

Palladium Catalyzed Synthesis of 2,3-Disubstituted Indoles *via* Arylation of *ortho*-Alkynylanilines with Arylsiloxanes

Yang-Ting Hsia,^a Yu-Lin Lu,^a Rekha Bai,^a Satpal Singh Badsara*^d and Chin-Fa Lee*^{a,b,c}

^a Department of Chemistry, National Chung Hsing University, Taichung, Taiwan 402, R.O.C

E-mail: cfalee@dragon.nchu.edu.tw;

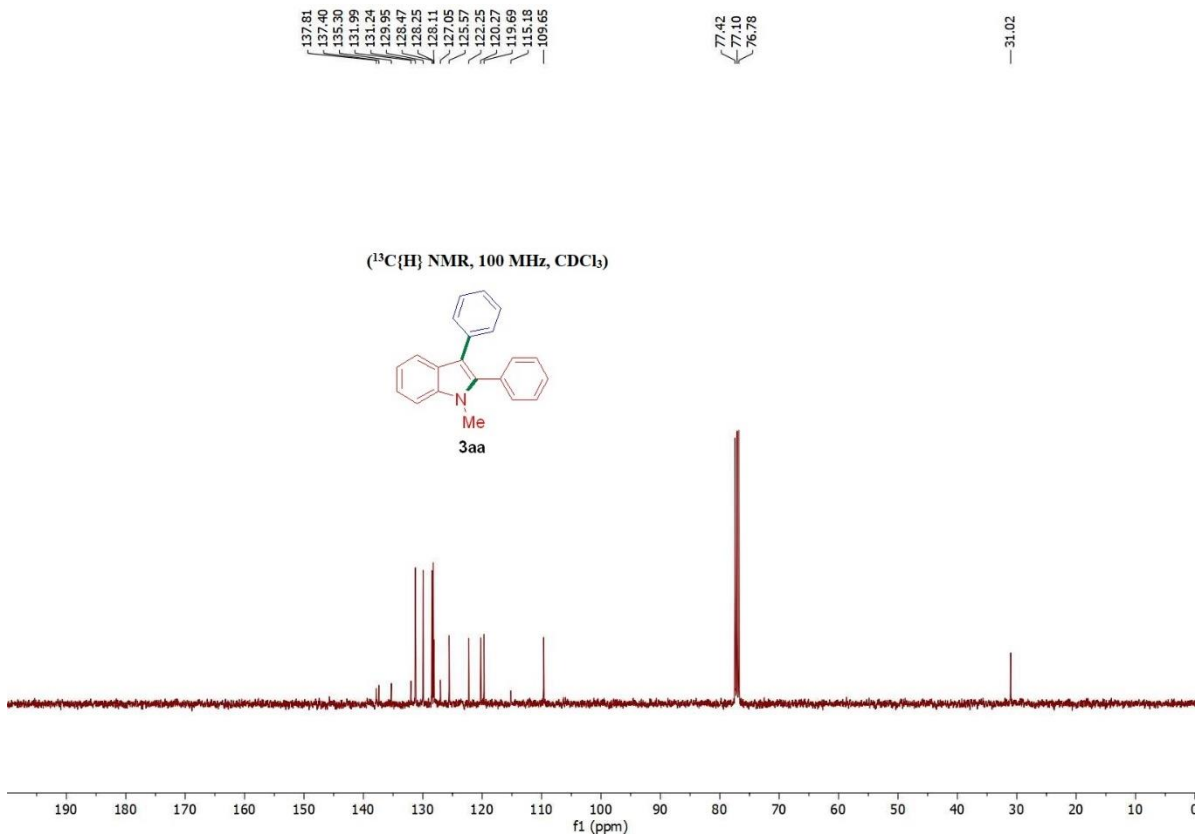
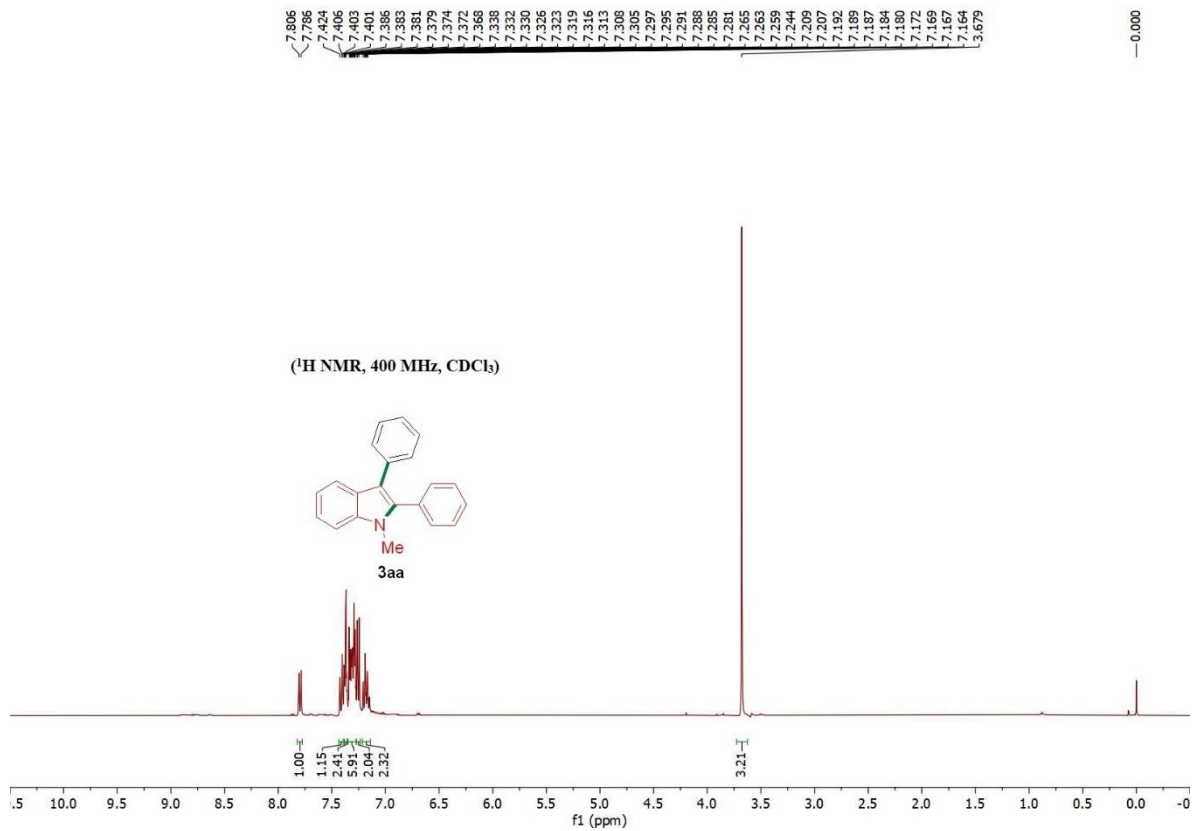
^b *i*-Center for Advanced Science and Technology (*i*CAST), National Chung Hsing University, Taichung City 402, Taiwan, R.O.C.

^c Innovation and Development Center of Sustainable Agriculture (IDCSA), National Chung Hsing University, Taichung City 402, Taiwan, R.O.C.

^d MFOS Laboratory, Department of Chemistry, University of Rajasthan, Jaipur, Rajasthan 302004, India.

E-mail: sattubhu2005@gmail.com

¹H, ¹³C and ¹⁹F NMR Spectra of products **3**

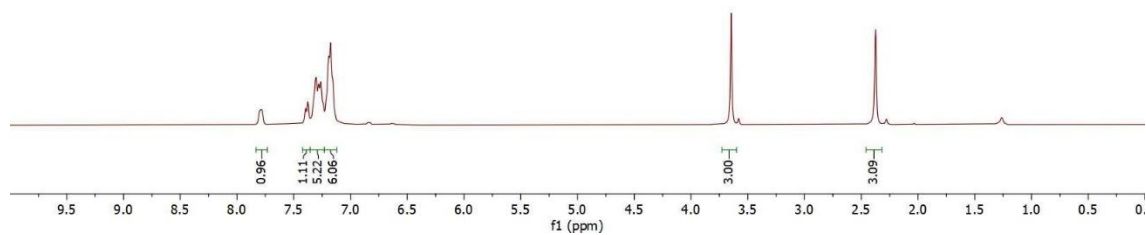
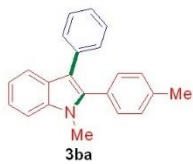


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7.794
7.784
7.774
7.765
7.336
7.306
7.282
7.261
7.240
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7.194
7.175
7.155
7.138

—3.645

—2.374

(¹H NMR, 400 MHz, CDCl₃)



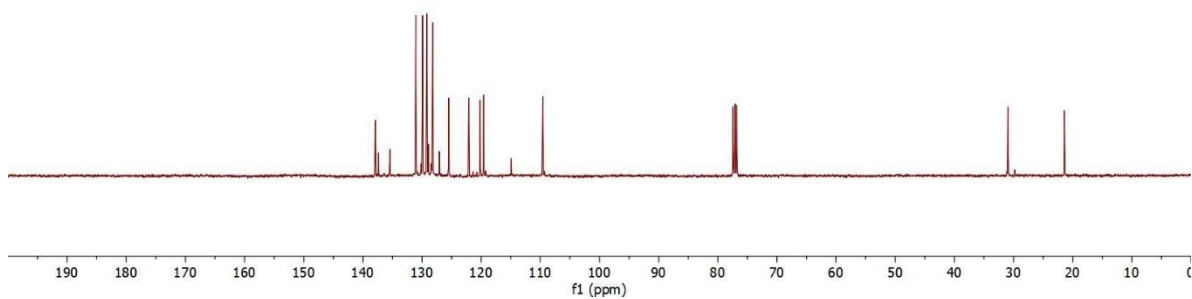
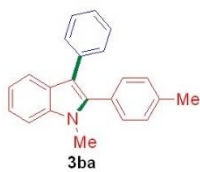
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137.34
135.45
131.06
129.92
128.20
128.91
128.22
127.07
125.48
122.10
120.19
119.58
114.91
108.60

77.42
77.10
76.78

—30.94

—21.42

(¹³C NMR, 100 MHz, CDCl₃)

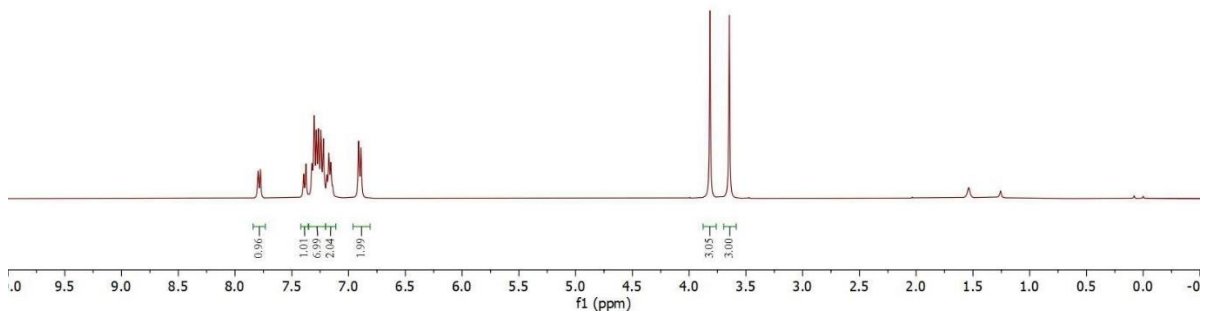


7.797
7.777
7.396
7.375
7.325
7.321
7.303
7.283
7.265
7.243
7.221
7.211
7.192
7.174
7.156
7.140
6.911
6.890

3.816
3.647

0.000

(¹H NMR, 400 MHz, CDCl₃)



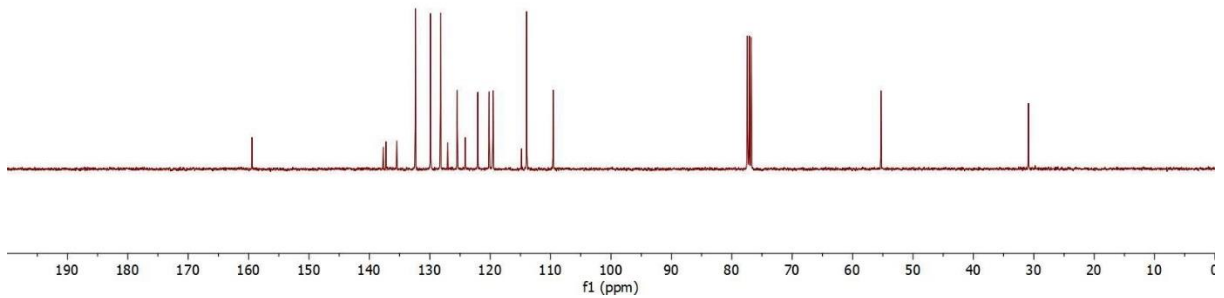
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127.02
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114.80
113.86
109.58

77.42
77.10
76.78

55.30

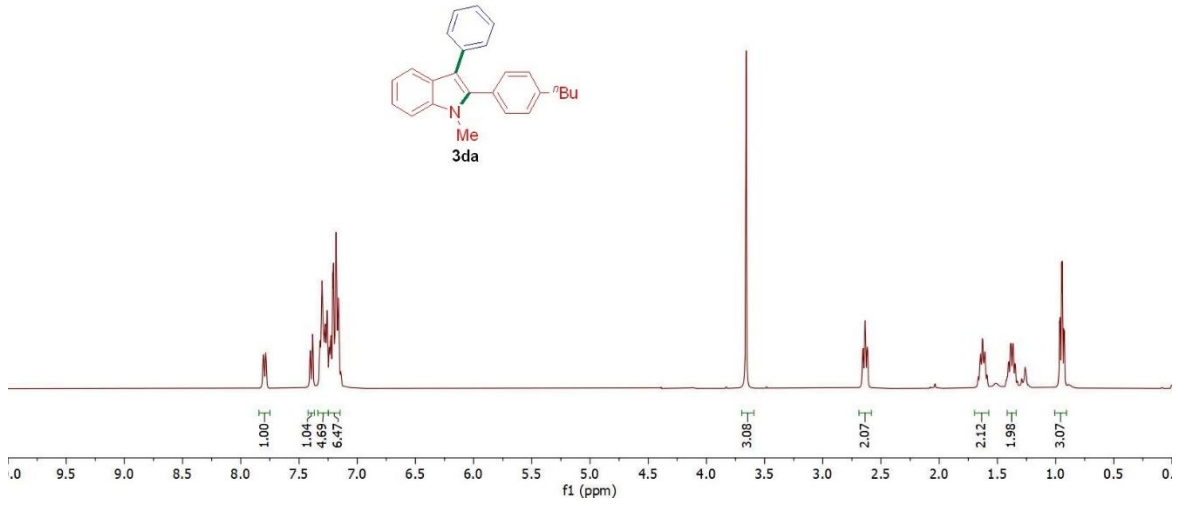
30.90

(¹³C NMR, 100 MHz, CDCl₃)



