# *Supporting Information*

## 1,3-Dipolar cycloaddition of isatin N,N′-cyclic azomethine imines with α,β-unsaturated aldehydes catalyzed by DBU in water

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## 1. General Information

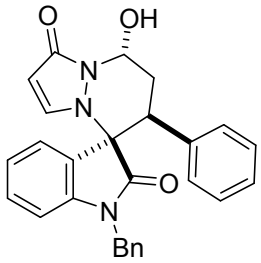
$^{1}H$ NMR (400 MHz) and $^{13}C$ NMR (100 MHz) were collected on a Bruker. The NMR spectra recorded in $CDCl_3$ or DMSO-D6 solutions were referenced to TMS (0.00 ppm). The optimized solvent was primary deionized water and organic solvents used were dried by standard methods. The mass analyzer type for the high resolution mass spectra (HRMS) was ESI-FTMS. All other available chemical reagents were used without further purification. Flash column chromatography was performed using 300-400 mesh silica gel of Huanghai. The isatin derivated cyclic imine 1,3-dipoles **1**[1] were prepared according to literature method.

1 X. Wang, P. Yang, Y. Zhang, C.-Z. Tang, F. Tian, L. Peng and L.-X. Wang, *Org. Lett.* 2017, **19**, 646-649.

## General procedure for DBU catalyzed [3+3] cycloaddition reaction of isatin derivated cyclic imine 1,3-dipoles with α, β-unsaturated aldehydes

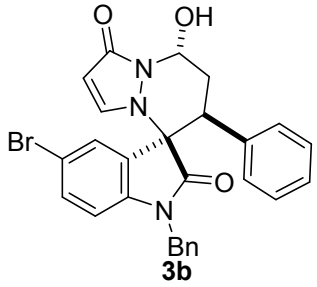
Under $N_2$ atmosphere, isatin derivated cyclic imine 1,3-dipoles **1** (0.1 mmol), α,β-unsaturated aldehydes **2** (0.12 mmol), primary deionized water (1.0 ml) were successively added into a reaction tube, finally DBU (1.0 equiv) was added with stirring. The mixture was stirred vigorously at the specified temperature. After completion of the reaction, the mixture was extracted with dichloromethane 3 times. The combined organic layers were dried over $Na_2SO_4$, filtered and concentrated. Then the residue was purified by a flash column chromatography ($SiO_2$) using petroleum ether-ethyl acetate-ethanol mixture to give the products as a couple of diastereoisomers.

## 2. The data of the products 3, 4a




**3a**

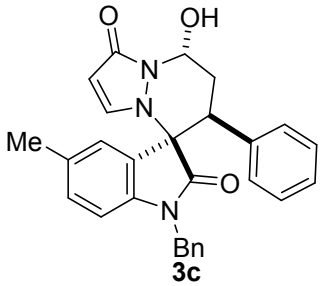
**1-benzyl-8'-hydroxy-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3a**: Yield of two diastereoisomeric mixture 61%, dr = 8:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 7.4 Hz, 1H), 7.22 – 7.13 (m, 6H), 7.07 (t, *J* = 7.5 Hz, 2H), 7.00 (d, *J* = 7.7 Hz, 2H), 6.73 (d, *J* = 3.5 Hz, 1H), 6.65 (d, *J* = 7.3 Hz, 2H), 6.40 – 6.34 (m, 2H), 5.51 (d, *J* = 3.5 Hz, 1H), 4.70 (d, *J* = 15.9 Hz, 1H), 4.44 (d, *J* = 15.9 Hz, 1H), 4.31 (dd, *J* = 13.3, 2.7 Hz, 1H), 3.51 (td, *J* = 13.5, 3.2 Hz, 1H), 2.29 (d, *J* = 13.6 Hz, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.2, 165.8, 143.3, 138.9, 135.6, 134.6, 131.0, 129.2, 128.7, 128.3, 127.7, 127.5, 126.8, 125.0, 124.3, 123.4, 109.8, 100.2, 71.2, 68.3, 43.5, 41.8, 29.7. HRMS: $[M + H]^+$ calcd for $C_{27}H_{24}N_3O_3$+: 438.1812; found: 438.1804.




**3b**

**1-benzyl-5-bromo-8'-hydroxy-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3b**: Yield of two diastereoisomeric mixture 80%, dr = 8:1, white solid, $^1$H NMR (400 MHz, DMSO) δ 8.03 (s, 1H), 7.48 (d, *J* = 8.3 Hz, 1H), 7.22 – 7.11 (m, 6H), 7.08 – 6.98 (m, 3H), 6.72 (dd, *J* = 13.7, 6.0 Hz, 3H), 6.58 (d, *J* = 8.3 Hz, 1H), 5.98 (s, 1H), 5.45 (s, 1H), 4.68 (d, *J* = 16.1 Hz, 1H), 4.51 (d, *J* = 16.2 Hz, 1H), 4.32 (d, *J* = 12.9 Hz, 1H), 3.23 (t, *J* = 13.3 Hz, 1H), 2.00 (d, *J* = 13.1 Hz, 1H). $^{13}$C NMR (100 MHz, DMSO) δ 170.8, 164.9, 142.8, 141.5, 136.4, 135.3, 134.1, 129.3, 128.9, 128.8, 128.5, 128.1, 127.8, 127.2, 126.6, 115.4,

112.2, 101.6, 70.3, 68.2, 43.0, 41.2, 31.2. HRMS: $[M + H]^+$ calcd for $C_{27}H_{23}BrN_3O_3$+: 516.0917; found: 516.0914.

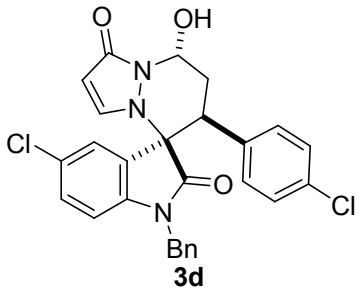



**3c**

**1-benzyl-8'-hydroxy-5-methyl-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3c**: Yield of two diastereoisomeric mixture 67%, dr = 5:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.53 (s, 1H), 7.19 – 7.11 (m, 4H), 7.08 (t, *J* = 7.6 Hz, 2H), 7.02 – 6.98 (m, 3H), 6.75 (d, *J* = 3.5 Hz, 1H), 6.62 (d, *J* = 6.8 Hz, 2H), 6.35 (s, 1H), 6.26 (d, *J* = 8.0 Hz, 1H), 5.51 (d, *J* = 3.5 Hz, 1H), 4.69 (d, *J* = 15.9 Hz, 1H), 4.41 (d, *J* = 15.9 Hz, 1H), 4.29 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.50 (td, *J* = 13.5, 3.3 Hz, 1H), 2.39 (s, 3H), 2.28 (d, *J* = 13.9 Hz, 1H).

$^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.2, 165.8, 140.9, 138.9, 135.7, 134.7, 133.2, 131.3, 129.2, 128.6, 128.3, 127.6, 127.4, 126.7, 125.6, 124.3, 109.6, 100.0, 71.2, 68.4, 43.5, 41.7, 29.8, 21.1.

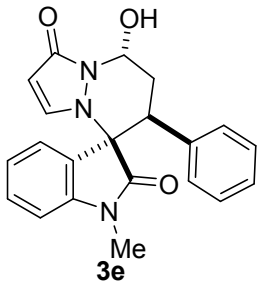
HRMS: $[M + H]^+$ calcd for $C_{28}H_{26}N_3O_3$+: 452.1969; found: 452.1966.




**3d**

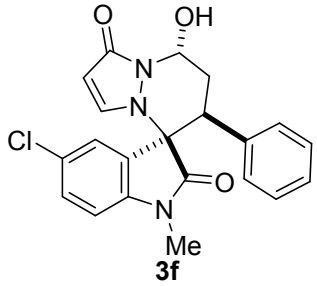
**1-benzyl-5-chloro-6'-(4-chlorophenyl)-8'-hydroxy-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3d**: Yield of two diastereoisomeric mixture 77%, dr = 9:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.70 (dd, *J* = 7.2, 0.9 Hz, 1H), 7.25 – 7.17 (m, 5H), 7.01 (d, *J* = 8.5 Hz, 2H), 6.91 (d, *J* = 8.5 Hz, 2H), 6.73 (d, *J* = 3.6 Hz, 1H), 6.66 (dd, *J* = 6.4, 2.7 Hz, 2H), 6.46 (d, *J* = 7.5 Hz, 1H), 6.34 (s, 1H), 5.51 (d, *J* = 3.6 Hz, 1H), 4.77 (d, *J* = 15.9 Hz, 1H), 4.42 (d, *J* = 15.9 Hz, 1H), 4.28 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.45 (td, *J* = 13.5, 3.4 Hz, 1H), 2.28 – 2.21 (m, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.0, 165.8, 143.3, 139.0, 134.4, 134.2, 133.7,

131.2, 130.5, 128.7, 128.5, 127.7, 126.8, 125.0, 124.0, 123.5, 110.0, 100.3, 71.1, 68.1, 43.6, 41.2, 29.7. HRMS: $[M + H]^+$ calcd for $C_{27}H_{22}Cl_2N_3O_3$+: 506.1033; found: 506.1030.



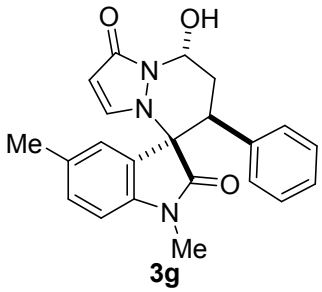

**3e**

**8'-hydroxy-1-methyl-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3e**: Yield of two diastereoisomeric mixture 40%, dr = 8:1, white solid, $^1$H NMR (400 MHz, DMSO) δ 7.70 (d, *J* = 6.8 Hz, 1H), 7.36 – 7.32 (m, 1H), 7.20 (t, *J* = 7.2 Hz, 1H), 7.12 – 7.03 (m, 3H), 6.95 (d, *J* = 3.6 Hz, 1H), 6.91 (dd, *J* = 7.5, 1.8 Hz, 2H), 6.79 (d, *J* = 7.8 Hz, 1H), 6.73 (d, *J* = 5.0 Hz, 1H), 5.96 (s, 1H), 5.38 (d, *J* = 3.7 Hz, 1H), 4.15 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.18 (td, *J* = 13.4, 3.2 Hz, 1H), 2.77 (s, 3H), 1.97 – 1.90 (m, 1H). $^{13}$C NMR (100 MHz, DMSO) δ 171.3, 164.8, 144.0, 141.1, 136.7, 131.2, 128.9, 128.3, 128.0, 125.0, 124.3, 123.5, 109.4, 100.8, 70.2, 68.2, 42.2, 31.0, 26.0. HRMS: $[M + H]^+$ calcd for $C_{21}H_{20}N_3O_3$+: 362.1499; found: 362.1495.



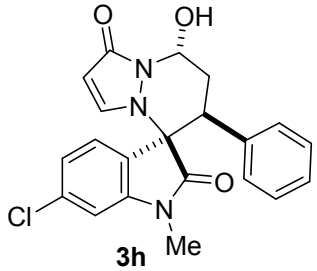

**3f**

**5-chloro-8'-hydroxy-1-methyl-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3f**: Yield of two diastereoisomeric mixture 73%, dr = 15:1, white solid, $^1$H NMR (400 MHz, DMSO) δ 7.82 (s, 1H), 7.40 (d, *J* = 7.7 Hz, 1H), 7.12 (s, 4H), 6.95 (s, 2H), 6.82 (d, *J* = 8.1 Hz, 1H), 6.71 (d, *J* = 3.8 Hz, 1H), 5.95 (s, 1H), 5.41 (s, 1H), 4.20 (d, *J* = 12.2 Hz, 1H), 3.15 (t, *J* = 12.6 Hz, 1H), 2.77 (s, 3H), 1.95 (d, *J* = 12.9 Hz, 1H). $^{13}$C NMR (100 MHz, DMSO) δ 171.0, 164.7, 143.0, 141.6, 136.4, 131.1, 128.9, 128.4, 128.1, 127.5, 126.3, 125.3, 111.0, 101.2, 70.2, 68.2, 42.1, 31.1, 26.2. HRMS: $[M + H]^+$ calcd for $C_{21}H_{19}ClN_3O_3$+: 396.1109; found: 396.1107.



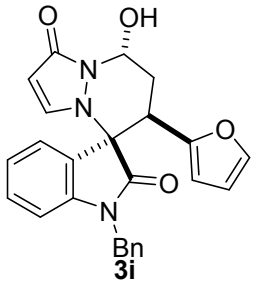

**3g**

**8'-hydroxy-1,5-dimethyl-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3g**: Yield of two diastereoisomeric mixture 40%, dr > 20:1, white solid, $^1$H NMR (400 MHz, DMSO) δ 7.53 (s, 1H), 7.17 – 7.06 (m, 4H), 6.97 – 6.88 (m, 3H), 6.73 (d, *J* = 4.9 Hz, 1H), 6.67 (d, *J* = 8.0 Hz, 1H), 5.96 (s, 1H), 5.36 (d, *J* = 3.7 Hz, 1H), 4.13 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.17 (td, *J* = 13.5, 3.3 Hz, 1H), 2.74 (s, 3H), 2.37 (s, 3H), 1.93 (dd, *J* = 10.8, 2.4 Hz, 1H). $^{13}$C NMR (100 MHz, DMSO) δ 171.3, 164.8, 141.7, 141.1, 136.7, 132.6, 131.4, 128.9, 128.3, 127.9， 125.5, 124.3, 109.1, 100.6, 70.2, 68.3, 42.2, 31.1, 26.0, 21.2. HRMS: $[M + H]^+$ calcd for $C_{22}H_{22}N_3O_3$+: 376.1656; found: 376.1651.



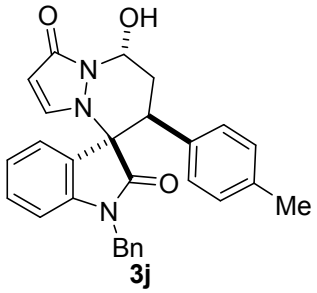

**3h**

**6-chloro-8'-hydroxy-1-methyl-6'-phenyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3h**: Yield of two diastereoisomeric mixture 58%, dr = 10:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.0 Hz, 1H), 7.18 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.14 – 7.04 (m, 3H), 6.92 (d, *J* = 7.0 Hz, 2H), 6.79 (d, *J* = 3.5 Hz, 1H), 6.52 (d, *J* = 1.7 Hz, 1H), 6.31 (s, 1H), 5.51 (d, *J* = 3.6 Hz, 1H), 4.17 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.36 (td, *J* = 13.6, 3.4 Hz, 1H), 2.78 (s, 3H), 2.25 – 2.16 (m, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.2, 165.6, 145.0, 138.9, 136.9, 135.2, 128.7, 128.0, 127.9, 125.7, 123.3, 122.7, 109.2, 100.4, 71.1, 68.1, 42.8, 29.5, 25.8. HRMS: $[M + H]^+$ calcd for $C_{21}H_{19}ClN_3O_3$+: 396.1109; found: 396.1106.



