Supporting Information

DAST-mediated ring-opening of cyclopropyl silyl ethers in nitriles: Facile synthesis of allylic amides *via* Ritter-type process

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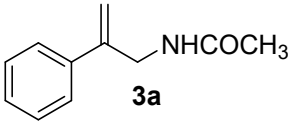
General

All reagents were purchased from Nacalai Tesque, Wako Pure Chemicals Industries, Kanto Kagaku, Kishida Reagents Chemical Co., Tokyo Chemical Industry, or Aldrich, and used without further purification. Melting Points (MPs) were measured with a Yanaco micro melting point apparatus (MP-J3) and are uncorrected. NMR spectra were recorded with a JEOL JNM-EX400 spectrometer (^{1}H-NMR 400 MHz, ^{13}C-NMR 100 MHz, ^{19}F-NMR 376 MHz) and a JEOL ECA600 spectrometer (^{1}H-NMR 600 MHz, ^{13}C-NMR 151 MHz). ^{1}H-NMR spectra are reported as follows: chemical shift in ppm relative to the chemical shift of $CHCl_3$ at 7.26 ppm, integration, multiplicities (s = singlet, d = doublet, t = triplet, q = quartet, sep = septet, m = multiplet), and coupling constants (Hz). ^{13}C-NMR spectra reported in ppm relative to the central line of triplet for $CDCl_3$ at 77 ppm. ^{19}F-NMR spectra reported in ppm relative to the central line of singlet for CF_3CO_2H at 0 ppm as an external standard. The IR spectra were recorded using a Jasco IR-8300 FT-IR spectrophotometer and a METTLER React-IR45m. The mass spectra were recorded on a Shimadzu GCMS-QP1100EX spectrometer (EI), JEOL JMS-T100LC spectromete (ESI) or JEOL JMS-700 (FAB).

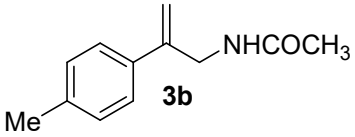
***N*-(2-phenylallyl) acetamido (3a)**[1]



3a

Brown oil; IR (neat) 3286, 3077, 1654, 1550, 903, 708 cm^{-1}; ^{1}H-NMR (400MHz, $CDCl_3$) δ 1.92 (3H, s), 4.28－4.26 (2H, d, *J* = 5.6 Hz), 5.20 (1H, s), 5.43 (1H, s), 5.93 (1H, br), 7.24－7.33 (3H, m), 7.37－7.40 (2H, m); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 23.1, 43.1, 113.7, 125.9, 127.9, 128.4, 138.2, 144.1, 177.0.

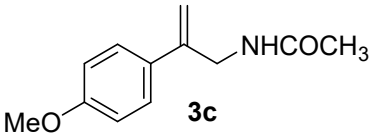
***N*-(2-(4-methylphenyl)-2-propen-1-yl) acetamide (3b)**[2]



3b

Pale yellow crystal (MP 93 ℃); IR (neat) 3290, 3089, 2924, 2856, 1638, 1551, 893 cm^{-1}; ^{1}H-NMR (400MHz, $CDCl_3$) δ 1.93 (3H, s), 2.32 (3H, s), 4.26－4.28 (2H, d, *J* = 6.0 Hz), 5.16 (1H, s), 5.41 (1H, s), 5.70 (1H, br), 7.11－7.13 (2H, d, *J* = 7.8 Hz), 7.26－7.31 (2H, d, *J* = 7.8 Hz); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 21.0, 23.1, 43.3, 113.1, 125.8, 129.2, 135.3, 137.9, 143.9, 169.9; MS (EI) (m/z) 189 $[M]^+$; HRMS (ESI) calcd for $C_{12}H_{15}NONa$ $[M+Na]^+$ 212.1046, found 212.1046.

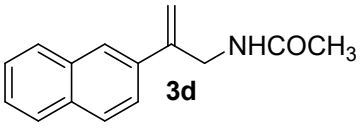
***N*-(2-(4-methoxylphenyl)-2-propen-1-yl) acetamide (3c)**[2]



3c

White solid (MP 98 ℃); ^{1}H-NMR (400MHz, $CDCl_3$) δ 1.92 (3H, s), 3.78 (3H, s), 4.25 (2H, d, *J* = 5.6 Hz), 5.11 (1H, d, *J* = 1.2 Hz), 5.35 (1H, s), 5.68 (1H, br), 6.84(2H, d, *J* = 8.8 Hz), 7.34 (2H, d, *J* = 8.8 Hz); ^{13}C-NMR (100MHz, $CDCl_3$) δ 23.17, 43.35, 55.21, 112.30, 113.83, 127.13, 130.54, 143.41, 159.47, 169.87.

***N*-(2-Naphthalen-2-ylallyl) acetamide (3d)**

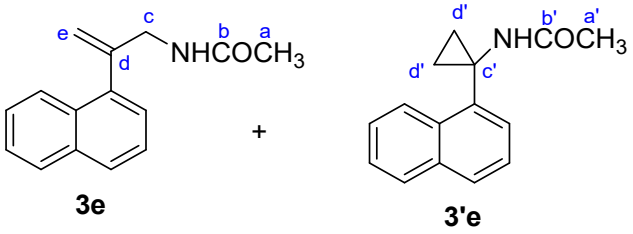


3d

Pale yellow solid (MP 104 ℃); IR ($CHCl_3$) 3271, 3085, 1642, 1568, 1430, 892, 745 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.96 (3H, s), 4.44 (2H, d, *J* = 5.2 Hz), 5.35 (1H, s), 5.62 (1H, s), 5.72 (1H, br), 7.58 (1H, dd, *J* = 8.2 Hz, 1.8 Hz), 7.45 – 7.50 (2H, m), 7.80－7.86 (4H, m); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 23.2, 43.4, 114.6, 124.1, 124.6, 126.2, 126.2, 126.4, 127.5, 128.2, 128.3, 133.0, 133.3,

135.3, 170.0; MS (EI) (m/z) 225 $[M]^+$; HRMS (ESI) calcd for $C_{15}H_{15}NONa$ $[M+Na]^+$ 248.1046, found 248.1047.

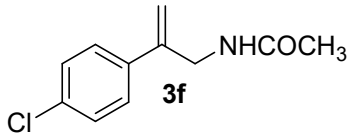
_N_-(2-(1-naphthyl)-2-propen-1-yl) acetamide (3e) and _N_-(1-(1-naphthyl) cyclopropyl)acetamide (3'e) as inseparable mixtures



3e **3'e**

Brown solid; IR (neat) 3422, 3284, 3056, 3008, 2925, 1650, 1544, 912 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.26－1.27 (2.6H, m), 1.38－1.43 (2.5H, m), 1.74 (3H, s), 1.94 (3.4H, s), 4.21－4.23 (1.7H, d, J = 6.0 Hz), 4.41－4.43 (0.6H, d, J = 6.0 Hz), 5.20－5.21 (0.8H, d, J = 1.2 Hz), 5.53－5.55 (0.8H, m), 5.92－5.96 (1H, m), 6.63－6.66 (1H, m), 7.26－7.30 (0.8H, m), 7.36－7.57 (7.5H, m), 7.73－7.86 (6.5H, m), 8.03－8.07 (0.9H, m), 8.41－8.43 (1H, d, J = 8.0 Hz); Selected ^{13}C-NMR (100 MHz, $CDCl_3$) δ 14.7 ($C^{d'}$), 23.1 (C^a or $C^{a'}$), 23.5 (C^a or $C^{a'}$), 34.3 ($C^{c'}$), 45.5 (C^c), 115.8 (C^e), 145.1 (C^d), 170.0 (C^b or $C^{b'}$), 170.1 (C^b or $C^{b'}$); MS (EI) (m/z) : 225 $[M]^+$; HRMS (ESI) calcd for, $C_{15}H_{15}NONa$ $[(M+Na)^+]$, 248.1046, found : 248.1045.

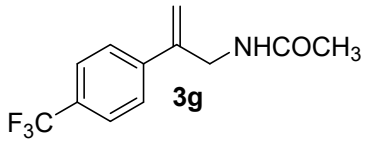
_N_-[2-(4-chlorophenyl)-2-propen-1-yl] acetamide (3f)[3]



3f

Pale yellow solid (MP 98.3 ℃); IR (400 MHz, $CHCl_3$) 3276, 3087, 1635, 1556, 1497, 1372, 1285, 1230, 1100, 1017, 903, 833, 730 cm^{-1}; ^{1}H-NMR (100 MHz, $CDCl_3$) δ 1.97 (3H, s), 4.32 (2H, dd, J = 12.0, 5.6 Hz), 5.25 (1H, s), 5.46 (1H, s), 5.51 (1H, br), 7.32 (2H, d, J = 8.6 Hz), 7.37 (2H, d, J = 8.6 Hz); ^{13}C-NMR ($CDCl_3$) δ 23.0, 42.9, 114.3, 127.2, 128.5, 133.7, 136.4, 143.0, 169.6; HRMS (ESI) calcd for $C_{11}H_{12}ClNONa$ $[M+Na]^+$ 232.0500, found 232.0498.

_N_-[2-[4-(trifluoromethyl)phenyl]-2-propen-1-yl] acetamide (3g)[2]

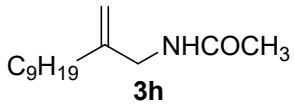


3g

White solid (MP 121.7 ℃); IR ($CHCl_3$) 3273, 3080, 1639, 1552, 1324, 1151, 1112, 1061, 845 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.97 (3H, s), 4.35 (2H. d, J = 6.0 Hz), 5.35 (1H, s), 5.54 (1H, s), 5.67

(1H, br), 7.53 (2H, d, J = 8.2 Hz), 7.60 (2H, d, J = 8.2 Hz); ^{19}F-NMR ($CDCl_3$) δ 63.09 (s); ^{13}C-NMR (100MHz, $CDCl_3$) δ 23.2, 43.0, 115.9, 124.0 (q, $J_{C\text{-}F}$ = 272.0 Hz), 125.5 (q, J = 3.8 Hz), 129.5 (q, J = 32.6 Hz), 141.8, 143.4, 169.9; MS (EI) (m/z) 243 $[M]^+$; HRMS (ESI) calcd for $C_{12}H_{17}F_3NONa$ $[M+Na]^+$ 266.0763, found 266.0761.

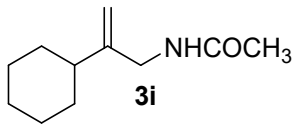
***N*-(2-methylene-1-undecyl) acetamide (3h)**



3h

White solid (MP 37 ℃); IR (neat) 3284, 3084, 2925, 2859, 1647, 1552, 896 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 0.80－0.83 (3H, t, J = 6.4 Hz), 1.11－1.25 (12H, m), 1.36－1.39 (2H, m), 1.92－1.97 (5H, m), 3.73－3.75 (2H, d, J = 5.6 Hz), 4.77－4.79 (2H, d, J = 10.4 Hz), 6.02 (1H, br); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 13.7, 22.6, 23.0, 27.5, 29.2, 29.2, 29.4, 29.5, 31.8, 34.0, 43.9, 109.6, 146.1, 170.0; MS (EI) (m/z) 225 $[M]^+$; HRMS (ESI) calcd for $C_{14}H_{27}NONa$ $[M+Na]^+$ 248.1985, found 248.1983.

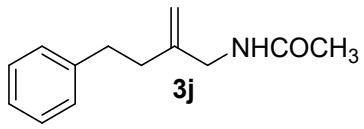
***N*-(2-cyclohexylallyl) acetamide (3i)**



3i

Yellow solid (MP 60 ℃); IR ($CHCl_3$) 3245, 3079, 2921, 1639, 1544, 750 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.08－1.88 (11H, m), 1.99 (3H, s), 3.83 (2H, d, J = 6.0 Hz), 4.81 (1H, d, J = 0.8 Hz), 4.83 (1H, d, J = 0.8 Hz); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 23.3, 26.2, 26.6, 32.2, 42.5, 43.1, 108.3, 151.4, 169.8; MS (EI) (m/z) 181 $[M]^+$; HRMS (ESI) calcd for $C_{11}H_{19}NONa$ $[M+Na]^+$ 204.1359, found 204.1359.

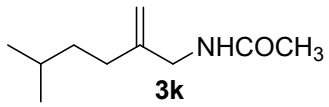
***N*-(2-phenethylallyl) acetamide (3j)**[4]



3j

Yellow solid (MP 50 ℃); IR (neat) 3280, 3075, 2922, 1647, 1552, 1285, 746, 699 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.97 (3H, s), 2.32 (2H, t, J = 8.0 Hz), 2.76 (2H, t, J = 8.0 Hz), 3.84 (2H, d, J = 6.0 Hz), 4.88－4.90 (2H, m), 5.47 (1H, br), 7.15－7.28 (5H, m); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 23.3, 34.2, 35.7, 44.2, 110.9, 125.9, 128.4, 128.4, 141.6, 145.4, 169.9; MS (EI) (m/z) 203 $[M]^+$; HRMS (ESI) calcd for $C_{13}H_{17}NONa$ $[M+Na]^+$ 226.1202, found 226.1201.

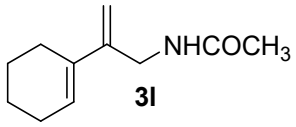
***N*-[2-(3-methylbutyl)allyl] acetamide (3k)**



3k

Yellow oil; IR (neet) 3276, 3080, 2950, 1651, 1549, 892, 754 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 0.87 (6H, d, *J* = 7.2 Hz), 1.28－1.34 (2H, m), 1.47－1.57 (1H, m), 1.96－2.02 (5H, m), 3.81 (2H, s), 4.83 (2H, s), 5.50 (1H, br); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 22.6, 23.4, 27.8, 32.1, 36.1, 44.2, 109.8, 146.6, 170.0; MS (EI) (m/z) 169 $[M]^+$; HRMS (ESI) calcd for $C_{10}H_{19}NONa$ $[M+Na]^+$ 192.1359, found 192.1359.

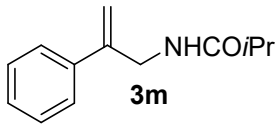
***N*-(2-cyclohex-1-enyl-allyla)acetamide (3l)**



3l

Brown oil; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.00 (3H, s), 4.07 (2H, d, *J* = 5.6 Hz), 4.99 (1H, s), 5.10 (1H, s), 5.57 (1H, br), 5.91－5.92 (1H, m); ^{13}C-NMR (100 MHz, $CDCl_3$,) δ 22.0, 22.7, 23.3, 25.8 x 2, 42.5, 111.0, 125.7, 134.0, 144.1, 169.7; MS (EI) (m/z) 181 $[M]^+$; HRMS (ESI) calcd for $C_{11}H_{17}NONa$ $[M+Na]^+$ 202.1202, found 202.1202.

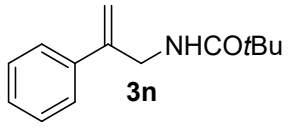
***N*-(2-phenylallyl) isobutyramide (3m)**



3m

Brown solid (MP 44 ℃); IR ($CHCl_3$) 3297, 3081, 2968, 2931, 1646, 1543, 1232, 697 cm^{-1}; ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.09 (6H, d, *J* = 6.8 Hz), 2.30 (1H, sep, *J* = 6.8 Hz), 4.32 (2H, d, *J* = 5.6 Hz), 5.21 (1H, s), 5.45 (1H, s), 5.52 (1H, br), 7.26－7.35 (3H, m), 7.39－7.42 (2H, m); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 19.5, 35.6, 43.0, 113.6, 126.1, 128.0, 128.5, 138.3, 144.5, 176.7; MS (EI) (m/z) 203 $[M]^+$; HRMS (ESI) calcd for $C_{13}H_{17}NONa$ $[M+Na]^+$ 226.1202, found 226.1206.

