Catalyst-Free Regioselective Hydroxyfluorination and Aminofluorination of *α, β*-Unsaturated Carbonyl Compounds

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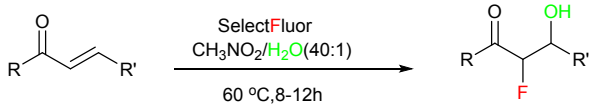
Contents

1. General information

All commercials obtained from commercial sources were used as received unless otherwise noted. Substrate **1** were prepared by literature reports (*Tetrahedron* 2012, **68**, 9616; *Tetrahedron* 2012, **68**, 7941; *Org. Lett*. 2012, **14**, 3936; *Tetrahedron* 2013, **69**, 6364.). The progress of the reactions was monitored by TLC with silica gel plates, and the visualization was carried out under UV light (254nm). ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra were recorded on a Varian spectrometer in $CDCl_3$ or DMSO-d_6 using tetramethylsilane (TMS) as internal standards Mass spectra were measured with a HRMS-APCI instrument or a low-resolution MS instrument using ESI ionization.

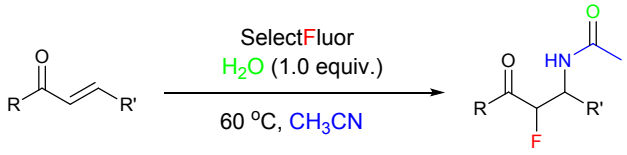
2. General procedure for *α*-fluoro-*β*-hydroxylation.



1 **2**

α, *β*-Unsaturated ketone (**1**, 1 mmol) and Selectfluor (1.2 equiv) were dissolved in 7 mL of CH_3NO_2/H_2O (40:1, v:v). The mixture was stirred at 60 °C for 12h. After the completion of the reaction (as indicated by TLC), the reaction mixture was quenched with satd. aq. $NaHCO_3$ (10 mL). The mixture was extracted with EtOAc twice. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude products were purified on a silica gel column using hexane/EtOAc.

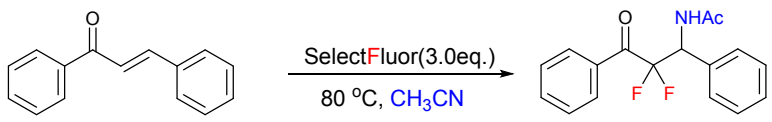
3. General procedure for *α*-fluoro-*β*-amidation.



1 **3**

α, *β*-Unsaturated ketone (**1**, 1 mmol) and Selectfluor (1.2 equiv) were dissolved in CH_3CN (10 mL). The mixture was stirred at 60 °C for 36h. After the completion of the reaction (as indicated by TLC), the reaction mixture was quenched with satd. aq. $NaHCO_3$ (10 mL). The mixture was extracted with EtOAc twice. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude products were purified on a silica gel column using hexane/EtOAc.

4. General procedure for *α*-difluoro-*β*-amidation.



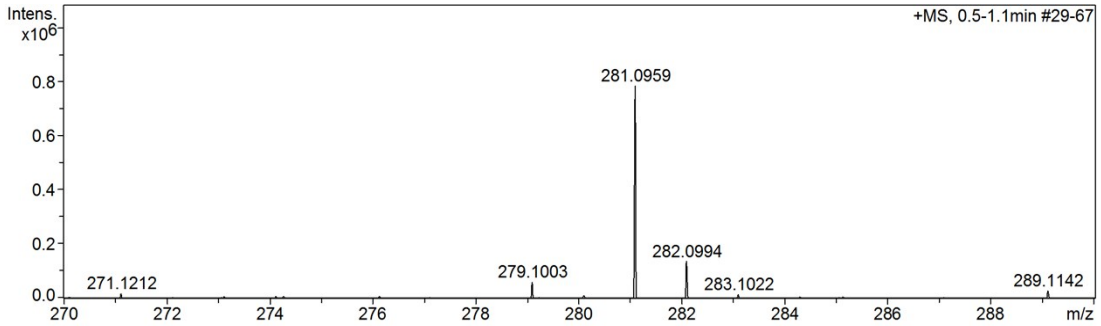
1a **4a**

55%

Chalcone (**1a**, 1 mmol) and Selectfluor (3 equiv) were dissolved in CH_3CN (10 mL). The mixture was stirred at 80 °C for 18h. After the completion of the reaction (as indicated by TLC), the reaction mixture was quenched with satd. aq. $NaHCO_3$ (15 mL). The mixture was extracted with EtOAc twice. The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude products were purified by silica gel column chromatography (hexane /ethyl acetate =1/10→1/5) to give **4a** (167 mg, 55% yield) as pale yellow semisolid.

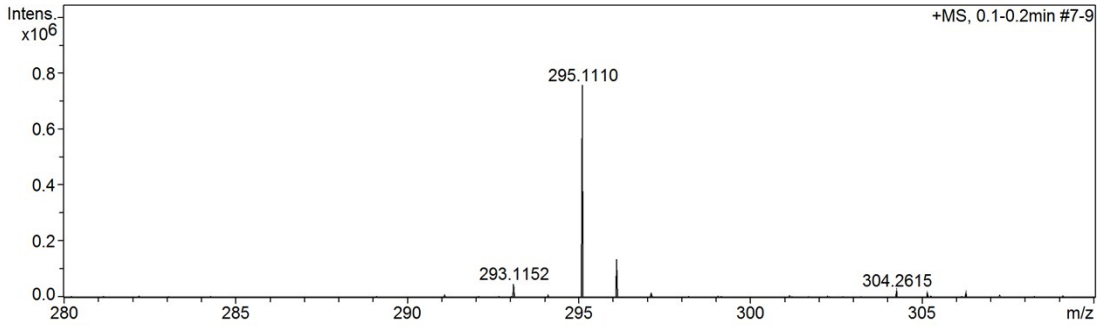
5. Characterization analysis of control experiments

High-resolution mass spectrometry (HRMS) analysis of the product 6a



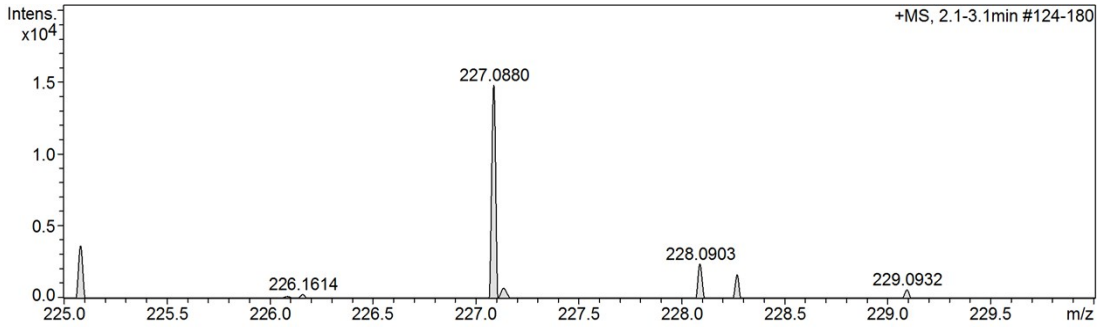
Meas. m/z	Formula	m/z	err [ppm]	mSigma
281.0959	$C_{16}H_{15}FNaO_2$	281.0948	-3.9	1.4

High-resolution mass spectrometry (HRMS) analysis of the product 6b



Meas. m/z	Formula	m/z	err [ppm]	mSigma
295.1110	$C_{17}H_{17}FNaO_2$	295.1105	-1.7	4.2

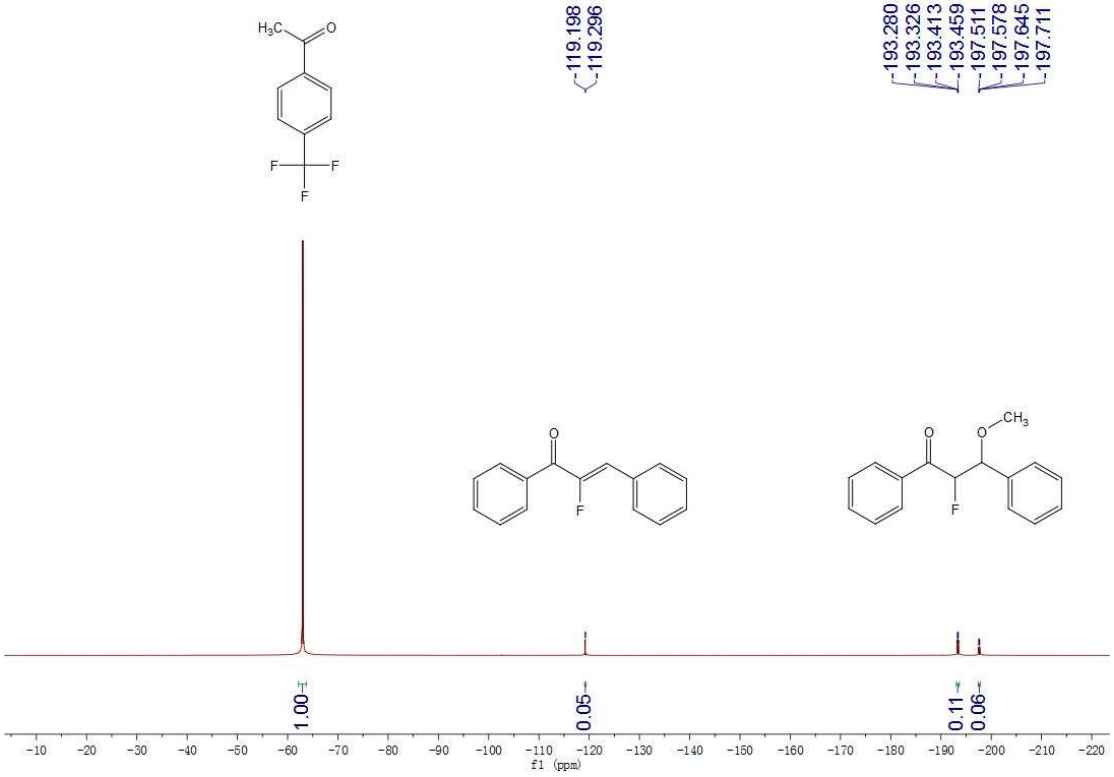
High-resolution mass spectrometry (HRMS) analysis of the product 5a



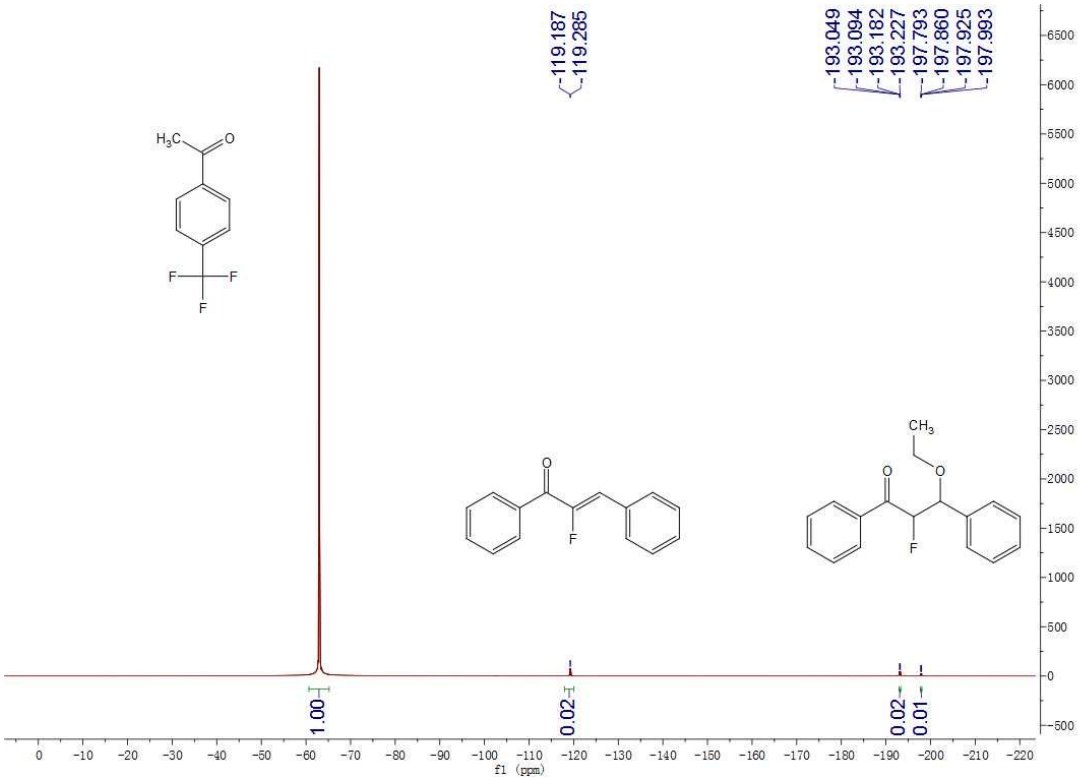
Meas. m/z	Formula	m/z	err [ppm]	mSigma
227.0880	$C_{15}H_{12}FO$	227.0867	-5.8	14.1

Crude ^{19}F NMR spectra of the control experiment 3, 1-(4-(trifluoromethyl)phenyl)ethan-1-one was used as internal standard substances

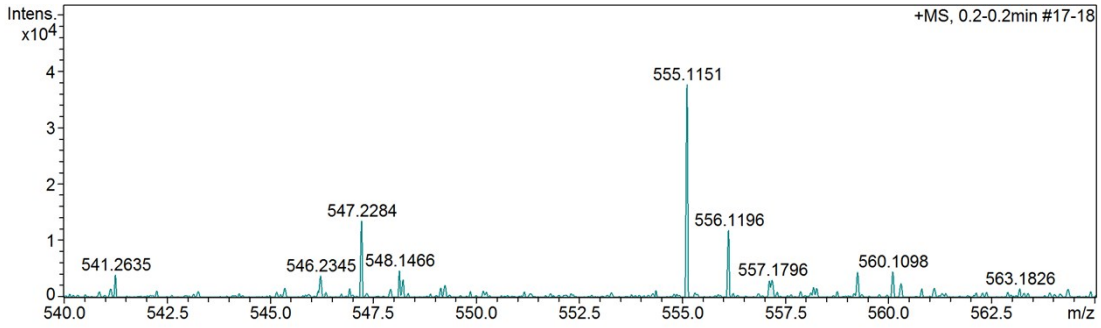
The crude ^{19}F NMR spectra of methoxyfluorination: ^{19}F NMR (376 MHz, $CDCl_3$) δ -119.25 (d, *J* = 36.8 Hz, 0.05F), -193.37 (dd, *J* = 50.0, 17.3 Hz, 0.11F), -197.61 (dd, *J* = 50.1, 25.0 Hz, 0.06F).



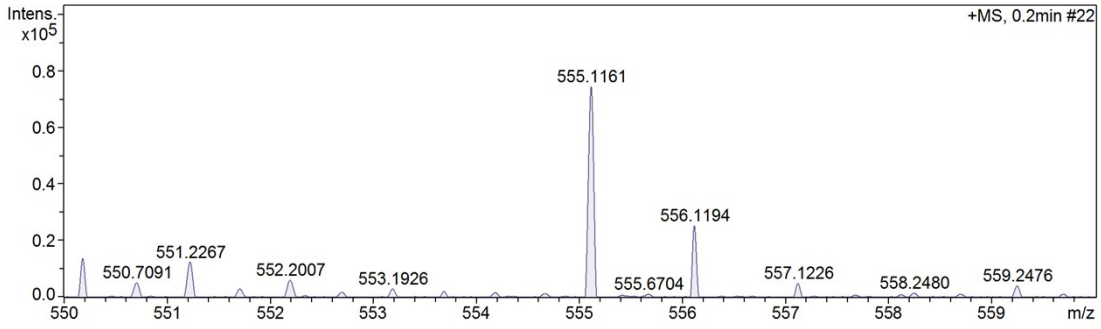
The crude ^{19}F NMR spectra of ethoxyfluorination: ^{19}F NMR (376 MHz, $CDCl_3$) δ -119.24 (d, *J* = 36.8 Hz, 0.02F), -193.14 (dd, *J* = 50.0, 16.7 Hz, 0.02F), -197.89 (dd, *J* = 49.9, 25.5 Hz, 0.01F).



High-resolution mass spectrometry (HRMS) analysis of the product 7



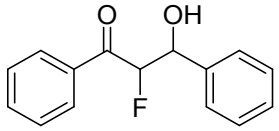
Meas. m/z	Formula	m/z	err [ppm]	mSigma
555.1151	$C_{31}H_{20}N_2NaO_7$	555.1163	2.1	16.6



Meas. m/z	Formula	m/z	err [ppm]	mSigma
555.1161	$C_{31}H_{20}N_2NaO_7$	555.1163	0.3	4.1

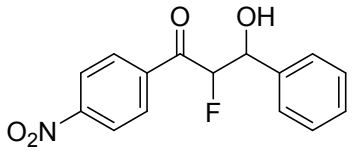
6. Characterization of the products.

2-fluoro-3-hydroxy-1,3-diphenylpropan-1-one (2a)



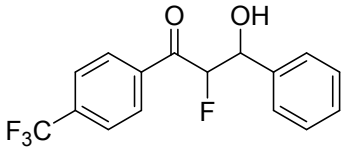
Product **2a** was 1:2.6 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), white solid (171 mg, 70%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (t, *J* = 8.7 Hz, 2H), 7.62 (t, *J* = 7.3 Hz, 1H), 7.48 (dd, *J* = 12.9, 7.0 Hz, 4H), 7.43 – 7.33 (m, 3H), 5.65 (dd, *J* = 48.1, 3.8 Hz, 0.68H)/5.62 (dd, *J* = 47.6, 6.4 Hz, 0.26H), 5.40 – 5.25 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.2 (d, *J* = 20.4 Hz)/196.0 (d, *J* = 21.2 Hz), 138.2/138.2/138.2/138.1, 135.0/135.0, 134.1/133.9, 129.2/129.2/129.1, 128.6/128.6, 128.5, 127.0/127.0, 126.8, 95.3 (d, *J* = 192.4 Hz)/93.3 (d, *J* = 188.4 Hz), 74.0 (d, *J* = 19.8 Hz)/73.4 (d, *J* = 23.5 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -189.80 (dd, *J* = 47.6, 11.2 Hz, 0.27F), -198.25 (dd, *J* = 48.1, 22.1 Hz, 0.71F); HRMS(ESI) *m/z* Calcd for $C_{15}H_{13}FNaO_2$ $[M+Na]^+$: 267.0792, Found: 267.0803.

