Supporting Information

Skeletal remodeling of chalcone-based pyridinium salts to access isoindoline polycycles and their bridged derivatives

Lele Wang, [a,+] Huabin Han,[a,+] Lijie Gu, [a] Wenjing Zhang, [b*] Junwei Zhao, [a,*] and Qilin Wang [a,*]

[a] College of Chemistry and Chemical Engineering, Henan University, Kaifeng 475004, China

[b] Green Catalysis Center, and College of Chemistry, Zhengzhou University, Zhengzhou 450001, China

[+] These authors contributed equally to this work.

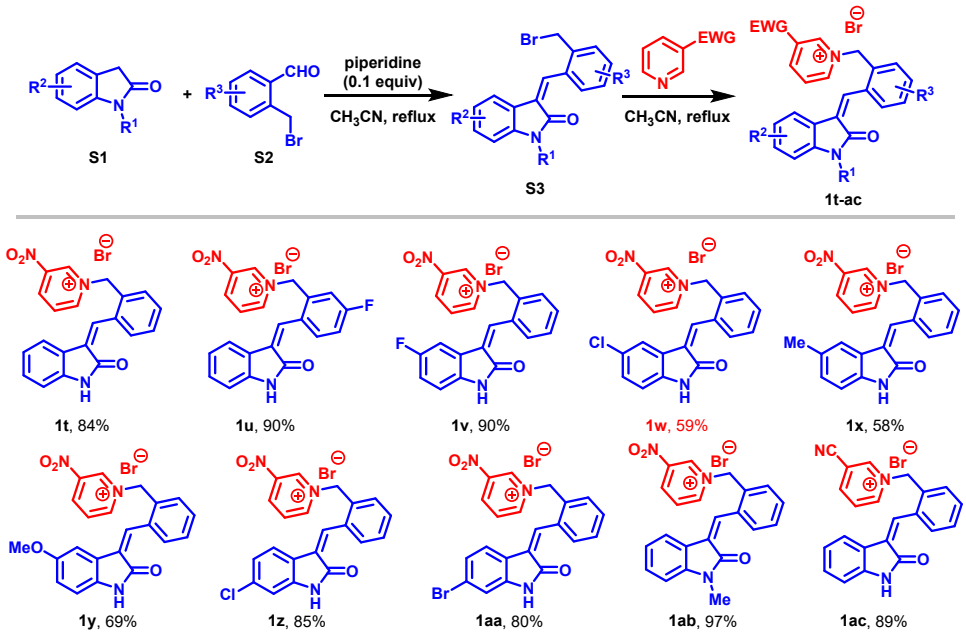
E-mail: wangqilin@henu.edu.cn, zhangwj@zzu.edu.cn, zhaojunwei@henu.edu.cn.

Table of Contents

1. General methods

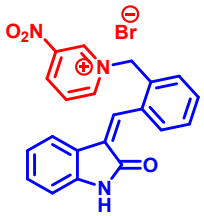
NMR spectra were recorded with tetramethylsilane as the internal standard. ^{1}H NMR spectra were recorded at 400 MHz, and ^{13}C NMR spectra were recorded at 100 MHz (Bruker Avance). ^{1}H NMR chemical shifts (δ) are reported in ppm relative to tetramethylsilane (TMS) with the solvent signal as the internal standard ($CDCl_3$ at 7.26 ppm, $(CD_3)_2SO$ at 2.50 ppm). ^{13}C NMR chemical shifts are reported in ppm from tetramethylsilane (TMS) with the solvent resonance as the internal standard ($CDCl_3$ at 77.00 ppm, $(CD_3)_2SO$ at 39.52 ppm). Data are given as: s (singlet), d (doublet), t (triplet), q (quartet), dd (double of doublet), br (broad) or m (multiplets), coupling constants (Hz) and integration. Flash column chromatography was carried out using silica gel eluting with ethyl acetate and petroleum ether. High resolution mass spectra were obtained with the Q-TOF-Premier mass spectrometer. Reactions were monitored by TLC and visualized with ultraviolet light. IR spectra were recorded on a Thermo Fisher Nicolet Avatar 360 FTIR spectrometer on a KBr beam splitter. All the solvents were used directly without any purification. Pyridinium salts **1a-s** were prepared according to our previous method.[1]

2. Experimental data for the preparation of 1t-ac



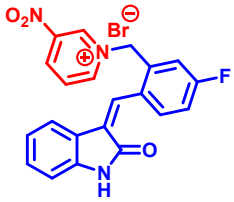
General procedure (step 1): To a mixture of **S1** (1.0 equiv) and **S2**[2] (1.2 equiv) in CH_3CN was added piperidine (0.1 equiv). The reaction mixture was stirred at 80 °C until complete consumption of **S1** (monitored by TLC). Then, the solvent was removed in vacuum and the crude reaction mixture was purified by silica gel column chromatography using petroleum ether/ethyl

acetate (v/v = 4:1) as the eluent to give **S3**. (**Step 2**): To a solution of **S3** (1.0 equiv) in CH_3CN, 3-nitropyridine (1.0 equiv) was added. The reaction mixtures were stirred under reflux until completion as monitored by TLC. During the reaction processes, the pyridinium salts **1t-ac** were precipitated from the reaction system, and a simple filtration was employed to purify them.



(*Z*)-3-nitro-1-(2-((2-oxoindolin-3-ylidene)methyl)benzyl)pyridin-1-ium bromide (**1t**)

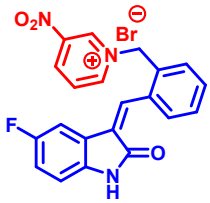
According to the general procedure, **1t** was prepared on a scale of 4.8 mmol. Yellow solids, 1.77 g, 84% isolated yield obtained by filtration of the precipitate; Reaction time = 20 h; mp 185.0-185.6 ^{o}C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.65 (s, 1H), 10.15 (s, 1H), 9.32 (d, J = 8.0 Hz, 1H), 9.22 (dd, J_1 = 8.0 Hz, J_2 = 4.0 Hz, 1H), 8.27 (q, J = 4.0 Hz, 1H), 7.80 (s, 1H), 7.61-7.56 (m, 3H), 7.51-7.49 (m, 1H), 7.18 (t, J = 8.0 Hz, 1H), 6.82 (d, J = 8.0 Hz, 1H), 6.65 (d, J = 8.0 Hz, 1H), 6.52 (d, J = 4.0 Hz, 1H), 6.18 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.5, 149.8, 145.8, 143.0, 142.7, 140.0, 135.1, 132.5, 131.6, 131.0, 130.7, 130.0, 129.9, 129.8, 129.2, 128.9, 122.3, 121.2, 120.4, 110.2, 62.1. IR (KBr) v 3432, 3134, 3060, 1700, 1354, 748 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{16}N_3O_3$ $[M\text{-}Br]^+$ 358.1186, found 358.1186.



(*Z*)-1-(5-fluoro-2-((2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1u**)

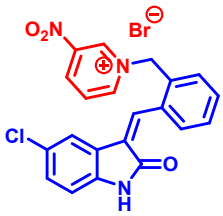
According to the general procedure, **1u** was prepared on a scale of 1.89 mmol. Yellow solids, 0.78 g, 90% isolated yield obtained by filtration of the precipitate; Reaction time = 80 h; mp 188.1-189.1 ^{o}C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.73 (s, 1H), 10.22 (s, 1H), 9.45 (d, J = 4.0 Hz, 1H), 9.27 (d, J = 12.0 Hz, 1H), 8.34 (t, J = 8.0 Hz, 1H), 7.75 (s, 1H), 7.65 (q, J = 4.0 Hz, 1H), 7.46-7.43 (m, 2H), 7.18 (t, J = 8.0 Hz, 1H), 6.85 (d, J = 8.0 Hz, 1H), 6.68 (t, J = 8.0 Hz, 1H), 6.61 (d, J = 8.0 Hz, 1H), 6.26 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.5, 162.3 (d, J = 246.0 Hz, 1C), 150.0, 146.0 (d, J = 5.0 Hz, 1C), 143.1, 143.0, 140.2, 134.4 (d, J = 8.0 Hz, 1C), 131.6, 131.5,

131.2, 131.1, 130.7, 129.1, 122.4, 121.2, 120.4, 117.1, 116.8 (d, J = 22.0 Hz, 1C), 110.3, 61.4; ^{19}F NMR (375 MHz, $CDCl_3$) δ -110.7. IR (KBr) v 3441, 3136, 1706, 1357, 777 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{15}FN_3O_3$ $[M\text{-}Br]^+$ 376.1092, found 376.1091.



(*Z*)-1-(2-((5-fluoro-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1v**)

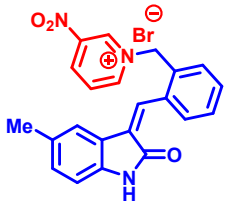
According to the general procedure, **1v** was prepared on a scale of 2.6 mmol. Yellow solids, 1.07 g, 90% isolated yield obtained by filtration of the precipitate; Reaction time = 41 h; mp 200.1-201.5 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.71 (s, 1H), 10.18 (s, 1H), 9.39 (d, J = 8.0 Hz, 1H), 9.30 (d, J = 12.0 Hz, 1H), 8.35 (q, J = 4.0 Hz, 1H), 7.89 (s, 1H), 7.61-7.57 (m, 3H), 7.49 (d, J = 8.0 Hz, 1H), 7.08-7.03 (m, 1H), 6.85 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 6.31 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 6.22 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.5, 157.0 (d, J = 234.0 Hz, 1C), 149.9, 146.1, 142.8, 140.2, 139.4, 134.3, 134.2, 131.9, 130.6 (d, J = 3.0 Hz, 1C), 130.1, 129.8, 129.7, 129.1, 129.0, 121.4 (d, J = 9.0 Hz, 1C), 116.9 (d, J = 23.0 Hz, 1C), 111.0 (d, J = 9.0 Hz, 1C), 109.3 (d, J = 26.0 Hz, 1C), 62.0; ^{19}F NMR (375 MHz, $CDCl_3$) δ -122.0. IR (KBr) v 3442, 3141, 2984, 1700, 1465, 769 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{15}FN_3O_3$ $[M\text{-}Br]^+$ 376.1092, found 376.1092.



(*Z*)-1-(2-((5-chloro-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1w**)

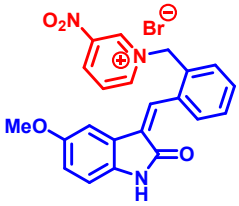
According to the general procedure, **1w** was prepared on a scale of 0.72 mmol. Yellow solids, 0.20 g, 59% isolated yield obtained by filtration of the precipitate; Reaction time =14 h; mp 191.2-192.1 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.83 (s, 1H), 10.18 (s, 1H), 9.40 (d, J = 8.0 Hz, 1H), 9.31 (d, J = 12.0 Hz, 1H), 8.37 (t, J = 8.0 Hz, 1H), 7.90 (s, 1H), 7.61 (d, J = 8.0 Hz, 3H), 7.47 (d, J = 8.0 Hz, 1H), 7.25 (d, J = 8.0 Hz, 1H), 6.87 (d, J = 8.0 Hz, 1H), 6.53 (s, 1H), 6.21 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.2, 149.9, 146.1, 142.8, 141.8, 140.2, 134.4, 134.3, 132.0, 130.2,

130.1, 130.0, 129.8, 129.6, 129.0, 129.0, 125.0, 122.1, 121.8, 111.7, 61.9. IR (KBr) *v* 3427, 3120, 1706, 1643, 763 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{15}ClN_3O_3$ $[M\text{-}Br]^+$ 392.0796, found 392.0794.



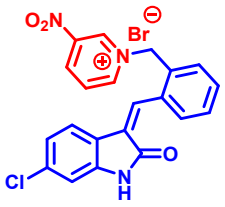
(*Z*)-1-(2-((5-methyl-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1x**)

According to the general procedure, **1x** was prepared on a scale of 1.6 mmol. Yellow solids, 0.42 g, 58% isolated yield obtained by filtration of the precipitate; Reaction time = 67 h; mp 195.8-197.0 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.56 (s, 1H), 10.14 (s, 1H), 9.40 (d, J = 8.0 Hz, 1H), 9.18 (d, J = 8.0 Hz, 1H), 8.30 (t, J = 8.0 Hz, 1H), 7.78 (s, 1H), 7.64-7.54 (m, 4H), 6.95 (d, J = 8.0 Hz, 1H), 6.69 (d, J = 8.0 Hz, 1H), 6.24 (s, 2H), 6.17 (s, 1H), 1.95 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.5, 149.8, 145.6, 142.6, 140.7, 139.8, 135.3, 132.4, 131.4, 131.2, 131.1, 130.3, 130.0, 129.8, 129.8, 129.2, 128.8, 122.7, 120.5, 110.0, 62.2, 20.6. IR (KBr) *v* 3479, 3007, 1693, 1640, 759 cm^{-1}. HRMS (ESI) calcd for $C_{22}H_{18}N_3O_3$ $[M\text{-}Br]^+$ 372.1343, found 372.1341.



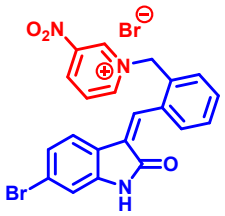
(*Z*)-1-(2-((5-methoxy-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1y**)

According to the general procedure, **1y** was prepared on a scale of 2.2 mmol. Yellow solids, 0.71 g, 69% isolated yield obtained by filtration of the precipitate; Reaction time = 48 h; mp 179.6-180.5 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.49 (s, 1H), 10.16 (s, 1H), 9.41 (d, J = 4.0 Hz, 1H), 9.23 (d, J = 8.0 Hz, 1H), 8.31 (t, J = 8.0 Hz, 1H), 7.81 (s, 1H), 7.60-7.56 (m, 4H), 6.80-6.72 (m, 2H), 6.24 (s, 2H), 5.95 (d, J = 4.0 Hz, 1H), 3.46 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.4, 153.8, 149.8, 145.7, 142.6, 139.9, 136.5, 135.1, 132.9, 131.5, 131.5, 130.2, 129.9, 129.9, 129.1, 128.9, 121.3, 115.3, 110.6, 108.9, 62.1, 55.1. IR (KBr) *v* 3418, 3130, 1707, 1640, 1477, 761 cm^{-1}. HRMS (ESI) calcd for $C_{22}H_{18}N_3O_4$ $[M\text{-}Br]^+$ 388.1292, found 388.1291.



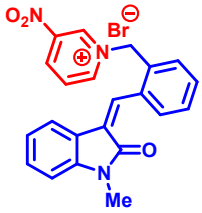
(*Z*)-1-(2-((6-chloro-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1z**)

According to the general procedure, **1z** was prepared on a scale of 4.0 mmol. Yellow solids, 1.60 g, 85% isolated yield obtained by filtration of the precipitate; Reaction time = 61 h; mp 192.7-193.8 ^{o}C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.87 (s, 1H), 10.18 (s, 1H), 9.40 (d, J = 8.0 Hz, 1H), 9.30 (dd, J_1 = 8.0 Hz, J_2 = 4.0 Hz, 1H), 8.37 (t, J = 8.0 Hz, 1H), 7.85 (s, 1H), 7.60-7.56 (m, 3H), 7.51 (d, J = 8.0 Hz, 1H), 6.75 (d, J = 4.0 Hz, 1H), 6.73 (d, J = 4.0 Hz, 1H), 6.62 (d, J = 8.0 Hz, 1H), 6.24 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.5, 149.8, 146.0, 144.3, 142.8, 140.2, 134.7, 134.5, 133.3, 131.9, 130.1, 129.9, 129.8, 129.8, 129.1, 129.1, 123.6, 121.0, 119.4, 110.2, 61.9. IR (KBr) v 3432, 3115, 1707, 1615, 754 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{15}ClN_3O_3$ $[M\text{-}Br]^+$ 392.0796, found 392.0794.



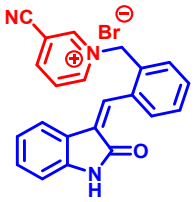
(*Z*)-1-(2-((6-bromo-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1aa**)

According to the general procedure, **1aa** was prepared on a scale of 2.54 mmol. Yellow solids, 1.05 g, 80% isolated yield obtained by filtration of the precipitate; Reaction time = 50 h; mp 190.1-191.9 ^{o}C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.87 (s, 1H), 10.18 (s, 1H), 9.39 (d, J = 8.0 Hz, 1H), 9.30 (d, J = 8.0 Hz, 1H), 8.36 (t, J = 8.0 Hz, 1H), 7.87 (s, 1H), 7.59 (s, 3H), 7.50 (s, 1H), 7.03 (s, 1H), 6.88 (d, J = 4.0 Hz, 1H), 6.57 (d, J = 8.0 Hz, 1H), 6.23 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.3, 149.8, 146.1, 144.4, 142.8, 140.2, 134.5, 133.4, 131.9, 130.1, 129.9, 129.8, 129.7, 129.1, 129.0, 123.9, 123.8, 123.2, 119.7, 113.0, 61.9. IR (KBr) v 3427, 3113, 1708, 1609, 755 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{15}BrN_3O_3$ $[M\text{-}Br]^+$ 436.0291, found 436.0290.



(*Z*)-1-(2-((1-methyl-2-oxoindolin-3-ylidene)methyl)benzyl)-3-nitropyridin-1-ium bromide (**1ab**)

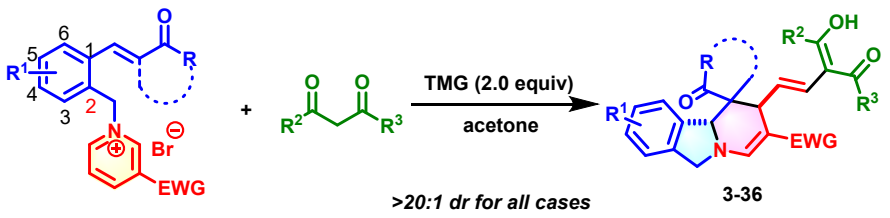
According to the general procedure, **1ab** was prepared on a scale of 2.5 mmol. Yellow solids, 1.09 g, 97% isolated yield obtained by filtration of the precipitate; Reaction time = 52 h; mp 179.5-180.5 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.13 (s, 1H), 9.34 (d, J = 4.0 Hz, 1H), 9.18 (d, J = 8.0 Hz, 1H), 8.27 (t, J = 8.0 Hz, 1H), 7.91 (s, 1H), 7.59 (d, J = 8.0 Hz, 4H), 7.27 (d, J = 8.0 Hz, 1H), 6.99 (d, J = 8.0 Hz, 1H), 6.71 (t, J = 8.0 Hz, 1H), 6.49 (d, J = 8.0 Hz, 1H), 6.20 (s, 2H), 3.17 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 166.0, 149.8, 145.6, 143.9, 142.6, 139.8, 135.0, 133.3, 131.5, 130.7, 130.2, 130.1, 130.0, 129.9, 129.1, 128.9, 121.9, 121.7, 119.7, 109.0, 62.1, 25.9. IR (KBr) v 3434, 2924, 1701, 1605, 1368, 751 cm^{-1}. HRMS (ESI) calcd for $C_{22}H_{18}N_3O_3$ [M-Br]$^+$ 372.1343, found 372.1343.



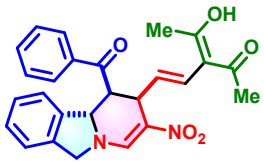
(*Z*)-3-cyano-1-(2-((2-oxoindolin-3-ylidene)methyl)benzyl)pyridin-1-ium bromide (**1ac**)

According to the general procedure, **1ac** was prepared on a scale of 1.5 mmol. Yellow solids, 0.56 g, 89% isolated yield obtained by filtration of the precipitate; Reaction time = 17 h; mp 194.5-195.7 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.68 (s, 1H), 9.81 (s, 1H), 9.30 (d, J = 4.0 Hz, 1H), 8.97 (d, J = 8.0 Hz, 1H), 8.22 (t, J = 8.0 Hz, 1H), 7.77 (s, 1H), 7.64-7.54 (m, 4H), 7.17 (t, J = 8.0 Hz, 1H), 6.85 (d, J = 8.0 Hz, 1H), 6.65 (d, J = 8.0 Hz, 1H), 6.50 (d, J = 8.0 Hz, 1H), 6.08 (s, 2H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 167.4, 149.1, 148.6, 148.5, 143.0, 135.3, 132.5, 131.1, 131.0, 130.7, 130.6, 130.0, 129.8, 129.1, 128.4, 122.3, 121.2, 120.3, 113.4, 112.5, 110.2, 62.2. IR (KBr) v 3468, 3142, 3008, 1703, 764 cm^{-1}. HRMS (ESI) calcd for $C_{22}H_{16}N_3O$ [M-Br]$^+$ 338.1288, found 338.1286.

3. Experimental data for the formation of 3-36

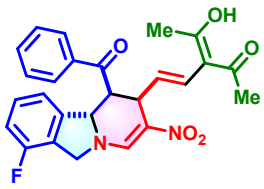


General procedure：To a 5.0 mL vial were successively added pyridinium salts **1** (0.225 mmol, 1.5 equiv), 1,3-dicarbonyl compounds (0.15 mmol) and 1.0 mL of acetone. And then, TMG (34.6 mg, 0.30 mmol) was added by syringe. The resulting mixture was stirred at 60 °C, and then the reaction mixture was directly subjected to flash column chromatography on silica gel (petroleum ether/ ethyl acetate) to afford the corresponding products **3-25**. For the synthesis of **26-36**, the reactions were conducted on a 0.10 mmol scale at 35 °C and the substrate ratio of pyridinium salts to 1,3-dicarbonyl compounds was 1:1.2. *(Note: the products were not very stable in solution under high temperatures. However, they were very stable in solid state. To avoid their decomposition, after column chromatography, the concentrated temperature was below 38 °C.)*



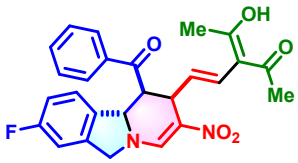
(*Z*)-3-((*E*)-2-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**3**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 4:1); 59.9 mg, 90% yield; dr > 20:1; reaction time = 5 min; mp 128.9-129.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.52 (s, 1H), 8.55 (s, 1H), 8.02 (d, J = 8.0 Hz, 2H), 7.67 (t, J = 8.0 Hz, 1H), 7.54 (t, J = 8.0 Hz, 2H), 7.34-7.29 (m, 2H), 7.20 (t, J = 8.0 Hz, 1H), 7.11 (d, J = 8.0 Hz, 1H), 5.94 (d, J = 16.0 Hz, 1H), 5.43 (d, J = 8.0 Hz, 1H), 5.30 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.10 (d, J = 16.0 Hz, 1H), 4.89 (d, J = 16.0 Hz, 1H), 4.42 (q, J = 4.0 Hz, 1H), 3.85 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.3, 190.9, 142.7, 137.5, 136.2, 135.5, 134.3, 129.6, 129.2, 128.7, 128.6, 128.4, 128.1, 124.1, 122.4, 122.0, 110.4, 60.0, 57.0, 48.0, 40.0, 24.1. IR (KBr) ν 3434, 2926, 1674, 1617, 1409, 1254, 1002, 753 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{25}N_2O_5$ $[M+H]^+$: 445.1758, found: 445.1754.



(*Z*)-3-((*E*)-2-(1-benzoyl-7-fluoro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**4**)

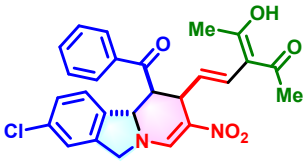
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1); 35.4 mg, 51% yield; dr > 20:1; reaction time = 5 min; mp 172.9-173.4 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.51 (s, 1H), 8.52 (s, 1H), 8.03 (d, *J* = 8.0 Hz, 2H), 7.66 (t, *J* = 8.0 Hz, 1H), 7.54 (t, *J* = 8.0 Hz, 2H), 7.21-7.15 (m, 1H), 6.99 (t, *J* = 8.0 Hz, 1H), 6.90 (d, *J* = 4.0 Hz, 1H), 5.92 (d, *J* = 16.0 Hz, 1H), 5.43 (d, *J* = 8.0 Hz, 1H), 5.28 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.08 (d, *J* = 16.0 Hz, 1H), 4.97(d, *J* = 12.0 Hz, 1H), 4.40 (t, *J* = 8.0 Hz, 1H), 3.88 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.01 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.1, 190.8, 157.3 (d, *J* = 247.0 Hz, 1C), 142.5, 140.6 (d, *J* = 4.0 Hz, 1C), 136.0, 134.3, 130.8 (d, *J* = 7.0 Hz, 1C), 129.4, 129.2, 128.3, 128.1, 122.6 (d, *J* = 18.0 Hz, 1C), 122.3, 119.8 (d, *J* = 4.0 Hz, 1C), 115.2 (d, *J* = 19.0 Hz, 1C), 110.3, 60.2, 53.9, 47.7, 39.8, 24.0; ^{19}F NMR (375 MHz, $CDCl_3$) δ -116.8. IR (KBr) ν 3419, 2924, 1674, 1572, 1411, 1297, 1013, 715 cm^{-1}. IR (KBr) ν 3450, 2927, 1671, 1622, 1249, 711 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}FN_2O_5$ $[M+H]^+$: 463.1664, found: 463.1663.



(*Z*)-3-((*E*)-2-(1-benzoyl-8-fluoro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**5**)

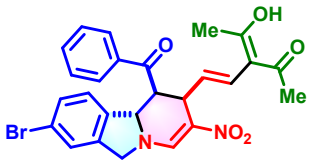
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 51.9 mg, 75% yield; dr > 20:1; reaction time = 5 min; mp 126.4-127.3 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.54 (s, 1H), 8.52 (s, 1H), 8.01 (d, *J* = 8.0 Hz, 2H), 7.68 (t, *J* = 8.0 Hz, 1H), 7.5 (t, *J* = 8.0 Hz, 2H), 7.10 (q, *J* = 4.0 Hz, 1H), 7.00 (d, *J* = 8.0 Hz, 1H), 6.93-6.88 (m, 1H), 5.94 (d, *J* = 16.0 Hz, 1H), 5.38 (d, *J* = 12.0 Hz, 1H), 5.28 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.08 (d, *J* = 16.0 Hz, 1H), 4.87 (d, *J* = 16.0 Hz, 1H), 4.42 (q, *J* = 8.0 Hz, 1H), 3.81 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.3, 190.8, 162.9 (d, *J* = 247.0 Hz, 1C), 142.6, 137.7 (d, *J* = 9.0 Hz, 1C), 136.0, 134.4, 133.1 (d, *J* = 3.0 Hz, 1C), 129.4, 129.2, 128.3, 128.1,

125.7 (d, J = 9.0 Hz, 1C), 122.2, 115.7 (d, J = 23.0 Hz, 1C), 110.4, 109.7 (d, J = 23.0 Hz, 1C), 59.4, 56.6, 48.1, 40.0, 24.0; ^{19}F NMR (375 MHz, $CDCl_3$) δ -112.4. IR (KBr) ν 3430, 2923, 1672, 1620, 1265, 713 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}FN_2O_5$ $[M+H]^+$: 463.1664, found: 463.1662.



(*Z*)-3-((*E*)-2-(1-benzoyl-8-chloro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**6**)

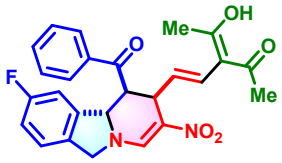
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 5:1); 58.9 mg, 82% yield; dr > 20:1; reaction time = 5 h; mp 104.5-104.9 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.52 (s, 1H), 8.51 (s, 1H), 8.00 (d, J = 8.0 Hz, 2H), 7.68 (t, J = 8.0 Hz, 1H), 7.55 (t, J = 8.0 Hz, 2H), 7.29 (s, 1H), 7.18 (d, J = 8.0 Hz, 1H), 7.06 (d, J = 8.0 Hz, 1H), 5.94 (d, J = 16.0 Hz, 1H), 5.38 (d, J = 12.0 Hz, 1H), 5.28 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.07 (d, J = 12.0 Hz, 1H), 4.86 (d, J = 12.0 Hz, 1H), 4.42 (q, J = 8.0 Hz, 1H), 3.80 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.3, 190.9, 142.4, 137.5, 136.1, 136.1, 134.9, 134.5, 129.6, 129.3, 128.9, 128.4, 128.4, 125.5, 122.8, 122.5, 110.4, 59.63, 56.5, 48.1, 40.0, 24.1. IR (KBr) ν 3418, 2924, 1674, 1615, 1253, 704 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}ClN_2O_5$ $[M+H]^+$: 479.1368, found: 479.1371.



(*Z*)-3-((*E*)-2-(1-benzoyl-8-bromo-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**7**)

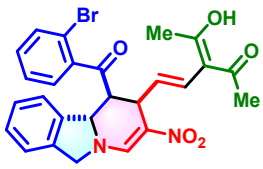
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 65.8 mg, 84% yield; dr > 20:1; reaction time = 5 min; mp 168.1-169.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.52 (s, 1H), 8.50 (s, 1H), 8.01 (d, J = 8.0 Hz, 2H), 7.66 (t, J = 8.0 Hz, 1H), 7.53 (t, J = 8.0 Hz, 2H), 7.42 (s, 1H), 7.29 (d, J = 8.0 Hz, 1H), 6.98 (d, J = 8.0 Hz, 1H), 5.92 (d, J = 12.0 Hz, 1H), 5.35 (d, J = 12.0 Hz, 1H), 5.27 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.06 (d, J = 16.0 Hz, 1H), 4.88 (d, J = 12.0 Hz, 1H), 4.40 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 3.83 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.01 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.2, 190.8, 142.5, 137.8, 136.5, 136.0,

134.4, 131.6, 129.3, 129.2, 128.3, 128.1, 125.7, 125.6, 122.6, 122.2, 110.3, 59.6, 56.3, 47.8, 39.9, 24.0. IR (KBr) ν 3429, 2922, 1677, 1610, 1242, 758 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}BrN_2NaO_5$ $[M+Na]^+$: 545.0683, found: 545.0682.



(*Z*)-3-((*E*)-2-(1-benzoyl-9-fluoro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**8**)

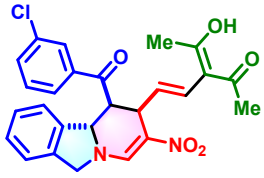
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1); 34.9 mg, 50% yield; dr > 20:1; reaction time = 5 min; mp 155.9-156.7 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.51 (s, 1H), 8.51 (s, 1H), 8.01 (d, *J* = 8.0 Hz, 2H), 7.67 (t, *J* = 8.0 Hz, 1H), 7.54 (t, *J* = 8.0 Hz, 2H), 7.25-7.22 (m, 1H), 7.01 (t, *J* = 8.0 Hz, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 5.93 (d, *J* = 12.0 Hz, 1H), 5.40 (d, *J* = 8.0 Hz, 1H), 5.26 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.04 (d, *J* = 16.0 Hz, 1H), 4.85 (d, *J* = 12.0 Hz, 1H), 4.42 (q, *J* = 8.0 Hz, 1H), 3.83 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.02 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.2, 190.7, 162.5 (d, *J* = 245.0 Hz, 1C), 142.6, 139.4 (d, *J* = 9.0 Hz, 1C), 135.8, 134.3, 131.1 (d, *J* = 3.0 Hz, 1C), 129.3, 129.1, 128.3, 128.0, 123.6 (d, *J* = 9.0 Hz, 1C), 121.9, 115.8 (d, *J* = 23.0 Hz, 1C), 111.6 (d, *J* = 23.0 Hz, 1C), 110.2, 59.7 (d, *J* = 2.0 Hz, 1C), 56.2, 47.7, 39.9, 23.9. ^{19}F NMR (375 MHz, $CDCl_3$) δ -112.18. (s). IR (KBr) ν 3446, 2922, 1674, 1619, 1258, 702 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}FN_2NaO_5$ $[M+Na]^+$: 485.1483, found: 485.1483.



(*Z*)-3-((*E*)-2-(1-(2-bromobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**9**)

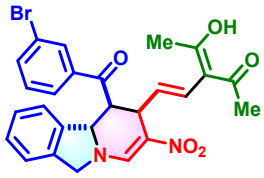
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 4:1); 51.2 mg, 65% yield; dr > 20:1; reaction time = 5 h; mp 163.1-163.4 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.67 (s, 1H), 8.51 (s, 1H), 7.67 (d, *J* = 8.0 Hz, 1H), 7.47 (d, *J* = 8.0 Hz, 1H), 7.43-7.39 (m, 2H), 7.36-7.29 (m, 3H), 7.24 (d, *J* = 8.0 Hz, 1H), 6.09 (d, *J* = 16.0 Hz, 1H), 5.46 (dd, J_1 = 16.0 Hz, J_2 = 8.0 Hz, 1H), 5.38 (d, *J* = 8.0 Hz, 1H), 5.08 (d, *J* = 12.0 Hz, 1H), 4.90 (d, *J* = 16.0 Hz, 1H),

4.26 (q, J = 4.0 Hz, 1H), 3.92 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 191.0, 142.9, 138.9, 136.8, 135.5, 134.8, 133.1, 129.8, 128.8, 128.8, 128.3, 128.2, 127.8, 124.6, 122.4, 121.9, 119.8, 110.4, 59.9, 57.0, 51.3, 39.0, 24.2. IR (KBr) ν 3432, 2960, 1690, 1618, 1418, 1253, 1001, 752 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}BrN_2O_5$ $[M+H]^+$: 523.0863, found: 523.0861.



(*Z*)-3-((*E*)-2-(1-(3-chlorobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**10**)

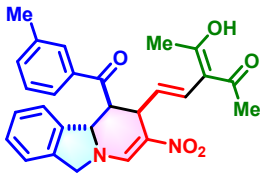
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 68.5 mg, 95% yield; dr > 20:1; reaction time = 5 min; mp 164.1-164.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.54 (s, 1H), 8.55 (s, 1H), 7.99 (s, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.64 (d, J = 8.0 Hz, 1H), 7.49 (t, J = 8.0 Hz, 1H), 7.35-7.29 (m, 2H), 7.21 (t, J = 8.0 Hz, 1H), 7.07 (d, J = 8.0 Hz, 1H), 5.97 (d, J = 16.0 Hz, 1H), 5.41 (d, J = 8.0 Hz, 1H), 5.29 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.10 (d, J = 12.0 Hz, 1H), 4.90 (d, J = 16.0 Hz, 1H), 4.39 (q, J = 4.0 Hz, 1H), 3.80 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.05 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.3, 190.9, 142.7, 137.6, 137.2, 135.7, 135.5, 134.2, 130.6, 129.4, 128.8, 128.6, 128.3, 128.3, 126.5, 123.9, 122.5, 122.0, 110.4, 59.9, 56.9, 48.2, 39.9, 24.0. IR (KBr) ν 3416, 2922, 1613, 1257, 751 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}ClN_2O_5$ $[M+H]^+$: 479.1368, found: 479.1364.



(*Z*)-3-((*E*)-2-(1-(3-bromobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**11**)

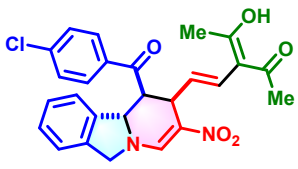
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 4:1); 76.9 mg, 98% yield; dr > 20:1; reaction time = 1 h; mp 164.3-165.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.54 (s, 1H), 8.55 (s, 1H), 8.14 (t, J = 4.0 Hz, 1H), 7.93 (d, J = 8.0 Hz, 1H), 7.80 (d, J = 8.0 Hz, 1H), 7.43 (t, J = 8.0 Hz, 1H), 7.36-7.30 (m, 2H), 7.22 (t, J = 8.0 Hz, 1H), 7.07 (d, J = 8.0

Hz, 1H), 5.98 (d, J = 16.0 Hz, 1H), 5.41 (d, J = 8.0 Hz, 1H), 5.28 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.10 (d, J = 16.0 Hz, 1H), 4.89 (d, J = 16.0 Hz, 1H), 4.39 (q, J = 4.0 Hz, 1H), 3.79 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.06 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.2, 190.9, 142.7, 137.8, 137.2, 137.2, 135.5, 131.3, 130.8, 129.3, 128.8, 128.6, 128.3, 126.9, 124.0, 123.7, 122.5, 122.0, 110.4, 59.9, 57.0, 48.2, 39.9, 24.1. IR (KBr) ν 3430, 2921, 1681, 1617, 1415, 1256, 750 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}BrN_2O_5$ $[M+H]^+$: 523.0863, found: 523.0859.



(*Z*)-4-hydroxy-3-((*E*)-2-(1-(3-methylbenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)pent-3-en-2-one (**12**)

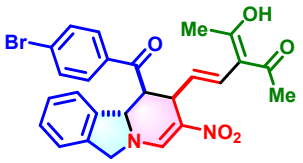
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 4:1); 66.7 mg, 97% yield; dr > 20:1; reaction time = 20 min; mp 165.9-166.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.52 (s, 1H), 8.56 (s, 1H), 7.81 (d, J = 4.0 Hz, 2H), 7.48 (d, J = 4.0 Hz, 1H), 7.42 (t, J = 8.0 Hz, 1H), 7.30 (t, J = 8.0 Hz, 2H), 7.20 (t, J = 8.0 Hz, 1H), 7.11 (d, J = 8.0 Hz, 1H), 5.96 (d, J = 12.0 Hz, 1H), 5.43 (d, J = 12.0 Hz, 1H), 5.31 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.10 (d, J = 16.0 Hz, 1H), 4.89 (d, J = 16.0 Hz, 1H), 4.41 (q, J = 4.0 Hz, 1H), 3.83 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.44 (s, 3H), 2.05 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.5, 190.9, 142.8, 139.2, 137.5, 136.3, 135.5, 135.1, 129.7, 129.1, 128.8, 128.7, 128.6, 128.0, 125.6, 124.1, 122.4, 122.1, 110.5, 60.0, 57.0, 48.0, 39.9, 24.1, 21.4. IR (KBr) ν 3433, 1673, 1614, 1256, 757 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{27}N_2O_5$ $[M+H]^+$: 459.1914, found: 459.1911.



(*Z*)-3-((*E*)-2-(1-(4-chlorobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**13**)

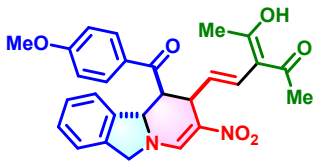
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 5:1); 68.7 mg, 96% yield; dr > 20:1; reaction time = 5 min; mp 193.6-194.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.44 (s, 1H), 8.47 (s, 1H), 7.92 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 7.26-7.19 (m, 2H), 7.11 (t, J = 8.0 Hz, 1H), 6.99 (d, J = 8.0 Hz, 1H), 5.87 (d, J = 16.0 Hz, 1H), 5.33 (d, J =

8.0 Hz, 1H), 5.21 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.02 (d, J = 12.0 Hz, 1H), 4.84 (d, J = 12.0 Hz, 1H), 4.30 (q, J = 4.0 Hz, 1H), 3.74 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 1.96 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.2, 190.8, 142.8, 140.9, 137.2, 135.5, 134.4, 129.8, 129.5, 129.5, 128.7, 128.5, 128.0, 123.9, 122.4, 121.8, 110.3, 59.8, 56.9, 47.9, 40.0, 24.0. IR (KBr) ν 3432, 1674, 1620, 1254, 759 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}ClN_2O_5$ $[M+H]^+$: 479.1368, found: 479.1371.



(*Z*)-3-((*E*)-2-(1-(4-bromobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**14**)

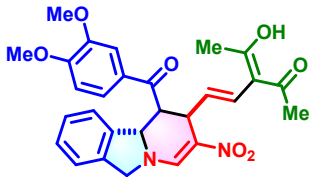
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1); 63.5 mg, 81% yield; dr > 20:1; reaction time = 30 min; mp 206.9-207.8 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.52 (s, 1H), 8.54 (s, 1H), 7.89 (d, J = 8.0 Hz, 2H), 7.69 (d, J = 8.0 Hz, 2H), 7.35-7.29 (m, 2H), 7.20 (t, J = 8.0 Hz, 1H), 7.07 (d, J = 8.0 Hz, 1H), 5.96 (d, J = 16.0 Hz, 1H), 5.41 (d, J = 8.0 Hz, 1H), 5.28 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.09 (d, J = 16.0 Hz, 1H), 4.89 (d, J = 16.0 Hz, 1H), 4.38 (q, J = 4.0 Hz, 1H), 3.79 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.4, 190.9, 142.7, 137.3, 135.5, 134.9, 132.6, 129.8, 129.4, 128.8, 128.6, 128.2, 124.0, 122.5, 122.0, 110.4, 60.0, 57.0, 48.0, 40.0, 24.1, one carbon missing in the aromatic region. IR (KBr) ν 3432, 1671, 1618, 1582, 1257, 756 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}BrN_2O_5$ $[M+H]^+$: 523.0863, found: 523.0861.



(*Z*)-4-hydroxy-3-((*E*)-2-(1-(4-methoxybenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)pent-3-en-2-one (**15**)

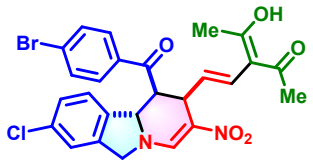
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1-4:1); 69.7 mg, 98% yield; dr > 20:1; reaction time = 5 min; mp 166.3-166.6 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.50 (s, 1H), 8.55 (s, 1H), 8.01 (d, J = 12.0 Hz, 2H), 7.33-7.28 (m, 2H), 7.19 (t, J = 8.0 Hz, 2H), 7.12 (d, J = 8.0 Hz, 1H), 7.00 (d, J = 12.0 Hz, 1H), 5.94 (d, J = 16.0 Hz, 1H), 5.42 (d, J = 12.0 Hz, 1H), 5.31 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.09 (d, J = 16.0 Hz, 1H), 4.88 (d, J = 16.0 Hz, 1H),

4.40 (q, J = 4.0 Hz, 1H), 3.89 (s, 3H), 3.77 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.4, 190.9, 164.4, 142.8, 137.6, 135.5, 130.8, 129.9, 129.3, 128.6, 128.5, 127.8, 124.2, 122.3, 122.0, 114.4, 110.5, 60.0, 56.9, 55.6, 47.5, 40.2, 24.0. IR (KBr) ν 3418, 2923, 1682, 1616, 1413, 1255, 748 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{27}N_2O_6$ $[M+H]^+$: 475.1864, found: 475.1861.



(*Z*)-3-((*E*)-2-(1-(3,4-dimethoxybenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one **(16)**

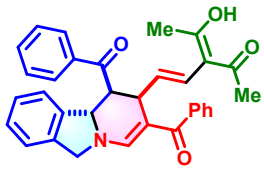
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 2:1); 66.6 mg, 88% yield; dr > 20:1; reaction time = 5 min; mp 168.6-169.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.48 (s, 1H), 8.54 (s, 1H), 7.64 (d, J = 8.0 Hz, 1H), 7.59 (s, 1H), 7.29 (t, J = 8.0 Hz, 2H), 7.18 (t, J = 8.0 Hz, 1H), 7.10 (d, J = 8.0 Hz, 1H), 6.92 (d, J = 8.0 Hz, 1H), 5.93 (d, J = 16.0 Hz, 1H), 5.41 (d, J = 12.0 Hz, 1H), 5.31 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.08 (d, J = 16.0 Hz, 1H), 4.88 (d, J = 16.0 Hz, 1H), 4.40 (q, J = 4.0 Hz, 1H), 3.95 (s, 3H), 3.94 (s, 3H), 3.80 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.03 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.4, 190.8, 154.3, 149.5, 142.8, 137.5, 135.5, 130.0, 129.3, 128.6, 128.5, 127.7, 124.0, 123.4, 122.3, 121.9, 110.4, 110.3, 110.0, 60.0, 56.9, 56.2, 56.0, 47.3, 40.3, 24.0. IR (KBr) ν 3435, 2930, 1659, 1617, 1414, 1263, 757 cm^{-1}. HRMS (ESI) calcd for $C_{28}H_{29}N_2O_7$ $[M+H]^+$: 505.1969 , found: 505.1967.



(*Z*)-3-((*E*)-2-(1-(4-bromobenzoyl)-8-chloro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-4-hydroxypent-3-en-2-one (**17**)

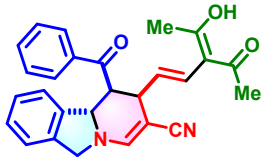
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1); 47.8 mg, 57% yield; dr > 20:1; reaction time = 5 min; mp 236.5-237.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.53 (s, 1H), 8.50 (s, 1H), 7.87 (d, J = 8.0 Hz, 2H), 7.70 (d, J = 8.0 Hz, 2H), 7.29 (s, 1H), 7.19 (d, J = 8.0 Hz, 1H), 7.02 (d, J = 8.0 Hz, 1H), 5.96 (d, J = 16.0 Hz, 1H), 5.36 (d, J = 8.0 Hz, 1H), 5.26 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.06 (d, J = 16.0 Hz, 1H), 4.86 (d, J = 12.0 Hz, 1H), 4.39 (q, J

= 4.0 Hz, 1H), 3.74 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) 197.4, 190.9, 142.3, 137.5, 135.9, 135.0, 134.7, 132.7, 130.1, 129.8, 129.2, 128.9, 128.6, 125.3, 122.8, 122.4, 110.3, 59.6, 56.5, 48.1, 40.0, 24.1. IR (KBr) ν 3424, 2923, 1675, 1620, 1257, 759 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{22}BrClN_2NaO_5$ $[M+Na]^+$: 579.0293, found: 579.0293 .



2-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindole-1,3-diyl)bis(phenylmethanone) (**18**)

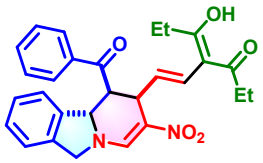
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1); 27.1 mg, 36% yield; dr > 20:1; reaction time = 30 min; mp 111.9-112.0 ℃; ^{1}H NMR (400 MHz, $CDCl_3$), ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.46 (s, 1H), 8.04 (d, J = 8.0 Hz, 2H), 7.64 (t, J = 8.0 Hz, 1H), 7.53 (t, J = 8.0 Hz, 4H), 7.47-7.41 (m, 3H), 7.39 (s, 1H), 7.28 (d, J = 8.0 Hz, 1H), 7.23 (d, J = 8.0 Hz, 1H), 7.19-7.13 (m, 2H), 5.97 (d, J = 16.0 Hz, 1H), 5.47 (d, J = 4.0 Hz, 1H), 5.43 (dd, J_1 = 16.0 Hz, J_2 = 8.0 Hz, 1H), 4.95 (d, J = 16.0 Hz, 1H), 4.66 (d, J = 16.0 Hz, 1H), 4.45 (q, J = 4.0 Hz, 1H), 3.70 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.06 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.9, 191.5, 190.8, 148.5, 140.7, 138.9, 136.7, 136.1, 133.8, 132.5, 129.8, 129.0, 128.3, 128.1, 128.1, 126.2, 123.9, 122.1, 110.9, 110.0, 59.5, 56.9, 48.3, 38.6, 24.0, two carbons missing in the aromatic region. IR (KBr) ν 3419, 2924, 1674, 1572, 1251, 715 cm^{-1}. HRMS (ESI) calcd for $C_{33}H_{30}NO_4$ $[M+H]^+$: 504.2169, found: 504.2170.



2-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-1-benzoyl-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindole-3-carbonitrile (**19**)

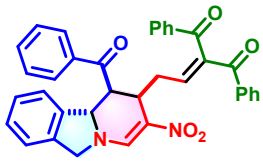
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1); 56.8 mg, 89% yield; dr > 20:1; reaction time = 5 min; mp 137.8-138.5 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.57 (s, 1H), 7.90 (d, J = 12.0 Hz, 2H), 7.59 (t, J = 8.0 Hz, 1H), 7.44 (t, J = 8.0 Hz, 2H), 7.33-7.22 (m, 3H), 7.01 (t, J = 8.0 Hz, 1H), 6.77 (d, J = 8.0 Hz, 1H), 6.17 (d, J = 16.0 Hz, 1H), 5.31 (dd, J_1 = 12.0 Hz, J_2 = 16.0 Hz, 1H), 5.09 (d, J = 8.0 Hz, 1H), 4.94 (d, J = 12.0 Hz, 1H), 4.77 (d, J =

12.0 Hz, 1H), 3.64 (t, J = 12.0 Hz, 1H), 3.54 (t, J = 12.0 Hz, 1H), 1.78 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.9, 190.7, 143.9, 137.6, 136.9, 135.7, 133.8, 132.3, 128.7, 128.7, 128.4, 128.2, 127.5, 123.1, 122.5, 121.3, 110.0, 79.9, 64.2, 55.8, 47.7, 44.2, 23.6. IR (KBr) ν 3453, 2953, 2180, 1664, 1615, 1407, 752 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{25}N_2O_3$ $[M+H]^+$: 425.1860, found: 425.1859.



(*Z*)-4-((*E*)-2-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-5-hydroxyhept-4-en-3-one (**20**)

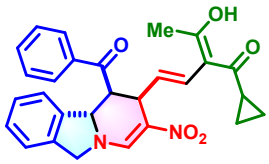
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 5:1); 50.9 mg, 72% yield; dr > 20:1; reaction time = 5 min; mp 173.4-173.7 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.53 (s, 1H), 8.53 (s, 1H), 8.00 (d, J = 8.0 Hz, 2H), 7.62 (t, J = 8.0 Hz, 1H), 7.51 (t, J = 8.0 Hz, 2H), 7.29-7.23 (m, 2H), 7.17-7.13 (m, 1H), 7.08 (d, J = 8.0 Hz, 1H), 5.92 (d, J = 16.0 Hz, 1H), 5.39 (d, J = 12.0 Hz, 1H), 5.28 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.06 (d, J = 16.0 Hz, 1H), 4.88 (d, J = 16.0 Hz, 1H), 4.40 (q, J = 4.0 Hz, 1H), 3.83 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz 1H), 2.29 (q, J = 8.0 Hz, 4H), 1.04 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.1, 194.0, 142.8, 137.4, 136.0, 135.5, 134.2, 129.8, 129.1, 128.6, 128.4, 128.3, 127.4, 124.0, 122.3, 121.9, 109.0, 59.8, 56.9, 47.8, 39.9, 29.6, 9.5. IR (KBr) ν 3449, 2937, 1672, 1618, 1411, 1257, 718 cm^{-1}. HRMS (ESI) calcd for $C_{28}H_{29}N_2O_5$ $[M+H]^+$: 473.2071, found: 473.2071.



2-((*E*)-2-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-1,3-diphenylpropane-1,3-dione (**21**)

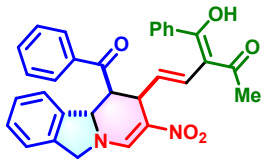
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 54.2 mg, 64% yield; dr > 20:1; reaction time = 5 min; mp 128.7-129.4 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (s, 1H), 7.93 (d, J = 8.0 Hz, 2H), 7.85 (d, J = 4.0 Hz, 2H), 7.71 (d, J = 8.0 Hz, 2H), 7.61(t, J = 8.0 Hz, 1H), 7.53-7.49 (m, 4H), 7.43-7.36 (m, 4H), 7.30-7.26 (m, 2H), 7.15 (t, J = 8.0 Hz, 1H), 6.99 (d, J = 8.0 Hz, 1H), 6.71 (t, J = 8.0 Hz, 1H), 5.33 (d, J = 8.0 Hz, 1H), 4.92 (d, J =

16.0 Hz, 1H), 4.74 (d, J = 16.0 Hz, 1H), 4.04-3.99 (m, 1H), 3.69 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.57-2.43 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.5, 195.0, 194.1, 146.1, 143.7, 142.8, 137.4, 137.1, 136.9, 135.8, 135.6, 134.3, 133.4, 132.3, 129.2, 129.2, 129.1, 128.6, 128.5, 128.4, 128.4, 123.7, 122.3, 122.1, 59.6, 57.3, 47.1, 34.7, 31.7. IR (KBr) ν 3433, 2923, 1674, 1618, 1251, 704 cm^{-1}. HRMS (ESI) calcd for $C_{36}H_{29}N_2O_5$ $[M+H]^+$: 569.2071, found: 569.2069.



(*Z*)-2-((*E*)-2-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-1-cyclopropyl-3-hydroxybut-2-en-1-one (**22**)

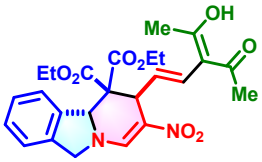
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1); 57.8 mg, 82% yield; dr > 20:1; reaction time = 20 min; mp 158.6-159.4 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.81 (s, 1H), 8.56 (s, 1H), 8.01 (d, J = 8.0 Hz, 2H), 7.65 (t, J = 8.0 Hz, 1H), 7.53 (t, J = 8.0 Hz, 2H), 7.30 (s, 2H), 7.18 (t, J = 8.0 Hz, 1H), 7.10 (d, J = 8.0 Hz, 1H), 6.07 (d, J = 16.0 Hz, 1H), 5.41 (dd, J_1 = 20.0 Hz, J_2 = 8.0 Hz, 2H), 5.10 (d, J = 12.0 Hz, 1H), 4.90 (d, J = 16.0 Hz, 1H), 4.45 (q, J = 4.0 Hz, 1H), 3.86 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.02 (s, 3H), 1.98 (s, 1H), 1.06 (s, 2H), 0.91 (t, J = 12.0 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.3, 196.8, 185.6, 142.8, 137.5, 136.2, 135.5, 134.2, 129.7, 129.1, 128.6, 128.5, 128.3, 128.0, 124.0, 122.4, 122.0, 110.1, 59.9, 56.9, 48.0, 40.1, 22.7, 15.9, 11.0. IR (KBr) ν 3453, 3021, 1673, 1619, 1253, 754 cm^{-1}.HRMS (ESI) calcd for $C_{28}H_{27}N_2O_5$ $[M+H]^+$: 471.1914, found: 471.1914.



(4*Z*,5*E*)-6-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)-4-(hydroxy(phenyl)methylene)hex-5-en-3-one (**23**)

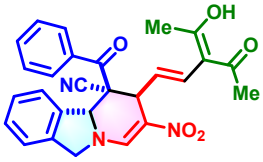
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1); 20.1 mg, 27% yield; dr > 20:1; reaction time = 5 min; mp 119.8-120.7 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 17.23 (s, 1H), 8.44 (s, 1H), 7.99 (d, J = 8.0 Hz, 2H), 7.65 (t, J = 8.0 Hz, 1H), 7.53 (t, J = 8.0 Hz, 4H), 7.35-7.28 (m, 5H), 7.19 (t, J = 8.0 Hz, 1H), 7.08 (d, J = 8.0 Hz, 1H), 5.97 (d, J = 16.0 Hz, 1H), 5.24 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 2H), 5.00 (d, J = 16.0 Hz, 1H), 4.81 (d, J = 16.0 Hz, 1H),

4.41 (q, J = 4.0 Hz, 1H), 3.76 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.24 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.3, 195.5, 185.0, 142.8, 137.5, 136.2, 135.9, 135.5, 134.2, 130.7, 129.2, 129.1, 128.9, 128.7, 128.6, 128.5, 128.4, 127.9, 124.1, 122.4, 121.7, 109.7, 60.0, 56.9, 48.0, 39.8, 25.5. IR (KBr) ν 3429, 2924, 1676, 1615, 1255, 708 cm^{-1}. (ESI) calcd for $C_{31}H_{27}N_2O_5$ $[M+H]^+$: 507.1914, found: 507.1916.



Diethyl-2-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-3-nitro-6,10b-dihydropyrido[2,1-*a*]isoindole-1,1(2H)-dicarboxylate (**24**)

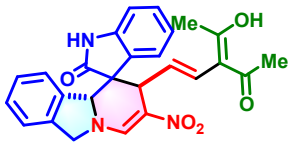
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 58.1 mg, 80% yield; dr > 20:1; reaction time = 5 min; mp 161.2-161.5 °C; 1H NMR (400 MHz, $CDCl_3$) δ 16.60 (s, 1H), 8.39 (s, 1H), 7.53 (d, J = 8.0 Hz, 1H), 7.34-7.28 (m, 2H), 7.24 (t, J = 8.0 Hz, 1H), 6.25 (d, J = 16.0 Hz, 1H), 5.34 (s, 1H), 5.30 (d, J = 8.0 Hz, 1H), 4.95 (d, J=16.0 Hz, 1H), 4.75 (d, J = 16.0 Hz, 1H), 4.67 (d, J = 8.0 Hz, 1H), 4.43-4.35 (m, 1H), 4.28-4.22 (m, 1H), 3.86-3.74 (m, 2H), 2.08 (s, 6H), 1.31 (t, J = 8.0 Hz, 3H) , 0.72 (t, J = 8.0 Hz, 3H) ; ^{13}C NMR (100 MHz, $CDCl_3$) δ 190.9, 167.9, 166.2, 141.7, 135.8, 135.2, 129.5, 129.4, 128.5, 127.9, 125.7, 122.8, 122.0, 110.3, 62.3, 62.2, 61.5, 57.7, 56.2, 42.5, 24.1, 14.1, 13.2. IR (KBr) ν 3436, 2982, 1727, 1620, 1250, 754 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{29}N_2O_8$ $[M+H]^+$: 485.1918, found: 485.1919.



2-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindole-1-carbonitrile (**25**)

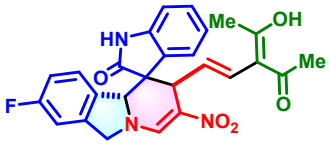
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 3:1); 22.3 mg, 32% yield; dr > 20:1; reaction time = 25 min; mp 158.2-158.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$), δ 16.57 (s, 1H), 8.62 (s, 1H), 8.36 (d, J = 8.0 Hz, 2H), 7.74 (t, J = 8.0 Hz, 1H), 7.61 (t, J = 8.0 Hz, 2H), 7.42 (t, J = 8.0 Hz, 1H), 7.33 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 2H), 7.21 (d, J = 8.0 Hz, 1H), 6.08 (d, J = 16.0 Hz, 1H), 5.64 (s, 1H), 5.14 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.11 (d, J = 4.0 Hz, 1H), 5.01 (t, J = 12.0 Hz, 2H), 1.93 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 190.9, 190.2,

142.0, 136.2, 135.4, 134.3, 134.0, 130.9, 129.8, 129.4, 129.4, 128.9, 126.6, 124.8, 122.8, 120.9, 116.3, 109.8, 63.0, 57.1, 51.0, 46.0, 24.0. IR (KBr) ν 3451, 2923, 1680, 1623, 1420, 1239, 751 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{24}N_3O_5$ $[M+H]^+$: 470.1710, found: 470.1708.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**26**)

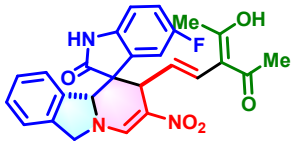
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1); 40.1 mg, 88% yield; dr > 20:1; reaction time = 5 min; mp 230.0-230.5 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.64 (s, 1H), 11.01 (s, 1H), 9.00 (s, 1H), 7.29 (d, J = 8.0 Hz, 1H), 7.20 (t, J = 8.0 Hz, 1H), 7.13 (t, J = 8.0 Hz, 1H), 7.08 (t, J = 8.0 Hz, 1H), 6.96 (d, J = 8.0 Hz, 1H), 6.84 (t, J = 8.0 Hz, 2H), 6.72 (t, J = 8.0 Hz, 1H), 6.08 (d, J = 16.0 Hz, 1H), 5.80 (q, J = 8.0 Hz, 1H), 5.37 (s, 1H), 5.19 (d, J = 16.0 Hz, 1H), 5.07 (d, J = 16.0 Hz, 1H), 3.71 (d, J = 8.0 Hz, 1H), 2.15 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.0, 176.1, 144.3, 141.5, 136.3, 134.9, 131.4, 128.9, 128.5, 128.4, 127.8, 125.4, 123.3, 122.9, 121.8, 121.3, 120.6, 110.6, 109.7, 62.6, 56.2, 49.3, 45.3, 23.8. IR (KBr) v 3419, 3022, 2922, 1622, 1399, 1083, 746 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}N_3O_5$ $[M+H]^+$ 458.1710, found 458.1710.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-8'-fluoro-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**27**)

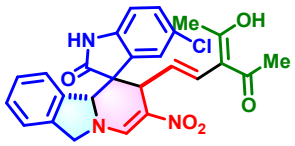
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 24.7 mg, 52% yield; dr > 20:1; reaction time = 10 min; mp 147.7-148.0 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.63 (s, 1H), 11.02 (s, 1H), 9.00 (s, 1H), 7.18 (d, J = 8.0 Hz, 1H), 7.09 (t, J = 8.0 Hz, 1H), 7.01-6.92 (m, 2H), 6.85 (t, J = 8.0 Hz, 2H), 6.74 (t, J = 8.0 Hz, 1H), 6.08 (d, J = 16.0 Hz, 1H), 5.78 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.32 (s, 1H), 5.19 (d, J = 16.0 Hz, 1H), 5.06 (d, J = 16.0 Hz, 1H), 3.73 (d, J = 8.0 Hz, 1H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 190.9, 176.1, 162.1 (d, J = 243.0 Hz, 1C), 144.2, 141.5, 139.0, 138.9, 131.4, 131.0, 128.6 (d, J = 12.0 Hz, 1C),

125.5, 123.4, 123.0 (d, J = 9.0 Hz, 1C), 121.9, 120.8, 115.1 (d, J = 23.0 Hz, 1C), 110.6, 110.3 (d, J = 24.0 Hz, 1C), 109.7, 62.1, 56.1, 49.3, 45.2, 23.8; ^{19}F NMR (375 MHz, $CDCl_3$) δ -113.5. IR (KBr) v 3420, 3244, 1723, 1619, 1269, 1223, 745 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}FN_3O_5$ $[M+H]^+$ 476.1616, found 476.1616.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-5-fluoro-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**28**)

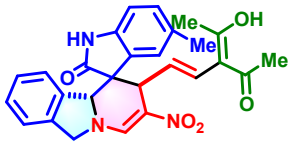
Light yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1); 30.1 mg, 63% yield; dr > 20:1; reaction time = 5 min; mp 242.7-243.7 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.64 (s, 1H), 11.05 (s, 1H), 8.98 (s, 1H), 7.33 (d, J = 8.0 Hz, 1H), 7.22 (t, J = 8.0 Hz, 1H), 7.15 (t, J = 8.0 Hz, 1H), 6.96-6.90 (m, 2H), 6.81 (dd, J_1 = 8.0 Hz, J_2 = 4.0 Hz, 1H), 6.75 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 6.09 (d, J = 16.0 Hz, 1H), 5.78 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.36 (s, 1H), 5.26 (d, J = 16.0 Hz, 1H), 5.05 (d, J = 16.0 Hz, 1H), 3.74 (d, J = 8.0 Hz, 1H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.0, 176.0, 157.8 (d, J = 235.0 Hz, 1C), 144.4, 137.8, 136.4, 134.6, 131.2, 130.3 (d, J = 9.0 Hz, 1C), 128.6, 127.9, 125.6, 123.0, 121.3, 120.1, 114.9 (d, J = 23.0 Hz, 1C), 111.4 (d, J = 25.0 Hz, 1C), 110.6, 110.3 (d, J = 9.0 Hz, 1C), 62.3, 56.1, 49.7, 45.0, 23.9; ^{19}F NMR (375 MHz, $CDCl_3$) δ -121.1. IR (KBr) v 3379, 3075, 2921, 1729, 1617, 1220, 755 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}FN_3O_5$ $[M+H]^+$ 476.1616, found 476.1616.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-5-chloro-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**29**)

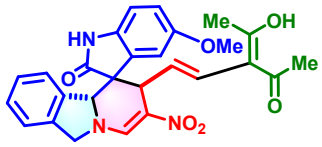
Light yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 23.0 mg, 47% yield; dr > 20:1; reaction time = 5 min; mp 197.8-198.8 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.63 (s, 1H), 11.16 (s, 1H), 9.03 (s, 1H), 7.35 (d, J = 8.0 Hz, 1H), 7.24 (t, J = 8.0 Hz, 1H), 7.16 (t, J = 8.0 Hz, 2H), 6.93 (d, J = 8.0 Hz, 1H), 6.84 (d, J = 8.0 Hz, 2H), 6.09 (d, J = 16.0 Hz, 1H), 5.77 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 5.36 (s, 1H), 5.25 (d, J = 16.0 Hz, 1H),

5.04 (d, J = 16.0 Hz, 1H), 3.75 (d, J = 8.0 Hz, 1H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.0, 175.7, 144.3, 140.6, 136.4, 134.5, 131.1, 130.7, 128.6, 127.9, 125.8, 125.7, 123.2, 123.0, 121.2, 120.2, 118.0, 111.1, 110.6, 62.3, 56.1, 49.6, 44.9, 23.8. IR (KBr) v 3423, 2923, 1711, 1623, 1405, 751 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}ClN_3O_5$ $[M+H]^+$ 492.1321, found 492.1320.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-5-methyl-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-a]isoindol]-2-one (**30**)

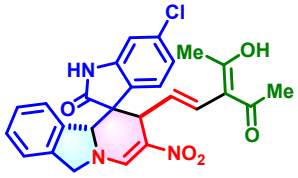
Light yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1); 22.7 mg, 48% yield; dr > 20:1; reaction time = 5 min; mp 221.2-222.2 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.62 (s, 1H), 10.89 (s, 1H), 9.01 (s, 1H), 7.31 (d, J = 8.0 Hz, 1H), 7.21 (t, J = 8.0 Hz, 1H), 7.14 (t, J = 8.0 Hz, 1H), 6.96 (d, J = 8.0 Hz, 1H), 6.88 (d, J = 8.0 Hz, 1H), 6.71 (d, J = 8.0 Hz, 1H), 6.65 (s, 1H), 6.06 (d, J = 16.0 Hz, 1H), 5.78 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.34 (s, 1H), 5.21 (d, J = 16.0 Hz, 1H), 5.07 (d, J = 16.0 Hz, 1H), 3.68 (d, J = 8.0 Hz, 1H), 2.14 (s, 6H), 2.08 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.0, 176.0, 144.2, 139.0, 136.3, 134.9, 131.6, 130.6, 129.0, 128.8, 128.4, 127.8, 125.3, 123.8, 122.9, 121.4, 120.6, 110.6, 109.3, 62.6, 56.1, 49.3, 45.3, 23.8, 20.7. IR (KBr) v 3470, 3178, 2865, 1709, 1616, 1283, 1236, 757 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{26}N_3O_5$ $[M+H]^+$ 472.1867, found 472.1868.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-5-methoxy-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**31**)

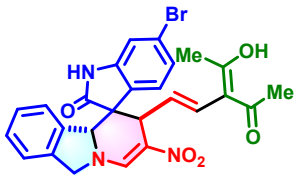
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1 to 2:1); 19.1 mg, 40% yield; dr > 20:1; reaction time = 5 min; mp 189.0-189.1 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.63 (s, 1H), 10.85 (s, 1H), 9.04 (s, 1H), 7.31 (s, 1H), 7.18 (d, J = 24.0 Hz, 2H), 6.97 (s, 1H), 6.70 (d, J = 24.0 Hz, 2H), 6.39 (s, 1H), 6.07 (d, J = 12.0 Hz, 1H), 5.79 (s, 1H), 5.35 (s, 1H), 5.22 (d, J = 16.0 Hz, 1H), 5.05 (d, J = 16.0 Hz, 1H), 3.69 (s, 1H), 3.54 (s, 3H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.0, 175.8, 154.6, 114.2, 136.3, 134.8, 134.7, 131.5,

130.3, 128.4, 127.9, 125.4, 122.9, 121.4, 120.3, 111.6, 111.6, 110.6, 109.7, 62.4, 56.2, 55.2, 49.4, 45.2, 23.8. IR (KBr) *v* 3427, 2253, 1699, 1623, 1227, 998, 762 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{26}N_3O_6$ $[M+H]^+$ 488.1816, found 488.1815.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-6-chloro-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**32**)

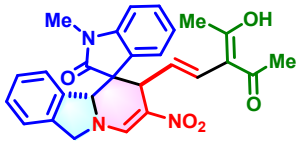
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1 to 2:1); 27.9 mg, 57% yield; dr > 20:1; reaction time = 5 min; mp 209.6-210.6 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.64 (s, 1H), 11.17 (s, 1H), 8.98 (s, 1H), 7.31 (d, J = 8.0 Hz, 1H), 7.22 (t, J = 8.0 Hz, 1H), 7.15 (t, J = 8.0 Hz, 1H), 6.94 (d, J = 8.0 Hz, 1H), 6.87-6.84 (m, 2H), 6.76 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 6.09 (d, J = 16.0 Hz, 1H), 5.78 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.36 (s, 1H), 5.18 (d, J = 16.0 Hz, 1H), 5.06 (d, J = 16.0 Hz, 1H), 3.76 (d, J = 8.0 Hz, 1H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 191.0, 176.1, 144.2, 143.1, 136.3, 134.6, 133.0, 131.1, 128.5, 127.9, 127.6, 125.7, 124.9, 123.0, 121.4, 121.2, 120.5, 110.6, 109.8, 62.4, 56.2, 49.1, 45.0, 23.8. IR (KBr) *v* 3197, 3080, 2364, 1723, 1616, 1283, 1222, 745 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}ClN_3O_5$ $[M+H]^+$ 492.1321, found 492.1321.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-6-bromo-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**33**)

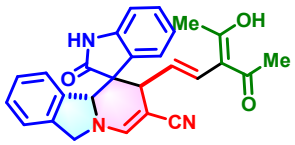
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 24.4 mg, 46% yield; dr > 20:1; reaction time = 5 min; mp 114.5-115.5 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.63 (s, 1H), 11.16 (s, 1H), 8.97 (s, 1H), 7.31 (d, J = 8.0 Hz, 1H), 7.22 (t, J = 8.0 Hz, 1H), 7.16 (t, J = 8.0 Hz, 1H), 6.97 (s, 1H), 6.92 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 2H), 6.79 (d, J = 8.0 Hz, 1H), 6.09 (d, J = 16.0 Hz, 1H), 5.77 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.36 (s, 1H), 5.18 (d, J = 16.0 Hz, 1H), 5.06 (d, J = 16.0 Hz, 1H), 3.75 (d, J = 8.0 Hz, 1H), 2.14 (s, 6H); ^{13}C NMR

(100 MHz, DMSO-d_6) δ 191.0, 175.9, 144.2, 143.3, 136.3, 134.6, 131.1, 128.6, 128.1, 128.0, 125.7, 125.2, 124.4, 123.0, 121.3, 121.2, 120.5, 112.5, 110.6, 62.4, 56.2, 49.2, 44.9, 23.8. IR (KBr) v 3468, 2924, 2857, 1720, 1618, 1280, 1232, 741 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}BrN_3O_5$ $[M+H]^+$ 536.0816, found 536.0816.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-1-methyl-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**34**)

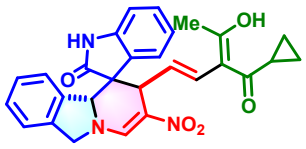
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1); 17.4 mg, 37% yield; dr > 20:1; reaction time = 75 min; mp 121.4-121.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.60 (s, 1H), 8.77 (s, 1H), 7.20-7.14 (m, 3H), 7.08 (t, J = 8.0 Hz, 1H), 6.86 (d, J = 8.0 Hz, 1H), 6.83-6.77 (m, 3H), 6.13 (d, J = 16.0 Hz, 1H), 5.81 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.36 (s, 1H), 5.11 (d, J = 12.0 Hz, 1H), 4.91 (d, J = 12.0 Hz, 1H), 3.94 (d, J = 8.0 Hz, 1H), 3.35 (s, 3H), 2.20 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 191.1, 174.5, 142.8, 142.5, 135.0, 134.4, 131.0, 128.8, 128.7, 128.3, 127.8, 127.0, 123.0, 123.0, 122.7, 122.5, 121.9, 110.6, 108.3, 63.7, 56.9, 49.5, 44.5, 26.4, 24.1. IR (KBr) v 3423, 2925, 1709, 1617, 1281, 1234, 751 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{26}N_3O_5$ $[M+H]^+$ 472.1867, found 472.1867.



2'-((1*E*,3*Z*)-3-acetyl-4-hydroxypenta-1,3-dien-1-yl)-2-oxo-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindole]-3'-carbonitrile (**35**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 2:1); 36.0 mg, 82% yield; dr > 20:1; reaction time = 35 min; mp 205.2-206.7 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 16.50 (s, 1H), 10.91 (s, 1H), 7.82 (s, 1H), 7.21 (d, J = 8.0 Hz, 1H), 7.17-7.09 (m, 2H), 7.03 (t, J = 8.0 Hz, 1H), 6.95 (t, J = 8.0 Hz, 2H), 6.77 (t, J = 8.0 Hz, 1H), 6.71 (d, J = 8.0 Hz, 1H), 6.26 (d, J = 16.0 Hz, 1H), 5.04 (s, 1H), 4.86 (d, J = 16.0 Hz, 2H), 4.58 (dd, J_1 = 12.0 Hz, J_2 = 16.0 Hz, 1H), 3.70 (d, J = 8.0 Hz, 1H), 1.93 (s, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 190.7, 177.8, 145.7, 142.3, 136.5, 135.3, 130.6, 128.8, 128.3, 128.3, 127.5, 126.0, 124.2, 122.8, 121.8, 121.7,

121.4, 110.3, 109.4, 76.2, 66.3, 55.6, 50.1, 45.4, 23.6. IR (KBr) ν 3428, 3265, 2192, 1714, 1614, 1410, 753 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{24}N_3O_3$ $[M+H]^+$ 438.1812, found 438.1810.

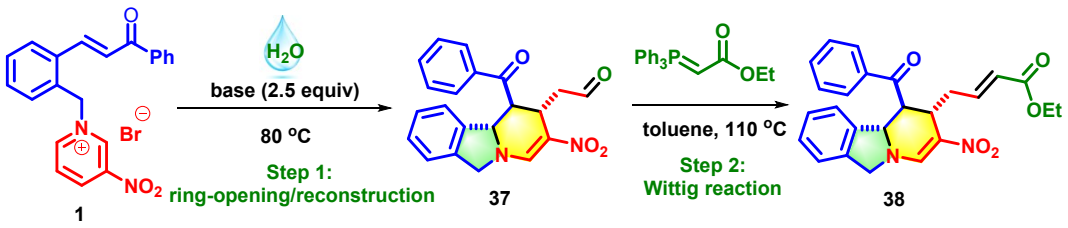


2'-((1*E*,3*Z*)-3-(cyclopropanecarbonyl)-4-hydroxypenta-1,3-dien-1-yl)-3'-nitro-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**36**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1); 24.2 mg, 50% yield; dr > 20:1; reaction time = 30 min; mp 181.2-182.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 16.92 (s, 1H), 8.79 (s, 1H), 8.60 (s, 1H), 7.18 (s, 2H), 7.10 (d, J = 8.0 Hz, 3H), 6.83-6.77 (m, 3H), 6.32 (d, J = 16.0 Hz, 1H), 5.90 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.39 (s, 1H), 5.13 (d, J = 12.0 Hz, 1H), 4.95 (d, J = 16.0 Hz, 1H), 4.03 (d, J = 8.0 Hz, 1H), 2.35-2.28 (m, 1H), 2.18 (s, 3H), 1.12-1.07 (m, 2H), 0.94-0.91 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.1, 186.1, 176.7, 142.5, 139.8, 135.0, 134.6, 130.7, 128.9, 128.9, 128.5, 128.5, 127.3, 123.4, 123.0, 122.7, 122.5, 122.2, 110.4, 110.0, 63.5, 57.0, 50.0, 45.2, 22.9, 16.0, 11.1, 11.0. IR (KBr) ν 3414, 3261, 2926, 1718, 1619, 1281, 1235, 754 cm^{-1}. HRMS (ESI) calcd for $C_{28}H_{26}N_3O_5$ $[M+H]^+$ 484.1867, found 484.1866.

4. Optimization of conditions for the synthesis of 37

■ Table S1. Optimization of the reaction conditions[a]



entry	base	time	**37**, yield (%)[b]
1	piperidine	2 h	89
2	pyrrolidine	8 h	64
3	piperazine	8 h	79
4	morpholine	9 h	67
5	Et_2NH	4 h	42
6	DMAP	72 h	7
7	TMG	72 h	10

8	KOH	19 h	17
9[c]	piperidine	2 h	80
10[d]	piperidine	26 h	55
11[e]	piperidine	48 h	12
12[f]	piperidine	12 h	34
13[g]	piperidine	12 h	23
14[h]	piperidine	18 h	19
15[i]	piperidine	18 h	21

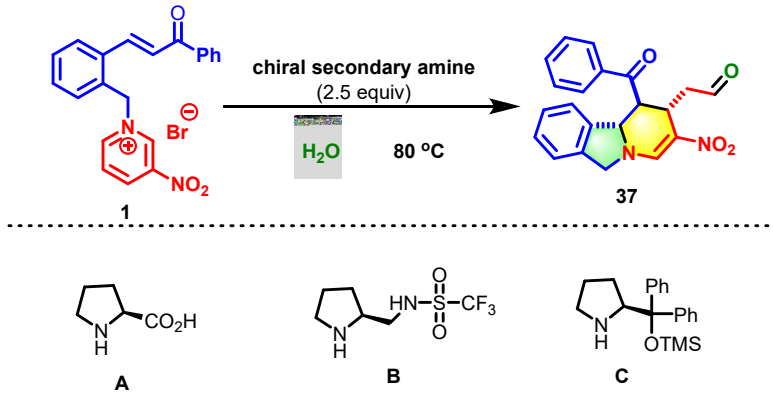
[a] **1** (0.2 mmol), base (2.5 equiv) and water (1.0 mL) at 80 °C. [b] Isolated yields obtained by silica gel column chromatography. [c] 2.0 Equivalents of base were used. [d] 1.0 Equivalent of base was used. [e] 20 mol% of Piperidine was used. [f] 20 mol% of Piperidine and 1.0 equivalent of Na_2CO_3 were used. [g] 20 mol% of Piperidine and 1.0 equivalent of Na_2HPO_4 were used. [h] 20 mol% of Piperidine and 1.0 equivalent of KOH were used. [i] 20 mol% of Piperidine and 1.0 equivalent of DBN were used. TMG = tetramethyl guanidine.

Upon treatment with 2.5 equivalents of piperidine in 1.0 mL of water at 80 °C for 2 h, to our delight, the desired polycyclic isoindoline **37** with three contiguous stereocenters were afforded in 89% isolated yield. Remarkably, the product was precipitated out from the sustainable water system and only a simple filtration was needed to purify it. To improve the synthetic efficiency, some other bases including secondary amines, tertiary amines and inorganic base were evaluated. However, all gave inferior results in terms of reaction time and yields. Specially, the reactions underwent very sluggish in the presence of tertiary amines and inorganic base and delivered extremely low yields, which strongly revealed that this reaction proceeded through a secondary amine-promoted ring-opening process. Variation of the amounts of piperidine had significant influence on the reaction outcomes. When 2.0 equivalents of piperidine were employed, the yield was reduced to 80%. Further lowering to 1.0 equivalent, the yields decreased sharply to 55% and prolonged reaction time was required. A catalytic amount of piperidine only gave **37** in 12% yield (entry S11). A combination of catalytic amount of piperidine and one equivalent of inorganic base or tertiary amine also delivered unsatisfactory results (entries 12-15). As a consequence, the optimal conditions for the formation of **37** were recommended as follows: 0.2 mmol of **1**, 2.5 equivalents of piperidine with 1.0 mL of H_2O at 80 °C. In addition, in order to enrich the diversity

of the thus obtained product **37** as well as to improve its solubility, a sequential Wittig reaction was conducted in toluene at 110 °C, and the desired product **38** was delivered in 74% yield with 9:1 dr.

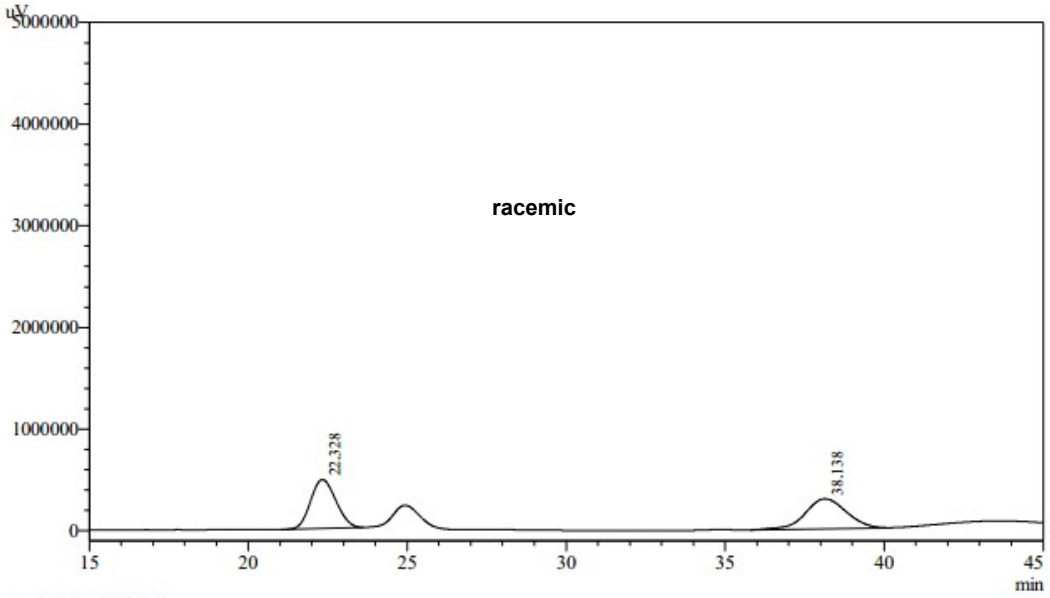
We also attempted the asymmetric synthesis of polycyclic isoindoline **37** by evaluating some secondary amine catalyst. Proline could not promote this reaction efficiently (Table S2, entry 1). Among the catalysts tested, proline-derived trifluoromethanesulfonamide **B** gave the best yield and stereoselectivity (Table S2, entry 2 yield, 89%, 68% ee).

■ Table S2. Conditions Optimization for the asymmetric synthesis of **37**[a]



entry	amine	time (h)	yield (%)[b]	ee (%)[c]
1	**A**	72	trace	N.D.
2[d]	**B**	2	89	68
3	**C**	2	55	18

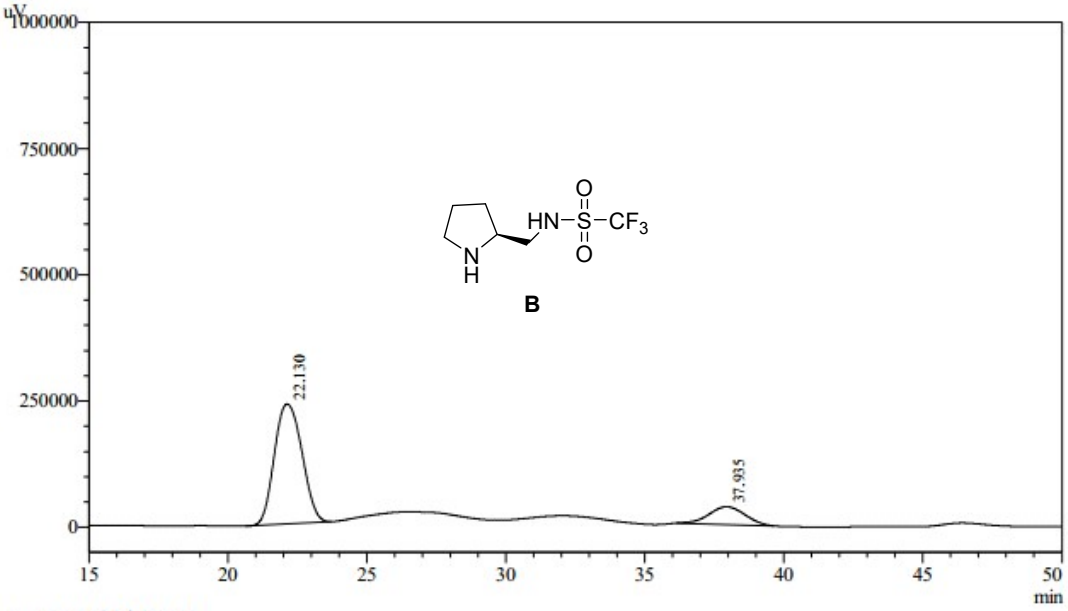
[a] **1** (0.2 mmol), secondary amine (0.5 mmol) and water (1.0 mL) at 80 °C. [b] Isolated yields obtained by silica gel column chromatography. [c] The enantiomeric excess (ee) was determined by chiral HPLC. [d] **1** (0.1 mmol), secondary amine (0.25 mmol) and water (1.0 mL) at 80 °C.



1 Det.A Ch1 / 220nm

Detector A Ch1 220nm

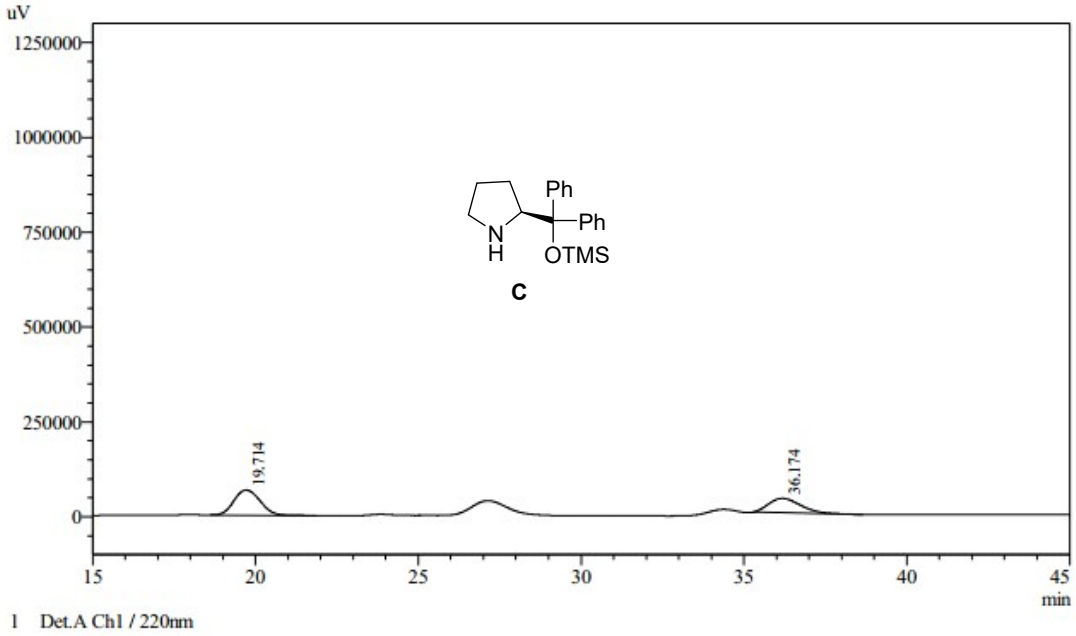
Peak#	Ret. Time	Area	Height	Area %	Height %
1	22.328	26585467	479480	50.191	61.959
2	38.138	26382722	294391	49.809	38.041
Total		52968188	773871	100.000	100.000



1 Det.A Ch1 / 220nm

Detector A Ch1 220nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	22.130	16400442	237600	83.850	87.166
2	37.935	3158840	34984	16.150	12.834
Total		19559282	272584	100.000	100.000



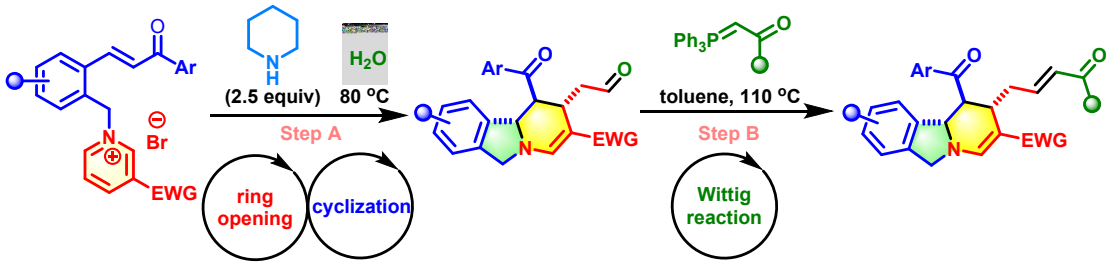
Detector A Ch1 220nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	19.714	3708244	66125	58.818	63.619
2	36.174	2596333	37814	41.182	36.381
Total		6304577	103939	100.000	100.000

NOTE:

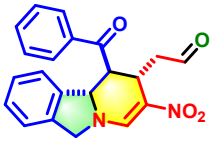
HPLC: Chiralcel IC column, hexane/EtOH = 65/35, flow rate 1.0 mL/min, UV detection at 220 nm.

5. Experimental data for the preparation of 37-59



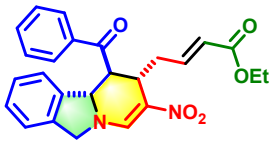
General procedure: To a mixture of pyridinium salts (0.2 mmol) in water (1 mL) was added piperidine (0.50 mmol, 2.5 equiv). The reaction mixture was stirred at 80 °C until complete consumption of pyridinium salts (monitored by TLC). During the reaction progress, a lot of precipitates were generated, which were the aldehyde intermediates. To purify them, a filtration was employed and the filter cake was dried in a vacuum drying oven. Then, the above aldehydes were dissolved in 1.0 mL of toluene, and 1.5 equivalents of ylides were added. The reaction

mixture was stirred at 110 °C until full conversion of the aldehyde intermediates by TLC analysis. Finally, the crude reaction mixture was purified by silica gel column chromatography using petroleum ether/ethyl acetate as the eluent to give **38-59**.



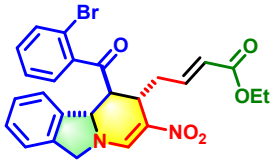
2-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)acetaldehyde (**37**)

Yellow solid obtained by filtration of the precipitate; 64.2 mg, 89% yield; dr > 20:1; reaction time = 2 h; mp 285.1-286.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.59 (s, 1H), 8.62 (s, 1H), 7.91 (d, J = 8.0 Hz, 2H), 7.63 (t, J = 8.0 Hz, 1H), 7.48 (t, J = 8.0 Hz, 2H), 7.29 (t, J = 8.0 Hz, 2H), 7.03 (t, J = 8.0 Hz, 1H), 6.73 (d, J = 8.0 Hz, 1H), 5.07-4.93 (m, 3H), 4.09 (t, J = 8.0 Hz, 1H), 3.65-3.60 (m, 1H), 3.42 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.43 (dd, J_1 = 4.0 Hz, J_2 = 16.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.4, 200.0, 143.9, 137.9, 136.0, 135.2, 134.5, 129.3, 128.9, 128.8, 128.2, 124.2, 123.5, 122.8, 65.4, 55.9, 49.2, 41.9, 35.3. IR (KBr) ν 3422, 2923, 2308, 1619, 760 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{19}N_2O_4$ $[M+H]^+$: 363.1339, found: 363.1338.



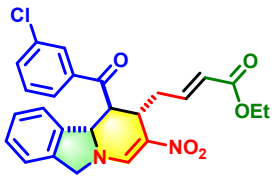
ethyl (*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**38**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 56.3 mg, 74% yield; dr = 9:1; reaction time = 2 h (first step), 30 min (second step); mp 84.4-85.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.87 (d, J = 8.0 Hz, 2H), 7.64 (t, J = 8.0 Hz, 1H), 7.47 (t, J = 8.0 Hz, 2H), 7.28 (q, J = 8.0 Hz, 2H), 7.02 (t, J = 16.0 Hz, 1H), 6.72-6.62 (m, 2H), 5.43 (d, J = 16.0 Hz, 1H), 5.00 (d, J = 8.0 Hz, 2H), 4.92 (d, J = 16.0 Hz, 1H), 4.13-4.03 (m, 2H), 3.76 (t, J = 12.0 Hz, 1H), 3.61-3.58 (m, 1H), 3.39-3.32 (m, 1H), 2.19 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.22 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.2, 165.9, 144.0, 143.1, 138.0, 135.9, 135.2, 134.3, 129.0, 128.8, 128.7, 128.1, 124.8, 124.3, 123.5, 122.9, 64.9, 60.2, 55.4, 50.0, 38.4, 30.7, 14.2. IR (KBr) ν 3418, 2927, 1717, 1620, 1287, 755 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{25}N_2O_5$ $[M+H]^+$: 433.1758, found: 433.1759.



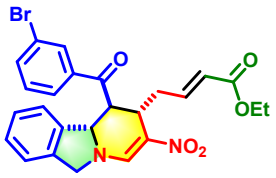
ethyl (*E*)-4-(1-(2-bromobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**39**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 2:1); 29.8 mg, 73% yield; dr = 11:1; reaction time = 2 h (first step), 30 min (second step); mp 82.3-83.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.58 (s, 1H), 7.75 (d, *J* = 8.0 Hz, 1H), 7.35-7.27 (m, 5H), 7.20 (t, *J* = 8.0 Hz, 1H), 7.03 (d, *J* = 4.0 Hz, 1H), 6.53-6.46 (m, 1H), 5.13 (d, *J* = 8.0 Hz, 1H), 5.06 (d, *J* = 12.0 Hz, 1H), 5.00 (d, *J* = 16.0 Hz, 1H), 4.90 (d, *J* = 16.0 Hz, 1H), 4.04 (t, *J* = 8.0 Hz, 2H), 3.63 (t, *J* = 8.0 Hz, 1H), 3.49 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 2H), 2.14 (t, *J* = 12.0 Hz, 1H), 1.18 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 202.3, 165.8, 144.2, 142.6, 139.7, 136.3, 135.4, 135.2, 133.3, 130.5, 129.1, 128.4, 127.4, 124.7, 124.0, 123.8, 123.1, 120.4, 64.1, 60.2, 55.4, 53.5, 39.0, 30.4, 14.2. IR (KBr) ν 3425, 2941, 1717, 1613, 1217, 754 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}BrN_2O_5$ $[M+H]^+$: 511.0863, found: 511.0861.



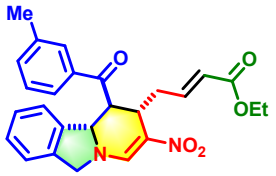
ethyl (*E*)-4-(1-(3-chlorobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**40**)

Yellow oil obtained by column chromatography (petroleum ether/ethyl acetate = 3:1 to 2:1); 55.8 mg, 93% yield; dr = 6:1; reaction time = 2 h (first step), 30 min (second step); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (s, 1H), 7.81 (s, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 7.53 (d, *J* = 8.0 Hz, 1H), 7.33 (t, *J* = 8.0 Hz, 1H), 7.24-7.20 (m, 2H), 6.98 (t, *J* = 8.0 Hz, 1H), 6.62-6.53 (m, 2H), 5.37 (d, *J* = 16.0 Hz, 1H), 4.95-4.83 (m, 3H), 4.06-3.98 (m, 2H), 3.60 (t, *J* = 8.0 Hz, 1H), 3.53-3.49 (m, 1H), 3.30-3.23 (m, 1H), 2.13 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.15 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.0, 165.7, 144.0, 143.1, 139.3, 135.6, 135.5, 135.3, 134.2, 130.3, 129.0, 128.6, 128.1, 126.9, 124.9, 124.2, 123.3, 123.0, 64.9, 60.3, 55.4, 50.4, 38.5, 30.8, 14.1. IR (KBr) ν 3429, 2923, 1728, 1581, 1274, 757 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}ClN_2O_5$ $[M+H]^+$: 467.1368, found: 467.1367.



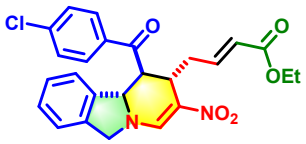
ethyl (*E*)-4-(1-(3-bromobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**41**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1 to 2:1); 53.5 mg, 62% yield; dr = 4:1; reaction time = 2 h (first step), 30 min (second step); mp 80.9-81.9 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.55 (s, 1H), 7.97 (s, 1H), 7.67 (t, *J* = 8.0 Hz, 2H), 7.28-7.20 (m, 3H), 6.99-6.95 (m, 1H), 6.61-6.53 (m, 2H), 5.37 (d, *J* = 16.0 Hz, 1H), 4.95-4.84 (m, 3H), 4.06-3.98 (m, 2H), 3.60 (t, *J* = 8.0 Hz, 1H), 3.54-3.48 (m, 1H), 3.29-3.22 (m, 1H), 2.14 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.15 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.9, 165.7, 143.9, 143.0, 139.4, 137.1, 135.6, 135.3, 131.5, 130.5, 129.0, 128.1, 127.3, 124.9, 124.2, 123.5, 123.3, 123.0, 64.9, 60.2, 55.4, 50.3, 38.5, 30.8, 14.1. IR (KBr) ν 3418, 1716, 1621, 1244, 753 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}BrN_2O_5$ $[M+H]^+$: 511.0863, found: 511.0857.



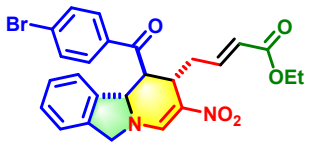
ethyl (*E*)-4-(1-(3-methylbenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**42**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 36.2 mg, 90% yield; dr = 5:1; reaction time = 2 h (first step), 30 min (second step); mp 100.9-101.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 7.70 (s, 1H), 7.65 (d, *J* = 8.0 Hz, 1H), 7.45 (d, *J* = 8.0 Hz, 1H), 7.36 (d, *J* = 8.0 Hz, 1H), 7.30-7.27 (m, 2H), 7.03 (t, *J* = 8.0 Hz, 1H), 6.74-6.64 (m, 2H), 5.45 (d, *J* = 16.0 Hz, 1H), 5.00 (d, *J* = 12.0 Hz, 2H), 4.92 (d, *J* = 16.0 Hz, 1H), 4.13-4.07 (m, 2H), 3.79-3.67 (m, 1H), 3.60-3.55 (m, 1H), 3.42-3.35 (m, 1H), 2.39 (s, 3H), 2.16 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 1.23 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.4, 165.9, 144.0, 143.3, 139.0, 138.0, 136.0, 135.2, 135.1, 129.2, 128.9, 128.8, 128.1, 126.1, 124.8, 124.2, 123.5, 122.8, 64.8, 60.2, 55.5, 49.9, 38.4, 30.6, 21.2, 14.1. IR (KBr) ν 3417, 2934, 1713, 1618, 1290, 752 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{27}N_2O_5$ $[M+H]^+$: 447.1914, found: 447.1914.



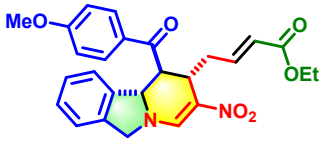
ethyl (*E*)-4-(1-(4-chlorobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**43**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 2:1); 61.8 mg, 83% yield; dr = 7:1; reaction time = 14 h (first step), 30 min (second step); mp 80.3-81.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.81 (d, *J* = 8.0 Hz, 2H), 7.44 (d, *J* = 8.0 Hz, 2H), 7.33-7.27 (m, 2H), 7.04 (t, *J* = 8.0 Hz, 1H), 6.68-6.60 (m, 2H), 5.45 (d, *J* = 16.0 Hz, 1H), 5.03-4.90 (m, 3H), 4.15-4.04 (m, 2H), 3.70 (t, *J* = 8.0 Hz, 1H), 3.61-3.57 (m, 1H), 3.35-3.28 (m, 1H), 2.22 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.23 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.9, 165.7, 143.9, 143.1, 141.0, 136.2, 135.6, 135.3, 130.1, 129.3, 128.9, 128.1, 124.8, 124.3, 123.4, 123.0, 64.9, 60.2, 55.4, 50.2, 38.4, 30.8, 14.1. IR (KBr) ν 3416, 1715, 1618, 1289, 753 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}ClN_2O_5$ $[M+H]^+$: 467.1368, found: 467.1367.



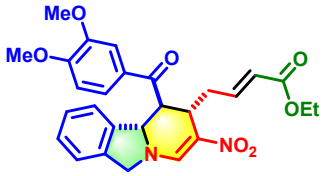
ethyl (*E*)-4-(1-(4-bromobenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**44**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 2:1); 52.1 mg, 68% yield; dr = 14:1; reaction time = 5 h (first step), 30 min (second step); mp 83.0-84.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.73 (d, *J* = 8.0 Hz, 2H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.33-7.27 (m, 2H), 7.04 (t, *J* = 8.0 Hz, 1H), 6.68-6.60 (m, 2H), 5.45 (d, *J* = 16.0 Hz, 1H), 5.03-4.90 (m, 3H), 4.13-4.04 (m, 2H), 3.69 (t, *J* = 8.0 Hz, 1H), 3.61-3.58 (m, 1H), 3.34-3.28 (m, 1H), 2.22 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.23 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.1, 165.7, 143.9, 143.1, 136.6, 135.6, 135.3, 132.3, 130.1, 129.8, 128.9, 128.1, 124.8, 124.3, 123.4, 123.0, 64.9, 60.2, 55.4, 50.2, 38.4, 30.8, 14.1. IR (KBr) ν 3427, 2930, 1714, 1617, 1290, 754 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}BrN_2O_5$ $[M+H]^+$: 511.0863, found: 511.0861.



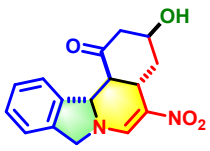
ethyl (*E*)-4-(1-(4-methoxybenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**45**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 2:1); 33.2 mg, 86% yield; dr = 18:1; reaction time = 8 h (first step), 30 min (second step); mp 73.7-74.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.87 (d, J = 8.0 Hz, 2H), 7.31-7.25 (m, 2H), 7.03 (t, J = 8.0 Hz, 1H), 6.93 (d, J = 8.0 Hz, 2H), 6.72 (d, J = 8.0 Hz, 1H), 6.67 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.52 (d, J = 12.0 Hz, 1H), 5.02-4.89 (m, 3H), 4.16-4.04 (m, 2H), 3.89 (s, 3H), 3.69 (t, J = 8.0 Hz, 1H), 3.61-3.57 (m, 1H), 3.40-3.34 (m, 1H), 2.20 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.23 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.1, 165.9, 164.5, 144.0, 143.4, 136.1, 135.2, 131.2, 131.1, 128.7, 128.0, 124.8, 124.3, 123.6, 122.8, 114.2, 64.8, 60.2, 55.5, 55.4, 49.5, 38.1, 30.6, 14.1. IR (KBr) ν 3415, 2927, 1716, 1660, 1608, 1283, 755 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{27}N_2O_6$ $[M+H]^+$: 463.1864, found: 463.1861.



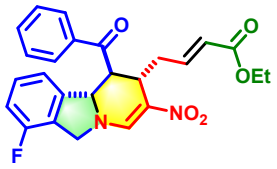
ethyl (*E*)-4-(1-(3,4-dimethoxybenzoyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**46**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 2:1); 45.5 mg, 91% yield; dr = 14:1; reaction time = 2 h (first step), 30 min (second step); mp 87.4-88.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 7.57 (s, 1H), 7.38 (d, J = 8.0 Hz, 1H), 7.29 (t, J = 4.0 Hz, 2H), 7.04 (t, J = 8.0 Hz, 1H), 6.83 (d, J = 8.0 Hz, 1H), 6.71 (d, J = 8.0 Hz, 2H), 5.55 (d, J = 16.0 Hz, 1H), 5.02-4.90 (m, 3H), 4.13-4.07 (m, 2H), 3.95 (s, 3H), 3.94 (s, 3H), 3.70 (t, J = 8.0 Hz, 1H), 3.61-3.58 (m, 1H), 3.41-3.34 (m, 1H), 2.23 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.23 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.0, 165.9, 154.4, 149.4, 143.9, 143.4, 136.0, 135.2, 131.2, 128.7, 128.0, 124.7, 124.2, 124.2, 123.6, 122.8, 110.1, 110.1, 64.8, 60.2, 56.1, 56.0, 55.4, 49.4, 38.1, 30.6, 14.1. IR (KBr) ν 3419, 2924, 1708, 1626, 761 cm^{-1}. HRMS (ESI) calcd for $C_{27}H_{29}N_2O_7$ $[M+H]^+$: 493.1969, found: 493.1971.



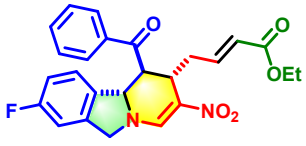
3-Hydroxy-5-nitro-3,4,4a,8,12b,12c-hexahydroisoindolo[1,2-*a*]isoquinolin-1(2*H*)-one (**47**)

Brown solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 1:1); 6.2 mg, 10% yield; dr > 20:1; reaction time = 2 h; mp (not obtained. Note: the product was decomposed directly after heating to 261.0 °C without melting.); ^{1}H NMR (300 MHz, DMSO-d_6) δ 8.65 (s, 1H), 7.35-7.27 (m, 4H), 5.11 (s, 1H), 4.92 (d, J = 9.0 Hz, 3H), 4.41 (s, 1H), 3.24 (t, J = 9.0 Hz, 1H), 3.09 (d, J = 12.0 Hz, 1H), 2.94 (d, J = 12.0 Hz, 2H), 2.42 (d, J = 12.0 Hz, 1H), 1.57 (t, J = 12.0 Hz, 1H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 208.3, 145.3, 138.3, 136.5, 128.1, 127.8, 124.6, 122.5, 121.9, 67.8, 60.4, 55.8, 55.7, 50.4, 35.2, 35.1. IR (KBr) ν 3398, 2919, 2376, 1711, 1621, 1282, 757 cm^{-1}. HRMS (ESI) calcd for $C_{16}H_{17}N_2O_4$ [M+H]$^+$: 301.1183, found: 301.1181.



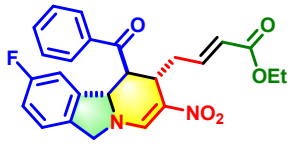
ethyl (*E*)-4-(1-benzoyl-7-fluoro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**48**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1); 35.5 mg, 66% yield; dr = 12:1; reaction time = 2 h (first step), 30 min (second step); mp 114.6-115.4 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 (s, 1H), 7.85 (d, J = 8.0 Hz, 2H), 7.63 (t, J = 8.0 Hz, 1H), 7.46 (t, J = 8.0 Hz, 2H), 7.04-6.93 (m, 2H), 6.66-6.58 (m, 1H), 6.47 (d, J = 8.0 Hz, 1H), 5.41 (d, J = 16.0 Hz, 1H), 5.02-4.92 (m, 3H), 4.13-4.01 (m, 2H), 3.75 (t, J = 8.0 Hz, 1H), 3.58-3.54 (m, 1H), 3.33-3.26 (m, 1H), 2.18 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.20 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.9, 165.7, 157.6 (d, J = 248.0 Hz, 1C), 143.5, 142.9, 139.1 (d, J = 5.0 Hz, 1C), 137.8, 134.5, 130.4 (d, J = 5.0 Hz, 1C), 129.0, 128.7, 124.9, 124.8, 122.4 (d, J = 18.0 Hz, 1C), 119.2 (d, J = 3.0 Hz, 1C), 115.4 (d, J = 18.0 Hz, 1C), 65.0, 60.2, 52.5, 49.7, 38.3, 30.6, 14.1; ^{19}F NMR (375 MHz, $CDCl_3$) δ -116.2. IR (KBr) ν 3421, 2918, 1715, 1623, 1282, 783 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}FN_2O_5$ [M+H]$^+$: 451.1664, found: 451.1662.



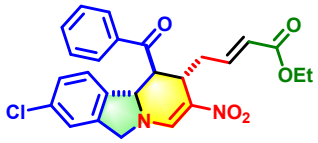
ethyl (*E*)-4-(1-benzoyl-8-fluoro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**49**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 38.1 mg, 57% yield; dr = 6:1; reaction time = 30 min (first step), 30 min (second step); mp 112.4-113.2 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 (s, 1H), 7.85 (d, *J* = 8.0 Hz, 2H), 7.63 (t, *J* = 8.0 Hz, 1H), 7.46 (t, *J* = 8.0 Hz, 2H), 6.99 (d, *J* = 8.0 Hz, 1H), 6.72-6.59 (m, 3H), 5.42 (d, *J* = 16.0 Hz, 1H), 4.99-4.87 (m, 3H), 4.13-4.01 (m, 2H), 3.79-3.68 (m, 1H), 3.58-3.55 (m, 1H), 3.34-3.27 (m, 1H), 2.18 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.20 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 165.8, 162.9 (d, *J* = 247.0 Hz, 1C), 143.6, 143.0, 137.8, 137.6 (d, *J* = 9.0 Hz, 1C), 134.4, 131.6 (d, *J* = 3.0 Hz, 1C), 129.1, 128.7, 124.9 (d, *J* = 9.0 Hz, 1C), 124.9, 122.6, 115.4 (d, *J* = 23.0 Hz, 1C), 110.2 (d, *J* = 23.0 Hz, 1C), 64.4, 60.2, 55.2, 50.0, 38.3, 30.7, 14.1; ^{19}F NMR (375 MHz, $CDCl_3$) δ -112.0. IR (KBr) ν 3443, 2930, 1717, 1622, 1281, 755 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}FN_2O_5$ $[M+H]^+$: 451.1664, found: 451.1663.



