Electronic Supplementary Information

Solvent-free iodine-promoted synthesis of 3,2′-pyrrolinyl spirooxindoles from alkylidene oxindoles and enamino esters under ball-milling conditions

Hui Xu,[a] Hong-Wei Liu,[a] Hao-Sheng Lin[a] and Guan-Wu Wang*[a,b]

[a] *CAS Key Laboratory of Soft Matter Chemistry, iChEM (Collaborative Innovation Center of Chemistry for Energy Materials), Hefei National Laboratory for Physical Sciences at Microscale, and Department of Chemistry, University of Science and Technology of China, Hefei, Anhui 230026, P. R. China.*
[b] *State Key Laboratory of Applied Organic Chemistry, Lanzhou University, Lanzhou, Gansu 730000, P. R. China*

E-mail: gwang@ustc.edu.cn

Table of contents

1. General information

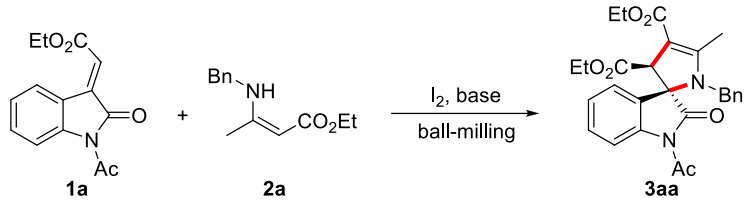
All reagents were obtained from commercial sources and used without further purification. NMR spectra were recorded on a 400 MHz NMR spectrometer (400 MHz for ^{1}H NMR; 101 MHz for ^{13}C NMR). ^{1}H NMR chemical shifts were determined relative to internal TMS at δ 0.0 ppm. ^{13}C NMR chemical shifts were determined relative to $CDCl_3$ at δ 77.16 ppm. Data for ^{1}H NMR and ^{13}C NMR are reported as follows: chemical shift (δ, ppm), multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, q = quartet, br = broad). High-resolution mass spectra (HRMS) were measured with FTMS-ESI in a positive mode. Ball-milling reactions were performed in a Spex SamplePrep 5100 mixer mill, using a 3.5 mL stainless steel jar with eight 5 mm-diameter stainless steel balls and were milled vigorously at a rate of 3000 rounds per minute (50 Hz) at room temperature (~25 °C). Alkylidene oxindoles **1** and enamino esters **2** were prepared according to the reported protocols.[1,2] Single crystal of **3bm** was obtained from dichloromethane/*n*-hexane.

2. Optimization of the reaction conditions

At first, the mixture of alkylidene oxindole **1a** (0.2 mmol), enamine ester **2a** (0.2 mmol) and I_2 (0.2 mmol) together with 8 stainless steel balls (5 mm in diameter) were introduced into a stainless steel jar (3.5 mL) and milled vigorously (50 Hz) in a Spex SamplePrep 5100 mixer mill at room temperature for 0.5 h. As a result, the desired product 3,2'-pyrrolinyl spirooxindole **3aa** was easily generated, but in a poor yield of 32% (Table S1, entry 1). Encouraged by this outcome, we further optimized the reaction conditions for a highly efficient construction of such spirocyclic compound by screening molar ratio of the starting materials, reaction time, grinding auxiliaries, bases and solvents. The results are summarized in Table S1. The effect of the amount of **2a** on the product yield was firstly examined. Increasing the amount of **2a** to 1.5 equiv., the yield of the product **3aa** was improved to 41% (entry 2). Delightedly, a higher yield was obtained when 2 equiv. of **2a** was used (entry 3). However, continuing to increase the dosage of **2a** could not achieve a better yield (entry 4). Next, the amount of I_2 was optimized and the results undoubtedly indicated that 1 equiv. of I_2 was necessary for this transformation, since a decreased yield was obtained as the usage of I_2 was reduced to 0.8 equiv. (entry 5), and excess I_2 failed to improve the transformation (entry 6). It was found that no product could be detected in the absence of I_2, indicating that I_2 was indispensable (entry 7). The influence of the reaction time on the product yield was also investigated. As the reaction time was extended to 1 h, the yield of **3aa** was increased to 52% (entry 8). However, a longer reaction time of 1.5 h led to a slightly decreased yield (entry 9). Silica gel has been utilized as the milling auxiliary in mechanosynthesis and can dramatically facilitate many transformations.[3] Accordingly, 200 mg of silica gel (200−300 mesh) was added and resulted in a higher yield of 63% (entry 10). It is worth mentioning that the resulting powdery silica gel containing the reaction mixture could be directly loaded on a silica gel column to separate out the desired product. Therefore, the work-up procedure of this protocol was facile and straightforward. Considering that HI was formed during this process, we speculated that the introduction of a base would be beneficial to this transformation. Thus, various inorganic and organic bases were attempted with the molar ratio of **1a**, **2a** and I_2 fixed at 1:2:1 under the mechanical ball-milling conditions for 1 h. It was found that the addition of 1 equiv. of Na_2CO_3, K_2CO_3, NaOH, Et_3N, pyridine and 1,8-

diazabicyclo[5.4.0]undec-7-ene (DBU) were detrimental to the reaction (entries 11−16), while 4-dimethylaminopyridine (DMAP) could facilitate the reaction slightly (entry 17). To our delight, 1,4-diazobicyclo[2,2,2]octane hexahydrate (DABCO·$6H_2O$) exhibited higher efficiency to deliver the desired product in 75% yield (entry 18). Moreover, the influence of DABCO·$6H_2O$ loadings on the product yield was further investigated, and the results indicated that 0.5 equiv. of the base was sufficient (entry 19 *vs*. entries 18 and 20). It should be noted that a decreased yield (68%) was obtained when DABCO·$6H_2O$ was replaced by anhydrous DABCO (entry 21). To identify whether the water in DABCO·$6H_2O$ facilitated the reaction as a liquid-assisted grinding (LAG) agent, thus we added the same amount of water (11 μL, 0.6 mmol, 3 equiv) into the reaction system with anhydrous DABCO as the base, and obtained product **3aa** in an increased yield of 75% (entry 22 *vs*. entry 21). Furthermore, when DMAP was chosen as the base and the same amount of water was added, a similar yield (73%) was obtained (entry 23 *vs*. entry 22). Nevertheless, a decreased yield of 62% was obtained when the water was added without any base (entry 24 *vs*. entries 22 and 23). These results indicated that both the base and water were important to facilitate this reaction. It was found that when the amount of **2a** was reduced to 1 equiv., and the reaction was carried out under otherwise the same conditions, product **3aa** was obtained in a poor yield of 36% (entry 25). A low yield (38%) was also obtained when the amount of DABCO·$6H_2O$ was increased to 1.0 equiv. (entry 26). In addition, several grinding auxiliaries including Na_2CO_3, K_2CO_3, NaCl, Na_2SO_4, γ-Al_2O_3 (neutral) and γ-Al_2O_3 (neutral) were also examined. Unfortunately, all of these grinding auxiliaries gave the desired product **3aa** in lower yields (28−61%, entries 27−32). On the other hand, LAG has demonstrated as a power tool to promote mechanochemical reactions.[4] However, the addition of a variety of solvents such as 1,2-dichloroethane (DCE), acetonitrile, toluene, ethanol and water was detrimental to this reaction, and afforded the spirooxindole **3aa** in only moderate yields (entries 33−37). Next, we performed the reaction with a catalytic amount of I_2 in the presence of oxidant $FeCl_3$, product **3aa** was isolated in a poor yield of 33% (entry 38). For the purpose of comparing the present solvent-free reaction and its liquid-phase counterpart, the reaction was also carried out in several organic solvents including DCE, acetonitrile and toluene (entries 39−44). At first, the reaction was carried out in solvents at ambient temperature (entries 39−41). The results demonstrated that acetonitrile was the most effective solvent, and afforded **3aa** in 62% yield after reaction time of 6 h (entry 40). When the liquid-phase reactions were performed at a higher temperature of 50 °C (entries 42−44), DCE exhibited the highest efficiency and delivered **3aa** in 71% yield after reaction time of 5 h (entry 42). From these results, it can be obviously found that the mechanochemical protocol has remarkable advantages, including shorter reaction time, higher yield and easier work-up procedure. Thus, the optimal reaction conditions were as follows: **1a** (0.2 mmol), 2 equiv. of **2a**, 1 equiv. of I_2, 0.5 equiv. of DABCO·$6H_2O$ and 200 mg of silica gel under solvent-free ball-milling conditions for 1 h (entry 19).

Table S1 Optimization of the reaction conditions[a]



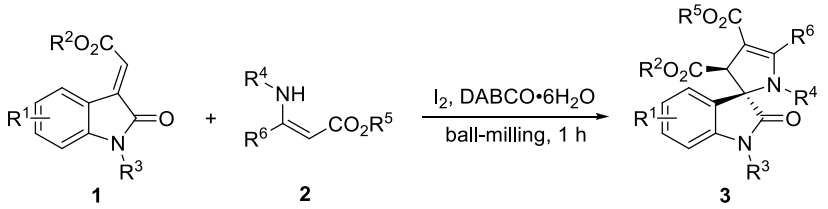
Entry	Molar ratio (**1a**:**2a**:I_2)	Grinding auxiliary (200 mg)	Base (equiv.)	Time (h)	Yield[b] (%)
1	1:1:1	—	—	0.5	32
2	1:1.5:1	—	—	0.5	41
3	1:2:1	—	—	0.5	46
4	1:2.5:1	—	—	0.5	46
5	1:2:0.8	—	—	0.5	39
6	1:2:1.2	—	—	0.5	45
7	1:2:0	—	—	0.5	0
8	1:2:1	—	—	1	52
9	1:2:1	—	—	1.5	49
10	1:2:1	silica gel	—	1	63
11	1:2:1	silica gel	Na_2CO_3 (1)	1	44
12	1:2:1	silica gel	K_2CO_3 (1)	1	39
13	1:2:1	silica gel	NaOH (1)	1	36
14	1:2:1	silica gel	Et_3N (1)	1	52
15	1:2:1	silica gel	pyridine (1)	1	43
16	1:2:1	silica gel	DBU (1)	1	51
17	1:2:1	silica gel	DMAP (1)	1	65
18	1:2:1	silica gel	DABCO·$6H_2O$ (1)	1	75
19	**1:2:1**	**silica gel**	**DABCO·$6H_2O$ (0.5)**	**1**	**74**
20	1:2:1	silica gel	DABCO·$6H_2O$ (0.4)	1	65
21	1:2:1	silica gel	DABCO (0.5)	1	68
22[c]	1:2:1	silica gel	DABCO (0.5)	1	75
23[c]	1:2:1	silica gel	DMAP (1)	1	73
24[c]	1:2:1	silica gel	—	1	62
25	1:1:1	silica gel	DABCO·$6H_2O$ (0.5)	1	36
26	1:1:1	silica gel	DABCO·$6H_2O$ (1.0)	1	38
27	1:2:1	Na_2CO_3	DABCO·$6H_2O$ (0.5)	1	55
28	1:2:1	K_2CO_3	DABCO·$6H_2O$ (0.5)	1	28
29	1:2:1	NaCl	DABCO·$6H_2O$ (0.5)	1	56
30	1:2:1	Na_2SO_4	DABCO·$6H_2O$ (0.5)	1	52
31	1:2:1	γ-Al_2O_3 (neutral)	DABCO·$6H_2O$ (0.5)	1	61
32	1:2:1	γ-Al_2O_3 (basic)	DABCO·$6H_2O$ (0.5)	1	55
33[d]	1:2:1	—	DABCO·$6H_2O$ (0.5)	1	52
34[e]	1:2:1	—	DABCO·$6H_2O$ (0.5)	1	53
35[f]	1:2:1	—	DABCO·$6H_2O$ (0.5)	1	54
36[g]	1:2:1	—	DABCO·$6H_2O$ (0.5)	1	52

37[h]	1:2:1	—	DABCO·6H$_2$O (0.5)	1	53
38[i]	1:2:0.2	silica gel	DABCO·6H$_2$O (0.5)	1	33
39[j]	1:2:1	—	DABCO·6H$_2$O (0.5)	12	31
40[k]	1:2:1	—	DABCO·6H$_2$O (0.5)	6	62
41[l]	1:2:1	—	DABCO·6H$_2$O (0.5)	10	45
42[m]	1:2:1	—	DABCO·6H$_2$O (0.5)	5	71
43[n]	1:2:1	—	DABCO·6H$_2$O (0.5)	3	67
44[o]	1:2:1	—	DABCO·6H$_2$O (0.5)	10	35

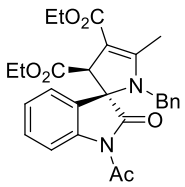
[a] Unless otherwise noted, the reactions were carried out in a Spex SamplePrep 5100 mixer mill with 0.2 mmol of **1a**. [b] Isolated yield based on **1a**. [c] 11μL of water was used. [d] 20 μL of 1,2-dichloroethane was used. [e] 20 μL of acetonitrile was used. [f] 20 μL of toluene was used. [g] 20 μL of ethanol was used. [h] 20 μL of water was used. [i] 2 equiv. of $FeCl_3$ was added. [j] The reaction was performed in 1,2-dichloroethane (2 mL) at 25 °C for 12 h. [k] The reaction was performed in acetonitrile (2 mL) at 25 °C for 6 h. [l] The reaction was performed in toluene (2 mL) at 25 °C for 10 h. [m] The reaction was performed in 1,2-dichloroethane (2 mL) at 50 °C for 5 h. [n] The reaction was performed in acetonitrile (2 mL) at 50 °C for 3 h. [o] The reaction was performed in toluene (2 mL) at 50 °C for 10 h.

3. Synthesis and characterization of products 3

General procedure for the iodine-promoted synthesis of 3,2′-pyrrolinyl spirooxindoles from alkylidene oxindoles and enamino esters under ball-milling conditions

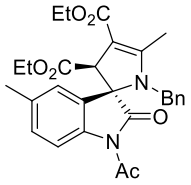


A mixture of alkylidene oxindoles (**1**, 0.2 mmol), enamino esters (**2**, 0.4 mmol), I_2 (0.2 mmol), DABCO·6H$_2$O (0.1 mmol) and silica gel (200−300 mesh, 200 mg) together with eight stainless balls (5 mm in diameter) was introduced into a stainless steel jar (3.5 mL), and the jar was fixed on a Spex SamplePrep 5100 mixer mill and milled vigorously at a rate of 3000 rounds per minute (50 Hz) at room temperature for 1 h. After the reaction was completed, a powdery mixture was obtained, and the temperature of the reaction mixture reached to approximately 35 °C. Then, the resulting powdery mixture was directly loaded on a silica gel column and separated with ethyl acetate/petroleum ether as the eluent to afford products **3**.

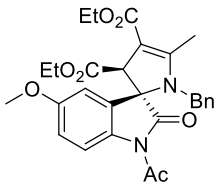


Diethyl 1-acetyl-1'-benzyl-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3aa). General procedure was followed to afford **3aa** as a white solid (70.3 mg, 74% yield, dr = 95:5); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, J = 8.0 Hz, 1H), 7.40 (td, J = 7.9, 1.3 Hz, 1H), 7.33 (d, J = 6.4 Hz, 1H), 7.24–7.15 (m, 4H), 6.89–6.83 (m, 2 H), 4.39 (d, J = 15.4 Hz, 1H), 4.30 (q, J = 1.1 Hz, 1H), 4.18 (dq, J = 10.8, 7.1 Hz, 1H), 4.10 (dq, J = 10.8, 7.1 Hz, 1H), 3.735 (d,

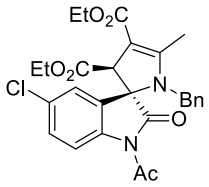
J = 15.4 Hz, 1H), 3.729 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.63 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.52 (d, *J* = 1.1 Hz, 3H), 2.30 (s, 3H), 1.21 (t, *J* = 7.1 Hz, 3H), 0.78 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) *δ* 176.7, 170.5, 169.2, 165.7, 161.7, 140.7, 135.3, 131.0, 128.9 (2C), 128.5 (2C), 128.3, 125.8, 125.2, 123.3, 116.9, 96.5, 72.8, 60.8, 59.3, 57.6, 48.3, 26.4, 14.6, 13.8, 13.4; HRMS (ESI) Calcd for $C_{27}H_{29}N_2O_6$ $[M+H]^+$ 477.2020; found 477.2019.



Diethyl 1-acetyl-1'-benzyl-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ba). General procedure was followed to afford **3ba** as a white solid (80.0 mg, 82% yield, dr = 93:7); ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 8.03 (d, *J* = 8.3 Hz, 1H), 7.22–7.15 (m, 4H), 7.12 (s, 1H), 6.90–6.85 (m, 2H), 4.37 (d, *J* = 15.4 Hz, 1H), 4.30 (q, *J* = 1.2 Hz, 1H), 4.19 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.75 (d, *J* = 15.4 Hz, 1H), 3.73 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.67 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.52 (d, *J* = 1.2 Hz, 3H), 2.33 (s, 3H), 2.28 (s, 3H), 1.21 (t, *J* = 7.1 Hz, 3H), 0.78 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) *δ* 176.8, 170.4, 169.2, 165.7, 161.6, 138.3, 135.5, 135.0, 131.4, 128.8 (2C), 128.4 (2C), 128.2, 126.1, 123.2, 116.6, 96.3, 72.9, 60.8, 59.2, 57.5, 48.2, 26.3, 21.1, 14.6, 13.7, 13.3; HRMS (ESI) Calcd for $C_{28}H_{31}N_2O_6$ $[M+H]^+$ 491.2177; found 491.2175.

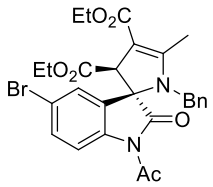


Diethyl 1-acetyl-1'-benzyl-5-methoxy-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ca). General procedure was followed to afford **3ca** as a white solid (71.7 mg, 71% yield, dr = 93:7); ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 8.09 (d, *J* = 9.0 Hz, 1H), 7.24–7.16 (m, 3H), 6.94–6.87 (m, 3H), 6.85 (d, *J* = 2.7 Hz, 1H), 4.36 (d, *J* = 15.5 Hz, 1H), 4.29 (q, *J* = 1.0 Hz, 1H), 4.18 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.80 (d, *J* = 15.5 Hz, 1H), 3.78 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.77 (s, 3H), 3.70 (dq, *J* = 10.7, 7.1 Hz, 1H), 2.52 (d, *J* = 1.0 Hz, 3H), 2.28 (s, 3H), 1.21 (t, *J* = 7.1 Hz, 3H), 0.82 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) *δ* 176.6, 170.2, 169.3, 165.6, 161.6, 157.1, 135.5, 134.1, 128.7 (2C), 128.5 (2C), 128.3, 124.5, 118.0, 116.5, 110.9, 96.4, 73.0, 60.9, 59.2, 57.5, 55.9, 48.2, 26.2, 14.6, 13.8, 13.3; HRMS (ESI) Calcd for $C_{28}H_{31}N_2O_7$ $[M+H]^+$ 507.2126; found 507.2123.

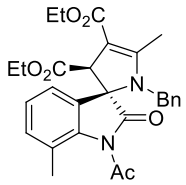


Diethyl 1-acetyl-1'-benzyl-5-chloro-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-

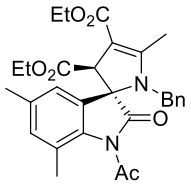
pyrrole]-3',4'-dicarboxylate (3da). General procedure was followed to afford **3da** as a white solid (58.4 mg, 57% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, J = 8.7 Hz, 1H), 7.37 (dd, J = 8.7, 2.2 Hz, 1H), 7.30 (d, J = 2.2 Hz, 1H), 7.25–7.16 (m, 3H), 6.90–6.85 (m, 2H), 4.41 (d, J = 15.3 Hz, 1H), 4.30 (q, J = 1.3 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.10 (dq, J = 10.8, 7.1 Hz, 1H), 3.79 (dq, J = 10.8, 7.1 Hz, 1H), 3.77 (d, J = 15.3 Hz, 1H), 3.75 (dq, J = 10.8, 7.1 Hz, 1H), 2.53 (d, J = 1.3 Hz, 3H), 2.29 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.87 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.0, 170.3, 169.0, 165.5, 161.4, 139.0, 135.0, 130.9, 130.7, 128.9 (2C), 128.53 (2C), 128.49, 125.8, 125.2, 118.1, 96.7, 72.5, 61.1, 59.3, 57.8, 48.4, 26.3, 14.6, 13.8, 13.3; HRMS (ESI) Calcd for $C_{27}H_{28}{}^{35}ClN_2O_6$ $[M+H]^+$ 511.1630; found 511.1628.



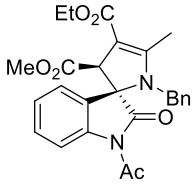
Diethyl 1-acetyl-1'-benzyl-5-bromo-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ea). General procedure was followed to afford **3ea** as a white solid (66.5 mg, 60% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (d, J = 8.7 Hz, 1H), 7.51 (dd, J = 8.7, 2.1 Hz, 1H), 7.44 (d, J = 2.1 Hz, 1H), 7.25–7.16 (m, 3H), 6.90–6.85 (m, 2H), 4.41 (d, J = 15.3 Hz, 1H), 4.30 (q, J = 1.3 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.79 (dq, J = 10.8, 7.1 Hz, 1H), 3.77 (d, J = 15.3 Hz, 1H), 3.76 (dq, J = 10.8, 7.1 Hz, 1H), 2.53 (d, J = 1.3 Hz, 3H), 2.29 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.88 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.9, 170.3, 169.0, 165.5, 161.4, 139.5, 135.0, 133.8, 128.9 (2C), 128.7, 128.52 (2C), 128.50, 125.5, 118.5, 118.2, 96.7, 72.4, 61.1, 59.3, 57.8, 48.4, 26.3, 14.5, 13.9, 13.3; HRMS (ESI) Calcd for $C_{27}H_{28}{}^{79}BrN_2O_6$ $[M+H]^+$ 555.1125; found 555.1124.



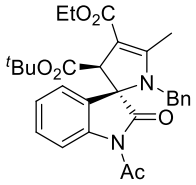
Diethyl 1-acetyl-1'-benzyl-5',7-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3fa). General procedure was followed to afford **3fa** as a white solid (79.7 mg, 81% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25–7.10 (m, 6H), 6.87 (d, J = 7.0 Hz, 2H), 4.34 (d, J = 15.6 Hz, 1H), 4.32 (s, 1H), 4.18 (dq, J = 10.7, 7.1 Hz, 1H), 4.09 (dq, J = 10.7, 7.1 Hz, 1H), 3.72 (dq, J = 10.7, 7.1 Hz, 1H), 3.70 (d, J = 15.6 Hz, 1H), 3.62 (dq, J = 10.7, 7.1 Hz, 1H), 2.47 (s, 3H), 2.35 (s, 3H), 2.07 (s, 3H), 1.20 (t, J = 7.1 Hz, 3H), 0.77 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.5, 169.4, 169.1, 165.7, 161.8, 139.0, 135.5, 133.7, 128.7 (2C), 128.4 (2C), 128.1, 127.1, 125.4, 124.9, 123.0, 96.4, 73.9, 60.8, 59.2, 57.8, 48.3, 26.1, 21.5, 14.6, 13.7, 13.3; HRMS (ESI) Calcd for $C_{28}H_{31}N_2O_6$ $[M+H]^+$ 491.2177; found 491.2173.



Diethyl 1-acetyl-1'-benzyl-5,5',7-trimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ga). General procedure was followed to afford **3ga** as a white solid (81.1 mg, 80% yield, dr = 98:2); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25–7.16 (m, 3H), 7.01 (s, 1H), 6.94 (s, 1H), 6.92–6.87 (m, 2H), 4.33 (d, J = 15.6 Hz, 1H), 4.32 (q, J = 1.1 Hz, 1H), 4.18 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.722 (dq, J = 10.8, 7.1 Hz, 1H), 3.719 (d, J = 15.6 Hz, 1H), 3.65 (dq, J = 10.8, 7.1 Hz, 1H), 2.48 (d, J = 1.1 Hz, 3H), 2.33 (s, 3H), 2.29 (s, 3H), 2.05 (s, 3H), 1.20 (t, J = 7.1 Hz, 3H), 0.78 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.6, 169.3, 169.1, 165.7, 161.7, 136.6, 135.6, 135.2, 134.2, 128.6 (2C), 128.4 (2C), 128.0, 126.8, 124.9, 123.4, 96.2, 73.9, 60.8, 59.2, 57.7, 48.3, 26.0, 21.4, 21.0, 14.6, 13.6, 13.3; HRMS (ESI) Calcd for $C_{29}H_{33}N_2O_6$ $[M+H]^+$ 505.2333; found 505.2331.

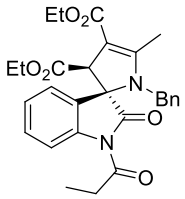


4'-Ethyl 3'-methyl 1-acetyl-1'-benzyl-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ha). General procedure was followed to afford **3ha** as a white solid (64.9 mg, 70% yield, dr = 98:2); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, J = 8.2 Hz, 1H), 7.40 (td, J = 7.9, 1.2 Hz, 1H), 7.31 (dd, J = 7.5, 0.7 Hz, 1H), 7.24–7.15 (m, 4H), 6.89–6.82 (m, 2H), 4.38 (d, J = 15.4 Hz, 1H), 4.31 (q, J = 0.9 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.75 (d, J = 15.4 Hz, 1H), 3.23 (s, 3H), 2.53 (d, J = 0.9 Hz, 3H), 2.29 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.5, 170.5, 169.8, 165.6, 161.7, 140.6, 135.3, 131.0, 128.8 (2C), 128.5 (2C), 128.3, 125.5, 125.1, 123.2, 116.9, 96.3, 72.6, 59.2, 57.5, 51.8, 48.1, 26.3, 14.6, 13.3; HRMS (ESI) Calcd for $C_{26}H_{27}N_2O_6$ $[M+H]^+$ 463.1864; found 463.1864.

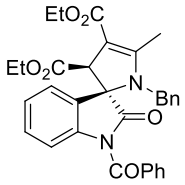


3'-tert-Butyl 4'-ethyl 1-acetyl-1'-benzyl-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ia). General procedure was followed to afford **3ia** as a white solid (72.5 mg, 72% yield, dr = 98:2); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, J = 8.2 Hz, 1H), 7.44–7.36 (m, 2H), 7.24–7.15 (m, 4H), 6.87–6.83 (m, 2H), 4.41 (d, J = 15.0 Hz, 1H), 4.30 (q, J = 1.4 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.08 (dq, J = 10.8, 7.1 Hz, 1H), 3.65 (d, J = 15.0 Hz, 1H), 2.48 (d, J = 1.4 Hz, 3H), 2.29 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.97 (s, 9H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.2, 170.5, 167.7, 165.8, 161.4, 140.7, 135.2, 130.8, 129.1 (2C), 128.4 (2C), 128.3, 126.2, 125.2, 123.5, 116.8, 97.1, 81.0, 73.1, 59.2, 58.5, 48.5, 27.4 (3C), 26.3, 14.5, 13.2; HRMS (ESI) Calcd for

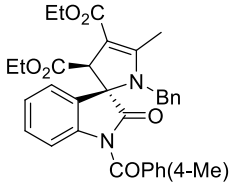
$C_{29}H_{33}N_2O_6$ $[M+H]^+$ 505.2333; found 505.2330.



Diethyl 1'-benzyl-5'-methyl-2-oxo-1-propionyl-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ja). General procedure was followed to afford **3ja** as a white solid (68.9 mg, 70% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, J = 8.2 Hz, 1H), 7.40 (t, J = 7.6 Hz, 1H), 7.33 (d, J = 7.4 Hz, 1H), 7.23–7.14 (m, 4H), 6.88–6.84 (m, 2H), 4.38 (d, J = 15.4 Hz, 1H), 4.31 (s, 1H), 4.18 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.729 (d, J = 15.4 Hz, 1H), 3.725 (dq, J = 10.8, 7.1 Hz, 1H), 3.64 (dq, J = 10.8, 7.1 Hz, 1H), 2.81 (dq, J = 18.4, 7.2 Hz, 1H), 2.51 (s, 3H), 2.45 (dq, J = 18.4, 7.2 Hz, 1H), 1.21 (t, J = 7.1 Hz, 3H), 1.08 (t, J = 7.2 Hz, 3H), 0.77 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.6, 174.5, 169.2, 165.7, 161.6, 140.8, 135.4, 130.9, 128.8 (2C), 128.4 (2C), 128.1, 125.7, 125.0, 123.4, 116.9, 96.4, 72.8, 60.8, 59.2, 57.5, 48.2, 31.5, 14.5, 13.7, 13.3, 8.1; HRMS (ESI) Calcd for $C_{28}H_{31}N_2O_6$ $[M+H]^+$ 491.2177; found 491.2174.

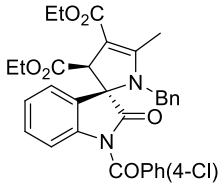


Diethyl 1-benzoyl-1'-benzyl-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ka). General procedure was followed to afford **3ka** as a white solid (73.2 mg, 68% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, J = 8.1 Hz, 1H), 7.56 (t, J = 7.4 Hz, 1H), 7.52–7.47 (m, 2H), 7.45–7.34 (m, 4H), 7.26–7.21 (m, 3H), 7.18 (t, J = 7.5 Hz, 1H), 7.06–6.99 (m, 2H), 4.42 (q, J = 1.2 Hz, 1H), 4.28 (d, J = 16.1 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.89 (d, J = 16.1 Hz, 1H), 3.79 (dq, J = 10.8, 7.1 Hz, 1H), 3.69 (dq, J = 10.8, 7.1 Hz, 1H), 2.39 (d, J = 1.2 Hz, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.86 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.4, 169.2, 168.7, 165.7, 162.2, 140.6, 136.0, 133.6, 133.2, 130.9, 129.4 (2C), 128.7 (2C), 128.3 (2C), 127.9, 127.8 (2C), 125.9, 125.0, 123.9, 115.3, 96.2, 73.8, 60.9, 59.2, 57.8, 48.5, 14.6, 13.9, 13.3; HRMS (ESI) Calcd for $C_{32}H_{31}N_2O_6$ $[M+H]^+$ 539.2177; found 539.2176.

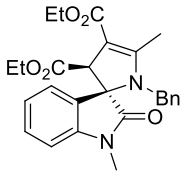


Diethyl 1'-benzyl-5'-methyl-1-(4-methylbenzoyl)-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3la). General procedure was followed to afford **3la** as a white solid (65.2 mg, 59% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, J = 8.1 Hz, 1H), 7.46–7.38 (m, 3H), 7.35 (d, J = 7.5 Hz, 1H), 7.25–7.14 (m, 6H), 7.07–7.00 (m, 2H), 4.43 (q, J = 1.0 Hz, 1H), 4.25 (d, J = 16.2 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.89 (d,

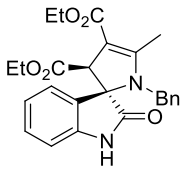
J = 16.2 Hz, 1H), 3.79 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.68 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.41 (s, 3H), 2.38 (d, *J* = 1.0 Hz, 3H), 1.22 (t, *J* = 7.1 Hz, 3H), 0.85 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.5, 169.3, 168.5, 165.7, 162.3, 144.3, 140.7, 136.2, 130.8, 130.7, 129.7 (2C), 129.1 (2C), 128.7 (2C), 127.9, 127.8 (2C), 125.9, 124.8, 123.9, 115.2, 96.2, 74.0, 60.9, 59.2, 57.7, 48.5, 21.9, 14.6, 13.9, 13.3; HRMS (ESI) Calcd for $C_{33}H_{33}N_2O_6$ $[M+H]^+$ 553.2333; found 553.2331.



Diethyl 1'-benzyl-1-(4-chlorobenzoyl)-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3ma). General procedure was followed to afford **3ma** as a white solid (72.6 mg, 63% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 8.2 Hz, 1H), 7.43 (td, *J* = 7.9, 1.2 Hz, 1H), 7.40–7.32 (m, 5H), 7.26–7.18 (m, 4H), 7.03–6.97 (m, 2H), 4.40 (q, *J* = 1.1 Hz, 1H), 4.33 (d, *J* = 16.1 Hz, 1H), 4.19 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.09 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.84 (d, *J* = 16.1 Hz, 1H), 3.78 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.68 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.42 (d, *J* = 1.1 Hz, 3H), 1.22 (t, *J* = 7.1 Hz, 3H), 0.85 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.5, 169.1, 167.6, 165.6, 162.0, 140.3, 139.5, 135.9, 131.9, 130.94, 130.85 (2C), 128.72 (2C), 128.67 (2C), 128.00, 127.98 (2C), 126.0, 125.1, 123.8, 115.4, 96.3, 73.7, 61.0, 59.3, 57.9, 48.4, 14.6, 13.9, 13.3; HRMS (ESI) Calcd for $C_{32}H_{30}{}^{35}ClN_2O_6$ $[M+H]^+$ 573.1787; found 573.1777.

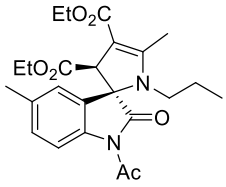


Diethyl 1'-benzyl-1,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3na). General procedure was followed to afford **3na** as a colorless oil (48.5 mg, 54% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 (td, *J* = 7.7, 0.6 Hz, 1H), 7.26 (d, *J* = 7.2 Hz, 1H), 7.22–7.14 (m, 3H), 6.99 (t, *J* = 7.5 Hz, 1H), 6.97–6.93 (m, 2H), 6.71 (d, *J* = 7.8 Hz, 1H), 4.30 (q, *J* = 0.8 Hz, 1H), 4.17 (d, *J* = 15.7 Hz, 1H), 4.15 (dq, *J* = 10.7, 7.1 Hz, 1H), 4.08 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.85 (d, *J* = 15.7 Hz, 1H), 3.75 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.68 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.92 (s, 3H), 2.42 (d, *J* = 0.8 Hz, 3H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.81 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.6, 169.9, 165.7, 162.3, 144.1, 136.0, 130.5, 128.2 (2C), 128.0 (2C), 127.7, 126.1, 124.2, 122.5, 108.4, 96.7, 72.7, 60.4, 58.9, 56.2, 48.4, 26.3, 14.5, 13.8, 13.4; HRMS (ESI) Calcd for $C_{26}H_{29}N_2O_5$ $[M+H]^+$ 449.2071; found 449.2069.

