Supporting information

CuBr-Catalyzed Selective Oxidation of N-Azomethine: Highly Efficient Synthesis of Methine-Bridged bis-Indole Compounds

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1. Synthetic experiment

Typical experimental procedure (3a) Bis(indol-3-yl)(phenyl)methane [1]. To a mixture of CuBr (3.6 mg, 0.025 mmol) and indole (59 mg, 0.5 mmol), N-benzyl-piperidine (88 mg, 0.5 mmol) was added. Then tert-butyl hydroperoxide (0.6 mmol, 5–6 M in decane) was added dropwise into the mixture under nitrogen at room temperature. The resulting mixture was stirred at 80 °C for 18 h. Then, the cooled reaction mixture was dissolved in water (5 mL) and extracted with CH_2Cl_2 (3×5 mL). The combined organic layer was dried with anhydrous $MgSO_4$, and the product was further purified by silica gel column chromatography and eluted with cyclohexane and petroleum ether mixture to afford the product. Pink solid; mp 122–124 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.91 (br s, 2H, NH), 7.34-7.39 (m, 6H), 7.25–7.29 (m, 2H), 7.14–7.17 (m, 3H), 7.00 (t, J = 6.8 Hz, 2H), 6.66 (s, 2H), 5.88 (s, 1H, Ar-CH); ^{13}C NMR (50 MHz, $CDCl_3$): δ 144.2, 136.9, 128.9, 128.4, 127.3, 126.3, 123.8, 122.1, 120.1, 120.0, 119.5, 111.2, 40.4; IR (KBr) ν_{max}/cm^{-1} 3410, 3051, 2924, 2858, 1612; HRMS (El) calcd. for $C_{23}H_{18}N_2$: 322.1470; found 322.1472.

[3b] Bis(6-chloroindol-3-yl)(phenyl)methane. Pink solid; mp 128–130°C; ^{1}H NMR (200 MHz, $CDCl_3$): δ 7.96 (br s, 2H, NH), 7.34 (s, 2H), 7.28-7.30 (m, 4H), 7.23-7.26 (m, 3H), 6.96 (d, J = 8.4 Hz, 2H), 6.61 (s, 2H), 5.78 (s, 1H, Ar-CH); ^{13}C NMR (50 MHz, $CDCl_3$): δ 143.5, 137.2, 128.8, 128.6, 128.2, 126.7, 125.8, 124.3, 120.9, 120.3, 119.8, 111.2, 40.3. IR ν_{max}/cm^{-1} 3423, 3026, 2927, 2858, 1610; HRMS (El) calcd. for $C_{23}H_{16}N_2Cl_2$: 390.0691; found 390.0694.

[3c] Bis(6-fluoroindol-3-yl)(phenyl)methane. Pink solid; mp 133-135°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 (br, s, 2H, NH), 7.19-7.31 (m, 7H), 6.98-7.00 (dd, J = 1.8, 9.8 Hz, 2H), 6.74(dt, J = 2.0, 9.2 Hz, 2H), 6.58 (s, 2H), 5.78 (s, 1H, Ar-CH); ^{13}C NMR (50 MHz, $CDCl_3$): δ 162.5, 157.8, 143.8,

136.9, 136.7, 128.8, 128.6, 126.6, 124.0, 123.9, 123.8, 120.9, 120.7, 119.8, 108.5, 108.0, 97.8, 97.3, 40.4. IR ν_{max}/cm^{-1} 3421, 3064, 3030, 2929, 1624; HRMS (El) calcd. for $C_{23}H_{16}N_2F_2$: 358.1282; found 358.1284.

[3d] Bis(5-methylindol-3-yl)(phenyl)methane.[2] Red solid; mp 193–194°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74 (br, s, 2H, NH), 7.32 (d, *J* = 7.2 Hz, 2H), 7.26 (t, *J* = 7.2 Hz, 2H), 7.20-7.22 (m, 3H), 7.18 (s, 2H), 6.98 (d, *J* = 8.0 Hz, 2H), 6.54 (s, 2H), 5.81 (s, 1H, Ar-CH); ^{13}C NMR (50 MHz, $CDCl_3$): δ 144.4, 135.3, 128.9, 128.7, 128.4, 127.5, 126.3, 124.1, 123.8, 119.7, 119.5, 110.9, 40.3, 21.7. IR ν_{max}/cm^{-1} 3408, 3022, 2920, 2856, 1597; HRMS (El) calcd. for $C_{25}H_{22}N_2$: 350.1783; found 350.1786.

[3e] Bis(indol-3-yl)(4-chlorophenyl)methane.[1] Pink solid; mp 76–77°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (br, s, 2H, NH), 7.35 (t, *J* = 7.2 Hz, 4H), 7.21-7.27 (m, 4H), 7.17 (t, *J* = 7.4 Hz, 2H), 7.01 (t, *J* = 7.4 Hz, 2H), 6.61 (s, 2H), 5.85 (s, 1H, Ar-CH); ^{13}C NMR (50 MHz, $CDCl_3$): δ 142.8, 136.9, 132.0, 130.3, 128.6, 127.1, 123.8, 122.3, 120.1, 119.6, 119.4, 111.4, 39.8. IR ν_{max}/cm^{-1} 3410, 3051, 2923, 2858, 1614; HRMS (El) calcd. for $C_{23}H_{17}ClN_2$: 356.1080; found 356.1075.

[3f] Bis(6-fluoroindol-3-yl)(4-chlorophenyl)methane. Pink solid; mp 98-100°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.94 (br, s, 2H, NH), 7.21-7.24 (m, 6H), 7.02 (d, *J* = 9.6 Hz, 2H), 6.77 (dt, *J* = 1.1, 9.2 Hz, 2H), 6.60 (s, 2H), 5.77 (s, 1H, Ar-CH); ^{13}C NMR (50 MHz, $CDCl_3$): δ 162.6, 157.8, 142.3, 136.9, 136.7, 132.3, 130.2, 128.7, 124.1, 124.0, 123.6, 120.8, 120.6, 119.3, 108.7, 108.2, 98.0, 97.4, 39.8. IR ν_{max}/cm^{-1} 3427, 3066, 2864, 1624; HRMS (El) calcd. for $C_{23}H_{15}F_2ClN_2$: 392.0892; found 392.0892.

[3g] Bis(5-bromoindol-3-yl)(4-chlorophenyl)methane.[3] Pink solid; mp 212-214°C; ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 8.02 (br s, 2H), 7.44 (s, 2H), 7.18-7.24 (m, 8H), 6.59(d, *J* = 1.6 Hz, 2H), 5.71 (s, 1H) ^{13}C NMR (50 MHz, $CDCl_3$): δ 141.8, 135.5, 132.4, 130.1, 128.8, 128.7, 125.3, 125.1, 122.4, 118.7, 113.0, 39.5. IR ν_{max}/cm^{-1} 3431, 3130, 2856, 1616; HRMS (El) calcd. for $C_{23}H_{15}Br_2ClN_2$: 511.9291; found 511.9297.

[3h] Bis(5-methylindol-3-yl)(4-chlorophenyl)methane. Pink solid; mp 148-150°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.78 (br, s, 2H, NH), 7.21-7.23 (m, 6H), 7.15 (s, 2H), 7.00 (d, *J* = 8.8 Hz, 2H), 6.54 (s, 2H), 5.78 (s, 1H, Ar-CH), 2.35 (s, 6H, CH_3); ^{13}C NMR (50 MHz, $CDCl_3$): δ 143.0, 135.2, 131.9, 130.3, 128.8, 128.6, 127.3, 124.1, 123.9, 119.6, 119.0, 111.0, 39.7, 21.7. IR ν_{max}/cm^{-1} 3408, 3026, 2922, 2858, 1622; HRMS (El) calcd. for $C_{25}H_{21}N_2Cl$: 384.1393; found 384.1389.

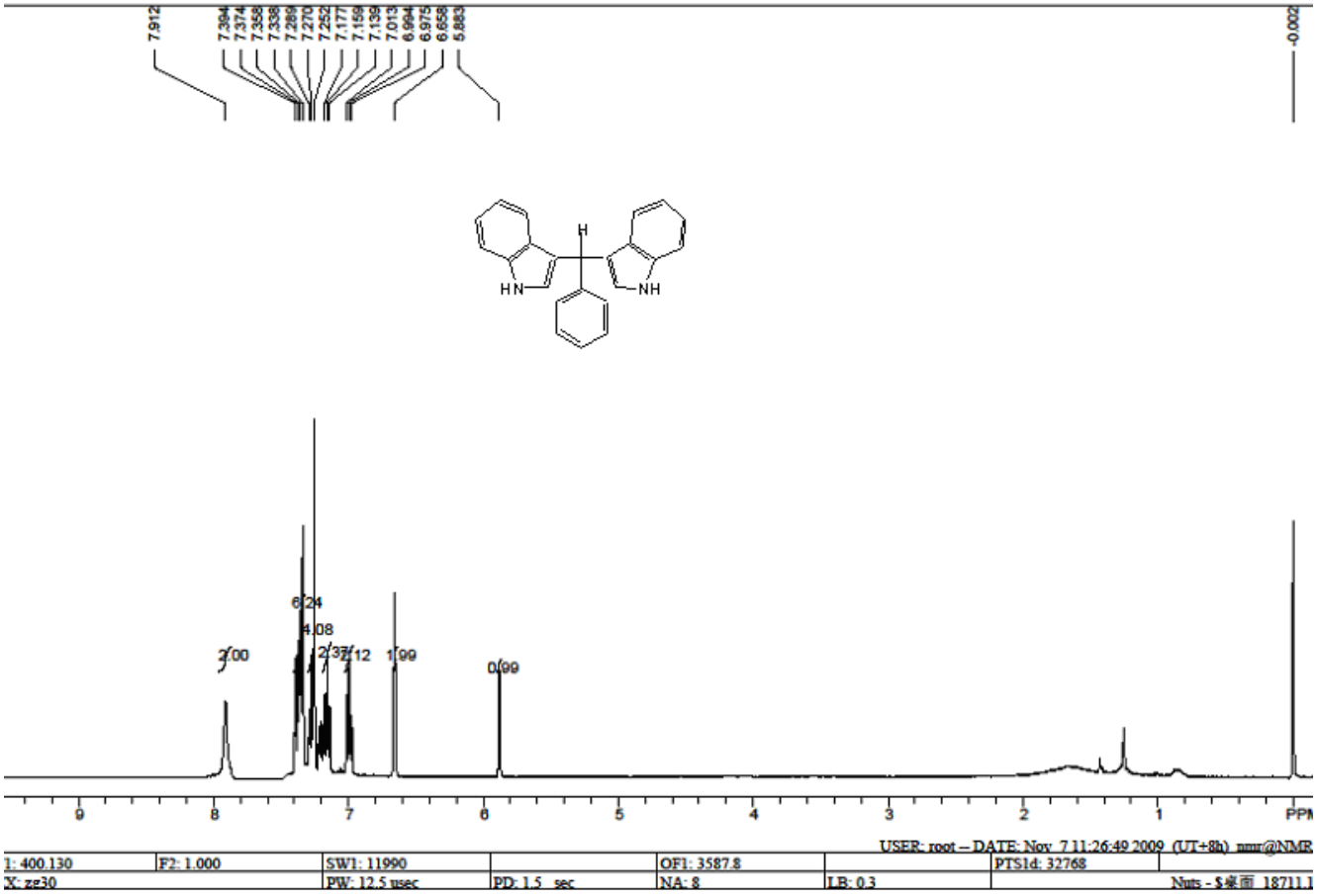
[3i] Bis(5-bromoindol-3-yl)(3-methylphenyl)methane. Pink solid; mp 155-157°C; ^{1}H NMR (400 MHz, $CDCl_3$): 7.97 (br, s, 2H, NH); 7.47 (s, 2H), 7.14-7.23 (m, 6H), 7.09 (s, 1H), 7.02-7.05 (m, 3H), 6.58

(s, 2H), 5.68 (s, 1H, Ar-CH), 2.28 (s, 3H, CH_3); ^{13}C NMR (50 MHz, $CDCl_3$): δ 143.2, 138.2, 135.5, 129.5, 128.9, 128.5, 127.6, 125.8, 125.1, 125.0, 122.5, 119.3, 112.8, 40.0, 21.8. IR ν_{max}/cm^{-1} 3421, 3024, 2922, 2864, 1602; HRMS (El) calcd. for $C_{24}H_{18}N_2Br_2$: 491.9837; found 491.9840.

