

Supporting Information

Fixing CO₂ into β -Oxopropylcarbamates in neat condition by ionic gelation/Ag(I) supported on dendritic fibrous nanosilica

Liping Chang ^{a,*}, Rahele Zhiani ^b, Seyed Mohsen Sadeghzadeh ^{b,*}

^a*School of Continuing Education of Xinxiang University, Xinxiang, Henan, 453000, P.R.China*

^b*New Materials Technology and Processing Research Center, Department of Chemistry, Neyshabur Branch, Islamic Azad University, Neyshabur, Iran*

*Corresponding author. E-mail address: xinxiangxueyuan@aliyun.com (L. Chang); seyedmohsen.sadeghzadeh@gmail.com (S. M. Sadeghzadeh)

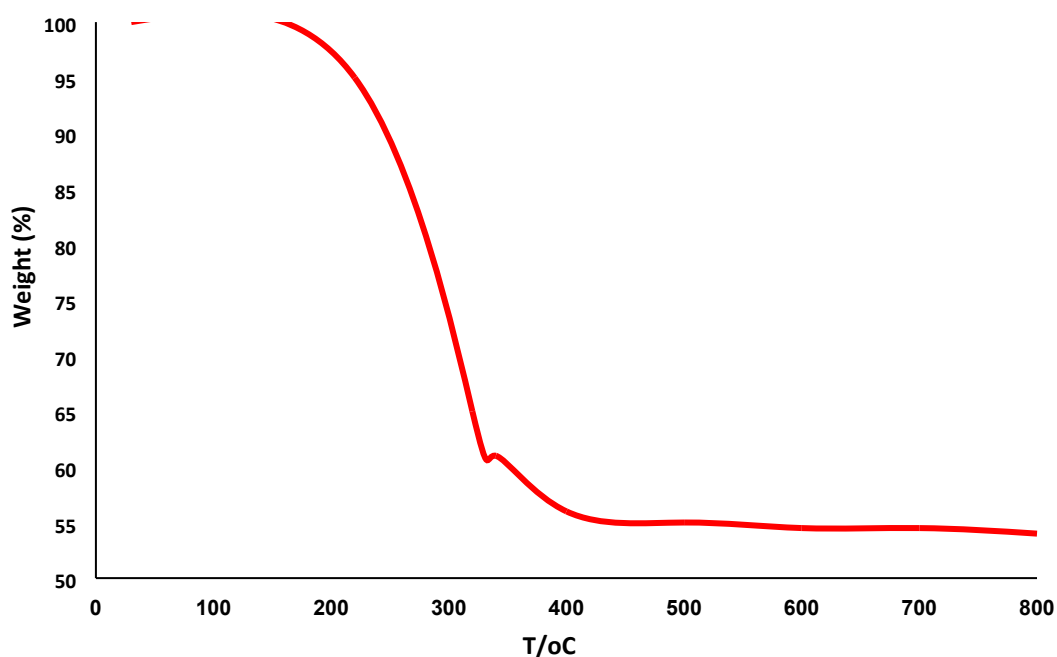


Figure S1 TGA diagram of DFNS/IG NPs.

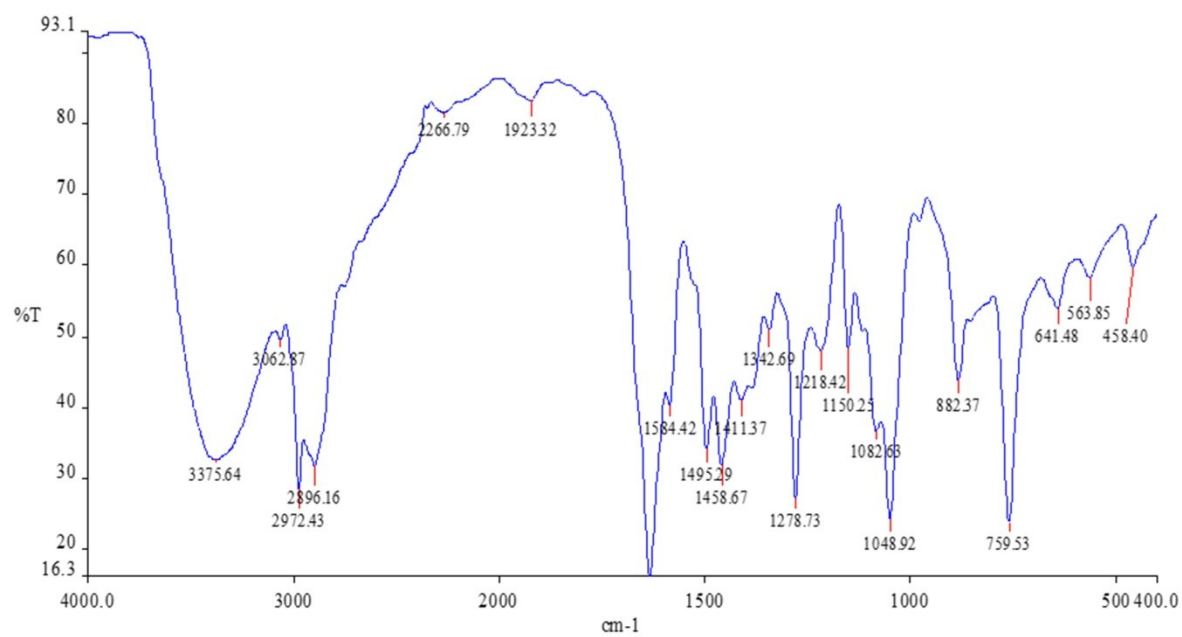
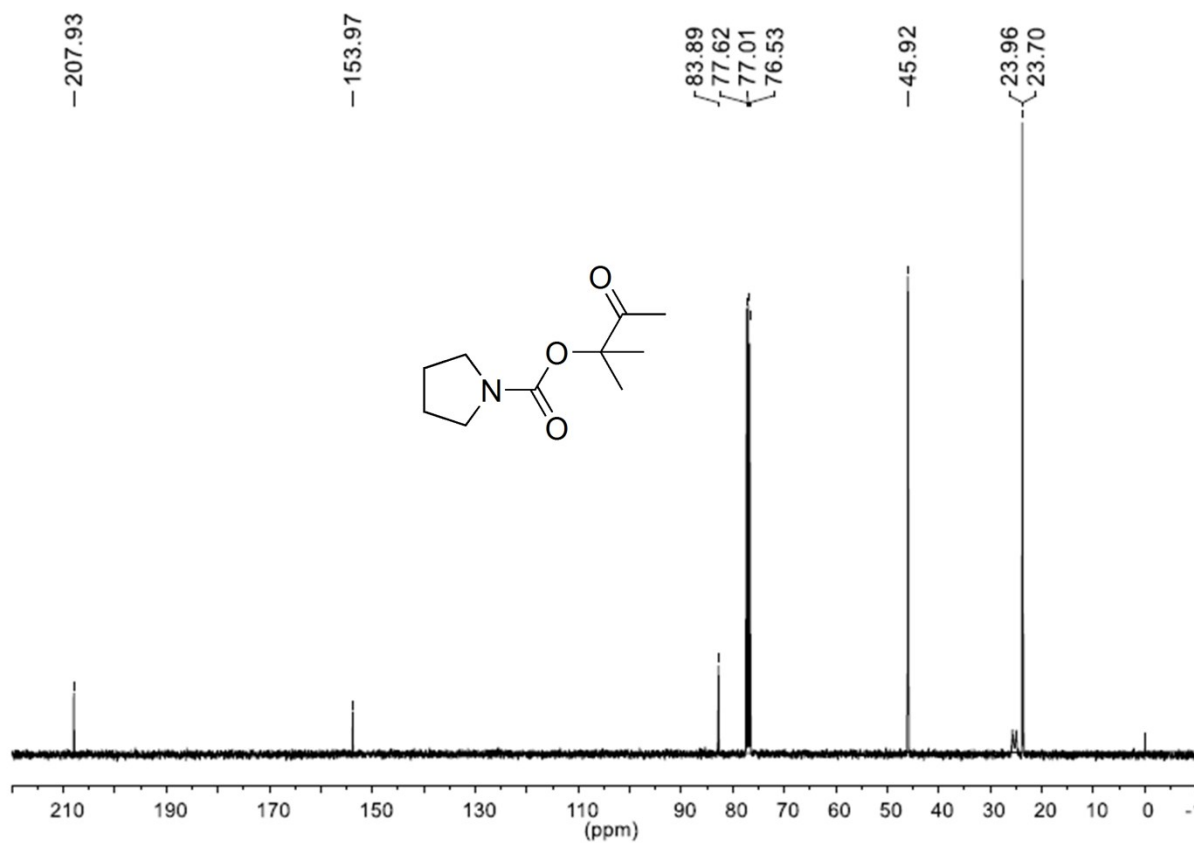
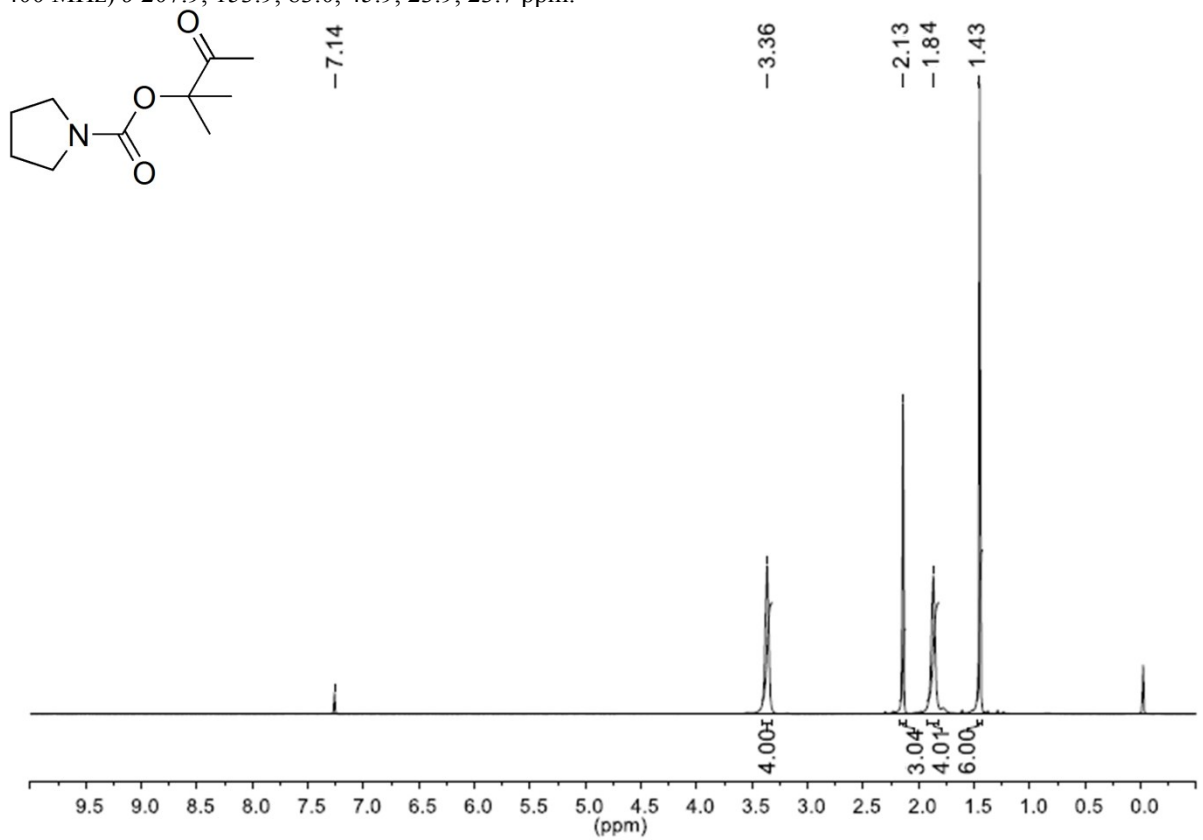


Figure S2 FTIR spectra of DFNS/IG NPs.