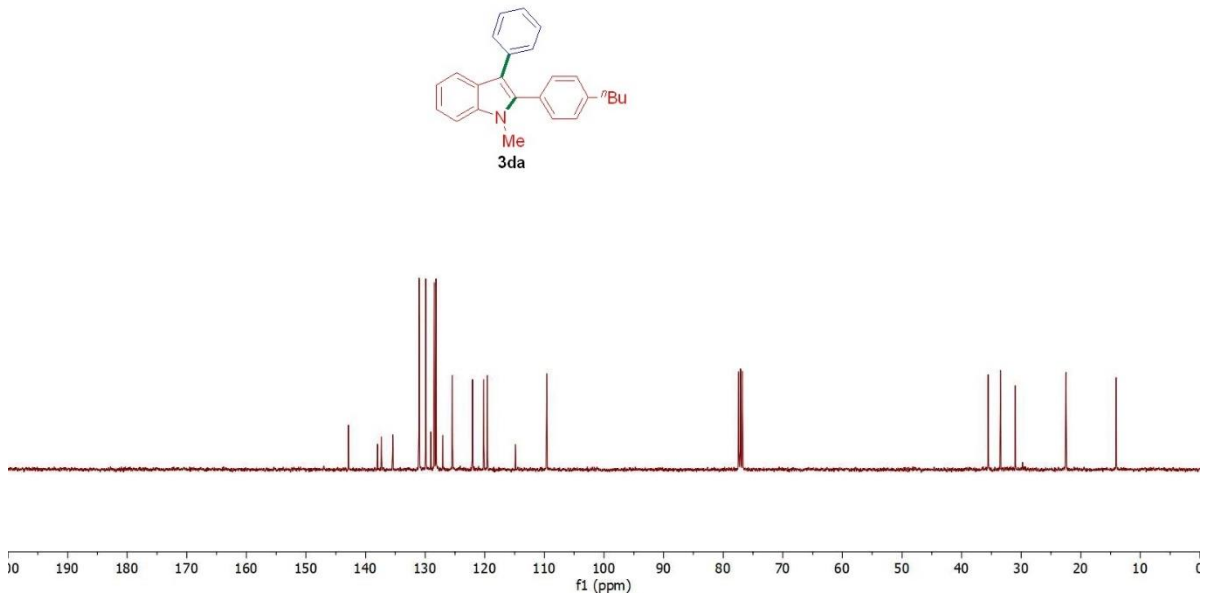
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7.805
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7.402
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7.316
7.305
7.298
7.295
7.290
7.287
7.285
7.279
7.274
7.268
7.264
7.261
7.256
7.241
7.236
7.230
7.225
7.210
7.204
7.195
7.186
7.181
7.175
7.165
7.161
7.155
3.857
2.888
2.886
2.880
2.834
2.659
2.614
1.668
1.662
1.653
1.649
1.644
1.638
1.630
1.624
1.617
1.610
1.605
1.600
1.591
1.586
1.406
1.401
1.387
1.382
1.369
1.363
1.350
1.345
0.980
0.948
0.942
0.929
0.924
0.000

(¹H NMR, 400 MHz, CDCl₃)



142.88
138.00
137.32
135.45
131.03
129.91
129.06
128.48
128.19
127.04
125.44
122.07
120.17
119.57
114.87
109.60
77.41
77.10
76.78
35.53
33.50
30.98
22.48
14.07

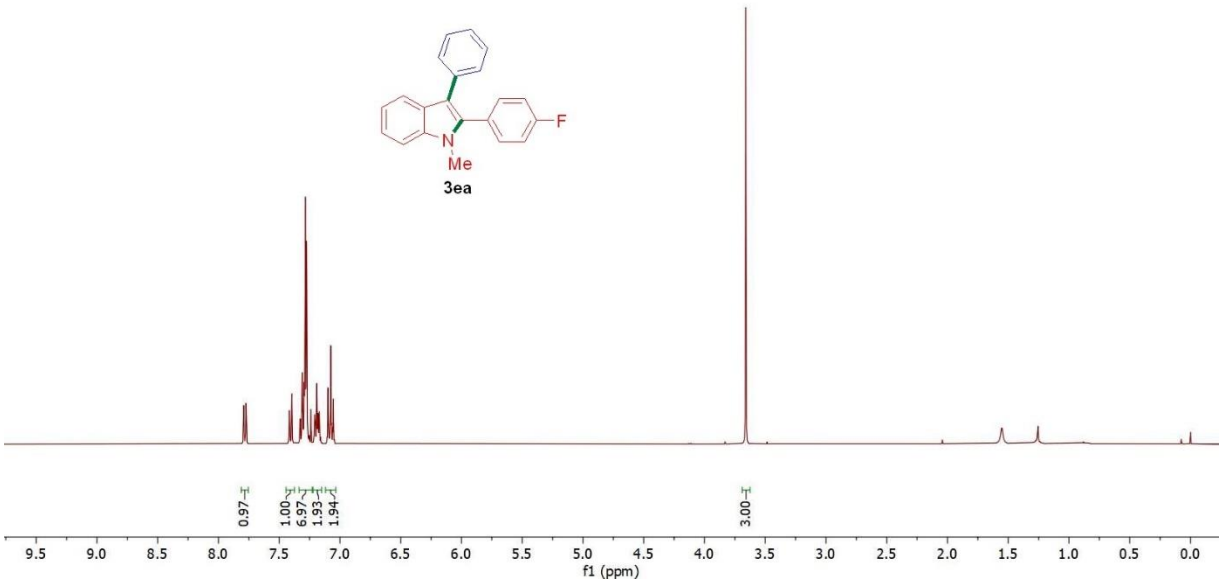
(¹³C NMR, 100 MHz, CDCl₃)



7.794
7.792
7.790
7.774
7.772
7.770
7.419
7.416
7.414
7.398
7.396
7.393
7.379
7.376
7.317
7.308
7.305
7.296
7.281
7.288
7.285
7.280
7.282
7.274
7.272
7.267
7.264
7.259
7.254
7.251
7.238
7.210
7.207
7.202
7.193
7.190
7.187
7.184
7.180
7.176
7.172
7.170
7.167
7.159
7.105
7.098
7.092
7.083
7.081
7.076
7.071
7.068
7.059
7.054
7.047
3.659

-0.000

(¹H NMR, 400 MHz, CDCl₃)

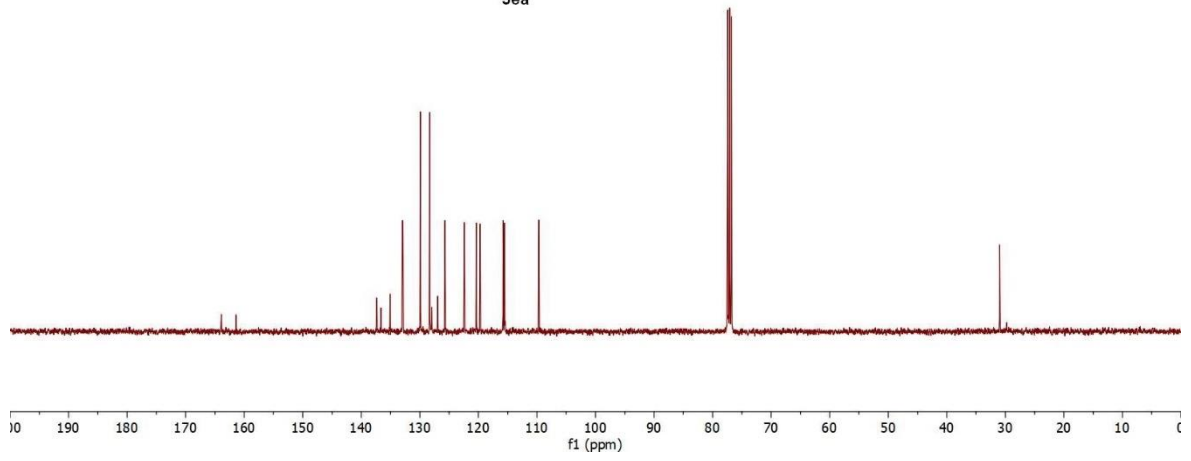
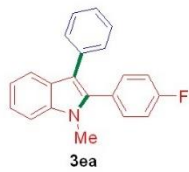


163.88
161.42
137.36
136.64
135.08
132.99
132.91
129.92
128.33
127.99
126.95
125.72
122.41
120.37
119.71
115.76
115.55
115.44
109.66

77.42
77.10
76.78

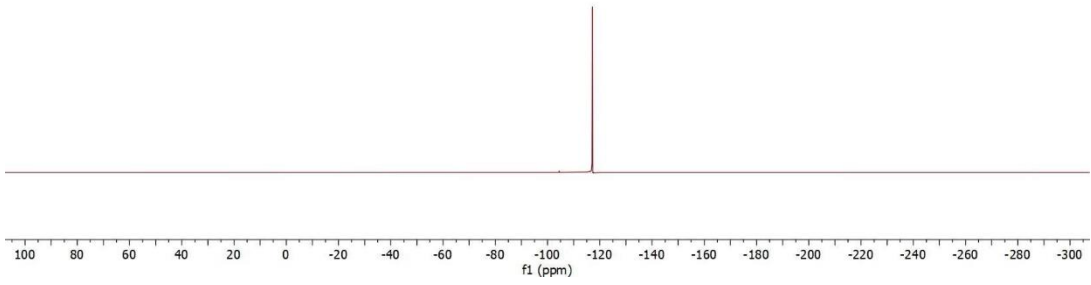
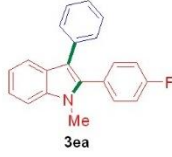
30.96

(¹³C NMR, 100 MHz, CDCl₃)



-117.148

(¹⁹F NMR, 376 MHz, CDCl₃)

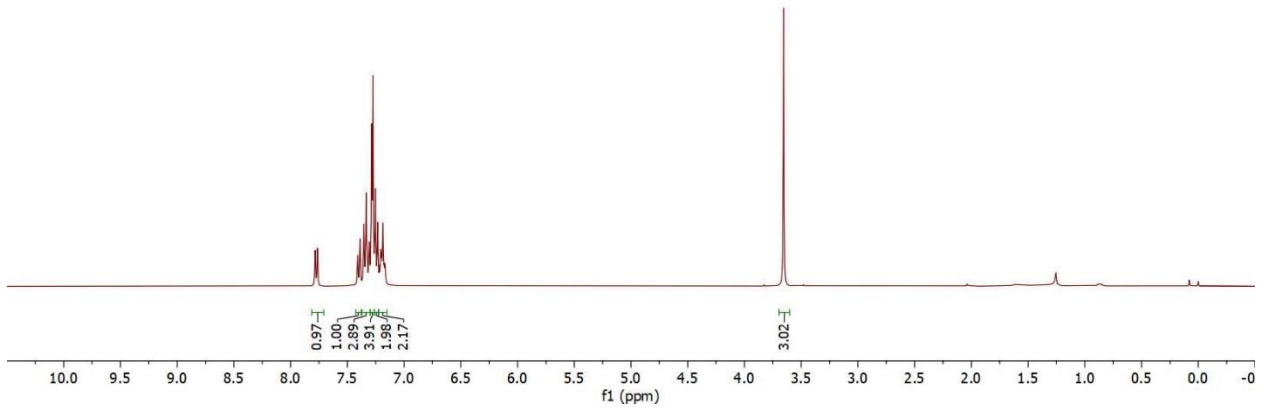
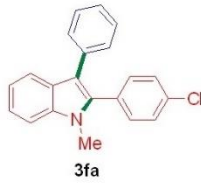


7.784
7.764
7.409
7.389
7.355
7.350
7.339
7.334
7.327
7.324
7.310
7.306
7.286
7.275
7.254
7.248
7.237
7.233
7.218
7.207
7.204
7.197
7.186
7.175
7.169
7.166

3.655

-0.000

(¹H NMR, 400 MHz, CDCl₃)

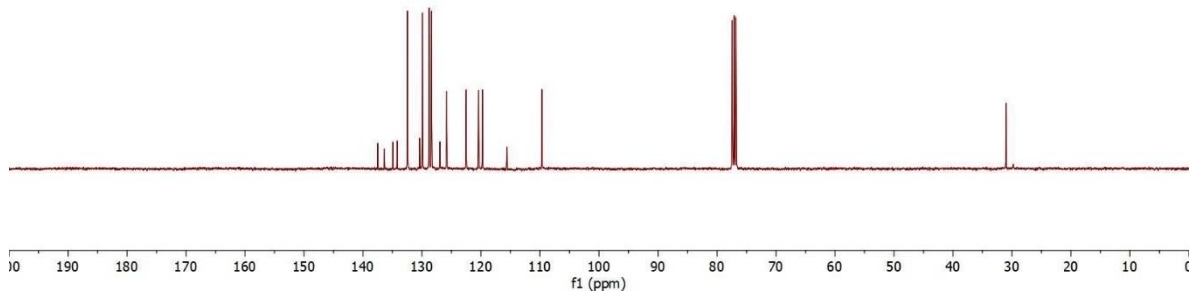
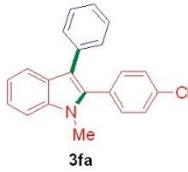


137.49
136.36
134.93
134.20
132.47
130.41
129.94
128.81
126.97
125.81
122.53
120.42
119.75
115.62
109.69

77.42
77.10
76.78

31.03

(¹³C NMR, 100 MHz, CDCl₃)

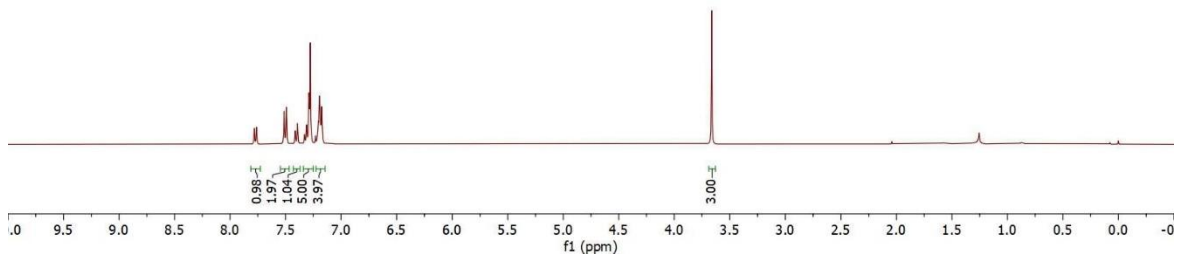


7.782
7.762
7.754
7.493
7.413
7.392
7.331
7.328
7.313
7.310
7.307
7.291
7.287
7.278
7.266
7.231
7.214
7.206
7.196
7.191
7.187
7.180
7.175
7.169

3.663

0.000

(¹H NMR, 400 MHz, CDCl₃)

