Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supporting Information

Primary Alkyl Bis-Catecholato Silicates in Dual Photoredox/Nickel Catalysis: Aryl- and Heteroaryl-Alkyl Cross Coupling Reactions

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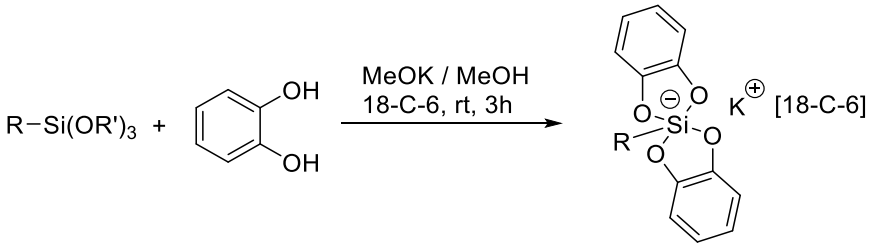
I. General informations

Unless otherwise noted, reactions were carried out under an argon atmosphere in oven-dried glassware. Methanol was distillated over CaH_2, THF and diethyl ether were distillated over sodium/benzophenone, triethylamine over potassium hydroxide. Catechol was purchased from commercial source and purified by crystallization from toluene followed by sublimation. Reagents and chemicals were purchased from commercial sources and used as received. Infrared (IR) spectra were recorded on a Bruker Tensor 27 (ATR diamond) spectrophotometer. Melting points were determined on a melting point apparatus SMP3 (Stuart scientific) and are uncorrected. ^{1}H, ^{19}F, ^{13}C NMR spectra were recorded at room temperature at 400, 377 and 100 MHz respectively, on a Bruker AVANCE 400 spectrometer. ^{29}Si NMR spectra were recorded at 119 MHz on a Bruker AVANCE III 600 spectrometer. Chemical shifts (δ) are reported in ppm and coupling constants (*J*) are given in Hertz (Hz). Abbreviations used for peak multiplicity are: s (singlet); bs (broad singlet); d (doublet); t (triplet); q (quartet); quint (quintet); sept (septet); m (multiplet). Thin layer chromatographies (TLC) were performed on Merck silica gel 60 F 254 and revealed with a UV lamp (λ = 254 nm) and $KMnO_4$ staining. Flash Column Chromatographies were conducted on silica Geduran® Si 60 Å (40 – 63 μm). High resolution mass spectrometries were performed on a microTOF (ESI). Photocatalysts were synthesized as described.[1],[2] Silicates **1a-1f** and **1k-1l** were synthesized as described.[3]

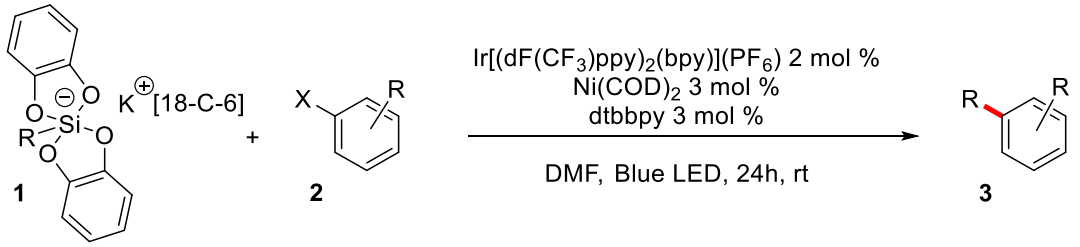
II. General procedures

1. General procedure A for silicate synthesis



To a stirred solution of catechol (2 eq.) in dry methanol (0.25 M) was added 18-C-6 (1 eq.). After dissolution of the crown ether, the trialkoxy organosilane (1 eq.) was added, followed by a solution of potassium methoxide in methanol (1 eq.). The reaction mixture was stirred for 3 hours and the solvent was removed under reduced pressure. The residue was dissolved in the minimum volume of acetone and diethyl ether was added until a cloudy solution was obtained (scrapping on the edge of the flask could be done to induce crystallization). The flask was placed at -20°C overnight. The crystals were collected by filtration, washed with diethyl ether and dried under vacuum to afford [18-C-6] silicate.

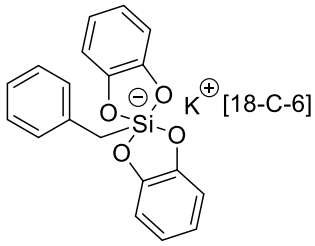
2. General procedure B for photoredox/nickel cross-coupling dual catalysis



To a schlenk flask was added aryl or heteroaryl halide (1 eq., 0.3 mmol), silicate (1.5 eq., 0.45 mmol), Ir[(dF(CF_3)ppy)$_2$(bpy)](PF_6) (2 mol %, 6 µmol, 6 mg), and 4,4'-di-*tert*-butyl-2,2'-bipyridine (3 mol %, 9 µmol, 2.4 mg). The schlenk flask was taken into a glovebox and Ni(COD)$_2$ (3 mol %, 9 µmol, 2.5 mg) was added. The schlenk flask was sealed with a rubber septum, removed from the glovebox, and evacuated / purged with vacuum / argon three times. Degassed DMF (3 mL) was introduced (followed by the aryl or heteroaryl halide if liquid) and the reaction mixture was irradiated with blue LEDs (477 nm) for 24 hours. The reaction mixture was diluted with diethyl ether (50 mL), washed with saturated $NaHCO_3$ (2 times), brine (2 times), dried over $MgSO_4$ and evaporated under reduced pressure. The residue was purified by flash column chromatography on silica gel to afford the coupling adduct **3**.

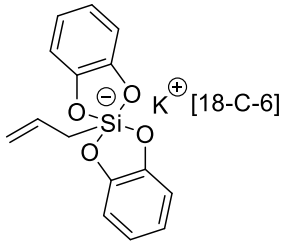
III. Compound characterizations

Potassium [18-Crown-6] bis(catecholato)-benzylsilicate (1a)



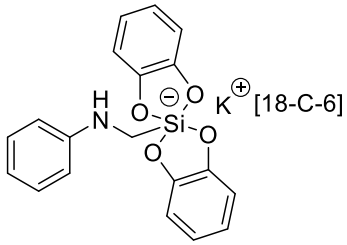
Silicate **1a** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-allylsilicate (1b)



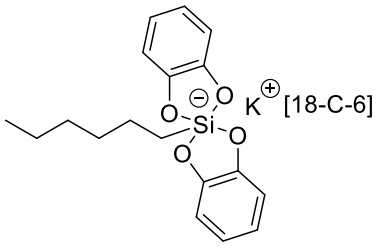
Silicate **1b** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-anilinomethylsilicate (1c)



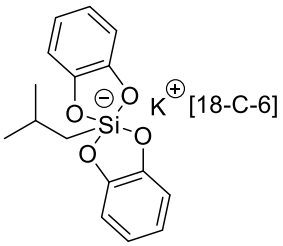
Silicate **1c** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-hexylsilicate (1d)



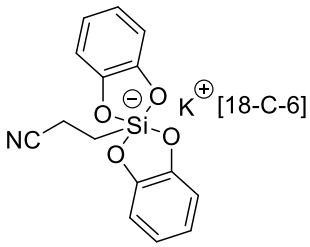
Silicate **1d** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-isobutylsilicate (1e)



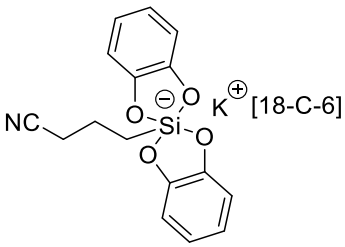
Silicate **1e** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-2-cyanoethylsilicate (1f)



Silicate **1f** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

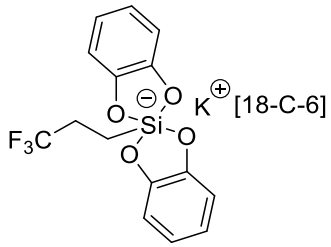
Potassium [18-Crown-6] bis(catecholato)-3-cyanopropylsilicate (1g)



Following the general procedure A with 3-cyanopropyltriethoxysilane (5 mmol, 1.16 mL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford **1g** (2.76 g, 90%) as a white solid.

M.p. 167.6°C. **^{1}H NMR** (600 MHz, Methanol-d_4): δ 6.69 (dd, J = 5.6, 3.5 Hz, 4H), 6.57 (dd, J = 5.7, 3.4 Hz, 4H), 3.54 (s, 24H), 2.29 (t, J = 7.2 Hz, 2H), 1.69 – 1.60 (m, 2H), 0.82 – 0.75 (m, 2H). **^{13}C NMR** (151 MHz, Methanol-d_4): δ 150.9 (4 C), 121.6, 119.5 (4 C), 111.6 (4 C), 71.2 (12 C), 22.5, 20.2, 17.6. **^{29}Si NMR** (119 MHz, Methanol-d_4): δ -77.6. **IR** (neat): 3039, 2952, 2870, 2236, 1702, 1599, 1484, 1353, 1245, 1227, 1098, 1011, 953, 820, 737 cm^{-1}. **HRMS** calc. for $[C_{16}H_{14}NO_4Si]^-$ 312.0698; found 312.0699.

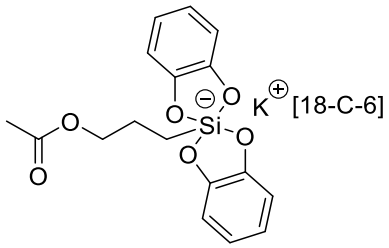
Potassium [18-Crown-6] bis(catecholato)-3,3,3-trifluoropropylsilicate (1h)



Following the general procedure A with 3,3,3-trifluoropropyltrimethoxysilane (5 mmol, 956 μL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford **1h** (2.56 g, 80%) as a white solid.

M.p. 177.7°C. **^{1}H NMR** (600 MHz, Methanol-d_4): δ 6.70 (dd, J = 5.6, 3.5 Hz, 4H), 6.59 (dd, J = 5.7, 3.4 Hz, 4H), 3.54 (s, 24H), 2.06 – 1.95 (m, 2H), 0.83 – 0.76 (m, 2H). **^{13}C NMR** (151 MHz, Methanol-d_4): δ 150.8 (4 C), 130.6 (q, J = 275.6 Hz), 119.6 (4 C), 111.6 (4 C), 71.2 (12 C), 30.5 (q, J = 28.6 Hz), 9.6. **^{19}F NMR** (376 MHz, Methanol-d_4): δ -70.5 (t, J = 11.1 Hz). **^{29}Si NMR** (119 MHz, Methanol-d_4): δ -78.6. **IR** (neat): 3040, 2907, 2871, 1597, 1485, 1353, 1245, 1201, 1098, 1057, 820, 739 cm^{-1}. **HRMS** calc. for $[C_{15}H_{12}F_3O_4Si]^-$ 341.0462; found 341.0460.

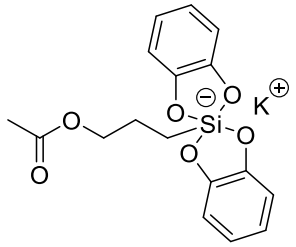
Potassium [18-Crown-6] bis(catecholato)-acetoxypropylsilicate (1i)



Following the general procedure A with acetoxypropyltrimethoxysilane (10 mmol, 2.10 mL), catechol (20 mmol, 2.20 g), 18-Crown-6 (10 mmol, 2.64 g) and potassium methoxide (10 mmol, 2.8 mL of a 3.56 M solution in methanol) in 40 mL of dry methanol. The crude product was purified according the general procedure to afford **1i** (5.88 g, 91%) as a white solid.

M.p. 160°C. **^{1}H NMR** (400 MHz, Methanol-d_4): δ 6.67 (dd, J = 5.6, 3.5 Hz, 4H), 6.58 (dd, J = 5.6, 3.4 Hz, 4H), 3.9 (t, J = 7.1 Hz, 2H), 3.5 (s, 24H), 1.9 (s, 3H), 1.7 – 1.5 (m, 2H), 0.7 – 0.6 (m, 2H). **^{13}C NMR** (101 MHz, Methanol-d_4): δ 173.1, 150.9 (4 C), 119.3 (4 C), 111.5 (4 C), 71.2 (12 C), 68.6, 24.9, 20.8, 13.9. **^{29}Si NMR** (119 MHz, Methanol-d_4): δ -76.6. **IR** (neat): 3016, 2950, 2882, 1735, 1597, 1486, 1351, 1242, 1105, 955, 819, 749, 725 cm^{-1}. **HRMS** calc. for $[C_{17}H_{17}O_6Si]^-$ 345.0800; found 345.0813.

Potassium bis(catecholato)-acetoxypropylsilicate (1i')



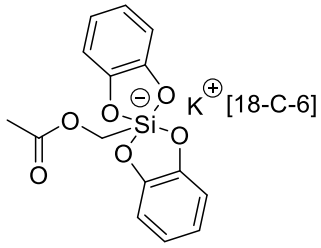
Following the general procedure A with acetoxypropyltrimethoxysilane (5 mmol, 1.05 mL), catechol (10 mmol, 1.10 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford **1i'** (1.55 g, 62%*) as a white solid.

M.p. 160°C. **^{1}H NMR** (400 MHz, Methanol-d_4): δ 6.68 (dd, J = 5.6, 3.5 Hz, 4H), 6.56 (dd, J = 5.6, 3.5 Hz, 4H), 3.88 (t, J = 7.0 Hz, 2H), 1.92 (s, 3H), 1.66 – 1.56 (m, 2H), 0.7 – 0.65 (m, 2H). **^{13}C NMR** (101 MHz, Methanol-d_4): δ 173.3, 150.8 (4 C), 119.4 (4 C), 111.5 (4 C), 68.6,

24.9, 20.8, 13.7. **IR** (neat): 3016, 2950, 2882, 1735, 1597, 1486, 1351, 1242, 1105, 955, 819, 749, 725 cm^{-1}. **HRMS** calc. for $[C_{17}H_{17}O_6Si]^-$ 345.0800; found 345.0813.

*Silicate without [18-Crown-6] cristallyze with a molecule of acetone.

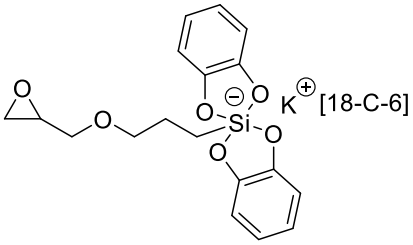
Potassium [18-Crown-6] bis(catecholato)-acetoxymethylsilicate (1j)



Following the general procedure A with acetoxymethyltriethoxysilane (5 mmol, 1.13 mL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford **1j** (2.92 g, 94%) as a white solid.

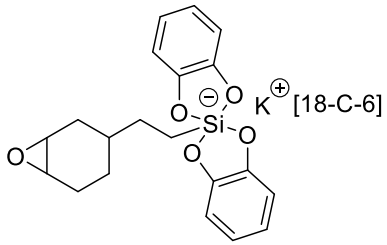
M.p. 110°C. **^{1}H NMR** (600 MHz, Methanol-d_4): δ 6.68 (dd, J = 5.6, 3.4 Hz, 4H), 6.57 (dd, J = 5.8, 3.5 Hz, 4H), 3.82 (s, 2H), 3.53 (s, 24H), 1.83 (s, 3H). **^{13}C NMR** (151 MHz, Methanol-d_4): δ 174.1, 150.9 (4 C), 119.5 (4 C), 111.7 (4C), 71.2 (12 C), 58.1, 20.7. **^{29}Si NMR** (119 MHz, Methanol-d_4): δ -85.8 (t, J = 5.7 Hz). **IR** (neat): 3028, 2901, 2868, 1719, 1599, 1487, 1348, 1243, 1102, 963, 830, 737 cm^{-1}. **HRMS** calc. for $[C_{15}H_{13}O_6Si]^-$ 317.0487; found 317.0495.

Potassium [18-Crown-6] bis(catecholato)-(3-glycidyloxypropyl)silicate (1k)



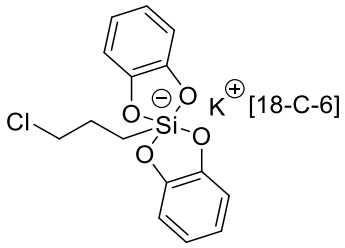
Silicate **1k** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

Potassium [18-Crown-6] bis(catecholato)-[2-(7-oxabicyclo[4.1.0]hept-3-yl)ethyl]silicate (1l)



Silicate **1l** was synthesized as described. The spectroscopic data are in agreement with those reported in the literature.[3]

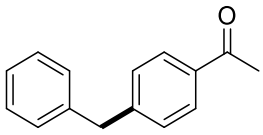
Potassium [18-Crown-6] bis(catecholato)-3-chloropropylsilicate (1m)



Following the general procedure A with 3-chloropropyltrimethoxysilane (5 mmol, 910 μL), catechol (10 mmol, 1.10 g), 18-Crown-6 (5 mmol, 1.32 g) and potassium methoxide (5 mmol, 1.4 mL of a 3.56 M solution in methanol) in 20 mL of dry methanol. The crude product was purified according the general procedure to afford **1m** (2.96 g, 95%) as a white solid.

M.p. 147.7°C. **^{1}H NMR** (600 MHz, Methanol-d_4): δ 6.68 (dd, J = 5.6, 3.4 Hz, 4H), 6.56 (dd, J = 5.6, 3.4 Hz, 4H), 3.53 (s, 24H), 3.37 (t, J = 7.2 Hz, 2H), 1.80 – 1.69 (m, 2H), 0.79 – 0.69 (m, 2H). **^{13}C NMR** (151 MHz, Methanol-d_4): δ 150.9 (4 C), 119.4 (4 C), 111.5 (4 C), 71.2 (12 C), 48.8, 29.6, 15.8. **^{29}Si NMR** (119 MHz, Methanol-d_4): δ -76.9. **IR** (neat): 3044, 2894, 2872, 1598, 1485, 1351, 1243, 1104, 952, 817, 741 cm^{-1}. **HRMS** (ESI-) calc. for $[C_{15}H_{14}ClO_4Si]^-$ 321.0355; found 321.0367.

4'-(Benzyl)acetophenone (3aa)

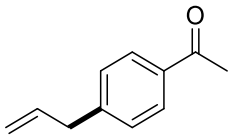


Following general procedure B with benzylsilicate **1a** (0.45 mmol, 287 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column

chromatography (pentane/diethyl ether, 95/5) to afford **3aa** as a colorless oil (56 mg, 88%). The spectroscopic data are in agreement with those reported in the literature.[4]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.89 (d, *J* = 8.4 Hz, 2H), 7.32 – 7.17 (m, 7H), 4.04 (s, 2H), 2.58 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.8, 146.8, 140.1, 135.3, 129.1 (2 C), 129.0 (2 C), 128.7 (4 C), 126.40, 41.9, 26.6. **IR** (neat): 2937, 1678, 1602, 1265 cm^{-1}.

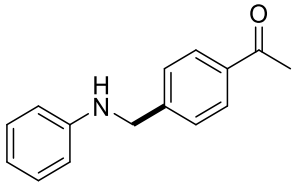
4'-(Allyl)acetophenone (3ba)



Following general procedure B with allylsilicate **1b** (0.45 mmol, 265 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 98/2) to afford **3ba** as a colorless oil (41 mg, 86%). The spectroscopic data are in agreement with those reported in the literature.[5]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.90 (d, *J* = 8.4 Hz, 2H), 7.28 (d, *J* = 8.4 Hz, 2H), 5.95 (ddt, *J* = 17.1 Hz, 10.5 Hz, 6.7 Hz, 1H), 5.13 – 5.08 (m, 2H), 3.45 (d, *J* = 6.7 Hz, 2H), 2.59 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.8, 145.8, 136.3, 135.3, 128.8 (2 C), 128.6 (2 C), 116.7, 40.1, 26.6. **IR** (neat): 3050, 1680, 1604, 1356, 1266 cm^{-1}.

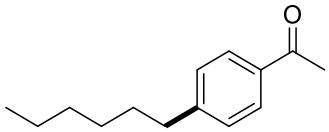
4'-(Anilinomethyl)acetophenone (3ca)



Following general procedure B with anilinomethylsilicate **1c** (0.45 mmol, 294 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford **3ca** as a colorless oil (62 mg, 91%). The spectroscopic data are in agreement with those reported in the literature.[6]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.93 (d, *J* = 8.4 Hz, 2H), 7.47 (d, *J* = 8.4 Hz, 2H), 7.17 – 7.15 (m, 2H), 6.75 – 6.71 (m, 1H), 6.66 – 6.60 (m, 2H), 4.42 (s, 2H), 4.16 (s, 1H), 2.59 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.7, 147.7, 145.2, 136.2, 129.3 (2 C), 128.7 (2 C), 127.3 (2 C), 117.9, 112.9 (2 C), 47.9, 26.6. **IR** (neat): 3321, 1669, 1597, 1510 cm^{-1}.

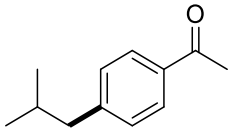
4'-(Hexyl)acetophenone (3da)



Following general procedure B with hexylsilicate **1d** (0.45 mmol, 285 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1) to afford **3da** as a colorless oil (53 mg, 85%). The spectroscopic data are in agreement with those reported in the literature.[7]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 (d, *J* = 8.2 Hz, 2H), 7.26 (d, *J* = 8.2 Hz, 2H), 2.68 – 2.64 (m, 2H), 2.58 (s, 3H), 1.67 – 1.58 (m, 2H), 1.38 – 1.26 (m, 6H), 0.88 (t, *J* = 6.8 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 198.0, 149.0, 135.1, 128.7 (2 C), 128.6 (2 C), 36.1, 31.8, 31.2, 29.0, 26.7, 22.7, 14.2. **IR** (neat): 2900, 1681, 1605, 1265 cm^{-1}.

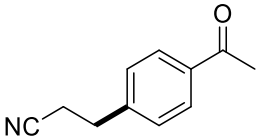
4'-(Isobutyl)acetophenone (3ea)



Following general procedure B with isopropylsilicate **1e** (0.45 mmol, 272 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 98/2) to afford **3ea** as a colorless oil (39 mg, 75%). The spectroscopic data are in agreement with those reported in the literature.[8]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 (d, *J* = 8.3 Hz, 2H), 7.23 (d, *J* = 8.3 Hz, 2H), 2.58 (s, 3H), 2.53 (d, *J* = 7.2 Hz, 2H), 1.93 – 1.87 (m, 1H), 0.91 (d, *J* = 6.6 Hz, 6H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 198.0, 147.7, 135.1, 129.4 (2 C), 128.4 (2 C), 45.5, 30.2, 29.7, 22.5 (2 C). **IR** (neat): 2909, 1680, 1605, 1265 cm^{-1}.

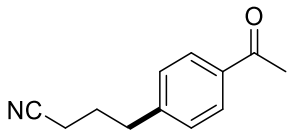
4'-(2-Cyanoethyl)acetophenone (3fa)



Following general procedure B with 2-cyanoethylsilicate **1e** (0.45 mmol, 271 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 1/1) to afford **3ea** as a colorless oil (36 mg, 69%). The spectroscopic data are in agreement with those reported in the literature.[9]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.93 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 8.4 Hz, 2H), 3.01 (t, *J* = 7.3 Hz, 2H), 2.65 (t, *J* = 7.3 Hz, 2H), 2.58 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.6, 143.3, 136.2, 129.0 (2 C), 128.6 (2 C), 118.7, 31.4, 26.6, 19.0. **IR** (neat): 2910, 2245, 1675, 1607, 1266 cm^{-1}.

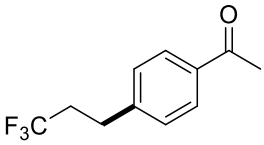
4'-(3-Cyanopropyl)acetophenone (3ga)



Following general procedure B with 2-cyanoethylsilicate **1g** (0.45 mmol, 277 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 1/1) to afford **3ga** as a colorless oil (48 mg, 85%). The spectroscopic data are in agreement with those reported in the literature.[10]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.90 (d, *J* = 8.4 Hz, 2H), 7.28 (d, *J* = 8.4 Hz, 2H), 2.86 – 2.82 (m, 2H), 2.58 (s, 3H), 2.33 (t, *J* = 7.0 Hz, 2H), 2.0 (dd, *J* = 7.5 Hz, 7.0 Hz, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.6, 145.3, 135.6, 128.8 (2 C), 128.6 (2 C), 119.1, 34.3, 26.5, 26.5, 16.4. **IR** (neat): 2905, 2258, 1675, 1605, 1266 cm^{-1}.

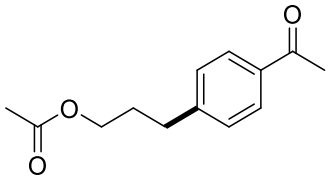
4'-(3,3,3-Trifluoropropyl)acetophenone (3ha)



Following general procedure B with 3,3,3-trifluoropropylsilicate **1h** (0.45 mmol, 290 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford **3ha** as a colorless oil (52 mg, 80%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.4 Hz, 2H), 2.95 – 2.91 (m, 2H), 2.59 (s, 3H), 2.47 – 2.35 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.6, 144.4, 135.8, 128.8 (2 C), 128.5 (2 C), 126.5 (q, *J* = 275 Hz), 35.1 (q, *J* = 28 Hz), 28.2 (q, *J* = 3 Hz), 26.5. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -66.57. **IR** (neat): 2871, 1677, 1607, 1266 cm^{-1}.

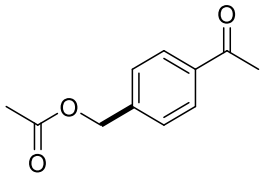
4'-(Acetoxypropyl)acetophenone (3ia)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford **3ia** as a colorless oil (56 mg, 85%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (d, *J* = 8.4 Hz, 2H), 7.27 (d, *J* = 8.4 Hz, 2H), 4.08 (t, *J* = 6.5 Hz, 2H), 2.76 – 2.72 (m, 2H), 2.57 (s, 3H), 2.04 (s, 3H), 2.01 – 1.94 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.7, 171.0, 147.0, 135.3, 128.6 (2 C), 128.6 (2 C), 63.5, 32.2, 29.8, 26.5, 20.9. **IR** (neat): 2900, 1735, 1679, 1606, 1233 cm^{-1}. **HRMS** calc for $[C_{13}H_{16}NaO_3]^+$ 243.0992; found 243.0999.

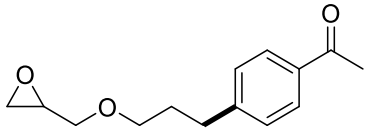
4'-(Acetoxymethyl)acetophenone (3ja)



Following general procedure B with acetoxymethylsilicate **1j** (0.45 mmol, 279 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford **3ja** as a colorless oil (38 mg, 66%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.43 (d, *J* = 8.4 Hz, 2H), 5.15 (s, 2H), 2.59 (s, 3H), 2.12 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.6, 170.6, 141.2, 136.8, 128.6 (2 C), 127.9 (2 C), 65.4, 26.6, 20.9. **IR** (neat): 2905, 2855, 1736, 1681, 1264, 1224 cm^{-1}. **HRMS** calc for $[C_{11}H_{12}NaO_3]^+$ 215.0673; found 215.0679.

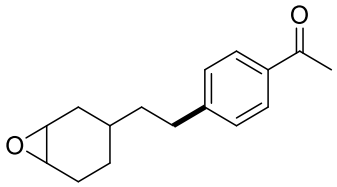
4'-(3-Glycidyloxypropyl)acetophenone (3ka)



Following general procedure B with 3-glycidyloxypropylsilicate **1k** (0.45 mmol, 239 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford **3ka** as a colorless oil (29 mg, 40%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (d, *J* = 8.4 Hz, 2H), 7.28 (d, *J* = 8.4 Hz, 2H), 3.73 (dd, *J* = 11.5 Hz, 2.9 Hz, 1H), 3.57 – 3.42 (m, 2H), 3.36 (dd, *J* = 11.5 Hz, 5.9 Hz, 1H), 3.21 – 3.07 (m, 1H), 2.85 – 2.64 (m, 3H), 3.60 (dd, *J* = 5.0 Hz, 2.7 Hz, 1H), 2.58 (s, 3H), 1.92 (ddt, *J* = 12.7 Hz, 7.6 Hz, 6.3 Hz, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.8, 147.7, 135.1, 128.7 (2 C), 128.5 (2 C), 71.6, 70.3, 50.8, 44.2, 32.3, 30.9, 26.5. **IR** (neat): 2905, 1678, 1605, 1266, 1106 cm^{-1}. **HRMS** calc for $[C_{14}H_{18}NaO_3]^+$ 257.1148; found 257.1155.

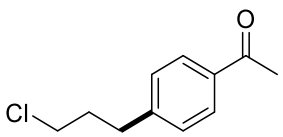
4'-(2-(7-Oxabicyclo-[4.1.0]hept-3-yl)ethyl)acetophenone (3la)



Following general procedure B with 2-(7-oxabicyclo-[4.1.0]hept-3-yl)ethylsilicate **3l** (0.45 mmol, 303 mg) and 4'-bromoacetophenone (0.3 mmol, 60 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford a 45/55 mixture of diastereoisomers of **3la** as a colorless oil (48 mg, 65%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 – 7.85 (m, 4H), 7.26 – 7.21 (m, 4H), 3.20 – 3.14 (m, 4H), 2.69 – 2.66 (m, 4H), 2.60 (s, 6H), 2.25 – 1.99 (m, 4H), 1.89 – 1.51 (m, 10H), 1.44 – 1.37 (m, 2H), 1.25 – 0.95 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.8 (197.8), 148.4 (148.3), 135.0 (135.0), 128.5 (128.5), 128.5 (128.5), 53.0 (52.5), 51.8 (51.7), 38.1 (37.8), 33.3 (33.0), 32.1 31.8), 30.6 (29.3), 27.0 (25.1), 26.5, 24.3 (23.5). **IR** (neat): 2935, 1671, 1604, 1568, 1298 cm^{-1}. **HRMS** calc for $[C_{16}H_{20}NaO_2]^+$ 267.1365; found 267.1135.

4'-(3-Chloropropyl)acetophenone (3ma)

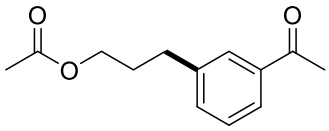


Following general procedure B with chloropropylsilicate **1m** (0.45 mmol, 282 mg) and 4'-bromoacetophenone **2a** (0.3 mmol, 60 mg). The crude product was purified by flash

column chromatography (pentane/diethyl ether, 80/20) to afford **3ma** as a colorless oil (42 mg, 71%). The spectroscopic data are in agreement with those reported in the literature.[11]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.89 (d, *J* = 8.4 Hz, 2H), 7.29 (d, *J* = 8.4 Hz, 2H), 3.52 (t, *J* = 6.4 Hz, 2H), 2.86 – 2.82 (m, 2H), 2.58 (s, 3H), 2.13 – 2.07 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 197.8, 146.5, 135.5, 128.8 (2 C), 128.7 (2 C), 44.1, 33.6, 32.8, 26.6. **IR** (neat): 2935, 1678, 1605, 1358, 1265 cm^{-1}.

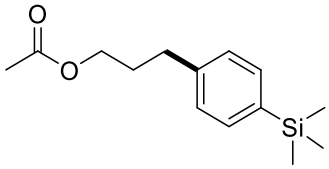
3-(3-Acetylphenyl)propyl acetate (3ib)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 3'-bromoacetophenone **2b** (0.3 mmol, 35 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3ib** as a colorless oil (53 mg, 80%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80 – 7.71 (m, 2H), 7.40 – 7.34 (m, 2H), 4.08 (t, *J* = 6.5 Hz, 2H), 2.76 – 2.72 (m, 2H), 2.59 (s, 3H), 2.04 (s, 3H), 2.01 – 1.94 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 198.2, 171.1, 141.7, 137.3, 133.2, 128.6, 128.0, 126.3, 63.6, 32.0, 30.0, 26.6, 20.9. **IR** (neat): 2941, 1734, 1684, 1601, 1232, 839 cm^{-1}. **HRMS** calc. for $[C_{13}H_{16}NaO_3]^+$ 243.0992; found 243.0992.

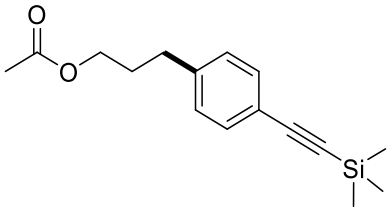
3-(4-(Trimethylsilyl)phenyl)propyl acetate (3ic)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and (4-bromophenyl)trimethylsilane **2c** (0.3 mmol, 59 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3hic** as a colorless oil (54 mg, 72%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 (d, *J* = 8.0 Hz, 2H), 7.19 (d, *J* = 8.0 Hz, 2H), 4.10 (t, *J* = 6.6 Hz, 2H), 2.71 – 2.67 (m, 2H), 2.06 (s, 3H), 1.99 – 1.91 (m, 2H), 0.27 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 141.8, 137.7, 133.5 (2 C), 127.9 (2 C), 63.6, 32.1, 30.0, 20.9, -1.1 (3 C). **IR** (neat): 2936, 1739, 1601, 1233 cm^{-1}. **HRMS** calc. for $[C_{14}H_{22}NaO_2Si]^+$ 273.1281; found 273.1277.

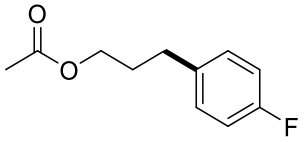
3-(4-((Trimethylsilyl)ethynyl)phenyl)propyl acetate (3id)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and ((4-bromophenyl)ethynyl)trimethylsilane **2d** (0.3 mmol, 76 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford **3id** as a colorless oil (54 mg, 72%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38 (d, *J* = 8.3 Hz, 2H), 7.11 (d, *J* = 8.3 Hz, 2H), 4.06 (t, *J* = 6.5 Hz, 2H), 2.69 – 2.65 (m, 2H), 2.04 (s, 3H), 1.97 – 1.89 (m, 2H), 0.24 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.0, 141.8, 132.0 (2 C), 128.3 (2 C), 120.8, 105.1, 93.6, 63.6, 32.21, 29.9, 20.9, 0.0 (3 C). **IR** (neat): 2944, 2156, 1738, 1608, 1233, 839 cm^{-1}. **HRMS** calc. for $[C_{16}H_{22}NaO_2Si]^+$ 297.1281; found 297.1281.

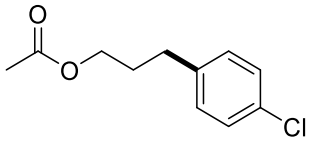
3-(4-Fluorophenyl)propyl acetate (3ie)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 1-bromo-4-fluorobenzene **2e** (0.3 mmol, 33 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford **3ie** as a colorless oil (45 mg, 75%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.16 – 7.08 (m, 2H), 7.00 – 6.92 (m, 2H), 4.07 (t, *J* = 6.5 Hz, 2H), 2.68 – 2.64 (m, 2H), 2.05 (s, 3H), 1.95 – 1.89 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 161.3 (d, *J* = 243.7 Hz), 136.7 (d, *J* = 3.2 Hz), 129.7 (d, *J* = 7.8 Hz, 2 C), 115.1 (d, *J* = 21.1 Hz, 2 C), 63.6, 31.3, 30.3, 20.9. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -117.48. **IR** (neat): 2930, 1733, 1600, 1509, 1218, 1036 cm^{-1}. **HRMS** calc. for $[C_{11}H_{13}FNaO_2]^+$ 219.0797; found 219.0792

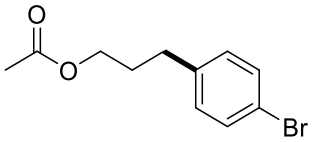
3-(4-Chlorophenyl)propyl acetate (3if)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 1-bromo-4-chlororobenzene **2f** (0.3 mmol, 58 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3if** as a colorless oil (51 mg, 80%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 (d, *J* = 8.6 Hz, 1H), 7.11 (d, *J* = 8.6 Hz, 1H), 4.07 (t, *J* = 6.5 Hz, 2H), 2.68 – 2.64 (m, 2H), 2.05 (s, 3H), 1.97 – 1.89 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.0, 139.6, 131.7, 129.7 (2 C), 128.5 (2 C), 63.6, 31.5, 30.1, 21.9. **IR** (neat): 2936, 1736, 1597, 1231, 836 cm^{-1}. **HRMS** calc. for $[C_{11}H_{13}ClNaO_2]^+$ 235.0496; found 235.0505.

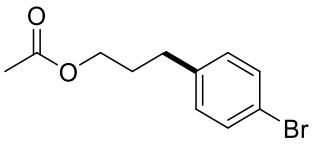
3-(4-Bromophenyl)propyl acetate (3ig)

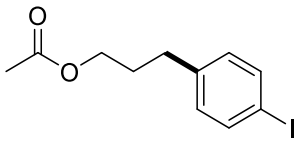


Following general procedure B with acetoxypropylsilicate **1h** (0.45 mmol, 292 mg) and 1,4-dibromobenzene **2g** (0.3 mmol, 71 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3ig** as a colorless oil (52 mg, 67%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.40 (d, *J* = 8.4 Hz, 2H), 7.06 (d, *J* = 8.4 Hz, 2H), 4.07 (t, *J* = 6.6 Hz, 2H), 2.66 – 2.62 (m, 2H), 2.05 (s, 3H), 1.97 – 1.89 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 140.1, 131.5 (2 C), 130.1 (2 C), 119.8, 63.6, 31.6, 30.0, 20.9. **IR** (neat): 2940, 1735, 1591, 1299, 1231 cm^{-1}. **HRMS** calc. for $[C_{11}H_{13}BrNaO_2]^+$ 278.9991; found 278.9991

3-(4-Bromophenyl)propyl acetate (3ig) and 3-(4-iodophenyl)propyl acetate (3ig')



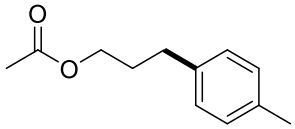


Following general procedure B with acetoxypropylsilicate **1h** (0.45 mmol, 292 mg) and 1-bromo-4-iodobenzene **2g'** (0.3 mmol, 85 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford a 10:1 mixture of **3ig** and **3ig'** as a colorless oil (43 mg, 48%).

3-(4-Iodophenyl)propyl acetate (3ig')

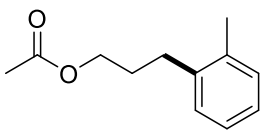
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (d, *J* = 8.4 Hz, 2H), 6.95 (d, *J* = 8.4 Hz, 2H), 4.07 (t, *J* = 6.6 Hz, 2H), 2.66 – 2.63 (m, 2H), 2.05 (s, 3H), 1.96 – 1.86 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 140.8, 137.5 (2 C), 130.5 (2 C), 119.8, 63.6, 31.7, 30.0, 20.9. **IR** (neat): 2940, 1735, 1591, 1299, 1231 cm^{-1}. **HRMS** calc. for $[C_{11}H_{13}INaO_2]^+$ 326.9852; found 326.9847.

3-(*p*-Tolyl)propyl acetate (3ih)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4-bromotoluene **2h** (0.3 mmol, 51 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3ih** as a colorless oil (42 mg, 73%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.12 – 7.07 (m, 4H), 4.09 (t, *J* = 6.6 Hz, 2H), 2.67 – 2.64 (m, 2H), 2.33 (s, 3H), 2.06 (s, 3H), 1.96 – 192 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 138.1, 135.4, 129.1 (2 C), 128.2 (2 C), 63.8, 31.7, 30.3, 21.0 (2 C).* **IR** (neat): 2920, 1736, 1232, 1036 cm^{-1}. **HRMS** calc. for $[C_{12}H_{16}NaO_2]^+$ 215.1043; found 215.1045.
*signal for both CH_3 (verified by HSQC)

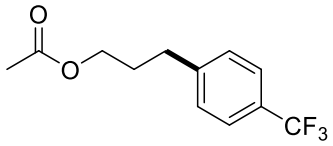
3-(*o*-Tolyl)propyl acetate (3ii)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 2-bromotoluene **2i** (0.3 mmol, 36 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford **3ii** as a colorless oil (44 mg, 76%).

^{1}H NMR (400 MHz, $CDCl_3$): 7.17 – 7.11 (m, 4H), 4.13 (t, *J* = 6.5 Hz, 2H), 2.71 – 2.67 (m, 2H), 2.33 (s, 3H), 2.08 (s, 3H), 1.97 – 1.90 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 139.4, 135.8, 130.2, 128.7, 126.1, 126.0, 64.0, 29.5, 29.0, 20.9, 19.2. **IR** (neat): 2942, 1736, 1601, 1231 cm^{-1}. **HRMS** calc. for $[C_{12}H_{16}NaO_2]^+$ 215.1043; found 215.1035.

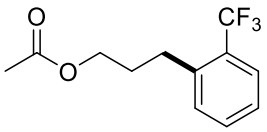
3-(4-(Trifluoromethyl)phenyl)propyl acetate (3ij)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4-bromobenzotrifluoride **2j** (0.3 mmol, 41 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3ij** as a colorless oil (70 mg, 94%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54 (d, *J* = 8.0 Hz, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 4.09 (t, *J* = 6.5 Hz, 2H), 2.77 – 2.73 (m, 2H), 2.05 (s, 3H), 1.99 – 1.94 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 145.3, 128.7, 128.5 (q, *J* = 32.3 Hz, 2 C), 125.4 (q, *J* = 3.9 Hz, 2 C), 124.3 (q, *J* = 270 Hz), 63.5, 32.1, 29.9, 21.9. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -62.4. **IR** (neat): 2922, 1737, 1584, 1232, 845 cm^{-1}. **HRMS** calc. for $[C_{12}H_{13}F_3NaO_2]^+$ 269.0760; found 269.0752.

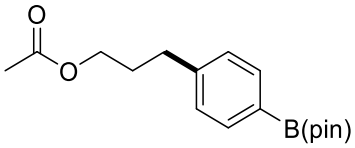
3-(2-(Trifluoromethyl)phenyl)propyl acetate (3ik)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 2-bromobenzotrifluoride **2k** (0.3 mmol, 42 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford **3ik** as a colorless oil (51 mg, 69%).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (dd, *J* = 7.9, 1.3 Hz, 1H), 7.47 (td, *J* = 7.6, 1.3 Hz, 1H), 7.36 – 7.27 (m, 2H), 4.13 (t, *J* = 6.4 Hz, 2H), 2.86 (ddd, *J* = 9.7, 6.2, 1.3 Hz, 2H), 2.06 (s, 3H), 2.01 – 1.91 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 140.1, 131.8 (d, *J* = 0.8 Hz), 131.0, 128.6 (q, *J* = 29.8 Hz), 126.2, 126.0 (q, *J* = 5.8 Hz), 124.6 (q, *J* = 5.8 Hz), 63.8, 30.4, 29.1 (d, *J* = 1.7 Hz), 20.9. **^{19}F NMR** (376 MHz, $CDCl_3$)**:** δ -59.7. **IR** (neat): 2940, 1737, 1608, 1311, 1111, 1030 cm^{-1}. **HRMS** calc. for $[C_{12}H_{13}F_3LiO_2]^+$ 253.1022; found 253.1019.

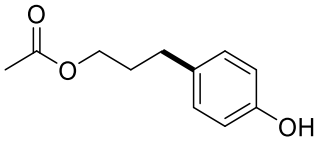
4-Acetoxypropylphenylboronic pinacol ester (3il)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4-Bromophenylboronic acid pinacol ester (0.3 mmol, 85 mg. The crude product was purified by flash column chromatography (pentane/EtOAc, 90/10) to afford **3il** as a brown oil (49 mg, 53%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74 (d, *J* = 8.0 Hz, 2H), 7.20 (d, *J* = 8.0 Hz, 2H), 4.08 (t, *J* = 6.6 Hz, 2H), 2.72 – 2.68 (m, 2H), 2.05 (s, 3H), 1.97 – 1.94 (m, 2H), 1.34 (s, 12H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 144.6, 135.0 (2 C), 127.8 (2 C), 83.7 (2 C), 63.8, 32.4, 30.1, 24.9 (4 C), 21.0. **^{11}B NMR** (128 MHz, $CDCl_3$): 30.6. **IR** (neat): 2960, 1737, 1611, 1357, 1235, 657 cm^{-1}. **HRMS** calc. for $[C_{17}H_{25}BNaO_4]^+$ 327.1741; found 327.1754

3-(4-Hydroxyphenyl)propyl acetate (3im)

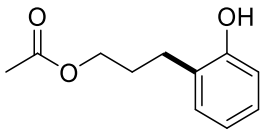


Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4-bromophenylboronic acid pinacol ester **2m** (0.3 mmol, 85 mg). After 24h of reaction, the crude reaction mixture was filtered through a plug of celite, washing with THF (15 mL). The filtrate was concentrated by rotary evaporation. The resulting solution of DMF was diluted with THF (10 mL) and cooled to 0°C in an ice water bath. To the cold stirring solution was added 1M NaOH (1.5 mL, 5 equiv.) and 30% aq. H_2O_2 (171 µl, 5 equiv.). After 30 min the mixture was diluted with water (10 mL) and diethyl ether (10 mL) and neutralized by addition of 1M HCl (2.5 mL). The organic layer was collected and washed with water (2 x 10 mL), brine (2 x 10 mL), dried over $MgSO_4$ and evaporated under reduced pressure. The crude product was purified by flash column chromatography (pentane/EtOAc, 90/10) to afford **3im** as a brown oil (41 mg, 69%). The spectroscopic data are in agreement with those reported in the literature.[12]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.04 (d, *J* = 8.5 Hz, 2H), 6.76 (d, *J* = 8.5 Hz, 2H), 5.19 (s, 1H) 4.08 (t, *J* = 6.6 Hz, 2H), 2.63 – 2.59 (m, 2H), 2.06 (s, 3H), 1.95 – 1.89 (m, 2H). **^{13}C NMR**

(100 MHz, $CDCl_3$): δ 171.5, 153.9, 133.2, 129.4 (2 C), 115.3 (2 C), 63.9, 31.2, 30.4, 21.0. **IR** (neat): 3356, 2978, 1707, 1595, 1514, 1227, 1035 cm^{-1}.

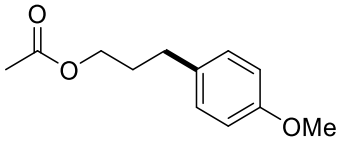
3-(2-Hydroxyphenyl)propyl acetate (3in)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 2-bromophenylboronic acid pinacol ester **2m** (0.3 mmol, 67 µl). After 24h of reaction, the crude reaction mixture was filtered through a plug of celite, washing with THF (15 mL). The filtrate was concentrated by rotary evaporation. The resulting solution of DMF was diluted with THF (10 mL) and cooled to 0°C in an ice water bath. To the cold stirring solution was added 1M NaOH (1.5 mL, 5 equiv.) and 30% aq. H_2O_2 (171 µl, 5 equiv.). After 30 min the mixture was diluted with water (10 mL) and diethyl ether (10 mL) and neutralized by addition of 1M HCl (2.5 mL). The organic layer was collected and washed with water (2 x 10 mL), brine (2 x 10 mL), dried over $MgSO_4$ and evaporated under reduced pressure. The crude product was purified by flash column chromatography (pentane/EtOAc, 90/10) to afford **3in** as a colorless oil (34 mg, 58%). The spectroscopic data are in agreement with those reported in the literature.[13]

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.12 – 7.06 (m, 2H), 6.88 – 6.84 (m, 1H), 6.77 – 6.75 (m, 1H) 5.43 (s, 1H) 4.12 (t, *J* = 6.5 Hz, 2H), 2.72 – 2.68 (m, 2H), 2.07 (s, 3H), 1.99 – 1.94 (m, 2H), **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.6, 153.7, 130.3, 127.4, 127.3, 120.7, 115.4, 64.2, 28.6, 26.3, 21.0. **IR** (neat): 3355, 2999, 1707, 1491, 1236, 1032 cm^{-1}.

3-(4-Methoxyphenyl)propyl acetate (3io)

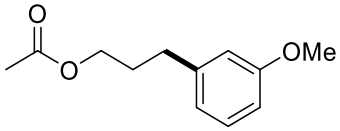


Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4-iodoanisole **2o** (0.3 mmol, 70 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3io** as a colorless oil (29 mg, 46%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.10 (d, *J* = 8.7 Hz, 2H), 6.83 (d, *J* = 8.7 Hz, 2H), 4.07 (t, *J* = 6.6 Hz, 2H), 3.79 (s, 3H), 2.65 – 2.61 (m, 2H), 2.05 (s, 3H), 1.96 – 1.89 (m, 2H). **^{13}C NMR**

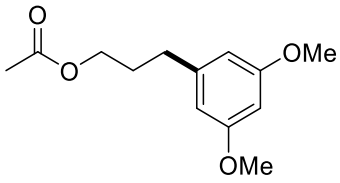
(100 MHz, $CDCl_3$): δ 171.2, 157.9, 133.2, 129.3 (2 C), 113.9 (2 C), 63.8, 55.3, 31.2, 30.4, 21.0. **IR** (neat): 2941, 1734, 1612, 1299, 1234 cm^{-1}. **HRMS** calc. for $[C_{12}H_{16}NaO_3]^+$ 231.0992; found 231.0989.

3-(3-Methoxyphenyl)propyl acetate (3ip)



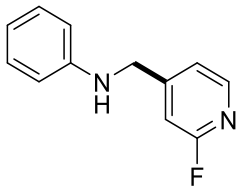
Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 3-bromoanisole **2p** (0.3 mmol, 38 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3ip** as a colorless oil (34mg, 54%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.22 – 7.18 (m, 1H), 6.79 – 6.74 (m, 3H), 4.09 (t, *J* = 6.6 Hz, 2H), 3.80 (s, 3H), 2.69 – 2.65 (m, 2H), 2.06 (s, 3H), 1.99 – 1.92 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 159.7, 142.8, 129.4, 120.8, 114.2, 111.2, 63.8, 55.1, 32.2, 30.1, 21.0. **IR** (neat): 2941, 1734, 1600, 1594, 1234, 1035 cm^{-1}. **HRMS** calc. for $[C_{12}H_{16}NaO_3]^+$ 231.0992; found 231.0992.

3-(3,5-Dimethoxyphenyl)propyl acetate (3iq)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 1-bromo-3,5-dimethoxybenzene **2q** (0.3 mmol, 65 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3iq** as a colorless oil (46 mg, 65%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 6.37 – 6.29 (m, 3H), 4.09 (t, *J* = 6.6 Hz, 2H), 3.78 (s, 6H), 2.65 – 2.61 (m, 2H), 2.06 (s, 3H), 1.98 – 1.91 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.3, 161.0, 143.7, 106.6 (2 C), 98.1 (2 C), 63.9, 55.4 (2 C), 32.6, 30.1, 21.1. **IR** (neat): 1734, 1594, 1236, 1204, 1147, 1036 cm^{-1}. **HRMS** calc. for $[C_{13}H_{18}NaO_4]^+$ 261.1097; found 261.1087.

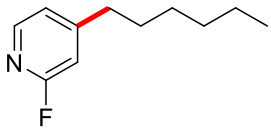
4-Anilinomethyl-2-fluoropyridine (3cr)



Following general procedure B with anilinomethylylsilicate **1c** (0.45 mmol, 294 mg) and 4-bromo-2-fluoropyridine **2r** (0.3 mmol, 31 µl). The crude product was purified by flash column chromatography (pentane/EtOAc, 80/20) to afford **3cr** as a colorless oil (53 mg, 86%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.15 (d, *J* = 5.2 Hz, 1H), 7.20 – 7.16 (m, 3H), 6.94 (s, 1H), 6.78 – 6.74 (m, 1H), 6.58 – 6.56 (m, 2H), 4.41 (s, 2H), 4.41 (s, 1H (N-H)). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 164.3 (d, *J* = 238.8 Hz), 155.5 (d, *J* = 7.5 Hz), 147.7 (d, *J* = 15.1 Hz) 147.1, 129.34, 119.7(d, *J* = 3.9 Hz), 118.3, 112.8, 107.7 (d, *J* = 37.8 Hz), 46.8 (d, *J* = 3.2 Hz). **^{19}F NMR** (376 MHz, $CDCl_3$)**:** δ -68.12. **IR** (neat): 3345, 3060, 1602, 1264, 732 cm^{-1}. **HRMS** calc. for $[C_{12}H_{12}FN_2]^+$ 203.0979; found 203.0977.