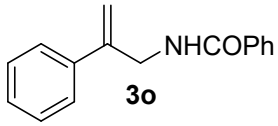
2,2-dimethyl-*N*-(2-phenylallyl) propionamide (3n)[5]



3n

Pale yellow solid (MP 108 ℃, lit.[5] 102-104 ℃); ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.14 (9H, s), 4.32 (2H, d, *J* = 5.6 Hz), 5.20 (1H, d, *J* = 0.8 Hz), 5.44 (1H, s), 5.72 (1H, br), 7.27－7.42 (5H, m); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 27.4, 38.6, 43.1, 113.3, 126.1, 127.9, 128.4, 138.4, 144.8, 178.1.

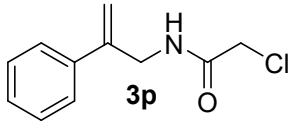
***N*-(2-phenylallyl) benzamide (3o)**[6]



3o

Pale yellow solid (MP 123 ℃, lit. [6] 123-125 ℃); ^{1}H-NMR (400 MHz, $CDCl_3$) δ 4.53 (2H, d, *J* = 5.6 Hz), 5.31 (1H, s), 5.52 (1H, s), 6.27 (1H, br), 7.26－7.49 (8H, m), 7.70－7.78 (2H, m); ^{13}C-NMR (100 MHz, $CDCl_3$) δ 43.7, 114.1, 126.1, 126.9, 128.1, 128.5, 128.6, 131.5, 134.4, 138.2, 144.2, 137.3.

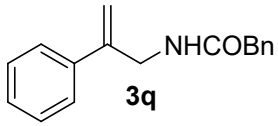
2-Chloro-*N*-(2-phenylallyl) acetamide (3p)



3p

White solid (MP 44-45 ℃); IR (KBr) 3309, 3067, 2890, 1656, 1551, 1415, 1224, 914 cm^{-1}; ^{1}H-NMR (600 MHz, $CDCl_3$) δ 4.05 (2H, s), 4.38 (2H, d, *J* = 5.5 Hz), 5.26 (1H, s), 5.50 (1H, s), 6.69 (1H, br), 7.32 (1H, tt, *J* = 7.2, 1.7 Hz), 7.35-7.37 (2H, m), 7.41-7.43 (2H, m); ^{13}C-NMR (151 MHz, $CDCl_3$) δ 42.6, 43.3, 114.0, 126.0, 128.2, 128.6, 138.0, 143.5, 165.7; HRMS (ESI) calcd for $C_{11}H_{12}ClNONa$ $[M+Na]^+$ 232.0500, found 232.0503.

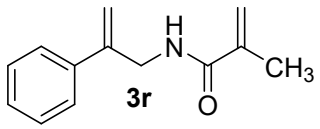
2-Phenyl-*N*-(2-phenylallyl) acetamide (3q)[7]



3q

White solid (MP 68-69 ℃); IR (KBr) 3324, 3087, 3031, 2931, 1639, 1541, 1496, 906 cm^{-1}; ^{1}H-NMR (600 MHz, $CDCl_3$) δ 3.55 (2H, s), 4.29 (2H, d, *J* = 5.5 Hz), 5.08 (1H, s), 5.36 (1H, s), 5.51 (1H, br), 7.12-7.14 (2H, m), 7.26-7.35 (8H, m); ^{13}C-NMR (151 MHz, $CDCl_3$) δ 43.1, 43.7, 113.4, 126.0, 127.3, 128.0, 128.4, 128.9, 129.3, 134.6, 138.3, 144.3, 170.7; HRMS (ESI) calcd for $C_{17}H_{17}NONa$ $[M+Na]^+$ 274.1203, found 274.1204.

***N*-(2-phenylallyl) methacrylamide (3r)**

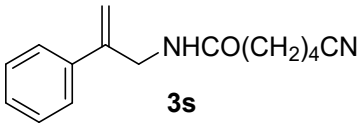


3r

White solid (MP 52-53 ℃); IR (KBr) 3309, 3080, 3057, 2924, 1656, 1614, 1269, 905 cm^{-1}; ^{1}H-NMR (600 MHz, $CDCl_3$) δ 1.92 (3H, s), 4.39 (2H, d, *J* = 5.5 Hz), 5.25 (1H, s), 5.29 (1H, s), 5.48 (1H, s), 5.61 (1H, s), 5.93 (1H, br), 7.29-7.31 (1H, m), 7.33-7.36 (2H, m), 7.42-7.44 (2H, m); ^{13}C-NMR (151

MHz, $CDCl_3$) δ 18.6, 43.2, 113.8, 119.5, 126.0, 128.0, 128.5, 138.3, 139.9, 144.2, 168.2; HRMS (ESI) calcd for $C_{15}H_{18}N_2ONa$ $[M+Na]^+$ 265.1311, found 265.1307.

5-Cyano-pentanoic acid (2-phenylallyl) amide (3s)

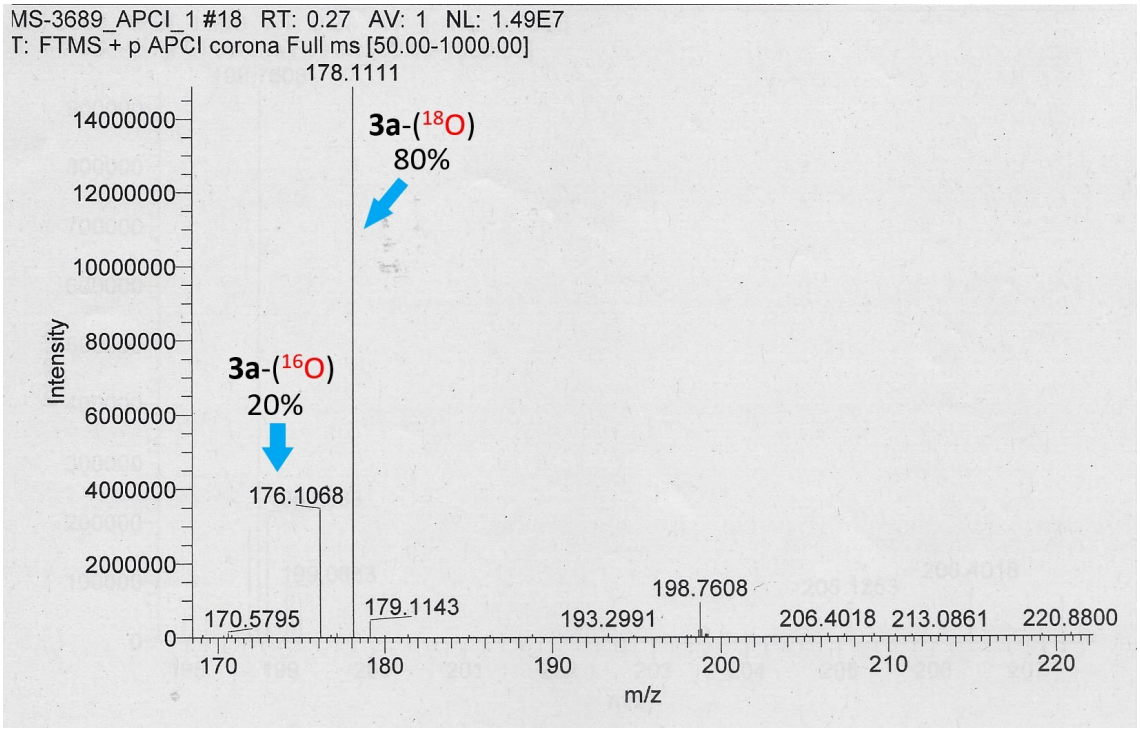


3s

Yellow oil; IR ($CHCl_3$) 3294, 3074, 2938, 2872, 2250, 1650, 1544, 1426, 1247, 906, 778, 705 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.56-1.63 (2H, m), 1.70-1.78 (2H, m), 2.18 (2H, t, J = 7.0 Hz), 2.29 (2H, t, J = 7.0 Hz), 4.3 (2H, d, J = 6.0 Hz), 5.23 (1H, d, J = 0.8 Hz), 5.46 (1H, s), 5.56 (1H, br), 7.28-7.37 (3H, m), 7.40-7.43 (2H, m); ^{13}C NMR ($CDCl_3$) δ 16.91, 24.51, 24.67, 35.35, 43.24, 114.19, 119.42, 126.11, 128.12, 128.53, 138.16, 144.34, 171.55; HRMS (ESI) calcd for

O-isotopic labeled mechanistic studies

When the O-isotopic labeled H_2O (97 atom% ^{18}O) was used for the reaction work-up, scrambling of ^{16}O and ^{18}O in the amide group was observed and the ratio between them (20/80) was determined *via* HRMS

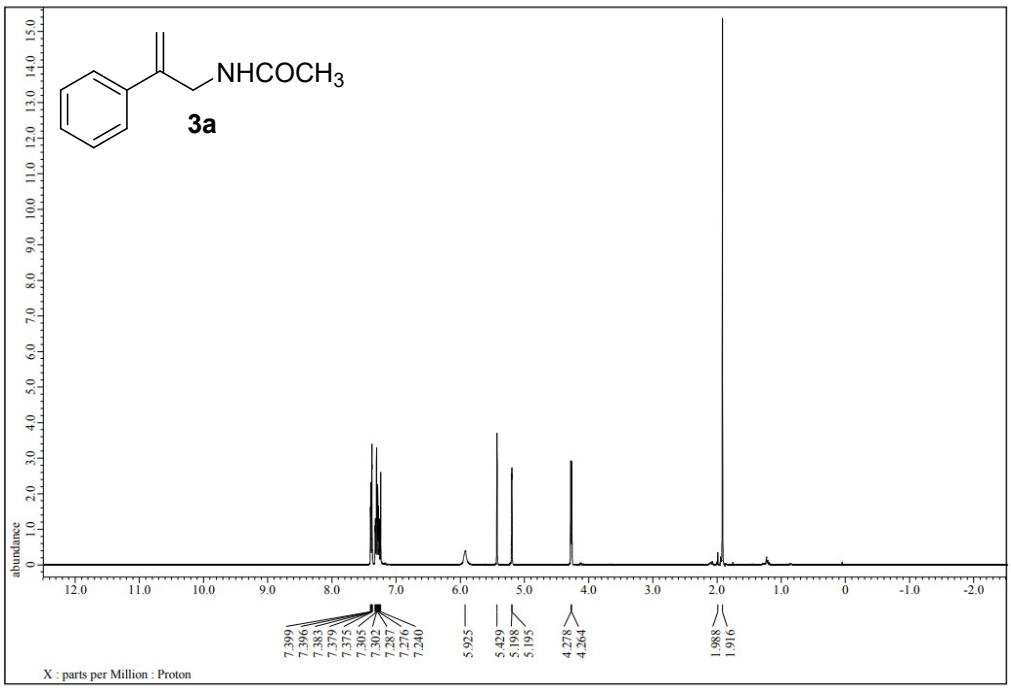


References

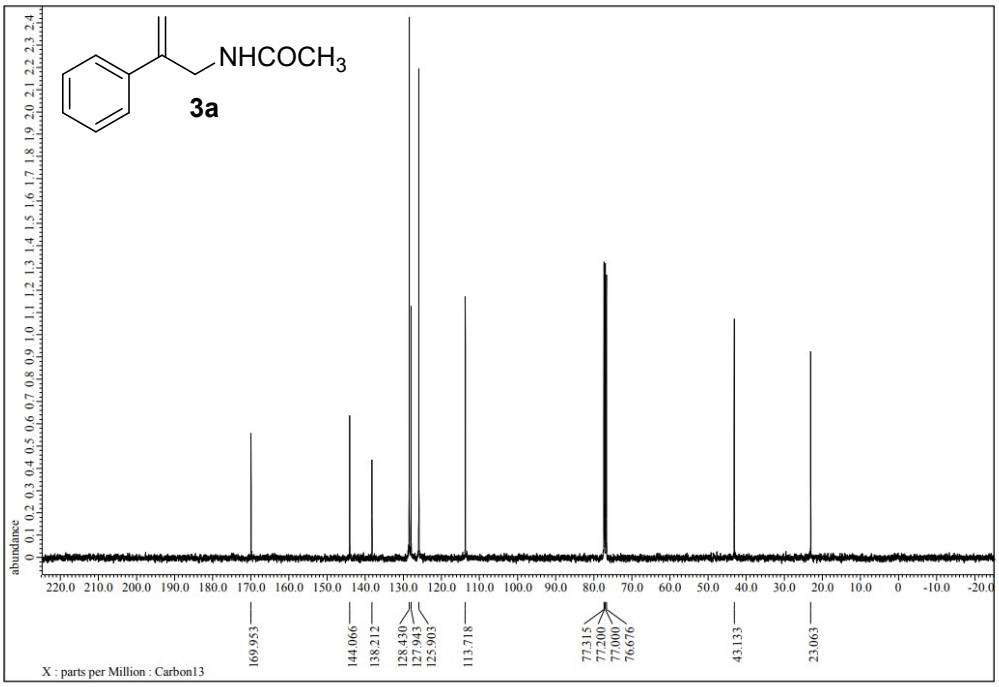
1. D. P. Steinhuebel, S. W. Krska, A. Alorati, J. M. Baxter, K. Belyk, B. Bishop, M. Palucki, Y. Sun, I. W. Davies, *Org. Lett.* **2010**, *12*, 4201–4203.
2. C. You, S. Li, X. Li, H. Lv, X. Zhang, *ACS Caytal.* **2019**, *9*, 8529–8533.
3. G. Abbenante, R. H. Prager, *Aust. J. Chem*. **1992**, *45*, 1791–1800.
4. J. L. Charlton, G. L. Williams, G. N. Lypka, *Can. J. Chem*. **1980**, *58*, 1271–1274.
5. E. Cahard, N. Bremeyer, M. J. Gaunt, *Angew. Chem. Int. Ed*. **2013**, *52*, 9284–9288.
6. A. Jaganathan, A. Garzan, D. C. Whitehead, R. J. Staples, B. Borhan, *Angew. Chem. Int. Ed.* **2011**, *50*, 2593-2596.
7. X. Kang, S. Yang, Z. Ding, *Org. Chem. Front.* **2019**, *7*, 69-72.