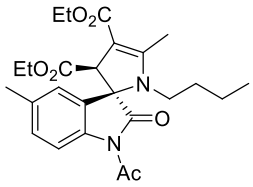


Diethyl 1'-benzyl-5'-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-

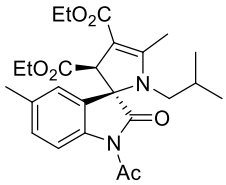
dicarboxylate (3oa). General procedure was followed to afford **3oa** as a colorless oil (52.1 mg, 60% yield, dr = 95:5); ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.21 (s, 1H), 7.28–7.21 (m, 2H), 7.18–7.10 (m, 3H), 7.04 (d, *J* = 7.3 Hz, 2H), 6.95 (t, *J* = 7.6 Hz, 1H), 6.86 (d, *J* = 7.7 Hz, 1H), 4.34 (s, 1H), 4.17 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.14 (d, *J* = 16.2 Hz, 1H), 4.08 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.98 (d, *J* = 16.2 Hz, 1H), 3.80 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.73 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.40 (s, 3H), 1.20 (t, *J* = 7.1 Hz, 3H), 0.85 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 178.3, 170.0, 165.8, 162.7, 141.6, 136.5, 130.5, 128.3 (2C), 127.7 (3C), 126.5, 124.8, 122.6, 110.7, 96.4, 73.5, 60.7, 59.1, 56.1, 48.4, 14.5, 13.8, 13.4; HRMS (ESI) Calcd for $C_{25}H_{27}N_2O_5$ $[M+H]^+$ 435.1915; found 435.1914.



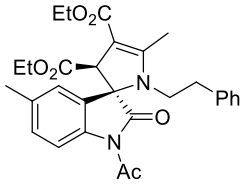
Diethyl 1-acetyl-5,5'-dimethyl-2-oxo-1'-propyl-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bb). General procedure was followed to afford **3bb** as a white solid (66.9 mg, 76% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, *J* = 8.3 Hz, 1H), 7.19 (dd, *J* = 8.3, 1.2 Hz, 1H), 7.08 (d, *J* = 1.2 Hz, 1H), 4.28 (q, *J* = 1.2 Hz, 1H), 4.16 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.06 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.73 (dq, *J* = 10.7, 7.1 Hz, 1H), 3.65 (dq, *J* = 10.7, 7.1 Hz, 1H), 2.92–2.83 (m, 1H), 2.80–2.71 (m, 1H), 2.70 (s, 3H), 2.46 (d, *J* = 1.2 Hz, 3H), 2.32 (s, 3H), 1.32–1.22 (m, 2H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.82 (t, *J* = 7.1 Hz, 3H), 0.74 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.5, 170.6, 169.3, 165.7, 162.6, 138.0, 135.2, 131.3, 126.0, 124.1, 116.5, 94.6, 73.5, 60.7, 59.0, 57.7, 46.2, 26.7, 23.5, 21.1, 14.6, 13.8, 12.9, 11.3; HRMS (ESI) Calcd for $C_{24}H_{31}N_2O_6$ $[M+H]^+$ 443.2177; found 443.2177.



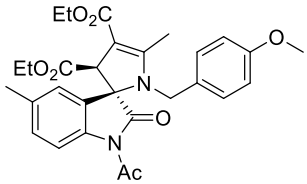
Diethyl 1-acetyl-1'-butyl-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bc). General procedure was followed to afford **3bc** as a white solid (60.5 mg, 66% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, *J* = 8.4 Hz, 1H), 7.19 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.09 (d, *J* = 1.2 Hz, 1H), 4.28 (q, *J* = 1.2 Hz, 1H), 4.16 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.06 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.74 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.65 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.96–2.87 (m, 1H), 2.82–2.73 (m, 1H), 2.70 (s, 3H), 2.45 (d, *J* = 1.2 Hz, 3H), 2.32 (s, 3H), 1.27–1.06 (m, 4H), 1.19 (t, *J* = 7.1 Hz, 3H), 0.82 (t, *J* = 7.1 Hz, 3H), 0.76 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.5, 170.6, 169.3, 165.7, 162.6, 138.0, 135.2, 131.3, 126.0, 124.1, 116.5, 94.5, 73.5, 60.7, 59.0, 57.6, 44.2, 32.2, 26.6, 21.1, 19.9, 14.5, 13.74, 13.66, 12.9; HRMS (ESI) Calcd for $C_{25}H_{33}N_2O_6$ $[M+H]^+$ 457.2333; found 457.2337.



Diethyl 1-acetyl-1'-isobutyl-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bd). General procedure was followed to afford **3bd** as a white solid (62.4 mg, 71% yield, dr = 92:8); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, J = 8.4 Hz, 1H), 7.19 (dd, J = 8.5, 1.2 Hz, 1H), 7.07 (s, 1H), 4.31 (q, J = 1.2 Hz, 1H), 4.17 (dq, J = 10.8, 7.1 Hz, 1H), 4.07 (dq, J = 10.8, 7.1 Hz, 1H), 3.73 (dq, J = 10.8, 7.1 Hz, 1H), 3.64 (dq, J = 10.8, 7.1 Hz, 1H), 2.73 (dd, J = 14.9, 9.2 Hz, 1H), 2.69 (s, 3H), 2.60 (dd, J = 14.9, 6.3 Hz, 1H), 2.44 (d, J = 1.2 Hz, 3H), 2.32 (s, 3H), 1.34–1.24 (m, 1H), 1.20 (t, J = 7.1 Hz, 3H), 0.815 (t, J = 7.1 Hz, 3H), 0.813 (d, J = 6.6 Hz, 3H), 0.70 (d, J = 6.6 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.4, 170.6, 169.3, 165.7, 163.0, 137.9, 135.1, 131.3, 126.1, 123.8, 116.5, 95.1, 73.5, 60.7, 59.0, 57.9, 52.2, 28.3, 26.7, 21.1, 20.3, 20.0, 14.6, 13.8, 13.3; HRMS (ESI) Calcd for $C_{25}H_{33}N_2O_6$ $[M+H]^+$ 457.2333; found 457.2335.

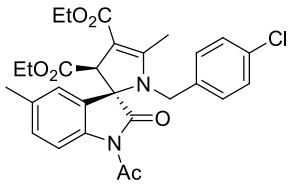


Diethyl 1-acetyl-5,5'-dimethyl-2-oxo-1'-phenethyl-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3be). General procedure was followed to afford **3be** as a white solid (78.9 mg, 78% yield, dr = 92:8); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, J = 8.4 Hz, 1H), 7.26–7.17 (m, 4H), 7.10 (s, 1H), 6.95–6.91 (m, 2H), 4.32 (q, J = 1.1 Hz, 1H), 4.17 (dq, J = 10.8, 7.1 Hz, 1H), 4.07 (dq, J = 10.8, 7.1 Hz, 1H), 3.75 (dq, J = 10.8, 7.1 Hz, 1H), 3.67 (dq, J = 10.8, 7.1 Hz, 1H), 3.14–2.98 (m, 2H), 2.70 (s, 3H), 2.56 (t, J = 7.8 Hz, 2H), 2.35 (d, J = 1.1 Hz, 3H), 2.32 (s, 3H), 1.20 (t, J = 7.1 Hz, 3H), 0.83 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.6, 170.5, 169.3, 165.6, 162.3, 138.2, 138.0, 135.3, 131.5, 128.8 (2C), 128.7 (2C), 126.9, 126.1, 124.1, 116.6, 95.1, 73.7, 60.8, 59.1, 57.6, 46.4, 36.9, 26.7, 21.2, 14.6, 13.8, 12.7; HRMS (ESI) Calcd for $C_{29}H_{33}N_2O_6$ $[M+H]^+$ 505.2333; found 505.2333.

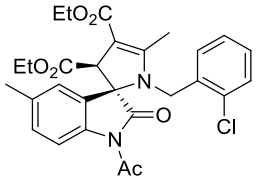


Diethyl 1-acetyl-1'-(4-methoxybenzyl)-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bf). General procedure was followed to afford **3bf** as a white solid (86.3 mg, 83% yield, dr = 97:3); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, J = 8.3 Hz, 1H), 7.19 (d, J = 8.3 Hz, 1H), 7.11 (s, 1H), 6.72 (d, J = 8.8 Hz, 2H), 6.68 (d, J = 8.8 Hz, 2H), 4.36 (d, J = 15.0 Hz, 1H), 4.28 (q, J = 1.0 Hz, 1H), 4.18 (dq, J = 10.8, 7.1 Hz, 1H), 4.08 (dq, J = 10.8, 7.1 Hz, 1H), 3.75 (s, 3H), 3.71 (dq, J = 10.8, 7.1 Hz, 1H), 3.68 (d, J = 15.0 Hz, 1H), 3.65 (dq, J = 10.8, 7.1 Hz, 1H), 2.53 (d, J = 1.0 Hz, 3H), 2.34 (s, 3H), 2.30 (s, 3H), 1.20 (t, J = 7.1 Hz, 3H), 0.78 (t, J = 7.1 Hz, 3H);

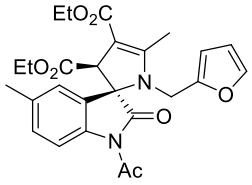
^{13}C NMR (101 MHz, $CDCl_3$) δ 176.9, 170.4, 169.2, 165.7, 161.5, 159.6, 138.3, 134.9, 131.3, 130.5 (2C), 126.9, 126.0, 123.3, 116.7, 113.7 (2C), 96.2, 72.7, 60.7, 59.2, 57.6, 55.4, 47.6, 26.2, 21.1, 14.6, 13.7, 13.3; HRMS (ESI) Calcd for $C_{29}H_{33}N_2O_7$ $[M+H]^+$ 521.2282; found 521.2279.



Diethyl 1-acetyl-1'-(4-chlorobenzyl)-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bg). General procedure was followed to afford **3bg** as a white solid (83.6 mg, 80% yield, dr = 92:8); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, J = 8.4 Hz, 1H), 7.19 (dd, J = 8.4, 1.4 Hz, 1H), 7.16 (d, J = 8.4 Hz, 2H), 7.08 (s, 1H), 6.83 (d, J = 8.4 Hz, 2H), 4.31 (q, J = 1.1 Hz, 1H), 4.29 (d, J = 15.5 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.76 (d, J = 15.5 Hz, 1H), 3.73 (dq, J = 10.8, 7.1 Hz, 1H), 3.66 (dq, J = 10.8, 7.1 Hz, 1H), 2.49 (d, J = 1.1 Hz, 3H), 2.36 (s, 3H), 2.32 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.78 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.7, 170.2, 169.1, 165.6, 161.3, 138.2, 135.1, 134.12, 134.10, 131.5, 130.0 (2C), 128.5 (2C), 126.0, 123.1, 116.7, 96.7, 72.9, 60.8, 59.3, 57.5, 47.6, 26.1, 21.1, 14.5, 13.7, 13.3; HRMS (ESI) Calcd for $C_{28}H_{30}{}^{35}ClN_2O_6$ $[M+H]^+$ 525.1787; found 525.1787.

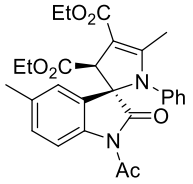


Diethyl 1-acetyl-1'-(2-chlorobenzyl)-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bh). General procedure was followed to afford **3bh** as a white solid (74.4 mg, 71% yield, dr = 95:5); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, J = 8.3 Hz, 1H), 7.25 (d, J = 7.9 Hz, 1H), 7.20–7.13 (m, 2H), 7.10 (s, 1H), 7.06 (t, J = 7.5 Hz, 1H), 6.78 (d, J = 7.6 Hz, 1H), 4.42 (d, J = 15.7 Hz, 1H), 4.32 (q, J = 1.1 Hz, 1H), 4.19 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.98 (d, J = 15.7 Hz, 1H), 3.71 (dq, J = 10.7, 7.1 Hz, 1H), 3.64 (dq, J = 10.7, 7.1 Hz, 1H), 2.53 (d, J = 1.1 Hz, 3H), 2.36 (s, 3H), 2.31 (s, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.79 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.4, 170.3, 169.1, 165.6, 161.9, 138.2, 135.0, 134.6, 132.9, 131.4, 130.7, 129.7, 129.6, 126.6, 126.0, 123.2, 116.7, 96.4, 73.1, 60.8, 59.2, 57.8, 46.1, 26.4, 21.1, 14.5, 13.7, 13.1; HRMS (ESI) Calcd for $C_{28}H_{30}{}^{35}ClN_2O_6$ $[M+H]^+$ 525.1787; found 525.1787.

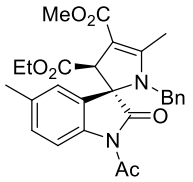


Diethyl 1-acetyl-1'-(furan-2-ylmethyl)-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bi). General procedure was followed to afford **3bi** as a white solid (64.5 mg, 67% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, J = 8.4 Hz, 1H), 7.34 (d, J

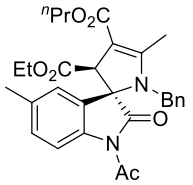
= 1.2 Hz, 1H), 7.20 (dd, *J* = 8.4, 1.0 Hz, 1H), 7.07 (s, 1H), 6.13 (dd, *J* = 3.1, 1.9 Hz, 1H), 5.68 (d, *J* = 3.2 Hz, 1H), 4.33 (d, *J* = 16.1 Hz, 1H), 4.22 (q, *J* = 1.0 Hz, 1H), 4.16 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.07 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.81 (d, *J* = 16.1 Hz, 1H), 3.75 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.67 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.60 (d, *J* = 1.0 Hz, 3H), 2.47 (s, 3H), 2.33 (s, 3H), 1.20 (t, *J* = 7.1 Hz, 3H), 0.81 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.0, 170.6, 169.2, 165.6, 161.3, 148.9, 143.3, 138.3, 135.1, 131.3, 125.8, 123.1, 116.6, 110.1, 109.9, 96.1, 72.3, 60.8, 59.1, 57.4, 39.9, 26.5, 21.1, 14.5, 13.7, 12.9; HRMS (ESI) Calcd for $C_{26}H_{29}N_2O_7$ $[M+H]^+$ 481.1969; found 481.1968.



Diethyl 1-acetyl-5,5'-dimethyl-2-oxo-1'-phenyl-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bj). General procedure was followed to afford **3bj** as a white solid (64.1 mg, 67% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.4 Hz, 1H), 7.27 (d, *J* = 1.2 Hz, 1H), 7.22–7.15 (m, 3H), 7.09 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.90–6.84 (m, 2H), 4.51 (q, *J* = 1.3 Hz, 1H), 4.22 (dq, *J* = 10.8, 7.1 Hz, 1H), 4.13 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.79 (dq, *J* = 10.8, 7.1 Hz, 1H), 3.71 (dq, *J* = 10.8, 7.1 Hz, 1H), 2.61 (s, 3H), 2.32 (s, 3H), 2.22 (d, *J* = 1.3 Hz, 3H), 1.24 (t, *J* = 7.1 Hz, 3H), 0.83 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.6, 170.4, 169.3, 165.7, 161.2, 137.9, 137.4, 135.0, 131.2, 129.3 (2C), 129.1 (2C), 128.2, 126.3, 124.6, 116.3, 97.6, 74.9, 60.9, 59.3, 57.6, 26.6, 21.2, 14.6, 14.1, 13.8; HRMS (ESI) Calcd for $C_{27}H_{29}N_2O_6$ $[M+H]^+$ 477.2020; found 477.2022.

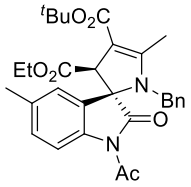


3'-Ethyl 4'-methyl 1-acetyl-1'-benzyl-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bk). General procedure was followed to afford **3bk** as a white solid (74.7 mg, 78% yield, dr = 96:4); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.4 Hz, 1H), 7.22–7.16 (m, 4H), 7.11 (s, 1H), 6.90–6.85 (m, 2H), 4.37 (d, *J* = 15.4 Hz, 1H), 4.29 (q, *J* = 1.0 Hz, 1H), 3.78–3.63 (m, 2H), 3.75 (d, *J* = 15.4 Hz, 1H), 3.67 (s, 3H), 2.52 (d, *J* = 1.0 Hz, 3H), 2.33 (s, 3H), 2.27 (s, 3H), 0.77 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.7, 170.4, 169.2, 166.1, 161.8, 138.4, 135.4, 135.0, 131.4, 128.8 (2C), 128.4 (2C), 128.3, 126.0, 123.2, 116.7, 96.1, 72.9, 60.8, 57.4, 50.7, 48.2, 26.3, 21.1, 13.7, 13.4; HRMS (ESI) Calcd for $C_{27}H_{29}N_2O_6$ $[M+H]^+$ 477.2020; found 477.2019.

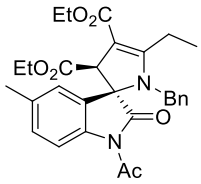


3'-Ethyl 4'-propyl 1-acetyl-1'-benzyl-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-

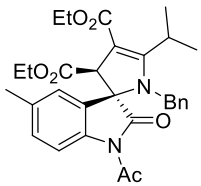
pyrrole]-3',4'-dicarboxylate (3bl). General procedure was followed to afford **3bl** as a white solid (75.9 mg, 75% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, J = 8.4 Hz, 1H), 7.24–7.15 (m, 4H), 7.12 (s, 1H), 6.91–6.84 (m, 2H), 4.37 (d, J = 15.4 Hz, 1H), 4.30 (q, J = 1.1 Hz, 1H), 4.10 (dt, J = 10.7, 6.5 Hz, 1H), 3.98 (dt, J = 10.7, 6.5 Hz, 1H), 3.75 (d, J = 15.4 Hz, 1H), 3.76–3.62 (m, 2H), 2.53 (d, J = 1.1 Hz, 3H), 2.33 (s, 3H), 2.28 (s, 3H), 1.65–1.55 (m, 2H), 0.90 (t, J = 7.4 Hz, 3H), 0.77 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.8, 170.4, 169.2, 165.7, 161.7, 138.3, 135.5, 134.9, 131.4, 128.8 (2C), 128.4 (2C), 128.2, 126.1, 123.2, 116.6, 96.3, 72.8, 64.9, 60.8, 57.5, 48.2, 26.3, 22.3, 21.1, 13.7, 13.3, 10.7; HRMS (ESI) Calcd for $C_{29}H_{33}N_2O_6$ $[M+H]^+$ 505.2333; found 505.2331.



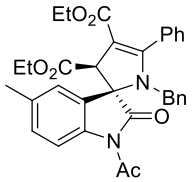
4'-tert-Butyl 3'-ethyl 1-acetyl-1'-benzyl-5,5'-dimethyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bm). General procedure was followed to afford **3bm** as a white solid (81.5 mg, 79% yield, dr = 95:5); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 (d, J = 8.3 Hz, 1H), 7.23–7.15 (m, 4H), 7.13 (s, 1H), 6.90–6.84 (m, 2H), 4.36 (d, J = 15.3 Hz, 1H), 4.27 (q, J = 1.3 Hz, 1H), 3.71 (d, J = 15.3 Hz, 1H), 3.70 (dq, J = 10.8, 7.1 Hz, 1H), 3.67 (dq, J = 10.8, 7.1 Hz, 1H), 2.49 (d, J = 1.3 Hz, 3H), 2.33 (s, 3H), 2.28 (s, 3H), 1.43 (s, 9H), 0.78 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.0, 170.3, 169.3, 165.1, 160.7, 138.2, 135.5, 134.8, 131.2, 128.8 (2C), 128.3 (2C), 128.1, 126.1, 123.2, 116.5, 97.6, 79.1, 72.6, 60.6, 58.0, 48.1, 28.4 (3C), 26.2, 21.1, 13.7, 13.1; HRMS (ESI) Calcd for $C_{30}H_{35}N_2O_6$ $[M+H]^+$ 519.2490; found 519.2490.



Diethyl 1-acetyl-1'-benzyl-5'-ethyl-5-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bn). General procedure was followed to afford **3bn** as a white solid (74.9 mg, 74% yield, dr = 97:3); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (d, J = 8.3 Hz, 1H), 7.23–7.14 (m, 4H), 7.08 (s, 1H), 6.85 (d, J = 7.1 Hz, 2H), 4.39 (d, J = 15.3 Hz, 1H), 4.29 (s, 1H), 4.18 (dq, J = 10.8, 7.1 Hz, 1H), 4.09 (dq, J = 10.8, 7.1 Hz, 1H), 3.75 (d, J = 15.3 Hz, 1H), 3.76–3.60 (m, 2H), 3.05–2.91 (m, 2H), 2.33 (s, 3H), 2.26 (s, 3H), 1.33 (t, J = 7.5 Hz, 3H), 1.21 (t, J = 7.1 Hz, 3H), 0.77 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.8, 170.3, 169.1, 167.1, 165.3, 138.2, 135.2, 134.8, 131.3, 129.0 (2C), 128.31 (2C), 128.28, 126.0, 123.2, 116.6, 95.3, 72.8, 60.7, 59.1, 57.5, 48.1, 26.2, 21.1, 19.8, 14.5, 13.7, 12.7; HRMS (ESI) Calcd for $C_{29}H_{33}N_2O_6$ $[M+H]^+$ 505.2333; found 505.2348.



Diethyl 1-acetyl-1'-benzyl-5'-isopropyl-5-methyl-2-oxo-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bo). General procedure was followed to afford **3bo** as a colorless oil (70.6 mg, 68% yield, dr = 98:2); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (d, J = 8.3 Hz, 1H), 7.23–7.14 (m, 4H), 7.11 (s, 1H), 6.88 (d, J = 6.7 Hz, 2H), 4.57 (d, J = 15.4 Hz, 1H), 4.31 (s, 1H), 4.16 (dq, J = 10.8, 7.1 Hz, 1H), 4.06 (dq, J = 10.8, 7.1 Hz, 1H), 4.11–3.93 (m, 1H), 3.80 (d, J = 15.4 Hz, 1H), 3.69 (dq, J = 10.7, 7.1 Hz, 1H), 3.64 (dq, J = 10.7, 7.1 Hz, 1H), 2.34 (s, 3H), 2.25 (s, 3H), 1.49 (d, J = 7.3 Hz, 3H), 1.45 (d, J = 7.3 Hz, 3H), 1.18 (t, J = 7.1 Hz, 3H), 0.77 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.0, 170.3, 170.0, 169.2, 165.3, 138.2, 135.2, 134.7, 131.3, 128.8 (2C), 128.2 (3C), 125.9, 123.3, 116.6, 95.6, 72.8, 60.6, 59.2, 57.9, 49.6, 26.2, 25.8, 21.2, 19.6, 19.1, 14.4, 13.6; HRMS (ESI) Calcd for $C_{30}H_{35}N_2O_6$ $[M+H]^+$ 519.2490; found 519.2500.



Diethyl 1-acetyl-1'-benzyl-5-methyl-2-oxo-5'-phenyl-1',3'-dihydrospiro[indoline-3,2'-pyrrole]-3',4'-dicarboxylate (3bp). General procedure by using 0.3 mmol of I_2 and 0.2 mmol of DABCO·6H_2O was followed to afford **3bp** as a white solid (53.3 mg, 48% yield, dr > 99:1); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (d, J = 8.3 Hz, 1H), 7.63–7.52 (bs, 2H), 7.52–7.42 (m, 3H), 7.26 (s, 1H), 7.21 (d, J = 8.4 Hz, 1H), 7.15 (t, J = 7.2 Hz, 1H), 7.09 (t, J = 7.2 Hz, 2H), 6.70 (d, J = 7.2 Hz, 2H), 4.49 (s, 1H), 4.12 (d, J = 14.8 Hz, 1H), 3.99 (dq, J = 10.8, 7.1 Hz, 1H), 3.91 (dq, J = 10.8, 7.1 Hz, 1H), 3.74 (dq, J = 10.9, 7.1 Hz, 1H), 3.69 (dq, J = 10.9, 7.1 Hz, 1H), 3.51 (d, J = 14.8 Hz, 1H), 2.39 (s, 3H), 2.22 (s, 3H), 0.96 (t, J = 7.1 Hz, 3H), 0.77 (t, J = 7.1 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.7, 170.3, 168.8, 164.7, 162.7, 138.3, 135.0, 134.8, 131.5, 131.4, 130.0, 129.48, 129.45 (2C), 128.6, 128.4, 128.2, 128.1 (3C), 126.1, 123.0, 116.7, 98.6, 72.7, 60.8, 59.2, 57.9, 49.2, 26.2, 21.2, 14.1, 13.7; HRMS (ESI) Calcd for $C_{33}H_{33}N_2O_6$ $[M+H]^+$ 553.2339; found 553.2339.

4. References

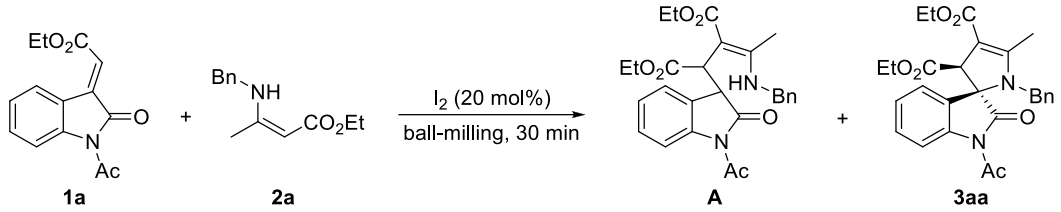
[1]. J.-Y. Liu, G.-E. Cao, W. Xu, J. Cao and W.-L. Wang, *Appl. Organometal. Chem.*, 2010, **24**, 685.

[2]. S.-H. Cao, X.-C. Zhang, Y. Wei and M. Shi, *Eur. J. Org. Chem.*, 2011, 2668.

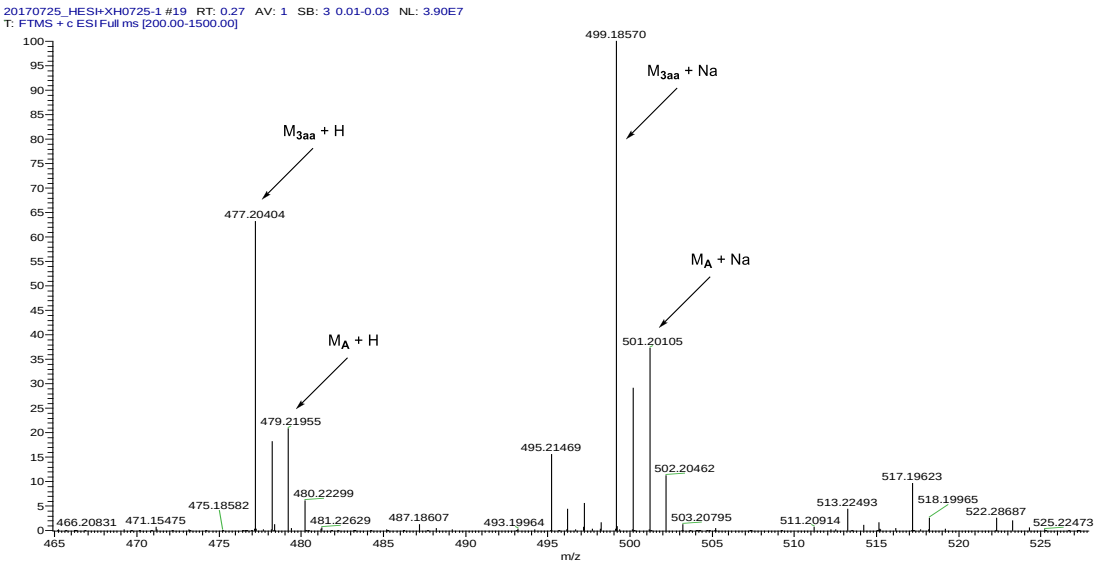
[3]. (*a*) X. Zhu, Z. Li, C. Jin, L. Xu, Q. Wu and W. Su, *Green Chem.*, 2009, **11**, 163; (*b*) W. Su, J. Yu, Z. Li and Z. Jiang, *J. Org. Chem.*, 2011, **76**, 9144; (*c*) Z. Li, Z. Jiang and W. Su, *Green Chem.*, 2015, **17**, 2330; (*d*) K.-Y. Jia, J.-B. Yu, Z.-J. Jiang and W.-K. Su, *J. Org. Chem.*, 2016, **81**, 6049; (*e*) J.-B. Yu, Y. Zhang, Z.-J. Jiang and W.-K. Su, *J. Org. Chem.*, 2016, **81**, 11514.

[4]. (*a*) T. Friščić, S. L. Childs, S. A. A. Rizvi and W. Jones, *CrystEngComm*, 2009, **11**, 418; (*b*) G. A. Bowmaker, *Chem. Commun.*, 2013, **49**, 334; (*c*) J. Bonnamour, T.-X. Métro, J. Martinez and F. Lamaty; *Green Chem.*, 2013, **15**, 1116; (*d*) Z.-J. Jiang, Z.-H. Li, J.-B. Yu and W.-K. Su, *J. Org. Chem.*, 2016, **81**, 10049.

5. HRMS of intermediate A



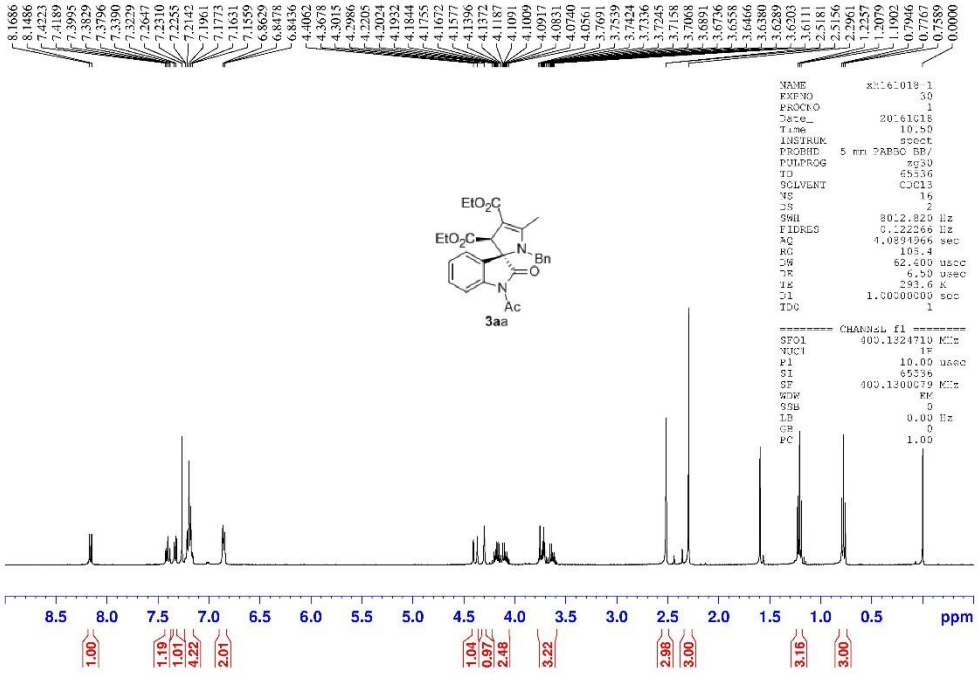
A mixture of alkylidene oxindole **1a** (0.1 mmol), enamino ester **2a** (1.1 equiv) and I_2 (20 mol%) together with eight stainless balls (5 mm in diameter) was introduced into a stainless steel jar (3.5 mL), and the jar was fixed on a Spex SamplePrep 5100 mixer mill and milled vigorously at a rate of 3000 rounds per minute (50 Hz) at room temperature for 30 min. Then the resulting oily mixture was analyzed by HRMS.



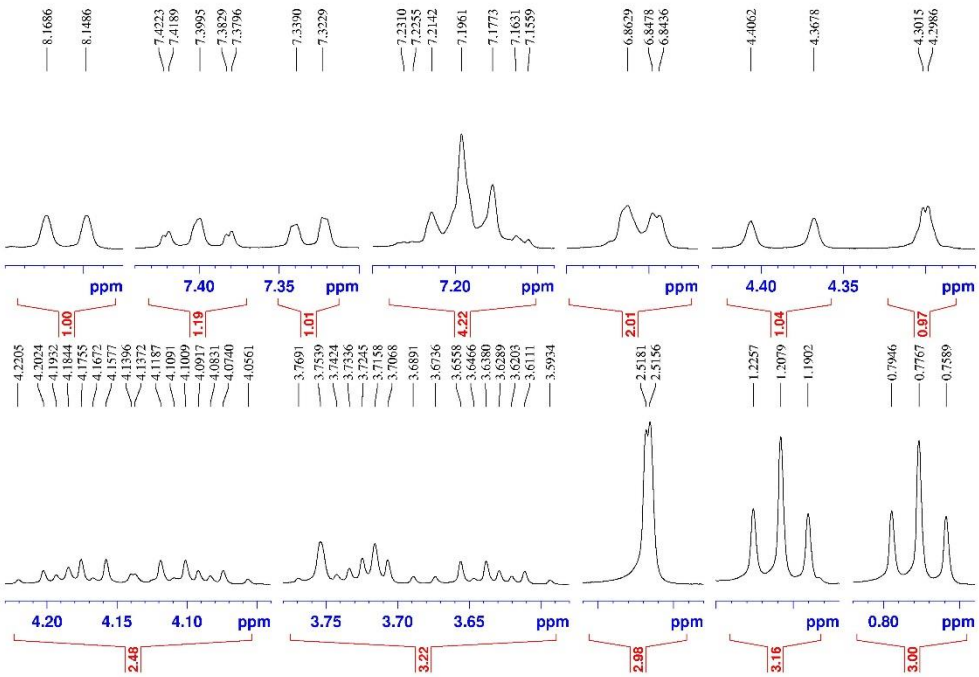
HRMS (ESI) Calcd for $C_{27}H_{29}N_2O_6$ $[M_{\mathbf{3aa}}+H]^+$ 477.2020; found 477.2040;
HRMS (ESI) Calcd for $C_{27}H_{31}N_2O_6$ $[M_{\mathbf{A}}+H]^+$ 479.2177; found 479.2196;
HRMS (ESI) Calcd for $C_{27}H_{28}N_2O_6Na$ $[M_{\mathbf{3aa}}+Na]^+$ 499.1840; found 499.1857;
HRMS (ESI) Calcd for $C_{27}H_{30}N_2O_6Na$ $[M_{\mathbf{A}}+Na]^+$ 501.1996; found 501.2011.

