Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry.

Diastereoselective Synthesis of Spiro[carbazole-3,5'-pyrimidines] and Spiro[carbazole-3,1'-cyclohexanes] via Four-component Reaction

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Supporting Information

Single crystals were grown by slow evaporation of concentrated solution in $CHCl_3$ / DCM / EtOH (compounds **1a**, **1b, 1c, 1e, 1m, 1k', 2o, 2o', 3b and 4g**) in glass vials, which were then sealed by plugs with needles on them.

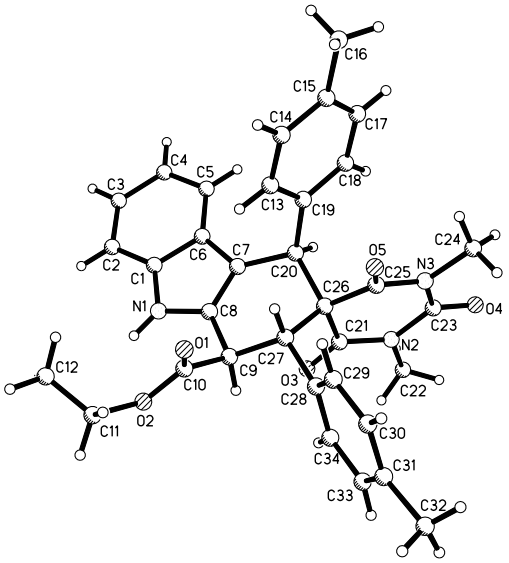


Fig. S1 ORTEP drawing (30%) of the crystal structure of **1a**

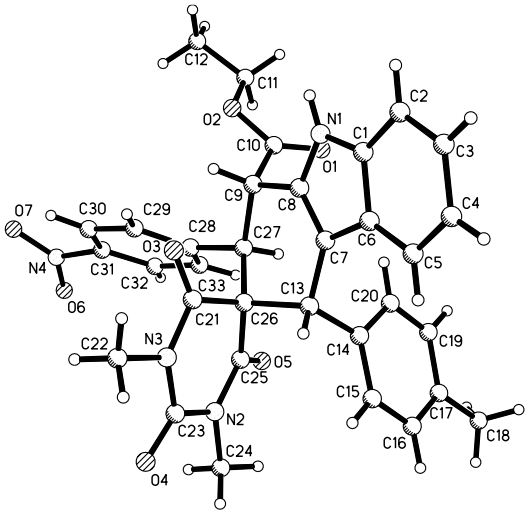


Fig. S2 ORTEP drawing (30%) of the crystal structure of **1b**

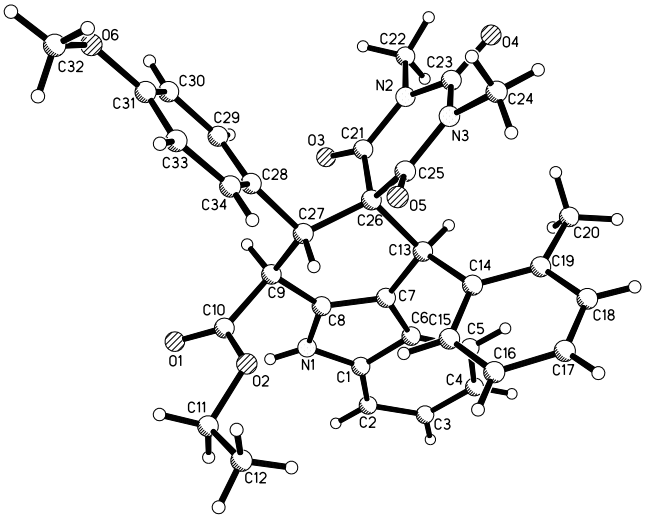


Fig. S3 ORTEP drawing (30%) of the crystal structure of **1c**

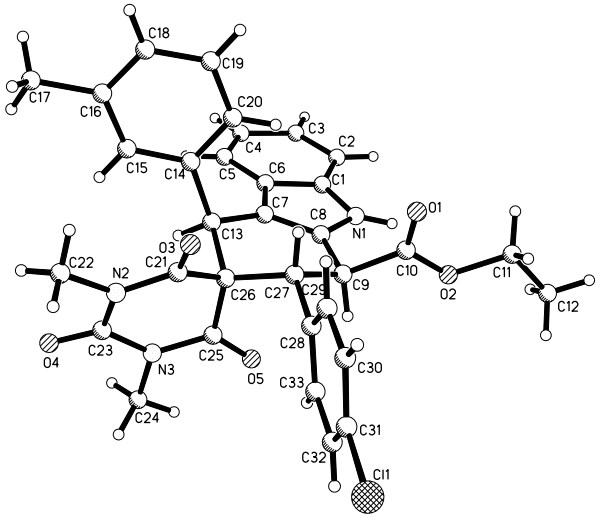


Fig. S4 ORTEP drawing (30%) of the crystal structure of **1e**

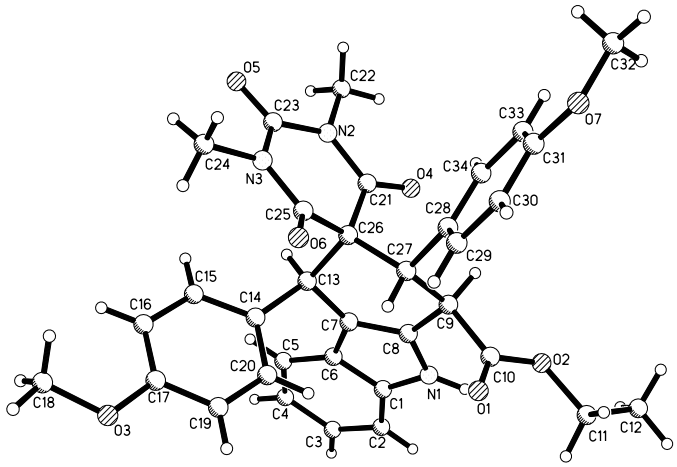


Fig. S5 ORTEP drawing (30%) of the crystal structure of **1m**

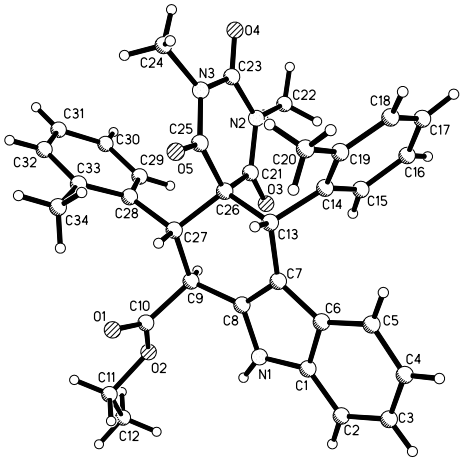


Fig. S6 ORTEP drawing (30%) of the crystal structure of **1k'**

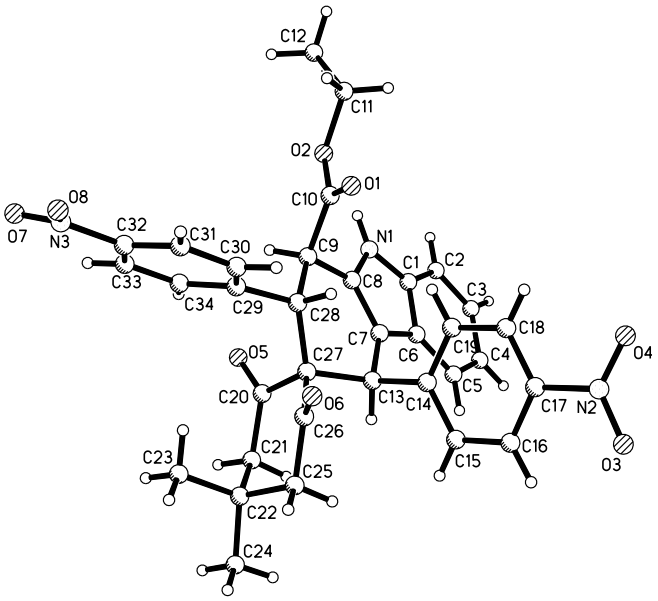


Fig. 7 ORTEP drawing (30%) of the crystal structure of **2o**

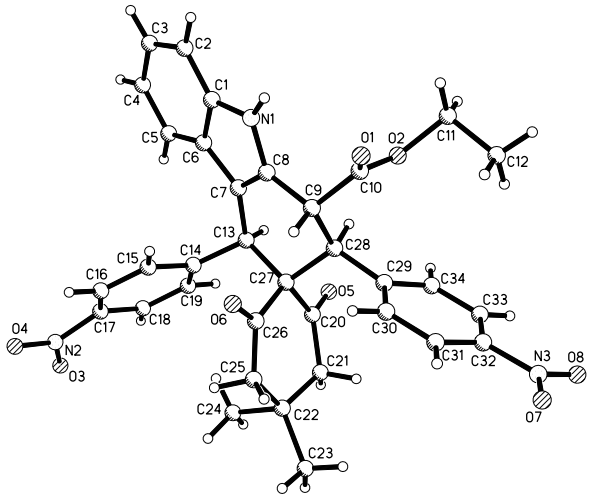


Fig. S8 ORTEP drawing (30%) of the crystal structure of **2o'**

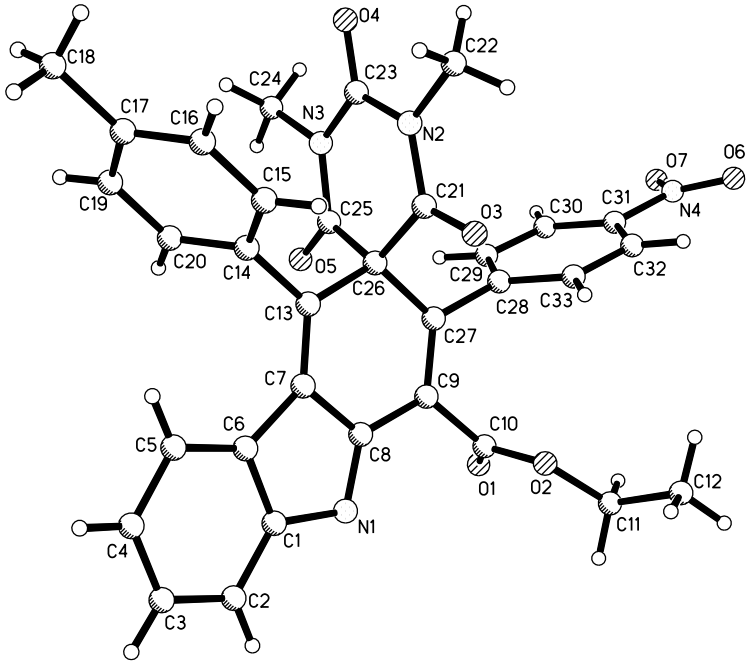


Fig. S9 ORTEP drawing (30%) of the crystal structure of **3b**

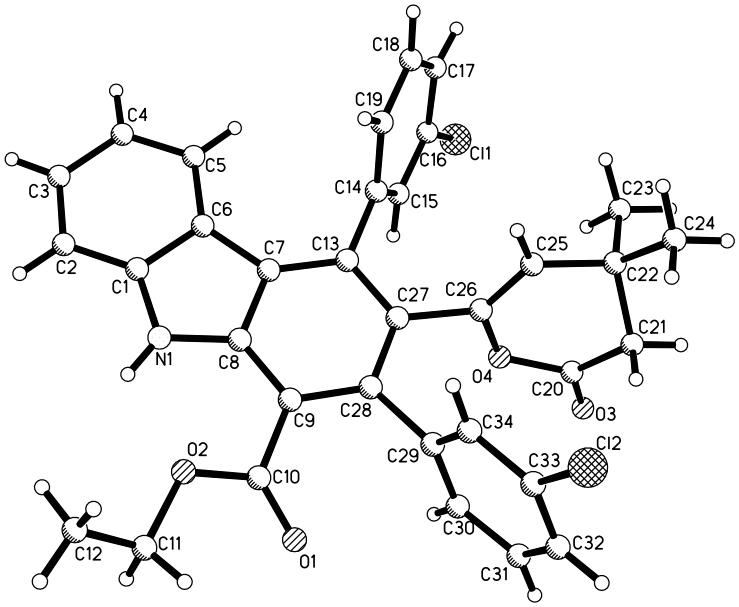


Fig.S10 ORTEP drawing (30%) of the crystal structure of **4g**

Table S1 The single crystal date of compounds **1a, 1b, 1c**

Phase	**1a**	**1b**	**1c**
Empirical formula	$C_{34}H_{33}N_3O_5$	$C_{33}H_{30}N_4O_7$	$C_{34}H_{33}N_3O_6$
Formula weight	563.63	594.61	579.63
Temperature/K	296(2) K	296(2) K	296(2) K
Wavelength/ Å	0.71073	0.71073	0.71073
Crystal system	Triclinic	Triclinic	Monoclinic
Space group	P-1	P-1	P2(1)/n
a /Å	10.0138(5)	12.1728(16)	11.3100(8)
b / Å	11.7765(6)	13.4083(18)	9.5077(6)
c / Å	12.7363(6)	22.278(3)	27.4588(19)
α (°)	84.6324(15)	86.724(4)	90
β (°)	78.1330(15)	89.748(4)	96.138(3)
γ (°)	84.1528(16)	78.705(4)	90
V (Å ^{3})	1458.14(13)	3559.7(8)	2935.8(3)
Z	2	4	4
Calculated density (g·cm^{-3})	1.284	1.109	1.311
Absorption coefficient(mm^{-1})	0.087	0.079	0.091
F(000)	596	1248	1224
θ range /(°)	2.086 to 25.998 deg.	1.931 to 25.998 deg.	2.268 to 25.998
Limiting indices	-12<=h<=12, -14<=k<=14, -15<=l<=15	-15<=h<=14, -16<=k<=16, -27<=l<=27	-13<=h<=13, -10<=k<=11, -33<=l<=33
Reflections collected/unique	20829 / 5718 [R(int) = 0.0311]	47241 / 13916 [R(int) = 0.1627]	26618 / 5756 [R(int) = 0.0744]
Completeness to theta	99.6 %	99.5 %	99.9 %
Max. and min. transmission	0.7456 and 0.6875	0.7456 and 0.5936	0.7456 and 0.6830
Refinement method	Full-matrix least-squares on F^2	Full-matrix least-squares on F^2	Full-matrix least-squares on F^2
Data/restraints/parameters	5718 / 0 / 384	13916 / 0 / 801	5756 / 0 / 404
Goodness-of-fit on F^2	1.028	1.020	1.020
Final *R* indices[I>2sigma(I)]	R1 = 0.0512, wR2 = 0.1208	R1 = 0.0987, wR2 = 0.2202	R1 = 0.0625, wR2 = 0.1231
R indices (all data)	R1 = 0.0792, wR2 = 0.1367	R1 = 0.2259, wR2 = 0.2709	R1 = 0.1611, wR2 = 0.1568
Largest diff. peak and hole /(e ·Å^{-3})	0.218 and -0.265	0.606 and -0.342	0.185 and -0.164

Table S1 The single crystal date of compounds **1e, 1m, 1k'**

Phase	**1e**	**1m**	**1k'**
Empirical formula	$C_{33}H_{30}ClN_3O_5$	$C_{34}H_{33}N_3O_7$	$C_{34}H_{33}N_3O_5$
Formula weight	584.05	595.63	563.63
Temperature/K	296(2) K	296(2) K	296(2) K
Wavelength/ Å	0.71073	0.71073	0.71073
Crystal system	Monoclinic	Monoclinic	Monoclinic
Space group	P2(1)/n	P2(1)/n	P2(1)/c
a /Å	8.6348(3)	8.8520(7)	17.6658(12)
b / Å	17.8206(7)	18.3198(15)	12.4540(8)
c / Å	18.8901(8)	18.4779(17)	26.766(2)
α (°)	90	90	90
β (°)	94.7464(13)	95.474(3)	95.226(2)
γ (°)	90	90	90
V (Å ^{3})	2896.8(2)	2982.8(4)	5864.3(7)
Z	4	4	8
Calculated density (g·cm^{-3})	1.339	1.326	1.277
Absorption coefficient(mm^{-1})	0.179	0.094	0.086
F(000)	1224	1256	2384
θ range /(°)	2.164 to 25.997 deg.	2.214 to 25.998	1.528 to 25.999 deg.
Limiting indices	-10<=h<=9, -21<=k<=21, -20<=l<=23	-10<=h<=10, -22<=k<=22, -20<=l<=22	-21<=h<=21, -15<=k<=15, -32<=l<=33
Reflections collected/unique	27001 / 5683 [R(int) = 0.0352]	27845 / 5836 [R(int) = 0.1304]	59155 / 11530 [R(int) = 0.1698]
Completeness to theta	99.6 %	99.8 %	99.9 %
Max. and min. transmission	0.7456 and 0.7042	0.7456 and 0.5371	0.7456 and 0.6887
Refinement method	Full-matrix least-squares on F^2	Full-matrix least-squares on F^2	Full-matrix least-squares on F^2
Data/restraints/parameters	5683 / 48 / 383	5836 / 0 / 402	11530 / 396 / 767
Goodness-of-fit on F^2	1.034	1.004	1.022
Final *R* indices[I>2sigma(I)]	R1 = 0.0487, wR2 = 0.1118	R1 = 0.0681, wR2 = 0.1163	R1 = 0.1063, wR2 = 0.2190
R indices (all data)	R1 = 0.0792, wR2 = 0.1278	R1 = 0.2193, wR2 = 0.1593	R1 = 0.2613, wR2 = 0.2918
Largest diff. peak and hole /(e ·Å^{-3})	0.328 and -0.516	0.197 and -0.188	0.527 and -0.702

Table S2 The single crystal date of compounds **2o, 2o'**

Phase	**2o**	**2o'**
Empirical formula	$C_{34}H_{31}N_3O_8$	$C_{34}H_{31}N_3O_8$
Formula weight	609.62	609.62
Temperature/K	296(2) K	296(2) K
Wavelength/ Å	0.71073	0.71073
Crystal system	Monoclinic	Triclinic
Space group	P2(1)/n	P-1
a /Å	13.3152(19)	10.8318(6)
b / Å	11.0682(15)	11.4013(7)
c / Å	20.681	15.4837(8)
α (°)	90.000(4)	105.432(2)
β (°)	96.176(4)	103.175(2)
γ (°)	90	103.079(2)
V (Å ^{3})	3030.2(6)	1708.79(17)
Z	4	2
Calculated density (g·cm^{-3})	1.336	1.185
Absorption coefficient(mm^{-1})	0.096	0.085
F(000)	1280	640
θ range /(°)	2.090 to 25.999	1.946 to 25.999
Limiting indices	-16<=h<=16, -13<=k<=13, -25<=l<=20	-13<=h<=13, -14<=k<=14, -19<=l<=17
Reflections collected/unique	23239 / 5934 [R(int) = 0.2259]	17530 / 6537 [R(int) = 0.0475]
Completeness to theta	99.5 %	97.3 %
Max. and min. transmission	0.7456 and 0.6561	0.7456 and 0.6729
Refinement method	Full-matrix least-squares on F^2	Full-matrix least-squares on F^2
Data/restraints/parameters	5934 / 23 / 421	6537 / 205 / 478
Goodness-of-fit on F^2	1.117	1.024
Final *R* indices[I>2sigma(I)]	R1 = 0.1208, wR2 = 0.2225	R1 = 0.0946, wR2 = 0.2299
R indices (all data)	R1 = 0.1741, wR2 = 0.2476	R1 = 0.1818, wR2 = 0.2804
Largest diff. peak and hole /(e ·Å^{-3})	0.324 and -0.341	0.563 and -0.857

Table S3 The single crystal date of compounds **3b, 4g**

Phase	**3b**	**4g**
Empirical formula	$C_{33}H_{26}N_4O_7$	$C_{34}H_{27}Cl_2NO_4$
Formula weight	590.58	584.46
Temperature/K	273(2) K	296(2) K
Wavelength/ Å	0.71073	0.71073
Crystal system	Triclinic	Triclinic
Space group	P-1	P-1
a /Å	8.9596(5)	10.7954(11)
b / Å	9.3710(6)	11.0062(10)
c / Å	19.8144(11)	13.5566(12)
α (°)	99.2210(18)	68.256(3)
β (°)	100.1718(17)	87.382(3)
γ (°)	96.4144(19)	86.599(3)
V (Å ^{3})	1599.44(16)	1493.0(2)
Z	2	2
Calculated density (g·cm^{-3})	1.226	1.300
Absorption coefficient(mm^{-1})	0.088	0.256
F(000)	616	608
θ range /(°)	2.125 to 25.995	2.053 to 25.996
Limiting indices	-10<=h<=11, -11<=k<=11, -24<=l<=24	-13<=h<=13, -13<=k<=13, -16<=l<=16
Reflections collected/unique	22802 / 6250 [R(int) = 0.0351]	21316 / 5862 [R(int) = 0.0432]
Completeness to theta	99.5 %	99.8 %
Max. and min. transmission	0.7456 and 0.6860	0.7456 and 0.6956
Refinement method	Full-matrix least-squares on F^2	Full-matrix least-squares on F^2
Data/restraints/parameters	6250 / 15 / 402	5862 / 0 / 373
Goodness-of-fit on F^2	1.015	1.034
Final *R* indices[I>2sigma(I)]	R1 = 0.0602, wR2 = 0.1498	R1 = 0.0788, wR2 = 0.2039
R indices (all data)	R1 = 0.0960, wR2 = 0.1709	R1 = 0.1288, wR2 = 0.2348
Largest diff. peak and hole /(e ·Å^{-3})	0.424 and -0.347	1.021 and -0.567

Experimental section

Unless noted, the commercial reagents and solvents were used without further purification. Melting points were recorded with a micromelting point apparatus and are uncorrected. IR spectra were recorded using a Bruker Tensor 27 spectrometer (KBr disc). The ^{1}H and 13C{^{1}H} NMR spectra were recorded with a Varian 400 spectrometer at 400 or 100 MHz. High-resolution mass spectra (HRMS) were recorded in ESI mode using a MicroTOF mass spectrometer. Single-crystal X-ray data were collected with a Bruker Smart APEX-2 CCD diffractometer. All reactions were monitored by thin-layer chromatography (TLC) using silica gel plates (silica gel 60 F254 0.25 mm), and components were monitored by observation under UV light (254 and 365 nm).

1. **General procedures for the Synthesis of functionalized spiro[carbazole-3,5'-pyrimidines] spiro[carbazole-2,4'-pyrazoles] via three-component reaction**: A mixture of indole-2-acetate (0.5 mmol), aldehyde (0.6 mmol) and 2-arylidene-1,3'-dimethylbarbituric acid (0.5 mmol) in dry toluene (6.0 mL) was stirred at 110^{o}C for three hours. After removing the solvent by evaporating at reduced pressure, the residue was subjected to column chromatography with ethyl acetate and light petroleum (V/V=1:5-1:8) to give pure **1a**-**1j** and **1a'-1j'**.

2. **General procedures for the Synthesis of functionalized spiro[carbazole-3,5'-pyrimidines] spiro[carbazole-2,4'-pyrazoles] via four-component reaction**: A mixture of indole-2-acetate (0.5 mmol), aldehyde (1.0 mmol) and 1,3'-dimethylbarbituric acid (0.5 mmol) in dry toluene (6.0 mL) was stirred at 110^{o}C for three hours. After removing the solvent by evaporating at reduced pressure, the residue was subjected to column chromatography with ethyl acetate and light petroleum (V/V=1:5-1:8) to give pure **1k**-**1r** and **1k'-1r'**.

3. **General procedures for the Synthesis of functionalized spiro[carbazole-3,1'-cyclohexanes]**

via four-component reaction: A mixture of indole-2-acetate (0.5 mmol), aromatic aldehyde (1.0 mmol) and cyclohexane-1,3-dione or dimedone (0.5 mmol) in dry toluene (6.0 mL) was stirred at 110^{o}C for three hours. After removing the solvent by evaporating at reduced pressure, the residue was subjected to column chromatography with ethyl acetate and light petroleum (V/V=1:4-1:8) to give pure **2a-2o** and **2a'-2o'**.

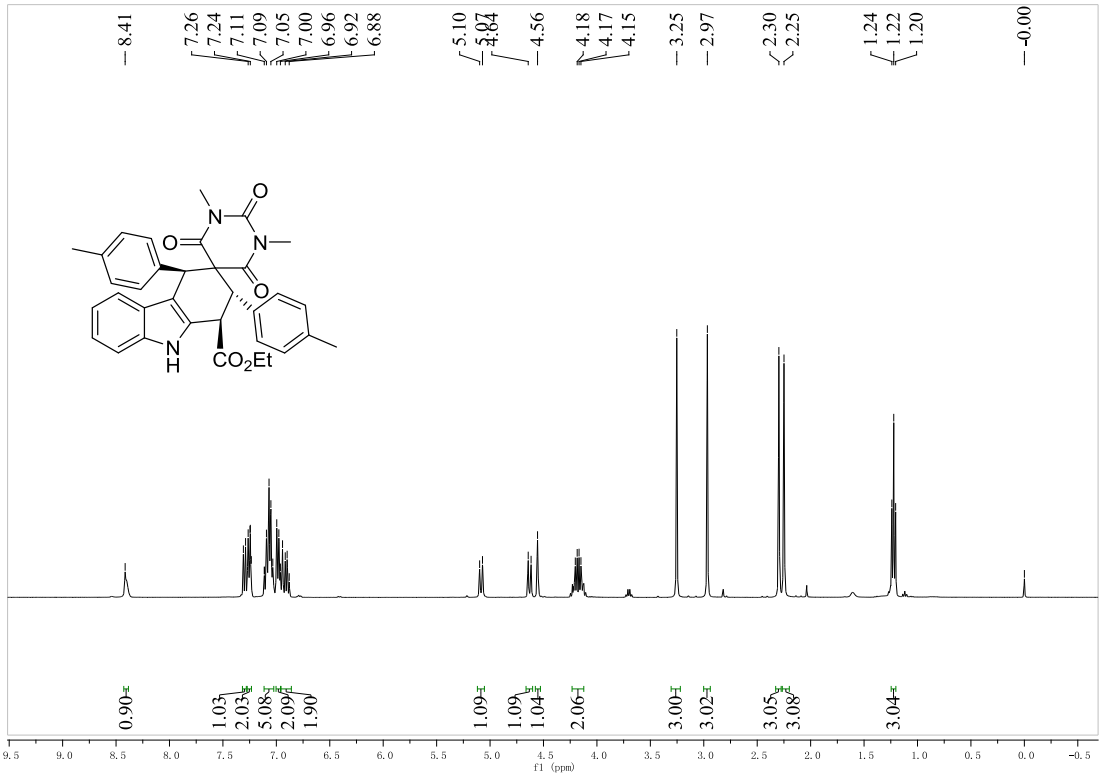
4. **General procedures for the Synthesis of functionalized spiro[carbazole-3,5'-pyrimidines] 3a-3d**: A mixture of indole-2-acetate (0.5 mmol), aldehyde (0.6 mmol) and 2-arylidene-1,3'-dimethylbarbituric acid (0.5 mmol) in dry toluene (6.0 mL) was stirred at 110^{o}C for three hours. After removing the solvent by evaporating at reduced pressure, DDQ (1.0 mmol) and acetonitrile (10. 0 mL) was added. The suspension was stirred at room temperature for four hours. Then, the solvent was removed at reduced pressure. The residue was subjected to column chromatography with ethyl acetate and light petroleum (V/V=1:3 ~ 1:6) to give pure product **3a**-**3d**.

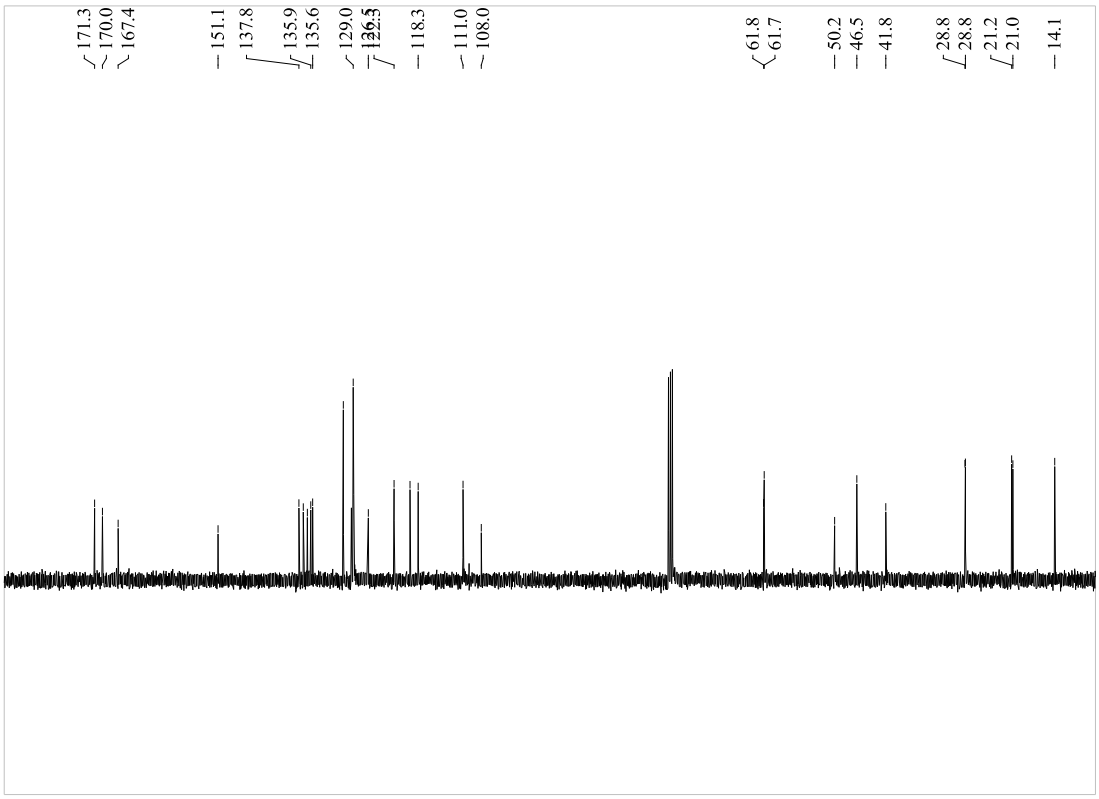
5. **General procedures for the Synthesis of functionalized δ-valerolactone-substituted carbazoles 4a-4g**: A mixture of indole-2-acetate (0.5 mmol), aromatic aldehyde (1.0 mmol) and cyclohexane-1,3-dione or dimedone (0.5 mmol) in dry toluene (6.0 mL) was stirred at 110^{o}C for three hours. After removing the solvent by evaporating at reduced pressure, DDQ (1.0 mmol) and acetonitrile (10. 0 mL) was added. The suspension was stirred at room temperature for four hours. Then, the solvent was removed at reduced pressure. The residue was subjected to column chromatography with ethyl acetate and light petroleum (V/V=1:3 ~ 1:6) to give pure product **4a**-**4g**.

Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-2',4',6'-trioxo-2,4-di-*p*-tolyl-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1a):**

yellow solid, 70%, m.p. 206-208 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.42 (s, 1H, NH), 7.29 (d, *J* = 8.4 Hz, 1H, ArH), 7.26-7.23 (m, 2H, ArH), 7.11-7.03 (m, 5H, ArH), 6.99-6.96 (m, 2H, ArH), 6.94-6.88 (m, 2H, ArH), 5.08 (d, *J* = 10.8 Hz, 1H, CH), 4.63 (d, *J* = 10.8 Hz, 1H, CH), 4.56 (s, 1H, CH), 4.17 (q, *J* = 7.2 Hz, 2H, CH_2), 3.25 (s, 3H, CH_3), 2.97 (s, 3H, CH_3), 2.30 (s, 3H, CH_3), 2.25 (s, 3H, CH_3), 1.22 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.2, 169.9, 167.4, 151.0, 137.8, 137.1, 136.4, 135.9, 135.5, 130.5, 128.9, 126.4, 122.2, 119.6, 118.3, 110.9, 107.9, 61.7, 61.6, 50.1, 46.5, 41.7, 28.8, 28.7, 21.1, 20.9, 14.1; IR(KBr) υ: 3350, 3245, 3167, 3055, 2932, 2852, 2812, 1852, 1666, 1632, 1544, 1432, 1325, 1207, 1132, 1109, 978, 923, 856, 742 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_5$([M+Na]$^+$): 586.2312, found: 586.2301.

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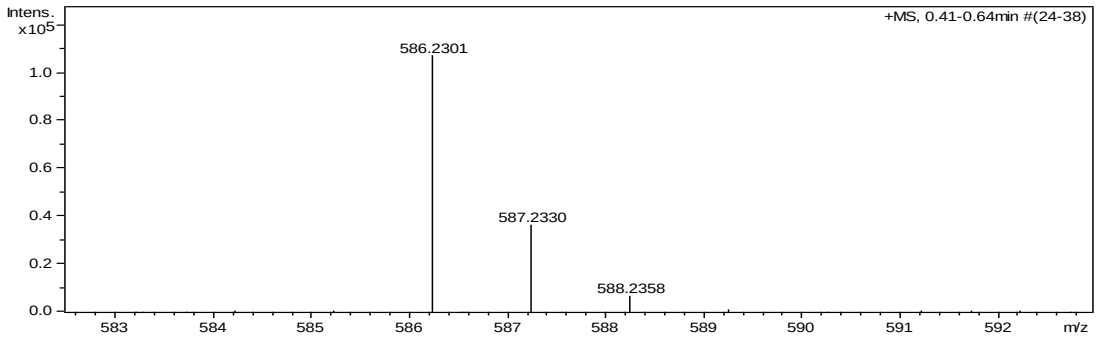
14.1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590
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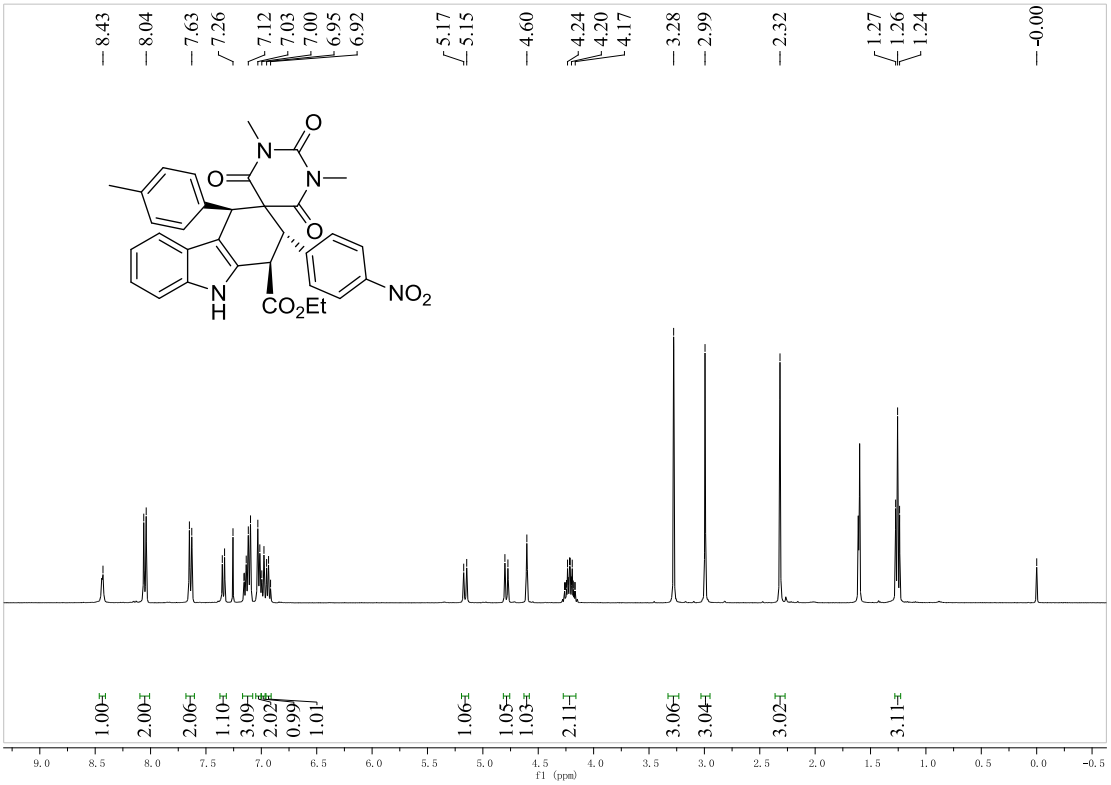
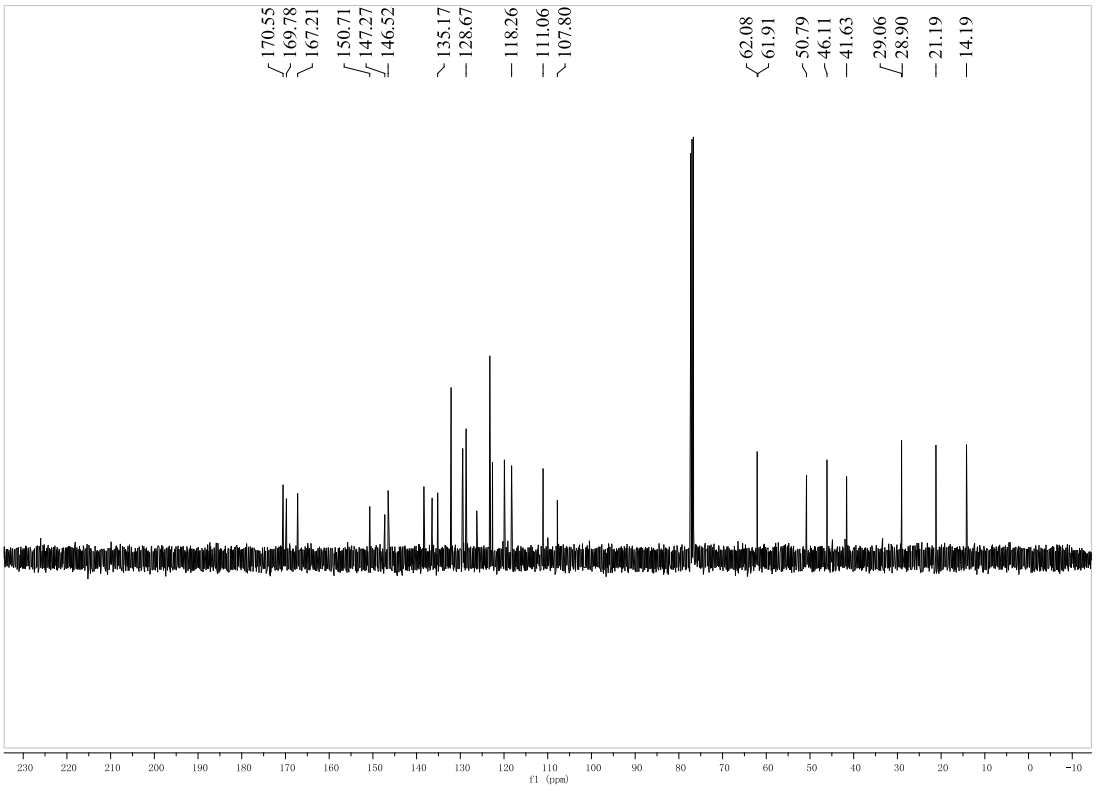
592
m/z

Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-2-(4-nitrophenyl)-2',4',6'-trioxo-4-(*p*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1b):**

yellow solid, 58%, m.p. 210-214 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.43 (s, 1H, NH), 8.05 (d, *J* = 8.8 Hz, 2H, ArH), 7.26-7.23 (m, 2H, ArH), 7.11-7.03 (m, 5H, ArH), 6.99-6.96 (m, 2H, ArH), 6.95-6.92 (m, 2H, ArH), 5.16 (d, *J* = 10.8 Hz, 1H, CH), 4.63 (d, *J* = 10.8 Hz, 1H, CH), 4.60 (s, 1H, CH), 4.20 (q, *J* = 7.2 Hz, 2H, CH_2), 3.28 (s, 3H, CH_3), 2.99 (s, 3H, CH_3), 2.32 (s, 3H, CH_3), 1.26 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.5, 169.7, 167.2, 150.7, 147.2, 146.5, 138.3, 136.4, 135.1, 132.1, 129.4, 128.6, 123.2, 122.6, 119.9, 118.2, 111.0, 107.7, 62.0, 61.9, 50.7, 46.1, 41.6, 29.0, 28.9, 21.1, 14.1; IR(KBr) υ: 3390, 3275, 3234, 3167, 3049, 2932, 2852, 2836, 2014, 1853, 1672, 1613, 1554, 1489, 1367, 1289, 1145, 1112, 980, 923, 834, 742 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{30}N_4O_7$([M+Na]$^+$): 617.2007, found: 617.1997.

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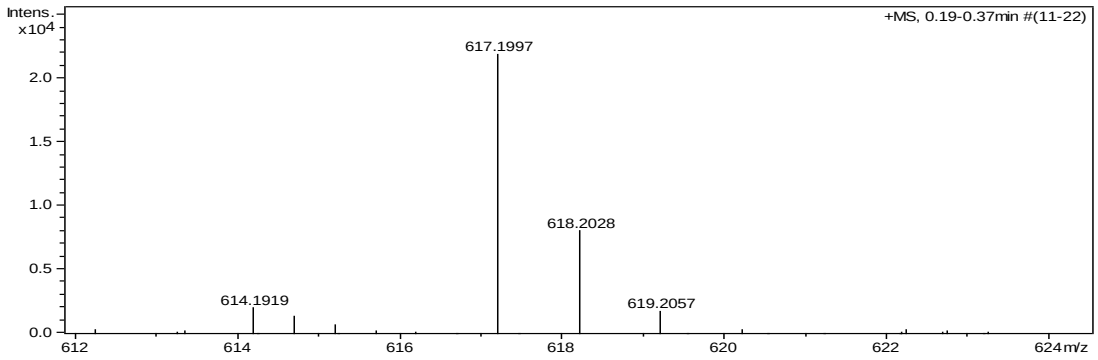
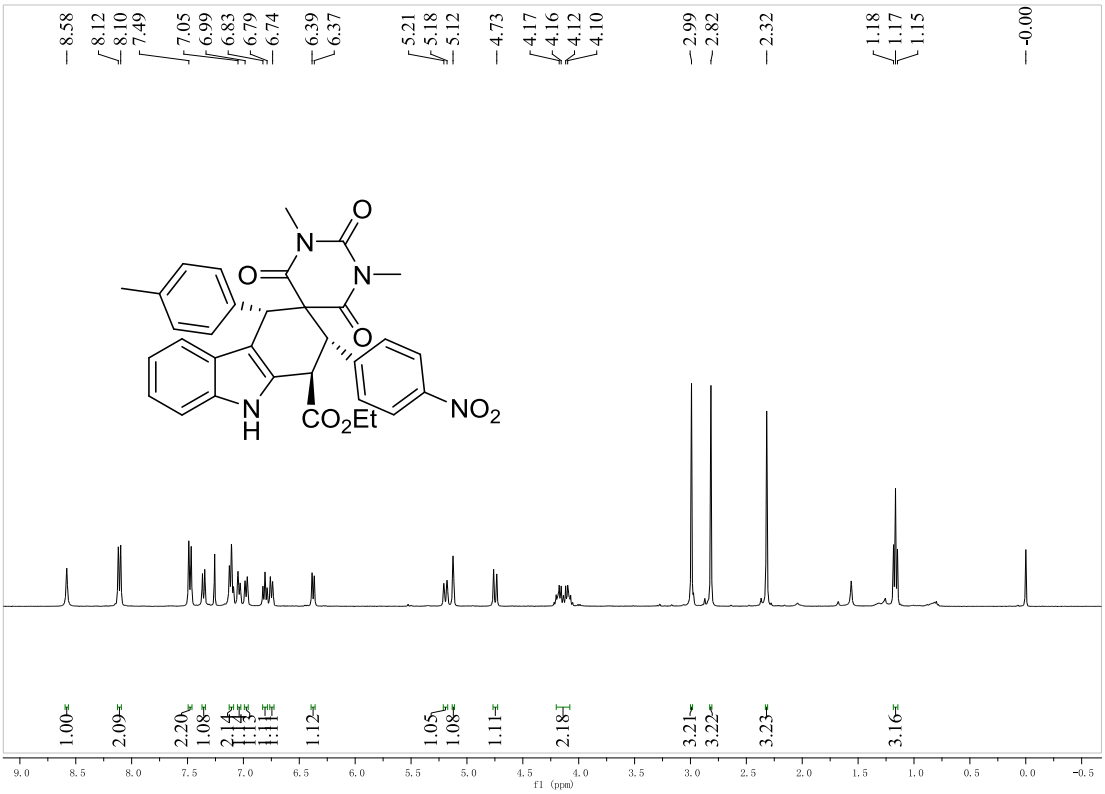
61.91
50.79
46.11
41.63
29.06
28.90
21.19
14.19
f1 (ppm)

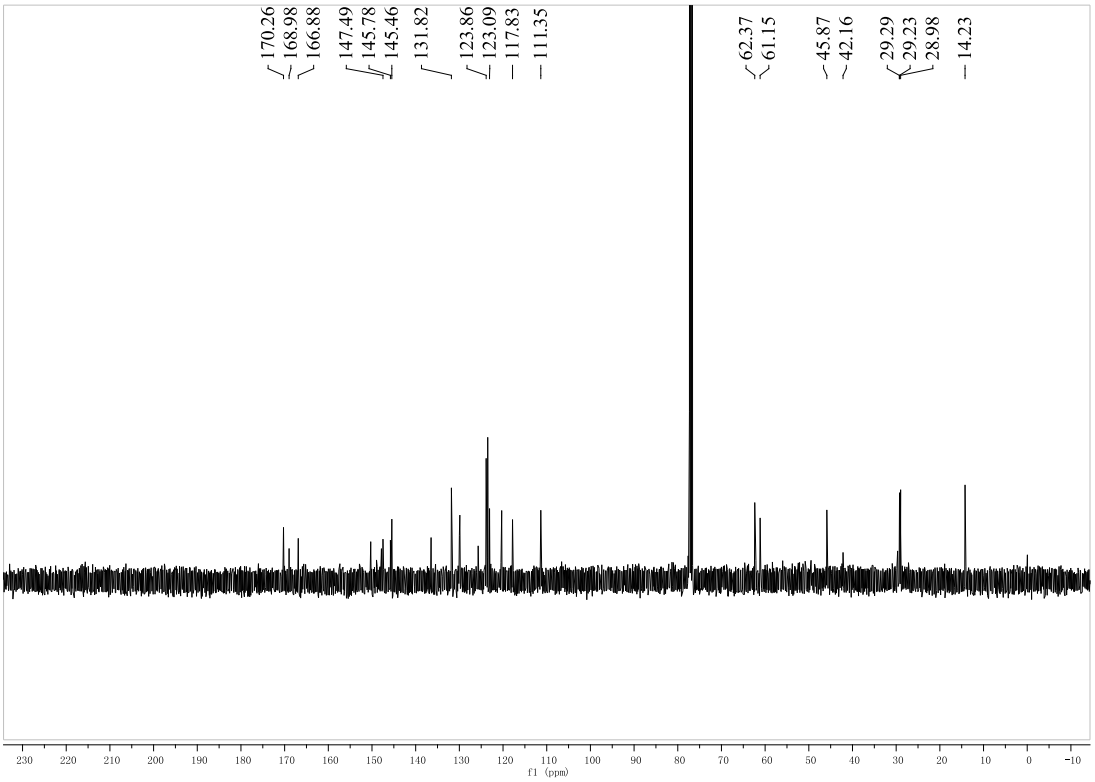

Intens.
x10^4
+MS, 0.19-0.37min #(11-22)
617.1997
618.2028
614.1919
619.2057
m/z

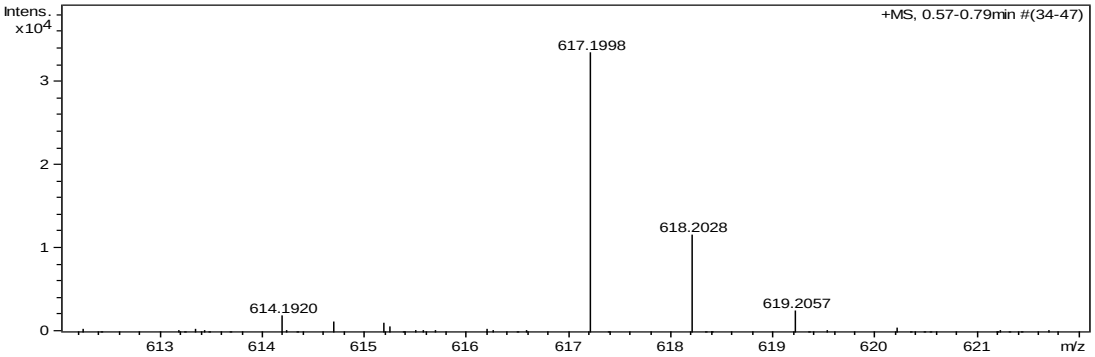
Ethyl

***rel-(1R,2S,4S)*-1',3'-dimethyl-2-(4-nitrophenyl)-2',4',6'-trioxo-4-(*p*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1b'):**

yellow solid, 7%, m.p. 216-218 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.58 (s, 1H, NH), 8.11 (d, *J* = 8.8 Hz, 2H, ArH), 7.48 (d, *J* = 8.8 Hz, 2H, ArH), 7.35 (d, *J* = 8.0 Hz, 2H, ArH), 7.11 (d, *J* = 7.6 Hz, 2H, ArH), 7.04 (d, *J* = 8.0 Hz, 1H, ArH), 6.98 (d, *J* = 8.0 Hz, 1H, ArH), 6.81 (t, *J* = 7.6 Hz, 1H, ArH), 6.75 (d, *J* = 8.0 Hz, 1H, ArH), 6.38 (d, *J* = 8.0 Hz, 1H, ArH), 5.19 (d, *J* = 7.6 Hz, 1H, CH), 5.13 (s, 1H, CH), 4.15 (d, *J* = 7.6 Hz, 1H, CH), 4.13 (q, *J* = 7.2 Hz, 2H, CH_2), 2.99 (s, 3H, CH_3), 2.82 (s, 3H, CH_3), 2.32 (s, 3H, CH_3), 1.17 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.2, 168.9, 166.8, 150.2, 147.8, 147.4, 145.7, 145.4, 136.4, 131.8, 129.9, 129.8, 125.6, 123.8, 123.5, 123.0, 120.3, 117.8, 111.3, 62.3, 61.1, 45.8, 42.1, 29.6, 29.2, 29.2, 28.9, 14.2; IR(KBr) υ: 3372, 3260, 3182, 3042, 2976, 2832, 2806, 1844, 1672, 1643, 1521, 1416, 1373, 1268, 1172, 1132, 978, 924, 856, 742 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{30}N_4O_7$([M+Na]$^+$): 617.2007, found: 617.1998.



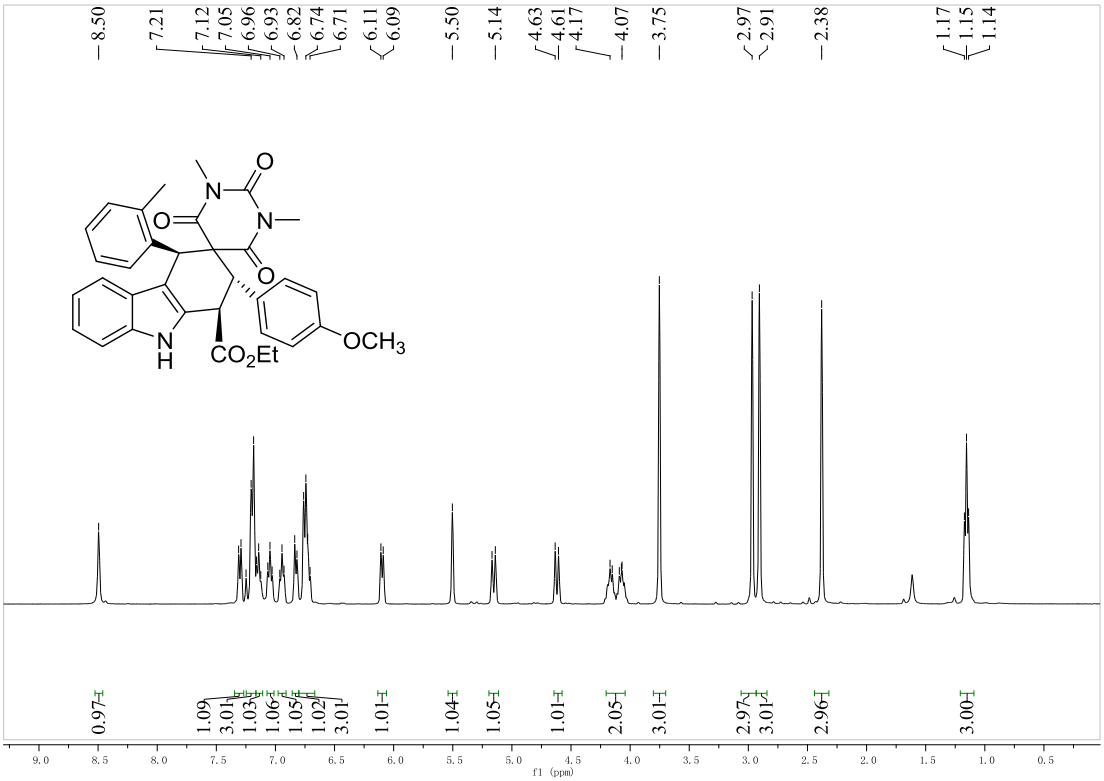

170.26
168.98
166.88
147.49
145.78
145.46
131.82
123.86
123.09
117.83
111.35
62.37
61.15
45.87
42.16
29.29
29.23
28.98
14.23
f1 (ppm)

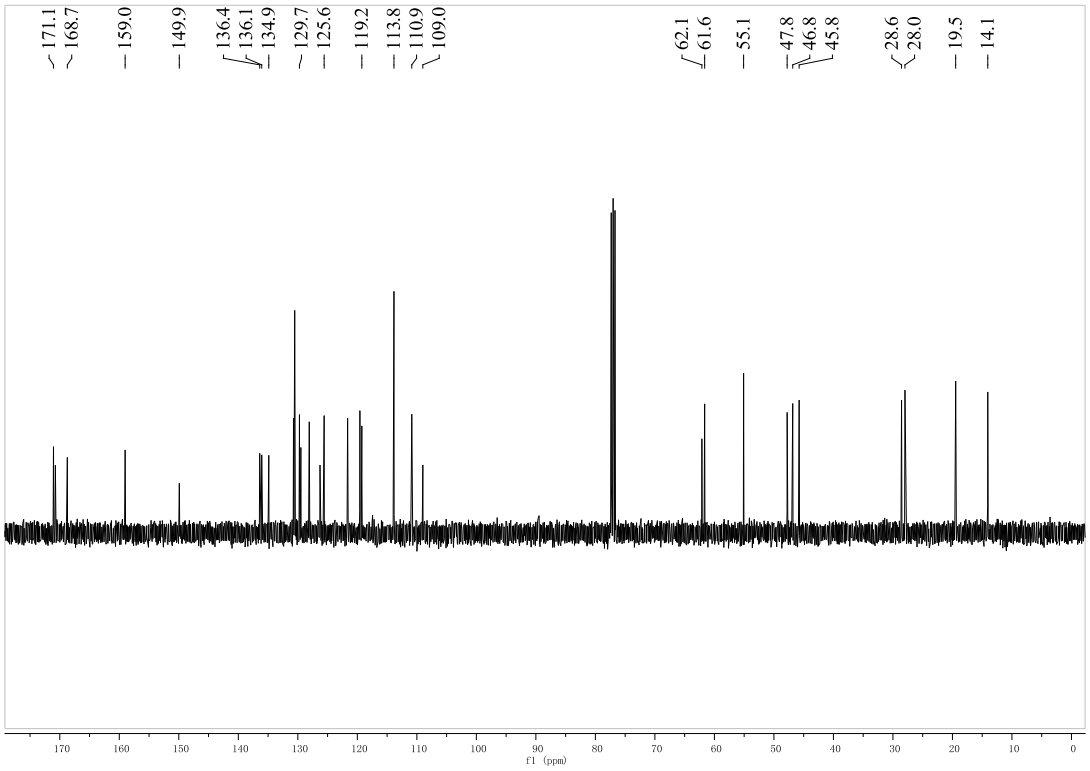

Intens.
x10^4
+MS, 0.57-0.79min #(34-47)
617.1998
618.2028
614.1920
619.2057
m/z

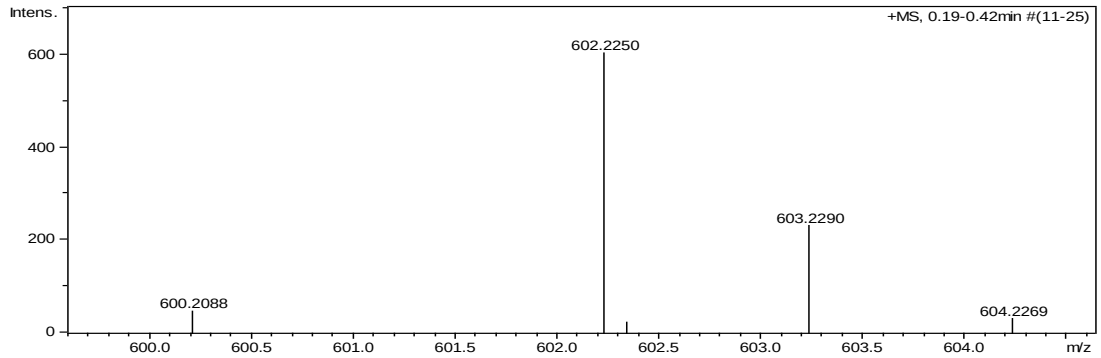
Ethyl

***rel-(1R,2S,4R)*-2-(4-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-4-(*o*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1c):**

yellow solid, 61%, m.p. 200-203 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.49 (s, 1H, NH), 7.31-7.29 (m, 1H, ArH), 7.21-7.19 (m, 3H, ArH), 7.16-7.13 (m, 1H, ArH), 7.05 (t, *J* = 7.2 Hz, 1H, ArH), 6.95 (t, *J* = 7.2 Hz, 1H, ArH), 6.84-6.82 (m, 1H, ArH), 6.76-6.71 (m, 3H, ArH), 6.11-6.09 (m, 1H, ArH), 5.50 (s, 1H, CH), 5.15 (d, *J* = 11.2 Hz, 1H, CH), 4.62 (d, *J* = 11.2 Hz, 1H, CH), 4.09 (q, *J* = 7.2 Hz, 2H, CH_2), 3.75 (s, 3H, OCH_3), 2.97 (s, 3H, CH_3), 2.91 (s, 3H, CH_3), 2.38 (s, 3H, CH_3), 1.16 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.0, 168.7, 159.0, 149.9, 136.4, 136.0, 134.8, 130.7, 130.6, 130.5, 129.7, 129.4, 128.0, 126.2, 125.5, 121.6, 119.5, 119.2, 113.8, 110.8, 108.9, 62.1, 61.6, 55.0, 47.7, 46.8, 45.7, 28.5, 27.9, 19.4, 14.0; IR(KBr) υ: 3335, 3272, 3196, 3056, 2942, 2871, 2821, 2066, 1831, 1655, 1621, 1547, 1435, 1321, 1249, 1112, 1107, 932, 956, 843, 762 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_6$([M+Na]$^+$): 602.2262, found: 602.2250.