NMR chart

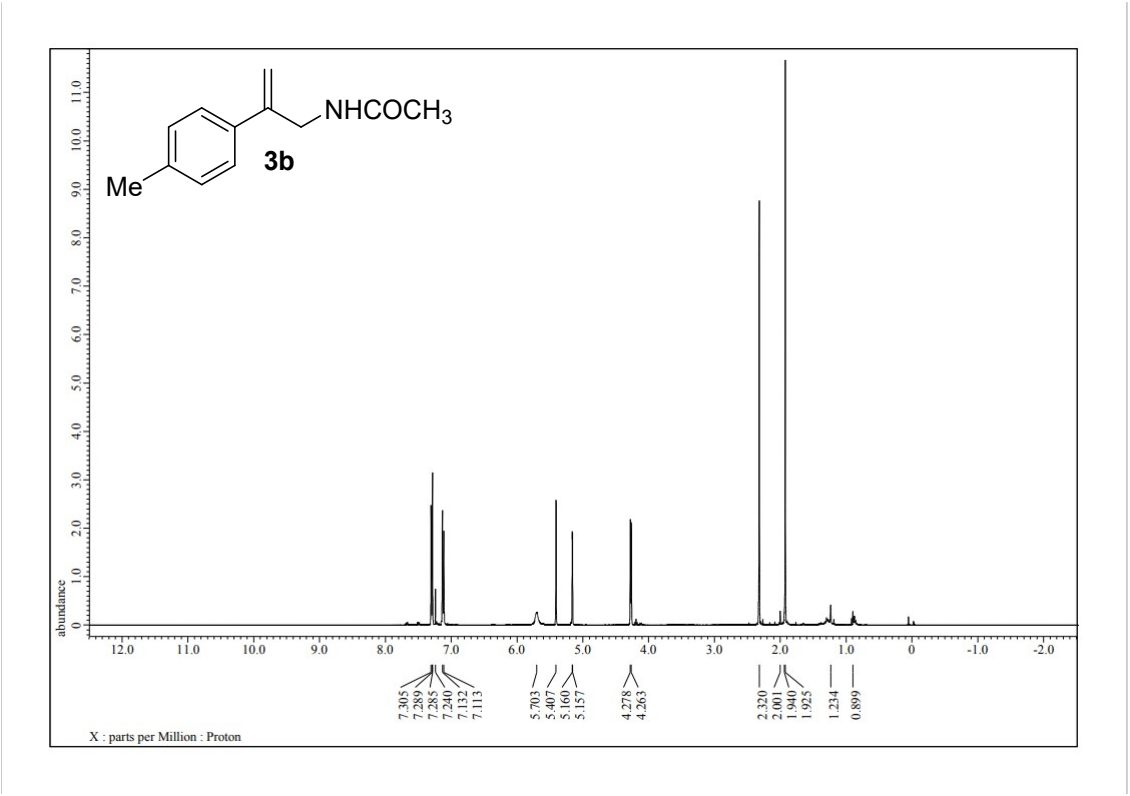
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3a**



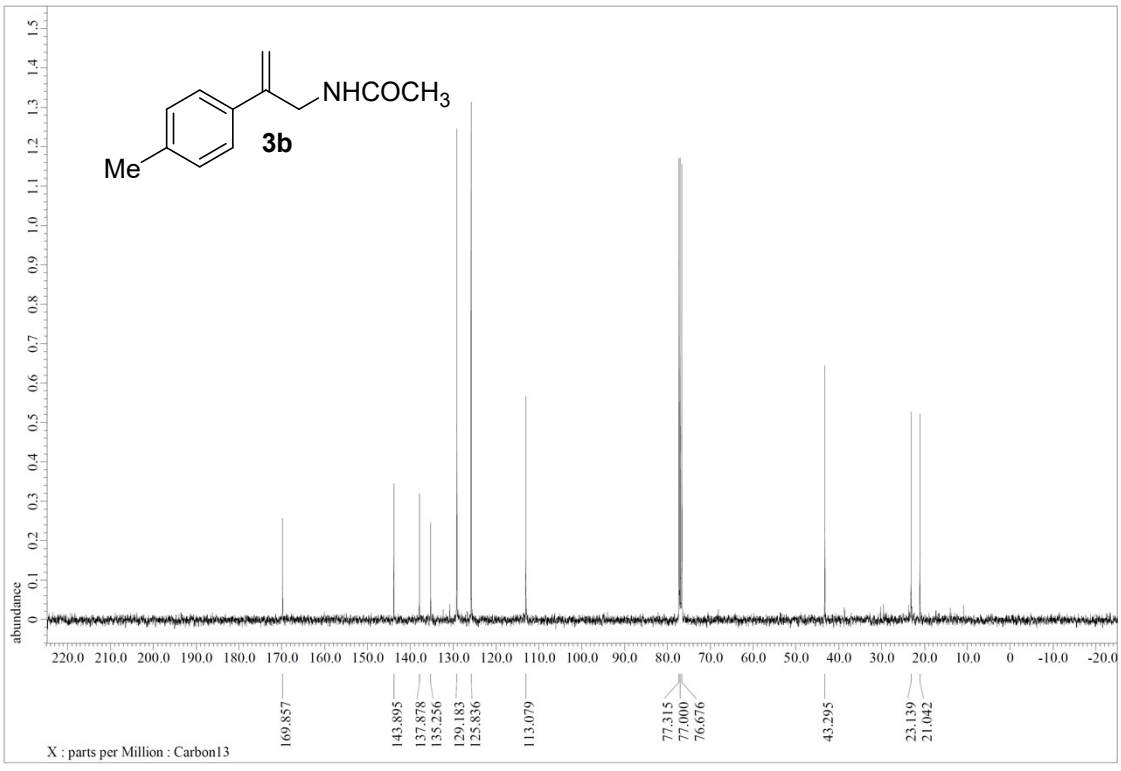
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3a**



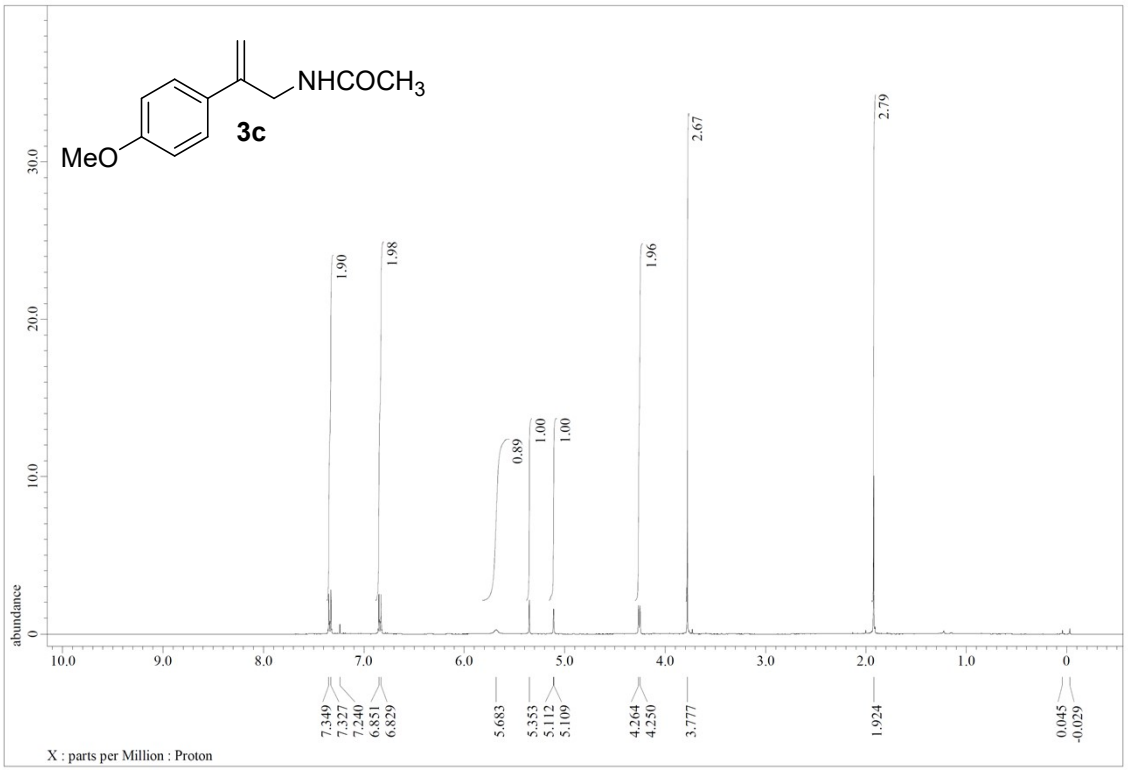
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3b**



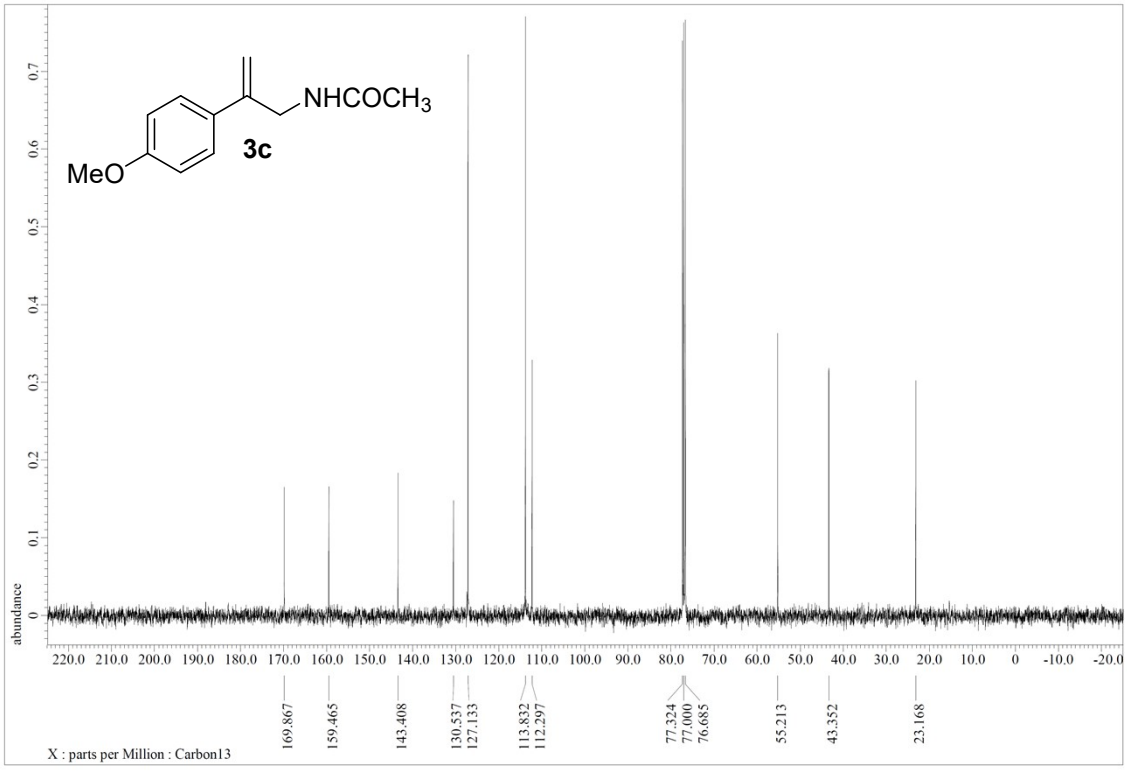
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3b**



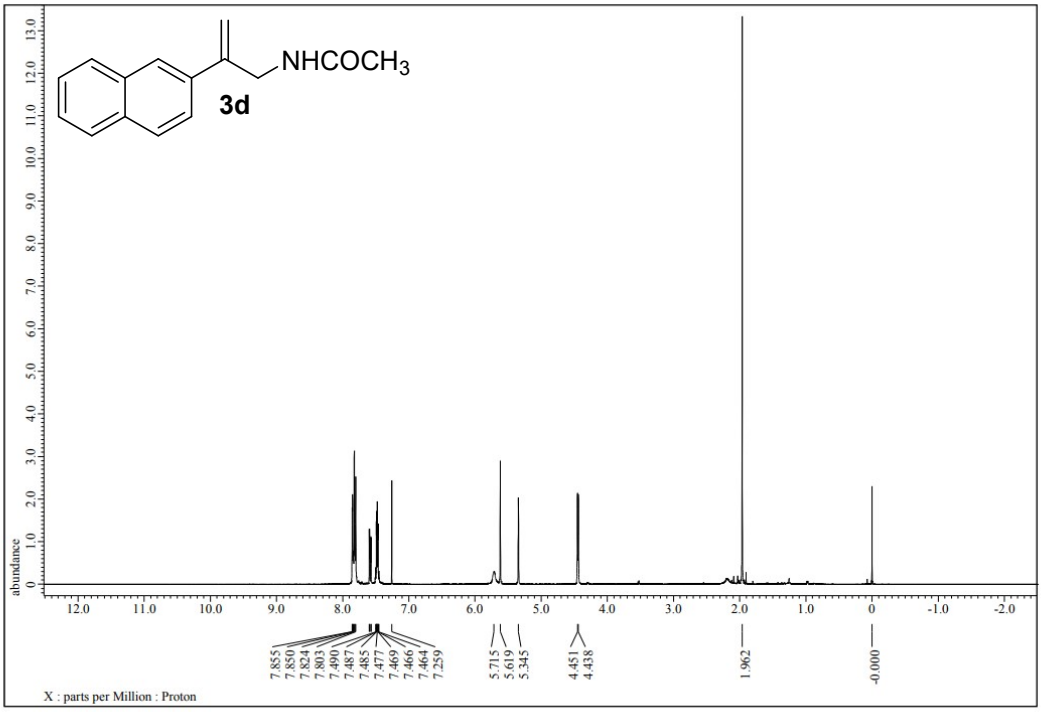
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3c**



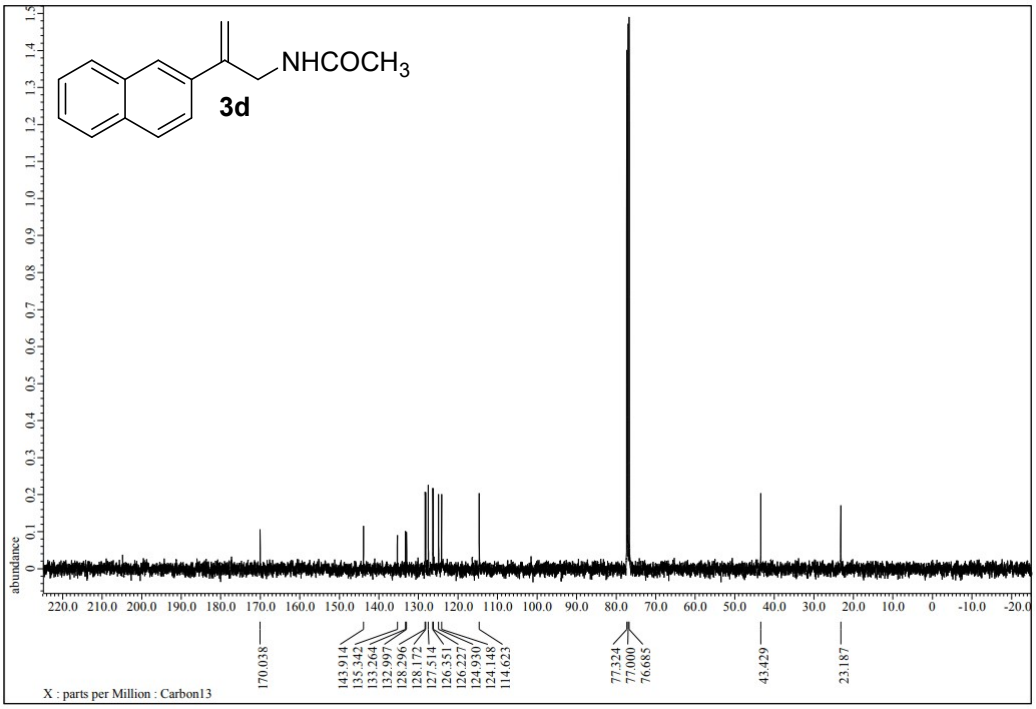
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3c**



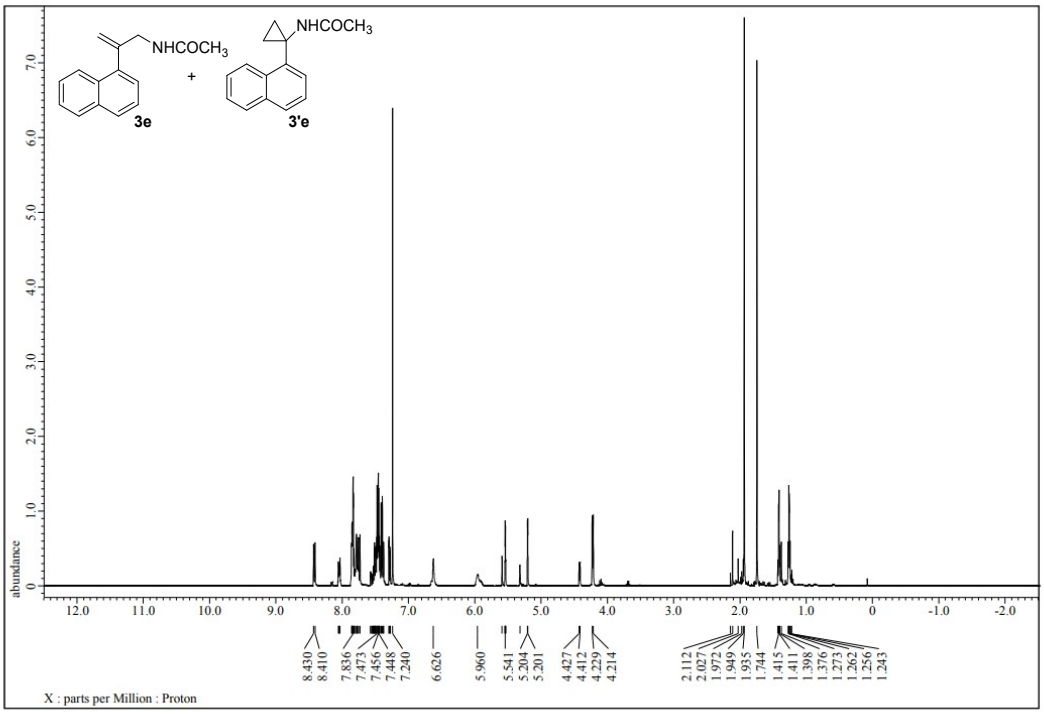
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3d**