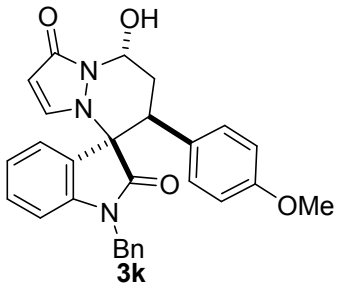

**3i**

**1-benzyl-6'-(furan-2-yl)-8'-hydroxy-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3i**: Yield of two diastereoisomeric mixture 77%, dr = 8:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 6.9 Hz, 1H), 7.29 (dd, *J* = 7.8, 1.0 Hz, 1H), 7.25 – 7.21 (m, 3H), 7.18 (t, *J* = 7.6 Hz, 1H), 7.04 (d, *J* = 1.1 Hz, 1H), 6.91 (dd, *J* = 5.5, 3.8 Hz, 2H), 6.75 (d, *J* = 3.6 Hz, 1H), 6.57 (d, *J* = 7.8 Hz, 1H), 6.31 (s, 1H), 6.12 (dd, *J* = 3.2, 1.9 Hz, 1H), 6.05 (s, 1H), 5.87 (d, *J* = 3.2 Hz, 1H), 5.50 (d, *J* = 3.6 Hz, 1H), 4.79 (d, *J* = 15.8 Hz, 1H), 4.53 (d, *J* = 15.8 Hz, 1H), 4.41 (dd, *J* = 13.3, 3.3 Hz, 1H), 3.40 (td, *J* = 13.5, 2.7 Hz, 1H), 2.38 – 2.30 (m, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 170.7, 165.9, 150.5, 143.5, 142.1, 139.1, 134.8, 131.1, 128.8, 127.7, 127.1, 125.0, 124.2, 123.5, 110.1, 109.6, 108.4, 100.6, 70.8, 66.8, 43.6, 36.6, 28.8. HRMS: $[M + H]^+$ calcd for $C_{25}H_{22}N_3O_4$+: 428.1605; found: 428.1602.



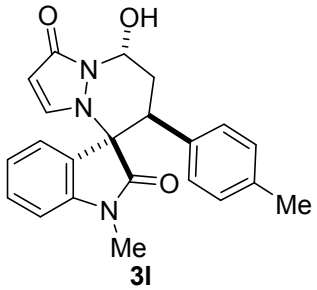

**3j**

**1-benzyl-8'-hydroxy-6'-(p-tolyl)-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3j**: Yield of two diastereoisomeric mixture 52%, dr = 10:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 6.7 Hz, 1H), 7.20 – 7.12 (m, 5H), 6.87 (s, 4H), 6.74 – 6.64 (m, 3H), 6.48 (s, 1H), 6.42 – 6.32 (m, 2H), 5.50 (s, 1H), 4.76 (d, *J* = 15.9 Hz, 1H), 4.41 (d, *J* = 15.9 Hz, 1H), 4.27 (d, *J* = 13.0 Hz, 1H), 3.47 (t, *J* = 13.3 Hz, 1H), 2.18 (d, *J* = 59.3 Hz, 4H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.3, 165.8, 143.4, 138.8, 137.2, 134.6, 132.6, 130.9, 129.1, 128.9, 128.5, 127.5, 126.9, 125.0, 124.5, 123.3, 109.8, 100.1, 71.2, 68.4, 43.5, 41.3, 29.9, 21.1. HRMS: $[M + H]^+$ calcd for $C_{28}H_{26}N_3O_3$+: 452.1969; found: 452.1963.



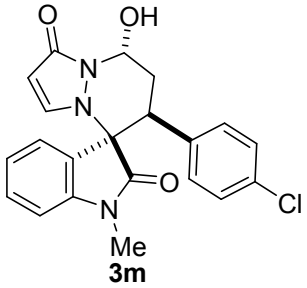

**3k**

**1-benzyl-8'-hydroxy-6'-(4-methoxyphenyl)-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3k**: Yield of two diastereoisomeric mixture 52%, dr = 4:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.69 (d, *J* = 6.6 Hz, 1H), 7.23 – 7.11 (m, 5H), 6.90 (d, *J* = 7.6 Hz, 2H), 6.72 (s, 1H), 6.61 (dd, *J* = 17.8, 7.3 Hz, 4H), 6.46 – 6.18 (m, 3H), 5.49 (s, 1H), 4.76 (d, *J* = 15.9 Hz, 1H), 4.42 (d, *J* = 15.9 Hz, 1H), 4.26 (d, *J* = 13.1 Hz, 1H), 3.72 (s, 3H), 3.45 (t, *J* = 13.4 Hz, 1H), 2.26 (d, *J* = 12.9 Hz, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.3, 165.8, 159.0, 143.4, 138.9, 134.5, 130.9, 130.2, 128.6, 127.5, 126.8, 125.0, 124.5, 123.4, 113.6, 109.9, 100.0, 71.2, 68.4, 55.1, 43.5, 40.9, 29.9. HRMS: $[M + H]^+$ calcd for $C_{28}H_{26}N_3O_4$+: 468.1918; found: 468.1915.



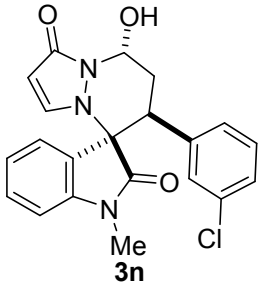

**3l**

**8'-hydroxy-1-methyl-6'-(p-tolyl)-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3l**: Yield of two diastereoisomeric mixture 48%, dr > 20:1, white solid, $^1$H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.59 (m, 1H), 7.33 – 7.29 (m, 1H), 7.20 – 7.16 (m, 1H), 6.86 – 6.71 (m, 5H), 6.53 (d, *J* = 7.8 Hz, 1H), 6.32 (s, 1H), 5.48 (d, *J* = 3.6 Hz, 1H), 4.16 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.37 (td, *J* = 13.6, 3.5 Hz, 1H), 2.81 (s, 3H), 2.24 – 2.14 (m, 4H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.4, 165.7, 143.9, 138.9, 137.2, 132.4, 130.9, 128.6, 128.5, 124.7, 124.5, 123.3, 108.4, 99.8, 71.2, 68.5, 42.4, 29.7, 25.7, 21.0. HRMS: $[M + H]^+$ calcd for $C_{22}H_{22}N_3O_3$+: 376.1656; found: 376.1653.



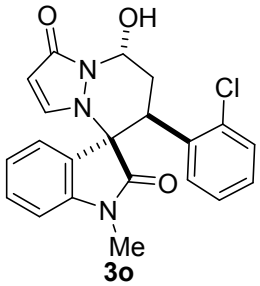

**3m**

**6'-(4-chlorophenyl)-8'-hydroxy-1-methyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3m**: Yield of two diastereoisomeric mixture 35%, dr > 20:1, white solid, $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.0 Hz, 1H), 7.36 – 7.32 (m, 1H), 7.20 (t, *J* = 7.3 Hz, 1H), 7.02 (d, *J* = 8.5 Hz, 2H), 6.86 (d, *J* = 8.5 Hz, 2H), 6.78 (d, *J* = 3.5 Hz, 1H), 6.58 (d, *J* = 7.8 Hz, 1H), 6.32 (s, 1H), 5.49 (d, *J* = 3.6 Hz, 1H), 4.19 (dd, *J* = 13.4, 3.1 Hz, 1H), 3.36 (td, *J* = 13.5, 3.4 Hz, 1H), 2.83 (s, 3H), 2.20 (dd, *J* = 11.3, 2.7 Hz, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.1, 165.7, 143.8, 139.0, 134.2, 133.6, 131.2, 130.1, 128.1, 124.7, 124.0, 123.5, 108.7, 100.1, 71.1, 68.2, 42.2, 29.5, 25.8. HRMS: $[M + H]^+$ calcd for $C_{21}H_{19}ClN_3O_3$+: 396.1109; found: 396.1106.



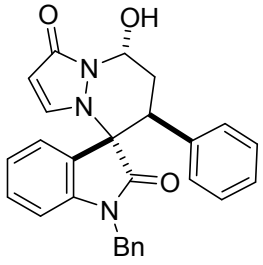

**3n**

**6'-(3-chlorophenyl)-8'-hydroxy-1-methyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3n**: Yield of two diastereoisomeric mixture 61%, dr > 20:1, white solid, $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.3 Hz, 1H), 7.34 (t, *J* = 7.7 Hz, 1H), 7.22 (t, *J* = 7.5 Hz, 1H), 7.08 (d, *J* = 8.7 Hz, 1H), 6.98 (t, *J* = 7.8 Hz, 1H), 6.91 (s, 1H), 6.84 – 6.77 (m, 2H), 6.57 (d, *J* = 7.8 Hz, 1H), 6.32 (s, 1H), 5.50 (d, *J* = 3.5 Hz, 1H), 4.17 (dd, *J* = 13.4, 3.0 Hz, 1H), 3.36 (td, *J* = 13.5, 3.3 Hz, 1H), 2.84 (s, 3H), 2.22 (d, *J* = 13.8 Hz, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ 171.0, 165.7, 143.7, 139.0, 137.7, 133.8, 131.2, 129.1, 128.8, 127.9, 127.0, 124.7, 123.9, 123.5, 108.6, 100.1, 71.1, 68.1, 42.7, 29.3, 25.7. HRMS: $[M + H]^+$ calcd for $C_{21}H_{19}ClN_3O_3$+: 396.1109; found: 396.1107.




**3o**

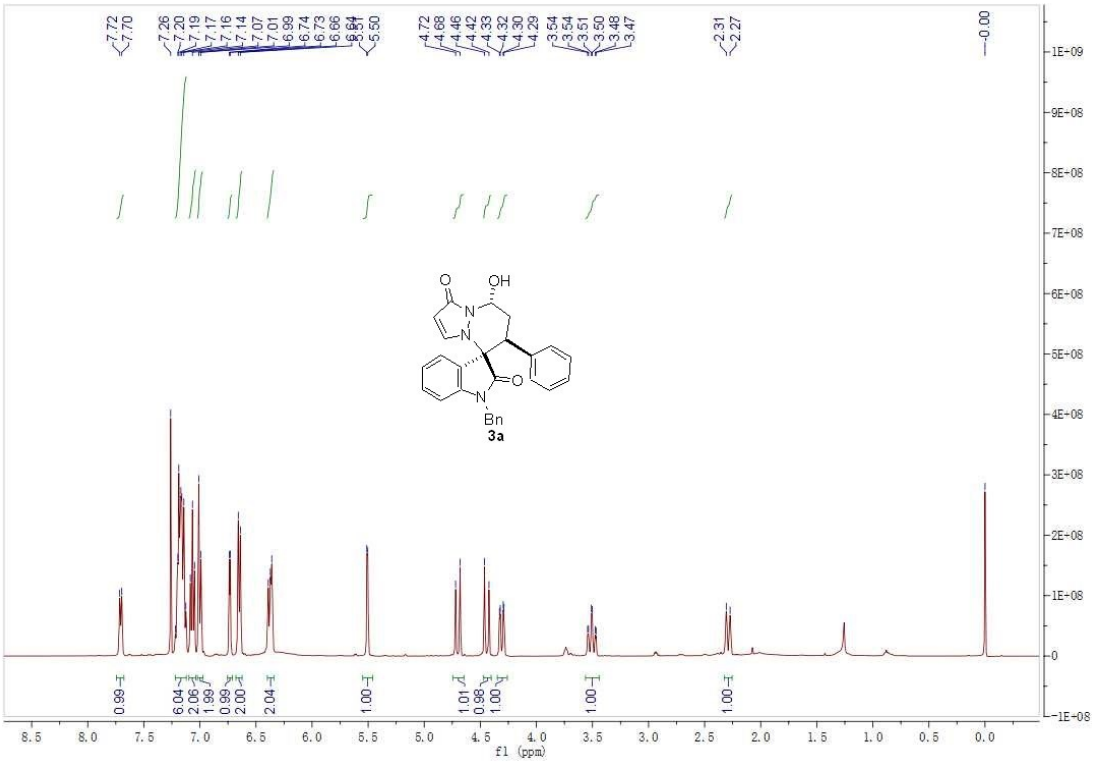
**6'-(2-chlorophenyl)-8'-hydroxy-1-methyl-7',8'-dihydro-1'*H*,6'*H*-spiro[indoline-3,5'-pyrazolo[1,2-*a*]pyridazine]-1',2-dione 3o**: Yield of two diastereoisomeric mixture 45%, dr > 20:1, white solid, $^{1}$H NMR (400 MHz, DMSO) δ 7.65 (d, *J* = 7.1 Hz, 1H), 7.38 – 7.29 (m, 1H), 7.21 (d, *J* = 6.8 Hz, 2H), 7.18 – 7.10 (m, 2H), 6.93 (d, *J* = 3.6 Hz, 1H), 6.84 (d, *J* = 7.8 Hz, 1H), 6.80 (d, *J* = 4.6 Hz, 1H), 5.95 (s, 1H), 5.41 (d, *J* = 3.7 Hz, 1H), 4.90 (dd, *J* = 13.2, 3.2 Hz, 1H), 3.06 (td, *J* = 13.3, 2.9 Hz, 1H), 2.92 (s, 3H), 1.91 – 1.79 (m, 1H). $^{13}$C NMR (100 MHz, DMSO) δ 171.5, 164.8, 143.8, 141.2, 134.9, 134.0, 131.5, 130.0, 129.7, 128.5, 127.6, 125.7, 123.2, 123.0, 109.3, 101.4, 70.0, 67.8, 37.4, 32.0, 26.3. HRMS: $[M + H]^+$ calcd for $C_{21}H_{19}ClN_3O_3$+: 396.1109; found: 396.1107.

