

Efficient construction of C-S and C-N bond *via* metal-free reductive coupling of *N*-tosylhydrazones with benzo[*d*]thiazole-2-thiol

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Nanchang, Jiangxi 330022, P. R. China

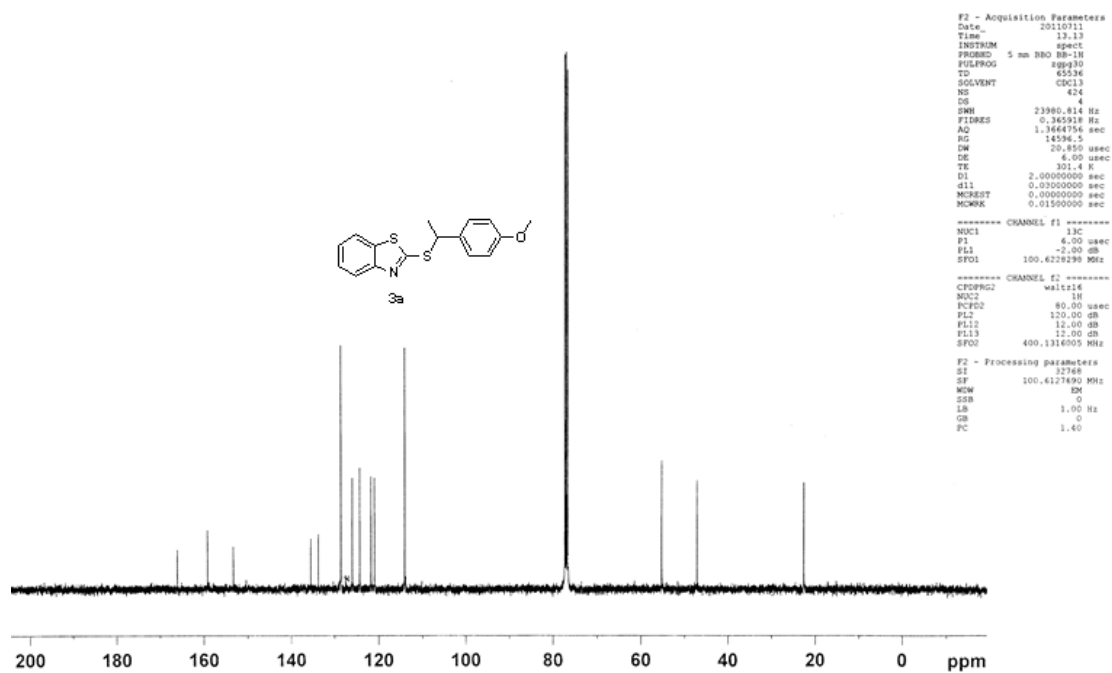
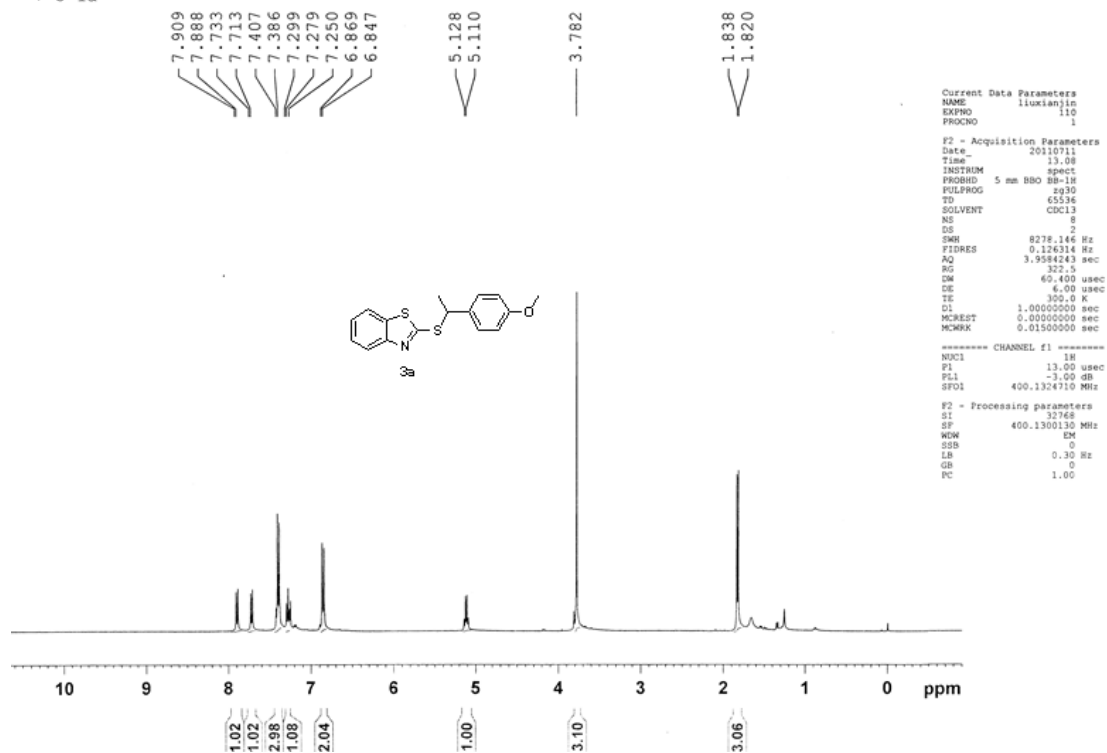
^b *Department of Obstetrics and Gynecology, Jiangxi Provincial people's Hospital,*

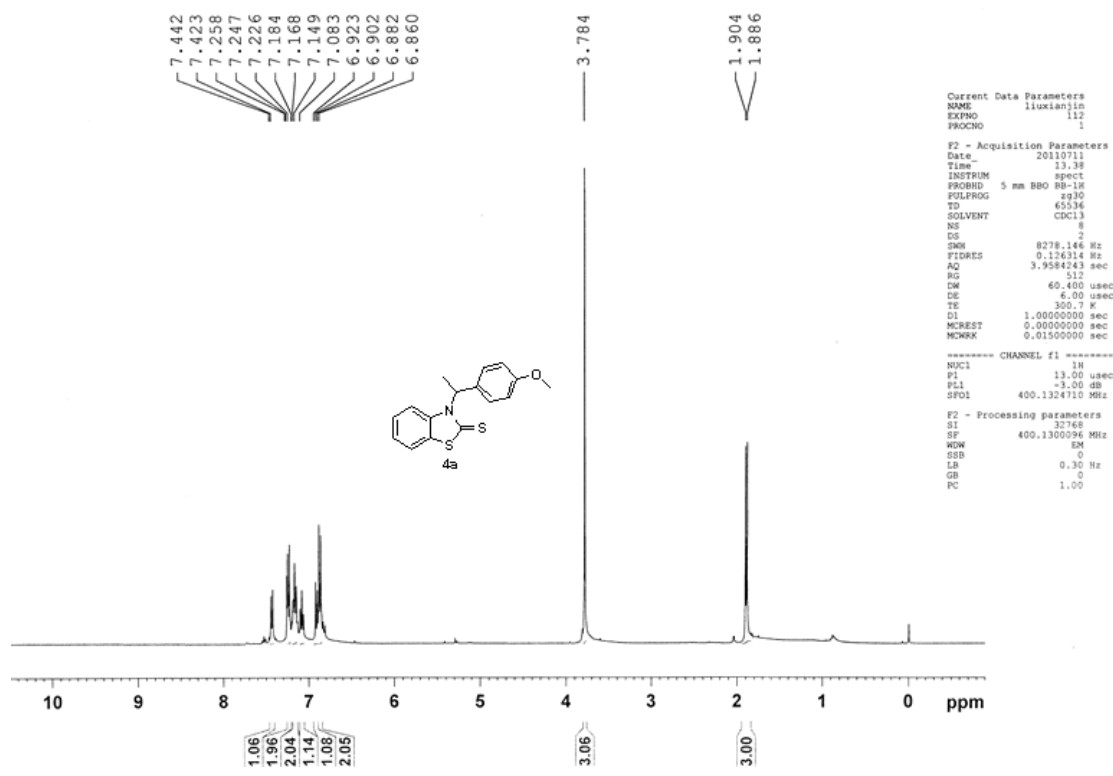
Nanchang, Jiangxi 330006, P. R. China

Supporting Information

1. NMR spectra of all compounds **3** and **4**. P2-P47

7-5-1a



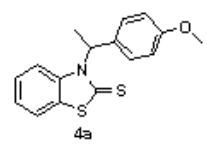
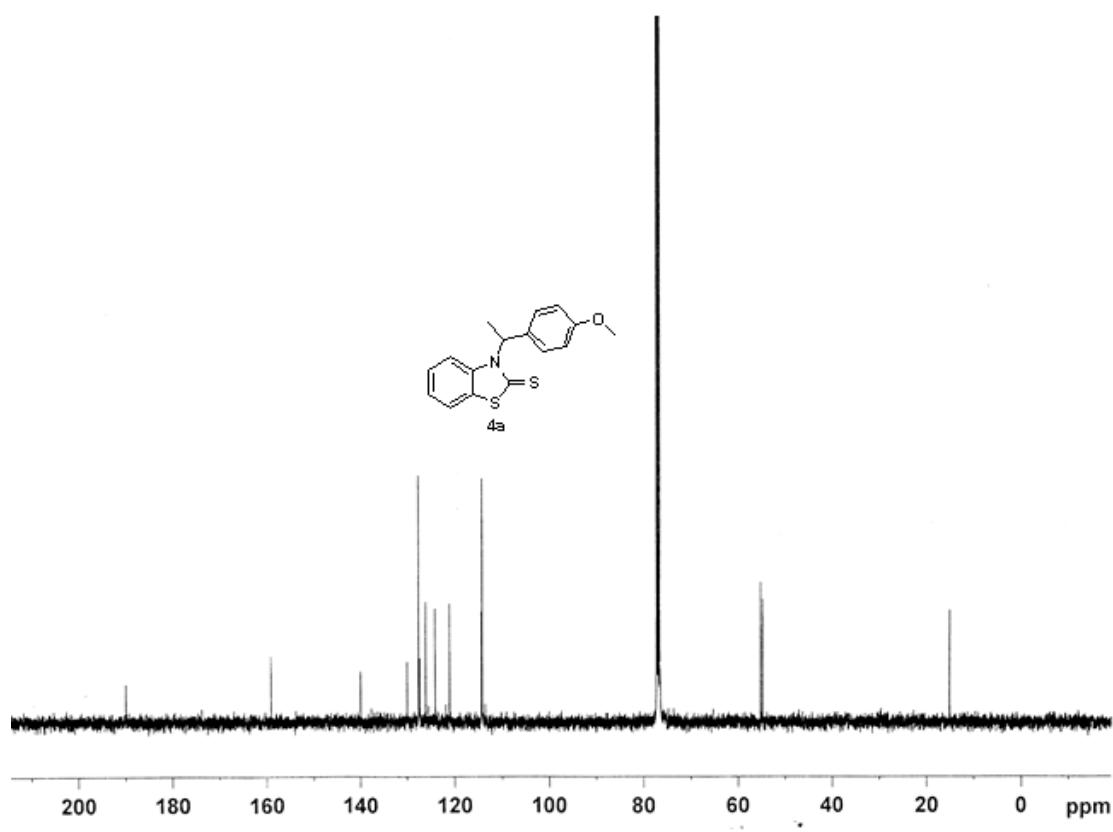
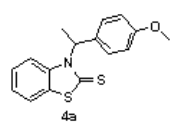


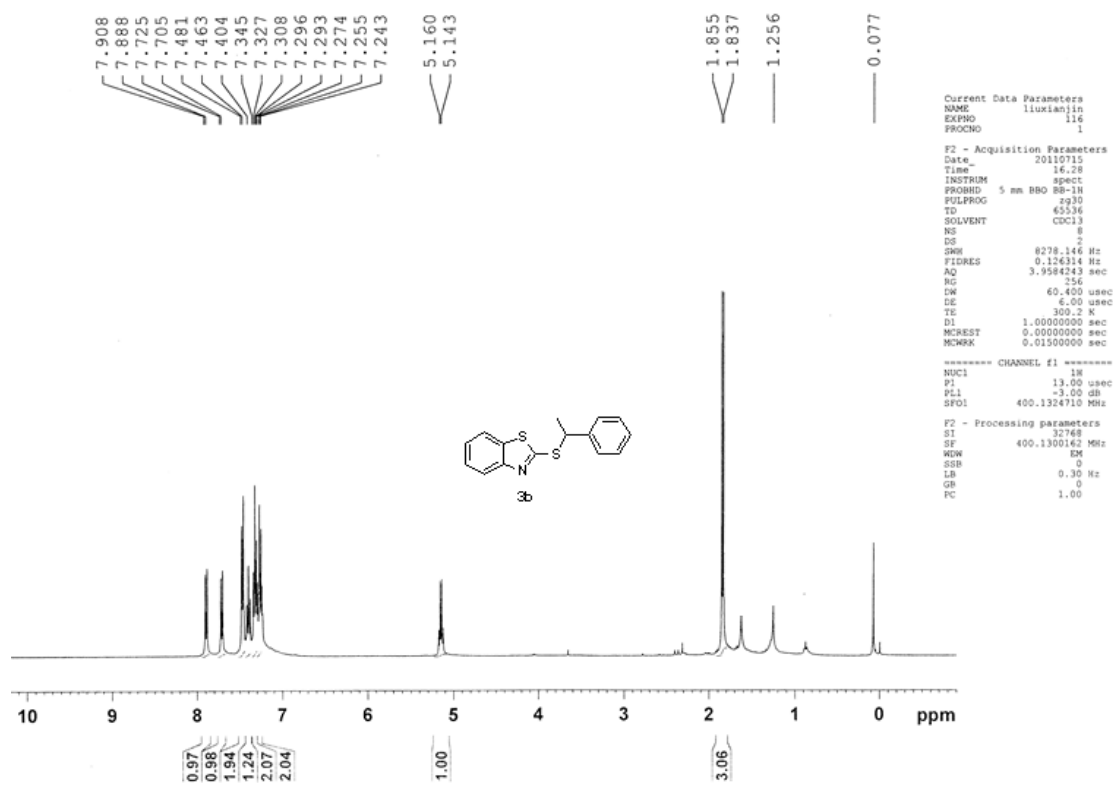
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 Time 13.38
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 PULPROG zg30
 TD 65536
 SOLVENT CDCl3
 NS 8
 DS 2
 SWS 8278.146 Hz
 FIDRES 0.126314 Hz
 AQ 3.9584243 sec
 RG 512
 DW 60.400 usec
 DE 6.00 usec
 TE 300.7 K
 D1 1.00000000 sec
 MCKREST 0.00000000 sec
 MCKRR 0.01500000 sec

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 NUC1 1H
 P1 13.00 usec
 PC1 -3.00 dB
 SFO1 400.1324710 MHz

F2 - Processing parameters
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 SF 400.1300096 MHz
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 SSB 0
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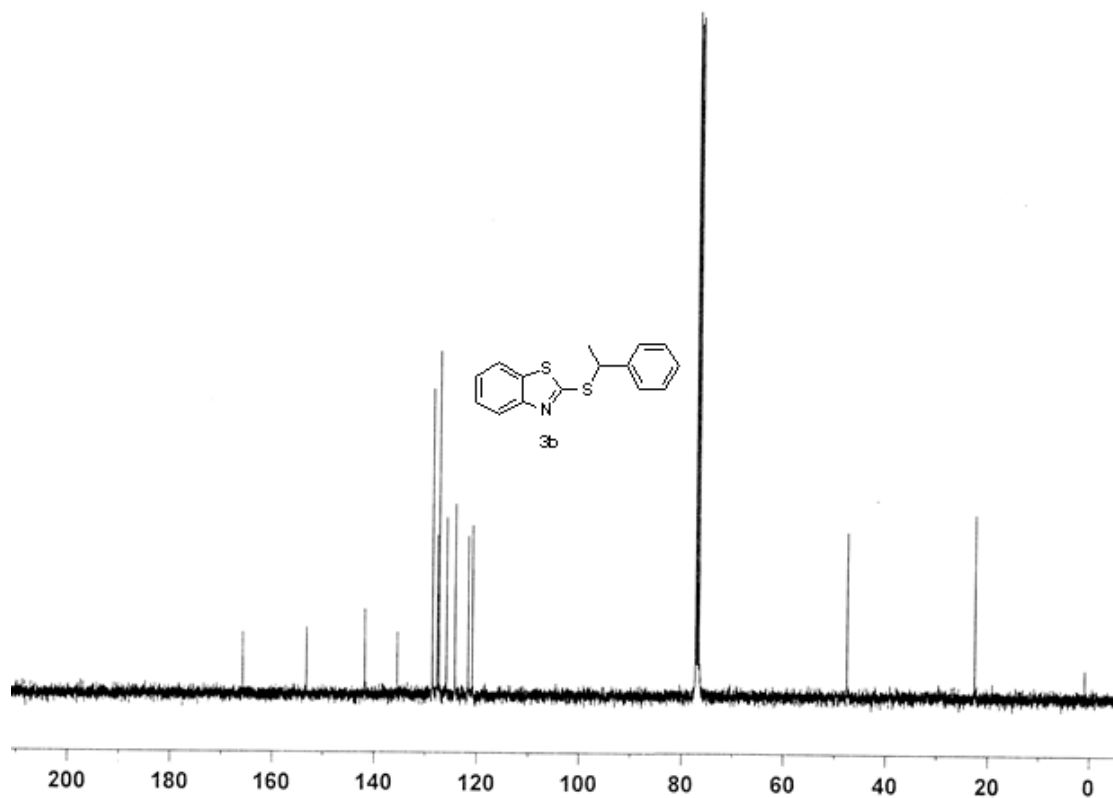
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EXPRO     116
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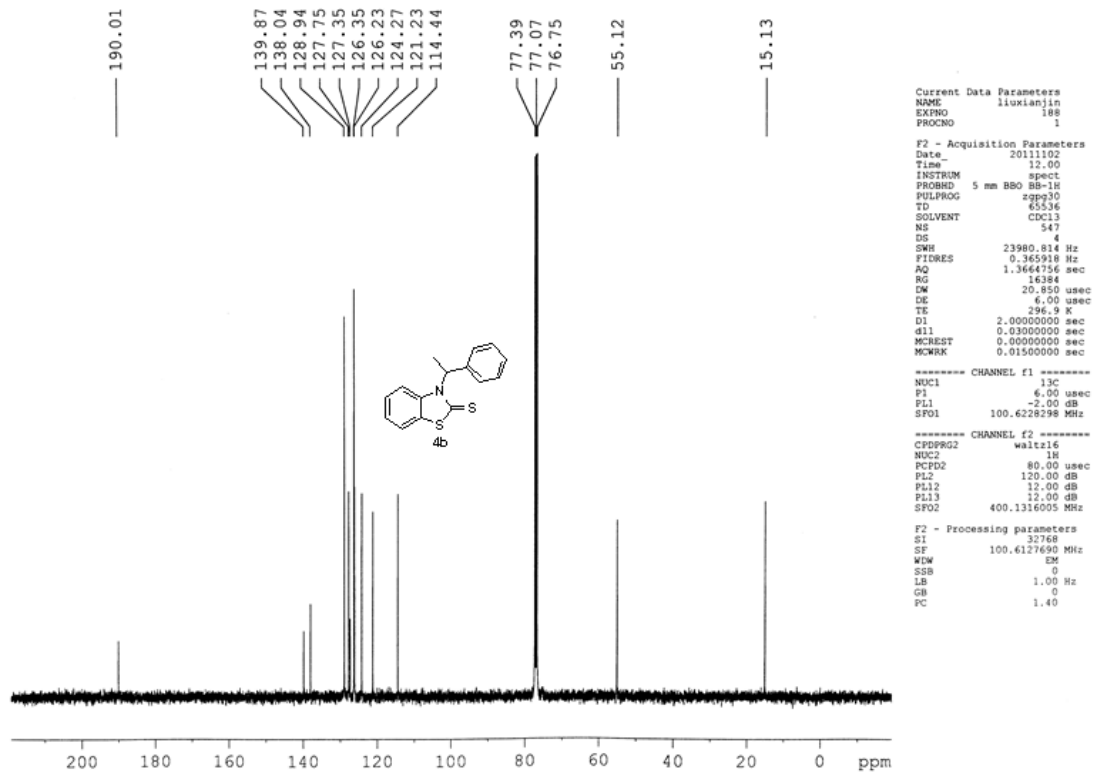
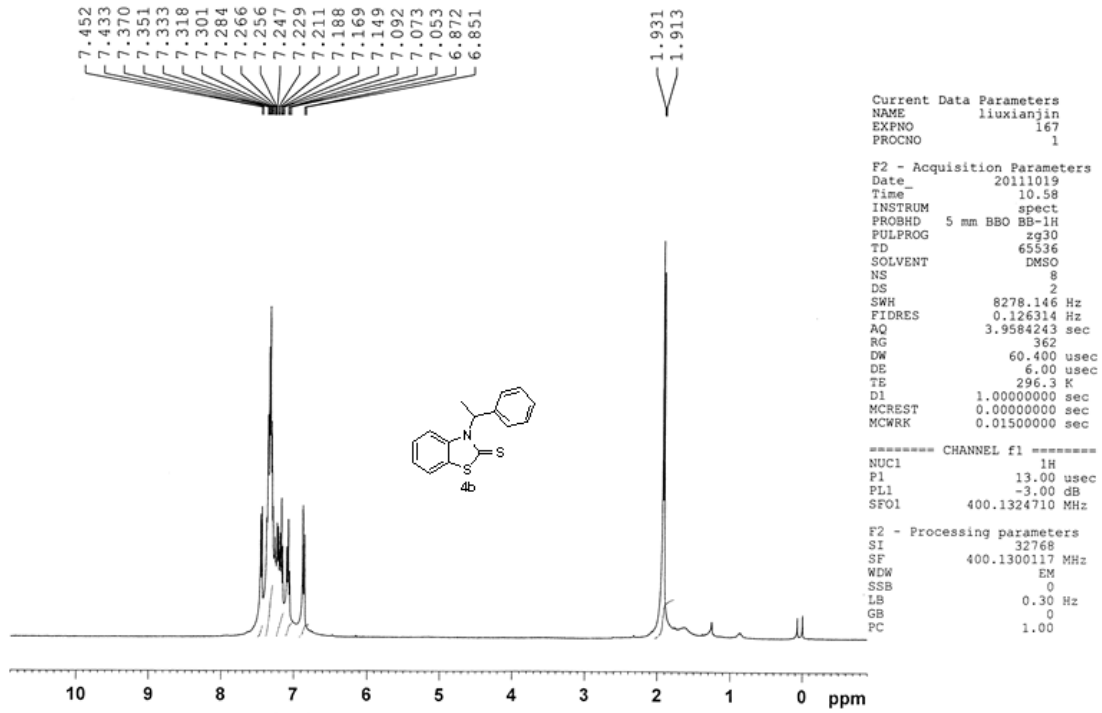
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TD         45536
SOLVENT   CDCl3
NS         8
DS         2
SWH        8278.146 Hz
FIDRES     0.126314 Hz
AQ         3.988423 sec
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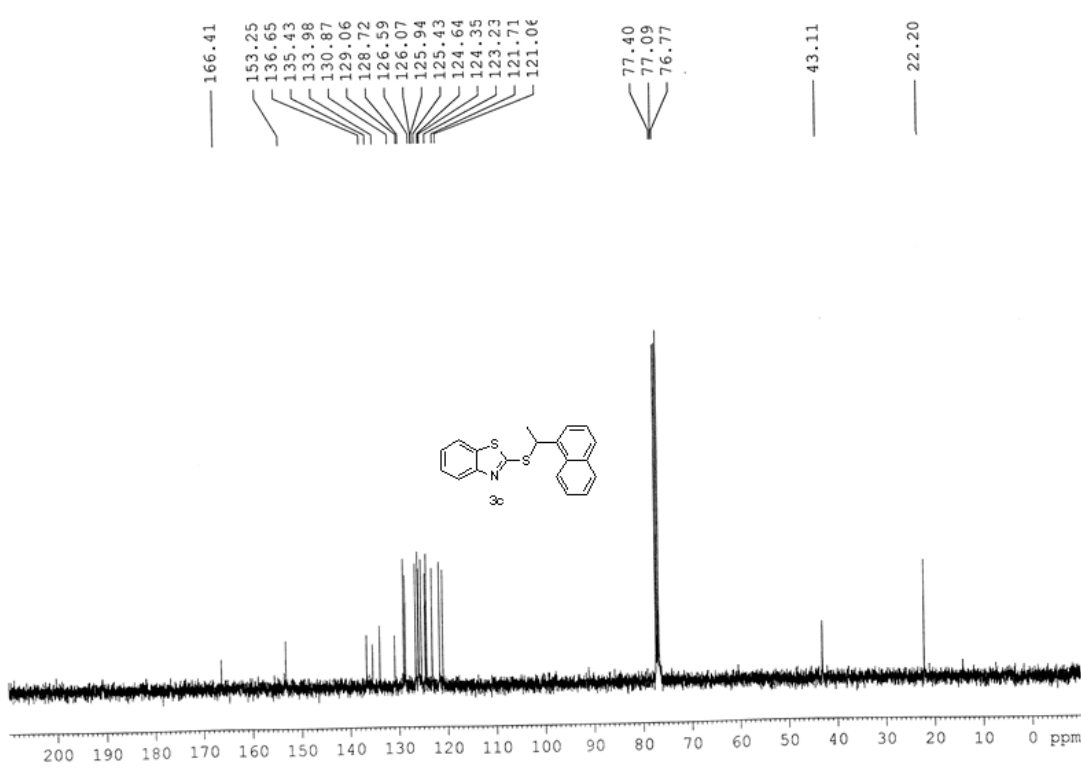
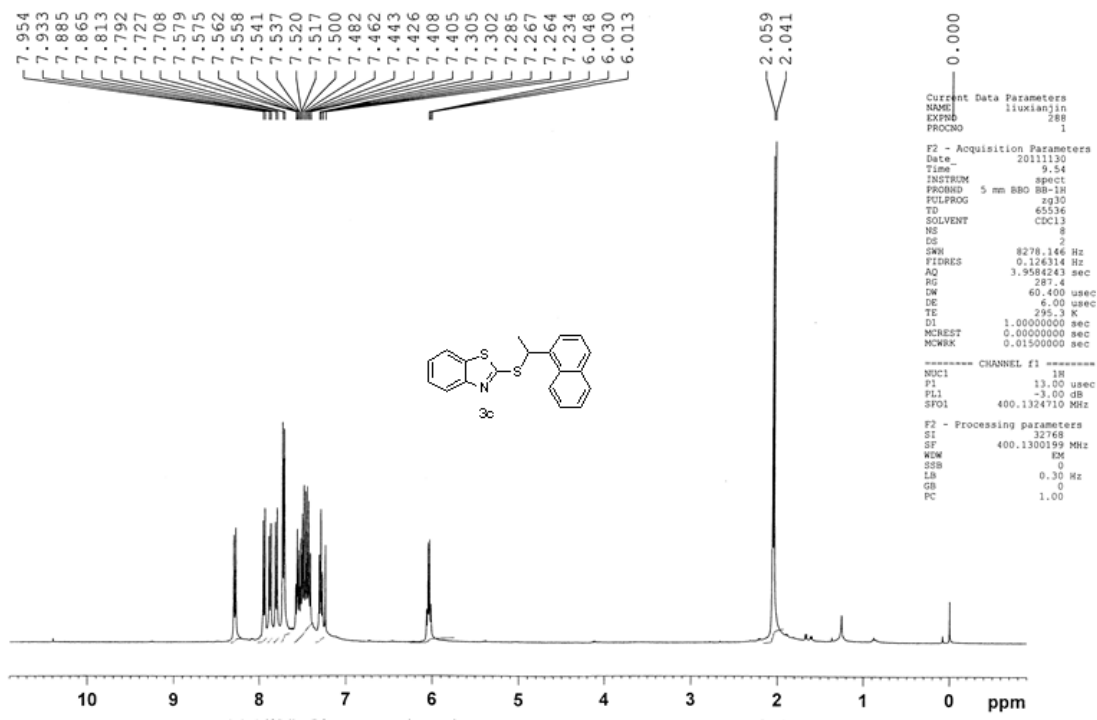
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P1         13.00 usec
PL1        -3.00 dB
SFO1       400.1324710 MHz

