Supporting Information

Facile fabrication of glycosylpyridyl-triazole@nickel nanoparticles as recyclable nanocatalyst for acylation of amines in water

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1. Catalyst Characterization

1.1 Figure S1. ESI-MS of GPT-Ni.

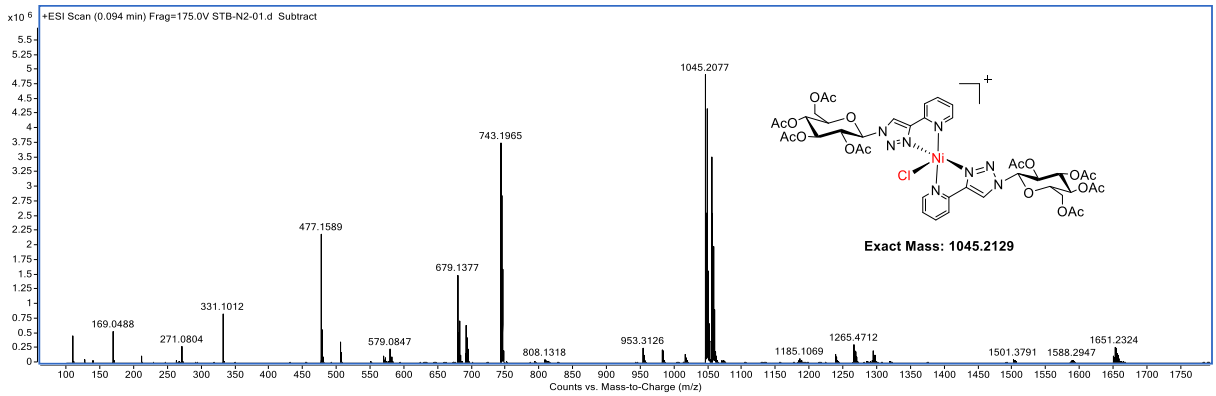
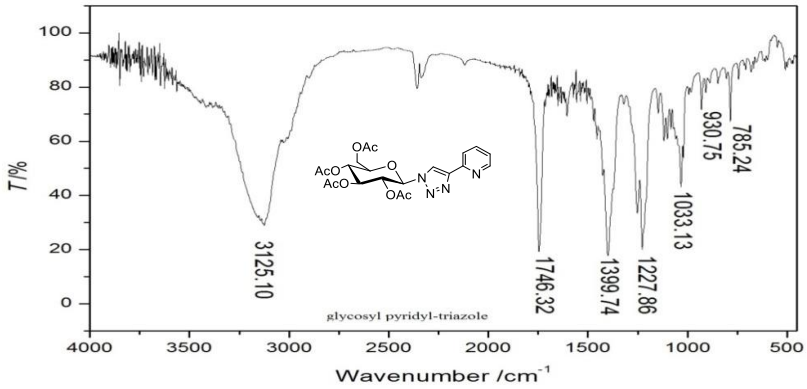


Figure S1. ESI-MS of GPT-Ni $[GPT\text{-}Ni(-Cl)]^+$ (Exact Mass: 1045.2129)

1.2 Figure S2 IR spectra of ligand and GPT-Ni.[2]



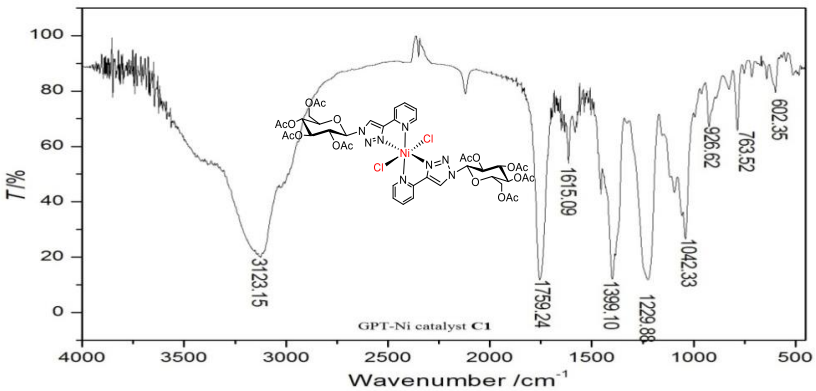


Figure S2 IR spectra of ligand and GPT-Ni

1.3 Figure S3 XPS spectra of GPT-Ni catalyst.

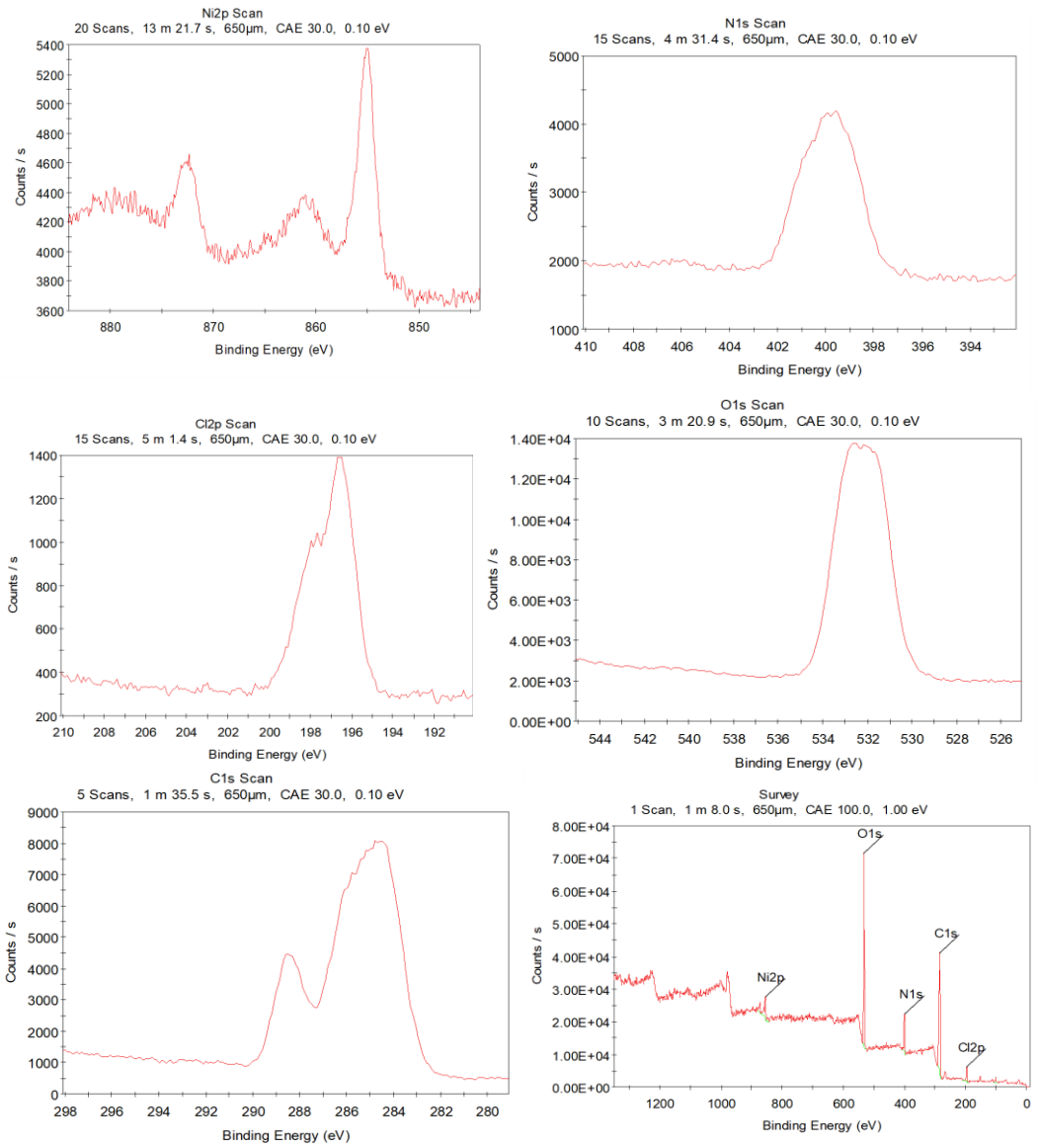
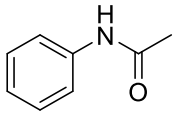


Figure S3 XPS spectra of GPT-Ni catalyst.

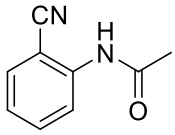
2. Characterization of the Products[3]

_N_-phenylacetamide (3a)



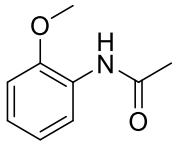
The product was obtained as white solid in 85% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.50 (d, *J* = 7.9 Hz, 2H), 7.36 (s, 1H), 7.31 (t, *J* = 7.9 Hz, 2H), 7.10 (t, *J* = 7.4 Hz, 1H), 2.17 (s, 3H).

_N_-(2-cyanophenyl)acetamide (3b)



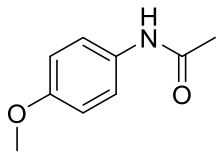
The product was obtained as yellow solid in 74% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 10.76 (s, 1H), 7.84 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.45 (dd, *J* = 7.1, 1.5 Hz, 1H), 6.98 (dd, *J* = 8.4, 0.8 Hz, 1H), 6.92 – 6.84 (m, 1H), 3.95 (s, 3H).

_N_-(2-methoxyphenyl)acetamide (3c)



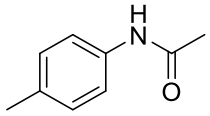
The product was obtained as yellow solid in 76% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.28 (dd, *J* = 3.1, 1.4 Hz, 1H), 7.69 (s, 1H), 7.00 (td, *J* = 7.9, 1.6 Hz, 1H), 6.89 (dd, *J* = 5.9, 1.4 Hz, 1H), 6.81 (d, *J* = 1.7 Hz, 1H), 3.81 (s, 3H), 2.13 (s, 3H).

_N_-(4-methoxyphenyl)acetamide (3d)



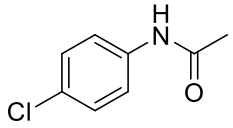
The product was obtained as yellow solid in 84% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38 (d, *J* = 8.6 Hz, 2H), 7.08 (s, 1H), 6.86 (d, *J* = 8.6 Hz, 2H), 3.79 (s, 3H), 2.15 (s, 3H).

_N_-(p-tolyl)acetamide (3e)



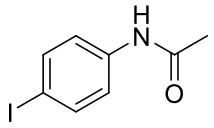
The product was obtained as white solid in 88% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.49 (s, 1H), 7.37 (d, *J* = 8.3 Hz, 2H), 7.10 (d, *J* = 8.4 Hz, 2H), 2.30 (s, 3H), 2.14 (s, 3H).

***N*-(4-chlorophenyl)acetamide (3f)**



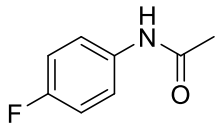
The product was obtained as yellow solid in 80% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.38 (s, 1H), 7.33 (d, *J* = 8.4 Hz, 2H), 7.09 (d, *J* = 8.3 Hz, 2H), 2.08 (s, 3H).

***N*-(4-iodophenyl)acetamide (3g)**



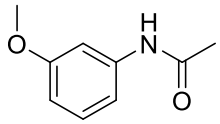
The product was obtained as yellow solid in 81% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.76 (s, 1H), 7.53 (d, *J* = 4.5 Hz, 2H), 7.26 (d, *J* = 8.8 Hz, 2H), 2.09 (s, 3H).

***N*-(4-fluorophenyl)acetamide (3h)**



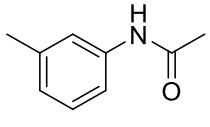
The product was obtained as yellow solid in 78% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 (dd, *J* = 9.0, 4.8 Hz, 2H), 7.32 (s, 1H), 7.00 (t, *J* = 8.7 Hz, 2H), 2.16 (s, 3H).

***N*-(3-methoxyphenyl)acetamide (3i)**



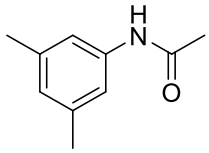
The product was obtained as yellow solid in 70% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.40 (s, 1H), 7.26 (d, *J* = 4.0 Hz, 1H), 7.19 (t, *J* = 8.1 Hz, 1H), 6.96 (d, *J* = 7.8 Hz, 1H), 6.64 (d, *J* = 8.0 Hz, 1H), 3.78 (s, 3H), 2.15 (s, 3H).

***N*-(m-tolyl)acetamide (3j)**



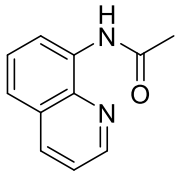
The product was obtained as white solid in 76% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.35 (s, 1H), 7.31 (s, 1H), 7.28 (s, 1H), 7.19 (t, *J* = 7.7 Hz, 1H), 6.92 (d, *J* = 7.4 Hz, 1H), 2.33 (s, 3H), 2.16 (s, 3H).

***N*-(3,5-dimethylphenyl)acetamide (3k)**



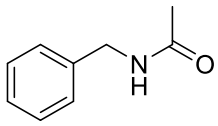
The product was obtained as white solid in 78% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.30 (s, 1H), 7.12 (s, 2H), 6.75 (s, 1H), 2.28 (s, 6H), 2.15 (s, 3H).^{13}C NMR (126 MHz, $CDCl_3$) δ 167.33 (s), 137.65 (s), 136.69 (s), 125.06 (s), 116.68 (s), 23.60 (s), 20.33 (s).

***N*-(quinolin-8-yl)acetamide (3l)**



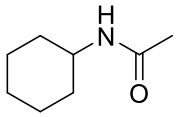
The product was obtained as yellow solid in 40% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 9.77 (s, 1H), 8.80 – 8.71 (m, 2H), 8.13 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.49 (dt, *J* = 8.1, 7.6 Hz, 2H), 7.42 (dd, *J* = 8.2, 4.2 Hz, 1H), 2.34 (s, 3H).^{13}C NMR (126 MHz, $CDCl_3$) δ 167.72 (s), 147.03 (s), 137.14 (s), 135.38 (s), 133.47 (s), 126.88 (s), 126.37 (s), 120.47 (d, *J* = 15.6 Hz), 115.41 (s), 24.09 (s).

***N*-benzylacetamide (3m)**



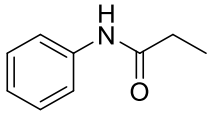
The product was obtained as white solid in 57% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.33 – 7.29 (m, 2H), 7.25 (t, J = 6.4 Hz, 3H), 6.37 – 6.17 (m, 1H), 4.37 (d, J = 5.7 Hz, 2H), 1.97 (s, 3H).^{13}C NMR (126 MHz, $CDCl_3$) δ 170.14 (s), 138.29 (s), 128.65 (s), 127.78 (s), 127.44 (s), 43.66 (s), 23.11 (s)

***N*-cyclohexylacetamide (3n)**



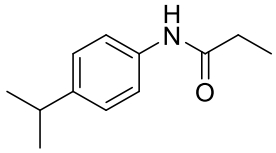
The product was obtained as white solid in 69% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.90 (t, *J* = 22.2 Hz, 1H), 3.72 (tdt, *J* = 11.7, 8.0, 3.9 Hz, 1H), 1.98 (s, 3H), 1.91 – 1.85 (m, 2H), 1.76 – 1.70 (m, 2H), 1.65 – 1.58 (m, 1H), 1.37 – 1.28 (m, 2H), 1.16 (dddd, *J* = 15.9, 12.5, 9.6, 6.4 Hz, 3H).

***N*-phenylpropionamide (3o)**



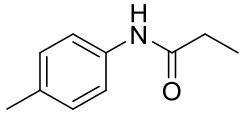
The product was obtained as white solid in 71% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.51 (d, *J* = 7.8 Hz, 2H), 7.32 (t, *J* = 7.8 Hz, 2H), 7.14 (s 1H), 7.10 (t, *J* = 7.2 Hz, 1H), 2.40 (q, *J* = 7.5 Hz, 2H), 1.25 (t, *J* = 7.5 Hz, 3H).

***N*-(4-isopropylphenyl)propionamide (3p)**



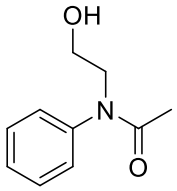
The product was obtained as white solid in 67% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.42 (d, *J* = 8.2 Hz, 2H), 7.17 (d, *J* = 8.2 Hz, 3H), 2.87 (dt, *J* = 13.8, 6.9 Hz, 1H), 2.37 (q, *J* = 7.5 Hz, 2H), 1.24 (dd, *J* = 11.8, 7.0 Hz, 9H).

***N*-(p-tolyl)propionamide (3q)**



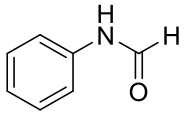
The product was obtained as white solid in 69% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.39 (d, *J* = 8.3 Hz, 2H), 7.17 (s, 1H), 7.11 (d, *J* = 8.1 Hz, 2H), 2.37 (q, *J* = 7.6 Hz, 2H), 2.31 (s, 3H), 1.23 (d, *J* = 7.6 Hz, 3H).^{13}C NMR (126 MHz, $CDCl_3$) δ 170.87 (s), 128.44 (s), 118.87 (s), 28.68 (s), 19.82 (s), 8.70 (s).