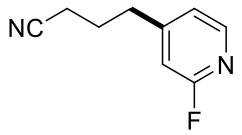
2-Fluoro-4-hexylpyridine (3dr)



Following general procedure B with hexylsilicate **1d** (0.45 mmol, 285 mg) and 4-bromo-2-fluoropyridine **2r** (0.3 mmol, 31 µL). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford **3dr** as a colorless oil (47 mg, 87%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.07 (d, *J* = 5.1 Hz, 1H), 6.98 (dt, *J* = 5.1, 1.7 Hz, 1H), 6.72 (t, *J* = 1.8 Hz, 1H), 2.68 – 2.56 (m, 2H), 1.68 – 1.56 (m, 2H), 1.30 - 1.28 (m, 6H), 0.87 (t, *J* = 6.8 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 164.2 (d, *J* = 237.9 Hz), 158.0 (d, *J* = 7.8 Hz), 147.3 (d, *J* = 15.5 Hz), 121.7 (d, *J* = 4.2 Hz), 109.1 (d, *J* = 36.3 Hz), 35.2 (d, *J* = 2.7 Hz), 31.6, 30.1, 28.9, 22.6, 14.1. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -69.4. **IR** (neat): 2955, 2925, 2857, 1612, 1567, 1481, 1465, 1410, 1276, 1146, 1096, 1072 cm^{-1}. **HRMS** (ESI-) calc. for $[C_{11}H_{16}FNNa]^+$ 204.1159; found 204.1166.

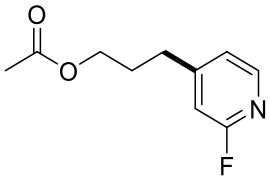
4-(2-Fluoropyridin-4-yl)butanenitrile (3gr)



Following general procedure B with cyanopropylsilicate **1g** (0.45 mmol, 277 mg) and 4-4-bromo-2-fluoropyridine **2r** (0.3 mmol, 31 µl). The crude product was purified by flash column chromatography (pentane/EtOAc, 80/20) to afford **3gr** as a colorless oil (29 mg, 59%).

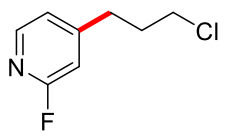
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.15 (d, *J* = 5.1 Hz, 1H), 7.04 – 7.01 (m, 1H), 6.78 – 6.74 (m, 1H), 2.85 – 2.81 (m, 2H), 2.39 – 2.36 (m, 2H), 2.05 – 1.98 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 164.2 (d, *J* = 239.0 Hz), 154.6 (d, *J* = 7.7 Hz), 147.9 (d, *J* = 15.3 Hz), 121.5 (d, *J* = 4.0 Hz), 118.7, 107.7 (d, *J* = 37.0 Hz), 33.5 (d, *J* = 3.0 Hz), 25.6, 16.5. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -68.10. **IR** (neat): 3060, 1672, 1613, 1412, 1265, 731 cm^{-1}. **HRMS** calc. for $[C_9H_{10}FN_2]^+$ 165.0823; found 165.0822

3-(2-Fluoropyridin-4-yl)propyl acetate (3ir)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 4-bromo-2-fluoropyridine **2r** (0.3 mmol, 31 µl). The crude product was purified by flash column chromatography (pentane/EtOAc, 80/20) to afford **3ir** as a colorless oil (48 mg, 81%). **^{1}H NMR** (400 MHz, $CDCl_3$): δ 8.09 (d, *J* = 5.2 Hz, 1H), 7.02 – 6.98 (m, 1H), 6.74 (s, 1H), 4.08 (t, *J* = 6.4 Hz, 2H), 2.74 – 2.71 (m, 2H), 2.03 (s, 3H), 2.02 – 1.95 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 170.9, 164.1 (d, *J* = 238.5 Hz), 156.2 (d, *J* = 7.7 Hz), 147.5 (d, *J* = 15.4 Hz), 121.5 (d, *J* = 3.9 Hz), 109.1 (d, *J* = 36.9 Hz), 63.2, 31.5 (d, *J* = 3.0 Hz), 28.9, 20.8. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -68.84. **IR** (neat): 2935, 1733, 1612, 1411, 1233 cm^{-1}. **HRMS** calc. for $[C_{10}H_{12}FLiNO_2]^+$ 204.1007; found 204.1015.

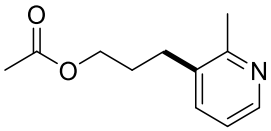
4-(3-Chloropropyl)-2-fluoropyridine (3mr)



Following general procedure B with 3-chloropropylsilicate **1m** (0.45 mmol, 281 mg) and 4-bromo-2-fluoropyridine **2r** (0.3 mmol, 31 μL). The crude product was purified by flash column chromatography (pentane/diethyl ether, 99/1 then 95/5) to afford **3mr** as a colorless oil (42 mg, 81%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.12 (d, *J* = 5.1 Hz, 1H), 7.02 (dt, *J* = 5.0, 1.6 Hz, 1H), 6.85 – 6.68 (m, 1H), 3.53 (t, *J* = 6.3 Hz, 2H), 2.83 (dd, *J* = 8.4, 6.8 Hz, 2H), 2.19 – 2.02 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 164.1 (d, *J* = 239.5 Hz), 155.7 (d, *J* = 7.7 Hz), 147.6, 121.7, 109.3 (d, *J* = 38.0 Hz), 43.6, 32.5, 31.9 (d, *J* = 2.8 Hz). **^{19}F NMR** (376 MHz, $CDCl_3$): δ -68.6. **IR** (neat): 2926, 1613, 1558, 1411, 1275, 1148, 908, 728 cm^{-1}. **HRMS** (ESI-) calc. for $[C_8H_9ClFNNa]^+$ 196.0300; found 196.0306.7

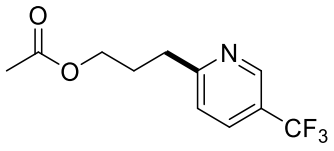
3-(2-Methylpyridin-3-yl)propyl acetate (3is)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 3-bromo-2-methylpyridine **2s** (0.3 mmol, 35 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 50/50) to afford **3is** as a colorless oil (39 mg, 67%).

^{1}H NMR (300 MHz, $CDCl_3$): δ 8.34 (d, *J* = 3.5 Hz, 1H), 7.40 (d, *J* = 7.5, 1H), 7.06 (dd, *J* = 7.6 Hz, *J* = 3.5 Hz, 1H), 4.10 (t, *J* = 6.4 Hz, 2H), 2.70 – 2.65 (m, 2H), 2.53 (s, 3H), 2.05 (s, 3H) 1.96 – 1.87 (m, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$): δ 171.0, 156.5, 147.7, 136.3, 134.4, 121.3, 63.6, 29.0, 28.5, 22.0, 20.9. **IR** (neat): 2942, 1736, 1574, 1441, 1232, 1035, 729 cm^{-1}. **HRMS** calc. for $[C_{11}H_{15}NNaO_2]^+$ 216.0995; found 216.1003.

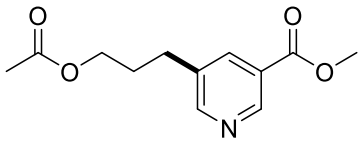
3-(5-(Trifluoromethyl)pyridin-2-yl)propyl acetate (3it)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 2-bromo-5-(trifluoromethyl)pyridine **2t** (0.3 mmol, 67 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 80/20) to afford **3it** as a colorless oil (30 mg, 40%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.80 (d, *J* = 0.8 Hz, 1H), 7.84 (dd, *J* = 8.1 Hz, *J* = 1.9 Hz, 1H), 7.30 (d, *J* = 8.1 Hz, 1H), 4.10 (t, *J* = 6.4 Hz, 2H), 2.97 – 2.94 (m, 2H), 2.16 – 2.09 (m, 2H), 2.04 (s, 3H). **^{13}C NMR** (75 MHz, $CDCl_3$): δ 171.1, 165.0 (d, *J* = 1.3 Hz), 146.3 (q, *J* = 4.1 Hz), 133.5(q, *J* = 3.5 Hz), 124.4 (d, *J* = 30 Hz), 123.7 (d, *J* = 270 Hz), 122.6, 63.6, 34.6, 28.2, 20.9. **^{19}F NMR** (376 MHz, $CDCl_3$): δ -62.3. **IR** (neat): 2940, 1737, 1608, 1326, 1232, 1125, 732 cm^{-1}. **HRMS** calc. for $[C_{11}H_{12}F_3NNaO_2]^+$ 270.0712; found 270.0707.

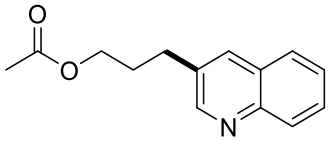
Methyl 5-(3-acetoxypropyl)nicotinate (3iu)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 5-bromopyridine-3-carboxylate **2u** (0.3 mmol, 65 mg). The crude product was purified by flash column chromatography (pentane/ethyl acetate, 60/40) to afford **3iu** as a colorless oil (47 mg, 75%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 9.05 (d, *J* = 1.7 Hz, 1H), 8.61 (d, *J* = 1.9, 1H), 8.12 (dd, *J* = 1.9 Hz, 1.7 Hz, 1H), 4.09 (t, *J* = 6.4 Hz, 2H), 3.94 (s, 3H), 2.78 – 2.74 (m, 2H), 2.04 (s, 3H) 2.02 – 1.95 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.0, 165.8, 153.4, 148.6, 136.8, 136.5, 125.8, 63.3, 52.4, 29.7, 29.2, 20.9. **IR** (neat): 2942, 1722, 1426, 1231, 1027, 765 cm^{-1}. **HRMS** calc. for $[C_{12}H_{15}NNaO_4]^+$ 260.0893; found 260.0897.

3-(Quinolin-3-yl)propyl acetate (3iv)

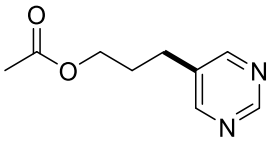


Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 3-bromoquinoline **2v** (0.3 mmol, 41 μl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3iv** as a colorless oil (45 mg, 65%).

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.78 (d, *J* = 2.2 Hz, 1H), 8.07 (d, *J* = 8.5 Hz, 1H), 7.92 (d, *J* = 2.2 Hz, 1H), 7.76 (d, *J* = 8.2 Hz, 1H), 7.68 – 7.62 (m, 1H), 7.58 – 7.50 (m, 1H), 4.14 (t, *J* = 6.6 Hz, 2H), 2.90 – 2.85 (m, 2H), 2.10 – 2.06 (m, 2H), 2.05 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.0, 151.9, 146.9, 134.2, 133.8, 129.2, 128.8, 128.0, 127.3, 126.7, 63.5, 29.8,

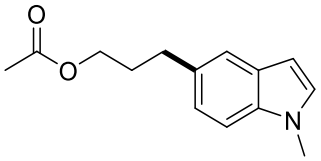
29.6, 20.9. **IR** (neat): 2938, 1732, 1605, 1494, 1365, 1232 cm^{-1}. **HRMS** calc. for $[C_{14}H_{16}NO_2]^+$ 230.1176; found 230.1183.

3-(Pyrimidin-5-yl)propyl acetate (3iw)



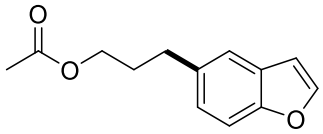
Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 5-bromopyrimidine **2w** (0.3 mmol, 48 mg). The crude product was purified by flash column chromatography (pentane/ethyl acetate, 50/50) to afford **3iw** as a colorless oil (18 mg, 33%).
^{1}H NMR (300 MHz, $CDCl_3$): δ 9.09 (s, 1H), 8.60 (s, 2H), 4.12 (t, *J* = 6.3 Hz, 2H), 2.73 – 2.68 (m, 2H), 2.05 (s, 3H), 2.03 – 1.94 (m, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$): δ 170.9, 156.9 (2 C), 156.7, 134.2, 63.1, 29.4, 27.0, 20.9. **IR** (neat): 2942, 1734, 1232, 1040, 697 cm^{-1}. **HRMS** calc. for $[C_9H_{12}N_2NaO_2]^+$ 203.0791; found 270.0797.

3-(1-Methyl-1H-indol-5-yl)propyl acetate (3ix)



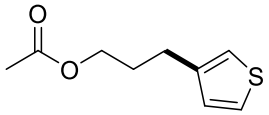
Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 5-bromo-1-methyl-1H-indole **2x** (0.3 mmol, 63 mg). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3ix** as a colorless oil (12 mg, 17%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47 – 7.42 (m, 1H), 7.28 (s, 1H), 7.09 – 7.04 (m, 2H), 6.44 (d, *J* = 3.1 Hz, 1.8 Hz, 1H), 4.13 (t, *J* = 6.6 Hz, 2H), 3.80 (s, 3H), 2.84 – 2.79 (m, 2H), 2.10 – 2.05 (m, 3H), 2.04 – 2.00 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.2, 135.5, 132.0, 129.0, 128.7, 122.4, 120.1, 109.1, 100.5, 64.0, 32.8, 32.2, 31.0, 21.0. **IR** (neat): 2912, 1732, 1615, 1239, 1101, 1036, 718 cm^{-1}. **HRMS** calc. for $[C_{14}H_{17}NNaO_2]^+$ 254.11151; found 254.1153.

3-(Benzofuran-5-yl)propyl acetate (3iy)



Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 5-bromobenzofuran **2y** (0.3 mmol, 38 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 95/5) to afford **3iy** as a colorless oil (48 mg, 73%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (d, *J* = 2.2 Hz, 1H), 7.41 (m, 2H), 7.12 (dd, *J* = 8.4 Hz, 1.7 Hz, 1H), 6.71 (dd, *J* = 2.2 Hz, 0.9 Hz, 1H), 4.10 (t, *J* = 6.6 Hz, 2H), 2.80 – 2.77 (m, 2H), 2.06 (s, 3H) 2.03 – 1.96 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 153.6, 145.2, 135.6, 127.6, 124.8, 120.5, 111.1, 106.3, 63.8, 32.0, 30.8, 21.0. **IR** (neat): 2948, 1733, 1467, 1234, 1030, 734 cm^{-1}. **HRMS** calc. for $[C_{13}H_{14}NaO_3]^+$ 241,0835; found 241.0841.

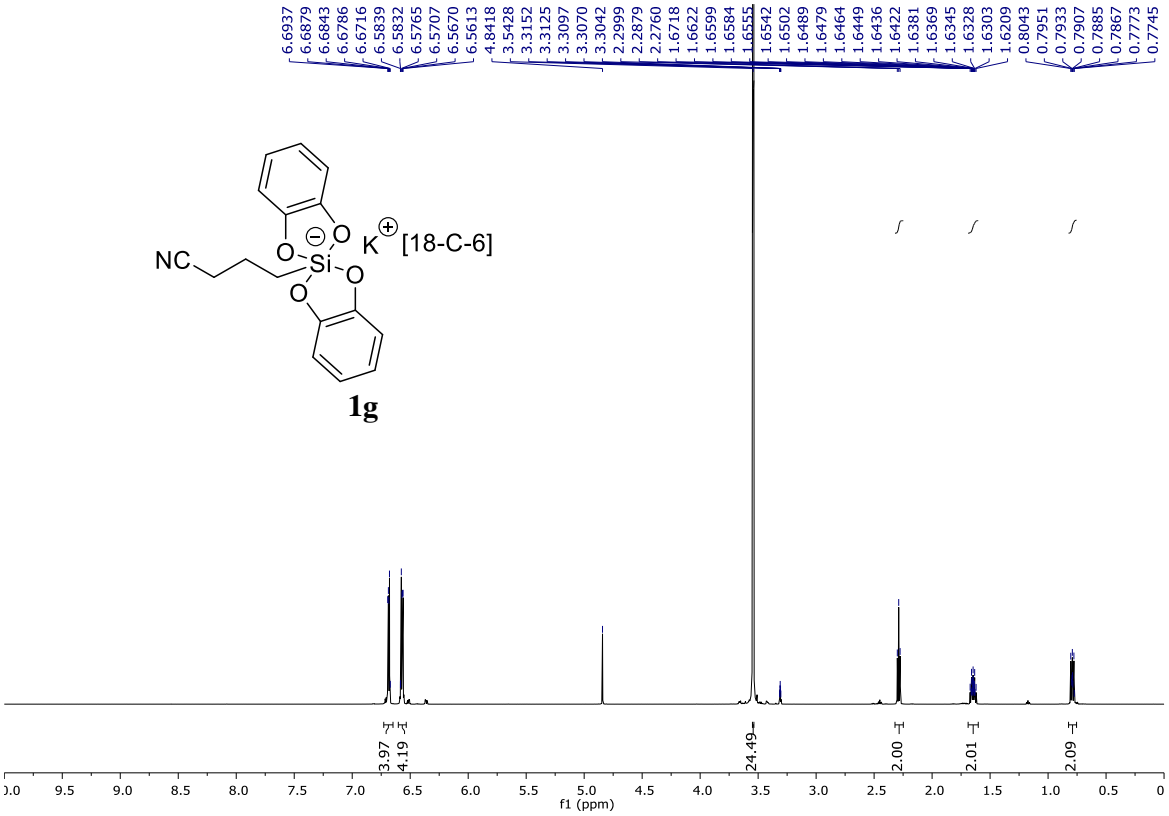
3-(Thiophen-3-yl)propyl acetate (3iz)



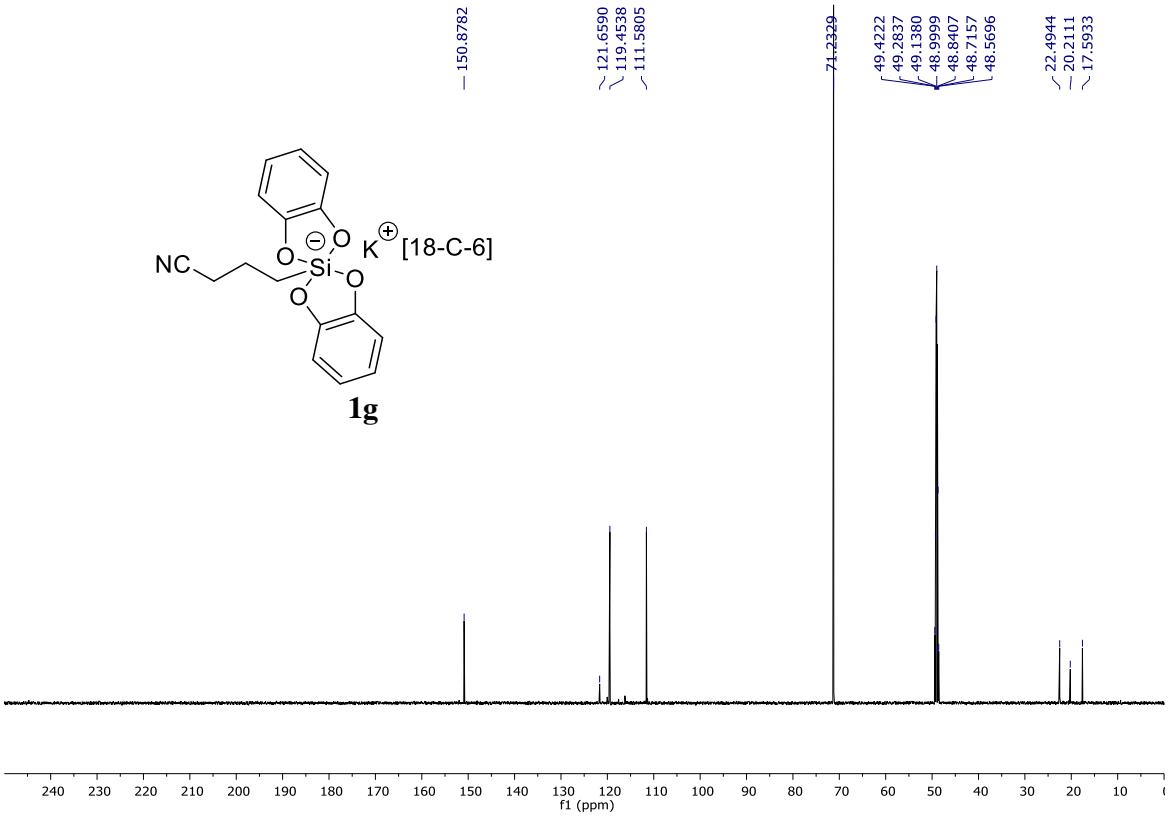
Following general procedure B with acetoxypropylsilicate **1i** (0.45 mmol, 292 mg) and 3-bromothiophene **2z** (0.3 mmol, 29 µl). The crude product was purified by flash column chromatography (pentane/diethyl ether, 90/10) to afford **3iz** as a colorless oil (28 mg, 50%).
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.13 (dd, *J* = 5.2 Hz, 1.2 Hz, 1H), 6.92 (dd, *J* = 5.1 Hz, 3.4 Hz, 1H), 6.80 (s, 1H), 4.12 (t, *J* = 6.4 Hz, 2H), 2.95 – 2.90 (m, 2H), 2.06 (s, 3H), 2.04 – 1.99 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 171.1, 143.9, 126.8, 124.5, 123.2, 63.5, 30.5, 26.3, 20.9. **IR** (neat): 2942, 1734, 1232, 1040, 697 cm^{-1}. **HRMS** calc. for $[C_9H_{12}SLiO_2]^+$ 191.0713; found 191.0710.

IV. ^{1}H, ^{13}C, ^{11}B, ^{19}F and ^{29}Si NMR spectra

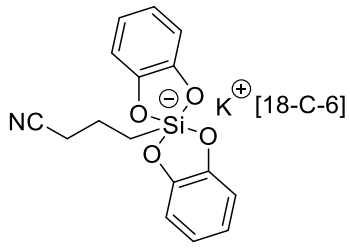
^{1}H spectrum of 1g



^{13}C spectrum of 1g

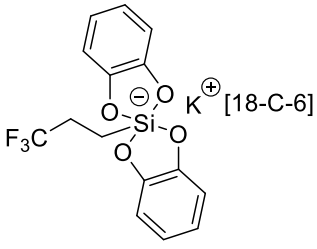


^{29}Si spectrum of 1g



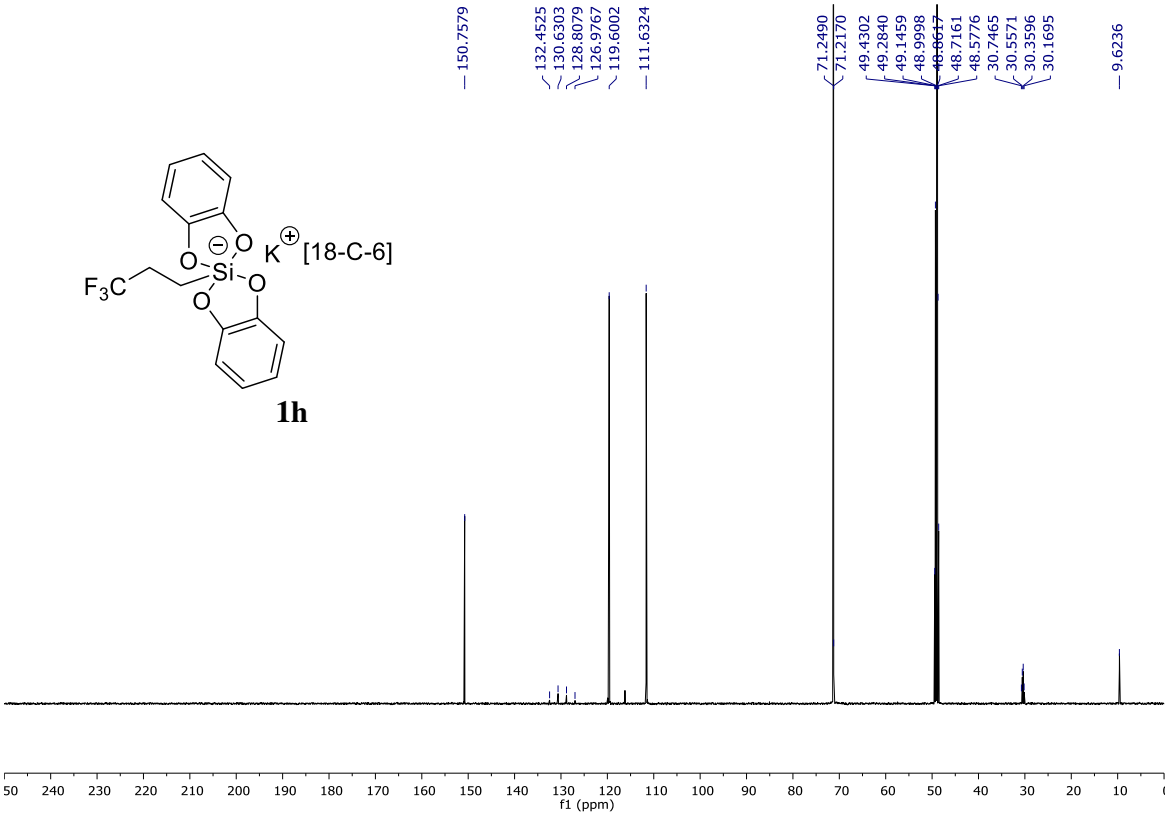
1g

^{1}H spectrum of 1h

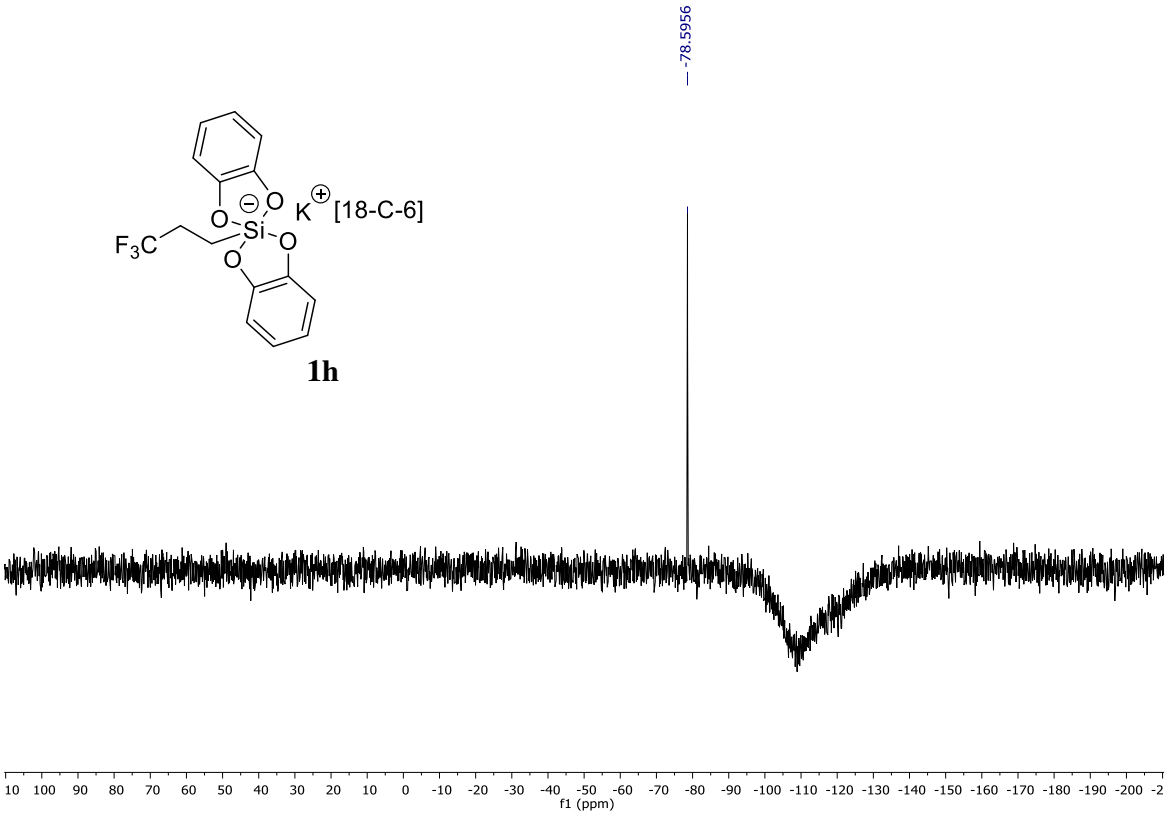


1h

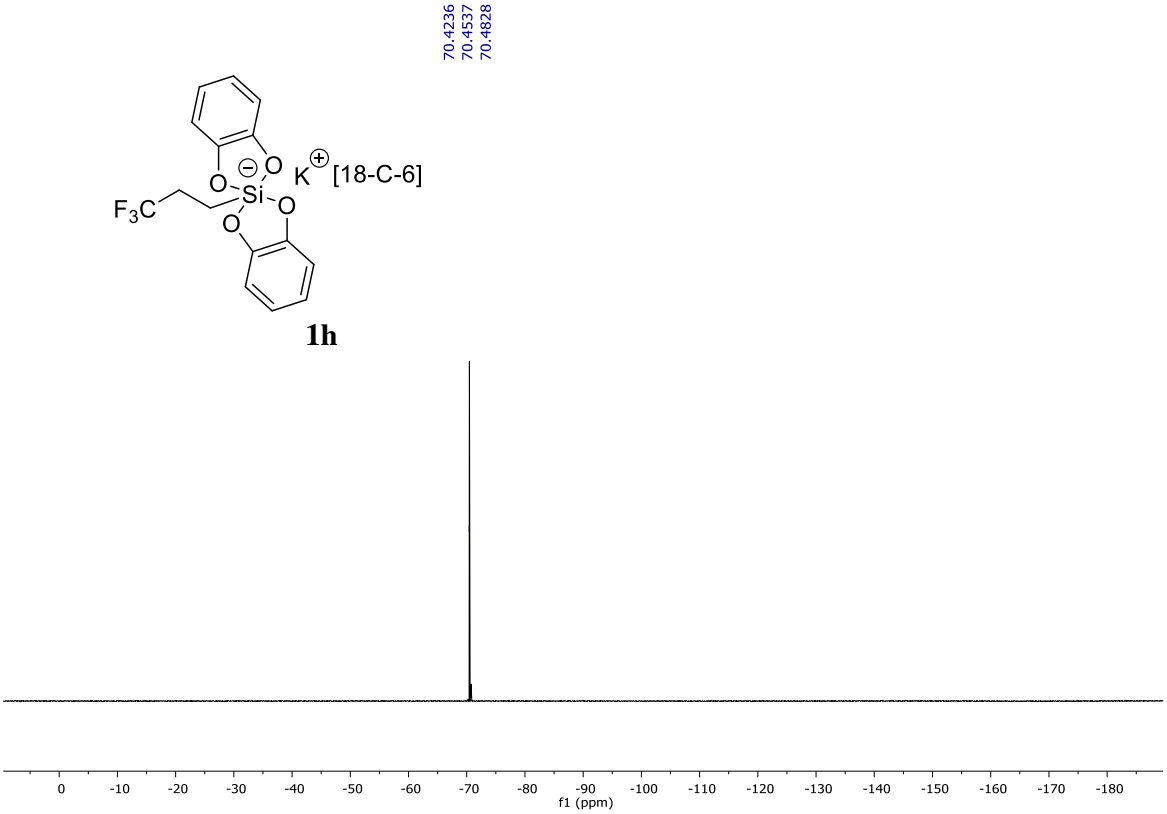
^{13}C spectrum of 1h



^{29}Si spectrum of 1h

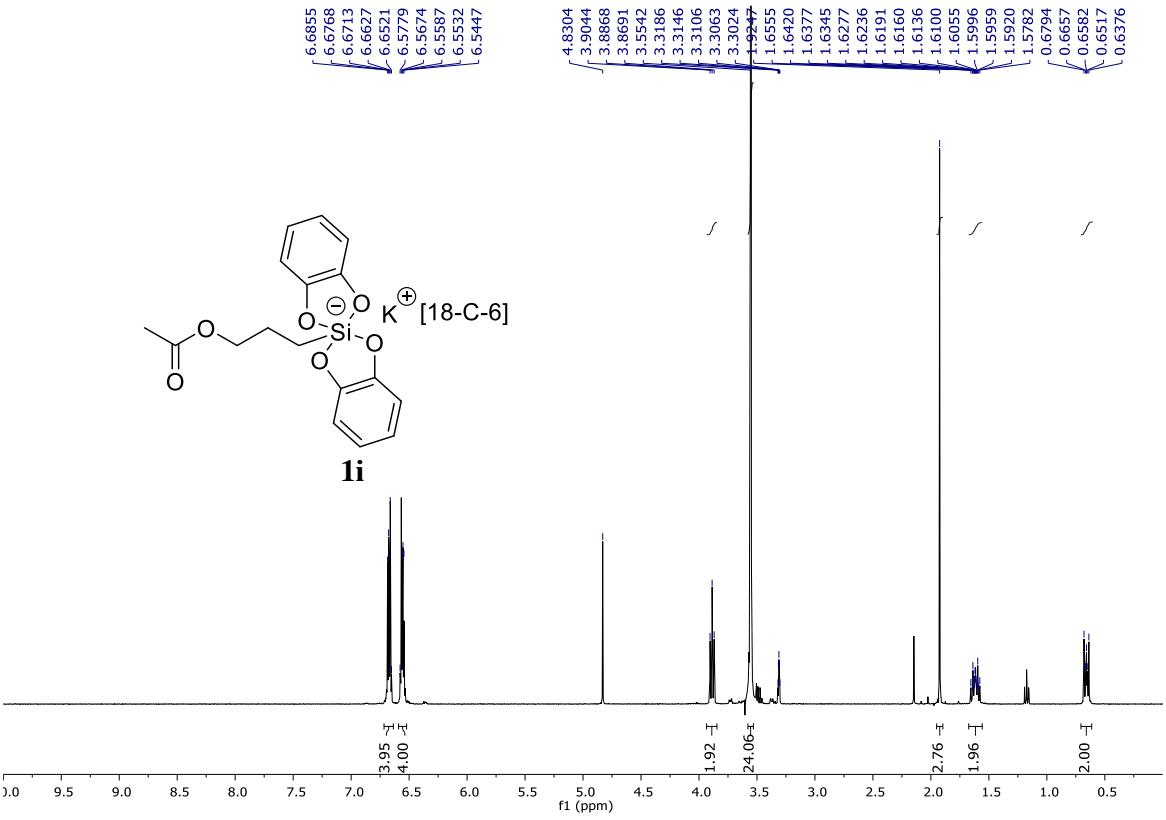


^{19}F spectrum of 1h



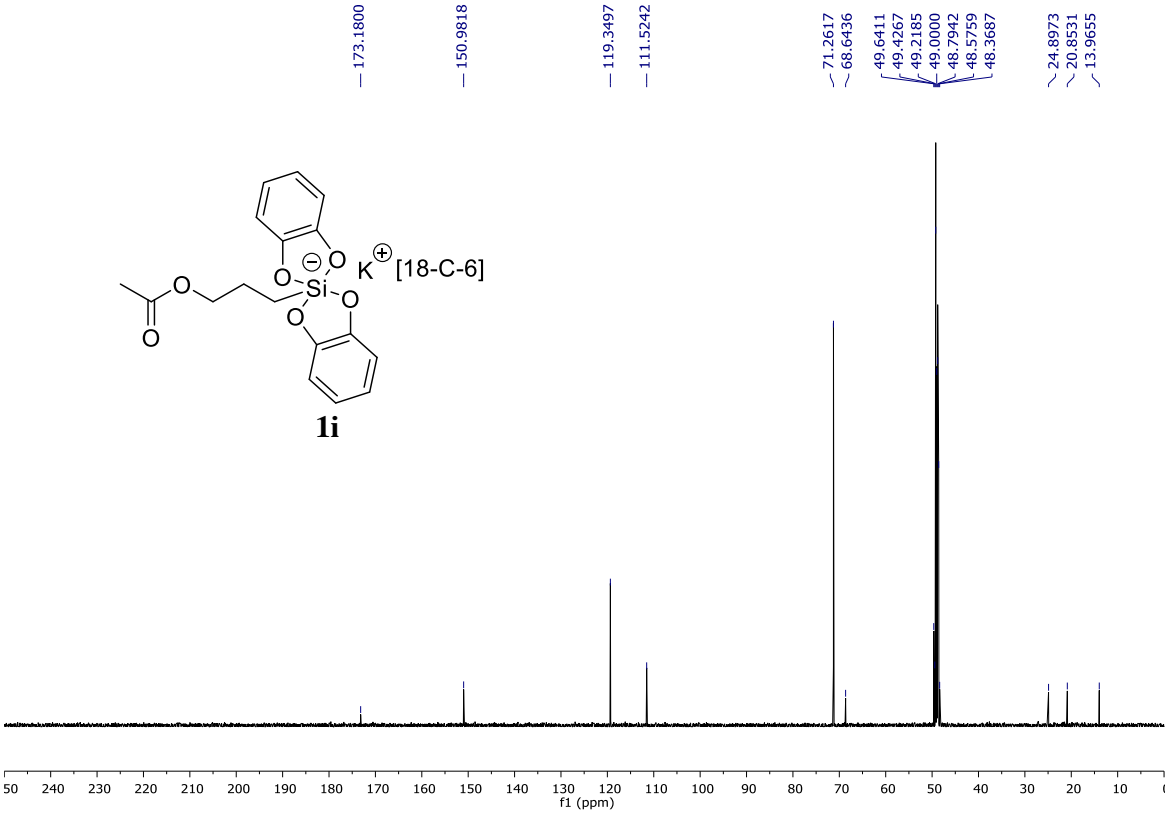
1h

^{1}H spectrum of 1i



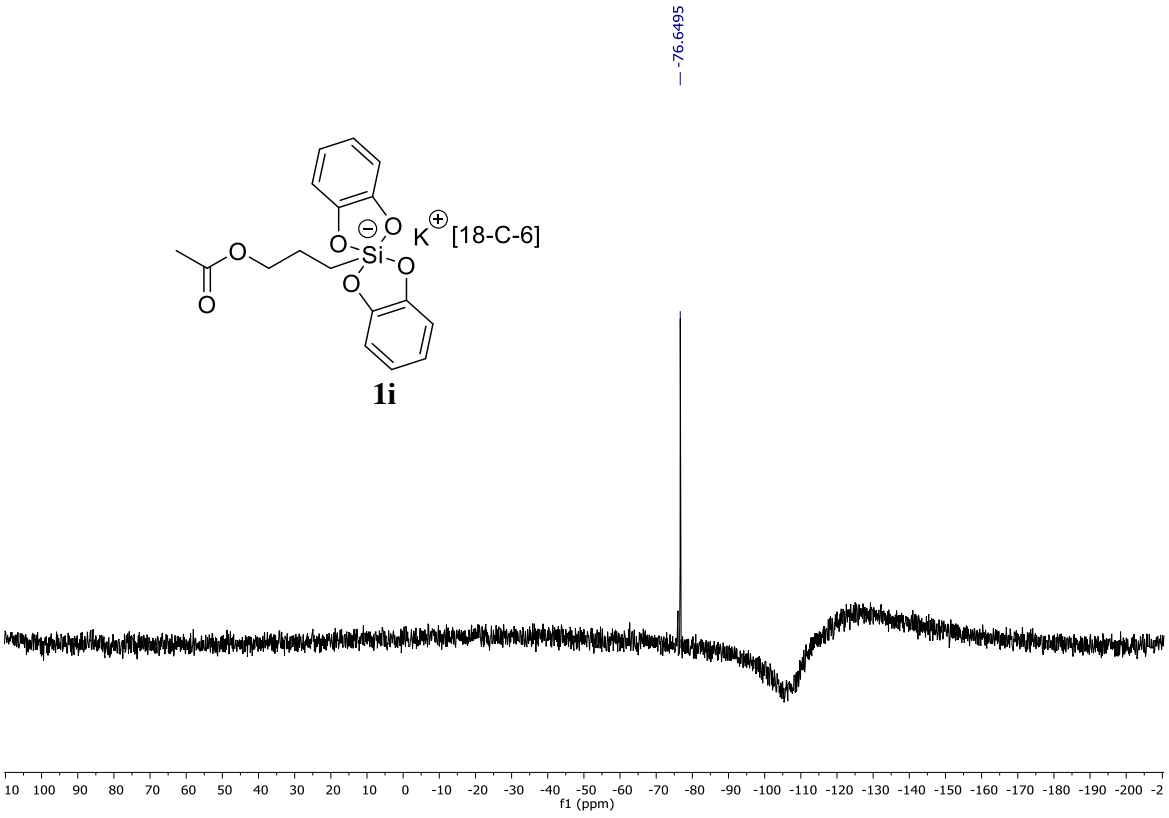
1i

^{13}C spectrum of 1i



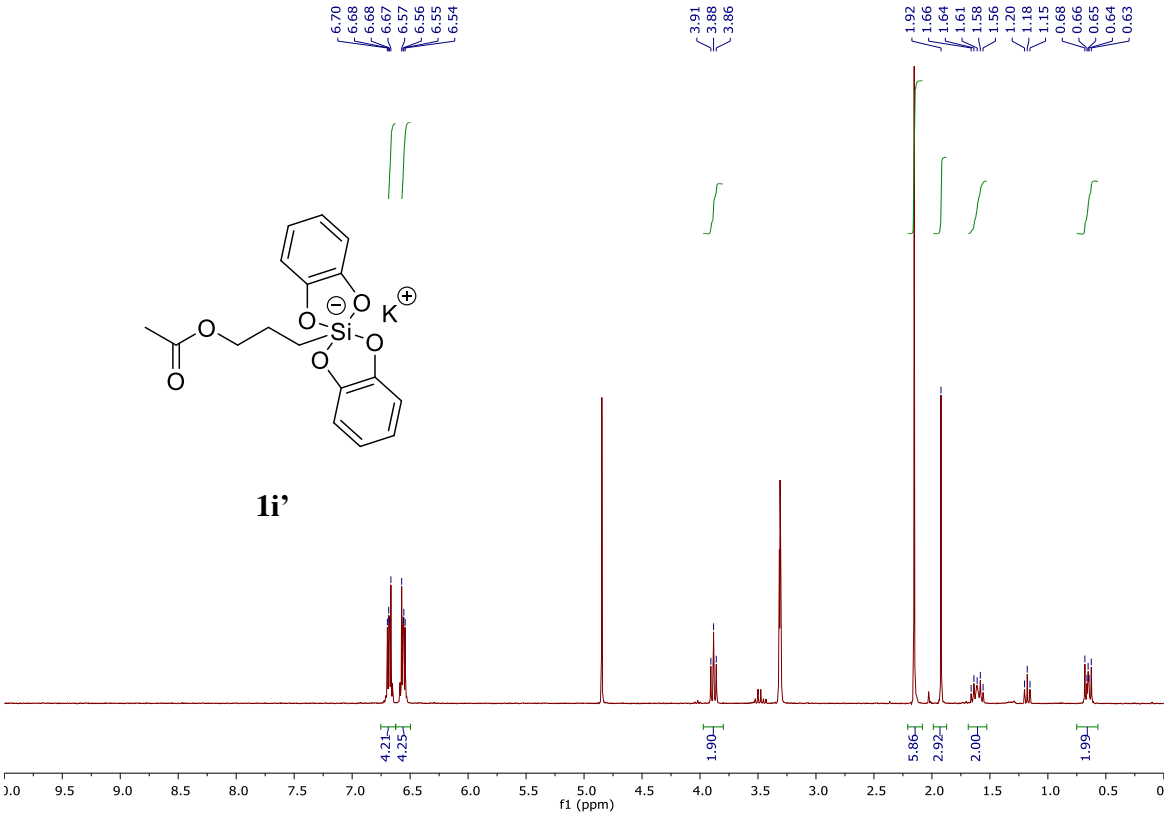
1i

^{29}Si spectrum of 1i



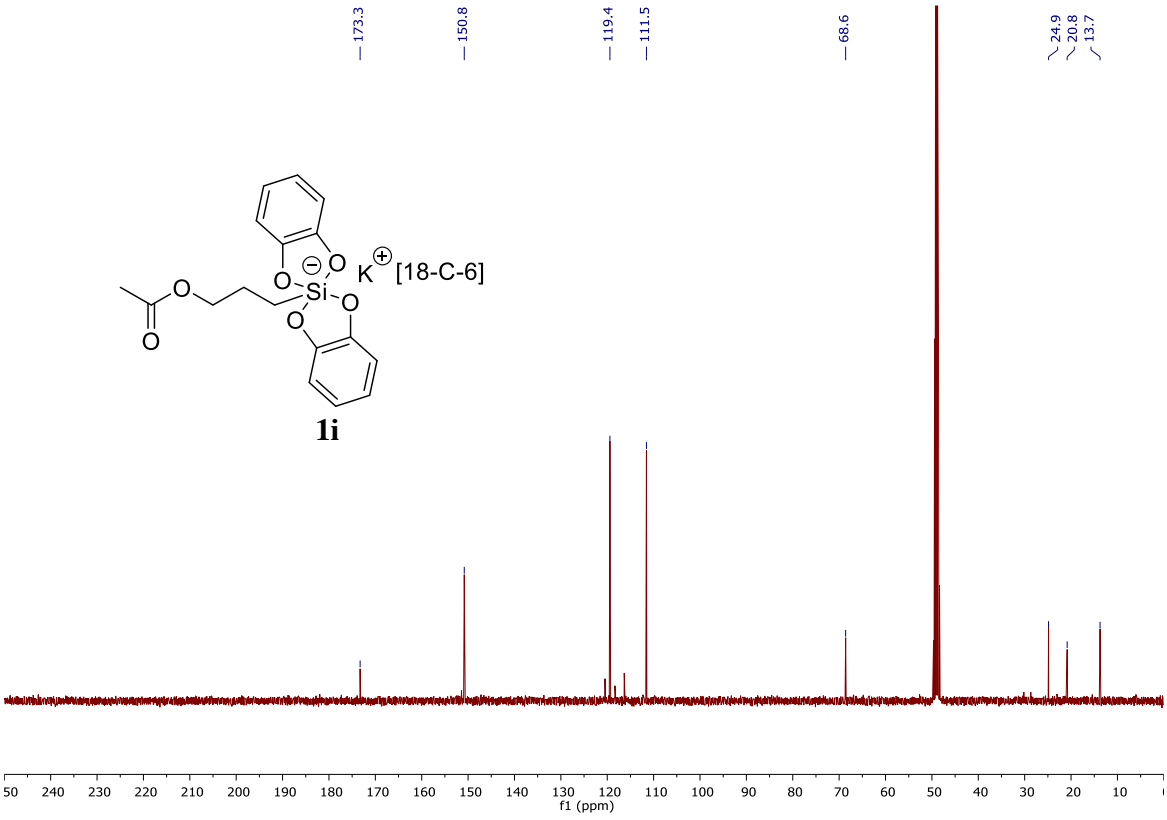
1i

^{1}H spectrum of 1i'



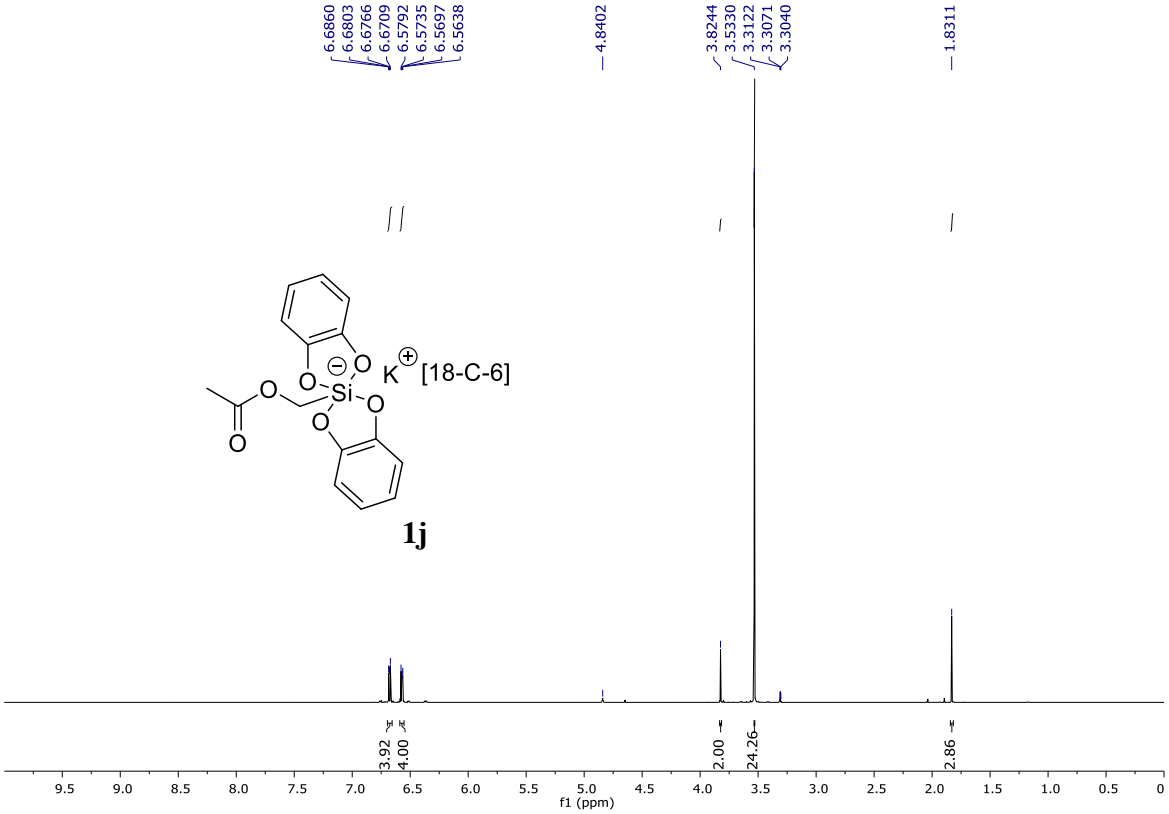
1i'

^{13}C spectrum of 1i'