[3j] Bis(6-fluoroindol-3-yl)(3-methylphenyl)methane (3j). Pink solid; mp 141-143°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (br, s, 2H, NH), 7.23-7.27 (m, 2H), 7.14-7.18 (m, 2H), 7.09 (d, *J* = 8.0 Hz, 1H), 6.98-7.03 (m, 3H), 6.75 (dt, *J*= 1.2, 9.1 Hz, 2H), 6.60 (s, 2H), 5.75 (s, 1H, Ar-CH), 2.28 (s, 3H, CH_3); ^{13}C NMR (50 MHz, $CDCl_3$): δ 162.5, 157.8, 143.7, 138.1, 136.9, 136.6, 129.6, 128.4, 127.4, 125.8, 124.0, 123.8, 120.9, 120.7, 119.9, 108.5, 108.0, 97.8, 97.3, 40.3, 21.8. IR ν_{max}/cm^{-1} 3419, 3061, 2920, 2858, 1624; HRMS (El) calcd. for $C_{24}H_{18}N_2F_2$: 372.1438; found 372.1435.

[3k] Bis(5-methylindol-3-yl)(3-methylphenyl)methane. Pink solid; mp 140-142°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.70 (br, s, 2H, NH), 7.09-7.21 (m, 8H), 6.96-7.01 (m, 2H), 6.52 (s, 2H), 5.77 (s, 1H, Ar-CH), 2.34 (s, 6H, CH_3), 2.27 (s, 3H, CH_3); ^{13}C NMR (50 MHz, $CDCl_3$): δ 144.3, 137.8, 135.2, 129.7, 128.6, 128.3, 127.6, 127.1, 125.9, 124.1, 123.7, 119.7, 110.9, 40.1, 21.8, 21.7. IR ν_{max}/cm^{-1} 3408, 3022, 2918, 2858, 1601; HRMS (El) calcd. for $C_{26}H_{24}N_2$: 364.1940; found 364.1945.