Characterizations of all Compounds:

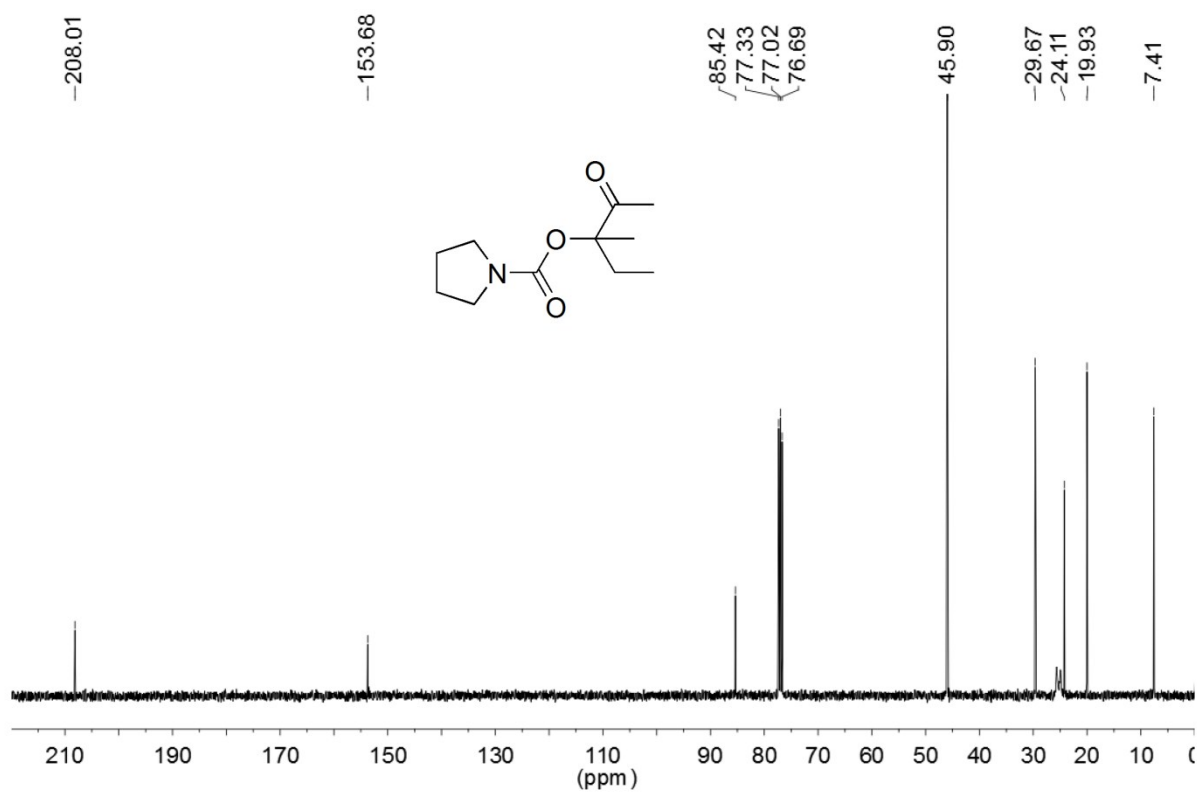
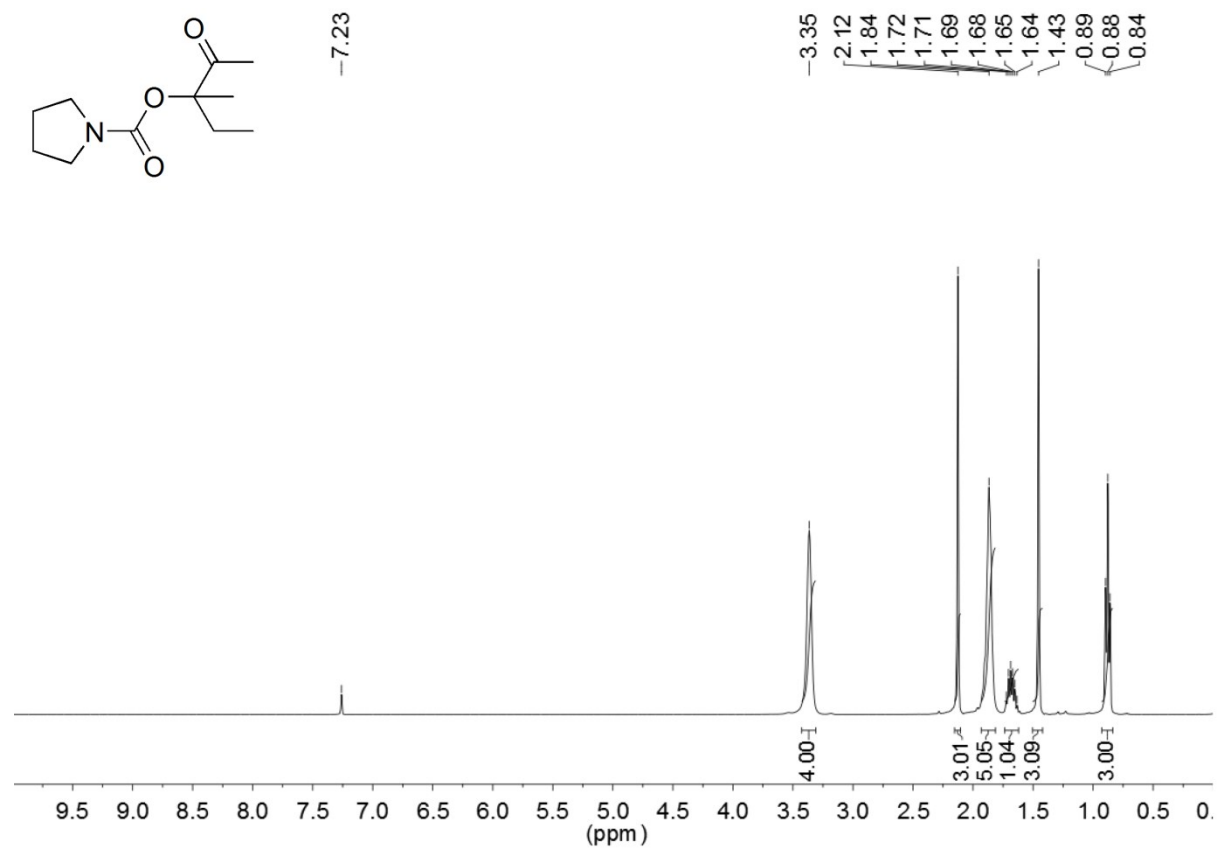
1) 2-methyl-3-oxobutan-2-yl pyrrolidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.36 (m, 4H), 2.13 (s, 3H), 1.84 (m, 4H), 1.43 (s, 6H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.9, 153.9, 83.0, 45.9, 23.9, 23.7 ppm.



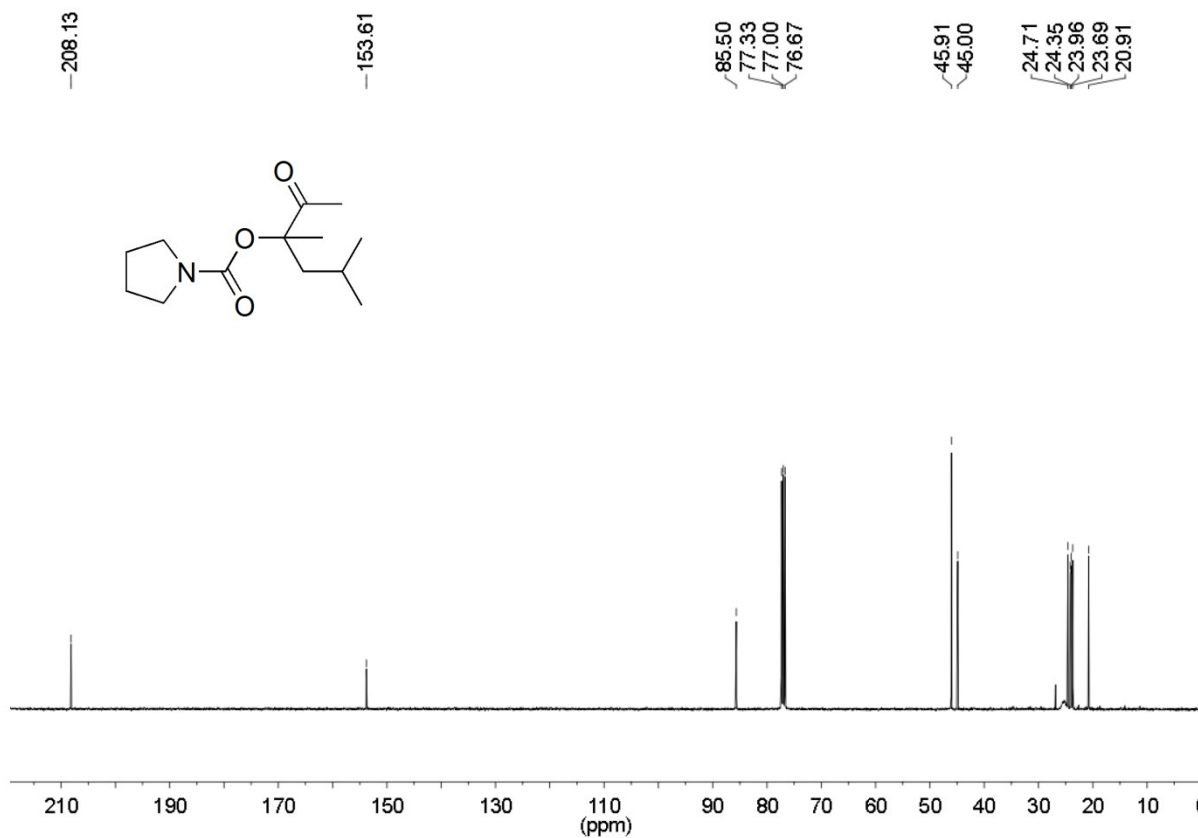
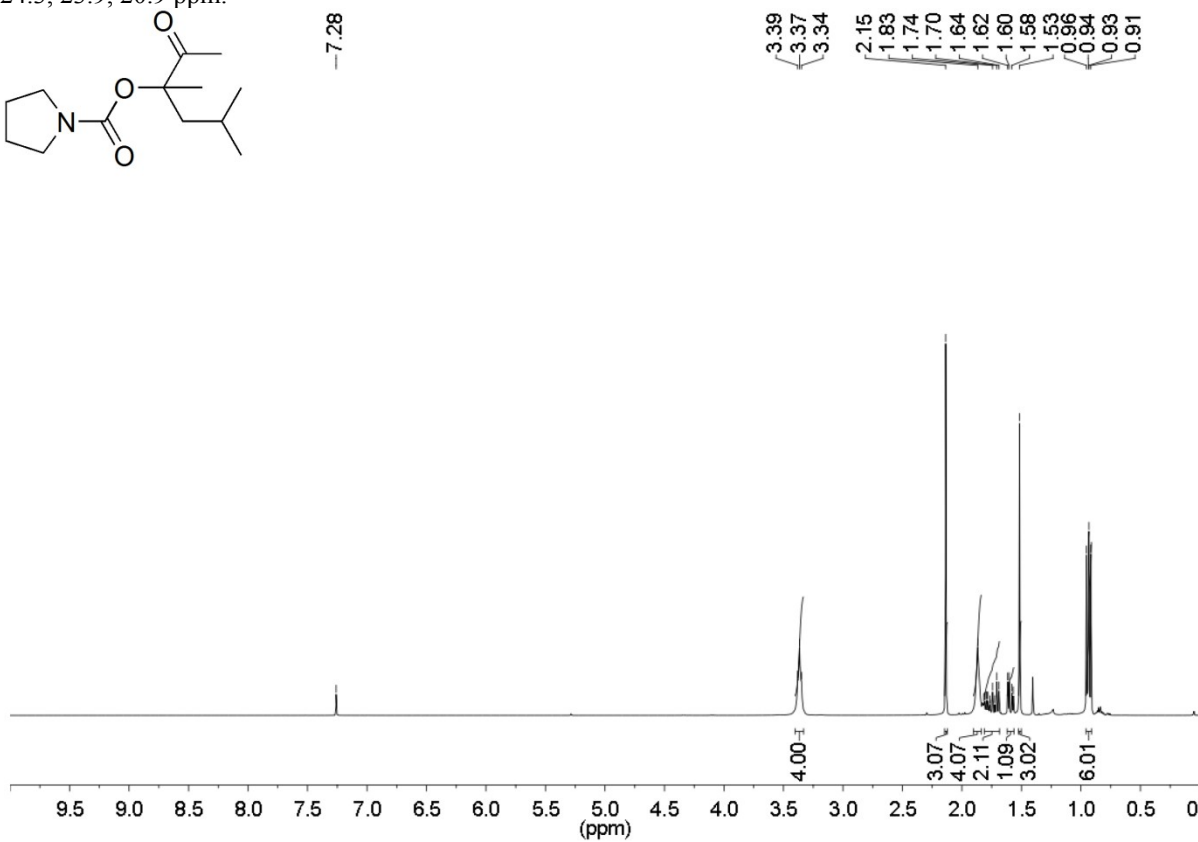
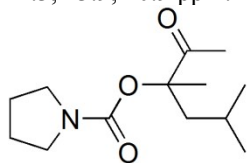
2) 3-methyl-2-oxopentan-3-yl pyrrolidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.35 (m, 4H), 2.12 (s, 3H), 1.84 (m, 5H), 1.71-1.64 (m, 1H), 1.43 (s, 3H), 0.89-0.84 (3H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 208.0, 153.6, 85.4, 45.9, 29.6, 24.1, 19.9, 7.4 ppm.