6. NMR spectra

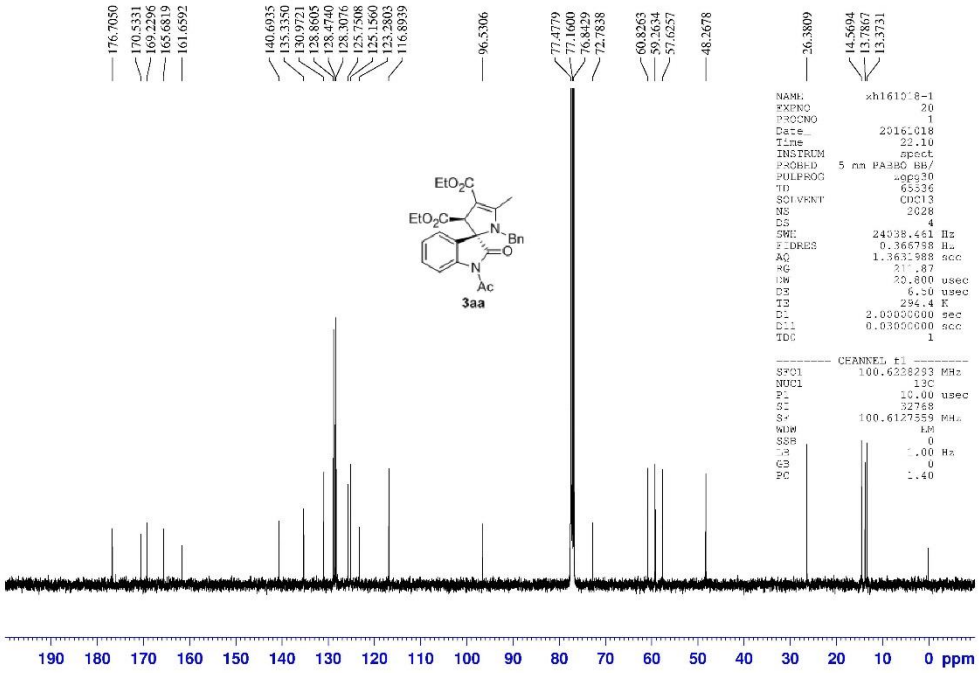
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3aa



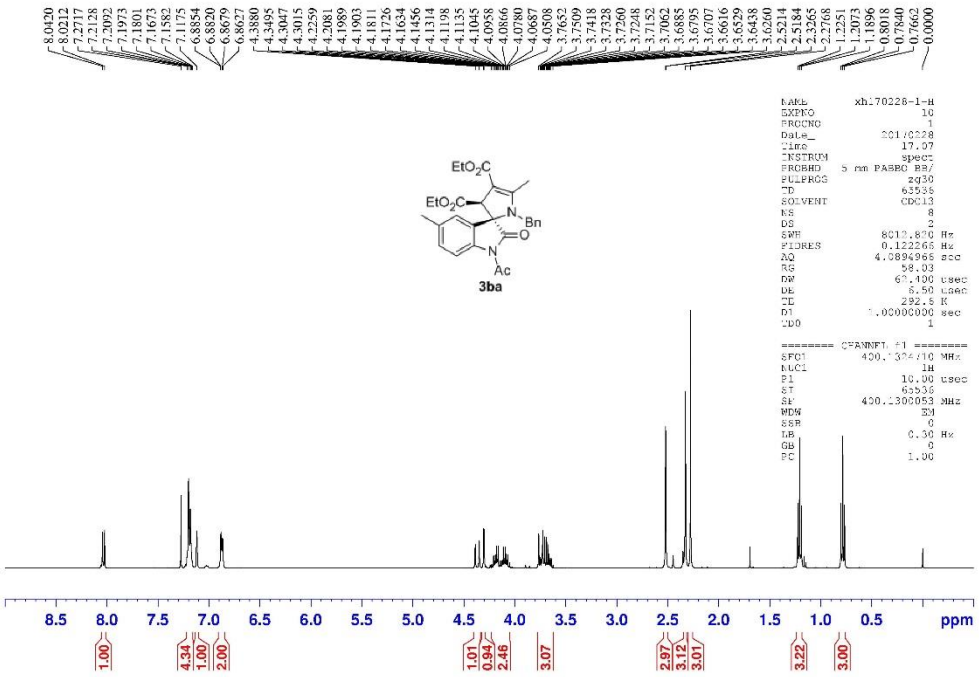
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3aa



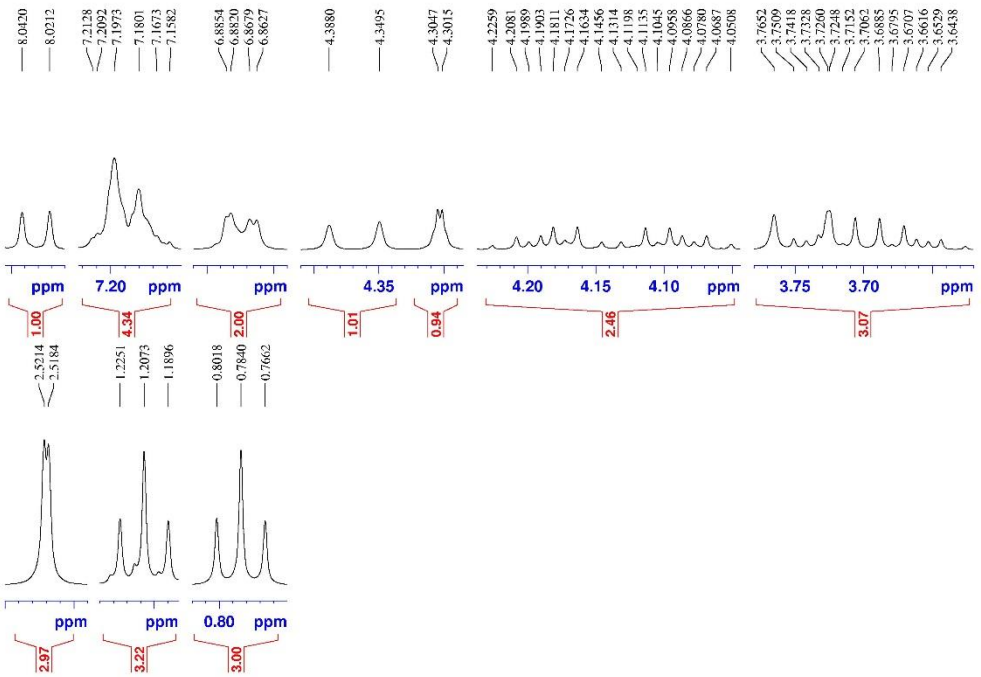
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3aa



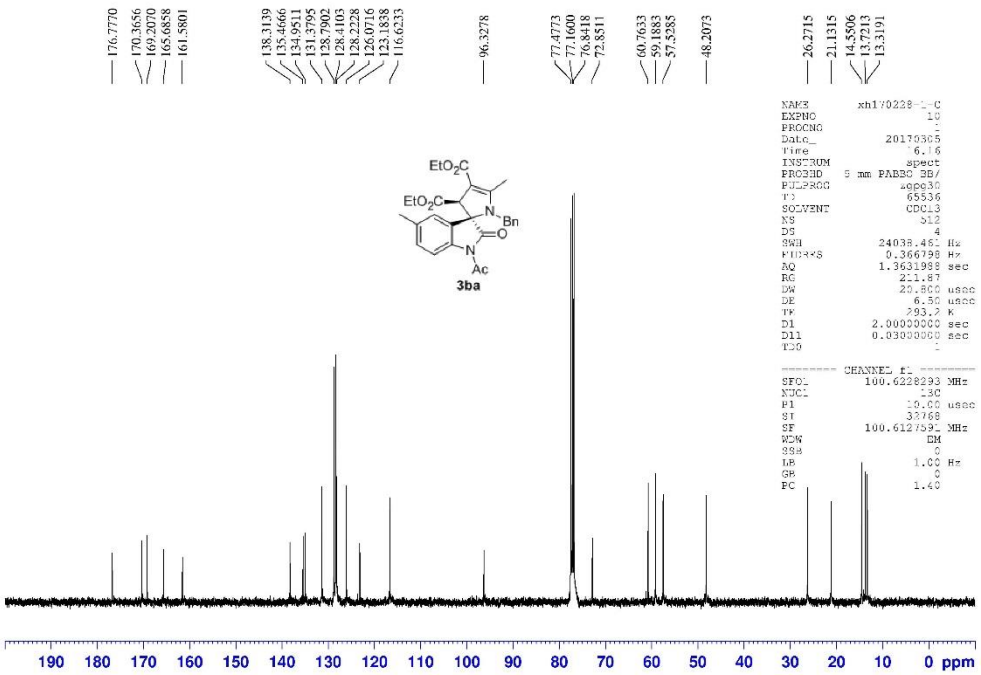
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ba



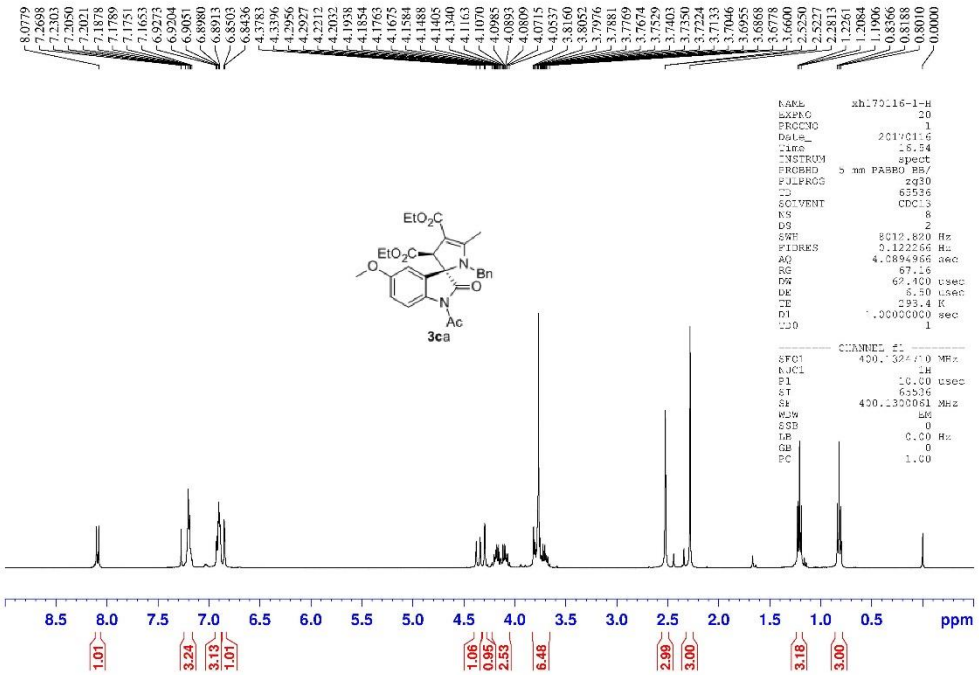
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ba



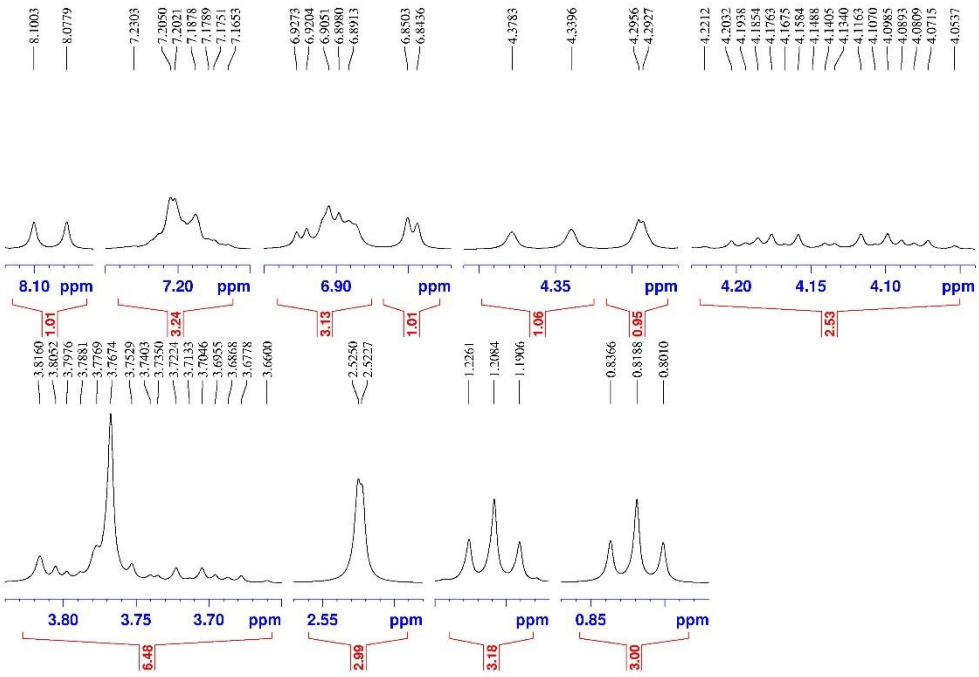
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ba



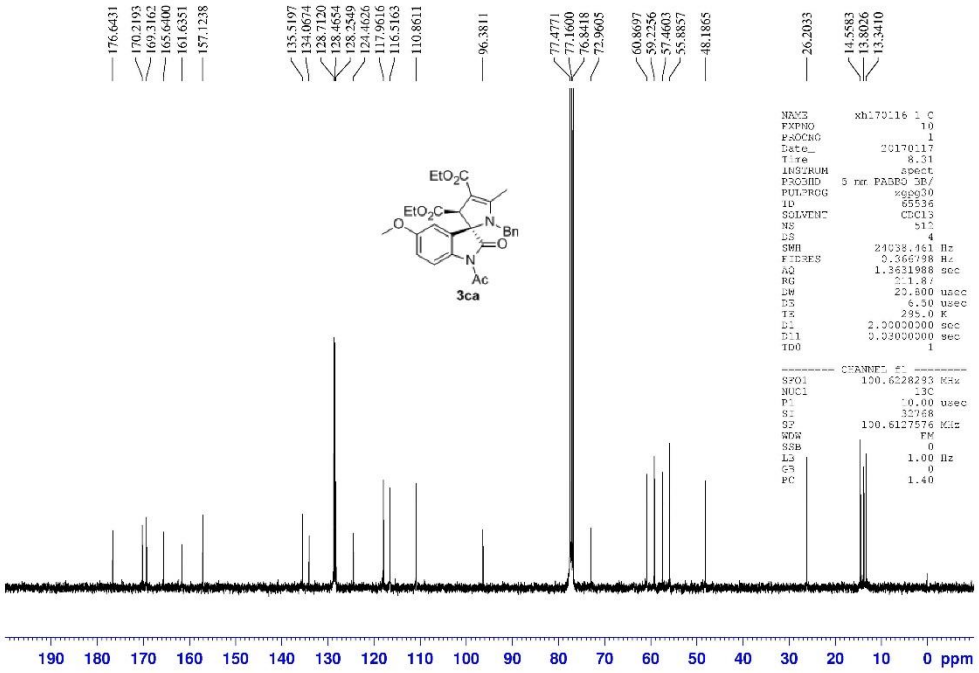
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ca



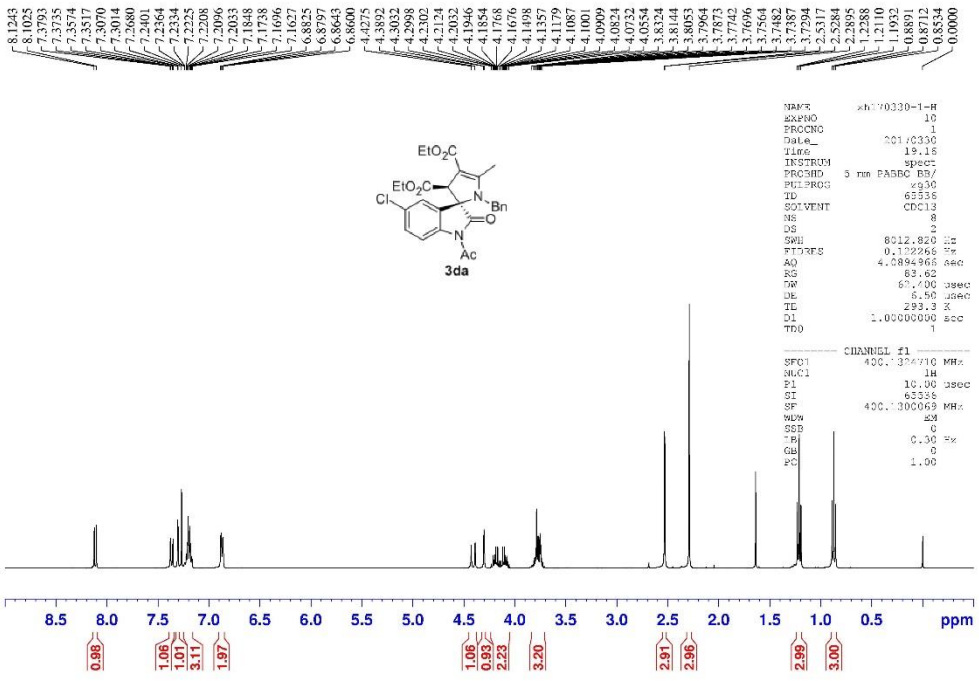
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ca



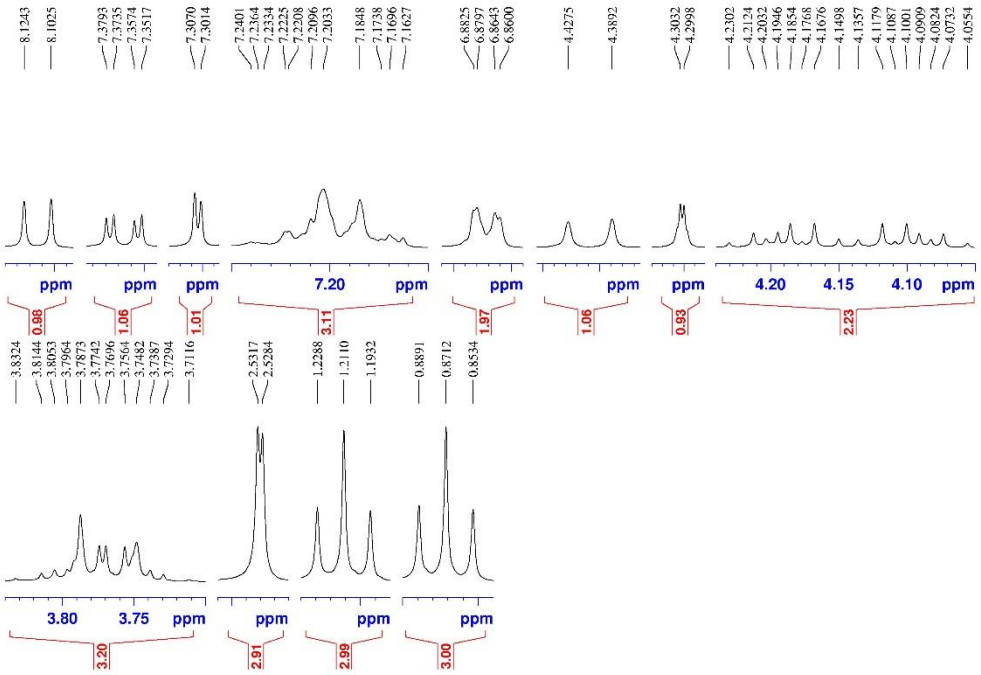
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ca



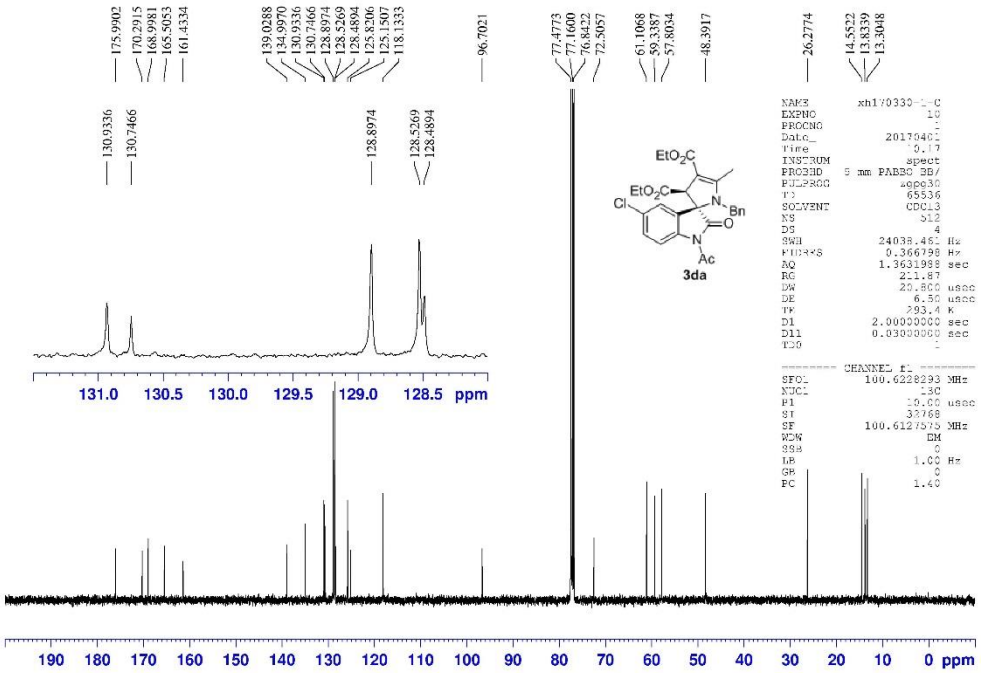
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3da



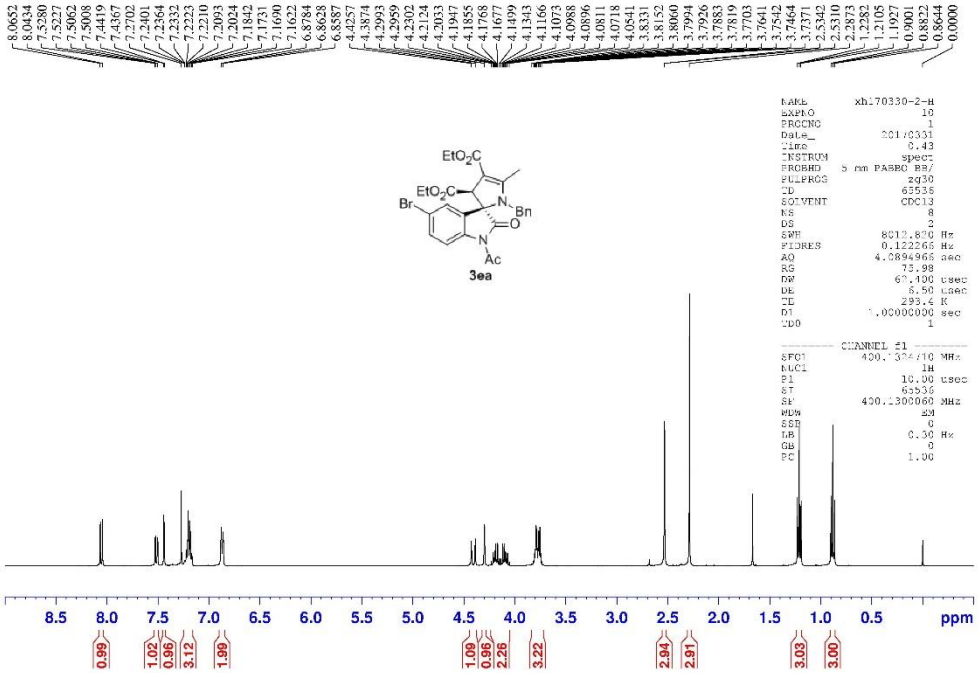
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3da



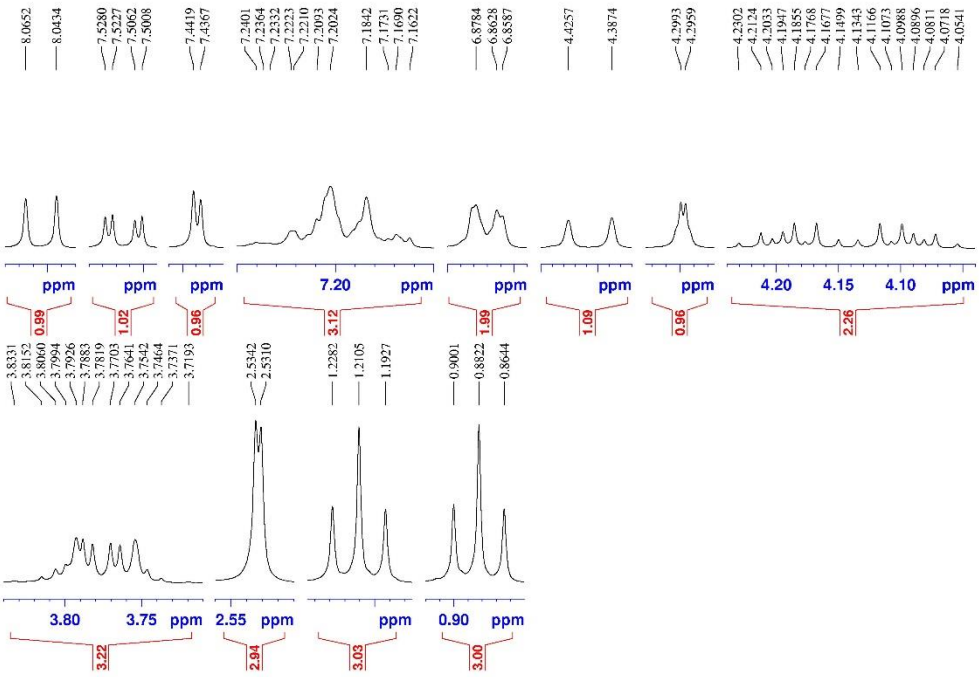
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3da



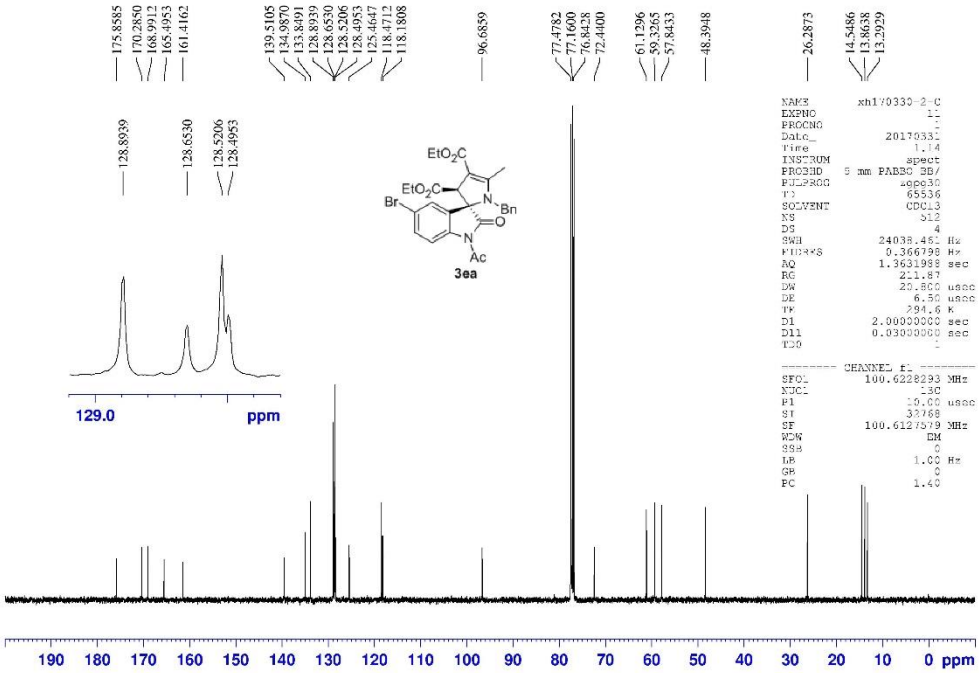
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ea



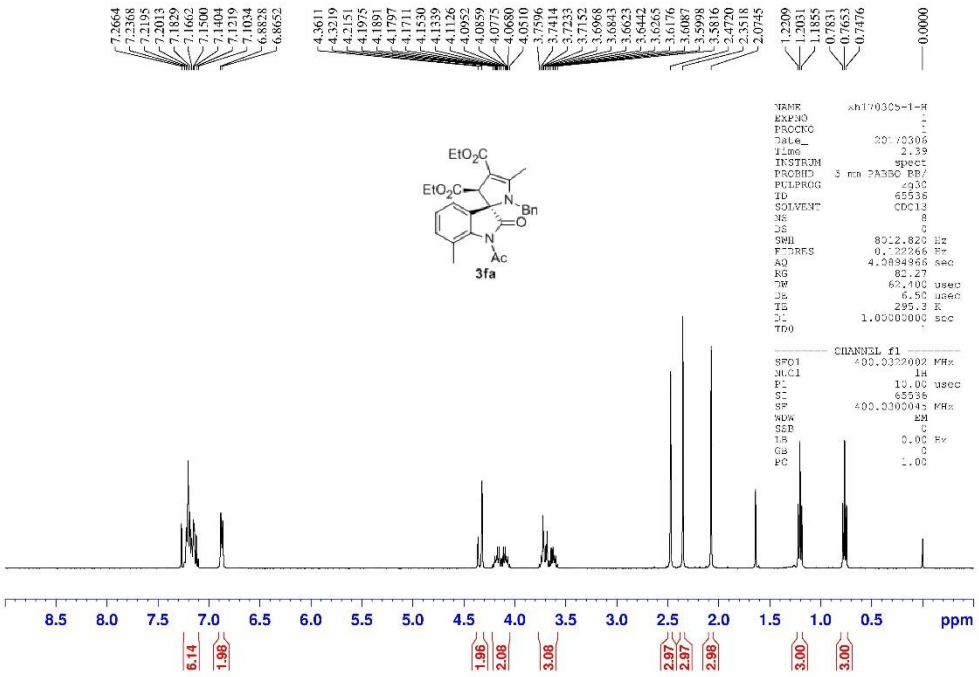
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ea



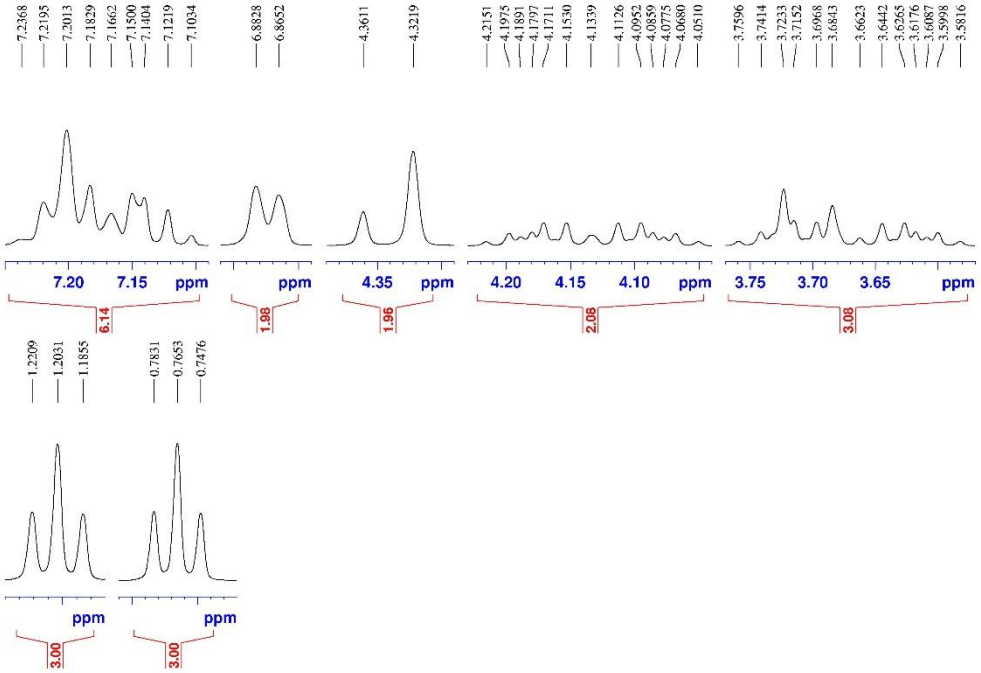
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ea



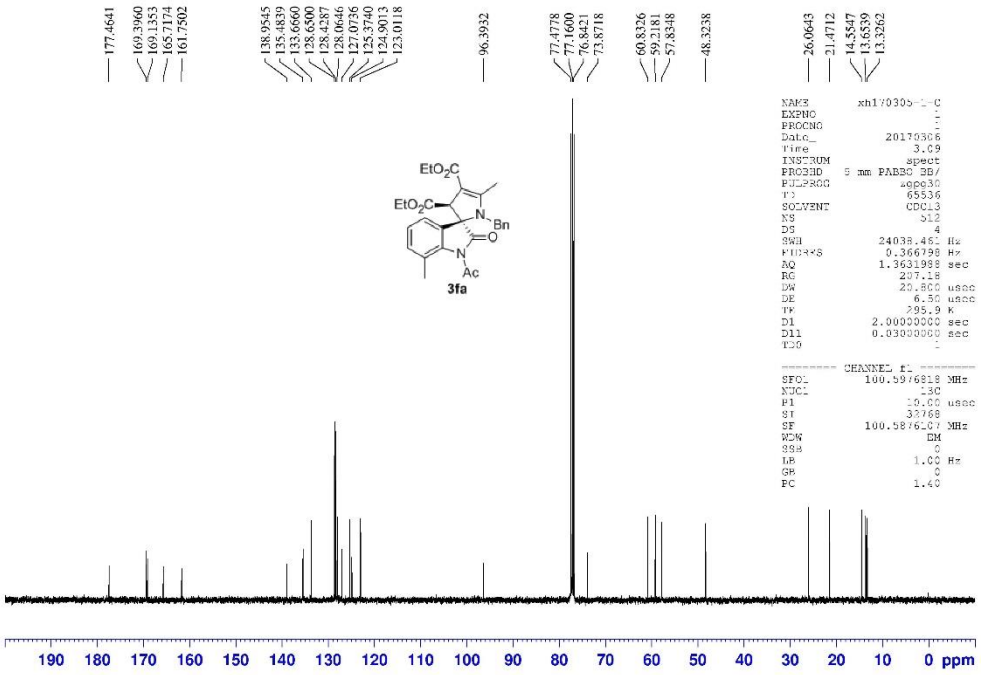
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3fa



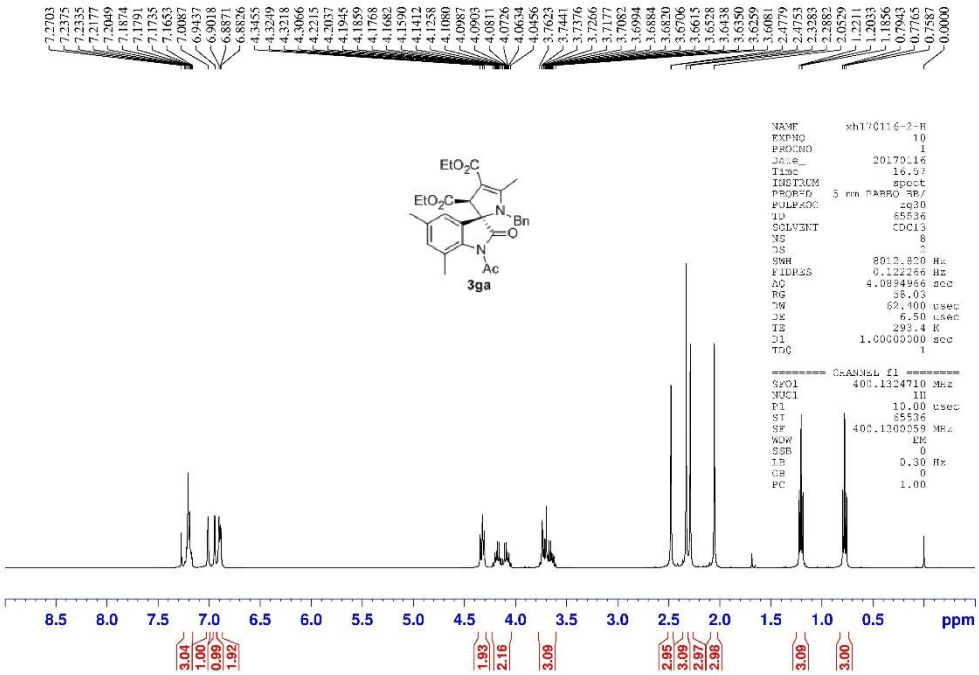
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3fa