***N*-(2-hydroxyethyl)-N-phenylacetamide (3r)**



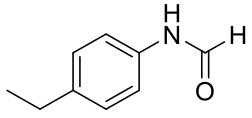
The product was obtained as white solid in 68% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 – 7.17 (m, 2H), 6.74 (t, *J* = 7.3 Hz, 1H), 6.67 – 6.61 (m, 2H), 5.30 (s, 1H), 4.30 – 4.27 (m, 2H), 3.43 – 3.38 (m, 2H), 2.08 (s, 3H)

***N*-phenylformamide (5a)**



The product was obtained as white solid in 78% yield. ^{1}H NMR (500 MHz, DMSO-d_6) δ 10.28 (s, 1H), 8.29 (d, *J* = 1.8 Hz, 1H), 7.69 – 7.62 (m, 3H), 7.44 – 7.41 (m, 2H).

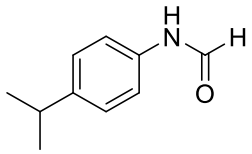
***N*-(4-ethylphenyl)formamide (5b)**



The product was obtained as white solid in 73% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ

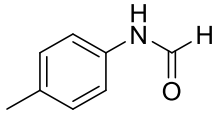
8.55 (d, *J* = 11.5 Hz, 1H), 8.28 (s, 1H), 7.77 (s, 1H), 7.37 (d, *J* = 8.3 Hz, 2H), 7.10 (t, *J* = 9.1 Hz, 4H), 6.93 (d, *J* = 8.2 Hz, 2H), 2.60 – 2.51 (m, 4H), 1.20 – 1.12 (m, 8H).

***N*-(4-isopropylphenyl)formamide (5c)**



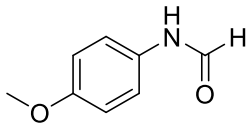
The product was obtained as white solid in 74% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.55 (d, *J* = 11.5 Hz, 1H), 8.28 (d, *J* = 1.7 Hz, 1H), 7.74 (dt, *J* = 4.5, 2.6 Hz, 2H), 7.40 – 7.36 (m, 2H), 7.16 – 7.10 (m, 5H), 6.99 – 6.90 (m, 3H), 6.61 – 6.54 (m, 1H), 2.82 (dd, *J* = 15.1, 7.0 Hz, 2H), 1.17 (d, *J* = 5.4 Hz, 6H), 1.16 (d, *J* = 5.4 Hz, 6H).

***N*-p-tolylformamide (5d)**



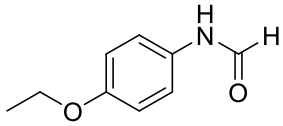
The product was obtained as white solid in 78% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.61 (d, *J* = 11.5 Hz, 1H), 8.35 (d, *J* = 1.4 Hz, 1H), 7.82 (s, 1H), 7.42 (d, *J* = 8.4 Hz, 2H), 7.15 (dd, *J* = 11.9, 8.3 Hz, 4H), 6.98 (d, *J* = 8.3 Hz, 2H), 2.33 (s, 3H), 2.32 (s, 3H).

***N*-(4-methoxyphenyl)formamide (5e)**



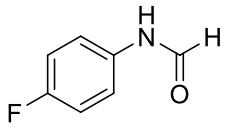
The product was obtained as yellow solid in 73% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51 (d, *J* = 11.4 Hz, 1H), 8.31 (s, 1H), 8.11 (s, 1H), 7.44 (d, *J* = 8.9 Hz, 3H), 7.03 (d, *J* = 8.8 Hz, 2H), 6.87 (dd, *J* = 11.6, 8.9 Hz, 4H), 3.80 (s, 3H), 3.78 (s, 3H).

***N*-(4-ethoxyphenyl)formamide (5f)**



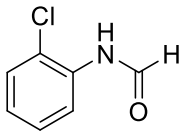
The product was obtained as yellow solid in 70% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.49 (d, *J* = 11.6 Hz, 1H), 8.33 (d, *J* = 1.5 Hz, 1H), 7.54 (s, 1H), 7.46 – 7.38 (m, 2H), 7.08 (dd, *J* = 9.7, 7.2 Hz, 1H), 7.05 – 6.98 (m, 2H), 6.91 – 6.83 (m, 4H), 4.02 (qd, *J* = 7.0, 2.3 Hz, 4H), 1.41 (dd, *J* = 13.2, 7.0 Hz, 6H).

***N*-(4-fluorophenyl)formamide (5g)**



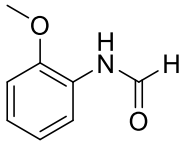
The product was obtained as white solid in 75% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.50 (d, *J* = 11.4 Hz, 1H), 8.29 (d, *J* = 1.2 Hz, 1H), 7.98 (s, 1H), 7.47 – 7.41 (m, 3H), 7.30 (d, *J* = 17.9 Hz, 1H), 7.00 (d, *J* = 6.3 Hz, 4H), 6.96 (t, *J* = 8.7 Hz, 3H).

***N*-(2-chlorophenyl)formamide (5h)**



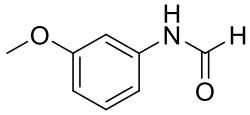
The product was obtained as yellow solid in 75% yield. ^{1}H NMR (500 MHz, DMSO-*d6*) δ 10.01 (s, 1H), 8.20 (d, *J* = 2.0 Hz, 1H), 7.50 (d, *J* = 9.0 Hz, 2H), 6.89 (d, *J* = 9.1 Hz, 2H).

***N*-(2-methoxyphenyl)formamide (5i)**



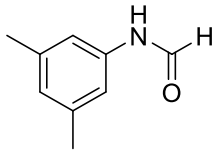
The product was obtained as yellow solid in 71% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.67 (d, *J* = 11.6 Hz, 1H), 8.39 (s, 1H), 8.29 (d, *J* = 7.9 Hz, 1H), 7.72 (s, 1H), 7.13 (d, *J* = 7.7 Hz, 1H), 7.06 (t, *J* = 7.7 Hz, 1H), 7.01 (t, *J* = 7.7 Hz, 1H), 6.95 – 6.78 (m, 3H), 3.82 (d, *J* = 3.8 Hz, 3H), 3.81 (d, *J* = 3.3 Hz, 1H)

***N*-(3-methoxyphenyl)formamide (5j)**



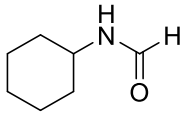
The product was obtained as yellow solid in 65% yield. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.62 (d, *J* = 11.4 Hz, 1H), 8.30 (s, 1H), 7.92 (s, 1H), 7.27 (s, 1H), 7.22 – 7.13 (m, 3H), 6.94 (d, *J* = 7.9 Hz, 1H), 6.64 (ddd, *J* = 21.3, 11.7, 5.0 Hz, 3H), 6.54 (s, 1H), 3.74 (s, 3H), 3.73 (s, 3H).

***N*-(3,5-dimethylphenyl)formamide (5k)**



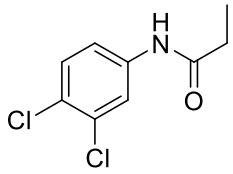
The product was obtained as white solid in 60% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.66 (d, *J* = 11.5 Hz, 1H), 8.35 (d, *J* = 1.3 Hz, 1H), 7.68 (s, 1H), 7.16 (s, 1H), 6.81 (d, *J* = 20.9 Hz, 2H), 6.69 (s, 2H), 2.31 (s, 6H), 2.30 (s, 4H).

***N*-cyclohexylformamide (5l)**



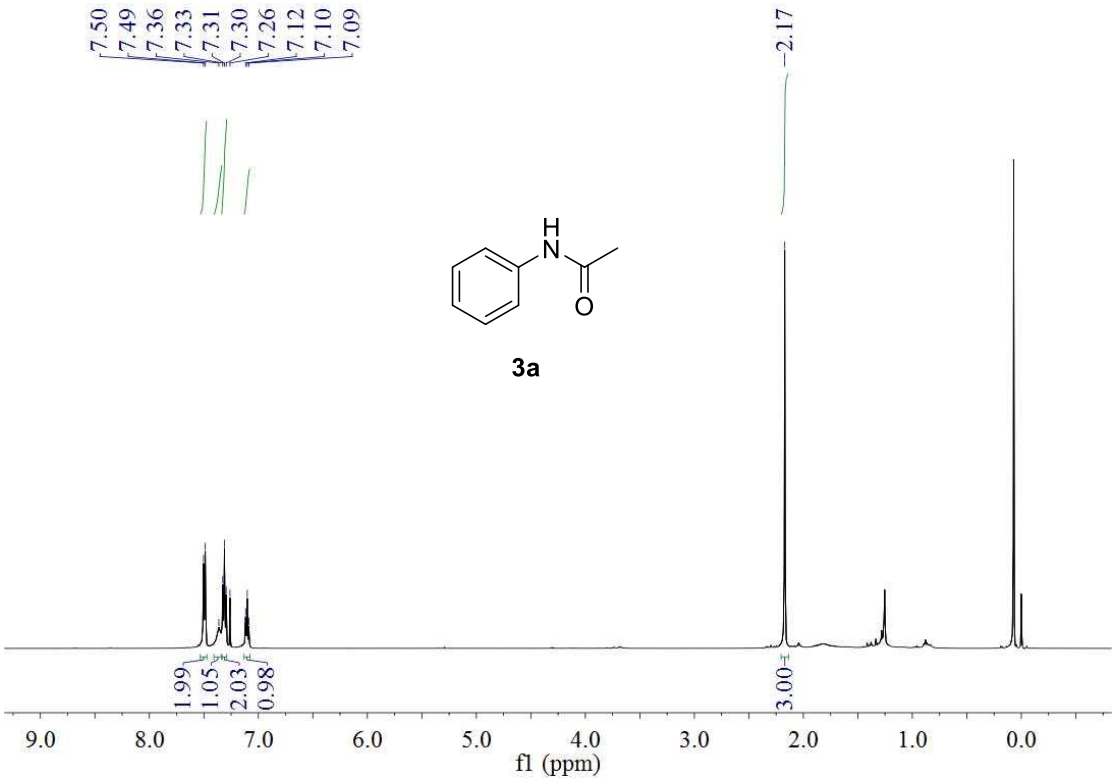
The product was obtained as white solid in 67% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.07 (d, *J* = 1.1 Hz, 1H), 7.00 – 6.84 (m, 1H), 3.94 – 3.70 (m, 1H), 1.92 – 1.87 (m, 2H), 1.77 – 1.71 (m, 2H), 1.64 – 1.60 (m, 1H), 1.36 – 1.31 (m, 2H), 1.25 – 1.15 (m, 3H).

***N*-(3,4-dichlorophenyl)propionamide (propanil)**

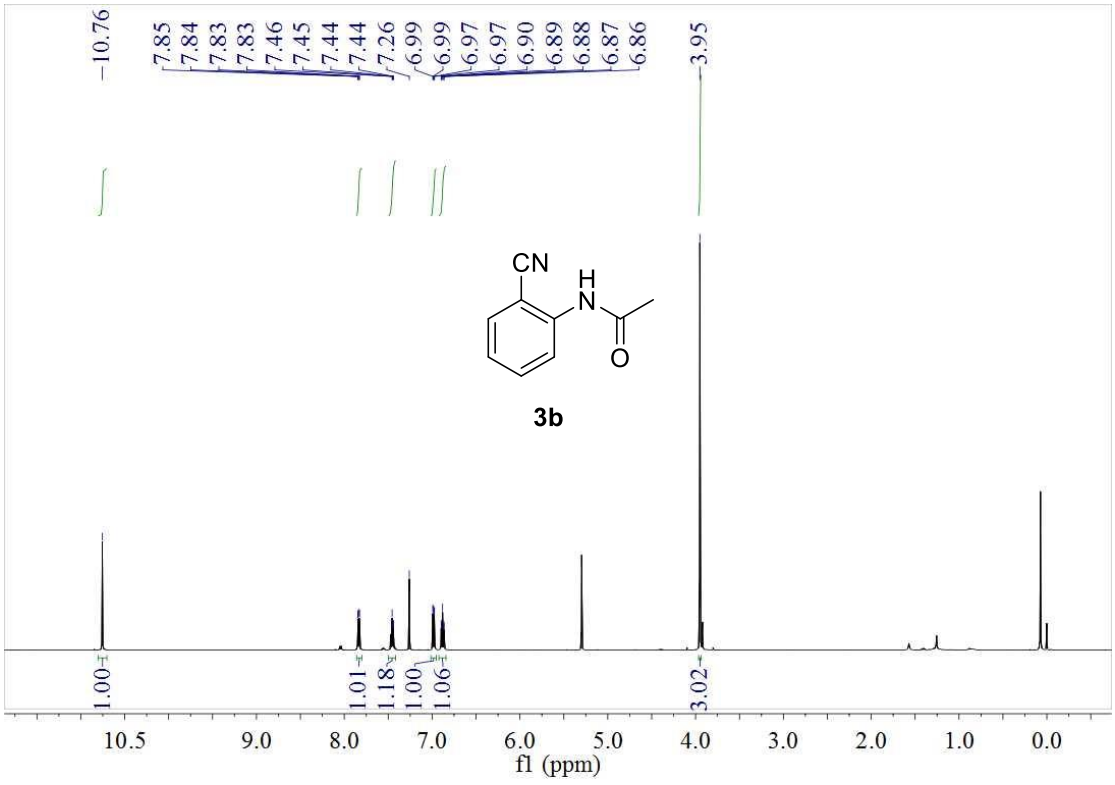


The product was obtained as yellow solid in 72% yield. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.76 (s, 1H), 7.35 (d, *J* = 8.6 Hz, 2H), 7.29 (s, 1H), 2.39 (q, *J* = 7.5 Hz, 2H), 1.23 (t, *J* = 7.5 Hz, 3H).^{13}C NMR (126 MHz, $CDCl_3$) δ 171.09 (s), 136.38 (s), 131.75 (s), 129.46 (s), 120.42 (s), 117.90 (s), 28.68 (s), 8.45 (s).

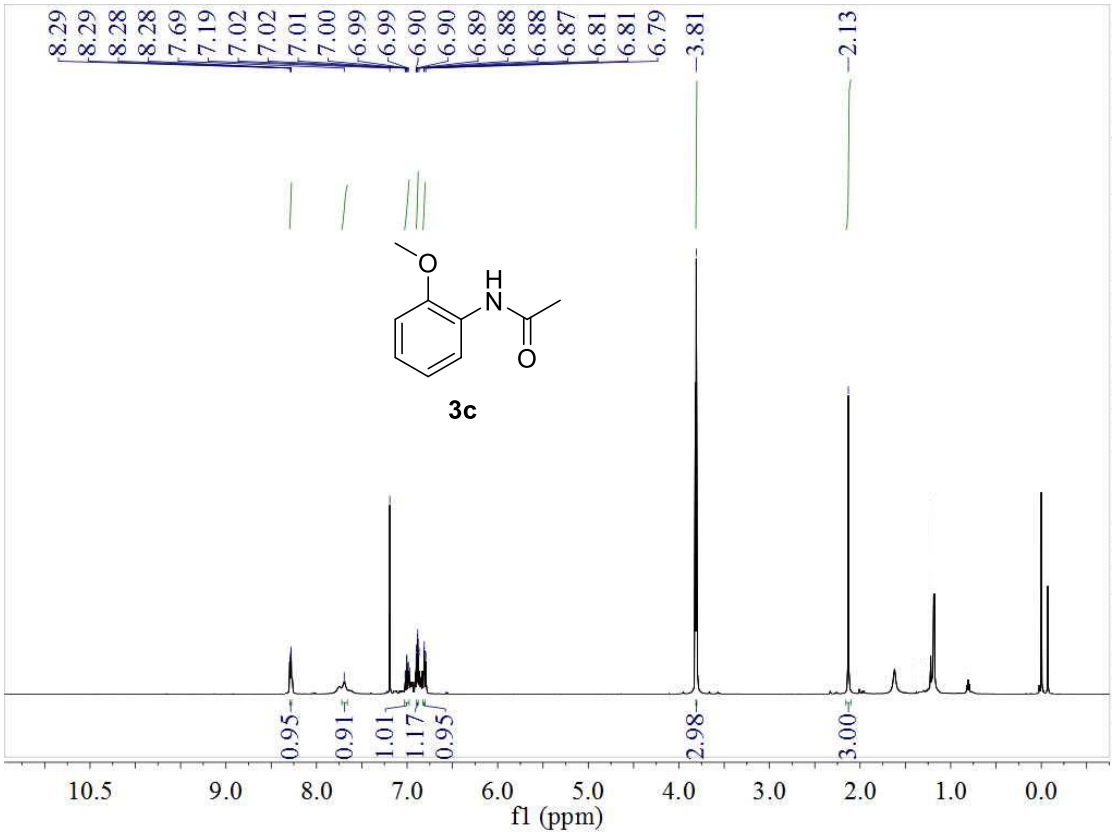
3. Copies of NMR spectra



3a



3b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8.29
8.28
8.28
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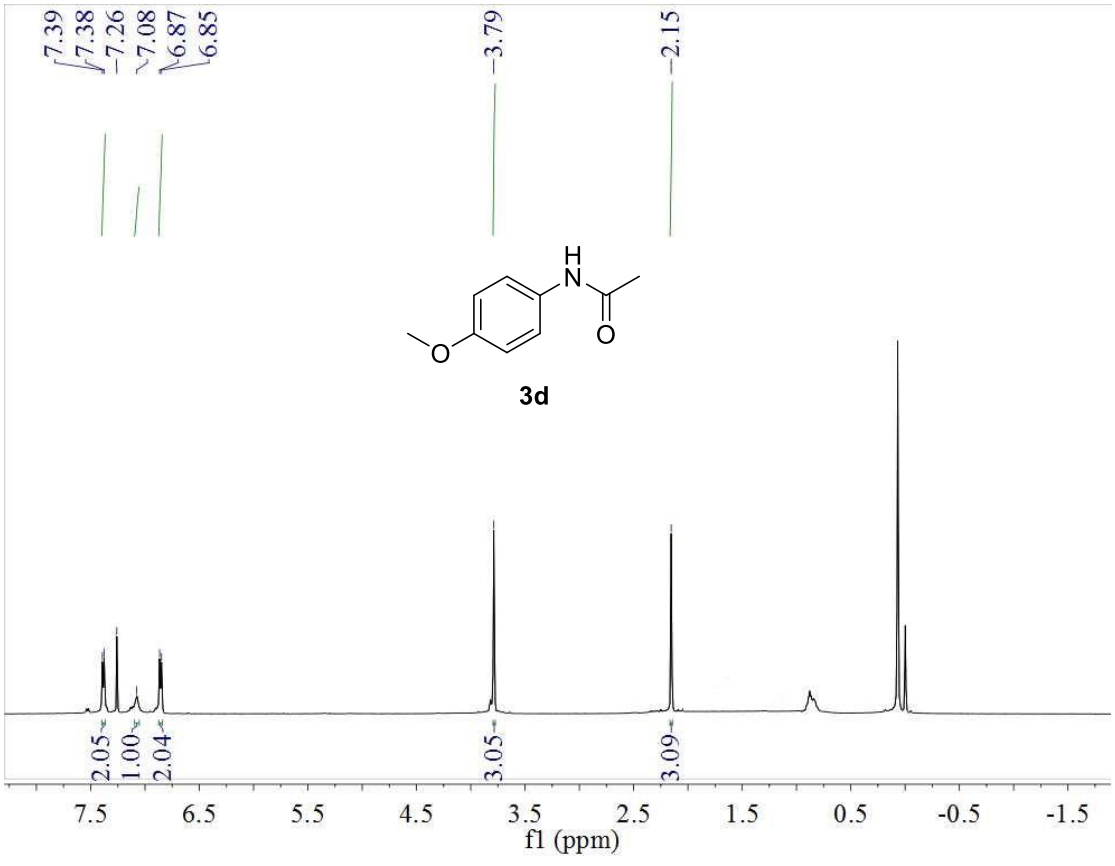
7.19
7.02
7.02
7.01
7.00
6.99
6.99
6.90
6.90
6.89
6.88
6.88
6.87
6.81
6.81
6.79
3.81
2.13
0.95
0.91
1.01
1.17
0.95
2.98
3.00
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