2. Spectroscopy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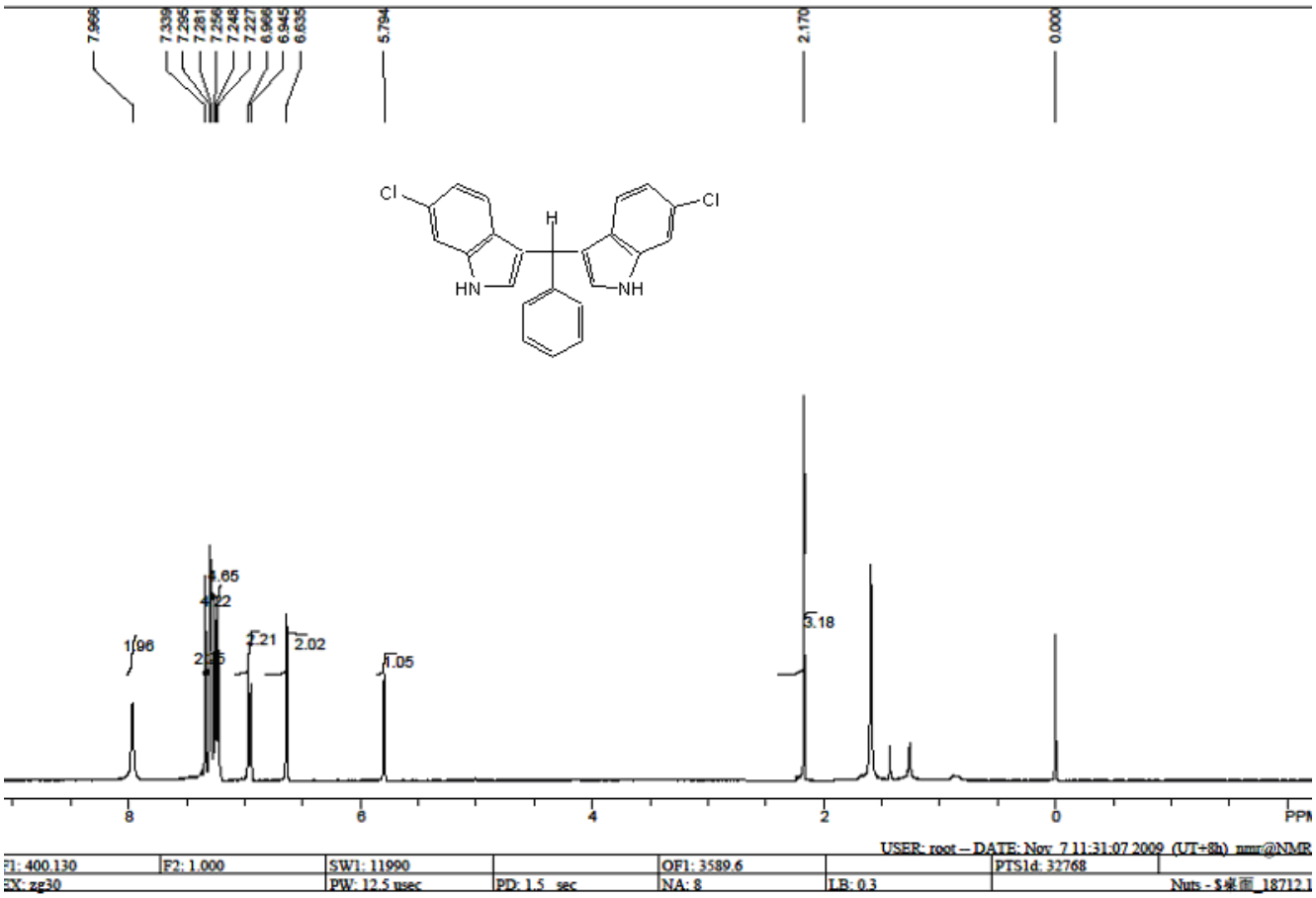
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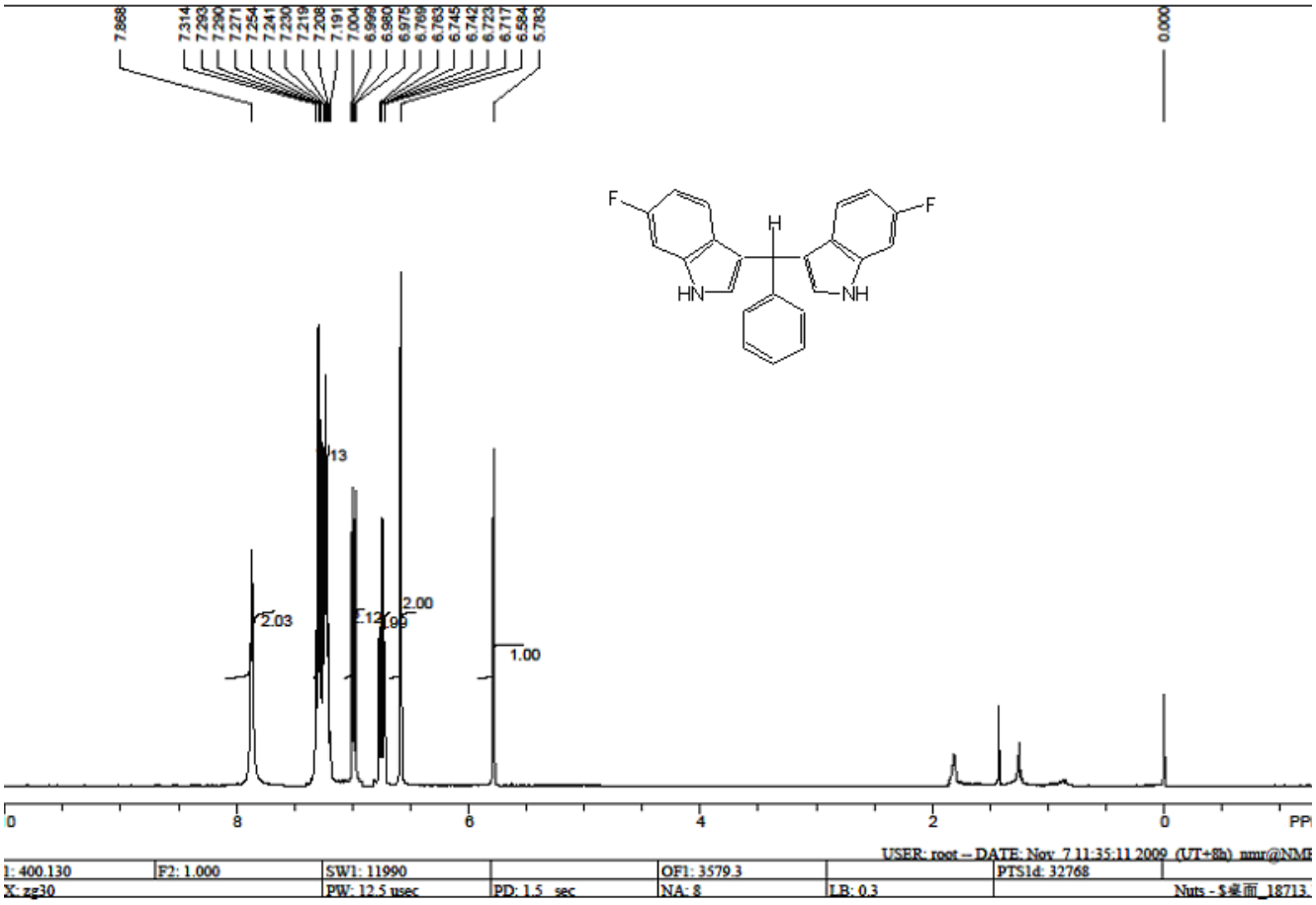
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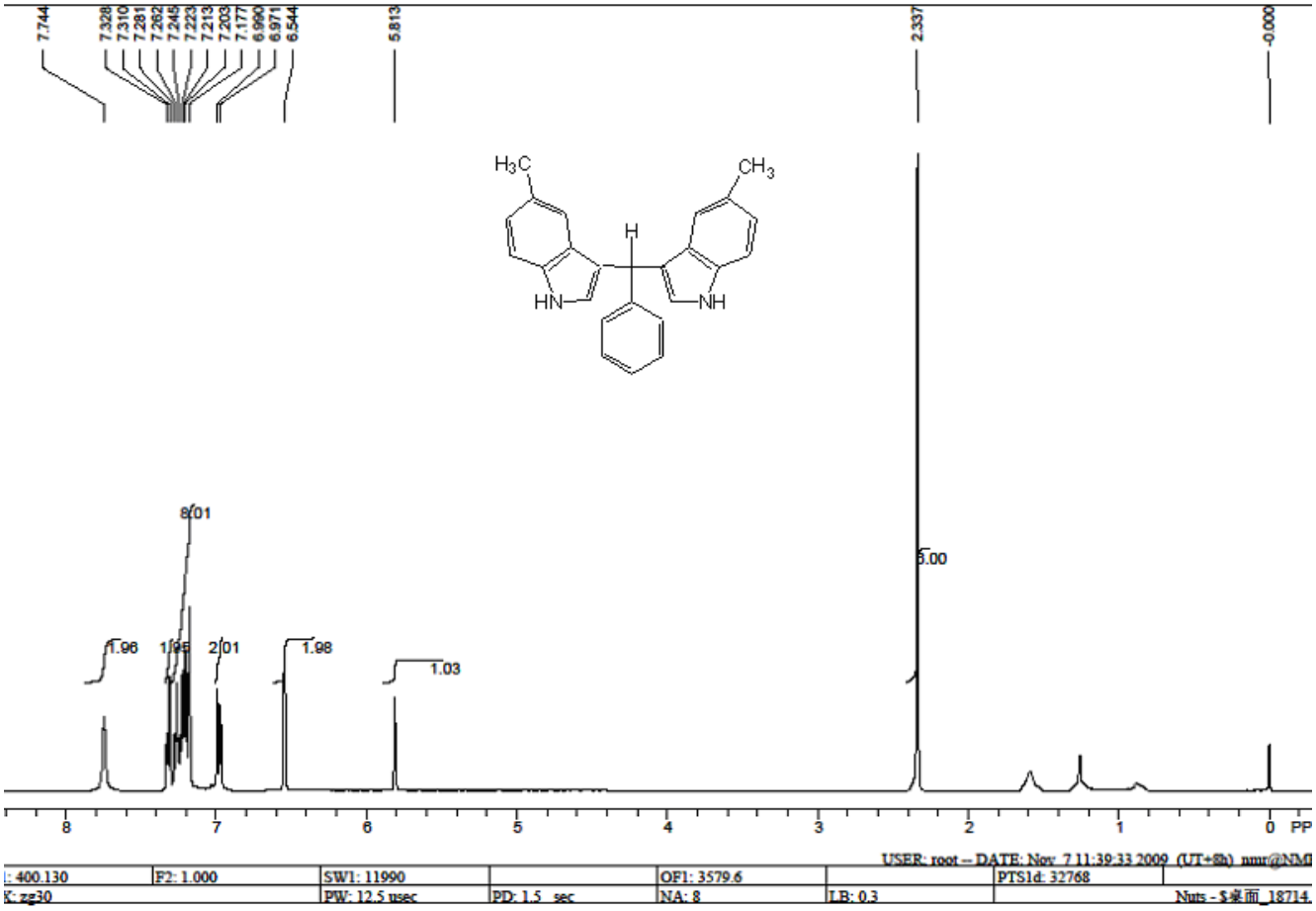
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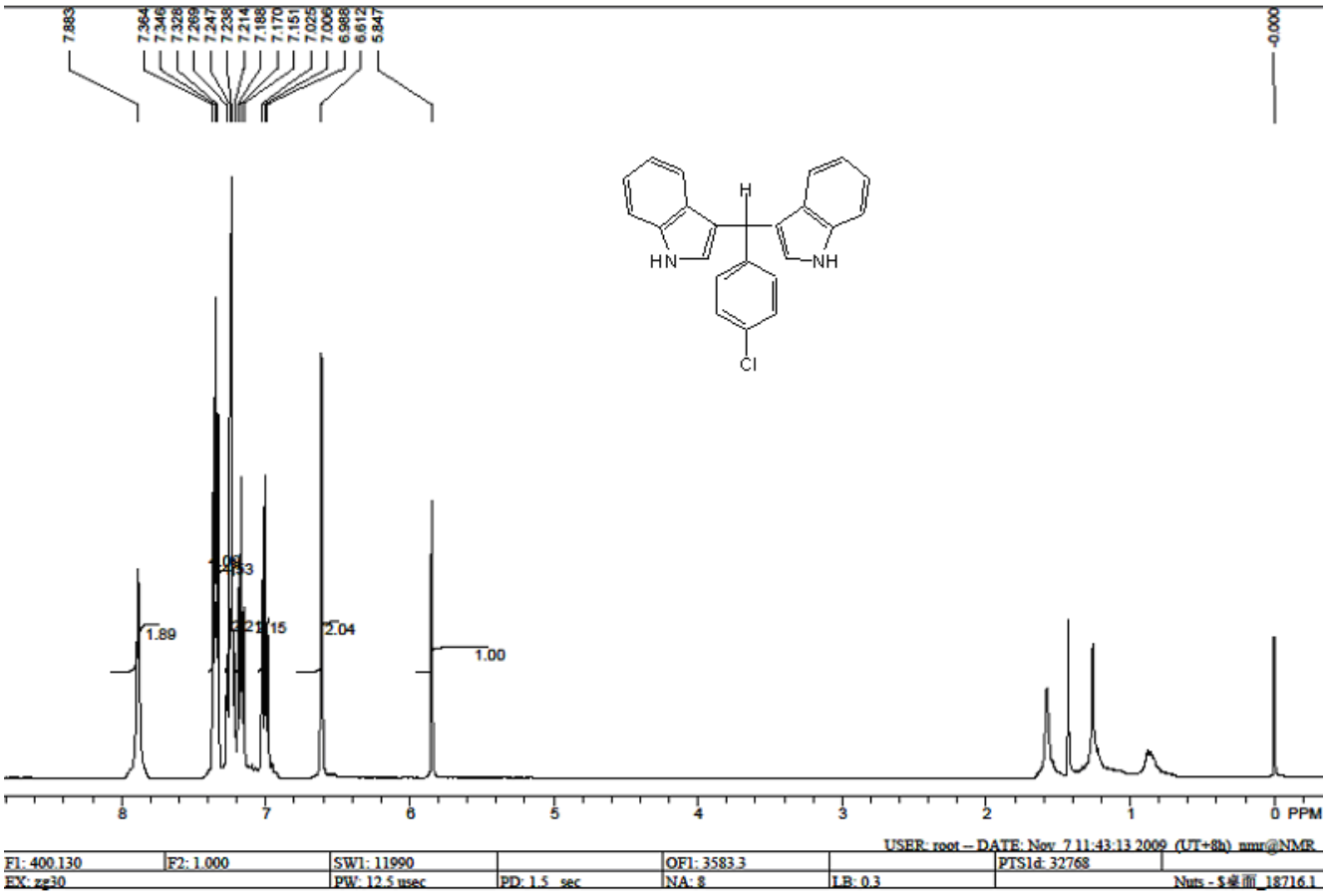
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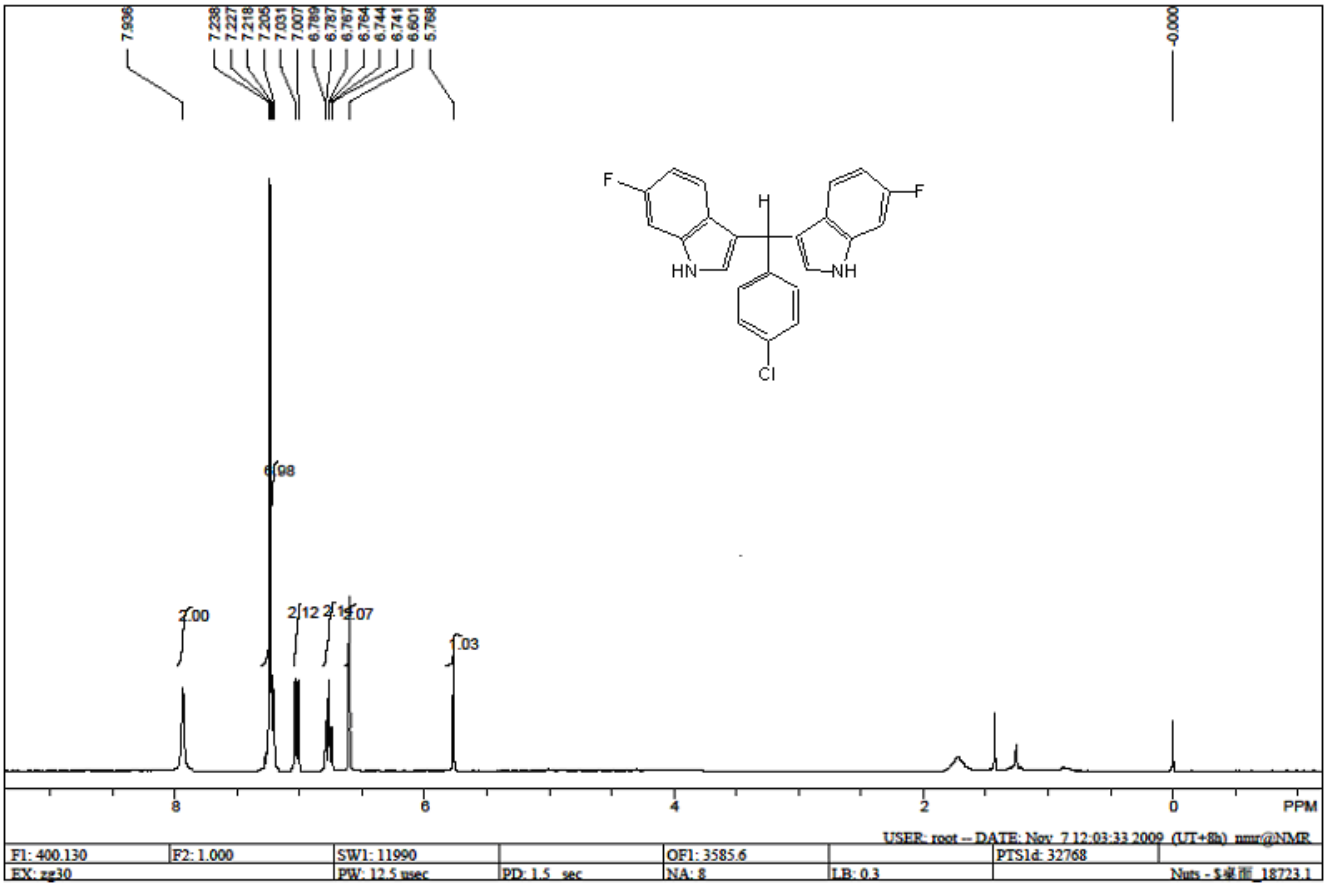
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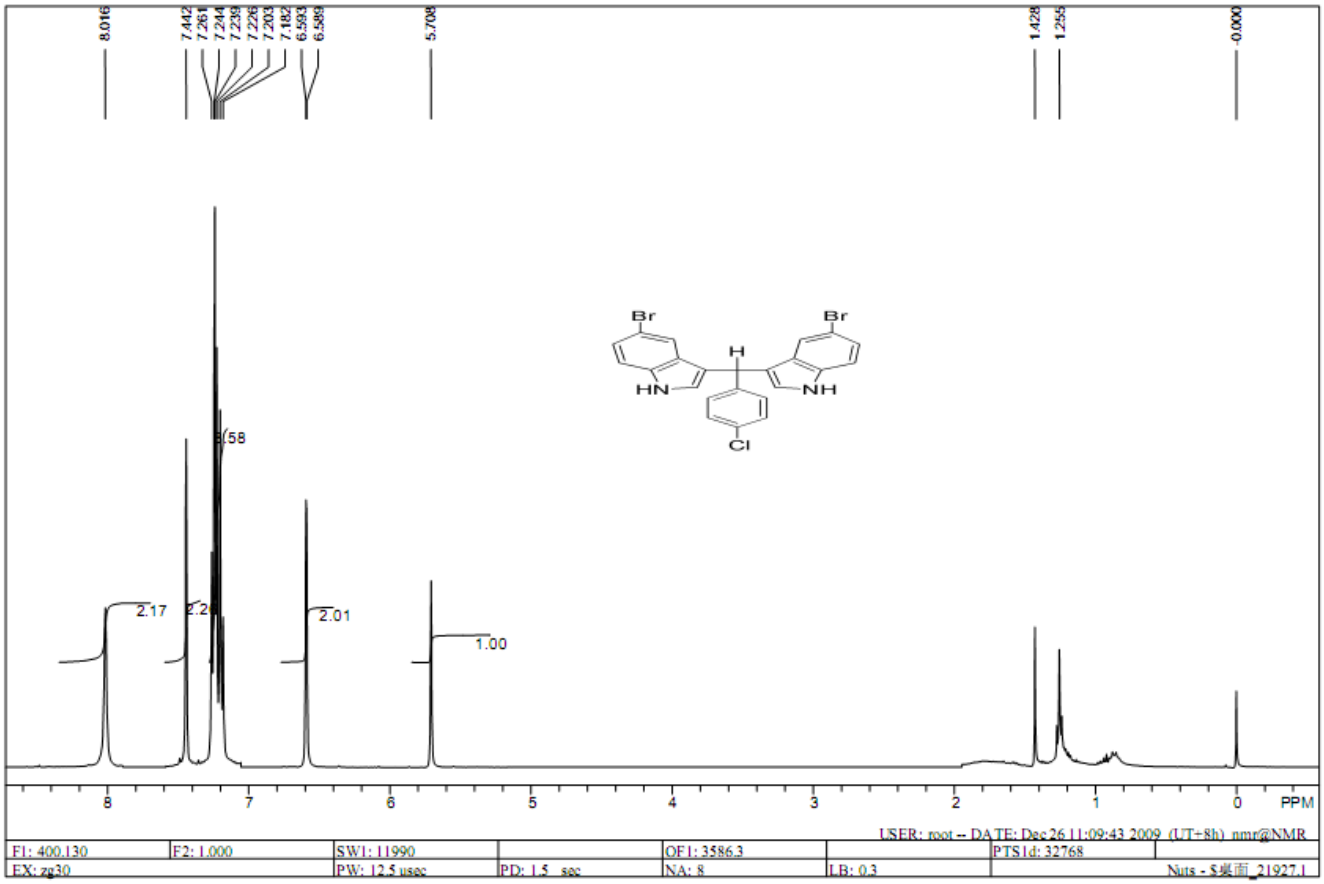