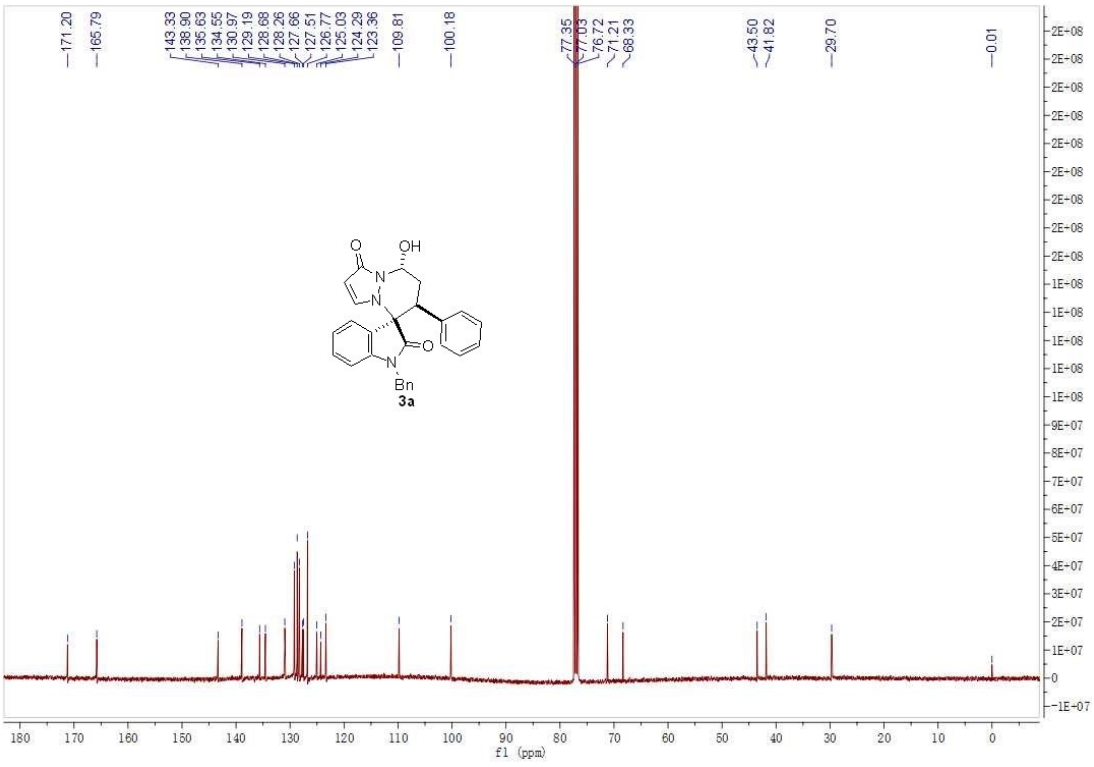


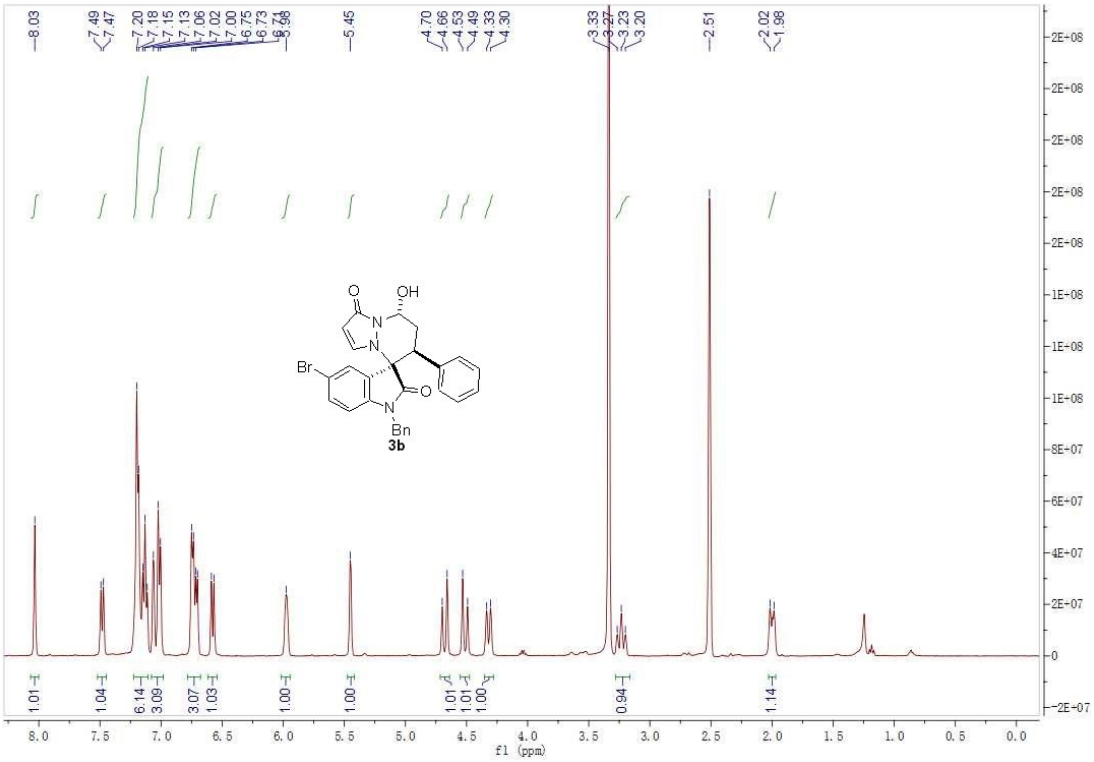

**4a**

**1-benzyl-8'-hydroxy-6'-phenyl-7',8'-dihydro-1'H,6'H-spiro[indoline-3,5'-pyrazolo[1,2-a]pyridazine]-1',2-dione 4a**: white solid, $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.39 (d, *J* = 7.4 Hz, 1H), 7.23 (t, *J* = 7.4 Hz, 1H), 7.18 – 7.10 (m, 4H), 7.08 (t, *J* = 6.6 Hz, 2H), 7.02 (t, *J* = 7.6 Hz, 1H), 6.99 (d, *J* = 3.6 Hz, 1H), 6.86 (d, *J* = 7.4 Hz, 2H), 6.51 (d, *J* = 7.3 Hz, 2H), 6.41 (d, *J* = 7.9 Hz, 1H), 6.36 (s, 1H), 5.48 (d, *J* = 3.6 Hz, 1H), 5.13 (s, 1H), 4.98 (d, *J* = 15.9 Hz, 1H), 4.45 (m, 2H), 2.88 – 2.80 (m, 1H), 2.40 (dd, *J* = 14.3, 1.6 Hz, 1H). $^{13}$C NMR (101 MHz, $CDCl_3$) δ 171.3, 167.1, 142.1, 141.5, 135.6, 134.2, 130.3, 129.0, 128.8, 128.4, 128.1, 127.5, 126.5, 125.0, 124.1, 123.0, 110.3, 101.3, 71.5, 70.3, 44.1, 42.8, 31.5.