3c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7.38
7.26
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6.85
3.79
2.15
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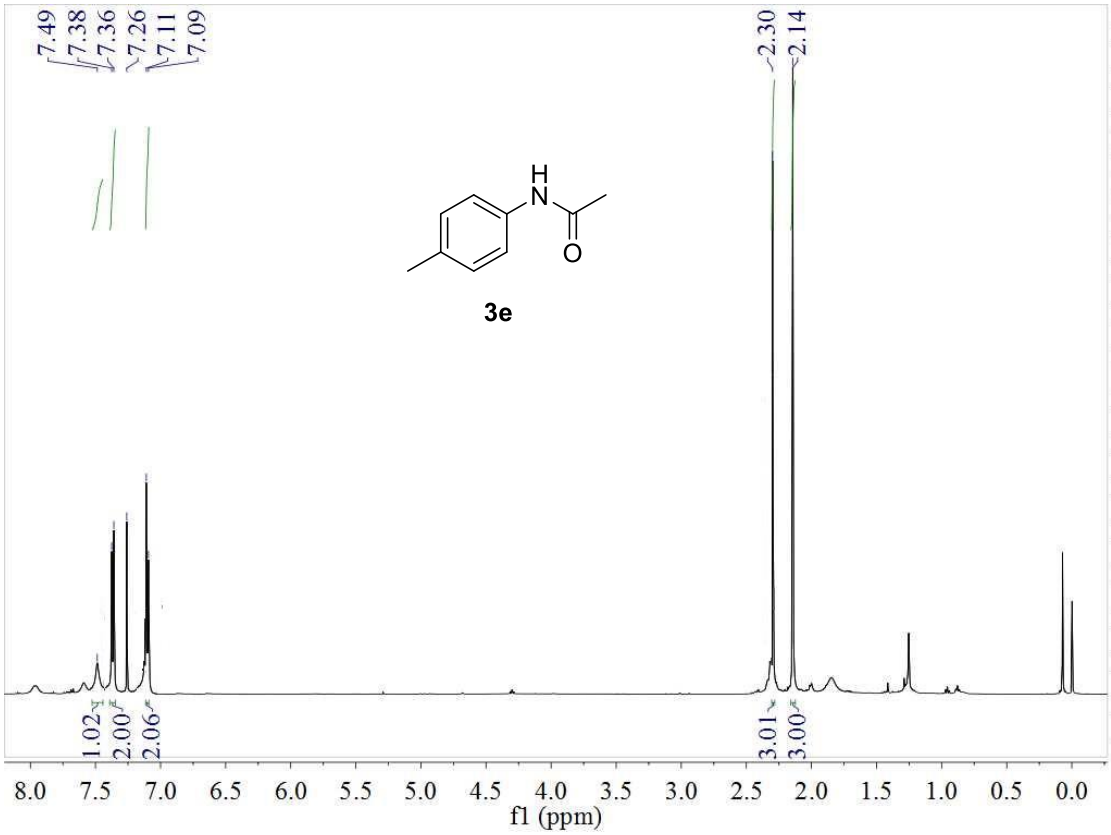
1.00
2.04
3.05
3.09
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
-1.5
f1 (ppm)

3d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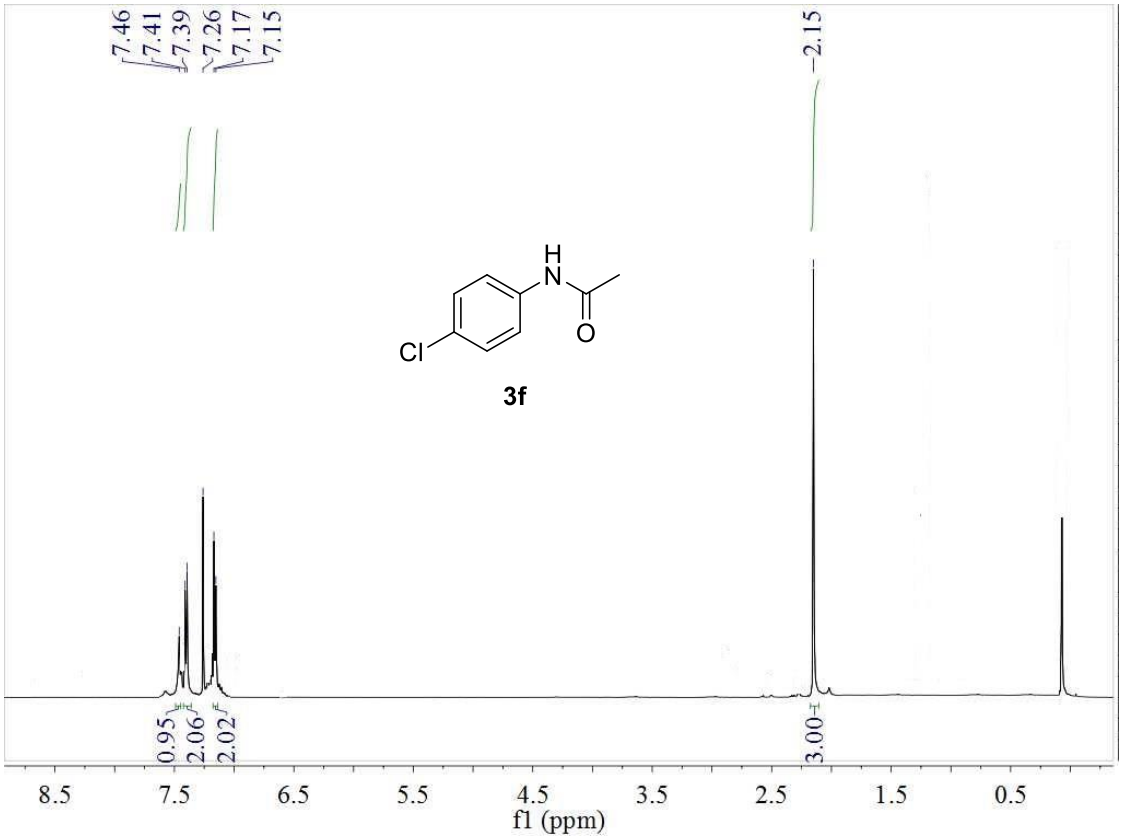
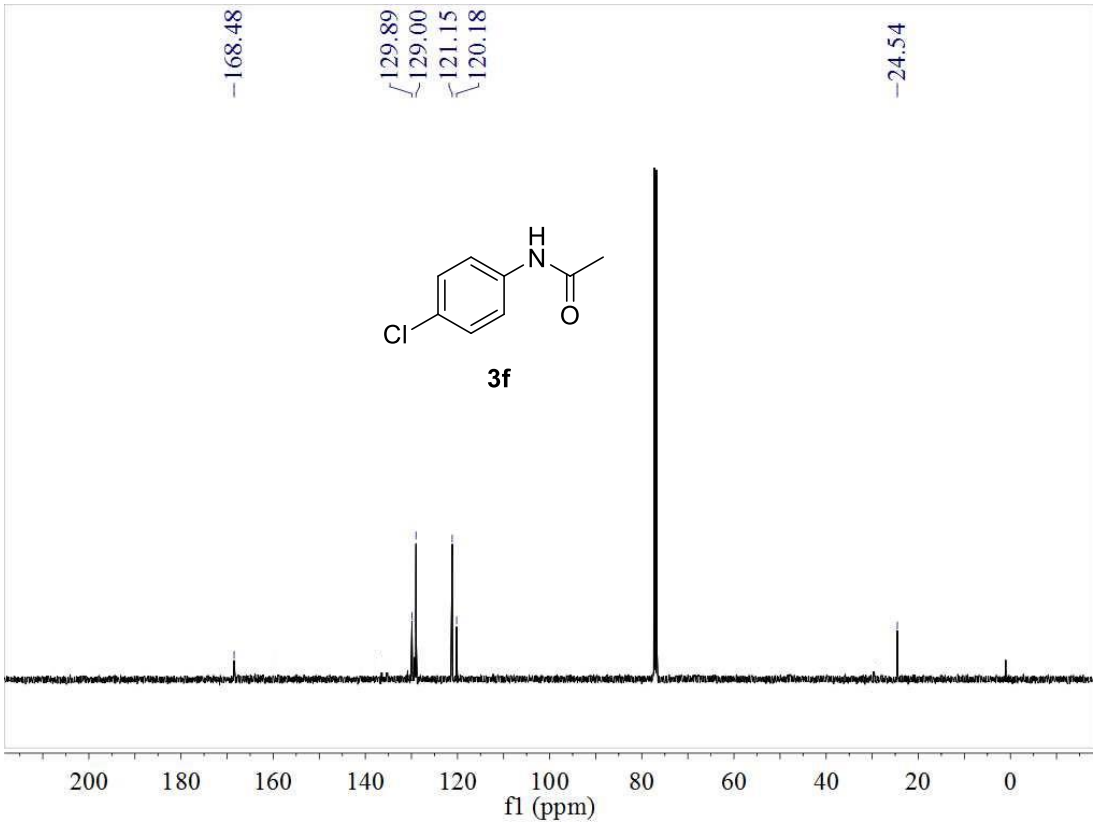
7.38
7.36
7.26
7.11
7.09
2.30
2.14
H
N
O
1.02
2.00
2.06
3.01
3.00
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

3e


7.46
7.41
7.39
7.26
7.17
7.15
2.15
H
N
O
Cl
0.95
2.06
2.02
3.00
8.5 7.5 6.5 5.5 4.5 3.5 2.5 1.5 0.5
f1 (ppm)

3f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121.15
120.18
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N
O
Cl
3f
200
180
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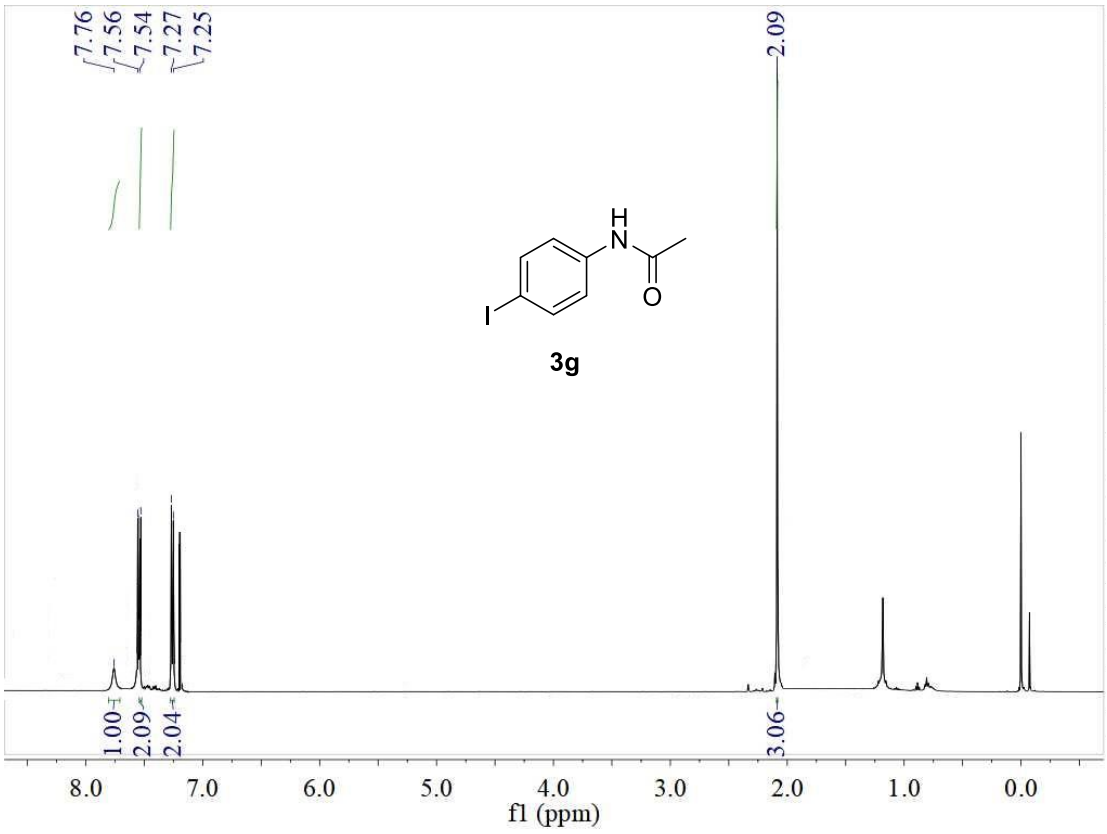
140
120
100
80
60
40
20
0
f1 (ppm)