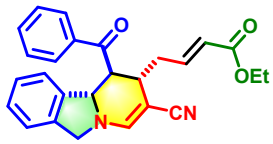
ethyl (*E*)-4-(1-benzoyl-9-fluoro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**50**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 3:1); 50.2 mg, 67% yield; dr = 12:1; reaction time = 2 h (first step), 30 min (second step); mp 81.1-82.0 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (s, 1H), 7.89 (d, *J* = 8.0 Hz, 2H), 7.66 (t, *J* = 8.0 Hz, 1H), 7.50 (t, *J* = 8.0 Hz, 2H), 7.27 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 7.01-6.96 (m, 1H), 6.70-6.63 (m, 1H), 6.41 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 5.46 (d, *J* = 16.0 Hz, 1H), 5.00-4.87 (m, 3H), 4.13-4.05 (m, 2H), 3.78 (t, *J* = 8.0 Hz, 1H), 3.61-3.56 (m, 1H), 3.37-3.30 (m, 1H), 2.21 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 1.22 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 165.9, 162.4 (d, *J* = 246.0 Hz, 1C), 143.8, 143.1, 138.0 (d, *J* = 9.0 Hz, 1C), 137.8, 134.6, 131.0 (d, *J* = 3.0 Hz, 1C), 129.2, 128.7, 125.0, 124.6, 124.3 (d, *J* = 9.0 Hz, 1C), 116.3 (d, *J* = 23.0 Hz, 1C), 110.1 (d, *J* = 23.0 Hz, 1C), 64.8 (d, *J* = 2.0 Hz, 1C), 60.3, 55.0, 49.8, 38.4, 30.7, 14.2; ^{19}F NMR (375 MHz, $CDCl_3$) δ -112.6. IR (KBr) ν 3429, 2930, 1710, 1619, 1283, 766 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}FN_2O_5$ $[M+H]^+$: 451.1664, found: 451.1665.



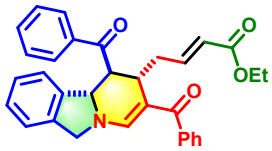
ethyl (*E*)-4-(1-benzoyl-8-chloro-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**51**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 36.8 mg, 83% yield; dr = 7:1; reaction time = 23 h (first step), 30 min (second step); mp 84.3-85.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.59 (s, 1H), 7.87 (d, *J* = 8.0 Hz, 2H), 7.66 (t, *J* = 8.0 Hz, 1H), 7.49 (t, *J* = 8.0 Hz, 2H), 7.30 (s, 1H), 6.99 (d, *J* = 8.0 Hz, 1H), 6.69-6.60 (m, 2H), 5.44 (d, *J* = 16.0 Hz, 1H), 5.01-4.88 (m, 3H), 4.15-4.02 (m, 2H), 3.74 (t, *J* = 8.0 Hz, 1H), 3.61-3.56 (m, 1H), 3.36-3.29 (m, 1H), 2.20 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 1.22 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.9, 165.8, 143.6, 142.9, 137.8, 137.3, 134.9, 134.4, 129.1, 128.7, 128.7, 128.3, 124.9, 124.6, 124.6, 123.2, 64.5, 60.2, 55.0, 49.8, 38.3, 30.7, 14.1. IR (KBr) ν 3425, 1711, 1619, 1294, 764 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}ClN_2O_5$ $[M+H]^+$: 467.1368, found: 467.1368.



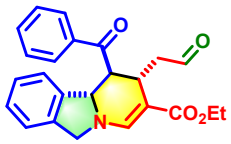
ethyl (*E*)-4-(1-benzoyl-3-cyano-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**52**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 3:1); 72.3 mg, 96% yield; dr > 20:1; reaction time = 2 h (first step), 30 min (second step); mp 65.9-66.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 4.0 Hz, 2H), 7.59 (t, *J* = 8.0 Hz, 1H), 7.42 (t, *J* = 8.0 Hz, 2H), 7.28-7.21 (m, 3H), 6.97 (t, *J* = 8.0 Hz, 1H), 6.79-6.69 (m, 2H), 5.31 (d, *J* = 16.0 Hz, 1H), 4.98 (d, *J* = 8.0 Hz, 1H), 4.89 (d, *J* = 12.0 Hz, 1H), 4.73 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 4.15-4.02 (m, 2H), 3.33 (t, *J* = 8.0 Hz, 1H), 3.21-3.17 (m, 1H), 2.68-2.61 (m, 1H), 2.31-2.24 (m, 1H), 1.22 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 165.7, 144.8, 142.7, 138.2, 137.0, 135.9, 133.9, 128.8, 128.6, 128.4, 127.6, 125.3, 123.5, 122.7, 120.8, 80.3, 64.9, 60.1, 55.8, 46.8, 37.9, 32.1, 14.2. IR (KBr) ν 3422, 2944, 2186, 1713, 1619, 1172, 751 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{25}N_2O_3$ $[M+H]^+$: 413.1860, found: 413.1859.



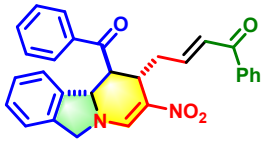
ethyl (*E*)-4-(1,3-dibenzoyl-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**53**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 25.0 mg, 71% yield; dr > 20:1; reaction time = 17 h (first step), 4 h (second step); mp 65.8-66.7 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, J = 8.0 Hz, 2H), 7.61 (t, J = 8.0 Hz, 1H), 7.56 (d, J = 8.0 Hz, 2H), 7.48-7.38 (m, 6H), 7.23 (d, J = 4.0 Hz, 2H), 7.02-6.98 (m, 1H), 6.85-6.74 (m, 2H), 5.35 (d, J = 16.0 Hz, 1H), 4.98 (d, J = 12.0 Hz, 1H), 4.74 (q, J = 8.0 Hz, 2H), 4.09 (q, J = 8.0 Hz, 2H), 3.74 (d, J = 8.0 Hz, 1H), 3.60-3.57 (m, 1H), 3.50-3.43 (m, 1H), 2.12 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.21 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 203.3, 192.7, 166.3, 148.6, 145.1, 140.8, 138.6, 137.6, 135.9, 133.8, 129.9, 128.9, 128.6, 128.5, 128.3, 128.1, 127.7, 123.9, 123.5, 122.6, 112.0, 64.3, 59.9, 55.5, 49.8, 38.6, 30.3, 14.2. IR (KBr) ν 3423, 2930, 1715, 1591, 1572, 1293, 1259, 743 cm^{-1}. HRMS (ESI) calcd for $C_{32}H_{30}NO_4$ $[M+H]^+$: 492.2169, found: 492.2168.



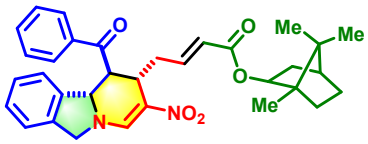
ethyl 1-benzoyl-2-(2-oxoethyl)-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindole-3-carboxylate (**54**)

Yellow oil obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 4:1); 57.3 mg, 74% yield; dr > 20:1; reaction time = 11 h; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.60 (s, 1H), 7.89 (d, J = 8.0 Hz, 2H), 7.85 (s, 1H), 7.57 (t, J = 8.0 Hz, 1H), 7.43 (t, J = 8.0 Hz, 2H), 7.21 (q, J = 8.0 Hz, 2H), 6.96 (t, J = 8.0 Hz, 1H), 6.72 (d, J = 8.0 Hz, 1H), 4.97 (d, J = 12.0 Hz, 1H), 4.89 (d, J = 16.0 Hz, 1H), 4.76 (d, J = 16.0 Hz, 1H), 4.16-4.10 (m, 2H), 3.79 (t, J = 8.0 Hz, 1H), 3.45-3.41 (m, 1H), 3.15 (dd, J_1 = 4.0 Hz, J_2 = 16.0 Hz, 1H), 2.35-2.29 (m, 1H), 1.26 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 203.6, 201.4, 167.1, 143.6, 138.4, 137.7, 136.3, 133.9, 128.9, 128.7, 128.2, 127.5, 123.5, 122.6, 99.0, 64.9, 59.2, 55.6, 49.4, 42.8, 35.3, 14.5. IR (KBr) ν 3431, 2927, 1724, 1618, 1398, 758 cm^{-1}. HRMS (ESI) calcd for $C_{24}H_{24}NO_4$ $[M+H]^+$: 390.1700, found: 390.1698.



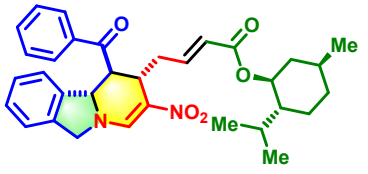
(*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)-1-phenylbut-2-en-1-one (**55**)

Yellow solid obtained by filtration of the precipitate; 71.1 mg, 87% yield; dr > 20:1; reaction time = 10 h; mp 211.7-212.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (s, 1H), 7.88 (d, *J* = 8.0 Hz, 2H), 7.76 (d, *J* = 8.0 Hz, 2H), 7.59 (t, *J* = 8.0 Hz, 1H), 7.53 (t, *J* = 8.0 Hz, 1H), 7.44-7.39 (m, 4H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.01 (t, *J* = 8.0 Hz, 1H), 6.86-6.78 (m, 1H), 6.71 (d, *J* = 8.0 Hz, 1H), 6.59 (d, *J* = 12.0 Hz, 1H), 5.02-4.88 (m, 3H), 3.81 (t, *J* = 8.0 Hz, 1H), 3.68-3.64 (m, 1H), 3.55-3.49 (m, 1H), 2.29 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.4, 189.5, 143.9, 143.2, 138.2, 137.4, 135.9, 135.3, 134.2, 132.9, 129.1, 128.9, 128.8, 128.8, 128.5, 128.5, 128.1, 124.5, 123.6, 122.9, 65.0, 55.5, 50.1, 38.7, 31.0. IR (KBr) ν 3442, 2923, 1665, 1615, 1288, 756 cm^{-1}. HRMS (ESI) calcd for $C_{29}H_{25}N_2O_4$ $[M+H]^+$: 465.1809, found: 465.1808.



1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl (*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**56**)

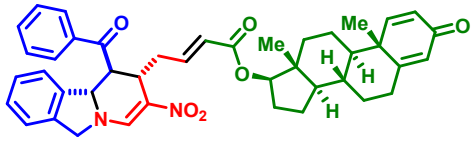
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 15:1 to 4:1); 64.8 mg, 68% yield; dr = 2:1; reaction time = 7 h; mp 77.2-78.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (s, 1H), 7.84 (t, *J* = 8.0 Hz, 2H), 7.62 (q, *J* = 8.0 Hz, 1H), 7.46 (t, *J* = 8.0 Hz, 2H), 7.29 (t, *J* = 8.0 Hz, 2H), 7.01 (t, *J* = 8.0 Hz, 1H), 6.71 (d, *J* = 8.0 Hz, 1H), 6.67-6.61 (m, 1H), 5.46-5.33 (m, 1H), 4.99 (d, *J* = 12.0 Hz, 2H), 4.93-4.88 (m, 1H), 4.85-4.58 (m, 1H), 3.77-3.68 (m, 1H), 3.61-3.57 (m, 1H), 3.40-3.34 (m, 1H), 2.35-2.13 (m, 2H), 1.87-1.49 (m, 4H), 1.30-1.01 (m, 2H), 0.93-0.75 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.3, 166.3, 144.0, 143.1, 142.9, 135.9, 138.1, 135.3, 134.2, 129.0, 128.9, 128.7, 128.1, 125.2, 123.6, 122.9, 79.7, 64.9, 55.5, 50.1, 47.8, 44.8, 38.5, 36.6, 30.6, 27.9, 27.0, 19.7, 18.8, 13.4, 11.3. IR (KBr) ν 3416, 2930, 1713, 1669, 1282, 755 cm^{-1}. HRMS (ESI) calcd for $C_{33}H_{37}N_2O_5$ $[M+H]^+$: 541.2697, found: 541.2698.



2-isopropyl-5-methylcyclohexyl (*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-

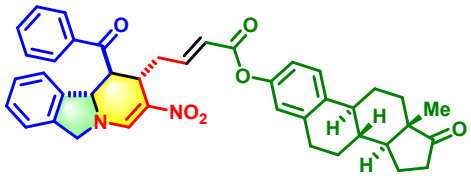
a]isoindol-2-yl)but-2-enoate (**57**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 20:1 to 6:1); 67.4 mg, 70% yield; dr = 1:1; reaction time = 2 h; mp 160.0-161.0 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.85 (d, *J* = 8.0 Hz, 2H), 7.63 (q, *J* = 8.0 Hz, 1H), 7.45 (q, *J* = 8.0 Hz, 2H), 7.31 (t, *J* = 8.0 Hz, 2H), 7.02 (t, *J* = 8.0 Hz, 1H), 6.71 (d, *J* = 8.0 Hz, 1H), 6.69-6.61 (m, 1H), 5.40 (d, *J* = 16.0 Hz, 1H), 5.02-4.90 (m, 3H), 4.67-4.60 (m, 1H), 3.78-3.71 (m, 1H), 3.62-3.57 (m, 1H), 3.42-3.34 (m, 1H), 2.19 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 1.95-1.91 (m, 1H), 1.80-1.72 (m, 1H), 1.68-1.63 (m, 2H), 1.50-1.42 (m, 1H), 1.37-1.30 (m, 1H), 1.06-0.84 (m, 9H), 0.72 (t, *J* = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.3, 165.6, 143.9, 142.9, 137.9, 135.9, 135.2, 134.3, 129.0, 128.8, 128.7, 128.1, 125.2, 124.3, 123.6, 122.9, 74.0, 64.9, 55.5, 50.0, 46.9, 40.8, 38.4, 34.2, 31.3, 26.2, 23.4, 21.9, 20.6, 16.6. IR (KBr) ν 3421, 2925, 1710, 1626, 1399, 755 cm^{-1}. HRMS (ESI) calcd for $C_{33}H_{39}N_2O_5$ $[M+H]^+$: 543.2853, found: 543.2852.



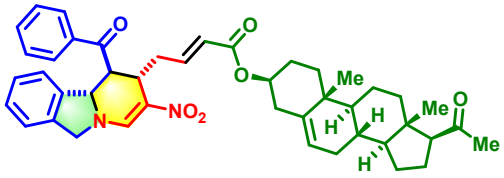
9,10,13-trimethyl-3-oxo-6,7,8,9,10,11,12,13,14,15,16,17-dodecahydro-3*H*-cyclopenta[*a*]phenanthren-17-yl (*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**58**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 2:1); 70.9 mg, 60% yield; dr = 9:1; reaction time = 2 h; mp 96.7-97.6 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.61 (s, 1H), 7.86 (d, *J* = 8.0 Hz, 2H), 7.64 (d, *J* = 8.0 Hz, 1H), 7.46 (t, *J* = 8.0 Hz, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.04 (d, *J* = 8.0 Hz, 2H), 6.72-6.62 (m, 2H), 6.22 (d, *J* = 8.0 Hz, 1H), 6.06 (s, 1H), 5.44 (d, *J* = 16.0 Hz, 1H), 5.03-4.90 (m, 3H), 5.43 (d, *J* = 4.0 Hz, 1H), 3.76 (d, *J* = 8.0 Hz, 1H), 3.60 (m, 1H), 3.36-3.33 (m, 1H), 2.47 (t, *J* = 12.0 Hz, 1H), 2.37 (d, *J* = 12.0 Hz, 1H), 2.23-2.14 (m, 2H), 1.96 (d, *J* = 12.0 Hz, 1H), 1.77-1.64 (m, 6H), 1.51-1.34 (m, 2H), 1.24 (s, 3H), 1.16-0.99 (m, 3H), 0.82 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.2, 186.2, 168.8, 165.9, 155.6, 143.9, 143.3, 138.0, 135.9, 135.2, 134.2, 129.0, 128.9, 128.7, 128.1, 127.5, 124.8, 124.3, 123.9, 123.5, 122.9, 82.2, 64.9, 55.5, 52.2, 50.0, 49.8, 43.5, 42.8, 38.4, 36.4, 35.3, 33.0, 32.7, 30.7, 27.5, 23.7, 22.3, 18.7, 12.1. IR (KBr) ν 3422, 2925, 2382, 1655, 1401, 758 cm^{-1}. HRMS (ESI) calcd for $C_{42}H_{45}N_2O_6$ $[M+H]^+$: 673.3272, found: 673.3271.



13-methyl-17-oxo-7,8,9,11,12,13,14,15,16,17-decahydro-6*H*-cyclopenta[*a*]phenanthren-3-yl (*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**59**)

Brown solid obtained by filtration of the precipitate; 84.6 mg, 73% yield; dr > 20:1; reaction time = 5 h; mp 208.5-209.1 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56 (s, 1H), 7.82 (d, J = 8.0 Hz, 2H), 7.57 (t, J = 8.0 Hz, 1H), 7.41 (d, J = 8.0 Hz, 2H), 7.25-7.16 (m, 3H), 6.95 (t, J = 8.0 Hz, 1H), 6.78-6.64 (m, 4H), 5.53 (d, J = 16.0 Hz, 1H), 4.95-4.84 (m, 3H), 3.71 (t, J = 8.0 Hz, 1H), 3.57-3.53 (m, 1H), 3.37-3.30 (m, 1H), 2.80 (t, J = 8.0 Hz, 2H), 2.42 (dd, J_1 = 8.0 Hz, J_2 = 20.0 Hz, 1H), 2.34-2.27 (m, 1H), 2.24-2.16 (m, 2H), 2.11-1.86 (m, 4H), 1.60-1.30 (m, 6H), 0.82 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 201.1, 164.3, 148.3, 145.5, 144.1, 137.9, 137.8, 137.2, 135.8, 135.2, 134.3, 129.0, 128.8, 128.8, 128.7, 128.1, 126.2, 124.1, 124.0, 123.5, 122.9, 121.4, 118.6, 64.9, 55.5, 50.3, 50.0, 47.8, 44.0, 38.4, 37.9, 35.8, 31.4, 31.0, 29.3, 26.2, 25.6, 21.5, 13.7. IR (KBr) ν 3428, 2382, 2309, 2025, 1636 cm^{-1}. HRMS (ESI) calcd for $C_{41}H_{41}N_2O_6$ $[M+H]^+$: 657.2959, found: 657.2962.



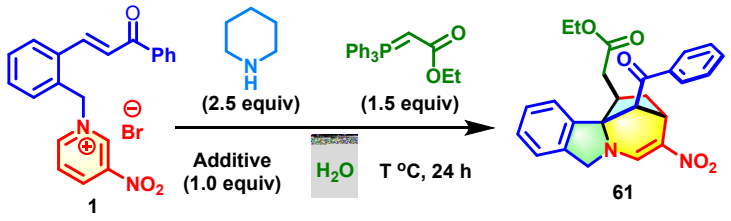
17-acetyl-10,13-dimethyl-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1*H*-cyclopenta[*a*]phenanthren-3-yl (*E*)-4-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)but-2-enoate (**60**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 3:1); 102.4 mg, 82% yield; dr = 15:1; reaction time = 3 h; mp 165.4-166.2 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.87 (d, J = 8.0 Hz, 2H), 7.64 (d, J = 8.0 Hz, 1H), 7.47 (t, J = 8.0 Hz, 2H), 7.29 (q, J = 8.0 Hz, 2H), 7.02 (t, J = 8.0 Hz, 1H), 6.71 (d, J = 8.0 Hz, 1H), 6.68-6.60 (m, 1H), 5.42 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 5.36 (s, 1H), 5.02-4.91 (m, 3H), 4.61-4.53 (m, 1H), 3.76 (d, J = 8.0 Hz, 1H), 3.61-3.58 (m, 1H), 3.38-3.33 (m, 1H), 2.54 (t, J = 8.0 Hz, 1H), 2.28 (d, J = 8.0 Hz, 2H), 2.19 (t, J = 12.0 Hz, 2H), 2.12 (s, 3H), 2.06-1.97 (m, 2H), 1.88-1.80 (m, 2H), 1.68-1.44 (m,

9H), 1.19-1.13 (m, 3H), 1.02 (s, 3H), 0.63 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.5, 201.2, 165.3, 144.0, 143.0, 139.7, 138.0, 135.9, 135.2, 134.3, 129.0, 128.8, 128.7, 128.1, 125.2, 124.3, 123.6, 122.9, 122.3, 73.7, 64.9, 63.6, 56.8, 55.5, 50.0, 49.8, 43.9, 38.7, 38.4, 38.1, 36.9, 36.5, 31.7, 31.5, 30.7, 27.7, 27.6, 24.4, 22.8, 21.0, 19.3, 13.2. IR (KBr) ν 3421, 2933, 1708, 1660, 755 cm^{-1}. HRMS (ESI) calcd for $C_{44}H_{50}N_2NaO_6$ $[M+Na]^+$: 725.3561, found: 725.3558.

6. Optimization of conditions for the synthesis of 61

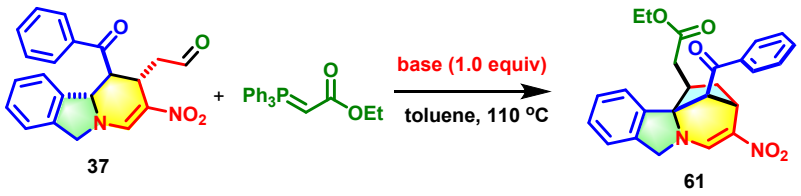
■ **Table S3.** One-pot approach[a]



entry	T	Additive	Yield (%)[b]
1	100	none	25
2	120	none	34
3[c]	120	none	27
4	130	none	31
5	120	TMG	36
6	120	DBU	14
7	120	DABCO·6H_2O	22
8	120	NaOH	30
9	120	Cs_2CO_3	9

[a] **1** (0.20 mmol), piperidine (2.5 equiv), ylide (1.5 equiv), H_2O (1.0 mL), at specified reaction temperature for 24 h. [b] Isolated yields obtained by silica gel column chromatography. [c] Combined solvents of water and CH_3CN (v/v = 1:1). TMG = tetramethyl guanidine; DBU = 1,8-diazabicyclo[5.4.0]undec-7-ene; DABCO = 1,4-diazabicyclo[2.2.2]octane.

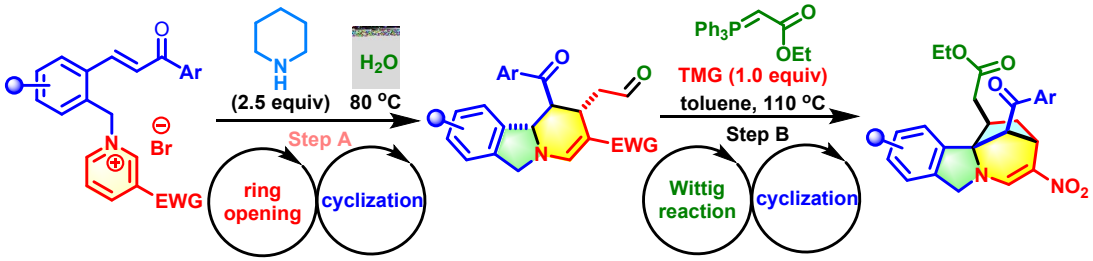
■ **Table S4.** Stepwise approach[a]



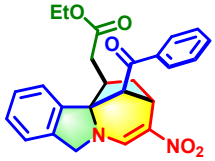
entry	base	time (h)	Yield (%)[b]
1	TMG	45	61
2	DBU	5	30
3	DBU	5	24
4	Cs_2CO_3	57	13
5	NaOH	17	9
6	DIPEA	36	15
7[c]	TMG	48	33
8[d]	TMG	16	35

[a] **37** (0.18 mmol, obtained from the first ring-opening/cyclization step), ylide (1.5 equiv), TMG (1.0 equiv), toluene (1.0 mL), 110 °C. [b] Isolated yields obtained by silica gel column chromatography. [c] TMG (0.5 equiv). [d] TMG (1.5 equiv).

7. Experimental data for the preparation of 61-69

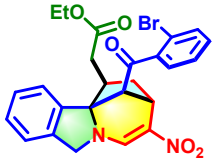


General procedure: To a mixture of pyridinium salts (0.2 mmol) in water (1 mL) was added piperidine (0.50 mmol, 2.5 equiv). The reaction mixture was stirred at 80 °C until complete consumption of pyridinium salts (monitored by TLC). During the reaction progress, a lot of precipitates were generated, which were the aldehyde intermediates. To purify them, a filtration was employed and the filter cake was dried in a vacuum drying oven. The above aldehydes were dissolved in 1.0 mL of toluene. Then, 1.5 equivalents of ylides and 1.0 equivalent of TMG were added. The reaction mixture was stirred at 110 °C until full conversion of the aldehyde intermediates by TLC analysis. Finally, the crude reaction mixture was purified by silica gel column chromatography using petroleum ether/ethyl acetate as the eluent to give **60-68**.



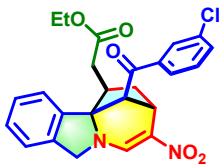
ethyl 2-(12-benzoyl-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**61**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 3:1); 46.3 mg, 61% yield; dr > 20:1; reaction time = 45 h; mp 82.0-82.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (s, 1H), 7.83 (d, J = 8.0 Hz, 2H), 7.54 (t, J = 8.0 Hz, 1H), 7.42 (t, J = 8.0 Hz, 2H), 7.33 (d, J = 4.0 Hz, 2H), 7.25-7.23 (m, 1H), 7.11 (d, J = 8.0 Hz, 1H), 5.14 (d, J = 12.0 Hz, 1H), 4.99 (d, J = 12.0 Hz, 1H), 4.27 (t, J = 8.0 Hz, 1H), 4.07 (d, J = 4.0 Hz, 1H), 3.95-3.89 (m, 2H), 2.90-2.82 (m, 1H), 2.64 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.46 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.33 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.14-2.08 (m, 1H), 1.15 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.7, 170.9, 142.8, 137.1, 136.1, 135.9, 133.6, 128.8, 128.8, 128.0, 127.6, 124.1, 122.9, 122.7, 76.8, 60.7, 55.5, 48.0, 47.9, 42.6, 40.0, 39.2, 14.1. IR (KBr) ν 3432, 2921, 1732, 1678, 1587, 1269, 761 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{25}N_2O_5$ $[M+H]^+$: 433.1758, found: 433.1759.



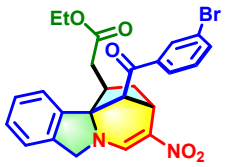
ethyl 2-(12-(2-bromobenzoyl)-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**62**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 6:1 to 3:1); 20.8 mg, 50% yield; dr > 20:1; reaction time = 19 h; mp 80.7-81.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (s, 1H), 7.51 (d, J = 8.0 Hz, 1H), 7.36-7.20 (m, 6H), 6.99 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 5.12 (d, J = 16.0 Hz, 1H), 4.90 (d, J = 16.0 Hz, 1H), 4.13 (d, J = 4.0 Hz, 1H), 3.98 (t, J = 4.0 Hz, 1H), 3.90-3.84 (m, 2H), 2.92-2.84 (m, 1H), 2.54 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.43 (dd, J_1 = 4.0 Hz, J_2 = 16.0 Hz, 1H), 2.28 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 1.93-1.86 (m, 1H), 1.12 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.3, 170.8, 142.5, 140.7, 136.7, 135.6, 133.2, 131.6, 128.8, 127.7, 127.6, 127.5, 124.5, 123.3, 122.8, 117.7, 76.6, 60.7, 55.4, 51.3, 48.1, 42.1, 39.0, 38.2, 14.0. IR (KBr) ν 3422, 2924, 2853, 1722, 1638, 1400, 756 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}BrN_2O_5$ $[M+H]^+$: 511.0863, found: 511.0860.



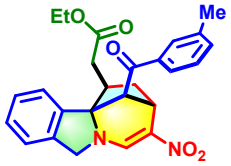
ethyl 2-(12-(3-chlorobenzoyl)-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**63**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 4:1); 25.3 mg, 42% yield; dr > 20:1; reaction time = 24 h; mp 81.4-82.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (s, 1H), 7.78 (s, 1H), 7.72 (d, J = 8.0 Hz, 1H), 7.50 (d, J = 8.0 Hz, 1H), 7.36 (t, J = 8.0 Hz, 3H), 7.27 (s, 1H), 7.13 (d, J = 8.0 Hz, 1H), 5.15 (d, J = 16.0 Hz, 1H), 4.97 (d, J = 16.0 Hz, 1H), 4.25 (s, 1H), 4.05 (d, J = 4.0 Hz, 1H), 3.92 (t, J = 4.0 Hz, 2H), 2.90-2.83 (m, 1H), 2.64 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.47 (dd, J_1 = 4.0 Hz, J_2 = 16.0 Hz, 1H), 2.34 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.15-2.11 (m, 1H), 1.14 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 193.6, 170.8, 142.7, 137.7, 137.0, 135.7, 135.1, 133.5, 130.1, 128.9, 128.0, 127.7, 126.0, 124.0, 122.9, 122.7, 76.8, 60.7, 55.5, 47.9, 47.9, 42.6, 39.9, 39.0, 14.0. IR (KBr) ν 3426, 2927, 1726, 1578, 1283, 757 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}ClN_2O_5$ $[M+H]^+$: 467.1368, found: 467.1368.



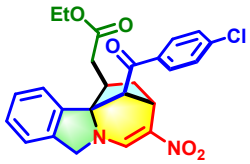
ethyl 2-(12-(3-bromobenzoyl)-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**64**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 4:1); 41.4 mg, 48% yield; dr > 20:1; reaction time = 24 h; mp 74.9-75.8 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.46 (s, 1H), 8.12 (s, 1H), 7.92 (d, J = 8.0 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.46-7.25 (m, 5H), 5.15 (d, J = 16.0 Hz, 1H), 4.92 (d, J = 16.0 Hz, 1H), 4.79 (s, 1H), 3.94 (s, 1H), 3.79 (d, J = 8.0 Hz, 2H), 2.75 (t, J = 4.0 Hz, 1H), 2.61 (t, J = 8.0 Hz, 1H), 2.41-2.31 (m, 2H), 2.16 (s, 1H), 1.05 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 194.8, 170.8, 143.8, 138.2, 137.2, 136.1, 136.0, 131.0, 130.4, 128.2, 127.1, 127.0, 123.3, 122.9, 122.5, 122.2, 76.4, 59.8, 55.1, 47.4, 46.7, 41.6, 37.8, 13.9, one carbon missing in the aliphatic region. IR (KBr) ν 3430, 2923, 2584, 1635, 1401 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}BrN_2O_5$ $[M+H]^+$: 511.0863, found: 511.0866.



ethyl 2-(12-(3-methylbenzoyl)-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**65**)

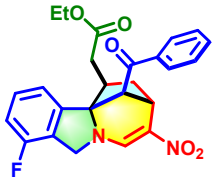
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 5:1); 14.1 mg, 35% yield; dr > 20:1; reaction time = 34 h; mp 194.7-195.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (s, 1H), 7.65 (d, J = 8.0 Hz, 1H), 7.61 (s, 1H), 7.34-7.30 (m, 4H), 7.25-7.24 (m, 1H), 7.11 (d, J = 8.0 Hz, 1H), 5.15 (d, J = 16.0 Hz, 1H), 4.99 (d, J = 16.0 Hz, 1H), 4.26 (s, 1H), 4.06 (d, J = 4.0 Hz, 1H), 3.92 (d, J = 8.0 Hz, 2H), 2.90-2.82 (m, 1H), 2.64 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.47 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.36 (s, 3H), 2.32 (d, J = 8.0 Hz, 1H), 2.15-2.08 (m, 1H), 1.15 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.9, 170.9, 142.8, 138.6, 137.0, 136.2, 135.9, 134.4, 128.8, 128.6, 128.5, 127.6, 125.2, 124.2, 122.8, 122.7, 76.7, 60.7, 55.6, 47.9, 47.9, 42.6, 40.0, 39.2, 21.3, 14.1. IR (KBr) ν 3433, 2924, 1729, 1634, 1400, 1277, 757 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{27}N_2O_5$ $[M+H]^+$: 447.1915, found: 447.1916.



ethyl 2-12-(4-chlorobenzoyl)-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-ylacetate (**66**)

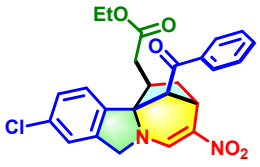
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 6:1); 32.6 mg, 44% yield; dr > 20:1; reaction time = 45 h; mp 85.9-86.4 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (s, 1H), 7.77 (d, J = 8.0 Hz, 2H), 7.40 (d, J = 8.0 Hz, 2H), 7.34 (s, 2H), 7.26 (s, 1H), 7.11 (d, J = 8.0 Hz, 1H), 5.14 (d, J = 16.0 Hz, 1H), 4.97 (d, J = 16.0 Hz, 1H), 4.24 (s, 1H), 4.02 (d, J = 4.0 Hz, 1H), 3.93 (d, J = 8.0 Hz, 2H), 2.90-2.83 (m, 1H), 2.64 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.46 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.33 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.14-2.04 (m, 1H), 1.15 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 193.6, 170.9, 142.7, 140.2, 137.1, 135.8, 134.5, 129.4, 129.1, 128.9, 127.7, 124.0, 122.9, 122.7, 76.7, 60.8, 55.6, 48.0, 47.9, 42.6, 40.0, 39.1, 14.1. IR (KBr) ν 3422, 2923, 1728, 1629, 1401, 1275 cm^{-1}. HRMS (ESI) calcd for

$C_{25}H_{24}ClN_2O_5$ $[M+H]^+$: 467.1368, found: 467.1369.



ethyl 2-(12-benzoyl-4-fluoro-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**67**)

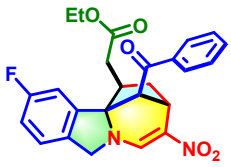
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 4:1); 26.2 mg, 49% yield; dr > 20:1; reaction time = 35 h; mp 103.2-104.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (s, 1H), 7.83 (d, J = 4.0 Hz, 2H), 7.53 (t, J = 8.0 Hz, 1H), 7.41 (t, J = 8.0 Hz, 2H), 7.24 (t, J = 8.0 Hz, 1H), 7.03 (t, J = 8.0 Hz, 1H), 6.93 (d, J = 8.0 Hz, 1H), 5.14 (d, J = 16.0 Hz, 1H), 5.02 (d, J = 16.0 Hz, 1H), 4.25 (s, 1H), 4.11 (d, J = 4.0 Hz, 1H), 3.94-3.90 (m, 2H), 2.92-2.84 (m, 1H), 2.61 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.46 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.33 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.14-2.08 (m, 1H), 1.15 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.7, 170.7, 157.5 (d, J = 248.0 Hz, 1C), 142.4, 139.4 (d, J = 5.0 Hz, 1C), 135.9, 133.7, 129.8 (d, J = 7.0 Hz, 1C), 128.7, 127.9, 124.4, 124.0 (d, J = 8.0 Hz, 1C), 118.4 (d, J = 3.0 Hz, 1C), 115.4 (d, J = 19.0 Hz, 1C), 60.7, 52.7, 48.0, 48.0, 42.5, 39.9, 38.9, 14.0, one carbon missing in the aliphatic region; ^{19}F NMR (375 MHz, $CDCl_3$) δ -116.5. IR (KBr) ν 3430, 2930, 1726, 1677, 1250, 786 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}FN_2O_5$ $[M+H]^+$: 451.1664, found: 451.1663.



ethyl 2-(12-benzoyl-3-chloro-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**68**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 4:1); 15.6 mg, 35% yield; dr > 20:1; reaction time = 18 h; mp 116.7-117.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (s, 1H), 7.83 (d, J = 4.0 Hz, 2H), 7.53 (t, J = 8.0 Hz, 1H), 7.42 (t, J = 8.0 Hz, 2H), 7.33 (s, 1H), 7.22 (dd, J_1 = 8.0 Hz, J_2 = 4.0 Hz, 1H), 7.05 (d, J = 8.0 Hz, 1H), 5.10 (d, J = 16.0 Hz, 1H), 4.95 (d, J = 16.0 Hz, 1H), 4.26 (t, J = 4.0 Hz, 1H), 4.05 (d, J = 4.0 Hz, 1H), 3.97-3.91 (m, 2H), 2.87-2.82 (m, 1H), 2.62 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.43 (dd, J_1 = 4.0 Hz, J_2 = 16.0

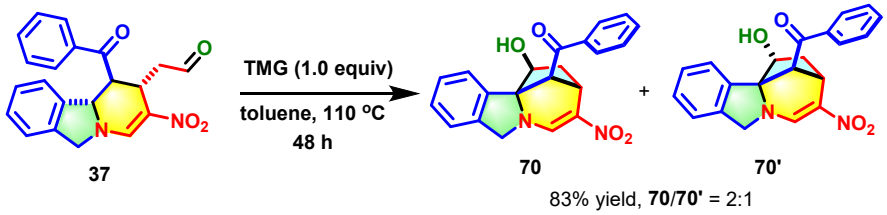
Hz, 1H), 2.31 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.13-2.07 (m, 1H), 1.15 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.7, 170.8, 142.4, 139.1, 136.0, 134.9, 134.7, 133.7, 128.8, 128.0, 128.0, 124.3, 123.7, 123.3, 76.4, 60.8, 55.1, 48.0, 47.9, 42.6, 40.0, 38.9, 14.1. IR (KBr) ν 3426, 2926, 1727, 1600, 1266, 767 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}ClN_2O_5$ $[M+H]^+$: 467.1368, found: 467.1372.



ethyl 2-(12-benzoyl-2-fluoro-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-11-yl)acetate (**69**)

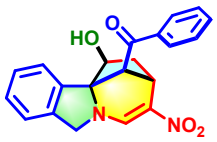
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 8:1 to 4:1); 44.6 mg, 59% yield; dr > 20:1; reaction time = 19 h; mp 125.2-126.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (s, 1H), 7.83 (d, J = 8.0 Hz, 2H), 7.54 (t, J = 8.0 Hz, 1H), 7.42 (t, J = 8.0 Hz, 2H), 7.29 (t, J = 4.0 Hz, 1H), 7.04 (t, J = 8.0 Hz, 1H), 6.84 (d, J = 8.0 Hz, 1H), 5.10 (d, J = 16.0 Hz, 1H), 4.93 (d, J = 16.0 Hz, 1H), 4.26 (t, J = 4.0 Hz, 1H), 4.07 (d, J = 4.0 Hz, 1H), 3.95-3.91 (m, 2H), 2.92-2.84 (m, 1H), 2.62 (dd, J_1 = 8.0 Hz, J_2 = 12.0 Hz, 1H), 2.46 (dd, J_1 = 4.0 Hz, J_2 = 16.0 Hz, 1H), 2.32 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.13-2.07 (m, 1H), 1.16 (t, J = 8.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.7, 170.8, 162.3 (d, J = 244.0 Hz, 1C), 142.3, 138.2 (d, J = 8.0 Hz, 1C), 135.9, 133.7, 132.6 (d, J = 2.0 Hz, 1C), 128.8, 128.0, 124.2, 124.1, 116.9 (d, J = 22.0 Hz, 1C), 110.1 (d, J = 25.0 Hz, 1C), 76.6, 60.8, 55.0, 48.0, 48.0, 42.5, 39.9, 38.8, 14.0; ^{19}F NMR (375 MHz, $CDCl_3$) δ -113.6. IR (KBr) ν 3447, 2923, 1731, 1633, 1404, 769 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{24}FN_2O_5$ $[M+H]^+$: 451.1664, found: 451.1666.

8. Experimental data for the preparation of 70 and 70'



General procedure: To a mixture of aldehyde **37** (0.2 mmol) in toluene (1 mL) was added TMG (0.20 mmol, 1.0 equiv). The reaction mixture was stirred at 110 °C until complete consumption of **37** (monitored by TLC). Then, the crude reaction mixture was purified by silica

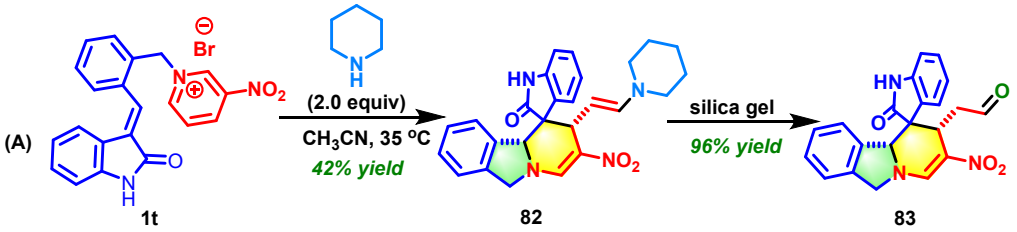
gel column chromatography using petroleum ether/ethyl acetate (5:1 to 1:1) as the eluent to give **70**, whose structure and relative configuration was unambiguously determined by X-Ray analysis (CCDC 2086417). [Note: The dr value was determined by ^{1}H NMR of the crude mixture. To obtain pure **70'**, we tried several times to separate it from the reaction system. However, there was always some **70** accompanying with it. So the pure NMR spectrum of **70'** was not obtained.]



(11-hydroxy-8-nitro-10,11-dihydro-5*H*,9*H*-9,11a-methanoazepino[2,1-*a*]isoindol-12-yl)(phenyl)methanone (**70**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 1:1); 39.6 mg, 55% yield; dr > 20:1; reaction time = 48 h; mp 46.1-47.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (s, 1H), 7.86 (d, J = 8.0 Hz, 2H), 7.55 (t, J = 8.0 Hz, 1H), 7.45-7.29 (m, 6H), 5.09 (q, J = 16.0 Hz, 2H), 4.27 (dd, J_1 = 8.0 Hz, J_2 = 4.0 Hz, 2H), 4.00 (d, J = 4.0 Hz, 1H), 2.67 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 2.41-2.35 (m, 1H), 2.23 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 195.2, 142.7, 136.8, 135.9, 135.5, 133.6, 129.0, 128.7, 128.0, 127.9, 124.5, 123.9, 122.6, 78.4, 77.6, 56.3, 45.6, 45.5, 38.2. IR (KBr) ν 3424, 2924, 2383, 1673, 1604, 1279, 761 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{19}N_2O_4$ $[M+H]^+$: 363.1339, found: 363.1338.

9. Mechanistic studies



By using a novel 3-alkenyl oxindole-based pyridinium salt **1t** as substrate, we could obtain the reconstruction/reconstruction product **82** bearing an enamine skeleton, in which the enamine could be converted into aldehyde **83** in nearly quantitative yield by subjecting it to silica gel chromatography. This case together with the data shown in Table S1 jointly confirmed the indispensable role of secondary amines. They attacked the C-6 position of pyridine core to form an unstable *N,N*-ketal, which was the driving force to make the pyridine core open and to undergo subsequent reconstruction.

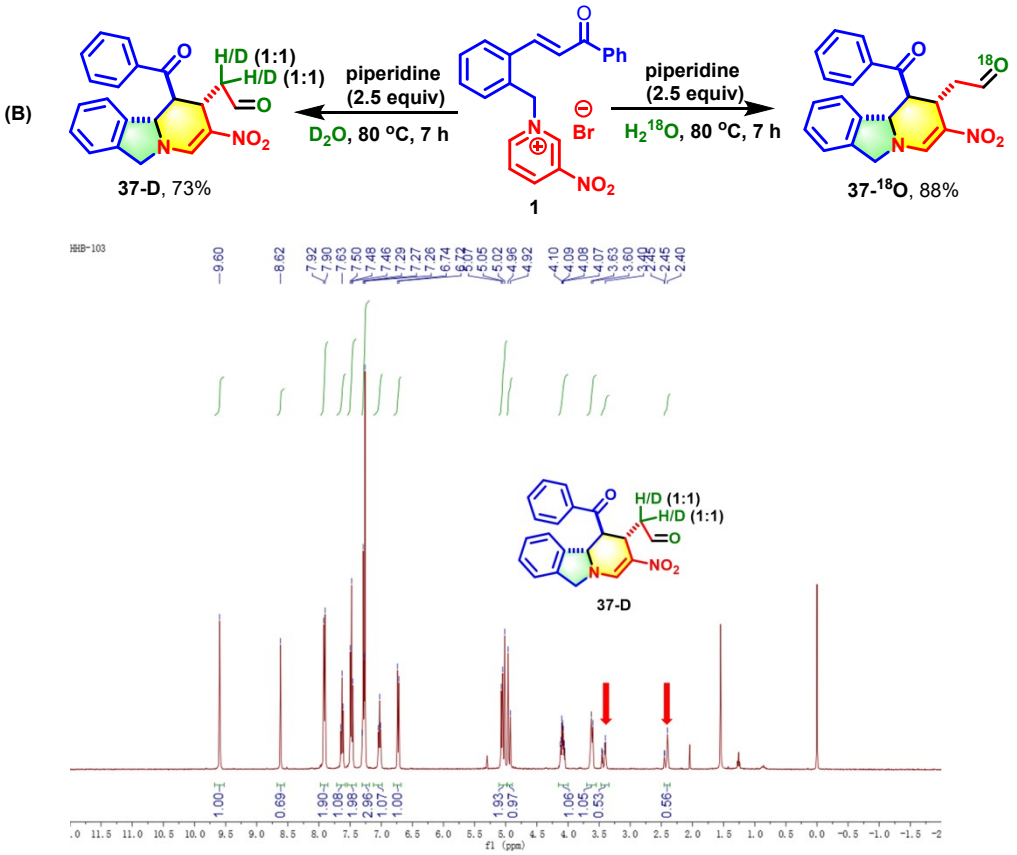


Figure S1. ^{1}H NMR spectrum of **37-D**

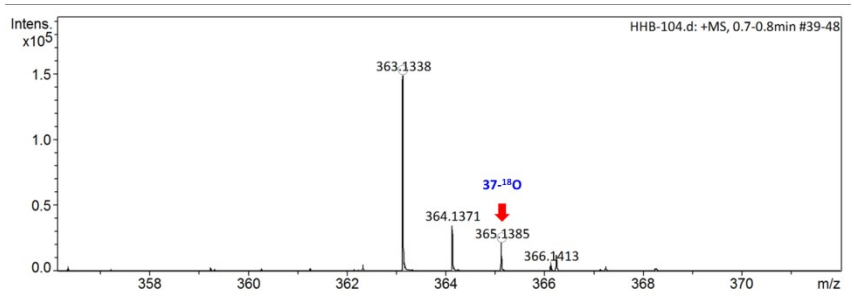
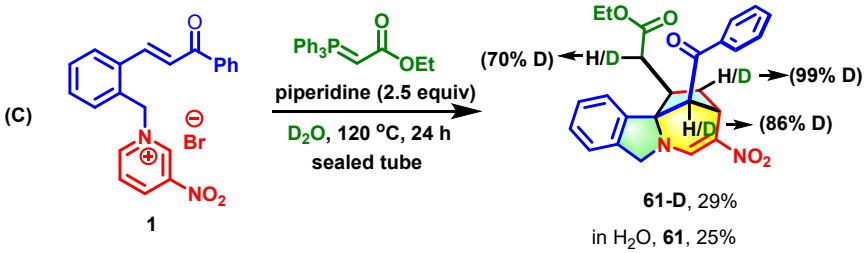


Figure S2. HRMS spectrum of **37-^{18}O**



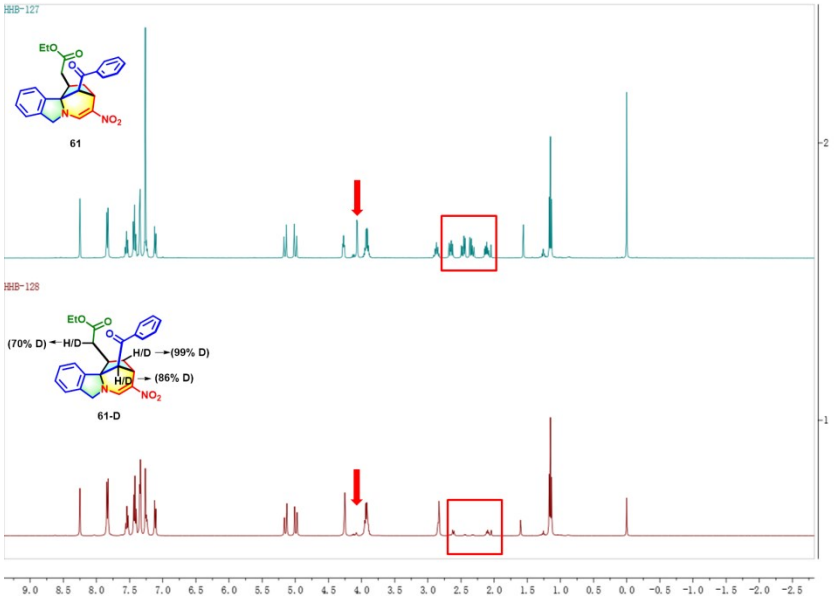
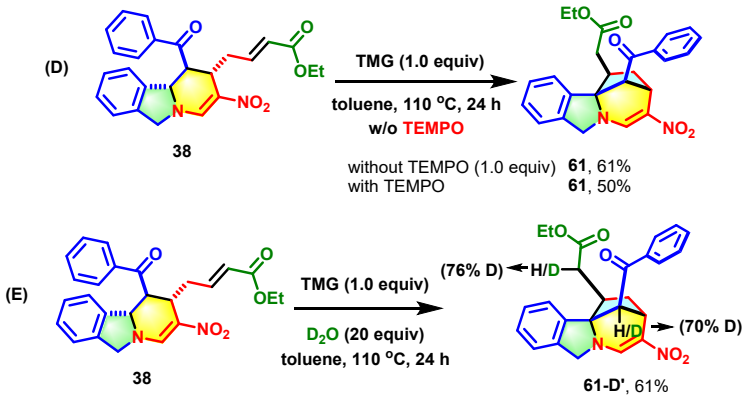


Figure S3. ^{1}H NMR spectrum of **61** and **61-D**



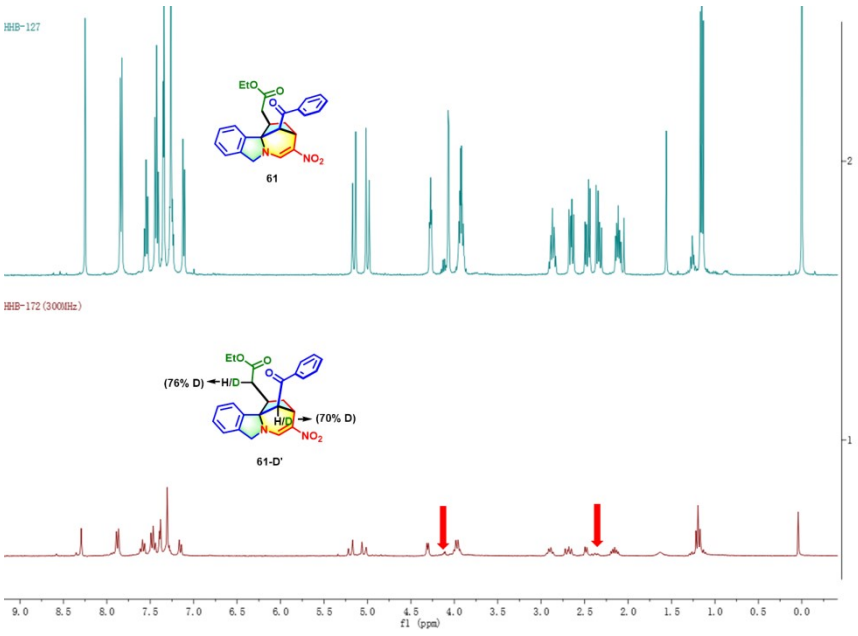


Figure S4. ^{1}H NMR spectrum of **61** and **61-D'**

10. Details about theoretical studies

(1) Reaction mechanism

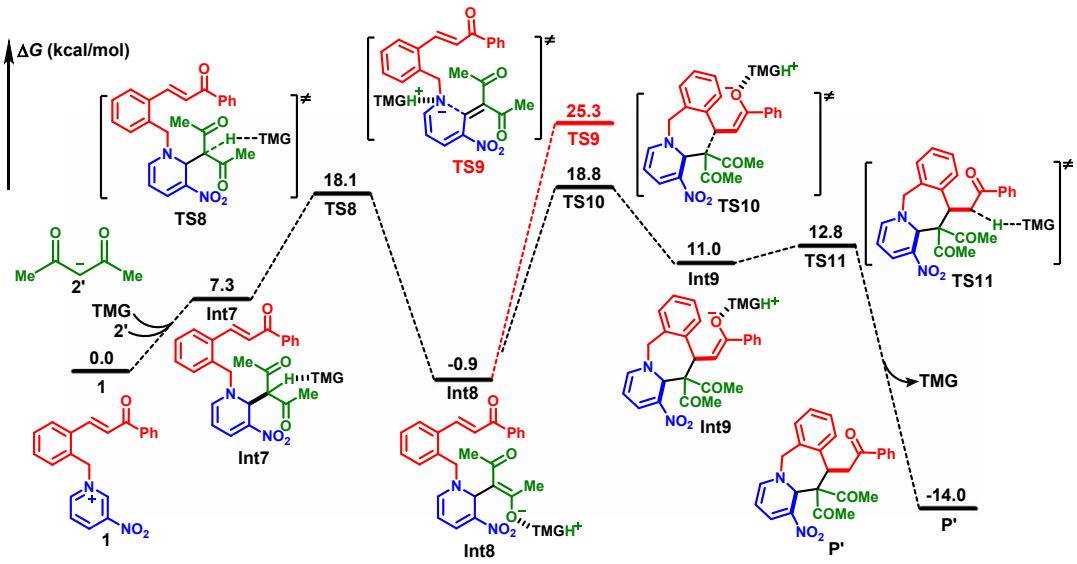


Figure S5. Free-energy profiles for reaction with acetylacetone combined at the C(2)-position of pyridinium **1**. Free energies are given in kcal/mol and represent relative free energies calculated by the M06-2X functional in acetone.

(2) Computational details

The density functional theory (DFT)[3-4] calculations were performed by using the *Gaussian 09* program.[5] The geometric structures of all involved transition states were optimized by using the M06-2X[6-7] density functional, combined with the 6-31G(d, p)[8-9] basis set. The harmonic frequency calculations were conducted at the same level to corroborate each transition state has one and only one imaginary frequency and other structures have no imaginary frequency. Based on the optimized structures, all energies were refined by conducting single point energy calculations at the M06-2X/6-311++G(d, p)[10] level of theory, with the solvent effects of acetone (reaction with acetylacetone) or water (reaction with piperidine) simulated by the SMD[11] model.

(3) Cartesian coordinates of all structures involved.

R1

1 1

O	-1.08273900	-2.67471700	0.82362500
O	0.20978000	3.25907700	-0.83791800
O	-1.90469300	2.96185000	-0.44818100
N	1.24465200	0.39541500	1.76272600
N	-0.72828800	2.73840300	-0.27209200

C	-2.44494900	-0.20941300	-1.46085700
C	-3.64767100	0.45124900	-1.69528600
C	-4.80471000	0.04432700	-1.03518100
C	-4.76213100	-1.02528600	-0.13872500
C	-3.56163000	-1.67778400	0.10603500
C	-2.39232600	-1.27694400	-0.55456600
C	-1.11571400	-1.93448000	-0.14652800
C	0.15910700	-1.52014500	-0.81059900
C	1.30319600	-1.70136500	-0.14137100
C	2.59388900	-1.08944300	-0.50569800
C	3.14459600	-1.22720200	-1.77949000
C	4.34160000	-0.59326700	-2.10584400
C	4.99028800	0.20308800	-1.16829300
C	4.43770900	0.36985500	0.10016700
C	3.25333500	-0.27841200	0.44201600
C	2.67348700	-0.07521900	1.82221100
C	0.92637400	1.37994300	0.90596200
C	-0.40052700	1.70563600	0.73018700
C	-1.41856700	1.04955800	1.40998600
C	-1.04816800	0.06210600	2.31770000
C	0.29032800	-0.25424000	2.46258200
H	-1.55658100	0.12547800	-1.98680200
H	-3.67849000	1.28491600	-2.38819800
H	-5.74190600	0.55792200	-1.22194200
H	-5.66685000	-1.34647100	0.36615300
H	-3.50191500	-2.50521600	0.80526700
H	0.14631200	-0.97605200	-1.74938400
H	1.23833300	-2.25095700	0.79947800
H	2.63962400	-1.85655100	-2.50545200
H	4.76566500	-0.72222000	-3.09559000
H	5.91946800	0.70084500	-1.42157600
H	4.93615800	1.00483300	0.82755400
H	2.65482700	-0.99900200	2.40568900
H	3.23907100	0.67342400	2.38148300
H	1.72401600	1.85066800	0.34129300
H	-2.45526600	1.30140900	1.20721900
H	-1.78845800	-0.51031800	2.86280300
H	0.62755300	-1.05449600	3.11090400

R2

-1 1

C	1.32983700	-0.30090700	0.00003900
O	2.31041500	-1.06552200	0.00024200
C	-0.02515000	-0.74689600	-0.00044200
H	-0.15716000	-1.82508500	-0.00110000
C	-1.16944700	0.07455200	-0.00028100
O	-1.22989000	1.32395200	0.00000000
C	-2.52567200	-0.65555800	0.00023700
H	-3.09515100	-0.34069700	0.88135600
H	-3.09817400	-0.33627200	-0.87727800
H	-2.44163000	-1.74570500	-0.00245100
C	1.59347100	1.20501300	0.00007000
H	1.12485700	1.68130000	0.86528300
H	2.67557600	1.36147000	0.00254000
H	1.12925000	1.68032700	-0.86802300

TMG

0 1

C	-0.01153600	0.54042900	-0.01243600
N	-0.08910600	1.81752200	-0.01989600
N	1.15703200	-0.22936400	0.12931700
N	-1.17009700	-0.22762100	-0.14114500
C	2.36404900	0.49050800	0.47312400
H	3.12606500	-0.22945800	0.78224800
H	2.77102500	1.07412600	-0.36934100
H	2.16775300	1.16636800	1.30791600
C	-2.38486000	0.52265500	-0.40589900
H	-2.72548900	1.07988600	0.47790900
H	-2.20341300	1.24103400	-1.20369300
H	-3.16539100	-0.18040400	-0.70988300
C	-1.37594000	-1.31772700	0.80338200
H	-2.05741800	-2.05354200	0.36619800
H	-0.43014400	-1.80431600	1.03627900
H	-1.81828100	-0.95432900	1.74331000
C	1.38665300	-1.29775100	-0.83570900
H	2.00388900	-2.07950300	-0.38200000

H	0.43596200	-1.72777600	-1.14647400
H	1.90605600	-0.92413500	-1.73121200
H	0.83439400	2.23959800	-0.08396300

TMGH+

1 1

C	0.00022800	0.49409200	0.00009600
N	0.00190000	1.83570600	0.00158700
N	-1.16826900	-0.16109900	0.01353900
N	1.16779100	-0.16238900	-0.01334400
C	-2.41133800	0.49916500	-0.38551100
H	-3.07861500	-0.25685000	-0.80189800
H	-2.90979100	0.96723800	0.47071700
H	-2.21239600	1.24252900	-1.15768100
C	2.41103900	0.49833300	0.38409000
H	2.90581600	0.97248300	-0.47102100
H	2.21355500	1.23705800	1.16111600
H	3.08154800	-0.25874600	0.79320200
C	1.32589800	-1.45774600	-0.68011600
H	1.54431100	-2.24880300	0.04163500
H	0.42451000	-1.70536800	-1.23810800
H	2.15837300	-1.38085800	-1.38389400
C	-1.32710900	-1.45637900	0.68074400
H	-1.54446900	-2.24778400	-0.04081300
H	-0.42634400	-1.70357200	1.24002100
H	-2.16065900	-1.37921600	1.38317200
H	-0.80883800	2.35653800	0.29810900
H	0.81073600	2.35504100	-0.30285300

Int1

0 1

C	2.26938700	-4.36754700	-0.18822500
C	1.78836700	-3.12092400	-0.58233700
C	2.52562000	-2.35216500	-1.50486300
C	3.73196600	-2.85617100	-1.99774200
C	4.19542000	-4.10887600	-1.60668600
C	3.46218400	-4.86923200	-0.70235600
H	1.70324300	-4.94881000	0.53428300

H	4.29528400	-2.25780800	-2.70693400
H	5.12919300	-4.48813200	-2.00833000
H	3.81841500	-5.84528400	-0.39089100
C	2.06769900	-1.00098400	-1.89347600
C	2.82410800	0.09092600	-1.73158900
H	1.05537000	-0.86951000	-2.27608500
H	3.81499500	0.01752200	-1.28925800
C	2.25954100	1.43266800	-2.06873200
O	1.40306000	1.54806400	-2.92697500
C	2.70623400	2.61107200	-1.26254900
C	3.48449000	2.46579000	-0.11134800
C	2.25219400	3.88031400	-1.63664100
C	3.79582200	3.57608200	0.66976400
H	3.84655000	1.49153500	0.19695400
C	2.57982500	4.98923400	-0.86883000
H	1.64071500	3.96696300	-2.52901500
C	3.34654300	4.83679800	0.28825200
H	4.37538600	3.43923100	1.57672500
H	2.23290300	5.97455300	-1.16333200
H	3.58961400	5.70440700	0.89368000
C	0.51053600	-2.59063100	0.01668200
H	-0.14619800	-2.22228600	-0.78233000
H	-0.02713300	-3.39480000	0.53489000
N	0.69188100	-1.49161900	0.98285900
C	1.89044300	-0.98925700	1.29506600
C	-0.55739300	-1.05417200	1.64620500
C	2.05252400	0.00667300	2.21784500
H	2.75594600	-1.39764300	0.78891400
C	-0.29639500	0.01145800	2.68160400
H	-0.99859000	-1.93556800	2.13486500
C	0.91206600	0.51401100	2.94747500
H	-1.17610300	0.35708900	3.21619800
H	1.07059600	1.28244400	3.69351100
N	3.35865900	0.50244400	2.45699200
O	3.48395700	1.41856600	3.26245300
O	4.30662700	0.01658800	1.83281400
C	-2.54096100	-1.77894900	0.19754100
O	-2.80316600	-2.62270500	1.03588500

C	-1.63148300	-0.61225400	0.60499900
H	-2.30934400	0.07163700	1.13732800
C	-1.03847200	0.24105100	-0.51377100
O	-1.02168300	-0.14261300	-1.66764400
C	-0.43506500	1.56333100	-0.12117200
H	0.56714900	1.38552300	0.29262100
H	-0.32945200	2.18211000	-1.01386800
H	-1.03341200	2.05567200	0.64764000
C	-3.15957600	-1.85799200	-1.17610300
H	-3.90153600	-2.65660000	-1.16689600
H	-3.62162900	-0.90694900	-1.45721000
H	-2.38934900	-2.05907200	-1.92275400
C	-4.66763400	0.95369900	0.10580500
N	-3.67153900	1.70297500	0.43247900
N	-5.34668600	0.98733200	-1.12607900
N	-5.11177100	-0.01891900	0.97332000
C	-4.67781400	1.69995000	-2.19984600
H	-5.16255400	1.44005000	-3.14393300
H	-4.72866300	2.79459700	-2.08388400
H	-3.62888700	1.39672000	-2.25124800
C	-4.68632700	-0.00928100	2.35939000
H	-3.94332600	-0.79759500	2.54800000
H	-4.25569300	0.96277900	2.59489600
H	-5.55032800	-0.19851800	3.00630200
C	-5.84301200	-1.20533700	0.56909600
H	-6.84320200	-1.22472100	1.02154300
H	-5.94080700	-1.23390600	-0.51529100
H	-5.29805400	-2.09846200	0.89895400
C	-6.78206200	1.24760000	-1.08262100
H	-7.25773900	0.83890200	-1.97881100
H	-7.22644200	0.77853400	-0.20546800
H	-6.99054900	2.32666300	-1.03890400
H	-3.56316000	2.46872400	-0.22714900

Int2

0 1

C	-2.08778400	4.46743800	-0.04214300
C	-1.75160500	3.19412600	-0.49718800

C	-2.63963000	2.50870700	-1.34902300
C	-3.84018800	3.12234300	-1.71859700
C	-4.15872500	4.39836500	-1.26595800
C	-3.28017200	5.07489900	-0.42625600
H	-1.40480300	4.98580100	0.62495400
H	-4.51424800	2.59139500	-2.38376100
H	-5.09085500	4.86261000	-1.57058600
H	-3.52199600	6.06961900	-0.06711200
C	-2.34131700	1.13405000	-1.79635900
C	-3.22639600	0.13527000	-1.71193100
H	-1.33828600	0.90274000	-2.15772100
H	-4.20700100	0.30230000	-1.27208900
C	-2.83664200	-1.24714400	-2.12183300
O	-2.11219700	-1.43084700	-3.08367100
C	-3.29194800	-2.37712200	-1.25863400
C	-3.83924700	-2.14242900	0.00474400
C	-3.07253000	-3.68855800	-1.69103300
C	-4.15767600	-3.20961600	0.84041000
H	-4.00083600	-1.13066600	0.36099000
C	-3.41109500	-4.75295400	-0.86658800
H	-2.62893500	-3.84421800	-2.66924700
C	-3.94802300	-4.51366800	0.40043800
H	-4.54900700	-3.00610900	1.83203300
H	-3.24867400	-5.77218000	-1.20261800
H	-4.19738900	-5.34929800	1.04715200
C	-0.45772600	2.56070600	-0.06028100
H	0.10111700	2.20049100	-0.93145500
H	0.18576600	3.30076800	0.43088600
N	-0.59682300	1.41979000	0.85575500
C	-1.76341600	1.00584400	1.33993500
C	0.71986400	0.80772200	1.23575600
C	-1.86005000	-0.02578400	2.24281900
H	-2.66355500	1.50498900	0.99938900
C	0.52625900	-0.23612800	2.31000900
H	1.30617800	1.63922500	1.65413500
C	-0.66170000	-0.64080300	2.76864400
H	1.44395100	-0.66095700	2.70991600
H	-0.76441500	-1.40330500	3.53060600

N	-3.13844000	-0.43307400	2.67764600
O	-3.20491500	-1.35166800	3.49245600
O	-4.14139500	0.12711800	2.21774300
C	2.52917600	1.26844000	-0.42686900
O	2.85622000	2.28856700	0.21792200
C	1.53006100	0.34317000	0.03976900
H	3.09358000	-0.89015700	0.89168100
C	1.26096200	-0.89019200	-0.65351800
O	2.08494800	-1.43130400	-1.41942000
C	-0.04580800	-1.62935700	-0.42367100
H	-0.87142000	-0.98040100	-0.12417700
H	-0.29937500	-2.14511900	-1.35176400
H	0.08001400	-2.38081000	0.36282700
C	3.18817000	1.08484500	-1.79080200
H	3.54958500	2.06609900	-2.10532500
H	4.03813800	0.39779500	-1.73873400
H	2.50481000	0.65906300	-2.52596700
C	5.00438100	-0.76732200	0.33452800
N	3.92681100	-1.46673600	0.71332600
N	5.79287000	-1.21766400	-0.65962100
N	5.30422400	0.36341700	0.99019100
C	5.26482700	-2.13311800	-1.67024300
H	5.77403800	-1.92287100	-2.61353900
H	5.45563600	-3.17847800	-1.39930300
H	4.19332900	-1.95774900	-1.81013100
C	4.62231700	0.69325000	2.24231000
H	3.71694500	1.27562400	2.03343200
H	4.38756800	-0.22224700	2.78505300
H	5.30497900	1.29783100	2.84356600
C	5.90241400	1.51540500	0.31094200
H	6.81850400	1.82621200	0.82152100
H	6.12527600	1.26756600	-0.72537500
H	5.15969800	2.32002600	0.31702400
C	7.23443500	-1.01154000	-0.66582800
H	7.54453000	-0.38745400	-1.50978100
H	7.54869600	-0.54227900	0.26569700
H	7.72630100	-1.98536600	-0.75236400
H	3.69323200	-2.27864300	0.15757900

Int3

0 1

C	-1.14865400	4.82931000	-1.36068200
C	-1.30590100	3.44991900	-1.46738900
C	-2.57443400	2.88543600	-1.22312700
C	-3.64625800	3.72191400	-0.89852600
C	-3.47720000	5.09960800	-0.80779200
C	-2.22379800	5.65554900	-1.03869700
H	-0.16630700	5.26332200	-1.52718900
H	-4.62636800	3.28103500	-0.74174800
H	-4.32160000	5.73460200	-0.56092200
H	-2.07896800	6.72852500	-0.96521400
C	-2.75902500	1.42803300	-1.30222100
C	-3.54665700	0.70975400	-0.49031600
H	-2.18102300	0.87728300	-2.04203100
H	-4.09173800	1.17564200	0.32466700
C	-3.60497200	-0.76040400	-0.67464100
O	-3.30045400	-1.27097500	-1.74130300
C	-4.01019900	-1.62747700	0.47930600
C	-4.06893300	-1.15273600	1.79245200
C	-4.27595800	-2.97636200	0.22148700
C	-4.39164500	-2.01738400	2.83485500
H	-3.83318700	-0.11633500	2.01196400
C	-4.60654500	-3.83606900	1.26103000
H	-4.21490000	-3.32476500	-0.80461600
C	-4.66438400	-3.35662600	2.56955300
H	-4.42401500	-1.64560200	3.85360100
H	-4.81746700	-4.88044100	1.05513700
H	-4.91830000	-4.02884000	3.38302600
C	-0.12241700	2.56103600	-1.79993200
H	-0.23913900	2.16114800	-2.81410300
H	0.78757300	3.17782200	-1.81293300
N	0.04807700	1.41414400	-0.90177000
C	0.07026400	1.68325700	0.35177400
C	0.53398000	-1.38929400	-0.56845700
C	0.00402500	0.70158300	1.41361800
H	0.08259100	2.71849900	0.72083100

C	-0.54016400	-1.49724400	0.36629500
H	1.20087100	-0.56908200	-0.33174200
C	-0.64188800	-0.57803800	1.37429300
H	-1.19853800	-2.35607500	0.39445400
H	-1.24835500	-0.82566200	2.24401700
N	0.42733600	1.15183200	2.65820400
O	0.18001400	0.51017400	3.68450100
O	1.17200700	2.17178600	2.69705700
C	2.27560900	-1.65460400	-2.19127600
O	2.91700600	-0.75595300	-1.63929200
C	0.98908700	-2.14220400	-1.62192500
C	0.33439000	-3.35065900	-2.18126400
O	0.89830800	-4.05938100	-3.00182300
C	-1.05433000	-3.73322300	-1.71517400
H	-1.74238300	-2.88365200	-1.72294500
H	-1.41653000	-4.51920300	-2.37811000
H	-1.00904200	-4.13214200	-0.69612500
C	2.83153600	-2.22615700	-3.47420000
H	3.66197400	-1.59324000	-3.79144300
H	3.16689100	-3.25252100	-3.31332300
H	2.06548200	-2.28564200	-4.24881400
H	2.62842100	1.17650100	-0.32123100
C	4.09161000	0.48525100	0.87808700
N	3.02878100	1.23972300	0.61154700
N	4.23367400	-0.07847000	2.08864800
N	5.05306000	0.32583100	-0.05426600
C	3.06976500	-0.31017700	2.94824600
H	3.30404400	-1.14482300	3.61100100
H	2.80912200	0.56954300	3.54465400
H	2.21251000	-0.58994600	2.33243200
C	5.11986900	1.22474000	-1.20129400
H	4.48683600	0.85335500	-2.01287000
H	4.80451000	2.22393700	-0.90118700
H	6.15973000	1.26673000	-1.53465700
C	5.66935800	-0.97913600	-0.27296400
H	6.76033000	-0.90429900	-0.23635200
H	5.32565300	-1.68668500	0.48010500
H	5.35079500	-1.34409500	-1.25419200

C	5.54006000	-0.31036000	2.68751400
H	5.74612200	-1.38046700	2.79223700
H	6.31561100	0.14839500	2.07497500
H	5.55601600	0.14700600	3.68095600
H	2.43411600	1.60013500	1.36624300

Int4

0 1

C	5.36741500	-2.98822800	-0.01552000
C	4.13260700	-2.39002700	-0.24997500
C	4.05502800	-1.34397200	-1.19427900
C	5.20467500	-0.93851100	-1.87602100
C	6.42633100	-1.56252200	-1.64448200
C	6.50770400	-2.58981200	-0.71129200
H	5.43859100	-3.77638700	0.72915200
H	5.12684400	-0.13824300	-2.60612800
H	7.30976500	-1.24340900	-2.18730500
H	7.45780100	-3.07616700	-0.51563500
C	2.77388400	-0.65273700	-1.40783800
C	2.62622400	0.67944100	-1.45969200
H	1.86631100	-1.25476100	-1.42516700
H	3.47661500	1.34285700	-1.33932700
C	1.26321900	1.24511500	-1.52151800
O	0.31233000	0.55721900	-1.89367300
C	1.03961000	2.65286100	-1.08577100
C	1.92637700	3.30395600	-0.22413100
C	-0.12861700	3.30462800	-1.50244900
C	1.63101400	4.58222300	0.24143600
H	2.83274000	2.81367100	0.11764200
C	-0.40468700	4.59018600	-1.05999200
H	-0.80243500	2.79205700	-2.18223300
C	0.47210300	5.22625900	-0.17905000
H	2.30302000	5.05636600	0.94791600
H	-1.30373500	5.09829300	-1.39344900
H	0.24596800	6.22465900	0.18162300
C	2.89729100	-2.84329600	0.50964000
H	2.24000200	-3.38426300	-0.18529300
H	3.19209500	-3.57788300	1.26972800

N	2.07180600	-1.80764100	1.13274900
C	2.65644200	-0.72713700	1.49872200
C	-1.74856500	-0.00738700	1.87949000
C	1.94458000	0.43429800	1.99261100
H	3.73423000	-0.57864200	1.39127700
C	-0.40184900	-0.36868500	1.87332200
H	-1.94972100	1.05621200	2.02347300
C	0.57359300	0.60415100	2.09971700
H	-0.06985100	-1.37347800	1.66447900
H	0.24809600	1.60997800	2.35794000
N	2.75127400	1.59833900	2.22733200
O	2.24220200	2.58708600	2.74779800
O	3.93000500	1.58551300	1.85893700
C	-4.15349700	-0.01563500	1.58292200
O	-4.16968600	1.16196800	1.20688600
C	-2.89923300	-0.77589700	1.67448000
C	-2.90547100	-2.23071800	1.50536500
O	-3.77395000	-2.80765000	0.84369900
C	-1.82292200	-3.08147500	2.14536600
H	-1.40977000	-2.62562600	3.04618400
H	-2.26259700	-4.05453500	2.36984700
H	-0.99559500	-3.24226700	1.44498200
C	-5.43727300	-0.63205400	2.10260300
H	-6.28695600	-0.02655000	1.78358000
H	-5.55105900	-1.66951500	1.79181000
H	-5.39295600	-0.61147600	3.19705900
H	-2.82312800	1.39667200	-0.38775100
C	-3.23417800	-0.21611100	-1.48934700
N	-2.45839600	0.81754800	-1.14382900
N	-2.70449400	-1.40911000	-1.78532000
N	-4.56369300	-0.01432400	-1.60250800
C	-1.40341900	-1.84070400	-1.28274200
H	-1.51945100	-2.85903800	-0.90018000
H	-0.65864700	-1.82056000	-2.08312900
H	-1.06372500	-1.19292400	-0.47454800
C	-5.09614100	1.33968100	-1.71350500
H	-5.30626000	1.75310800	-0.72107500
H	-4.37923200	1.97523200	-2.23243000

H	-6.01900000	1.29153300	-2.29661800
C	-5.53563300	-1.03307700	-1.20850300
H	-6.08239400	-1.42212200	-2.07379800
H	-5.03544200	-1.83820600	-0.66648000
H	-6.25162600	-0.56448600	-0.52767600
C	-3.37318600	-2.37880700	-2.63958900
H	-3.80451800	-3.18919800	-2.04295100
H	-4.15060600	-1.89018600	-3.22518400
H	-2.63011700	-2.79659800	-3.32420700
H	-1.44652100	0.75307900	-1.27415100

Int5

0 1

C	-5.17140300	-3.22748100	0.83885300
C	-4.40107600	-2.21564800	0.27742100
C	-3.21380000	-1.81255200	0.87213800
C	-2.76021800	-2.40250400	2.04555200
C	-3.52738800	-3.41825400	2.61014800
C	-4.72262300	-3.82727100	2.01296000
H	-6.10331000	-3.54268800	0.37886600
H	-1.83110000	-2.06424000	2.49462400
H	-3.19693900	-3.89601200	3.52676700
H	-5.30910700	-4.61741400	2.47016200
C	-2.54408400	-0.70420500	0.09470900
C	-2.25864900	0.54349300	0.87696000
H	-1.58771300	-1.06707800	-0.31120500
H	-3.03243100	1.29575200	0.97203000
C	-1.05500800	0.68840800	1.46197600
O	-0.20842900	-0.35088100	1.45956100
C	-0.62068900	1.93400000	2.14083100
C	-1.09850100	3.18244300	1.72698700
C	0.29544500	1.87134100	3.19651800
C	-0.68685500	4.34315600	2.37183400
H	-1.77707200	3.23880400	0.88029700
C	0.71040900	3.03438700	3.83655600
H	0.67817100	0.90395400	3.50535000
C	0.21789700	4.27204100	3.42919200
H	-1.06041600	5.30593300	2.03846600

H	1.41708600	2.97457000	4.65837200
H	0.54406700	5.17922100	3.92766300
C	-4.65575700	-1.41496300	-0.96836600
H	-4.65881100	-2.03862600	-1.87039500
H	-5.60224500	-0.86108600	-0.93621100
N	-3.52200900	-0.47476100	-0.99582400
C	-3.56781700	0.59350400	-1.78959500
C	1.06055600	0.56130700	-1.84132900
C	-2.58725800	1.52774400	-2.03426900
H	-4.52803500	0.77496900	-2.26699700
C	-0.36518400	0.38328600	-1.96086000
H	1.34473300	1.56384600	-1.51861800
C	-1.15961400	1.47464300	-1.81902400
H	-0.80035300	-0.56061000	-2.26382400
H	-0.68503000	2.43289400	-1.62342200
N	-3.06382000	2.74664600	-2.66317300
O	-2.23633900	3.61404400	-2.90793300
O	-4.25730900	2.86052600	-2.91910900
C	3.46530200	0.44605000	-2.04598700
O	3.66390600	1.35959000	-1.26338100
C	2.12818300	-0.23730700	-2.11685000
C	2.12170400	-1.68514200	-2.43937200
O	3.14524100	-2.34118900	-2.31273700
C	0.84793700	-2.37394600	-2.87836700
H	0.34769900	-1.82112300	-3.67719700
H	1.10514500	-3.37777500	-3.21584000
H	0.15587900	-2.45302500	-2.03284600
C	4.52578800	0.06085500	-3.05648800
H	5.28267500	0.84550300	-3.07388400
H	4.97524700	-0.89715900	-2.79340900
H	4.08063300	-0.05588900	-4.04866800
H	2.57914700	1.14270600	1.15503700
C	3.29265300	-0.63859800	1.10228300
N	2.30087400	0.17643000	1.29742900
N	3.06978500	-1.97213400	0.88957000
N	4.62157100	-0.25729500	1.12112000
C	1.72987400	-2.44781900	0.61462900
H	1.80503600	-3.34821200	-0.00343800

H	1.17911200	-2.68270700	1.53499900
H	1.16927900	-1.68234100	0.07917600
C	4.94594800	1.06942900	1.61180200
H	4.77296800	1.83855900	0.84702700
H	4.34757400	1.29087000	2.49760900
H	6.00207700	1.08474500	1.89358500
C	5.53395800	-0.75483400	0.09711200
H	6.42715400	-1.20340400	0.54693600
H	5.02774000	-1.49877100	-0.52202800
H	5.84211800	0.07541900	-0.54924700
C	4.00011600	-2.99952500	1.32223000
H	4.34617600	-3.59583900	0.46992500
H	4.85705200	-2.54773500	1.81947100
H	3.50152900	-3.66850100	2.03390600
H	0.80380800	-0.09267700	1.44081300

Int6

0 1

C	-5.97486900	-0.95826700	-2.16681200
C	-4.92176900	-0.21764400	-1.64682300
C	-3.70612700	-0.81780100	-1.32072700
C	-3.52421100	-2.18248400	-1.52754100
C	-4.58267600	-2.93031100	-2.04100000
C	-5.79922600	-2.32678600	-2.35707700
H	-6.91802700	-0.48181200	-2.41738200
H	-2.57609100	-2.65702600	-1.30481700
H	-4.45477500	-3.99601800	-2.20024600
H	-6.61189600	-2.92502900	-2.75575600
C	-2.73205400	0.21631600	-0.79360500
C	-2.09909400	-0.05639400	0.57896100
H	-1.91619200	0.37320600	-1.51305600
H	-2.90460100	-0.26092200	1.29365100
C	-1.13937500	-1.22221000	0.52361800
O	-0.63239500	-1.54921200	-0.54245000
C	-0.77187500	-1.93348400	1.78382900
C	-1.25023900	-1.54059300	3.03912600
C	0.08501400	-3.03731800	1.69092000
C	-0.86156900	-2.22986600	4.18236300

H	-1.92008000	-0.69326100	3.13662500
C	0.46950900	-3.72545000	2.83315800
H	0.43829200	-3.34531600	0.71269500
C	-0.00091500	-3.31943600	4.08096300
H	-1.22815100	-1.91288200	5.15255800
H	1.13545600	-4.57806000	2.75354100
H	0.30290800	-3.85379000	4.97528400
C	-4.87800800	1.26135900	-1.36979900
H	-4.93236200	1.84914000	-2.29609400
H	-5.68918100	1.59061600	-0.71073000
N	-3.58159400	1.41633500	-0.71340400
C	-3.32356700	2.40007400	0.17167200
C	1.18652800	1.29434200	0.78820900
C	-2.26237200	2.36038600	1.01100800
H	-4.00760800	3.24201700	0.19885000
C	-0.04869300	1.47336300	0.27157900
H	1.22928800	0.86761900	1.79326400
C	-1.30324800	1.20949700	1.06640000
H	-0.20272500	1.87084100	-0.72894000
H	-1.01804100	1.05657400	2.11115500
N	-2.05866700	3.47060500	1.89332300
O	-1.15236300	3.37775100	2.71026500
O	-2.79720200	4.44710400	1.79798500
C	3.59366900	0.99028100	0.97311200
O	3.44459900	0.01241100	1.74403700
C	2.49968200	1.55859500	0.23249500
C	2.72684400	2.34427800	-0.95780700
O	3.71576100	2.20051900	-1.69890000
C	1.72076800	3.41197100	-1.36939900
H	1.10039100	3.75500000	-0.54034800
H	2.29210800	4.24138300	-1.79082800
H	1.06325500	3.03893500	-2.16357000
C	4.94922500	1.67443000	0.99272900
H	5.73295100	0.93796000	1.18606400
H	5.15812500	2.23815700	0.08600800
H	4.94112300	2.36231400	1.84535400
H	2.56152600	-1.22942000	0.70499000
C	3.20932000	-1.19614100	-1.18342300

N	2.33573400	-1.58433800	-0.24048200
N	2.78566300	-0.75788700	-2.37813300
N	4.52360000	-1.34053100	-0.93314700
C	1.49133400	-0.11053100	-2.54990400
H	1.65718700	0.82868200	-3.08661100
H	0.81292600	-0.75092500	-3.12397100
H	1.04415800	0.11761300	-1.58321800
C	4.96756700	-2.17465700	0.18130000
H	4.99406100	-1.59426100	1.11012700
H	4.28225700	-3.01326200	0.30403700
H	5.96293900	-2.55450800	-0.05908700
C	5.52043300	-0.41144500	-1.47198800
H	6.09070800	-0.86033200	-2.29166200
H	5.02997400	0.51532400	-1.78137000
H	6.21354300	-0.16700800	-0.66532600
C	3.59065900	-0.83450200	-3.58627900
H	4.04566300	0.13395800	-3.81748200
H	4.36238800	-1.59498800	-3.47518700
H	2.93359800	-1.12556200	-4.41065800
H	1.35057000	-1.58024000	-0.48799700

Int7

0 1

C	0.58129300	3.67817100	1.25041400
C	1.56182100	2.72903900	0.96551800
C	2.38716000	2.92784400	-0.16289400
C	2.17621900	4.05421400	-0.96716800
C	1.14297300	4.94550100	-0.71127300
C	0.34109600	4.75919200	0.40865100
H	-0.02374400	3.55544500	2.14201700
H	2.82923200	4.21221800	-1.82054100
H	0.98295300	5.79334100	-1.36922200
H	-0.45419700	5.45813300	0.64545300
C	3.50872300	2.05730900	-0.54505600
C	3.53439400	0.71823900	-0.55722500
H	4.41303700	2.55934500	-0.89018500
H	2.64975500	0.14821700	-0.30445200
C	4.79878900	0.02077300	-0.93031600

O	5.78878700	0.65169900	-1.25732400
C	4.86189800	-1.47559200	-0.83619700
C	3.73098200	-2.28250800	-0.68672800
C	6.12628200	-2.07171400	-0.89757700
C	3.86366600	-3.66538800	-0.59108400
H	2.73845100	-1.84832700	-0.66099000
C	6.25832500	-3.44974000	-0.79656400
H	6.98950200	-1.42713500	-1.02385400
C	5.12588900	-4.24938800	-0.64049800
H	2.97798300	-4.28323300	-0.48154600
H	7.24255200	-3.90461800	-0.83870900
H	5.22871300	-5.32701000	-0.56151300
C	1.76947200	1.61715900	1.97377600
H	2.83753200	1.40882400	2.07232100
H	1.40755500	1.97198300	2.94765000
N	1.11226400	0.32174800	1.71260000
C	-0.37493600	0.28458000	1.73074100
C	1.86430500	-0.79691700	1.85606200
C	-0.82364100	-1.10288800	2.13539100
H	-0.72157300	1.01772800	2.47260200
C	1.37304300	-2.05736100	2.03050600
H	2.93724900	-0.62906600	1.81318600
C	-0.03075400	-2.19179400	2.22266500
H	2.04776600	-2.89897200	2.09155000
H	-0.48607300	-3.14293000	2.47484300
N	-2.22420300	-1.23777900	2.40680600
O	-2.70872800	-2.35748200	2.55397100
O	-2.88245300	-0.20296300	2.45268600
C	-1.91112000	1.96635900	0.51321400
O	-2.04291000	2.56157500	1.55973200
C	-1.07536500	0.69487300	0.39861300
C	-0.19952300	0.59429800	-0.84713800
O	0.07560700	1.55038600	-1.53947400
C	0.20506800	-0.81076100	-1.21991000
H	0.64461900	-1.33835800	-0.36802900
H	-0.71095500	-1.35980000	-1.47160700
H	0.89703800	-0.78856800	-2.06321700
C	-2.66787500	2.37344500	-0.72632400

H	-3.09825800	1.48626900	-1.20352500
H	-3.45274900	3.07859800	-0.45322800
H	-1.96839000	2.83186300	-1.43053500
C	-4.21382900	-1.27766600	-1.10487600
N	-3.08860700	-1.63394700	-0.58431700
N	-4.23167000	-0.67052500	-2.34801000
N	-5.47077500	-1.43333400	-0.52148100
C	-3.01196800	-0.67317100	-3.12898800
H	-3.26968100	-0.51341200	-4.17982300
H	-2.30870100	0.11661000	-2.82196000
H	-2.51429800	-1.63668700	-3.02042600
C	-5.50558200	-1.81383300	0.88004700
H	-5.27531100	-2.87962700	1.03313100
H	-4.79541400	-1.21860100	1.45613200
H	-6.51244700	-1.62573800	1.26148500
C	-6.53763700	-2.03759300	-1.30941700
H	-7.50302000	-1.60770200	-1.02439800
H	-6.37237100	-1.86303800	-2.37152300
H	-6.58113600	-3.12346600	-1.14214200
C	-5.18130500	0.37816100	-2.68024900
H	-5.73464400	0.13520400	-3.59558600
H	-5.88725500	0.51192000	-1.86106700
H	-4.65810900	1.32895100	-2.84512400
H	-1.84428100	-0.07340300	0.19221500
H	-3.24000600	-2.23088700	0.22799000

Int8

0 1

C	0.12084600	3.26254200	-2.10740900
C	-0.73412100	2.42516100	-1.38717600
C	-1.03804600	2.76830900	-0.05670300
C	-0.46792900	3.91720000	0.50452500
C	0.34372400	4.76200000	-0.24175300
C	0.64031400	4.43033700	-1.55913600
H	0.40420300	2.97673500	-3.11596700
H	-0.68763800	4.15055100	1.54260100
H	0.75604600	5.65876300	0.20904600
H	1.29573200	5.05959500	-2.15220800

C	-1.91421800	1.96468300	0.81839000
C	-3.16456200	1.59520200	0.52447900
H	-1.52056400	1.68037100	1.79491700
H	-3.60578300	1.87644300	-0.42655000
C	-3.90778000	0.69935400	1.44948300
O	-3.50058100	0.47299600	2.57502600
C	-5.12887900	-0.00861400	0.93551200
C	-5.85945700	0.42355400	-0.17515300
C	-5.52453100	-1.16903000	1.60805700
C	-6.96556900	-0.30092300	-0.61140300
H	-5.58935700	1.33846200	-0.69335700
C	-6.62076100	-1.89750100	1.16528100
H	-4.94647000	-1.48052800	2.47152800
C	-7.34191000	-1.46520200	0.05253700
H	-7.53390900	0.04496600	-1.46849600
H	-6.91548500	-2.80329300	1.68506400
H	-8.19885000	-2.03371700	-0.29429600
C	-1.29783300	1.22918500	-2.15339000
H	-2.31206100	1.46876100	-2.49240900
H	-0.68243000	1.11663600	-3.05501400
N	-1.36102300	-0.07818900	-1.51332500
C	-0.05137400	-0.74022300	-1.22390200
C	-2.54110900	-0.69182400	-1.36016100
C	-0.30385000	-2.22186800	-1.05515700
H	0.57377700	-0.59059500	-2.11379300
C	-2.69631200	-2.00740600	-0.99749800
H	-3.41461600	-0.07842300	-1.56329100
C	-1.52651200	-2.79674200	-0.90422000
H	-3.68755100	-2.41843900	-0.86920300
H	-1.57604000	-3.86856300	-0.74660100
N	0.84254300	-3.06072200	-1.08696500
O	0.74346600	-4.25438300	-0.83255400
O	1.92675500	-2.53185200	-1.38777100
C	1.78145400	0.80004000	-0.55846000
O	2.12938100	0.87116900	-1.74720200
C	0.73224700	-0.09130600	-0.10634400
C	0.55760100	-0.41311900	1.25310200
O	1.47020700	-0.24173700	2.12641300

C	-0.71926700	-1.04579600	1.76570100
H	-1.56727200	-0.93961900	1.08958600
H	-0.55028700	-2.11124200	1.95719200
H	-0.96825300	-0.57705400	2.72130500
C	2.41200000	1.80580000	0.39805700
H	3.44796500	1.51846200	0.61261600
H	2.44297500	2.75893800	-0.13540700
H	1.87702400	1.90362600	1.34100500
C	4.65431500	-0.79728000	0.65617900
N	3.43256200	-1.26429600	0.76134000
N	5.21183000	-0.13539600	1.70563400
N	5.38129100	-0.96440700	-0.47328800
C	4.51830200	-0.14390900	2.99074900
H	5.24336800	0.10627200	3.76791600
H	3.68887000	0.57278400	3.00746800
H	4.11268000	-1.13723300	3.18396900
C	4.70601700	-1.32401700	-1.71955700
H	4.50927400	-2.40078700	-1.78032000
H	3.76454900	-0.77594400	-1.80993000
H	5.35952800	-1.03289300	-2.54456300
C	6.81422100	-1.21645300	-0.42649500
H	7.36567900	-0.46754000	-1.00439100
H	7.16516800	-1.20489600	0.60494400
H	7.01998500	-2.20446700	-0.85212600
C	6.08374800	1.01278200	1.48550600
H	7.04763800	0.87606600	1.98615800
H	6.24669500	1.16340300	0.41891800
H	5.60354900	1.91172000	1.88766400
H	2.70554800	-0.80579600	1.41354000
H	3.05744400	-1.84959700	0.01557300

Int9

0 1

C	1.06441700	4.30381700	-0.10354500
C	1.22837800	2.94343400	0.16128000
C	1.15077600	2.01058000	-0.88670000
C	0.93470400	2.49560100	-2.18105400
C	0.79401800	3.85385500	-2.44327300

C	0.85341500	4.76751900	-1.39661000
H	1.10995800	5.01173800	0.72097000
H	0.90060900	1.78206900	-3.00037900
H	0.63544400	4.19573700	-3.46116900
H	0.73513700	5.82996000	-1.58194100
C	1.30191500	0.51238700	-0.67440800
C	2.68879800	0.13927200	-0.24320500
H	1.22767000	0.04207100	-1.66169900
H	3.25025700	0.81139000	0.39457100
C	3.36930500	-0.76653500	-1.05212000
O	2.83932800	-1.43023200	-1.99463200
C	4.83686100	-1.00618200	-0.78554300
C	5.44787800	-0.75436400	0.44626900
C	5.61315100	-1.53439100	-1.82024900
C	6.80635800	-0.99371100	0.63095500
H	4.84255100	-0.39492300	1.27376700
C	6.97224700	-1.76890800	-1.64219900
H	5.11100900	-1.75634300	-2.75599800
C	7.57588700	-1.49594200	-0.41604200
H	7.26456100	-0.79896200	1.59646400
H	7.56455400	-2.17086800	-2.45927100
H	8.63569300	-1.68416000	-0.27309400
C	1.54691100	2.55675000	1.59045300
H	2.63031000	2.58732800	1.75471400
H	1.09911800	3.29955800	2.26341900
N	1.09231500	1.23132900	1.98574100
C	-0.18768200	0.74322200	1.48262000
C	1.88465700	0.37728500	2.64102600
C	-0.79465400	-0.07834000	2.58149100
H	-0.82811200	1.59935900	1.26191800
C	1.39356800	-0.76637900	3.24768000
H	2.91910500	0.68348700	2.76483600
C	-0.00452000	-0.90714000	3.33113000
H	2.06703100	-1.42527000	3.77631500
H	-0.46611600	-1.60487700	4.02117300
N	-2.18619700	-0.05026400	2.78326300
O	-2.73546700	-0.96547000	3.39697900
O	-2.83682000	0.88808700	2.29368600

C	-1.16865600	0.27078400	-0.81001400
O	-2.05409300	1.05525600	-0.54519900
C	0.02453600	-0.02288100	0.11468900
C	-0.06319400	-1.55648900	0.29137100
O	-1.19287900	-2.03337200	0.39872700
C	1.12227700	-2.45301700	0.26370100
H	1.91062400	-2.08120000	0.91865900
H	0.80247200	-3.46137800	0.52594600
H	1.56436500	-2.41868200	-0.74776100
C	-1.19770200	-0.46640300	-2.14082500
H	-2.13619500	-1.02359600	-2.18736500
H	-1.20424500	0.27585300	-2.94340800
H	-0.36007100	-1.15059700	-2.28843000
C	-4.55466000	-0.92726900	-0.51381300
N	-3.89253000	-1.09415200	0.62123500
N	-4.46371400	-1.87036500	-1.47611100
N	-5.35185500	0.14340400	-0.69140700
C	-3.85718100	-3.16479400	-1.17048000
H	-4.24469400	-3.89767900	-1.88004900
H	-2.76369300	-3.12724600	-1.24064000
H	-4.13195700	-3.46758800	-0.15972400
C	-5.15237600	1.34810200	0.11368600
H	-5.72197900	1.30171200	1.04960600
H	-4.09136600	1.48230300	0.32506600
H	-5.50473500	2.20045500	-0.47076200
C	-6.62419100	0.04813400	-1.39570000
H	-6.62612500	0.65840700	-2.30418500
H	-6.83597500	-0.98874600	-1.65435700
H	-7.41791500	0.40609200	-0.73301700
C	-4.60583100	-1.54046100	-2.89041500
H	-5.52416700	-1.96004200	-3.31302900
H	-4.60163700	-0.45797200	-3.02124000
H	-3.75257900	-1.95425900	-3.43501900
H	-2.97522000	-1.55192100	0.60851600
H	-4.02683600	-0.43024900	1.38011900

P

0 1

C	-5.78799300	0.22091400	-0.86436100
C	-4.47968300	0.65610100	-0.70094100
C	-3.40660600	-0.22712500	-0.81217400
C	-3.62874300	-1.56859100	-1.10810800
C	-4.94178000	-2.00932700	-1.26488200
C	-6.01327800	-1.12535100	-1.14188100
H	-6.61932000	0.91399100	-0.77686100
H	-2.79961000	-2.25532800	-1.23078300
H	-5.13032300	-3.05331100	-1.49212500
H	-7.02837700	-1.48682300	-1.26841000
C	-2.09799900	0.50395800	-0.60580500
C	-1.16571300	-0.04316000	0.48561100
H	-1.53320300	0.54989800	-1.54686400
H	-1.74374900	-0.14631700	1.41005800
C	-0.53562900	-1.35993700	0.07027200
O	-0.48667600	-1.66010700	-1.11279600
C	0.15502600	-2.19673800	1.09314500
C	-0.02327300	-2.01585600	2.46841300
C	1.04001000	-3.17844600	0.63120500
C	0.66919700	-2.81612900	3.37091000
H	-0.70337100	-1.25821500	2.84402600
C	1.73561300	-3.96982700	1.53453500
H	1.17437100	-3.29498100	-0.43956600
C	1.54820000	-3.79050100	2.90480100
H	0.52542800	-2.67689900	4.43689300
H	2.42703200	-4.72379300	1.17394000
H	2.09214300	-4.40922500	3.61121100
C	-3.99675800	2.05394400	-0.41694300
H	-4.19775000	2.73294700	-1.25605400
H	-4.44783700	2.48199900	0.48508900
N	-2.56064200	1.84898100	-0.23142700
C	-1.76587300	2.68868500	0.44970600
C	2.33913300	0.44929700	-0.05550100
C	-0.52870300	2.32703900	0.87350700
H	-2.14324200	3.68376700	0.66407700
C	1.08832900	0.83916000	-0.32124700
H	2.58761500	0.25338200	0.98968700
C	0.02394600	0.94089100	0.74400900

H	0.80204000	1.11175600	-1.33842800
H	0.48547500	0.66853100	1.69898400
N	0.27368900	3.30278300	1.54339000
O	1.35211900	2.92565600	1.99104900
O	-0.14404100	4.45144700	1.64194000
C	3.27078500	-0.51770100	-2.13933400
O	2.15237900	-1.21347600	-2.39532500
C	3.42219900	0.28806500	-1.04707500
C	4.70460000	0.98278100	-0.79248600
O	5.66617000	0.91257800	-1.54141900
C	4.78557900	1.81489500	0.47462300
H	4.79596100	1.15854300	1.35204500
H	5.71005300	2.39048000	0.45261900
H	3.92160300	2.47678200	0.58278200
C	4.30873500	-0.77277400	-3.18943500
H	4.61165600	0.16212500	-3.66336600
H	5.21531800	-1.18445200	-2.74266200
H	3.89637000	-1.46119900	-3.92707800
H	1.47484800	-1.07039600	-1.71392800

P'

0 1

C	0.80532000	3.55194900	-1.95873500
C	0.60475600	2.27677800	-1.42565100
C	0.19377600	2.14544900	-0.09199400
C	-0.02853500	3.30710500	0.65369000
C	0.15531800	4.57221100	0.11147100
C	0.58081400	4.69690000	-1.20659600
H	1.14639300	3.64362200	-2.98758600
H	-0.36042000	3.20602300	1.68322900
H	-0.02521800	5.45352300	0.71774100
H	0.74251600	5.67600300	-1.64493200
C	-0.05833900	0.80964500	0.59104300
C	-1.28734900	0.10776700	-0.02256400
H	-0.34947800	1.06894200	1.61387300
H	-1.12298700	-0.96519300	-0.16781300
C	-2.55863300	0.30230900	0.79413300
O	-2.57247100	0.97363800	1.80701300

C	-3.80904600	-0.36268500	0.30455000
C	-3.82766000	-1.19687300	-0.81755400
C	-4.99139100	-0.13661600	1.01610500
C	-5.01643100	-1.79631300	-1.22163300
H	-2.91832100	-1.38788300	-1.37954000
C	-6.17717100	-0.73366600	0.61027000
H	-4.95171500	0.51236700	1.88440500
C	-6.19020800	-1.56459100	-0.50949800
H	-5.02671400	-2.44507300	-2.09108800
H	-7.09240700	-0.55431700	1.16454300
H	-7.11648700	-2.03287900	-0.82660300
C	0.83281200	1.12140700	-2.38277700
H	0.01147100	1.08150500	-3.10887300
H	1.74478600	1.33089200	-2.95975000
N	0.94386400	-0.19951900	-1.78892600
C	1.88201800	-0.37357900	-0.68007300
C	0.30488000	-1.25803100	-2.34534700
C	2.53248300	-1.71466000	-0.84657300
H	2.63661800	0.41428000	-0.77054700
C	0.68658900	-2.54757200	-2.13035200
H	-0.51762100	-1.00598200	-3.01149100
C	1.93623500	-2.75244900	-1.46245700
H	0.14082200	-3.36546400	-2.57793000
H	2.43533000	-3.71471100	-1.46834200
N	3.81138200	-1.89357800	-0.20679200
O	4.41182200	-2.94225300	-0.36372400
O	4.21090000	-0.95943700	0.47940800
C	2.23891300	0.74350400	1.55645100
O	2.78224000	1.68037900	1.02620500
C	1.20298800	-0.10042600	0.73432100
C	0.91877700	-1.38355200	1.53783300
O	1.79179200	-2.22074300	1.62817200
C	-0.37316300	-1.59450200	2.31243500
H	-1.09807100	-2.13306500	1.69270800
H	-0.13318600	-2.23214200	3.16366100
H	-0.84514900	-0.67160000	2.65267900
C	2.48524000	0.39826000	3.00399000
H	3.07997400	-0.51891400	3.04080100

H	3.03331000	1.21595200	3.46945000
H	1.54872600	0.21263200	3.54060000
H	-1.50112300	0.50385800	-1.02269600

TS1 (Imaginary Frequency = -1135.1031 cm^{-1})

0 1

C	-1.82175200	4.44614300	0.02108300
C	-1.61807000	3.16832200	-0.49616000
C	-2.63347100	2.56390300	-1.26247500
C	-3.82803900	3.25545600	-1.48101300
C	-4.01468200	4.53466400	-0.96697900
C	-3.00871300	5.13393700	-0.21630300
H	-1.03976500	4.90301400	0.62101700
H	-4.60349800	2.78268800	-2.07569500
H	-4.94458300	5.06129600	-1.15407200
H	-3.14756300	6.13070300	0.18860800
C	-2.46672000	1.18979100	-1.77588800
C	-3.35093500	0.21159700	-1.55334100
H	-1.55738400	0.93848900	-2.32357000
H	-4.23613400	0.39239900	-0.94797900
C	-3.05901500	-1.16699600	-2.05175600
O	-2.45441600	-1.33044600	-3.09685700
C	-3.43791600	-2.32123700	-1.18380500
C	-3.87926100	-2.13389800	0.12850700
C	-3.25279400	-3.61664100	-1.67819000
C	-4.12566900	-3.23239400	0.94817500
H	-4.02257300	-1.13677500	0.53037700
C	-3.51722400	-4.71121500	-0.86676900
H	-2.89430600	-3.73559500	-2.69554100
C	-3.94831500	-4.51916300	0.44767500
H	-4.43860200	-3.06669500	1.97383900
H	-3.37998300	-5.71694800	-1.25094700
H	-4.14189700	-5.37790400	1.08306200
C	-0.33358700	2.43951700	-0.19819000
H	0.07893600	2.01255600	-1.12146700
H	0.42255700	3.13453900	0.18220500
N	-0.45312700	1.34228200	0.77638100
C	-1.61544600	0.98602800	1.32140100

C	0.84873200	0.70676500	1.15028700
C	-1.72447700	-0.03695100	2.22715900
H	-2.50452500	1.52592000	1.01927800
C	0.64563200	-0.38424500	2.17684800
H	1.44778400	1.51310300	1.59843600
C	-0.54203500	-0.73832500	2.67504700
H	1.55624900	-0.88499100	2.49391100
H	-0.65408400	-1.53020300	3.40508400
N	-3.00730000	-0.38078300	2.70813900
O	-3.09308600	-1.32008500	3.49552700
O	-3.99140400	0.25195200	2.30760400
C	2.55586700	1.27186100	-0.63375300
O	2.77567400	2.32945300	-0.03981500
C	1.68346200	0.23005300	-0.04174500
H	2.69797100	-0.52320600	0.51763000
C	1.21886200	-0.88942300	-0.90069700
O	1.95808900	-1.37281200	-1.75421400
C	-0.12425900	-1.54344000	-0.65610600
H	-0.90407600	-0.83516300	-0.37143100
H	-0.41194500	-2.07782100	-1.56263700
H	-0.03210700	-2.26174700	0.16547500
C	3.24428600	1.04679500	-1.96655600
H	3.76537800	1.96839000	-2.22875000
H	3.94862700	0.21237000	-1.90872900
H	2.52639000	0.77098300	-2.74179500
C	4.87119900	-0.79058300	0.41943800
N	3.72661400	-1.31585300	0.79712100
N	5.69601600	-1.36497200	-0.50651000
N	5.24356700	0.40897300	0.93930300
C	5.17280100	-2.40576900	-1.37876000
H	5.76381200	-2.41267000	-2.29787500
H	5.24451500	-3.40155500	-0.91981200
H	4.13215200	-2.18697300	-1.63553400
C	4.59898000	0.91750200	2.14284600
H	3.78365400	1.60318600	1.88375000
H	4.21284200	0.08348700	2.72694300
H	5.34528200	1.46176000	2.72939200
C	5.91709200	1.42653400	0.14185300

H	6.84646600	1.74862500	0.62370400
H	6.14117800	1.03867300	-0.85141200
H	5.24215900	2.28426900	0.03659400
C	7.14480100	-1.29977400	-0.39129400
H	7.59474800	-0.86490700	-1.29021900
H	7.42271300	-0.69829300	0.47344400
H	7.54765400	-2.31008400	-0.25594700
H	3.59669700	-2.26982600	0.47842800

TS2 (Imaginary Frequency = -116.2304 cm^{-1})

0 1

C	-0.20805700	-3.68898500	-2.78581900
C	-0.64421300	-3.01401200	-1.64901600
C	-2.01626500	-2.72346300	-1.50773100
C	-2.90877200	-3.12680800	-2.50393700
C	-2.46065300	-3.81343700	-3.62839800
C	-1.10680300	-4.09653600	-3.76996200
H	0.85222900	-3.89642700	-2.90310600
H	-3.96623600	-2.91572100	-2.37548300
H	-3.16820400	-4.12719200	-4.38871500
H	-0.74751200	-4.62888500	-4.64455000
C	-2.49378600	-1.97375300	-0.33257000
C	-3.36668300	-0.96162900	-0.38931300
H	-2.06900900	-2.21823200	0.64092100
H	-3.76676600	-0.62174000	-1.34071200
C	-3.74242500	-0.23427800	0.85304900
O	-3.61373000	-0.74480500	1.95293600
C	-4.26358000	1.16206300	0.71619900
C	-3.94601000	1.95869100	-0.38796700
C	-5.01236500	1.69919800	1.76663000
C	-4.37009100	3.28283200	-0.43831500
H	-3.31780800	1.56750200	-1.18342700
C	-5.46226500	3.01161200	1.70057300
H	-5.22363300	1.06939300	2.62471200
C	-5.13866100	3.80446200	0.59925200
H	-4.08360900	3.90521000	-1.27902300
H	-6.05510300	3.42361800	2.51082500
H	-5.47716300	4.83491200	0.55620800