## 3.The NMR of 3, 4a

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6.71
5.98
5.45
4.70
4.66
4.53
4.49
4.33
4.30
3.33
3.27
3.23
3.20
2.51
2.02
1.98
1.01
1.04
6.14
3.09
3.07
1.03
1.00
1.00
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1.01
1.00
0.94
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f1 (ppm)
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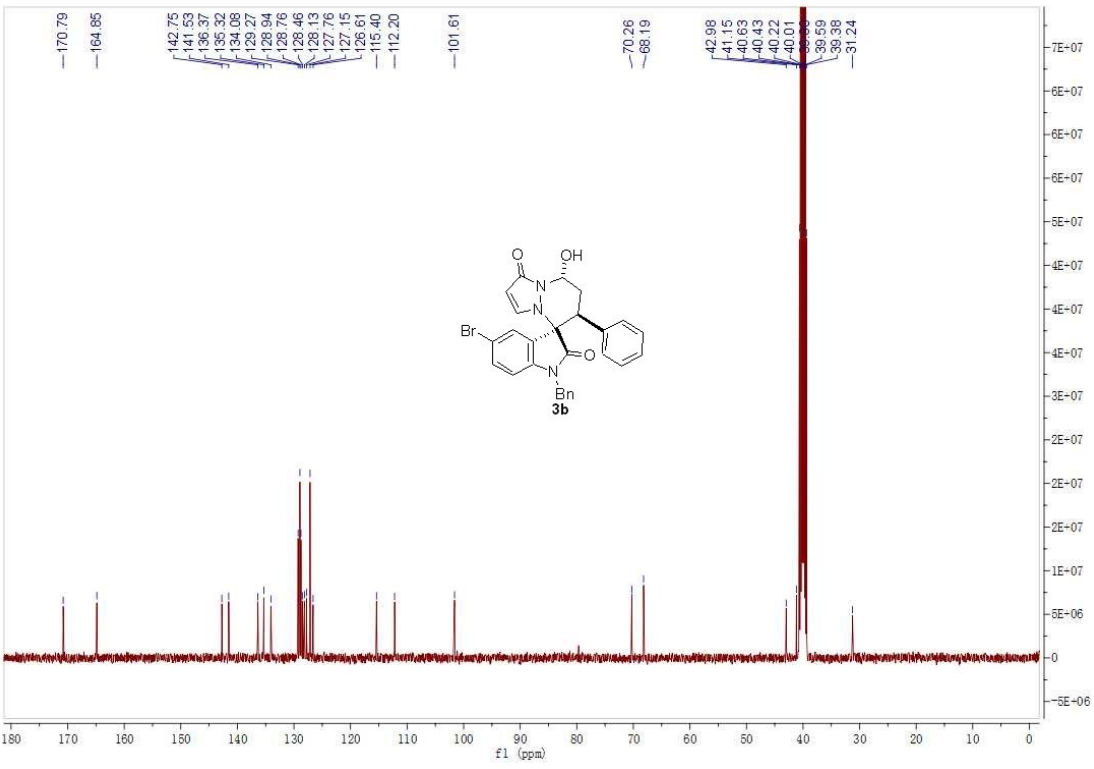
O
N
Br
Bn
3b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127.76
127.15
126.61
115.40
112.20
101.61
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68.19
42.98
41.15
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f1 (ppm)
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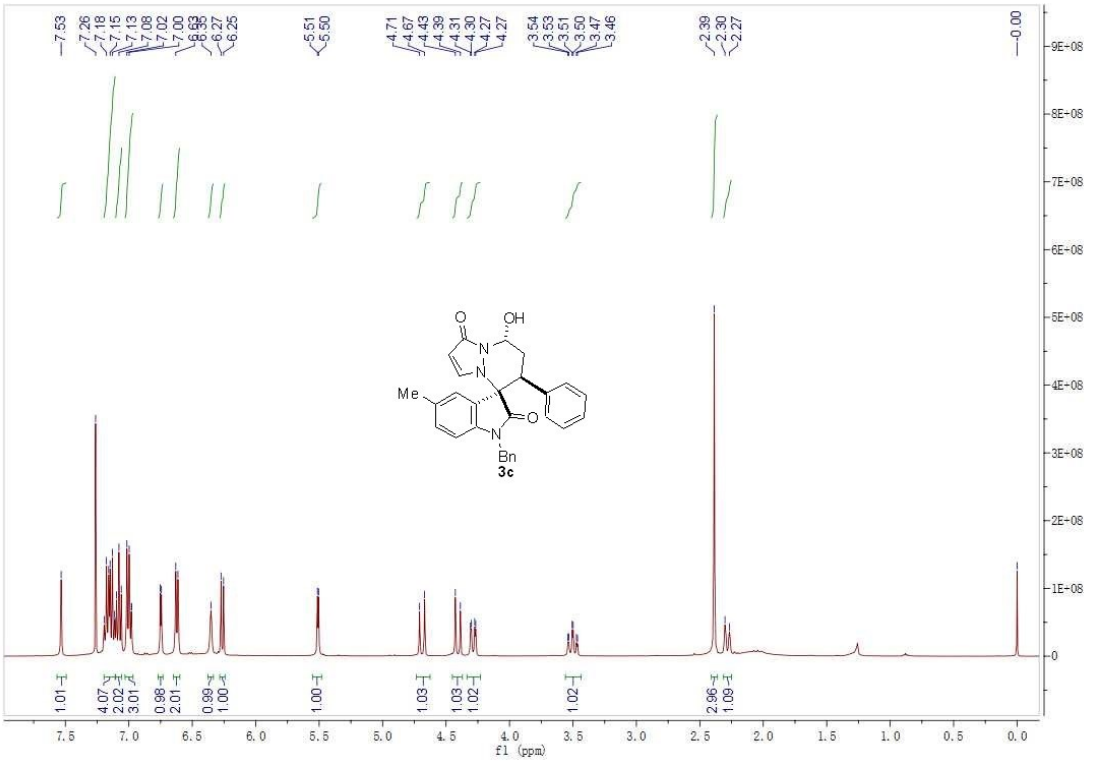
O
N
Br
Bn
3b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Me
O
N
Bn
3c
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2.02
3.01
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1.02
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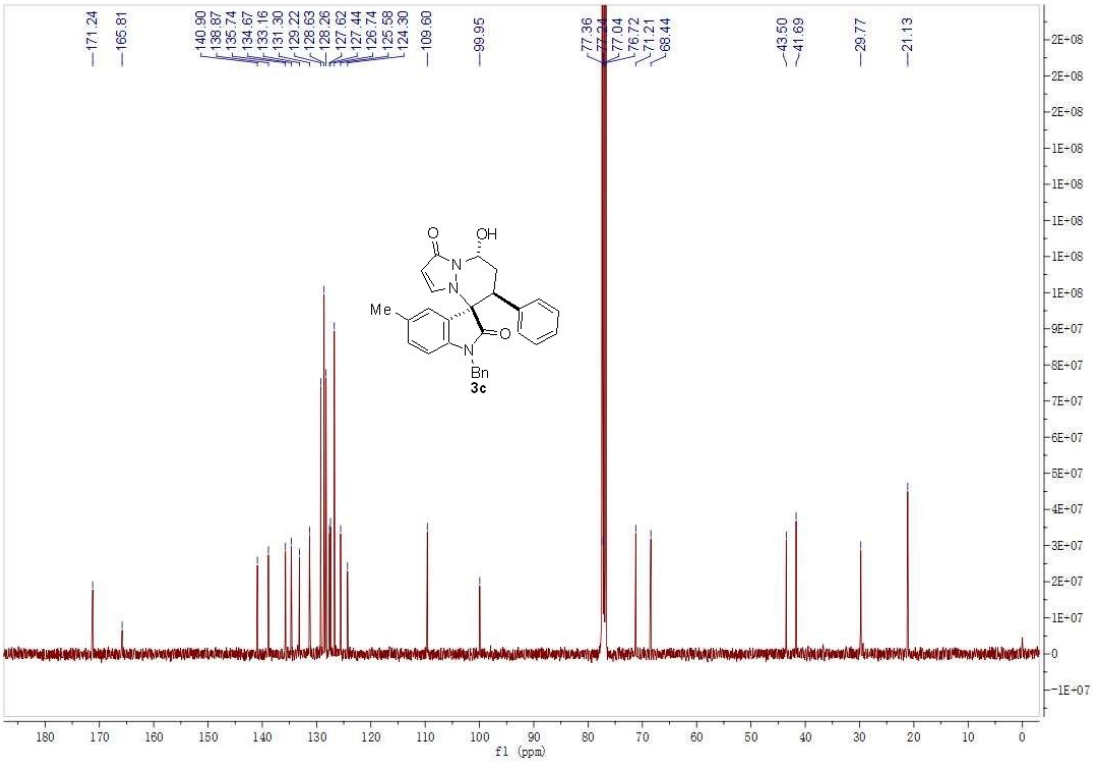
f1 (ppm)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125.58
124.30
109.60
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77.04
76.72
71.21
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OH
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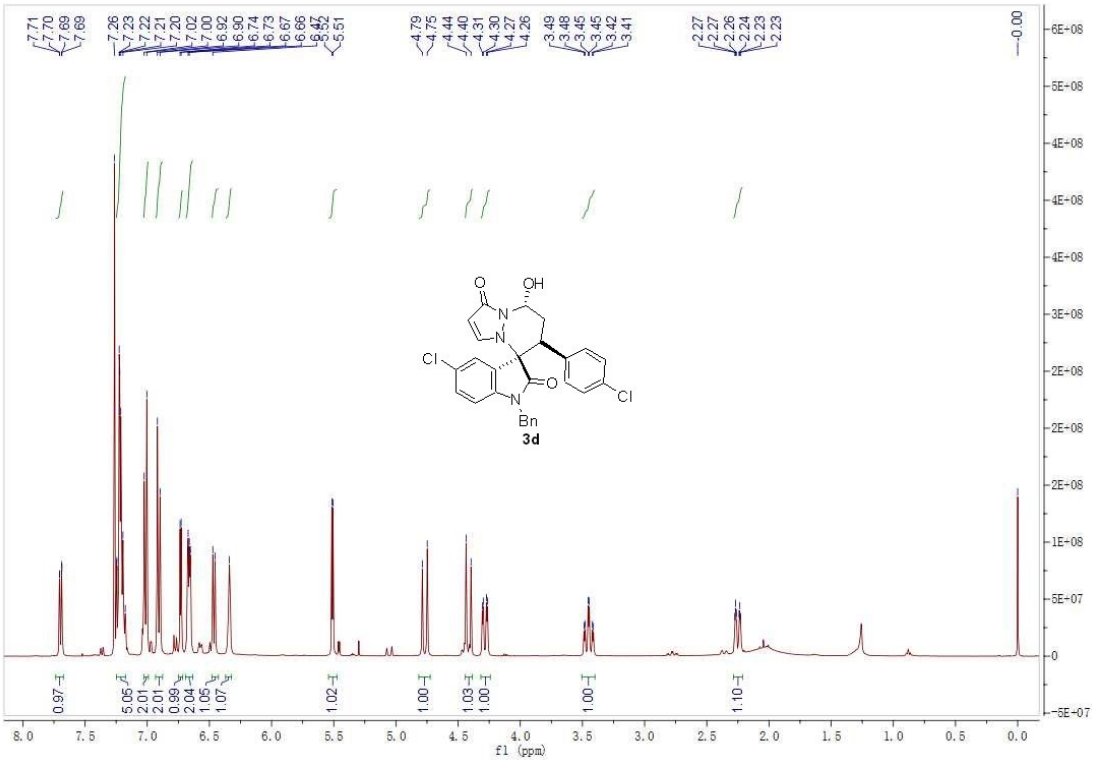
N
N
Me
O
N
Bn
3c
f1 (ppm)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6.73
6.67
6.66
5.51
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4.31
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Cl
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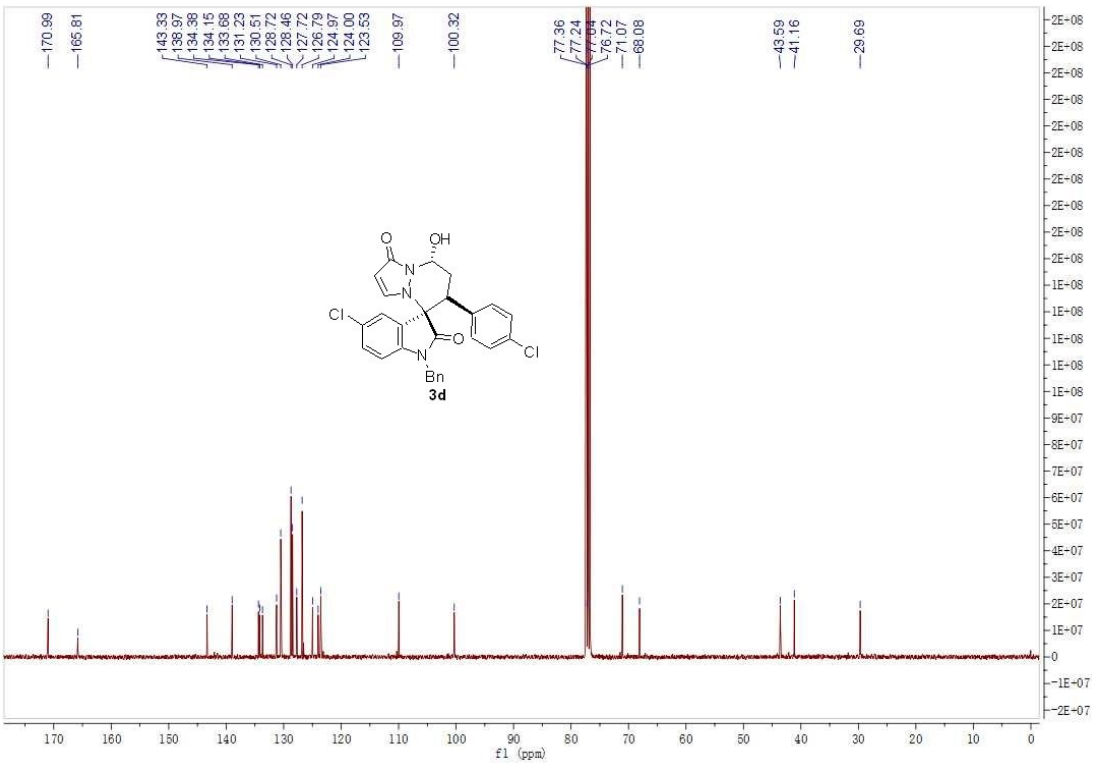