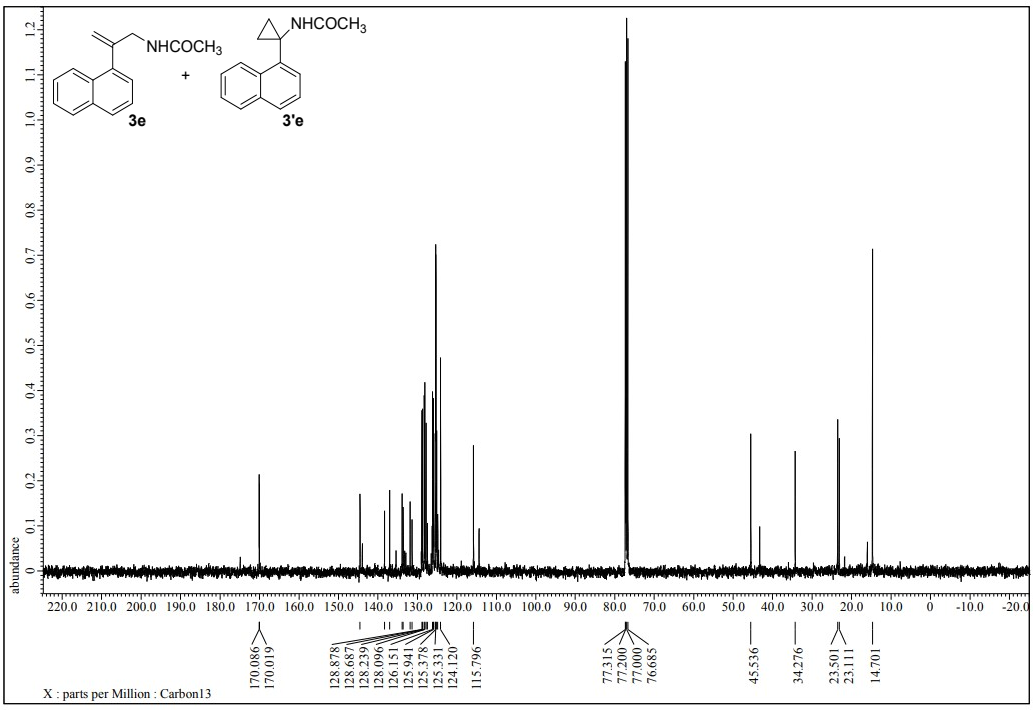
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3d**



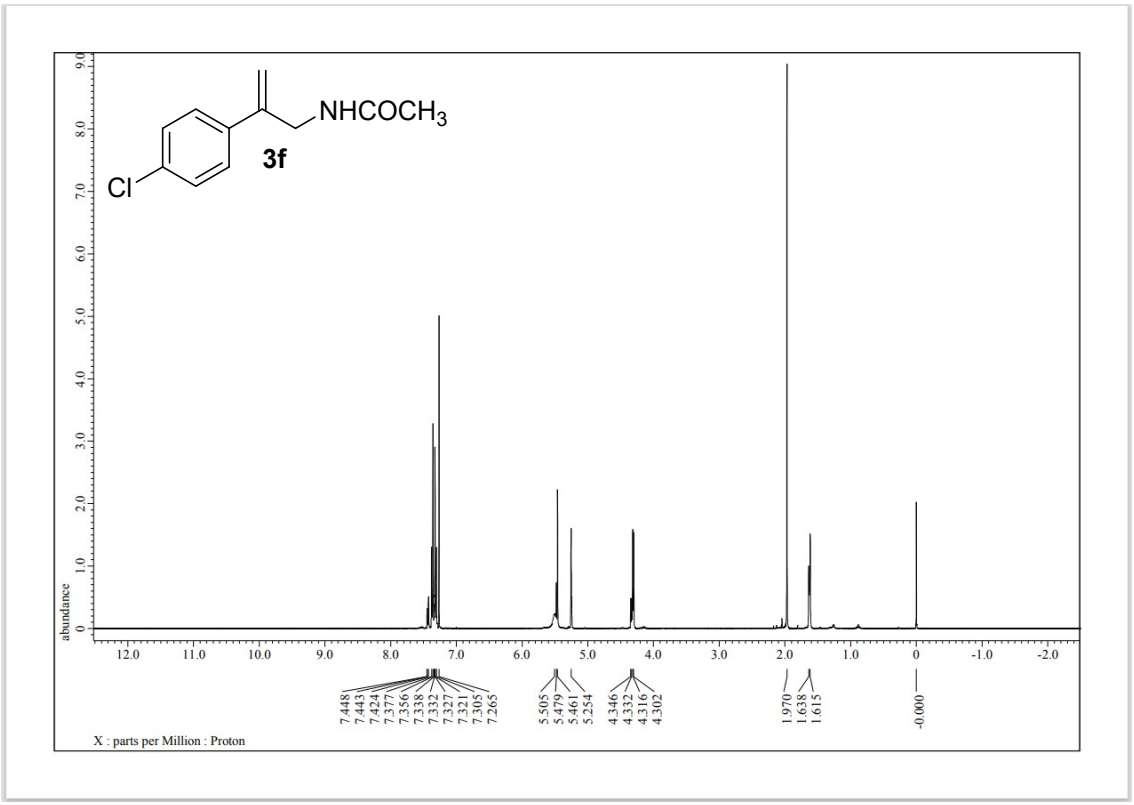
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3e** and **3'e** as inseparable mixtures



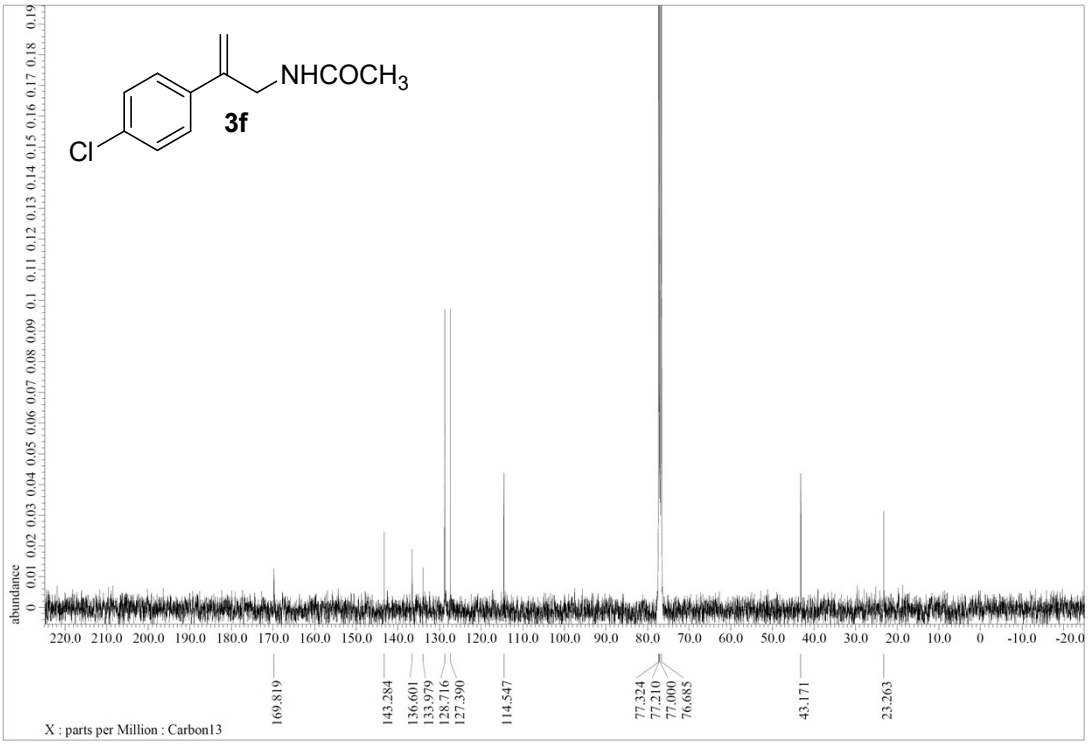
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3e** and **3'e** as inseparable mixtures



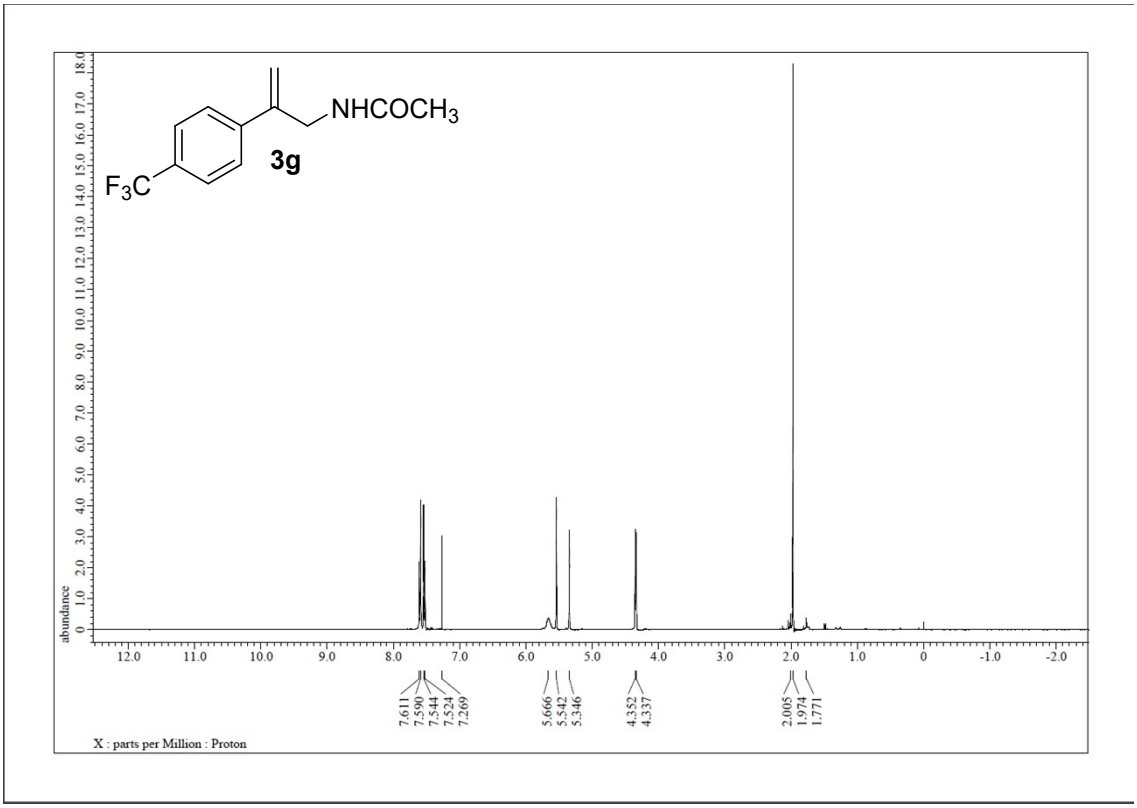
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3f**



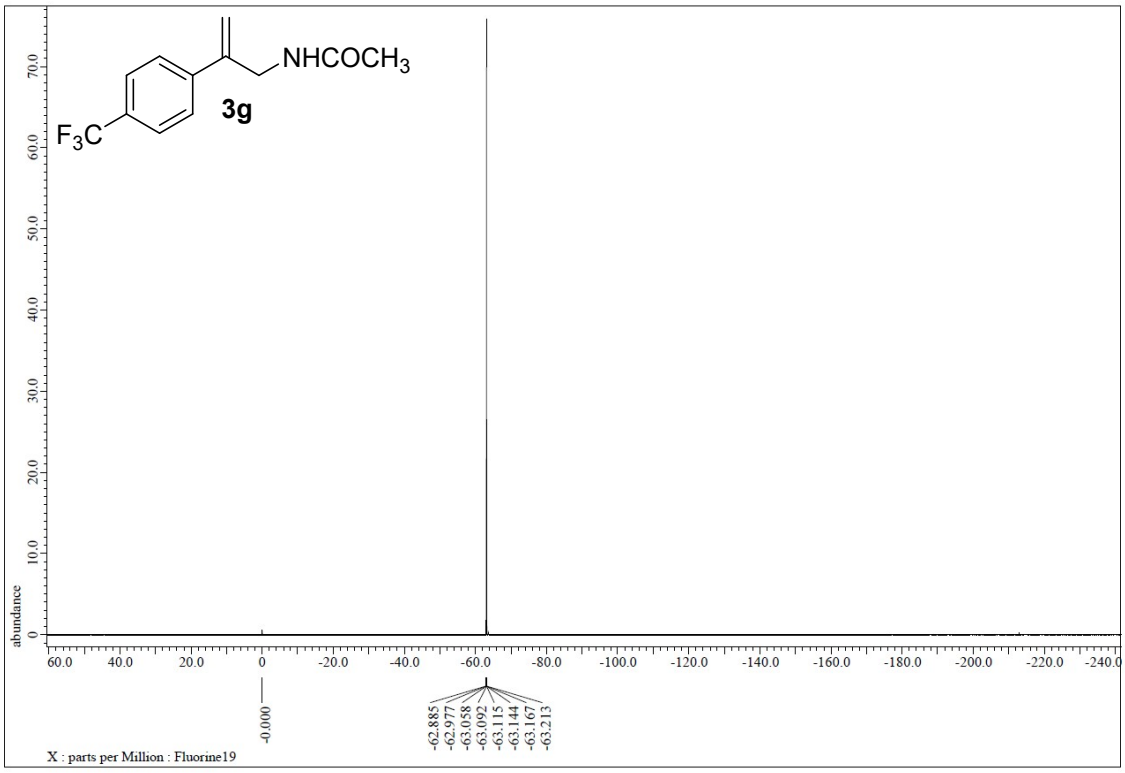
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3f**