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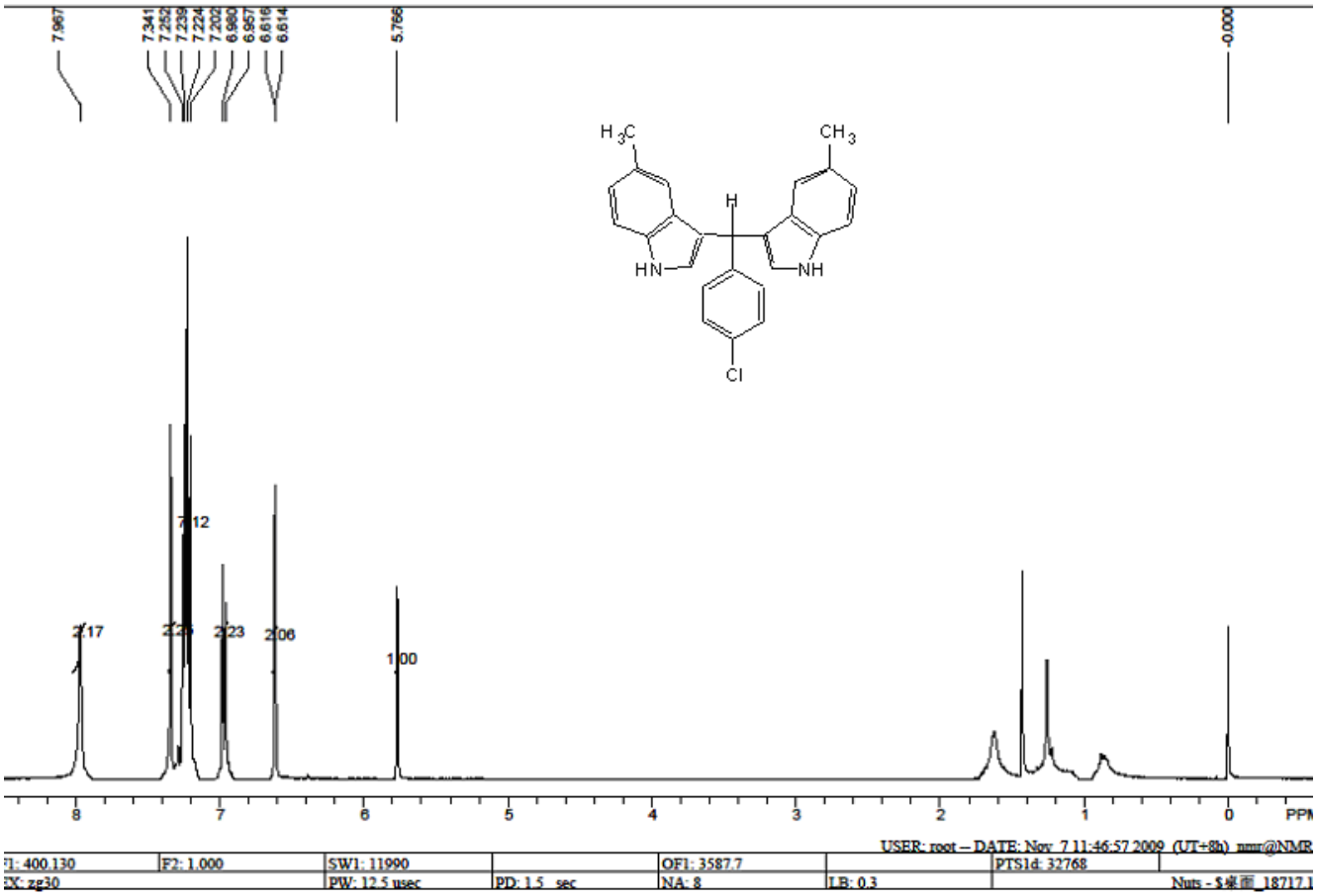
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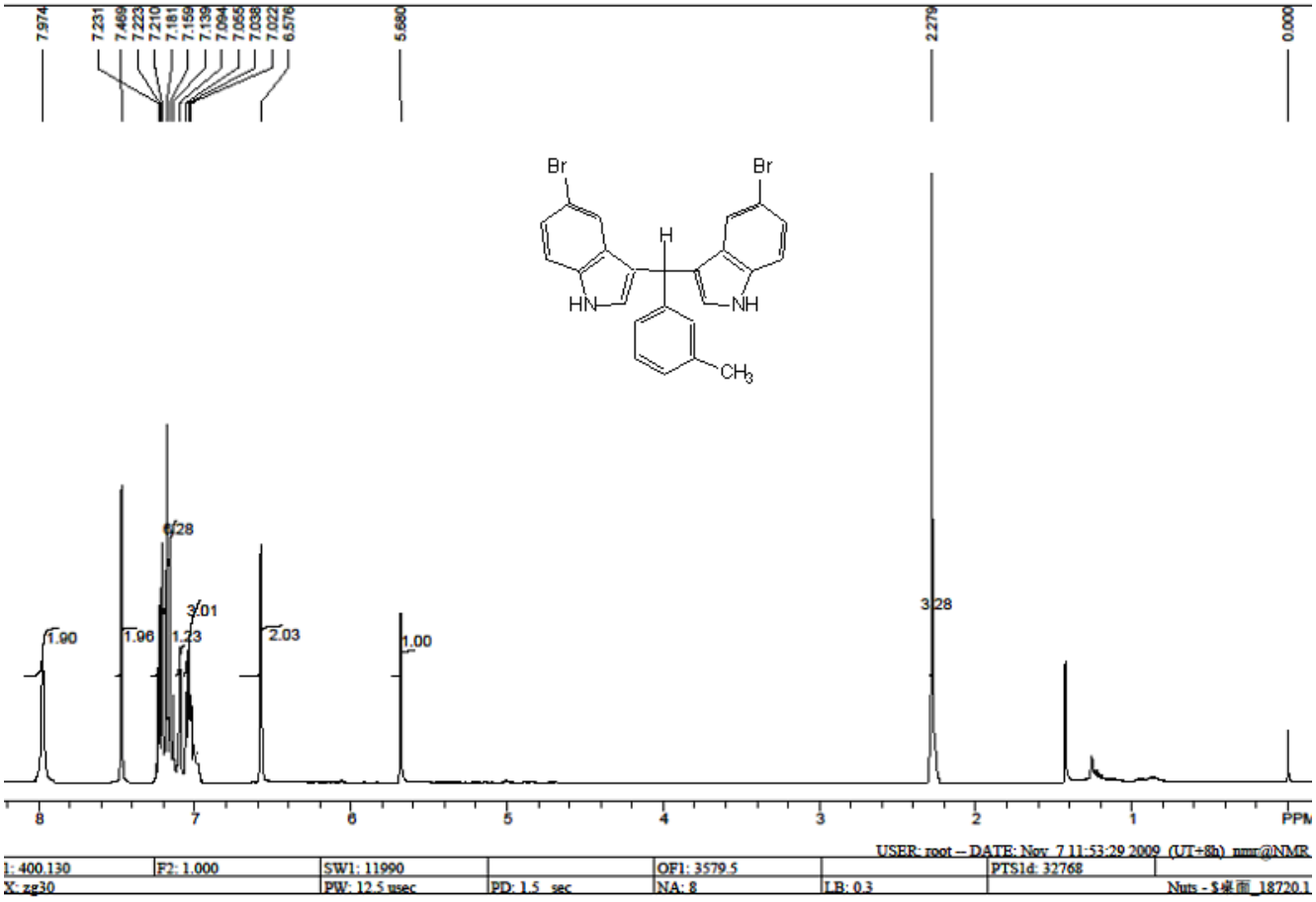
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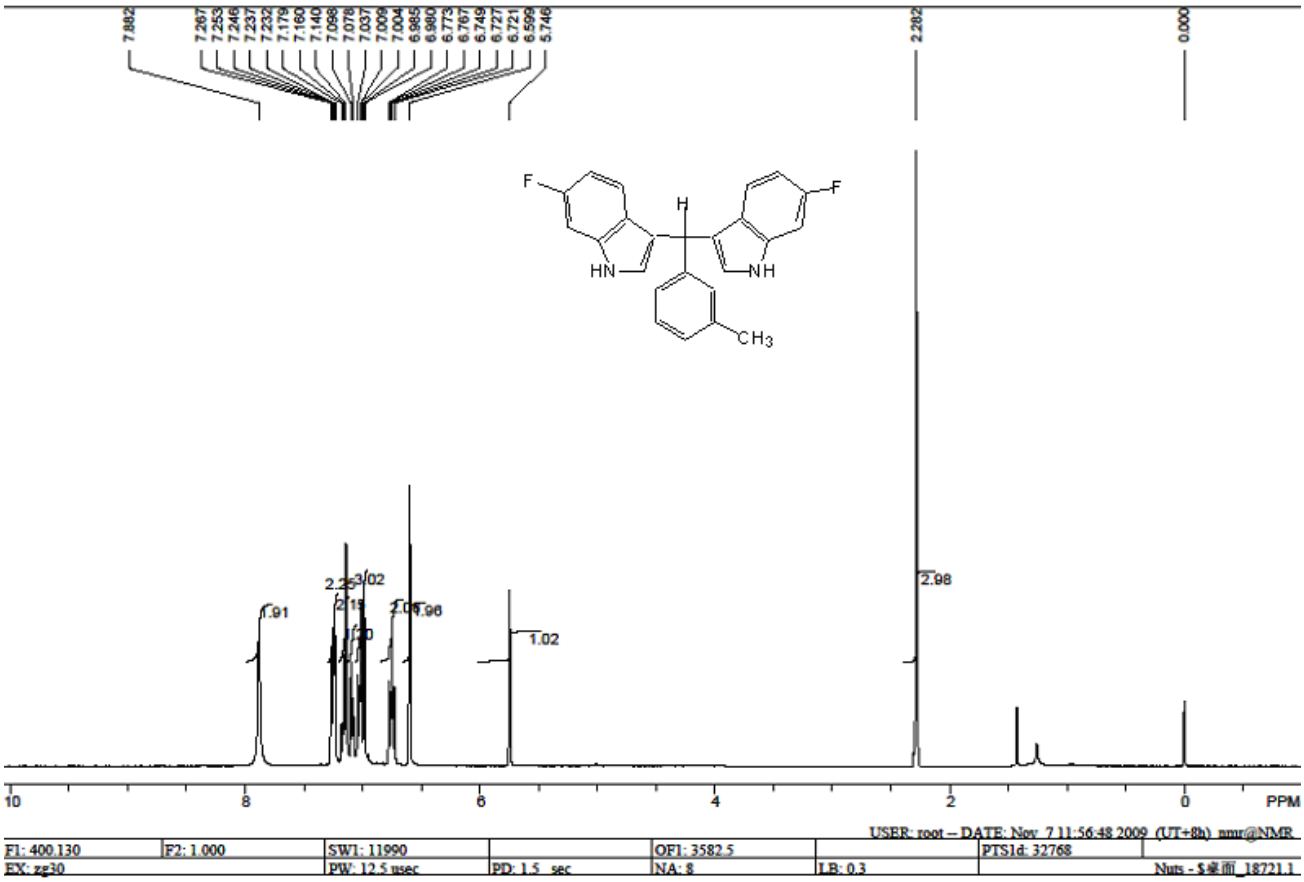
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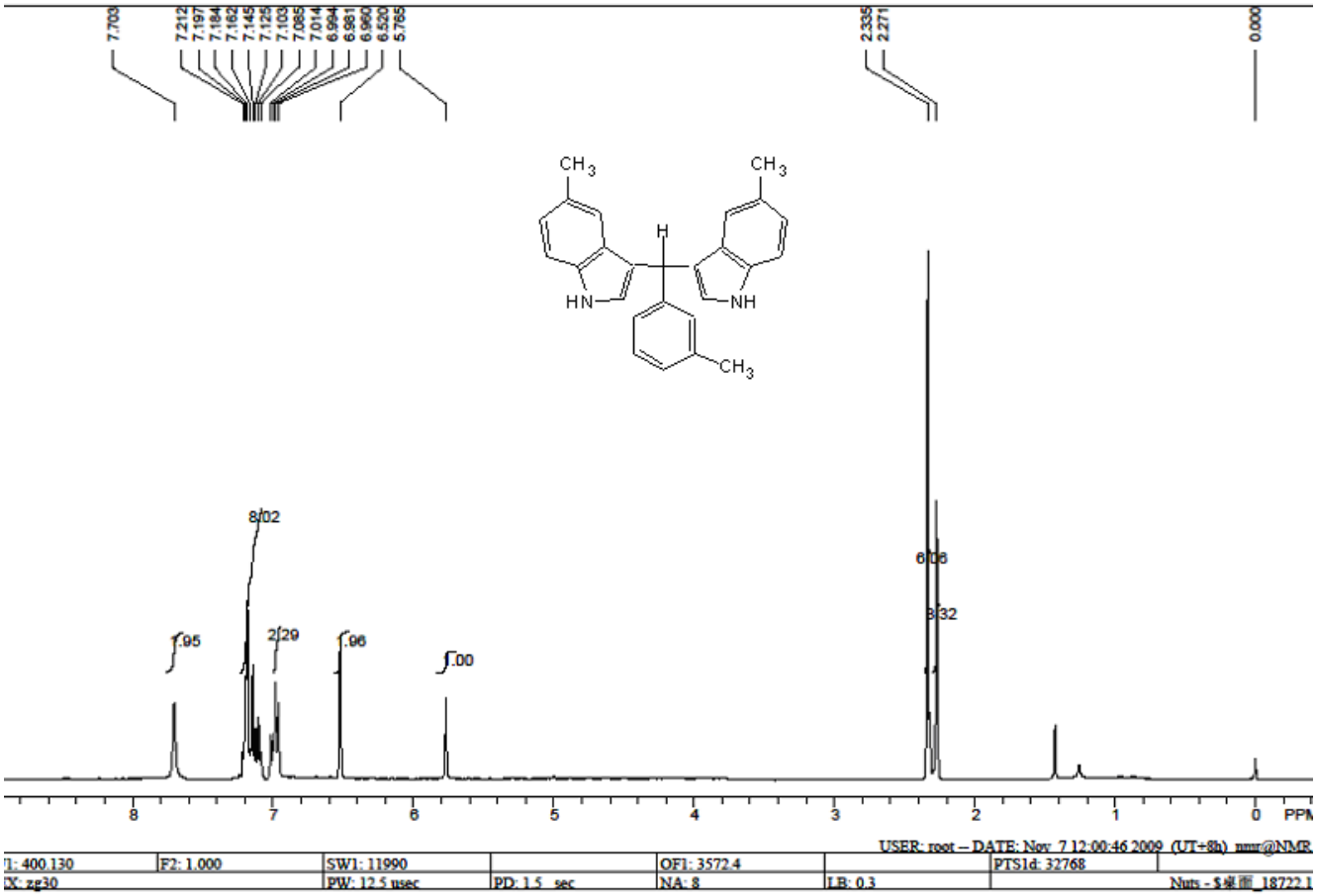
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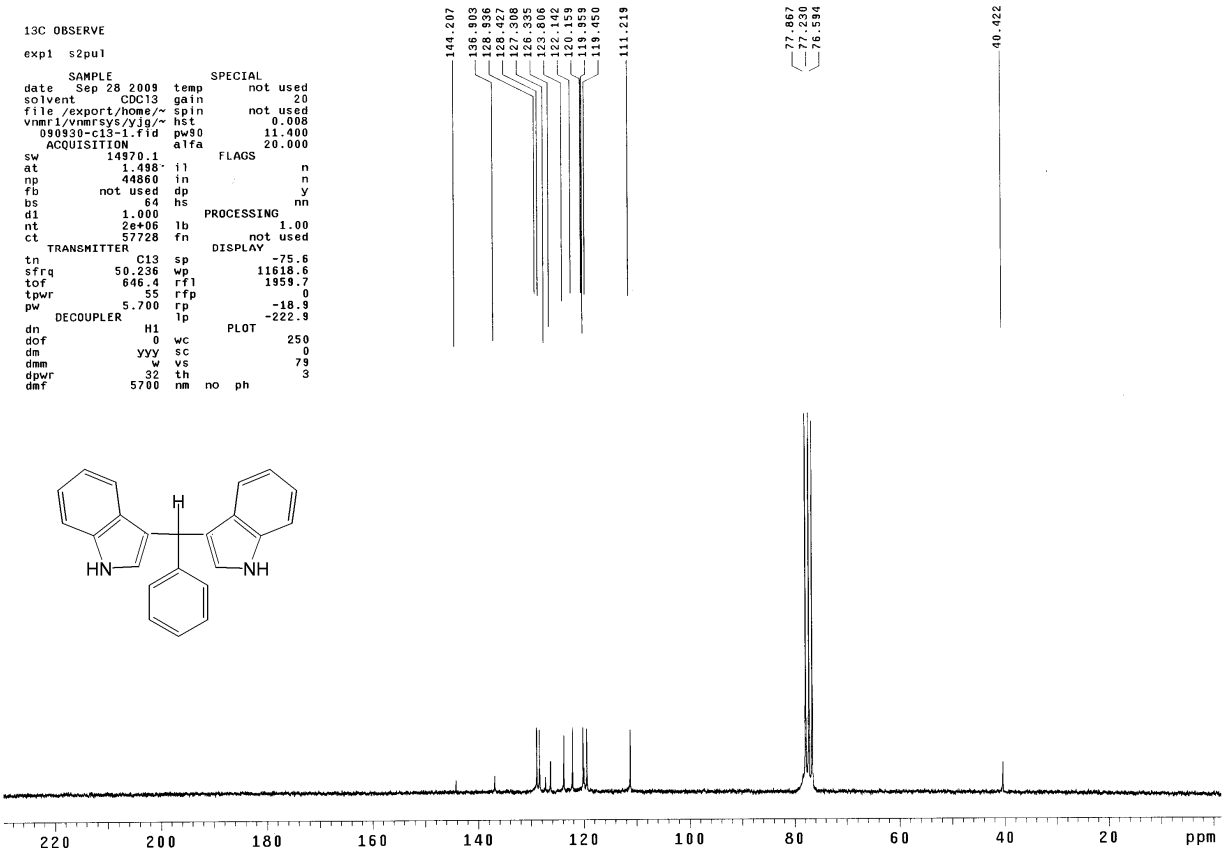