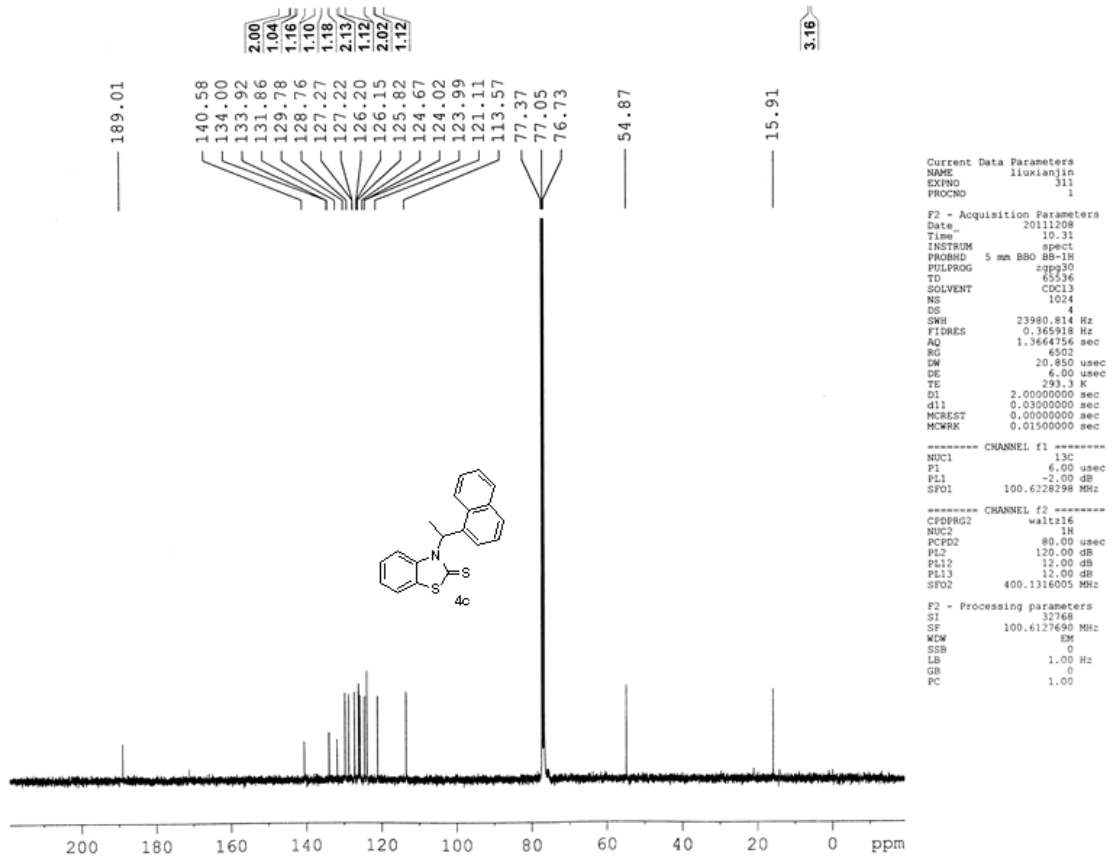
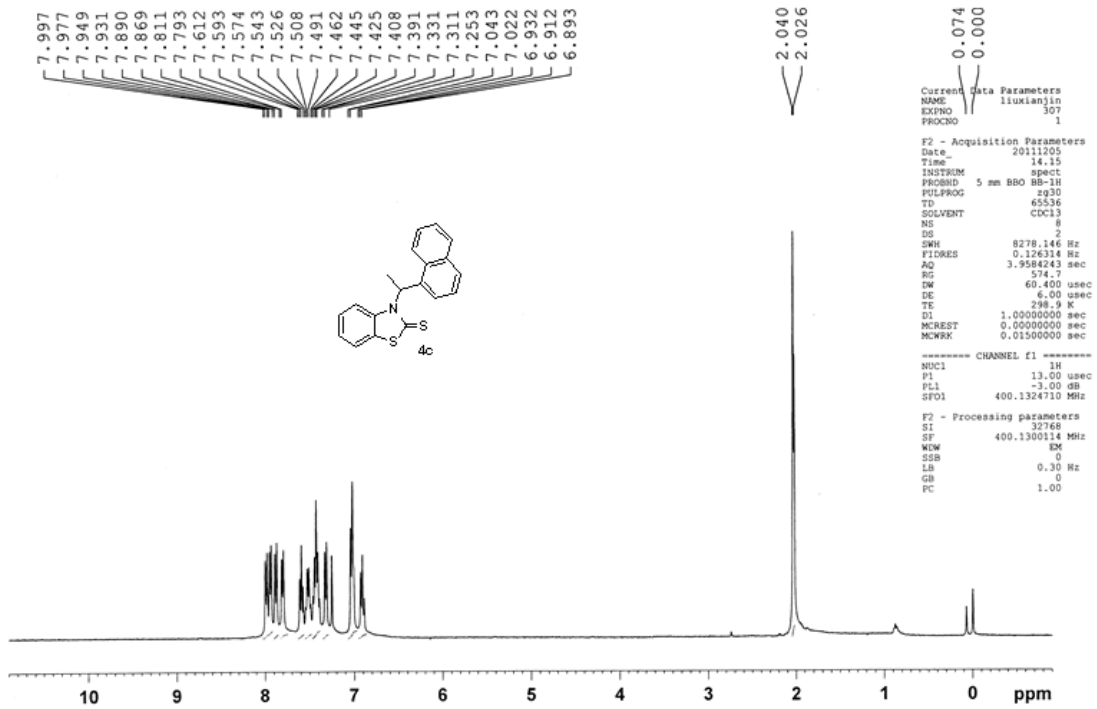
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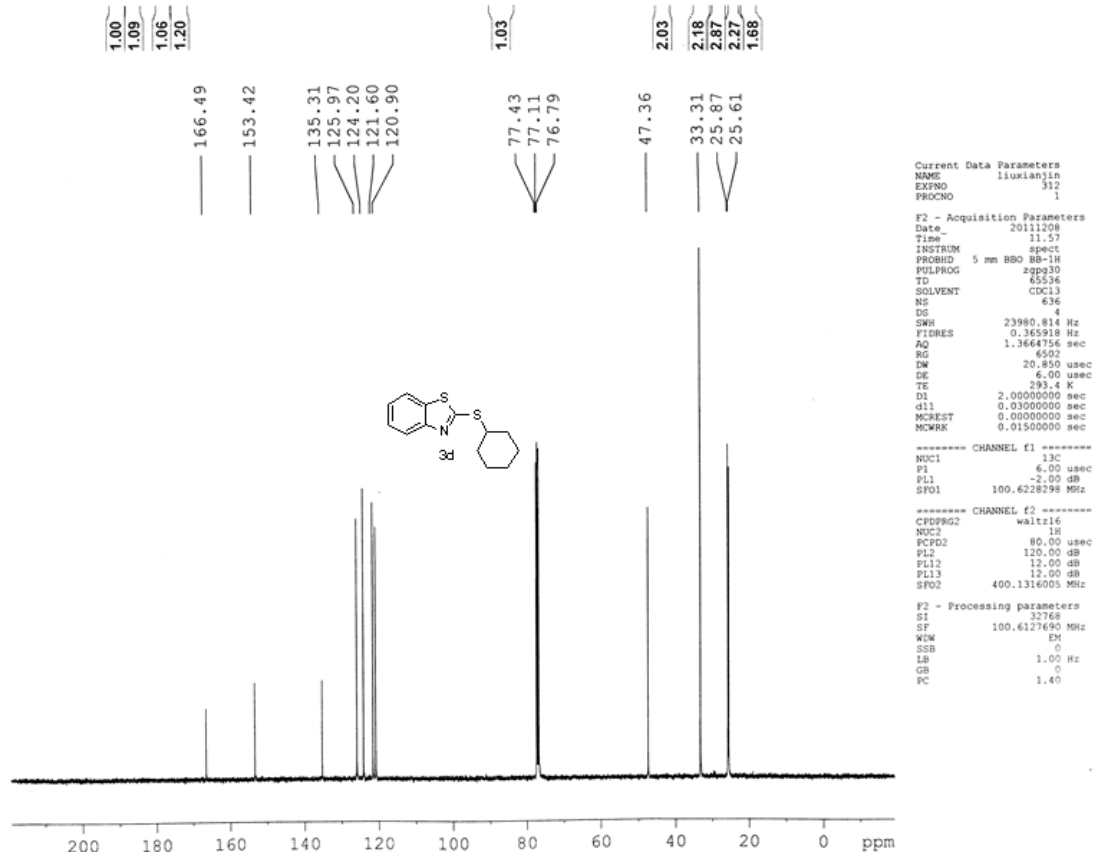
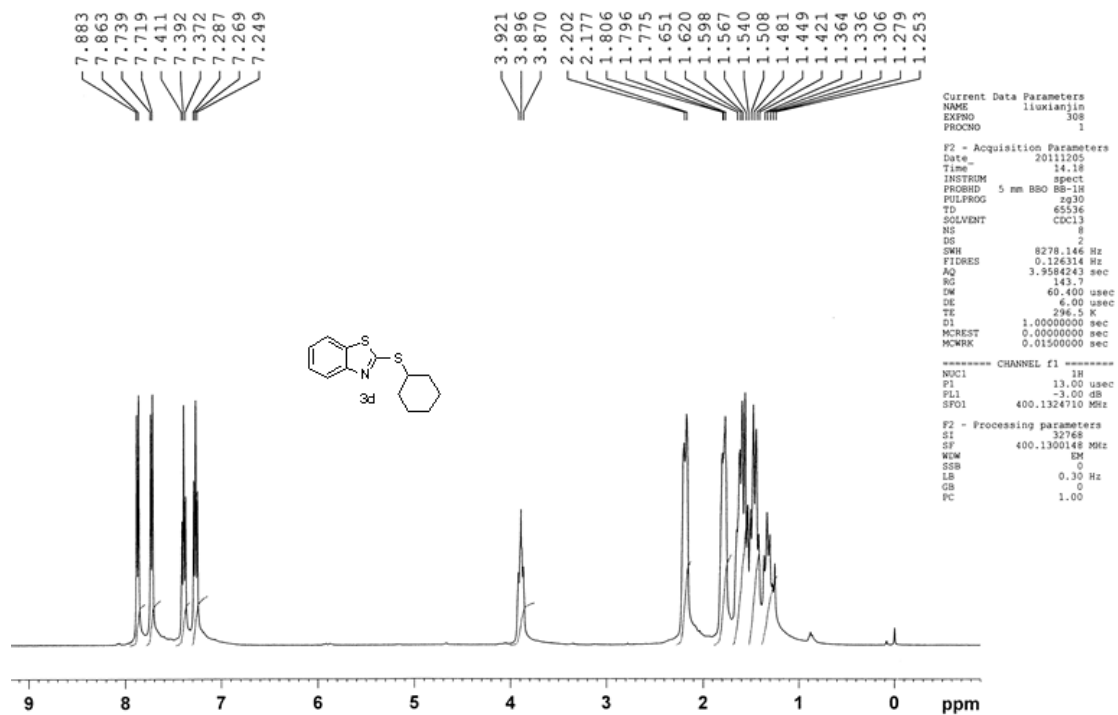
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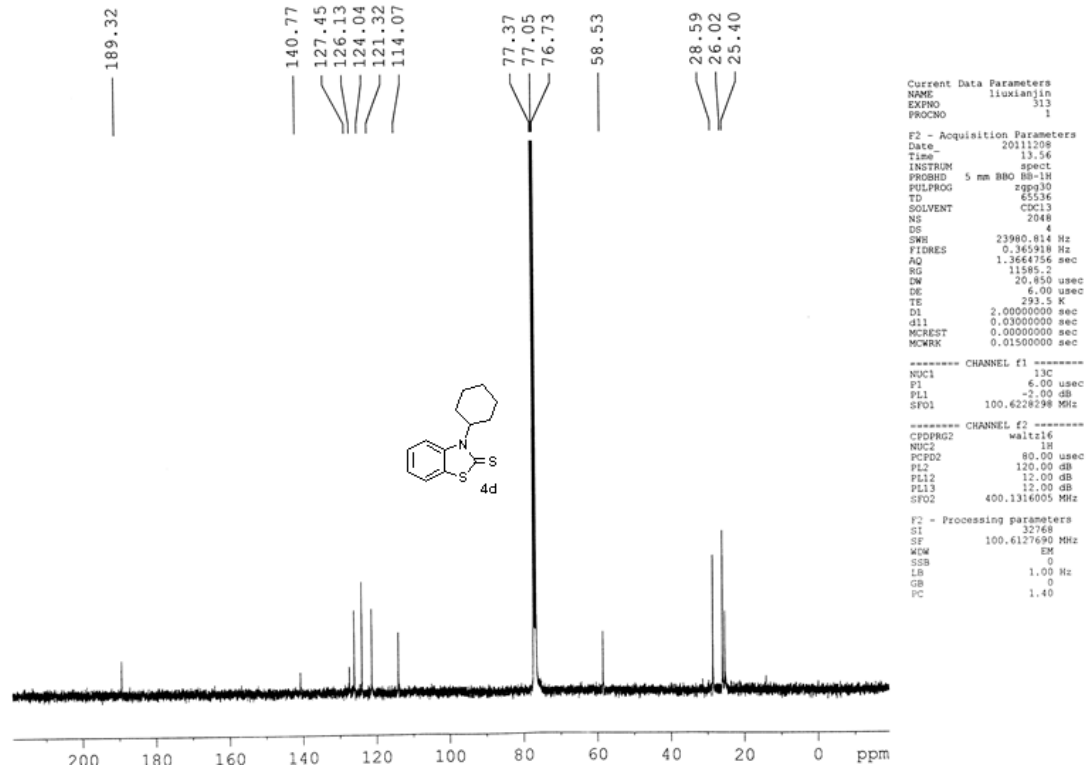
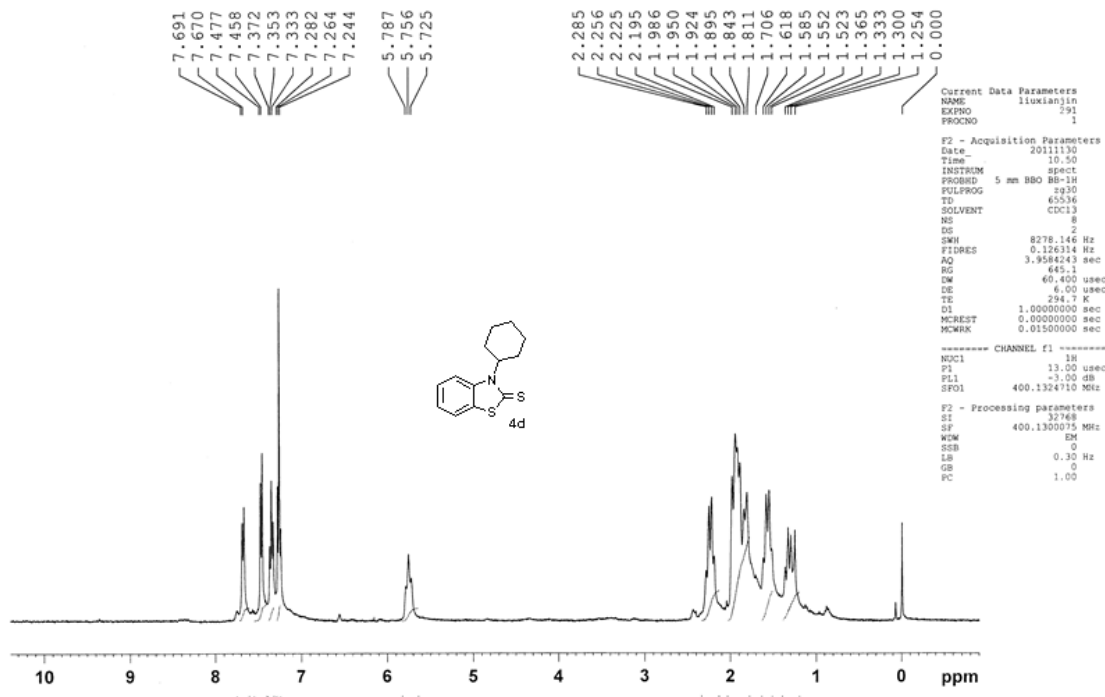