2-fluoro-3-hydroxy-1-(4-nitrophenyl)-3-phenylpropan-1-one (2b)



Product **2b** was 1:1.2 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), pale yellow solid (162 mg, 56%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, *J* = 8.9 Hz, 1H), 8.25 (d, *J* = 8.8 Hz, 1H), 8.12 (d, *J* = 8.3 Hz, 1H), 7.97 (d, *J* = 8.6 Hz, 1H), 7.51 – 7.31 (m, 5H), 5.60 (dd, *J* = 48.0, 5.6 Hz, 0.50H)/5.50 (dd, *J* = 48.0, 3.6Hz, 0.42H), 5.38 – 5.26 (m, 1H), 2.85 (s, 0.49H)/2.68 (s, 0.42H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.2 (d, *J* = 23.4 Hz)/195.2 (d, *J* = 21.6 Hz), 150.4/150.4, 139.8/139.6/139.6/139.6, 137.9/137.9/137.7/137.7, 130.5/130.4/130.3/130.2, 129.0/128.9, 128.8/128.7, 126.8/126.8/126.7/126.7, 123.6/123.5, 96.7 (d, *J* = 195.9 Hz)/94.7 (d, *J* = 190.6 Hz), 74.3 (d, *J* = 19.4 Hz)/73.8 (d, *J* = 22.9 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -190.75 (dd, *J* = 48.1, 13.6 Hz, 0.45F), -198.46 (dd, *J* = 48.1, 23.7 Hz, 0.52F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{12}FNNaO_4$ $[M+Na]^+$: 312.0643, Found: 312.0653.

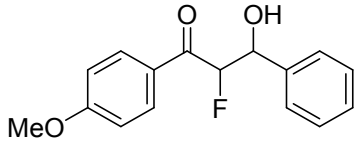
2-fluoro-3-hydroxy-3-phenyl-1-(4-(trifluoromethyl)phenyl)propan-1-one (2c)



Product **2c** was pale yellow solid (172 mg, 55%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.1 Hz, 2H), 7.74 (d, *J* = 8.2 Hz, 2H), 7.48 (d, *J* = 7.1 Hz, 2H), 7.44 – 7.34 (m, 3H), 5.55 (dd, *J* = 48.1, 3.5 Hz, 1H), 5.35 (d, *J* = 23.0 Hz, 1H), 2.72 (s, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 195.6 (d, *J* = 21.0 Hz), 137.9/137.9, 137.8, 134.9 (q, *J* = 32.8 Hz), 129.5/129.5, 128.8/128.6, 126.9, 125.5/125.5, 124.8/122.0, 94.2 (d, *J* = 189.7 Hz), 73.7 (d, *J* = 23.2 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.27 (s, 3F), -198.39 (dd,

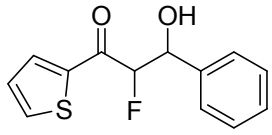
J = 48.1, 23.0 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{16}H_{12}F_4NaO_2$ $[M+Na]^+$: 335.0666, Found: 335.0666.

2-fluoro-3-hydroxy-1-(4-methoxyphenyl)-3-phenylpropan-1-one (2d)



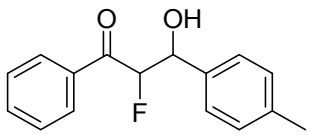
Product **2d** was 1:1.2 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), pale yellow oil (173 mg, 63%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (t, J = 8.6 Hz, 2H), 7.50 – 7.32 (m, 5H), 6.93 (d, J = 8.8 Hz, 2H), 5.59 (dd, J = 48.2, 3.8 Hz, 0.42H)/5.55 (dd, J = 47.6, 6.8 Hz, 0.50H), 5.35 – 5.22 (m, 1H), 3.90 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.4 (d, J = 19.8 Hz), 194.2 (d, J = 20.1 Hz), 164.3/164.2, 138.5/138.5/138.4/138.3, 131.8/131.7/131.7, 128.6/128.6, 128.5/ 128.4, 128.0/127.9, 127.0/127.0, 126.8, 113.9/113.9, 95.2 (d, J = 192.0 Hz)/93.1 (d, J = 188.1 Hz), 74.0 (d, J = 19.9 Hz), 73.4 (d, J = 23.6 Hz), 56.3/55.6/55.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -188.72 (dd, J = 47.6, 10.8 Hz，0.55F), -197.16 (dd, J = 48.2, 22.1 Hz, 0.45F); HRMS (ESI) m/z Calcd for $C_{16}H_{15}FNaO_3$ $[M+Na]^+$: 297.0897, Found: 297.0895.

2-fluoro-3-hydroxy-3-phenyl-1-(thiophen-2-yl)propan-1-one (2e)



Product **2e** was 1:1 mixture of diastereomers (determined by ^{19}F NMR spectroscopy), yellow oil (112 mg, 45%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, J = 3.5 Hz, 0.5H)/7.82 (d, J = 3.5 Hz, 0.5H), 7.75 (d, J = 3.4 Hz, 1H), 7.46 (t, J = 7.9 Hz, 2H), 7.42 – 7.32 (m, 3H), 7.14 (dt, J = 12.7, 4.4 Hz, 1H), 5.48 – 5.45 (m, 0.49H)/5.35 – 5.33 (m, 0.51H), 5.38 – 5.36 (m, 0.19 H)/5.32 – 5.22 (m, 0.74H), 3.30 (d, J = 3.2 Hz, 0.47H)/2.98 (d, J = 4.8 Hz, 0.46H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.1 (d, J = 22.0 Hz)/188.9 (d, J = 22.8 Hz), 141.1/141.1/141.0/141.0, 138.3/138.3/138.0/138.0, 135.9/135.9/135.8/135.8, 135.1/135.0, 128.6/128.6, 128.5/128.5/128.5, 127.1/127.1, 126.7, 96.7 (d, J = 195.7 Hz)/95.0 (d, J = 192.5 Hz), 74.14 (d, J = 19.6 Hz), 73.82 (d, J = 22.7 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -190.49 (dd, J = 48.1, 12.7 Hz, 0.50F), -198.11 (dd, J = 47.9, 22.9 Hz, 0.50F); HRMS (ESI) *m/z* Calcd for $C_{13}H_{11}FNaO_2S$ $[M+Na]^+$: 273.0356, Found: 273.0366.

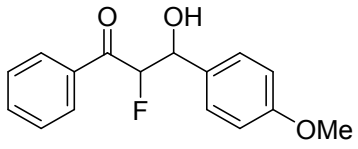
2-fluoro-3-hydroxy-1-phenyl-3-(p-tolyl)propan-1-one (2f)



Product **2f** was 1:1.4 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), white solid (191 mg, 74%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (t, J = 6.7 Hz, 2H), 7.62 (t, J = 7.2 Hz, 1H), 7.49 (t, J = 7.7 Hz, 2H), 7.35 (t, J = 7.3 Hz, 2H), 7.21 (t, J = 6.4 Hz, 2H), 5.62 (dd, J = 48.4, 3.9 Hz, 0.58H)/5.60 (d, J = 47.6 Hz, 0.40H), 5.36 – 5.22 (m, 1H), 2.39 (s, 1.01H)/2.37 (s, 2.02H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.0 (d,

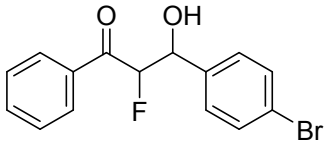
J = 20.7 Hz), 138.4, 135.2/135.2, 135.0, 134.0, 133.8, 129.3/129.2/129.1, 128.6/128.6, 126.9/126.7, 95.4 (d, *J* = 192.3 Hz), 73.9 (d, *J* = 19.8 Hz), 21.1; ^{19}F NMR (376 MHz, $CDCl_3$) δ -190.01 (dd, *J* = 47.6, 11.2 Hz, 0.42F), -198.27 (dd, *J* = 48.2, 22.1 Hz, 0.57F); HRMS (ESI) *m/z* Calcd for $C_{16}H_{15}FNaO_2$ $[M+Na]^+$: 281.0948, Found: 281.0954.

2-fluoro-3-hydroxy-3-(4-methoxyphenyl)-1-phenylpropan-1-one (2g)



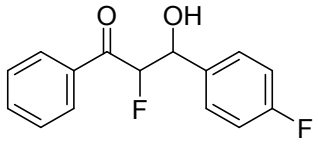
Product **2g** was 1:1.2 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), pale yellow oil (222 mg, 81%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.3 Hz, 2H), 7.64 – 7.58 (m 1H), 7.47 (t, *J* = 7.6 Hz, 2H), 7.41 – 7.33 (m, 2H), 6.90 (t, *J* = 8.5 Hz, 2H), 5.60 (d, *J* = 48.0 Hz, 0.40H), 6.65/5.65/5.53(m, 0.46H), 5.31 – 5.19 (m, 1H), 3.83 (s, 1.35H)/3.81 (s, 1.66H), 3.03 (s, 0.40H)/2.84 (s, 0.48H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.2 (d, *J* = 20.3 Hz)/196.0 (d, *J* = 20.2 Hz), 159.8/159.7, 135.0/134.02, 133.8, 130.4/130.2/130.2, 129.2/129.2/129.1, 128.6/128.6, 128.3, 128.1, 114.0/113.9, 95.4 (d, *J* = 191.8 Hz)/93.4 (d, *J* = 187.8 Hz), 73.7 (d, *J* = 19.8 Hz)/73.1 (d, *J* = 23.4 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -195.19 (dd, *J* = 47.7, 11.8 Hz, 0.42F), -202.02 (dd, *J* = 48.3, 21.4 Hz, 0.57F); HRMS (ESI) *m/z* Calcd for $C_{16}H_{15}FNaO_3$ $[M+Na]^+$: 297.0897, Found: 297.0906.

3-(4-bromophenyl)-2-fluoro-3-hydroxy-1-phenylpropan-1-one (2h)



Product **2h** was 1:1 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), white solid (184 mg, 57%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (t, *J* = 6.8 Hz, 2H), 7.73 – 7.68 (m, 1H), 7.60 – 7.53 (m, 4H), 7.40 (t, *J* = 7.7 Hz, 2H), 5.64 (dd, *J* = 47.8, 3.8 Hz, 0.48H)/5.59 (dd, *J* = 47.4, 6.6 Hz, 0.46H), 5.42 – 5.27 (m, 1H), 3.17 (s, 0.35H)/2.95 (s, 0.35H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.0 (d, *J* =16.8 Hz)/195.8 (d, *J* =17.3 Hz), 137.3/137.3/137.2/137.2, 134.8/134.8/134.8/134.8, 134.3/134.1, 131.7/131.6, 129.2/129.2/129.2, 128.7/128.7/128.7, 128.5, 122.6/122.5, 95.0 (d, *J* = 193.0 Hz)/92.8 (d, *J* = 188.8 Hz), 73.3 (d, *J* = 19.9 Hz)/72.6 (d, *J* = 23.5 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -189.38 (dd, *J* = 47.3, 10.4 Hz, 0.49F), -198.07 (dd, *J* = 47.9, 21.9 Hz, 0.51F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{12}BrFNaO_2$ $[M+Na]^+$: 344.9897, Found: 344.9905.

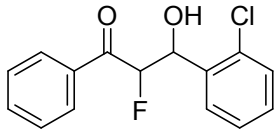
2-fluoro-3-(4-fluorophenyl)-3-hydroxy-1-phenylpropan-1-one (2i)



Product **2i** was 1:1.1 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), white solid (168 mg, 64%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (t, *J* = 7.1 Hz, 2H),

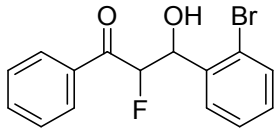
7.67 – 7.58 (m, 1H), 7.52 – 7.37 (m, 4H), 7.09 – 7.03 (m, 2H), 5.59 (dd, *J* = 48.0, 4.6 Hz, 0.44H)/5.64 (dd, *J* = 47.6, 6.8 Hz, 0.50H), 5.36 – 5.23 (m, 1H), 3.31 (s, 0.35H)/3.15 (s, 0.38H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.1 (d, *J* = 20.0 Hz)/196.0 (d, *J* = 20.4 Hz), 162.8 (d, *J* = 246.9 Hz)/162.7 (d, *J* = 247.0 Hz), 134.9, 134.2, 134.1, 134.0, 129.2/129.2/129.1, 128.8/128.7/128.7/128.6/128.6, 115.6/115.5/115.4/115.2, 95.2 (d, *J* = 193.0 Hz)/93.2 (d, *J* = 189.0 Hz), 73.3 (d, *J* = 20.0 Hz)/72.7 (d, *J* = 23.3 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -111.95 – -115.10 (m, 1F), -190.47 (dd, *J* = 47.6, 11.8 Hz, 0.49F), -197.79 (dd, *J* = 48.1, 21.8 Hz, 0.46F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{12}F_2NaO_2$ $[M+Na]^+$: 285.0698, Found: 285.0708.

3-(2-chlorophenyl)-2-fluoro-3-hydroxy-1-phenylpropan-1-one (2j)



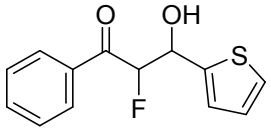
Product **2j** was 1:1.2mixture of diastereomers (determined by ^{19}F NMR spectroscopy), yellow oil (167 mg, 60%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, *J* = 7.9 Hz, 1H), 7.80 (d, *J* = 7.9 Hz, 1H), 7.76 – 7.62 (m, 1H), 7.53 (q, *J* = 7.8 Hz, 1.6H), 7.45 (dd, *J* = 7.5, 1.7 Hz, 0.61H)/7.31 (dd, *J* = 7.6, 1.6 Hz, 0.45H), 7.41 – 7.34 (m, 2.6H), 7.24 – 7.13 (m, 1H), 5.94 – 5.90 (m, 0.54H), 5.85 – 5.69 (m, 1.62H), 3.33 (s, 0.54H)/3.03 (s, 0.46H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 195.5 (d, *J* = 17.8 Hz)/195.3 (d, *J* = 17.0 Hz), 136.0/136.0, 135.3/135.3, 135.2/135.2/134.6/134.6, 134.1/133.9, 132.5/131.3, 129.5/129.5/129.3/129.3, 129.1/129.1/129.0/129.0/, 128.9/128.9, 128.8, 128.5/128.5, 127.2/127.1, 93.0 (d, *J* = 192.0 Hz)/92.3 (d, *J* = 189.0 Hz), 70.7 (d, *J* = 24.2 Hz)/70.4 (d, *J* = 19.1 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -189.18 (dd, *J* = 46.7, 10.7 Hz, 0.54F), -205.61 (dd, *J* = 47.0, 26.1 Hz, 0.46F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{12}ClFNaO_2$ $[M+Na]^+$: 301.0402, Found: 301.0420.

3-(2-bromophenyl)-2-fluoro-3-hydroxy-1-phenylpropan-1-one (2k)



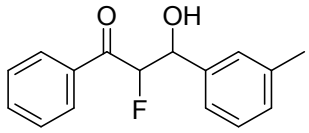
Product **2k** was 1:1.2mixture of diastereomers (determined by ^{1}H NMR spectroscopy), yellow oil (145 mg, 45%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.4 Hz, 1H), 7.80 (d, *J* = 8.0 Hz, 1H), 7.74 (d, *J* = 8.0 Hz, 0.47H), 7.65 (t, *J* = 7.4 Hz, 0.54H), 7.61 – 7.50 (m, 2.7H), 7.46 – 7.41 (m, 1H), 7.37 (t, *J* = 7.8 Hz, 1H), 7.27 – 7.17 (m, 1H), 7.15 – 7.11 (m 0.5H), 5.89 (dd, *J* = 46.8, 5.2 Hz, 0.54H)/5.85 (dd, *J* = 47.0, 2.2 Hz, 0.46H), 5.77 – 5.69 (m, 1H), 3.23 (s, 0.63H)/2.90 (s, 0.52H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 195.5 (d, *J* = 20.5 Hz)/195.2 (d, *J* = 19.6 Hz), 137.4/137.4/136.8/136.8, 135.2/134.7/134.6, 134.1/133.9, 132.7/132.6, 129.8, 129.5/129.5, 129.2/129.2/128.9/128.9, 128.8/128.8/128.7/128.5, 127.8/127.6, 122.6/121.4, 92.8 (d, *J* = 192.5 Hz)/92.1 (d, *J* = 189.1 Hz), 72.8 (d, *J* = 24.2 Hz)/72.5 (d, *J* = 18.9 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -189.04 (dd, *J* = 47.0, 10.9 Hz, 0.55F), -205.74 (dd, *J* = 47.0, 26.4 Hz, 0.44F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{12}BrFNaO_2$ $[M+Na]^+$: 344.9897, Found: 344.9903.

2-fluoro-3-hydroxy-1-phenyl-3-(thiophen-2-yl)propan-1-one (2l)



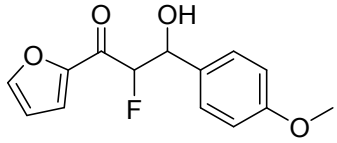
Product **2l** was 1:1.2 mixture of diastereomers (determined by ^{19}F NMR spectroscopy), brown oil (120 mg, 48%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 – 7.94 (m, 2H), 7.66 – 7.59 (m, 1H), 7.53 – 7.46 (m, 2H), 7.34 (dd, *J* = 5.1, 1.2 Hz, 0.40H)/7.32 (dd, *J* = 5.1, 1.2 Hz, 0.46H), 7.13 – 7.08 (m, 1H), 7.02 (dd, *J* = 5.1, 3.6 Hz, 0.42H) /6.99 (dd, *J* = 5.1, 3.6 Hz, 0.49H), 5.75 – 5.51 (m, 2H), 3.19 (s, 0.49H)/2.95 (s, 0.6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 195.7 (d, *J* = 20.0 Hz)/195.6 (d, *J* = 20.4 Hz), 141.3/141.3/141.1/141.08, 134.9/134.9/134.8/134.8, 134.2/134.0, 129.2/129.2/129.2/129.1, 128.7/128.7, 126.8/126.8, 126.1/126.1/126.1, 126.0/125.9, 94.7 (d, *J* = 193.1 Hz)/92.8 (d, *J* = 189.3 Hz), 70.3 (d, *J* = 20.8 Hz)/69.8 (d, *J* = 23.9 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -190.09 (dd, *J* = 47.4, 12.7 Hz, 0.44F), -196.48 (dd, *J* = 47.9, 21.0 Hz, 0.56F); HRMS (ESI) *m/z* Calcd for $C_{13}H_{11}FNaO_2S$ $[M+Na]^+$: 273.0356, Found: 273.0361.

2-fluoro-3-hydroxy-3-phenyl-1-(m-tolyl)propan-1-one (2m)



Product **2m** was a 1:2.4 mixture of diastereomers (determined by ^{1}F NMR spectroscopy), white solid (129 mg, 50%); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (t, *J* = 8.7 Hz, 2H), 7.62 (t, *J* = 7.3 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.30 – 7.20 (m, 3H), 7.20 – 7.12 (m, 1H), 5.73 – 5.66 (m, 0.48H), 5.60 – 5.55 (m, 0.48H), 5.35 – 5.20 (m, 1H), 3.15 (s, 0.56H)/2.95 (s, 0.23H), 2.38 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.2 (d, *J* = 20.1 Hz)/196.1 (d, *J* = 20.6 Hz), 138.3/138.2/138.2/138.2, 135.1/135.1, 134.0, 133.8, 129.3/129.2, 129.2/129.1, 128.6/128.6, 128.5/128.4, 127.6/127.4, 124.1/123.8, 95.5 (d, *J* = 192.3 Hz)/93.4 (d, *J* = 188.1 Hz), 74.0 (d, *J* = 19.9 Hz)/73.5 (d, *J* = 23.6 Hz), 21.40; ^{19}F NMR (376 MHz, $CDCl_3$) δ -189.81 (dd, *J* = 47.6, 11.4 Hz, 0.70H), -198.43 (dd, *J* = 48.2, 22.3 Hz, 0.29H); HRMS (ESI) *m/z* Calcd for $C_{16}H_{15}FNaO_2$ $[M+Na]^+$: 281.0948, Found: 281.0958.