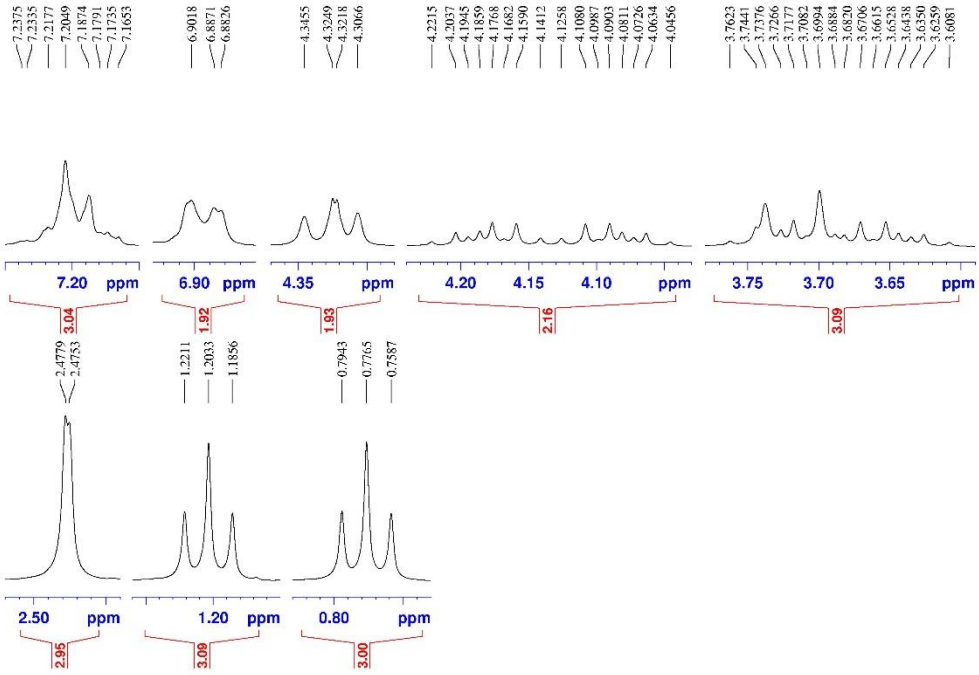
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3fa



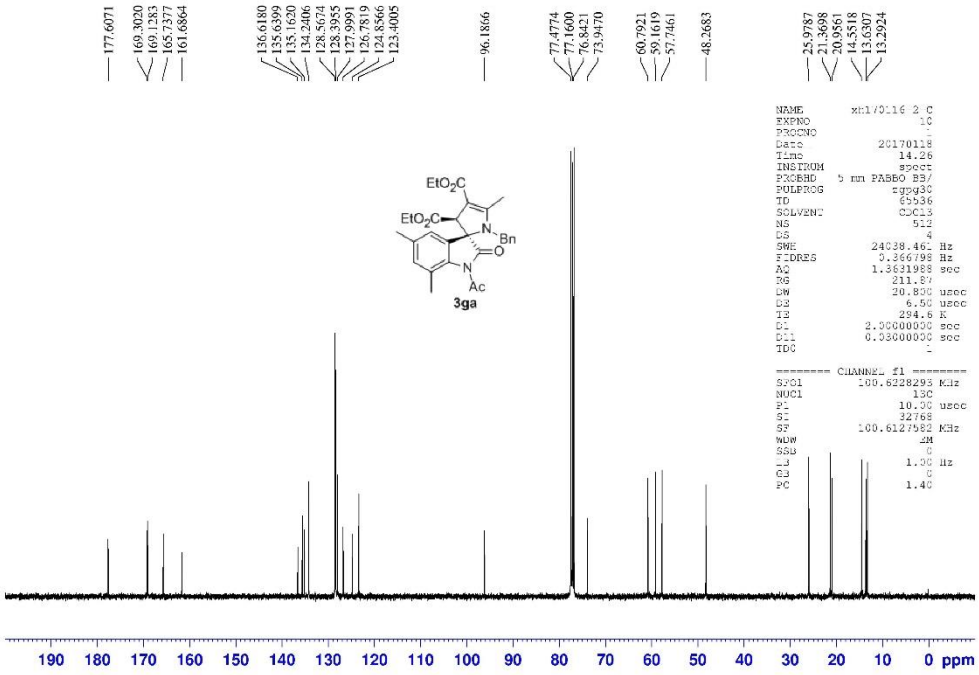
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ga



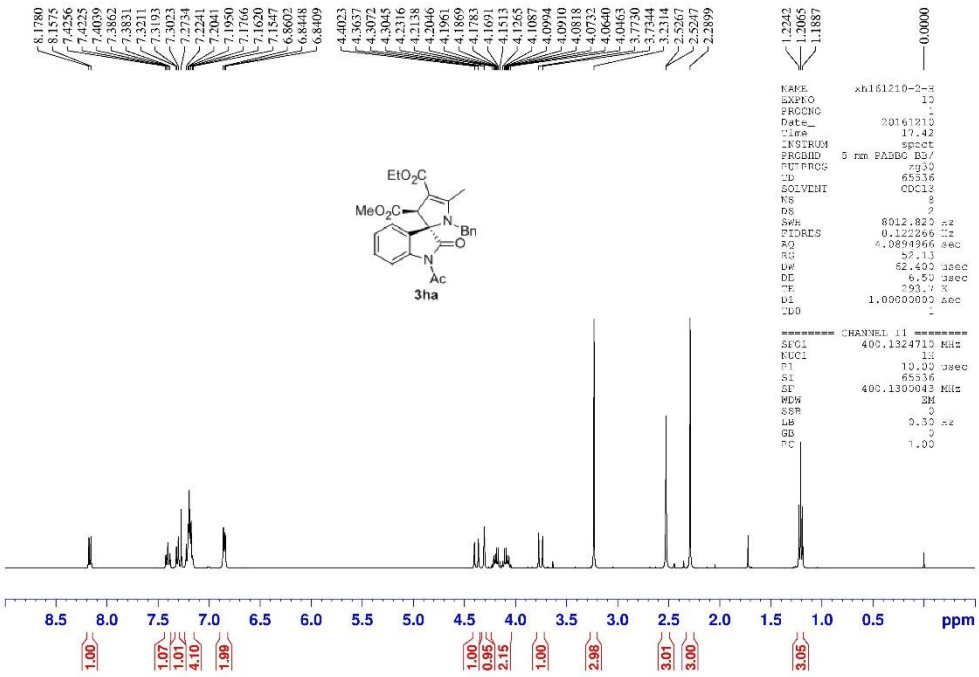
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ga



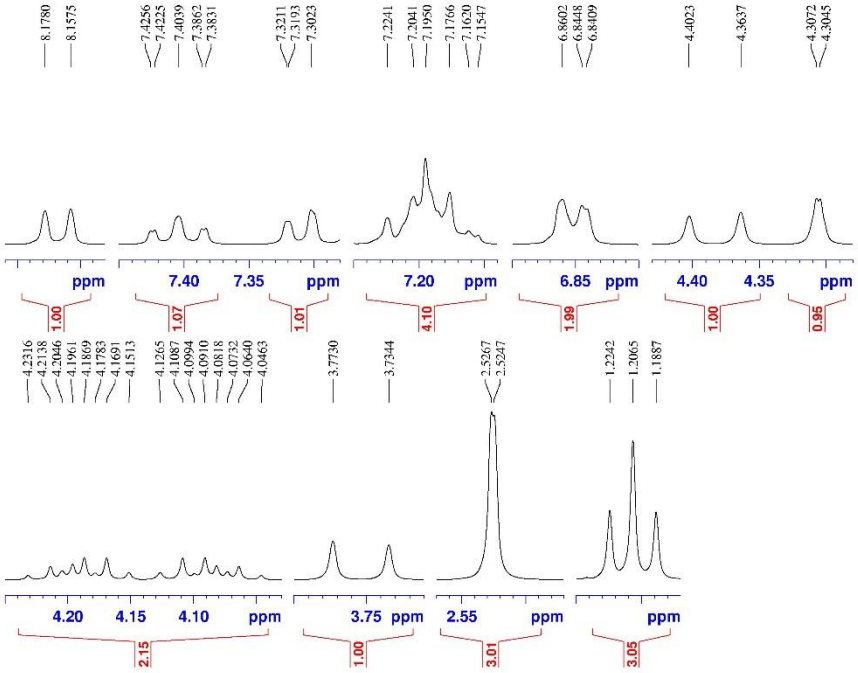
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ga



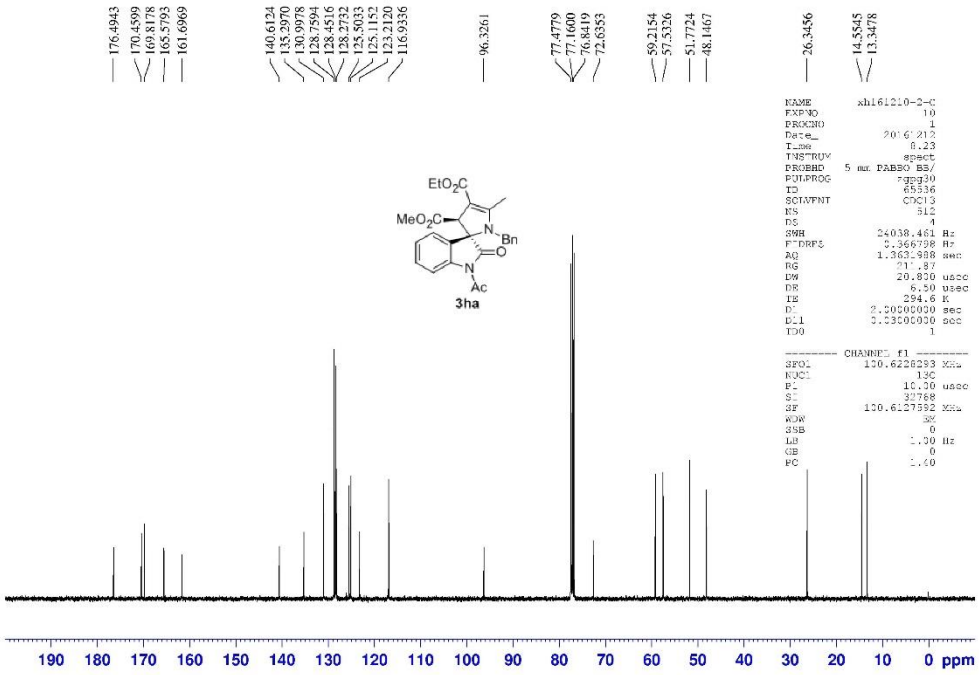
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ha



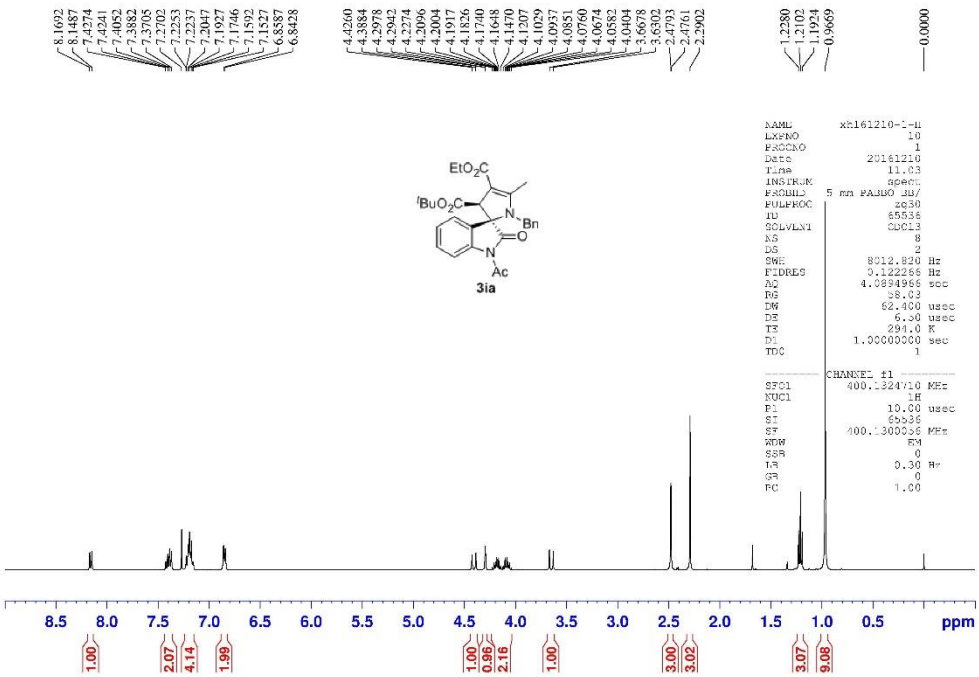
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ha



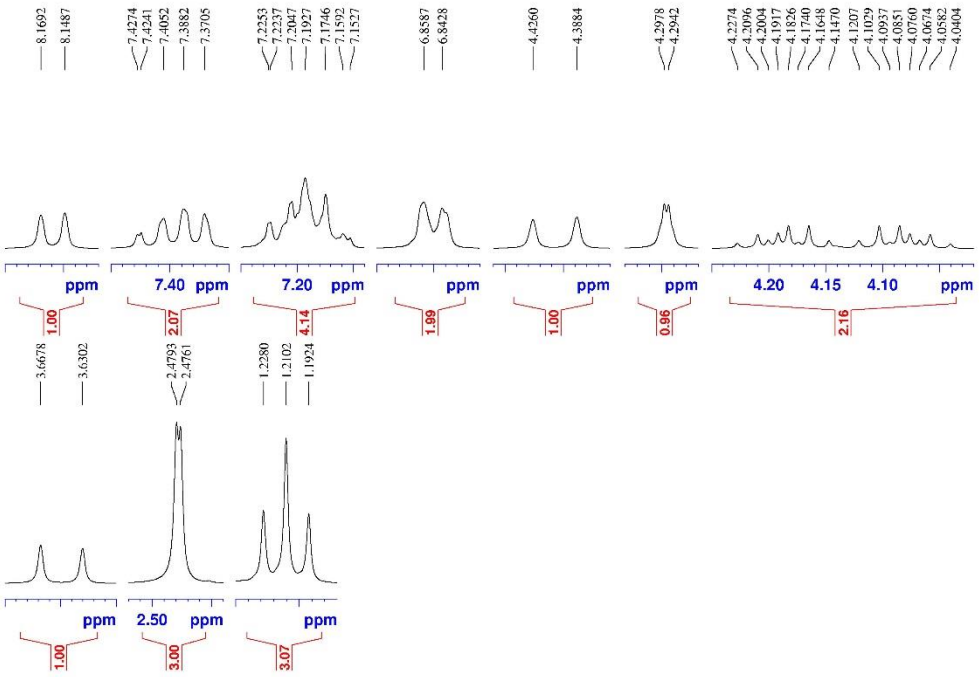
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ha



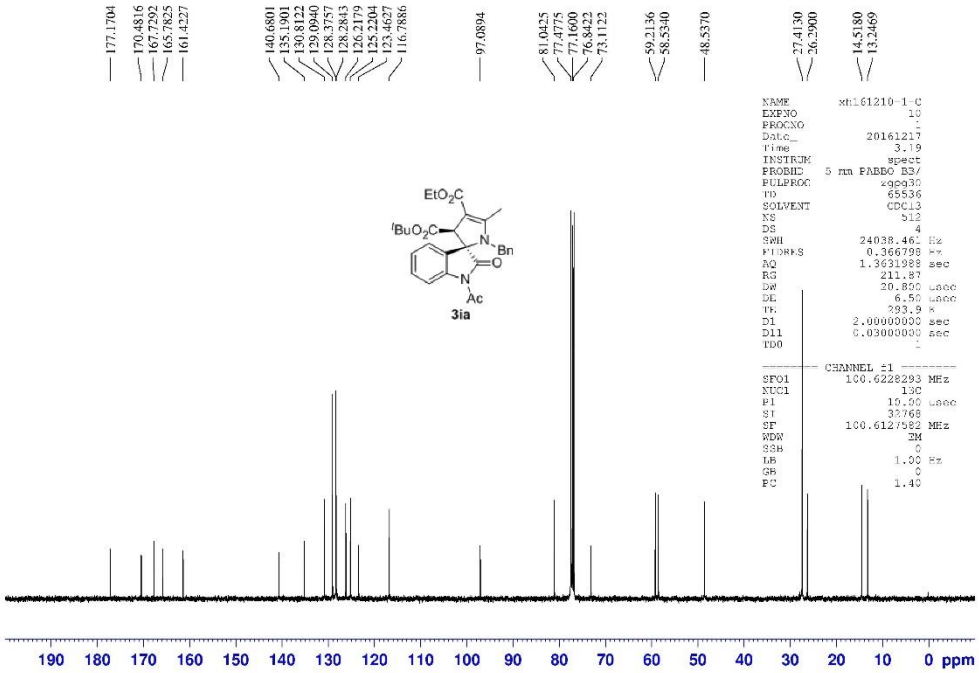
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ia



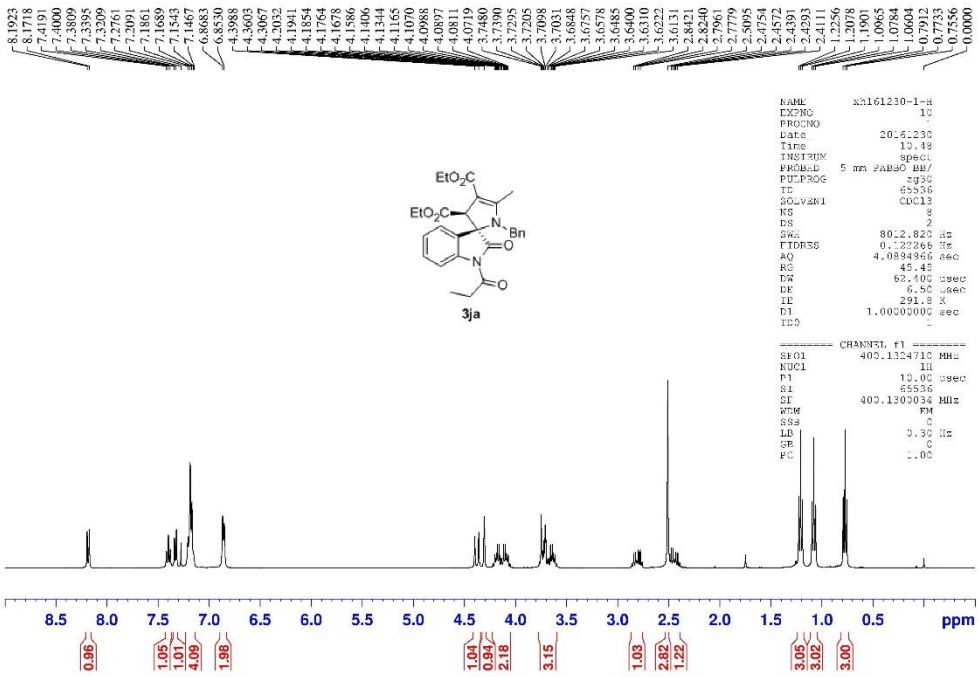
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ia



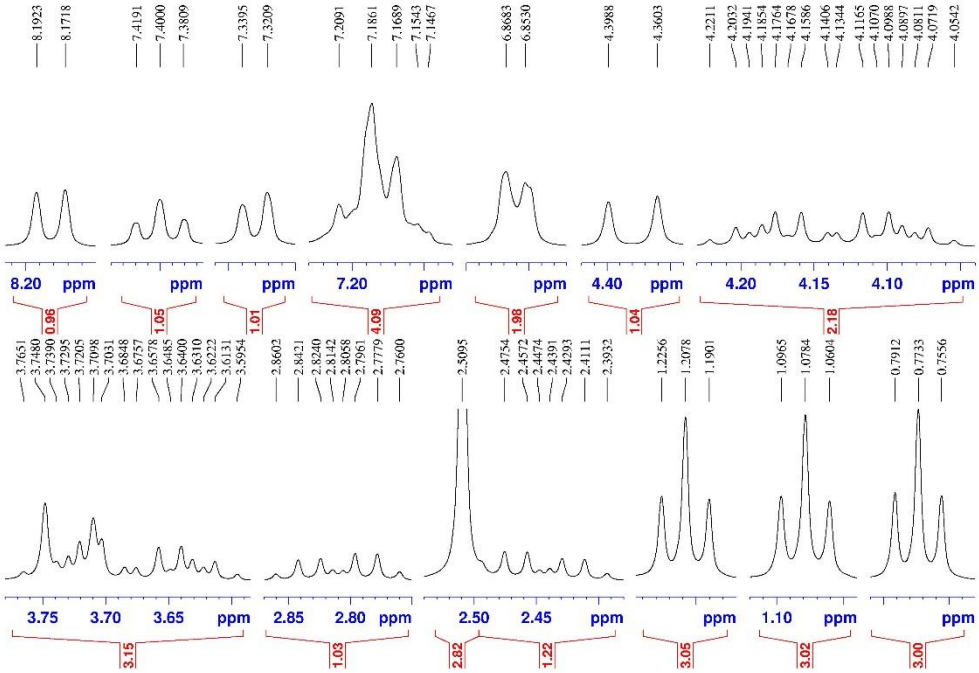
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ia



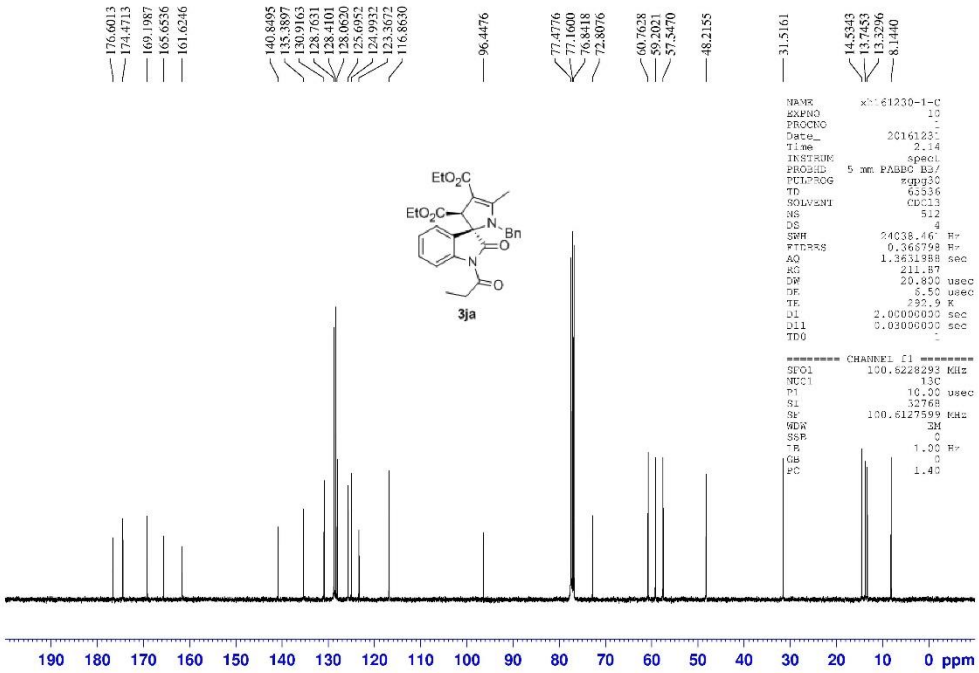
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ja



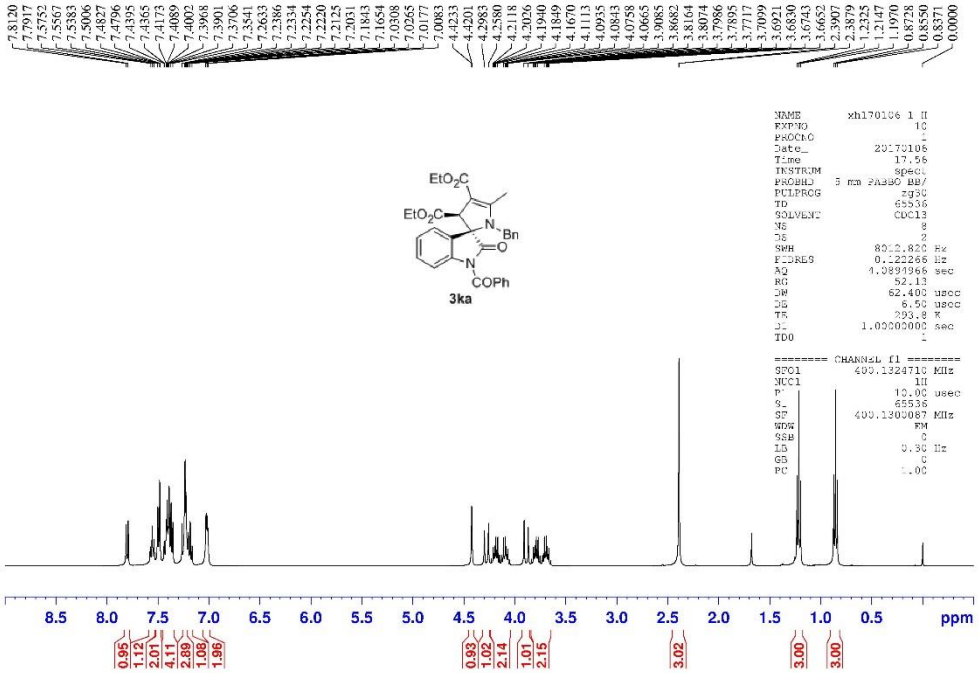
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ja



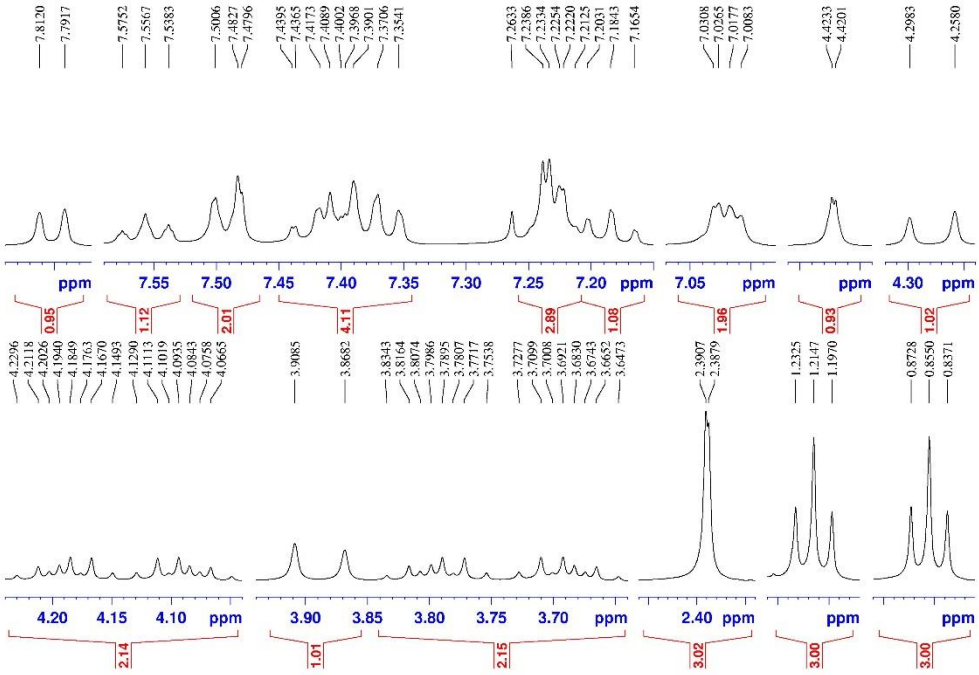
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ja



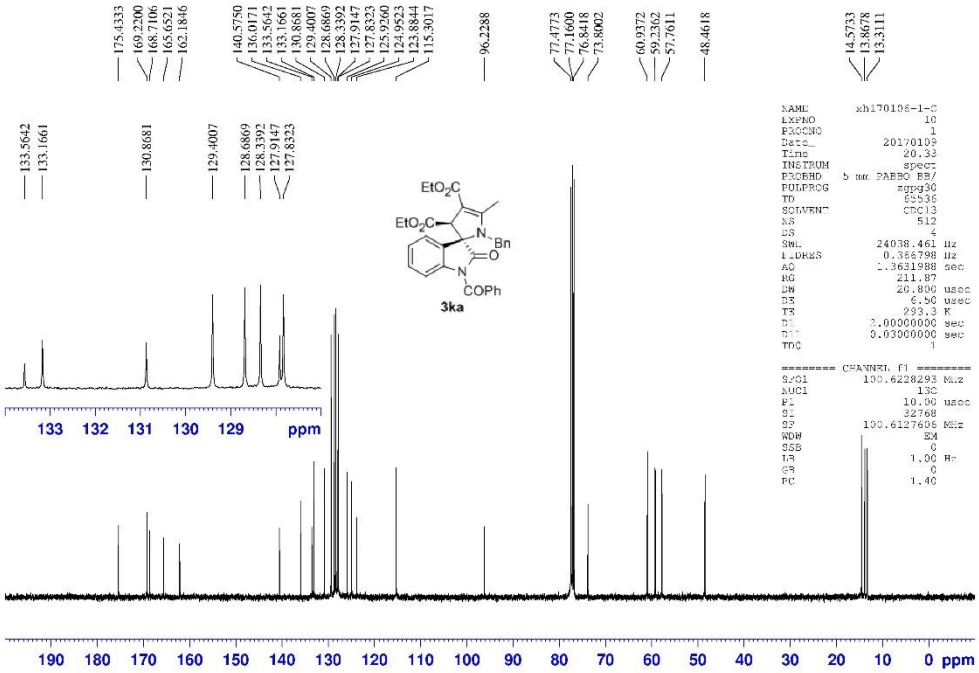
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ka



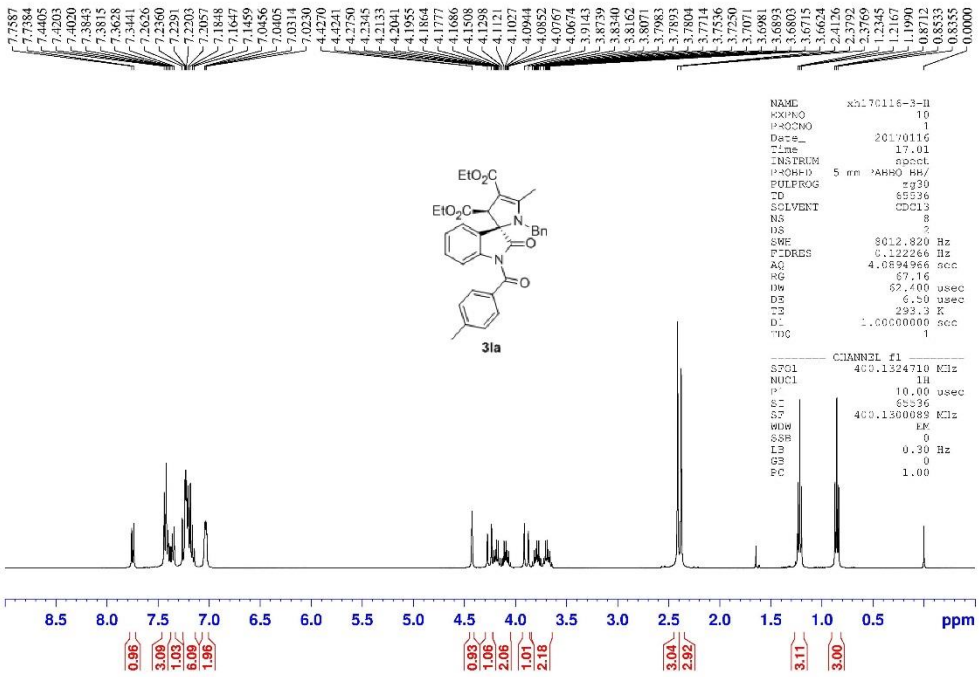
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ka



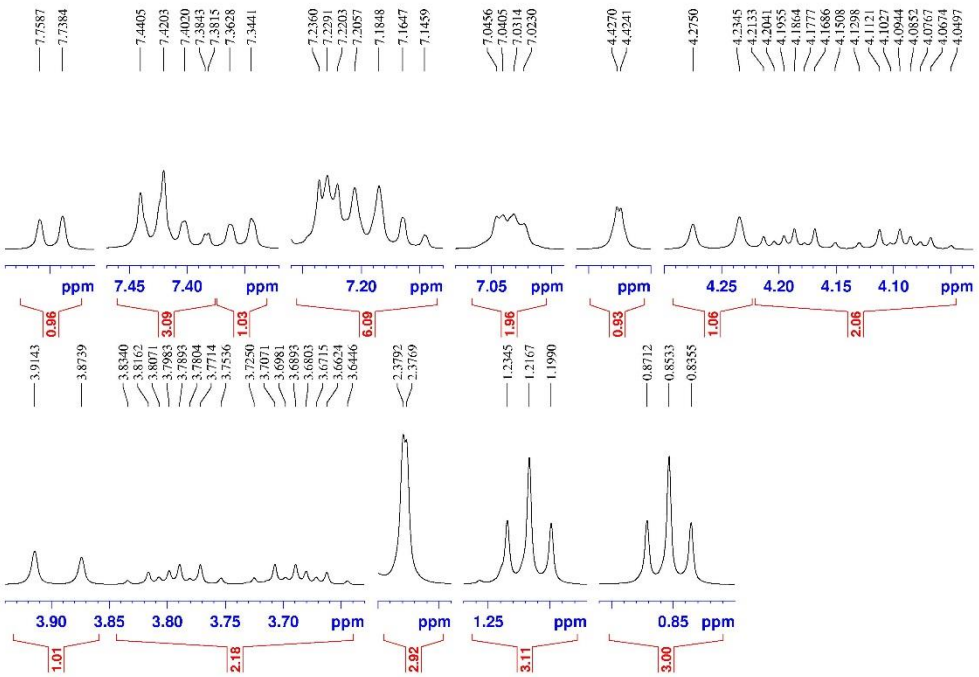
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ka



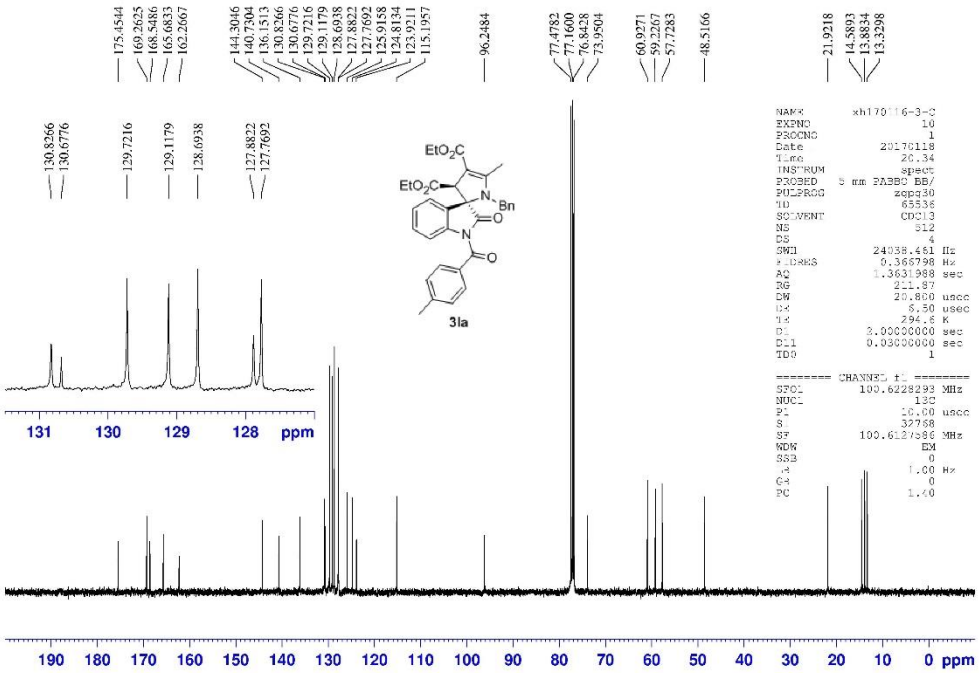
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3la