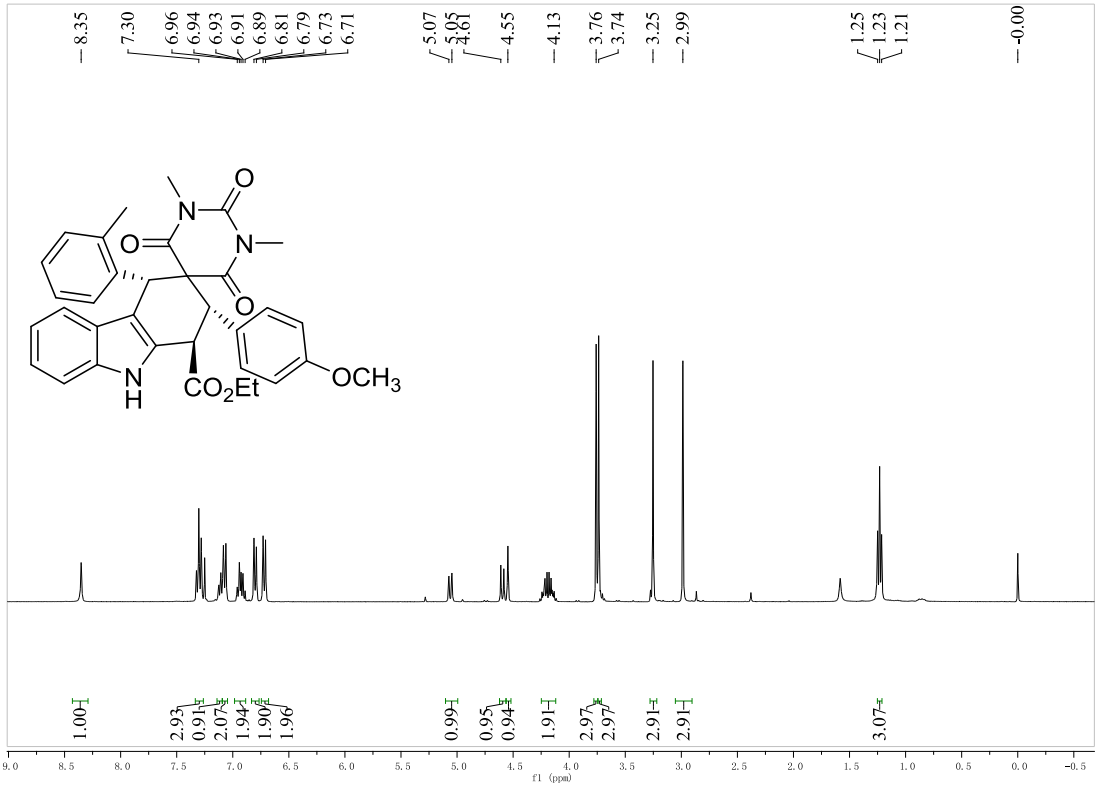

171.1
168.7
159.0
149.9
136.4
136.1
134.9
129.7
125.6
119.2
113.8
110.9
109.0
62.1
61.6
55.1
47.8
46.8
45.8
28.6
28.0
19.5
14.1
f1 (ppm)

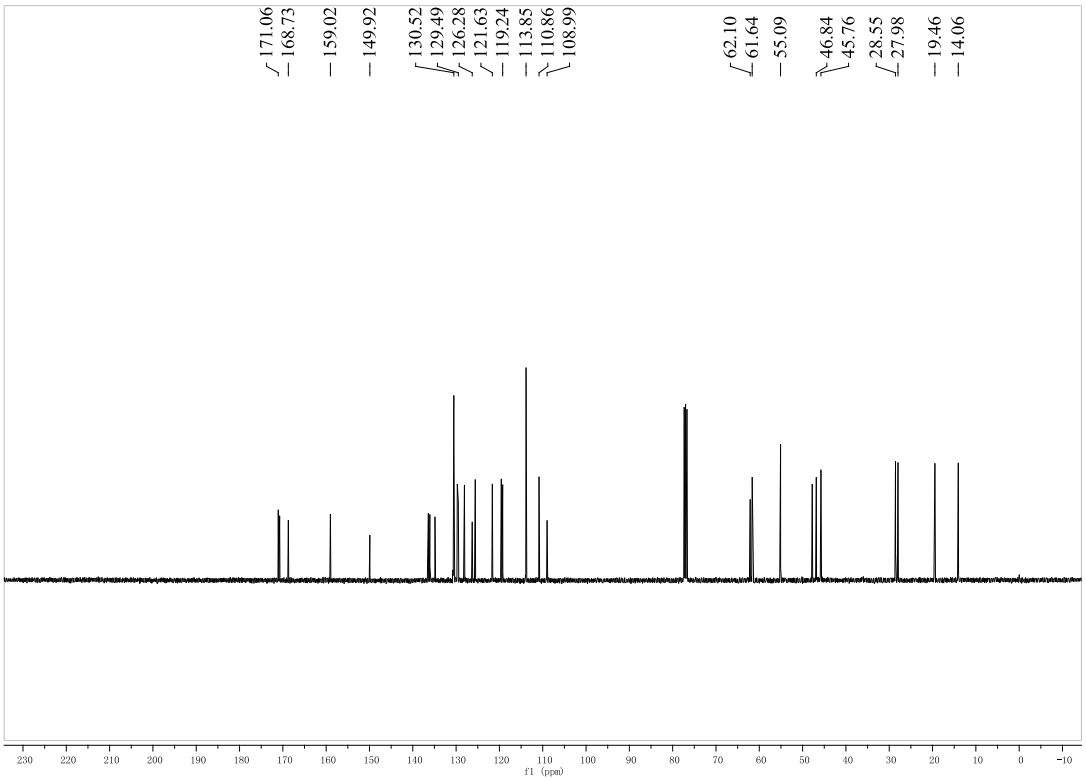

Intens.
+MS, 0.19-0.42min #(11-25)
602.2250
603.2290
600.2088
604.2269
m/z

Ethyl

***re-(1R,2S,4S)*-2-(4-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-4-(*o*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1c'):**

yellow solid, 12.1%, m.p. 216-218 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.35 (s, 1H, NH), 7.30 (t, *J* = 8.8 Hz, 3H, ArH), 7.11 (d, *J* = 6.8 Hz, 1H, ArH), 7.07 (d, *J* = 8.8 Hz, 2H, ArH), 6.96-6.89 (m, 2H, ArH), 6.80 (d, *J* = 8.4 Hz, 2H, ArH), 6.72 (d, *J* = 8.8 Hz, 2H, ArH), 5.06 (d, *J* = 10.8 Hz, 1H, CH), 4.60 (d, *J* = 10.8 Hz, 1H, CH), 4.55 (s, 1H, CH), 4.18 (q, *J* = 7.2 Hz, 2H, CH_2), 3.76 (s, 3H, OCH_3), 3.74 (s, 3H, CH_3), 3.25 (s, 3H, CH_3), 2.98 (s, 3H, CH_3), 1.23 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.0, 168.7, 159.0, 149.9, 136.4, 136.0, 134.8, 130.7, 130.6, 130.5, 129.7, 129.4, 128.0, 126.2, 125.5, 121.6, 119.5, 119.2, 113.8, 110.8, 108.9, 62.1, 61.6, 55.0, 47.7, 46.8, 45.7, 28.5, 27.9, 19.4, 14.0; IR(KBr) υ: 3362, 3306, 3184, 3042, 2913, 2855, 2809, 2100, 1845, 1642, 1603, 1547, 1442, 1376, 1251, 1134, 1157, 972, 962, 832, 759 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_6$([M+Na]$^+$): 602.2262, found: 602.2260.




171.06
168.73
159.02
149.92
130.52
129.49
126.28
121.63
119.24
113.85
110.86
108.99
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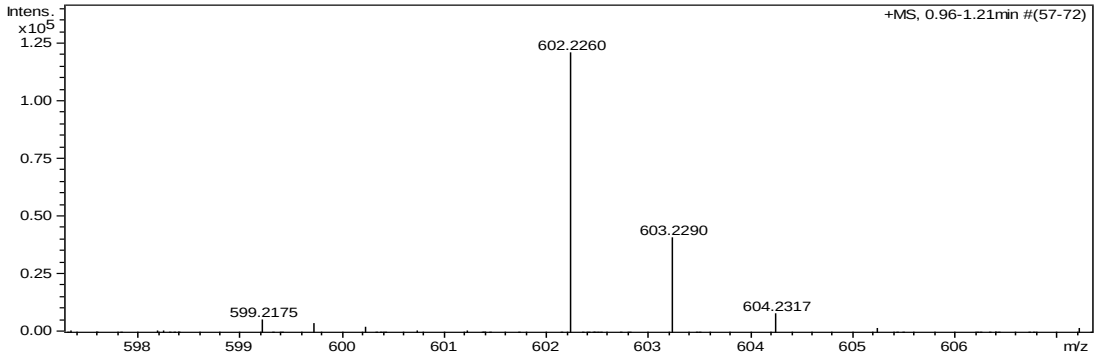
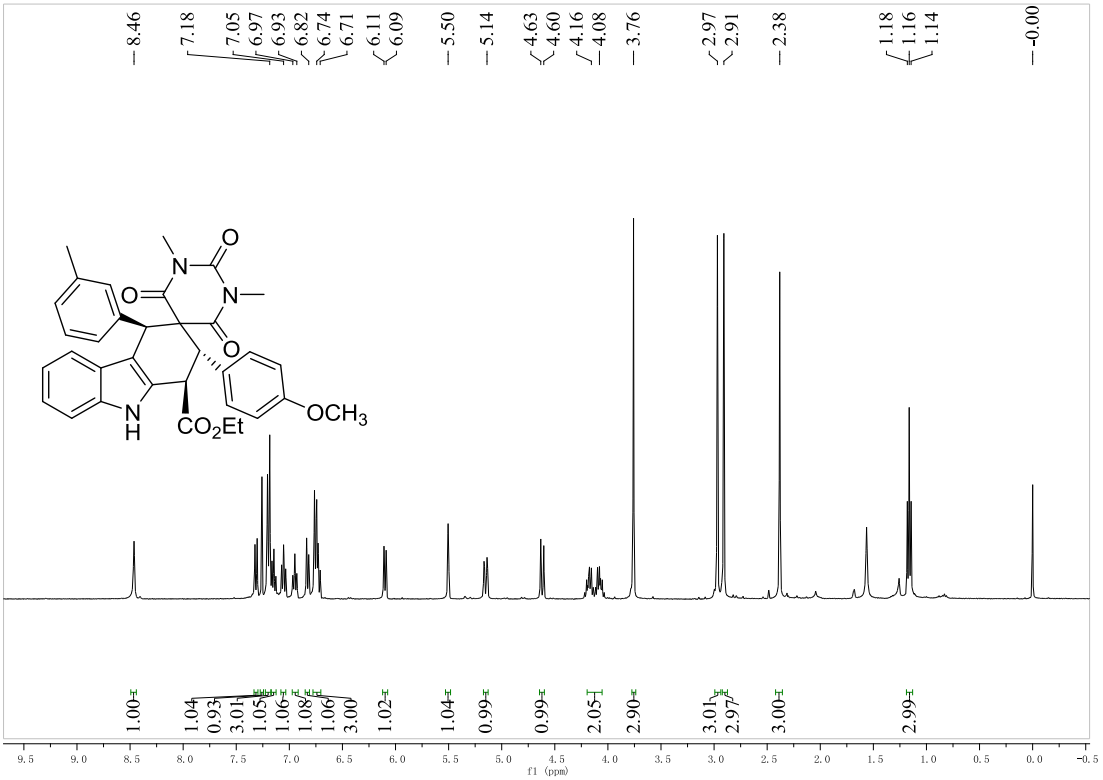
61.64
55.09
46.84
45.76
28.55
27.98
19.46
14.06
f1 (ppm)

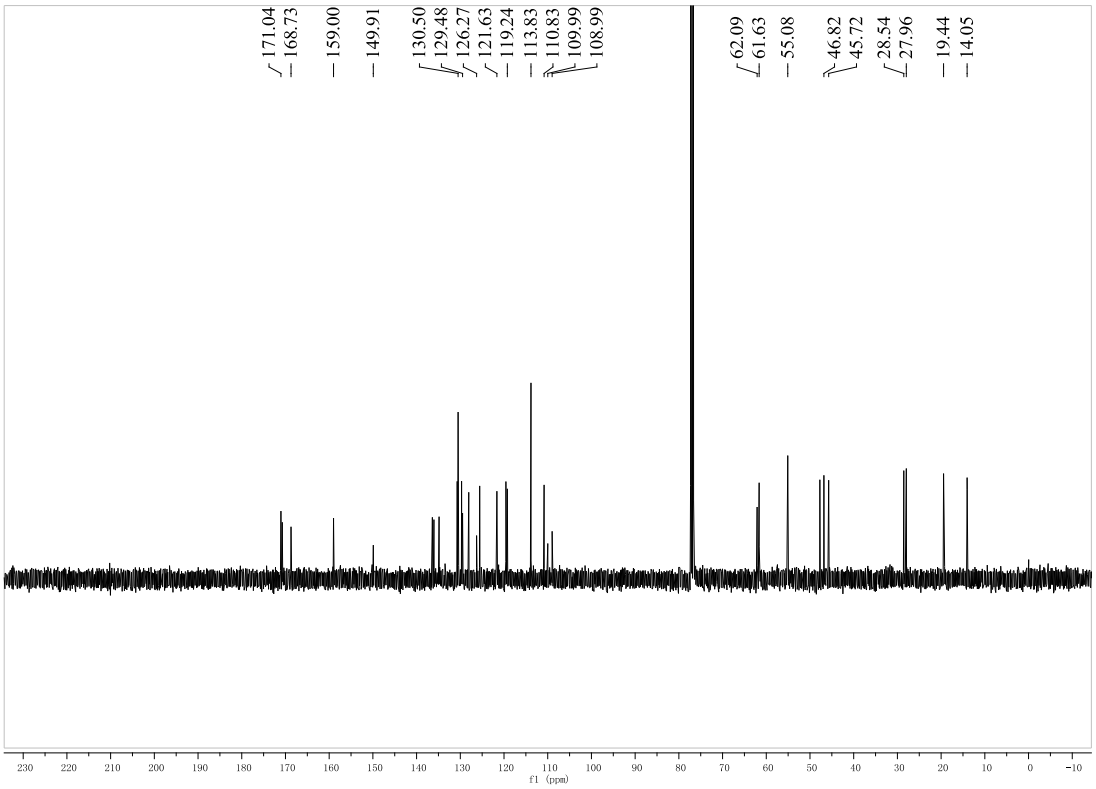

Intens.
x10^5
+MS, 0.96-1.21min #(57-72)
602.2260
603.2290
599.2175
604.2317
m/z

Ethyl

***rel-(1R,2S,4R)*-2-(4-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-4-(*m*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1d):**

yellow solid, 70%, m.p. 205-209 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.46 (s, 1H, NH), 7.31 (d, *J* = 8.4 Hz, 1H, ArH), 7.26-7.25 (m, 1H, ArH), 7.19 (d, *J* = 8.4 Hz, 3H, ArH), 7.15 (t, *J* = 7.6 Hz, 1H, ArH), 7.05 (t, *J* = 7.6 Hz, 1H, ArH), 6.95 (t, *J* = 7.6 Hz, 1H, ArH), 6.82 (d, *J* = 8.4 Hz, 1H, ArH), 6.76-6.71 (m, 3H, ArH), 6.09 (d, *J* = 8.4 Hz, 1H, ArH), 5.51 (s, 1H, CH), 5.15 (d, *J* = 11.2 Hz, 1H, CH), 4.62 (d, *J* = 11.2 Hz, 1H, CH), 4.12 (q, *J* = 6.8 Hz, 2H, CH_2), 3.76 (s, 3H, OCH_3), 2.97 (s, 3H, CH_3), 2.91 (s, 3H, CH_3), 2.38 (s, 3H, CH_3), 1.16 (t, *J* = 6.8 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.0, 168.7, 159.0, 149.9, 136.3, 136.0, 134.8, 130.7, 130.5, 130.5, 129.7, 129.4, 128.0, 126.2, 125.5, 121.6, 119.5, 119.2, 113.8, 110.8, 109.9, 108.9, 62.0, 61.6, 55.0, 47.7, 46.8, 45.7, 28.5, 27.9, 19.4, 14.0; IR(KBr) υ: 3348, 3321, 3207, 3176, 3055, 2972, 2846, 2813, 2102, 1855, 1638, 1621, 1536, 1476, 1332, 1278, 1164, 1143, 946, 911, 854, 763 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_6$([M+Na]$^+$): 602.2262, found: 602.2241.




171.04
168.73
159.00
149.91
130.50
129.48
126.27
121.63
119.24
113.83
110.83
109.99
108.99
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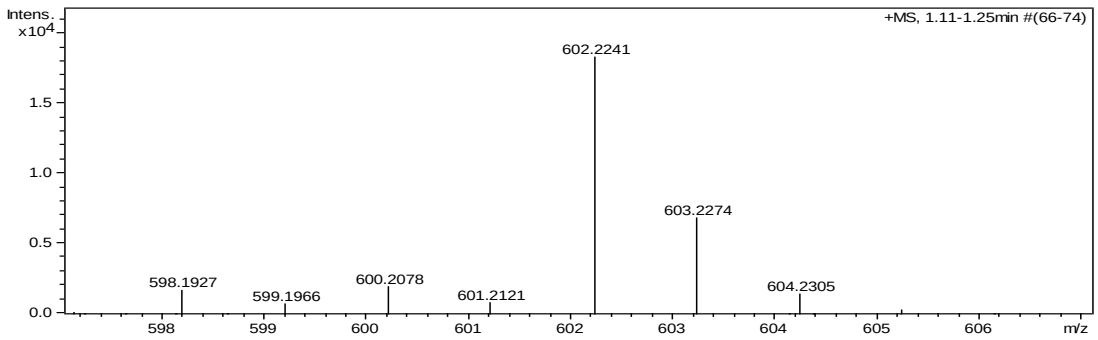
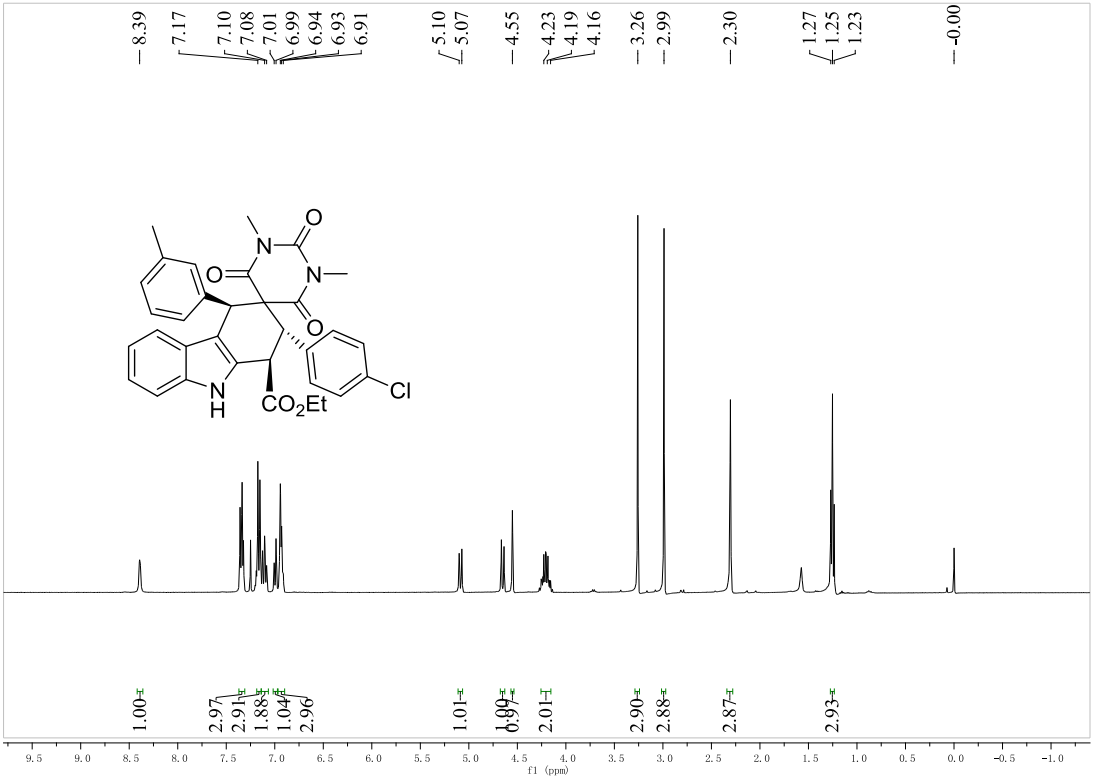
61.63
55.08
46.82
45.72
28.54
27.96
19.44
14.05
f1 (ppm)

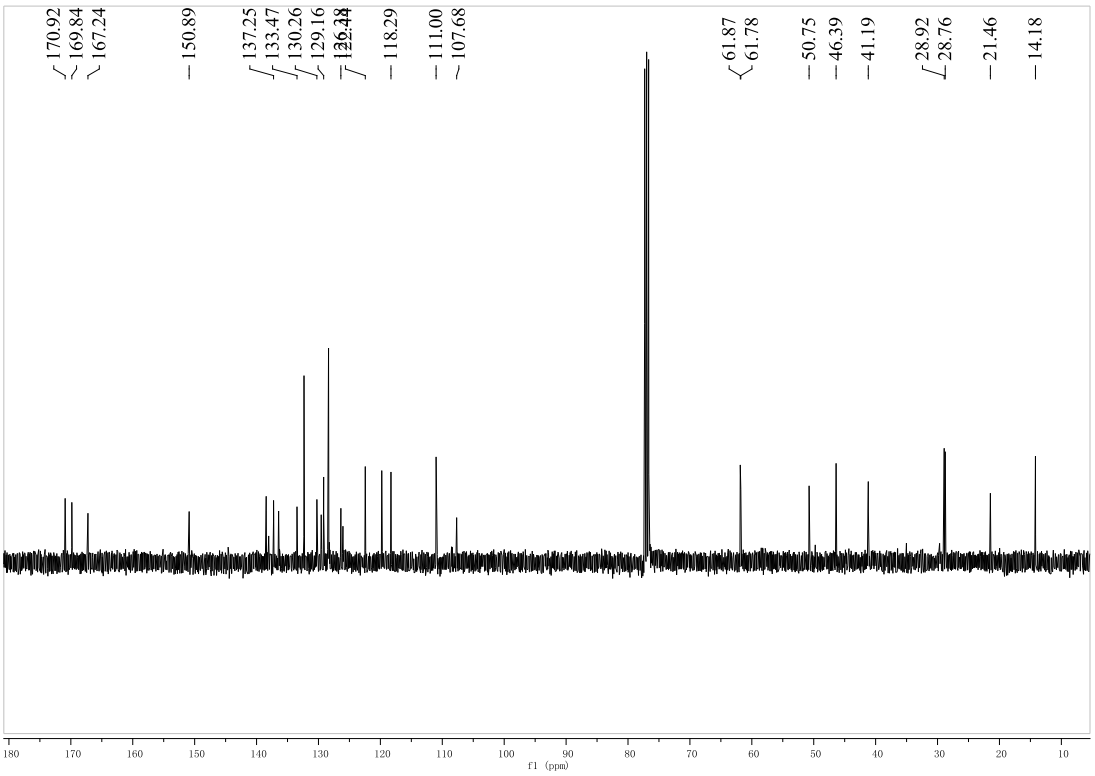

Intens.
x10^4
+MS, 1.11-1.25min #(66-74)
602.2241
603.2274
598.1927
599.1966
600.2078
601.2121
604.2305
m/z

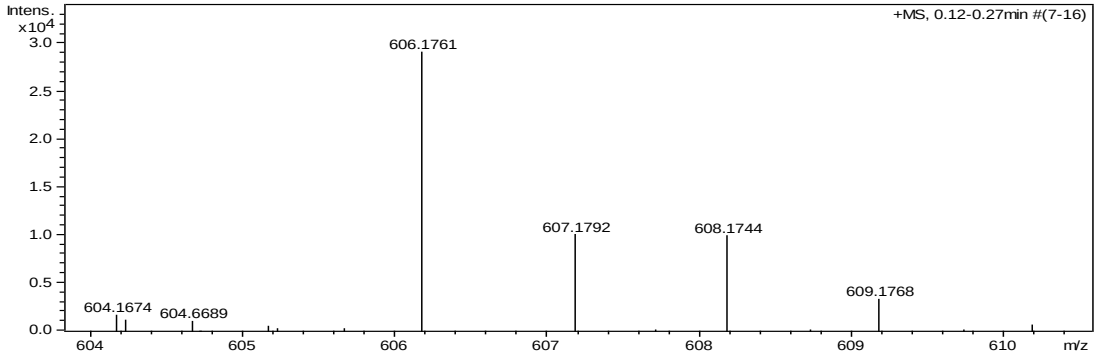
Ethyl

***rel-(1R,2S,4R)*-2-(4-chlorophenyl)-1',3'-dimethyl-2',4',6'-trioxo-4-(*m*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1e):**

yellow solid, 60%, m.p. 211-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.39 (s, 1H, NH), 7.36-7.32 (m, 3H, ArH), 7.18-7.15 (m, 3H, ArH), 7.13-7.08 (m, 2H, ArH), 7.01-6.99 (m, 1H, ArH), 6.94-6.91 (m, 3H, ArH), 5.09 (d, *J* = 10.8 Hz, 1H, CH), 4.65 (d, *J* = 10.8 Hz, 1H, CH), 4.55 (s, 1H, CH), 4.21 (q, *J* = 6.8 Hz, 2H, CH_2), 3.26 (s, 3H, CH_3), 2.99 (s, 3H, CH_3), 2.31 (s, 3H, CH_3), 1.25 (t, *J* = 6.8 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.9, 169.8, 167.2, 150.8, 138.4, 137.2, 136.4, 133.4, 132.3, 130.2, 129.5, 129.1, 128.3, 126.3, 122.4, 119.7, 118.2, 111.0, 107.6, 61.8, 61.7, 50.7, 46.3, 41.1, 28.9, 28.7, 21.4, 14.1; IR(KBr) υ: 3327, 3306, 3267, 3152, 3072, 2989, 2832, 2813, 2145, 1802, 1645, 1621, 1578, 1445, 1324, 1245, 1147, 1129, 952, 933, 862, 792 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{30}ClN_3O_5$([M+Na]$^+$): 606.1766, found: 606.1761.



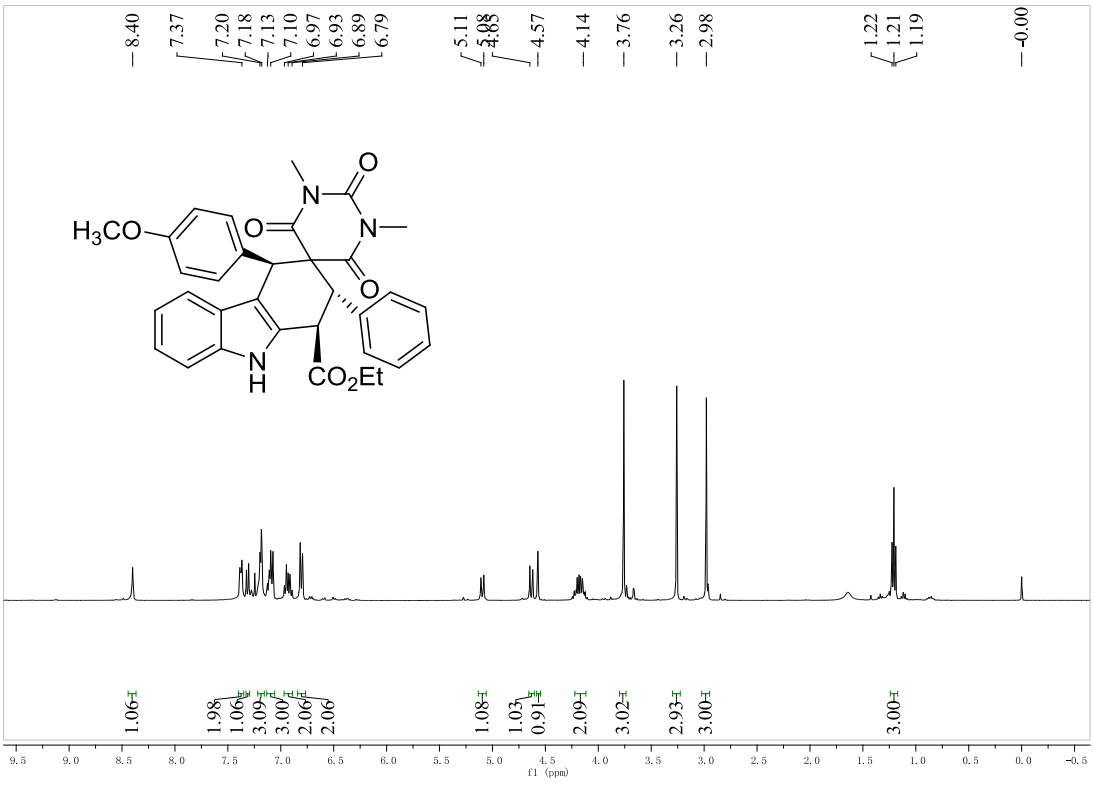

170.92
169.84
167.24
150.89
137.25
133.47
130.26
129.16
118.29
111.00
107.68
61.87
61.78
50.75
46.39
41.19
28.92
28.76
21.46
14.18
f1 (ppm)

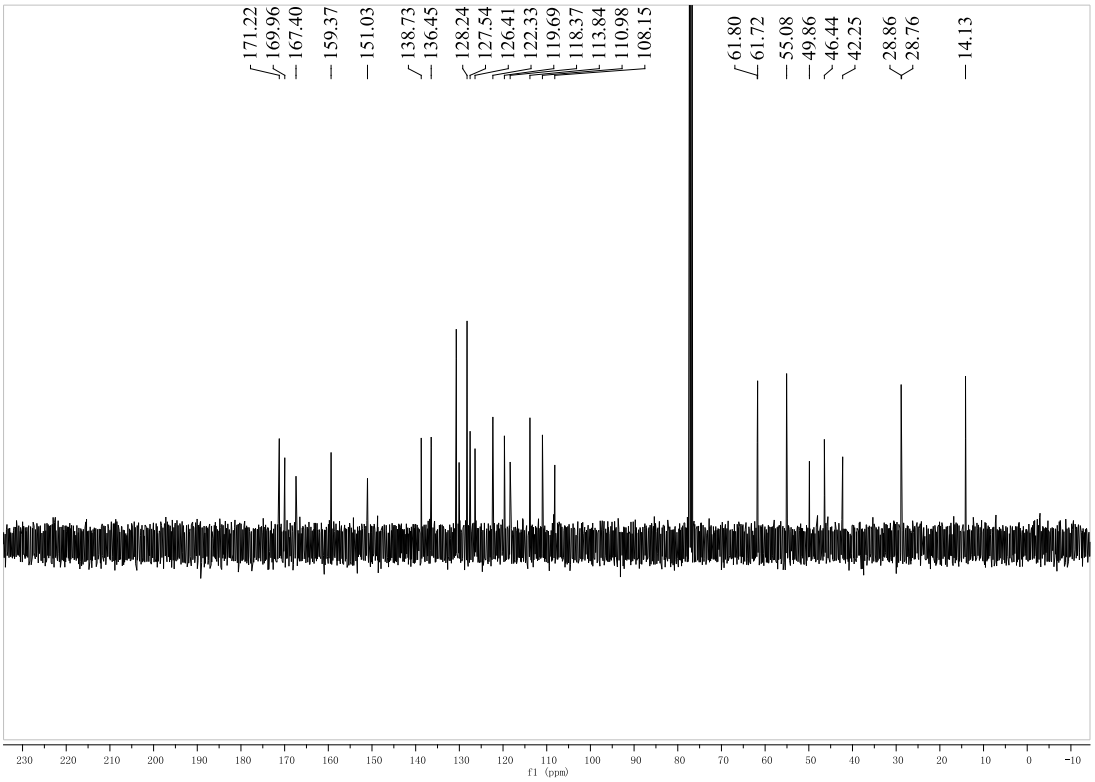

Intens.
x10^4
+MS, 0.12-0.27min #(7-16)
606.1761
607.1792
608.1744
609.1768
604.1674
604.6689
m/z

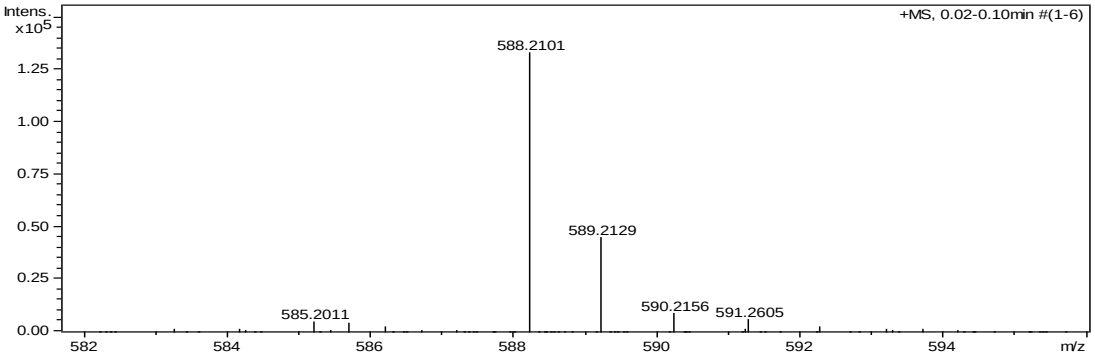
Ethyl

***rel-(1R,2S,4R)*-4-(4-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-2-phenyl-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1f):**

yellow solid, 70%, m.p. 204-206 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.40 (s, 1H, NH), 7.39-7.37 (m, 2H, ArH), 7.31 (d, *J* = 8.0 Hz, 1H, ArH), 7.21-7.18 (m, 3H, ArH), 7.13-7.07 (m, 3H, ArH), 6.97-6.89 (m, 2H, ArH), 6.80 (d, *J* = 8.0 Hz, 2H, ArH), 5.09 (d, *J* = 10.8 Hz, 1H, CH), 4.63 (d, *J* = 10.8 Hz, 1H, CH), 4.57 (s, 1H, CH), 4.17 (q, *J* = 7.2 Hz, 2H, CH_2), 3.76 (s, 3H, OCH_3), 3.26 (s, 3H, CH_3), 2.98 (s, 3H, CH_3), 1.21 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.2, 169.9, 167.3, 159.3, 151.0, 138.7, 136.4, 130.7, 130.7, 130.4, 130.0, 128.2, 127.5, 126.4, 122.3, 119.6, 118.3, 113.8, 110.9, 108.1, 61.8, 61.7, 55.0, 49.8, 46.4, 42.2, 28.8, 28.7, 14.1; IR(KBr) υ: 3362, 3348, 3213, 3162, 3078, 2963, 2832, 2814, 2162, 1873, 1642, 1613, 1566, 1481, 1365, 1262, 1178, 1137, 952, 921, 862, 782 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{31}N_3O_6$([M+Na]$^+$): 588.2105, found: 588.2101.



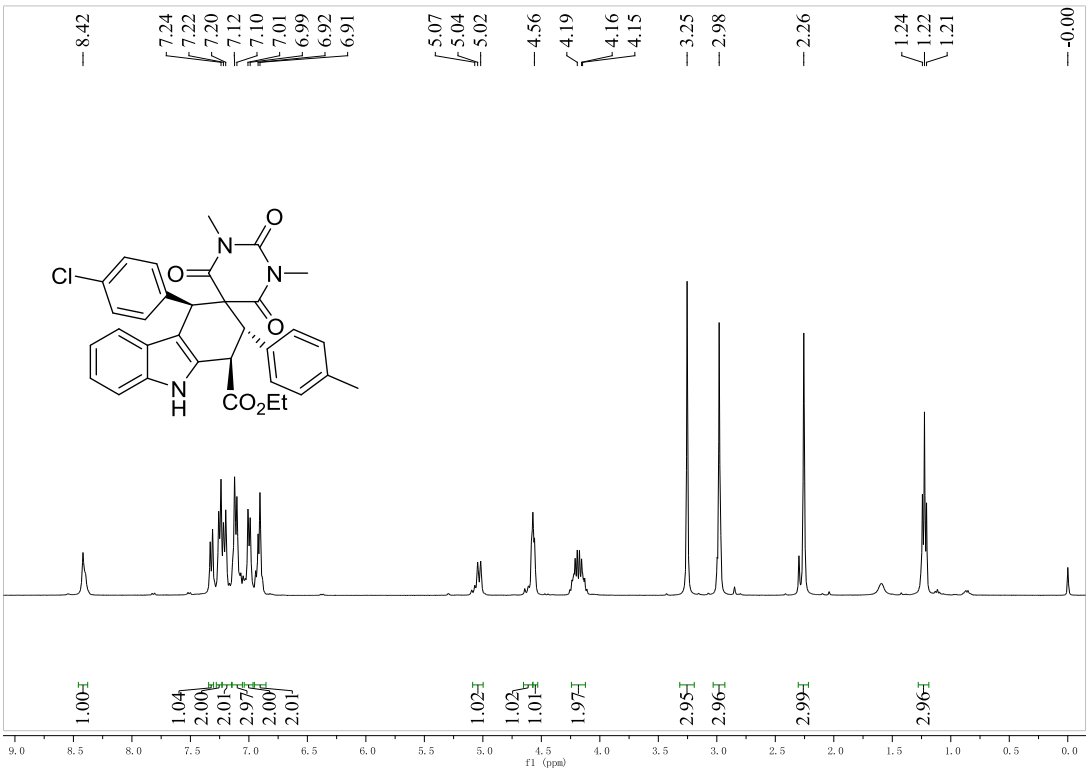

171.22
169.96
167.40
159.37
151.03
138.73
136.45
128.24
127.54
126.41
122.33
119.69
118.37
113.84
110.98
108.15
61.80
61.72
55.08
49.86
46.44
42.25
28.86
28.76
14.13
f1 (ppm)

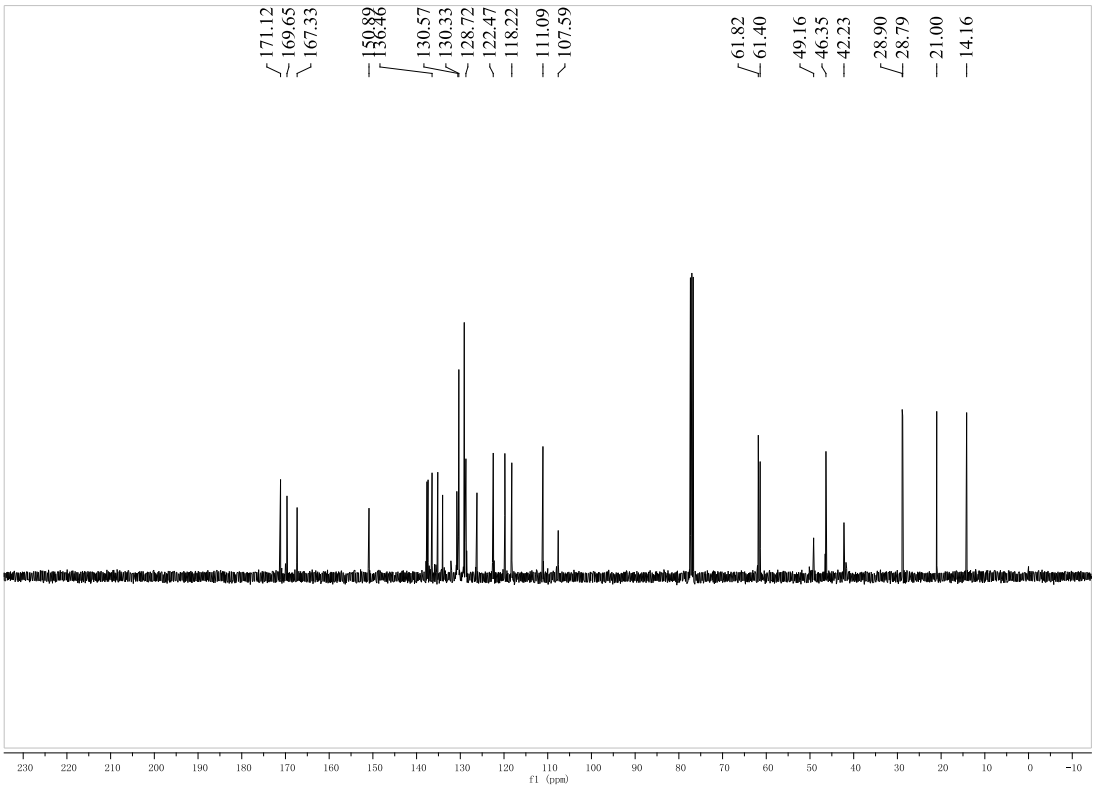

Intens.
x10^5
+MS, 0.02-0.10min #(1-6)
588.2101
589.2129
585.2011
590.2156
591.2605
m/z

Ethyl

***rel-(1R,2S,4R)*-4-(4-chlorophenyl)-1',3'-dimethyl-2',4',6'-trioxo-2-(*p*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1g):**

yellow solid, 75%, m.p. 206-210 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.42 (s, 1H, NH), 7.32 (d, *J* = 8.0 Hz, 1H, ArH), 7.24 (d, *J* = 8.0 Hz, 2H, ArH), 7.20 (d, *J* = 8.0 Hz, 1H, ArH), 7.12-7.10 (m, 3H, ArH), 7.01-6.99 (m, 2H, ArH), 6.92-6.91 (m, 2H, ArH), 5.07-5.02 (m, 1H, CH), 4.64-4.58 (m, 1H, CH), 4.57-4.56 (m, 1H, CH), 4.17 (q, *J* = 7.2 Hz, 2H, CH_2), 3.25 (s, 3H, CH_3), 2.98 (s, 3H, CH_3), 2.26 (s, 3H, CH_3), 1.23 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.1, 169.6, 167.3, 150.8, 137.6, 137.3, 136.4, 135.1, 134.0, 130.7, 130.5, 130.3, 130.3, 129.0, 128.7, 126.1, 122.4, 119.8, 118.2, 111.0, 107.5, 61.8, 61.4, 49.1, 46.3, 42.2, 28.9, 28.7, 21.0, 14.1; IR(KBr) υ: 3323, 3307, 3264, 3153, 3042, 2982, 2832, 2855, 2172, 1842, 1673, 1643, 1521, 1455, 1367, 1272, 1183, 1142, 952, 963, 872, 746 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{30}ClN_3O_5$ ($[M+Na]^+$): 606.1766, found: 606.1762.




171.12
169.65
167.33
150.89
136.46
130.57
130.33
128.72
122.47
118.22
111.09
107.59
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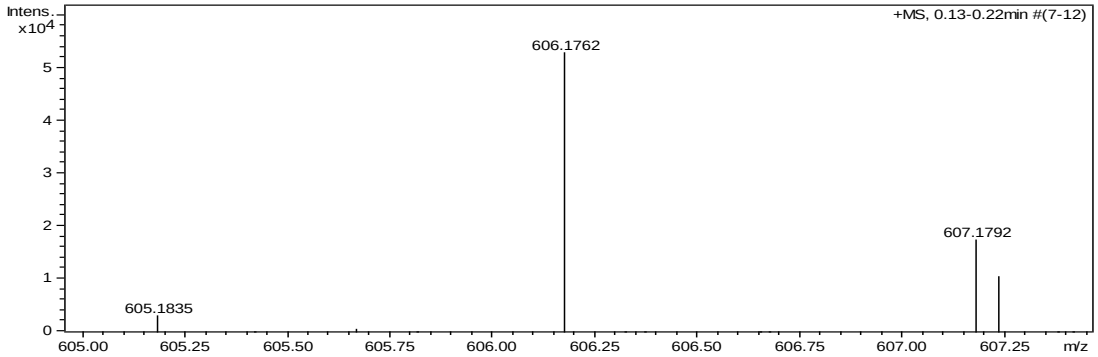
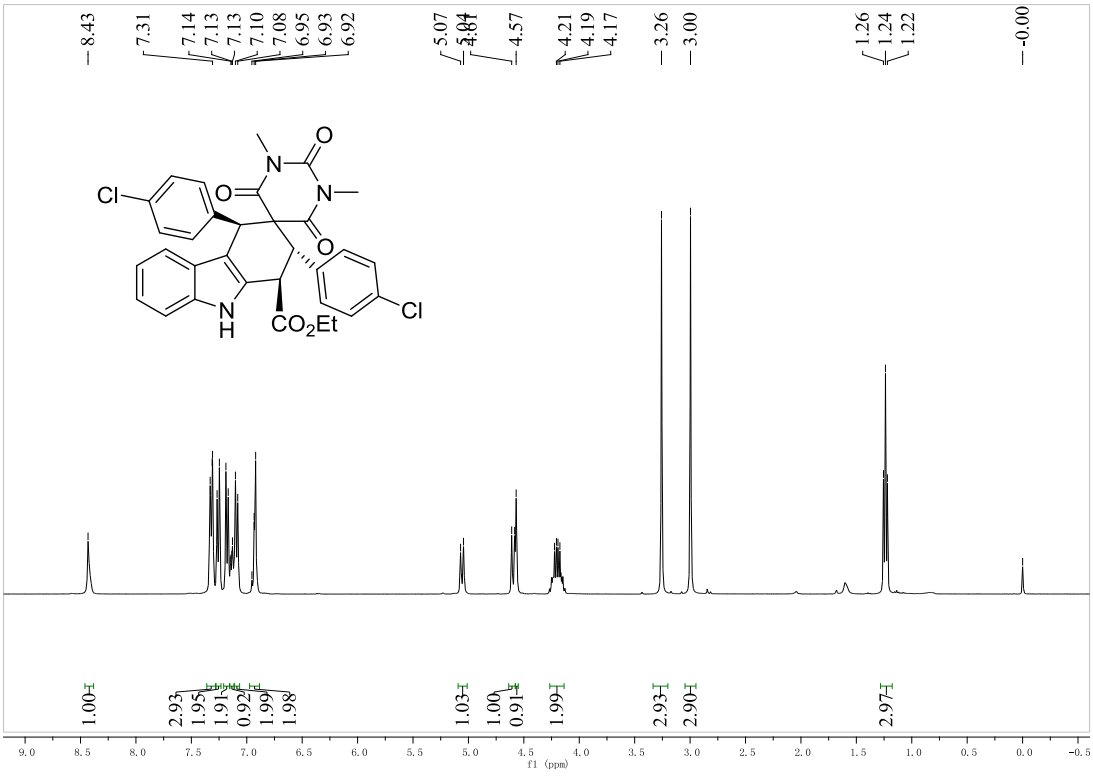
61.40
49.16
46.35
42.23
28.90
28.79
21.00
14.16
f1 (ppm)

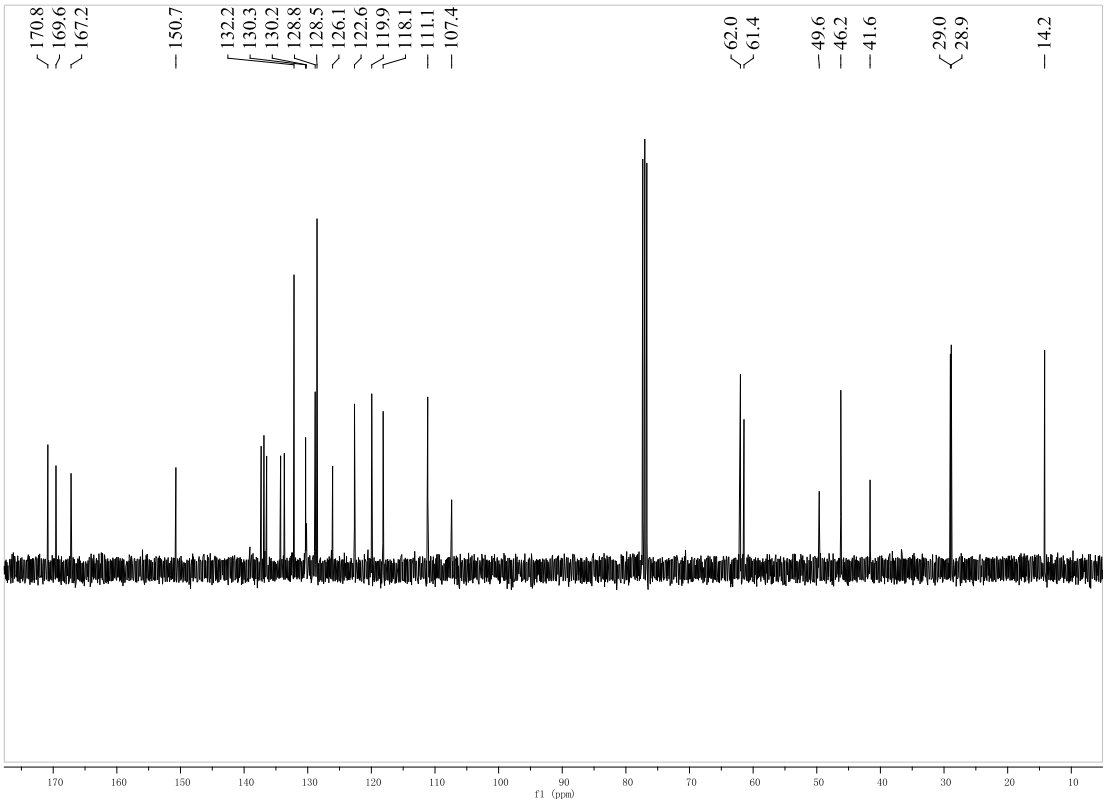

Intens.
x10^4
+MS, 0.13-0.22min #(7-12)
606.1762
607.1792
605.1835
m/z

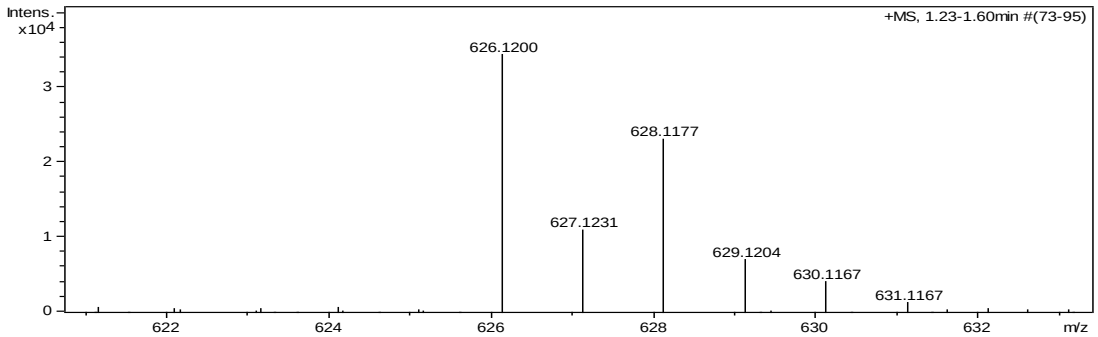
Ethyl

***rel-(1R,2S,4R)*-2,4-bis(4-chlorophenyl)-1',3'-dimethyl-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1h):**

yellow solid, 68%, m.p. 212-214 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.43 (s, 1H, NH), 7.31 (d, *J* = 8.4 Hz, 3H, ArH), 7.25 (d, *J* = 8.4 Hz, 2H, ArH), 7.17 (d, *J* = 8.0 Hz, 2H, ArH), 7.15-7.13 (m, 1H, ArH), 7.09 (d, *J* = 8.0 Hz, 2H, ArH), 6.95-6.92 (m, 2H, ArH), 5.06 (d, *J* = 10.4 Hz, 1H, CH), 4.59 (d, *J* = 10.4 Hz, 1H, CH), 4.57 (s, 1H, CH), 4.20 (q, *J* = 7.2 Hz, 2H, CH_2), 3.26 (s, 3H, CH_3), 3.00 (s, 3H, CH_3), 1.24 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.8, 169.5, 167.1, 150.7, 137.3, 136.8, 136.4, 134.2, 133.6, 132.1, 130.3, 130.2, 128.8, 128.5, 126.0, 122.6, 119.9, 118.1, 111.1, 107.3, 61.9, 61.4, 49.6, 46.2, 41.6, 29.0, 28.8, 14.1; IR(KBr) υ: 3379, 3321, 3265, 3178, 3045, 2978, 2864, 2832, 2187, 1839, 1655, 1632, 1576, 1462, 1348, 1267, 1178, 1132, 976, 948, 862, 755 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}Cl_2N_3O_5$([M+Na]$^+$): 626.1220, found: 606.1200.