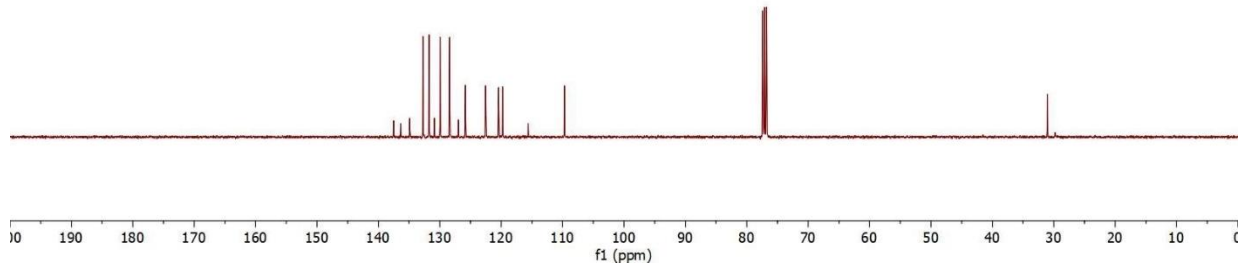


137.51
136.35
134.90
132.75
131.75
130.89
129.95
128.41
126.99
125.83
122.95
122.47
120.43
119.76
115.63
109.70

77.42
77.10
76.78

31.06

(¹³C NMR, 100 MHz, CDCl₃)

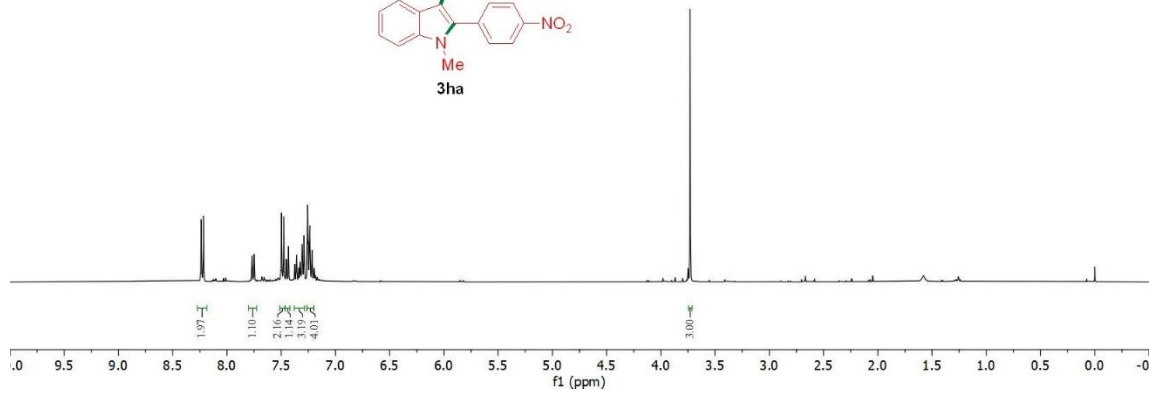
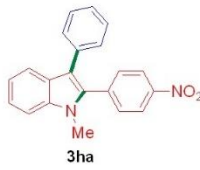


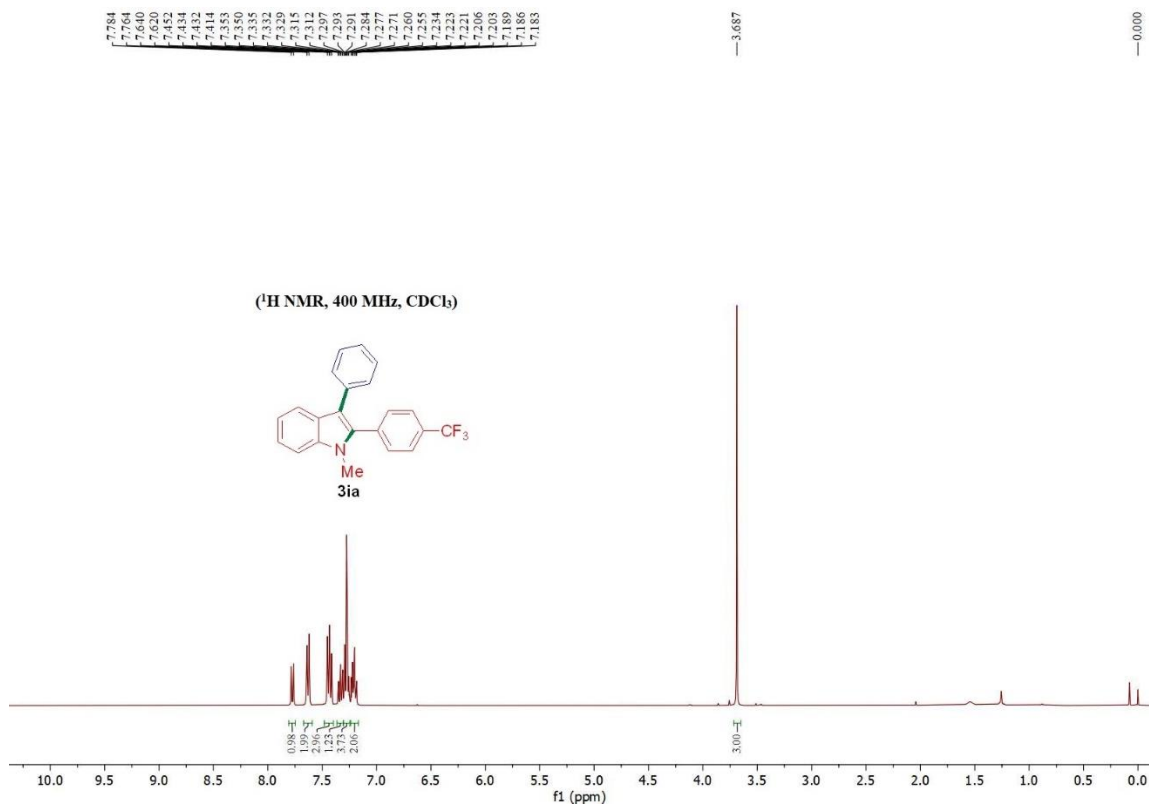
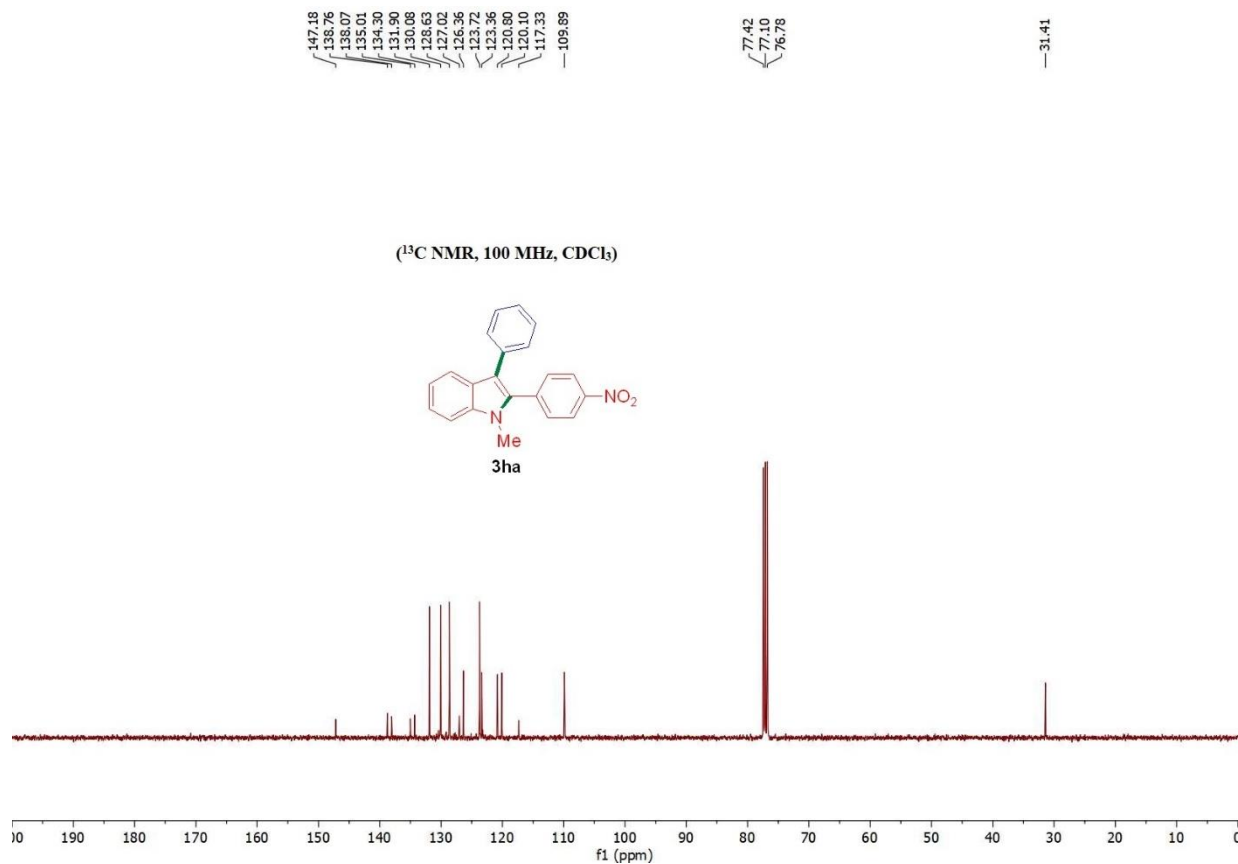
8.238
8.216
7.770
7.750
7.504
7.498
7.493
7.471
7.476
7.453
7.432
7.378
7.375
7.361
7.348
7.346
7.340
7.337
7.326
7.322
7.318
7.308
7.304
7.297
7.287
7.280
7.243
7.235
7.215

3.730

0.000

(¹H NMR, 400 MHz, CDCl₃)



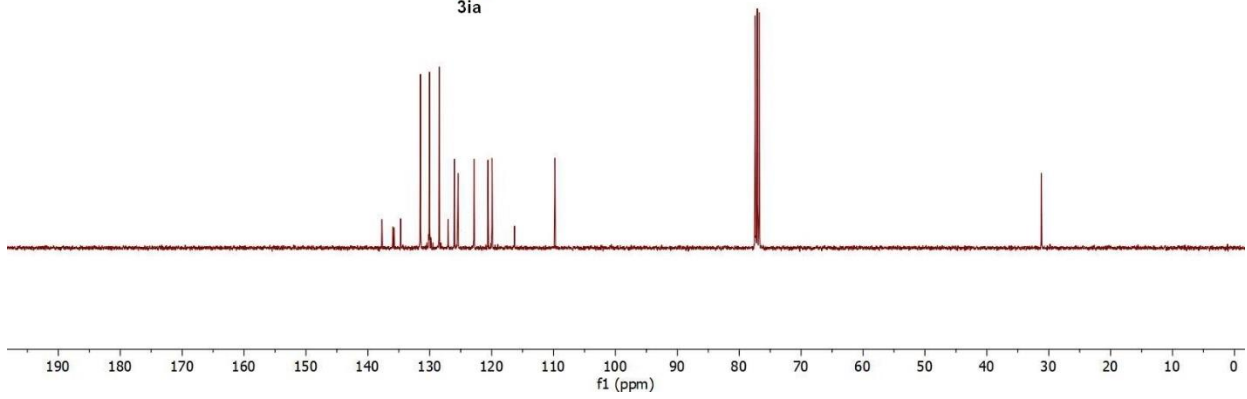
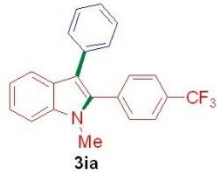


137.72
135.97
135.75
134.68
131.51
130.03
128.48
127.03
126.02
125.49
125.45
125.42
125.37
122.86
120.58
119.93
116.32
109.78