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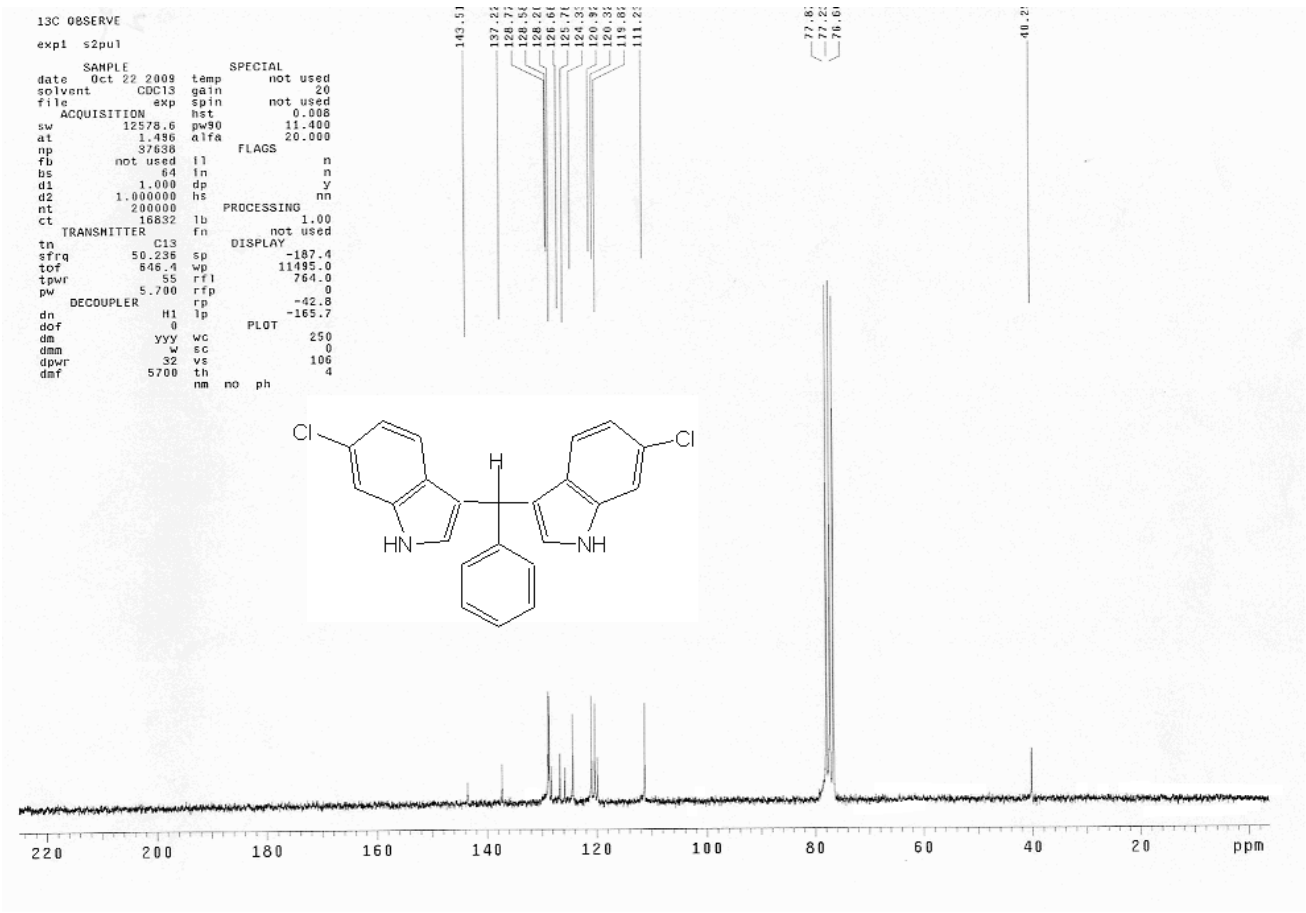
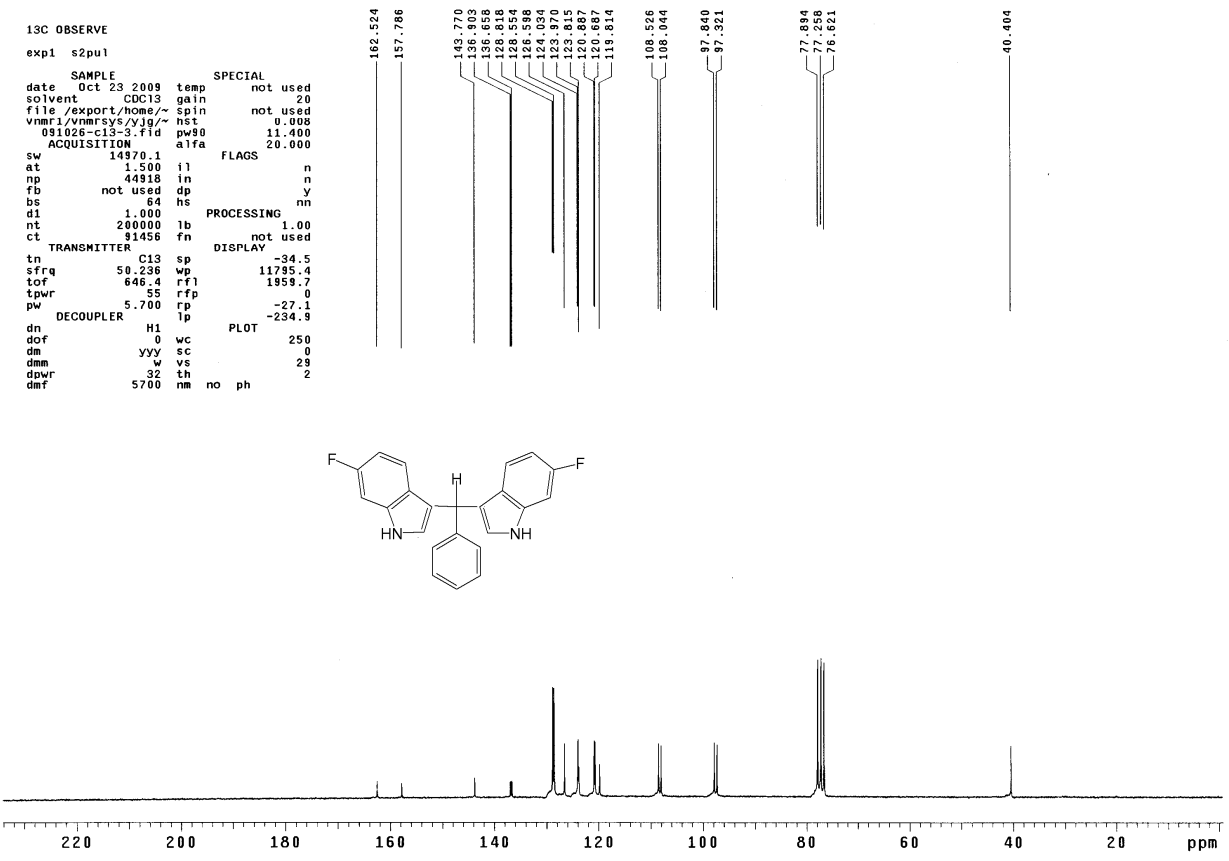
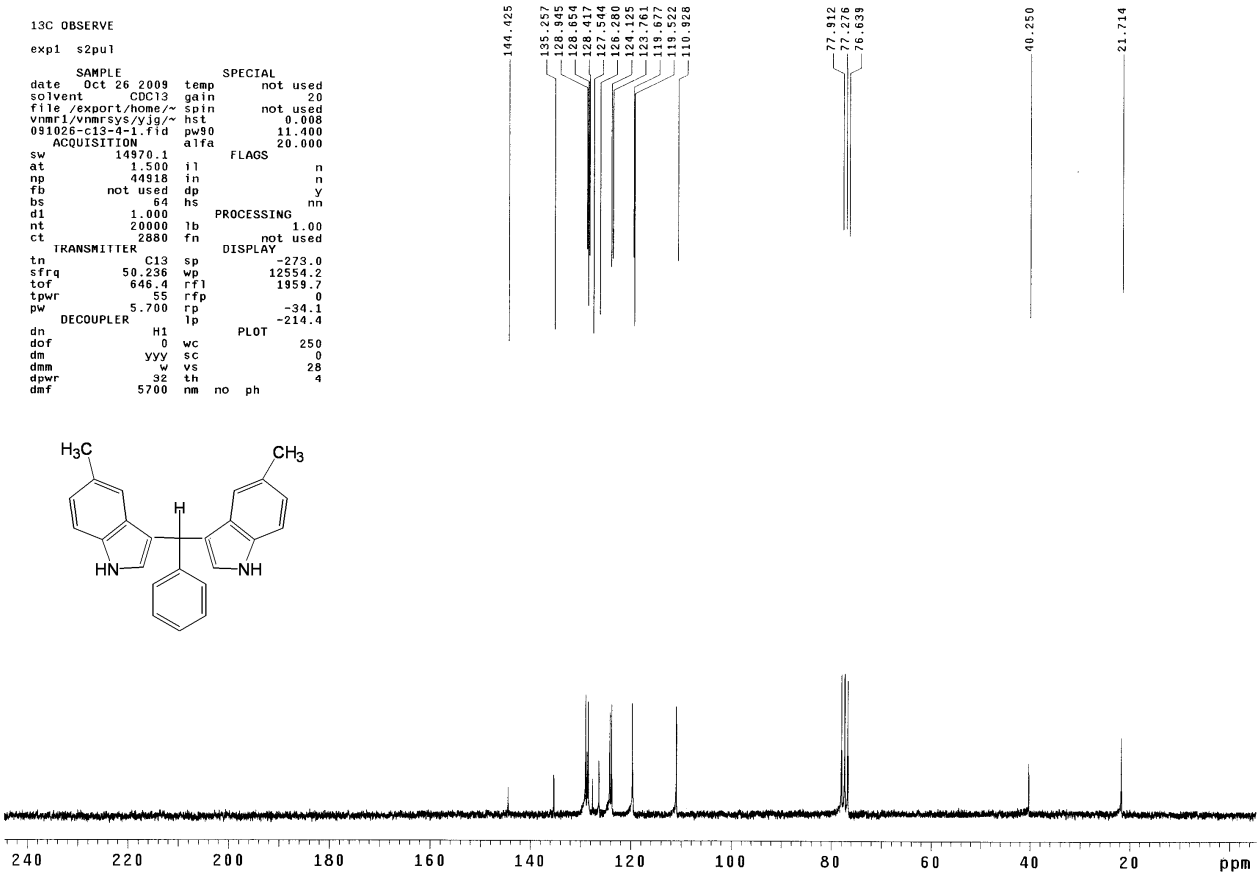
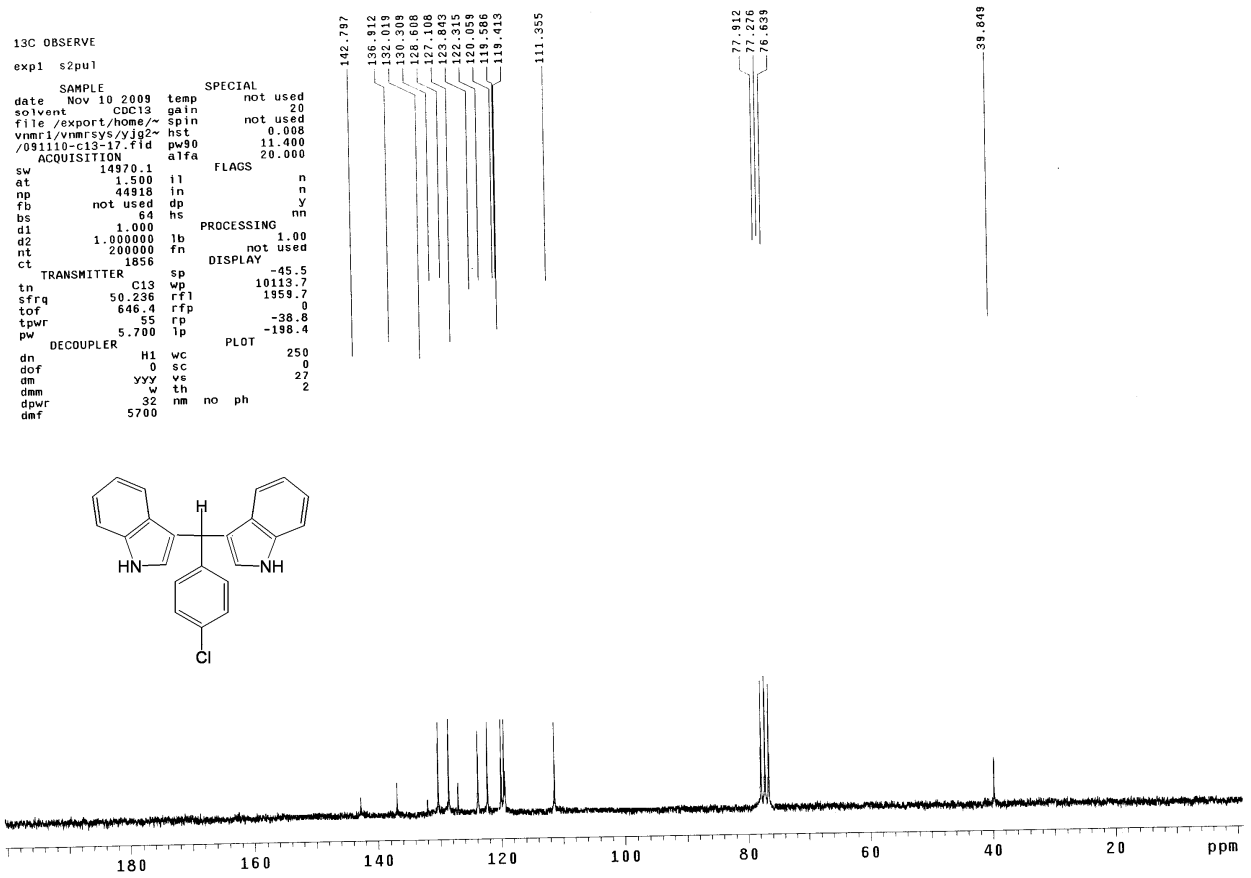
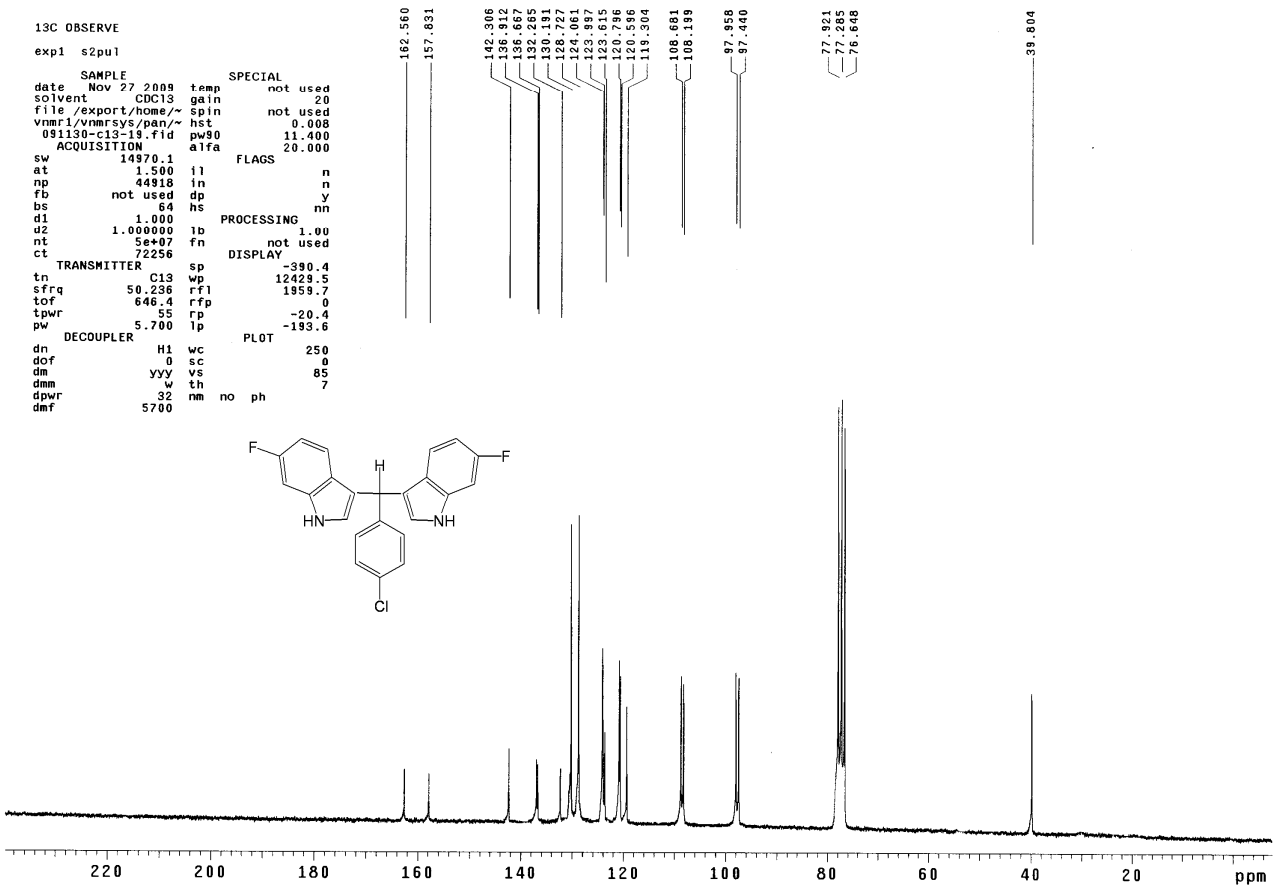
pw 5.700
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -75.6
wp 11618.6
rfl 1959.7
rfp 0
rp -18.9
lp -222.9
PLOT
wc 250
sc 0
vs 79
th 3
nm no ph
144.207
136.903
128.936
128.427
127.308
126.335
123.806
122.142
120.159
119.959
119.450
111.219
77.867
77.230
76.594
40.422
H
HN
NH
220
200
180
160
140
120
100
80
60
40
20
ppm