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126.79
124.97
124.00
123.53
109.97
100.32
77.36
77.24
76.72
71.07
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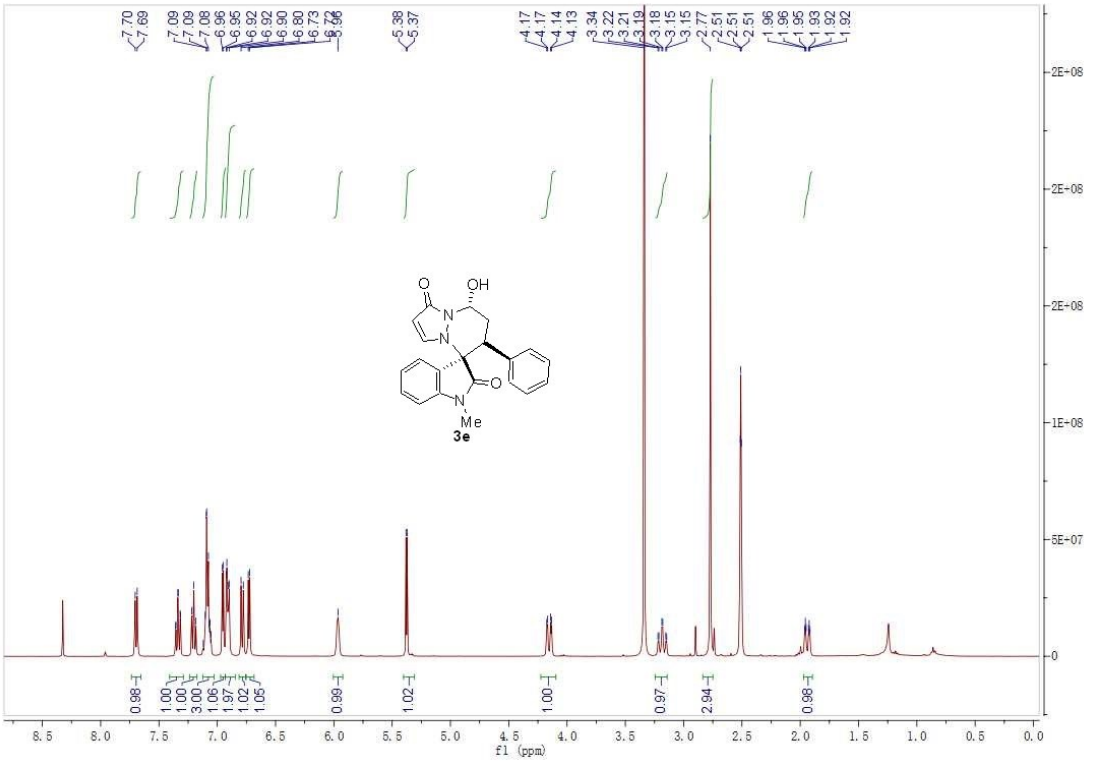
Cl
O
N
Cl
Bn
3d
f1 (ppm)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1.92
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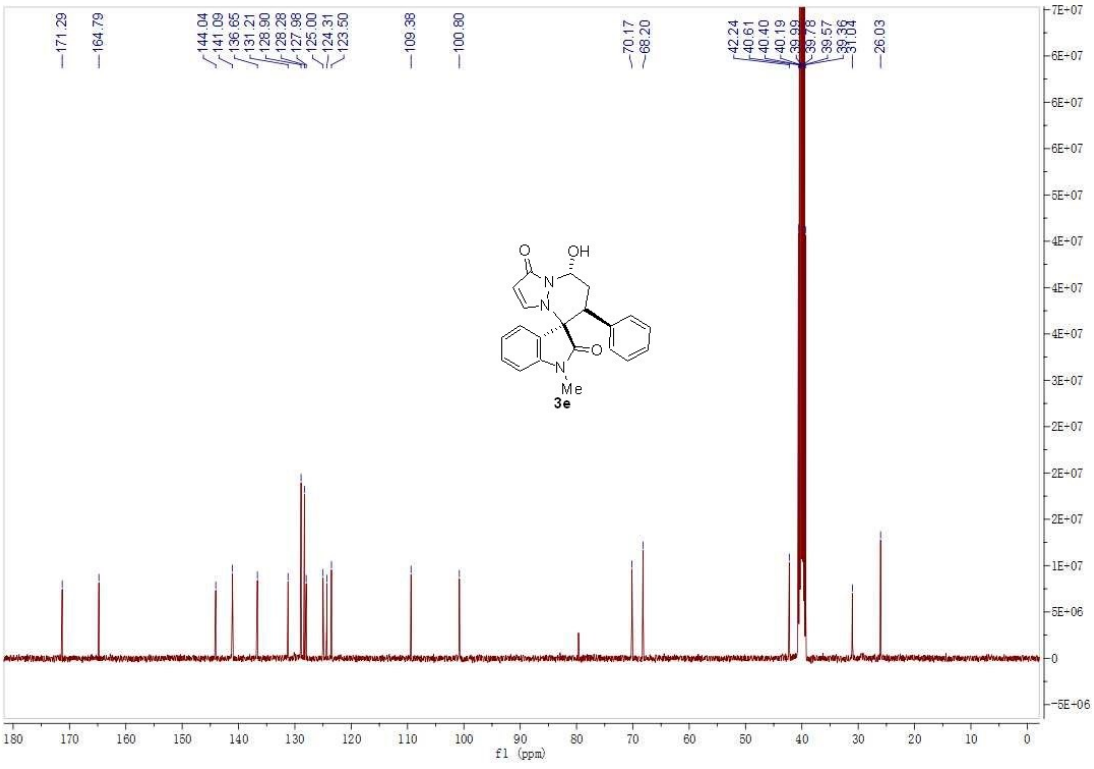
0.98
f1 (ppm)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40.19
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26.03
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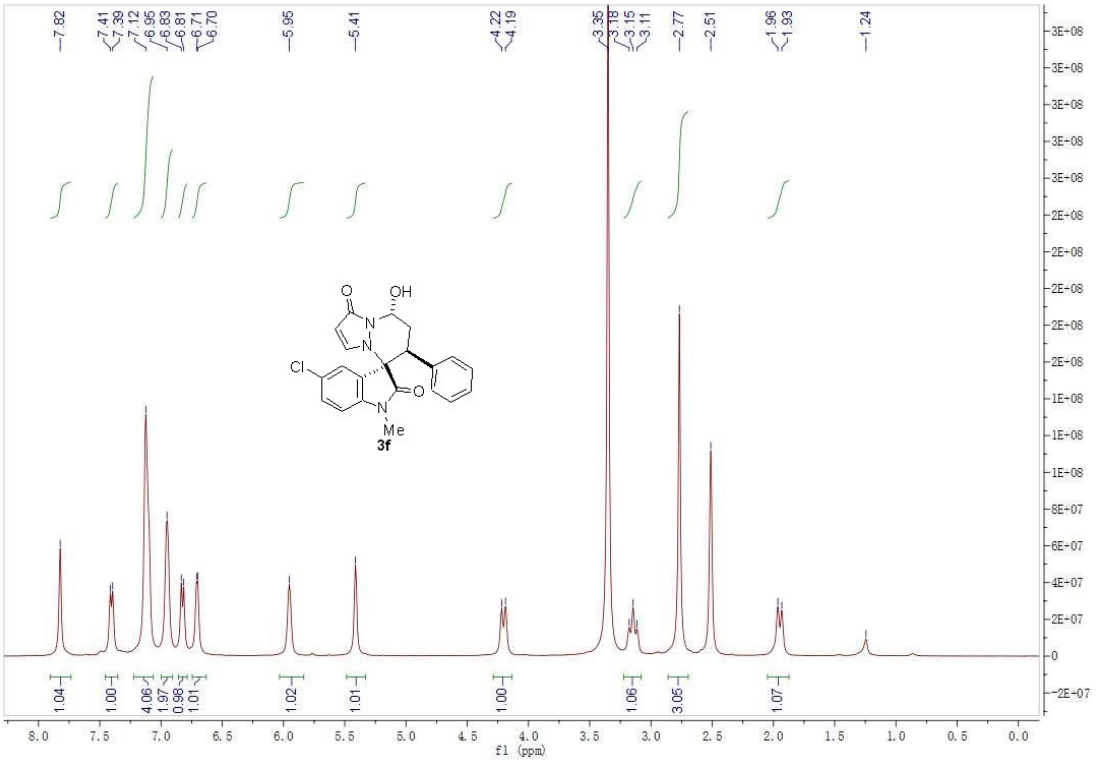
N
N
O
N
Me
3e
f1 (ppm)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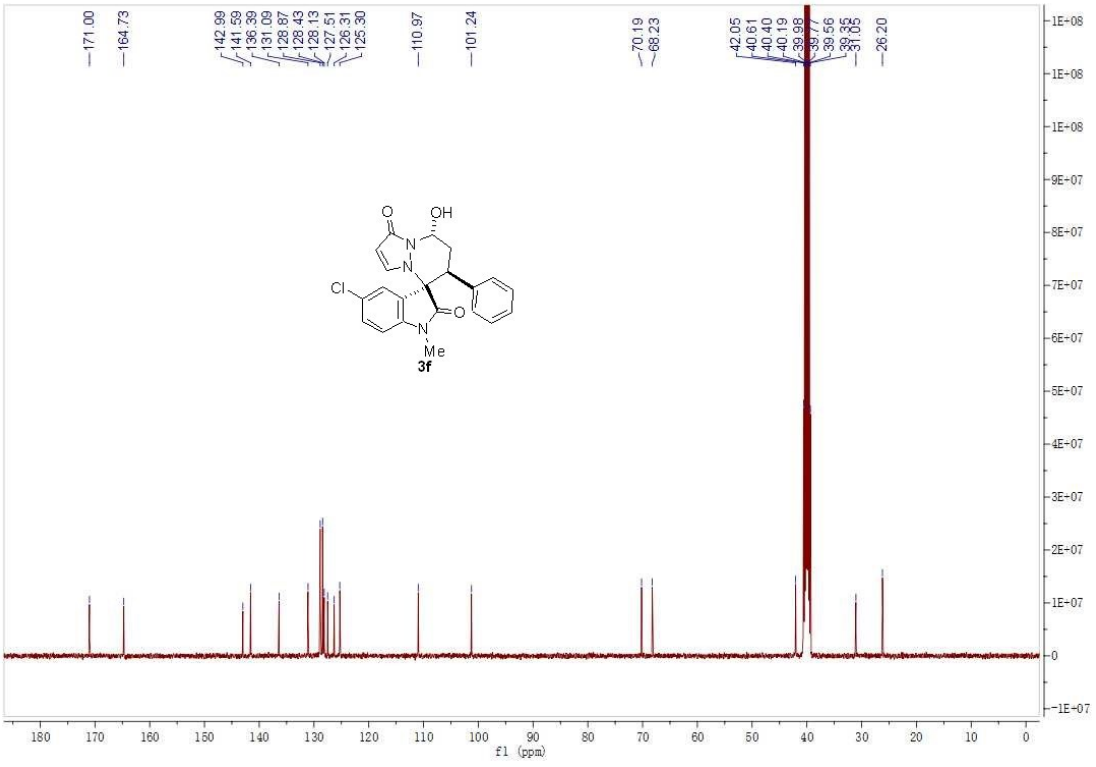
Me
3f
f1 (ppm)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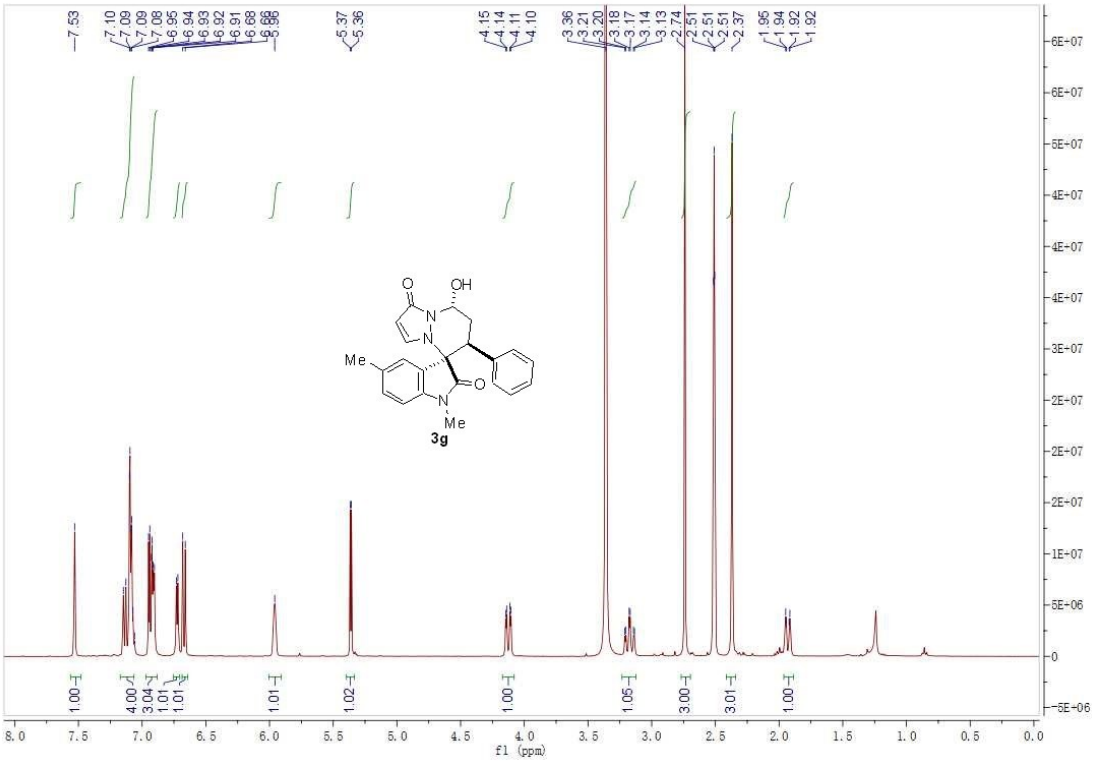
f1 (ppm)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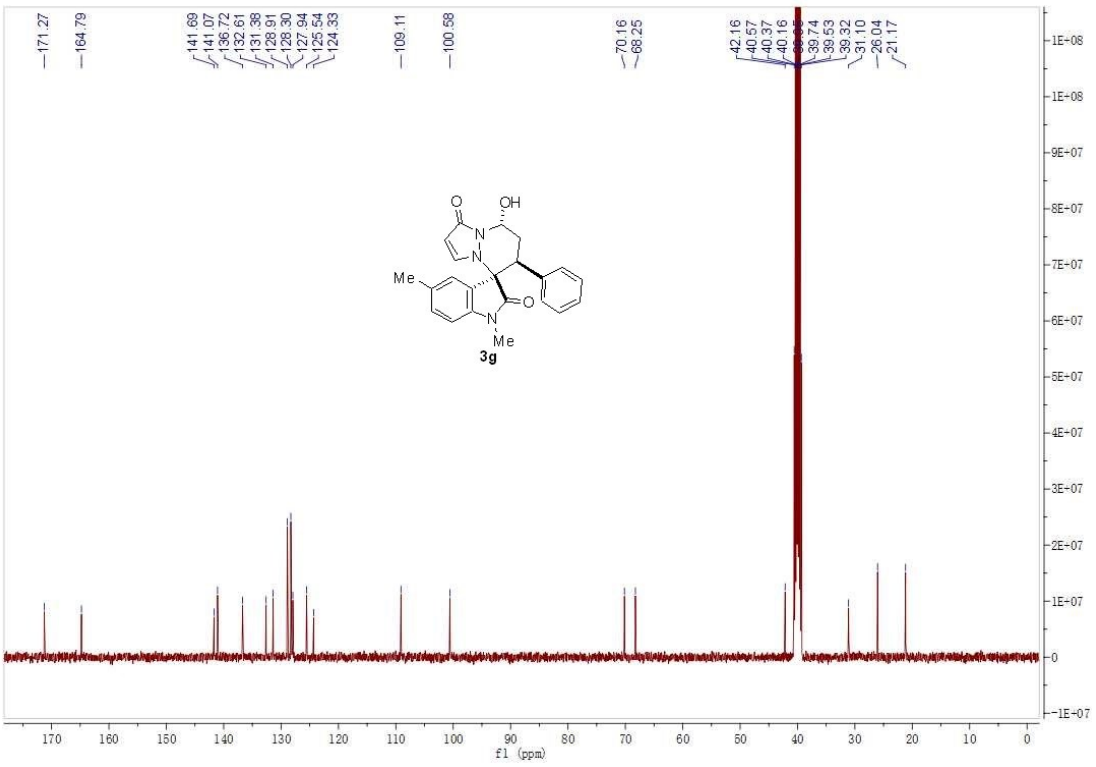
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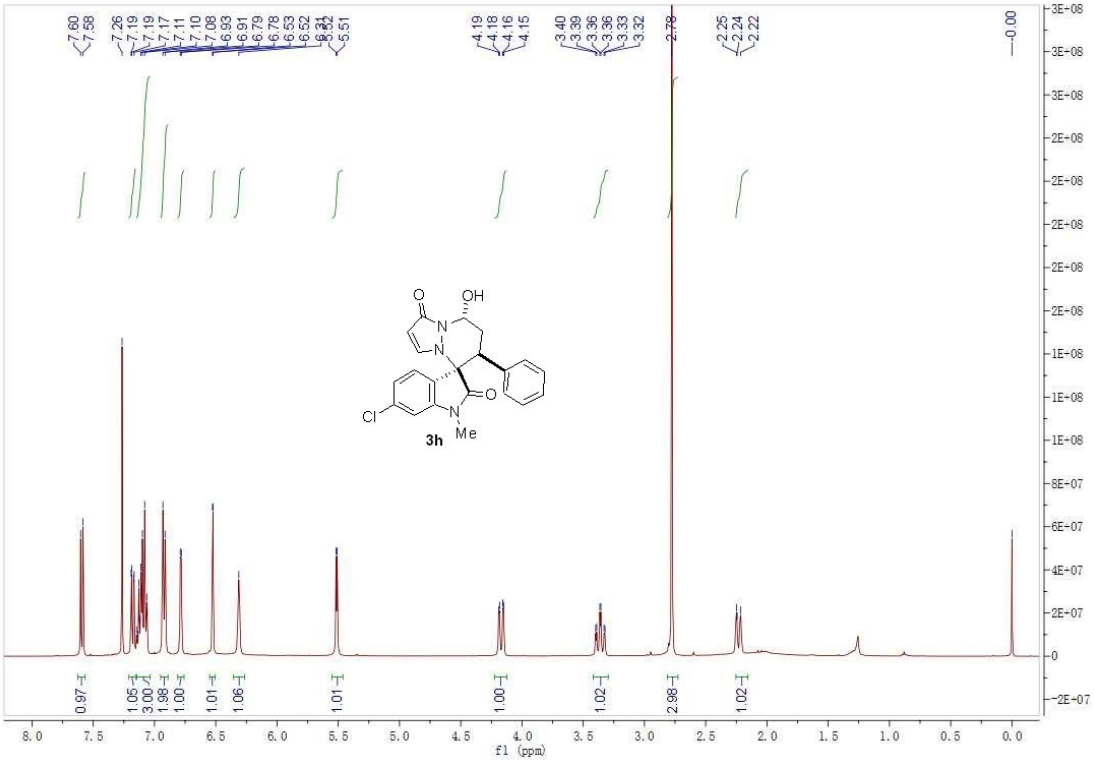
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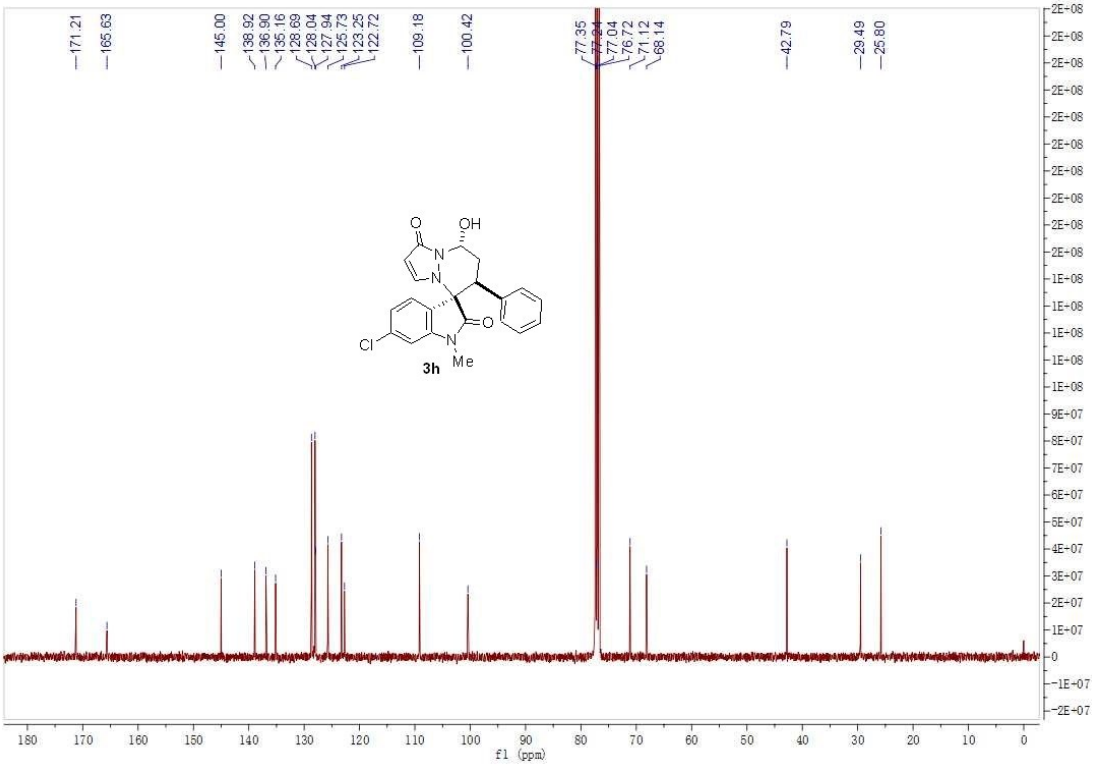
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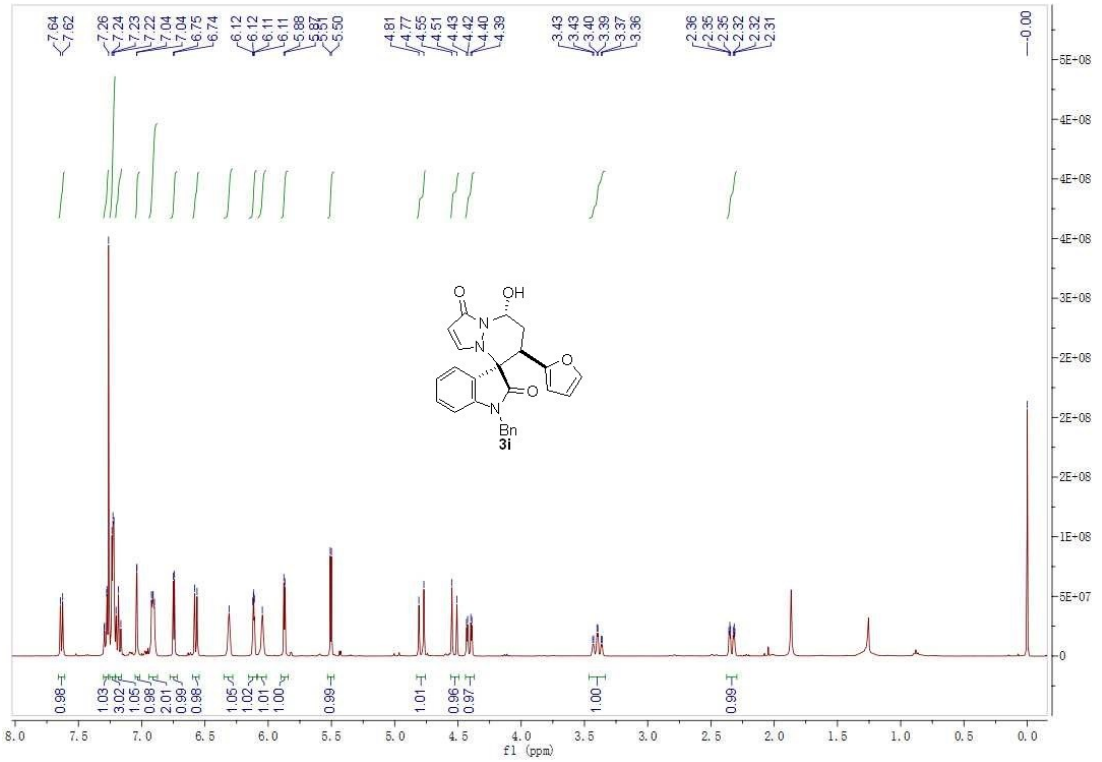
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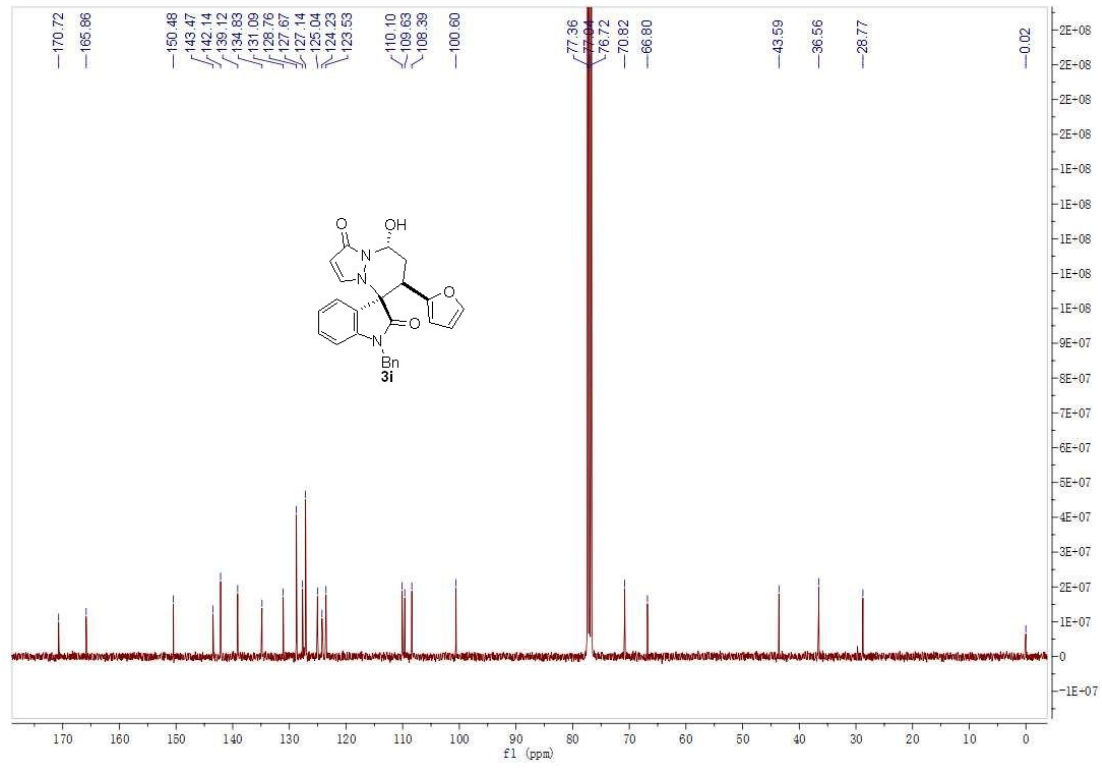
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108.39
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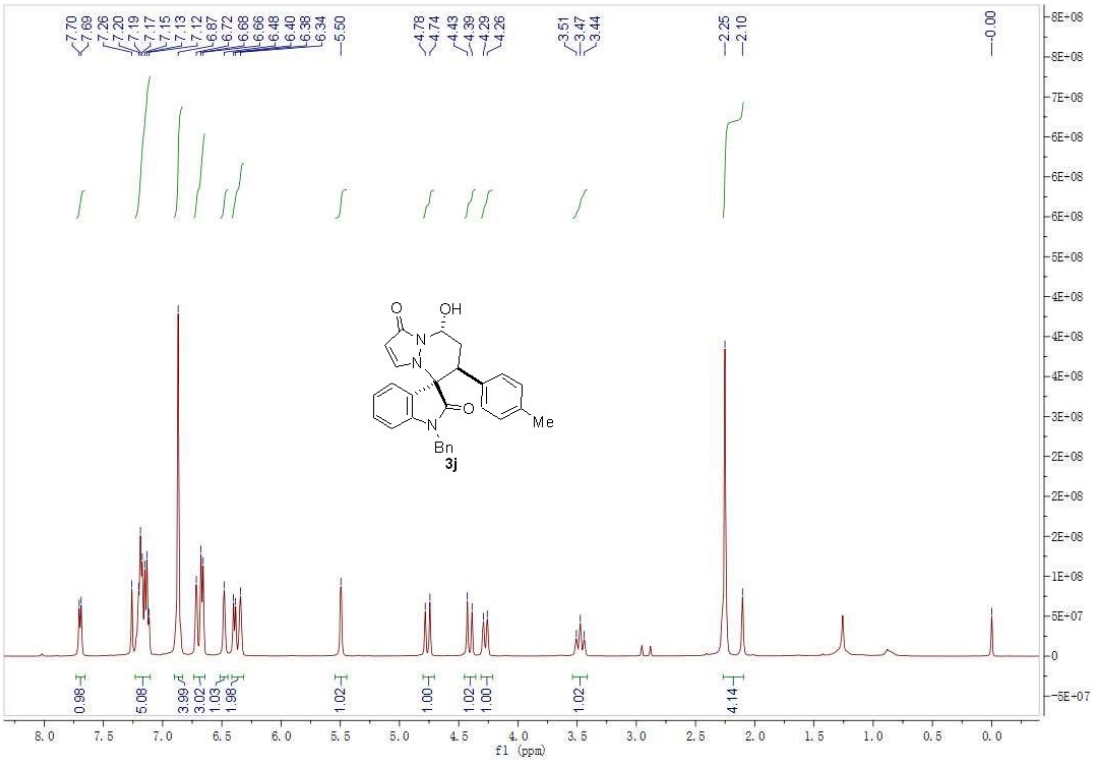
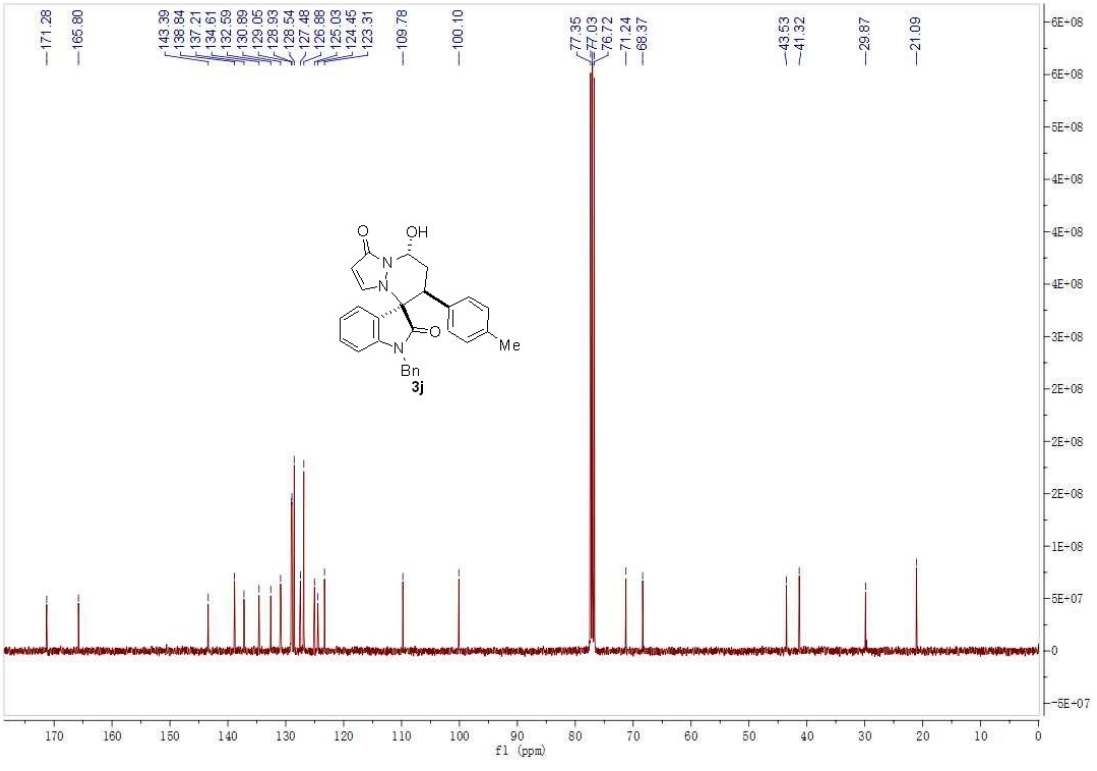
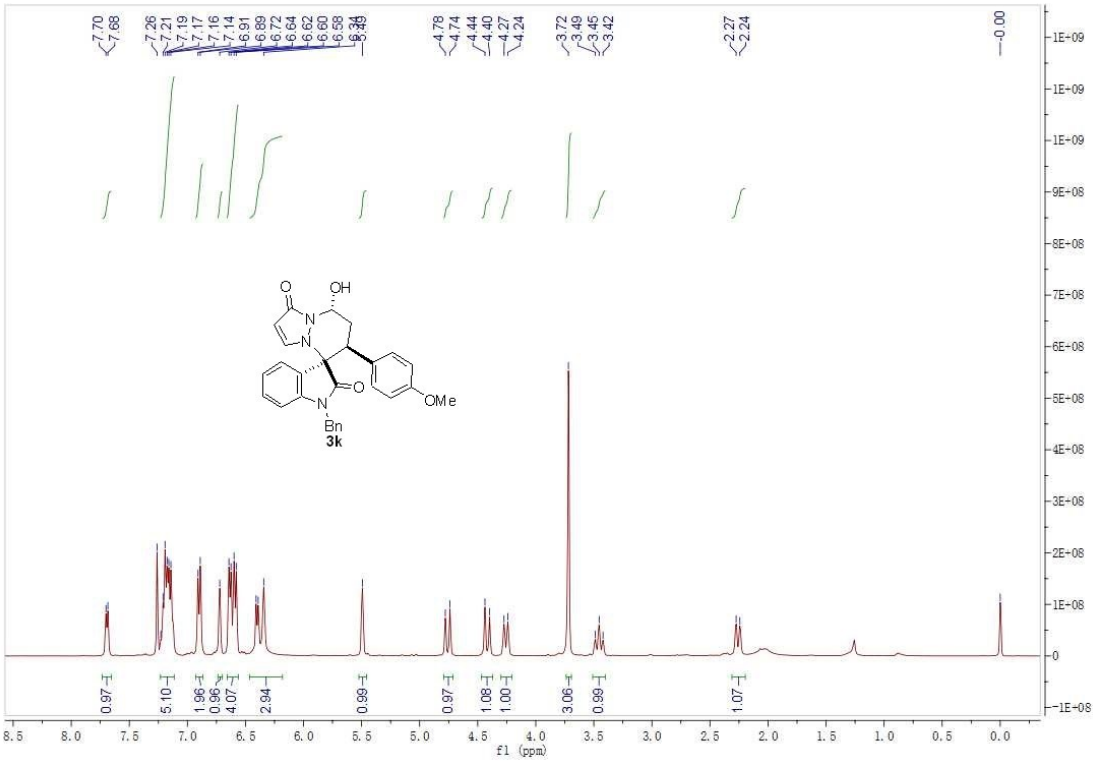
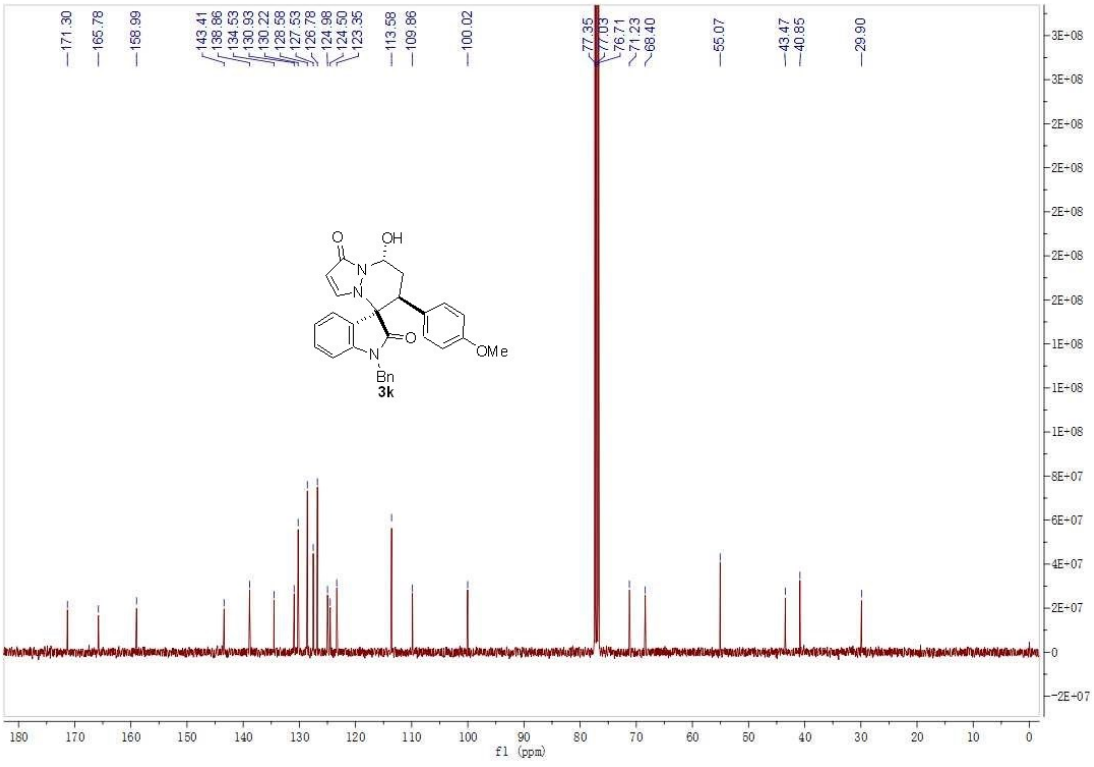
36.56
28.77
0.02
OH
O
N
N
O
N
Bn
3i
f1 (ppm)