77.42
77.10
76.78

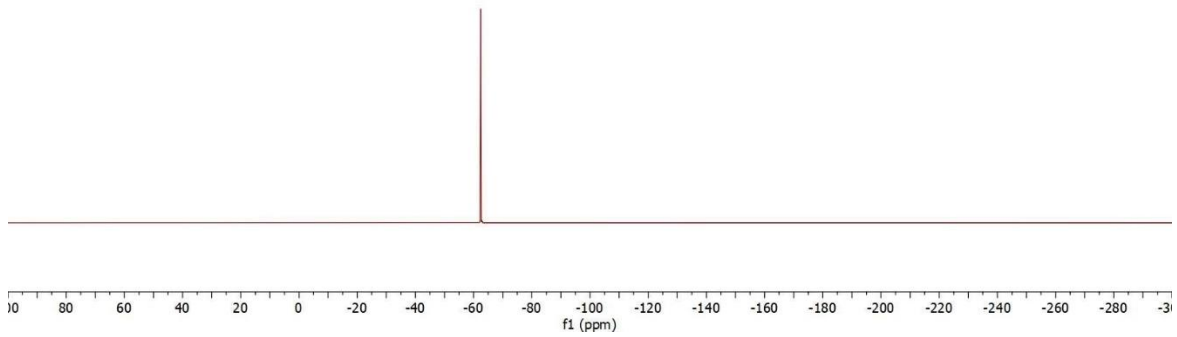
31.19

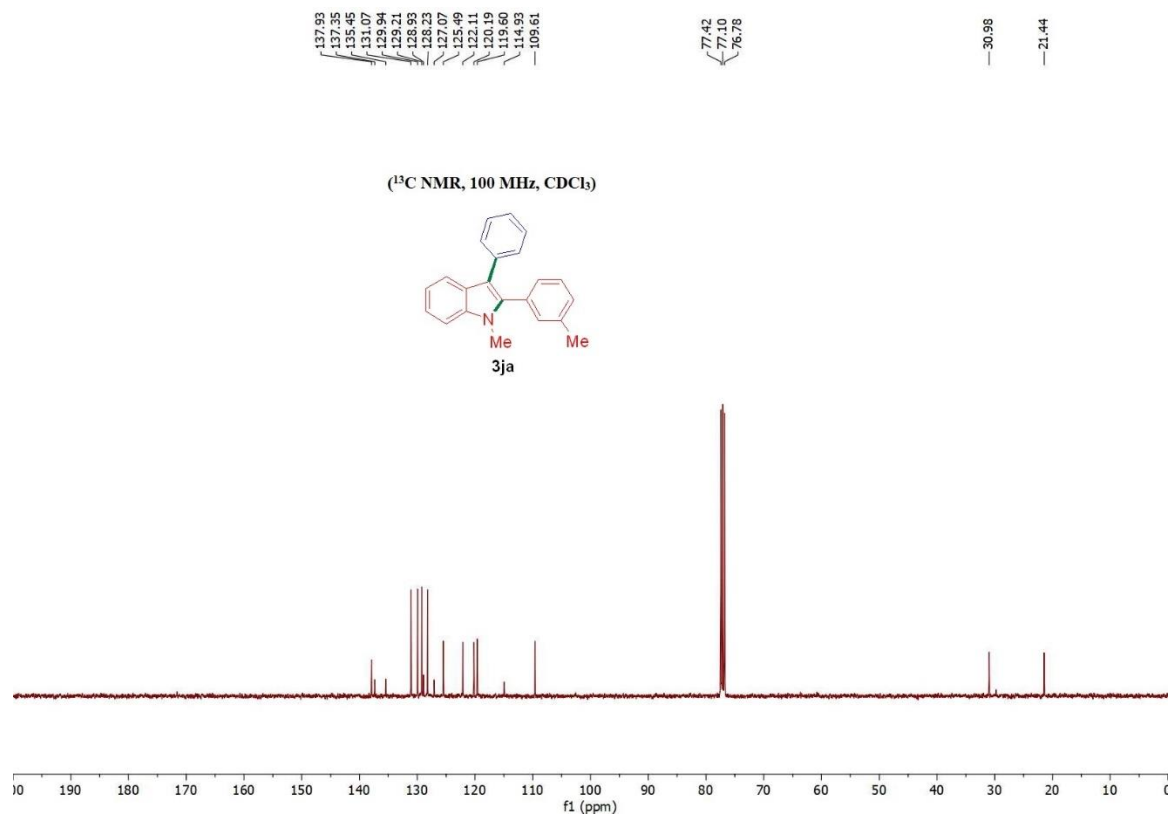
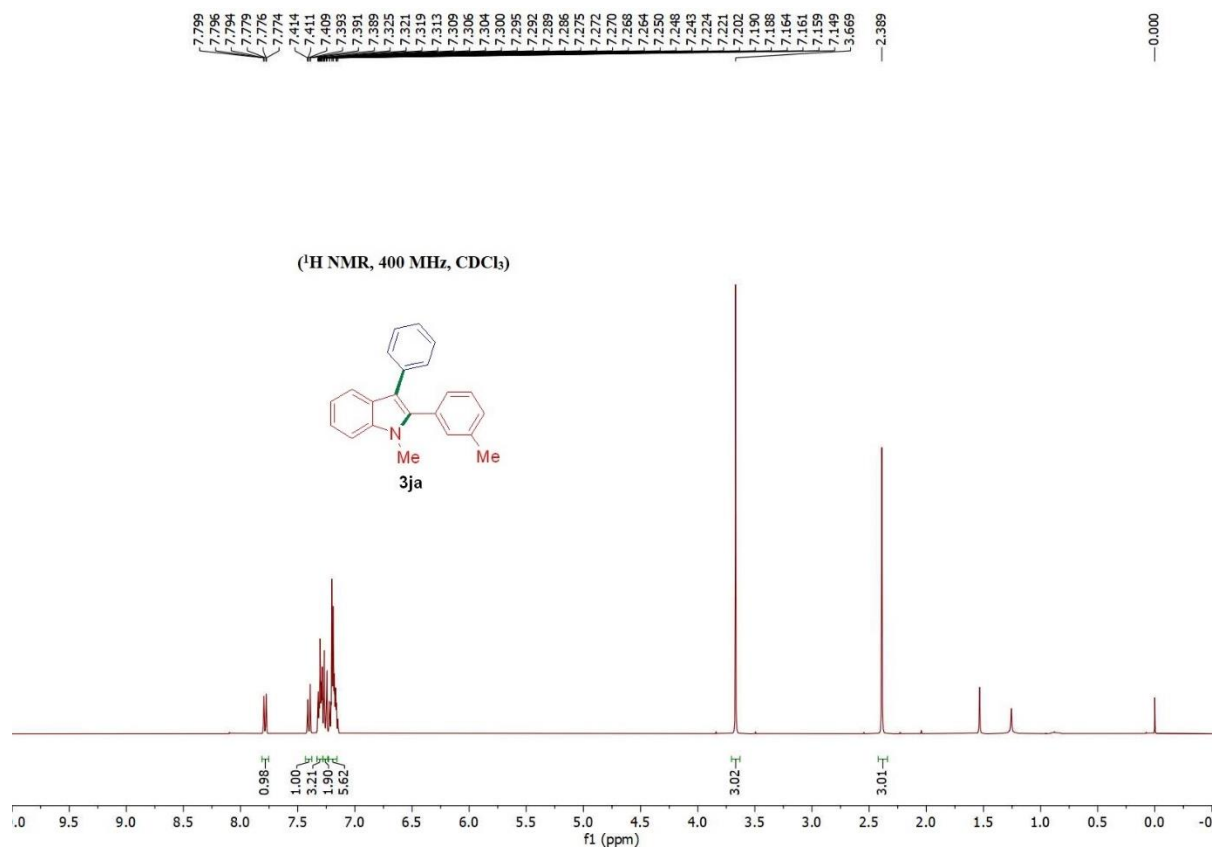
(¹³C NMR, 100 MHz, CDCl₃)



62.424

(¹⁹F NMR, 376 MHz, CDCl₃)

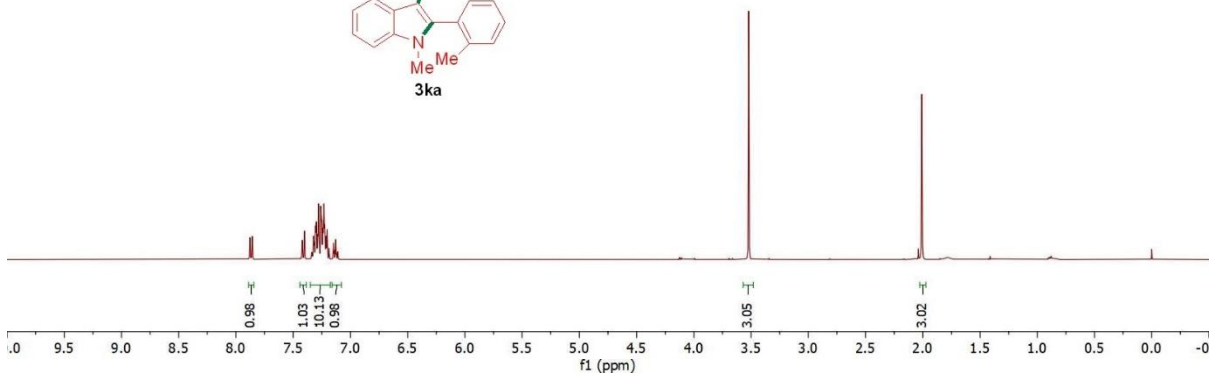




7.877
7.857
7.421
7.400
7.339
7.335
7.326
7.323
7.320
7.316
7.308
7.305
7.300
7.297
7.292
7.279
7.276
7.259
7.256
7.253
7.250
7.243
7.238
7.236
7.234
7.231
7.228
7.224
7.222
7.215
7.207
7.204
7.202
7.187
7.184
7.150
7.147
7.143
7.134
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7.114
7.110
7.107
3.520
2.008

-0.000

(¹H NMR, 400 MHz, CDCl₃)



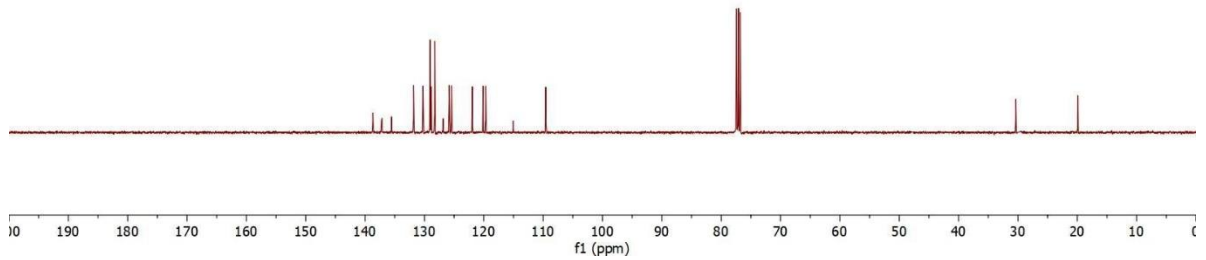
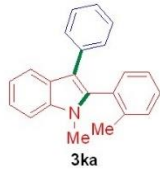
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135.53
131.82
131.74
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121.93
120.12
119.68
115.03
109.55

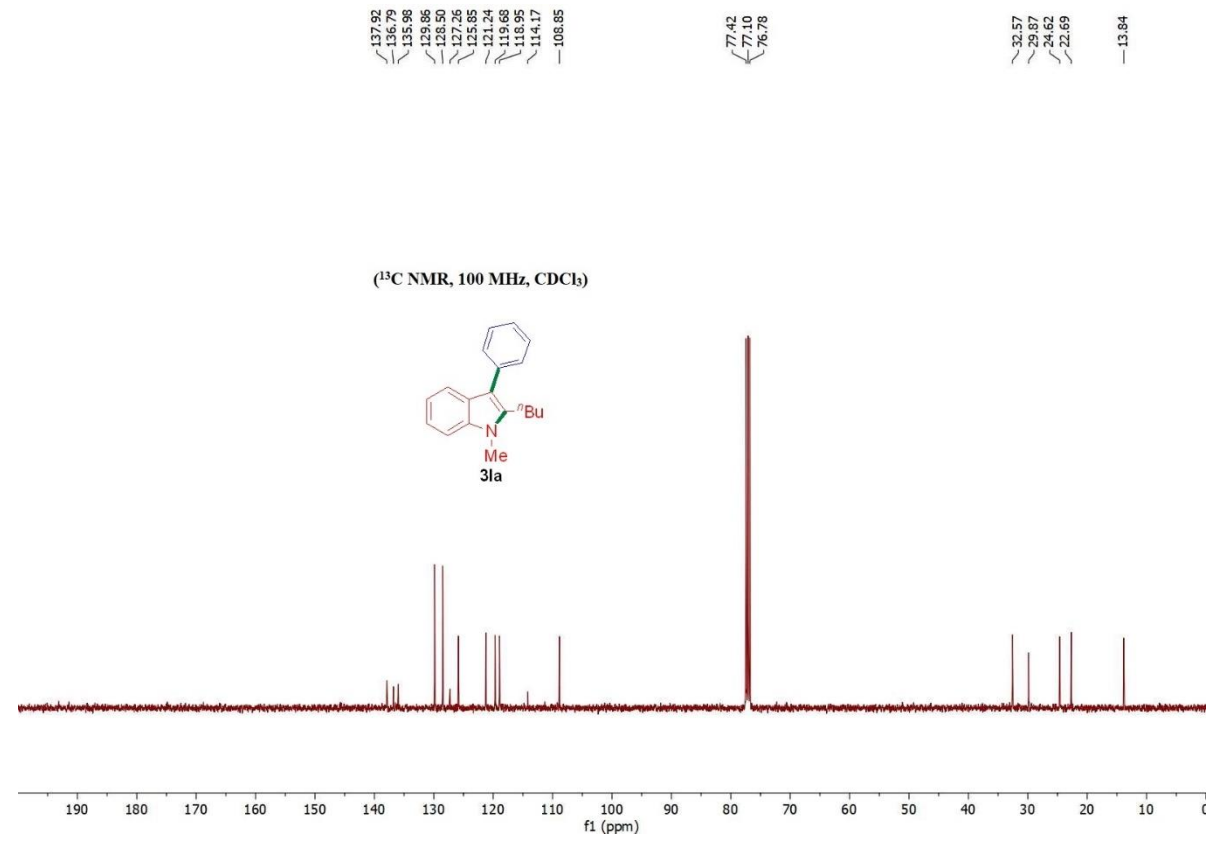
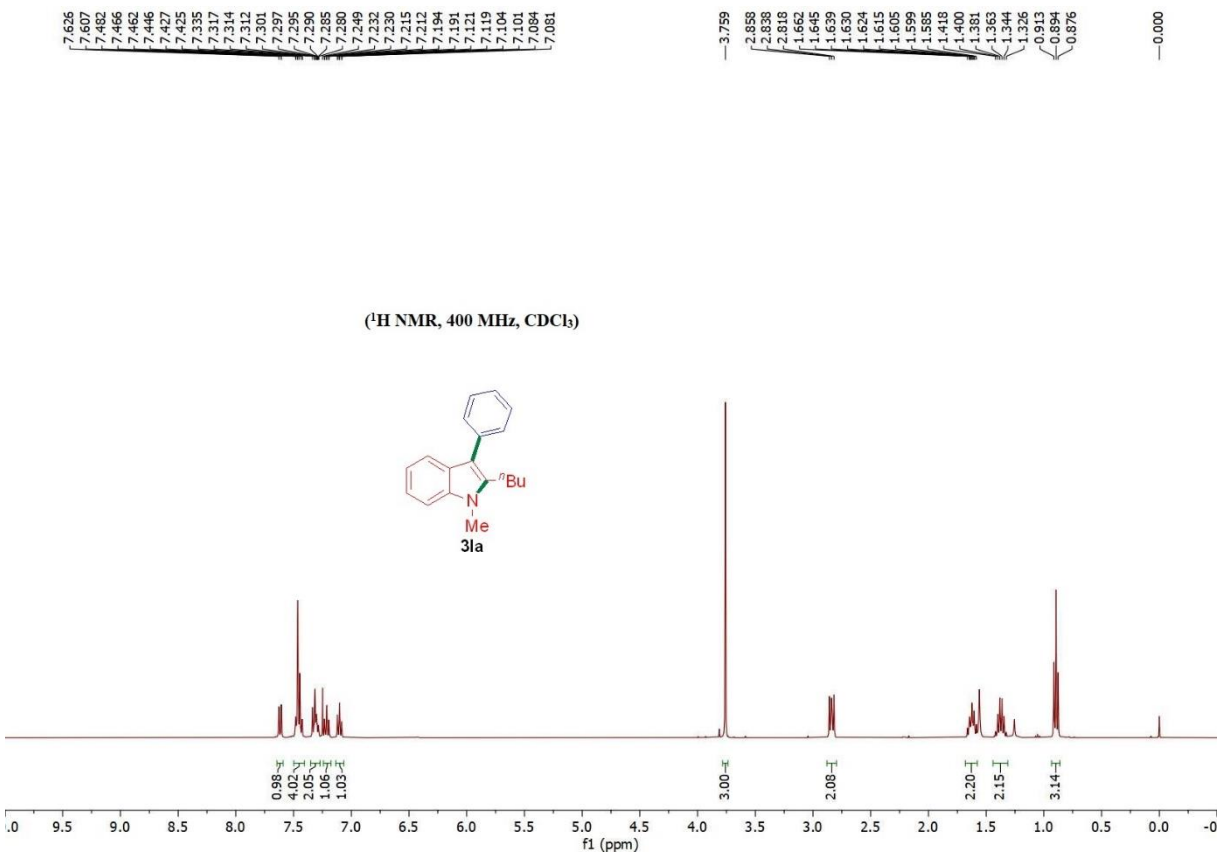
77.42
77.10
76.78

30.35

19.91

(¹³C NMR, 100 MHz, CDCl₃)