7.76
7.56
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7.27
7.25
2.09
H
N
O
I
3g
1.00
2.09
2.04
3.06
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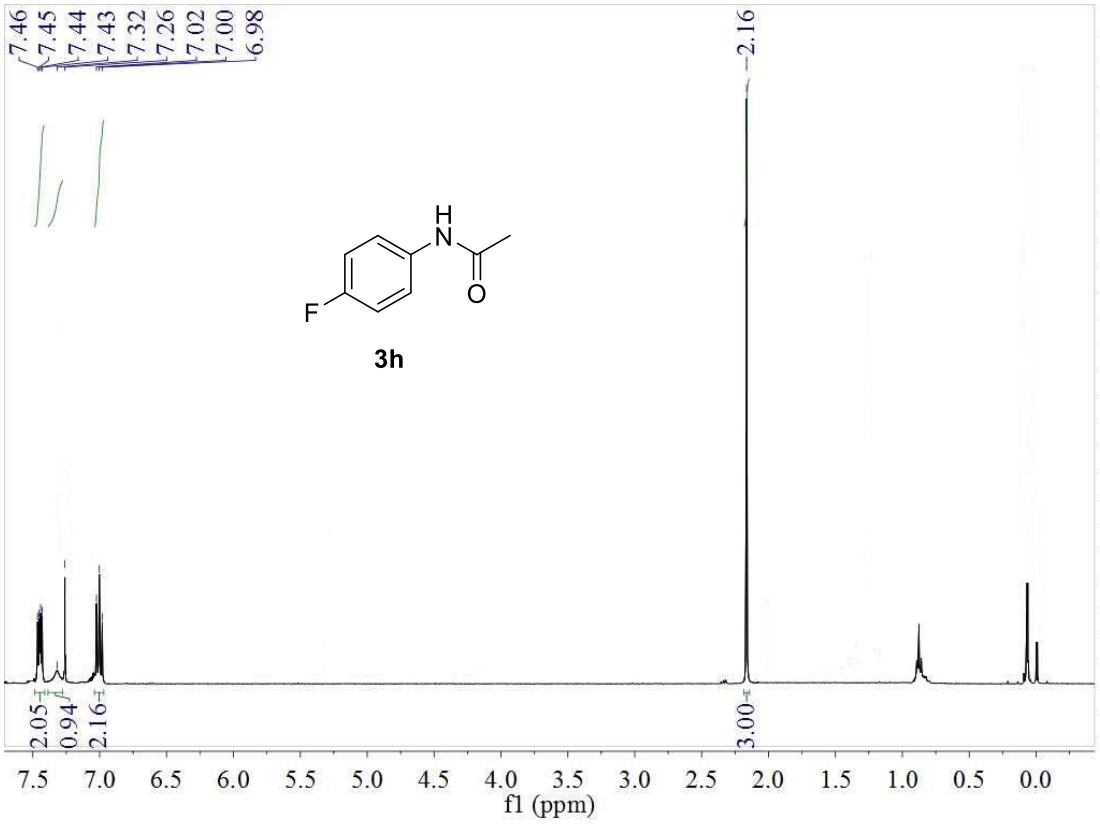
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)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7.32
7.26
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7.00
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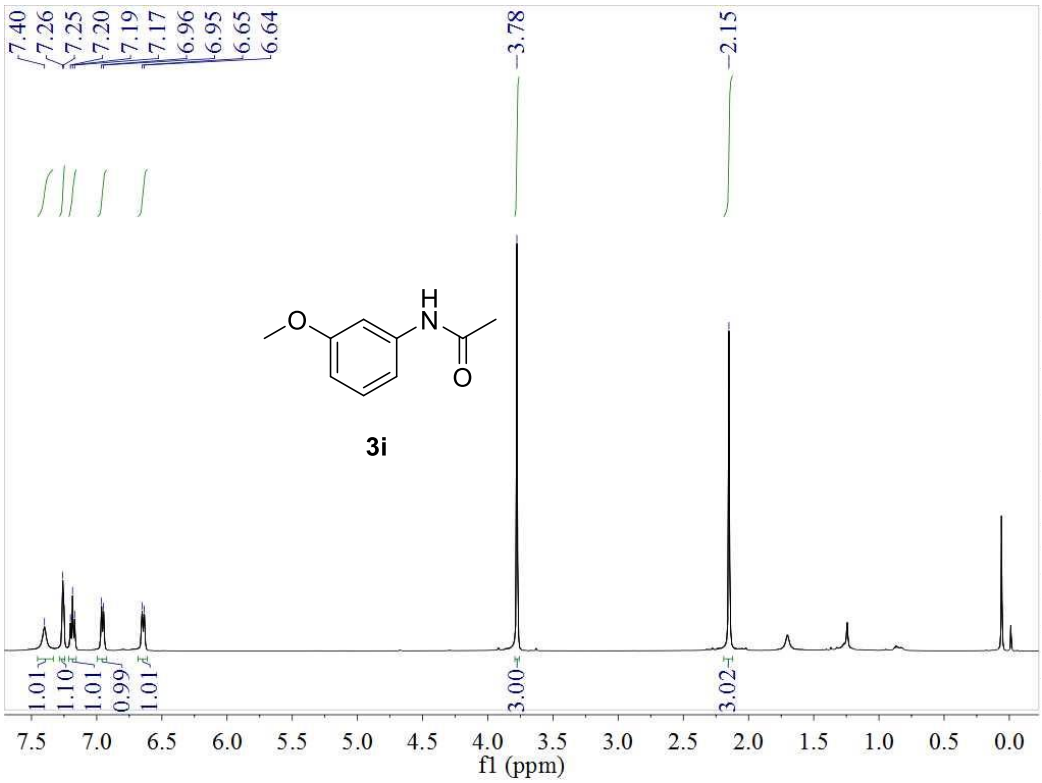
2.16
H
N
O
F
2.05
0.94
2.16
3.00
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

3h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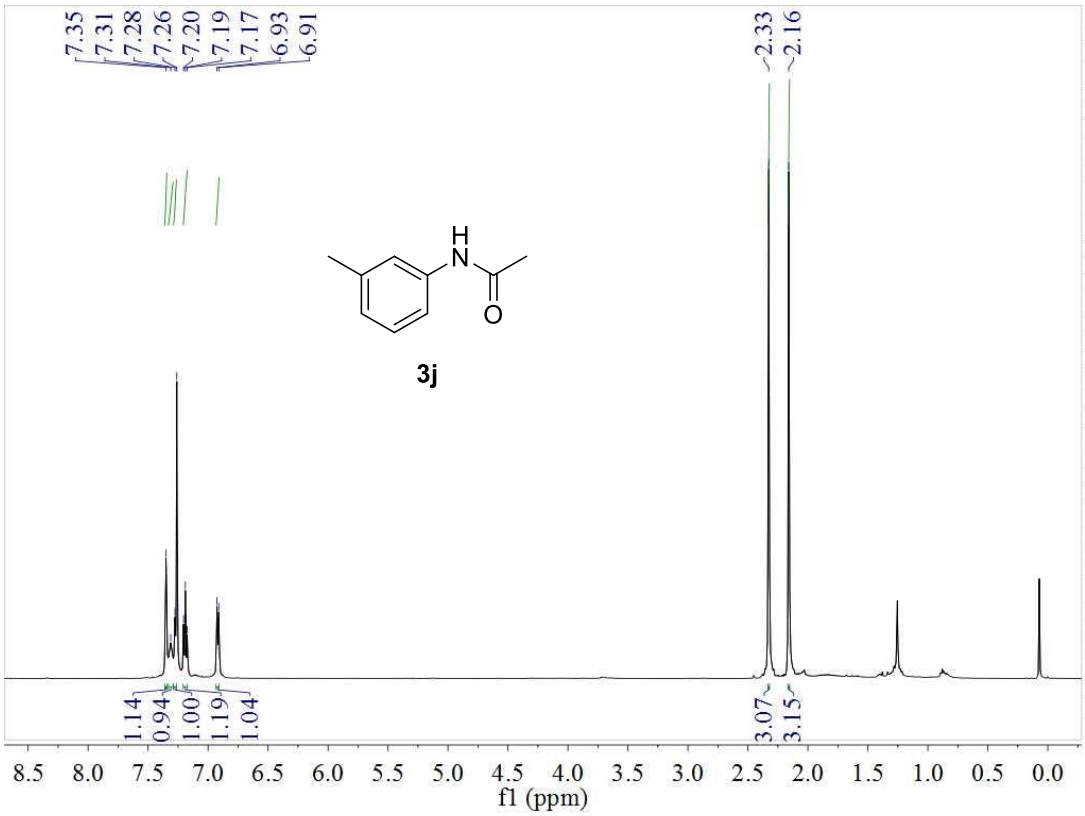
7.26
7.25
7.20
7.19
7.17
6.96
6.95
6.65
6.64
3.78
2.15
H
N
O
O
1.01
1.10
1.01
0.99
1.01
3.00
3.02
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

3i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7.28
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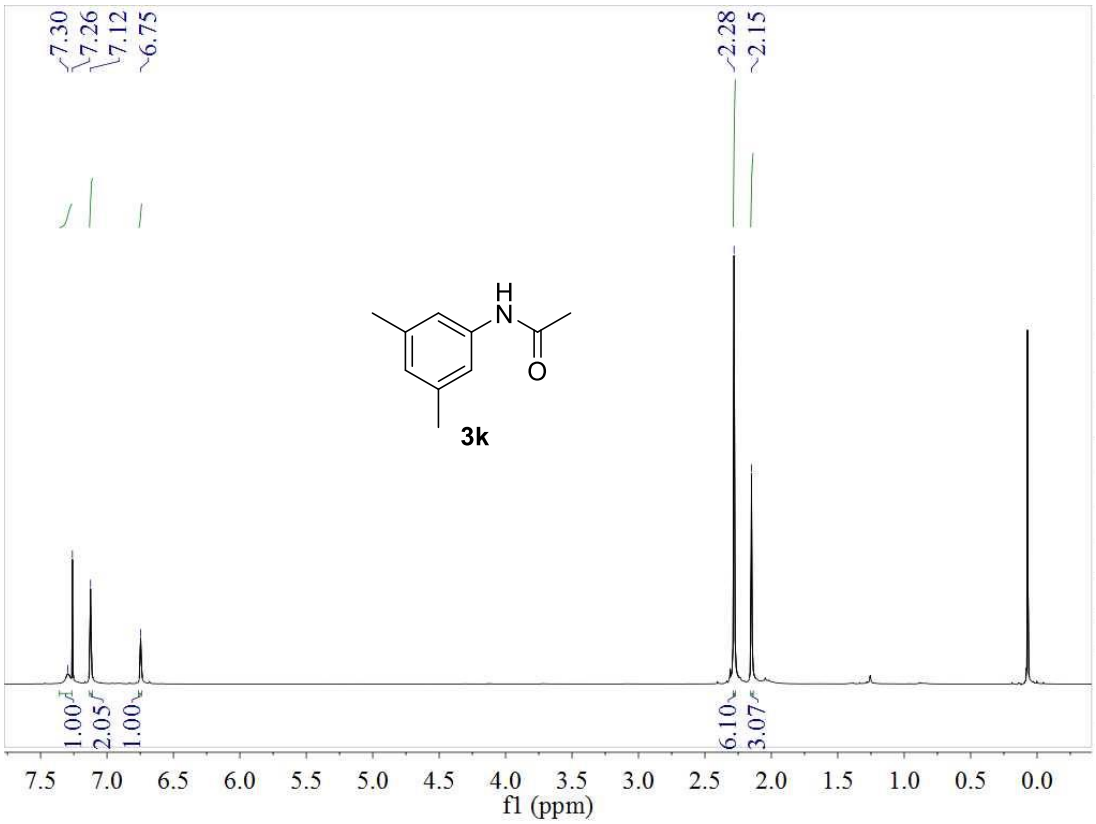
7.20
7.19
7.17
6.93
6.91
2.33
2.16
H
N
O
1.14
0.94
1.00
1.19
1.04
3.07
3.15
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

3j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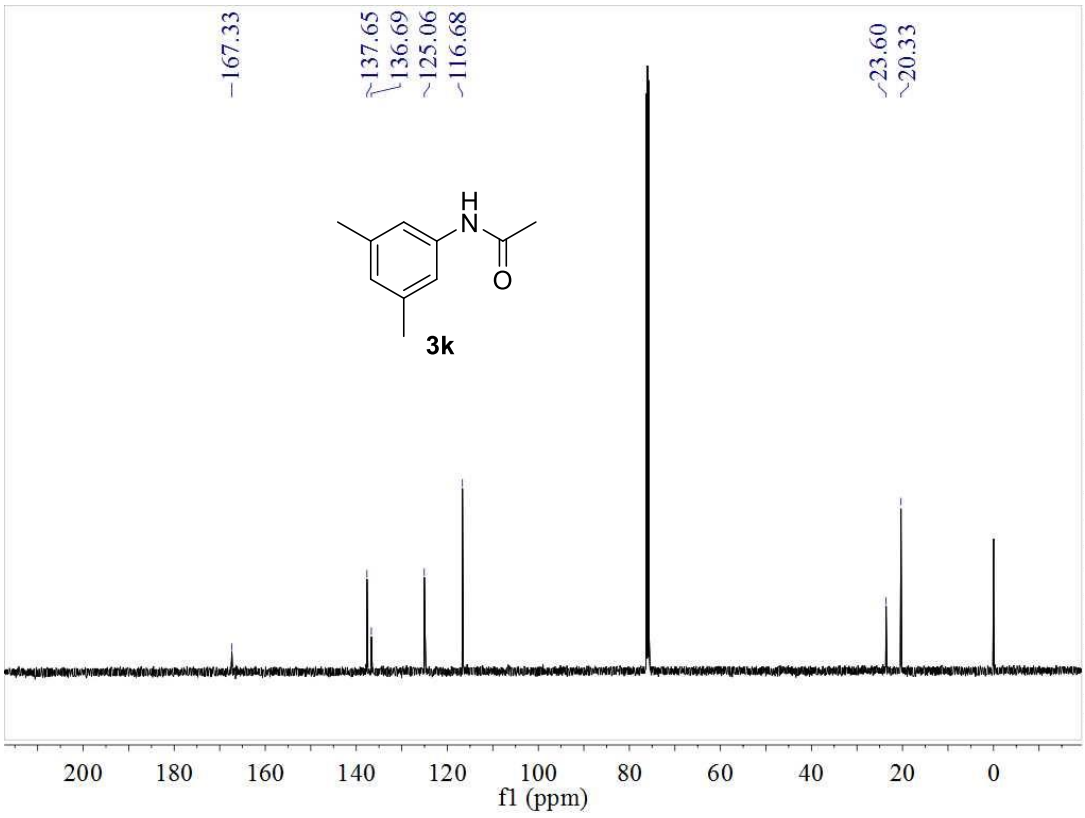
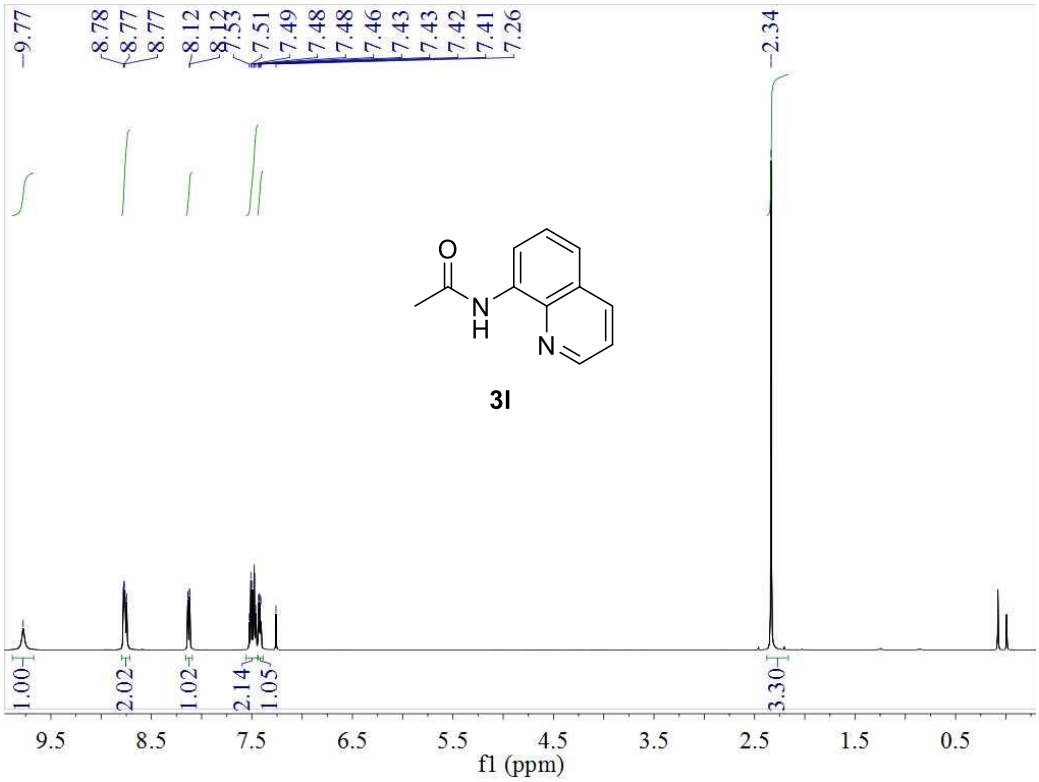
7.26
7.12
6.75
2.28
2.15
H
N
O
1.00
2.05
1.00
6.10
3.07
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

