Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Synthesis of smart bimetallic nano-Cu/Ag@SiO_2 for clean oxidation of alcohols

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ESI 1. Preparation of silica embedded Cu/Ag nanoparticles:

Preparation of silica nanoparticles: 5 gm TEOS in 10 ml ethanol was added drop wise over 30 minutes to 50 ml of ethanol-water mixture (1:1) containing 10 ml of 25% aq. NH_4OH at room temperature under vigorous stirring. Subsequently, the whole mixture was sonicated for 1 h and then aged over night at room temperature. The as prepared silica nanoparticles were then separated by simple filtration using whatman no. 1 filter paper and washed well with distilled H_2O followed by ethanol and then dried at 70^{o}C for 6 h. Next, the silica nanoparticles were calcined at 550^{o}C for 7 h.

Preparation of silica embedded Cu/Ag nanoparticles: Silica (1.0 gm) was dispersed in water (100 ml) under sonication, copper nitrate (152 mg) and silver nitrate (16 mg) were added to the aqueous suspension and stirred for 2h at room temperature. Sodium borohydride (250 mg) was added, in portion, with constant stirring at room temperature. The reaction mixture turns brown after $NaBH_4$ addition due to the formation of copper and silver nanoparticles. After 4 h stirring the nanoparticles were centrifuged, washed with acetone and dried under vacuum. The Cu/Ag@SiO_2 NPs were then characterized using XRD, SEM, HRTEM analysis.

ESI 2. FTIR spectra of fresh Cu/Ag@SiO_2 nanoparticles:

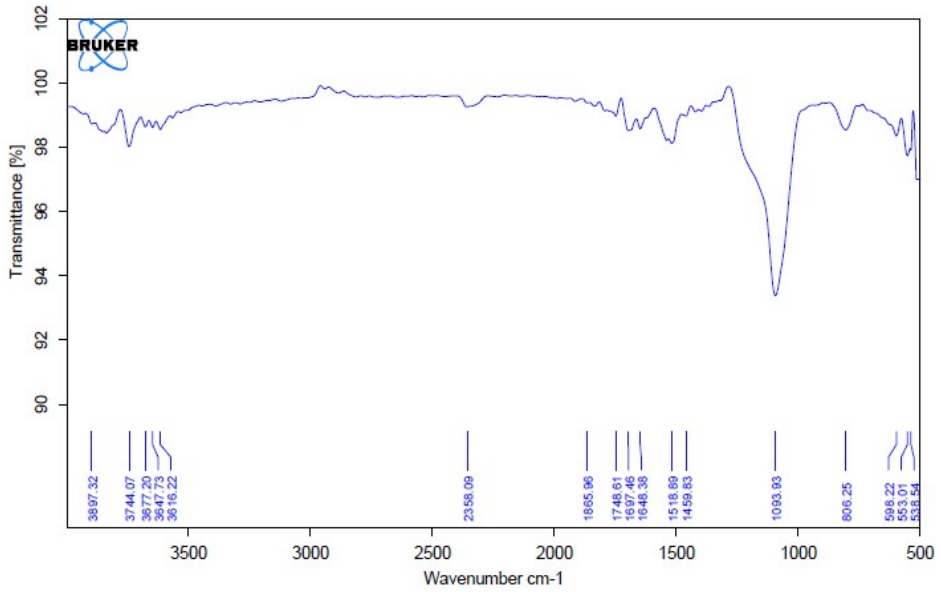


Fig. S1. FTIR spectra of fresh Cu/Ag@SiO_2 nanoparticles.

ESI 3. General synthetic procedure for Cu/Ag@SiO_2 nanoparticles catalyzed oxidation of benzylic alcohols: Representative procedure for Cu/Ag@SiO_2 nanoparticles catalyzed oxidation of benzylalcohol: A 25 ml round bottomed flask equipped with a magnetic stirring bar, charged with benzylalcohol (1 mmol, 108.14), 70% aq. TBHP (2 equivalent, 180 mg), catalyst CuAg@SiO_2 NPs (20 mg) and 4 ml of toluene, heated at 120 ^oC for 4 h. The progress of the reaction was monitored by TLC. After the completion of the reaction, CuAg@SiO_2 NPs catalyst was separated using centrifuge and the product was isolated using ethyl acetate extraction and then purified by column chromatographic technique (isolated yield 99%, 105 mg).

All the prepared aldehydes/ketones were characterized by ^1H NMR spectroscopic studies. The spectroscopic data of all the prepared compounds were resembles with the reported data as all the compounds are reported in literature.

ESI 4. FTIR spectra of eight times reused Cu/Ag@SiO_2 NPs:

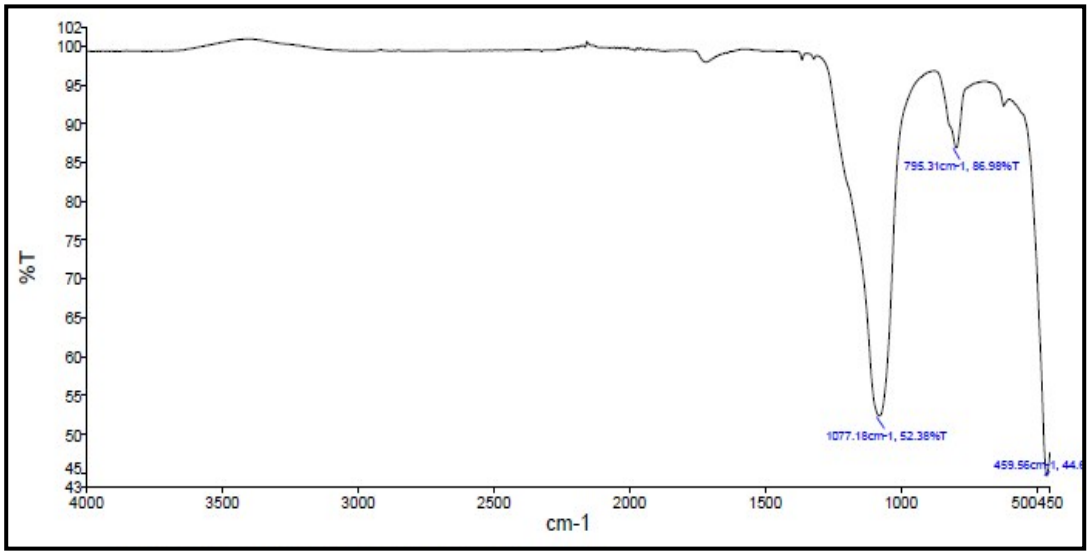
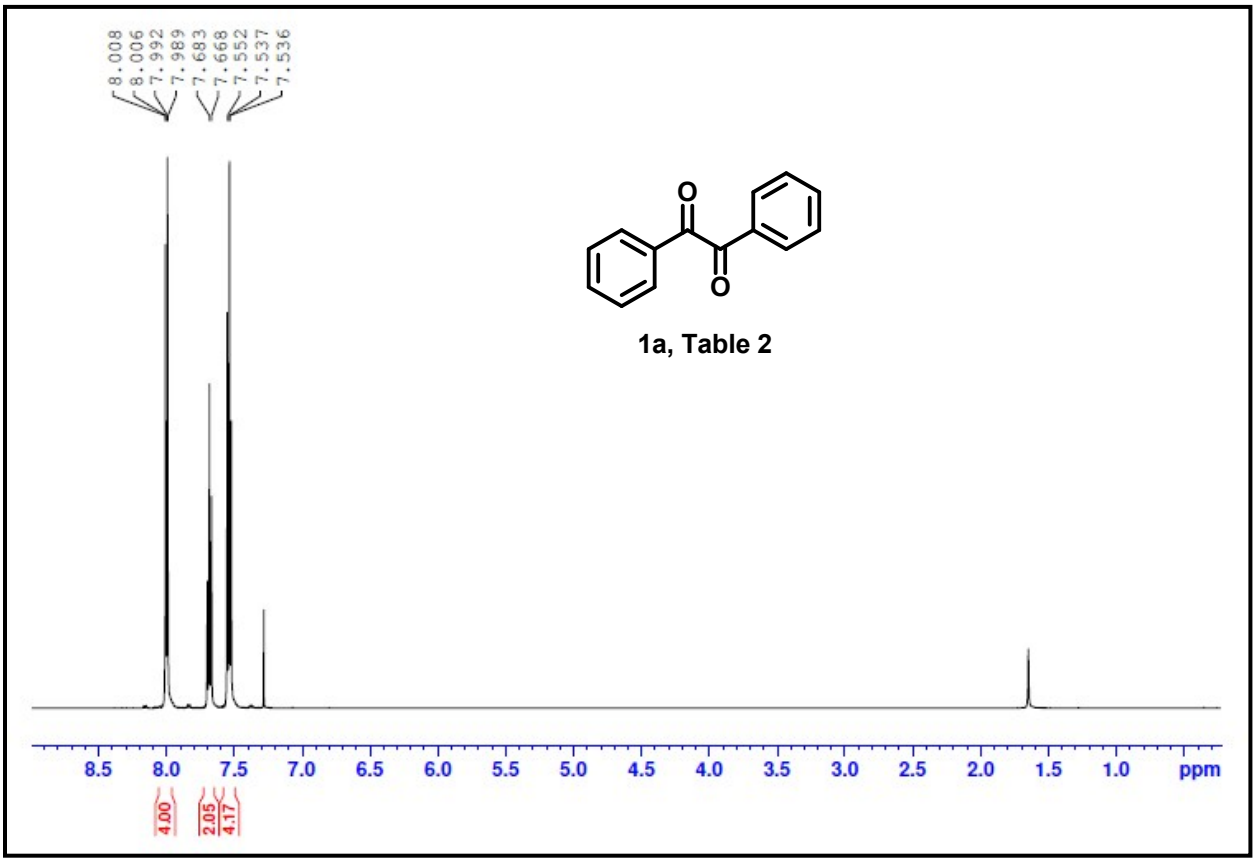
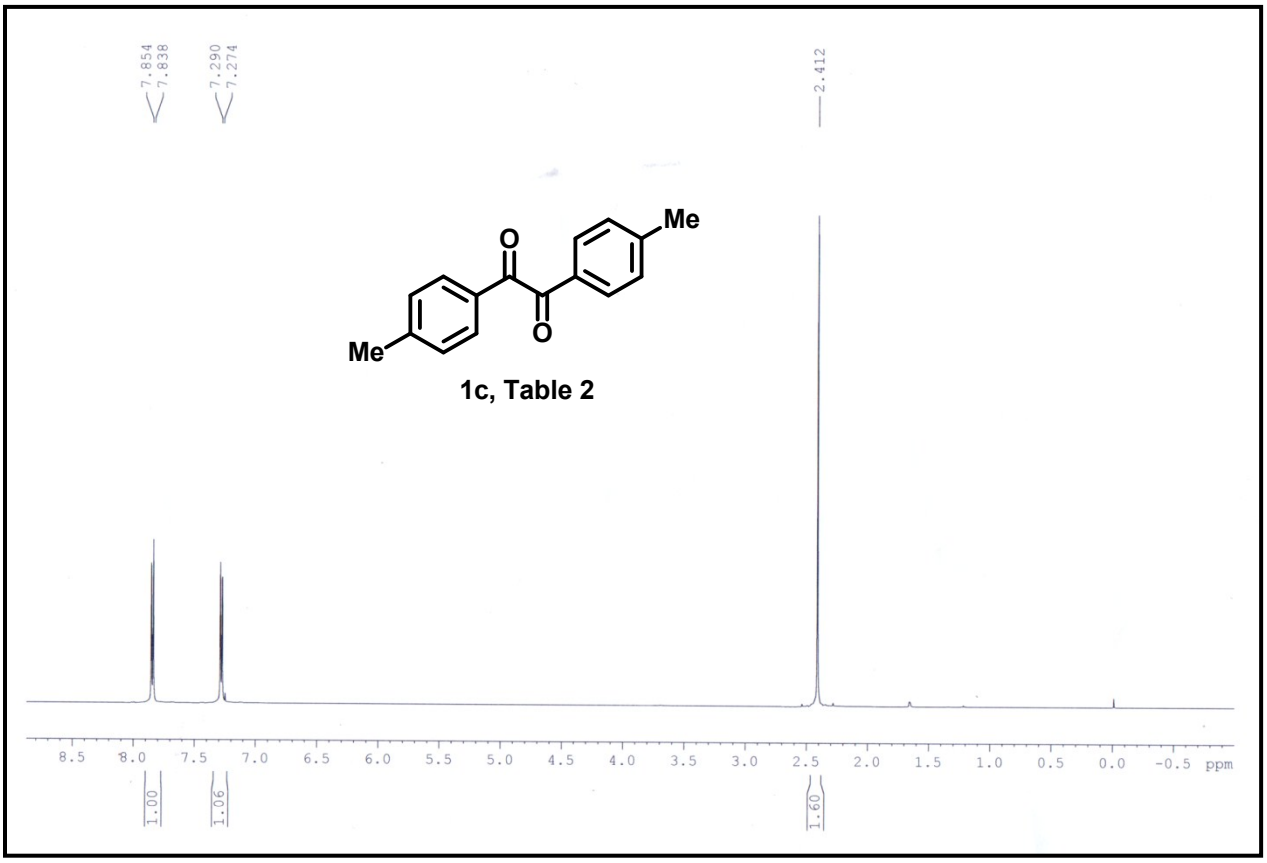