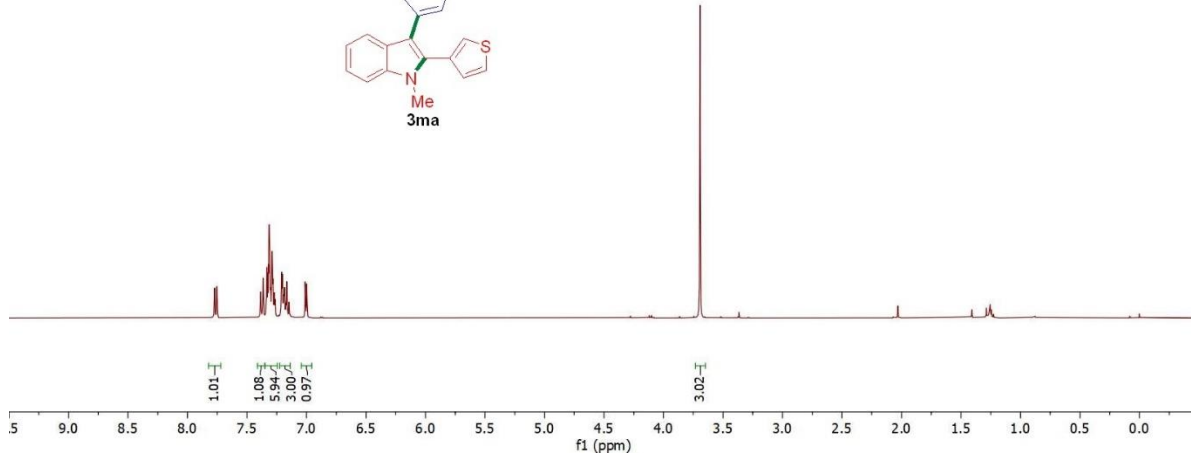




7.772
7.752
7.385
7.365
7.338
7.333
7.326
7.321
7.316
7.313
7.309
7.300
7.293
7.291
7.286
7.283
7.280
7.275
7.273
7.271
7.265
7.262
7.212
7.209
7.207
7.205
7.202
7.197
7.196
7.190
7.186
7.183
7.168
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6.996
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—0.000

(¹H NMR, 400 MHz, CDCl₃)

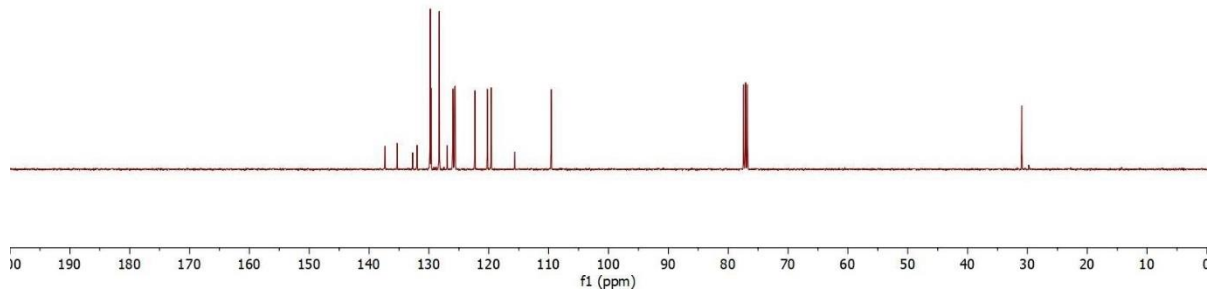
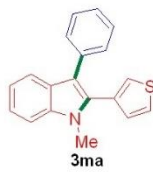


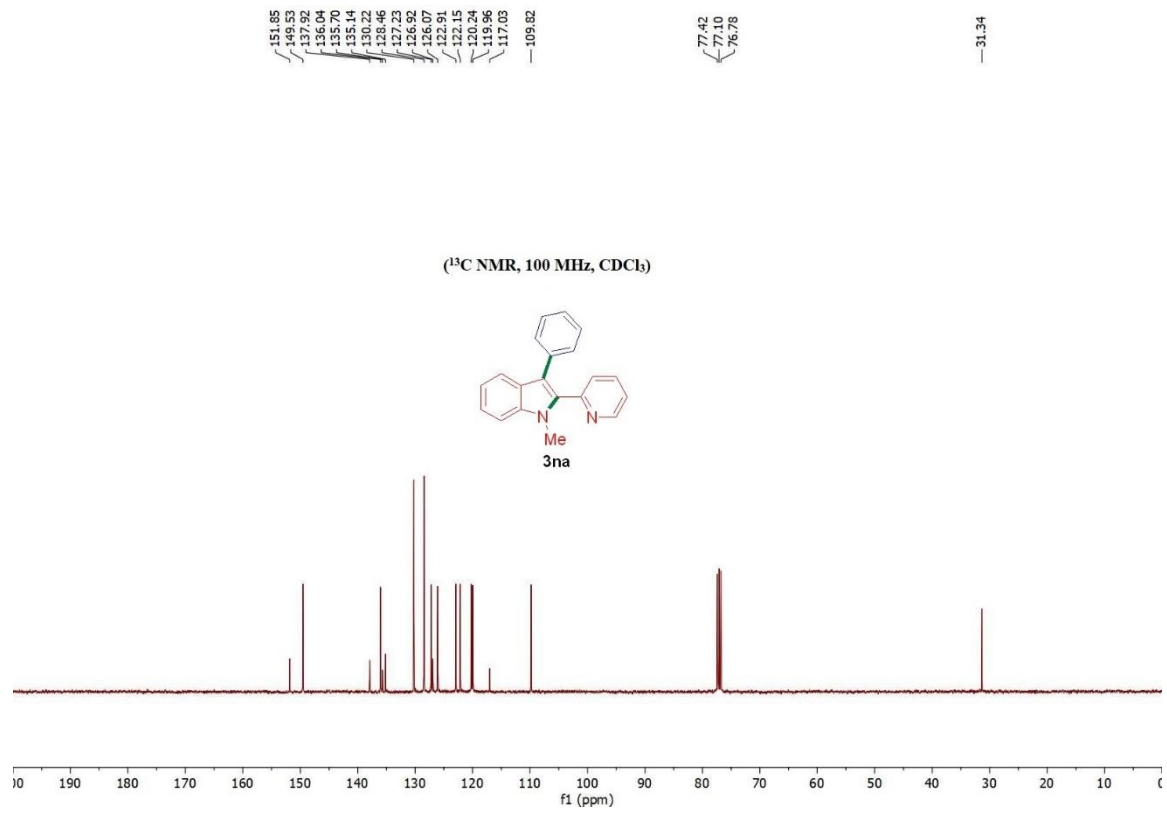
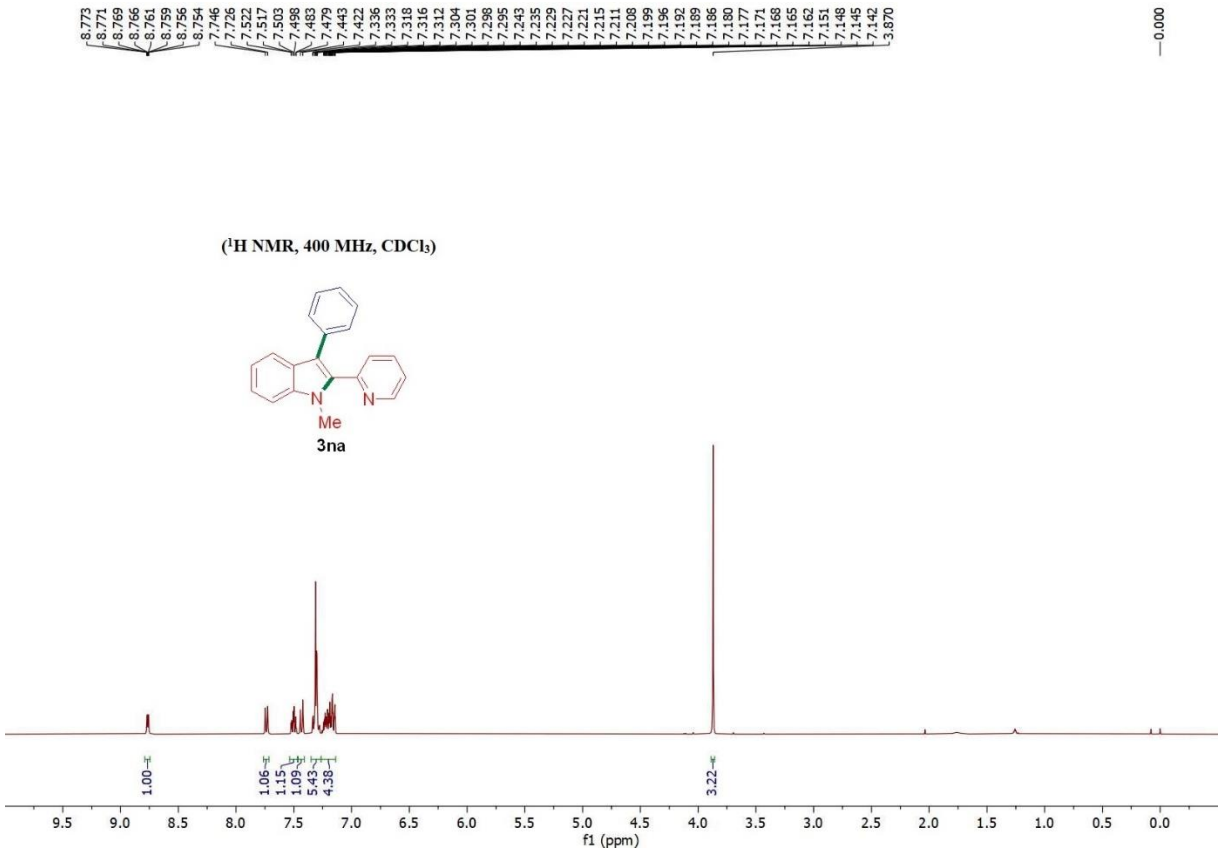
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135.31
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132.00
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129.65
128.28
126.93
126.01
125.73
125.64
122.31
120.24
119.61
115.65
109.58

77.42
77.10
76.78

—30.94

(¹³C NMR, 100 MHz, CDCl₃)





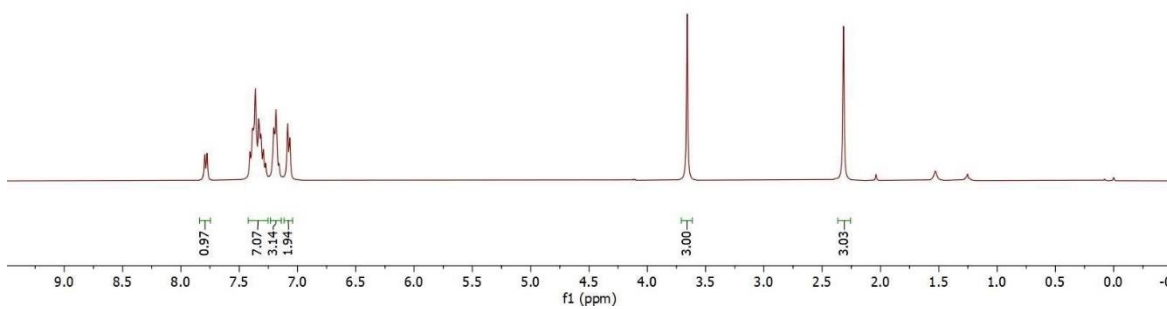
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7.776
7.407
7.387
7.377
7.361
7.334
7.327
7.312
7.293
7.273
7.217
7.204
7.185
7.176
7.158
7.085
7.066

3.658

2.317

0.000

(¹H NMR, 400 MHz, CDCl₃)



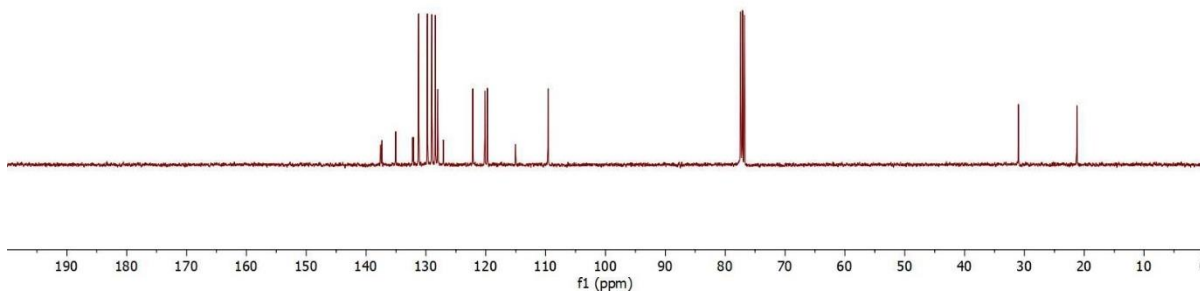
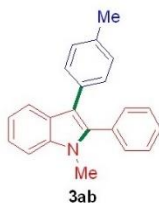
137.57
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129.01
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120.15
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115.03
109.60

77.42
77.10
76.78

30.99

21.24

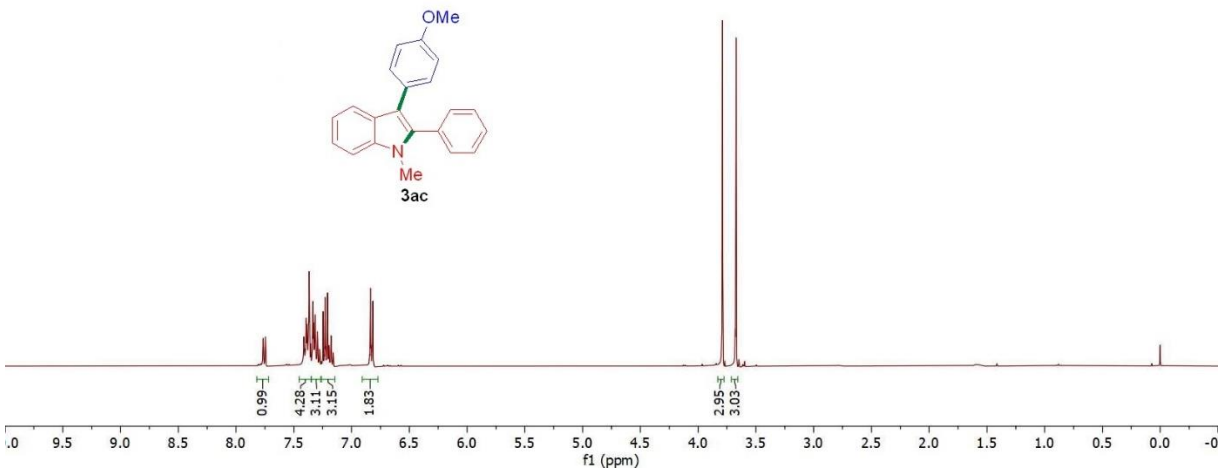
(¹³C NMR, 100 MHz, CDCl₃)



7.765
7.745
7.415
7.395
7.392
7.390
7.386
7.383
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7.372
7.367
7.362
7.334
7.328
7.315
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7.229
7.224
7.213
7.208
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3.671