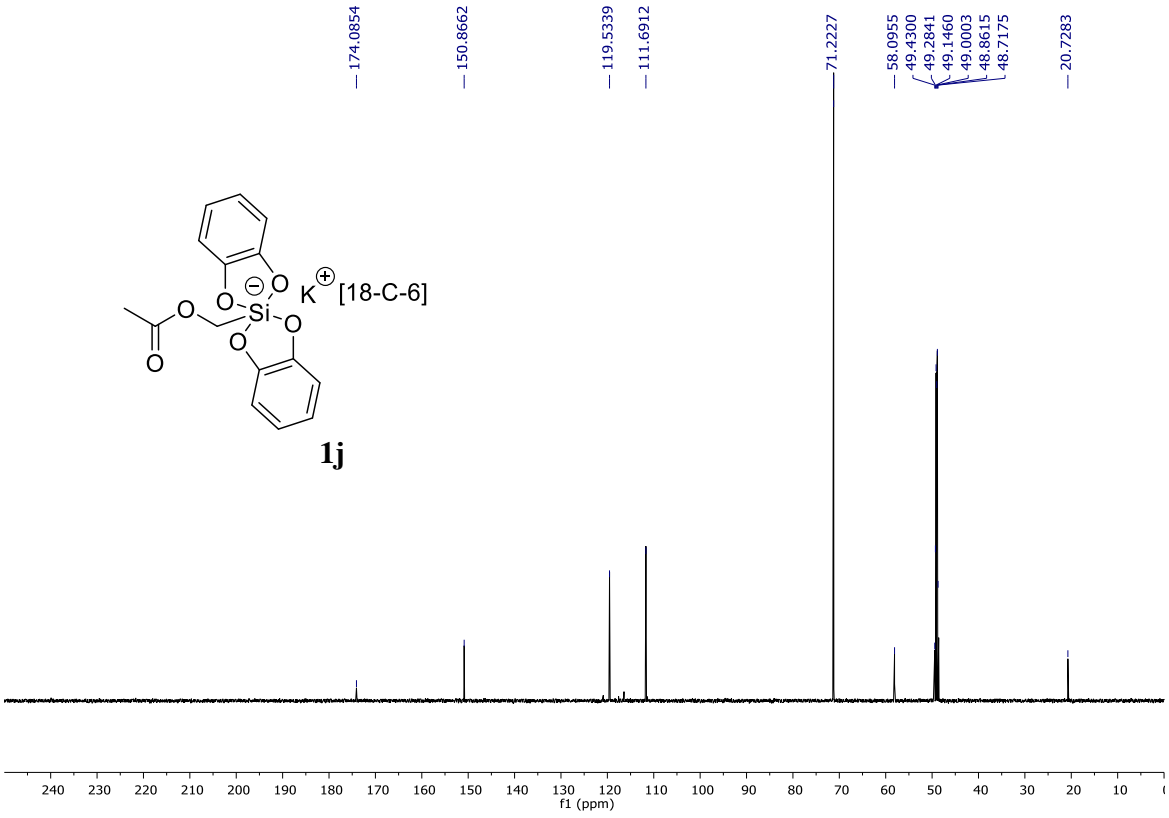


1i

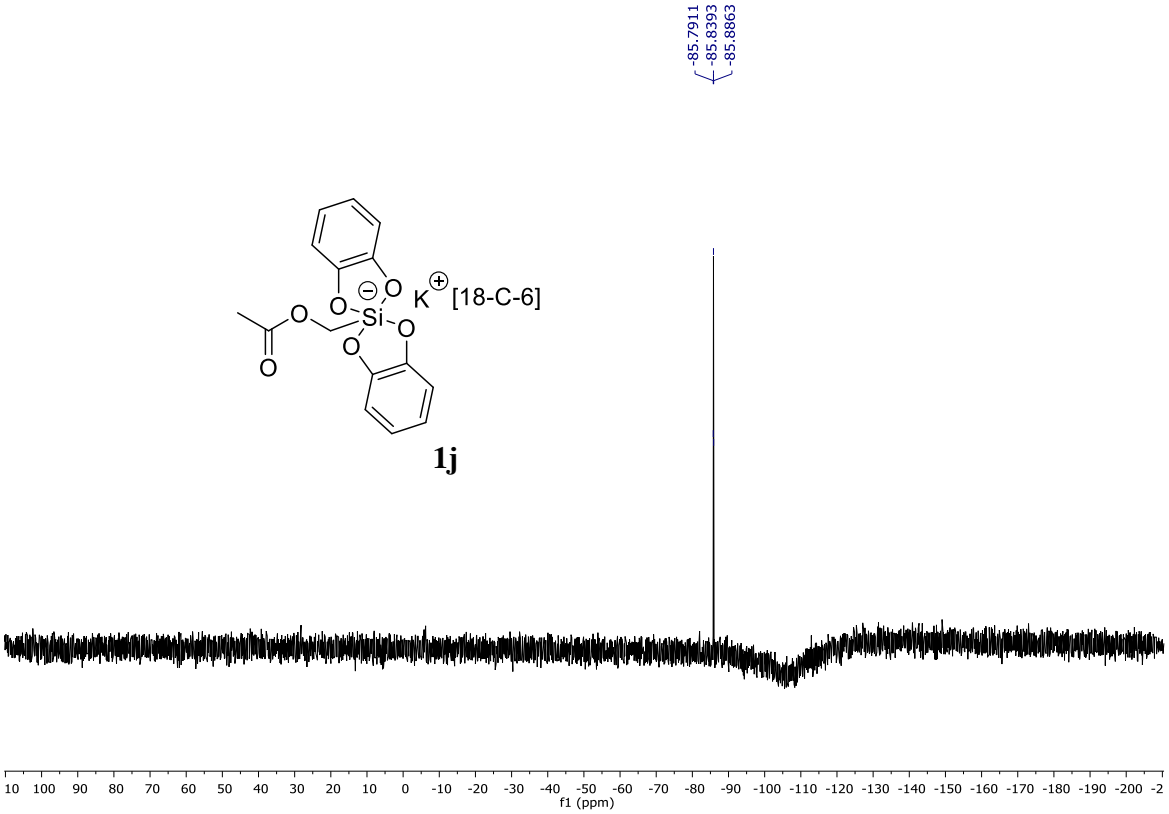
^{1}H spectrum of 1j



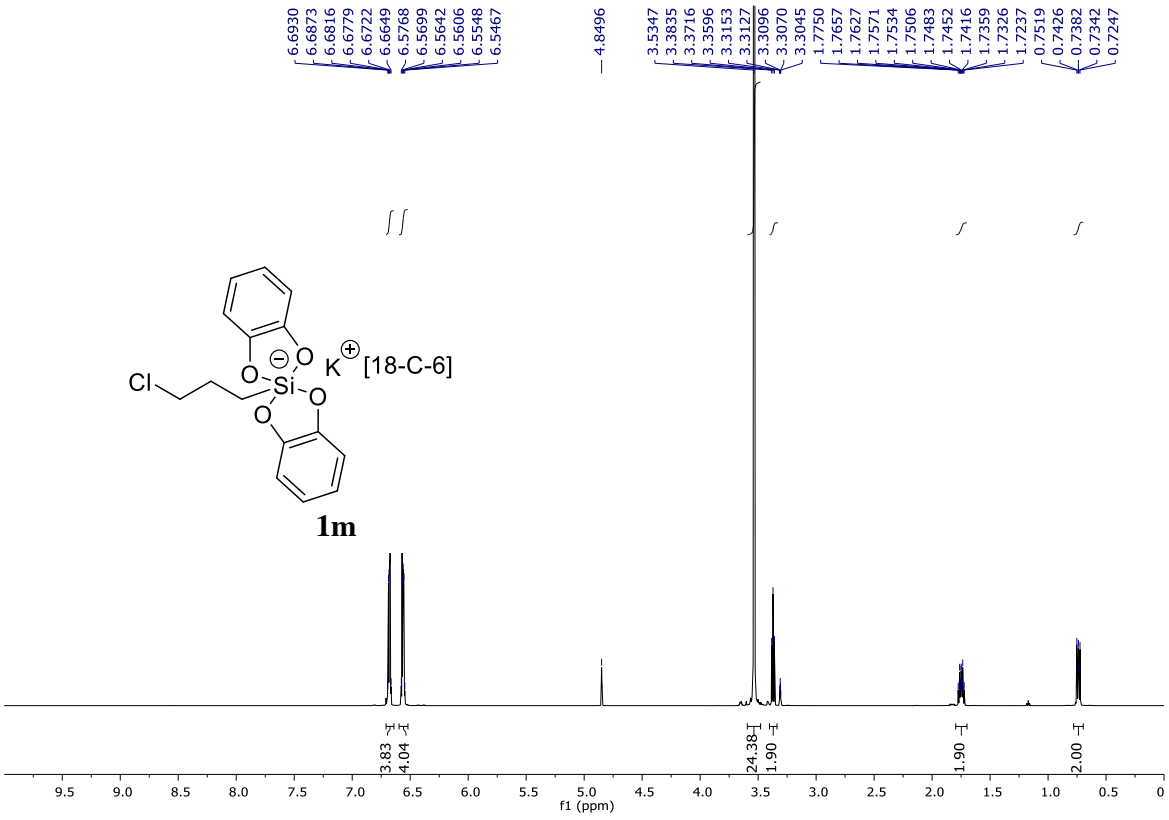
^{13}C spectrum of 1j



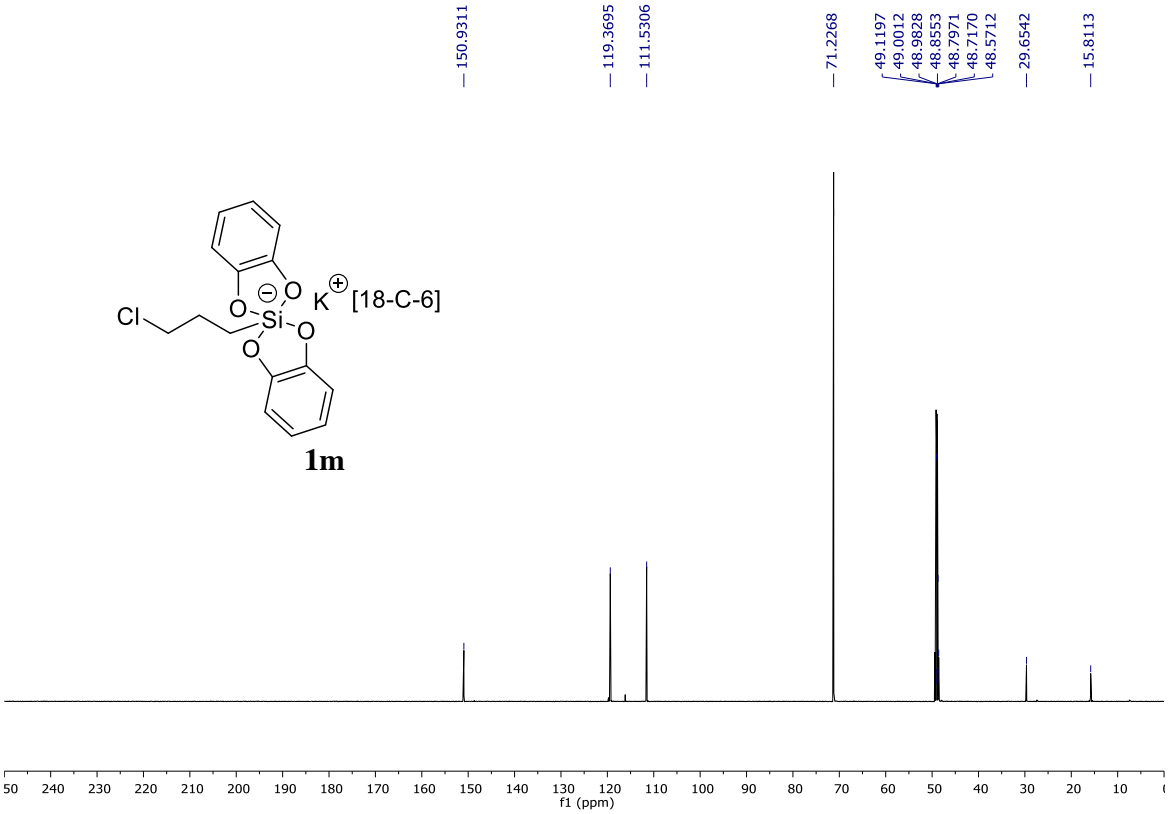
^{29}Si spectrum of 1j



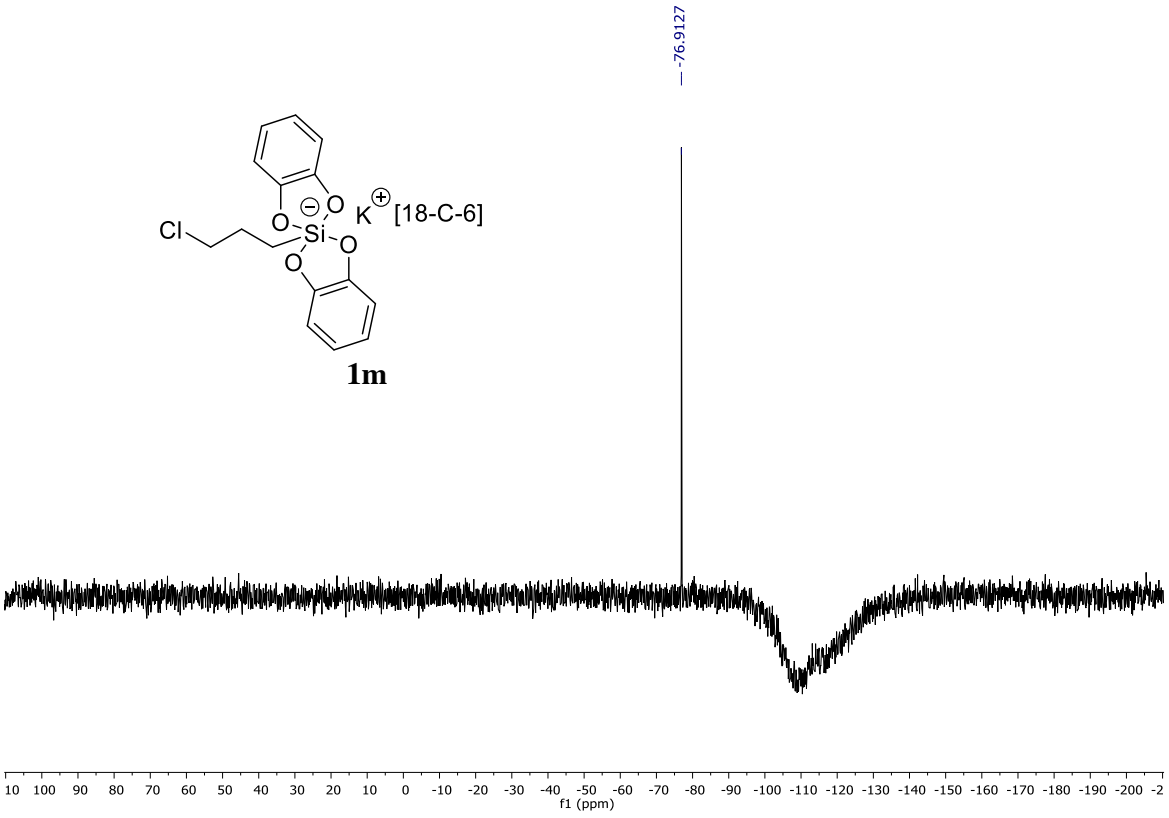
^{1}H spectrum of 1m



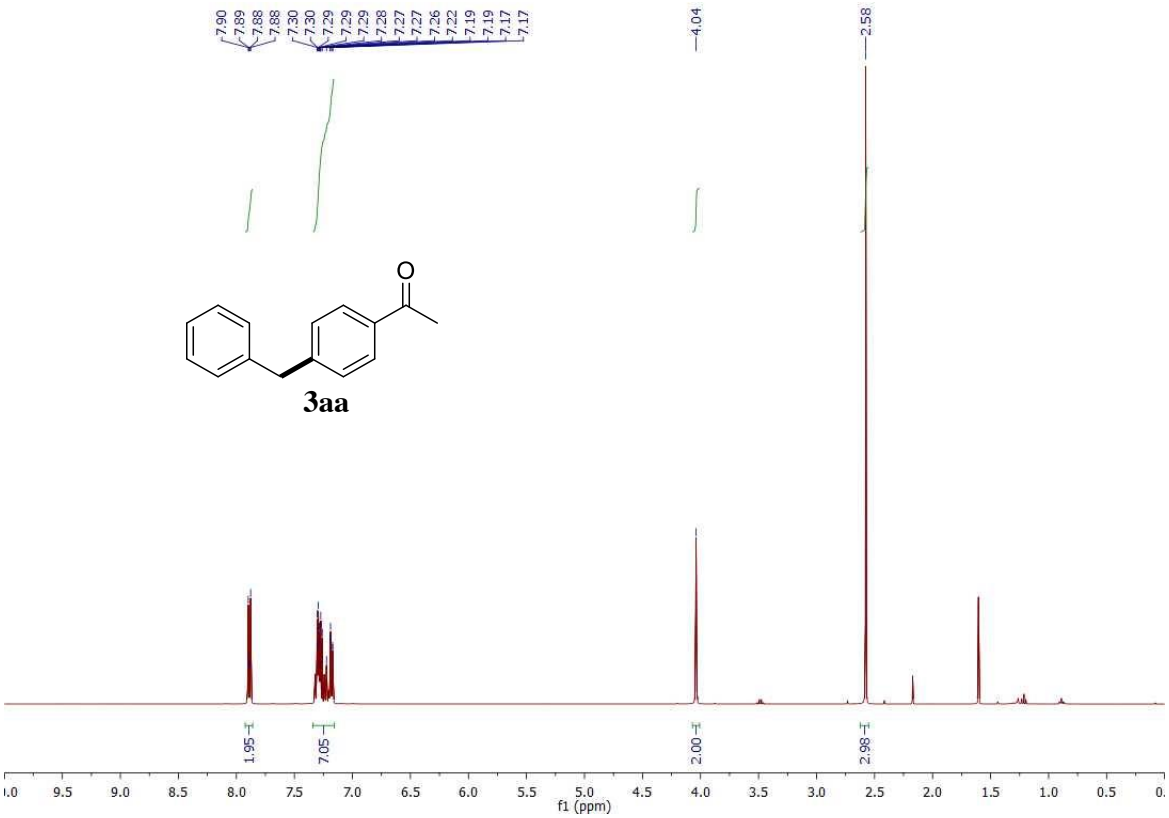
^{13}C spectrum of 1m



^{29}Si spectrum of 1m

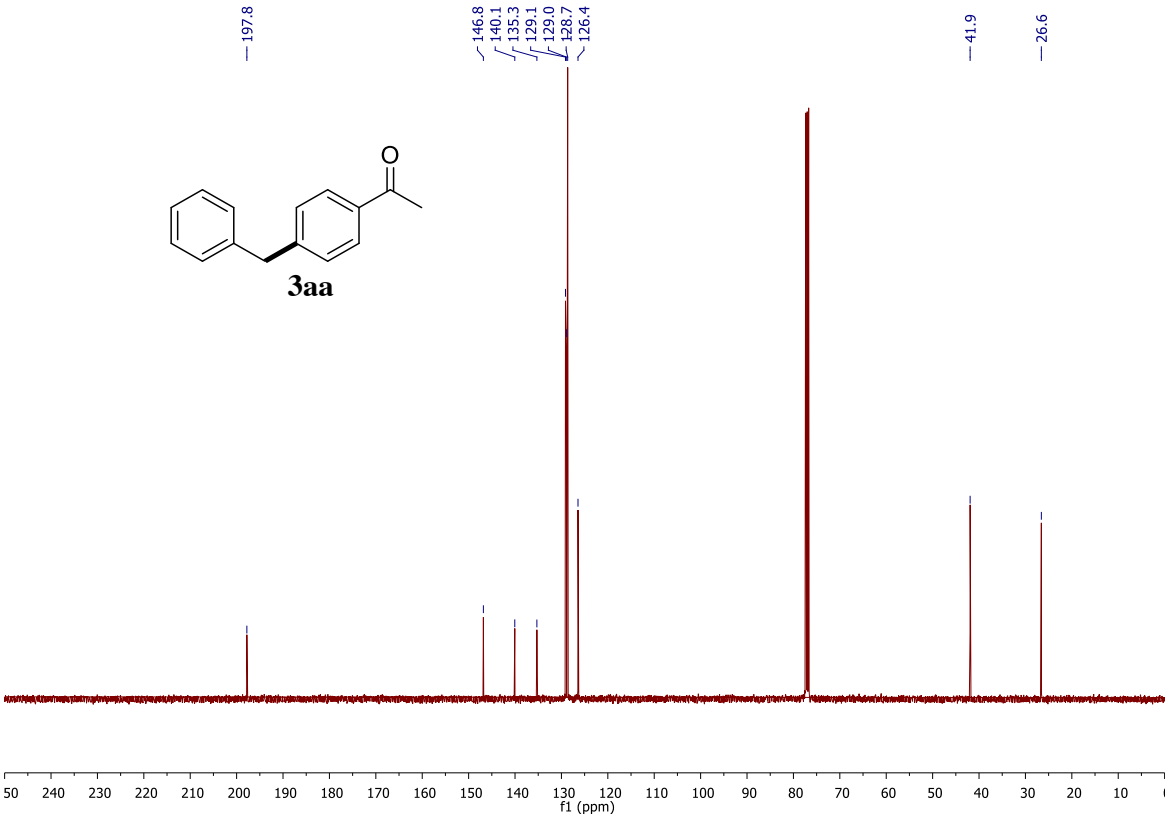


^{1}H spectrum of 3aa



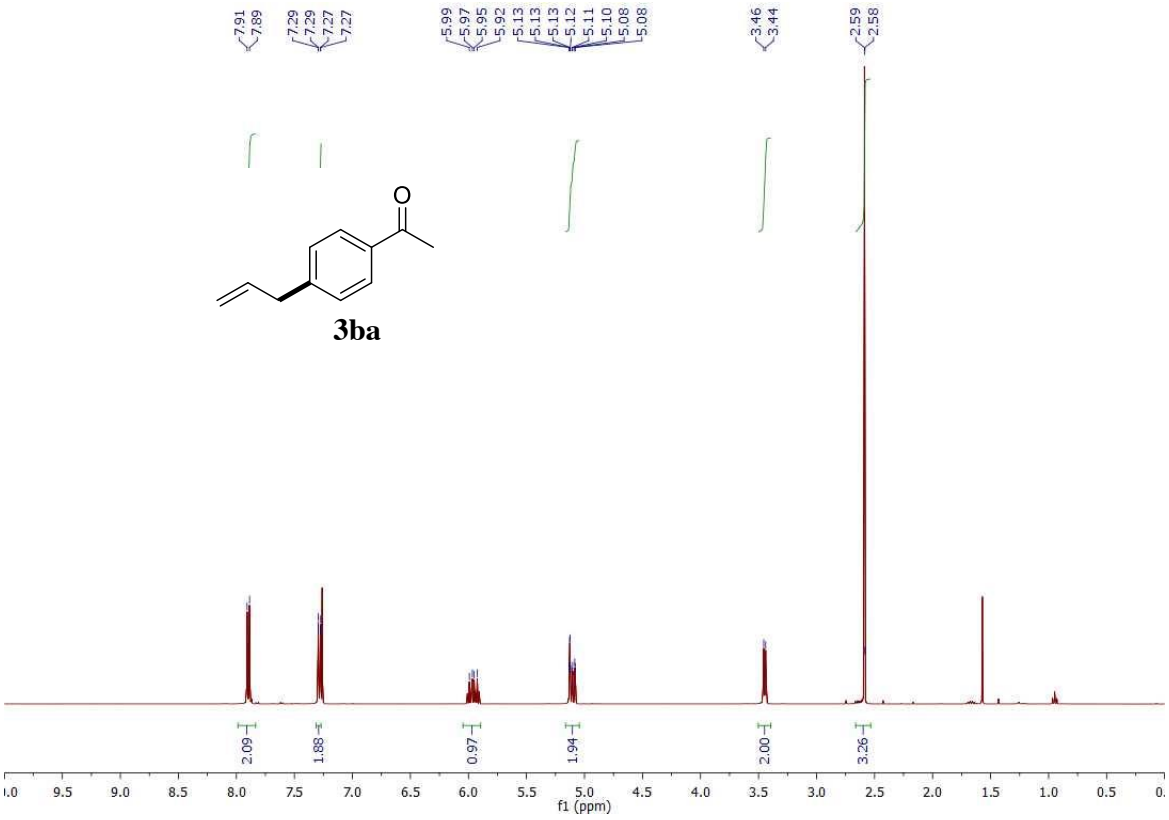
3aa

^{13}C spectrum of 3aa

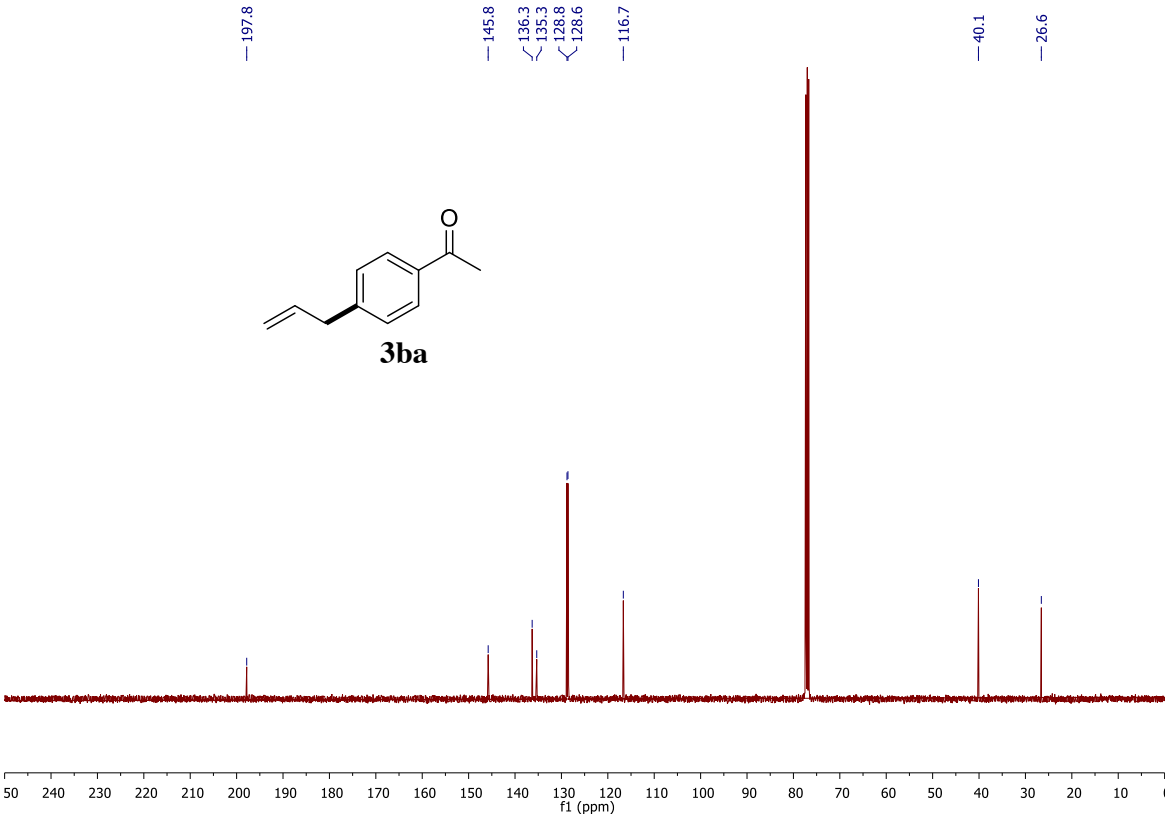


3aa

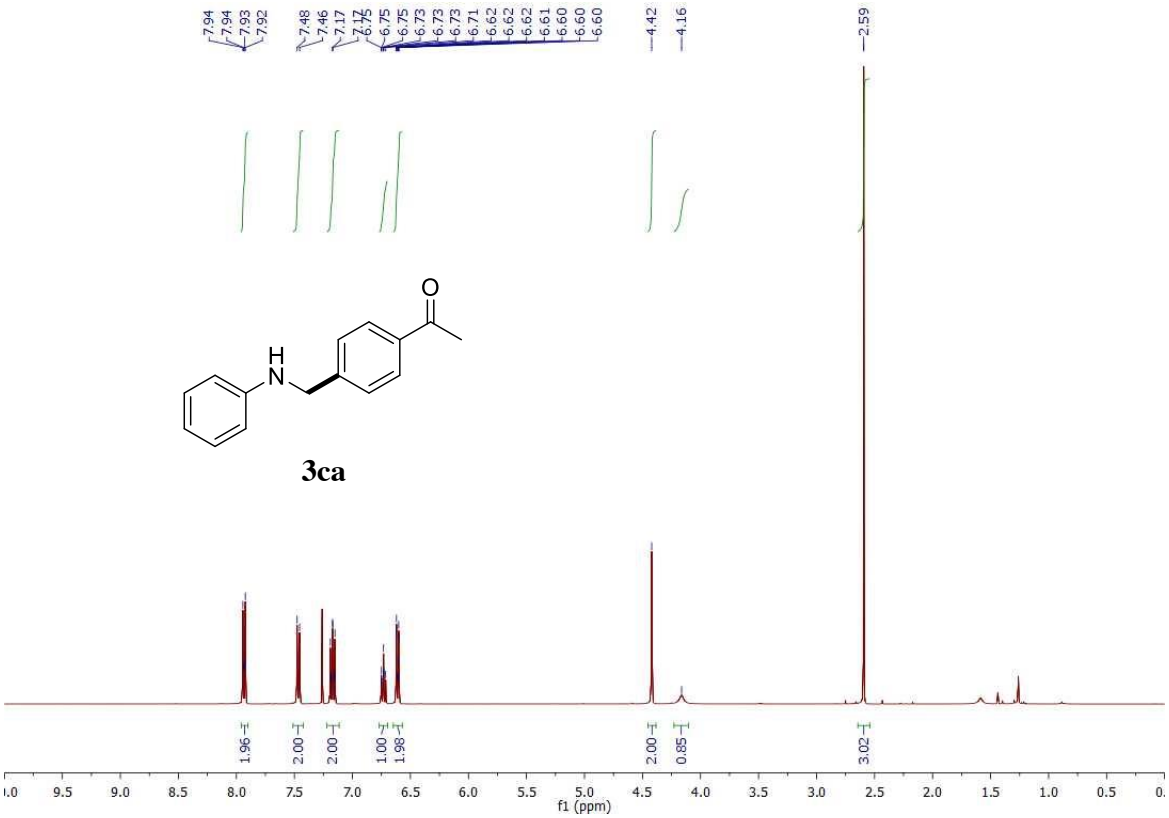
^{1}H spectrum of 3ba



^{13}C spectrum of 3ba

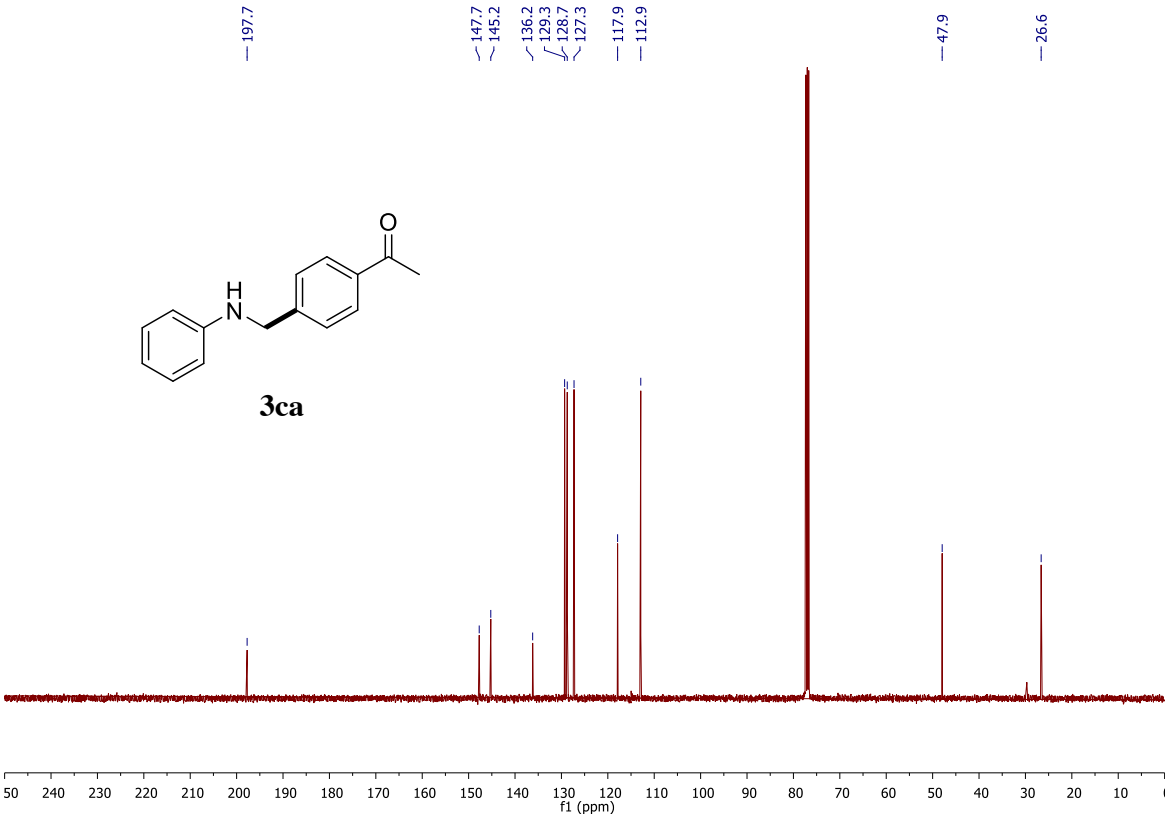


^{1}H spectrum of 3ca



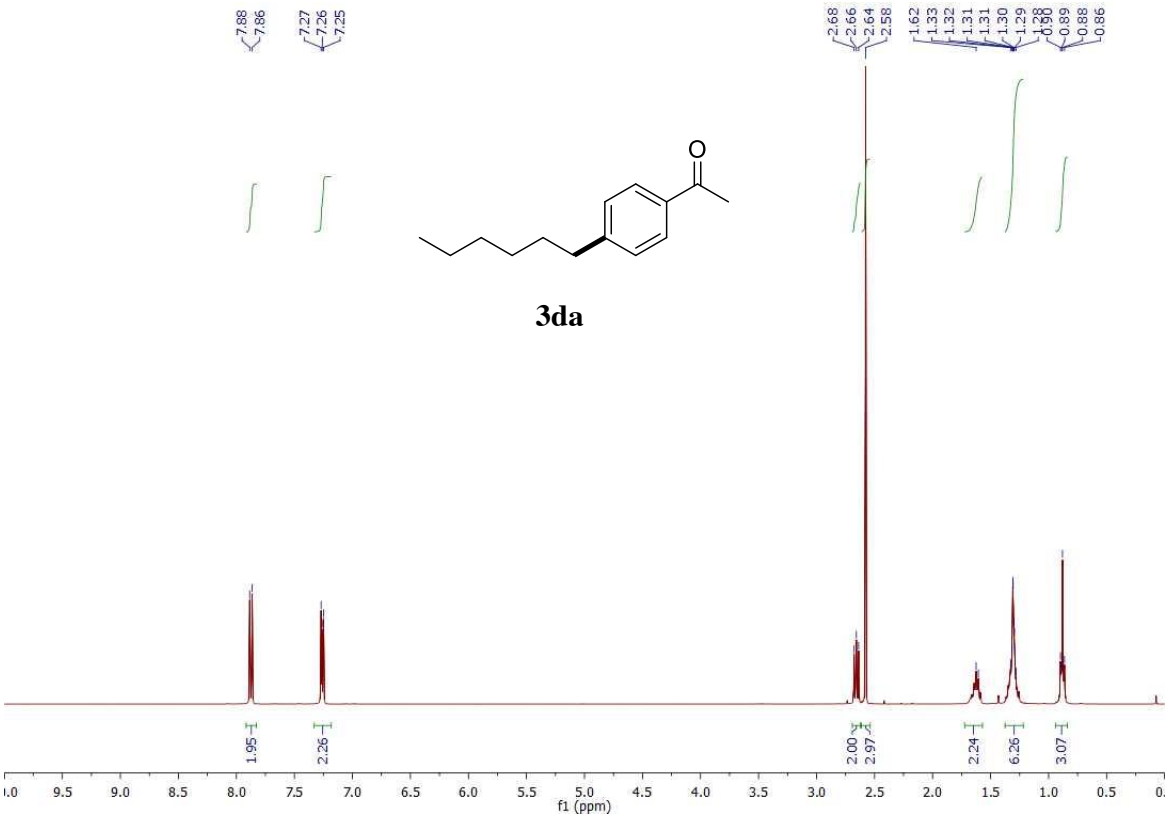
3ca

^{13}C spectrum of 3ca



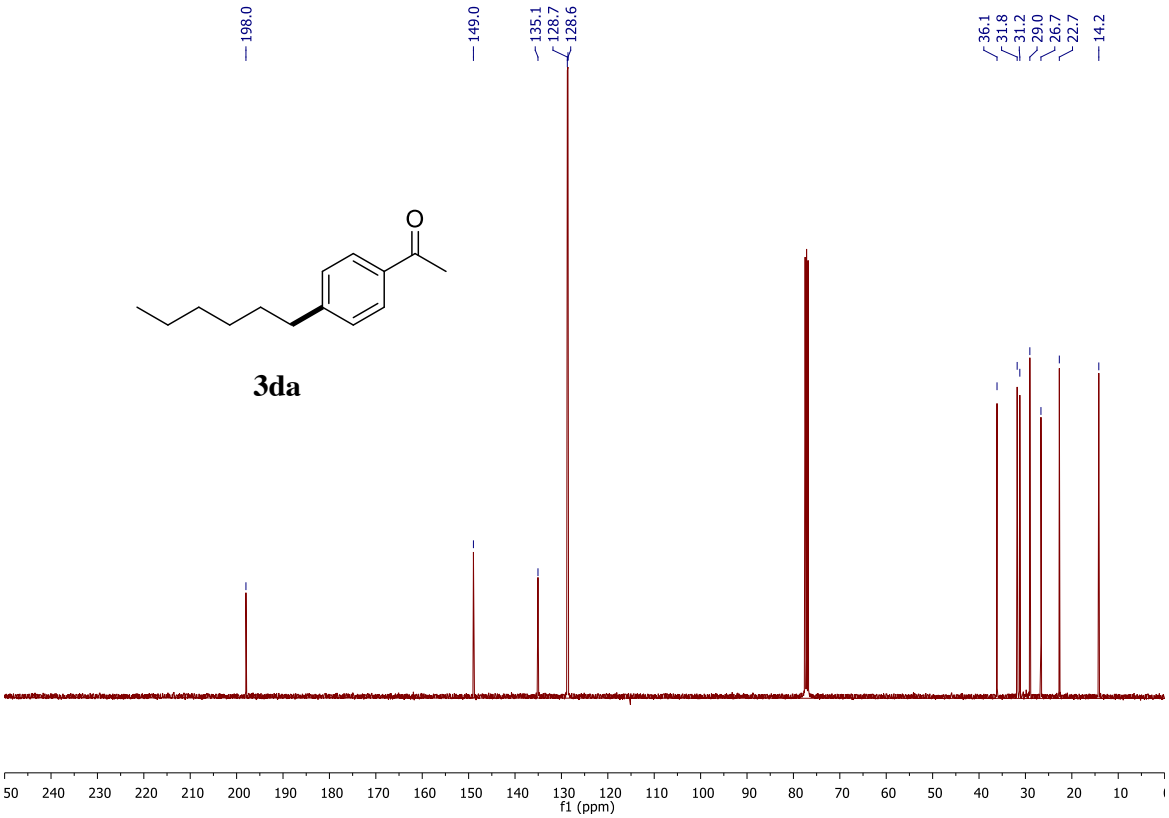
3ca

^{1}H spectrum of 3da



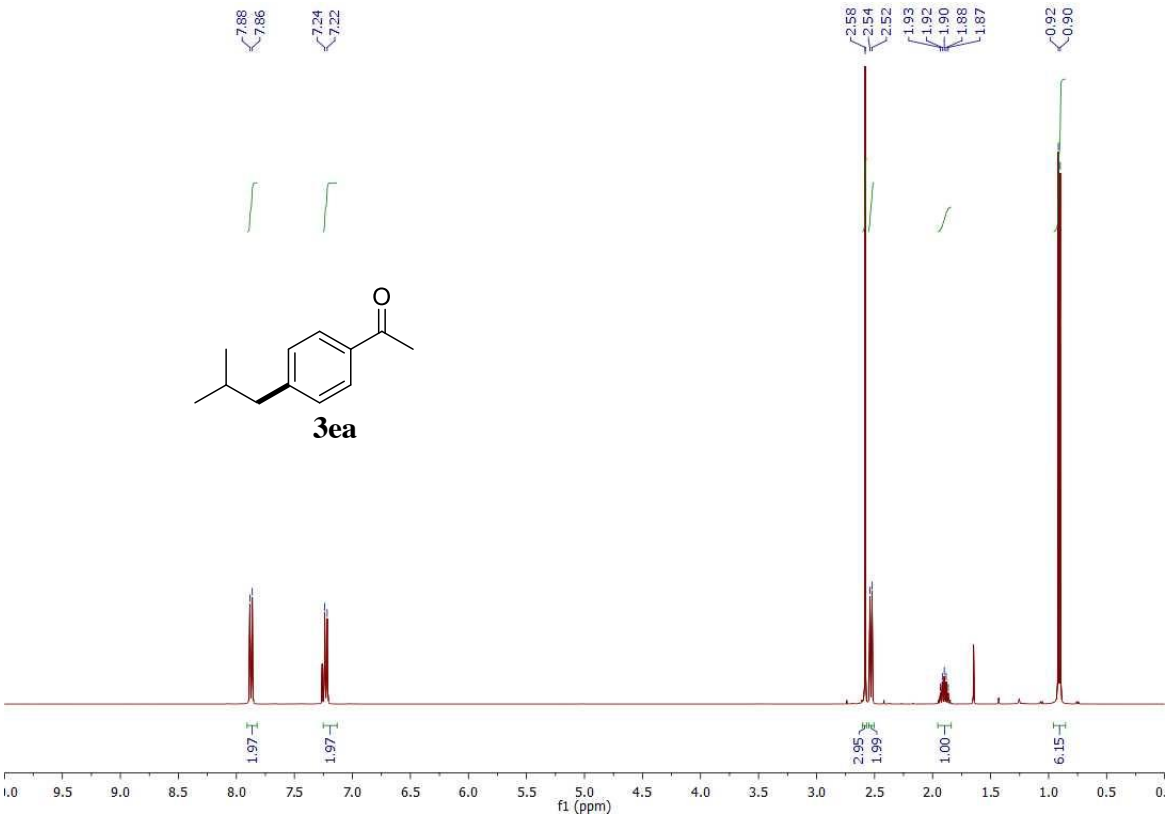
3da

^{13}C spectrum of 3da

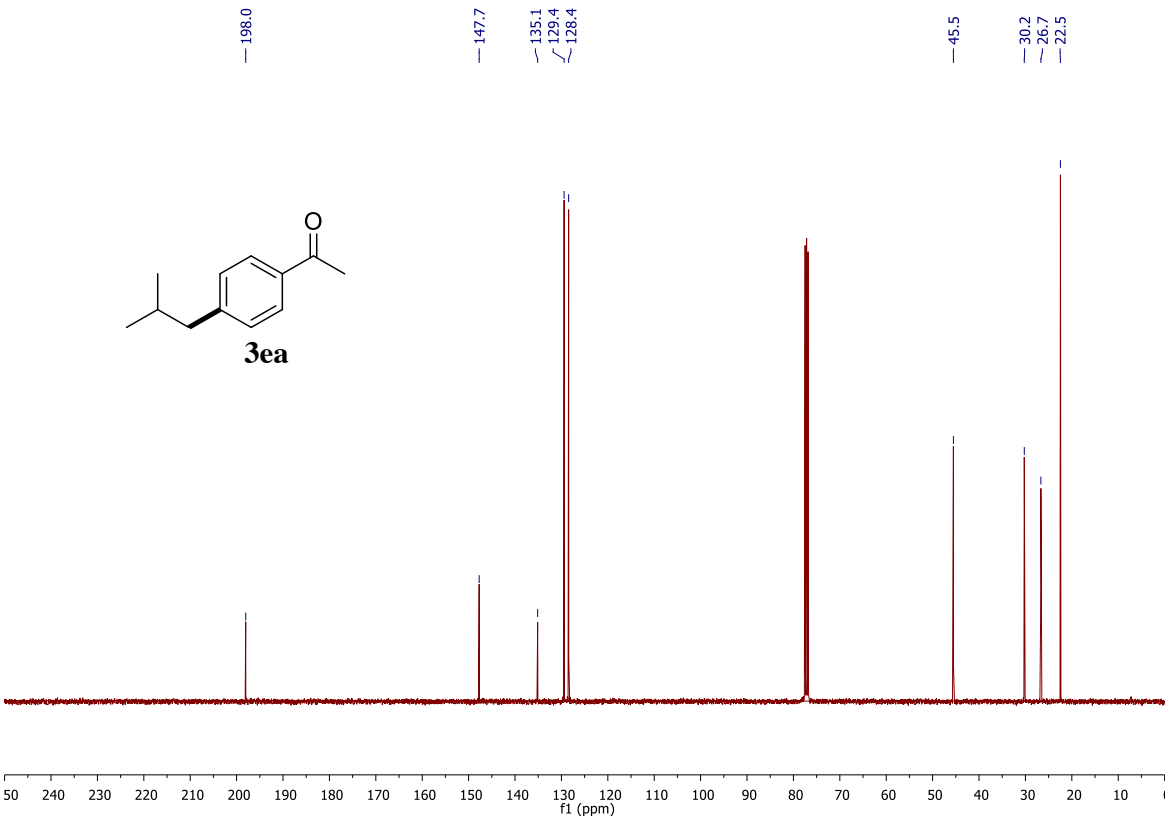


3da

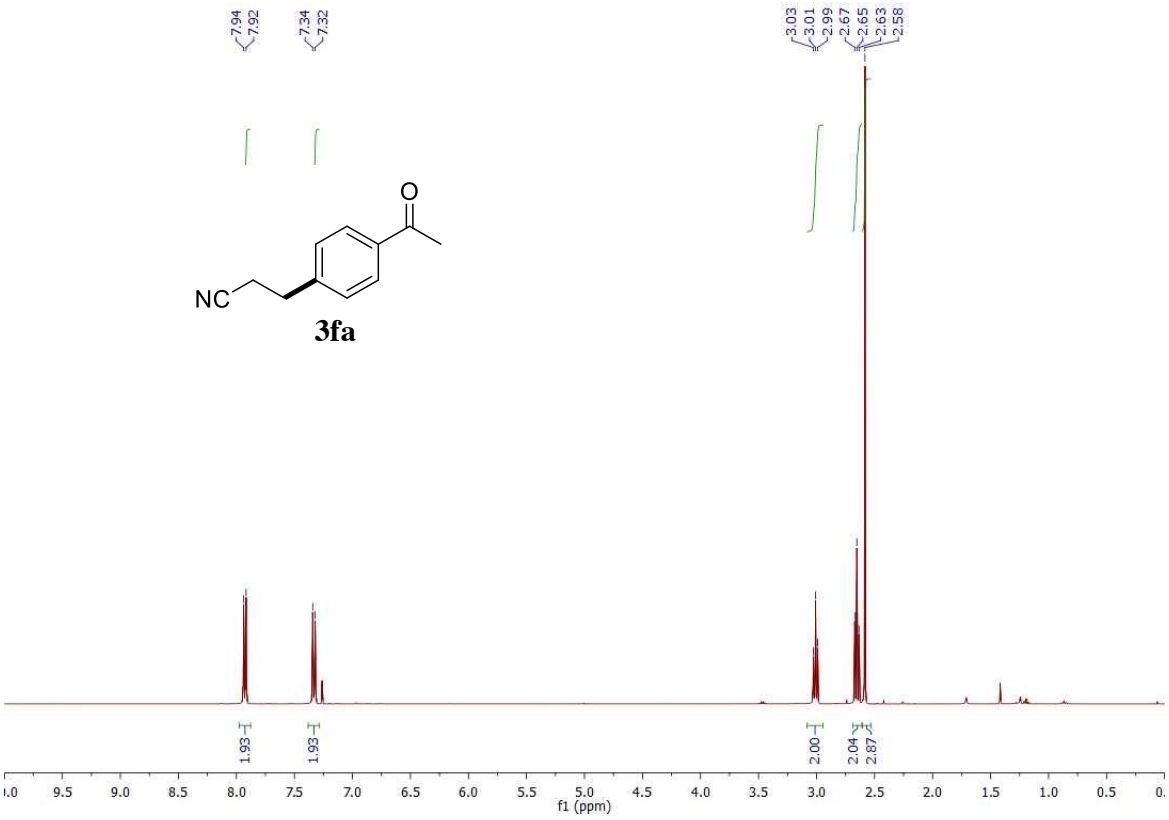
^{1}H spectrum of 3ea



^{13}C spectrum of 3ea

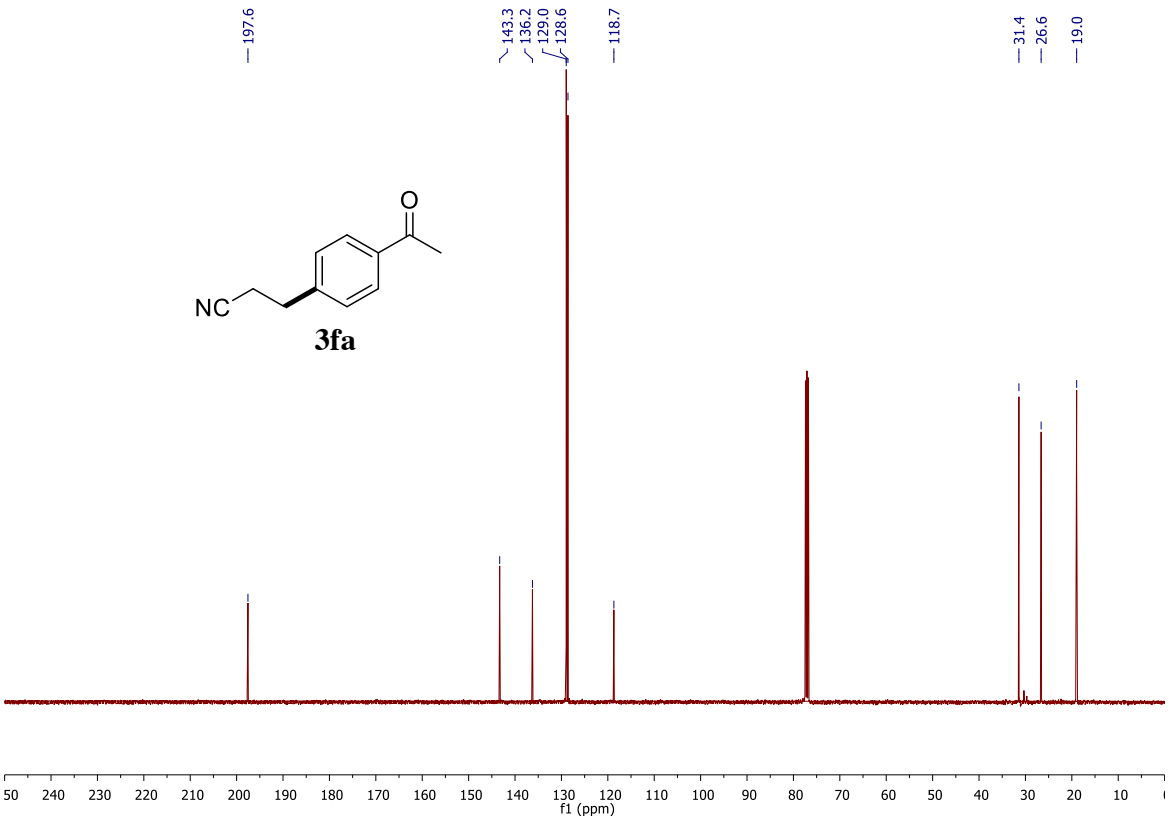