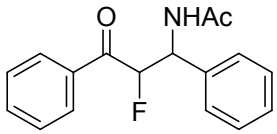
2-fluoro-1-(furan-2-yl)-3-hydroxy-3-(4-methoxyphenyl)propan-1-one (2n)



Product **2n** was 1:1.4 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), yellow oil (140 mg, 53%). ^{1}H NMR (400 MHz, DMSO-*d6*) δ 8.09 – 8.08 (m, 1H), 7.60 (d, *J* = 3.4 Hz, 0.43H)/7.60 (d, *J* = 3.4 Hz, 0.60H), 7.38 (d, *J* = 8.5 Hz, 1H)/7.34 (d, *J* = 8.5 Hz, 1H), 6.92 (dd, *J* = 8.4, 4.4 Hz, 2H), 6.77 (d, *J* = 3.4 Hz, 0.43H)/ 6.75 (d, *J* = 2.1 Hz, 0.60H), 6.00 (d, *J* = 4.6 Hz, 0.41H)/5.95 (d, *J* = 5.5 Hz, 0.59H), 5.62 (dd, *J* = 47.4, 3.7 Hz, 0.54H)/5.58 (dd, *J* = 48.4, 6.3 Hz, 0.40H), 5.13 (dt,

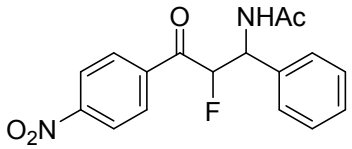
J = 25.3, 4.5 Hz, 0.54H)/4.96 (dt, *J* = 14.3, 5.6 Hz, 0.39H), 3.76 (s, 1.33H)/3.75 (s, 1.76H); ^{13}C NMR (101 MHz, DMSO-*d6*) δ 188.2 (d, *J* = 19.8 Hz)/188.0 (d, *J* = 21.6 Hz), 164.2/163.9, 155.7/155.2, 154.2/153.8, 137.4/137.1/137.1, 133.6/133.2, 126.9/126.9/126.6/126.5, 118.6/118.6, 118.0/117.9, 100.9 (d, *J* = 189.2 Hz)/98.6 (d, *J* = 182.8 Hz), 77.6 (d, *J* = 19.8 Hz)/77.3 (d, *J* = 24.1 Hz), 60.2; ^{19}F NMR (376 MHz, DMSO-*d6*) δ -194.07 (dd, *J* = 48.1, 14.0 Hz, 0.41F), -202.01 (dd, *J* = 47.3, 25.3 Hz, 0.57F); HRMS (ESI) *m/z* Calcd for $C_{14}H_{13}FNaO_4$ $[M+Na]^+$: 287.0690, Found: 287.0699.

2-fluoro-3-acetamido-1,3-diphenylpropan-1-one (3a)



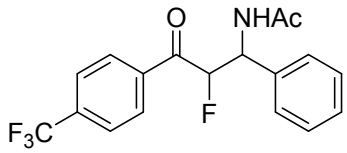
Product **3a** was pale yellow semisolid (162 mg, 57%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.5 Hz, 2H), 7.63 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 7.45 – 7.31 (m, 5H), 6.65 (d, *J* = 8.8 Hz, 1H), 5.99 (dd, *J* = 47.2, 2.2 Hz, 1H), 5.73 (ddd, *J* = 27.6, 8.9, 1.9 Hz, 1H), 1.96 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.4 (d, *J* = 18.9 Hz), 169.6, 137.78, 134.19, 129.0, 128.9, 128.6, 128.5, 128.3, 127.1/127.1, 94.0 (d, *J* = 190.6 Hz), 53.9 (d, *J* = 19.1 Hz), 22.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -202.33 (dd, *J* = 47.2, 27.4 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{16}FNNaO_2$ $[M+Na]^+$: 308.1057, Found: 308.1086.

2-fluoro-3-acetamido-1-(4-nitrophenyl) -3-phenylpropan-1-one (3b)



Product **3b** was yellow oil (168 mg, 51%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (d, *J* = 8.9 Hz, 2H), 8.02 (d, *J* = 8.7 Hz, 2H), 7.45 – 7.33 (m, 5H), 6.40 (d, *J* = 8.8 Hz, 1H), 5.92 (dd, *J* = 47.1, 2.3 Hz, 1H), 5.72 (ddd, *J* = 26.1, 9.0, 2.3 Hz, 1H), 2.00 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.0 (d, *J* = 20.7 Hz), 169.6, 150.5, 139.1, 137.0, 129.8/129.8, 129.1, 128.7, 127.2, 127.1, 123.9, 94.5 (d, *J* = 193.0 Hz), 53.7 (d, *J* = 19.6 Hz), 23.0/23.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -199.58 (dd, *J* = 47.1, 26.0 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{15}FN_2NaO_4$ $[M+Na]^+$: 353.0908, Found: 353.0898.

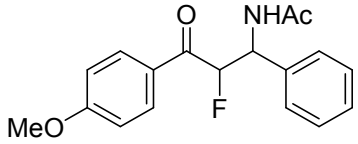
2-fluoro-3-acetamido-1-(4-trifluoromethylphenyl) -3-phenylpropan-1-one (3c)



Product **3c** was yellow oil (187 mg, 53%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (d, *J* = 8.1 Hz, 2H), 7.77 (d, *J* = 8.1 Hz, 2H), 7.47 – 7.34 (m, 5H), 6.67 – 6.60 (m, 1H), 5.95 (dd, *J* = 47.2, 1.6 Hz, 1H), 5.83 – 5.68 (m, 1H), 1.99 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.2 (d, *J* = 20.0 Hz), 169.7, 137.3/137.3, 135.1 (q, *J* = 32.9 Hz), 129.1, 128.6, 127.2, 126.0, 125.9, 124.8/122.09, 94.4 (d, *J* = 192.1 Hz), 53.8 (d, *J* = 19.4 Hz),

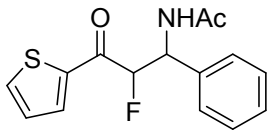
23.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.25(s, 1F), -200.55 (dd, *J* = 47.1, 26.7 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{18}H_{15}F_4NNaO_2$ $[M+Na]^+$: 376.0931, Found: 376.0936.

2-fluoro-3-acetamido-1-(4-methoxyphenyl) -3-phenylpropan-1-one (3d)



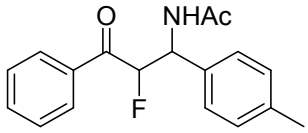
Product **3d** was pale yellow oil (183 mg, 58%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.7 Hz, 2H), 7.48 – 7.33 (m, 5H), 6.99 (d, *J* = 8.7 Hz, 2H), 6.63 (d, *J* = 8.6 Hz, 1H), 5.96 (d, *J* = 47.2 Hz, 1H), 5.72 (dd, *J* = 27.2, 8.8 Hz, 1H), 3.91 (s, 3H), 2.00 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 192.6 (d, *J* = 18.5 Hz), 169.5, 164.3, 137.9, 131.0/131.0, 128.9/128.9, 128.2, 127.1, 127.0, 114.2, 93.8 (d, *J* = 189.9 Hz), 55.6, 54.1 (d, *J* = 19.4 Hz), 23.01; ^{19}F NMR (376 MHz, $CDCl_3$) δ -201.37 (dd, *J* = 47.1, 27.3 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{18}H_{18}FNNaO_3$ $[M+Na]^+$: 338.1163, Found: 338.1169.

2-fluoro-3-acetamido-3-phenyl-1-(thiophen-2-yl)propan-1-one (3e)



Product **3e** was 1:5.3 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), claybank oil (157 mg, 54%). ^{1}H NMR (400 MHz, DMSO-*d6*) δ 8.78 (d, *J* = 9.5 Hz, 1H), 8.18 – 8.04 (m, 2H), 7.51 (d, *J* = 7.5 Hz, 1.61H), 7.40 (t, *J* = 7.5 Hz, 1.62H), 7.36 – 7.25 (m, 3H), 6.05 (dd, *J* = 47.0, 3.1 Hz, 0.75H)/5.97 (dd, *J* = 48.2, 4.7 Hz, 0.14H), 5.67 (ddd, *J* = 30.0, 9.5, 2.9 Hz, 0.75H)/5.54 (ddd, *J* = 24.8, 8.6, 4.8 Hz, 0.14H), 1.89 (s, 0.49H)/1.84 (s, 0.54H); ^{13}C NMR (101 MHz, DMSO-*d6*) δ 187.5 (d, *J* = 20.0 Hz)/187.5 (d, *J* = 20.8 Hz), 169.5/169.4, 140.9/140.8/, 138.6/138.6, 137.0/136.7/136.7, 135.3/135.2/135.2/135.1, 129.5, 128.8, 128.7, 128.4, 128.1, 127.7, 95.3 (d, *J* = 189.3 Hz)/94.6 (d, *J* = 189.3 Hz), 55.0 (d, *J* = 21.3 Hz)/54.2 (d, *J* = 19.1 Hz), 22.8/22.7; ^{19}F NMR (376 MHz, DMSO-*d6*) δ -196.16 (dd, *J* = 48.2, 24.8 Hz, 0.15F), -198.63 (dd, *J* = 46.8, 30.1 Hz, 0.82F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{14}FNNaO_2S$ $[M+Na]^+$: 314.0621, Found: 314.0625.

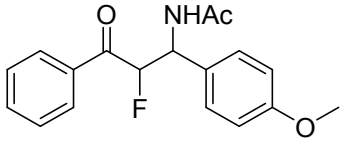
2-fluoro-3-acetamido-1-phenyl-3-*p*-tolylpropan-1-one (3f)



Product **3f** was yellow oil (162 mg, 54%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 – 7.88 (m, 2H), 7.64 (t, *J* = 7.4 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.21 (d, *J* = 7.9 Hz, 2H), 6.47 (d, *J* = 8.0 Hz, 1H), 5.98 (dd, *J* = 47.2, 2.1 Hz, 1H), 5.69 (ddd, *J* = 27.3, 8.8, 1.4 Hz, 1H), 2.37 (s, 3H), 1.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.3 (d, *J* = 18.8 Hz), 169.4/169.4, 138.1, 134.8, 134.2, 134.2, 129.6/129.5, 129.0/128.9, 128.6/128.5, 126.9, 94.0 (d, *J* = 190.6 Hz), 53.6 (d, *J* = 19.1 Hz), 23.0,

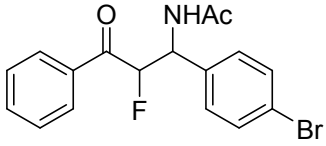
21.1; ^{19}F NMR (376 MHz, $CDCl_3$) δ -202.23 (dd, *J* = 47.2, 27.3 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{18}H_{18}FNNaO_2$ $[M+Na]^+$: 322.1214, Found: 322.1214.

2-fluoro-3-acetamido-1-phenyl-3-*p*- methoxyphenyl propan-1-one (3g)



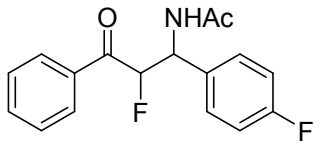
Product **3g** was 1:7.5 mixture of diastereomers (determined by ^{1}H NMR spectroscopy), pale yellow semisolid (233 mg, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 7.7 Hz, 2H), 7.65 (t, *J* = 7.3 Hz, 1H), 7.52 (t, *J* = 7.7 Hz, 2H), 7.37 (d, *J* = 8.4 Hz, 2H), 6.93 (d, *J* = 8.6 Hz, 2H), 6.65 – 6.50 (m, 1H), 5.97 (dd, *J* = 47.2, 2.0 Hz, 0.76H)/5.94 (dd, *J* =47.2, 2.0 Hz, 0.10H), 5.68 (dd, *J* = 26.6, 9.6 Hz, 1H), 3.91 (s, 0.35H)/3.83 (s, 2.60H), 1.99 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.5 (d, *J* = 19.1 Hz), 169.5, 159.5, 134.4, 134.3/134.2, 129.9, 129.1/129.0, 128.6/128.6, 128.4, 114.3, 94.1 (d, *J* = 190.0 Hz), 55.4, 53.4 (d, *J* = 19.3 Hz), 23.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -201.37 (dd, *J* = 47.1, 27.0 Hz, 0.12F), -201.93 (dd, *J* = 47.2, 27.2 Hz, 0.90F); HRMS (ESI) *m/z* Calcd for $C_{18}H_{18}FNNaO_3$ $[M+Na]^+$: 338.1163, Found: 338.1170.

2- fluoro -3-(4-bromophenyl)-3-acetamido-1-phenylpropan-1-one (3h)



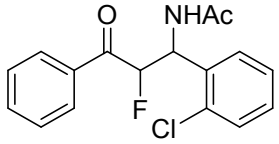
Product **3h** was pale yellow semisolid (134 mg, 37%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.1 Hz, 2H), 7.67 (t, *J* = 6.6 Hz, 1H), 7.58 – 7.44 (m, 4H), 7.32 (d, *J* = 8.0 Hz, 2H), 6.65 (d, *J* = 7.3 Hz, 1H), 5.95 (d, *J* = 47.1 Hz, 1H), 5.69 (dd, *J* = 27.0, 7.9 Hz, 1H), 1.99 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.2 (d, *J* = 19.5 Hz), 169.6, 136.8, 134.3, 134.1, 132.0, 129.0, 128.9, 128.6/128.6, 122.3, 93.6 (d, *J* = 191.0 Hz), 53.4 (d, *J* = 19.3 Hz), 23.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -201.47 (dd, *J* = 46.8, 27.2 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{15}BrFNNaO_2$ $[M+Na]^+$: 386.0162, Found: 386.0191.

2- fluoro-3-(4- fluorophenyl)-3-acetamido-1-phenylpropan-1-one (3i)



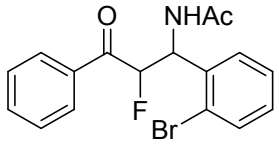
Product **3i** was white solid (115 mg, 38%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.7 Hz, 2H), 7.66 (t, *J* = 7.4 Hz, 1H), 7.53 (t, *J* = 7.7 Hz, 2H), 7.43 (dd, *J* = 8.0, 5.4 Hz, 2H), 7.09 (t, *J* = 8.5 Hz, 2H), 6.68 (d, *J* = 8.6 Hz, 1H), 5.96 (dd, *J* = 47.1, 2.0 Hz, 1H), 5.72 (dd, *J* = 26.7, 8.2 Hz, 1H), 1.99 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 194.3 (d, *J* = 19.0 Hz), 169.6, 162.5 (d, *J* = 247.2 Hz), 134.3, 134.1, 133.6, 133.6, 129.0/129.0/128.9, 128.6/128.5, 115.9/115.7, 93.8 (d, *J* = 190.8 Hz), 53.3 (d, *J* = 19.3 Hz), 22.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -113.59 – -113.67 (m, 1F), -201.44 (dd, *J* = 47.1, 27.2 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{15}F_2NNaO_2$ $[M+Na]^+$: 326.0963, Found: 326.0967.

2- fluoro-3-(2-chlorophenyl)-3- acetamido-1-phenylpropan-1-one (3j)



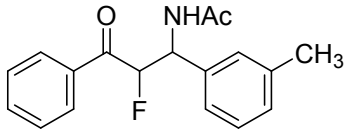
Product **3j** was yellow oil (134 mg, 42%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 7.5 Hz, 0.18H)/8.09 (d, *J* = 7.6 Hz, 1.99H), 7.70 (t, *J* = 7.4 Hz, 1H), 7.57 (t, *J* = 7.7 Hz, 2H), 7.48 (dt, *J* = 8.3, 5.3 Hz, 2H), 7.38 – 7.32 (m, 2H), 6.92 (d, *J* = 8.4 Hz, 1H), 6.16 (dd, *J* = 46.8, 1.6 Hz, 1H), 6.09 (dd, *J* =30.0, 9.2 Hz, 1H), 2.00 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.9 (d, *J* = 17.9 Hz), 169.6, 135.0, 134.6, 133.7, 133.2, 132.2, 130.1, 129.8/129.4, 129.1/128.7, 128.5/128.4, 127.3, 91.8 (d, *J* = 188.2 Hz), 51.8 (d, *J* = 18.4 Hz), 22.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -205.53 (dd, *J* = 46.9, 30.8 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{15}ClFNNaO_2$ $[M+Na]^+$: 342.0668, Found: 342.0673.

2- fluoro-3-(2-bromophenyl)-3-acetamido-1-phenylpropan-1-one (3k)



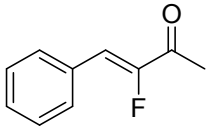
Product **3k** was pale yellow oil (160 mg, 44%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, *J* = 7.6 Hz, 2H), 7.74 – 7.63 (m, 2H), 7.57 (t, *J* = 7.7 Hz, 2H), 7.45 (d, *J* = 7.7 Hz, 1H), 7.39 (t, *J* = 7.5 Hz, 1H), 7.25 (t, *J* = 7.1 Hz, 1H), 6.78 (d, *J* = 8.1 Hz, 1H), 6.23 – 5.97 (m, 2H), 1.99 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.8 (d, *J* = 18.1 Hz), 169.3, 136.6, 134.5, 133.8, 133.8, 133.2, 129.7, 129.0, 128.6, 127.8, 122.6, 91.7 (d, *J* = 188.1 Hz), 53.9 (d, *J* = 18.2 Hz), 22.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -205.73 (dd, *J* = 46.9, 30.7 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{15}BrFNNaO_2$ $[M+Na]^+$: 386.0162, Found: 386.0157.