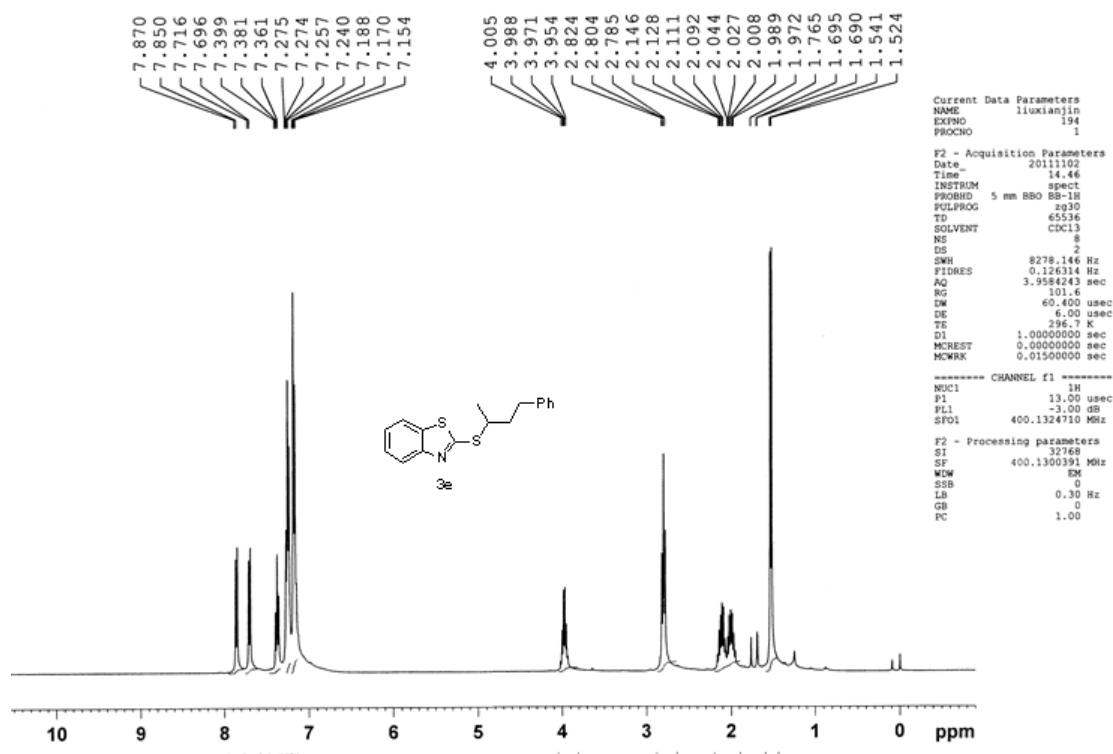










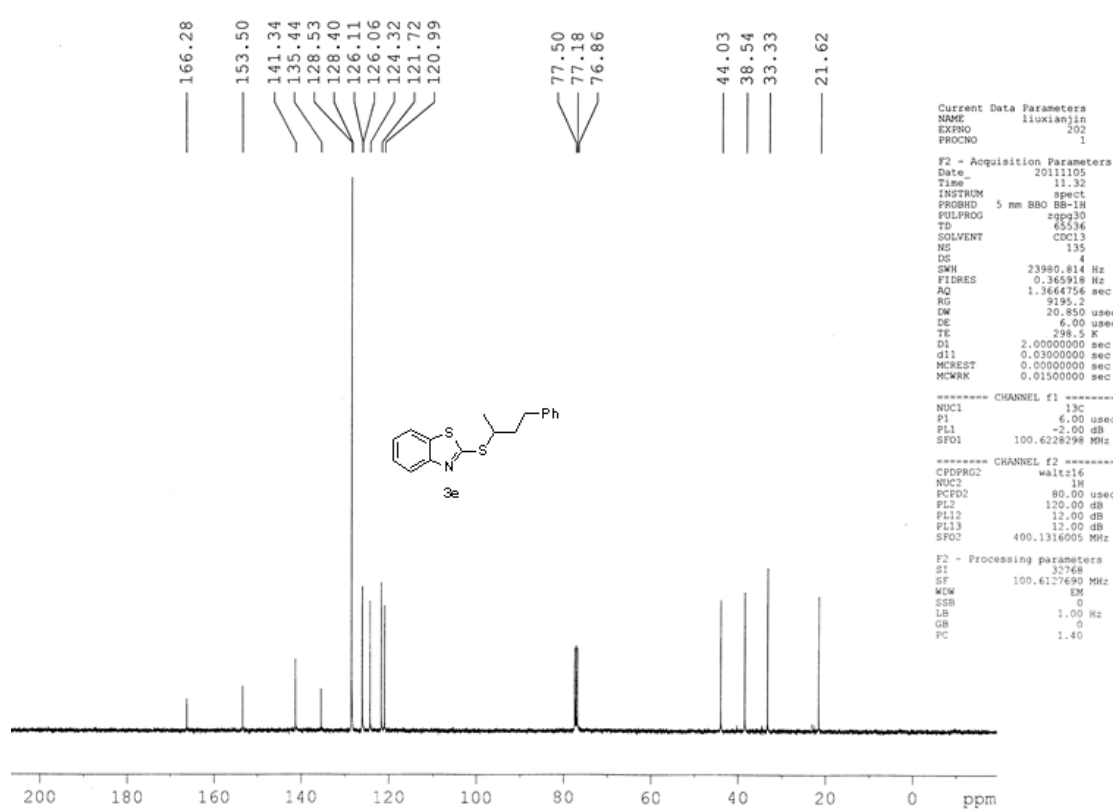


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 NAME lluxianjin
 EXPNO 194
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20111102
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 INSTRUM spect
 PROBHD 5 mm BBO BB-1H
 PULPROG zg30
 TD 65536
 SOLVENT CDCl3
 NS 8
 DS 2
 SWH 8278.146 Hz
 FIDRES 0.126314 Hz
 AQ 3.9584243 sec
 RG 101.6
 DW 60.400 usec
 DE 6.00 usec
 TE 296.7 K
 D1 1.0000000 sec
 MCREST 0.0000000 sec
 MCWRR 0.0150000 sec

----- CHANNEL f1 -----
 NUC1 1H
 P1 13.00 usec
 PL1 -3.00 dB
 SFO1 400.1324710 MHz

F2 - Processing parameters
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 SF 400.1300391 MHz
 MW EM
 SSB 0
 LB 0.30 Hz
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 PC 1.00



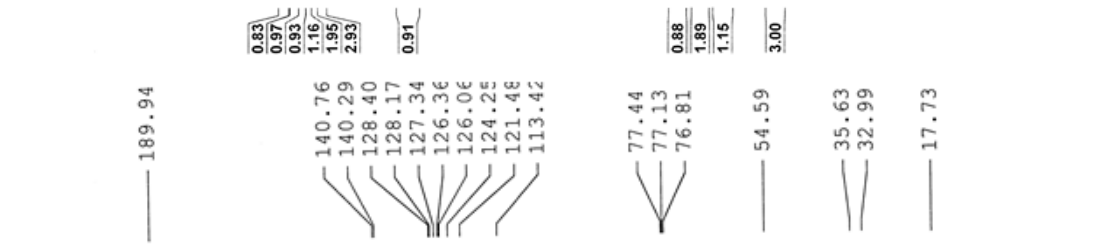
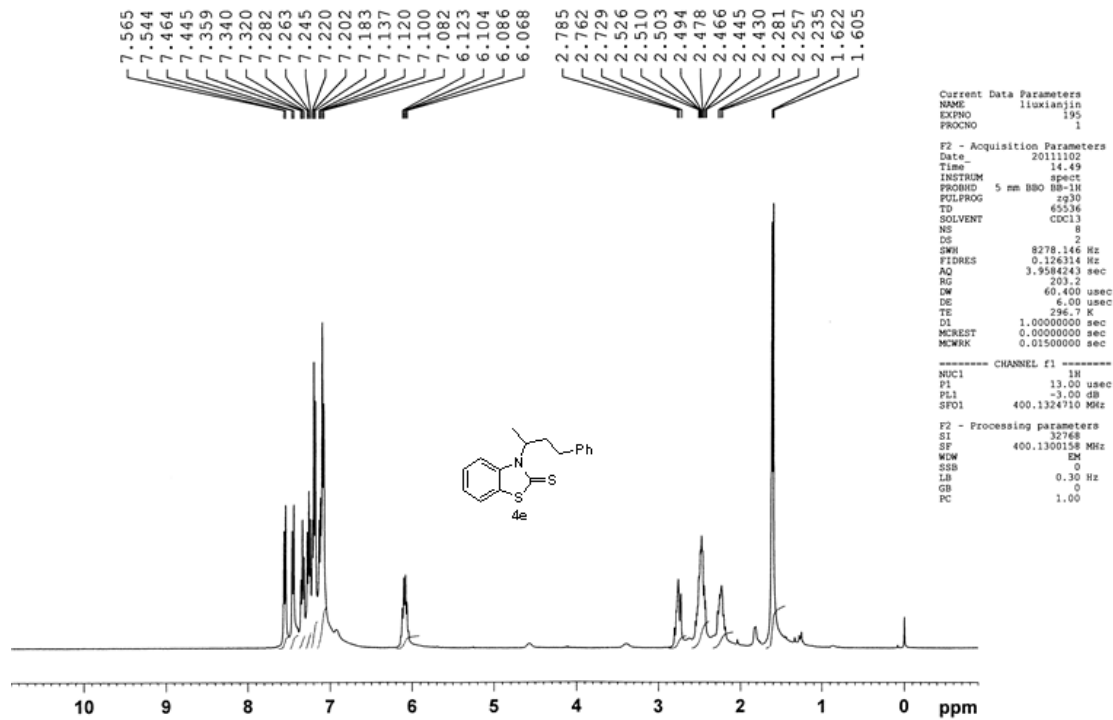
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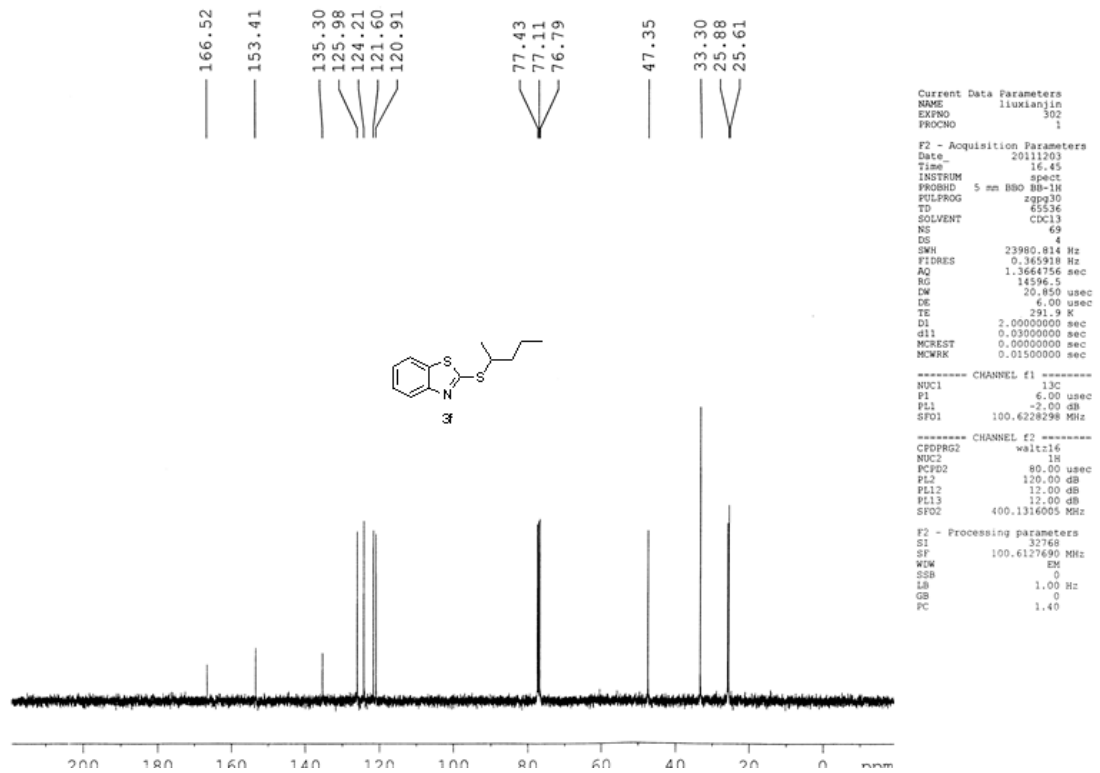
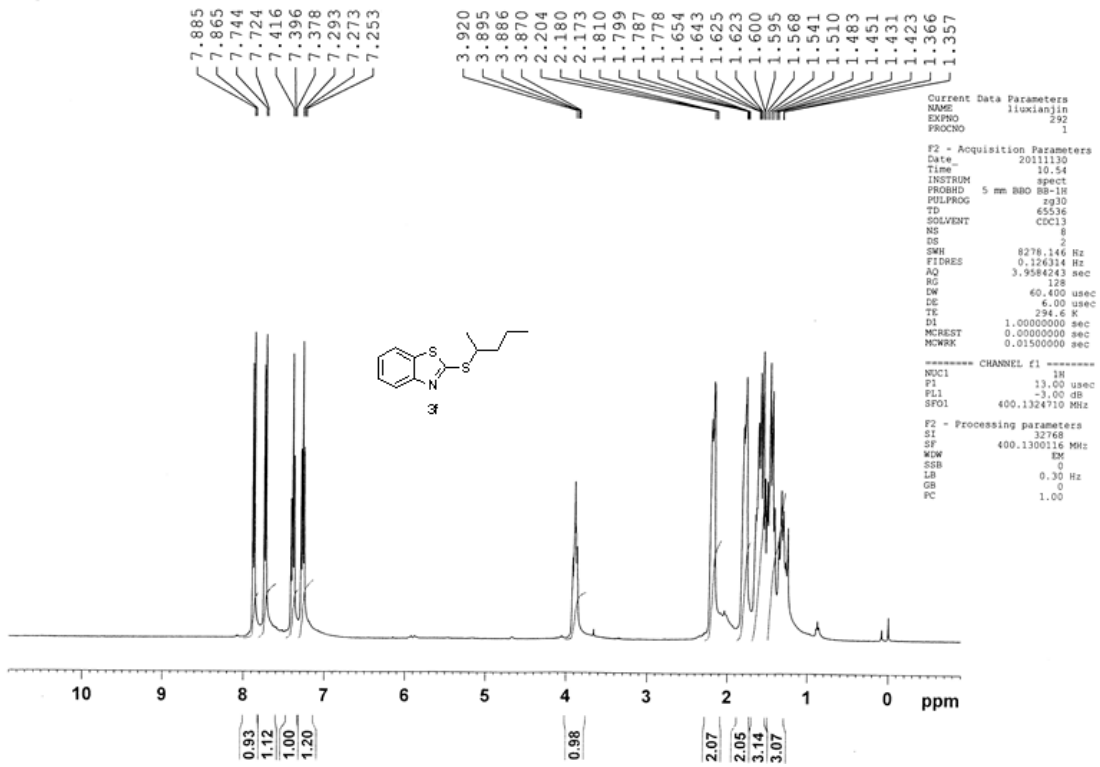
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 Time 11.32
 INSTRUM spect
 PROBHD 5 mm BBO BB-1H
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCl3
 NS 135
 DS 4
 SWH 23980.814 Hz
 FIDRES 0.365918 Hz
 AQ 1.3644756 sec
 RG 9195.2
 DW 20.850 usec
 DE 6.00 usec
 TE 298.5 K
 D1 2.0000000 sec
 d11 0.0300000 sec
 MCREST 0.0000000 sec
 MCWRR 0.0150000 sec

----- CHANNEL f1 -----
 NUC1 13C
 P1 6.00 usec
 PL1 -2.00 dB
 SFO1 100.6228298 MHz

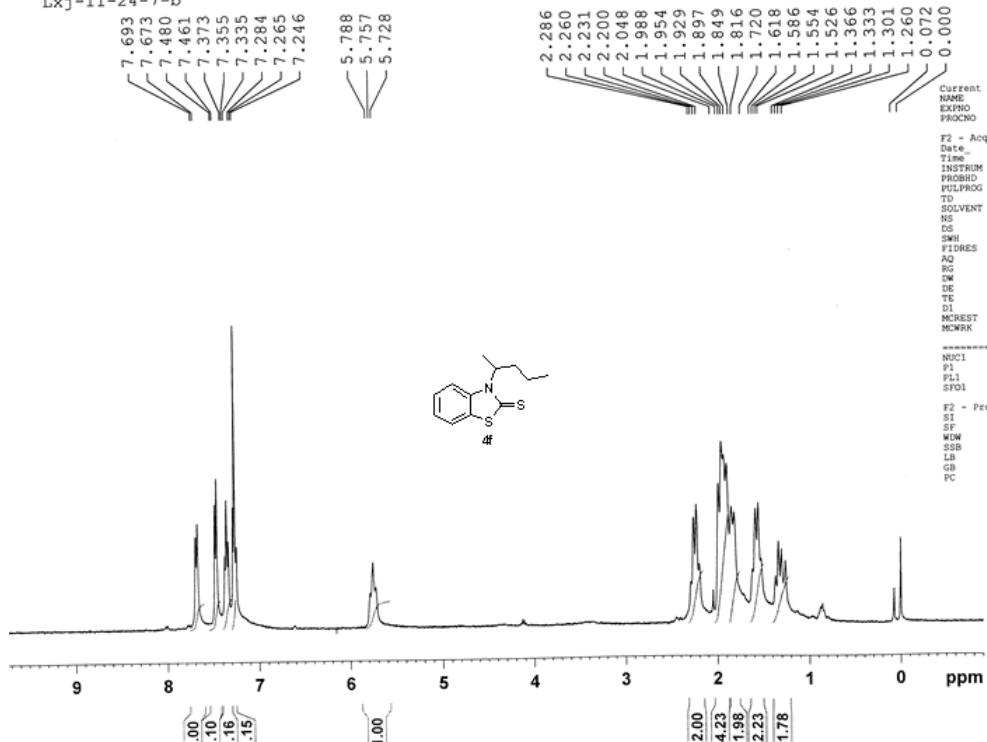
----- CHANNEL f2 -----
 CDPROG2 waltz16
 NUC2 1H
 PCPD2 80.00 usec
 PL2 120.00 dB
 PL12 12.00 dB
 PL13 12.00 dB
 SFO2 400.1316005 MHz

F2 - Processing parameters
 SI 32768
 SF 100.6127690 MHz
 MW EM
 SSB 0
 LB 1.00 Hz
 GB 0
 PC 1.40





Lxj-11-24-7-b



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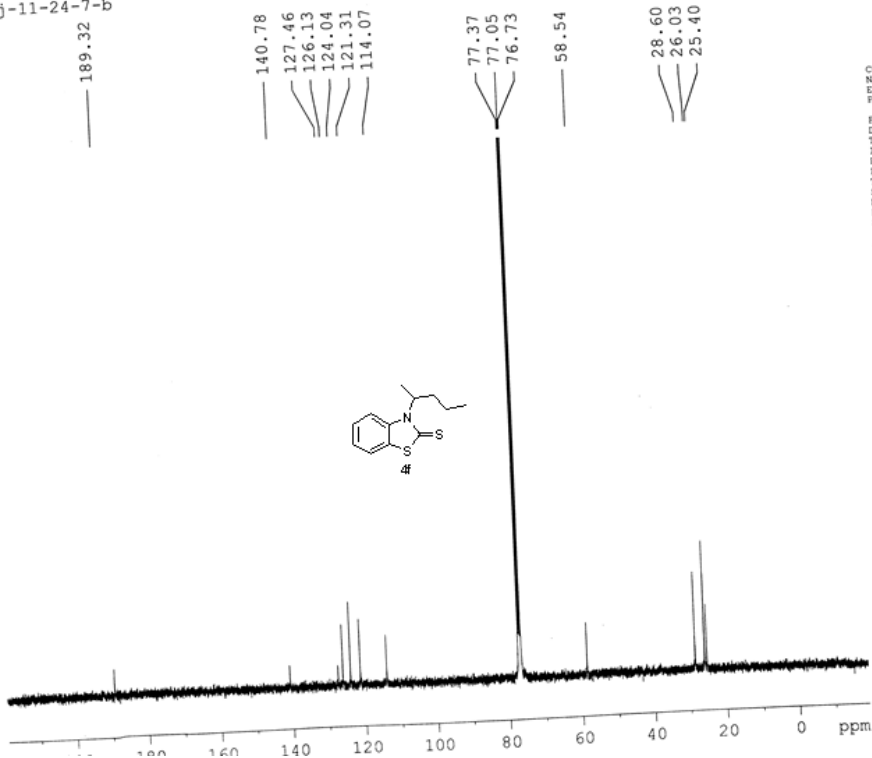
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NAME      liuxianjin
EXPNO    310
PROCNO   1

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Date_    2011205
Time     14.25
INSTRUM  spect
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PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       8
DS       2
SWH      8278.146 Hz
FIDRES   0.126314 Hz
AQ       3.9584243 sec
RG       512
DE       6.00 usec
TE       294.6 K
D1       1.00000000 sec
MCREST   0.00000000 sec
MCWRK    0.01500000 sec

----- CHANNEL f1 -----
NUC1     1H
P1       13.00 usec
PL1      -3.00 dB
SFO1     400.1324710 MHz

F2 - Processing parameters
SI       32768
SF       400.1300071 MHz
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SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
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Lxj-11-24-7-b



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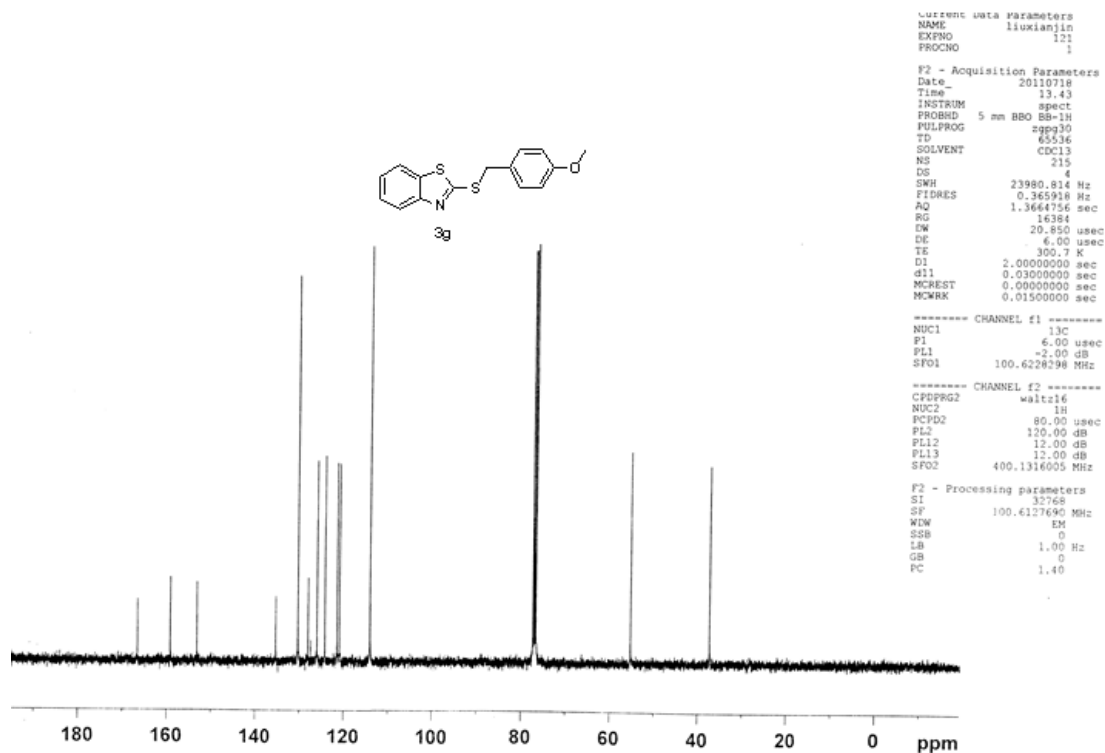
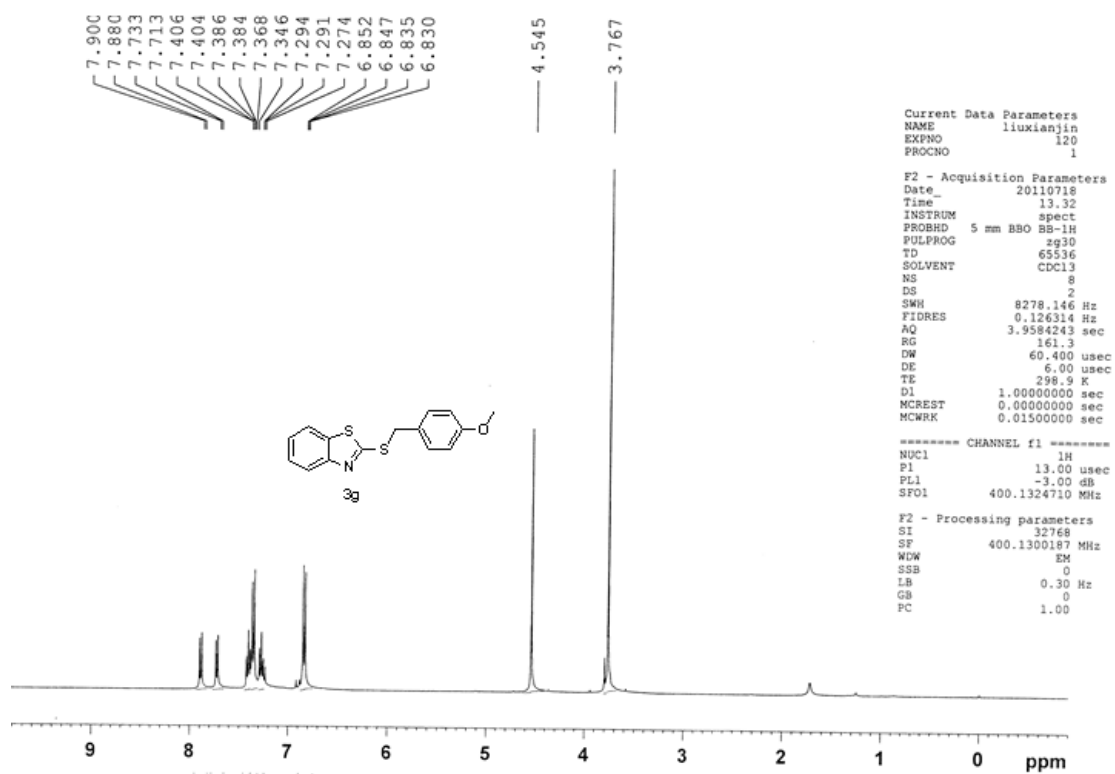
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NAME      liuxianjin
EXPNO    314
PROCNO   1