^{1}H spectrum of 3fa



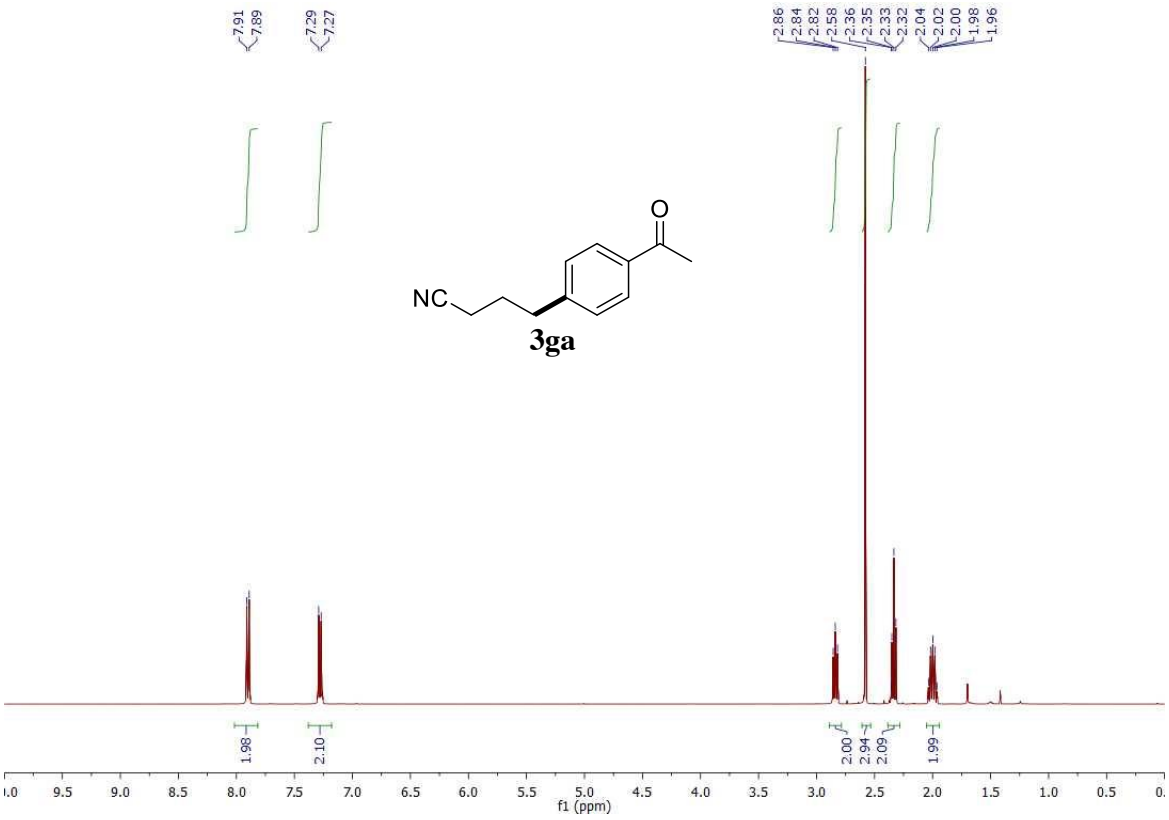
3fa

^{13}C spectrum of 3fa



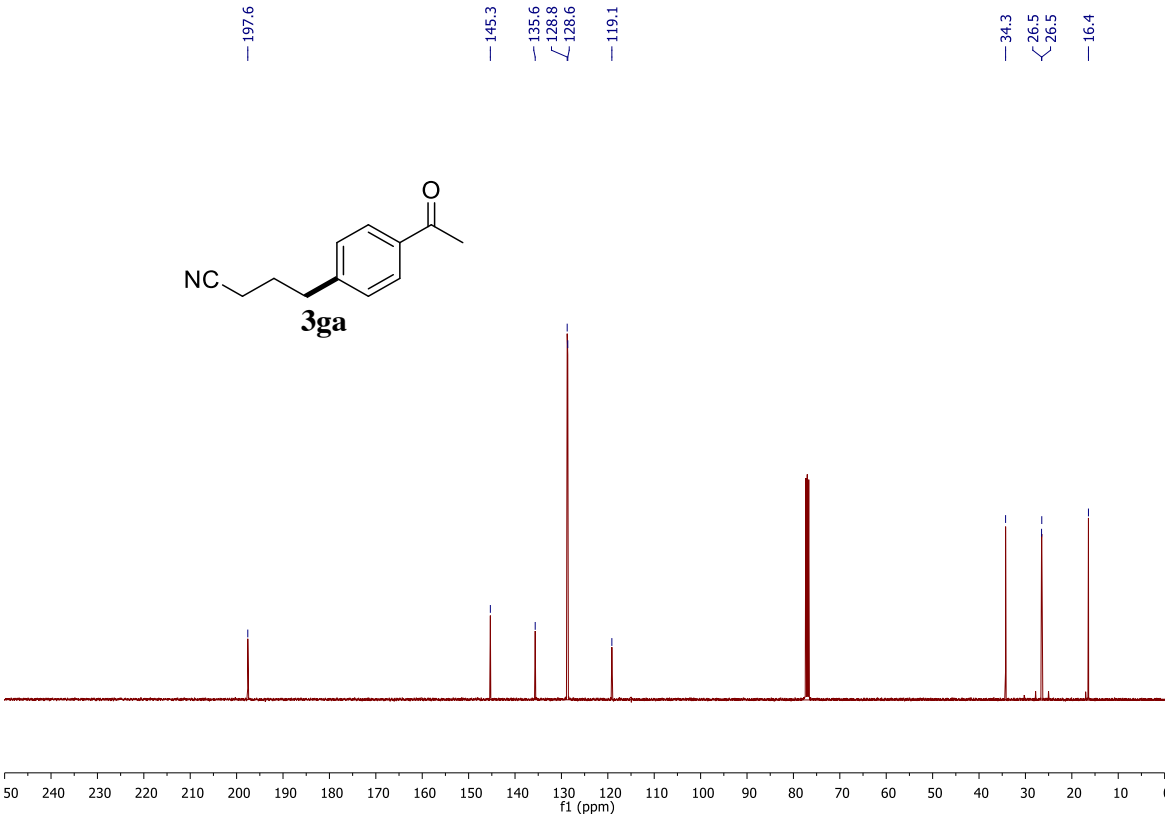
3fa

^{1}H spectrum of 3ga



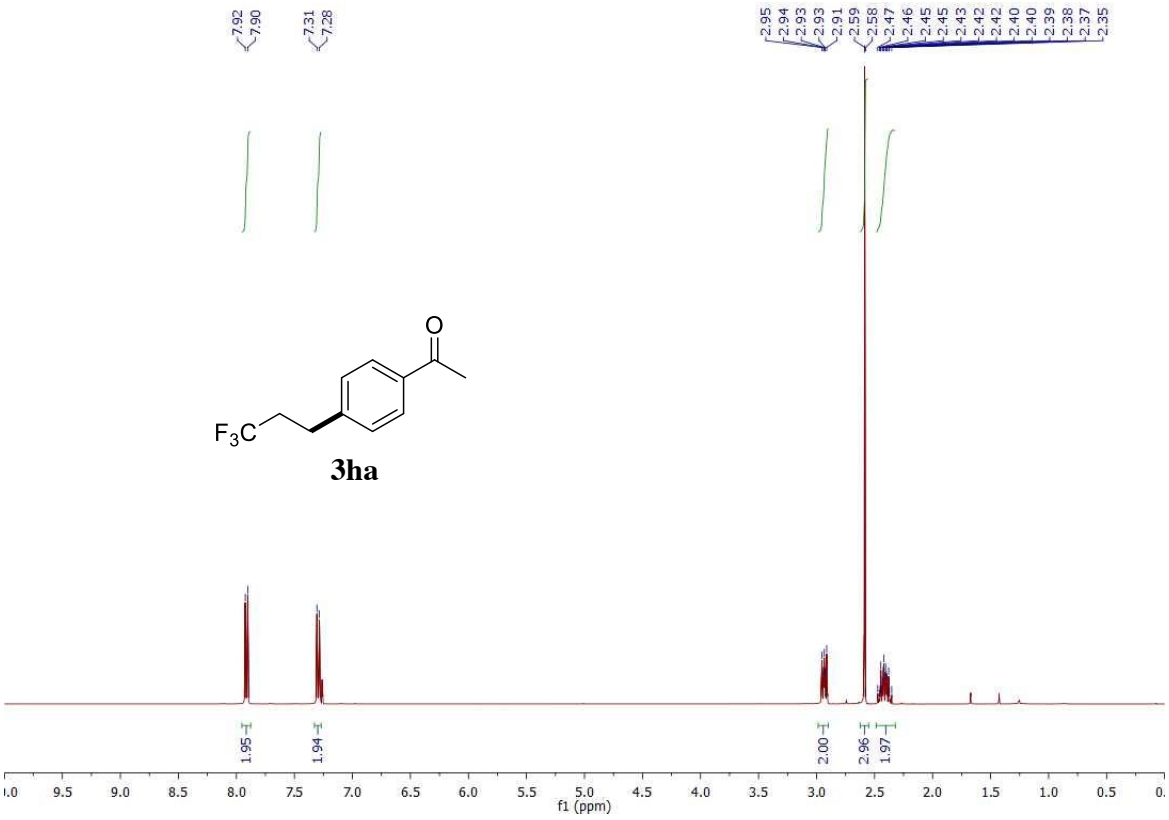
3ga

^{13}C spectrum of 3ga



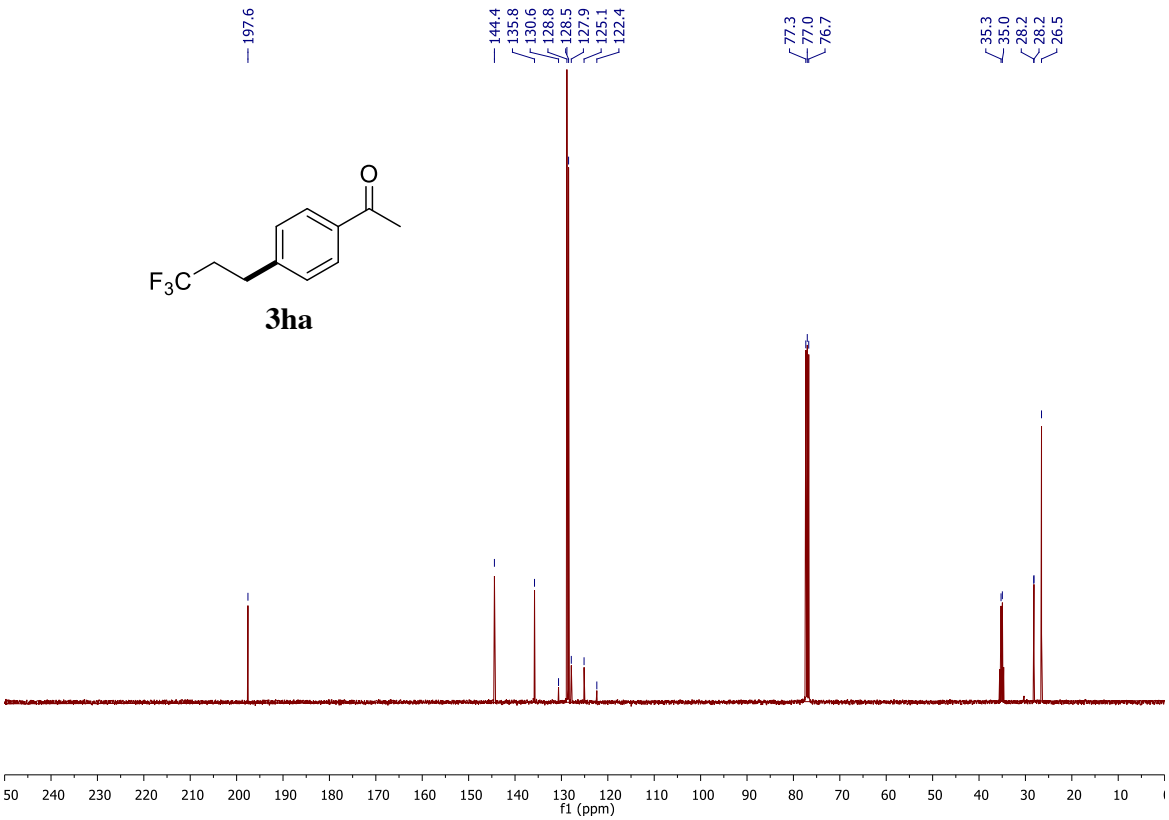
3ga

^{1}H spectrum of 3ha



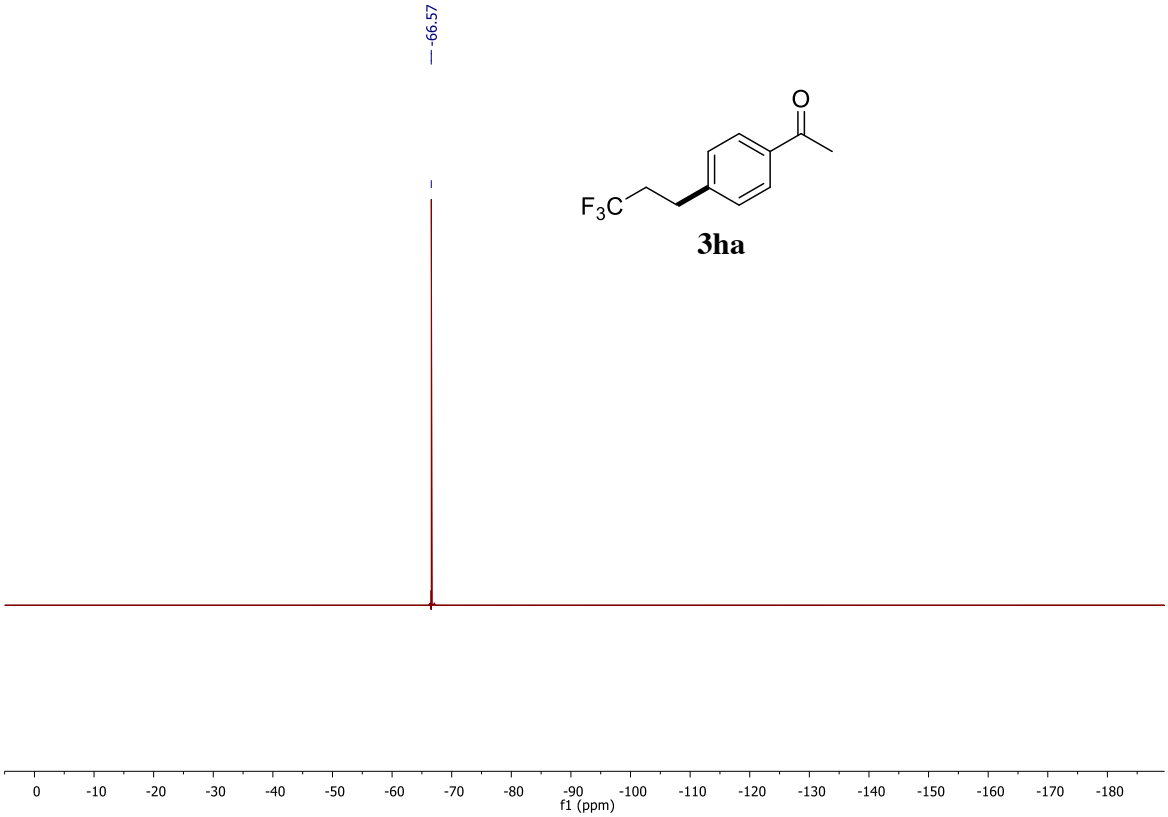
3ha

^{13}C spectrum of 3ha



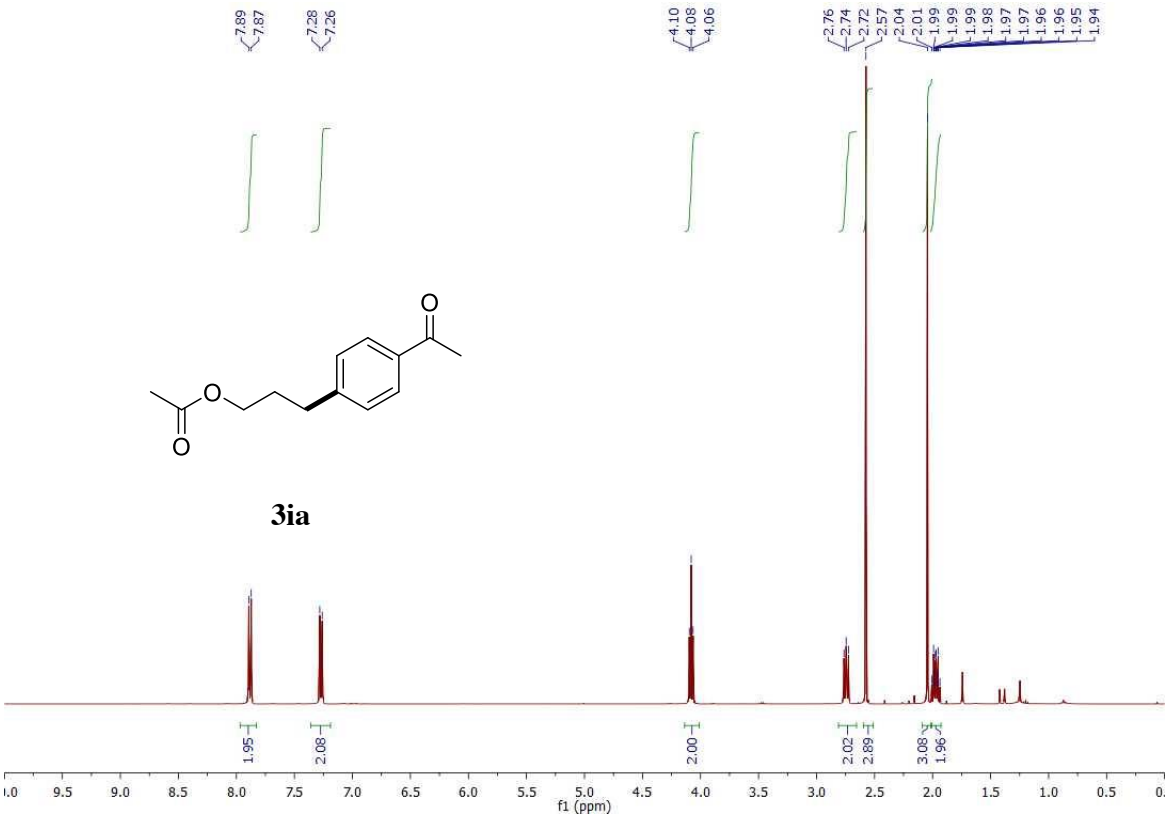
3ha

^{19}F spectrum of 3ha



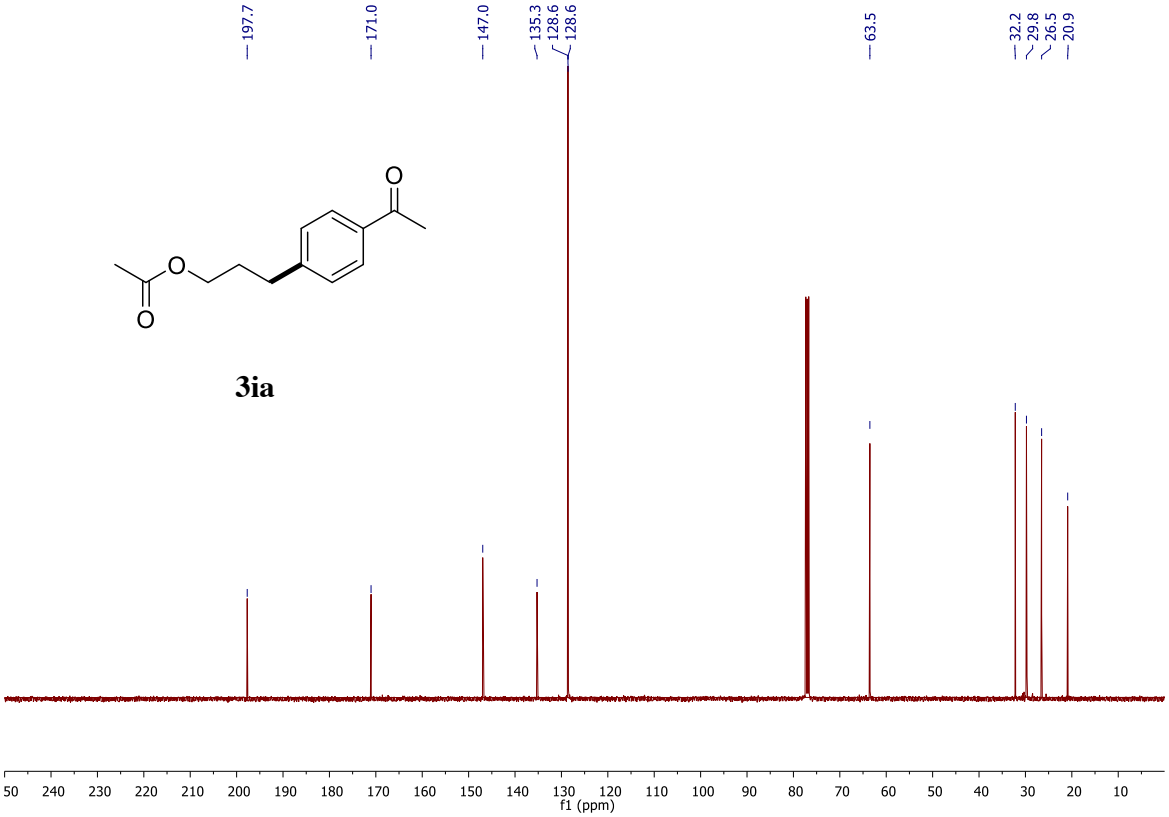
3ha

^{1}H spectrum of 3ia



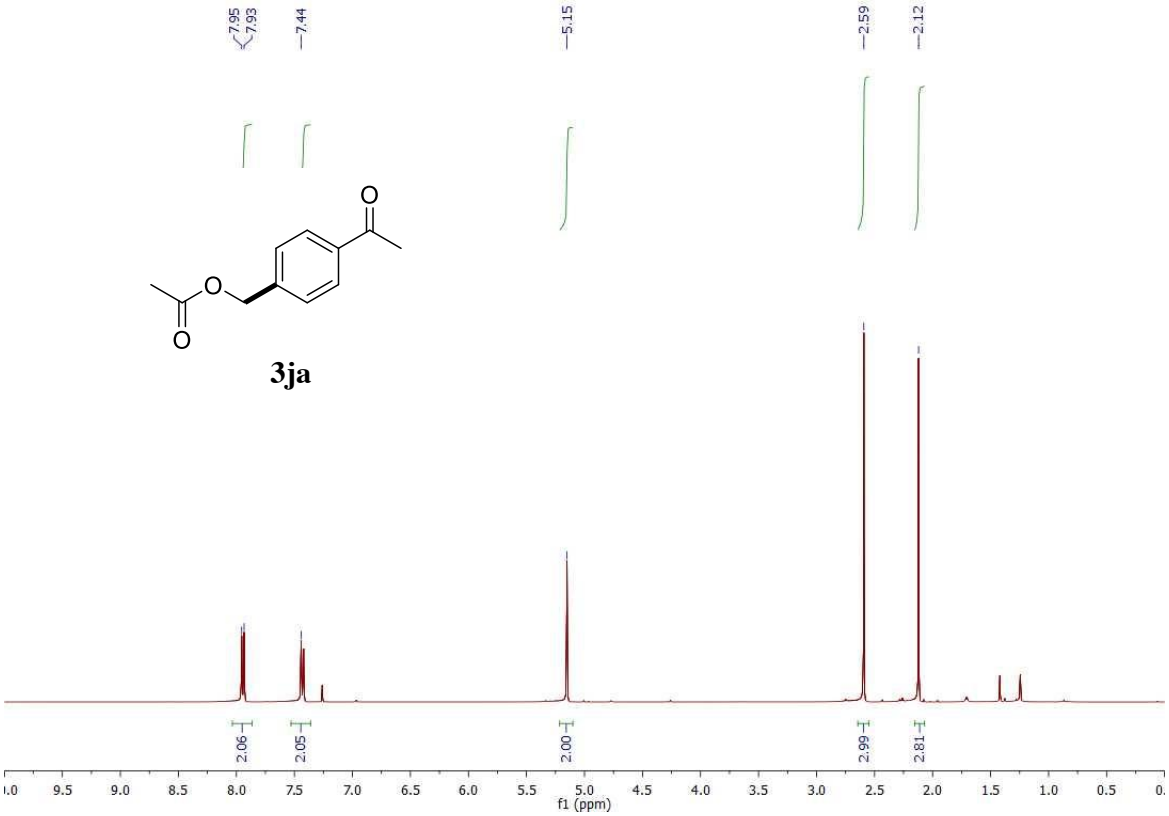
3ia

^{13}C spectrum of 3ia



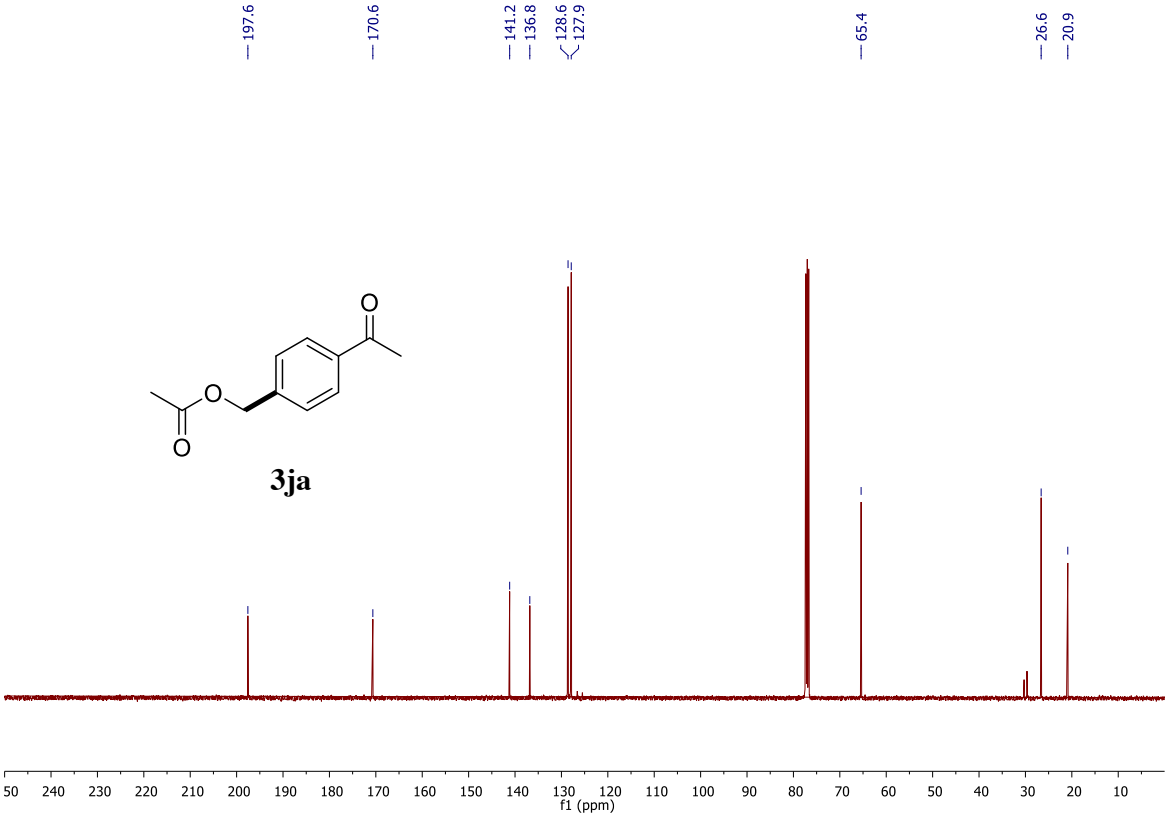
3ia

^{1}H spectrum of 3ja



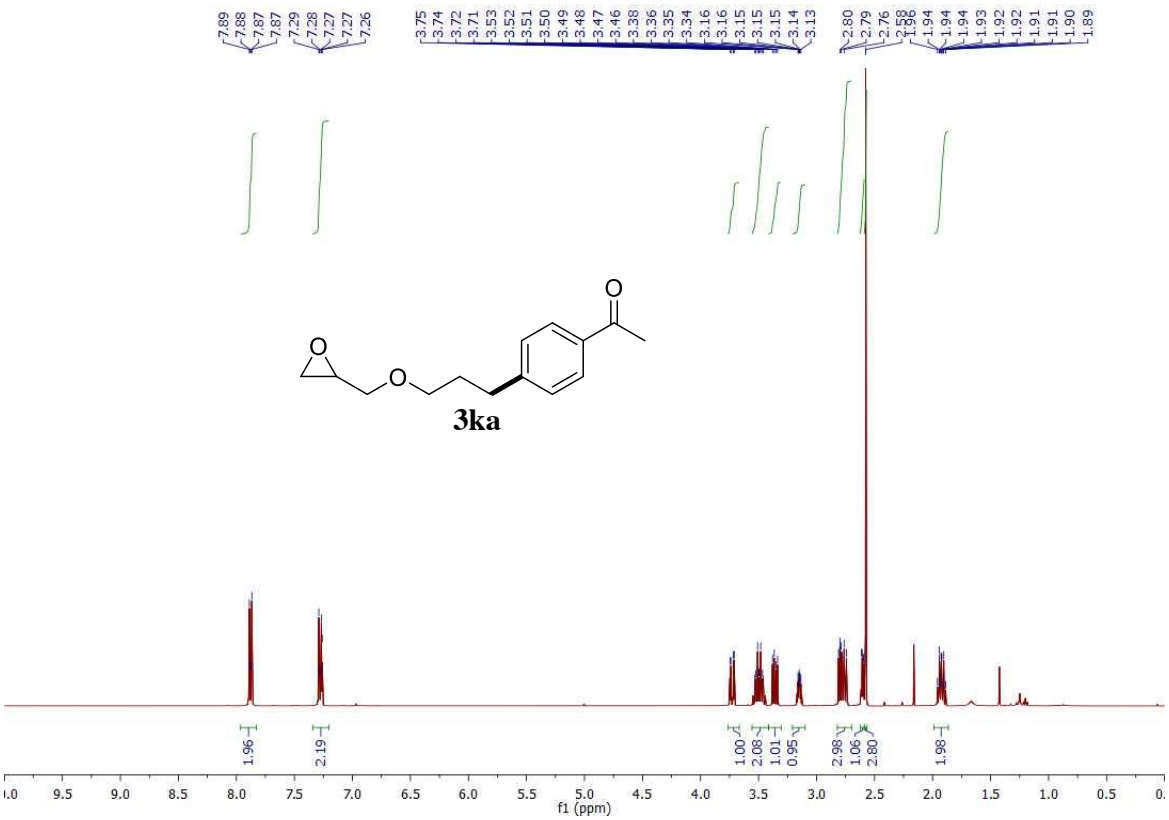
3ja

^{13}C spectrum of 3ja



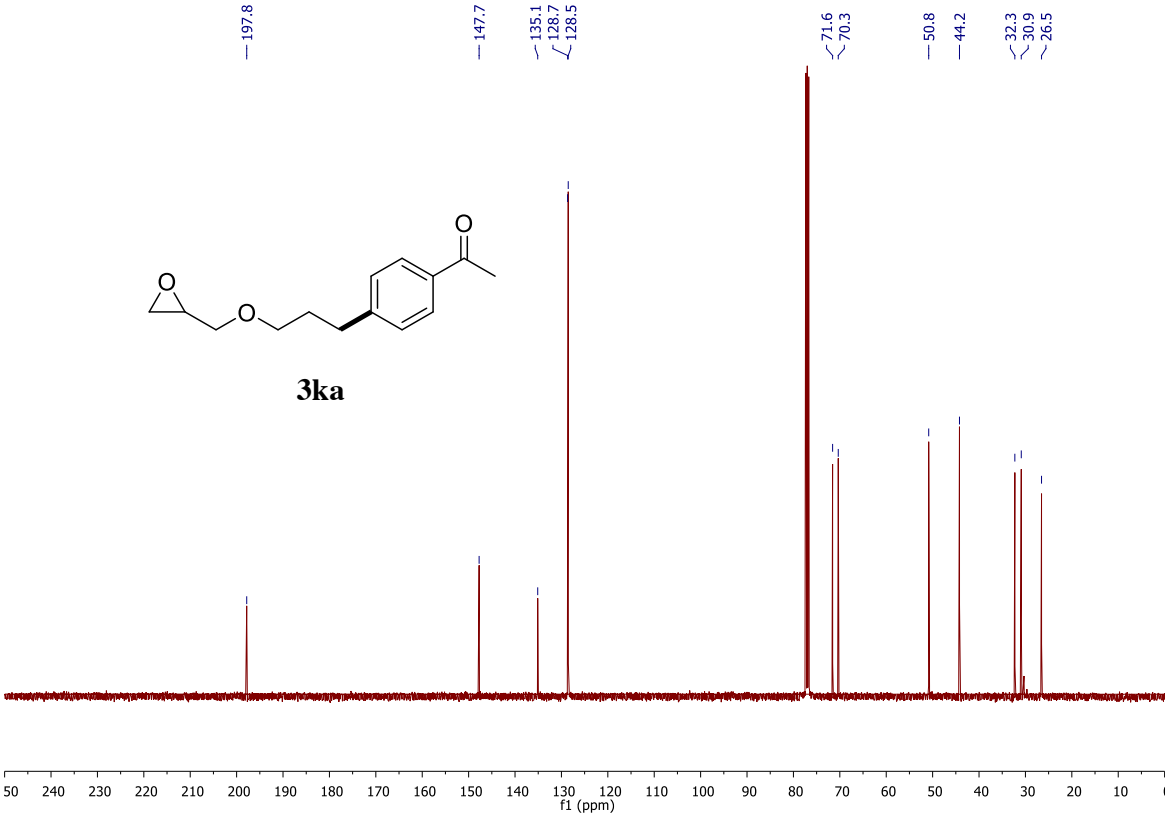
3ja

^{1}H spectrum of 3ka



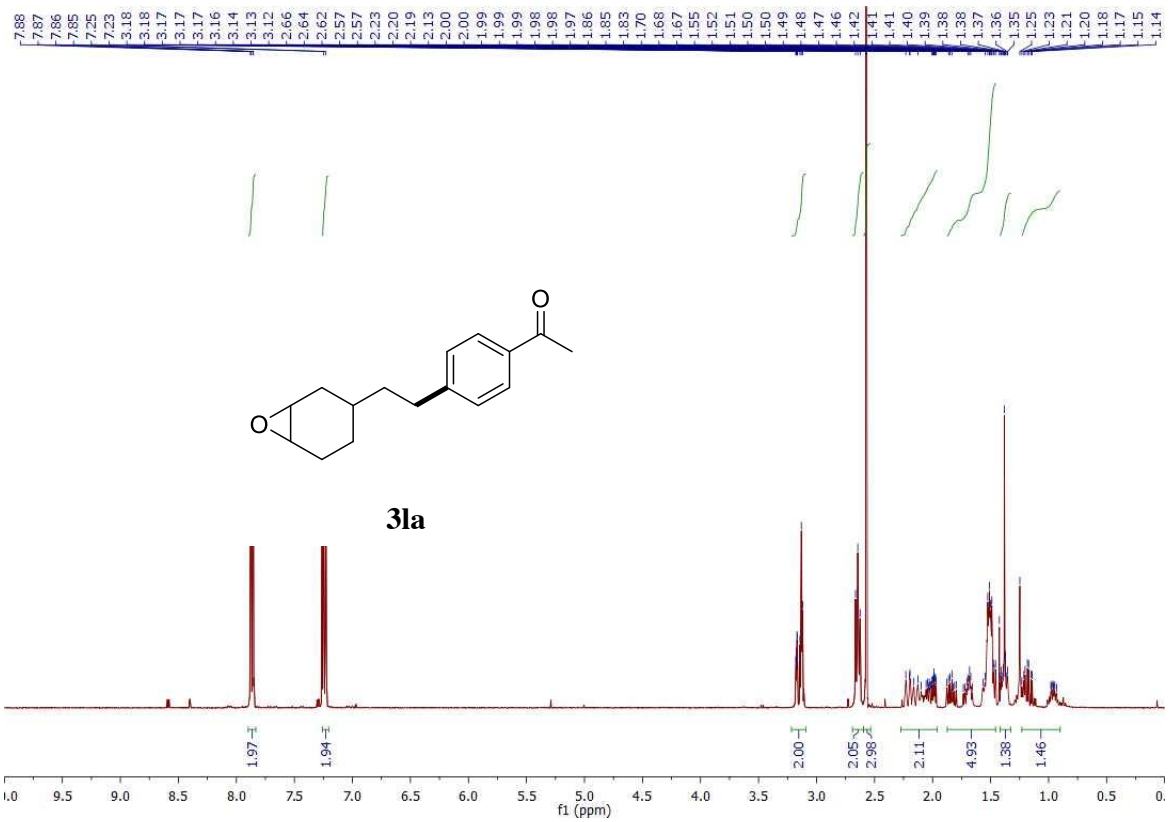
3ka

^{13}C spectrum of 3ka



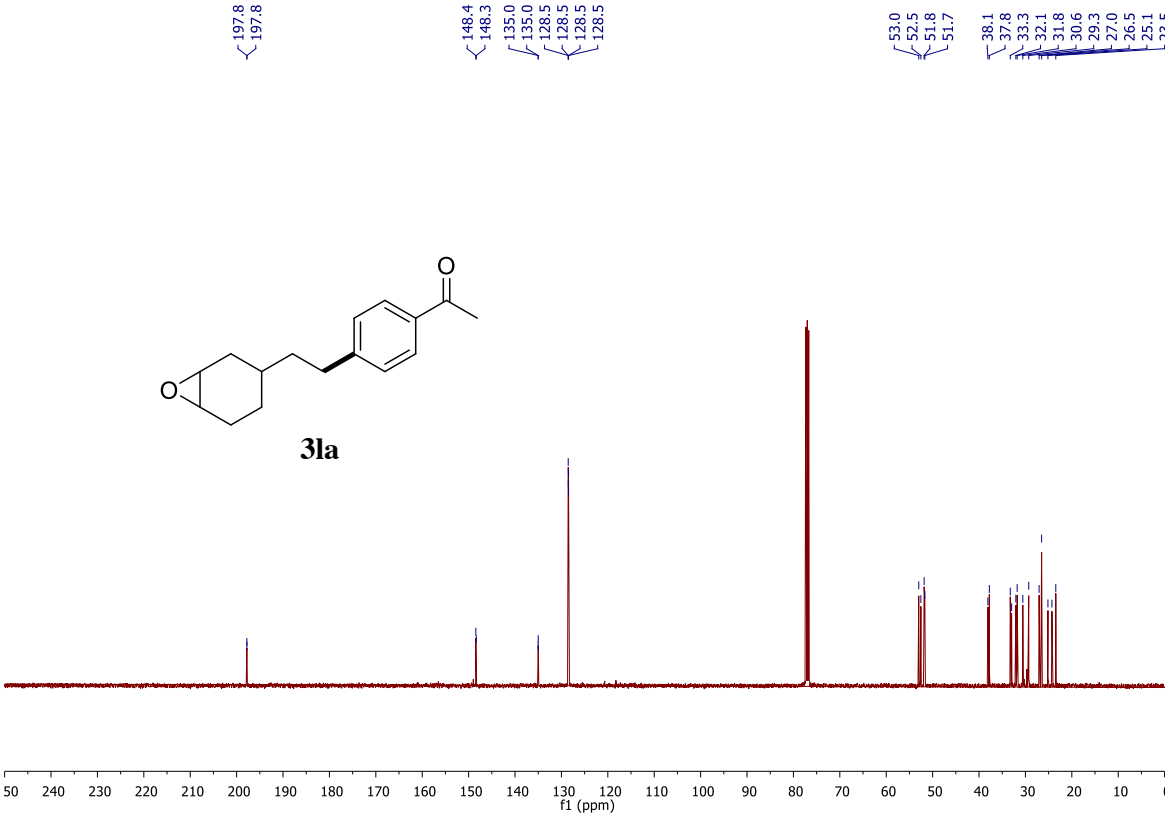
3ka

^{1}H spectrum of 3la

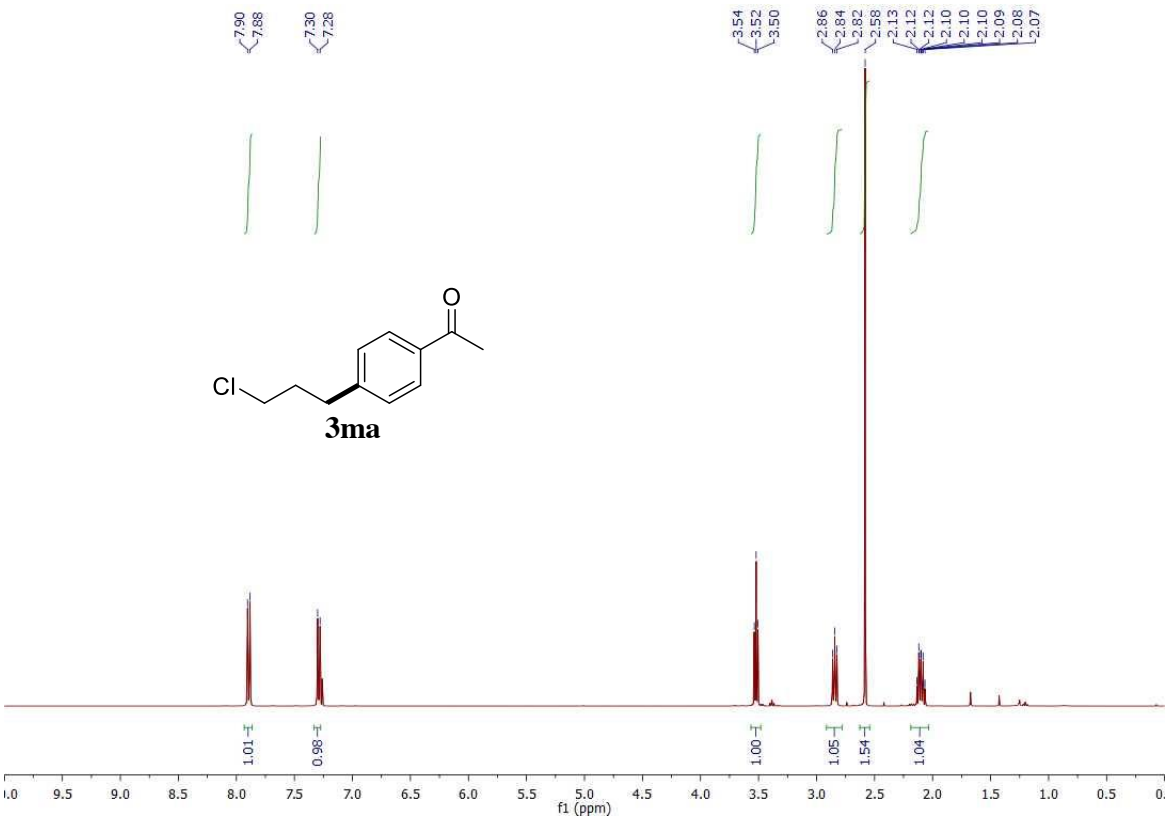


3la

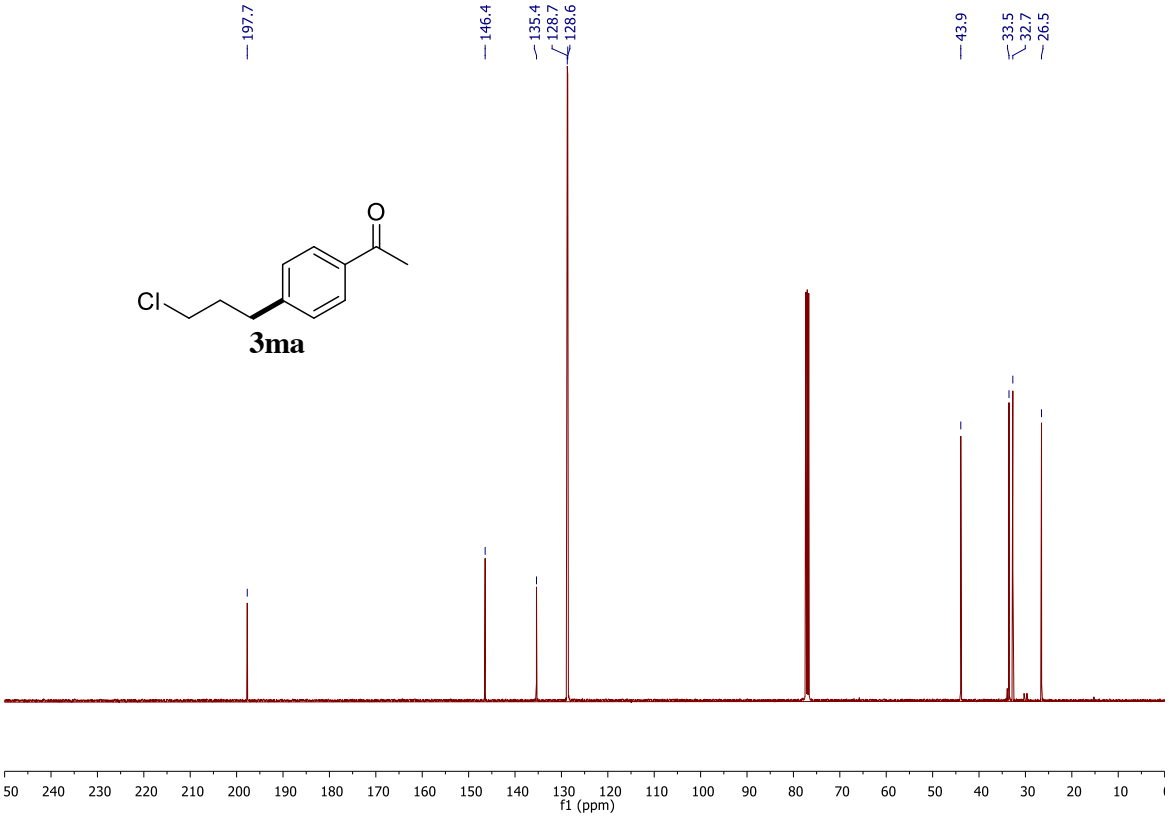
^{13}C spectrum of 3la



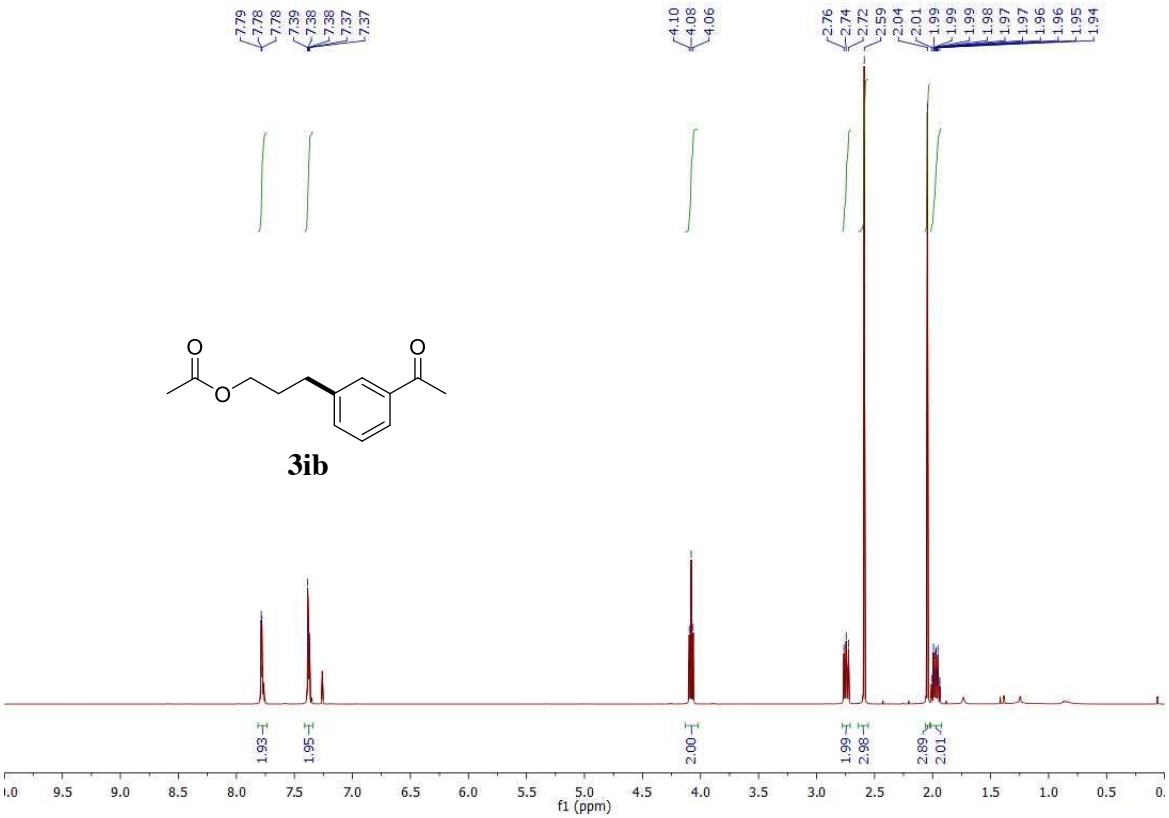