Fig. S2. FTIR spectra of eight times reused Cu/Ag@SiO_2 NPs.

ESI 5. ^{1}H NMR spectra of prepared compounds:

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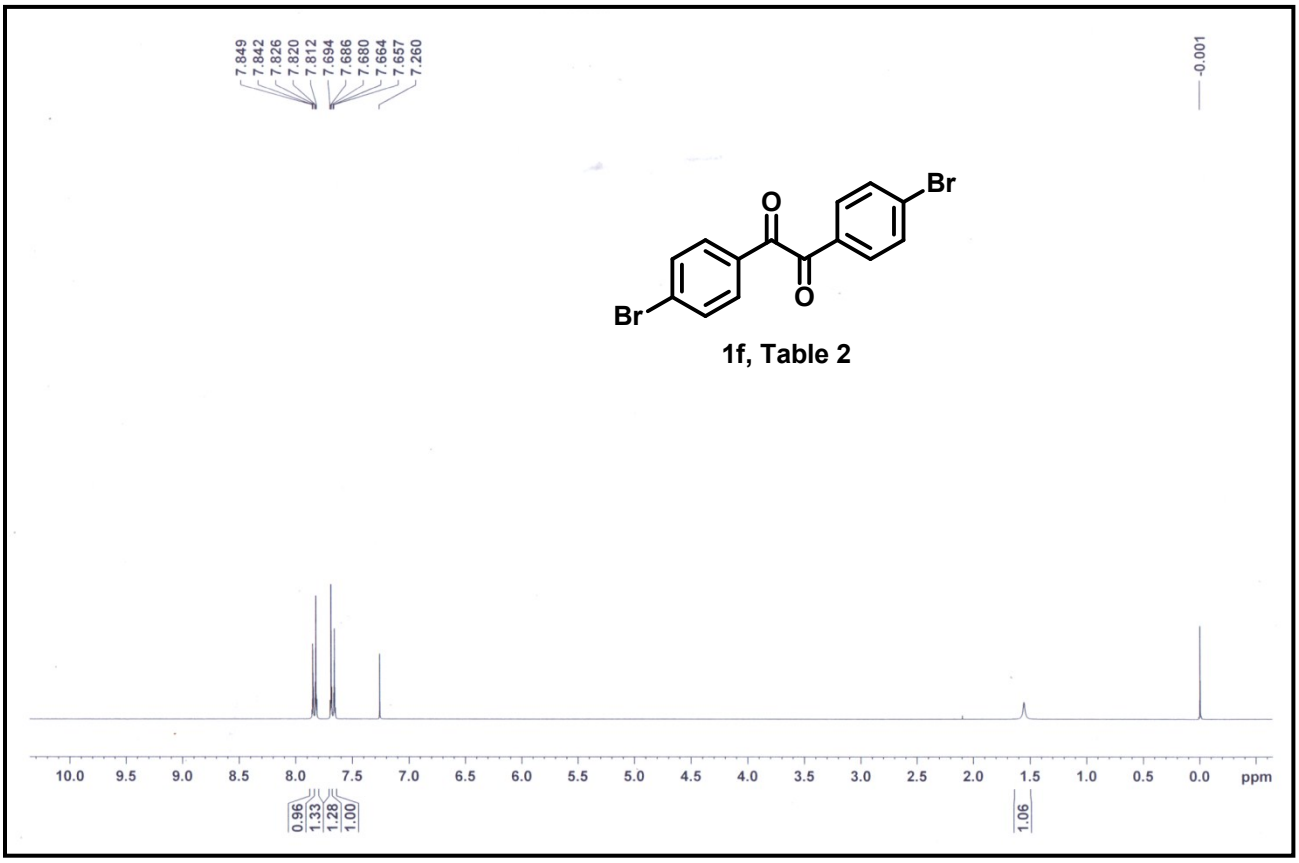
7.838
7.290
7.274
2.412
Me
O
O
Me
1c, Table 2
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
ppm
1.00
1.06
1.60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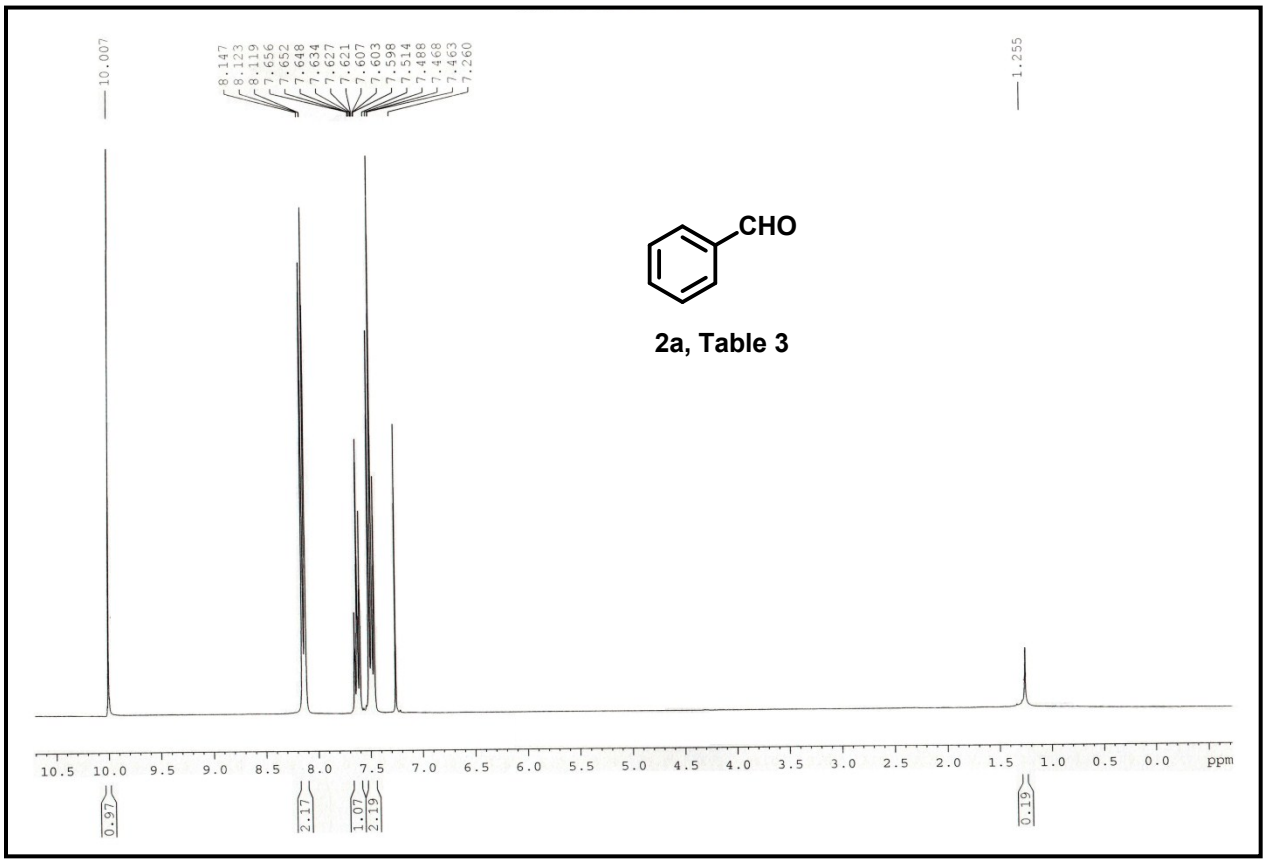
7.826
7.820
7.812
7.694
7.686
7.680
7.664
7.657
7.260
-0.001
Br
O
O
Br
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
0.96
1.33
1.28
1.00
1.06