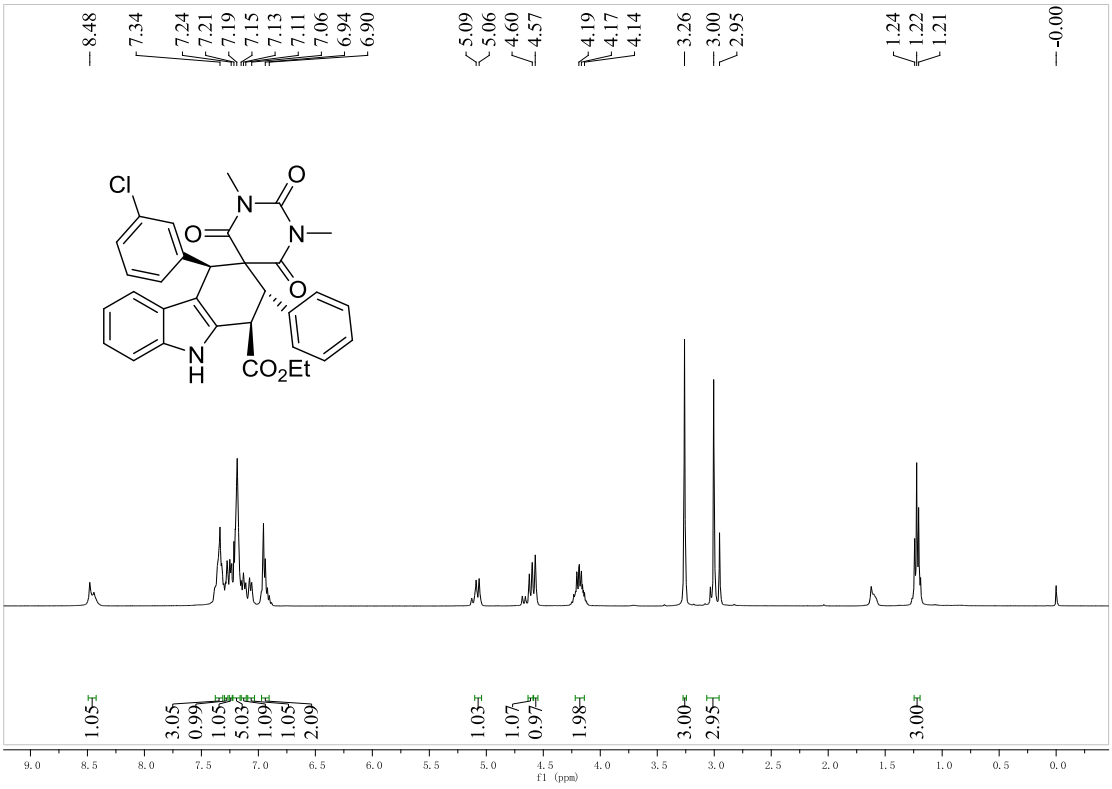

170.8
169.6
167.2
150.7
132.2
130.3
130.2
128.8
128.5
126.1
122.6
119.9
118.1
111.1
107.4
62.0
61.4
49.6
46.2
41.6
29.0
28.9
14.2
f1 (ppm)

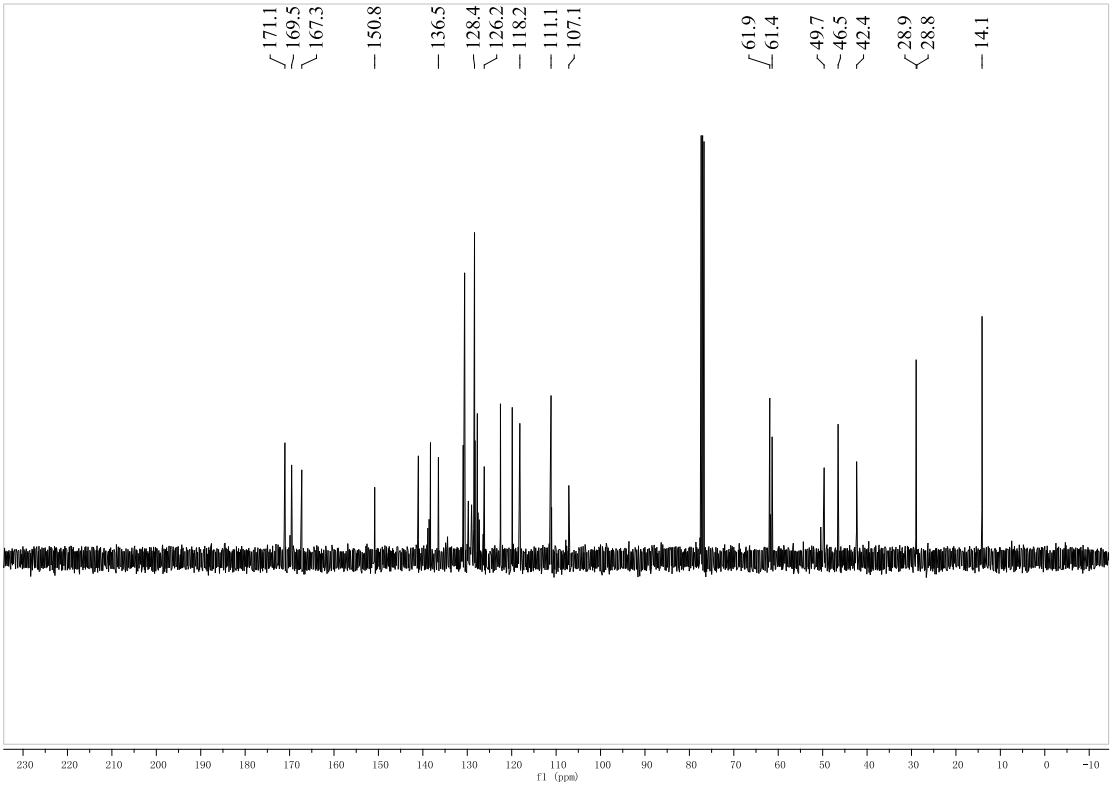

Intens.
x10^4
+MS, 1.23-1.60min #(73-95)
626.1200
628.1177
627.1231
629.1204
630.1167
631.1167
m/z

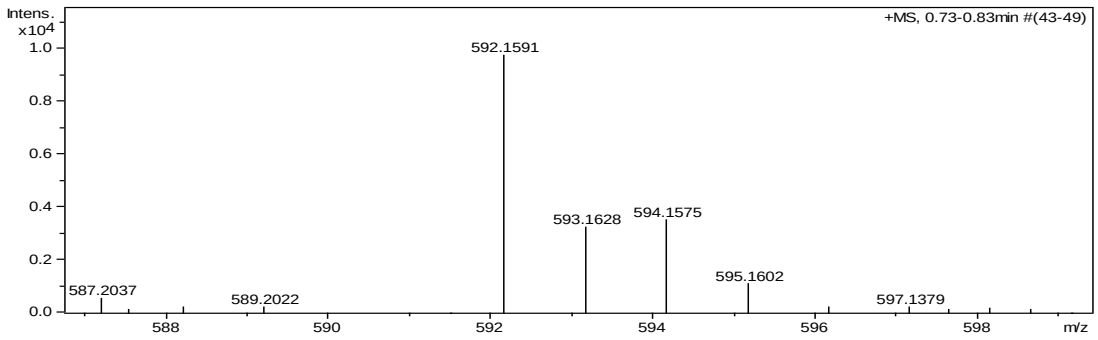
Ethyl

***rel*-(1R,2S,4R)-4-(3-chlorophenyl)-1',3'-dimethyl-2',4',6'-trioxo-2-phenyl-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1i):**

yellow solid, 76%, m.p. 216-219 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.48 (s, 1H, NH), 7.38-7.30 (m, 3H, ArH), 7.29-7.28 (m, 1H, ArH), 7.25-7.23 (m, 1H, ArH), 7.22-7.19 (m, 5H, ArH), 7.15-7.11 (m, 1H, ArH), 7.08-7.06 (m, 1H, ArH), 6.96-6.91 (m, 2H, ArH), 5.08 (d, *J* = 10.8 Hz, 1H, CH), 4.61 (d, *J* = 10.8 Hz, 1H, CH), 4.57 (s, 1H, CH), 4.18 (q, *J* = 7.2 Hz, 2H, CH_2), 3.26 (s, 3H, CH_3), 3.01 (s, 3H, CH_3), 1.22 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.0, 169.5, 167.2, 150.8, 141.0, 138.2, 136.4, 130.9, 130.7, 130.5, 128.4, 128.3, 128.2, 127.7, 126.1, 122.5, 119.8, 118.1, 111.1, 107.1, 61.9, 61.3, 49.6, 46.5, 42.3, 28.9, 28.7, 14.1; IR(KBr) υ: 3362, 3308, 3242, 3163, 3055, 2932, 2845, 2816, 2134, 1832, 1643, 1617, 1532, 1473, 1365, 1248, 1162, 1146, 982, 948, 872, 780 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{28}ClN_3O_5$([M+Na]$^+$): 592.1610, found: 592.1591.



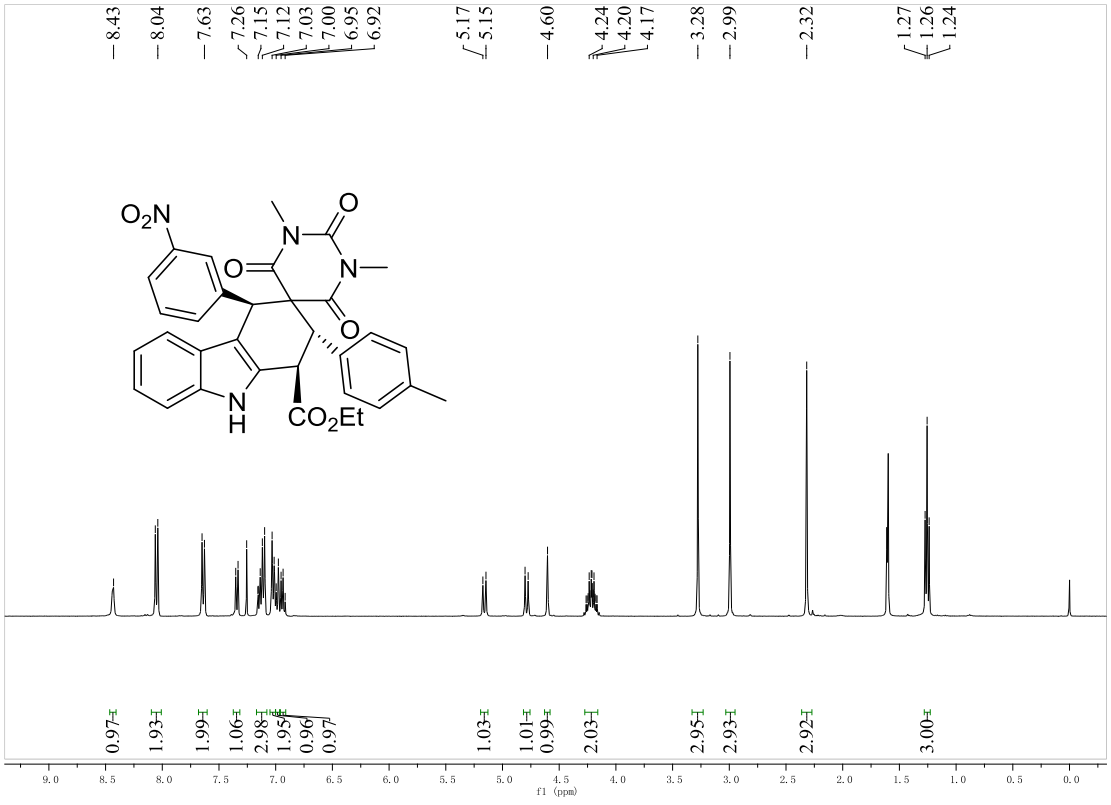

171.1
169.5
167.3
150.8
136.5
128.4
126.2
118.2
111.1
107.1
61.9
61.4
49.7
46.5
42.4
28.9
28.8
14.1
f1 (ppm)

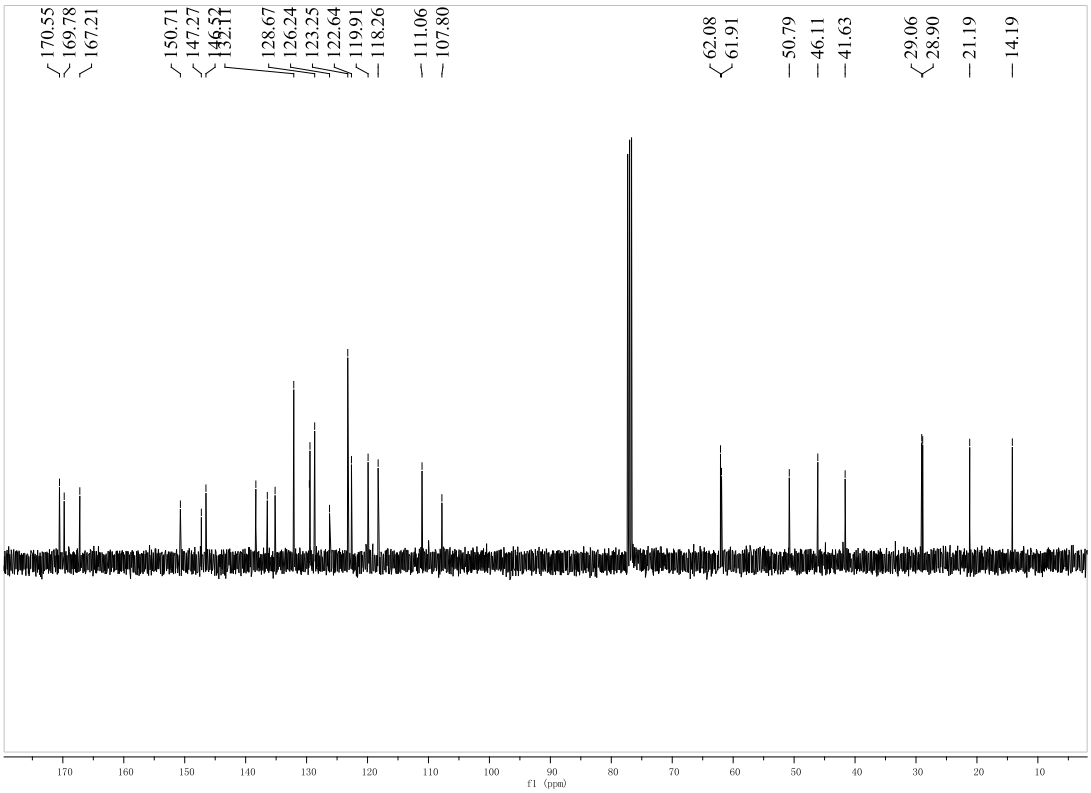

Intens.
x10^4
+MS, 0.73-0.83min #(43-49)
592.1591
593.1628
594.1575
595.1602
587.2037
589.2022
597.1379
m/z

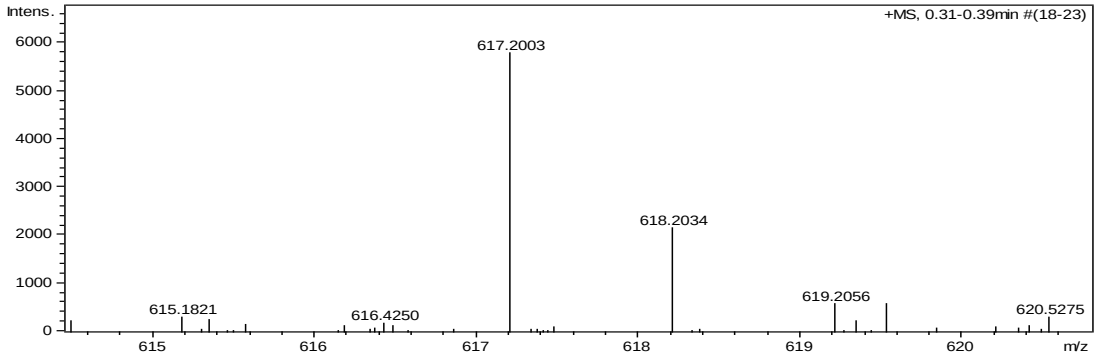
Ethyl

***rel-(1R,2S,4S)*-1',3'-dimethyl-4-(3-nitrophenyl)-2',4',6'-trioxo-2-(*p*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1j):**

yellow solid, 73%, m.p. 211-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.43 (s, 1H, NH), 8.05 (d, *J* = 8.8 Hz, 2H, ArH), 7.64 (d, *J* = 8.8 Hz, 2H, ArH), 7.34 (d, *J* = 8.8 Hz, 1H, ArH), 7.16-7.09 (m, 3H, ArH), 7.02 (d, *J* = 7.2 Hz, 2H, ArH), 6.98 (d, *J* = 7.2 Hz, 1H, ArH), 6.95-6.92 (m, 1H, ArH), 5.16 (d, *J* = 10.8 Hz, 1H, CH), 4.78 (d, *J* = 10.8 Hz, 1H, CH), 4.60 (s, 1H, CH), 4.21 (d, *J* = 7.2 Hz, 2H, CH_2), 3.28 (s, 3H, CH_3), 2.99 (s, 3H, CH_3), 2.32 (s, 3H, CH_3), 1.26 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.5, 169.7, 167.2, 150.7, 147.2, 146.5, 138.3, 136.4, 135.1, 132.1, 129.5, 129.4, 128.6, 126.2, 123.2, 122.6, 119.9, 118.2, 111.0, 107.7, 62.0, 61.9, 50.7, 46.1, 41.6, 29.0, 28.9, 21.1, 14.1; IR(KBr) υ: 3364, 3321, 3278, 3168, 3055, 2962, 2872, 2844, 2132, 1847, 1617, 1601, 1532, 1431, 1333, 1241, 1162, 1142, 972, 931, 872, 782 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{30}N_4O_7$([M+Na]$^+$): 617.2007, found: 617.2003.



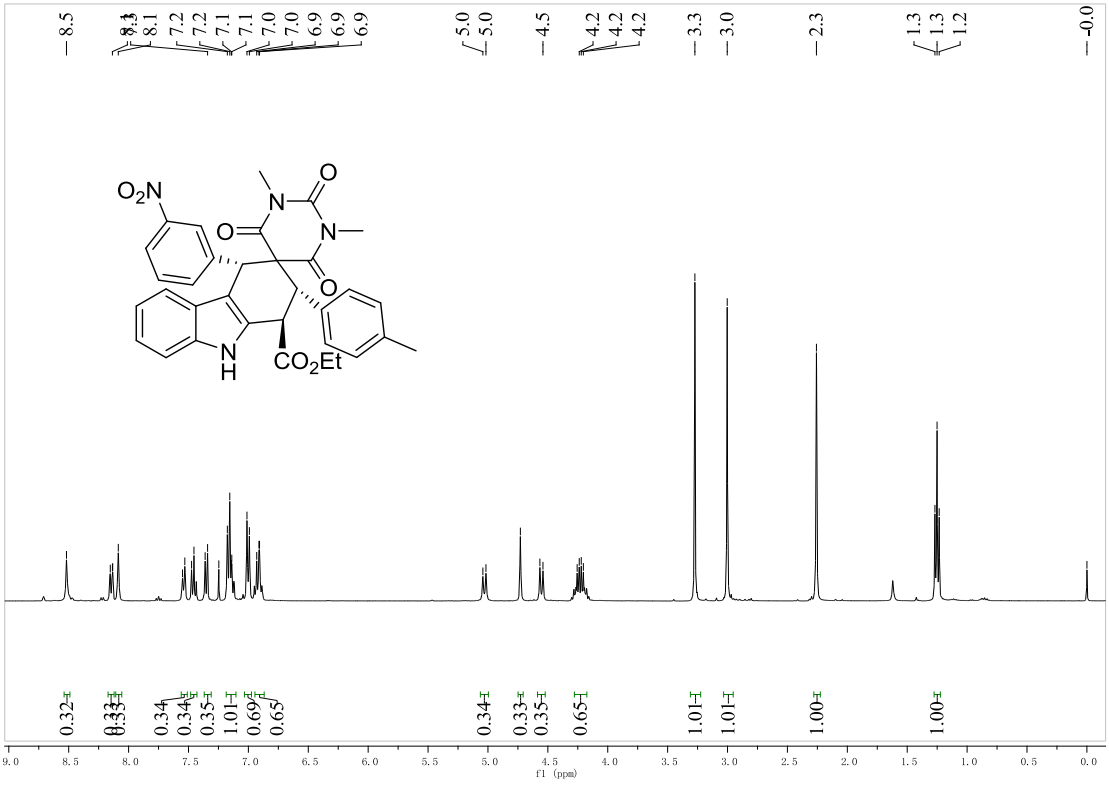

170.55
169.78
167.21
150.71
147.27
146.52
135.11
128.67
126.24
123.25
122.64
119.91
118.26
111.06
107.80
62.08
61.91
50.79
46.11
41.63
29.06
28.90
21.19
14.19
f1 (ppm)

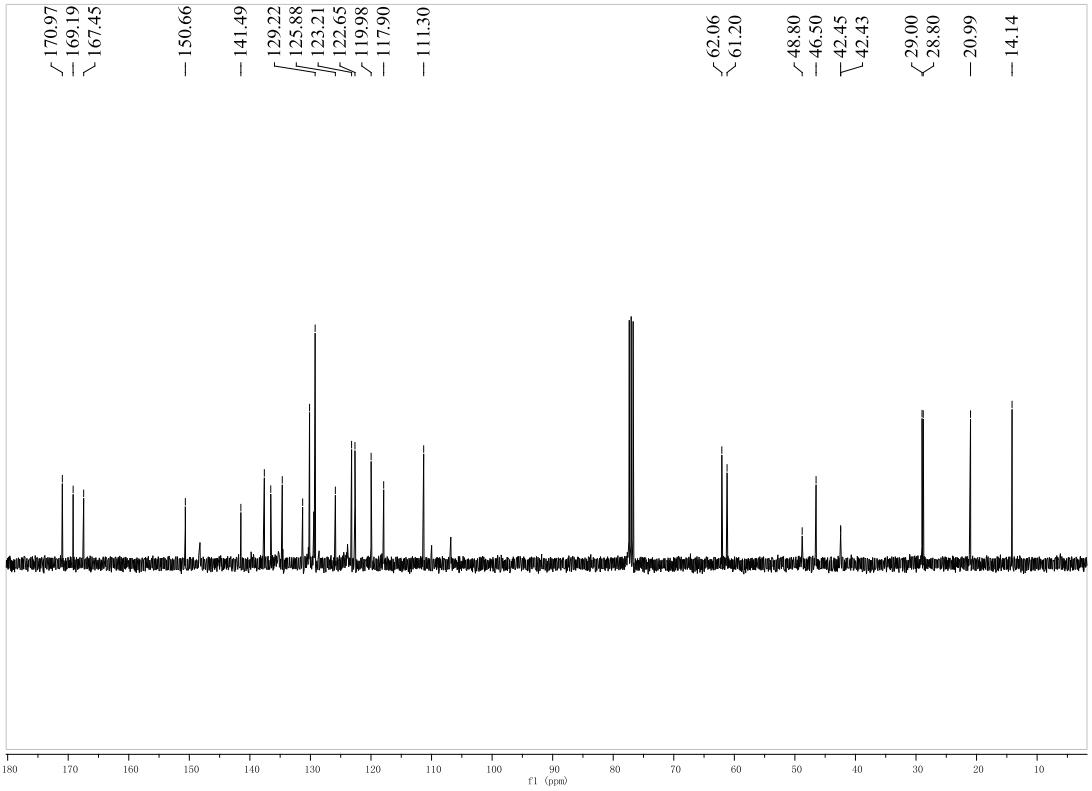

Intens.
+MS, 0.31-0.39min #(18-23)
617.2003
618.2034
615.1821
616.4250
619.2056
620.5275
m/z

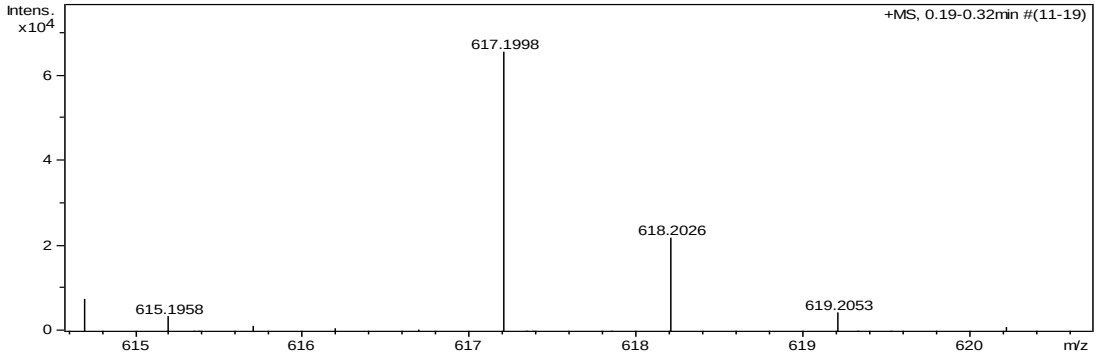
Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-4-(3-nitrophenyl)-2',4',6'-trioxo-2-(*p*-tolyl)-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1j'):**

yellow solid, 9%, m.p. 220-222 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.52 (s, 1H, NH), 8.14 (d, *J* = 8.0 Hz, 1H, ArH), 8.09 (s, 1H, ArH), 7.54 (d, *J* = 8.0 Hz, 1H, ArH), 7.47-7.44 (m, 1H, ArH), 7.35 (d, *J* = 8.0 Hz, 1H, ArH), 7.18-7.12 (m, 3H, ArH), 7.00 (d, *J* = 8.0 Hz, 2H, ArH), 6.95-6.89 (m, 2H, ArH), 5.03 (d, *J* = 10.4 Hz, 1H, CH), 4.73 (s, 1H, CH), 4.55 (d, *J* = 10.4 Hz, 1H, CH), 4.22 (q, *J* = 7.2 Hz, 2H, CH_2), 3.27 (s, 3H, CH_3), 3.00 (s, 3H, CH_3), 2.26 (s, 3H, CH_3), 1.25 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.9, 169.1, 167.4, 150.6, 141.4, 137.6, 136.5, 134.6, 131.2, 130.1, 129.2, 125.8, 123.2, 122.6, 119.9, 117.9, 111.3, 62.0, 61.2, 48.7, 46.5, 42.4, 42.4, 29.0, 28.8, 20.9, 14.1; IR(KBr) υ: 3378, 3314, 3255, 3172, 3046, 2978, 2856, 2832, 2114, 1856, 1632, 1642, 1577, 1438, 1348, 1255, 1179, 1135, 980, 952, 889, 779 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{30}N_4O_7$([M+Na]$^+$): 617.2007, found: 617.1998.



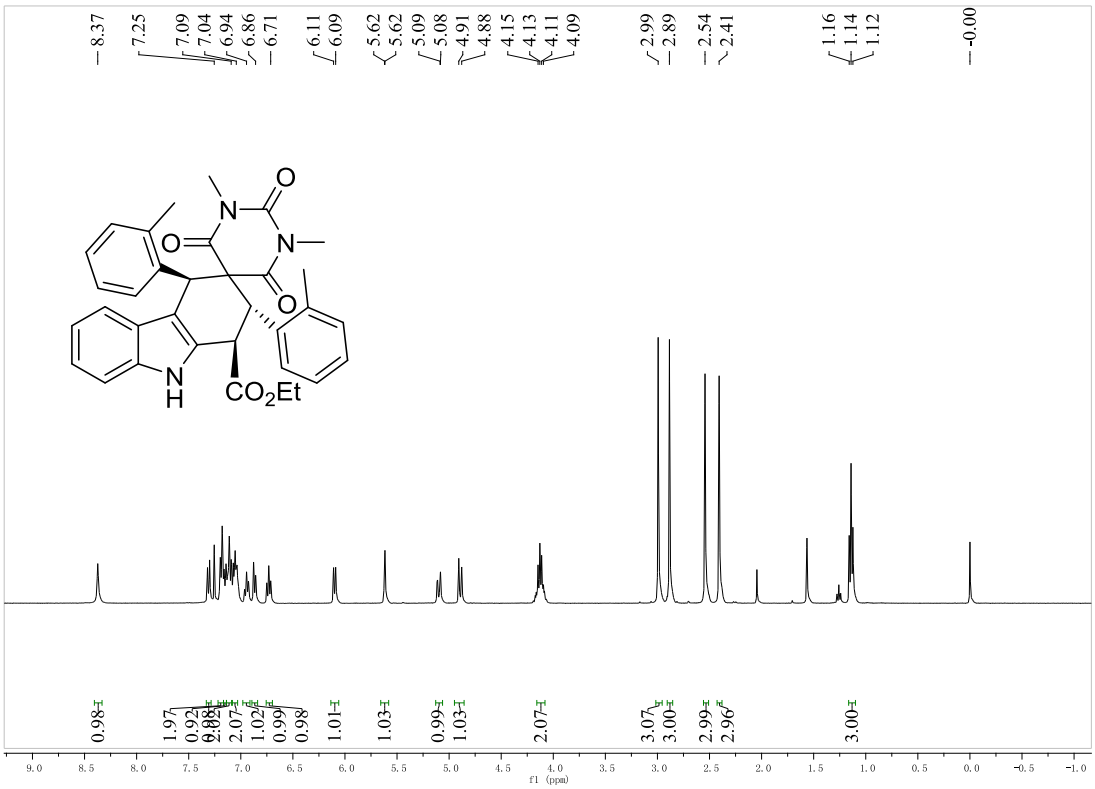

170.97
169.19
167.45
150.66
141.49
129.22
125.88
123.21
122.65
119.98
117.90
111.30
62.06
61.20
48.80
46.50
42.45
42.43
29.00
28.80
20.99
14.14
f1 (ppm)

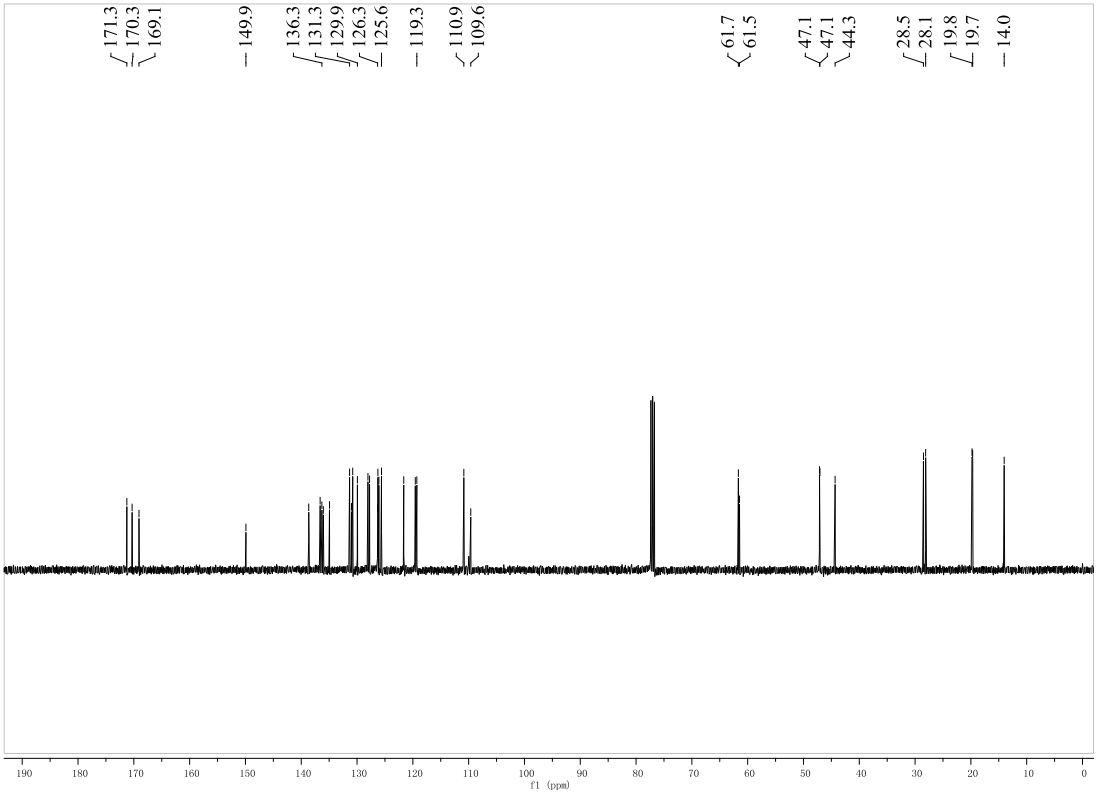

Intens.
x10^4
+MS, 0.19-0.32min #(11-19)
617.1998
618.2026
615.1958
619.2053
m/z

Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-2',4',6'-trioxo-2,4-di-*o*-tolyl-1,1',2,3',4,4',6',9-octahydro-2'H-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1k'):**

yellow solid, 71%, m.p. 203-206 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.37 (s, 1H, NH), 7.31 (d, *J* = 8.4 Hz, 1H, ArH), 7.18 (t, *J* = 7.2 Hz, 1H, ArH), 7.15 (d, *J* = 7.2 Hz, 1H, ArH), 7.13-7.09 (m, 2H, ArH), 7.07-7.04 (m, 2H, ArH), 6.95 (t, *J* = 7.2 Hz, 1H, ArH), 6.86 (d, *J* = 8.0 Hz, 1H, ArH), 6.73 (t, *J* = 7.2 Hz, 1H, ArH), 6.09 (d, *J* = 8.0 Hz, 1H, ArH), 5.61 (d, *J* =1.6 Hz, 1H, CH), 5.10 (dd, J_1 =11.2 Hz, J_2 =2.0 Hz, 1H, CH), 4.89 (d, *J* =11.2 Hz, 1H, CH), 4.11 (q, *J* = 7.2 Hz, 2H, CH_2), 2.99 (s, 3H, CH_3), 2.88 (s, 3H, CH_3), 2.54 (s, 3H, CH_3), 2.41 (s, 3H, CH_3), 1.14 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.2, 170.3, 169.0, 149.9, 138.6, 136.6, 136.3, 136.0, 134.9, 131.3, 130.9, 130.7, 129.9, 128.0, 127.7, 126.3, 126.2, 126.0, 125.6, 121.6, 119.5, 119.2, 110.8, 109.6, 61.6, 61.4, 47.1, 47.0, 44.3, 28.5, 28.1, 19.8, 19.6, 14.0; IR(KBr) υ: 3382, 3245, 3163, 3023, 2918, 2832, 2152, 1873, 1655, 1631, 1542, 1428, 1317, 1295, 1167, 1145, 956, 923, 872, 745 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_5$ ([M+Na]$^+$):586.2312, found: 586.2297.




171.3
170.3
169.1
149.9
136.3
131.3
129.9
126.3
125.6
119.3
110.9
109.6
61.7
61.5
47.1
47.1
44.3
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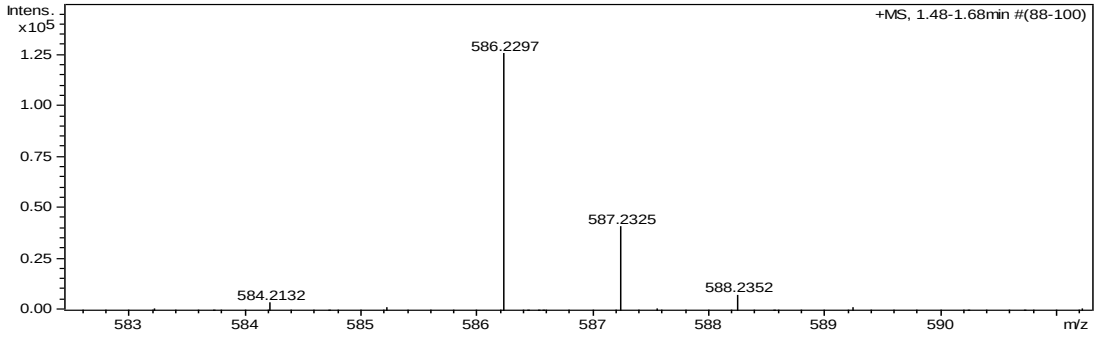
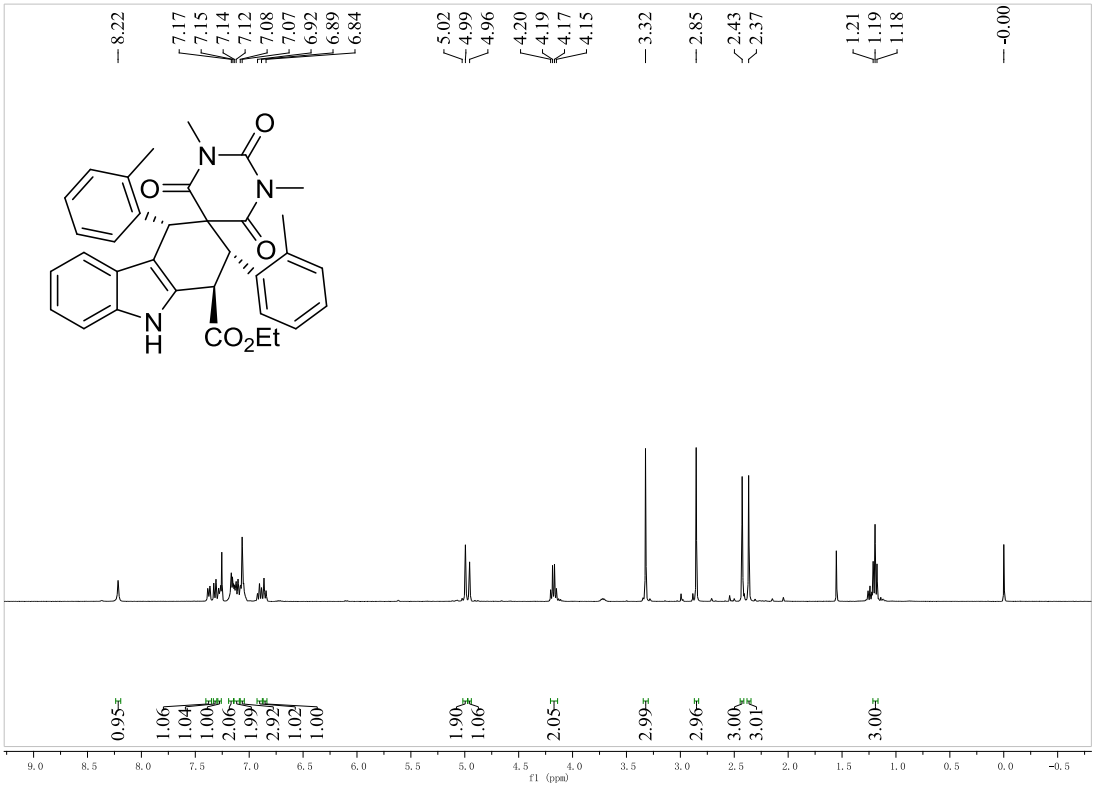
28.1
19.8
19.7
14.0
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

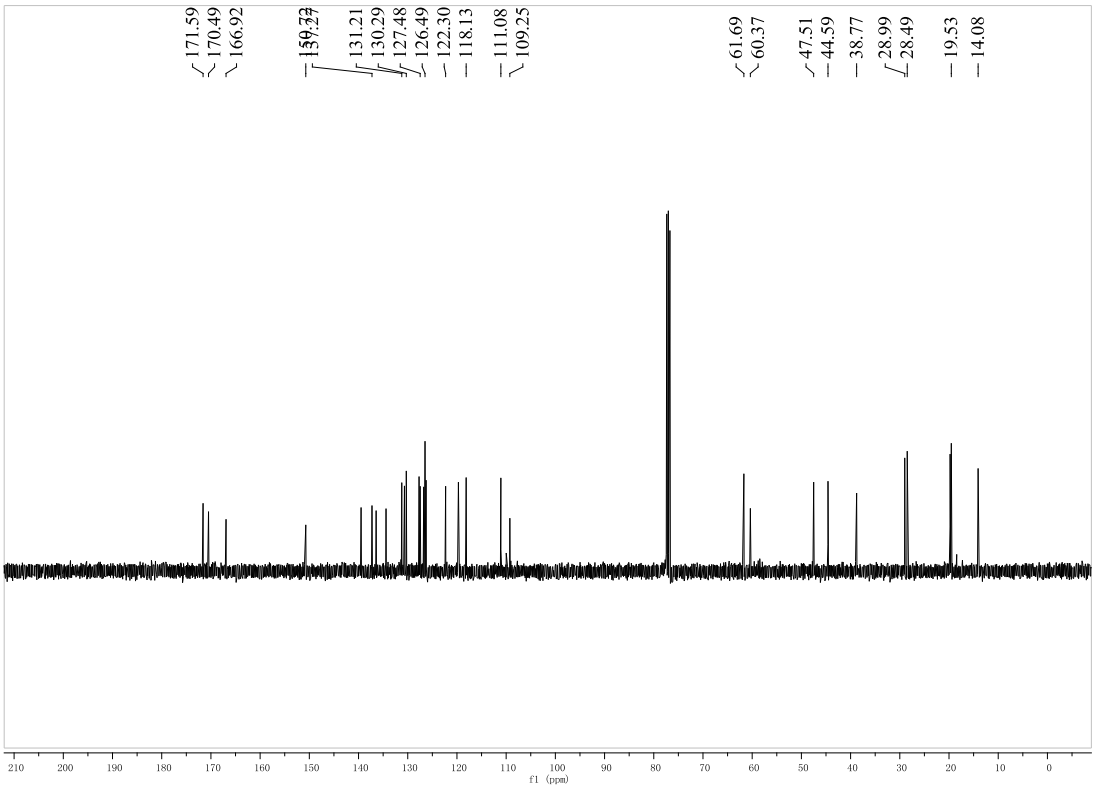

Intens.
x10^5
1.25
1.00
0.75
0.50
0.25
0.00
+MS, 1.48-1.68min #(88-100)
586.2297
587.2325
584.2132
588.2352
583 584 585 586 587 588 589 590
m/z

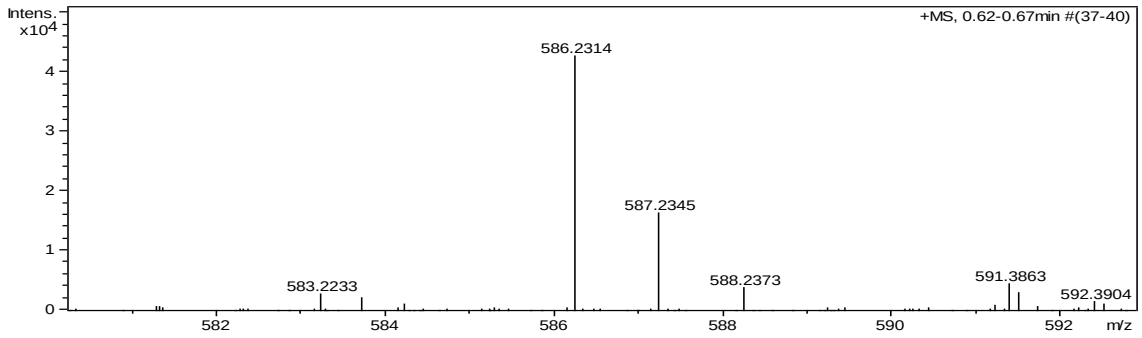
Ethyl

***rel*-(*1R,2S,4S)*-1',3'-dimethyl-2',4',6'-trioxo-2,4-di-*o*-tolyl-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1k'):**

yellow solid, 9%, m.p. 211-214 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.22 (s, 1H, NH), 7.37 (d, *J* = 8.4 Hz, 1H, ArH), 7.31 (d, *J* = 8.4 Hz, 1H, ArH), 7.28-7.26 (m, 1H, ArH), 7.17-7.15 (m, 2H, ArH), 7.14-7.10 (m, 2H, ArH), 7.08-7.05 (m, 3H, ArH), 6.91 (t, *J* = 7.6 Hz, 1H, ArH), 6.85 (d, *J* = 7.6 Hz, 1H, ArH), 5.02-4.99 (m, 2H, CH), 4.96 (s, 1H, CH), 4.17 (q, *J* = 7.2 Hz, 2H, CH_2), 3.32 (s, 3H, CH_3), 2.85 (s, 3H, CH_3), 2.43 (s, 3H, CH_3), 2.37 (s, 3H, CH_3), 1.19 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.5, 170.4, 166.9, 150.7, 139.4, 137.2, 137.2, 136.4, 134.4, 131.3, 131.2, 130.6, 130.2, 127.7, 127.4, 126.7, 126.4, 126.2, 122.3, 119.7, 118.1, 111.0, 109.2, 61.6, 60.3, 47.5, 44.5, 38.7, 28.9, 28.4, 19.7, 19.5, 14.0; IR(KBr) υ: 3379, 3251, 3148, 3033, 2973, 2864, 2173, 1849, 1667, 1618, 1537, 1471, 1365, 1288, 1173, 1151, 982, 907, 866, 755 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_5$ ([M+Na]$^+$): 586.2312, found: 586.2314.



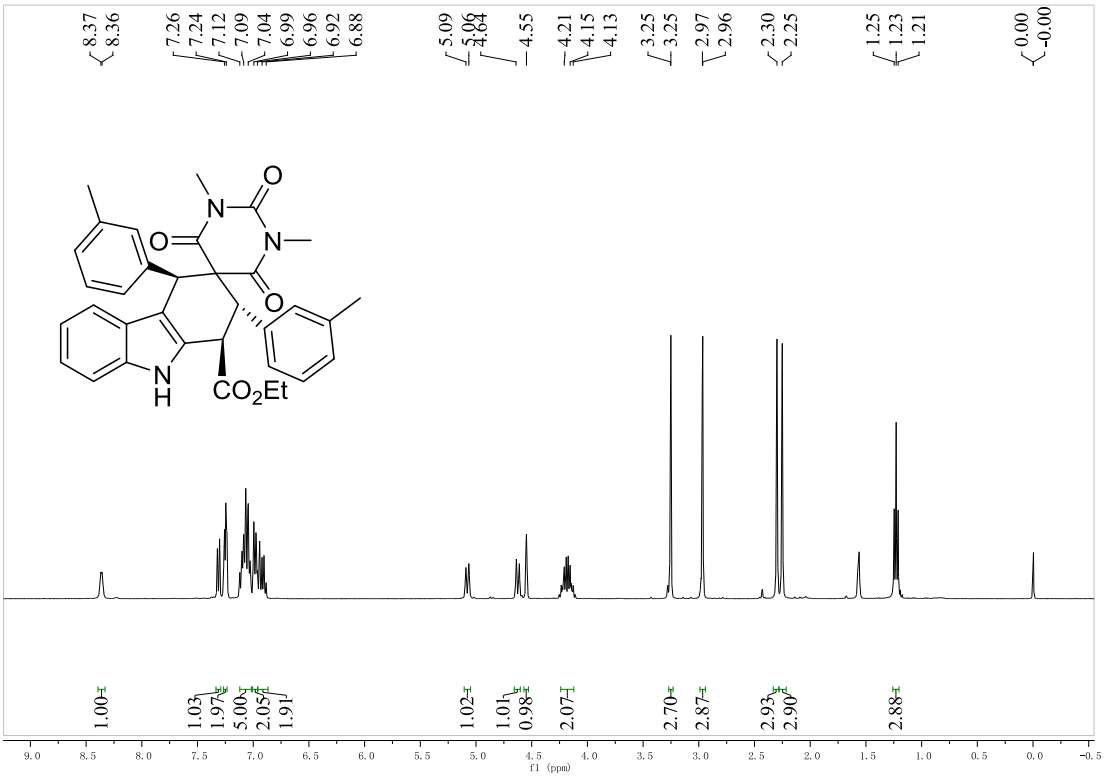

171.59
170.49
166.92
150.73
137.27
131.21
130.29
127.48
126.49
122.30
118.13
111.08
109.25
61.69
60.37
47.51
44.59
38.77
28.99
28.49
19.53
14.08
f1 (ppm)

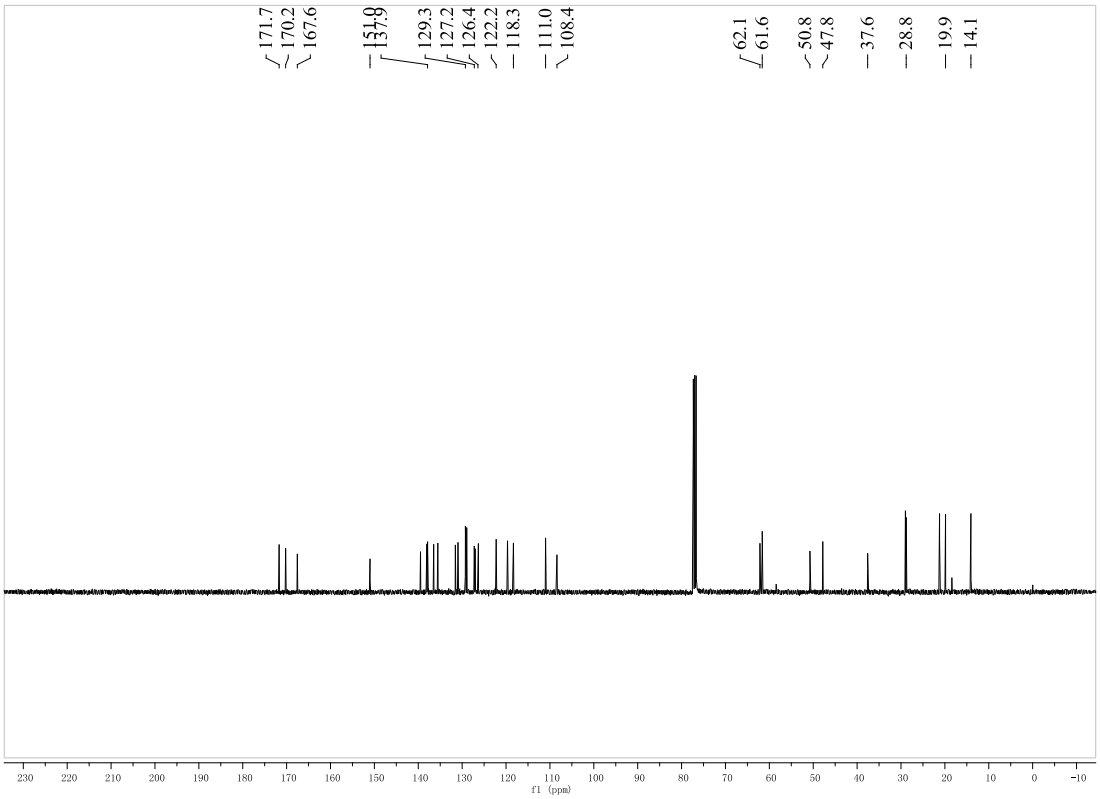

Intens.
x10^4
+MS, 0.62-0.67min #(37-40)
586.2314
587.2345
583.2233
588.2373
591.3863
592.3904
m/z

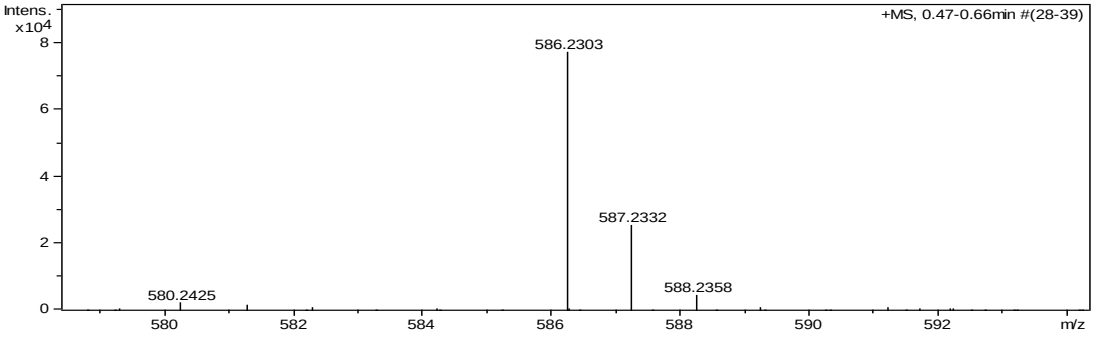
Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-2',4',6'-trioxo-2,4-di-*m*-tolyl-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1l):**

yellow solid, 77%, m.p. 201-204 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.36 (s, 1H, NH), 7.31 (d, *J* = 8.0 Hz, 1H, ArH), 7.26-7.24 (m, 2H, ArH), 7.12-7.03 (m, 5H, ArH), 6.99-6.96 (m, 2H, ArH), 6.94-6.88 (m, 2H, ArH), 5.08 (d, *J* =10.4 Hz, 1H, CH), 4.62 (d, *J* =10.4 Hz, 1H, CH), 4.55 (s, 1H, CH), 4.17 (q, *J* = 7.2 Hz, 2H, CH_2), 3.25 (s, 3H, CH_3), 2.97 (s, 3H, CH_3), 2.30 (s, 3H, CH_3), 2.26 (s, 3H, CH_3), 1.23 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.7, 170.2, 167.5, 150.9, 139.4, 138.0, 137.8, 136.4, 135.5, 131.5, 130.9, 129.2, 128.9, 127.2, 127.0, 126.4, 126.3, 122.2, 119.6, 118.3, 110.9, 108.3, 62.1, 61.6, 50.7, 47.8, 37.6, 28.9, 28.8, 21.2, 19.8, 14.0; IR(KBr) υ: 3371, 3213, 3148, 3056, 2972, 2846, 2133, 1892, 1665, 1641, 1572, 1435, 1326, 1287, 1155, 1123, 942, 913, 865, 738 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_5$ ([M+Na]$^+$): 586.2312, found: 586.2303.



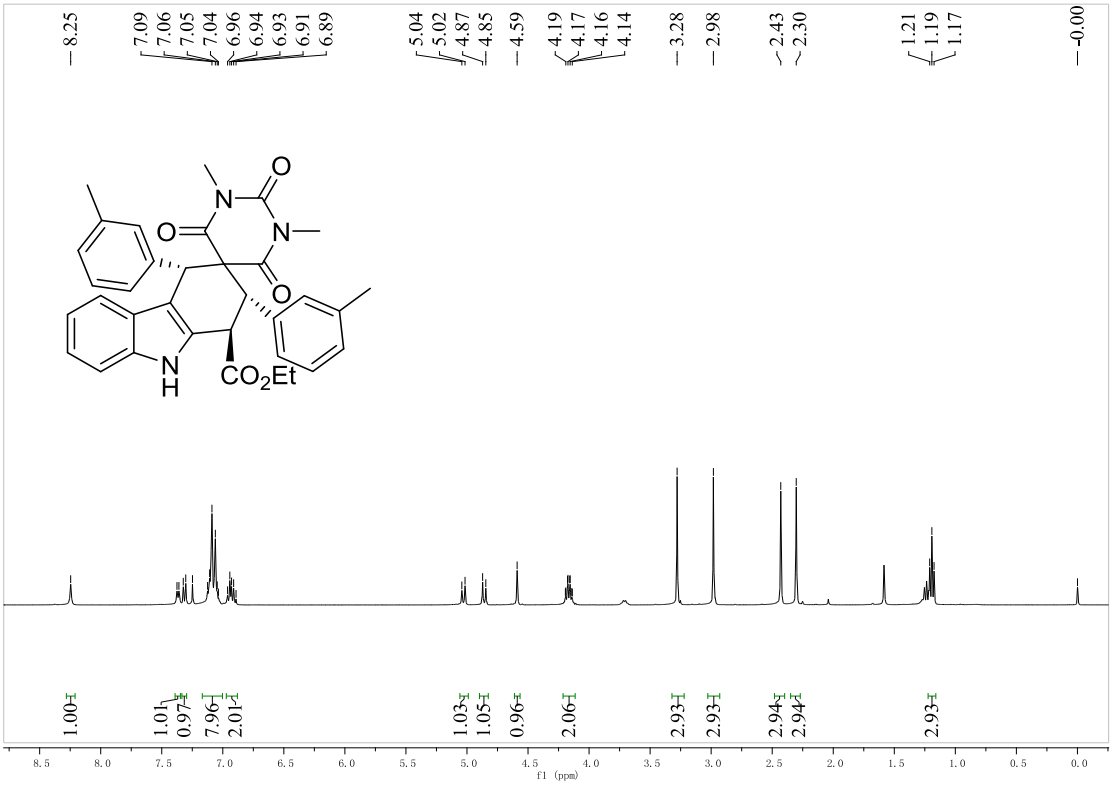

171.7
170.2
167.6
151.0
137.9
129.3
127.2
126.4
122.2
118.3
111.0
108.4
62.1
61.6
50.8
47.8
37.6
28.8
19.9
14.1
f1 (ppm)

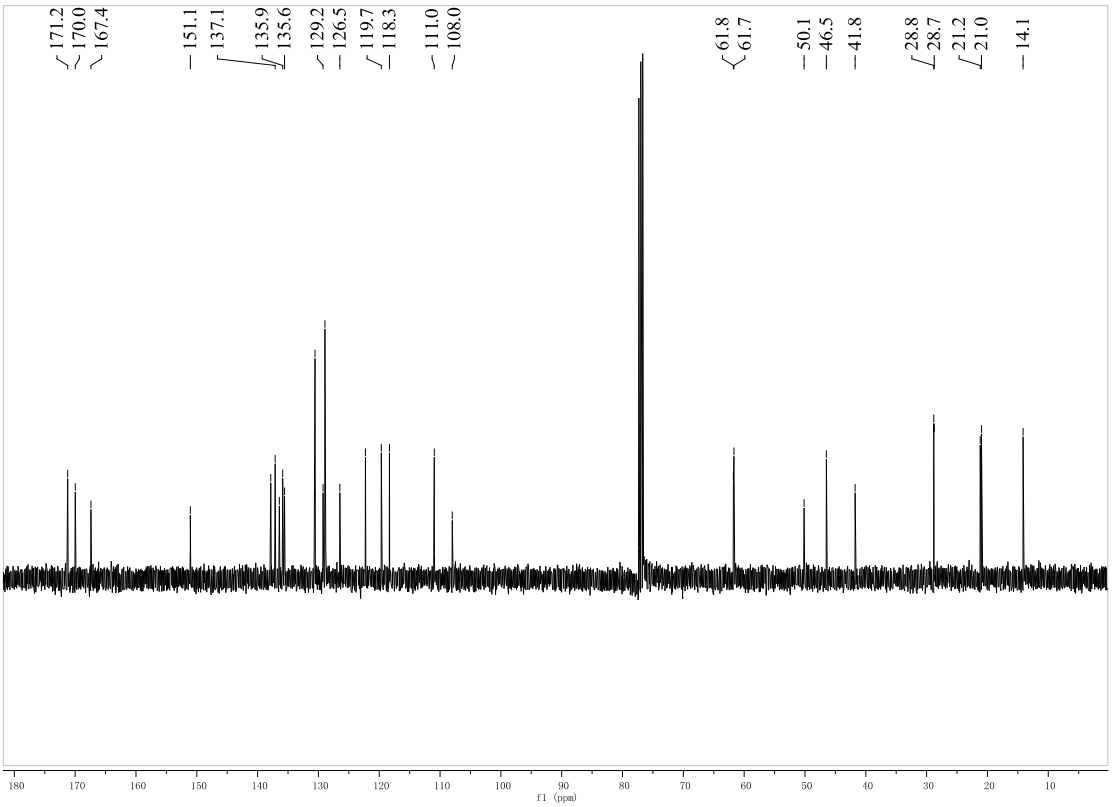

Intens.
x10^4
+MS, 0.47-0.66min #(28-39)
586.2303
587.2332
588.2358
580.2425
m/z

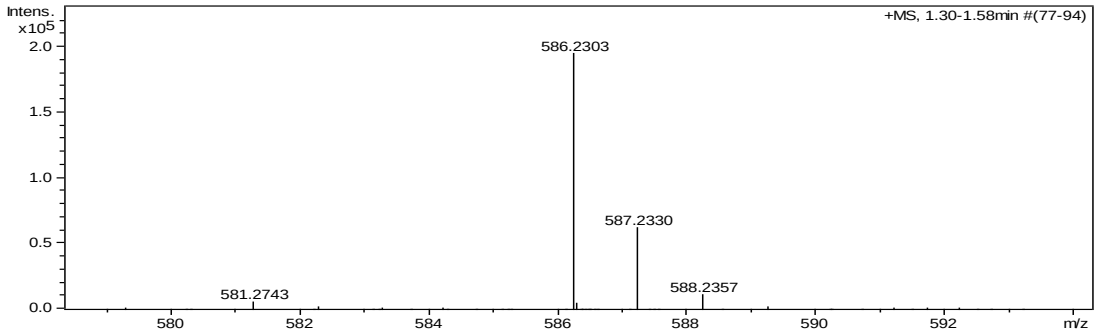
Ethyl

***rel-(1R,2S,4S)*-1',3'-dimethyl-2',4',6'-trioxo-2,4-di-*m*-tolyl-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1l'):**

yellow solid, 6%, m.p. 213-215 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.25 (s, 1H, NH), 7.36 (d, *J* = 6.4 Hz, 1H, ArH), 7.31 (d, *J* = 6.4 Hz, 1H, ArH), 7.12-7.04 (m, 8H, ArH), 6.96-6.89 (m, 2H, ArH), 5.03 (d, *J* =10.4 Hz, 1H, CH), 4.86 (d, *J* =10.4 Hz, 1H, CH), 4.59 (s, 1H, CH), 4.17 (q, *J* = 6.8 Hz, 2H, CH_2), 3.28 (s, 3H, CH_3), 2.98 (s, 3H, CH_3), 2.43 (s, 3H, CH_3), 2.30 (s, 3H, CH_3), 1.19 (t, *J* = 6.8 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.2, 169.9, 167.4, 151.0, 137.8, 137.1, 136.4, 135.8, 135.5, 130.6, 130.5, 129.2, 128.9, 128.8, 126.4, 122.2, 119.6, 118.3, 110.9, 107.9, 61.7, 61.6, 50.1, 46.4, 41.7, 28.8, 28.7, 21.1, 20.9, 14.1; IR(KBr) υ: 3359, 3278, 3154, 3066, 2965, 2852, 2148, 1876, 1642, 1612, 1565, 1487, 1345, 1245, 1123, 1111, 999, 945, 865, 742 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_5$ ([M+Na]$^+$): 586.2312, found: 586.2303.