F2 - Acquisition Parameters
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Time     15.02
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       1288
DS       4
SWH      23980.814 Hz
FIDRES   0.365918 Hz
AQ       1.3664756 sec
RG       11585.2
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TE       295.1 K
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d11      0.03000000 sec
MCREST   0.00000000 sec
MCWRK    0.01500000 sec

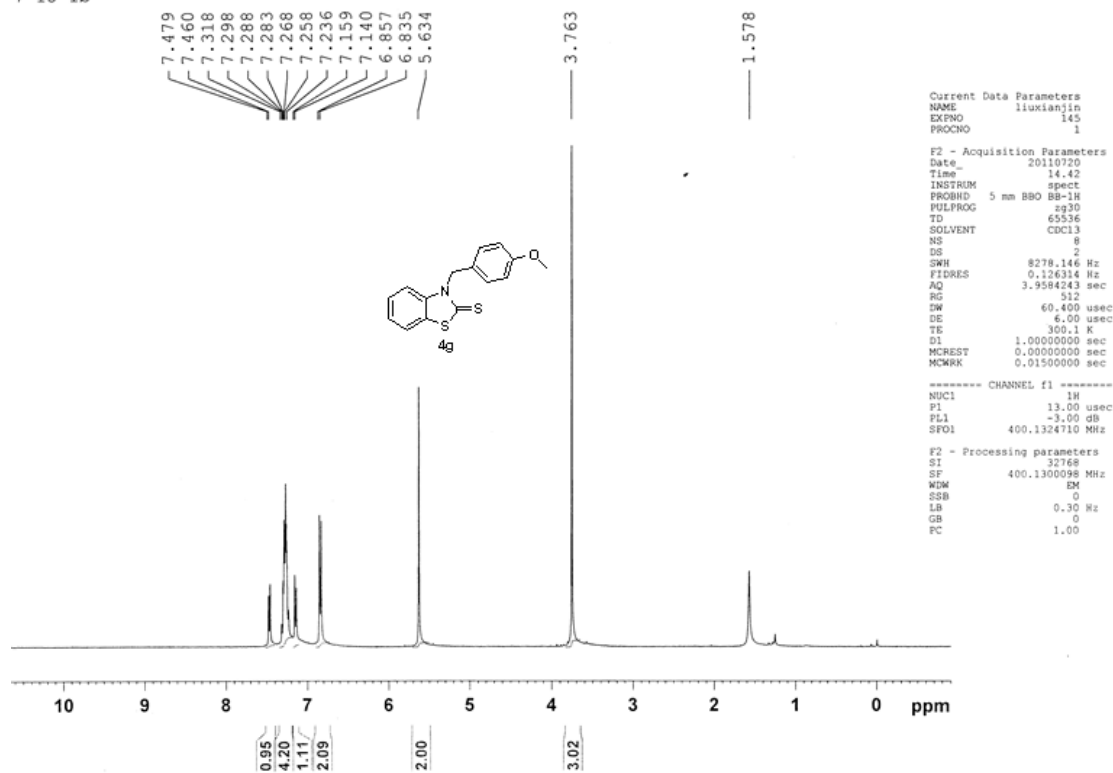
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NUC1     13C
P1       4.00 usec
PL1      -2.00 dB
SFO1     100.6228298 MHz

----- CHANNEL f2 -----
CPDPRG2  waltz16
NUC2     1H
PCPD2    80.00 usec
PL2      120.00 dB
PL22     12.00 dB
PL12     12.00 dB
PL13     12.00 dB
SFO2     400.1316000 MHz