2- fluoro-3-acetamido-1-phenyl-3-m-tolylpropan-1-one (3m)



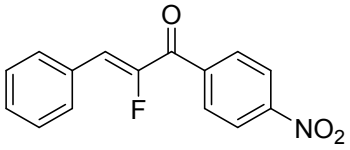
Product **3m** was 1:10 mixture of diastereomers (determined by ^{19}F NMR spectroscopy), white solid (150 mg, 50%). ^{1}H NMR (400 MHz, DMSO-*d6*) δ 8.71 (d, *J* = 9.4 Hz, 1H), 7.98 (d, *J* = 7.6 Hz, 2H), 7.71 (t, *J* = 7.3 Hz, 1H), 7.59 (t, *J* = 7.6 Hz, 2H), 7.33 (s, 1H), 7.31 – 7.24 (m, 2H), 7.14 (d, *J* = 3.8 Hz, 1H), 6.35 (dd, *J* = 46.6, 2.2 Hz, 1H), 5.66 – 5.51 (m, 1H), 2.35 (s, 3H), 1.84 (s, 3H); ^{13}C NMR (101 MHz, DMSO-*d6*) δ 199.6 (d, *J* = 18.4 Hz), 174.0, 143.6, 142.7, 139.7, 138.9, 134.0, 133.6, 133.5, 133.3, 133.0, 129.5, 99.6 (d, *J* = 187.9 Hz), 58.3 (d, *J* = 18.9 Hz), 27.4/26.3; ^{19}F NMR (376 MHz, DMSO-*d6*) δ -198.93 (dd, *J* = 47.8, 24.9 Hz, 0.09F), -202.42 (dd, *J* = 46.4, 31.2 Hz, 0.90F); HRMS (ESI) *m/z* Calcd for $C_{18}H_{18}FNaNO_2$ $[M+Na]^+$: 322.1214, Found: 322.1223.

(*Z*)-3-fluoro-4-phenylbut-3-en-2-one (5p)



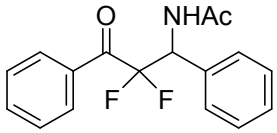
Product **5p** was colorless semisolid (74 mg, 45%).^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 – 7.67 (m, 2H), 7.50 – 7.40 (m, 3H), 6.86 (d, *J* = 36.4 Hz, 1H), 2.46 (d, *J* = 3.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 192.3 (d, *J* = 33.4 Hz), 154.0 (d, *J* = 271.5 Hz), 131.1/131.0, 130.7/130.6, 129.9/129.9, 128.9, 115.6 (d, *J* = 5.5 Hz), 25.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -123.49 (dd, *J* = 36.4, 3.2 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{10}H_9FNaO$ $[M+Na]^+$: 187.0530, Found: 187.0557.

(*Z*)-2-fluoro-1-(4-nitrophenyl)-3-phenylprop-2-en-1-one (5b)



Product **5b** was white semisolid (95 mg, 35%).^{1}H NMR (400 MHz, $CDCl_3$) δ 8.40 (d, *J* = 8.7 Hz, 2H), 8.10 (d, *J* = 7.6 Hz, 2H), 7.83 – 7.72 (m, 2H), 7.54 – 7.46 (m, 3H), 6.98 (d, *J* = 36.3 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 186.1 (d, *J* = 30.6 Hz), 153.8 (d, *J* = 271.8 Hz), 150.1, 141.2/141.2, 131.0/130.9, 130.8/130.8, 130.7/130.7, 130.3/130.3, 129.1, 123.7, 121.1 (d, *J* = 5.3 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -120.73 (d, *J* = 36.3 Hz, 1F); HRMS (ESI) *m/z* Calcd for $C_{15}H_{10}FNNaO_3$ $[M+Na]^+$: 294.0537, Found: 294.0530.

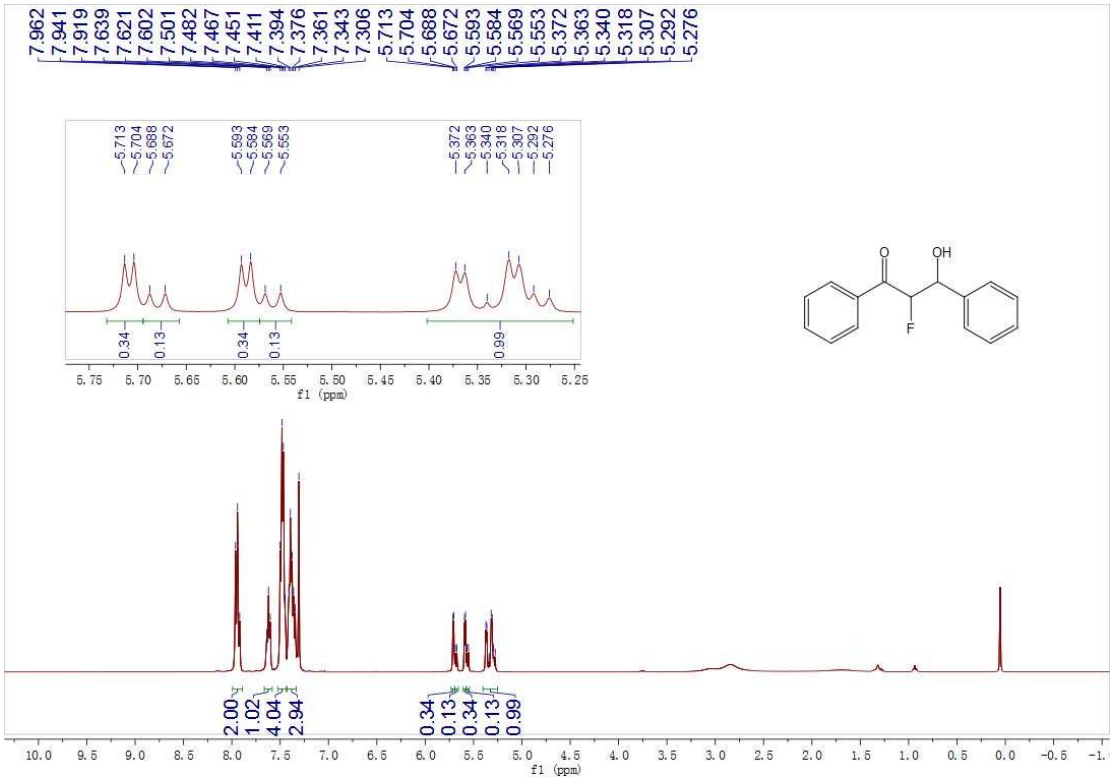
2,2-difluoro-3-acetamido-1,3-diphenylpropan-1-one (4a)

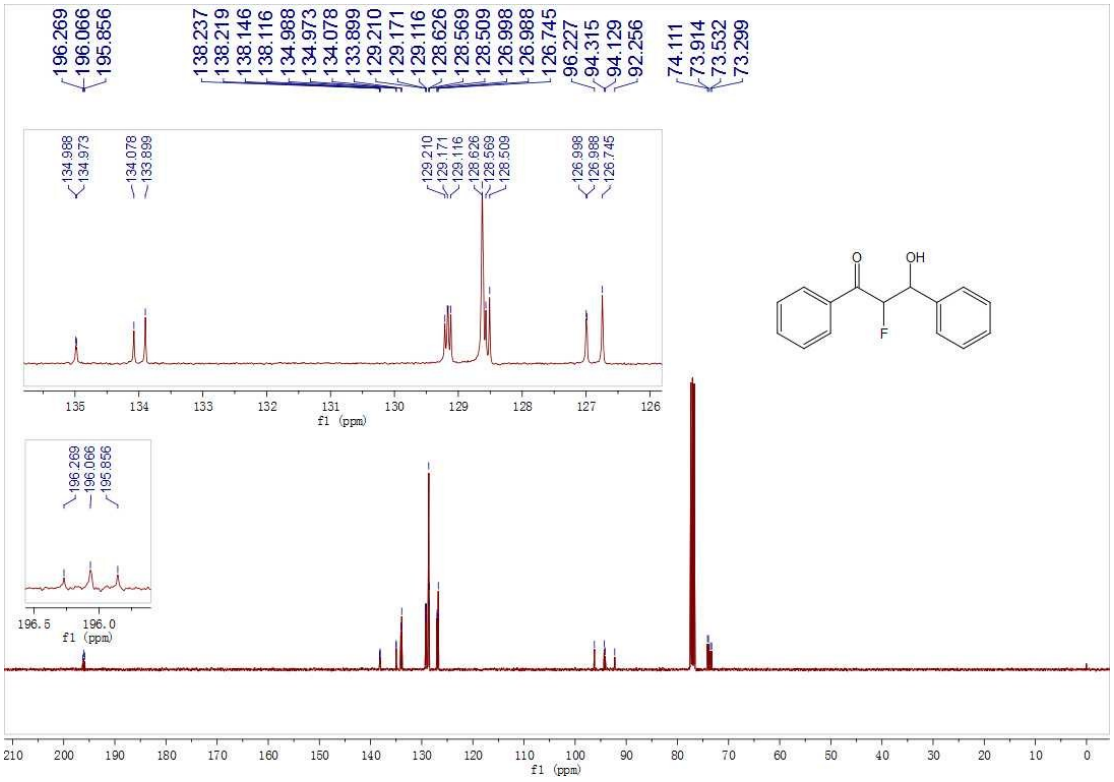


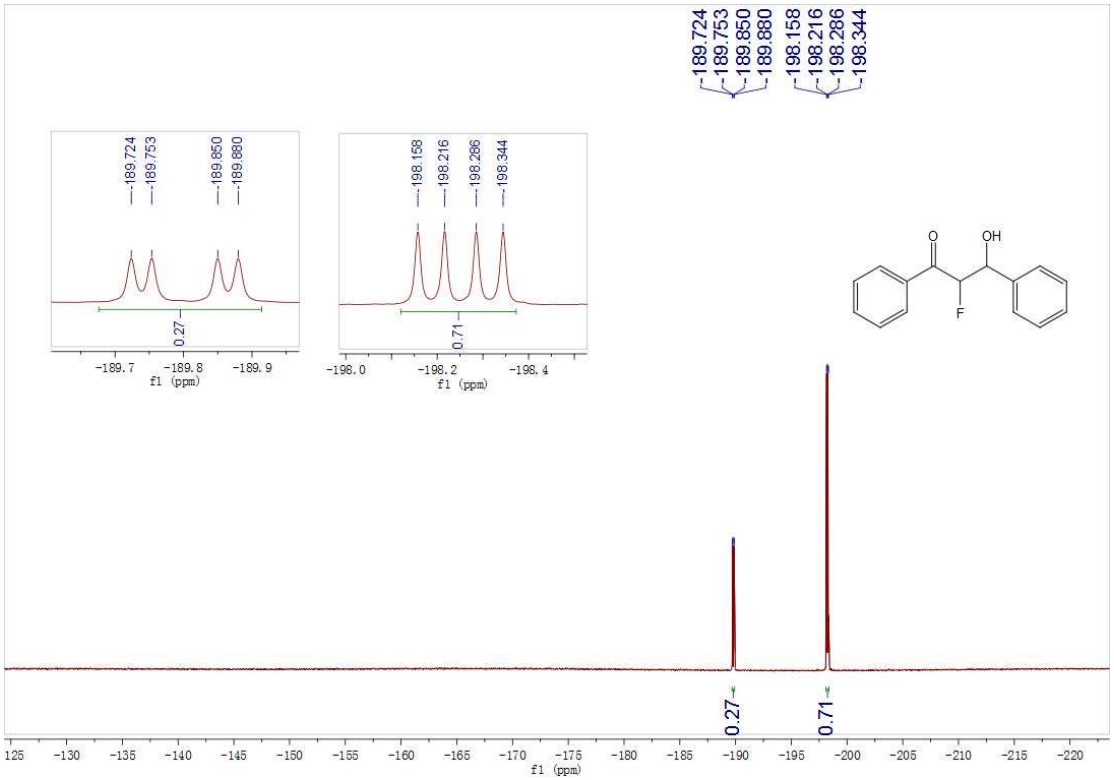
Product **4a** was pale yellow solid (167 mg, 55%). ^{1}H NMR (400 MHz, $CDCl_3$) δ8.02 (d, *J* = 7.7 Hz, 2H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.40 – 7.33 (m, 5H), 6.65 (d, *J* = 9.4 Hz, 1H), 5.99 (td, *J* = 13.4, 9.6 Hz, 1H), 2.06 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.0 (t, *J* = 28.8 Hz), 169.5, 134.6, 133.6 (t, *J* = 1.7 Hz), 132.2 (t, *J* = 1.7 Hz), 130.0 (t, *J* = 3.3 Hz), 128.8/128.8, 128.7, 128.5, 116.8 (t, *J* = 259.8 Hz), 55.5 (t, *J* = 24.5 Hz), 23.2/23.2; ^{19}F NMR (376 MHz, $CDCl_3$) δ -105.62 (d, *J* = 9.1 Hz, 2F); HRMS (ESI) *m/z* Calcd for $C_{17}H_{15}F_2NNaO_2$, $[M+Na]^+$: 326.0963, Found: 326.0965.

7. NMR spectra for the products

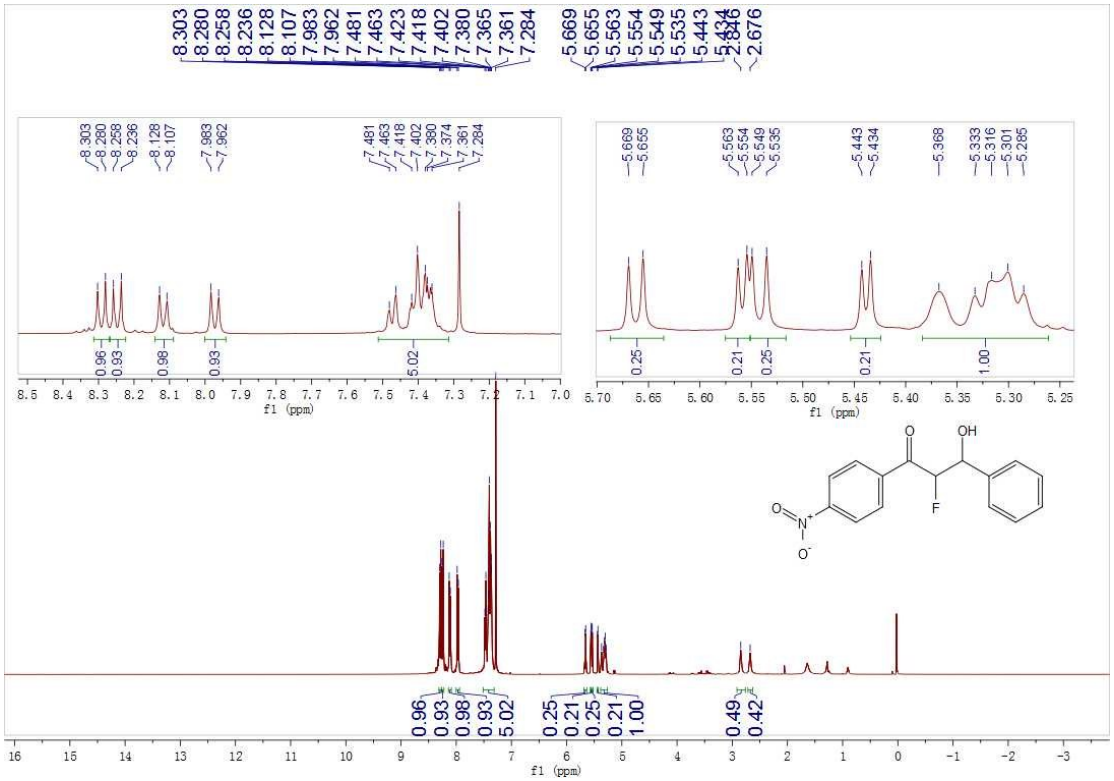
2-fluoro-3-hydroxy-1,3-diphenylpropan-1-one (2a)