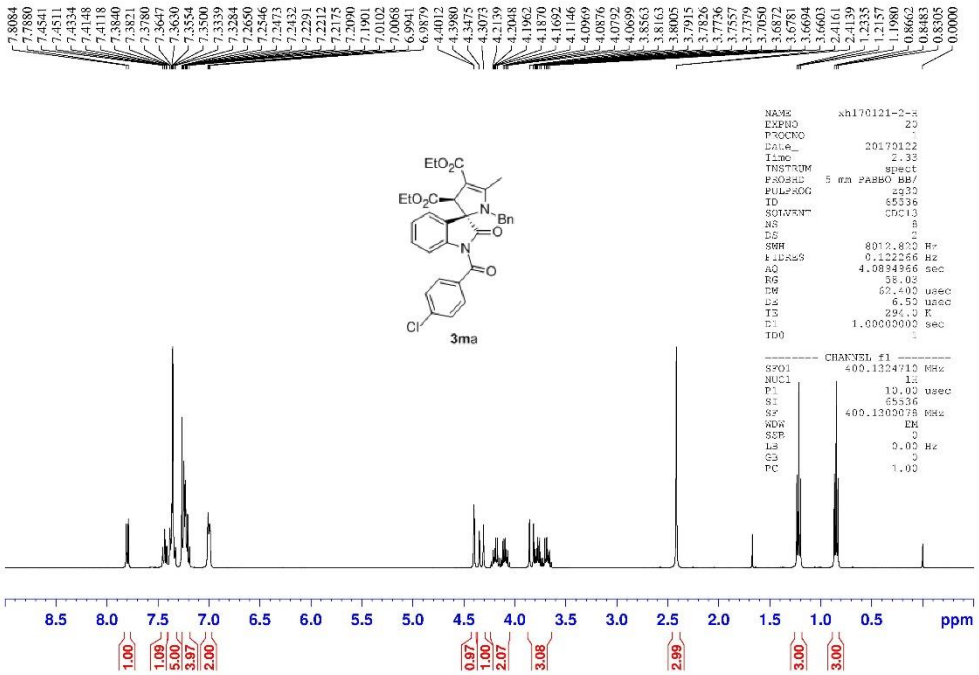
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3la



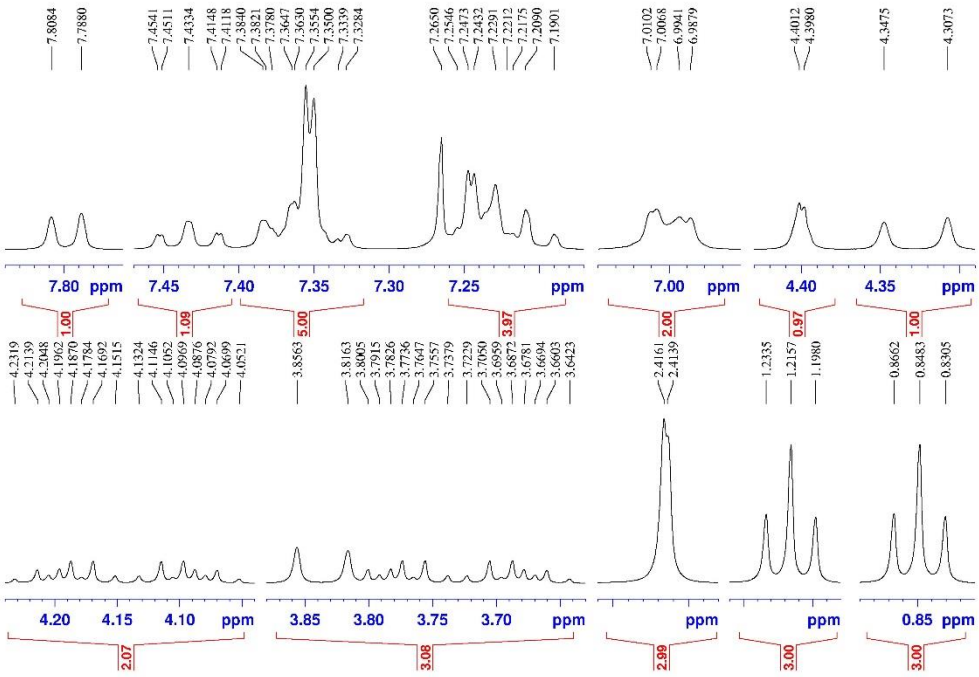
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3la



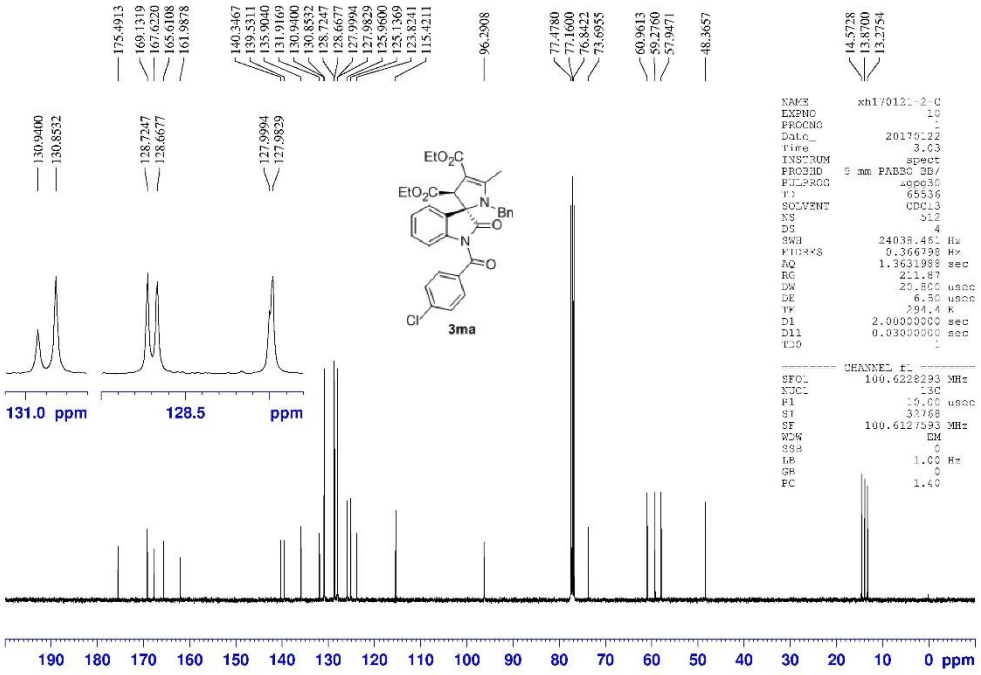
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ma



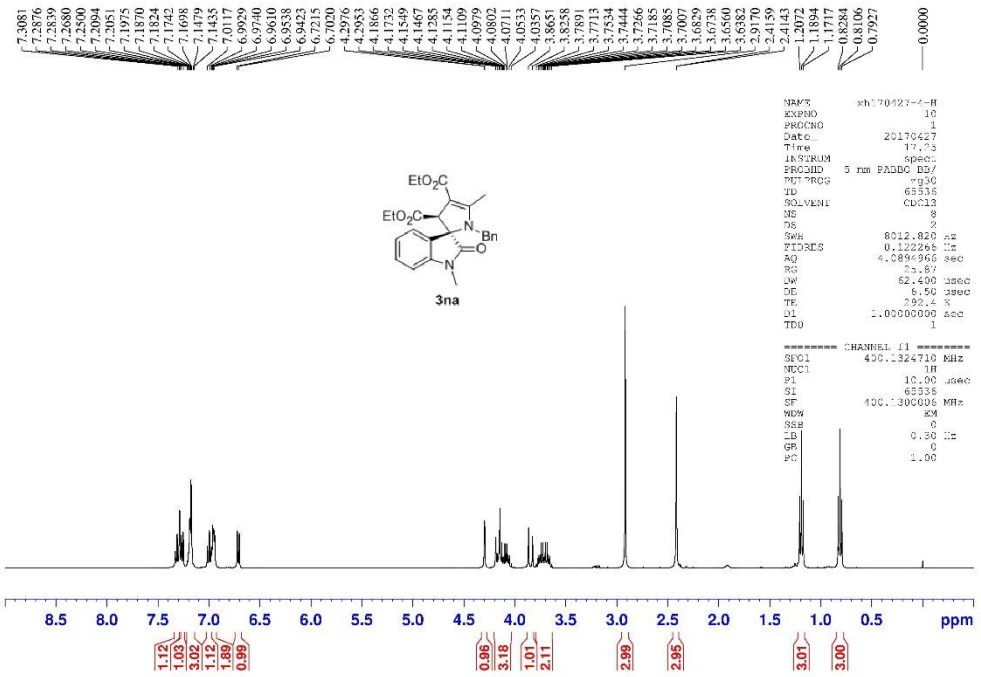
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3ma



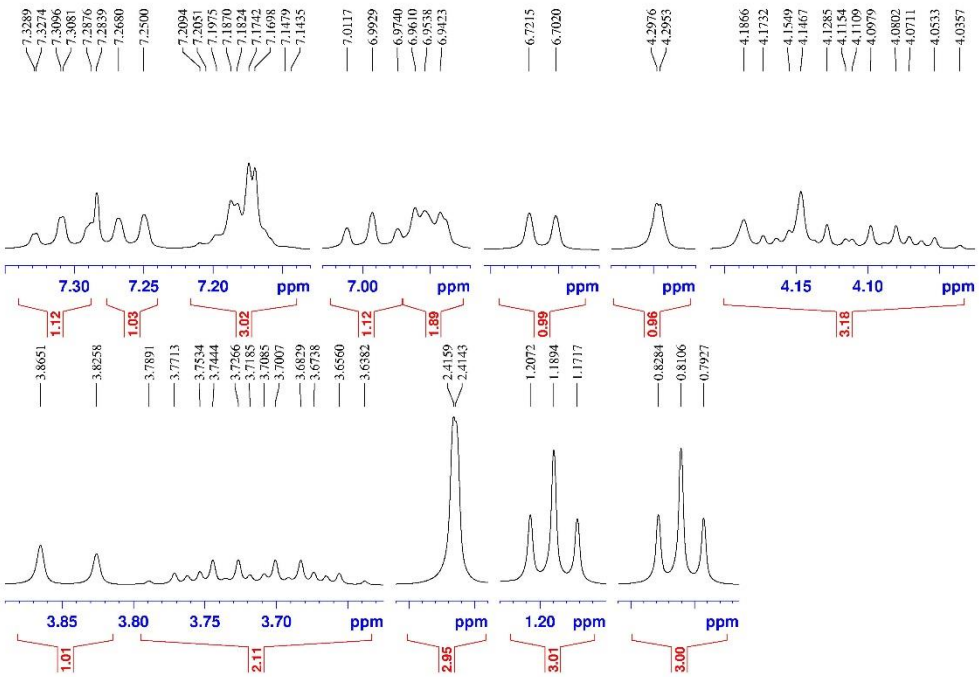
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3ma



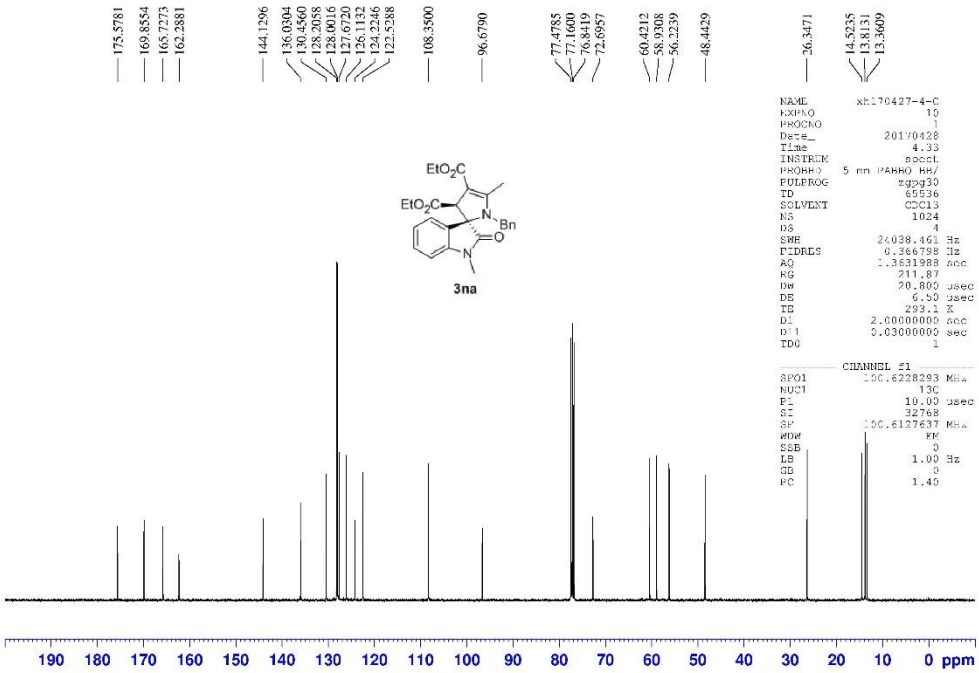
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3na



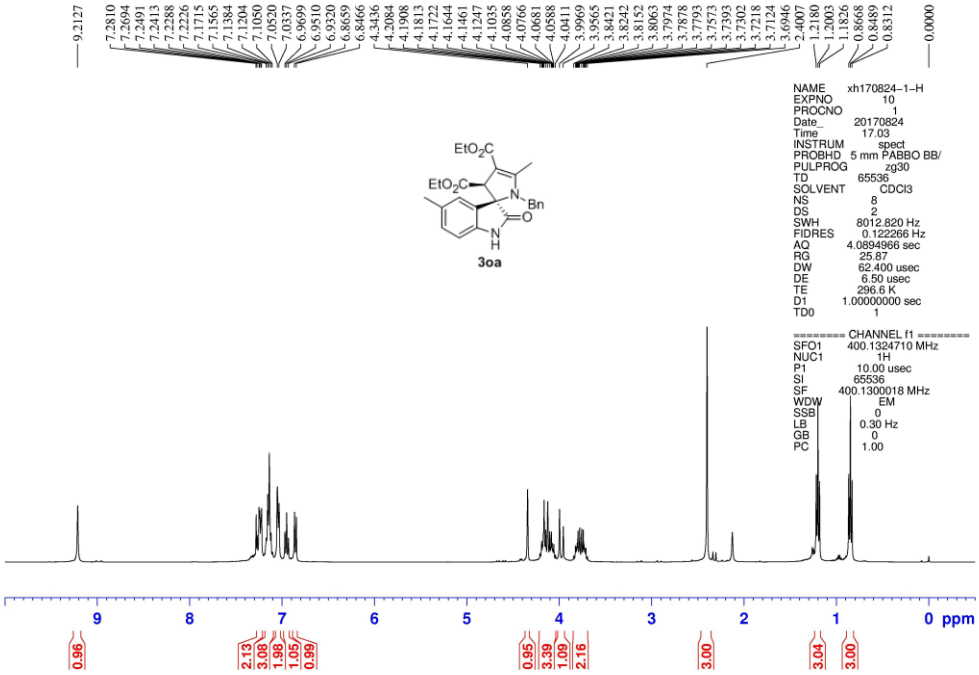
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3na



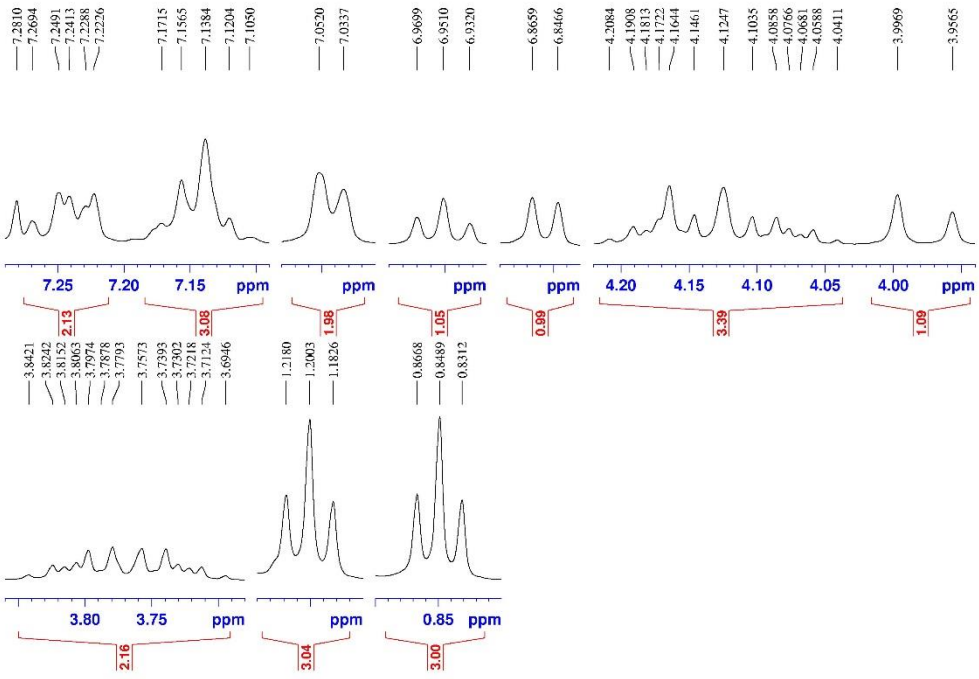
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3na



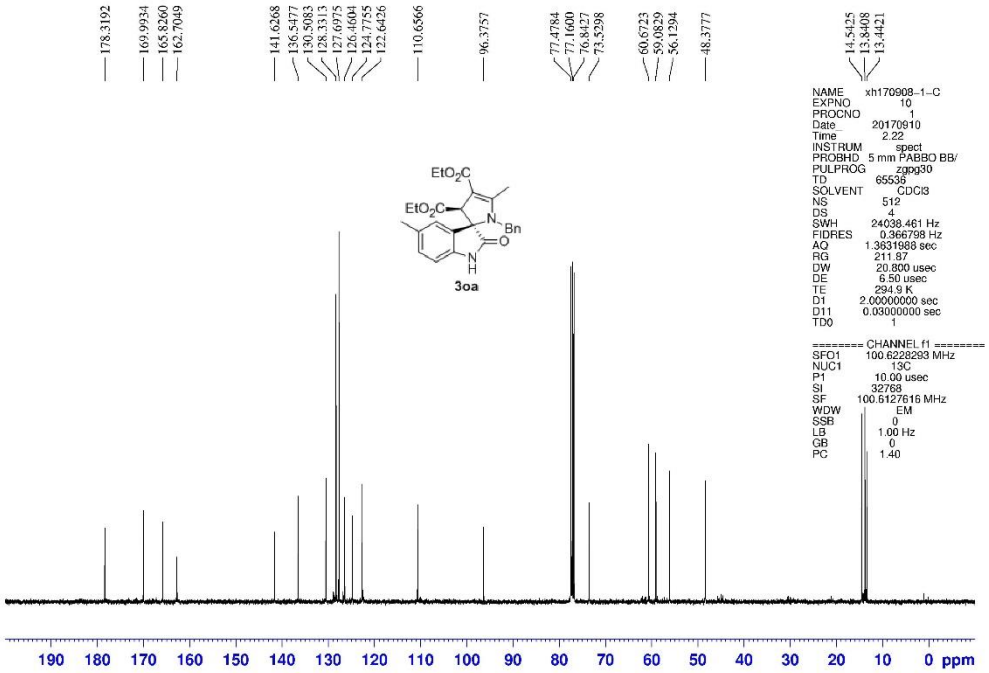
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3oa



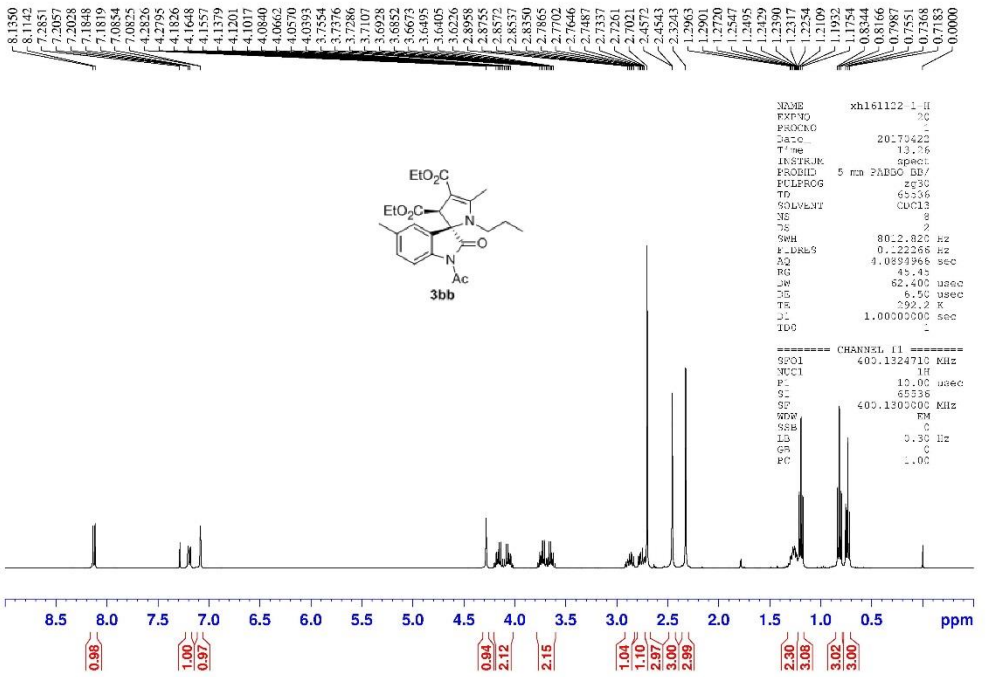
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3oa



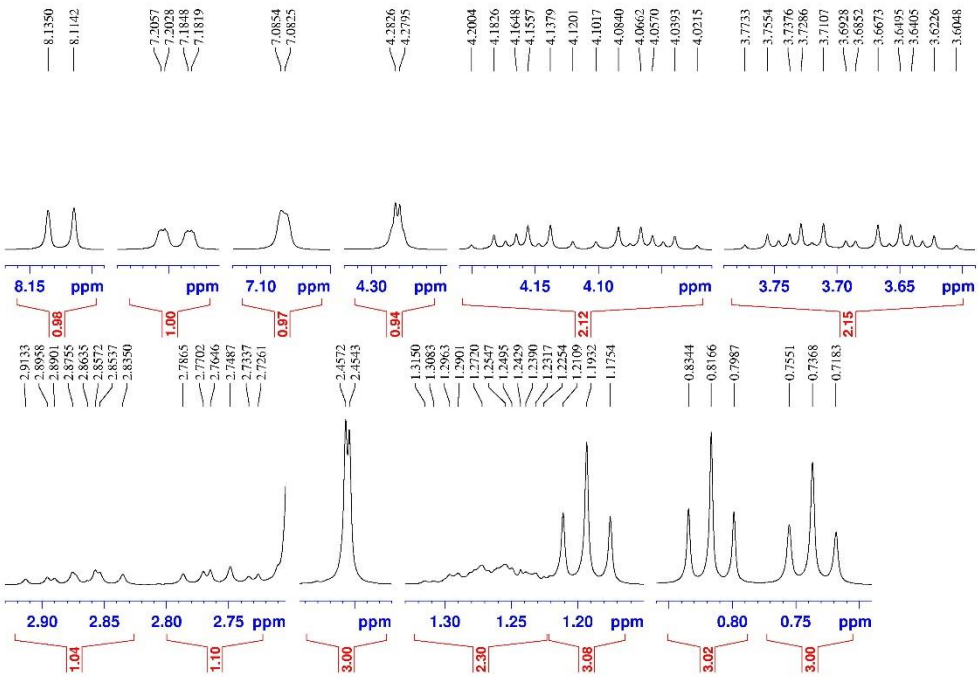
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3oa



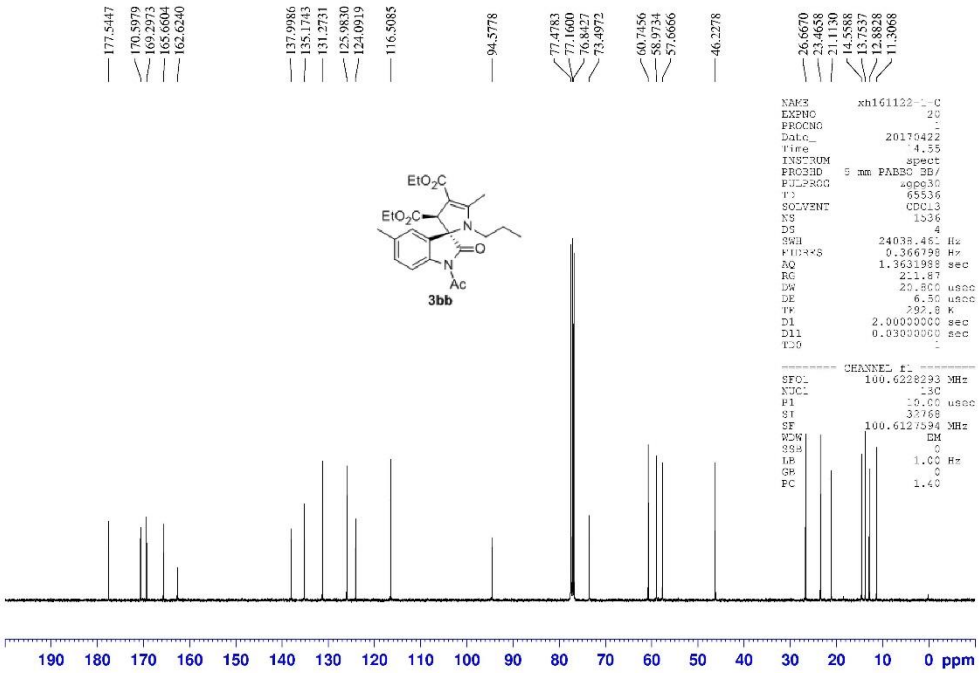
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bb



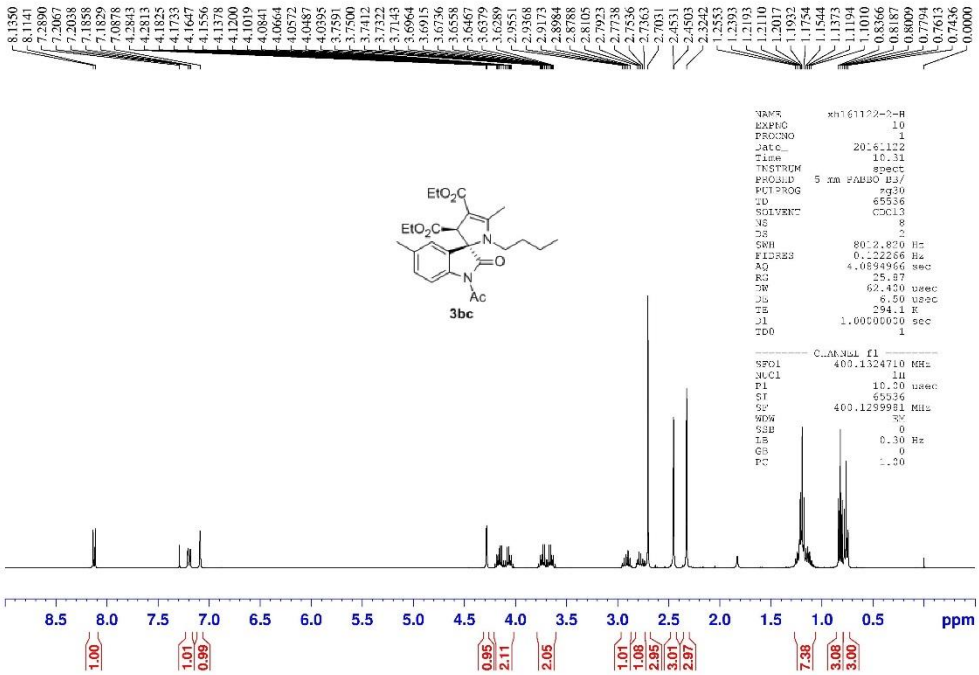
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bb



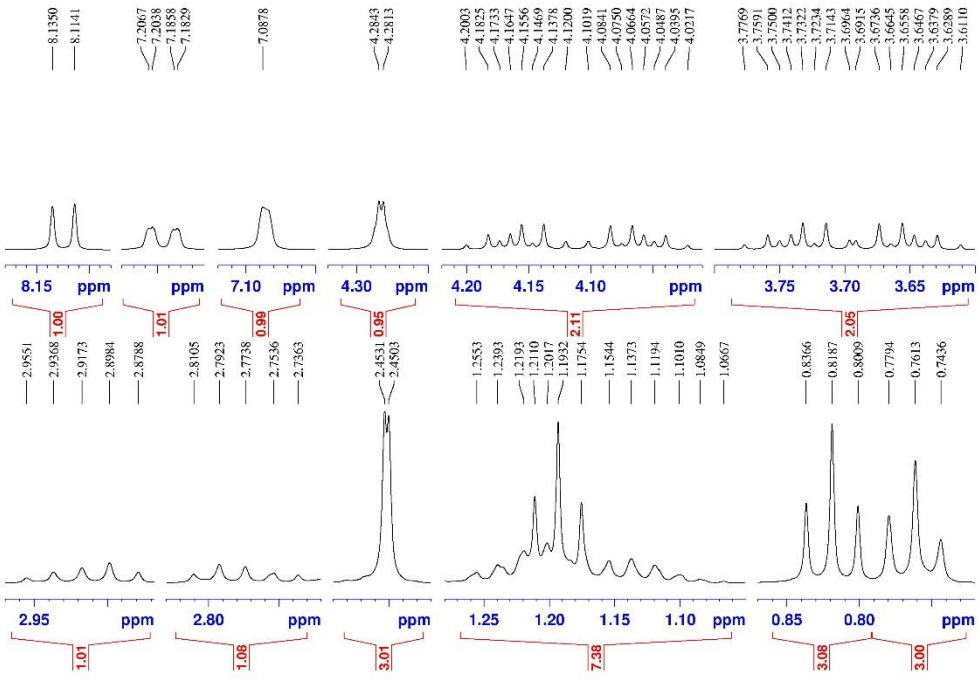
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bb



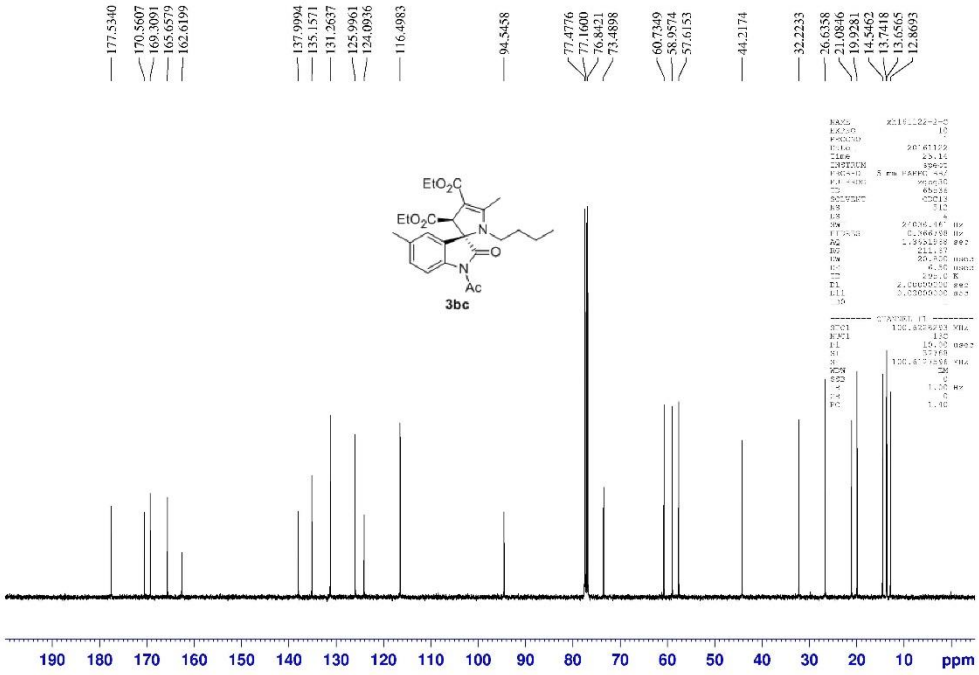
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bc



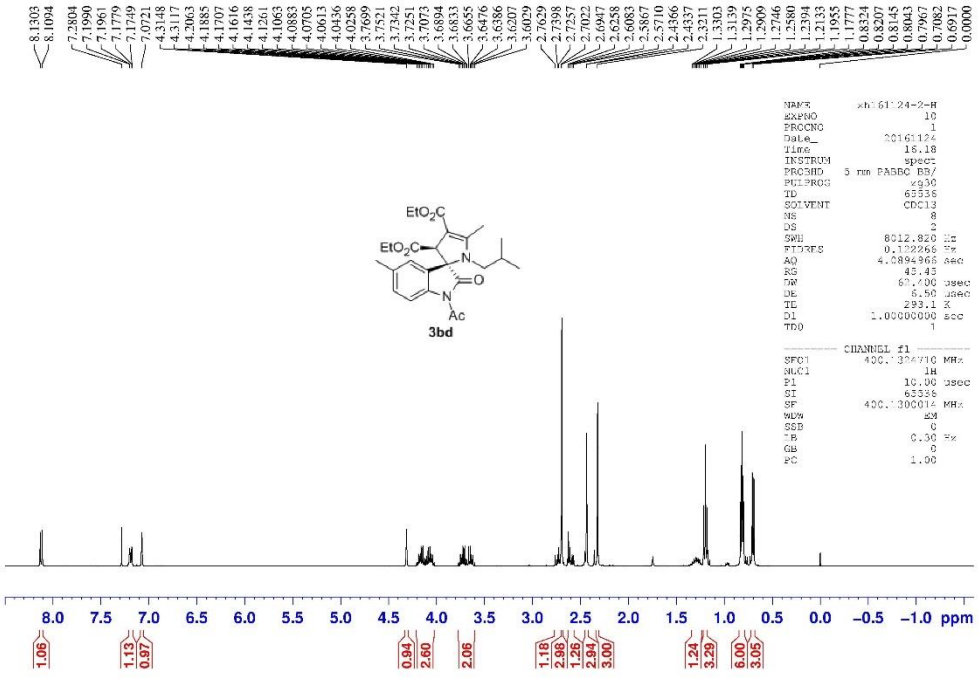
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bc