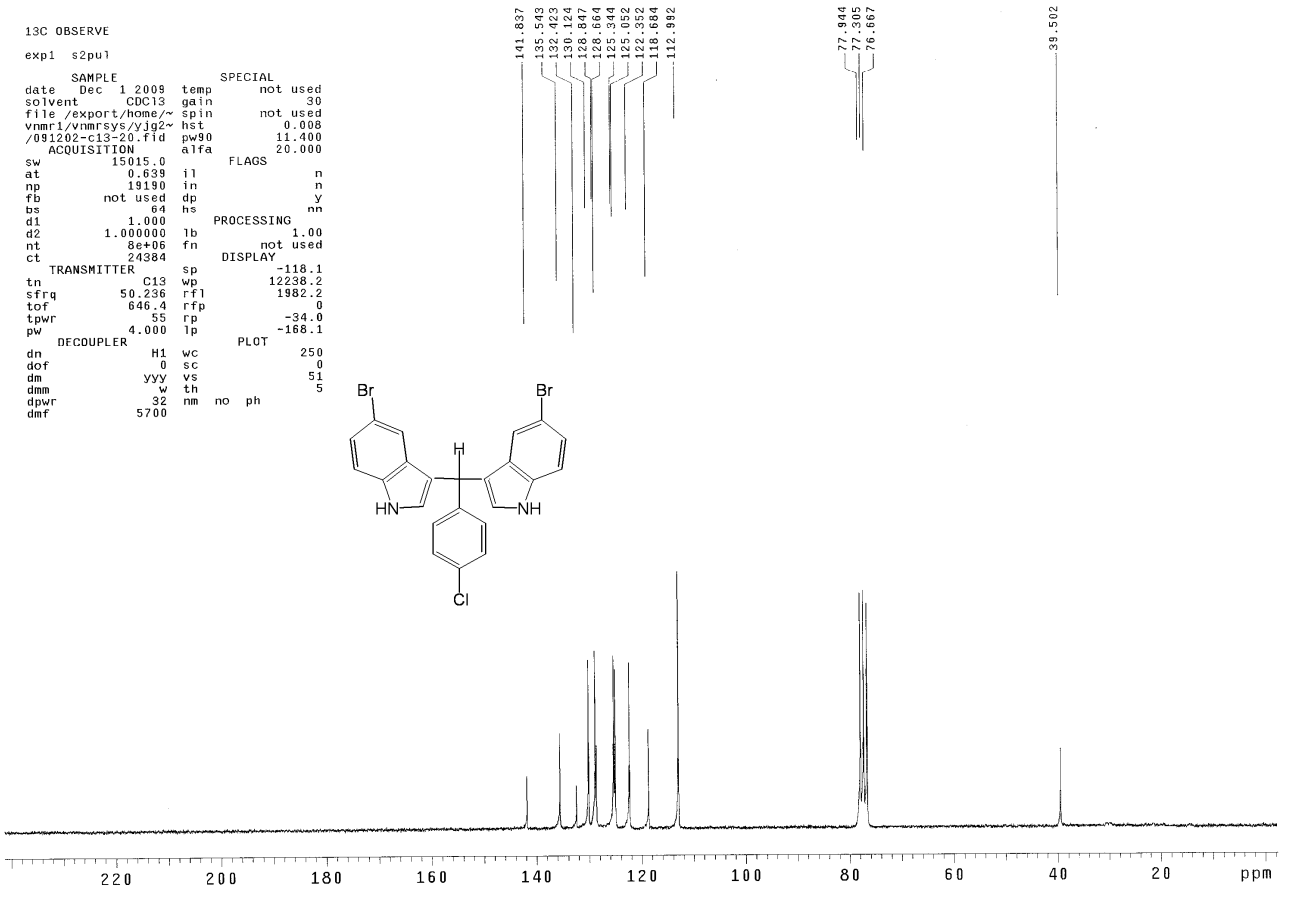

13C OBSERVE
exp1 s2pul
SAMPLE
date Oct 22 2009
solvent CDCl3
file exp
ACQUISITION
sw 12578.6
at 1.496
np 37638
fb not used
bs 64
d1 1.000
d2 1.000000
nt 200000
ct 16832
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 5.700
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -187.4
wp 11495.0
rfl 764.0
rfp 0
rp -42.8
lp -165.7
PLOT
wc 250
sc 0
vs 106
th 4
nm no ph
143.51
137.21
128.77
128.54
128.21
126.64
125.71
124.33
120.91
120.33
119.66
111.21
77.81
77.23
76.60
40.21
Cl
H
HN
NH
Cl
220
200
180
160
140
120
100
80
60
40
20
ppm