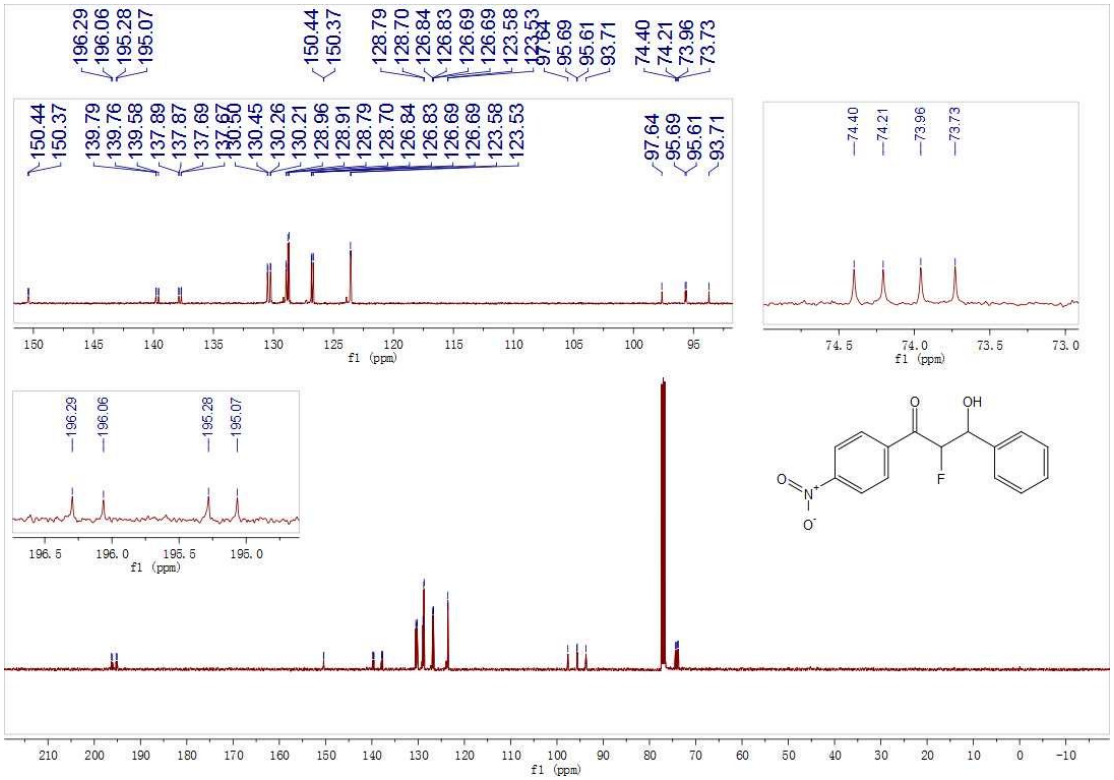


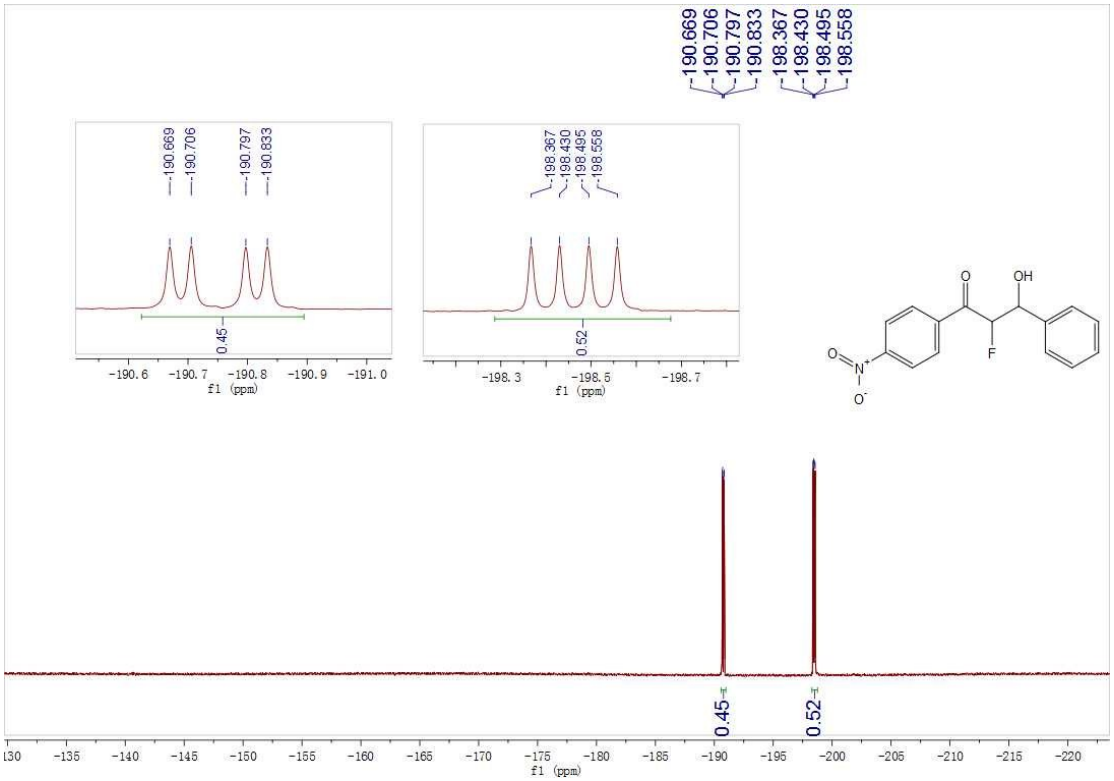




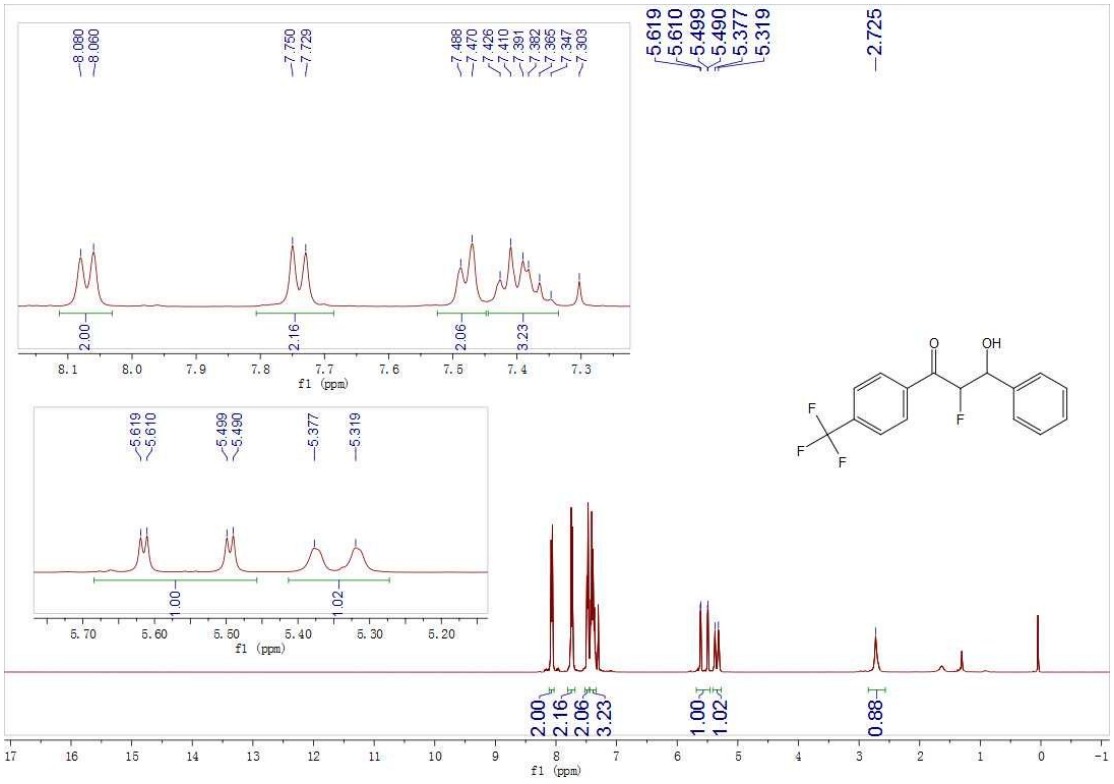
2-fluoro-3-hydroxy-1-(4-nitrophenyl)-3-phenylpropan-1-one (2b)

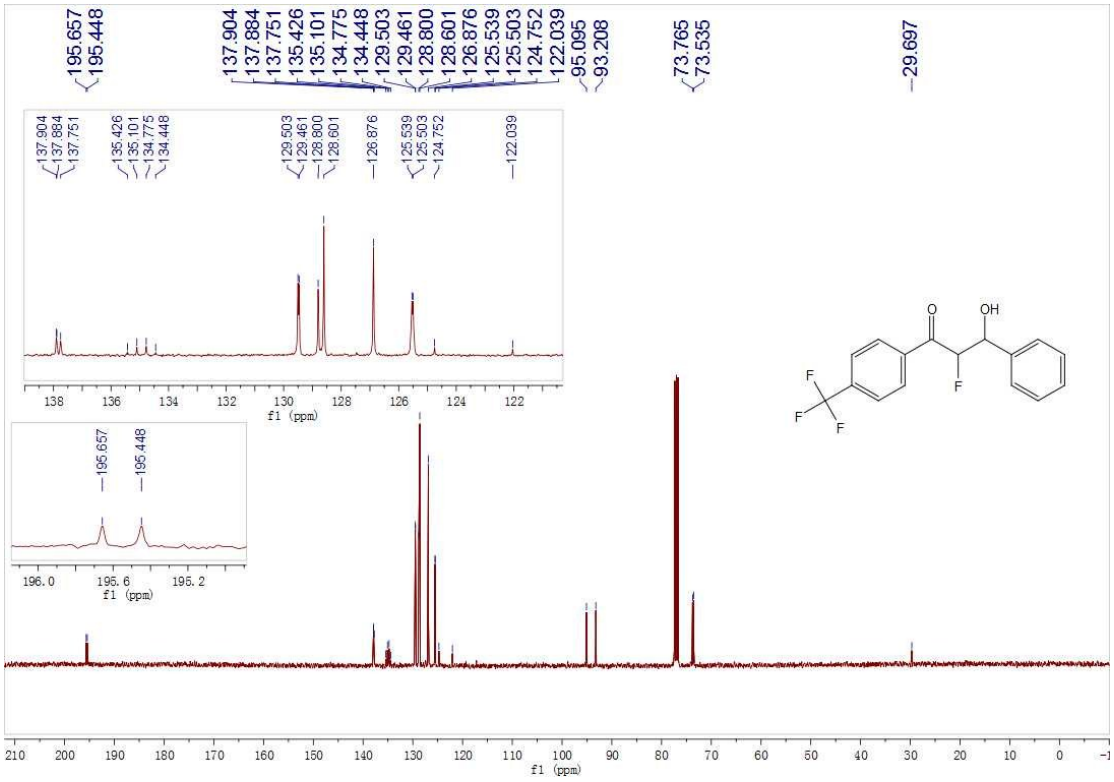


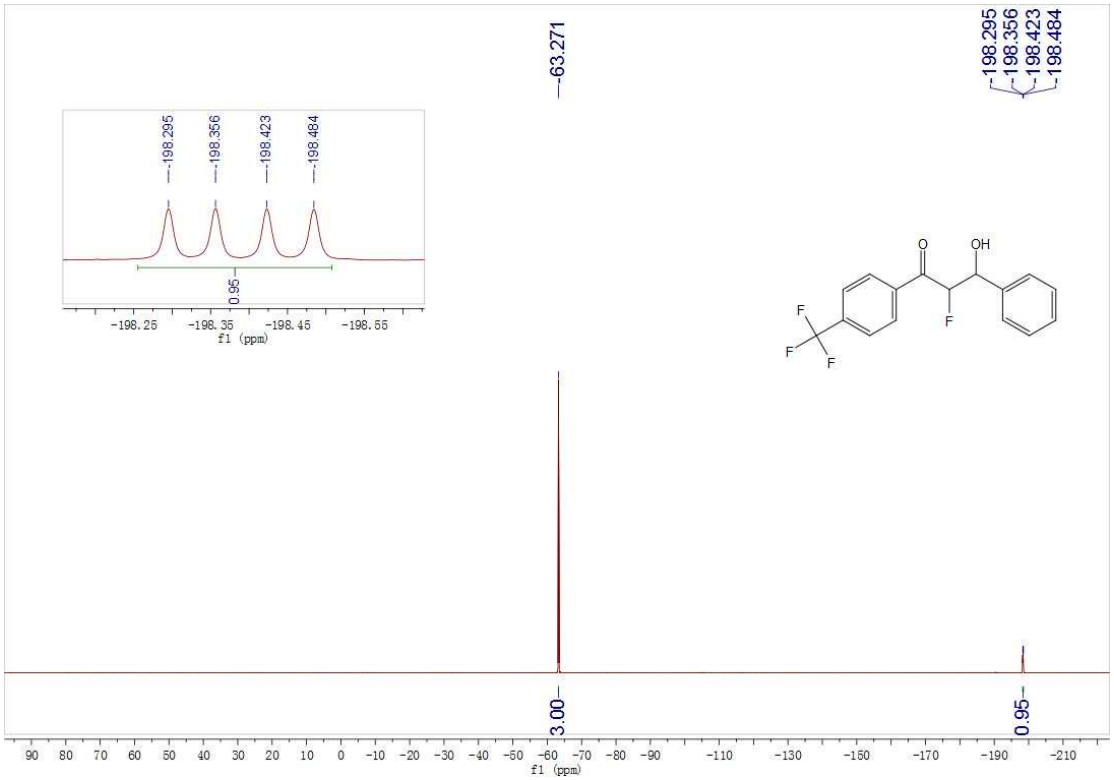

196.29
196.06
195.28
195.07
150.44
150.37
128.79
128.70
126.84
126.83
126.69
126.69
123.58
123.53
97.64
95.69
95.61
93.71
74.40
74.21
73.96
73.73
f1 (ppm)
OH
O
F
N+
O-


190.669
190.706
190.797
190.833
198.367
198.430
198.495
198.558
0.45
0.52
f1 (ppm)
OH
O
F
N+
O-

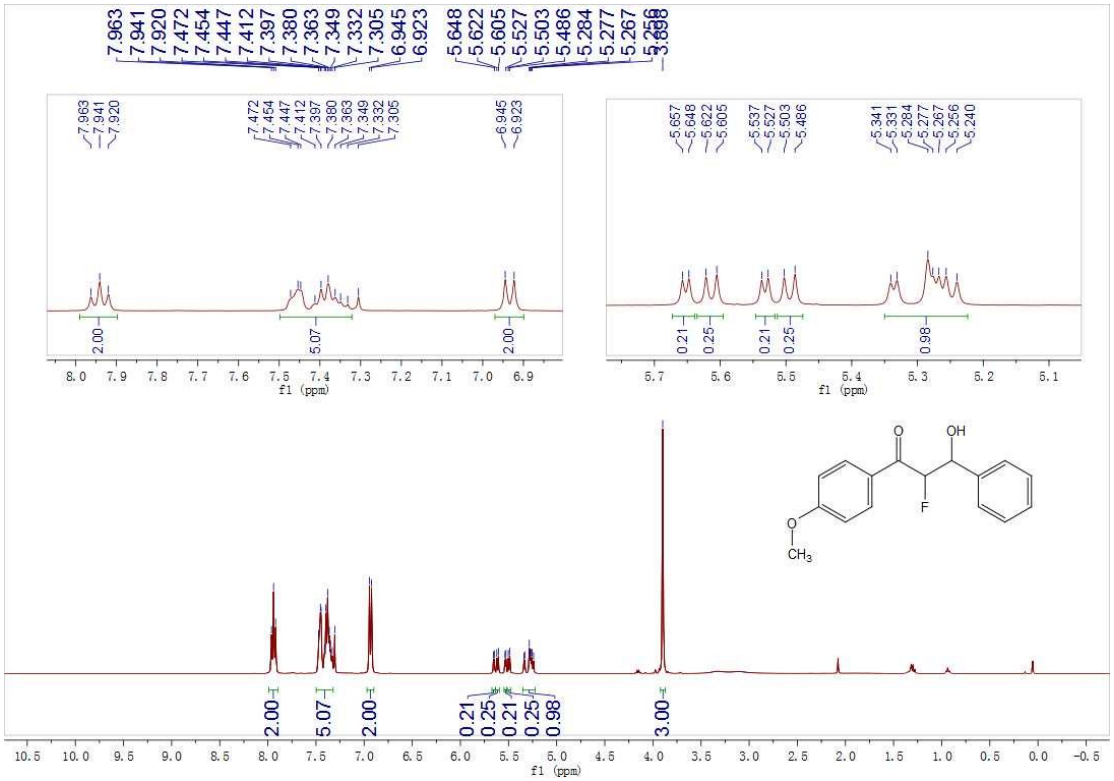
2-fluoro-3-hydroxy-3-phenyl-1-(4-(trifluoromethyl)phenyl)propan-1-one (2c)

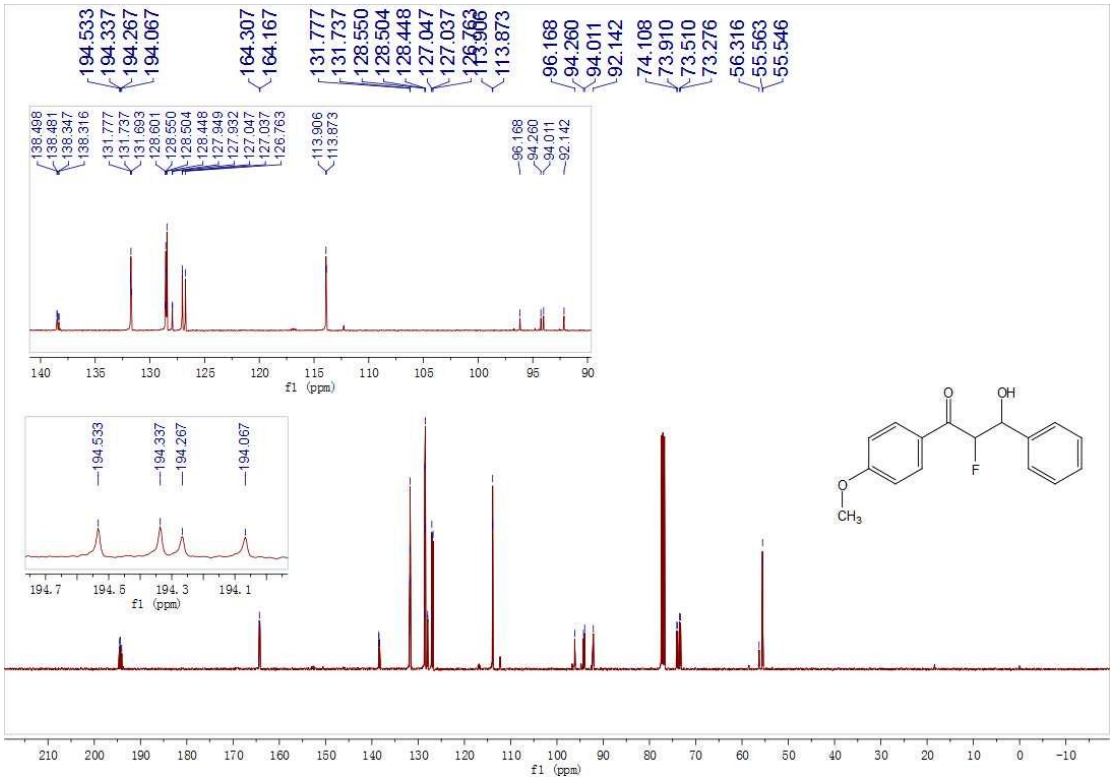


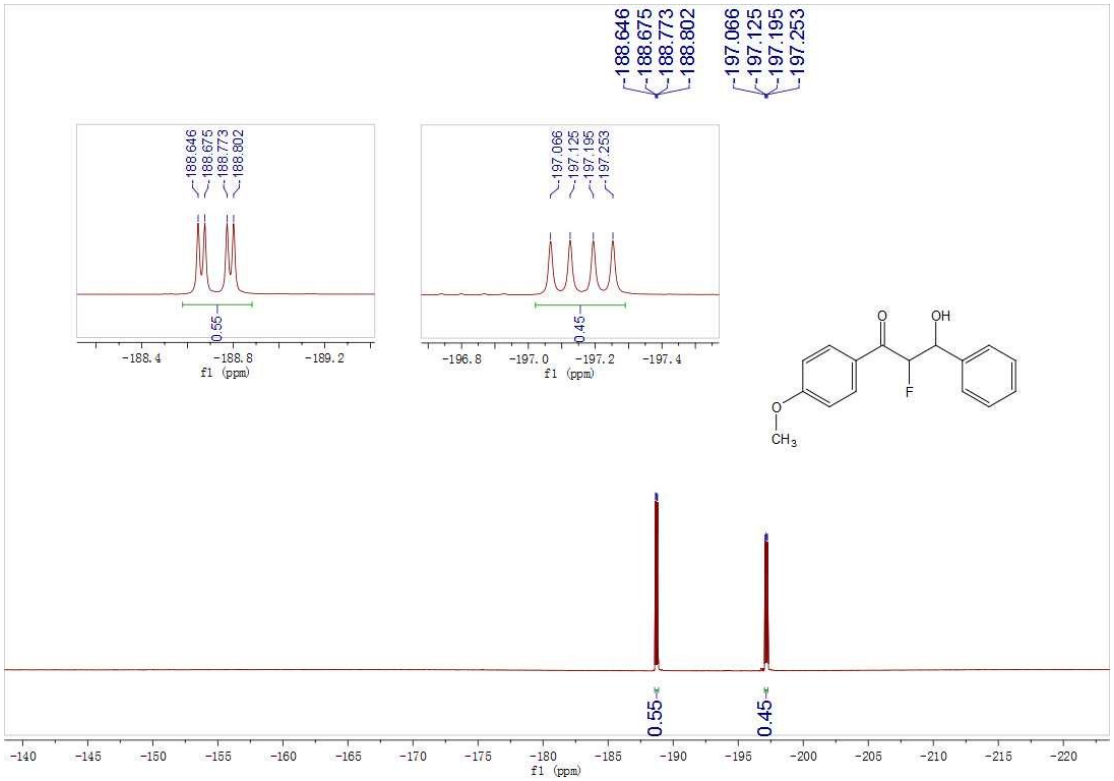




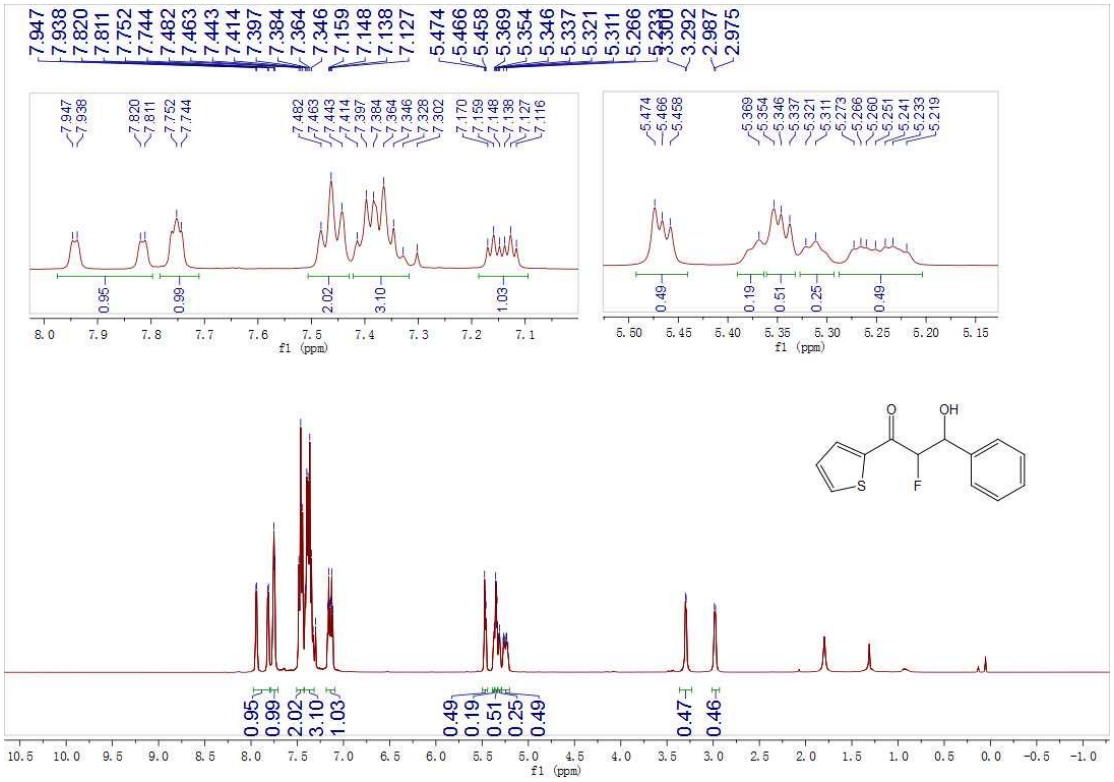
2-fluoro-3-hydroxy-1-(4-methoxyphenyl)-3-phenylpropan-1-one (2d)

