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Supporting Information for

Palladium–Catalyzed, Copper–Mediated Construction of Benzene Rings from the Reactions of Indoles with *in–situ* Generated Enones

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Experimental procedures and analytical data

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1. General considerations

The starting compounds *N*-ethylindole (**1b**),[1] *N*-propylindole (**1c**),[2] *N*-benzylindole (**1d**),[3] *N*-phenylindole (**1e**),[4] *N*-allylindole (**1f**),[3] 1,4-dimethylindole (**1g**),[4] 1,5-dimethylindole (**1h**),[1] 1,6-dimethylindole (**1i**),[5] 1,7-dimethylindole (**1j**),[4] 5-methoxy-1-methyl-1*H*-indole (**1k**),[3] 5-fluoro-1-methyl-1*H*-indole (**1l**),[3] 5-chloro-1-methyl-1*H*-indole (**1m**),[3] 1-methyl-5-nitro-1*H*-indole (**1n**),[1] 1-methyl-1*H*-indole-5-ca-rbonitrile (**1o**),[1] methyl 1-methyl-1*H*-indole-7-carboxylate (**1o**),[6] 1-methyl-1*H*-pyrrolo[2,3-*b*]pyridine (**1r**),[7] 4-methoxy-1-methyl-1*H*-indole (**1s**),[8] 3-chloro-1-(p-tolyl)propan-1-one (**2b**),[9] 1-(4-(tert-butyl)phenyl)-3-chloropropan-1-on-e (**2c**),[10] 3-chloro-1-(4-methoxyphenyl)propan-1-one (**2d**),[9] 1-([1,1'-biphenyl]4-yl)-3-chloropropan-1-one (**2g**),[11] 3-chloro-1-(naphthalen-1-yl)propan-1-one (**2h**), 3-chlor-o-1-(2,5-dimethylphenyl)propan-1-one (**2i**), 3-chloro-1-(2,4-dimethylphenyl)-propan-1-one (**2j**), 3-chloro-1-(3,4-dimethylphenyl)propan-1-one (**2k**), 3-chloro-1-(thiophen-2-yl)pro-pan-1-one (**2l**), 3-chloro-1-(furan-2-yl)propan-1-one (**2m**), phenyl 3-chloropropanoate (**2n**), 3-chloro-1-(*p*-tolyl)butan-1-one (**2o**), and 1-phenylprop-2-en-1-one (**6**),[9] (*E*)-3-(1-methyl-1H-indol-3-yl)-1-phenylprop-2-en-1-one (**4a**), and (*E*)-3-(1*H*-indol-3-yl)-1-phenylprop-2-en-1-one (**4a'**)[12] were prepared as reported. They were identified by comparison of their NMR features with the reported data of the authentic samples. The spectroscopic features of the known compounds **3a** and **5c-5e**,[13] **4b**,[14] 4d,[15] **4f**,[16] and benzene-1,3,5-triyltris(phenylmethanone)[17] are in good agreement with those reported in the literatures.

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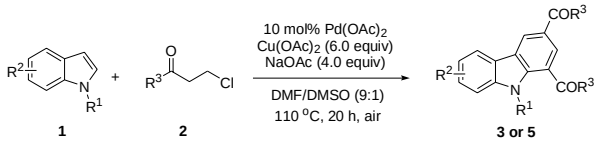
2. Experimental procedures

2.1. A typical procedure for the synthesis of carbazoles from the reactions of indoles (1) and β-chloroalkyl ketones (2)



Synthesis of 3a: A mixture of *N*-methylindole (**1a**) (26 mg, 0.2 mmol), 3-chloropropiophenone (**2a**) (133 mg, 0.8 mmol), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol), $Cu(OAc)_2$ (218 mg, 1.2 mmol), and NaOAc (66 mg, 0.8 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 110 ^oC under an air atmosphere for 20 h. After cooled to ambient temperature, the resultant mixture was diluted with 10 mL of CH_2Cl_2, filtered through a short pad of silica gel, followed by rinsing the silica gel with the same solvent (20 mL). The combined filtrate was washed with brine (15 mL). The organic phase was then dried over anhydrous Na_2SO_4, filtered, concentrated under reduced pressure. The resulting residue was purified by flash silica gel column chromatography (eluent: petroleum ether (60-90 ^oC)/EtOAc/CH_2Cl_2 = 30:1:2, v/v/v) to afford **3a** as a white solid (64 mg, 82%).

2.2. Screening of reaction conditions

Table S1. Screening of conditions for the reaction of *N*-methyl indole (**1a**) with 3-chloropropiophenone (**2a**).[a]

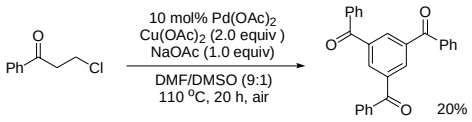
1a **2a** **3a**

Entry	Catalyst	Solvent	Oxidant	Base	Temp (^oC)	Yield[b] (%)
1	$Pd(OAc)_2$	dioxane	$Cu(OAc)_2$	Na_2CO_3	100	10
2	$Pd(OAc)_2$	DMSO	$Cu(OAc)_2$	Na_2CO_3	100	43
3	$Pd(OAc)_2$	DMF	$Cu(OAc)_2$	Na_2CO_3	100	51
4	$Pd(OAc)_2$	DMF/DMSO (v/v = 5:1)	$Cu(OAc)_2$	Na_2CO_3	100	71
5	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	100	74
6	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)		Na_2CO_3	100	<1
7[c]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	100	46
8[d]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2 + O_2$	Na_2CO_3	100	40
9	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2 \cdot H_2O$	Na_2CO_3	100	65
10	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	AgOAc	Na_2CO_3	100	45
11	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	Ag_2CO_3	Na_2CO_3	100	32
12	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$CuCl_2$	Na_2CO_3	100	24
13	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$K_2S_2O_8$	Na_2CO_3	100	0
14	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$PhI(OAc)_2$	Na_2CO_3	100	0
15	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	BQ	Na_2CO_3	100	<1
16	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$^tBuOO^tBu$	Na_2CO_3	100	<1
17	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	CuOAc	Na_2CO_3	100	<1
18	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	77
19	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	120	73
20		DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	0
21	$PdCl_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	68
22	$Pd(PPh_3)_2Cl_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	75
23	$Pd(CH_3CN)_2Cl_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	73
24	$Pd_2(dba)_3$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	76
25	$Pd(PPh_3)_4$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	Na_2CO_3	110	64
26	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	K_2CO_3	110	72
27	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	K_3PO_4	110	63
28	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	NaOAc	110	81
29	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	KOAc	110	80
30[e]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	NaOAc	110	82
31[e]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	air	NaOAc	110	<1

32[e,f]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	NaOAc	110	63
33[e]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	CuOAc	NaOAc	110	51
34[e]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$		110	29
35[e,g]	$Pd(OAc)_2$	DMF/DMSO (v/v = 9:1)	$Cu(OAc)_2$	NaOAc	110	70

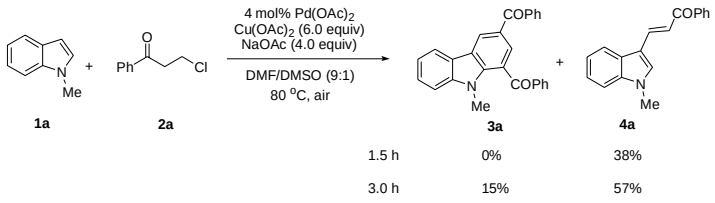
[a] Conditions: **1a** (0.2 mmol), **2a** (0.8 mmol), catalyst (0.02 mmol), base (0.8 mmol), oxidant (1.2 mmol), solvent (2.5 mL), N_2, 20 h. [b] Isolated yields. [c] $Cu(OAc)_2$ (0.6 mmol) [d] $Cu(OAc)_2$ (0.6 mmol), O_2 (1.0 atm). [e] In air. [f] $Cu(OAc)_2$ (1.0 mmol) were used. [g] Using 5 mol % catalyst.

2.3. Construction of a benzene ring from 3-chloropropiophenone (2a)



A mixture of 3-chloropropiophenone (**2a**) (101 mg, 0.6 mmol), $Pd(OAc)_2$ (13.5 mg, 0.06 mmol), $Cu(OAc)_2$ (218 mg, 1.2 mmol), and NaOAc (50 mg, 0.6 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 110 °C under an air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was diluted with 10 mL CH_2Cl_2, filtered through a short pad of silica gel, followed by rinsing the silica gel with the same solvent (20 mL). The combined filtrate was washed with brine (15 mL). The organic phase was then dried over anhydrous Na_2SO_4, filtered, concentrated under reduced pressure. The resulting residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/EtOAc/CH_2Cl_2 = 30:1:2, v/v/v) to afford benzene-1,3,5-triyltris(phenylmethanone) as a yellow liquid (16 mg, 20%).

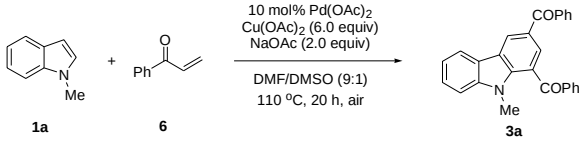
2.4. Monitoring the reaction of 1a with 2a



A mixture of *N*-methylindole (**1a**) (26 mg, 0.2 mmol), 3-chloropropiophenone (**2a**) (133 mg, 0.8 mmol), $Pd(OAc)_2$ (1.8 mg, 0.008 mmol), $Cu(OAc)_2$ (218 mg, 1.2 mmol), and NaOAc (66 mg, 0.8 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 80 °C under an air atmosphere for 1.5 h. In a fashion similar to the work-up procedure described in 2.1, **4a** was isolated as a yellow solid (20 mg, 38%) and compound **3a** was not observed. In a similar fashion the reaction was performed and stopped at 3.0 h, **4a** (30 mg,

57%) was then isolated as a yellow solid (20 mg, 38%) and compound **3a** (12 mg, 15%) was obtained as a white solid.

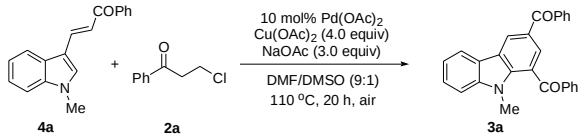
2.5. Synthesis of 3a from the reaction of 1a and enone 6



1a **6** **3a**

A mixture of *N*-methylindole (**1a**) (26 mg, 0.2 mmol), phenyl vinyl ketone (**6**) (106 mg, 0.8 mmol), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol), $Cu(OAc)_2$ (218 mg, 1.2 mmol), and NaOAc (33 mg, 0.4 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 110 ^oC under an air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was worked up in a fashion similar to that described in 2.1 to afford **3a** as a white solid (43 mg, 55%). Without a base, the same reaction gave **3a** (47 mg, 60%).

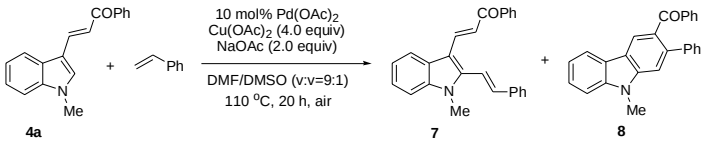
2.6. Controlled reaction of 4a with 2a



4a **2a** **3a**

The reaction conducted under the standard conditions: A mixture of **4a** (52 mg, 0.2 mmol), 3-chloropropiophenone (**2a**) (101 mg, 0.6 mmol), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol), $Cu(OAc)_2$ (145 mg, 0.8 mmol), and NaOAc (50 mg, 0.6 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 110 ^oC under an air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was worked up in a fashion similar to that described in 2.1 to afford **3a** as a white solid (59 mg, 75%).

2.7. Reaction of 4a with styrene

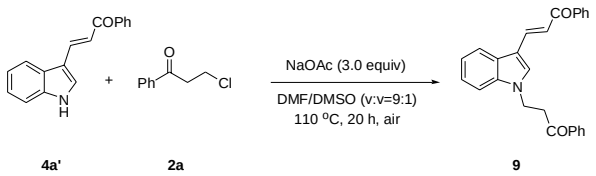


4a **7** **8**

A 10-mL screw-capped tube was charged with a mixture of **4a** (52 mg, 0.2 mmol), styrene (63 mg, 0.6 mmol), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol), $Cu(OAc)_2$ (145 mg, 0.8 mmol), and NaOAc (32 mg, 0.4 mmol) in DMF/DMSO (v/v = 9:1) 2.5 mL, and then fitted with a Teflon screwcap. The reaction mixture was

stirred at 110 ^{o}C under an air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was worked up in a fashion similar to that described in 2.1 to afford **7** as a yellow solid (16 mg, 22%) and **8** as a pale yellow solid (12 mg, 17%) by means of petroleum ether (60-90 ^{o}C)/EtOAc/CH_2Cl_2 = 30:1:4, v/v/v) as the eluent.

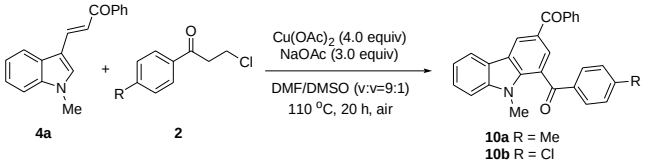
2.8. Reaction of 4a′ with 2a



4a' **2a** **9**

A mixture of **4a'** (48 mg, 0.2 mmol), 3-chloropropiophenone (**2a**) (110 mg, 0.6 mmol), and NaOAc (50 mg, 0.6 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 110 ^{o}C under an air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was worked up in a fashion similar to that described in 2.1 to afford **9** as a yellow solid (30 mg, 39%) by means of petroleum ether (60-90 ^{o}C)/EtOAc/CH_2Cl_2 = 30:1:5, v/v/v) as the eluent.

2.9. A typical procedure for the synthesis of mixed aroyl-substituted carbazoles

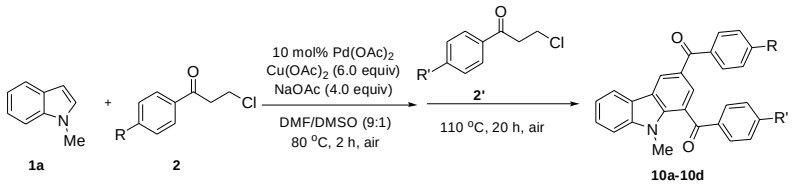


4a **2**

10a R = Me
10b R = Cl

***Synthesis of 10a*:** A mixture of **4a** (52 mg, 0.2 mmol), **2b** (110 mg, 0.6 mmol), $Cu(OAc)_2$ (145 mg, 0.8 mmol), and NaOAc (50 mg, 0.6 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 110 ^{o}C under an air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was worked up in a fashion similar to that described in 2.1 to afford **10a** as a white solid (60 mg, 74%) by means of petroleum ether (60-90 ^{o}C)/EtOAc/CH_2Cl_2 = 30:1:5, v/v/v) as the eluent.

2.10. A typical procedure for one-pot synthesis of functionalized carbazoles



***Synthesis of 10c*:** A mixture of *N*-methylindole (**1a**) (26 mg, 0.2 mmol), **2d** (40 mg, 0.2 mmol), $Pd(OAc)_2$ (4.5 mg, 0.02 mmol), $Cu(OAc)_2$ (218 mg, 1.2 mmol), and NaOAc (66 mg, 0.8 mmol) in 2.5 mL DMF/DMSO (v/v = 9:1) was stirred at 80 °C under air atmosphere for 2 h until **2d** was completely consumed by TLC monitoring. Then, 3-chloropropiophenone (**2a**) (101 mg, 0.6 mmol) was added, and the mixture was further stirred at 110 °C under air atmosphere for 20 h. After cooled to ambient temperature, the reaction mixture was worked up in a fashion similar to that described in 2.1 to afford **10c** as a white solid (52 mg, 62%).

3. X-Ray crystallographic studies

Single crystal X-ray diffraction studies for compounds **3i** and **8** were carried out on a SMART APEX diffractometer with graphite-monochromated Mo Kα radiation (λ= 0.71073 Å). Cell parameters were obtained by global refinement of the positions of all collected reflections. Intensities were corrected for Lorentz and polarization effects and empirical absorption. The structures were solved by direct methods and refined by full-matrix least squares on F^2. All non-hydrogen atoms were refined anisotropically. All hydrogen atoms were placed in calculated positions. Structure solution and refinement were performed by using the SHELXL-97 package. The X-ray crystallographic files, in CIF format, are available from the Cambridge Crystallographic Data Centre on quoting the deposition numbers CCDC 973030 for **3i** and CCDC 973031 for **8**. Copies of this information may be obtained free of charge from The Director, CCDC, 12 Union Road, Cambridge CB2 IEZ, UK (Fax: +44-1223-336033; e-mail: deposit@ccdc.cam.ac.uk or www: http://www. ccdc.cam.ac.uk).

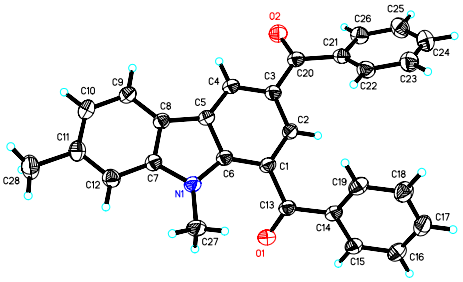


Figure 1. Molecular structure of **3i**.

Table S2. Crystal data and structure refinement for **3i**.

Identification code	cd213329
Empirical formula	C28 H21 N O2
Formula weight	403.46
Temperature	293(2) K
Wavelength	0.71073 A
Crystal system, space group	Monoclinic, P2(1)/n
Unit cell dimensions	a = 13.6381(14) A alpha = 90 deg.
	b = 10.0676(11) A beta = 91.542(2) deg.
	c = 15.0801(15) A gamma = 90 deg.
Volume	2069.8(4) A^3
Z, Calculated density	4, 1.295 Mg/m^3
Absorption coefficient	0.081 mm^-1
F(000)	848
Crystal size	0.232 x 0.175 x 0.121 mm
Theta range for data collection	1.99 to 26.00 deg.
Limiting indices	-13<=h<=16, -12<=k<=12, -17<=l<=18
Reflections collected / unique	12052 / 4067 [R(int) = 0.0489]
Completeness to theta = 26.00	99.9 %
Absorption correction	Empirical
Max. and min. transmission	1.00000 and 0.10650
Refinement method	Full-matrix least-squares on F^2

Data / restraints / parameters	4067 / 0 / 283
Goodness-of-fit on F^2	1.055
Final R indices [I>2sigma(I)]	R1 = 0.0513, wR2 = 0.1237
R indices (all data)	R1 = 0.0652, wR2 = 0.1343
Extinction coefficient	0.029(3)
Largest diff. peak and hole	0.274 and -0.261 e.A^-3

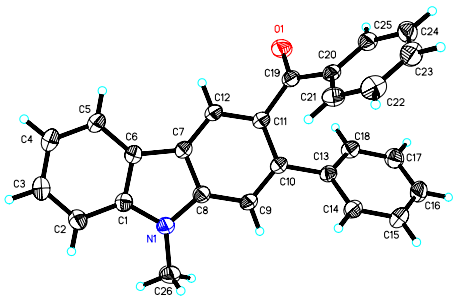


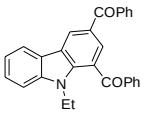
Figure 2. Molecular structure of **8**.

Table S3. Crystal data and structure refinement for **8**.

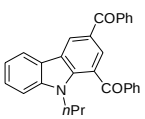
Identification code	cd213449
Empirical formula	C26 H19 N O
Formula weight	361.42
Temperature	293(2) K
Wavelength	0.71073 A
Crystal system, space group	Triclinic, P-1
Unit cell dimensions	a = 8.8997(14) A alpha = 79.341(3) deg.
	b = 9.2955(15) A beta = 78.262(3) deg.
	c = 11.9387(19) A gamma = 83.259(3) deg.
Volume	947.0(3) A^3
Z, Calculated density	2, 1.267 Mg/m^3
Absorption coefficient	0.077 mm^-1
F(000)	380
Crystal size	0.221 x 0.165 x 0.123 mm

Theta range for data collection	1.77 to 25.99 deg.
Limiting indices	-8<=h<=10, -11<=k<=11, -12<=l<=14
Reflections collected / unique	5740 / 3700 [R(int) = 0.0185]
Completeness to theta = 25.99	99.6 %
Absorption correction	Empirical
Max. and min. transmission	1.00000 and 0.59495
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	3700 / 0 / 254
Goodness-of-fit on F^2	1.058
Final R indices [I>2sigma(I)]	R1 = 0.0471, wR2 = 0.1344
R indices (all data)	R1 = 0.0555, wR2 = 0.1431
Largest diff. peak and hole	0.202 and -0.283 e.A^-3

4. Analytical data

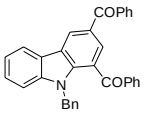


(9-Ethyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3b): Yield 70%. Pale yellow solid, m.p.: 110-113 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.75 (d, *J* = 1.3 Hz, 1 H, aromatic CH), 8.16 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.97 (m, 3 H, aromatic CH), 7.84 (d, *J* = 7.2 Hz, 2 H, aromatic CH), 7.64 (t, 1 H, aromatic CH), 7.57 and 7.50 (m each, 2:5 H, aromatic CH), 7.35 (t, 1 H, aromatic CH), 4.31 (q, 2 H, NCH_2CH_3), 1.22 (t, 3 H, NCH_2CH_3). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 196.2 and 195.8 (Cq each, C=O), 141.8, 139.6, 138.5, 137.5, 127.3, 125.1, 123.1, and 122.5 (Cq each), 133.9, 132.1, 130.8, 130.0, 129.6, 128.9, 128.4, 127.3, 125.6, 120.9, 120.7, and 109.8 (aromatic CH), 40.2 (NCH_2CH_3), 13.4 (NCH_2CH_3). HRMS Calcd for $C_{28}H_{21}NO_2$ $[M]^{+}$: 403.1572; Found: 403.1580.

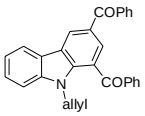


(9-Propyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3c): Yield 63%. Pale yellow solid, m.p.: 96-98 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.76 (d,

J = 1.2 Hz, 1 H, aromatic CH), 8.16 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.98 (m, 3 H, aromatic CH), 7.85 (d, *J* = 7.3 Hz, 2 H, aromatic CH), 7.64 (t, 1 H, aromatic CH), 7.54 (m, 7 H, aromatic CH), 7.34 (t, 1 H, aromatic CH), 4.24 (t, 2 H, $NCH_2CH_2CH_3$), 1.63 (m, 2 H, $NCH_2CH_2CH_3$), 0.72 (t, 3 H, $NCH_2CH_2CH_3$). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 196.0 and 195.8 (Cq each, C=O), 142.2, 139.8, 138.5, 137.5, 127.3, 125.0, 123.0, and 122.6 (Cq each), 133.9, 132.1, 130.8, 130.0, 129.7, 128.9, 128.4, 127.2, 125.6, 120.8, 120.6, and 110.1 (aromatic CH), 46.7 ($NCH_2CH_2CH_3$), 21.8 ($NCH_2CH_2CH_3$), 11.2 ($NCH_2CH_2CH_3$). HRMS Calcd for $C_{29}H_{23}NO_2$ $[M]^+$: 417.1729; Found: 417.1735.

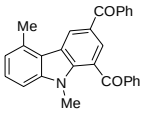


(9-Benzyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3d): Yield 63%. Pale yellow solid, m.p.: 115-117 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.79 and 7.86 (s each, 1:1 H, aromatic CH), 8.22 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.82 (d, *J* = 7.4 Hz, 2 H, aromatic CH), 7.56, 7.48, and 7.40 (m each, 3:5:1 H, aromatic CH), 7.28 (t, 2 H, aromatic CH), 6.92 and 6.86 (t each, 1:2 H, aromatic CH), 6.65 (d, *J* = 7.4 Hz, 2 H, aromatic CH), 5.61 (s, 2 H, CH_2Ph). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.8 and 195.5 (Cq each, C=O), 143.0, 139.8, 138.3, 137.2, 135.8, 127.6, 125.5, 123.4, and 122.9 (Cq each), 133.1, 132.2, 130.5, 130.1, 129.9, 128.5, 128.4, 128.2, 127.5, 127.4, 127.0, 125.6, 121.2, 120.8, and 110.0 (aromatic CH), 48.3 (CH_2Ph). HRMS Calcd for $C_{33}H_{23}NO_2$ $[M]^+$: 465.1729; Found: 465.1727.

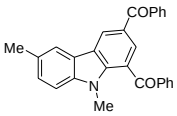


(9-Allyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3f): Yield 56%. Pale yellow solid, m.p.: 111-114 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.78 and 8.00 (s each, 1:1 H, aromatic CH), 8.17 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.93 (d, *J* = 7.9 Hz, 2 H, aromatic CH), 7.85 (d, *J* = 7.7 Hz, 2 H, aromatic CH), 7.58 and 7.49 (m each, 3:5 H, aromatic CH), 7.36 (t, 1 H, aromatic CH), 5.71 (m, 1 H, $CH_2CH=CH_2$), 4.97 (d, *J* = 4.6 Hz, 2 H, $CH_2CH=CH_2$), 4.93 and 4.74 (d each, *J* = 10.4 Hz and 17.2 Hz, 1:1 H, $CH_2CH=CH_2$). $^{13}C\{^1H\}$ NMR (100 MHz,

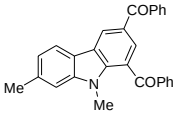
$CDCl_3$) δ 195.9 and 195.78 (Cq each, C=O), 142.3, 140.0, 138.4, 137.5, 127.5, 125.2, 123.0, and 122.9 (Cq each), 133.7, 132.2, 131.8, 131.0, 130.2, 130.0, 128.6, 128.4, 127.4, 125.7, 121.1, 120.6, 117.7, 110.1 (aromatic CH), 47.4 ($CH_2CH=CH_2$). HRMS Calcd for $C_{29}H_{21}NO_2$ $[M]^+$: 415.1572; Found: 415.1574.



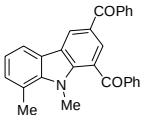
(5,9-Dimethyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3g): Yield 78%. Pale yellow solid, m.p.: 163-166 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.89 and 8.01 (s each, 1:1 H, aromatic CH), 7.97 (d, *J* = 7.5 Hz, 2 H, aromatic CH), 7.86 (d, *J* = 7.4 Hz, 2 H, aromatic CH), 7.64 and 7.58 (t each, 1:1 H, aromatic CH), 7.49 (m, 5 H, aromatic CH), 7.33 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.14 (d, *J* = 7.3 Hz, 1 H, aromatic CH), 3.67 (s, 3 H, NCH_3), 2.89 (s, 3 H, CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 196.0 and 195.9 (Cq each, C=O), 142.8, 141.2, 138.5, 137.8, 127.5, 125.5, 122.0, and 121.3 (Cq each), 133.8, 132.1, 130.7, 130.0, 129.3, 128.8, 128.4, 127.8, 127.0, 122.7, and 107.3 (aromatic CH), 33.45 (NCH_3), 21.01 (CH_3). HRMS Calcd for $C_{28}H_{21}NO_2$ $[M]^+$: 403.1572; Found: 403.1577.



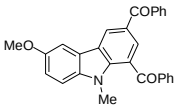
(6,9-Dimethyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3h): Yield 76%. Pale yellow solid, m.p.: 159-162 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72 and 8.04 (d each, *J* = 1.3 Hz and 1.2 Hz, 1:1 H, aromatic CH), 7.97 and 7.84 (m each, 3:2 H, aromatic CH), 7.64 and 7.59 (t each, 1:1 H, aromatic CH), 7.50 and 7.36 (m each, 4:2 H, aromatic CH), 3.66 (s, 3 H, NCH_3), 2.55 (s, 3 H, CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 196.0 and 195.9 (Cq each, C=O), 141.4, 141.0, 138.6, 137.8, 130.4, 127.3, 124.7, 122.9, and 122.4 (Cq each), 133.8, 132.1, 130.8, 130.0, 129.8, 128.8, 128.7, 128.4, 125.7, 120.6, and 109.4 (aromatic CH), 33.3 (NCH_3), 21.5 (CH_3). HRMS Calcd for $C_{28}H_{21}NO_2$ $[M]^+$: 403.1572; Found: 403.1580.



(7,9-Dimethyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3i): Yield 70%. Pale yellow solid, m.p.: 156-158 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.71 (d, *J* = 1.6 Hz, 1 H, aromatic CH), 8.02, 7.98, and 7.84 (m each, 2:2:2 H, aromatic CH), 7.64 and 7.58 (t each, 1:1 H, aromatic CH), 7.50 (m, 4 H, aromatic CH), 7.26 (s, 1 H, aromatic CH), 7.17 (d, *J* = 8.0 Hz, 1 H, aromatic CH), 3.65 (s, 3 H, NCH_3), 2.58 (s, 3 H, CH_3). ^{13}C{H^{1}} NMR (100 MHz, $CDCl_3$) δ 196.0 and 195.9 (Cq each, C=O), 143.2, 141.2, 138.5, 137.82, 137.77, 127.4, 124.9, 122.3, and 120.5 (Cq each), 133.8, 132.1, 130.8, 130.0, 129.4, 128.8, 128.4, 125.3, 122.4, 120.3, and 109.9 (aromatic CH), 33.2 (NCH_3), 22.4 (CH_3). HRMS Calcd for $C_{28}H_{21}NO_2$ $[M]^+$: 403.1572; Found: 403.1576.

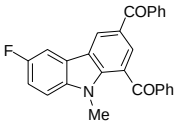


(8,9-Dimethyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3j): Yield 79%. Pale yellow solid, m.p.: 176-179 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72 and 8.06 (d each, *J* = 1.6 Hz, 1:1 H, aromatic CH), 7.98 and 7.84 (m each, 3:2 H, aromatic CH), 7.64 and 7.59 (t each, 1:1 H, aromatic CH), 7.51 (m, 4 H, aromatic CH), 7.27 (d, *J* = 6.4 Hz, 1 H, aromatic CH), 7.21 (t, 1 H, aromatic CH), 3.83 (s, 3 H, NCH_3), 2.80 (s, 3 H, CH_3). ^{13}C{H^{1}} NMR (100 MHz, $CDCl_3$) δ 195.9 and 195.8 (Cq each, C=O), 142.9, 142.0, 138.4, 137.7, 127.8, 125.1, 123.9, 122.5, and 121.7 (Cq each), 133.8, 132.1, 130.7, 130.6, 130.2, 130.0, 128.8, 128.4, 125.5, 121.2, and 118.5 (aromatic CH), 37.2 (NCH_3), 20.5 (CH_3). HRMS Calcd for $C_{28}H_{21}NO_2$ $[M]^+$: 403.1572; Found: 403.1578.

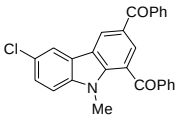


(6-Methoxy-9-methyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3k): Yield 80%. Pale yellow solid, m.p.: 166-169 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.73 and 8.03 (d each, *J* = 1.6 Hz, 1:1 H, aromatic CH), 7.98, 7.84, and 7.63 (m each, 2:2:2 H, aromatic CH), 7.58 (t, 1 H, aromatic CH), 7.50 (m, 4 H, aromatic CH), 7.36 (d, *J* = 8.9 Hz, 1 H, aromatic CH), 7.19 (dd, *J* = 8.9 and 2.4 Hz, 1 H, aromatic CH), 3.93 (s, 3 H, NCH_3), 3.65 (s, 3 H, OCH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.85 and 195.83 (Cq each, C=O), 155.0, 141.5, 138.6, 137.8, 137.6, 127.0, 124.6, 123.3, and 122.4 (Cq each), 133.8, 132.1,

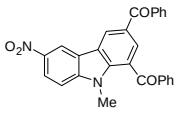
130.8, 130.0, 120.0, 128.8, 128.4, 125.8, 116.6, 110.5, and 103.2 (aromatic CH), 56.2 (OCH_3), 33.4 (NCH_3). HRMS Calcd for $C_{28}H_{21}NO_3$ $[M]^+$: 419.1521; Found: 419.1529.



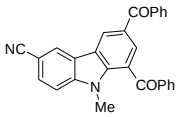
(6-Fluoro-9-methyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3l): Yield 70%. White solid, m.p.: 233-236 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.68 and 8.06 (d each, *J* = 1.4 Hz Hz, 1:1 H, aromatic CH), 7.98 (d, *J* = 7.2 Hz, 2 H, aromatic CH), 7.83 (m, 2 H, aromatic CH), 7.79 (dd, *J* = 8.5 and 2.4 Hz, 1 H, aromatic CH), 7.65 and 7.59 (t each, 1:1 H, aromatic CH), 7.51 (m, 4 H, aromatic CH), 7.39 (dd, *J* = 8.9, 4.1 Hz, 1 H, aromatic CH), 7.29 (m, 1 H, aromatic CH), 3.68 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.7 (Cq, C=O), 158.3 (Cq, d, *J* = 237 Hz, *i*-C of C_6H_3F), 141.9, 139.0, 138.3, 137.7, 127.5, 124.3 (Cq, d, *J* = 4.1 Hz, *p*-C of C_6H_3F), 123.4 (Cq, d, *J* = 9.7 Hz, *m*-C of C_6H_3F), and 122.8 (Cq each), 134.0, 132.3, 130.8, 130.3, 130.0, 128.9, 128.5, 126.1, 115.2 (CH, d, *J* = 25.4 Hz, *o*-C of C_6H_3F), 110.5 (CH, d, *J* = 8.9 Hz, *m*-C of C_6H_3F), and 106.5 (CH, d, *J* = 24.0 Hz, *o*-C of C_6H_3F) (aromatic CH), 33.5 (NCH_3). HRMS Calcd for $C_{27}H_{18}FNO_2$ $[M]^+$: 407.1322; Found: 407.1329.



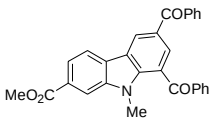
(6-Chloro-9-methyl-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3m): Yield 61%. White solid, m.p.: 247-249 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.67 (d, *J* = 1.3 Hz, 1 H, aromatic CH), 8.08 (dd, *J* = 8.9 and 1.5 Hz, 2 H, aromatic CH), 7.98 (d, *J* = 7.5 Hz, 2 H, aromatic CH), 7.83 (d, *J* = 7.3 Hz, 2 H, aromatic CH), 7.65 and 7.60 (t each, 1:1 H, aromatic CH), 7.52 (m, 5 H, aromatic CH), 7.38 (d, *J* = 8.7 Hz, 1 H, aromatic CH), 3.68 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.6 (Cq, C=O), 141.5, 141.1, 138.3, 137.6, 127.9, 126.6, 124.0, 123.8, and 122.9 (Cq each), 134.0, 132.3, 130.8, 130.3, 130.0, 128.9, 128.5, 127.5, 126.0 , 120.4, and 110.8 (aromatic CH), 33.5 (NCH_3). HRMS Calcd for $C_{27}H_{18}NO_2$ $[M]^+$: 423.1026; Found: 423.1033.



(9-Methyl-6-nitro-9*H*-carbazole-1,3-diyl)bis(phenylmethanone) (3n): Yield 60%. Pale yellow solid, m.p.: 227-229 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.04 and 8.75 (s each, 1:1 H, aromatic CH), 8.46 (d, *J* = 9.0 Hz, 1 H, aromatic CH), 8.14 (s, 1 H, aromatic CH), 7.99 (d, *J* = 7.6 Hz, 2 H, aromatic CH), 7.84 (d, *J* = 7.5 Hz, 2 H, aromatic CH), 7.68 (t, 1 H, aromatic CH), 7.62 (d, *J* = 7.3 Hz, 1 H, aromatic CH), 7.54 (m, 5 H, aromatic CH), 3.77 (s, 3 H, NCH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.4 and 195.2 (Cq each, C=O), 145.7, 142.3, 142.1, 137.9, 137.3, 129.3, 124.4, 123.9, and 122.6 (Cq each), 134.3, 132.6, 130.9, 130.7, 130.0, 129.1, 128.7, 126.0, 122.9, 117.4, and 109.7 (aromatic CH), 33.9 (NCH_3). HRMS Calcd for $C_{27}H_{18}N_2O_4$ $[M]^+$: 434.1267; Found: 434.1276.

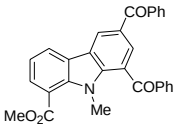


6,8-Dibenzoyl-9-methyl-9*H*-carbazole-3-carbonitrile (3o): Yield 65%. White solid, m.p.: 253-255 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72 and 8.11 (d each, *J* = 1.5 Hz, 1:1 H, aromatic CH), 8.45 (d, *J* = 0.8 Hz, 1 H, aromatic CH), 7.98 (d, *J* = 7.3 Hz, 2 H, aromatic CH), 7.82 (m, 3 H, aromatic CH), 7.67 and 7.62 (t each, 1:1 H, aromatic CH), 7.53 (m, 5 H, aromatic CH), 3.74 (s, 3 H, NCH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.4 and 195.3 (Cq each, C=O), 144.4, 141.7, 137.9, 137.4, 123.7, 123.5, 123.0, 119.9, and 104.0 (Cq each), 134.3, 132.6, 130.9, 130.6, 130.5, 130.0, 129.0, 128.6, 125.9, 125.6, and 110.6 (aromatic CH), 33.6 (NCH_3). HRMS Calcd for $C_{28}H_{18}N_2O_2$ $[M]^+$: 414.1368; Found: 414.1378.

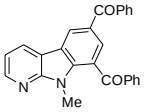


Methyl 6,8-dibenzoyl-9-methyl-9*H*-carbazole-2-carboxylate (3p): Yield 54%. Pale yellow solid, m.p.: 189-192 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.76 and 8.09 (s each, 1:1 H, aromatic CH), 8.18 (m, 2 H, aromatic CH), 8.03 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.98 (d, *J* = 7.9 Hz, 2 H, aromatic CH), 7.83

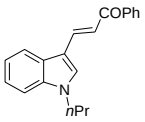
(d, *J* = 7.7 Hz, 2 H, aromatic CH), 7.65 and 7.59 (t each, 1:1 H, aromatic CH), 7.51 (m, 4 H, aromatic CH), 3.99 (s, 3 H, NCH_3), 3.74 (s, 3 H, CO_2CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.57 and 195.54 (Cq each, C=O), 167.4 (Cq, *C*OOMe), 142.3, 142.2, 138.2, 137.5, 128.8, 128.0, 124.0, and 123.0 (Cq each), 134.1, 132.3, 130.8, 130.8, 130.0, 128.9, 128.5, 126.5, 122.0, 120.4, and 111.5 (aromatic CH), 52.5 (CO_2CH_3), 33.4 (NCH_3). HRMS Calcd for $C_{29}H_{21}NO_4$ $[M]^+$: 447.1471; Found: 447.1471.



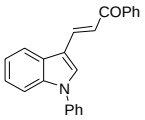
Methyl 6,8-dibenzoyl-9-methyl-9*H*-carbazole-1-carboxylate (3q): Yield 67%. Pale yellow solid, m.p.: 211-214 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.75 and 8.10 (d each, *J* = 1.7 Hz, 1:1 H, aromatic CH), 8.28 (dd, *J* = 7.7 and 1.1 Hz, 1 H, aromatic CH), 7.96 and 7.84 (m each, 3:2 H, aromatic CH), 7.65, 7.59, and 7.51 (t each, 1:1:4 H, aromatic CH), 7.36 (t, 1 H, aromatic CH), 3.97 (s, 3 H, NCH_3), 3.54 (s, 3 H, CO_2CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.7 and 195.4 (Cq each, C=O), 167.6 (Cq, *C*OOMe), 143.6, 141.5, 138.2, 137.5, 125.2 124.6, 123.2, and 116.7 (Cq each), 133.9, 132.34, 130.8, 130.6, 130.0, 130.0, 128.9, 128.5, 125.5, 124.4, and 120.5 (aromatic CH), 52.5 (CO_2CH_3), 38.8 (NCH_3). HRMS Calcd for $C_{29}H_{21}NO_4$ $[M]^+$: 447.1471; Found: 447.1474.



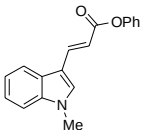
(9-Methyl-9*H*-pyrido[2,3-b]indole-6,8-diyl)bis(phenylmethanone) (3r): Yield 60%. Pale yellow solid, m.p.: 114-116 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.74 and 8.06 (d each, *J* = 1.6 Hz, 1:1 H, aromatic CH), 8.60 (dd, *J* = 4.8 and 1.4 Hz, 1 H, aromatic CH), 8.41 (dd, *J* = 7.7 and 1.5 Hz, 1 H, aromatic CH), 7.97 and 7.83 (m each, 2:2 H, aromatic CH), 7.65 and 7.59 (t each, 1:1 H, aromatic CH), 7.50 (m, 4 H, aromatic CH), 7.29 (dd, *J* = 7.7 and 4.9 Hz, 1 H, aromatic CH), 3.81 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 195.7 and 195.4 (Cq each, C=O), 153.2, 140.4, 138.1, 137.5, 128.3, 123.1, 122.2, and 115.7 (Cq each), 147.6, 134.1, 132.4, 130.8, 130.1, 130.0, 128.9, 128.8, 128.5, 126.0, and 116.8 (aromatic CH), 31.4 (NCH_3). HRMS Calcd for $C_{26}H_{18}N_2O_2$ $[M]^+$: 390.1368; Found: 390.1370.



(*E*)-1-Phenyl-3-(1-propyl-1*H*-indol-3-yl)prop-2-en-1-one (4c): Yield 30%. Pale yellow solid, m.p.: 127-130 °C ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 15.5 Hz, 1 H, C*H*=CHCOPh), 8.04 and 7.57 (m each, 3:1 H, aromatic CH), 7.52 (m, 4 H, aromatic CH and CH=C*H*COPh), 7.40 and 7.32 (m each, 1:2 H, aromatic CH), 4.12 (t, 2 H, NCH_2CH$_2$CH$_3$), 1.92 (m, 2 H, NCH$_2$CH_2CH$_3$), 0.97 (t, 3 H, NCH$_2$CH$_2$CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.9 (Cq, C=O), 139.3, 137.8, 138.93, 126.4 and 113.1 (Cq each), 133.9, 132.2, 128.6, 128.4, 123.2, 121.6, 121.0, 117.1, and 110.5 (CH), 48.6 (N*C*H$_2$CH$_2$CH$_3$), 23.4 (NCH$_2$*C*H$_2$CH$_3$), 11.6 (NCH$_2$CH$_2$*C*H$_3$). HRMS Calcd for $C_{20}H_{19}NO$ $[M]^+$: 289.1467; Found: 289.1469.

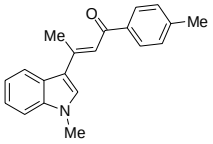


(*E*)-1-phenyl-3-(1-phenyl-1*H*-indol-3-yl)prop-2-en-1-one (4e): Yield 91%. Pale yellow solid, m.p.: 110-112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 and 7.65 (d each, *J* = 15.6 Hz, 1:1 H, C*H*=C*H*COPh), 8.08 (d, *J* = 7.6 Hz, 3 H, aromatic CH), 7.73 (s, 1 H, 2-H of indolyl), 7.60-7.48 (m, 8 H, aromatic CH), 7.45 (t, 1 H, aromatic CH), 7.35 (m, 2 H, aromatic CH). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.8 (Cq, C=O), 139.1, 138.6, 137.8, 126.9, and 115.0 (Cq each), 138.3, 133.1, 132.4, 130.0, 128.7, 128.5, 127.82, 124.83, 123.9, 122.4, 121.0, 118.5, and 111.5 (CH). HRMS Calcd for $C_{23}H_{17}NO$ $[M]^+$: 323.1310; Found: 323.1307.

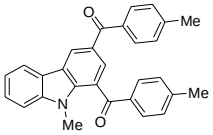


(*E*)-Phenyl 3-(1-methyl-1*H*-indol-3-yl)acrylate (4g): Yield 70%. Pale yellow solid, m.p.: 108-110 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 and 6.61 (d each, *J* = 15.9 Hz, 1:1 H, C*H*=C*H*COOPh), 7.98 (d, *J* = 7.7 Hz, 1 H, aromatic CH), 7.42 (m, 3 H, aromatic CH), 7.39-7.28 (m, 3 H, aromatic CH), 7.25 (d, *J* = 5.5 Hz, 1 H, aromatic CH), 7.21 (d, *J* = 7.9 Hz, 2 H, aromatic CH), 3.83 (s, 3 H, NCH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 166.9 (Cq, *C*OOPh), 151.3, 138.3,

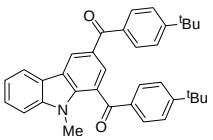
126.2, and 112.3 (Cq each), 140.1, 134.0, 129.5, 125.6, 123.3, 122.0, 121.7, 120.8, 111.4, and 110.2 (CH), 33.4 (NCH_3). HRMS Calcd for $C_{18}H_{15}NO_2$ $[M]^+$: 277.1103; Found: 277.1105.