7.70
7.69
7.26
7.20
7.19
7.17
7.15
7.13
7.12
6.87
6.72
6.68
6.66
6.48
6.40
6.38
6.34
5.50
4.78
4.74
4.43
4.39
4.29
4.26
3.51
3.47
3.44
2.25
2.10
0.00
OH
O
N
N
O
N
Bn
Me
3j
0.98
5.08
3.99
3.02
1.03
1.98
1.02
1.00
1.02
1.00
1.02
4.14
f1 (ppm)


171.28
165.80
143.39
138.84
137.21
134.61
132.59
130.89
129.05
128.93
128.54
127.48
126.88
125.03
124.45
123.31
109.78
100.10
77.35
77.03
76.72
71.24
68.37
43.53
41.32
29.87
21.09
OH
O
N
N
O
N
Bn
Me
3j
f1 (ppm)


7.70
7.68
7.26
7.21
7.19
7.17
7.16
7.14
6.91
6.89
6.72
6.64
6.62
6.60
6.58
4.78
4.74
4.44
4.40
4.27
4.24
3.72
3.49
3.45
3.42
2.27
2.24
0.00
OH
O
N
O
OMe
Bn
3k
0.97
5.10
1.96
0.96
4.07
2.94
0.99
0.97
1.08
1.00
3.06
0.99
1.07
f1 (ppm)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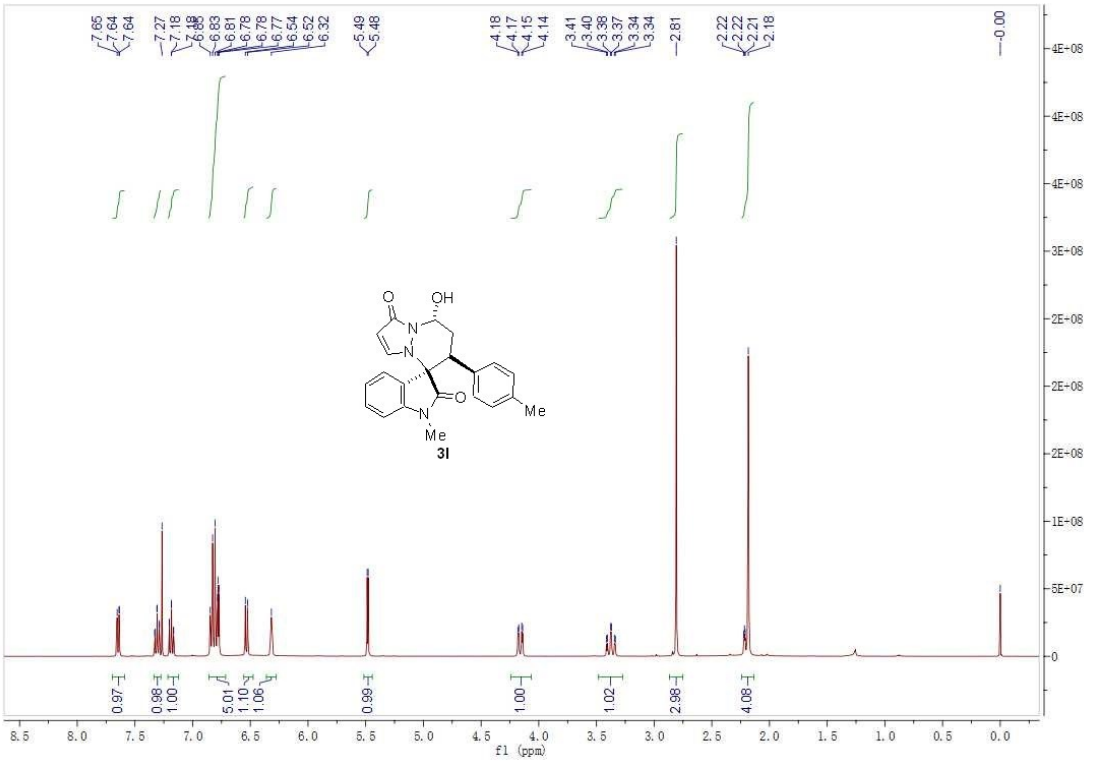
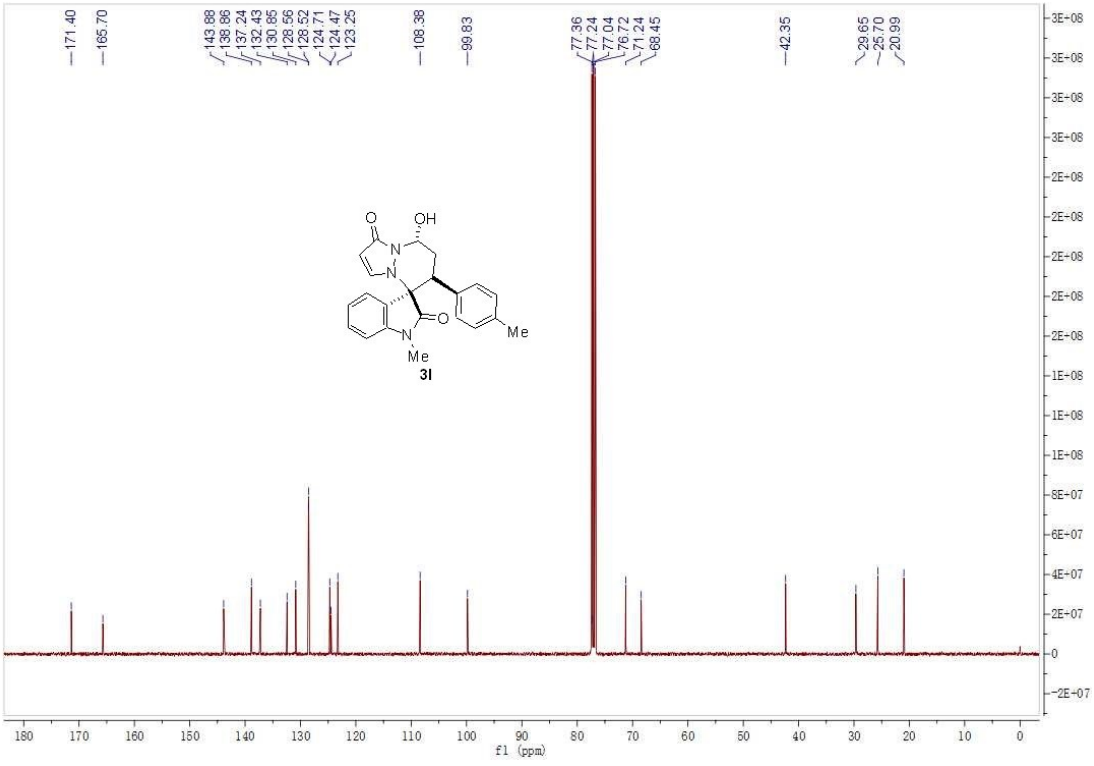
165.78
158.99
143.41
138.86
134.53
130.93
130.22
128.58
127.53
126.78
124.98
124.50
123.35
113.58
109.86
100.02
77.35
77.03
76.71
71.23
68.40
55.07
43.47
40.85
29.90
OH
O
N
O
OMe
Bn
3k
f1 (ppm)