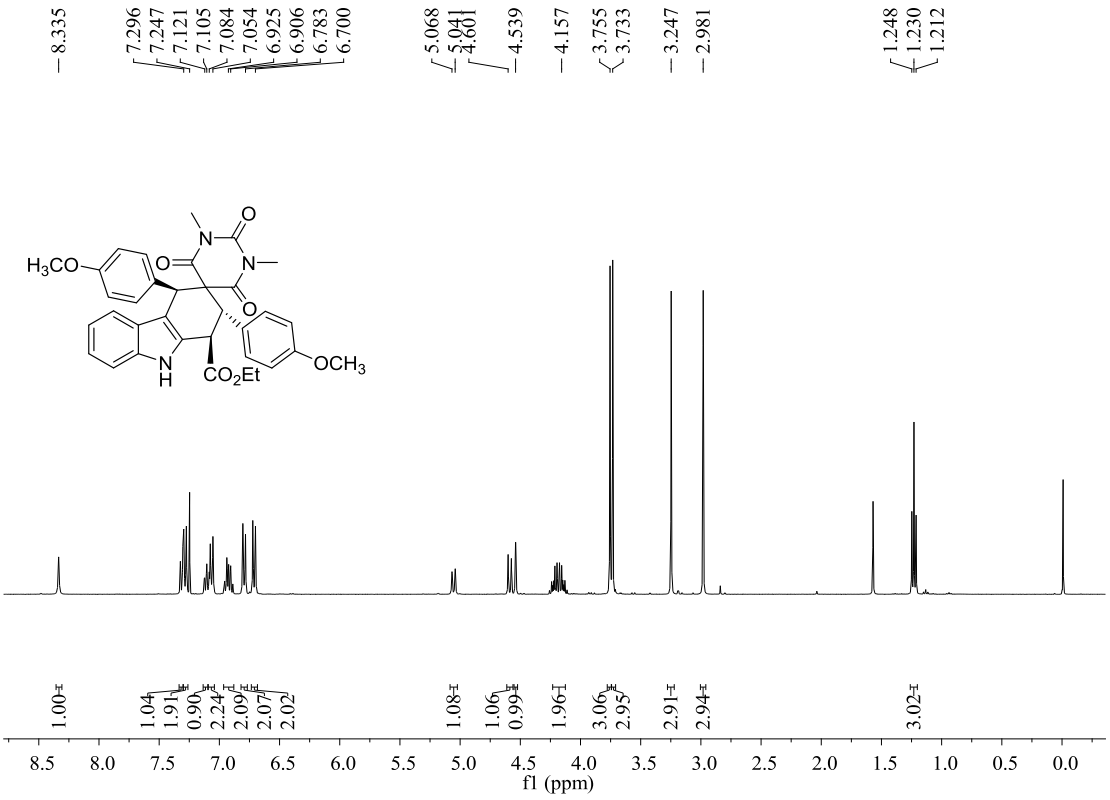

171.2
170.0
167.4
151.1
137.1
135.9
135.6
129.2
126.5
119.7
118.3
111.0
108.0
61.8
61.7
50.1
46.5
41.8
28.8
28.7
21.2
21.0
14.1
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

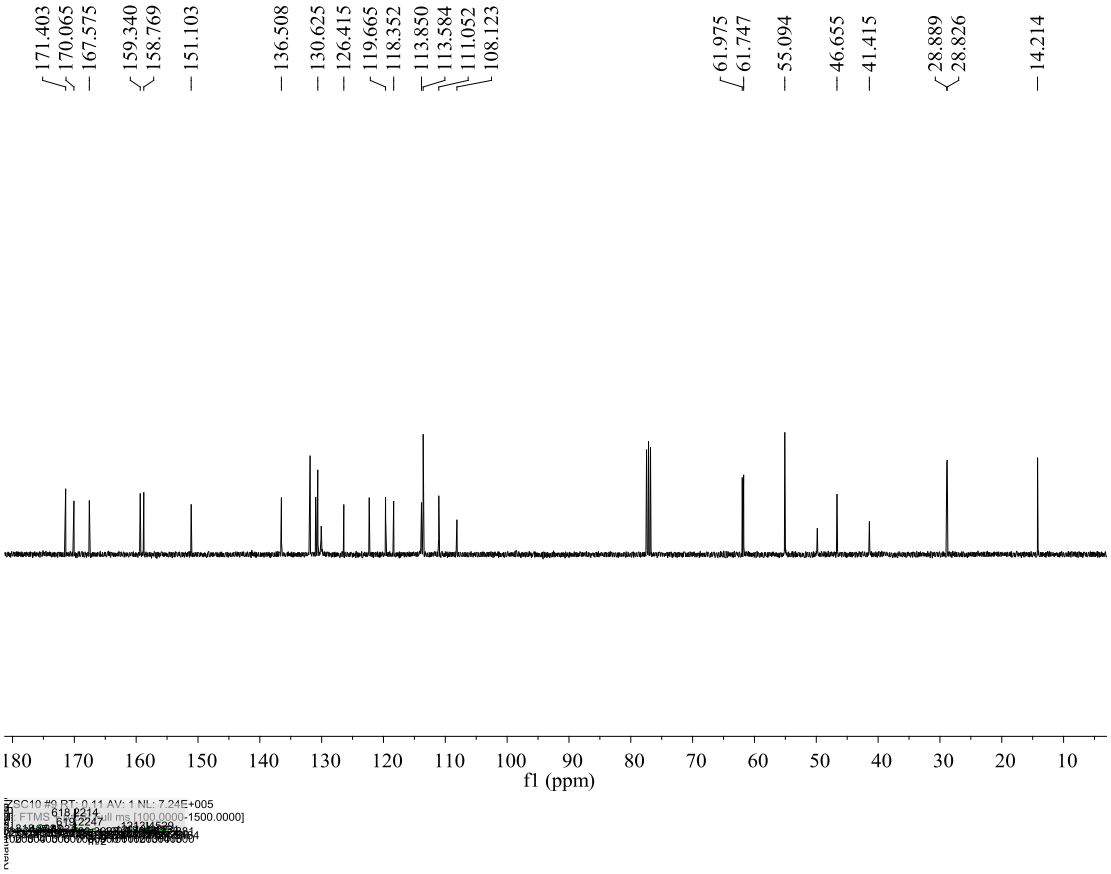

Intens.
x10^5
2.0
1.5
1.0
0.5
0.0
+MS, 1.30-1.58min #(77-94)
586.2303
587.2330
588.2357
581.2743
580
582
584
586
588
590
592
m/z

Ethyl

***rel-(1R,2S,4R)*-2,4-bis(4-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1m):**

yellow solid, 75%, m.p. 201-204 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.34 (s, 1H, NH), 7.32 (d, *J* = 8.0 Hz, 1H, ArH), 7.29 (d, *J* = 8.8 Hz, 2H, ArH), 7.13-7.06 (m, 3H, ArH), 6.96-6.90 (m, 2H, ArH), 6.80 (d, *J* = 8.8 Hz, 2H, ArH), 6.72 (d, *J* = 8.8 Hz, 2H, ArH), 5.06 (d, *J* =10.8 Hz, 1H, CH), 4.59 (d, *J* =10.8 Hz, 1H, CH), 4.55 (s, 1H, CH), 4.19 (q, *J* = 7.2 Hz, 2H, CH_2), 3.76 (s, 3H, OCH_3), 3.74 (s, 3H, OCH_3), 3.26 (s, 3H, CH_3), 2.99 (s, 3H, CH_3), 1.24 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.4, 170.0, 167.5, 159.3, 158.7, 151.1, 136.5, 131.8, 130.9, 130.6, 126.4, 122.3, 119.6, 118.3, 113.8, 113.5, 111.0, 108.1, 61.9, 61.7, 55.1, 55.0, 49.8, 46.6, 41.4, 28.8, 28.8, 14.2; IR(KBr) υ: 3345, 3267, 3132, 3017, 2960, 2833, 2140, 1873, 1641, 1601, 1514, 1411, 1372, 1255, 1146, 1137, 967, 941, 871, 765 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_7$ ($[M+Na]^+$): 618.2211, found: 618.2214.

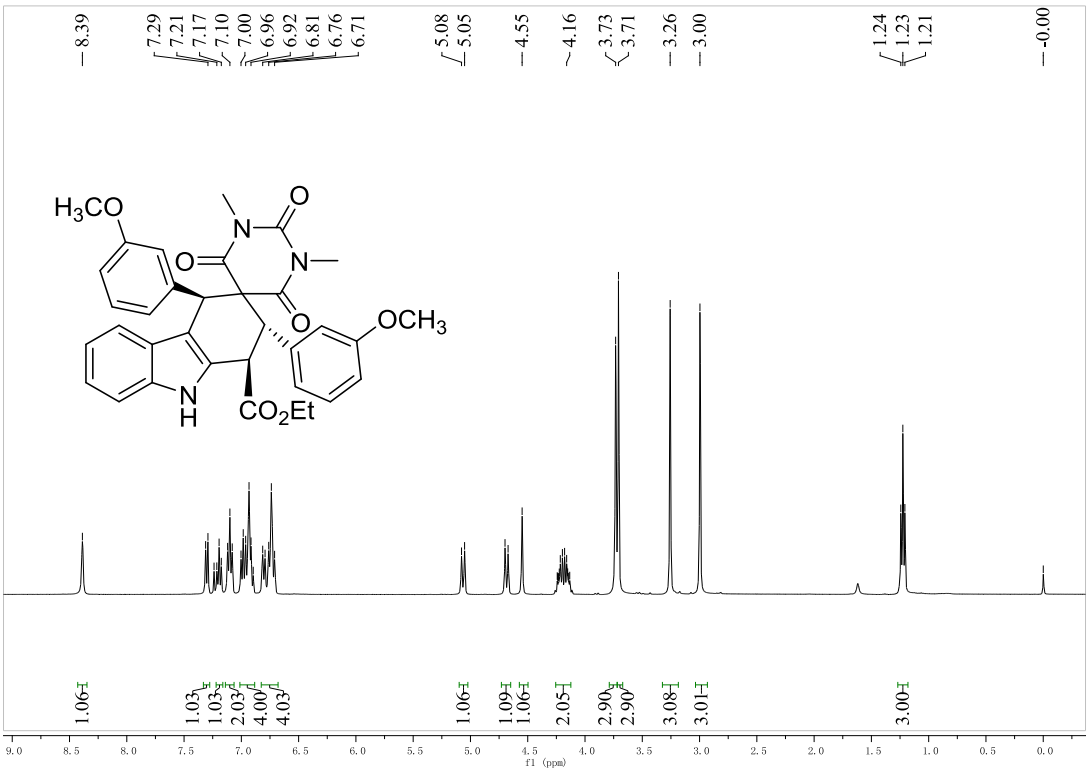


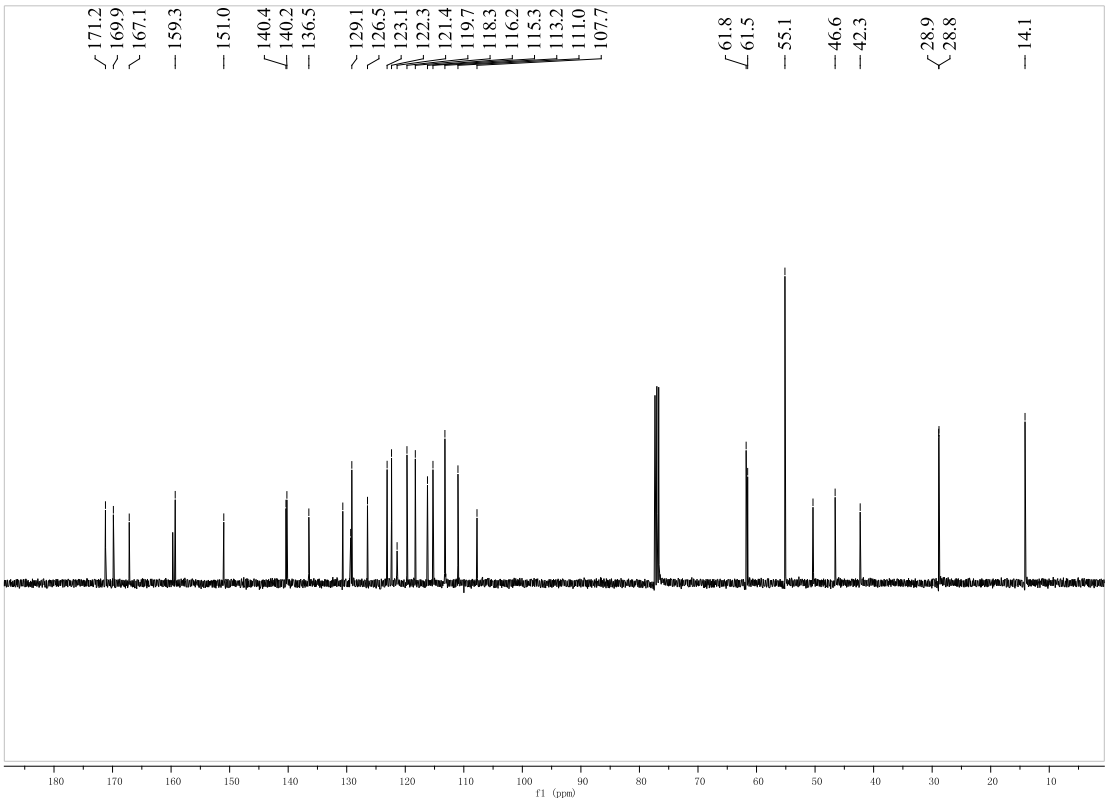

171.403
170.065
167.575
159.340
158.769
151.103
136.508
130.625
126.415
119.665
118.352
113.850
113.584
111.052
108.123
61.975
61.747
55.094
46.655
41.415
28.889
28.826
14.214
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

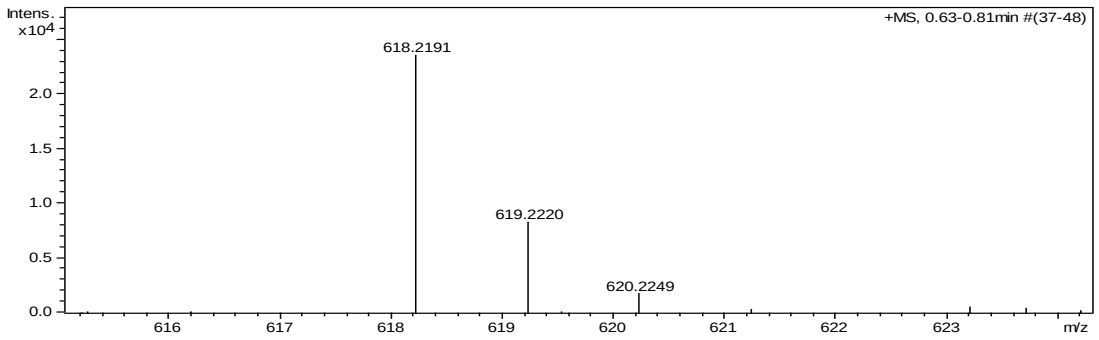
Ethyl

***rel-(1R,2S,4R)*-2,4-bis(3-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1n):**

yellow solid, 70%, m.p. 209-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.39 (s, 1H, NH), 7.30 (d, *J* = 8.0 Hz, 1H, ArH), 7.19 (t, *J* = 8.0 Hz, 1H, ArH), 7.10 (t, *J* = 8.0 Hz, 2H, ArH), 7.00-6.90 (m, 4H, ArH), 6.81-6.71 (m, 4H, ArH), 5.07 (d, *J* =10.4 Hz, 1H, CH), 4.68 (d, *J* =10.8 Hz, 1H, CH), 4.55 (s, 1H, CH), 4.18 (q, *J* = 7.2 Hz, 2H, CH_2), 3.73 (s, 3H, OCH_3), 3.71 (s, 3H, OCH_3), 3.26 (s, 3H, CH_3), 3.00 (s, 3H, CH_3), 1.23 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 171.2, 169.8, 167.1, 151.0, 140.3, 140.2, 136.4, 130.6, 129.3, 129.1, 126.4, 123.1, 122.3, 121.3, 119.7, 118.2, 116.2, 115.2, 113.2, 111.0, 107.7, 61.7, 61.5, 55.1, 50.3, 46.5, 42.2, 28.8, 28.8, 14.1; IR(KBr) υ: 3372, 3264, 3138, 3072, 2946, 2831, 2172, 1862, 1655, 1638, 1571, 1467, 1352, 1261, 1178, 1121, 973, 952, 834, 721 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}N_3O_7$ ([M+Na]$^+$): 618.2211, found: 618.2191.



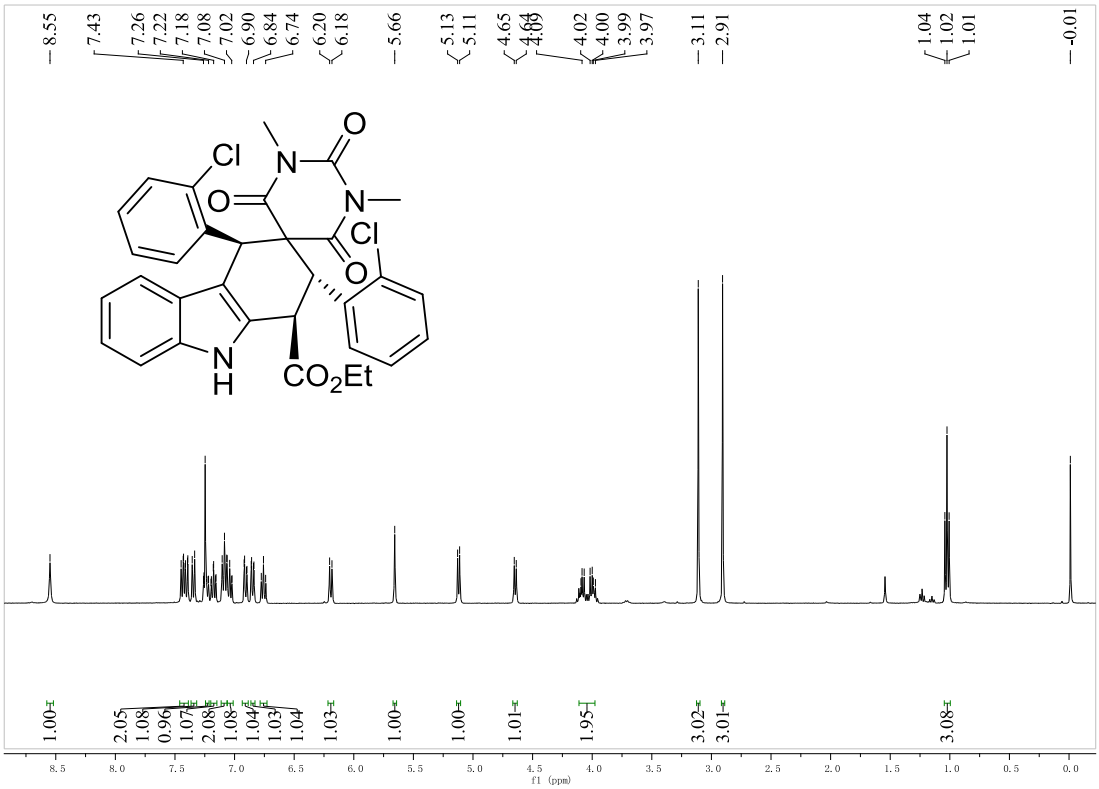

171.2
169.9
167.1
159.3
151.0
140.4
140.2
136.5
129.1
126.5
123.1
122.3
121.4
119.7
118.3
116.2
115.3
113.2
111.0
107.7
61.8
61.5
55.1
46.6
42.3
28.9
28.8
14.1
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

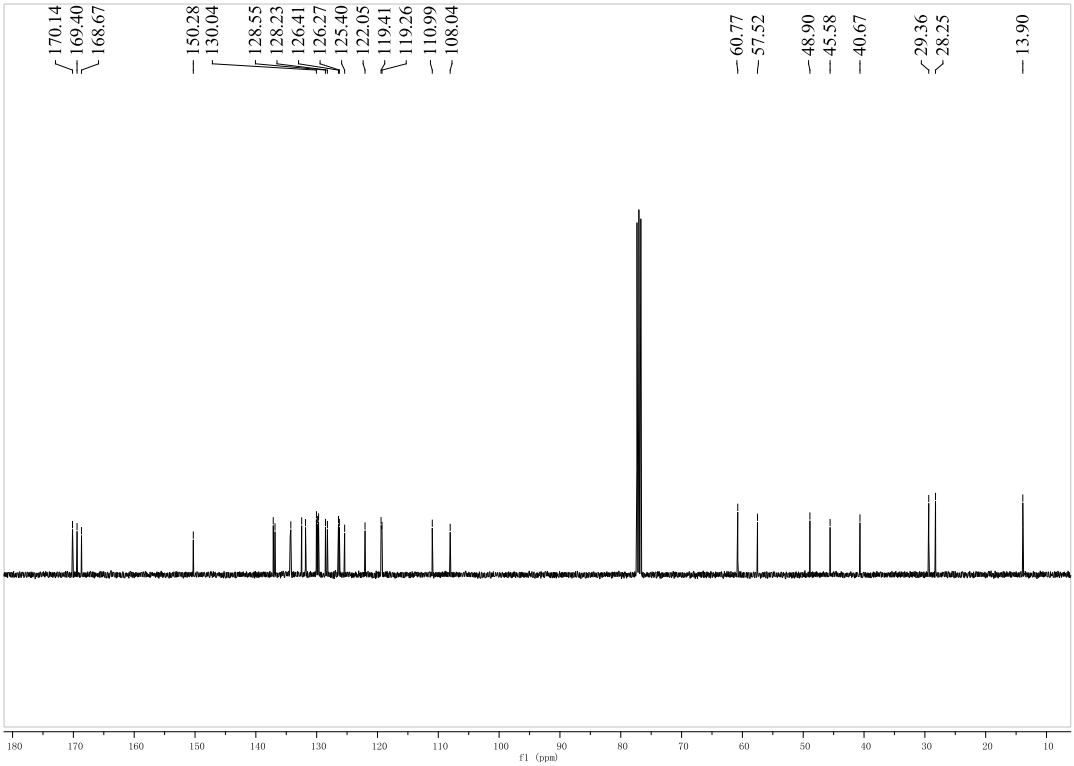

Intens.
x10^4
+MS, 0.63-0.81min #(37-48)
618.2191
619.2220
620.2249
2.0
1.5
1.0
0.5
0.0
616
617
618
619
620
621
622
623
m/z

Ethyl

***rel-(1R,2R,4R)*-2,4-bis(2-chlorophenyl)-1',3'-dimethyl-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1o):**

yellow solid, 72%, m.p. 214-216 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.55 (s, 1H, NH), 7.45-7.39 (m, 2H, ArH), 7.34 (d, J = 8.4 Hz, 1H, ArH), 7.26-7.22 (m, 1H, ArH), 7.20-7.16 (m, 1H, ArH), 7.09 (t, J = 7.6 Hz, 2H, ArH), 7.04 (t, J = 8.4 Hz, 1H, ArH), 6.91 (dd, J_1 = 8.0 Hz, J_2 = 1.6 Hz, 1H, ArH), 6.85 (dd, J_1 = 8.0 Hz, J_2 = 1.2 Hz, 1H, ArH), 6.76 (t, J = 7.2 Hz, 1H, ArH), 6.19 (d, J = 8.0 Hz, 1H, ArH), 5.66 (s, 1H, CH), 5.12 (d, J =6.8 Hz, 1H, CH), 4.64 (d, J =10.8 Hz, 1H, CH), 4.04 (q, J = 7.2 Hz, 2H, CH_2), 3.11 (s, 3H, CH_3), 2.91 (s, 3H, CH_3), 1.02 (t, J = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.1, 169.3, 168.6, 150.2, 137.1, 136.8, 134.2, 132.4, 131.8, 130.0, 129.8, 129.6, 128.5, 128.2, 126.4, 126.2, 125.4, 122.0, 119.4, 119.2, 110.9, 108.0, 60.7, 57.5, 48.9, 45.5, 40.6, 29.3, 28.2, 13.8; IR(KBr) υ: 3341, 3257, 3103, 2941, 2856, 2143, 1817, 1643, 1622, 1556, 1454, 1367, 1249, 1165, 1148, 945, 912, 864, 751 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}Cl_2N_3O_5$ ([M+Na]$^+$):626.1220, found: 626.1224.

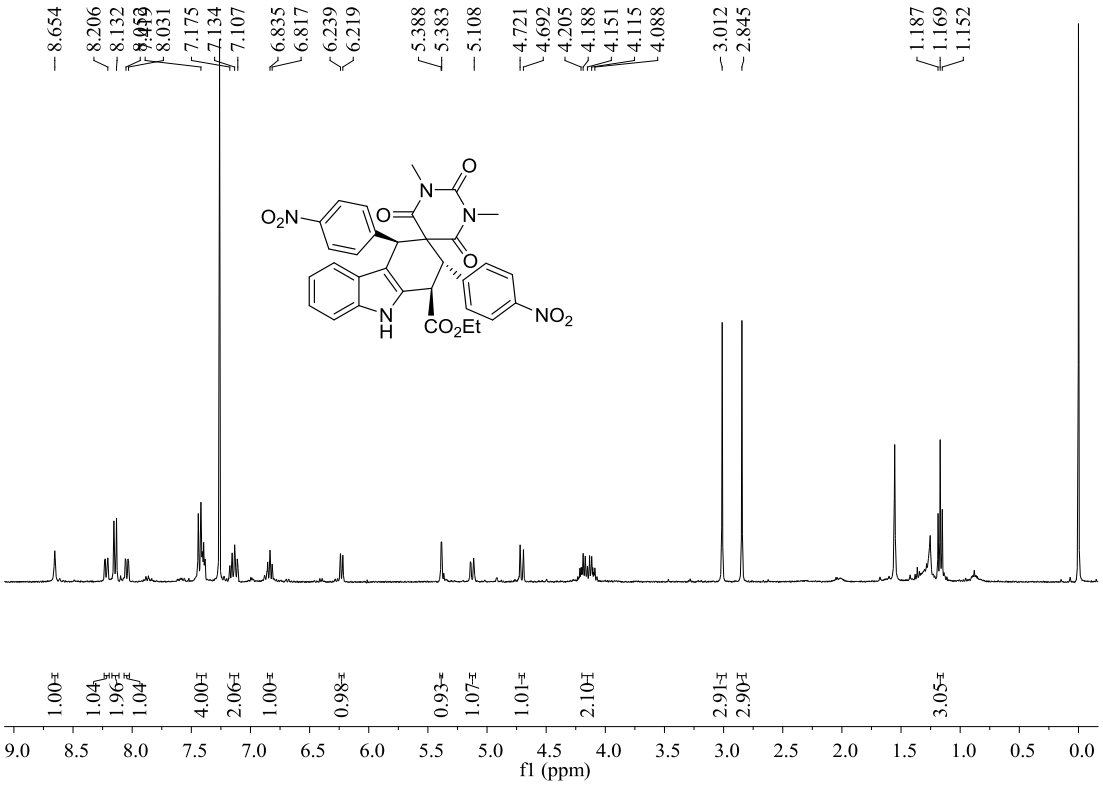


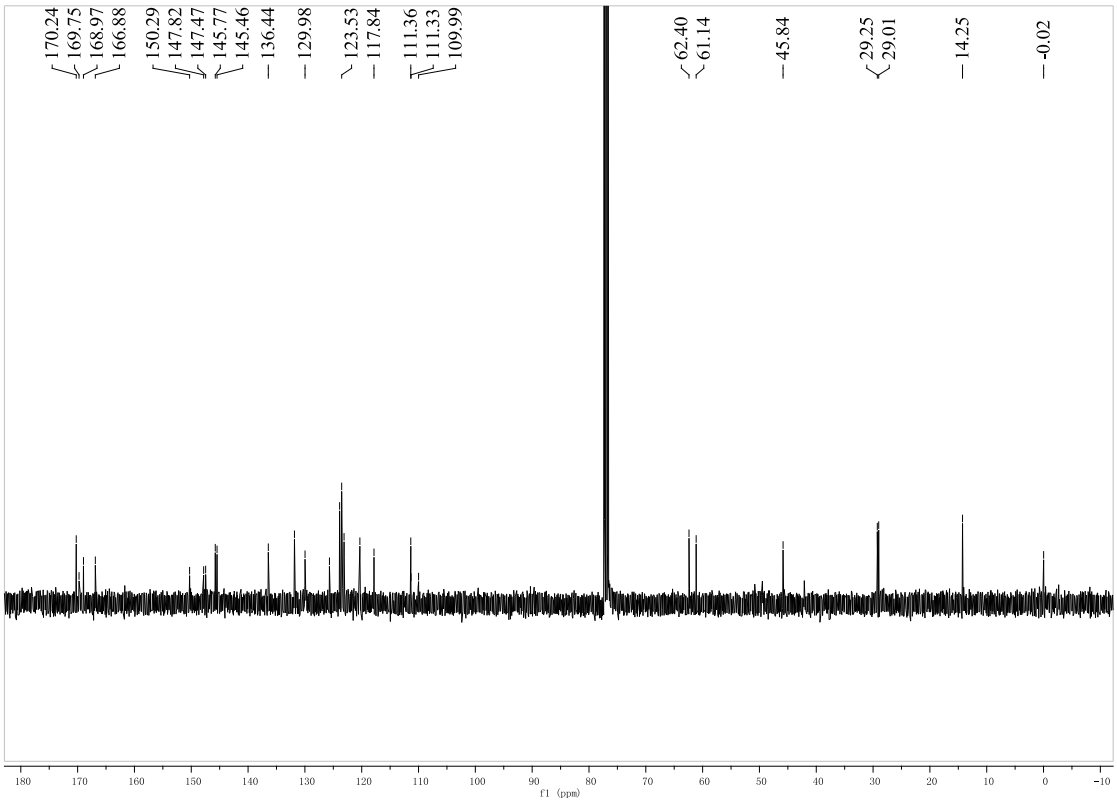

170.14
169.40
168.67
150.28
130.04
128.55
128.23
126.41
126.27
125.40
122.05
119.41
119.26
110.99
108.04
60.77
57.52
48.90
45.58
40.67
29.36
28.25
13.90
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-2,4-bis(4-nitrophenyl)-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1p):**

yellow solid, 63%, m.p. 206-209 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.65 (s, 1H, NH), 8.22 (dd, J_1 = 8.4 Hz, J_2 = 2.4 Hz, 1H, ArH), 8.14 (d, J = 8.4 Hz, 2H, ArH), 8.04 (dd, J_1 = 8.4 Hz, J_2 = 2.4 Hz, 1H, ArH), 7.44-7.40 (m, 4H, ArH), 7.17-7.11 (m, 2H, ArH), 6.84 (t, J = 8.0 Hz, 1H, ArH), 6.22 (d, J = 8.0 Hz, 1H, ArH), 5.38 (d, J =2.0 Hz, 1H, CH), 5.12 (dd, J_1 = 10.6 Hz, J_2 = 2.0 Hz, 1H, CH), 4.71 (d, J =10.6 Hz, 1H, CH), 4.15 (q, J = 7.2 Hz, 2H, CH_2), 3.01 (s, 3H, CH_3), 2.84 (s, 3H, CH_3), 1.17 (t, J = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.2, 169.7, 168.9, 166.8, 150.2, 147.8, 147.4, 145.7, 145.4, 136.4, 131.8, 129.9, 125.6, 123.8, 123.5, 123.1, 120.3, 117.8, 111.3, 111.3, 109.9, 62.4, 61.1, 45.8, 29.2, 29.0, 14.2; IR(KBr) υ: 3342, 3255, 3167, 3041, 2951, 2841, 2163, 1826, 1661, 1643, 1565, 1432, 1355, 1248, 1163, 1153, 963, 948, 827, 761 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}N_5O_9$ ([M+H]$^+$): 678.1701, found: 678.1703.

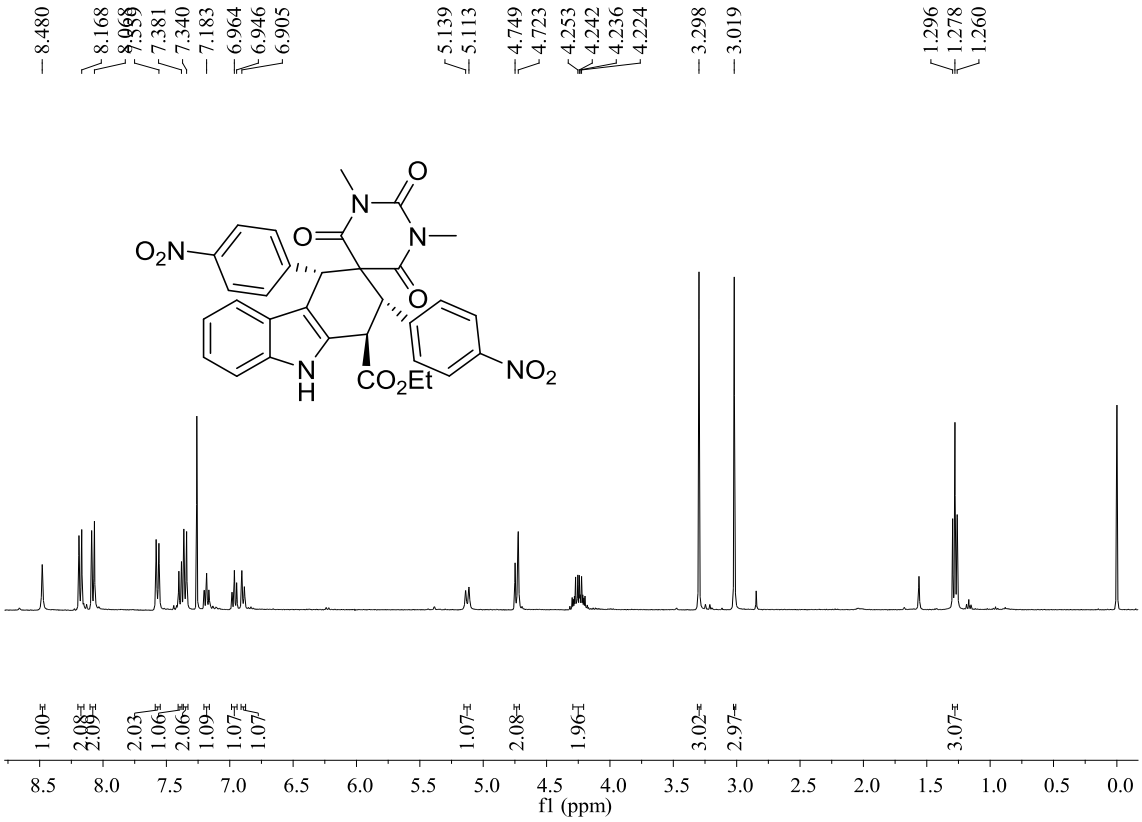


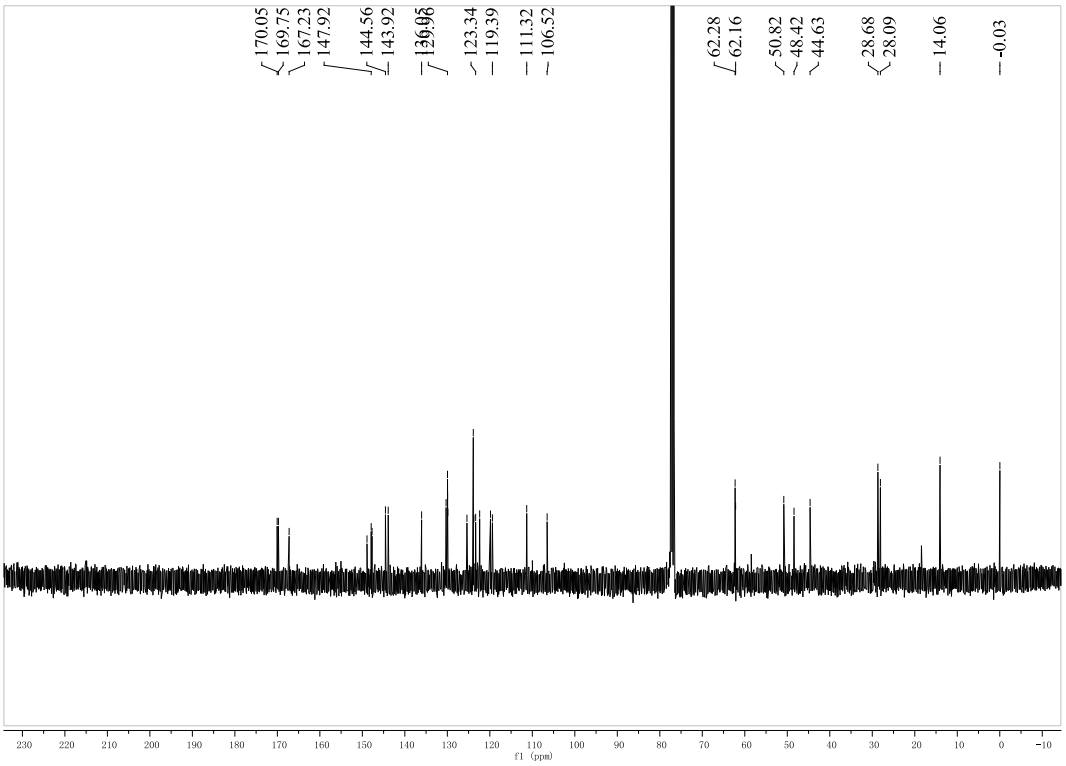

170.24
169.75
168.97
166.88
150.29
147.82
147.47
145.77
145.46
136.44
129.98
123.53
117.84
111.36
111.33
109.99
62.40
61.14
45.84
29.25
29.01
14.25
-0.02
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

Ethyl

***rel-(1R,2S,4S)*-1',3'-dimethyl-2,4-bis(4-nitrophenyl)-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1p'):**

yellow solid, 9%, m.p. 209-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.48 (s, 1H, NH), 8.17 (d, *J* = 8.8 Hz, 2H, ArH), 8.08 (d, *J* = 8.8 Hz, 2H, ArH), 7.57 (d, *J* = 8.8 Hz, 2H, ArH), 7.39 (d, *J* = 8.4 Hz, 1H, ArH), 7.35 (d, *J* = 8.8 Hz, 2H, ArH), 7.18 (t, *J* = 8.0 Hz, 1H, ArH), 6.96 (t, *J* = 7.2 Hz, 1H, ArH), 6.89 (d, *J* = 8.0 Hz, 1H, ArH), 5.12 (d, *J* =10.4 Hz, 1H, CH), 4.75 (d, *J* = 10.4 Hz, 1H, CH), 4.72 (s, 1H, CH), 4.24 (q, *J* = 7.2 Hz, 2H, CH_2), 3.30 (s, 3H, CH_3), 3.02 (s, 3H, CH_3), 1.28 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.0, 169.7, 167.2, 148.9, 147.9, 147.7, 144.5, 143.9, 136.0, 130.2, 129.9, 129.9, 129.8, 125.3, 123.8, 123.7, 123.3, 122.3, 119.8, 119.3, 111.3, 106.5, 62.3, 62.2, 50.8, 48.4, 44.6, 28.6, 28.0, 14.0; IR(KBr) υ: 3342, 3241, 3167, 3041, 2938, 2841, 2163, 1826, 1661, 1631, 1565, 1432, 1355, 1248, 1178, 1153, 963, 948, 827, 761 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}N_5O_9$ ([M+Na]$^+$): 648.1701, found: 648.1705.

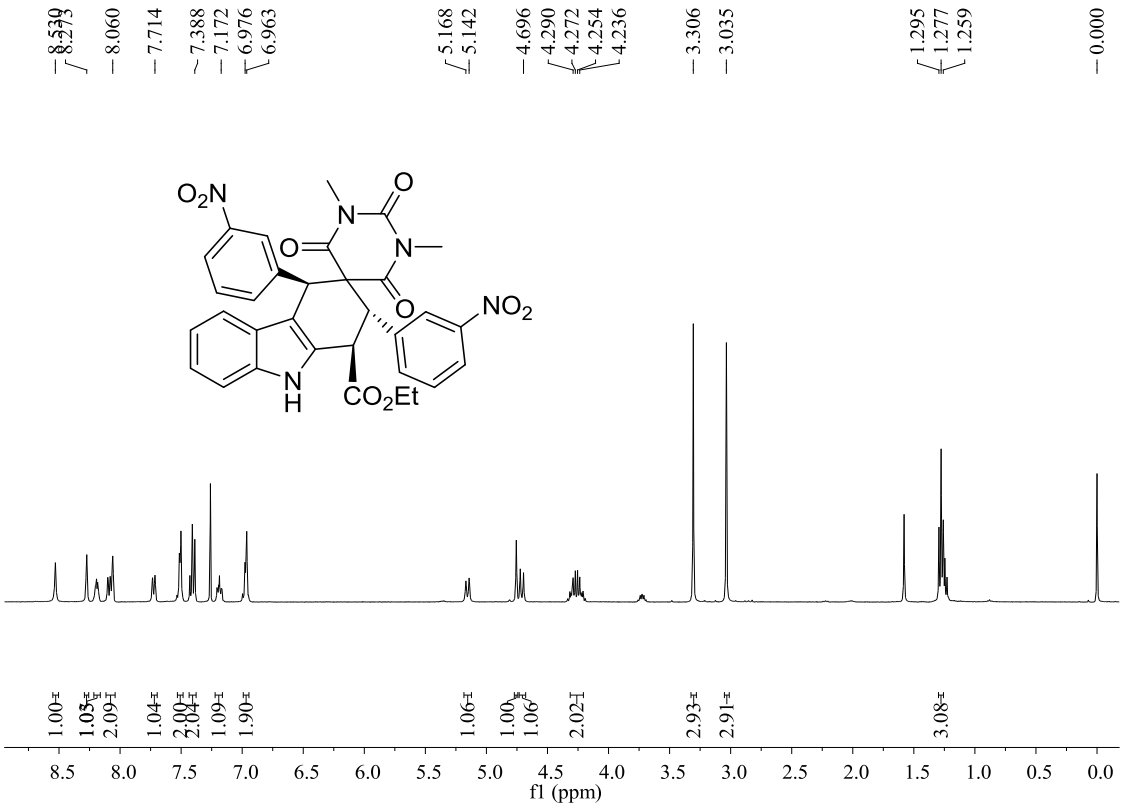


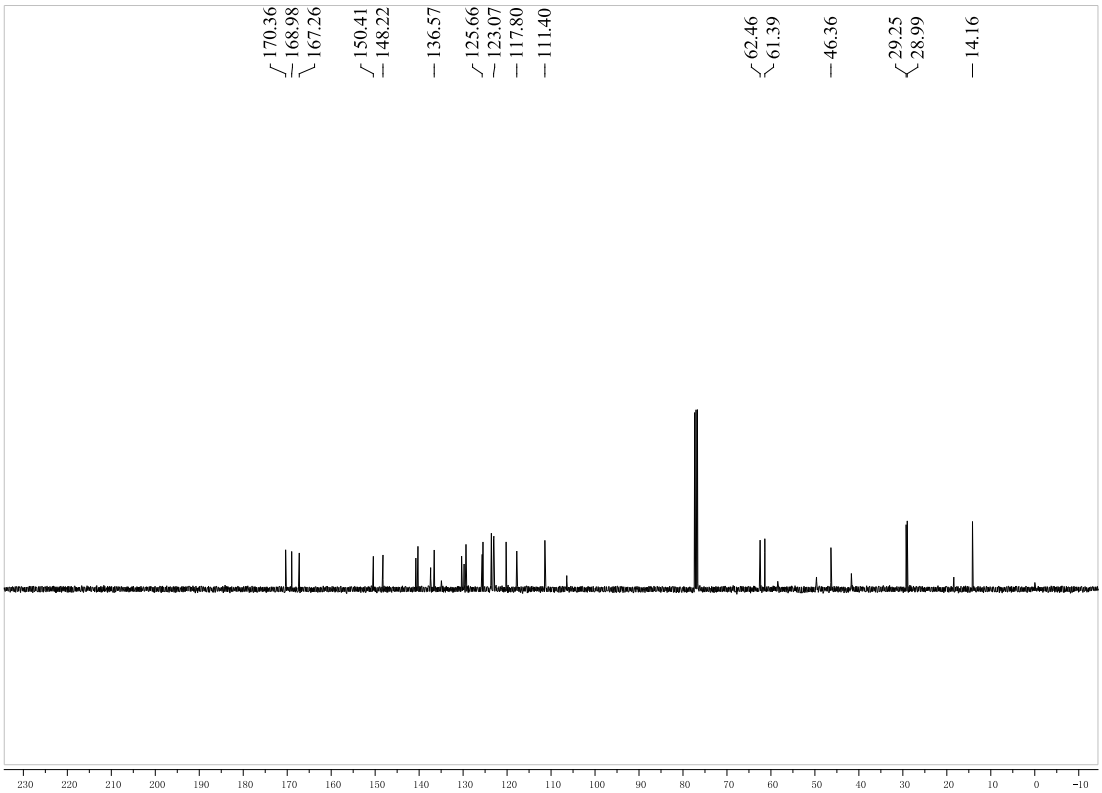

170.05
169.75
167.23
147.92
144.56
143.92
123.34
119.39
111.32
106.52
62.28
62.16
50.82
48.42
44.63
28.68
28.09
14.06
-0.03
f1 (ppm)

Ethyl

***rel-(1R,2S,4R)*-1',3'-dimethyl-2,4-bis(3-nitrophenyl)-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'H-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1q):**

yellow solid, 63%, m.p. 221-224 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.53 (s, 1H, NH), 8.27 (s, 1H, ArH), 8.20-8.18 (m, 1H, ArH), 8.10-8.06 (m, 2H, ArH), 7.72 (d, *J* = 8.0 Hz, 1H, ArH), 7.52-7.50 (m, 2H, ArH), 7.41 (t, *J* = 8.0 Hz, 2H, ArH), 7.21-7.17 (m, 1H, ArH), 6.98-6.96 (m, 2H, ArH), 5.15 (d, *J* =10.4 Hz, 1H, CH), 4.76 (s, 1H, CH), 4.71 (d, *J* =10.4 Hz, 1H, CH), 4.26 (q, *J* = 7.2 Hz, 2H, CH_2), 3.31 (s, 3H, CH_3), 3.04 (s, 3H, CH_3), 1.28 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.3, 168.9, 167.2, 150.4, 148.2, 140.7, 140.2, 137.3, 136.5, 130.3, 129.7, 129.3, 125.6, 125.4, 123.5, 123.0, 123.0, 120.2, 117.7, 111.4, 62.4, 61.3, 46.3, 29.2, 28.9, 14.1; IR(KBr) υ: 3369, 3244, 3157, 3032, 2934, 2857, 2163, 1843, 1631, 1611, 1562, 1483, 1346, 1231, 1159, 1146, 933, 902, 846, 751 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}N_5O_9$ ([M+Na]$^+$): 648.1701, found: 648.1704.

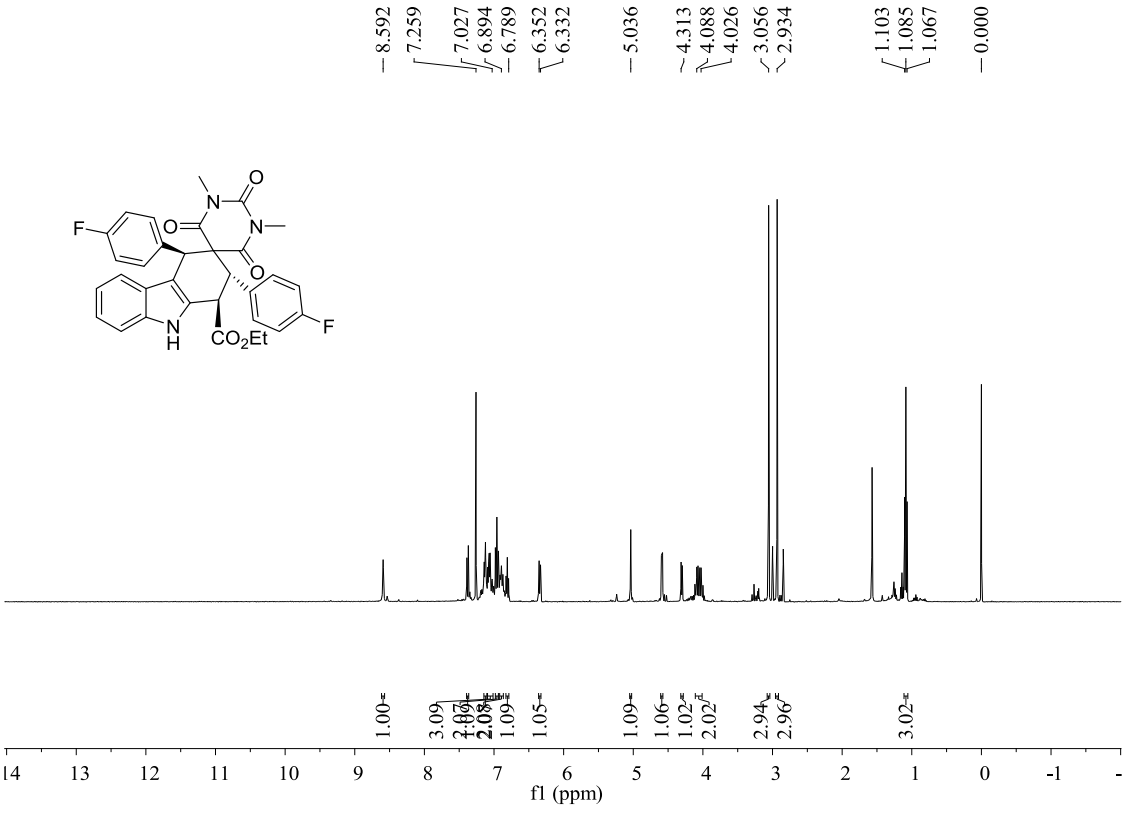


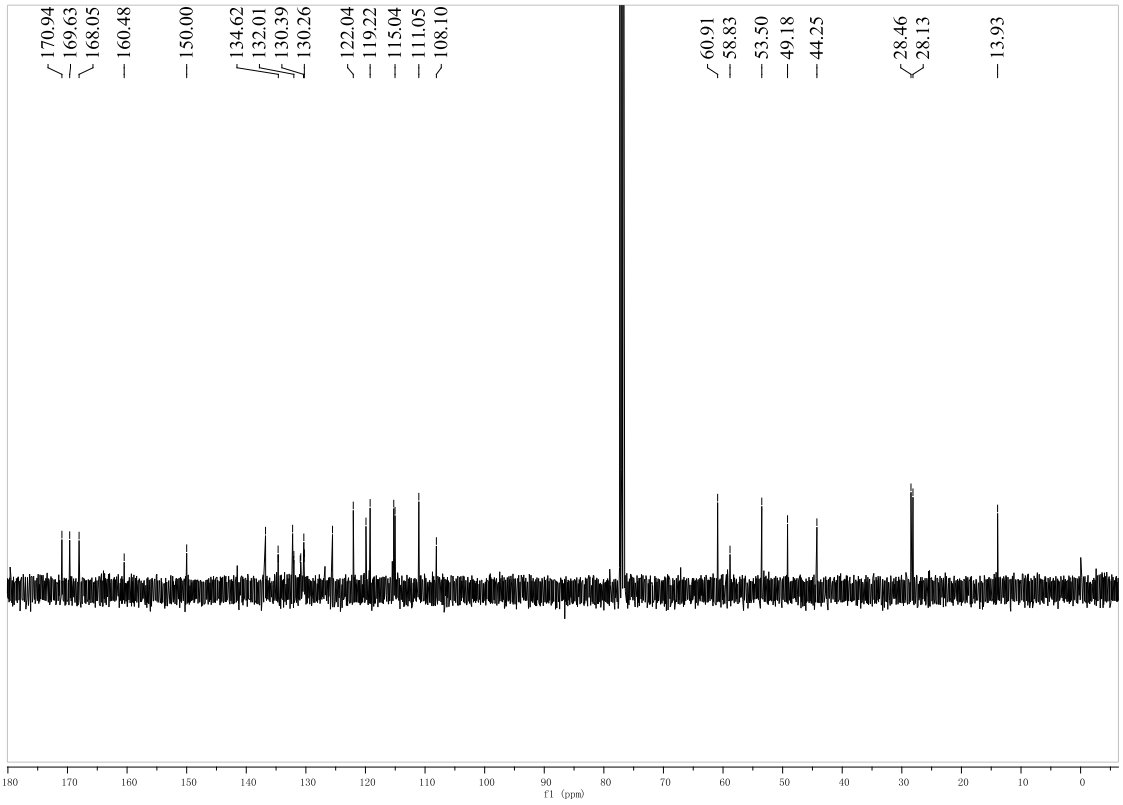

170.36
168.98
167.26
150.41
148.22
136.57
125.66
123.07
117.80
111.40
62.46
61.39
46.36
29.25
28.99
14.16
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

Ethyl

***rel-(1R,2S,4R)*-2,4-bis(4-fluorophenyl)-1',3'-dimethyl-2',4',6'-trioxo-1,1',2,3',4,4',6',9-octahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (1r):**

yellow solid, 65%, m.p. 212-214 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.59 (s, 1H, NH), 7.37 (d, *J* = 8.0 Hz, 1H, ArH), 7.13 (d, *J* = 7.2 Hz, 2H, ArH), 7.11-7.03 (m, 3H, ArH), 6.96 (t, *J* = 8.4 Hz, 2H, ArH), 6.89 (t, *J* = 8.4 Hz, 2H, ArH), 6.81 (t, *J* = 8.0 Hz, 1H, ArH), 6.34 (d, *J* = 8.0 Hz, 1H, ArH), 5.04 (s, 1H, CH), 4.58 (d, *J* =6.8 Hz, 1H, CH), 4.30 (d, *J* =6.8 Hz, 1H, CH), 4.05 (q, *J* = 7.2 Hz, 2H, CH_2), 3.06 (s, 3H, CH_3), 2.93 (s, 3H, CH_3), 1.08 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 170.9, 169.6, 168.0, 160.4, 150.0, 136.7, 134.6, 134.6, 132.2, 132.0, 132.0, 130.9, 130.8, 130.3, 130.3, 130.2, 130.2, 125.5, 122.0, 119.9, 119.2, 115.2, 115.0, 111.0, 108.1, 60.9, 58.8, 53.5, 49.1, 44.2, 28.4, 28.1, 13.9; IR(KBr) υ: 3361, 3257, 3143, 3066, 2917, 2857, 2163, 1874, 1666, 1621, 1588, 1493, 1367, 1288, 1165, 1134, 951, 967, 855, 787 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}F_2N_3O_5$ ([M+Na]$^+$): 594.1811, found: 594.1812.