1f, Table 2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8.123
8.119
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7.652
7.648
7.634
7.627
7.621
7.607
7.603
7.598
7.514
7.488
7.468
7.463
7.260
1.255
CHO
10.5 10.0 9.5 9.0 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 ppm
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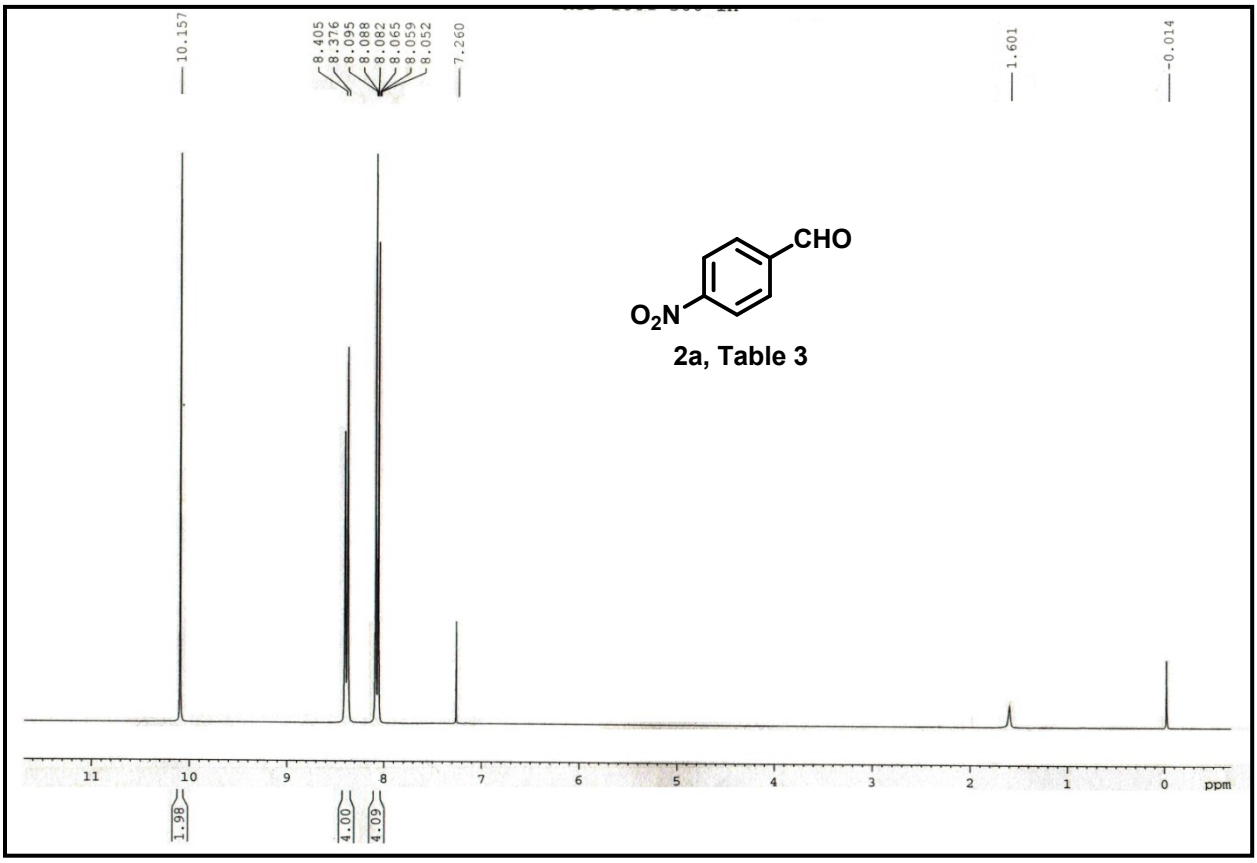
2.17
1.07
2.19
0.19