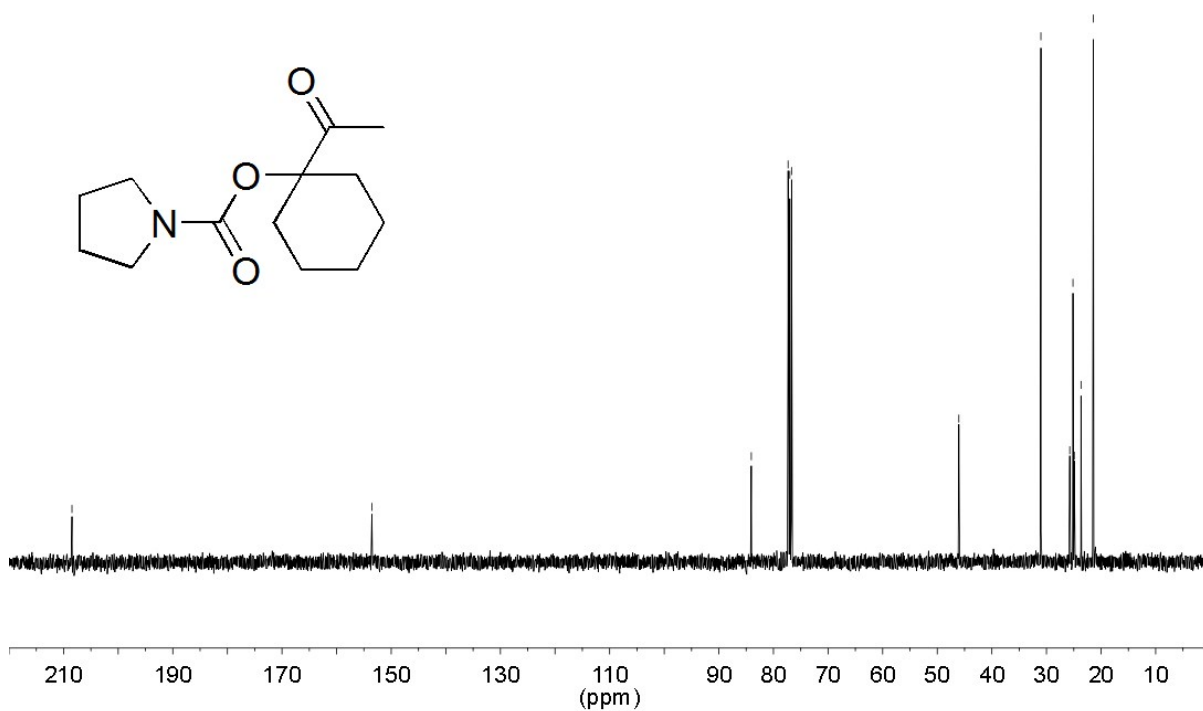
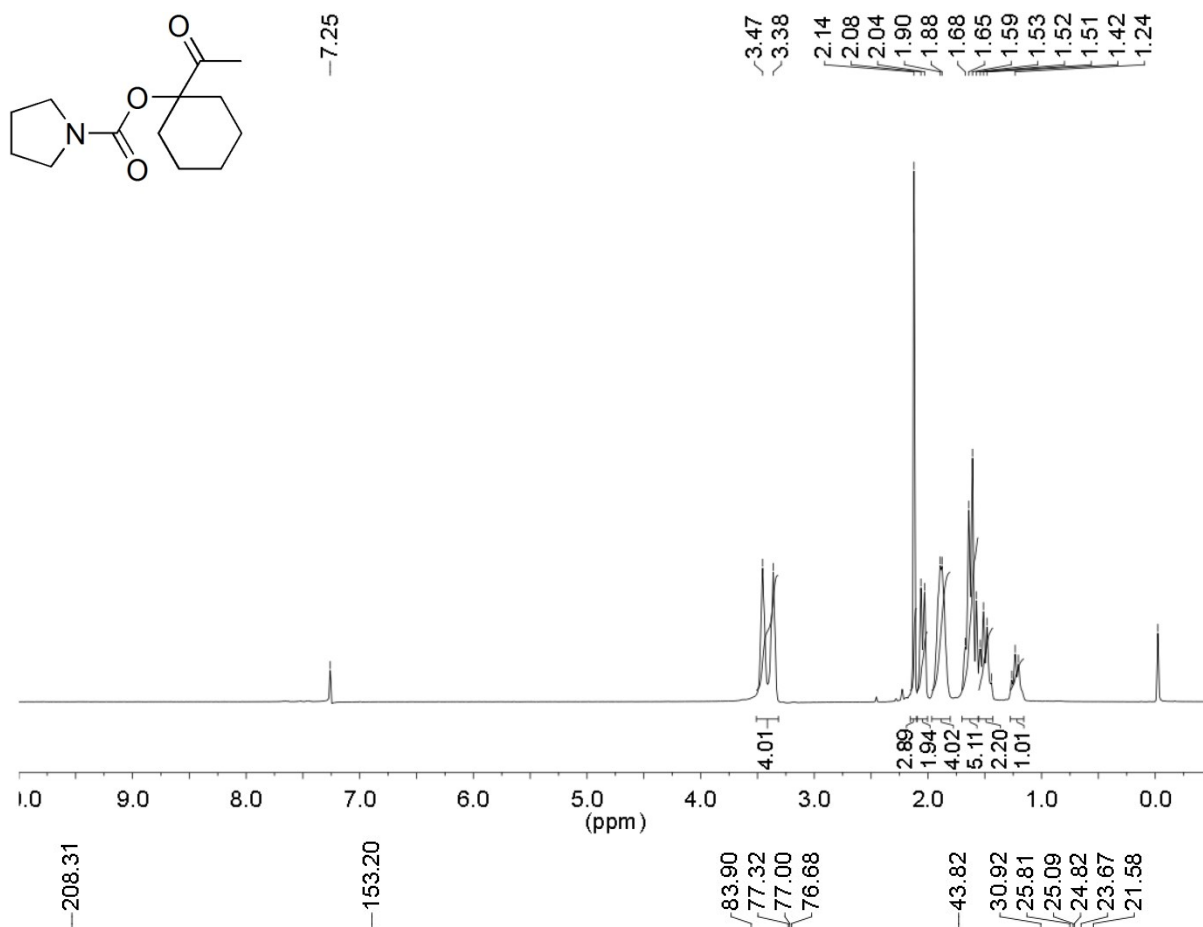
3) 3,5-dimethyl-2-oxohexan-3-yl pyrrolidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.39-3.34 (m, 4H), 2.15 (s, 3H), 1.89 (m, 4H), 1.83-1.70 (m, 2H), 1.64-1.58 (m, 1H), 1.53 (s, 3H), 0.96-0.91 (m, 6H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 208.1, 153.6, 85.5, 45.9, 45.0, 24.7, 24.3, 23.9, 20.9 ppm.



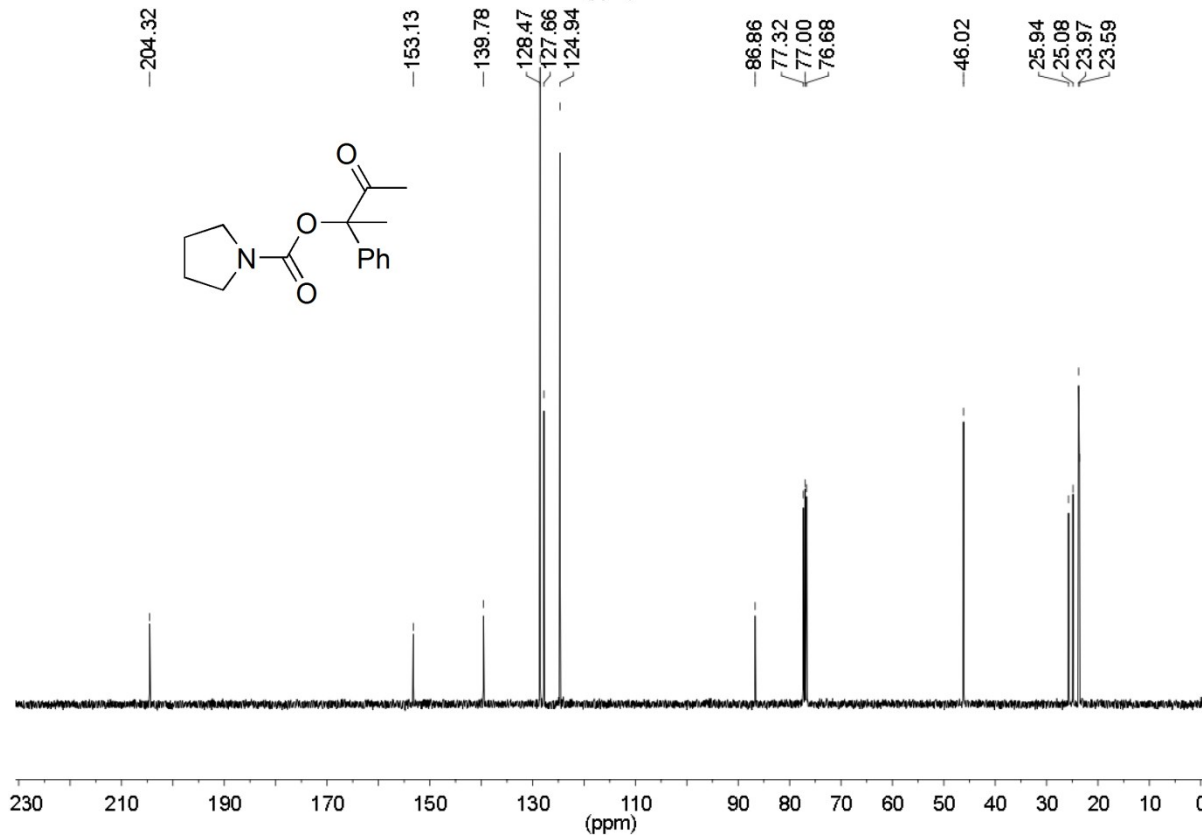
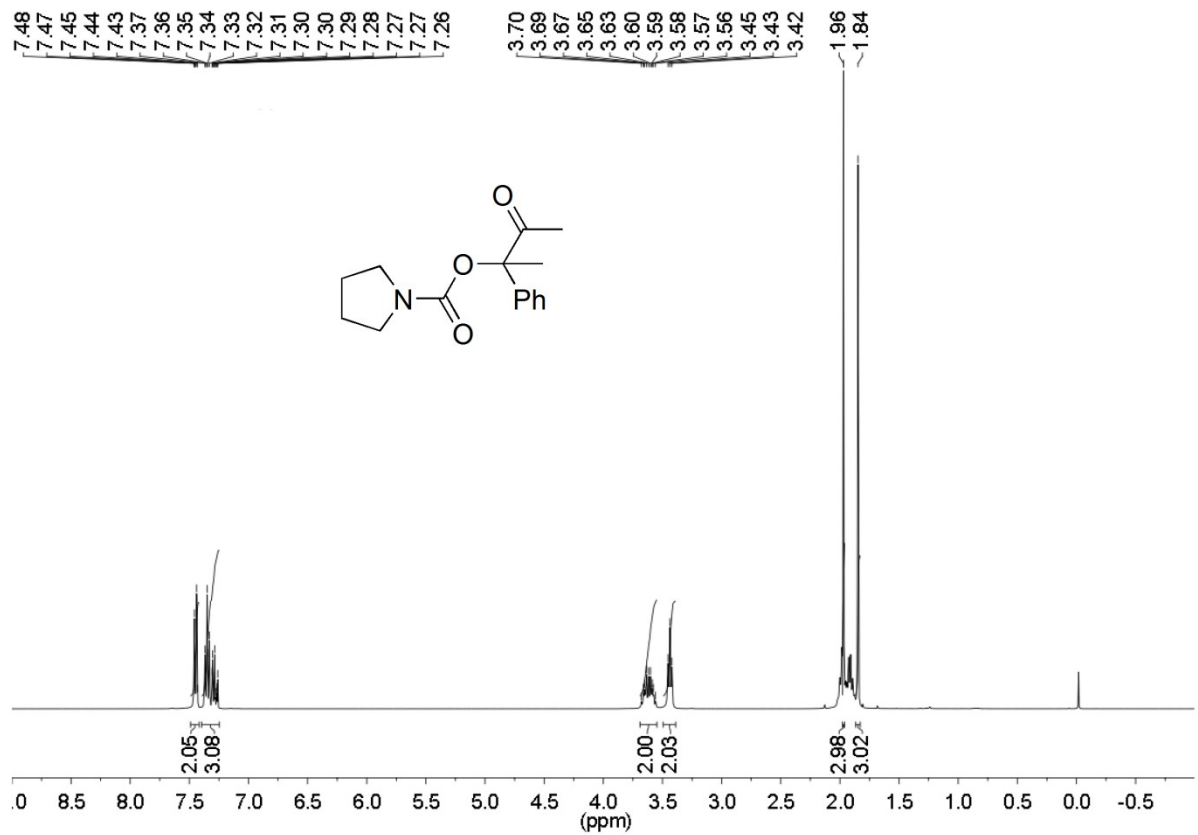
4) 1-acetylcyclohexyl pyrrolidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.47-3.38 (m, 4H), 2.14 (s, 3H), 2.08-2.04 (m, 2H), 1.90-1.88 (m, 4H), 1.68-1.59 (m, 5H), 1.53-1.42 (m, 2H), 1.24 (1H) ppm. ^{13}C NMR (CDCl_3 , 100.6 MHz) δ 208.3, 153.2, 83.9, 45.8, 30.9, 25.8, 25.0, 25.0, 24.8, 23.67, 21.5 ppm.