(*E*)-3-(1-Methyl-1*H*-indol-3-yl)-1-(p-tolyl)but-2-en-1-one (4h): Yield 69%. Pale yellow solid, m.p.: 168-170 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.04 and 7.38 (d each, J = 7.8 Hz, 1:1 H, aromatic CH), 7.94 (d, J = 8.1 Hz, 2 H, aromatic CH), 7.53 (s, 1 H, aromatic CH), 7.45 (s, 1 H, MeC=C*H*), 7.33 (m, 1 H, aromatic CH), 7.28 (m, 3 H, aromatic CH), 3.84 (s, 3 H, NCH_3), 2.74 and 2.43 (s each, 3:3 H, CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 191.4 (Cq, C=O), 150.7, 142.6, 138.2, 138.1, 125.6, and 118.6 (Cq each), 131.3, 129.3, 128.3, 122.8, 121.3, 121.2, 117.8, and 110.1 (CH), 33.3 (NCH_3), 21.7 and 19.4 (CH_3). HRMS Calcd for $C_{20}H_{19}NO$ $[M]^+$: 289.1467; Found: 289.1469.

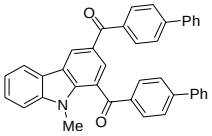


(9-Methyl-9*H*-carbazole-1,3-diyl)bis(p-tolylmethanone) (5a): Yield 81%. White solid, m.p.: 221-224 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.73 and 8.00 (d each, J = 1.4 Hz, 1:1 H, aromatic CH), 8.16 (d, J = 7.8 Hz, 1 H, aromatic CH), 7.87 (d, J = 8.1 Hz, 2 H, aromatic CH), 7.76 (d, J = 8.0 Hz, 2 H, aromatic CH), 7.56 (t, 1 H, aromatic CH), 7.46 (d, J = 8.2 Hz, 1 H, aromatic CH), 7.32 (m, 5 H, aromatic CH), 3.68 (s, 3 H, NCH_3), 2.45 (s, 6 H, 2×CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 195.8 (Cq, C=O), 145.0, 142.9, 142.7, 141.0, 135.8, 135.3, 127.9, 124.7, 122.9, and 122.7 (Cq each), 131.0, 130.0, 129.6, 129.5, 129.1, 127.2, 125.4, 120.8, 120.7, and 109.6 (aromatic CH), 33.2 (NCH_3), 21.9 and 21.8 (CH_3). HRMS Calcd for $C_{29}H_{23}NO_2$ $[M]^+$: 417.1729; Found: 417.1731.



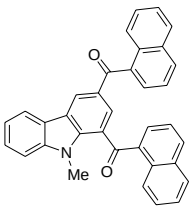
(9-Methyl-9*H*-carbazole-1,3-diyl)bis((4-(tert-butyl)phenyl)methanone)

(5b): Yield 81%. Pale yellow solid, m.p.: 168-170 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.77 and 8.05 (d each, *J* = 1.5 Hz, 1:1 H, aromatic CH), 8.17 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.93 (d, *J* = 8.5 Hz, 2 H, aromatic CH), 7.82 (d, *J* = 8.3 Hz, 2 H, aromatic CH), 7.55 (m, 5 H, aromatic CH), 7.47 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.34 (t, 1 H, aromatic CH), 3.70 (s, 3 H, NCH_3), 1.39 and 1.38 (s each, 9:9 H, 2×$C(CH_3)_3$). $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ 195.68 and 195.65 (Cq, C=O), 157.8, 155.8, 142.7, 141.1, 135.7, 135.2, 127.8, 124.7, 122.9, and 122.7 (Cq each), 130.9, 130.2, 129.8, 127.2, 125.8, 125.5, 125.4, 120.8, 120.7, and 109.6 (aromatic CH), 35.4 and 35.2 (Cq each, $C(CH_3)_3$), 33.2 (NCH_3), 31.3 and 31.2 ($C(CH_3)_3$). HRMS Calcd for $C_{35}H_{35}NO_2$ $[M]^+$: 501.2668; Found: 501.2677.



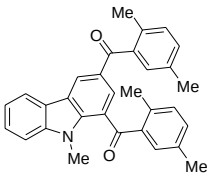
(9-Methyl-9*H*-carbazole-1,3-diyl)bis([1,1'-biphenyl]-4-ylmethanone)

(5f): Yield 64%. Pale yellow solid, m.p.: 225-228 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.82 and 8.12 (d each, *J* = 1.4 Hz, 1:1 H, aromatic CH), 8.19 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 8.07 (d, *J* = 8.3 Hz, 2 H, aromatic CH), 7.95 (d, *J* = 8.2 Hz, 2 H, aromatic CH), 7.73 and 7.65 (m each, 4:4 H, aromatic CH), 7.59 (t, 1 H, aromatic CH), 7.48 and 7.44-7.35 (m each, 5:3 H, aromatic CH), 3.74 (s, 3 H, NCH_3). $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ 195.50 and 195.47 (Cq, C=O), 146.6, 145.0, 142.7, 141.2, 140.1, 139.8, 137.1, 136.5, 127.8, 124.9, 122.9, and 122.6 (Cq each), 131.4, 130.7, 129.8, 129.1, 129.1, 128.6, 128.2, 127.52, 127.47, 127.4, 127.4, 127.1, 125.6, 120.9, 120.7, and 109.7 (aromatic CH), 33.3 (NCH_3). HRMS Calcd for $C_{39}H_{27}NO_2$ $[M]^+$: 541.2042; Found: 541.2043.

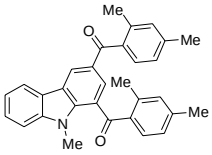


(9-Methyl-9*H*-carbazole-1,3-diyl)bis(naphthalen-1-ylmethanone) (5g): Yield 62%. Pale yellow solid, m.p.: 138-142 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.86 (d, *J* = 8.5 Hz, 1 H, aromatic CH), 8.75 and 8.14 (d each, *J* = 1.5 and 1.4 Hz, 1:1 H, aromatic CH), 8.07 (m, 3 H, aromatic CH), 7.96 (dd, *J* = 8.0 and 2.4

Hz, 2 H, aromatic CH), 7.90 (d, *J* = 7.6 Hz, 1 H, aromatic CH), 7.81 (d, *J* = 6.6 Hz, 1 H, aromatic CH), 7.67 and 7.61 (m each, 1:2 H, aromatic CH), 7.55 (dd, *J* = 8.9 and 4.1 Hz, 1 H, aromatic CH), 7.44 (m, 5 H, aromatic CH), 7.33 (t, 1 H, aromatic CH), 3.78 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 197.16 and 196.85 (Cq each, C=O), 142.9, 141.9, 136.9, 135.3, 134.2, 133.8, 131.5, 131.1, 128.6, 125.1, 124.8, and 122.9 (Cq each), 134.0, 132.9, 131.0, 128.8, 128.6, 128.5, 127.4, 127.2, 126.9, 126.5, 126.4, 126.0, 125.9, 124.5, 124.4, 121.1, 120.7, and 109.8 (aromatic CH), 33.7 (NCH_3). HRMS Calcd for $C_{35}H_{23}NO_2$ $[M]^+$: 489.1729; Found: 489.1736.

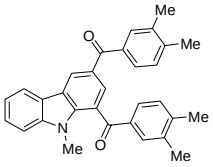


(9-Methyl-9*H*-carbazole-1,3-diyl)bis((2,5-dimethylphenyl)methanone) (5h): Yield 54%. Pale yellow solid, m.p.: 151-154 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.72 and 8.09 (d each, *J* = 1.4 Hz, 1:1 H, aromatic CH), 8.22 (d, *J* = 7.7 Hz, 1 H, aromatic CH), 7.8 (m, 1 H, aromatic CH), 7.60 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.45 and 7.39-7.25 (m each, 2:5 H, aromatic CH), 3.89 (s, 3 H, NCH_3), 2.64, 2.43, 2.39, and 2.38 (s each, 3:3:3:3 H, 4×CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 198.0 and 197.9 (Cq each, C=O), 142.9, 141.6, 139.2, 137.9, 136.5, 135.3, 135.0, 133.3, 128.1, 125.1, 124.8, and 122.9 (Cq each), 133.1 132.4, 132.0, 130.9, 130.8, 130.3, 128.7, 127.3, 126.2, 121.0, 120.6, and 109.8 (aromatic CH), 33.7 (NCH_3), 21.04, 20.99, 20.96, and 19.6 (CH_3). HRMS Calcd for $C_{31}H_{27}NO_2$ $[M]^+$: 445.2042; Found: 445.2047.

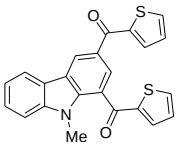


(9-Methyl-9*H*-carbazole-1,3-diyl)bis((2,4-dimethylphenyl)methanone) (5i): Yield 47%. Pale yellow solid, m.p.: 165-168 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.59 and 8.01 (d each, *J* = 1.4 Hz, 1:1 H, aromatic CH), 8.10 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.55 (t, 1 H, aromatic CH), 7.46 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.43 (d, *J* = 7.9 Hz, 1 H, aromatic CH), 7.31 (m, 2 H, aromatic CH), 7.18 and 7.13 (s each, 1:1 H, aromatic CH), 7.04 (m, 2 H, aromatic CH),

3.73 (s, 3 H, NCH_3), 2.63, 2.40 and 2.35 (s each, 3:6:3 H, 4×CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 197.6 and 197.6 (Cq each, C=O), 143.1, 142.8, 141.4, 140.4, 140.2, 137.0, 136.2, 135.0, 128.4, 124.93, 124.79, and 122.90 (Cq each), 133.1, 133.0, 132.0, 129.9, 129.0, 127.2, 126.4, 126.0, 125.9, 120.8, 120.6, and 109.7 (aromatic CH), 33.4 (NCH_3), 21.6, 21.5, and 20.2 (CH_3). HRMS Calcd for $C_{31}H_{27}NO_2$ $[M]^+$: 445.2042; Found: 445.2047.

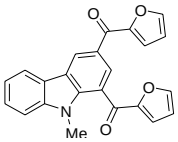


(9-Methyl-9*H*-carbazole-1,3-diyl)bis((3,4-dimethylphenyl)methanone) (5j): Yield 78%. Pale yellow solid, m.p.: 188-191 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.79 and 8.02 (d each, J = 1.5 Hz, 1:1 H, aromatic CH) 8.19 (d, J = 7.7 Hz, 1 H, aromatic CH), 7.83 (s, 1 H, aromatic CH), 7.71 and 7.59 (m each, 2:2 H, aromatic CH), 7.49 (d, J = 8.2 Hz, 1 H, aromatic CH), 7.37 (t, 1 H, aromatic CH), 7.28 (m, 2 H, aromatic CH), 3.72 (s, 3 H, NCH_3), 2.39 and 2.36 (s each, 6:6 H, 4×CH_3)**.** $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 196.00 and 195.97 (Cq each, C=O), 143.7, 142.7, 141.6, 141.0, 137.4, 136.9, 136.2, 135.7, 128.0, 124.7, 122.9, and 122.7 (Cq each), 131.6, 131.2, 130.1, 129.54, 129.53, 128.9, 128.0, 127.2, 125.3, 120.7, 120.6, and 109.6 (aromatic CH), 33.1 (NCH_3), 20.3, 20.1, and 19.9 (CH_3). HRMS Calcd for $C_{31}H_{27}NO_2$ $[M]^+$: 445.2042; Found: 445.2049.

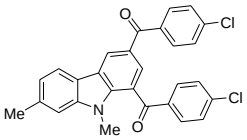


(9-Methyl-9*H*-carbazole-1,3-diyl)bis(thiophen-2-ylmethanone) (5k): Yield 76%. Pale yellow solid, m.p.: 158-161 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.85 and 8.25 (d each, J = 1.4 Hz, 1:1 H, aromatic CH), 8.17 (d, J = 7.8 Hz, 1 H, aromatic CH), 7.81 (d, J = 4.4 Hz, 1 H, thienyl CH), 7.75 (d, J = 3.4 Hz, 1 H, thienyl CH), 7.72 (d, J = 4.9 Hz, 1 H, thienyl CH), 7.62 (d, J = 3.3 Hz, 1 H, thienyl CH), 7.57 (t, 1 H, aromatic CH), 7.47 (d, J = 8.2 Hz, 1 H, aromatic CH), 7.35 (t, 1 H, aromatic CH), 7.18 (m, 2 H, thienyl CH), 3.75 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 187.8 and 187.1 (Cq, C=O), 145.0, 143.9,

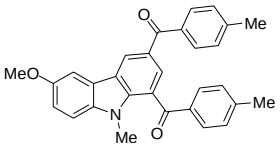
142.7, 140.5, 125.0, 122.7, and 122.4 (Cq each), 136.5, 135.9, 134.4, 133.7, 128.7, 128.6, 128.1, 127.4, 124.8, 120.9, 120.6, and 109.7 (aromatic CH), 33.1 (NCH_3). Calcd for $C_{23}H_{15}NO_2S_2$ $[M]^+$: 401.0544; Found: 401.0552.



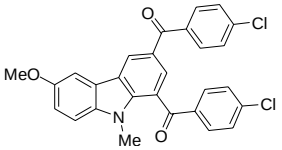
(9-Methyl-9*H*-carbazole-1,3-diyl)bis(furan-2-ylmethanone) (5l): Yield 75%. yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 8.99 and 8.43 (d each, J = 1.4 Hz, 1:1 H, aromatic CH), 8.18 (d, J = 7.7 Hz, 1 H, aromatic CH), 7.78 (d, J = 0.8 Hz, 1 H, furyl CH), 7.72 (d, J = 0.6 Hz, 1 H, furyl CH), 7.55 (t, 1 H, aromatic CH), 7.46 (d, J = 8.2 Hz, 1 H, aromatic CH), 7.38-7.31 (m, 2 H, aromatic CH and furyl CH), 7.22 (d, J = 3.4 Hz, 1 H, furyl CH), 6.63 (m, 2 H, furyl CH), 3.74 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 182.3 and 181.2 (Cq each, C=O), 152.9, 152.8, 142.7, 140.9, 127.0, 125.1, 122.7, and 121.6 (Cq each), 148.4, 146.8, 129.3, 127.4, 125.3, 122.5, 120.9, 120.6, 120.1, 112.9, 112.4, and 109.7 (aromatic CH), 33.2 (NCH_3). Calcd for $C_{23}H_{15}NO_4$ $[M]^+$: 369.1001; Found: 369.1007.



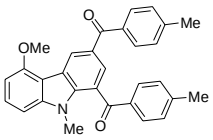
(7,9-Dimethyl-9*H*-carbazole-1,3-diyl)bis((4-chlorophenyl)methanone) (5m): Yield 72%. Pale yellow solid, m.p.: 166-168 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.64 (d, J = 1.5 Hz, 1 H, aromatic CH), 8.01 (d, J = 7.9 Hz, 1 H, aromatic CH), 7.92 (m, 3 H, aromatic CH), 7.77 (d, J = 8.4 Hz, 2 H, aromatic CH), 7.47 (m, 4 H, aromatic CH), 7.26 (s, 1 H, aromatic CH), 7.18 (d, J = 8.0 Hz, 1 H, aromatic CH), 3.64 (s, 3 H, NCH_3), 2.58 (s, 3 H, CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 194.5 (Cq, C=O), 143.2, 141.2, 140.6, 138.6, 138.1, 136.7, 136.1, 127.1, 125.1, and 122.0 (Cq each), 132.1, 131.4, 129.3, 129.0, 128.8, 125.3, 122.6, 120.4, and 109.9 (aromatic CH), 33.3 (NCH_3), 22.5 (CH_3). HRMS Calcd for $C_{28}H_{19}Cl_2NO_2$ $[M]^+$: 471.0793; Found: 471.0797.



(6-Methoxy-9-methyl-9*H*-carbazole-1,3-diyl)bis(p-tolylmethanone) (5n): Yield 78%. White solid, m.p.: 213-216 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.70 and 7.99 (d each, *J* = 1.3 Hz, 1:1 H, aromatic CH), 7.87 (d, *J* = 8.1 Hz, 2 H, aromatic CH), 7.76 (d, *J* = 8.0 Hz, 2 H, aromatic CH), 7.61 (d, *J* = 2.3 Hz, 1 H, aromatic CH), 7.35 (d, *J* = 8.9 Hz, 1 H, aromatic CH), 7.30 (d, *J* = 8.0 Hz, 4 H, aromatic CH), 7.18 (dd, *J* = 8.9 and 2.4 Hz, 1 H, aromatic CH), 3.93 (s, 3 H, NCH_3), 3.64 (s, 3 H, OCH_3), 2.45 (s, 6 H, 2×CH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 195.7 (Cq, C=O), 154.9, 144.9, 142.8, 141.3, 137.5, 135.8, 135.3, 127.4, 124.5, 123.3, and 122.6 (Cq each), 130.9, 130.3, 129.6, 129.1, 125.4, 116.5, 110.5, and 103.2 (aromatic CH), 56.2 (OCH_3), 33.2 (NCH_3), 21.9 and 21.7 (CH_3). HRMS Calcd for $C_{30}H_{25}NO_3$ $[M]^+$: 447.1834; Found: 447.1833.

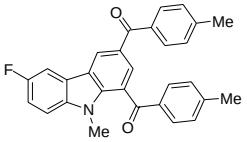


(6-Methoxy-9-methyl-9*H*-carbazole-1,3-diyl)bis((4-chlorophenyl)-methanone) (5o): Yield 74%. White solid, m.p.: 224-226 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.66 and 7.95 (d each, *J* = 1.6 Hz, 1:1 H, aromatic CH), 7.90 (d, *J* = 8.6 Hz, 2 H, aromatic CH), 7.77 (d, *J* = 8.5 Hz, 2 H, aromatic CH), 7.60 (d, *J* = 2.4 Hz, 1 H, aromatic CH), 7.48 (m, 4 H, aromatic CH), 7.37 (d, *J* = 8.9 Hz, 1 H, aromatic CH), 7.20 (dd, *J* = 8.9 and 2.5 Hz, 1 H, aromatic CH), 3.94 (s, 3 H, NCH_3), 3.64 (s, 3 H, OCH_3). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 194.50 and 194.45 (Cq, C=O), 155.2, 141.4, 140.6, 138.6, 136.8, 136.1, 132.1, 126.7, 124.8, 123.2, and 122.1 (Cq each), 131.4, 129.5, 129.3, 128.8, 125.8, 116.9, 110.7, and 103.2 (aromatic CH), 56.2 (OCH_3), 33.4 (NCH_3). HRMS Calcd for $C_{28}H_{19}Cl_2NO_3$ $[M]^+$: 487.0742; Found:487.0750.

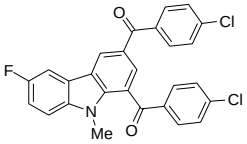


(5-Methoxy-9-methyl-9*H*-carbazole-1,3-diyl)bis(p-tolylmethanone) (5p): Yield 75%. Pale yellow solid. m.p.: 211-214 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.03 and 7.95 (d each, *J* = 1.7 Hz, 1:1 H, aromatic CH), 7.86 (d, *J* = 8.2 Hz, 2 H, aromatic CH), 7.79 (d, *J* = 8.1 Hz, 2 H, aromatic CH), 7.47 (t, 1 H, aromatic CH), 7.29 (d, *J* = 7.7 Hz, 4 H, aromatic CH), 7.06 (d, *J* = 8.2 Hz, 1 H,

aromatic CH), 6.78 (d, J = 8.0 Hz, 1 H, aromatic CH), 4.07 (s, 3 H, NCH_3), 3.65 (s, 3 H, OCH_3), 2.44 (s, 6 H, 2×CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 195.8 (Cq, C=O), 156.4, 144.8, 144.1, 142.7, 140.2, 135.8, 135.4, 128.2, 124.1, 122.0, and 111.9 (Cq each), 130.9, 130.4, 129.5, 129.0, 128.7, 128.1, 128.0, 102.3, and 101.7 (aromatic CH), 55.7 (OCH_3), 33.4 (NCH_3), 21.9 and 21.7 (CH_3). HRMS Calcd for $C_{30}H_{25}NO_3$ $[M]^+$: 447.1834; Found: 447.1832.

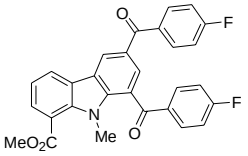


(6-Fluoro-9-methyl-9*H*-carbazole-1,3-diyl)bis(p-tolylmethanone) (5q): Yield 70%. White solid, m.p.: 231-233 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.66 and 8.02 (d each, J = 1.4 Hz, 1:1 H, aromatic CH), 7.87 (d, J = 8.1 Hz, 2 H, aromatic CH), 7.79 (dd, J = 8.5 and 2.4 Hz, 1 H, aromatic CH), 7.75 (d, J = 8.0 Hz, 2 H, aromatic CH), 7.37 (dd, J = 8.9 and 4.1 Hz, 1 H, aromatic CH), 7.29 (m, 5 H, aromatic CH), 3.67 (s, 3 H, NCH_3), 2.45 (s, 6 H, 2×CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 195.52 and 195.49 (Cq, C=O), 158.2 (Cq, d, J = 234.3 Hz, *i*-C of C_6H_3F), 145.1, 143.0, 141.7, 139.0, 135.6, 135.2, 127.9, 124.1 (Cq, d, J = 4.1 Hz, *p*-C of C_6H_3F), 123.4 (Cq, d, J = 9.7 Hz, *m*-C of C_6H_3F), and 123.0 (Cq each), 131.0, 130.3, 130.0, 129.6, 129.2, 125.7, 115.1 (CH, d, J = 25.5 Hz, *o*-C of C_6H_3F), 110.4 (CH, d, J = 9.1 Hz, *m*-C of C_6H_3F), 106.4 (CH, d, J = 23.9 Hz, *o*-C of C_6H_3F) (aromatic CH), 33.3 (NCH_3), 21.9 and 21.8 (CH_3). HRMS Calcd for $C_{29}H_{22}FNO_2$ $[M]^+$: 435.1635; Found:435.1639.

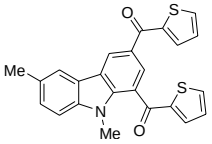


(6-Fluoro-9-methyl-9*H*-carbazole-1,3-diyl)bis((4-chlorophenyl)methanone) (5r): Yield 80%. White solid, m.p.: 225-227 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.63 and 7.99 (d each, J = 1.6 Hz, 1:1 H, aromatic CH), 7.91 (d, J = 8.5 Hz, 2 H, aromatic CH), 7.78 (m, 3 H, aromatic CH), 7.49 (m, 4 H, aromatic CH), 7.40 (dd, J = 8.9 and 4.0 Hz, 1 H, aromatic CH), 7.30 (m, 1 H, aromatic CH), 3.67 (s, 3 H, NCH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 194.3 and 194.2 (Cq each, C=O), 158.4 (Cq, d, J = 237.4 Hz, *i*-C of C_6H_3F), 141.8, 140.7, 139.0,

138.8, 136.5, 135.9, 127.2, 124.4 (Cq, d, J = 4.3 Hz, *p*-C of C_6H_3F), and 123.3 (Cq, d, J = 9.5 Hz, *m*-C of C_6H_3F) (Cq each), 132.1, 131.4, 129.9, 129.3, 128.9, 126.1, 122.4, 115.4 (CH, d, J = 25.4 Hz, *o*-C of C_6H_3F), 110.6 (CH, d, J = 8.9 Hz, *m*-C of C_6H_3F), and 106.5 (CH, d, J = 24.0 Hz, *o*-C of C_6H_3F) (aromatic CH), 33.56 (NCH_3). HRMS Calcd for $C_{27}H_{16}Cl_2FNO_2$ $[M]^+$: 475.0542; Found: 475.0539.

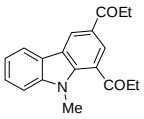


Methyl 6,8-bis(4-fluorobenzoyl)-9-methyl-9*H*-carbazole-1-carboxylate (5s): Yield 64%. Pale yellow solid, m.p.: 203-205 ^oC.^1H NMR (400 MHz, $CDCl_3$) δ 8.70 (d, J = 1.6 Hz, 1 H, aromatic CH), 8.28 (dd, J = 7.7 and 1.0 Hz, 1 H, aromatic CH), 7.99 (m, 4 H, aromatic CH), 7.87 (m, 2 H, aromatic CH), 7.37 (t, 1 H, aromatic CH), 7.18 (m, 4 H, aromatic CH), 3.97 (s, 3 H, NCH_3), 3.53 (s, 3 H, CO_2CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 194.2 and 193.8 (Cq, C=O), 167.5 ($COOCH_3$), 166.3 and 165.4 (Cq each, d each, J = 255.2 Hz and 252.4 Hz, *i*-C of C_6H_4F), 143.4, 141.5, 134.3 and 133.9 (Cq, d each, J = 3.0 Hz and 2.8 Hz, *p*-C of C_6H_4F), 128.8, 125.1, 124.7, 123.0, and 116.8 (Cq each), 133.2 and 132.6 (CH, d each, J = 9.4 Hz and 8.9 Hz, *m*-C of C_6H_4F), 130.3, 130.1, 125.4, 124.4, 120.6, 116.2 and 115.7 (CH, d each, J = 21.9 Hz and 21.7 Hz, *o*-C of C_6H_4F) (aromatic CH), 52.5 (CO_2CH_3), 38.8 (NCH_3). HRMS Calcd for $C_{29}H_{19}F_2NO_4$ $[M]^+$: 483.1282; Found: 483.1284.

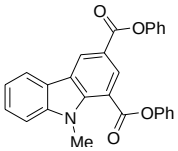


(6,9-Dimethyl-9*H*-carbazole-1,3-diyl)bis(thiophen-2-ylmethanone) (5t): Yield 66%. Pale yellow solid, m.p.: 137-140 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.81 and 8.23 (d each, J = 1.5 Hz, 1:1 H, aromatic CH), 7.96 (s, 1 H, aromatic CH), 7.80 (dd, J = 4.9 and 0.9 Hz, 1 H, thienyl CH), 7.75 (m, 1 H, thienyl CH), 7.71 (dd, J = 5.0 and 0.8 Hz, 1 H, thienyl CH), 7.62 (dd, J = 3.7 and 0.9 Hz, 1 H, thienyl CH), 7.36 (q, 2 H, aromatic CH), 7.18 (m, 2 H, thienyl CH), 3.72 (s, 3 H, NCH_3), 2.55 (s, 3 H, CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 187.8 and 187.1 (Cq each, C=O), 145.0, 144.0, 141.0, 140.7, 130.4, 127.8, 124.8, 122.8,

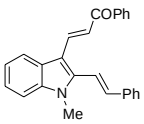
and 122.3 (Cq each), 136.5, 135.8, 134.3, 133.6, 128.8, 128.6, 128.6, 128.0, 124.7, 120.5, and 109.4 (aromatic CH), 33.1 (NCH_3), 21.5 (CH_3). HRMS Calcd for $C_{24}H_{17}NO_2S_2$ $[M]^+$: 415.0701; Found: 415.0695.



1,1'-(9-Methyl-9*H*-carbazole-1,3-diyl)bis(propan-1-one) (5u): Yield 26%. Pale yellow solid, m.p.: 139-142 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.78 and 8.35 (d each, J = 1.3 Hz, 1:1 H, aromatic CH), 8.12 (d, J = 7.8 Hz, 1 H, aromatic CH), 7.54 (t, 1 H, aromatic CH), 7.46 (d, J = 8.2 Hz, 1 H, aromatic CH), 7.33 (t, 1 H, aromatic CH), 3.73 (s, 3 H, NCH_3), 3.20 and 3.14 (q each, 2:2 H, 2×CH_2CH$_3$), 1.34 and 1.30 (t each, 3:3 H, 2×CH$_2$CH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 204.0 and 199.6 (Cq each, C=O), 143.0, 140.5, 127.5, 125.3, 124.4, and 122.7 (Cq each), 127.2, 126.3, 123.7, 120.9, 120.3, and 109.9 (aromatic CH), 35.4 and 31.7 (*C*H$_2$CH$_3$), 33.7 (NCH_3), 9.0 and 8.7 (CH$_2$*C*H$_3$). HRMS Calcd for $C_{19}H_{19}NO_2$ $[M]^+$: 293.1416; Found: 293.1420.

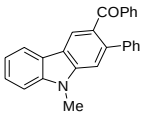


Diphenyl 9-methyl-9*H*-carbazole-1,3-dicarboxylate (5v): Yield 25%. Pale yellow solid, m.p.: 150-153 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 9.11 and 9.01 (s each, 1:1 H, aromatic CH), 8.19 (d, J = 7.8 Hz, 1 H, aromatic CH), 7.60 (t, 1 H, aromatic CH), 7.49 (m, 5 H, aromatic CH), 7.39 (t, 1 H, aromatic CH), 7.33 (m, 6 H, aromatic CH), 4.02 (s, 3 H, NCH_3). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 165.3 and 165.2 (Cq each, *C*OOPh), 151.2, 151.0, 143.2, 142.1, 125.98, 122.6, 119.6, and 114.3 (Cq each), 131.2, 129.8, 129.7, 127.6, 126.8, 126.34, 126.01, 122.0, 121.8, 121.3, 120.6, and 110.0 (aromatic CH), 34.1 (NCH_3). HRMS Calcd for $C_{27}H_{19}NO_4$ $[M]^+$: 421.1314; Found: 421.1324.

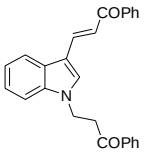


(*E*)-3-(1-Methyl-2-((*E*)-styryl)-1*H*-indol-3-yl)-1-phenylprop-2-en-1-one (7): Yield 22%. Yellow solid, m.p.: 126-129 ^oC**.** ^1H NMR (400 MHz, $CDCl_3$) δ

8.31 and 7.68 (d each, *J* = 15.5 Hz, 1:1 H, C*H*=C*H*COPh), 8.08 (m, 3 H, aromatic CH), 7.57 (m, 3 H, aromatic CH), 7.50 and 7.42 (t each, 2:2 H, aromatic CH), 7.35 (m, 4 H, aromatic CH), 7.20 and 6.99 (d each, *J* = 16.3 Hz, 1:1 H, C*H*=C*H*Ph), 3.79 (s, 3 H, NCH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 190.7 (Cq, C=O), 143.3, 139.4, 138.6, 136.4, 126.0, and 111.8 (Cq each), 139.1, 138.9, 132.2, 129.0, 129.0, 128.6, 128.4, 127.2, 123.6, 122.0, 121.0, 118.0, 115.7, and 110.0 (CH), 31.2 (NCH_3). HRMS Calcd for $C_{26}H_{21}NO$ $[M]^+$: 363.1623; Found: 363.1620.

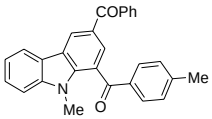


(9-Methyl-2-phenyl-9*H*-carbazol-3-yl)(phenyl)methanone (8): Yield 17%. Pale yellow solid, m.p.: 201-203 °C**.** ^1H NMR (400 MHz, $CDCl_3$) δ 8.34 (s, 1 H, aromatic CH), 8.11 (d, *J* = 7.7 Hz, 1 H, aromatic CH), 7.71, 7.55, 7.47, and 7.41 (m each, 2:1:2:3 H, aromatic CH), 7.28 and 7.19 (m each, 5:1 H, aromatic CH), 3.93 (s, 3 H, NCH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 199.1 (Cq, C=O), 142.2, 142.0, 141.8, 140.4, 139.0, 130.6, 122.8, and 121.4 (Cq each), 132.4, 130.2, 129.5, 128.3, 128.0, 127.2, 126.5, 122.7 , 121.4, 120.8, 120.0, 110.2, and 109.0 (aromatic CH), 29.4 (NCH_3). HRMS Calcd for $C_{26}H_{19}NO$ $[M]^+$: 361.1467; Found: 361.1462.

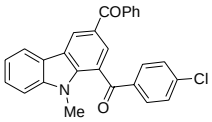


(*E*)-3-(1-(3-oxo-3-phenylpropyl)-1*H*-indol-3-yl)-1-phenylprop-2-en-1-one (9): Yield 39%. Pale yellow solid, m.p.: 104-107 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.07 (m, 2 H, C*H*=CHCOPh and aromatic CH), 8.02 and 7.90 (m each, 2:2 H, aromatic CH), 7.65 (s, 1 H, 2-H of indolyl), 7.52 (m, 5 H, aromatic CH), 7.44 (m, 3 H, aromatic CH and CH=C*H*COPh), 7.33 (m, 2 H, aromatic CH), 4.66 (t, 2 H, NC*H*$_2$CH$_2$COPh), 3.52 (t, 2 H, NCH$_2$C*H*$_2$COPh). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 197.1 and 190.8 (Cq each, C=O), 139.2, 137.3, 136.2, 126.6, and 113.4 (Cq each), 138.7, 134.2, 133.8, 132.2, 128.9, 128.6, 128.4, 128.1, 123.4, 121.8, 121.1, 117.5, and 110.2 (CH), 41.4 (N*C*H$_2$CH$_2$COPh), 38.4 (NCH$_2$*C*H$_2$COPh). HRMS Calcd for $C_{26}H_{21}NO_2$ $[M]^+$:

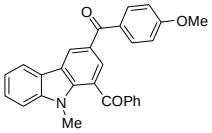
379.1572; Found: 379.1564.



(3-Benzoyl-9-methyl-9*H*-carbazol-1-yl)(*p*-tolyl)methanone (10a): Yield 71%. White solid, m.p.: 125-128 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.75 and 8.03 (d each, *J* = 1.6 Hz, 1:1 H, aromatic CH), 8.15 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.86 (m, 4 H, aromatic CH), 7.57 (m, 2 H, aromatic CH), 7.49 (t, 2 H, aromatic CH), 7.45 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.34 (m, 3 H, aromatic CH), 3.68 (s, 3 H, NCH_3), 2.45 (s, 3 H, CH_3). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 195.9 and 195.6 (Cq each, C=O), 145.0, 142.7, 141.1, 138.6, 135.4, 127.7, 124.8, 122.9, and 122.8 (Cq each), 132.1, 130.9, 130.0, 129.6, 128.4, 127.3, 125.4, 120.8, 120.6, and 109.6 (aromatic CH), 33.1 (NCH_3), 21.86 (CH_3). HRMS Calcd for $C_{28}H_{21}NO_2$ $[M]^+$: 403.1572; Found: 403.1569.

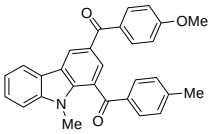


(3-Benzoyl-9-methyl-9*H*-carbazol-1-yl)(4-chlorophenyl)methanone (10b): Yield 75%. White solid, m.p.: 115-117 ^{o}C. ^{1}H NMR (400 MHz, CDCl3) δ 8.75 and 8.02 (d each, *J* = 1.6 Hz, 1:1 H, aromatic CH), 8.15 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.92 (m, 2 H, aromatic CH), 7.84 (m, 2 H, aromatic CH), 7.59 (m, 2 H, aromatic CH), 7.49 (m, 5 H, aromatic CH), 7.35 (t, 1 H, aromatic CH), 3.68 (s, 3 H, NCH_3). $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ 195.8 and 194.5 (Cq each, C=O), 142.7, 141.1, 140.5, 138.4, 136.1, 127.6, 125.0, 122.8, and 122.0 (Cq each), 132.2, 132.1, 130.0, 129.73, 129.2, 128.5, 127.5, 125.9, 121.0, 120.7, and 109.7 (aromatic CH), 33.3 (CH_3). HRMS Calcd for $C_{27}H_{18}ClNO_2$ $[M]^+$: 423.1026; Found: 423.1027.



(1-Benzoyl-9-methyl-9*H*-carbazol-3-yl)(4-methoxyphenyl)methanone (10c): Yield 62%.White solid, m.p.: 128-130 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.73 (d, *J* = 1.4 Hz, 1 H, aromatic CH), 8.16 (d, *J* = 7.8 Hz, 1 H, aromatic CH), 7.98 (m, 3 H, aromatic CH), 7.86 (d, *J* = 8.8 Hz, 2 H, aromatic CH), 7.64 and

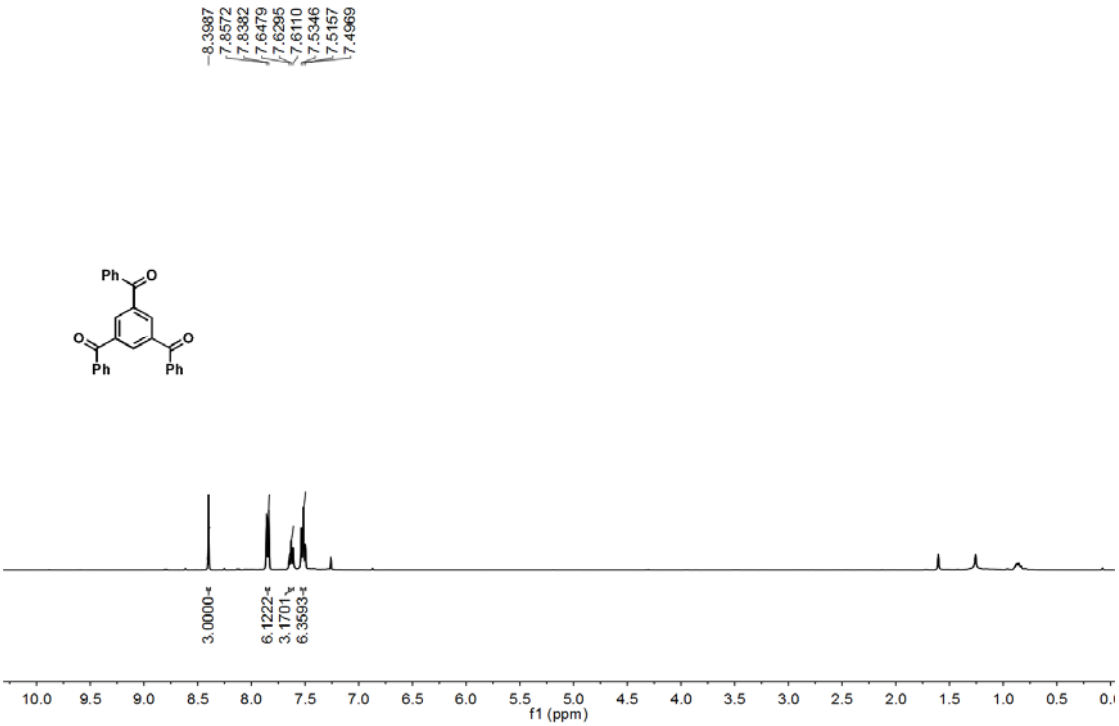
7.57 (t each, 1:1 H, aromatic CH), 7.49 (m, 3 H, aromatic CH), 7.35 (t, 1 H, aromatic CH), 6.98 (d, *J* = 8.8 Hz, 2 H, aromatic CH), 3.89 (s, 3 H, NCH_3), 3.69 (s, 3 H, OCH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 196.0 and 194.8 (Cq each, C=O), 163.1, 142.7, 141.0, 137.8, 130.9, 128.2, 124.8, 122.8, and 122.4 (Cq each), 133.9, 132.5, 130.8, 129.7, 128.9, 127.3, 125.4, 120.8, 120.7, 113.7, and 109.6 (aromatic CH), 55.6 (OCH_3), 33.3 (NCH_3). HRMS Calcd for $C_{28}H_{21}NO_3$ $[M]^+$: 419.1521; Found: 419.1522.



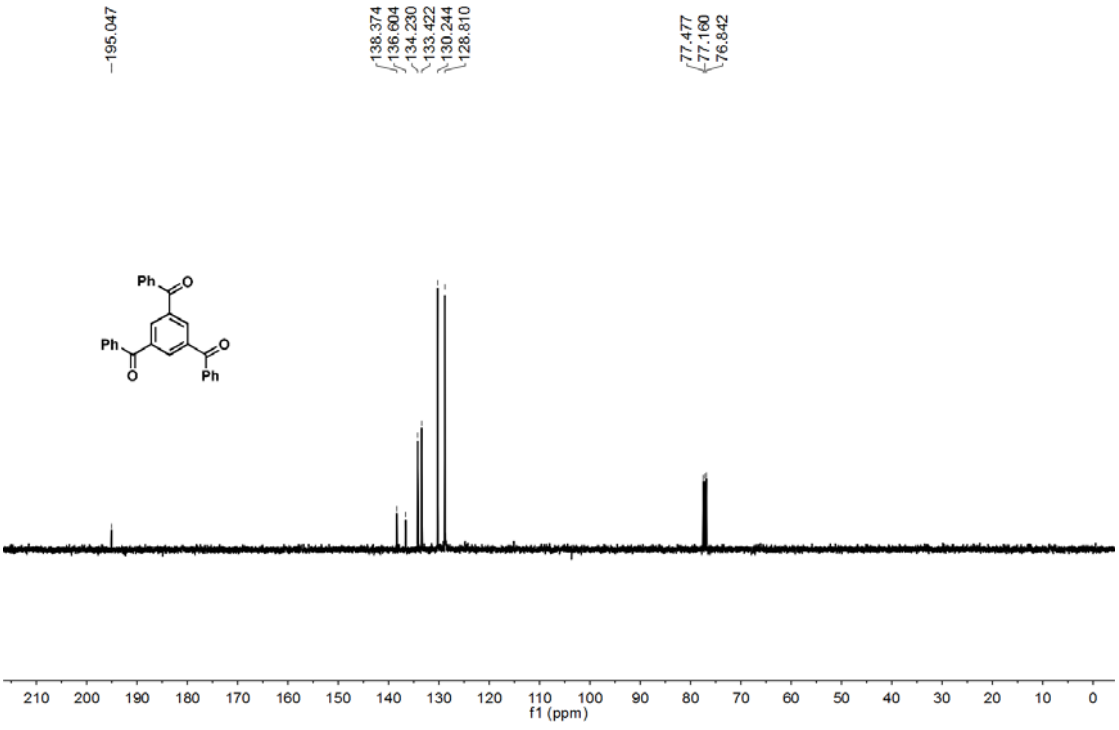
(3-(4-Methoxybenzoyl)-9-methyl-9*H*-carbazol-1-yl)(p-tolyl)methanone (10d): Yield 55%. White solid, m.p.: 190-193 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.72 and 7.97 (d each, *J* = 1.6Hz, 1:1 H, aromatic CH), 8.16 (d, *J* = 7.7 Hz, 1 H, aromatic CH), 7.86 (m, 4 H, aromatic CH), 7.55 (m, 1 H, aromatic CH), 7.45 (d, *J* = 8.2 Hz, 1 H, aromatic CH), 7.34 (t, *J* = 7.5 Hz, 1 H, aromatic CH), 7.30 (d, *J* = 8.0 Hz, 2 H, aromatic CH), 6.98 (d, *J* = 8.8 Hz, 2 H, aromatic CH), 3.89 (s, 3 H, NCH_3), 3.68 (s, 3 H, OCH_3), 2.45 (s, 3 H, CH_3). $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ 195.8 and 194.8 (Cq each, C=O), 163.0, 145.0, 142.7, 140.9, 135.4, 131.0, 128.2, 124.7, 122.8, and 122.6 (Cq each), 132.5, 130.9, 129.6, 129.5, 127.2, 125.2, 120.7, 120.6, 113.7, and 109.6 (aromatic CH), 55.6 (OCH_3), 33.2 (NCH_3), 21.9 (CH_3). HRMS Calcd for $C_{29}H_{23}NO_3$ $[M]^+$: 433.1678; Found: 433.1680.