2a, Table 3


10.157
8.405
8.376
8.095
8.088
8.082
8.065
8.059
8.052
7.260
1.601
-0.014
CHO
O2N
11
10
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8
7
6
5
4
3
2
1
0
ppm
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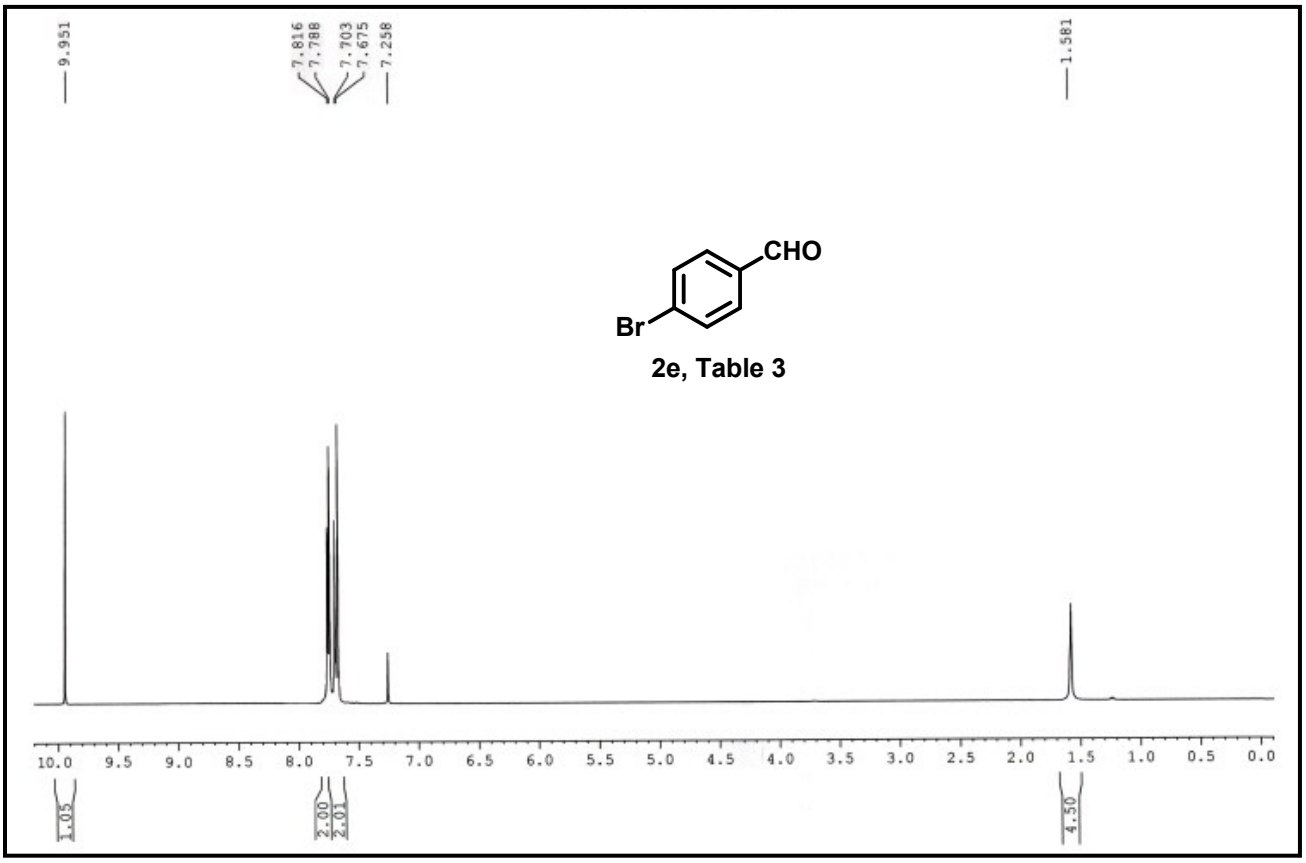
4.00
4.09

