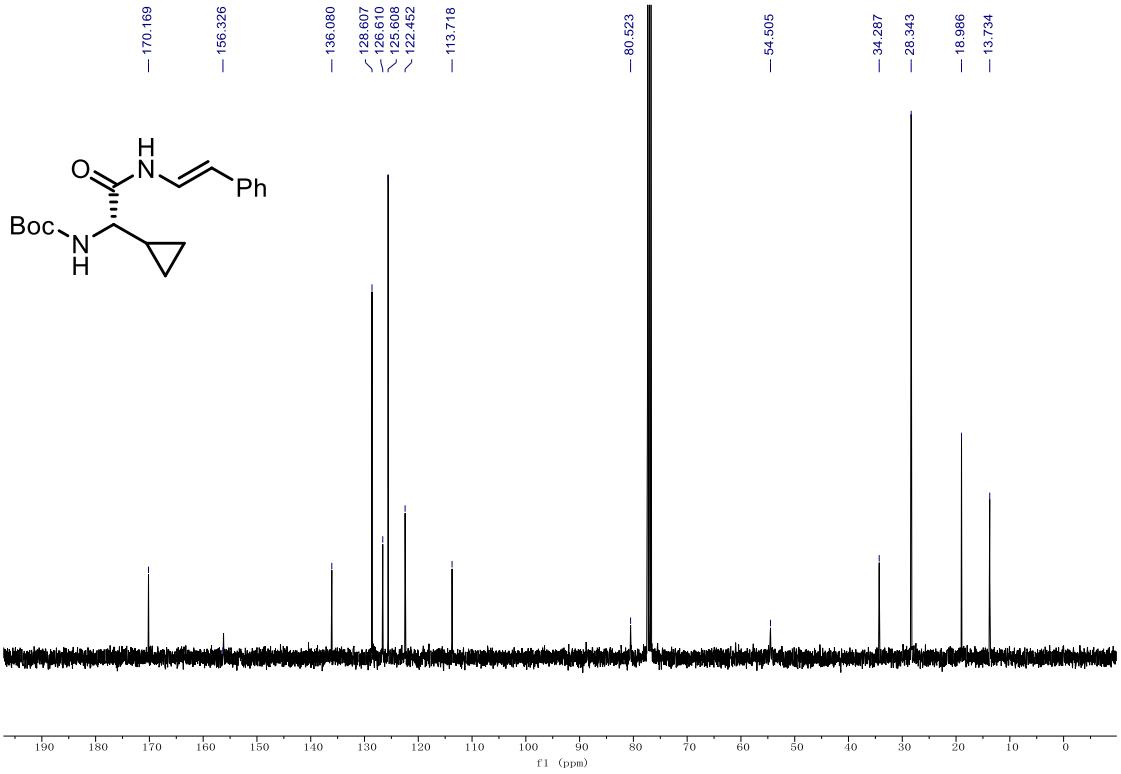
^{13}C NMR spectrum of **43** (**100 MHz, DMSO-*d*$_6$**)



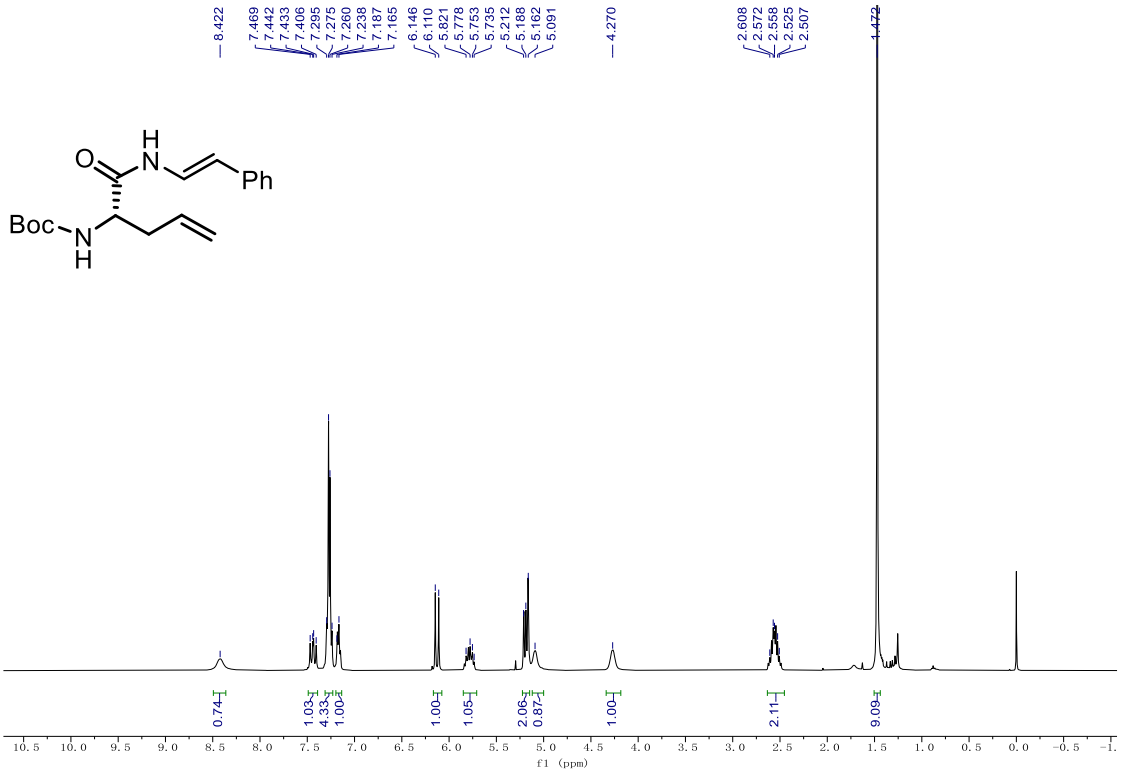
^{1}H NMR spectrum of **44** (**400 MHz, Chloroform-*d***)



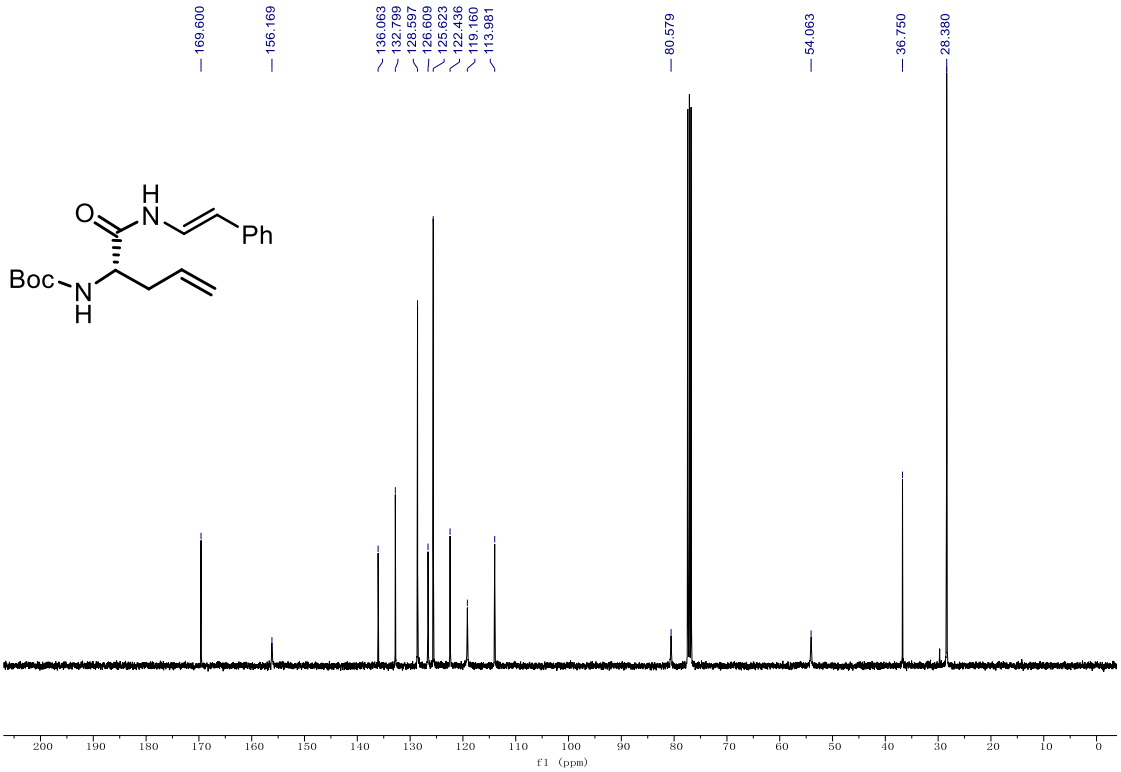
^{13}C NMR spectrum of **44** (**150 MHz, Chloroform-*d***)