F2 - Processing parameters
SI       32768
SF       100.6127690 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
PC       1.40
  
```



7-15-1b



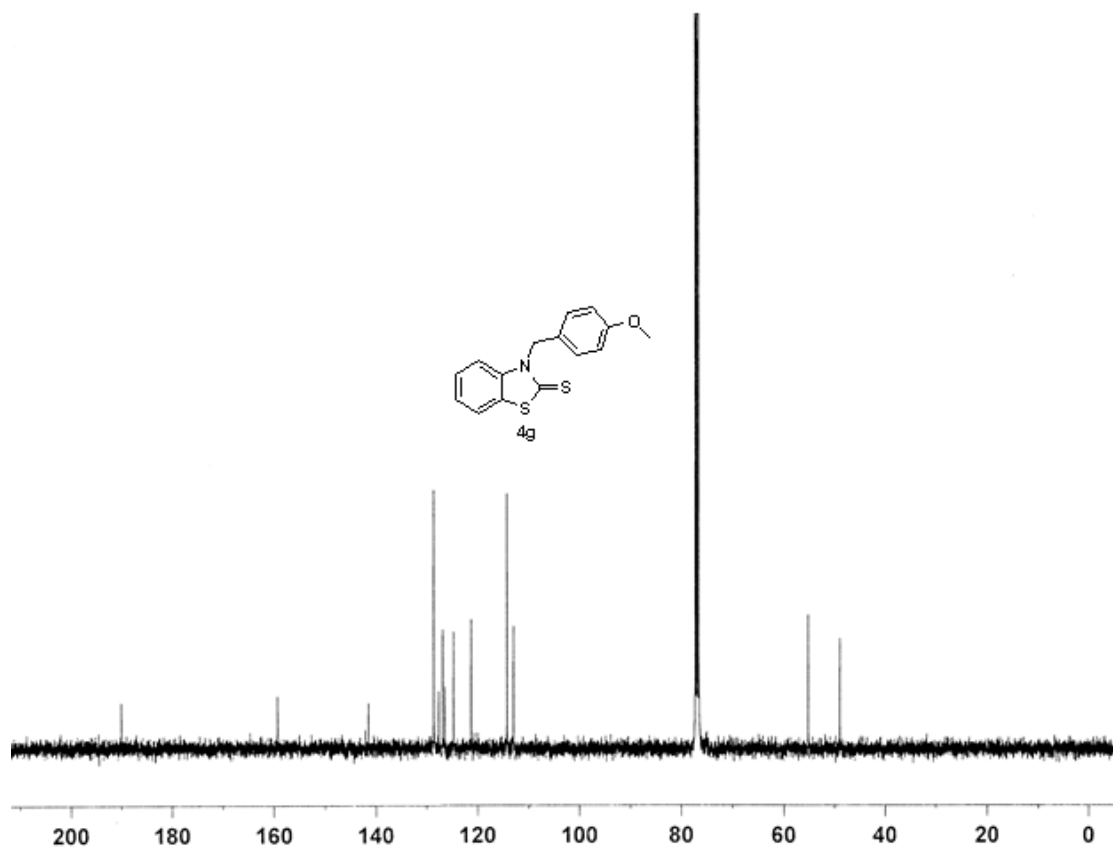
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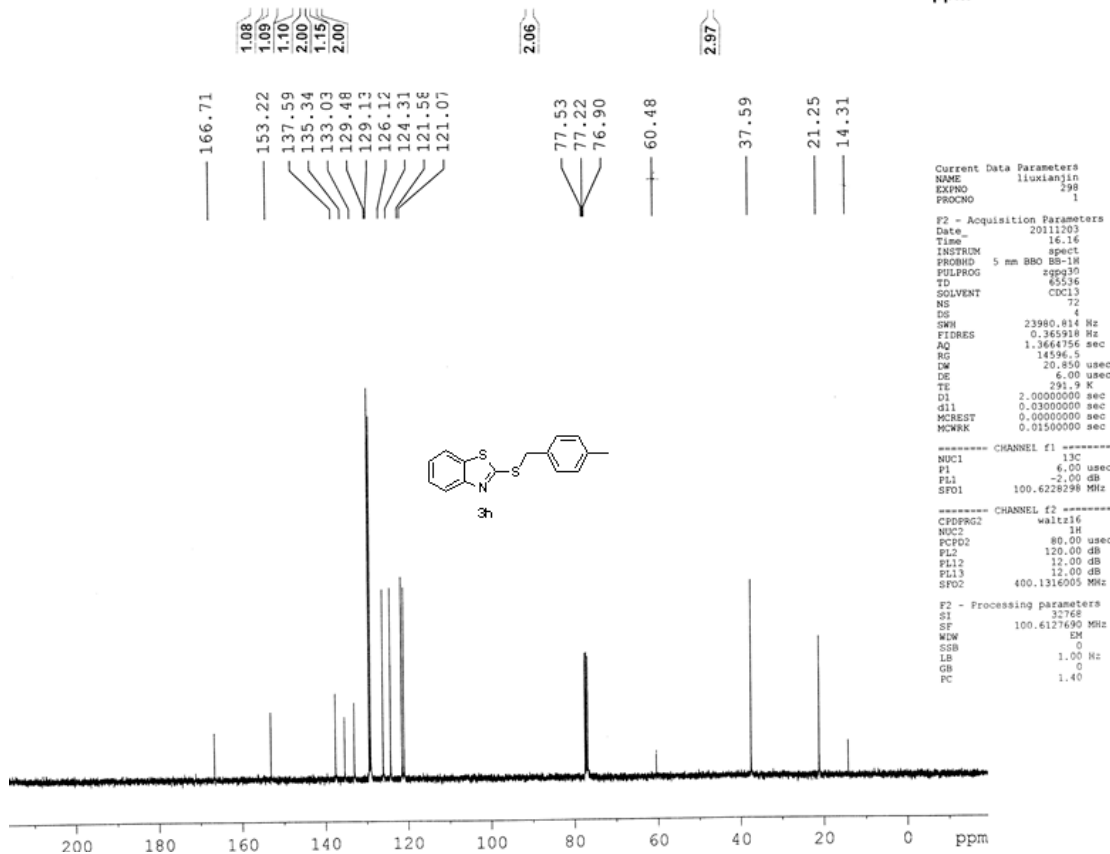
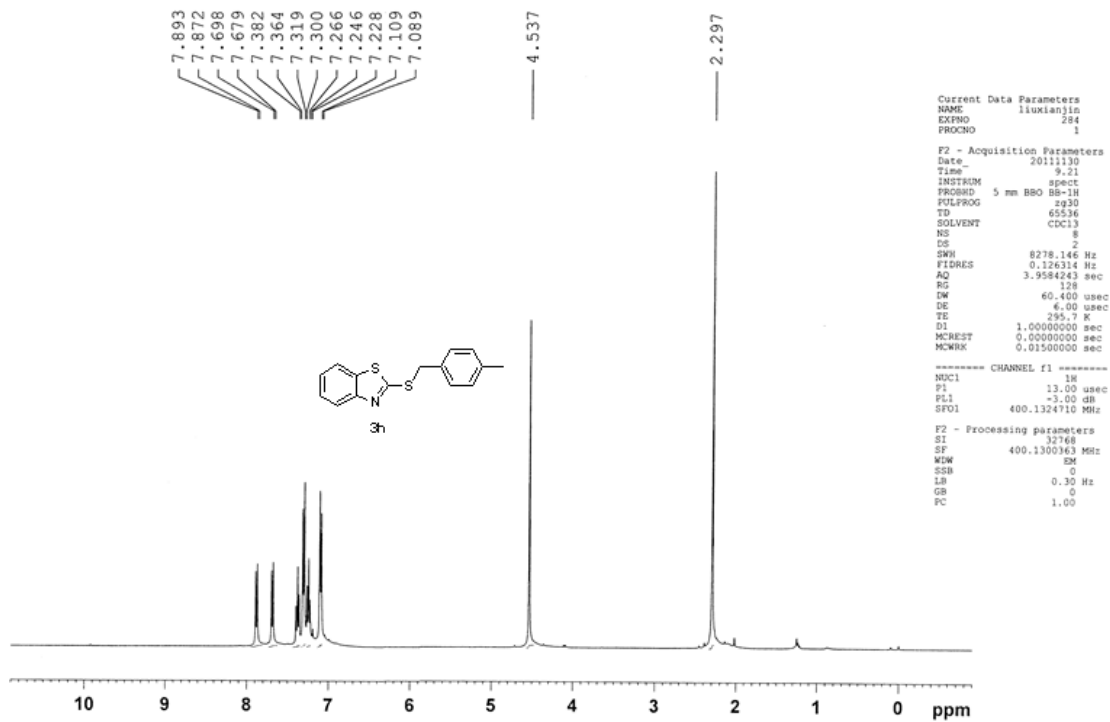
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NAME      lluxianjin
EXPNO    145
PROCNO   1

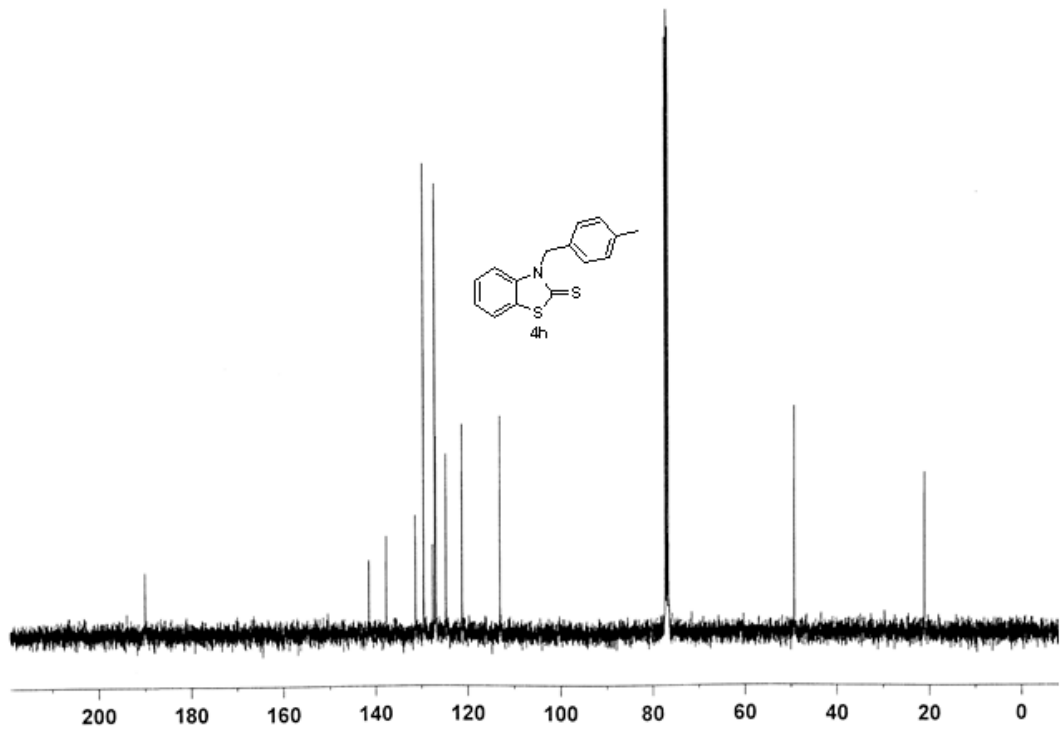
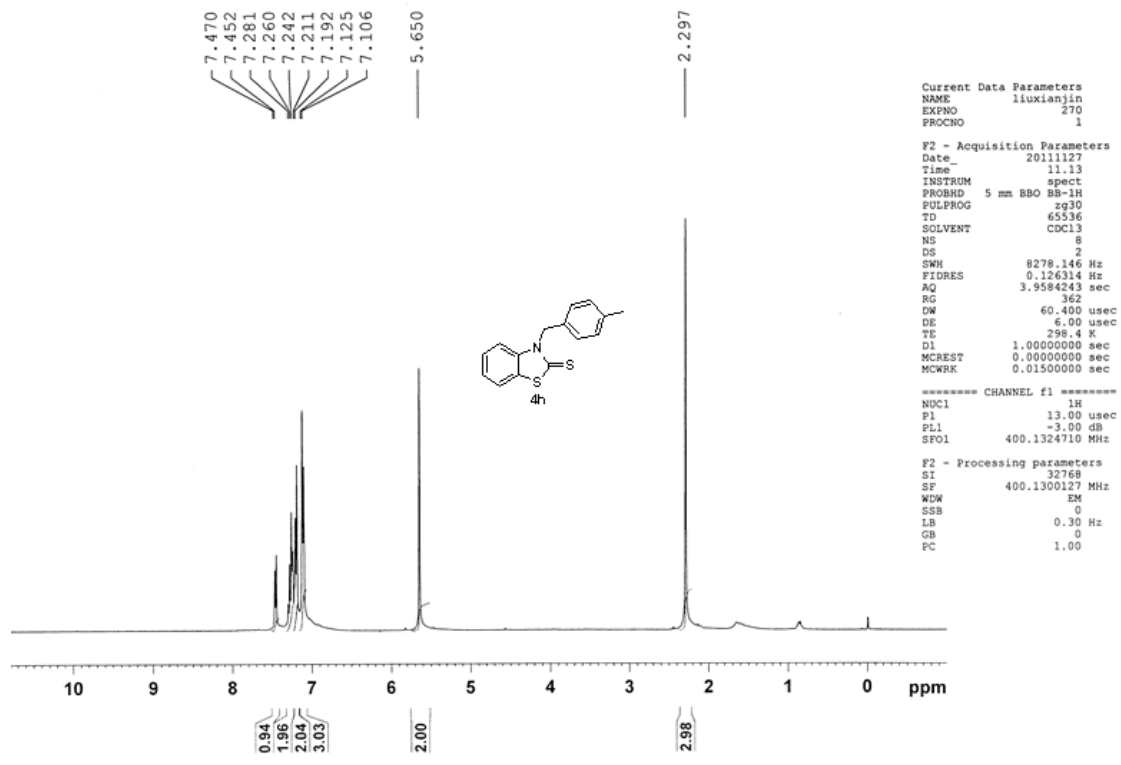
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PROBHD   5 mm BBO BB-1H
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH       8278.146 Hz
FIDRES    0.126314 Hz
AQ        3.9584243 sec
RG        512
SQ        60.400 usec
SE        4.00 usec
TE        300.1 K
D1        1.00000000 sec
MCREST    0.00000000 sec
MCKRR     0.01500000 sec

----- CHANNEL f1 -----
NUC1      1H
P1        13.00 usec
PL1       -3.00 dB
SFO1      400.1324710 MHz

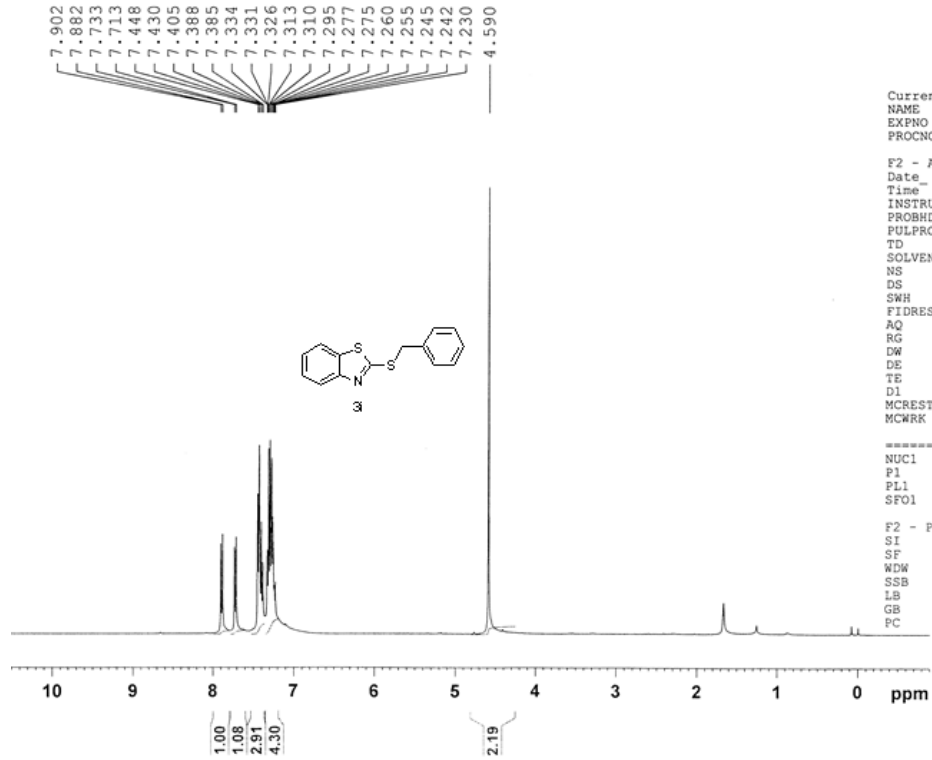
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SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
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7-15-2a

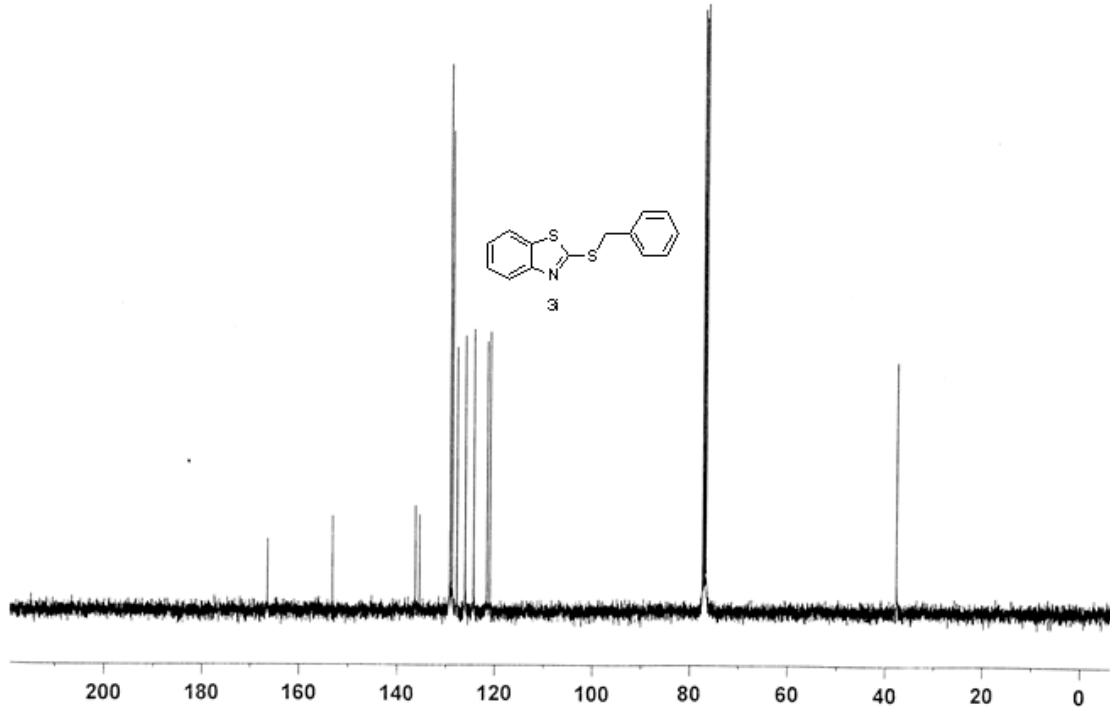


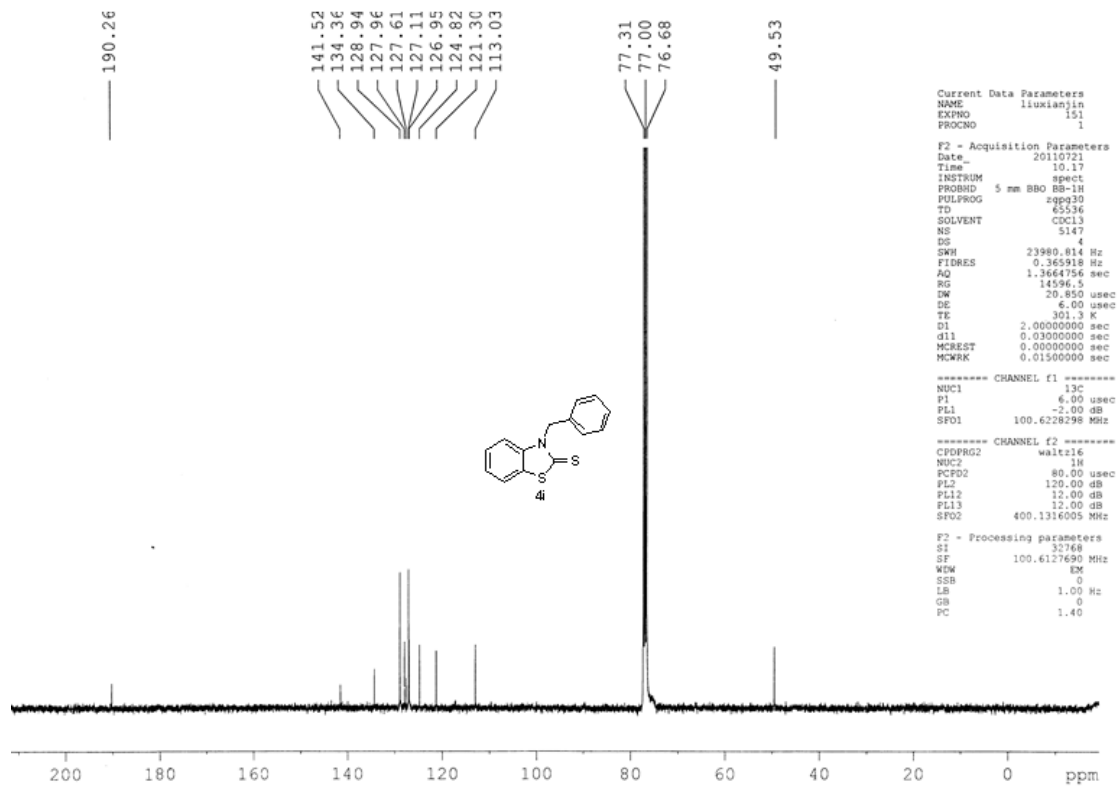
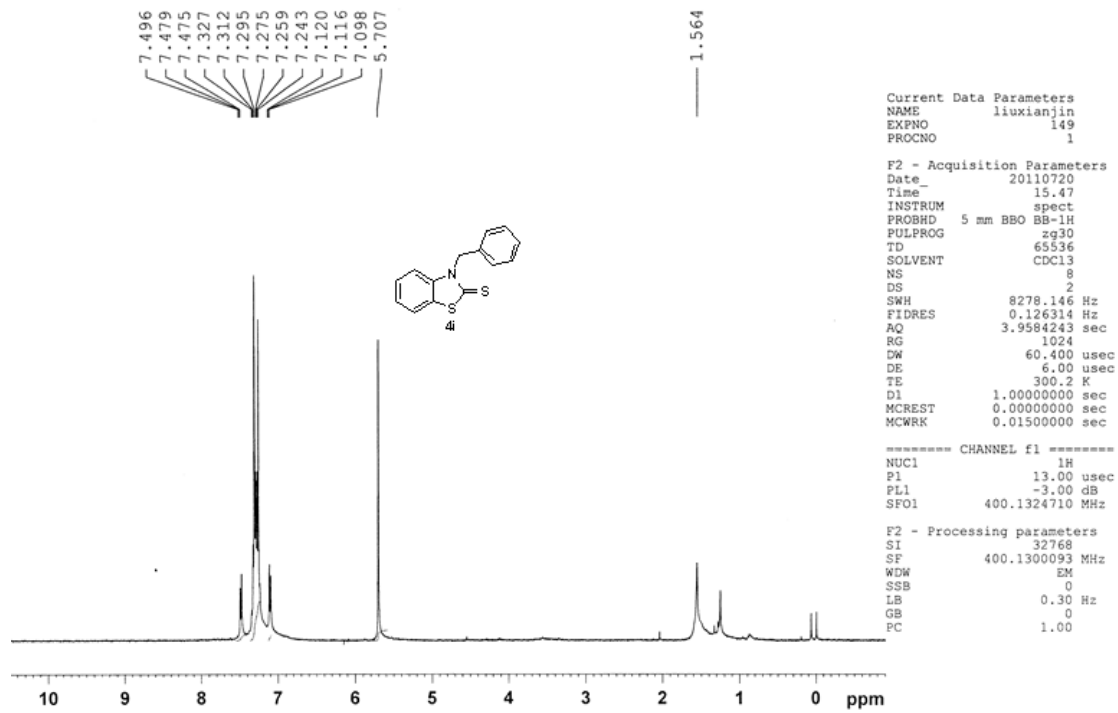
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NAME liuxianjin
EXPNO 122
PROCNO 1

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Time 13.49
INSTRUM spect
PROBHD 5 mm BBO BB-1H
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 2
SWH 8278.146 Hz
FIDRES 0.126314 Hz
AQ 3.9584243 sec
RG 228.1
DW 60.400 usec
DE 6.00 usec
TE 299.5 K
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MCREST 0.00000000 sec
MCWRK 0.01500000 sec

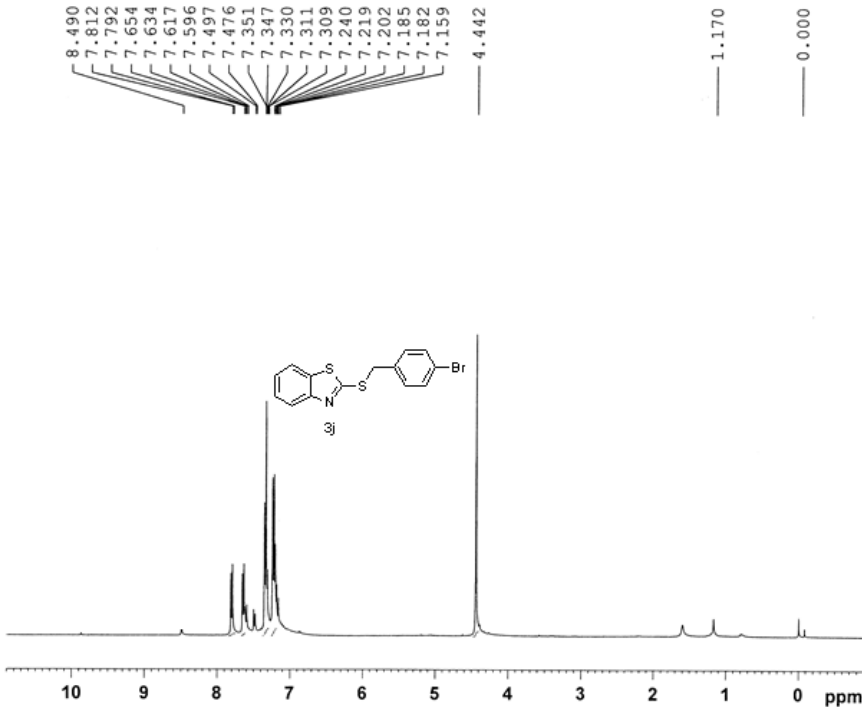
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NUC1 1H
P1 13.00 usec
PL1 -3.00 dB
SF01 400.1324710 MHz

F2 - Processing parameters
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SF 400.1300210 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00





lxj-10-16-2



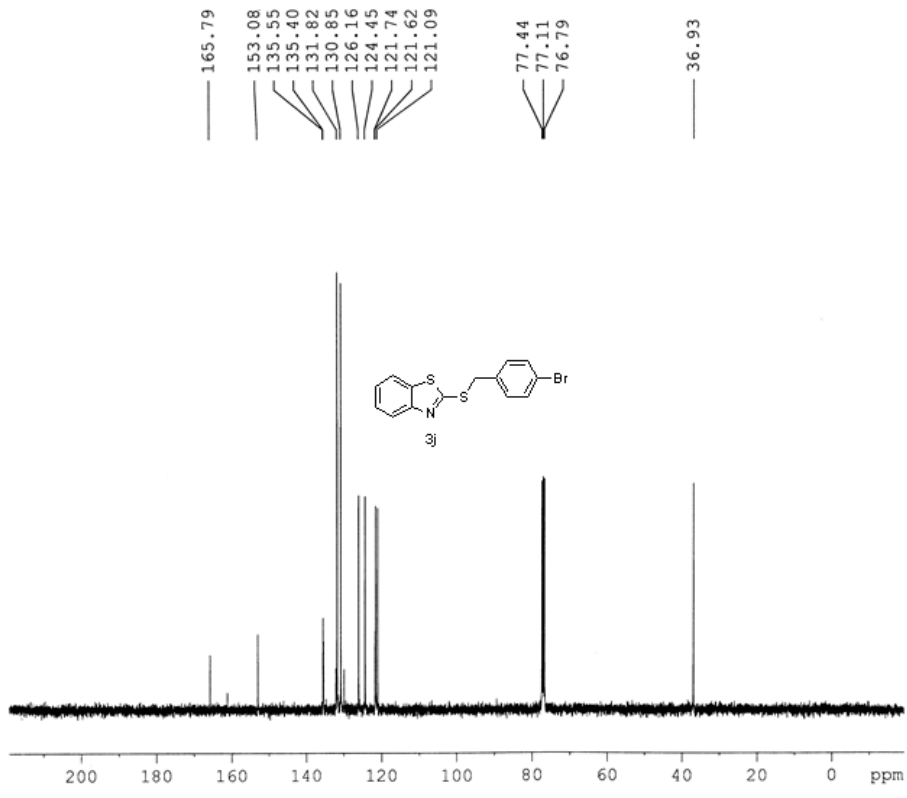
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Current Data Parameters
NAME liuxianjin
EXPNO 170
PROCNO 1

F2 - Acquisition Parameters
Date_ 20111021
Time 11.04
INSTRUM spect
PROBHD 5 mm BBO BB-1H
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 2
SWH 8278.146 Hz
FIDRES 0.126314 Hz
AQ 3.9584243 sec
RG 256
DW 60.400 usec
DE 6.00 usec
TE 297.9 K
D1 1.00000000 sec
MCREST 0.00000000 sec
MCWRK 0.01500000 sec

===== CHANNEL f1 =====
NUC1 1H
P1 13.00 usec
PL1 -3.00 dB
SFO1 400.1324710 MHz

F2 - Processing parameters
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SF 400.1300493 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
  
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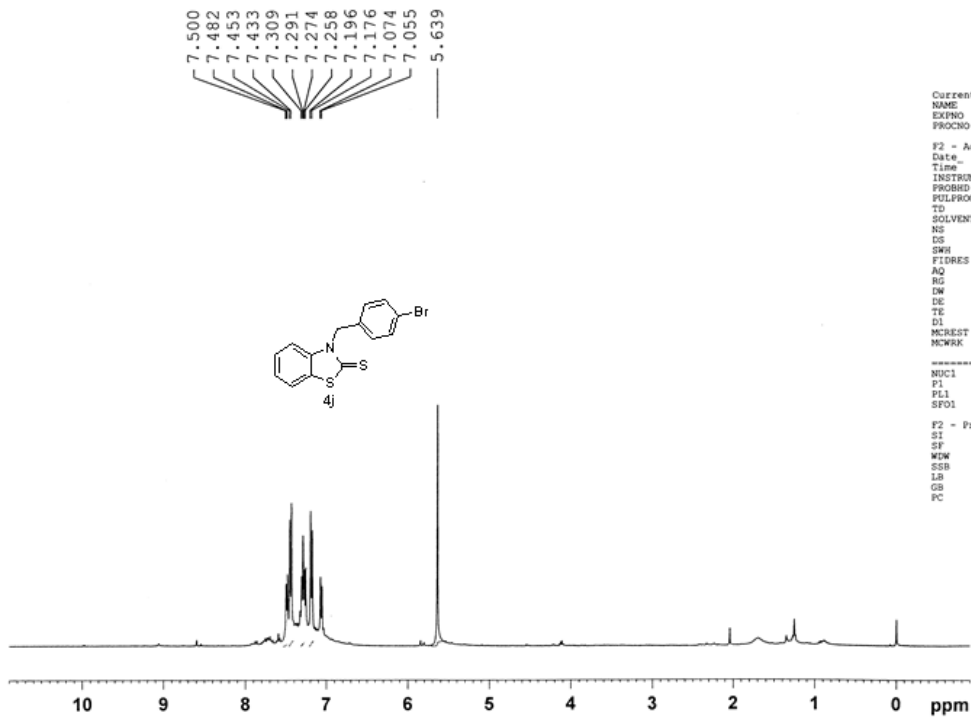
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NAME liuxianjin
EXPNO 191
PROCNO 1

F2 - Acquisition Parameters
Date_ 20111102
Time 14.33
INSTRUM spect
PROBHD 5 mm BBO BB-1H
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 232
DS 4
SWH 23980.814 Hz
FIDRES 0.365918 Hz
AQ 1.3664756 sec
RG 103213
DW 20.850 usec
DE 6.00 usec
TE 297.3 K
D1 2.00000000 sec
d11 0.03000000 sec
MCREST 0.00000000 sec
MCWRK 0.01500000 sec

===== CHANNEL f1 =====
NUC1 13C
P1 6.00 usec
PL1 -2.00 dB
SFO1 100.6228298 MHz

===== CHANNEL f2 =====
CFDPRG2 wait16
NUC2 1H
PCPD2 80.00 usec
PL2 120.00 dB
PL12 12.00 dB
PL13 12.00 dB
SFO2 400.1316005 MHz

F2 - Processing parameters
SI 32768
SF 100.6127690 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40
  
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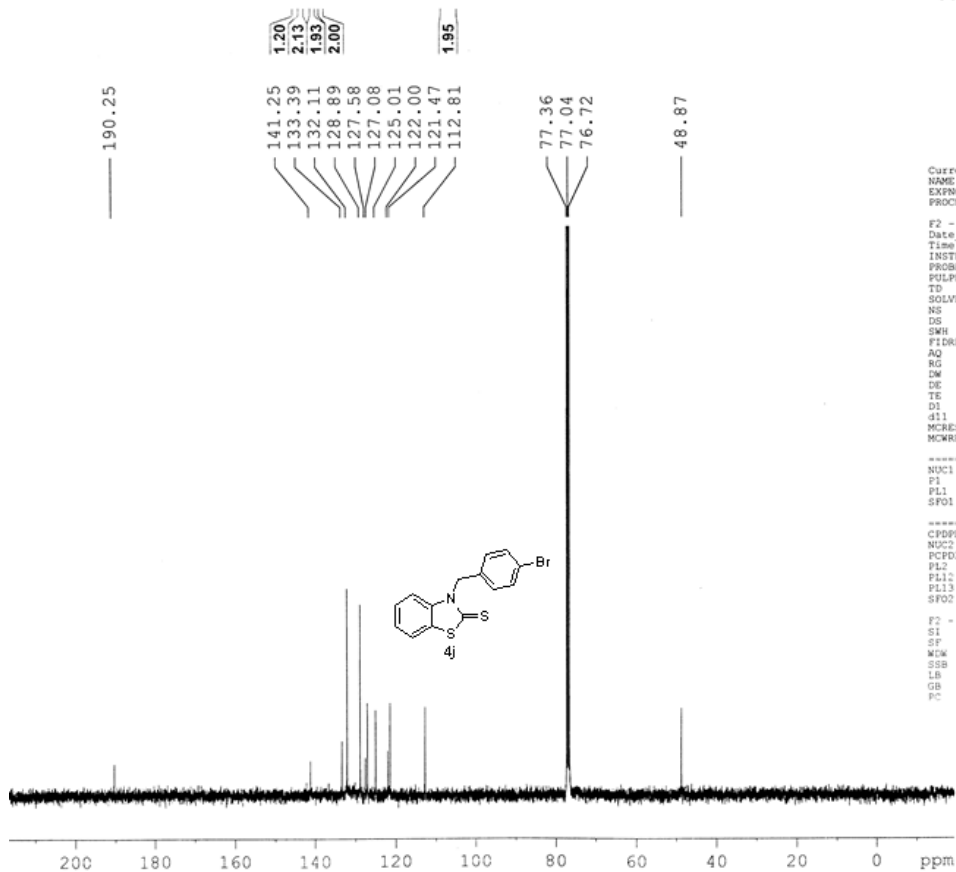
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Current Data Parameters
NAME      luxianjin
EXPNO    180
PROCNO   1

F2 - Acquisition Parameters
Date_    20111029
Time     13.06
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       8
DS       2
SWH      8278.146 Hz
FIDRES   0.126314 Hz
AQ       3.9584243 sec
RG       574.7
DW       60.400 usec
DE       6.00 usec
TE       296.8 K
D1       1.00000000 sec
MCREST   0.00000000 sec
MCWRK    0.01500000 sec

----- CHANNEL f1 -----
NUC1     1H
P1       13.00 usec
PL1      -1.00 dB
SFO1     400.1324710 MHz

F2 - Processing parameters
SI       32768
SF       400.1300099 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
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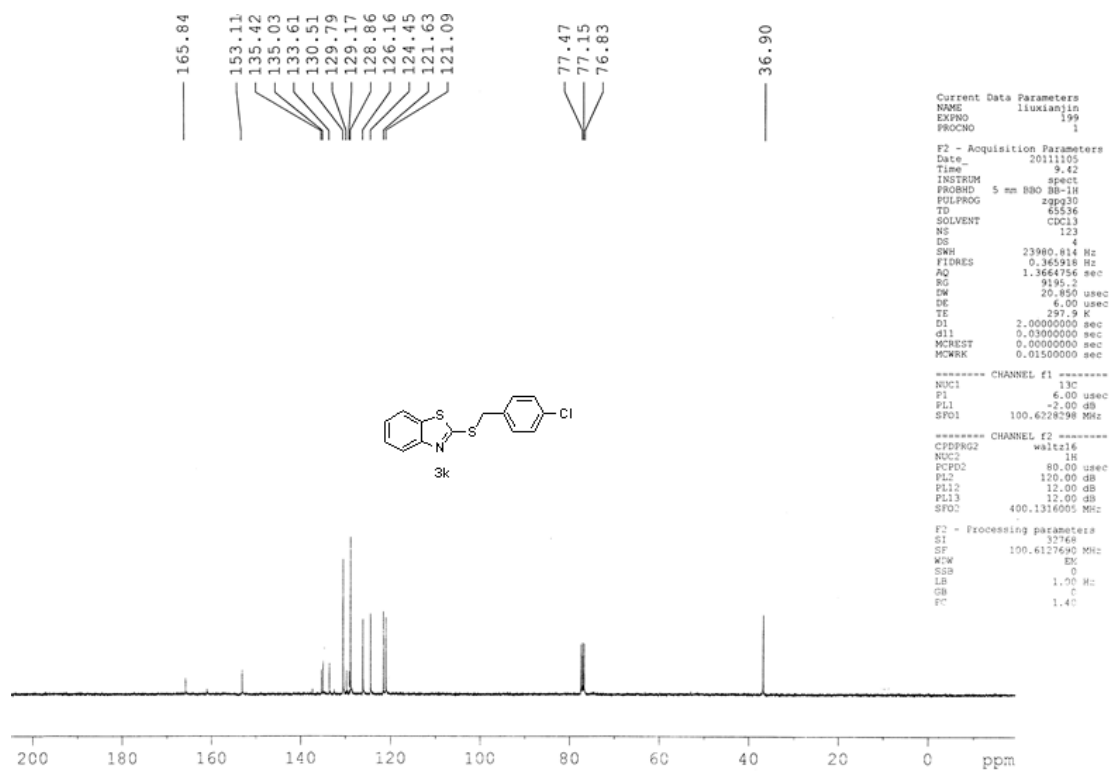
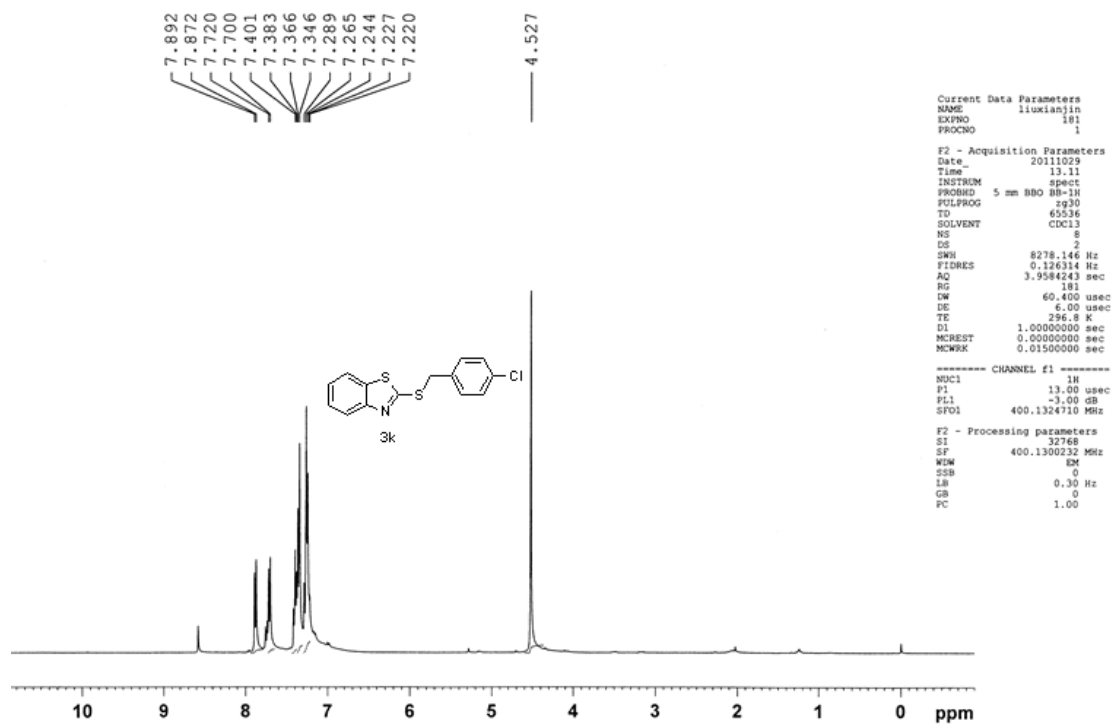
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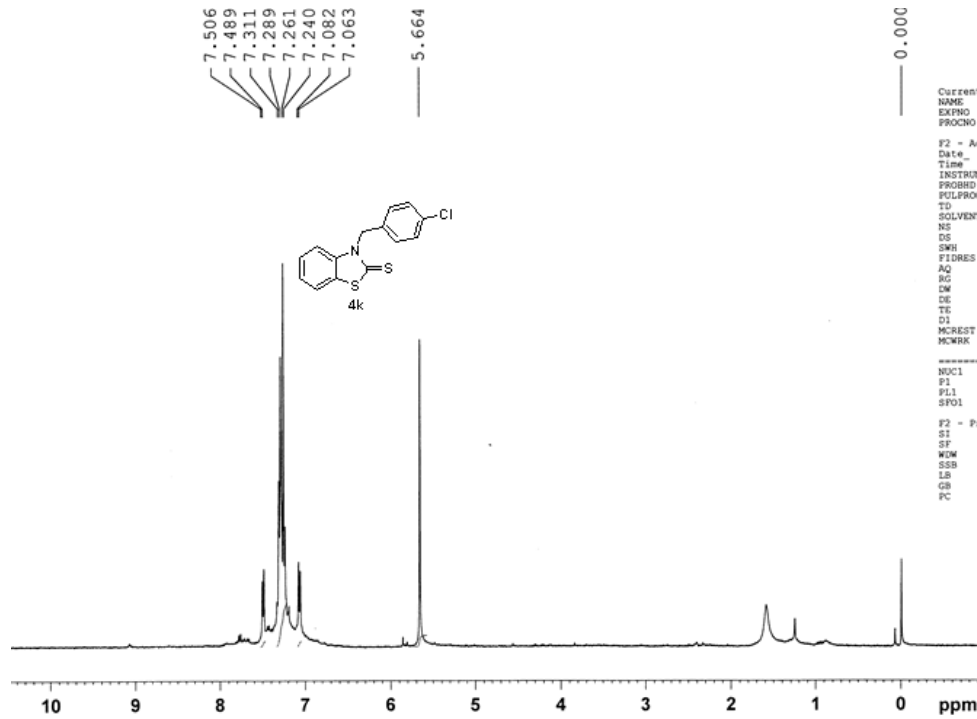
F2 - Acquisition Parameters
Date_    20111107
Time     17.00
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       430
DS       4
SWH      23980.814 Hz
FIDRES   0.365918 Hz
AQ       1.3664756 sec
RG       13004
DW       20.850 usec
DE       6.00 usec
TE       298.8 K
D1       2.00000000 sec
d11      0.03000000 sec
MCREST   0.00000000 sec
MCWRK    0.01500000 sec

----- CHANNEL f1 -----
NUC1     13C
P1       6.00 usec
PL1      -2.00 dB
SFO1     100.6228298 MHz

----- CHANNEL f2 -----
CPDPRG2  waltz16
NUC2     1H
PCPD2    80.00 usec
PL2      120.00 dB
PL12     12.00 dB
PL13     12.00 dB
SFO2     400.1316005 MHz

F2 - Processing parameters
SI       32768
SF       100.6127690 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
PC       1.40
  
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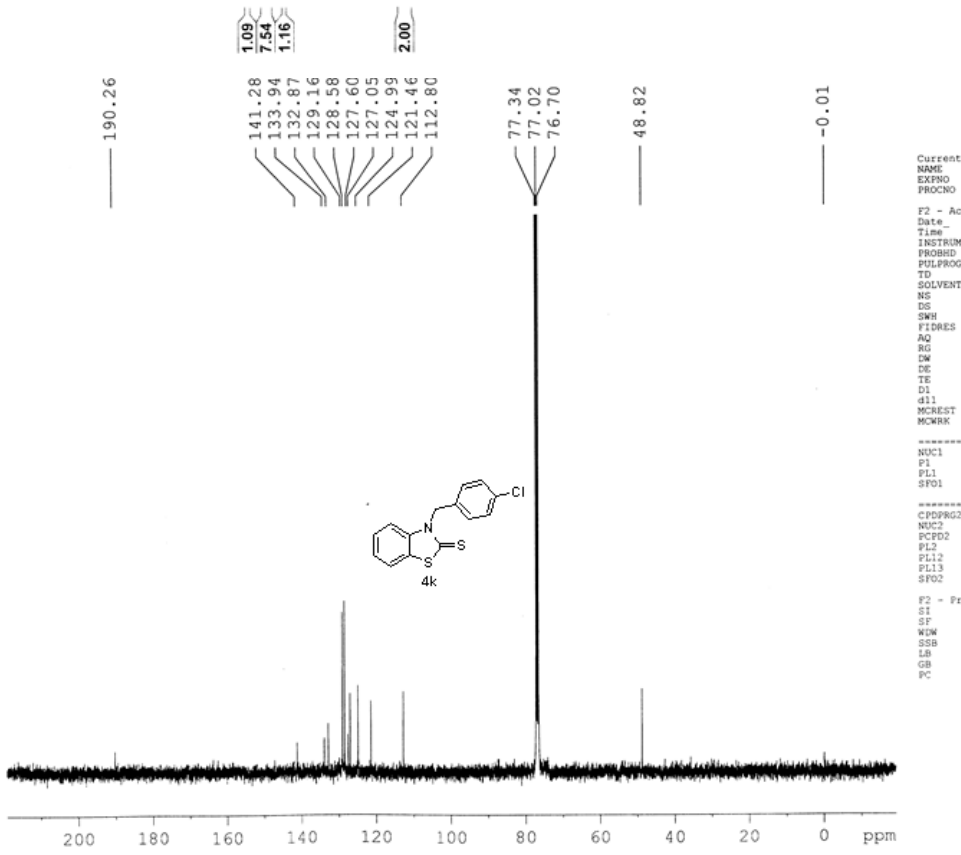
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Current Data Parameters
NAME      liuxianjin
EXPNO    182
PROCNO   1

F2 - Acquisition Parameters
Date_    2011029
Time     13.16
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH       8278.146 Hz
FIDRES   0.126314 Hz
AQ        3.9584243 sec
RG        724.1
DW        60.400 usec
DE        6.00 usec
TE        296.8 K
D1        1.00000000 sec
MCREST   0.00000000 sec
MCMRCK   0.01500000 sec

----- CHANNEL f1 -----
NUC1      1H
F1        13.00 usec
PL1       -3.00 dB
SFO1     400.1324710 MHz

F2 - Processing parameters
SI        32768
SF        400.1300096 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```