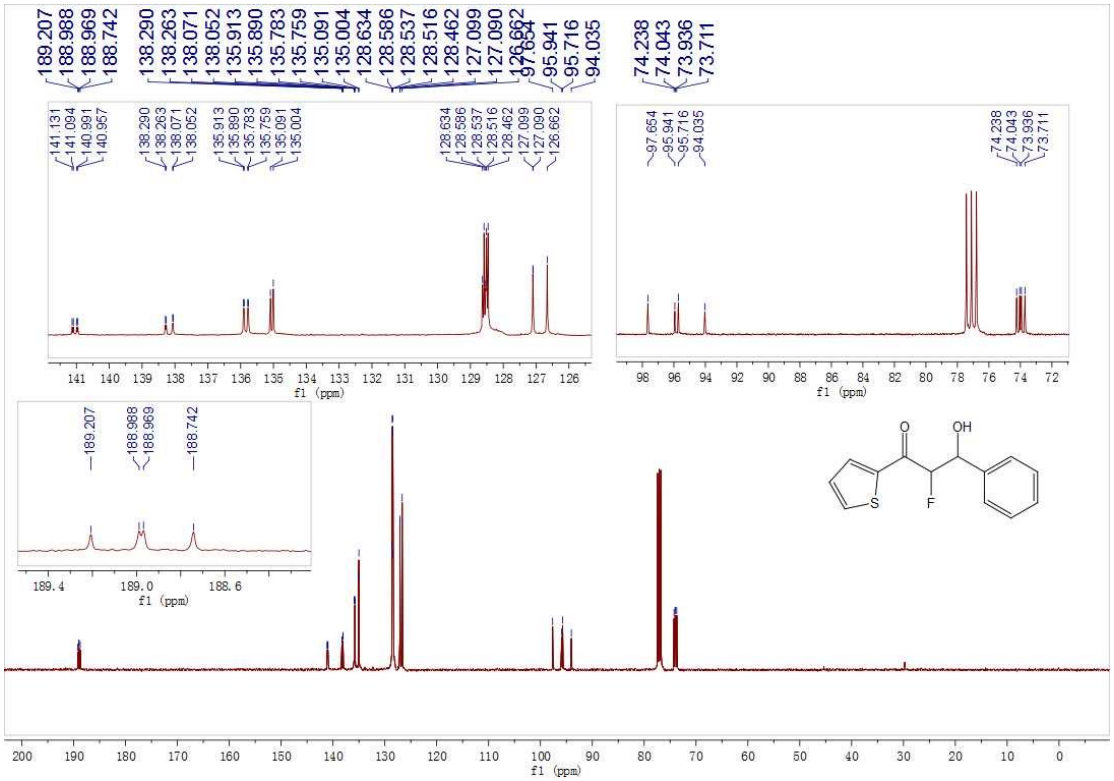


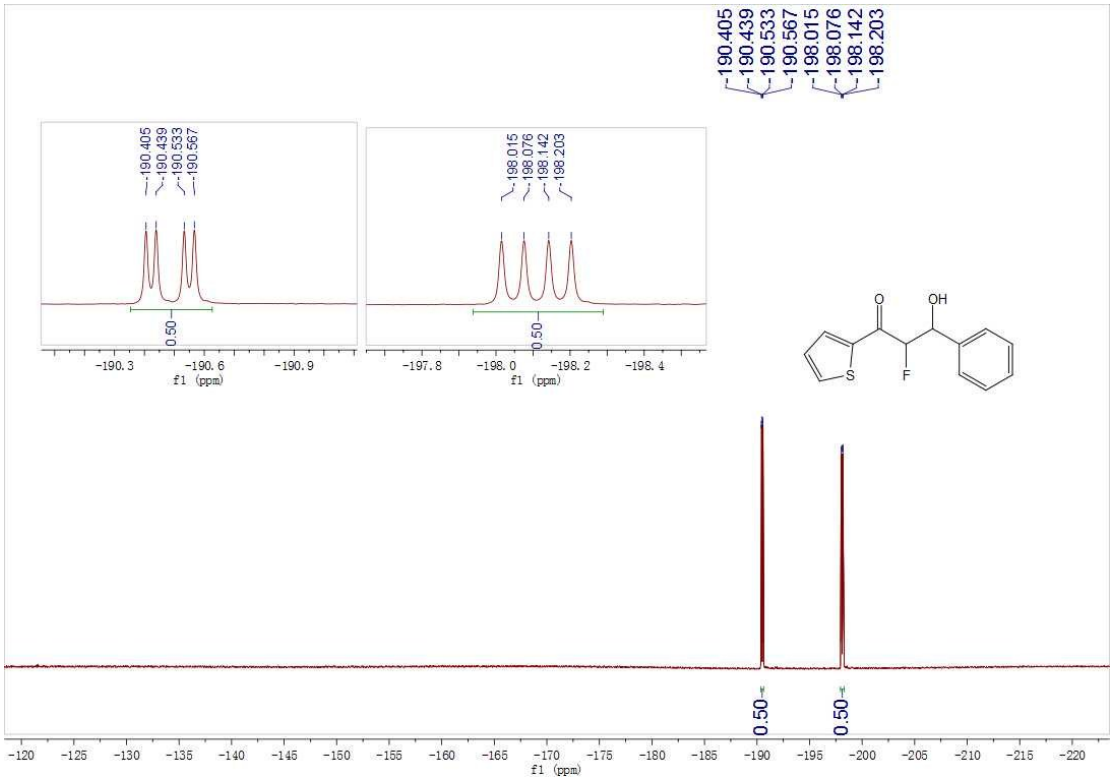

194.533
194.337
194.267
194.067
164.307
164.167
131.777
131.737
128.550
128.504
128.448
127.047
127.037
113.906
113.873
96.168
94.260
94.011
92.142
74.108
73.910
73.510
73.276
56.316
55.563
55.546
f1 (ppm)
O
OH
F
O
CH3


188.646
188.675
188.773
188.802
197.066
197.125
197.195
197.253
0.55
0.45
f1 (ppm)
O
OH
F
O
CH3

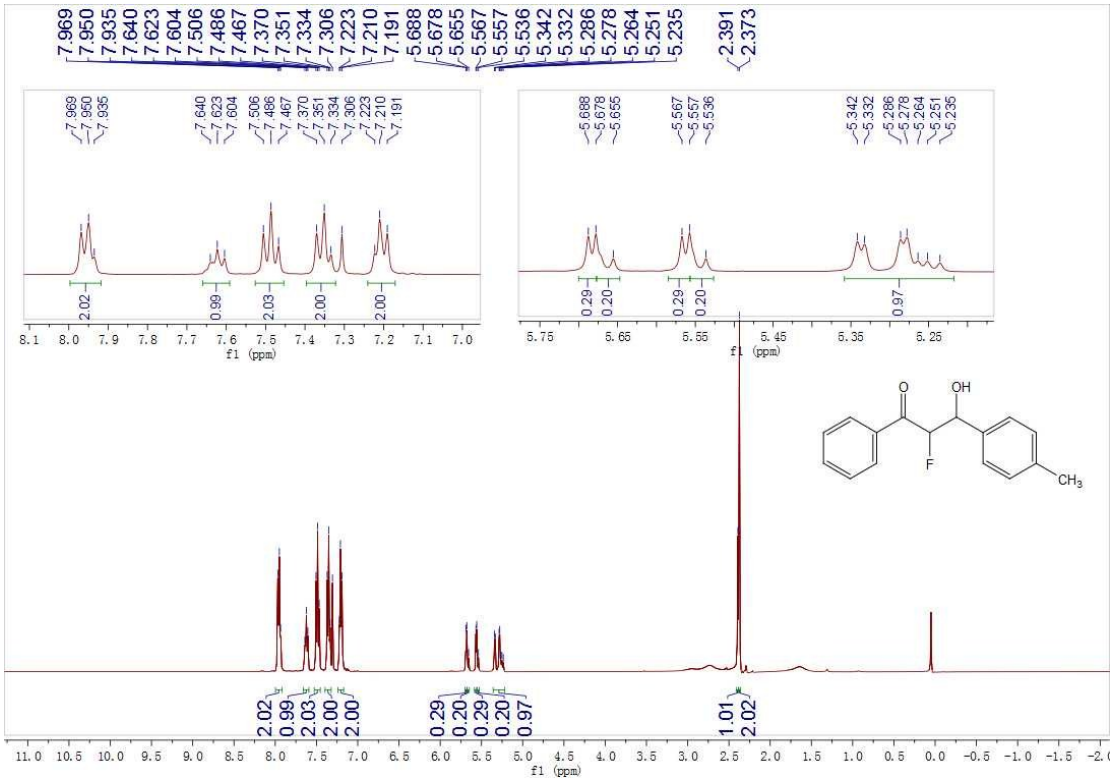
2-fluoro-3-hydroxy-3-phenyl-1-(thiophen-2-yl)propan-1-one (2e)

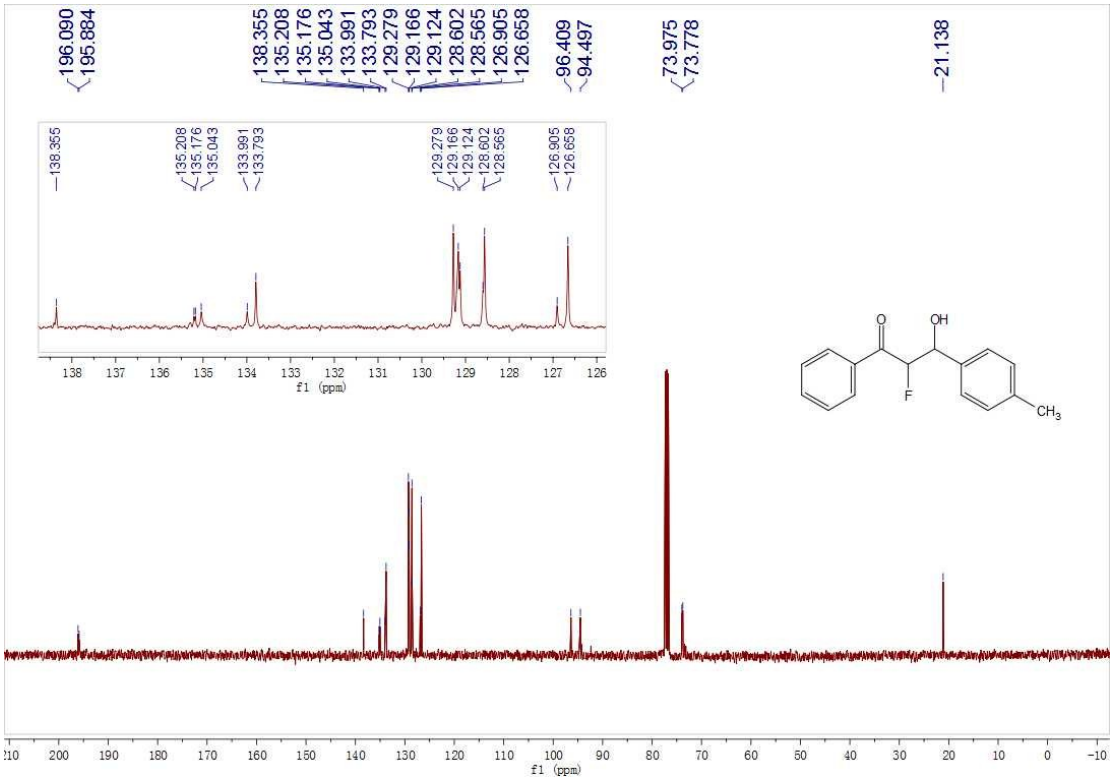


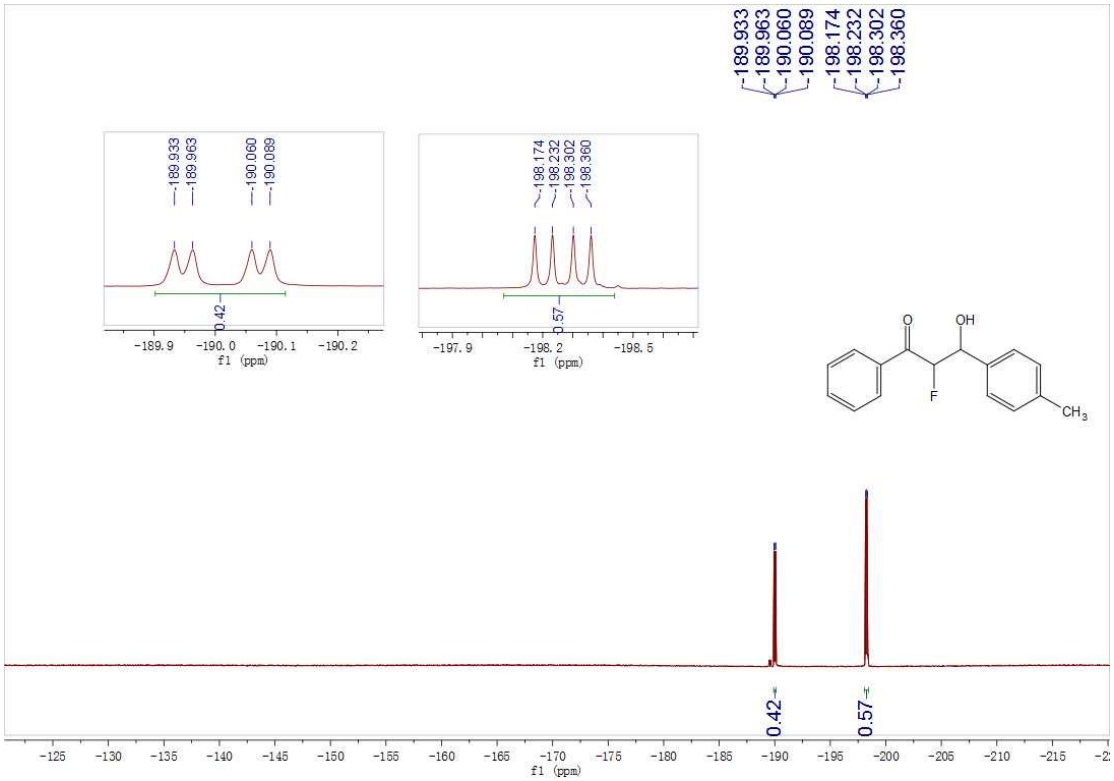




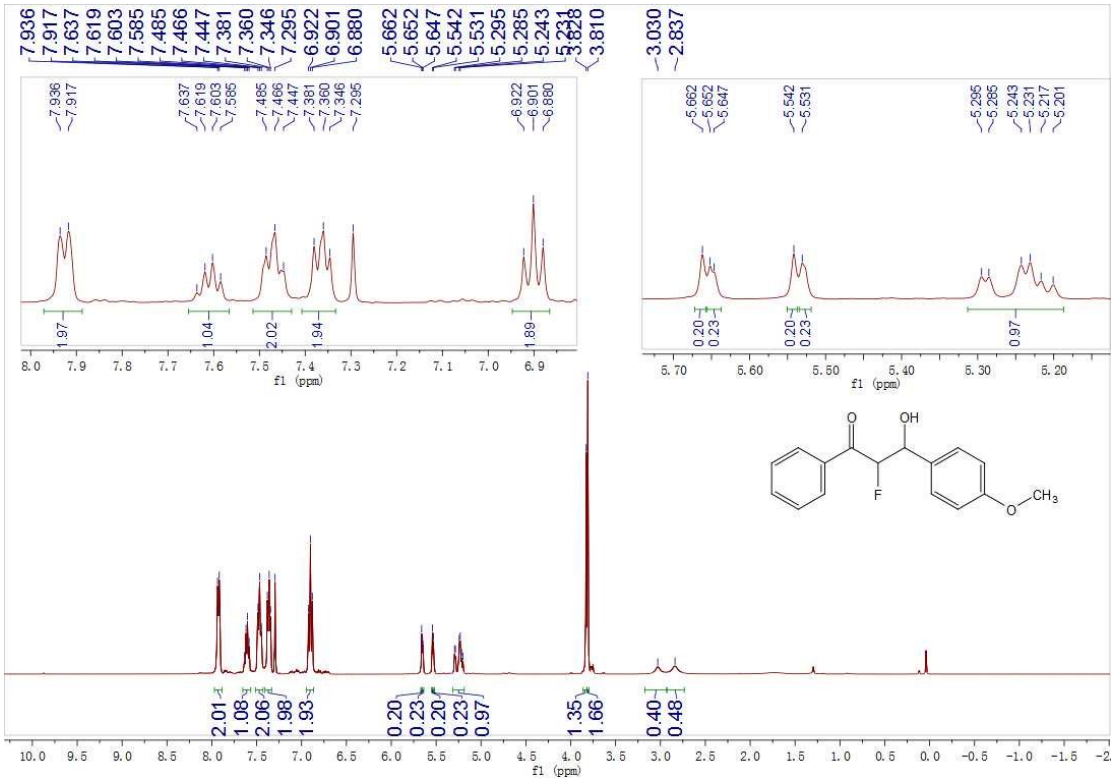
2-fluoro-3-hydroxy-1-phenyl-3-(p-tolyl)propan-1-one (2f)