C	0.34654200	-2.54445100	-0.60564900
H	0.17575100	-3.05575100	0.35539800
H	1.36614600	-2.82091600	-0.90465600
N	0.31346400	-1.12839900	-0.30429800
C	-0.08961200	-0.21375700	-1.10522600
C	0.76908700	-0.23505100	1.58273100
C	-0.35993400	1.11006500	-0.61268300
H	-0.31453200	-0.40621200	-2.16054500
C	-0.43639600	0.56165200	1.75389300
H	1.48728800	0.27738000	0.94934800
C	-0.83632400	1.34813100	0.72219100
H	-0.96686300	0.59192900	2.69728700
H	-1.58915600	2.11986700	0.85661000
N	-0.35852400	2.12837300	-1.55268400
O	-0.84914000	3.23039600	-1.29102100
O	0.24934000	1.92046500	-2.63753300
C	2.74685700	-1.51364900	1.96449300
O	3.23552100	-1.01802500	0.92957500
C	1.37731800	-1.21293700	2.37571500
C	0.71212400	-1.97381100	3.44208200
O	1.31665500	-2.74280000	4.18071100
C	-0.78702300	-1.81972000	3.64334100
H	-1.34962100	-1.67560700	2.71866900
H	-1.14123500	-2.70739100	4.16781000
H	-0.98706400	-0.95238800	4.28191200
C	3.62180200	-2.44633600	2.76869500
H	4.60783800	-2.47638200	2.30172200
H	3.68541000	-2.12316200	3.80886700
H	3.18149800	-3.44516900	2.80539200
H	2.61376800	-0.16128500	-0.92576300
C	3.73436600	1.49520300	-0.92713800
N	2.73383000	0.74548900	-1.38129300
N	3.59656600	2.82541800	-0.81130000
N	4.91264300	0.91300000	-0.61523200
C	2.26860400	3.43978000	-0.73078700
H	2.37297200	4.39952300	-0.22289200
H	1.82212300	3.59645800	-1.71788200
H	1.60809500	2.80542500	-0.13579600

C	5.25924800	-0.39719500	-1.16032200
H	4.90875400	-1.19228800	-0.49686600
H	4.81298000	-0.50737300	-2.14851600
H	6.34745400	-0.44016100	-1.25582900
C	5.59422700	1.24623800	0.63150800
H	6.65486000	1.44327300	0.44999000
H	5.13578000	2.12169500	1.08953700
H	5.48378000	0.39852200	1.31622900
C	4.72734900	3.73443800	-0.93437900
H	4.93890300	4.23530600	0.01582200
H	5.61045200	3.18408400	-1.25694700
H	4.48702800	4.49404700	-1.68355600
H	1.92975200	1.16777300	-1.85353200

TS3 (Imaginary Frequency = -346.8353 cm^{-1})

0 1

C	-2.68467700	4.80719500	1.32042200
C	-2.13651800	3.55507400	1.06242900
C	-2.69778900	2.71532500	0.10779400
C	-3.83225800	3.12388600	-0.59269400
C	-4.38290800	4.37696100	-0.34112600
C	-3.80955200	5.21908000	0.61175400
H	-2.24531000	5.45095100	2.07787500
H	-4.27224800	2.45212300	-1.32333000
H	-5.26684800	4.69646800	-0.88366300
H	-4.24779600	6.19192800	0.81024900
C	-2.03920200	1.39422100	-0.16427600
C	-2.80195600	0.21477600	-0.14981900
H	-1.31436700	1.41979700	-0.98137300
H	-3.60219000	0.10674000	0.57379800
C	-2.63751000	-0.76548200	-1.17056000
O	-1.89766500	-0.64236200	-2.16592000
C	-3.43101900	-2.04309100	-1.05035200
C	-3.81938800	-2.56782500	0.18523400
C	-3.72949800	-2.75215400	-2.21631500
C	-4.51270600	-3.77360100	0.25120900
H	-3.55112100	-2.04436300	1.09878800
C	-4.43404600	-3.94844200	-2.15296300

H	-3.39110700	-2.34098900	-3.16175500
C	-4.82872600	-4.46095700	-0.91770900
H	-4.79887600	-4.17958800	1.21627200
H	-4.67332600	-4.48703200	-3.06490300
H	-5.37331900	-5.39875300	-0.86619400
C	-0.95327500	2.94969200	1.76582500
H	-0.03019800	3.49404600	1.52241200
H	-1.07623700	2.98322400	2.85858900
N	-0.85340200	1.58348400	1.27671400
C	-0.63782000	0.63617300	2.14945000
C	1.28491900	0.26578800	-0.38951200
C	-0.46587800	-0.72464800	1.85221000
H	-0.61870400	0.88932200	3.21250400
C	0.42068100	-0.86904200	-0.48528900
H	1.42776700	0.71171000	0.59171900
C	-0.32314900	-1.33960600	0.56066000
H	0.30472900	-1.36788200	-1.44466800
H	-0.82740800	-2.29609400	0.43666300
N	-0.53064600	-1.62095400	2.96075100
O	-0.38677200	-2.82684100	2.73329400
O	-0.68685300	-1.17886800	4.09854600
C	2.97254000	1.88596400	-1.11289000
O	3.37133200	2.11557000	0.02353800
C	2.00338100	0.81250400	-1.40645200
C	1.87240400	0.27425800	-2.80777800
O	2.74898400	-0.44761900	-3.26488700
C	0.64768000	0.64225200	-3.58666500
H	-0.25228100	0.28628700	-3.06182200
H	0.57094900	1.73435500	-3.63688100
H	0.69676500	0.21945700	-4.59021900
C	3.46390100	2.71543400	-2.28121200
H	4.26107100	3.38023900	-1.94888000
H	3.81614000	2.07706000	-3.09717500
H	2.63604300	3.31548000	-2.67400700
H	2.46188900	-2.31515800	-0.67757900
C	3.91875400	-1.31548700	0.24534300
N	3.45508100	-2.10855900	-0.74268100
N	4.92465700	-0.46431200	0.02428200

N	3.40080700	-1.47098000	1.47622000
C	5.33730900	-0.06052800	-1.31448700
H	5.62202400	0.99375500	-1.27154800
H	6.19940300	-0.65070700	-1.64469900
H	4.51831000	-0.16023800	-2.02889200
C	2.70209300	-2.70714100	1.83506300
H	1.63591300	-2.66654700	1.59243200
H	3.17143700	-3.55260100	1.33142200
H	2.79497000	-2.84031200	2.91477100
C	3.16847400	-0.33161600	2.36853700
H	3.78464200	-0.40124800	3.27001700
H	3.36004500	0.60292000	1.83851600
H	2.11297800	-0.34909800	2.65994600
C	5.77242200	0.04852700	1.09431600
H	5.51580900	1.08831900	1.31788800
H	5.66948600	-0.56775600	1.98536400
H	6.80990500	-0.00177600	0.75405300
H	3.76326600	-1.92877700	-1.69014600

TS4 (Imaginary Frequency = -180.1305 cm^{-1})

0 1

C	5.08639000	-3.62358500	-0.56821200
C	4.04050800	-2.76429800	-0.25770800
C	3.73110500	-1.68476900	-1.07581500
C	4.47800300	-1.44358400	-2.22432100
C	5.52794800	-2.30195000	-2.54435400
C	5.83013800	-3.38803800	-1.72301400
H	5.33077200	-4.45690900	0.08499300
H	4.23149300	-0.58833300	-2.84581800
H	6.12034800	-2.11947900	-3.43527000
H	6.65597500	-4.04501600	-1.97644800
C	2.53895600	-0.86082800	-0.66979800
C	2.57753800	0.55581000	-0.77017300
H	1.60611400	-1.24840200	-1.09080200
H	3.45148900	1.10635600	-0.44378500
C	1.44828500	1.20621400	-1.31209200
O	0.49487600	0.61117700	-1.86405800
C	1.32127300	2.70577800	-1.17410000

C	2.02237900	3.43963900	-0.21288900
C	0.37676700	3.36273800	-1.96787400
C	1.79962200	4.80644800	-0.06445300
H	2.71867200	2.93263300	0.44862800
C	0.15967100	4.73025000	-1.82932800
H	-0.18201700	2.76679900	-2.68303300
C	0.87235800	5.45633100	-0.87529000
H	2.34300200	5.36125400	0.69399800
H	-0.56791600	5.23181200	-2.46139200
H	0.70010000	6.52208100	-0.75987300
C	3.14393600	-2.81237800	0.94908100
H	2.39322700	-3.60860800	0.86252000
H	3.70273100	-2.97883300	1.87868000
N	2.46566500	-1.51464500	0.96529500
C	2.55435100	-0.80908500	2.06181500
C	-1.23460000	1.16529100	0.50635700
C	1.93316400	0.42605300	2.33881800
H	3.18872000	-1.19712800	2.86075500
C	-0.15628400	0.38459900	0.95563800
H	-1.29045200	2.16258500	0.94532100
C	0.75096800	0.97348400	1.80722900
H	0.00124200	-0.60737100	0.55038800
H	0.52497800	1.97244000	2.17372600
N	2.53158400	1.15318800	3.43832600
O	2.01769800	2.20729800	3.79591000
O	3.53715900	0.68894800	3.96957500
C	-2.07988900	-0.41358700	-1.21970000
O	-1.76320600	-1.47759500	-0.69919700
C	-2.20338300	0.84596500	-0.43303900
C	-3.26742700	1.78027200	-0.72362200
O	-4.32670800	1.42639300	-1.28272000
C	-3.15638300	3.23136300	-0.30093300
H	-3.26430700	3.32869200	0.78490700
H	-2.18867200	3.65663000	-0.58017400
H	-3.96732900	3.78248000	-0.77591000
C	-2.25286100	-0.31707000	-2.71610000
H	-3.05745400	0.36119200	-2.99997600
H	-1.30038000	0.08307800	-3.08066700

H	-2.40724600	-1.31037700	-3.14322900
H	-4.75867000	-0.14114200	-1.09490500
C	-4.45335600	-1.76948600	0.15405100
N	-4.97227900	-1.15523500	-0.90857300
N	-4.15803000	-3.08074100	0.10125900
N	-4.25129700	-1.08689900	1.29377800
C	-3.79941600	-3.72253400	-1.15653500
H	-3.02567000	-4.46561600	-0.95246600
H	-4.65975800	-4.22533800	-1.61407700
H	-3.36907800	-2.98399000	-1.83156800
C	-4.97282800	0.14130400	1.60093300
H	-4.30390000	1.00254700	1.51694600
H	-5.81082300	0.27014300	0.91810400
H	-5.34354700	0.07986100	2.62829700
C	-3.08914000	-1.36418000	2.13898000
H	-3.37838300	-1.84409300	3.07938700
H	-2.37624800	-1.97244200	1.58307800
H	-2.59558000	-0.41346300	2.35555700
C	-4.21193900	-3.94245800	1.27213800
H	-3.21028200	-4.20774500	1.62498700
H	-4.75833400	-3.44535400	2.07281300
H	-4.74492800	-4.85890400	1.00314200
H	-5.29106600	-1.72373800	-1.67763600

TS5 (Imaginary Frequency = -350.5762 cm^{-1})

0 1

C	5.65692700	-2.93987300	-0.52469000
C	4.52775700	-2.22868900	-0.13602000
C	3.79749200	-1.49131000	-1.06139600
C	4.20290300	-1.44915700	-2.39365400
C	5.33284300	-2.16059900	-2.78865400
C	6.05591700	-2.90678200	-1.85871900
H	6.23003000	-3.50206500	0.20754700
H	3.63247100	-0.85792900	-3.10331000
H	5.65627700	-2.12725900	-3.82395700
H	6.94043500	-3.45217500	-2.17144600
C	2.55503900	-0.80215400	-0.58136100
C	2.29565300	0.53867100	-0.93297200

H	1.65999800	-1.42543600	-0.63731100
H	3.09968200	1.26570300	-0.95106500
C	0.98906200	0.92645900	-1.28145400
O	0.05351500	0.09817900	-1.47145600
C	0.67465600	2.38106300	-1.46623200
C	1.28543200	3.36563500	-0.68511900
C	-0.30090500	2.75391400	-2.39635500
C	0.92619100	4.70223200	-0.83195800
H	2.01414000	3.08350100	0.06778500
C	-0.64722800	4.09084100	-2.55545400
H	-0.77304700	1.98061600	-2.99497300
C	-0.03534000	5.06749600	-1.77071000
H	1.39207500	5.45312800	-0.20225300
H	-1.39449400	4.37427400	-3.29031400
H	-0.31254000	6.11052600	-1.88732400
C	3.98530300	-2.11166900	1.26326900
H	3.51069000	-3.04661700	1.58736600
H	4.77903000	-1.87652900	1.98510400
N	2.97960700	-1.05396600	1.21525500
C	3.17951400	-0.00745200	1.97593900
C	-1.32830200	0.15477300	1.73232400
C	2.27823700	1.06590000	2.07989600
H	4.10783200	0.07200600	2.54580300
C	0.06999800	-0.04800600	1.66995100
H	-1.61930400	1.20634100	1.76785800
C	0.88080600	1.04386000	1.88929000
H	0.51303400	-1.02270000	1.51549800
H	0.39855300	2.00708800	2.04102400
N	2.84339800	2.29482700	2.58945700
O	2.13122200	3.29342100	2.63432300
O	4.01844000	2.29634700	2.94134600
C	-3.73537300	-0.04484400	1.87312000
O	-3.94084700	1.04954100	1.35501300
C	-2.40823400	-0.70632400	1.78140800
C	-2.35508400	-2.17397200	1.73149400
O	-3.31950500	-2.83115900	1.34105300
C	-1.09258300	-2.90920200	2.13470900
H	-0.57857600	-2.42166000	2.96521300

H	-1.36929600	-3.93091400	2.39687000
H	-0.39757400	-2.95124300	1.28850200
C	-4.80544500	-0.67169100	2.74371300
H	-5.70937800	-0.06415100	2.69135900
H	-5.00600700	-1.70269600	2.45404700
H	-4.44327100	-0.68540300	3.77716500
H	-2.84316200	1.24650400	-0.61775700
C	-3.43403400	-0.49784300	-1.33807500
N	-2.56311100	0.49912800	-1.24603900
N	-3.04011600	-1.75907500	-1.56947100
N	-4.76484100	-0.23451900	-1.25858300
C	-1.68159800	-2.21519800	-1.30613200
H	-1.74807000	-3.21559200	-0.86936200
H	-1.09180600	-2.24290200	-2.22747300
H	-1.18131300	-1.54072600	-0.61333000
C	-5.24608100	1.12982200	-1.43233200
H	-5.22731700	1.67727800	-0.48305600
H	-4.63121000	1.64523600	-2.17040100
H	-6.27371700	1.08130900	-1.80087300
C	-5.64417500	-1.10460700	-0.48007700
H	-6.42123600	-1.55409800	-1.10722200
H	-5.05801600	-1.88306400	0.01396900
H	-6.12354700	-0.49838600	0.29521000
C	-3.90912600	-2.75404900	-2.17814100
H	-4.24244000	-3.48509700	-1.43389100
H	-4.77065100	-2.27139300	-2.63728600
H	-3.34241500	-3.27454800	-2.95539400
H	-1.52436100	0.37022300	-1.39255400

TS6 (Imaginary Frequency = -176.3133 cm^{-1})

0 1

C	-5.11470900	-3.33533500	0.67143900
C	-4.35163300	-2.31949100	0.10767200
C	-3.19839000	-1.86459100	0.73438300
C	-2.77191800	-2.41189500	1.93845900
C	-3.53365600	-3.43009400	2.50642500
C	-4.69555200	-3.88767600	1.87967400
H	-6.02006300	-3.68977600	0.18732000

H	-1.86524600	-2.03969500	2.40598500
H	-3.22506700	-3.87205600	3.44845400
H	-5.27898400	-4.67856300	2.33969800
C	-2.52601100	-0.77278500	-0.06150600
C	-2.22194200	0.49568600	0.66704400
H	-1.57201900	-1.15229400	-0.46191000
H	-3.02631000	1.19879300	0.84745500
C	-1.02980400	0.56997000	1.36894700
O	-0.17687400	-0.38181700	1.32791600
C	-0.68856400	1.80007300	2.15251800
C	-1.24880400	3.05104200	1.86824500
C	0.24067900	1.69739400	3.19294600
C	-0.88803200	4.17088400	2.61010400
H	-1.95718000	3.15494000	1.05104300
C	0.59942100	2.81667400	3.93631700
H	0.66618400	0.72372300	3.41463900
C	0.03660500	4.05731000	3.64589000
H	-1.32276500	5.13621300	2.37183900
H	1.31563000	2.72138700	4.74667600
H	0.31868700	4.93286500	4.22186000
C	-4.57910900	-1.56570400	-1.17560600
H	-4.49874700	-2.21638000	-2.05580800
H	-5.55591400	-1.06799900	-1.21148800
N	-3.50035600	-0.56983700	-1.16158200
C	-3.58441200	0.55496000	-1.87559500
C	1.01519700	0.79072000	-1.50612800
C	-2.64180200	1.54577200	-1.89746400
H	-4.50255400	0.71279500	-2.43437300
C	-0.35119200	0.56546800	-1.78337900
H	1.19689600	1.69299500	-0.91789000
C	-1.28950700	1.48884400	-1.35227500
H	-0.68882500	-0.24731400	-2.41262700
H	-0.92857700	2.40078300	-0.88476500
N	-3.04935800	2.80191800	-2.47025100
O	-2.26080700	3.73646000	-2.39034200
O	-4.15050500	2.88726700	-3.00461700
C	3.43654000	0.91496000	-1.62263700
O	3.54311200	1.67567700	-0.66391600

C	2.18653100	0.16103700	-1.90253000
C	2.29117200	-1.16487400	-2.52250600
O	3.32803400	-1.82589500	-2.44471700
C	1.09659400	-1.78663800	-3.21514400
H	0.63552100	-1.09230900	-3.92179000
H	1.43548300	-2.68475800	-3.73159800
H	0.33628400	-2.06687900	-2.47767300
C	4.54765500	0.87154600	-2.65397200
H	5.40717900	1.42537100	-2.27469400
H	4.81961600	-0.14869000	-2.92000500
H	4.18264000	1.36630300	-3.56054300
H	2.68158100	0.90941200	1.15826500
C	3.31827200	-0.95133600	0.99226600
N	2.43018300	-0.04856700	1.38667500
N	2.95008200	-2.18992900	0.62975700
N	4.64140900	-0.63986600	1.01815100
C	1.58579800	-2.50953500	0.22991500
H	1.64272600	-3.20374300	-0.61347200
H	1.03443100	-2.97502600	1.05390800
H	1.04973000	-1.60937800	-0.06835300
C	5.09203000	0.52413200	1.76998300
H	5.01484700	1.43619300	1.16625900
H	4.49682700	0.63039600	2.67717000
H	6.13607500	0.36258400	2.04889300
C	5.52537000	-1.04398500	-0.07397400
H	6.32490000	-1.70262000	0.28145600
H	4.95062000	-1.53238000	-0.86366400
H	5.97810500	-0.14171800	-0.49720600
C	3.85207200	-3.32921600	0.68844400
H	4.16901700	-3.62457300	-0.31740400
H	4.72246300	-3.08984400	1.29769100
H	3.31951700	-4.16472600	1.15184200
H	1.38649100	-0.23348500	1.43324200

TS7 (Imaginary Frequency = -1696.7385 cm^{-1})

0 1

C	-5.86857500	-1.71507600	-1.78015900
C	-4.82268100	-0.83996600	-1.51963300

C	-3.63770800	-1.27976000	-0.92956400
C	-3.48075100	-2.62434900	-0.60287100
C	-4.53269300	-3.50364900	-0.85530200
C	-5.71817200	-3.05628900	-1.43682700
H	-6.78670600	-1.36119400	-2.23964400
H	-2.55668900	-2.98630700	-0.16963500
H	-4.42311200	-4.55217000	-0.59841900
H	-6.52575600	-3.75586100	-1.62563300
C	-2.66357300	-0.12693100	-0.78199300
C	-2.09009000	0.14264700	0.61620900
H	-1.81766000	-0.25139600	-1.47374100
H	-2.92949800	0.22915500	1.31606000
C	-1.14570500	-0.95525800	1.06127700
O	-0.67538700	-1.72670200	0.23846300
C	-0.74247600	-1.03148000	2.49711400
C	-1.35500500	-0.26239800	3.49370200
C	0.29934000	-1.90050000	2.84321500
C	-0.92888500	-0.35939700	4.81337000
H	-2.16579600	0.41630300	3.25101000
C	0.72886400	-1.98844000	4.16032100
H	0.77116300	-2.49420900	2.06832400
C	0.11506900	-1.21858600	5.14653200
H	-1.40797700	0.24018000	5.57972100
H	1.54627900	-2.65309000	4.41794600
H	0.45276400	-1.28569400	6.17570100
C	-4.75865500	0.63399600	-1.81662000
H	-4.75177500	0.83065600	-2.89726800
H	-5.59282700	1.19029900	-1.37487700
N	-3.49339500	1.01894800	-1.19559400
C	-3.24064600	2.26517700	-0.75557500
C	1.20761900	1.30937800	0.46597500
C	-2.21089200	2.54543500	0.07896800
H	-3.89784500	3.06022300	-1.09292200
C	0.01135500	1.45310500	-0.13032500
H	1.21458100	1.08808200	1.53628000
C	-1.29573700	1.49442200	0.62945500
H	-0.05962400	1.63473500	-1.20150700
H	-1.07449600	1.74516700	1.67105900

N	-1.97427300	3.91273200	0.42669100
O	-1.03766300	4.14201400	1.18279300
O	-2.70733000	4.78095300	-0.03776400
C	3.61397100	0.99102200	0.61909200
O	3.44981900	0.06606700	1.51960600
C	2.53589500	1.48370300	-0.11493500
C	2.78292900	2.29350800	-1.31427200
O	3.77351400	2.11216600	-2.01983400
C	1.82549100	3.41371300	-1.69254000
H	1.20545100	3.74827800	-0.85948200
H	2.43046800	4.23582200	-2.07946000
H	1.16968300	3.08707200	-2.50649600
C	5.01470200	1.53716900	0.54710100
H	5.70776800	0.75999200	0.21333800
H	5.11137400	2.39758200	-0.10944500
H	5.30235400	1.79670500	1.57071800
H	2.81482100	-0.81670300	1.01525400
C	3.03562300	-1.70281200	-0.93984100
N	2.35516100	-1.68517000	0.18476600
N	2.45931200	-1.65869700	-2.17289300
N	4.39610600	-1.75760000	-0.90361000
C	1.11691400	-1.13511700	-2.34486300
H	1.07804700	-0.57660800	-3.28551100
H	0.36503900	-1.93464600	-2.37259600
H	0.88080700	-0.45841300	-1.52403600
C	5.07134500	-2.23360700	0.29577000
H	5.28873700	-1.41730400	0.99291300
H	4.42632700	-2.94992500	0.80428600
H	6.00005500	-2.72798600	-0.00170200
C	5.19583100	-0.99538000	-1.86235800
H	5.51183700	-1.59915500	-2.72006700
H	4.64485000	-0.11158600	-2.19931500
H	6.09676200	-0.64904400	-1.35224900
C	3.02317700	-2.34673000	-3.32031900
H	3.42394700	-1.64473400	-4.06055500
H	3.81670900	-3.02010100	-2.99675600
H	2.23724500	-2.94304300	-3.79586300
H	1.35338400	-1.80384700	0.06230600

TS8 (Imaginary Frequency = -1184.7184 cm^{-1})

0 1

C	0.42214400	3.23084600	-1.96164100
C	-0.67973400	2.52914600	-1.46824500
C	-1.30383600	2.99140200	-0.28564300
C	-0.78084800	4.13202200	0.34486500
C	0.33483800	4.79684100	-0.14386500
C	0.94372800	4.34138700	-1.30809700
H	0.89986500	2.87874900	-2.87063900
H	-1.27513200	4.49626500	1.24052500
H	0.71674900	5.67047700	0.37411700
H	1.81404600	4.84557500	-1.71402900
C	-2.53050800	2.45491100	0.31641700
C	-3.06064900	1.22361100	0.27202200
H	-3.09354800	3.17432000	0.91084100
H	-2.55568000	0.40411100	-0.21793100
C	-4.35335300	0.98802500	0.97813300
O	-4.93511500	1.90082500	1.53964600
C	-4.95877800	-0.38683700	0.97840700
C	-4.33437500	-1.50634800	0.42273600
C	-6.21776700	-0.53177300	1.57201500
C	-4.95985400	-2.74980000	0.45824100
H	-3.35580900	-1.43142600	-0.03573700
C	-6.84197000	-1.77093700	1.60518700
H	-6.68356700	0.34885000	2.00071400
C	-6.21330500	-2.88405400	1.04688100
H	-4.46193700	-3.61284100	0.02752700
H	-7.81902000	-1.87334300	2.06611900
H	-6.70035200	-3.85375700	1.07309200
C	-1.23770500	1.42894800	-2.34870600
H	-2.32654900	1.53373200	-2.39306100
H	-0.84717200	1.59109400	-3.36211600
N	-0.96739300	0.02942200	-1.98731400
C	0.45961900	-0.37113500	-1.77210100
C	-1.95444100	-0.86254300	-2.22124400
C	0.57482900	-1.85427300	-2.06545600
H	1.07128200	0.17039300	-2.50714000

C	-1.78744400	-2.21641400	-2.29309000
H	-2.94235500	-0.42374800	-2.34407900
C	-0.45280800	-2.70881500	-2.26603500
H	-2.63853900	-2.86402700	-2.44675000
H	-0.22656700	-3.75279800	-2.45236200
N	1.90809800	-2.35532400	-2.23029800
O	2.10550200	-3.56295600	-2.26374700
O	2.80982300	-1.51955100	-2.31565600
C	2.03582200	1.15185400	-0.52069800
O	2.61753400	1.36866800	-1.57942900
C	1.01218200	0.08393700	-0.40963900
C	0.15037200	-0.00322200	0.78428300
O	0.19809600	0.78139600	1.72671800
C	-0.68497900	-1.26141500	0.94899300
H	-1.17418600	-1.59925200	0.03680900
H	-0.00530100	-2.06715300	1.25453900
H	-1.42066700	-1.09669100	1.73826800
C	2.47137000	1.91614700	0.71063600
H	2.56255100	1.26567500	1.58105200
H	3.41238500	2.41959900	0.48031900
H	1.69771100	2.64507300	0.96653500
C	3.82239400	-1.09318700	1.36716600
N	2.96835500	-1.58728400	0.49480200
N	3.44538500	-0.89838700	2.65861000
N	5.09811700	-0.73878500	1.02298300
C	2.21667100	-1.49505700	3.16125600
H	2.35956600	-1.74376400	4.21686800
H	1.37195900	-0.80051200	3.06644400
H	2.00705600	-2.40390000	2.59873100
C	5.41525400	-0.52985300	-0.38444900
H	5.63977100	-1.47135800	-0.90353500
H	4.58490200	-0.03134600	-0.89127800
H	6.29666300	0.11343000	-0.44010700
C	6.23136700	-1.02545000	1.88942900
H	6.80666100	-0.11857200	2.10485100
H	5.88500600	-1.45906100	2.82710500
H	6.89428300	-1.74845500	1.40017600
C	3.97527400	0.18764200	3.46913600

H	4.50691400	-0.19289200	4.34845800
H	4.64970100	0.80441100	2.87535400
H	3.14339700	0.81453000	3.80943400
H	1.95351000	-0.86221300	0.10042800
H	3.43667900	-1.89736100	-0.35265200

TS9 (Imaginary Frequency = -227.5672 cm^{-1})

0 1

C	0.32973900	3.25290300	-1.39980700
C	-0.76711400	2.39830000	-1.28452500
C	-1.90952900	2.86661200	-0.59338200
C	-1.89403900	4.16865000	-0.06799800
C	-0.77915300	4.98906400	-0.16846200
C	0.34730400	4.52406900	-0.83679300
H	1.19791200	2.91169700	-1.95590700
H	-2.78525000	4.53070200	0.43641400
H	-0.79415400	5.98370000	0.26468800
H	1.23157200	5.14525500	-0.93213900
C	-3.17445600	2.13849000	-0.43409800
C	-3.39707300	0.81782700	-0.37359200
H	-4.05798500	2.76667700	-0.32175700
H	-2.58238900	0.10840700	-0.40021000
C	-4.80262400	0.34189300	-0.22041900
O	-5.73064600	1.13274400	-0.19839800
C	-5.07796000	-1.13018000	-0.11550000
C	-4.07392400	-2.09966000	-0.05726500
C	-6.41820200	-1.53067200	-0.07426200
C	-4.40505400	-3.44845100	0.03956500
H	-3.02585700	-1.82587000	-0.07851300
C	-6.74786800	-2.87560600	0.01888900
H	-7.18181700	-0.76163100	-0.11654800
C	-5.74006200	-3.83854900	0.07595900
H	-3.61432800	-4.19031700	0.09107700
H	-7.78984500	-3.17735700	0.04878800
H	-5.99712100	-4.89052200	0.15111000
C	-0.72123500	1.09601100	-2.06411900
H	-1.70793500	0.92637800	-2.52053200
H	-0.00952500	1.25144800	-2.88668300

N	-0.30103200	-0.10835800	-1.35039500
C	1.03376600	-0.10273400	0.34011400
C	-0.93756300	-1.20368900	-1.62361100
C	1.15972700	-1.59234400	0.41761800
H	1.84399000	0.32685300	-0.24325300
C	-0.60211400	-2.47329900	-1.08185500
H	-1.78852400	-1.16164000	-2.31948400
C	0.43249700	-2.61701600	-0.18524600
H	-1.15530200	-3.33877200	-1.42406900
H	0.74047700	-3.61623700	0.10938800
N	2.33926800	-1.94939200	1.06471700
O	2.82124500	-3.09717000	0.94450200
O	2.93618600	-1.06662700	1.71458900
C	1.32665600	2.05947100	1.32787000
O	2.33506700	2.24276300	0.62492200
C	0.57554600	0.79369300	1.28871100
C	-0.51707600	0.50858300	2.23522400
O	-0.86028000	1.29258000	3.10816300
C	-1.24730800	-0.81677500	2.12001800
H	-2.21478700	-0.71418200	2.61313100
H	-1.37711300	-1.13459600	1.08515700
H	-0.66810900	-1.59666600	2.62528300
C	0.91400800	3.17281700	2.25529600
H	1.02923300	2.85072400	3.29311600
H	1.54193000	4.03897100	2.04368300
H	-0.14394800	3.40832500	2.13358200
C	4.61594000	-0.40840400	-0.42947800
N	4.72771800	0.73139400	0.27010000
N	3.90511300	-0.36584000	-1.57617700
N	5.25910800	-1.52056400	-0.05851400
C	3.60453800	0.92498100	-2.19158800
H	4.44634700	1.60362800	-2.05550100
H	3.44243900	0.75618300	-3.25823500
H	2.71033600	1.38146400	-1.75234800
C	5.67031600	-1.78299500	1.31875300
H	5.20923100	-1.07418600	1.99941900
H	5.28372700	-2.76602600	1.59743400
H	6.76260800	-1.76187600	1.39143700

C	5.60019400	-2.59117700	-0.98538000
H	4.94375400	-3.45288700	-0.83053700
H	5.53037600	-2.24032400	-2.01365800
H	6.63332700	-2.89096700	-0.78889100
C	3.09876700	-1.48760600	-2.06442500
H	3.45930800	-1.82379000	-3.04212100
H	3.11615300	-2.31173100	-1.35145100
H	2.05995900	-1.15104100	-2.15656200
H	3.87471400	1.30266500	0.37326800
H	5.33292800	0.71728700	1.07582300

TS10 (Imaginary Frequency = -362.2491 cm^{-1})

0 1

C	0.50286000	4.50386000	0.21523500
C	0.89721500	3.16622100	0.29931200
C	0.91852500	2.37718500	-0.85830200
C	0.56460700	2.97856900	-2.07374400
C	0.19675100	4.31499500	-2.15415700
C	0.15737300	5.08589900	-0.99664500
H	0.46995100	5.09972700	1.12460000
H	0.59803200	2.37230700	-2.97496800
H	-0.06441300	4.74908700	-3.11390900
H	-0.14344400	6.12759100	-1.03508100
C	1.29637900	0.92792200	-0.89864500
C	2.63644600	0.55901900	-0.60821300
H	0.98934200	0.46416600	-1.83414700
H	3.27544700	1.18589000	0.00097700
C	3.14073000	-0.57073500	-1.30296100
O	2.44439500	-1.25324300	-2.08316700
C	4.57650800	-0.98097100	-1.09063700
C	5.30486300	-0.64370500	0.05281200
C	5.18605500	-1.76641800	-2.07204200
C	6.62393500	-1.06248800	0.20208300
H	4.82389900	-0.07618800	0.84422200
C	6.50591100	-2.17855200	-1.93029200
H	4.59085100	-2.04193300	-2.93634400
C	7.23037400	-1.82491900	-0.79298900
H	7.17760900	-0.80062000	1.09880500

H	6.97239700	-2.78084000	-2.70410600
H	8.25978200	-2.15033300	-0.67821800
C	1.34375500	2.69509400	1.66702600
H	2.38651100	2.99337300	1.82765800
H	0.74612600	3.22601500	2.42115900
N	1.26152500	1.27173000	1.94514300
C	0.00303800	0.56960900	1.63552700
C	2.29759800	0.64061800	2.50714900
C	-0.16998400	-0.48905400	2.69753000
H	-0.80320800	1.30337100	1.73915600
C	2.18143400	-0.56424900	3.16682900
H	3.23880400	1.18490500	2.49669100
C	0.88039800	-1.06674200	3.35439200
H	3.04935800	-1.03038600	3.60938800
H	0.68046000	-1.88455800	4.03851100
N	-1.48493300	-0.90536200	3.00200400
O	-1.68150100	-1.86748800	3.73308400
O	-2.41976400	-0.26153900	2.48385300
C	-1.31993100	0.66429400	-0.50926400
O	-2.04912700	1.48967100	0.02322500
C	-0.11998400	0.07445600	0.16833200
C	0.02041300	-1.39114600	-0.07314000
O	-0.85189200	-2.03095800	-0.68232300
C	1.20242000	-2.16890200	0.43832300
H	2.02285600	-1.53269500	0.76485200
H	0.86504400	-2.78786500	1.27584600
H	1.53665900	-2.81665200	-0.37179800
C	-1.57764300	0.34244800	-1.97785200
H	-2.58564400	-0.07143600	-2.07183200
H	-1.56978500	1.29419500	-2.51579600
H	-0.86629000	-0.35406800	-2.41790800
C	-4.40845200	-1.17362300	-0.55778900
N	-3.38261300	-1.49783400	0.20580300
N	-4.52501500	-1.73088500	-1.78690400
N	-5.34848300	-0.31289400	-0.11867400
C	-3.65040800	-2.84420800	-2.15100100
H	-4.11423300	-3.38061300	-2.98051400
H	-2.65335200	-2.49680200	-2.44702800

H	-3.54405000	-3.52154200	-1.30329600
C	-5.05105700	0.56872400	1.01075000
H	-5.21403500	0.06420600	1.97042400
H	-4.01882500	0.91920700	0.94791100
H	-5.71906800	1.42947600	0.94376800
C	-6.75605200	-0.47359800	-0.45803000
H	-7.13673200	0.40159500	-0.99378500
H	-6.89634200	-1.36273700	-1.07181200
H	-7.33149300	-0.59518100	0.46513100
C	-5.07721400	-0.97682300	-2.90810400
H	-5.95174800	-1.48057200	-3.33115100
H	-5.35409300	0.02657900	-2.58623000
H	-4.31226000	-0.88711900	-3.68627800
H	-2.47843900	-1.77119200	-0.22078900
H	-3.32709800	-1.15987500	1.16793200

TS11 (Imaginary Frequency = -380.3175 cm^{-1})

0 1

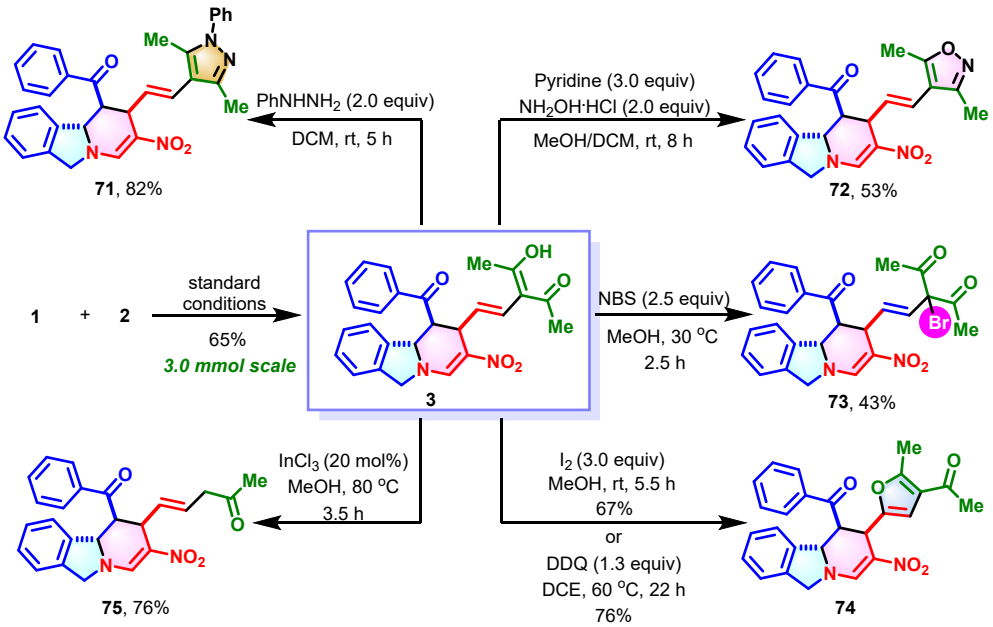
C	-0.13875000	-3.56457700	0.44726300
C	0.12594200	-2.19907800	0.33246700
C	0.27667100	-1.61994900	-0.93683300
C	0.10277600	-2.43330200	-2.05870800
C	-0.16089800	-3.79558800	-1.94187900
C	-0.27111600	-4.37059100	-0.67993700
H	-0.22092100	-4.00605000	1.43781700
H	0.21311900	-1.98648000	-3.04328800
H	-0.25994600	-4.40633200	-2.83378900
H	-0.45448700	-5.43469700	-0.57086700
C	0.66101500	-0.15670300	-1.12448900
C	-0.34369800	0.83761300	-0.55620400
H	0.63220800	0.00367800	-2.21149400
H	-0.08413900	1.34255900	0.36603300
C	-1.12472700	1.55989200	-1.49453500
O	-1.34556800	1.16872500	-2.65737900
C	-1.89815700	2.76097200	-0.98631800
C	-1.52764600	3.50595200	0.13894700
C	-3.06457900	3.10946400	-1.67217900
C	-2.31995100	4.56383800	0.57801600

H	-0.61282000	3.26778500	0.67604000
C	-3.86144100	4.16080000	-1.23031600
H	-3.31587600	2.53092200	-2.55523800
C	-3.49272900	4.88857800	-0.10032900
H	-2.01781700	5.14081900	1.44669500
H	-4.76898300	4.41769400	-1.76826500
H	-4.11051200	5.71194400	0.24444900
C	0.17573400	-1.37995600	1.59841200
H	-0.79553800	-0.87557900	1.71897500
H	0.29793800	-2.06019000	2.45312100
N	1.19057300	-0.33351700	1.65032300
C	2.39480300	-0.40978400	0.81542400
C	0.95619500	0.73370600	2.45142900
C	3.48720700	0.29487500	1.57728500
H	2.65375600	-1.46733800	0.70336200
C	1.92249500	1.61501900	2.82460600
H	-0.06387600	0.81626800	2.82267200
C	3.26478000	1.28519300	2.46211500
H	1.69097700	2.45573200	3.46218000
H	4.11668100	1.79626300	2.89504200
N	4.84689600	-0.03754700	1.23346300
O	5.75983500	0.44538000	1.88301400
O	5.00161900	-0.79410500	0.28239800
C	3.01367500	-0.84665800	-1.59565700
O	2.98437400	-2.04161000	-1.42292700
C	2.15172000	0.08651700	-0.68146600
C	2.63312100	1.52642700	-0.93025600
O	3.74191300	1.83497300	-0.54035100
C	1.83858900	2.52690100	-1.74700300
H	1.18670600	3.10677900	-1.08717800
H	2.55751500	3.20715400	-2.20589700
H	1.19990700	2.06737600	-2.50432700
C	3.80563500	-0.23841200	-2.72831700
H	4.67951000	0.26445300	-2.30539400
H	4.12397700	-1.03701900	-3.39690000
H	3.22083100	0.50810700	-3.27577800
C	-3.33309600	-1.21566100	0.40613000
N	-2.68328300	-0.64073900	-0.57355400

N	-3.43759200	-0.56763700	1.60044900
N	-3.92351600	-2.43302100	0.28696400
C	-3.20117600	0.87016100	1.66407100
H	-3.76665500	1.27424500	2.50742800
H	-2.13759500	1.10692600	1.79653000
H	-3.53608200	1.34538200	0.74108100
C	-3.58896800	-3.28970000	-0.83923700
H	-4.24965600	-3.10473000	-1.69632100
H	-2.54899000	-3.13701700	-1.12892000
H	-3.70241700	-4.33188800	-0.53074400
C	-5.16475100	-2.75723500	0.97681400
H	-5.03428500	-3.61291300	1.64735400
H	-5.50960600	-1.89829100	1.55081100
H	-5.93150400	-3.00966200	0.23683000
C	-3.33982500	-1.28473300	2.86351200
H	-4.23939900	-1.14865400	3.47314100
H	-3.18492900	-2.34837200	2.67963000
H	-2.47982500	-0.90619800	3.42880600
H	-1.74824600	0.02264500	-0.40387600
H	-2.76107300	-1.01889400	-1.50824300

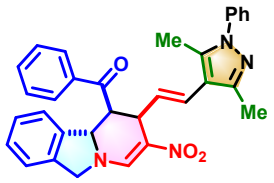
11. Methodology application

11.1 Scalable preparation of 3 and its chemical conversions



General procedure for scalable preparation of 3: To a solution of pyridinium salt **1** (1.91 g, 4.5 mmol) and acetylacetone **2** (0.30 g, 3.0 mmol) in acetone (20 mL) was added TMG (0.69 g, 6.0 mmol) successively. After being stirred at 60 °C for 2 h, the mixture was concentrated in vacuum. The residue was purified via flash column chromatography on silica gel (petroleum ether/ ethyl acetate) to afford the corresponding product **3** as yellow solid in 65% yield (0.86 g).

General procedure for the formation of 71: To a solution of **3** (88.9 mg, 0.20 mmol) in dichloromethane (2.0 mL) was added phenylhydrazine (43.2 mg, 0.40 mmol). The resulting reaction mixture was stirred at room temperature for 5 h until complete consumption of **3** as monitored by thin layer chromatography. Then, the reaction mixture was directly subjected to column chromatography on silica gel (petroleum ether/ethyl acetate = 3:1 to 1:1) to afford **71** as yellow solid in 82% yield.

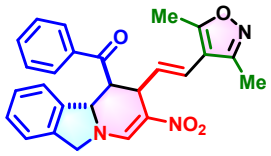


2-((*E*)-2-(3,5-dimethyl-1-phenyl-1H-pyrazol-4-yl)vinyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**71**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 3:1 to 1:1); 84.8 mg, 82% yield; dr > 20:1; reaction time = 5 h; mp 224.4-225.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 (s, 1H), 8.00 (d, J = 8.0 Hz, 2H), 7.62 (t, J = 8.0 Hz, 1H), 7.50 (t, J = 8.0 Hz, 2H), 7.40 (t, J = 8.0 Hz, 2H), 7.32 (t, J = 8.0 Hz, 3H), 7.26 (s, 2H), 7.14 (s, 2H), 6.09 (d, J = 16.0 Hz, 1H), 5.55 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.46 (d, J = 8.0 Hz, 1H), 5.07 (d, J = 16.0 Hz, 1H), 4.88 (d, J = 12.0 Hz, 1H), 4.46 (t, J = 8.0 Hz, 1H), 3.85 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.27 (s, 3H), 2.20 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.4, 147.3, 142.9, 139.4, 137.6, 136.8, 136.6, 135.6, 133.9, 129.0, 128.9, 128.4, 128.3, 128.2, 127.3, 124.8, 124.1, 123.9, 122.9, 122.3, 122.0, 115.7, 59.8, 56.9, 48.4, 40.0, 13.2, 11.4. IR (KBr) ν 3432, 2923, 1671, 1614, 1258, 758 cm^{-1}. HRMS (ESI) calcd for $C_{32}H_{29}N_4O_3$ $[M+H]^+$: 517.2234, found: 517.2234.

General procedure for the formation of 72: To a solution of **3** (88.9 mg, 0.20 mmol) and hydroxylamine hydrochloride (27.6 mg, 0.40 mmol) in combined solvents of methanol and dichloromethane (v/v = 2/1, 1.5 mL) was added pyridine (47.6 mg, 0.60 mmol). The resulting

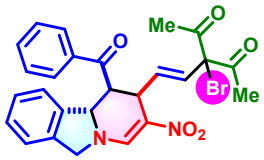
reaction mixture was stirred at room temperature for 8 h until complete consumption of **3** as monitored by thin layer chromatography. Then, the reaction mixture was directly subjected to column chromatography on silica gel (petroleum ether/ethyl acetate = 2:1 to 1:1) to afford **72** as yellow solid in 53% yield.



2-((*E*)-2-(3,5-dimethylisoxazol-4-yl)vinyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**72**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 2:1 to 1:1); 46.8 mg, 53% yield; dr > 20:1; reaction time = 8 h; mp 186.9-187.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (s, 1H), 7.97 (d, J = 8.0 Hz, 2H), 7.62 (t, J = 8.0 Hz, 1H), 7.50 (t, J = 8.0 Hz, 2H), 7.30-7.23 (m, 2H), 7.18-7.14 (m, 1H), 7.08 (d, J = 8.0 Hz, 1H), 5.87 (d, J = 16.0 Hz, 1H), 5.56 (dd, J_1 = 8.0 Hz, J_2 = 16.0 Hz, 1H), 5.40 (d, J = 12.0 Hz, 1H), 5.07 (d, J = 16.0 Hz, 1H), 4.87 (d, J = 16.0 Hz, 1H), 4.40 (q, J = 4.0 Hz, 1H), 3.83 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.28 (s, 3H), 2.18 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.4, 165.6, 158.2, 143.0, 137.4, 136.5, 135.5, 134.1, 129.1, 128.6, 128.4, 128.2, 126.0, 124.0, 122.3, 121.5, 120.9, 112.2, 59.8, 56.9, 48.1, 39.6, 11.5, 11.1. IR (KBr) ν 3422, 2925, 1676, 1620, 1256, 753 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}N_3O_4$ $[M+H]^+$: 442.1761, found: 442.1764.

General procedure for the formation of 73: To a solution of **3** (88.9 mg, 0.20 mmol) in methanol (1.5 mL) was added NBS (89.0 mg, 0.50 mmol). The resulting reaction mixture was stirred at room temperature for 2.5 h, which resulted in the formation of a white precipitate. The slurry was directly purified by a simple filtration to afford **73** as white solid in 43% yield.

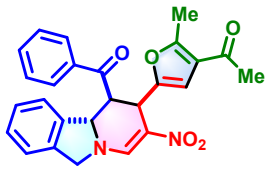


3-((*E*)-2-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)vinyl)-3-bromopentane-2,4-dione (**73**)

White solid obtained by direct filtration of the precipitate; 45.0 mg, 43% yield; dr > 20:1; reaction time = 2.5 h; mp 157.8-158.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.55 (s, 1H), 7.99 (d, J = 8.0 Hz,

2H), 7.66 (t, J = 8.0 Hz, 1H), 7.54 (t, J = 8.0 Hz, 2H), 7.29 (t, J = 8.0 Hz, 2H), 7.20-7.16 (m, 1H), 7.07 (d, J = 8.0 Hz, 1H), 5.81 (d, J = 12.0 Hz, 1H), 5.76 (d, J = 8.0 Hz, 1H), 5.38 (d, J = 8.0 Hz, 1H), 5.10 (d, J = 8.0 Hz, 1H), 4.90 (d, J = 12.0 Hz, 1H), 4.39 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 3.84 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 2.34 (s, 3H), 2.31 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.7, 198.5, 198.1, 143.2, 137.2, 136.3, 135.6, 134.3, 132.7, 129.2, 128.7, 128.5, 128.4, 128.3, 124.0, 122.4, 120.8, 73.8, 59.8, 57.0, 47.5, 38.8, 26.7, 26.5. IR (KBr) ν 3431 3063, 1675, 1622, 1259, 752 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{24}BrN_2O_5$ $[M+H]^+$: 523.0863, found: 523.0862.

General procedure for the formation of 74 (Method A): To a solution of **3** (88.9 mg, 0.20 mmol) in methanol (2.0 mL) was added iodine (152.3 mg, 0.60 mmol). The resulting reaction mixture was stirred at room temperature for 5.5 h. After complete transformation of **3** (monitored by TLC), saturated sodium thiosulfate was added. The resulting reaction mixture was extracted with dichloromethane (5 mL x 3). The combined organic phase was dried over anhydrous Na_2SO_4 and concentrated in vacuum. Then, the residue was purified by column chromatography on silica gel (petroleum ether/ethyl acetate = 5:1 to 3:1) to afford **74** as yellow solid in 67% yield (59.0 mg).
Method B: To a solution of **3** (66.7 mg, 0.15 mmol) in 1,2-dichloroethane (1.0 mL) was added DDQ (44.3 mg, 1.5 equiv) slowly. The resulting reaction mixture was stirred at room temperature for 22 h. Then, the mixture was concentrated in vacuum and purified by silica gel column chromatography (petroleum ether/ethyl acetate = 3:1 to 2:1) to afford **74** as yellow solid in 76% yield (50.5 mg).

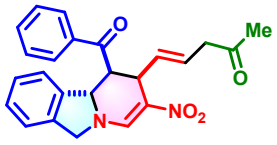


1-(5-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)-2-methylfuran-3-yl)ethan-1-one (**74**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 3:1); 59.0 mg, 67% yield; dr > 20:1; reaction time = 5.5 h; mp 153.1-153.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 7.99 (d, J = 4.0 Hz, 2H), 7.63 (t, J = 8.0 Hz, 1H), 7.52 (t, J = 8.0 Hz, 2H), 7.26 (d, J = 4.0 Hz, 2H), 7.14-7.10 (m, 1H), 7.02 (d, J = 8.0 Hz, 1H), 6.22 (s, 1H), 5.46 (d, J = 12.0 Hz, 1H), 5.11 (d, J = 16.0 Hz, 1H), 4.93 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 2H), 3.91 (dd, J_1 = 4.0

Hz, J_2 = 12.0 Hz, 1H), 2.43 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.9, 193.6, 158.0, 148.8, 143.4, 137.1, 136.4, 135.5, 133.9, 129.0, 128.5, 128.3, 128.2, 123.9, 122.3, 121.9, 120.0, 109.1, 60.1, 56.8, 47.6, 36.2, 28.9, 14.2. IR (KBr) ν 3438, 2924, 1675, 1622, 1412, 1258, 744 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{23}N_2O_5$ $[M+H]^+$: 443.1601, found: 443.1595.

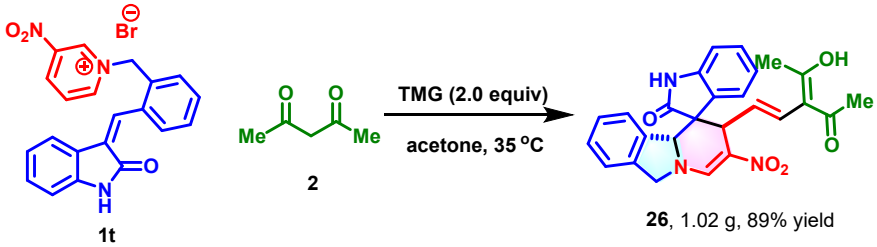
General procedure for the formation of 75: To a solution of **3** (88.9 mg, 0.20 mmol) in methanol (2.0 mL) was added $InCl_3$ (8.8 mg, 0.04 mmol). The resulting reaction mixture was stirred at room temperature for 3.5 h. After complete transformation of **3** (monitored by TLC), the mixture was concentrated in vacuum and purified by silica gel column chromatography (petroleum ether/ethyl acetate = 4:1 to 2:1) to afford **75** as yellow solid in 76% yield (61.0 mg).



(*E*)-5-(1-benzoyl-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-2-yl)pent-4-en-2-one (**75**)

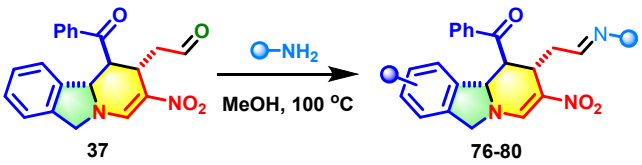
Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 4:1 to 2:1); 61.0 mg, 76% yield; dr > 20:1; reaction time = 3.5 h; mp 191.4-191.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (s, 1H), 7.98 (d, J = 8.0 Hz, 2H), 7.62 (t, J = 8.0 Hz, 1H), 7.50 (t, J = 8.0 Hz, 2H), 7.25 (s, 2H), 7.13 (s, 1H), 7.08 (d, J = 8.0 Hz, 1H), 5.50-5.43 (m, 1H), 5.36-5.31 (m, 2H), 5.06 (d, J = 12.0 Hz, 1H), 4.88 (d, J = 12.0 Hz, 1H), 4.30 (t, J = 4.0 Hz, 1H), 3.78 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 3.05 (d, J = 8.0 Hz, 2H), 2.06 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 206.3, 198.3, 143.1, 137.4, 136.3, 135.6, 134.0, 129.0, 128.7, 128.4, 128.2, 126.5, 123.9, 122.3, 121.6, 59.7, 56.9, 47.8, 47.1, 38.7, 29.1, one carbon missing in the aromatic region. IR (KBr) ν 3418, 2919, 1715, 1614, 1405, 1257, 752 cm^{-1}. HRMS (ESI) calcd for $C_{24}H_{23}N_2O_4$ $[M+H]^+$: 403.1652, found: 403.1654.

11.2 Scalable preparation of 26



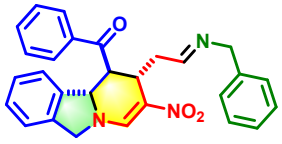
General procedure for scalable preparation of 26: To a solution of pyridinium salt **1t** (1.10 g, 2.5 mmol) and acetylacetone **2** (0.30 g, 3.0 mmol) in acetone (25 mL) was added TMG (0.58 g, 5.0 mmol) successively. After being stirred at 35 °C for 5 min, the mixture was concentrated in vacuum. The residue was purified via flash column chromatography on silica gel (petroleum ether/ ethyl acetate) to afford the corresponding product **26** as yellow solid in 89% yield (1.02 g).

11.3 Preparation of various imines from aldehyde 37



37 **76-80**

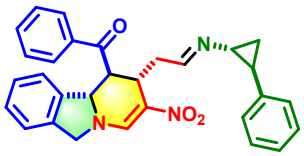
General procedure: To a mixture of aldehyde **37** (0.2 mmol) in methanol (1 mL) was added primary amine or their corresponding aminium salts (0.22 mmol, 1.1 equiv). The reaction mixture was stirred at 100 °C until complete consumption of **37** (monitored by TLC). Then, the crude reaction mixture was purified by silica gel column chromatography using petroleum ether/ethyl acetate (5:1 to 1:1) as the eluent to give the imines. It should be note that for the formation of **77** and **78**, the corresponding amine hydrochlorides were used. So, an additional addition of NEt_3 (1.1 equiv) was required to liberate the primary amine. For **80**, the starting amine was Fluvoxamine maleate, and 2.2 equivalents of NEt_3 were employed as the base. For **76**, **77** and **79**, the products were precipitated out from the homogenous system and a filtration was needed to purify them.



(2-((*E*)-2-(benzylimino)ethyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**76**)

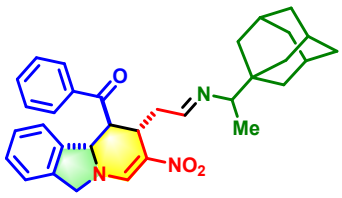
Pink solid obtained by filtration of the precipitate; 81.7 mg, 91% yield; dr > 20:1; reaction time = 2 h; mp 213.0-214.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46 (s, 1H), 7.84 (d, J = 8.0 Hz, 2H), 7.50 (t, J = 8.0 Hz, 1H), 7.39 (q, J = 8.0 Hz, 5H), 7.24 (dd, J_1 = 12.0 Hz, J_2 = 8.0 Hz, 3H), 7.16 (t, J = 8.0 Hz, 1H), 7.03 (t, J = 8.0 Hz, 1H), 6.96 (d, J = 4.0 Hz, 1H), 4.85 (d, J = 12.0 Hz, 1H), 4.75 (d, J = 12.0 Hz, 1H), 4.55 (d, J = 16.0 Hz, 1H), 4.31 (s, 1H), 4.19 (q, J = 12.0 Hz, 2H), 3.88 (s, 1H), 3.57 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 2.31 (d, J = 12.0 Hz, 1H), 1.58-1.53 (m, 1H); ^{13}C NMR

(100 MHz, $CDCl_3$) δ 199.7, 145.9, 142.0, 137.8, 137.4, 135.1, 132.7, 129.1, 128.5, 128.5, 128.1, 128.0, 127.3, 127.2, 123.1, 122.5, 119.9, 65.3, 57.9, 57.8, 53.8, 49.5, 29.5, 25.4. IR (KBr) ν 3420, 2920, 2381, 2309, 1626, 1403, 706 cm^{-1}. HRMS (ESI) calcd for $C_{28}H_{26}N_3O_3$ $[M+H]^+$: 452.1969, found: 452.1968.



(3-nitro-2-((*E*)-2-((2-phenylcyclopropyl)imino)ethyl)-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**77**)

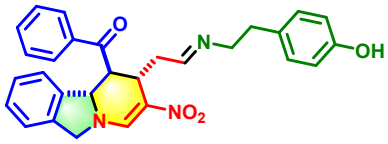
Grey solid obtained by filtration of the precipitate; 58.5 mg, 61% yield; dr = 1.2:1; reaction time = 28 h; mp 208.9-209.6 ℃; ^{1}H NMR (400 MHz, DMF-d_7) δ 8.47 (d, J = 8.0 Hz, 1H), 8.07 (d, J = 8.0 Hz, 2H), 7.63-7.52 (m, 3H), 7.31-7.17 (m, 8H), 7.04 (d, J = 4.0 Hz, 1H), 6.84 (d, J = 8.0 Hz, 1H), 4.86 (d, J = 16.0 Hz, 1H), 4.69 (s, 1H), 4.44-4.13 (m, 2H), 3.91 (t, J = 12.0 Hz, 2H), 3.50 (d, J = 16.0 Hz, 2H), 1.80-1.64 (m, 2H), 1.49-1.28 (m, 1H); ^{13}C NMR (100 MHz, DMF-d_7) δ 200.3, 145.6, 143.0, 140.8, 139.7, 139.6, 137.8, 133.3, 128.9, 128.8, 128.5, 127.4, 126.9, 126.6, 126.5, 123.1, 122.7, 120.7, 68.3, 58.1, 54.0, 49.3, 45.2, 25.3, 24.9, 15.8. IR (KBr) ν 3422, 2923, 2850, 2382, 1631, 1403, 762 cm^{-1}. HRMS (ESI) calcd for $C_{30}H_{28}N_3O_3$ $[M+H]^+$: 478.2125, found: 478.2122.



(2-((*E*)-2-((1-(adamantan-1-yl)ethyl)imino)ethyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**78**)

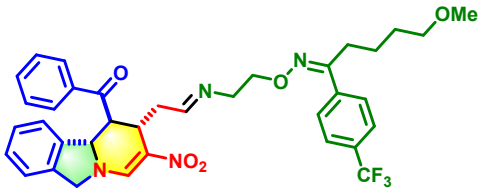
Light yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 15:1 to 8:1); 25.5 mg, 24% yield; dr = 1.1:1; reaction time = 10 h; mp 182.3-183.2 ℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 (d, J = 20.0 Hz, 1H), 7.86 (dd, J_1 = 24.0 Hz, J_2 = 8.0 Hz, 2H), 7.55-7.49 (m, 1H), 7.45-7.39 (m, 2H), 7.24-7.15 (m, 2H), 7.06-6.94 (m, 2H), 4.93 (d, J = 12.0 Hz, 0.44H), 4.67 (d, J = 12.0 Hz, 0.56H), 4.52 (s, 0.44H), 4.38 (s, 0.56H), 4.38-4.19 (m, 2H), 3.92 (s, 1H), 3.61 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 0.56H), 3.43 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 0.44H), 3.22 (q, J = 12.0 Hz, 0.56H), 3.14 (q, J = 12.0 Hz, 0.44H), 2.31 (t, J = 12.0 Hz, 1H), 2.03 (d, J = 4.0 Hz, 3H), 1.74-1.39

(m, 16H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.6, 147.4, 142.0, 138.0, 137.5, 132.7, 128.5, 128.2, 127.2, 127.2, 127.1, 123.1, 122.4, 118.7, 71.7, 71.1, 68.7, 64.7, 57.7, 54.1, 49.7, 38.8, 38.0, 36.6, 30.0, 29.4, 28.2, 28.1, 25.6, 15.2, one carbon missing in the aliphatic region. IR (KBr) ν 3421, 2914, 2849, 1637, 1401 cm^{-1}. HRMS (ESI) calcd for $C_{33}H_{38}N_3O_3$ $[M+H]^+$: 524.2908, found: 524.2905.



(2-((*E*)-2-((4-hydroxyphenethyl)imino)ethyl)-3-nitro-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**79**)

Grey solid obtained by filtration of the precipitate; 80.4 mg, 84% yield; dr > 20:1; reaction time = 15 h; mp 210.3-211.0 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.25 (s, 1H), 8.38 (s, 1H), 7.96 (d, J = 8.0 Hz, 2H), 7.60 (t, J = 8.0 Hz, 1H), 7.49 (t, J = 8.0 Hz, 2H), 7.29 (d, J = 8.0 Hz, 1H), 7.15 (t, J = 8.0 Hz, 1H), 7.08 (d, J = 8.0 Hz, 2H), 7.01 (t, J = 8.0 Hz, 1H), 6.74 (d, J = 4.0 Hz, 1H), 6.70 (d, J = 8.0 Hz, 2H), 4.63 (s, 1H), 4.47 (d, J = 12.0 Hz, 1H), 4.31 (d, J = 12.0 Hz, 1H), 4.15 (d, J = 12.0 Hz, 1H), 3.79-3.73 (m, 3H), 3.69 (s, 1H), 2.86 (t, J = 8.0 Hz, 2H), 2.55 (s, 1H), 1.41-1.38 (m, 1H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 199.6, 155.8, 146.8, 142.3, 139.0, 136.8, 132.9, 129.9, 128.6, 128.2, 128.0, 127.0, 126.6, 122.7, 122.1, 118.2, 115.2, 65.9, 57.3, 55.8, 53.1, 48.6, 34.3, 29.6, 24.3. IR (KBr) ν 3423, 2920, 2382, 2309, 1639 cm^{-1}. HRMS (ESI) calcd for $C_{29}H_{28}N_3O_4$ $[M+H]^+$: 482.2074, found: 482.2074.

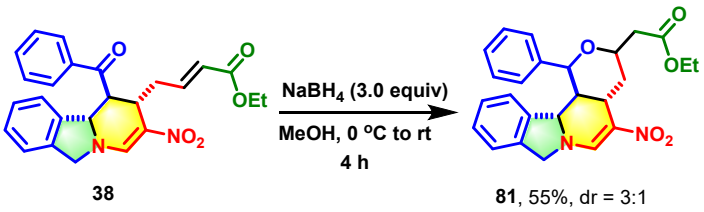


(3-nitro-2-(7-(4-(trifluoromethyl)phenyl)-2,9-dioxa-8,12-diazatetradeca-7,12-dien-14-yl)-1,2,6,10b-tetrahydropyrido[2,1-*a*]isoindol-1-yl)(phenyl)methanone (**80**)

Yellow oil obtained by column chromatography (petroleum ether/ethyl acetate = 5:1 to 1:1); 75.4 mg, 57% yield; dr > 20:1; reaction time = 10 h; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34 (s, 1H), 7.84 (d, J = 8.0 Hz, 2H), 7.72 (d, J = 8.0 Hz, 2H), 7.61 (d, J = 8.0 Hz, 2H), 7.52 (t, J = 8.0 Hz, 1H), 7.42 (t, J = 8.0 Hz, 2H), 7.22 (d, J = 8.0 Hz, 1H), 7.17 (t, J = 8.0 Hz, 1H), 7.03 (t, J = 8.0 Hz, 1H), 6.92 (d, J = 8.0 Hz, 1H), 4.81 (d, J = 8.0 Hz, 1H), 4.51-4.47 (m, 2H), 4.42-4.37 (m, 1H), 4.26 (q, J

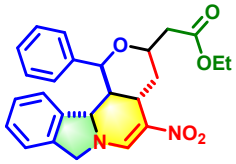
= 12.0 Hz, 2H), 3.96-3.89 (m, 1H), 3.85 (d, J = 4.0 Hz, 1H), 3.75-3.69 (m, 1H), 3.57 (dd, J_1 = 4.0 Hz, J_2 = 12.0 Hz, 1H), 3.37 (t, J = 8.0 Hz, 2H), 3.29 (s, 3H), 2.92-2.76 (m, 2H), 2.36-2.33 (m, 1H), 1.64-1.55 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.5, 159.4, 146.3, 142.1, 138.7, 137.8 (d, J = 31.0 Hz, 1C), 132.7, 131.0 (d, J = 32.0 Hz, 1C), 128.5, 128.1, 127.2 (d, J = 7.0 Hz, 1C), 126.7, 125.5, 125.4, 125.4, 125.4, 123.1, 122.5, 119.8, 72.1, 72.1, 67.7, 58.5, 57.7, 54.4, 53.7, 49.4, 29.6, 29.3, 26.6, 25.2, 23.1; ^{19}F NMR (375 MHz, $CDCl_3$) δ -62.7. IR (KBr) ν 3420, 2926, 2857, 1622, 1403, 706 cm^{-1}. HRMS (ESI) calcd for $C_{36}H_{38}F_3N_4O_5$ $[M+H]^+$: 663.2789, found: 663.2792.

11.4 Reductive cyclization of 38



38 **81**, 55%, dr = 3:1

General procedure for the formation of 81：A solution of **38** (43.3 mg, 0.10 mmol) in 1.5 mL of MeOH was cooled to 0 °C, and then $NaBH_4$ (11.5 mg, 0.30 mmol) was added successively. The reaction mixture was stirred at room temperature until the complete consumption of **38** as monitored by thin layer chromatography. Then, saturated aq. NH_4Cl solution was added. The mixture was extracted with CH_2Cl_2. The combined organic phase was dried over $MgSO_4$, filtered, concentrated and purified with silica gel column chromatography to obtain **81** in55% yield with 3:1 dr.

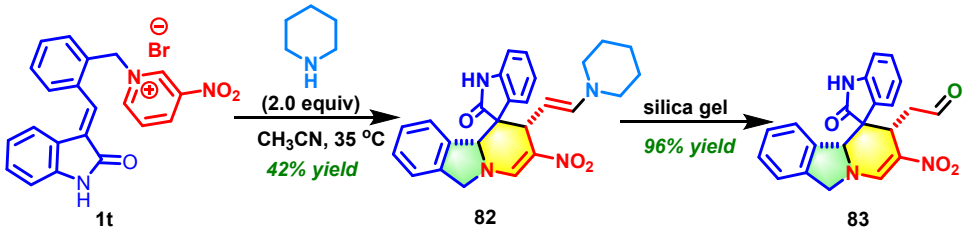


ethyl 2-(5-nitro-1-phenyl-3,4,4a,8,12b,12c-hexahydro-1*H*-pyrano[3',4':3,4]pyrido[2,1-*a*]isoindol-3-yl)acetate (**81**)

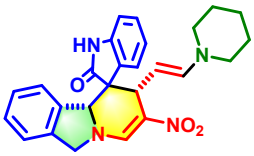
White solid obtained by column chromatography (petroleum ether/ethyl acetate = 10:1 to 4:1); 23.9 mg, 55% yield; dr = 3:1; reaction time = 4 h; mp 70.3-71.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, J = 8.0 Hz, 2H), 7.65-7.41 (m, 3H), 7.27-7.10 (m, 2H), 6.89 (q, J = 8.0 Hz, 1H), 6.76-6.65 (m, 1H), 6.56 (d, J = 8.0 Hz, 1H), 5.38 (d, J = 16.0 Hz, 1H), 4.89-4.82 (m, 1H), 4.28-4.06 (m, 4H), 3.94 (d, J = 12.0 Hz, 1H), 3.76-3.64 (m, 2H), 3.39 (t, J = 8.0 Hz, 1H), 3.10-3.02 (m, 1H), 2.54-2.10 (m, 2H), 1.26-1.21 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.6, 165.3, 141.3, 140.1, 138.8,

138.0, 134.0, 128.9, 128.7, 127.5, 126.6, 126.0, 122.7, 122.4, 83.8, 68.4, 60.2, 55.7, 52.9, 48.4, 42.2, 31.6, 14.1. IR (KBr) ν 3416, 2922, 2381, 1715, 754 cm^{-1}. HRMS (ESI) calcd for $C_{25}H_{27}N_2O_5$ $[M+H]^+$: 435.1914, found: 435.1913.

12. Experimental data for the preparation of 82 and 83

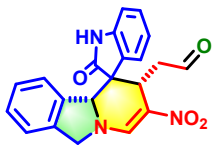


General procedure: To a mixture of pyridinium salt **1t** (0.1 mmol) in CH_3CN (1 mL) was added piperidine (0.20 mmol, 2.0 equiv). The reaction mixture was stirred at 35 °C until complete consumption of pyridinium salts (monitored by TLC). During the reaction progress, **82** was precipitated out from the homogeneous reaction system. To purify it, a filtration was employed, affording **82** in 42% yield (18.6 mg). The thus obtained **82** was dissolved in 1.0 mL of dichloromethane and then was subjected to silica gel chromatography. Finally, **83** was delivered in 96% yield.



3'-nitro-2'-((*E*)-2-(piperidin-1-yl)vinyl)-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2-one (**82**)

Yellow solid obtained by filtration of the precipitate; 18.6 mg, 42% yield; dr > 20:1; reaction time = 3 h; mp 169.8-170.2 °C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 10.85 (s, 1H), 8.84 (s, 1H), 7.24 (d, *J* = 8.0 Hz, 1H), 7.19-7.11 (m, 2H), 6.99 (t, *J* = 8.0 Hz, 2H), 6.92 (d, *J* = 8.0 Hz, 1H), 6.73 (t, *J* = 8.0 Hz, 1H), 6.69 (d, *J* = 4.0 Hz, 1H), 5.75 (d, *J* = 12.0 Hz, 1H), 5.04 (d, *J* = 16.0 Hz, 3H), 3.71 (d, *J* = 8.0 Hz, 1H), 3.18 (t, *J* = 8.0 Hz, 1H), 2.46-2.44 (m, 2H), 2.36-2.33 (m, 2H), 1.31-1.26 (m, 6H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 177.3, 143.9, 142.6, 141.1, 136.1, 134.9, 128.3, 128.1, 127.6, 127.0, 123.9, 123.9, 122.8, 121.4, 121.4, 109.1, 94.6, 66.6, 55.5, 55.4, 49.1, 43.5, 40.0, 24.0. IR (KBr) ν 3415, 2926, 2377, 1700, 1655, 1238, 754 cm^{-1}. HRMS (ESI) calcd for $C_{26}H_{27}N_4O_3$ $[M+H]^+$: 443.2078, found: 443.2076.



2-(3'-nitro-2-oxo-6',10b'-dihydro-2'*H*-spiro[indoline-3,1'-pyrido[2,1-*a*]isoindol]-2'-yl)acetaldehyde (**83**)

Yellow solid obtained by column chromatography (petroleum ether/ethyl acetate = 1:1); 15.1 mg, 96% yield; dr > 20:1; reaction time = 3 h; mp 287.5-288.7 ℃; ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.12 (s, 1H), 9.50 (d, J = 4.0 Hz, 1H), 8.99 (s, 1H), 7.25 (d, J = 8.0 Hz, 1H), 7.21-7.13 (m, 2H), 7.07 (t, J = 8.0 Hz, 1H), 7.01 (d, J = 4.0 Hz, 1H), 6.96 (d, J = 8.0 Hz, 1H), 6.78 (t, J = 8.0 Hz, 2H), 5.19 (s, 1H), 5.05 (s, 2H), 3.92 (d, J = 8.0 Hz, 1H), 2.06-1.98 (m, 1H), 1.74 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H); ^{13}C NMR (100 MHz, DMSO-d_6) δ 198.4, 176.5, 146.0, 142.3, 136.0, 134.1, 128.9, 128.6, 127.8, 125.8, 124.3, 122.9, 122.6, 122.1, 121.4, 109.9, 67.3, 55.8, 53.2, 40.9, 35.6. IR (KBr) ν 3427, 2942, 1713, 1615, 1233, 752 cm^{-1}. HRMS (ESI) calcd for $C_{21}H_{18}N_3O_4$ $[M+H]^+$: 376.1292, found: 376.1296.

13. Crystal structures

13.1 Crystal structure of 3

Preparation of the single crystals of **3**: 15.0 mg of pure compound **3** was dissolved in the combined solvents of dichloromethane and methanol (4 mL, v/v = 1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 0 ºC. After about five days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **3**. The data were collected by a Bruker D8 VENTURE PHOTON II CCD diffractometer at 273.0 K.

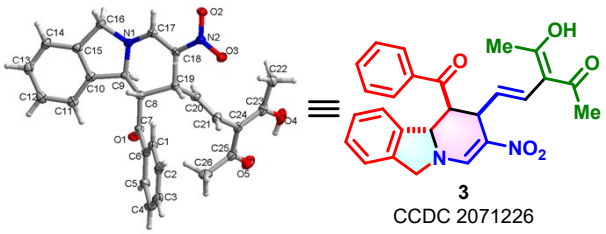


Table S4. Crystal data and structure refinement for **3**.

Bond precision: C-C = 0.0040 A Wavelength = 0.71073

Cell: a = 15.5191(7) b = 9.0804(5) c = 30.9354(13)

alpha = 90 beta = 90 gamma = 90

Temperature: 150 K

	Calculated	Reported
Volume	4359.4(4)	4359.4(4)
Space group	P b c n	P b c n
Hall group	-P 2n 2ab	-P 2n 2ab
Moiety formula	$C_{26}H_{24}N_2O_5$	$C_{26}H_{24}N_2O_5$
Sum formula	$C_{26}H_{24}N_2O_5$	$C_{26}H_{24}N_2O_5$
Mr	444.47	444.47
Dx,g cm^{-3}	1.354	1.354
Z	8	8
Mu (mm-1)	0.095	0.095
F000	1872.0	1872.0
F000'	1872.92	
h,k,lmax	19,11,38	19,11,38
Nref	4467	4463
Tmin,Tmax	0.984,0.992	0.647,0.746
Tmin'	0.980	

Correction method = # Reported T Limits: Tmin = 0.647 Tmax = 0.746

AbsCorr = MULTI-SCAN

Data completeness = 0.999 Theta(max) = 26.370

R(reflections) = 0.0556(2370) wR2(reflections) = 0.1364(4463)

S = 1.037 Npar = 301

13.2 Crystal structure of 21

Preparation of the single crystals of **21**: 20.0 mg of pure compound **21** was dissolved in the combined solvents of chloroform, petroleum ether and ethyl acetate (4 mL, v/v/v = 1:1:2) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 2-8 ^{o}C. After about three days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal

X-ray diffraction analysis for the determination of the structure and relative configuration of **21**.

The data were collected by a Rigaku Gemini E at 293.0 K.

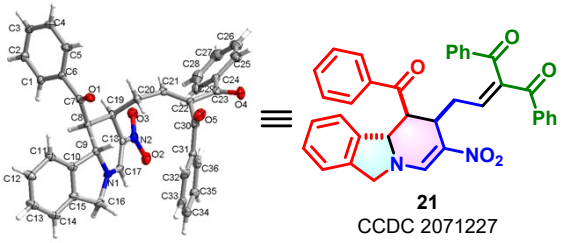


Table S5. Crystal data and structure refinement for **21**.

Bond precision: C-C = 0.0097 A Wavelength = 0.71073

Cell: a = 17.46(3) b = 13.75(2) c = 23.42(6)

alpha = 90 beta = 90 gamma = 90

Temperature: 150 K

	Calculated	Reported
Volume	5623(19)	5624(19)
Space group	P n a 21	P n a 21
Hall group	P 2c -2n	P 2c -2n
Moiety formula	$C_{36}H_{28}N_2O_5$	$C_{36}H_{28}N_2O_5$
Sum formula	$C_{36}H_{28}N_2O_5$	$C_{36}H_{28}N_2O_5$
Mr	568.60	568.60
Dx,g cm^{-3}	1.343	1.343
Z	8	8
Mu (mm-1)	0.090	0.090
F000	2384.0	2384.0
F000'	2385.12	
h,k,lmax	21,17,29	21,17,29
Nref	11488[5890]	10995
Tmin,Tmax	0.989,0.996	0.621,0.746
Tmin'	0.988	

Correction method = # Reported T Limits: Tmin = 0.621 Tmax = 0.746

AbsCorr = MULTI-SCAN

Data completeness = 1.87/0.96 Theta(max) = 26.365

R(reflections) = 0.0619(6628) wR2(reflections) = 0.1575(10995)

S = 1.021 Npar = 776

13.3 Crystal structure of 25

Preparation of the single crystals of **25**: 10.0 mg of pure compound **25** was dissolved in the combined solvents of dichloromethane and ethanol (4 mL, v/v = 1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 0 °C. After about six days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **25**. The data were collected by a Bruker D8 VENTURE PHOTON II CCD diffractometer at 273.0 K.

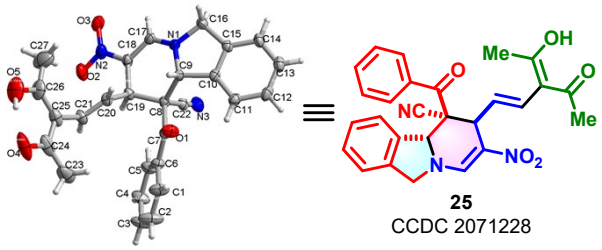


Table S6. Crystal data and structure refinement for **25**.

Bond precision: C-C = 0.0046 A Wavelength=0.71073

Cell: a = 8.719(3) b = 11.529(5) c = 12.887(5)

alpha = 86.887(13) beta = 72.756(13) gamma = 74.684(12)

Temperature: 298 K

	Calculated	Reported
Volume	1192.9(8)	1192.8(8)
Space group	P -1	P -1
Hall group	-P 1	-P 1
Moiety formula	$C_{27}H_{23}N_3O_5$	$C_{27}H_{23}N_3O_5$
Sum formula	$C_{27}H_{23}N_3O_5$	$C_{27}H_{23}N_3O_5$
Mr	469.48	469.48
Dx,g cm^{-3}	1.307	1.307
Z	2	2

Mu (mm-1)	0.092	0.092
F000	492.0	492.0
F000'	492.24	
h,k,lmax	10,14,16	10,14,16
Nref	4941	4927
Tmin,Tmax	0.985,0.989	0.595,0.746
Tmin'	0.977	

Correction method= # Reported T Limits: Tmin = 0.595 Tmax = 0.746

AbsCorr = MULTI-SCAN

Data completeness = 0.997 Theta(max) = 26.498

R(reflections) = 0.0685(2473) wR2(reflections) = 0.1937(4927)

S = 1.019 Npar = 320

13.4 Crystal structure of 26

Preparation of the single crystals of **26**: 10.0 mg of pure compound **26** was dissolved in the combined solvents of dichloromethane and ethanol (4 mL, v/v = 1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 0 °C. After about five days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **26**. The data were collected by a Rigaku Gemini E at 293.0 K.

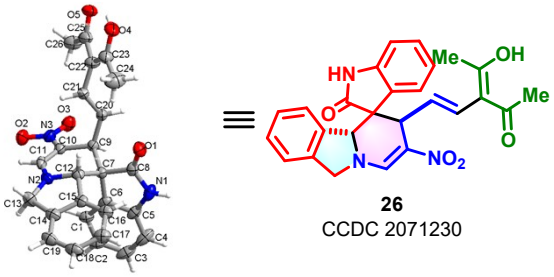


Table S7. Crystal data and structure refinement for **26**.

Bond precision: C-C = 0.0061 A Wavelength = 1.54184

Cell: a = 9.6642(4) b = 18.5733(7) c = 13.4479(6)

alpha = 90 beta = 110.324(4) gamma = 90

Temperature: 293 K

	Calculated	Reported
Volume	2263.57(17)	2263.57(17)
Space group	P 21/n	P 1 21/n 1
Hall group	-P 2yn	-P 2yn
Moiety formula	$C_{26}H_{23}N_3O_5$	$C_{26}H_{23}N_3O_5$
Sum formula	$C_{26}H_{23}N_3O_5$	$C_{26}H_{23}N_3O_5$
Mr	457.47	457.47
Dx,g cm^{-3}	1.342	1.342
Z	4	4
Mu (mm-1)	0.776	0.776
F000	960.0	960.0
F000'	963.08	
h,k,lmax	11,22,16	11,22,16
Nref	4039	4038
Tmin,Tmax	0.937,0.969	0.854,1.000
Tmin'	0.890	

Correction method= # Reported T Limits: Tmin = 0.854 Tmax = 1.000

AbsCorr = MULTI-SCAN

Data completeness = 1.000 Theta(max) = 67.073

R(reflections) = 0.0685(2516) wR2(reflections) = 0.2181(4038)

S = 1.030 Npar= 321

13.4 Crystal structure of 47

Preparation of the single crystals of **47**: 10.0 mg of pure compound **47** was dissolved in the combined solvents of dichloromethane and methanol (6 mL, v/v = 5:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at room temperature. After about one day, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **47**. The data were collected on a **SuperNova, Dual, Cu at zero, AtlasS2** diffractometer. The crystal was kept at 150.00(10) K during data collection.

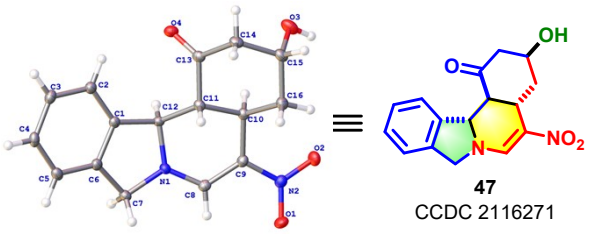


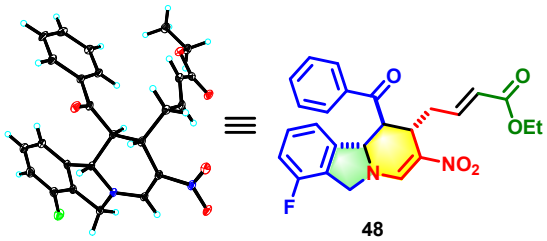
Table S8. Crystal data and structure refinement for **47.**

Identification code	**47**
Empirical formula	$C_{16}H_{16}N_2O_4$
Formula weight	300.31
Temperature/K	150.00(10)
Crystal system	monoclinic
Space group	$P2_1/n$
a/Å	11.6890(9)
b/Å	5.8460(4)
c/Å	19.4233(15)
α/°	90
β/°	92.761(7)
γ/°	90
Volume/Å^3	1325.74(18)
Z	4
ρ_{calc}g/cm^3	1.505
μ/mm^{-1}	0.908
F(000)	632.0
Crystal size/mm^3	0.14 × 0.12 × 0.11
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	8.65 to 147.044
Index ranges	-9 ≤ h ≤ 14, -3 ≤ k ≤ 6, -23 ≤ l ≤ 22
Reflections collected	4331
Independent reflections	2563 [R_{int} = 0.0386, R_{sigma} = 0.0538]

Data/restraints/parameters	2563/0/199
Goodness-of-fit on F^2	1.070
Final R indexes [I>=2σ (I)]	R_1 = 0.0576, wR_2 = 0.1507
Final R indexes [all data]	R_1 = 0.0722, wR_2 = 0.1660
Largest diff. peak/hole / e $Å^{-3}$	0.30/-0.45

13.5 Crystal structure of 48

Preparation of the single crystals of **48**: 10.0 mg of pure compound **48** was dissolved in the combined solvents of chloroform, petroleum ether and ethyl acetate (5 mL, v/v/v = 3:1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 2-8 °C. After about four days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **48**. The data were collected by a Bruker D8 QUEST PHOTON II diffractometer at 273.0 K.



48
CCDC 2086413

Table S9. Crystal data and structure refinement for **48**.

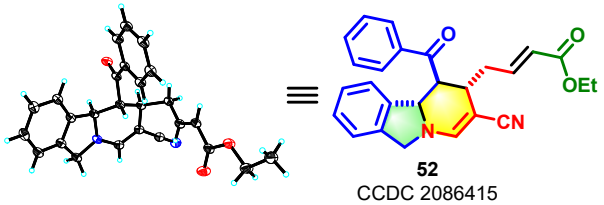
Identification code	global	
Empirical formula	$C_{25}H_{23}FN_2O_5$	
Formula weight	450.45	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P 1 21/c 1	
Unit cell dimensions	a = 5.98830(10) Å	□□= 90°.
	b = 22.0176(5) Å	□□=

95.3100(10)°.

	c = 16.5031(4) Å □ = 90°.
Volume	2166.56(8) $Å^3$
Z	4
Density (calculated)	1.381 Mg/m^3
Absorption coefficient	0.854 mm^{-1}
F(000)	944
Crystal size	0.470 x 0.090 x 0.080 mm^3
Theta range for data collection	3.36 to 72.43°.
Index ranges	-7<=h<=7, -24<=k<=27, -20<=l<=20
Reflections collected	24084
Independent reflections	4294 [R(int) = 0.0784]
Completeness to theta = 72.43°	99.9 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.94 and 0.64
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	4294 / 0 / 300
Goodness-of-fit on F^2	1.053
Final R indices [I>2sigma(I)]	R1 = 0.0492, wR2 = 0.1297
R indices (all data)	R1 = 0.0553, wR2 = 0.1362
Extinction coefficient	0.0028(4)
Largest diff. peak and hole	0.399 and -0.300 $e.Å^{-3}$

13.7 Crystal structure of 52

Preparation of the single crystals of **52**: 40.0 mg of pure compound **52** was dissolved in the combined solvents of chloroform, petroleum ether and ethyl acetate (5 mL, v/v/v = 3:1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 2-8 °C. After about five days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **52**. The data were collected by a Bruker D8 QUEST PHOTON II diffractometer at 273.0 K.



52
CCDC 2086415

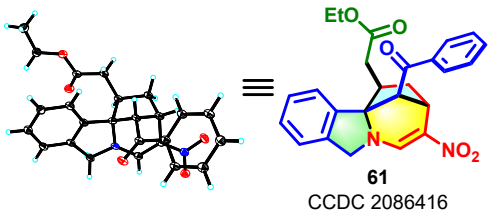
Table S10. Crystal data and structure refinement for **52**.

Identification code	global	
Empirical formula	$C_{26}H_{24}N_2O_3$	
Formula weight	412.47	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P 1 21/n 1	
Unit cell dimensions	a = 11.8952(8) Å	□□= 90°.
	b = 8.6715(6) Å	□□= 94.064(2)°.
	c = 21.1913(13) Å	□ = 90°.
Volume	2180.4(2) $Å^3$	
Z	4	
Density (calculated)	1.257 Mg/m^3	
Absorption coefficient	0.662 mm^{-1}	
F(000)	872	
Crystal size	0.600 x 0.430 x 0.100 mm^3	
Theta range for data collection	4.14 to 72.52°.	
Index ranges	-14<=h<=14, -10<=k<=8, -26<=l<=26	
Reflections collected	21965	
Independent reflections	4310 [R(int) = 0.0828]	
Completeness to theta = 72.52°	99.6 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.94 and 0.43	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	4310 / 0 / 281	

Goodness-of-fit on F^2	1.072
Final R indices [I>2sigma(I)]	R1 = 0.0738, wR2 = 0.2043
R indices (all data)	R1 = 0.0817, wR2 = 0.2161
Largest diff. peak and hole	0.415 and -0.384 e.Å^{-3}

13.8 Crystal structure of 61

Preparation of the single crystals of **61**: 15.0 mg of pure compound **61** was dissolved in the combined solvents of chloroform and petroleum ether (4 mL, v/v = 3:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 2-8 ºC. After about five days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **61**. The data were collected by a Bruker D8 QUEST PHOTON II diffractometer at 273.0 K.



61
CCDC 2086416

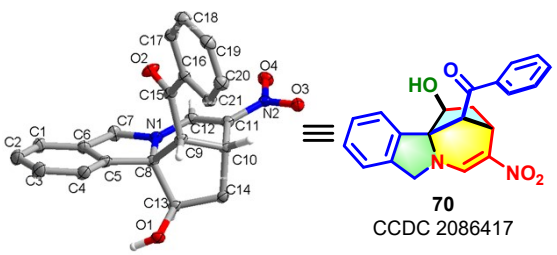
Table S11. Crystal data and structure refinement for **61**.

Identification code	global	
Empirical formula	$C_{25}H_{24}N_2O_5$	
Formula weight	432.46	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Orthorhombic	
Space group	Pbcn	
Unit cell dimensions	a = 25.4779(15) Å	□□= 90°.
	b = 11.8085(6) Å	□□= 90°.
	c = 13.8705(7) Å	□ = 90°.
Volume	4173.0(4) Å^3	
Z	8	
Density (calculated)	1.377 Mg/m^3	

Absorption coefficient	0.792 mm^{-1}
F(000)	1824
Crystal size	0.350 x 0.330 x 0.010 mm^3
Theta range for data collection	3.47 to 72.73°.
Index ranges	-31<=h<=31, -14<=k<=14, -17<=l<=17
Reflections collected	45327
Independent reflections	4147 [R(int) = 0.1556]
Completeness to theta = 72.73°	99.8 %
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.99 and 0.57
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	4147 / 0 / 291
Goodness-of-fit on F^2	1.053
Final R indices [I>2sigma(I)]	R1 = 0.0766, wR2 = 0.2010
R indices (all data)	R1 = 0.0928, wR2 = 0.2225
Extinction coefficient	0.0008(3)
Largest diff. peak and hole	0.430 and -0.462 $e.Å^{-3}$

13.9 Crystal structure of 70

Preparation of the single crystals of **70**: 8.0 mg of pure compound **70** was dissolved in the combined solvents of dichloromethane and methanol (4 mL, v/v = 1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at room temperature. After about four days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **70**. The data were collected by a Bruker D8 VENTURE PHOTON II CCD diffractometer at 273.0 K.



70
CCDC 2086417

Table S13. Crystal data and structure refinement for **70**.

Bond precision: C-C = 0.0027 A Wavelength = 1.54178

Cell: a = 7.5481(2) b = 11.4787(3) c = 12.3488(4)

alpha = 64.2362(13) beta = 78.0893(13) gamma = 87.4663(15)

Temperature: 150 K

	Calculated	Reported
Volume	941.57(5)	941.57(5)
Space group	P -1	P -1
Hall group	-P 1	-P 1
Moiety formula	$C_{21}H_{18}N_2O_4$, CH_4O	$C_{21}H_{18}N_2O_4$, CH_4O
Sum formula	$C_{22}H_{22}N_2O_5$	$C_{22}H_{22}N_2O_5$
Mr	394.42	394.41
Dx,g cm-3	1.391	1.391
Z	2	2
Mu (mm-1)	0.820	0.820
F000	416.0	416.0
F000'	417.35	
h,k,lmax	9,13,14	9,13,14
Nref	3448	3432
Tmin,Tmax	0.846,0.921	0.549,0.753
Tmin'	0.769	

Correction method= # Reported T Limits: Tmin=0.549 Tmax=0.753 AbsCorr =

MULTI-SCAN

Data completeness = 0.995 Theta(max) = 68.437

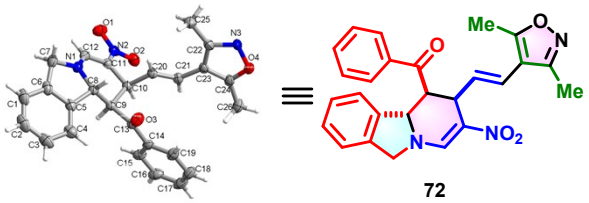
R(reflections) = 0.0543(3000) wR2(reflections) = 0.1564(3432)

S = 1.052 Npar= 278

13.10 Crystal structure of 72

Preparation of the single crystals of **72**: 10.0 mg of pure compound **72** was dissolved in the combined solvents of dichloromethane and ethanol (4 mL, v/v = 1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation

of the solvents at room temperature. After about ten days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **72**. The data were collected by a Rigaku Gemini E at 293.0 K.



72
CCDC 2071232

Table S13. Crystal data and structure refinement for **72**.

Bond precision: C-C = 0.0029 A Wavelength = 1.54184

Cell: a = 14.0994(5) b = 10.9354(3) c = 16.3508(6)

alpha = 90 beta = 115.198(4) gamma = 90

Temperature: 293 K

	Calculated	Reported
Volume	2281.11(15)	2281.11(14)
Space group	P 21/c	P 1 21/c 1
Hall group	-P 2ybc	-P 2ybc
Moiety formula	$C_{26}H_{23}N_3O_4$	$C_{26}H_{23}N_3O_4$
Sum formula	$C_{26}H_{23}N_3O_4$	$C_{26}H_{23}N_3O_4$
Mr	441.47	441.47
Dx,g cm^{-3}	1.286	1.285
Z	4	4
Mu (mm-1)	0.717	0.717
F000	928.0	928.0
F000'	930.88	
h,k,lmax	16,13,19	16,13,19
Nref	4074	4065
Tmin,Tmax	0.918,0.938	0.943,1.000
Tmin'	0.892	

Correction method= # Reported T Limits: Tmin = 0.943 Tmax =1.000

AbsCorr = MULTI-SCAN

Data completeness = 0.998 Theta(max) = 67.066

R(reflections) = 0.0445(3204) wR2(reflections) = 0.1275(4065)

S = 1.029 Npar = 317

13.11 Crystal structure of 74

Preparation of the single crystals of **74**: 15.0 mg of pure compound **74** was dissolved in the combined solvents of chloroform, petroleum ether and ethyl acetate (4 mL, v/v/v = 2:1:1) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 0 °C. After about four days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **74**. The data were collected by a Rigaku Gemini E at 293.0 K.

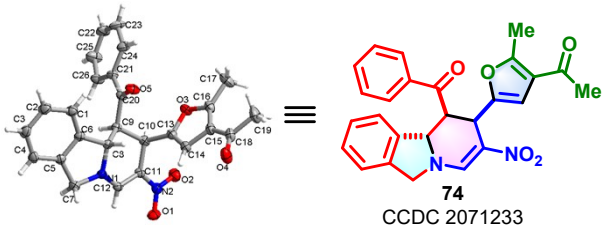


Table S14. Crystal data and structure refinement for **74**.

Bond precision: C-C = 0.0036 A Wavelength =1.54184

Cell: a = 11.5554(4) b = 11.9041(4) c = 20.6216(6)

alpha = 82.000(3) beta = 89.792(3) gamma = 61.583(4)

Temperature: 293 K

	Calculated	Reported
Volume	2464.18(17)	2464.17(16)
Space group	P -1	P -1
Hall group	-P 1	-P 1
Moiety formula	C_{26} $H_{22}N_2O_5$ [+ solvent]	1(C_{26} $H_{22}N_2O_5$)
Sum formula	C_{26} $H_{22}N_2O_5$ [+ solvent]	C_{26} $H_{22}N_2O_5$
Mr	442.46	442.45
Dx,g cm^{-3}	1.193	1.193

Z	4	4
Mu (mm-1)	0.685	0.685
F000	928.0	928.0
F000'	930.97	
h,k,lmax	13,14,24	13,14,24
Nref	8794	8791
Tmin,Tmax	0.899,0.940	0.596,1.000
Tmin'	0.896	

Correction method= # Reported T Limits: Tmin = 0.596 Tmax = 1.000

AbsCorr = MULTI-SCAN

Data completeness= 1.000 Theta(max)= 67.069

R(reflections) = 0.0505(6803) wR2(reflections) = 0.1574(8791)

S = 1.035 Npar = 606

13.12 Crystal structure of 82

Preparation of the single crystals of **82**: 10.0 mg of pure compound **82** was dissolved in the combined solvents of dichloromethane and ethyl acetate (4 mL, v/v = 1:3) at room temperature. The bottle was sealed by a piece of plastic film with several tiny holes, thus allowing slow evaporation of the solvents at 0 °C. After about six days, several small particles were observed at the bottom of the bottle. The crystals were chosen and subjected to the single crystal X-ray diffraction analysis for the determination of the structure and relative configuration of **82**. The data were collected by a Rigaku Gemini E at 293.0 K.

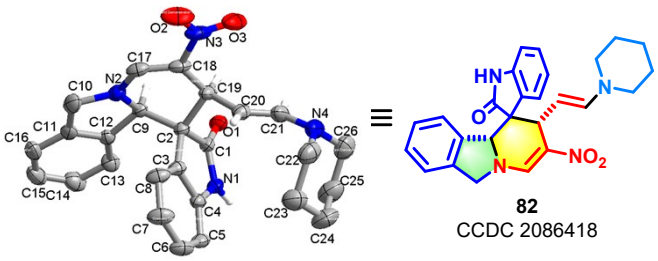


Table S15. Crystal data and structure refinement for **82**.

Bond precision: C-C = 0.0041 A Wavelength=1.54184

Cell: a =9.5216(3) b =10.7823(4) c =12.6332(5)

alpha =106.178(4) beta = 93.800(3) gamma = 114.614(3)

Temperature: 293 K

	Calculated	Reported
Volume	1107.48(8)	1107.47(8)
Space group	P -1	P -1
Hall group	-P 1	-P 1
Moiety formula	$C_{26}H_{26}N_4O_3$	$C_{26}H_{26}N_4O_3$
Sum formula	$C_{26}H_{26}N_4O_3$	$C_{26}H_{26}N_4O_3$
Mr	442.51	442.51
Dx,g cm-3	1.327	1.327
Z	2	2
Mu (mm-1)	0.715	0.715
F000	468.0	468.0
F000'	469.39	
h,k,lmax	11,12,15	11,12,15
Nref	3951	3949
Tmin,Tmax	0.918,0.938	0.870,1.000
Tmin'	0.854	

Correction method= # Reported T Limits: Tmin=0.870 Tmax=1.000 AbsCorr = MULTI-SCAN

Data completeness= 0.999 Theta(max)= 67.068

R(reflections)= 0.0570(2883) wR2(reflections)= 0.1847(3949)

S = 1.047 Npar= 326

14. References

1. L.-L. Wang, H.-B. Han, Z.-H. Cui, J.-W. Zhao, Z.-W. Bu and Q.-L. Wang, *Org. Lett.*, **2020**, *22*, 873-878.

2. B. Callebaut, J. Hullaert, K. V. Hecke and J. M. Winne, *Org. Lett.*, **2019**, *21*, 310-314.

3. W. Kohn and L. J. Sham *Phys. Rev.*, **1965**, *140*, A1133-A1138.

4. W. Kohn *Rev. Mod. Phys.* **1999**, *71*, 1253−1266.

5. M. J. Frisch, G. W. Trucks, H. B. Schlegel, G. E. Scuseria, M. A. Robb, J. R. Cheeseman, G. Scalmani, V. Barone, B. Mennucci, G. A. Petersson, H. Nakatsuji, M. Caricato, X. Li, H. P. Hratchian, A. F. Izmaylov, J. Bloino, G. Zheng, J. L. Sonnenberg, M. Hada, M. Ehara, K. Toyota, R. Fukuda, J. Hasegawa, M. Ishida, T. Nakajima, Y. Honda, O. Kitao, H. Nakai, T. Vreven, J. A. Montgomery, J. E. Peralta, Jr., F. Ogliaro, M. Bearpark, J. J. Heyd, E. Brothers, K. N. Kudin, V. N. Staroverov, T. Keith, R. Kobayashi, J. Normand, K. Raghavachari, A. Rendell, J. C. Burant, S. S. Iyengar, J. Tomasi, M. Cossi, N. Rega, J. M. Millam, M. Klene, J. E. Knox, J. B. Cross, V. Bakken, C. Adamo, J. Jaramillo, R. Gomperts, R. E. Stratmann, O. Yazyev, A. J. Austin, R. Cammi, C. Pomelli, J. W. Ochterski, R. L. Martin, K. Morokuma, V. G. Zakrzewski, G. A. Voth, P. Salvador, J. J. Dannenberg, S. Dapprich, A. D. Daniels, O. Farkas, J. B. Foresman, J. V. Ortiz, J. Cioslowski and D. J. Fox. *Gaussian 09, Revision C. 01; Gaussian, Inc., Wallingford CT*, 2010.

6. W. Zhang, D.-G. Truhlar and M. Tang *J. Chem. Theory. Comput.* **2014**, *10*, 2399-2409.

7. Y. Zhao and D. G. Truhlar *Theor. Chem. Acc.* **2008**, *120*, 215-241.

8. W. Sang-Aroon and V. Ruangpornvisuti *Int. J. Quantum Chem.* **2007**, *108*, 1181-1188.

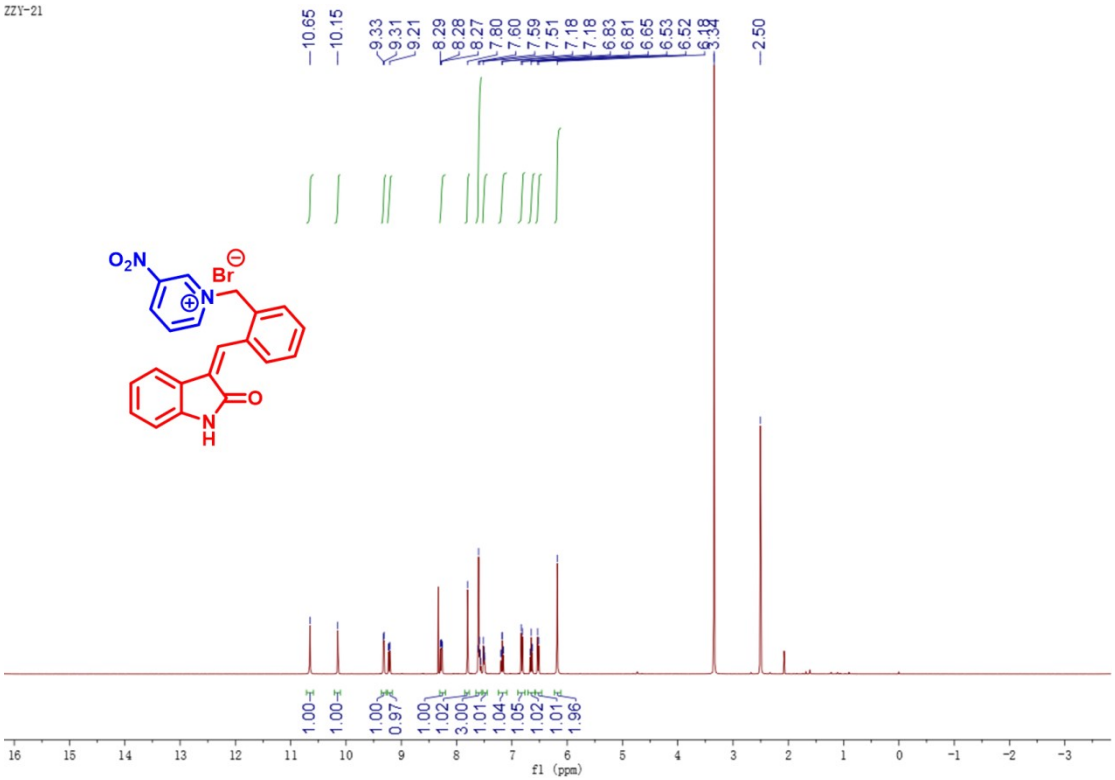
9. B. Mennucci and J. Tomasi *J. Chem. Phys.* **1996**, *106*, 5151-5158.

10. R. Krishnan, J. S. Binkley and R. Seeger, J. A. Pople *J. Chem. Phys.* **1980**, *72*, 650-654.

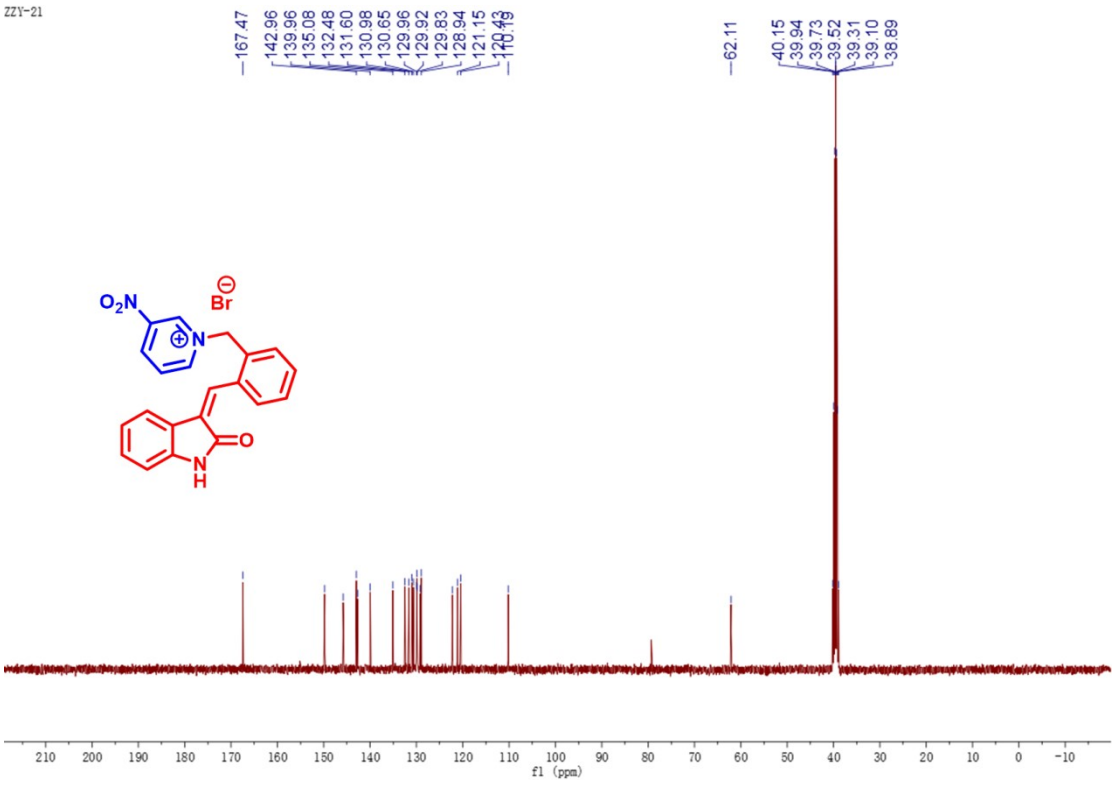
11. A. V. Marenich, C. J. Cramer and D. G. Truhlar *J. Phys.Chem. B* **2009**, *113*, 6378-6396.