5. Copies of NMR spectra for known compounds

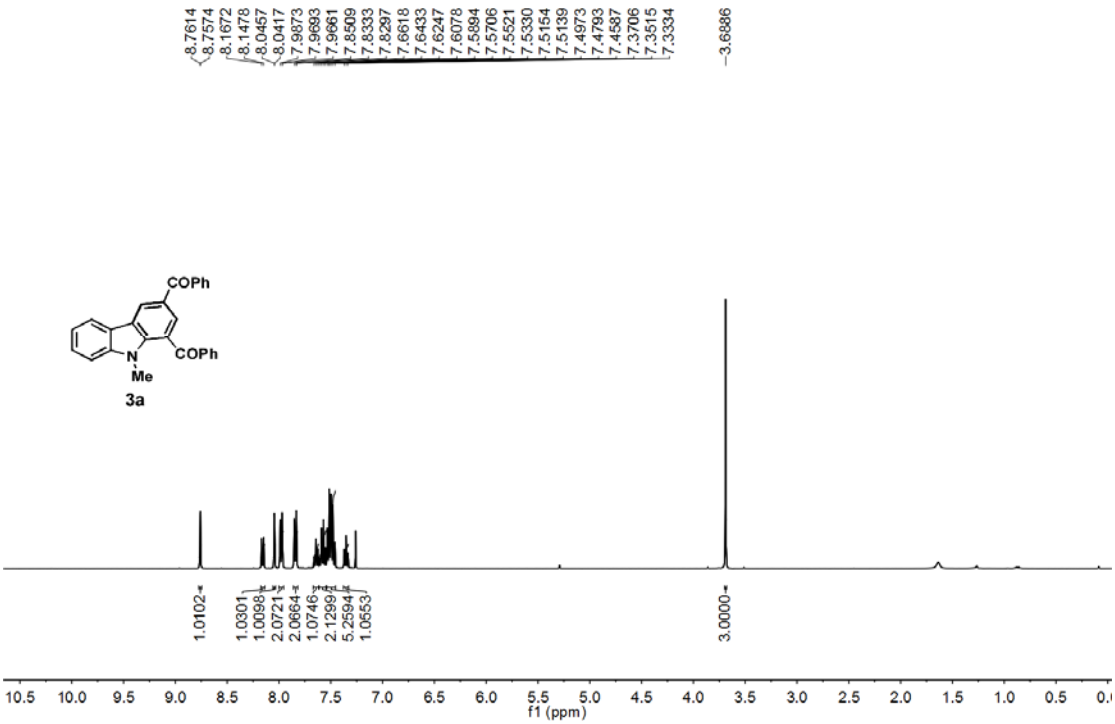
gtl-15800
1H NMR gtl-15800 in CDCl3



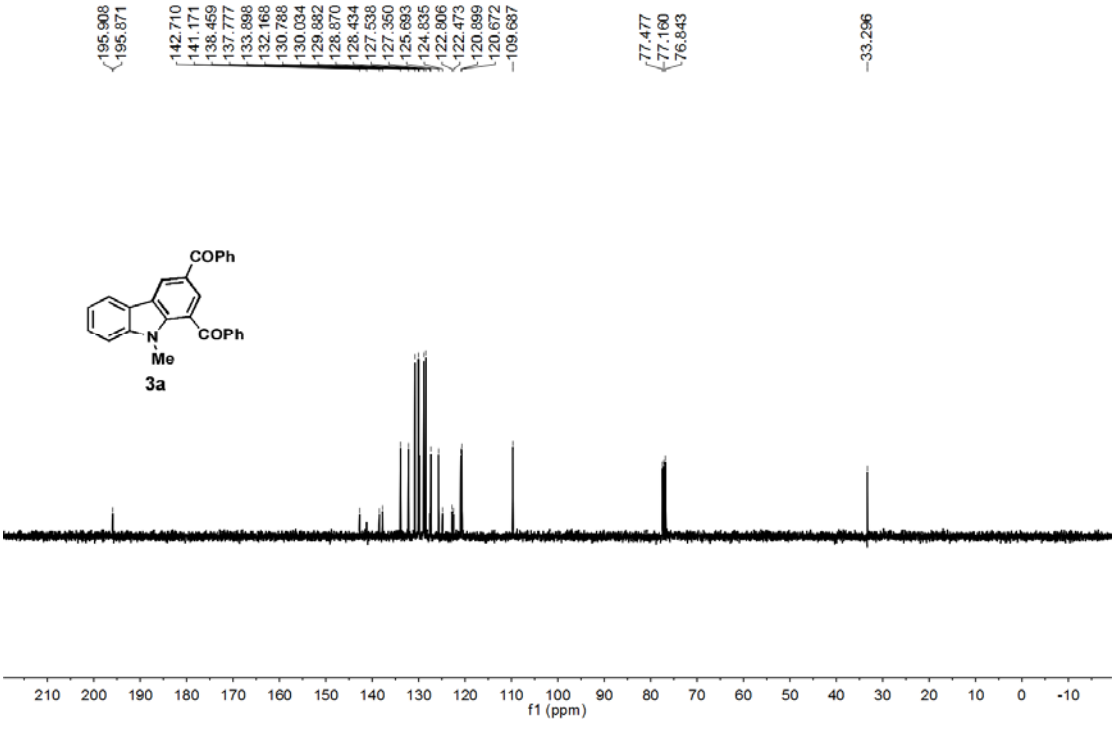
gtl-15800
13C NMR gtl-15800 CDCl3



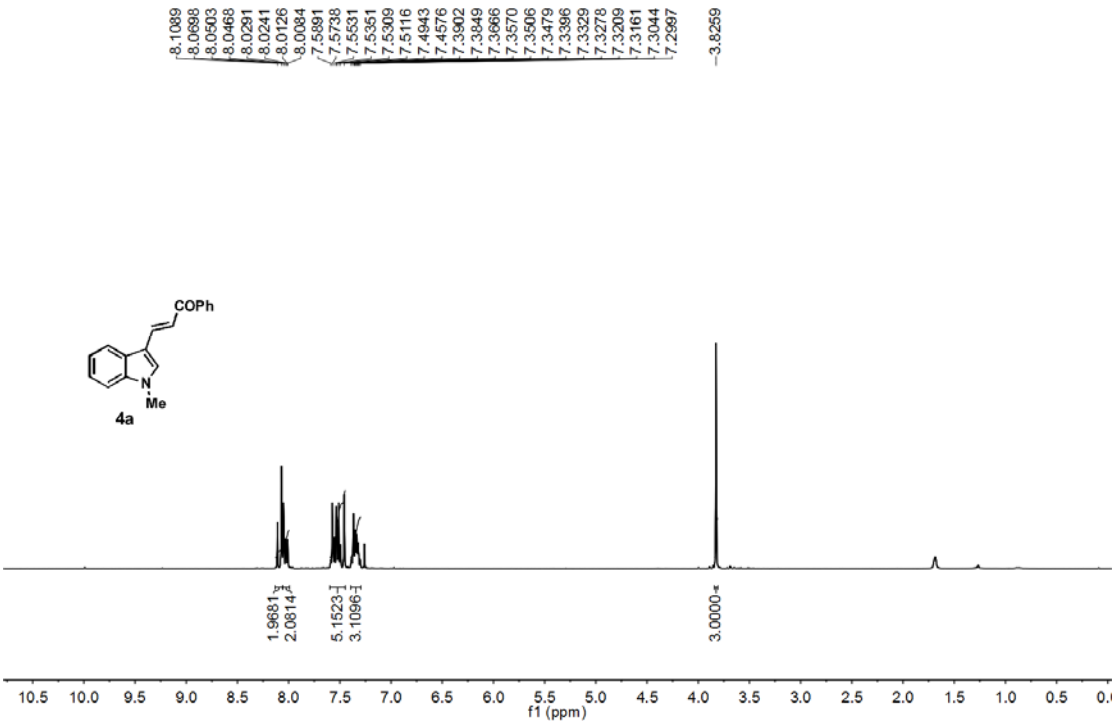
gtl-09800
1H NMR gtl-09800 in CDCl3



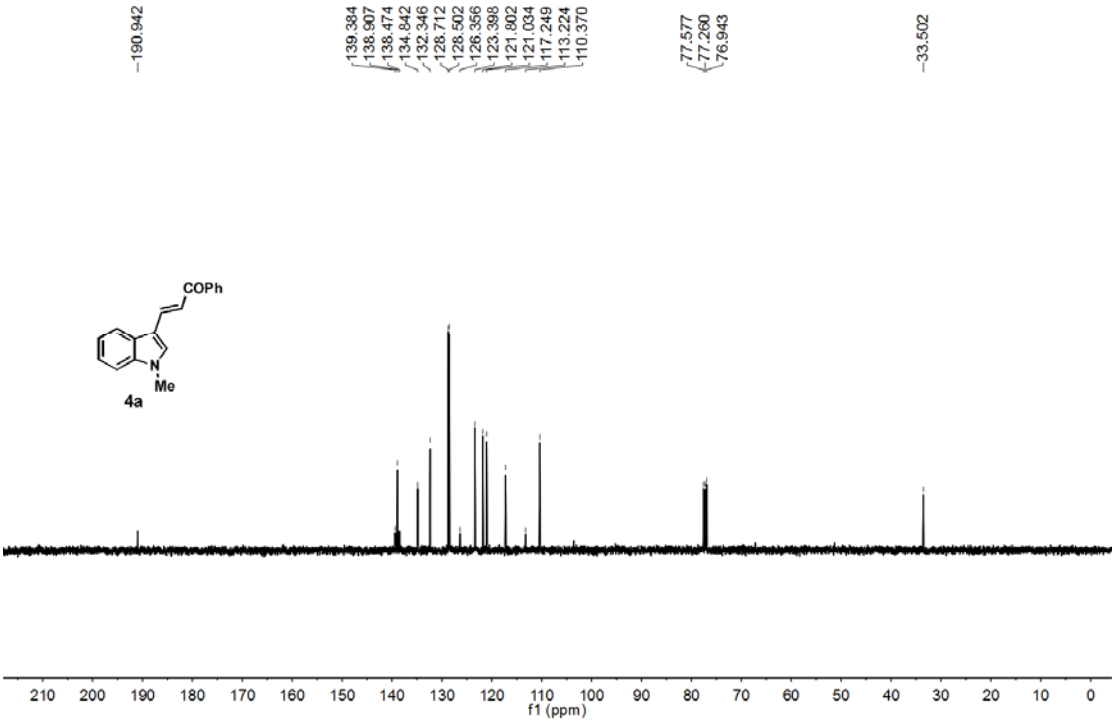
gtl-08400
13C NMR (gtl-08400 in CDCl3)



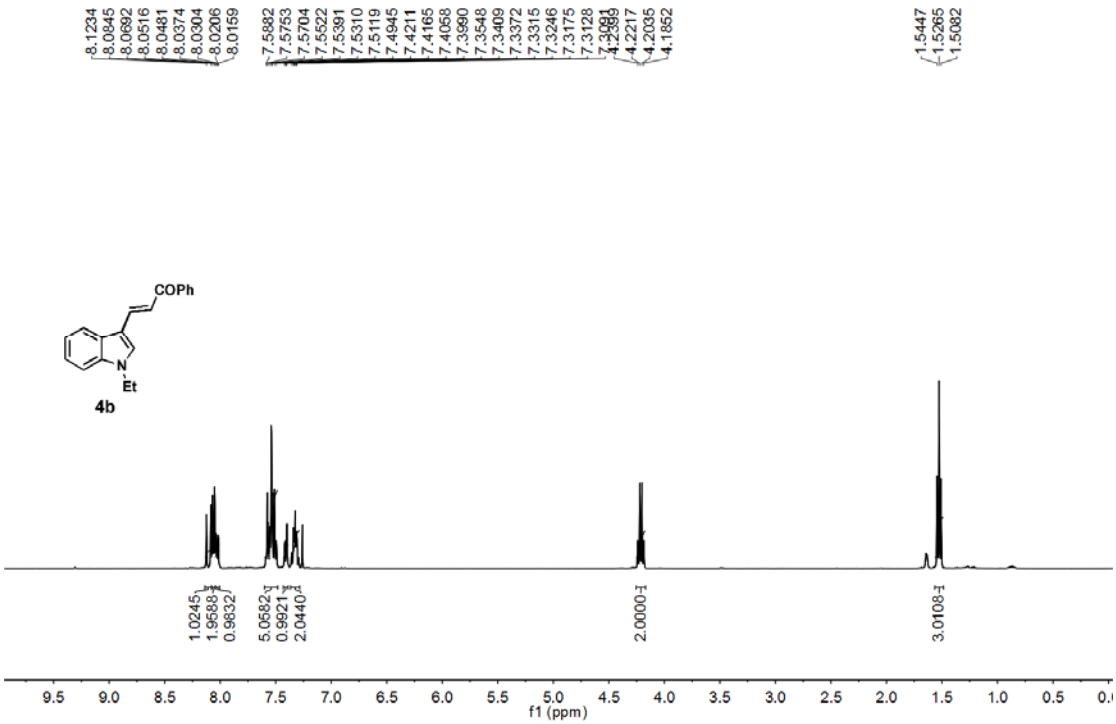
gtl-16802
1H NMR gtl-16802 in CDCl3



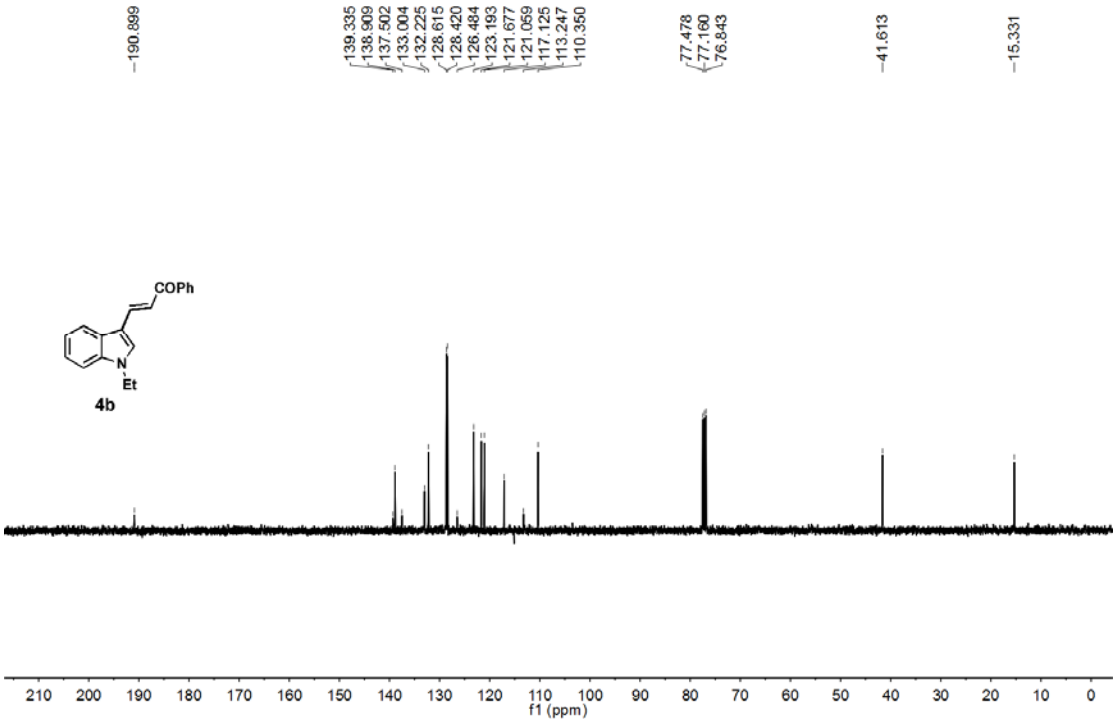
gtl-16802
13C NMR gtl-16802 CDCl3



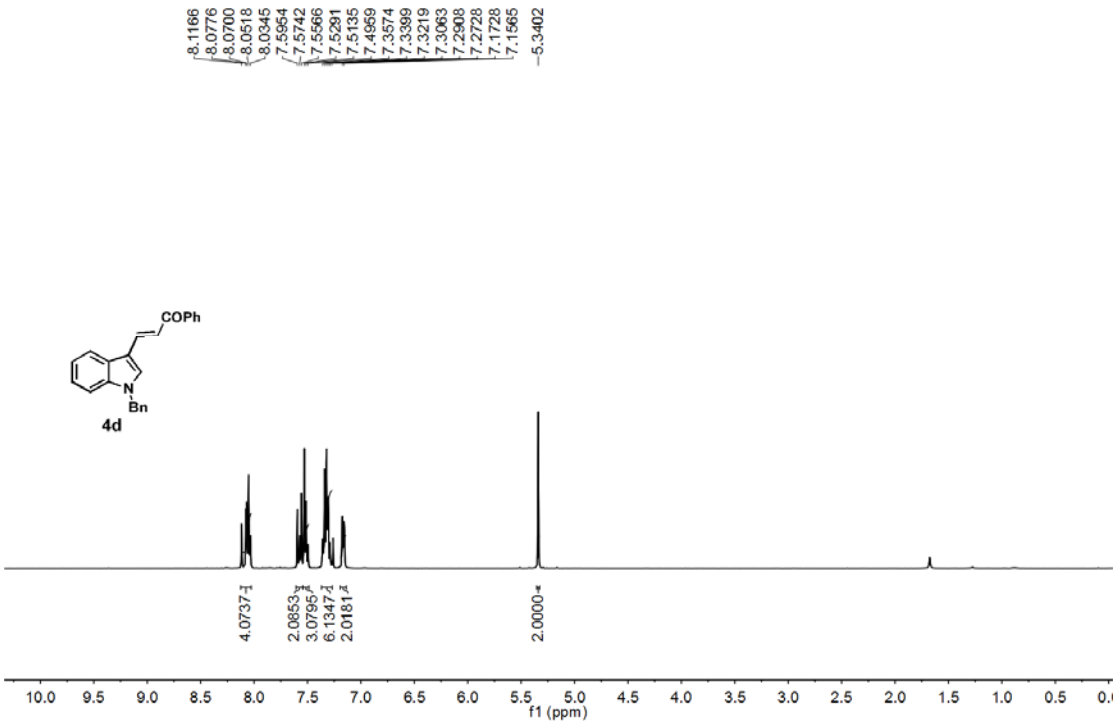
gtl-14701
1H NMR gtl-14701 in CDCl3



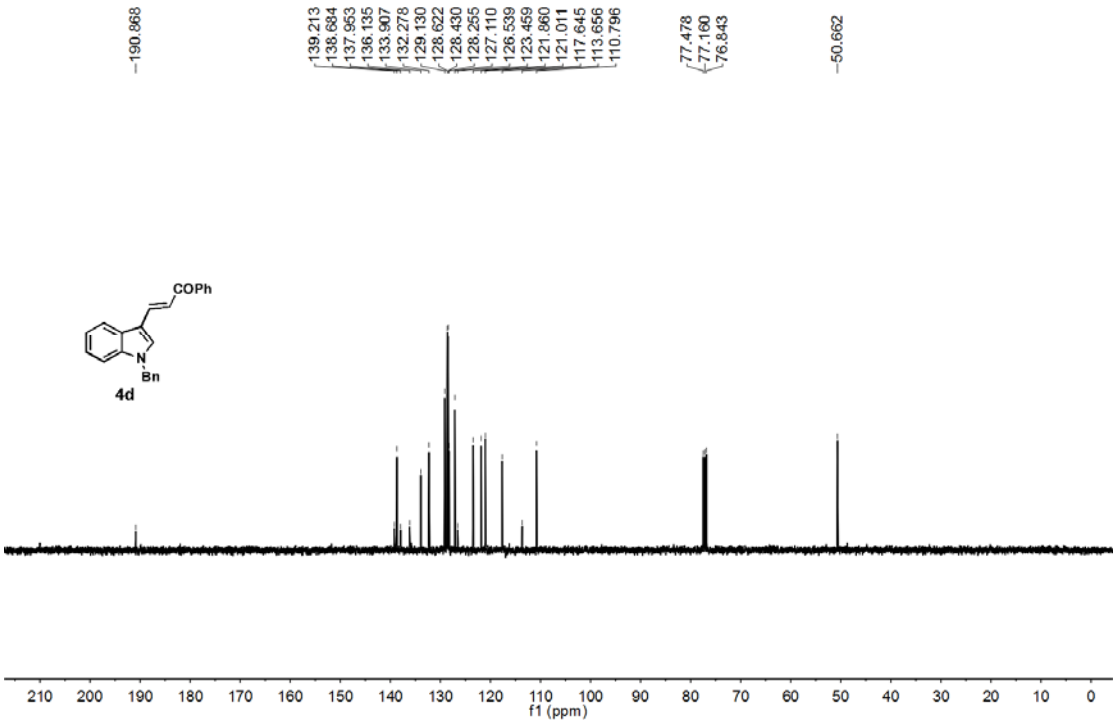
gtl-14701
13C NMR gtl-14701 CDCl3



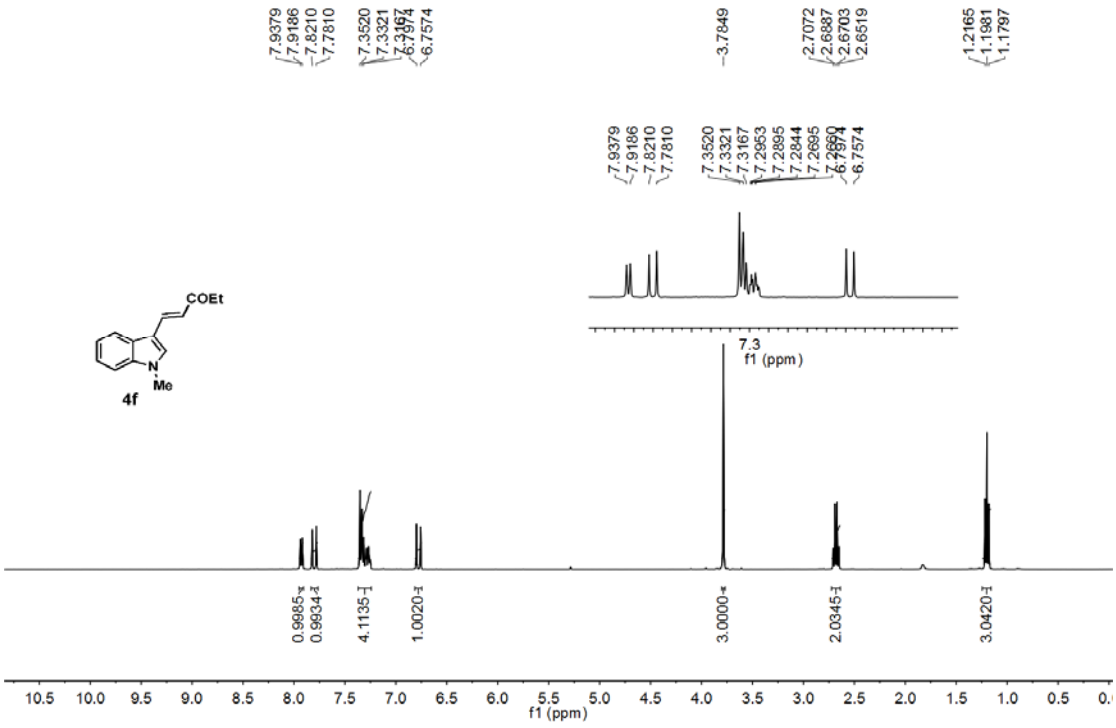
gtl-13400
1H NMR gtl-13400 in CDCl3



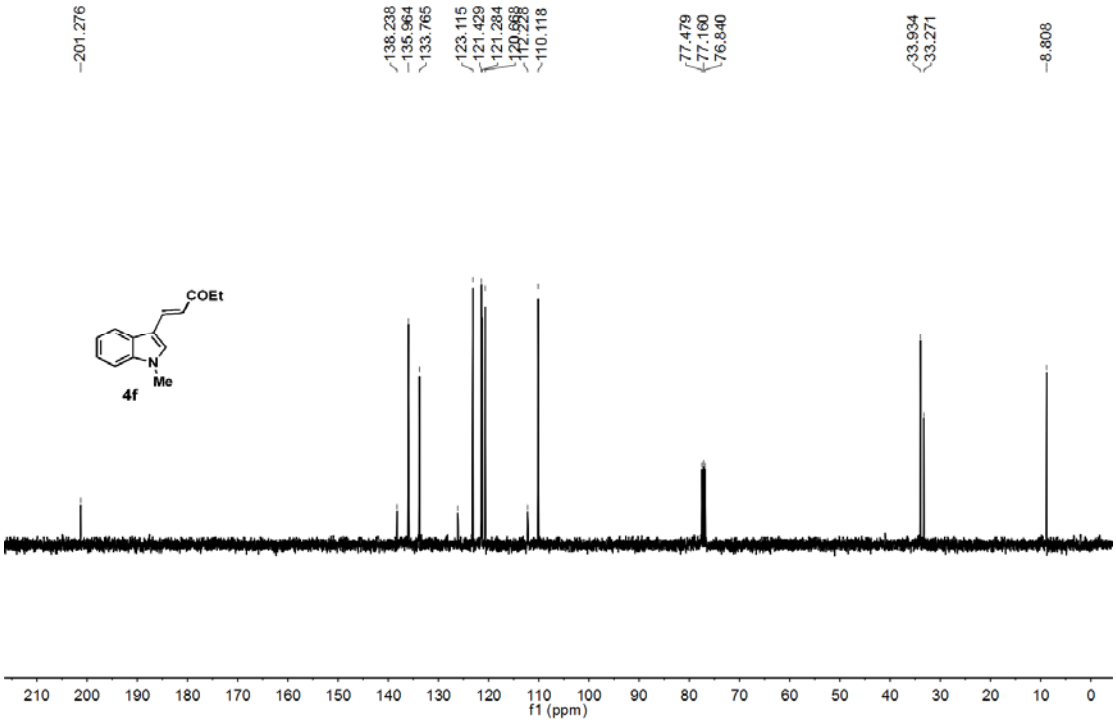
gtl-13400
13C NMR gtl-13400 CDCl3



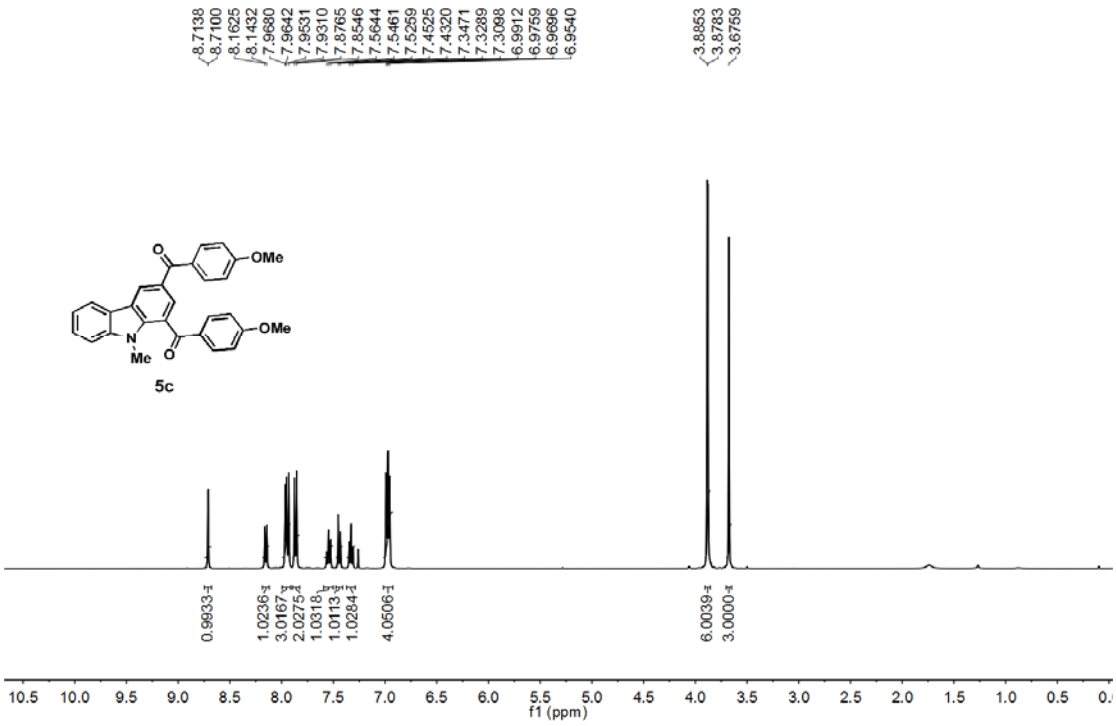
gtl-15601
1H NMR gtl-15601 in CDCl3



gtl-15601
13C NMR gtl-15601 CDCl3

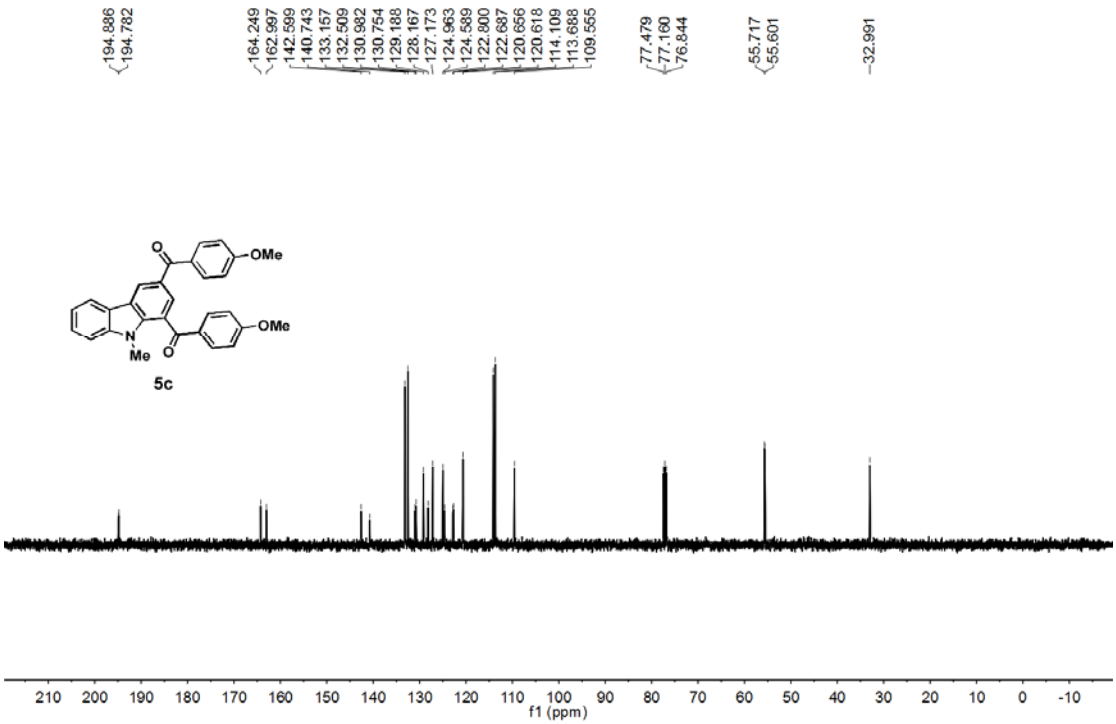


gtl-12300
1H NMR gtl-12300 in CDCl3



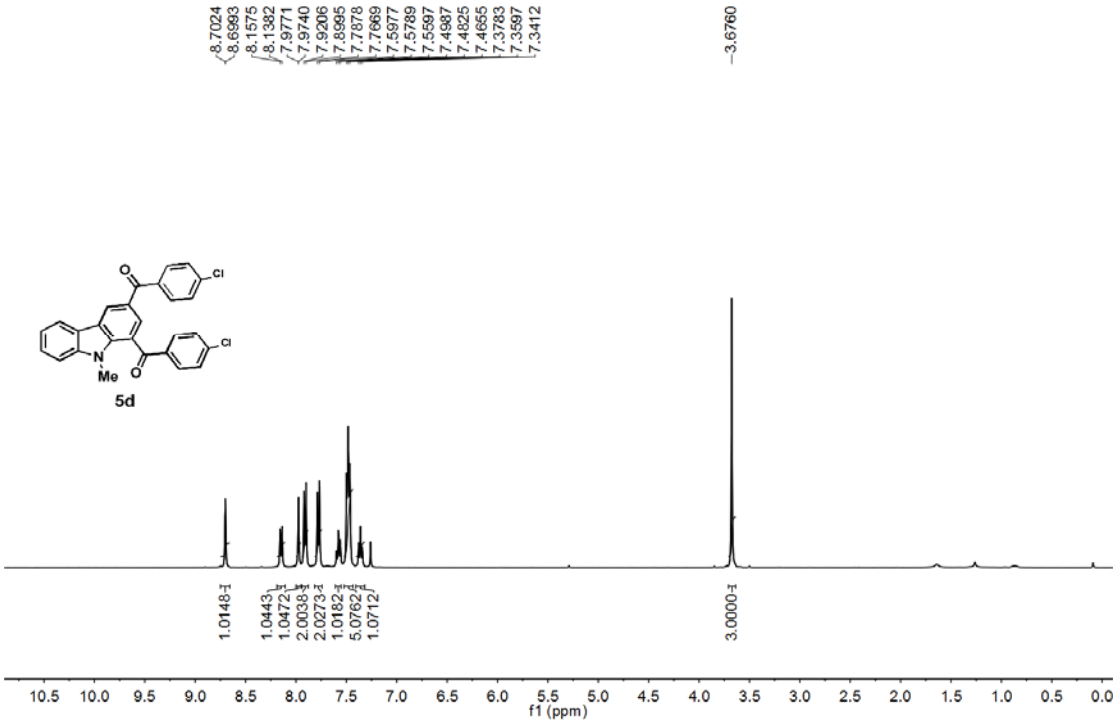
5c

gtl-12300
13C NMR (gtl-12300 in CDCl3)



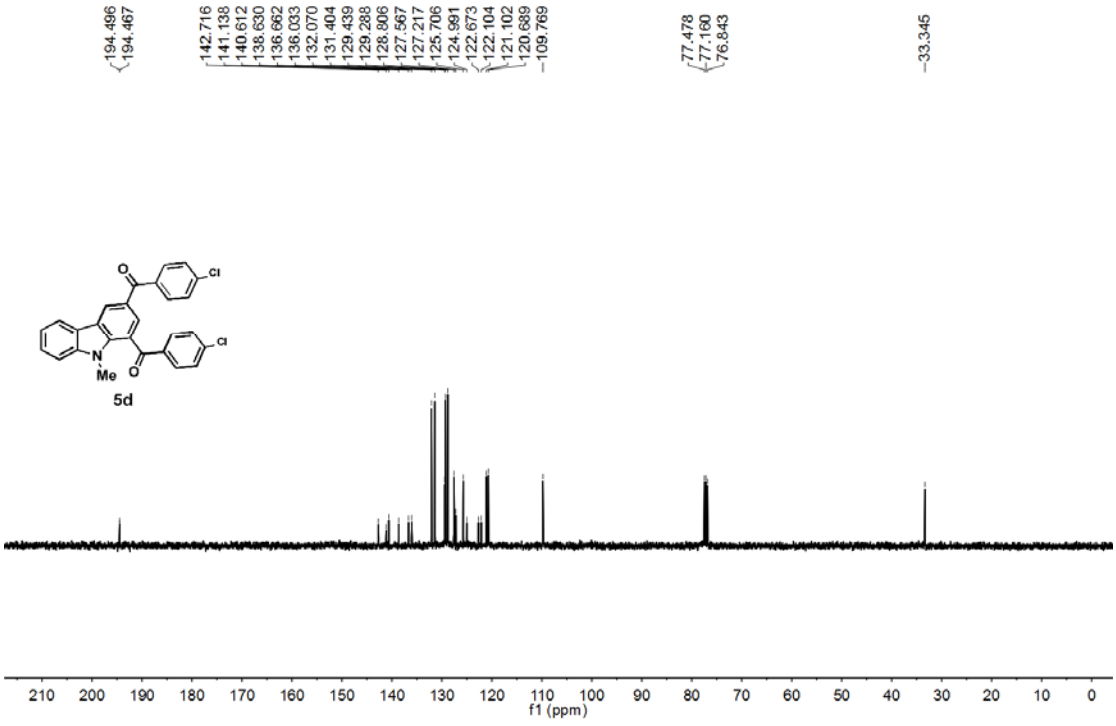
5c

gtl-11800
1H NMR (gtl-11800 in CDCl3)



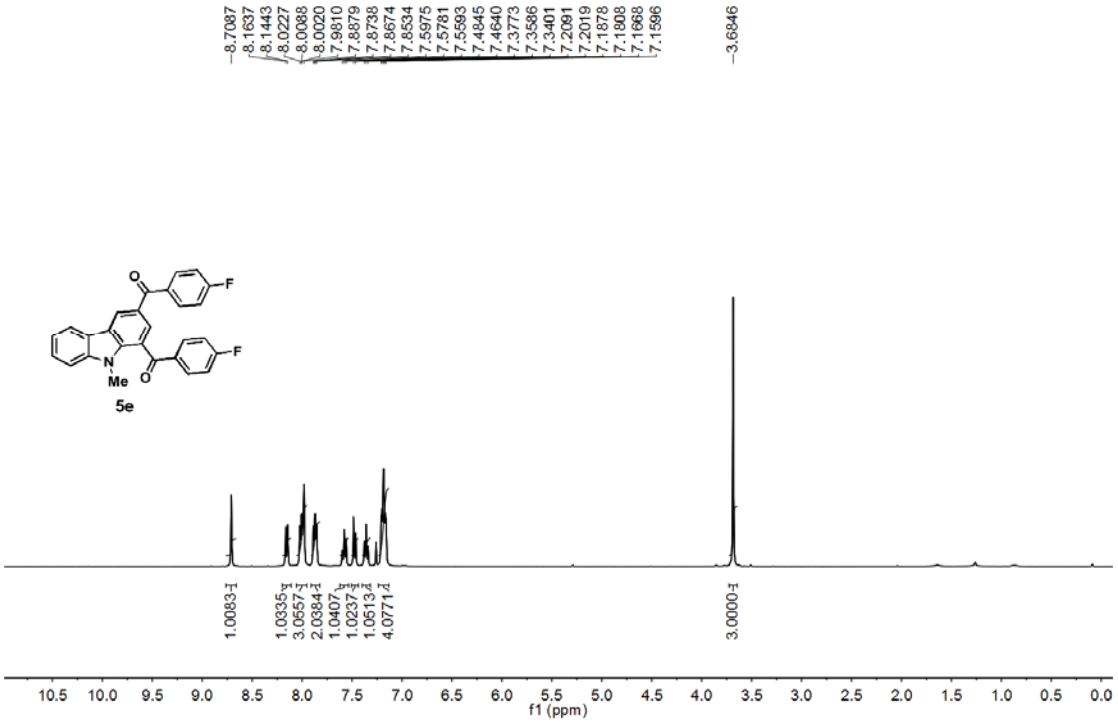
5d

gtl-11800
13C NMR (gtl-11800 in CDCl3)



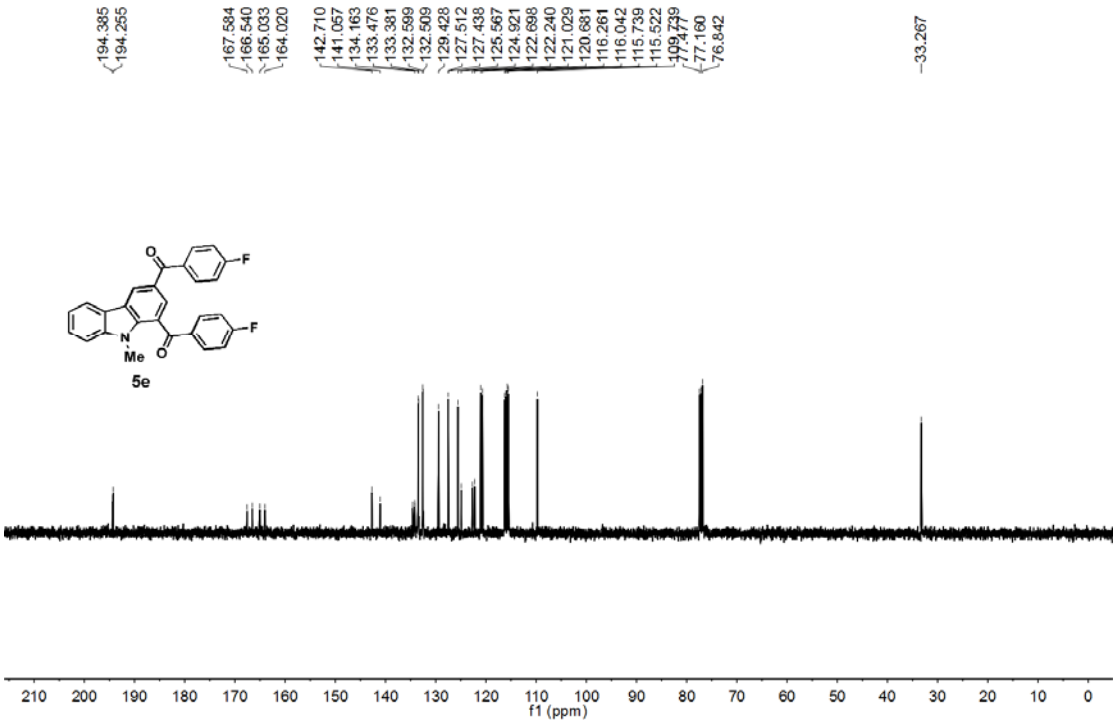
5d

gtl-12000
1H NMR (gtl-12000 in CDCl3)



5e

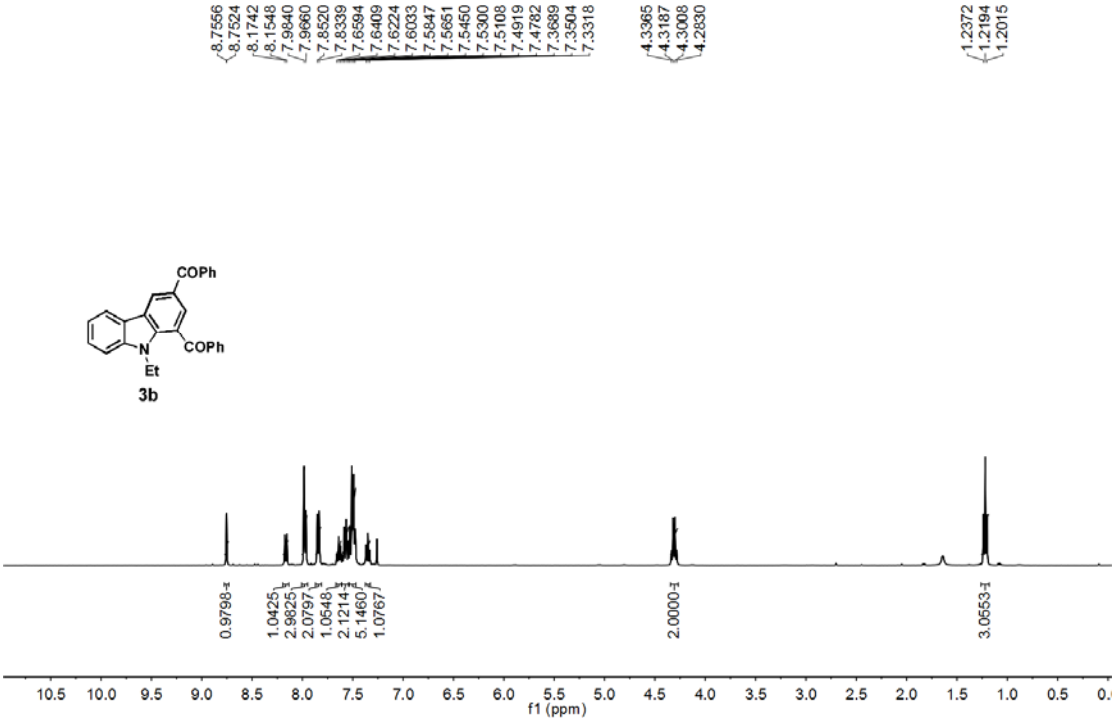
gtl-12000
13C NMR (gtl-12000 in CDCl3)