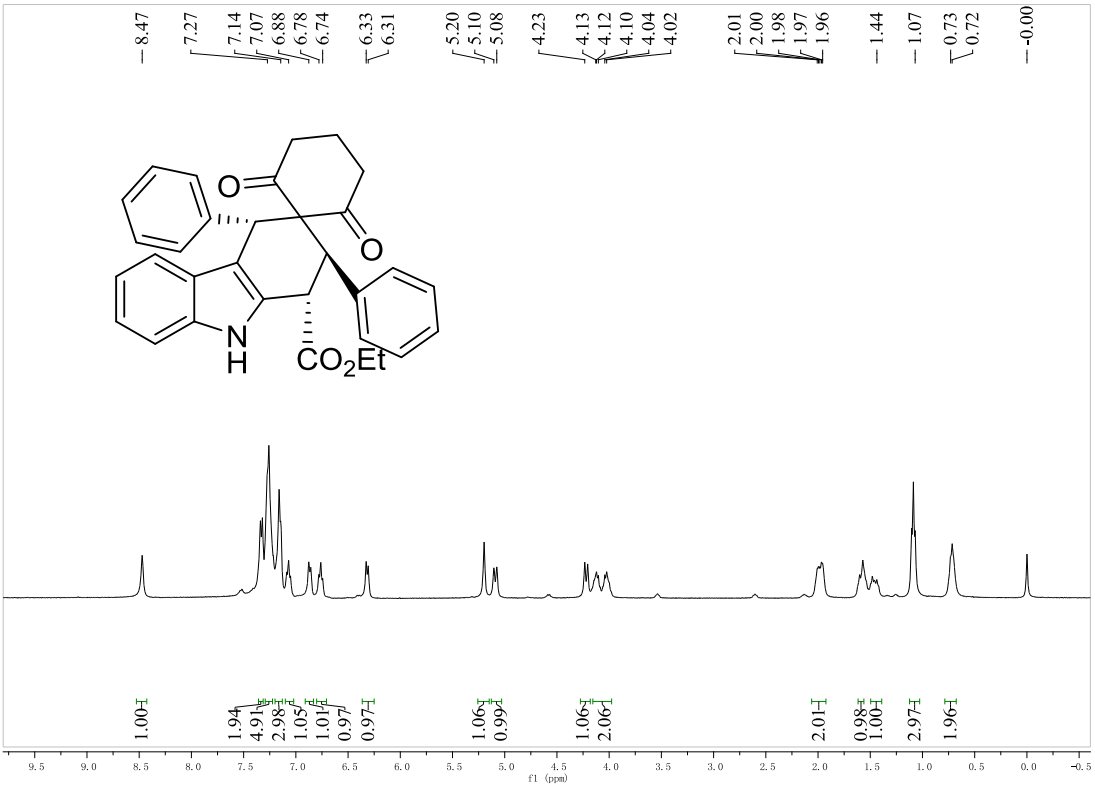


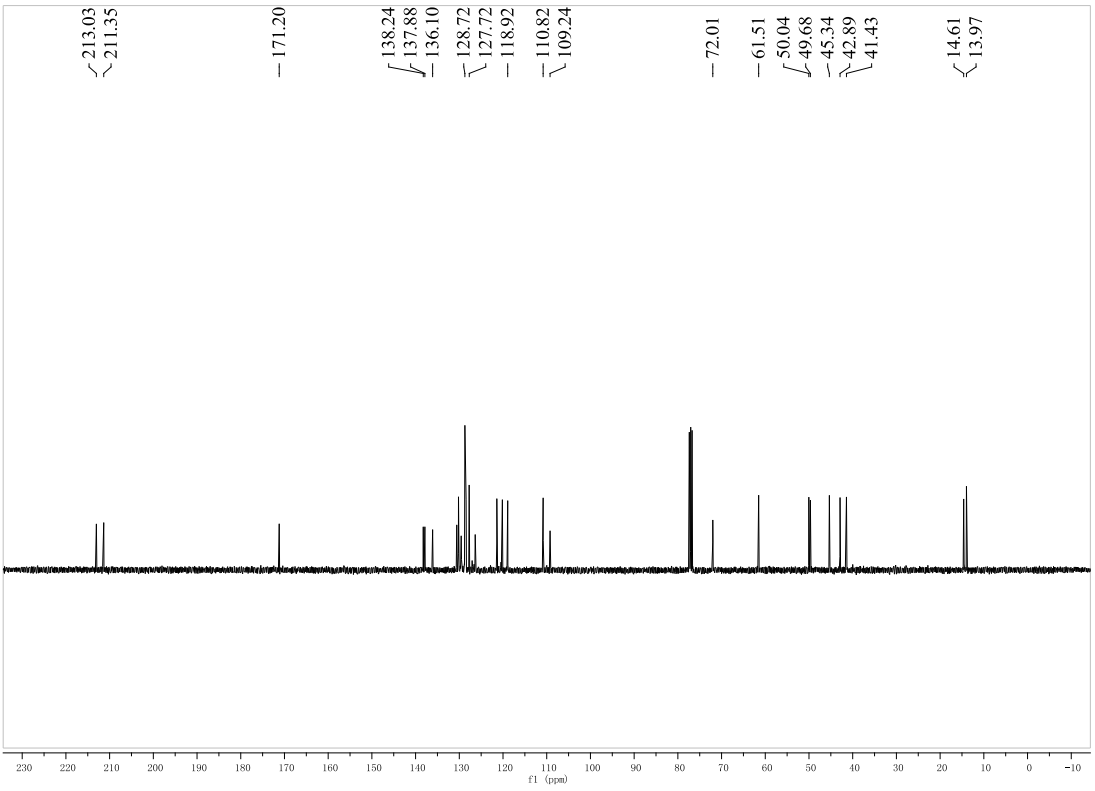

170.94
169.63
168.05
160.48
150.00
134.62
132.01
130.39
130.26
122.04
119.22
115.04
111.05
108.10
60.91
58.83
53.50
49.18
44.25
28.46
28.13
13.93
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

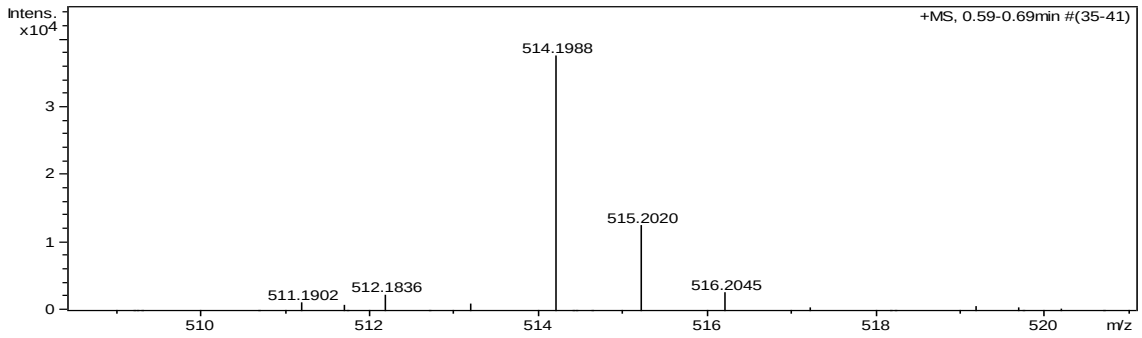
Ethyl

***rel-(1S,2R,4S)*-2',6'-dioxo-2,4-diphenyl-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2a):**

White solid, 76%, m.p. 175-178 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.47 (s, 1H, NH), 7.33 (d, *J* = 7.64 Hz, 2H, ArH), 7.27-7.22 (m, 5H, ArH), 7.16-7.15 (m, 3H, ArH), 7.07 (t, *J* = 7.2 Hz, 1H, ArH), 6.86 (d, *J* = 7.6 Hz, 1H, ArH), 6.76 (d, *J* = 7.2 Hz, 1H, ArH), 6.32 (d, *J* = 8.0 Hz, 1H, ArH), 5.20 (s, 1H, CH), 5.09 (d, *J* = 11.2 Hz, 1H, CH), 4.22 (d, *J* = 11.2 Hz, 1H, CH), 4.07 (q, *J* = 6.8 Hz, 2H, CH_2), 2.01-1.96 (m, 2H, CH_2), 1.60-1.54 (m, 1H, CH), 1.48-1.44 (m, 1H, CH), 1.09 (t, *J* = 6.8 Hz, 3H, CH_3), 0.73-0.71 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 213.03, 211.34, 171.20, 138.24, 137.87, 136.10, 130.58, 130.18, 130.13, 129.56, 128.72, 128.60, 128.44, 127.74, 127.72, 126.36, 121.41, 120.14, 118.92, 110.82, 109.23, 72.00, 61.51, 50.03, 49.68, 45.34, 42.89, 41.42, 14.61, 13.97; IR (KBr) υ: 3407, 3164, 2977, 1853, 1746, 1631, 1613, 1555, 1431, 1317, 1300, 1285, 1184, 906, 867 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{29}NO_4$([M+H]$^{+}$): 514.1989, found: 514.1988.



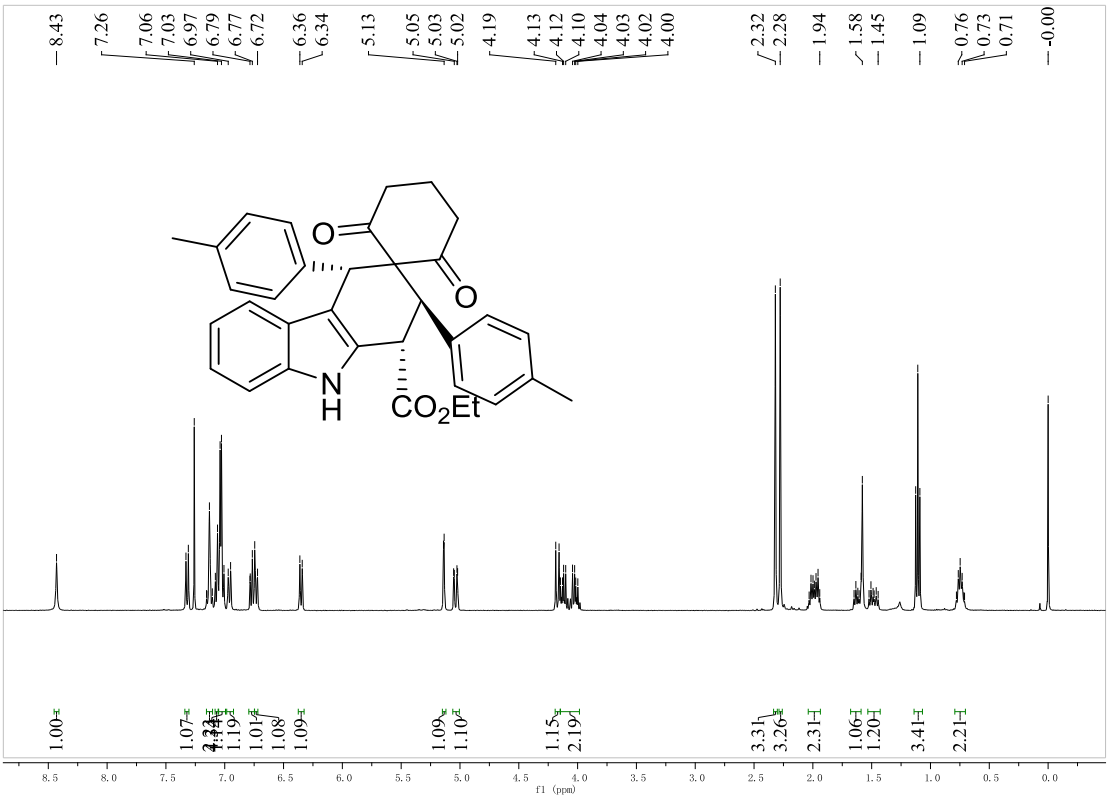

213.03
211.35
171.20
138.24
137.88
136.10
128.72
127.72
118.92
110.82
109.24
72.01
61.51
50.04
49.68
45.34
42.89
41.43
14.61
13.97
f1 (ppm)

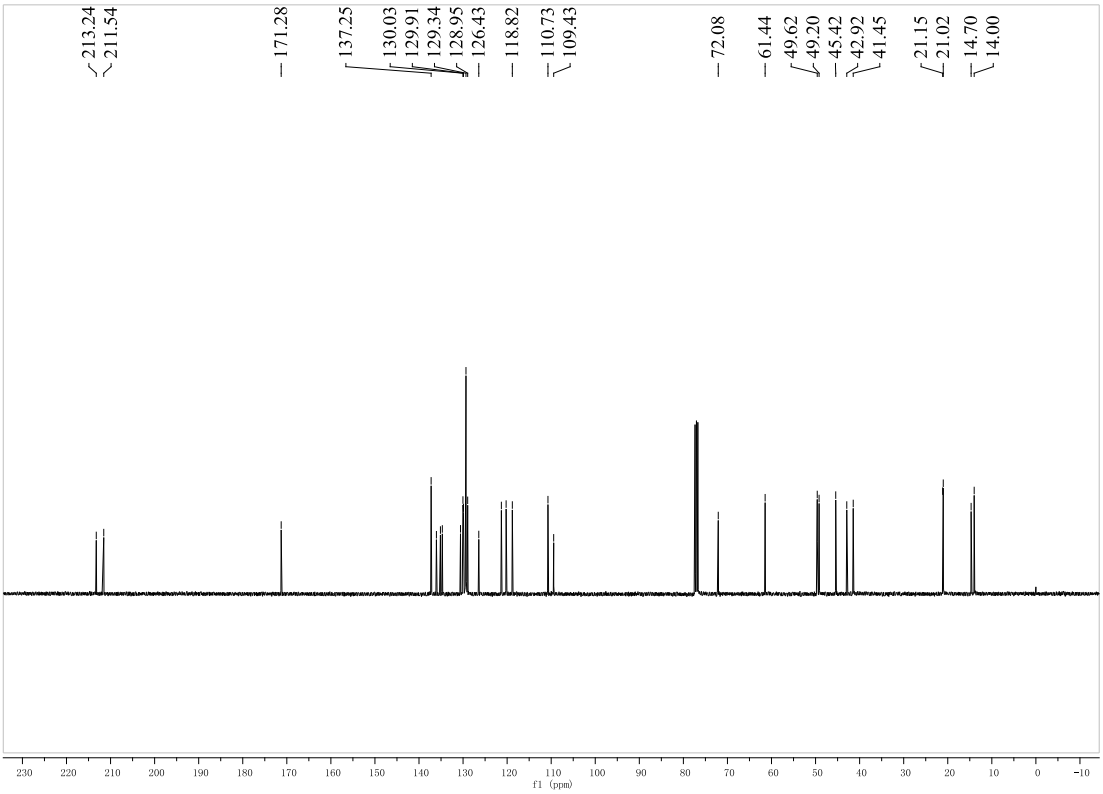

Intens.
x10^4
+MS, 0.59-0.69min #(35-41)
514.1988
515.2020
511.1902
512.1836
516.2045
m/z

Ethyl

***rel-(1S,2R,4S)*-2',6'-dioxo-2,4-di-*p*-tolyl-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2b):**

White solid, 84%, m.p. 181-183 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.43 (s, 1H, NH), 7.32 (d, *J* = 8.4 Hz, 1H, ArH), 7.13 (t, *J* = 9.6 Hz, 2H, ArH), 7.07 (d, *J* = 7.2 Hz, 1H, ArH), 7.04-7.01 (m, 4H, ArH), 6.96 (d, *J* = 8.4 Hz, 1H, ArH), 6.77 (d, *J* = 7.2 Hz, 1H, ArH), 6.73 (d, *J* = 9.6 Hz, 1H, ArH), 6.35 (d, *J* = 8.0 Hz, 1H, ArH), 5.14 (d, *J* = 2.4 Hz, 1H, CH), 5.04 (dd, J_1= 2.4 Hz, J_2= 11.6 Hz, 1H, CH), 4.17 (d, *J* = 11.2 Hz, 1H, CH), 4.07 (q, *J* = 7.2 Hz, 2H, CH_2), 2.32 (s, 3H, CH_3), 2.28 (s, 3H, CH_3), 2.03-1.94 (m, 2H, CH_2), 1.65-1.59 (m, 1H, CH), 1.52-1.45 (m, 1H, CH), 1.11 (t, *J* = 7.2 Hz, 3H, CH_3), 0.78-0.71 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 213.2, 211.5, 171.2, 137.2, 136.0, 135.1, 134.7, 130.5, 130.0, 129.9, 129.3, 128.9, 126.4, 121.3, 120.2, 118.8, 110.7, 109.4, 72.0, 61.4, 49.6, 49.2, 45.4, 42.9, 41.4, 21.1, 21.0, 14.7, 14.0; IR (KBr) υ: 3431, 3045, 2981, 1846, 1731, 1655, 1613, 1587, 1456, 1337, 1300, 1219, 1187, 845, 787 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}NO_4$([M+H]$^+$): 520.2468, found: 520.2462.



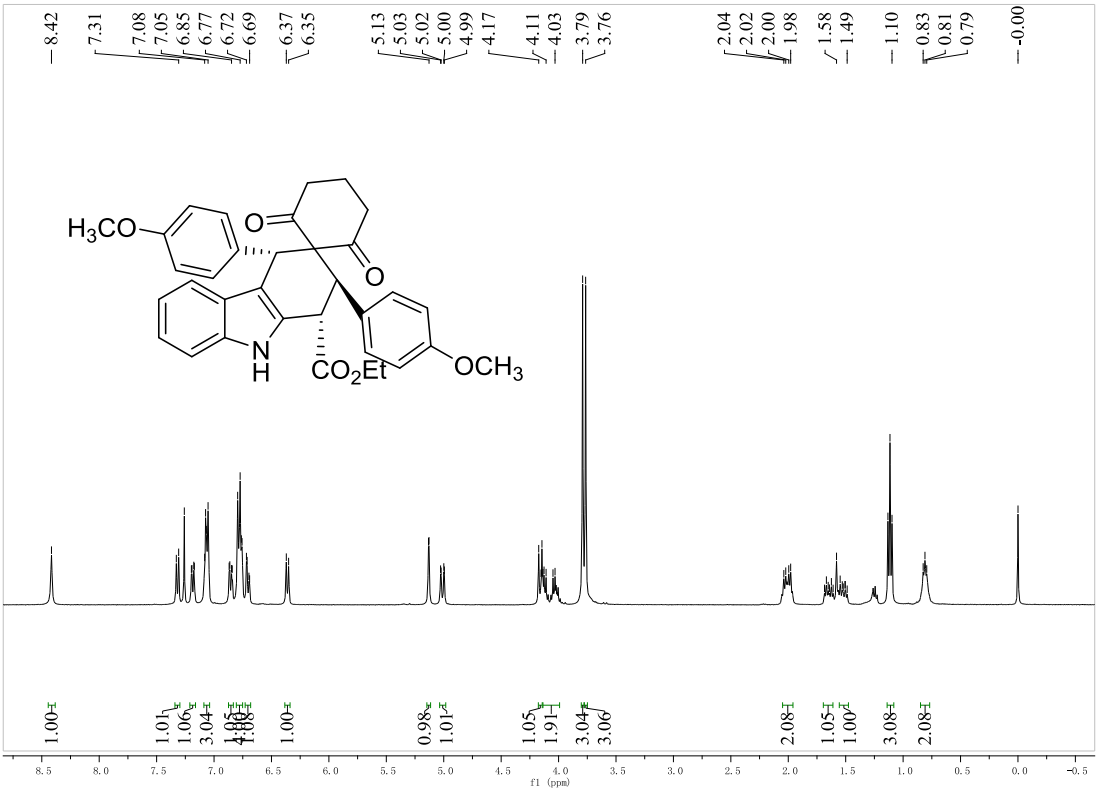

213.24
211.54
171.28
137.25
130.03
129.91
129.34
128.95
126.43
118.82
110.73
109.43
72.08
61.44
49.62
49.20
45.42
42.92
41.45
21.15
21.02
14.70
14.00
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

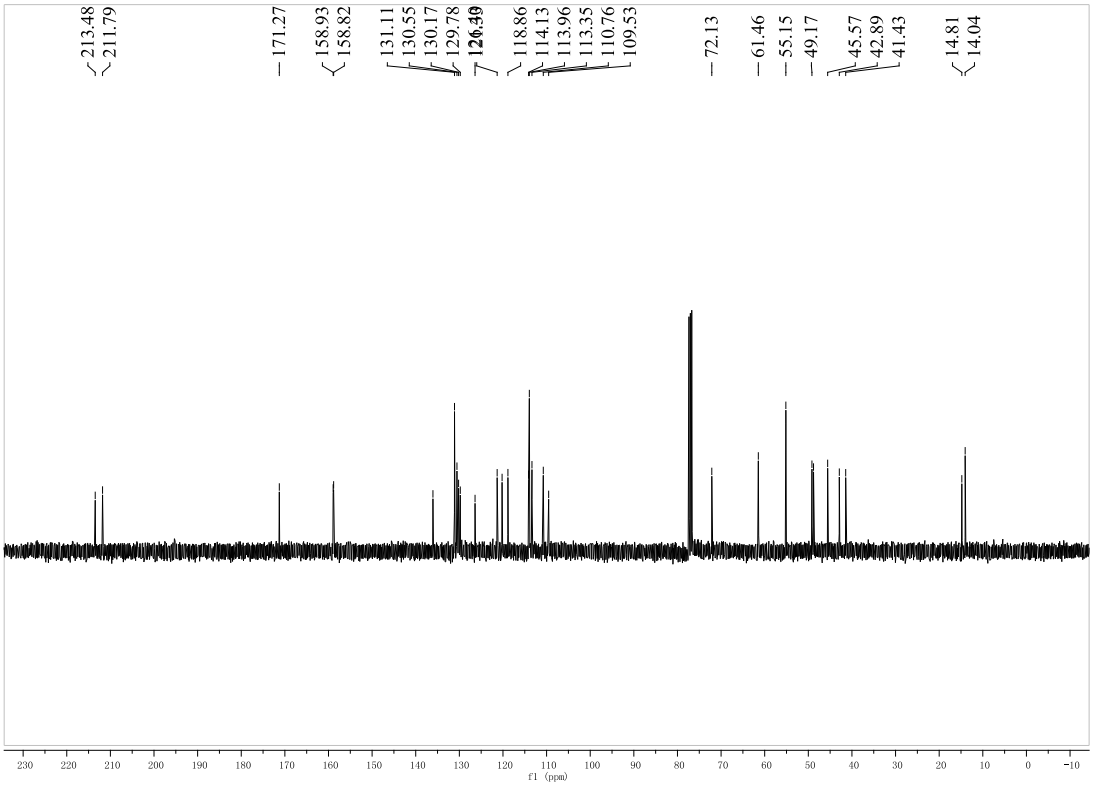

Full ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-2,4-bis(4-methoxyphenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2c):**

white solid, 82%, m.p. 183-185 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.42 (s, 1H, NH), 7.31 (d, J = 8.4 Hz, 1H, ArH), 7.18 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H, ArH), 7.08-7.05 (m, 3H, ArH), 6.85 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H, ArH), 6.80-6.76 (m, 4H, ArH), 6.70 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H, ArH), 6.36 (d, J = 8.0 Hz, 1H, ArH), 5.13 (d, J = 2.0 Hz, 1H, CH), 5.01 (dd, J_1= 11.2 Hz, J_2= 2.0 Hz, 1H, CH), 4.16 (d, J = 11.2 Hz, 1H, CH), 4.08 (q, J = 7.2 Hz, 2H, CH_2), 3.79 (s, 3H, OCH_3), 3.76 (s, 3H, OCH_3), 2.04-1.98 (m, 2H, CH_2), 1.69-1.61 (m, 1H, CH), 1.55-1.49 (m, 1H, CH), 1.12 (t, J = 7.2 Hz, 3H, CH_3), 0.83-0.80 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 213.4, 211.7, 171.2, 158.9, 158.8, 136.0, 131.1, 130.5, 130.1, 129.7, 126.4, 121.3, 120.2, 118.8, 114.1, 113.9, 113.3, 110.7, 109.5, 72.1, 61.4, 55.1, 49.1, 48.8, 45.5, 42.8, 41.4, 14.8, 14.0; IR (KBr) υ: 3451, 3145, 2978, 1906, 1732, 1656, 1617, 1509, 1487, 1355, 1341, 1279, 1164, 884, 762 cm^{-1}; MS (m/z): HRMS (ESI) Calcd. for $C_{34}H_{33}NO_6$([M+H]$^{+}$): 552.2361, found: 552.2358.



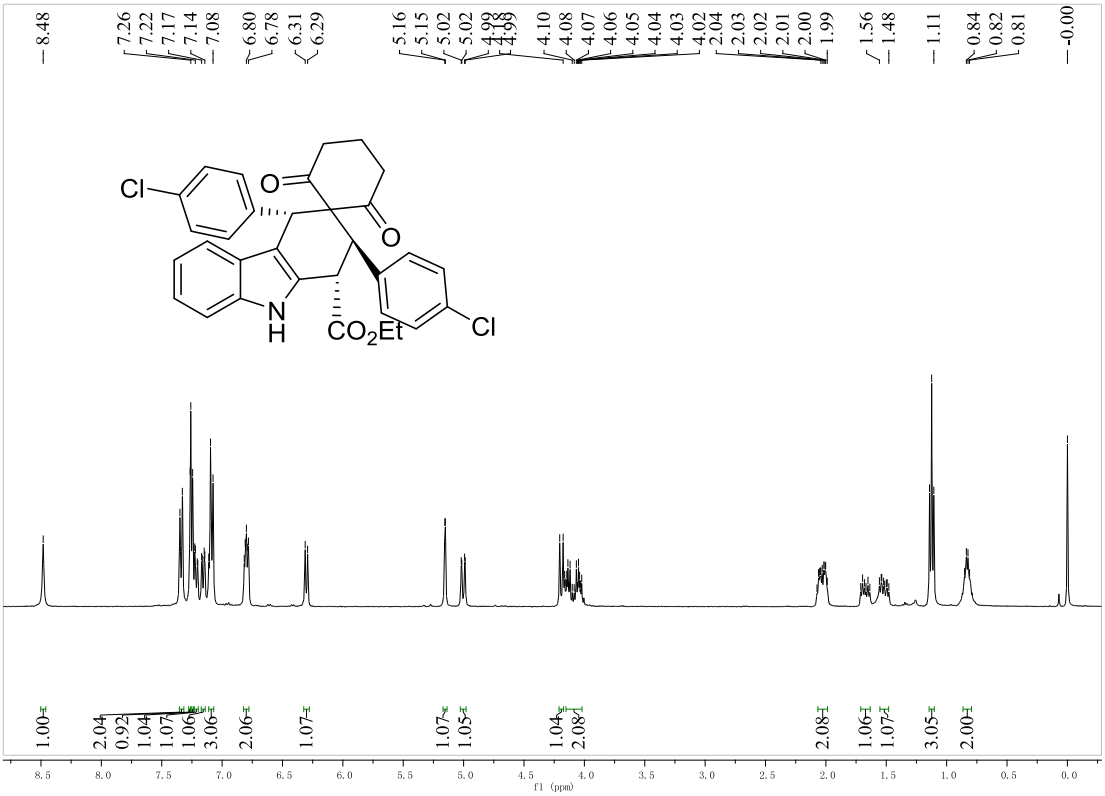


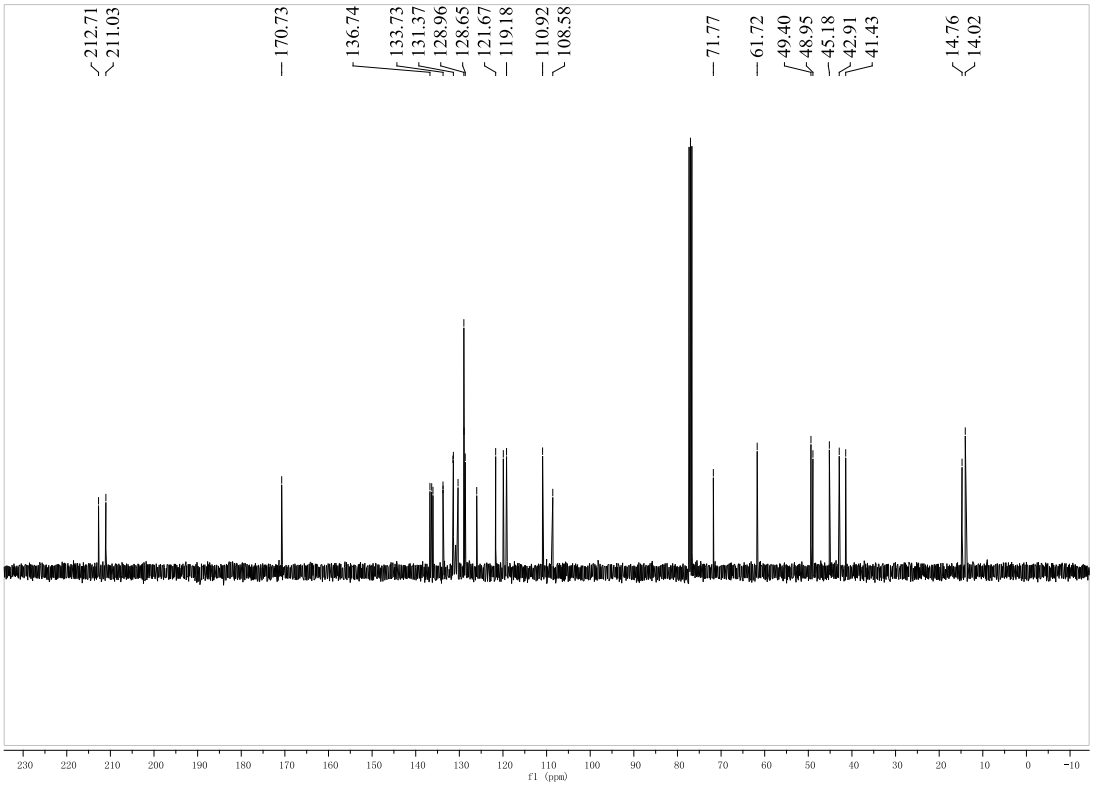
ZGC2_20210130102306 #43 RT: 0.42 AV: 1 NL: 3.39E+007
T: FTMS + p ESI Full ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-2,4-bis(4-chlorophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2d):**

white solid, 80%, m.p. 190-192 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.48 (s, 1H, NH), 7.33 (d, *J* = 8.0 Hz, 2H, ArH), 7.27-7.26 (m, 1H, ArH), 7.26-7.24 (m, 1H, ArH), 7.21 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H, ArH), 7.15 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H, ArH), 7.11-7.08 (m, 3H, ArH), 6.82-6.78 (m, 2H, ArH), 6.30 (d, *J* = 8.0 Hz, 1H, ArH), 5.15 (d, *J* = 2.0 Hz, 1H, CH), 5.00 (dd, J_1= 11.2 Hz, J_2= 2.0 Hz, 1H, CH), 4.19 (d, *J* = 11.2 Hz, 1H, CH), 4.08 (q, *J* = 7.2 Hz, 2H, CH_2), 2.07-1.99 (m, 2H, CH_2), 1.71-1.64 (m, 1H, CH), 1.54-1.48 (m, 1H, CH), 1.12 (t, *J* = 7.2 Hz, 3H, CH_3), 0.85-0.81 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.7, 211.0, 170.7, 136.7, 136.3, 136.0, 133.7, 133.7, 131.4, 131.3, 130.3, 128.9, 128.9, 128.6, 126.0, 121.6, 119.9, 119.1, 110.9, 108.5, 71.7, 61.7, 49.3, 48.9, 45.1, 42.9, 41.4, 14.7, 14.0; IR (KBr) υ: 3431, 3045, 2966, 1868, 1771, 1643, 1637, 1554, 1478, 1321, 1301, 1266, 1145, 882, 761 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}Cl_2NO_4$ ([M+Na]$^{+}$): 582.1209, found: 582.1208.

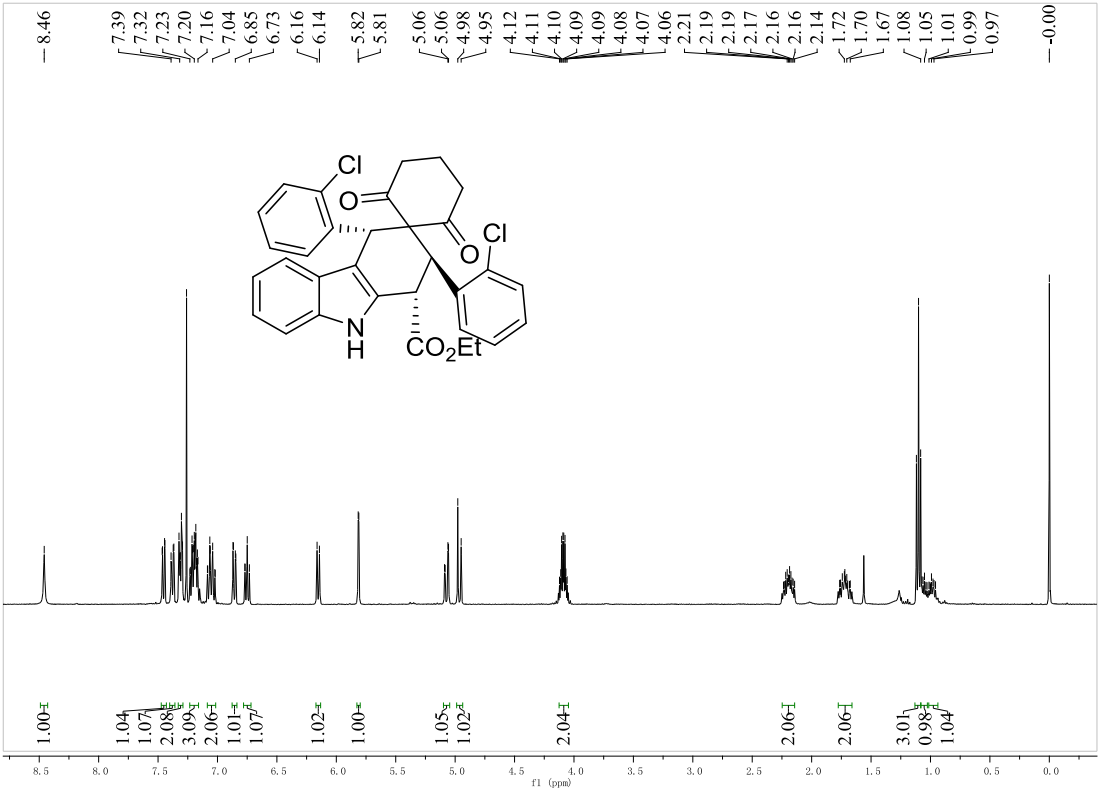


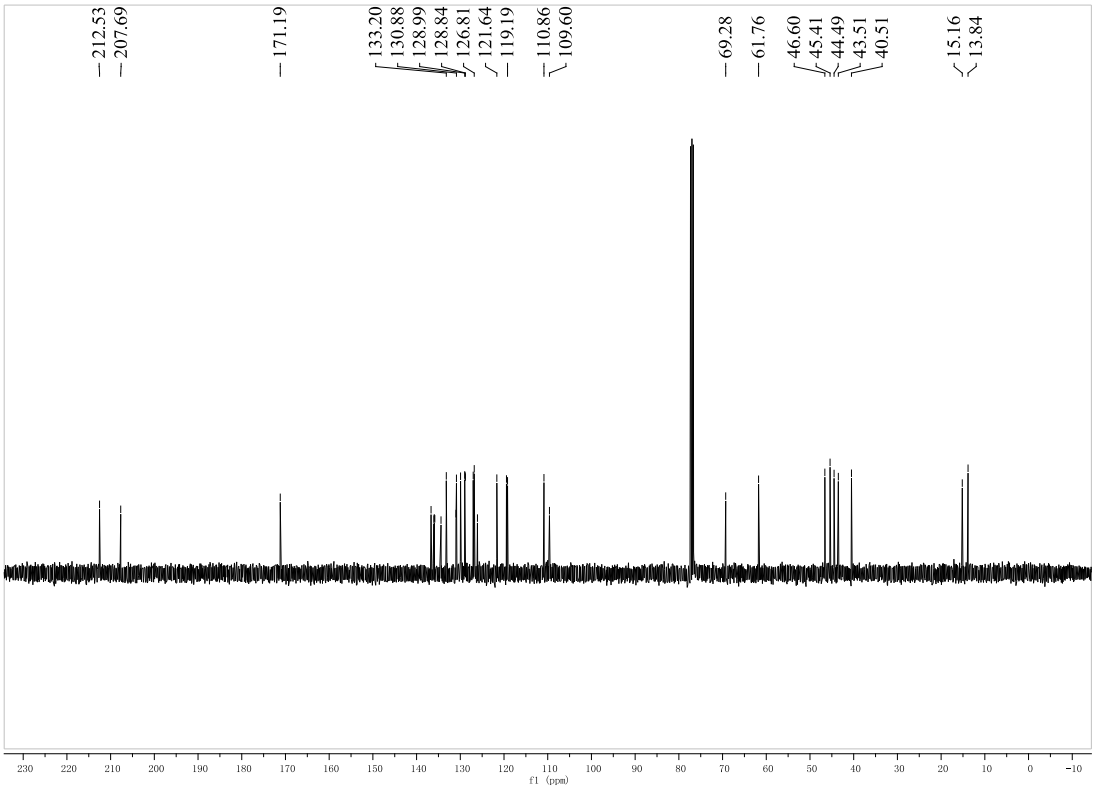

212.71
211.03
170.73
136.74
133.73
131.37
128.96
128.65
121.67
119.18
110.92
108.58
71.77
61.72
49.40
48.95
45.18
42.91
41.43
14.76
14.02
f1 (ppm)

Ethyl

***rel-(1S,2S,4S)*-2,4-bis(2-chlorophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2e):**

white solid, 74%, m.p. 198-200 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.46 (s, 1H, NH), 7.45 (dd, J_1 = 8.0 Hz, J_2 = 0.8 Hz, 1H, ArH), 7.38 (dd, J_1 = 8.0 Hz, J_2 = 2.0 Hz, 1H, ArH), 7.32-7.29 (m, 2H, ArH), 7.23-7.16 (m, 3H, ArH), 7.09-7.02 (m, 2H, ArH), 6.86 (dd, J_1 = 8.0 Hz, J_2 = 2.0 Hz, 1H, ArH), 6.75 (t, J = 8.0 Hz, 1H, ArH), 6.15 (d, J = 8.0 Hz, 1H, ArH), 5.81 (d, J = 2.0 Hz, 1H, CH), 5.07 (dd, J_1= 11.2 Hz, J_2= 2.0 Hz, 1H, CH), 4.96 (d, J = 11.2 Hz, 1H, CH), 4.09 (q, J = 7.2 Hz, 2H, CH_2), 2.24-2.14 (m, 2H, CH_2), 1.77-1.68 (m, 2H, CH_2), 1.10 (t, J = 7.2 Hz, 3H, CH_3), 1.07-1.03 (m, 1H, CH), 1.01-0.96 (m, 1H, CH); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.5, 207.6, 171.1, 136.6, 136.0, 135.9, 135.8, 134.4, 133.2, 130.9, 130.8, 129.9, 128.9, 128.9, 128.8, 127.0, 126.8, 126.0, 121.6, 119.4, 119.1, 110.8, 109.6, 69.2, 61.7, 46.6, 45.4, 44.4, 43.5, 40.5, 15.1, 13.8; IR (KBr) υ: IR (KBr) υ: 3411, 3045, 2966, 1868, 1761, 1643, 1637, 1574, 1478, 1321, 1301, 1245, 1145, 890, 761 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}Cl_2NO_4$([M+Na]$^{+}$): 582.1209, found: 582.1208.



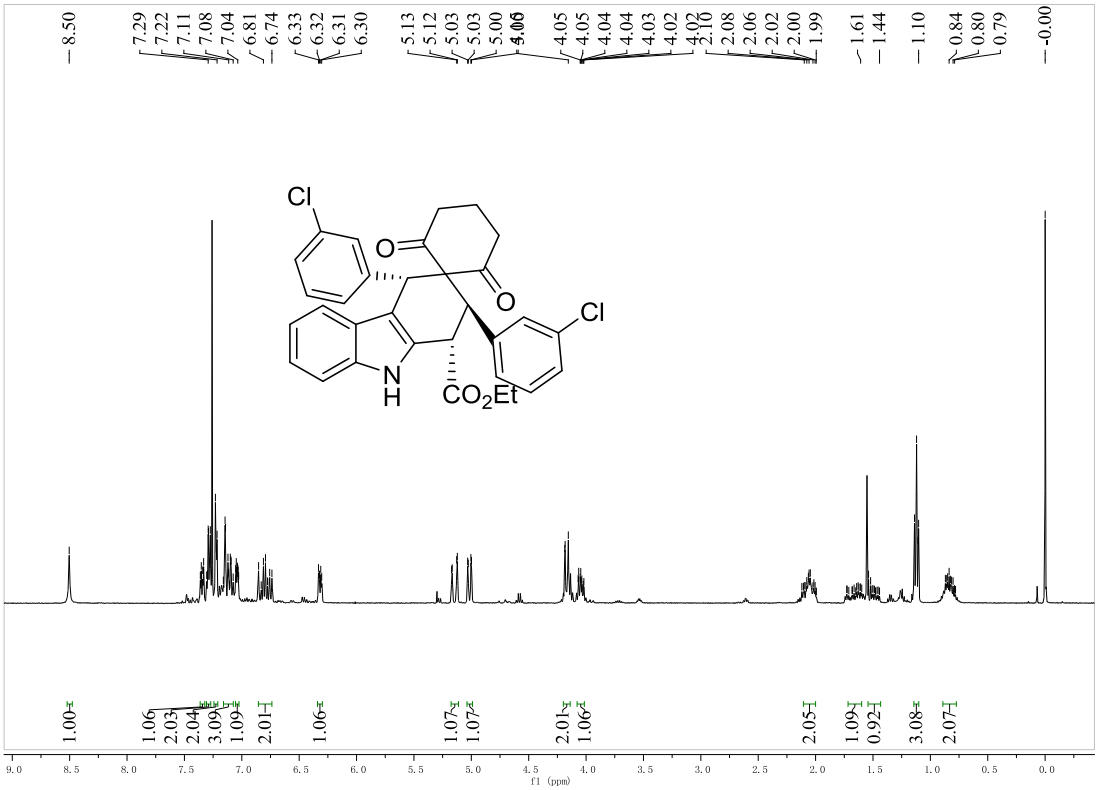

212.53
207.69
171.19
133.20
130.88
128.99
128.84
126.81
121.64
119.19
110.86
109.60
69.28
61.76
46.60
45.41
44.49
43.51
40.51
15.16
13.84
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

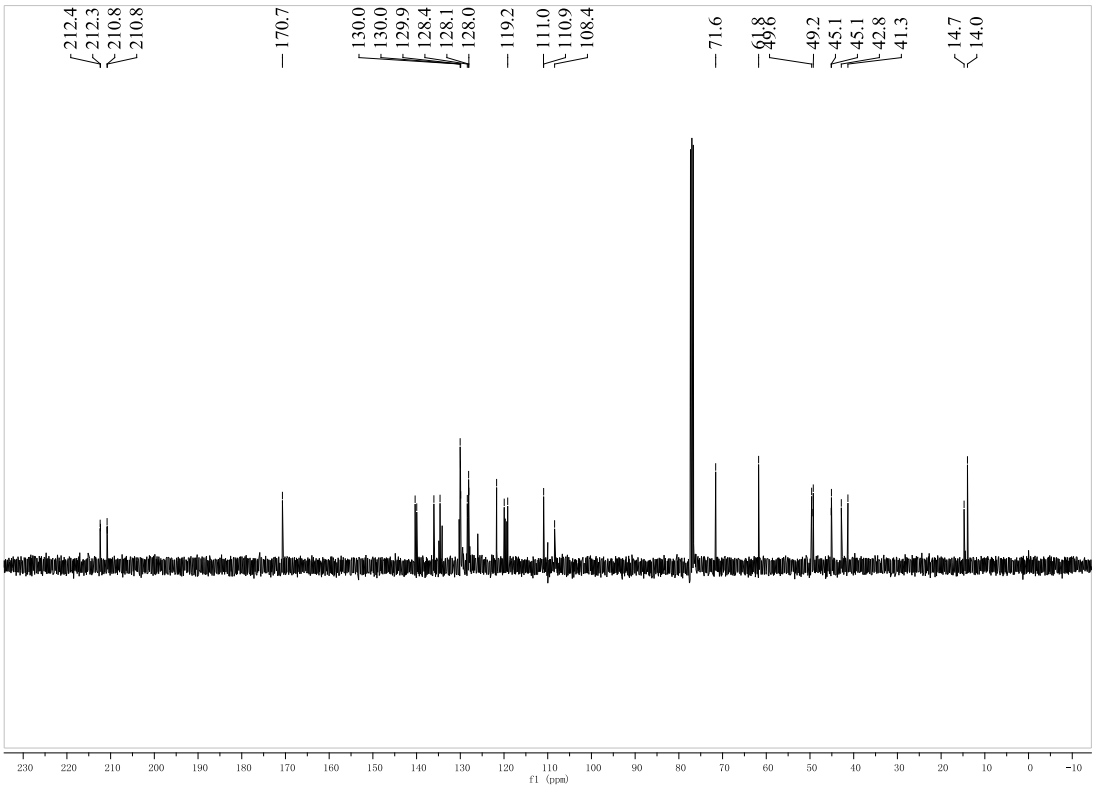

SC8_20210120103748 #9 RT: 0.11 AV: 1 NL: 2.09E+006
FTMS + c ESI Full ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-2,4-bis(3-chlorophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2f):**

white solid, 66%, m.p. 196-198 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.50 (s, 1H, NH), 7.35 (dd, J_1 = 8.0 Hz, J_2 = 3.2 Hz, 1H, ArH), 7.31-7.29 (m, 2H, ArH), 7.23-7.22 (m, 2H, ArH), 7.16-7.08 (m, 3H, ArH), 7.05-7.03 (m, 1H, ArH), 6.85-6.74 (m, 2H, ArH), 6.32 (dd, J_1 = 8.0 Hz, J_2 = 3.2 Hz, 1H, ArH), 5.14 (dd, J_1= 17.6 Hz, J_2= 2.0 Hz, 1H, CH), 5.01 (dd, J_1= 11.2 Hz, J_2= 2.0 Hz, 1H, CH), 4.17 (q, J = 7.2 Hz, 2H, CH_2), 4.07-4.02 (m, 1H, CH), 2.11-2.01 (m, 2H, CH_2), 1.71-1.61 (m, 1H, CH), 1.54-1.44 (m, 1H, CH), 1.12 (t, J = 7.2 Hz, 3H, CH_3), 0.87-0.78 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.3, 212.3, 210.8, 210.7, 170.6, 140.3, 139.9, 136.0, 134.6, 130.0, 129.9, 129.9, 128.3, 128.0, 128.0, 121.6, 119.9, 119.1, 110.9, 110.9, 108.4, 71.5, 61.7, 49.6, 49.3, 49.2, 45.1, 45.0, 42.8, 41.3, 14.7, 13.9; IR (KBr) υ: 3420, 3045, 2976, 1842, 1764, 1643, 1611, 1538, 1478, 1321, 1301, 1266, 1145, 882, 770 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}Cl_2NO_4$([M+Na]$^+$): 582.1209, found: 582.1210.



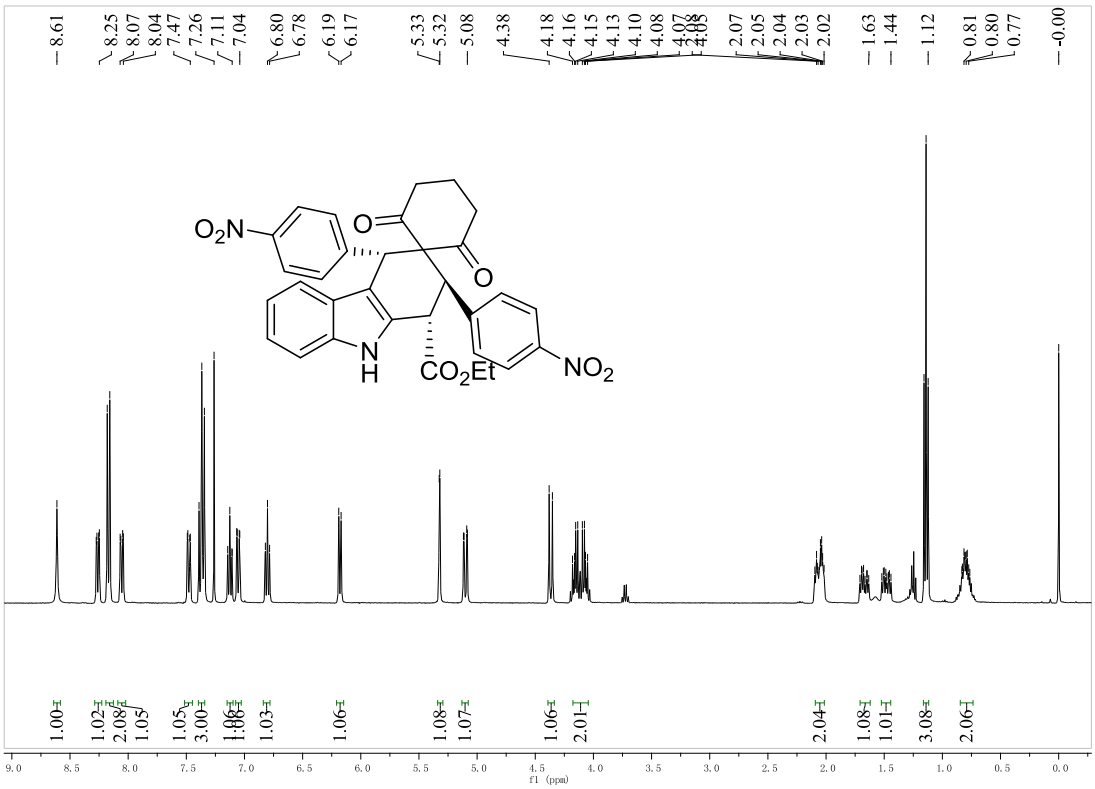

212.4
212.3
210.8
210.8
170.7
130.0
130.0
129.9
128.4
128.1
128.0
119.2
111.0
110.9
108.4
71.6
61.8
49.8
49.2
45.1
45.1
42.8
41.3
14.7
14.0
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

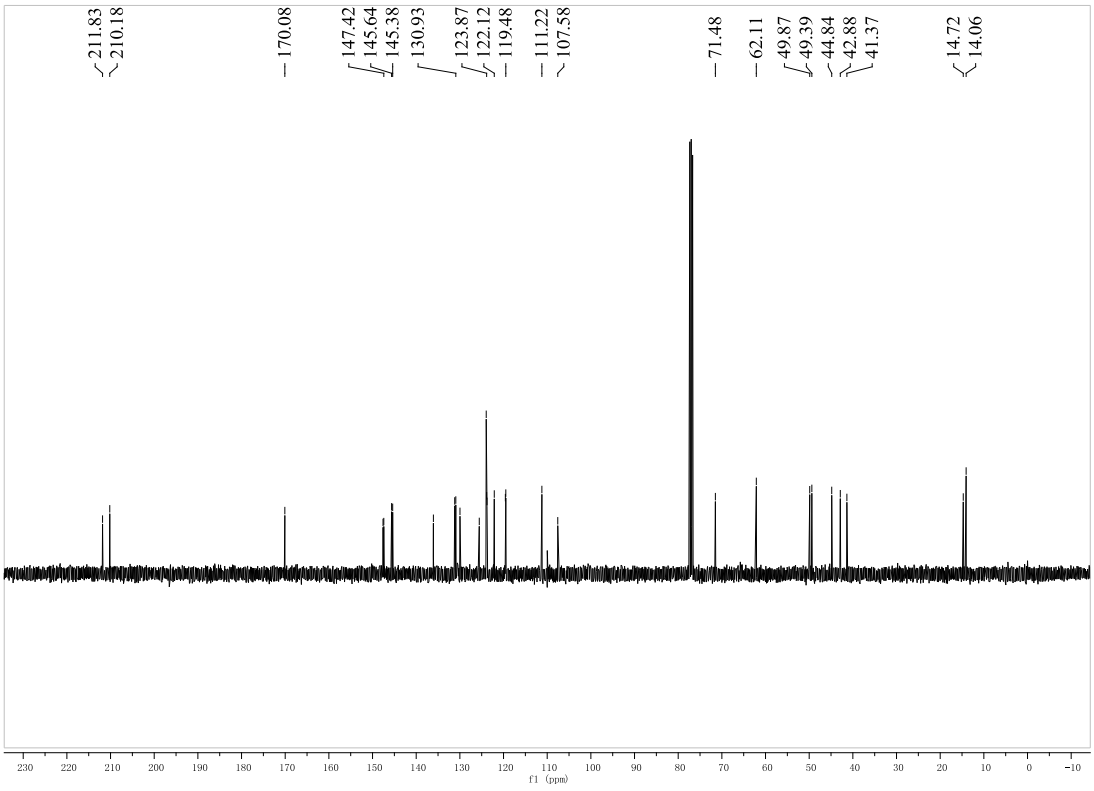

562.1218
FTMS

Ethyl

***rel-(1S,2R,4S)*-2,4-bis(4-nitrophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclo hexane]-1-carboxylate (2g):**

white solid, 76%, m.p. 203-205 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.61 (s, 1H, NH), 8.26 (dd, J_1 = 8.4 Hz, J_2 = 2.4 Hz, 1H, ArH), 8.17 (d, J = 8.8 Hz, 2H, ArH), 8.05 (dd, J_1 = 8.8 Hz, J_2 = 2.4 Hz, 1H, ArH), 7.48 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H, ArH), 7.39-7.35 (m, 3H, ArH), 7.13 (t, J = 7.2 Hz, 1H, ArH), 7.05 (dd, J_1 = 8.8 Hz, J_2 = 2.0 Hz, 1H, ArH), 6.80 (t, J = 7.2 Hz, 1H, ArH), 6.18 (d, J = 8.0 Hz, 1H, ArH), 5.32 (d, J = 2.0 Hz, 1H, CH), 5.09 (dd, J_1= 11.6 Hz, J_2= 2.4 Hz, 1H, CH), 4.37 (d, J = 11.6 Hz, 1H, CH), 4.12 (q, J = 7.2 Hz, 2H, CH_2), 2.09-2.02 (m, 2H, CH_2), 1.71-1.63 (m, 1H, CH), 1.52-1.44 (m, 1H, CH), 1.14 (t, J = 7.2 Hz, 3H, CH_3), 0.83-0.77 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 211.8, 210.1, 170.0, 147.5, 147.4, 145.6, 145.3, 136.0, 131.1, 130.9, 129.9, 125.5, 123.9, 123.8, 123.7, 122.1, 119.5, 119.4, 111.2, 107.5, 71.4, 62.1, 49.8, 49.3, 44.8, 42.8, 41.3, 14.7, 14.0; IR (KBr) υ: 3471, 3000, 2941, 1932, 1816, 1690, 1631, 1507, 1471, 1345, 1300, 1241, 1131, 932, 817 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}N_3O_8$([M+Na]$^{+}$): 604.1690, found: 604.1684.