15. NMR spectra

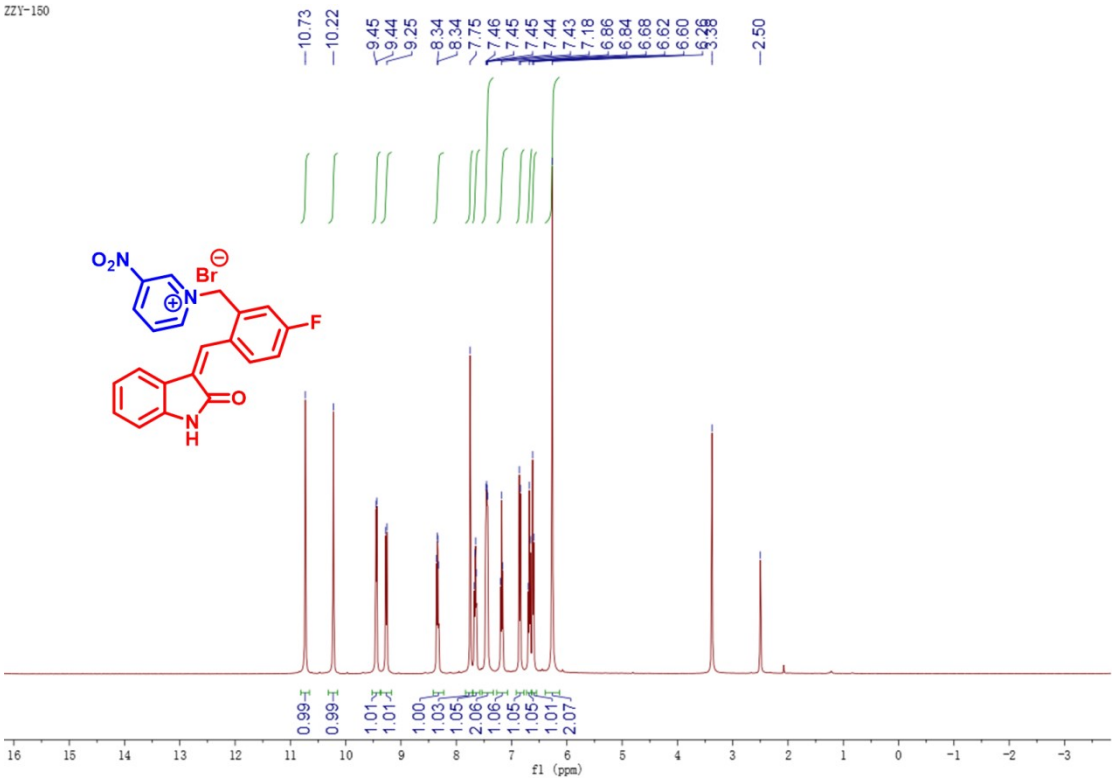
^{1}H NMR spectrum of **1t** (400 MHz, DMSO-d_6)



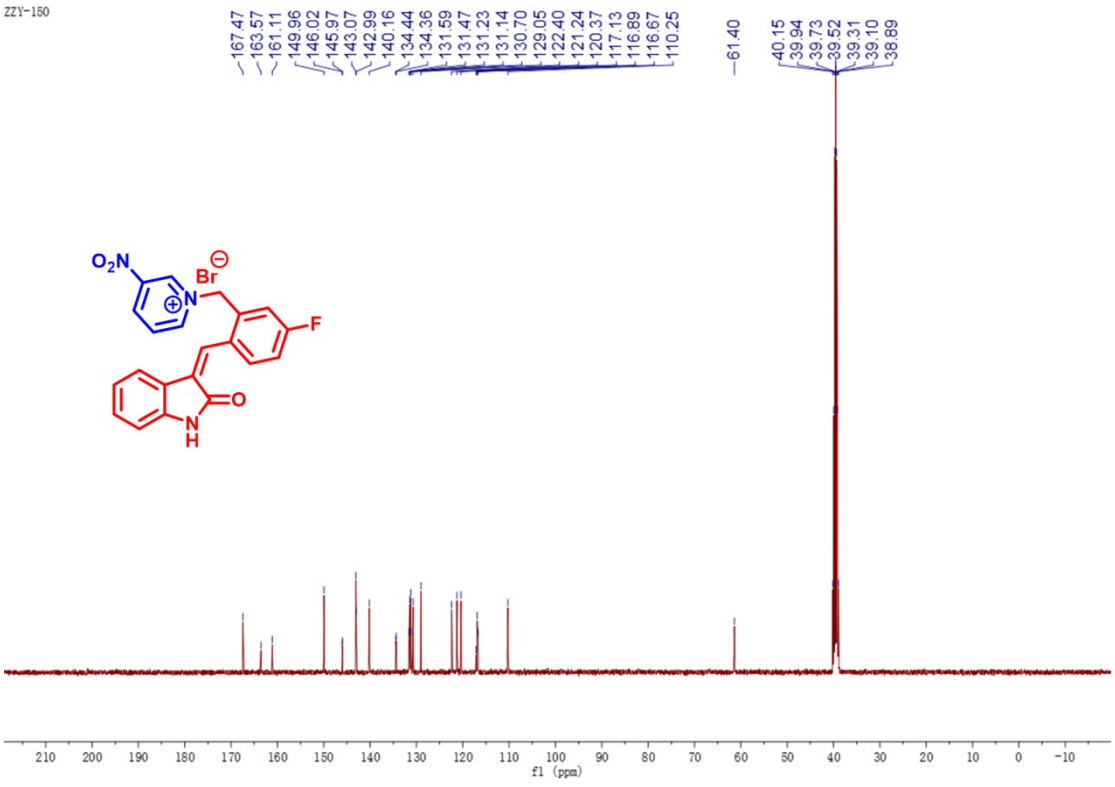
^{13}C NMR spectrum of **1t** (100 MHz, DMSO-d_6)



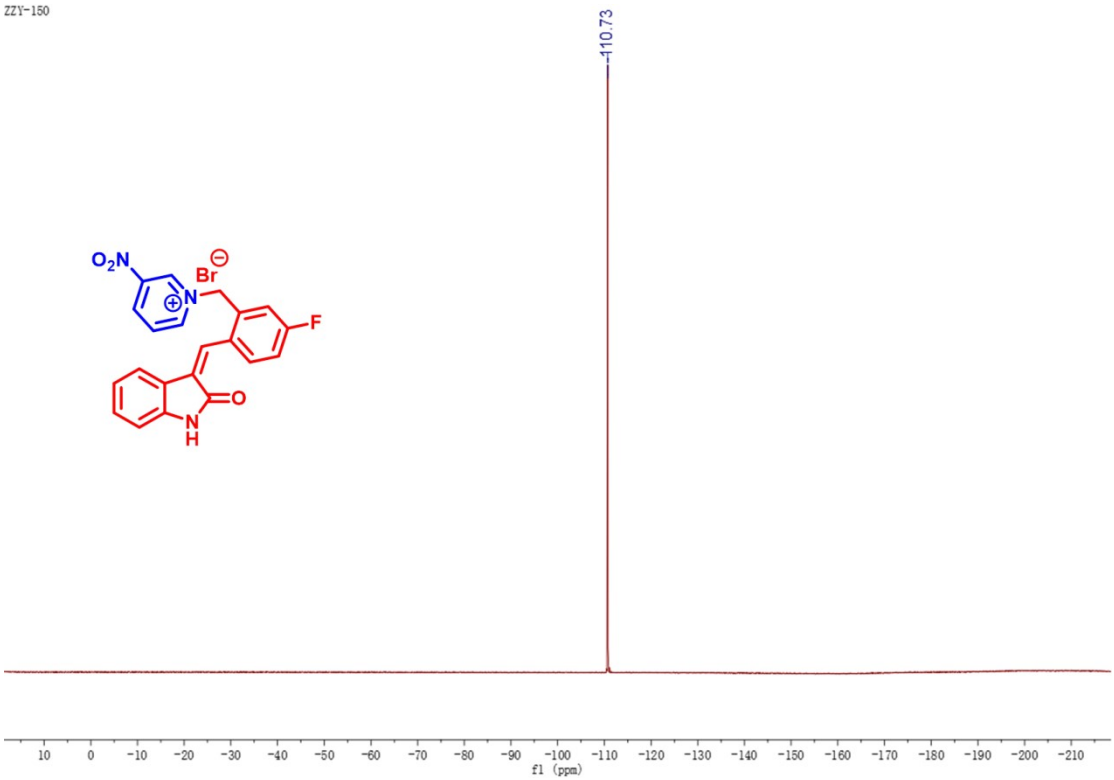
^{1}H NMR spectrum of **1u** (400 MHz, DMSO-d_6)



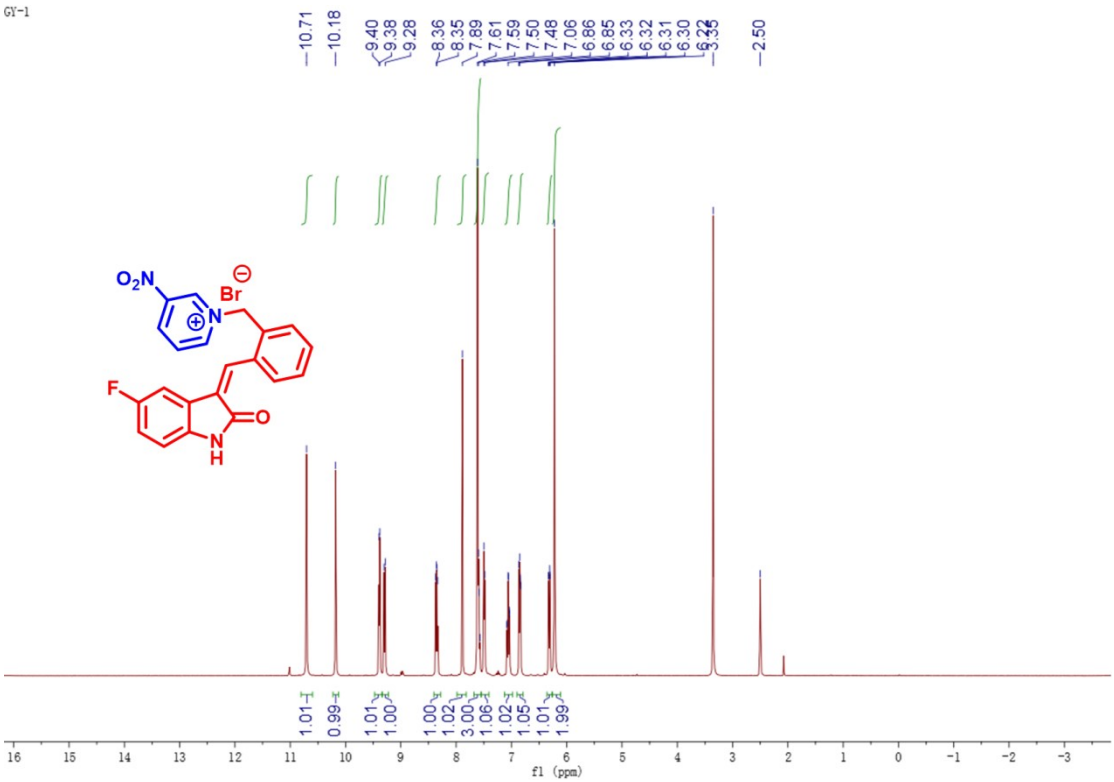
^{13}C NMR spectrum of **1u** (100 MHz, DMSO-d_6)



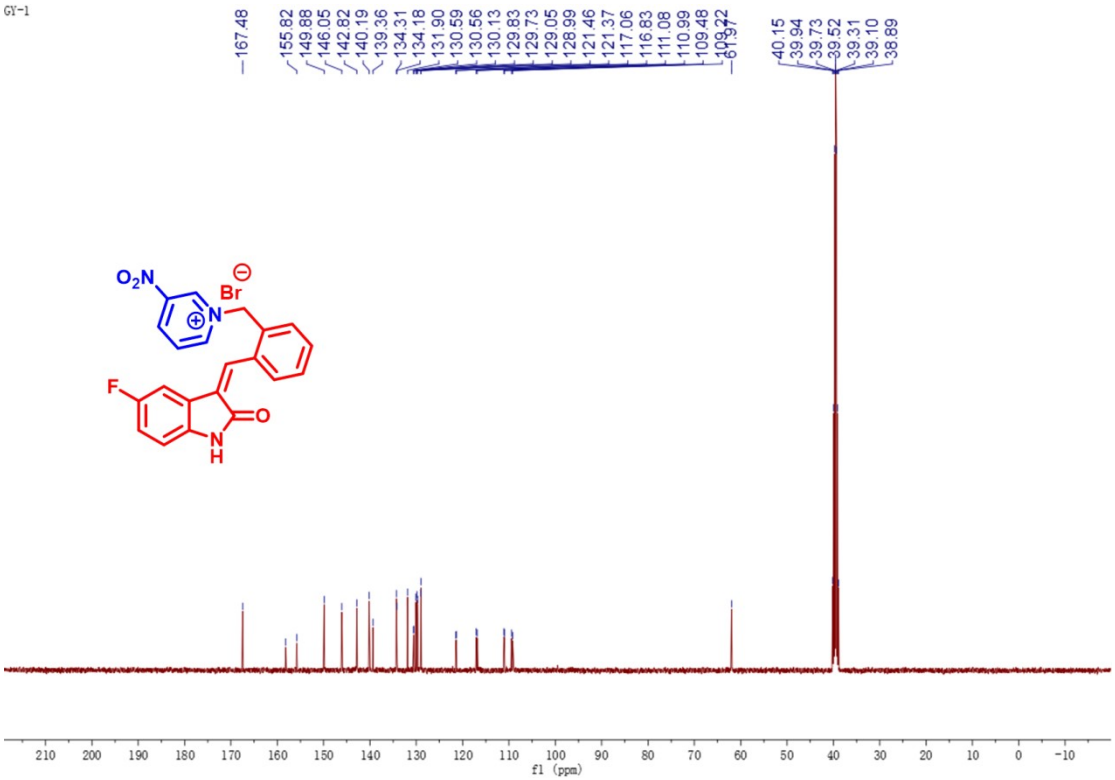
^{19}F NMR spectrum of **1u** (375 MHz, DMSO-d_6)



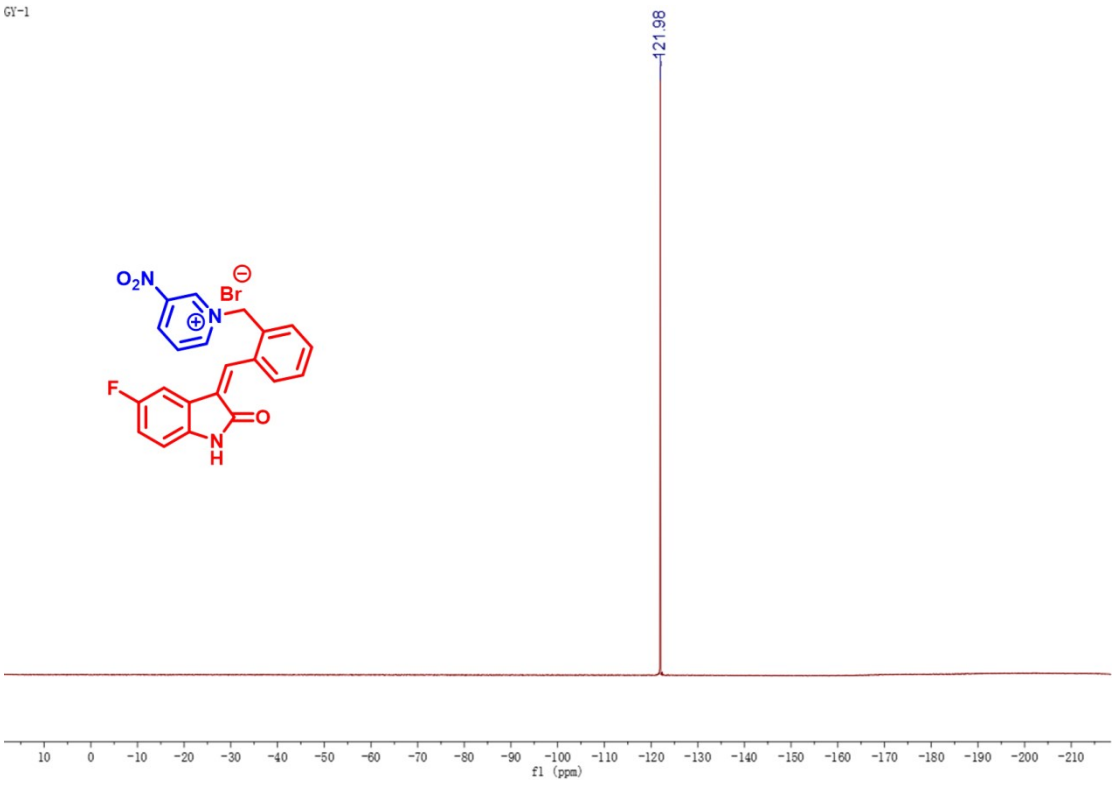
^{1}H NMR spectrum of **1v** (400 MHz, DMSO-d_6)



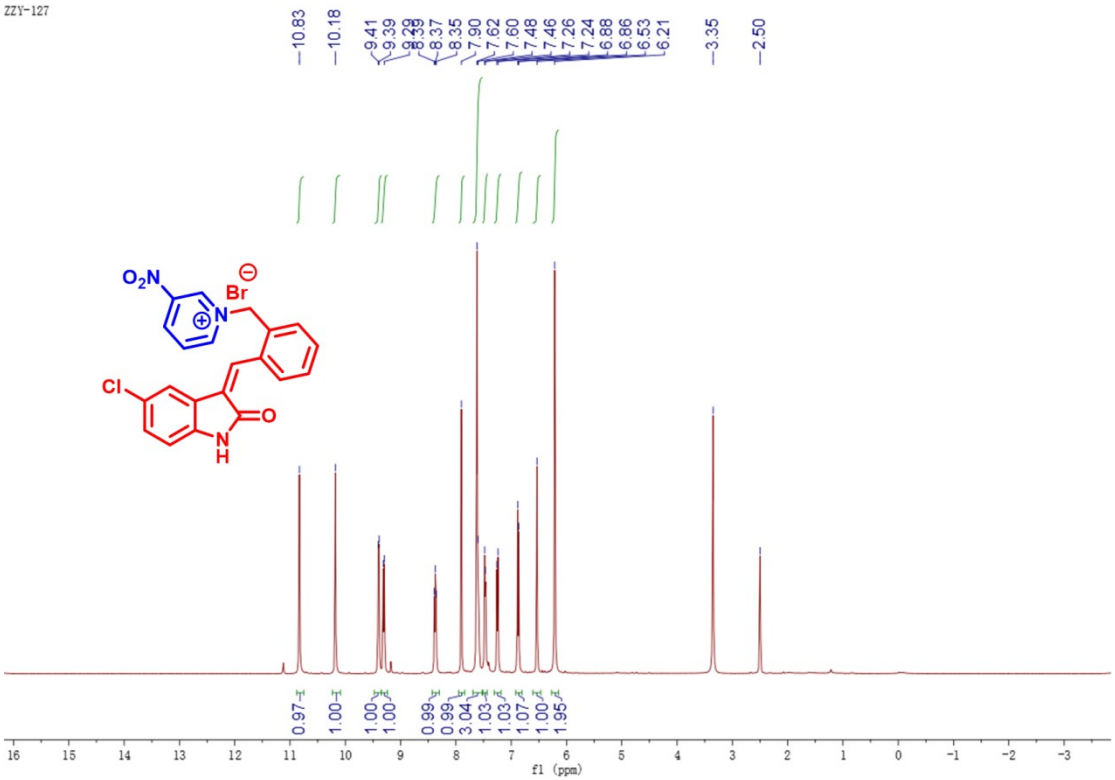
^{13}C NMR spectrum of **1v** (100 MHz, DMSO-d_6)



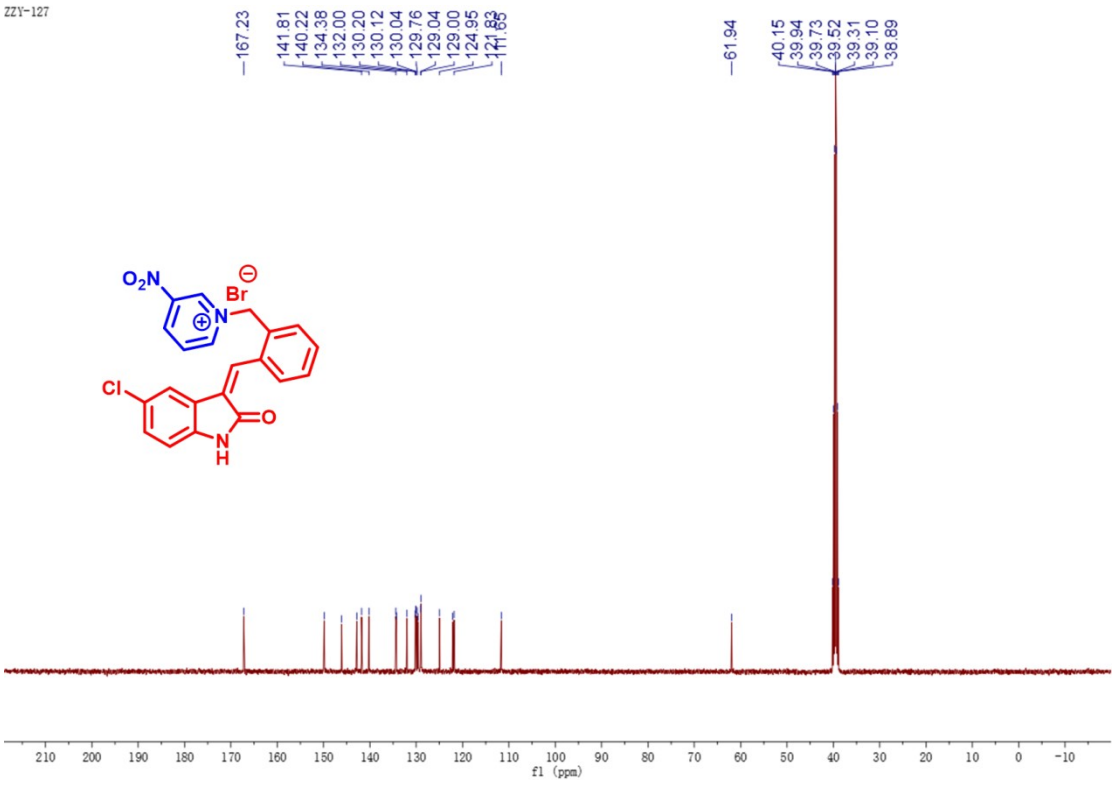
^{19}F NMR spectrum of **1v** (375 MHz, DMSO-d_6)



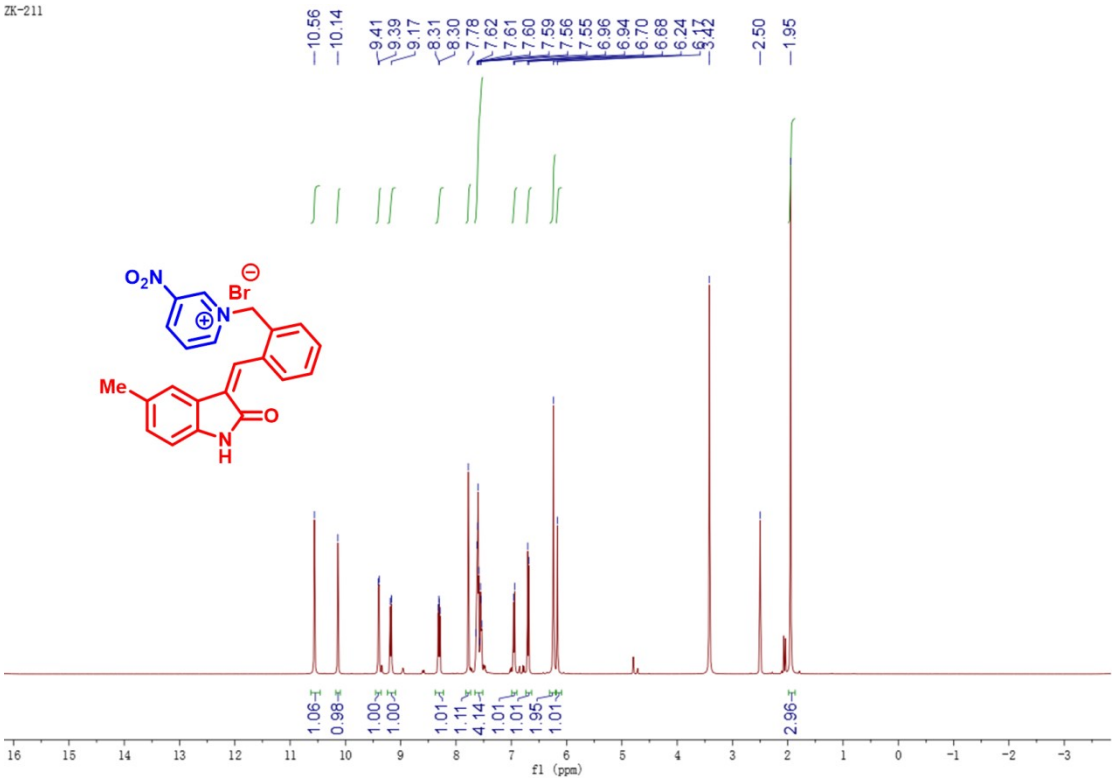
^{1}H NMR spectrum of **1w** (400 MHz, DMSO-d_6)



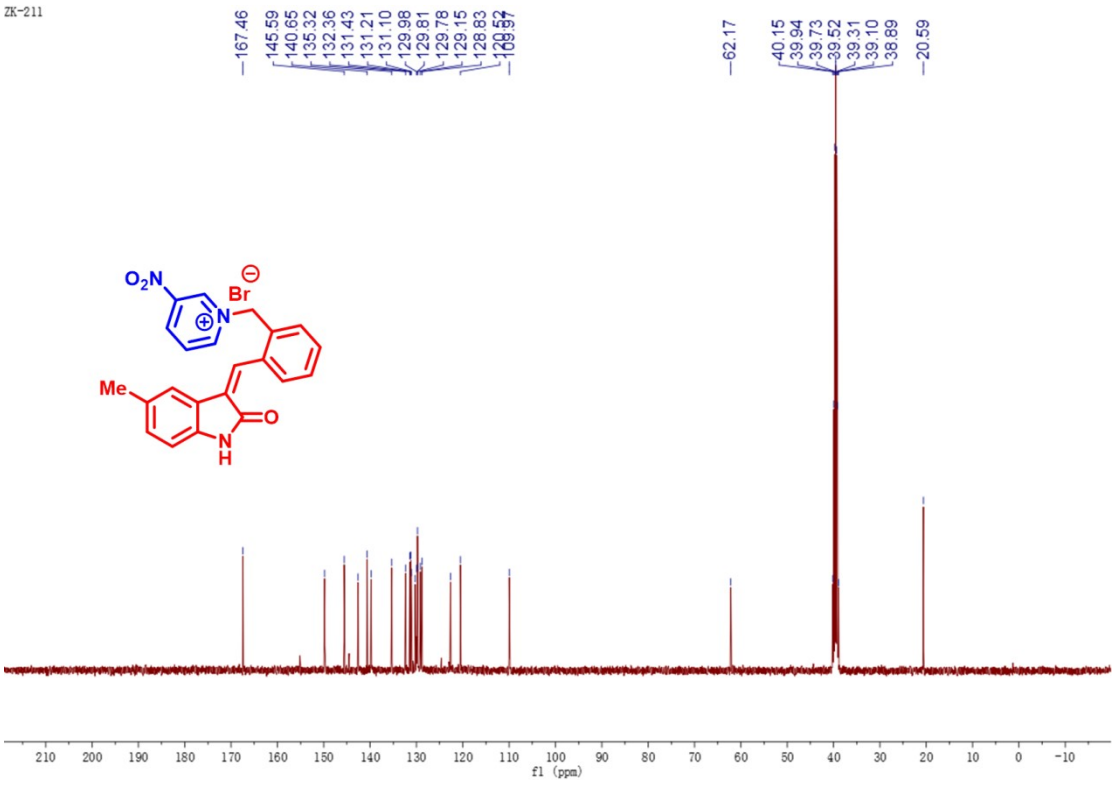
^{13}C NMR spectrum of **1w** (100 MHz, DMSO-d_6)



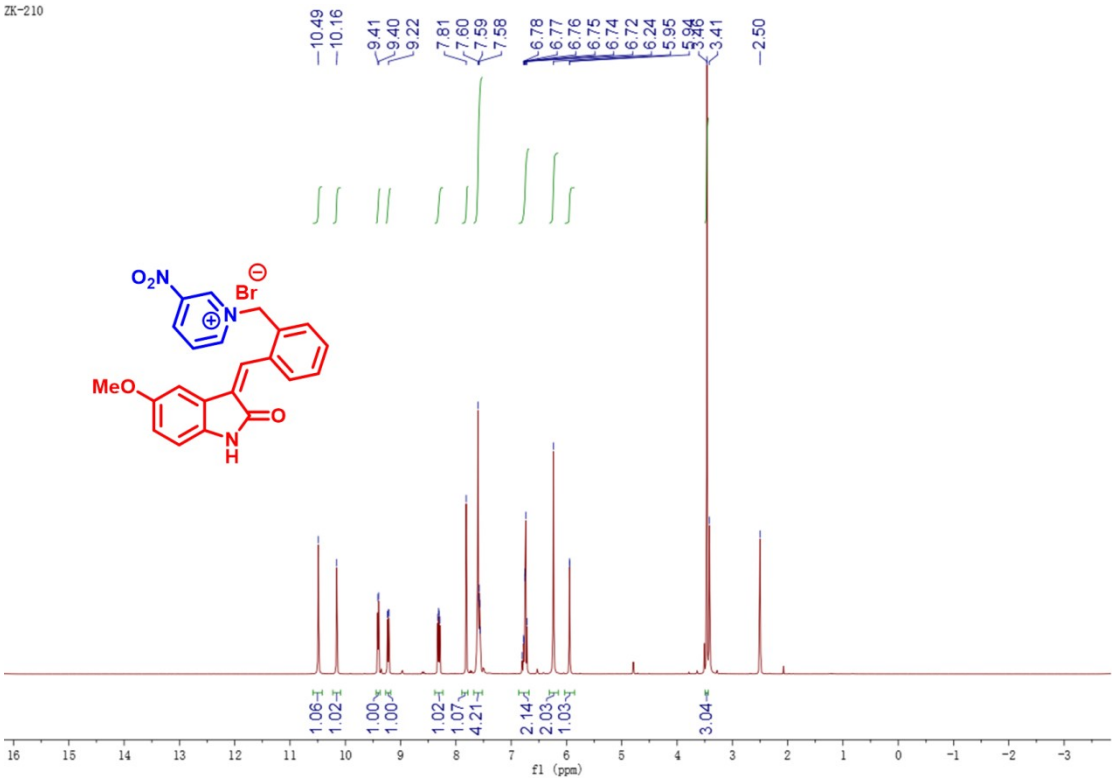
^{1}H NMR spectrum of **1x** (400 MHz, DMSO-d_6)



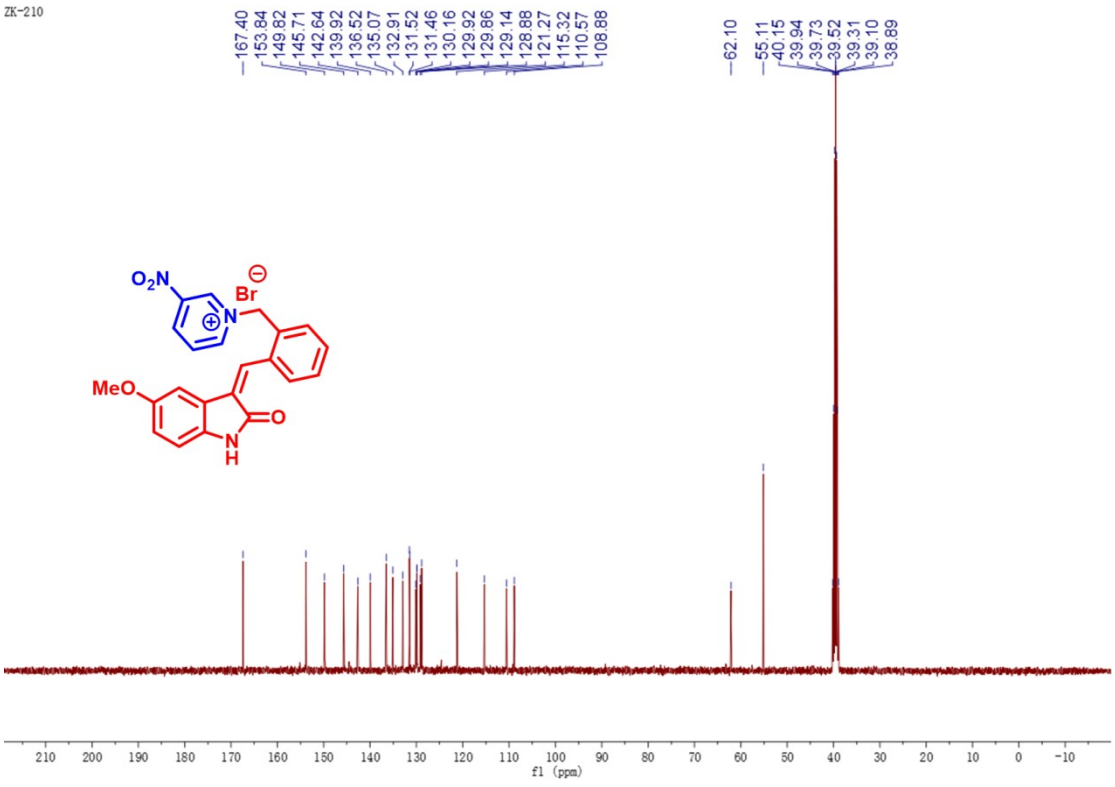
^{13}C NMR spectrum of **1x** (100 MHz, DMSO-d_6)



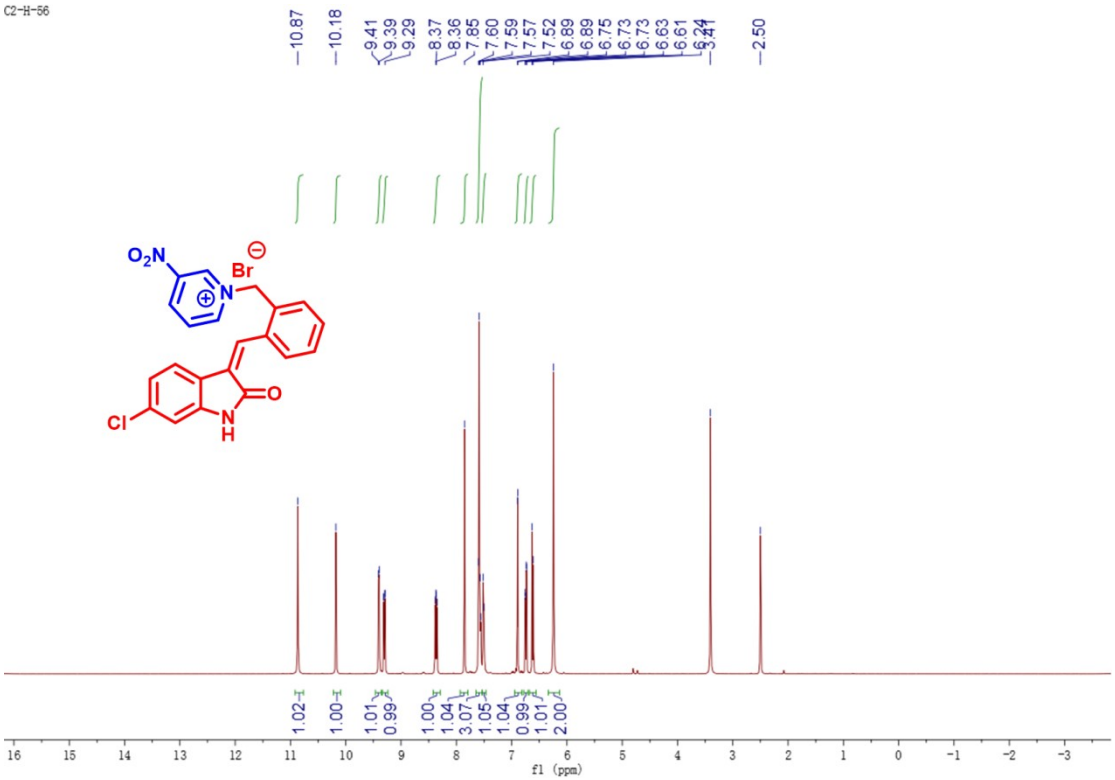
^{1}H NMR spectrum of **1y** (400 MHz, DMSO-d_6)



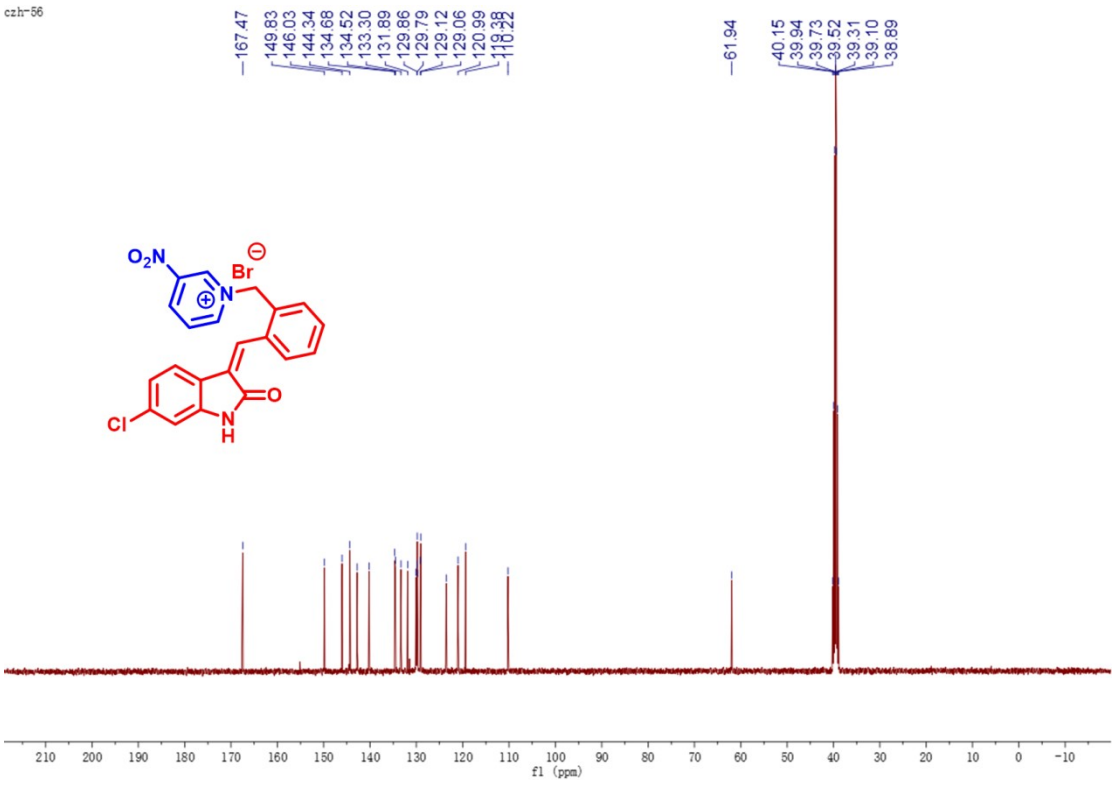
^{13}C NMR spectrum of **1y** (100 MHz, DMSO-d_6)



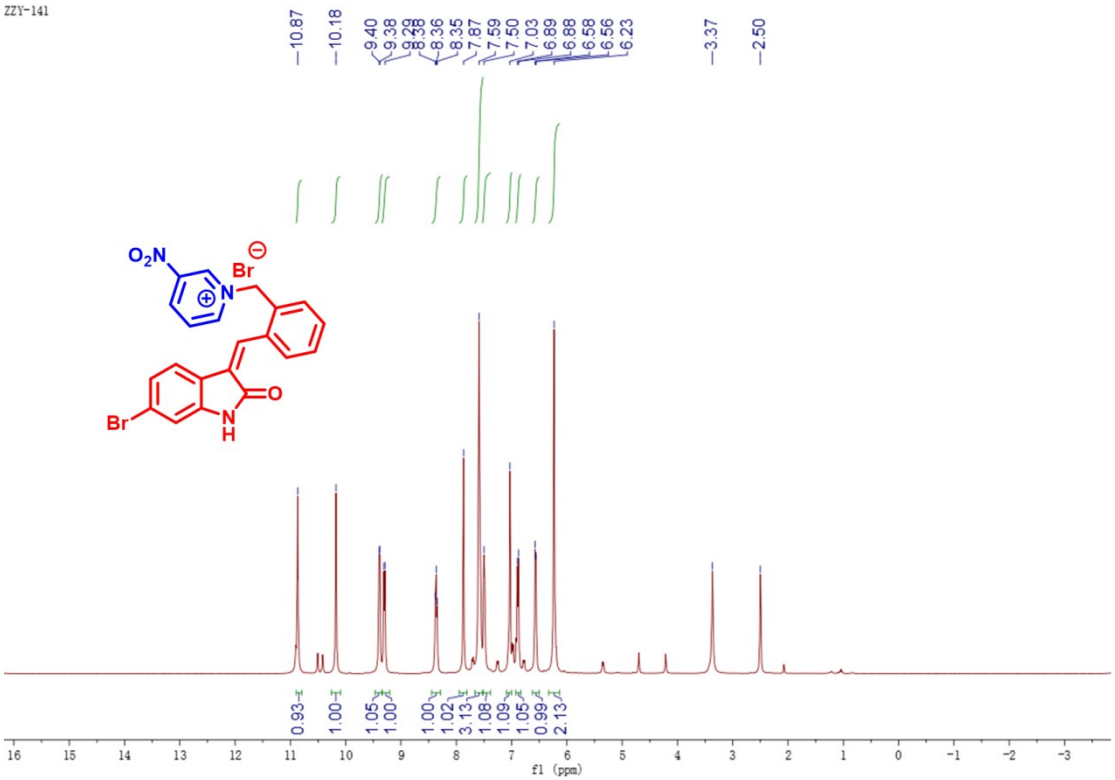
^{1}H NMR spectrum of **1z** (400 MHz, DMSO-d_6)



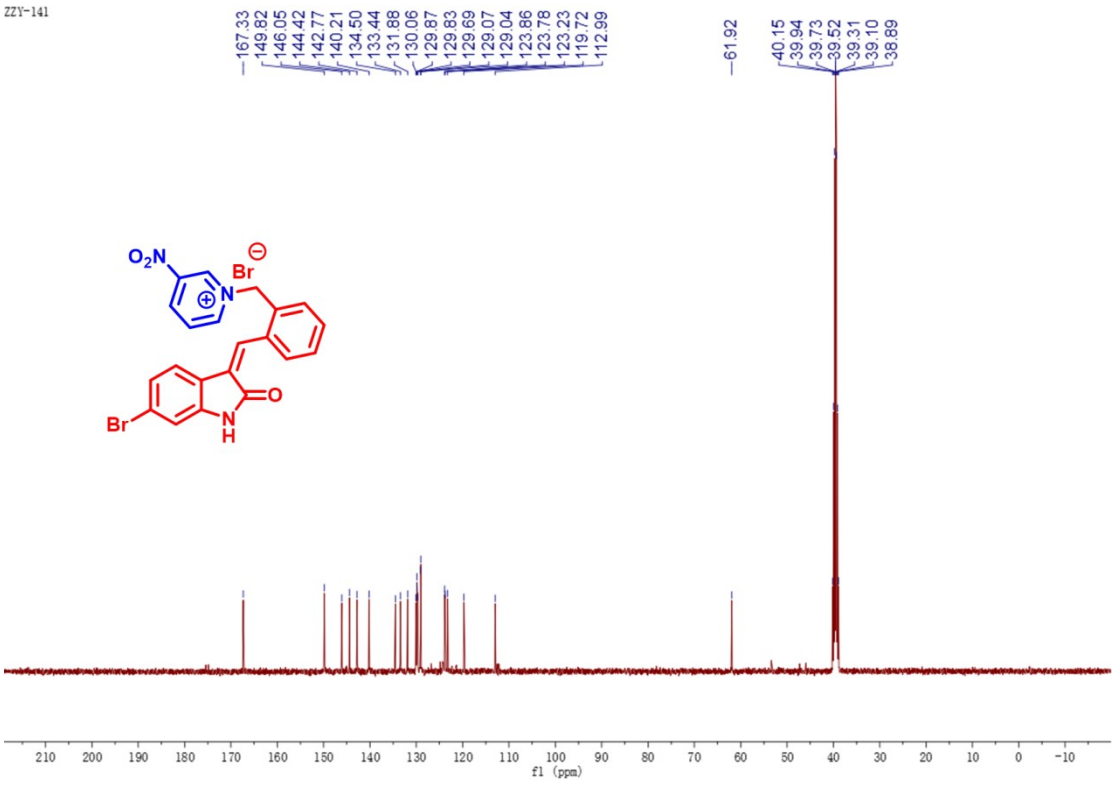
^{13}C NMR spectrum of **1z** (100 MHz, DMSO-d_6)



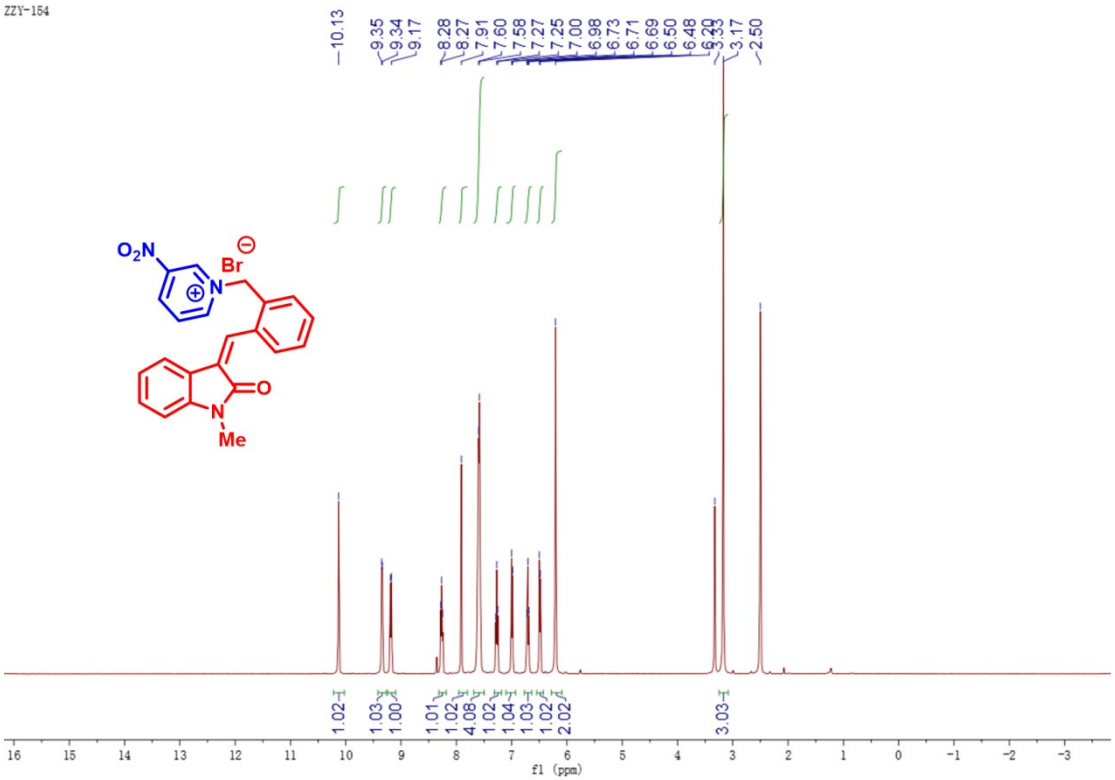
^{1}H NMR spectrum of **1aa** (400 MHz, DMSO-d_6)



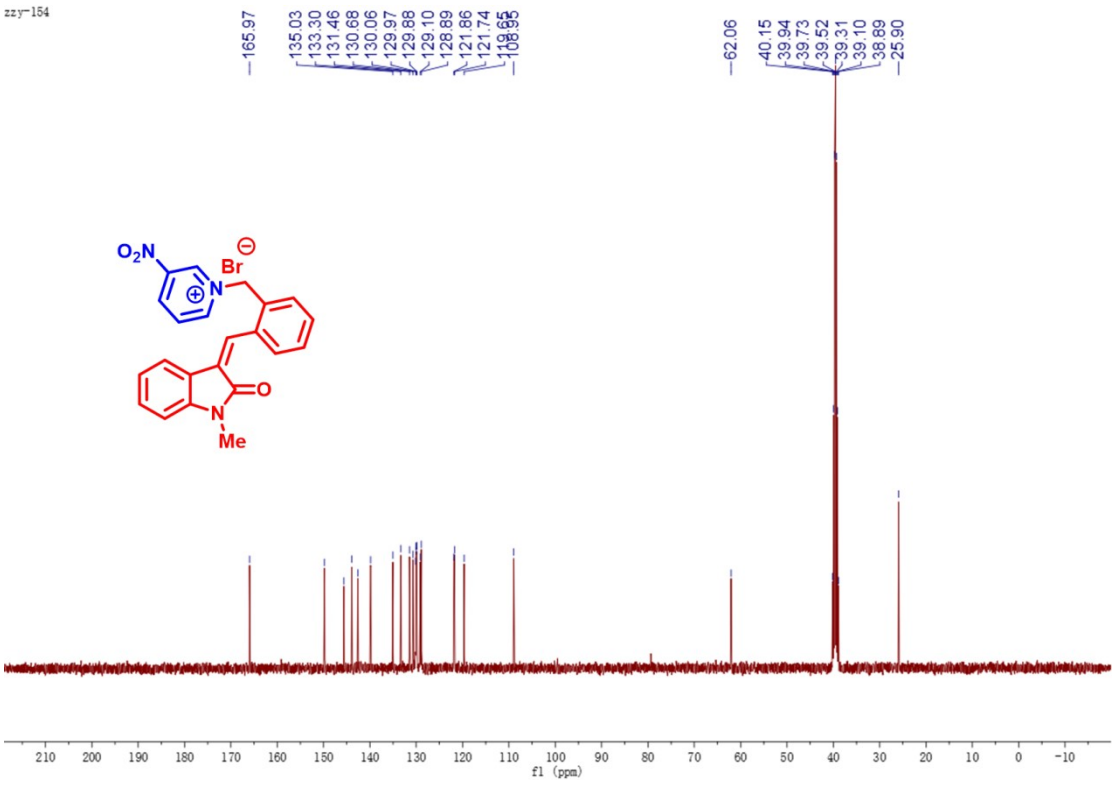
^{13}C NMR spectrum of **1aa** (100 MHz, DMSO-d_6)



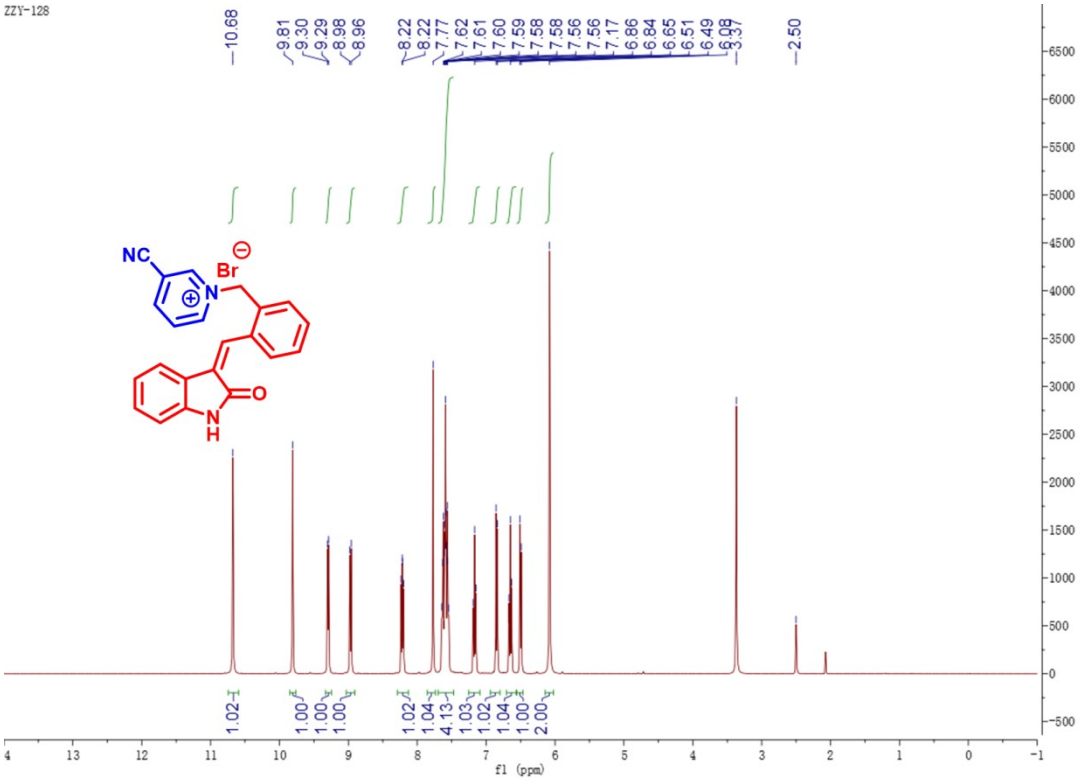
^{1}H NMR spectrum of **1ab** (400 MHz, DMSO-d_6)



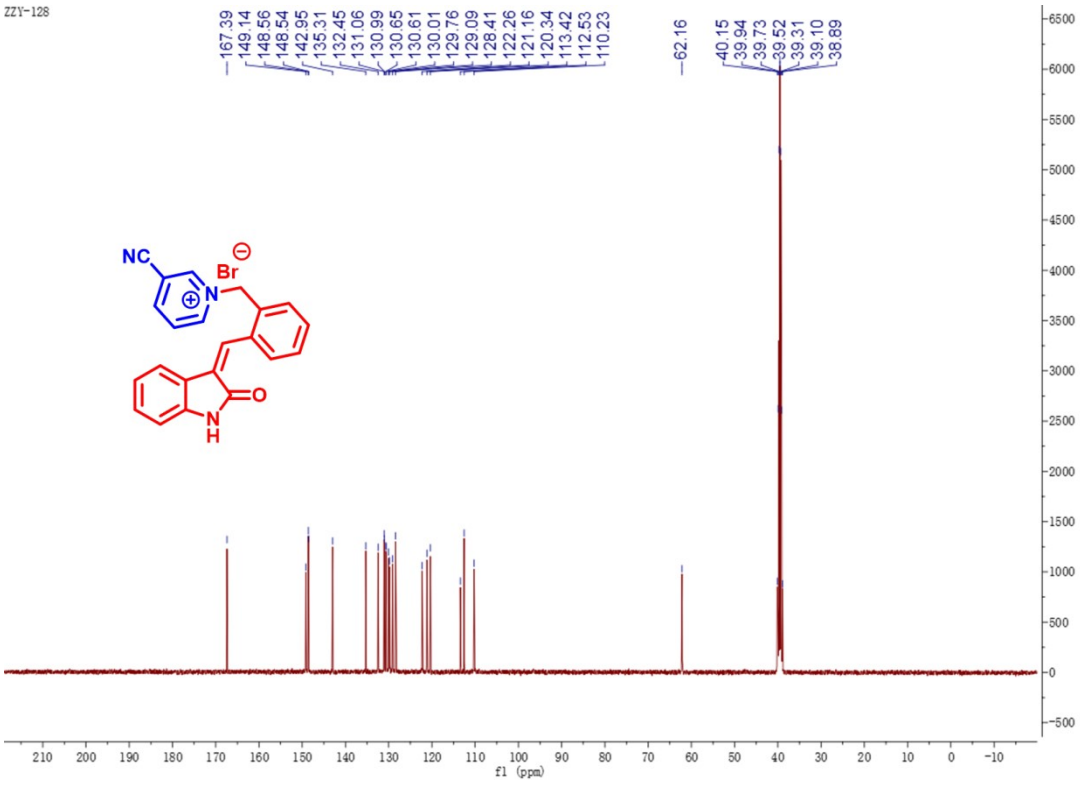
^{13}C NMR spectrum of **1ab** (100 MHz, DMSO-d_6)



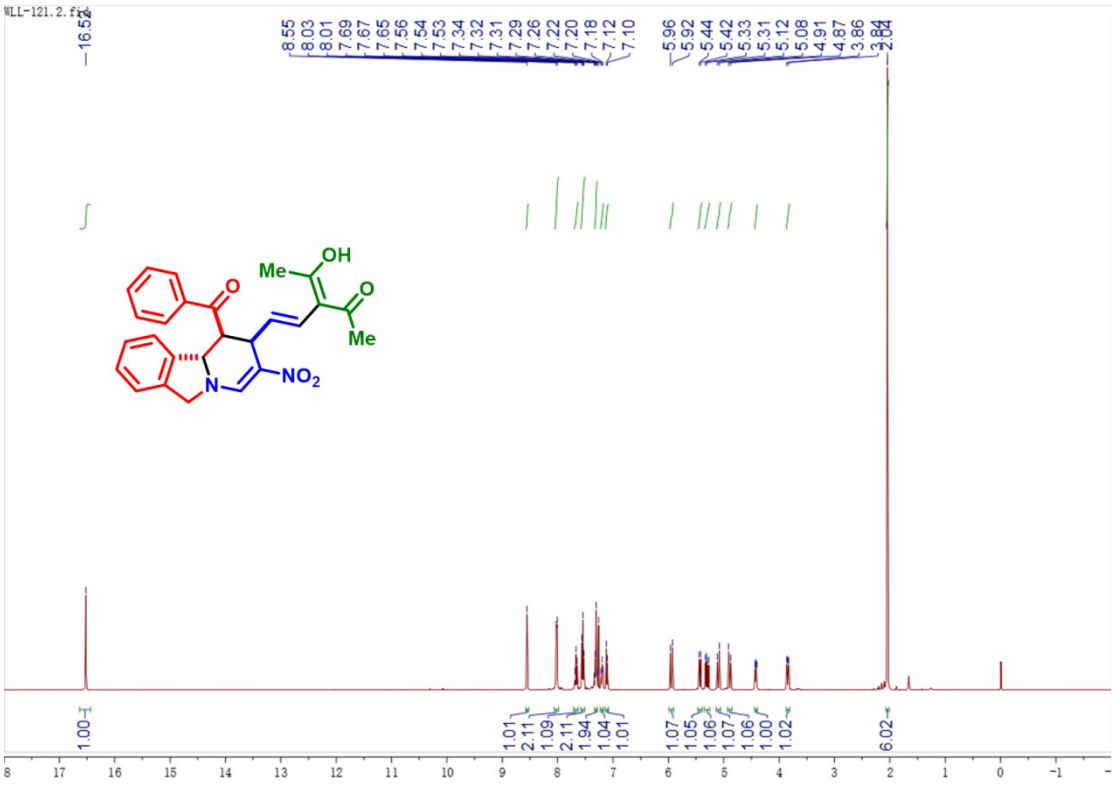
^{1}H NMR spectrum of **1ac** (400 MHz, DMSO-d_6)



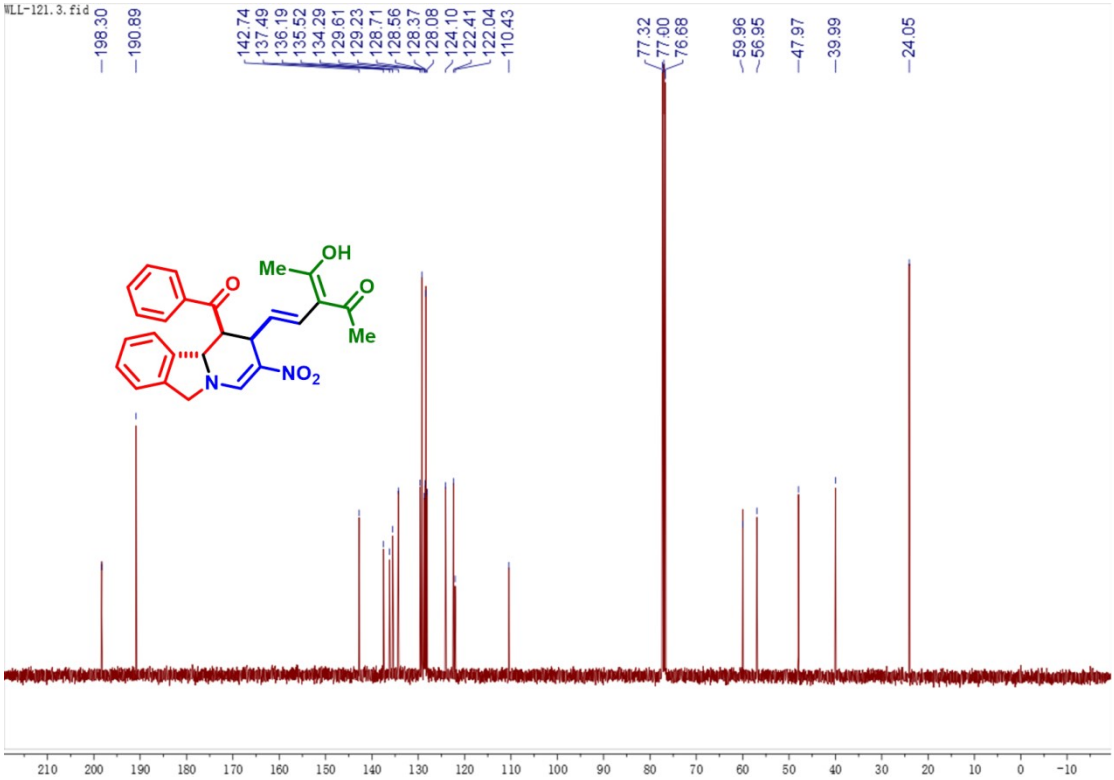
^{13}C NMR spectrum of **1ac** (100 MHz, DMSO-d_6)



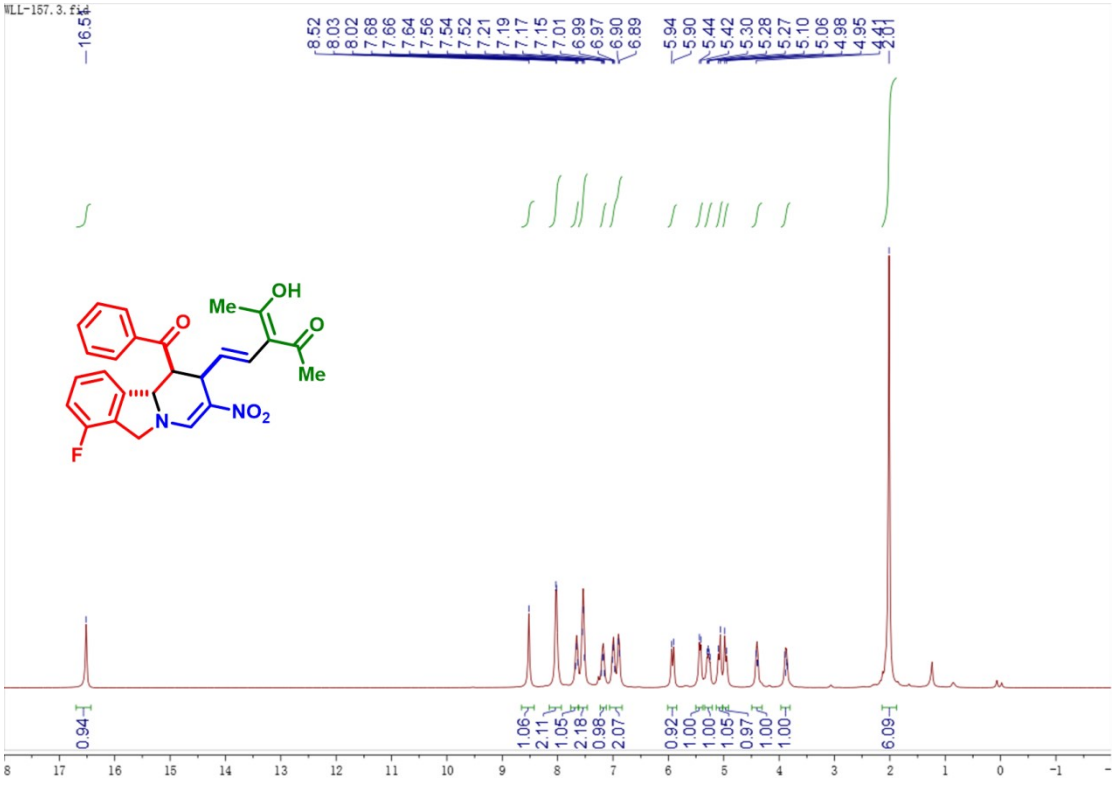
^{1}H NMR spectrum of **3** (400 MHz, $CDCl_3$)



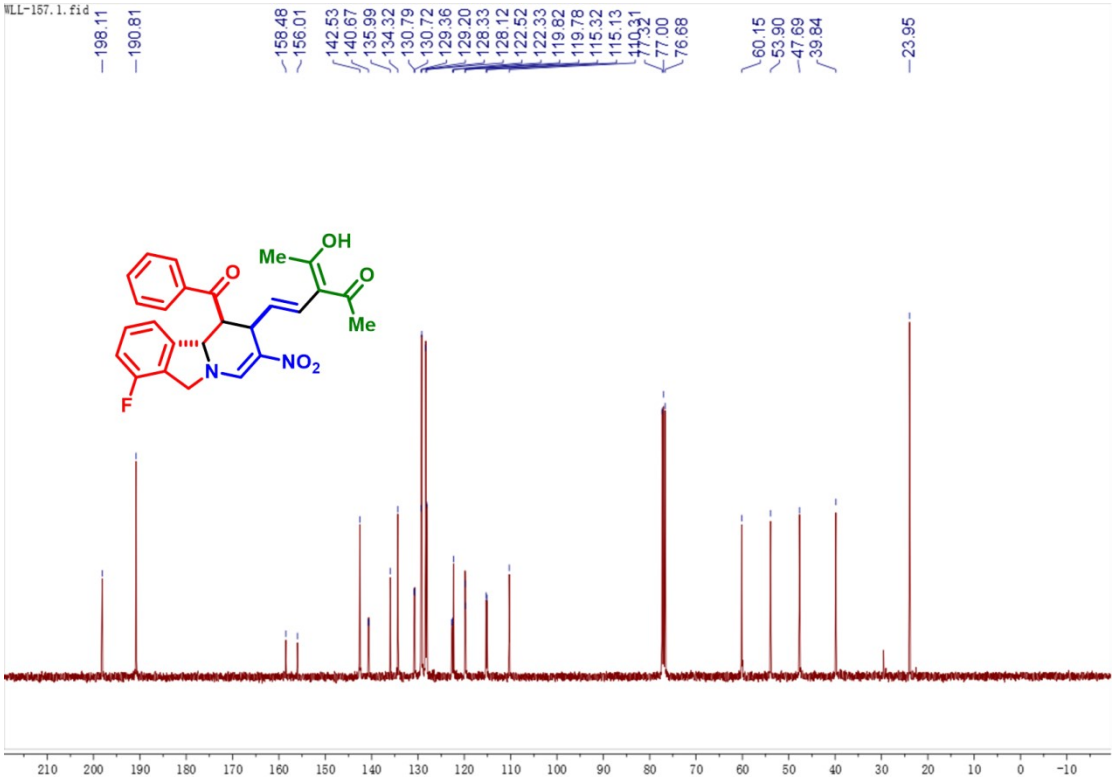
^{13}C NMR spectrum of **3** (100 MHz, $CDCl_3$)



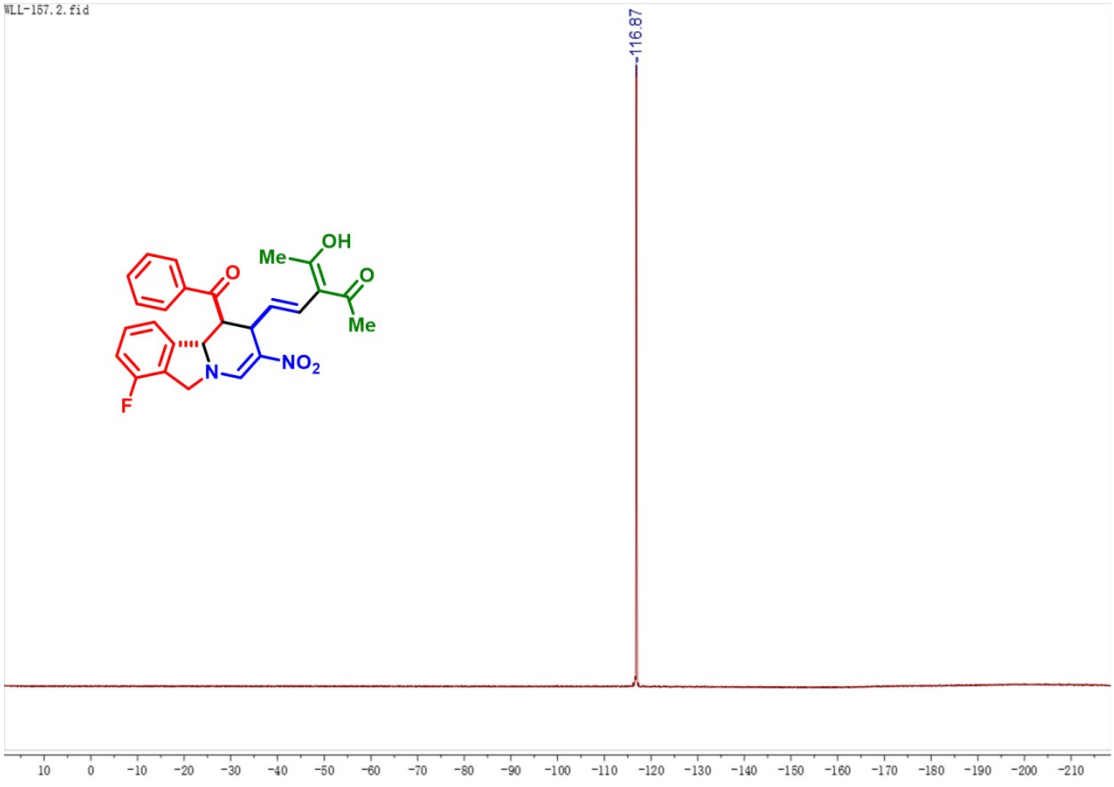
^{1}H NMR spectrum of **4** (400 MHz, $CDCl_3$)



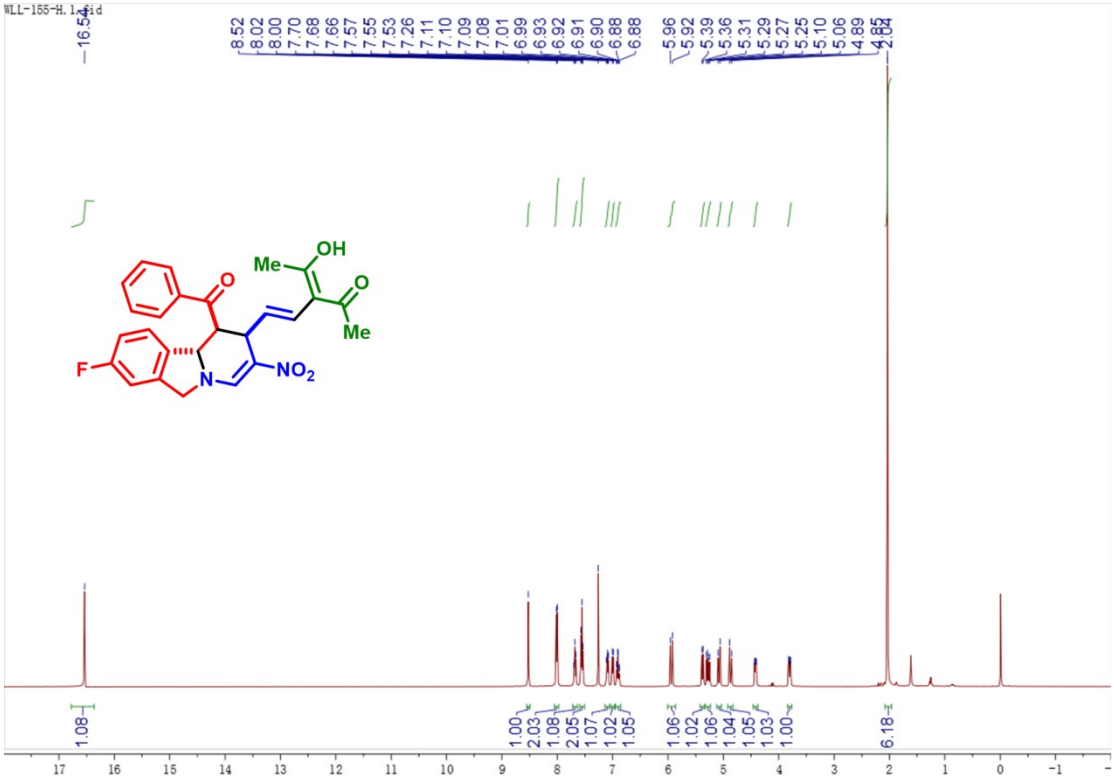
^{13}C NMR spectrum of **4** (100 MHz, $CDCl_3$)



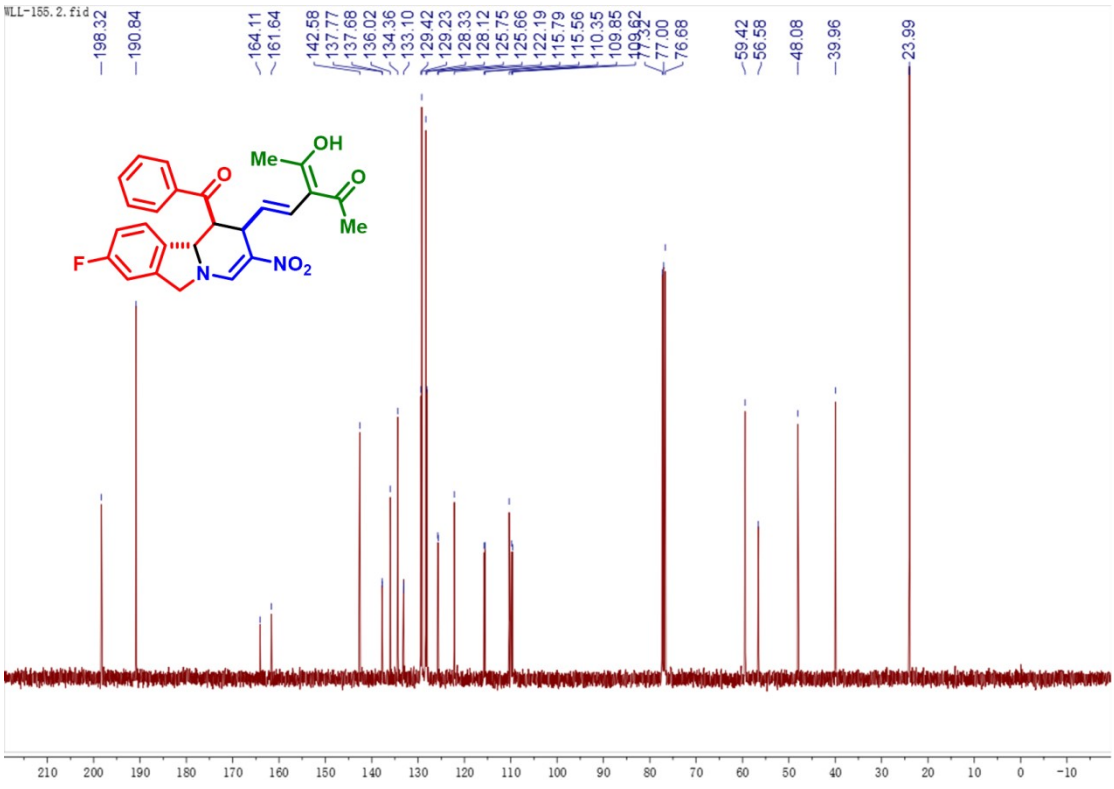
^{19}F NMR spectrum of **4** (375 MHz, $CDCl_3$)



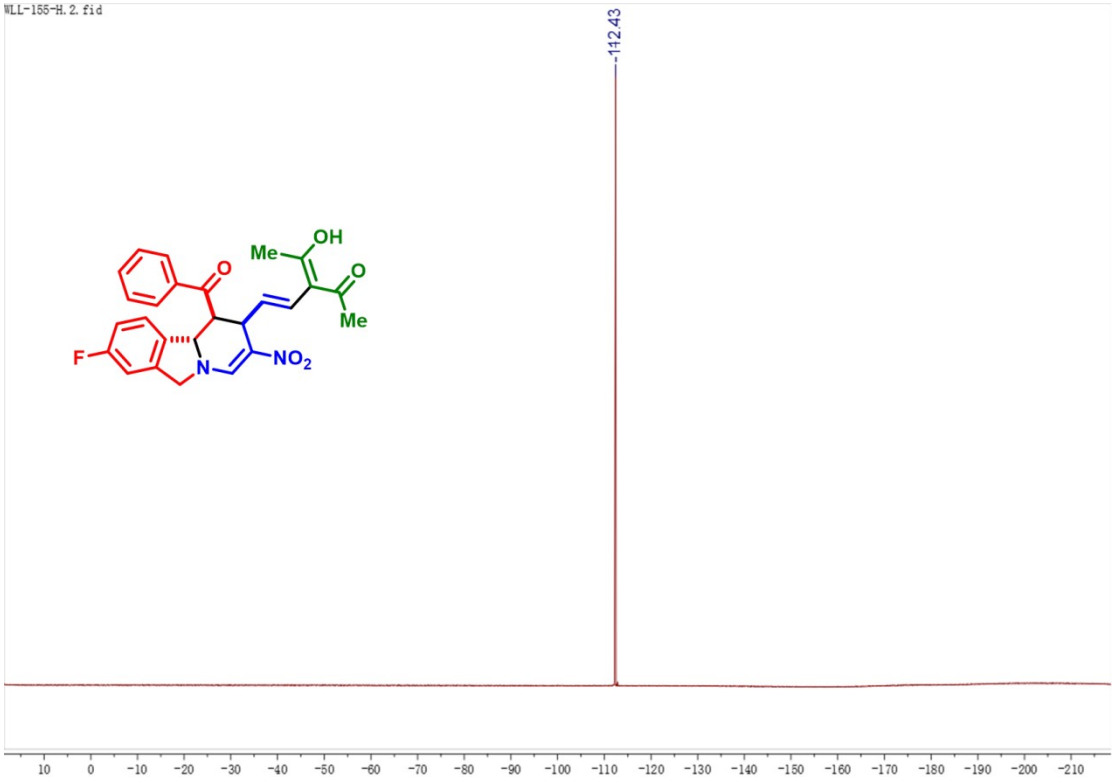
^{1}H NMR spectrum of **5** (400 MHz, $CDCl_3$)



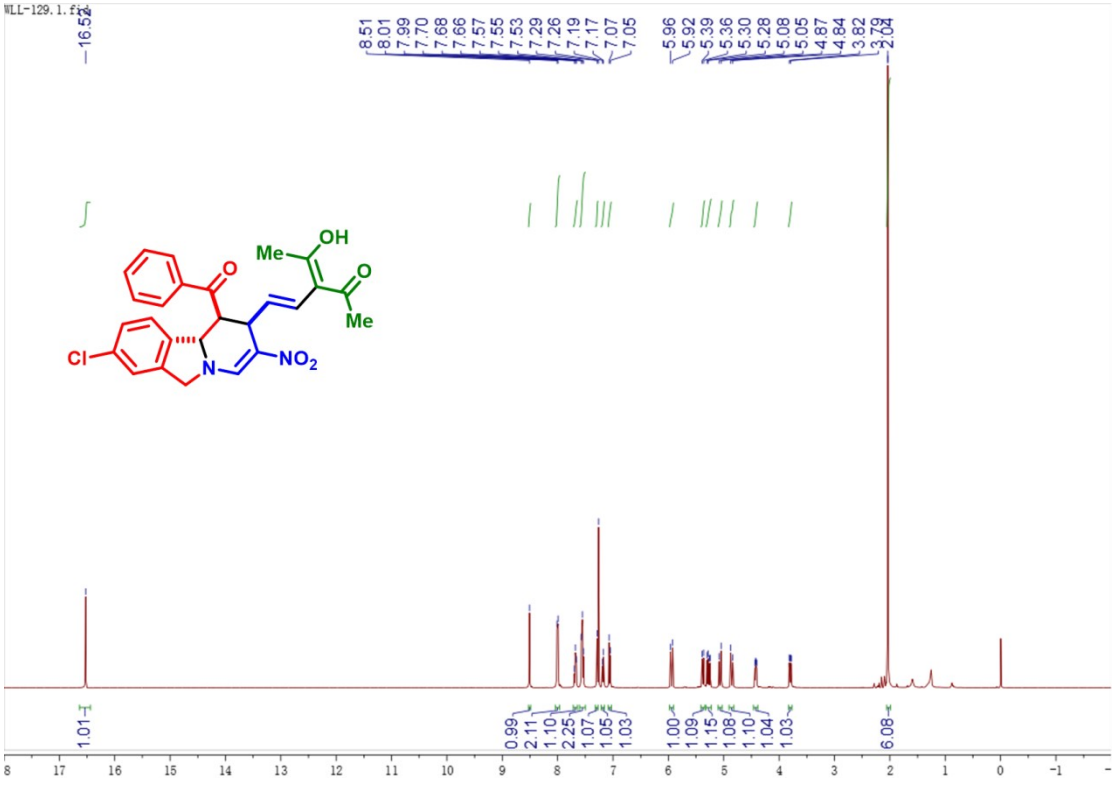
^{13}C NMR spectrum of **5** (100 MHz, $CDCl_3$)



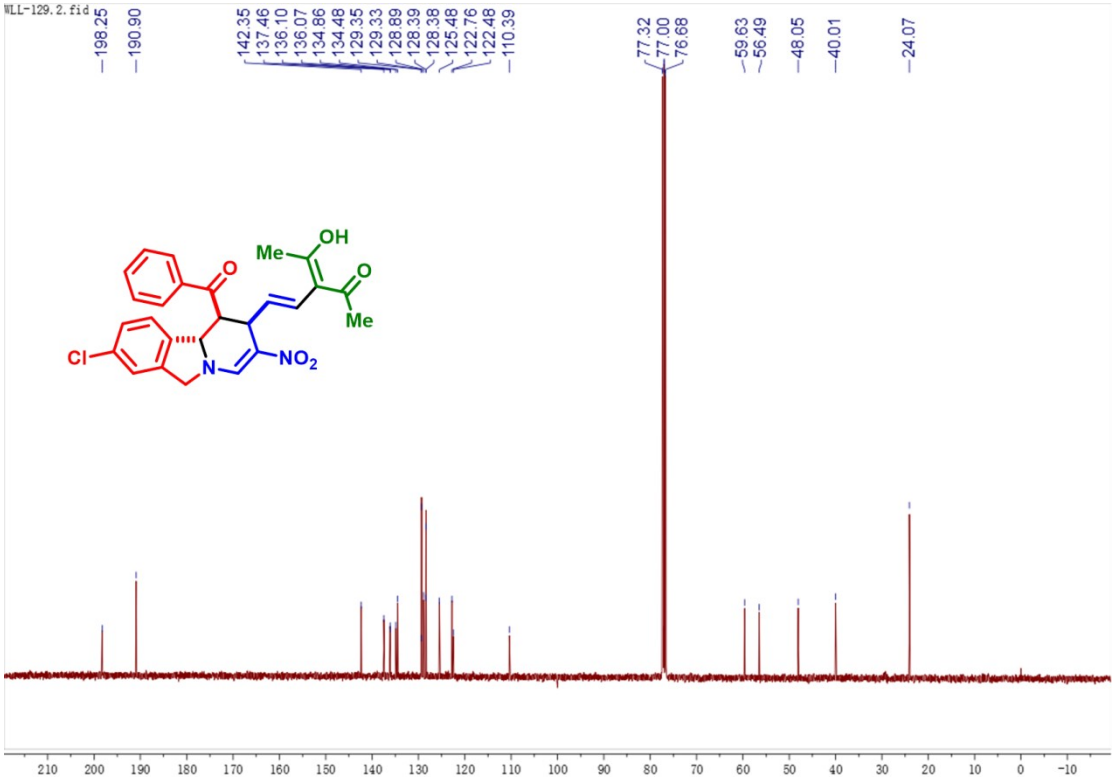
^{19}F NMR spectrum of **5** (375 MHz, $CDCl_3$)



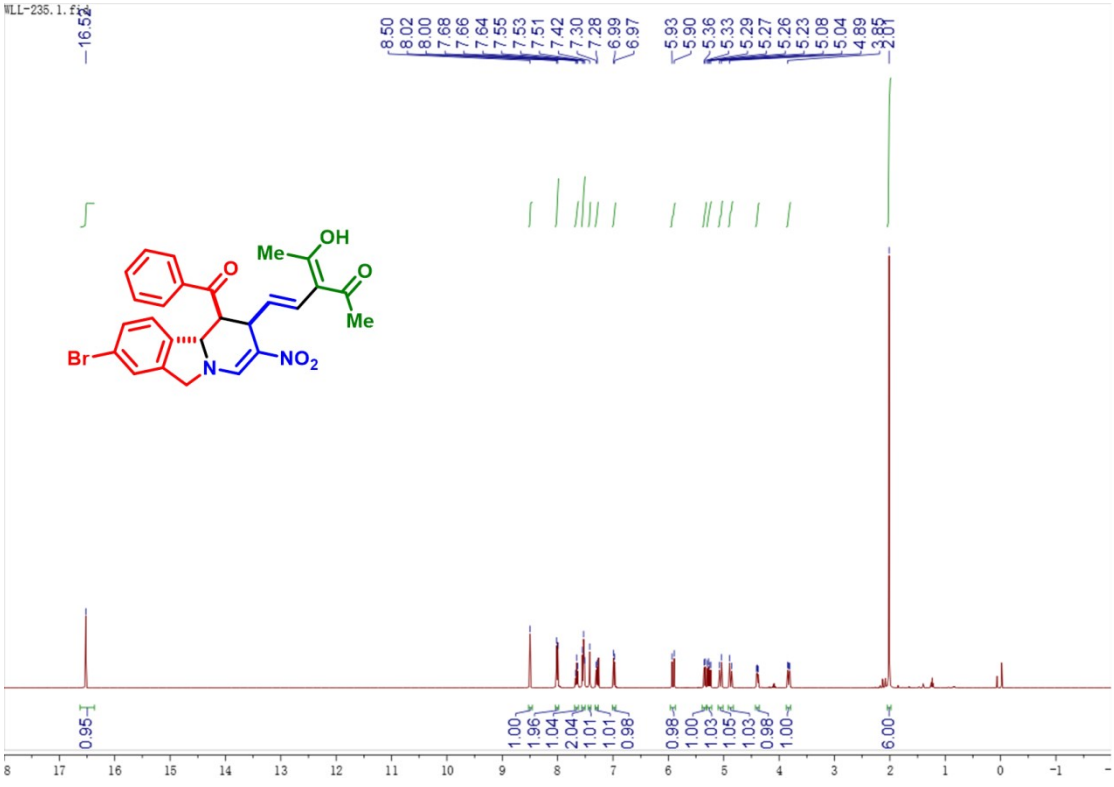
^{1}H NMR spectrum of **6** (400 MHz, $CDCl_3$)



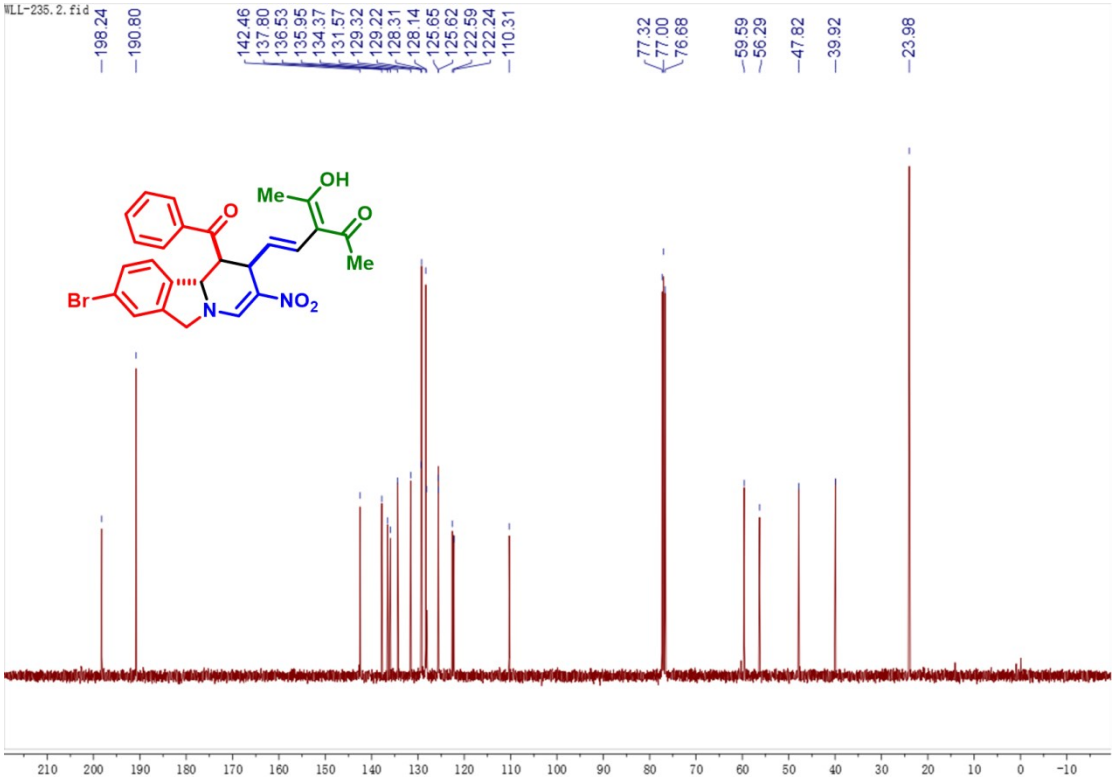
^{13}C NMR spectrum of **6** (100 MHz, $CDCl_3$)



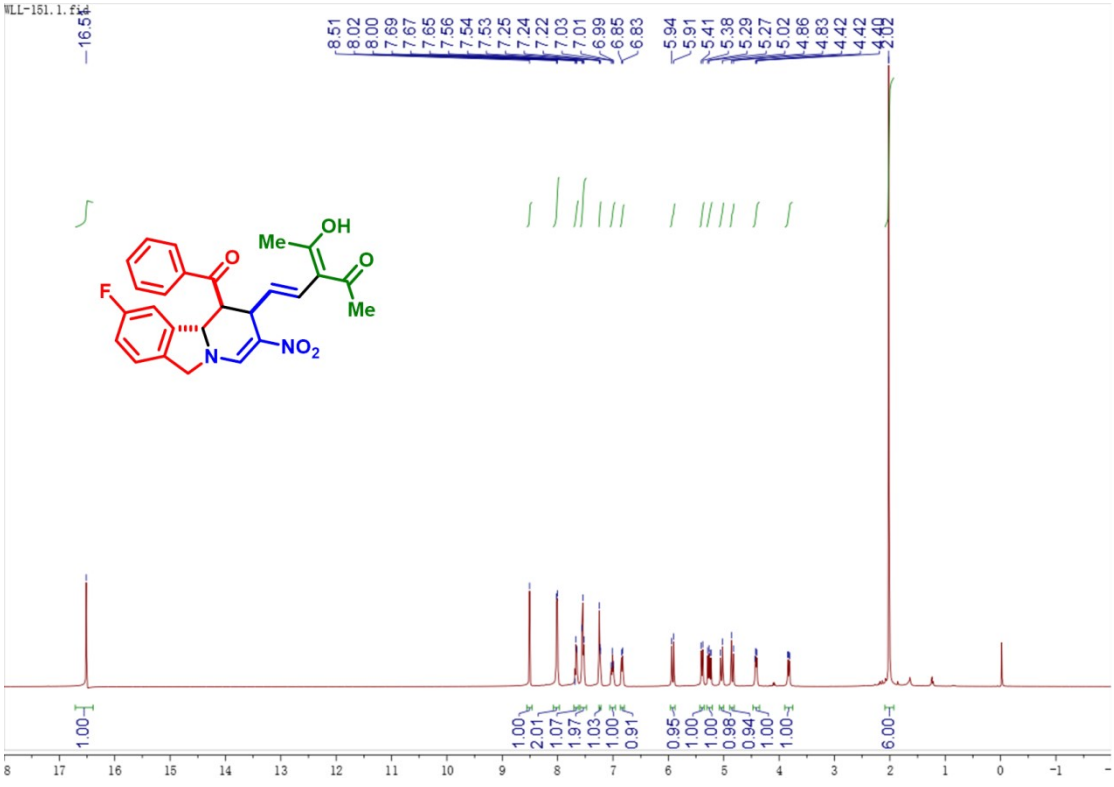
^{1}H NMR spectrum of **7** (400 MHz, $CDCl_3$)



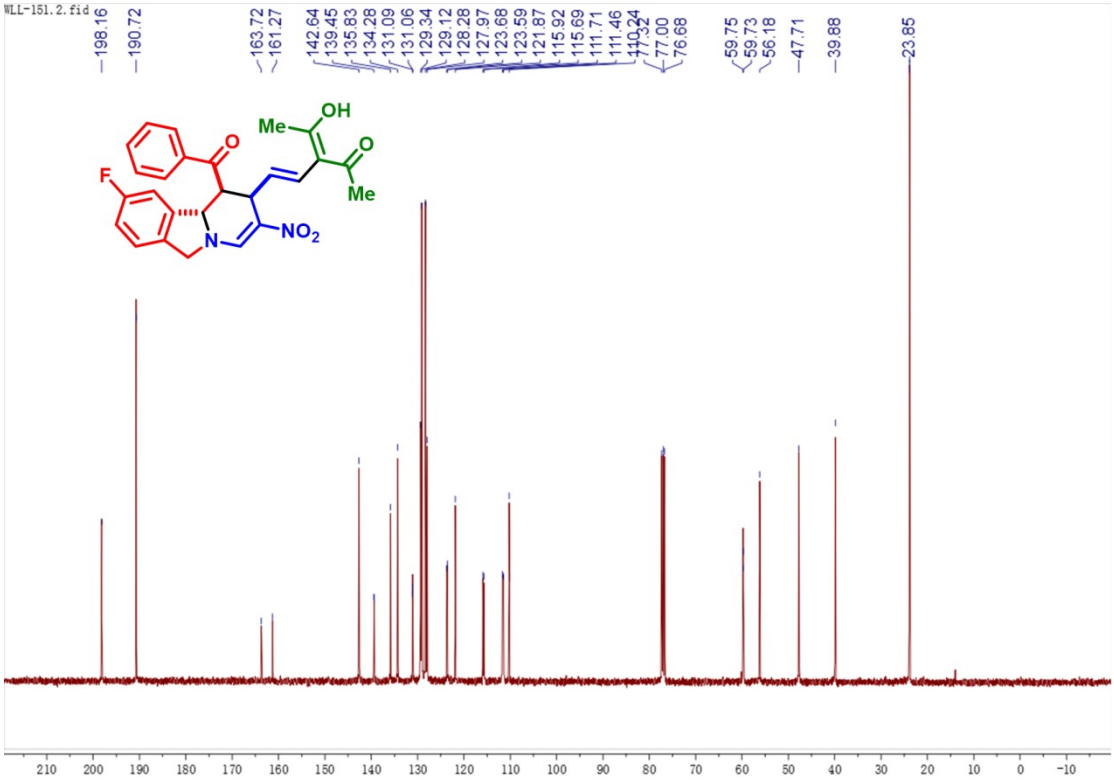
^{13}C NMR spectrum of **7** (100 MHz, $CDCl_3$)



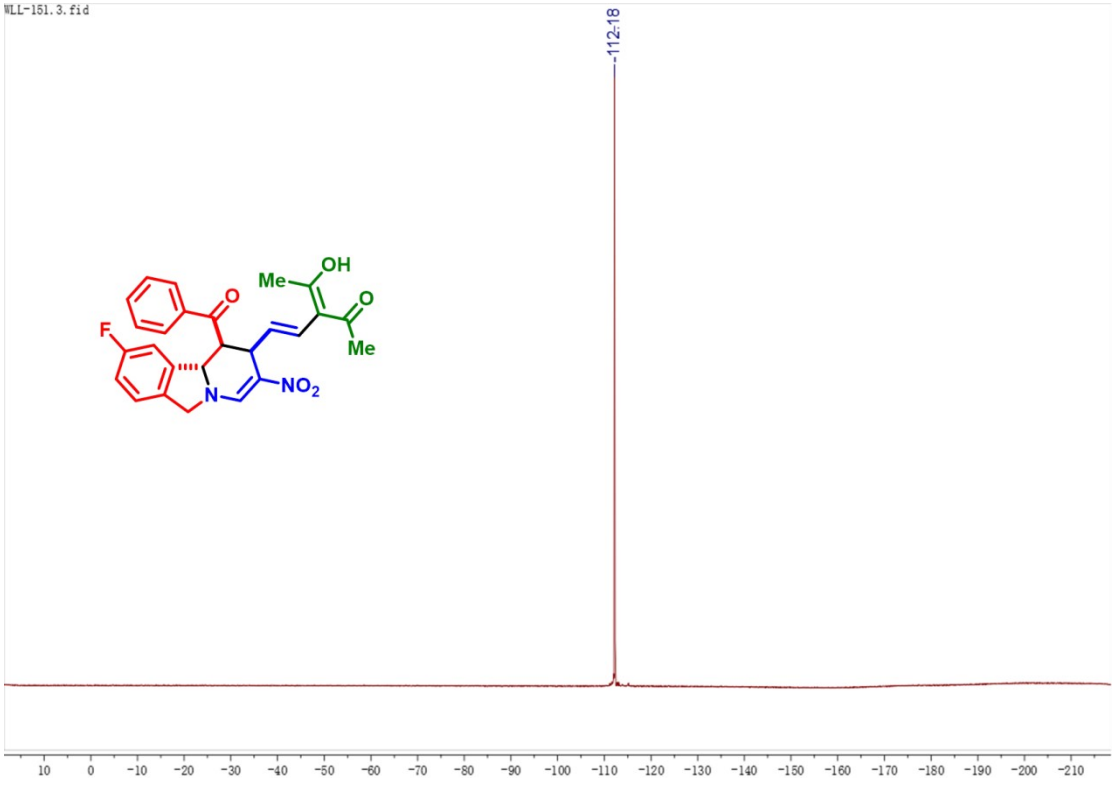
^{1}H NMR spectrum of **8** (400 MHz, $CDCl_3$)



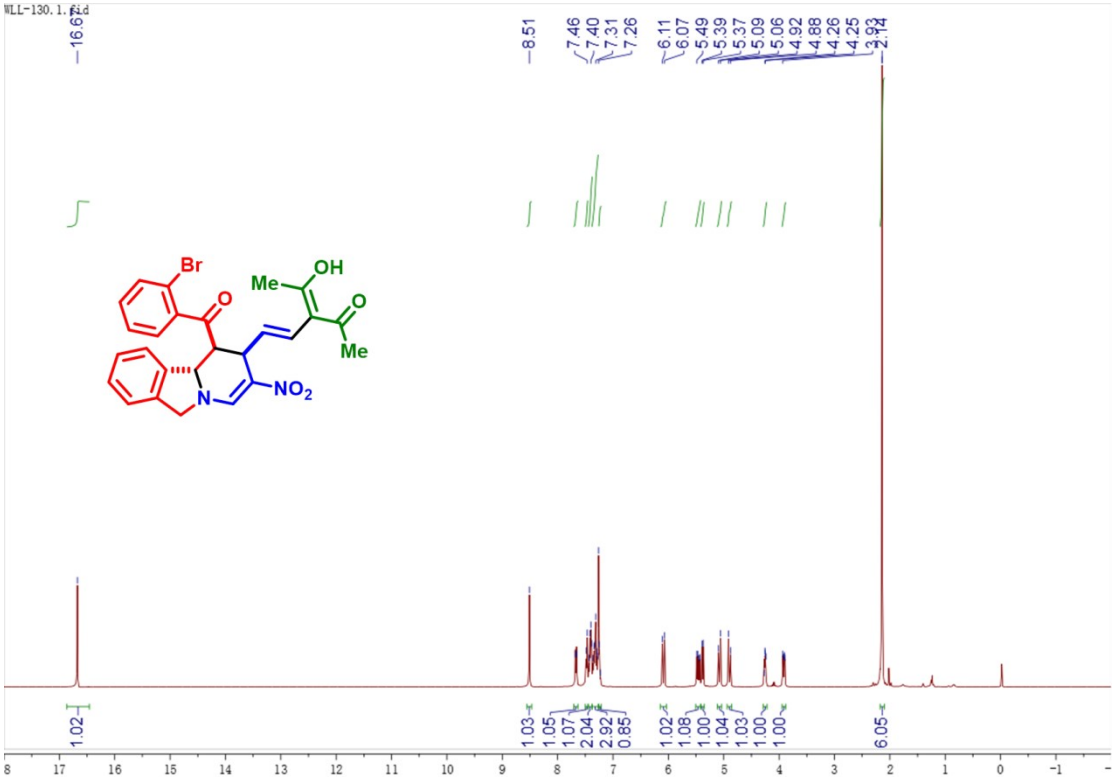
^{13}C NMR spectrum of **8** (100 MHz, $CDCl_3$)



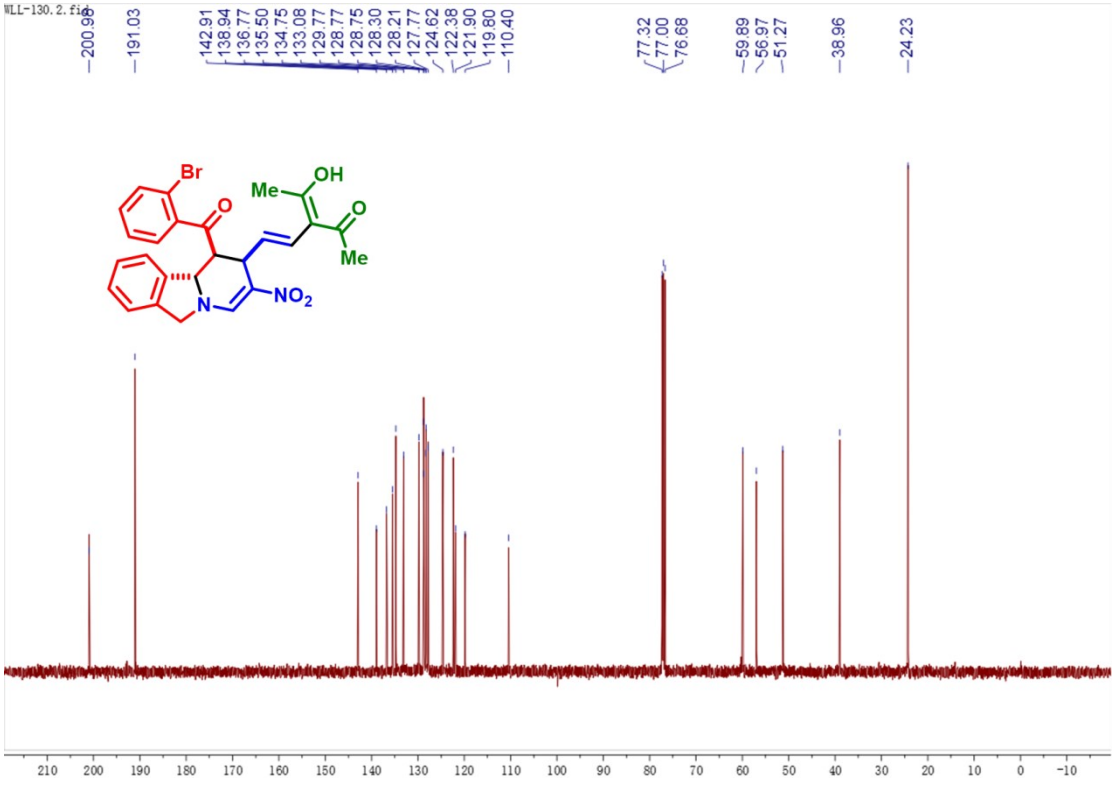
^{19}F NMR spectrum of **8** (375 MHz, $CDCl_3$)



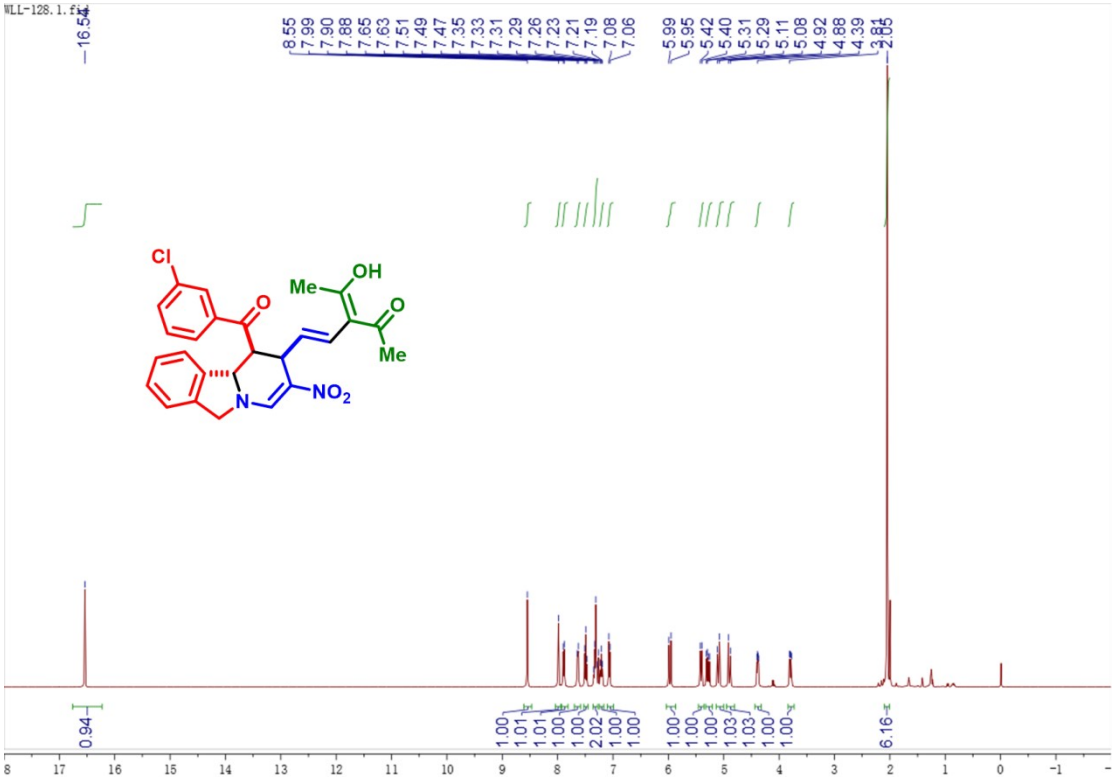
^{1}H NMR spectrum of **9** (400 MHz, $CDCl_3$)