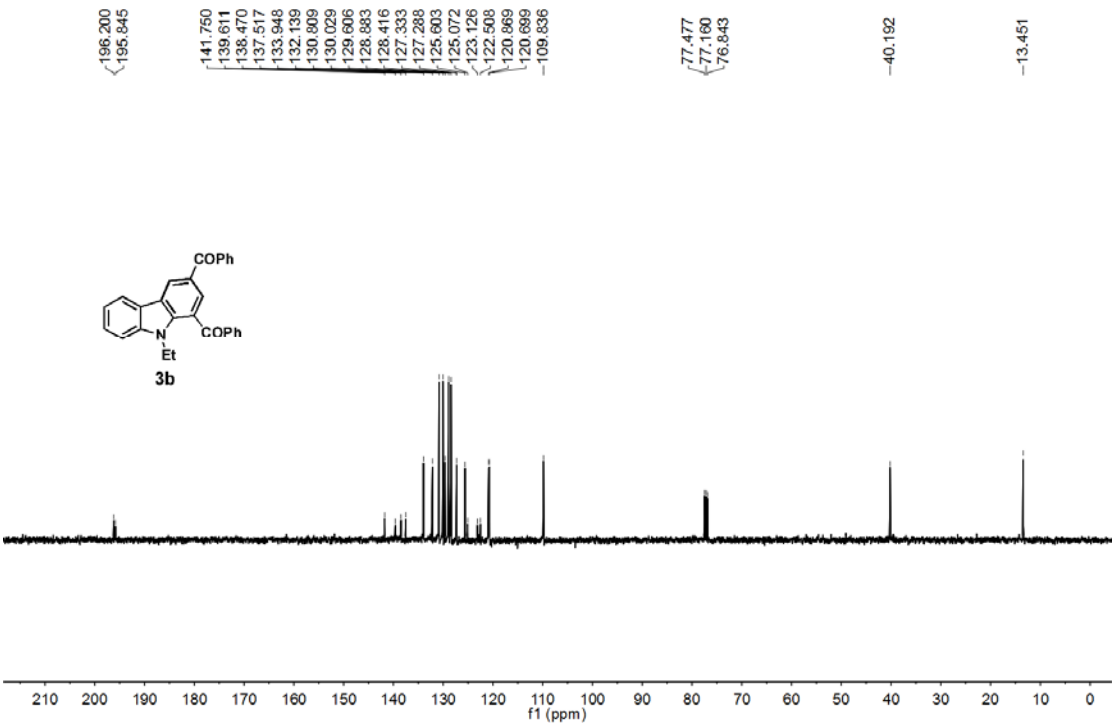
5e

6. Copies of NMR spectra for new compounds

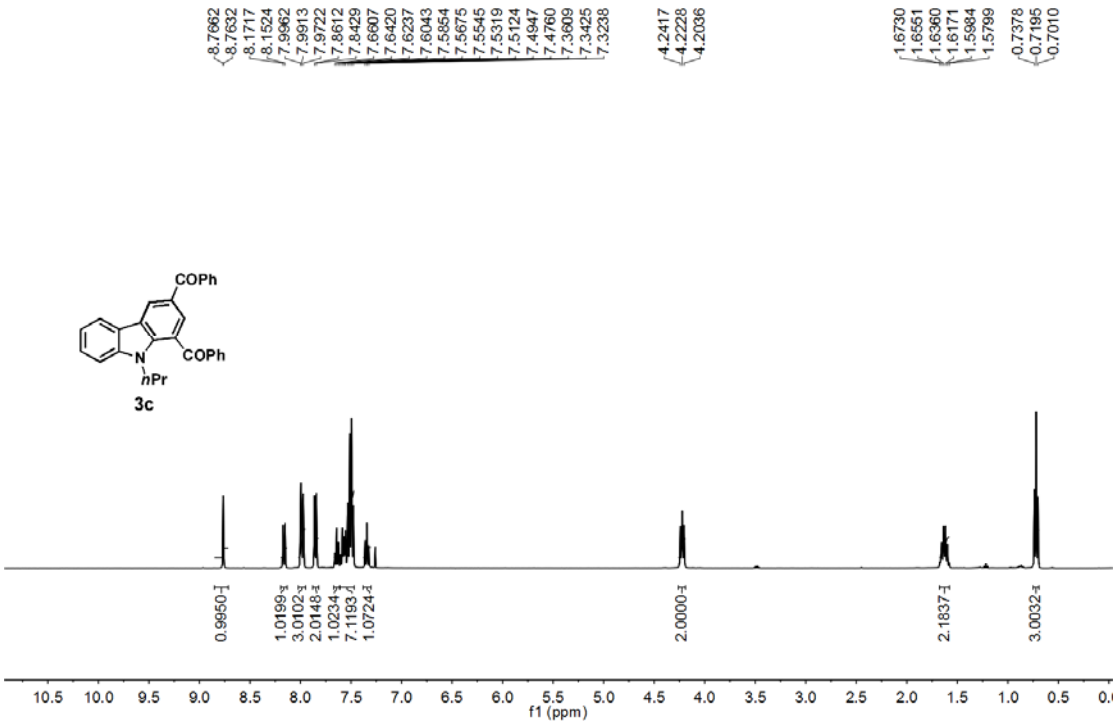
gtl-14700
1H NMR gtl-14700 in CDCl3



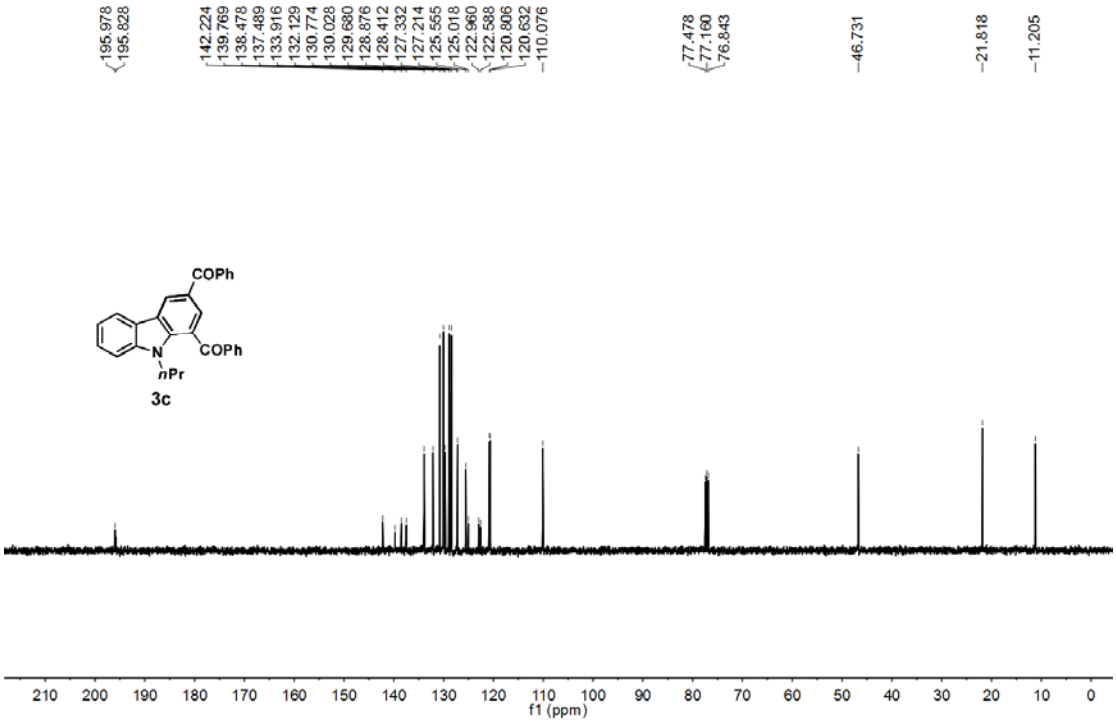
gtl-14700
13C NMR gtl-14700 CDCl3



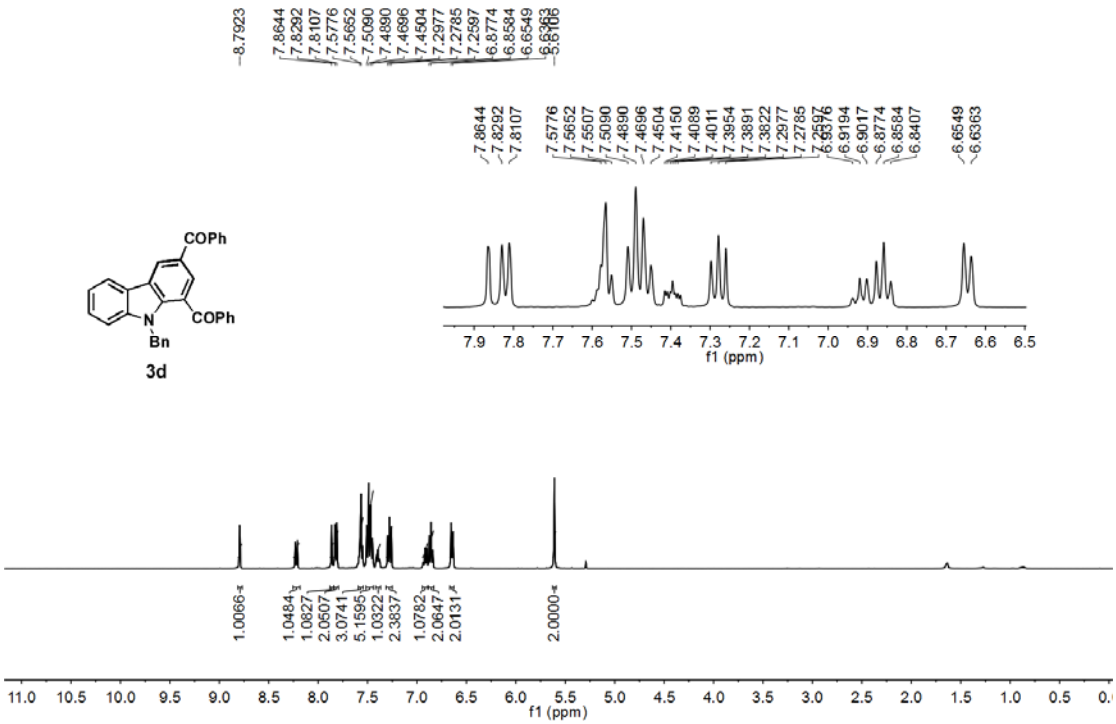
gtl-14100
1H NMR gtl-14100 in CDCl3



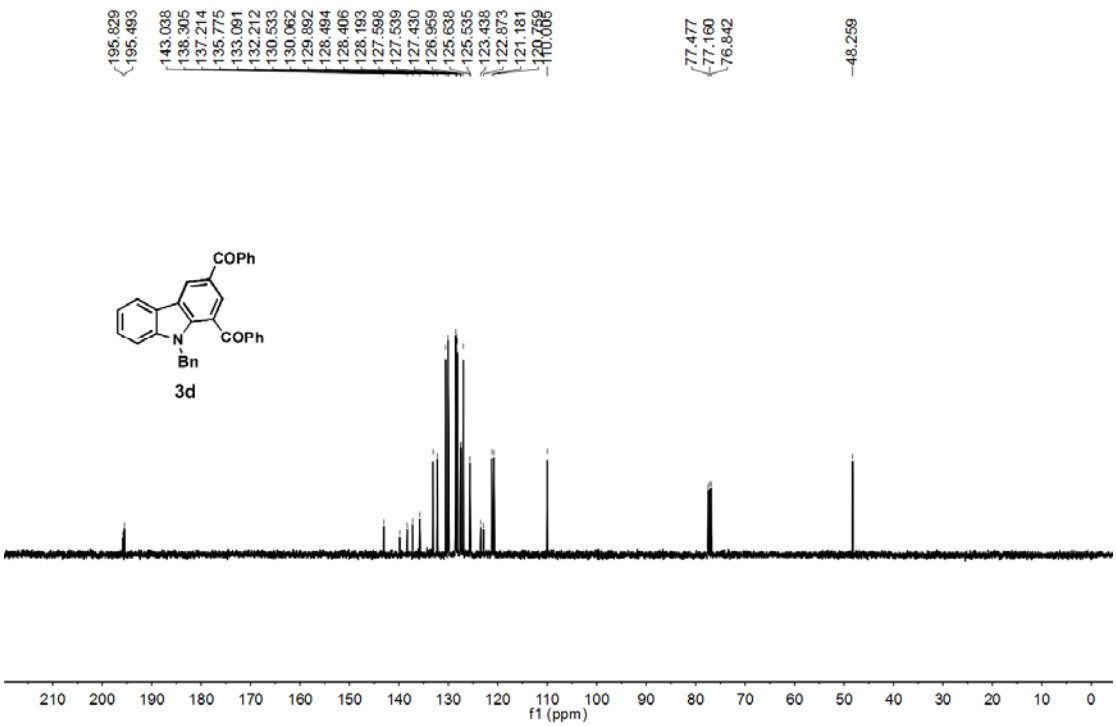
gtl-14100
13C NMR gtl-14100 CDCl3



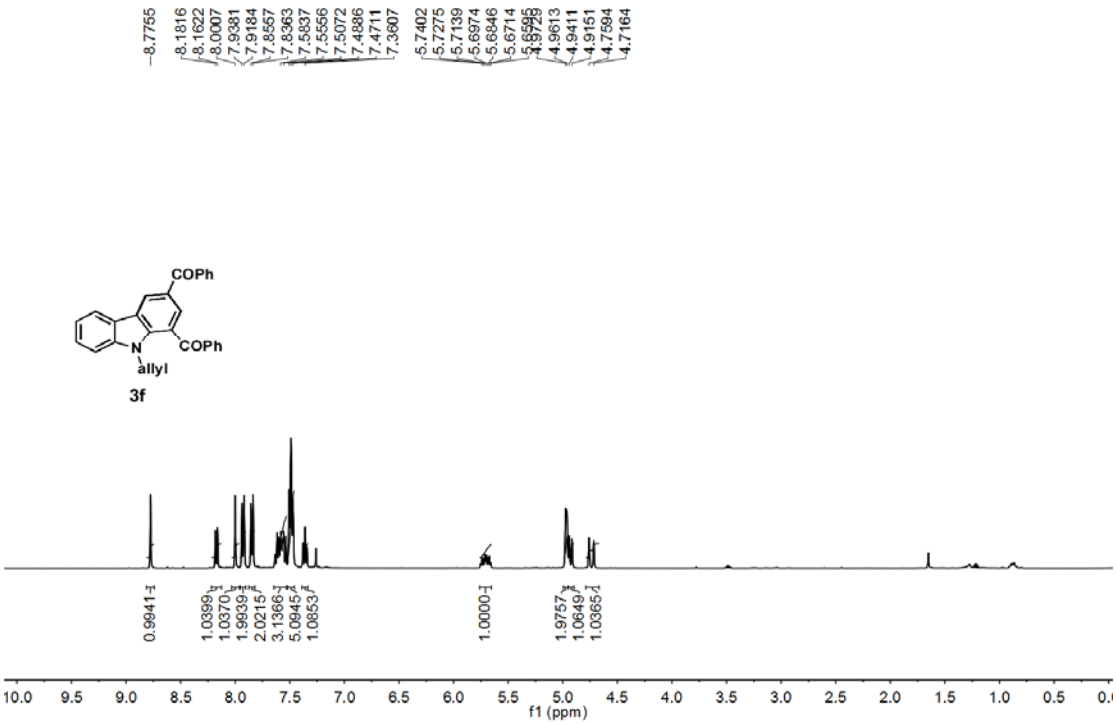
gtl-13401
1H NMR gtl-13401 in CDCl3



gtl-13401
13C NMR gtl-13401 CDCl3

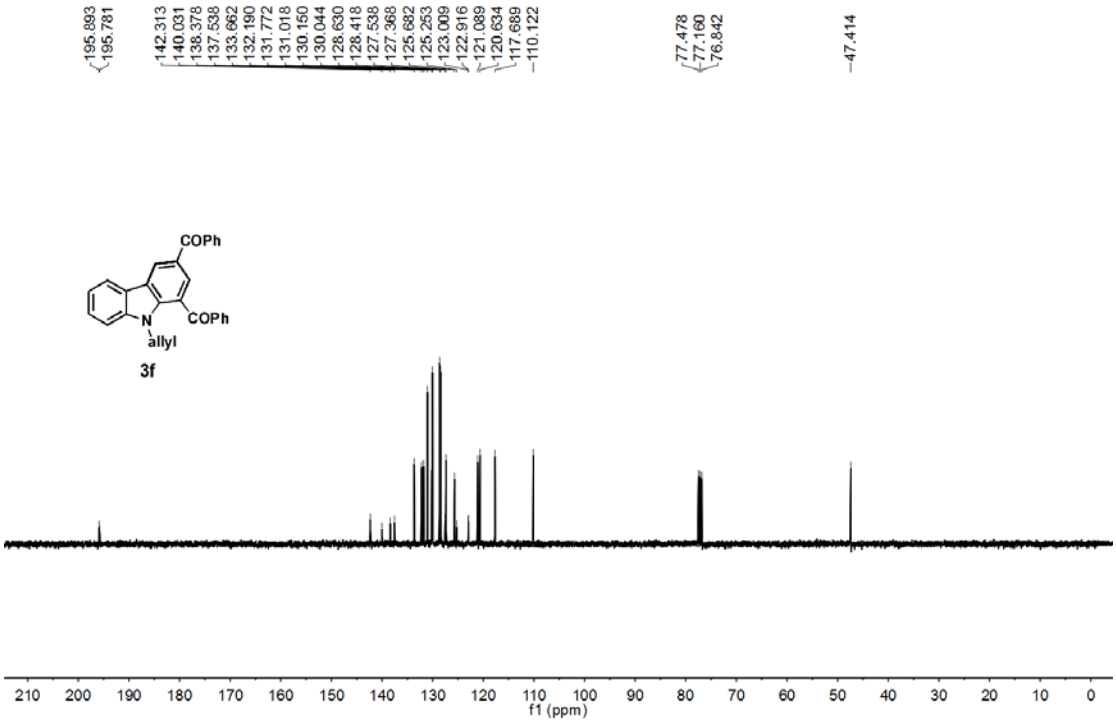


gtl-13700
1H NMR gtl-13700 in CDCl3



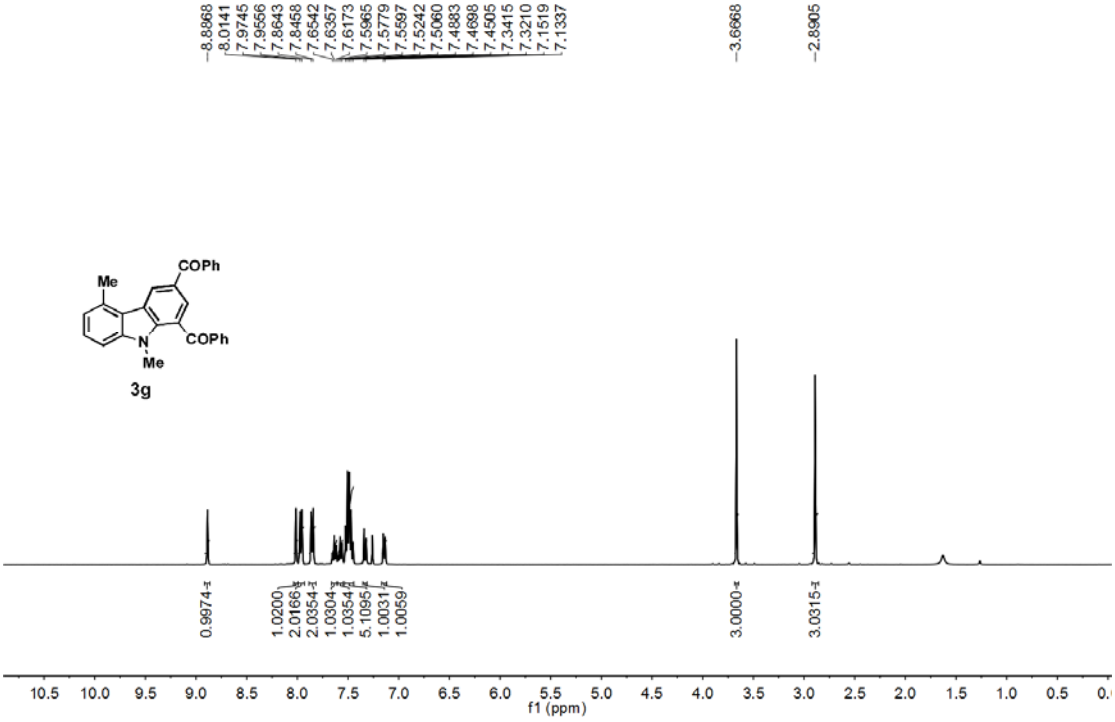
3f

gtl-13700
13C NMR gtl-13700 CDCl3

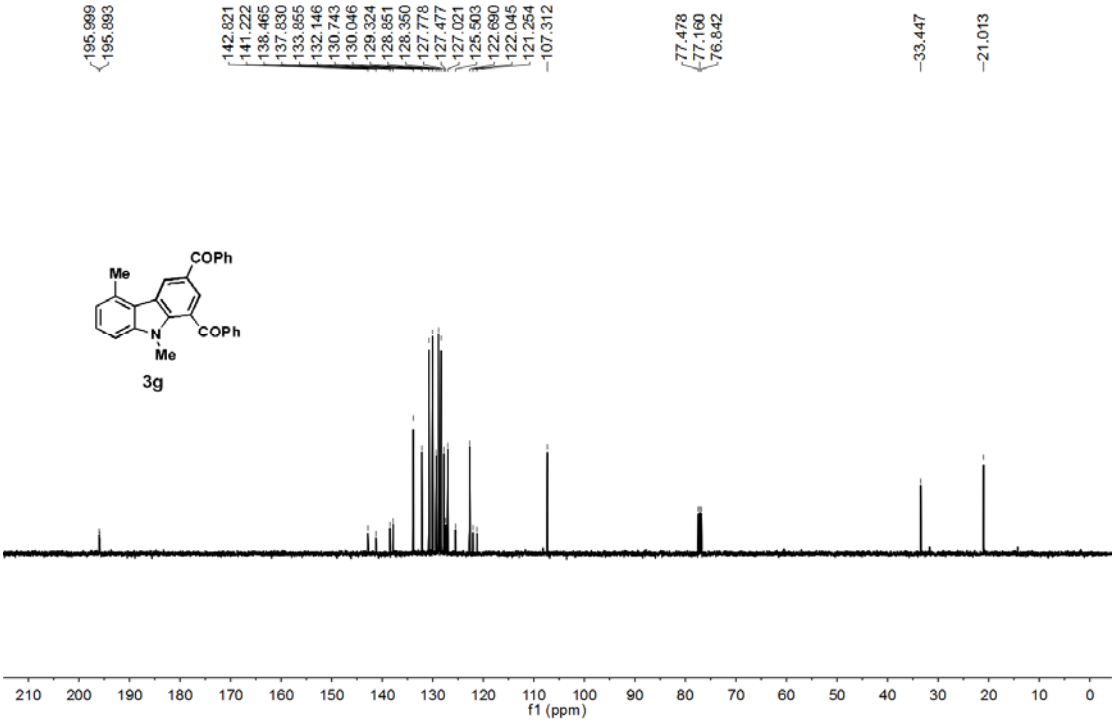


3f

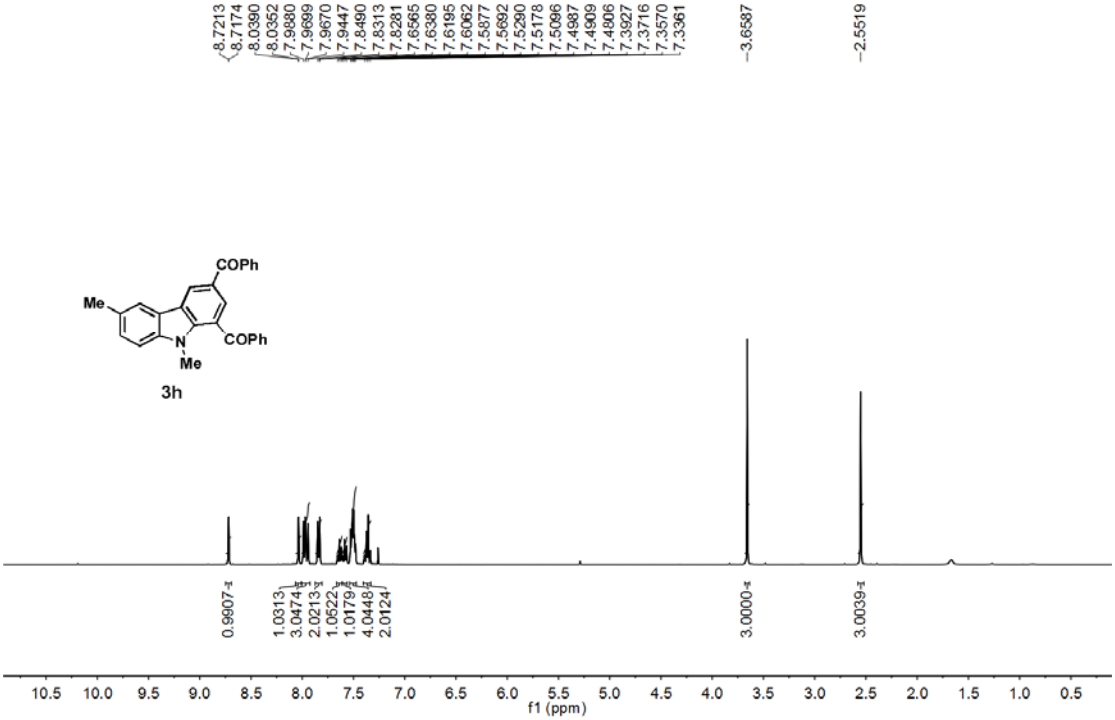
gtl-15500
1H NMR gtl-15500 in CDCl3



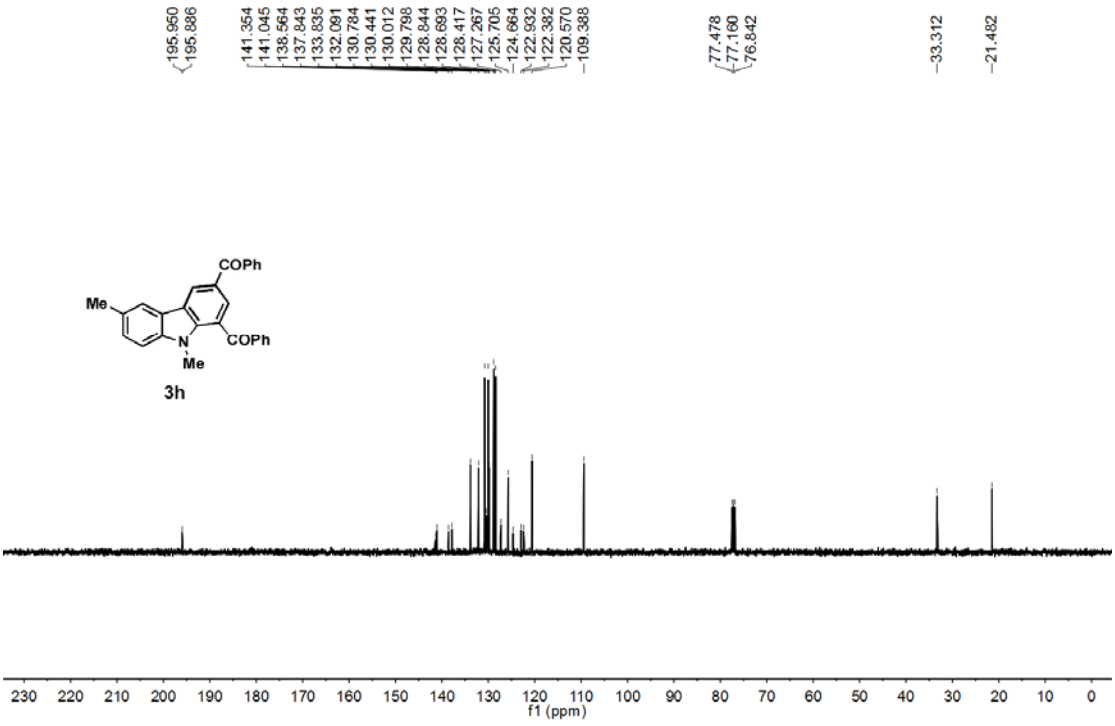
gtl-15500
13C NMR gtl-15500 CDCl3



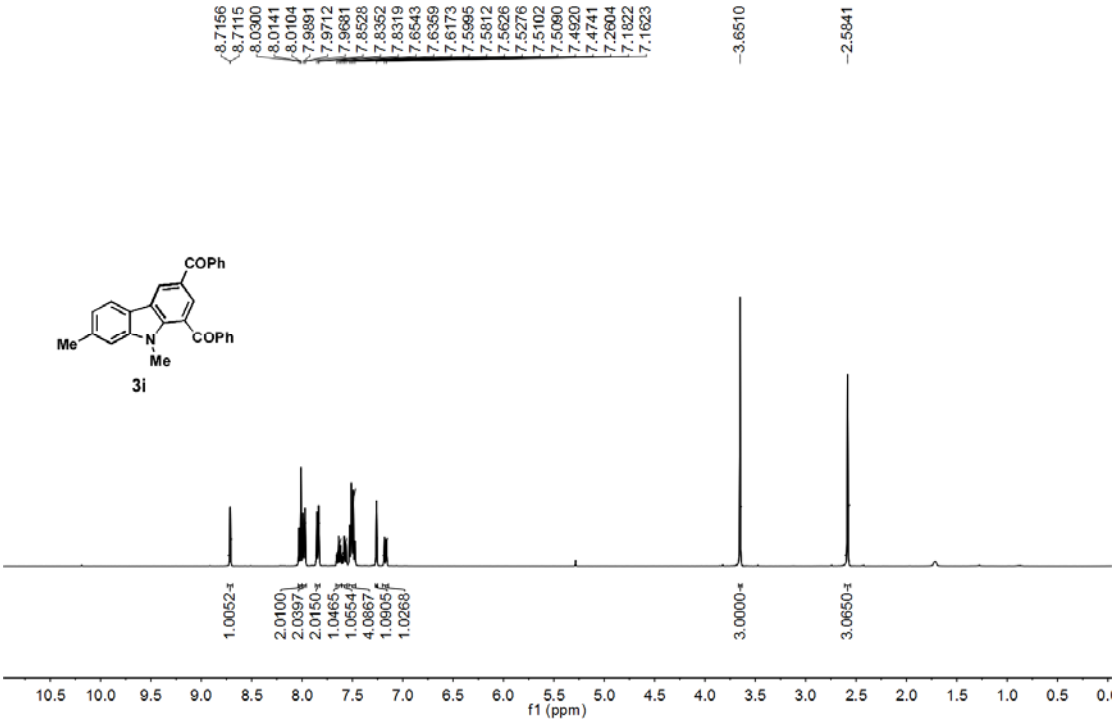
gtl-15400
1H NMR gtl-15400 in CDCl3



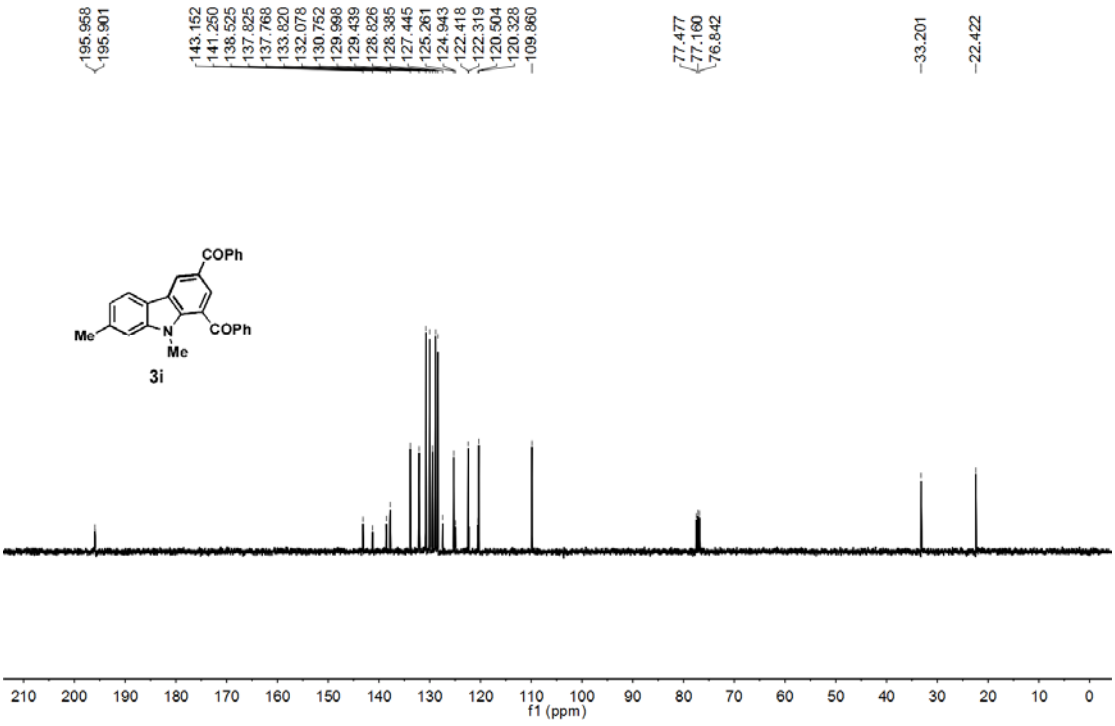
gtl-15400
13C NMR gtl-15400 CDCl3



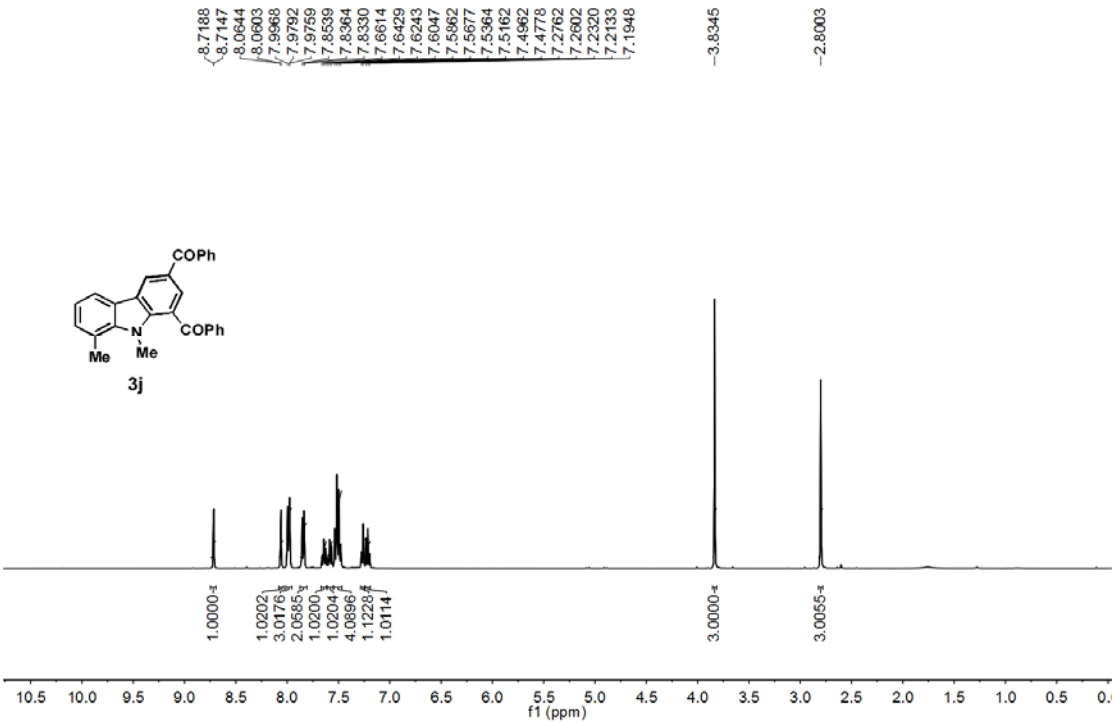
gtl-16600
1H NMR gtl-16600 in cdcl3



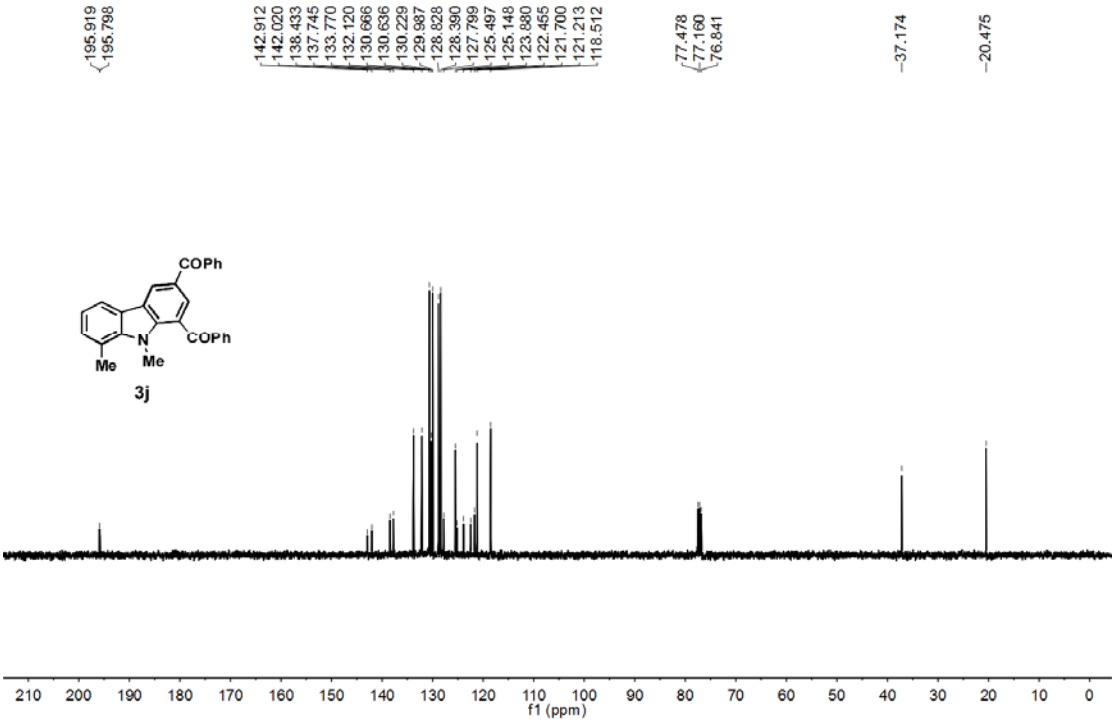
gtl-16600
13C NMR gtl-16600 CDCl3



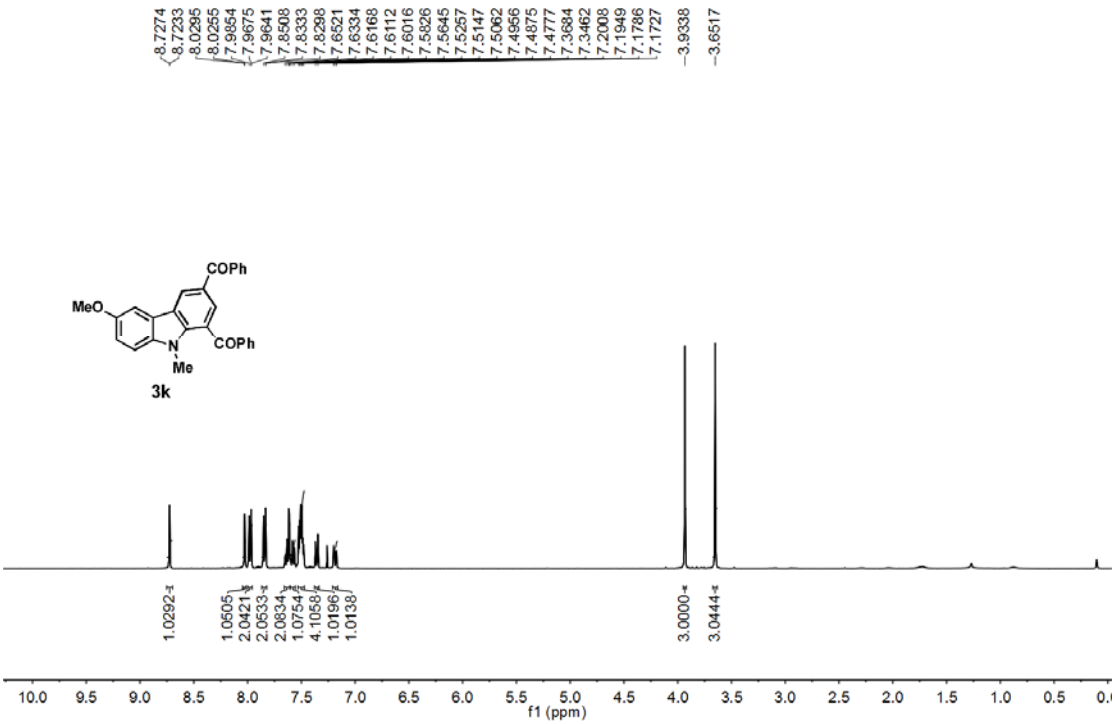
gtl-14500
1H NMR gtl-14500 in CDCl3



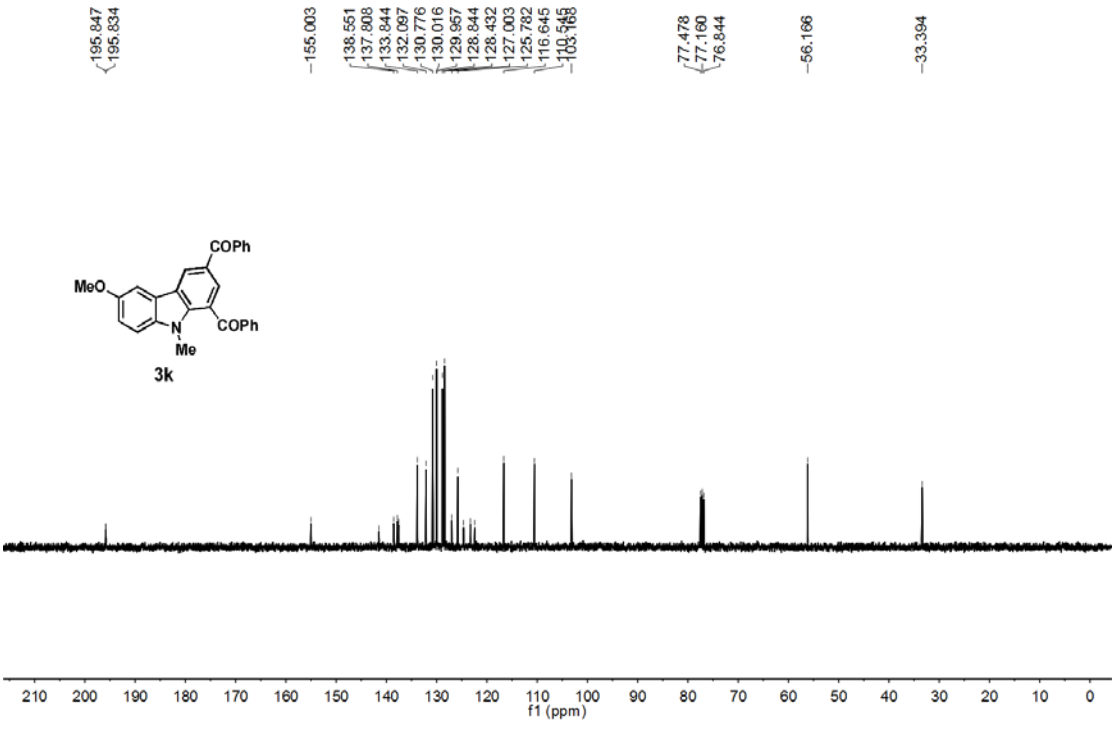
gtl-14500
13C NMR gtl-14500 CDCl3



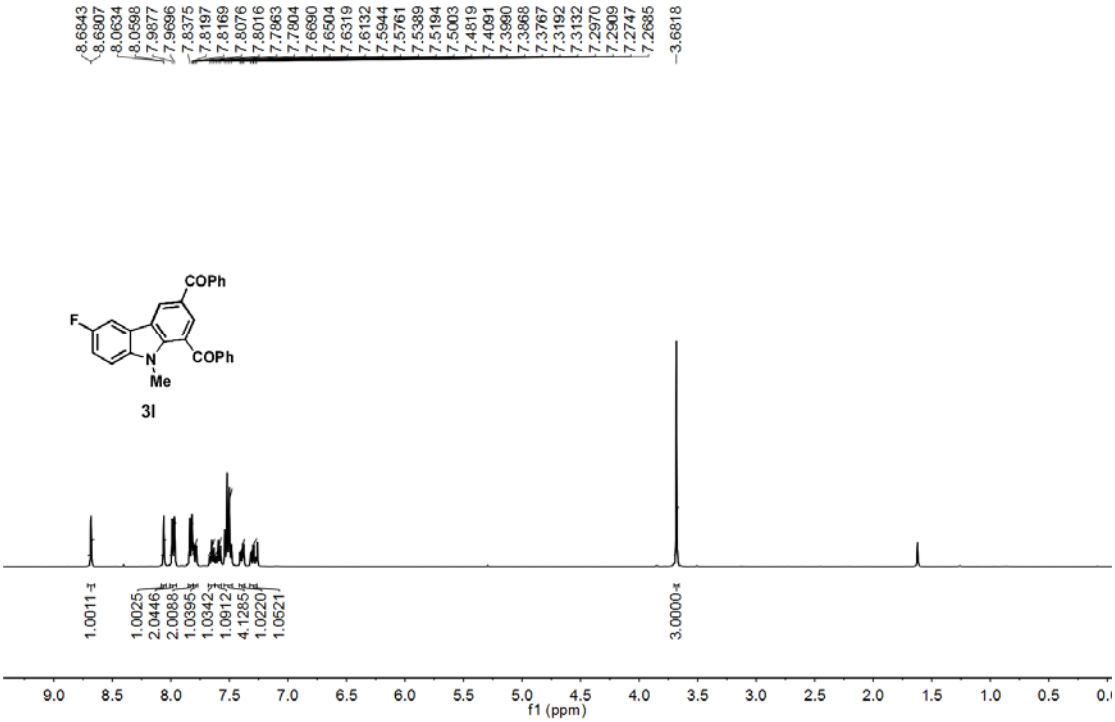
gtl-13600
1H NMR gtl-13600 in CDCl3



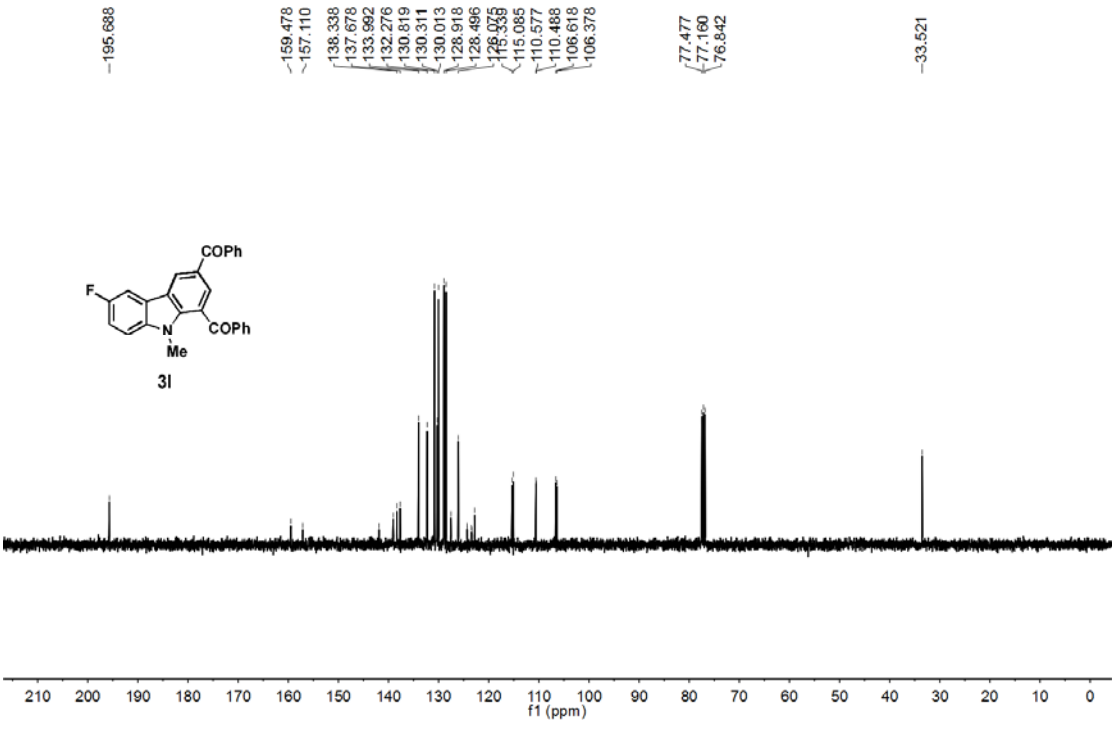
gtl-13600