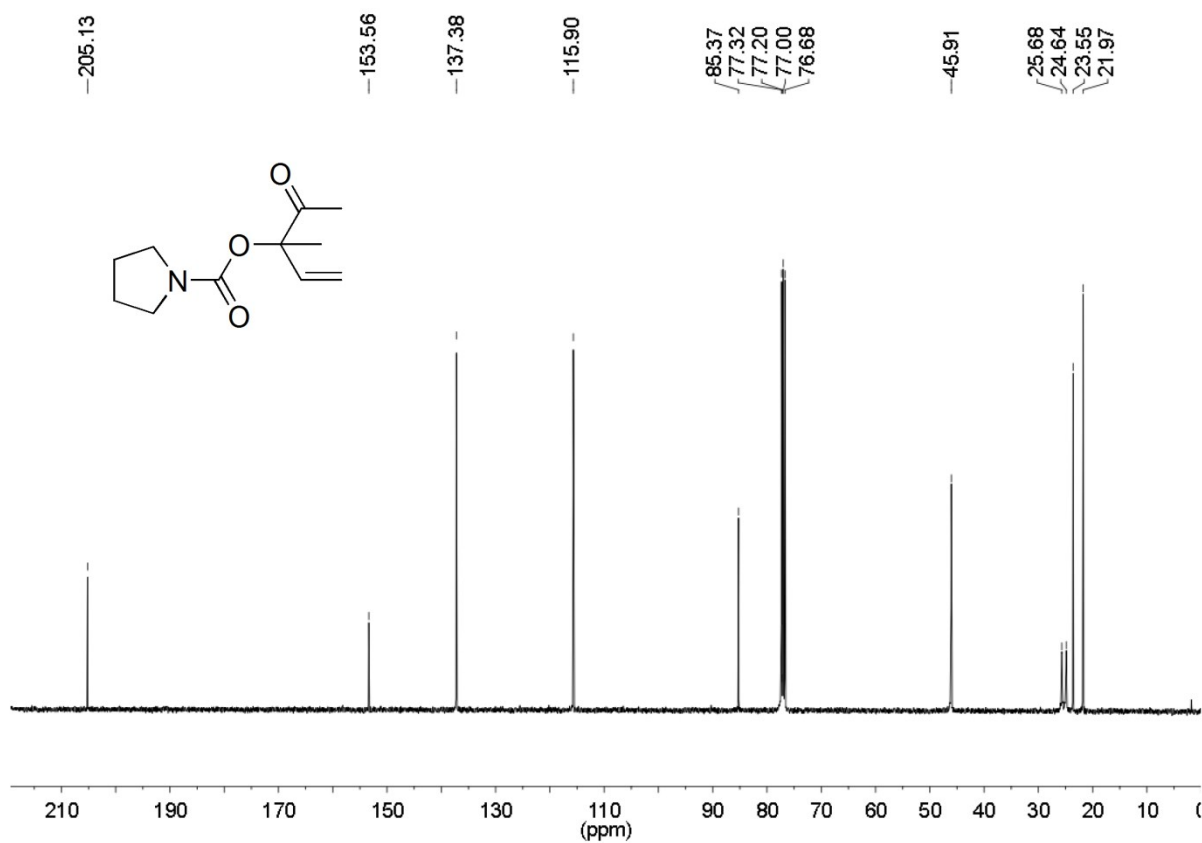
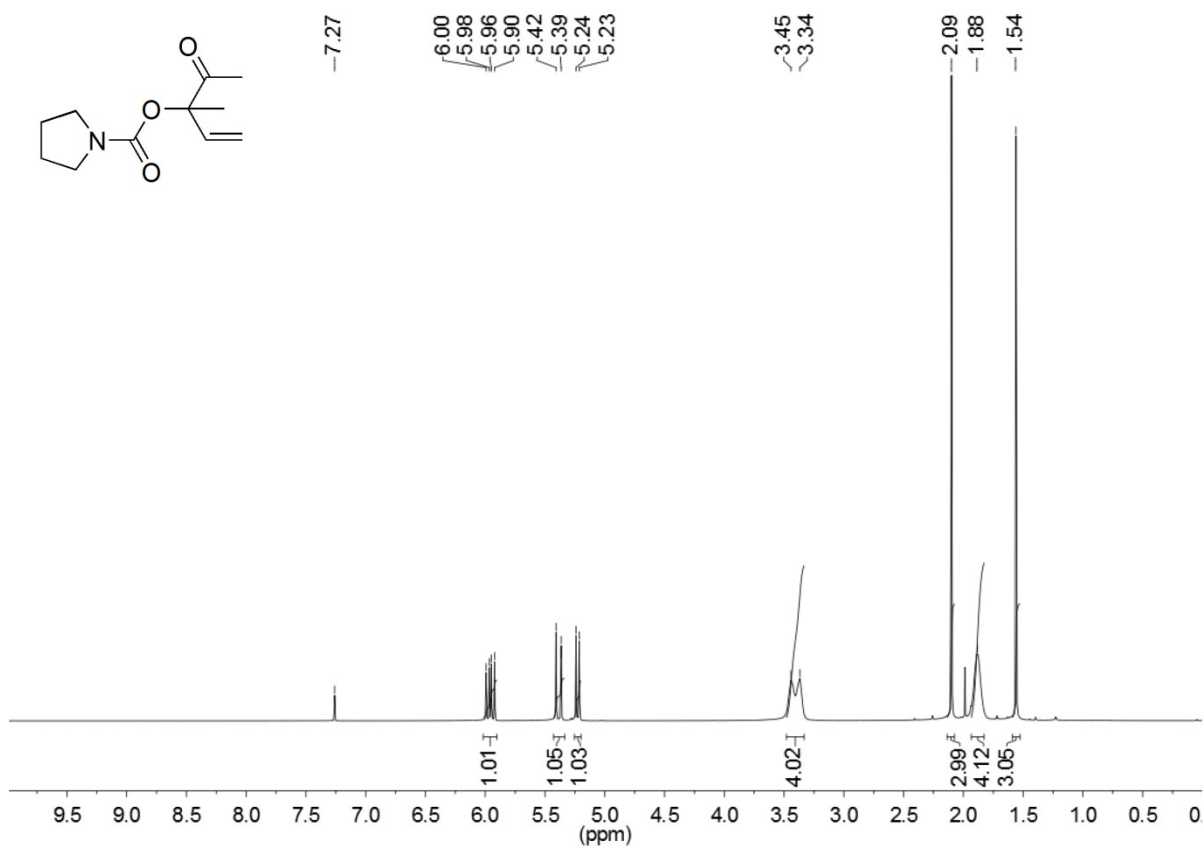
5) 3-oxo-2-phenylbutan-2-yl pyrrolidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 7.48-7.26 (5H), 3.70-3.42 (m, 4H), 1.96 (s, 3H), 1.84 (s, 3H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 204.3, 153.1, 139.7, 128.4, 127.6, 124.9, 86.8, 46.0, 25.9, 25.0, 23.9, 23.5 ppm.