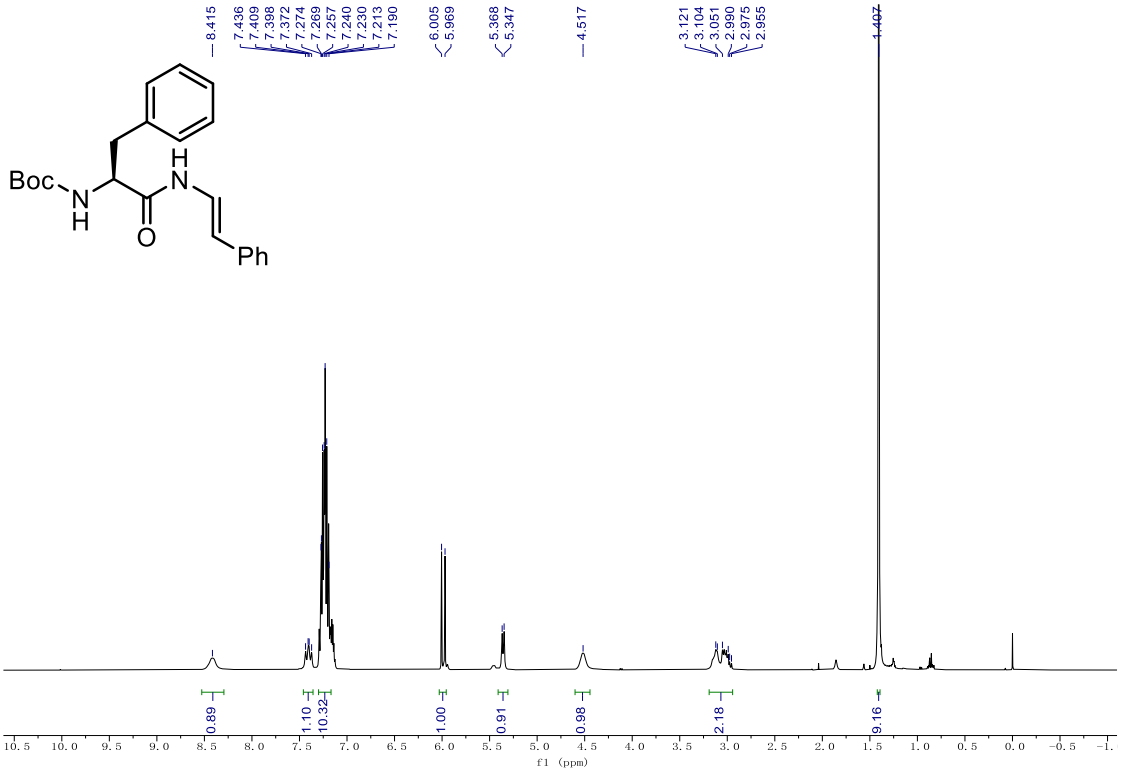
^{1}H NMR spectrum of **45** (**400 MHz, Chloroform-*d***)



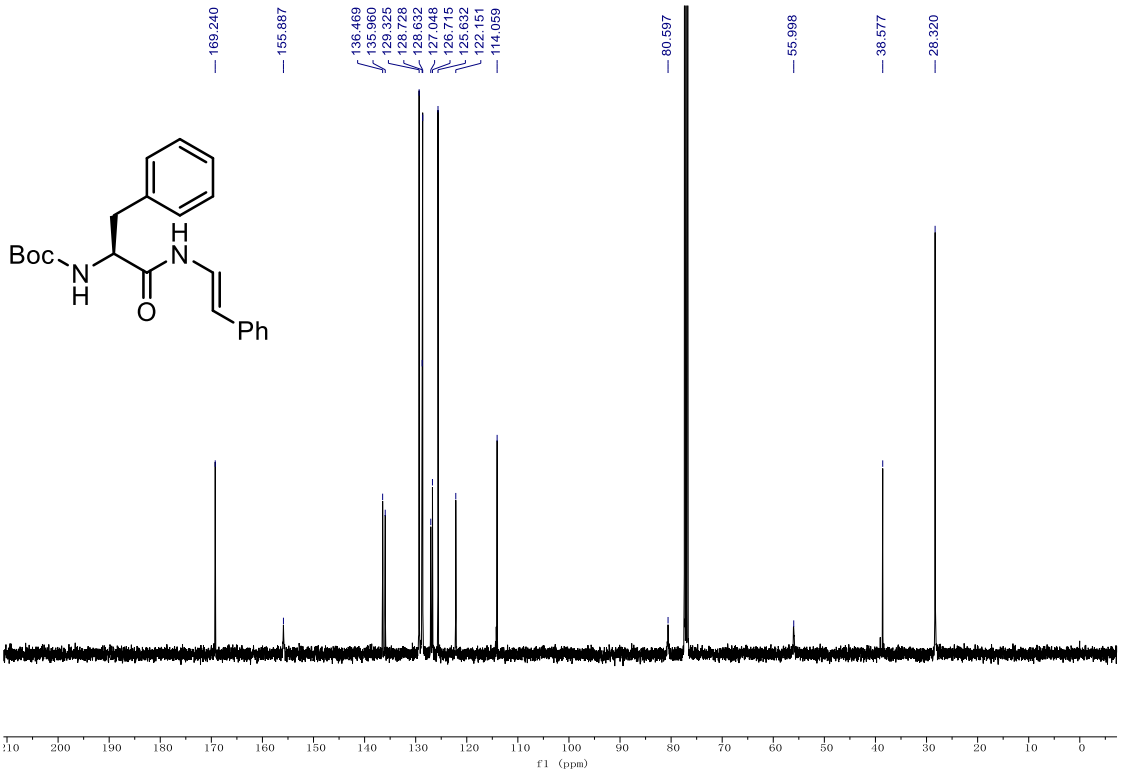
^{13}C NMR spectrum of **45** (**100 MHz, Chloroform-*d***)