13C NMR gtl-13600 CDCl3



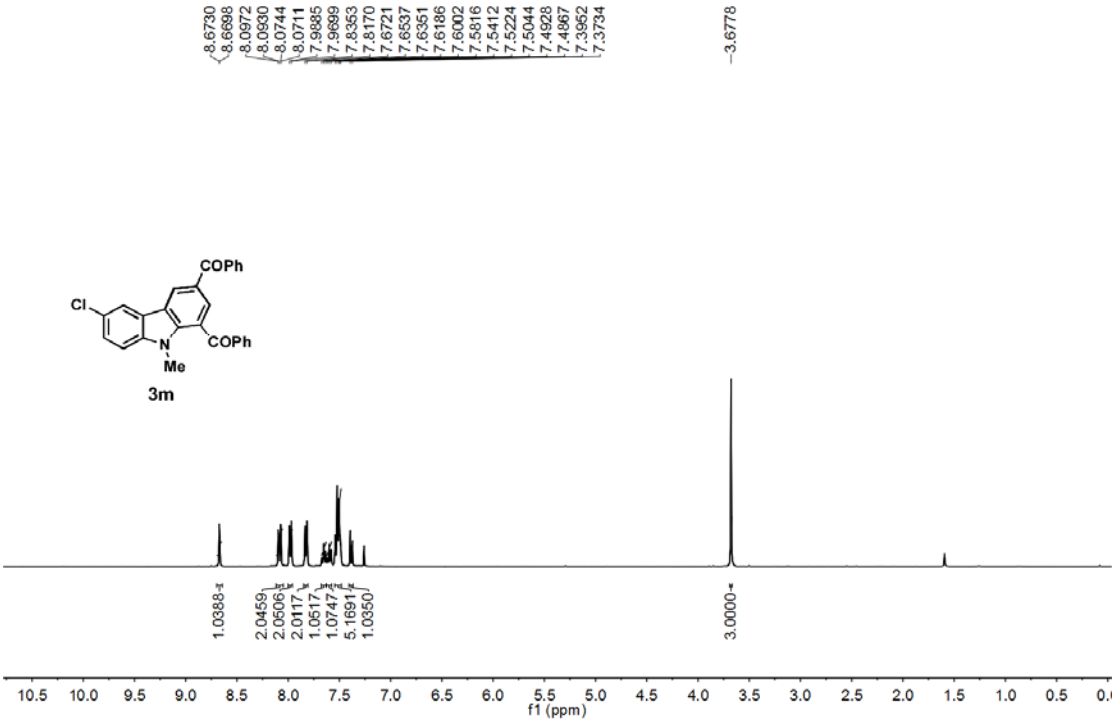
gtl-15200
1H NMR gtl-15200 in CDCl3



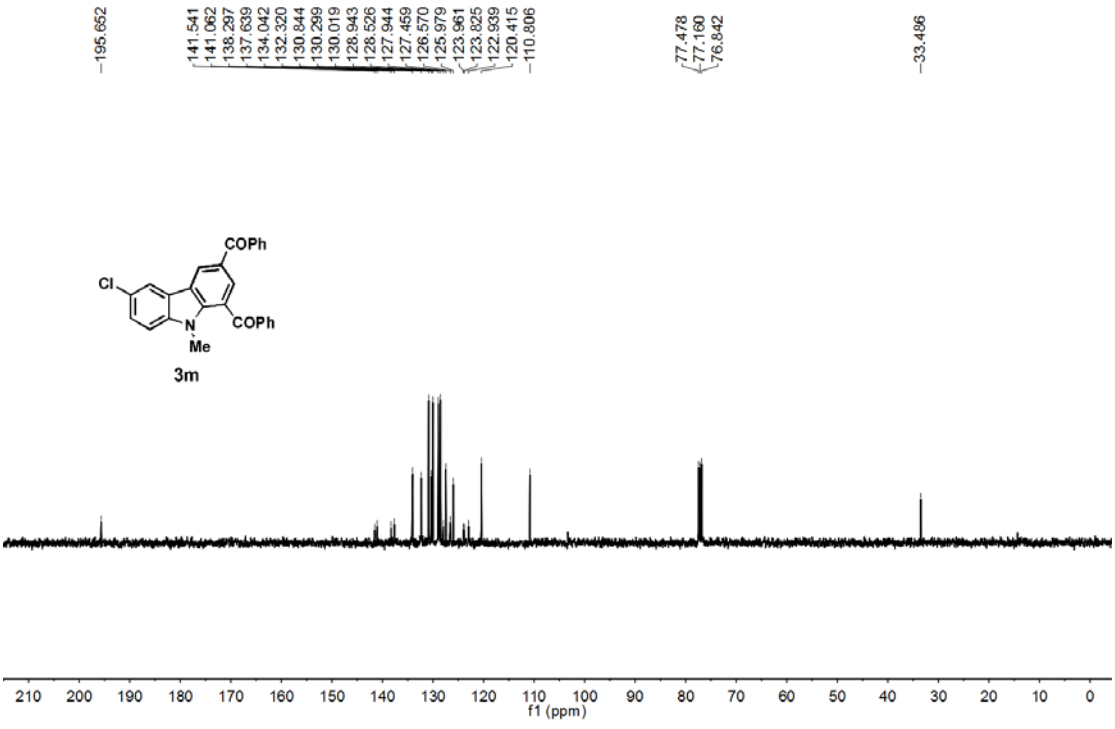
gtl-15200
13C NMR gtl-15200 CDCl3



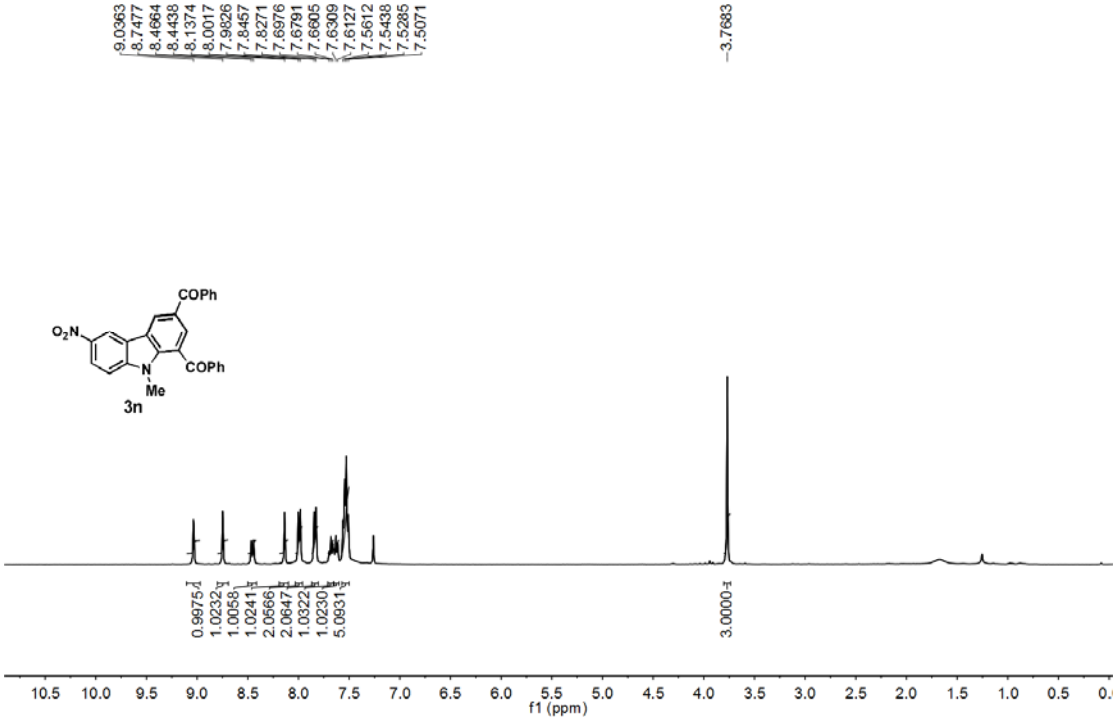
gtl-15300
1H NMR gtl-15300 in CDCl3



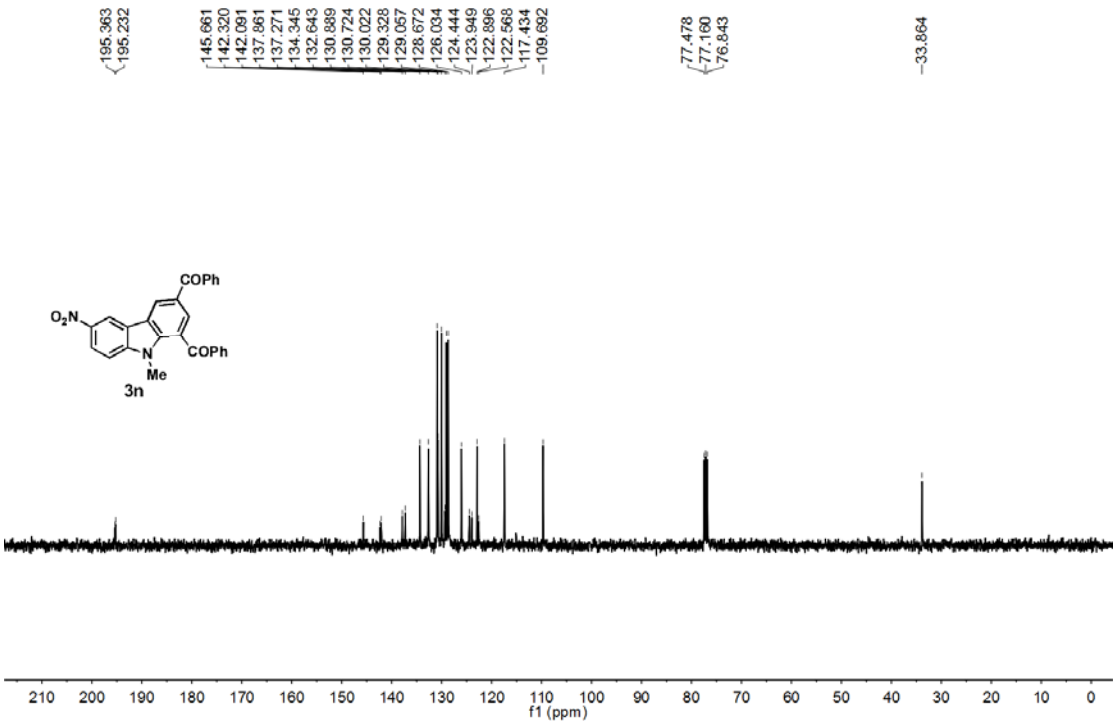
gtl-15300
13C NMR gtl-15300 CDCl3



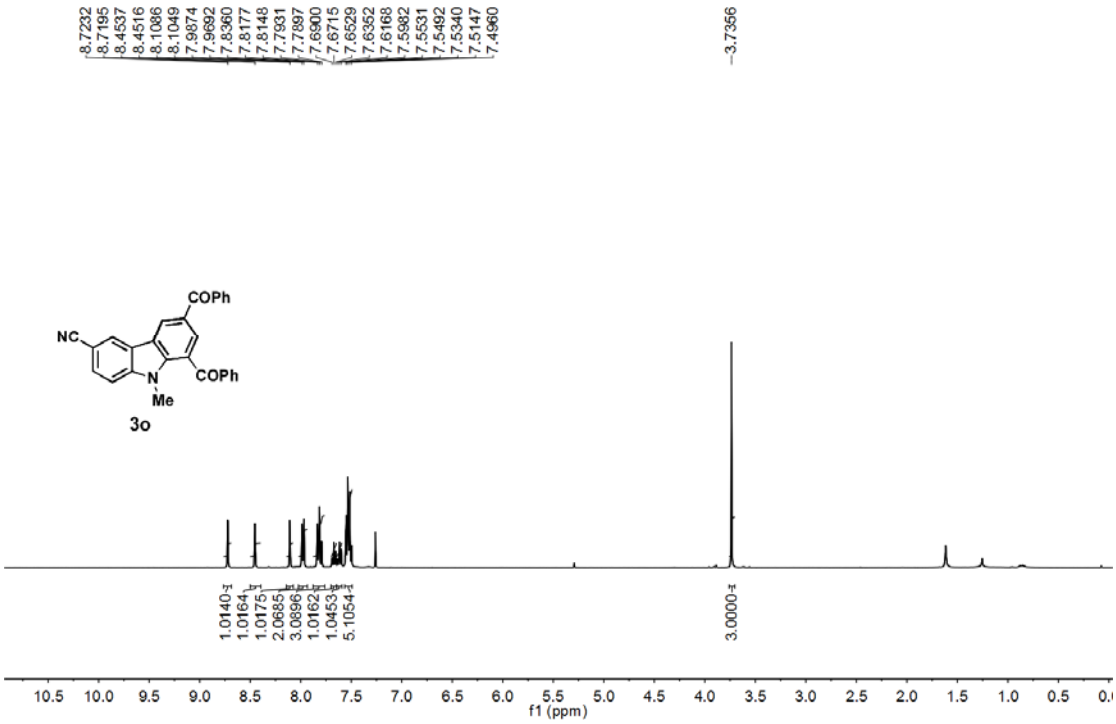
gtl-13800
1H NMR gtl-13800 in CDCl3



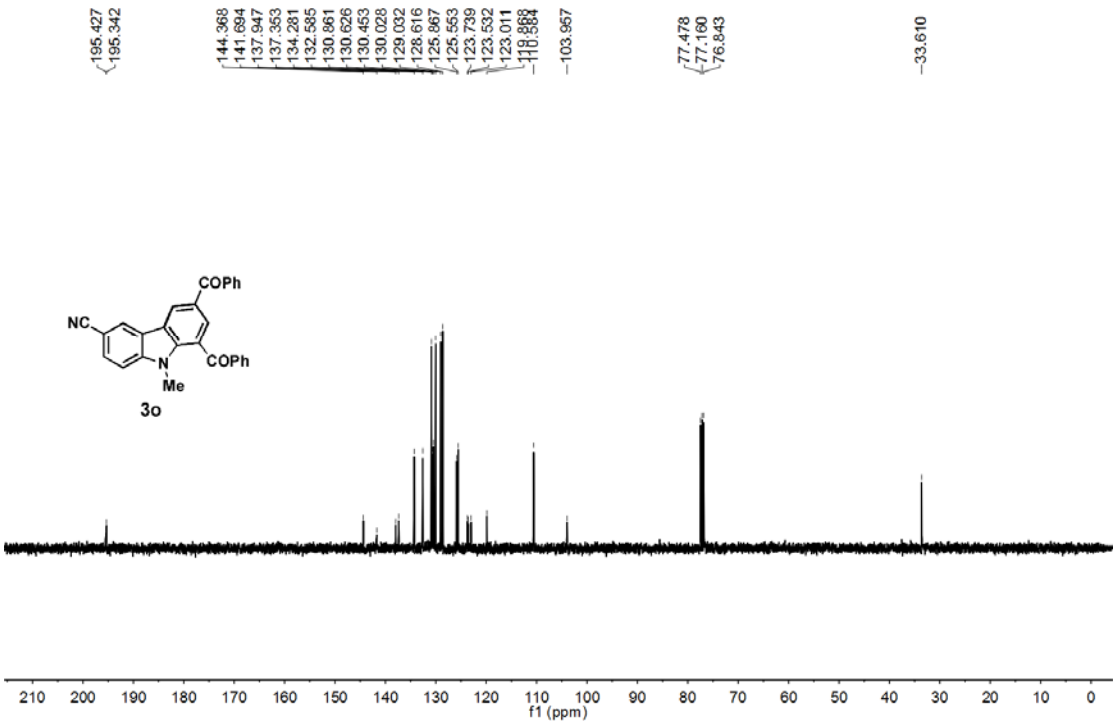
gtl-13800
13C NMR gtl-13800 CDCl3



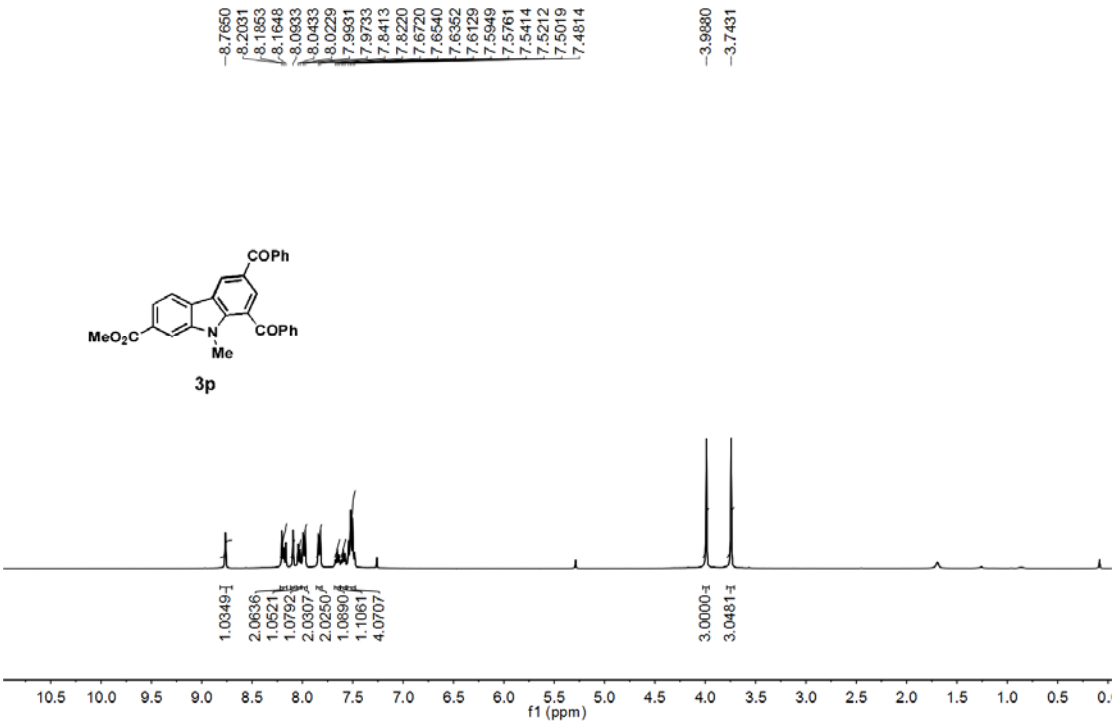
gtl-16700
1H NMR gtl-16700 in CDCl3



gtl-16700
13C NMR gtl-16700 CDCl3

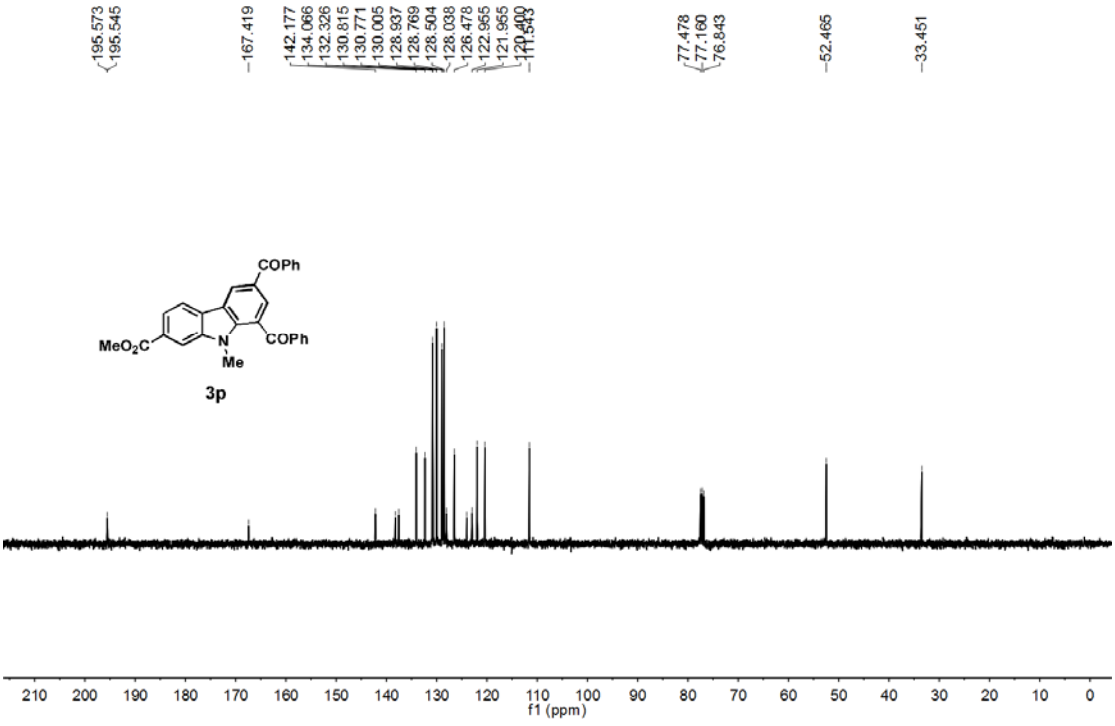


gtl-14900
1H NMR gtl-14900 in CDCl3



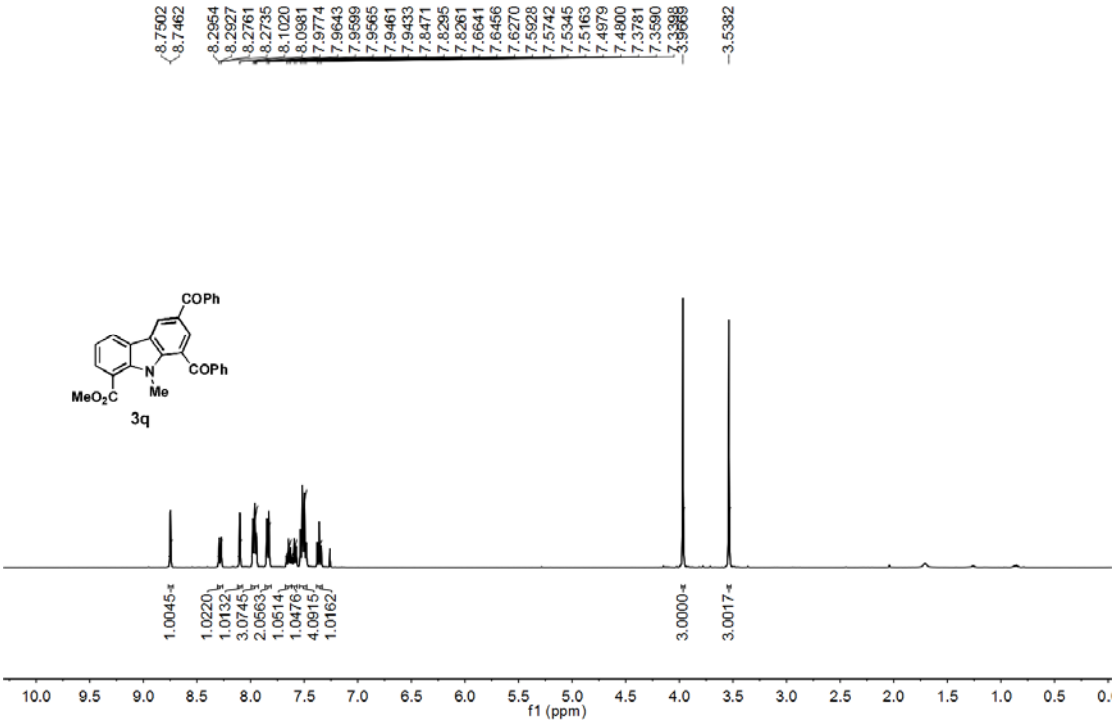
3p

gtl-14900
13C NMR gtl-14900 CDCl3

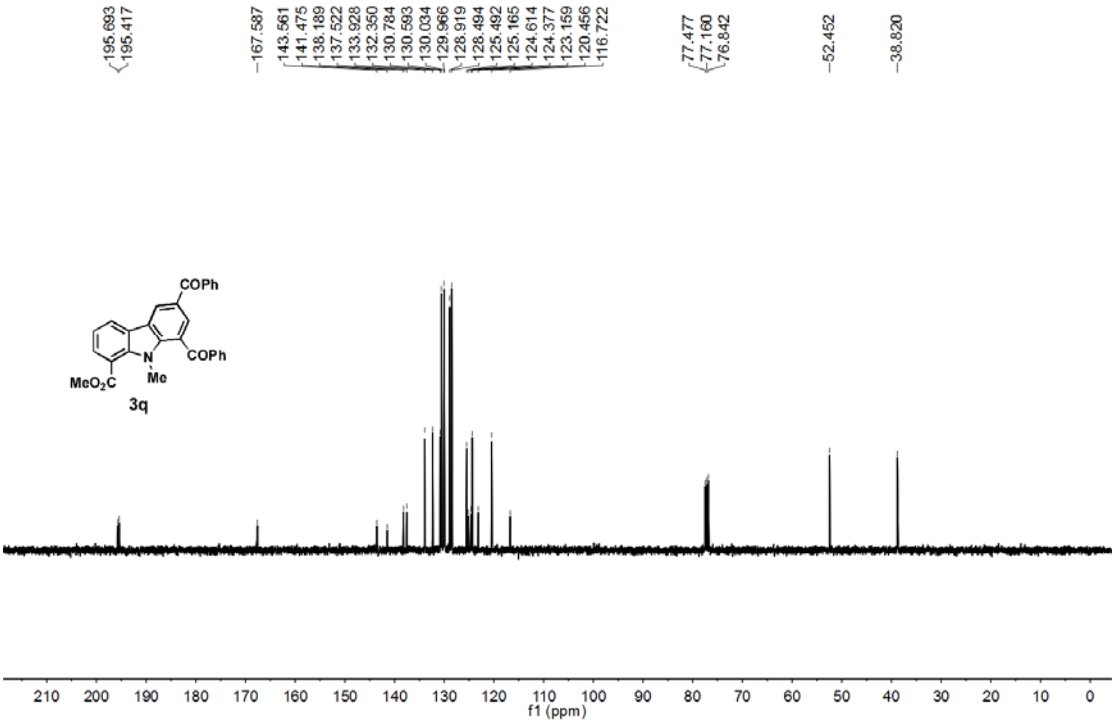


3p

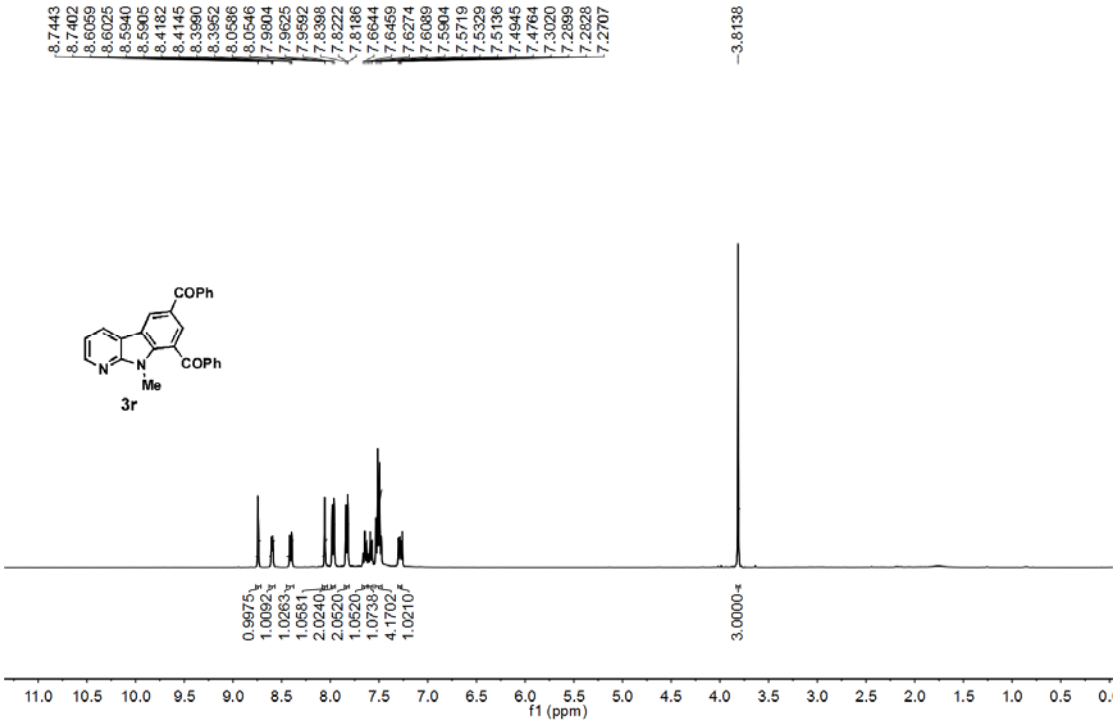
gtl-25700
1H NMR gtl-25700 in CDCl3



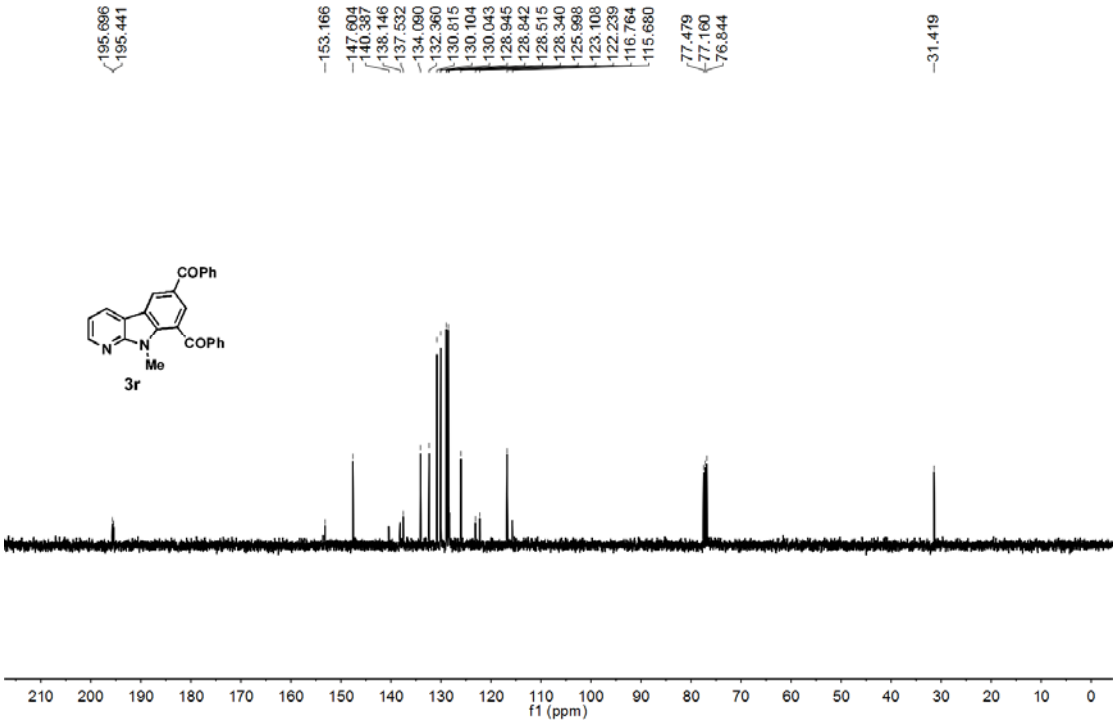
gtl-25700
13C NMR gtl-25700 CDCl3



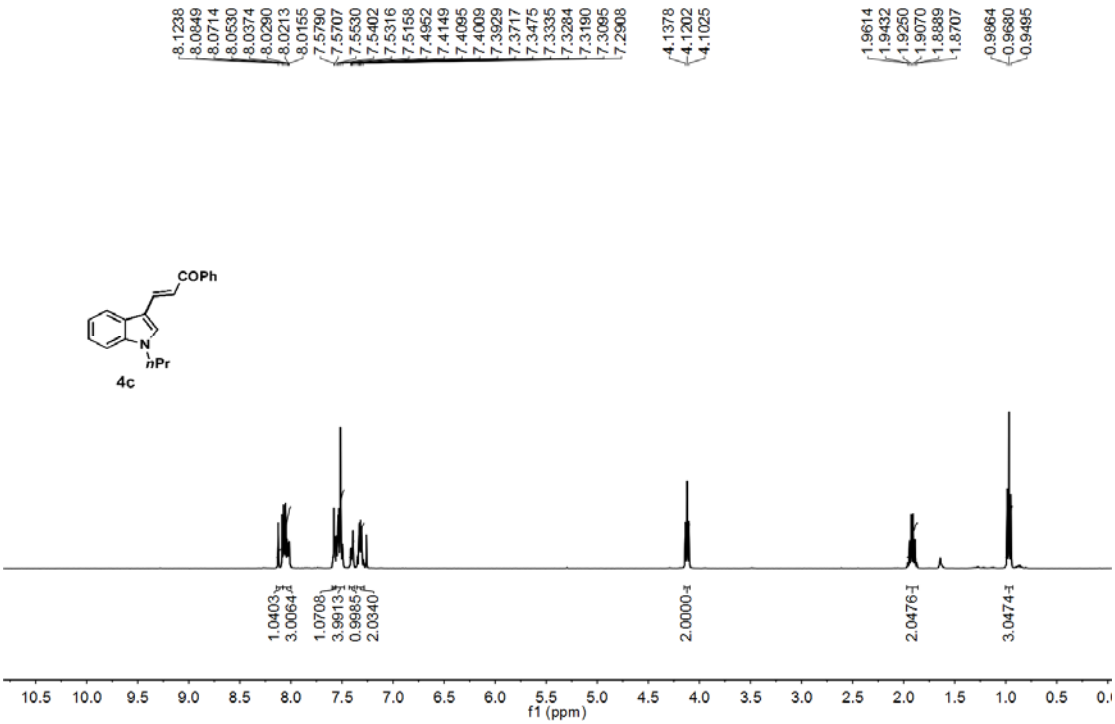
gtl-25100
1H NMR gtl-25100 in CDCl3



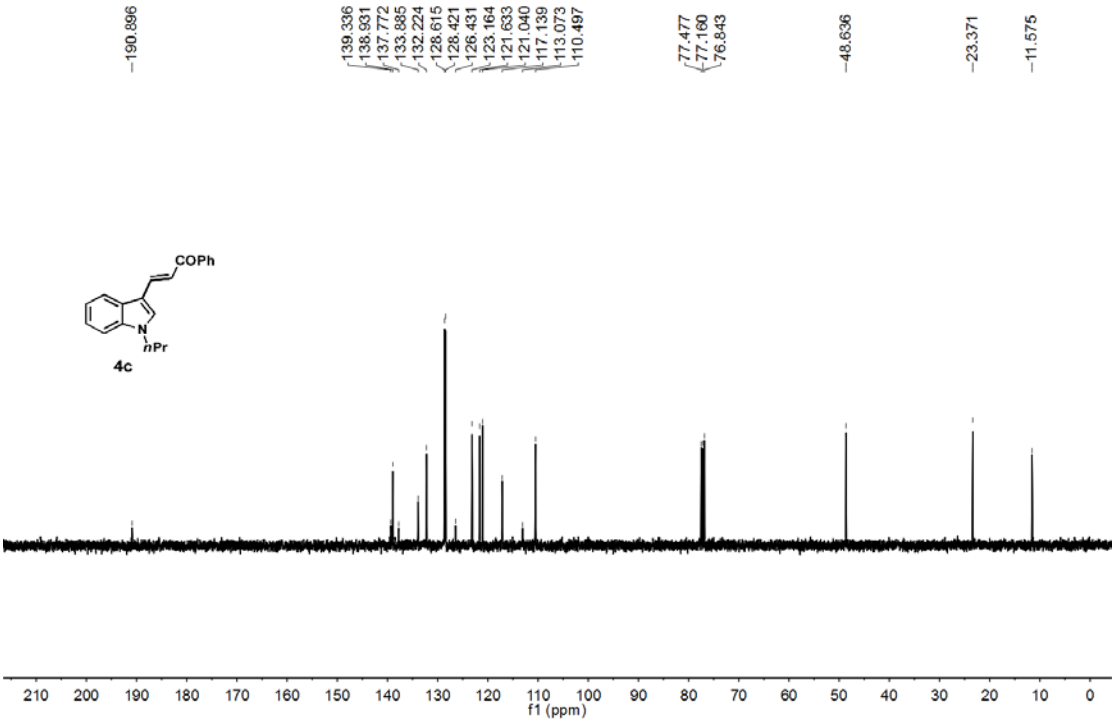
gtl-25100
13C NMR gtl-25100 CDCl3



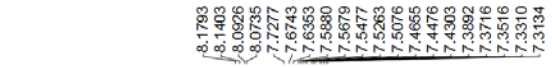
gtl-14101
1H NMR gtl-14101 in CDCl3

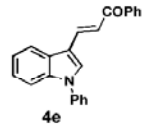


gtl-14101
13C NMR gtl-14101 CDCl3



gtl-17800
1H NMR gtl-17800 in CDCl3





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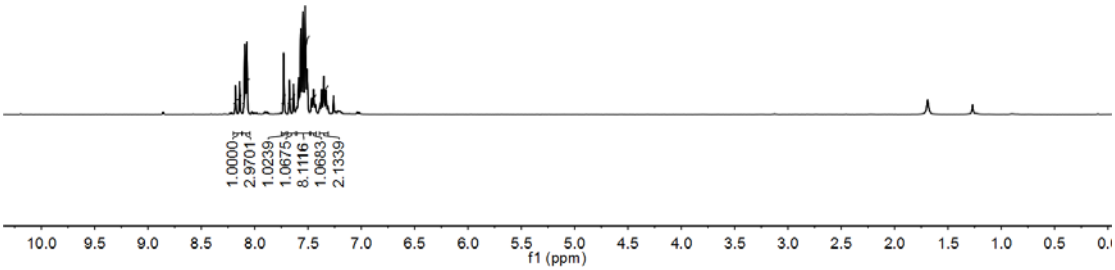
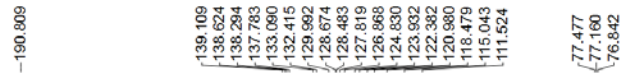
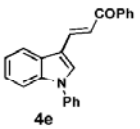