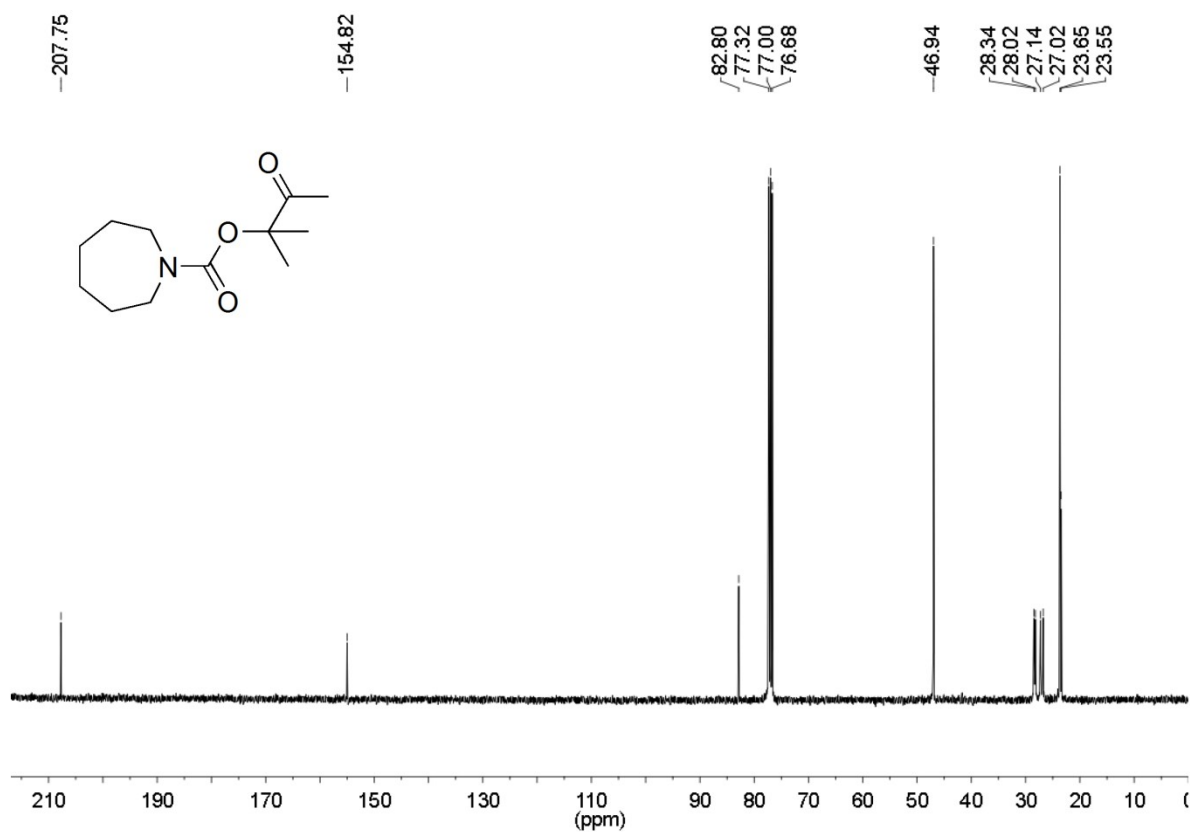
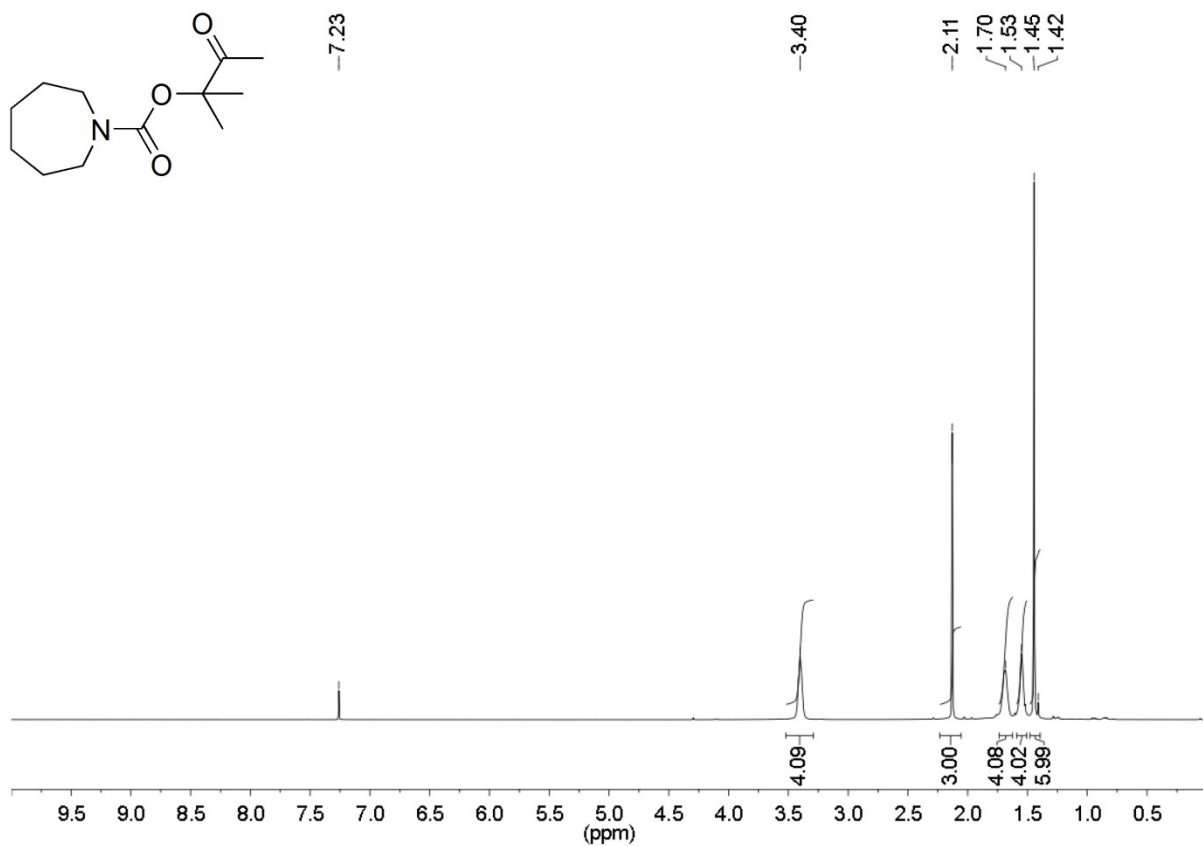
6) 3-methyl-4-oxopent-1-en-3-yl pyrrolidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 6.00-5.90 (dd, $J = 8$ Hz, $J = 12$ Hz, 1H), 5.42-5.23 (dd, $J = 20$ Hz, $J = 12$ Hz, 2H), 3.45-3.34 (m, 4H), 2.09 (s, 3H), 2.00-1.88 (m, 4H), 1.54 (s, 3H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 205.1, 153.5, 137.3, 115.9, 85.3, 45.9, 25.6, 24.6, 23.5, 21.9 ppm.



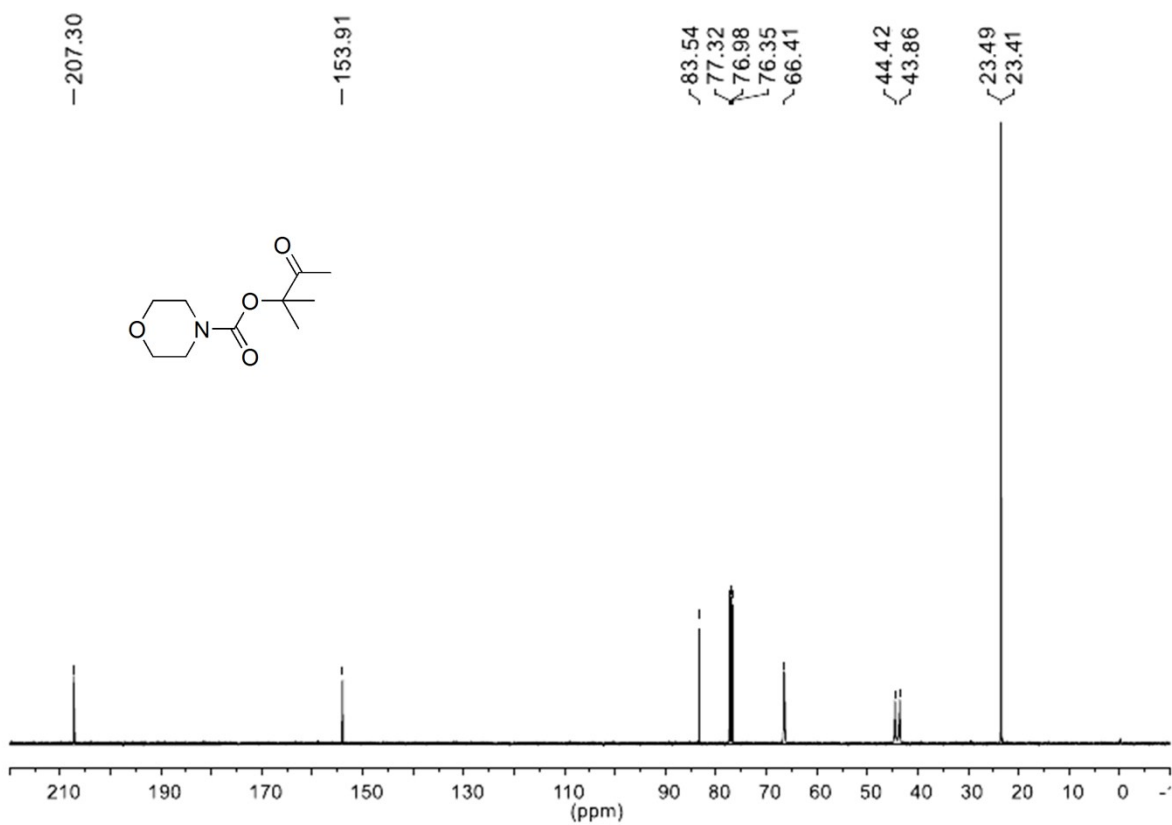
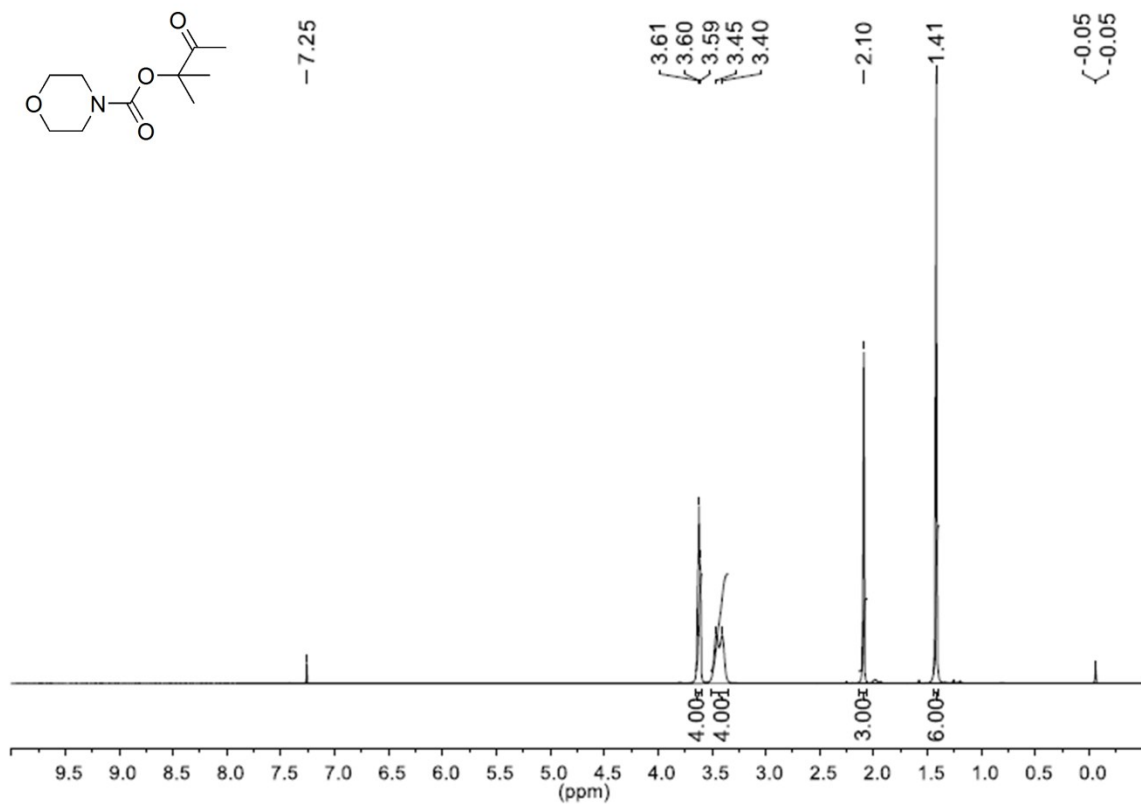
7) 2-methyl-3-oxobutan-2-yl azepane-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.40 (m, 4H), 2.11 (s, 3H), 1.70 (m, 4H), 1.53 (m, 4H), 1.45 (s, 6H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.5, 154.8, 82.8, 46.9, 28.3, 28.0, 27.1, 27.0, 23.6, 23.5 ppm.