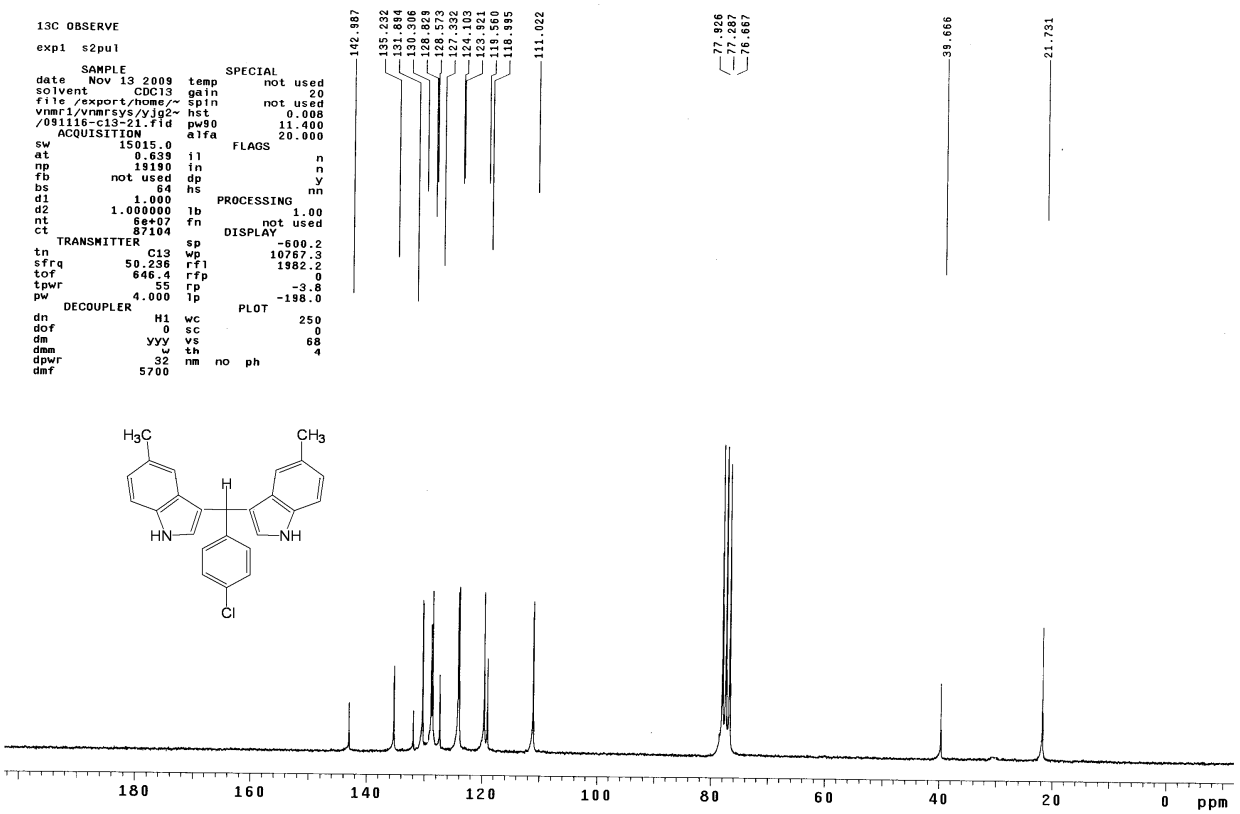

13C OBSERVE
exp1 s2pul
SAMPLE
date Oct 23 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg/~
091026-c13-3.fid
ACQUISITION
sw 14970.1
at 1.500
np 44918
fb not used
bs 64
d1 1.000
nt 200000
ct 91456
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 5.700
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -34.5
wp 11795.4
rfl 1959.7
rfp 0
rp -27.1
lp -234.9
PLOT
wc 250
sc 0
vs 29
th 2
nm no ph
162.524
157.786
143.770
136.903
136.656
128.810
128.554
126.598
124.034
123.870
123.845
120.887
119.814
108.526
108.044
97.840
97.321
77.894
77.258
76.621
40.404
F
H
F
HN
NH
220
200
180
160
140
120
100
80
60
40
20
ppm

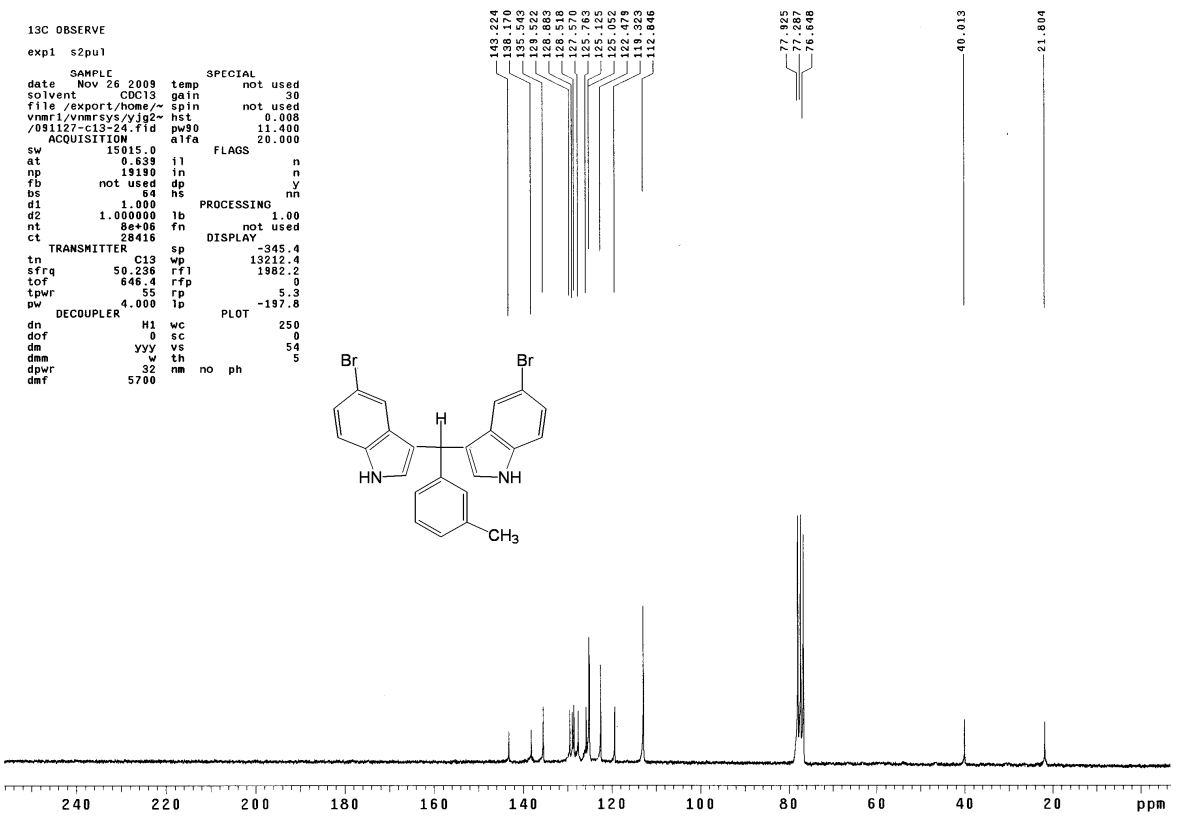

13C OBSERVE
exp1 s2pul
SAMPLE
date Oct 26 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg/~
091026-c13-4-1.fid
ACQUISITION
sw 14970.1
at 1.500
np 44918
fb not used
bs 64
d1 1.000
nt 20000
ct 2880
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 5.700
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -273.0
wp 12554.2
rfl 1959.7
rfp 0
rp -34.1
lp -214.4
PLOT
wc 250
sc 0
vs 28
th 4
nm no ph
144.425
135.257
128.945
128.654
128.417
127.544
126.280
124.125
123.761
119.677
119.522
110.928
77.912
77.276
76.639
40.250
21.714
H3C
CH3
H
HN
NH
240
220
200
180
160
140
120
100
80
60
40
20
ppm

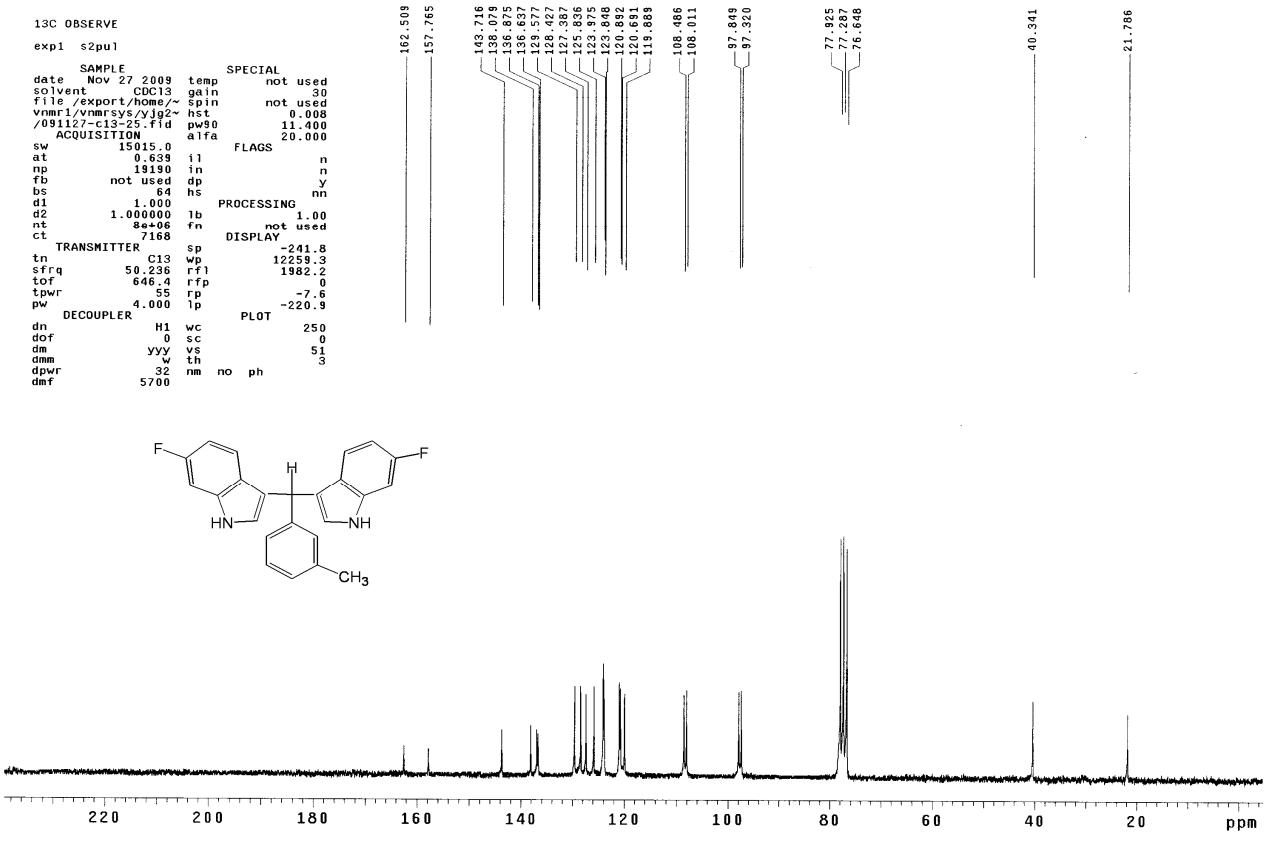

13C OBSERVE
exp1 s2pul
SAMPLE
date Nov 10 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg2~
/091110-c13-17.fid
ACQUISITION
sw 14970.1
at 1.500
np 44918
fb not used
bs 64
d1 1.000
d2 1.000000
nt 200000
ct 1856
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 5.700
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -45.5
wp 10113.7
rfl 1959.7
rfp 0
rp -38.8
lp -198.4
PLOT
wc 250
sc 0
vs 27
th 2
nm no ph
142.797
136.912
132.019
130.309
128.608
127.108
123.843
122.315
120.059
119.566
119.413
111.355
77.912
77.276
76.639
39.849
H
HN
NH
Cl
180
160
140
120
100
80
60
40
20
ppm