7.65
7.64
7.64
7.27
7.18
6.83
6.81
6.78
6.77
6.54
6.52
6.32
5.49
5.48
4.18
4.17
4.15
4.14
3.41
3.40
3.38
3.37
3.34
3.34
2.81
2.22
2.22
2.21
2.18
0.00
0.97
0.98
1.00
5.01
1.10
1.06
0.99
1.00
1.02
2.98
4.08
f1 (ppm)
OH
Me
Me
3l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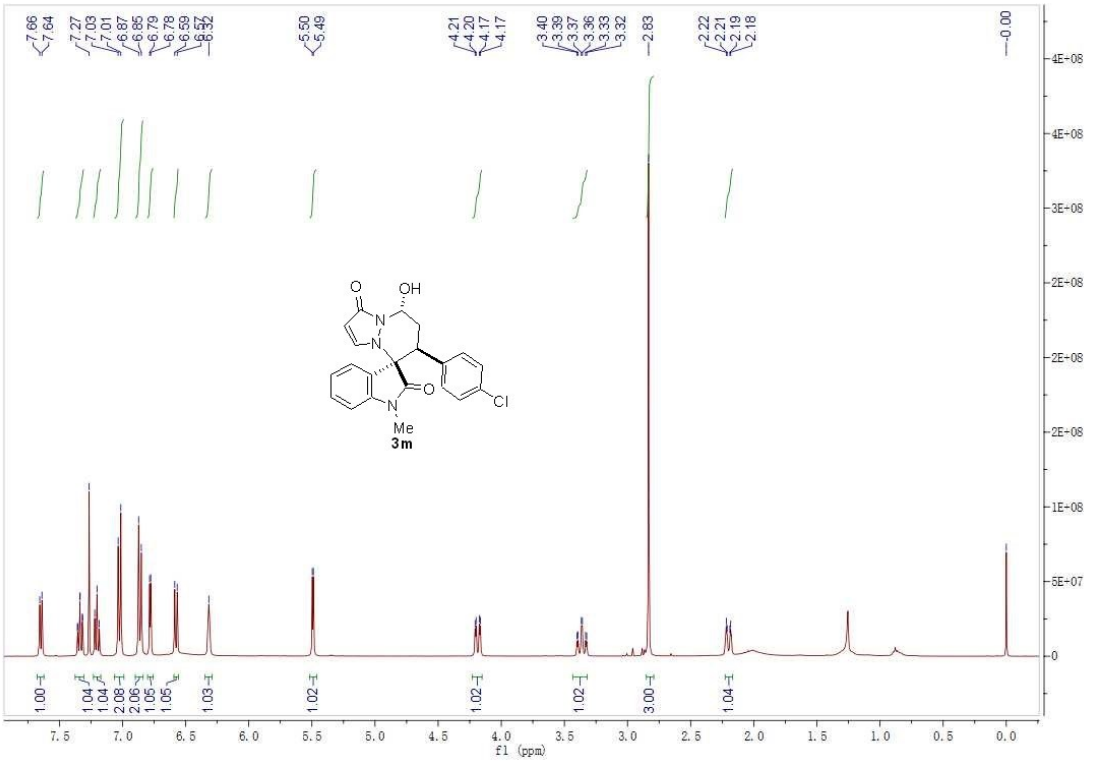
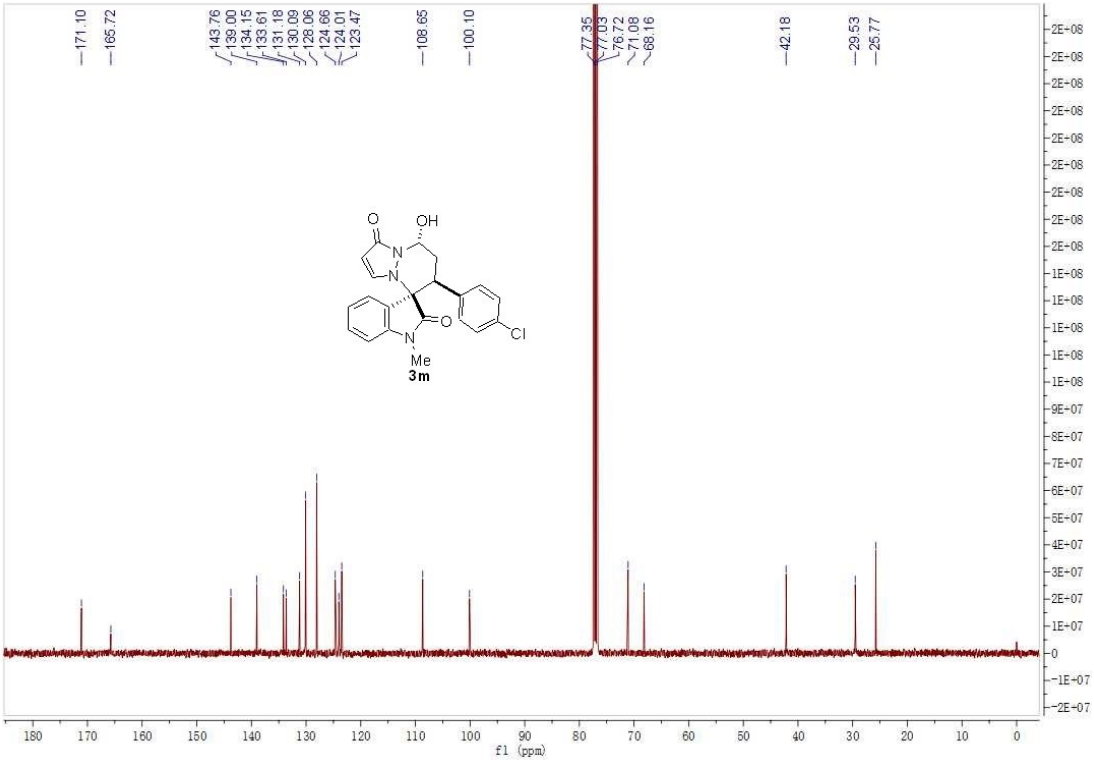
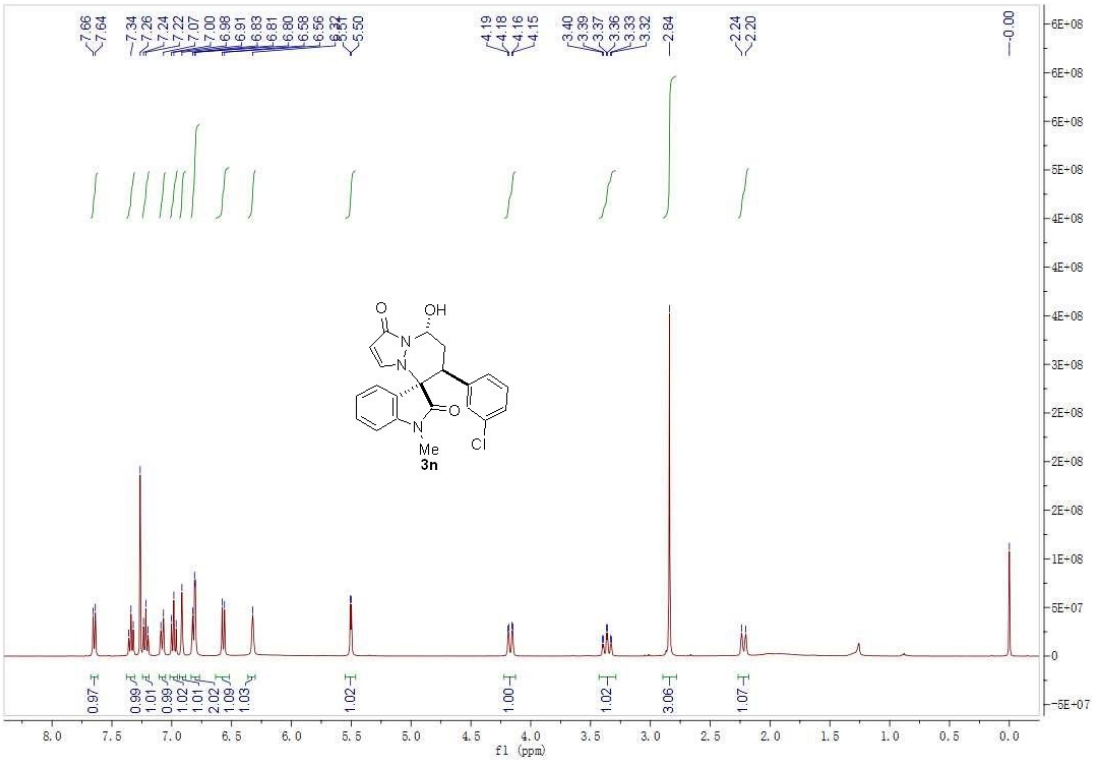
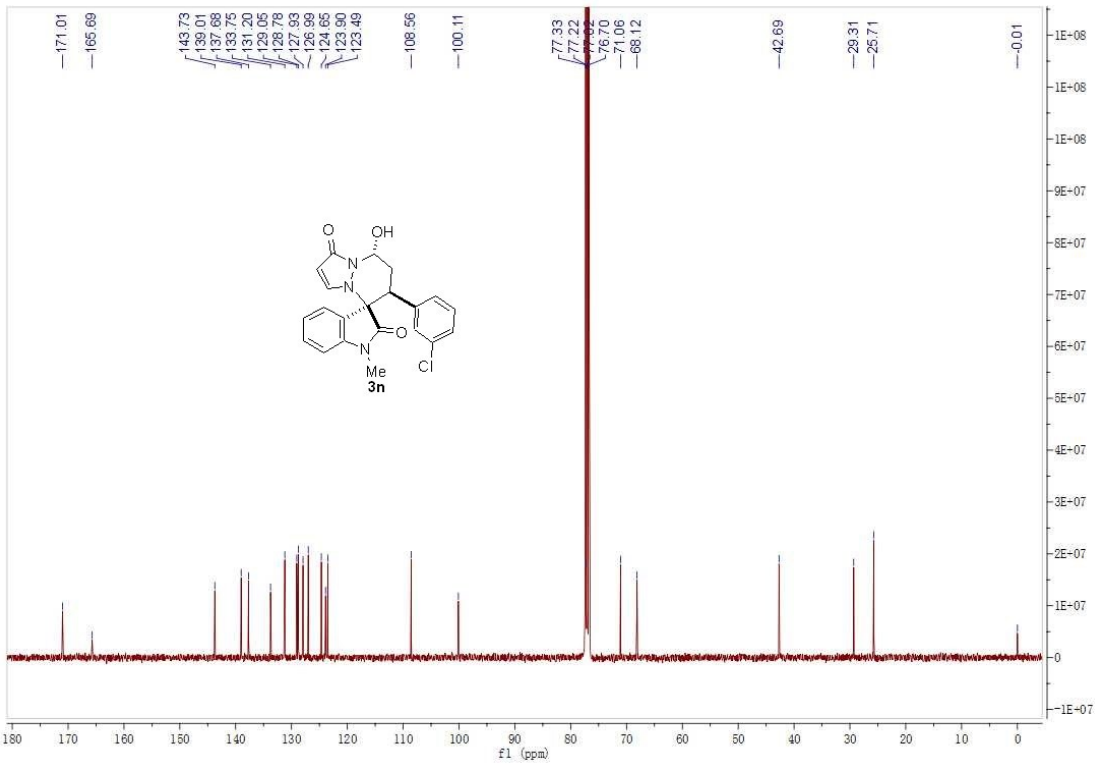
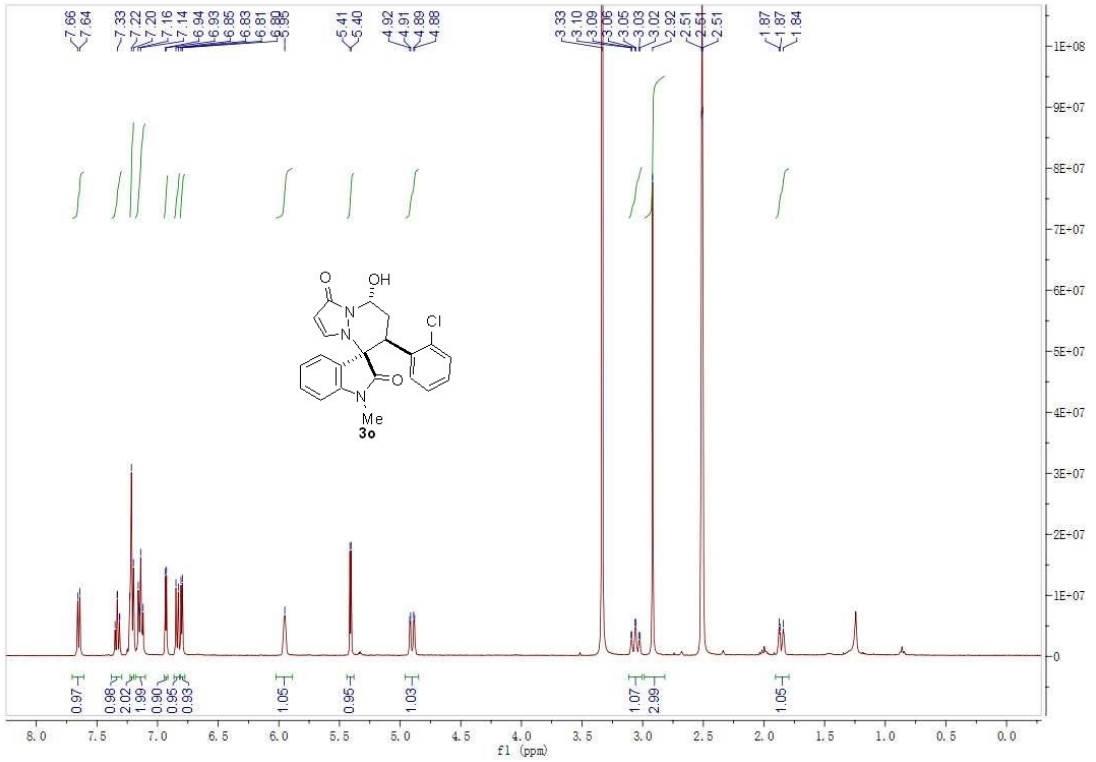
165.70
143.88
138.86
137.24
132.43
130.85
128.56
128.52
124.71
124.47
123.25
108.38
99.83
77.36
77.24
77.04
76.72
71.24
68.45
42.35
29.65
25.70
20.99
f1 (ppm)
OH
Me
Me
3l