2a, Table 3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7.788
7.703
7.675
7.258
1.581
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Br
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8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
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1.5
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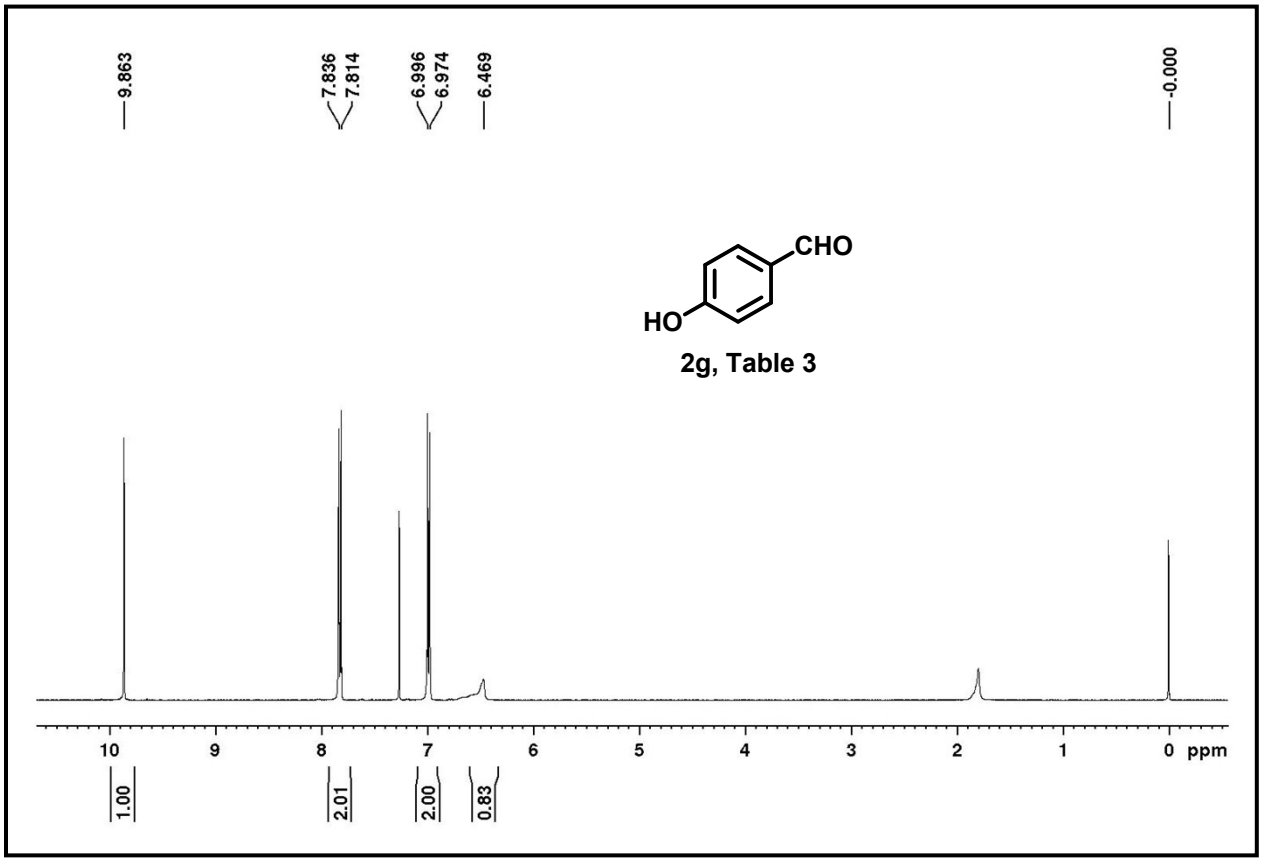
2.01
4.50

2e, Table 3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6.469
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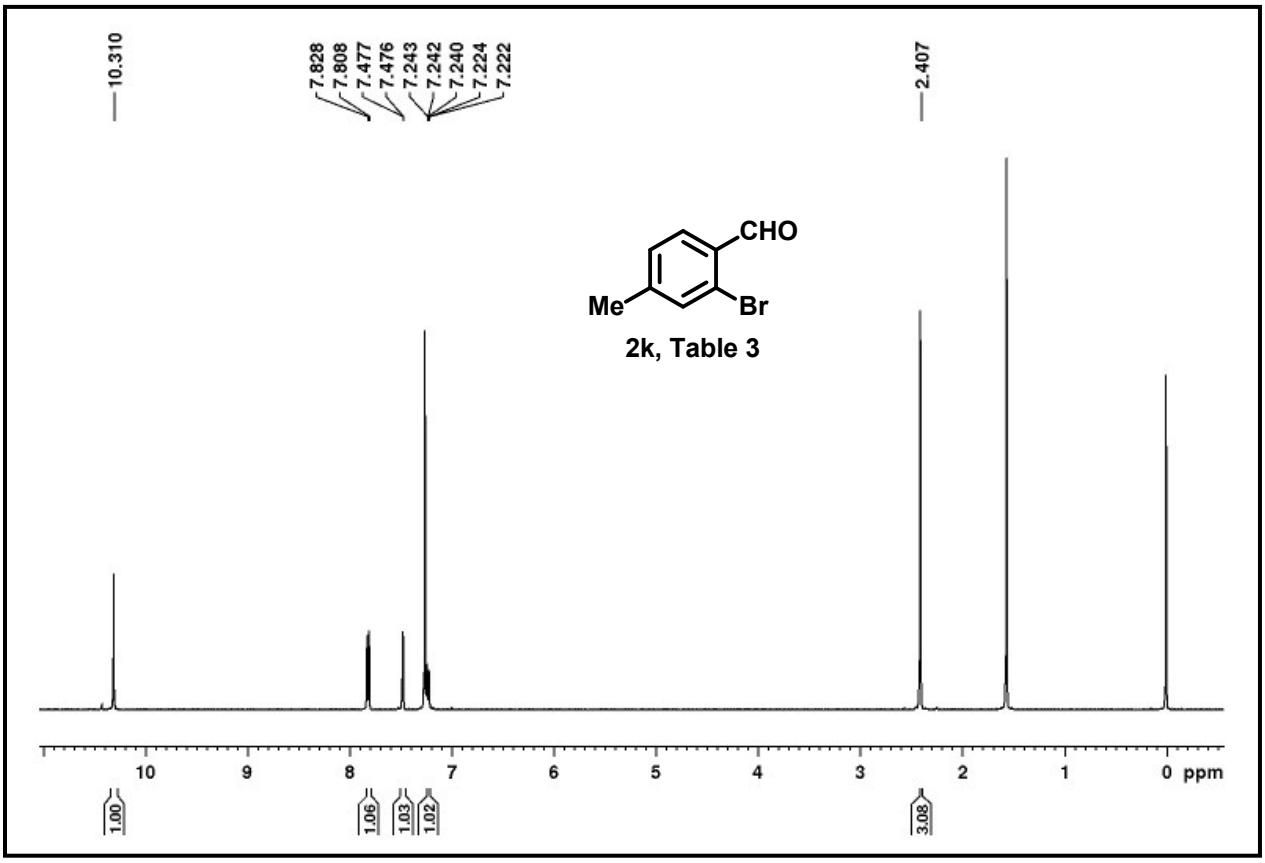
HO
10
9
8
7
6
5
4
3
2
1
0 ppm
1.00
2.01
2.00
0.83