^{1}H spectrum of 3ma



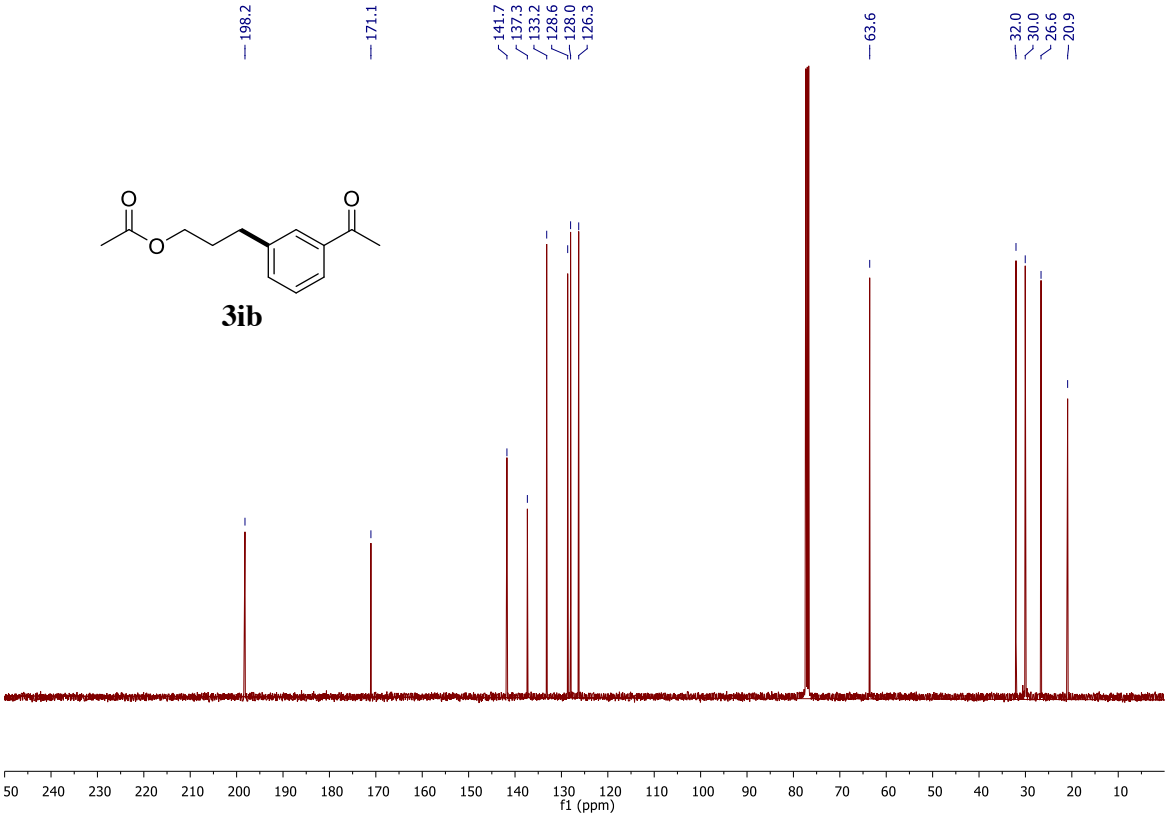
^{13}C spectrum of 3ma



^{1}H spectrum of 3ib

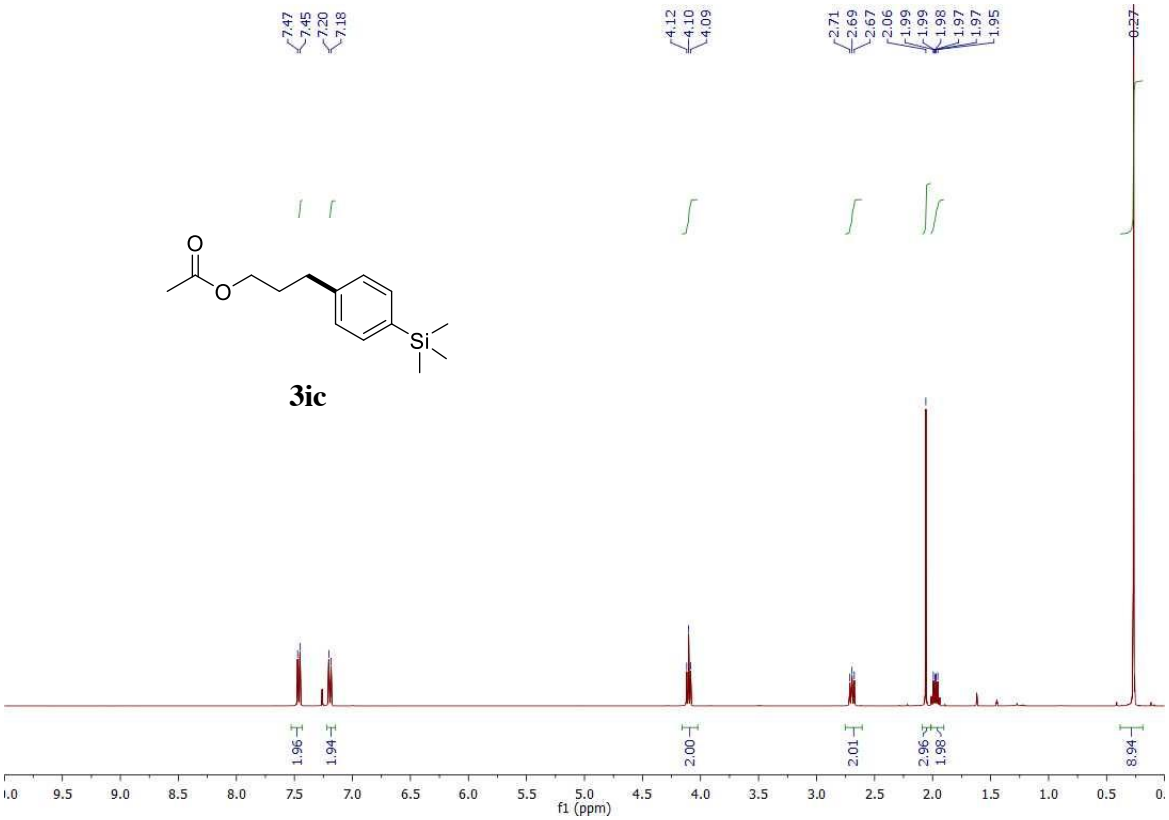


^{13}C spectrum of 3ib



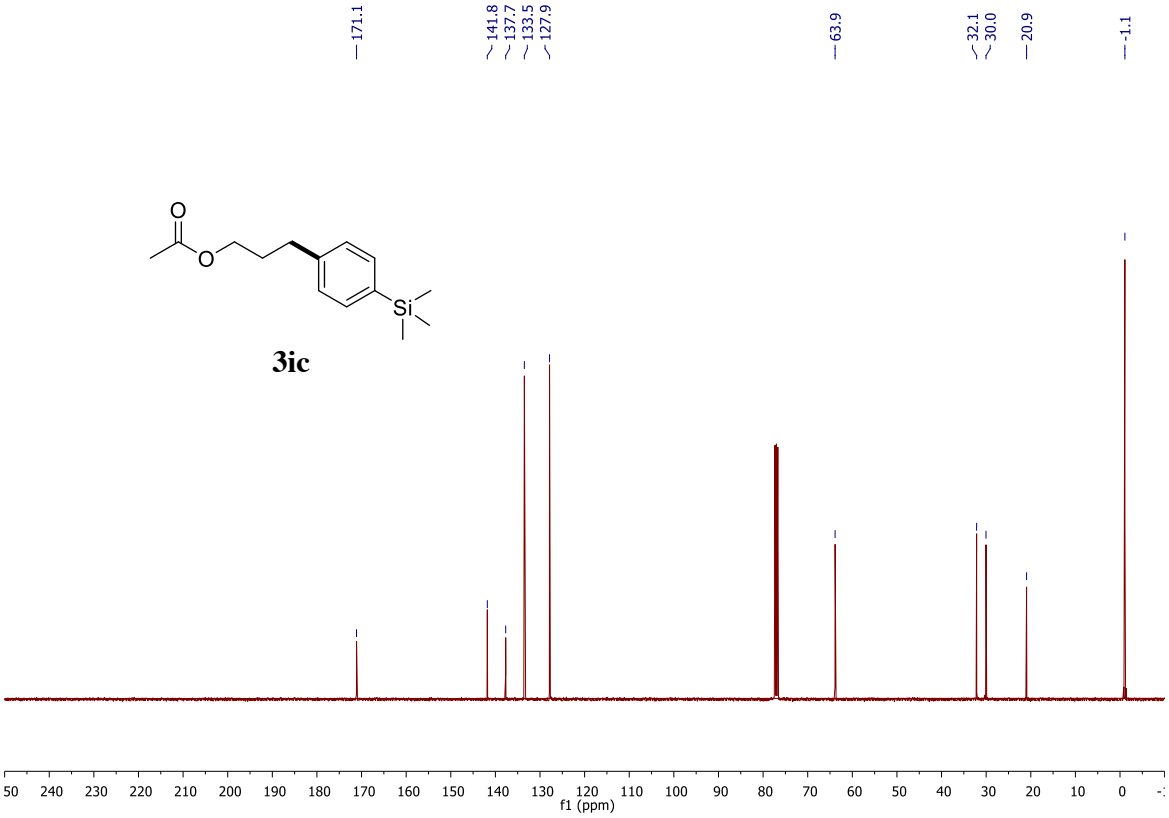
3ib

^{1}H spectrum of 3ic



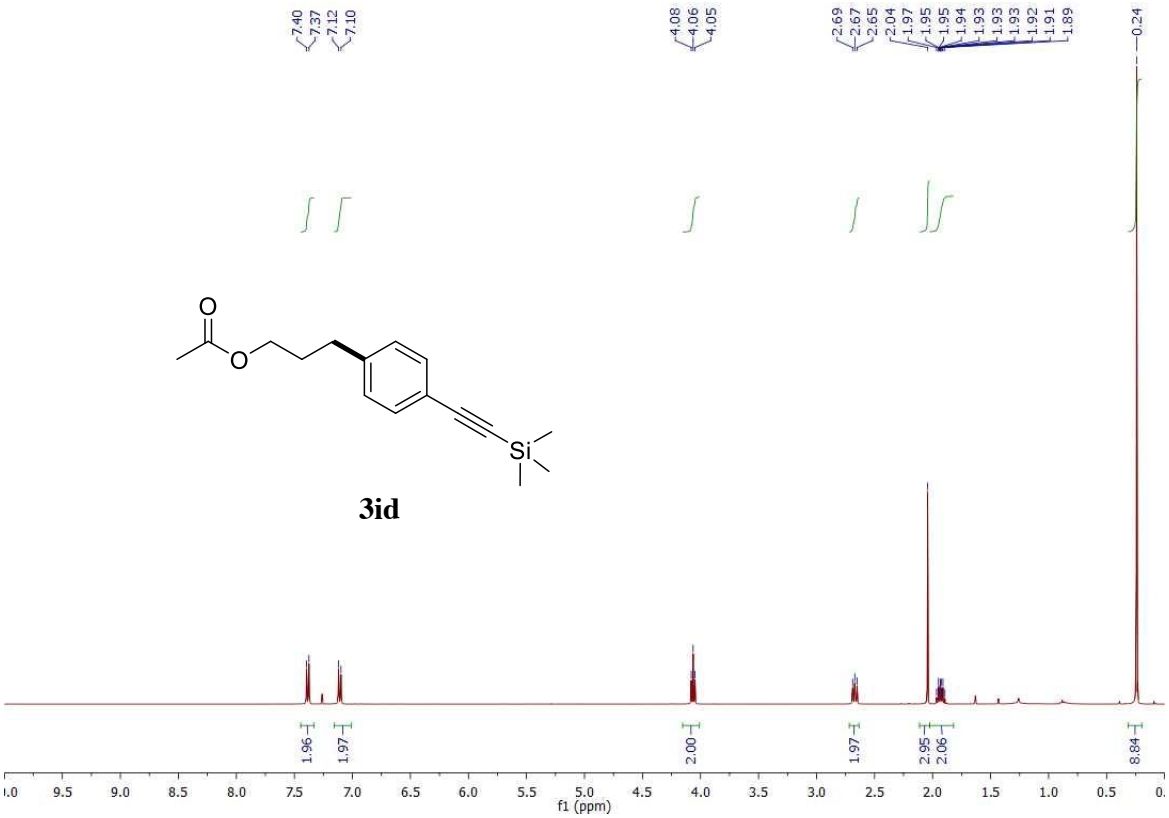
3ic

^{13}C spectrum of 3ic



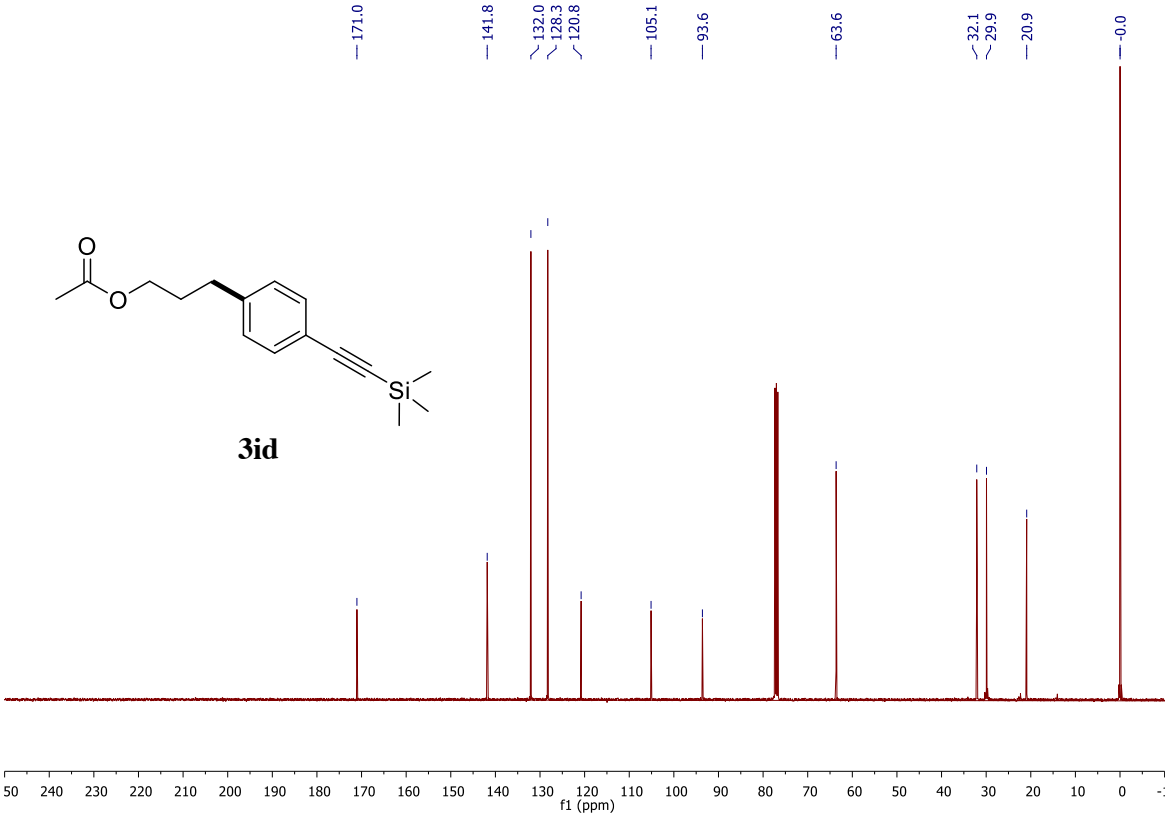
3ic

^{1}H spectrum of 3id



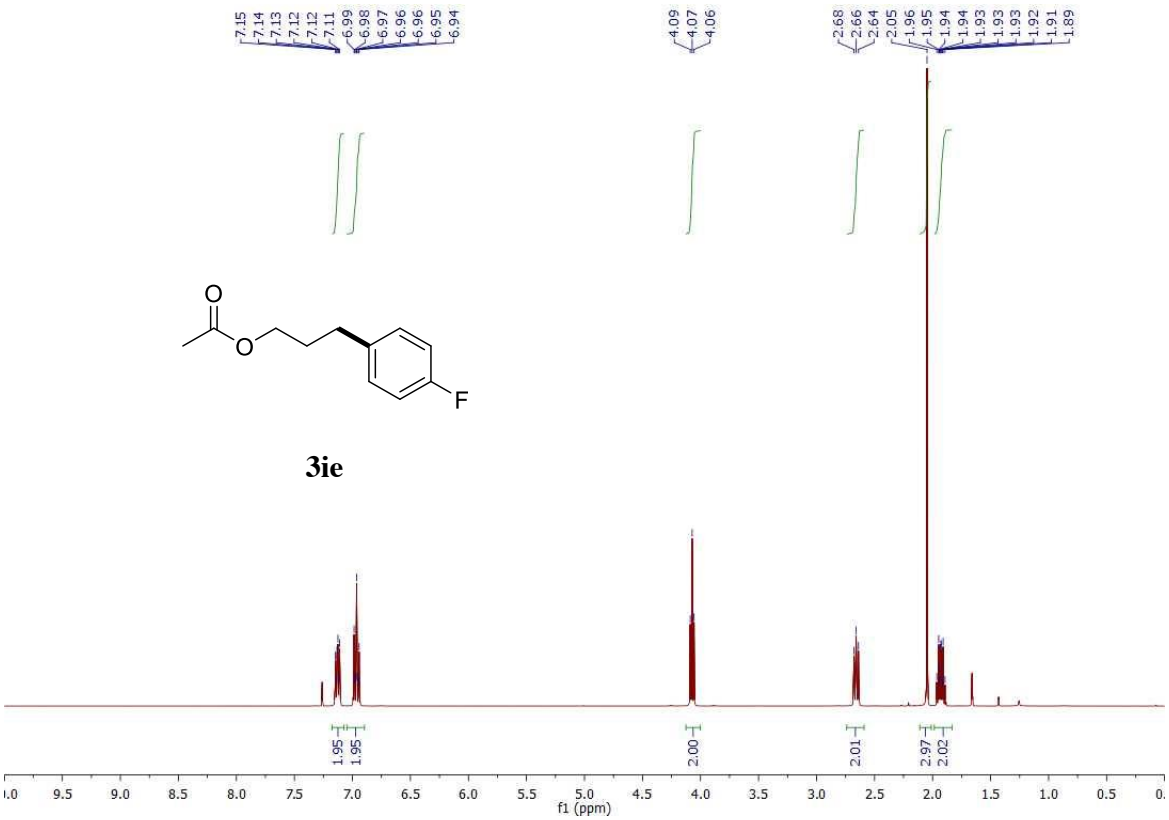
3id

^{13}C spectrum of 3id



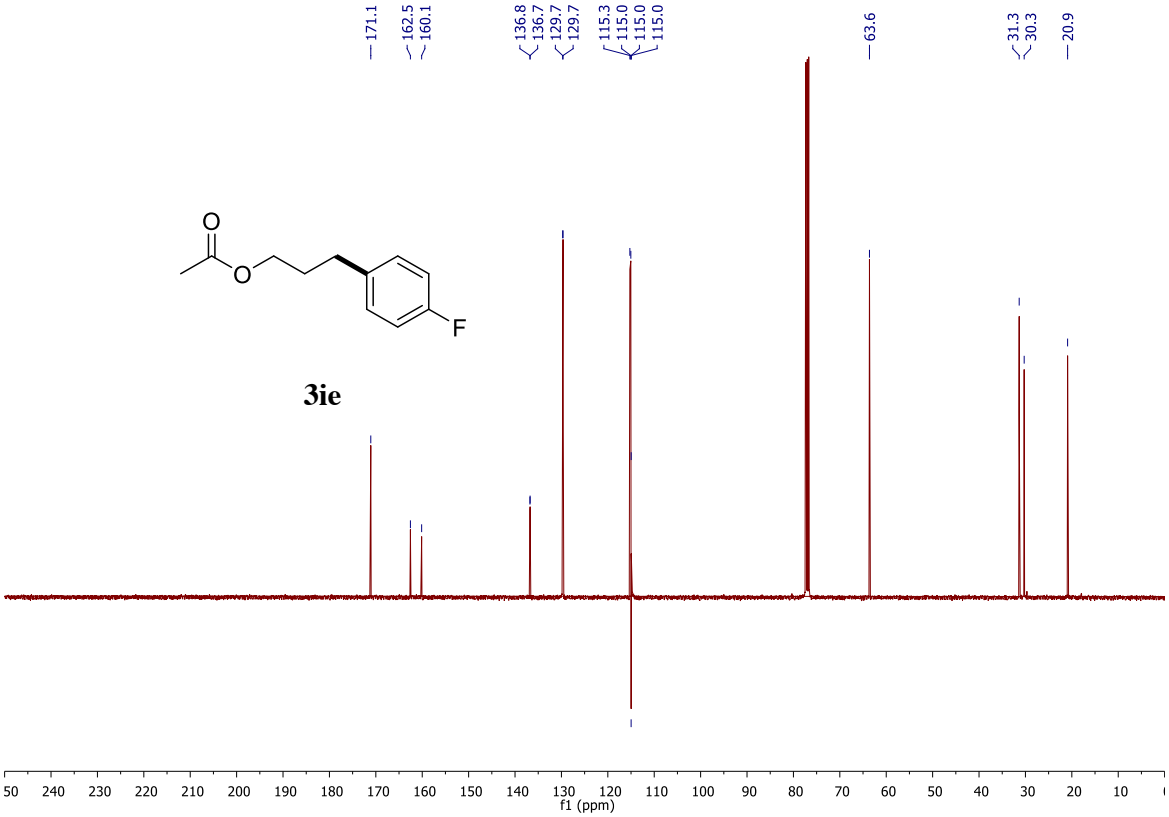
3id

^{1}H spectrum of 3ie

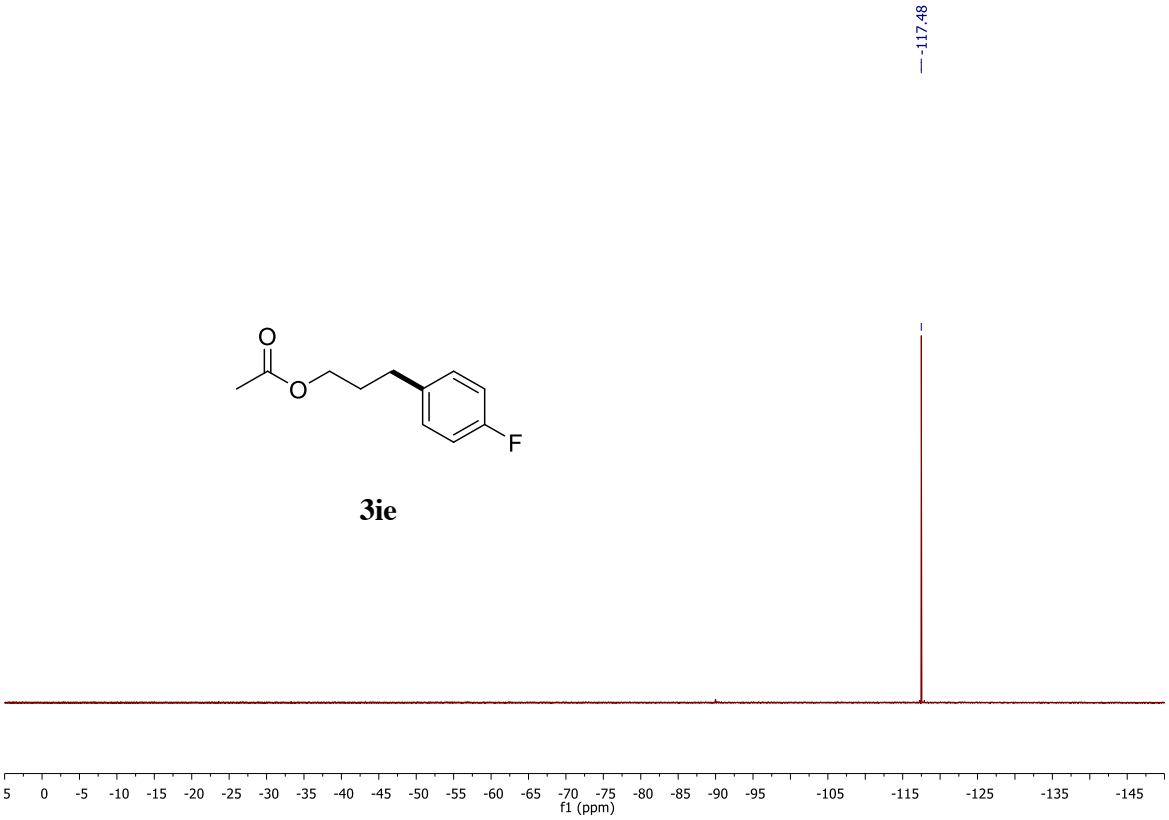


3ie

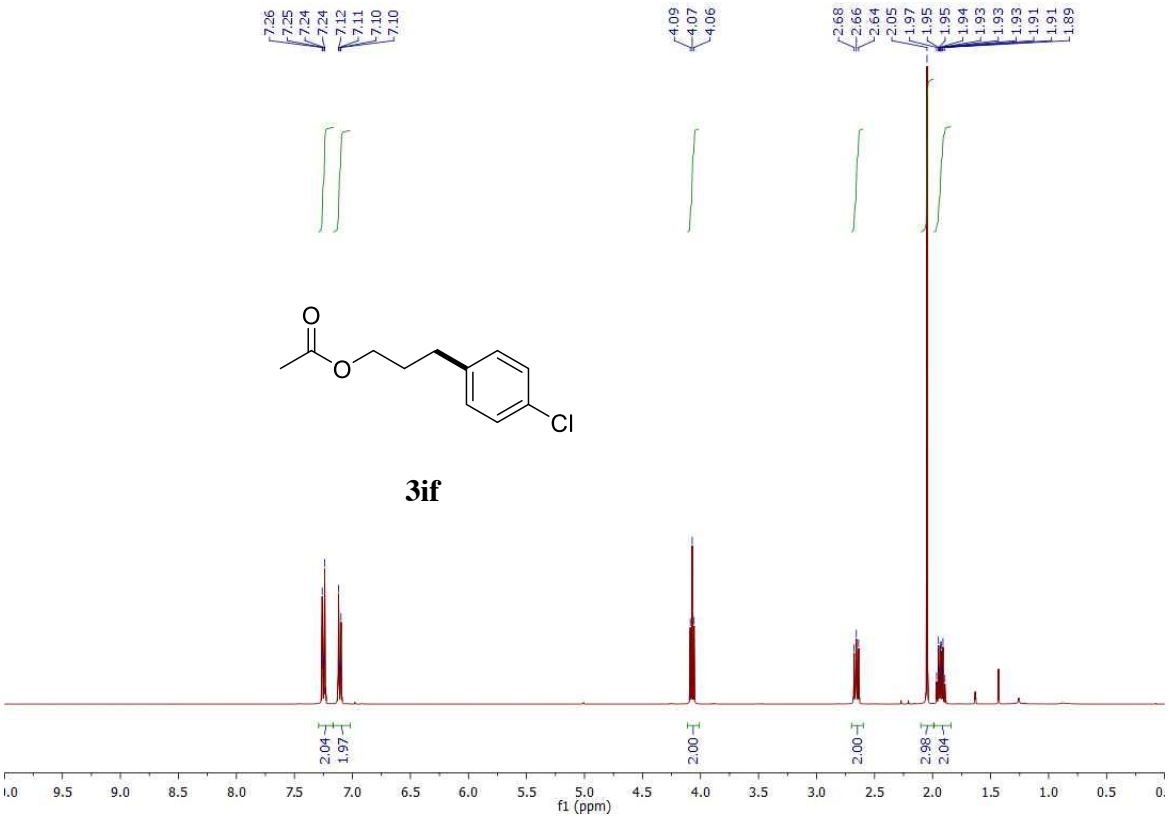
^{13}C spectrum of 3ie



^{19}F spectrum of 3ie

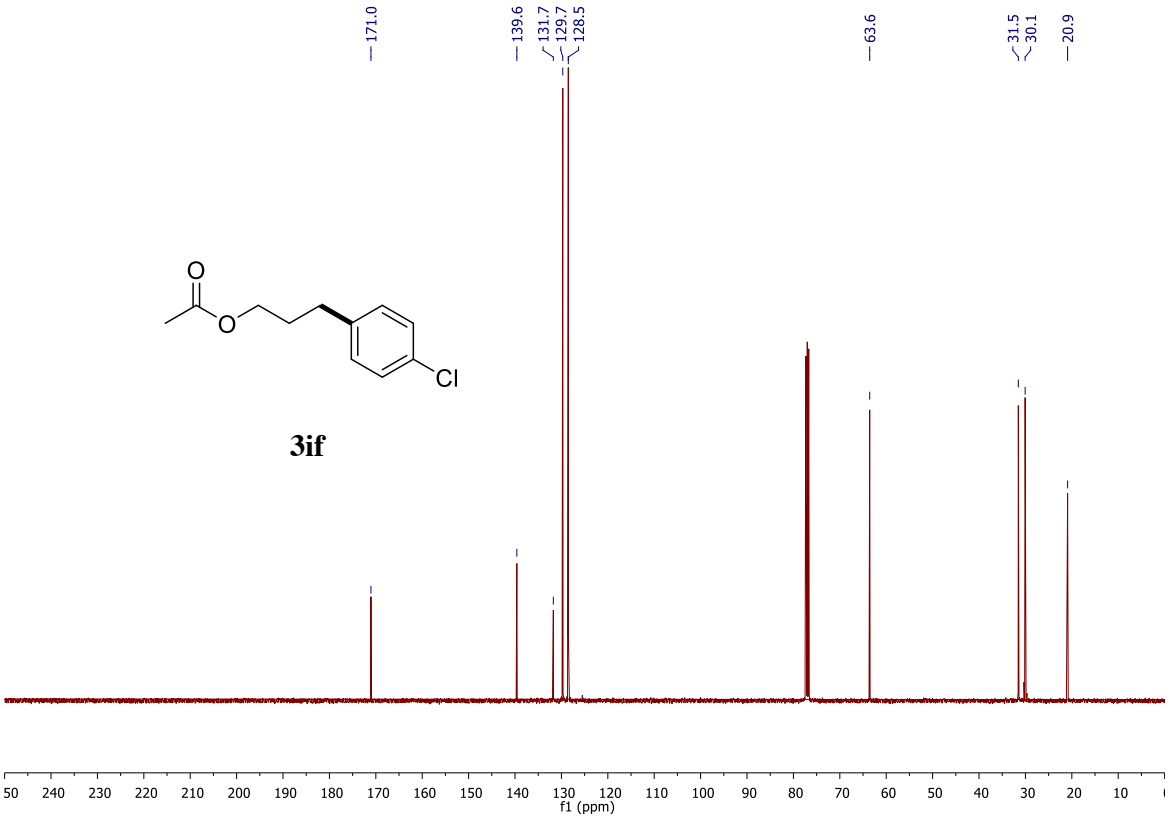


^{1}H spectrum of 3if



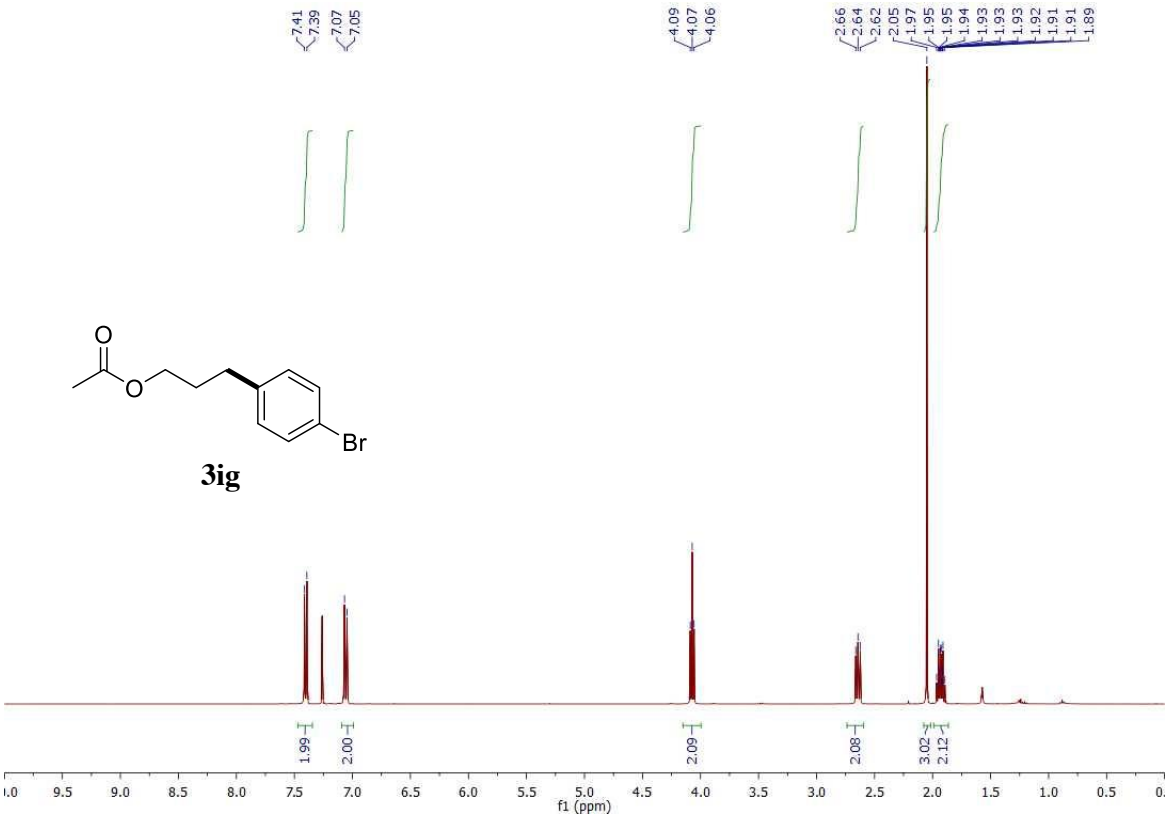
3if

^{13}C spectrum of 3if



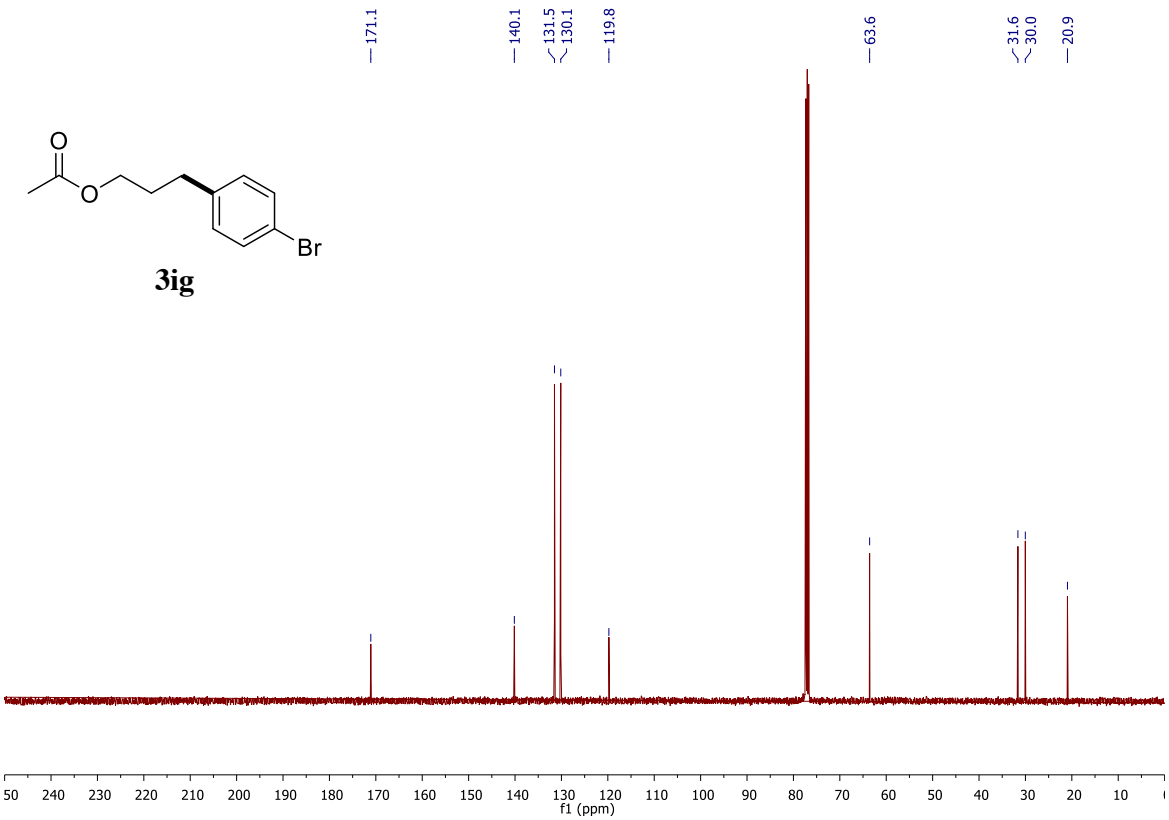
3if

^{1}H spectrum of 3ig



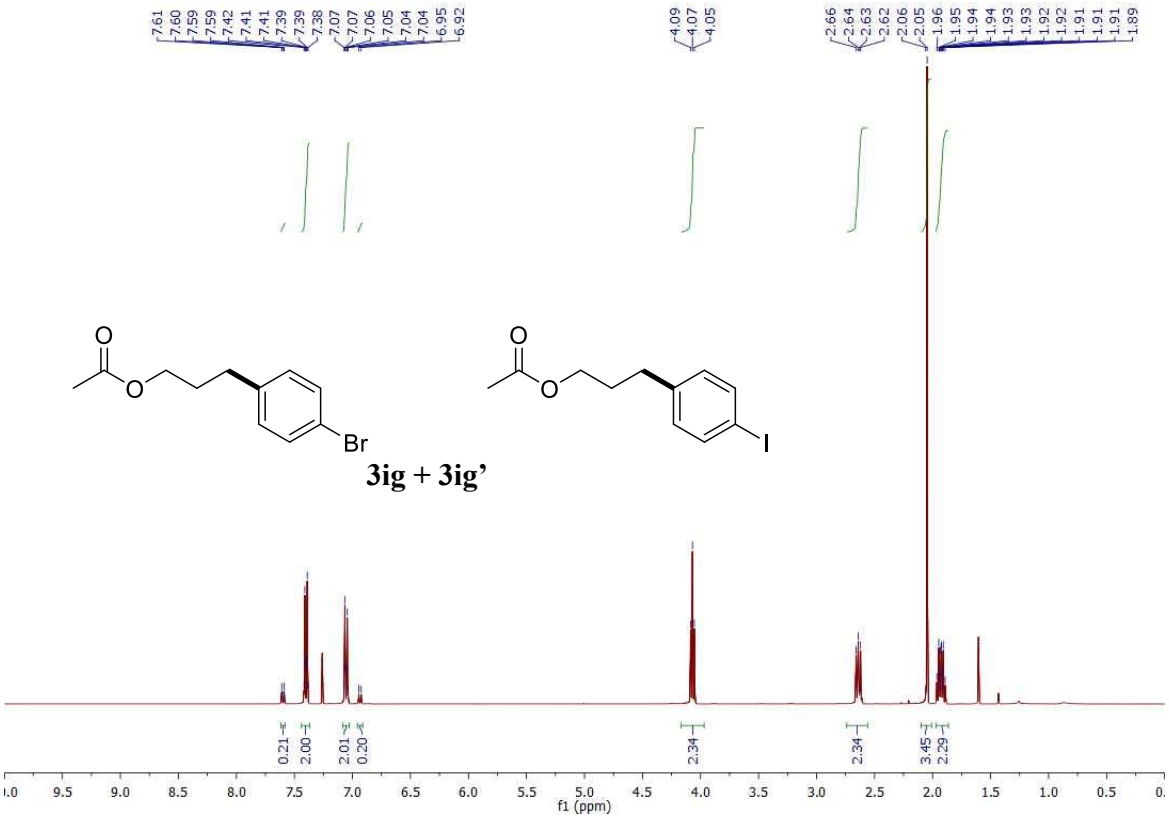
3ig

^{13}C spectrum of 3ig

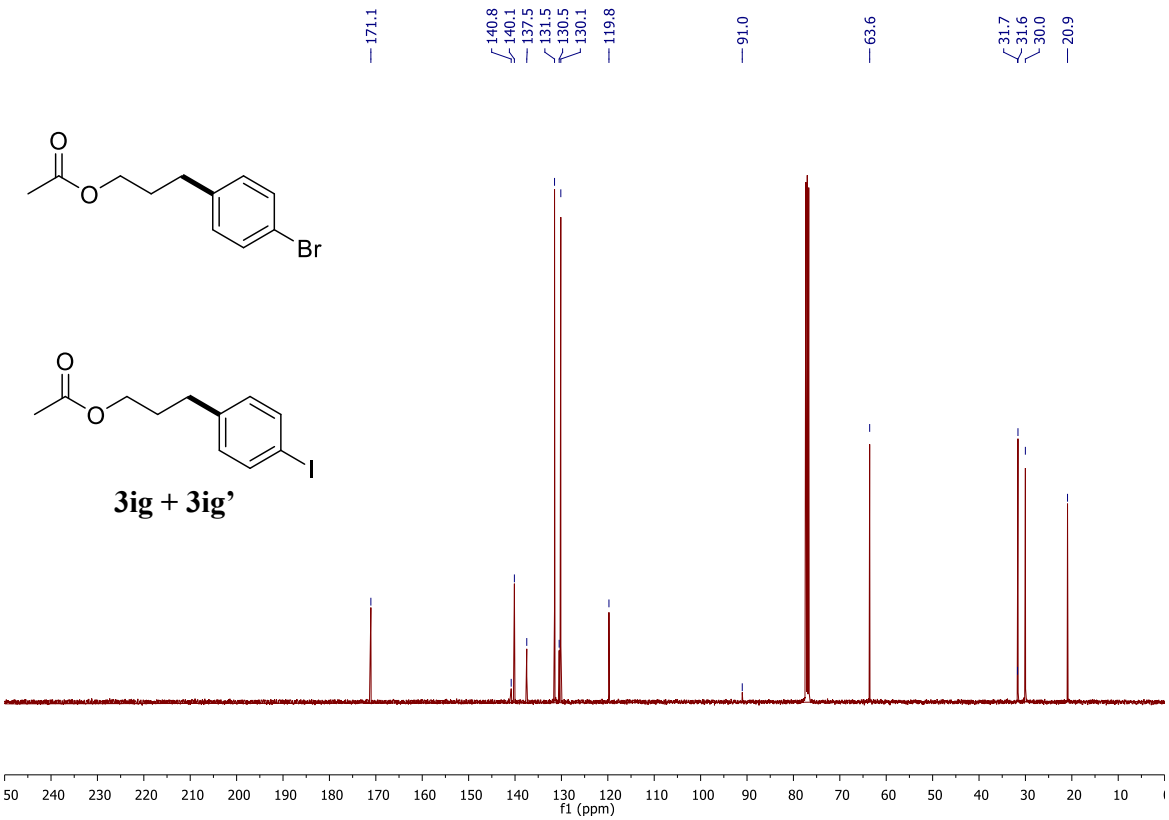


3ig

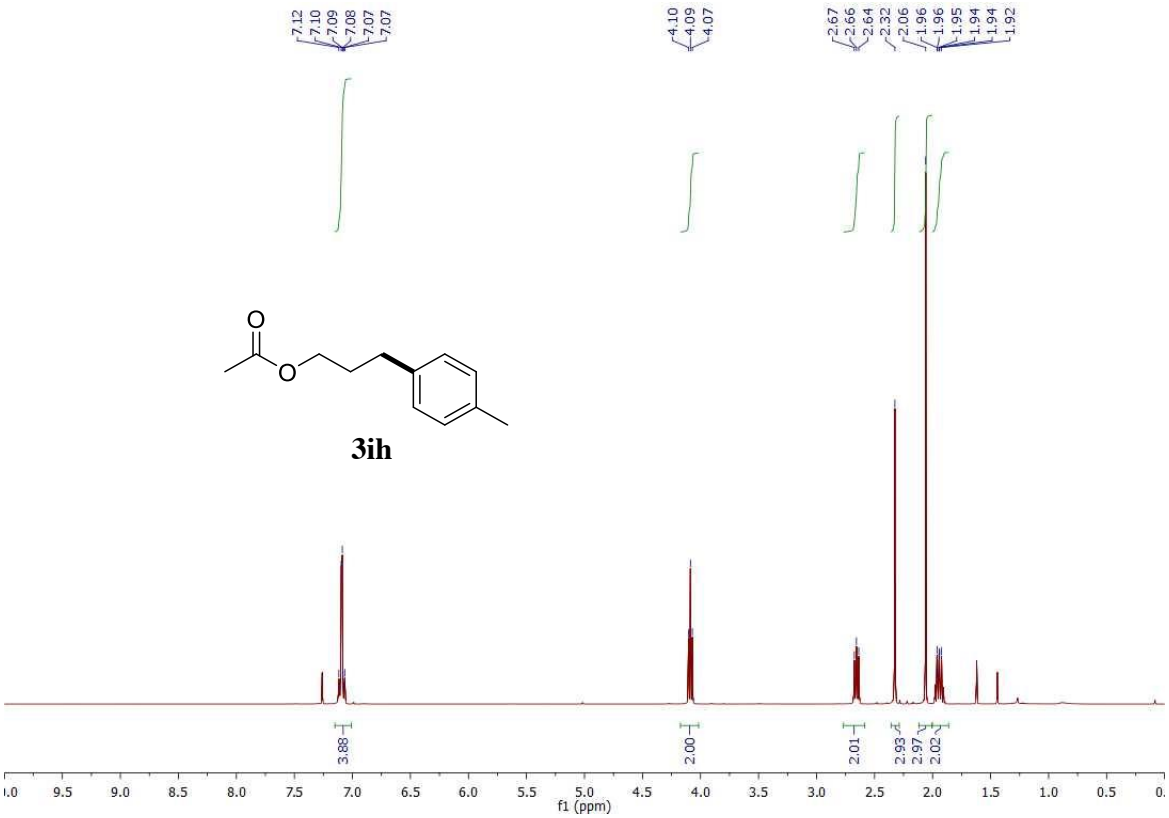
^{1}H spectrum of 3ig and 3ig'



^{13}C spectrum of 3ig and 3ig'