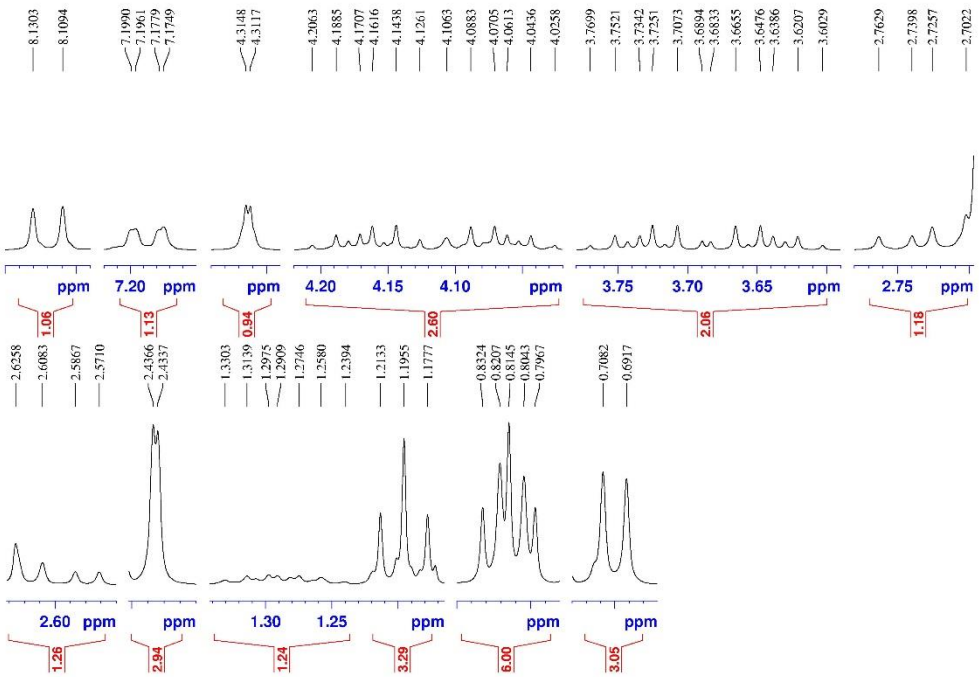
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bc



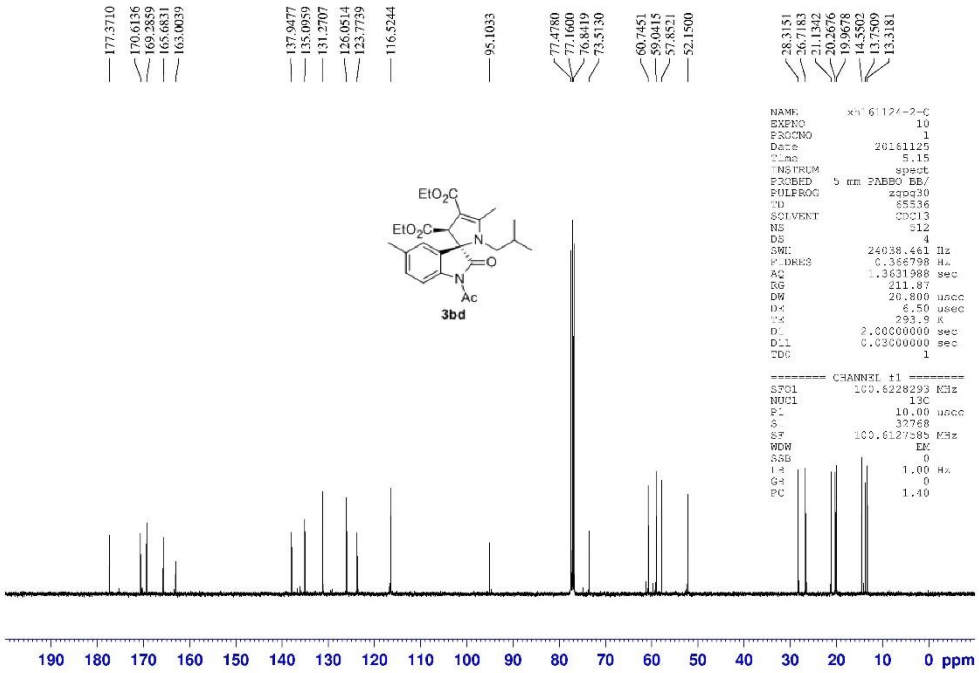
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bd



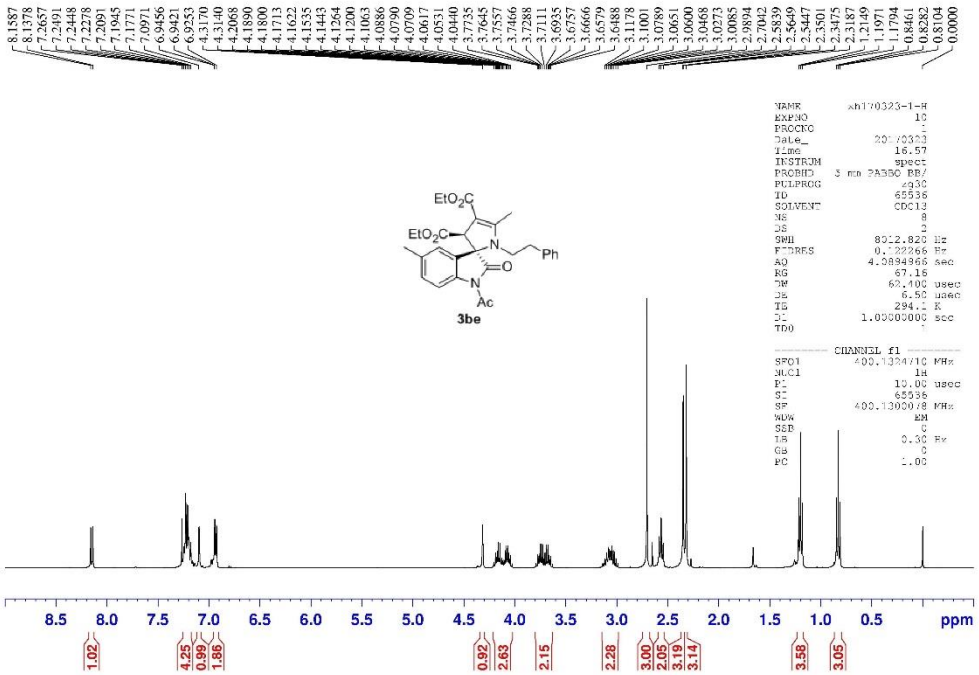
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bd



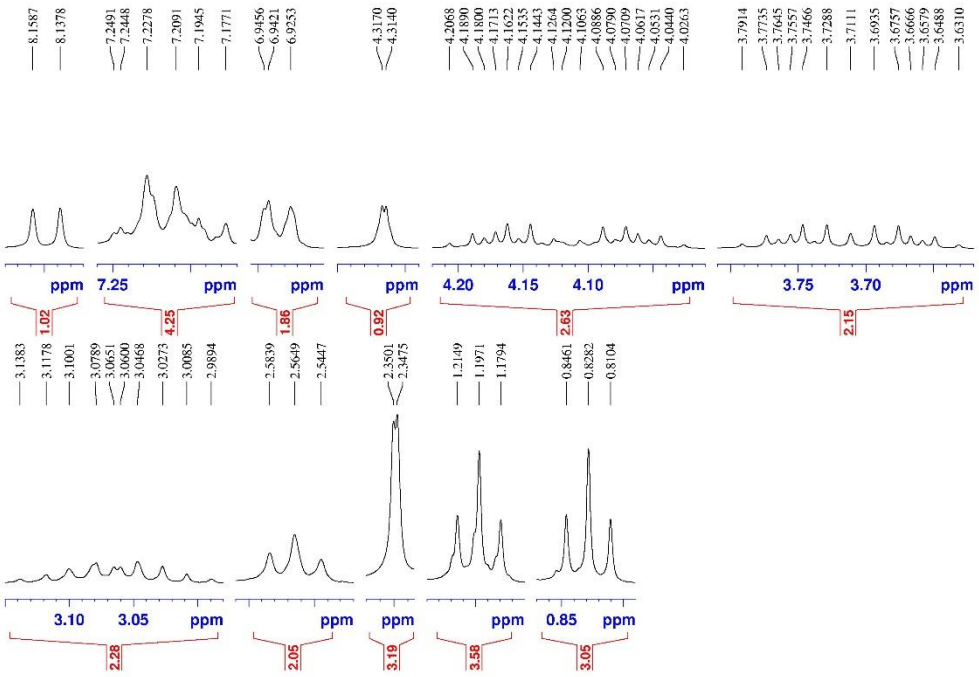
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bd



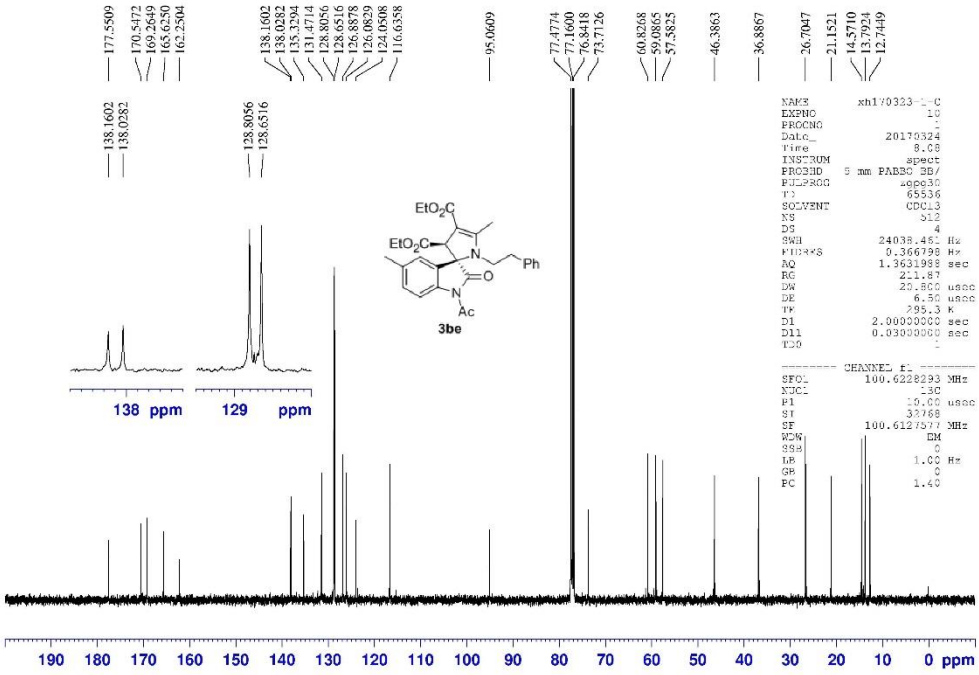
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3be



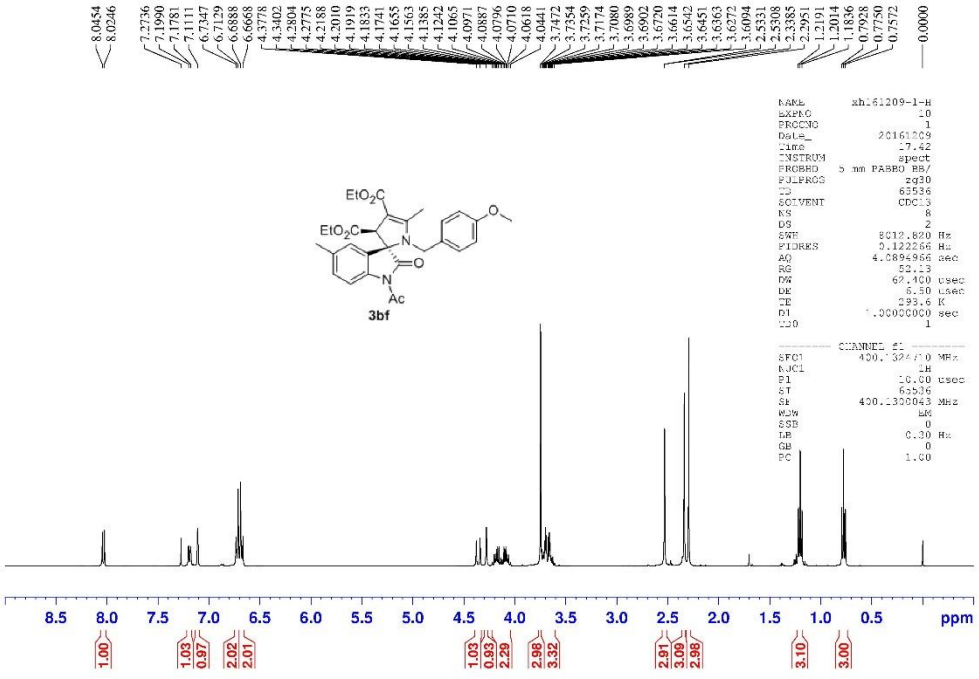
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3be



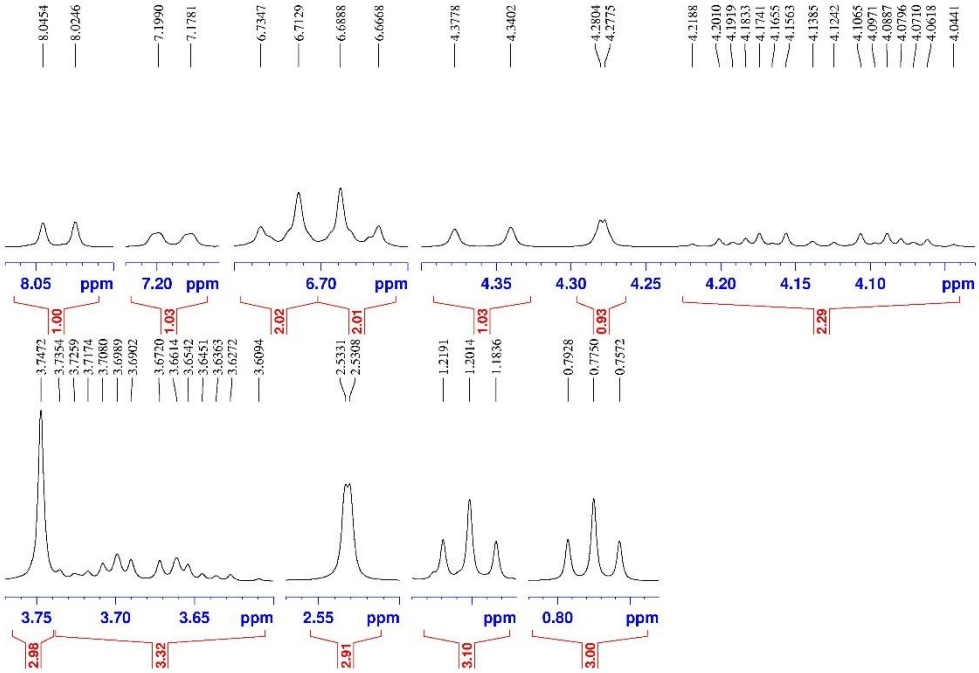
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3be



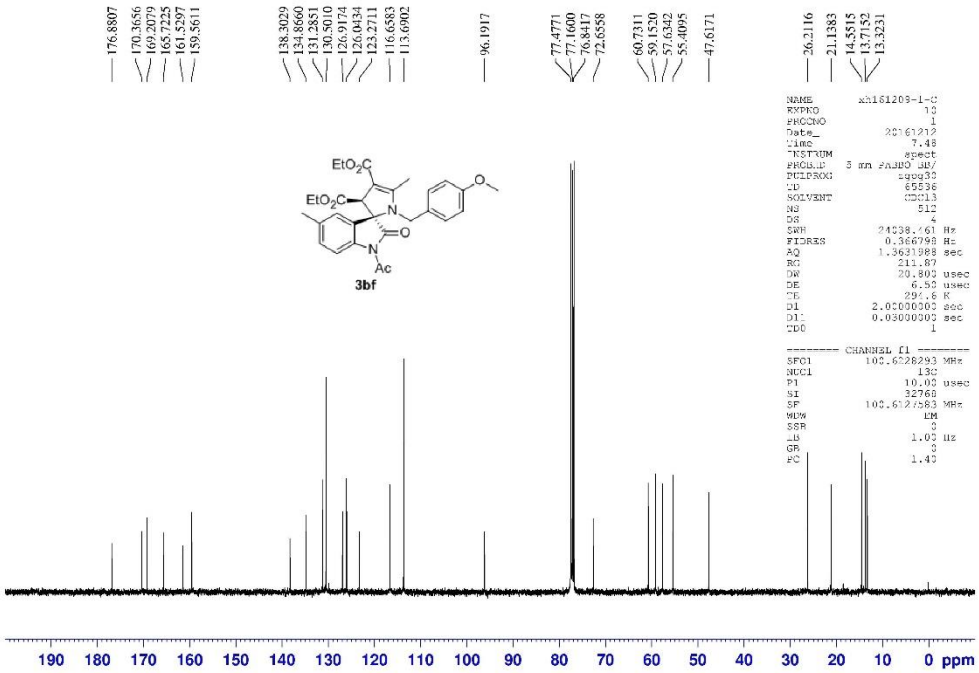
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bf



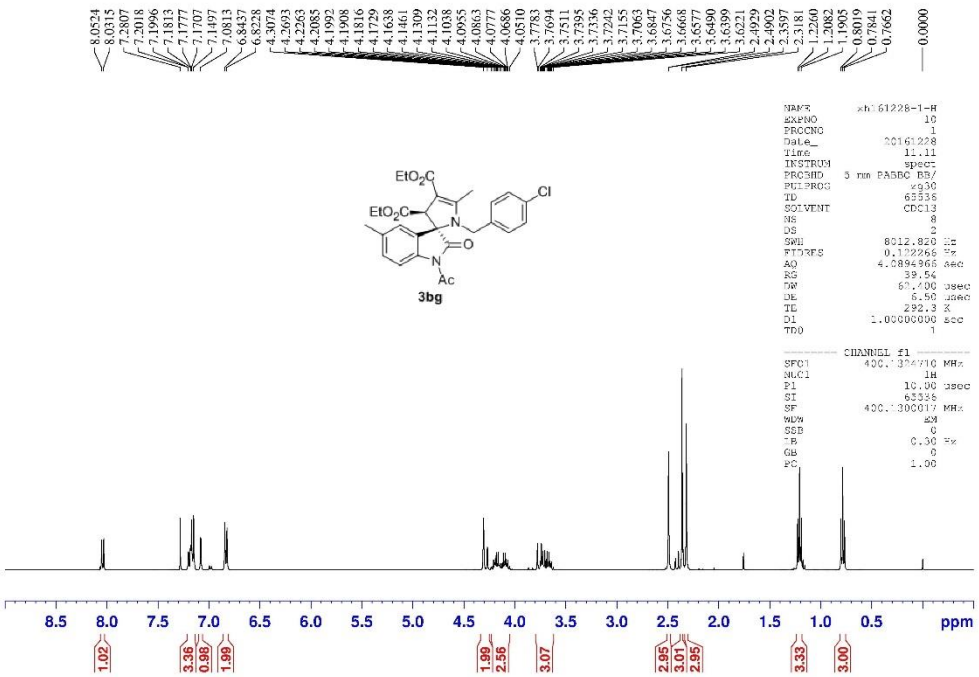
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bf



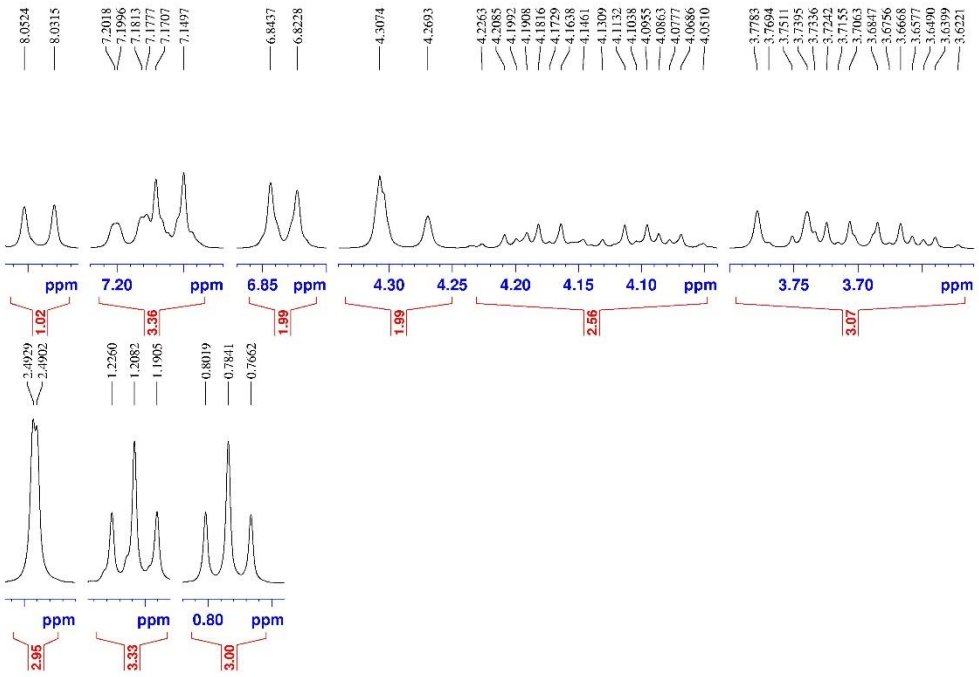
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bf



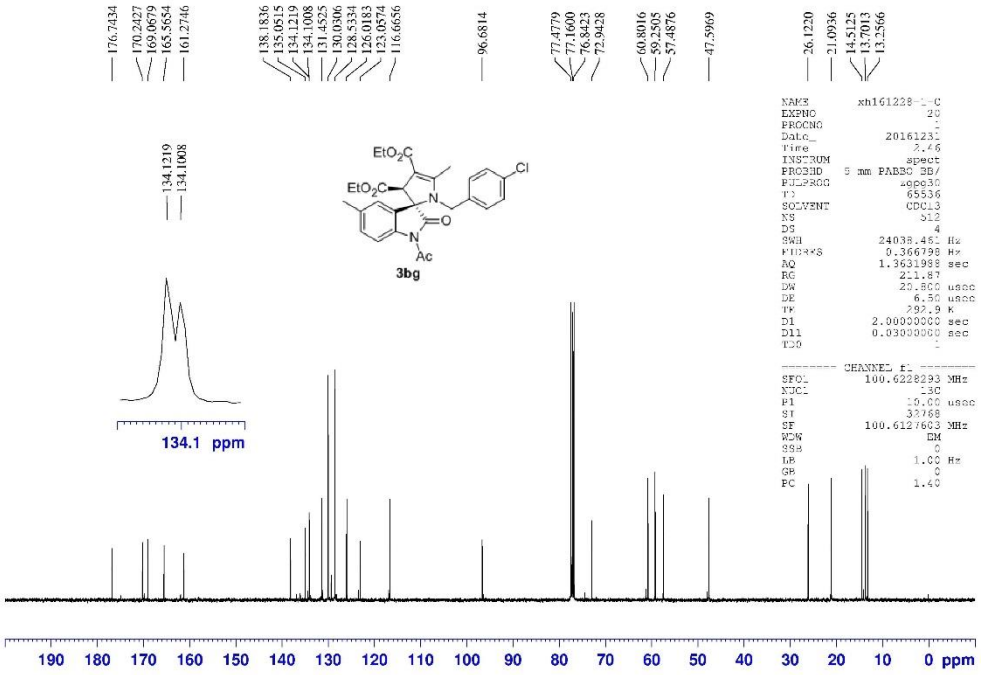
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bg



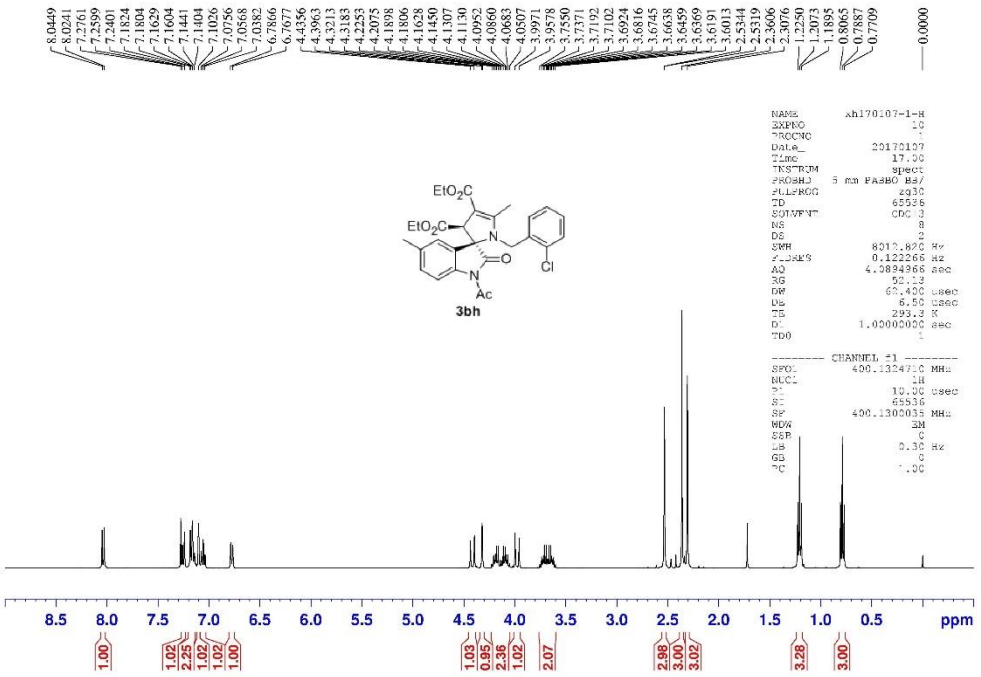
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bg



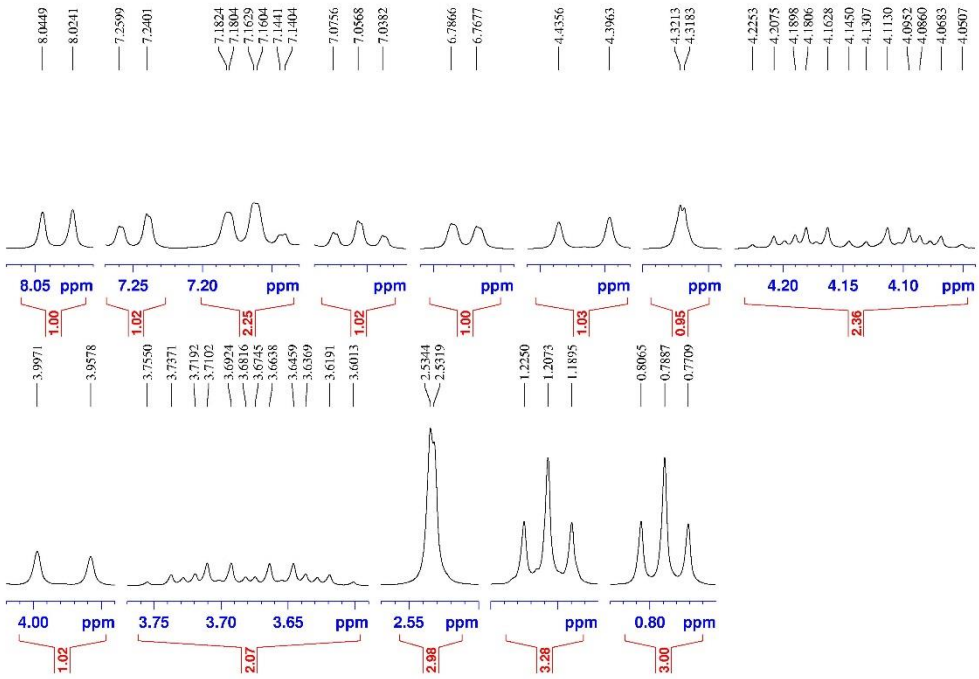
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bg



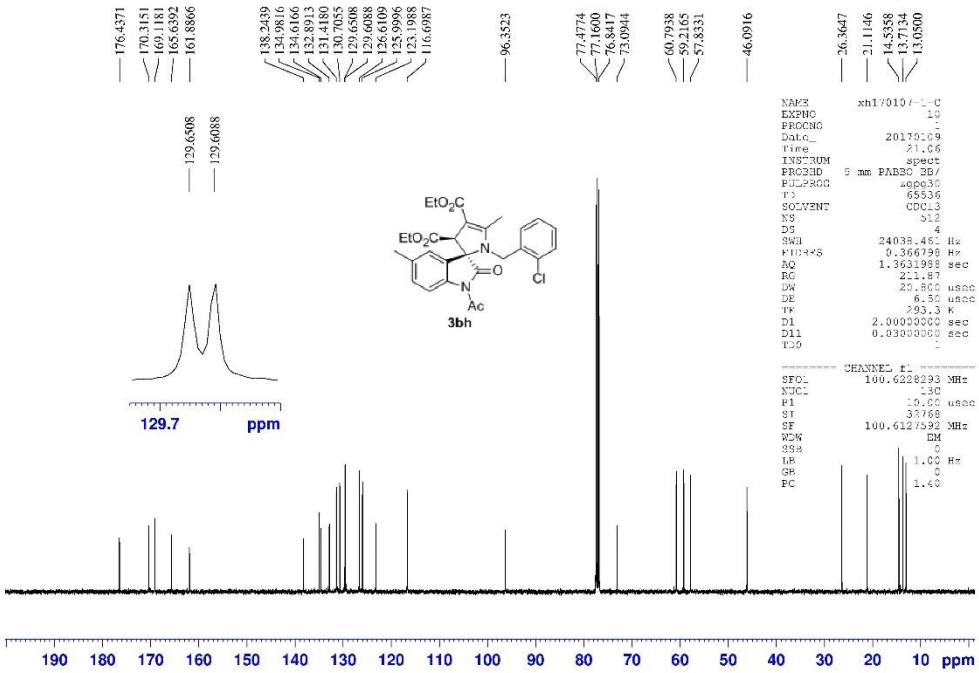
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bh



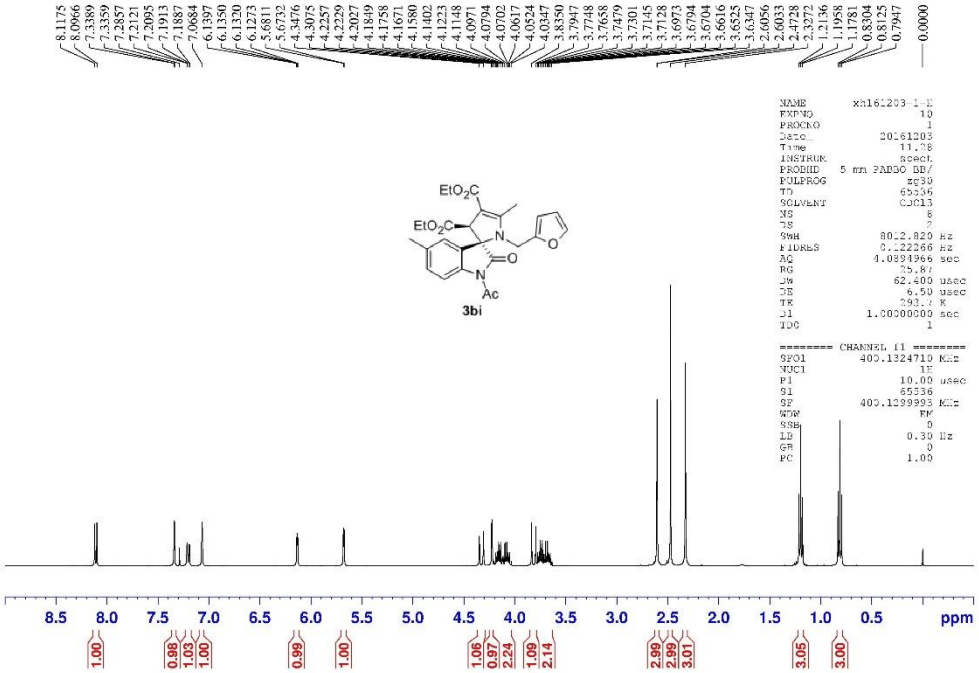
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bh



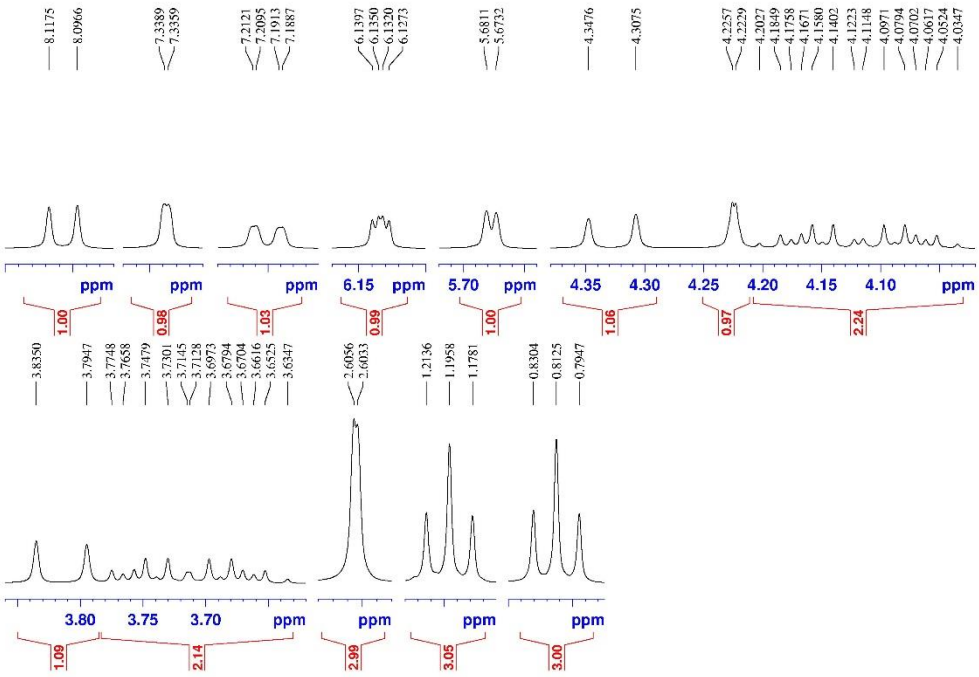
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bh