```

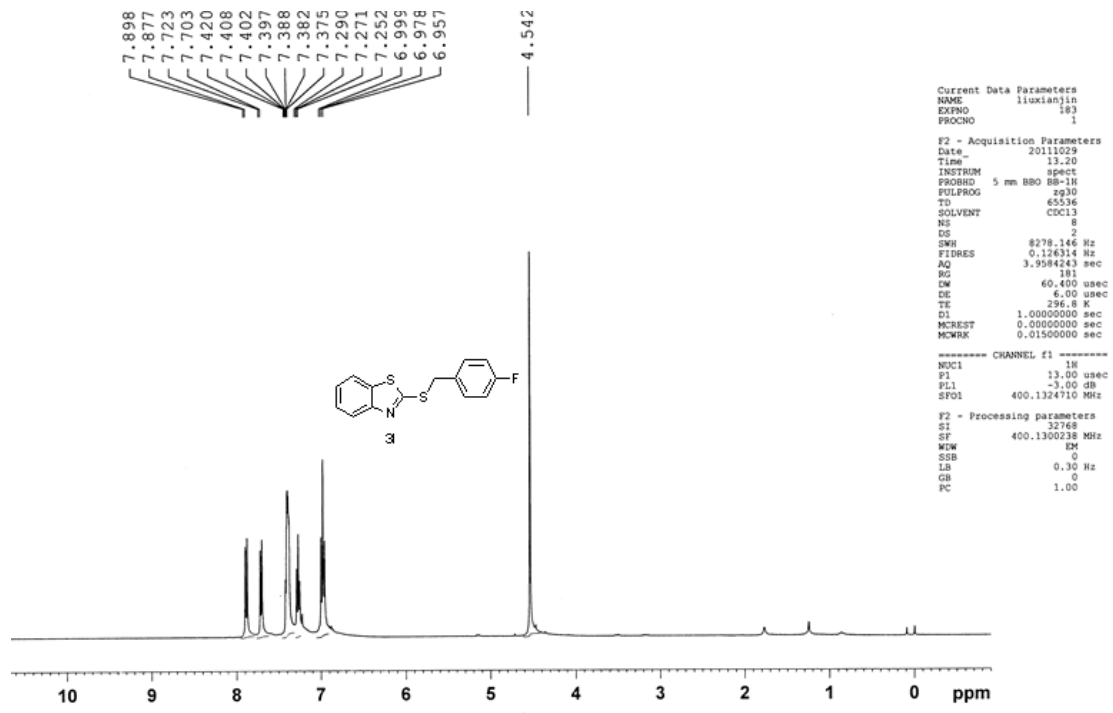
Current Data Parameters
NAME      liuxianjin
EXPNO    236
PROCNO   1

F2 - Acquisition Parameters
Date_    2011116
Time     17.18
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        1024
DS        4
SWH       23980.814 Hz
FIDRES   0.365918 Hz
AQ        1.3664756 sec
RG        16384
DW        20.850 usec
DE        6.00 usec
TE        299.3 K
D1        2.00000000 sec
d11       0.03000000 sec
MCREST   0.00000000 sec
MCMRCK   0.01500000 sec

----- CHANNEL f1 -----
NUC1      13C
F1        6.00 usec
PL1       -2.00 dB
SFO1     100.6228298 MHz

----- CHANNEL f2 -----
CPDPRG2  waltz16
NUC2      1H
PCPD2    80.00 usec
PL2       120.00 dB
PL12     12.00 dB
PL13     12.00 dB
SFO2     400.1316005 MHz

F2 - Processing parameters
SI        32768
SF        100.6127690 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```



```

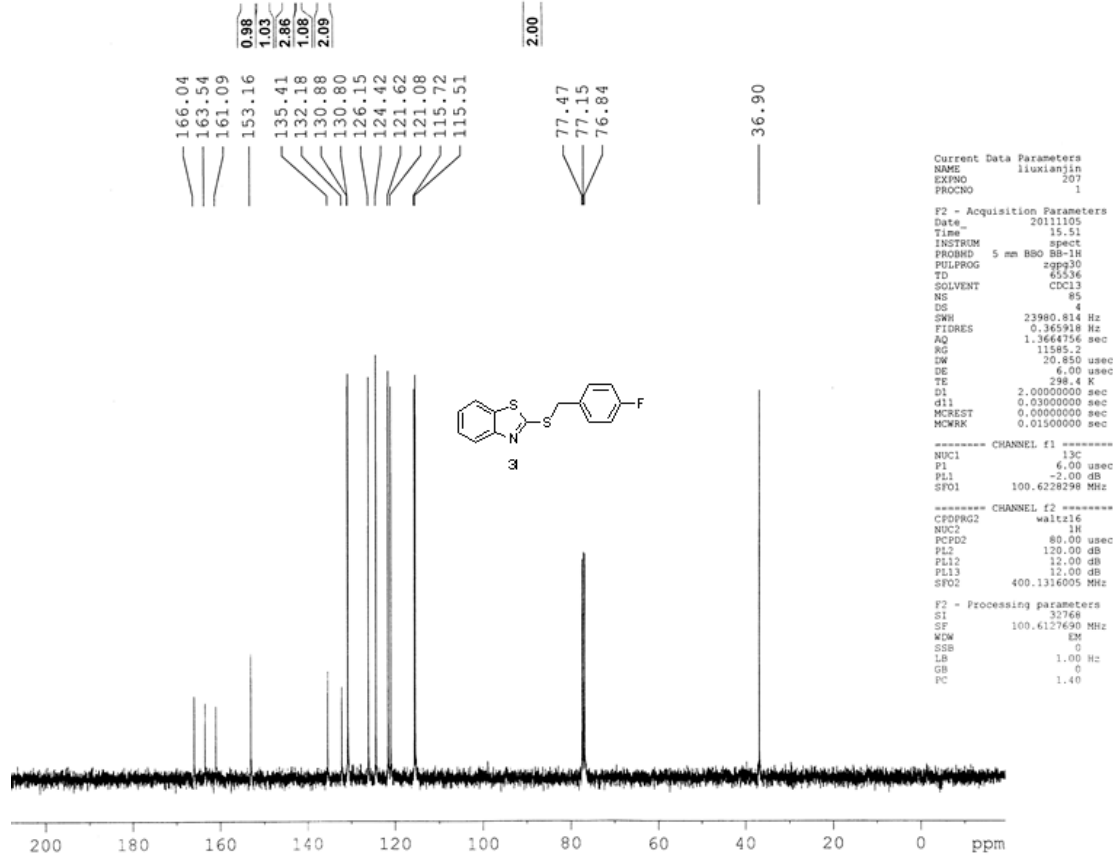
Current Data Parameters
NAME          liuxianjin
EXPNO         183
PROCNO        1

F2 - Acquisition Parameters
Date_         20111029
Time          13.20
INSTRUM       spect
PROBHD        5 mm BBO BB-1H
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            8
DS            2
SWH           8278.146 Hz
FIDRES        0.126314 Hz
AQ            3.9584243 sec
RG            181
DM            60.400 usec
DE            6.00 usec
TE            296.8 K
D1            1.0000000 sec
MCREST        0.0000000 sec
MCWRK         0.0150000 sec

----- CHANNEL f1 -----
NUC1          1H
P1            13.00 usec
PL1           -3.00 dB
SFO1          400.1324710 MHz

F2 - Processing parameters
SI            32768
SF            400.1300238 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00

```



```

Current Data Parameters
NAME          liuxianjin
EXPNO         207
PROCNO        1

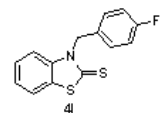
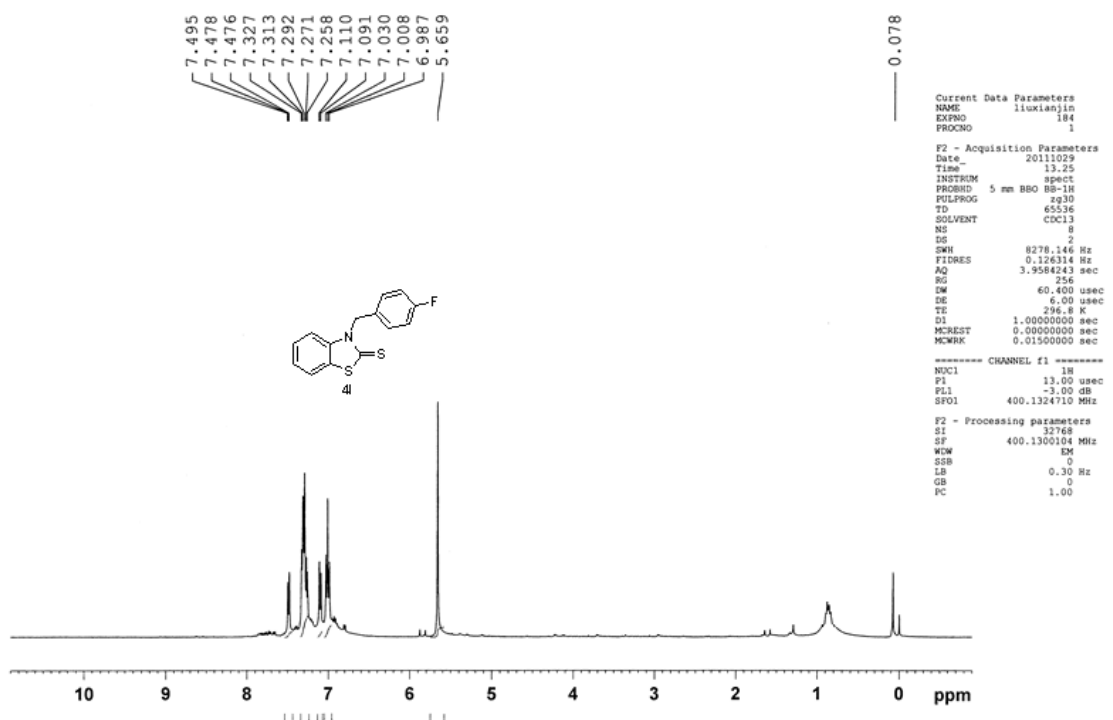
F2 - Acquisition Parameters
Date_         20111105
Time          15.51
INSTRUM       spect
PROBHD        5 mm BBO BB-1H
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            85
DS            4
SWH           23980.814 Hz
FIDRES        0.365918 Hz
AQ            1.3664756 sec
RG            11585.2
DM            20.850 usec
DE            6.00 usec
TE            298.4 K
D1            2.0000000 sec
d11           0.0300000 sec
MCREST        0.0000000 sec
MCWRK         0.0150000 sec

----- CHANNEL f1 -----
NUC1          13C
P1            6.00 usec
PL1           -2.00 dB
SFO1          100.6228298 MHz

----- CHANNEL f2 -----
CPDPRG2       waltz16
NUC2          1H
PCPD2         80.00 usec
PL2           120.00 dB
PL12          12.00 dB
PL13          12.00 dB
SFO2          400.1316005 MHz

F2 - Processing parameters
SI            32768
SF            100.6127690 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40

```

```

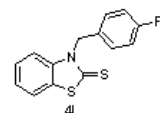
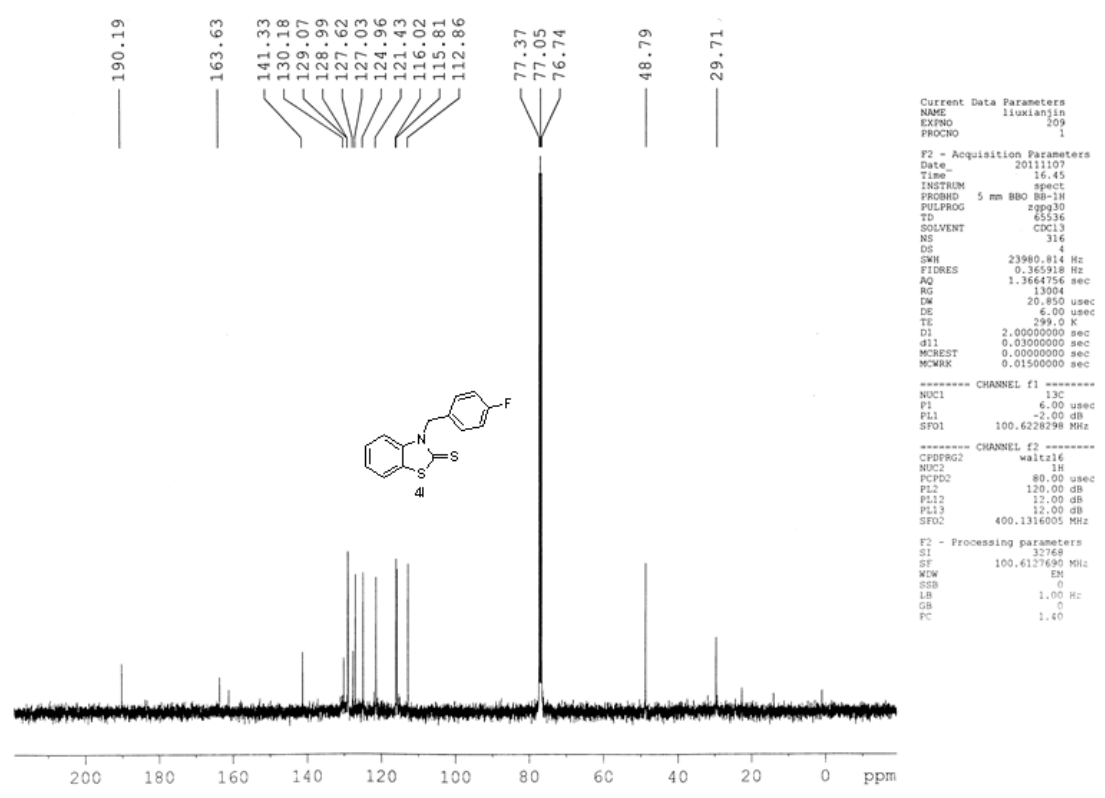
Current Data Parameters
NAME      liuxianjin
EXPNO    184
PROCNO   1

F2 - Acquisition Parameters
Date_    20111029
Time_    13.25
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        8
DS        2
SWH       8278.146 Hz
FIDRES   0.126314 Hz
AQ        3.9584243 sec
RG        256
DE        60.400 usec
TE        296.2 K
D1        1.00000000 sec
MCREST   0.00000000 sec
MCWRK    0.01500000 sec

----- CHANNEL f1 -----
NUC1      1H
P1        13.00 usec
PL1       -3.00 dB
SFO1      400.1324710 MHz

F2 - Processing parameters
SI        32768
SF        400.1300104 MHz
WDW       EM
SSB       0
LB        0.3 Hz
GB        0
PC        1.00