2g, Table 3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7.240
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7.222
2.407
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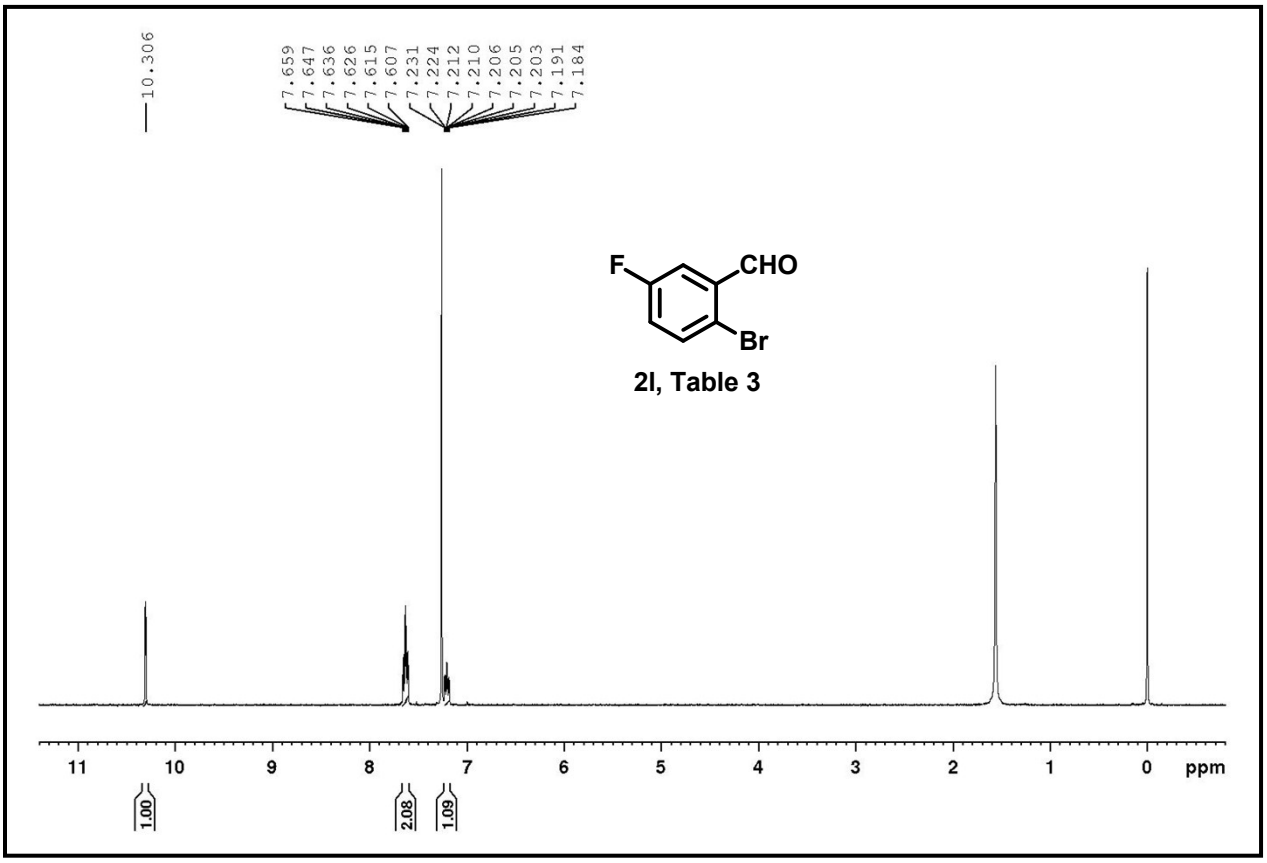
Me
Br
10
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.06
1.03
1.02
3.08