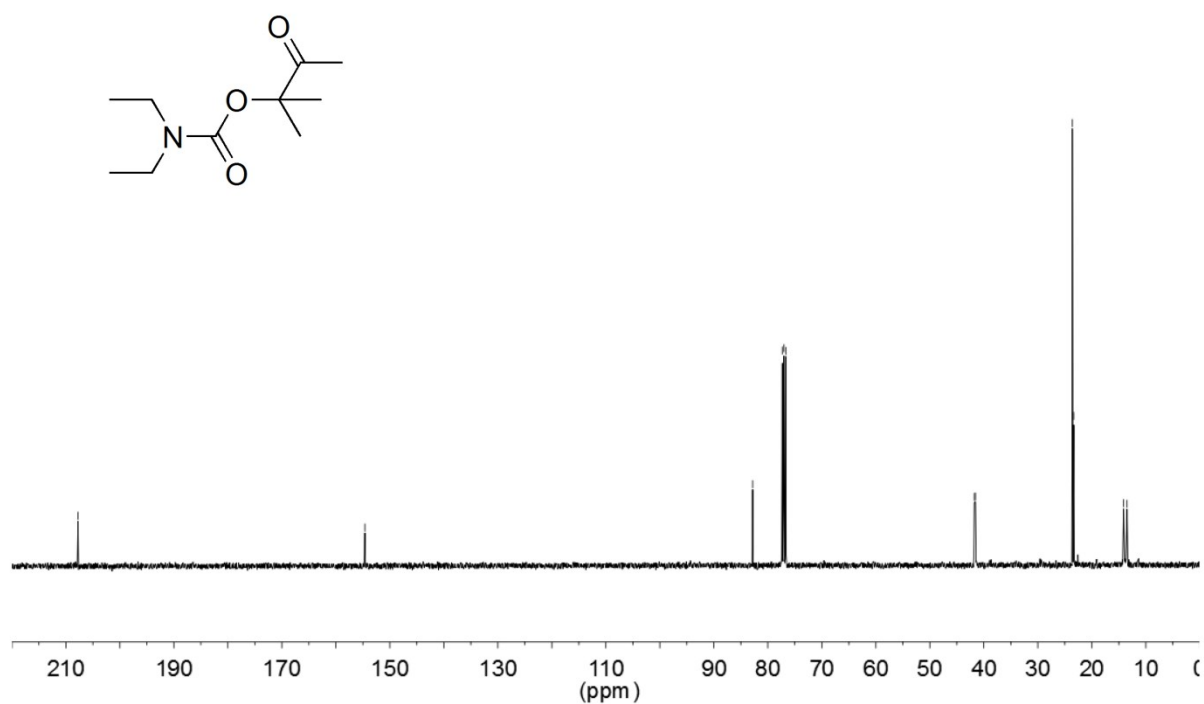
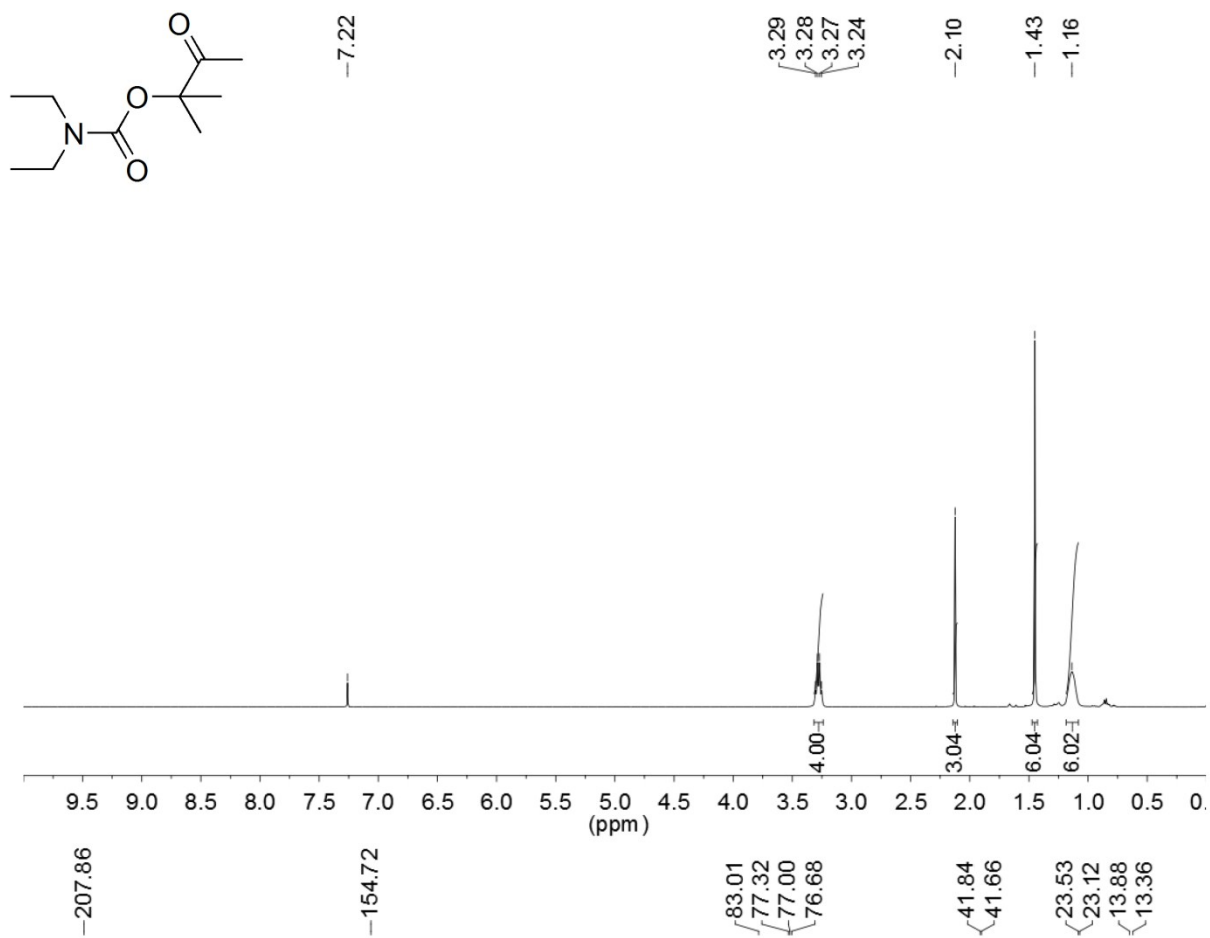
8) 2-methyl-3-oxobutan-2-yl morpholine-4-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.61-3.59 (t, $J = 4.0\text{Hz}$, 4H), 3.45-3.40 (t, $J = 20\text{ Hz}$, 4H), 2.10 (s, 3H), 1.41 (s, 6H) ppm. ^{13}C NMR (CDCl_3 , 100.6 MHz) δ 207.3, 153.9, 83.5, 44.4, 43.8, 23.4 ppm.



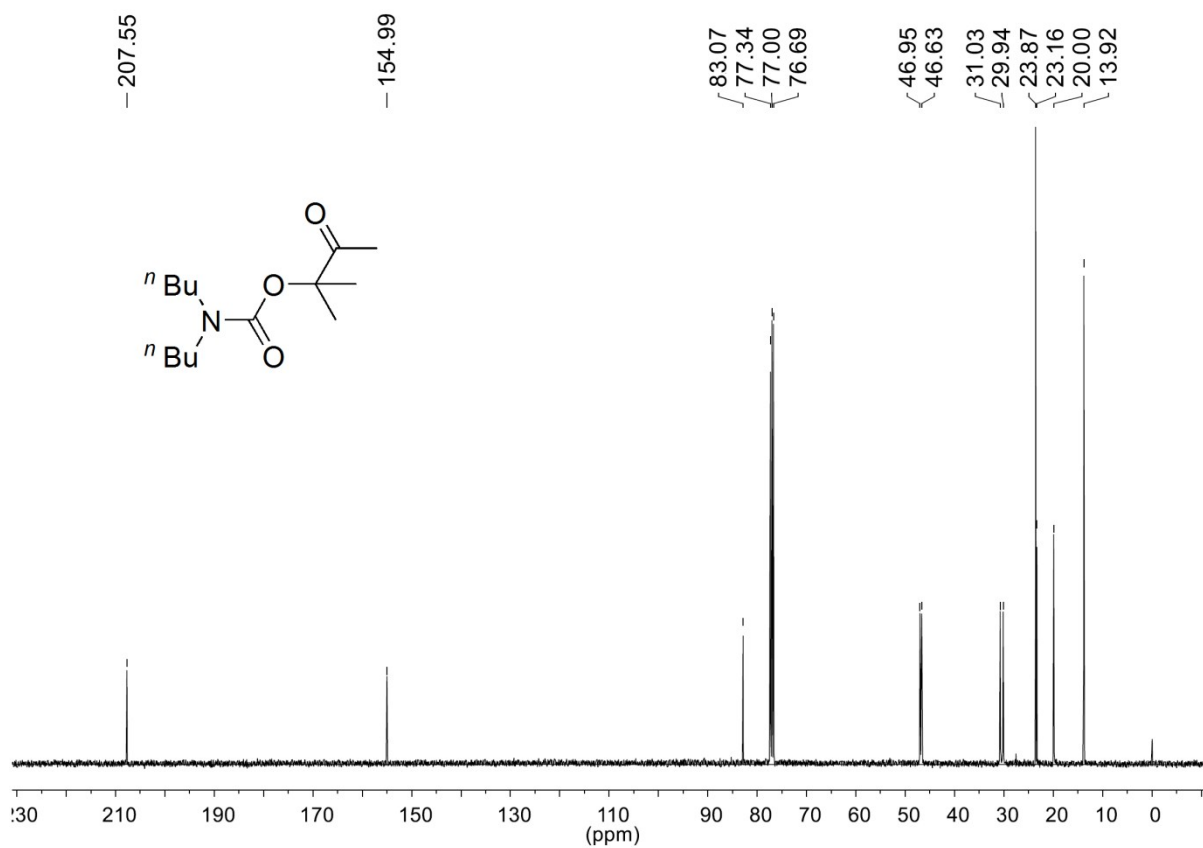
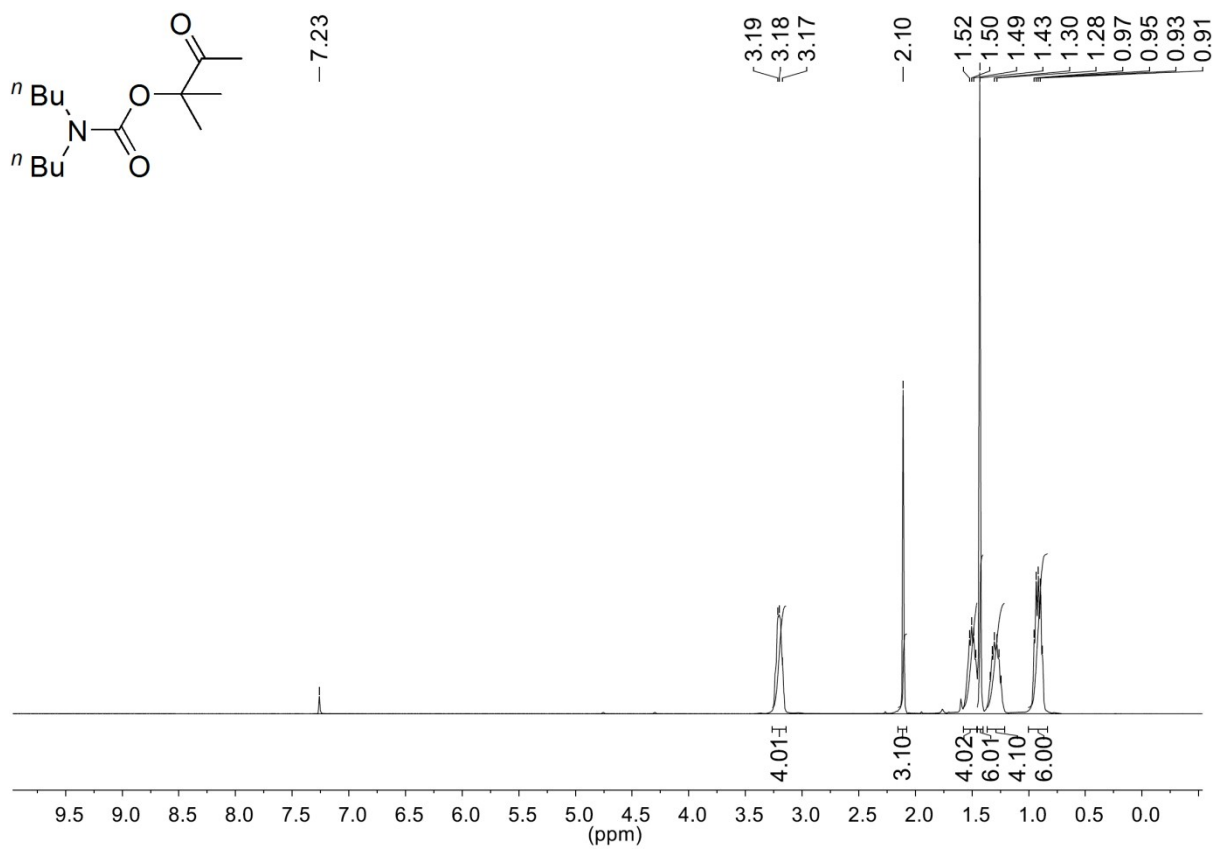
9) 2-methyl-3-oxobutan-2-yl diethylcarbamate

^1H NMR (CDCl_3 , 400 MHz) δ 3.29-3.24 (q, 4H), 2.10 (s, 3H), 1.43 (s, 6H), 1.16 (m, 6H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.8, 154.7, 83.0, 41.8, 41.6, 23.5, 23.1, 13.8, 13.3 ppm.