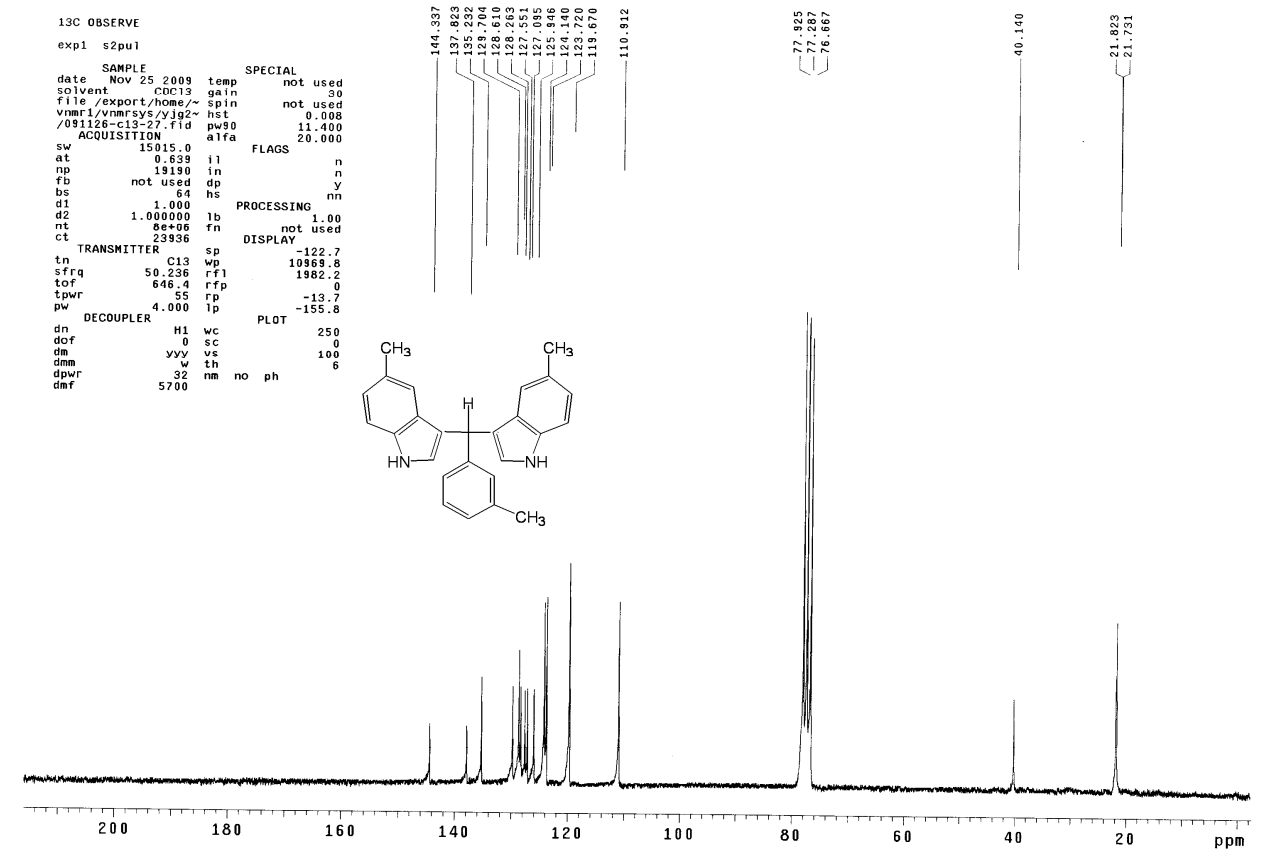

13C OBSERVE
exp1 s2pul
SAMPLE
date Nov 27 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/pan/~
091130-c13-19.fid
ACQUISITION
sw 14970.1
at 1.500
np 44918
fb not used
bs 64
d1 1.000
d2 1.0000000
nt 5e+07
ct 72256
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 5.700
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -390.4
wp 12429.5
rfl 1959.7
rfp 0
rp -20.4
lp -193.6
PLOT
wc 250
sc 0
vs 85
th 7
nm no ph
162.560
157.831
142.306
136.912
136.667
132.285
130.191
128.727
124.061
123.997
123.615
120.746
120.596
119.304
108.681
108.199
97.958
97.440
77.921
77.285
76.648
39.804
F
H
F
HN
NH
Cl
220
200
180
160
140
120
100
80
60
40
20
ppm


13C OBSERVE
exp1 s2pul
SAMPLE
date Dec 1 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg2~
/091202-c13-20.fid
ACQUISITION
sw 15015.0
at 0.639
np 19190
fb not used
bs 64
d1 1.000
d2 1.000000
nt 8e+06
ct 24384
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 4.000
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 30
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -118.1
wp 12238.2
rfl 1982.2
rfp 0
rp -34.0
lp -168.1
PLOT
wc 250
sc 0
vs 51
th 5
nm no ph
141.837
135.543
132.423
130.124
128.847
128.664
125.344
125.052
122.352
118.684
112.992
77.944
77.305
76.667
39.502
Br
Br
H
HN
NH
Cl
220
200
180
160
140
120
100
80
60
40
20
ppm


13C OBSERVE
exp1 s2pul
SAMPLE
date Nov 13 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg2~
/091116-c13-21.fid
ACQUISITION
sw 15015.0
at 0.639
np 19190
fb not used
bs 64
d1 1.000
d2 1.000000
nt 6e+07
ct 87104
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 4.000
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 20
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -600.2
wp 10767.3
rfl 1982.2
rfp 0
rp -3.8
lp -198.0
PLOT
wc 250
sc 0
vs 68
th 4
nm no ph
142.987
135.232
131.884
130.306
128.829
128.573
127.332
124.103
123.921
118.560
116.995
111.022
77.926
77.287
76.667
39.666
21.731
H3C
CH3
H
HN
NH
Cl
180
160
140
120
100
80
60
40
20
0
ppm


13C OBSERVE
exp1 s2pul
SAMPLE
date Nov 26 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg2~
/091127-c13-24.fid
ACQUISITION
sw 15015.0
at 0.639
np 19190
fb not used
bs 64
d1 1.000
d2 1.000000
nt 8e+06
ct 28416
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 4.000
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 30
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -345.4
wp 13212.4
rfl 1982.2
rfp 0
rp 5.3
lp -197.8
PLOT
wc 250
sc 0
vs 54
th 5
nm no ph
143.224
138.170
135.543
129.522
128.883
128.518
127.570
125.763
125.135
122.052
122.478
119.323
112.846
77.925
77.287
76.648
40.013
21.804
Br
Br
H
HN
NH
CH3
240
220
200
180
160
140
120
100
80
60
40
20
ppm


13C OBSERVE
exp1 s2pul
SAMPLE
date Nov 27 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg2~
/091127-c13-25.fid
ACQUISITION
sw 15015.0
at 0.639
np 19190
fb not used
bs 64
d1 1.000
d2 1.000000
nt 8e+06
ct 7168
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 4.000
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 30
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -241.8
wp 12259.3
rfl 1982.2
rfp 0
rp -7.6
lp -220.9
PLOT
wc 250
sc 0
vs 51
th 3
nm no ph
162.509
157.765
143.716
138.079
136.875
136.637
129.577
128.427
127.387
125.836
123.975
123.848
120.892
120.691
119.889
108.486
108.011
97.849
97.320
77.925
77.287
76.648
40.341
21.786
F
H
F
HN
NH
CH3
220
200
180
160
140
120
100
80
60
40
20
ppm


13C OBSERVE
exp1 s2pul
SAMPLE
date Nov 25 2009
solvent CDCl3
file /export/home/~
vnmr1/vnmrsys/yjg2~
/091126-c13-27.fid
ACQUISITION
sw 15015.0
at 0.639
np 19190
fb not used
bs 64
d1 1.000
d2 1.000000
nt 8e+06
ct 23936
TRANSMITTER
tn C13
sfrq 50.236
tof 646.4
tpwr 55
pw 4.000
DECOUPLER
dn H1
dof 0
dm yyy
dmm w
dpwr 32
dmf 5700
SPECIAL
temp not used
gain 30
spin not used
hst 0.008
pw90 11.400
alfa 20.000
FLAGS
il n
in n
dp y
hs nn
PROCESSING
lb 1.00
fn not used
DISPLAY
sp -122.7
wp 10869.8
rfl 1982.2
rfp 0
rp -13.7
lp -155.8
PLOT
wc 250
sc 0
vs 100
th 6
nm no ph
144.337
137.823
135.232
129.704
128.610
128.263
127.551
127.095
125.946
124.140
123.720
119.670
110.912
77.925
77.287
76.667
40.140
21.823
21.731
CH3
CH3
H
HN
NH
CH3
200
180
160
140
120
100
80
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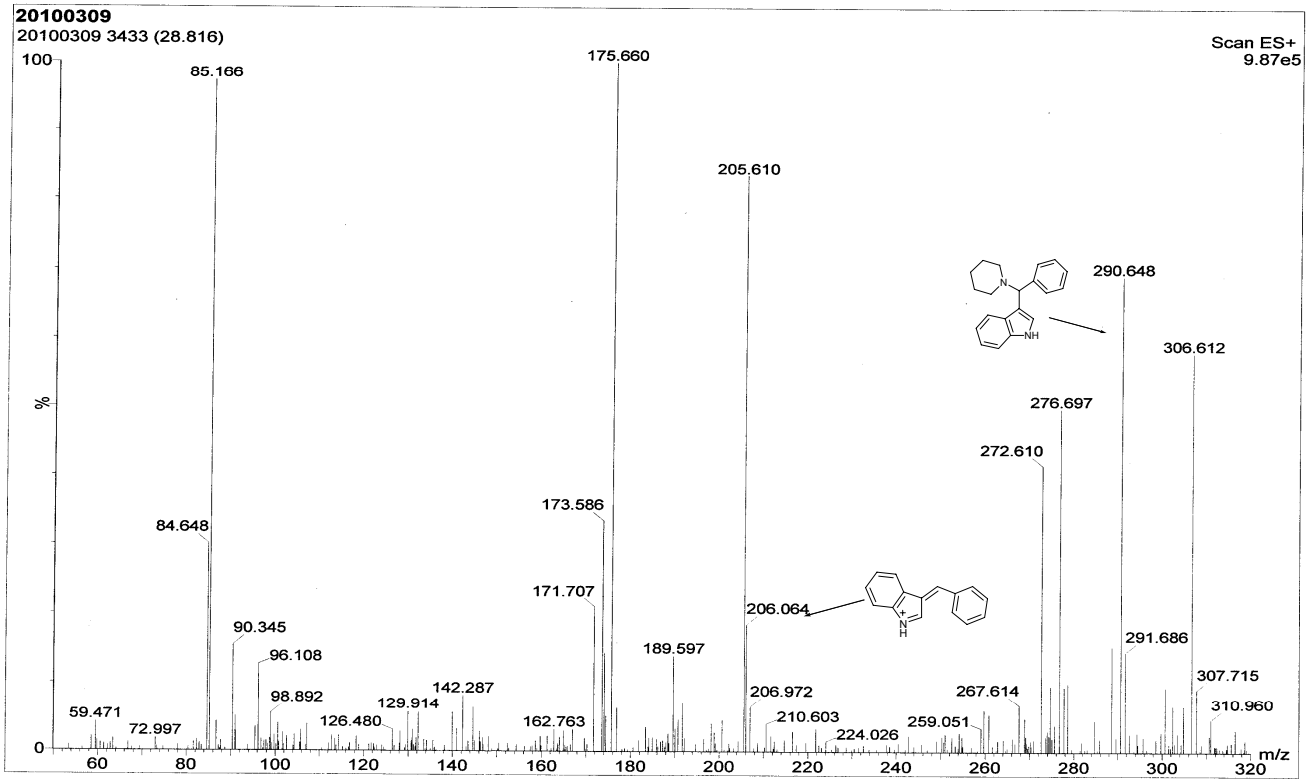
20
ppm



3. Reference

[1] a) S. J. Ji, S. Y. Wang, Y. Zhang, T. P. Loh, *Tetrahedron* 2004, 2051-2055; b) S. R. Sheng, Q. Y. Wang, Y. Ding, X. L. Liu, M. Z. Cai, *Catal. Lett.* 2009, 418-422.

[2] M. L. Deb, P. J. Bhuyan, *Tetrahedron Lett.* 2006, 1441-1443.

[3] W. J. Li, X. F. Lin, J. Wang, G. L. Li, Y. G. Wang, *Synth. Commun.* 2005, 2765-2769.