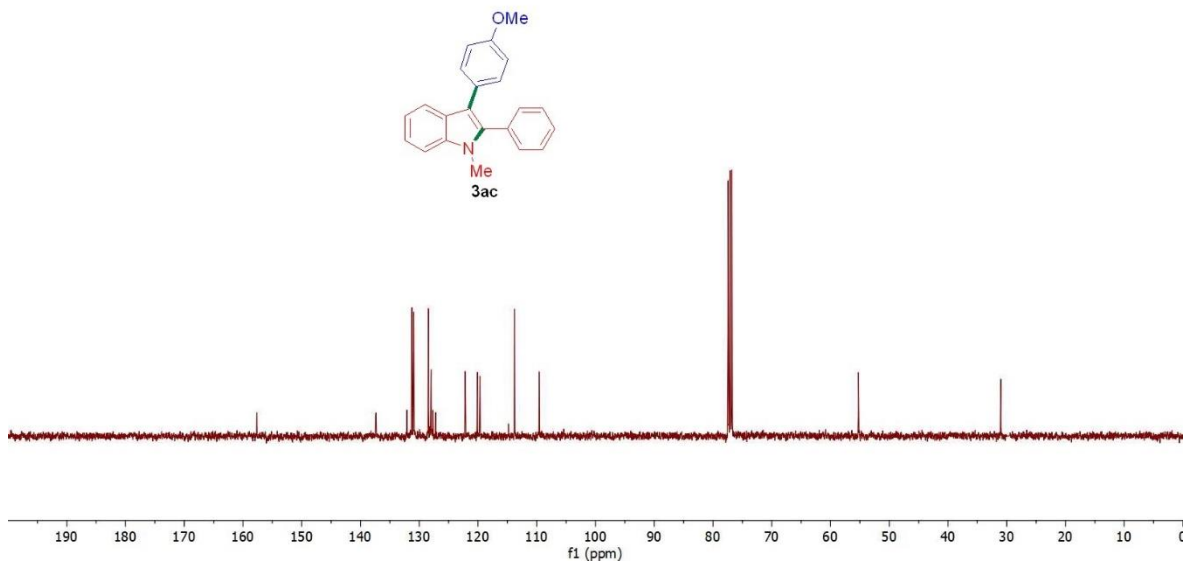
—0.000

(¹H NMR, 400 MHz, CDCl₃)



157.65
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132.11
131.24
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127.66
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55.24
31.02

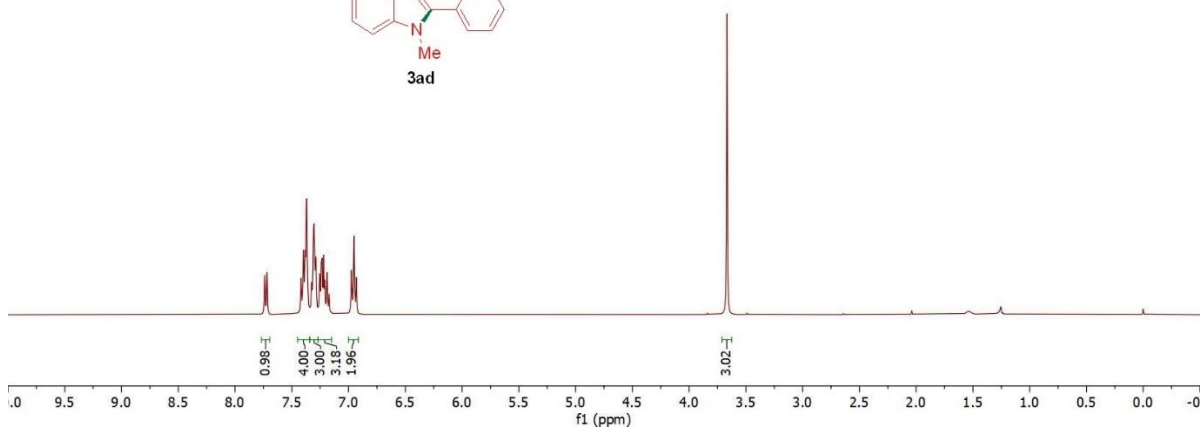
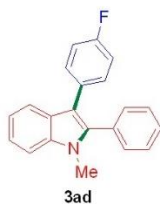
(¹³C NMR, 100 MHz, CDCl₃)



7.739
7.719
7.719
7.398
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7.381
7.373
7.368
7.360
7.326
7.323
7.311
7.305
7.299
7.292
7.287
7.255
7.250
7.241
7.233
7.228
7.210
7.198
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7.171
6.975
6.953
6.931
-3.666

-0.000

(¹H NMR, 400 MHz, CDCl₃)



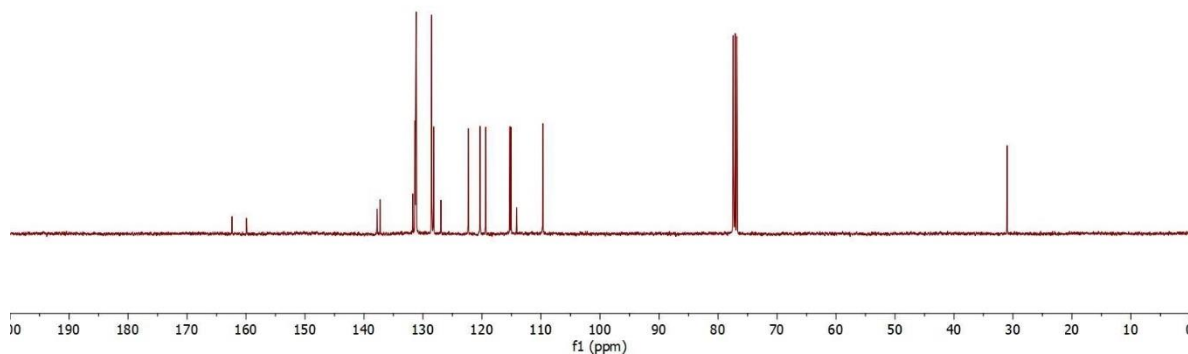
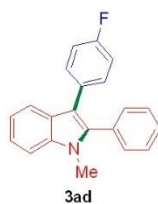
162.36
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137.29
131.74
131.34
131.26
131.22
131.16
128.53
128.20
126.96
122.33
120.34
119.38
115.28
115.07
114.15
109.70

77.42
77.10
76.78

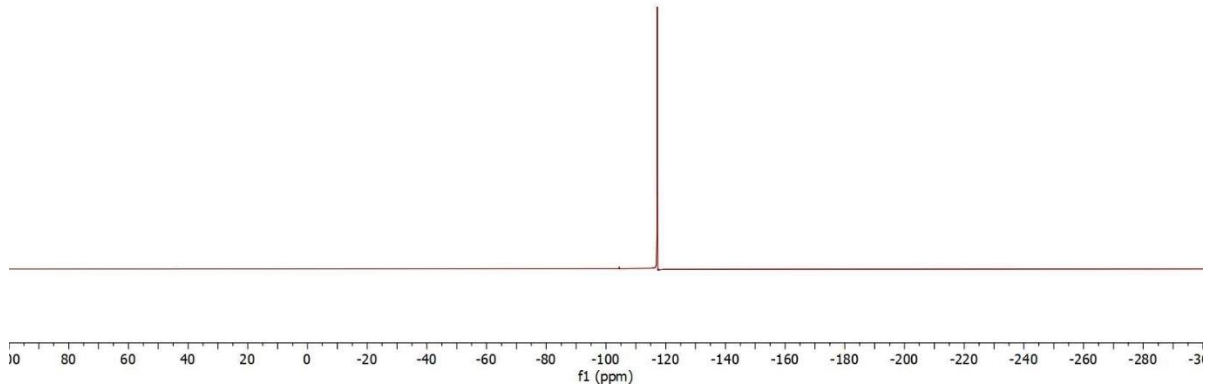
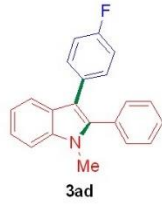
31.01

(¹³C NMR, 100 MHz, CDCl₃)



-117.148

(¹⁹F NMR, 376 MHz, CDCl₃)

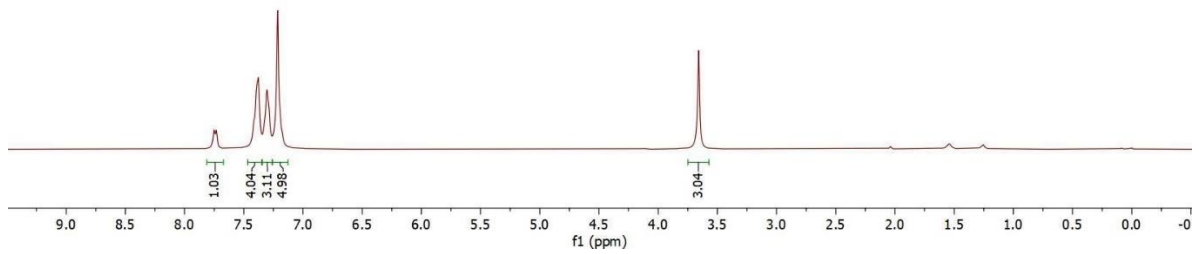
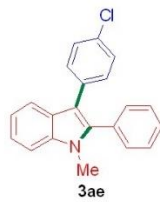


7.750
7.730
7.414
7.392
7.376
7.325
7.306
7.288
7.214
7.176

-3.698

-0.000

(¹H NMR, 400 MHz, CDCl₃)

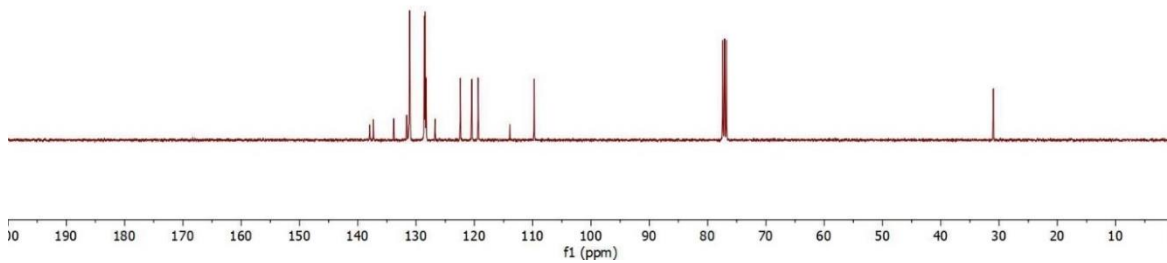
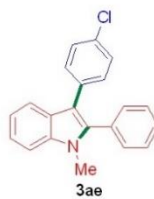


137.98
137.34
133.83
131.62
131.24
131.13
131.05
128.59
128.46
128.31
126.74
122.40
120.47
119.80
113.90
109.76

77.41
77.10
76.78

31.00

(¹³C NMR, 100 MHz, CDCl₃)

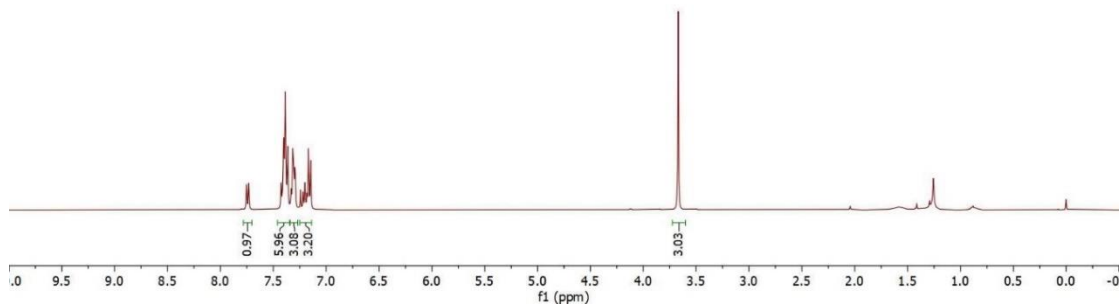
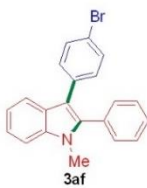


7.752
7.732
7.725
7.604
7.599
7.591
7.585
7.586
7.584
7.583
7.580
7.515
7.507
7.506
7.492
7.442
7.419
7.400
7.181
7.173
7.167
7.161
7.150
7.145

3.669

0.000

(¹H NMR, 400 MHz, CDCl₃)

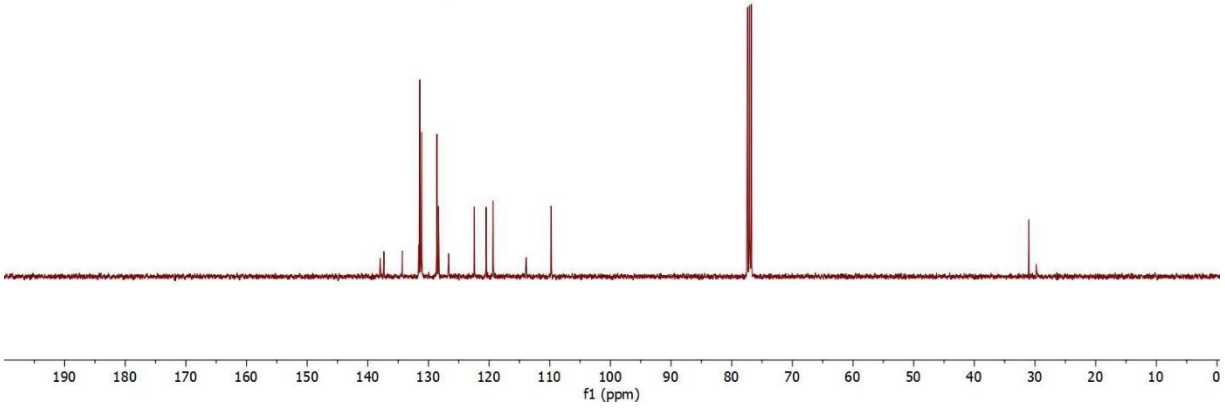
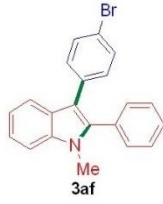


137.99
137.37
134.33
131.61
131.43
131.41
131.14
128.62
128.34
122.43
120.50
119.39
113.91
109.78

77.42
77.10
76.78

31.02

(¹³C NMR, 100 MHz, CDCl₃)