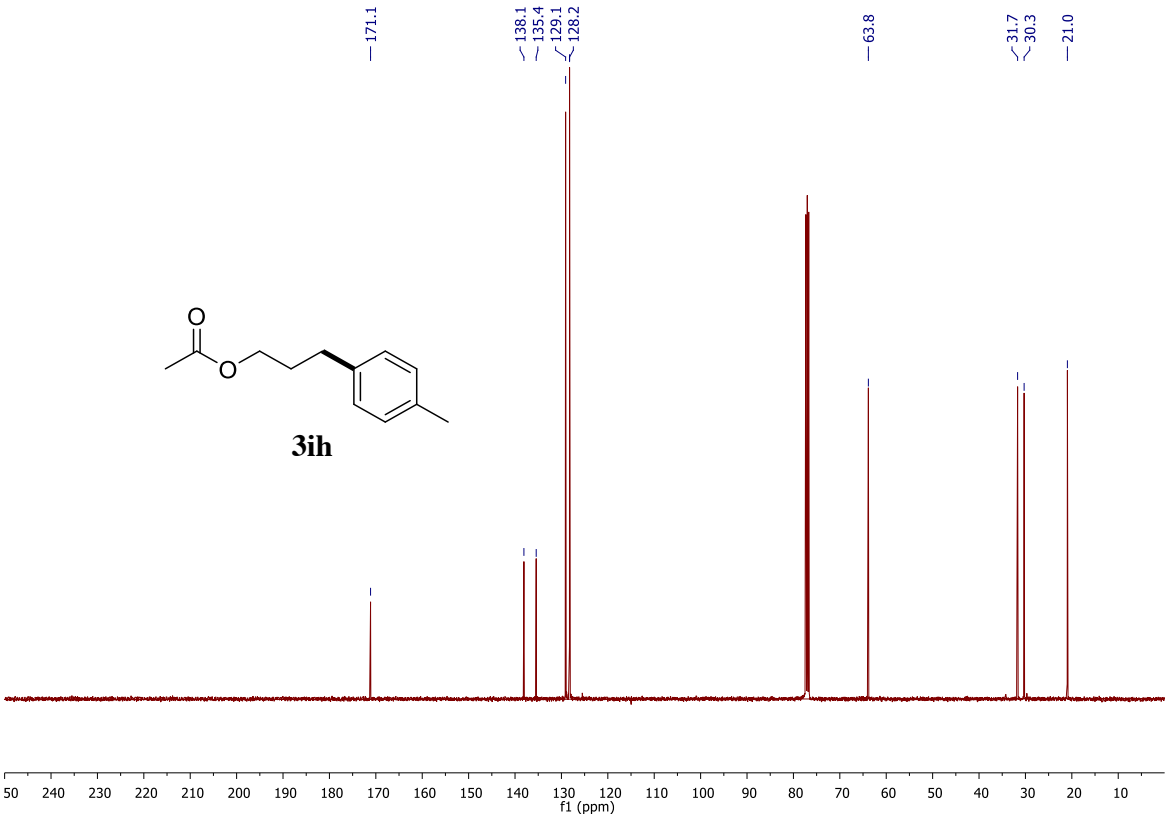


^{1}H spectrum of 3ih



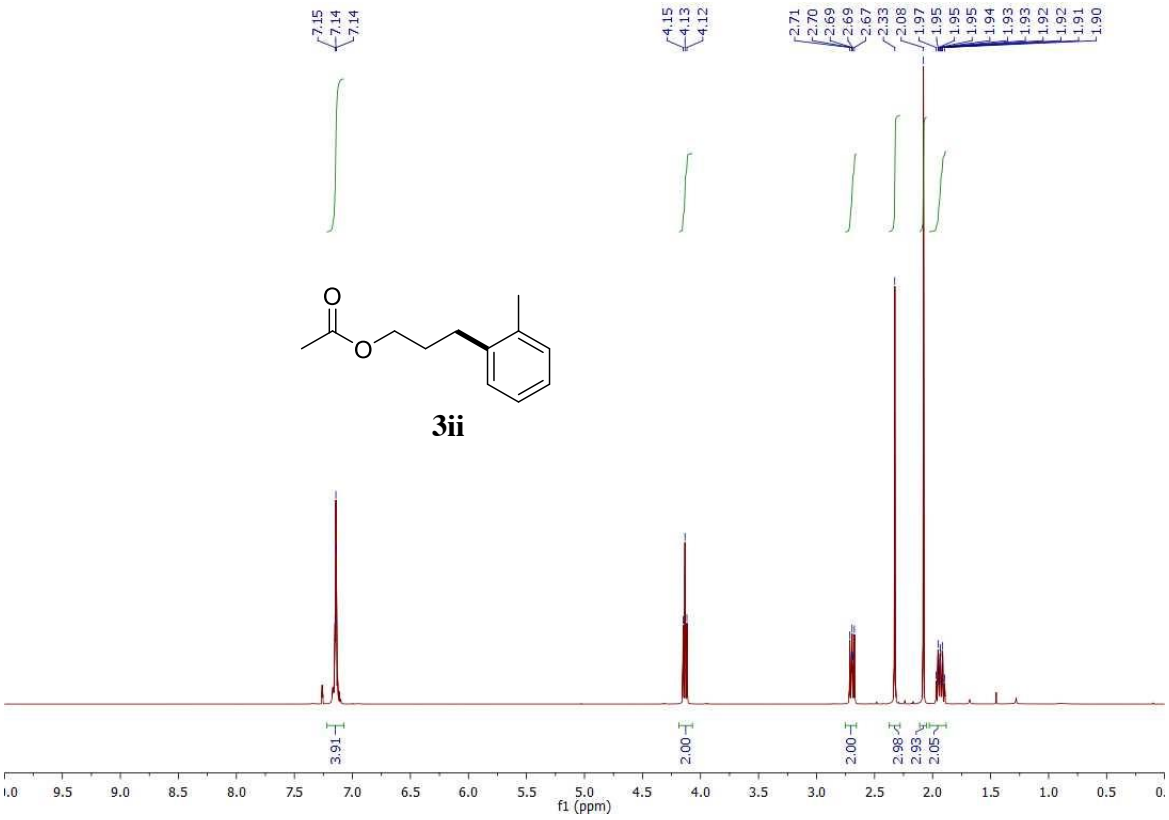
3ih

^{13}C spectrum of 3ih



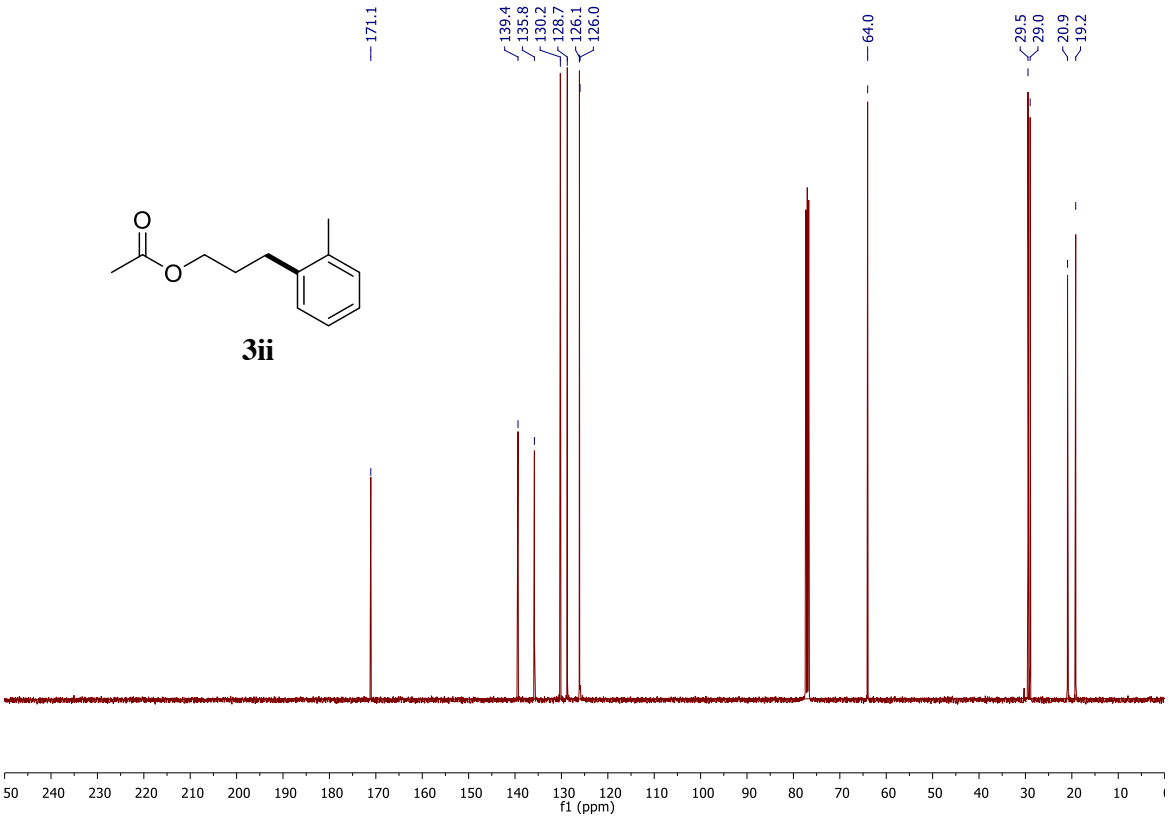
3ih

^{1}H spectrum of 3ii



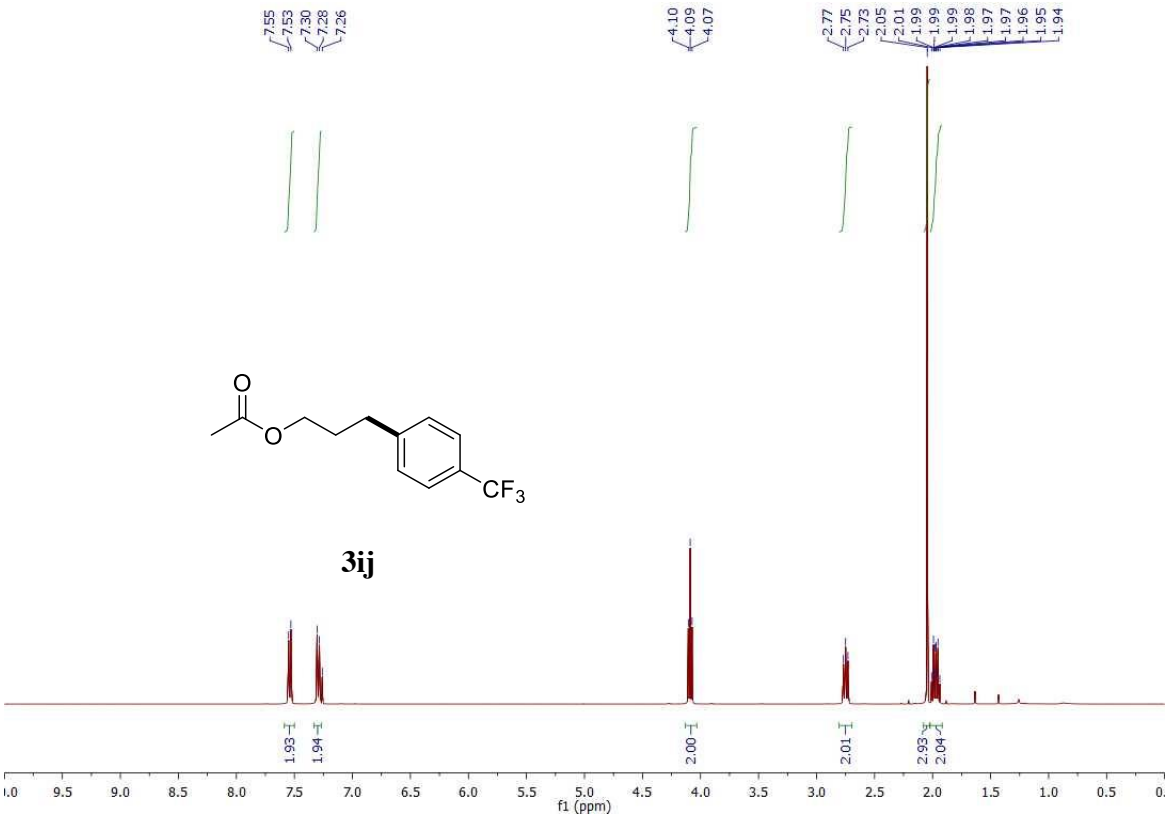
3ii

^{13}C spectrum of 3ii



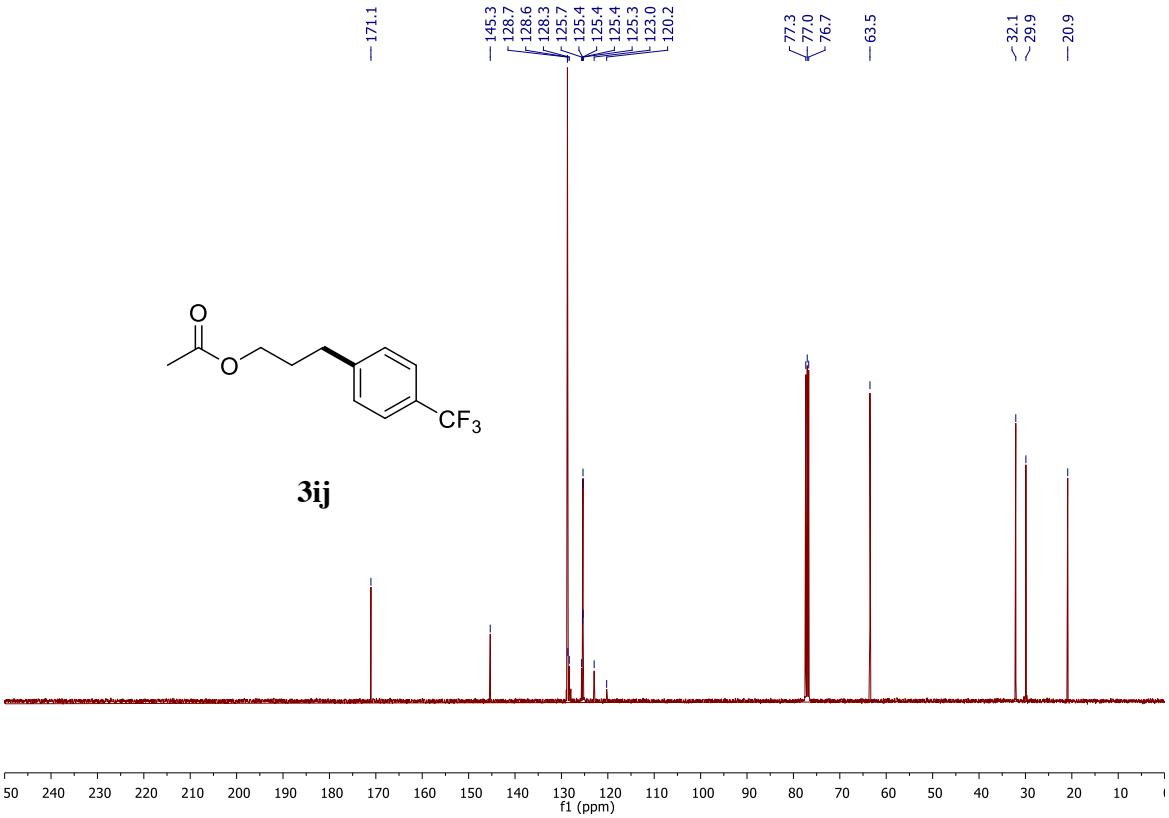
3ii

^{1}H spectrum of 3ij



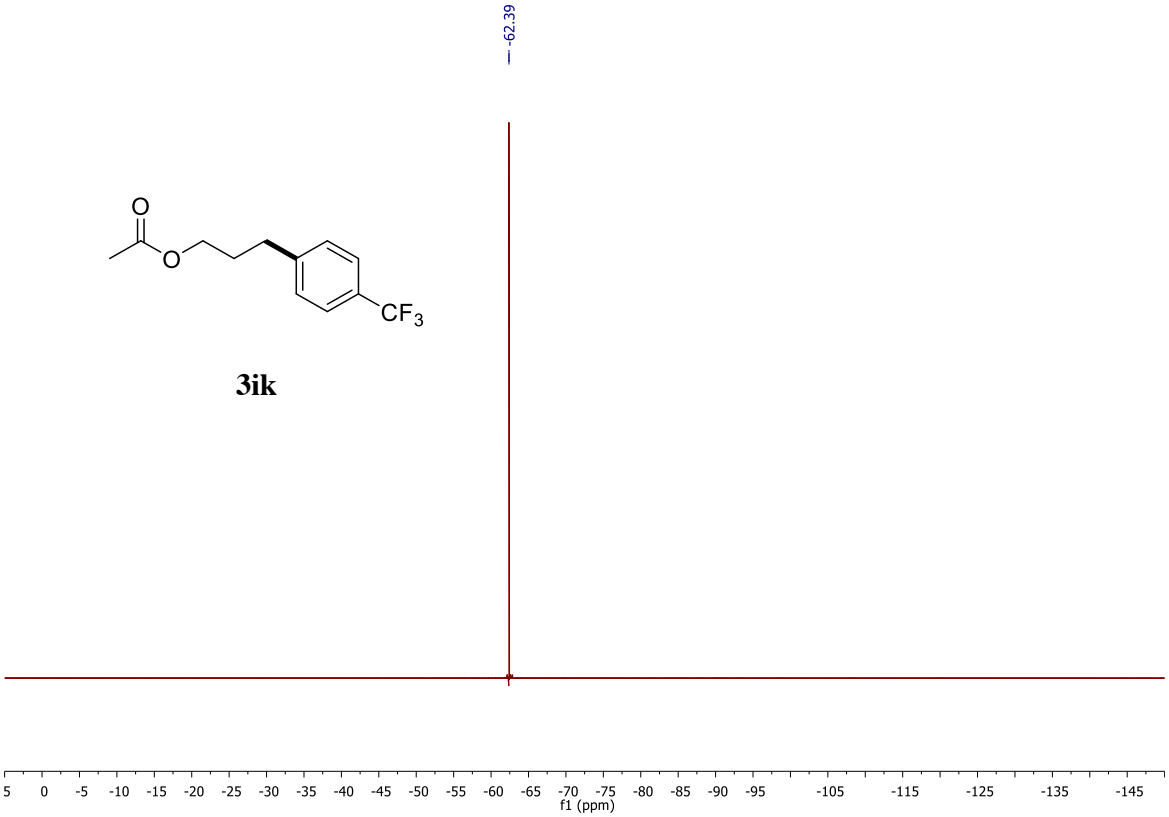
3ij

^{13}C spectrum of 3ij



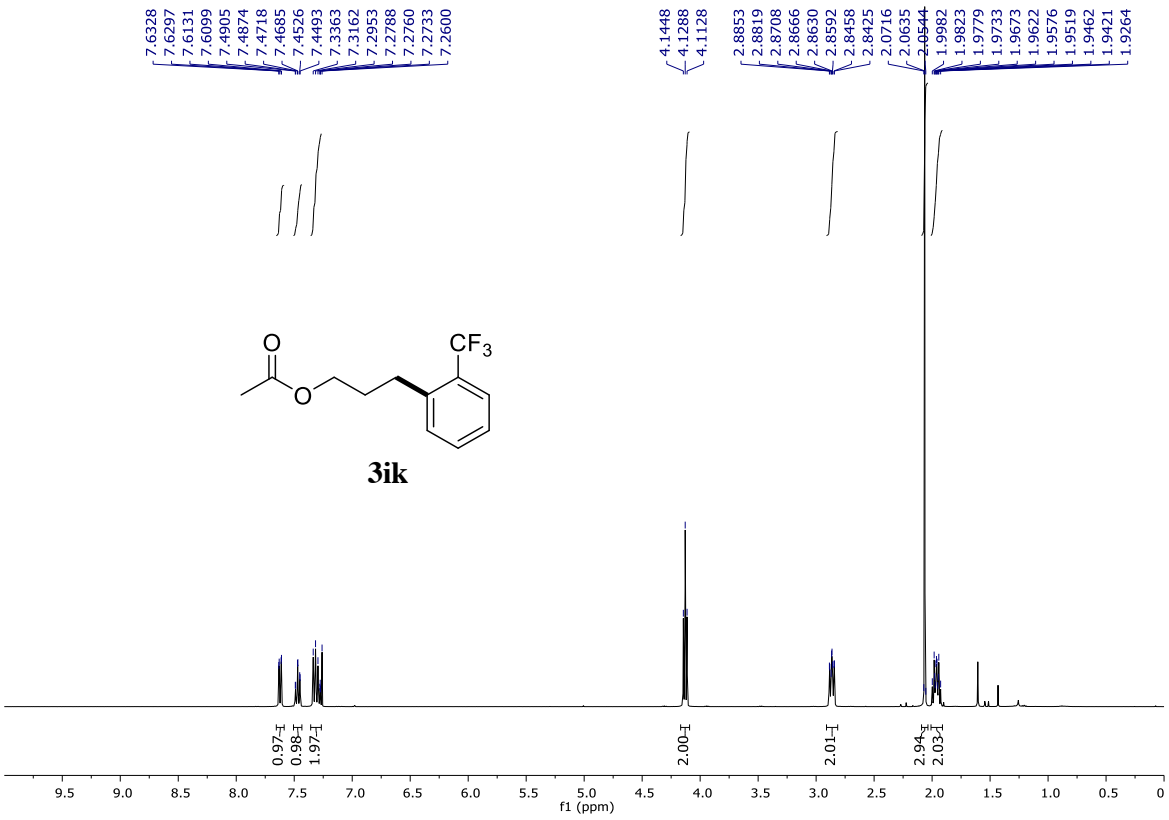
3ij

^{19}F spectrum of 3ij



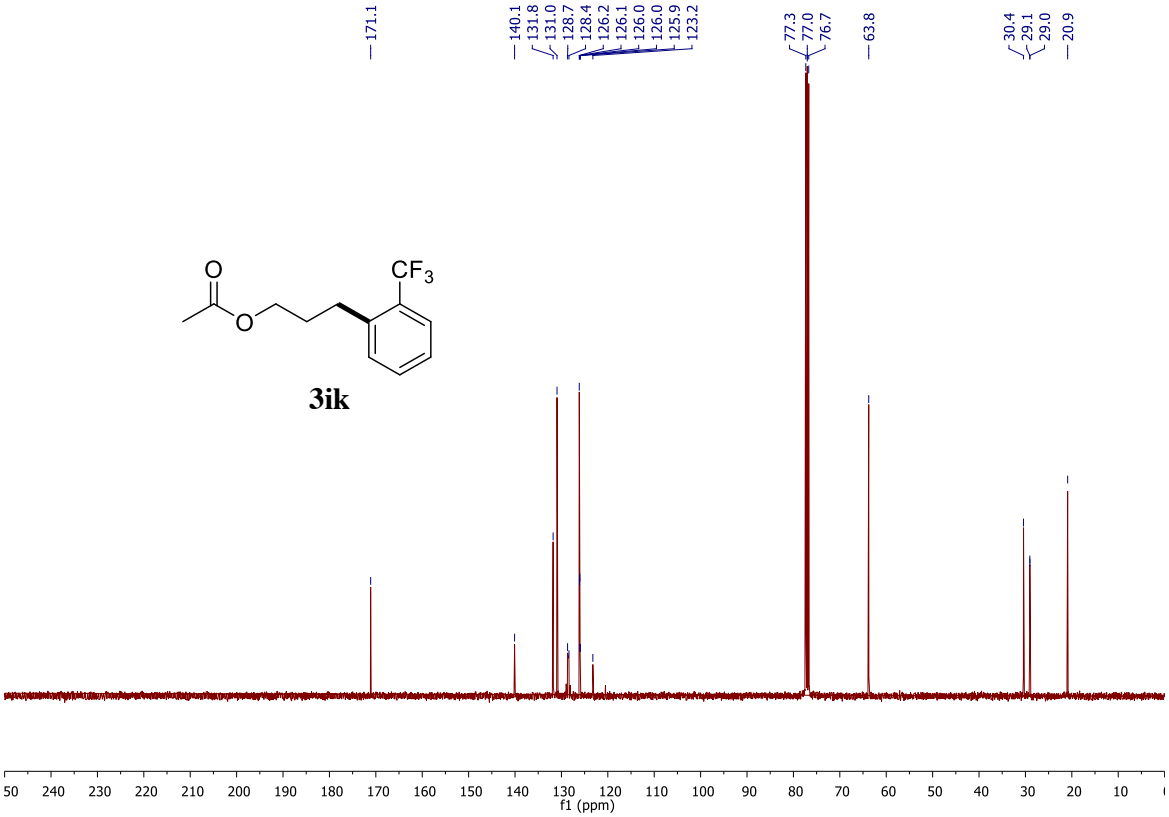
3ik

^{1}H spectrum of 3ik

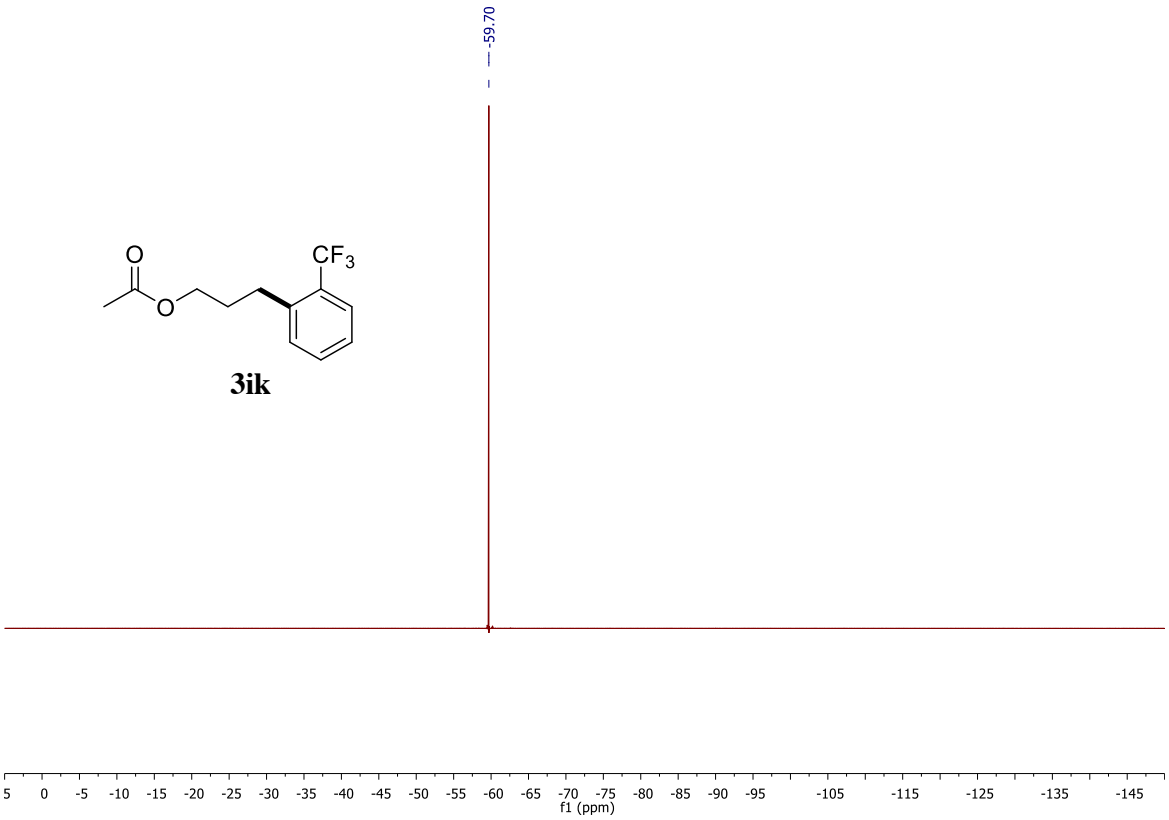


3ik

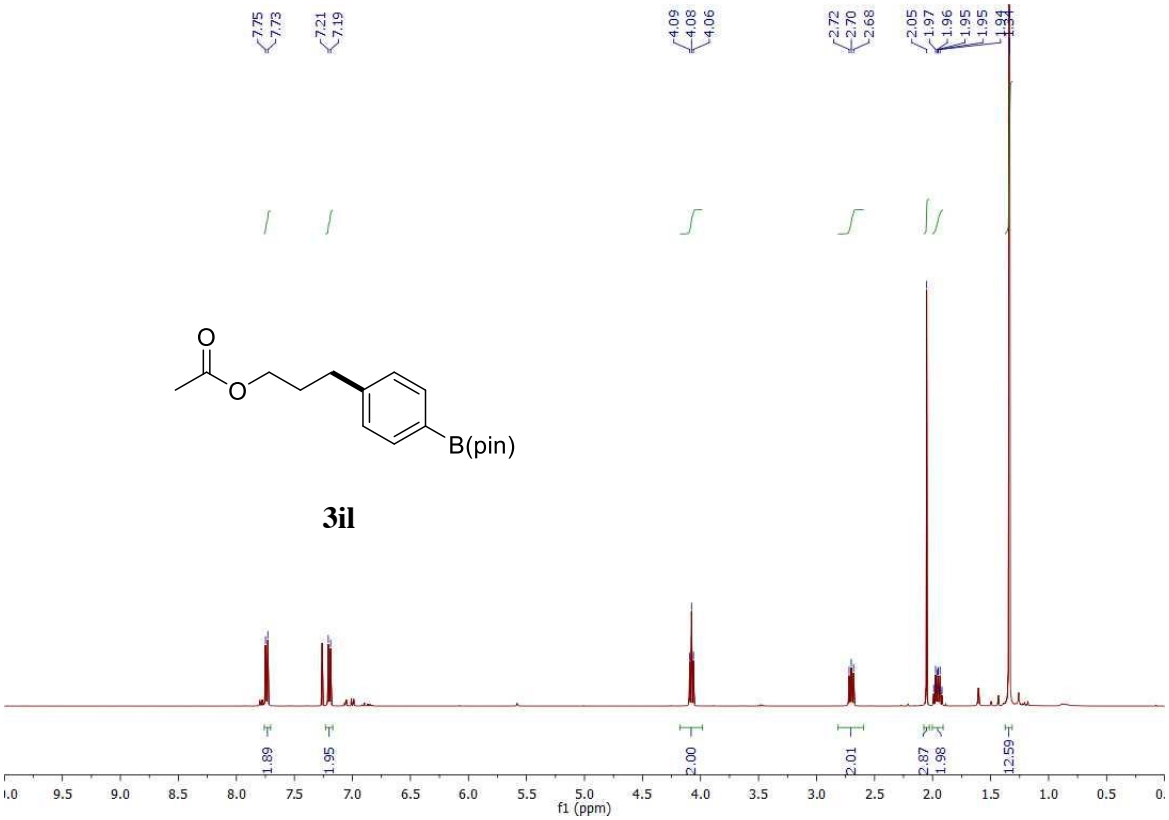
^{13}C spectrum of 3ik



^{19}F spectrum of 3ik

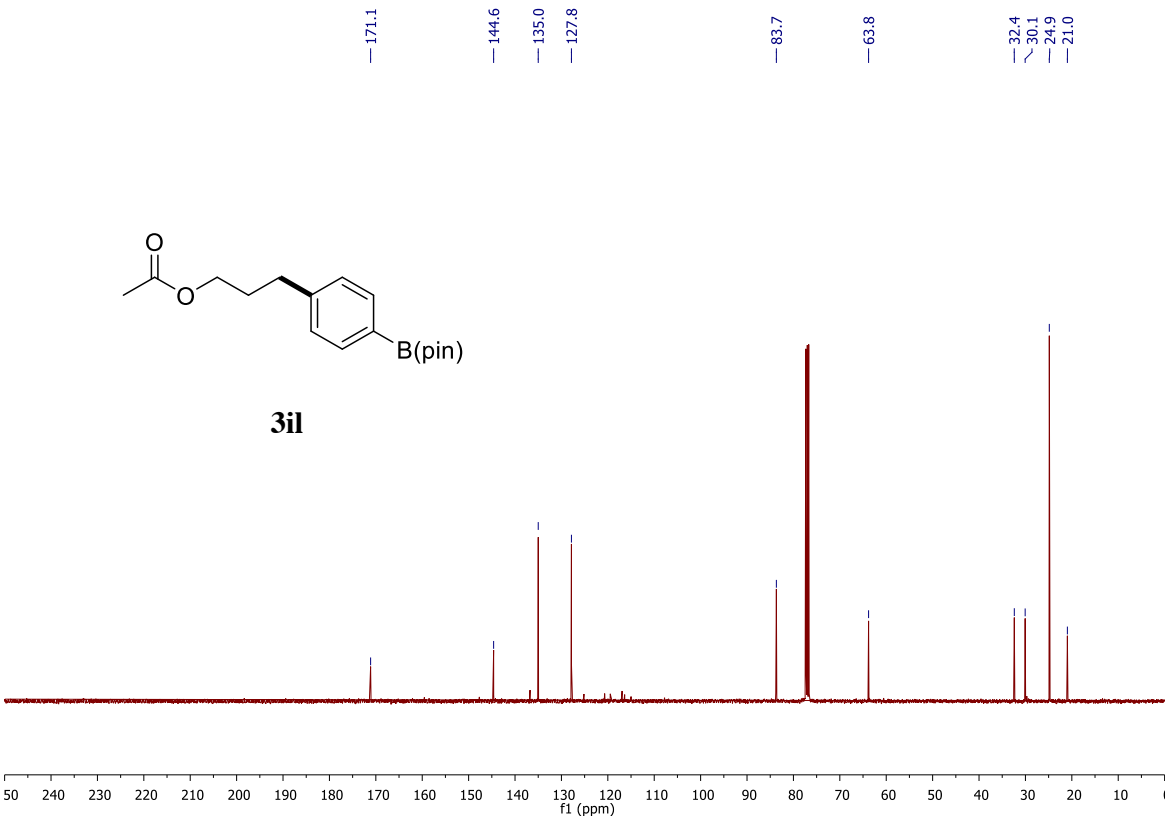


^{1}H spectrum of 3il



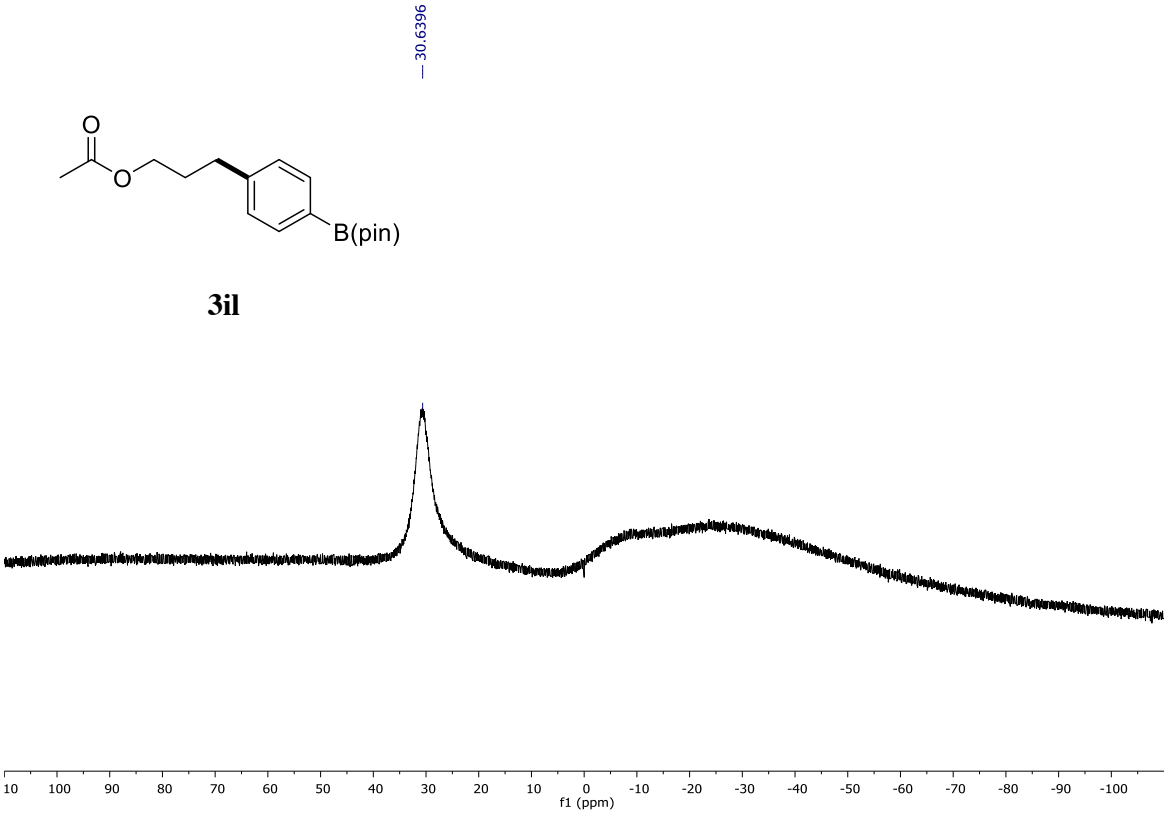
3il

^{13}C spectrum of 3il



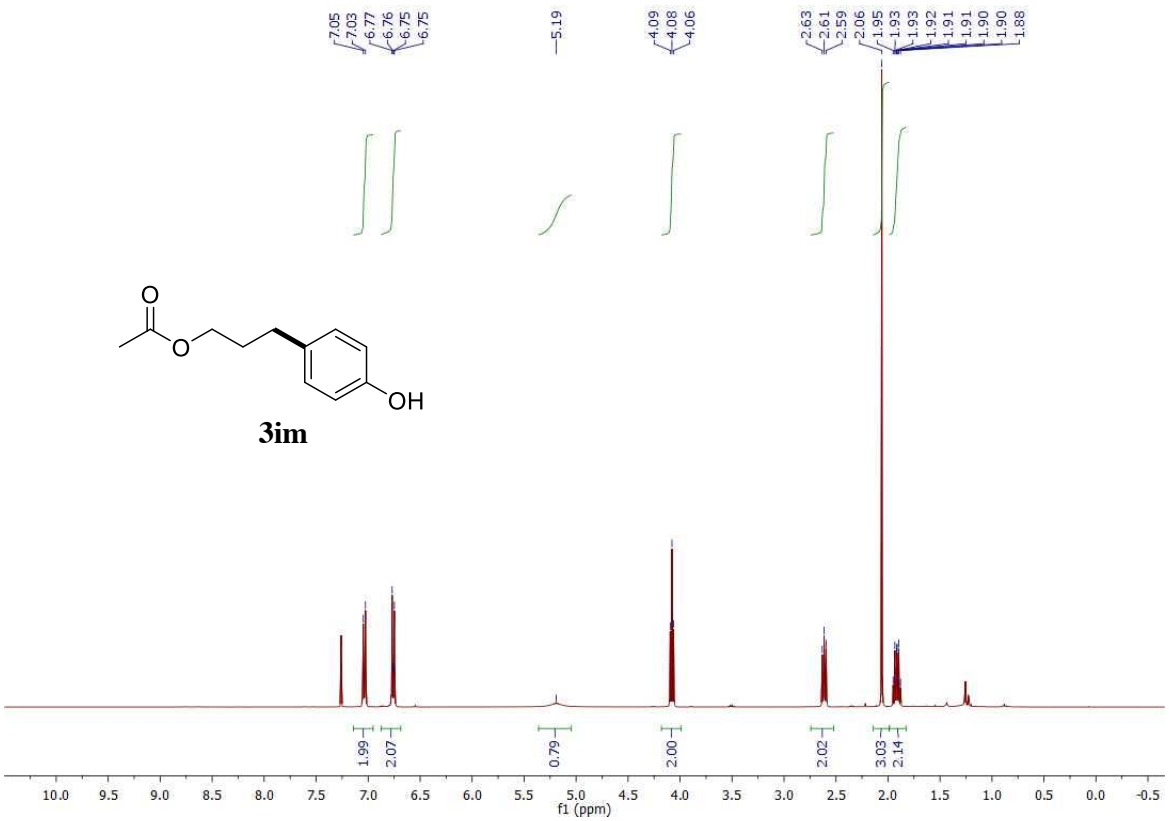
3il

^{10}B spectrum of 3il



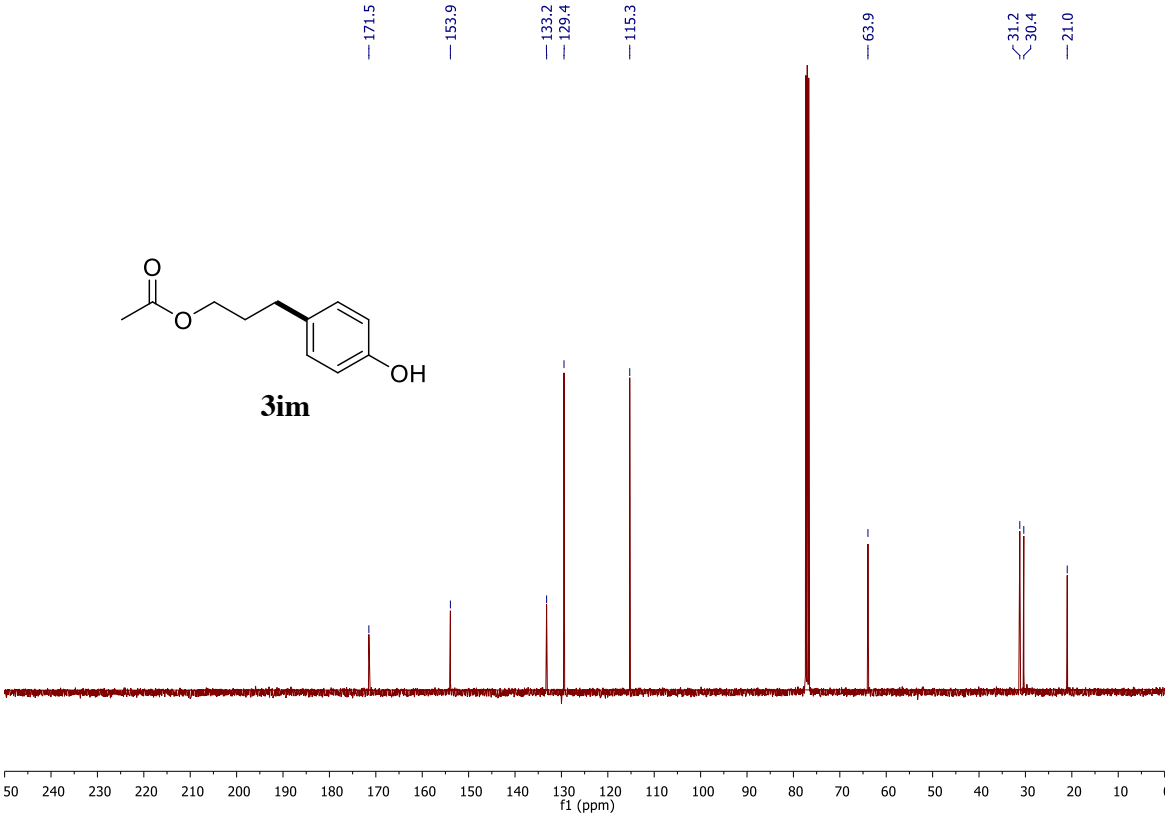
3il

^{1}H spectrum of 3im



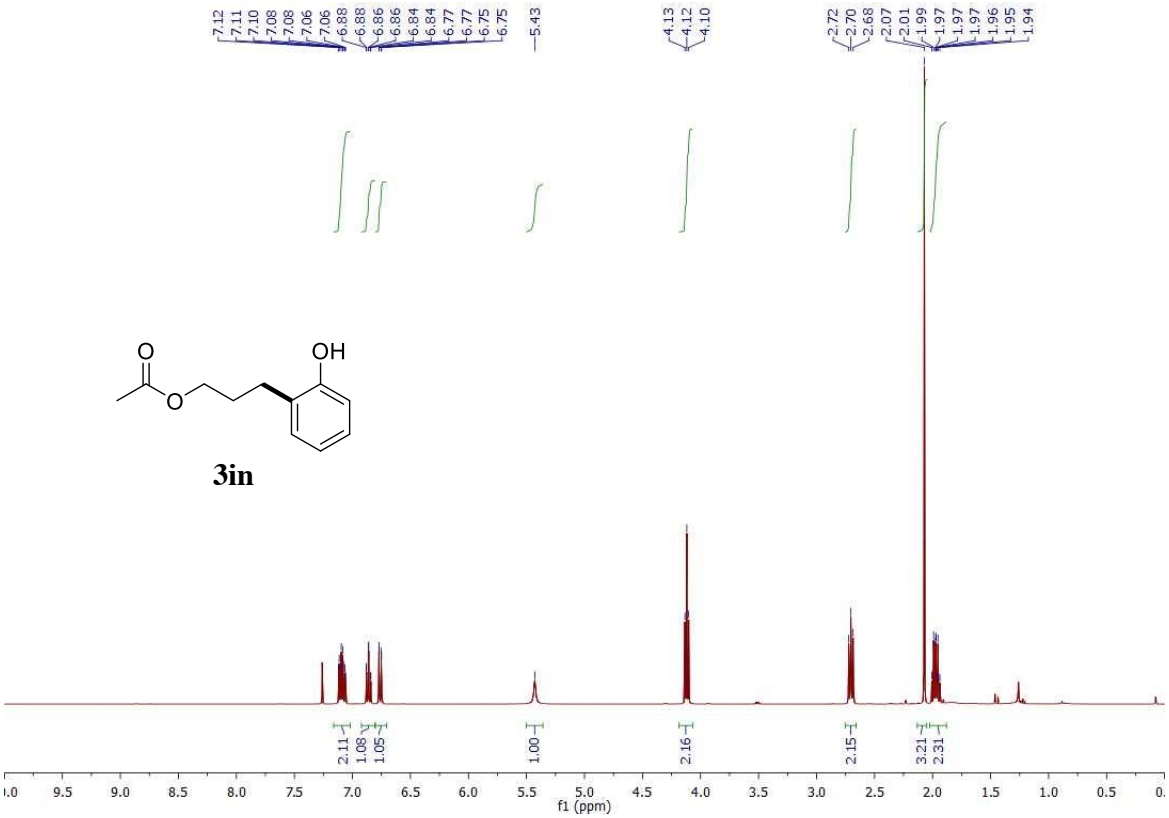
3im

^{13}C spectrum of 3im



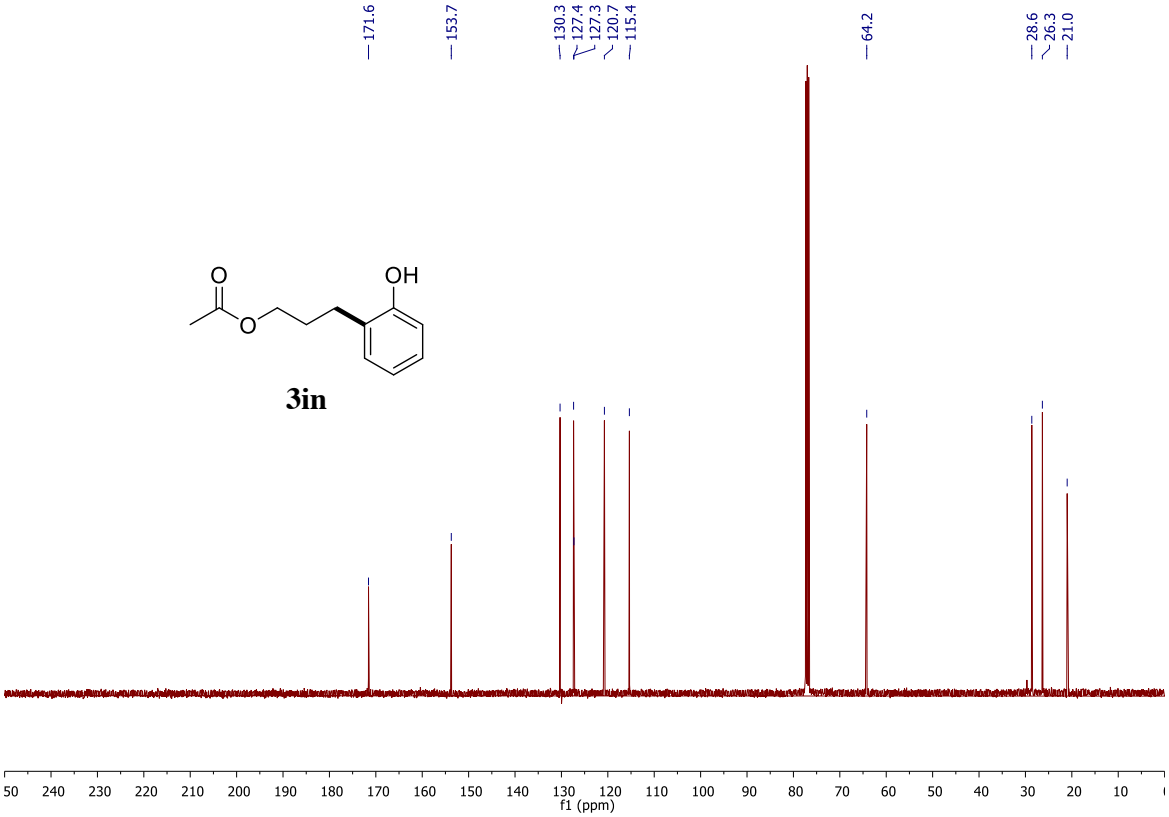
3im

^{1}H spectrum of 3in



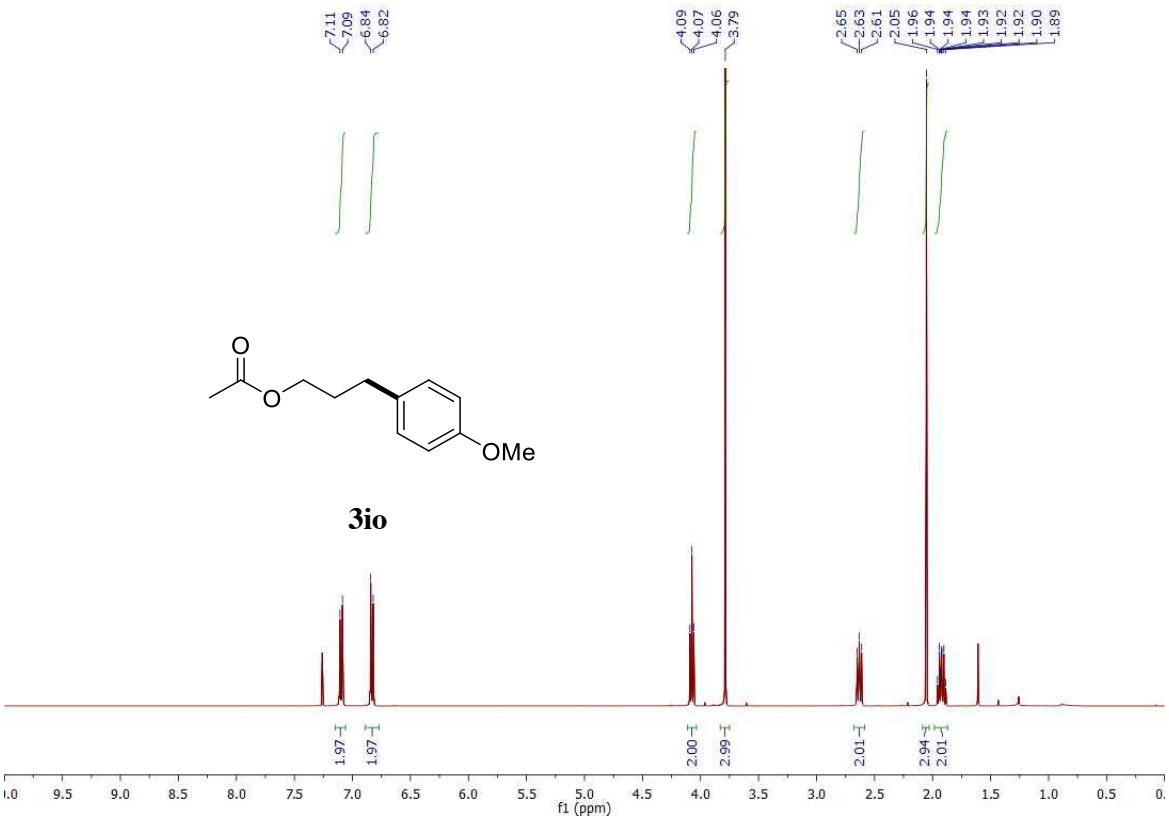
3in

^{13}C spectrum of 3in



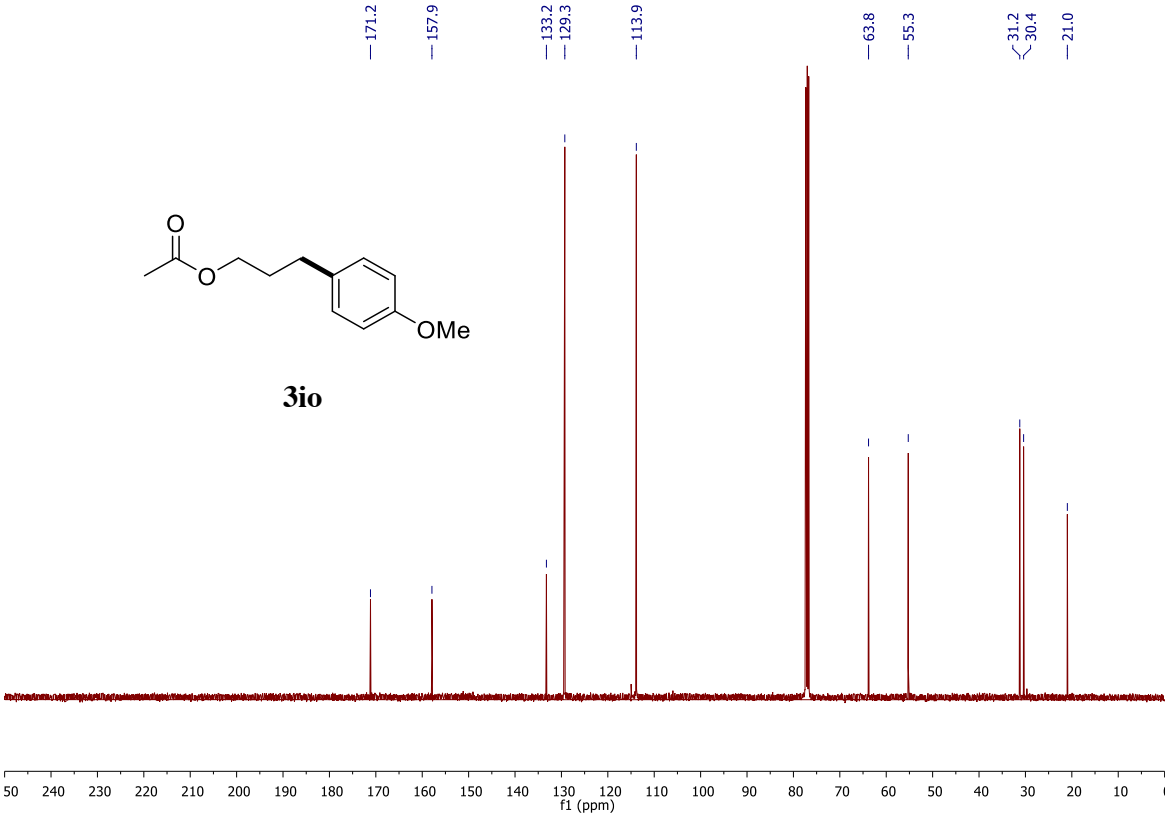
3in

^{1}H spectrum of 3io



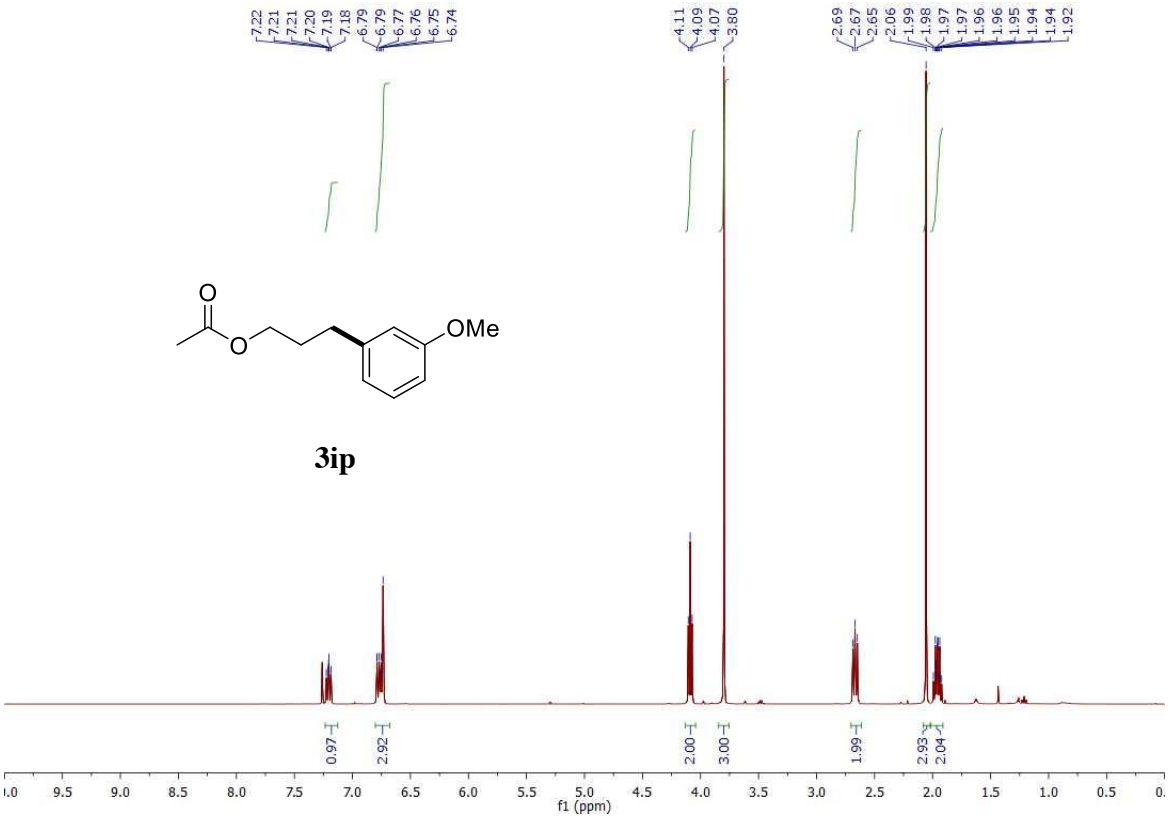