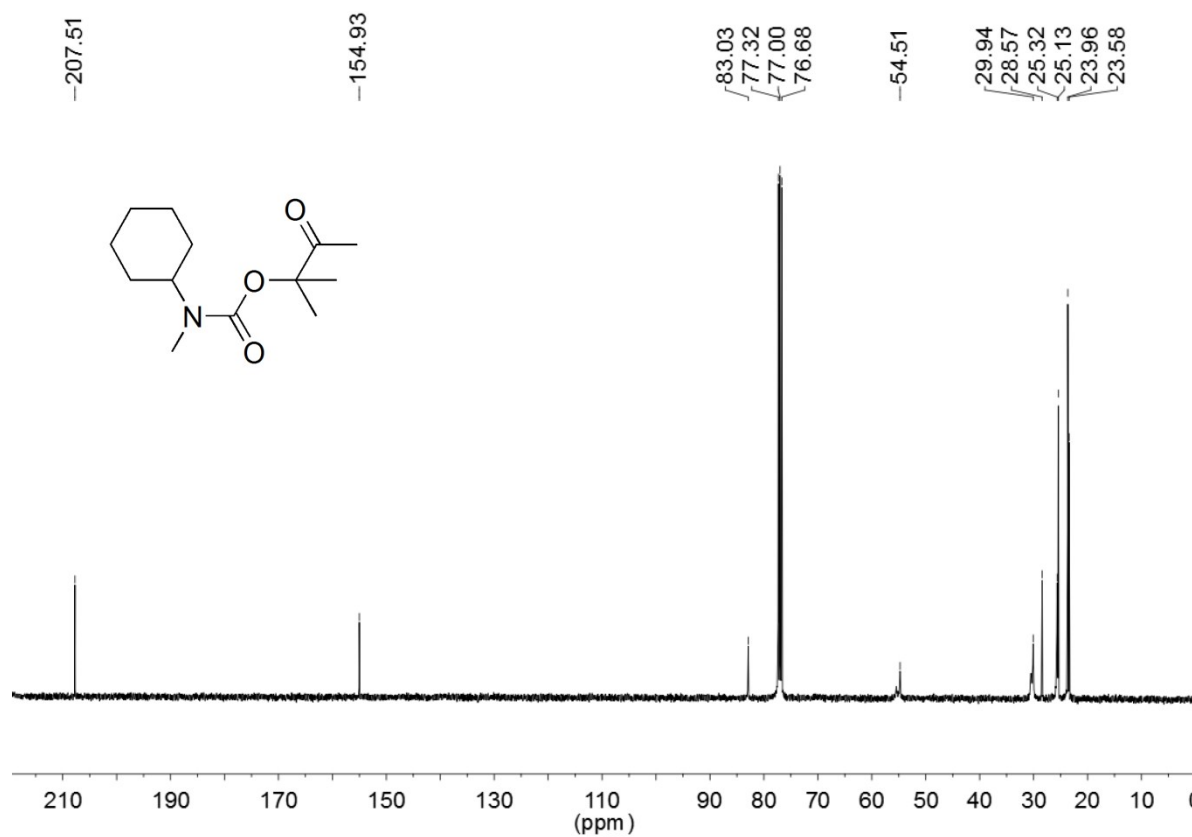
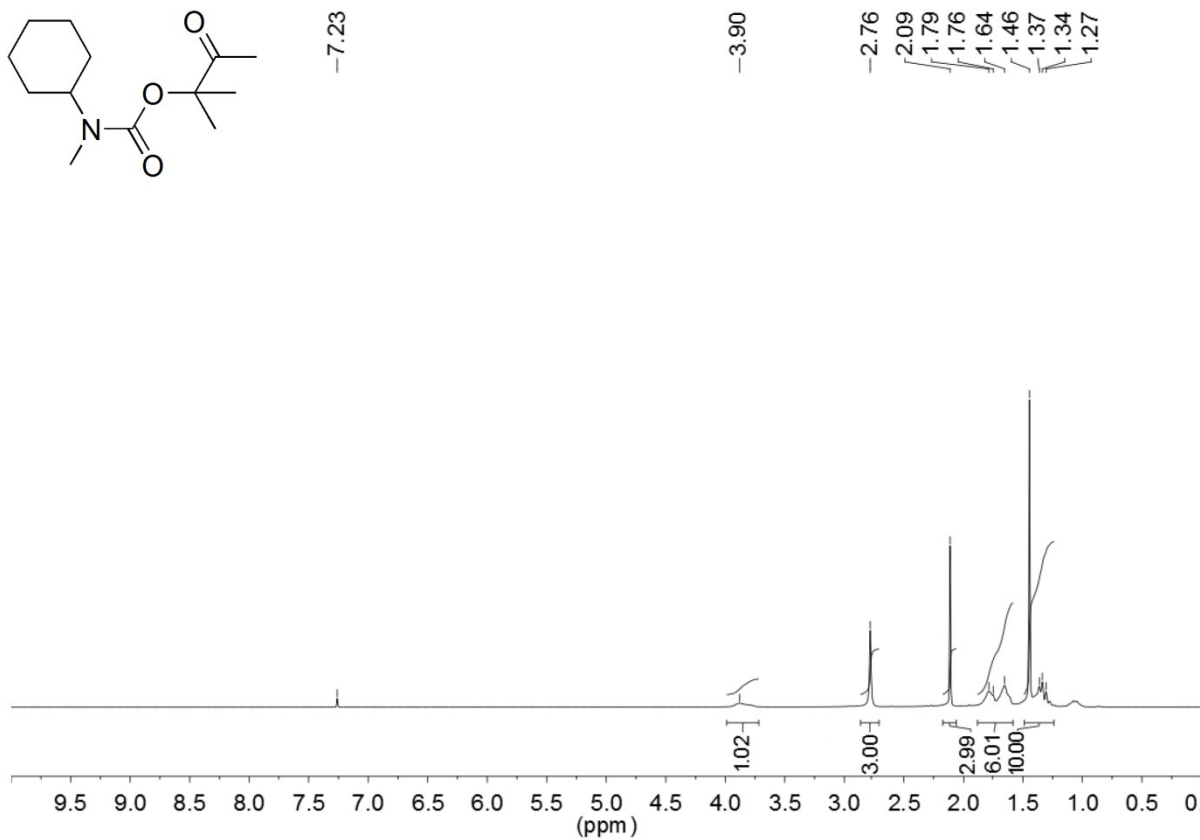
10) 2-methyl-3-oxobutan-2-yl dibutylcarbamate

^1H NMR (CDCl_3 , 400 MHz) δ 3.19 (t, 4H), 2.10 (s, 3H), 1.51-1.48 (m, 4H), 1.41 (s, 6H), 1.35-1.22 (m, 4H), 0.90 (s, 6H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.5, 154.9, 83.0, 46.9, 46.6, 31.0, 29.9, 23.8, 23.1, 20.0, 13.9 ppm.



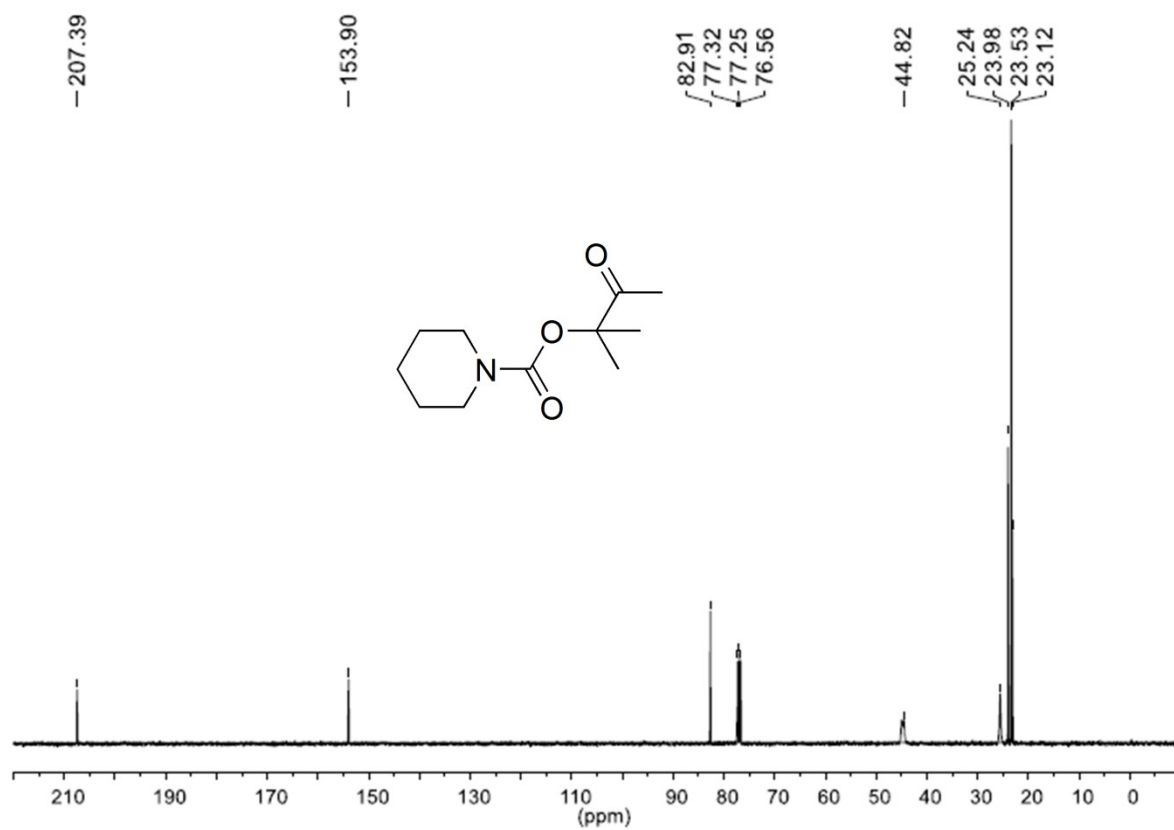
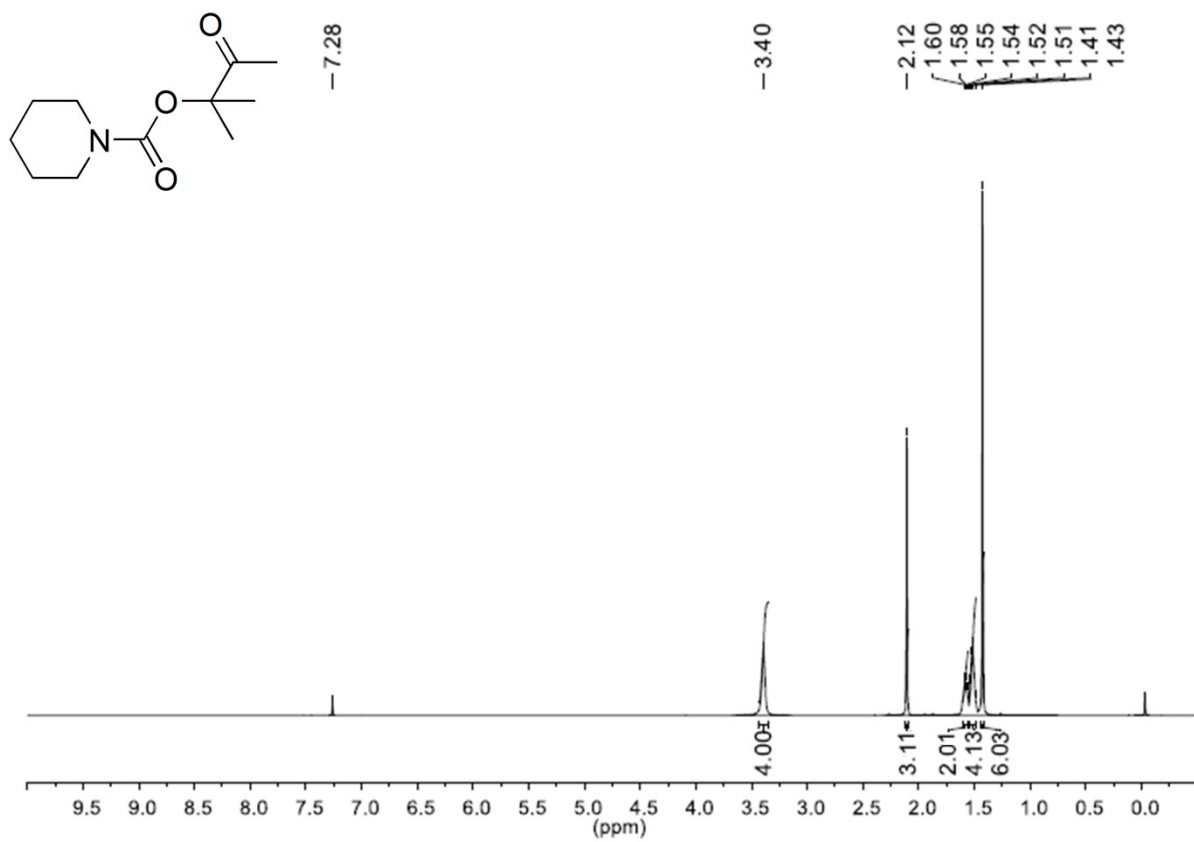
11) 2-methyl-3-oxobutan-2-yl cyclohexyl(methyl)carbamate

^1H NMR (CDCl_3 , 400 MHz) δ 3.90 (m, 1H), 2.76 (s, 3H), 2.09 (s, 3H), 1.79-1.64 (s, 6H), 1.46-1.27 (m, 10H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.5, 154.9, 83.0, 54.5, 29.9, 28.5, 25.3, 25.1, 23.9, 23.5 ppm.