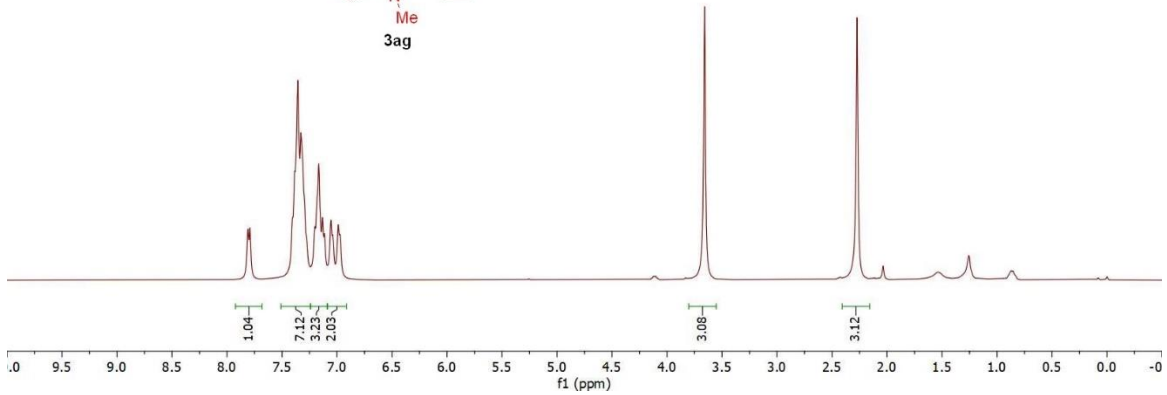
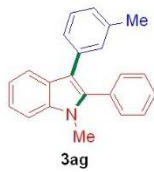
7.810
7.790
7.407
7.386
7.357
7.328
7.312
7.294
7.203
7.182
7.162
7.113
7.056
7.037
6.989
6.970

3.659

2.272

0.000

(¹H NMR, 400 MHz, CDCl₃)



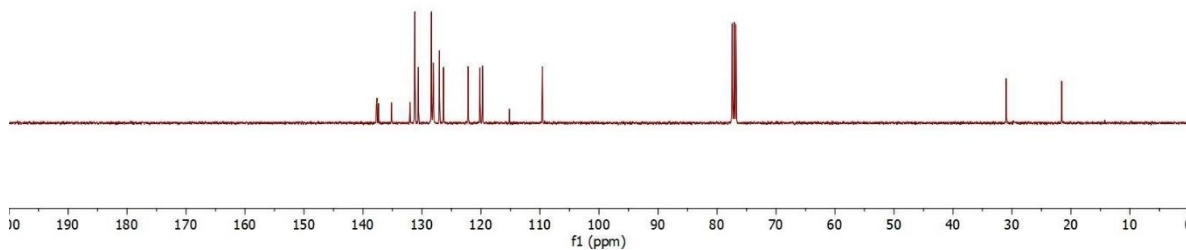
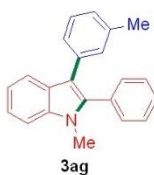
137.75
137.63
137.37
135.14
132.03
131.21
130.61
128.40
128.10
128.03
127.04
126.34
122.18
120.18
119.76
115.18
109.61

77.41
77.10
76.78

30.99

21.58

(¹³C NMR, 100 MHz, CDCl₃)

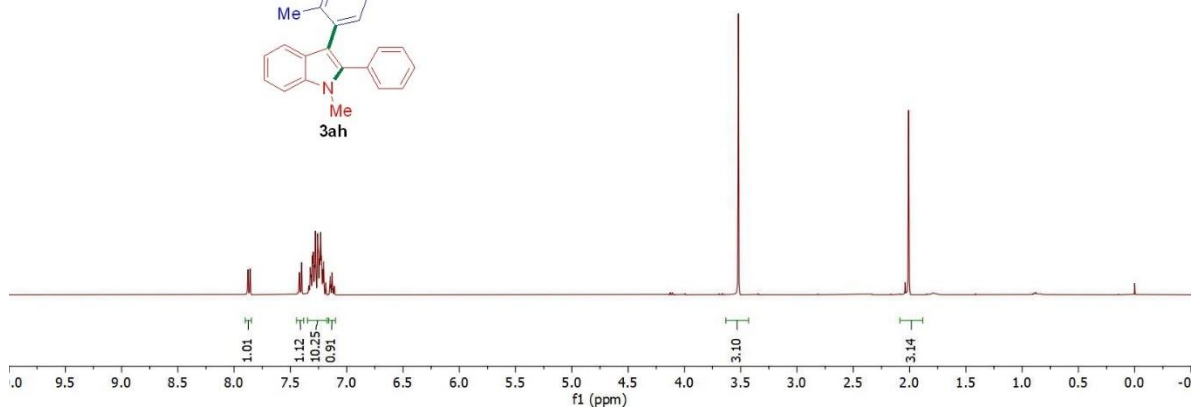
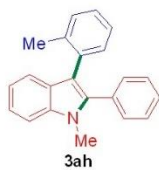


7.877
7.857
7.421
7.400
7.335
7.326
7.323
7.317
7.305
7.300
7.297
7.279
7.276
7.259
7.256
7.253
7.250
7.243
7.236
7.234
7.232
7.225
7.215
7.211
7.207
7.204
7.202
7.187
7.184
7.150
7.147
7.143
7.134
7.129
7.123
7.114
7.110
7.107
3.520

2.009

0.000

(¹H NMR, 400 MHz, CDCl₃)



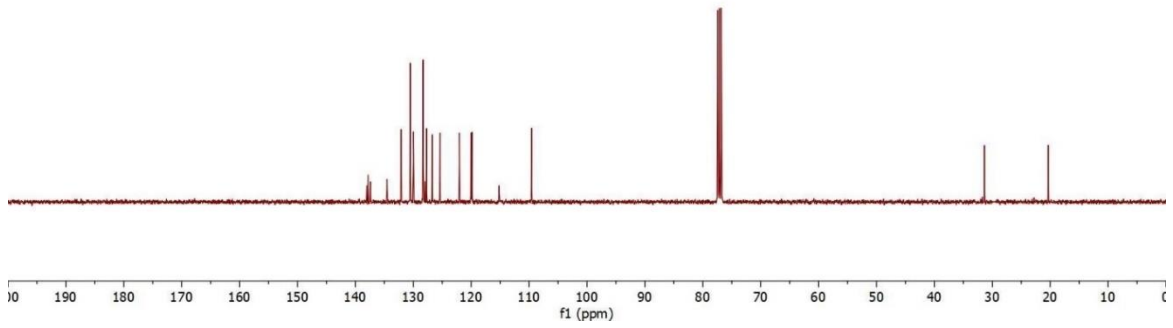
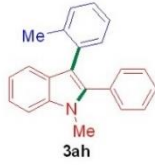
138.04
137.80
137.40
134.53
132.18
130.82
130.51
129.99
128.30
128.00
127.70
126.74
125.40
122.02
120.03
119.87
115.17
109.56

77.42
77.10
76.78

31.36

20.33

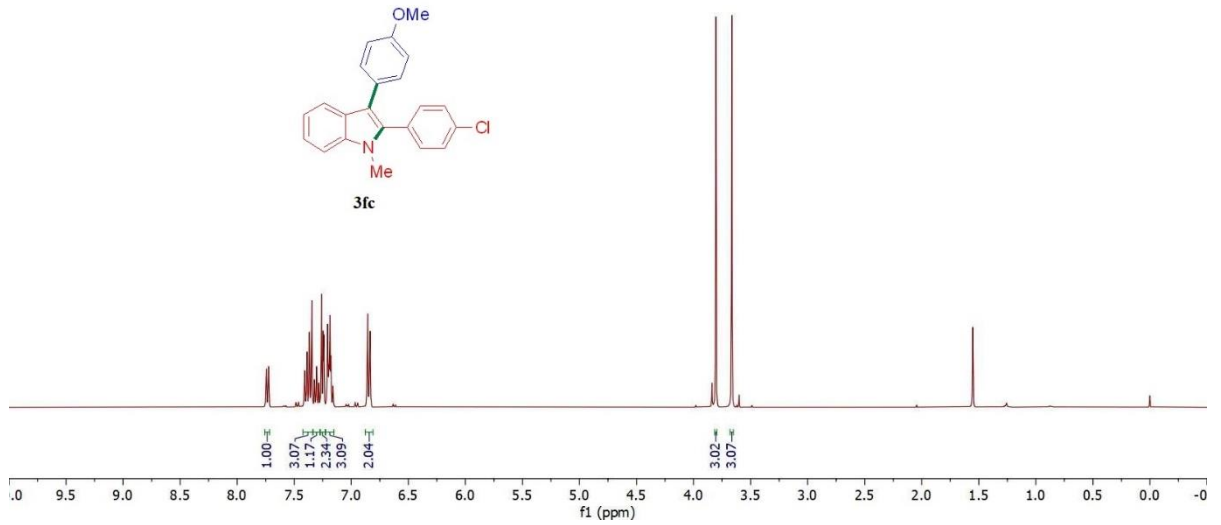
(¹³C NMR, 100 MHz, CDCl₃)

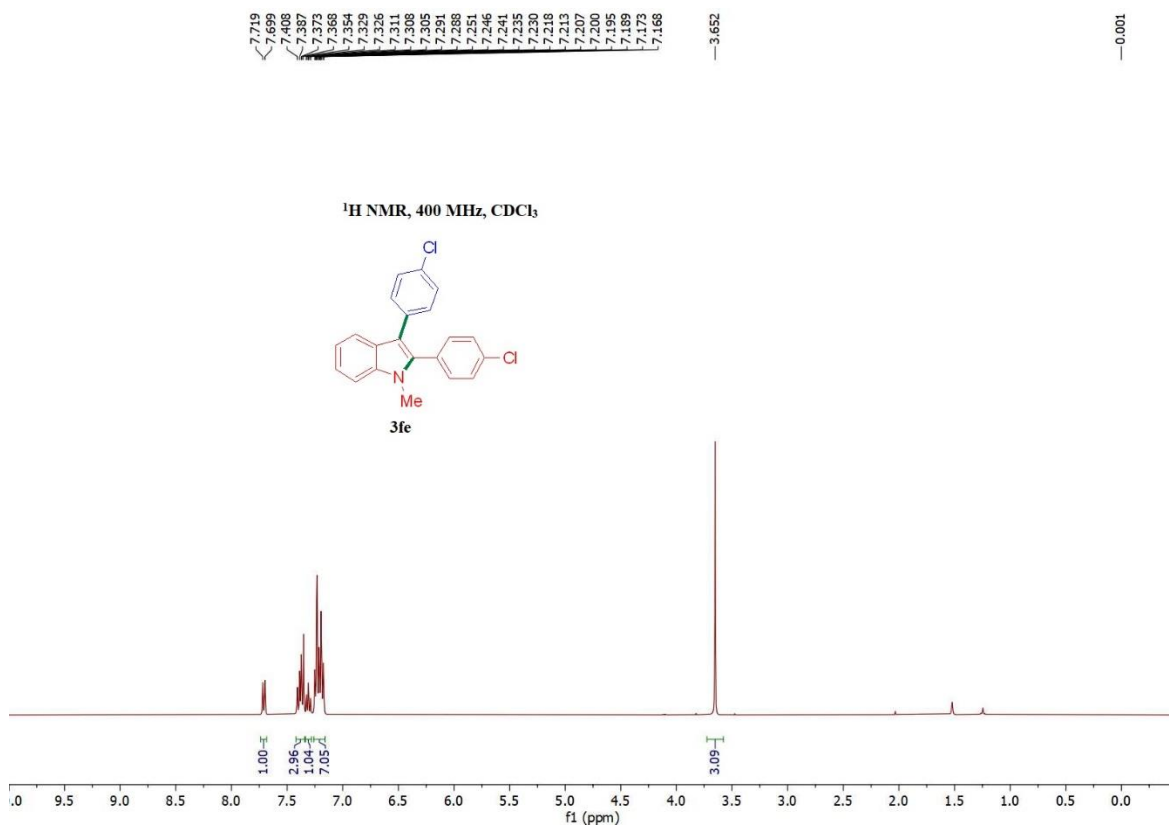
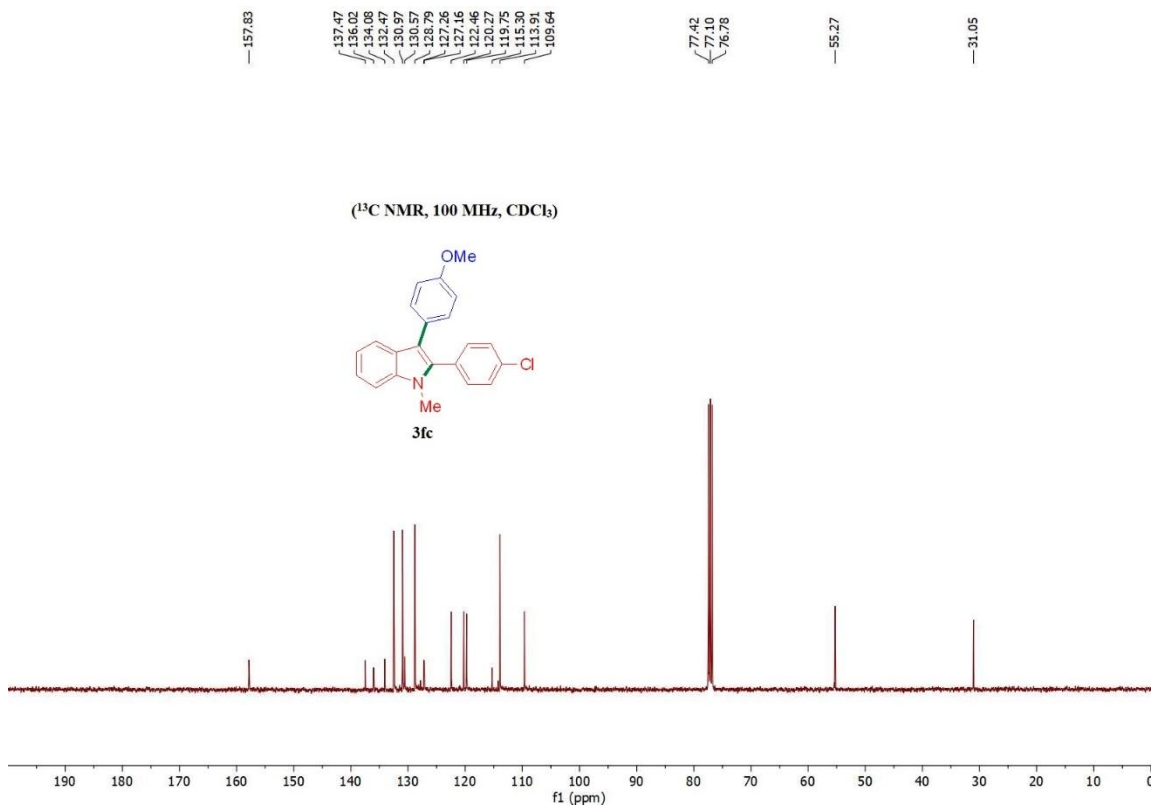


7.746
7.744
7.726
7.724
7.408
7.390
7.387
7.370
7.367
7.351
7.348
7.345
7.323
7.320
7.305
7.302
7.284
7.281
7.264
7.261
7.256
7.248
7.243
7.240
7.211
7.208
7.202
7.198
7.195
7.191
7.189
7.186
7.181
7.178
6.860
6.856
6.831
6.840
6.837
6.834
3.802
3.865