3io

^{13}C spectrum of 3io



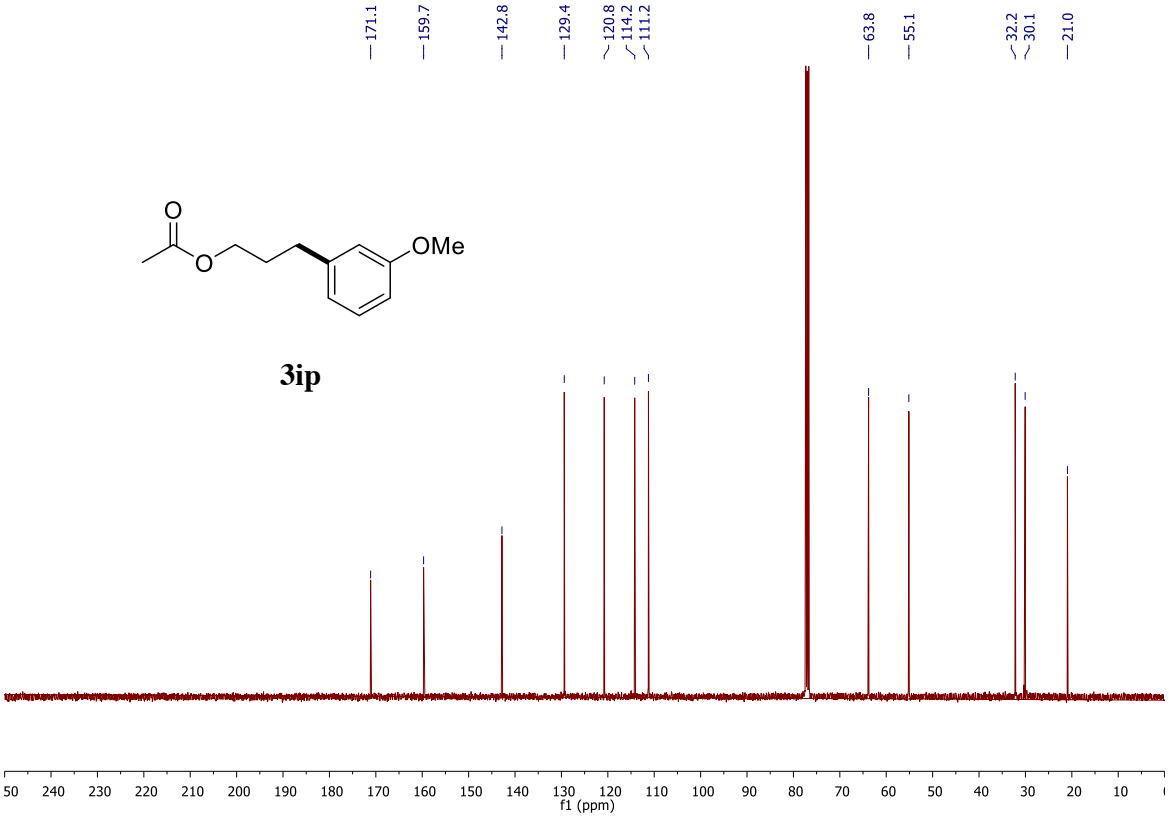
3io

^{1}H spectrum of 3ip



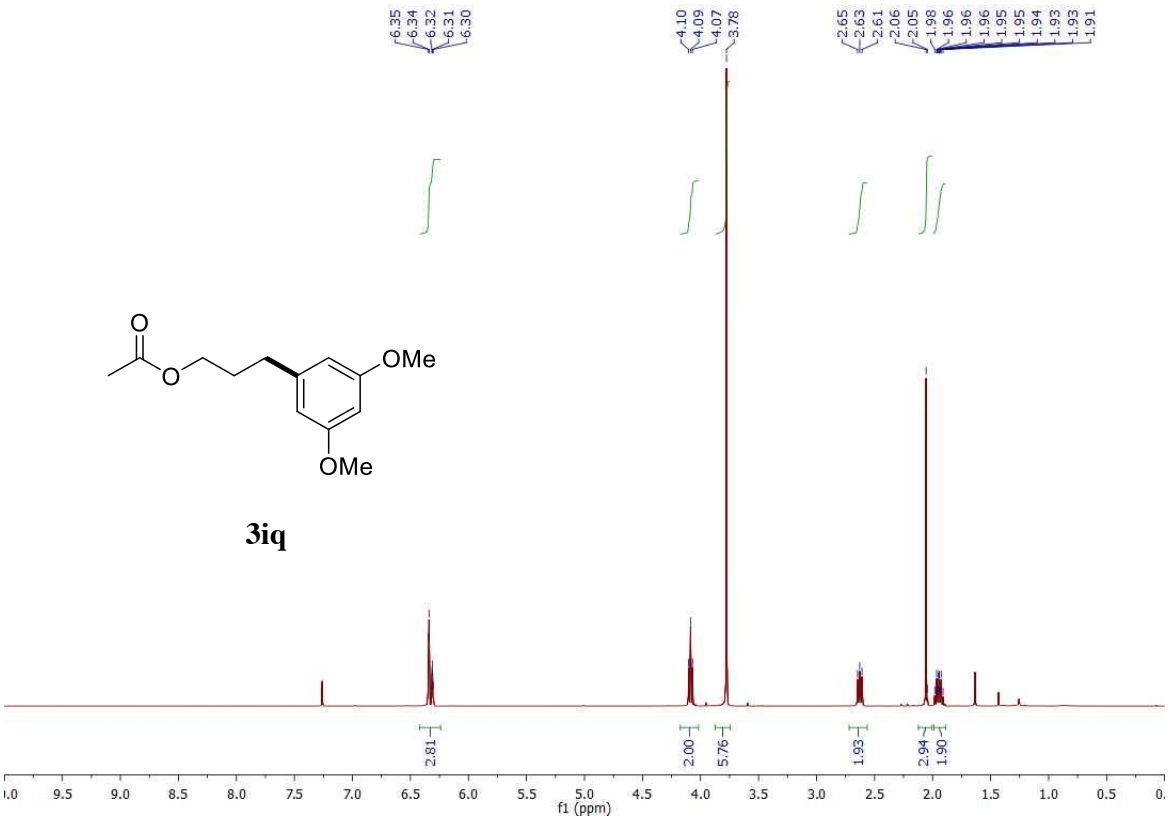
3ip

^{13}C spectrum of 3ip



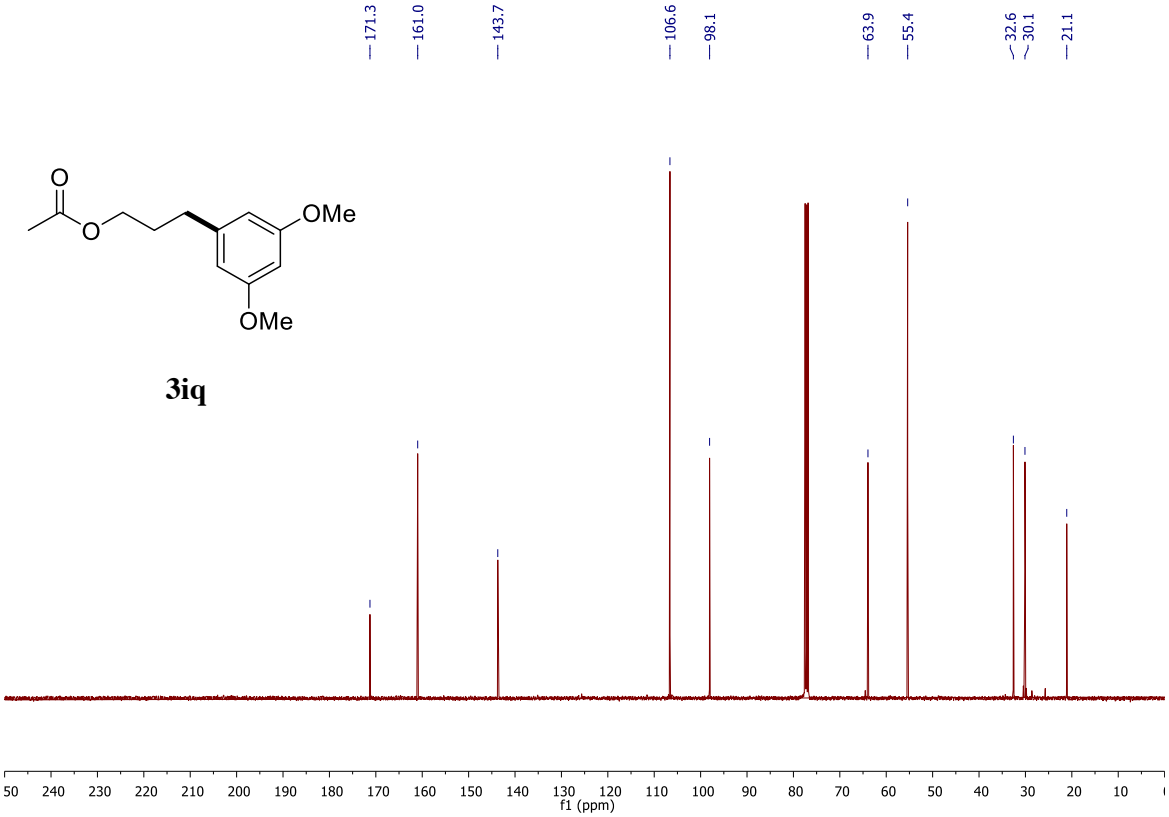
3ip

^{1}H spectrum of 3iq



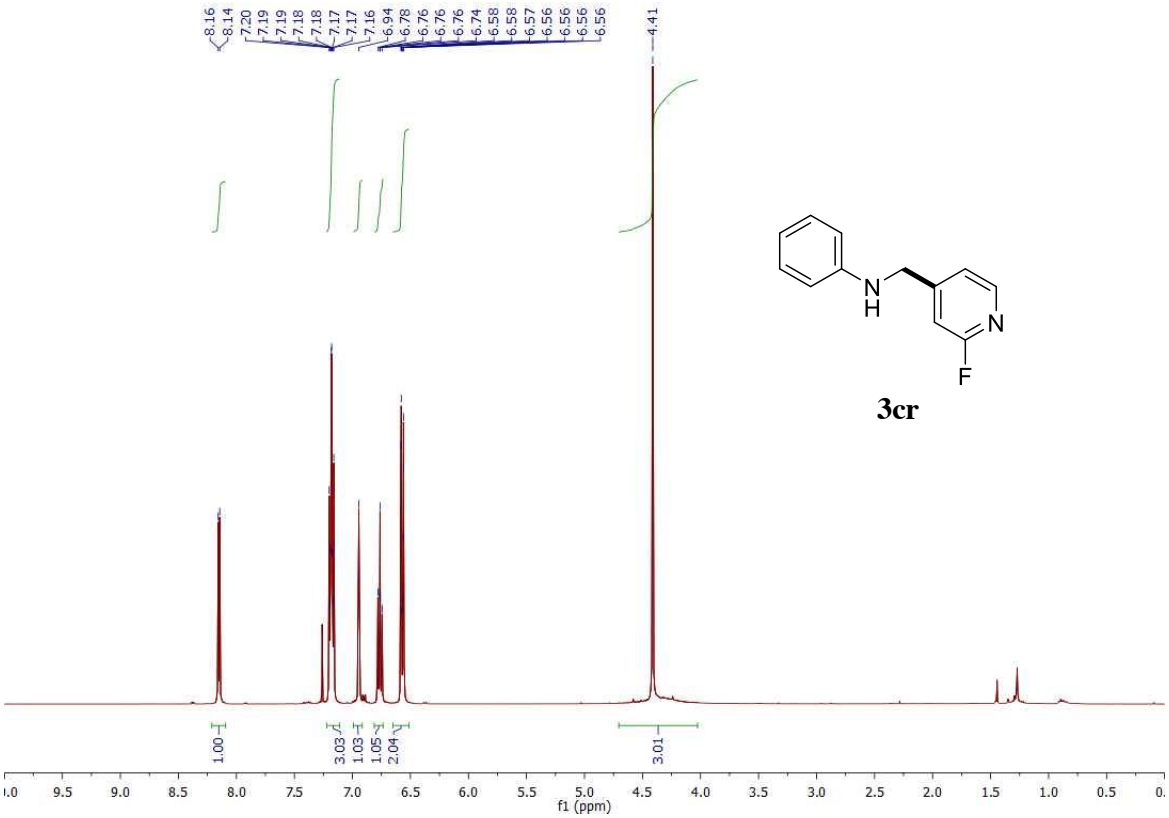
3iq

^{13}C spectrum of 3iq



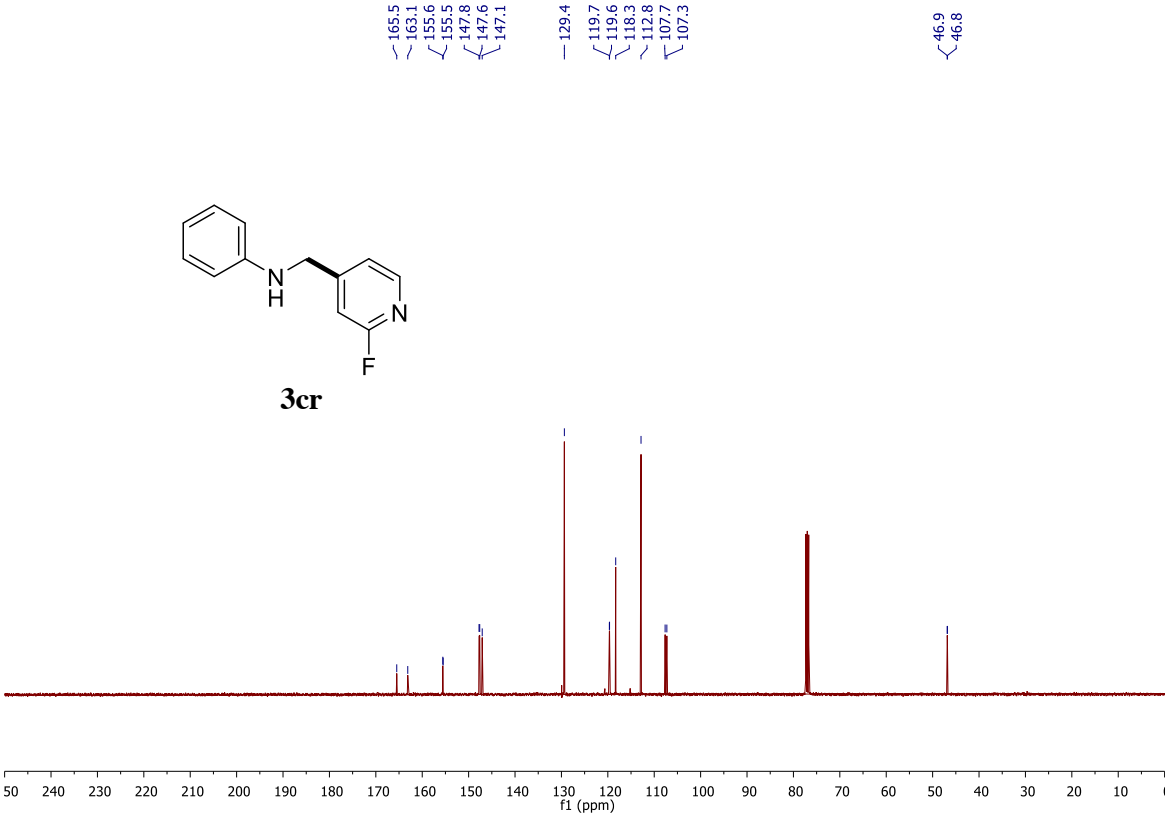
3iq

^{1}H spectrum of 3cr



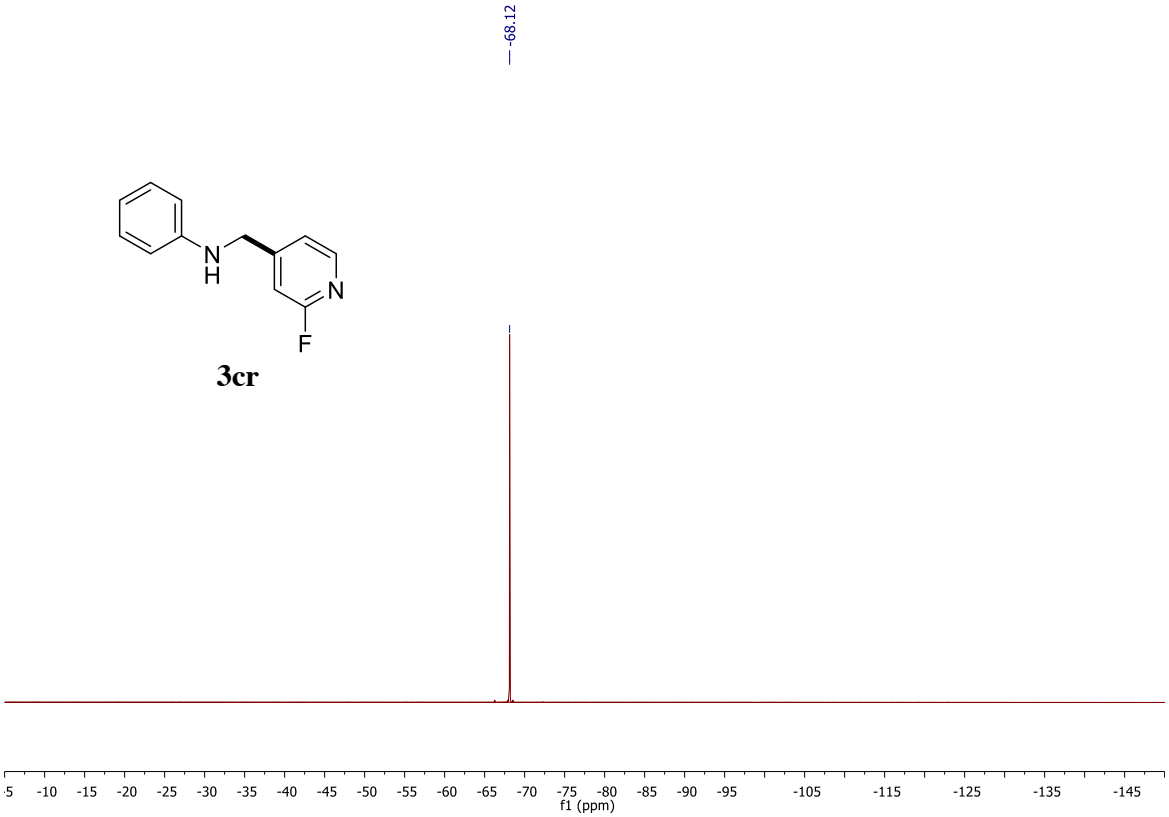
3cr

^{13}C spectrum of 3cr



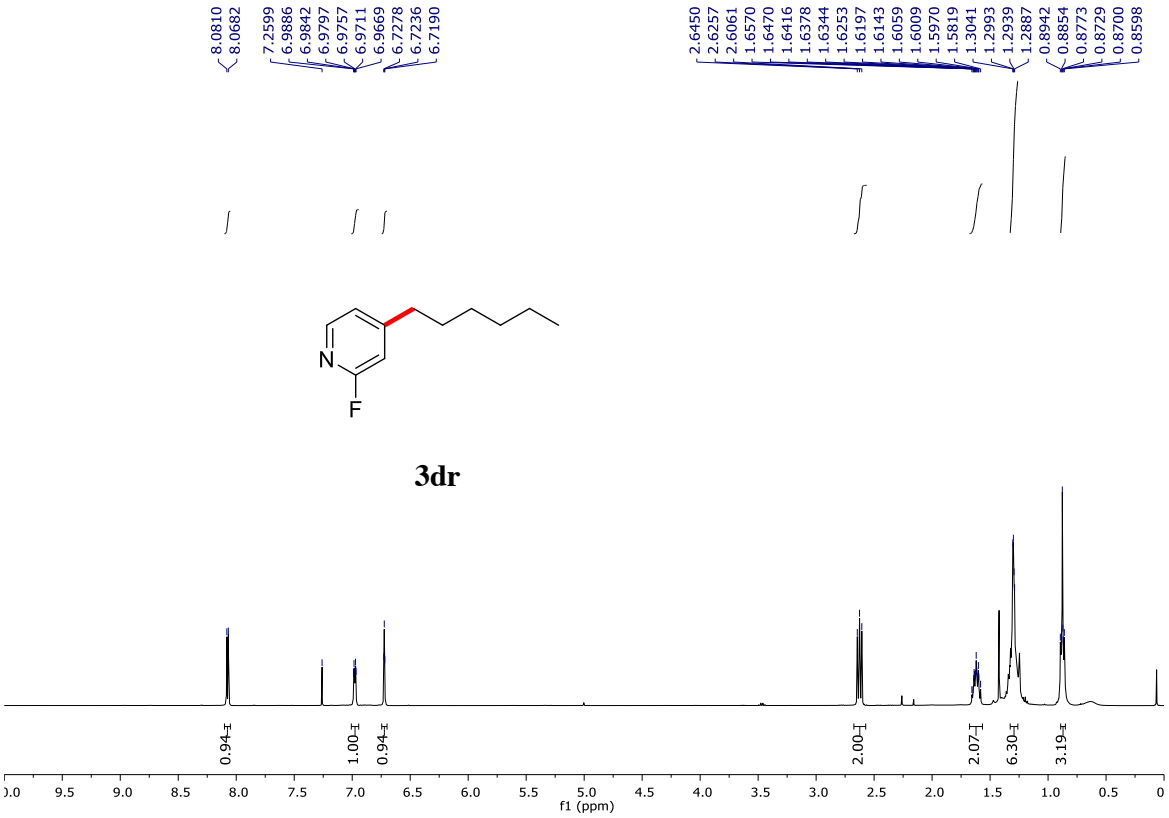
3cr

^{19}F spectrum of 3cr



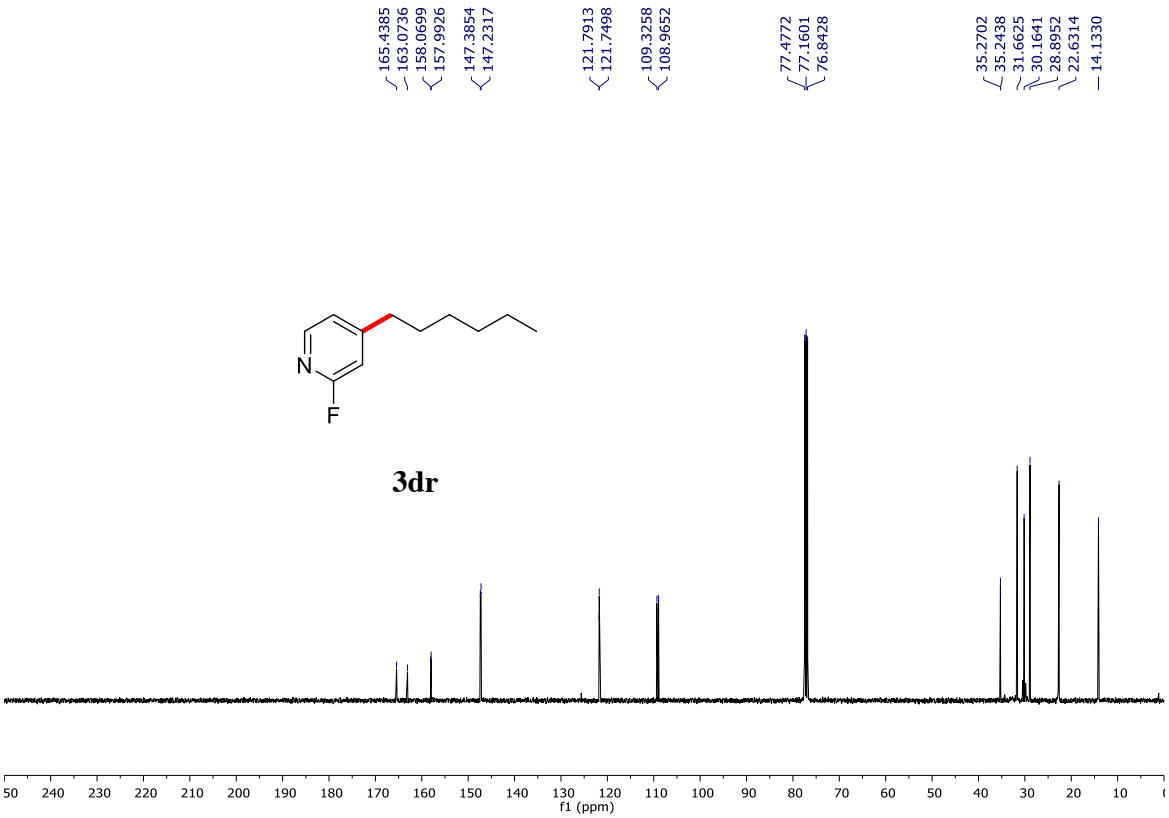
3cr

^{1}H spectrum of 3dr



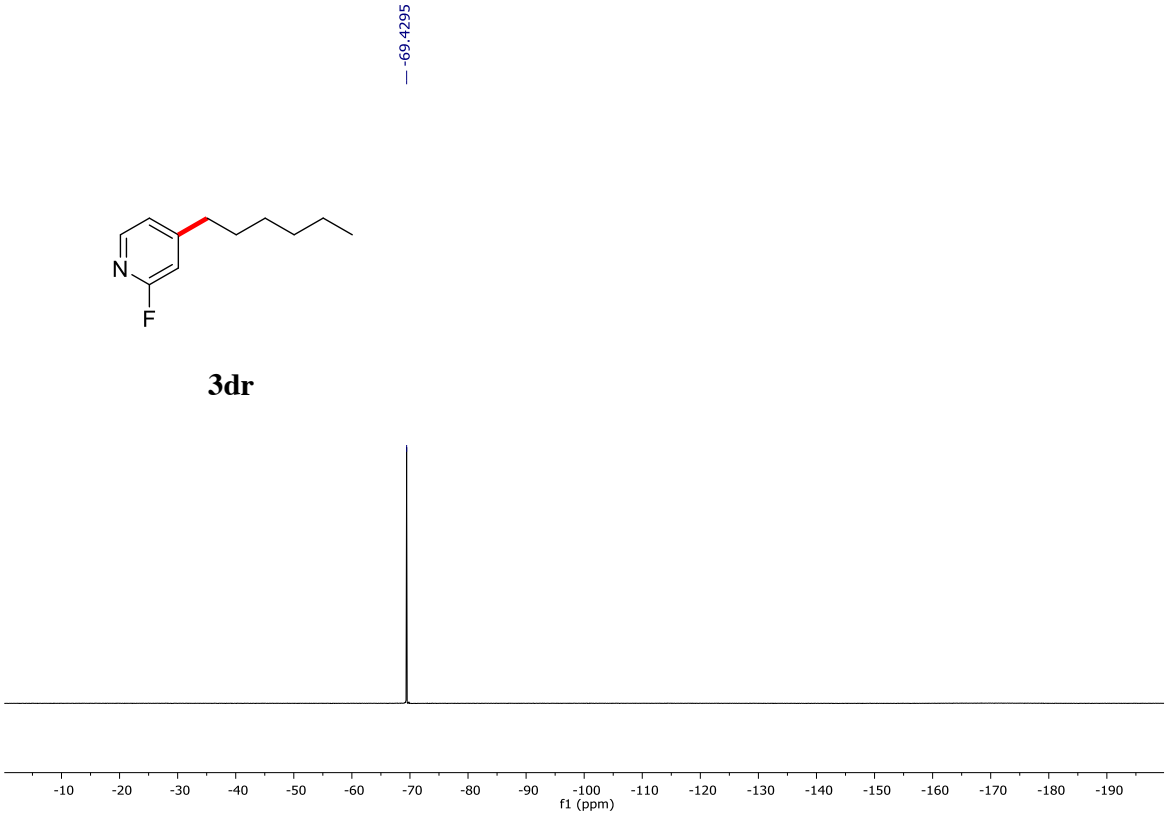
3dr

^{13}C spectrum of 3dr



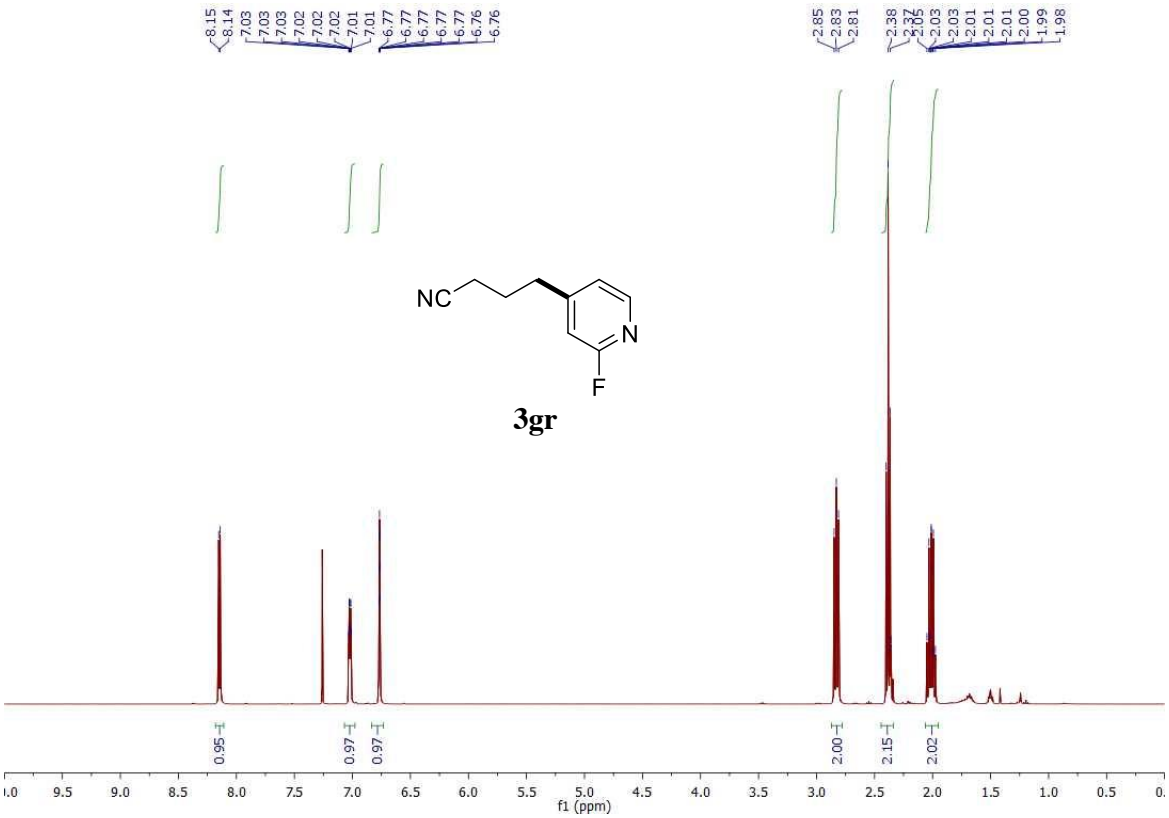
3dr

^{19}F spectrum of 3dr



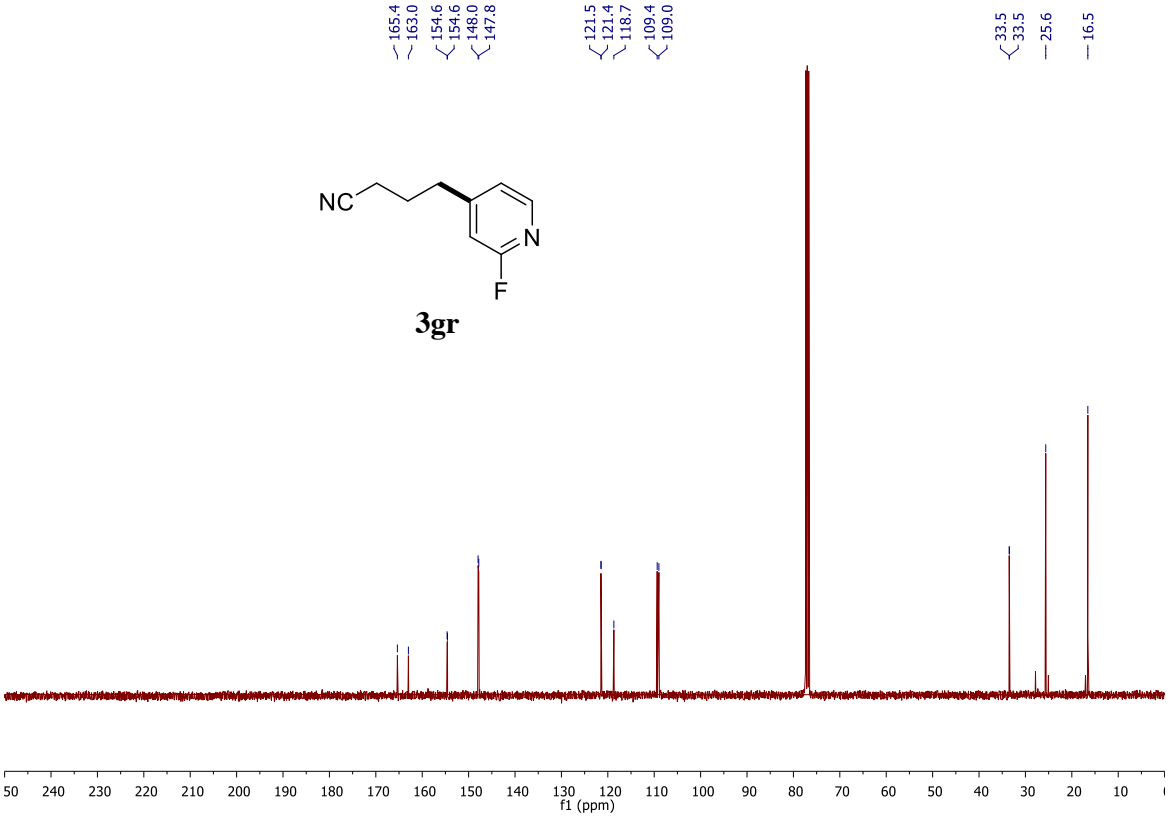
3dr

^{1}H spectrum of 3gr

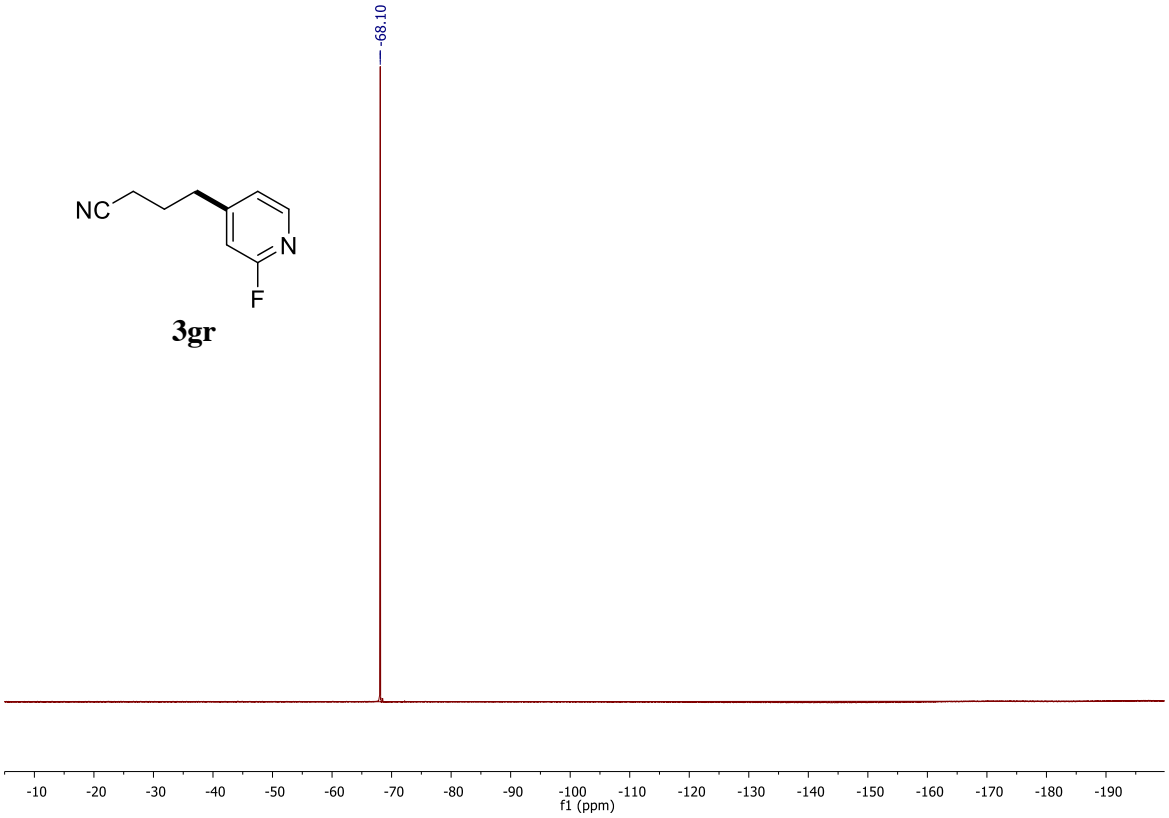


3gr

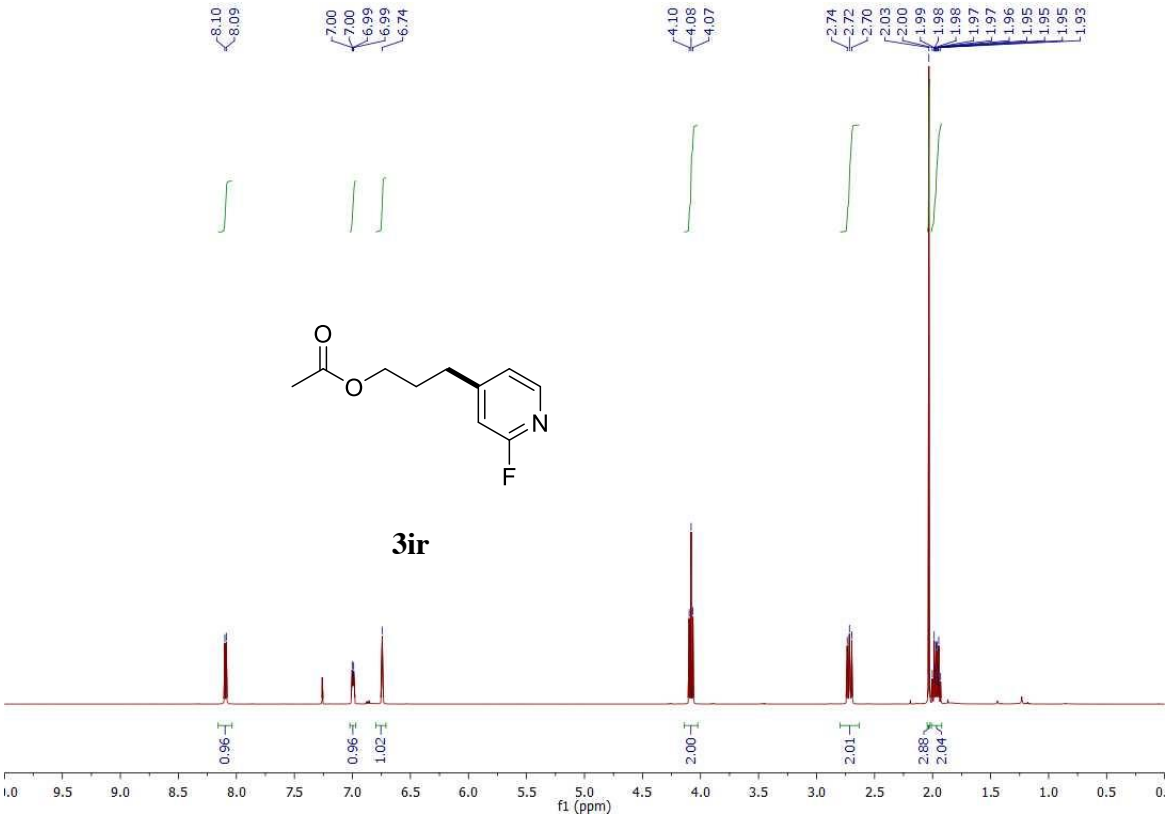
^{13}C spectrum of 3gr



^{19}F spectrum of 3gr

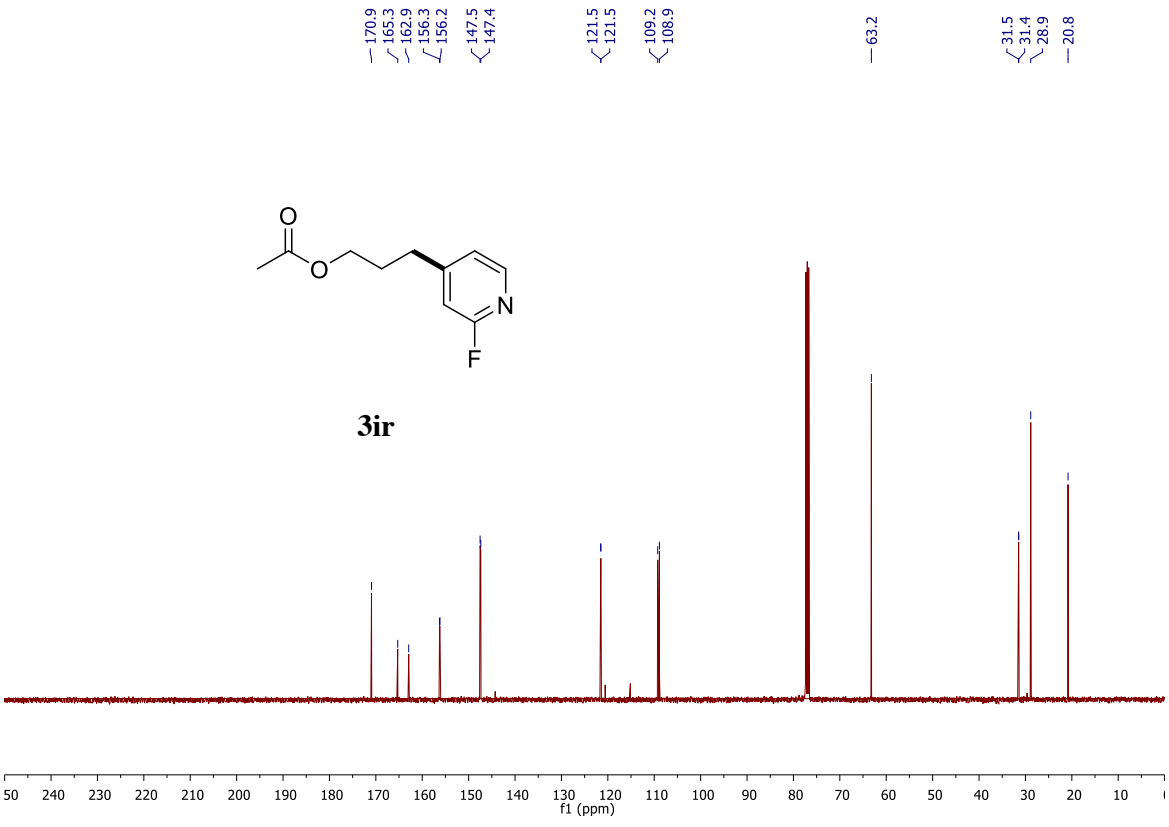


^{1}H spectrum of 3ir



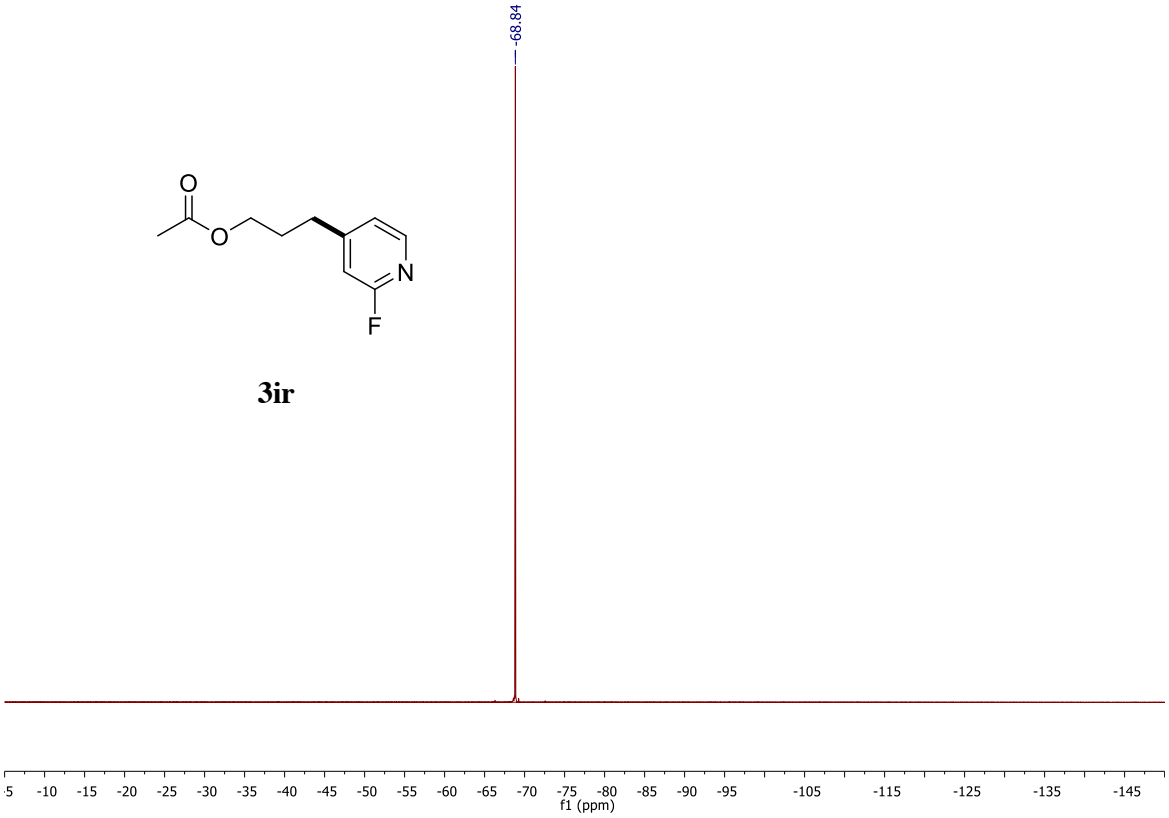
3ir

^{13}C spectrum of 3ir



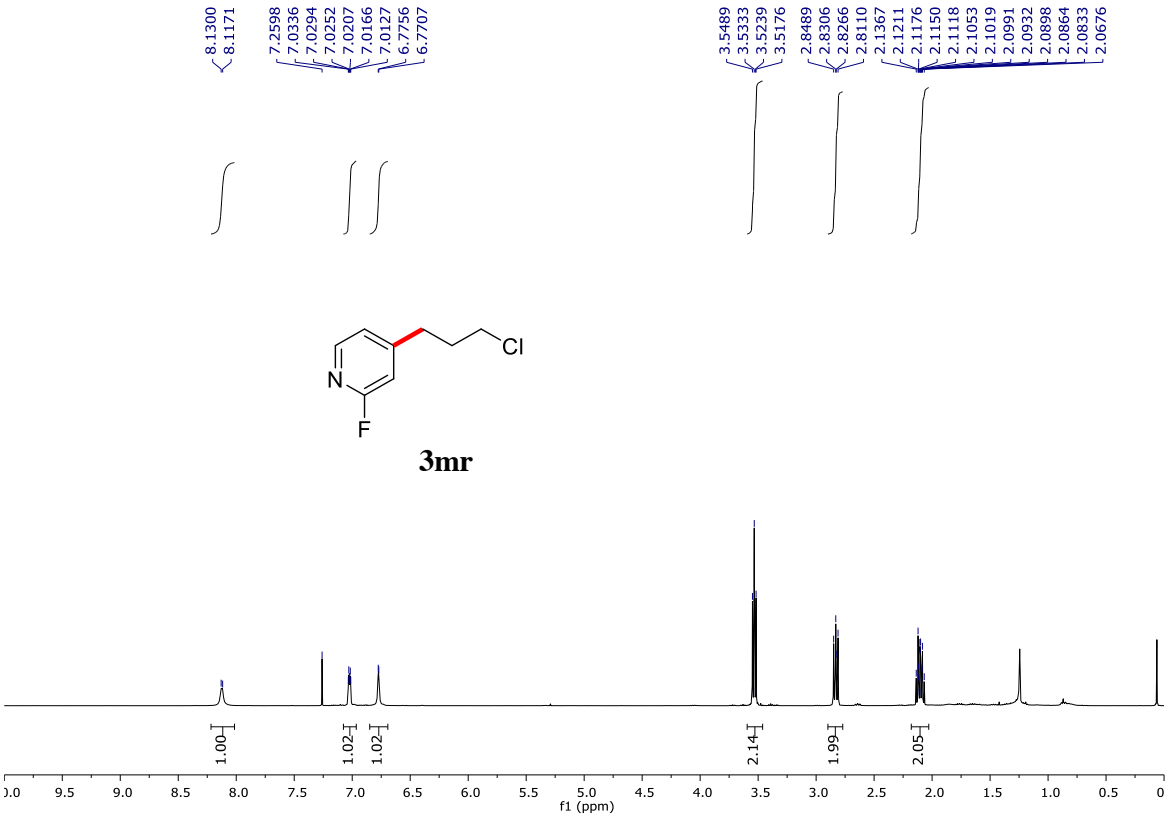
3ir

^{19}F spectrum of 3ir



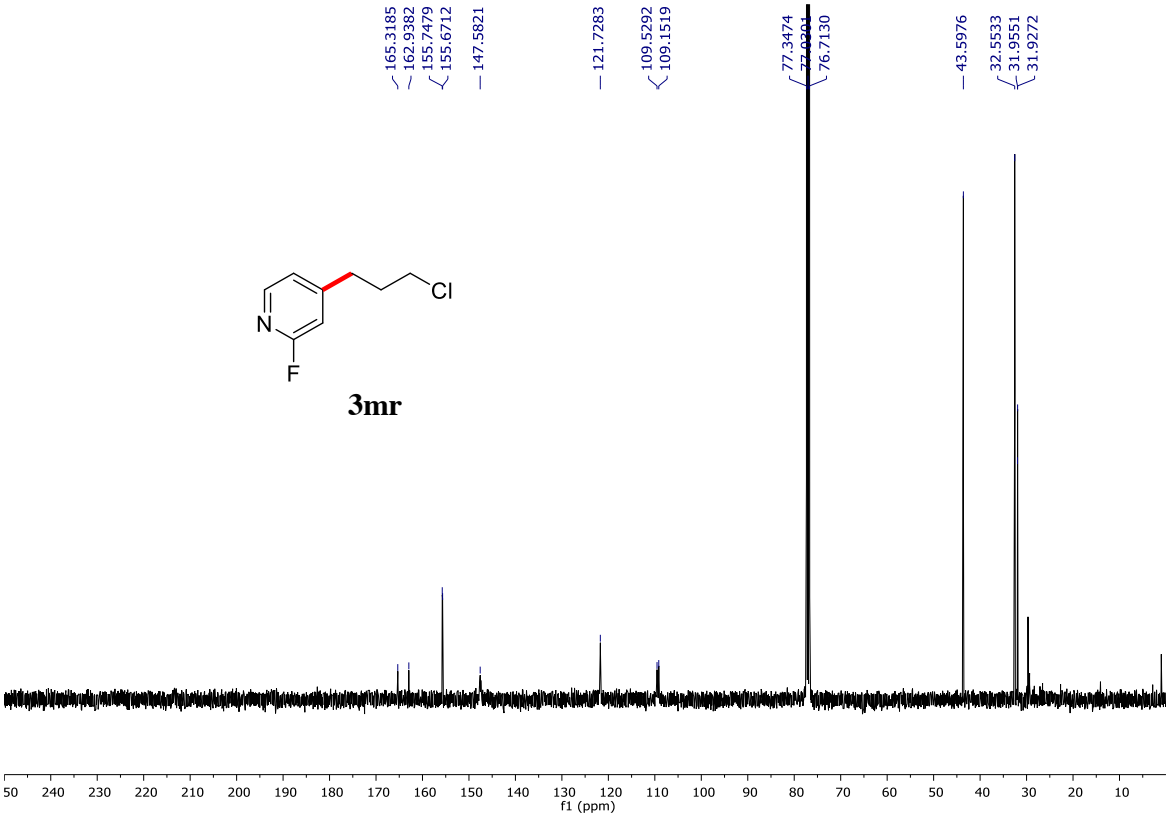
3ir

^{1}H spectrum of 3mr

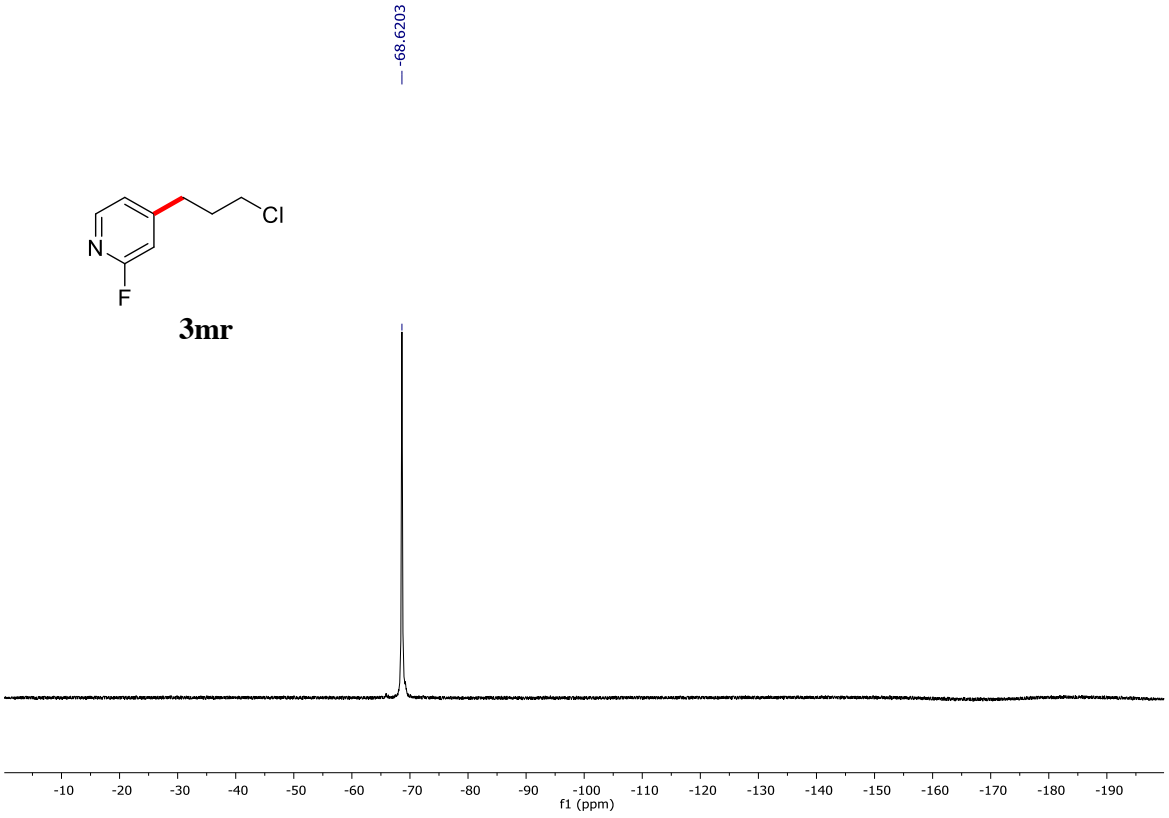


3mr