3k


167.33
137.65
136.69
125.06
116.68
23.60
20.33
H
N
O
3k
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)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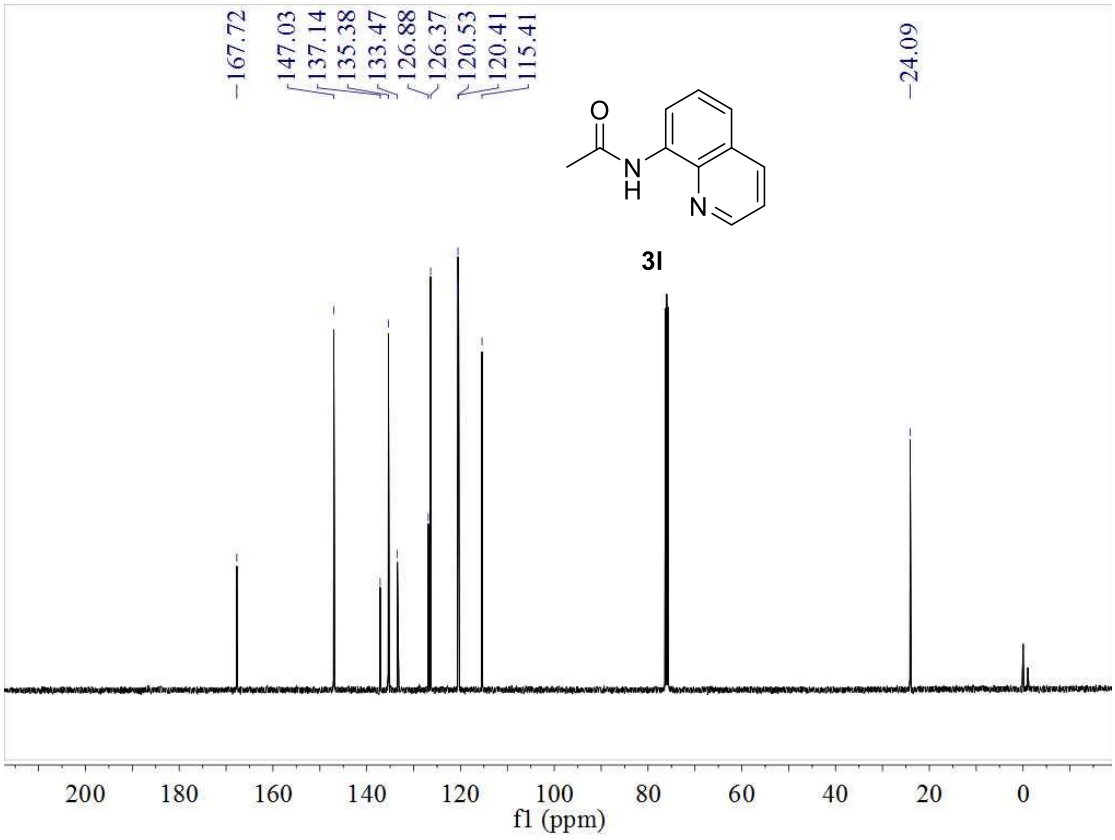
8.77
8.77
8.12
7.51
7.49
7.48
7.48
7.46
7.43
7.43
7.42
7.41
7.26
2.34
O
N
H
N
3l
1.00
2.02
1.02
2.14
1.05
3.30
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
f1 (ppm)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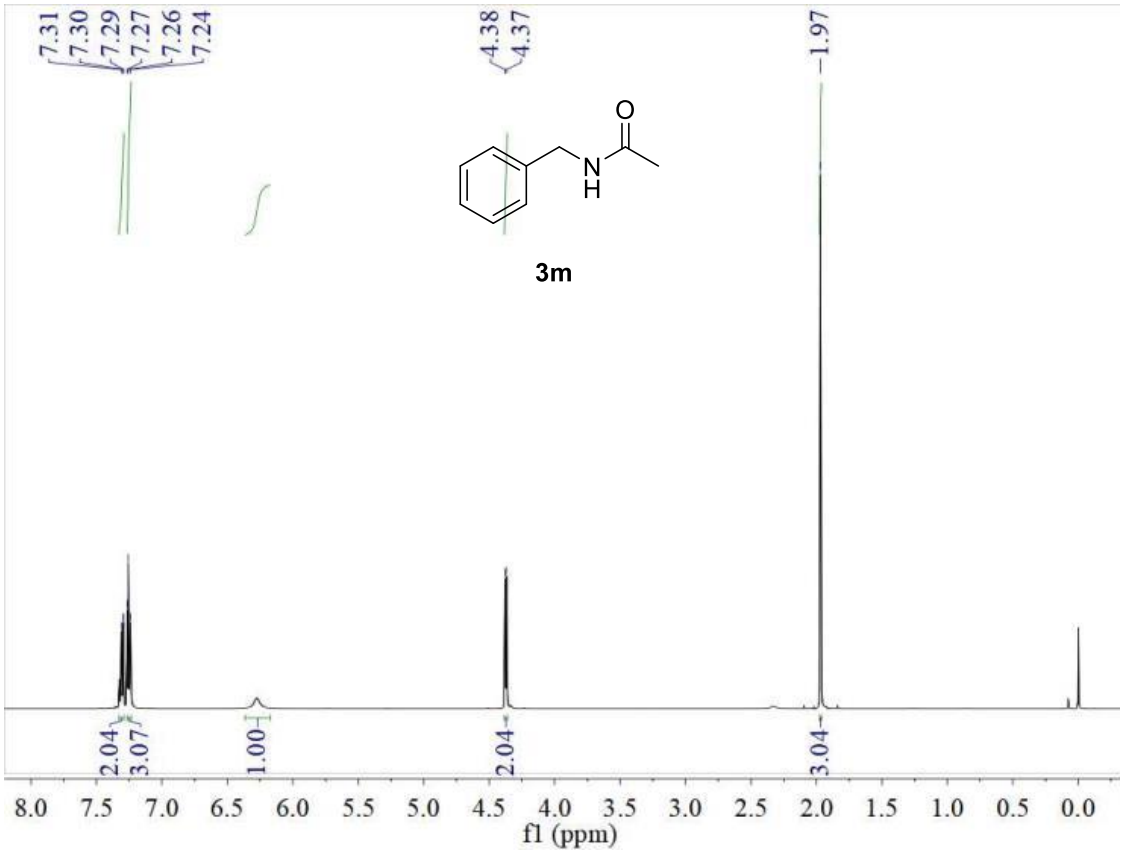
135.38
133.47
126.88
126.37
120.53
120.41
115.41
24.09
O
N
H
N
3l
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)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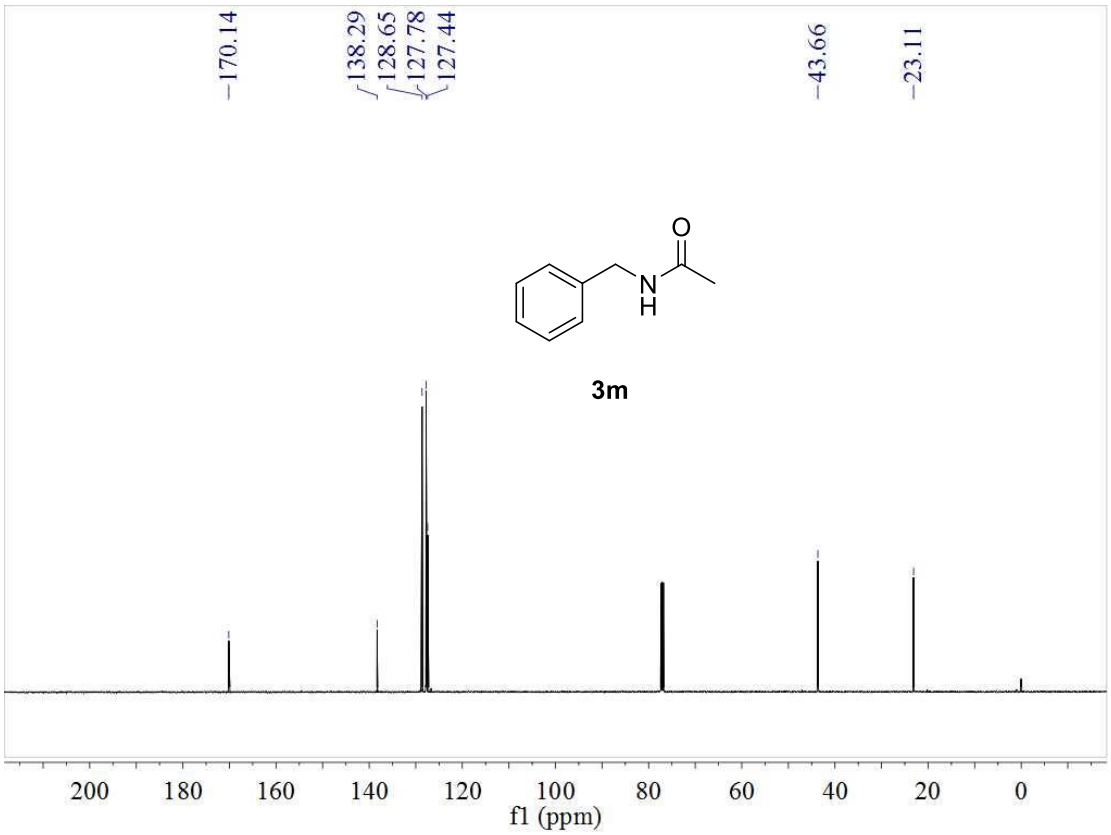
7.30
7.29
7.27
7.26
7.24
4.38
4.37
1.97
O
N
H
3m
2.04
3.07
1.00
2.04
3.04
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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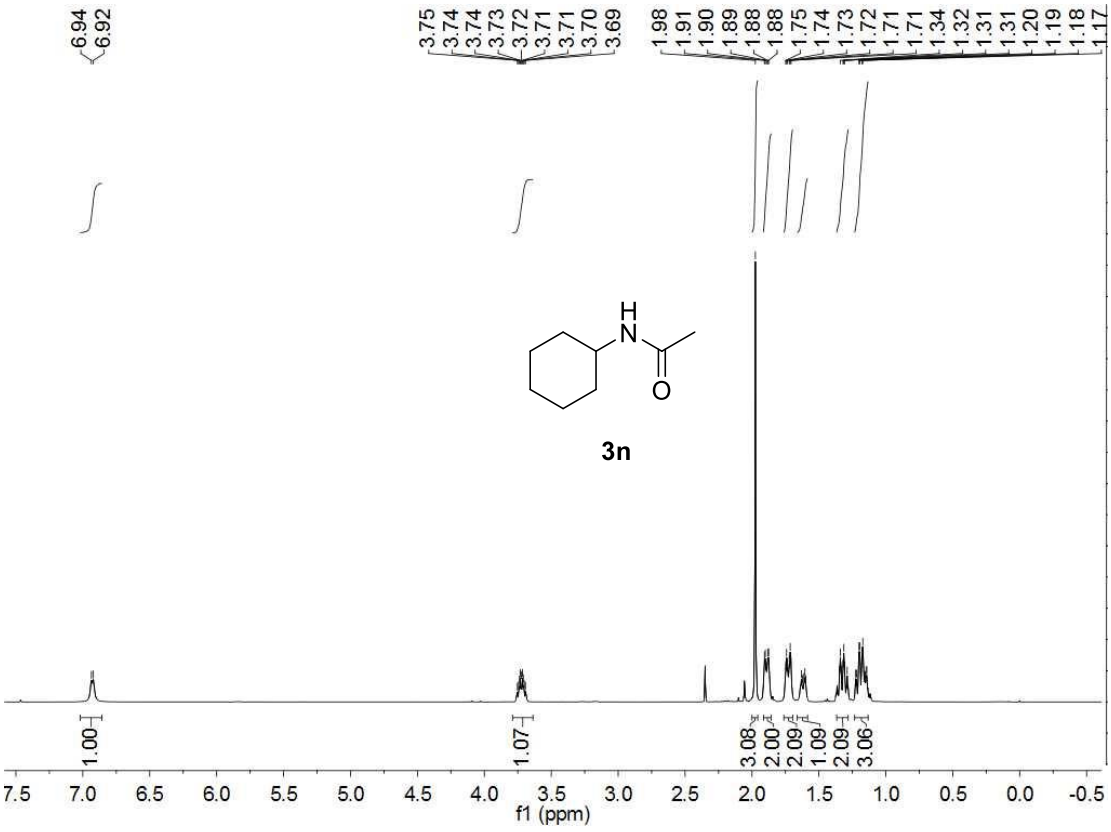
127.78
127.44
43.66
23.11
O
N
H
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)

3m


6.94
6.92
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3.74
3.74
3.73
3.72
3.71
3.71
3.70
3.69
1.98
1.91
1.90
1.89
1.88
1.88
1.75
1.74
1.73
1.72
1.71
1.71
1.34
1.32
1.31
1.31
1.20
1.19
1.18
1.17
H
N
O
1.00
1.07
3.08
2.00
2.09
1.09
2.09
3.06
7.5
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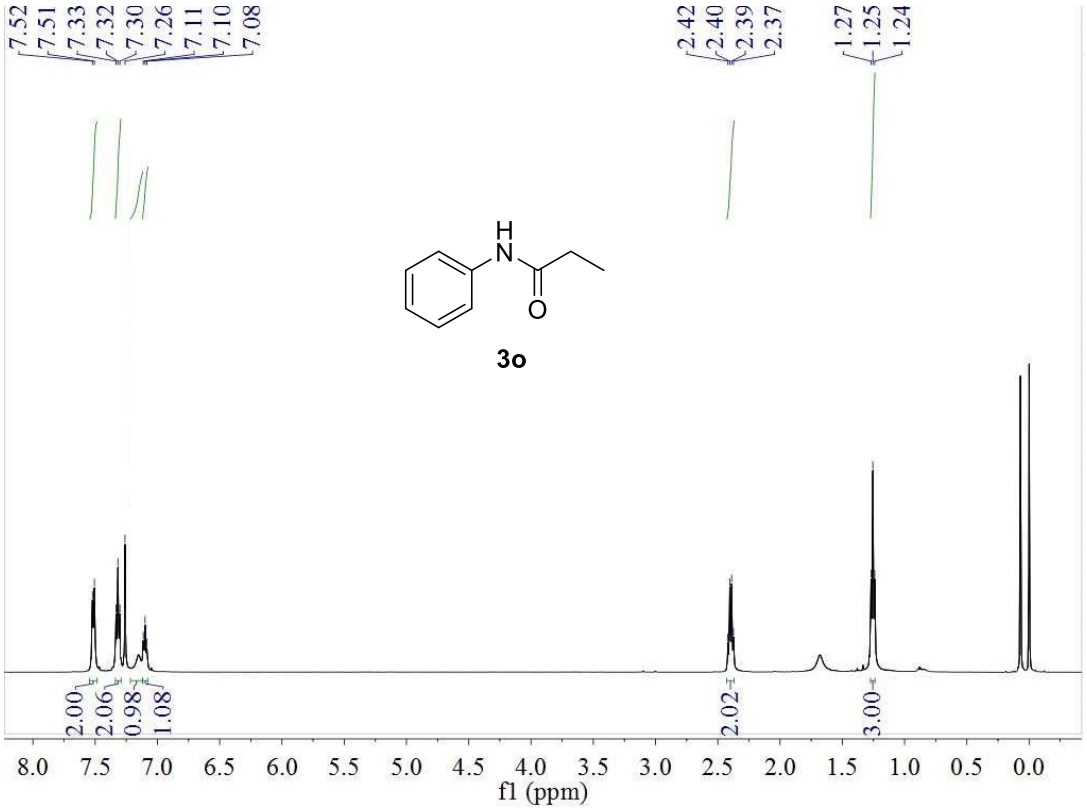
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