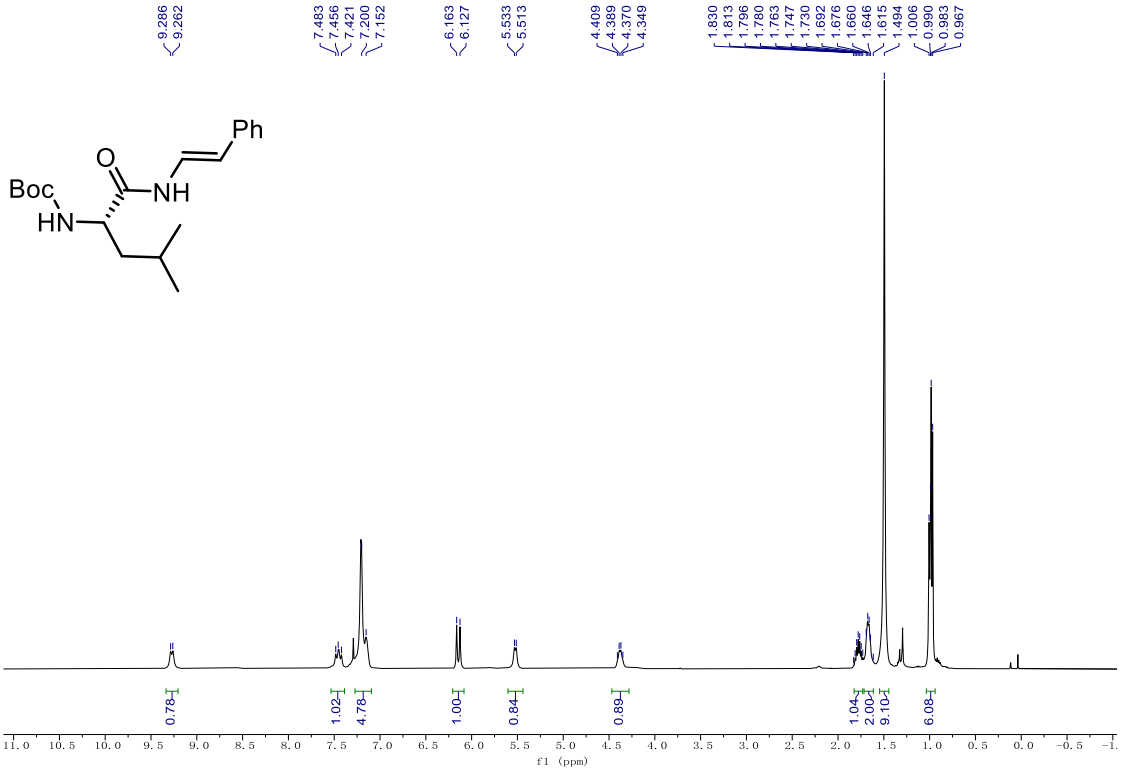
^{1}H NMR spectrum of **46** (**400 MHz, Chloroform-*d***)



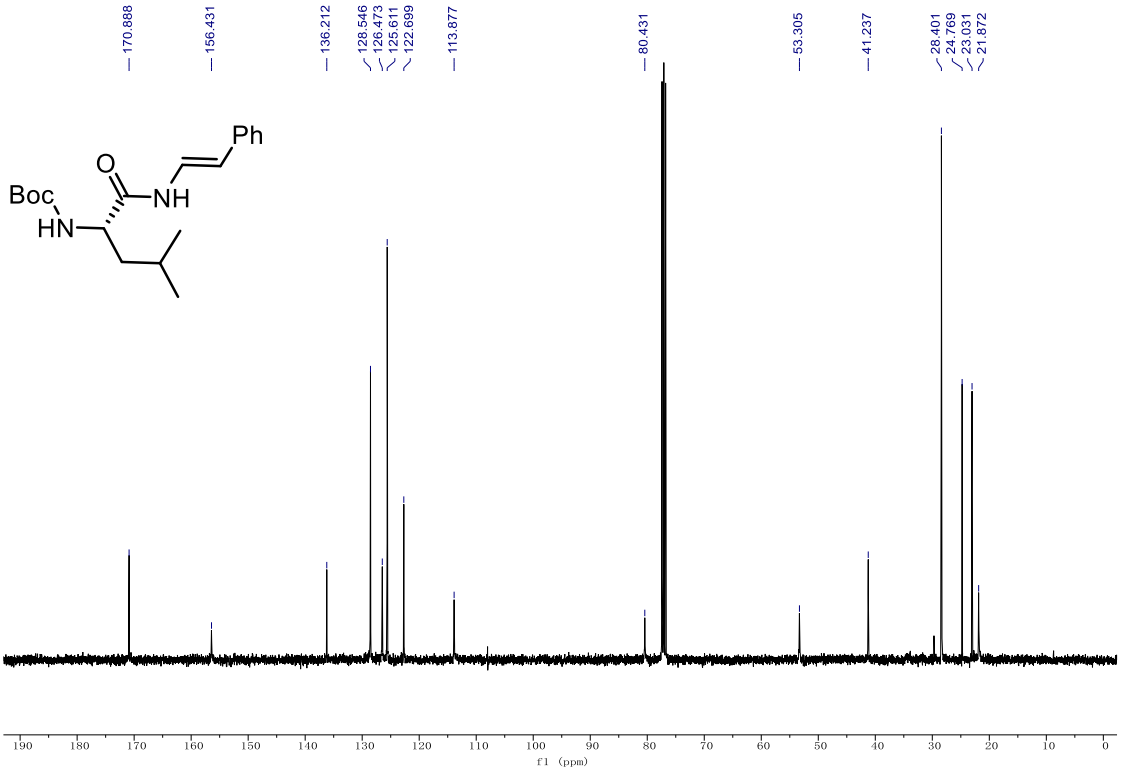
^{13}C NMR spectrum of **46** (**100 MHz, Chloroform-*d***)



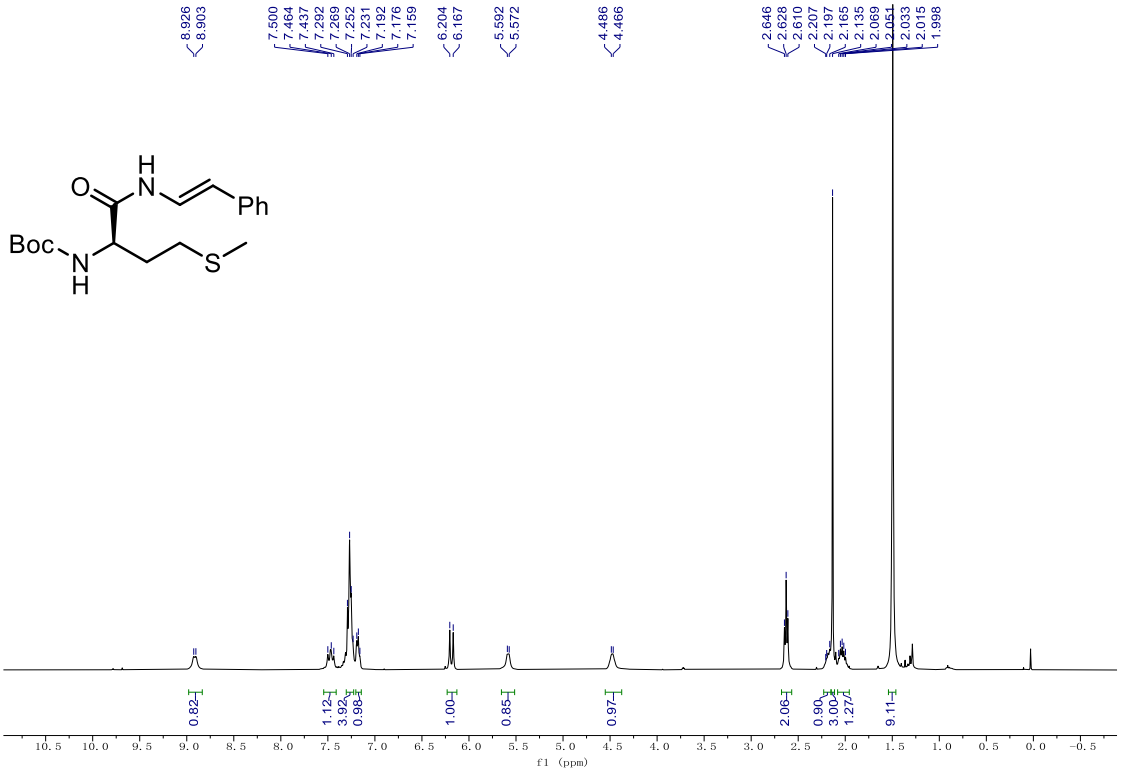
^{1}H NMR spectrum of **47** (**400 MHz, Chloroform-*d***)