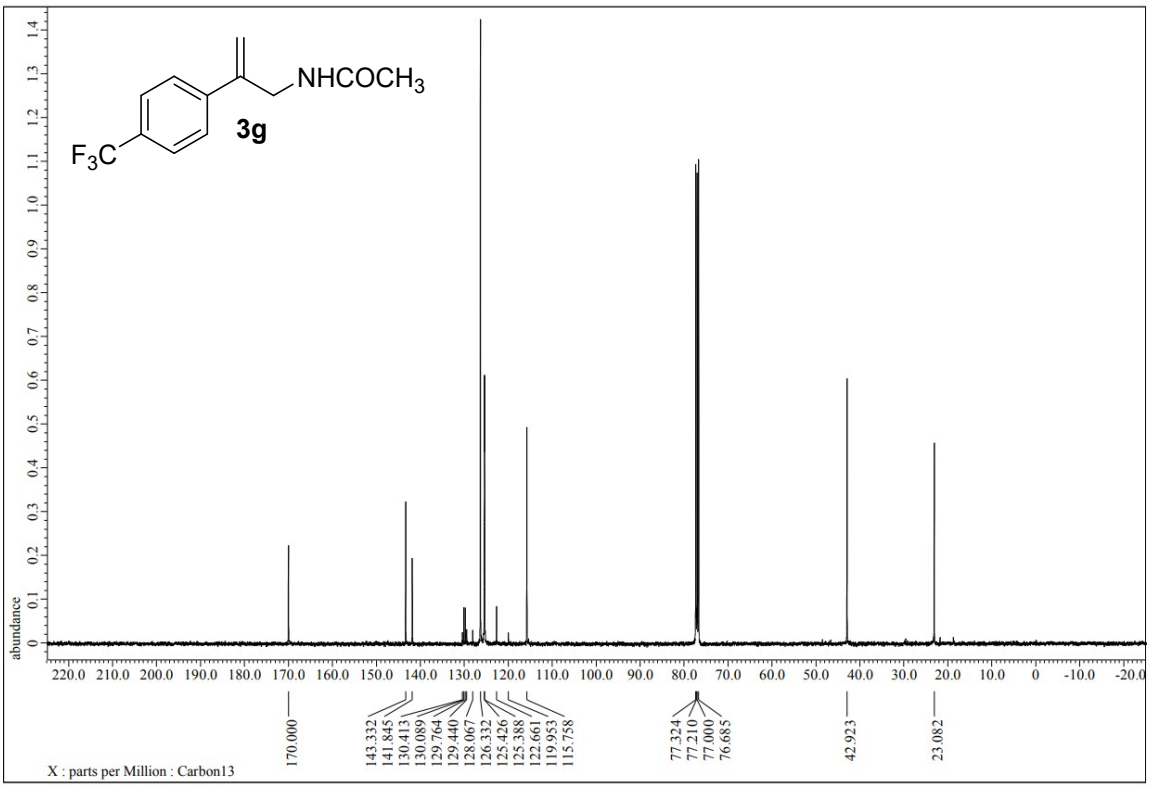
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3g**

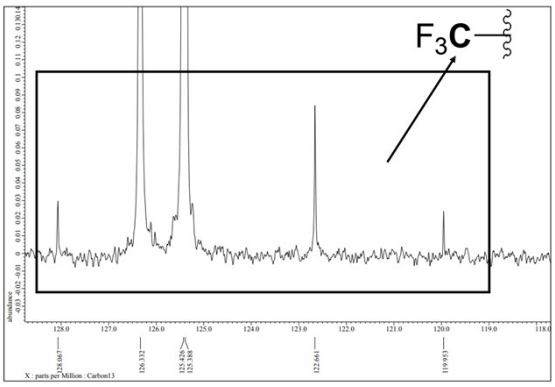


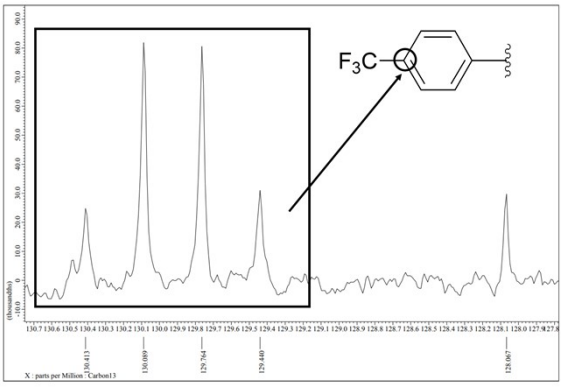
^{19}F-NMR (376 MHz, $CDCl_3$) chart of **3g**



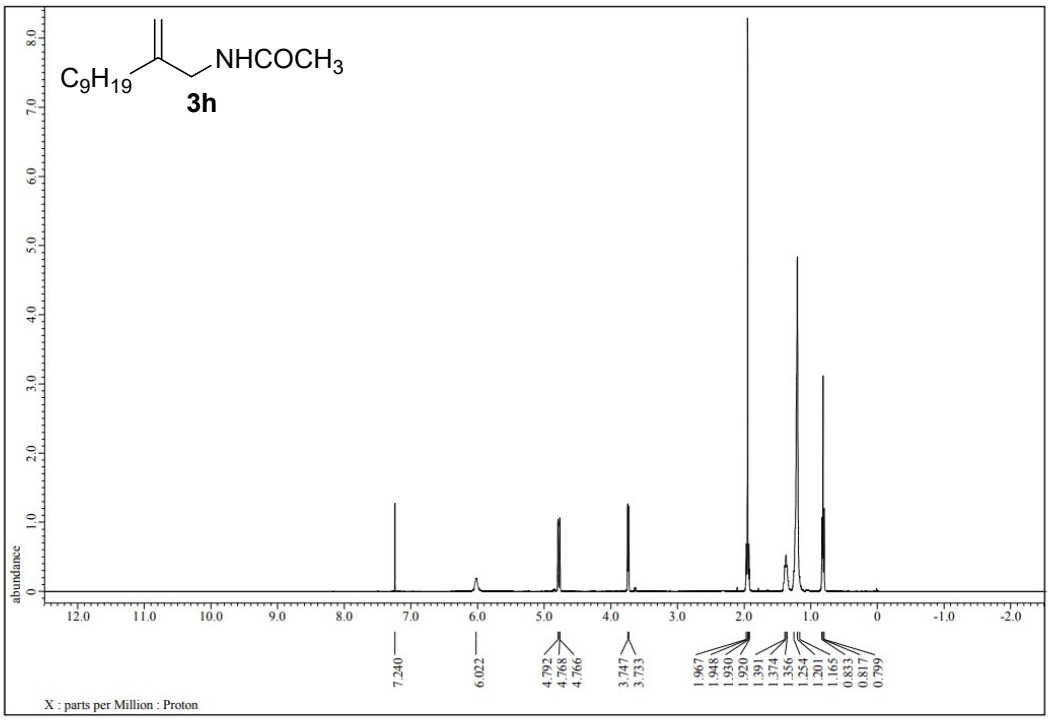
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3g**



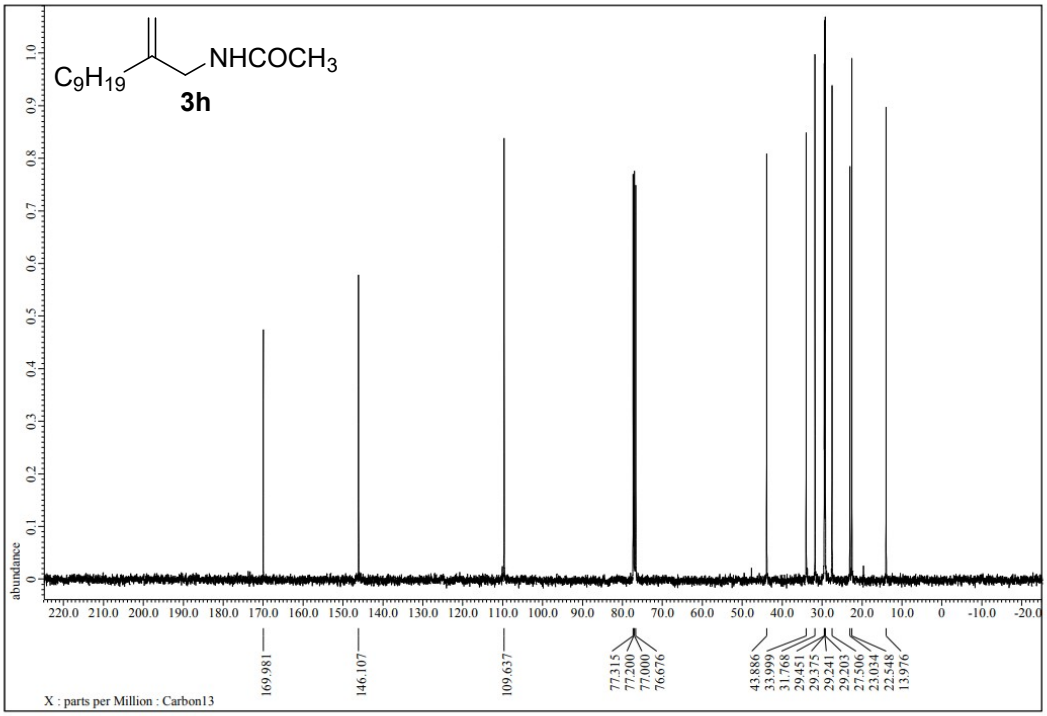




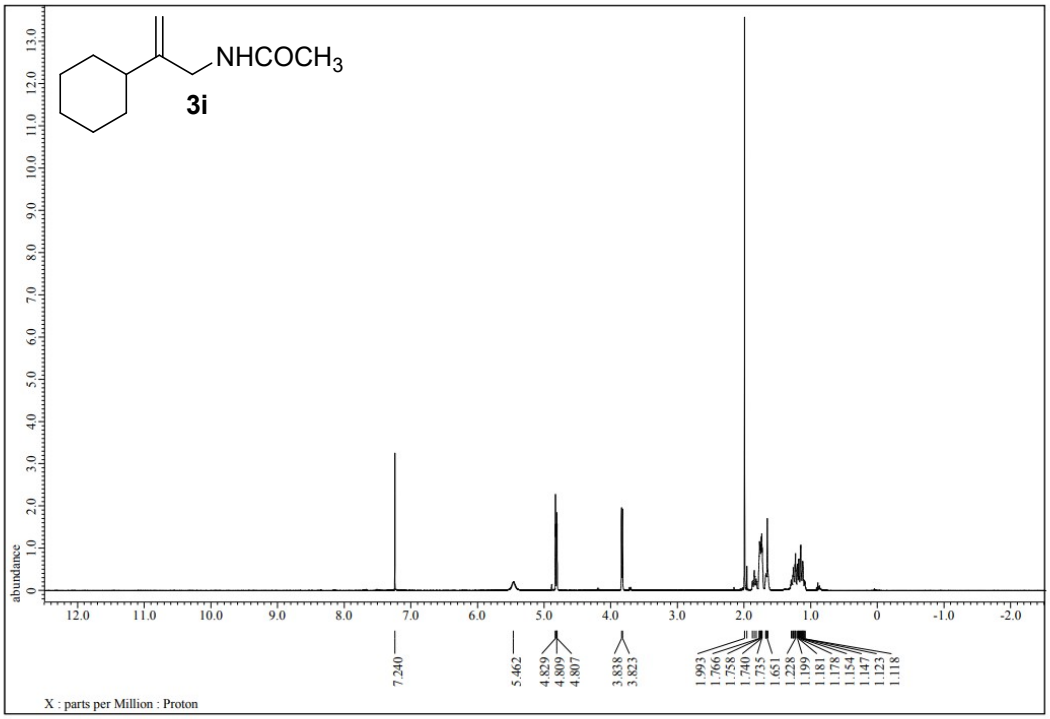
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3h**



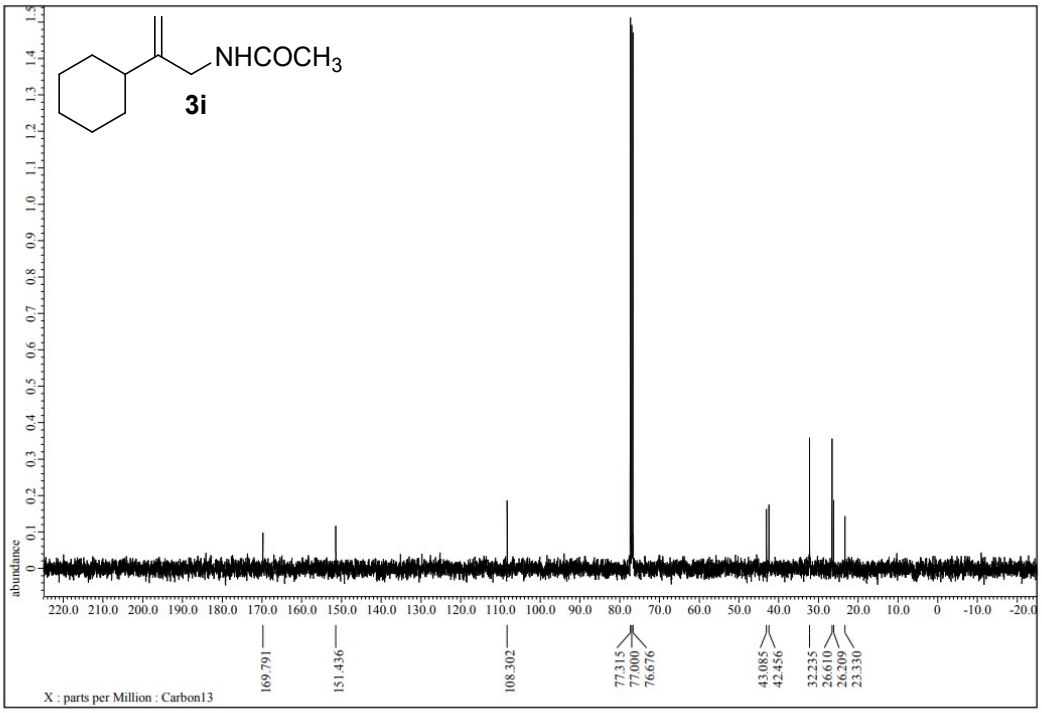
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3h**



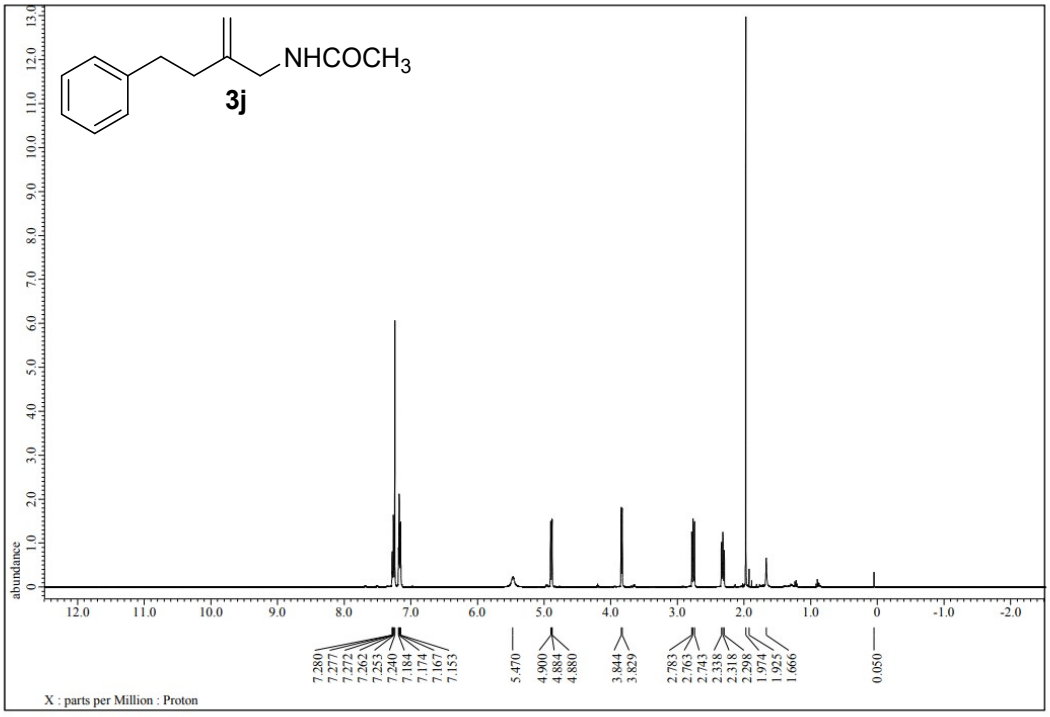
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3i**