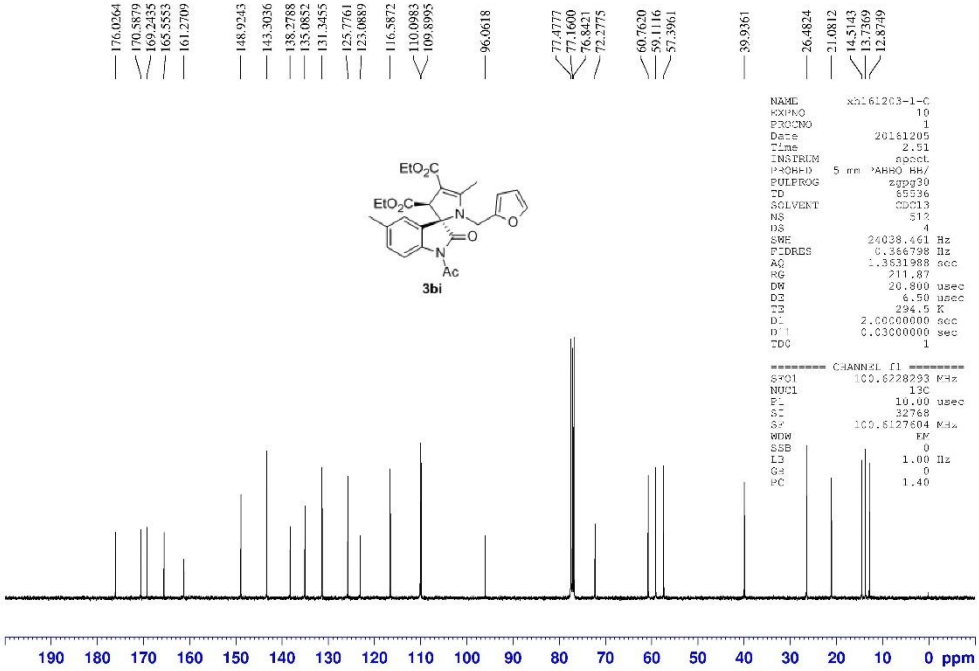
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bi



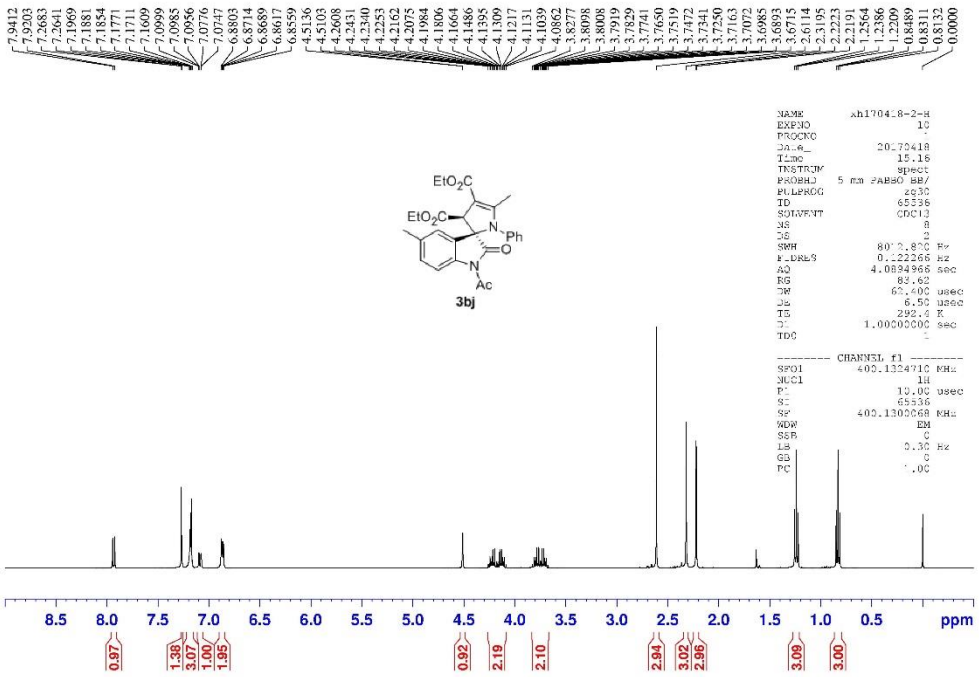
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bi



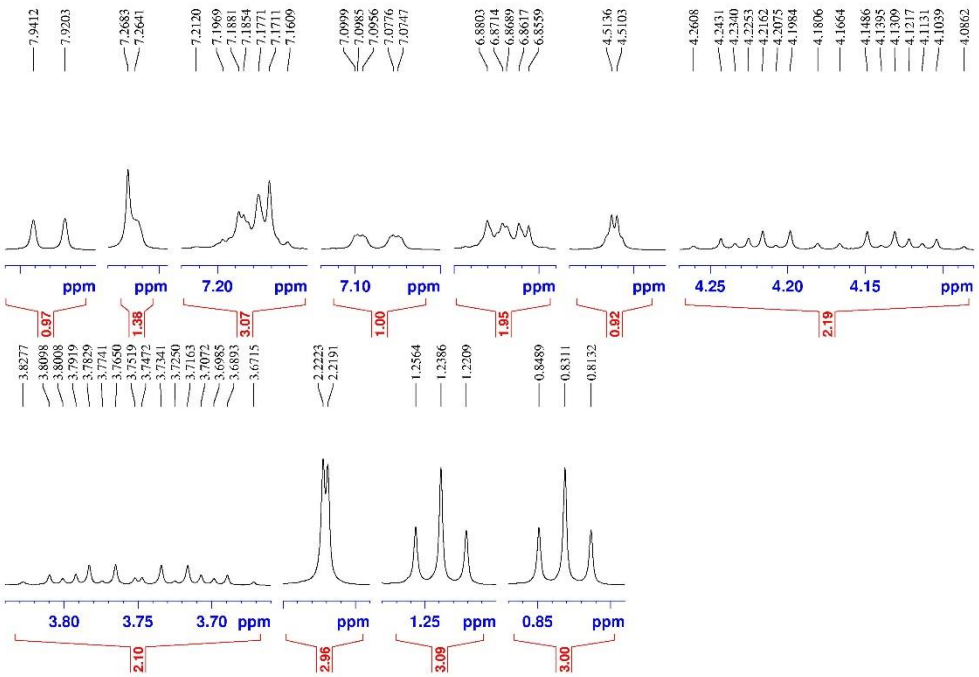
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bi



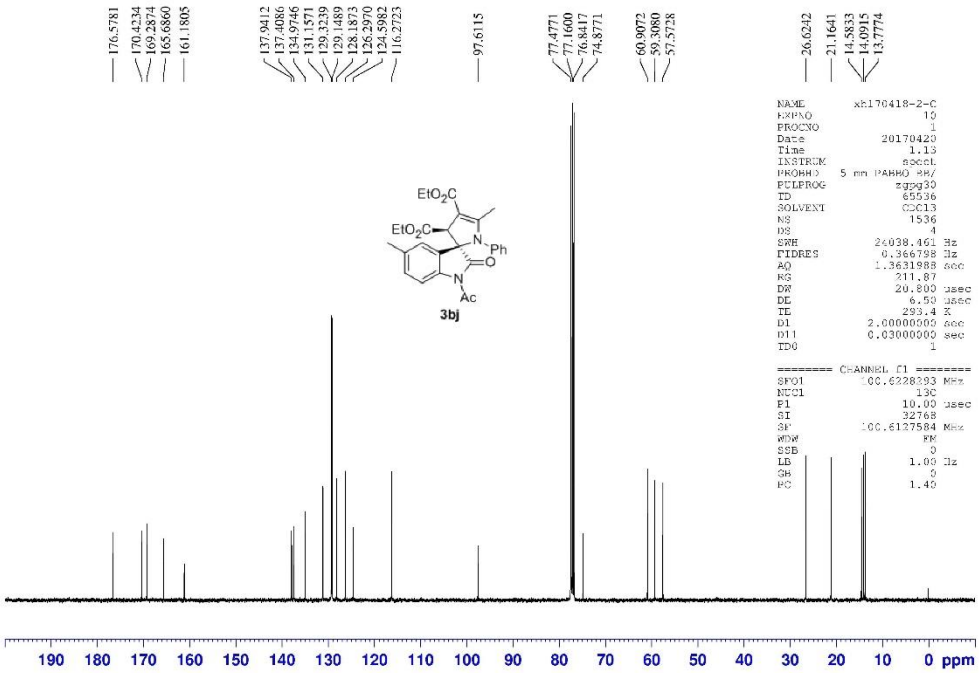
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bj



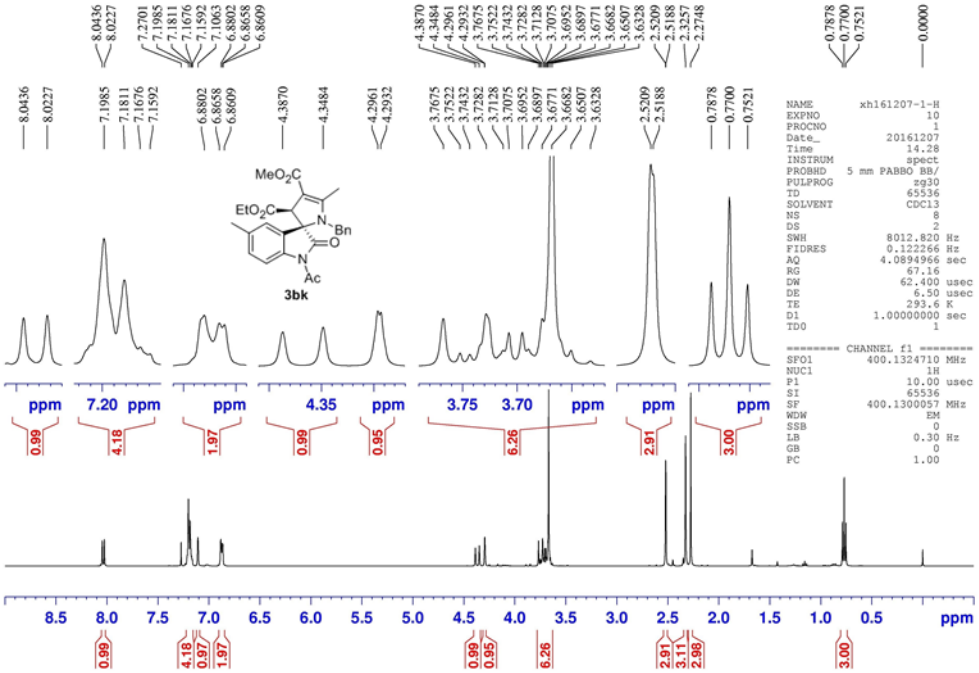
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bj



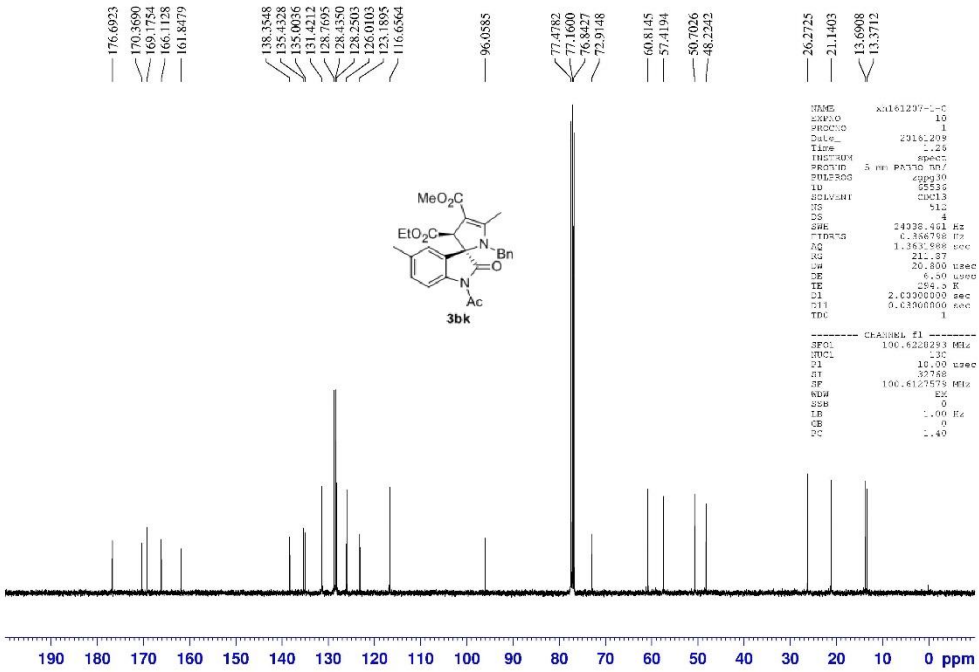
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bj



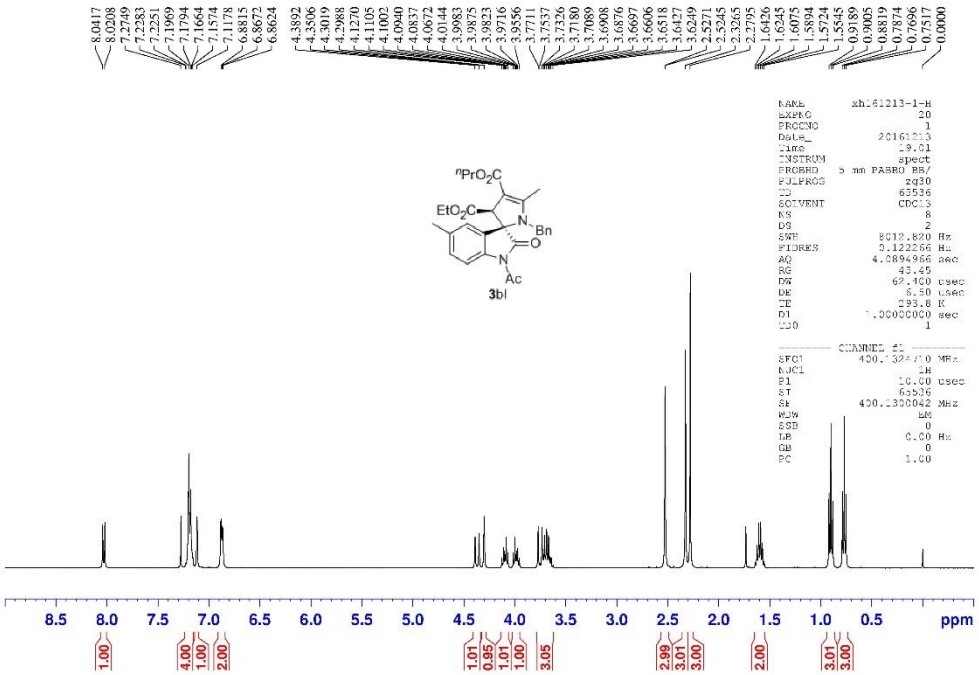
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bk



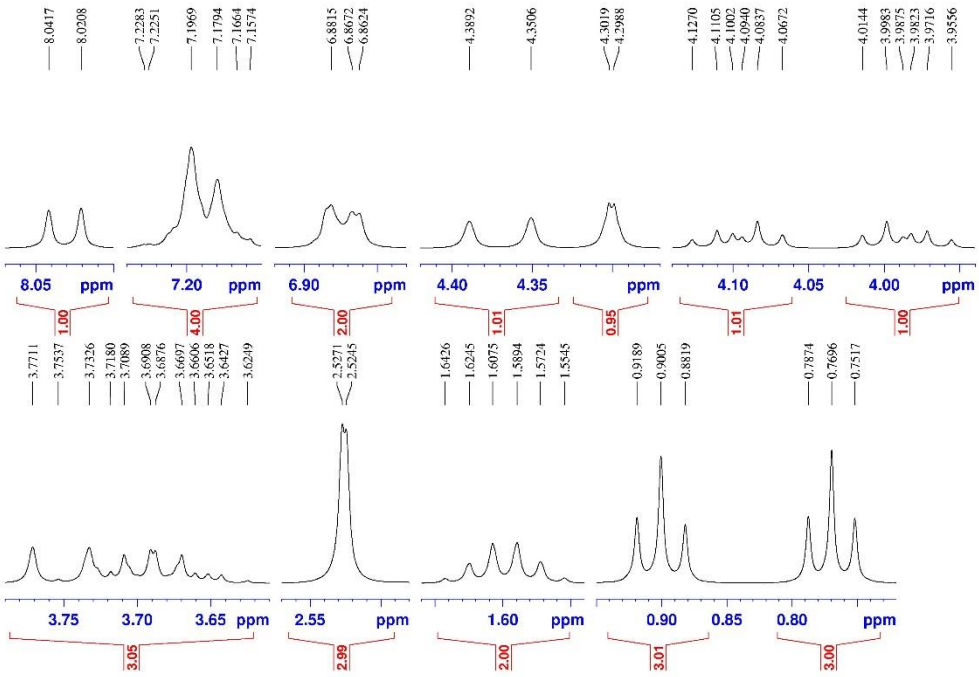
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bk



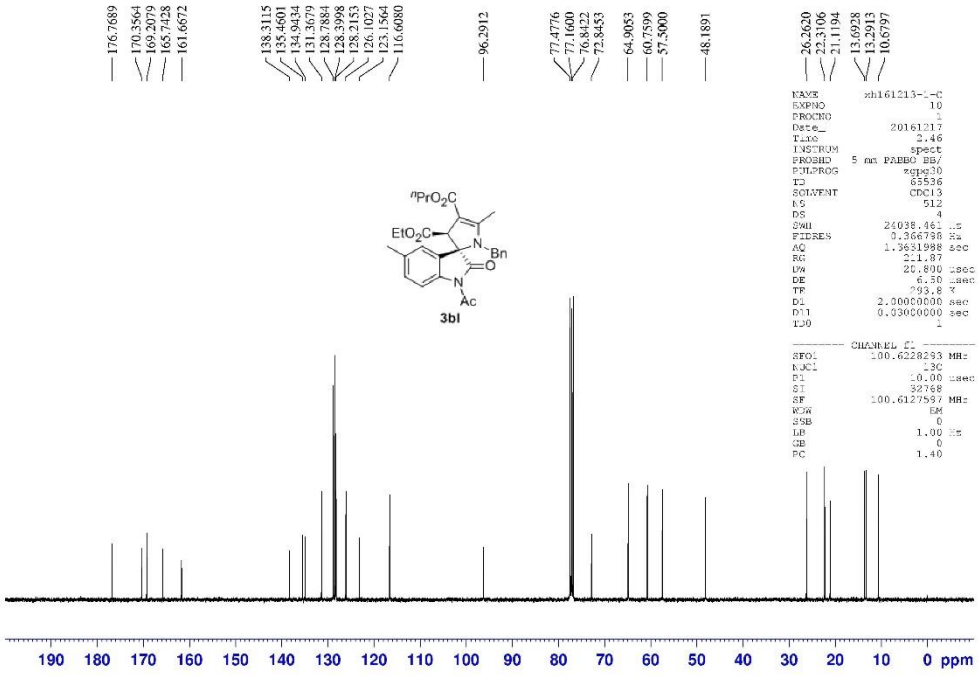
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bl



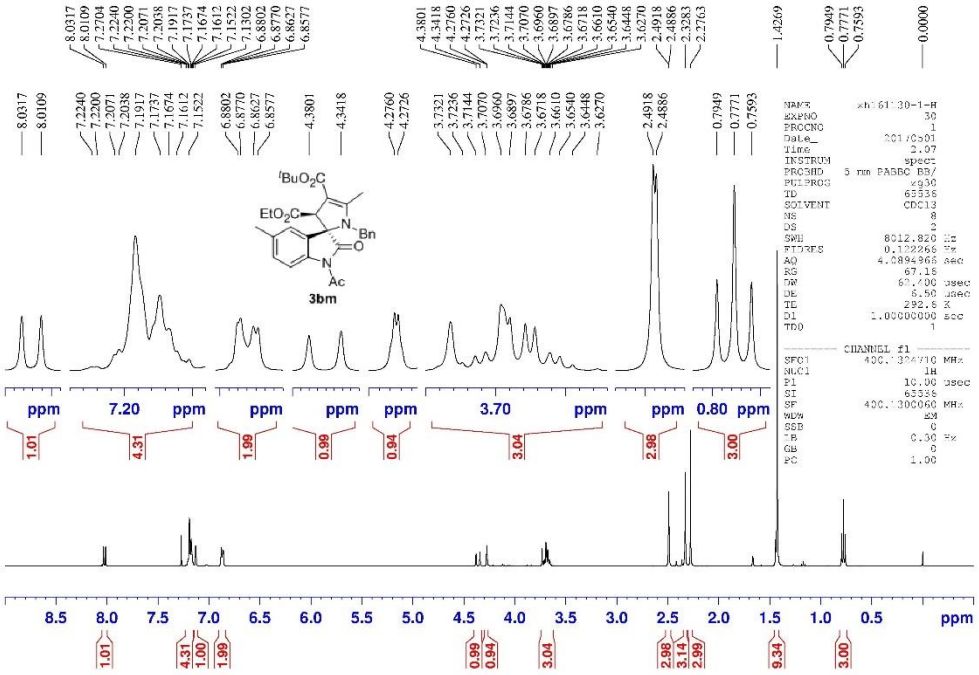
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bl



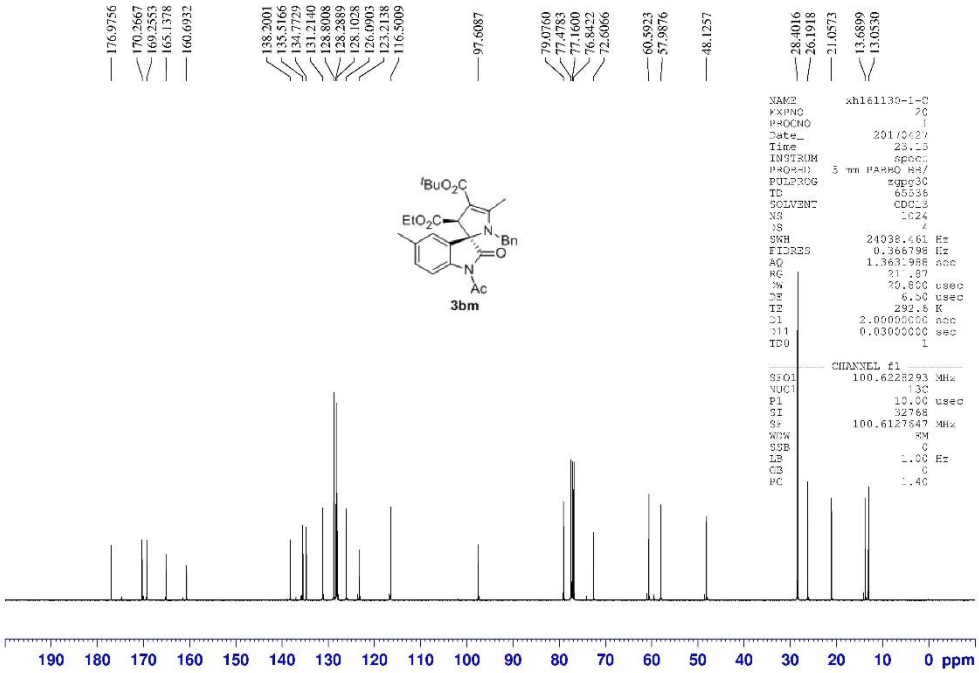
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bl



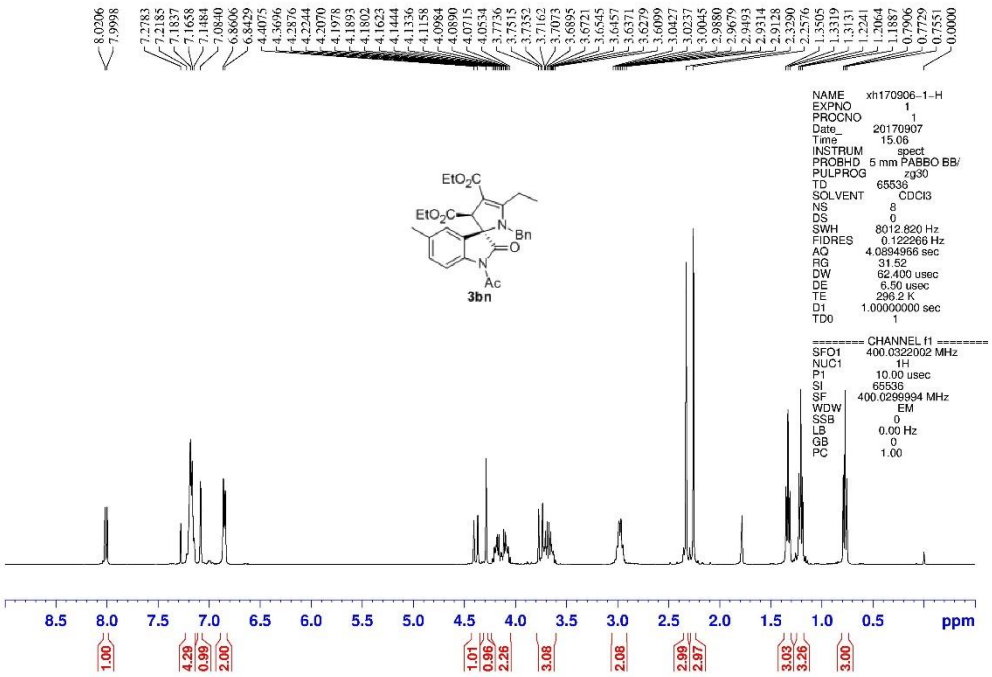
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bm



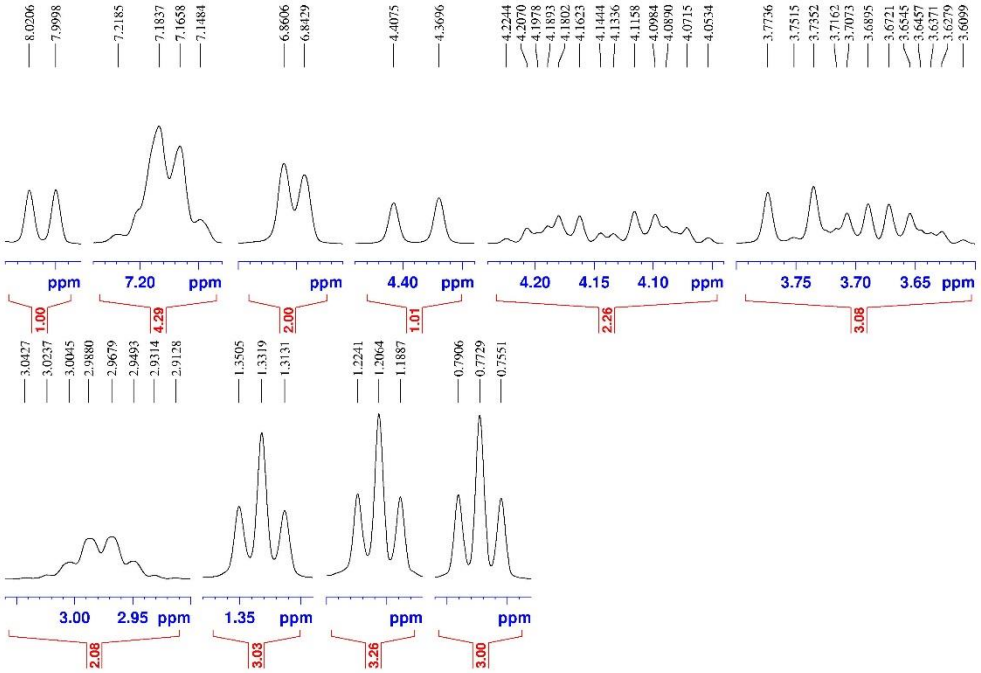
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bm



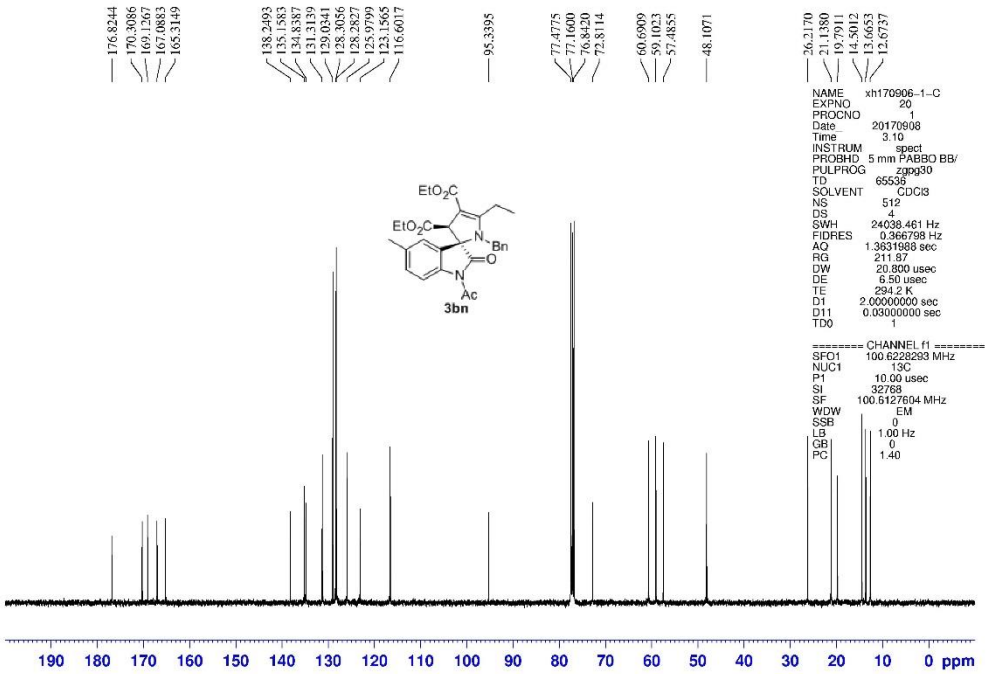
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bn



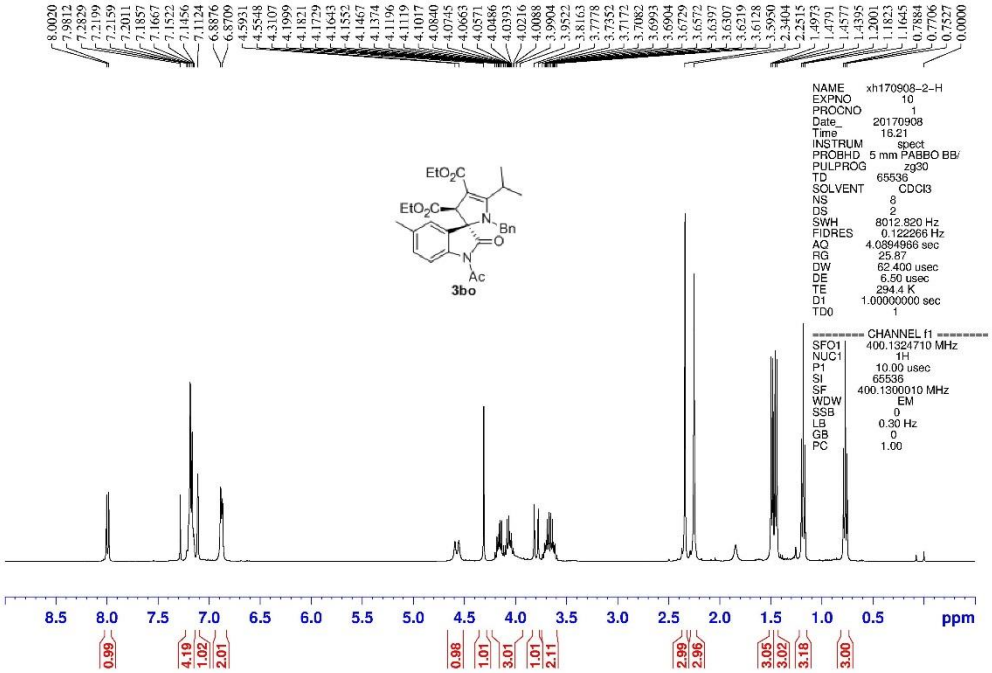
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bn



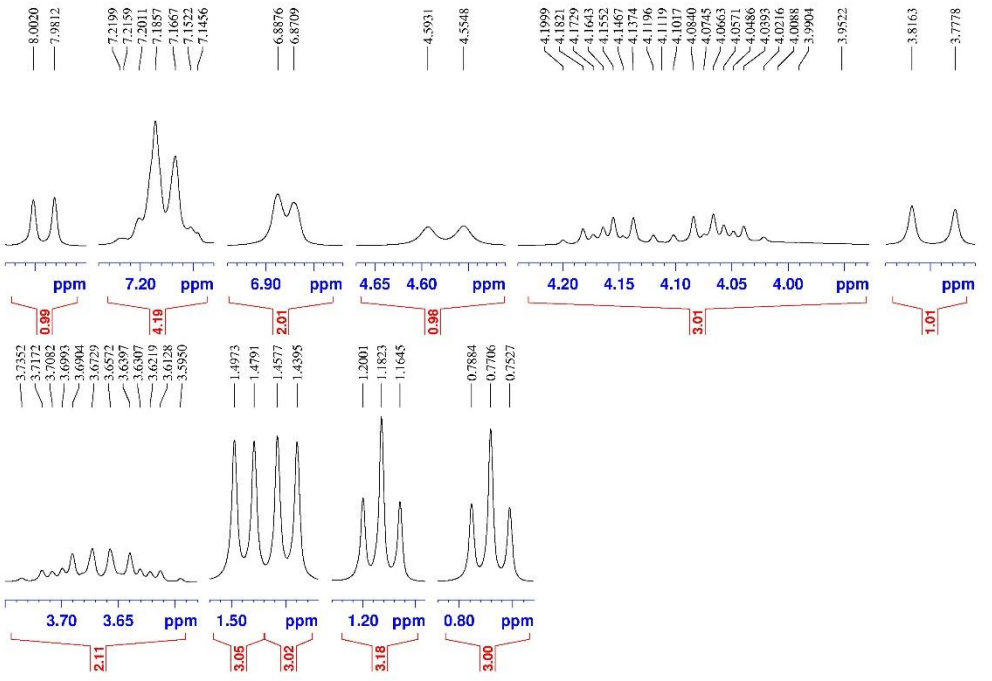
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bn



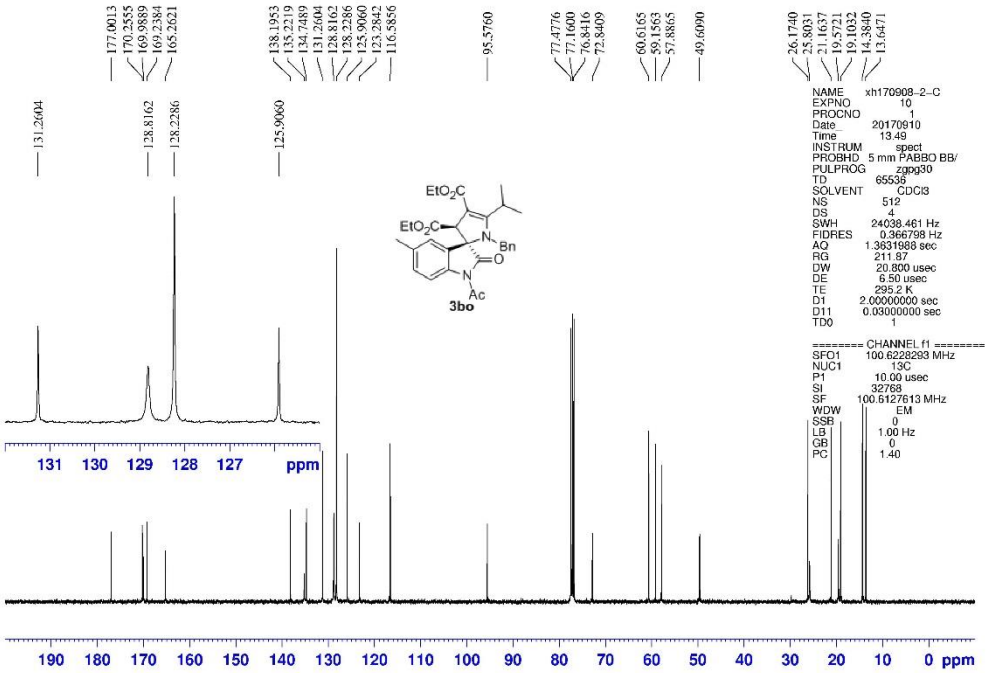
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bo