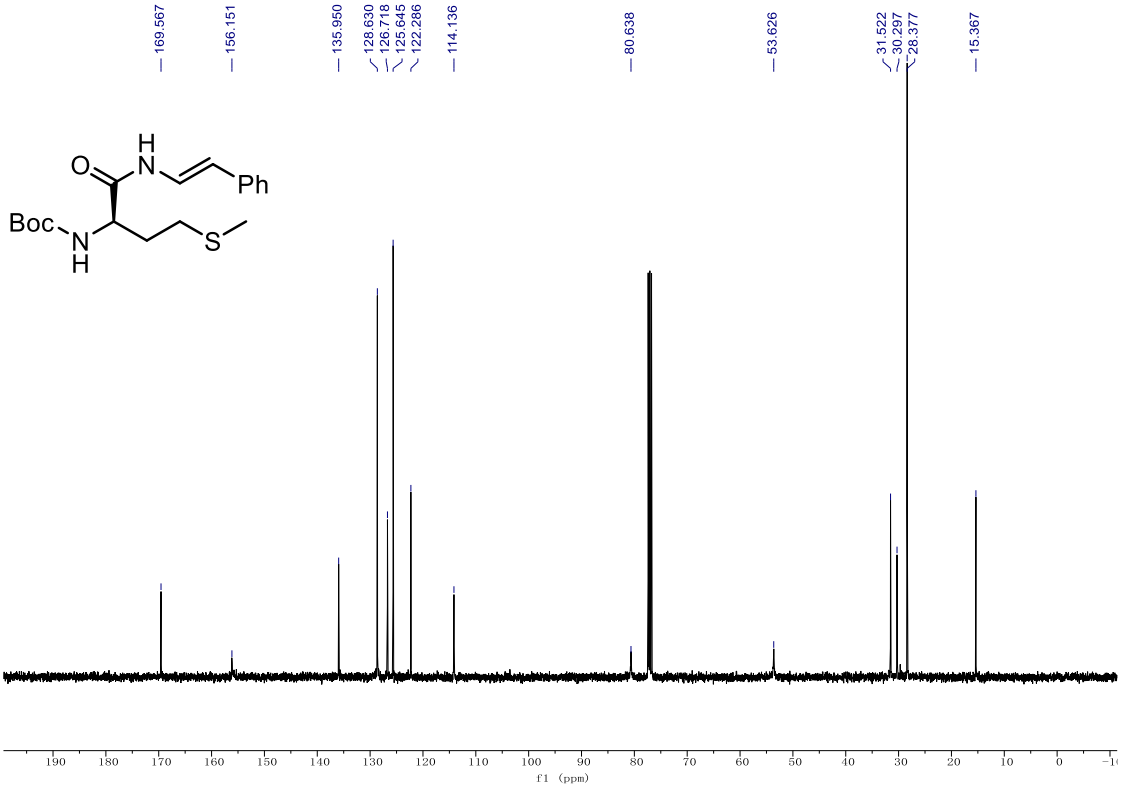
^{13}C NMR spectrum of **47** (**100 MHz, Chloroform-*d***)



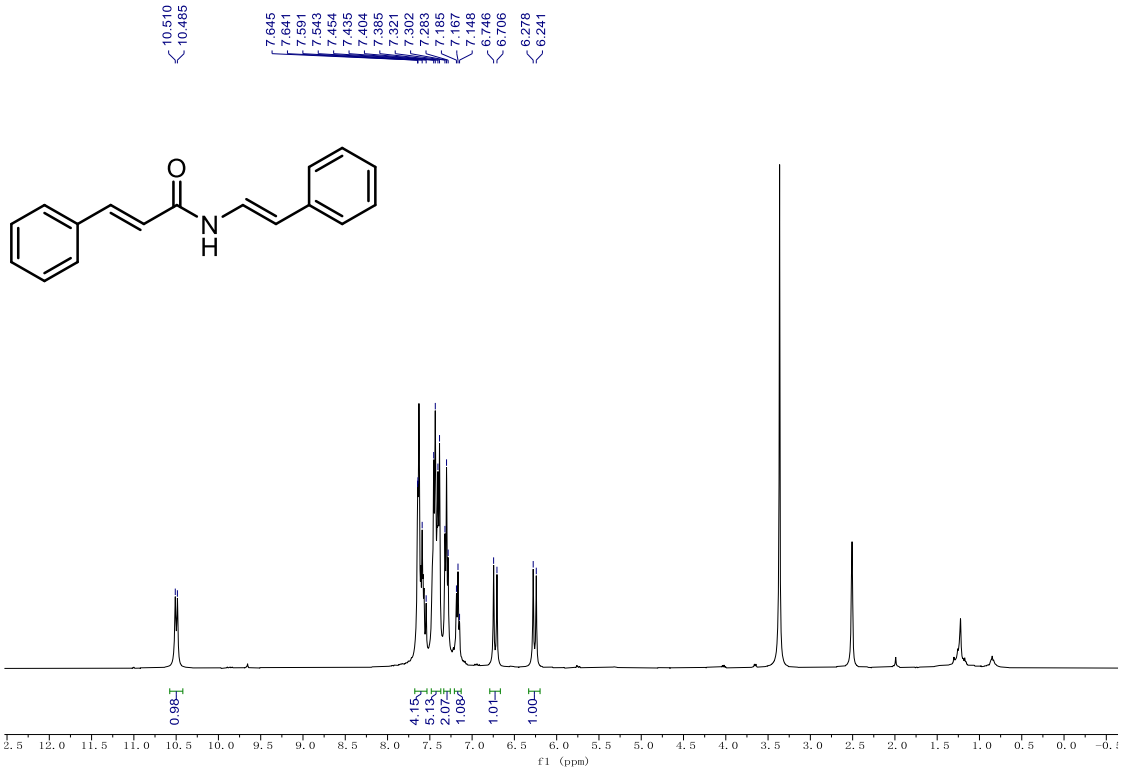
^{1}H NMR spectrum of **48** (**400 MHz, Chloroform-*d***)