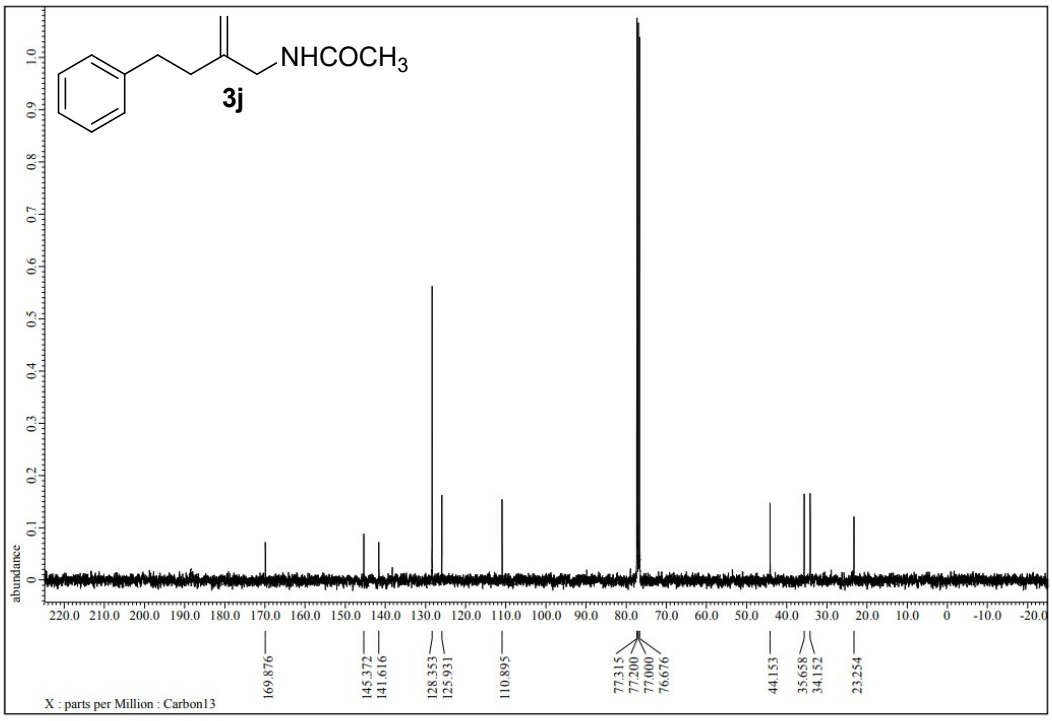
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3i**



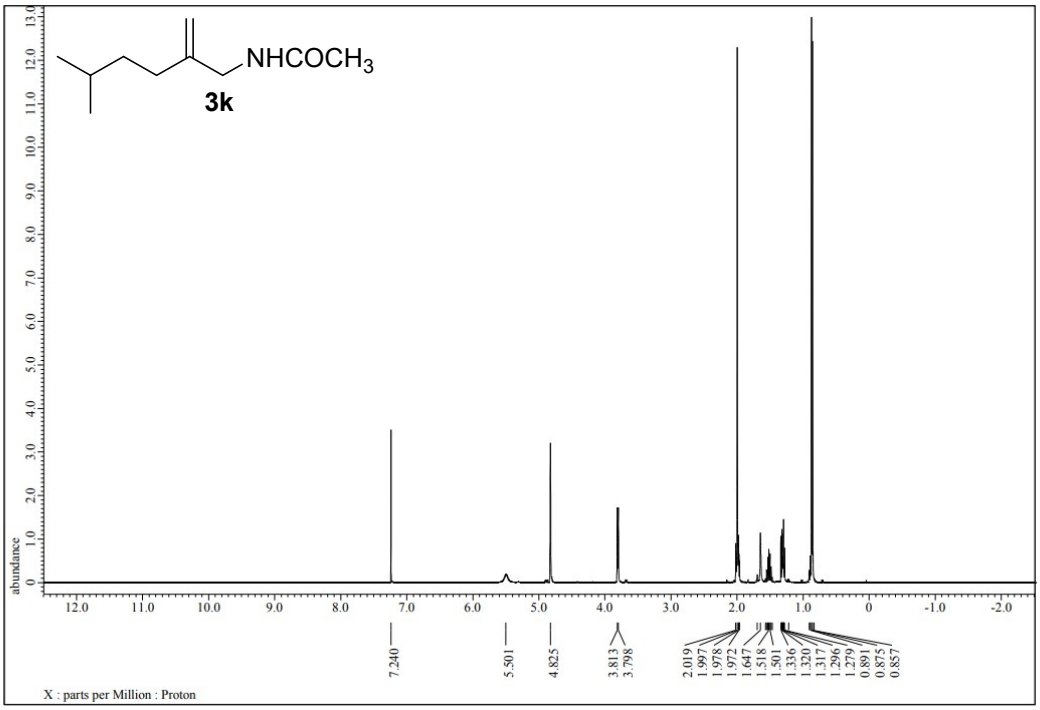
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3j**



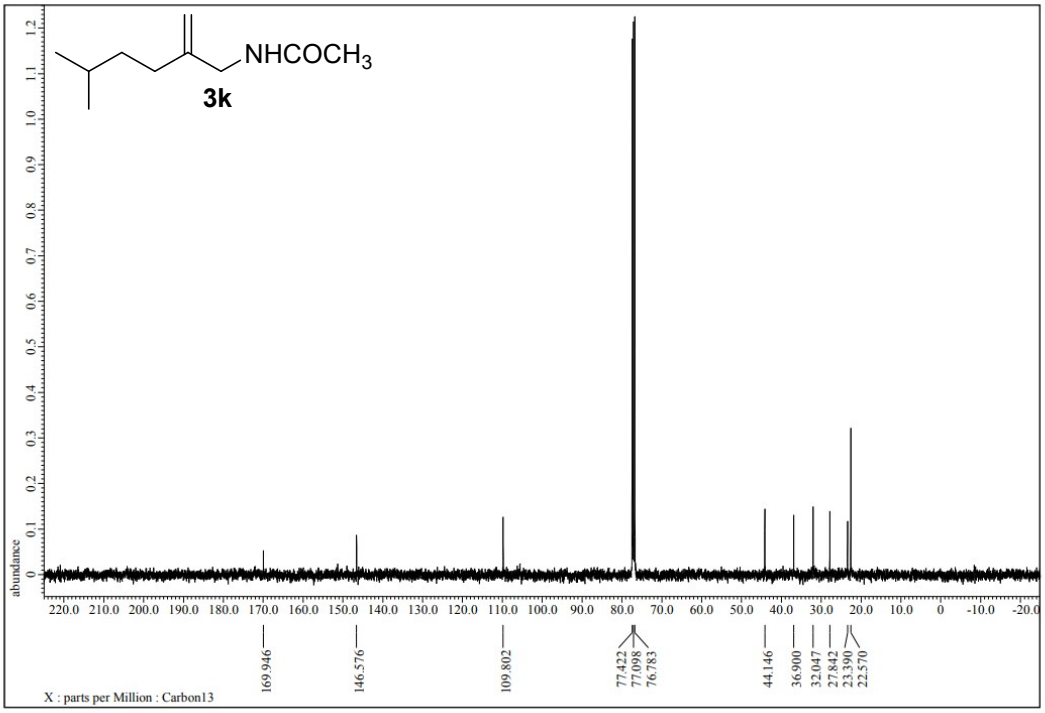
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3j**



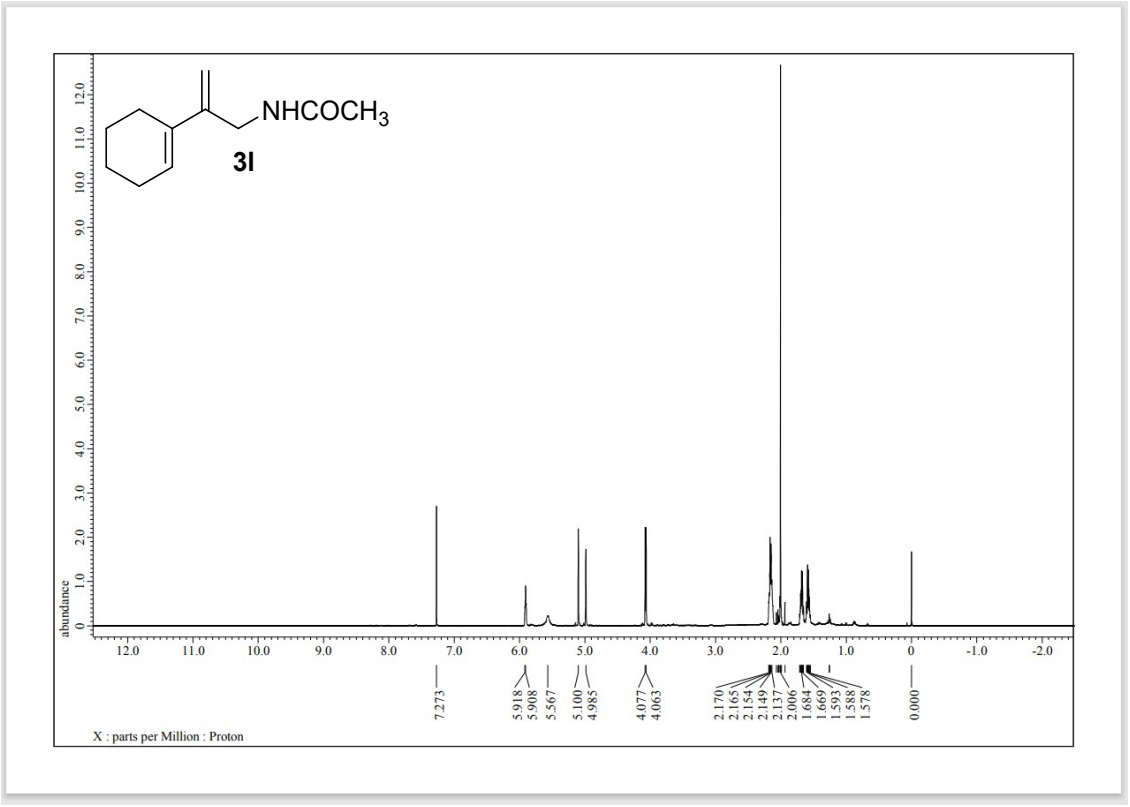
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3k**



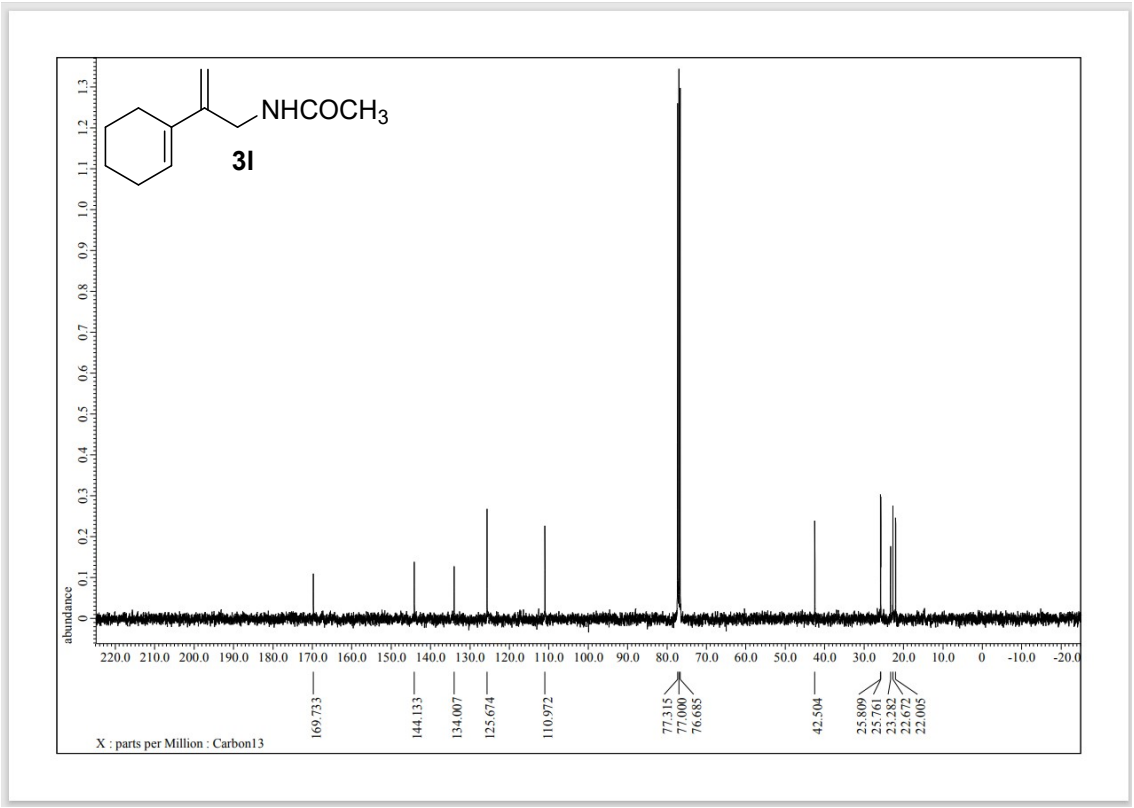
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3k**



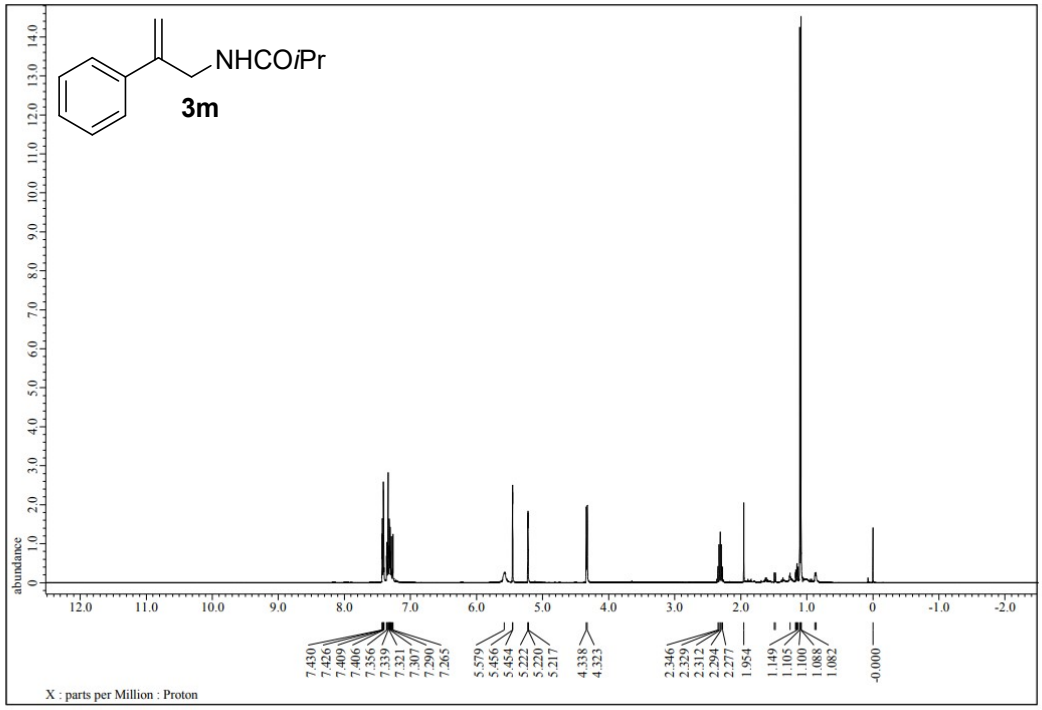
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3l**