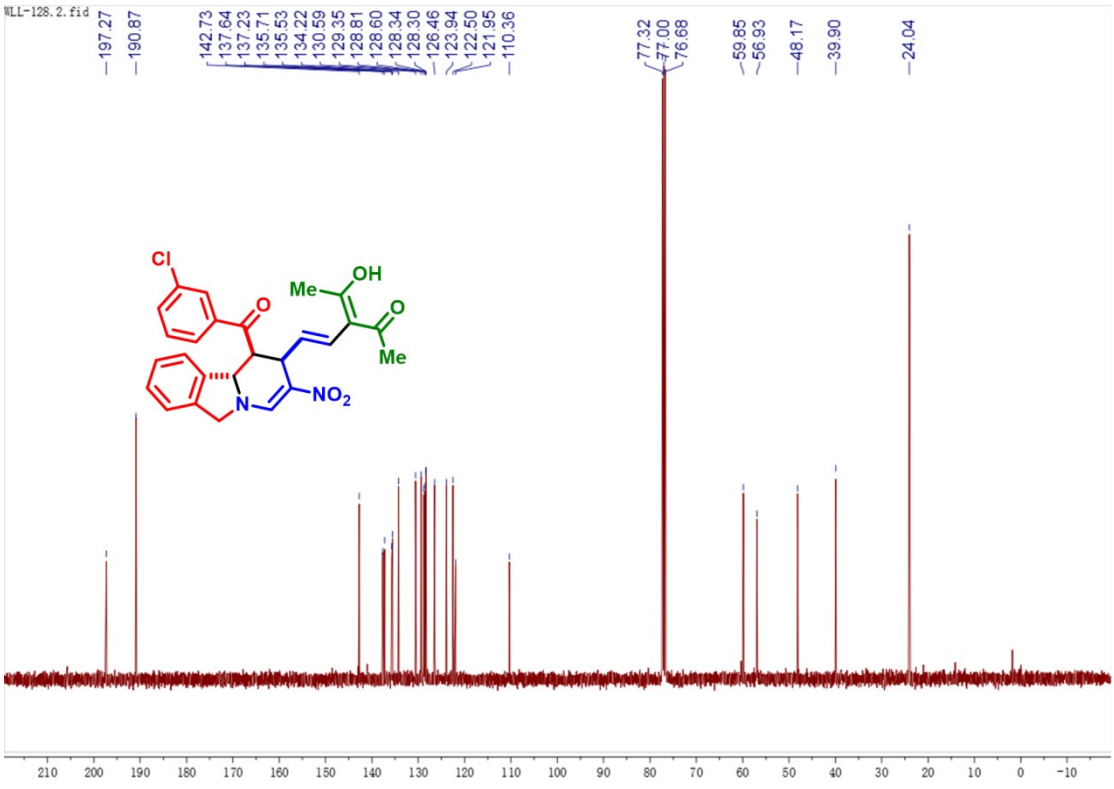
^{13}C NMR spectrum of **9** (100 MHz, $CDCl_3$)



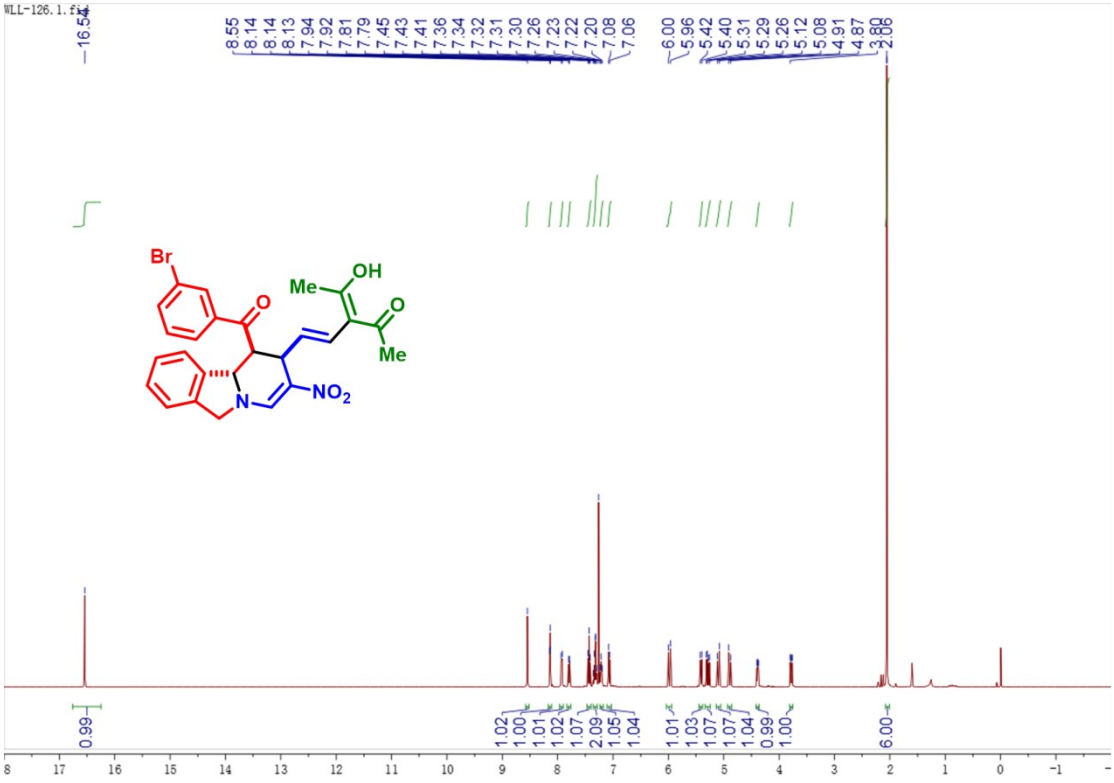
^{1}H NMR spectrum of **10** (400 MHz, $CDCl_3$)



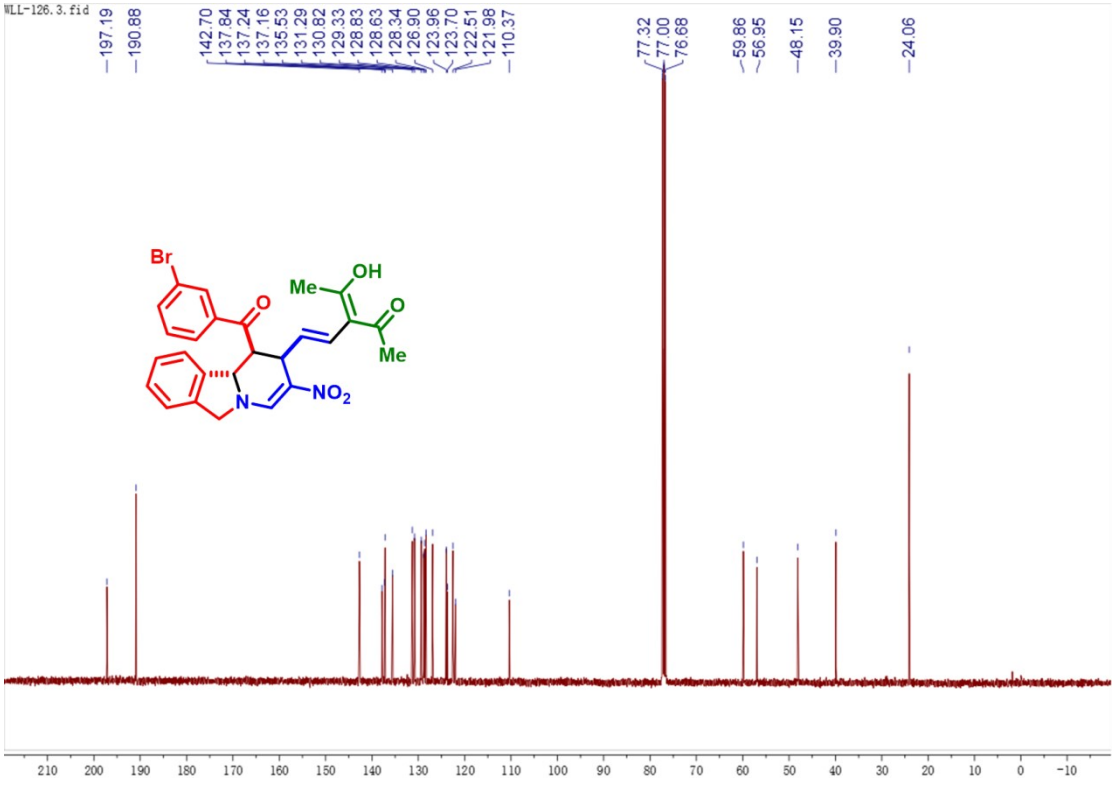
^{13}C NMR spectrum of **10** (100 MHz, $CDCl_3$)



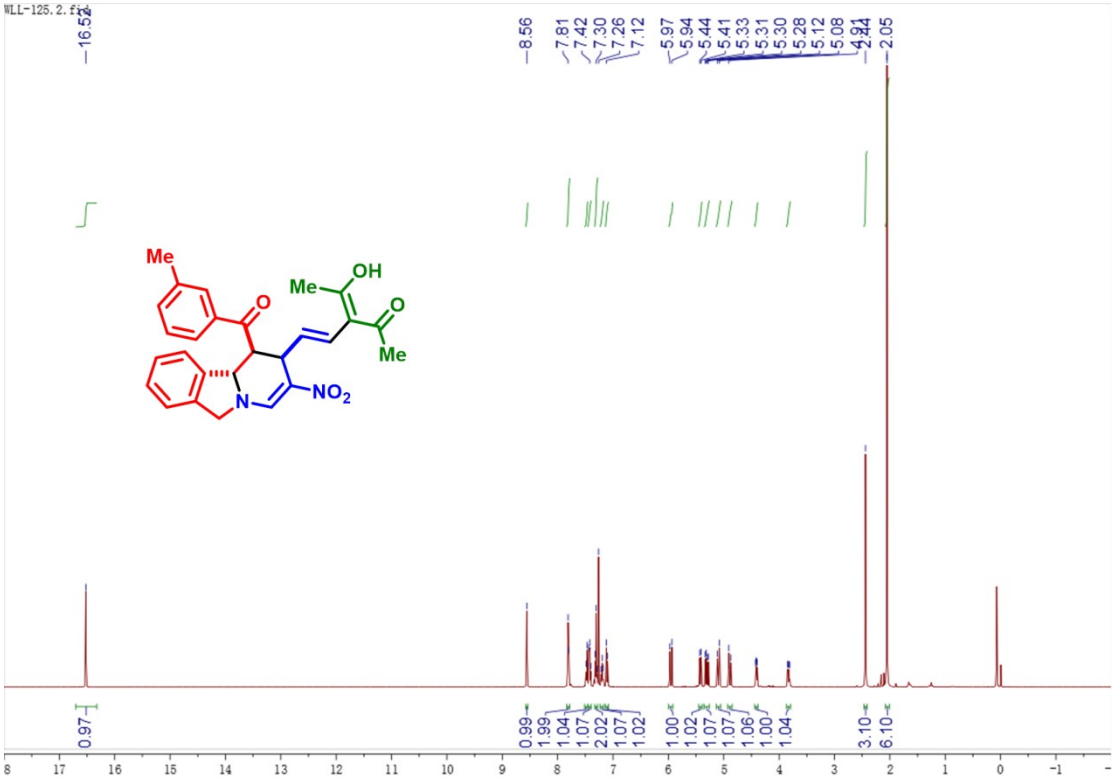
^{1}H NMR spectrum of **11** (400 MHz, $CDCl_3$)



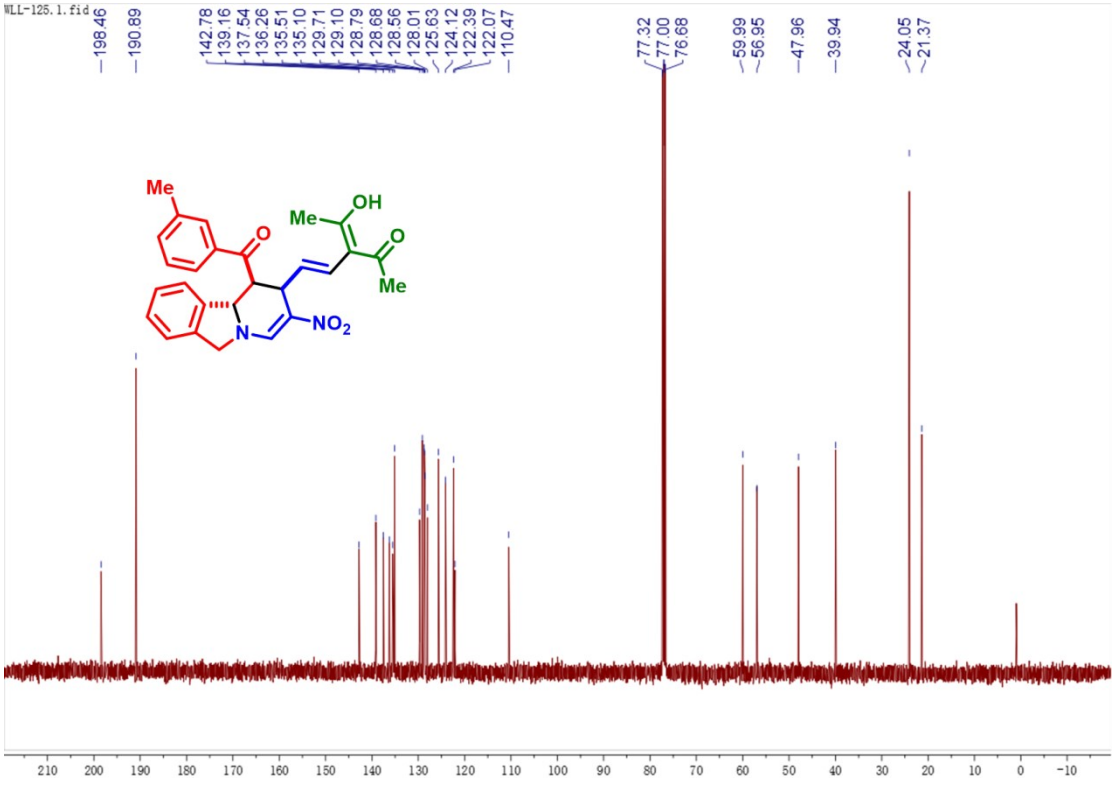
^{13}C NMR spectrum of **11** (100 MHz, $CDCl_3$)



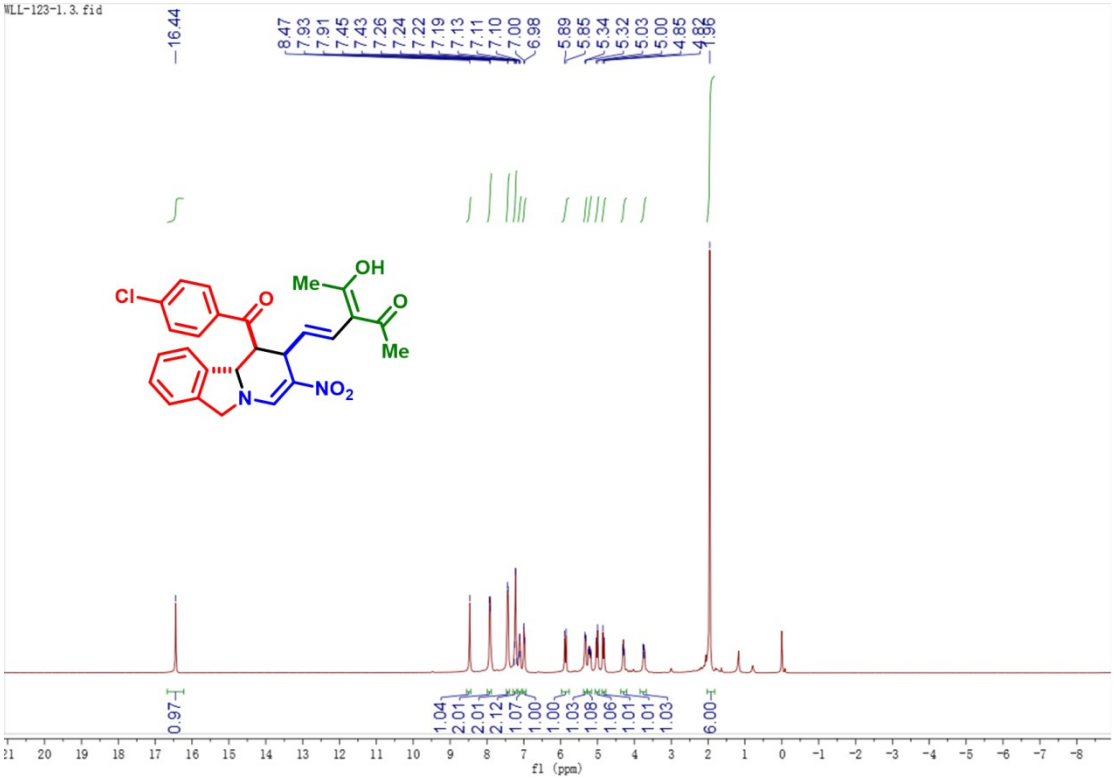
^{1}H NMR spectrum of **12** (400 MHz, $CDCl_3$)



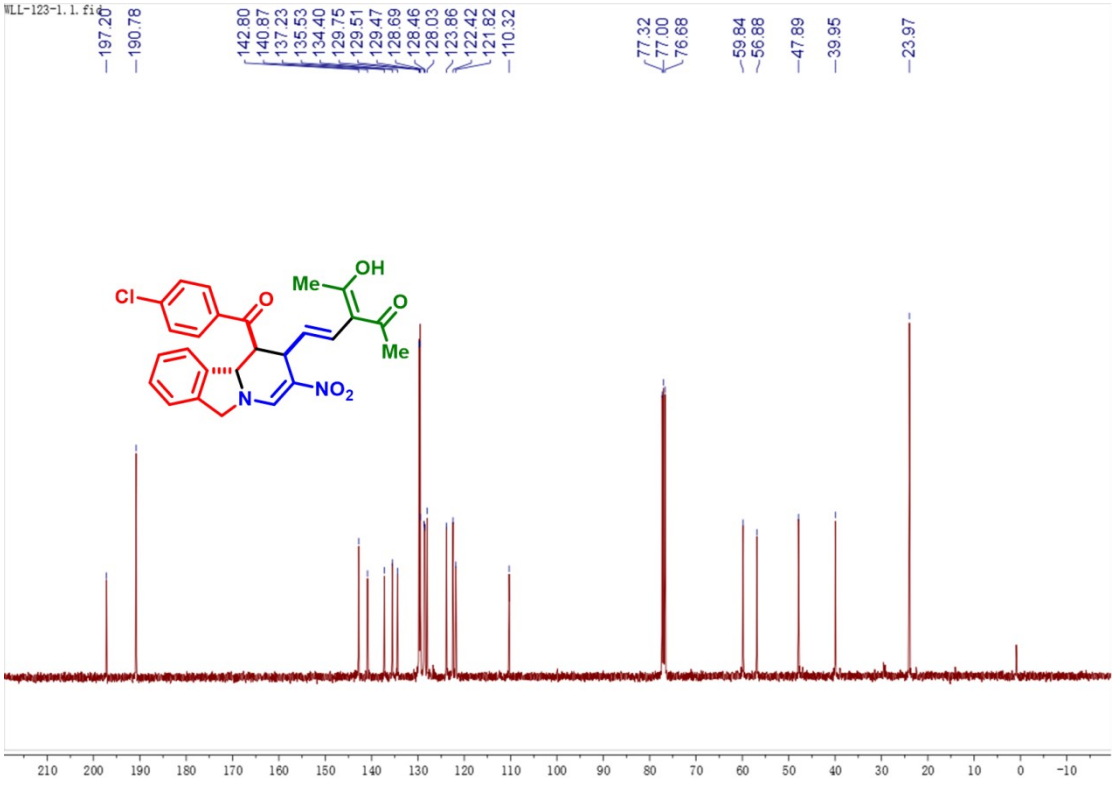
^{13}C NMR spectrum of **12** (100 MHz, $CDCl_3$)



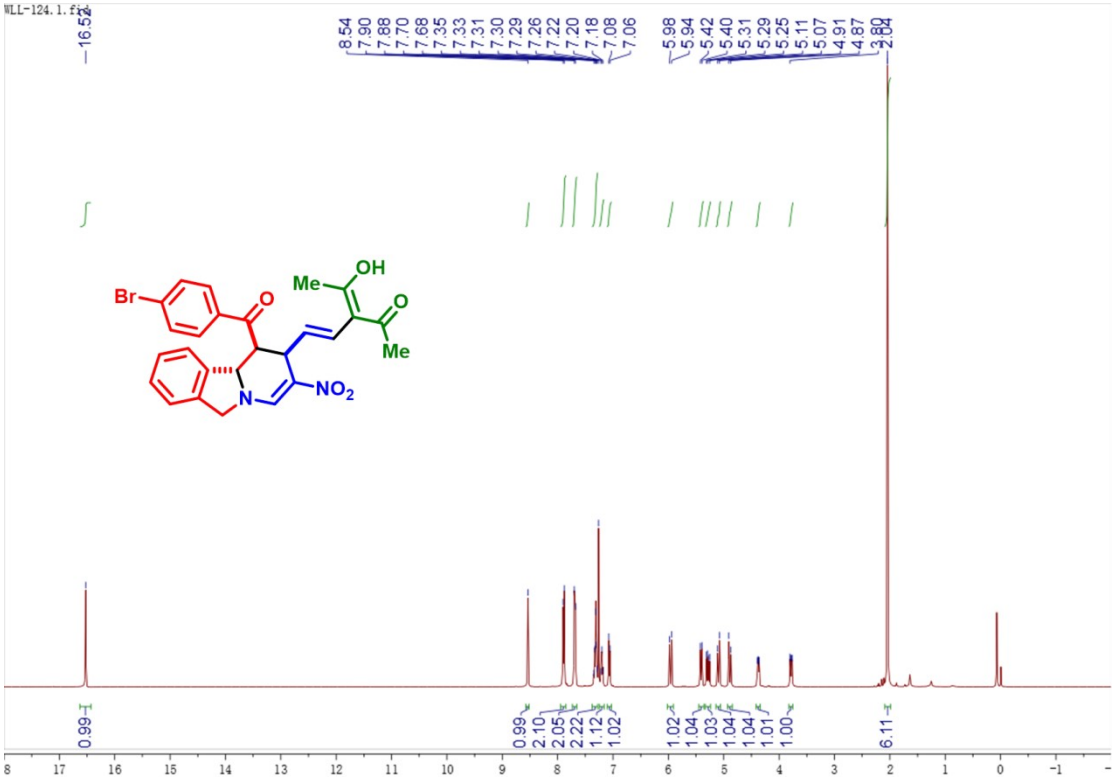
^{1}H NMR spectrum of **13** (400 MHz, $CDCl_3$)



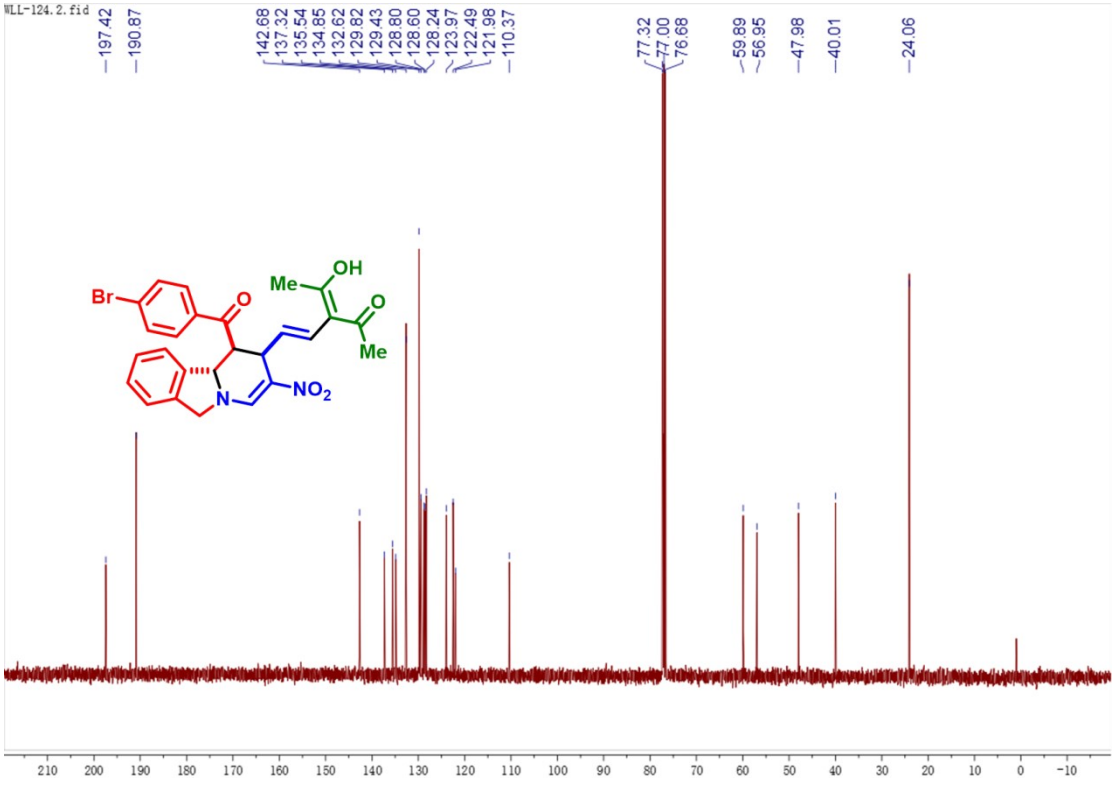
^{13}C NMR spectrum of **13** (100 MHz, $CDCl_3$)



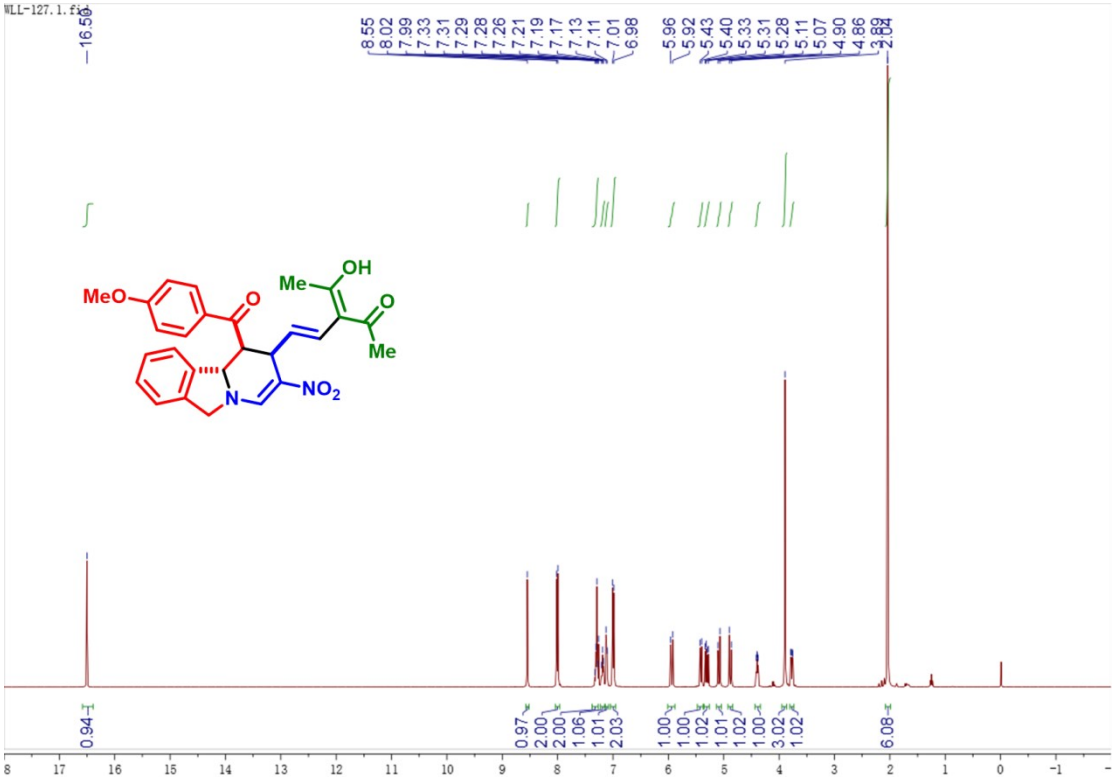
^{1}H NMR spectrum of **14** (400 MHz, $CDCl_3$)



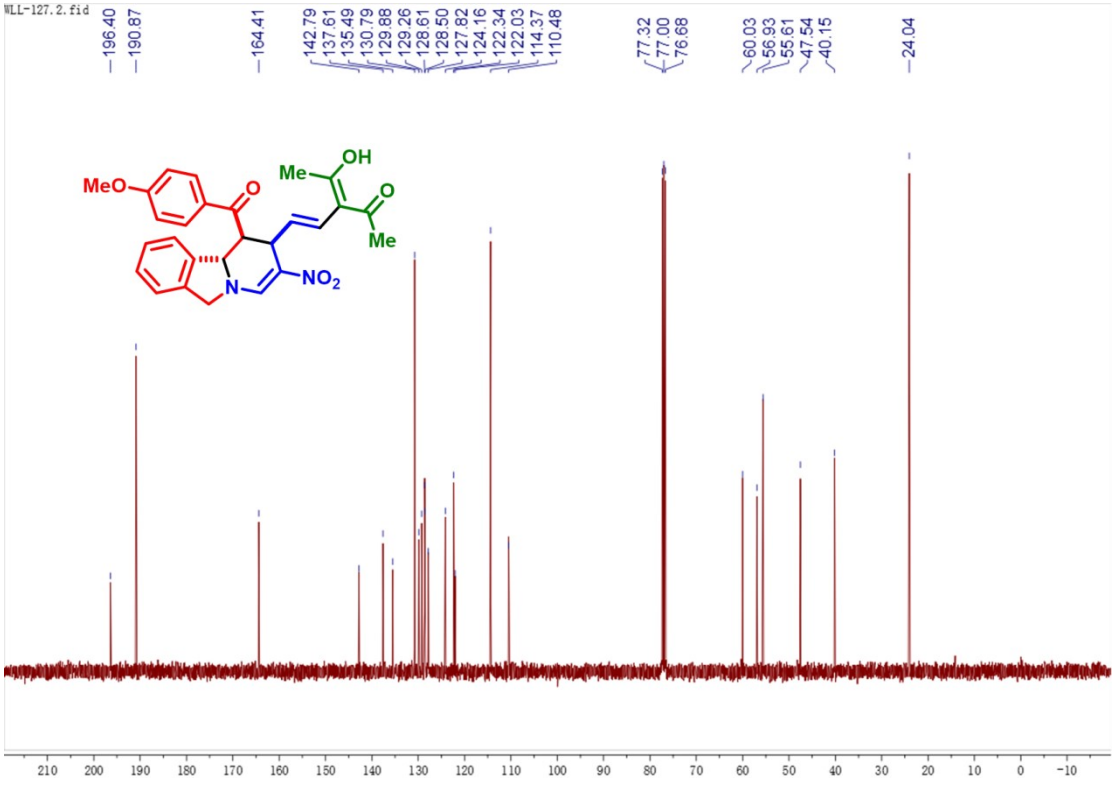
^{13}C NMR spectrum of **14** (100 MHz, $CDCl_3$)



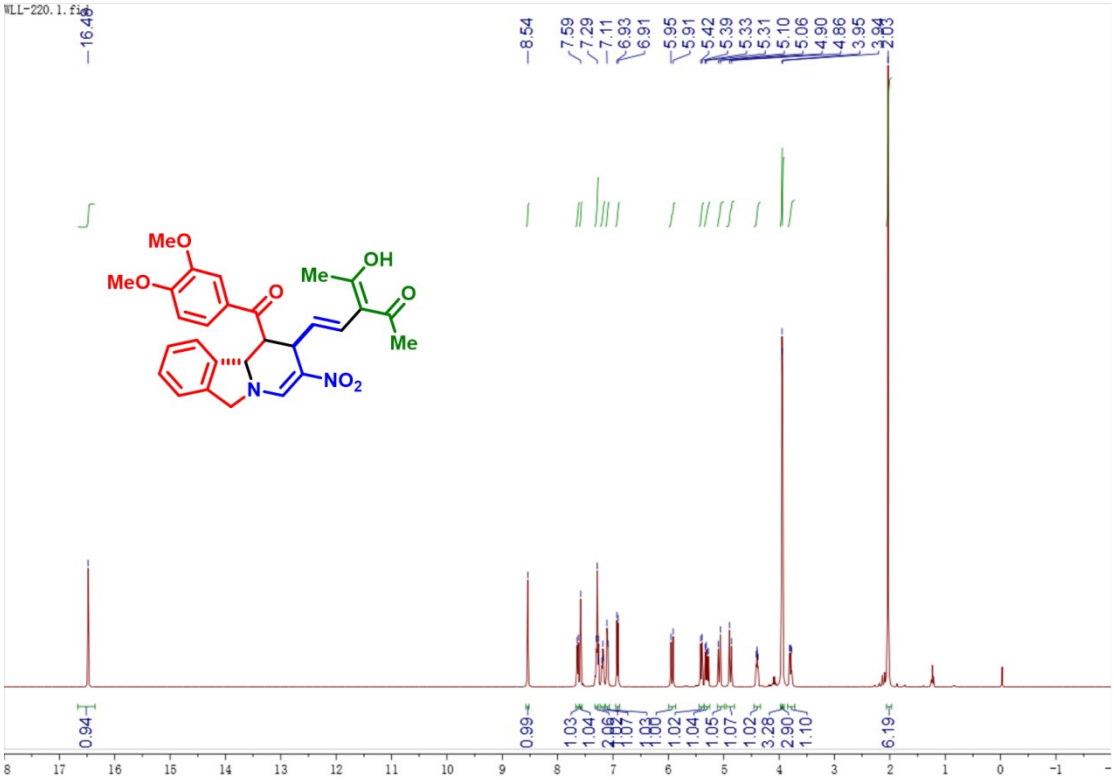
^{1}H NMR spectrum of **15** (400 MHz, $CDCl_3$)



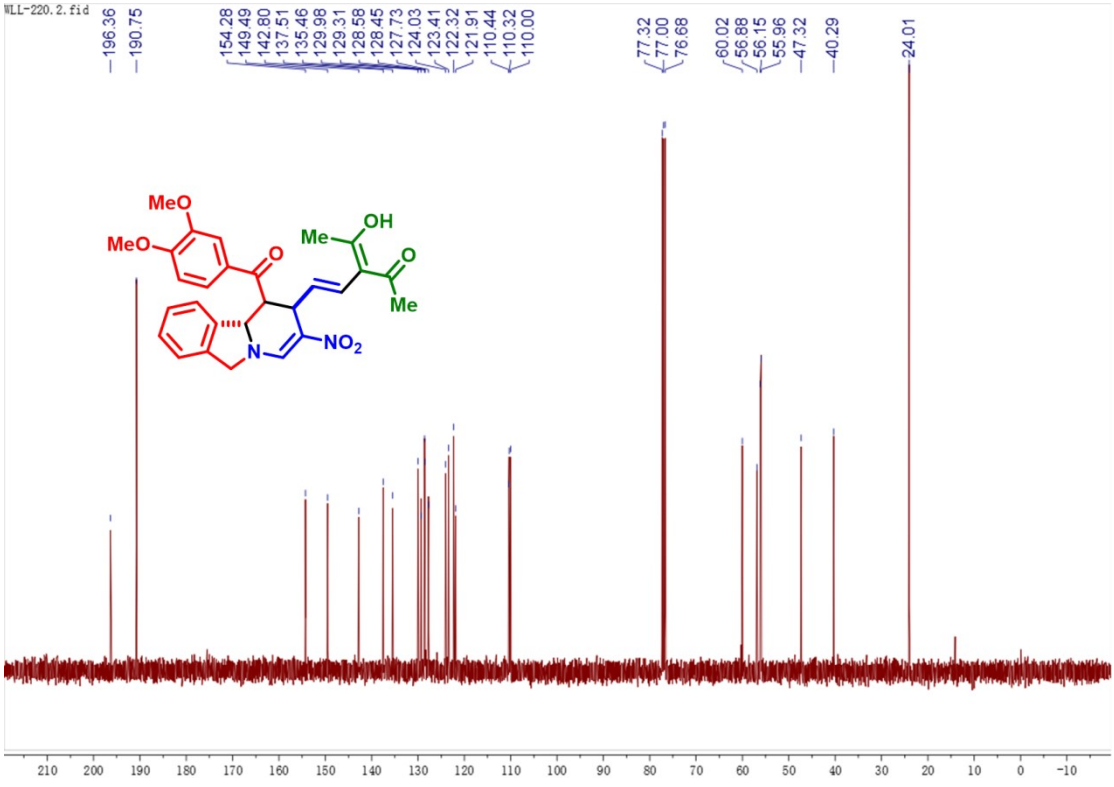
^{13}C NMR spectrum of **15** (100 MHz, $CDCl_3$)



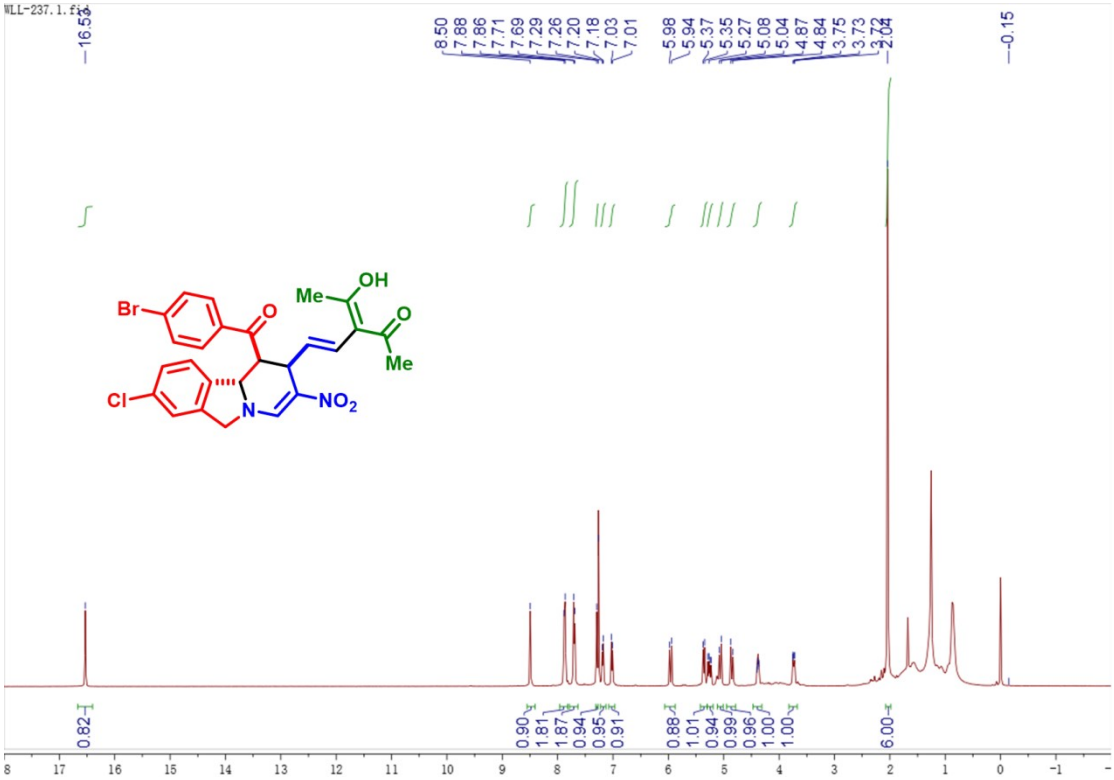
^{1}H NMR spectrum of **16** (400 MHz, $CDCl_3$)



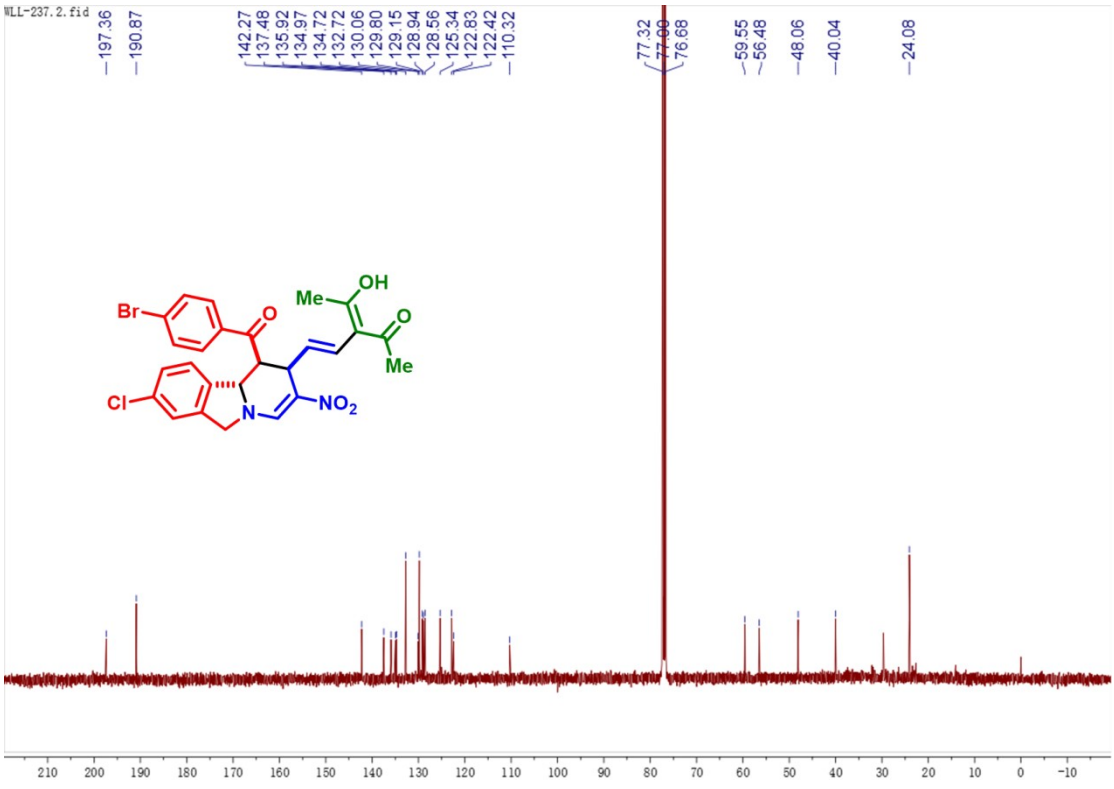
^{13}C NMR spectrum of **16** (100 MHz, $CDCl_3$)



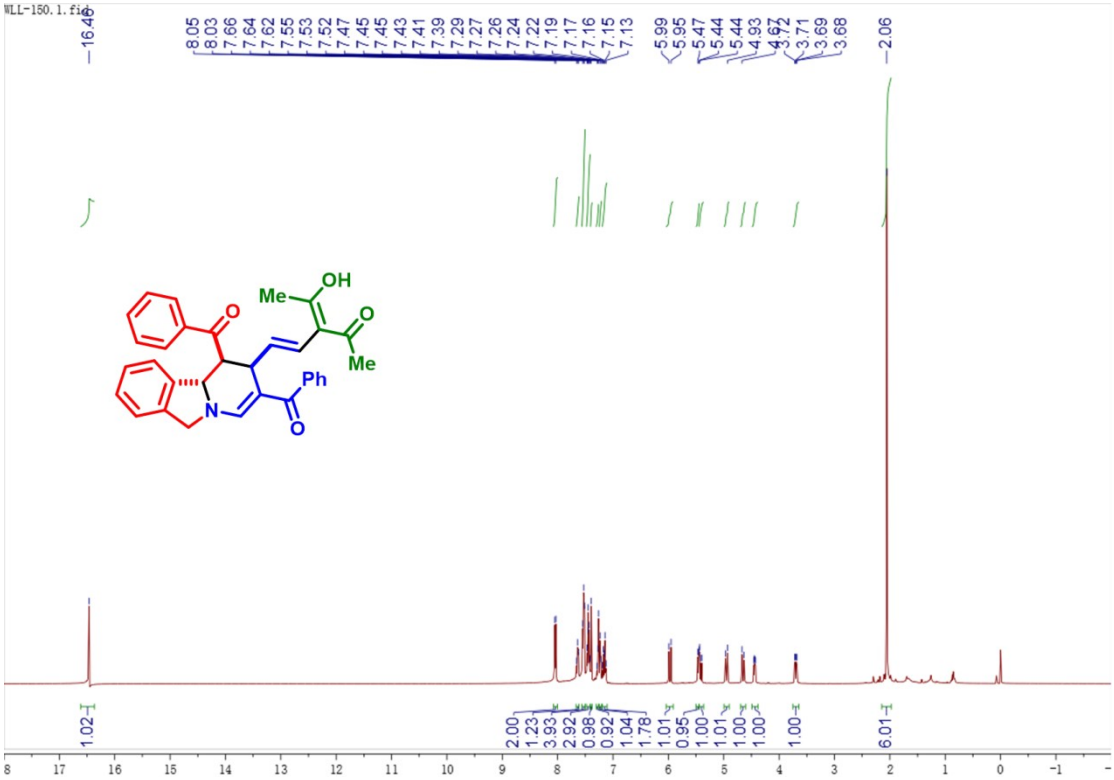
^{1}H NMR spectrum of **17** (400 MHz, $CDCl_3$)



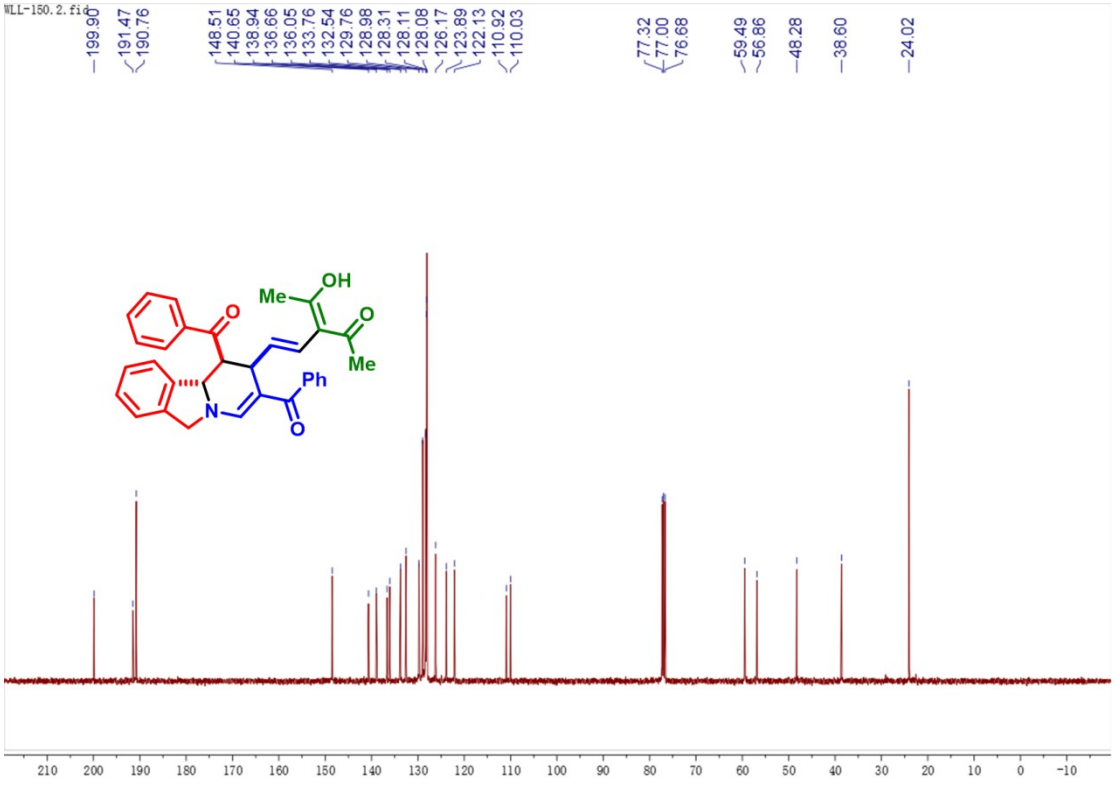
^{13}C NMR spectrum of **17** (100 MHz, $CDCl_3$)



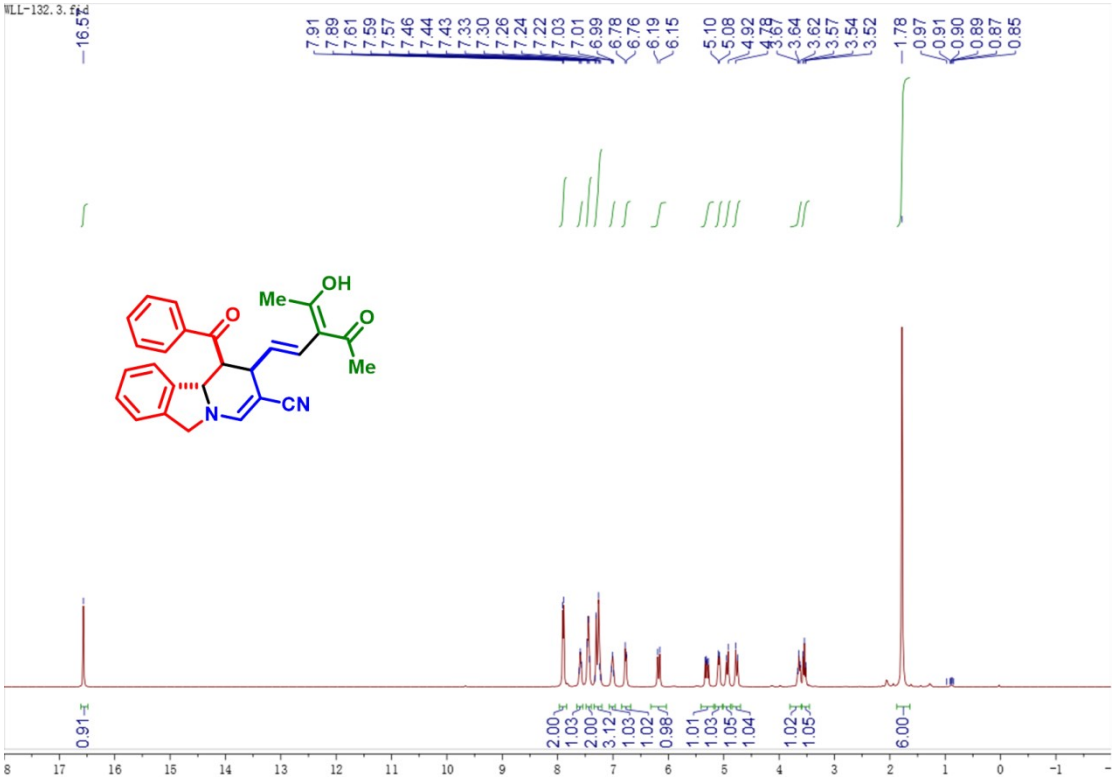
^{1}H NMR spectrum of **18** (400 MHz, $CDCl_3$)



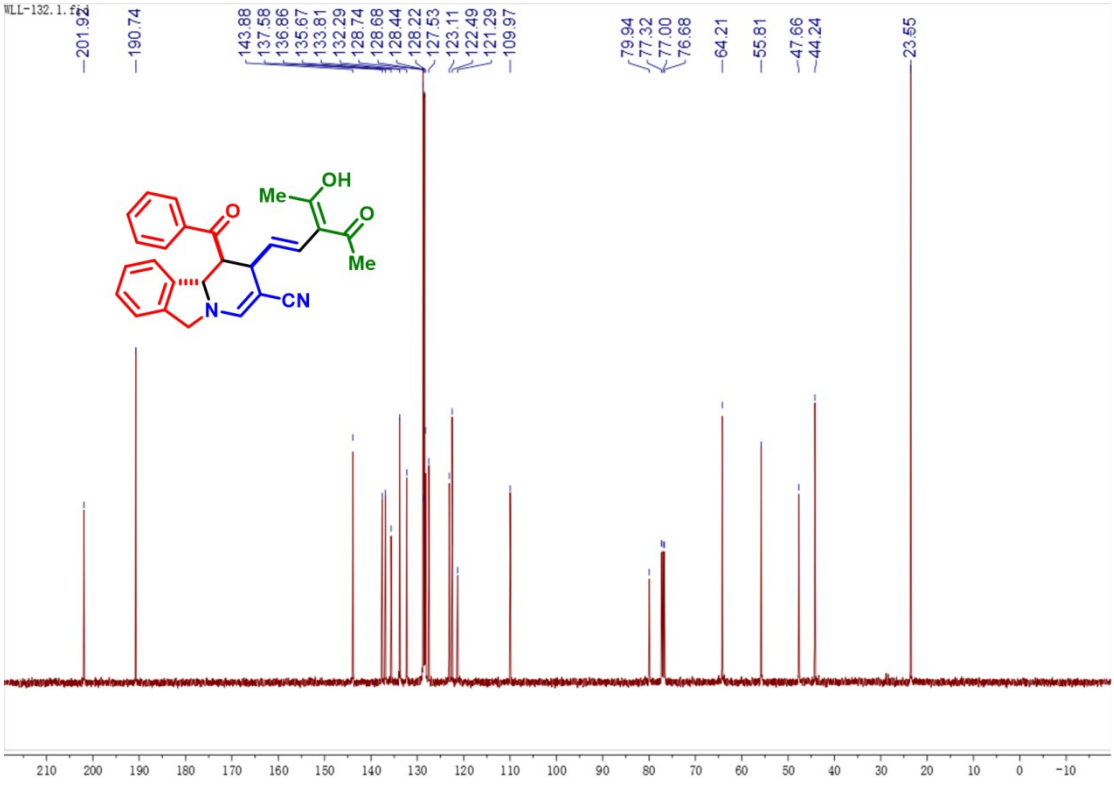
^{13}C NMR spectrum of **18** (100 MHz, $CDCl_3$)



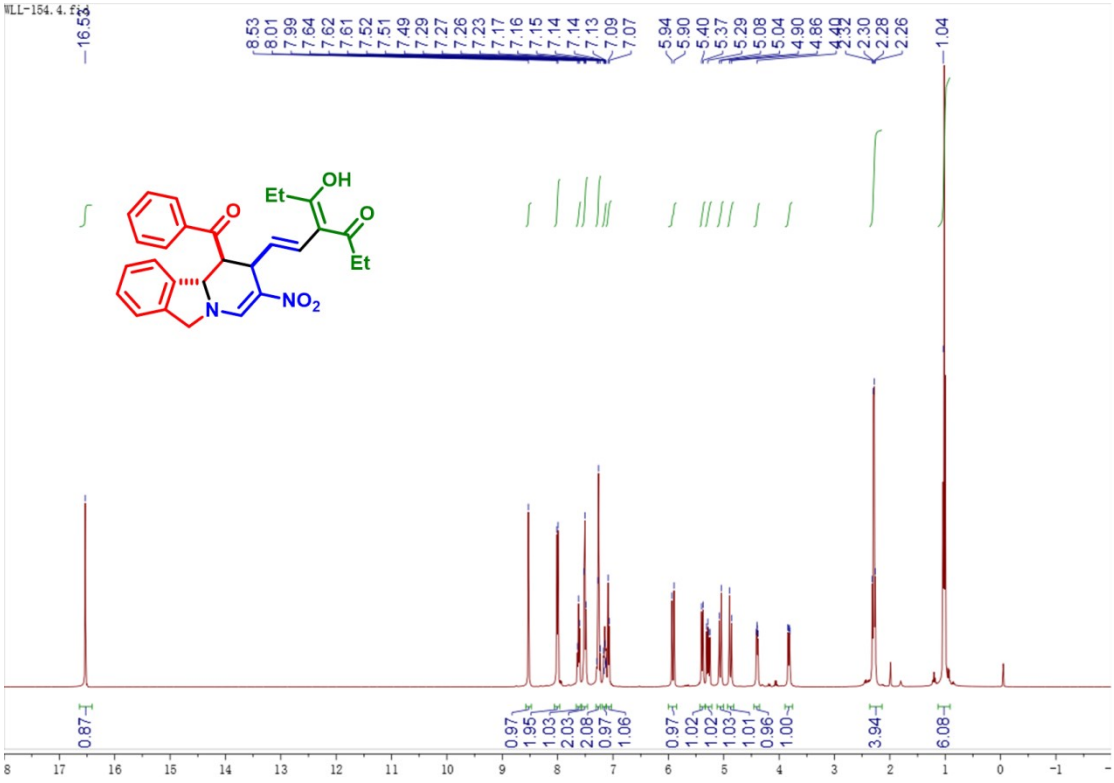
^{1}H NMR spectrum of **19** (400 MHz, $CDCl_3$)



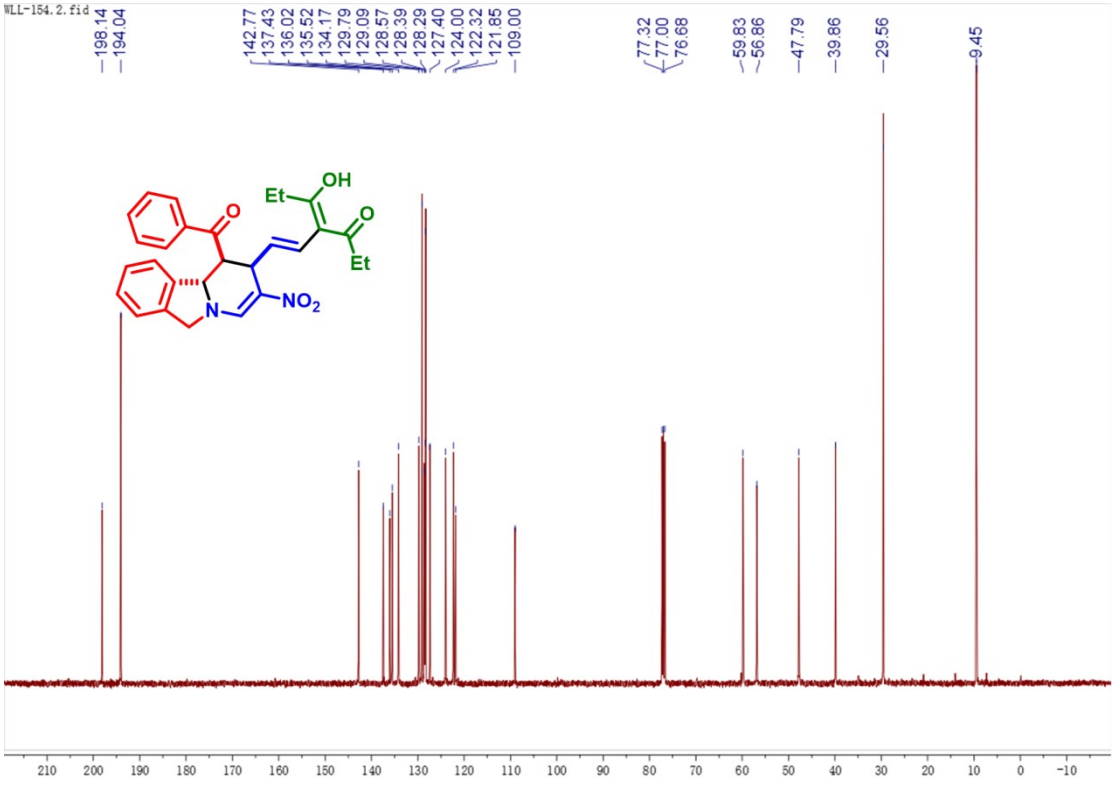
^{13}C NMR spectrum of **19** (100 MHz, $CDCl_3$)



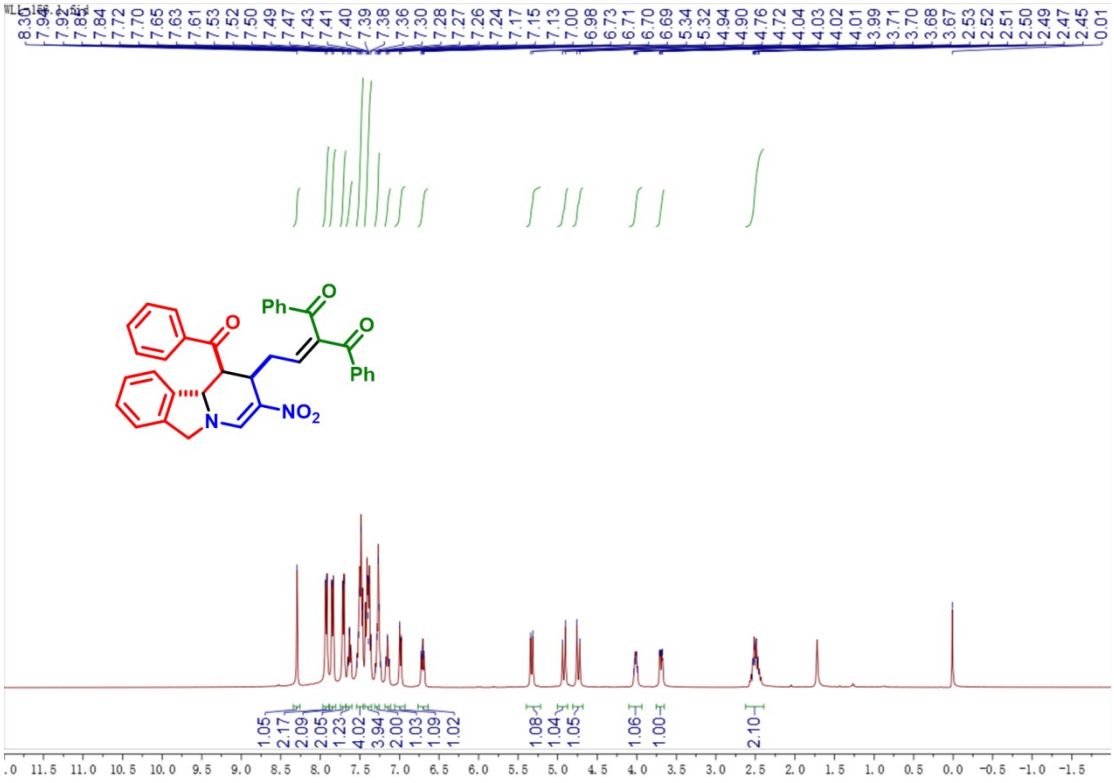
^{1}H NMR spectrum of **20** (400 MHz, $CDCl_3$)



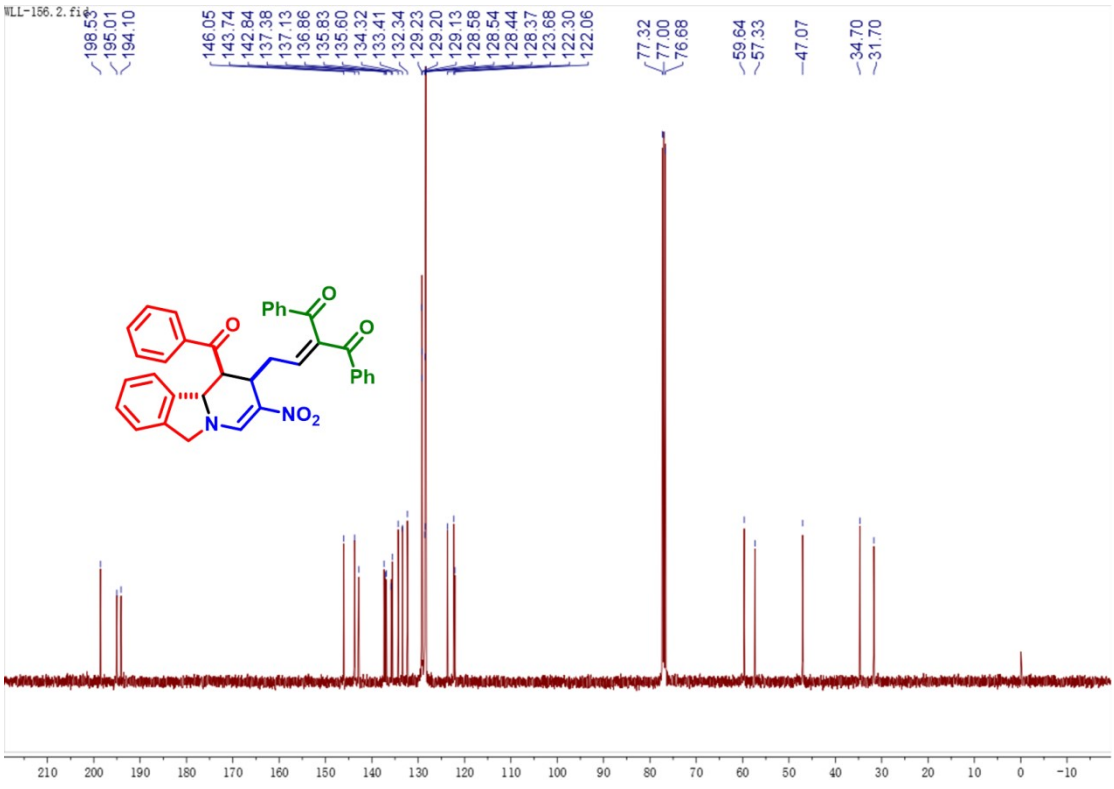
^{13}C NMR spectrum of **20** (100 MHz, $CDCl_3$)



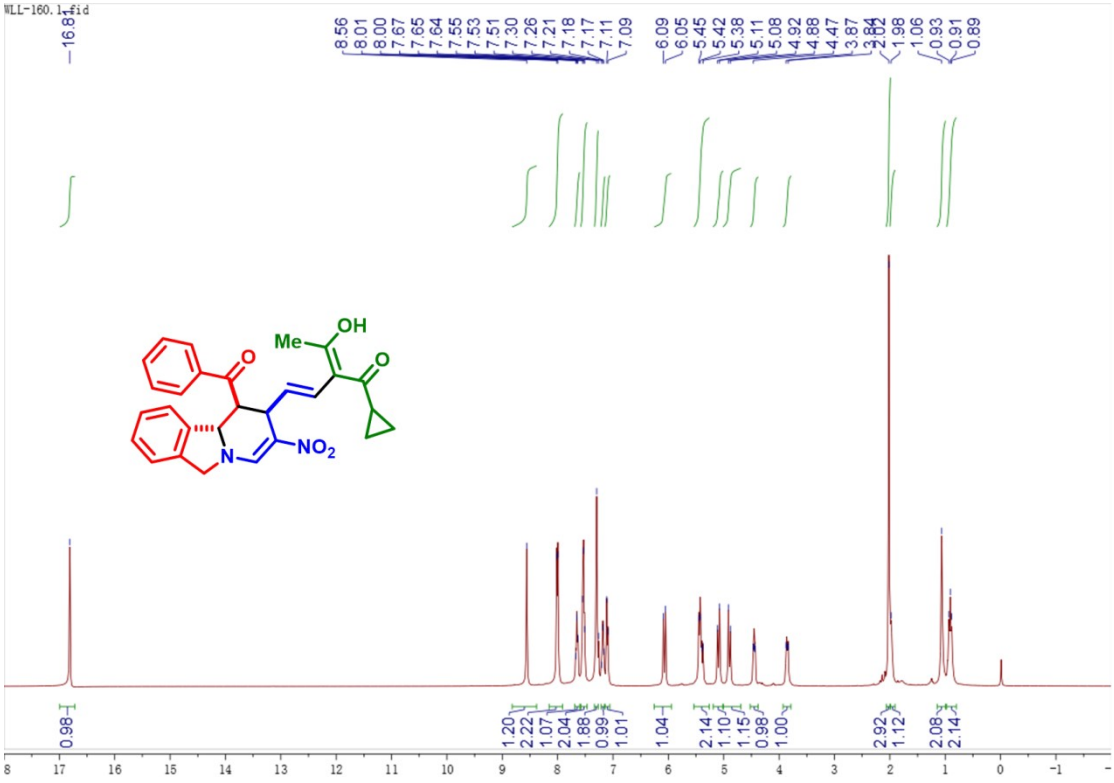
^{1}H NMR spectrum of **21** (400 MHz, $CDCl_3$)



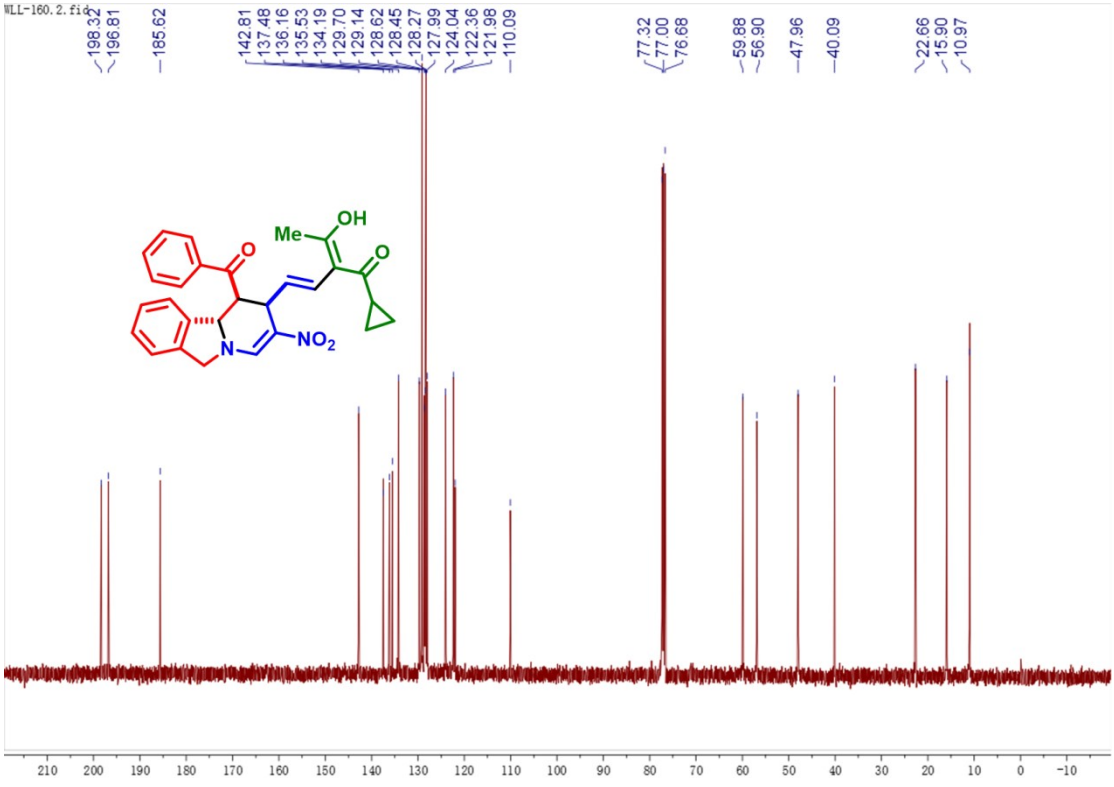
^{13}C NMR spectrum of **21** (100 MHz, $CDCl_3$)



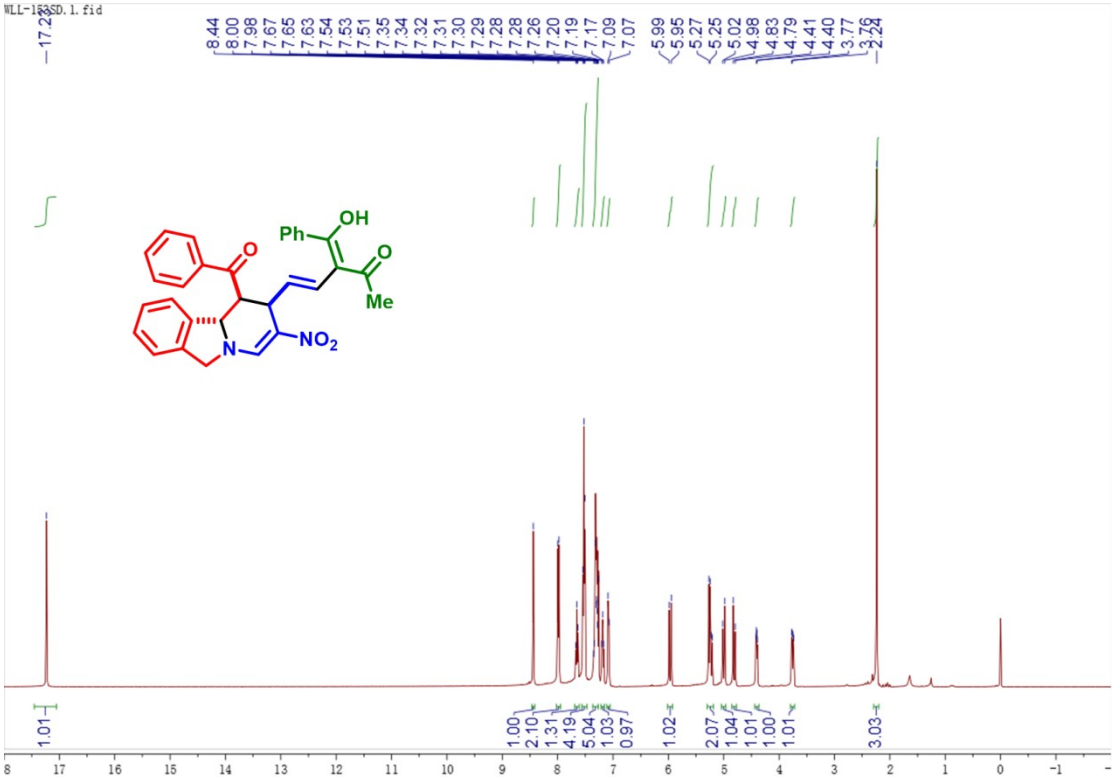
^{1}H NMR spectrum of **22** (400 MHz, $CDCl_3$)



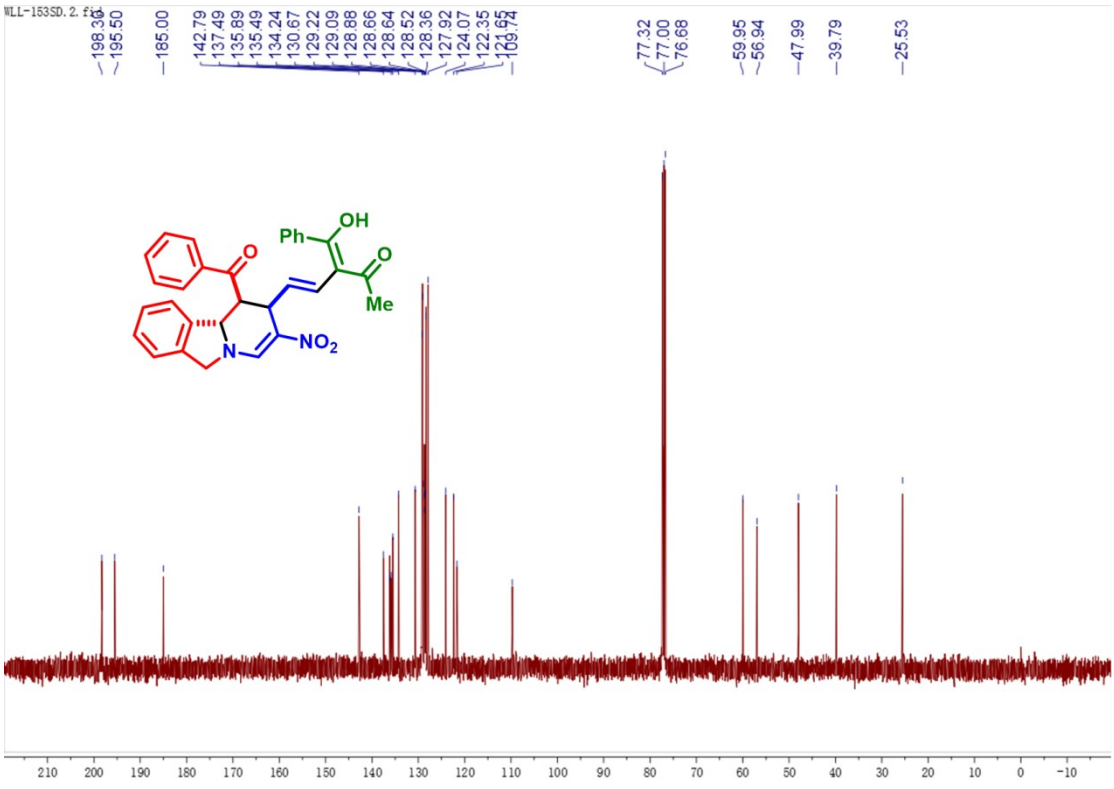
^{13}C NMR spectrum of **22** (100 MHz, $CDCl_3$)



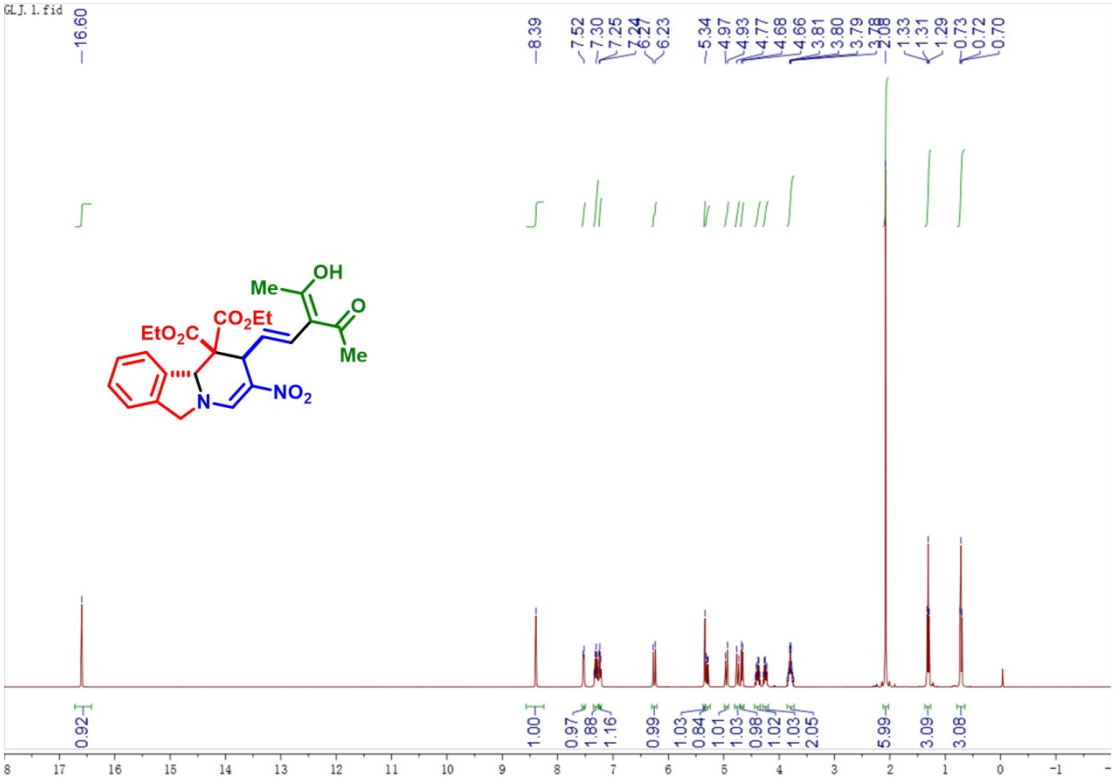
^{1}H NMR spectrum of **23** (400 MHz, $CDCl_3$)



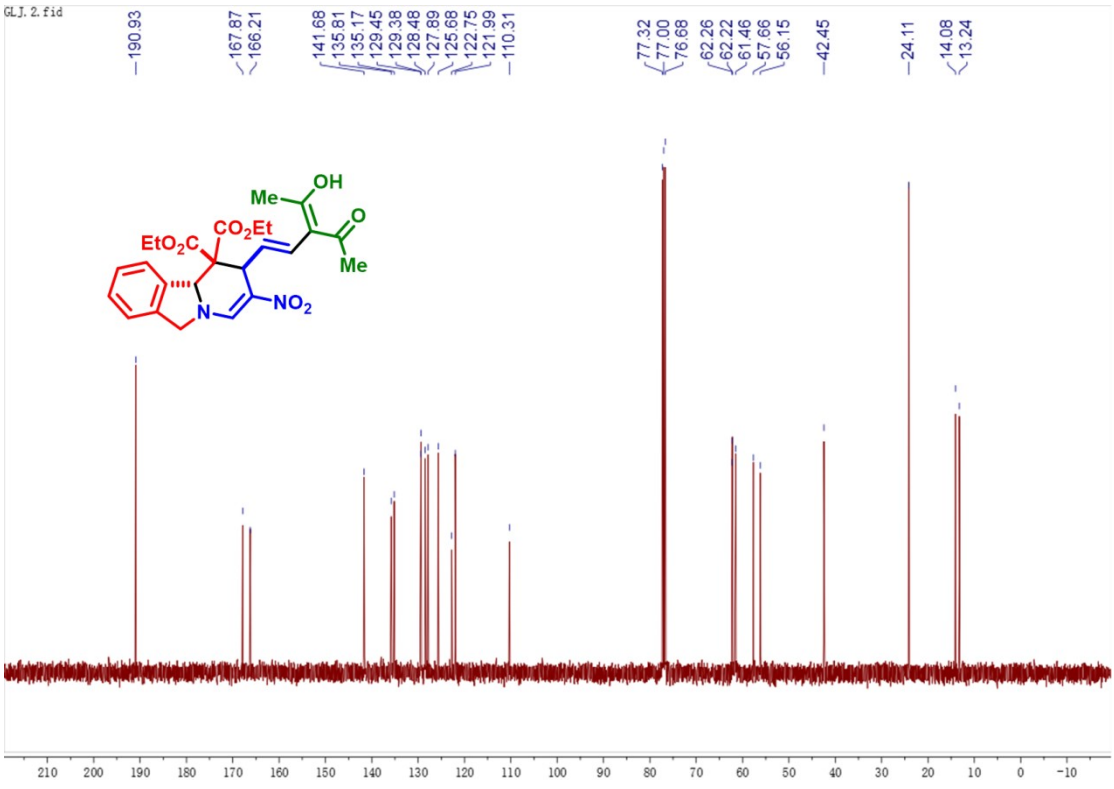
^{13}C NMR spectrum of **23** (100 MHz, $CDCl_3$)



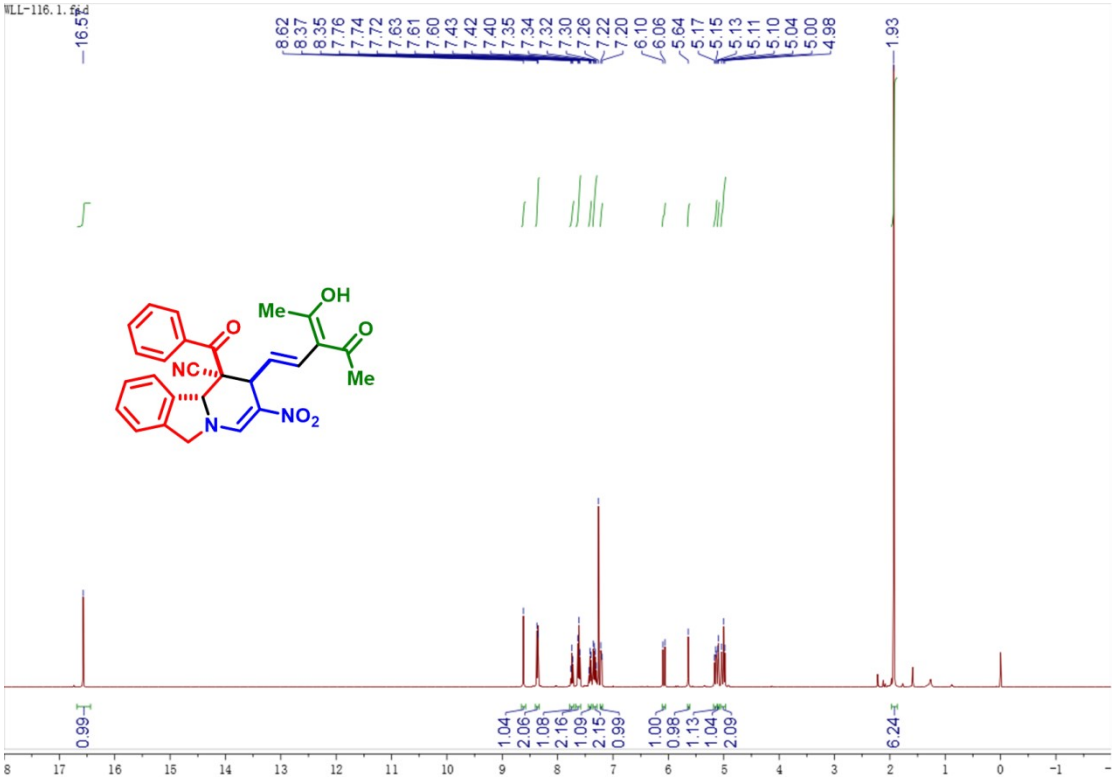
^{1}H NMR spectrum of **24** (400 MHz, $CDCl_3$)



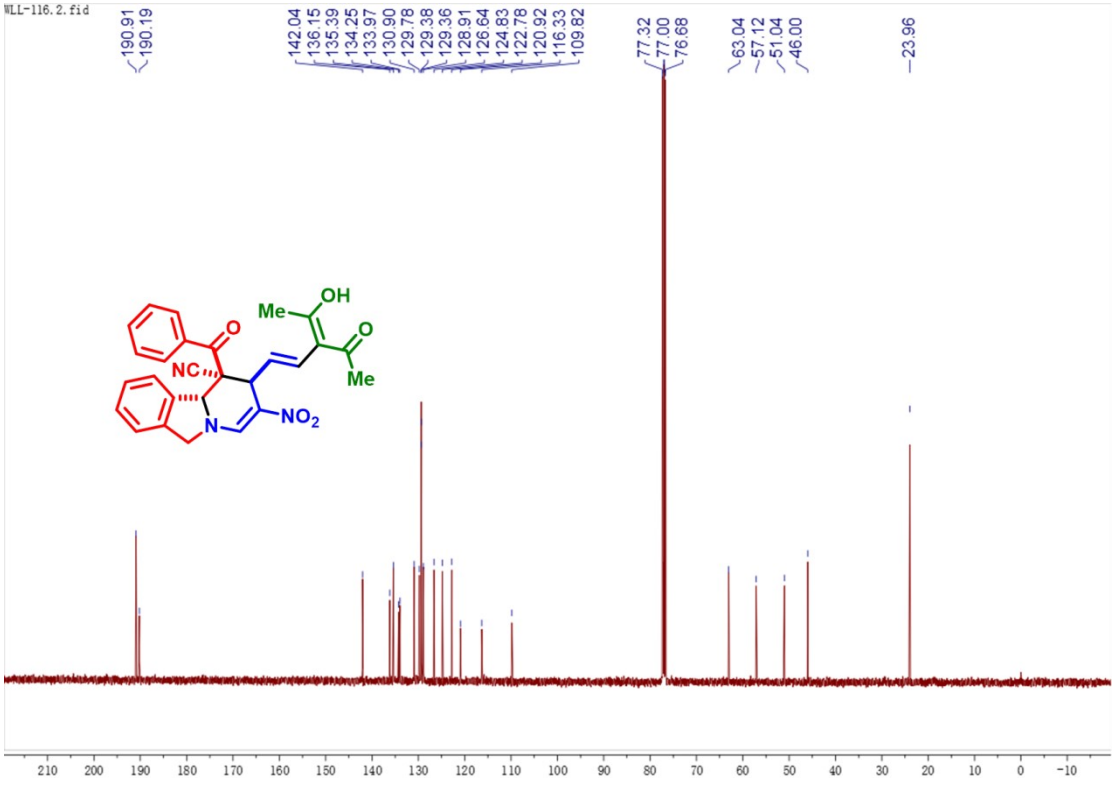
^{13}C NMR spectrum of **24** (100 MHz, $CDCl_3$)



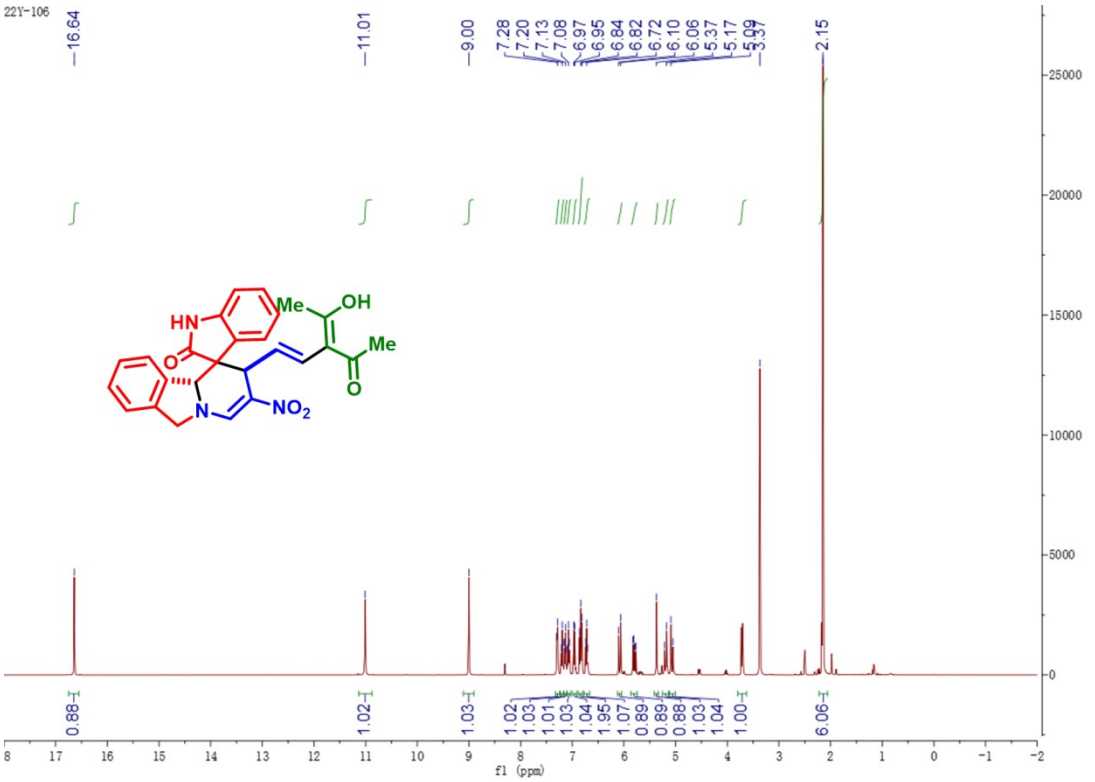
^{1}H NMR spectrum of **25** (400 MHz, $CDCl_3$)



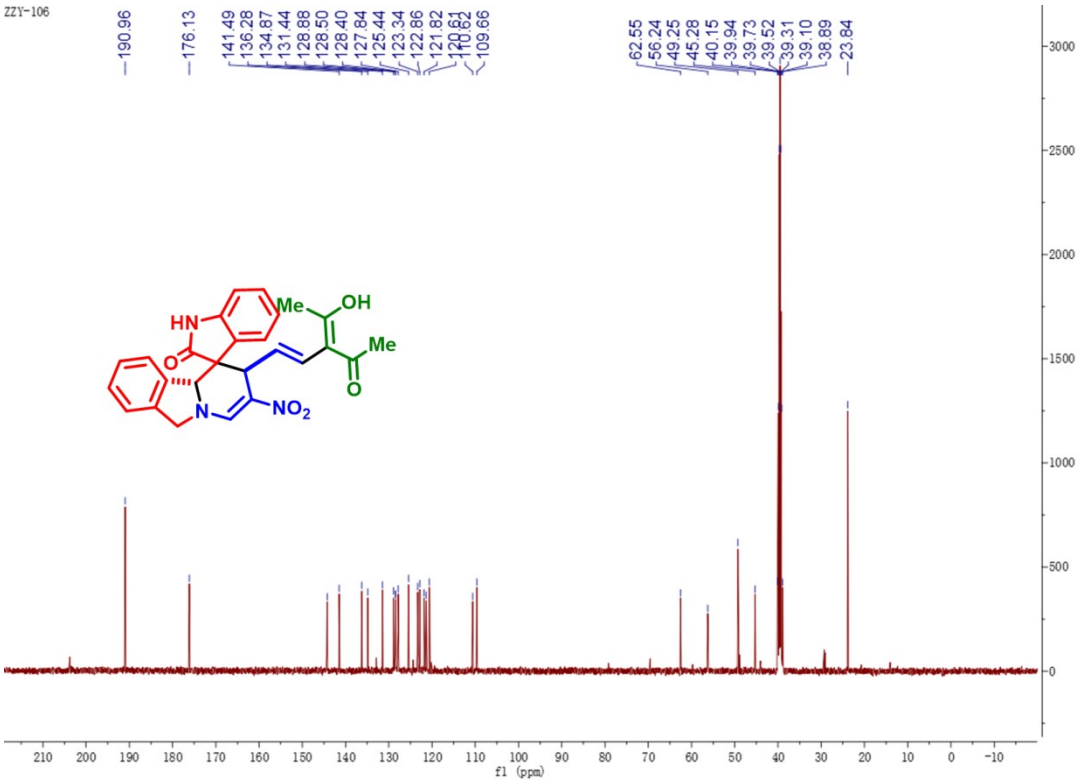
^{13}C NMR spectrum of **25** (100 MHz, $CDCl_3$)



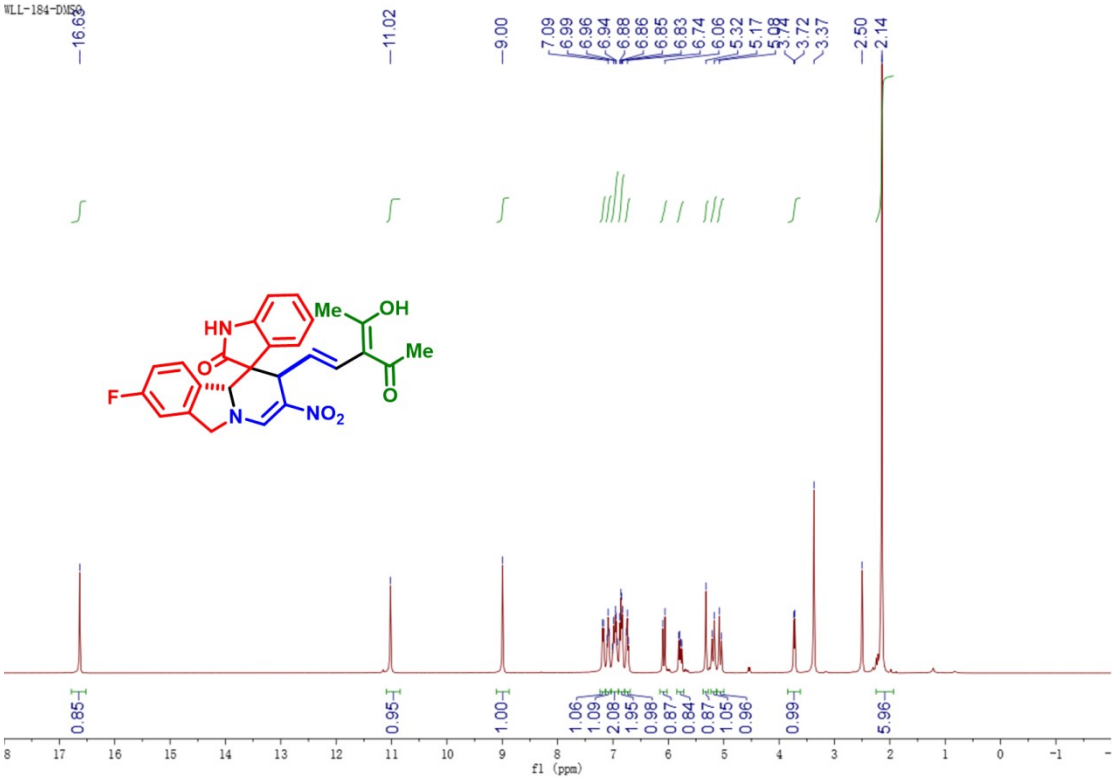
^{1}H NMR spectrum of **26** (400 MHz, DMSO-d_6)



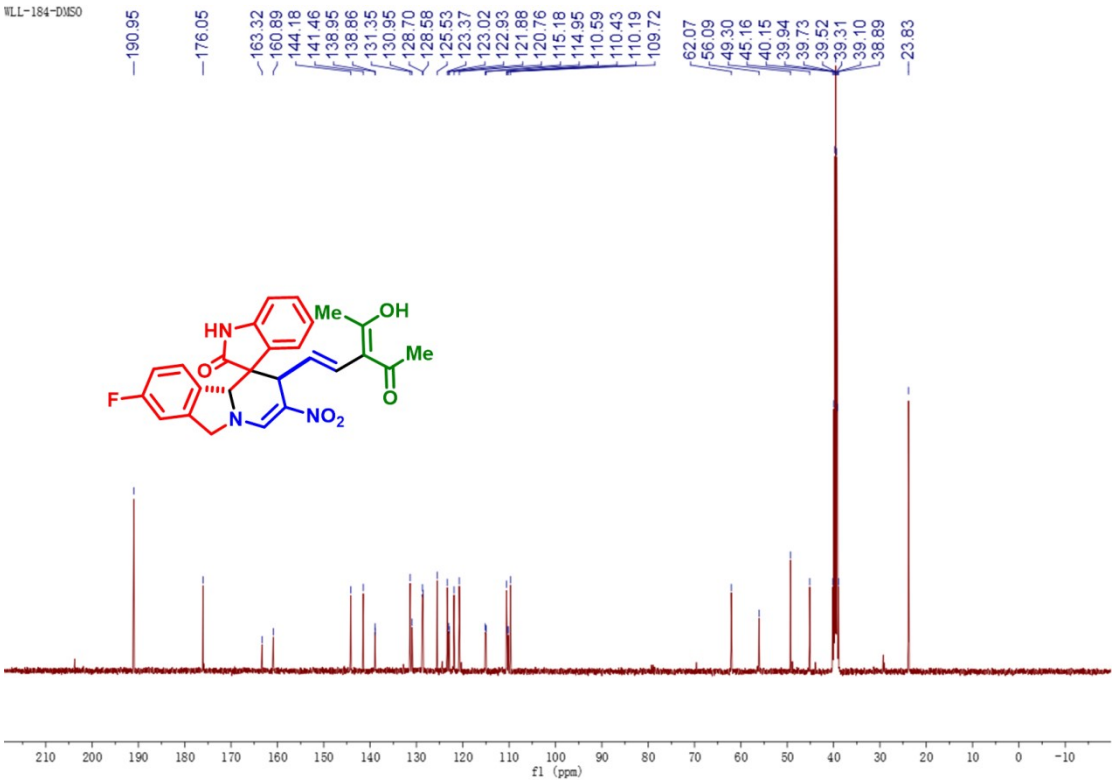
^{13}C NMR spectrum of **26** (100 MHz, DMSO-d_6)



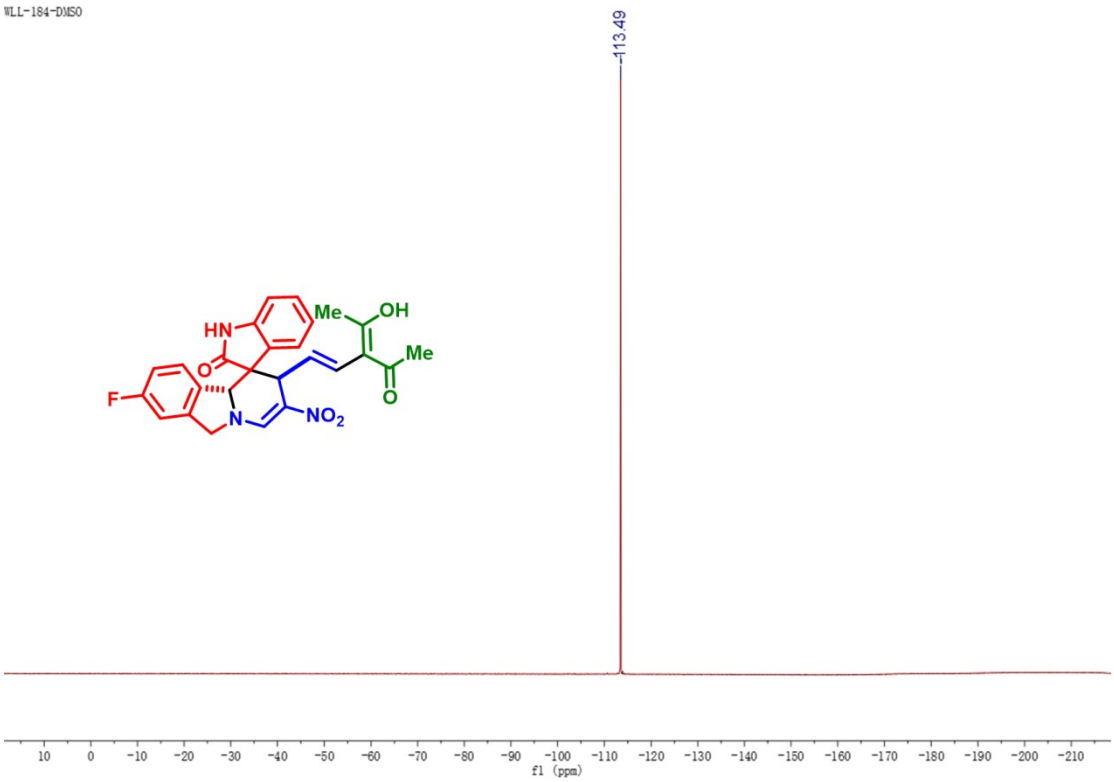
^{1}H NMR spectrum of **27** (400 MHz, DMSO-d_6)



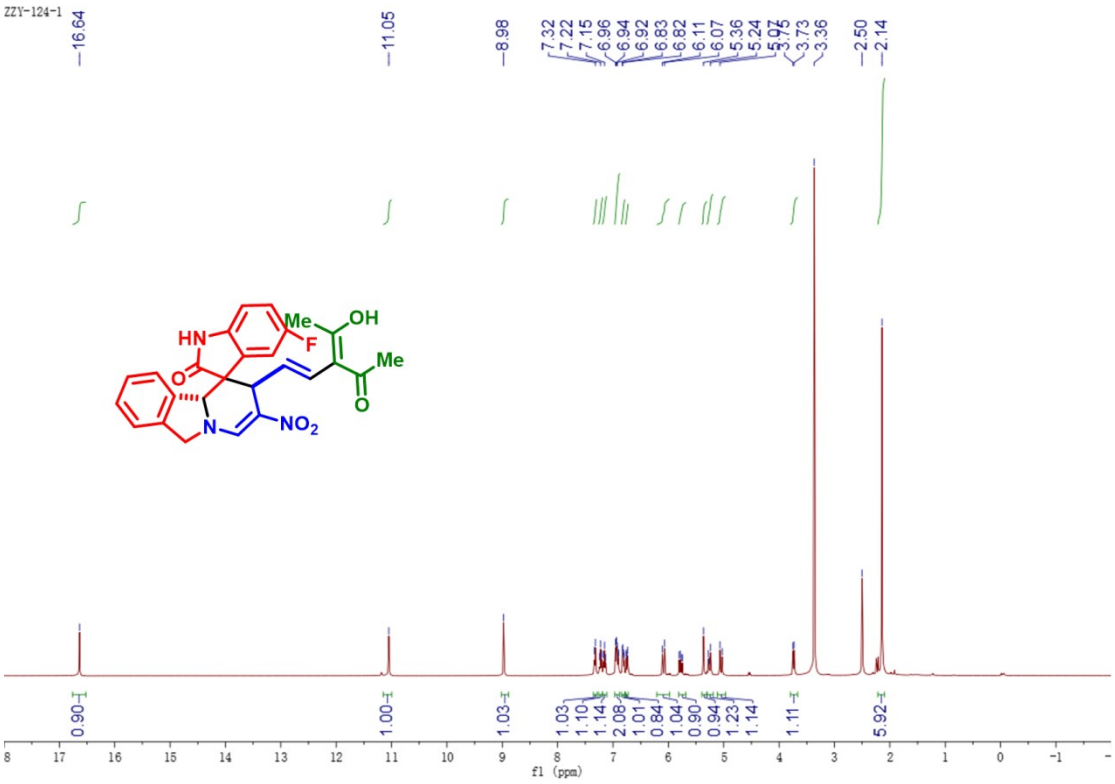
^{13}C NMR spectrum of **27** (100 MHz, DMSO-d_6)



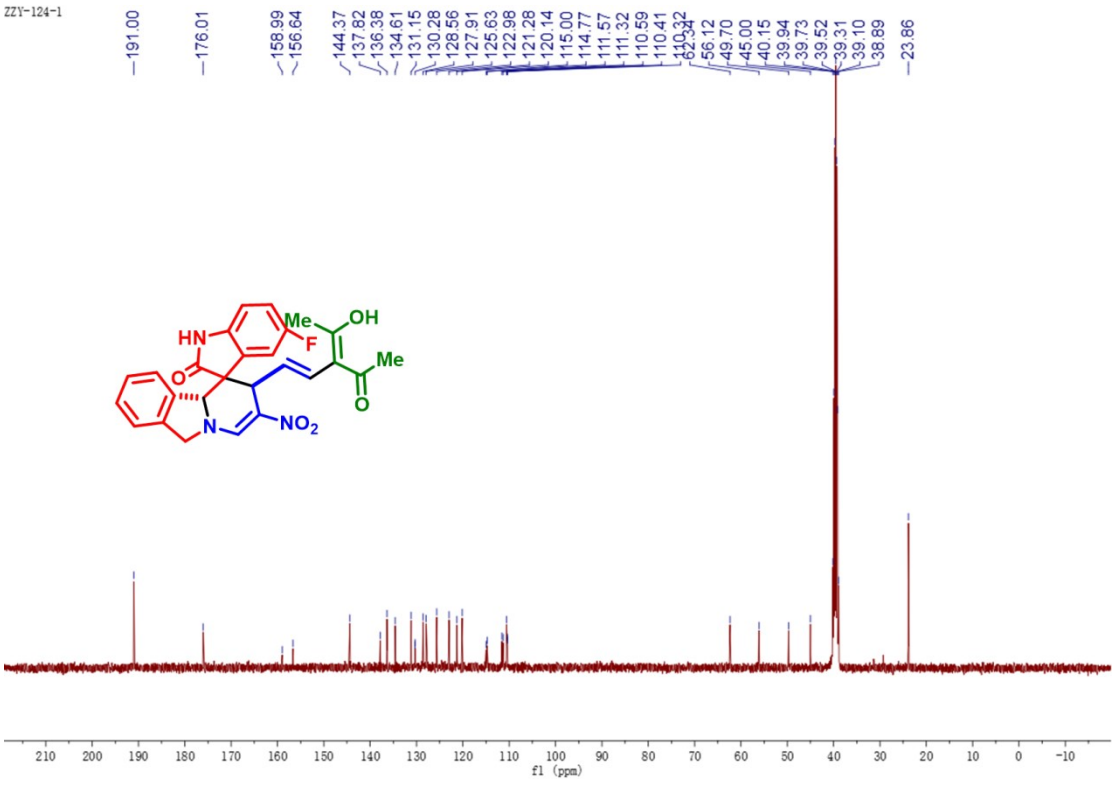
^{19}F NMR spectrum of **27** (375 MHz, DMSO-d_6)



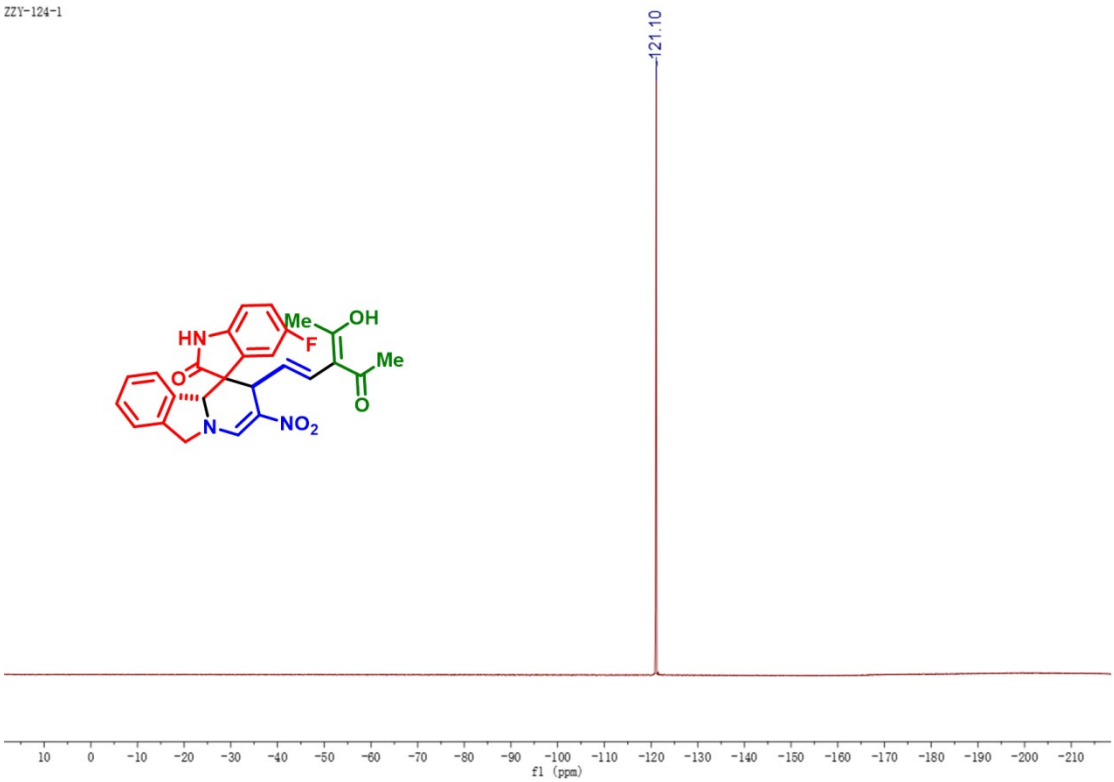
^{1}H NMR spectrum of **28** (400 MHz, DMSO-d_6)