3n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7.33
7.32
7.30
7.26
7.11
7.10
7.08
2.42
2.40
2.39
2.37
1.27
1.25
1.24
H
N
O
3o
2.00
2.06
0.98
1.08
2.02
3.00
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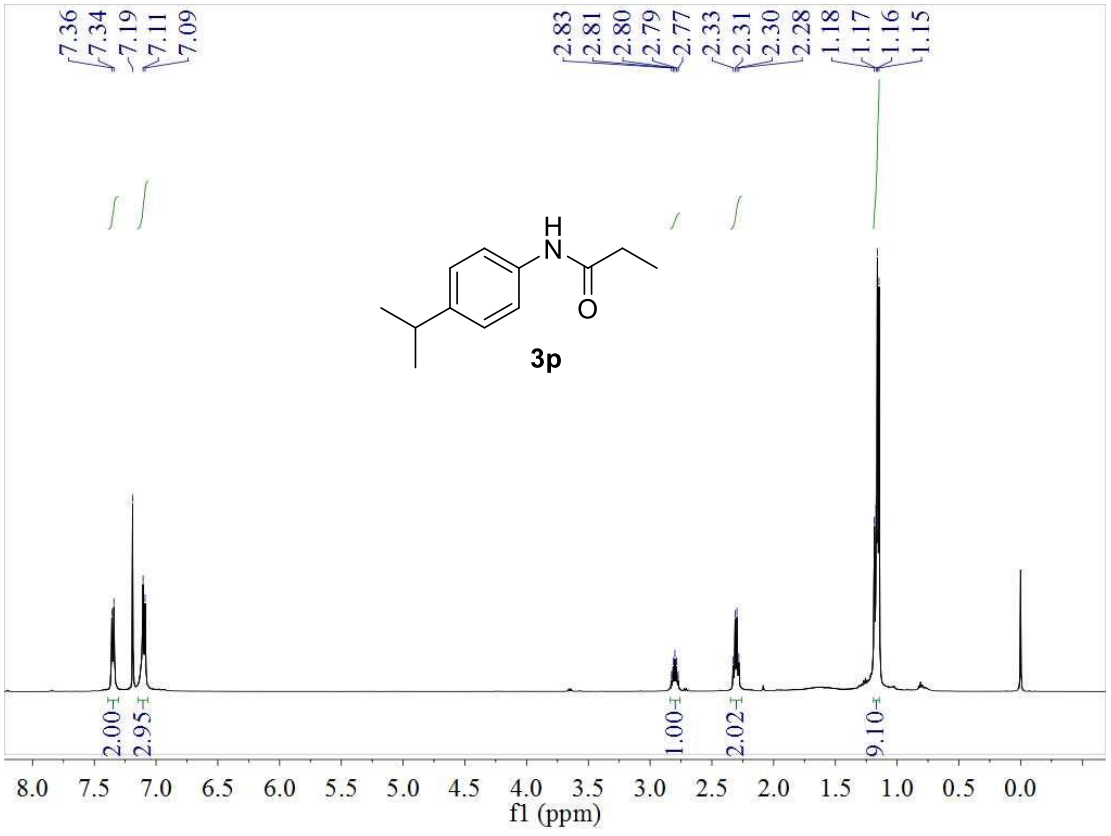
f1 (ppm)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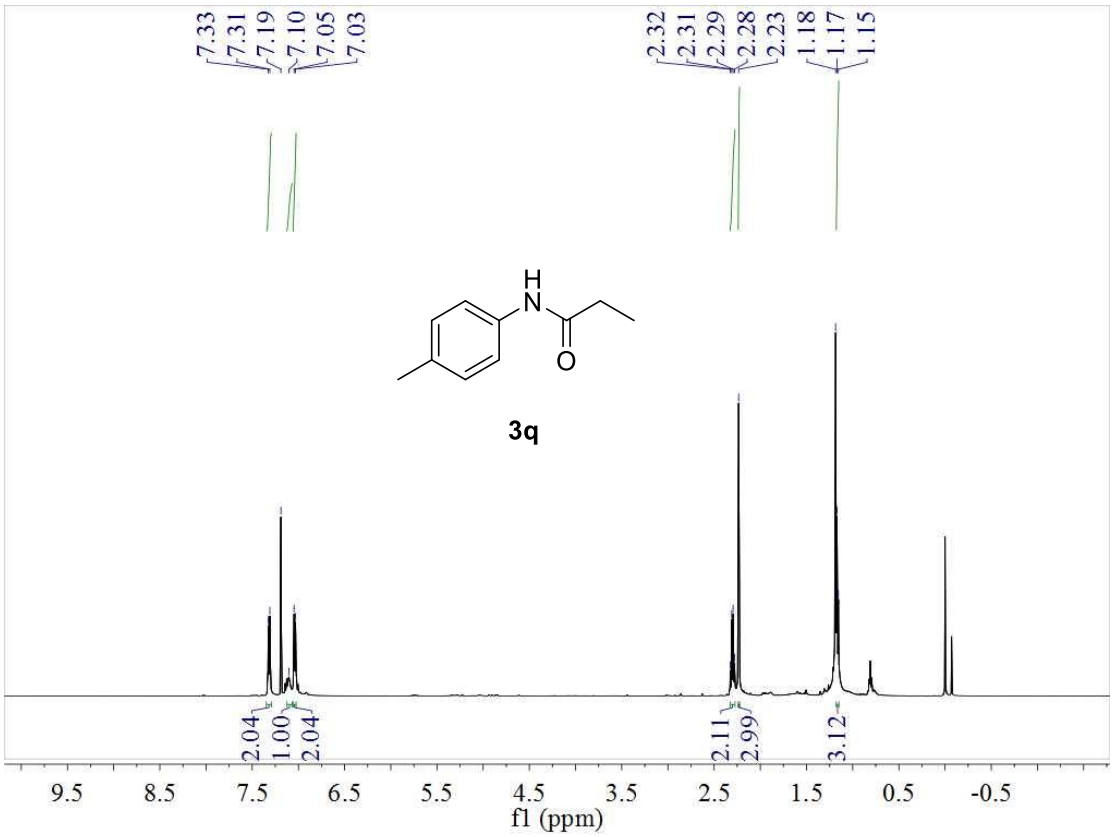
2.79
2.77
2.33
2.31
2.30
2.28
1.18
1.17
1.16
1.15
H
N
O
3p
2.00
2.95
1.00
2.02
9.10
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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7.19
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2.31
2.29
2.28
2.23
1.18
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1.15
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N
O
3q
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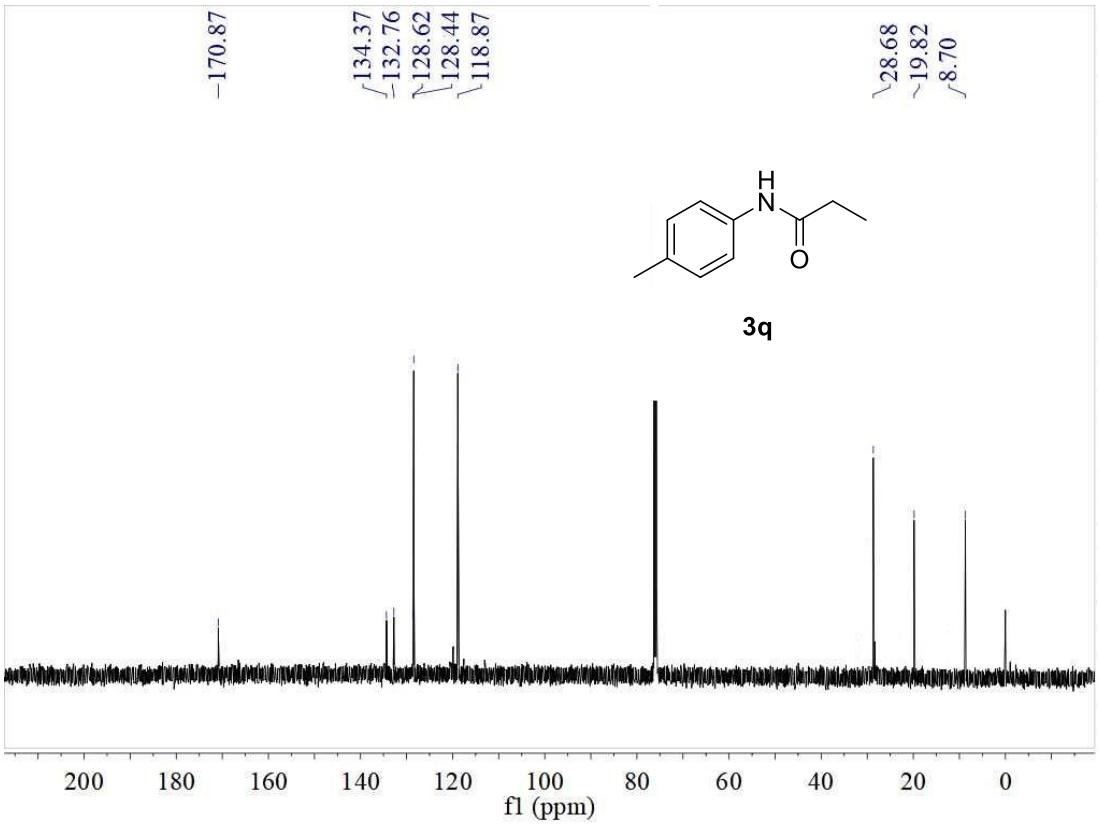
2.04
2.11
2.99
3.12
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
f1 (ppm)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128.62
128.44
118.87
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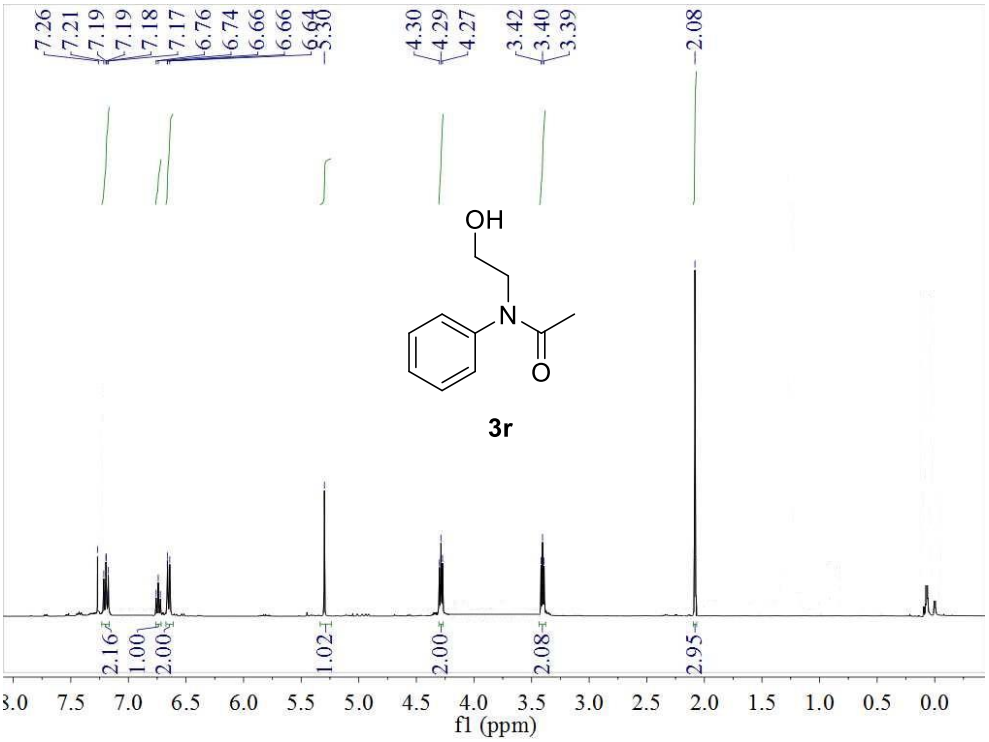
19.82
8.70
H
N
O
3q
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)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6.64
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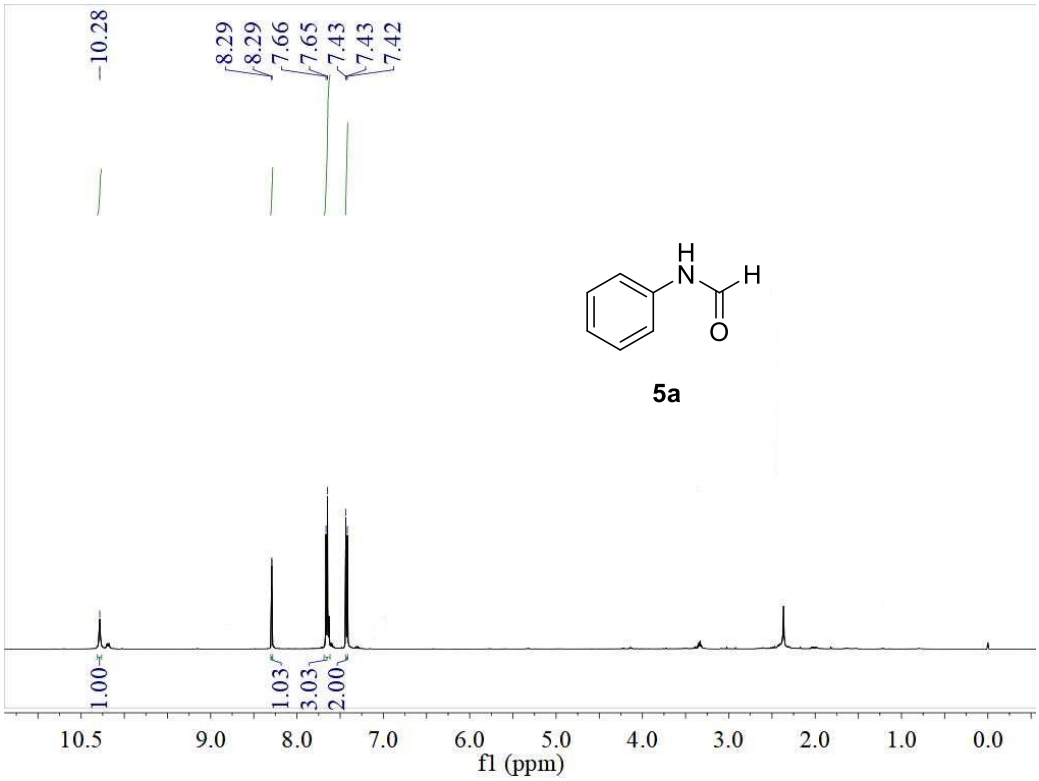
4.29
4.27
3.42
3.40
3.39
2.08
OH
N
O
3r
2.16
1.00
2.00
1.02
2.00
2.08
2.95
3.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


10.28
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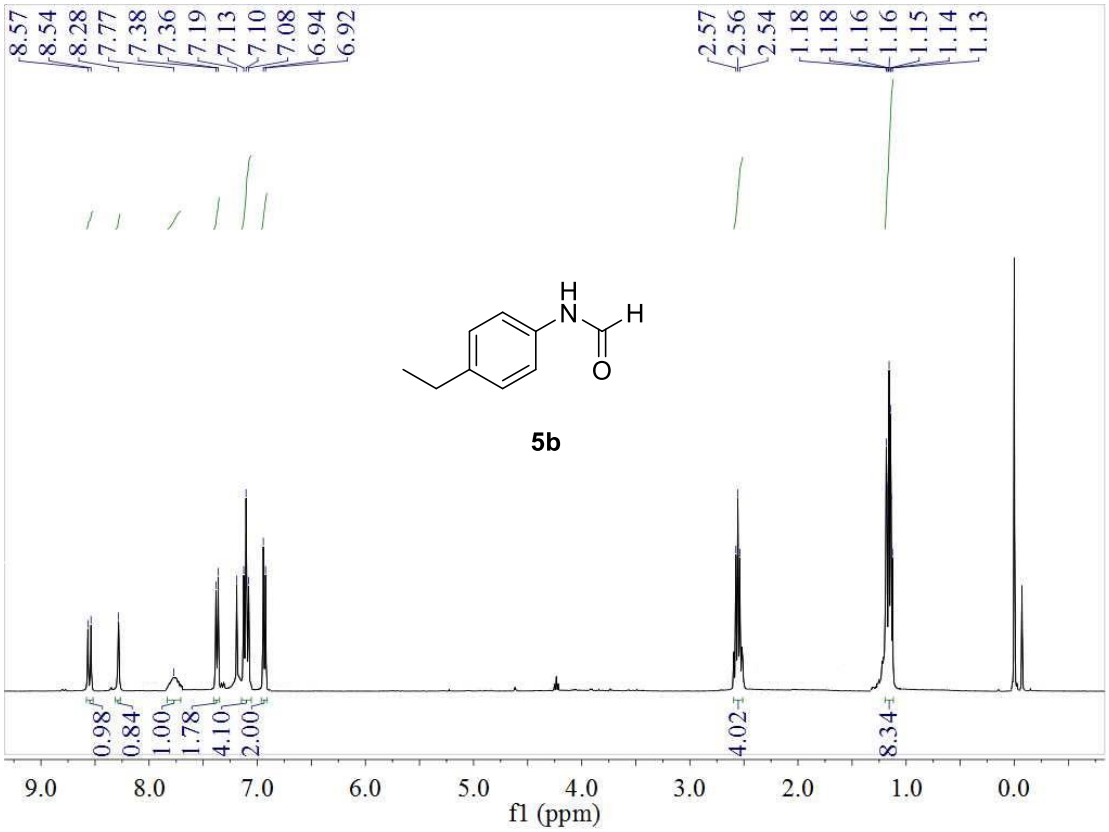
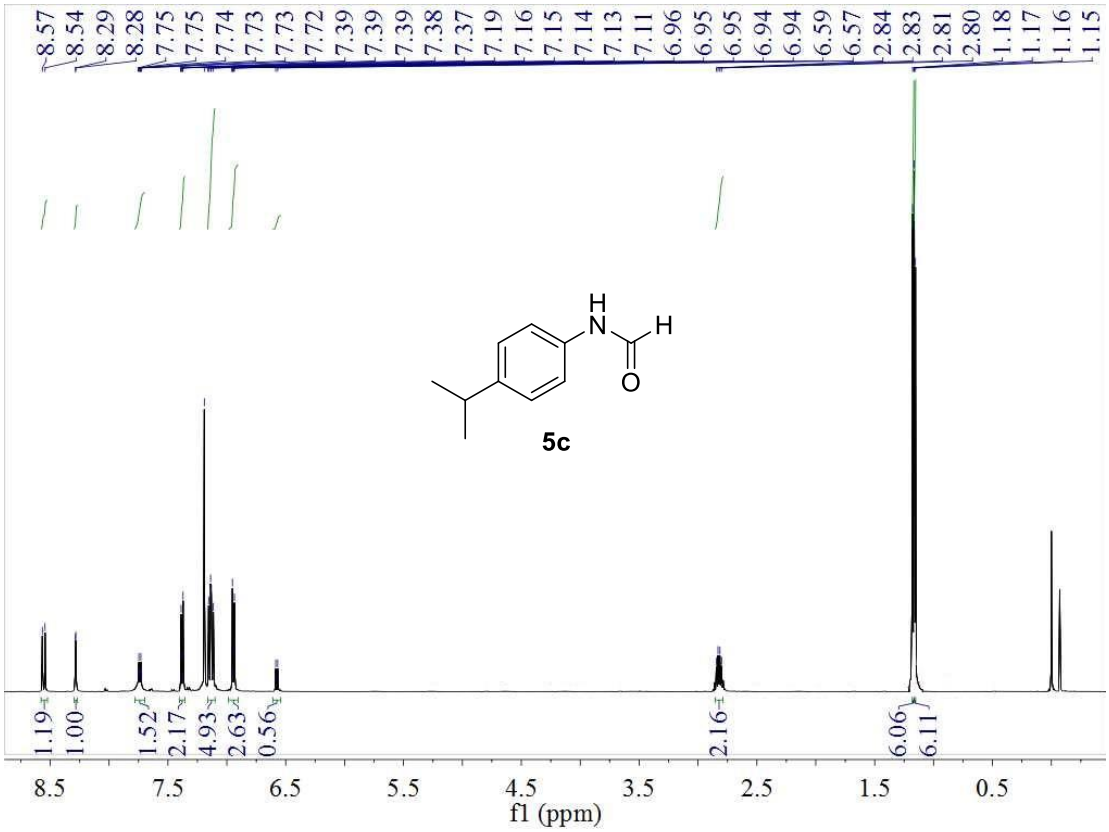
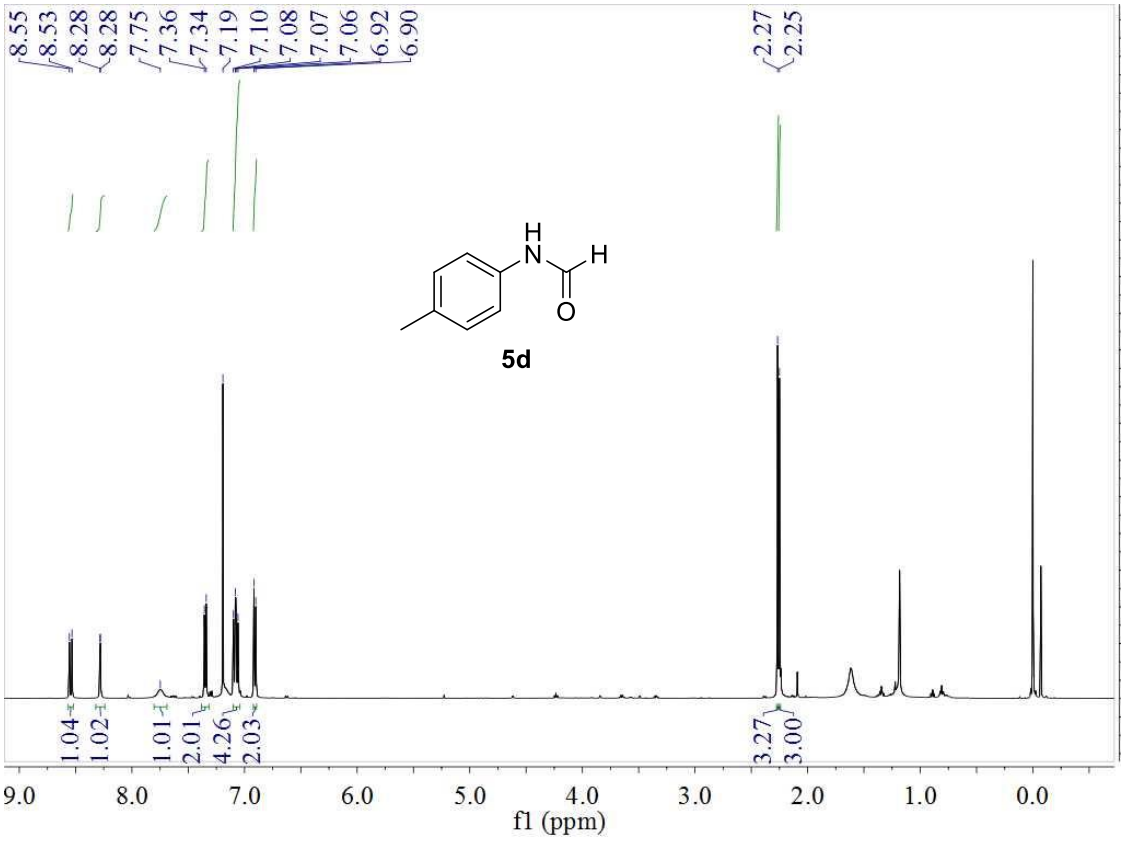
7.66
7.65
7.43
7.43
7.42
H
N
H
O
5a
1.00
1.03
3.03
2.00
10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
f1 (ppm)