2k, Table 3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7.636
7.626
7.615
7.607
7.231
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7.212
7.210
7.206
7.205
7.203
7.191
7.184
F
CHO
Br
2l, Table 3
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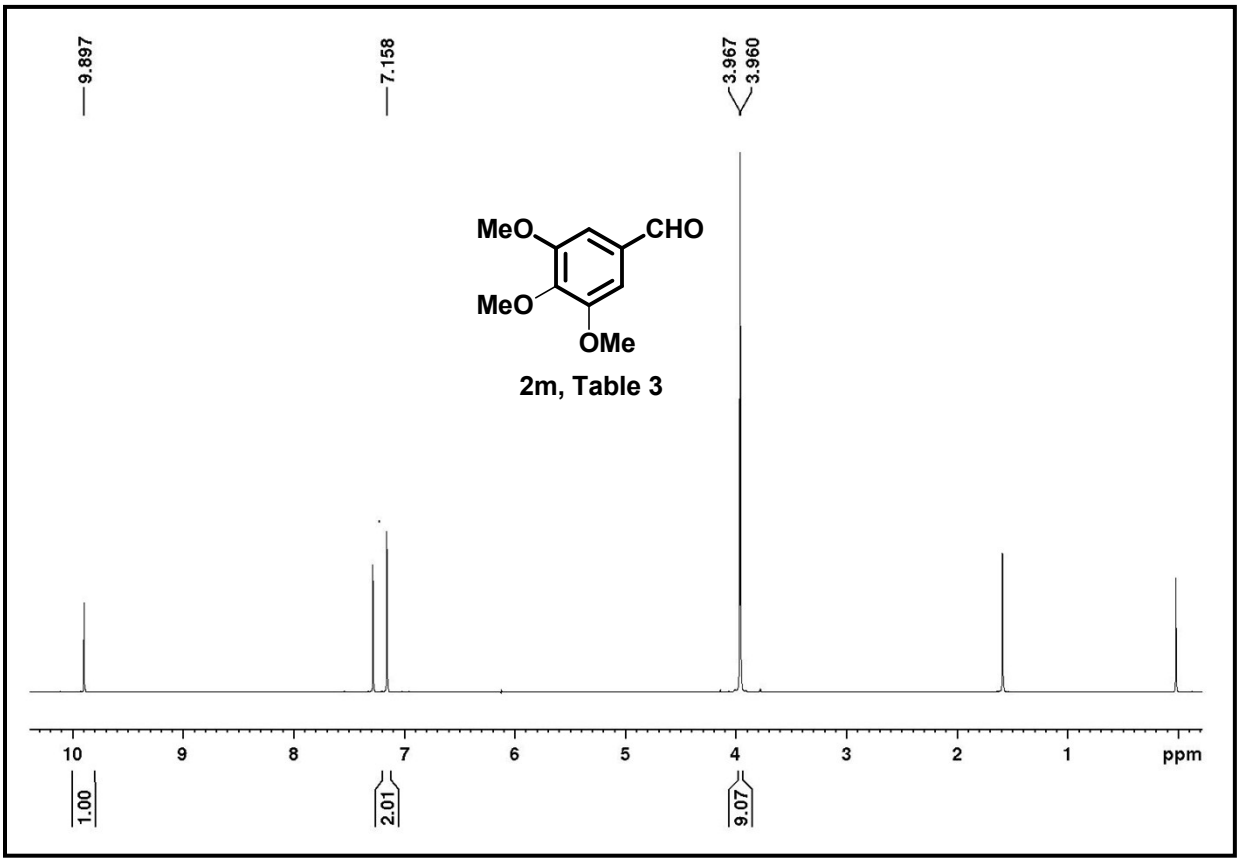
9
8
7
6
5
4
3
2
1
0
ppm
1.00
2.08
1.09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3.960
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CHO
MeO
OMe
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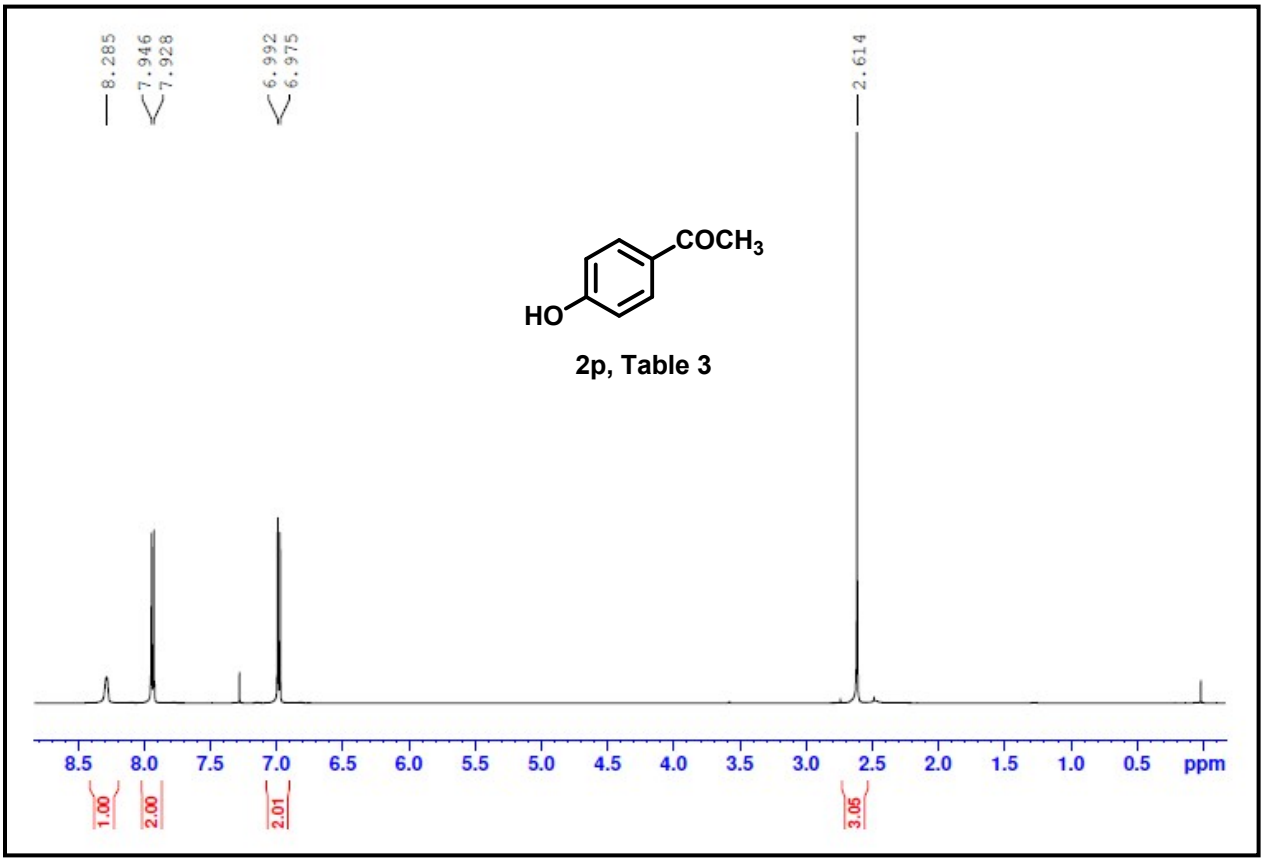
8
7
6
5
4
3
2
1
ppm
1.00
2.01
9.07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6.992
6.975
2.614
COCH3
HO
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8.0
7.5
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6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
2.00
2.01
3.05

2p, Table 3