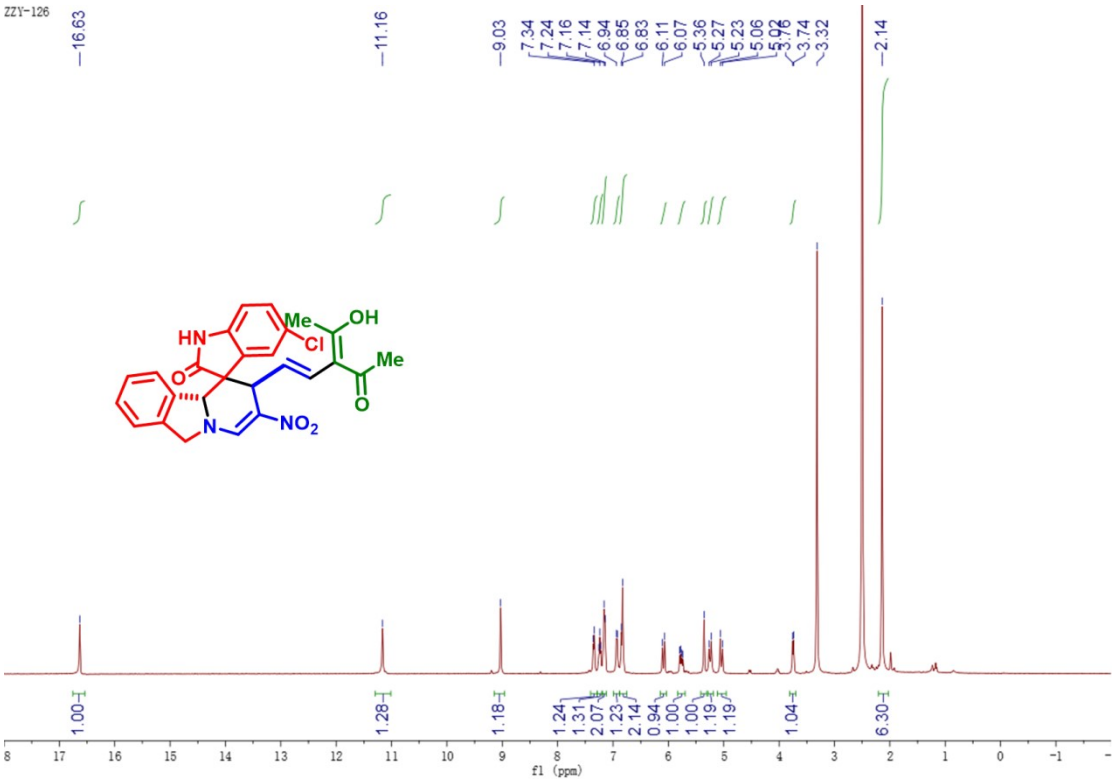
^{13}C NMR spectrum of **28** (100 MHz, DMSO-d_6)



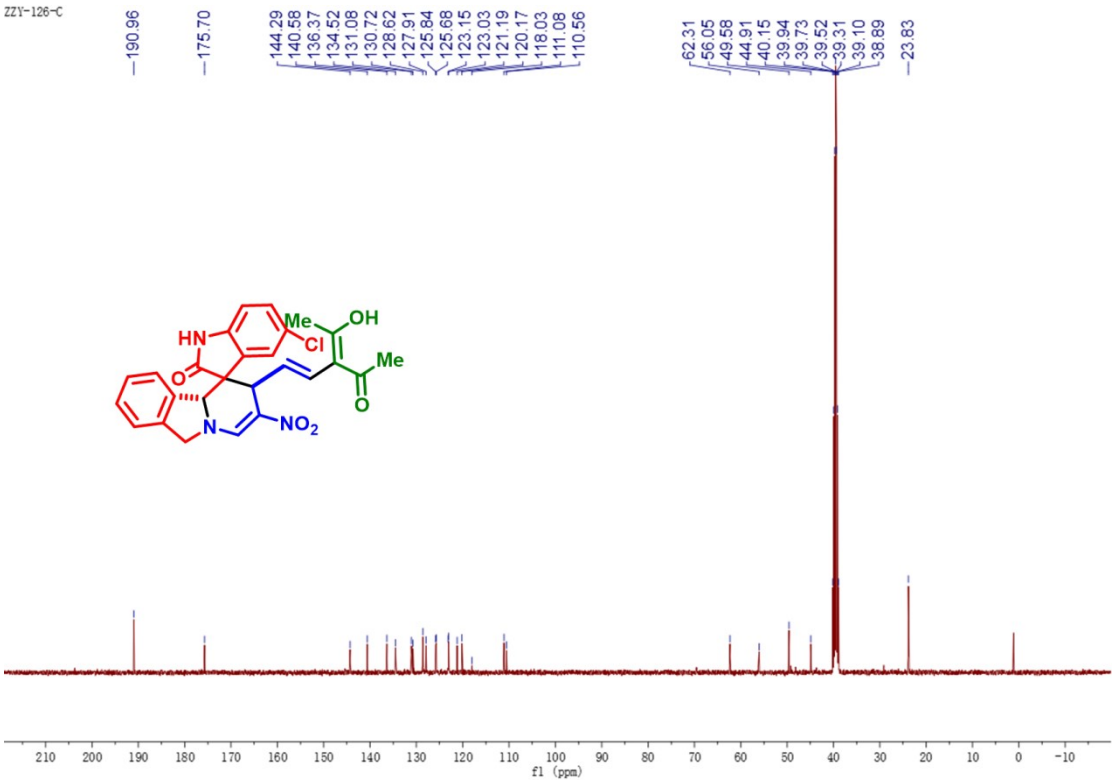
^{19}F NMR spectrum of **28** (375 MHz, DMSO-d_6)



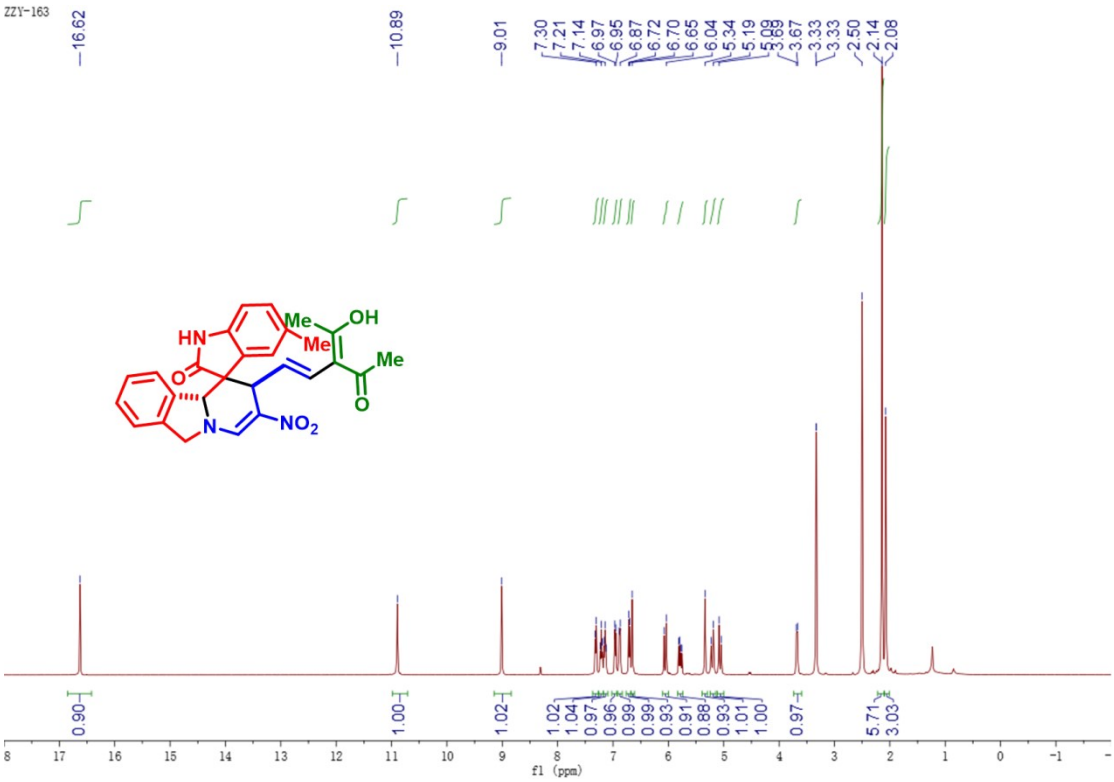
^{1}H NMR spectrum of **29** (400 MHz, DMSO-d_6)



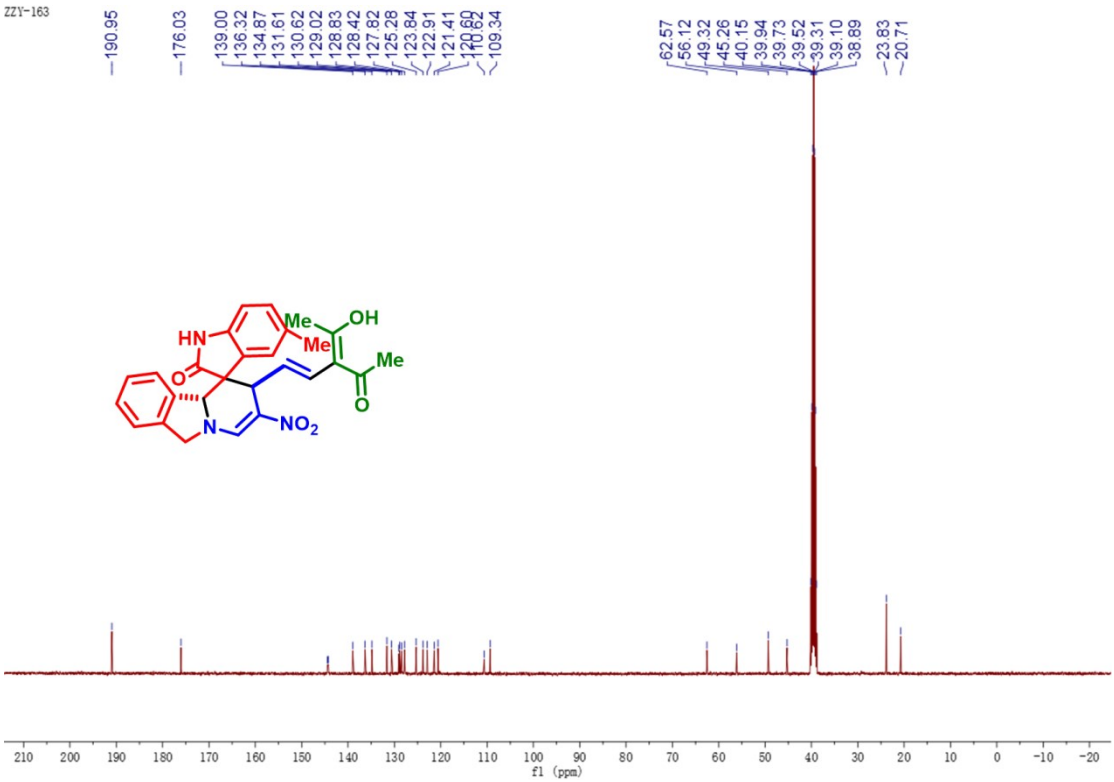
^{13}C NMR spectrum of **29** (100 MHz, DMSO-d_6)



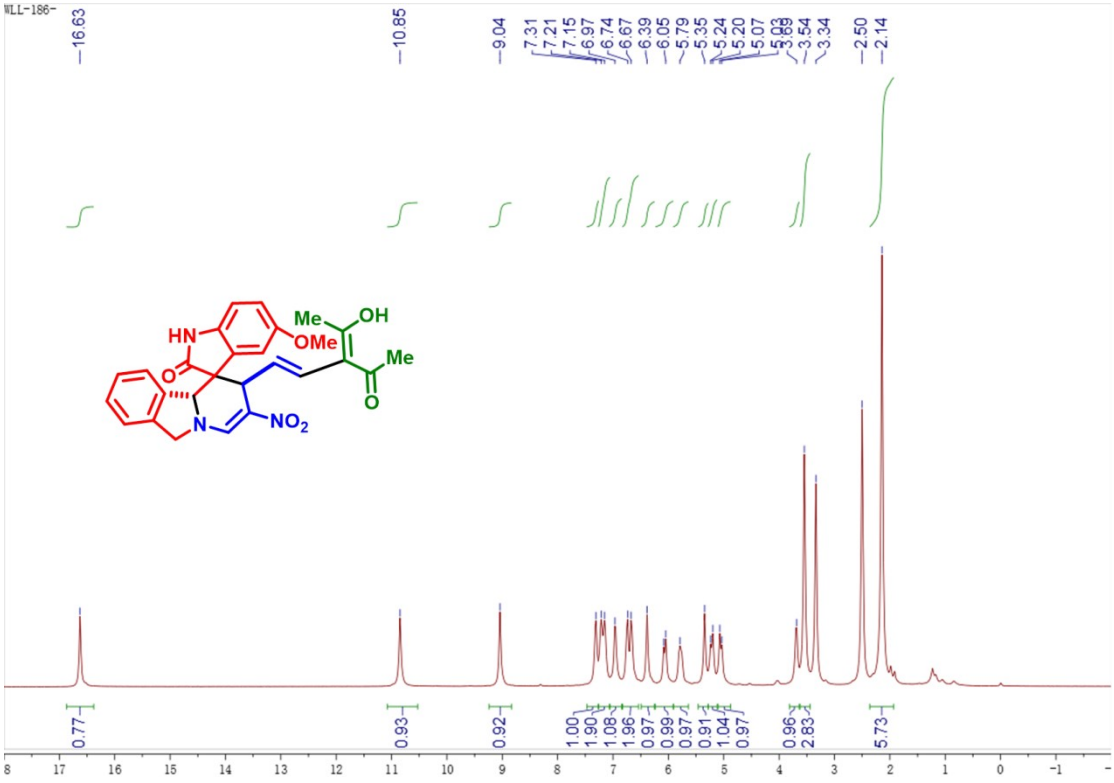
^{1}H NMR spectrum of **30** (400 MHz, DMSO-d_6)



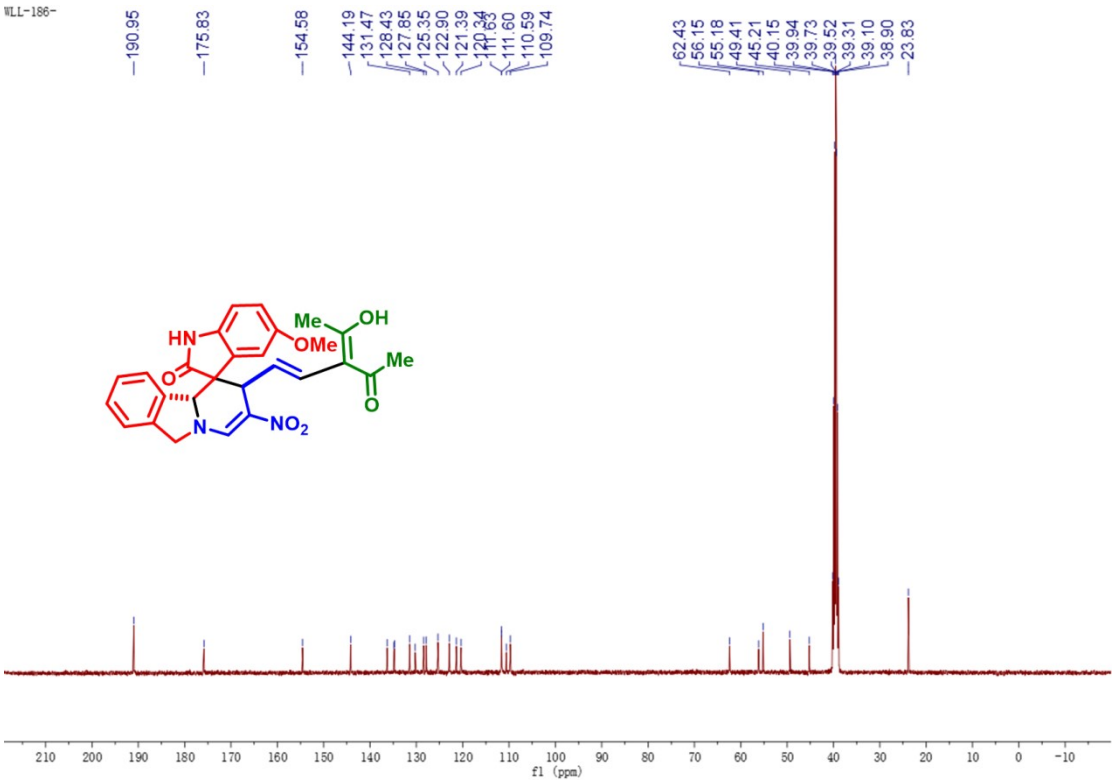
^{13}C NMR spectrum of **30** (100 MHz, DMSO-d_6)



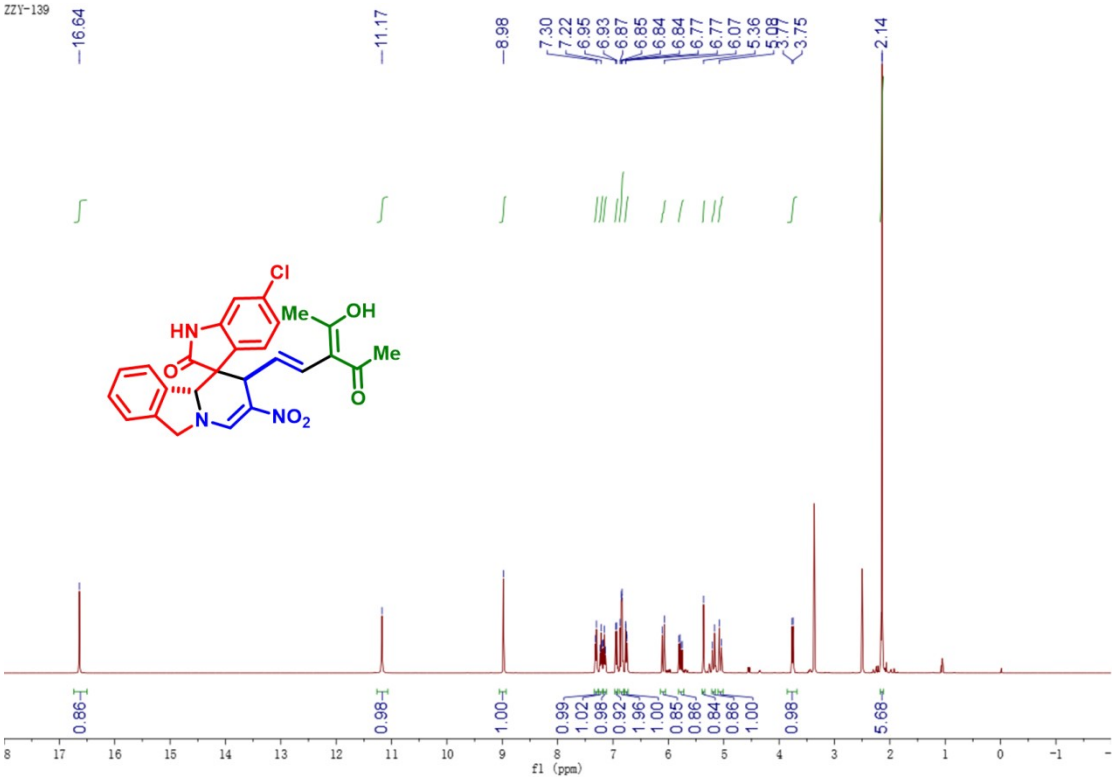
^{1}H NMR spectrum of **31** (400 MHz, DMSO-d_6)



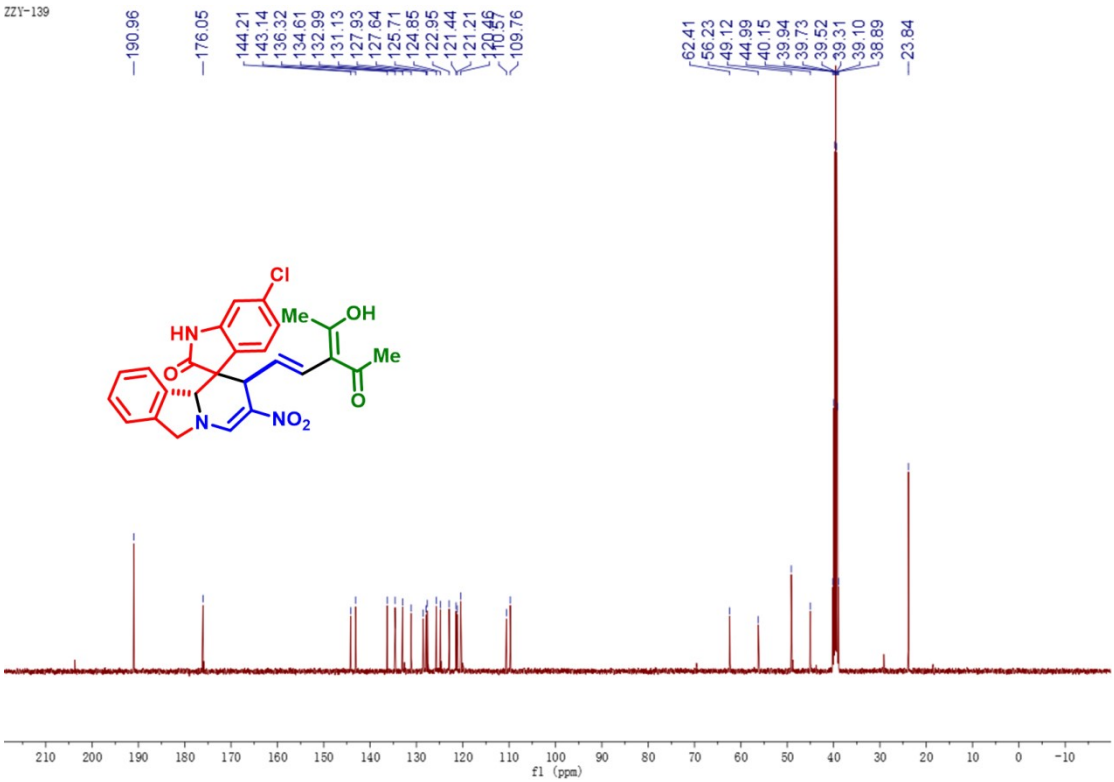
^{13}C NMR spectrum of **31** (100 MHz, DMSO-d_6)



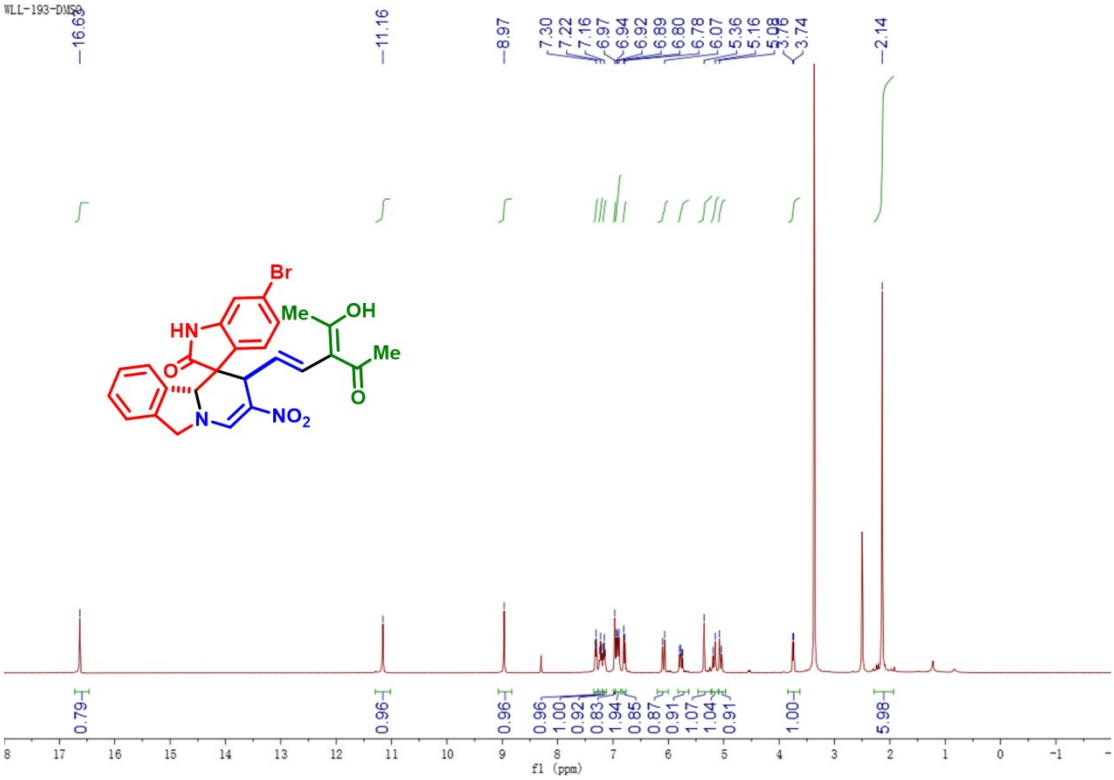
^{1}H NMR spectrum of **32** (400 MHz, DMSO-d_6)



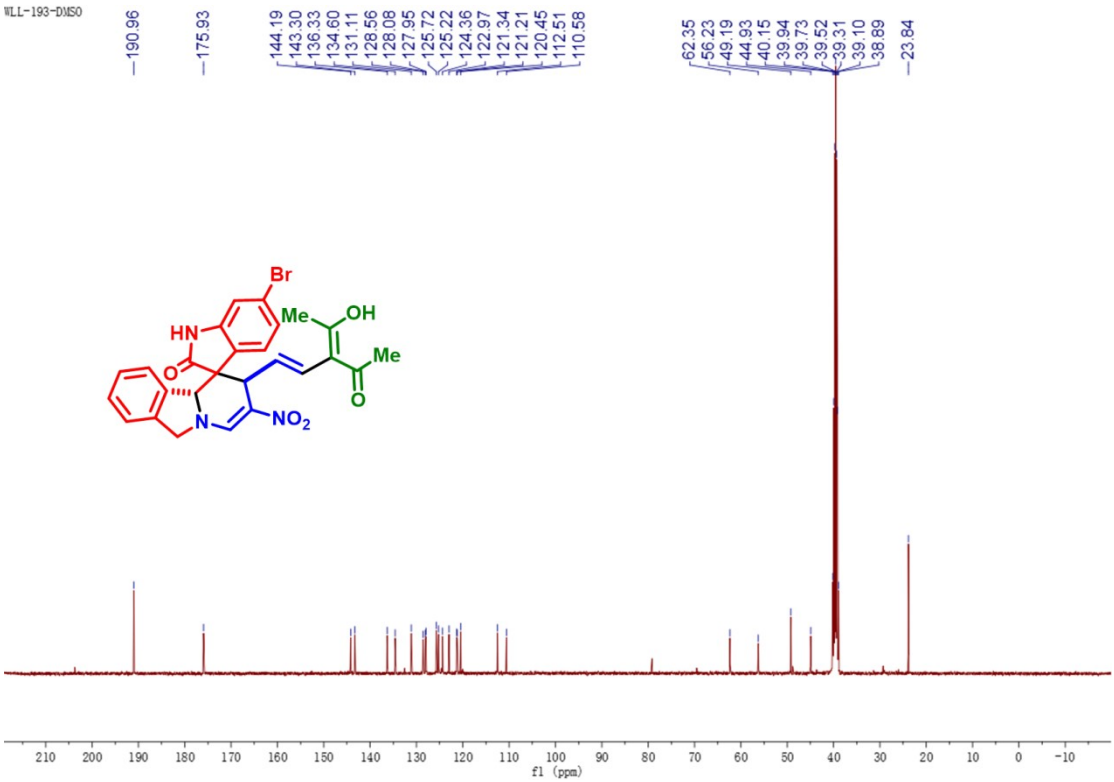
^{13}C NMR spectrum of **32** (100 MHz, DMSO-d_6)



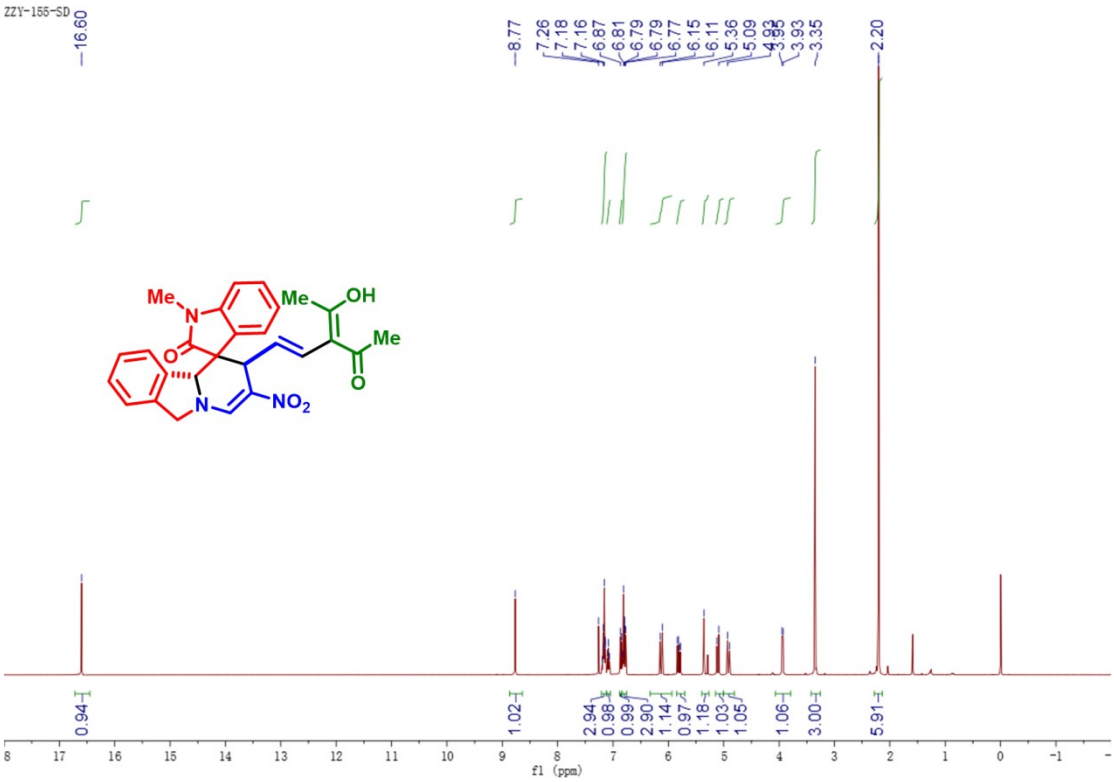
^{1}H NMR spectrum of **33** (400 MHz, DMSO-d_6)



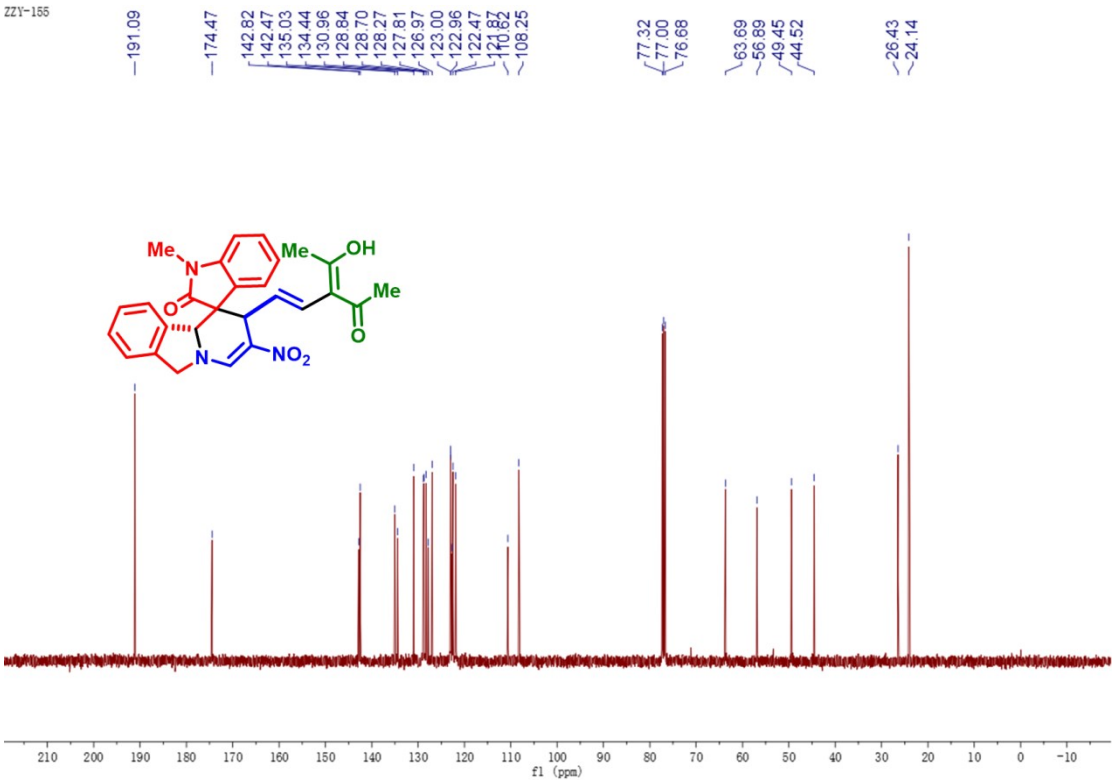
^{13}C NMR spectrum of **33** (100 MHz, DMSO-d_6)



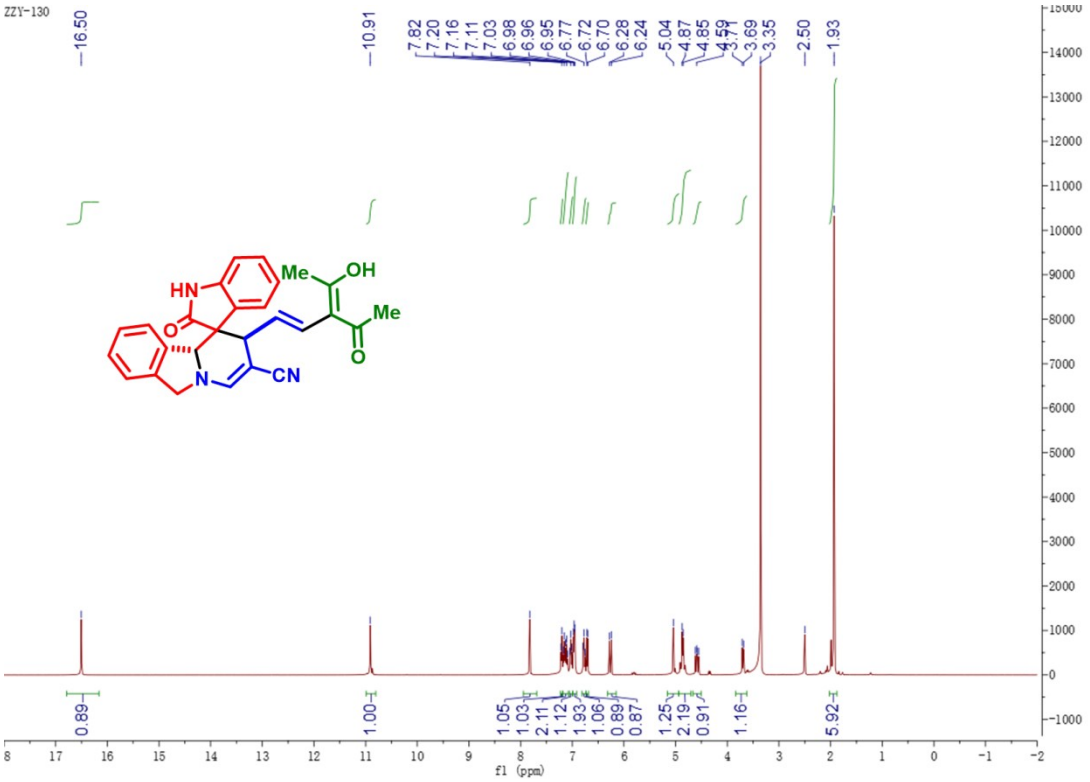
^{1}H NMR spectrum of **34** (400 MHz, $CDCl_3$)



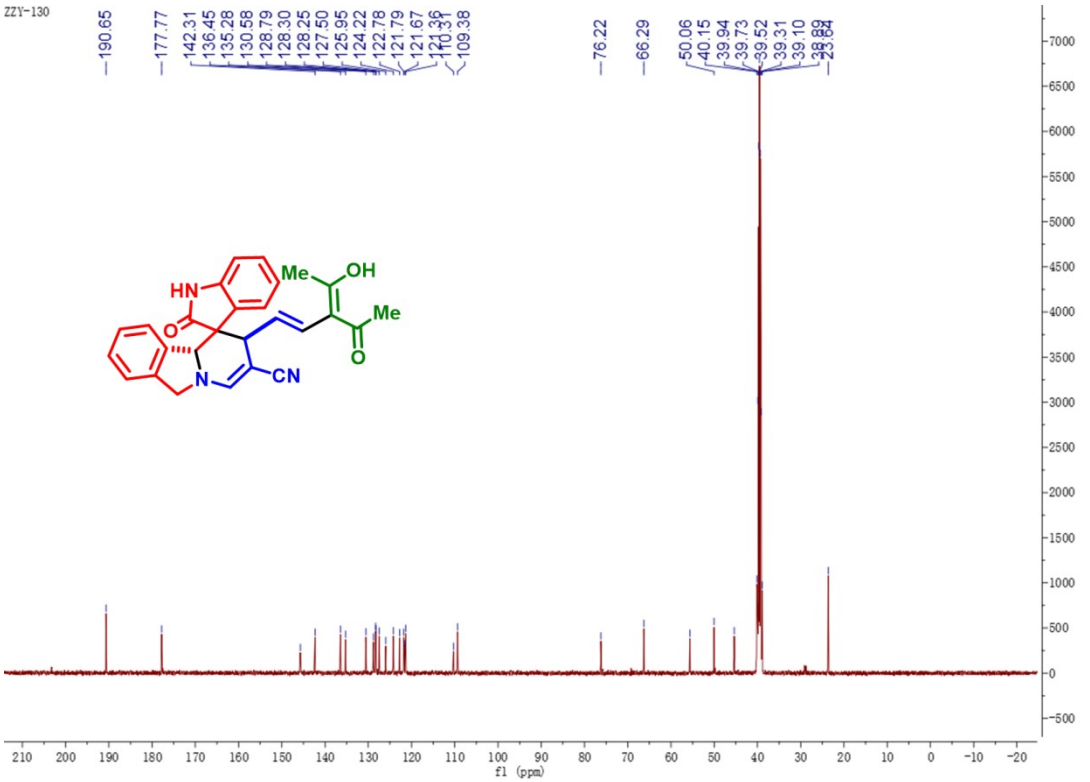
^{13}C NMR spectrum of **34** (100 MHz, $CDCl_3$)



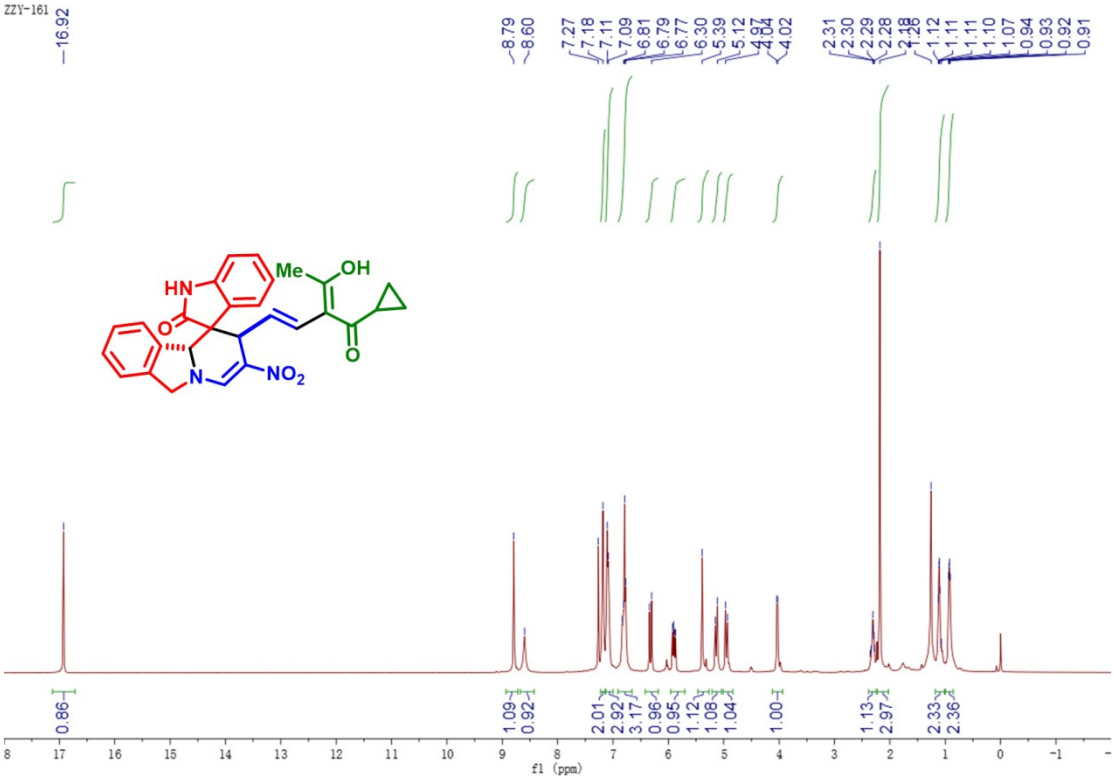
^{1}H NMR spectrum of **35** (400 MHz, DMSO-d_6)



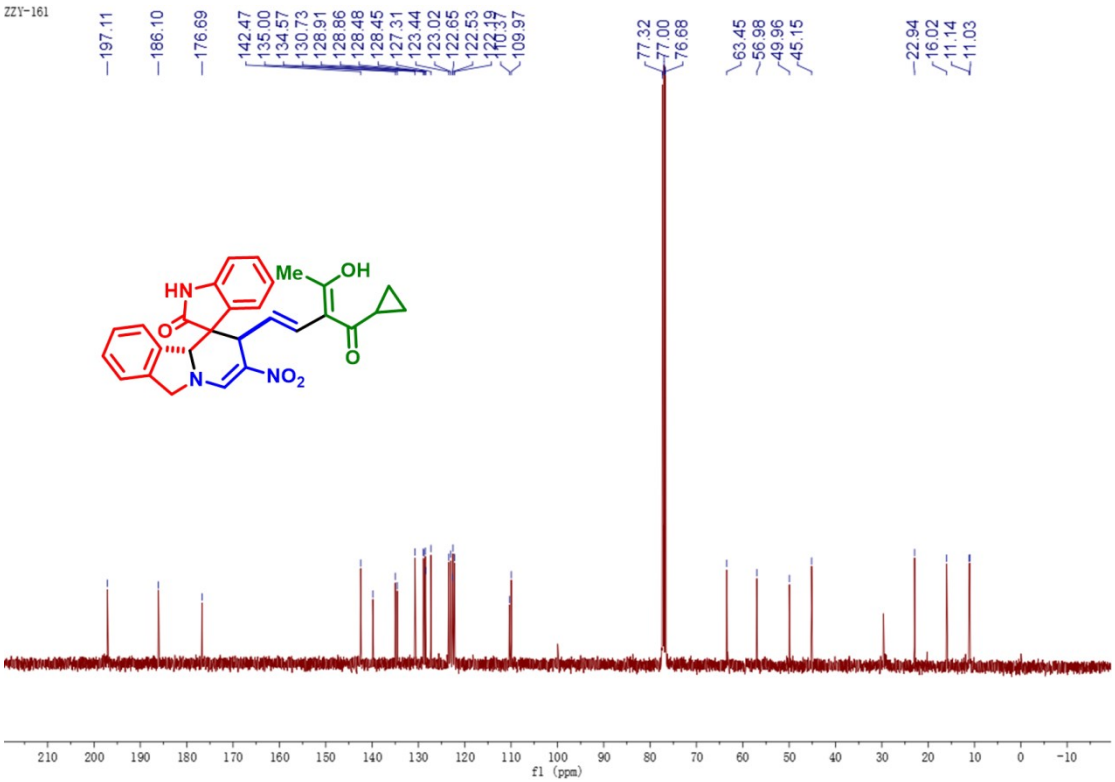
^{13}C NMR spectrum of **35** (100 MHz, DMSO-d_6)



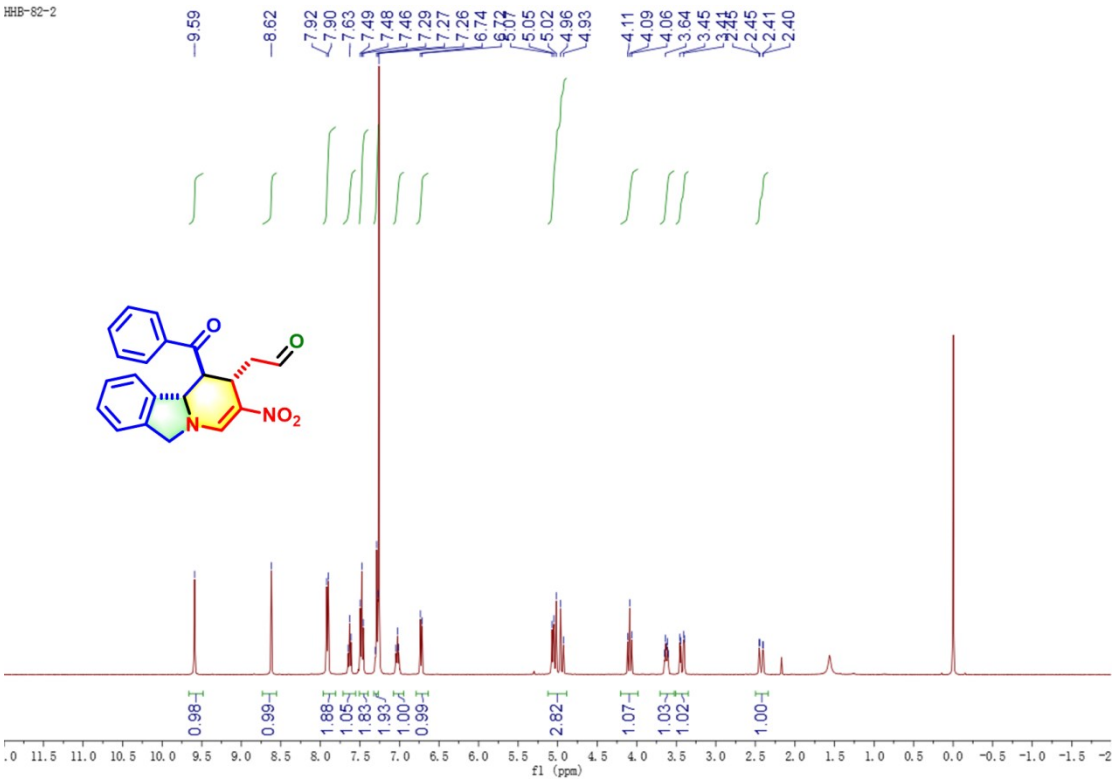
^{1}H NMR spectrum of **36** (400 MHz, $CDCl_3$)



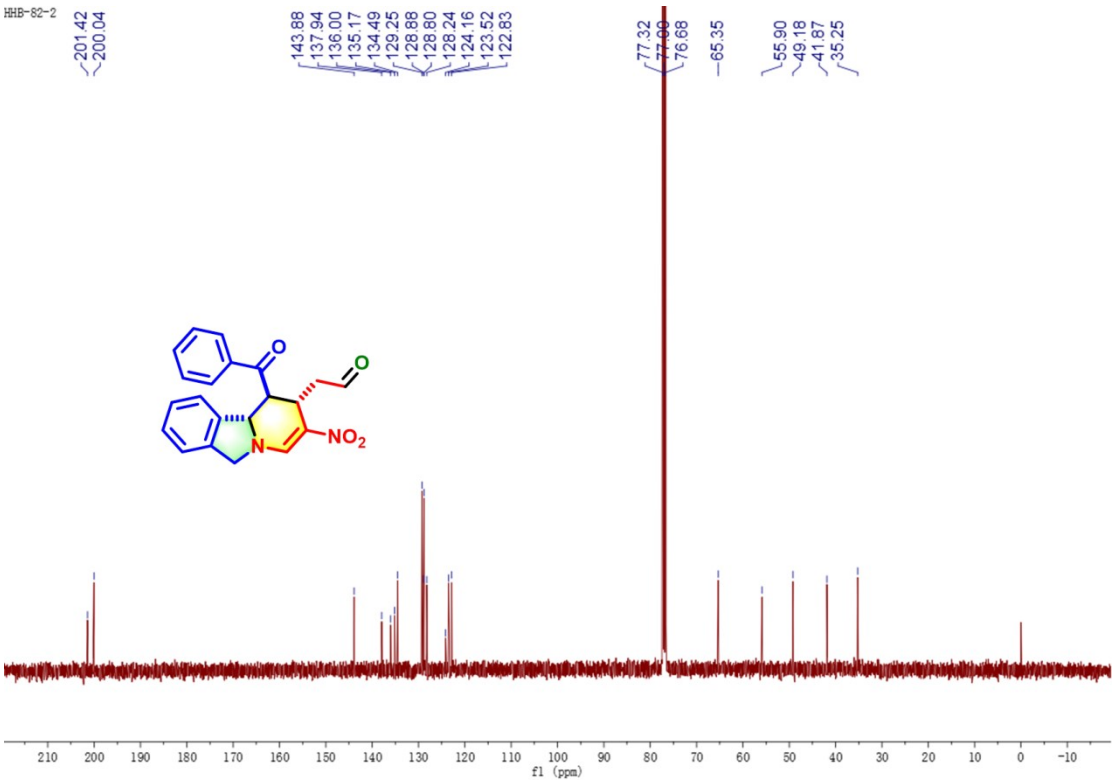
^{13}C NMR spectrum of **36** (100 MHz, $CDCl_3$)



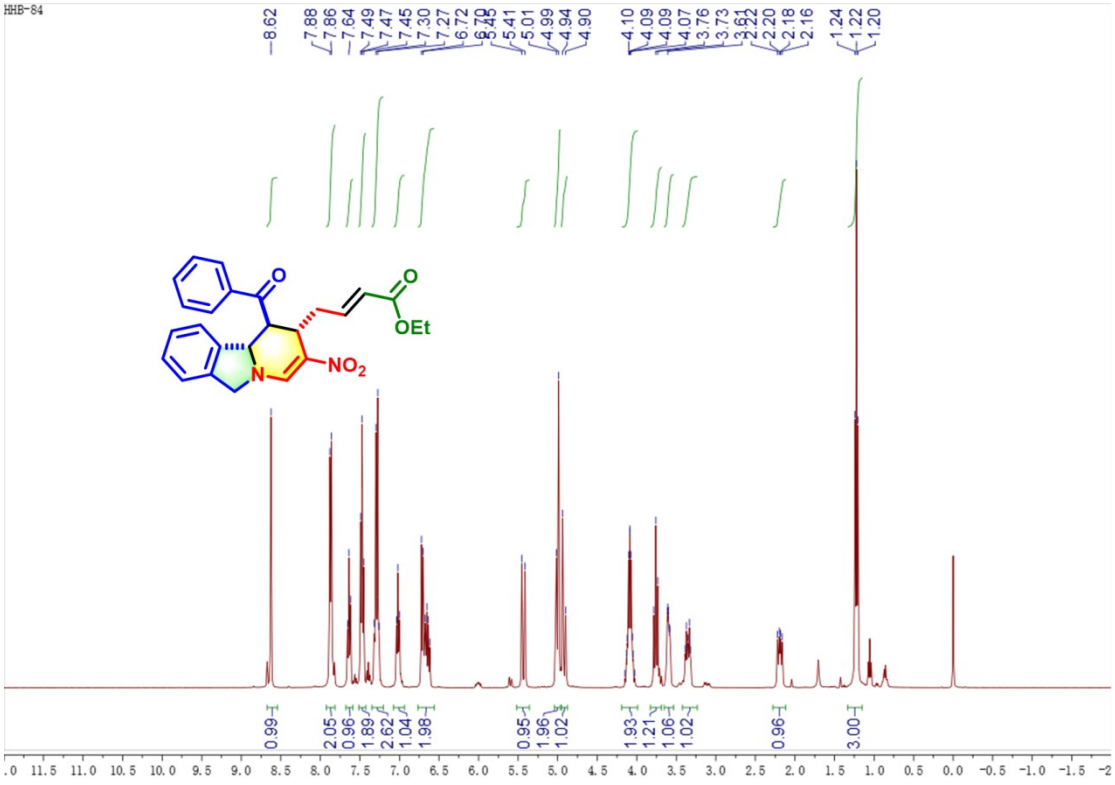
^{1}H NMR spectrum of **37** (400 MHz, $CDCl_3$)



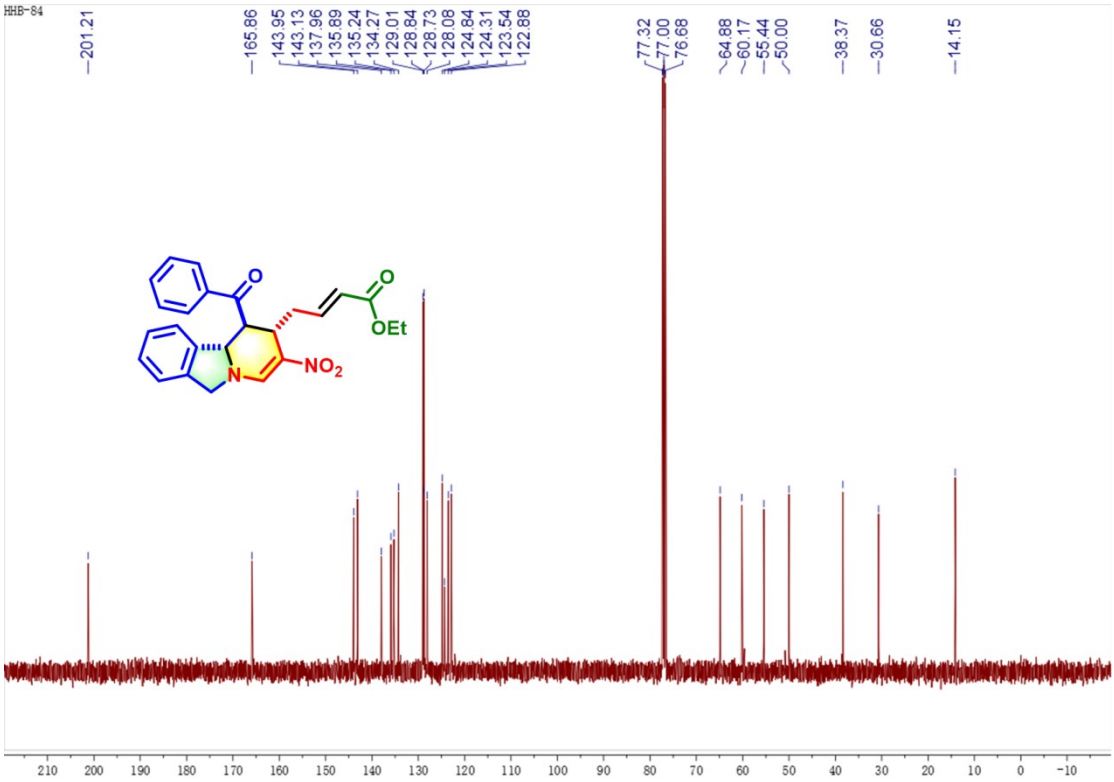
^{13}C NMR spectrum of **37** (100 MHz, $CDCl_3$)



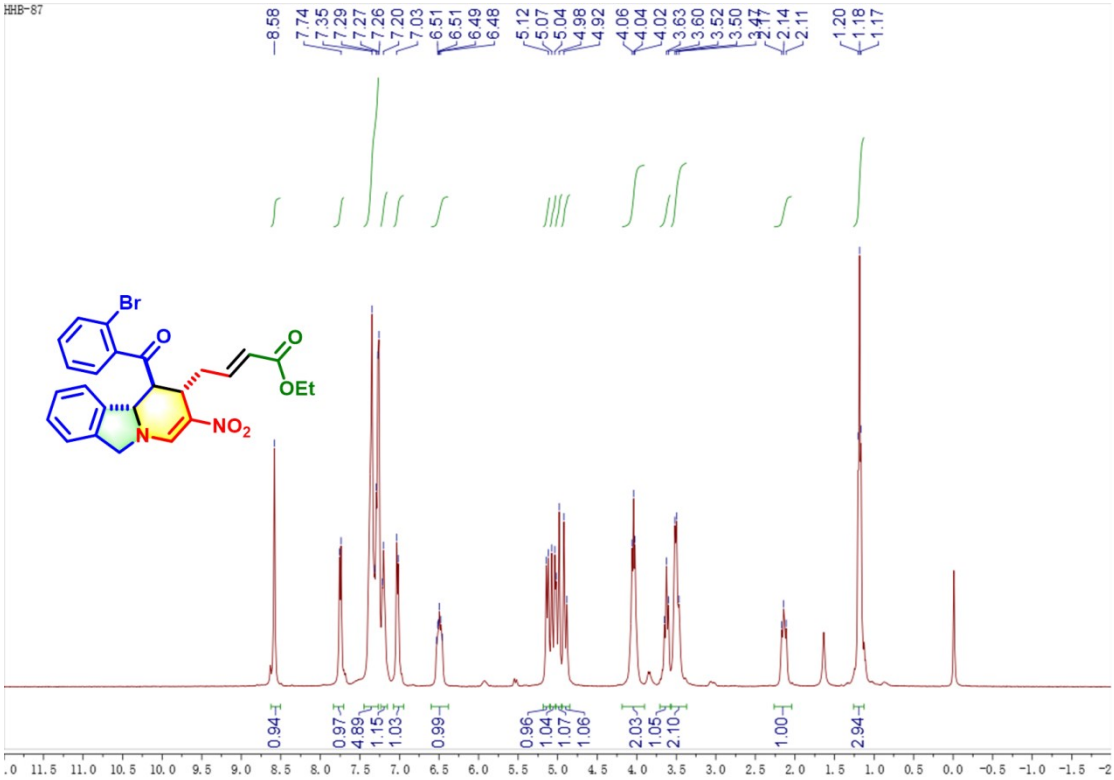
^{1}H NMR spectrum of **38** (400 MHz, $CDCl_3$)



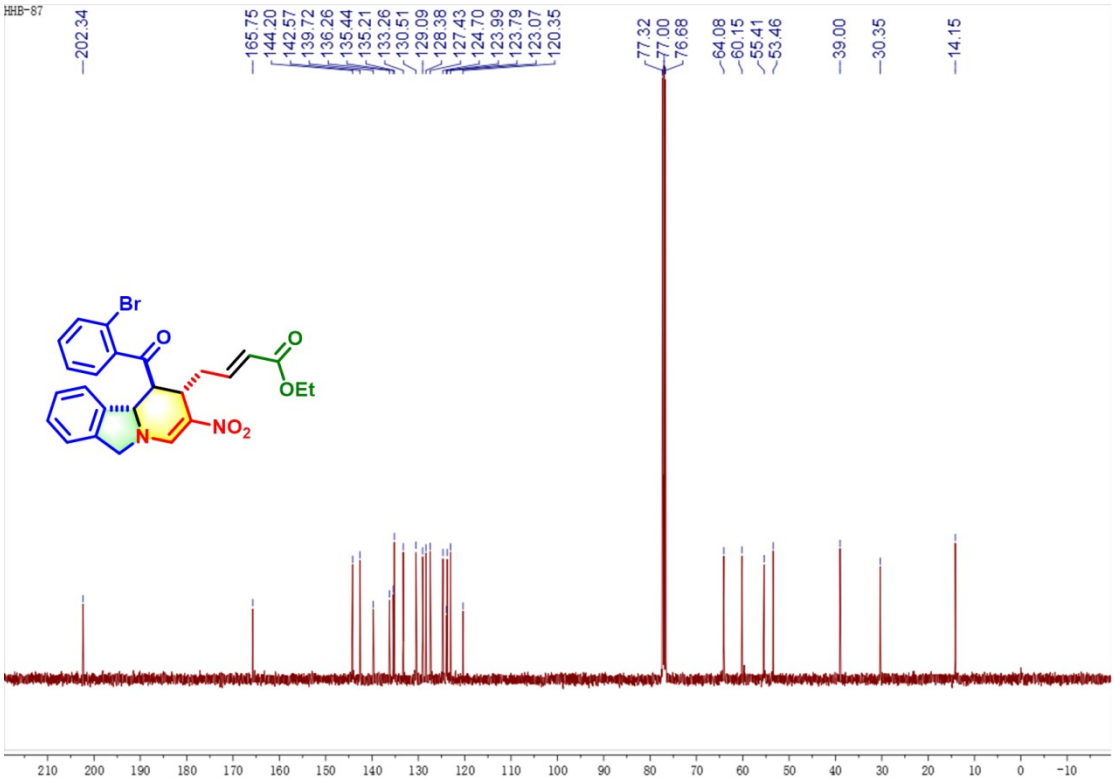
^{13}C NMR spectrum of **38** (100 MHz, $CDCl_3$)



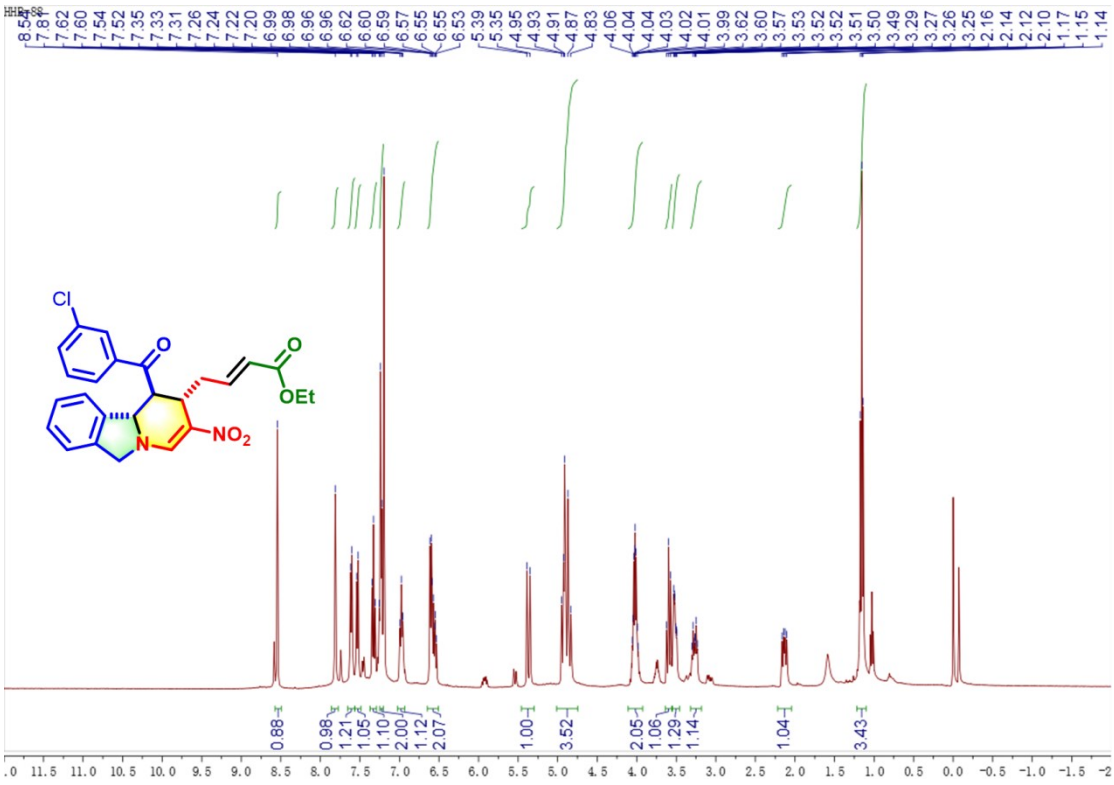
^{1}H NMR spectrum of **39** (400 MHz, $CDCl_3$)



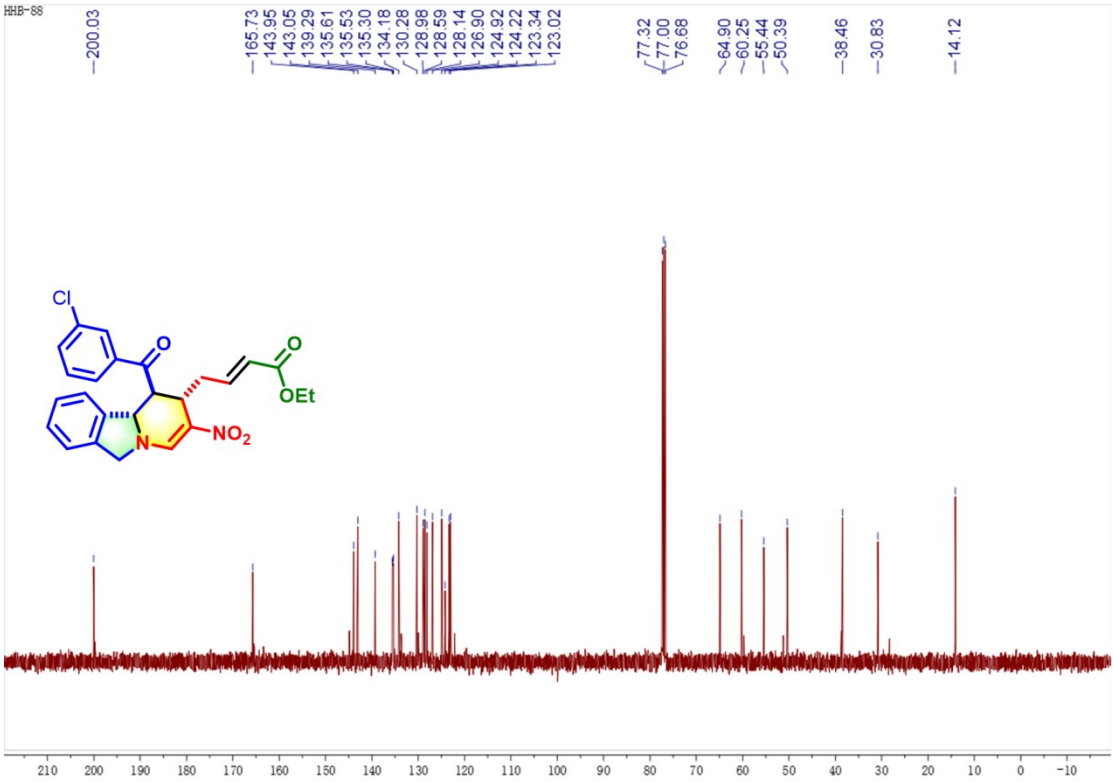
^{13}C NMR spectrum of **39** (100 MHz, $CDCl_3$)



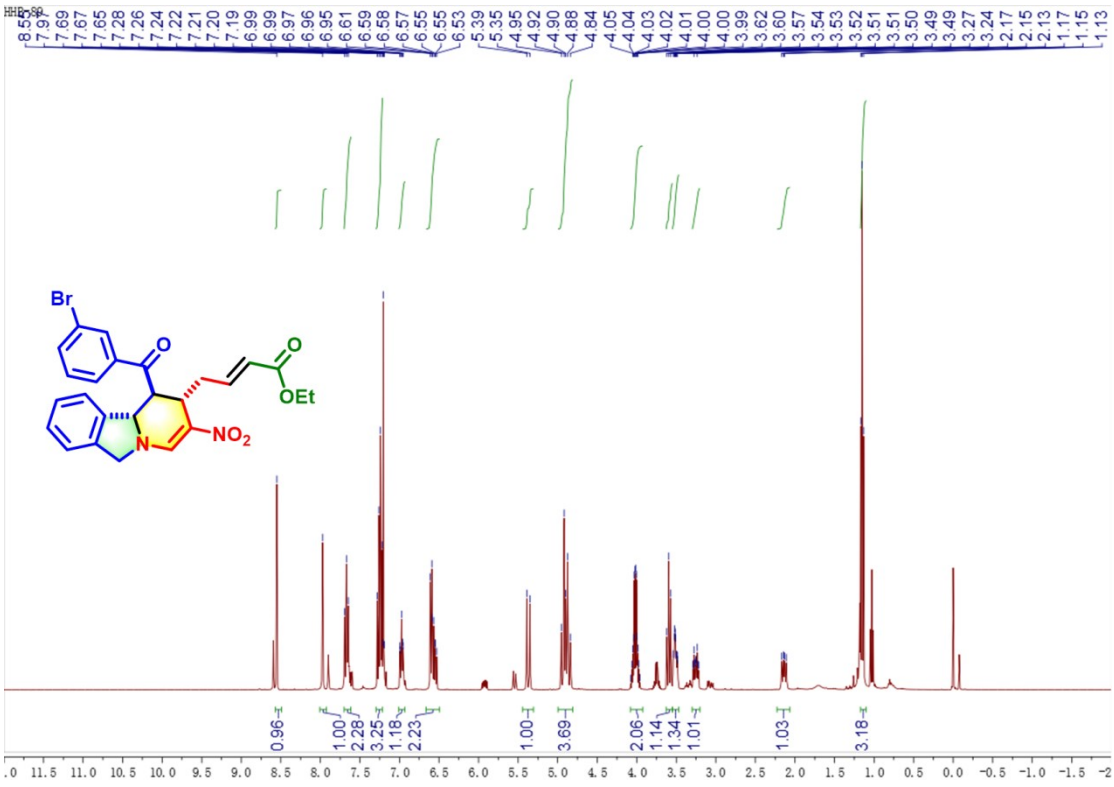
^{1}H NMR spectrum of **40** (400 MHz, $CDCl_3$)



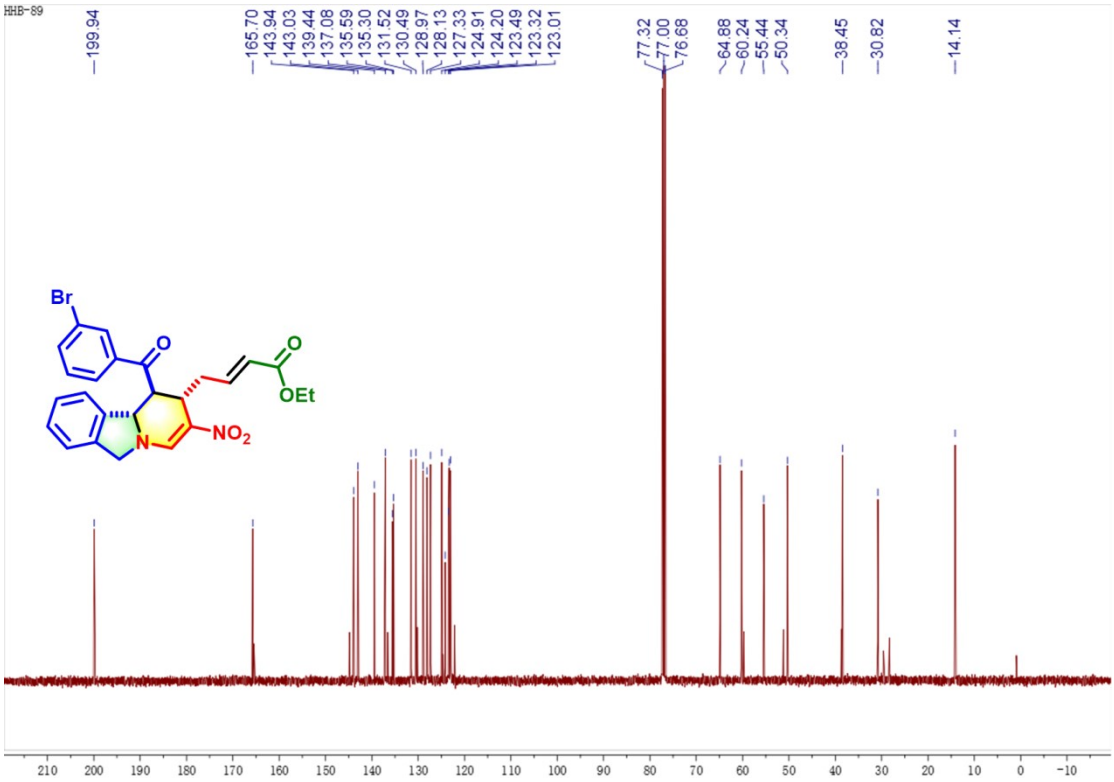
^{13}C NMR spectrum of **40** (100 MHz, $CDCl_3$)



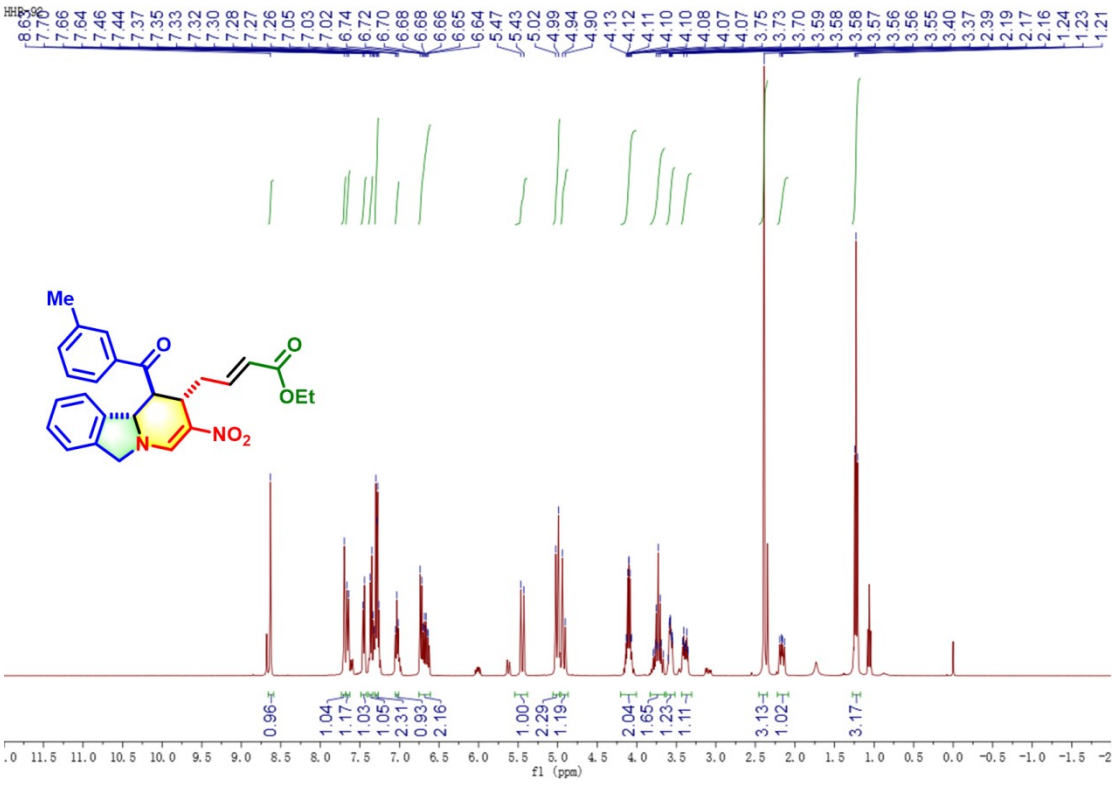
^{1}H NMR spectrum of **41** (400 MHz, $CDCl_3$)



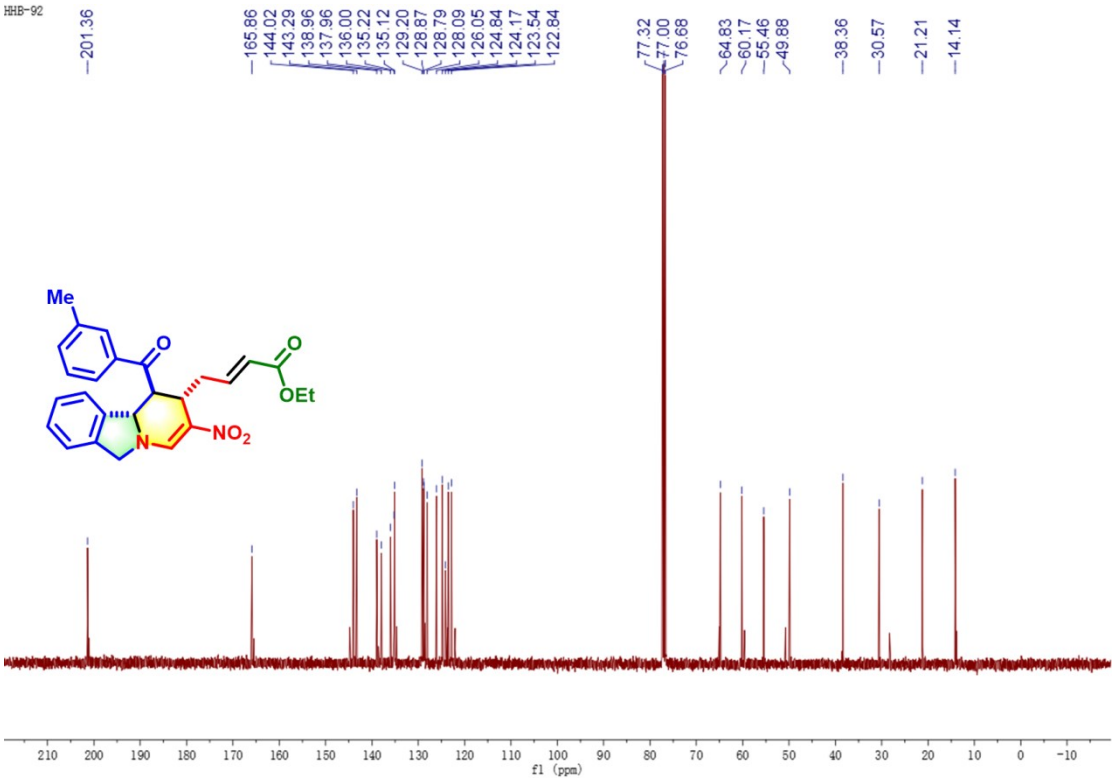
^{13}C NMR spectrum of **41** (100 MHz, $CDCl_3$)



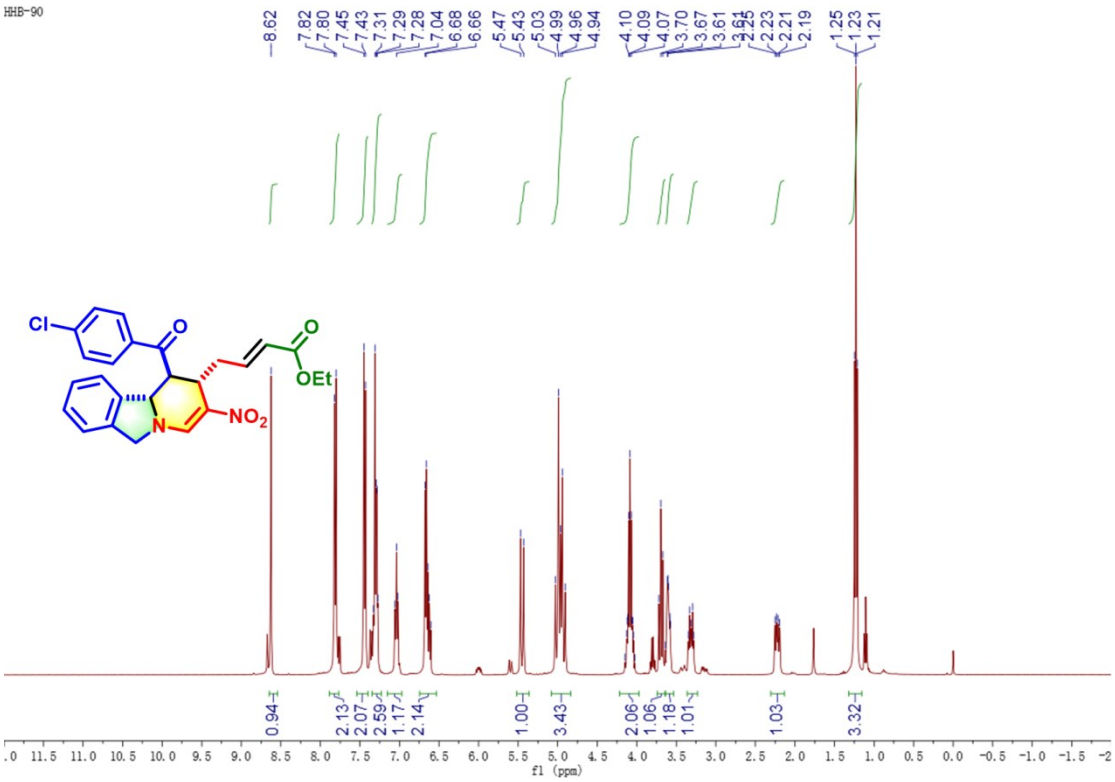
^{1}H NMR spectrum of **42** (400 MHz, $CDCl_3$)



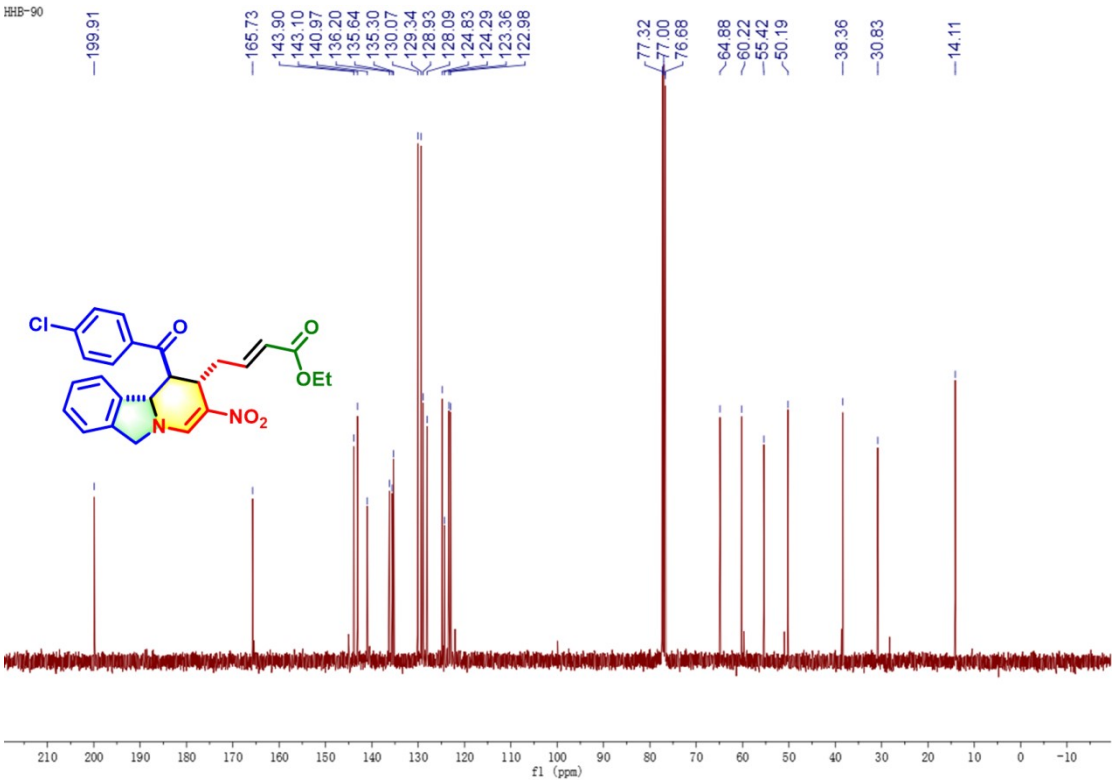
^{13}C NMR spectrum of **42** (100 MHz, $CDCl_3$)



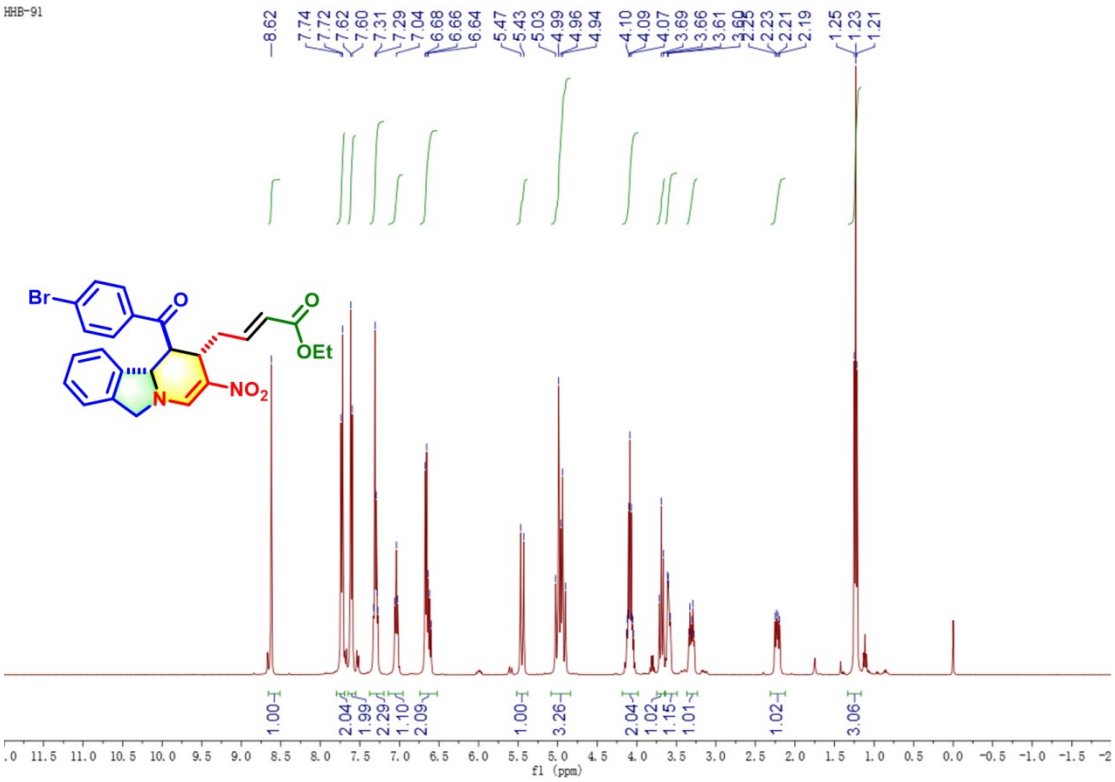
^{1}H NMR spectrum of **43** (400 MHz, $CDCl_3$)



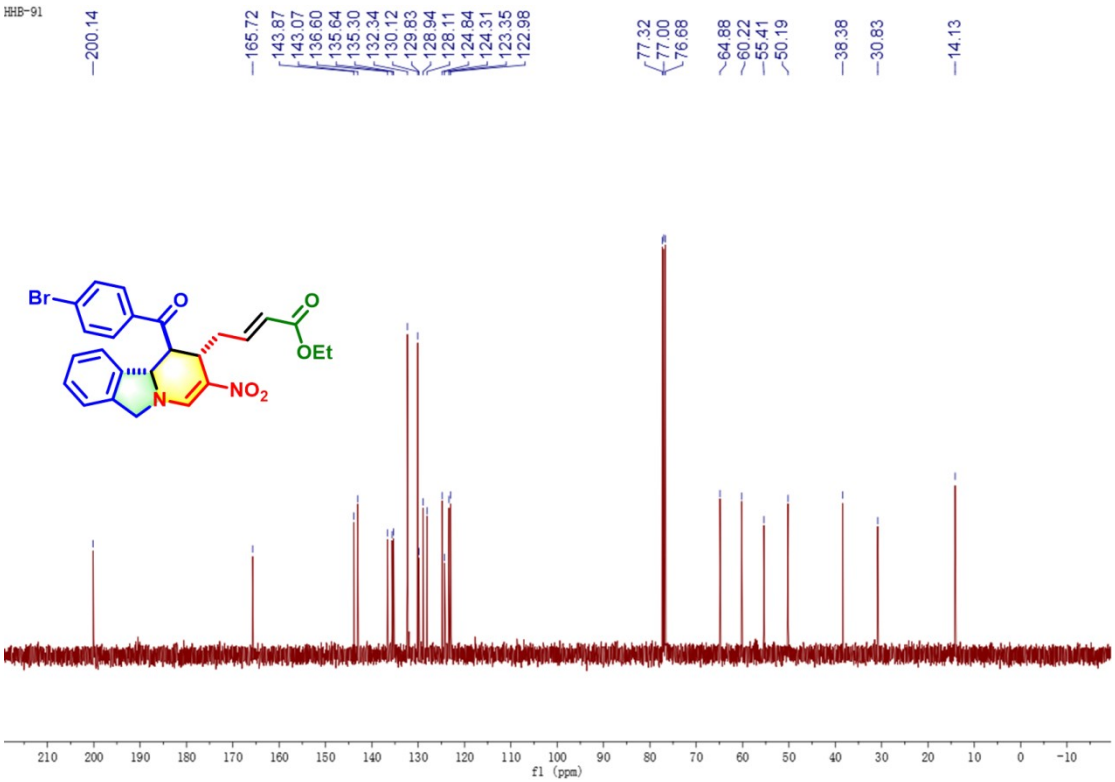
^{13}C NMR spectrum of **43** (100 MHz, $CDCl_3$)



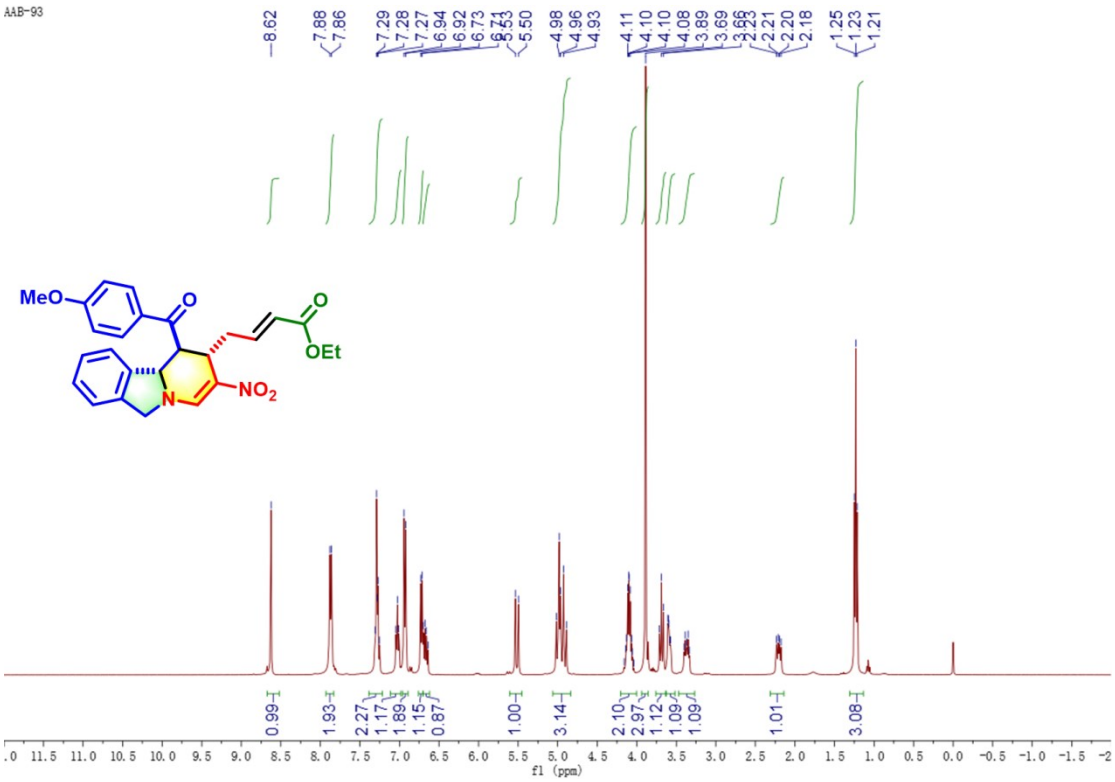
^{1}H NMR spectrum of **44** (400 MHz, $CDCl_3$)



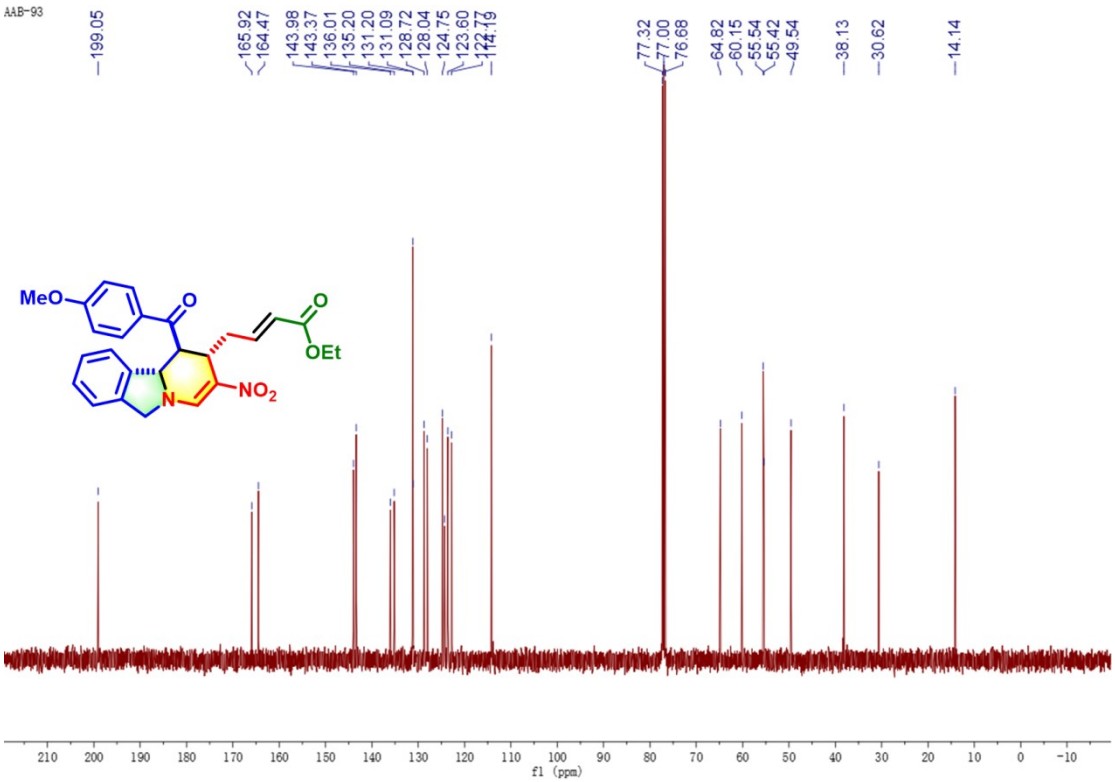
^{13}C NMR spectrum of **44** (100 MHz, $CDCl_3$)



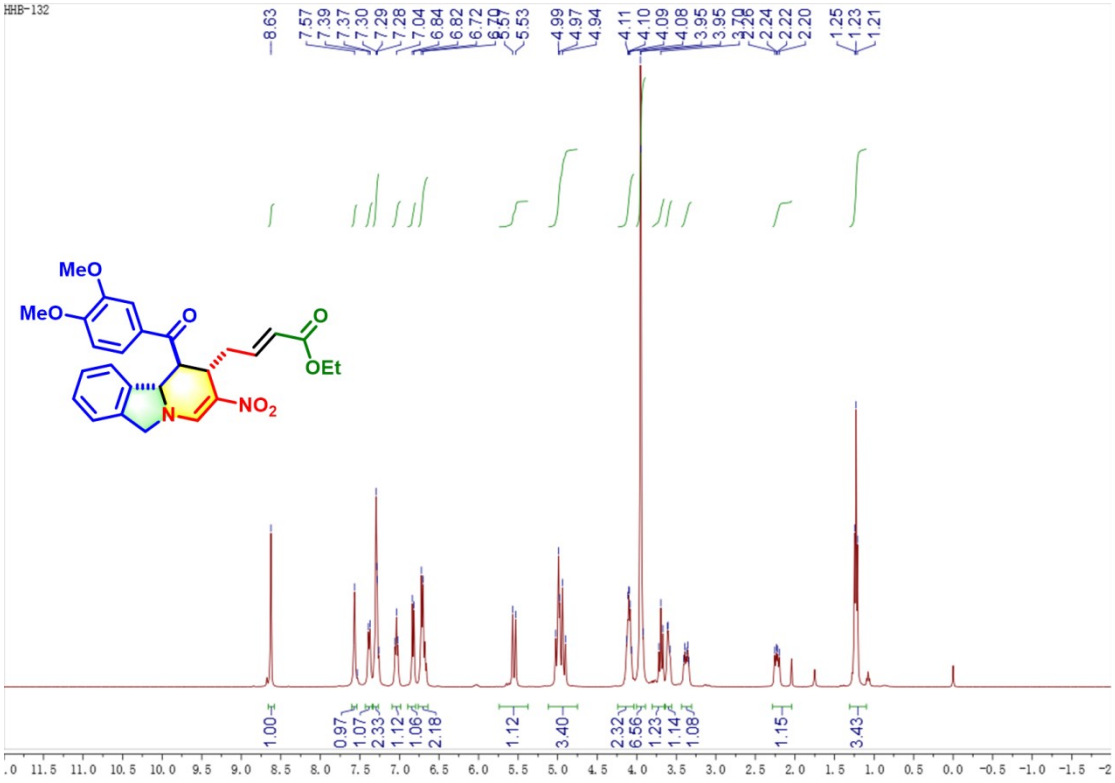
^{1}H NMR spectrum of **45** (400 MHz, $CDCl_3$)



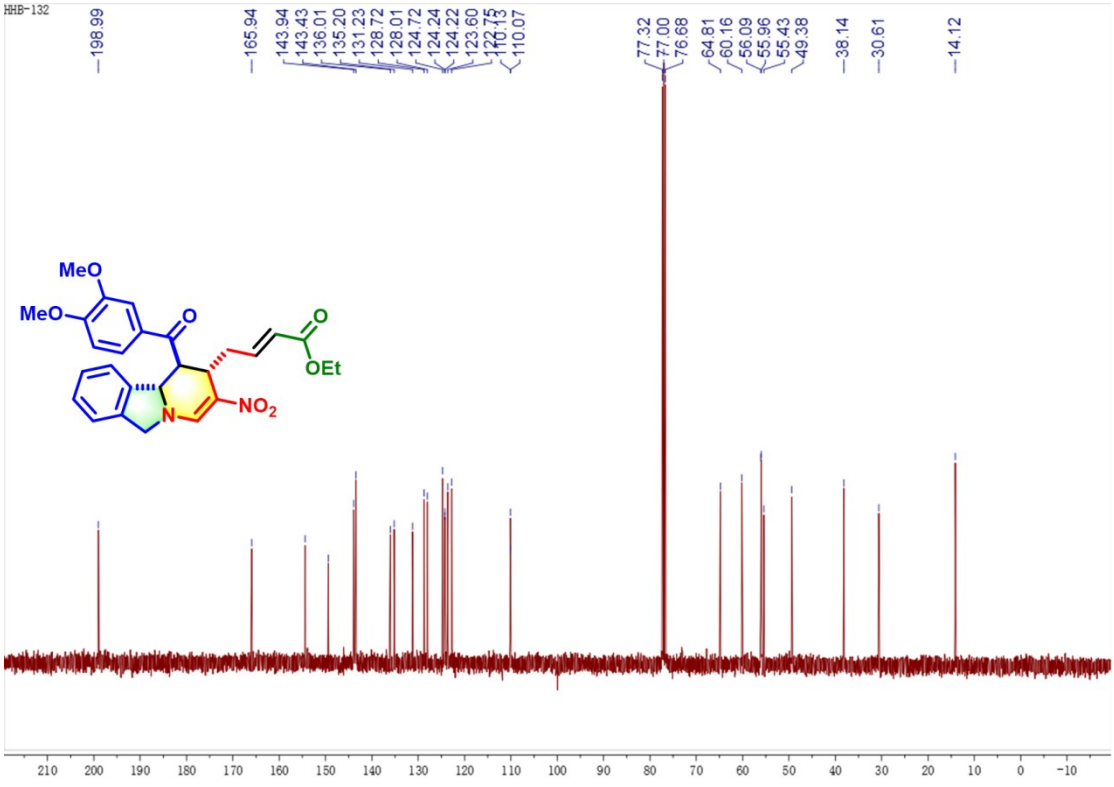
^{13}C NMR spectrum of **45** (100 MHz, $CDCl_3$)



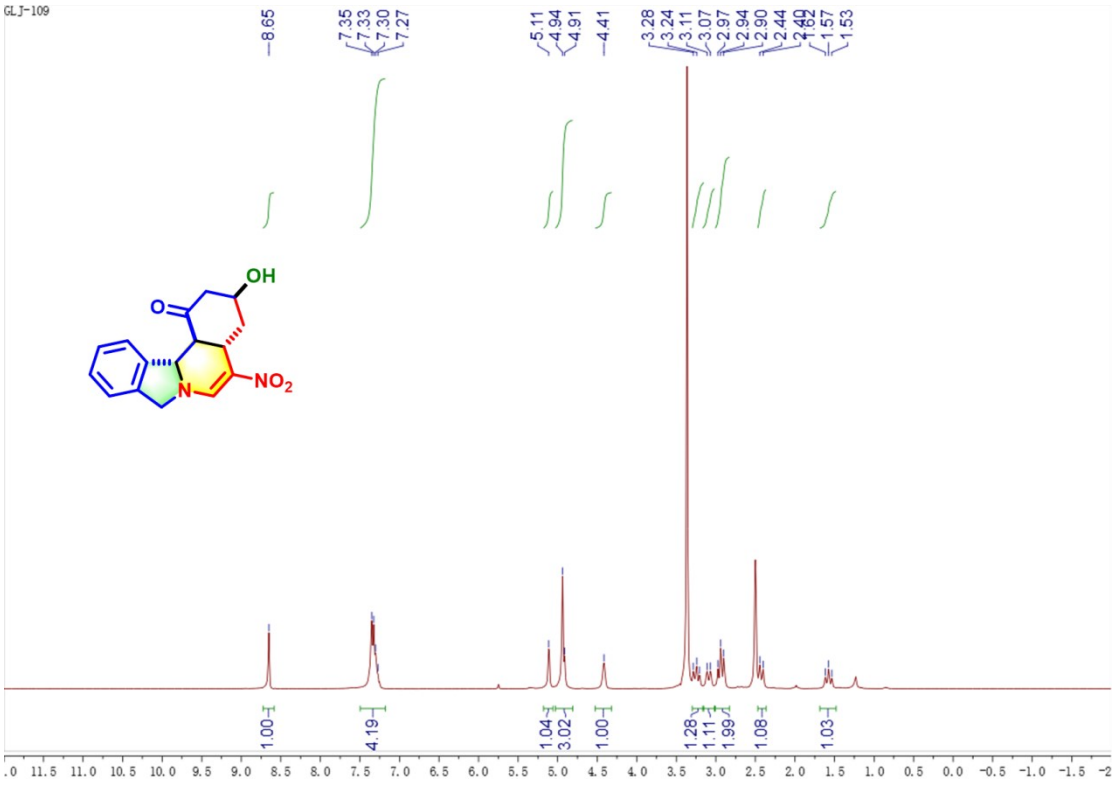
^{1}H NMR spectrum of **46** (400 MHz, $CDCl_3$)



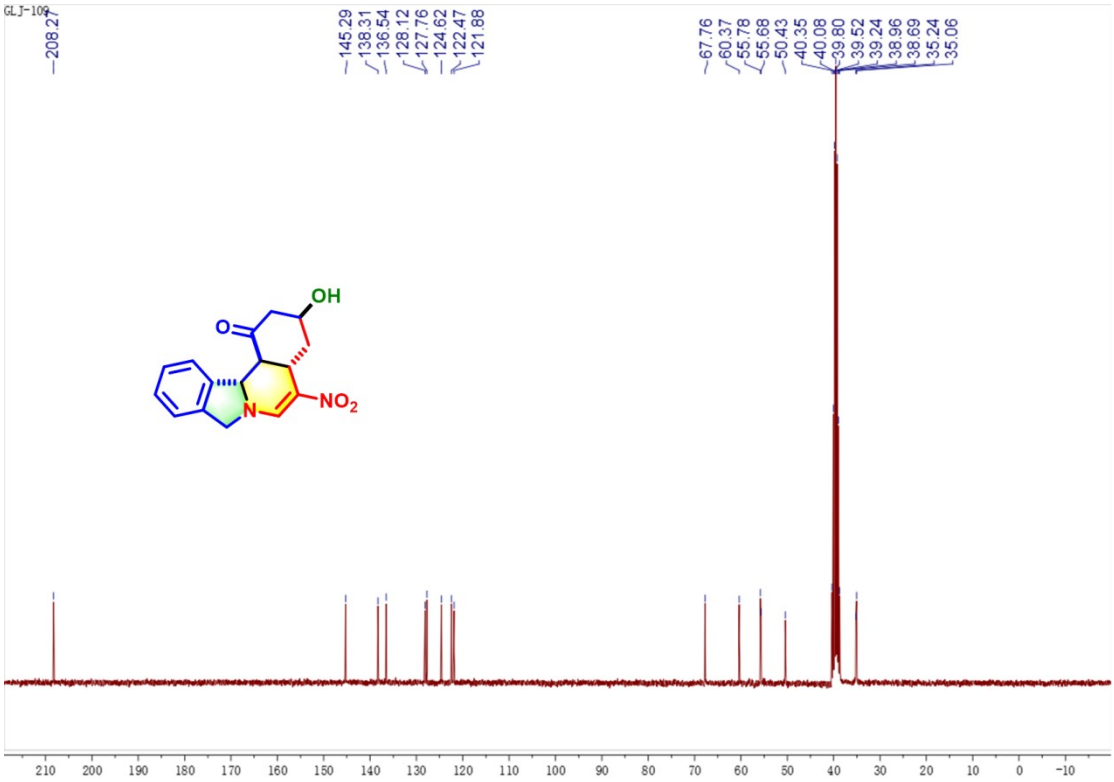
^{13}C NMR spectrum of **46** (100 MHz, $CDCl_3$)



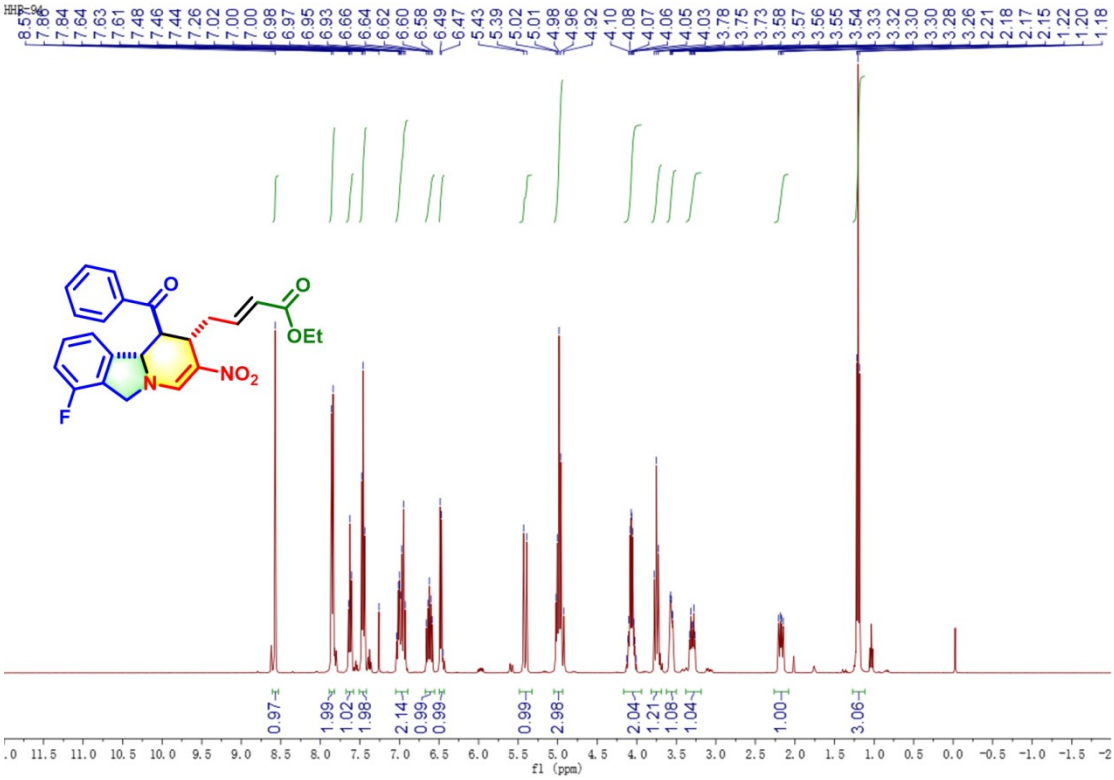
^{1}H NMR spectrum of **47** (300 MHz, $CDCl_3$)