8.57
8.54
8.28
7.77
7.38
7.36
7.19
7.13
7.10
7.08
6.94
6.92
2.57
2.56
2.54
1.18
1.18
1.16
1.16
1.15
1.14
1.13
H
N
H
O
0.98
0.84
1.00
1.78
4.10
2.00
4.02
8.34
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

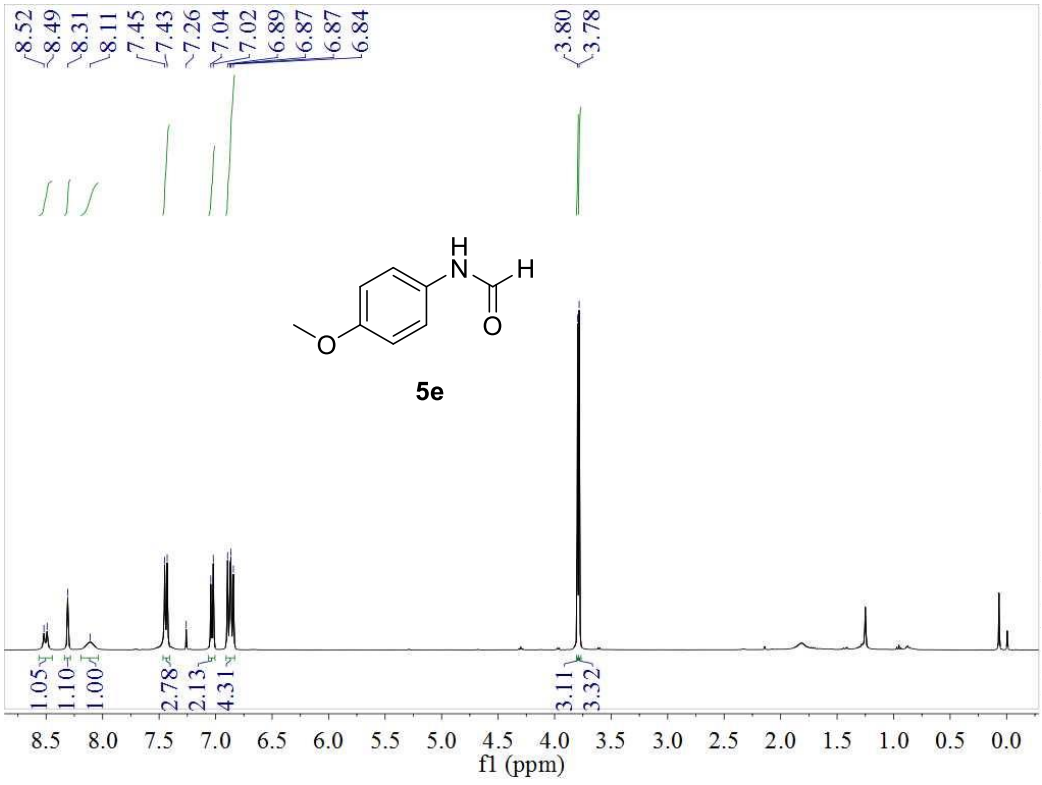
5b


8.57
8.54
8.29
8.28
7.75
7.75
7.74
7.73
7.73
7.72
7.39
7.39
7.39
7.38
7.37
7.19
7.16
7.15
7.14
7.13
7.11
6.96
6.95
6.95
6.94
6.94
6.59
6.57
2.84
2.83
2.81
2.80
1.18
1.17
1.16
1.15
H
N
H
O
1.19
1.00
1.52
2.17
4.93
2.63
0.56
2.16
6.06
6.11
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
f1 (ppm)

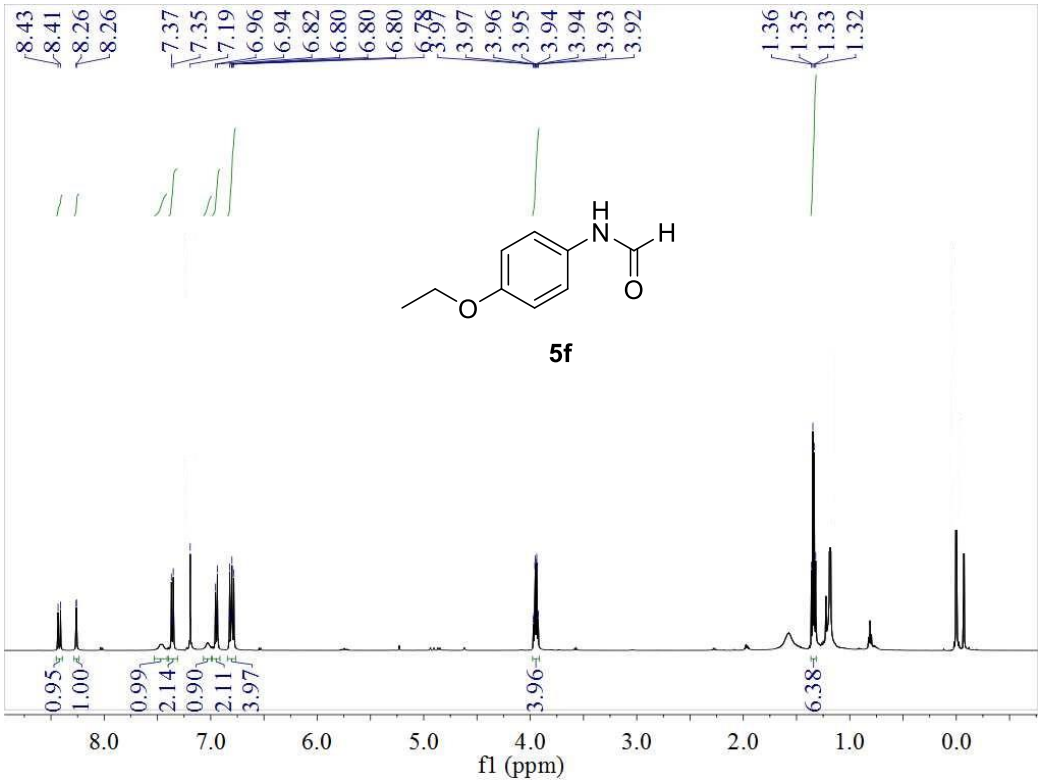
5c


8.55
8.53
8.28
8.28
7.75
7.36
7.34
7.19
7.10
7.08
7.07
7.06
6.92
6.90
2.27
2.25
1.04
1.02
1.01
2.01
4.26
2.03
3.27
3.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

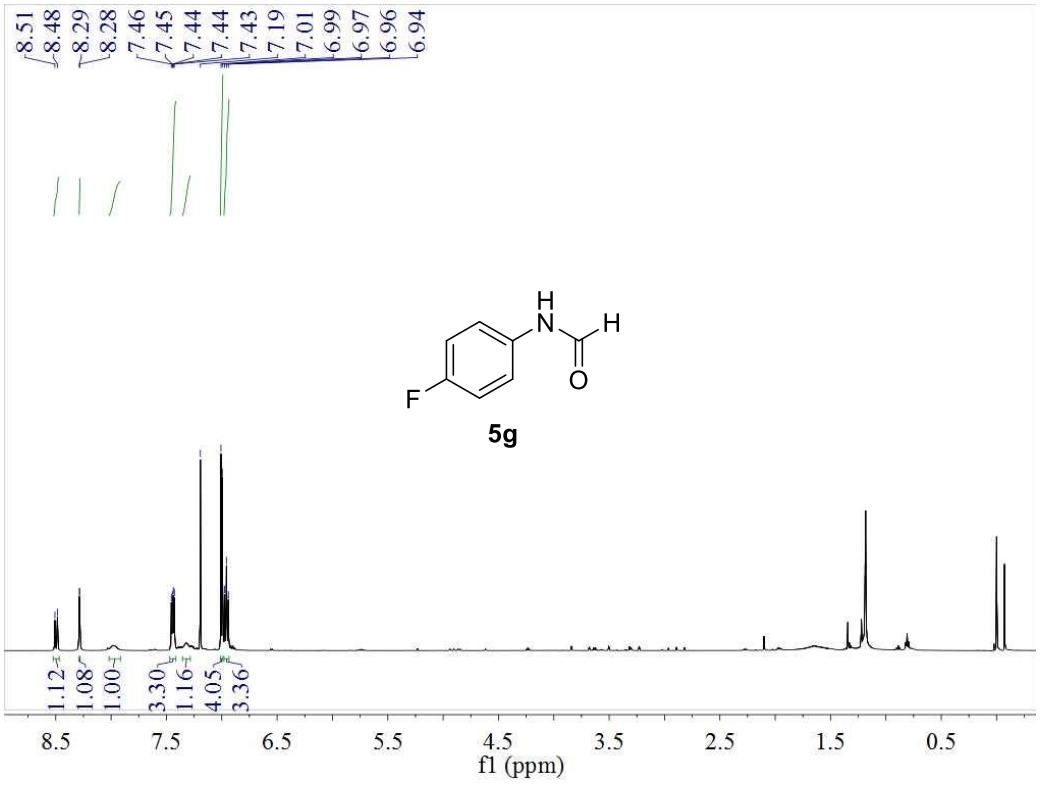
5d


8.52
8.49
8.31
8.11
7.45
7.43
7.26
7.04
7.02
6.89
6.87
6.87
6.84
3.80
3.78
1.05
1.10
1.00
2.78
2.13
4.31
3.11
3.32
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

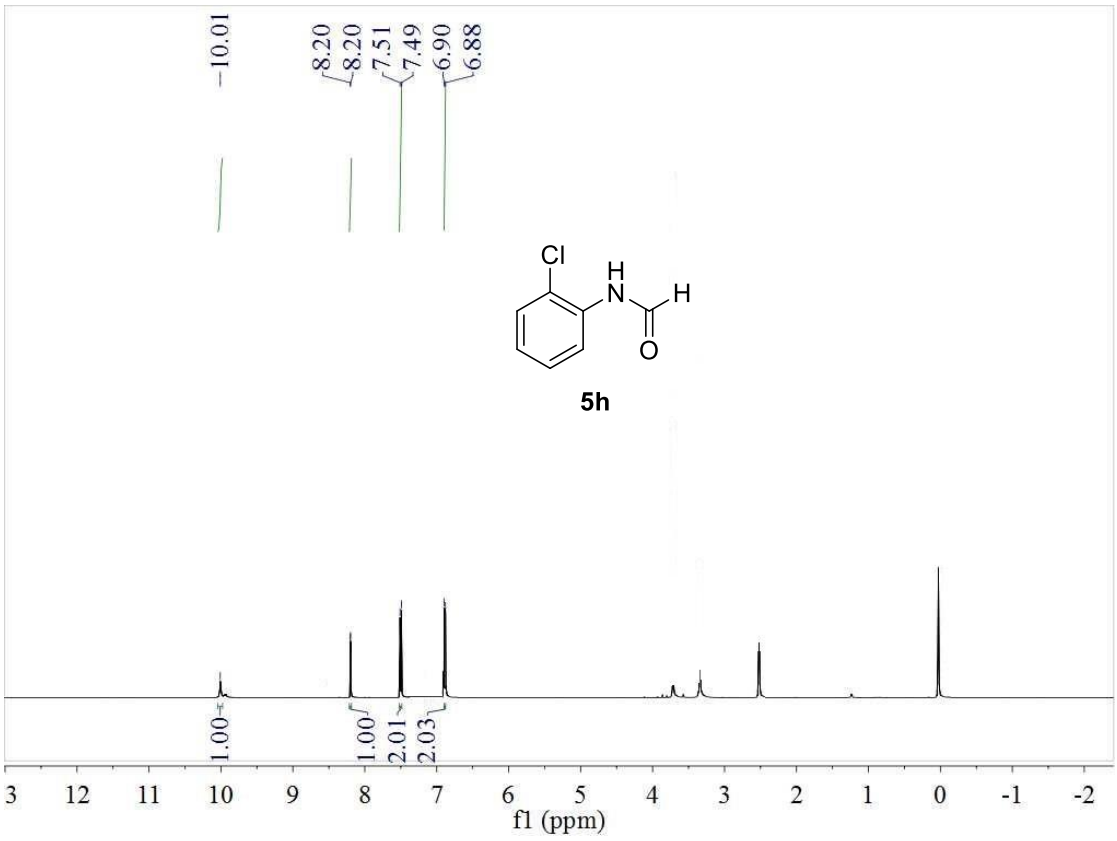
5e


8.43
8.41
8.26
8.26
7.37
7.35
7.19
6.96
6.94
6.82
6.80
6.80
6.80
6.78
3.97
3.97
3.96
3.95
3.94
3.94
3.93
3.92
1.36
1.35
1.33
1.32
H
N
H
O
O
0.95
1.00
0.99
2.14
0.90
2.11
3.97
3.96
6.38
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
f1 (ppm)

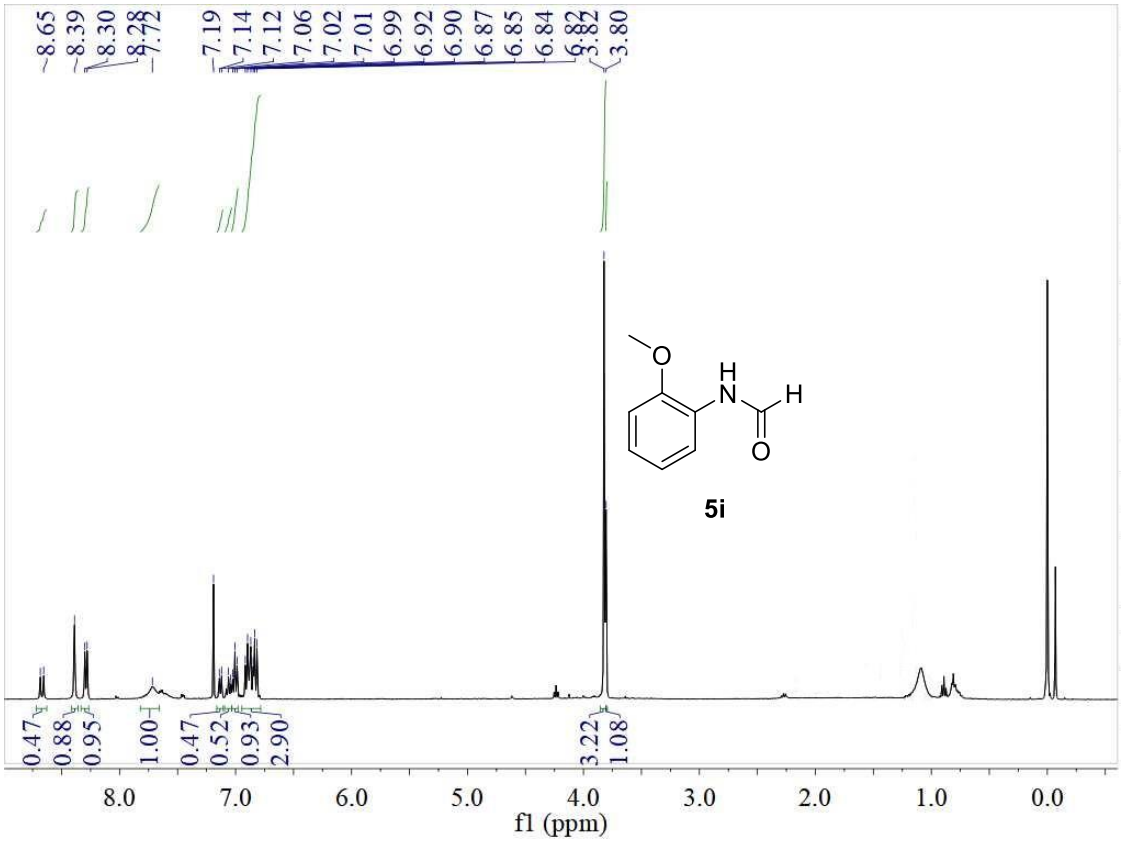
5f


8.51
8.48
8.29
8.28
7.46
7.45
7.44
7.44
7.43
7.19
7.01
6.99
6.97
6.96
6.94
H
N
H
O
F
1.12
1.08
1.00
3.30
1.16
4.05
3.36
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
f1 (ppm)