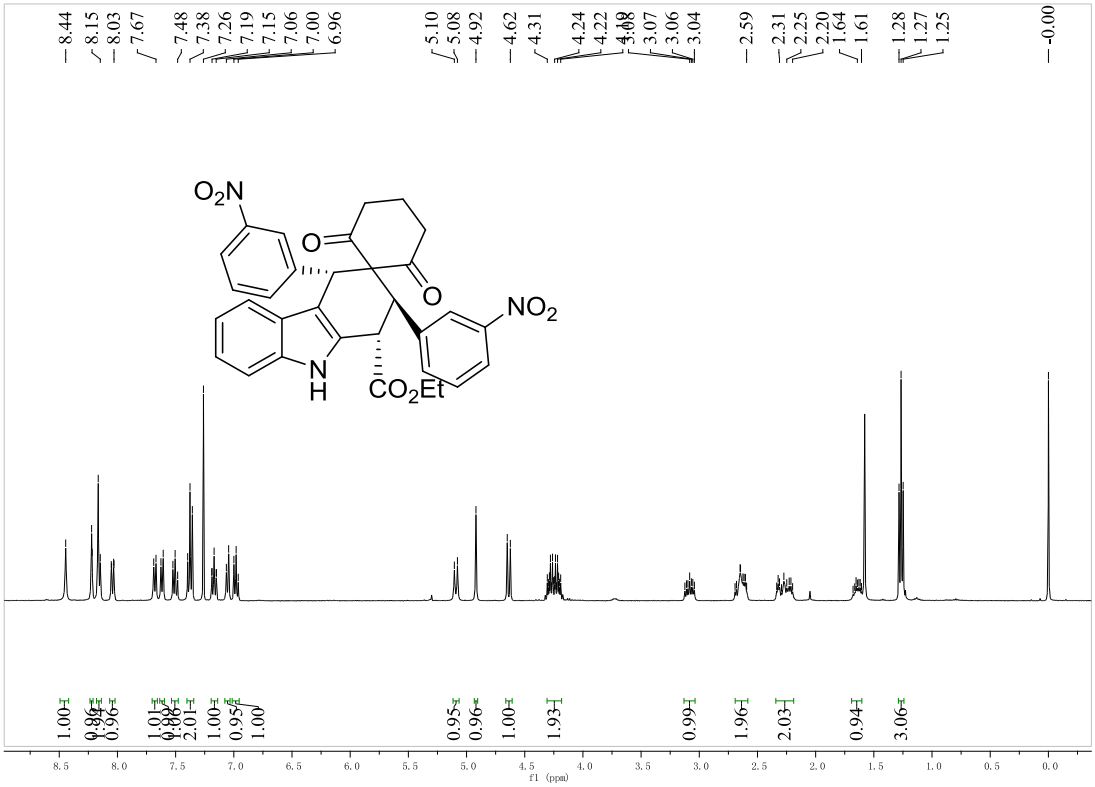

211.83
210.18
170.08
147.42
145.64
145.38
130.93
123.87
122.12
119.48
111.22
107.58
71.48
62.11
49.87
49.39
44.84
42.88
41.37
14.72
14.06
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

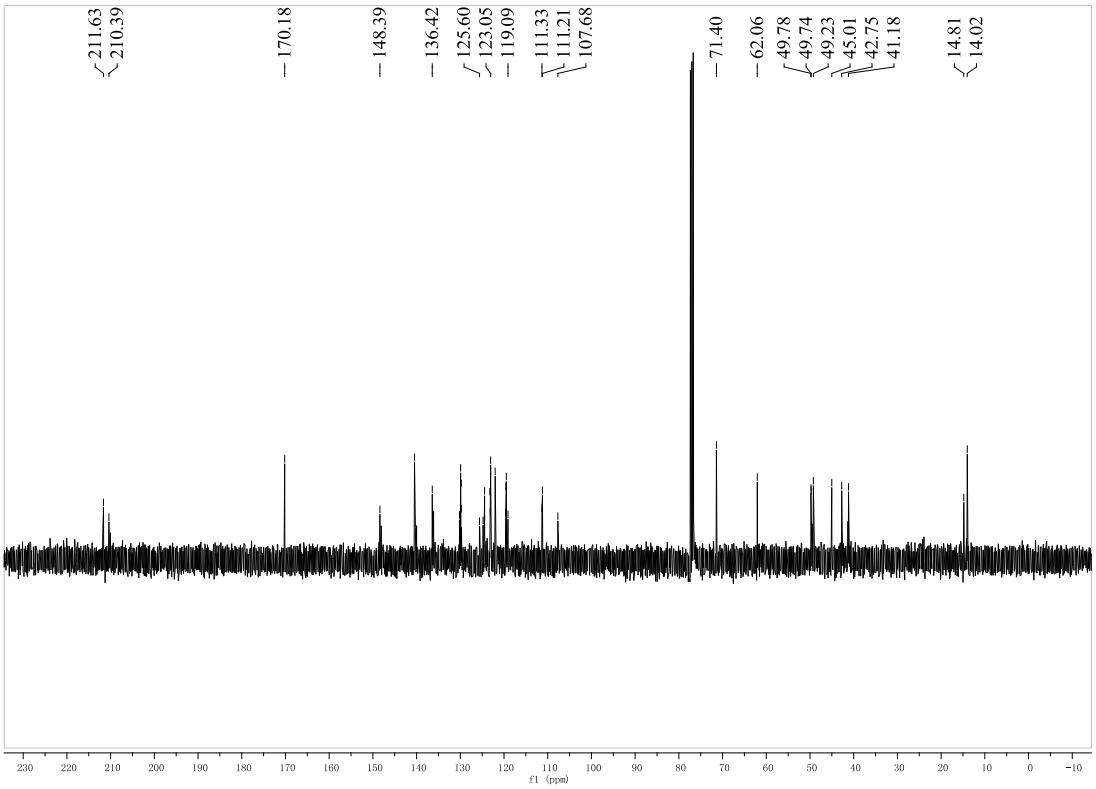
SCZ_20210130103451 #9 RT: 0.11 AV: 1 NL: 1.45E+006
ull ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-2,4-bis(3-nitrophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclo hexane]-1-carboxylate (2h):**

white solid, 62%, m.p. 213-215 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.45 (s, 1H, NH), 8.22-8.21 (m, 1H, ArH), 8.17-8.15 (m, 2H, ArH), 8.04 (dd, J_1 = 8.0 Hz, J_2 = 1.2 Hz, 1H, ArH), 7.67 (d, J = 7.6 Hz, 1H, ArH), 7.61 (d, J = 7.6 Hz, 1H, ArH), 7.50 (t, J = 8.0 Hz, 1H, ArH), 7.38 (t, J = 8.0 Hz, 2H, ArH), 7.17 (t, J = 8.0 Hz, 1H, ArH), 7.05 (d, J = 7.6 Hz, 1H, ArH), 6.98 (t, J = 7.6 Hz, 1H, ArH), 5.09 (d, J = 10.4 Hz, 1H, CH), 4.92 (s, 1H, CH), 4.63 (d, J = 10.4 Hz, 1H, CH), 4.25 (q, J = 7.2 Hz, 2H, CH_2), 3.12-3.04 (m, 1H, CH), 2.69-2.59 (m, 2H, CH_2), 2.34-2.20 (m, 2H, CH_2), 1.68-1.61 (m, 1H, CH), 1.27 (t, J = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 211.6, 210.3, 170.1, 148.3, 140.4, 136.4, 130.1, 129.9, 129.7, 129.7, 125.6, 124.7, 124.4, 123.2, 123.1, 123.0, 122.0, 119.6, 119.5, 119.4, 119.0, 111.3, 111.2, 107.6, 71.4, 62.0, 49.7, 49.7, 49.2, 45.0, 42.7, 41.1, 14.8, 14.0; IR (KBr) υ: 3459, 3010, 2941, 1932, 1816, 1690, 1653, 1507, 1462, 1345, 1331, 1248, 1131, 932, 817 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{27}N_3O_8$([M+Na]$^{+}$): 604.1690, found: 604.1688.



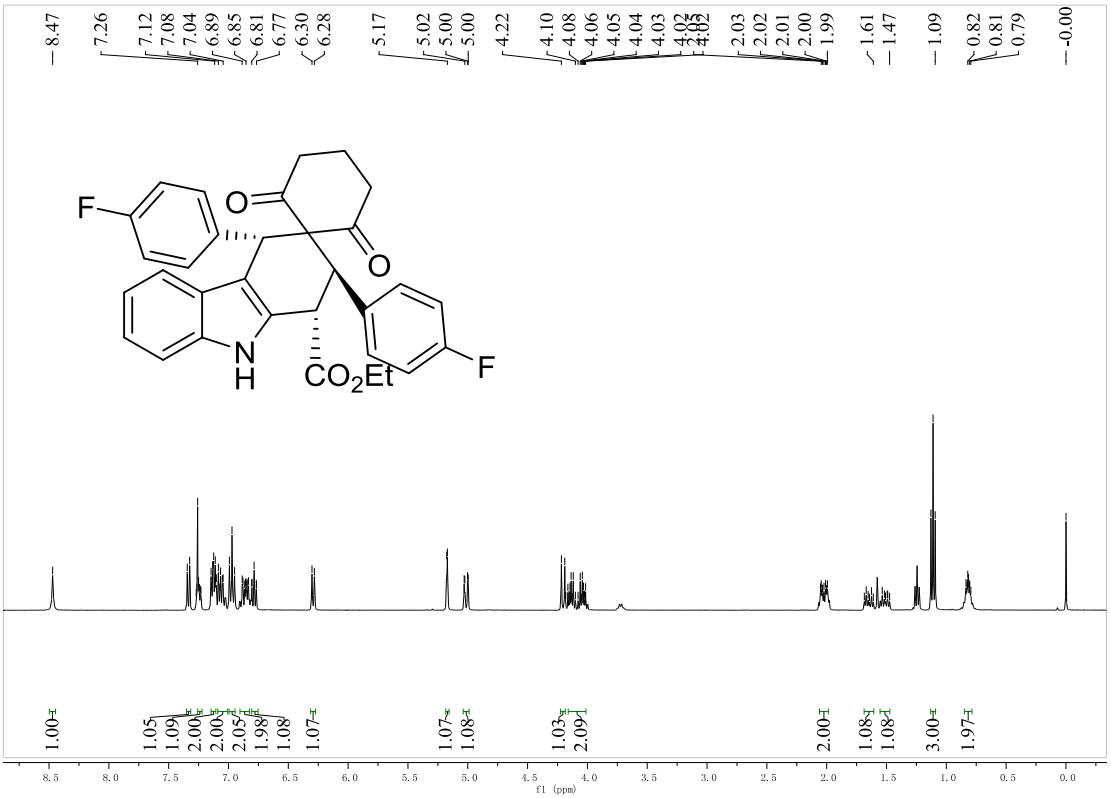


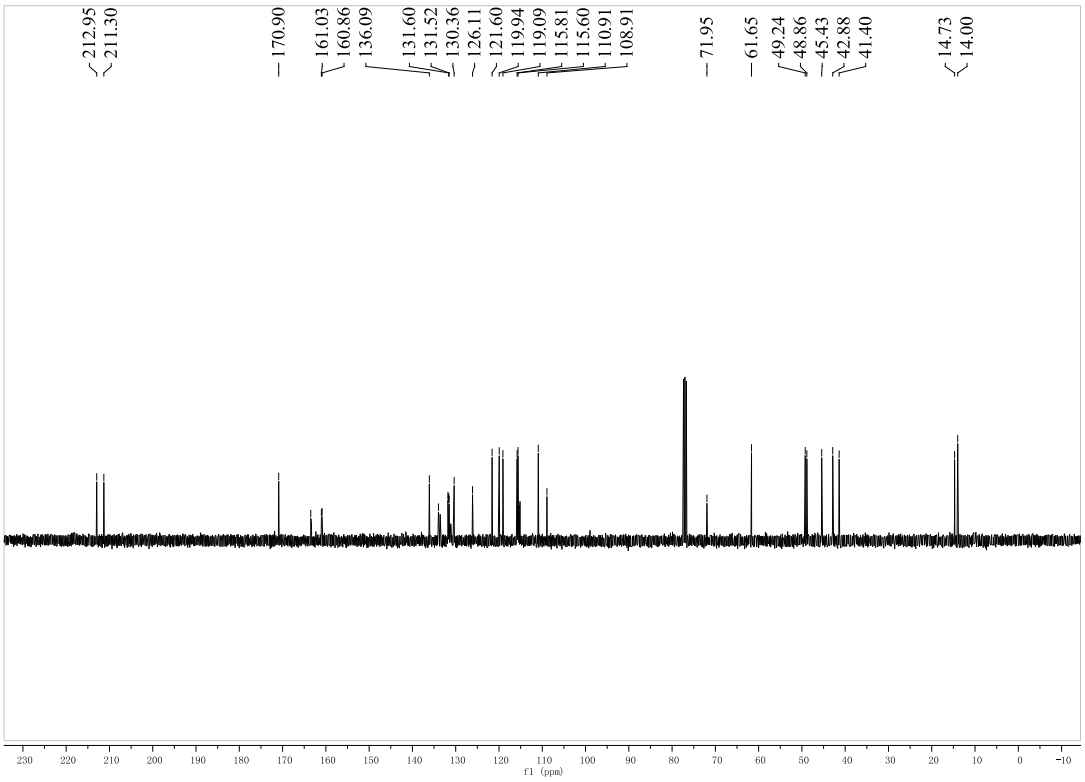
ZQC7_20210130103451 #22 RT: 0.28 AV: 1 NL: 1.73E+006
T: FTMS + p ESI Full ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-2,4-bis(4-fluorophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2i):**

white solid, 70%, m.p. 184-186 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.47 (s, 1H, NH), 7.33 (d, *J* = 8.4 Hz, 1H, ArH), 7.26-7.23 (m, 1H, ArH), 7.15-7.11 (m, 2H, ArH), 7.09-7.05 (m, 2H, ArH), 6.97 (t, *J* = 8.2 Hz, 2H, ArH), 6.89-6.83 (m, 2H, ArH), 6.79 (t, *J* = 8.0 Hz, 1H, ArH), 6.29 (d, *J* = 8.0 Hz, 1H, ArH), 5.17 (d, *J* = 2.0 Hz, 1H, CH), 5.01 (dd, J_1 = 11.2 Hz, J_2 = 2.0 Hz, 1H, CH), 4.20 (d, *J* = 11.2 Hz, 1H, CH), 4.09 (q, *J* = 7.2 Hz, 2H, CH_2), 2.05-1.99 (m, 2H, CH_2), 1.69-1.61 (m, 1H, CH), 1.54-1.48 (m, 1H, CH), 1.11 (t, *J* = 7.2 Hz, 3H, CH_3), 0.84-0.80 (m, 2H, CH_2); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.9, 211.3, 170.8, 163.4, 161.0, 160.8, 136.0, 133.9, 131.7, 131.7, 131.5, 131.5, 130.3, 126.1, 121.5, 119.9, 119.0, 115.8, 115.5, 110.9, 108.9, 71.9, 61.6, 49.2, 48.8, 45.4, 42.8, 41.4, 14.7, 14.0; IR (KBr) υ: 3441, 3082, 2973, 1845, 1761, 1688, 1648, 1565, 1483, 1343, 1382, 1266, 1141, 863, 745 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{28}F_2NO_4$([M+H]$^{+}$): 528.1981, found: 528.1973.




212.95
211.30
170.90
161.03
160.86
136.09
131.60
131.52
130.36
126.11
121.60
119.94
119.09
115.81
115.60
110.91
108.91
71.95
61.65
49.24
48.86
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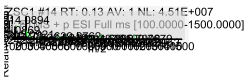
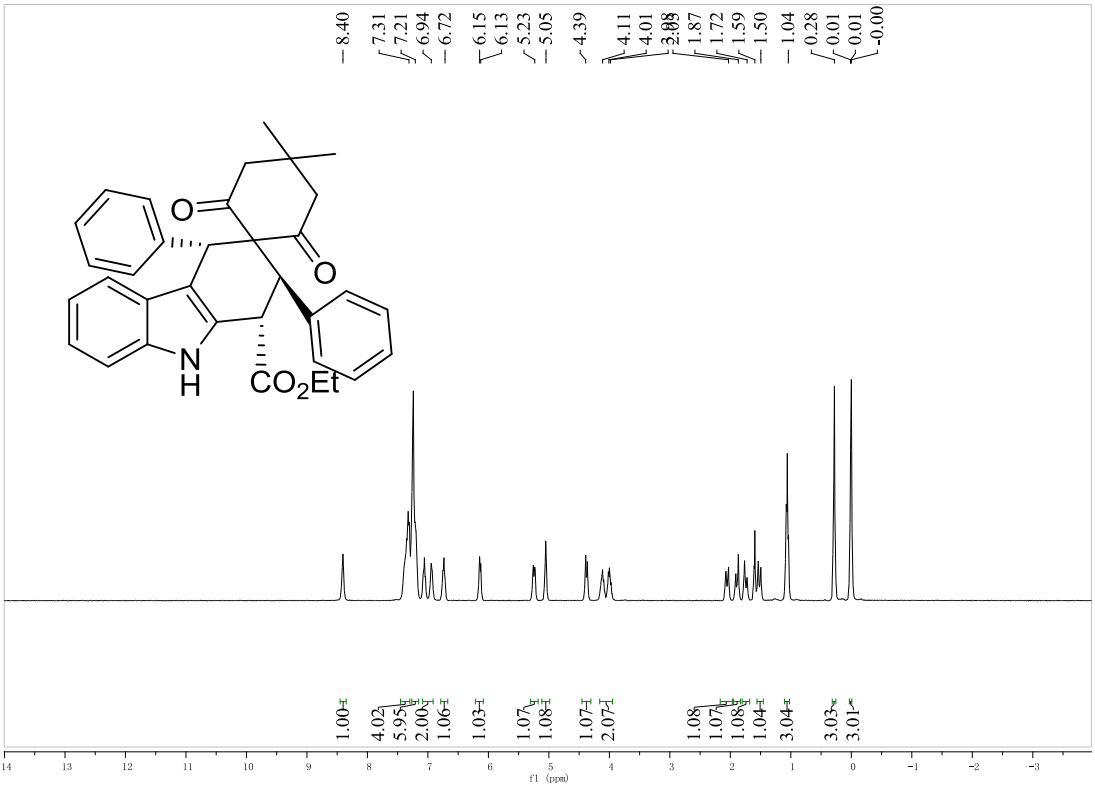
41.40
14.73
14.00
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

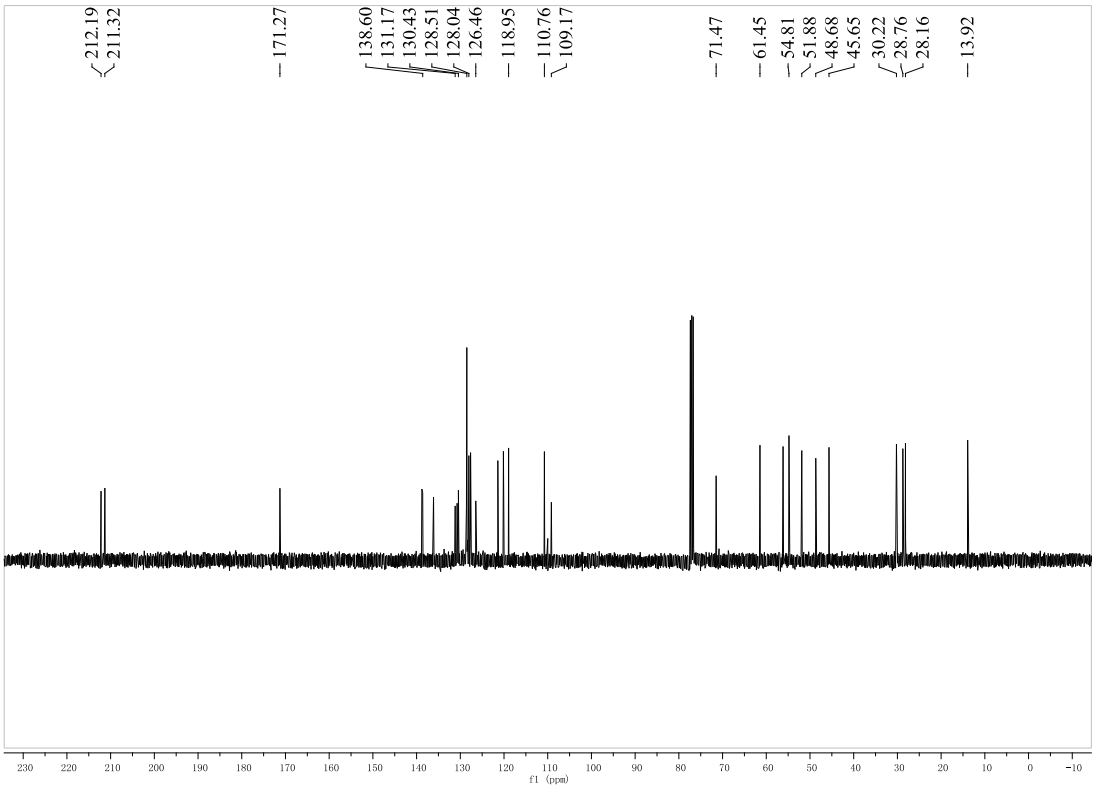

ZCC1 #11 RT: 0.13 AV: 1 NL: 4.51E+007
+ p ESI Full ms [100.0000-1500.0000]

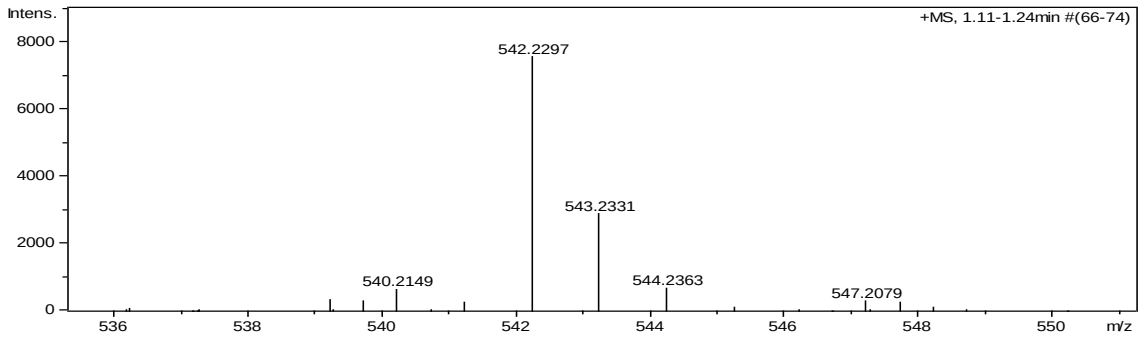
Ethyl

***rel-(1S,2R,4S)*-4',4'-dimethyl-2',6'-dioxo-2,4-diphenyl-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2j):**

white solid, 63%, m.p. 178-181 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.40 (s, 1H, NH), 7.39-7.31 (m, 4H, ArH), 7.27-7.20 (m, 6H, ArH), 7.08-6.93 (m, 2H, ArH), 6.75-6.72 (m, 1H, ArH), 6.15-6.13 (m, 1H, ArH), 5.24 (dd, J_1 = 10.8 Hz, J_2 = 2.4 Hz, 1H, CH), 5.04 (d, J = 2.4 Hz, 1H, CH), 4.37 (d, J = 10.8 Hz, 1H, CH), 4.06 (q, J = 7.2 Hz, 2H, CH_2), 2.05 (dd, J_1 = 17.2 Hz, J_2 = 1.6 Hz, 1H, CH), 1.88 (d, J = 17.2 Hz, 1H, CH), 1.74 (dd, J_1 = 16.4 Hz, J_2 = 1.6 Hz, 1H, CH), 1.52 (d, J = 16.4 Hz, 1H, CH), 1.06 (t, J = 7.2 Hz, 3H, CH_3), 0.28 (s, 3H, CH_3), 0.01 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.1, 211.3, 171.2, 138.7, 138.6, 136.1, 131.1, 130.7, 130.4, 128.5, 128.5, 128.3, 128.0, 127.6, 126.4, 121.4, 120.1, 118.9, 110.7, 109.1, 71.4, 61.4, 56.1, 54.8, 51.8, 48.6, 45.6, 30.2, 28.7, 28.1, 13.9; IR (KBr) υ: 3354, 3167, 3079, 2945, 1766, 1637, 1645, 1587, 1464, 1371, 1378, 1256, 1183, 967, 888 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{33}NO_4$([M+Na]$^+$): 542.2302, found: 542.2297.



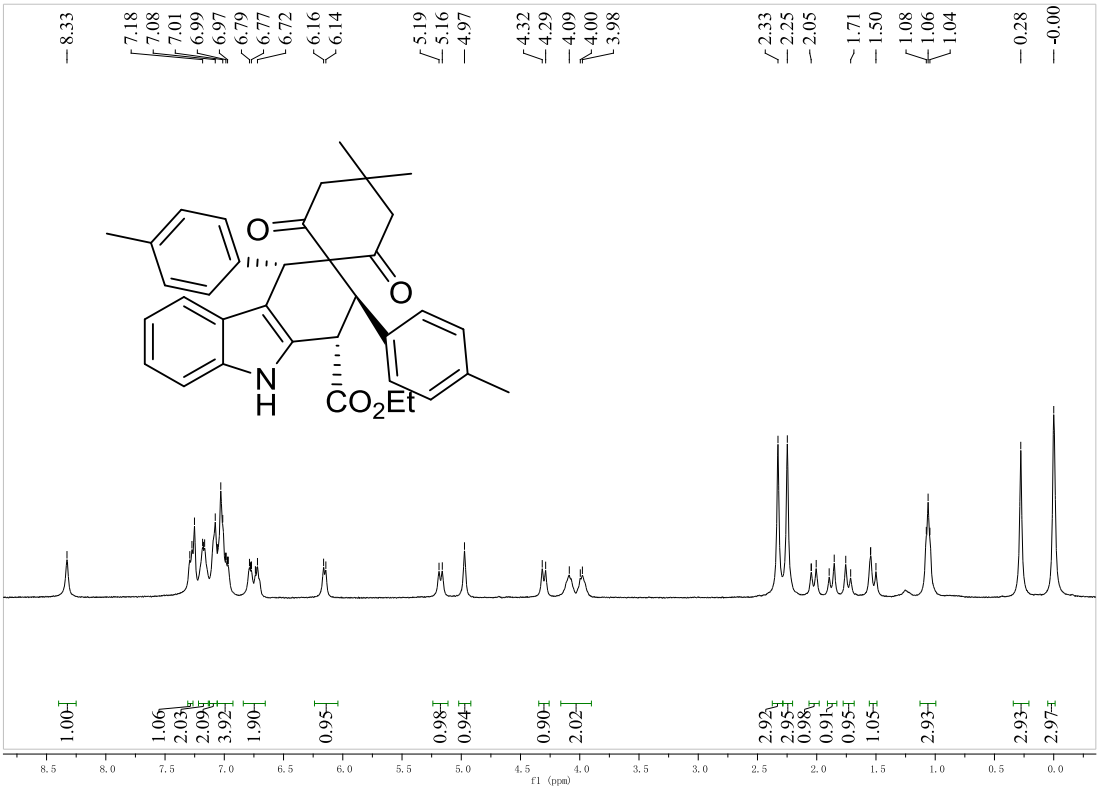

212.19
211.32
171.27
138.60
131.17
130.43
128.51
128.04
126.46
118.95
110.76
109.17
71.47
61.45
54.81
51.88
48.68
45.65
30.22
28.76
28.16
13.92
f1 (ppm)

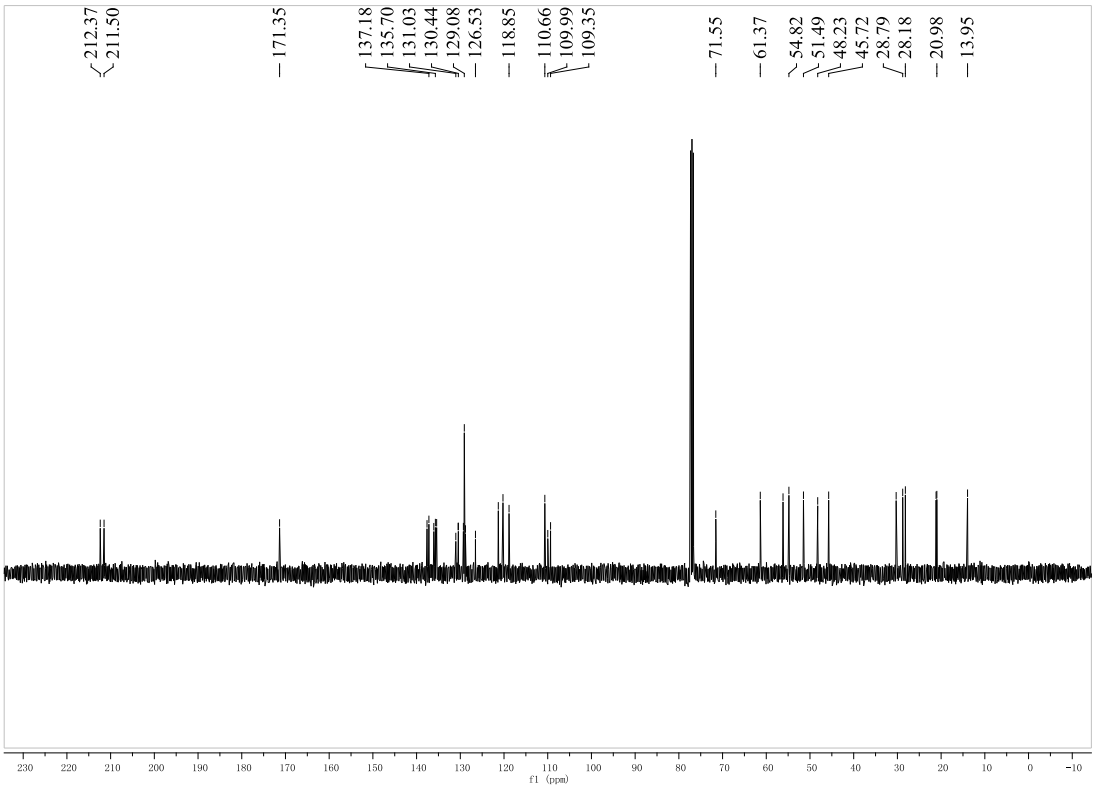

Intens.
+MS, 1.11-1.24min #(66-74)
542.2297
543.2331
540.2149
544.2363
547.2079
m/z

Ethyl

***rel-(1S,2R,4S)*-4',4'-dimethyl-2',6'-dioxo-2,4-di-p-tolyl-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2k):**

white solid, 63%, m.p. 178-181 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.33 (s, 1H, NH), 7.29-7.27 (m, 1H, ArH), 7.18-7.17 (m, 2H, ArH), 7.08-7.06 (m, 2H, ArH), 7.03-6.97 (m, 4H, ArH), 6.79-6.72 (m, 2H, ArH), 6.15 (d, *J* = 7.6 Hz, 1H, ArH), 5.17 (d, *J* = 11.2 Hz, 1H, CH), 4.97 (s, 1H, CH), 4.30 (d, *J* = 11.2 Hz, 1H, CH), 4.09 (q, *J* = 6.4 Hz, 2H, CH_2), 2.33 (s, 3H, CH_3), 2.25 (s, 3H, CH_3), 2.02 (d, *J* = 16.8 Hz, 1H, CH), 1.87 (d, *J* = 16.8 Hz, 1H, CH), 1.73 (d, *J* = 16.8 Hz, 1H, CH), 1.52 (d, *J* = 16.8 Hz, 1H, CH), 1.06 (t, *J* = 6.4 Hz, 3H, CH_3), 0.28 (s, 3H, CH_3), 0.10 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.3, 211.5, 171.3, 137.6, 137.1, 136.0, 135.7, 135.4, 131.0, 130.4, 130.4, 129.2, 129.0, 128.8, 126.5, 121.3, 120.2, 118.8, 110.6, 109.9, 109.3, 71.5, 61.3, 56.1, 54.8, 51.4, 48.2, 45.7, 30.2, 28.7, 28.1, 21.1, 20.9, 13.9; IR (KBr) υ: 3400, 3173, 3054, 2985, 1787, 1643, 1611, 1545, 1437, 1380, 1356, 1244, 1167, 932, 840 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{36}H_{37}NO_4$([M+Na]$^+$): 570.2615, found: 570.2607.



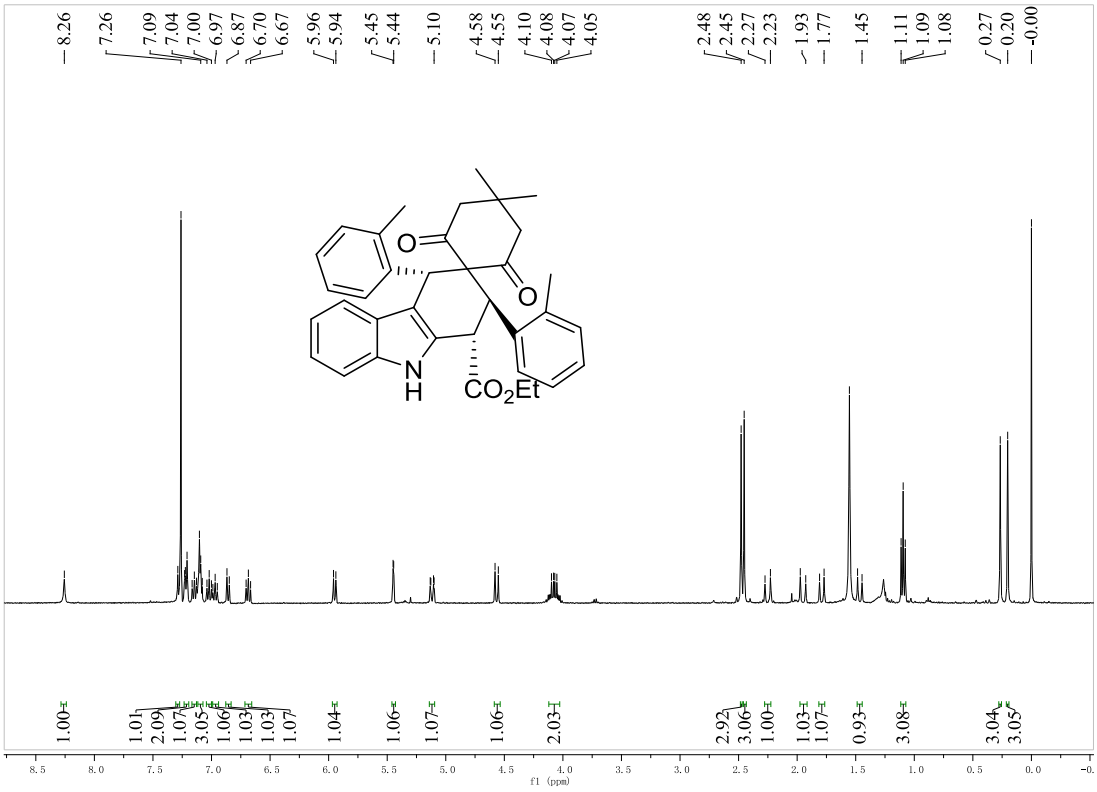

212.37
211.50
171.35
137.18
135.70
131.03
130.44
129.08
126.53
118.85
110.66
109.99
109.35
71.55
61.37
54.82
51.49
48.23
45.72
28.79
28.18
20.98
13.95
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

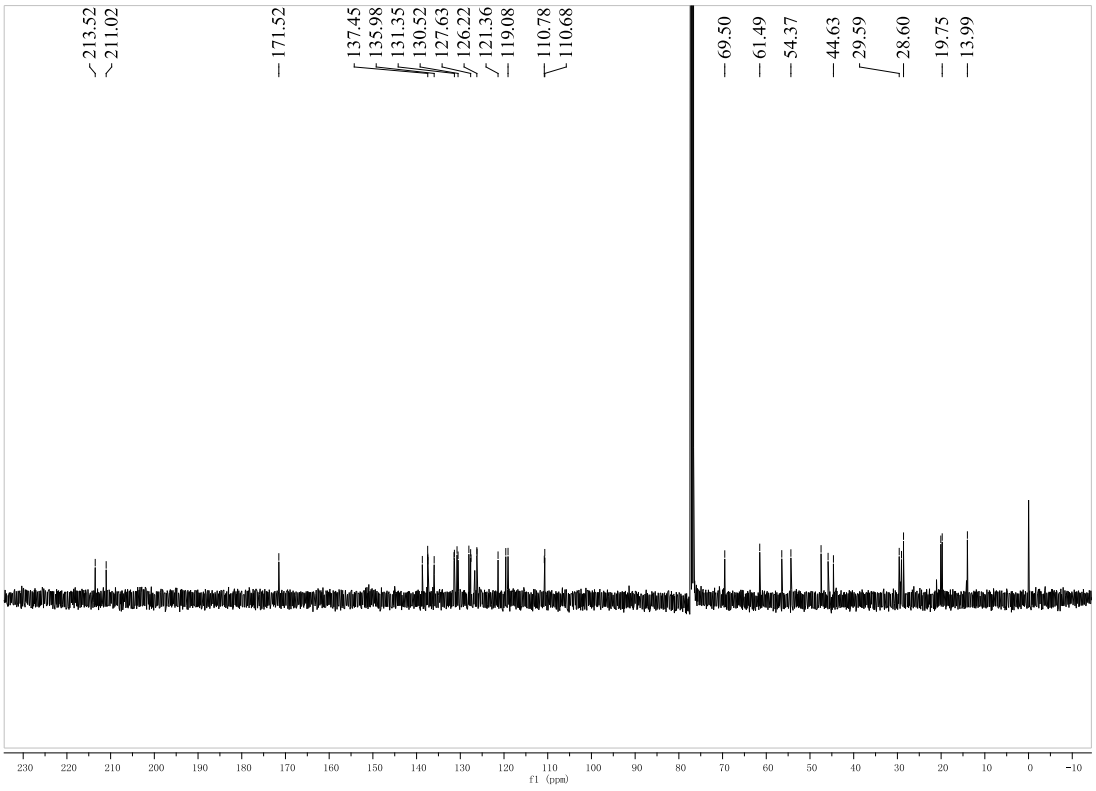

ZSC11_20210130104636 #21 RT: 0.26 AV: 1 NL: 1.12E+006
-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-4',4'-dimethyl-2',6'-dioxo-2,4-di-o-tolyl-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2l):**

white solid, 53%, m.p. 181-183 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.26 (s, 1H, NH), 7.28-7.26 (m, 1H, ArH), 7.23-7.21 (m, 2H, ArH), 7.15 (t, *J* = 7.6 Hz, 1H, ArH), 7.10-7.08 (m, 3H, ArH), 7.02 (t, *J* = 7.6 Hz, 1H, ArH), 6.97 (t, *J* = 8.0 Hz, 1H, ArH), 6.85 (d, *J* = 8.0 Hz, 1H, ArH), 6.69 (t, *J* = 8.0 Hz, 1H, ArH), 5.94 (d, *J* = 8.0 Hz, 1H, ArH), 5.45 (d, *J* = 2.0 Hz, 1H, CH), 5.11 (dd, J_1 = 11.2 Hz, J_2 = 2.0 Hz, 1H, CH), 4.57 (d, *J* = 11.2 Hz, 1H, CH), 4.08 (q, *J* = 7.2 Hz, 2H, CH_2), 2.48 (s, 3H, CH_3), 2.45 (s, 3H, CH_3), 2.25 (d, *J* = 18.4 Hz, 1H, CH), 1.95 (d, *J* = 18.4 Hz, 1H, CH), 1.78 (d, *J* = 15.4 Hz, 1H, CH), 1.46 (d, *J* = 15.2 Hz, 1H, CH), 1.09 (t, *J* = 7.2 Hz, 3H, CH_3), 0.27 (s, 3H, CH_3), 0.20 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 213.5, 211.0, 171.5, 138.6, 137.4, 137.4, 137.4, 135.9, 131.4, 130.7, 130.5, 128.0, 127.6, 126.1, 121.3, 119.5, 119.0, 110.7, 110.6, 69.5, 61.4, 56.4, 54.3, 47.4, 45.8, 44.6, 29.5, 29.0, 28.6, 20.0, 19.7, 13.9; IR (KBr) υ: 3413, 3155, 3081, 2961, 1766, 1651, 1630, 1543, 1466, 1358, 1318, 1260, 1141, 962, 860 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{36}H_{37}NO_4$([M+Na]$^+$): 570.2615, found: 570.2607.



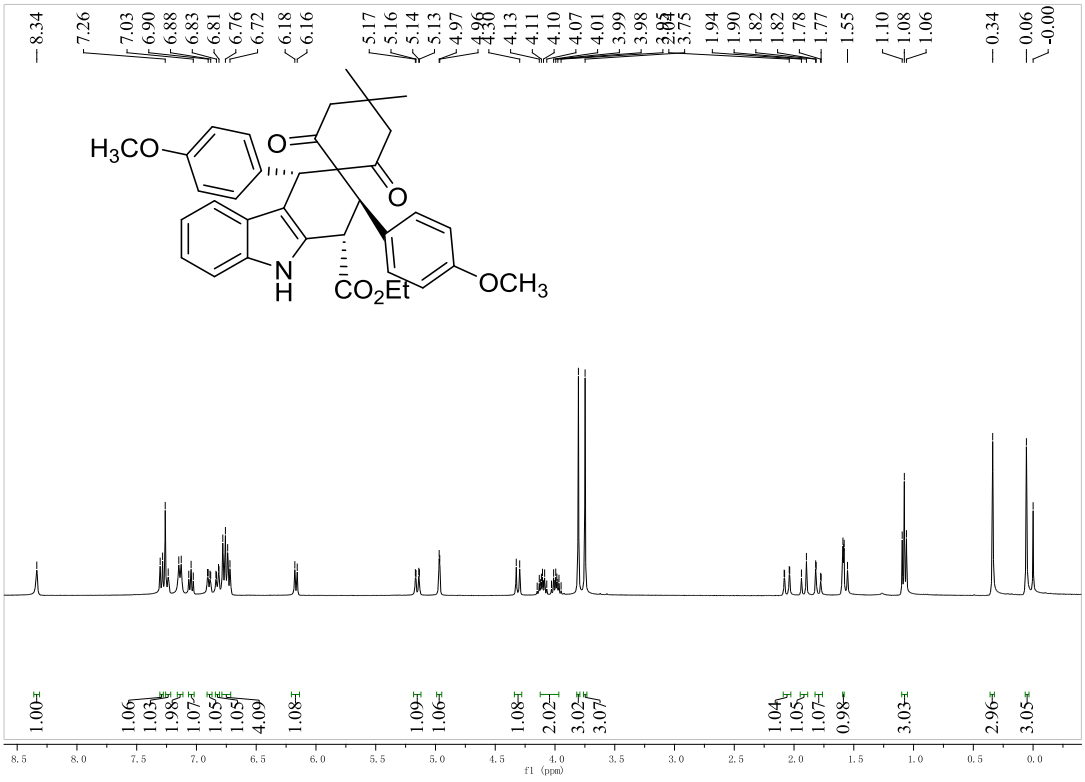


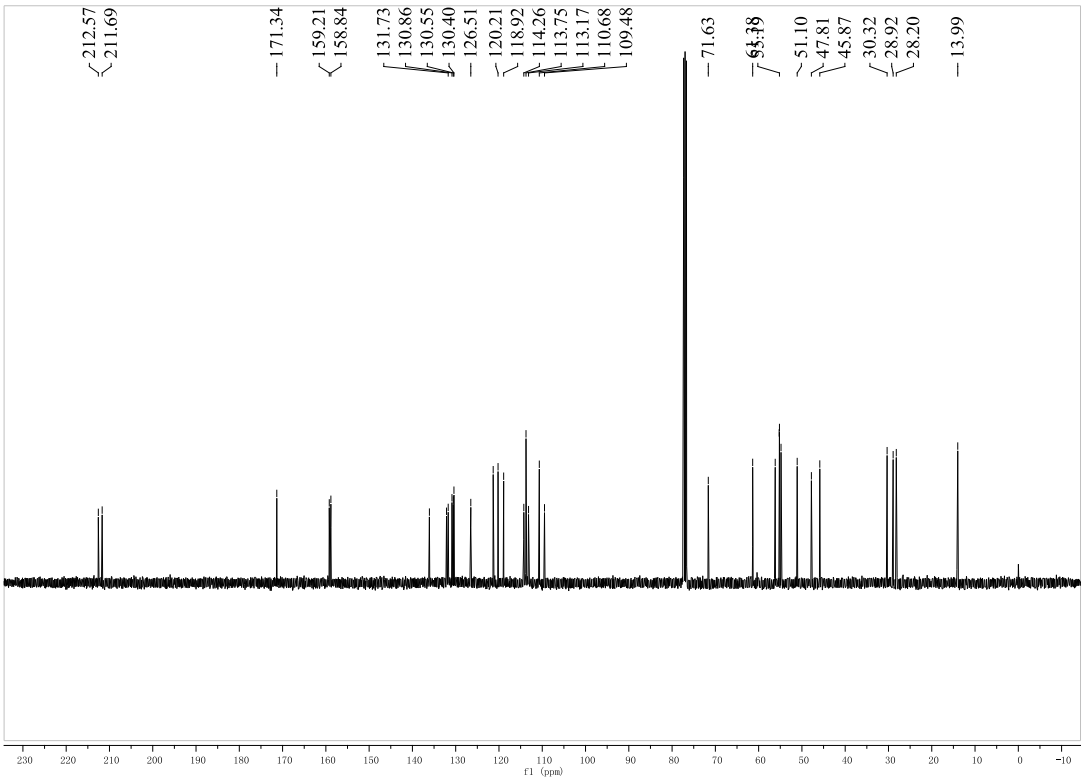
ZSC11_20210130104636 #28 RT: 0.35 AV: 1 NL: 8.07E+005
T: FTMS + p ESI Full ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-4',4'-dimethyl-2',6'-dioxo-2,4-di-o-tolyl-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2m):**

white solid, 61%, m.p. 177-179 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.34 (s, 1H, NH), 7.29 (d, J = 8.4 Hz, 1H, ArH), 7.26-7.24 (m, 1H, ArH), 7.13 (d, J = 8.4 Hz, 2H, ArH), 7.05 (t, J = 8.0 Hz, 1H, ArH), 6.89 (dd, J_1 = 8.4 Hz, J_2 = 2.4 Hz, 1H, ArH), 6.82 (dd, J_1 = 8.4 Hz, J_2 = 1.6 Hz, 1H, ArH), 6.78-6.72 (m, 4H, ArH), 6.16 (t, J = 7.6 Hz, 1H, ArH), 5.15 (dd, J_1 = 11.2 Hz, J_2 = 2.0 Hz, 1H, CH), 4.96 (d, J = 2.0 Hz, 1H, CH), 4.30 (d, J = 11.2 Hz, 1H, CH), 4.04 (q, J = 7.2 Hz, 2H, CH_2), 3.80 (s, 3H, OCH_3), 3.75 (s, 3H, OCH_3), 2.06 (dd, J_1 = 17.2 Hz, J_2 = 1.2 Hz, 1H, CH), 1.91 (d, J = 16.4 Hz, 1H, CH), 1.19 (dd, J_1 = 16.4 Hz, J_2 = 1.2 Hz, 1H, CH), 1.59-1.58 (m, 1H, CH), 1.08 (t, J = 7.2 Hz, 3H, CH_3), 0.34 (s, 3H, CH_3), 0.06 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 212.5, 211.6, 171.3, 159.2, 158.8, 136.0, 132.1, 131.7, 130.8, 130.5, 130.4, 126.5, 121.3, 120.2, 118.9, 114.2, 113.7, 113.1, 110.6, 109.4, 71.6, 61.3, 56.1, 55.2, 55.1, 54.8, 51.0, 47.8, 45.8, 30.3, 28.9, 28.1, 13.9; IR (KBr) υ: 3410, 3058, 2966, 1871, 1736, 1654, 1646, 1578, 1432, 1364, 1300, 1247, 1157, 899, 765 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{36}H_{37}NO_6$([M+Na]$^{+}$): 602.2513, found: 602.2507.

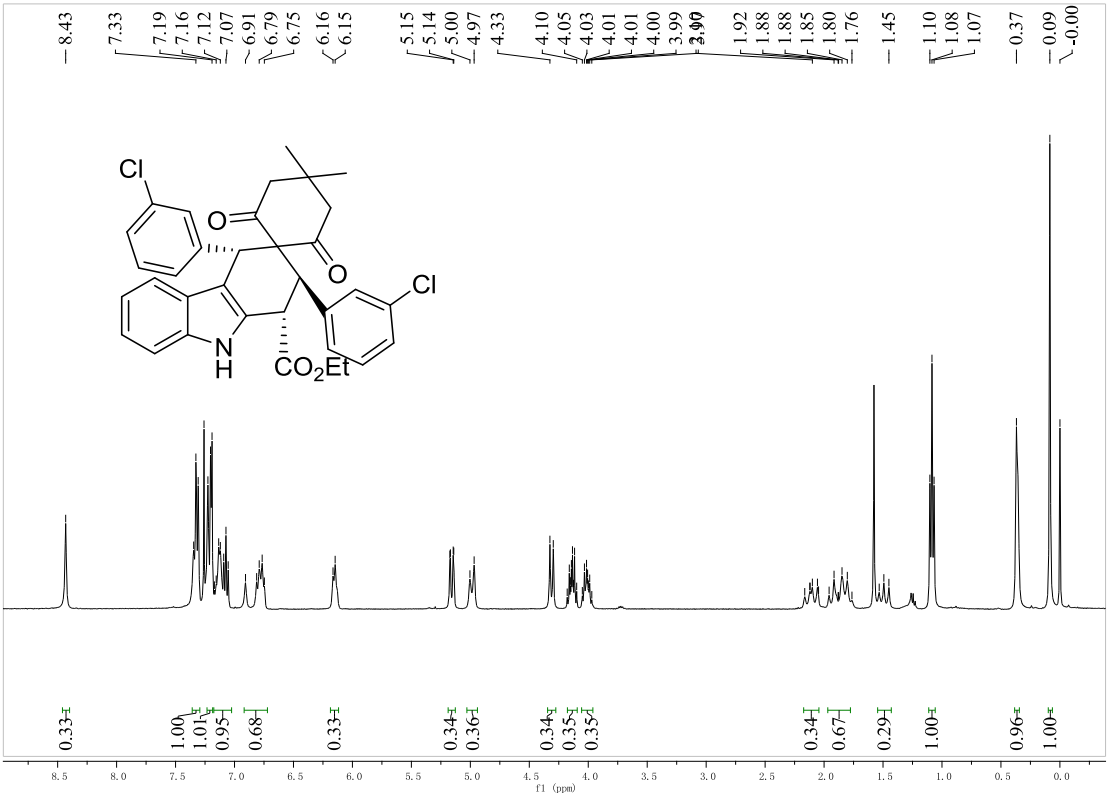


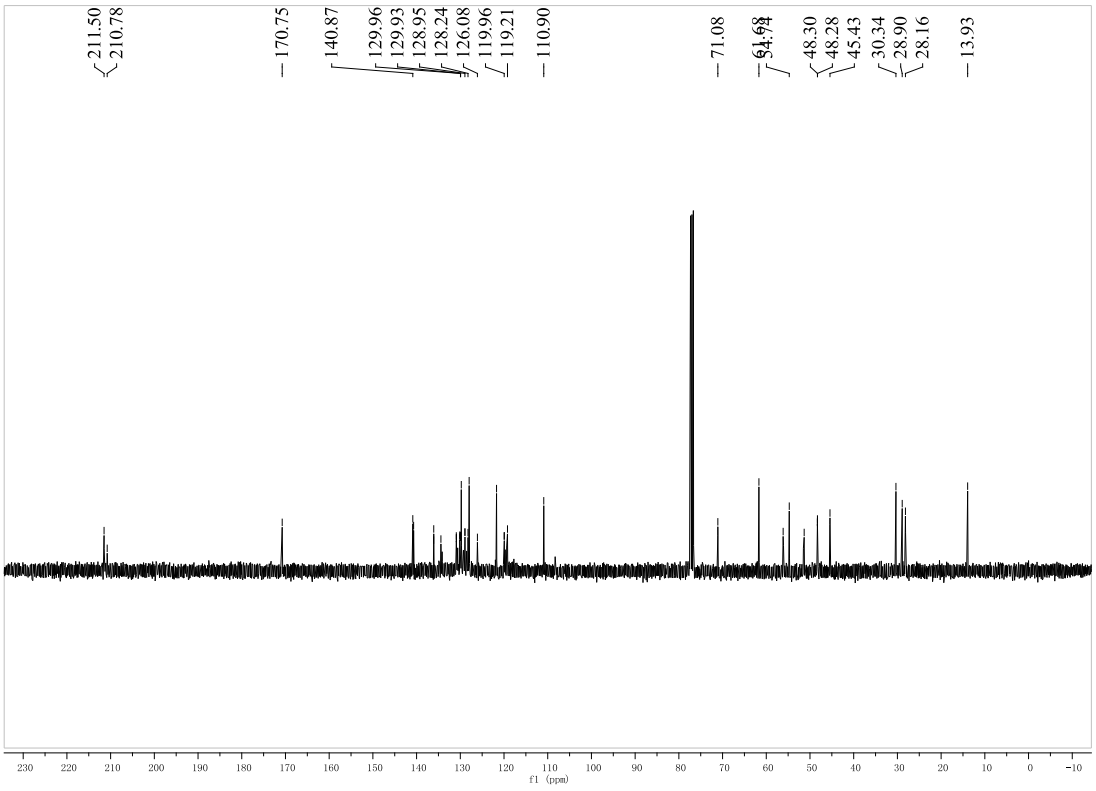

212.57
211.69
171.34
159.21
158.84
131.73
130.86
130.55
130.40
126.51
120.21
118.92
114.26
113.75
113.17
110.68
109.48
71.63
64.38
64.19
51.10
47.81
45.87
30.32
28.92
28.20
13.99
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Ethyl

***rel*-(1S,2R,4S)-2,4-bis(3-chlorophenyl)-4',4'-dimethyl-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2n):**

white solid, 50%, m.p. 190-193 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.43 (s, 1H, NH), 7.35-7.31 (m, 3H, ArH), 7.23-7.19 (m, 3H, ArH), 7.17-7.05 (m, 3H, ArH), 6.91-6.75 (m, 2H, ArH), 6.17-6.13 (m, 1H, ArH), 5.15 (dd, J_1 = 11.2 Hz, J_2 = 2.0 Hz, 1H, CH), 4.98 (d, J = 14.4 Hz, 1H, CH), 4.30 (d, J = 11.2 Hz, 1H, CH), 4.04 (q, J = 7.2 Hz, 2H, CH_2), 2.16-2.05 (m, 1H, CH), 1.96-1.76 (m, 2H, CH), 1.53-1.45 (m, 1H, CH), 1.09 (t, J = 7.2 Hz, 3H, CH_3), 0.37 (s, 3H, CH_3), 0.09 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 211.5, 210.7, 170.7, 140.8, 140.6, 136.1, 136.0, 134.4, 130.9, 130.8, 130.1, 130.1, 129.9, 129.7, 128.9, 128.2, 127.9, 126.0, 121.7, 119.9, 119.2, 110.9, 71.0, 61.6, 56.1, 54.7, 51.3, 48.3, 48.2, 48.2, 45.4, 30.3, 28.9, 28.1, 13.9; IR (KBr) υ: 3433, 3051, 2963, 1841, 1766, 1680, 1631, 1531, 1445, 1317, 1290, 1241, 1164, 921, 854, 746 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{31}ClNO_4$([M+Na]$^{+}$): 610.1522, found: 610.1515.