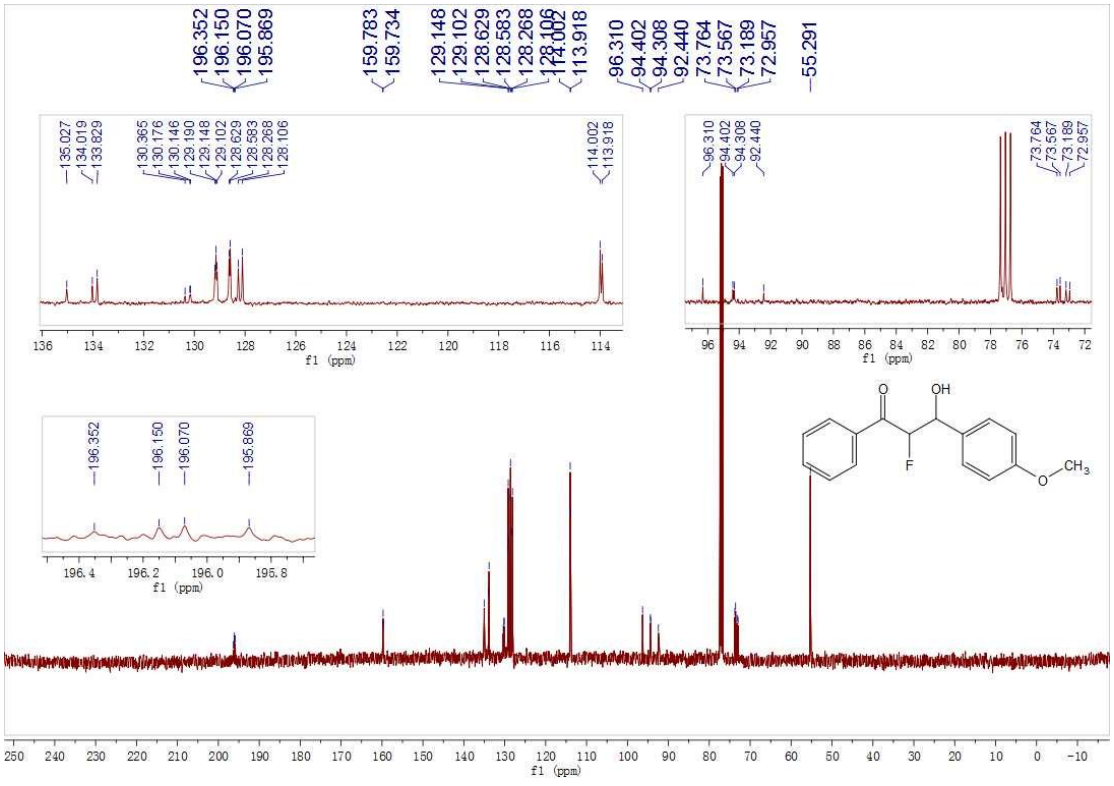


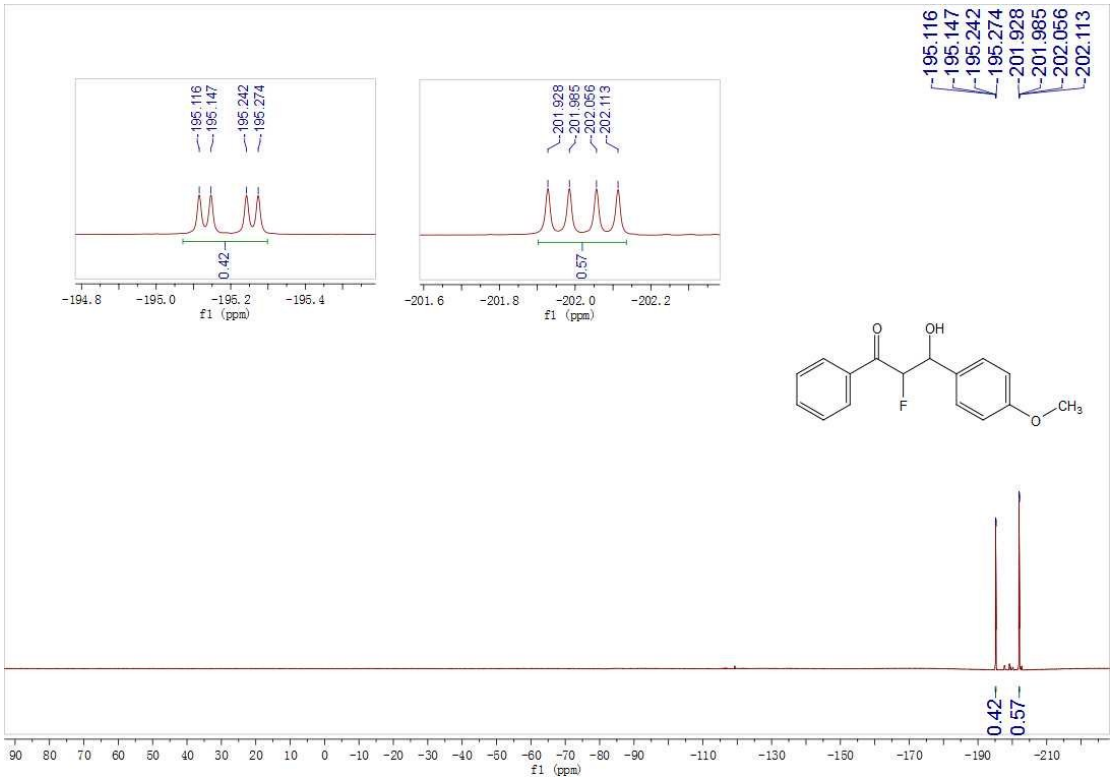

196.090
195.884
138.355
135.208
135.176
135.043
133.991
133.793
129.279
129.166
129.124
128.602
128.565
126.905
126.658
96.409
94.497
73.975
73.778
21.138
f1 (ppm)
O
OH
F
CH3


189.933
189.963
190.060
190.089
198.174
198.232
198.302
198.360
0.42
0.57
f1 (ppm)
O
OH
F
CH3

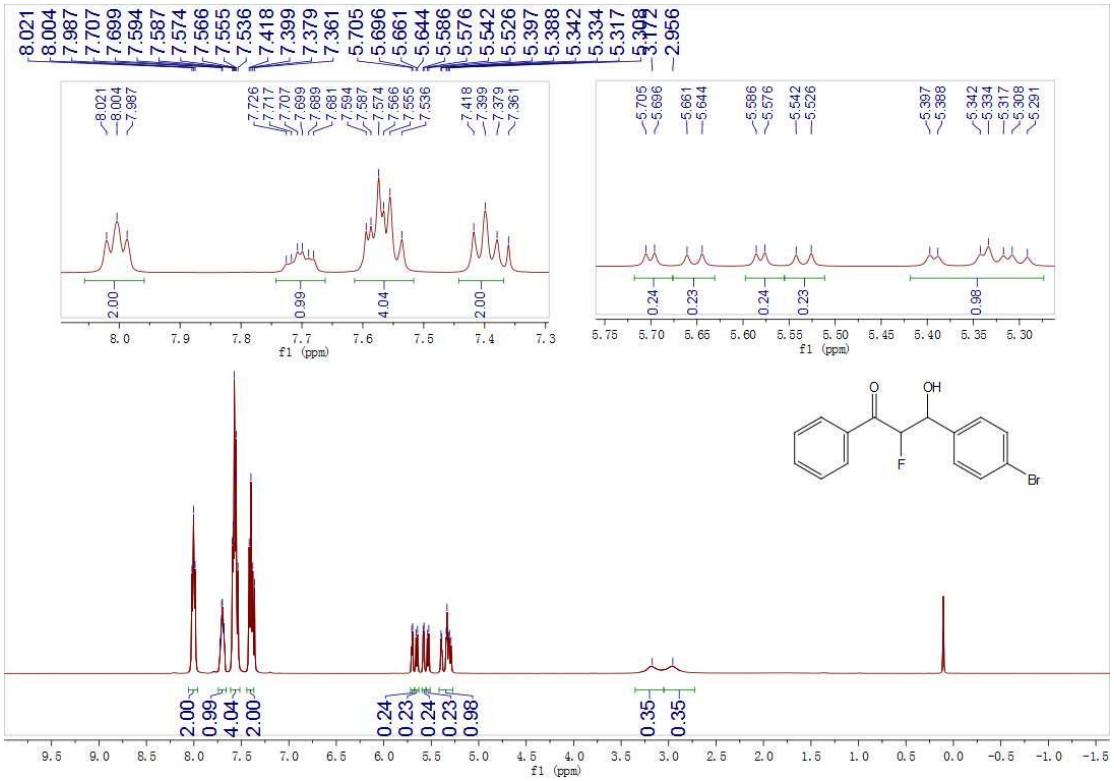
2-fluoro-3-hydroxy-3-(4-methoxyphenyl)-1-phenylpropan-1-one (2g)

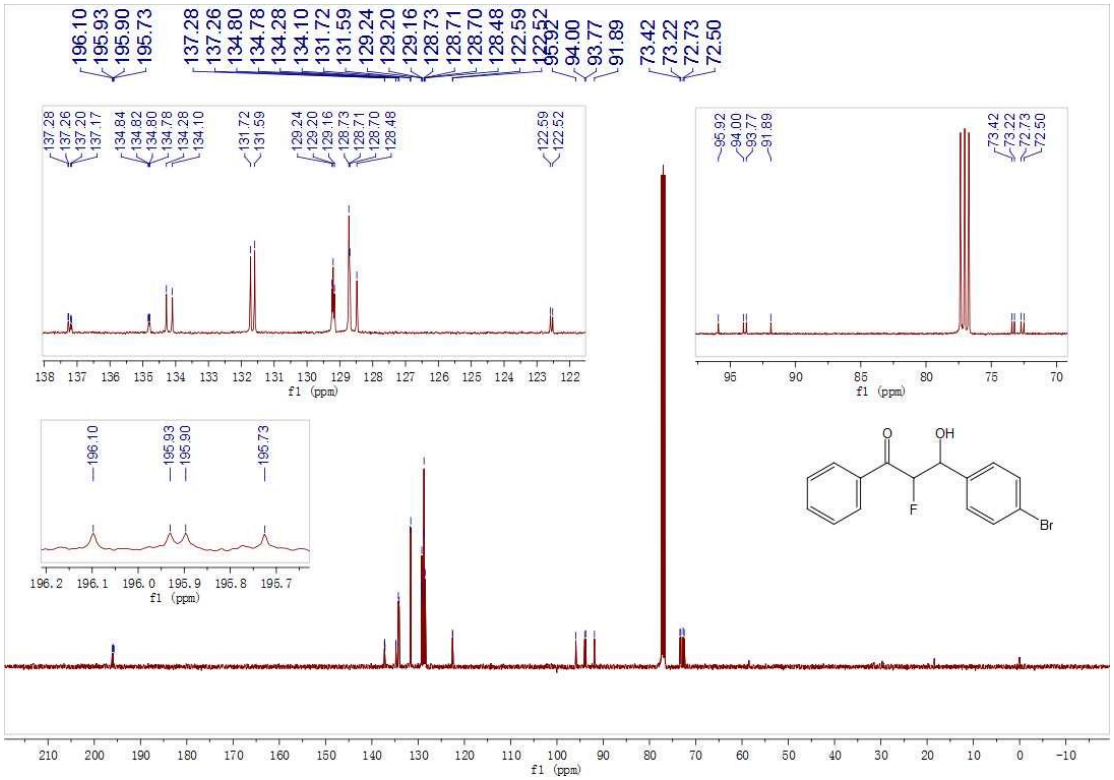


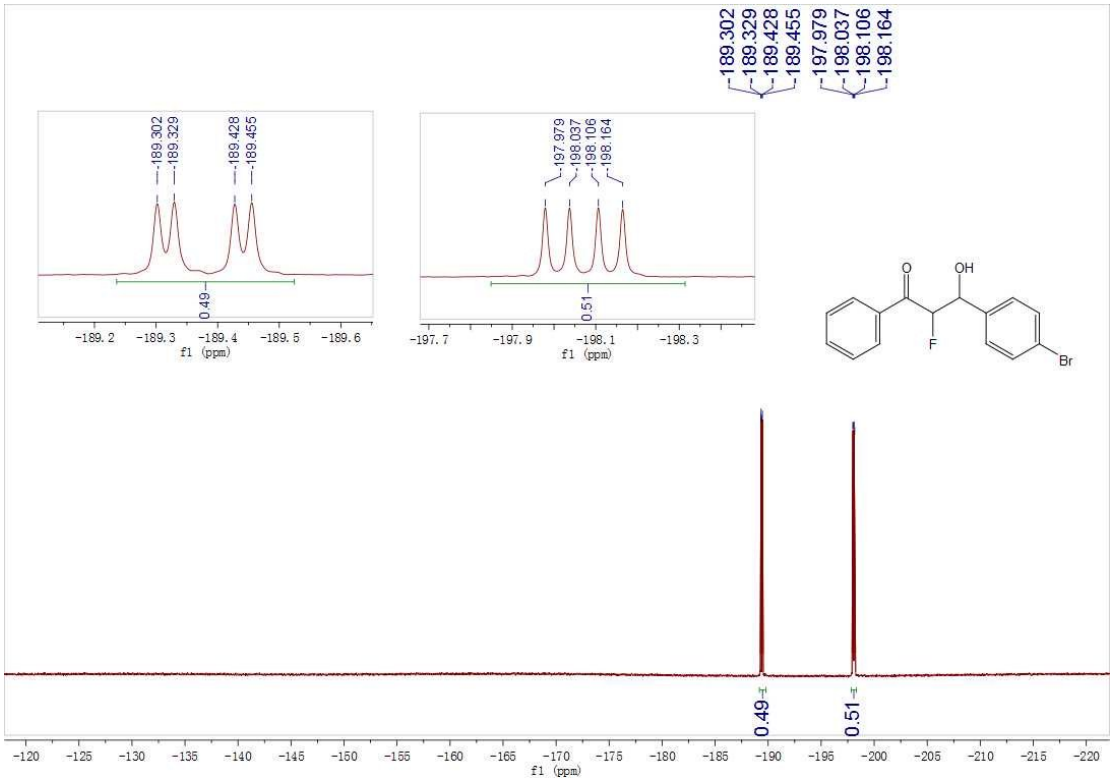




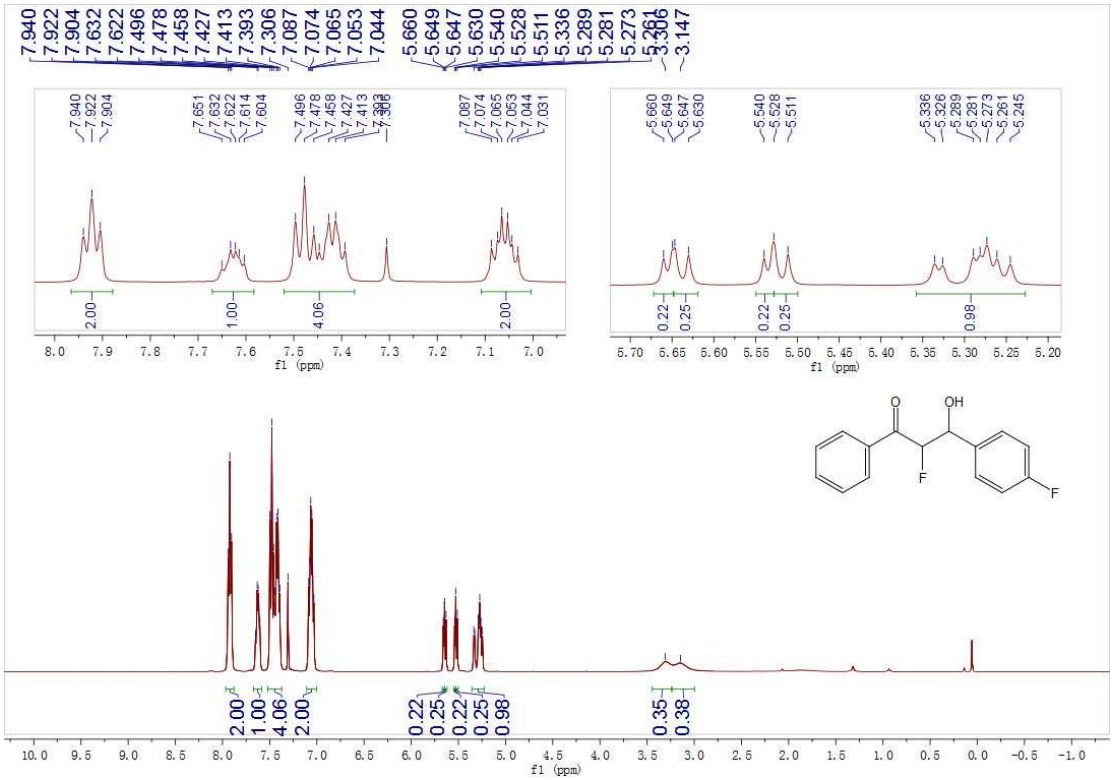
3-(4-bromophenyl)-2-fluoro-3-hydroxy-1-phenylpropan-1-one (2h)