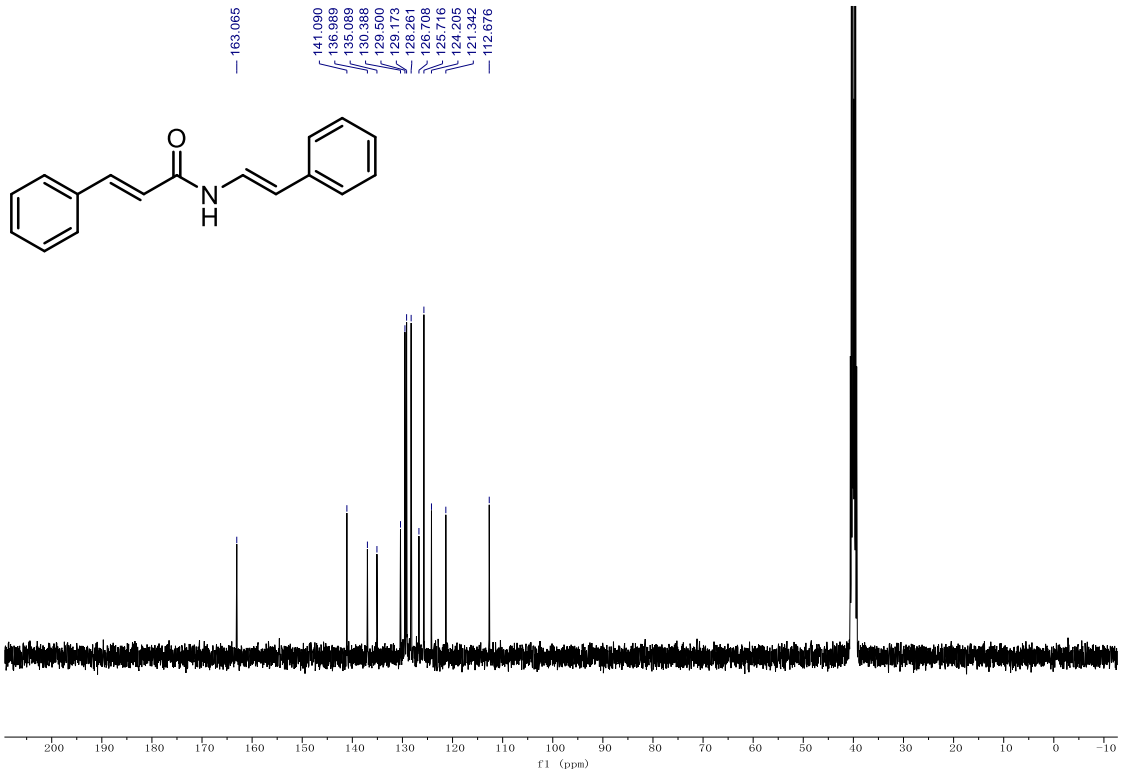
^{13}C NMR spectrum of **48** (**100 MHz, Chloroform-*d***)



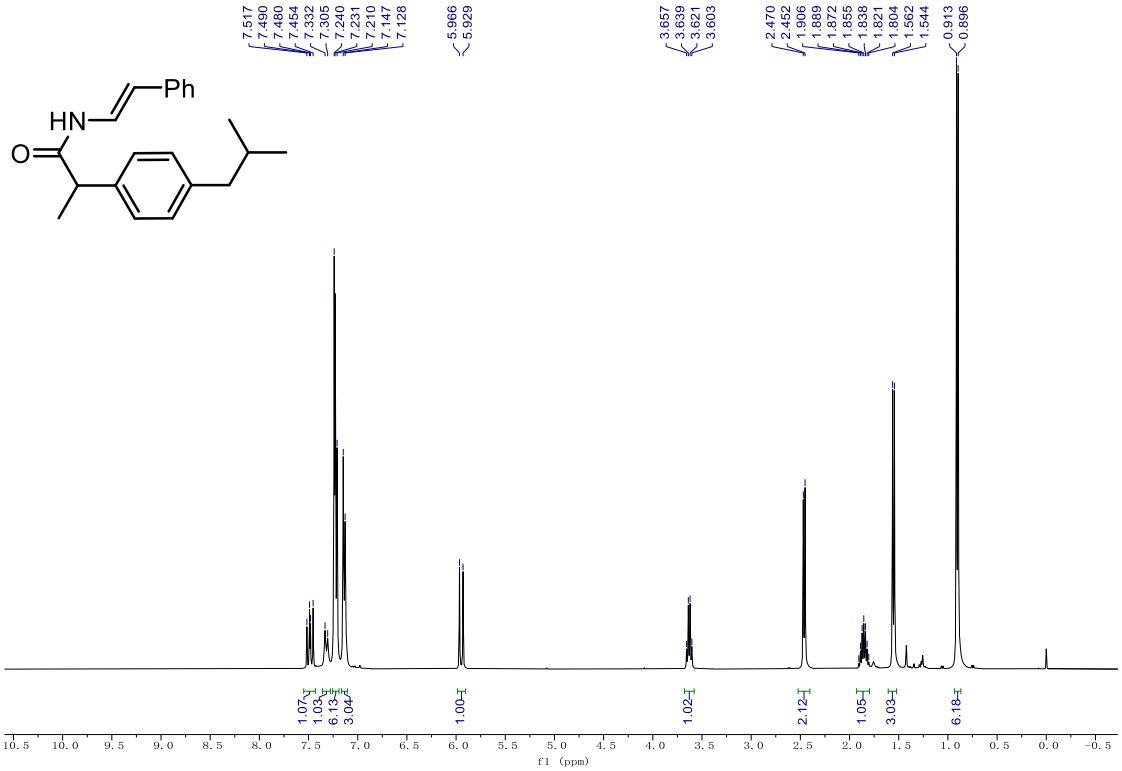
^{1}H NMR spectrum of **49** (**400 MHz, DMSO-*d*$_6$**)



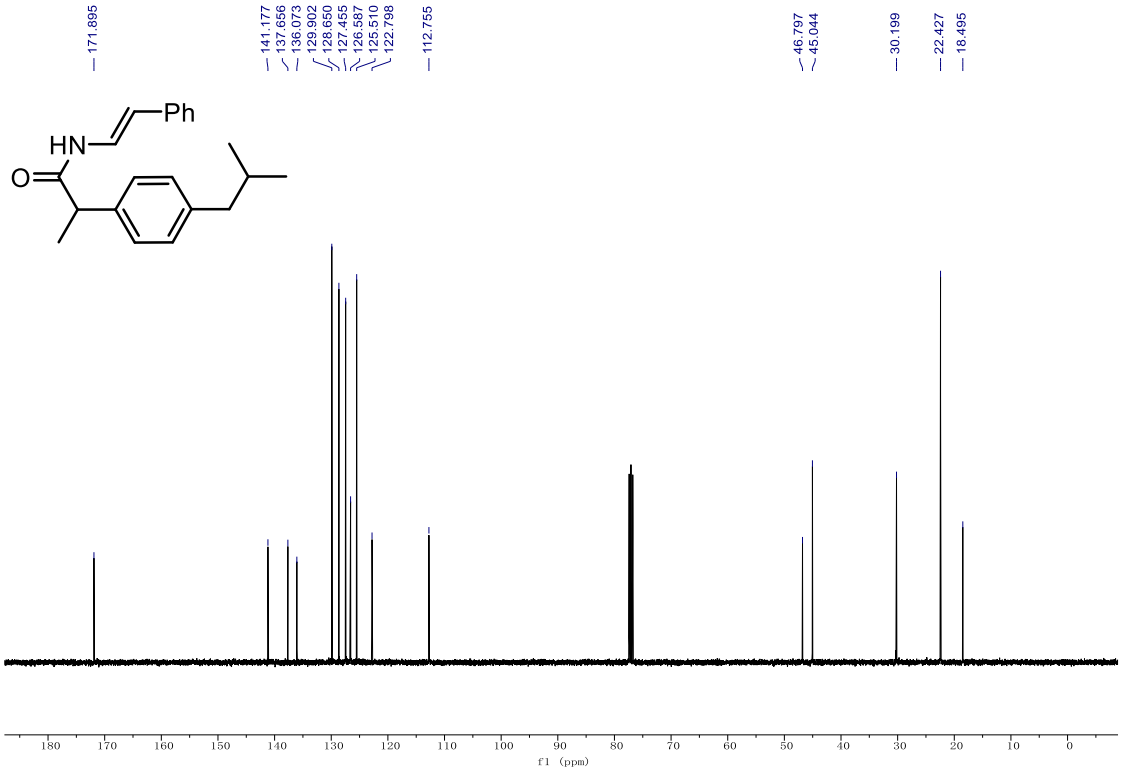
^{13}C NMR spectrum of **49** (**100 MHz, DMSO-*d*$_6$**)