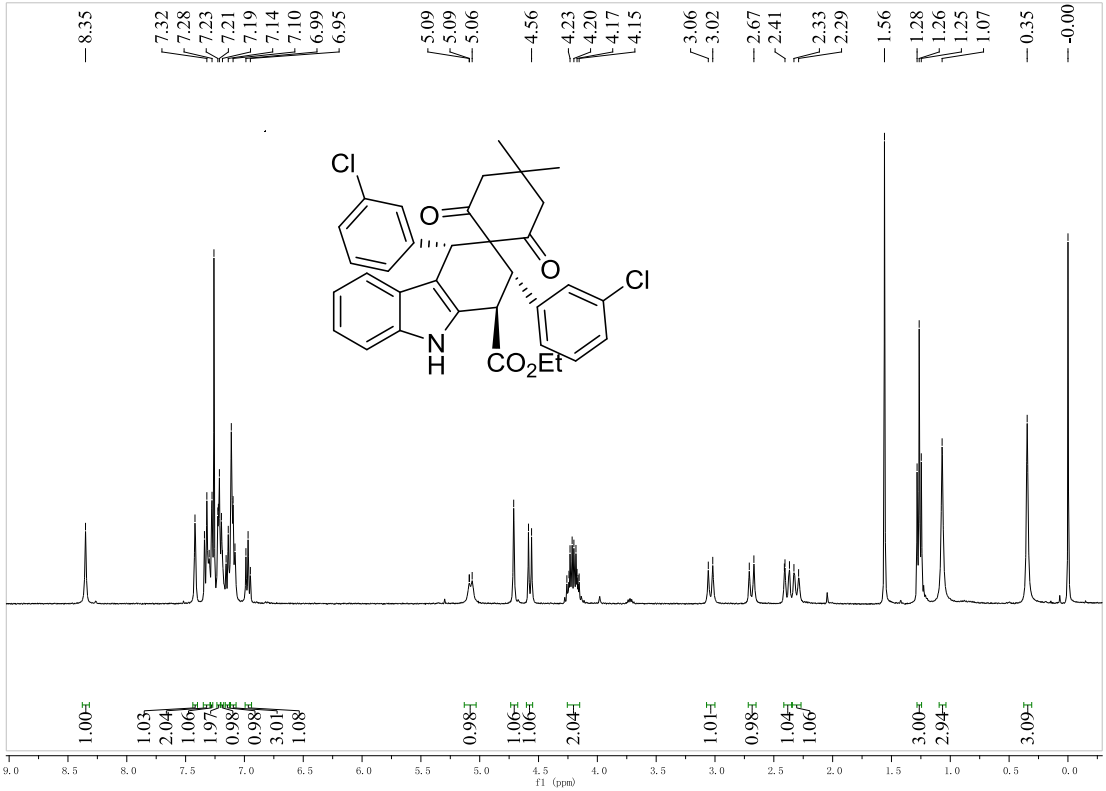

211.50
210.78
170.75
140.87
129.96
129.93
128.95
128.24
126.08
119.96
119.21
110.90
71.08
61.68
54.94
48.30
48.28
45.43
30.34
28.90
28.16
13.93
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

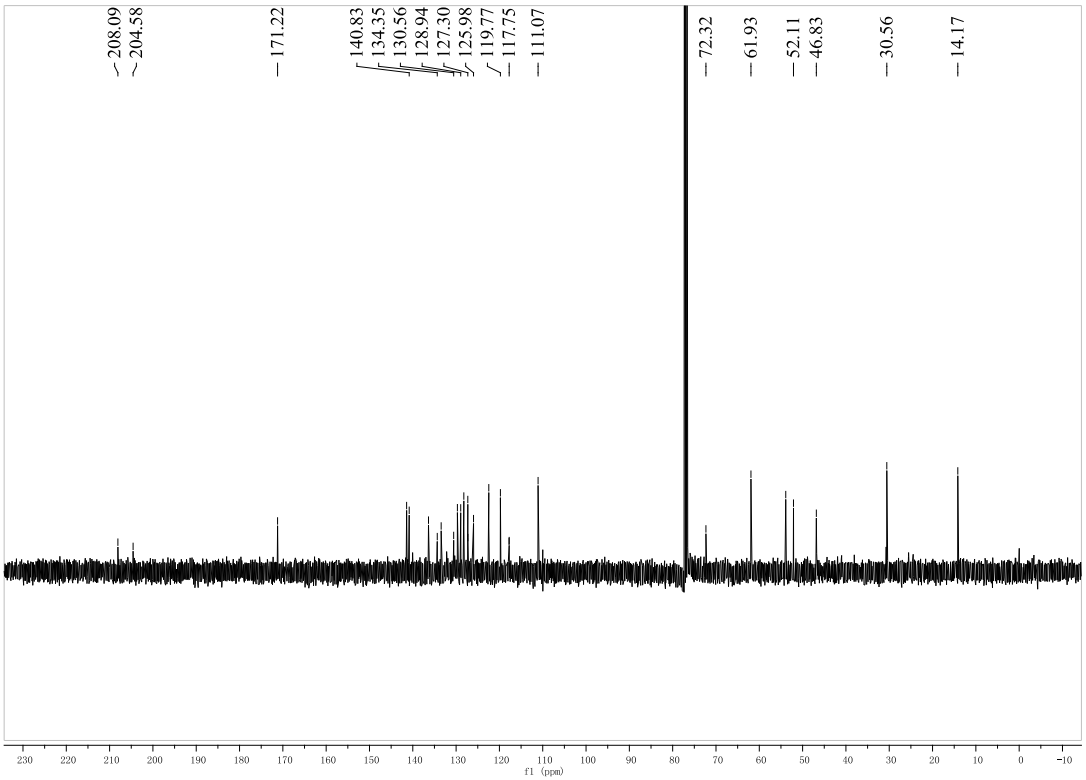
ZGC15_20210130105821 #25 RT: 0.32 AV: 1 NL: 7.71E+005
Full ms [100.0000-1500.0000]

Ethyl

***re-(1R,2S,4S)*-2,4-bis(3-chlorophenyl)-4',4'-dimethyl-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2n'):**

white solid, 6%, m.p. 167-169 ºC; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.35 (s, 1H, NH), 7.42 (s, 1H, ArH), 7.34-7.30 (m, 2H, ArH), 7.27-7.26 (m, 2H, ArH), 7.23-7.21 (m, 2H, ArH), 7.20-7.19 (m, 2H, ArH), 7.14 (d, *J* = 7.2 Hz, 1H, ArH), 7.11-7.08 (m, 3H, ArH), 6.97 (t, *J* = 7.2 Hz, 1H, ArH), 5.07 (d, *J* = 10.4 Hz, 1H, CH), 4.71 (s, 1H, CH), 4.57 (d, *J* = 10.4 Hz, 1H, CH), 4.20 (q, *J* = 7.2 Hz, 2H, CH_2), 3.03 (d, *J* = 14.2 Hz, 1H, CH), 2.68 (d, *J* = 14.2 Hz, 1H, CH), 2.38 (d, *J* = 14.2 Hz, 1H, CH), 2.31 (d, *J* = 14.2 Hz, 1H, CH), 1.27 (t, *J* = 7.2 Hz, 3H, CH_3), 1.07 (s, 3H, CH_3), 0.35 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 208.0, 204.5, 171.2, 141.4, 140.8, 136.3, 134.3, 133.4, 130.5, 129.7, 128.9, 128.2, 127.3, 127.2, 125.9, 122.4, 119.7, 117.7, 117.7, 111.0, 72.3, 61.9, 53.8, 52.1, 46.8, 30.5, 14.1; IR (KBr) υ: 3403, 3071, 2982, 1900, 1843, 1710, 1631, 1546, 1433, 1369, 1260, 1269, 1180, 951, 833, 767 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{31}ClNO_4$([M+Na]$^+$): 610.1522, found: 610.1519.



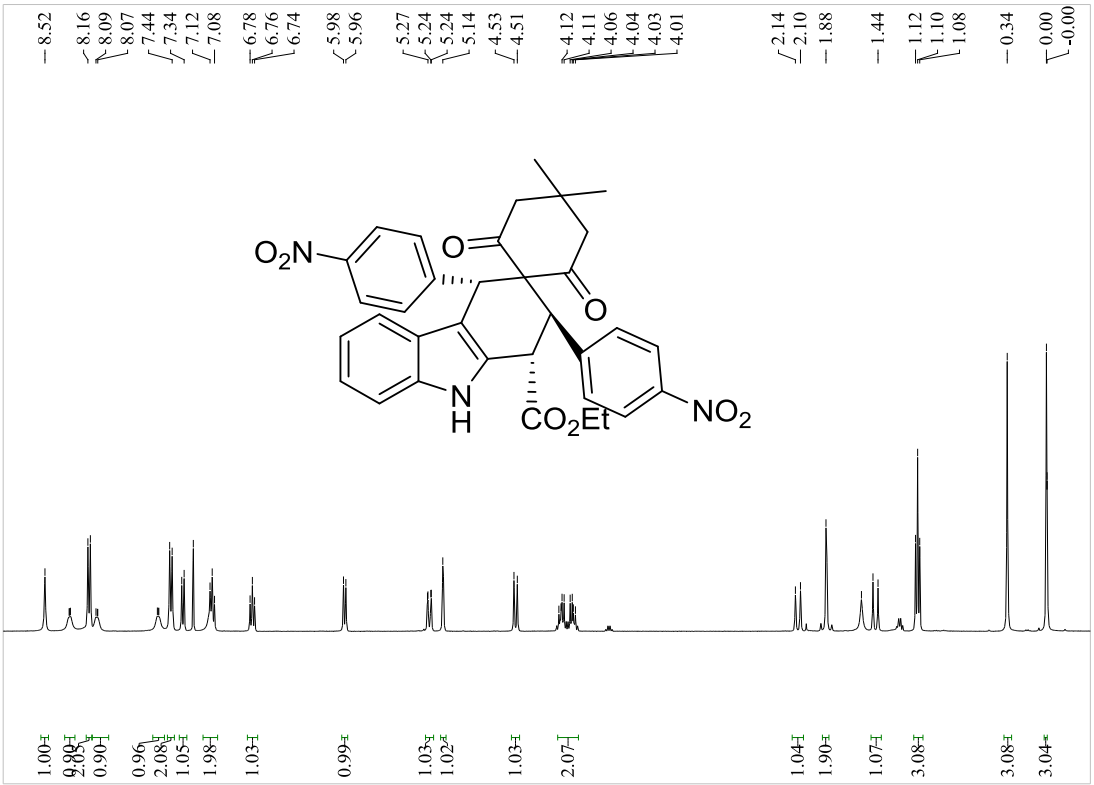

208.09
204.58
171.22
140.83
134.35
130.56
128.94
127.30
125.98
119.77
117.75
111.07
72.32
61.93
52.11
46.83
30.56
14.17
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

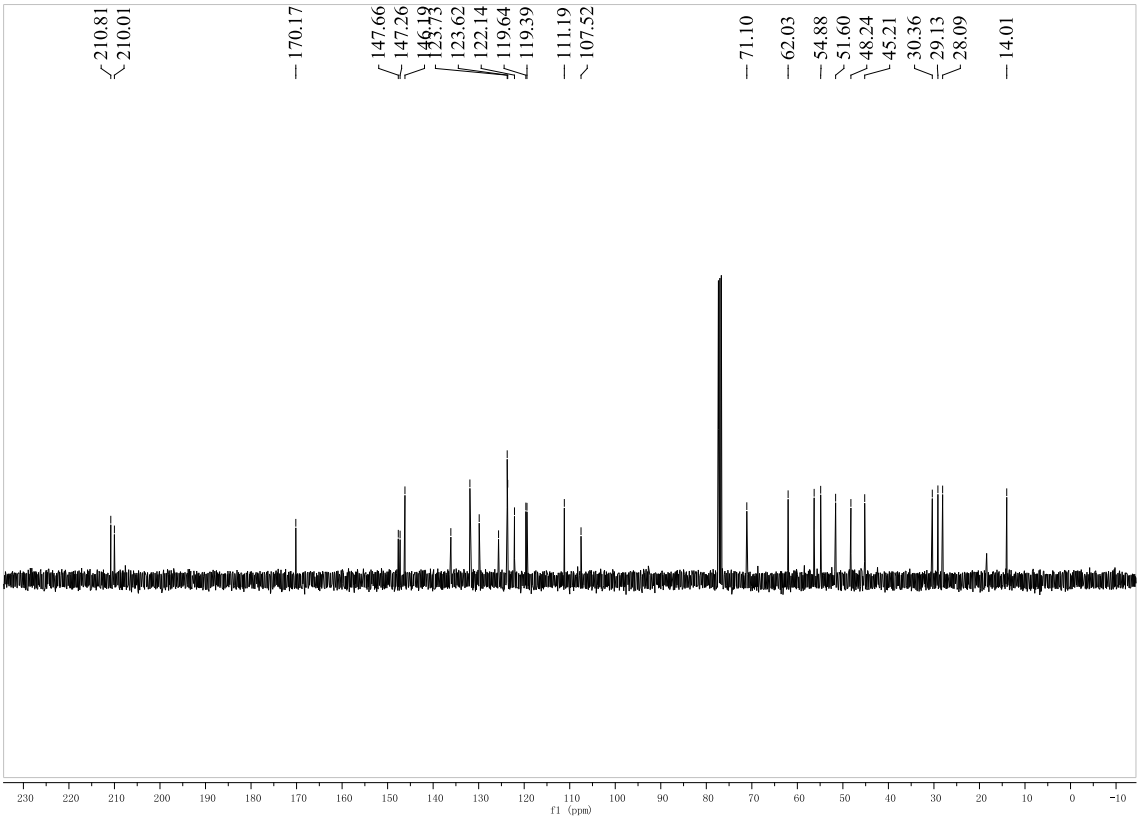
ZSC15_20210130105821 #28 RT: 0.35 AV: 1 NL: 6.63E+005
Full ms [100.0000-1500.0000]

Ethyl

***rel-(1S,2R,4S)*-4',4'-dimethyl-2,4-bis(4-nitrophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2o):**

white solid, 51%, m.p. 190-193 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.52 (s, 1H, NH), 8.31-8.30 (m, 1H, ArH), 8.14 (d, *J* = 8.4 Hz, 2H, ArH), 8.08-8.07 (m, 1H, ArH), 7.56-7.55 (m, 1H, ArH), 7.44 (d, *J* = 8.4 Hz, 2H, ArH), 7.34 (d, *J* = 8.0 Hz, 1H, ArH), 7.11-7.08 (m, 2H, ArH), 6.75 (d, *J* = 8.0 Hz, 1H, ArH), 5.96 (d, *J* = 8.0 Hz, 1H, ArH), 5.24 (dd, J_1 = 11.2 Hz, J_2 = 1.6 Hz, 1H, CH), 5.13 (s, 1H, CH), 4.51 (d, *J* = 11.6 Hz, 1H, CH), 4.07 (q, *J* = 7.2 Hz, 2H, CH_2), 2.11 (d, *J* = 17.2 Hz, 1H, CH), 1.88-1.87 (m, 2H, CH_2), 1.46 (d, *J* = 17.2 Hz, 1H, CH), 1.09 (t, *J* = 7.2 Hz, 3H, CH_3), 0.33 (s, 3H, CH_3), 0.07 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 210.8, 210.0, 170.1, 147.6, 147.2, 146.1, 136.1, 131.9, 129.8, 125.6, 123.7, 123.6, 122.1, 119.6, 119.3, 111.1, 107.5, 71.1, 62.0, 56.3, 54.8, 51.6, 48.2, 45.2, 30.3, 29.1, 28.0, 14.0; IR (KBr) υ: 3454, 3078, 2967, 1884, 1772, 1681, 1645, 1587, 1454, 1367, 1331, 1267, 1148, 833, 782 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{31}N_3O_8$ ($[M+Na]^+$): 632.2003, found: 632.1993.




210.81
210.01
170.17
147.66
147.26
146.19
123.73
123.62
122.14
119.64
119.39
111.19
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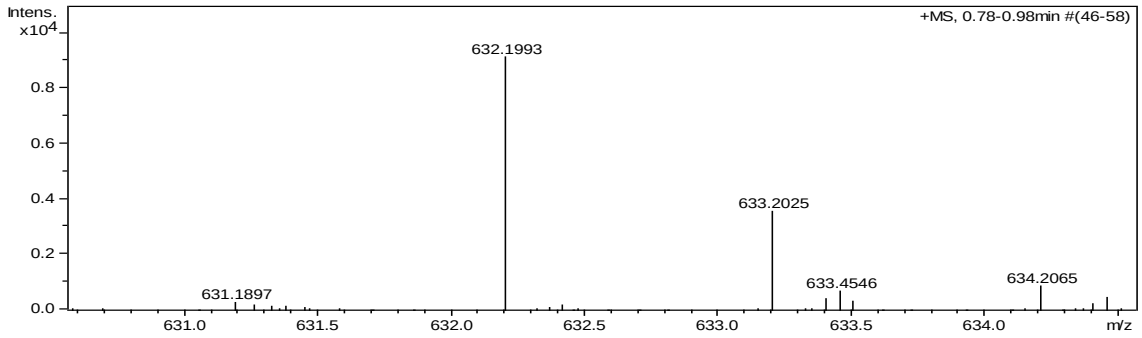
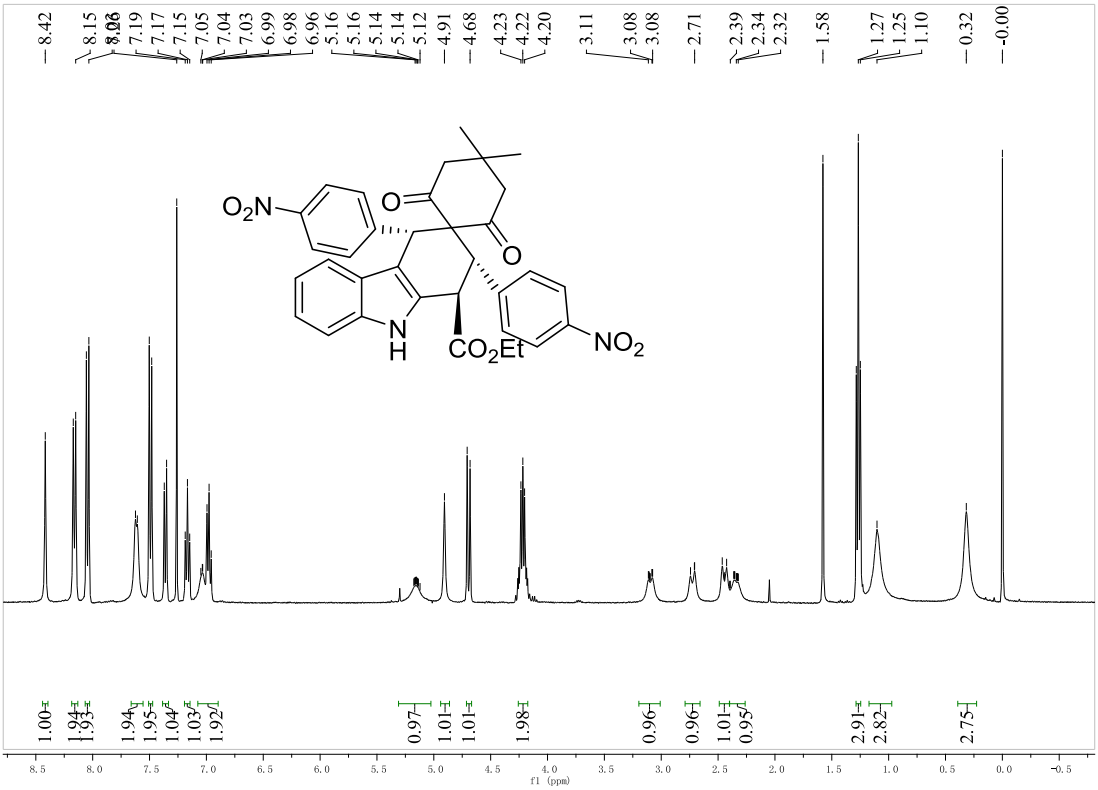
48.24
45.21
30.36
29.13
28.09
14.01
f1 (ppm)

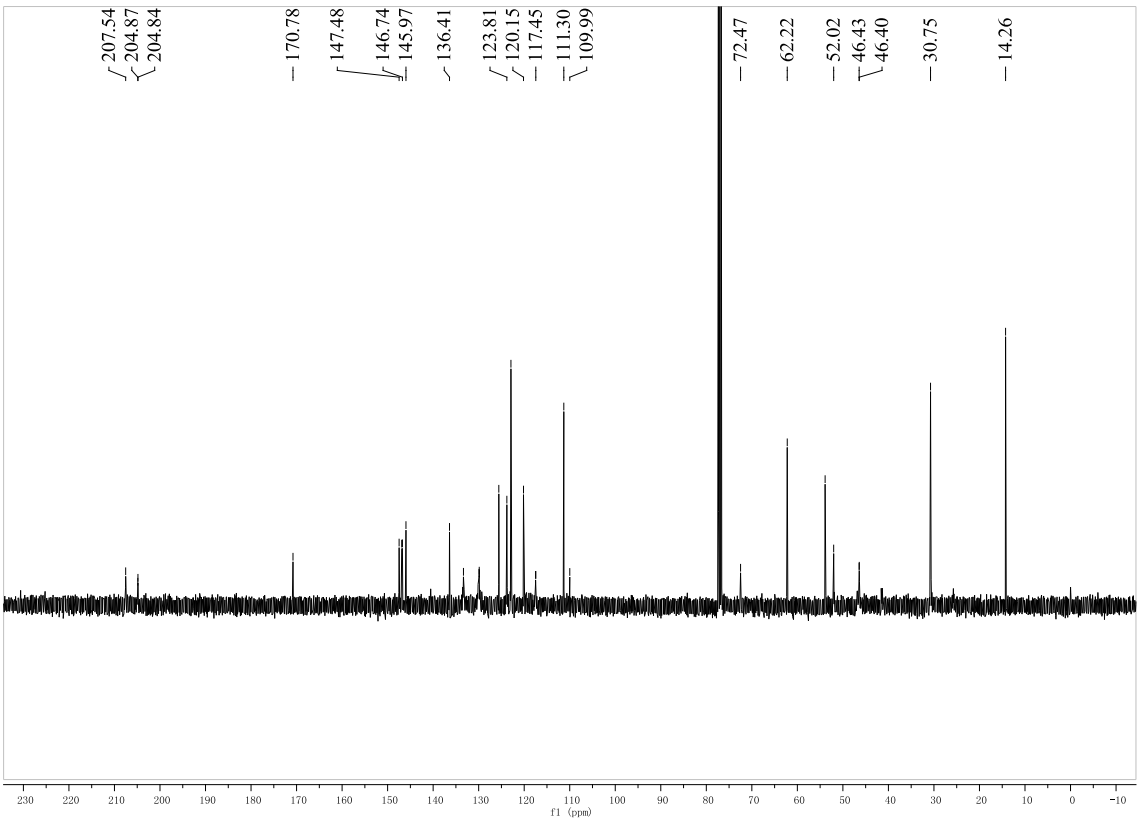

Intens.
x10^4
+MS, 0.78-0.98min #(46-58)
632.1993
633.2025
631.1897
633.4546
634.2065
m/z

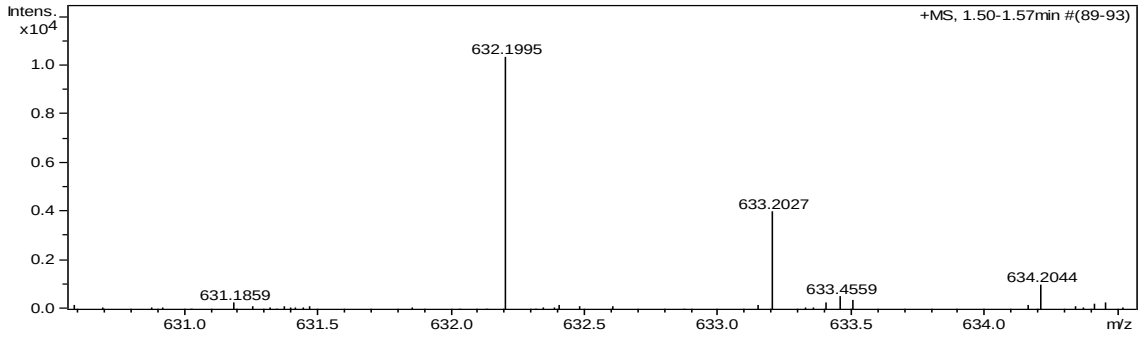
Ethyl

***rel-(1S,2R,4S)*-4',4'-dimethyl-2,4-bis(4-nitrophenyl)-2',6'-dioxo-1,2,4,9-tetrahydrospiro[carbazole-3,1'-cyclohexane]-1-carboxylate (2o'):**

white solid, 7%, m.p. 176-178 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.42 (s, 1H, NH), 8.16 (d, *J* = 8.4 Hz, 2H, ArH), 8.04 (d, *J* = 8.8 Hz, 2H, ArH), 7.62-7.61 (m, 2H, ArH), 7.49 (d, *J* = 8.4 Hz, 2H, ArH), 7.36 (d, *J* = 8.4 Hz, 1H, ArH), 7.17 (t, *J* = 7.6 Hz, 1H, ArH), 7.05-6.96 (m, 2H, ArH), 5.18-5.12 (m, 1H, ArH), 4.91 (s, 1H, CH), 4.69 (d, *J* = 10.4 Hz, 1H, CH), 4.21 (q, *J* = 7.2 Hz, 2H, CH_2), 3.10 (d, *J* = 14.4 Hz, 1H, CH), 2.71 (d, *J* = 14.4 Hz, 1H, CH), 2.45 (d, *J* = 14.4 Hz, 1H, CH), 2.36-2.32 (m, 1H, CH), 1.27 (t, *J* = 7.2 Hz, 3H, CH_3), 1.10 (s, 3H, CH_3), 0.32 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 207.5, 204.8, 204.8, 170.7, 147.4, 146.9, 146.7, 145.9, 136.4, 133.3, 129.9, 129.8, 129.8, 125.5, 123.8, 122.9, 120.1, 117.5, 117.4, 111.2, 109.9, 72.4, 62.2, 53.9, 52.0, 46.4, 46.4, 30.7, 14.2; IR (KBr) υ: 3400, 3098, 2974, 1863, 1755, 1678, 1664, 1581, 1417, 1309, 1287, 1240, 1113, 854, 763 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{31}N_3O_8$([M+Na]$^{+}$): 632.2003, found: 632.1995.



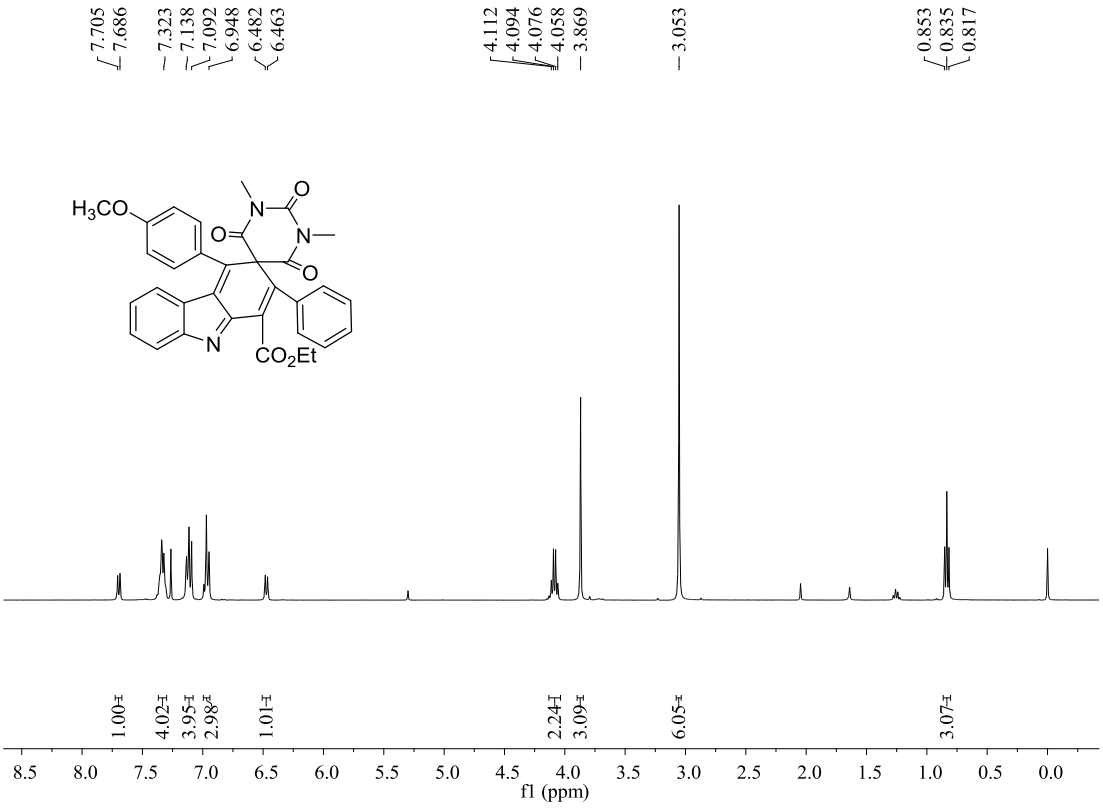

207.54
204.87
204.84
170.78
147.48
146.74
145.97
136.41
123.81
120.15
117.45
111.30
109.99
72.47
62.22
52.02
46.43
46.40
30.75
14.26
f1 (ppm)

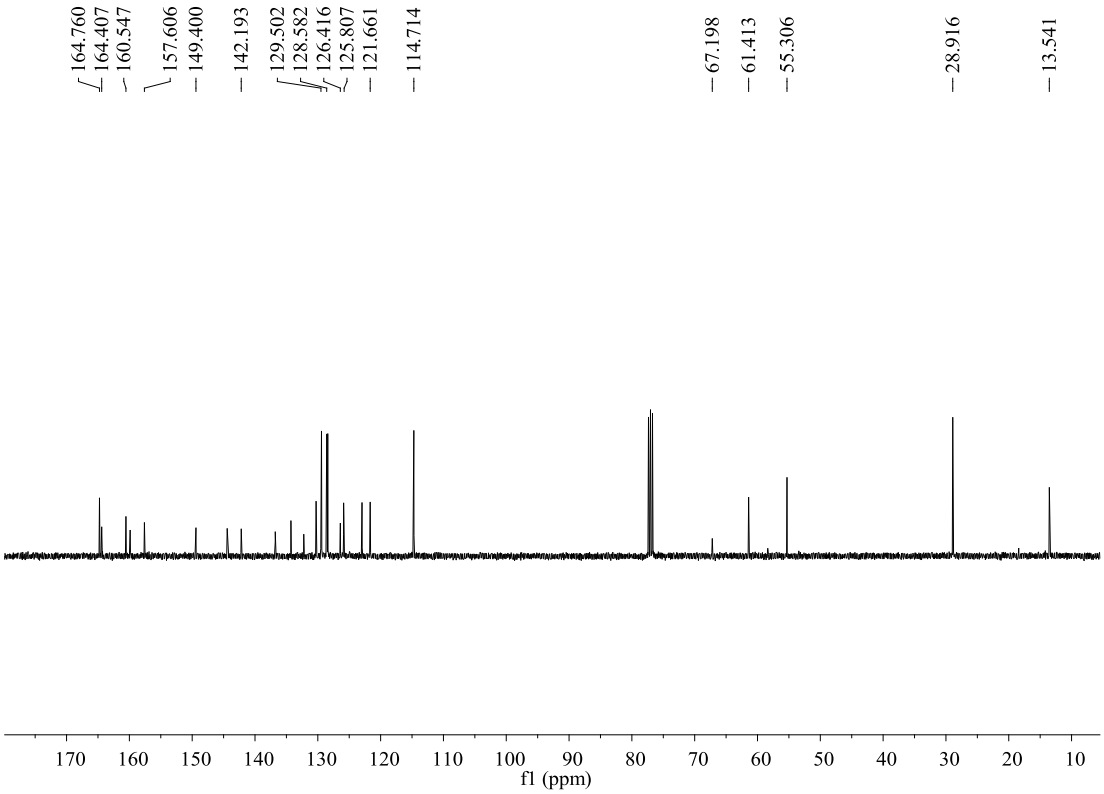

Intens.
x10^4
+MS, 1.50-1.57min #(89-93)
632.1995
633.2027
631.1859
633.4559
634.2044
m/z

Ethyl

4-(4-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-2-phenyl-1',3',4',6'-tetrahydro-2'H-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (3a):

yellow solid, 70%, m.p. 209-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.69 (d, *J* = 7.6 Hz, 1H, ArH), 7.36-7.26 (m, 4H, ArH), 7.14-7.09 (m, 4H, ArH), 6.99-6.95 (m, 3H, ArH), 6.47 (d, *J* = 7.6 Hz, 1H, ArH), 4.08 (q, *J* = 7.2 Hz, 2H, CH_2), 3.84 (s, 3H, OCH_3), 3.05 (s, 3H, CH_3), 3.04 (s, 3H, CH_3), 0.84 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 164.7, 164.4, 160.5, 159.8, 157.6, 149.3, 144.4, 142.1, 136.7, 134.2, 132.2, 130.2, 129.5, 129.4, 128.5, 128.4, 126.4, 125.8, 125.8, 122.9, 121.6, 114.7, 67.1, 61.4, 55.3, 28.9, 13.5; IR(KBr) υ: 3234, 3173, 3048, 2955, 2867, 2187, 1844, 1657, 1621, 1564, 1488, 1375, 1287, 1154, 1134, 951, 938, 821, 769 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{27}N_3O_6$ ([M+H]$^+$): 562.1973, found: 562.1973.

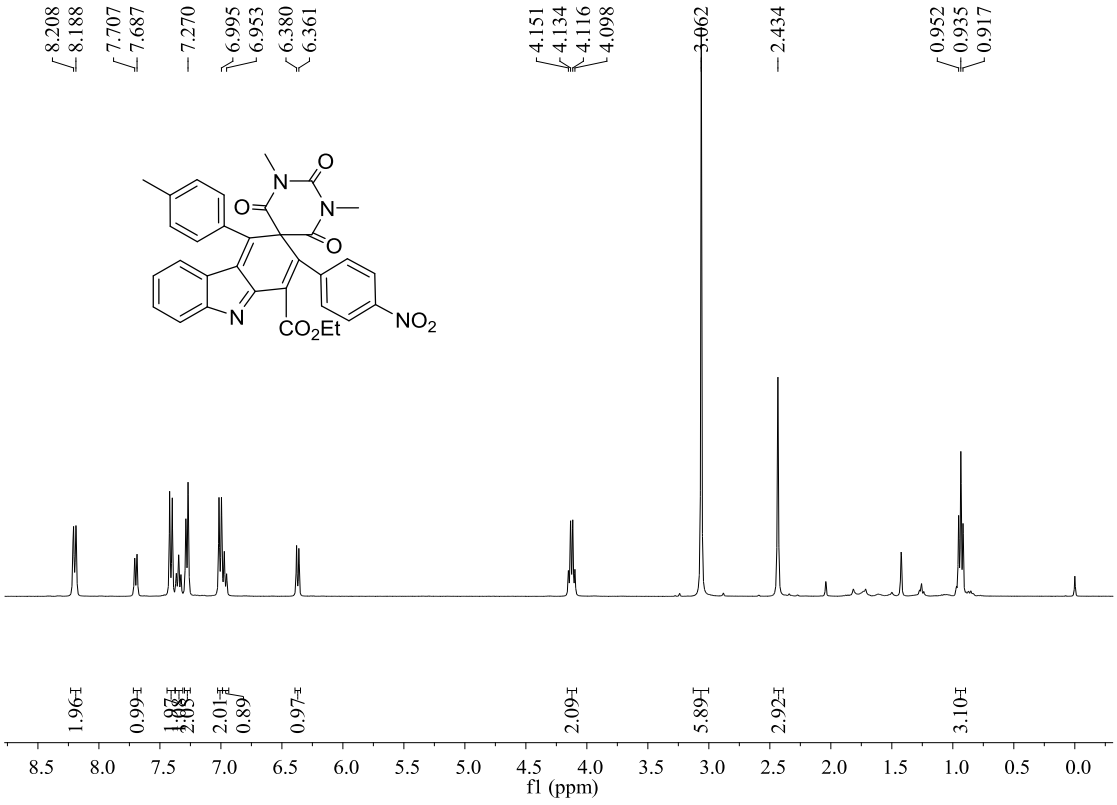


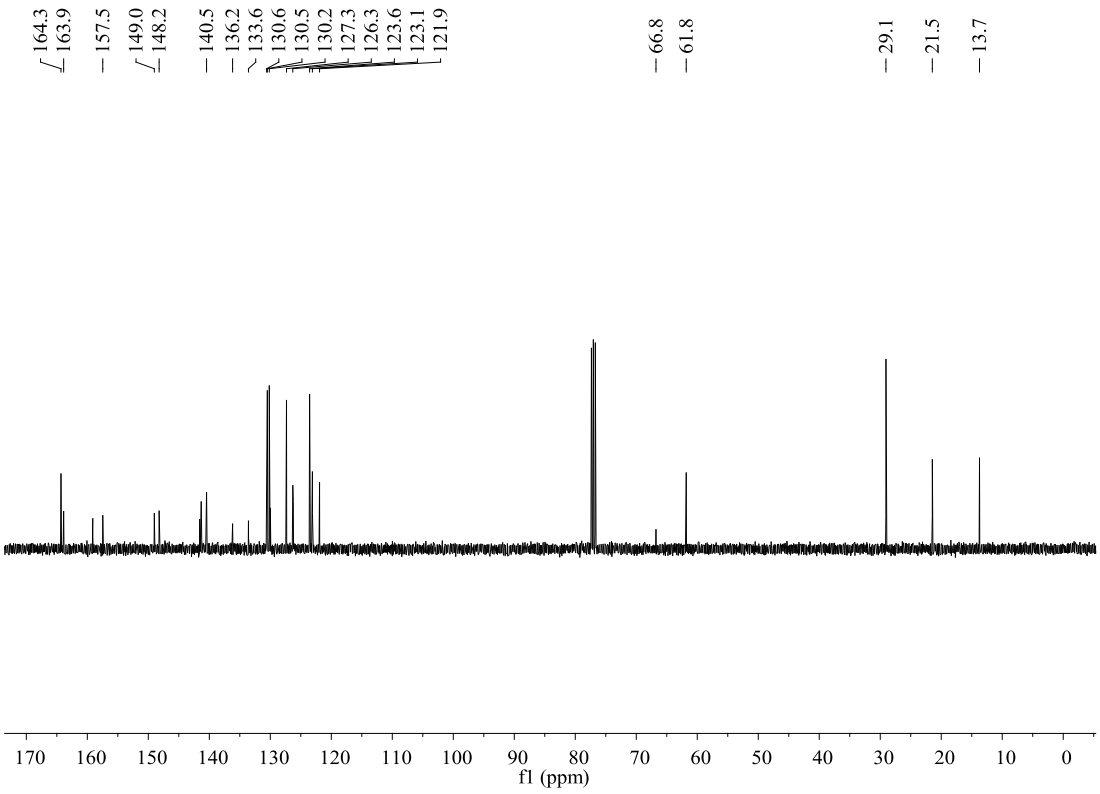

164.760
164.407
160.547
157.606
149.400
142.193
129.502
128.582
126.416
125.807
121.661
114.714
67.198
61.413
55.306
28.916
13.541
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

Ethyl

1',3'-dimethyl-2-(4-nitrophenyl)-2',4',6'-trioxo-4-(*p*-tolyl)-1',3',*4*',6'-tetrahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (3b):

yellow solid, 65%, m.p. 209-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.19 (d, *J* = 8.0 Hz, 2H, ArH), 7.69 (d, *J* = 8.0 Hz, 1H, ArH), 7.41 (d, *J* = 8.0 Hz, 2H, ArH), 7.35 (t, *J* = 7.6 Hz, 1H, ArH), 7.28 (d, *J* = 6.8 Hz, 2H, ArH), 7.00 (d, *J* = 8.0 Hz, 2H, ArH), 6.96 (d, *J* = 7.6 Hz, 1H, ArH), 6.37 (d, *J* = 7.6 Hz, 1H, ArH), 4.12 (q, *J* = 6.8 Hz, 2H, CH_2), 3.06 (s, 3H, CH_3), 3.05 (s, 3H, CH_3), 2.43 (s, 3H, CH_3), 0.94 (t, *J* = 6.8 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 164.3, 163.8, 159.1, 157.4, 149.0, 148.2, 141.5, 141.3, 140.4, 136.1, 133.5, 130.5, 130.4, 130.1, 127.3, 126.3, 123.5, 123.0, 121.9, 66.7, 61.8, 29.0, 21.4, 13.7; IR(KBr) υ: 3245, 3182, 3065, 2988, 2867, 2167, 1836, 1647, 1654, 1565, 1488, 1332, 1225, 1158, 976, 952, 812, 721 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{33}H_{26}N_4O_7$ ([M+Na]$^+$): 613.1694, found: 613.1696.

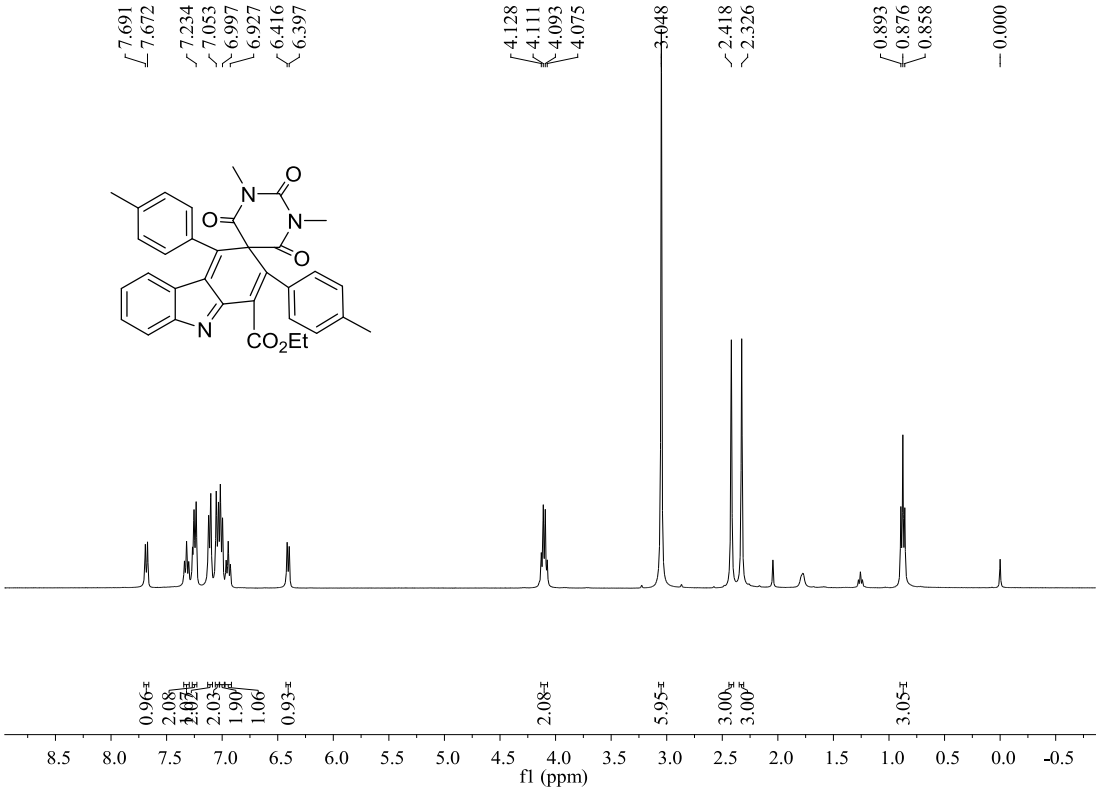


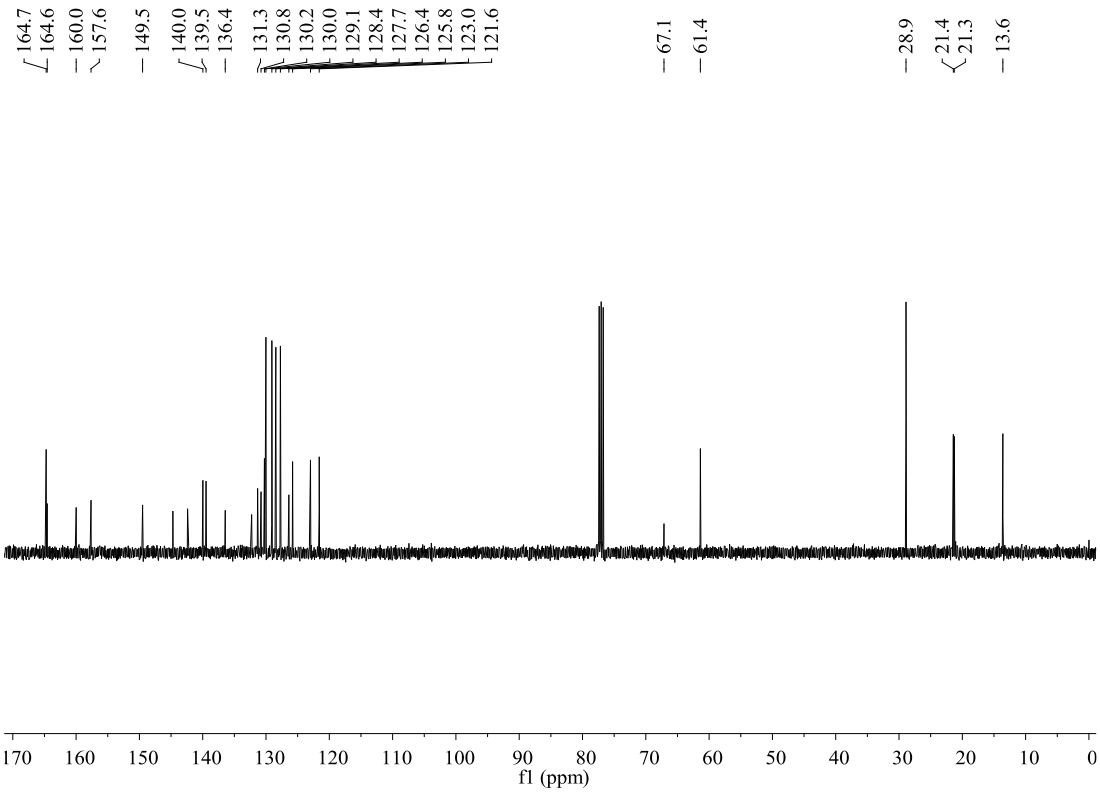

164.3
163.9
157.5
149.0
148.2
140.5
136.2
133.6
130.6
130.5
130.2
127.3
126.3
123.6
123.1
121.9
66.8
61.8
29.1
21.5
13.7
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

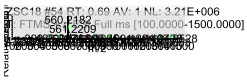
Ethyl

1',3'-dimethyl-2-(4-nitrophenyl)-2',4',6'-trioxo-4-(*p*-tolyl)-1',3',*4*',6'-tetrahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (3c):

yellow solid, 73%, m.p. 209-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.68 (d, *J* = 7.6 Hz, 1H, ArH), 7.32 (t, *J* = 7.2 Hz, 1H, ArH), 7.27-7.23 (m, 2H, ArH), 7.11 (d, *J* = 8.0 Hz, 2H, ArH), 7.04 (d, *J* = 7.6 Hz, 2H, ArH), 7.00 (d, *J* = 8.0 Hz, 2H, ArH), 6.95 (t, *J* = 7.2 Hz, 1H, ArH), 6.40 (d, *J* = 7.6 Hz, 1H, ArH), 4.10 (q, *J* = 6.8 Hz, 2H, CH_2), 3.05 (s, 3H, CH_3), 3.04 (s, 3H, CH_3), 2.42 (s, 3H, CH_3), 2.33 (s, 3H, CH_3), 0.88 (t, *J* = 6.8 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 164.7, 164.5, 159.9, 157.6, 149.4, 144.7, 142.3, 139.9, 139.4, 136.4, 132.2, 131.3, 130.7, 130.2, 130.0, 129.0, 128.4, 127.7, 126.3, 125.8, 122.9, 121.5, 67.1, 61.3, 28.8, 21.4, 21.2, 13.5; IR(KBr) υ: 3218, 3143, 3056, 2931, 2811, 2145, 1889, 1667, 1612, 1548, 1431, 1346, 1278, 1163, 1147, 982, 941, 878, 763 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{29}N_3O_5$ ([M+H]$^+$): 560.2180, found: 560.2182.



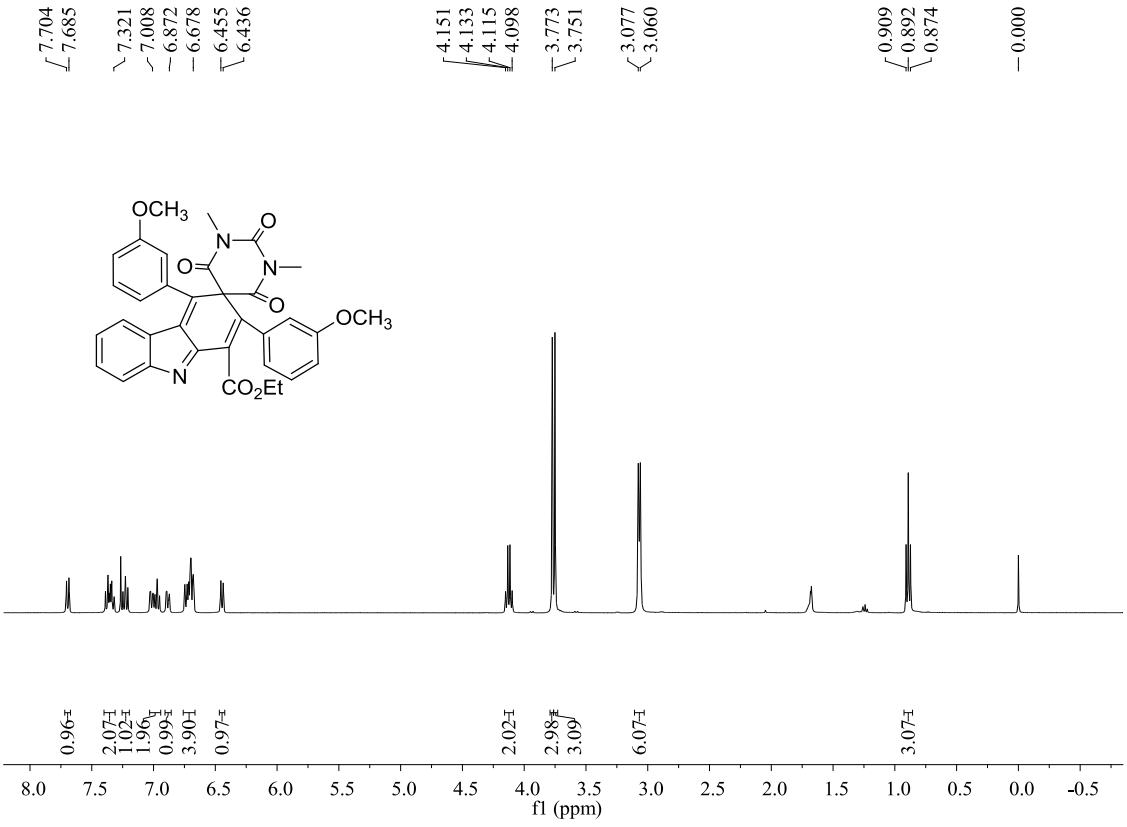

164.7
164.6
160.0
157.6
149.5
140.0
139.5
136.4
131.3
130.8
130.2
130.0
129.1
128.4
127.7
126.4
125.8
123.0
121.6
67.1
61.4
28.9
21.4
21.3
13.6
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

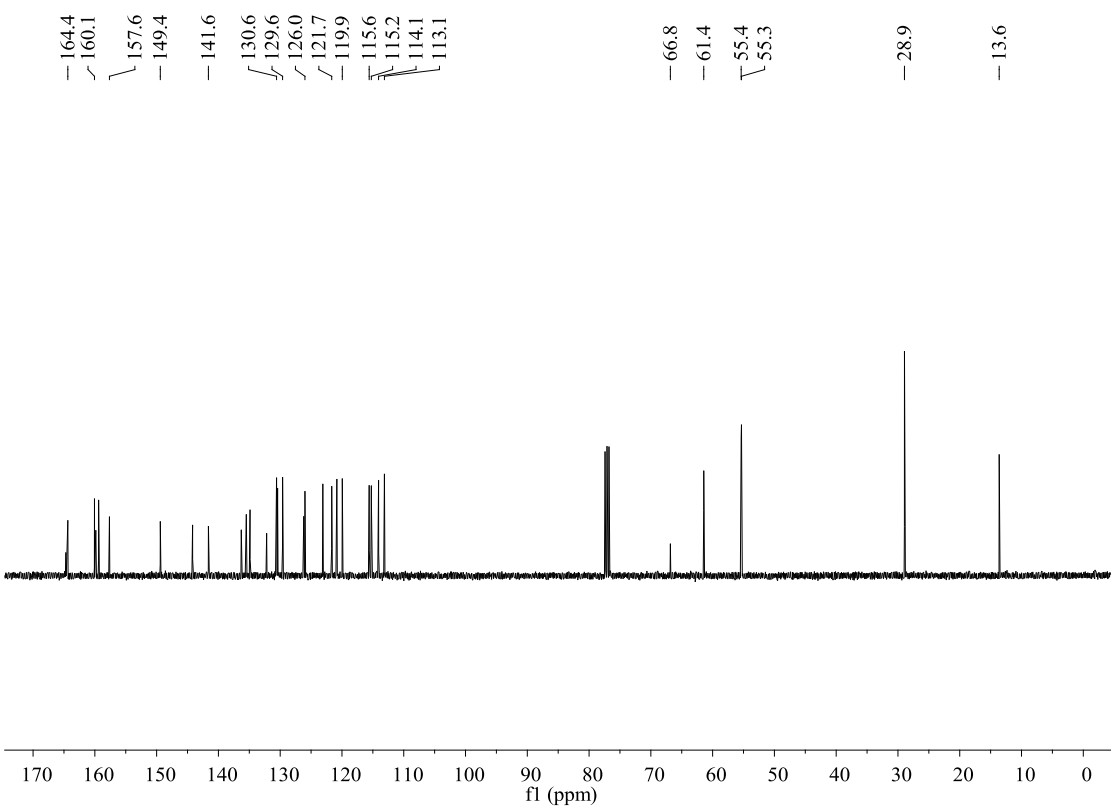

ZSC18 #54 RT: 0.69 AV: 1 NL: 3.21E+006
FTMS + p ESI Full ms [100.0000-1500.0000]
660.2182
561.2209

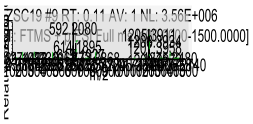
Ethyl

2,4-bis(3-methoxyphenyl)-1',3'-dimethyl-2',4',6'-trioxo-1',3',4',6'-tetrahydro-2'*H*-spiro[carbazole-3,5'-pyrimidine]-1-carboxylate (3d):

yellow solid, 70%, m.p. 209-213 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.69 (d, *J* = 7.6 Hz, 1H, ArH), 7.39-7.32 (m, 2H, ArH), 7.23 (t, *J* = 8.0 Hz, 1H, ArH), 7.03-6.95 (m, 2H, ArH), 6.88 (dd, J_1 = 8.4 Hz, J_2 = 2.4 Hz, 1H, ArH), 6.75-6.68 (m, 4H, ArH), 6.44 (d, *J* = 7.6 Hz, 1H, ArH), 4.12 (q, *J* = 6.8 Hz, 2H, CH_2), 3.77 (s, 3H, OCH_3), 3.75 (s, 3H, OCH_3), 3.08 (s, 3H, CH_3), 3.06 (s, 3H, CH_3), 0.89 (t, *J* = 6.8 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 164.3, 160.0, 159.3, 157.6, 149.4, 144.1, 141.6, 136.3, 135.4, 134.8, 132.1, 130.5, 130.4, 129.6, 126.1, 125.9, 123.0, 121.6, 120.8, 119.9, 115.5, 115.2, 114.0, 113.1, 66.8, 61.4, 55.3, 55.3, 28.9, 13.6; IR(KBr) υ: 3217, 3142, 3064, 2917, 2833, 2165, 1849, 1631, 1611, 1548, 1433, 1346, 1271, 1164, 1131, 912, 888, 823, 764 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{29}N_3O_7$ ([M+H]$^+$): 592.2078, found: 592.2080.