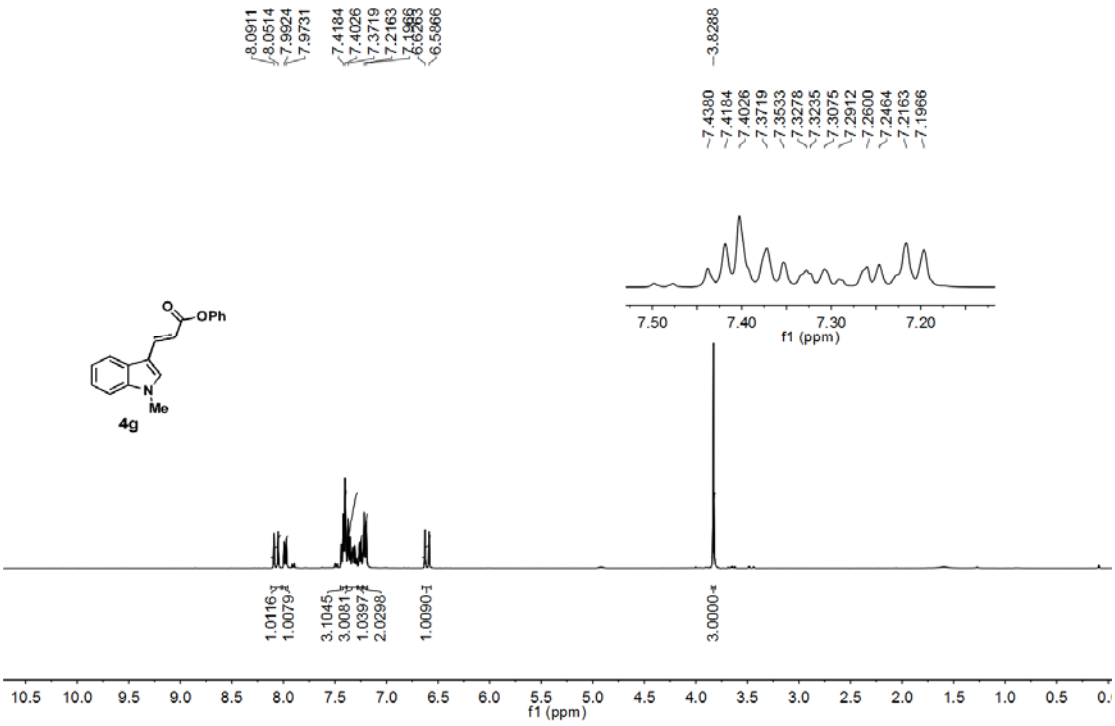
gtl-17800
13C NMR gtl-17800 CDCl3



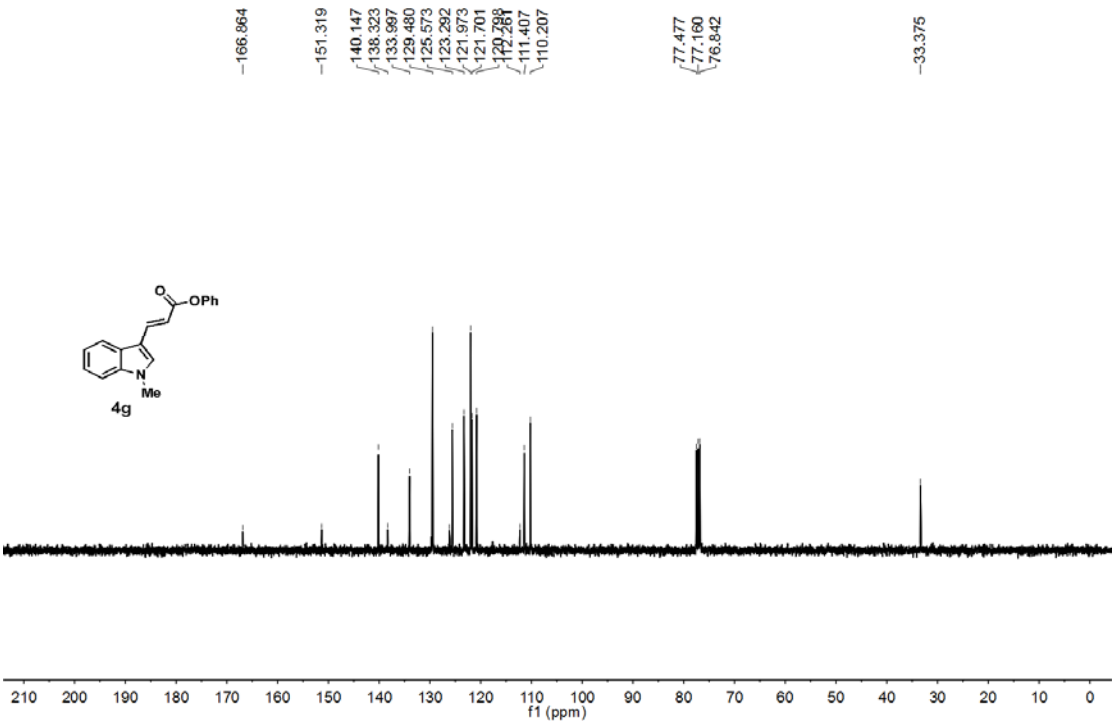


4e

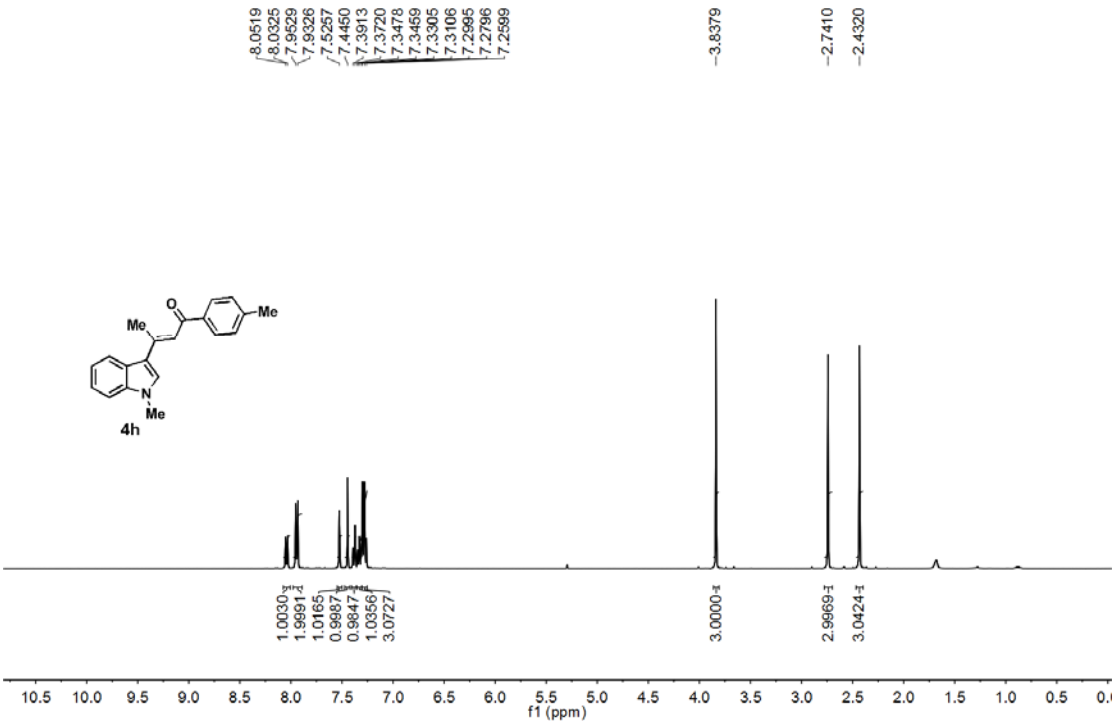
gtl-14301
1H NMR gtl-14301 in CDCl3



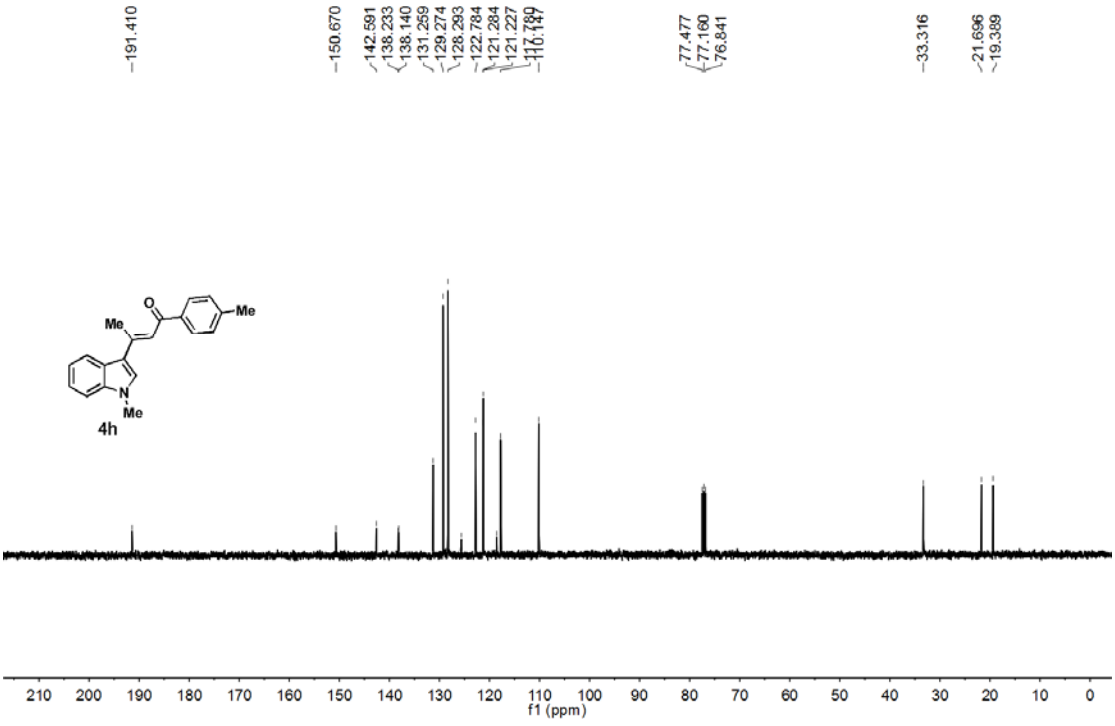
gtl-14301
13C NMR gtl-14301 CDCl3



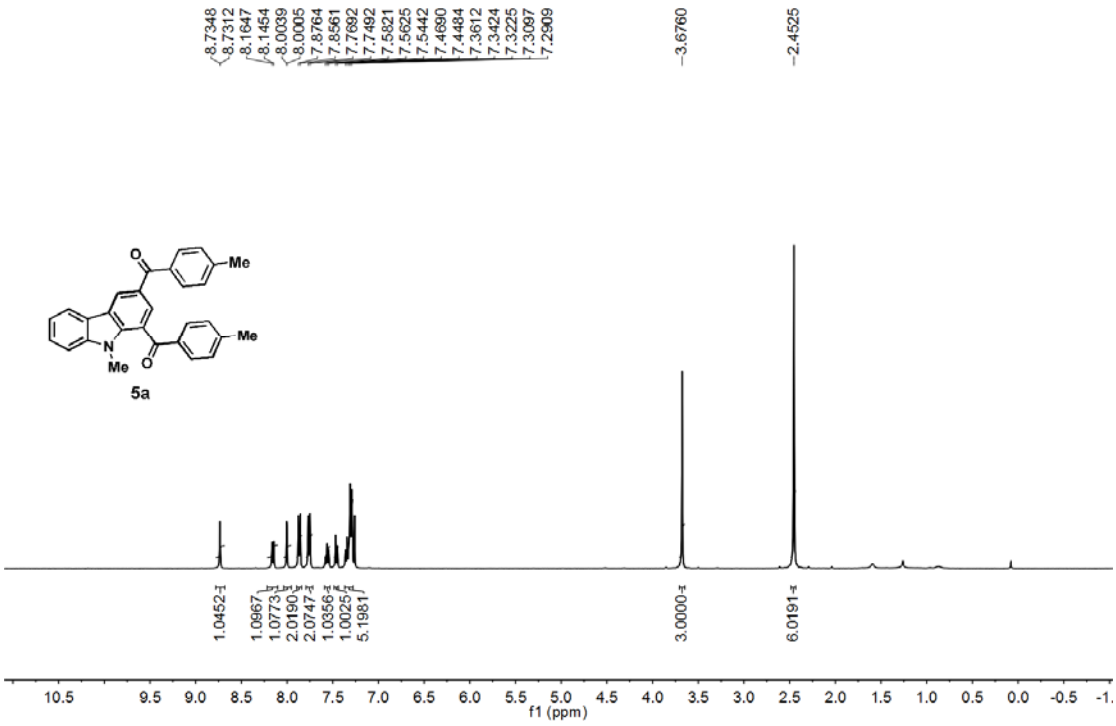
gtl-16300
1H NMR gtl-16300 in CDCl3



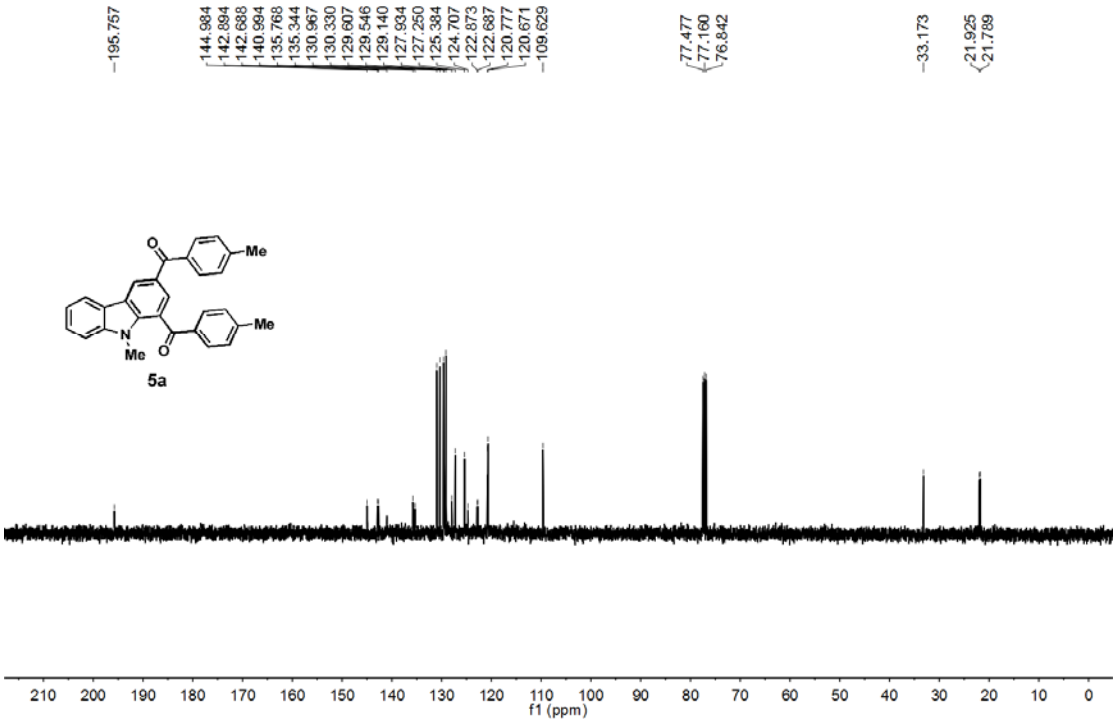
gtl-16301
13C NMR gtl-16300 CDCl3



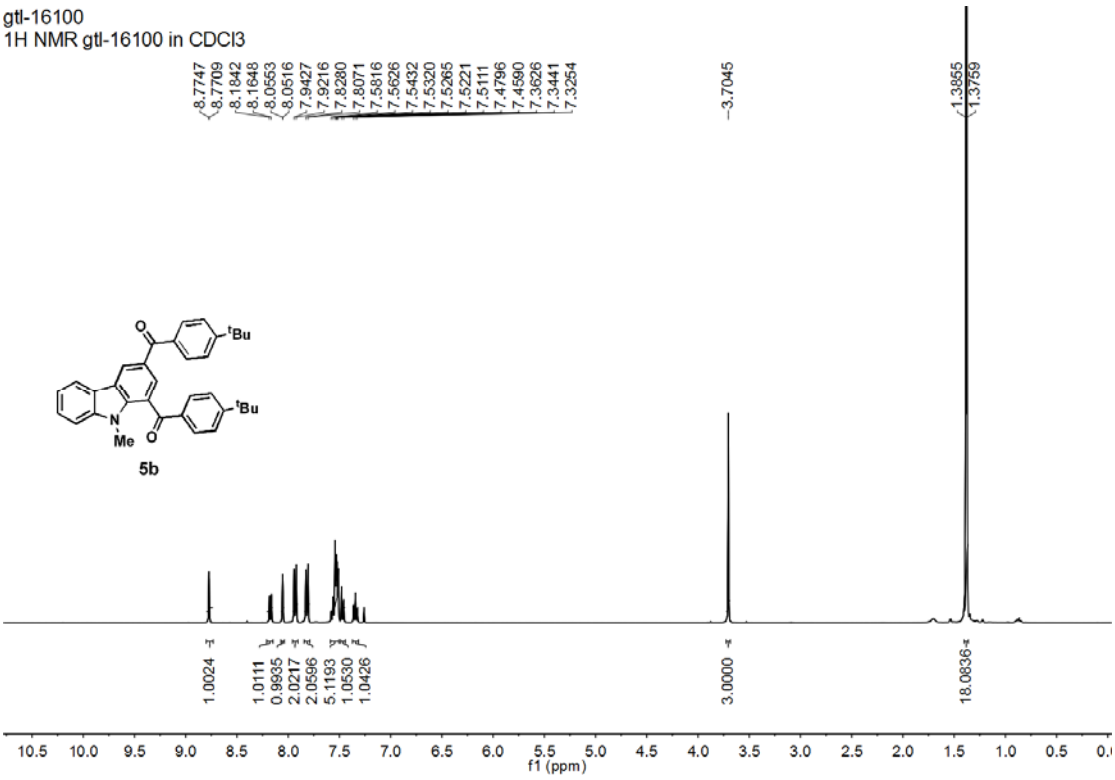
gtl-11900
1H NMR (gtl-11900 in CDCl3)



gtl-11900
13C NMR (gtl-11900 in CDCl3)

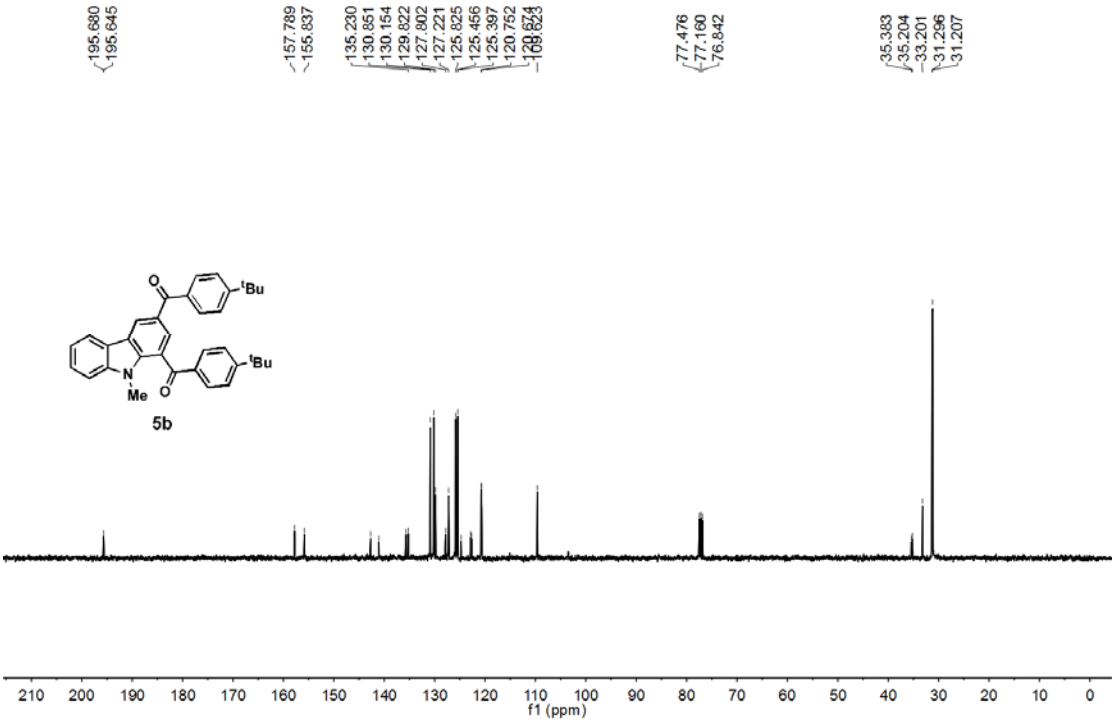


gtl-16100
1H NMR gtl-16100 in CDCl3



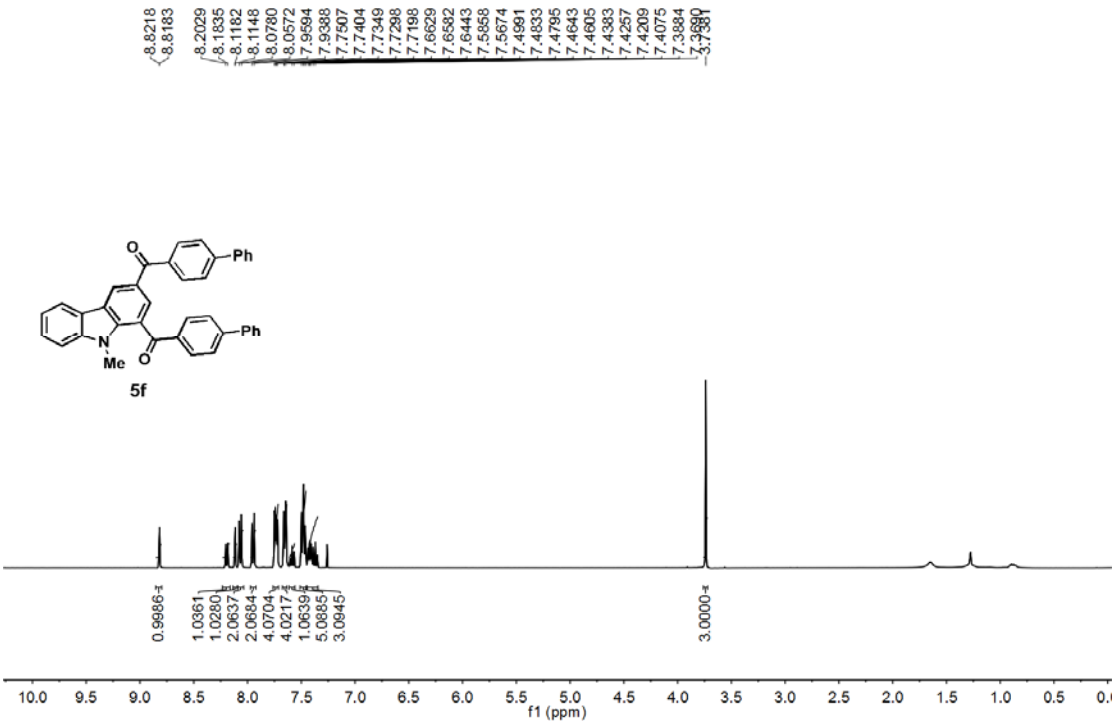
5b

gtl-16100
13C NMR gtl-16100 CDCl3

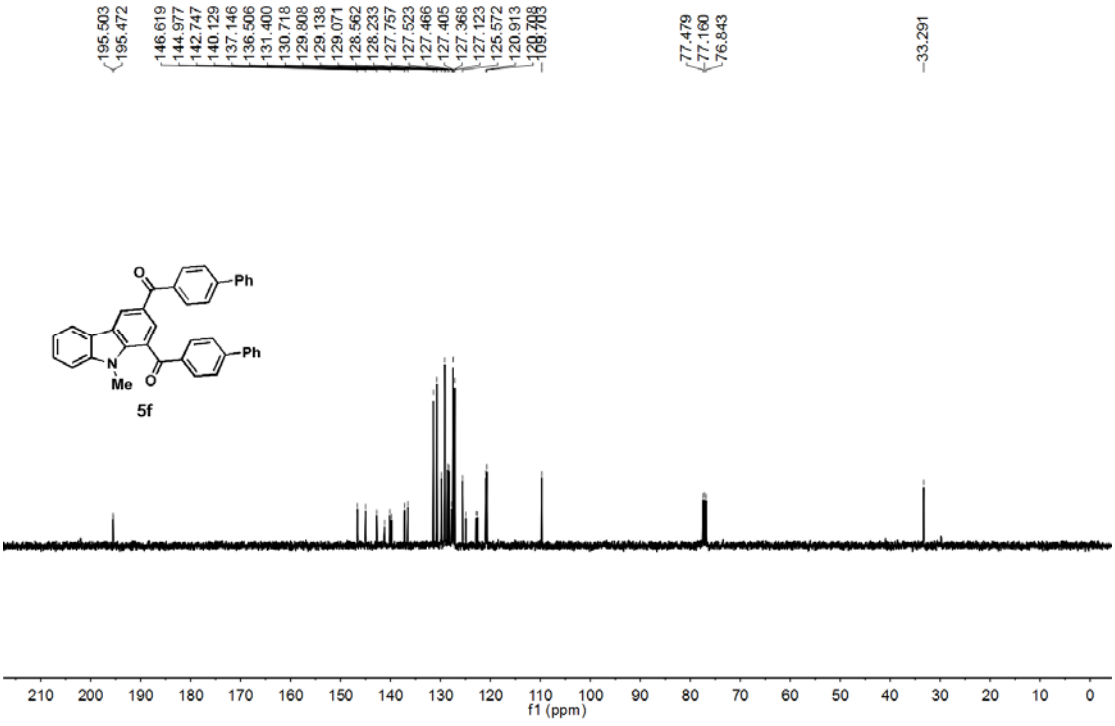


5b

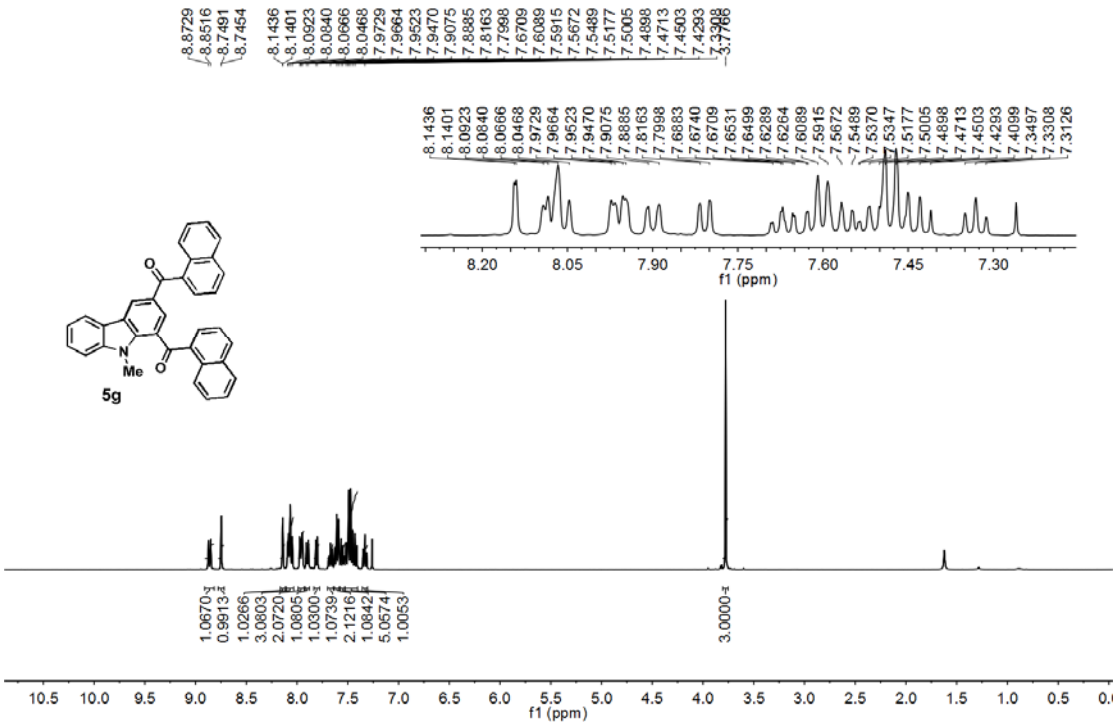
gtl-16200
1H NMR gtl-16200 in CDCl3



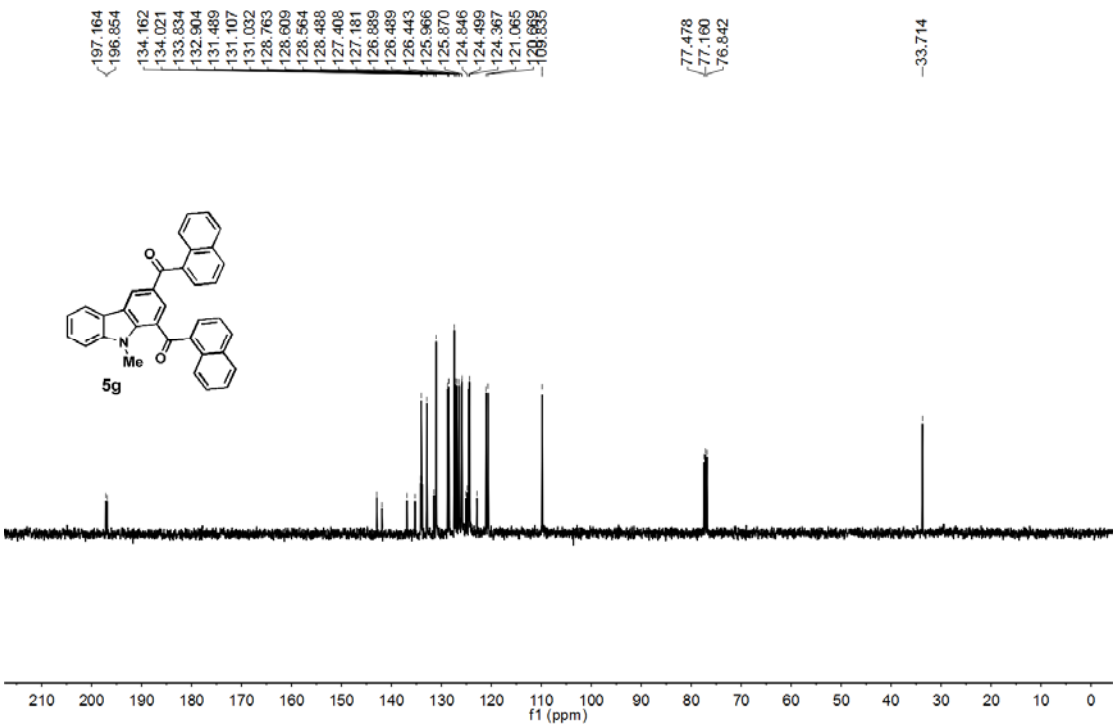
gtl-16201
13C NMR gtl-16200 CDCl3



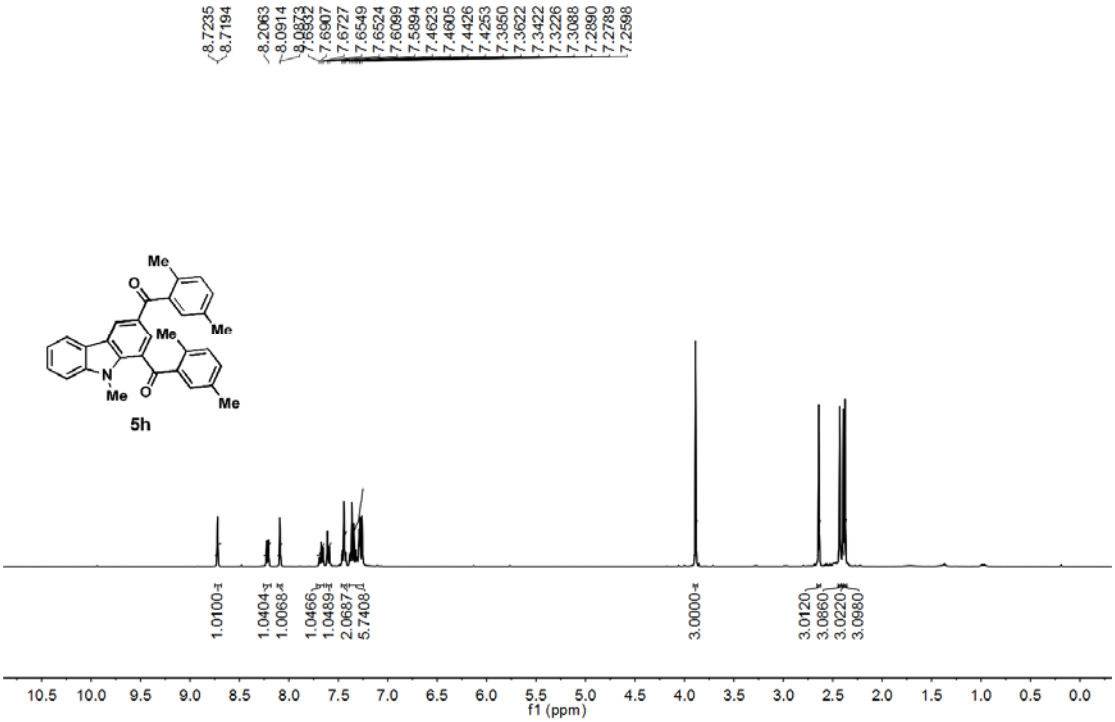
gtl-12800
1H NMR gtl-12800 in CDCl3



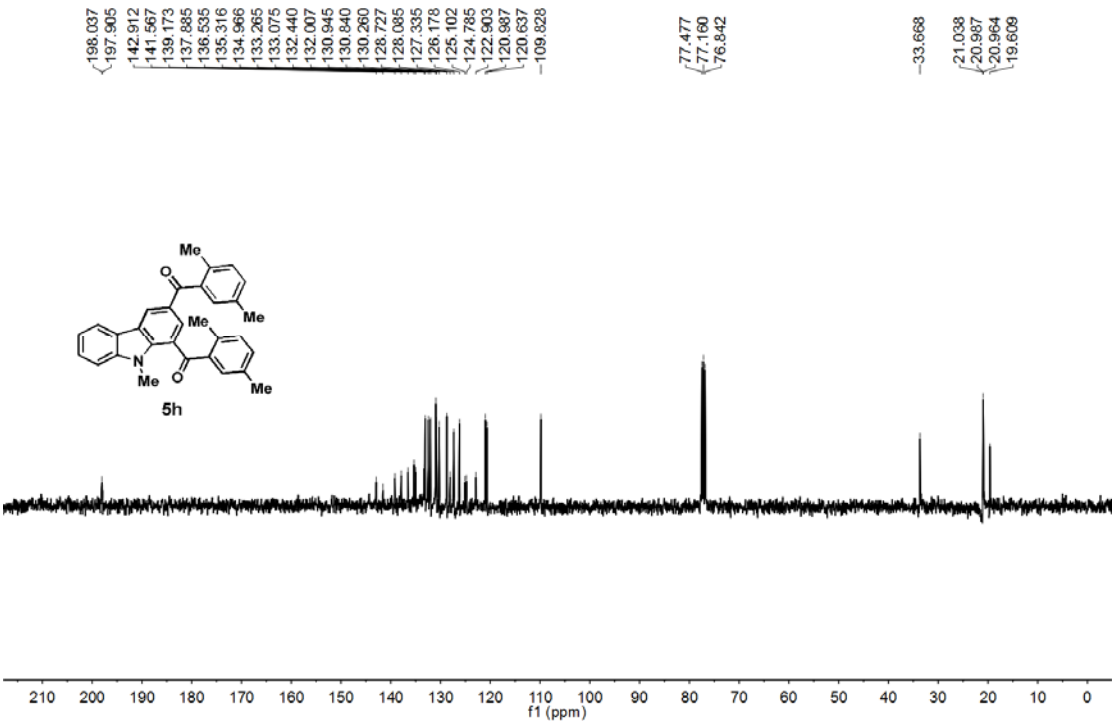
gtl-12800
13C NMR gtl-12800 CDCl3



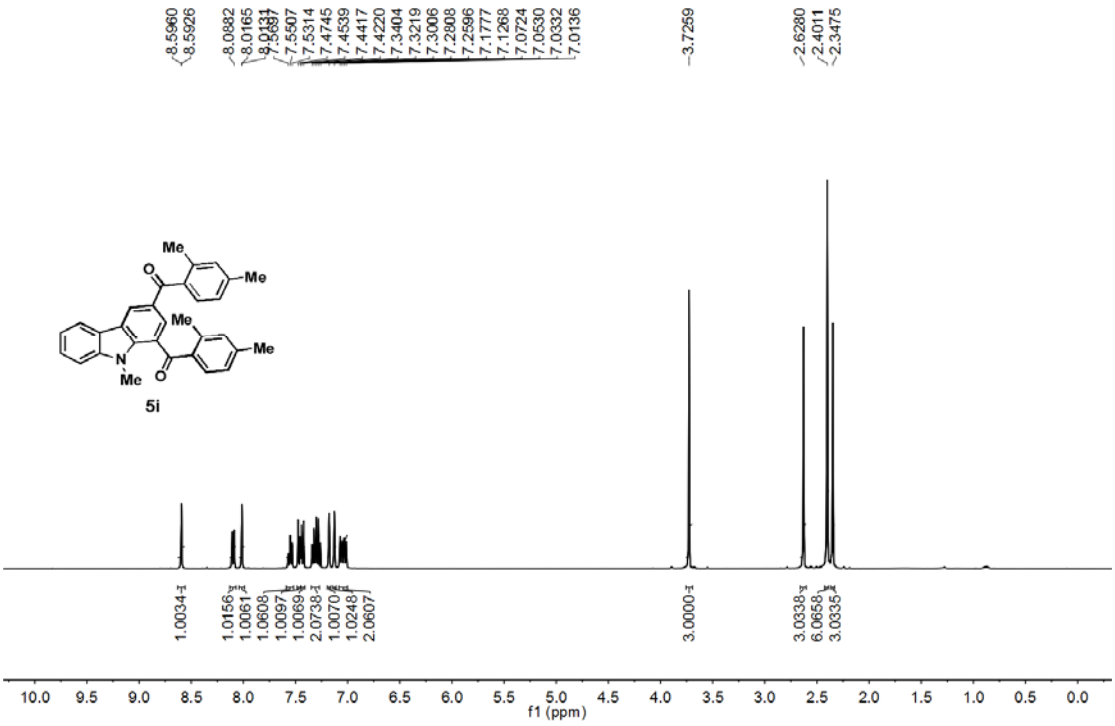
gtl-12400
1H NMR (gtl-12400 in CDCl3)



gtl-12400
13C NMR (gtl-12400 in CDCl3)

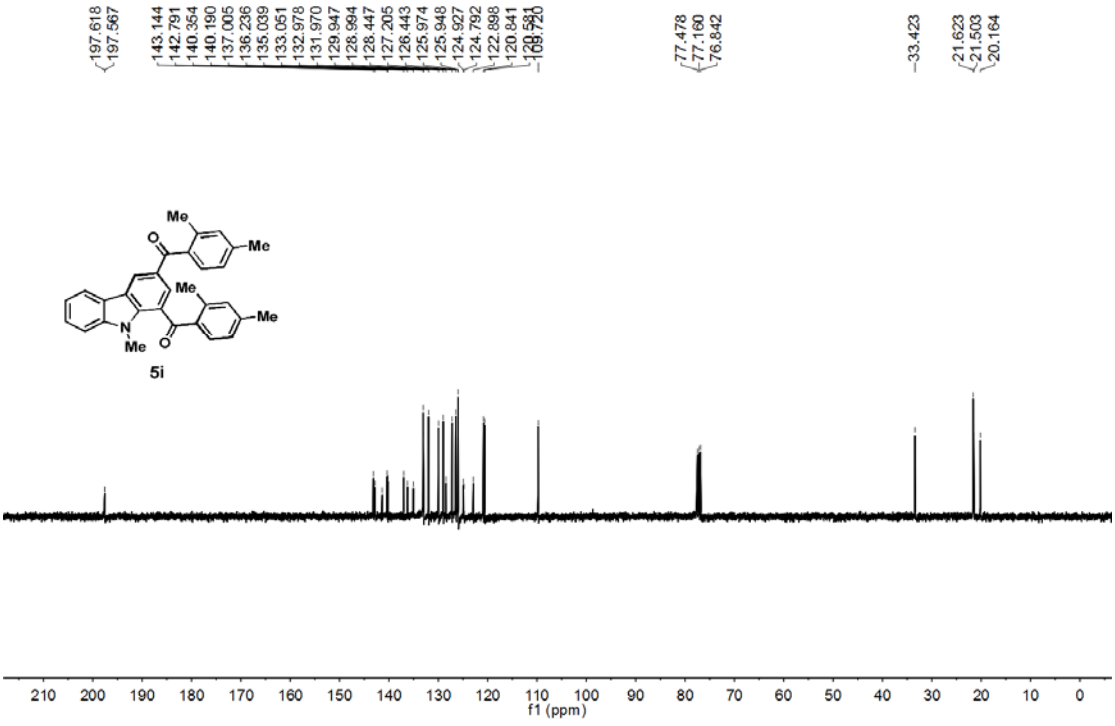


gtl-12500
1H NMR (gtl-12500 in CDCl3)



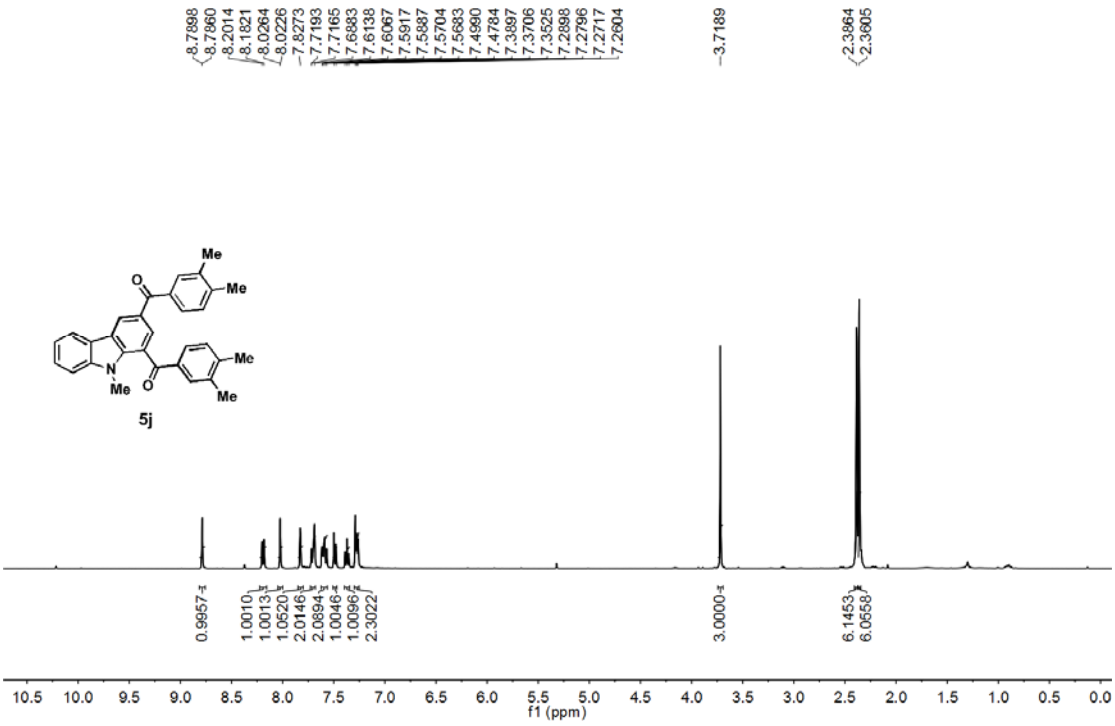
5i

gtl-12500
13C NMR (gtl-12500 in CDCl3)

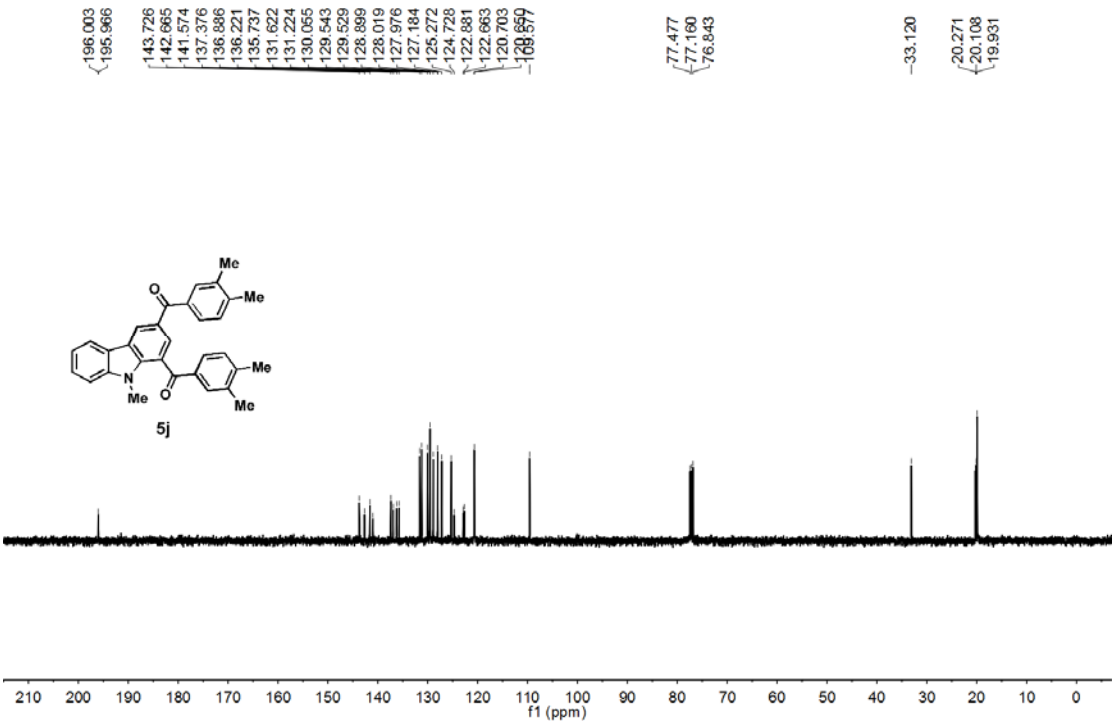


5i

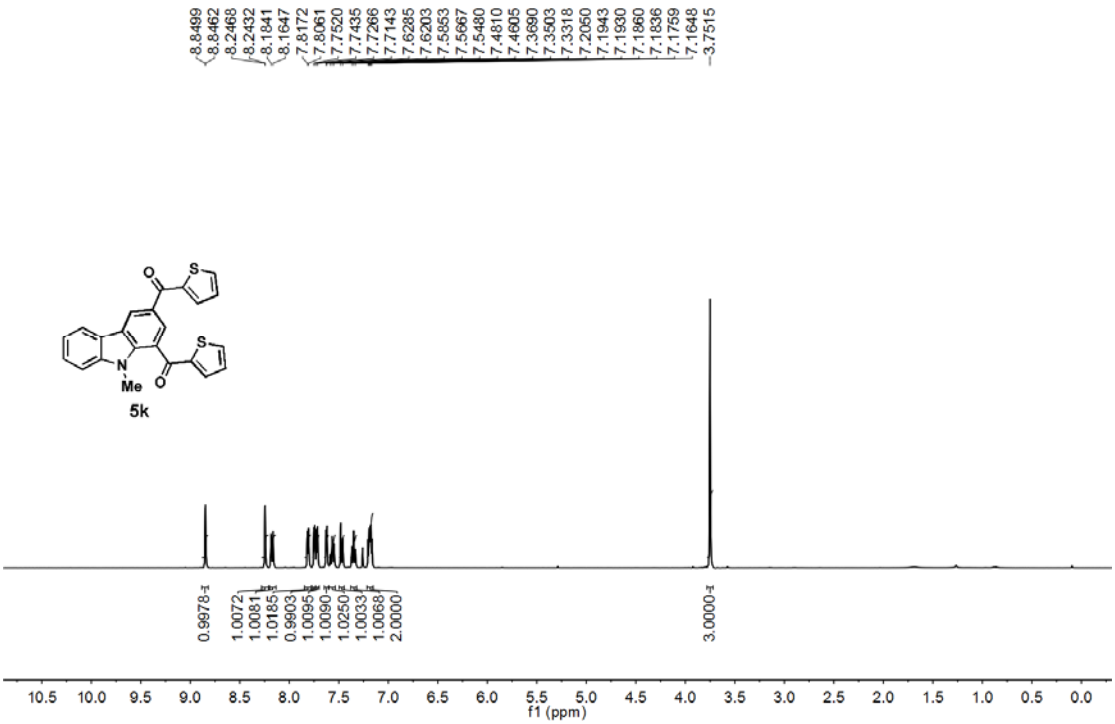
gtl-12900
1H NMR (gtl-12900 in CDCl3)



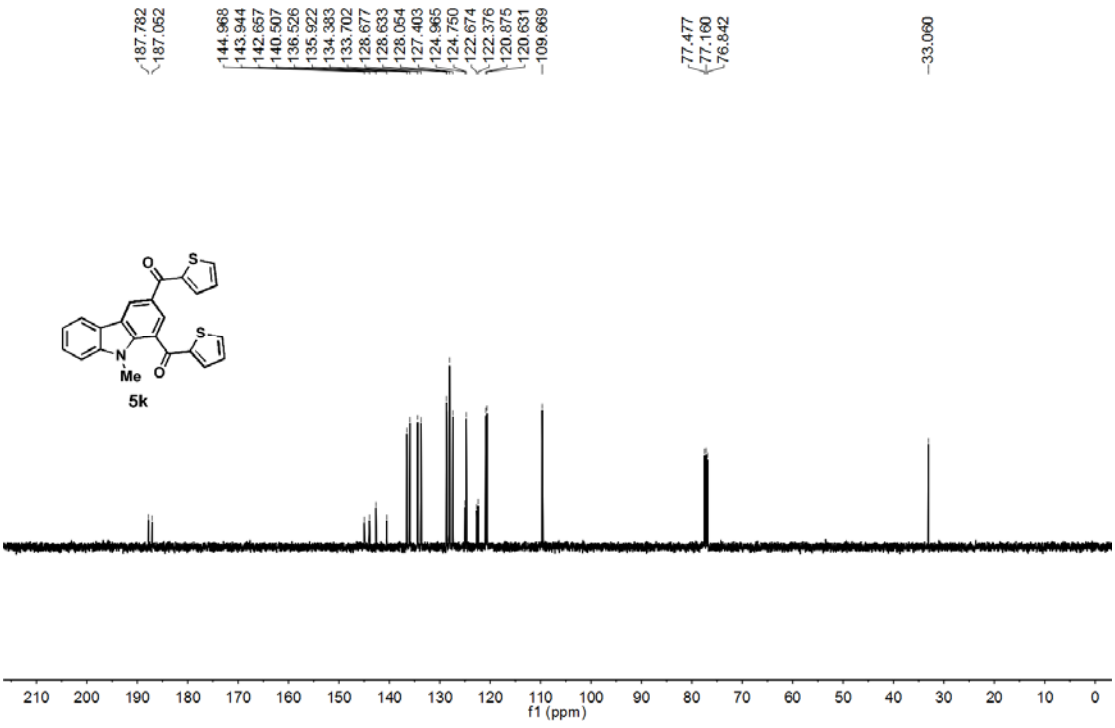
gtl-12900
13C NMR (gtl-12900 in CDCl3)