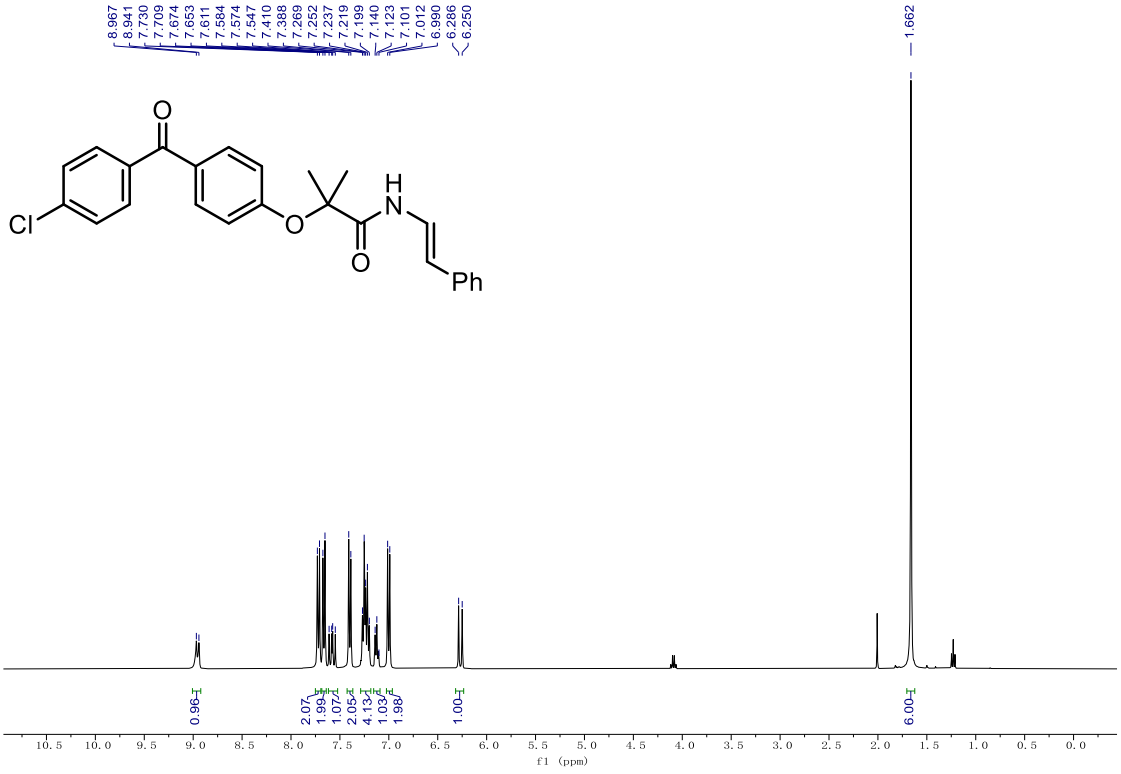
^{1}H NMR spectrum of **50** (**400 MHz, Chloroform-*d***)



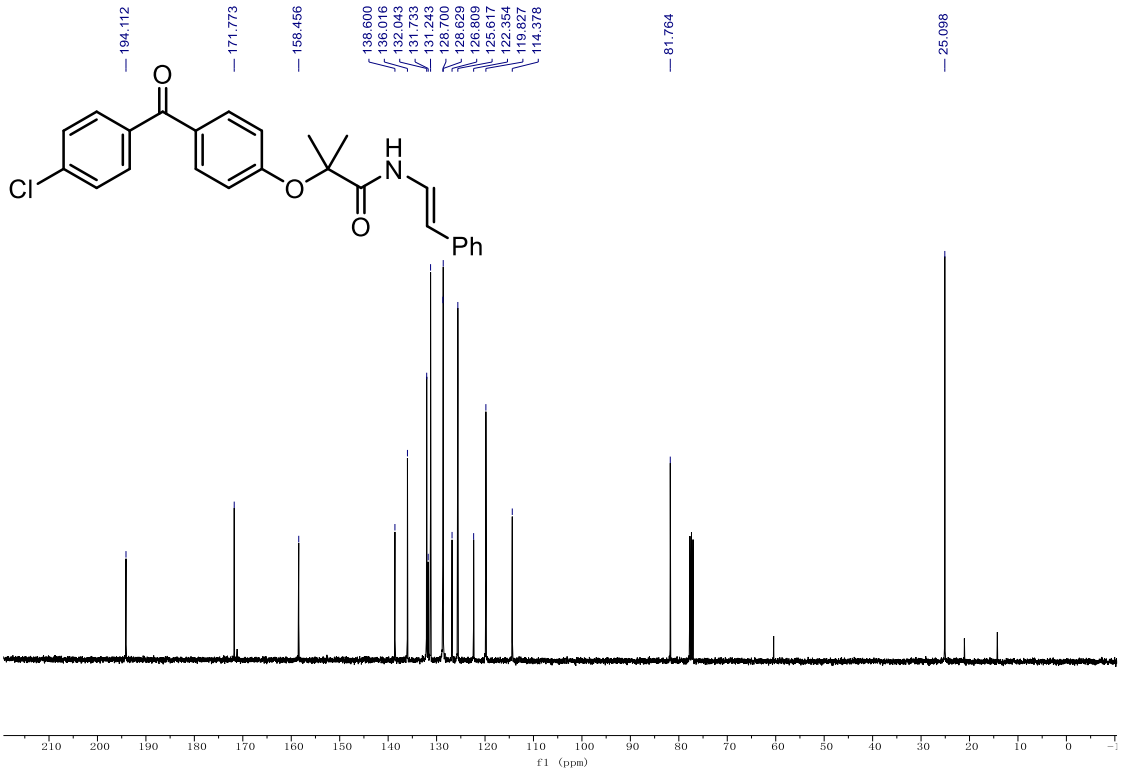
^{13}C NMR spectrum of **50** (**100 MHz, Chloroform-*d***)