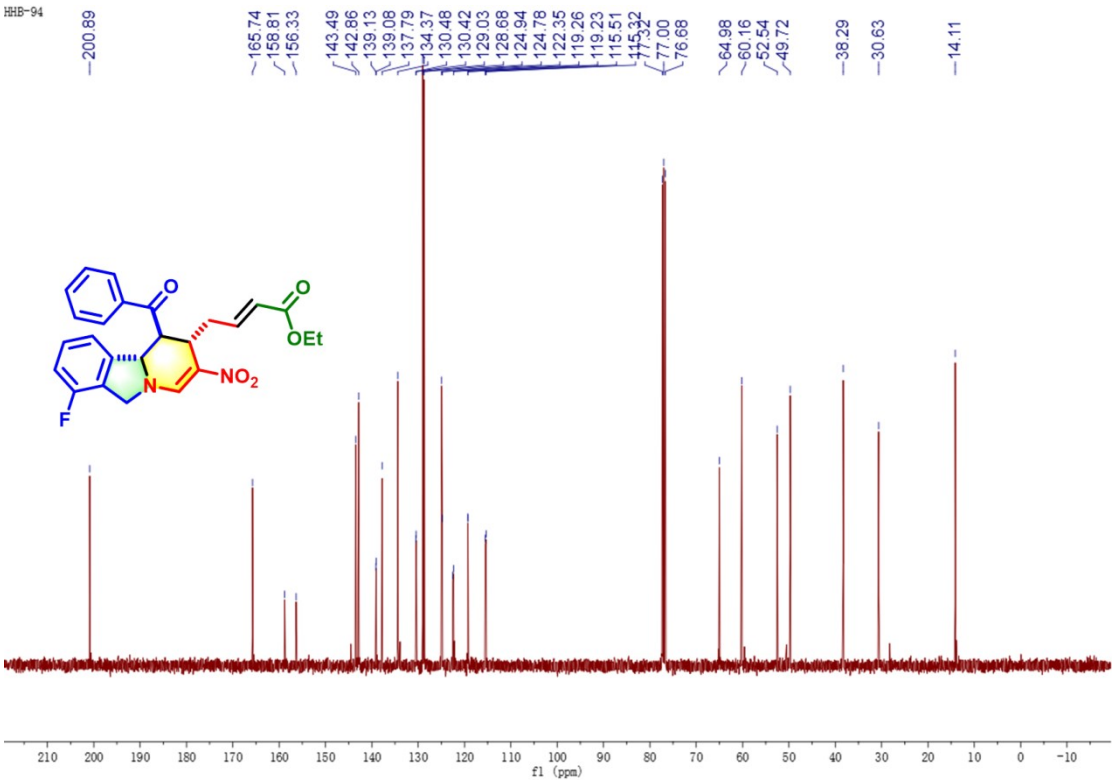
^{13}C NMR spectrum of **47** (75 MHz, $CDCl_3$)



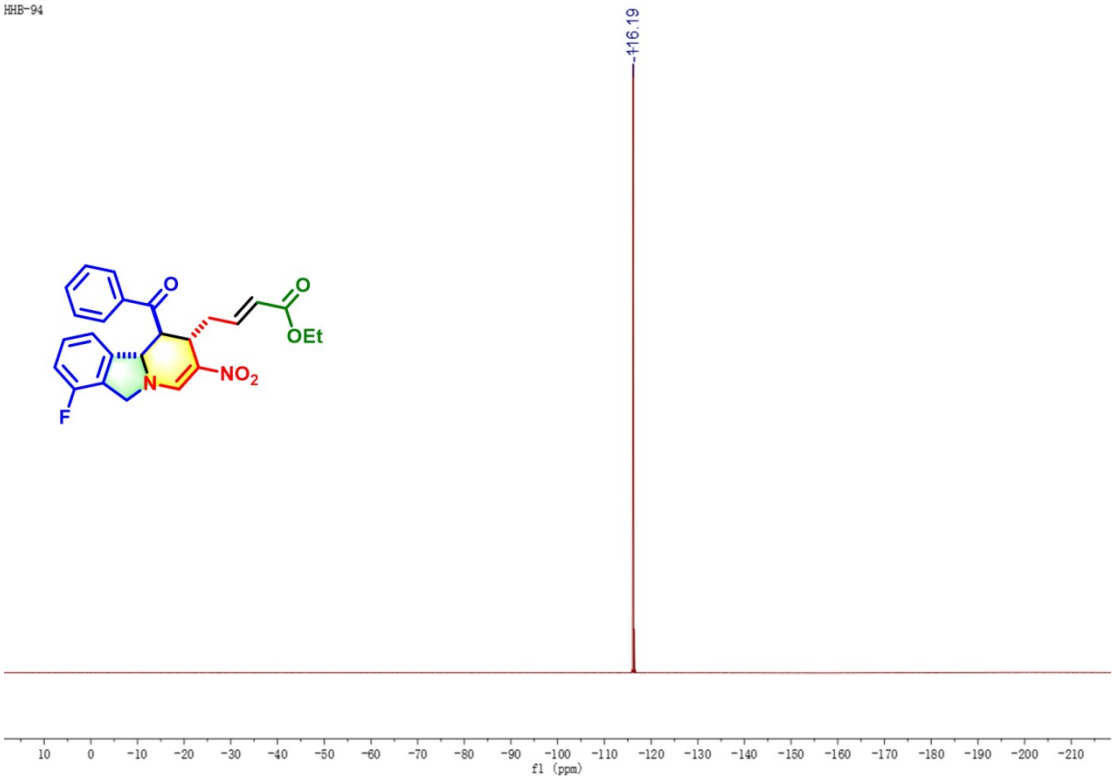
^{1}H NMR spectrum of **48** (400 MHz, $CDCl_3$)



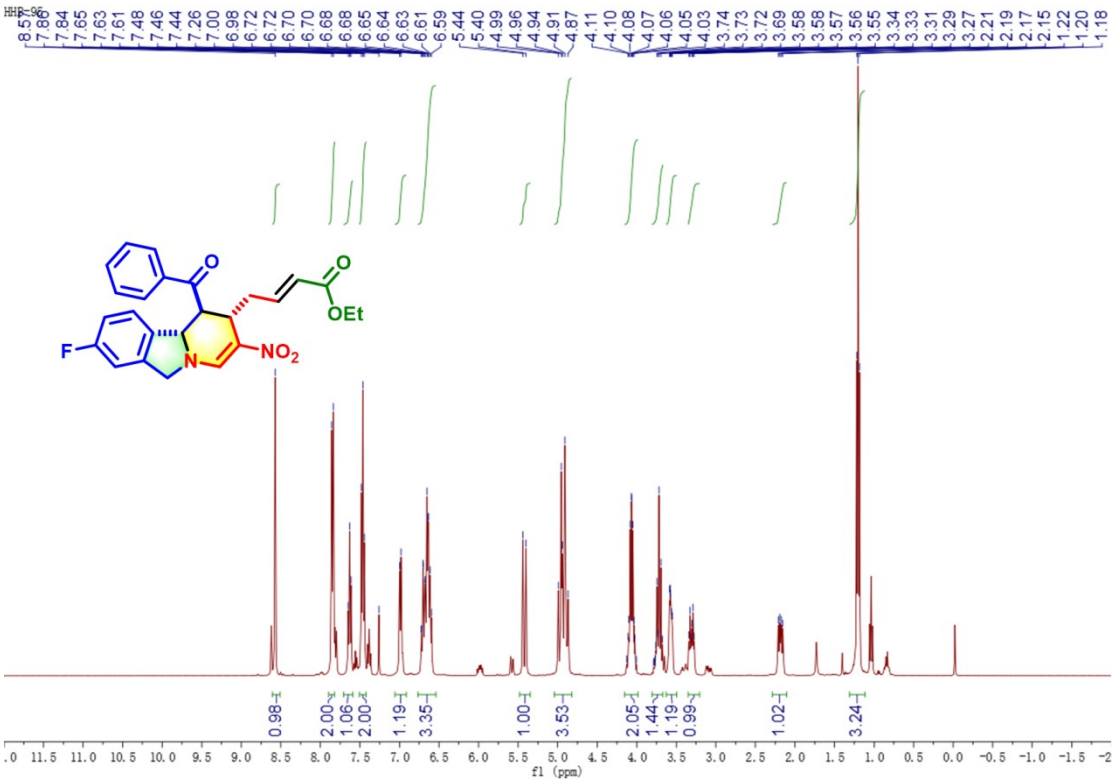
^{13}C NMR spectrum of **48** (100 MHz, $CDCl_3$)



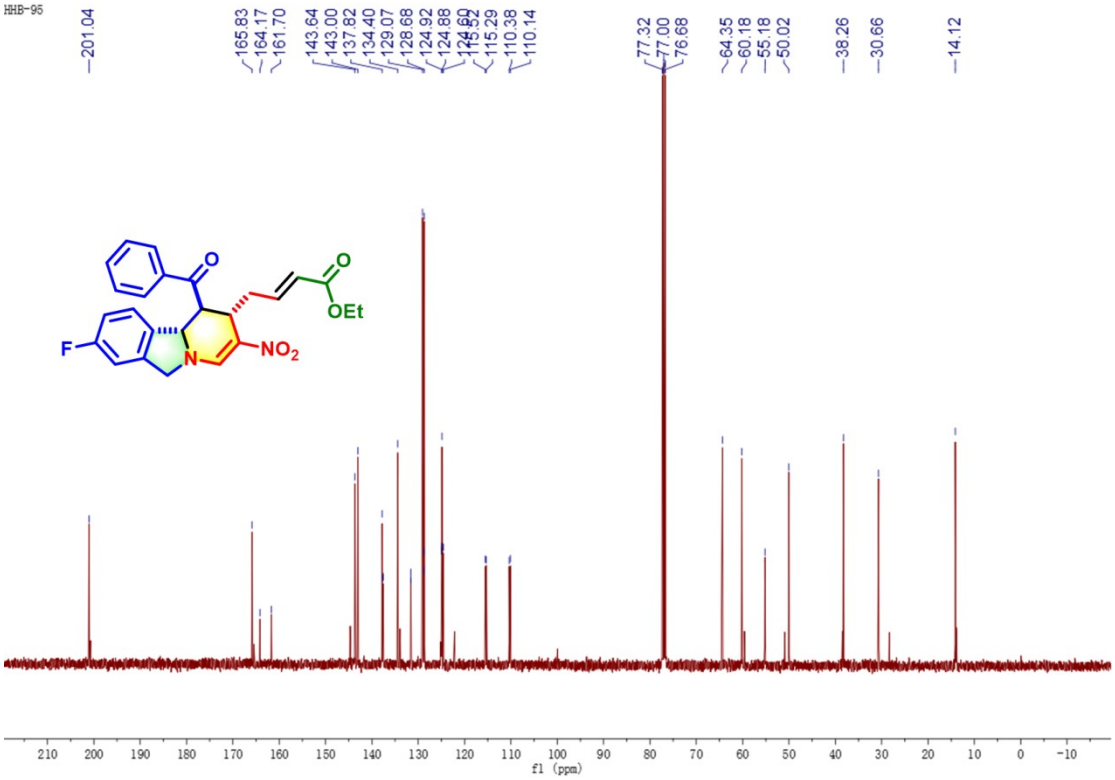
^{19}F NMR spectrum of **48** (375 MHz, $CDCl_3$)



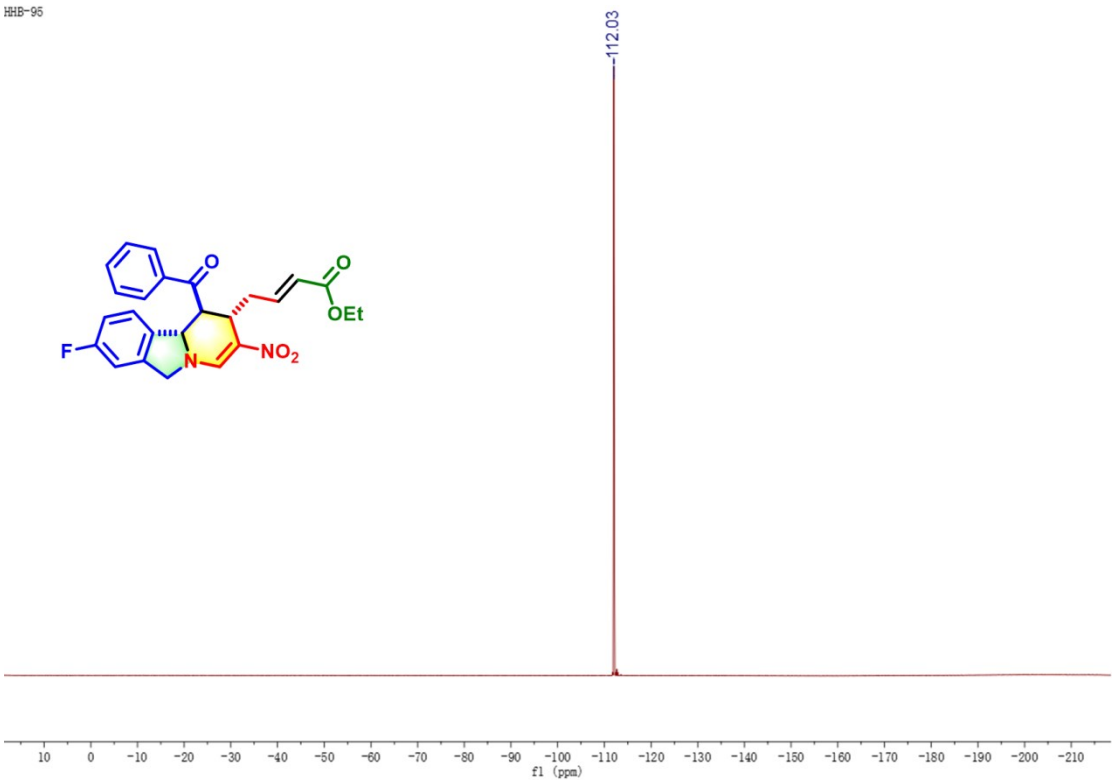
^{1}H NMR spectrum of **49** (400 MHz, $CDCl_3$)



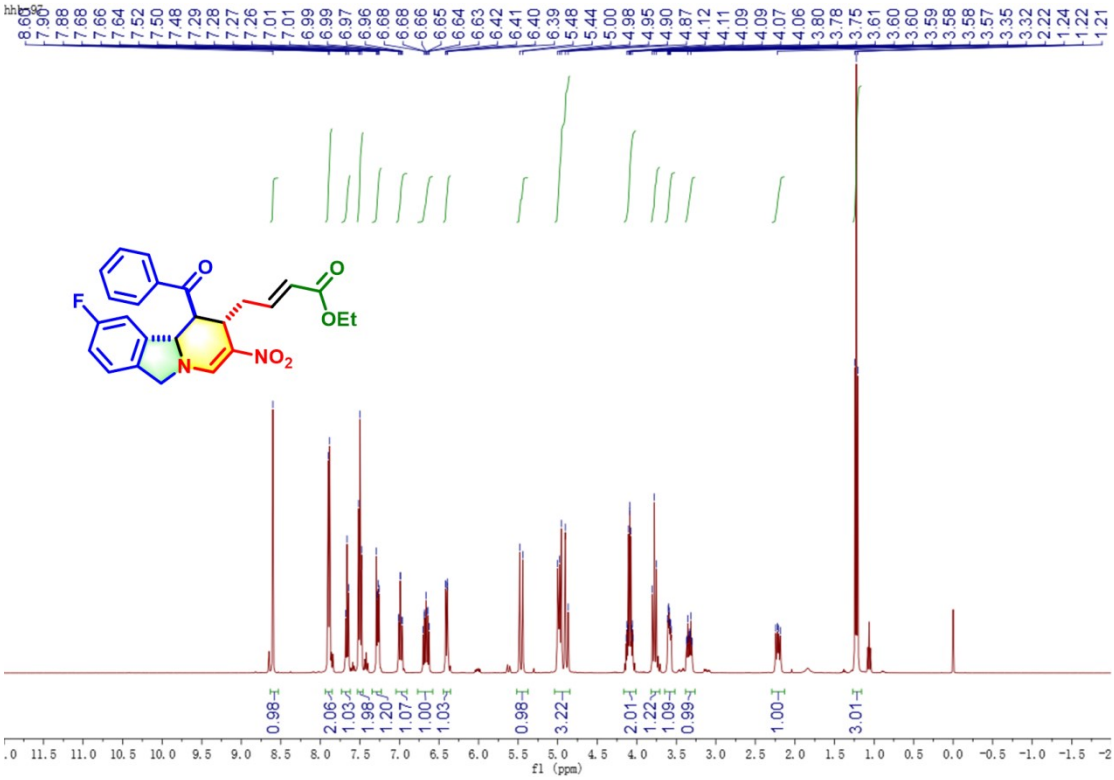
^{13}C NMR spectrum of **49** (100 MHz, $CDCl_3$)



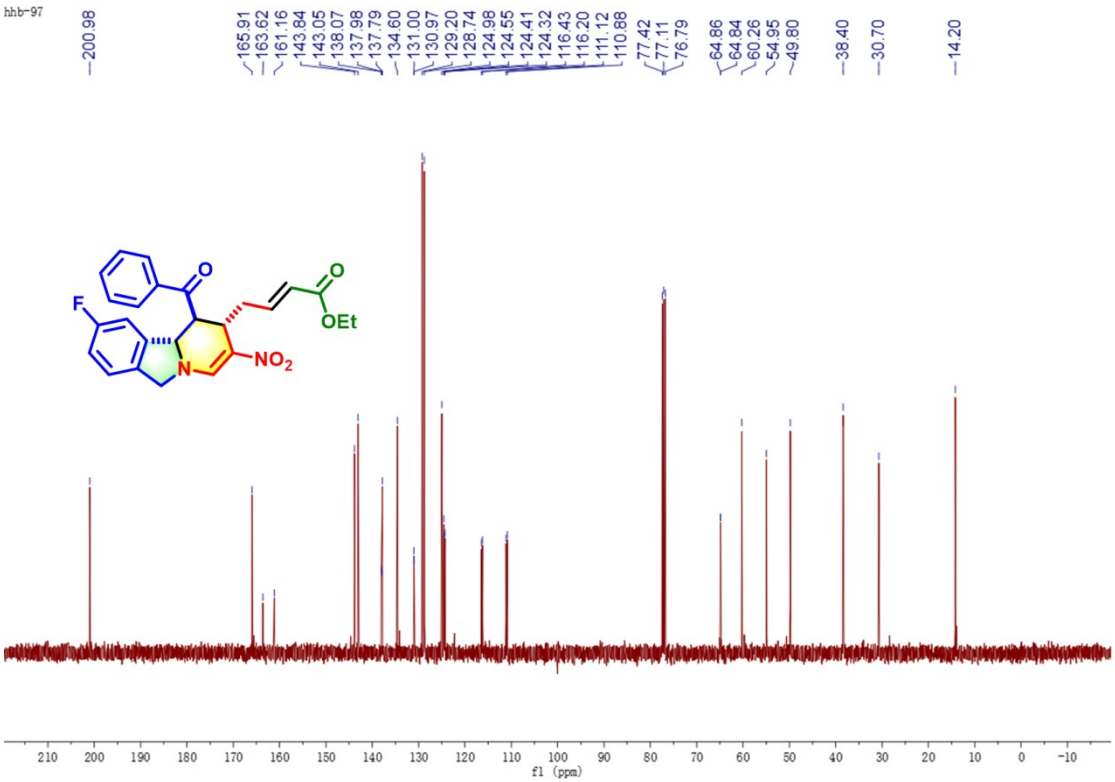
^{19}F NMR spectrum of **49** (375 MHz, $CDCl_3$)



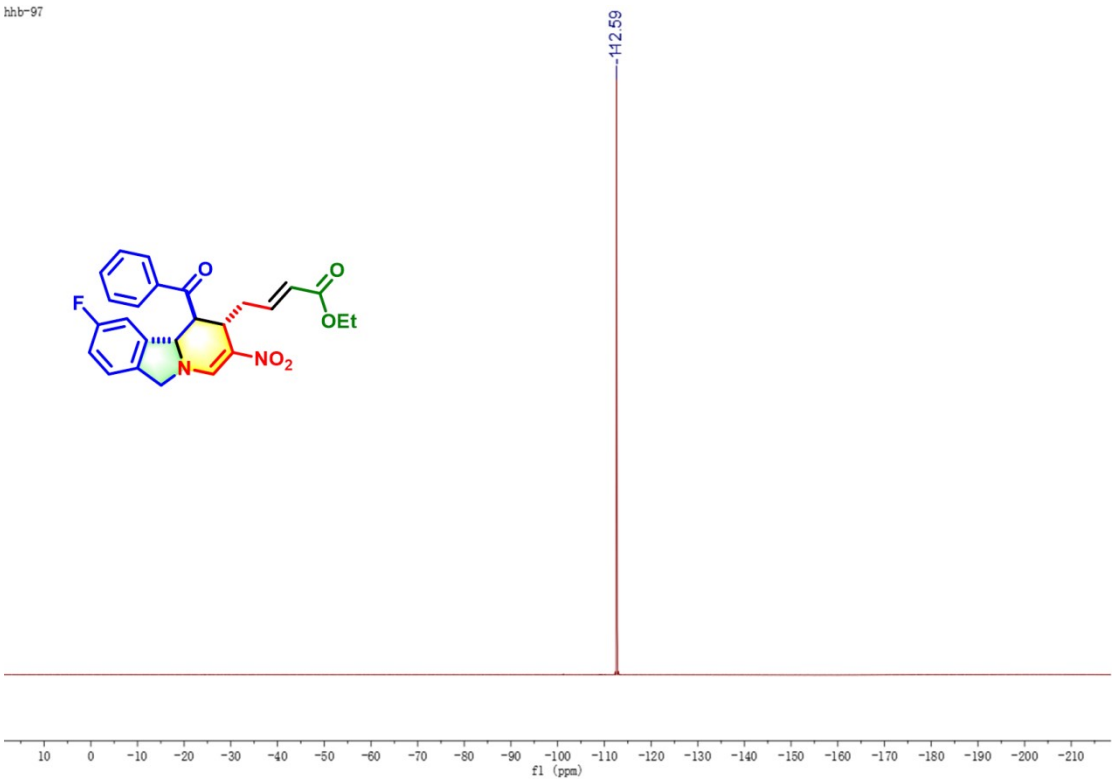
^{1}H NMR spectrum of **50** (400 MHz, $CDCl_3$)



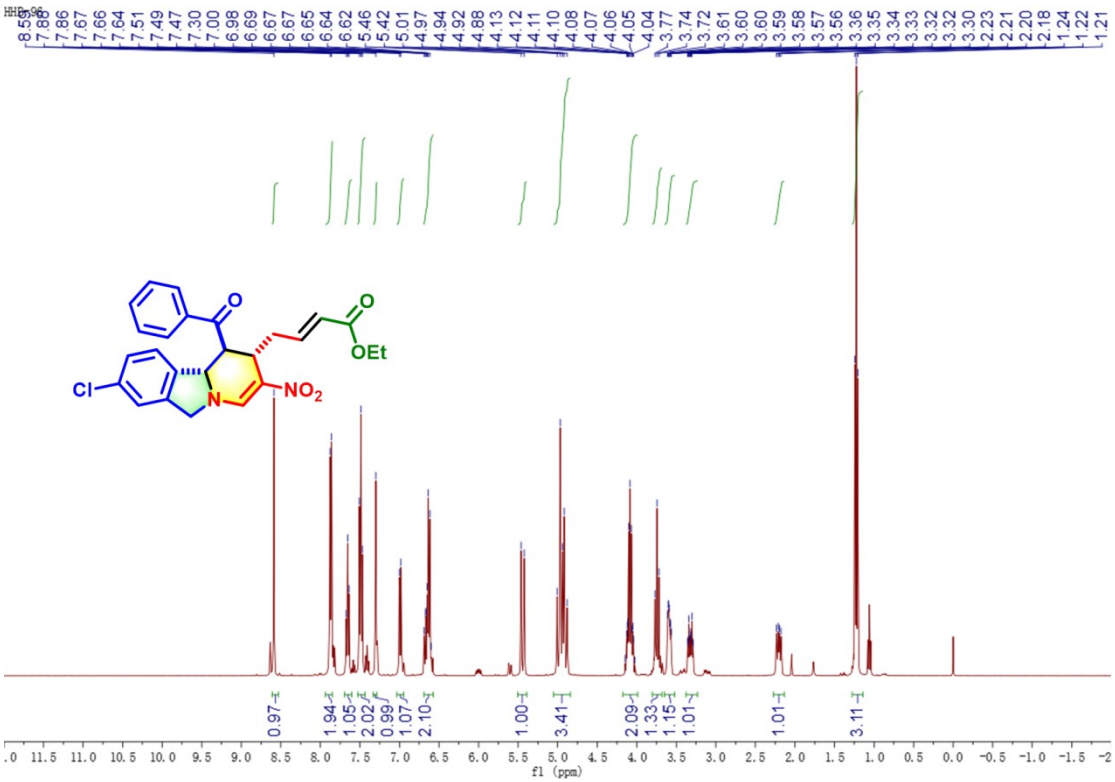
^{13}C NMR spectrum of **50** (100 MHz, $CDCl_3$)



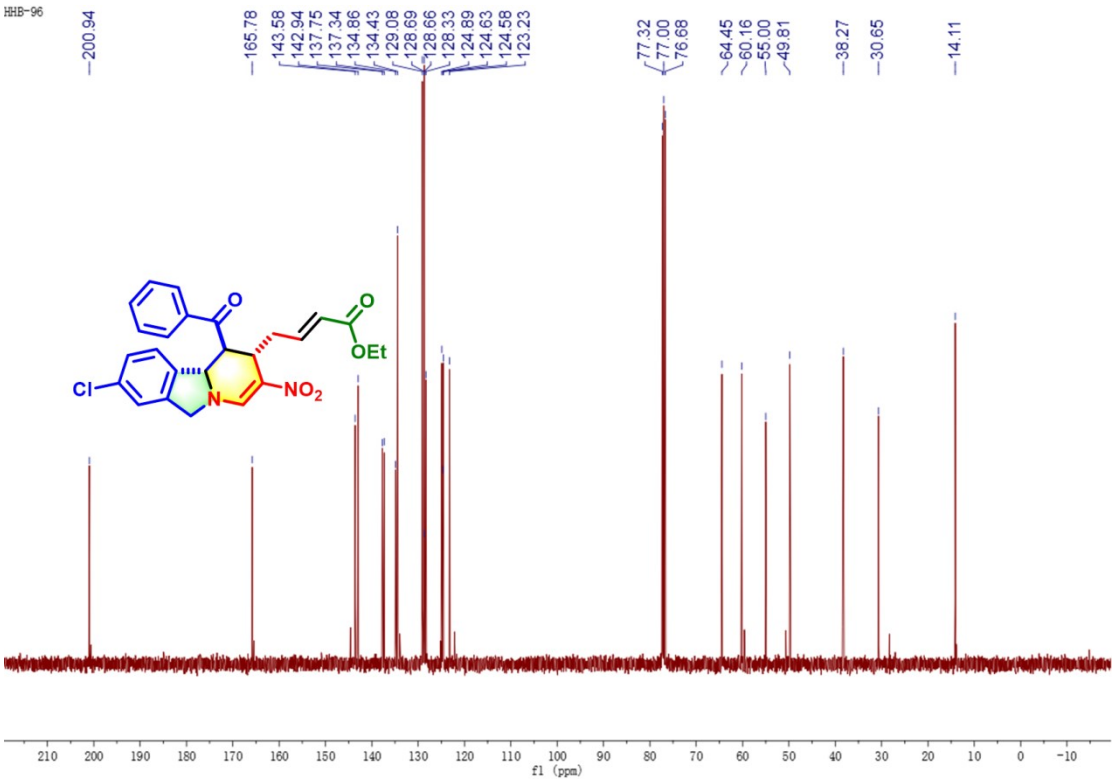
^{19}F NMR spectrum of **50** (375 MHz, $CDCl_3$)



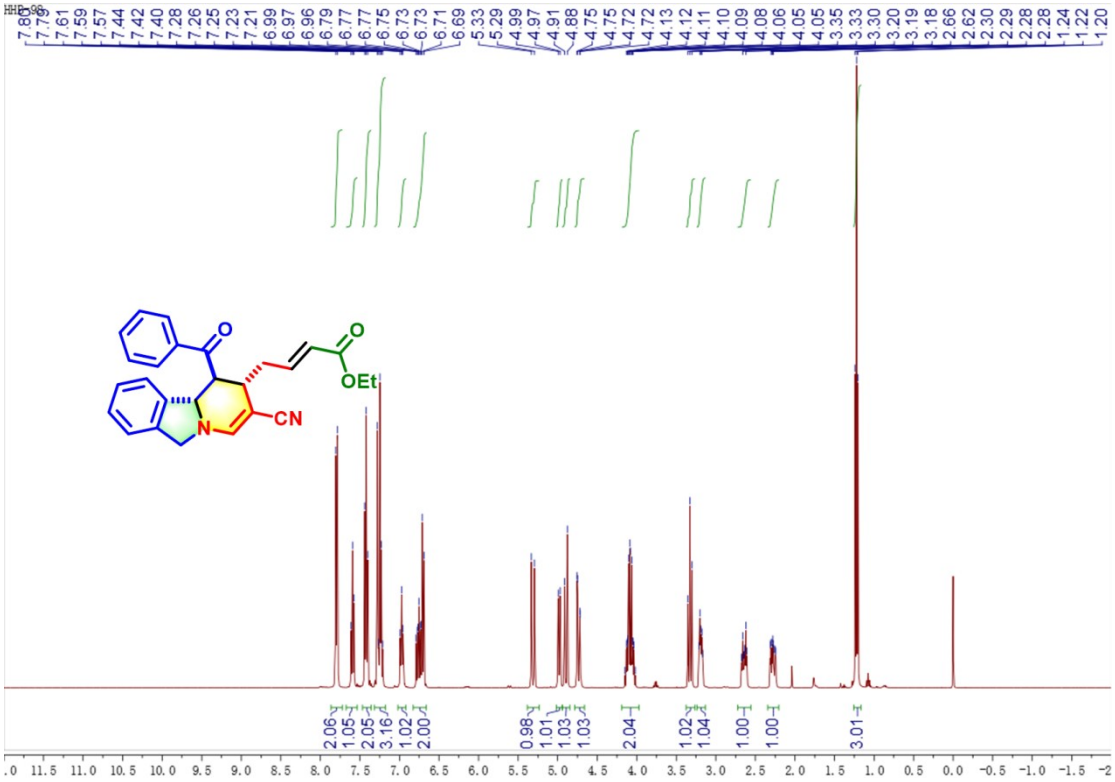
^{1}H NMR spectrum of **51** (400 MHz, $CDCl_3$)



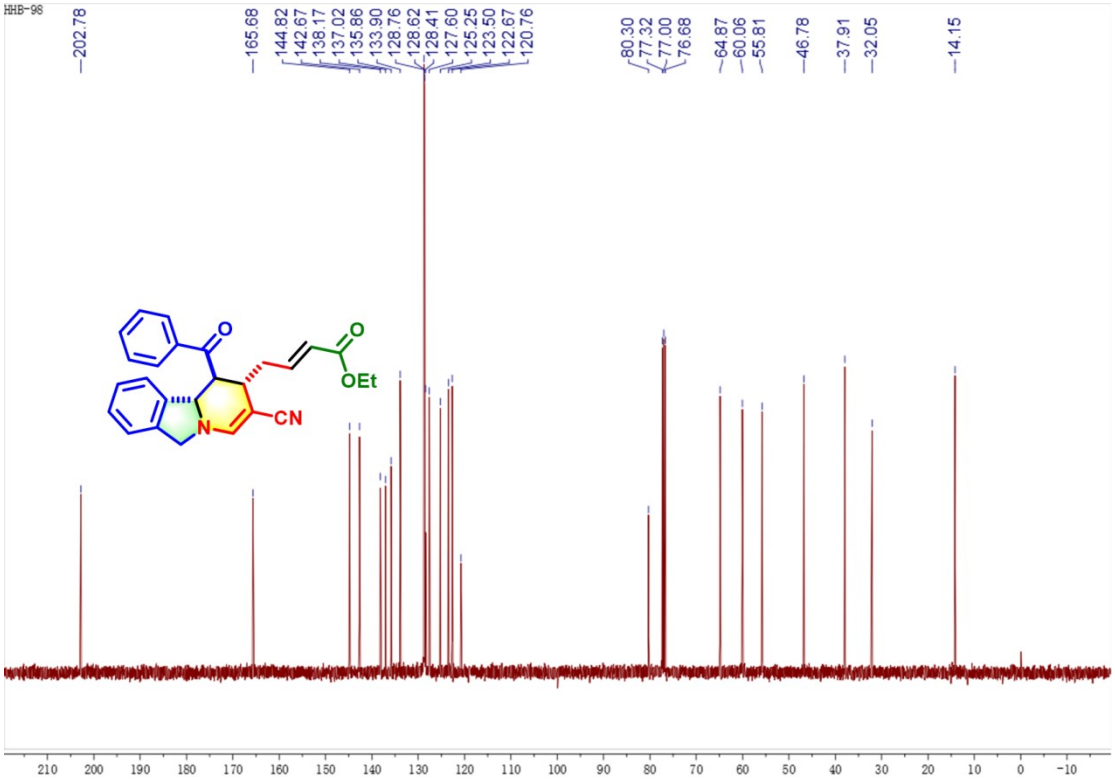
^{13}C NMR spectrum of **51** (100 MHz, $CDCl_3$)



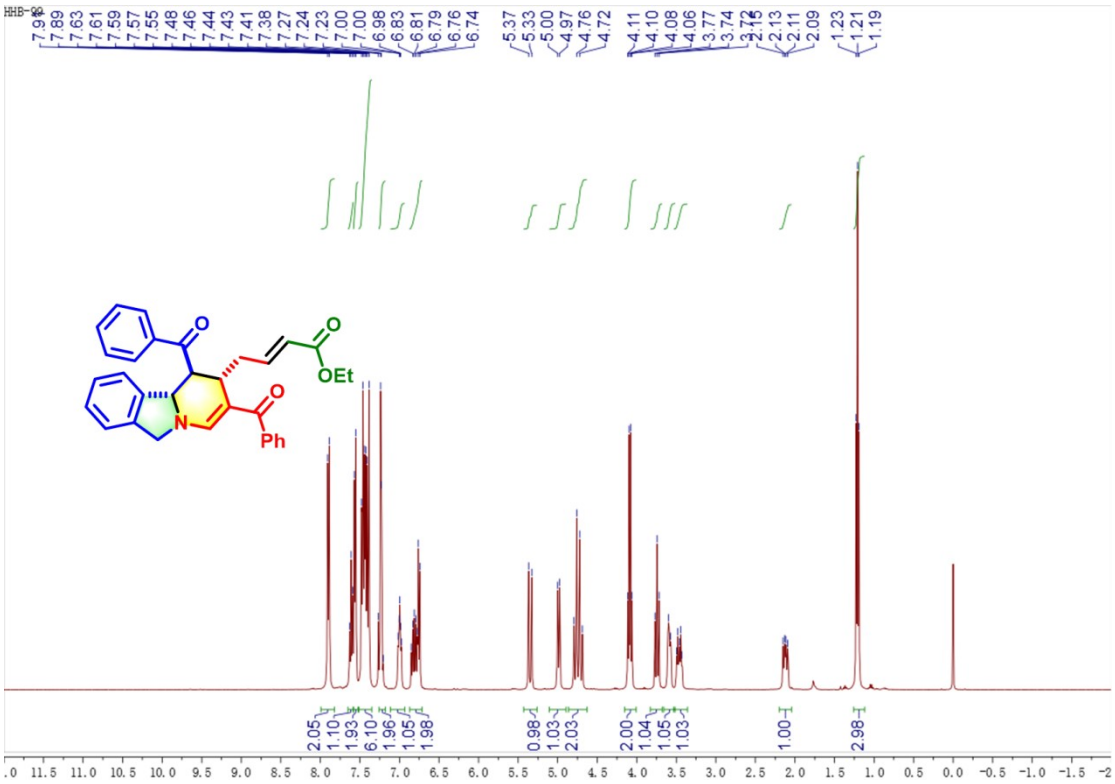
^{1}H NMR spectrum of **52** (400 MHz, $CDCl_3$)



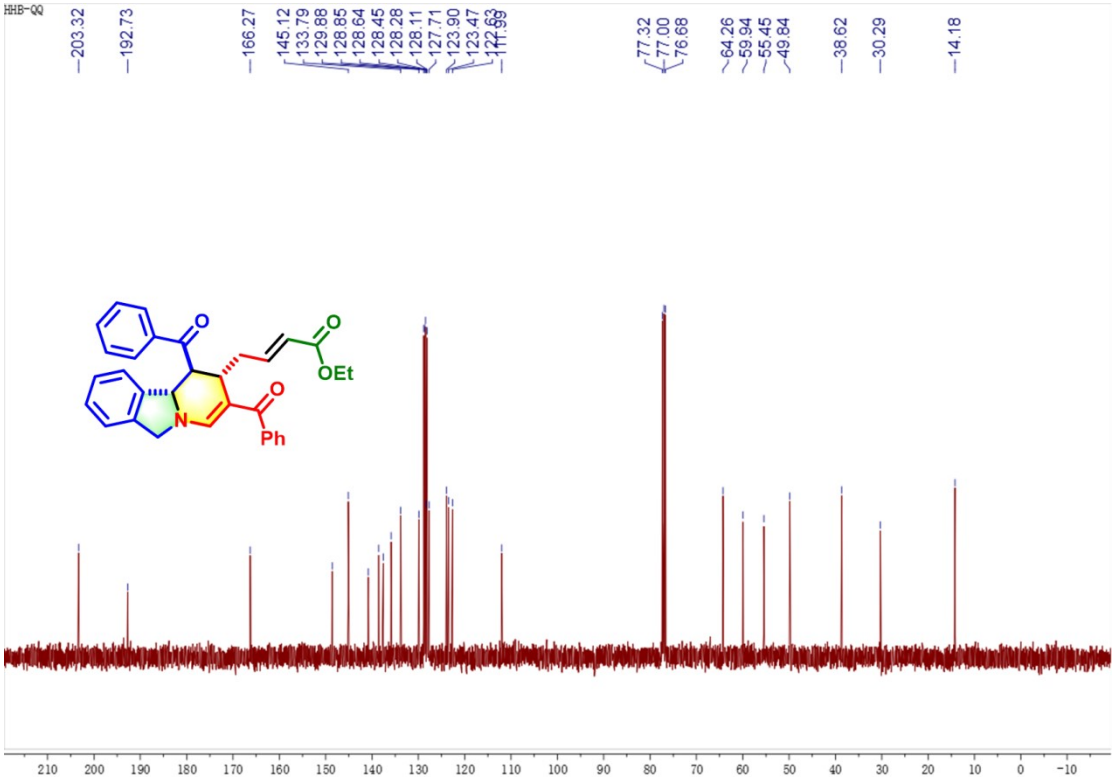
^{13}C NMR spectrum of **52** (100 MHz, $CDCl_3$)



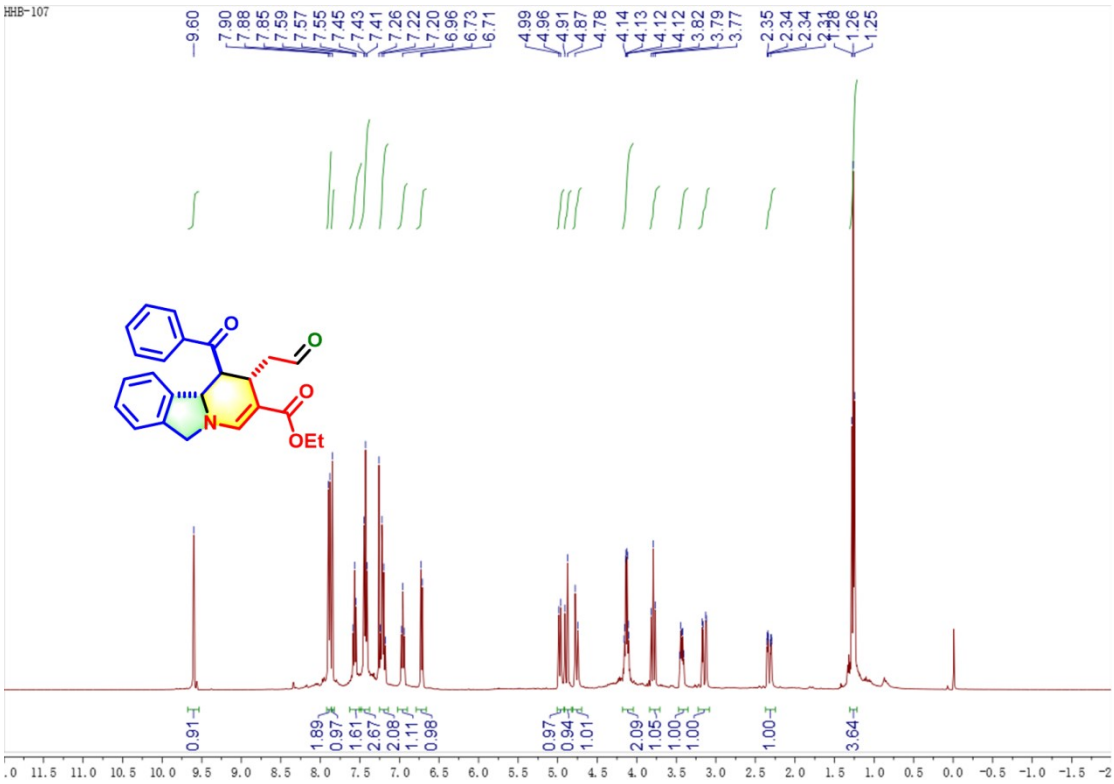
^{1}H NMR spectrum of **53** (400 MHz, $CDCl_3$)



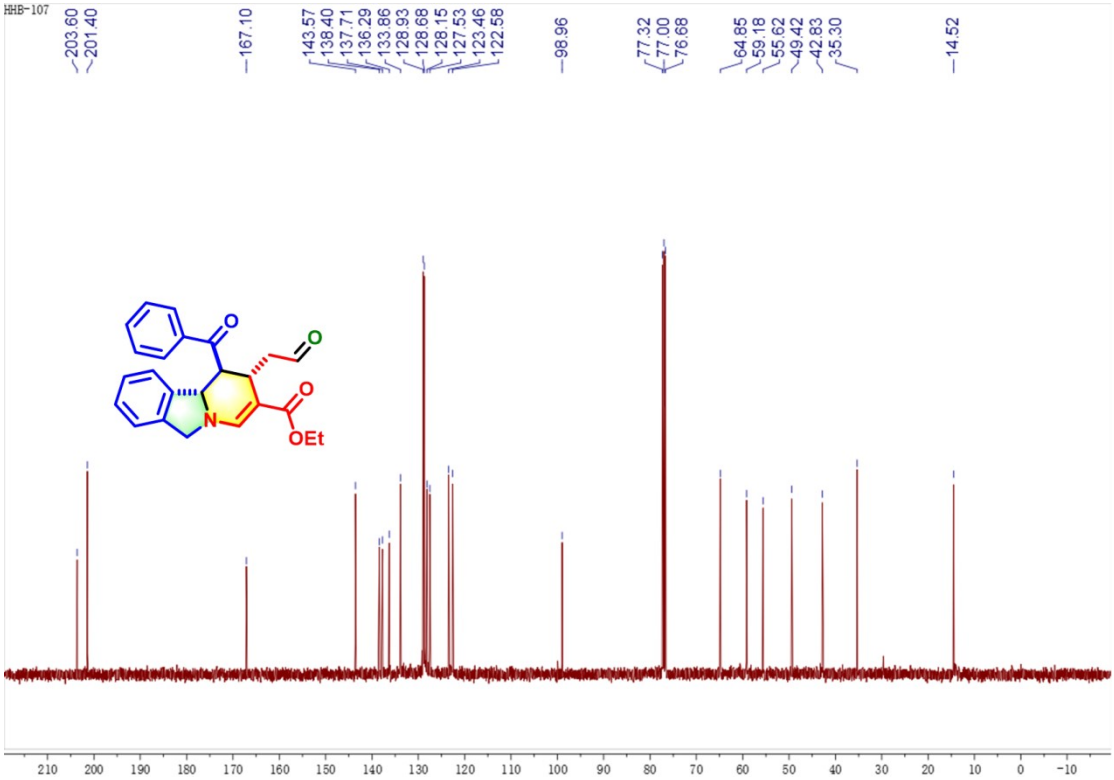
^{13}C NMR spectrum of **53** (100 MHz, $CDCl_3$)



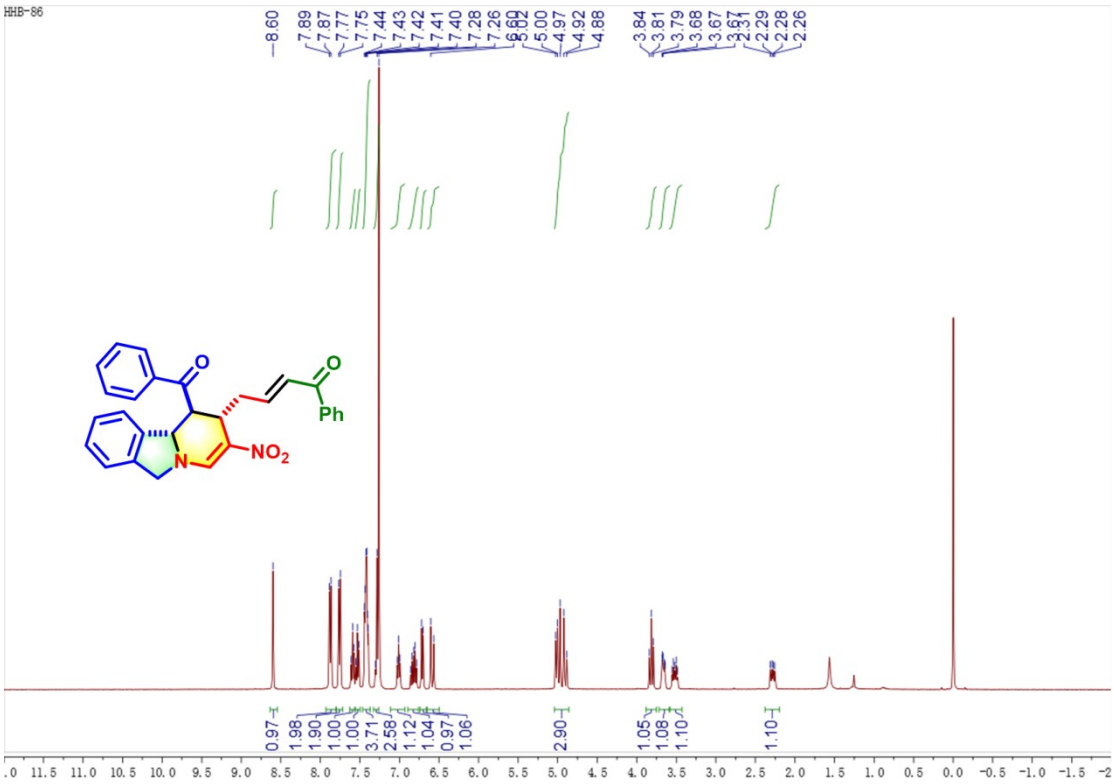
^{1}H NMR spectrum of **54** (400 MHz, $CDCl_3$)



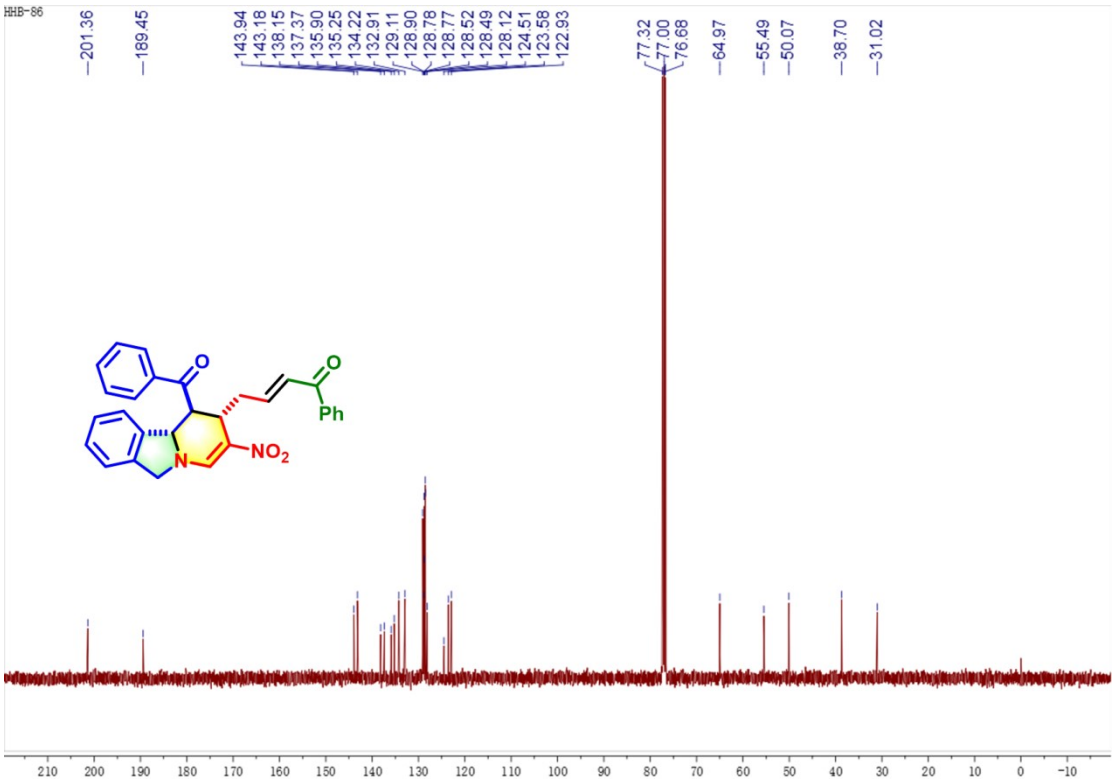
^{13}C NMR spectrum of **54** (100 MHz, $CDCl_3$)



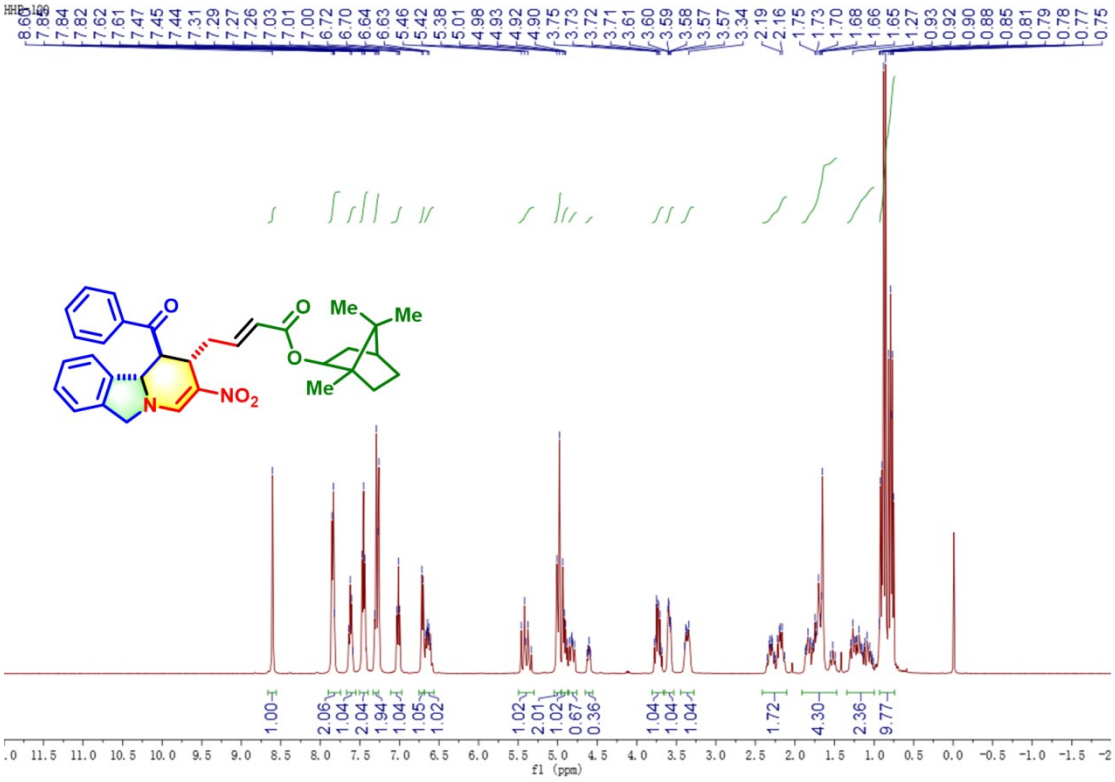
^{1}H NMR spectrum of **55** (400 MHz, $CDCl_3$)



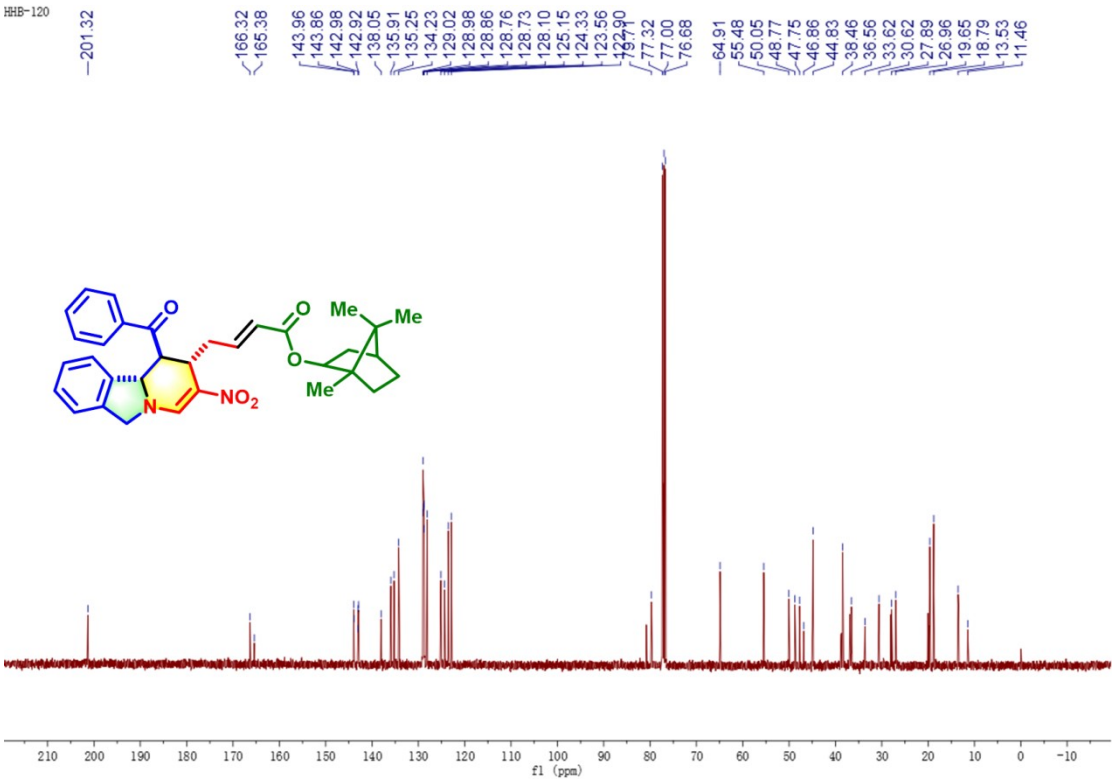
^{13}C NMR spectrum of **55** (100 MHz, $CDCl_3$)



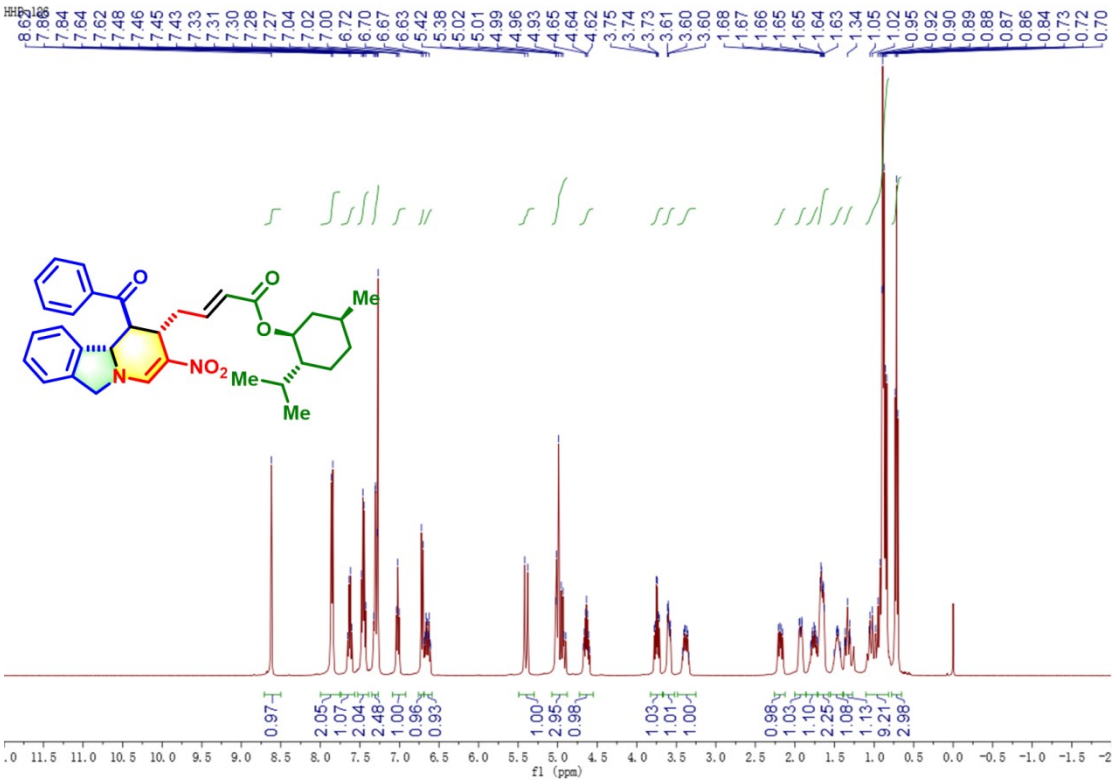
^{1}H NMR spectrum of **56** (400 MHz, $CDCl_3$)



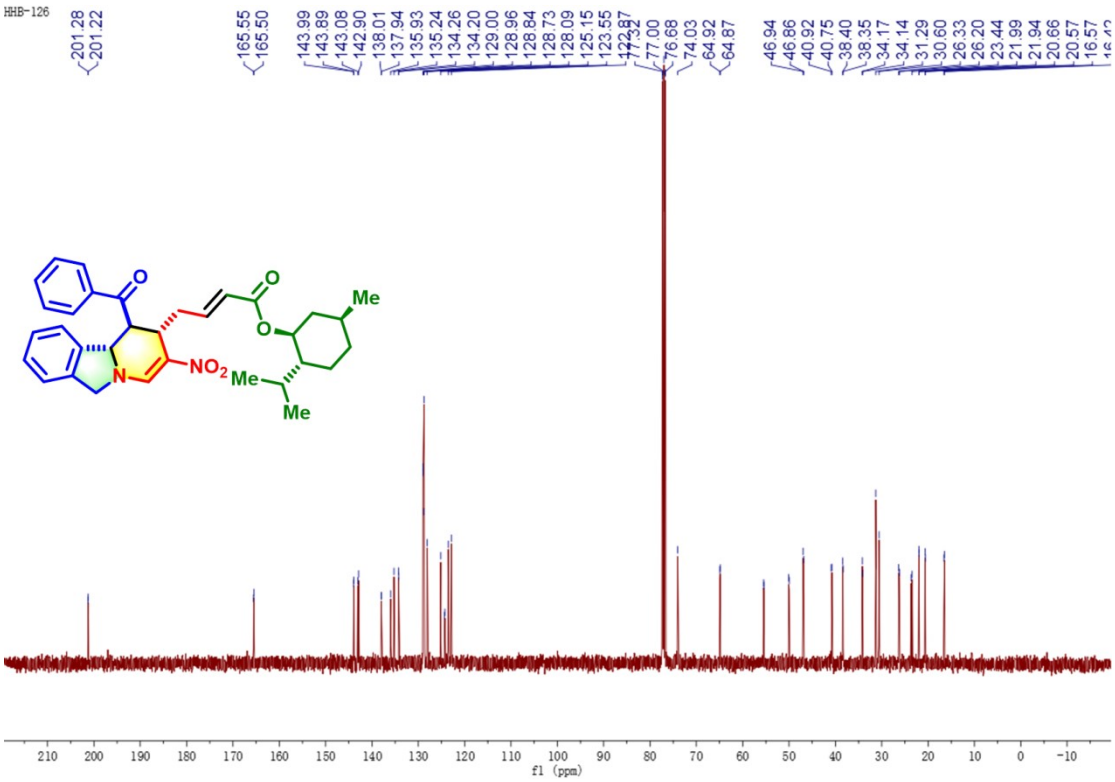
^{13}C NMR spectrum of **56** (100 MHz, $CDCl_3$)



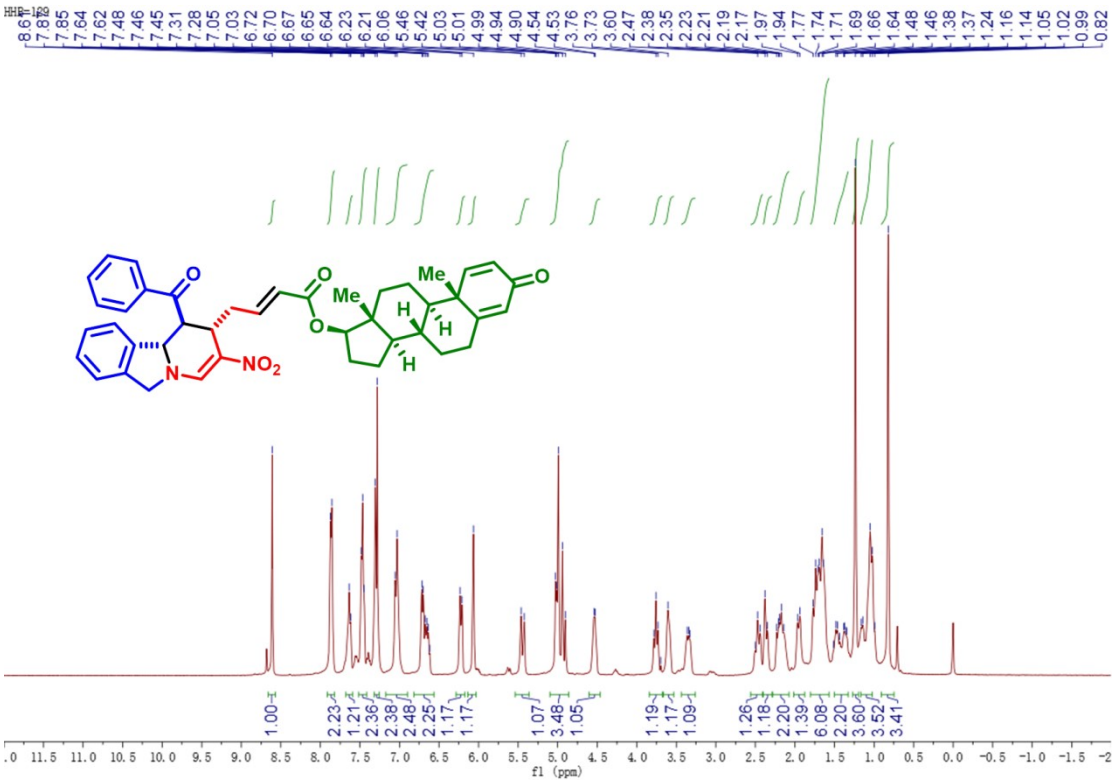
^{1}H NMR spectrum of **57** (400 MHz, $CDCl_3$)



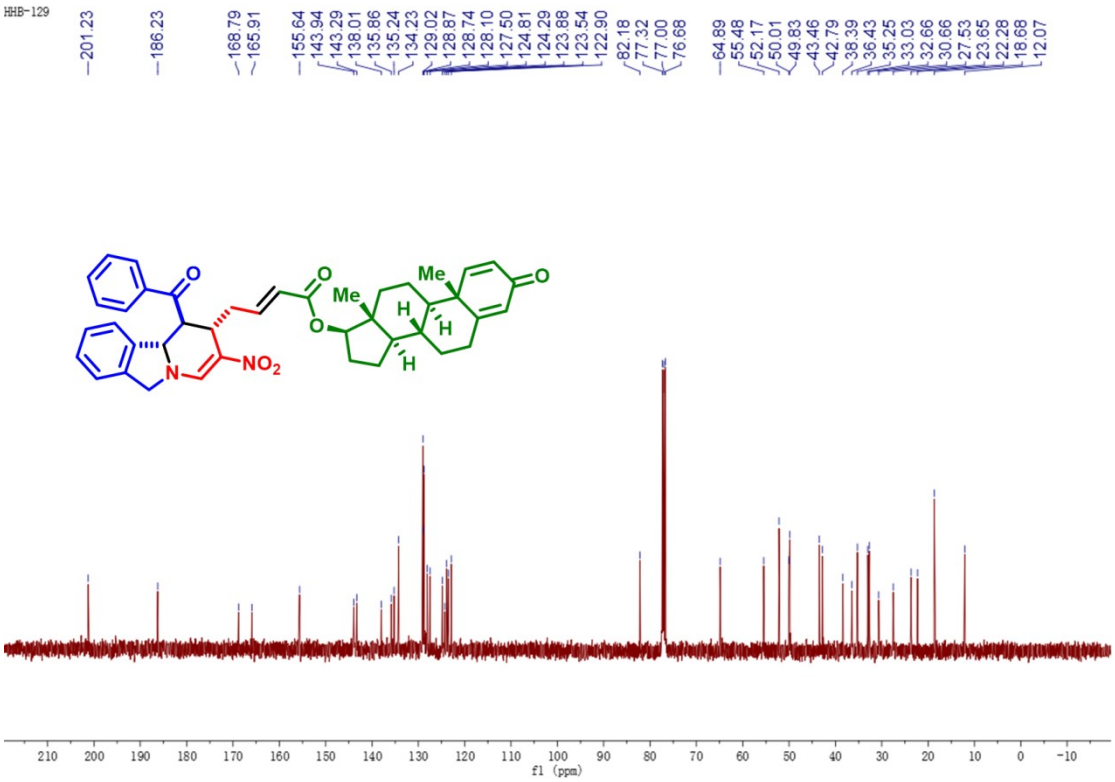
^{13}C NMR spectrum of **57** (100 MHz, $CDCl_3$)



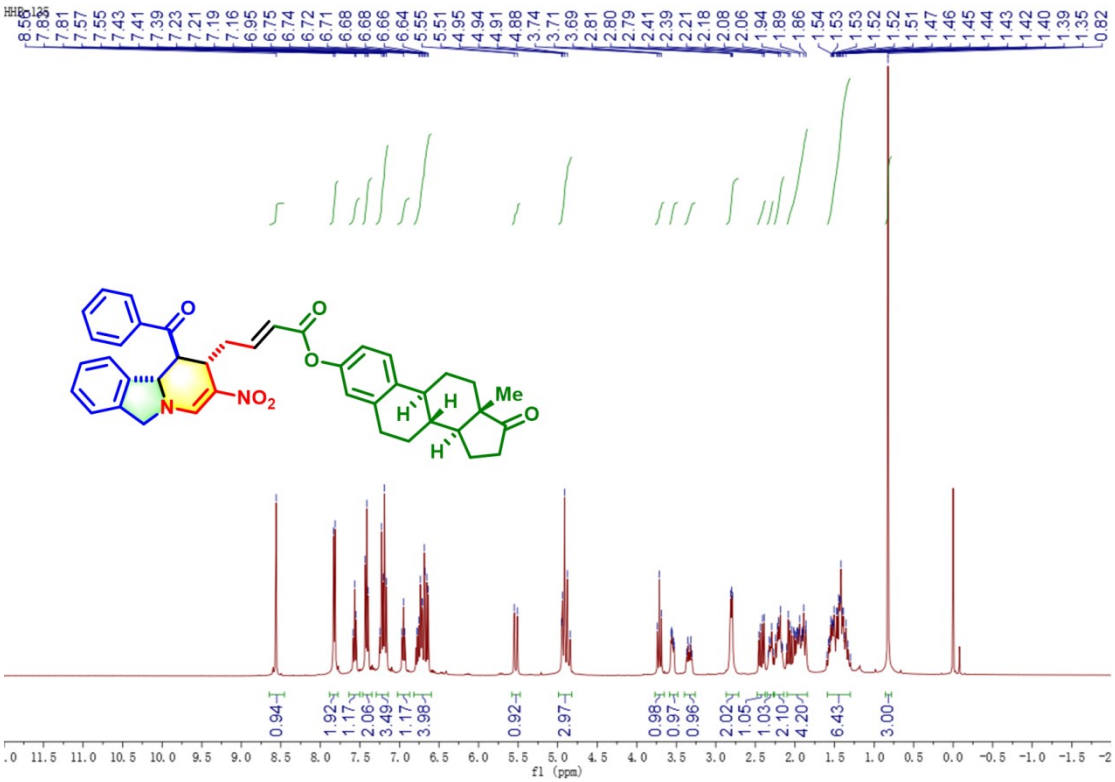
^{1}H NMR spectrum of **58** (400 MHz, $CDCl_3$)



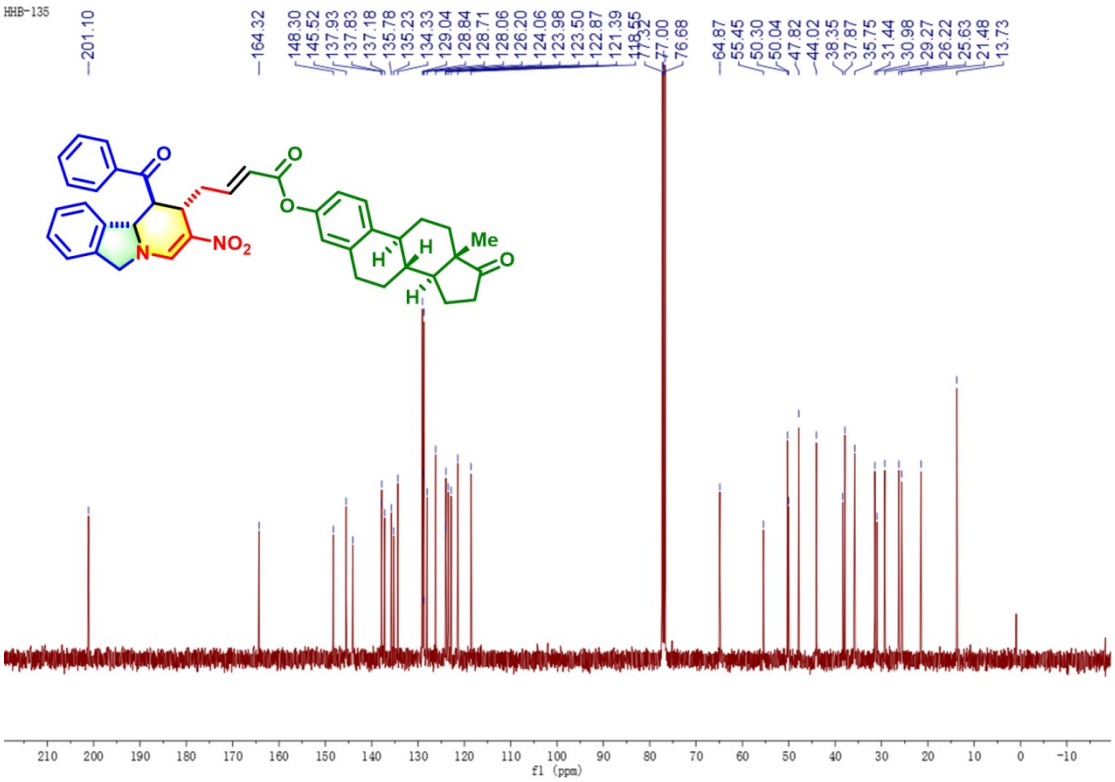
^{13}C NMR spectrum of **58** (100 MHz, $CDCl_3$)



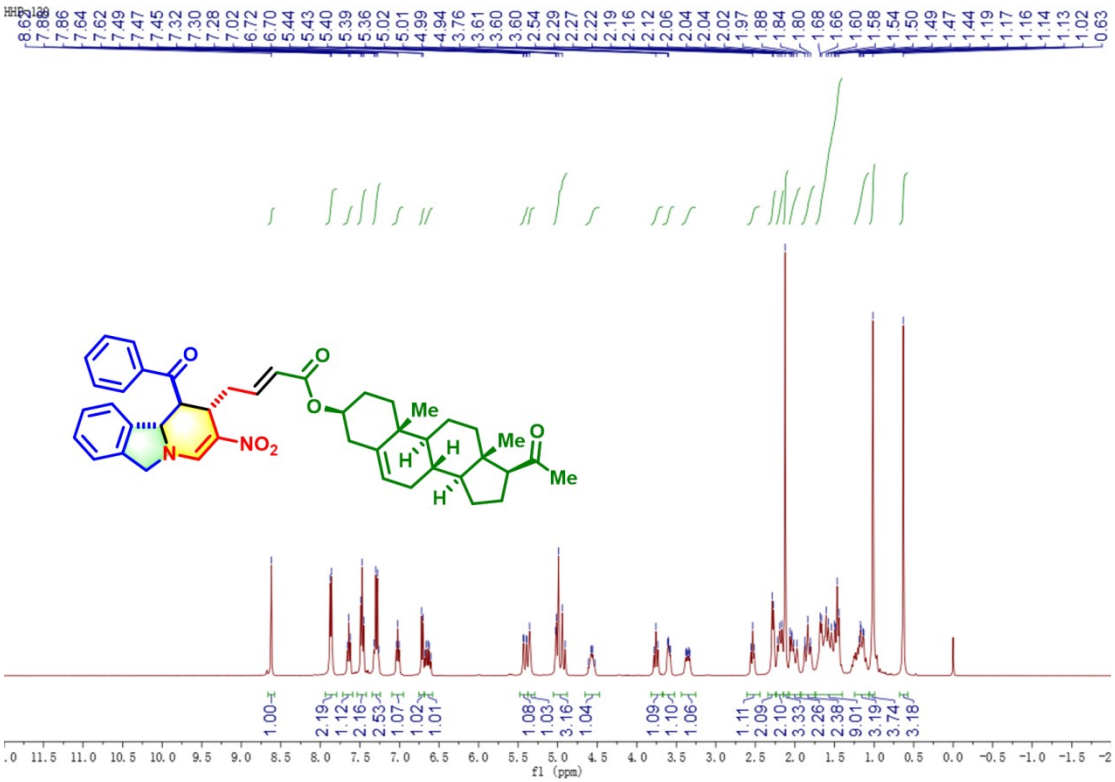
^{1}H NMR spectrum of **59** (400 MHz, $CDCl_3$)



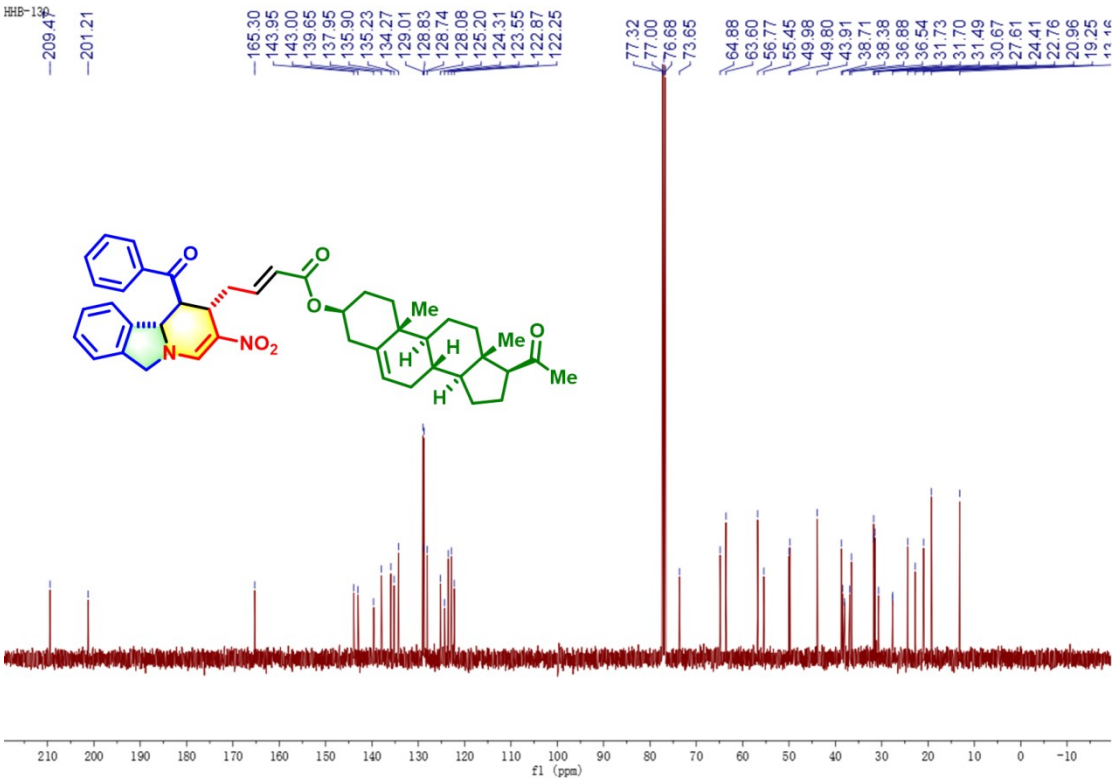
^{13}C NMR spectrum of **59** (100 MHz, $CDCl_3$)



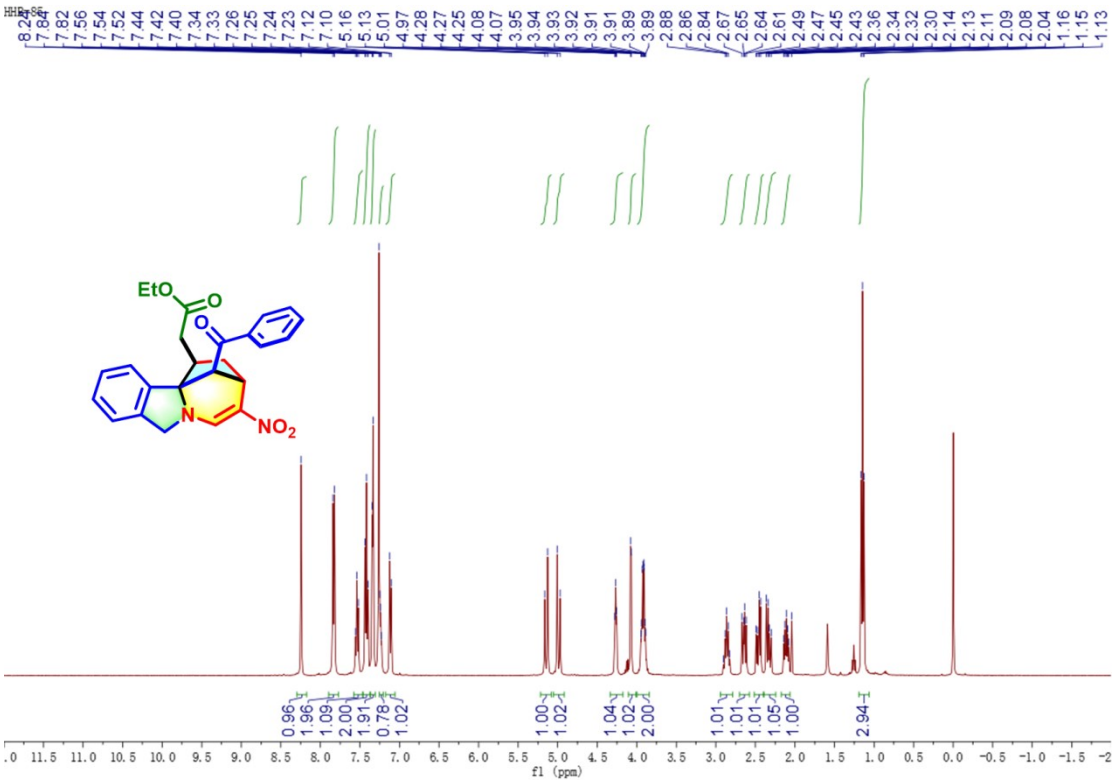
^{1}H NMR spectrum of **60** (400 MHz, $CDCl_3$)



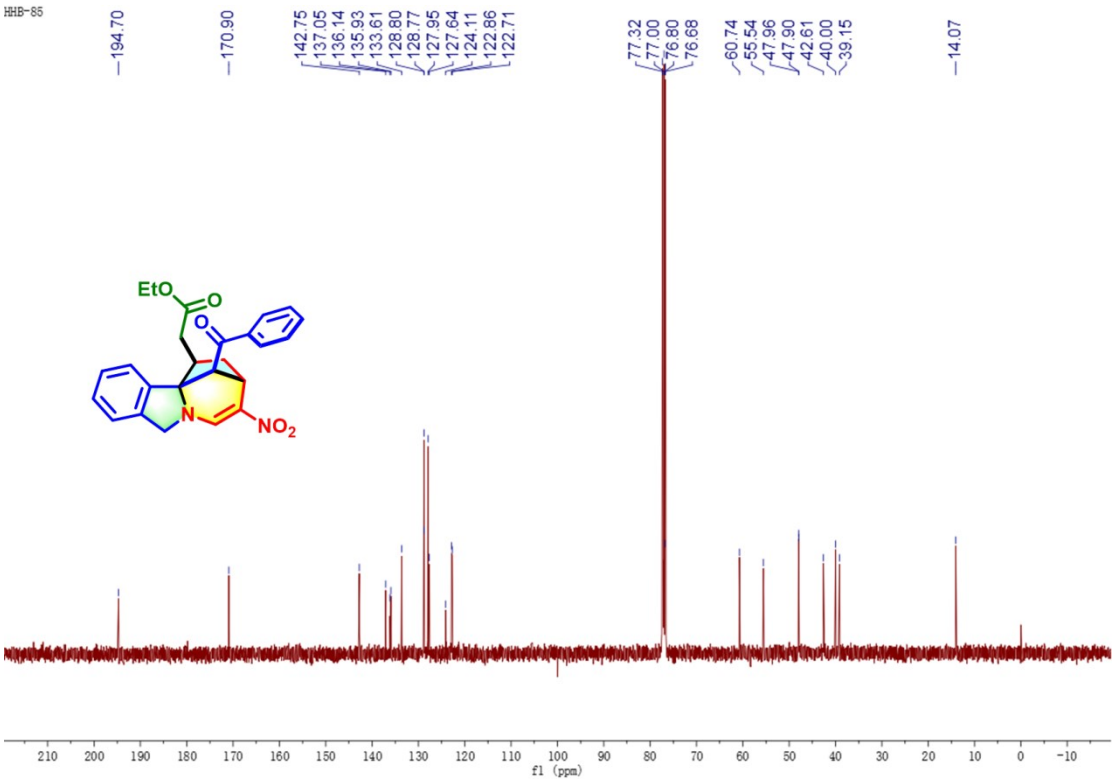
^{13}C NMR spectrum of **60** (100 MHz, $CDCl_3$)



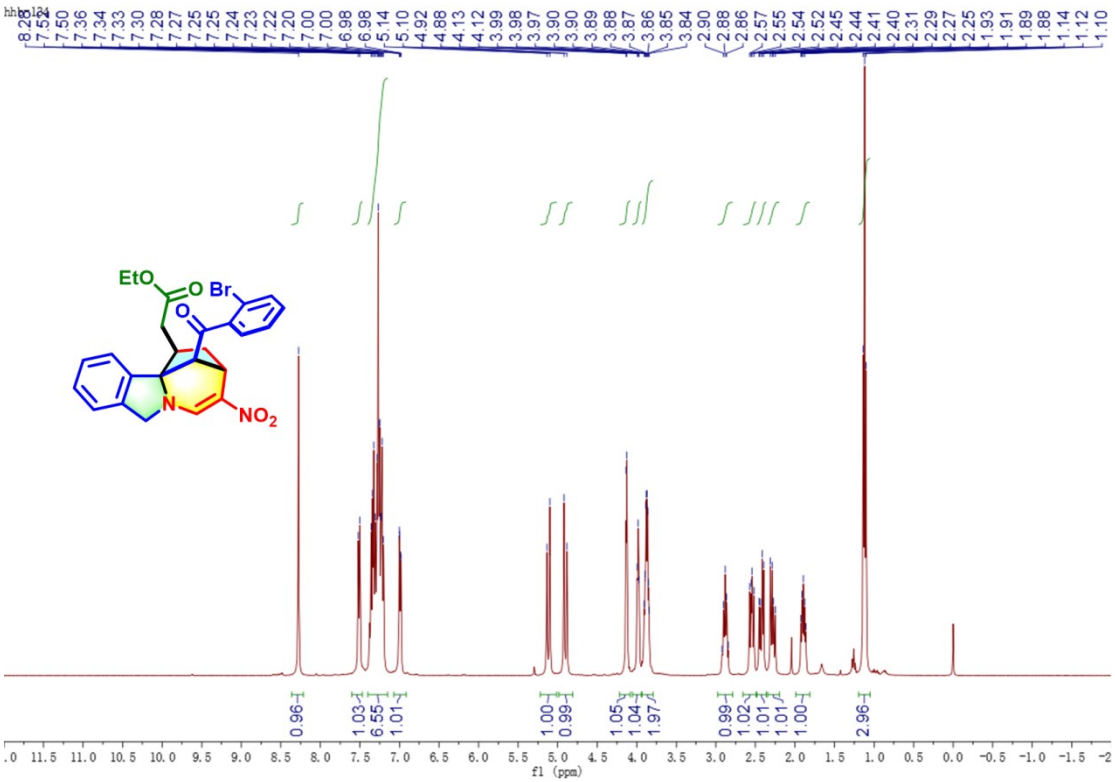
^{1}H NMR spectrum of **61** (400 MHz, $CDCl_3$)



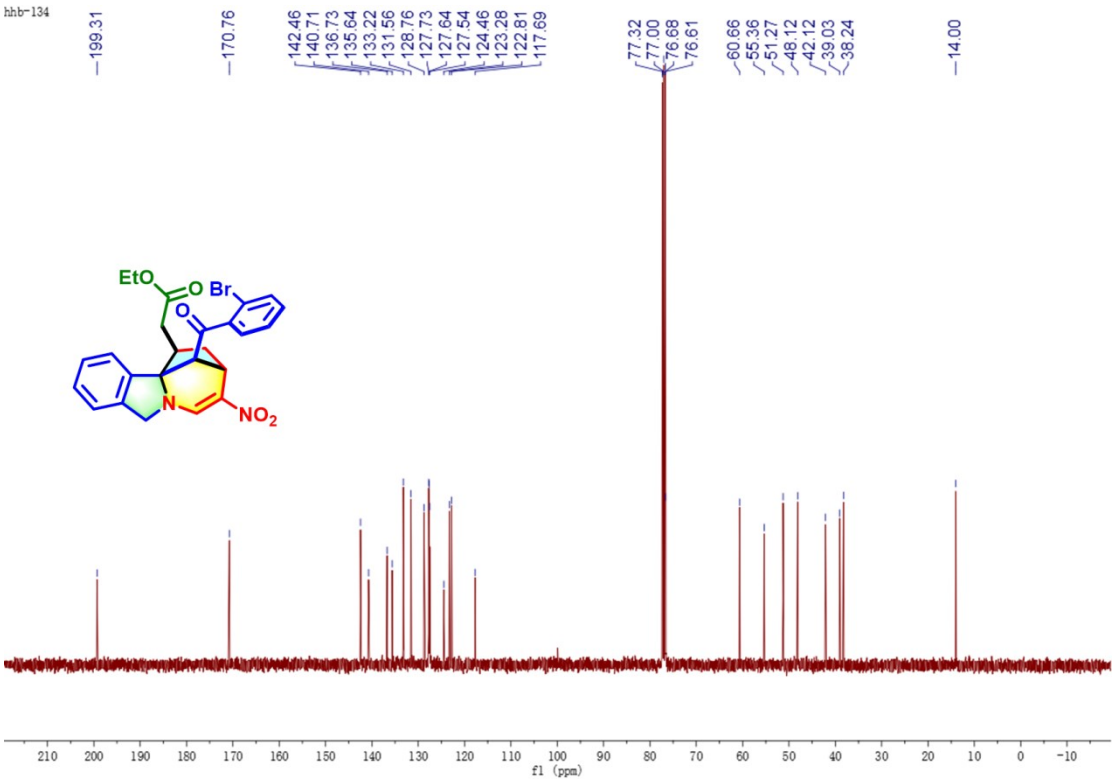
^{13}C NMR spectrum of **61** (100 MHz, $CDCl_3$)



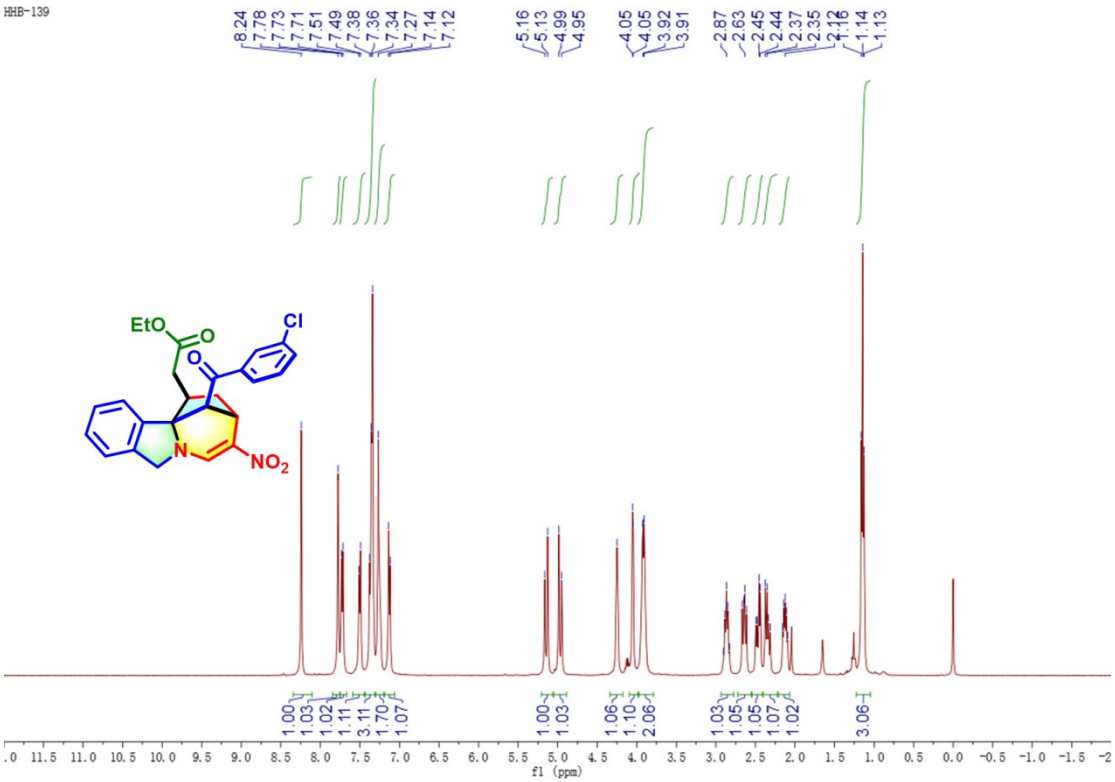
^{1}H NMR spectrum of **62** (400 MHz, $CDCl_3$)



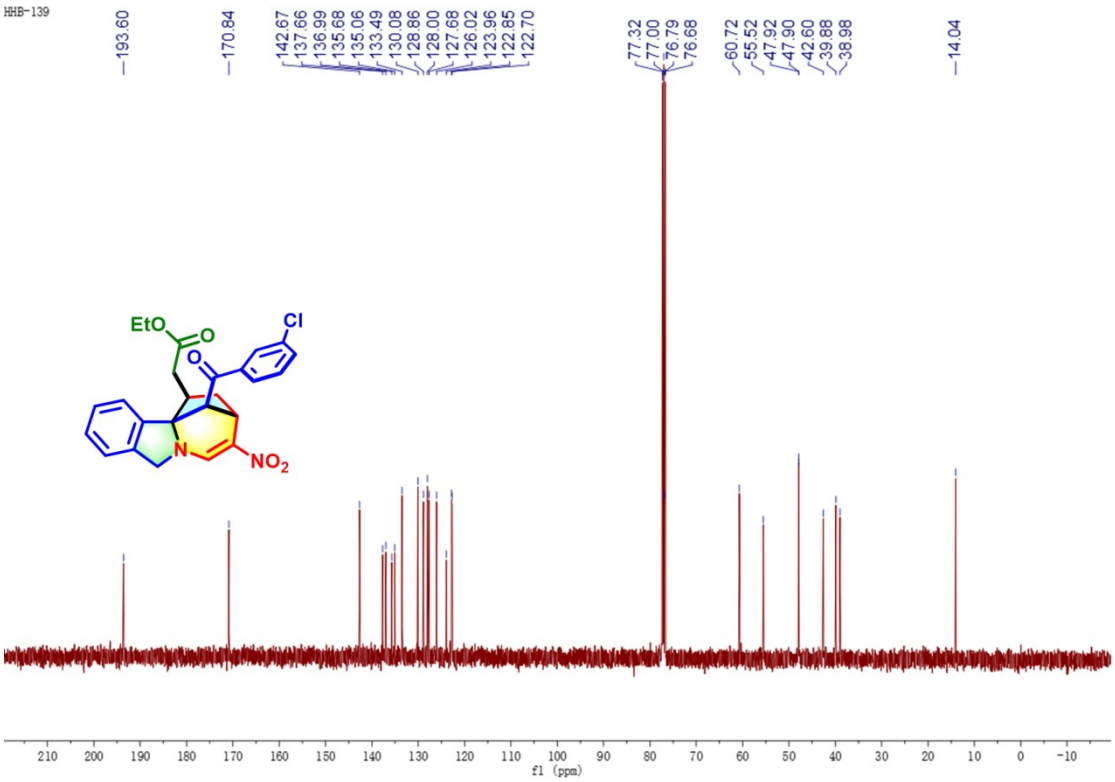
^{13}C NMR spectrum of **62** (100 MHz, $CDCl_3$)



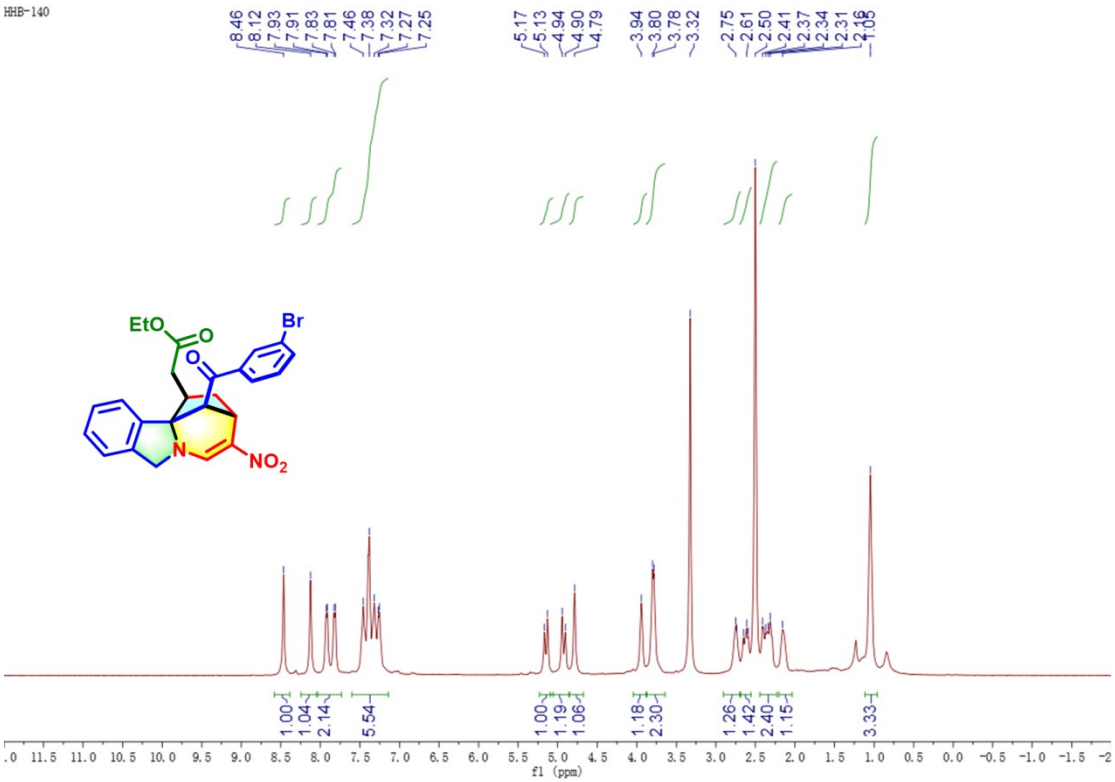
^{1}H NMR spectrum of **63** (400 MHz, $CDCl_3$)



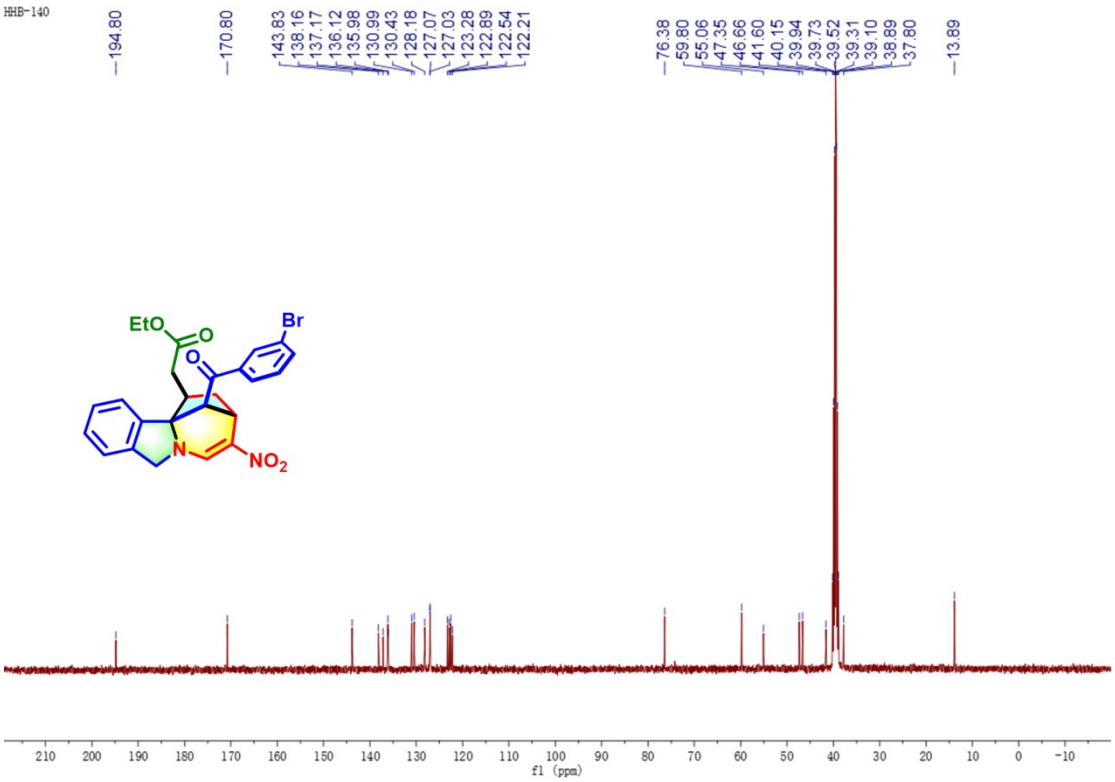
^{13}C NMR spectrum of **63** (100 MHz, $CDCl_3$)



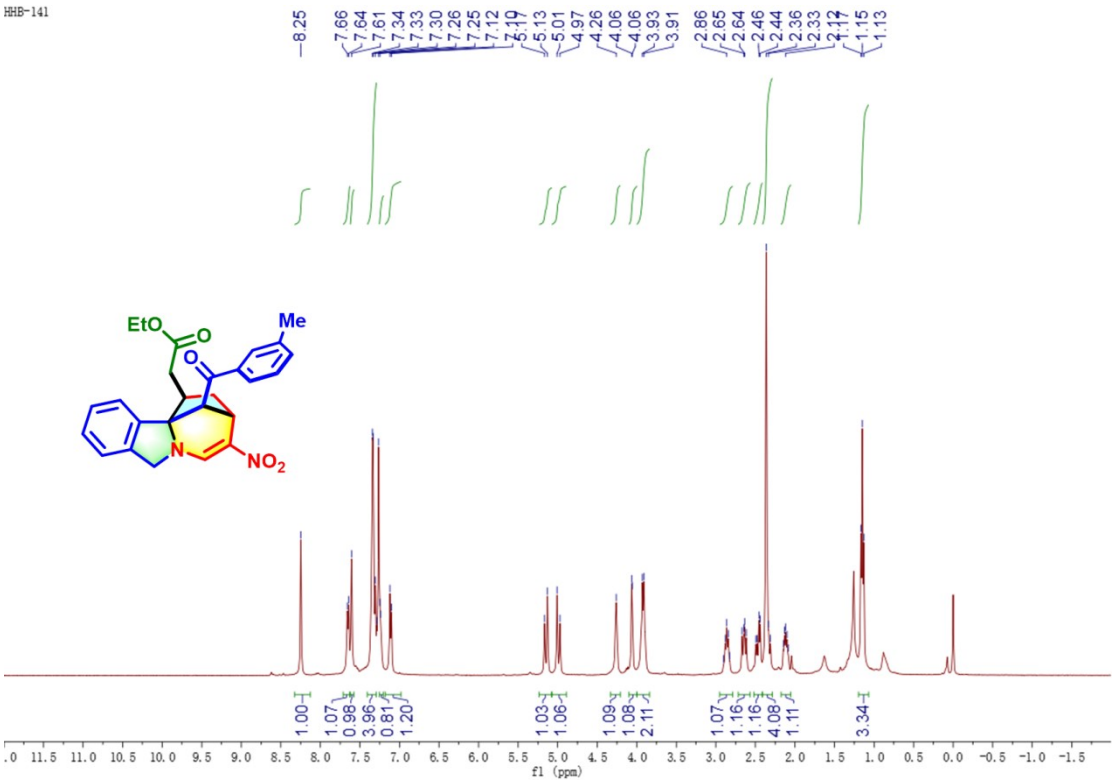
^{1}H NMR spectrum of **64** (400 MHz, DMSO-d_6)



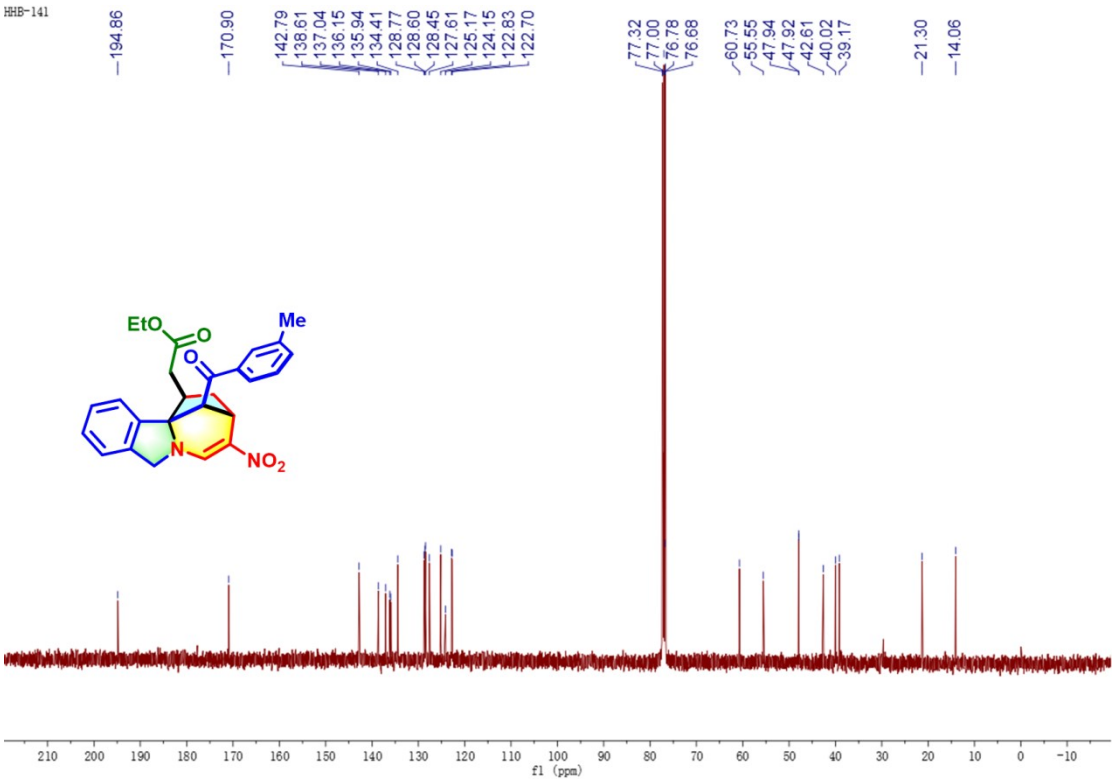
^{13}C NMR spectrum of **64** (100 MHz, DMSO-d_6)