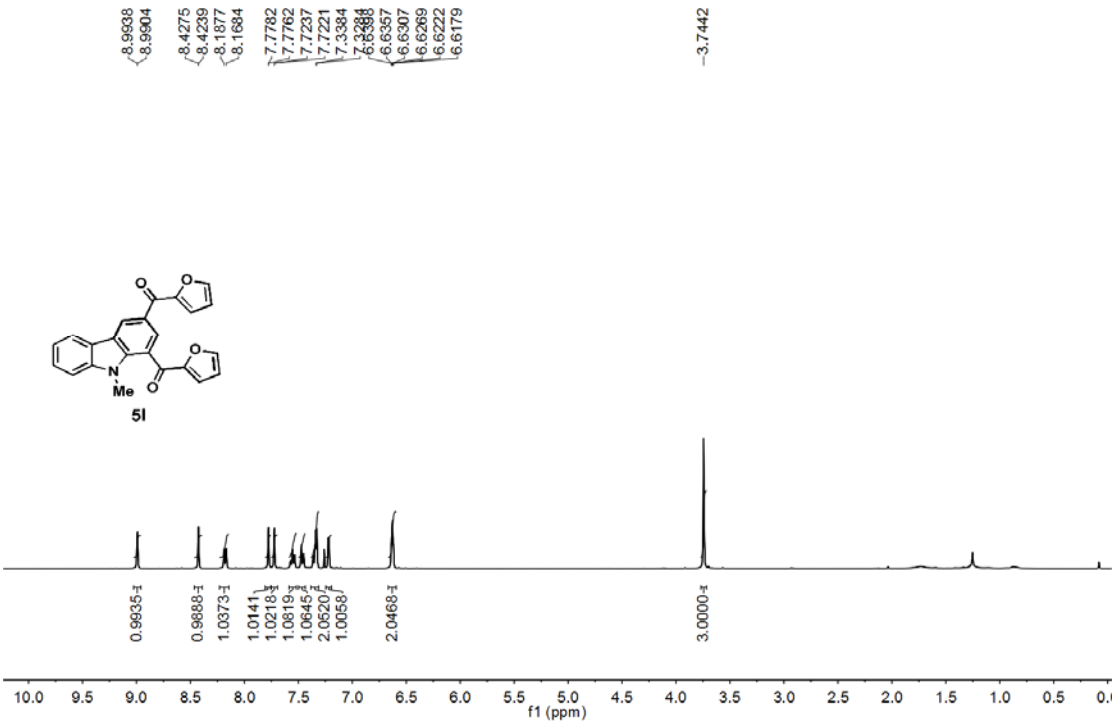
gtl-13100
1H NMR (gtl-13100 in CDCl3)



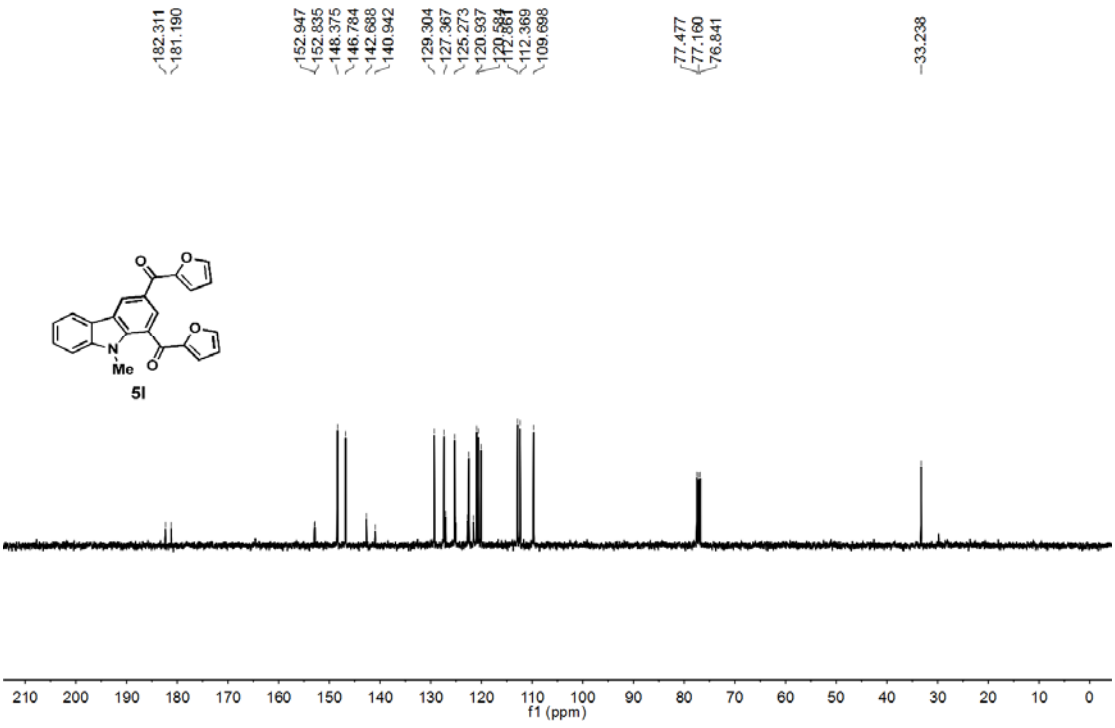
gtl-13100
13C NMR (gtl-13100 in CDCl3)