```



```

Current Data Parameters
NAME      liuxianjin
EXPNO    209
PROCNO   1

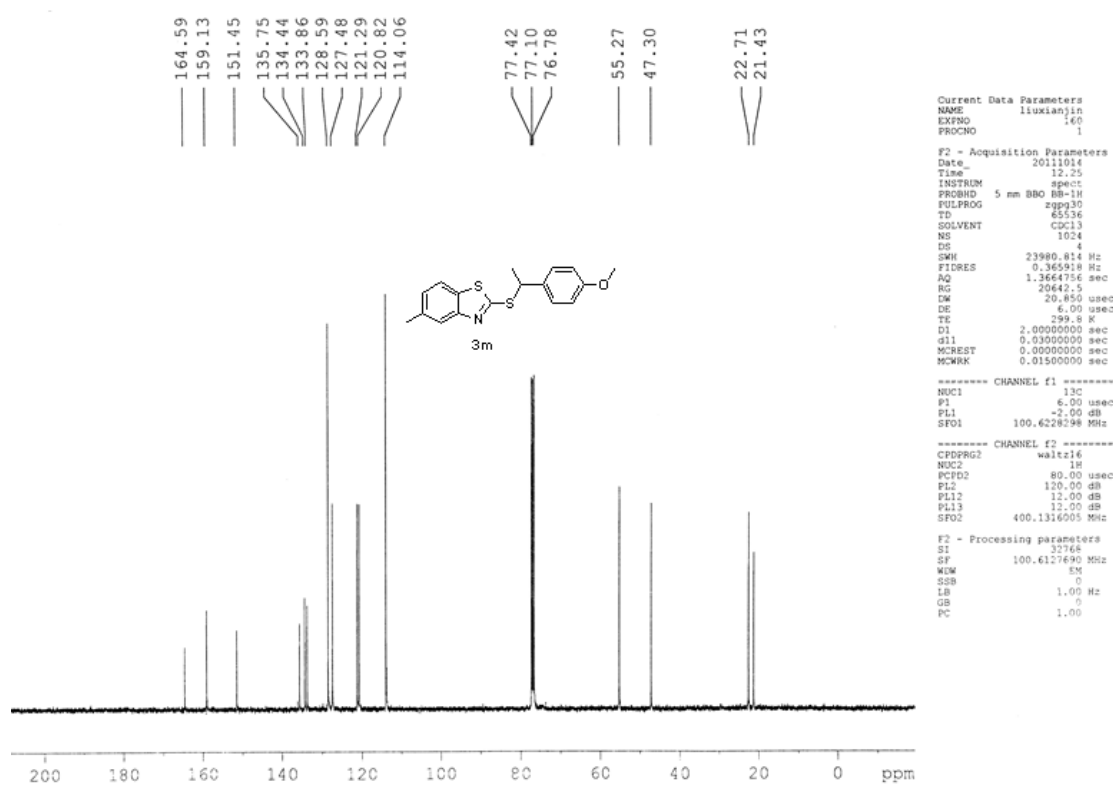
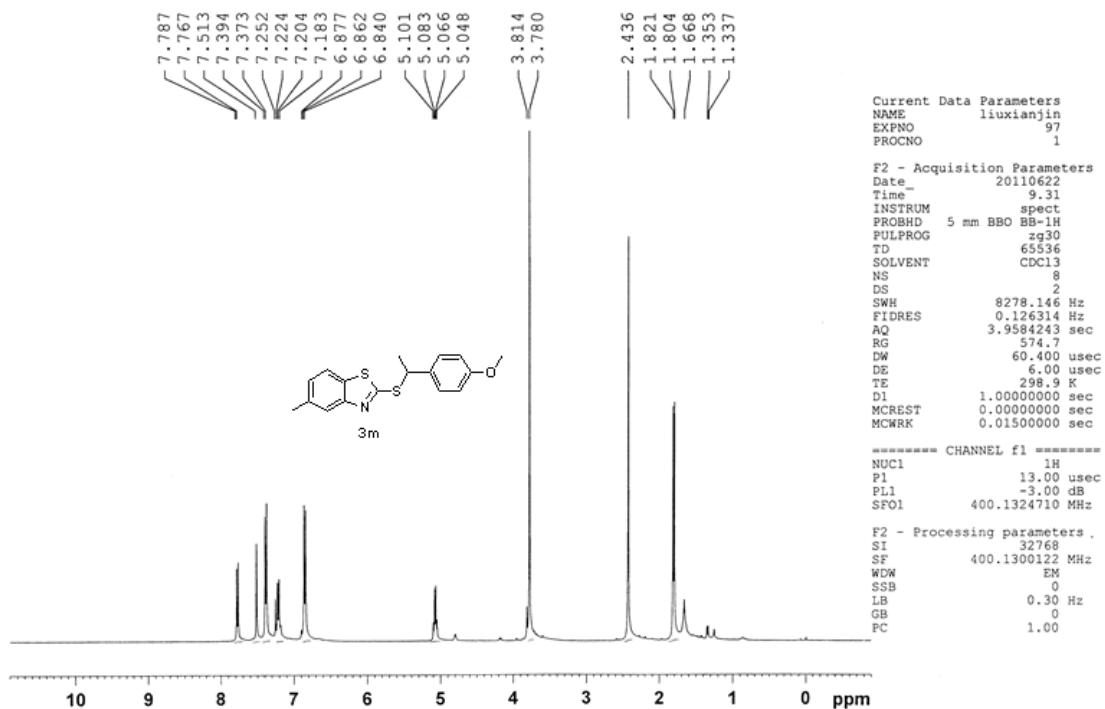
F2 - Acquisition Parameters
Date_    20111007
Time_    16.45
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        316
DS        4
SWH       23980.814 Hz
FIDRES   0.365918 Hz
AQ        1.3664756 sec
RG        13004
DE        20.850 usec
TE        299.0 K
D1        2.00000000 sec
d11       0.03000000 sec
MCREST   0.00000000 sec
MCWRK    0.01500000 sec

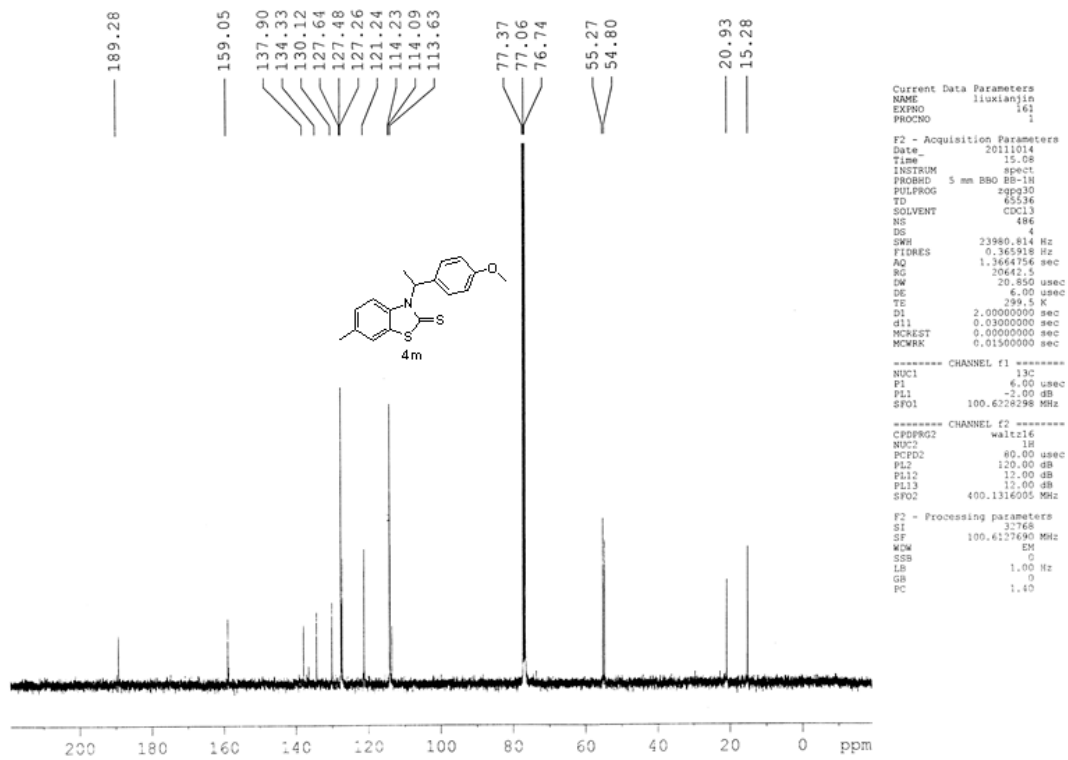
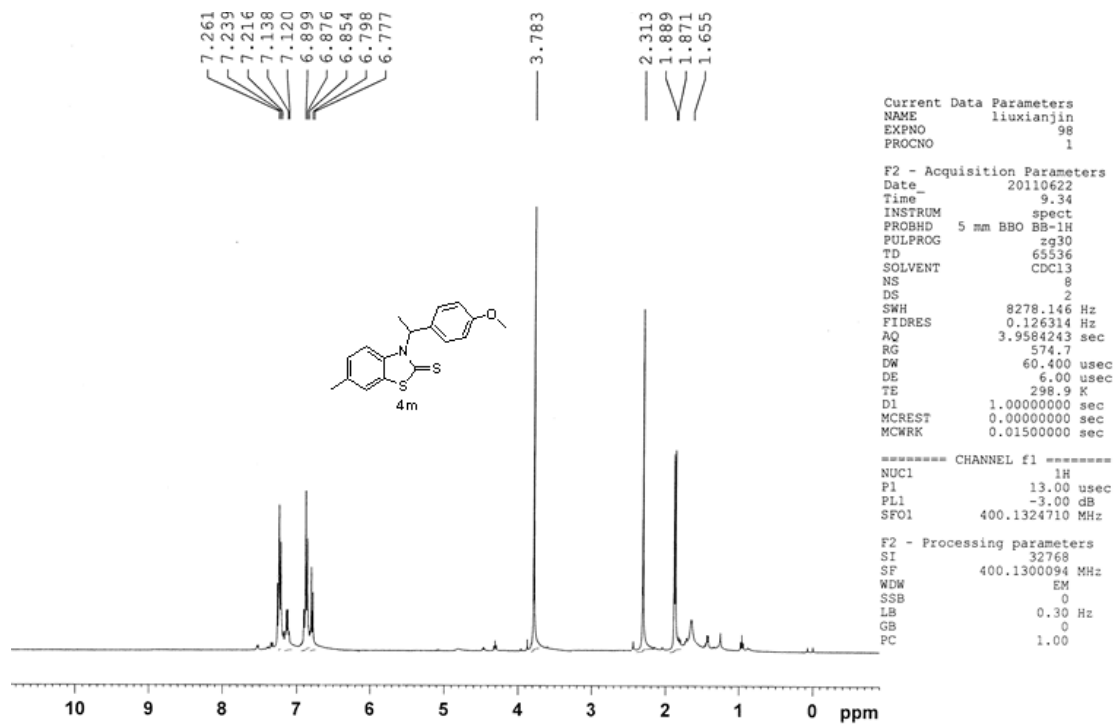
----- CHANNEL f1 -----
NUC1      13C
P1        6.00 usec
PL1       -2.00 dB
SFO1      100.6228298 MHz

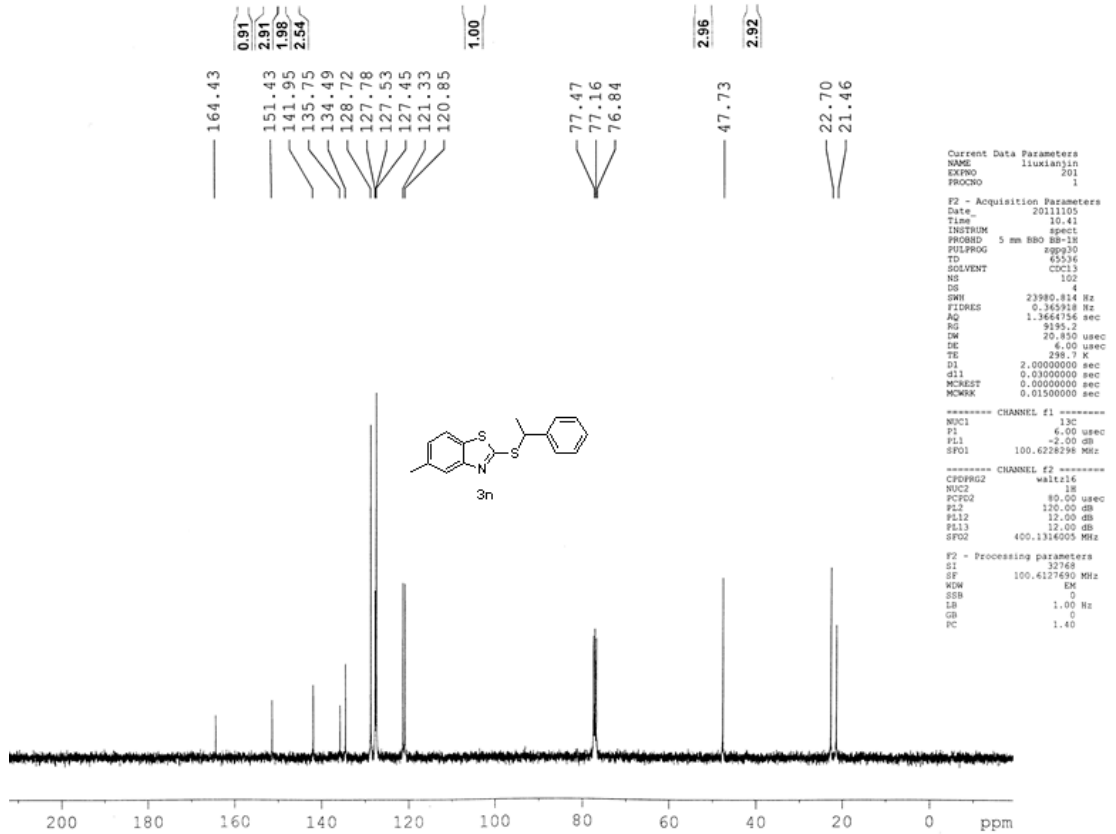
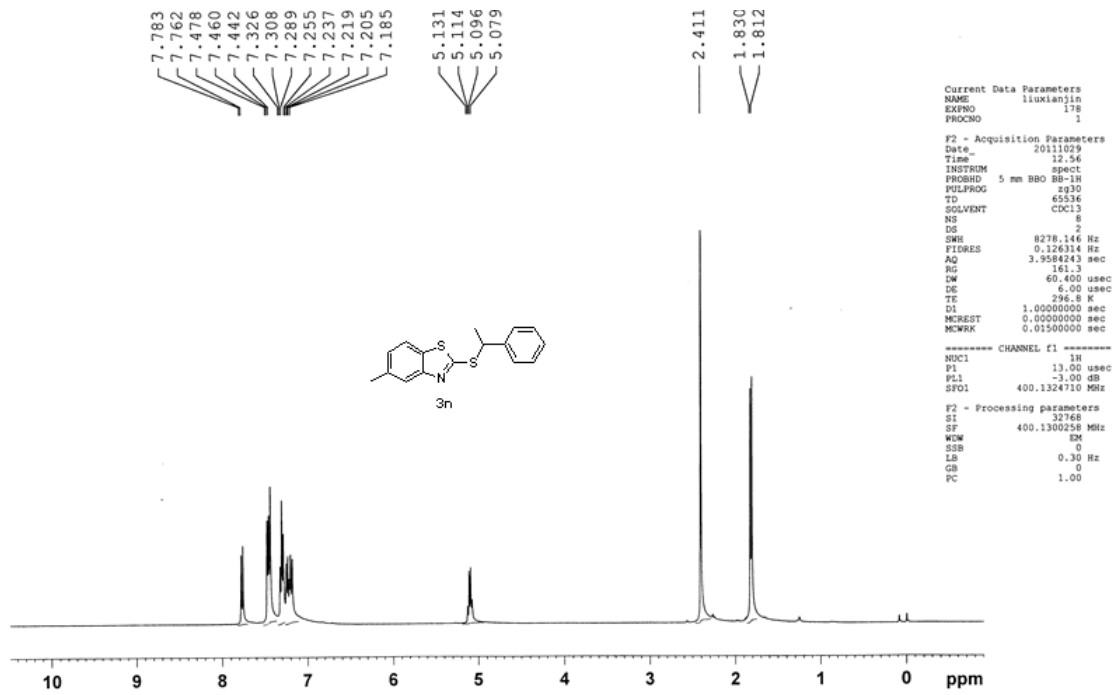
----- CHANNEL f2 -----
CPDPRG2  waltz16
NUC2      1H
PCPD2    80.00 usec
PL2       120.00 dB
PL12     12.00 dB
PL13     12.00 dB
SFO2     400.1316005 MHz

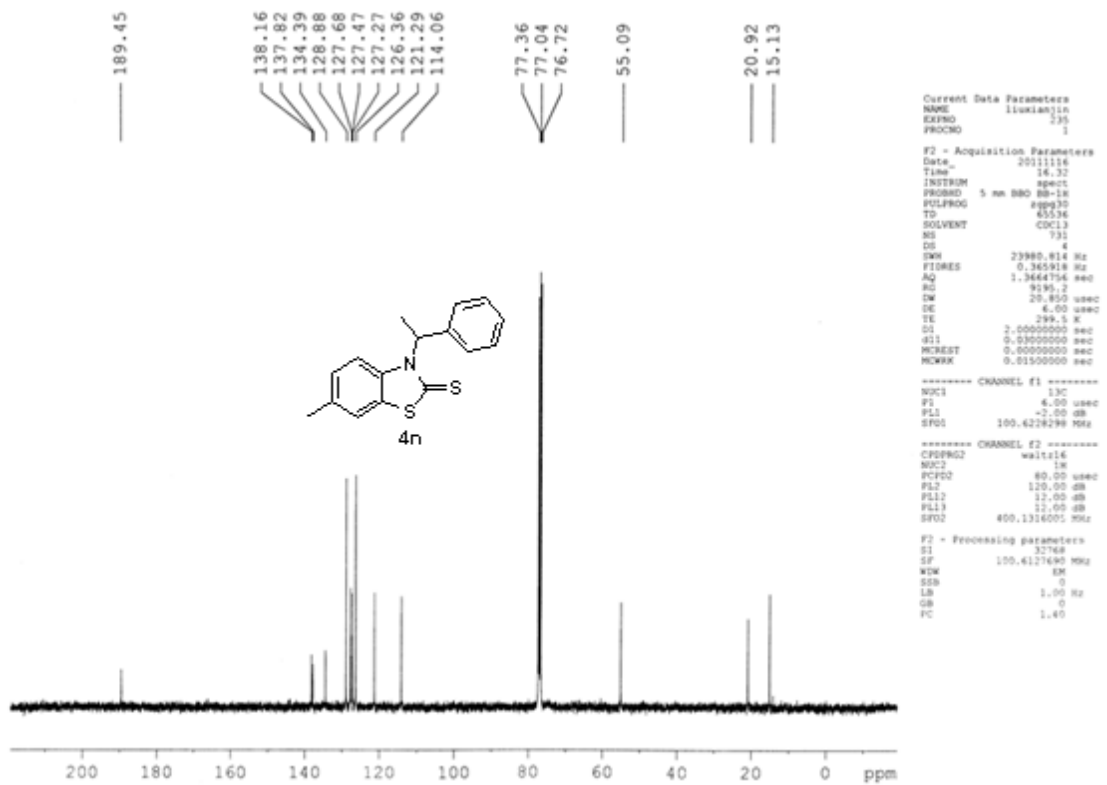
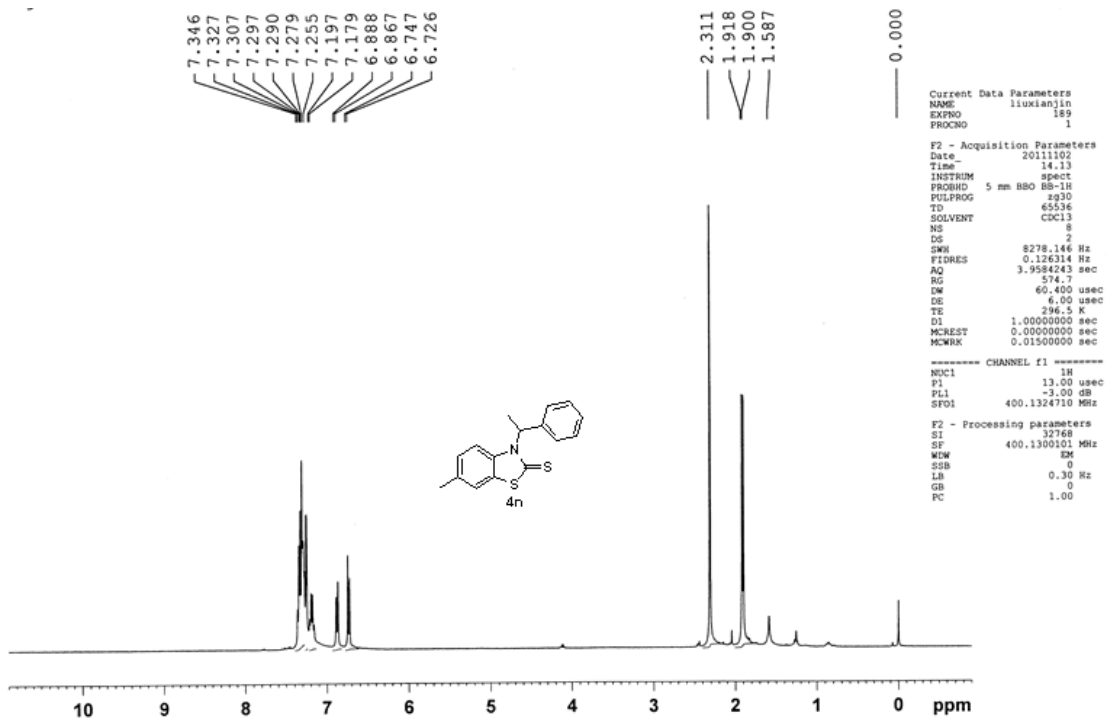
F2 - Processing parameters
SI        32768
SF        100.6127690 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40

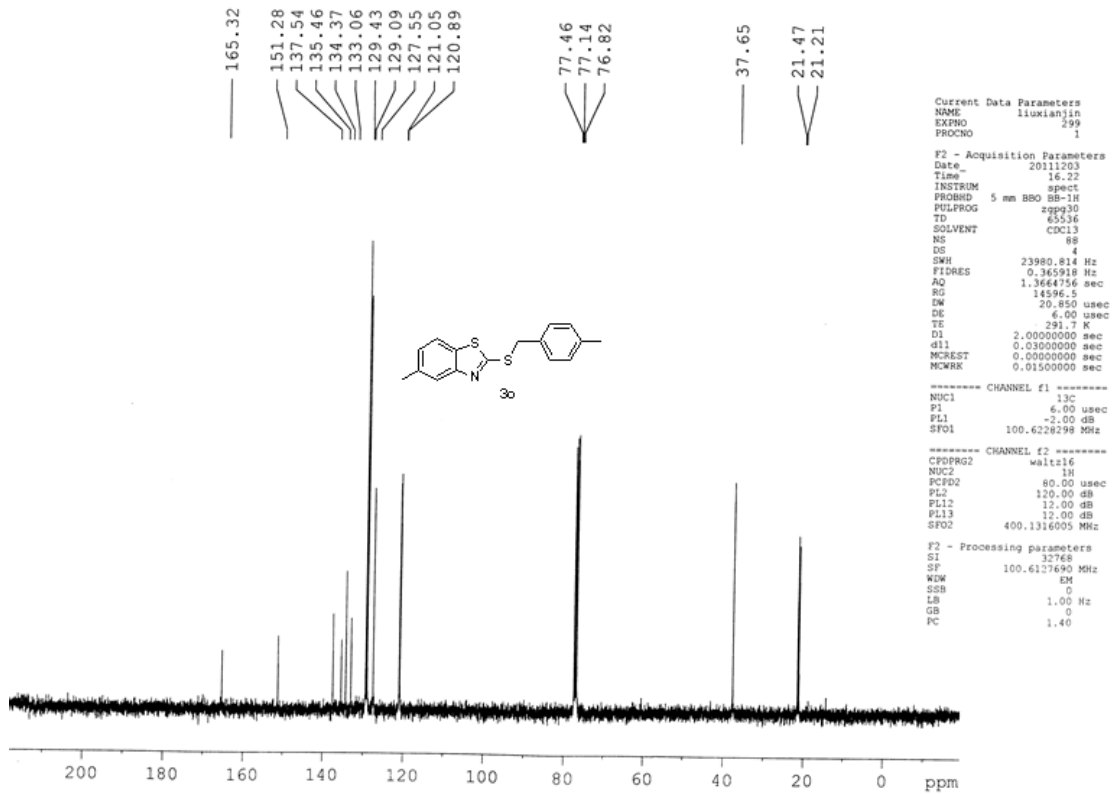
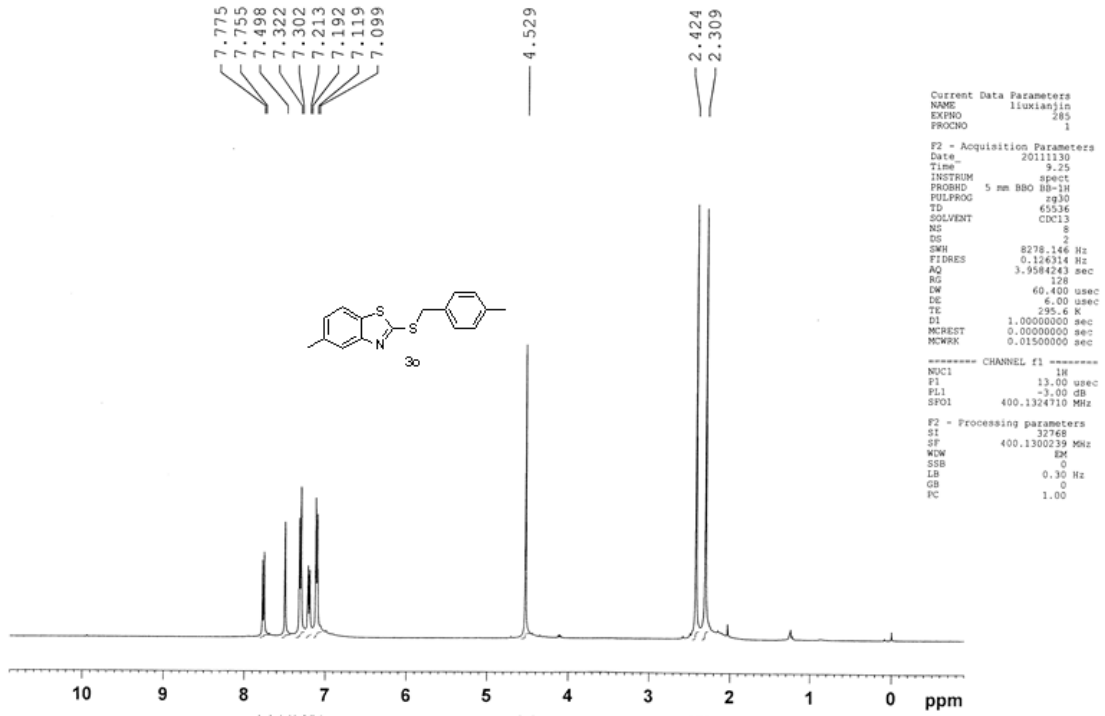
```