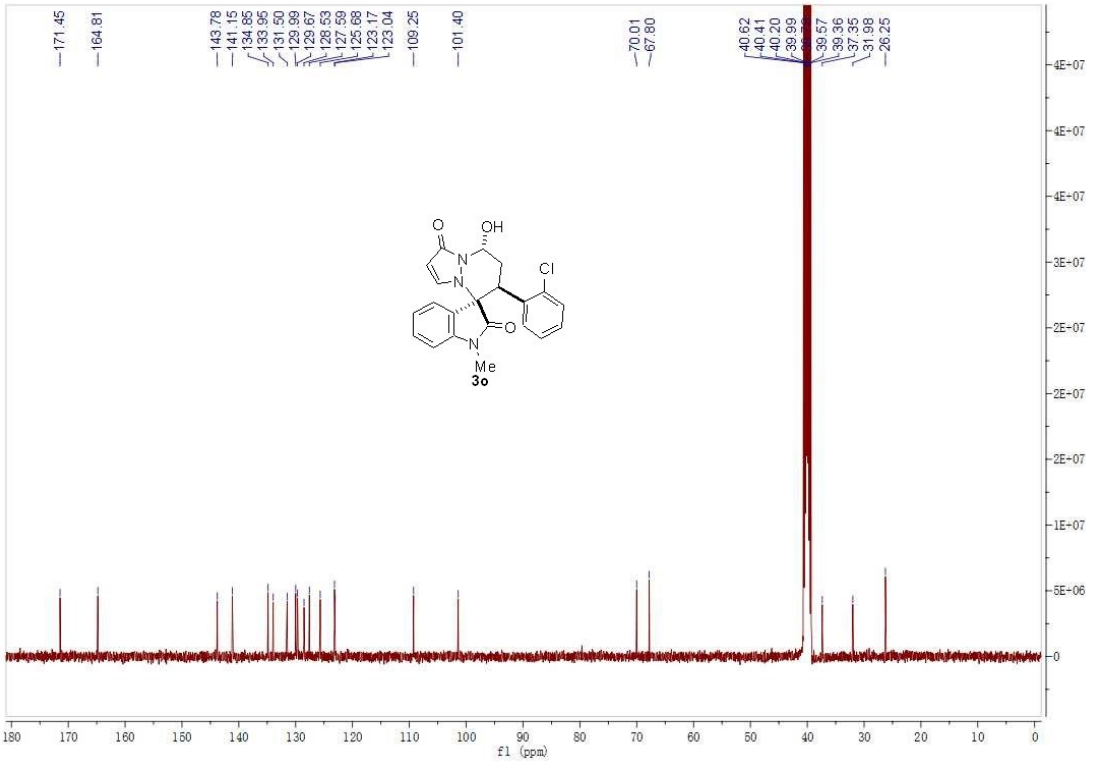

7.66
7.64
7.27
7.03
7.01
6.87
6.85
6.79
6.78
6.59
6.57
6.32
5.50
5.49
4.21
4.20
4.17
4.17
3.40
3.39
3.37
3.36
3.33
3.32
2.83
2.22
2.21
2.19
2.18
0.00
OH
O
N
N
O
N
Me
Cl
3m
1.00
1.04
1.04
2.08
2.06
1.05
1.05
1.03
1.02
1.02
1.02
3.00
1.04
f1 (ppm)

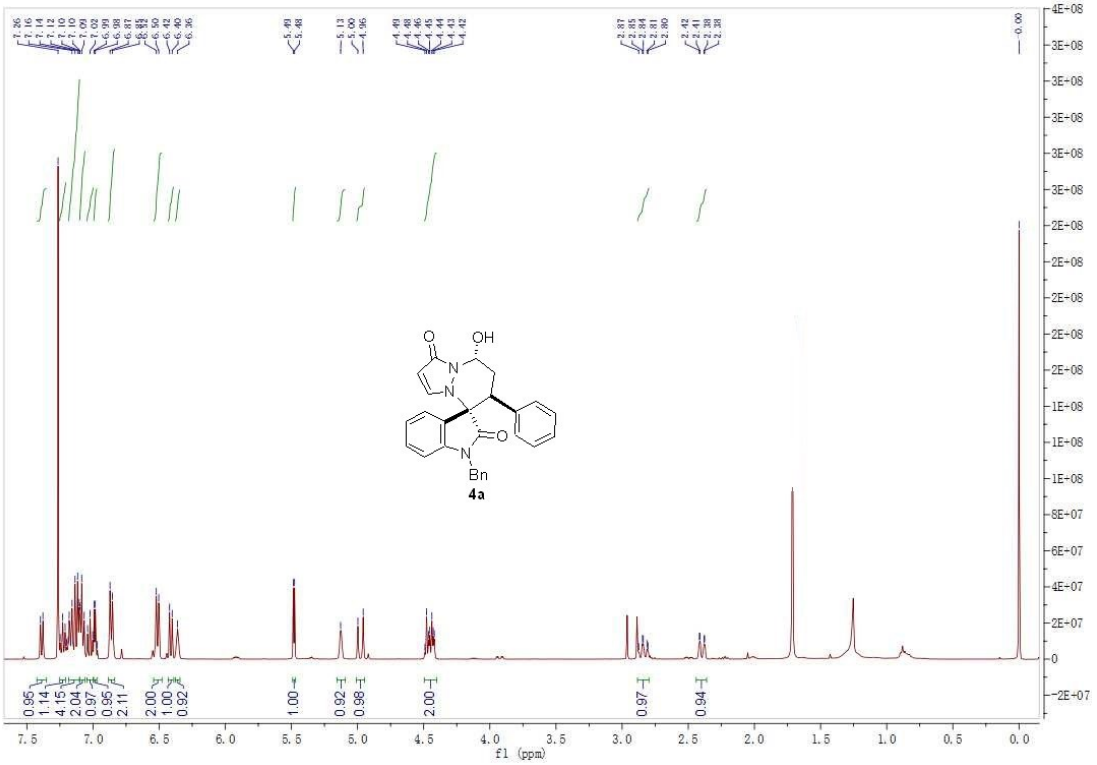

171.10
165.72
143.76
139.00
134.15
133.61
131.18
130.09
128.06
124.66
124.01
123.47
108.65
100.10
77.35
77.03
76.72
71.08
68.16
42.18
29.53
25.77
OH
O
N
N
O
N
Me
Cl
3m
f1 (ppm)

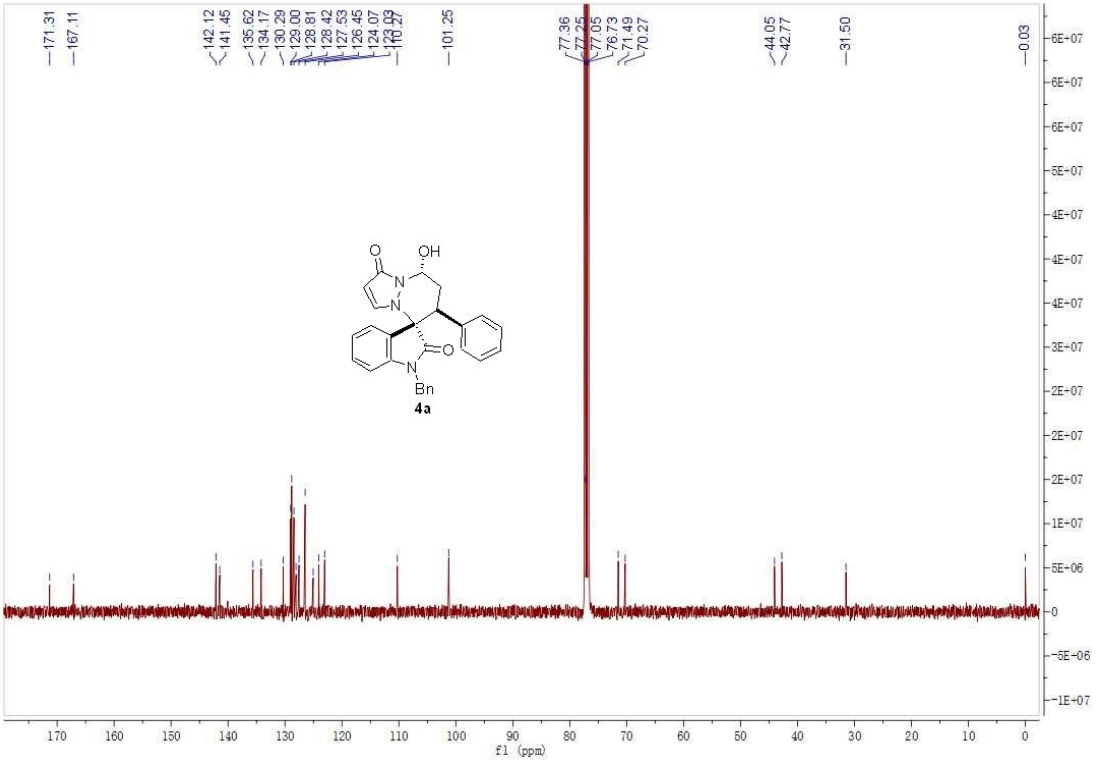

7.66
7.64
7.34
7.26
7.24
7.22
7.07
7.00
6.98
6.91
6.83
6.81
6.80
6.58
6.56
5.51
5.50
4.19
4.18
4.16
4.15
3.40
3.39
3.37
3.36
3.33
3.32
2.84
2.24
2.20
0.00
OH
O
N
N
O
N
Me
Cl
3n
0.97
0.99
1.01
1.02
0.99
1.01
2.02
1.09
1.03
1.02
1.00
1.02
3.06
1.07
f1 (ppm)


171.01
165.69
143.73
139.01
137.68
133.75
131.20
129.05
128.78
127.93
126.99
124.65
123.90
123.49
108.56
100.11
77.33
77.22
76.70
71.06
68.12
42.69
29.31
25.71
0.01
OH
O
N
N
O
N
Me
Cl
3n
f1 (ppm)


7.66
7.64
7.33
7.22
7.20
7.16
7.14
6.94
6.93
6.85
6.83
6.81
5.89
5.41
5.40
4.92
4.91
4.89
4.88
3.33
3.10
3.09
3.06
3.05
3.03
3.02
2.92
2.51
2.51
2.51
1.87
1.87
1.84
OH
Cl
O
N
N
O
N
Me
3o
0.97
0.98
2.02
1.99
0.90
0.95
0.93
1.05
0.95
1.03
1.07
2.99
1.05
f1 (ppm)

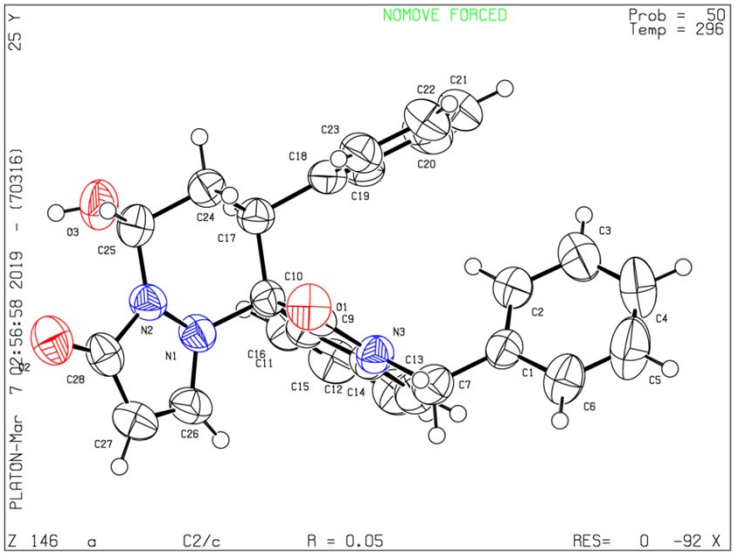

171.45
164.81
143.78
141.15
134.85
133.95
131.50
129.99
129.67
128.53
127.59
125.68
123.17
123.04
109.25
101.40
70.01
67.80
40.62
40.41
40.20
39.99
39.57
39.36
37.35
31.98
26.25
OH
Cl
O
N
N
O
N
Me
3o
f1 (ppm)


OH
N
N
O
O
N
Bn
4a
f1 (ppm)


OH
N
N
O
O
N
Bn
4a
f1 (ppm)

## 4 The crystal structure data of of 3a, 4a

### 3a




## Datablock: a

---

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

Cell:            a=31.47(2)     b=8.542(6)          c=16.198(12)
                 alpha=90       beta=95.700(15)     gamma=90
Temperature:     296 K

                 Calculated                 Reported
Volume           4333(5)                    4332(5)
Space group      C 2/c                      C2/c
Hall group       -C 2yc                     ?
Moiety formula   C27 H23 N3 O3              ?
Sum formula      C27 H23 N3 O3              C27 H23 N3 O3
Mr               437.48                     437.48
Dx,g cm-3        1.341                      1.341
Z                8                          8
Mu (mm-1)        0.089                      0.089
F000             1840.0                     1840.0
F000'            1840.79
h,k,lmax         37,10,19                   37,10,19
Nref             3809                       3795
Tmin,Tmax        0.975,0.982                0.975,0.982
Tmin'            0.975

Correction method= # Reported T Limits: Tmin=0.975 Tmax=0.982
AbsCorr = MULTI-SCAN

Data completeness= 0.996          Theta(max)= 24.990

R(reflections)= 0.0517( 1830)     wR2(reflections)= 0.1313( 3795)

S = 0.951                 Npar= 298
```

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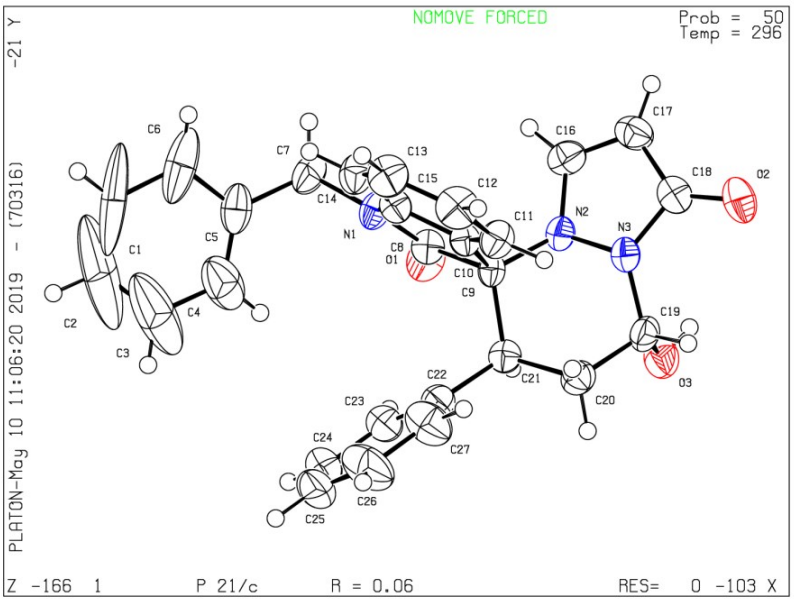
**4a**




# Datablock: 1

---

Bond precision: C-C = 0.0051 A Wavelength=0.71073

Cell: a=10.6100(12) b=9.0183(10) c=23.470(3)
alpha=90 beta=98.891(2) gamma=90
Temperature: 296 K

| | Calculated | Reported |
|---|---|---|
| Volume | 2218.7(5) | 2218.8(4) |
| Space group | P 21/c | P 21/c |
| Hall group | -P 2ybc | -P 2ybc |
| Moiety formula | C27 H23 N3 O3 | ? |
| Sum formula | C27 H23 N3 O3 | C27 H23 N3 O3 |
| Mr | 437.48 | 437.48 |
| Dx,g cm-3 | 1.310 | 1.310 |
| Z | 4 | 4 |
| Mu (mm-1) | 0.087 | 0.087 |
| F000 | 920.0 | 920.0 |
| F000' | 920.39 | |
| h,k,lmax | 12,10,27 | 12,10,27 |
| Nref | 3915 | 3907 |
| Tmin,Tmax | 0.983,0.990 | |
| Tmin' | 0.978 | |

Correction method= Not given

Data completeness= 0.998 Theta(max)= 24.999

R(reflections)= 0.0591( 2189) wR2(reflections)= 0.1328( 3907)

S = 0.959 Npar= 298

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