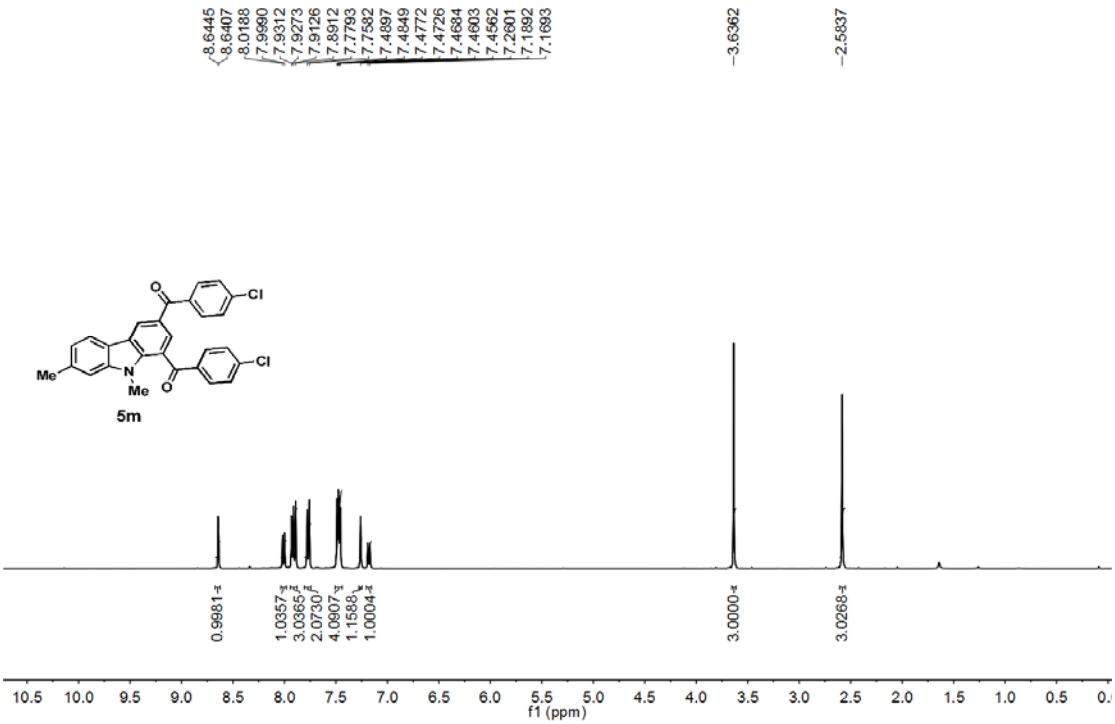
gtl-13001
1H NMR gtl-13000 in CDCl3



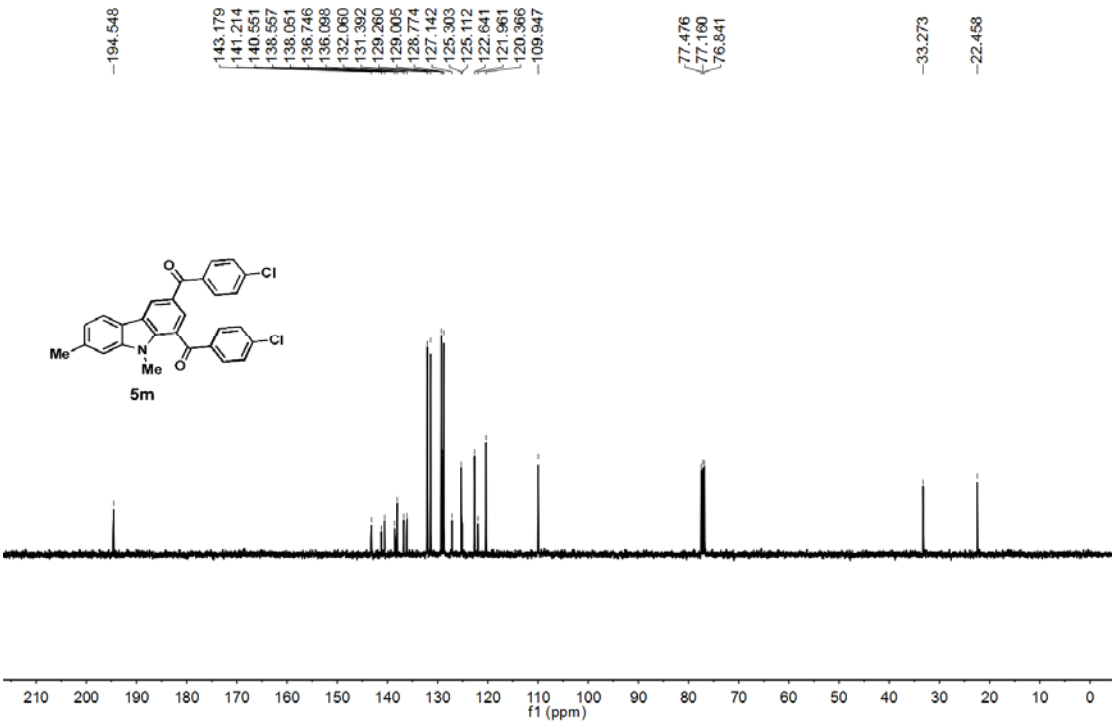
gtl-13000
13C NMR gtl-13000 CDCl3



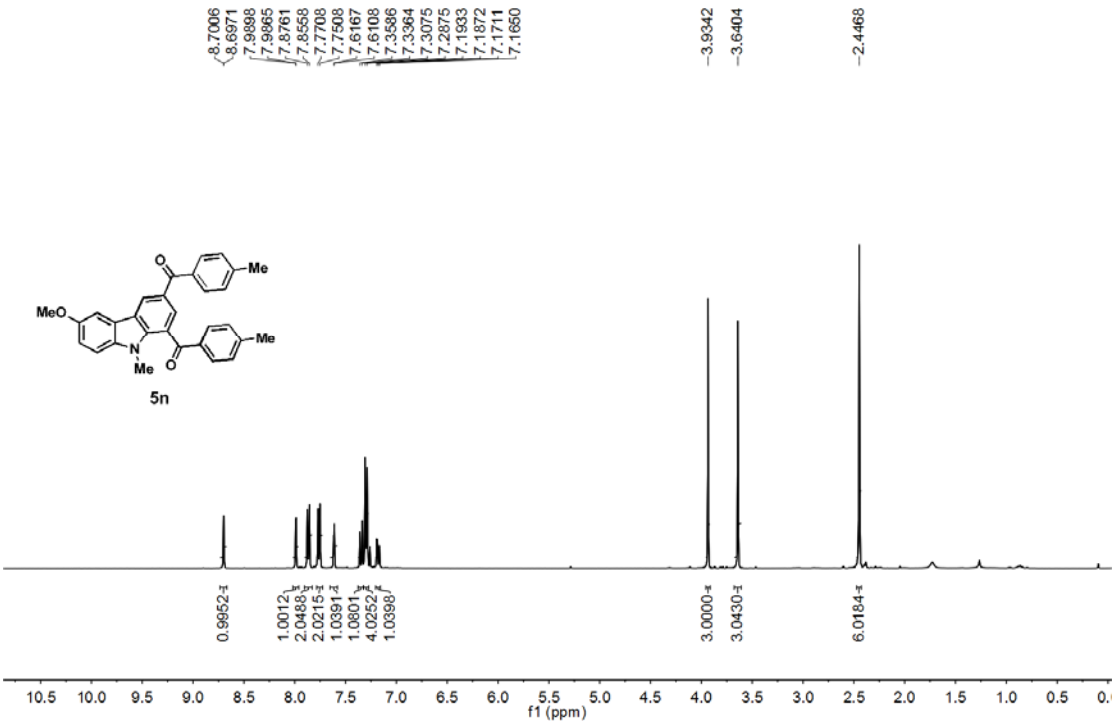
gtl-24800
1H NMR gtl-24800 in CDCl3



gtl-24800
13C NMR gtl-24800 CDCl3

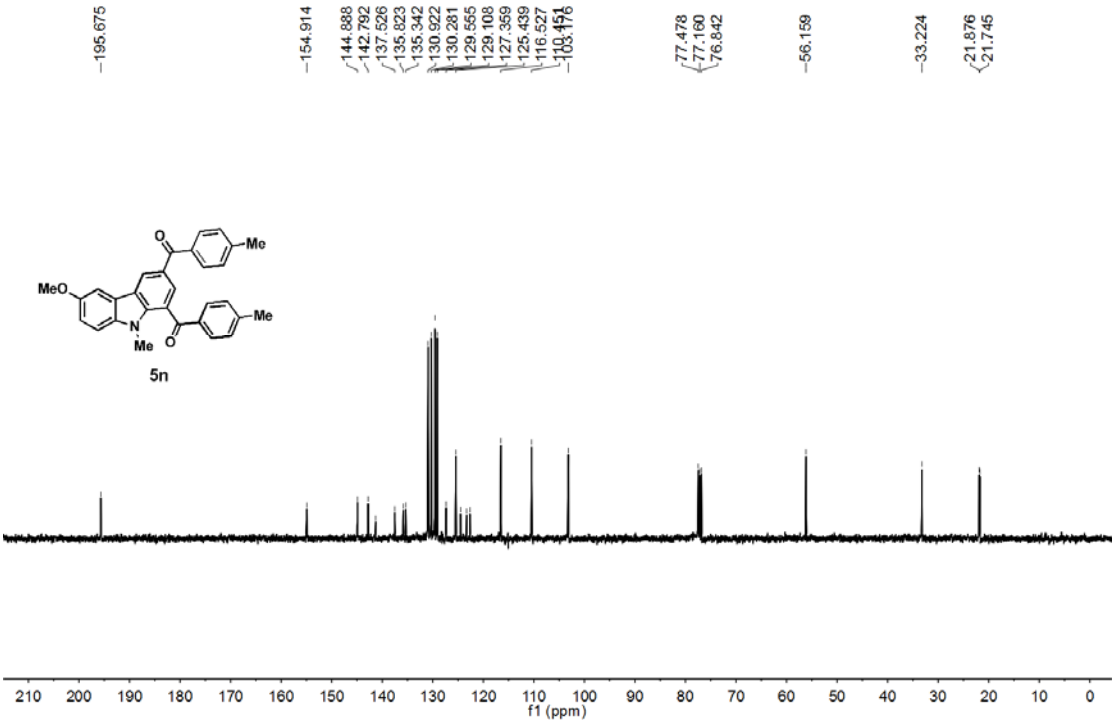


gtl-18000
1H NMR gtl-18000 in CDCl3



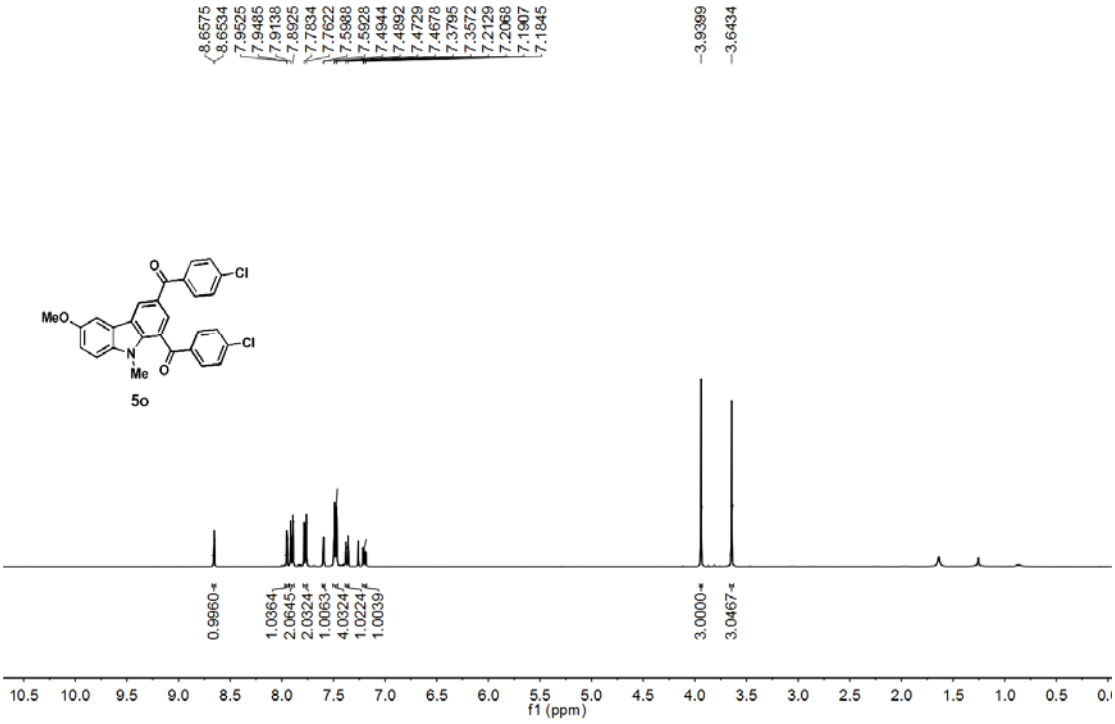
5n

gtl-18000
13C NMR gtl-18000 CDCl3

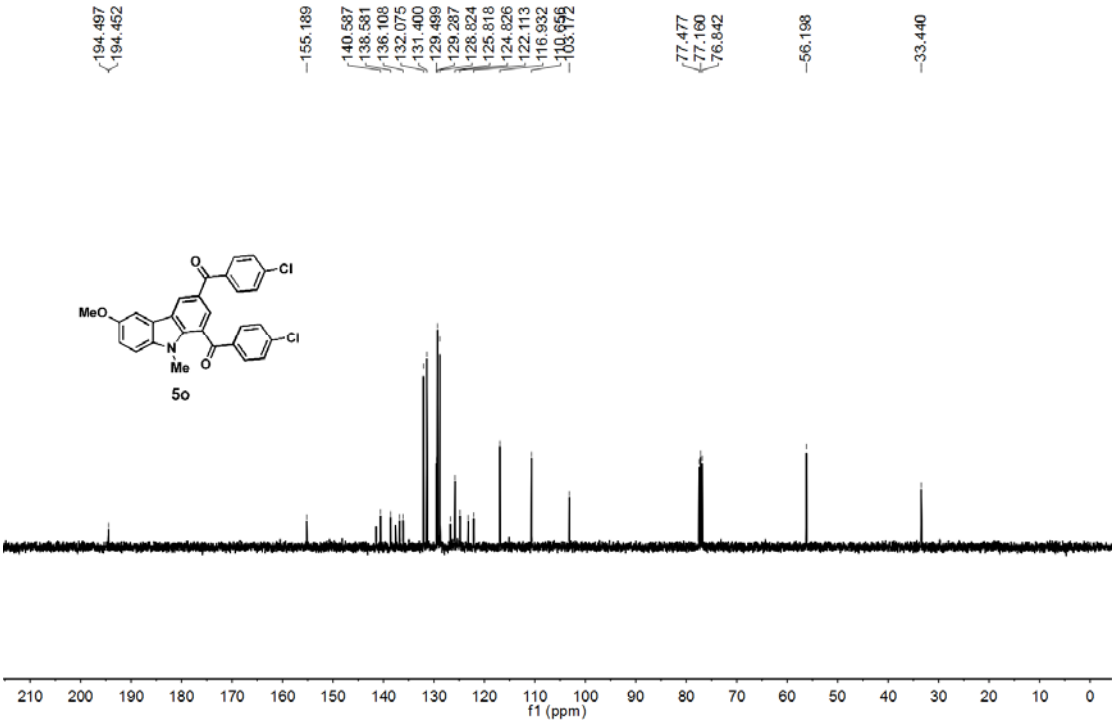


5n

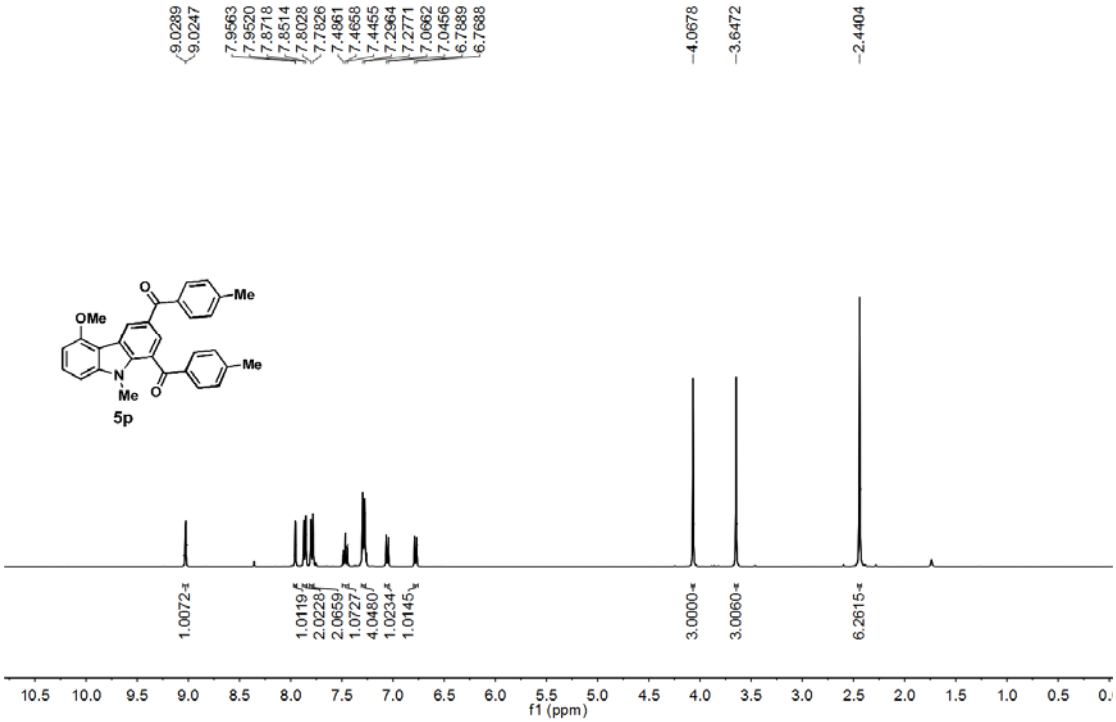
gtl-18100
1H NMR gtl-18100 in CDCl3



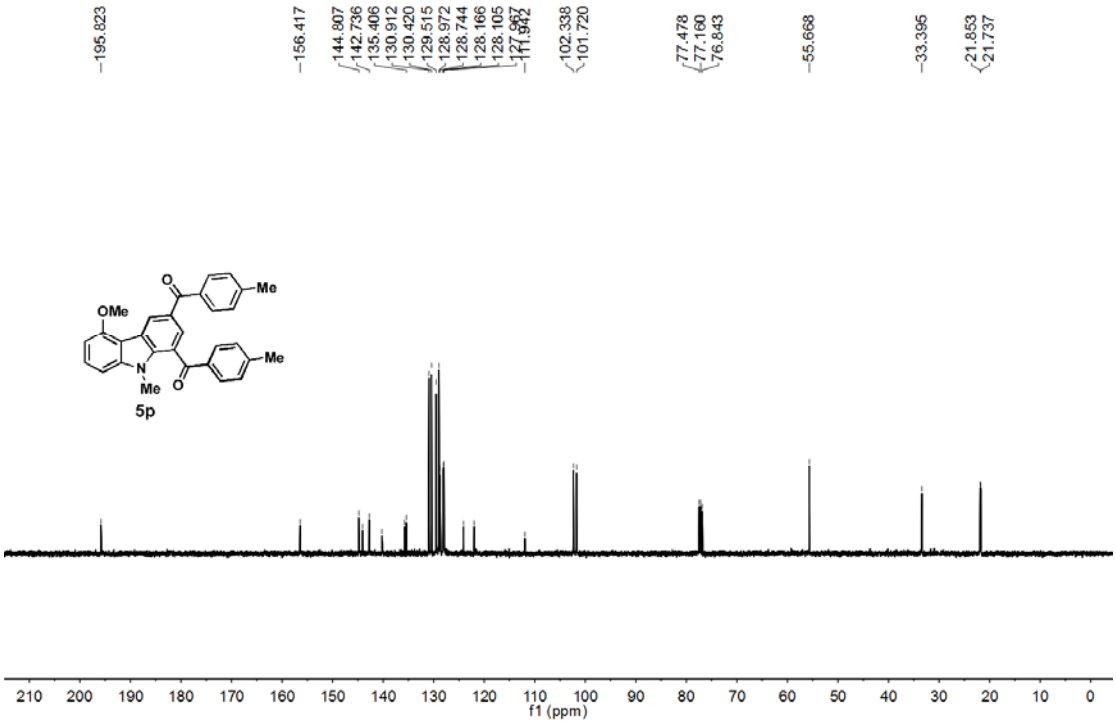
gtl-18100
13C NMR gtl-18100 CDCl3



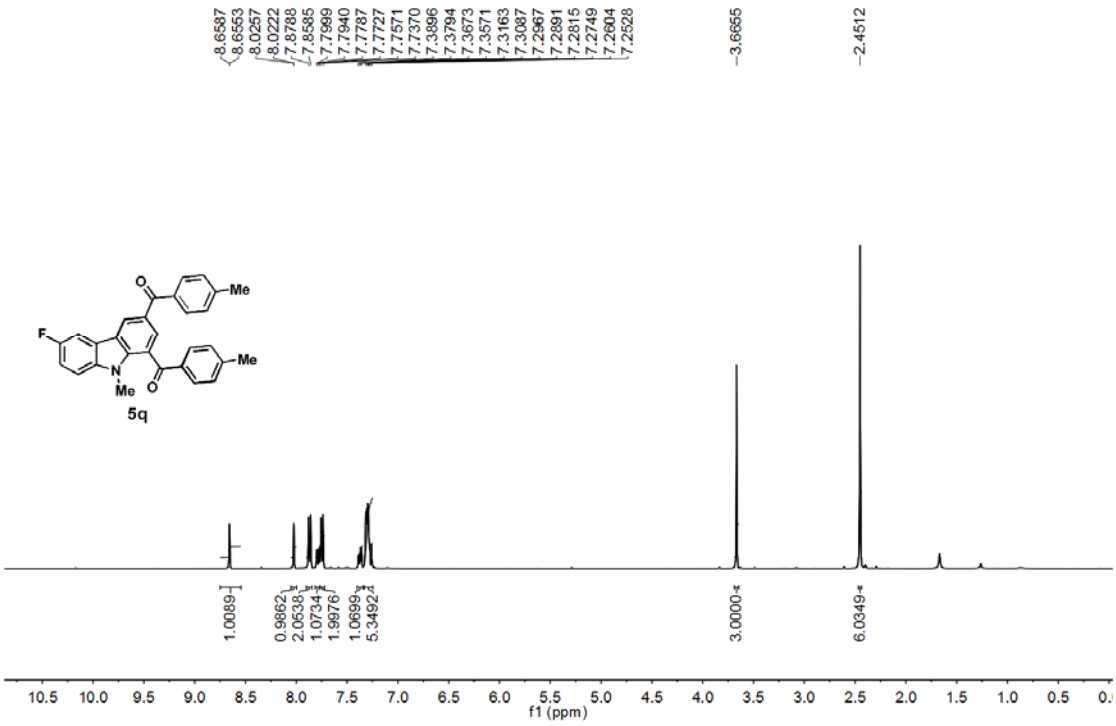
gtl-25600
1H NMR gtl-25600 in CDCl3



gtl-25600
13C NMR gtl-25600 CDCl3

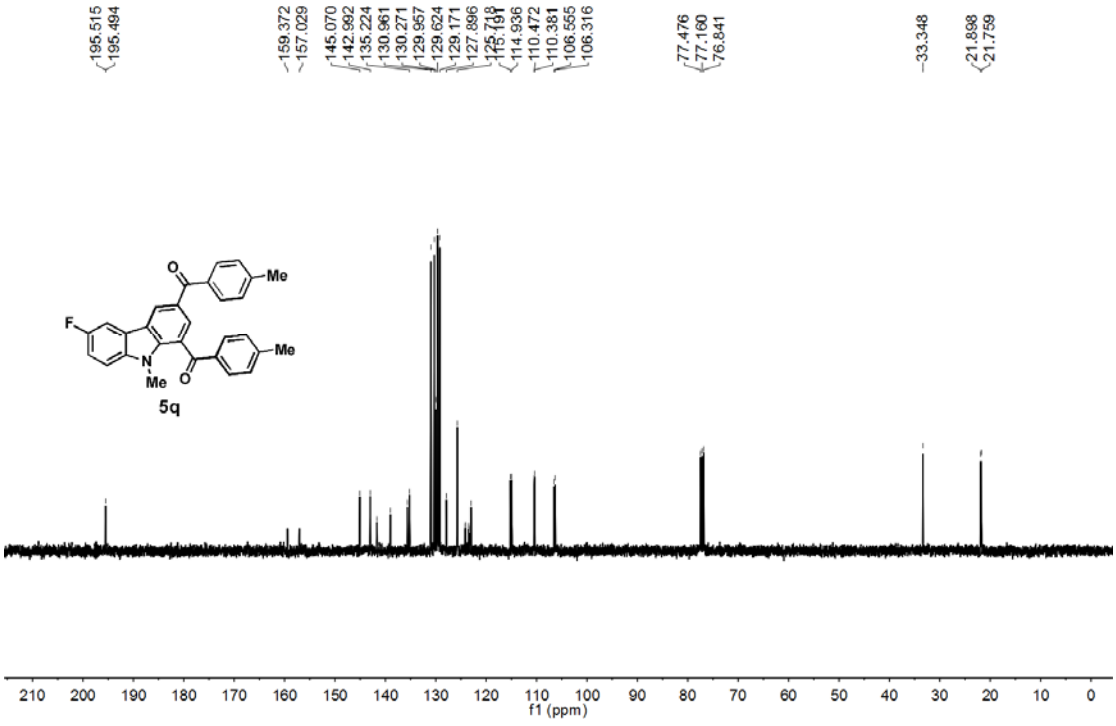


gtl-18400
1H NMR gtl-18400 in CDCl3



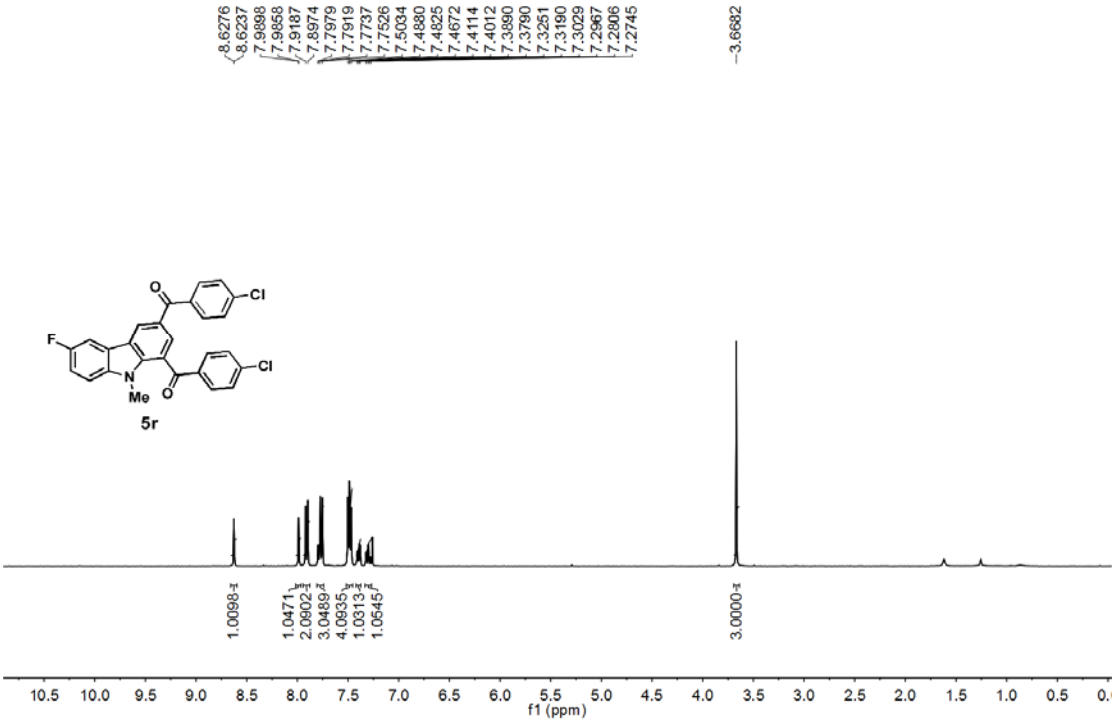
5q

gtl-18400
13C NMR gtl-18400 CDCl3



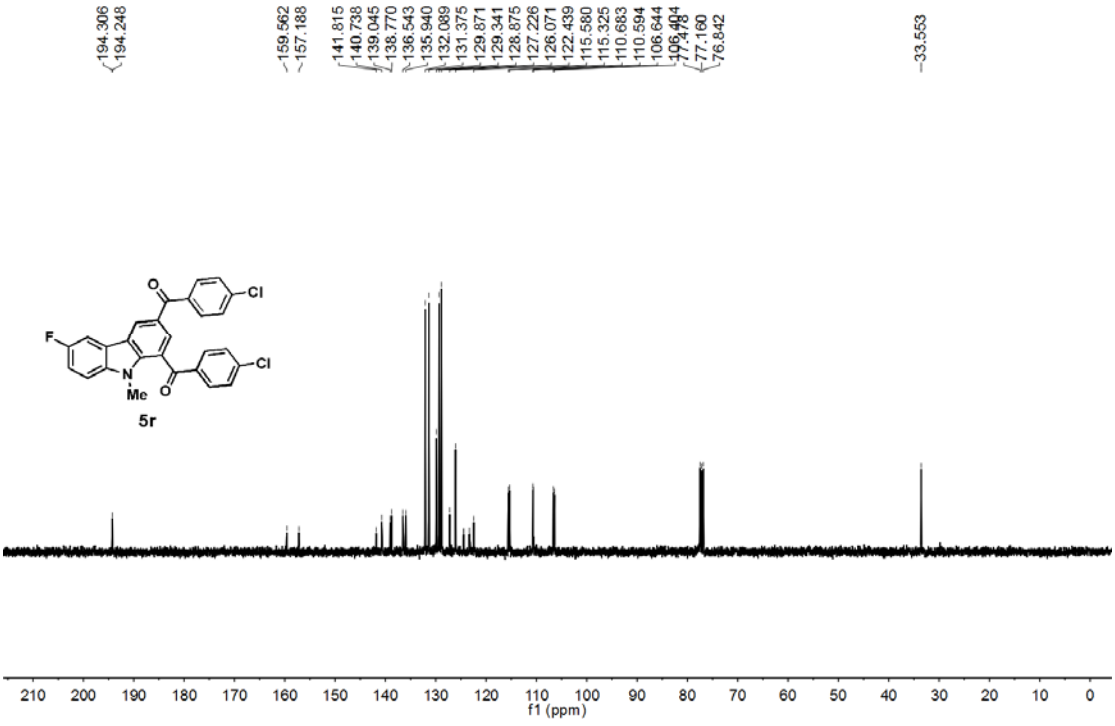
5q

gtl-18300
1H NMR gtl-18300 in CDCl3



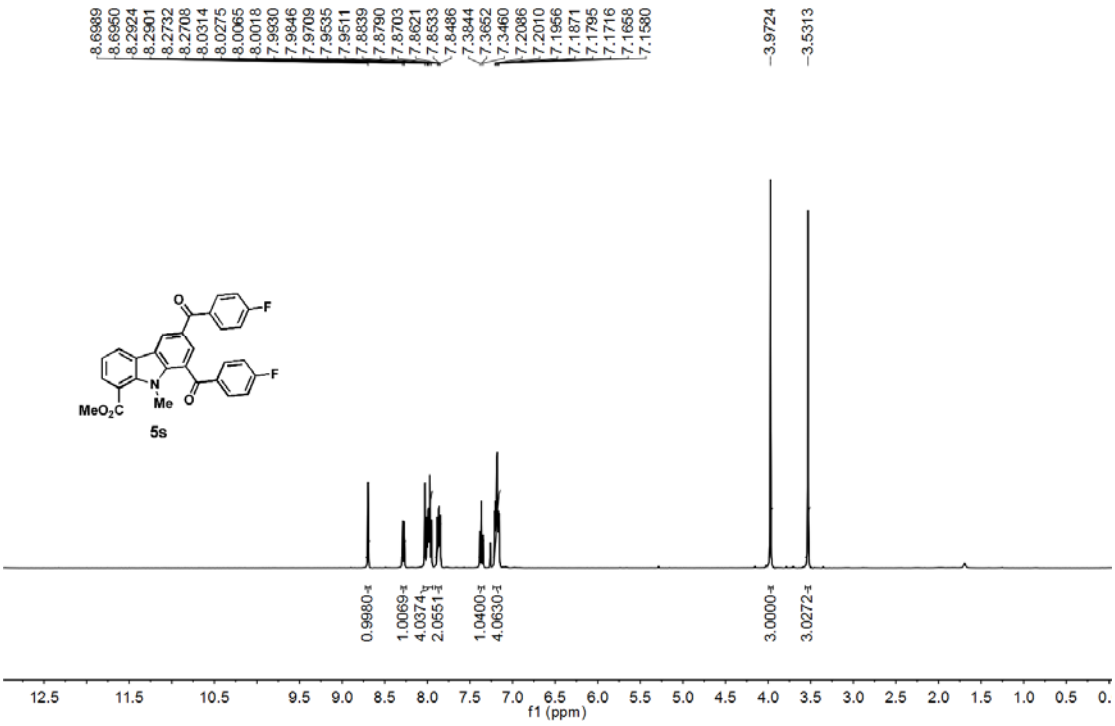
5r

gtl-18301
13C NMR gtl-18300 CDCl3

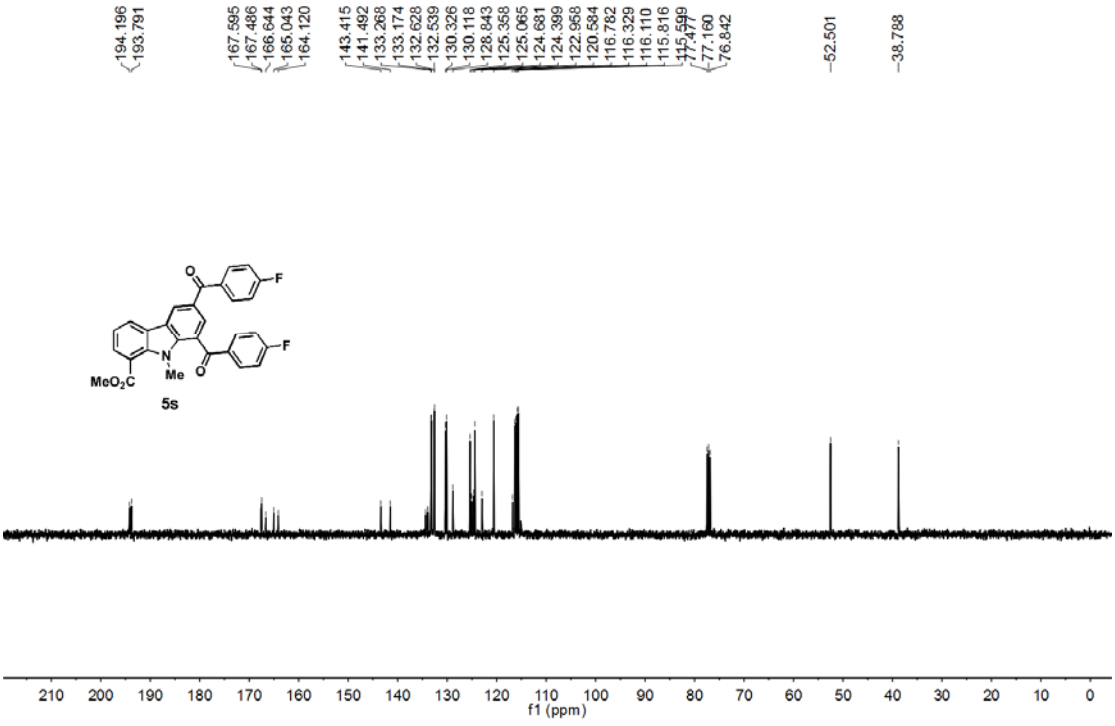


5r

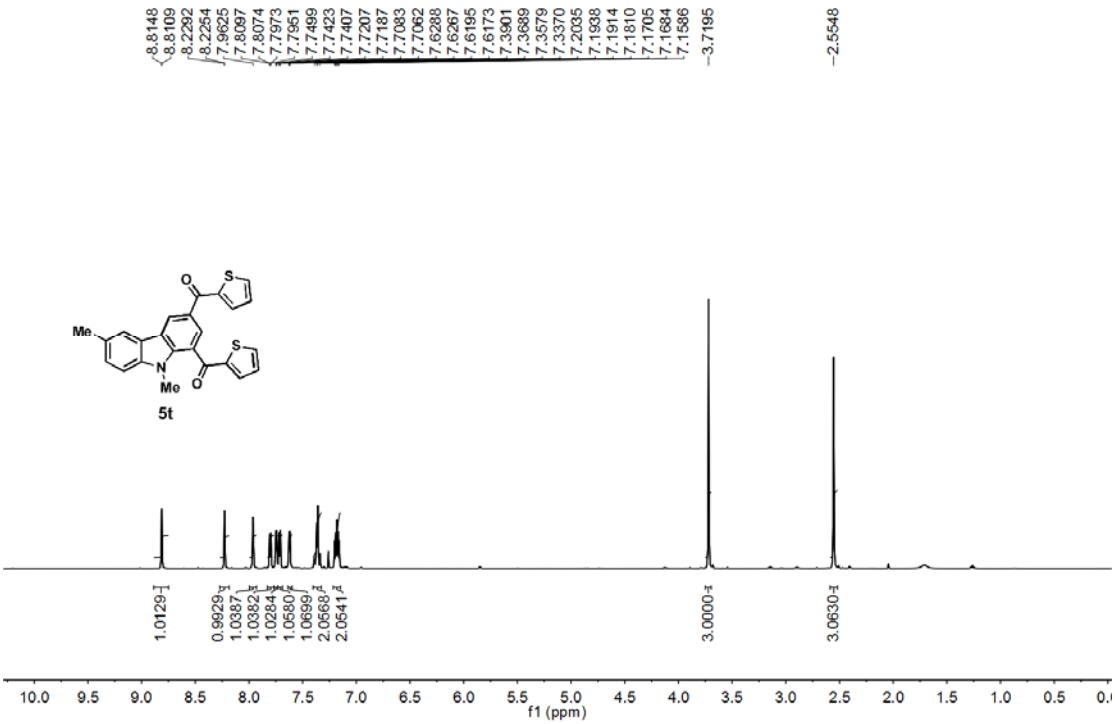
gtl-25400
1H NMR gtl-25400 in CDCl3



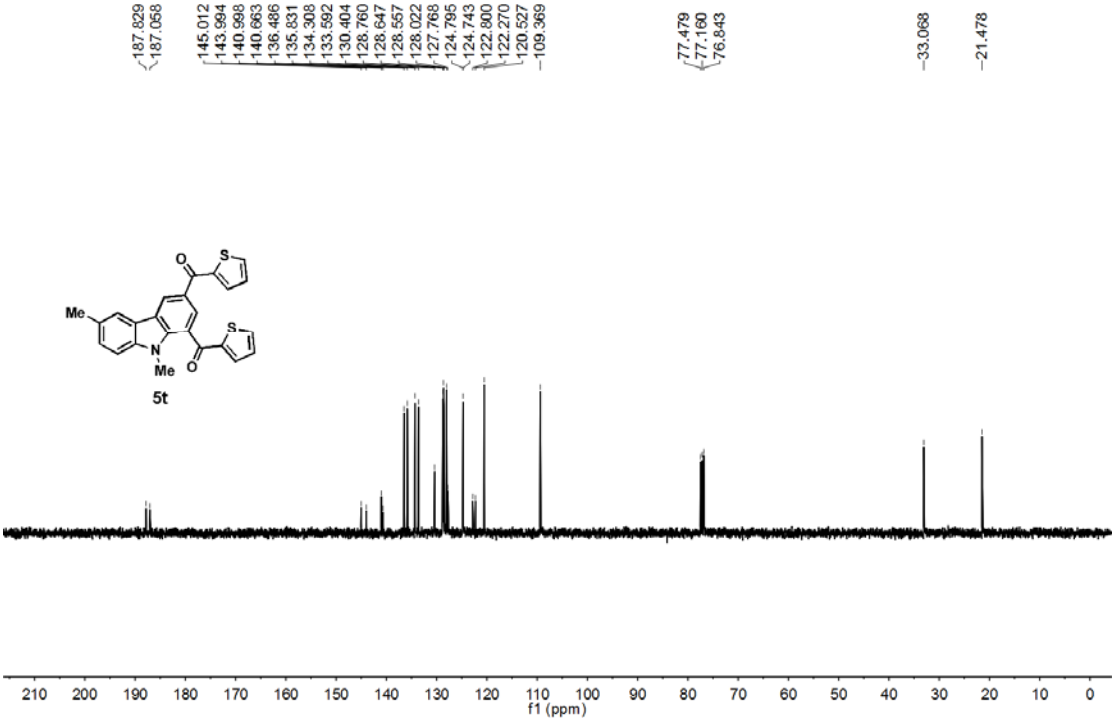
gtl-25400
13C NMR gtl-25400 CDCl3



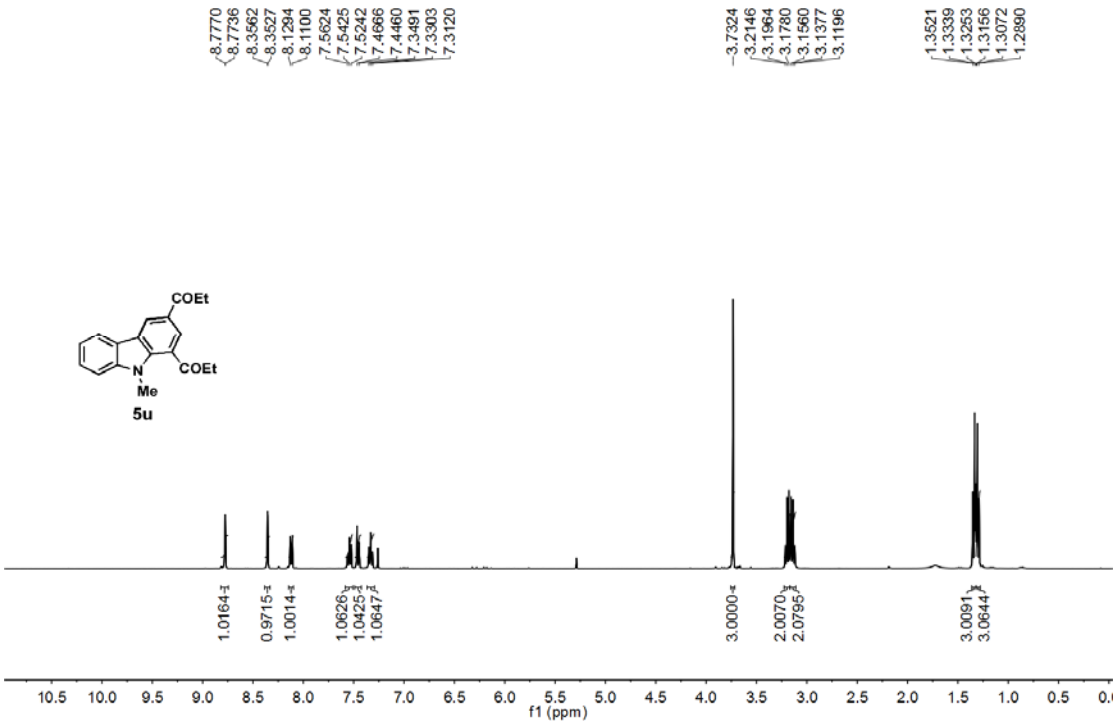
gtl-18600
1H NMR gtl-18600 in CDCl3



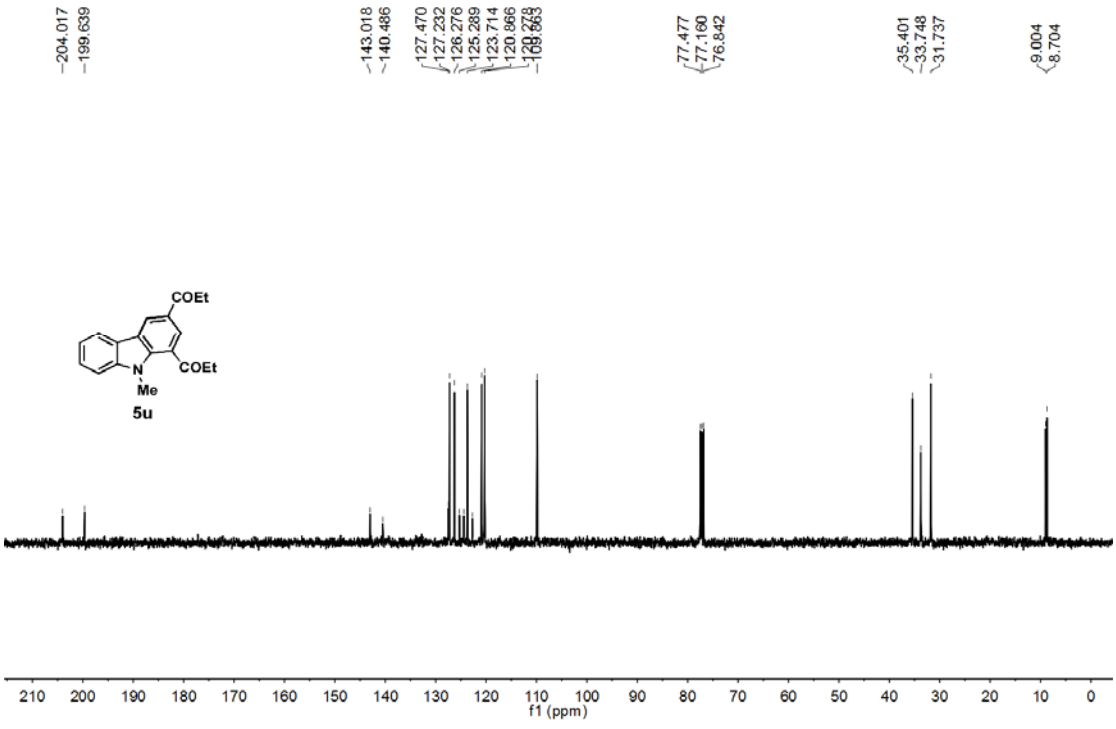
gtl-18600
13C NMR gtl-18600 CDCl3



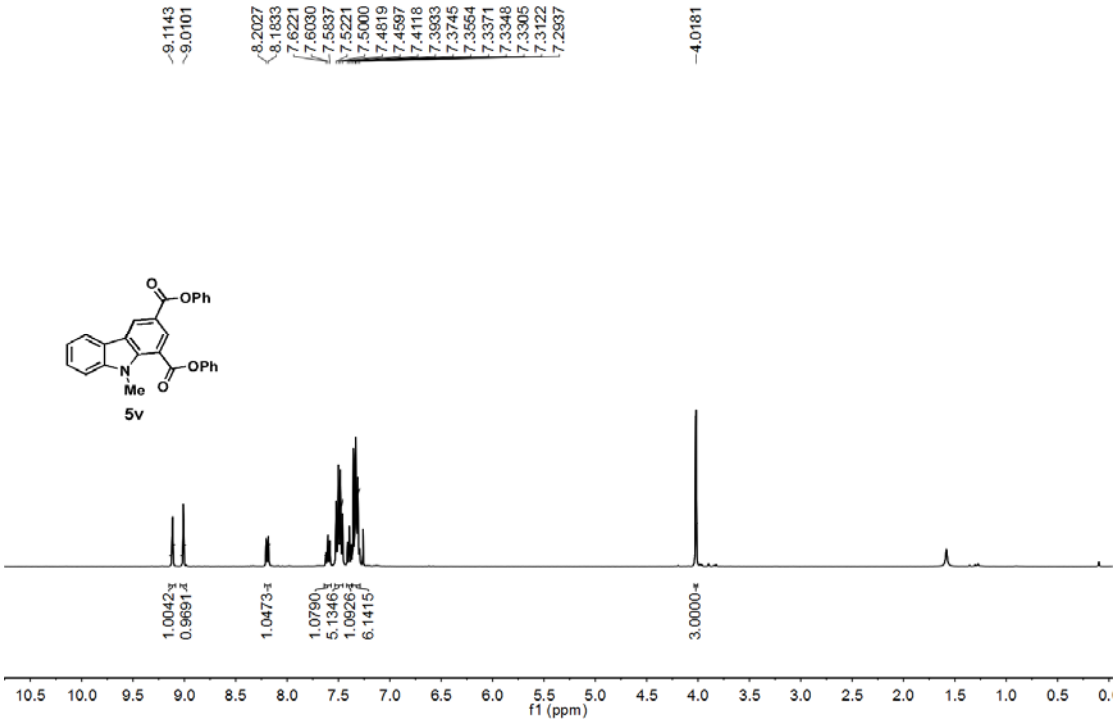
gtl-15600
1H NMR gtl-15600 in CDCl3



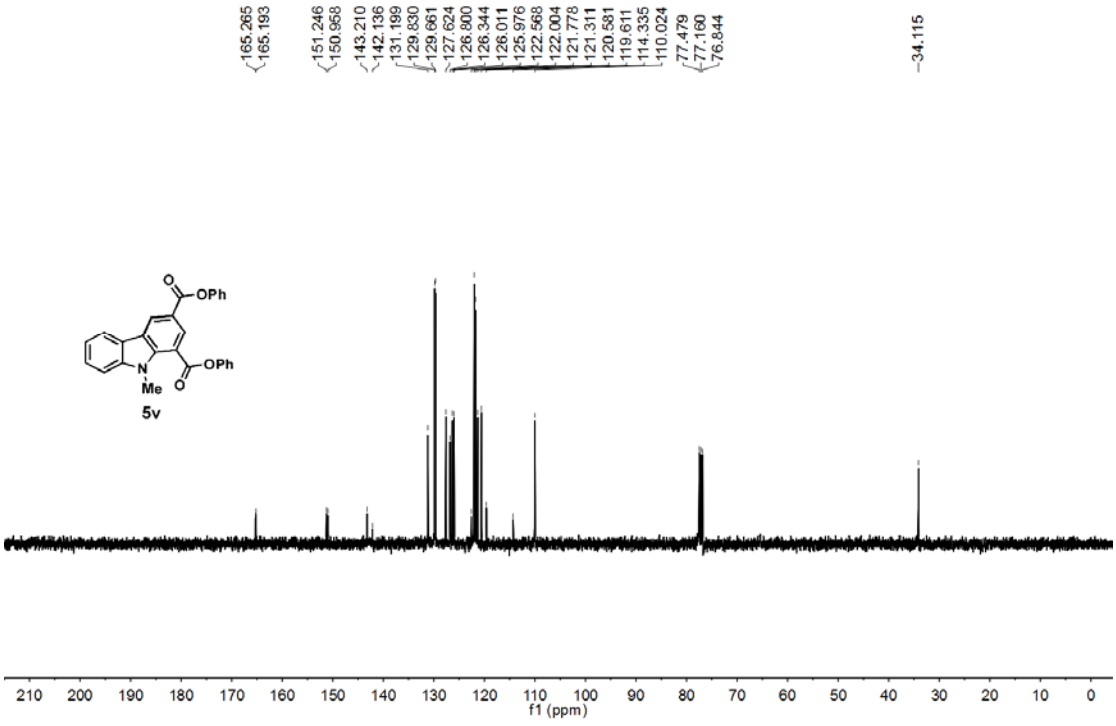
gtl-15600
13C NMR gtl-15600 CDCl3



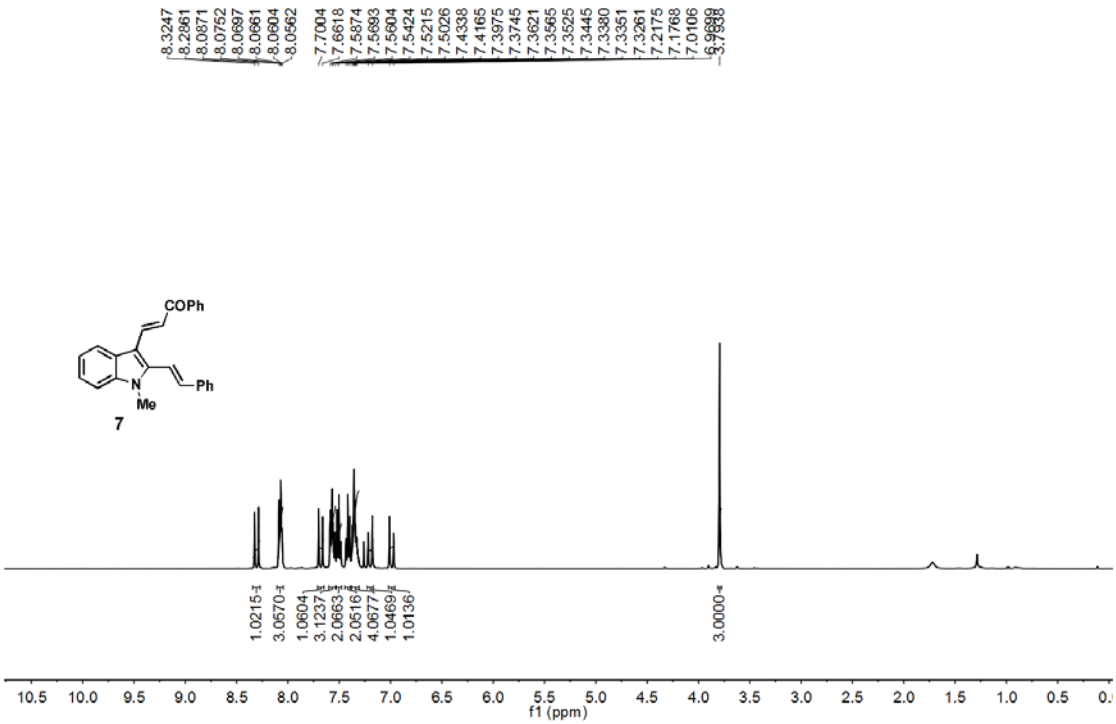
gtl-14300
1H NMR gtl-14300 in CDCl3



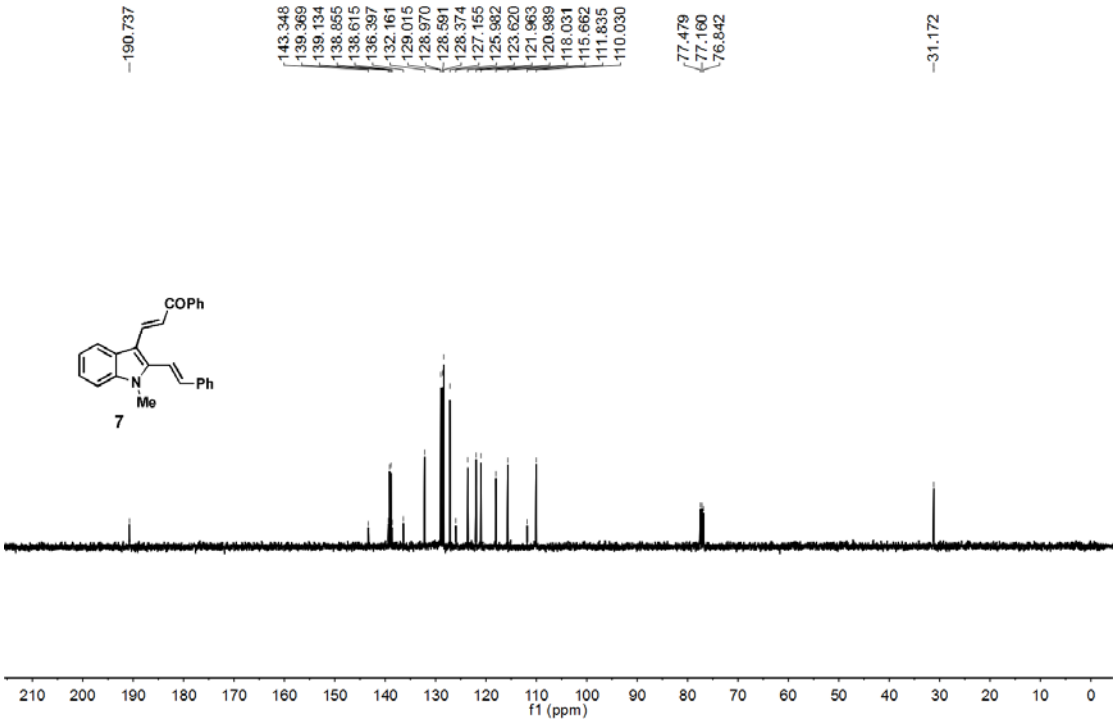
gtl-14300
13C NMR gtl-14300 CDCl3



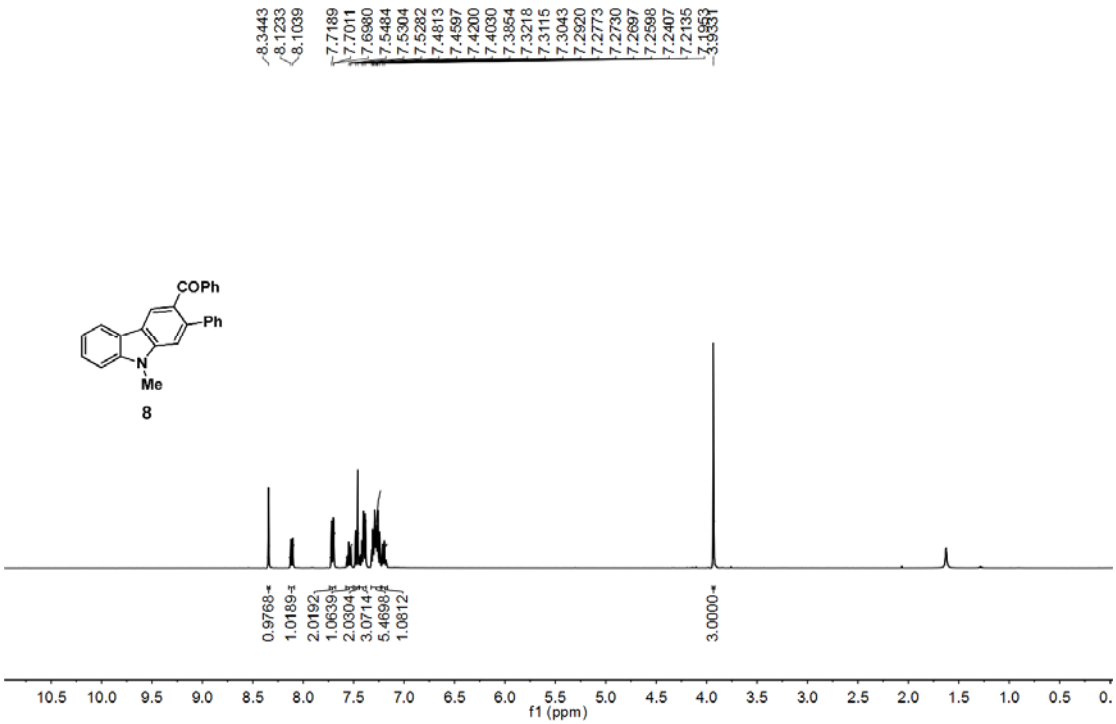
gtl-19702-1
1H NMR gtl-19702 in CDCl3



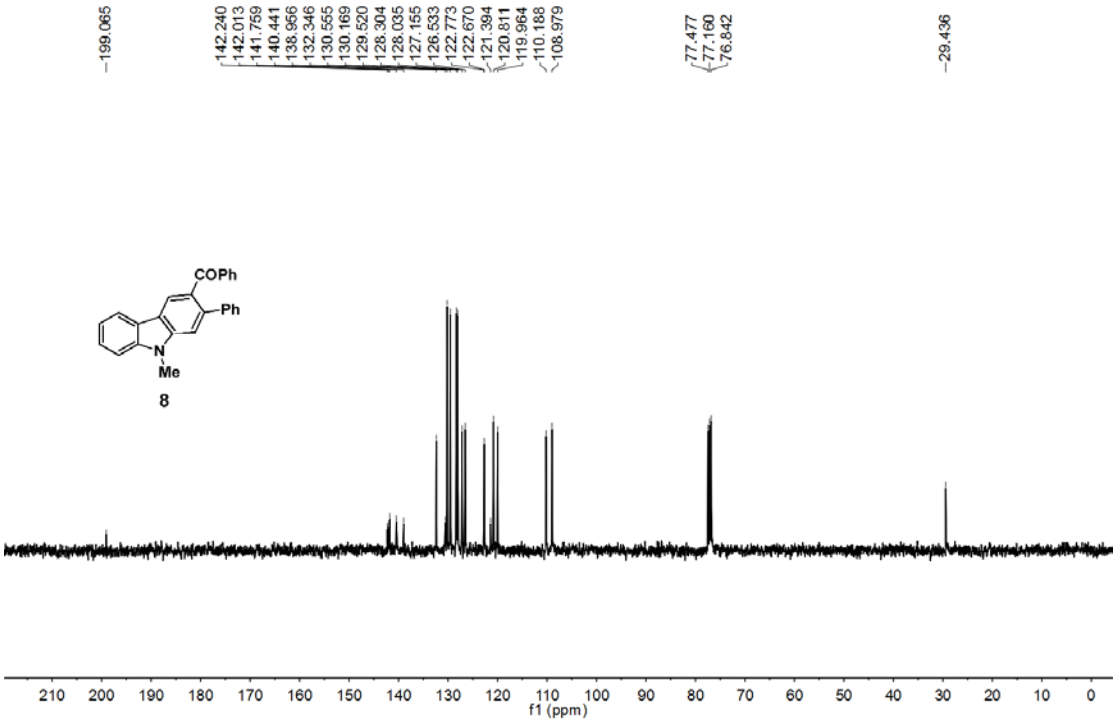
gtl-19702-1
13C NMR gtl-19702 CDCl3



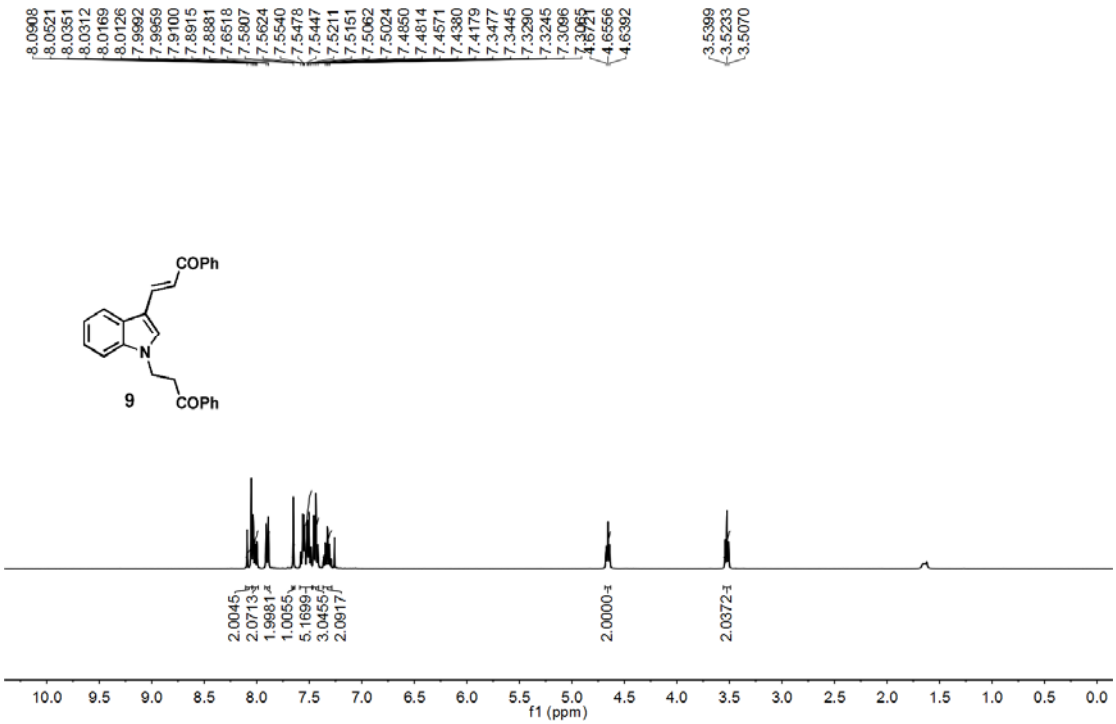
gtl-19701
1H NMR gtl-19701 in CDCl3



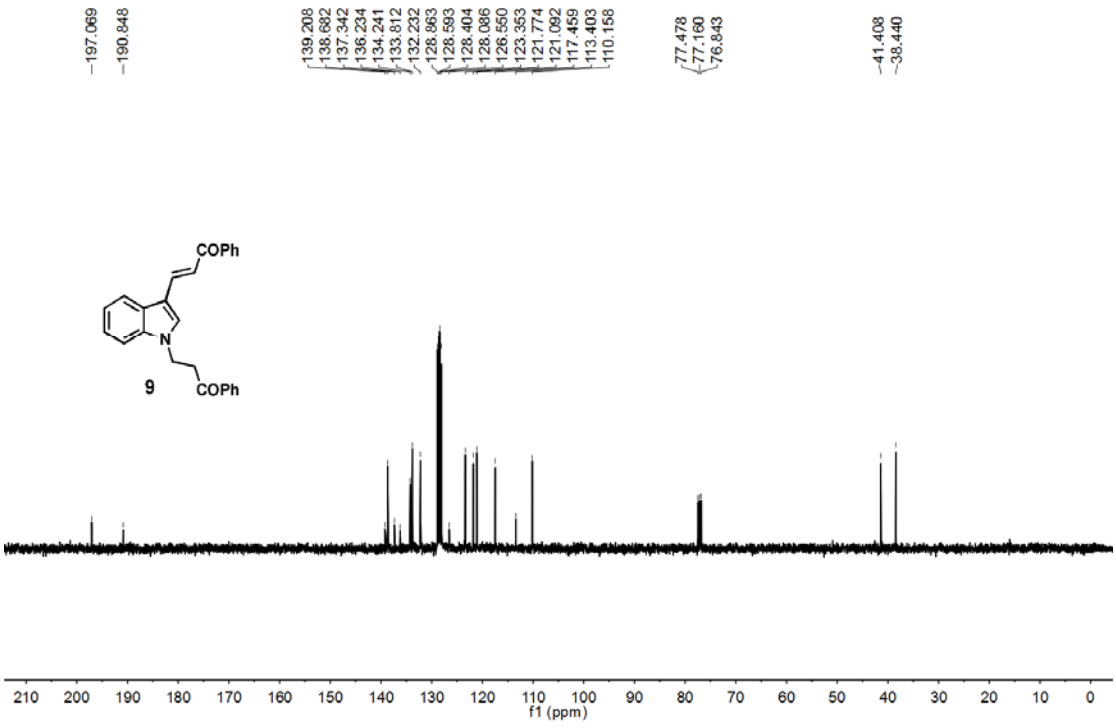
gtl-19701
13C NMR gtl-19701 CDCl3



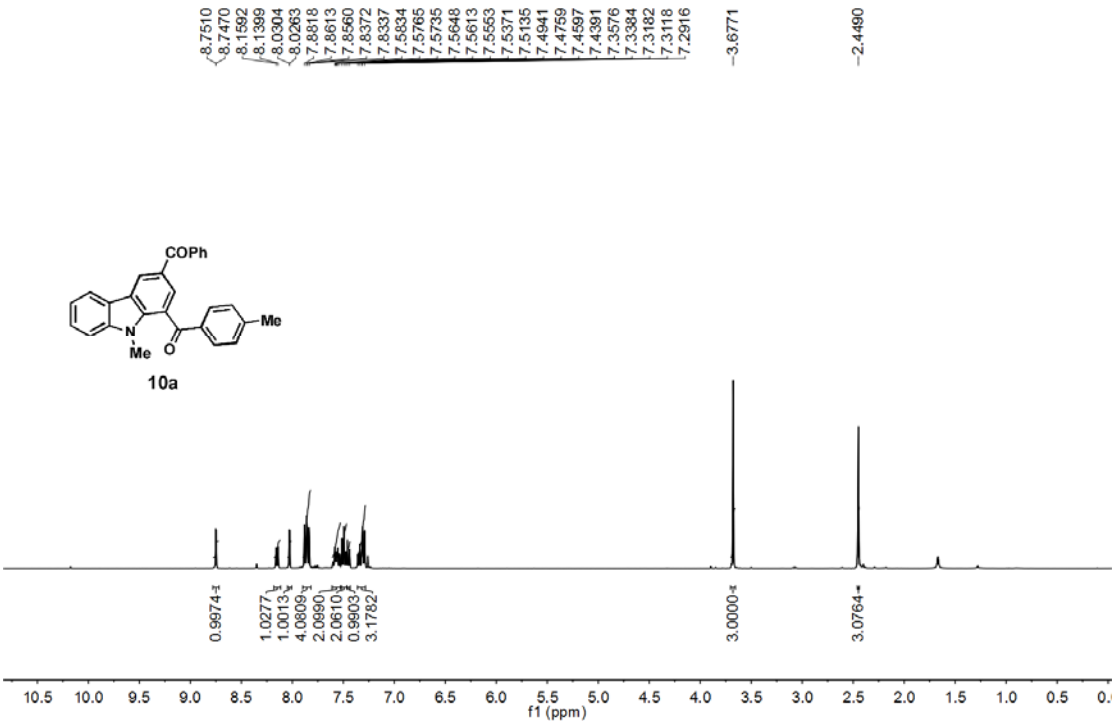
gtl-23005
1H NMR IN CDCl3



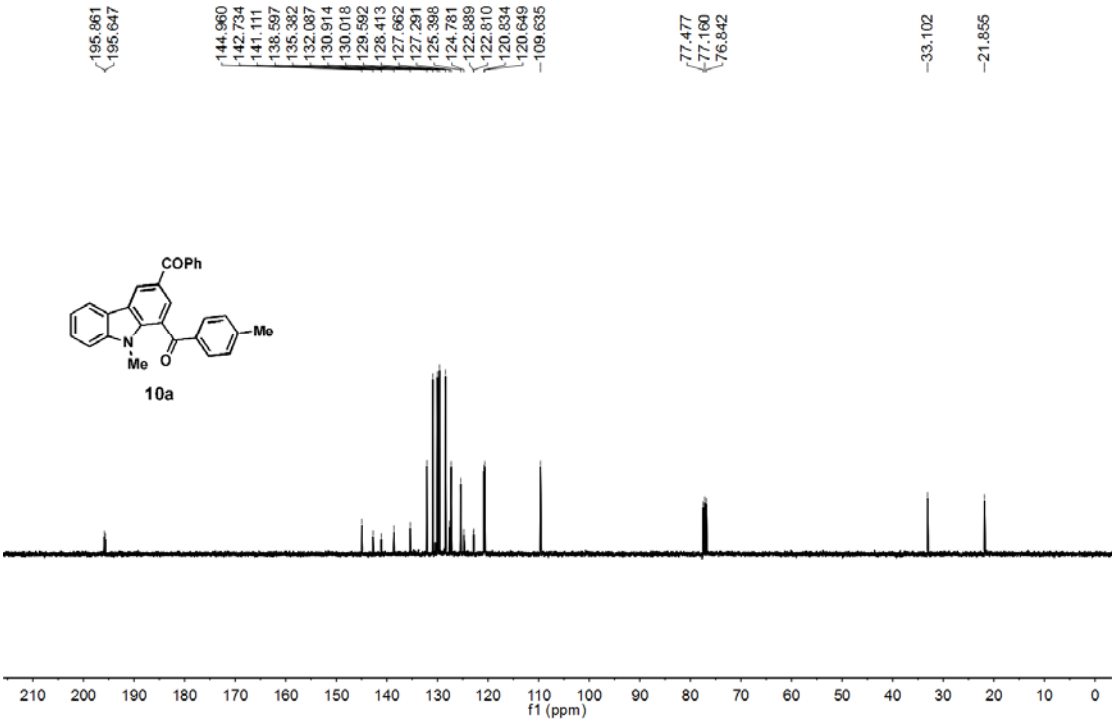
gtl-23005
13C NMR gtl-23005 CDCl3



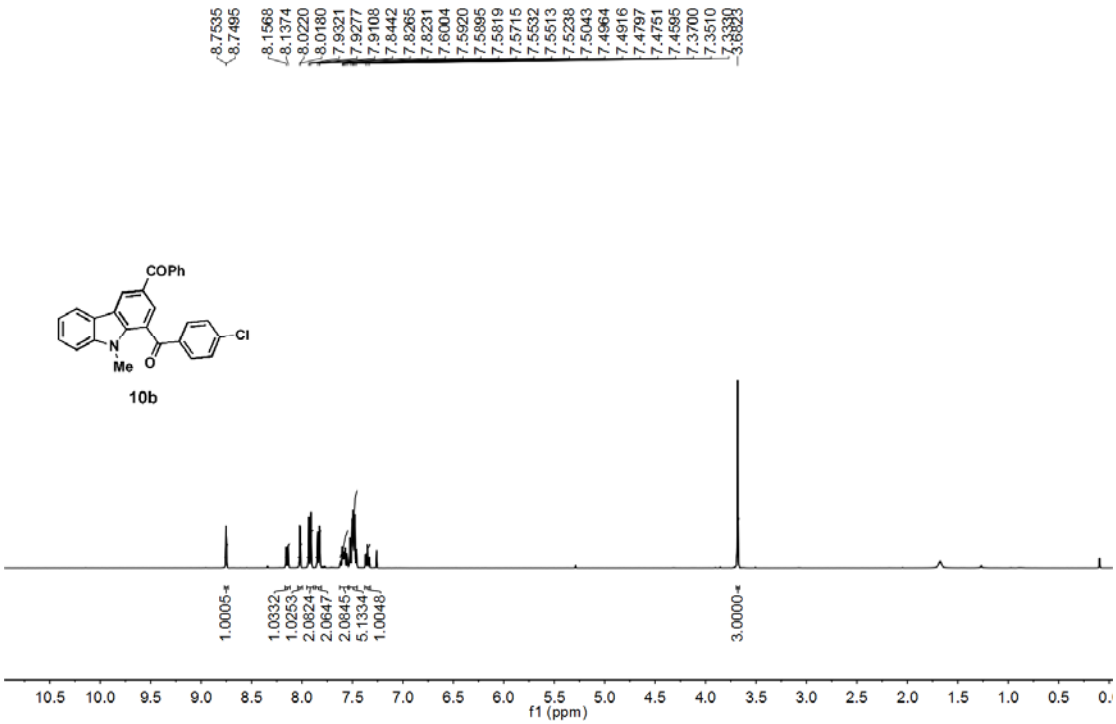
gtl-19400
1H NMR gtl-19400 in CDCl3



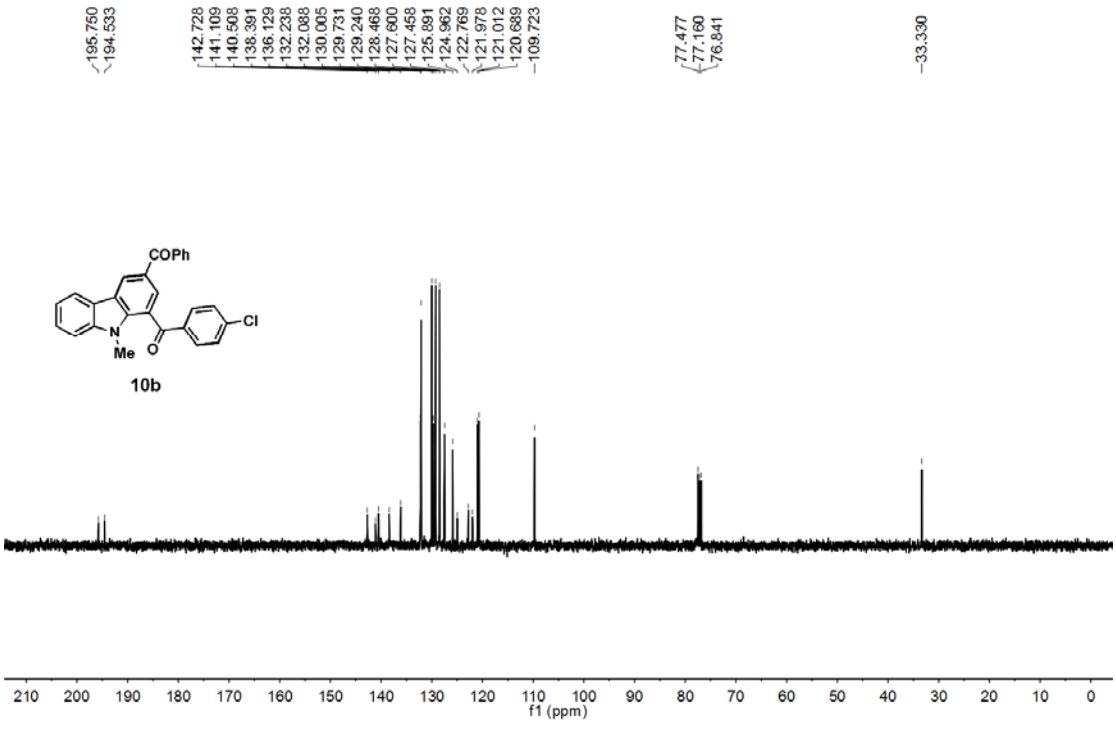
gtl-19400
13C NMR gtl-19400 CDCl3



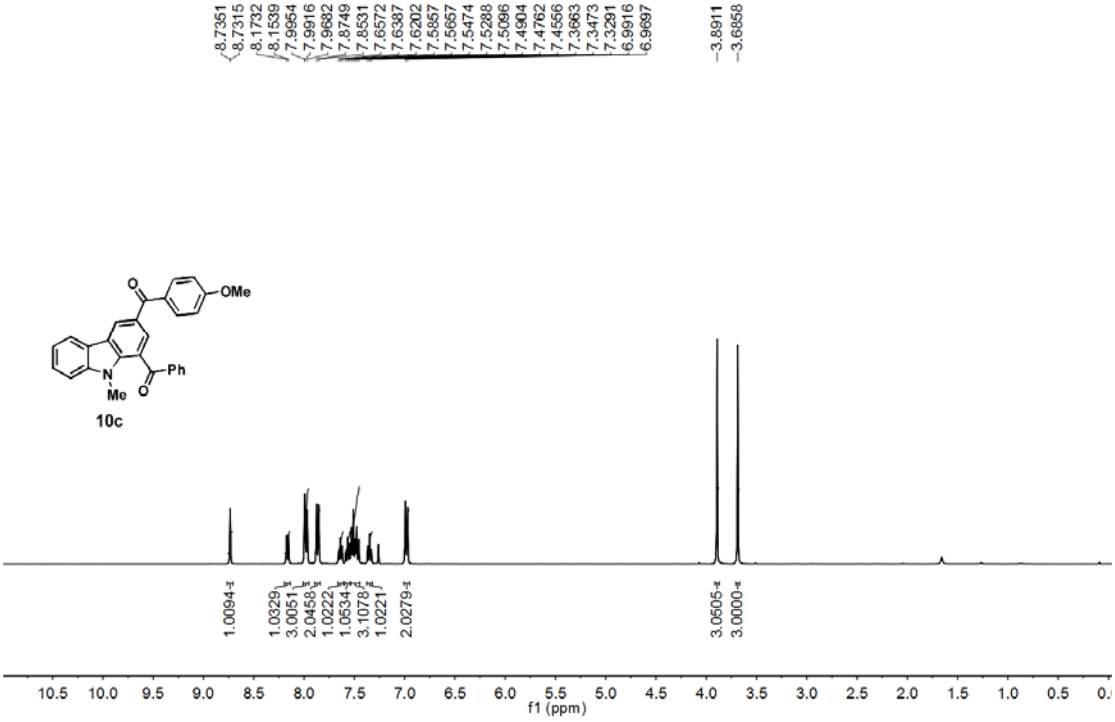
gtl-19500
1H NMR gtl-19500 in CDCl3



gtl-19500
13C NMR gtl-19500 CDCl3



gtl-24500
1H NMR gtl-24500 in CDCl3



gtl-24500
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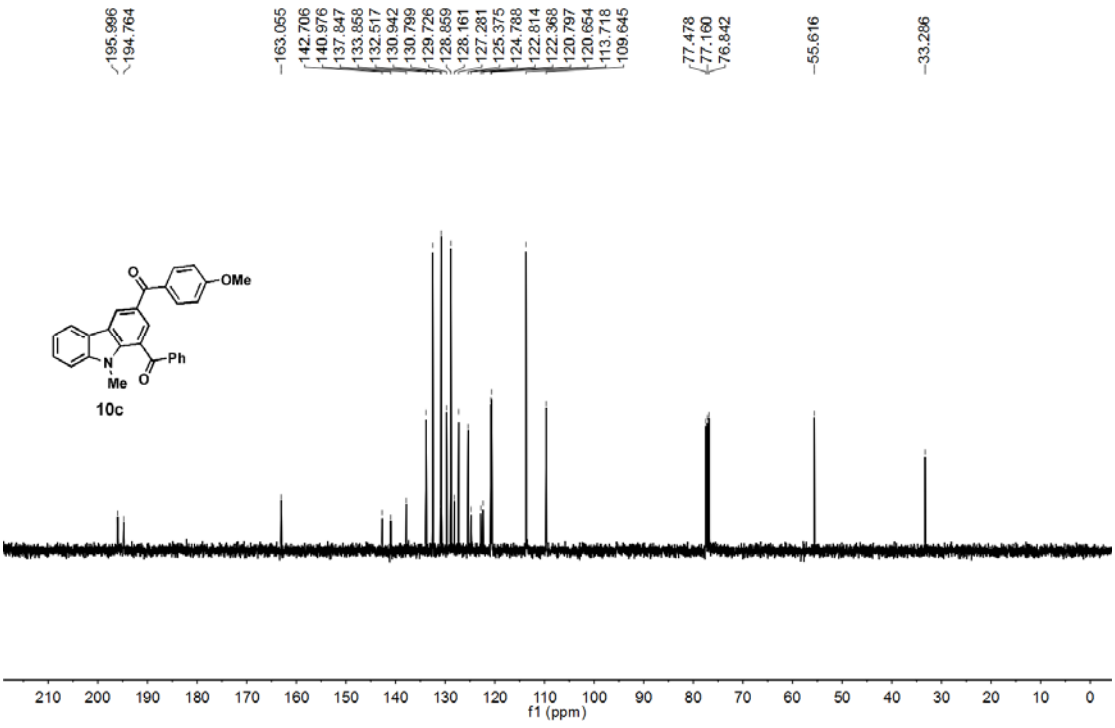
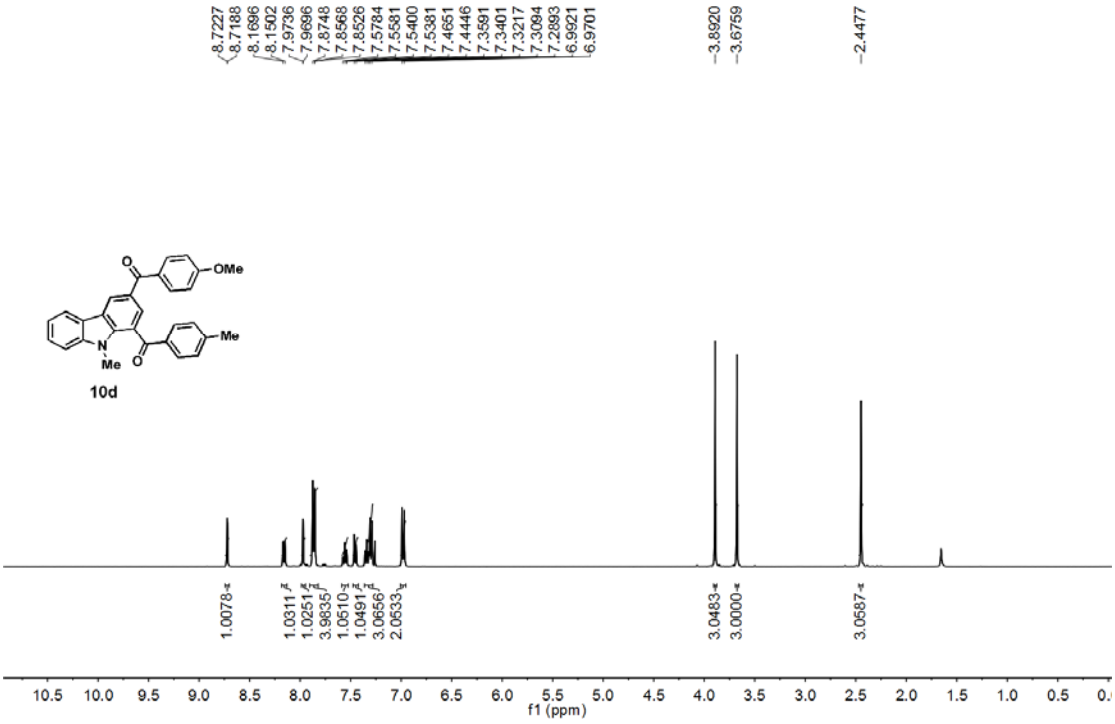


gtl-24600
1H NMR gtl-24600 in CDCl3



gtl-24600
13C NMR gtl-24600 CDCl3