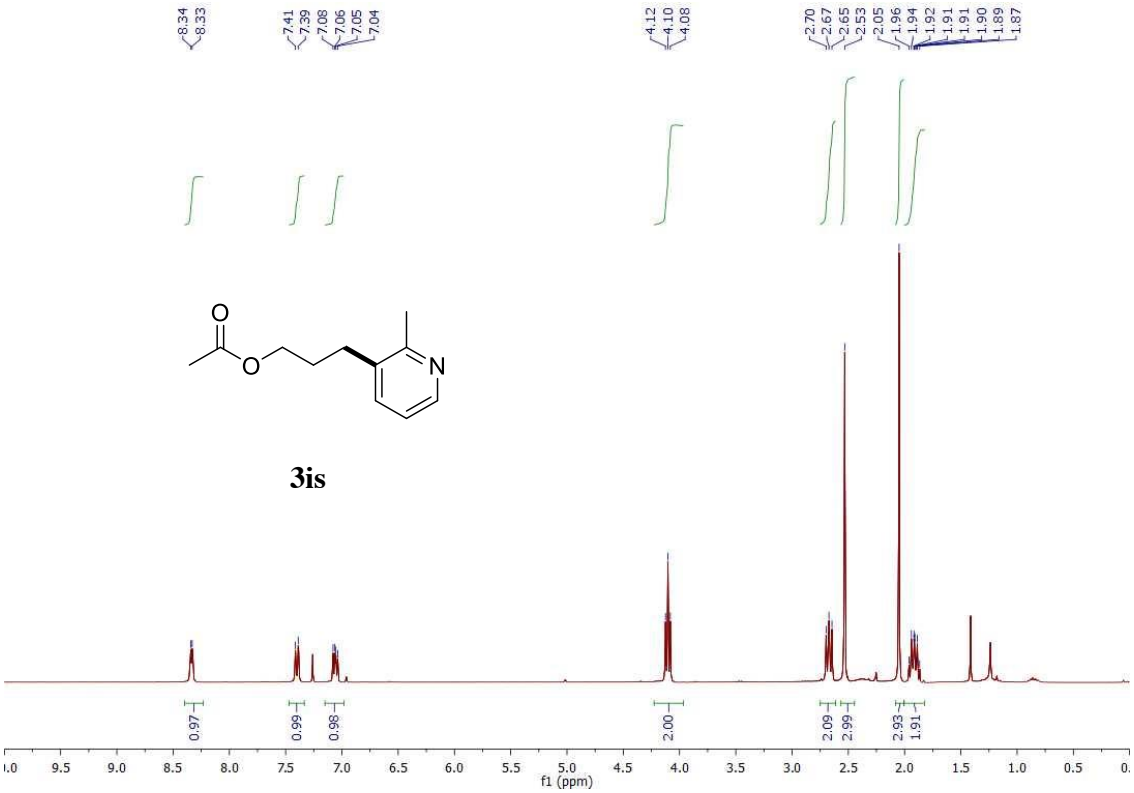
^{13}C spectrum of 3mr



^{19}F spectrum of 3mr

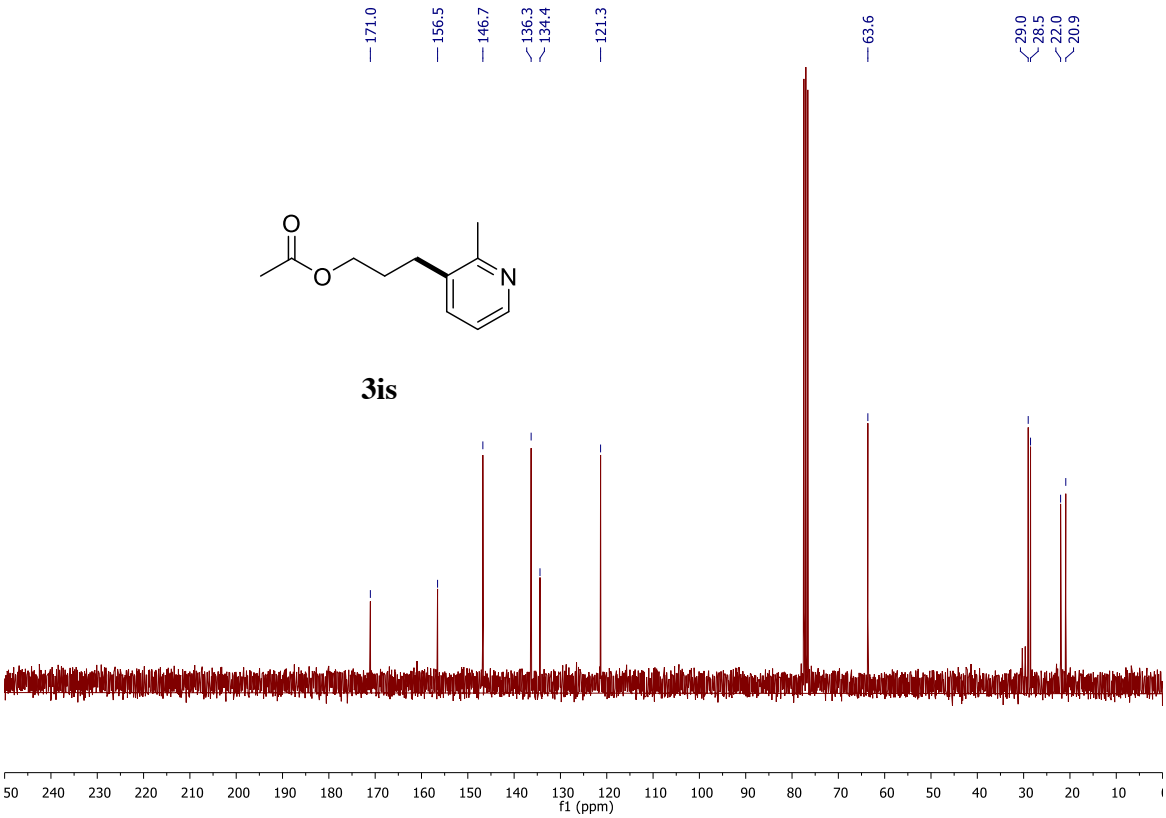


^{1}H spectrum of 3is



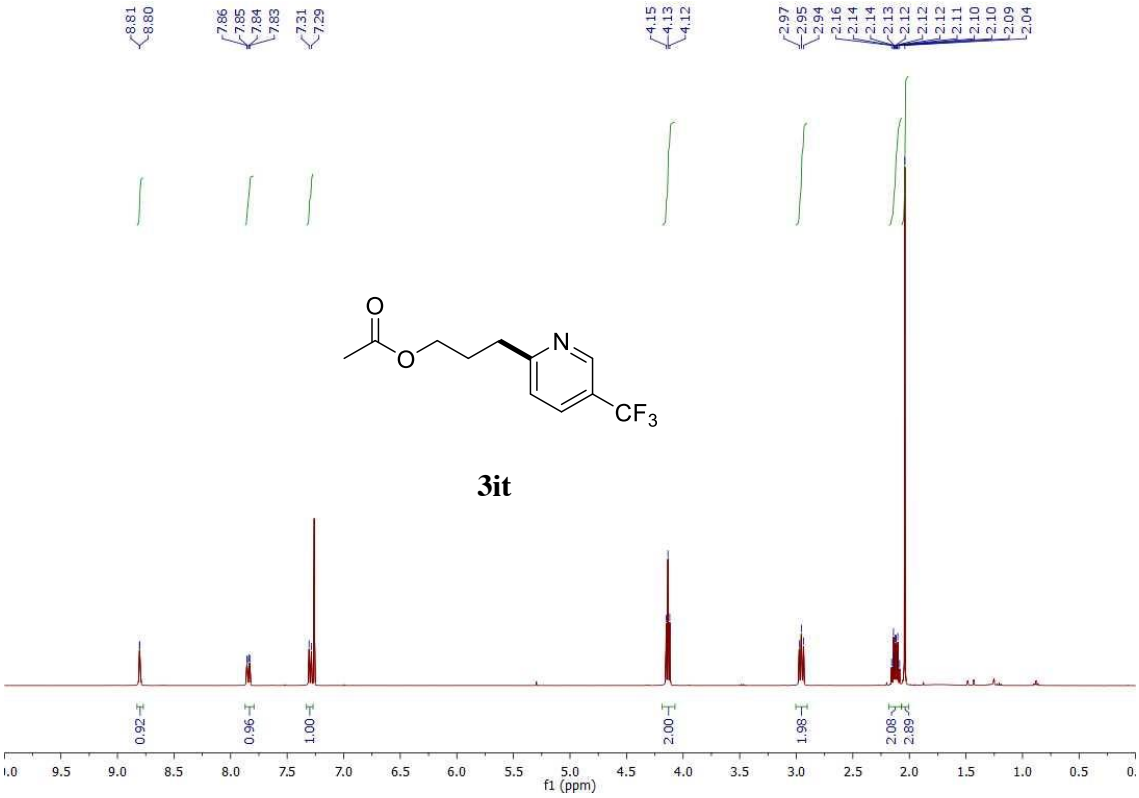
3is

^{13}C spectrum of 3is



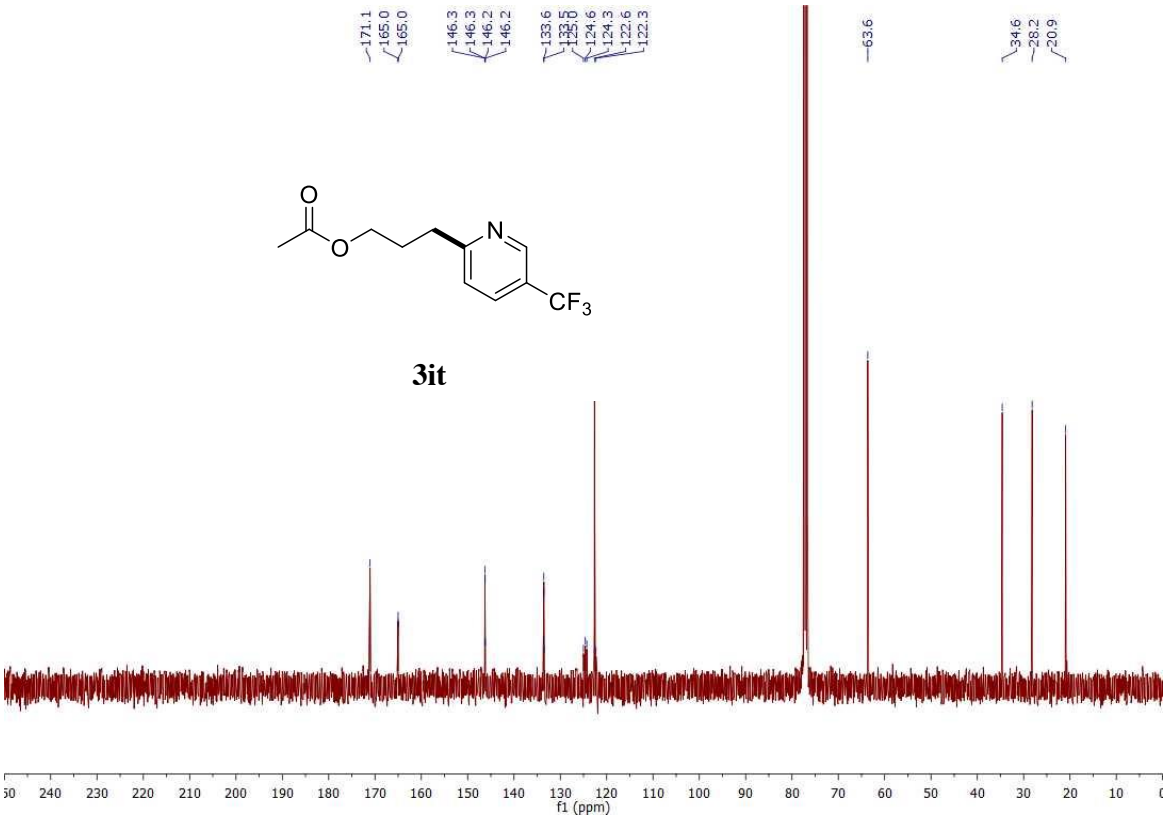
3is

^{1}H spectrum of 3it



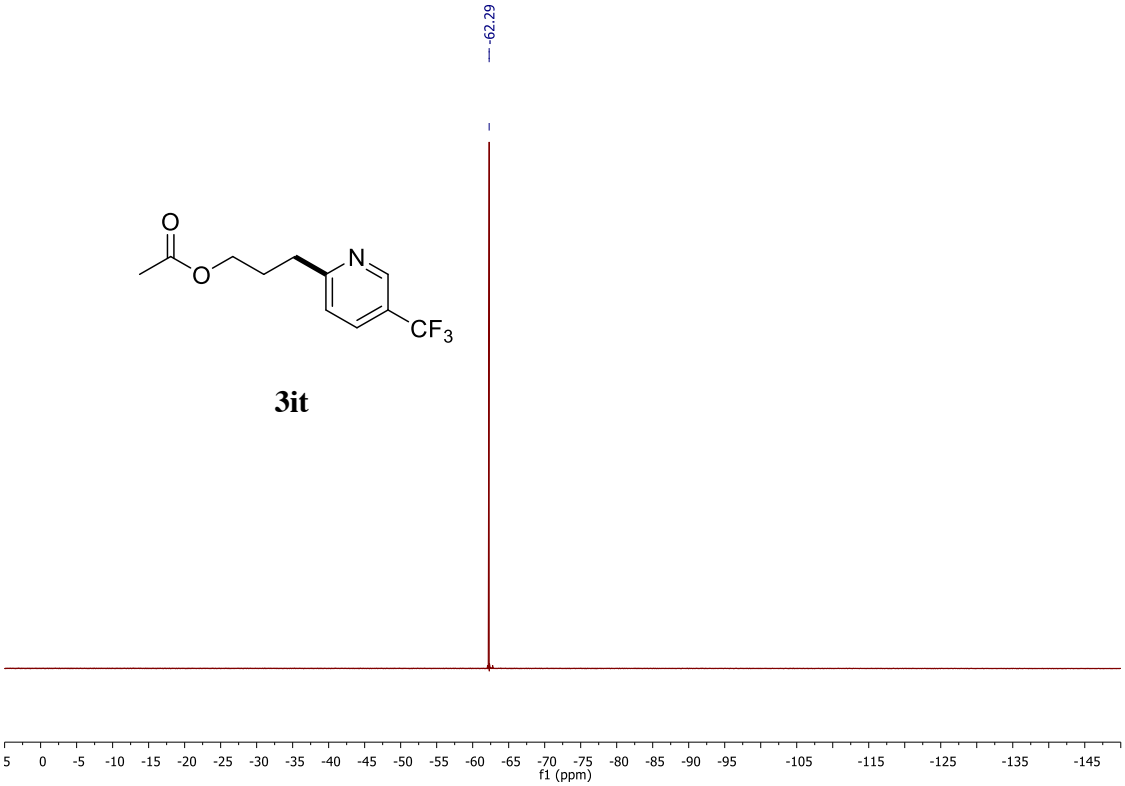
3it

^{13}C spectrum of 3it



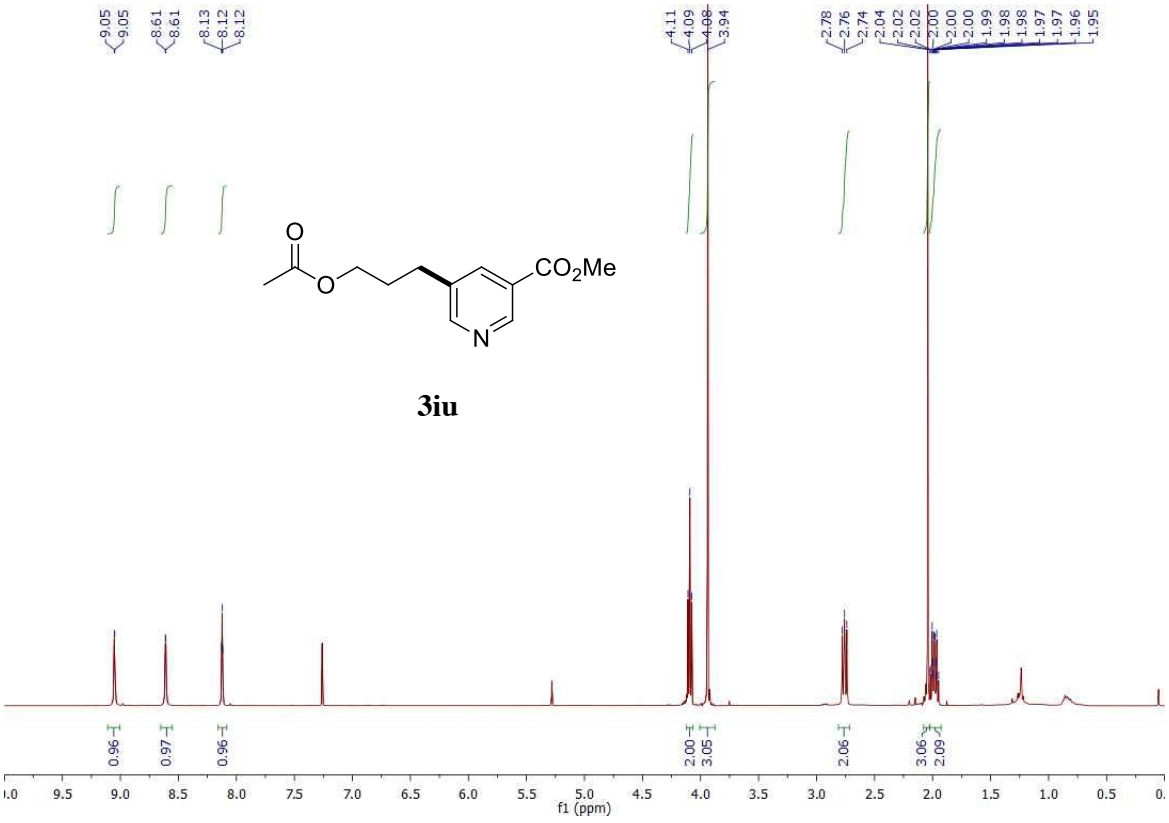
3it

^{19}F spectrum of 3it



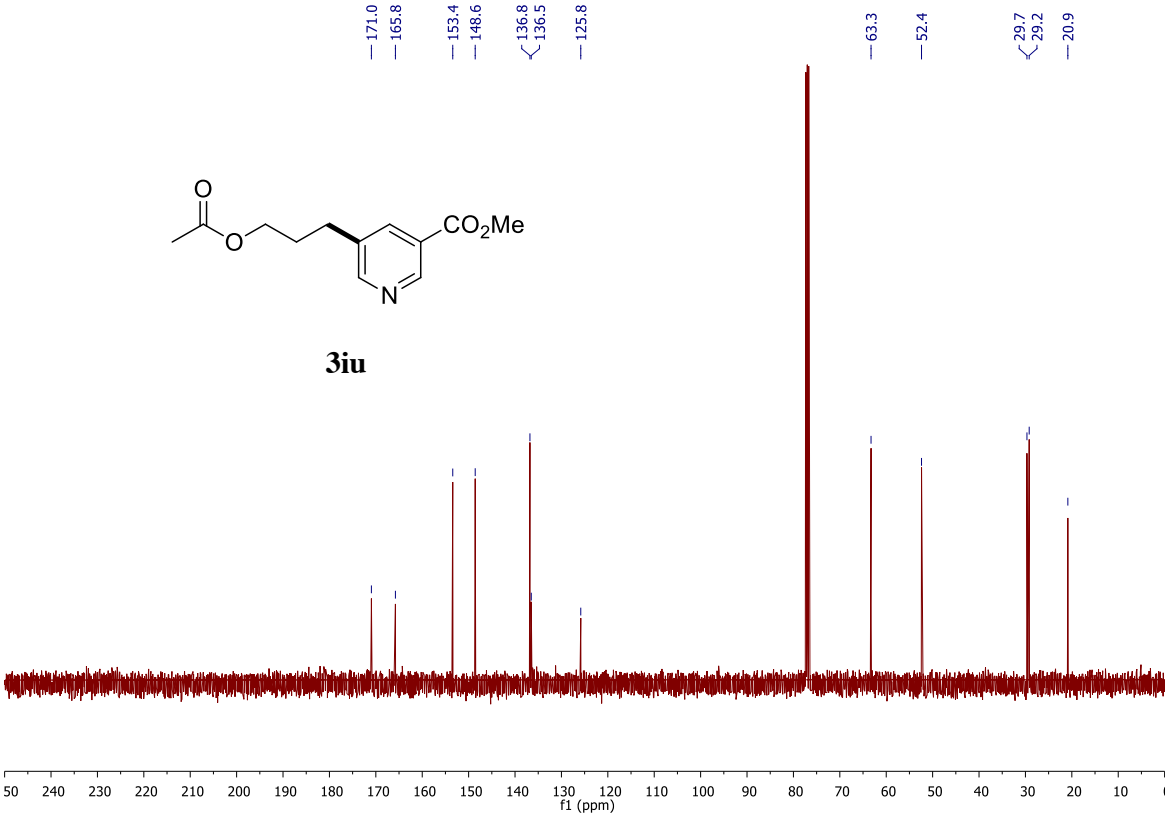
3it

^{1}H spectrum of 3iu



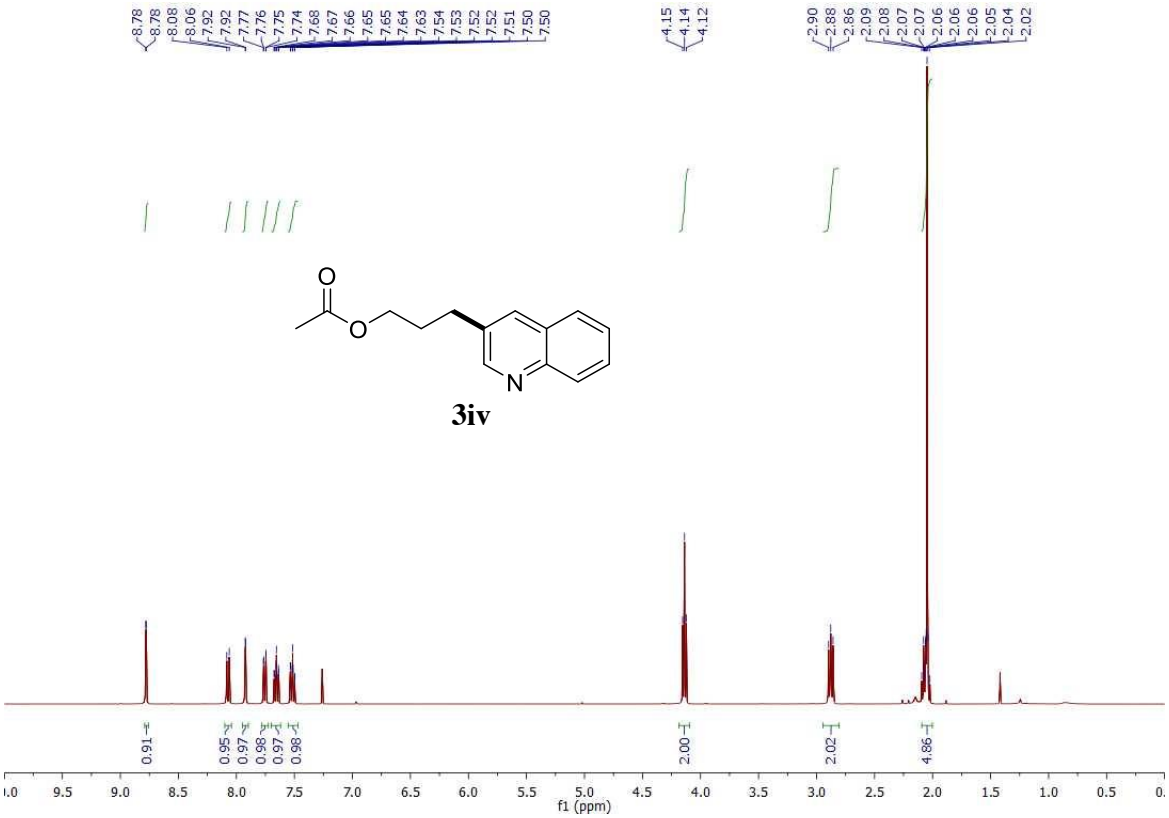
3iu

^{13}C spectrum of 3iu



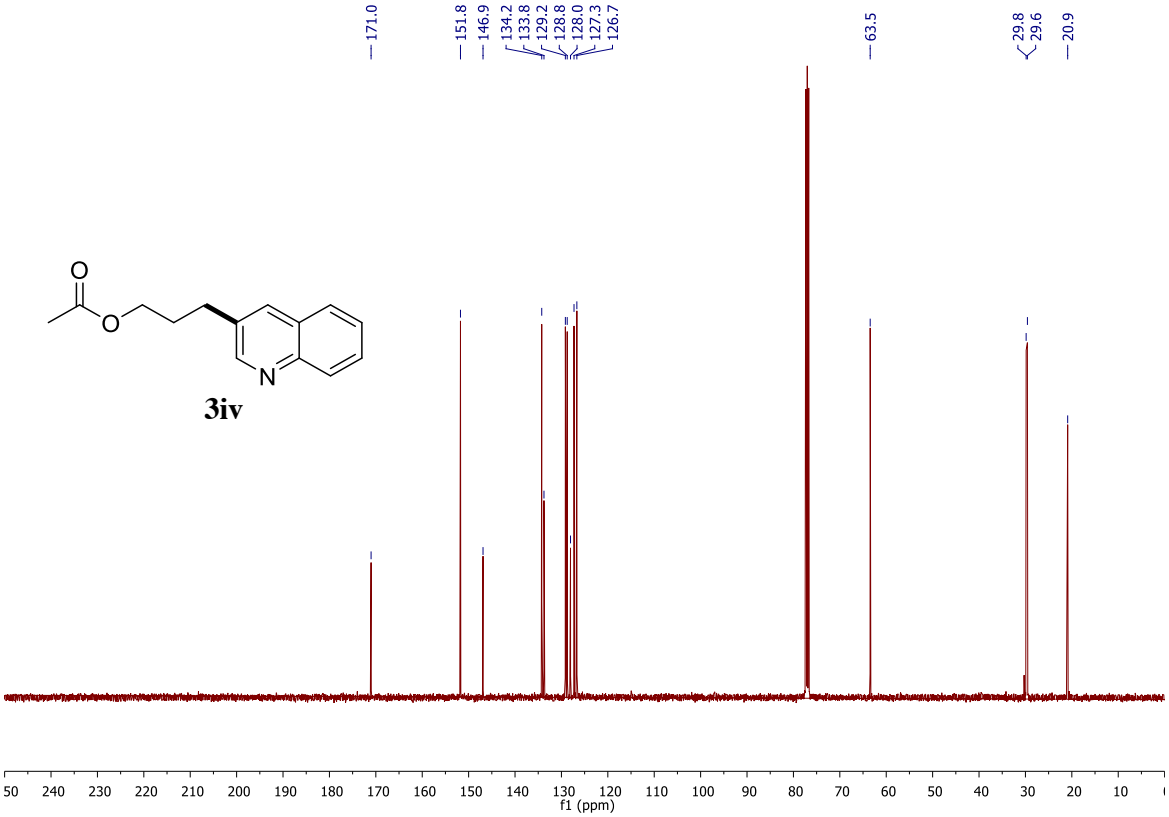
3iu

^{1}H spectrum of 3iv



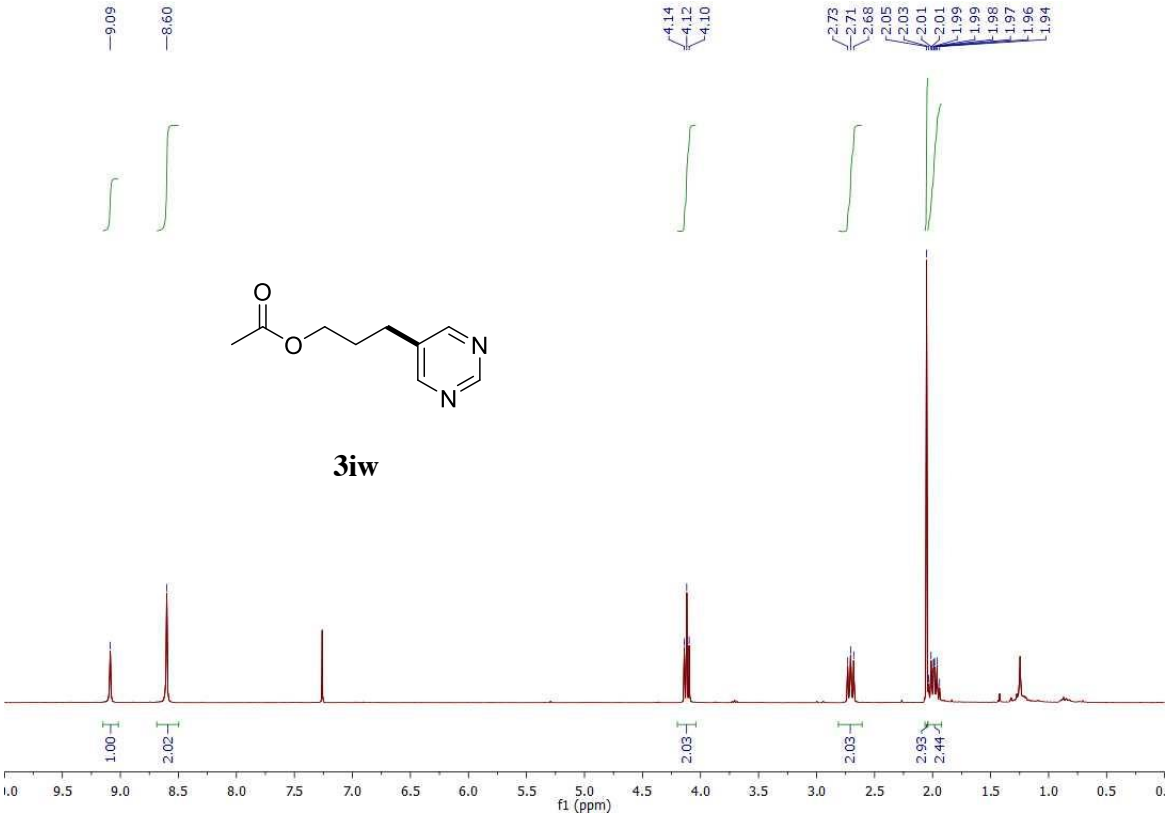
3iv

^{13}C spectrum of 3iv



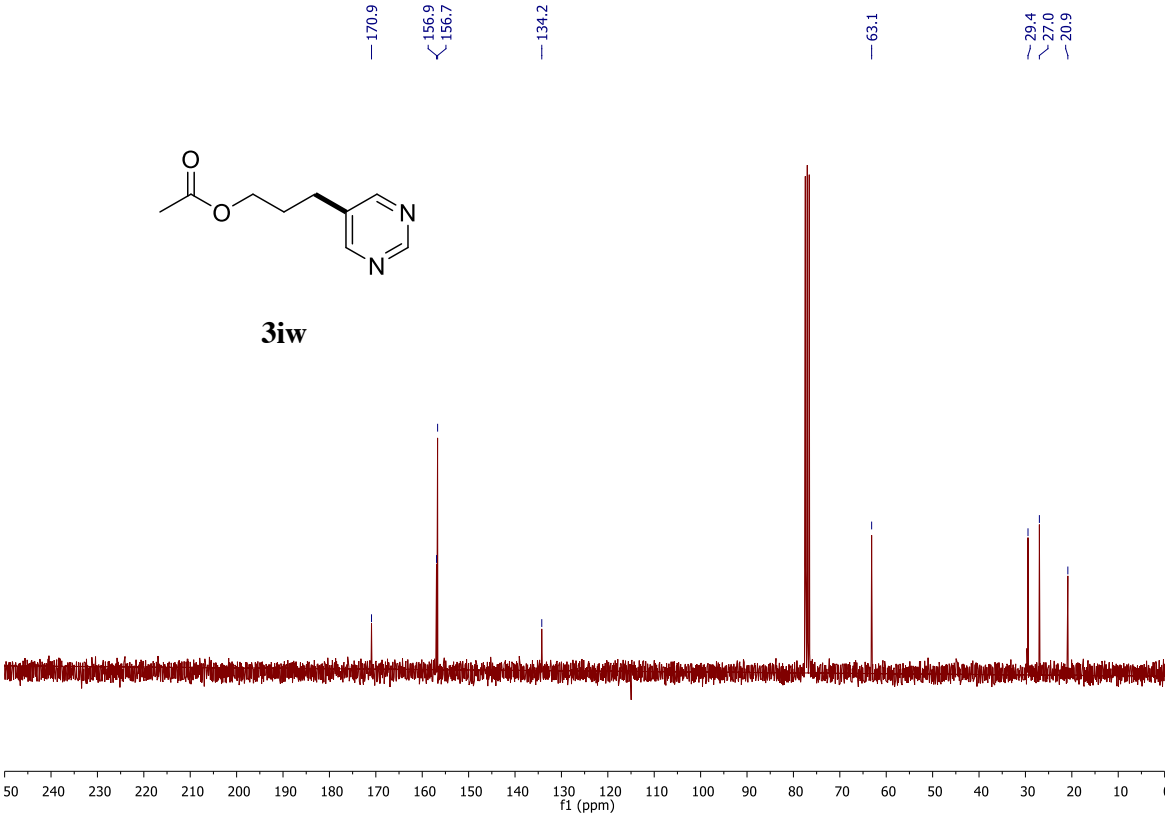
3iv

^{1}H spectrum of 3iw



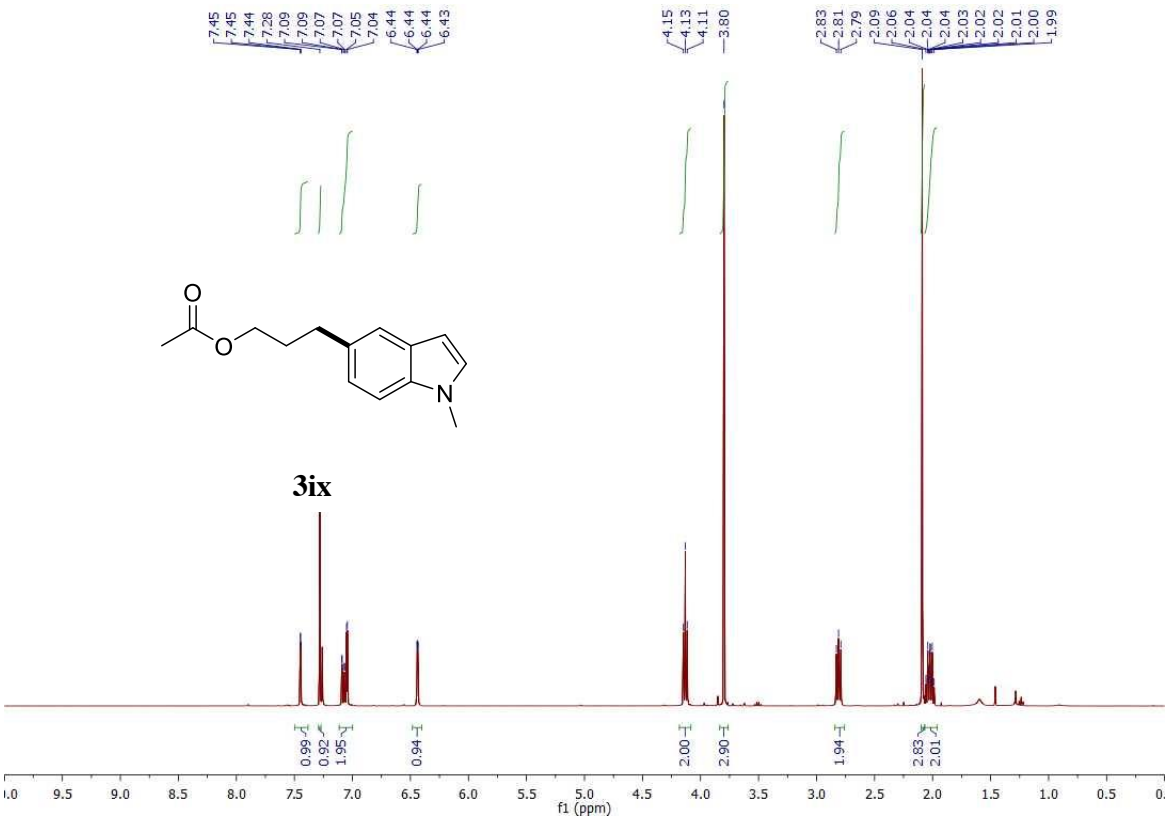
3iw

^{13}C spectrum of 3iw



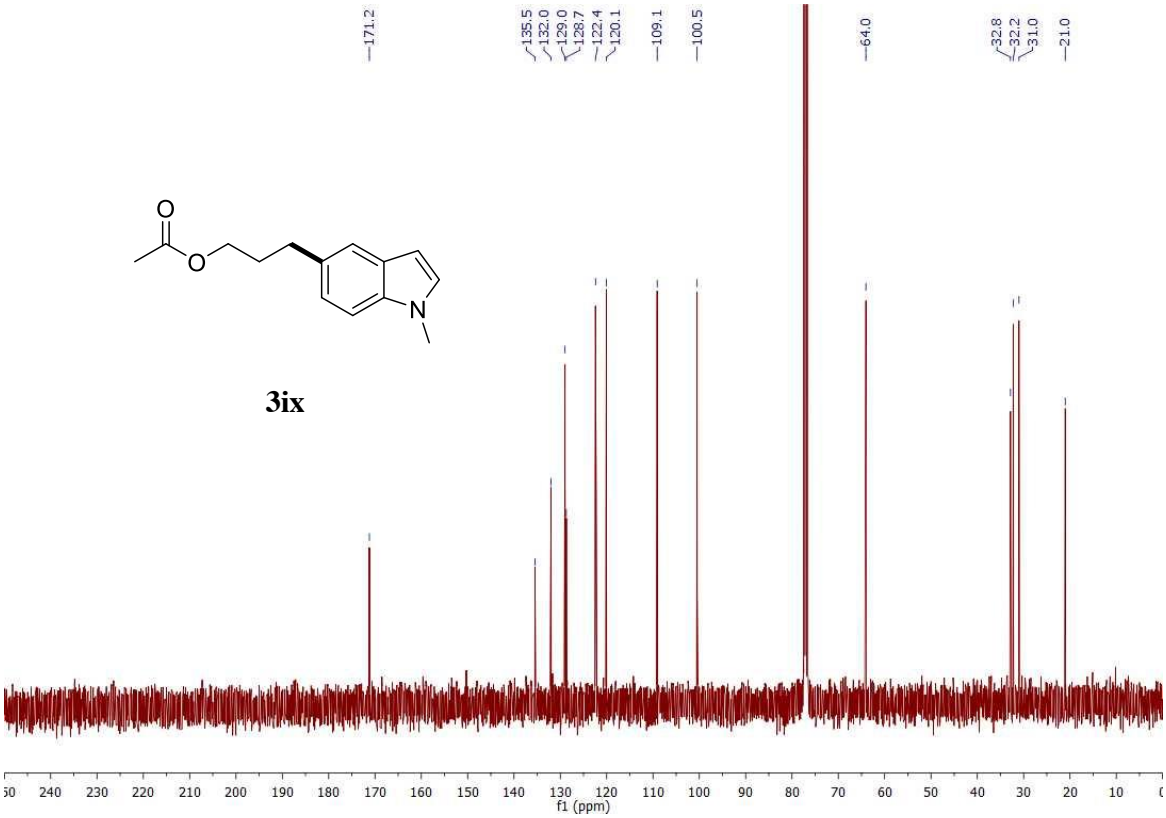
3iw

^{1}H spectrum of 3ix



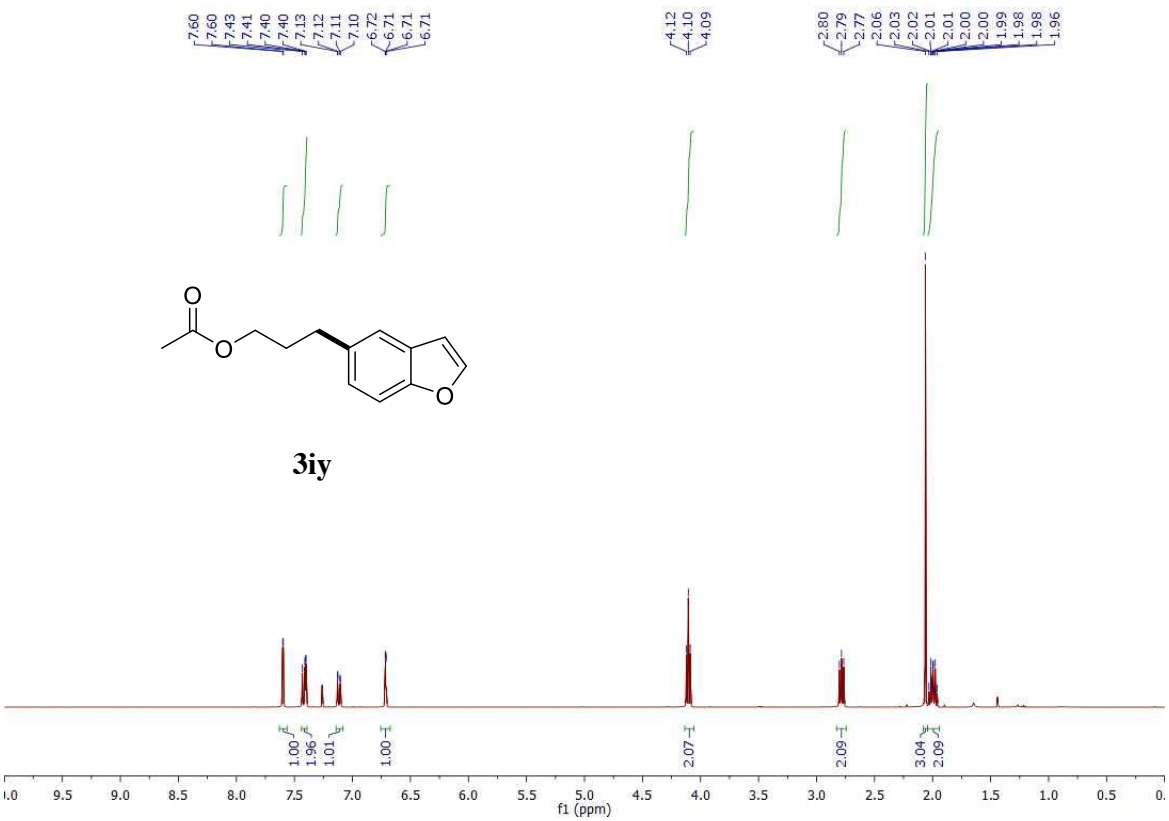
3ix

^{13}C spectrum of 3ix



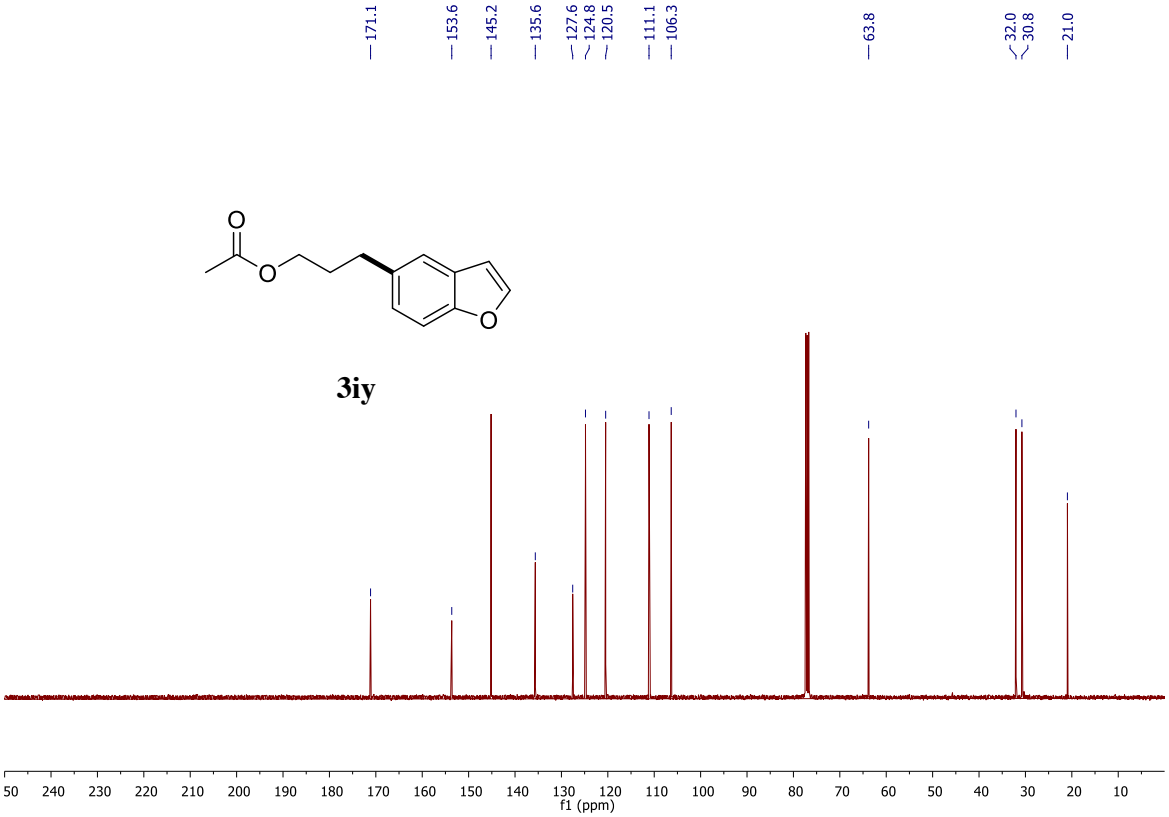
3ix

^{1}H spectrum of 3iy



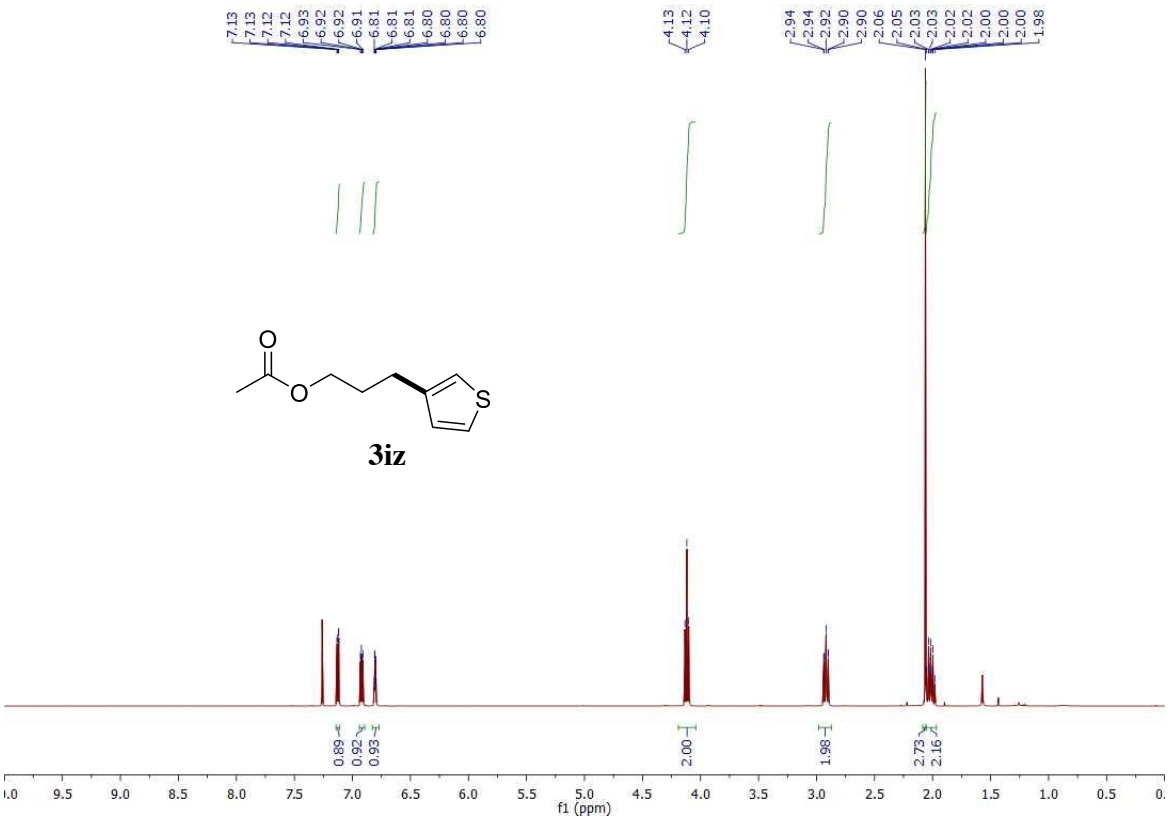
3iy

^{13}C spectrum of 3iy



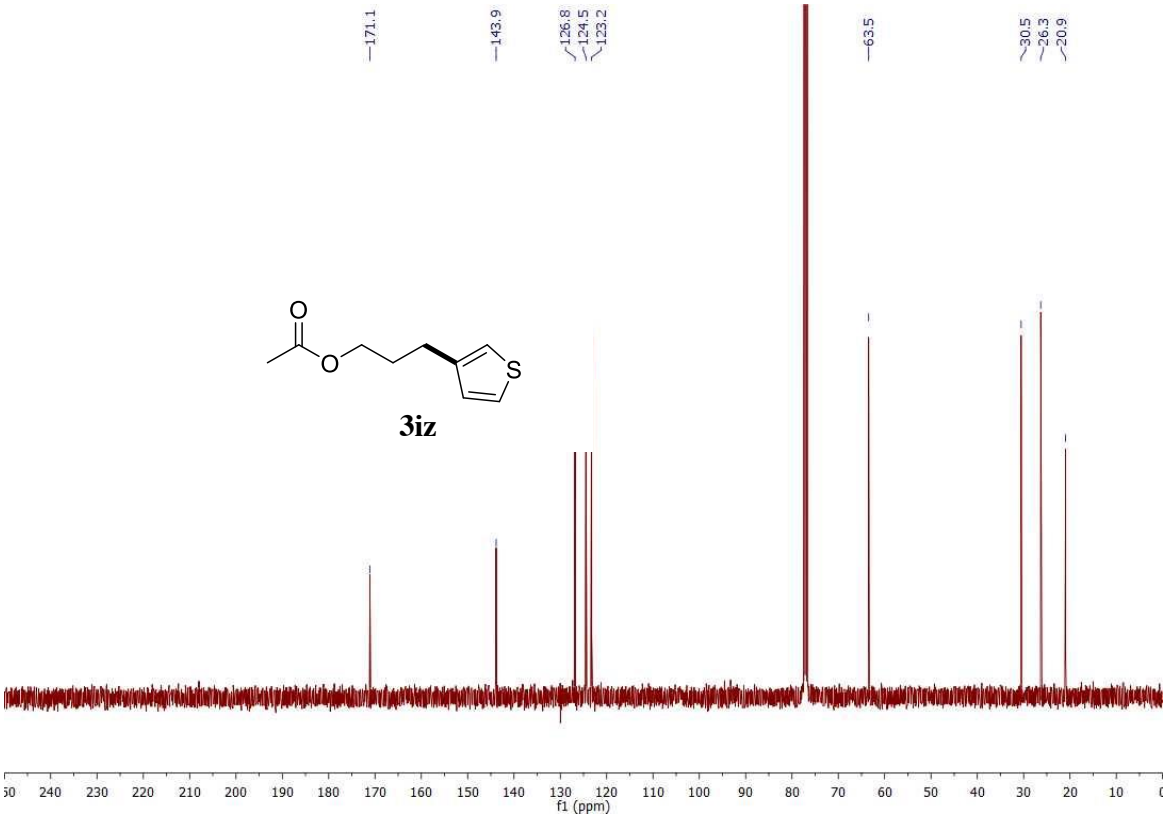
3iy

^{1}H spectrum of 3iz



3iz

^{13}C spectrum of 3iz



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