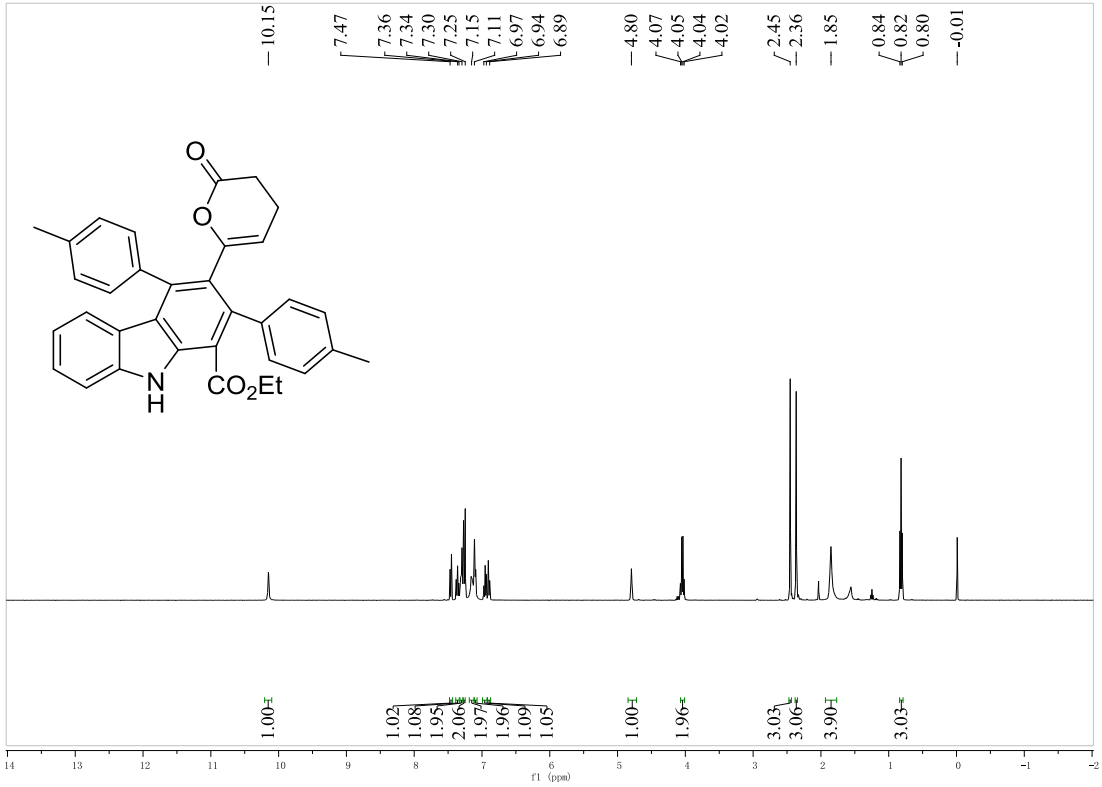


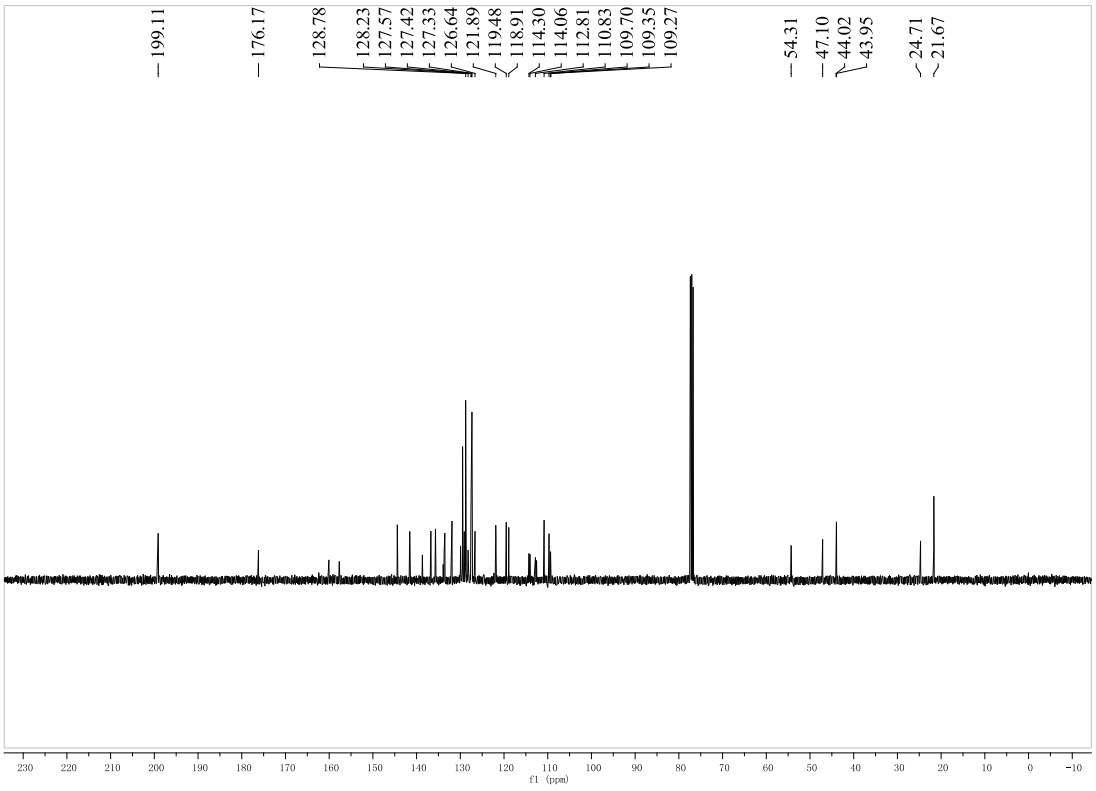

164.4
160.1
157.6
149.4
141.6
130.6
129.6
126.0
121.7
119.9
115.6
115.2
114.1
113.1
66.8
61.4
55.4
55.3
28.9
13.6
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

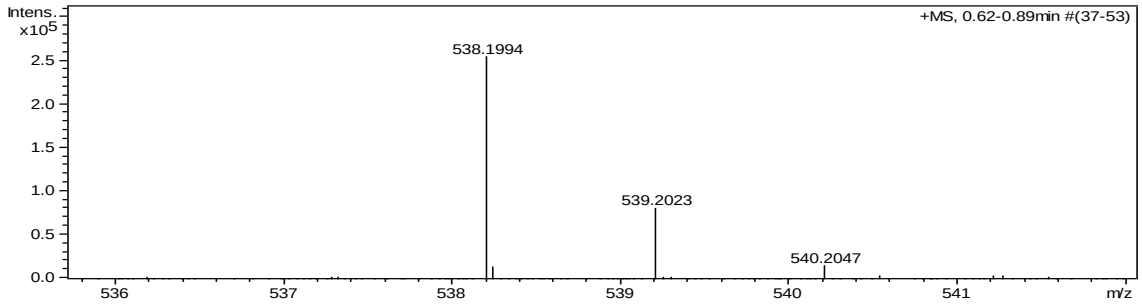

SC19 #9 RT: 0.11 AV: 1 NL: 3.56E+006
592.2080
FTMS

6-(1-((Ethylperoxy)-λ^2-methyl)-2,4-di-*p*-tolyl-9*H*-carbazol-3-yl)-3,4-dihydro-2*H*-pyran-2-one (4a):

yellow solid, 70%, m.p. 196-199 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 10.15 (s, 1H, NH), 7.46 (d, *J* = 8.4 Hz, 1H, ArH), 7.36 (t, *J* = 8.4 Hz, 1H, ArH), 7.30 (d, *J* = 7.6 Hz, 2H, ArH), 6.95 (t, *J* = 8.0Hz, 1H, ArH), 6.89 (d, *J* = 8.0 Hz, 1H, ArH), 4.81-4.80 (m, 1H, CH), 4.04 (q, *J* = 7.2 Hz, 2H, CH_2), 2.45 (s, 3H, CH_3), 2.37 (s, 3H, CH_3), 1.84-1.85 (m, 4H, CH), 0.82 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 199.1, 176.1, 144.4, 141.5, 138.6, 138.6, 136.7, 135.6, 133.5, 131.9, 129.9, 129.4, 129.0, 128.7, 128.6, 127.5, 127.4, 127.3, 126.6, 121.8, 119.4, 118.9, 114.2, 114.0, 112.8, 112.5, 110.8, 109.6, 54.3, 47.1, 44.0, 43.9, 24.7, 21.6; IR (KBr) υ: 3411, 3251, 3054, 2973, 1864, 1755, 1682, 1617, 1567, 1456, 1387, 1356, 1278, 1171, 937, 854 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{29}NO_4$([M+Na]$^+$): 538.1989, found: 538.1994.

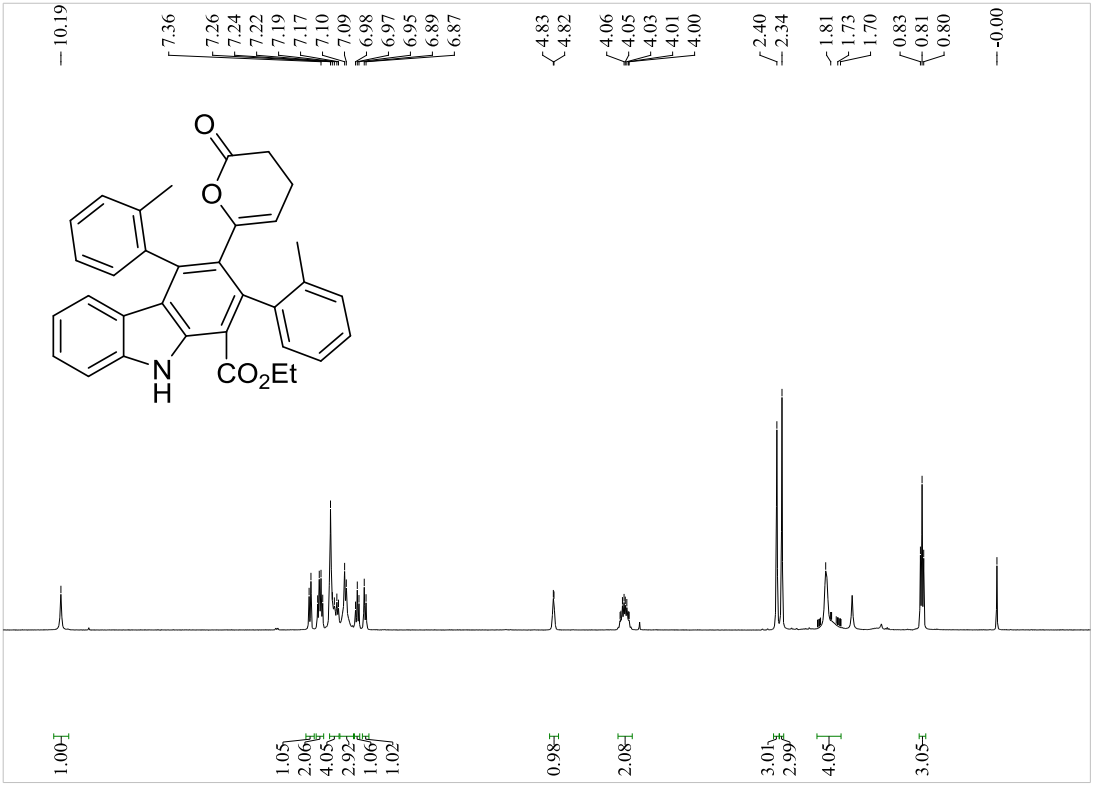


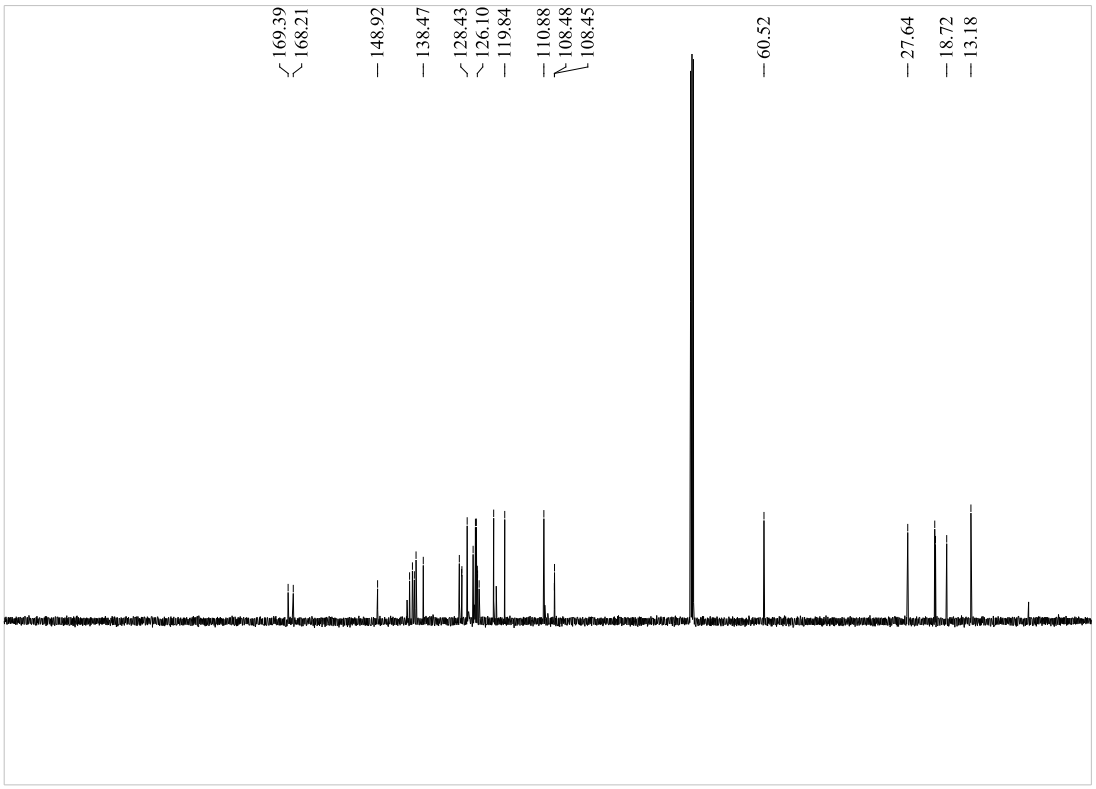

199.11
176.17
128.78
128.23
127.57
127.42
127.33
126.64
121.89
119.48
118.91
114.30
114.06
112.81
110.83
109.70
109.35
109.27
54.31
47.10
44.02
43.95
24.71
21.67
f1 (ppm)

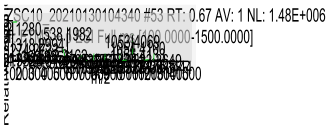

Intens.
x10^5
+MS, 0.62-0.89min #(37-53)
538.1994
539.2023
540.2047
m/z

6-(1-((Ethylperoxy)-λ^2-methyl)-2,4-di-*o*-tolyl-9*H*-carbazol-3-yl)-3,4-dihydro-2*H*-pyran-2-one (4b):

yellow solid, 70%, m.p. 201-203 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 10.19 (s, 1H, NH), 7.48 (d, *J* = 8.4 Hz, 1H, ArH), 7.40-7.34 (m, 2H, ArH), 7.26-7.17 (m, 4H, ArH), 7.10-7.09 (m, 3H, ArH), 6.97 (t, *J* = 8.0 Hz, 1H, ArH), 6.88 (d, *J* = 8.0 Hz, 1H, ArH), 4.83 (d, *J* = 2.8 Hz, 1H, CH), 4.05 (q, *J* = 7.2 Hz, 2H, CH_2), 2.40 (s, 3H, CH_3), 2.34 (s, 3H, CH_3), 1.95-1.87 (m, 2H, CH_2), 1.81-1.70 (m, 2H, CH_2), 0.82 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 169.3, 168.2, 148.9, 141.6, 140.9, 140.5, 140.1, 138.4, 130.2, 129.6, 129.6, 128.4, 127.0, 126.5, 126.3, 126.1, 126.0, 125.6, 122.3, 119.8, 110.8, 108.4, 108.4, 60.5, 27.6, 21.4, 21.2, 18.7, 13.1; IR (KBr) υ: 3471, 3055, 2961, 1832, 1740, 1655, 1637, 1583, 1471, 1350, 1301, 1261, 1185, 864, 768 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{29}NO_4$([M+Na]$^+$): 538.1989, found: 538.1982.

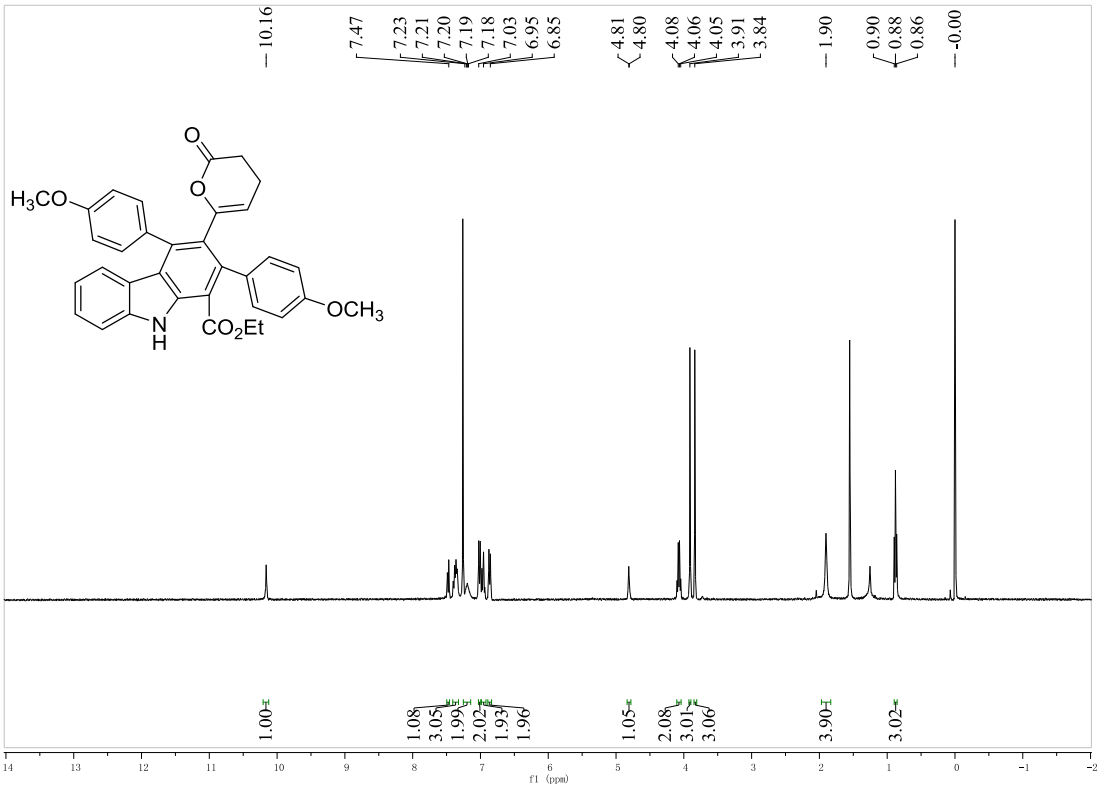


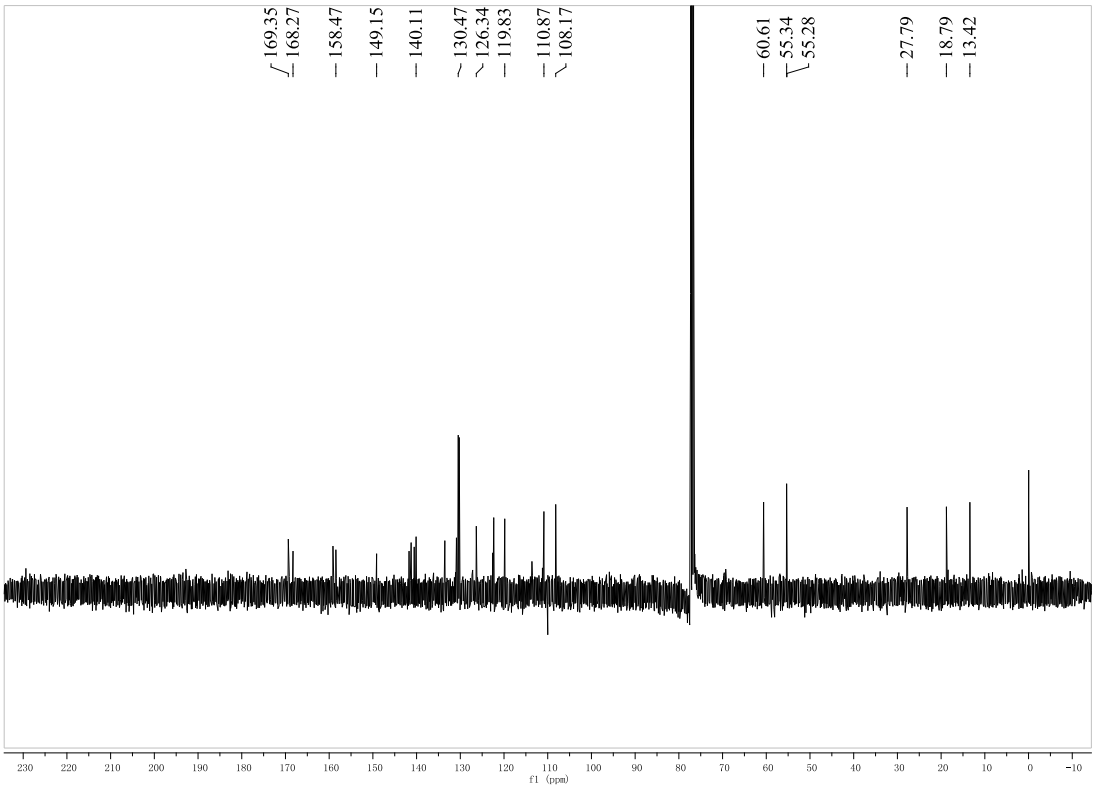

169.39
168.21
148.92
138.47
128.43
126.10
119.84
110.88
108.48
108.45
60.52
27.64
18.72
13.18

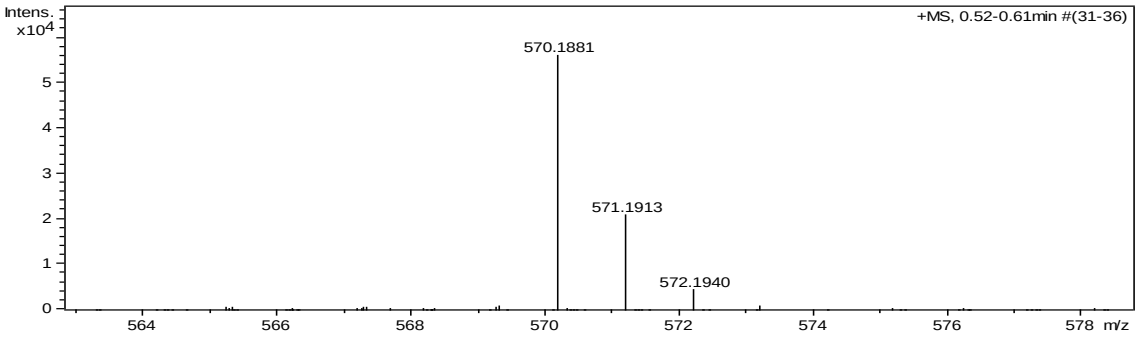

ZSC10_20210130104340 #53 RT: 0.67 AV: 1 NL: 1.48E+006
1280.538 1982

6-(1-((Ethylperoxy)-λ^2-methyl)-2,4-bis(4-methoxyphenyl)-9*H*-carbazol-3-yl)-3,4-dihydro-2*H*-pyran-2-one (4c):

yellow solid, 61%, m.p. 206-209 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 10.16 (s, 1H, NH), 7.48 (d, *J* = 8.0 Hz, 1H, ArH), 7.40-7.34 (m, 3H, ArH), 7.23-7.17 (m, 2H, ArH), 7.01 (d, *J* = 8.8 Hz, 2H, ArH), 6.98-6.94 (m, 2H, ArH), 6.86 (d, *J* = 8.8 Hz, 2H, ArH), 4.83-4.81 (m, 1H, CH), 4.07 (q, *J* = 7.2 Hz, 2H, CH_2), 3.91 (s, 3H, OCH_3), 3.84 (s, 3H, OCH_3), 1.92-1.90 (m, 4H, CH), 0.88 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 169.3, 168.2, 159.1, 158.4, 149.1, 141.2, 140.5, 140.1, 133.5, 130.8, 130.4, 130.2, 126.3, 122.3, 119.8, 110.8, 108.1, 60.6, 55.3, 55.2, 27.7, 18.7, 13.4; IR (KBr) υ: 3411, 3134, 2987, 1865, 1757, 1687, 1631, 1599, 1483, 1346, 1331, 1294, 1167, 887, 782 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{29}NO_6$([M+Na]$^+$): 570.1887, found: 570.1881.

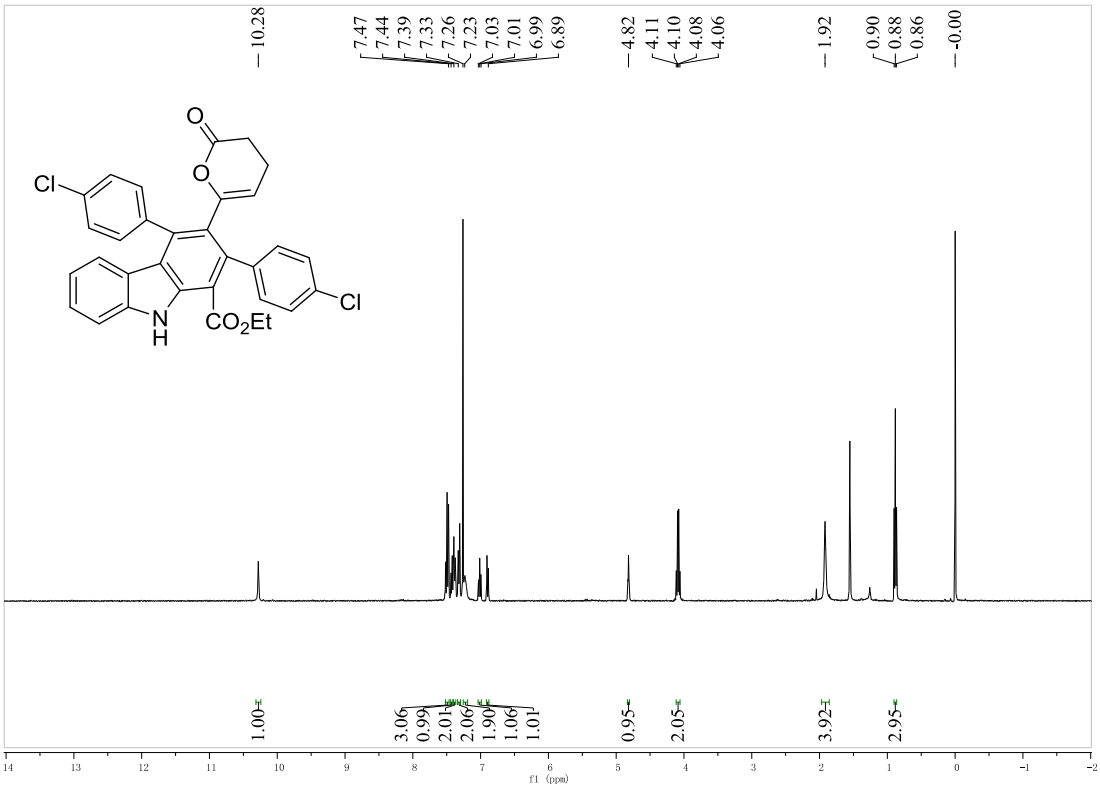


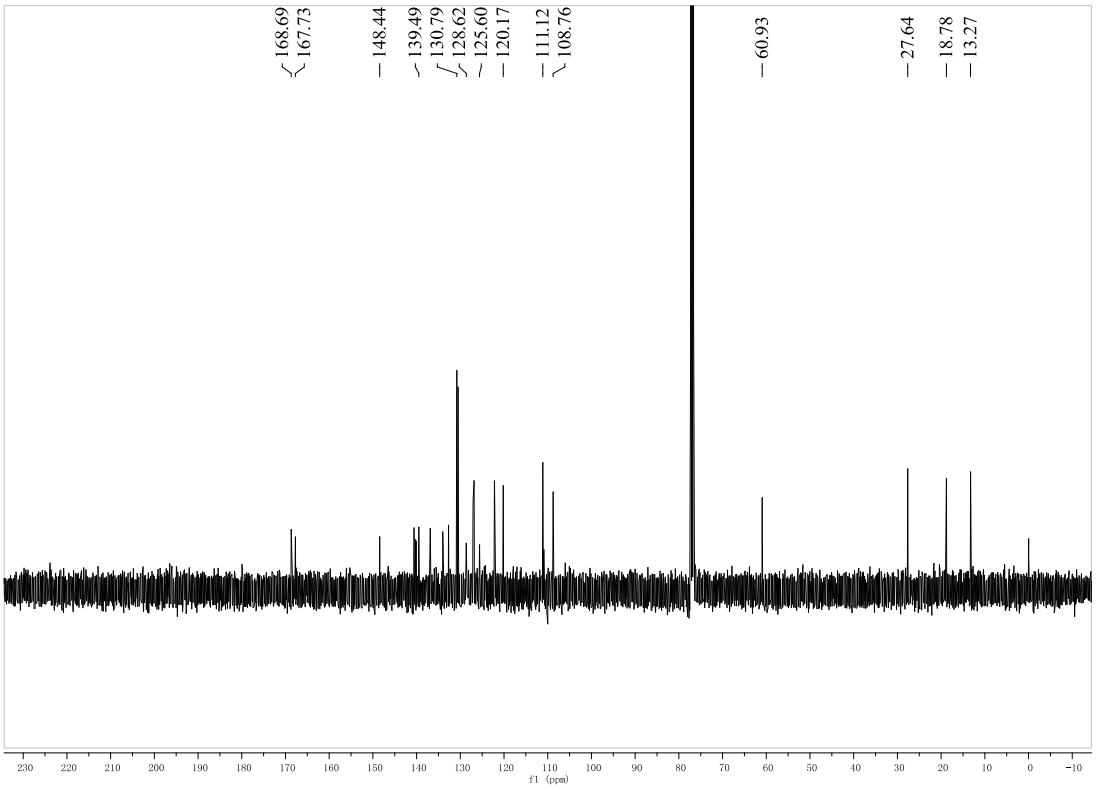

169.35
168.27
158.47
149.15
140.11
130.47
126.34
119.83
110.87
108.17
60.61
55.34
55.28
27.79
18.79
13.42
f1 (ppm)

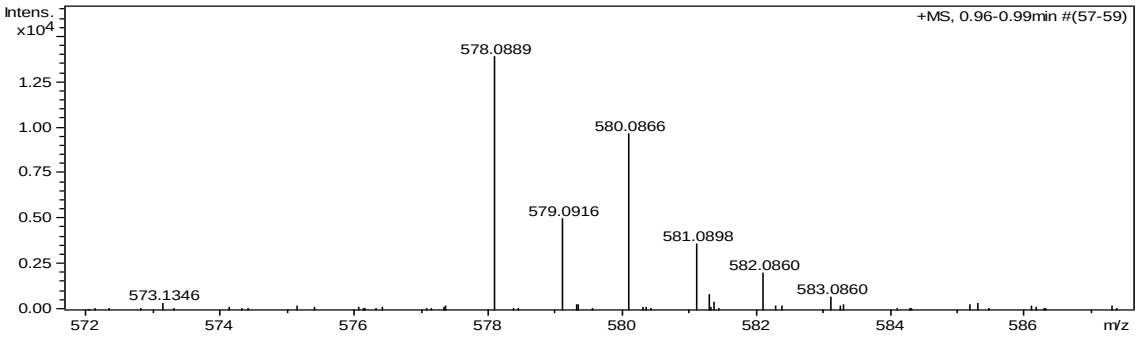

Intens.
x10^4
+MS, 0.52-0.61min #(31-36)
570.1881
571.1913
572.1940
m/z

6-(2,4-bis(4-chlorophenyl)-1-((ethylperoxy)-λ^2-methyl)-9*H*-carbazol-3-yl)-3,4-dihydro-2*H*-pyran-2-one (4d):

yellow solid, 54%, m.p. 217-220 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 10.28 (s, 1H, NH), 7.49 (t, *J* = 8.8 Hz, 3H, ArH), 7.42 (t, *J* = 7.2 Hz, 1H, ArH), 7.38 (d, *J* = 8.0 Hz, 2H, ArH), 7.32 (d, *J* = 8.4 Hz, 2H, ArH), 7.24-7.23 (m, 2H, ArH), 7.01 (t, *J* = 7.2 Hz, 1H, ArH), 6.89 (d, *J* = 8.0 Hz, 1H, ArH), 4.83-4.81 (m, 1H, CH), 4.08 (q, *J* = 7.2 Hz, 2H, CH_2), 1.92-1.91 (m, 4H, CH), 0.88 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 168.6, 167.7, 148.4, 140.5, 140.5, 140.2, 140.0, 139.4, 136.8, 132.6, 130.7, 130.5, 128.6, 128.6, 127.0, 126.8, 125.5, 122.1, 122.0, 120.1, 111.1, 108.7, 60.9, 27.6, 18.7, 13.2; IR (KBr) υ: 3465, 3038, 2973, 1844, 1787, 1667, 1612, 1567, 1455, 1382, 1345, 1277, 1162, 887, 792 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{23}Cl_2NO_4$ ([M+Na]$^+$): 578.0896, found: 578.0889.

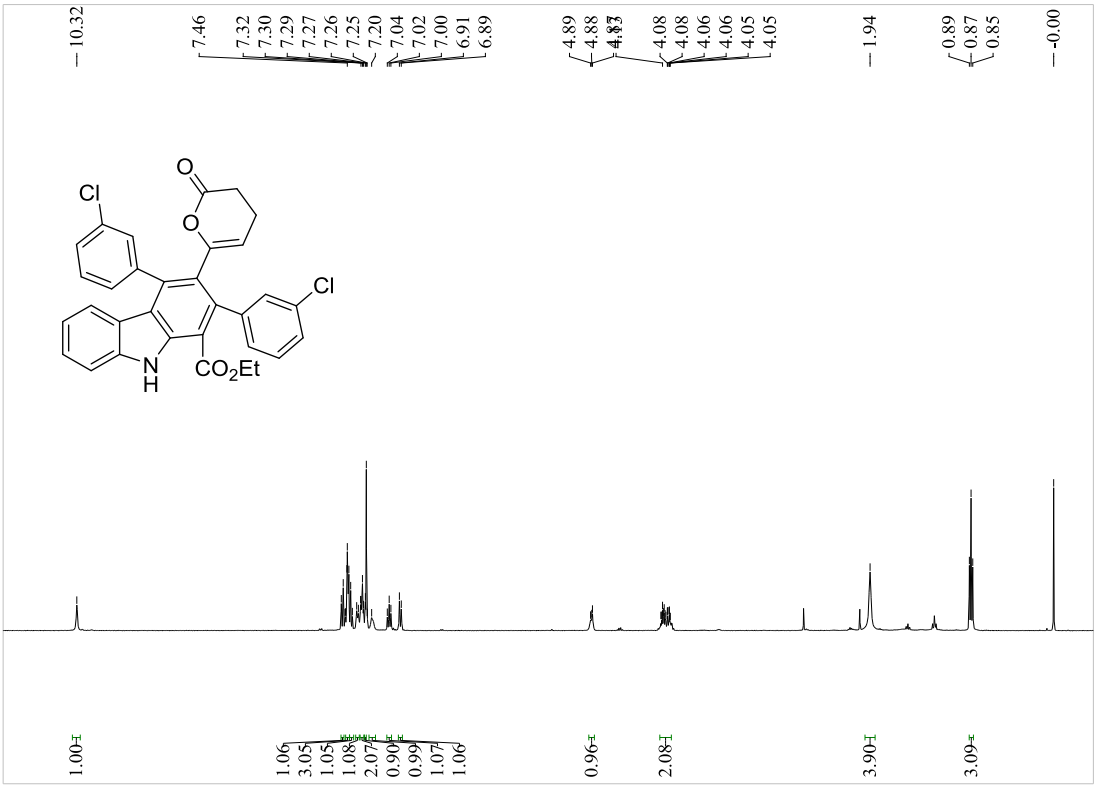


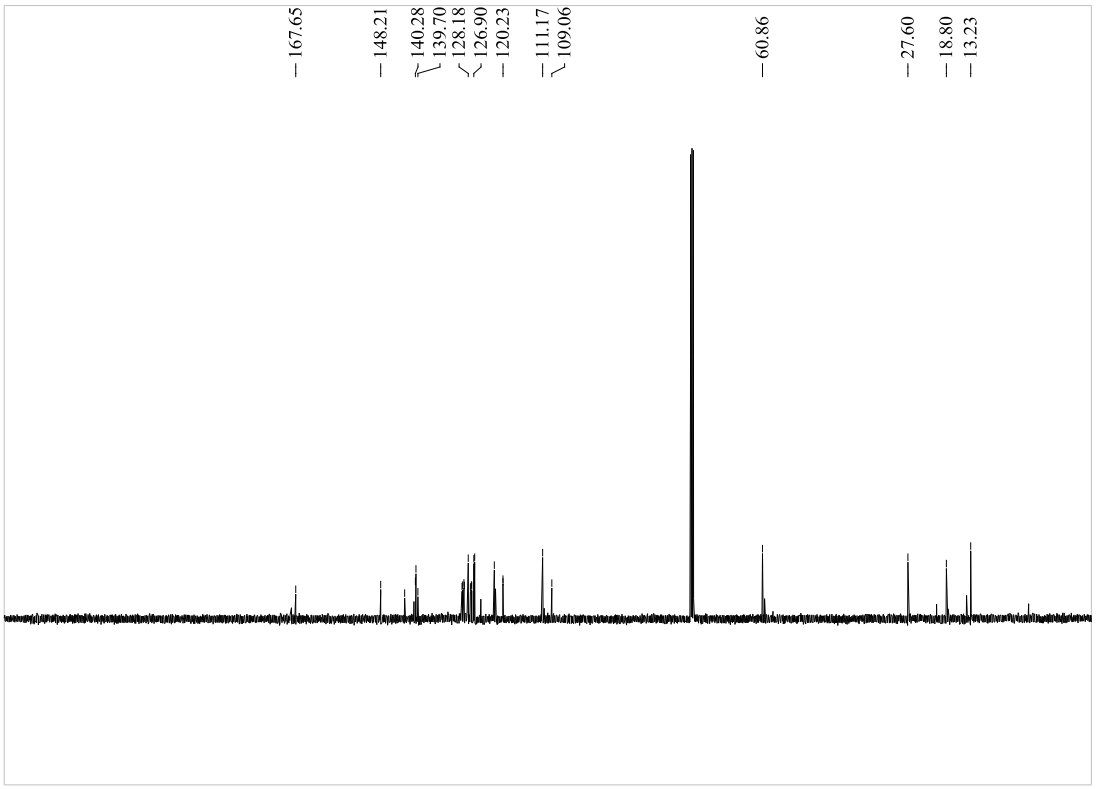

168.69
167.73
148.44
139.49
130.79
128.62
125.60
120.17
111.12
108.76
60.93
27.64
18.78
13.27
f1 (ppm)

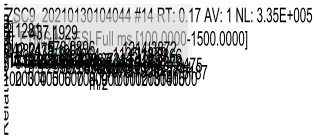

Intens.
x10^4
+MS, 0.96-0.99min #(57-59)
578.0889
580.0866
579.0916
581.0898
582.0860
583.0860
573.1346
m/z

6-(2,4-bis(3-chlorophenyl)-1-((ethylperoxy)-λ^2-methyl)-9*H*-carbazol-3-yl)-3,4-dihydro-2*H*-pyran-2-one (4e):

yellow solid, 62%, m.p. 198-200 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 10.32 (s, 1H, NH), 7.51 (d, *J* = 8.0 Hz, 1H, ArH), 7.47-7.44 (m, 3H, ArH), 7.41 (d, *J* = 7.2 Hz, 1H, ArH), 7.35 (d, *J* = 7.2 Hz, 1H, ArH), 7.32-7.29 (m, 2H, ArH), 7.27-7.26 (m, 1H, ArH), 7.20-7.19 (m, 1H, ArH), 7.02 (t, *J* = 7.2 Hz, 1H, ArH), 6.90 (d, *J* = 8.0 Hz, 1H, ArH), 4.87 (d, *J* = 2.8 Hz, 1H, CH), 4.09 (q, *J* = 7.2 Hz, 2H, CH_2), 1.98-1.93 (m, 2H, CH_2), 1.93-1.91 (m, 2H, CH_2), 0.87 (t, *J* = 7.2 Hz, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 167.6, 148.2, 142.7, 140.2, 140.1, 139.7, 129.6, 129.4, 129.1, 129.0, 128.1, 127.6, 127.4, 127.3, 126.9, 126.7, 122.2, 120.2, 120.2, 111.1, 109.0, 60.8, 27.6, 18.7, 13.2; IR (KBr) υ: 3456, 3044, 2957, 1871, 1788, 1667, 1654, 1531, 1487, 1368, 1341, 1266, 1132, 887, 768 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{32}H_{23}Cl_2N_3O_4$([M+Na]$^+$): 578.0896, found: 578.0896.

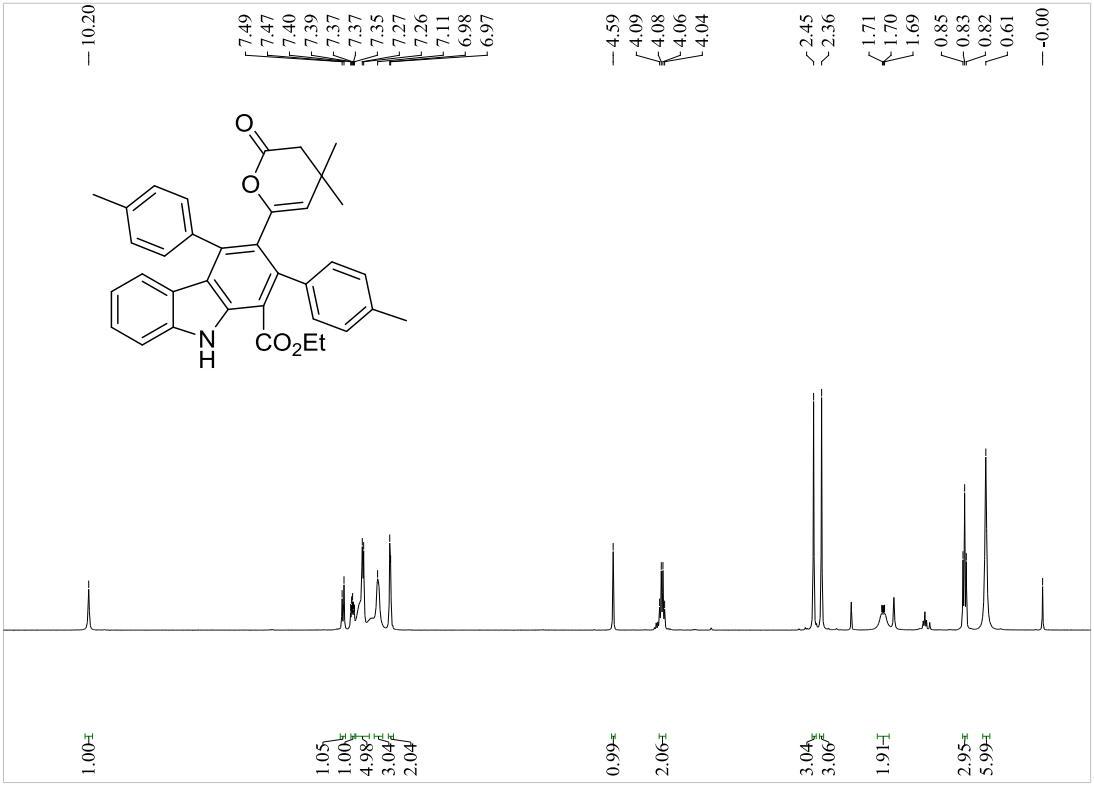


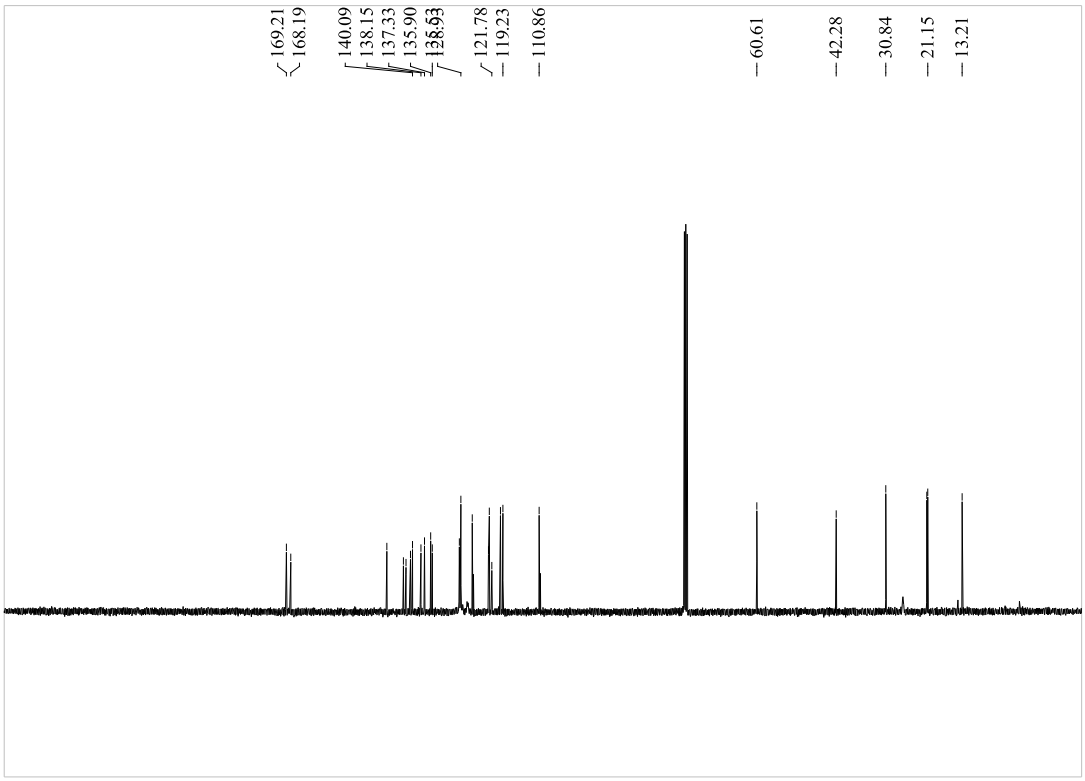

167.65
148.21
140.28
139.70
128.18
126.90
120.23
111.17
109.06
60.86
27.60
18.80
13.23


SC9_20210130104044 #14 RT: 0.17 AV: 1 NL: 3.35E+005
Full ms [400.0000-1500.0000]

6-(1-((Ethylperoxy)-λ^2-methyl)-2,4-di-*p*-tolyl-9*H*-carbazol-3-yl)-4,4-dimethyl-3,4-dihydro-2*H*-pyran-2-one (4f):

yellow solid, 63%, m.p. 200-203 ^oC; ^1H NMR (400 MHz, $CDCl_3$) δ: 10.20 (s, 1H, NH), 7.47 (d, *J* = 8.0 Hz, 1H, ArH), 7.40-7.36 (m, 1H, ArH), 7.27-7.26 (m, 5H, ArH), 7.11-7.10 (m, 3H, ArH), 6.97 (d, *J* = 8.0 Hz, 2H, ArH), 4.59 (s, 1H, CH), 4.06 (q, *J* = 7.2 Hz, 2H, CH_2), 2.45 (s, 3H, CH_3), 2.36 (s, 3H, CH_3), 1.72-1.70 (m, 1H, CH), 1.69-1.68 (m, 1H, CH), 0.83 (t, *J* = 7.2 Hz, 3H, CH_3), 0.61 (s, 3H, CH_3), 0.60 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 169.2, 168.1, 146.0, 142.1, 141.5, 140.5, 140.0, 138.1, 137.3, 135.9, 135.5, 129.2, 128.9, 126.3, 122.5, 122.3, 121.7, 119.7, 119.2, 110.8, 60.6, 42.2, 30.8, 21.3, 21.1, 13.2; IR (KBr) υ: 3431, 3055, 2918, 1865, 1753, 1667, 1653, 1587, 1472, 1350, 1368, 1250, 1138, 862, 755 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{36}H_{33}NO_4$([M+Na]$^+$): 566.2302, found: 566.2297.

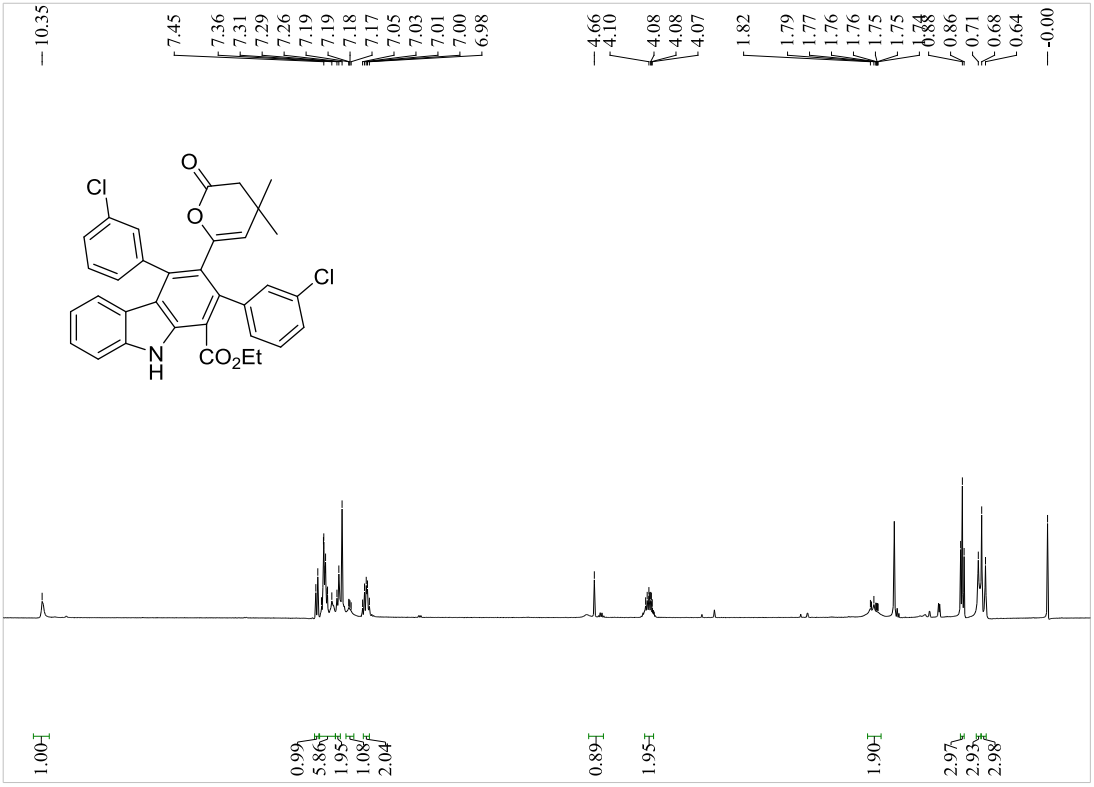


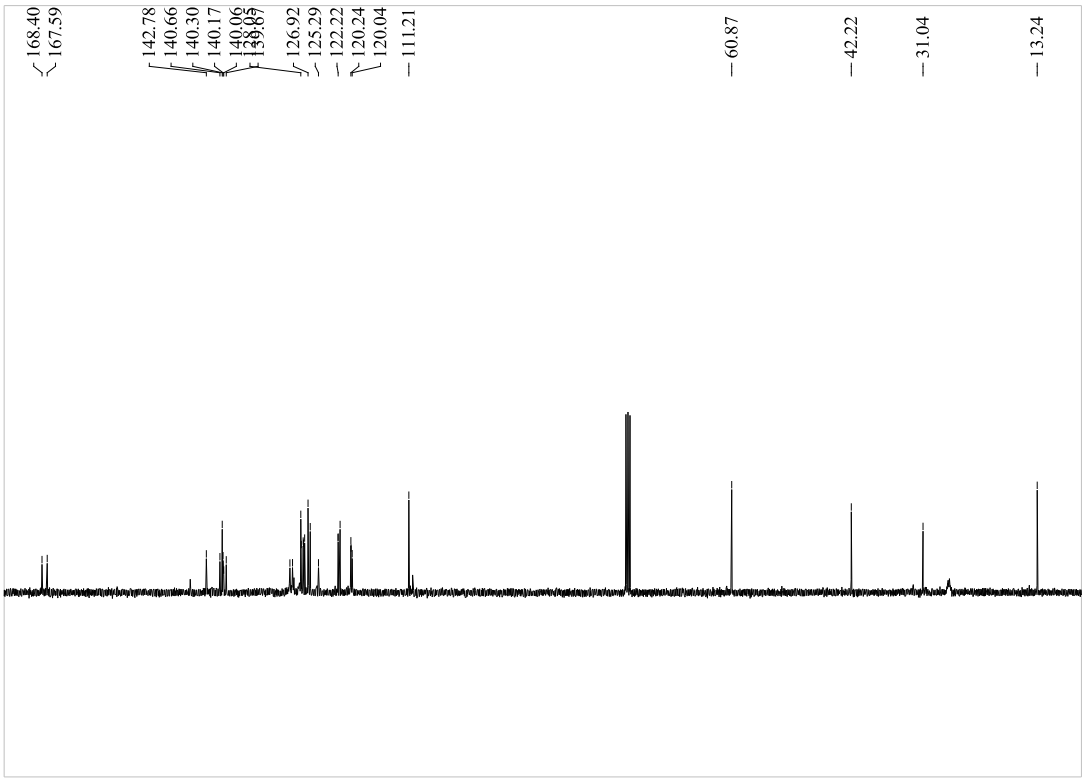


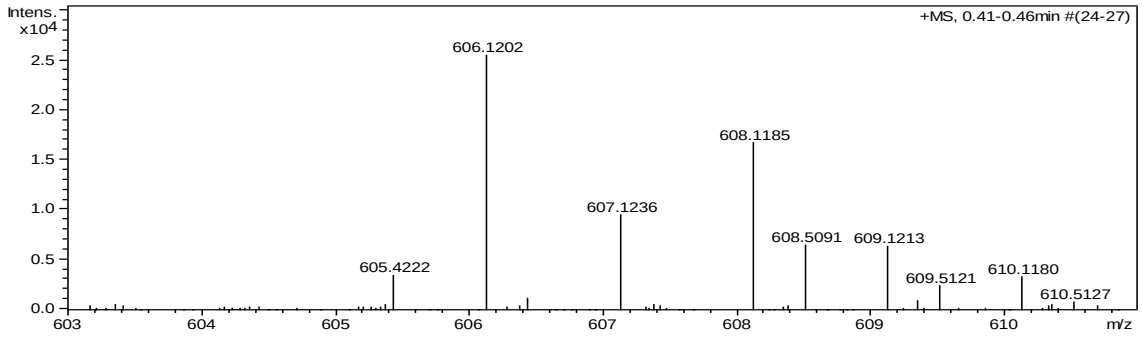
ZSC17_20210130110413 #37 RT: 0.46 AV: 1 NL: 3.37E+006
T: FTMS + p ESI Full ms [100.0000-1500.0000]

6-(2,4-Bis(3-chlorophenyl)-1-((ethylperoxy)-λ^2-methyl)-9*H*-carbazol-3-yl)-4,4-dimethyl-3,4-dihydro-2*H*-pyran-2-one (4g):

yellow solid, 51%, m.p. 205-207 ^{o}C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 10.35 (s, 1H, NH), 7.51 (d, *J* = 8.0 Hz, 1H, ArH), 7.47-7.36 (m, 6H, ArH), 7.30 (d, *J* = 8.0 Hz, 2H, ArH), 7.19-7.17 (m, 1H, ArH), 7.05-6.98 (m, 2H, ArH), 4.66 (s, 1H, CH), 4.09 (q, *J* = 7.2 Hz, 2H, CH_2), 1.82-1.76 (m, 1H, CH), 1.75-1.74 (m, 1H, CH), 0.88 (t, *J* = 7.2 Hz, 3H, CH_3), 0.71 (s, 3H, CH_3), 0.64 (s, 3H, CH_3); ^{13}C NMR (400 MHz, $CDCl_3$) δ: 168.3, 167.5, 142.7, 140.6, 140.3, 140.1, 140.0, 139.6, 129.7, 129.3, 128.0, 127.9, 127.6, 127.4, 126.9, 126.5, 125.2, 122.2, 121.9, 120.2, 120.0, 111.2, 60.8, 42.2, 31.0, 13.2; IR (KBr) υ: 3445, 3017, 2955, 1871, 1764, 1682, 1638, 1538, 1447, 1381, 1322, 1286, 1131, 855, 763 cm^{-1}; MS (*m*/*z*): HRMS (ESI) Calcd. for $C_{34}H_{27}Cl_2NO_4$([M+Na]$^+$): 606.1209, found: 606.1202.




168.40
167.59
142.78
140.66
140.30
140.17
140.06
139.87
126.92
125.29
122.22
120.24
120.04
111.21
60.87
42.22
31.04
13.24


Intens.
x10^4
+MS, 0.41-0.46min #(24-27)
606.1202
608.1185
607.1236
608.5091
609.1213
605.4222
609.5121
610.1180
610.5127
2.5
2.0
1.5
1.0
0.5
0.0
603
604
605
606
607
608
609
610
m/z