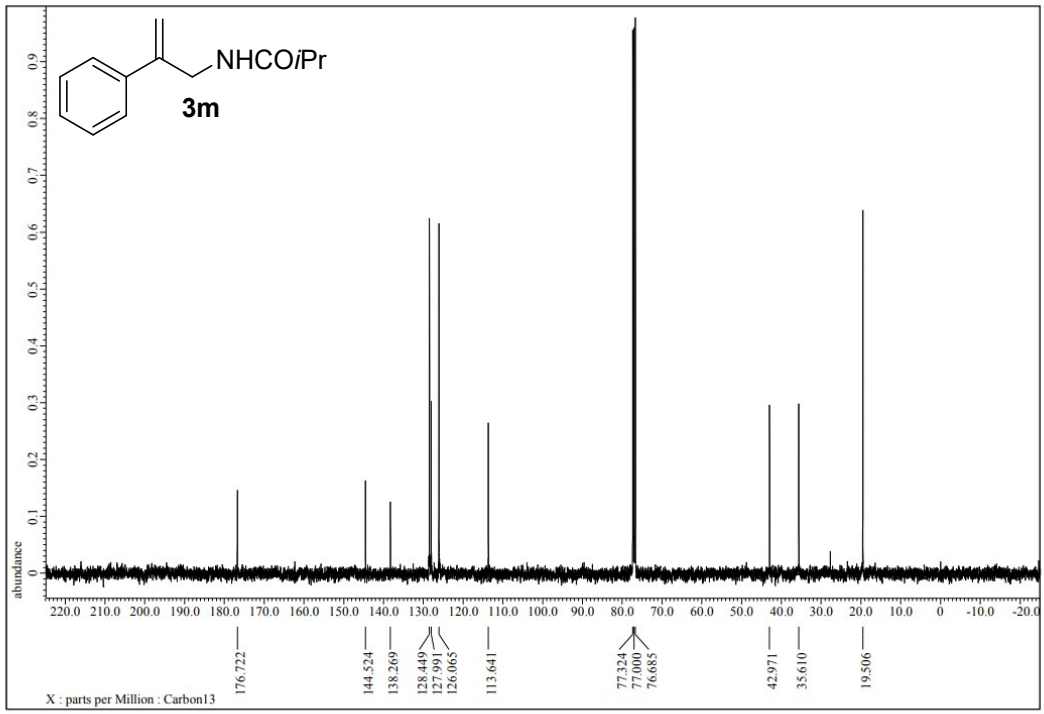
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3l**



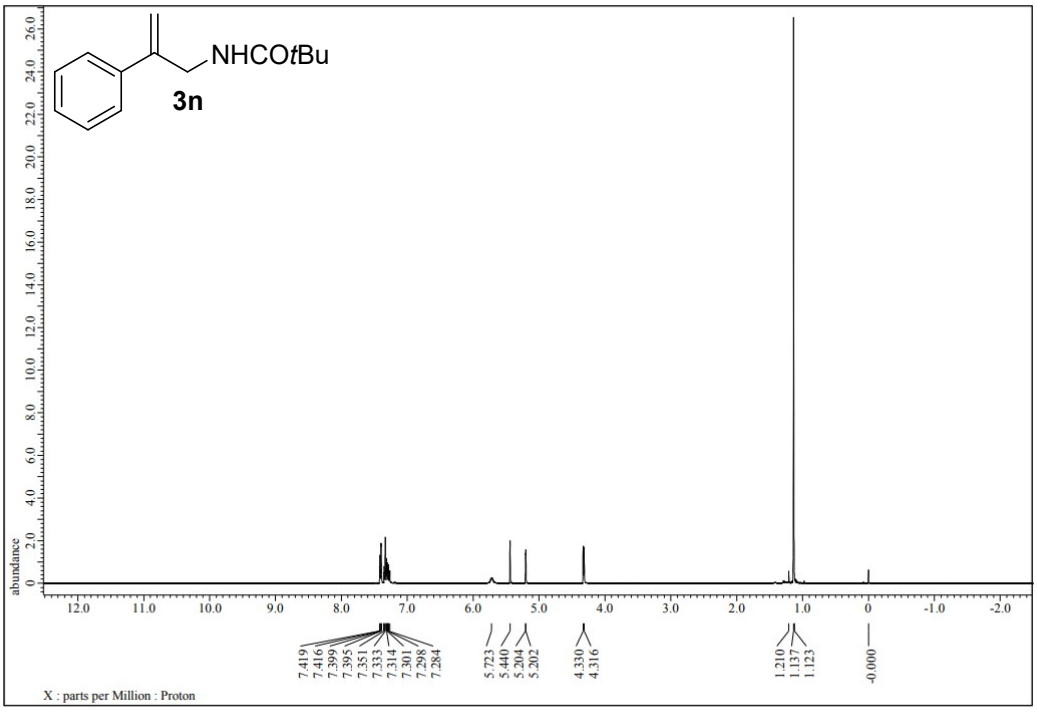
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3m**



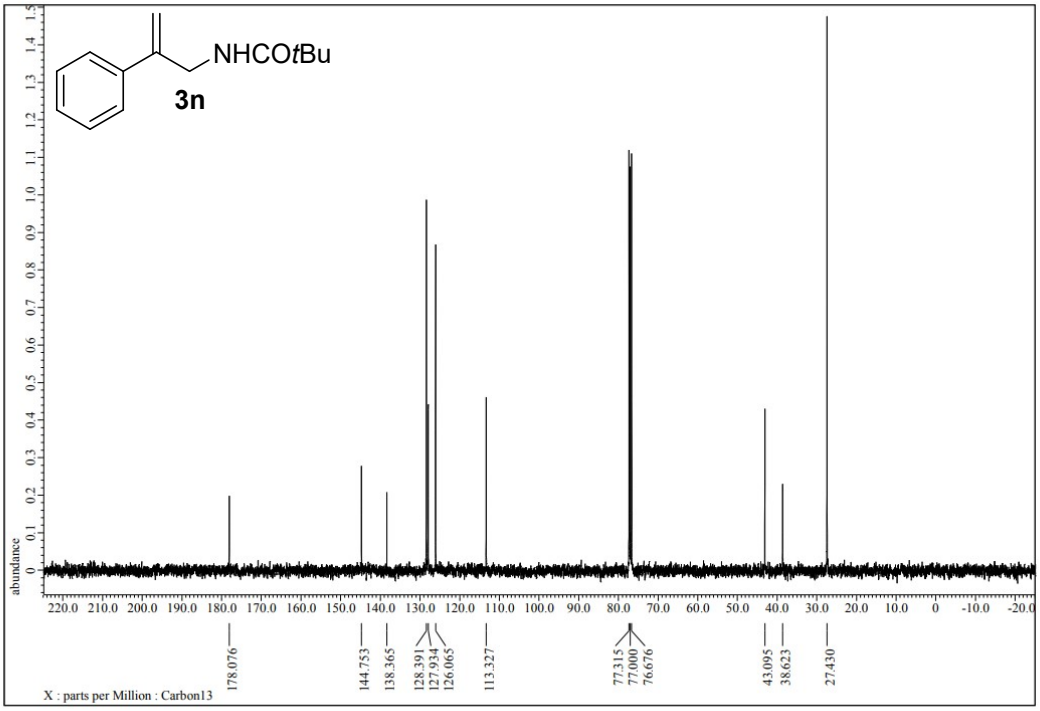
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3m**



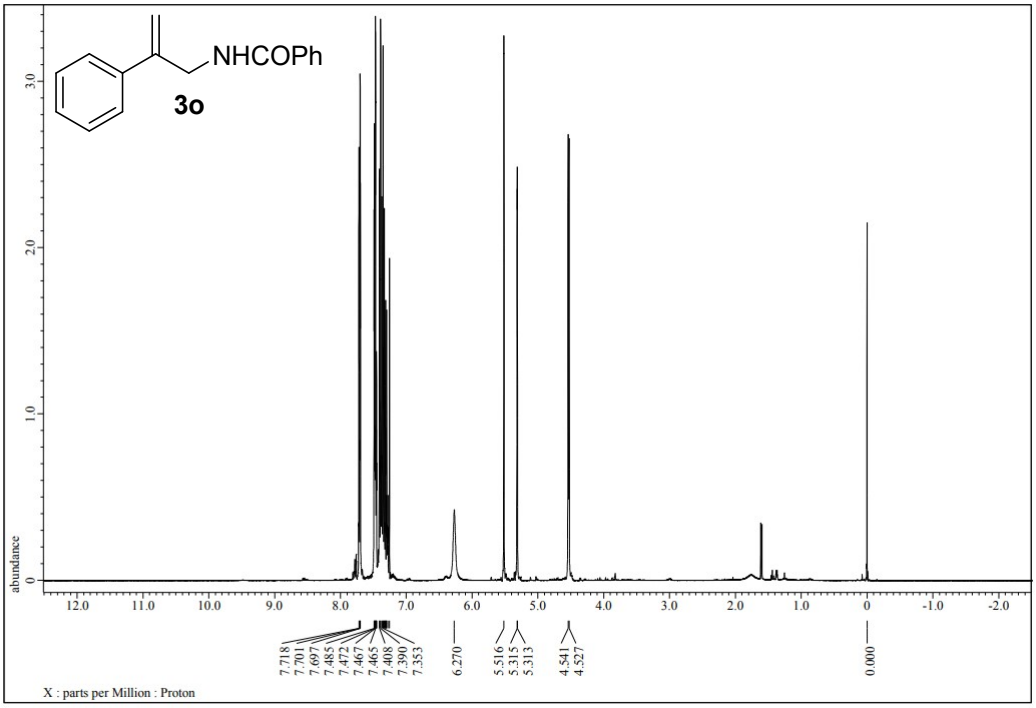
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3n**



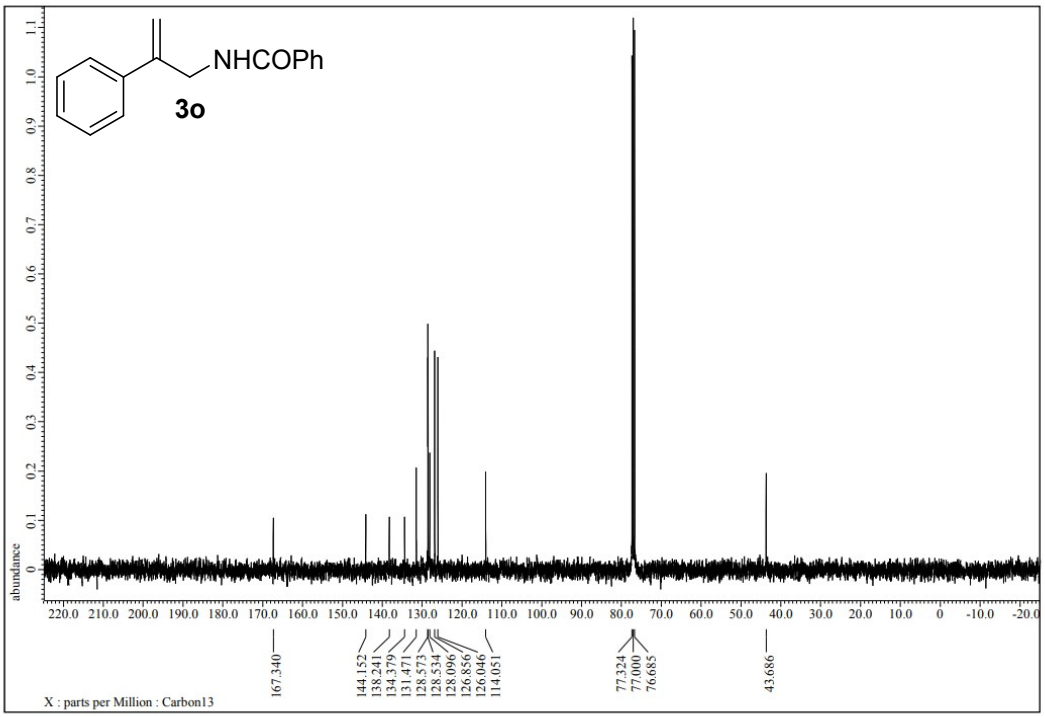
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3n**



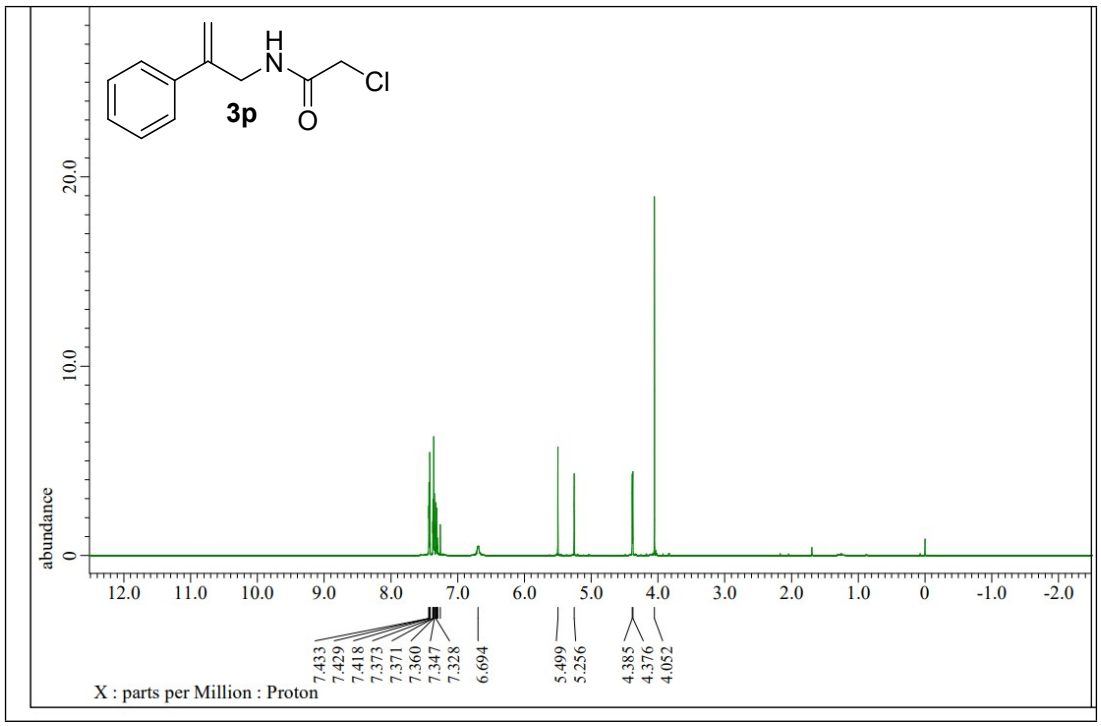
^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3o**



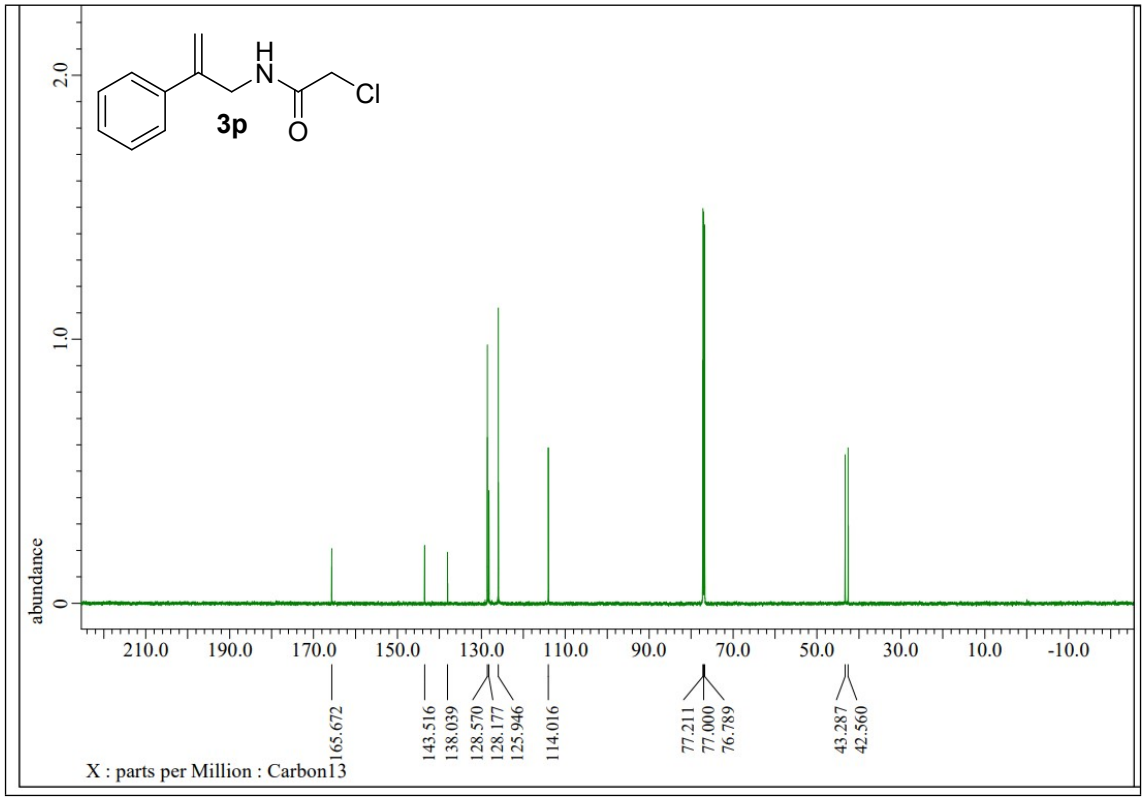
^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3o**