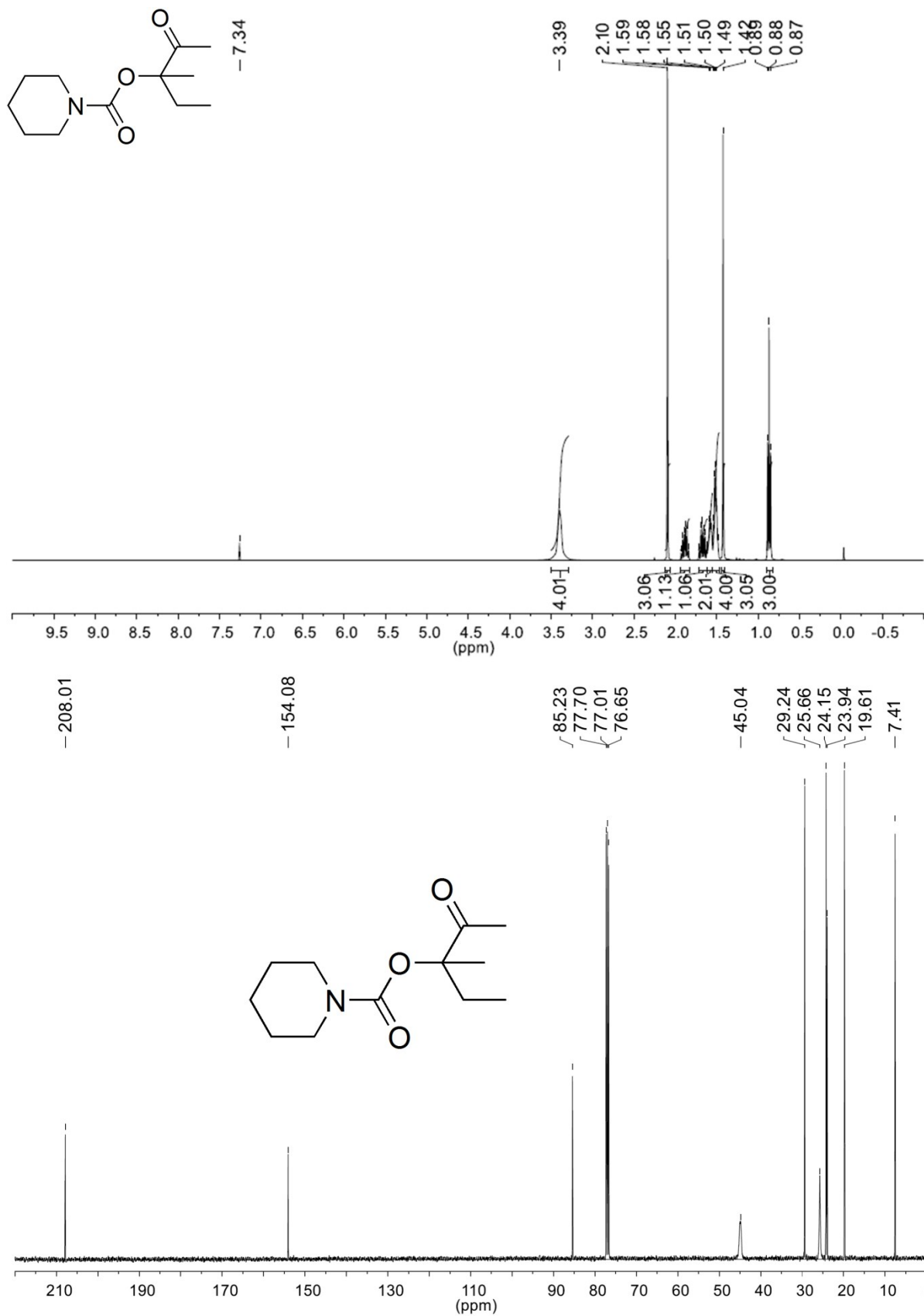
12) 2-methyl-3-oxobutan-2-yl piperidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.40 (m, 4H), 2.12 (s, 3H), 1.60-1.51 (m, 6H), 1.41 (s, 6H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.3, 153.9, 82.9, 44.8, 25.2, 23.9, 23.5, 23.1 ppm.



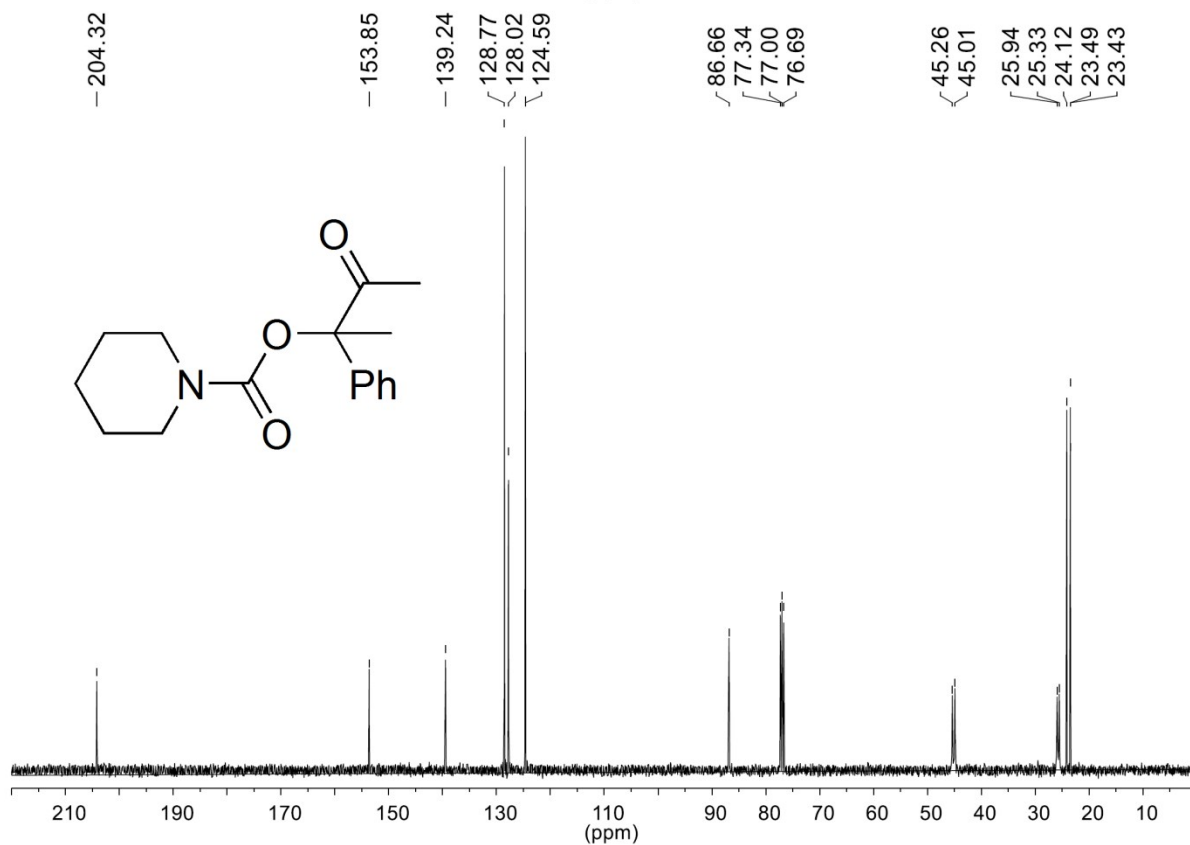
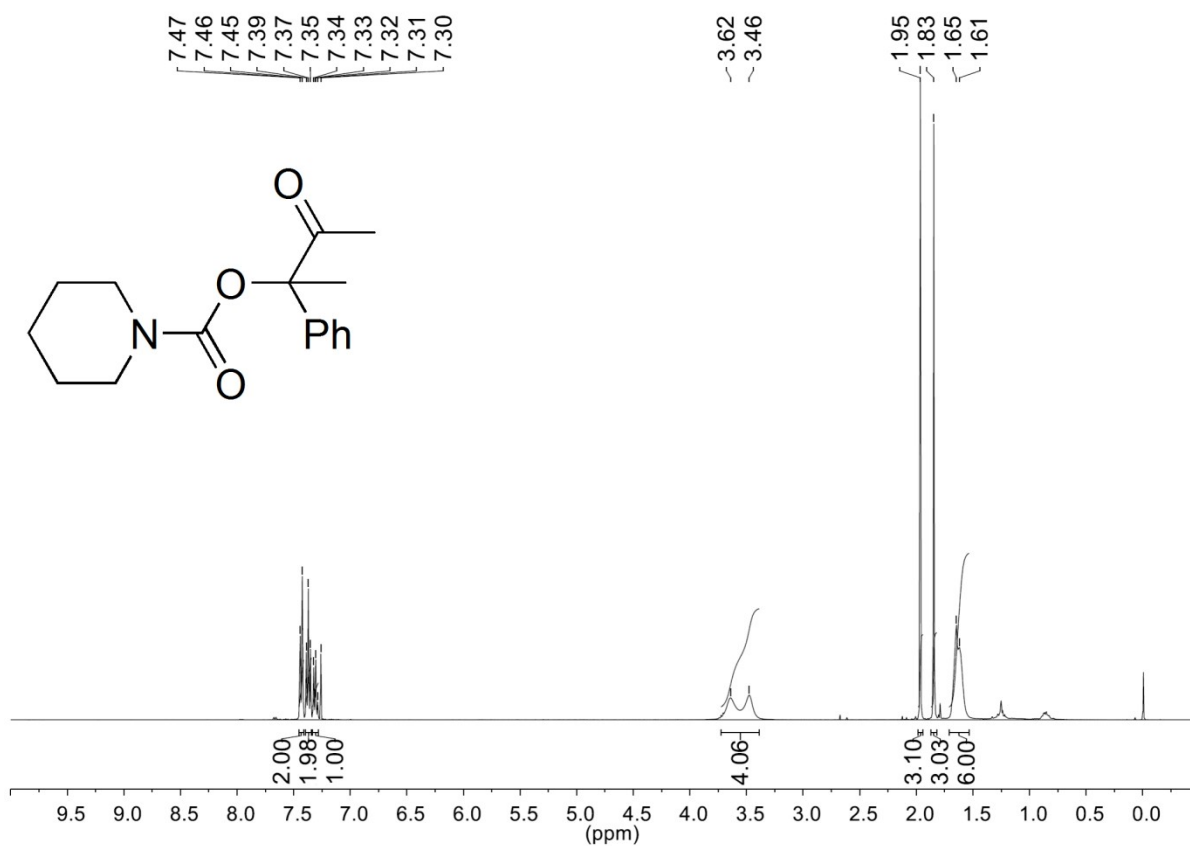
13) 3-methyl-2-oxopentan-3-yl piperidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 3.39 (4H), 2.10 (s, 3H), 1.95-1.81 (m, 1H), 1.59-1.55 (m, 1H), 1.51-1.49 (2H), 1.42 (7H), 1.40 (s, 1H), 0.89-0.87 (3H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 208.0, 154.0, 85.2, 45.0, 29.2, 25.6, 24.1, 23.9, 19.6, 7.4 ppm.



14) 3-oxo-2-phenylbutan-2-yl piperidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 7.47-7.30 (5H), 3.62-3.46 (m, 4H), 1.95 (s, 3H), 1.83 (s, 3H), 1.65-1.61 (6H) ppm. ^{13}C NMR (CDCl_3 , 100.6 MHz) δ 204.3, 153.8, 139.2, 128.7, 128.0, 124.5, 86.6, 45.2, 45.0, 25.9, 25.3, 24.1, 23.4 ppm.



15) 2-methyl-3-oxobutan-2-yl 2-methylpiperidine-1-carboxylate

^1H NMR (CDCl_3 , 400 MHz) δ 4.20-4.15 (m, 2H), 3.51-3.49 (d, $J = 8$ Hz, 2H), 2.84-2.74 (2H), 2.11 (s, 3H), 1.80-1.65 (d, 3H), 1.61 (m, 1H), 1.43 (s, 6H), 1.24-1.13 (m, 2H) ppm. ^{13}C NMR (CDCl_3 , 400 MHz) δ 207.6, 154.5, 83.0, 46.7, 38.9, 29.9, 25.4, 23.6, 23.4, 23.3, 18.5, 16.0 ppm.