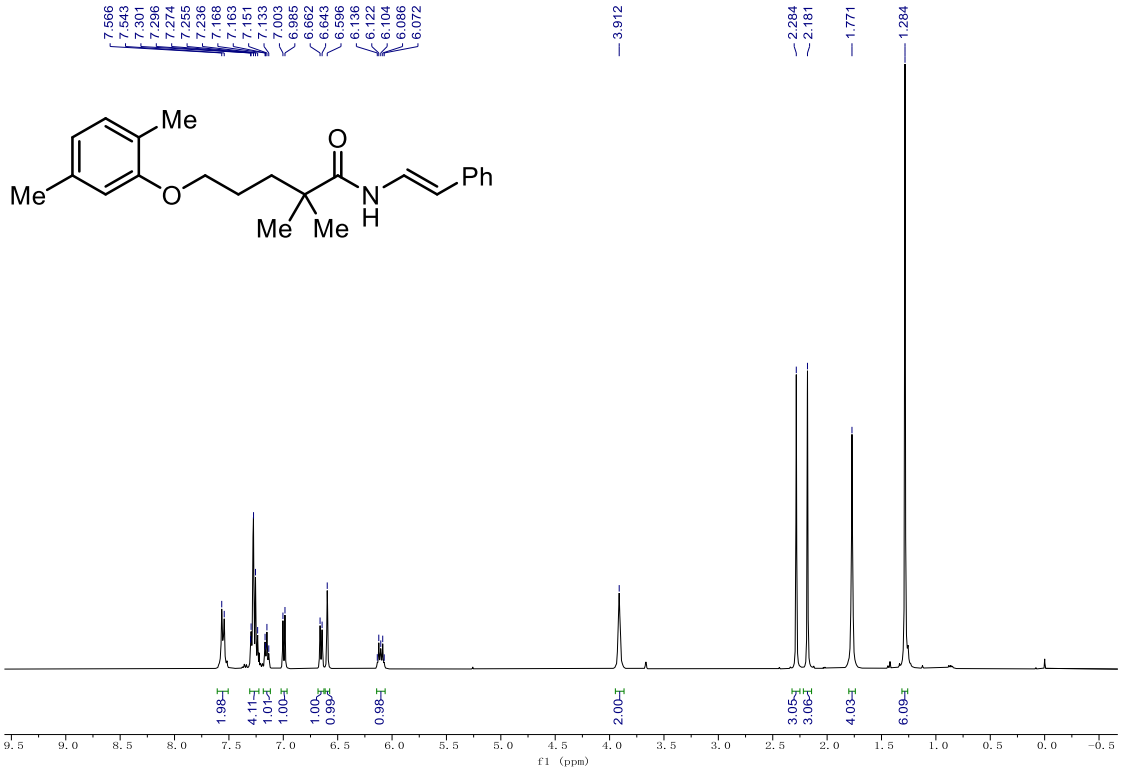
^{1}H NMR spectrum of **51** (**400 MHz, Chloroform-*d***)



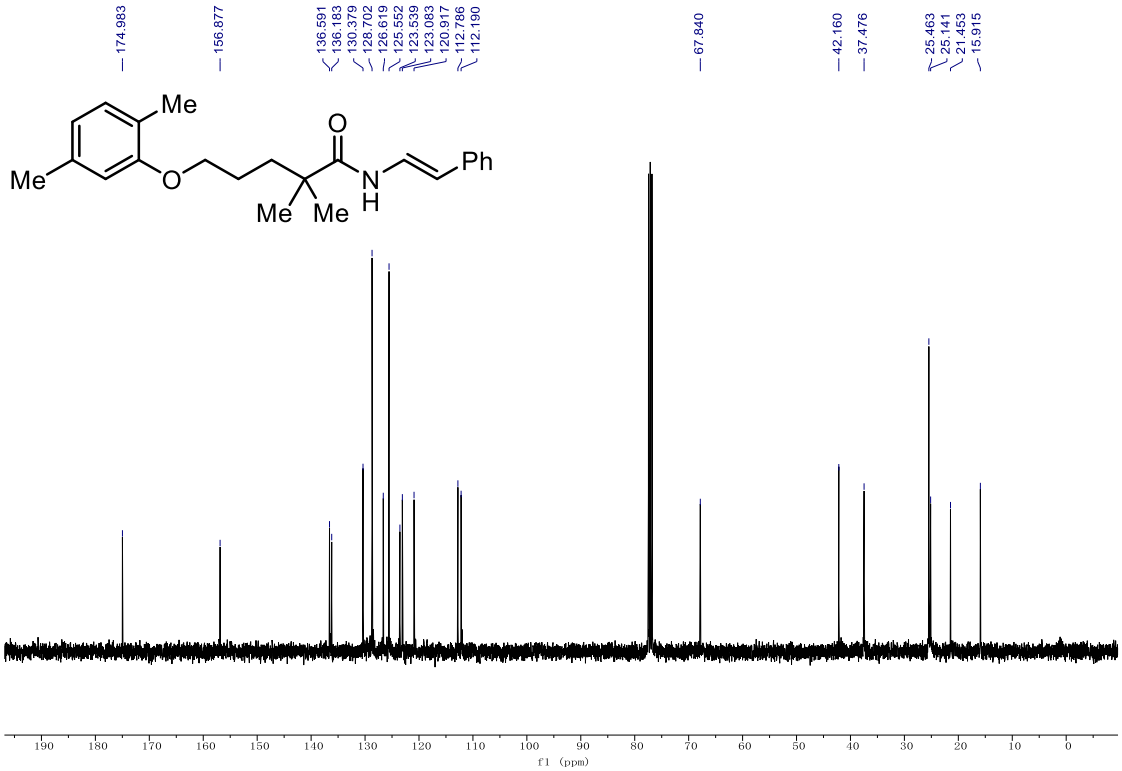
^{13}C NMR spectrum of **51** (**100 MHz, Chloroform-*d***)



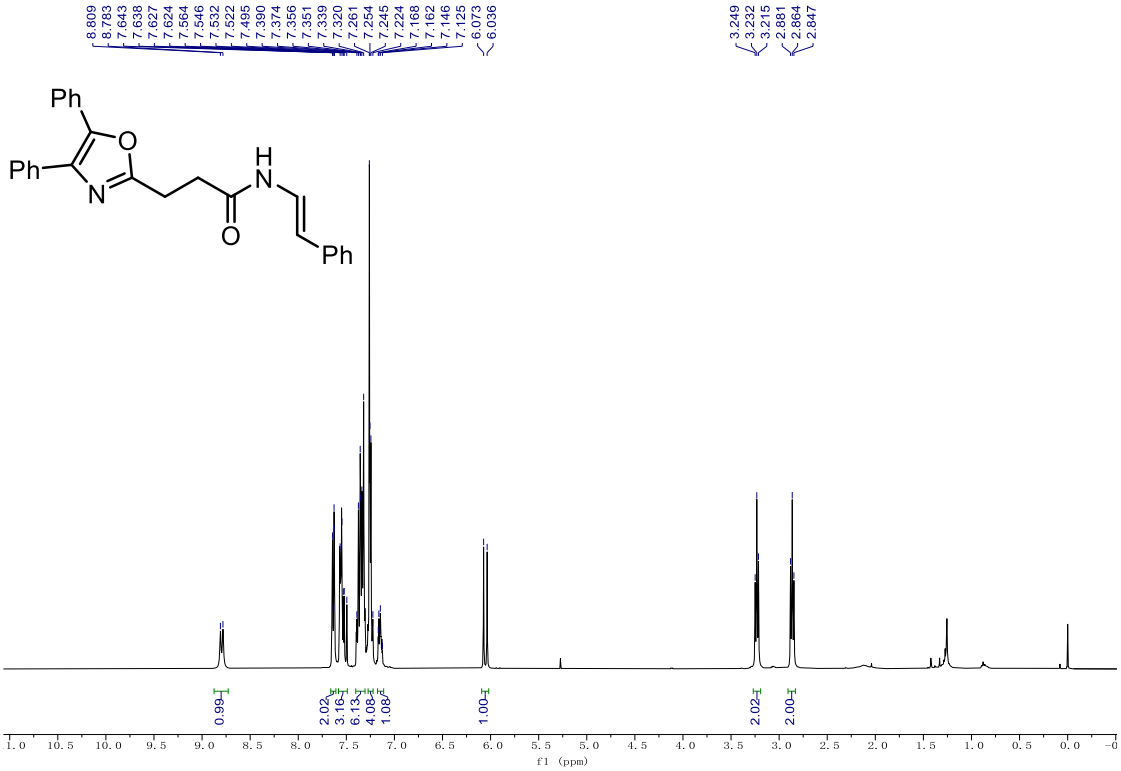
^{1}H NMR spectrum of **52** (**400 MHz, Chloroform-*d***)