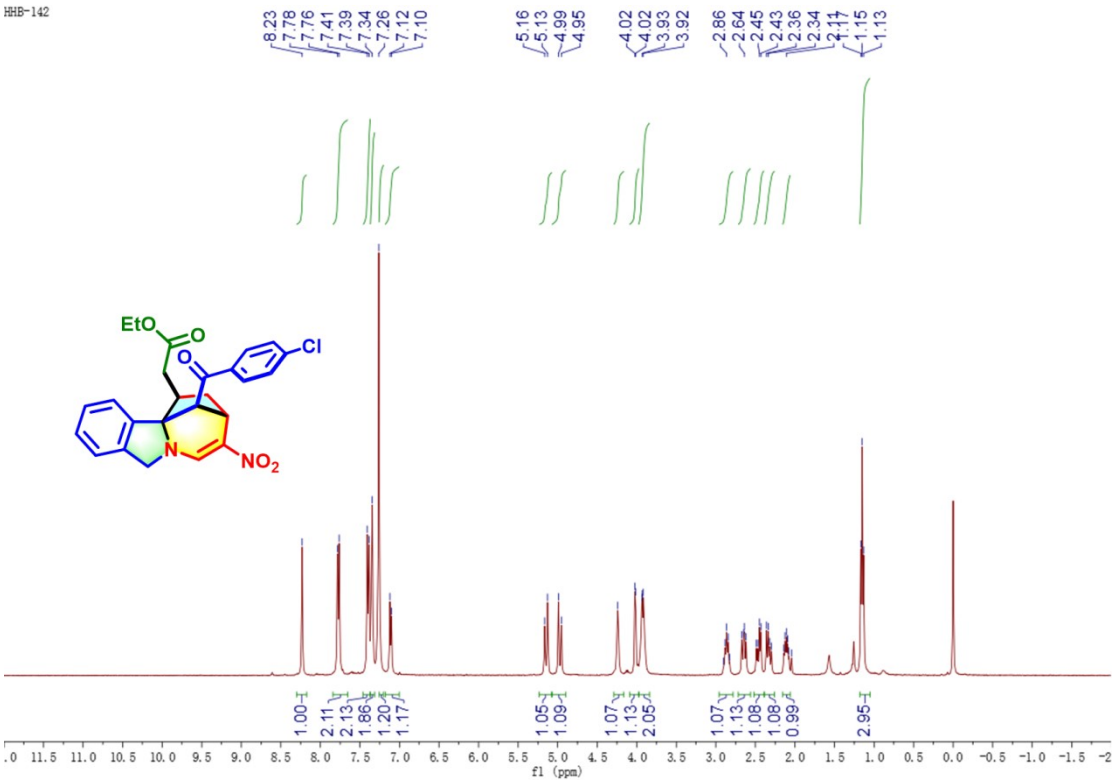
^{1}H NMR spectrum of **65** (400 MHz, $CDCl_3$)



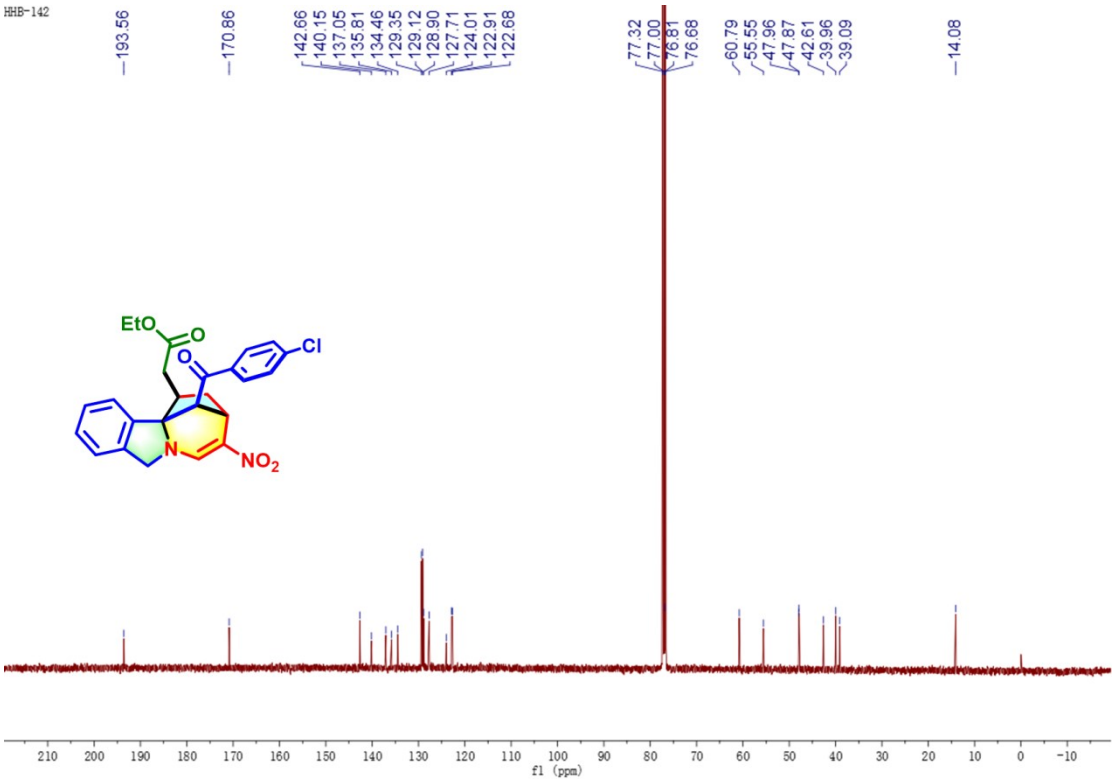
^{13}C NMR spectrum of **65** (100 MHz, $CDCl_3$)



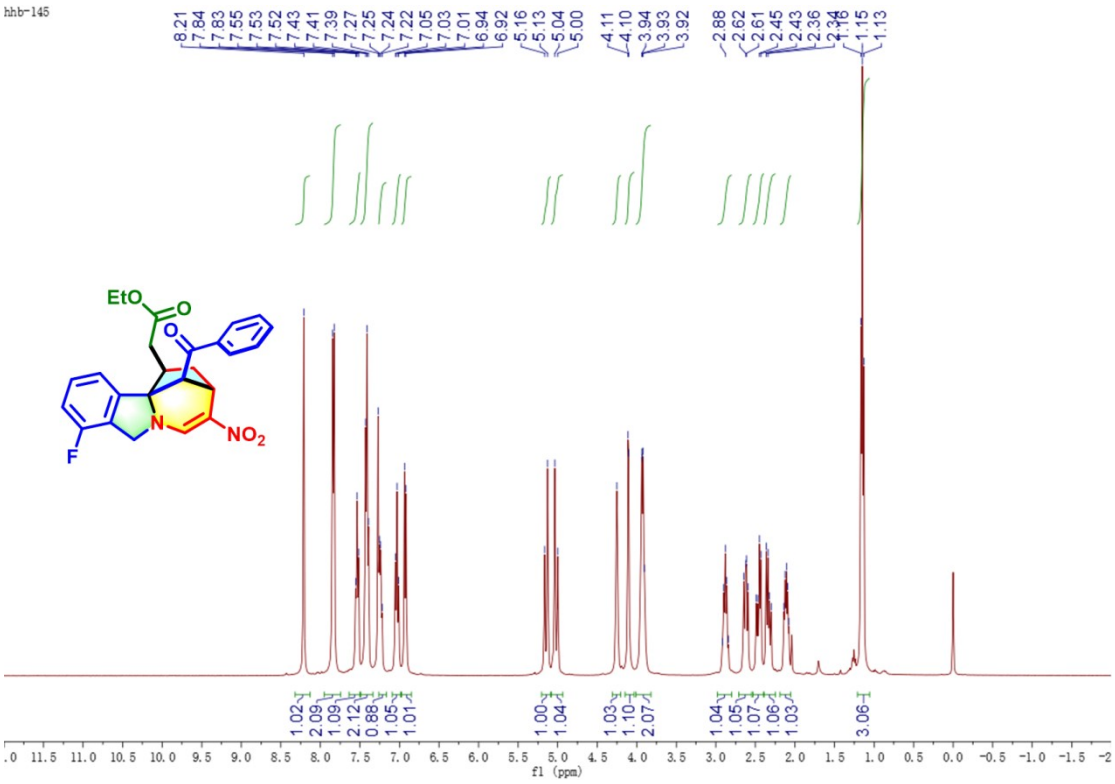
^{1}H NMR spectrum of **66** (400 MHz, $CDCl_3$)



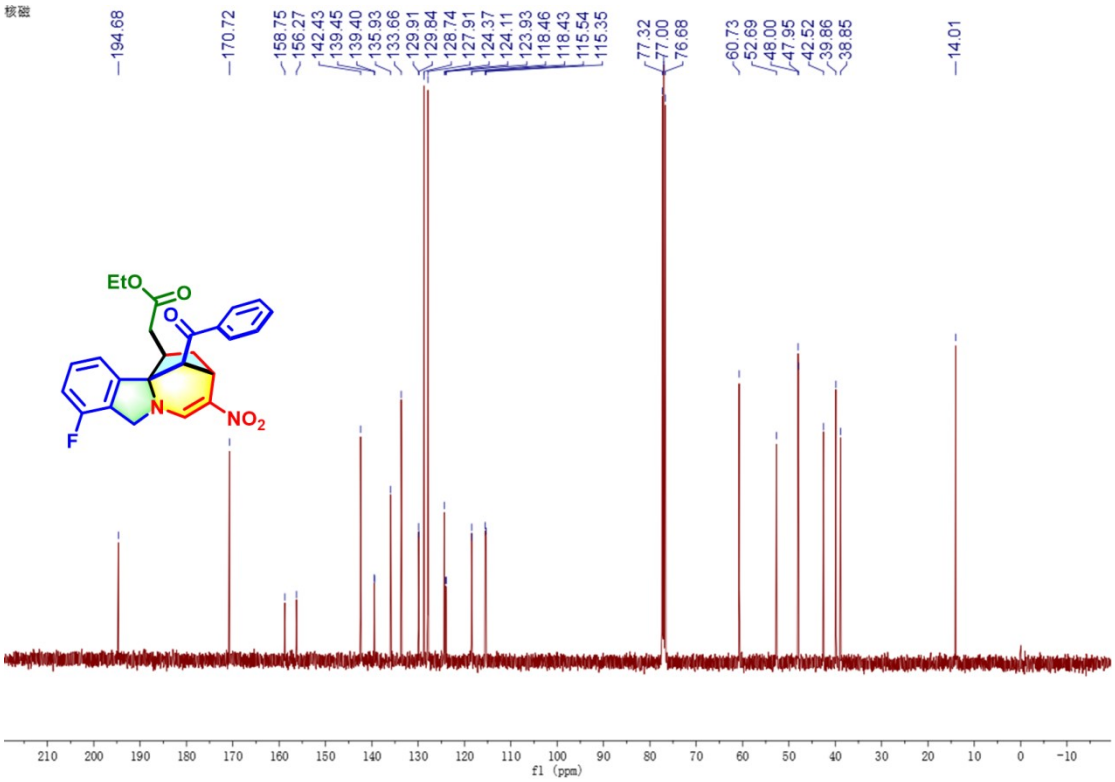
^{13}C NMR spectrum of **66** (100 MHz, $CDCl_3$)



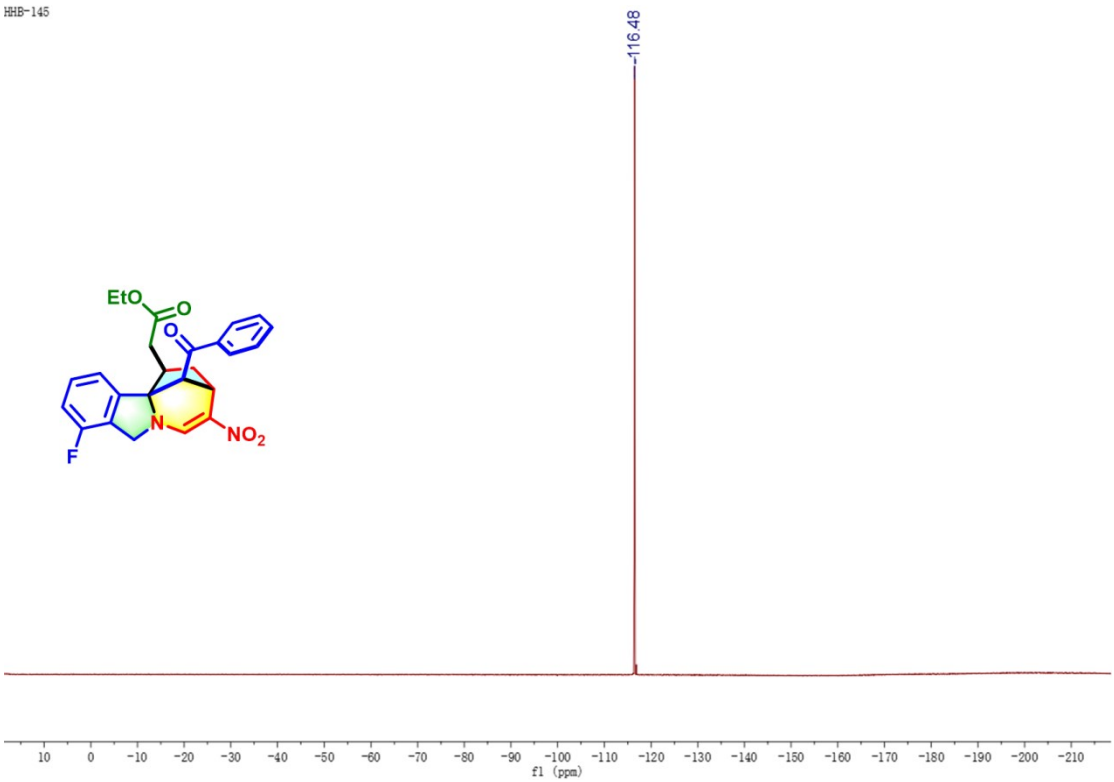
^{1}H NMR spectrum of **67** (400 MHz, $CDCl_3$)



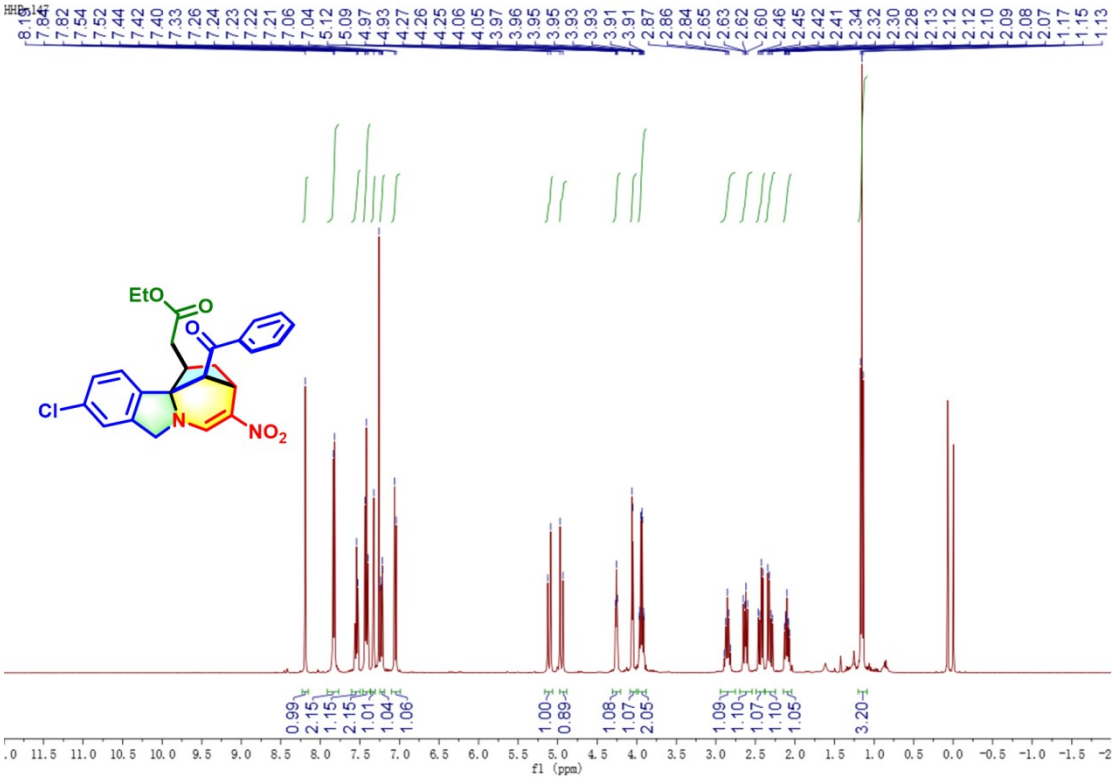
^{13}C NMR spectrum of **67** (100 MHz, $CDCl_3$)



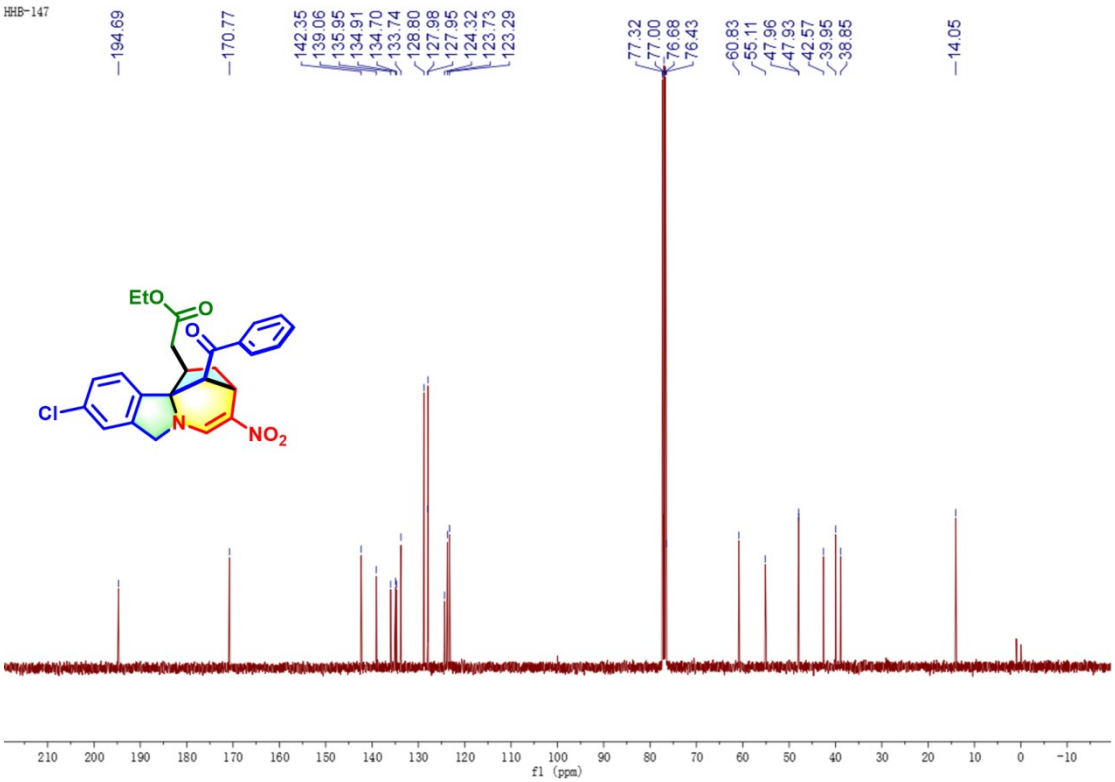
^{19}F NMR spectrum of **67** (375 MHz, $CDCl_3$)



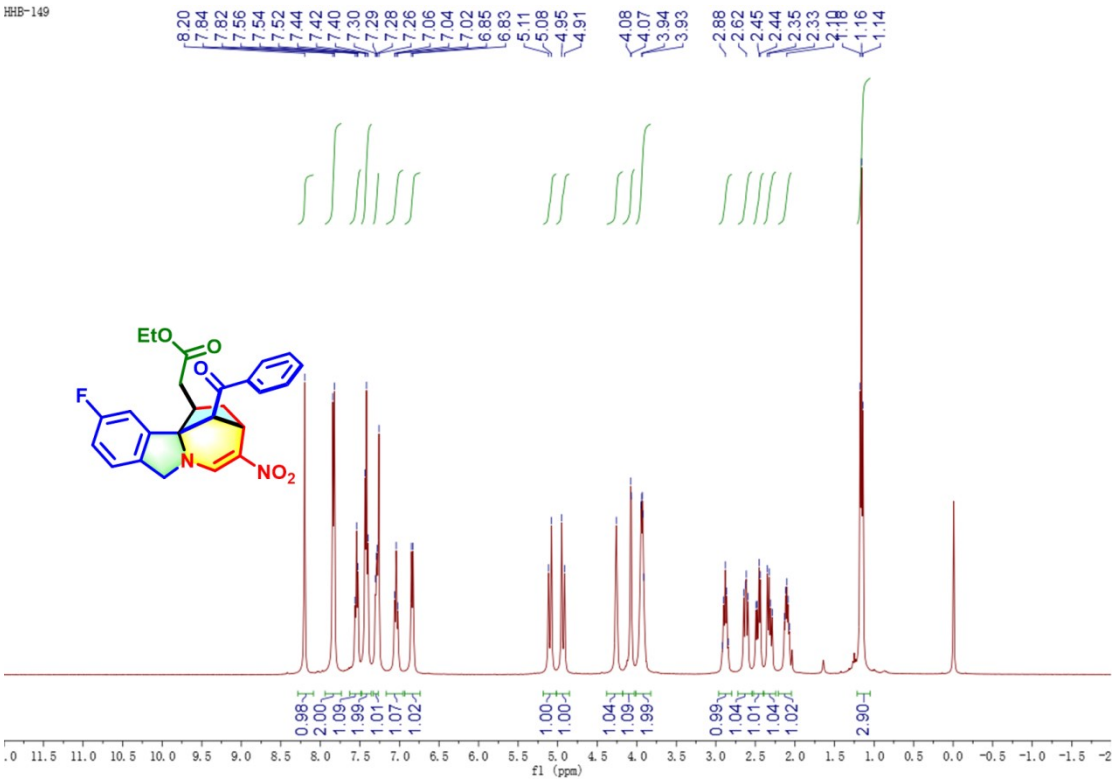
^{1}H NMR spectrum of **68** (400 MHz, $CDCl_3$)



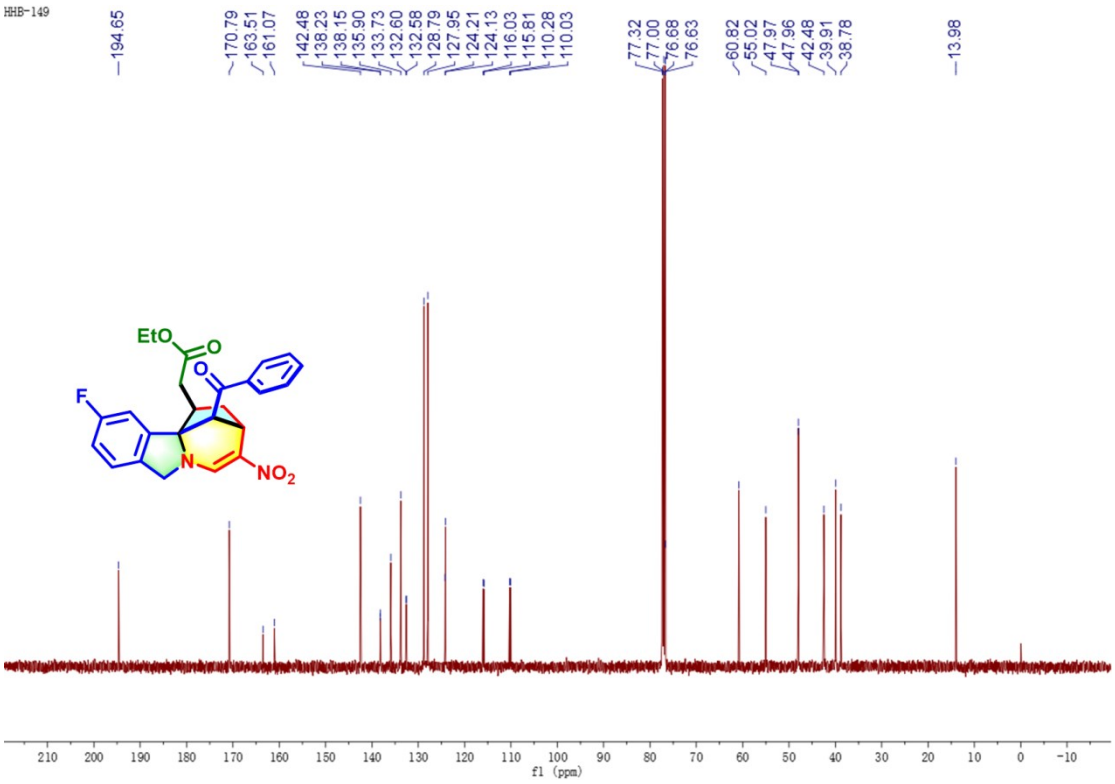
^{13}C NMR spectrum of **68** (100 MHz, $CDCl_3$)



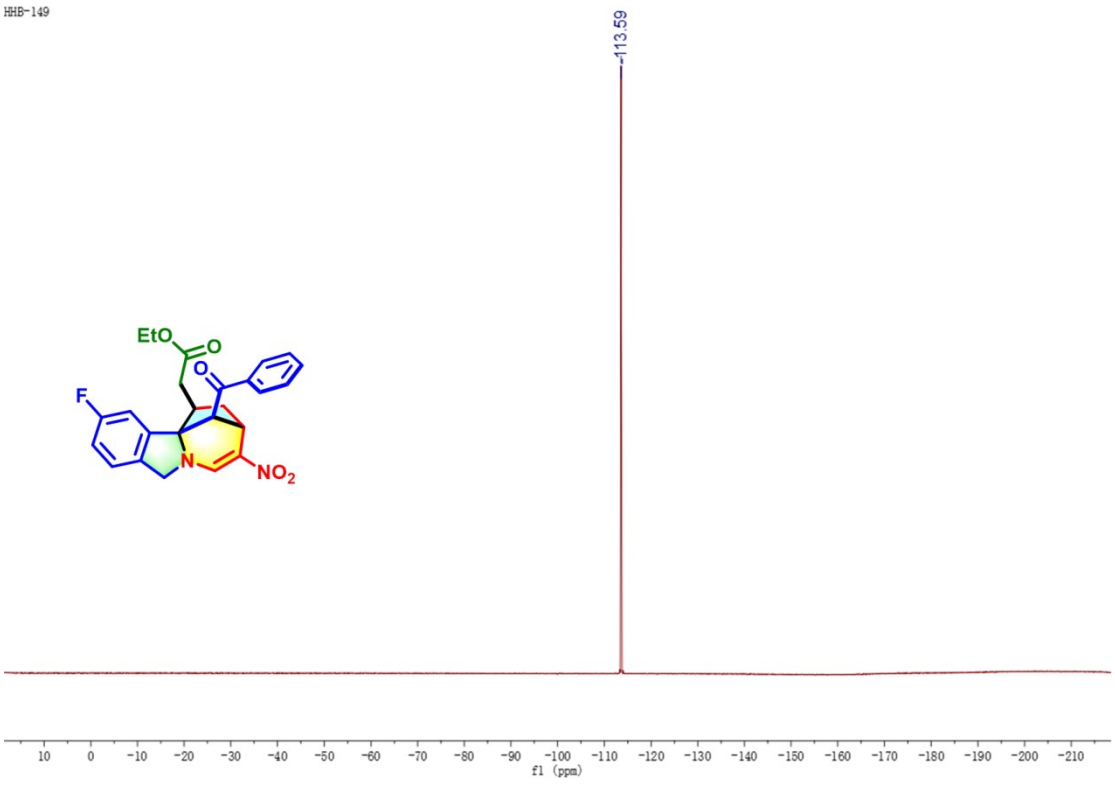
^{1}H NMR spectrum of **69** (400 MHz, $CDCl_3$)



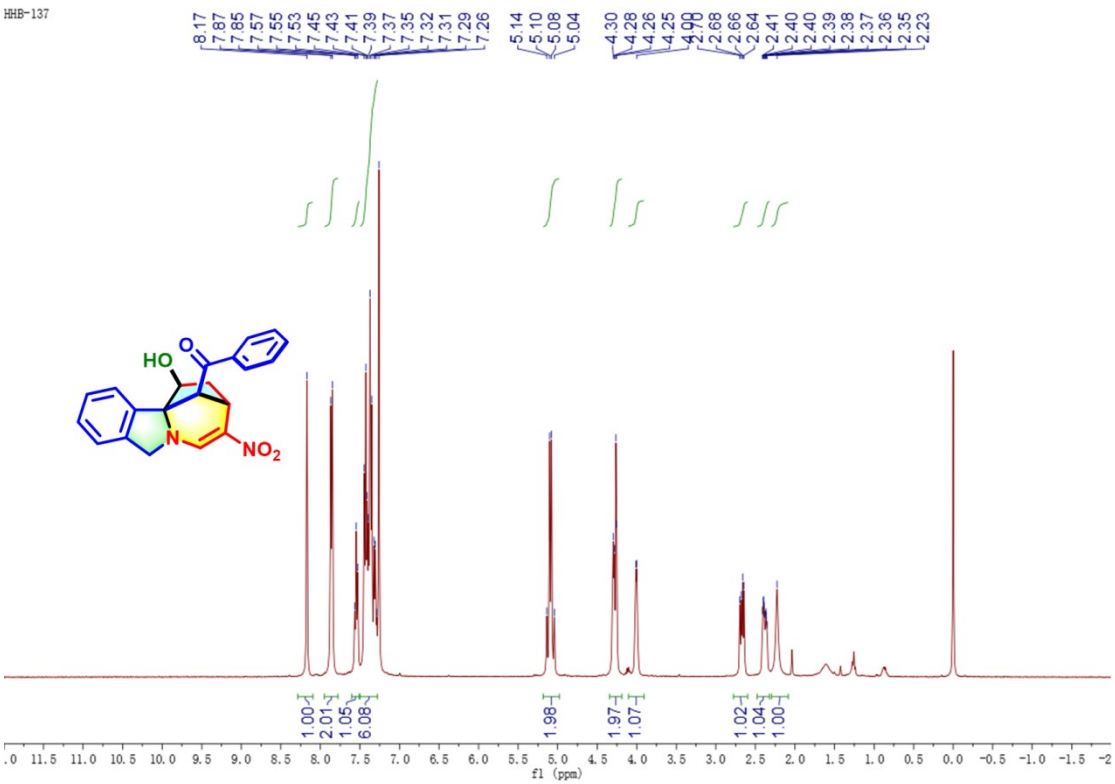
^{13}C NMR spectrum of **69** (100 MHz, $CDCl_3$)



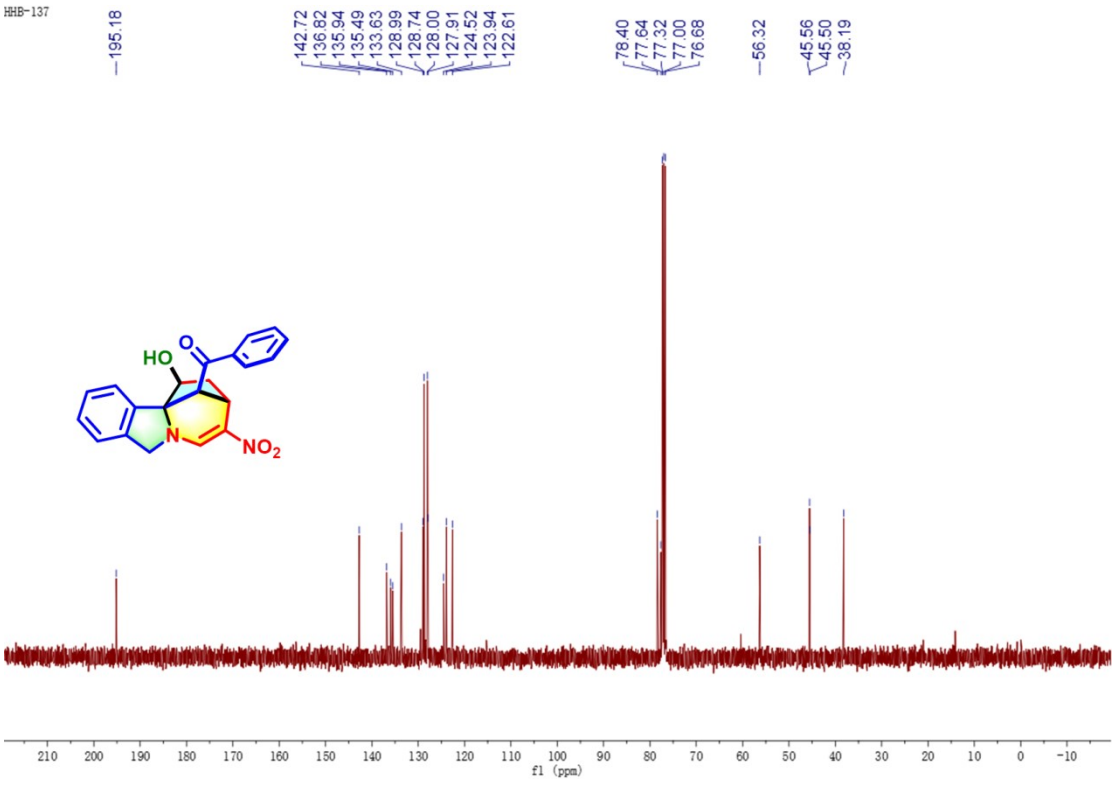
^{19}F NMR spectrum of **69** (375 MHz, $CDCl_3$)



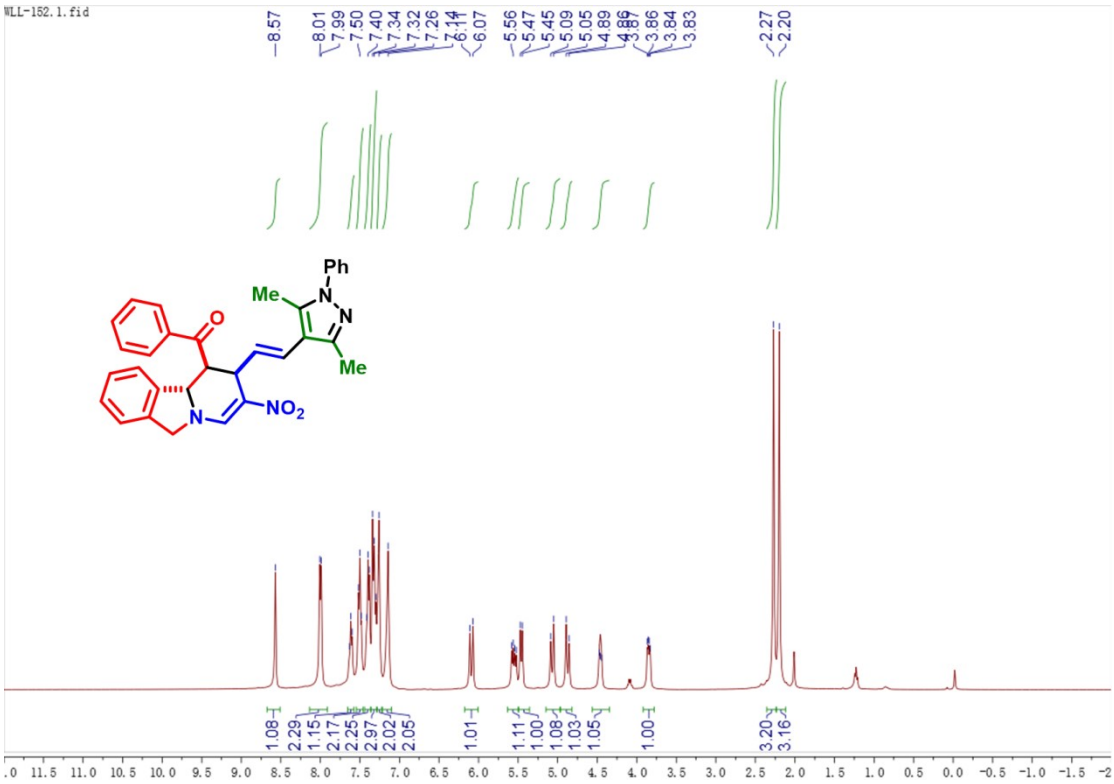
^{1}H NMR spectrum of **70** (400 MHz, $CDCl_3$)



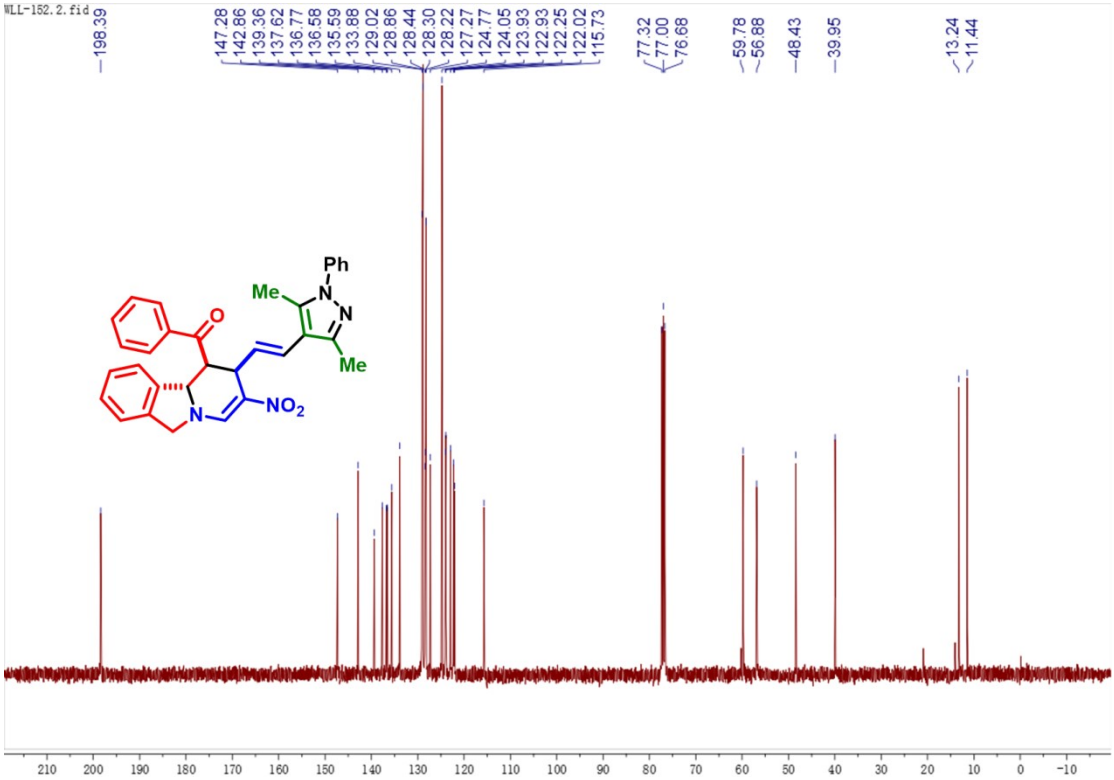
^{13}C NMR spectrum of **70** (100 MHz, $CDCl_3$)



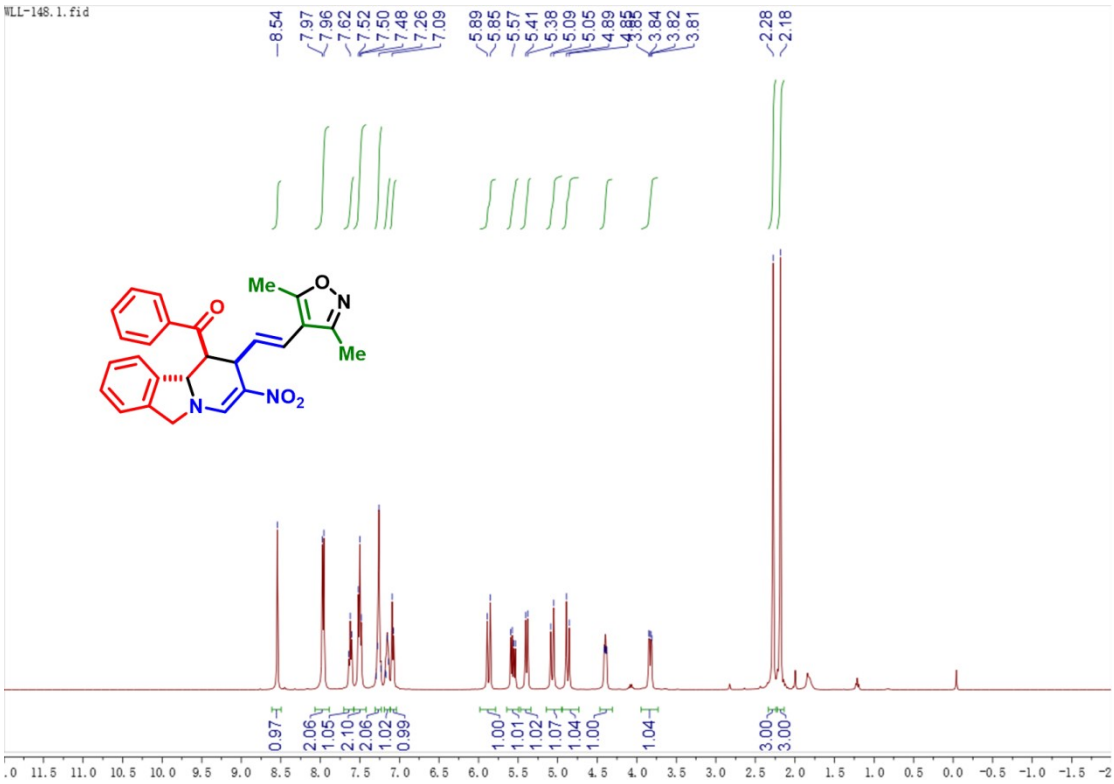
^{1}H NMR spectrum of **71** (400 MHz, $CDCl_3$)



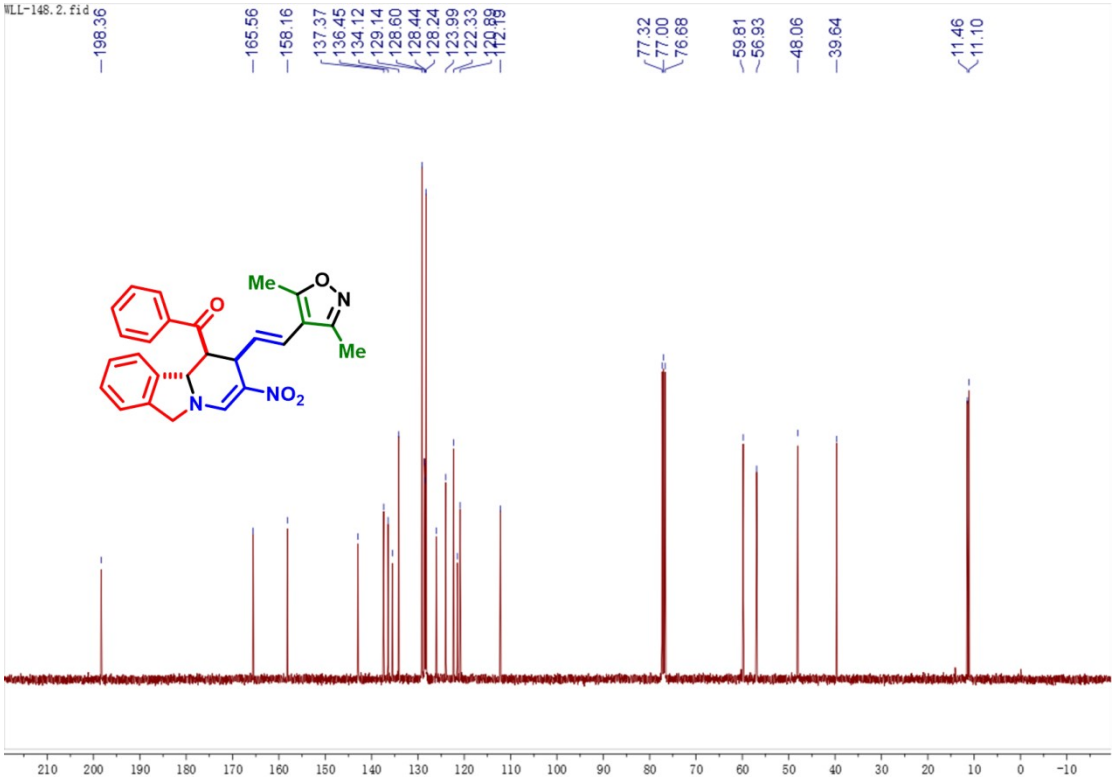
^{13}C NMR spectrum of **71** (100 MHz, $CDCl_3$)



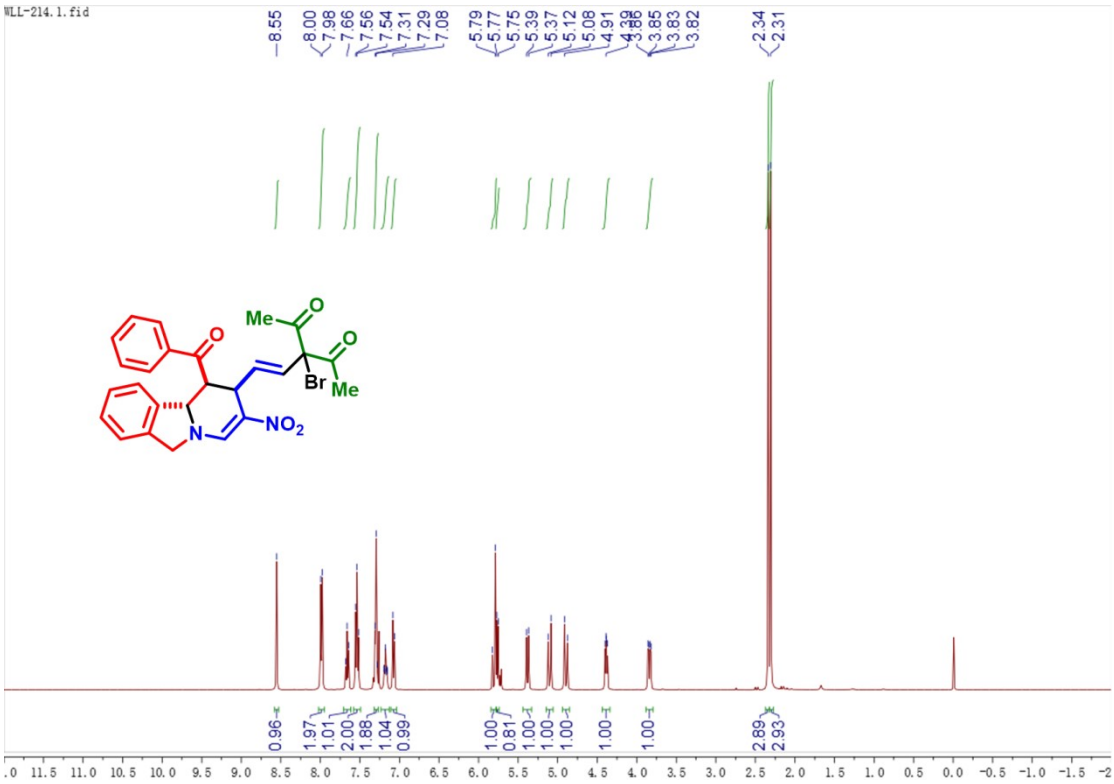
^{1}H NMR spectrum of **72** (400 MHz, $CDCl_3$)



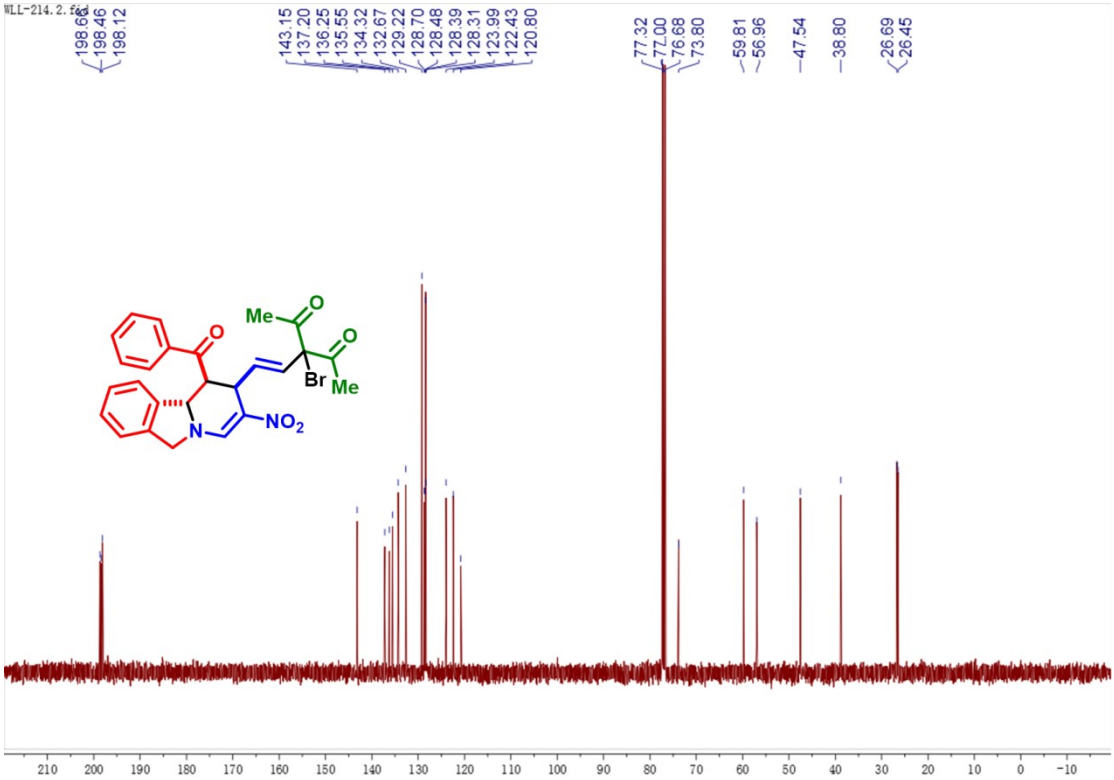
^{13}C NMR spectrum of **72** (100 MHz, $CDCl_3$)



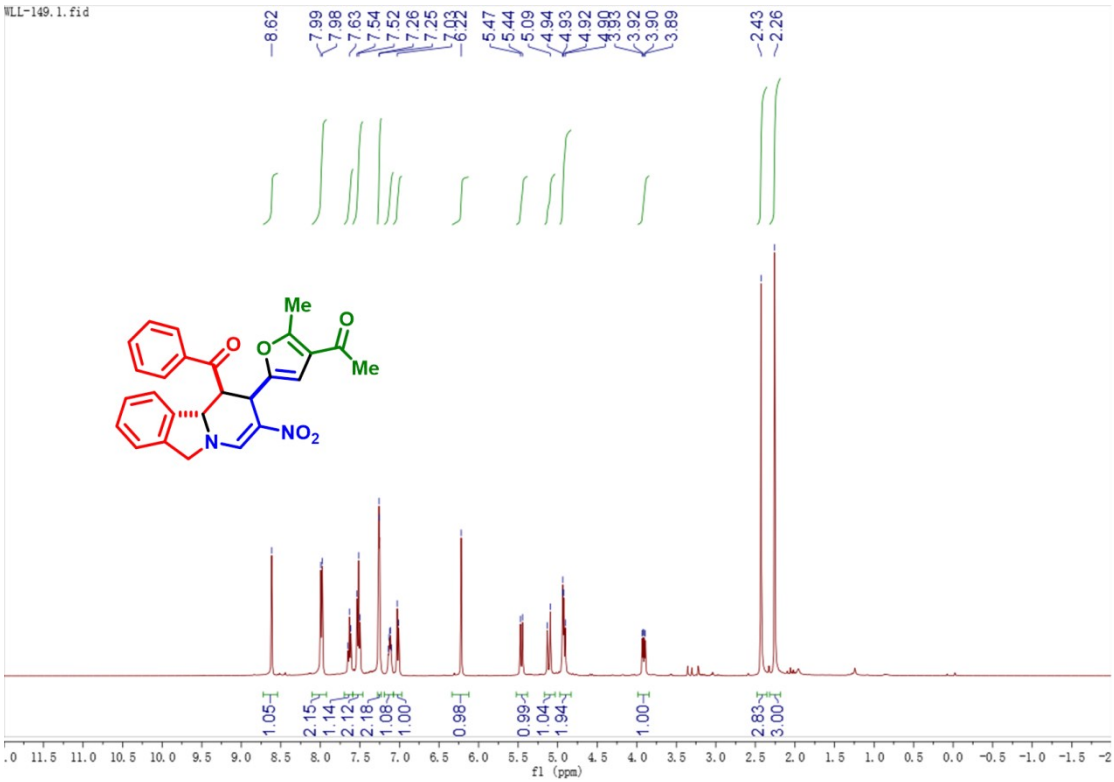
^{1}H NMR spectrum of **73** (400 MHz, $CDCl_3$)



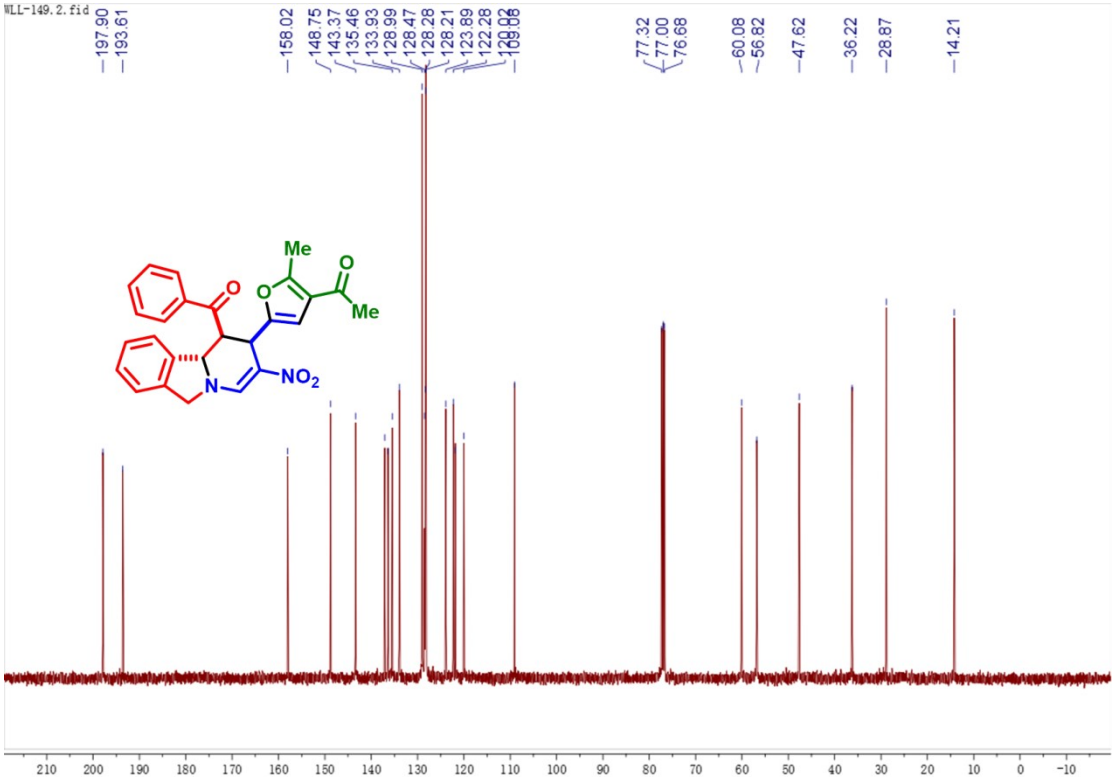
^{13}C NMR spectrum of **73** (100 MHz, $CDCl_3$)



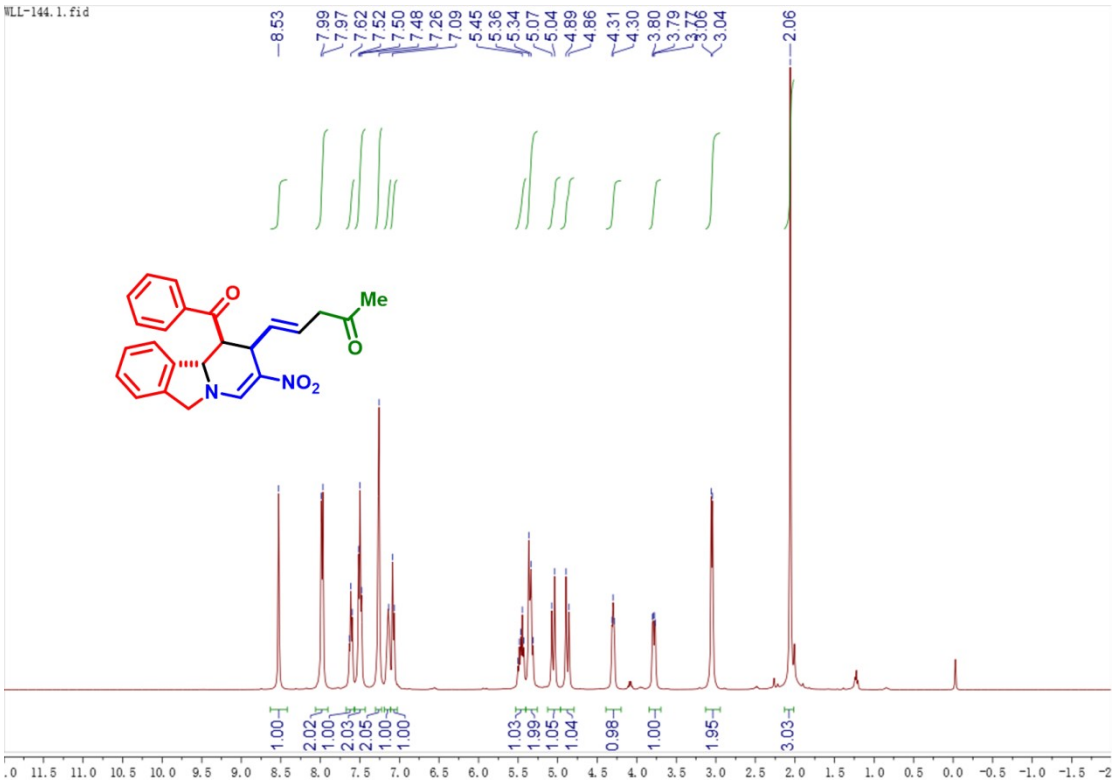
^{1}H NMR spectrum of **74** (400 MHz, $CDCl_3$)



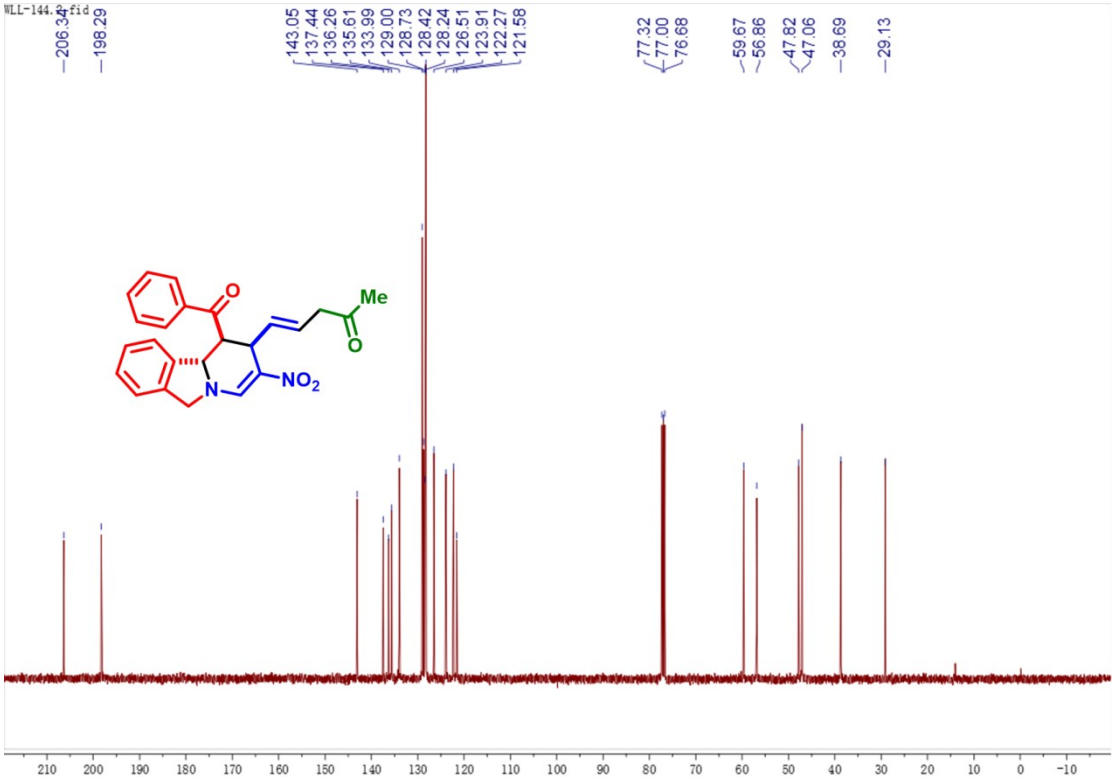
^{13}C NMR spectrum of **74** (100 MHz, $CDCl_3$)



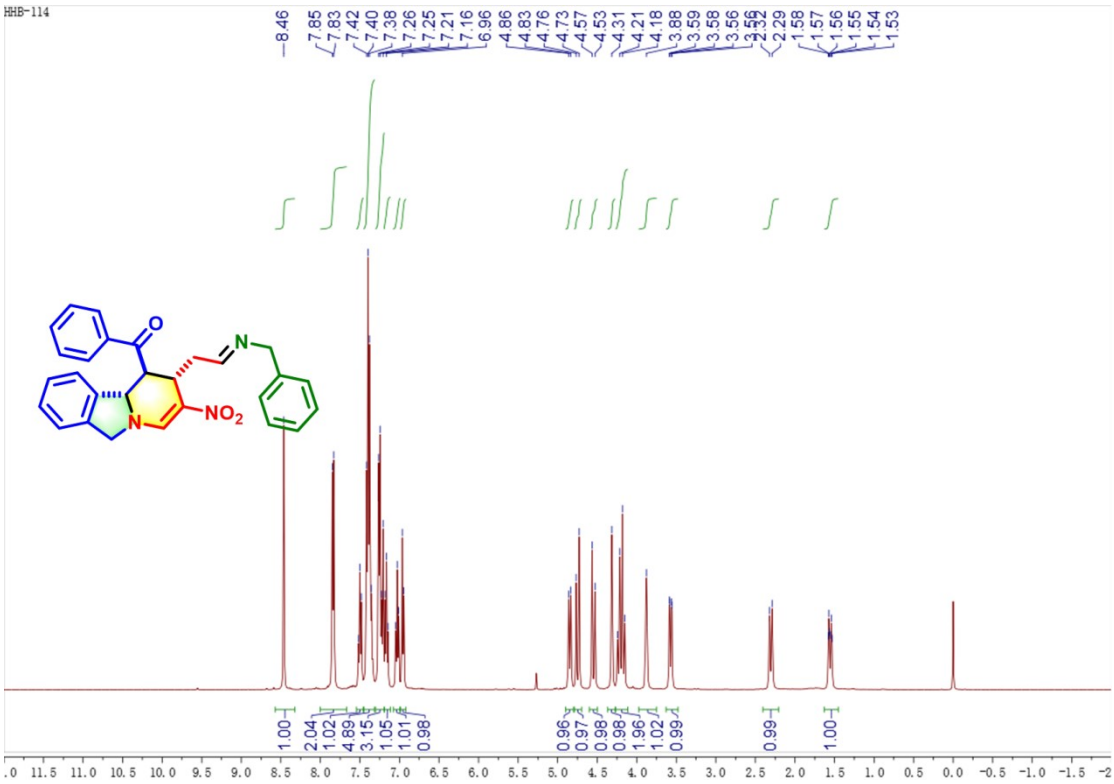
^{1}H NMR spectrum of **75** (400 MHz, $CDCl_3$)



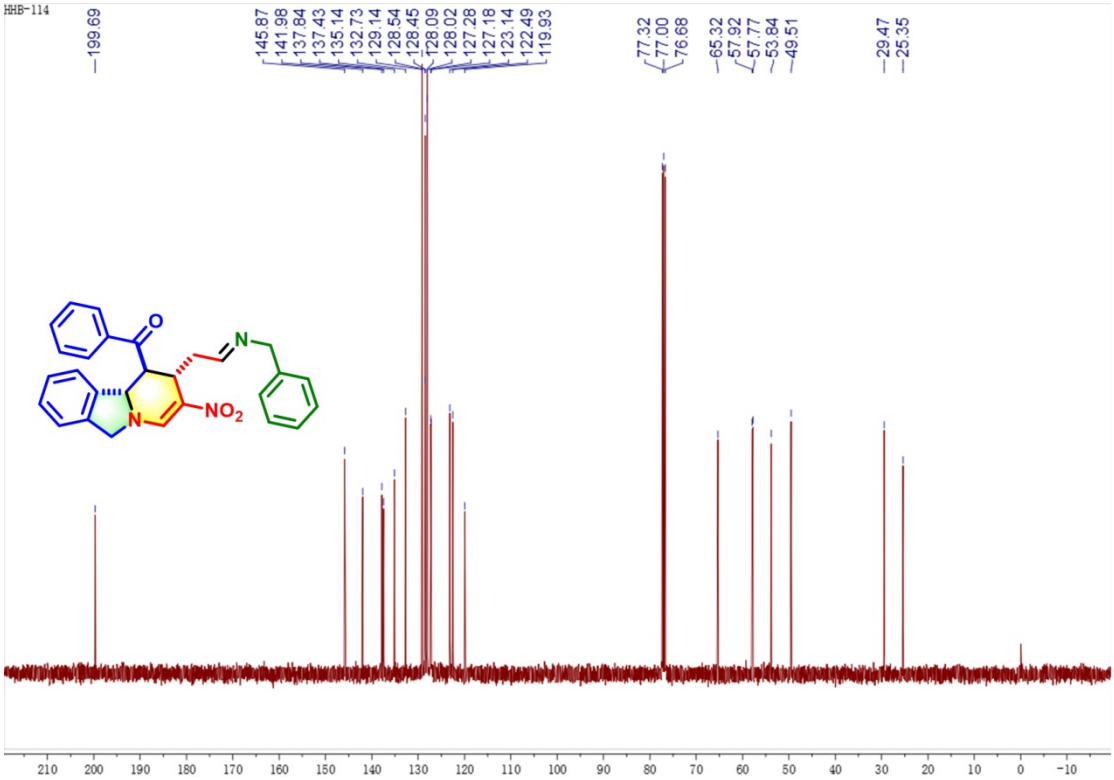
^{13}C NMR spectrum of **75** (100 MHz, $CDCl_3$)



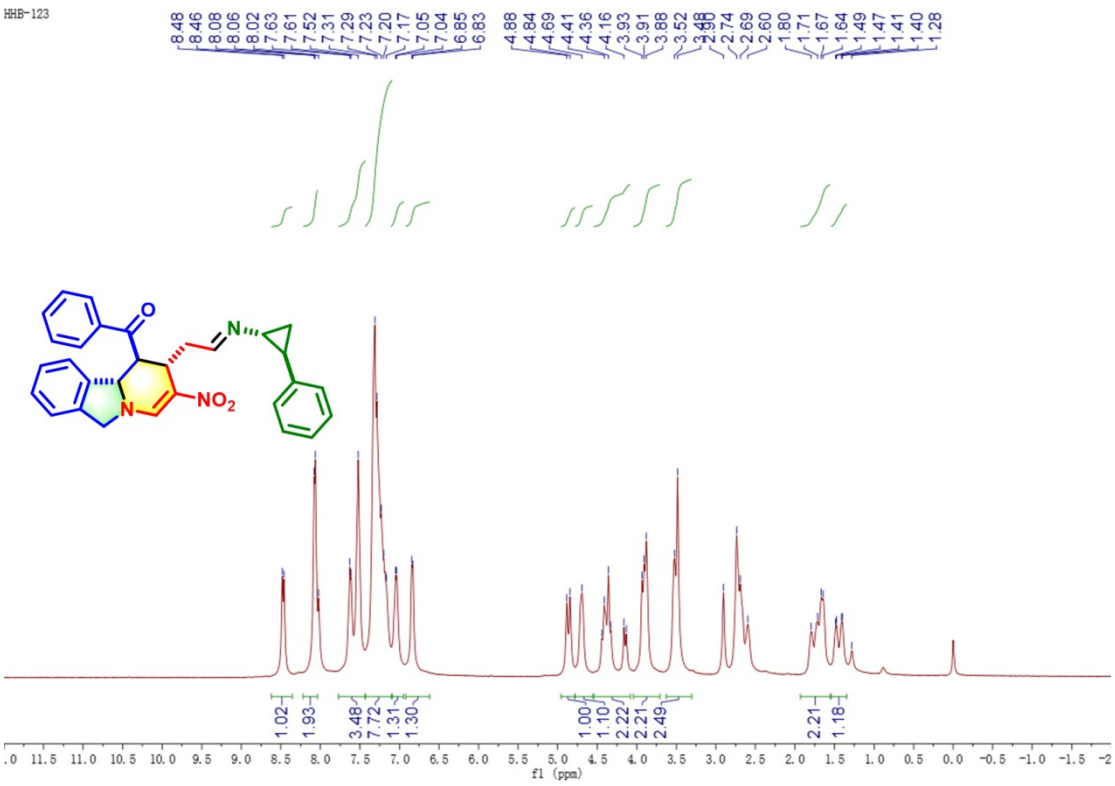
^{1}H NMR spectrum of **76** (400 MHz, $CDCl_3$)



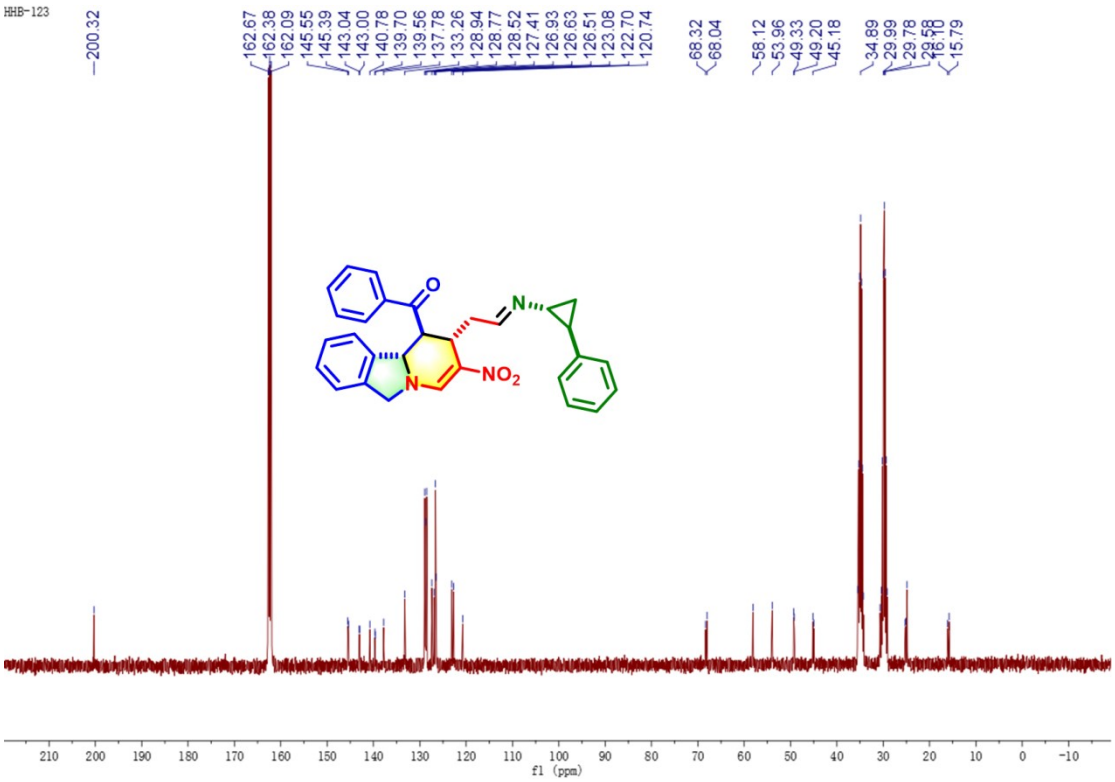
^{13}C NMR spectrum of **76** (100 MHz, $CDCl_3$)



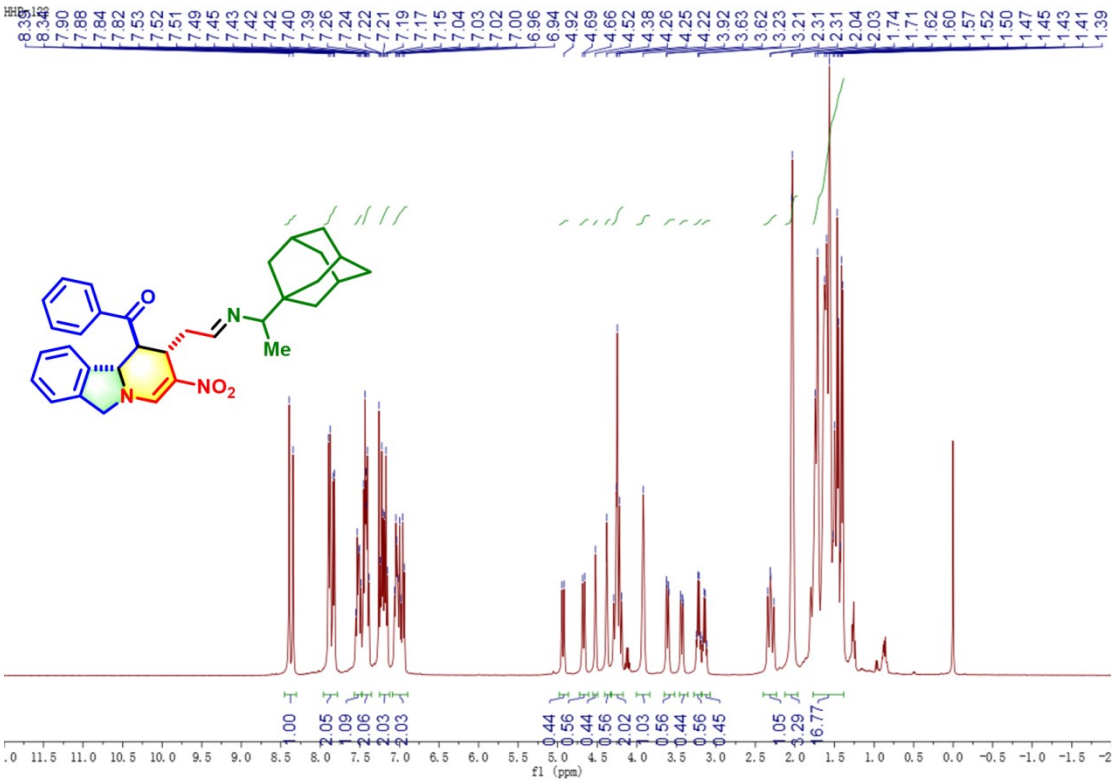
^{1}H NMR spectrum of **77** (400 MHz, DMF-d_7)



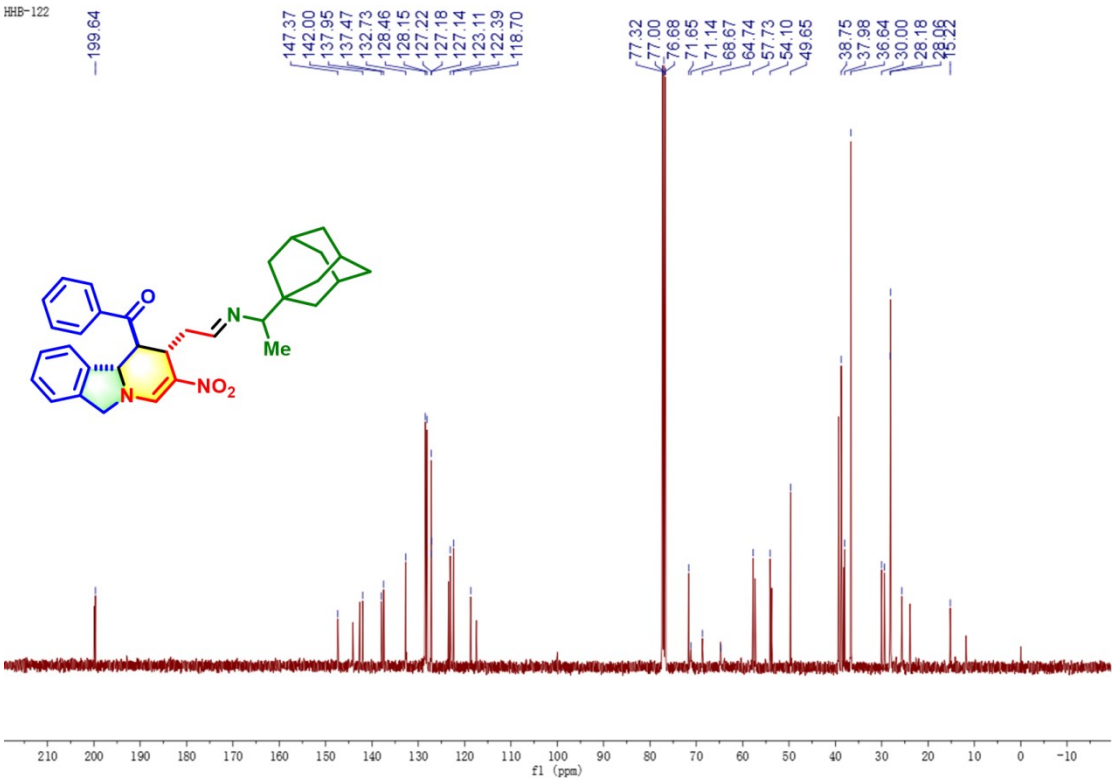
^{13}C NMR spectrum of **77** (100 MHz, DMF-d_7)



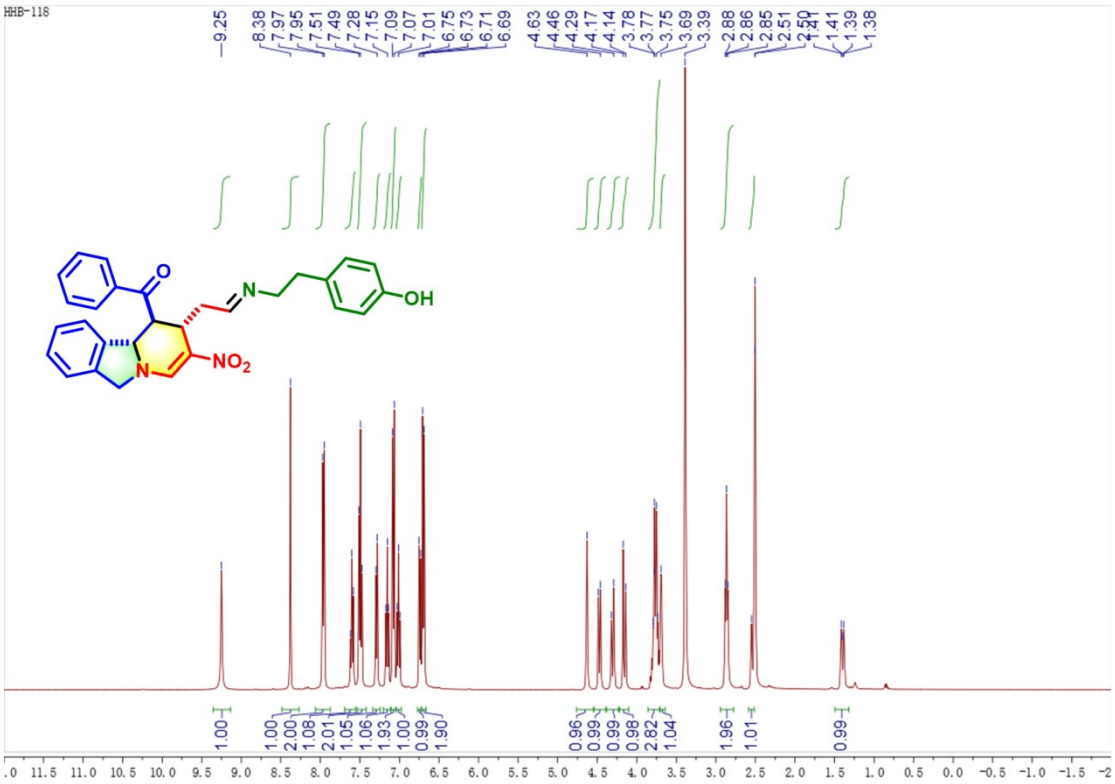
^{1}H NMR spectrum of **78** (400 MHz, $CDCl_3$)



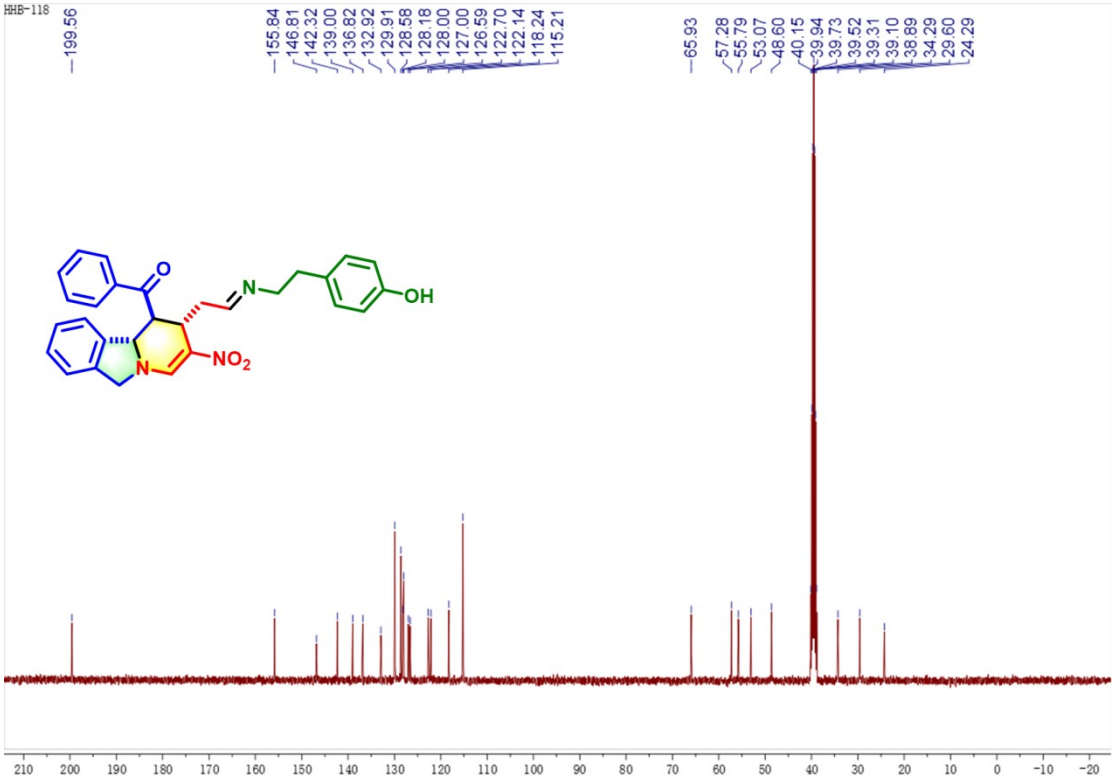
^{13}C NMR spectrum of **78** (100 MHz, $CDCl_3$)



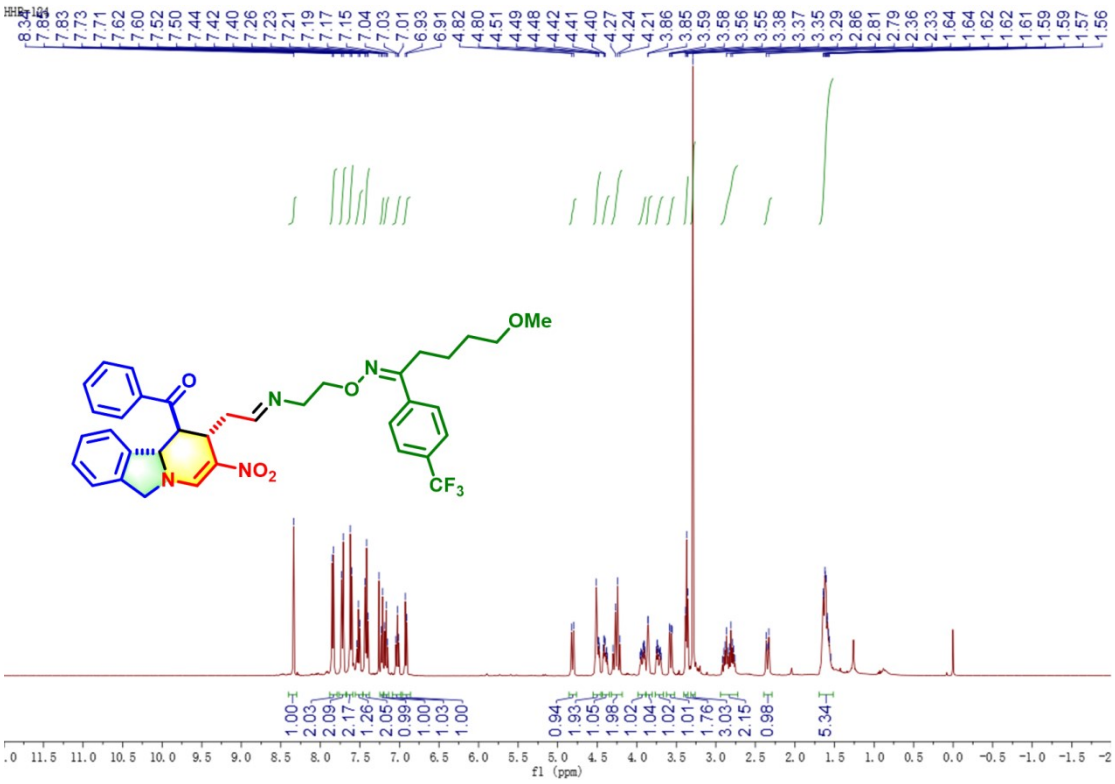
^{1}H NMR spectrum of **79** (400 MHz, DMSO-d_6)



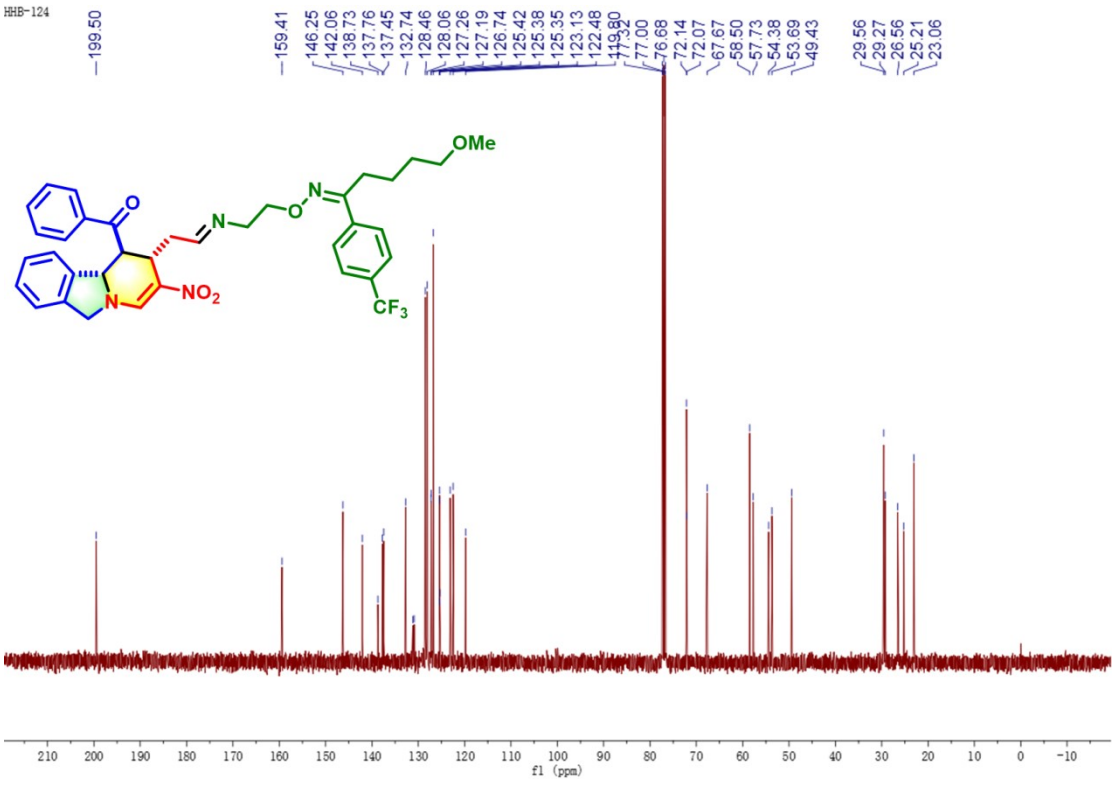
^{13}C NMR spectrum of **79** (100 MHz, DMSO-d_6)



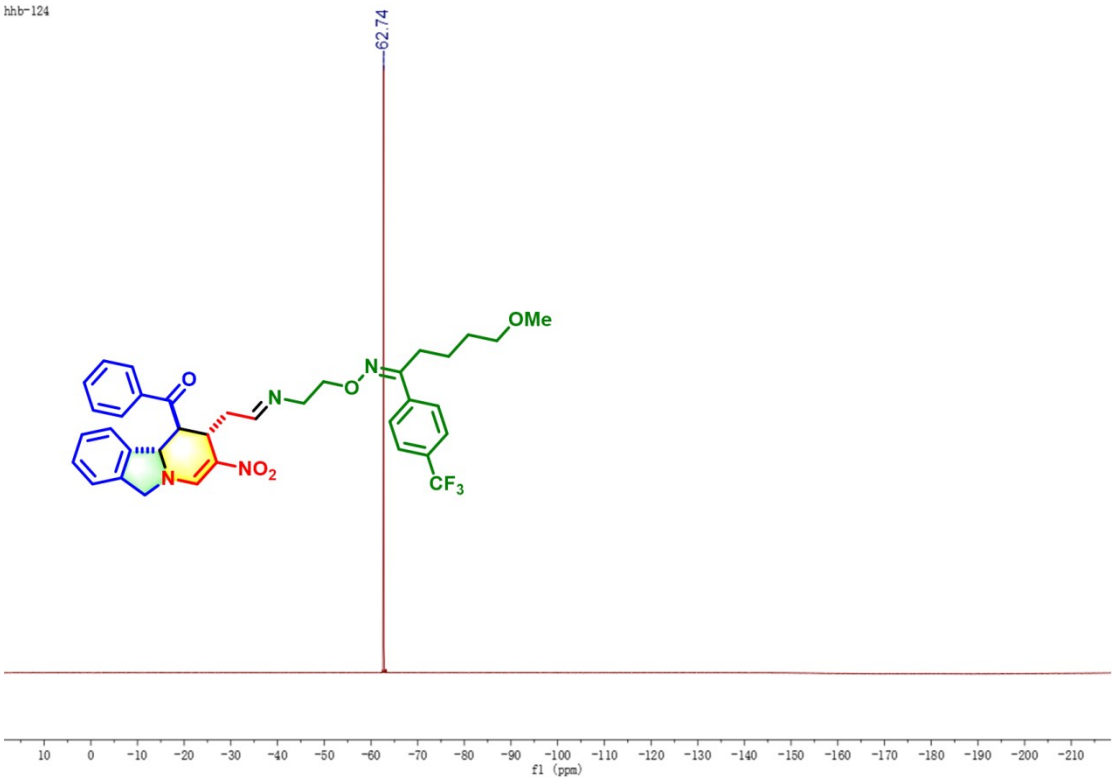
^{1}H NMR spectrum of **80** (400 MHz, $CDCl_3$)



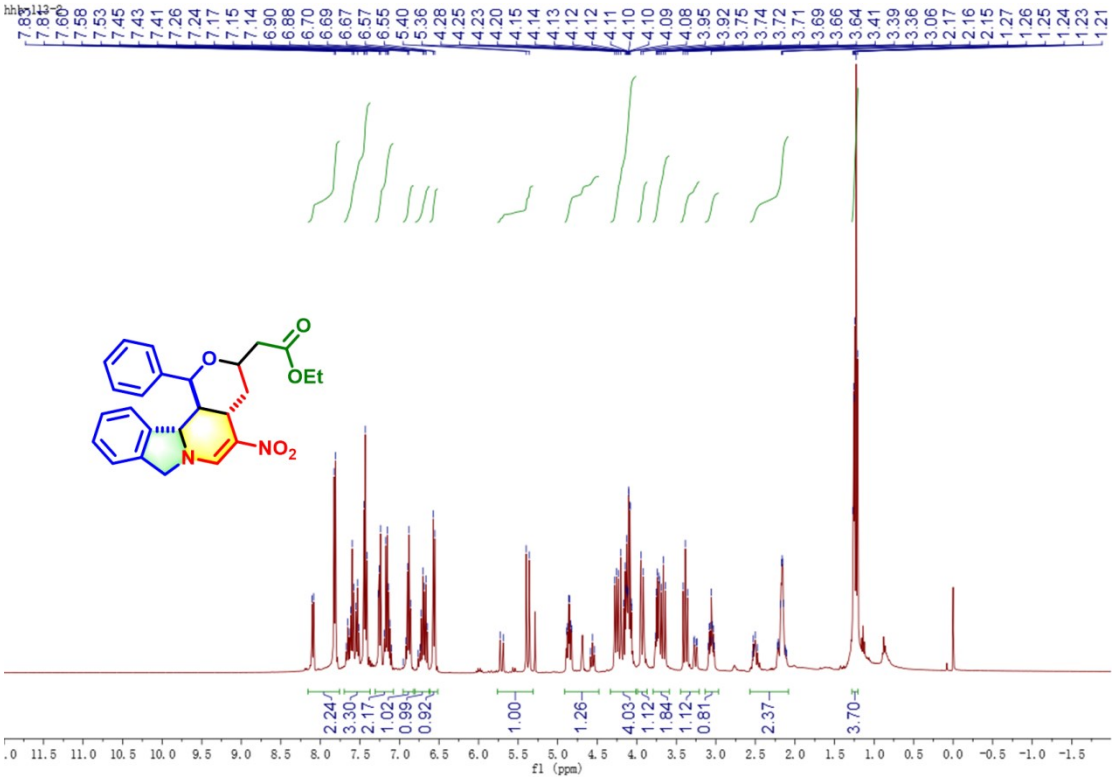
^{13}C NMR spectrum of **80** (100 MHz, $CDCl_3$)



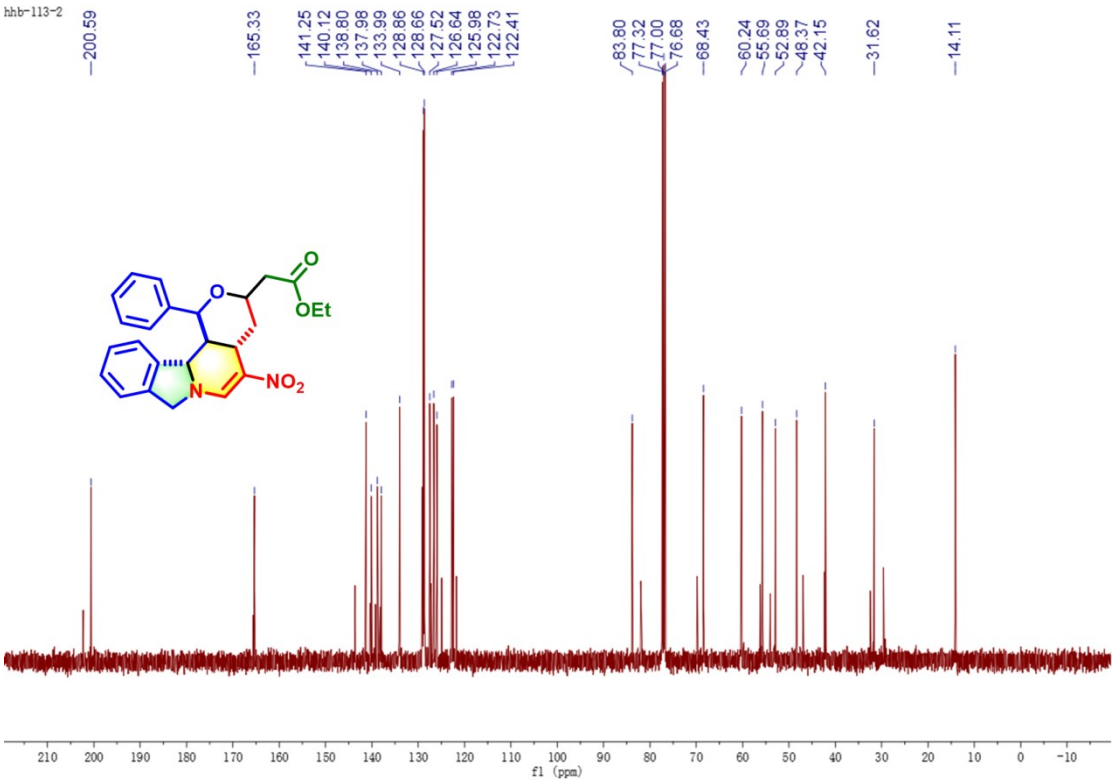
^{19}F NMR spectrum of **80** (375 MHz, $CDCl_3$)



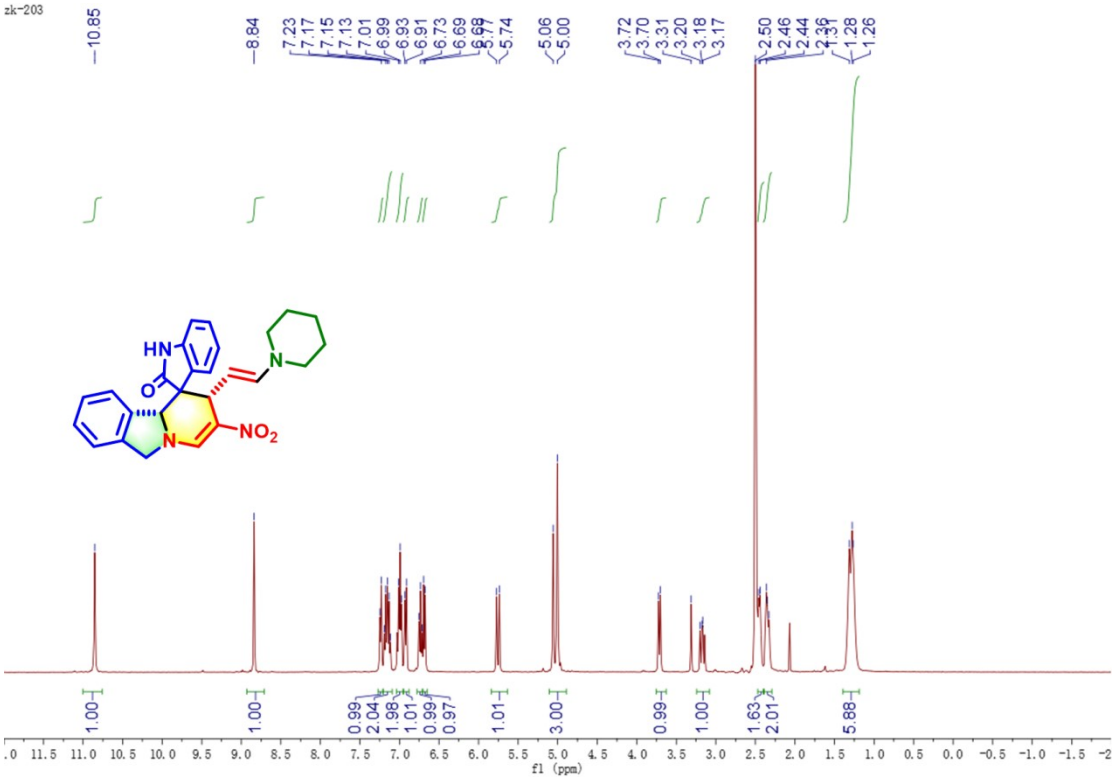
^{1}H NMR spectrum of **81** (400 MHz, $CDCl_3$)



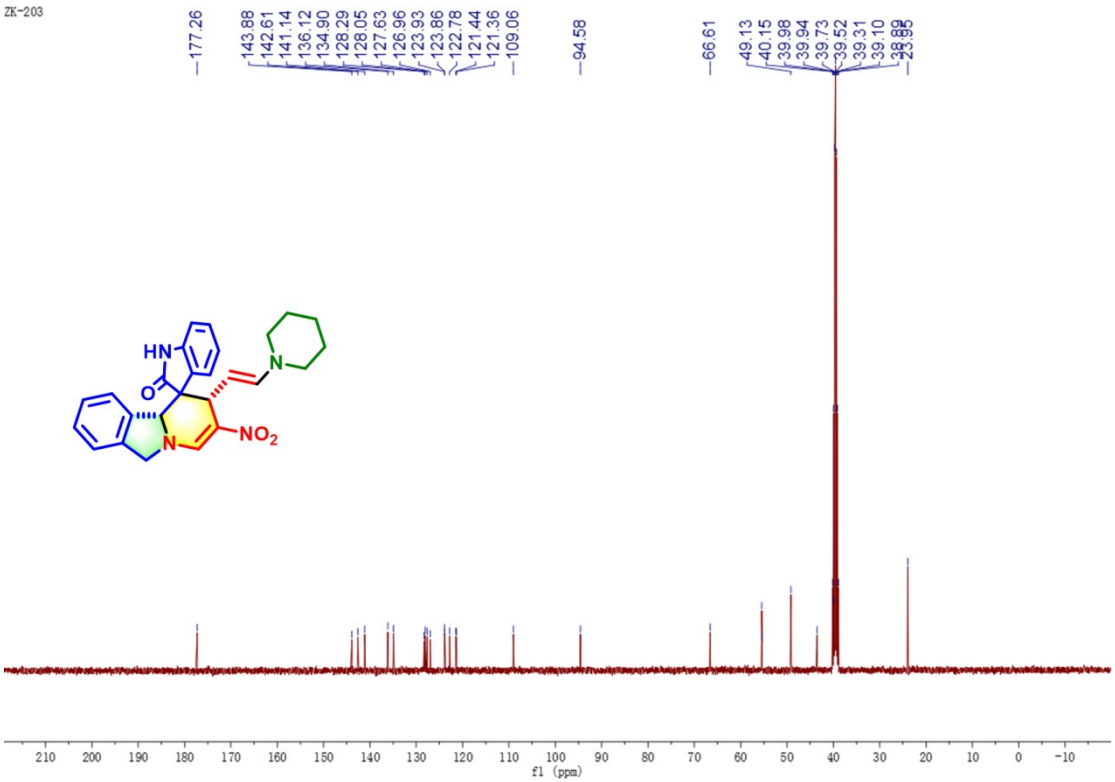
^{13}C NMR spectrum of **81** (100 MHz, $CDCl_3$)



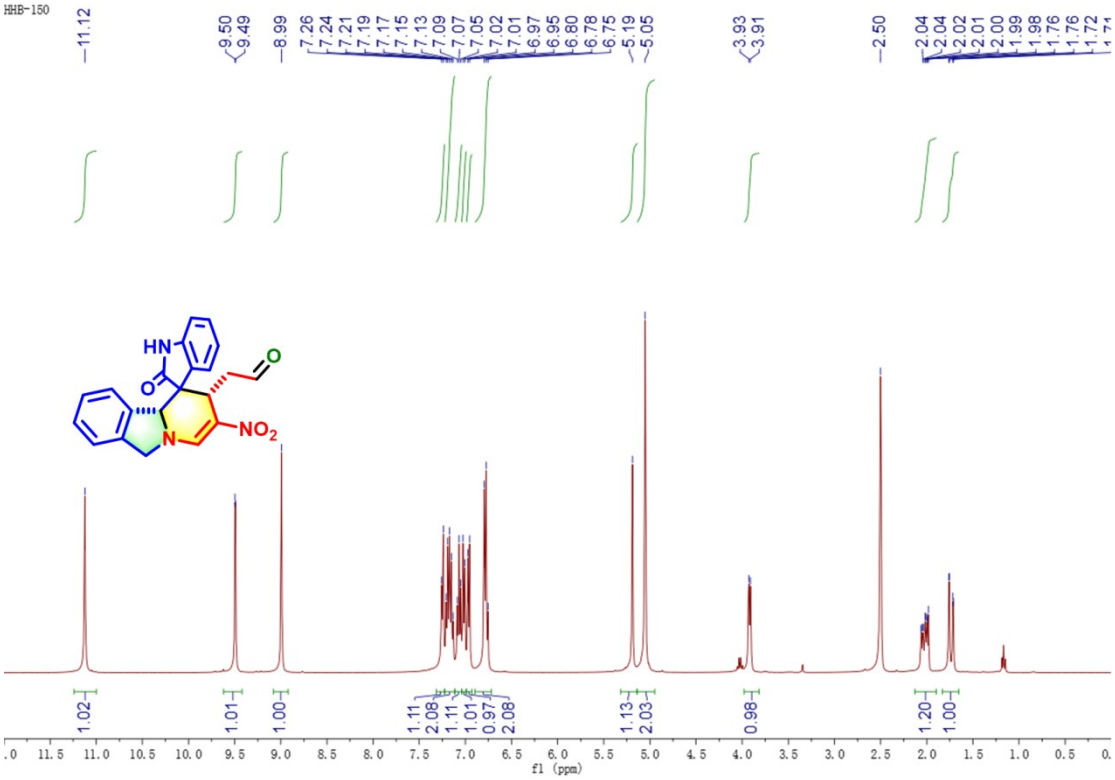
^{1}H NMR spectrum of **82** (400 MHz, DMSO-d_6)



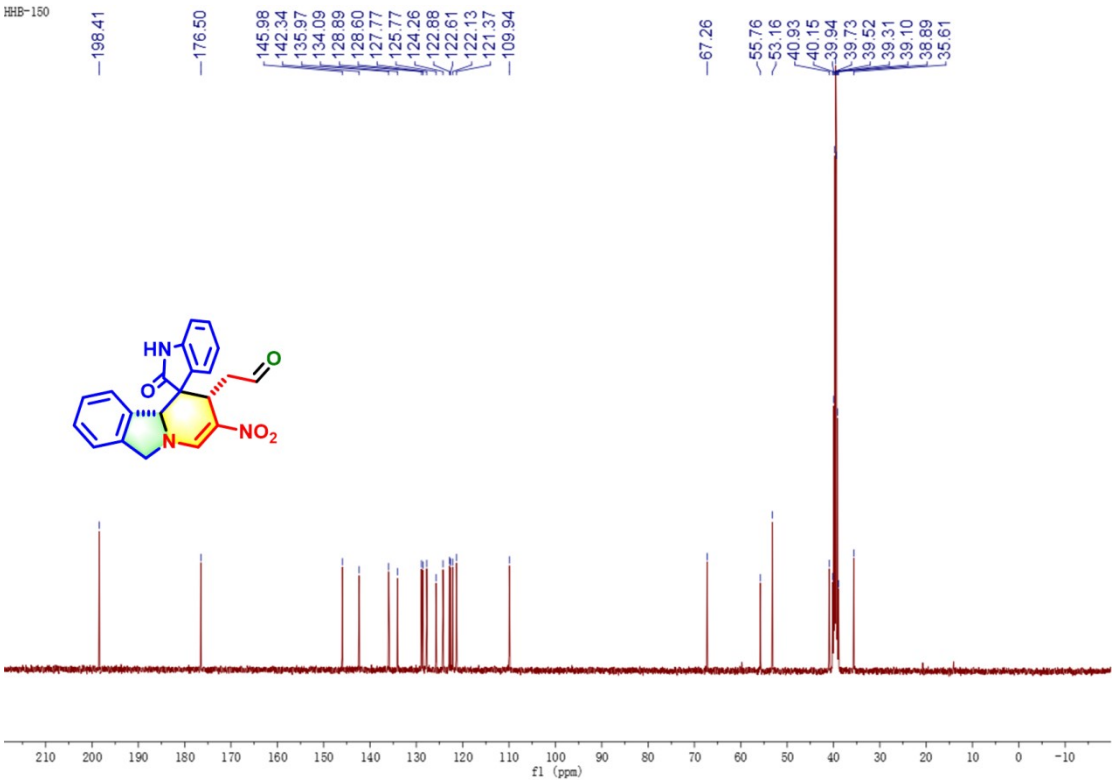
^{13}C NMR spectrum of **82** (100 MHz, DMSO-d_6)



^{1}H NMR spectrum of **83** (400 MHz, DMSO-d_6)



^{13}C NMR spectrum of **83** (100 MHz, DMSO-d_6)


HHB-150
198.41
176.50
145.98
142.34
135.97
134.09
128.89
128.60
127.77
125.77
124.26
122.88
122.61
122.13
121.37
109.94
67.26
55.76
53.16
40.93
40.15
39.94
39.73
39.52
39.31
39.10
38.89
35.61
HN
O
O
N
NO2
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)