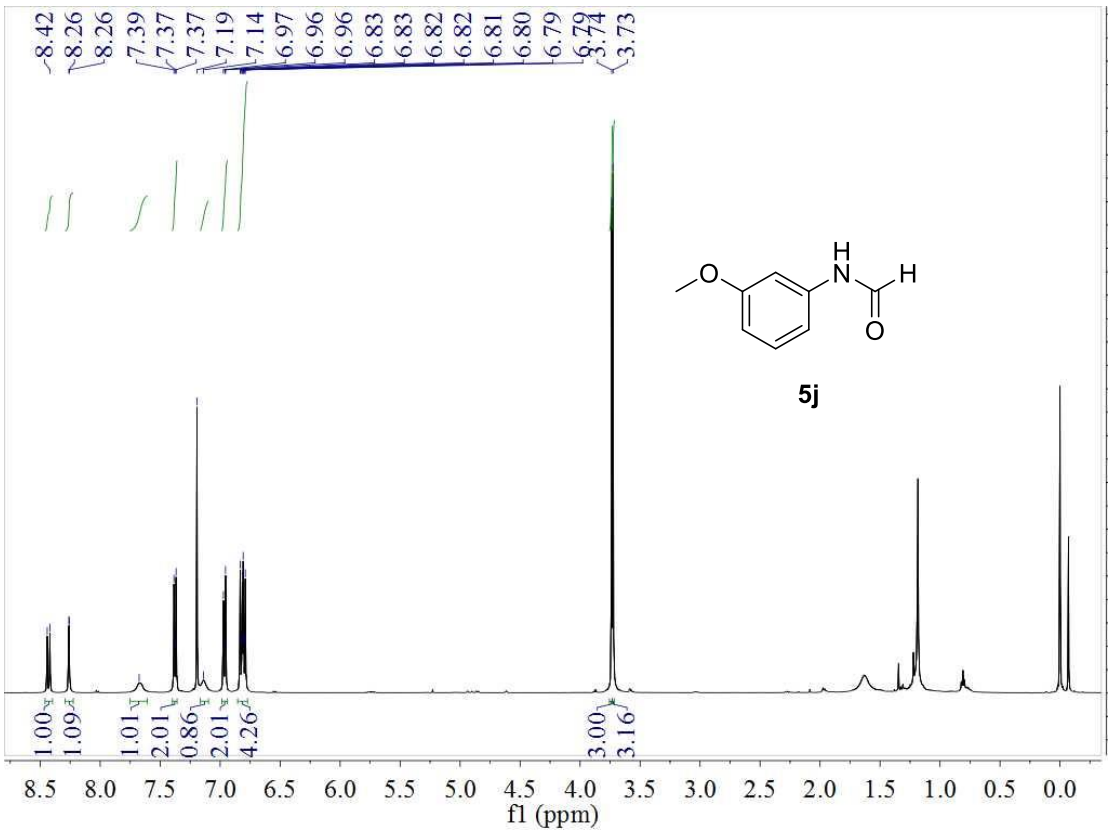
5g


10.01
8.20
8.20
7.51
7.49
6.90
6.88
Cl
H
N
H
O
1.00
1.00
2.01
2.03
f1 (ppm)

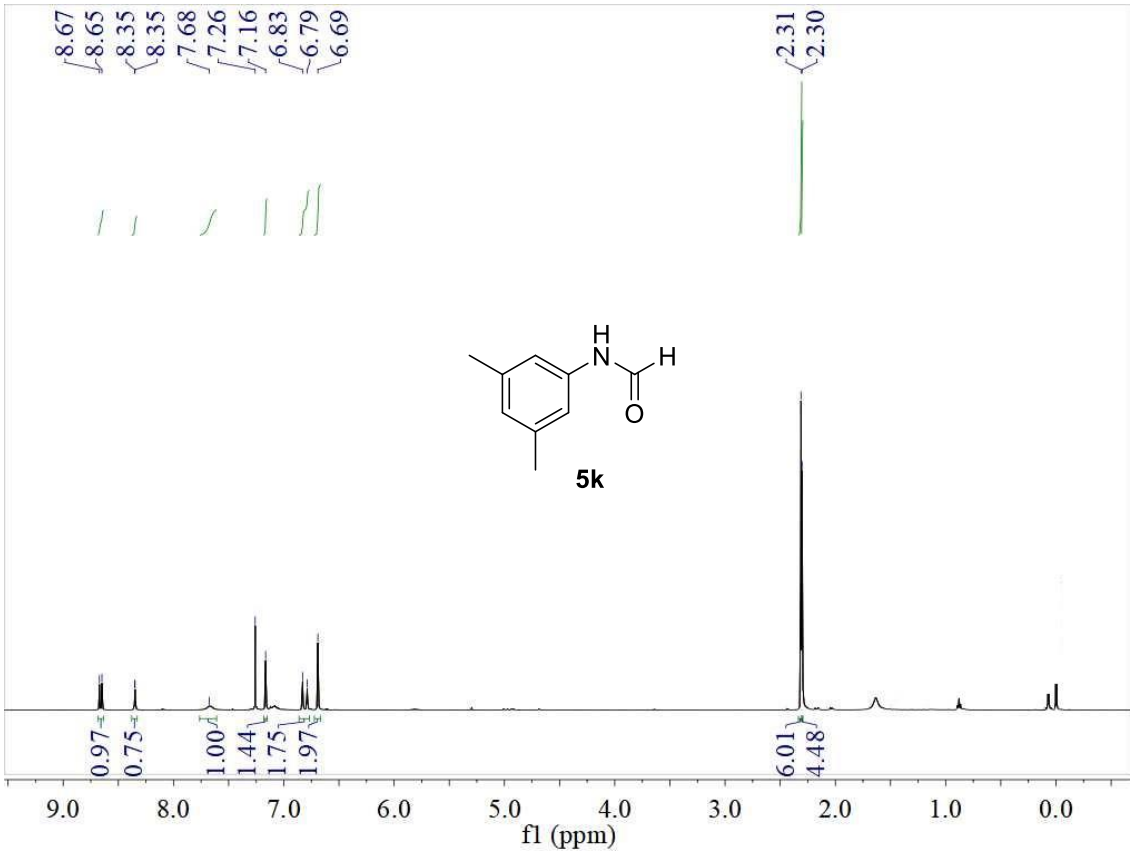
5h


8.65
8.39
8.30
7.19
7.14
7.12
7.06
7.02
7.01
6.99
6.92
6.90
6.87
6.85
6.84
3.80
O
H
N
H
O
0.47
0.88
0.95
1.00
0.47
0.52
0.93
2.90
3.22
1.08
f1 (ppm)

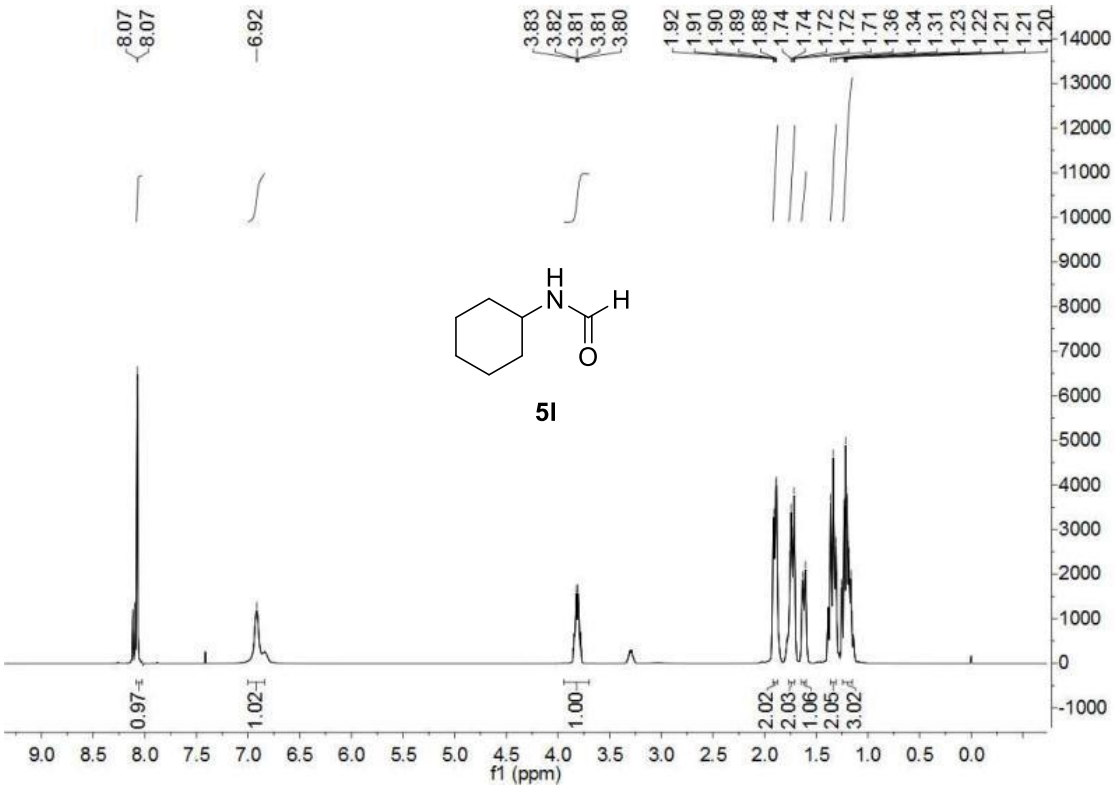
5i


8.42
8.26
8.26
7.39
7.37
7.37
7.19
7.14
6.97
6.96
6.96
6.83
6.83
6.82
6.82
6.81
6.80
6.79
6.79
3.74
3.73
1.00
1.09
1.01
2.01
0.86
2.01
4.26
3.00
3.16
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)
O
H
N
H
O

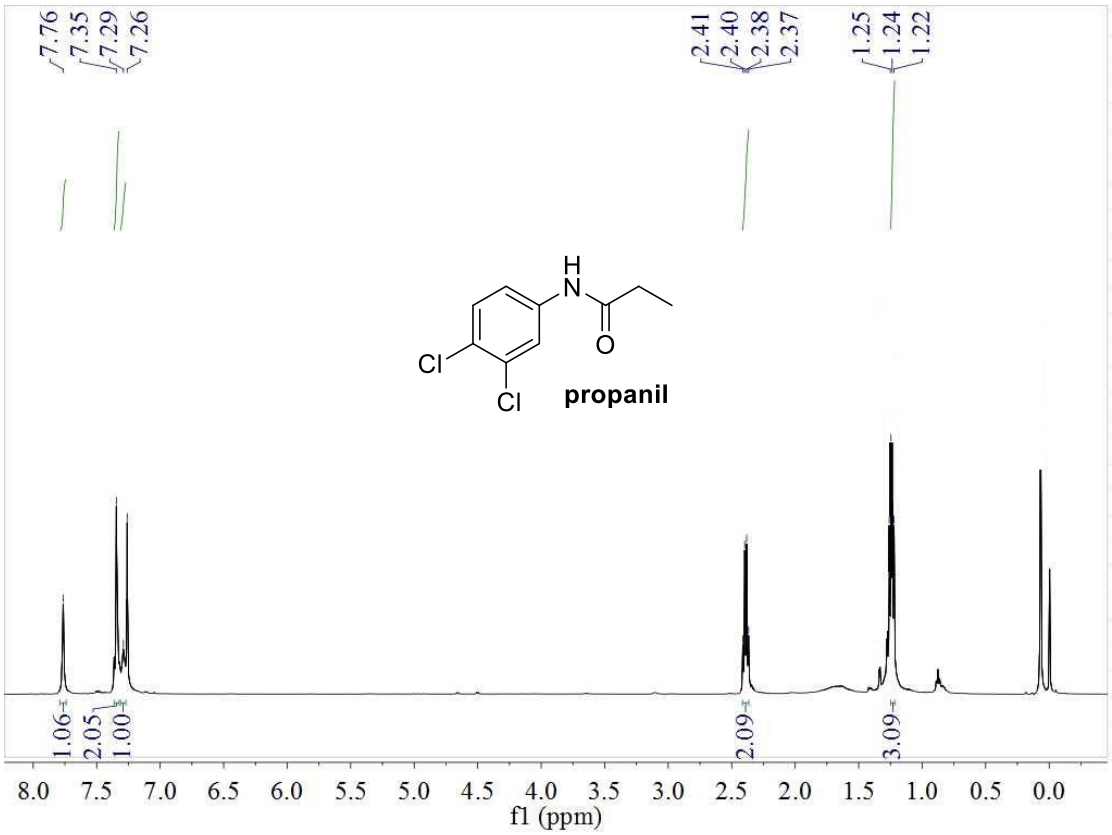
5j

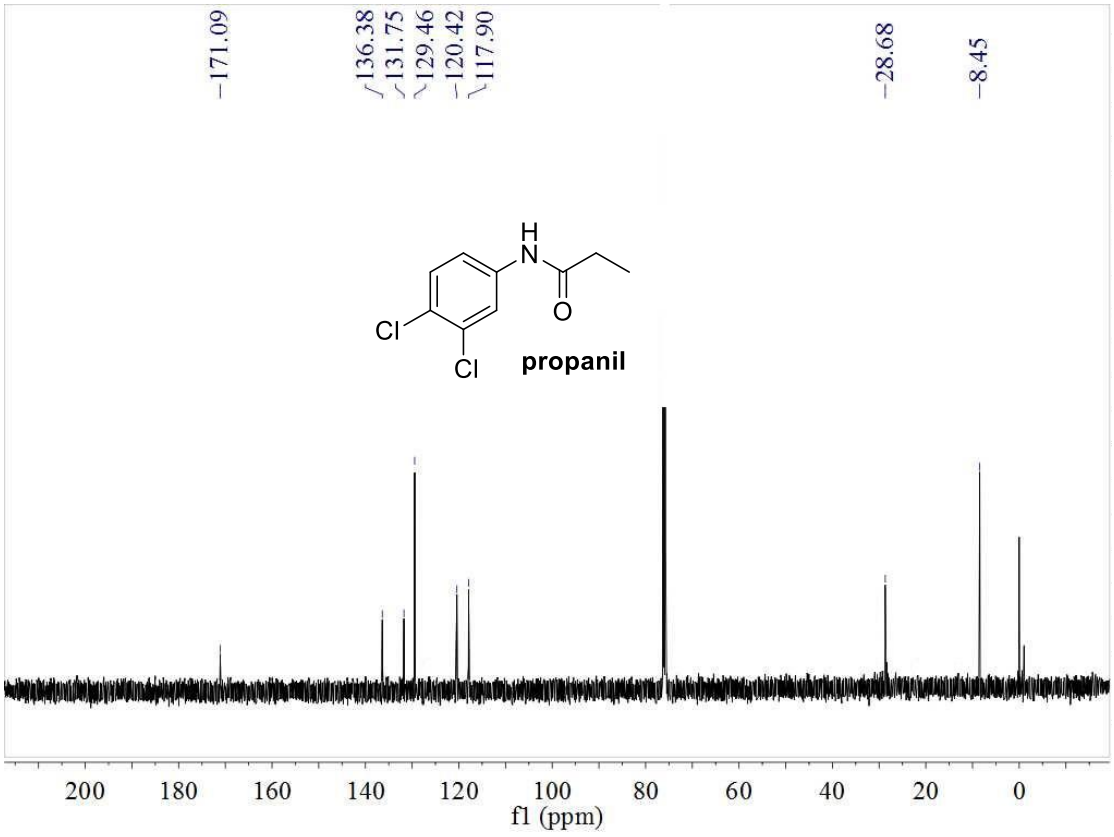

8.67
8.65
8.35
8.35
7.68
7.26
7.16
6.83
6.79
6.69
2.31
2.30
0.97
0.75
1.00
1.44
1.75
1.97
6.01
4.48
9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
f1 (ppm)
H
N
H
O

5k


8.07
8.07
6.92
3.83
3.82
3.81
3.81
3.80
1.92
1.91
1.90
1.89
1.88
1.74
1.74
1.72
1.72
1.71
1.36
1.34
1.31
1.23
1.22
1.21
1.21
1.20
H
N
H
O
0.97
1.02
1.00
2.02
2.03
1.06
2.05
3.02
f1 (ppm)

5l


7.76
7.35
7.29
7.26
2.41
2.40
2.38
2.37
1.25
1.24
1.22
H
N
O
Cl
Cl
propanil
1.06
2.05
1.00
2.09
3.09
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


171.09
136.38
131.75
129.46
120.42
117.90
28.68
8.45
H
N
O
Cl
Cl
propanil
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

6. References

1. C. Shen, H. Shen, M. Yang, C. Xia, P. Zhang, *Green Chem.*, 2015, **17**, 225.

2. H. Shen, C. Shen, C. Chen, A. Wang, P. Zhang, *Catal. Sci. Technol.*, 2015, **5**, 2065.

3. R. B. Sonawane, N. K. Rasaland, S. V. Jagtap, *Org. Lett.*, 2017, **19**, 2078.