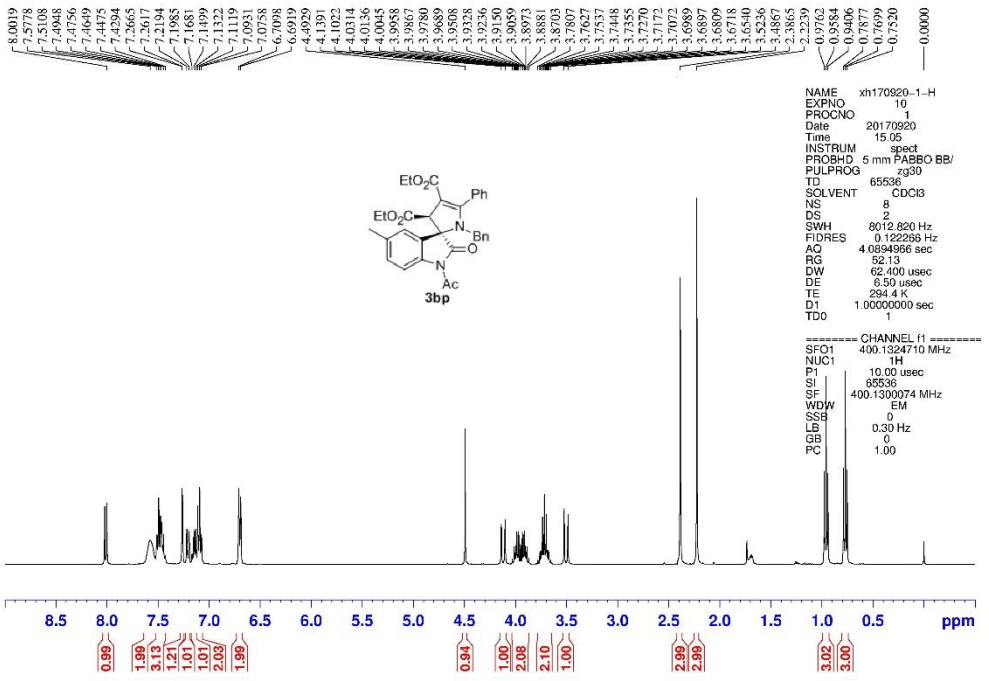
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bo



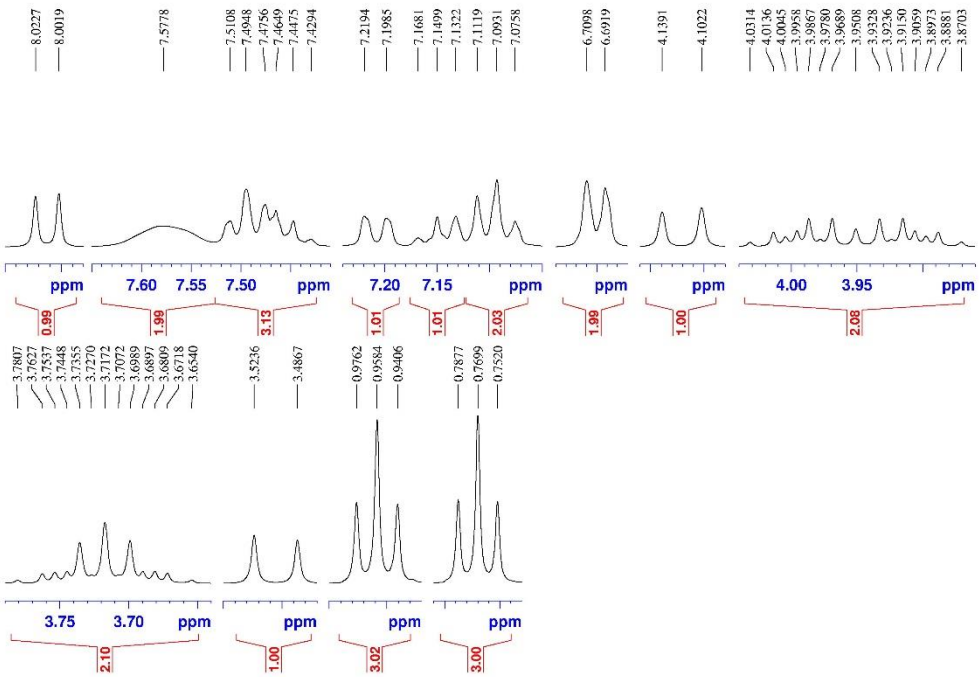
^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bo



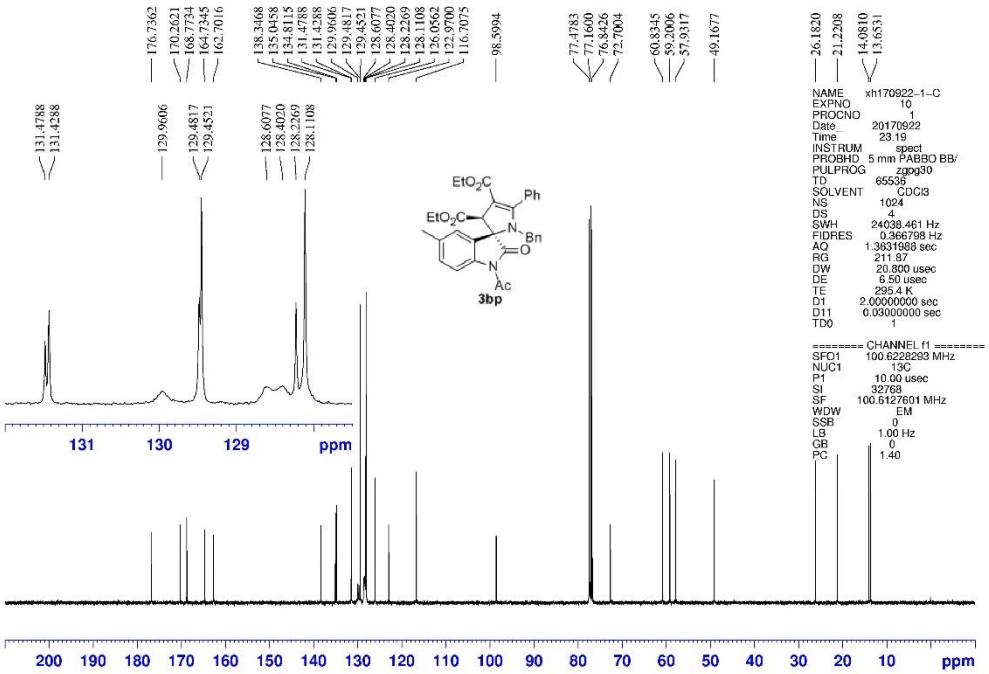
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bp



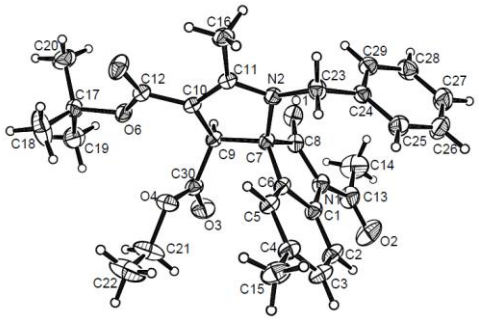
Expanded ^{1}H NMR (400 MHz, $CDCl_3$) spectrum of compound 3bp



^{13}C NMR (101 MHz, $CDCl_3$) spectrum of compound 3bp



7. X-ray single-crystal structure of 3bm



(CCDC 1557956)

Table S2 Crystal data and structure refinement for 3bm.

Identification code	1557956
Empirical formula	$C_{30}H_{34}N_2O_6$
Formula weight	518.59
Temperature/K	296(2)
Crystal system	monoclinic
Space group	$P2_1/n$
a/Å	11.13730(10)
b/Å	24.0612(2)
c/Å	11.22560(10)
α/°	90
β/°	112.9450(10)
γ/°	90
Volume/Å^3	2770.19(5)
Z	4
ρ_{calc}g/cm^3	1.243
μ/mm^{-1}	0.706
F(000)	1104.0
Crystal size/mm^3	0.240 × 0.210 × 0.170
Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	7.348 to 142.676
Index ranges	-13 ≤ h ≤ 13, -29 ≤ k ≤ 29, -11 ≤ l ≤ 13
Reflections collected	24796
Independent reflections	5269 [R_{int} = 0.0196, R_{sigma} = 0.0112]
Data/restraints/parameters	5269/0/354
Goodness-of-fit on F^2	1.045
Final R indexes [I>=2σ (I)]	R_1 = 0.0460, wR_2 = 0.1244
Final R indexes [all data]	R_1 = 0.0486, wR_2 = 0.1273

Largest diff. peak/hole / e Å^{-3} 0.29/-0.26

Table S3 Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for 3bm. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
O6	1493.1(10)	5062.0(4)	7337.1(10)	48.7(3)
O4	2297.4(12)	3925.4(5)	8439.4(12)	61.2(3)
O1	3544.2(12)	4010.5(5)	4535.2(10)	61.7(3)
N2	5227.1(11)	4455.1(5)	7214.9(11)	42.6(3)
O5	3114.5(12)	5589.3(5)	8718.4(13)	69.1(4)
N1	4155.1(12)	3171.6(5)	5660.6(12)	50.8(3)
O3	1482.9(14)	3559.4(6)	6459.6(14)	79.0(4)
C10	3571.0(13)	4795.2(5)	7697.1(12)	38.9(3)
C9	3022.1(12)	4289.6(5)	6874.5(12)	38.7(3)
C11	4816.6(13)	4869.6(5)	7829.4(13)	40.4(3)
C12	2753.5(14)	5192.5(5)	8004.1(13)	43.4(3)
C6	4726.6(13)	3493.4(5)	7744.6(13)	41.5(3)
C24	6905.0(13)	4000.9(6)	6599.8(15)	47.1(3)
C7	4278.6(13)	3994.8(5)	6885.0(12)	39.4(3)
C8	3959.3(13)	3749.6(6)	5527.8(14)	46.0(3)
C30	2170.5(14)	3889.7(6)	7222.7(15)	48.1(3)
C1	4618.2(14)	3021.0(6)	7001.4(15)	47.2(3)
O2	4156(2)	2307.0(6)	4886.0(16)	106.6(6)
C5	5213.8(14)	3460.9(6)	9076.0(14)	47.3(3)
C23	6616.3(14)	4323.1(7)	7607.3(16)	52.7(4)
C16	5700.0(16)	5345.3(6)	8442.4(17)	55.8(4)
C17	411.4(15)	5376.6(7)	7445.7(16)	52.9(4)
C4	5576.7(17)	2948.5(6)	9685.5(16)	55.9(4)
C29	6556.7(16)	4202.0(7)	5350.5(17)	57.4(4)
C2	4958.5(18)	2505.7(6)	7584.0(19)	63.8(5)
C25	7586.5(18)	3507.1(7)	6924.8(18)	62.3(4)
C28	6875.2(19)	3913.9(8)	4455.6(18)	67.4(5)
C3	5428.5(19)	2480.5(7)	8919.3(19)	65.6(5)
C13	3976(2)	2793.5(8)	4652.8(19)	71.7(5)
C27	7562(2)	3427.3(9)	4794(2)	76.9(6)
C15	6128(2)	2908.4(8)	11143.3(19)	79.8(6)
C26	7917(2)	3226.3(9)	6020(2)	80.7(6)
C19	-759.9(18)	5044.2(9)	6578(2)	82.8(6)
C20	356(2)	5948.2(8)	6891(3)	89.6(7)

C18	519(3)	5371.4(16)	8815(2)	119.7(11)
C14	3562(4)	3019.3(11)	3317(2)	116.3(10)
C21	1524(3)	3532.3(12)	8827(3)	103.8(9)
C22	1880(6)	3522(2)	10126(4)	124.9(18)
C21'	1524(3)	3532.3(12)	8827(3)	103.8(9)
C22'	2179(10)	3118(4)	9537(8)	124.9(18)

Table S4 Anisotropic Displacement Parameters ($Å^2×10^3$) for 3bm. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
O6	43.4(5)	42.7(5)	58.9(6)	-3.2(4)	18.7(4)	4.9(4)
O4	67.7(7)	57.0(6)	63.8(7)	6.2(5)	30.9(6)	-12.6(5)
O1	66.2(7)	72.6(7)	41.1(6)	-0.9(5)	15.1(5)	8.9(6)
N2	38.0(6)	40.4(6)	47.4(6)	-3.3(5)	14.5(5)	-2.1(4)
O5	60.7(7)	58.6(7)	80.9(8)	-32.0(6)	20.0(6)	-0.3(5)
N1	52.4(7)	48.4(7)	49.7(7)	-15.8(5)	17.8(5)	-2.8(5)
O3	71.7(8)	67.7(8)	90(1)	-22.2(7)	23.4(7)	-32.3(7)
C10	42.9(7)	31.9(6)	39.1(7)	-0.4(5)	12.8(5)	-0.9(5)
C9	38.8(7)	34.5(6)	38.4(6)	-1.7(5)	10.4(5)	1.0(5)
C11	44.4(7)	34.3(6)	38.9(7)	0.9(5)	12.3(5)	-1.5(5)
C12	47.4(7)	36.8(7)	44.3(7)	-0.3(5)	16.1(6)	1.1(5)
C6	39.4(7)	34.9(6)	46.2(7)	-3.8(5)	12.5(6)	1.8(5)
C24	38.4(7)	49.6(8)	54.5(8)	4.9(6)	19.5(6)	-0.3(6)
C7	38.7(6)	36.6(6)	39.2(7)	-3.8(5)	11.3(5)	-0.3(5)
C8	40.7(7)	52.2(8)	42.5(8)	-7.1(6)	13.4(6)	0.2(6)
C30	42.1(7)	38.2(7)	60.7(9)	-2.8(6)	16.5(6)	-2.1(6)
C1	44.2(7)	39.8(7)	53.7(8)	-9.6(6)	15.0(6)	-0.5(6)
O2	151.9(17)	64.3(9)	91.6(11)	-36.0(8)	34.5(11)	8.9(9)
C5	50.4(8)	39.4(7)	46.6(8)	-2.3(6)	12.8(6)	2.4(6)
C23	37.9(7)	60.7(9)	56.0(9)	-4.3(7)	14.7(6)	-1.3(6)
C16	52.1(8)	43.7(8)	66.4(10)	-8.9(7)	17.4(7)	-10.8(6)
C17	50.3(8)	51.7(8)	63.3(9)	8.3(7)	29.3(7)	11.9(6)
C4	57.5(9)	45.7(8)	57.4(9)	7.0(7)	14.7(7)	4.0(7)
C29	53.7(9)	56.0(9)	63.7(10)	15.4(7)	24.2(7)	7.0(7)
C2	72.3(11)	35.2(7)	77.9(12)	-9.7(7)	22.7(9)	2.6(7)
C25	69.1(10)	61.2(10)	61.3(10)	17.9(8)	30.6(8)	15.1(8)
C28	72.7(11)	78.7(12)	58.7(10)	15.3(9)	34.3(9)	5.3(9)
C3	74.6(11)	37.1(7)	75.9(12)	6.8(7)	19.5(9)	6.5(7)
C13	81.5(13)	67.0(12)	67.2(11)	-31.2(9)	29.5(10)	-9.2(9)
C27	95.3(15)	77.9(12)	75.5(13)	6.4(10)	52.8(11)	16.6(11)

C15	98.2(15)	64.7(11)	60.5(11)	18.1(9)	13.5(10)	8.8(10)
C26	103.9(16)	65.3(11)	87.6(14)	18.3(10)	53.5(12)	33.8(11)
C19	48.6(10)	77.6(13)	118.0(18)	7.7(12)	27.9(11)	5.4(9)
C20	72.4(13)	52.9(10)	144(2)	21.7(12)	42.5(13)	17.4(9)
C18	98.4(18)	205(3)	75.9(15)	14.5(18)	55.4(14)	44(2)
C14	197(3)	95.4(17)	66.9(14)	-37.8(13)	63.4(17)	-29.4(19)
C21	103.1(18)	109.0(19)	105.3(19)	31.6(15)	47.3(15)	-35.2(15)
C22	160(4)	137(4)	90(3)	5(2)	62(3)	-68(3)
C21'	103.1(18)	109.0(19)	105.3(19)	31.6(15)	47.3(15)	-35.2(15)
C22'	160(4)	137(4)	90(3)	5(2)	62(3)	-68(3)

Table S5 Bond Lengths for 3bm.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
O6	C12	1.3454(17)	C6	C7	1.5033(18)
O6	C17	1.4676(17)	C24	C25	1.380(2)
O4	C30	1.320(2)	C24	C29	1.388(2)
O4	C21	1.455(2)	C24	C23	1.506(2)
O1	C8	1.2033(18)	C7	C8	1.5405(19)
N2	C11	1.3875(18)	C1	C2	1.384(2)
N2	C23	1.4688(18)	O2	C13	1.199(3)
N2	C7	1.4748(17)	C5	C4	1.391(2)
O5	C12	1.2103(17)	C17	C18	1.494(3)
N1	C13	1.404(2)	C17	C20	1.501(2)
N1	C8	1.4065(19)	C17	C19	1.516(3)
N1	C1	1.434(2)	C4	C3	1.387(2)
O3	C30	1.2002(19)	C4	C15	1.510(3)
C10	C11	1.3483(19)	C29	C28	1.376(3)
C10	C12	1.4513(19)	C2	C3	1.383(3)
C10	C9	1.5053(17)	C25	C26	1.384(3)
C9	C30	1.5058(19)	C28	C27	1.369(3)
C9	C7	1.5649(18)	C13	C14	1.489(3)
C11	C16	1.4912(19)	C27	C26	1.364(3)
C6	C5	1.379(2)	C21	C22	1.354(5)
C6	C1	1.3871(18)			

Table S6 Bond Angles for 3bm.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C12	O6	C17	123.06(11)	O1	C8	N1	127.00(13)
C30	O4	C21	115.46(16)	O1	C8	C7	124.98(13)
C11	N2	C23	121.27(11)	N1	C8	C7	107.90(12)

C11	N2	C7	108.79(11)	O3	C30	O4	124.24(15)
C23	N2	C7	118.71(11)	O3	C30	C9	121.95(15)
C13	N1	C8	126.00(15)	O4	C30	C9	113.76(12)
C13	N1	C1	124.18(14)	C2	C1	C6	120.42(14)
C8	N1	C1	109.79(11)	C2	C1	N1	129.97(14)
C11	C10	C12	126.88(12)	C6	C1	N1	109.60(12)
C11	C10	C9	109.22(11)	C6	C5	C4	119.95(13)
C12	C10	C9	122.38(12)	N2	C23	C24	113.24(12)
C10	C9	C30	120.23(12)	O6	C17	C18	109.98(15)
C10	C9	C7	102.34(10)	O6	C17	C20	109.88(14)
C30	C9	C7	111.11(10)	C18	C17	C20	114.1(2)
C10	C11	N2	111.97(11)	O6	C17	C19	101.72(13)
C10	C11	C16	128.18(13)	C18	C17	C19	111.1(2)
N2	C11	C16	119.67(13)	C20	C17	C19	109.32(17)
O5	C12	O6	123.91(13)	C3	C4	C5	118.23(15)
O5	C12	C10	126.85(14)	C3	C4	C15	121.31(15)
O6	C12	C10	109.22(11)	C5	C4	C15	120.46(15)
C5	C6	C1	120.71(13)	C28	C29	C24	120.79(16)
C5	C6	C7	129.27(12)	C3	C2	C1	118.01(15)
C1	C6	C7	110.01(12)	C24	C25	C26	120.16(16)
C25	C24	C29	118.38(15)	C27	C28	C29	120.26(17)
C25	C24	C23	120.08(14)	C2	C3	C4	122.65(15)
C29	C24	C23	121.47(14)	O2	C13	N1	119.83(19)
N2	C7	C6	114.55(11)	O2	C13	C14	122.39(17)
N2	C7	C8	113.74(11)	N1	C13	C14	117.77(18)
C6	C7	C8	102.62(10)	C26	C27	C28	119.57(18)
N2	C7	C9	102.25(10)	C27	C26	C25	120.83(17)
C6	C7	C9	116.15(11)	C22	C21	O4	112.0(3)
C8	C7	C9	107.77(10)				

Table S7 Torsion Angles for 3bm.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
C11	C10	C9	C30	138.99(13)	C9	C7	C8	N1	-120.24(12)
C12	C10	C9	C30	-54.15(18)	C21	O4	C30	O3	-0.5(3)
C11	C10	C9	C7	15.34(14)	C21	O4	C30	C9	-177.94(17)
C12	C10	C9	C7	-177.81(12)	C10	C9	C30	O3	162.73(14)
C12	C10	C11	N2	-168.06(12)	C7	C9	C30	O3	-77.93(18)
C9	C10	C11	N2	-1.96(15)	C10	C9	C30	O4	-19.77(18)
C12	C10	C11	C16	7.0(2)	C7	C9	C30	O4	99.57(14)
C9	C10	C11	C16	173.14(14)	C5	C6	C1	C2	2.1(2)

C23	N2	C11	C10	-156.77(13)	C7	C6	C1	C2	-179.08(14)
C7	N2	C11	C10	-13.60(15)	C5	C6	C1	N1	-176.88(13)
C23	N2	C11	C16	27.67(19)	C7	C6	C1	N1	1.92(16)
C7	N2	C11	C16	170.84(12)	C13	N1	C1	C2	-1.0(3)
C17	O6	C12	O5	-2.6(2)	C8	N1	C1	C2	-178.85(16)
C17	O6	C12	C10	178.88(12)	C13	N1	C1	C6	177.92(15)
C11	C10	C12	O5	-20.5(2)	C8	N1	C1	C6	0.02(16)
C9	C10	C12	O5	175.08(15)	C1	C6	C5	C4	-1.4(2)
C11	C10	C12	O6	157.97(13)	C7	C6	C5	C4	-179.91(14)
C9	C10	C12	O6	-6.46(18)	C11	N2	C23	C24	-161.99(12)
C11	N2	C7	C6	-104.46(13)	C7	N2	C23	C24	58.33(17)
C23	N2	C7	C6	39.80(17)	C25	C24	C23	N2	-126.61(16)
C11	N2	C7	C8	137.95(11)	C29	C24	C23	N2	56.62(19)
C23	N2	C7	C8	-77.80(15)	C12	O6	C17	C18	-59.1(2)
C11	N2	C7	C9	22.05(13)	C12	O6	C17	C20	67.4(2)
C23	N2	C7	C9	166.30(12)	C12	O6	C17	C19	-176.89(14)
C5	C6	C7	N2	52.0(2)	C6	C5	C4	C3	-0.2(2)
C1	C6	C7	N2	-126.65(13)	C6	C5	C4	C15	179.21(17)
C5	C6	C7	C8	175.79(14)	C25	C24	C29	C28	0.4(2)
C1	C6	C7	C8	-2.89(15)	C23	C24	C29	C28	177.28(16)
C5	C6	C7	C9	-66.94(19)	C6	C1	C2	C3	-1.2(3)
C1	C6	C7	C9	114.39(13)	N1	C1	C2	C3	177.56(16)
C10	C9	C7	N2	-21.84(12)	C29	C24	C25	C26	0.5(3)
C30	C9	C7	N2	-151.39(11)	C23	C24	C25	C26	-176.35(18)
C10	C9	C7	C6	103.63(12)	C24	C29	C28	C27	-1.1(3)
C30	C9	C7	C6	-25.92(15)	C1	C2	C3	C4	-0.4(3)
C10	C9	C7	C8	-141.98(11)	C5	C4	C3	C2	1.1(3)
C30	C9	C7	C8	88.46(13)	C15	C4	C3	C2	-178.30(19)
C13	N1	C8	O1	4.3(3)	C8	N1	C13	O2	-178.85(19)
C1	N1	C8	O1	-177.87(15)	C1	N1	C13	O2	3.6(3)
C13	N1	C8	C7	-179.73(15)	C8	N1	C13	C14	1.1(3)
C1	N1	C8	C7	-1.88(15)	C1	N1	C13	C14	-176.5(2)
N2	C7	C8	O1	-56.76(18)	C29	C28	C27	C26	0.7(3)
C6	C7	C8	O1	178.93(14)	C28	C27	C26	C25	0.2(4)
C9	C7	C8	O1	55.84(18)	C24	C25	C26	C27	-0.9(3)
N2	C7	C8	N1	127.15(12)	C30	O4	C21	C22	168.5(4)
C6	C7	C8	N1	2.84(14)					

Table S8 Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for 3bm.

Atom	*x*	*y*	*z*	U(eq)
H9	2525	4418	5989	46
H5	5300	3781	9566	57
H23A	6905	4108	8401	63
H23B	7111	4667	7787	63
H16A	6426	5216	9187	84
H16B	5231	5622	8703	84
H16C	6012	5504	7832	84
H29	6103	4535	5116	69
H2	4874	2186	7092	77
H25	7824	3363	7754	75
H28	6623	4050	3618	81
H3	5654	2136	9320	79
H27	7786	3235	4191	92
H15A	5881	3232	11495	120
H15B	7061	2886	11464	120
H15C	5791	2582	11397	120
H26	8387	2896	6251	97
H19A	-775	5034	5717	124
H19B	-1544	5216	6562	124
H19C	-702	4672	6905	124
H20A	1064	6168	7468	134
H20B	-457	6121	6782	134
H20C	427	5922	6067	134
H18A	670	4998	9142	180
H18B	-275	5509	8850	180
H18C	1233	5604	9333	180
H14A	2747	3211	3089	174
H14B	3460	2719	2721	174
H14C	4212	3273	3279	174
H21A	611	3633	8416	125
H21B	1627	3164	8530	125
H22A	1347	3260	10341	187
H22B	1766	3885	10421	187
H22C	2779	3414	10536	187
H21C	1097	3732	9303	125
H21D	848	3383	8053	125
H22D	1595	2880	9743	187

H22E	2833	3260	10322	187
H22F	2589	2911	9069	187

Table S9 Atomic Occupancy for 3bm.

Atom	***Occupancy***	**Atom**	***Occupancy***	**Atom**	***Occupancy***
C21	0.633(4)	H21A	0.633(4)	H21B	0.633(4)
C22	0.633(4)	H22A	0.633(4)	H22B	0.633(4)
H22C	0.633(4)	C21'	0.367(4)	H21C	0.367(4)
H21D	0.367(4)	C22'	0.367(4)	H22D	0.367(4)
H22E	0.367(4)	H22F	0.367(4)		

checkCIF/PLATON report

No syntax errors found. CIF dictionary Interpreting this report

Datablock: shelxl

Bond precision:	C-C = 0.0024 A		Wavelength=1.54184
Cell:	a=11.1373(1)	b=24.0612(2)	c=11.2256(1)
	alpha=90	beta=112.945(1)	gamma=90
Temperature:	296 K		
	Calculated		Reported
Volume	2770.19(5)		2770.19(5)
Space group	P 21/n		P 21/n
Hall group	-P 2yn		-P 2yn
Moiety formula	C30 H34 N2 O6		?
Sum formula	C30 H34 N2 O6		C30 H34 N2 O6
Mr	518.59		518.59
Dx,g cm-3	1.243		1.243
Z	4		4
Mu (mm-1)	0.706		0.706
F000	1104.0		1104.0
F000'	1107.44		
h,k,lmax	13,29,13		13,29,13
Nref	5390		5269
Tmin,Tmax	0.844,0.887		0.743,1.000
Tmin'	0.844		

Correction method= # Reported T Limits: Tmin=0.743 Tmax=1.000 AbsCorr = MULTI-SCAN

Data completeness= 0.978 Theta(max)= 71.338

R(reflections)= 0.0460(4877) wR2(reflections)= 0.1273(5269)

S = 1.045 Npar= 354

The following ALERTS were generated. Each ALERT has the format

test-name_ALERT_alert-type_alert-level.

Click on the hyperlinks for more details of the test.

Alert level C

PLAT220_ALERT_2_C Non-Solvent Resd 1 C Ueq(max)/Ueq(min) Range 3.2 Ratio

PLAT222_ALERT_3_C Non-Solvent Resd 1 H Uiso(max)/Uiso(min) Range 4.1 Ratio

PLAT242_ALERT_2_C Low 'MainMol' Ueq as Compared to Neighbors of O4 Check

And 2 other PLAT242 Alerts

PLAT242_ALERT_2_C Low 'MainMol' Ueq as Compared to Neighbors of C13 Check

PLAT242_ALERT_2_C Low 'MainMol' Ueq as Compared to Neighbors of C17 Check

PLAT906_ALERT_3_C Large K value in the Analysis of Variance ..... 2.195 Check

PLAT911_ALERT_3_C Missing # FCF Refl Between THmin & STh/L= 0.600 31 Report

---

Alert level G

PLAT142_ALERT_4_G s.u. on b - Axis Small or Missing ..... 0.00020 Ang.

PLAT143_ALERT_4_G s.u. on c - Axis Small or Missing ..... 0.00010 Ang.

PLAT171_ALERT_4_G The CIF-Embedded .res File Contains EADP Records 2 Report

PLAT301_ALERT_3_G Main Residue Disorder .....(Resd 1).. 5 % Note

PLAT793_ALERT_4_G The Model has Chirality at C7 (Centro SPGR) R Verify

PLAT793_ALERT_4_G The Model has Chirality at C9 (Centro SPGR) S Verify

PLAT912_ALERT_4_G Missing # of FCF Reflections Above STh/L= 0.600 91 Note

PLAT978_ALERT_2_G Number C-C Bonds with Positive Residual Density. 7 Note

---

0 **ALERT level A** = Most likely a serious problem - resolve or explain

0 **ALERT level B** = A potentially serious problem, consider carefully

7 **ALERT level C** = Check. Ensure it is not caused by an omission or oversight

8 **ALERT level G** = General information/check it is not something unexpected

0 ALERT type 1 CIF construction/syntax error, inconsistent or missing data

5 ALERT type 2 Indicator that the structure model may be wrong or deficient

4 ALERT type 3 Indicator that the structure quality may be low

6 ALERT type 4 Improvement, methodology, query or suggestion

0 ALERT type 5 Informative message, check

It is advisable to attempt to resolve as many as possible of the alerts in all categories. Often the minor alerts point to easily fixed oversights, errors and omissions in your CIF or refinement

strategy, so attention to these fine details can be worthwhile. In order to resolve some of the more serious problems it may be necessary to carry out additional measurements or structure refinements. However, the purpose of your study may justify the reported deviations and the more serious of these should normally be commented upon in the discussion or experimental section of a paper or in the "special_details" fields of the CIF. checkCIF was carefully designed to identify outliers and unusual parameters, but every test has its limitations and alerts that are not important in a particular case may appear. Conversely, the absence of alerts does not guarantee there are no aspects of the results needing attention. It is up to the individual to critically assess their own results and, if necessary, seek expert advice.

Publication of your CIF in IUCr journals

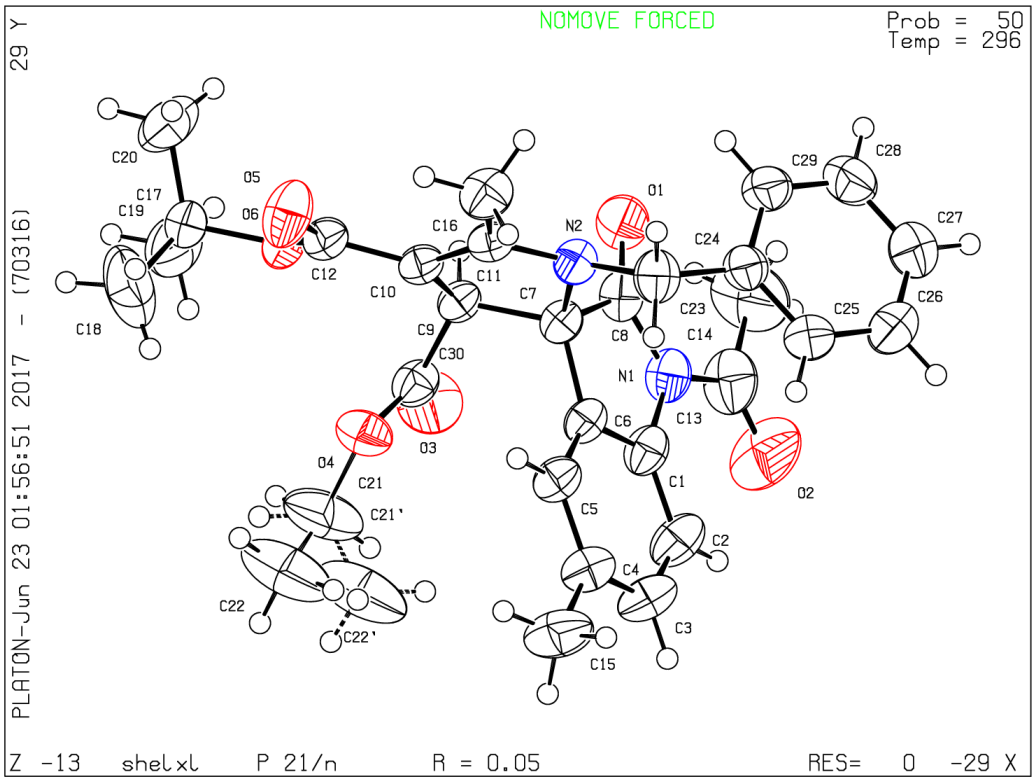
A basic structural check has been run on your CIF. These basic checks will be run on all CIFs submitted for publication in IUCr journals (*Acta Crystallographica*, *Journal of Applied Crystallography*, *Journal of Synchrotron Radiation*); however, if you intend to submit to *Acta Crystallographica Section C* or *E* or *IUCrData*, you should make sure that full publication checks are run on the final version of your CIF prior to submission.

Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to CIF submission.

PLATON version of 27/03/2017; check.def file version of 24/03/2017

Datablock shelxl - ellipsoid plot


NOMOVE FORCED
Prob = 50
Temp = 296
29 Y
PLATON-Jun 23 01:56:51 2017 - (70316)
Z -13 shelxl P 21/n R = 0.05 RES= 0 -29 X
C20
C17
C19
C18
O5
O6
C12
C10
C16
C11
C7
C9
C30
O3
O4
C21
C21'
C22
C22'
N2
O1
C24
C23
C8
C14
N1
C13
C6
C1
C5
C2
C4
C3
C15
C29
C28
C27
C26
C25
O2