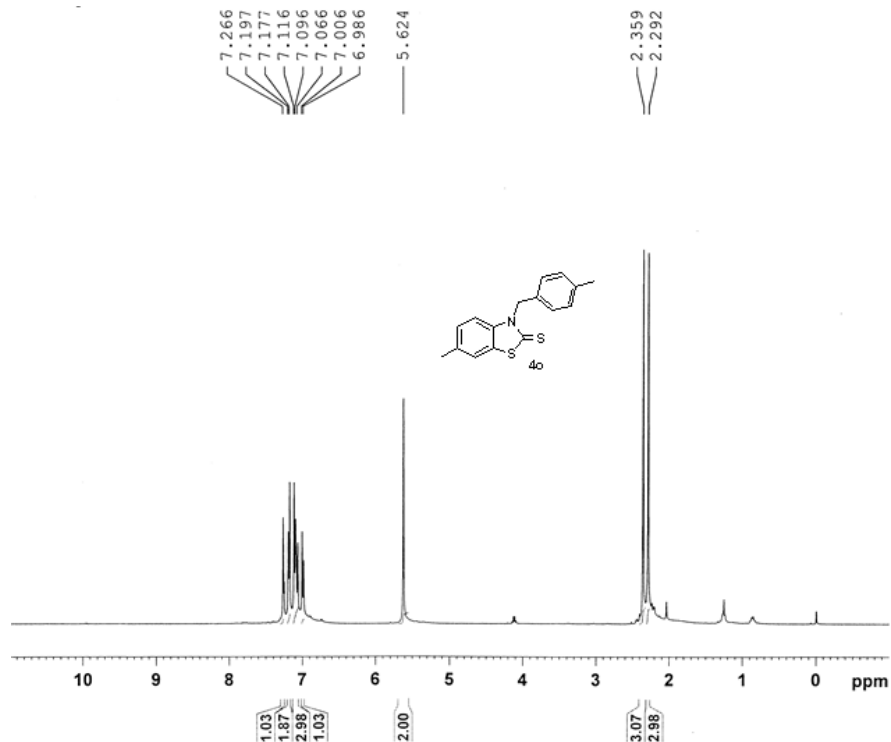












```

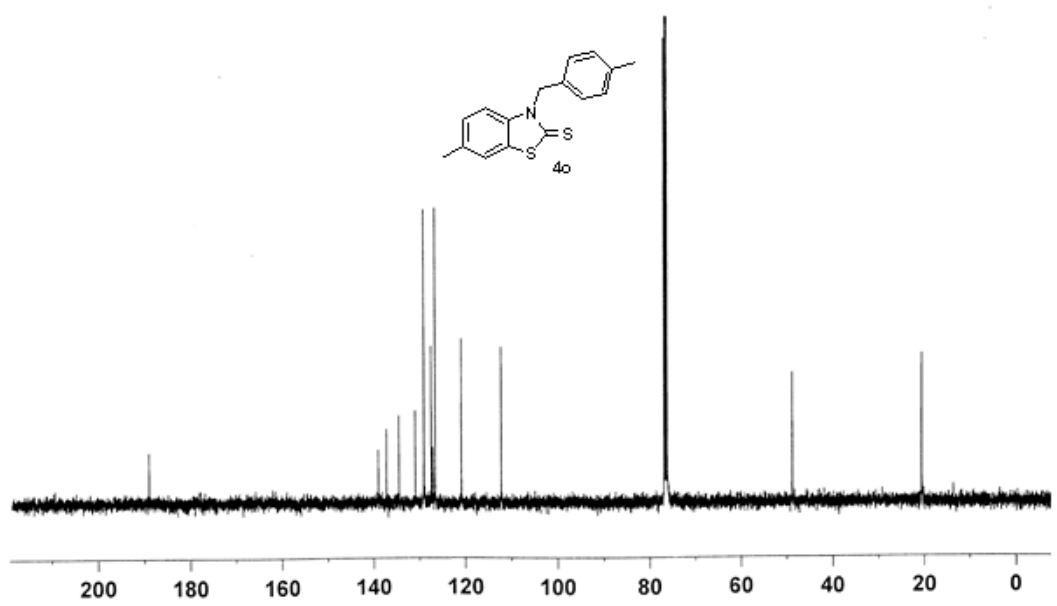
Current Data Parameters
NAME      liuxianjin
EXPNO    266
PROCNO   1

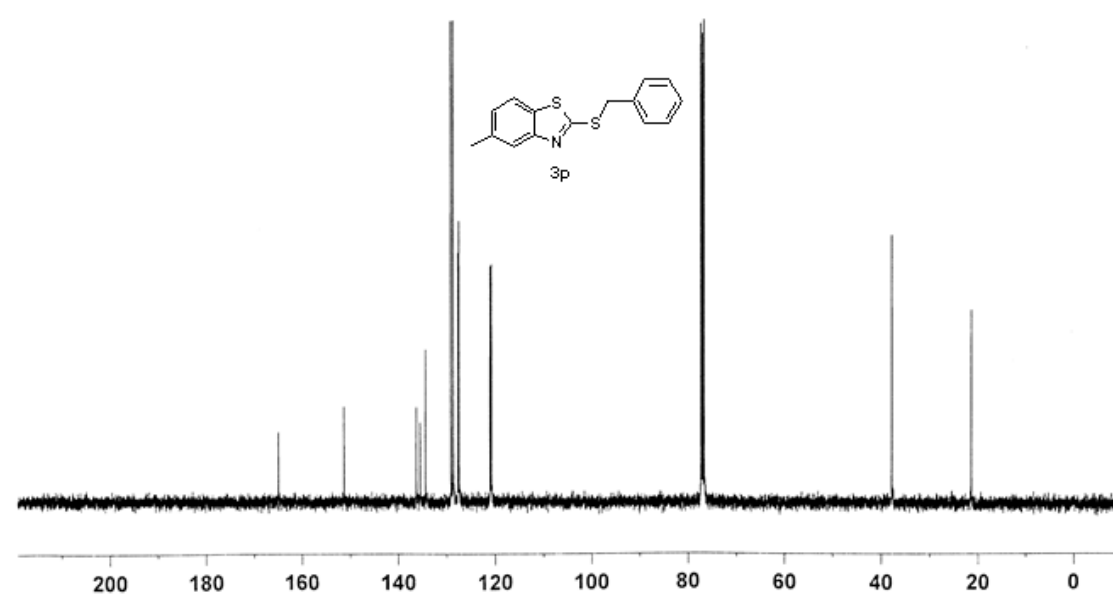
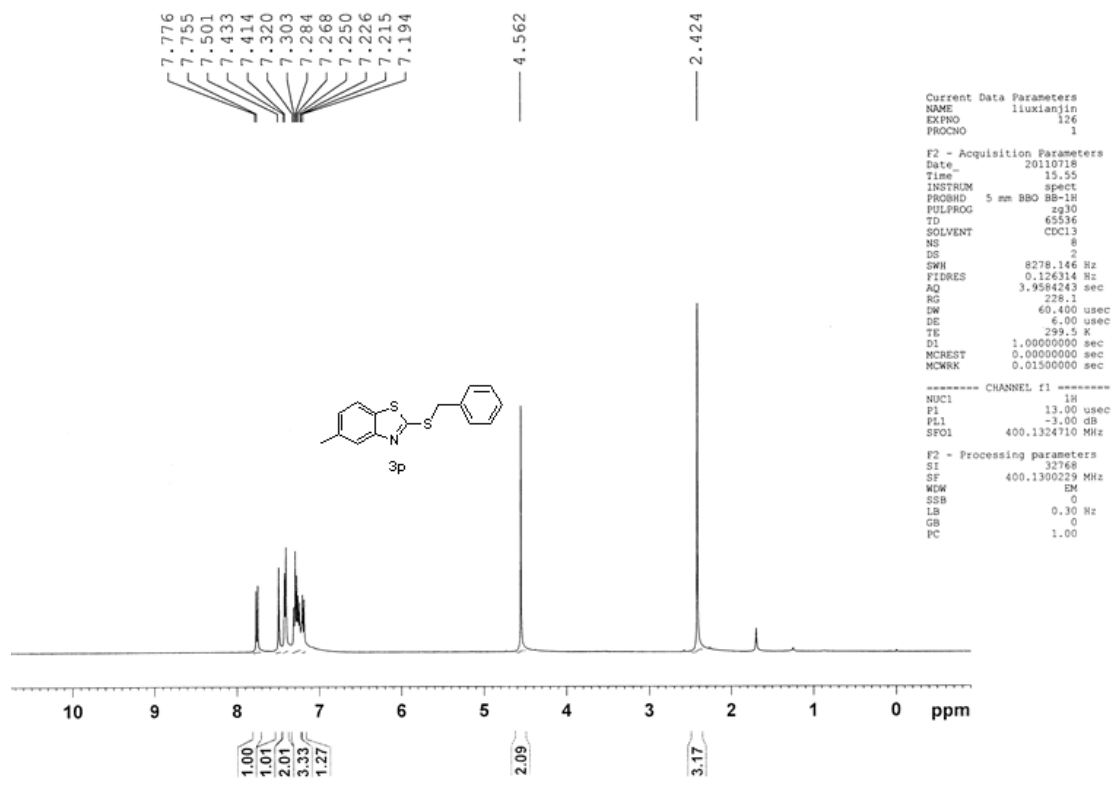
F2 - Acquisition Parameters
Date_    20111127
Time     10.26
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      8278.146 Hz
FIDRES   0.126314 Hz
AQ       3.9584243 sec
RG       322.5
DW       60.400 usec
DE       6.00 usec
TE       298.3 K
D1       1.00000000 sec
MCREST   0.00000000 sec
MCWRRK   0.01500000 sec

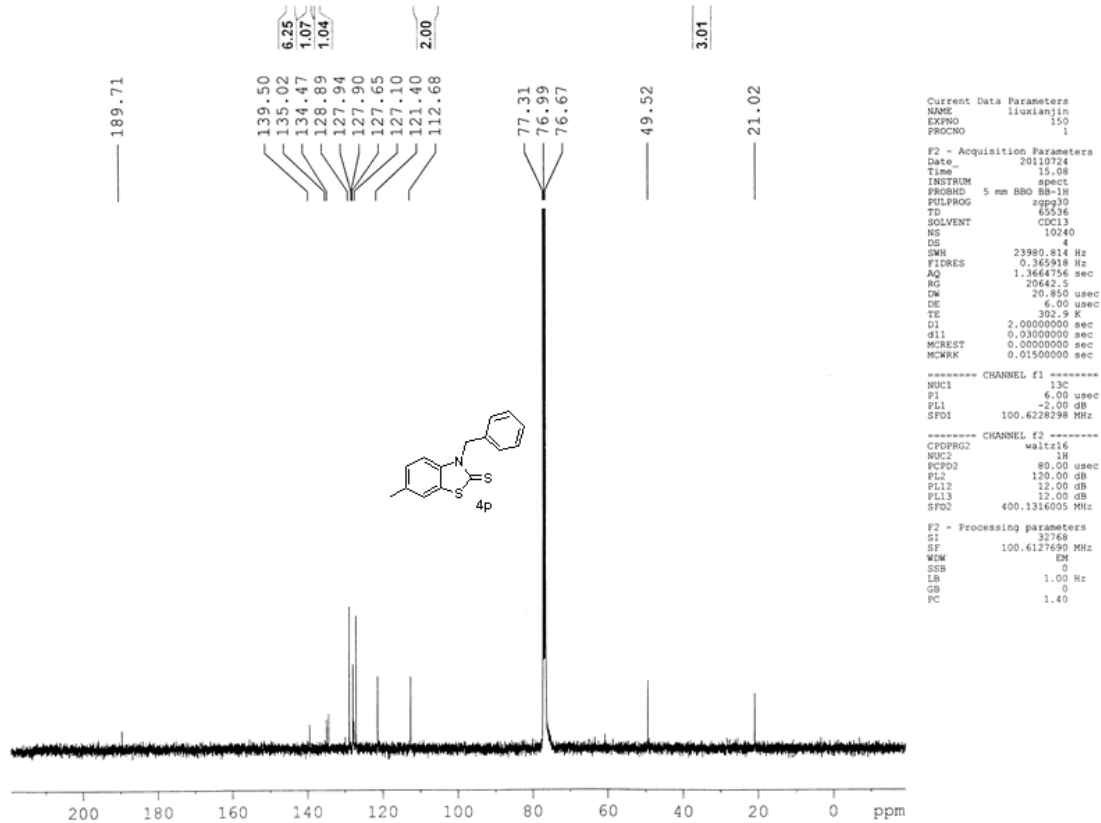
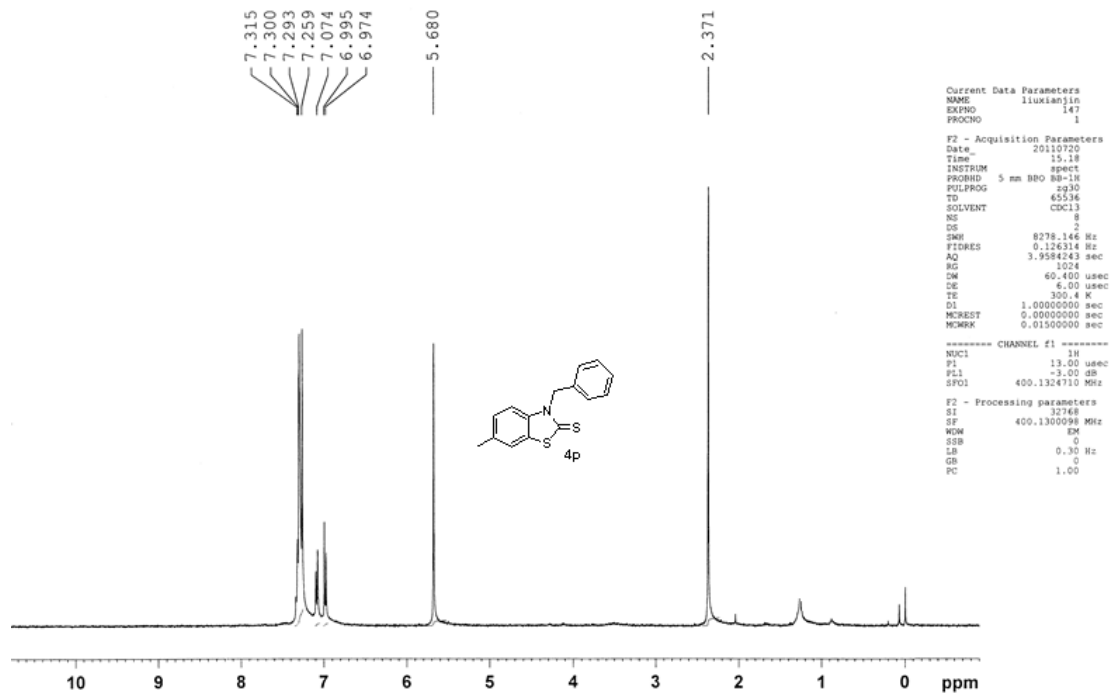
===== CHANNEL f1 =====
NUC1      1H
P1        13.00 usec
PL1       -3.00 dB
SFO1     400.1324710 MHz

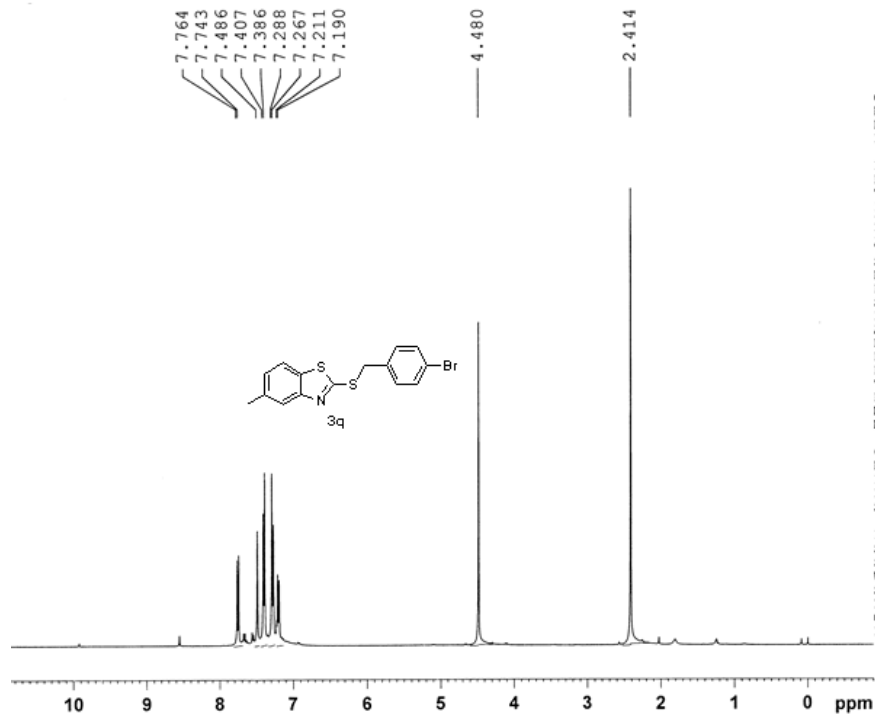
F2 - Processing parameters
SI        32768
SF        400.1300123 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00

```









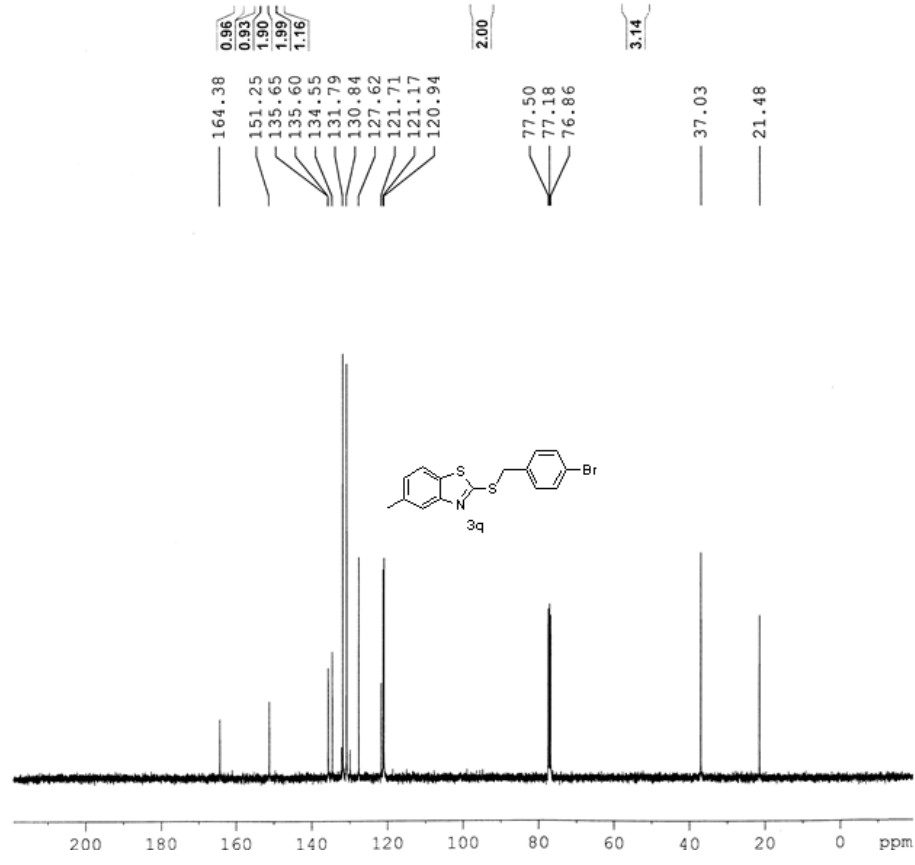
```

Current Data Parameters
NAME      liuxianjin
EXPNO    171
PROCNO   1

F2 - Acquisition Parameters
Date_    20111024
Time     14.44
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       8
DS       2
SWH      8278.146 Hz
FIDRES   0.126314 Hz
AQ       3.9584243 sec
RG       256
DW       60.400 usec
DE       6.00 usec
TE       295.9 K
D1       1.00000000 sec
MCREST   0.00000000 sec
MCWRRK   0.01500000 sec

===== CHANNEL f1 =====
NUC1     1H
P1       13.00 usec
PL1      -3.00 dB
SFO1     400.1324710 MHz

F2 - Processing parameters
SI       32768
SF       400.1300225 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
```



```

Current Data Parameters
NAME      liuxianjin
EXPNO    186
PROCNO   1

F2 - Acquisition Parameters
Date_    20111101
Time     9.34
INSTRUM  spect
PROBHD   5 mm BBO BB-1H
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       102
DS       4
SWH      23980.814 Hz
FIDRES   0.365918 Hz
AQ       1.3664756 sec
RG       8192
DW       20.850 usec
DE       6.00 usec
TE       298.2 K
D1       2.00000000 sec
d11      0.03000000 sec
MCREST   0.00000000 sec
MCWRRK   0.01500000 sec

===== CHANNEL f1 =====
NUC1     13C
P1       6.00 usec
PL1      -2.00 dB
SFO1     100.6228298 MHz

===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2     1H
PCPD2    80.00 usec
PL2      120.00 dB
PL12     12.00 dB
PL13     12.00 dB
SFO2     400.1316005 MHz

F2 - Processing parameters
SI       32768
SF       100.6127690 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
PC       1.00
  
```