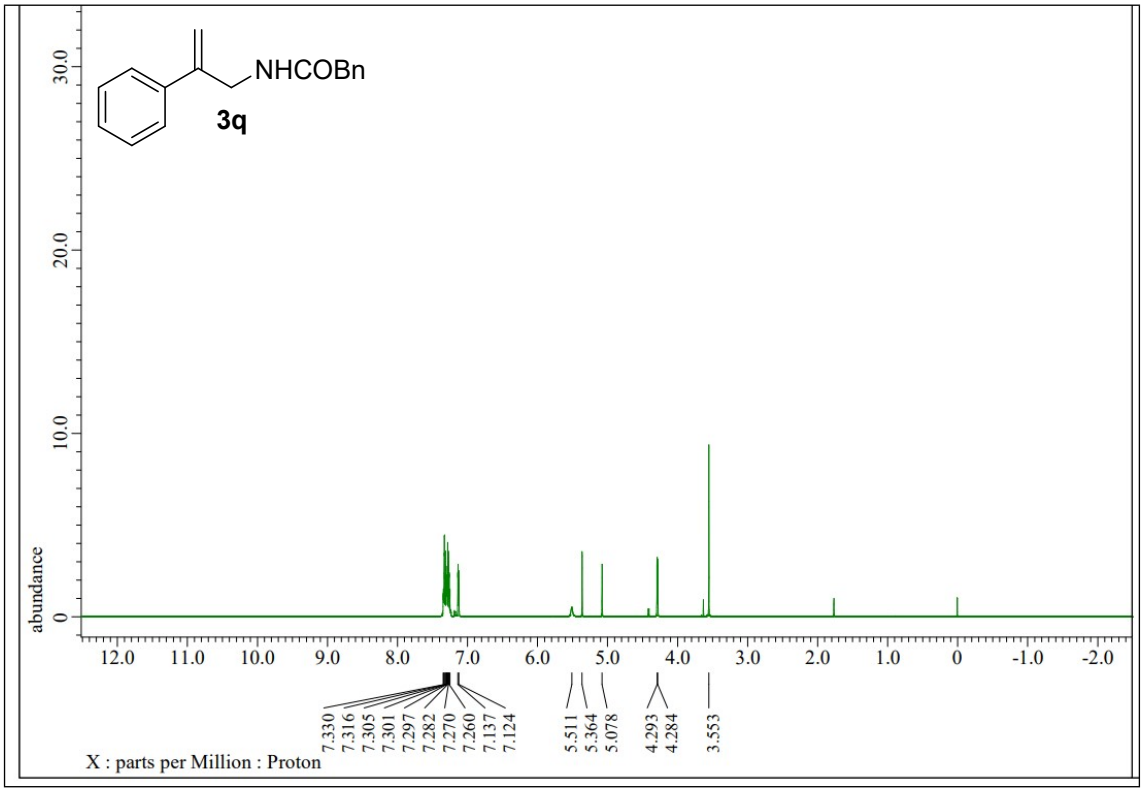
^{1}H-NMR (600 MHz, $CDCl_3$) chart of **3p**



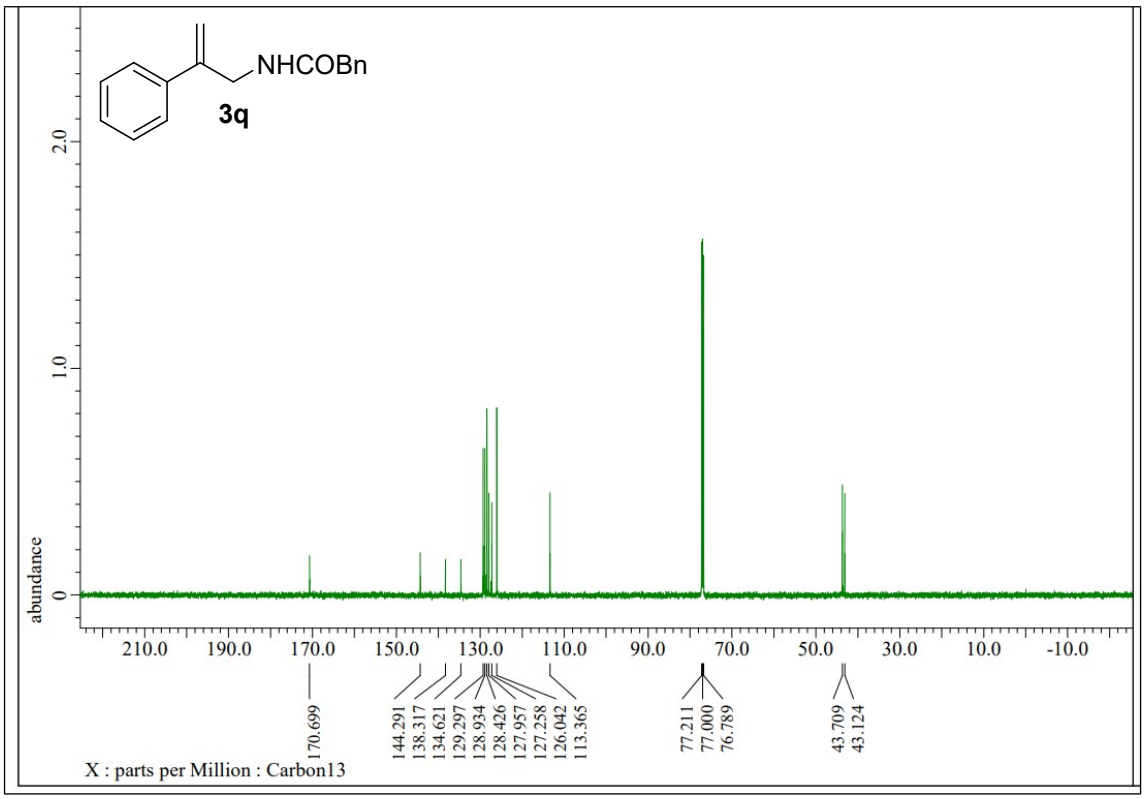
^{13}C-NMR (151 MHz, $CDCl_3$) chart of **3p**



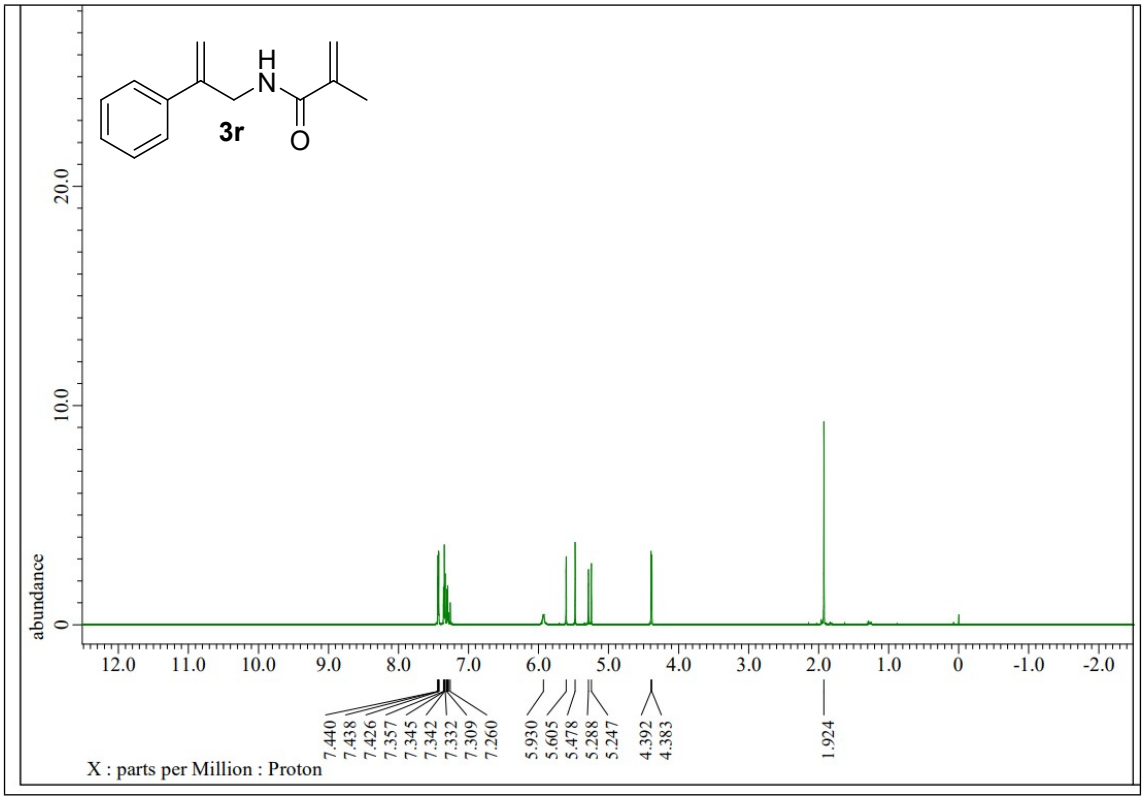
^{1}H-NMR (600 MHz, $CDCl_3$) chart of **3q**



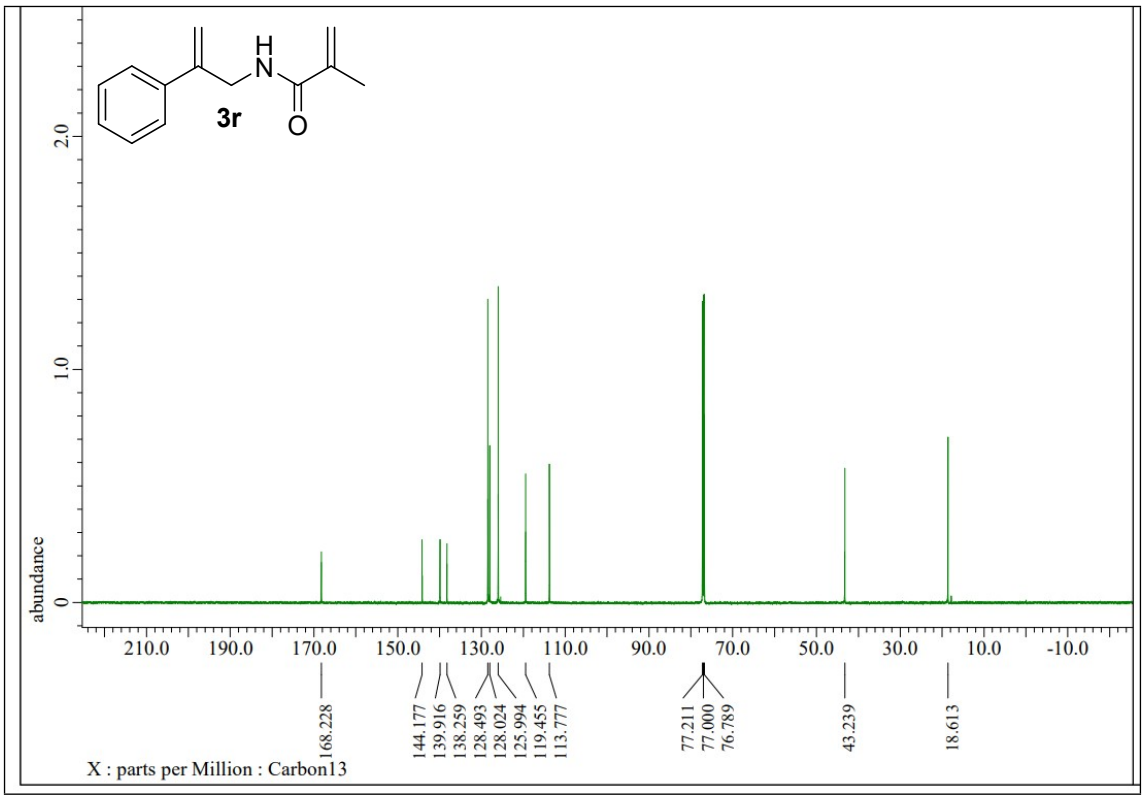
^{13}C-NMR (151 MHz, $CDCl_3$) chart of **3q**



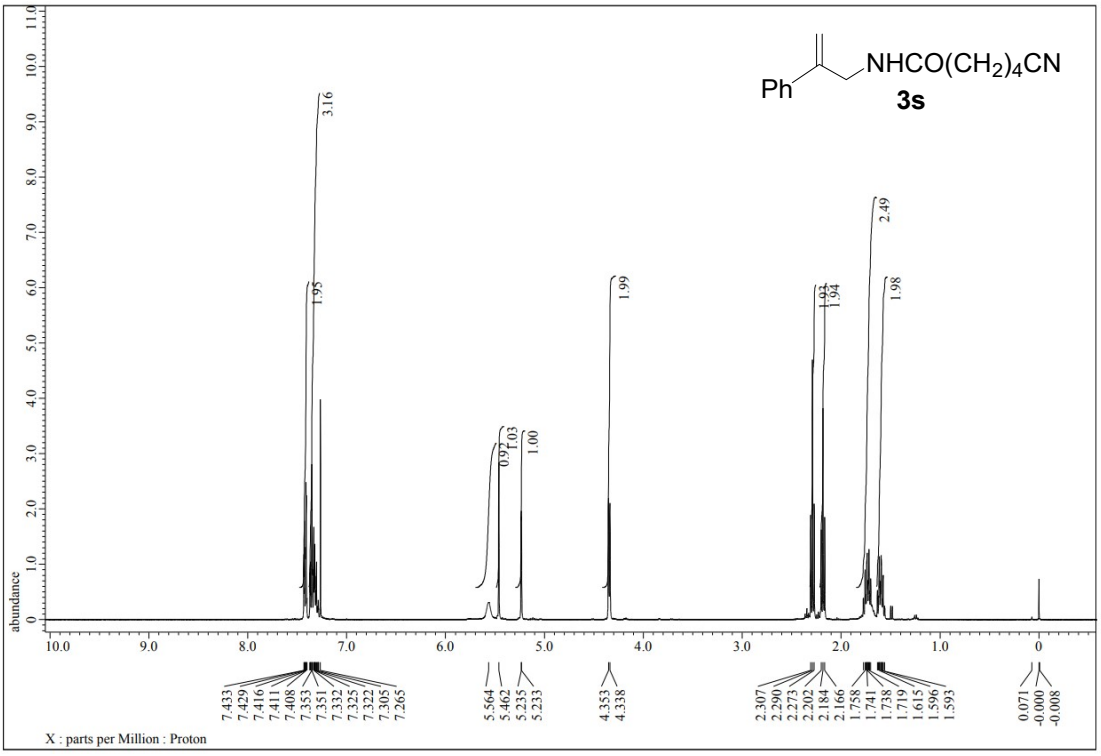
^{1}H-NMR (600 MHz, $CDCl_3$) chart of **3r**



^{13}C-NMR (151 MHz, $CDCl_3$) chart of **3r**



^{1}H-NMR (400 MHz, $CDCl_3$) chart of **3s**



^{13}C-NMR (100 MHz, $CDCl_3$) chart of **3s**