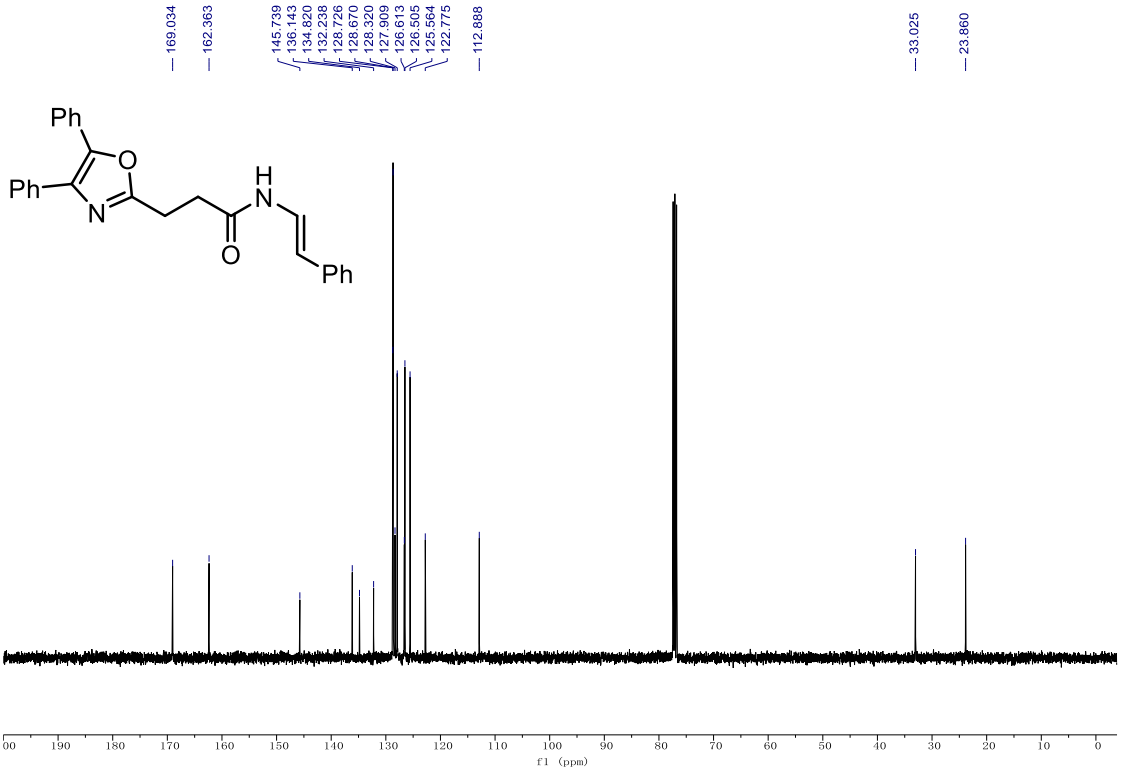
^{13}C NMR spectrum of **52** (**100 MHz, Chloroform-*d***)



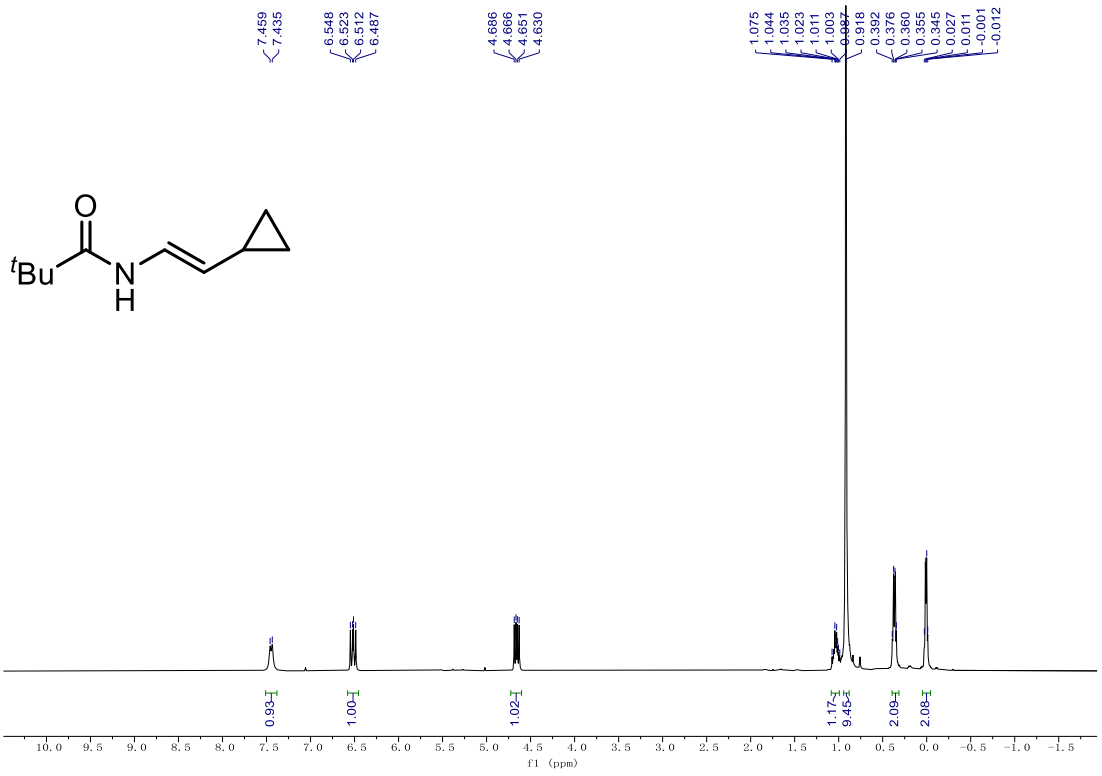
^{1}H NMR spectrum of **53** (**400 MHz, Chloroform-*d***)



^{13}C NMR spectrum of **53** (**100 MHz, Chloroform-*d***)



^{1}H NMR spectrum of **54** (**400 MHz, Chloroform-*d***)



^{13}C NMR spectrum of **54** (**100 MHz, Chloroform-*d***)