0.000

(¹H NMR, 400 MHz, CDCl₃)



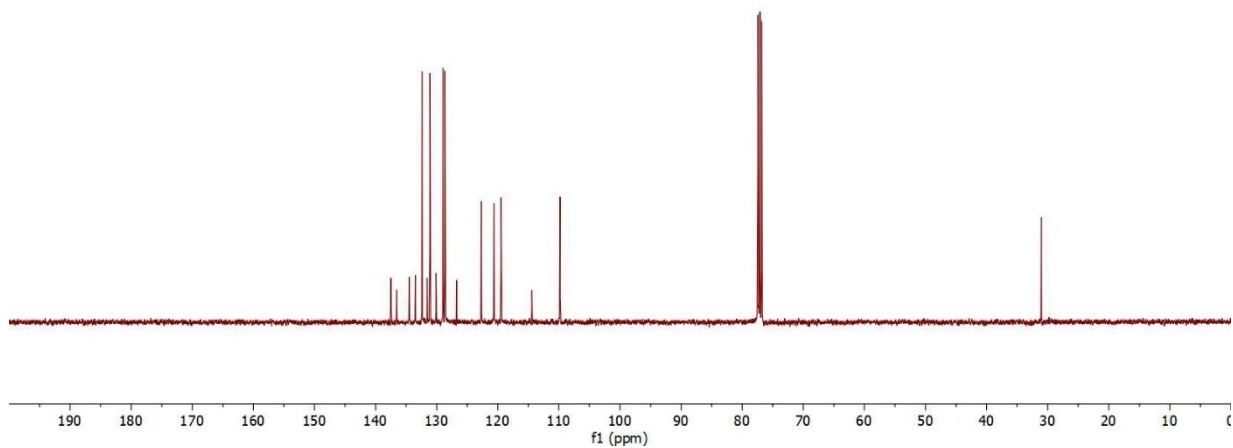


137.49
136.56
134.49
133.50
132.40
131.57
131.09
130.11
128.97
128.64
126.74
122.71
120.64
119.45
114.42
109.81

77.42
77.10
76.78

—31.05

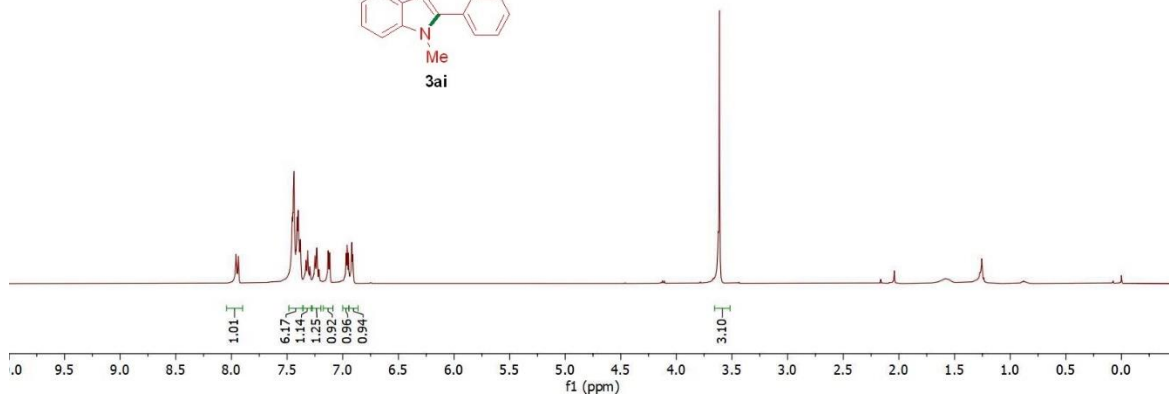
¹³C NMR, 100 MHz, CDCl₃



7.961
7.958
7.956
7.951
7.948
7.938
7.936
7.454
7.449
7.444
7.437
7.410
7.401
7.334
7.331
7.327
7.324
7.321
7.317
7.314
7.310
7.296
7.293
7.252
7.249
7.244
7.244
7.236
7.232
7.229
7.215
7.212
7.132
7.129
7.120
7.117
6.977
6.965
6.961
6.957
6.948
6.920
6.916
6.911
6.908
3.614

—0.000

¹H NMR, 400 MHz, CDCl₃

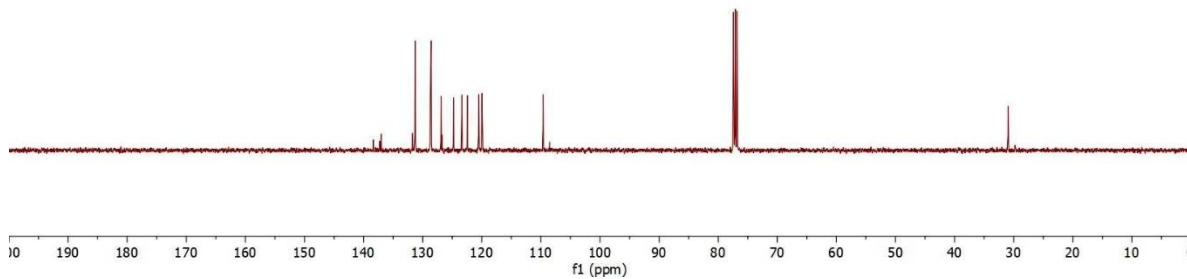


138.36
137.26
137.05
131.71
131.29
128.69
128.58
126.90
126.74
124.80
123.96
122.44
120.53
119.95
108.63
108.51

77.42
77.10
76.78

30.95

(¹³C NMR, 100 MHz, CDCl₃)



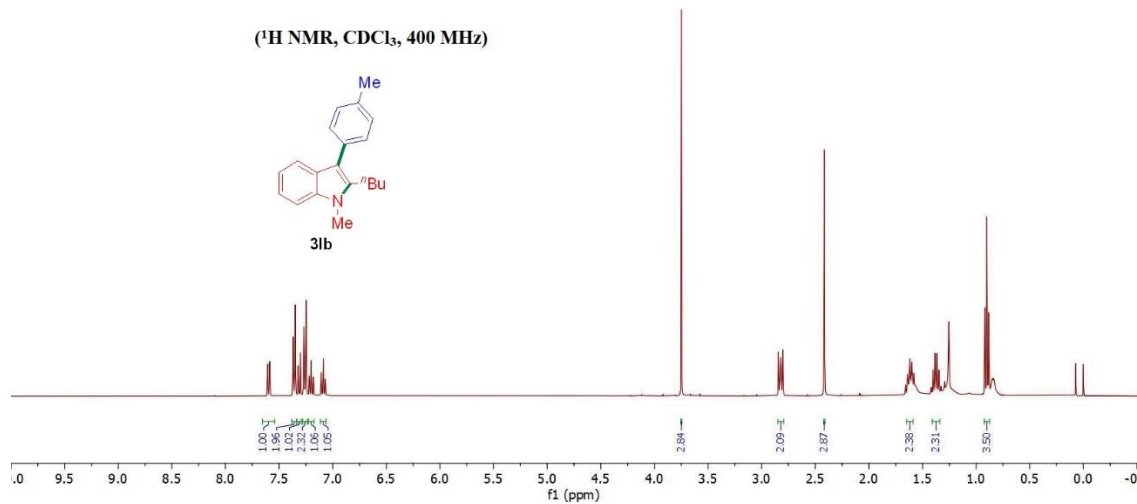
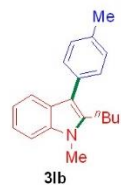
7.607
7.588
7.370
7.365
7.365
7.355
7.354
7.322
7.330
7.304
7.299
7.270
7.268
7.264
7.264
7.248
7.230
7.217
7.203
7.190
7.182
7.179
7.108
7.065
7.080
7.088
7.085
7.070

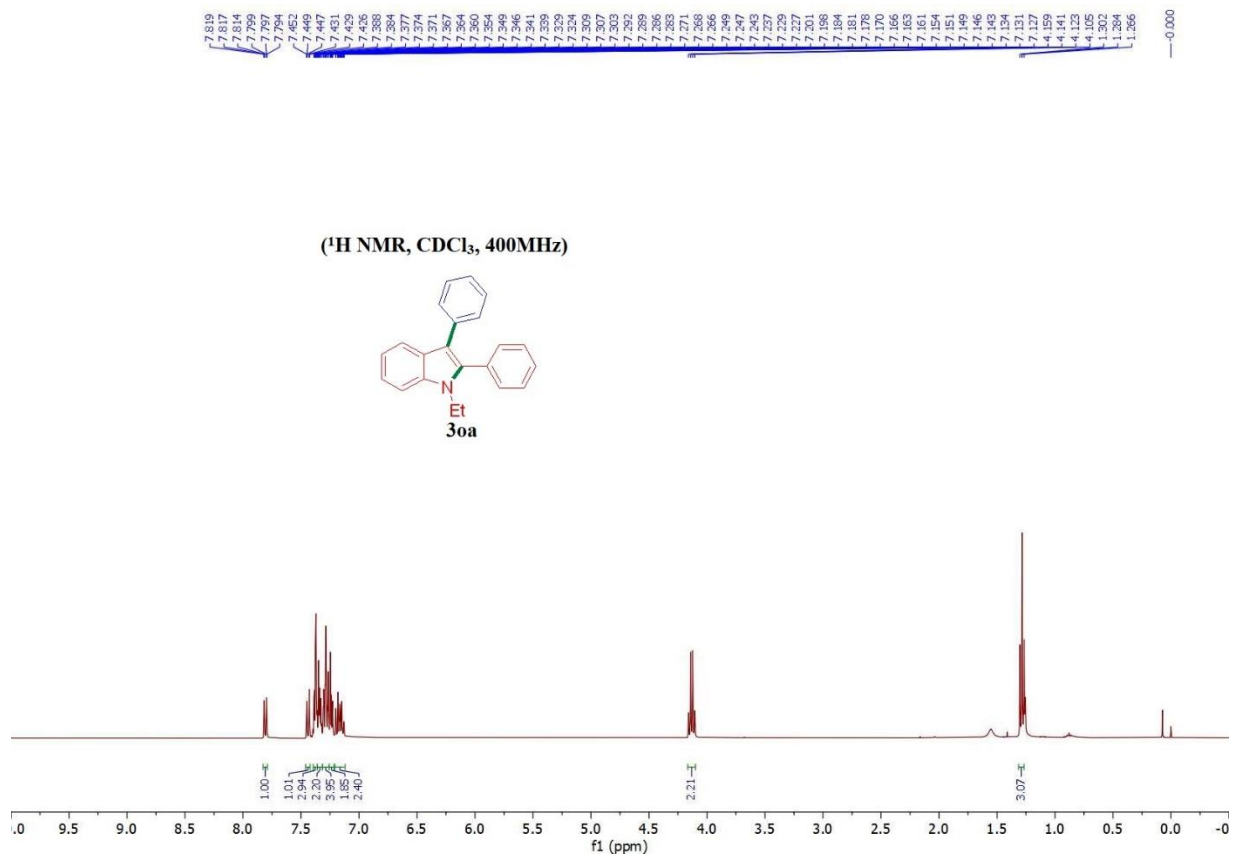
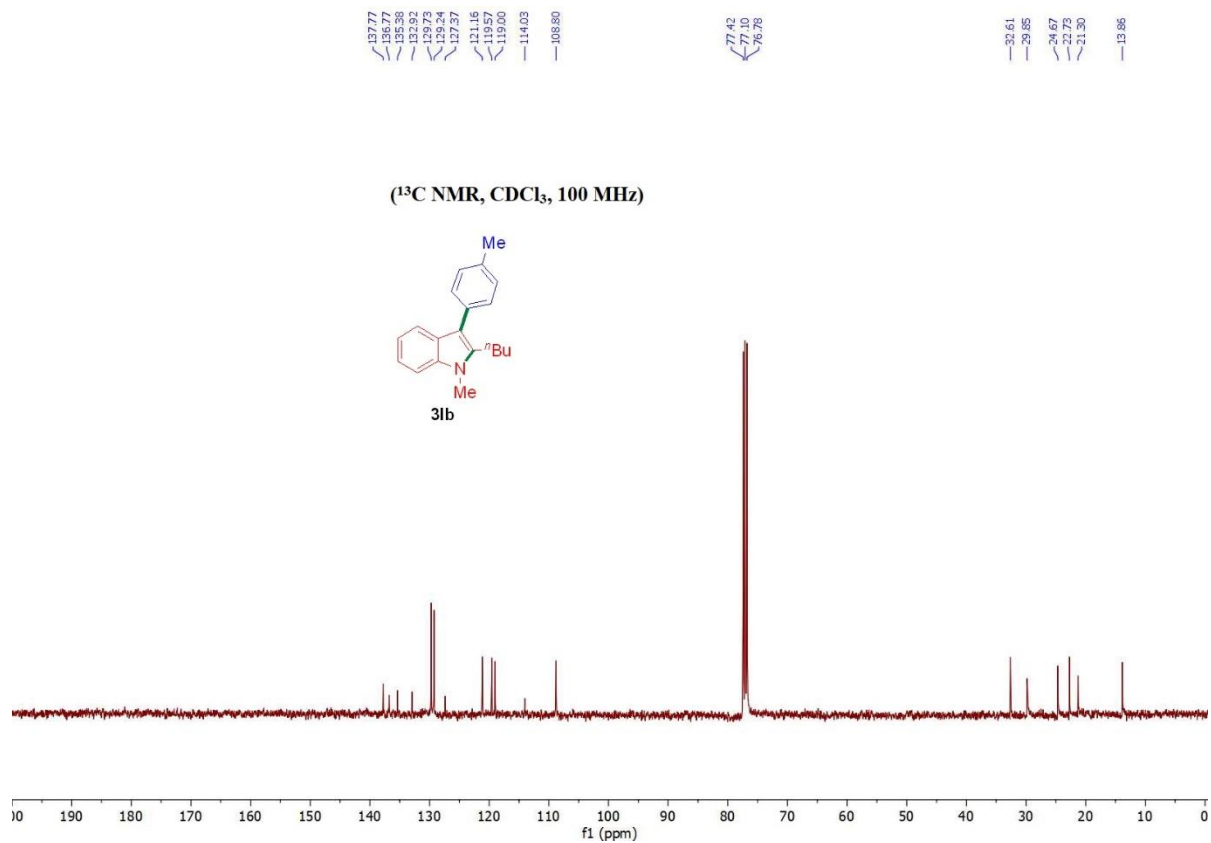
3.749

2.843
2.828
2.819
2.803
2.416

1.658
1.639
1.635
1.630
1.625
1.610
1.606
1.600
1.594
1.588
1.568
1.402
1.363
1.365
1.317
1.300
1.0.900
1.0.882
1.0.000

(¹H NMR, CDCl₃, 400 MHz)





137.35
136.14
135.29
132.22
131.14
129.89
129.70
128.37
127.31
125.47
122.10
120.16
119.83
115.76
109.86

77.42
77.10
76.78

38.71

15.47

(¹³C NMR, CDCl₃, 100MHz)