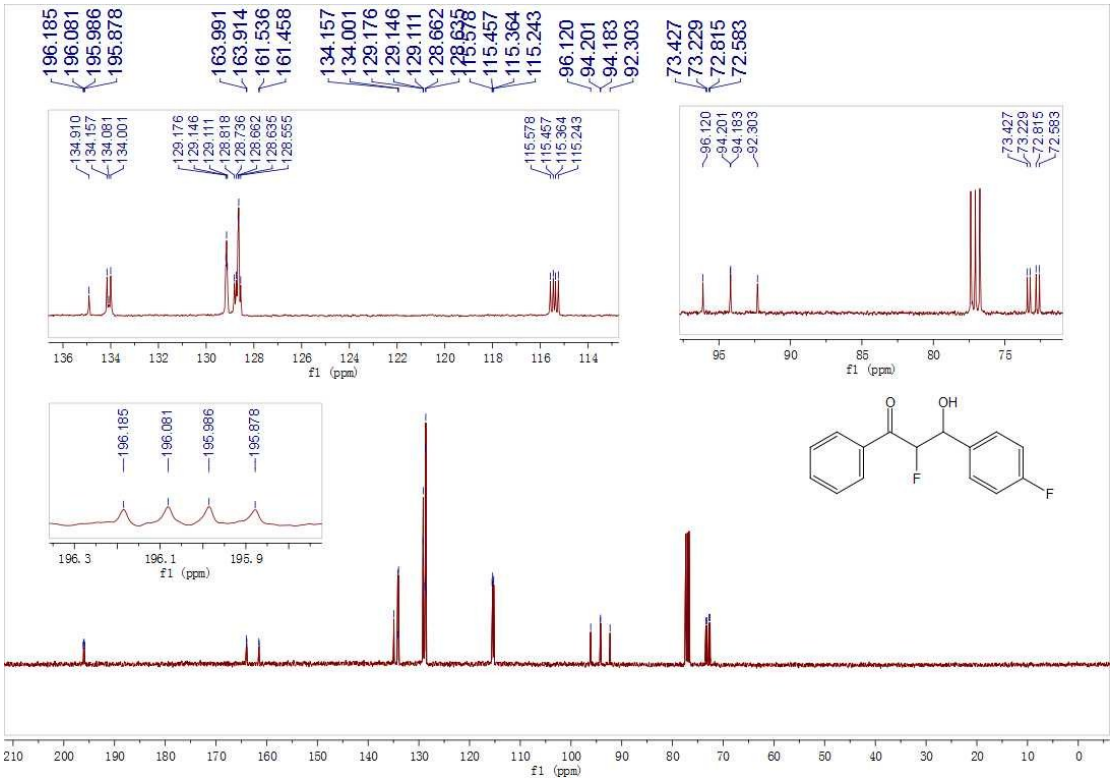


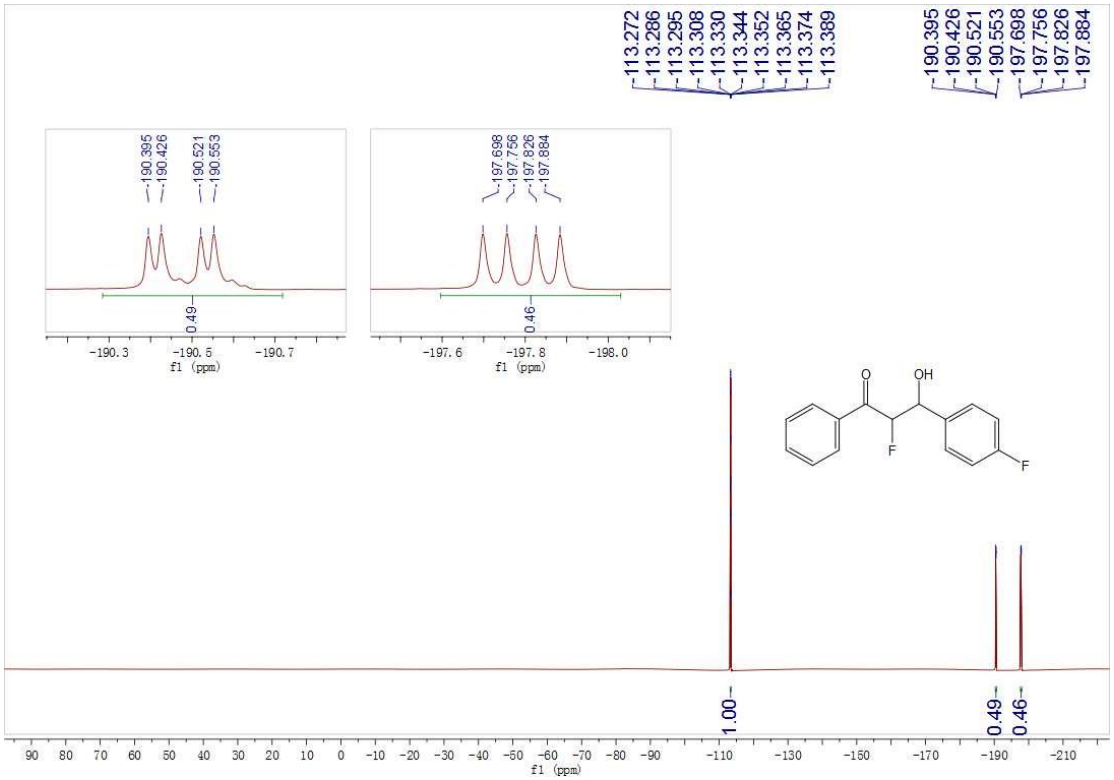




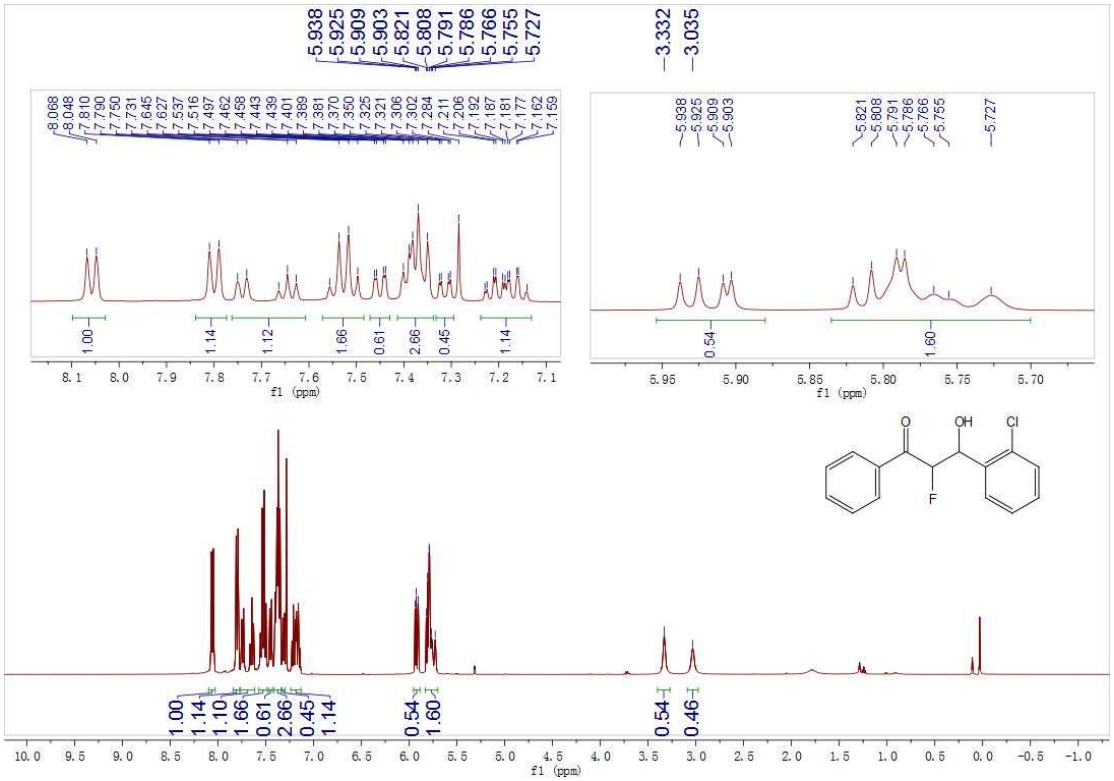
2-fluoro-3-(4-fluorophenyl)-3-hydroxy-1-phenylpropan-1-one (2i)

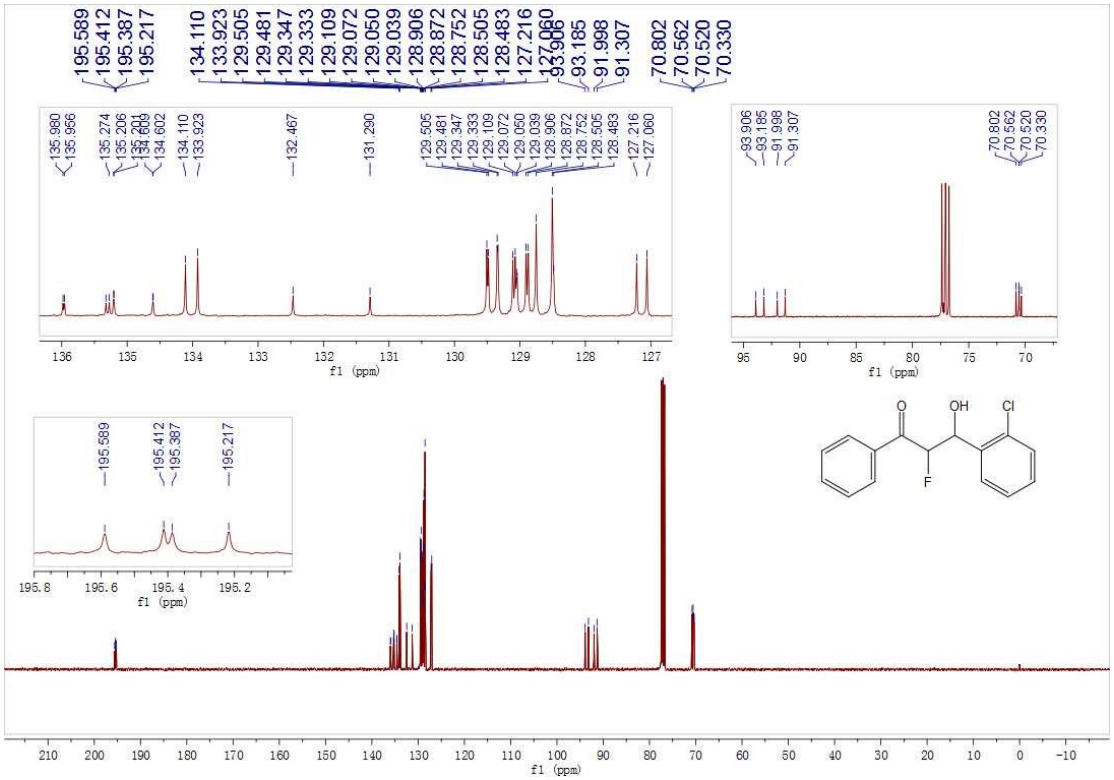

7.940
7.922
7.904
7.632
7.622
7.496
7.478
7.458
7.427
7.413
7.393
7.306
7.087
7.074
7.065
7.053
7.044
5.660
5.649
5.647
5.630
5.540
5.528
5.511
5.336
5.289
5.281
5.273
5.261
3.306
3.147
f1 (ppm)
O
OH
F
F

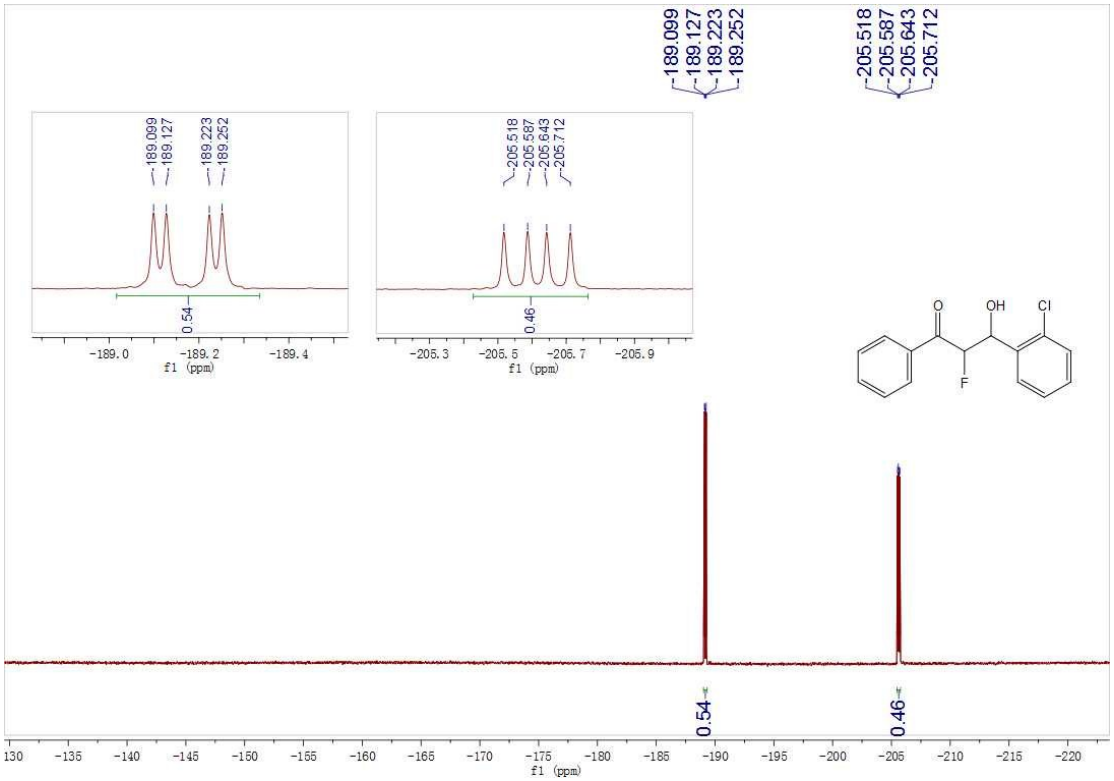

196.185
196.081
195.986
195.878
163.991
163.914
161.536
161.458
134.157
134.001
129.176
129.146
129.111
128.662
128.635
128.555
115.578
115.457
115.364
115.243
96.120
94.201
94.183
92.303
73.427
73.229
72.815
72.583
f1 (ppm)
O
OH
F
F



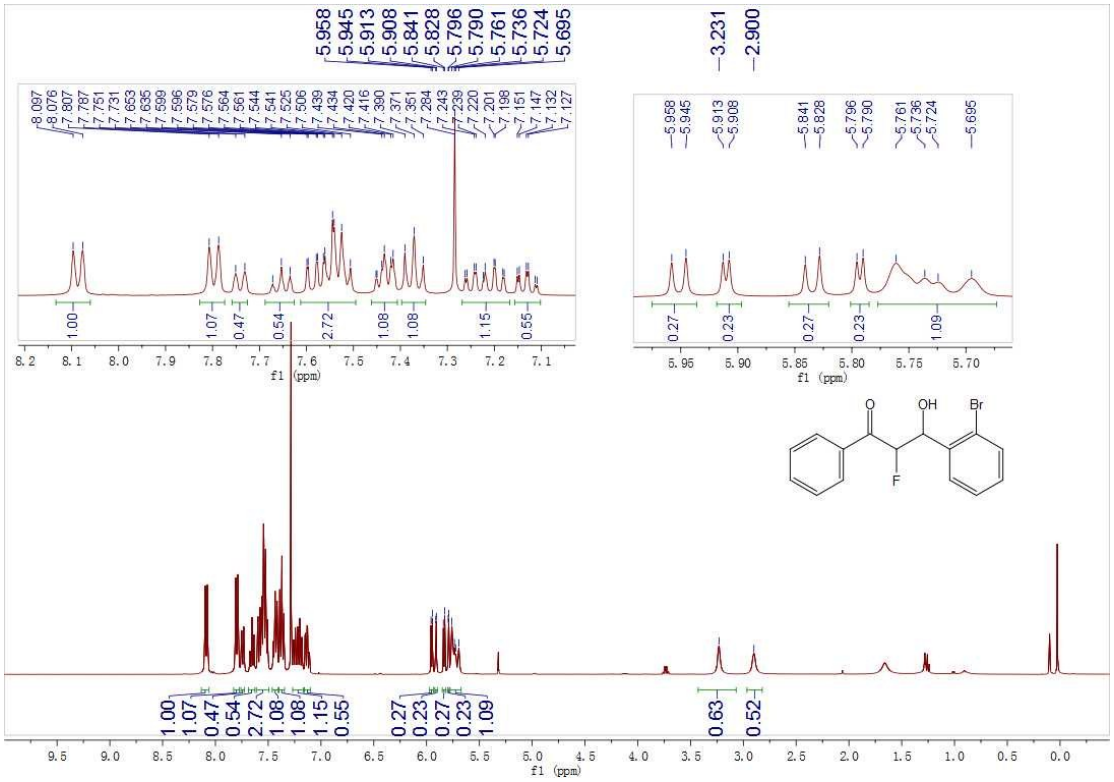
3-(2-chlorophenyl)-2-fluoro-3-hydroxy-1-phenylpropan-1-one (2j)

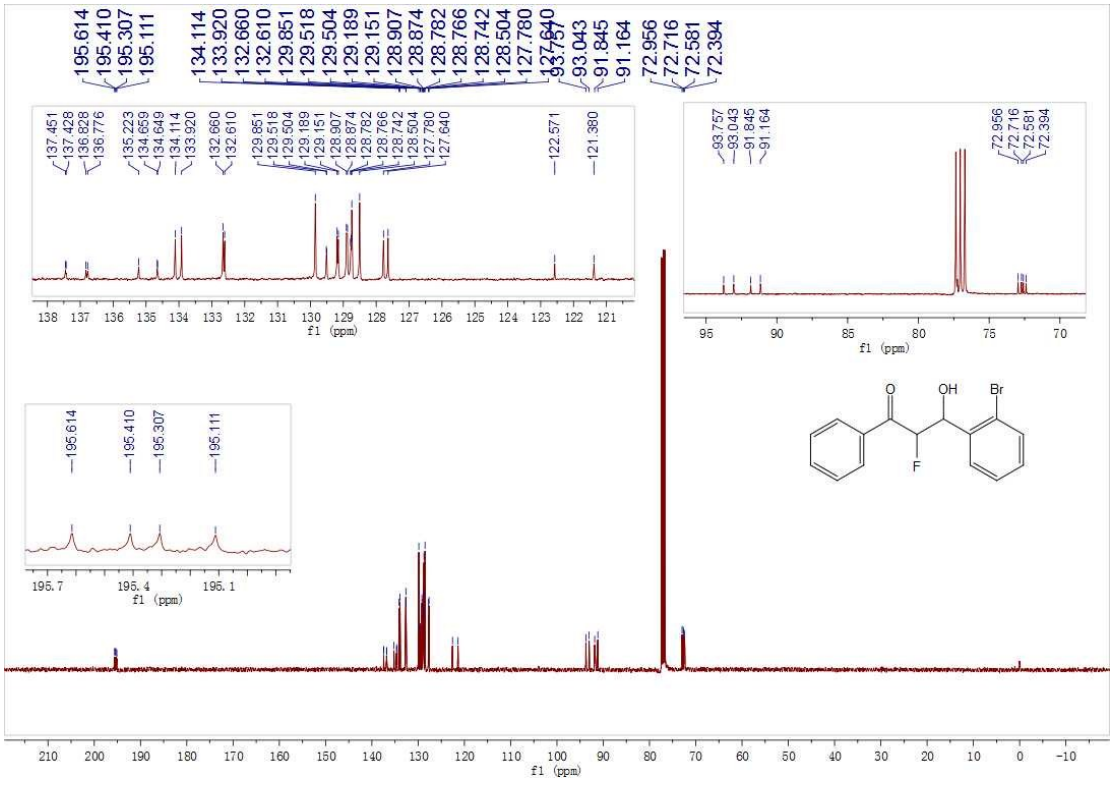


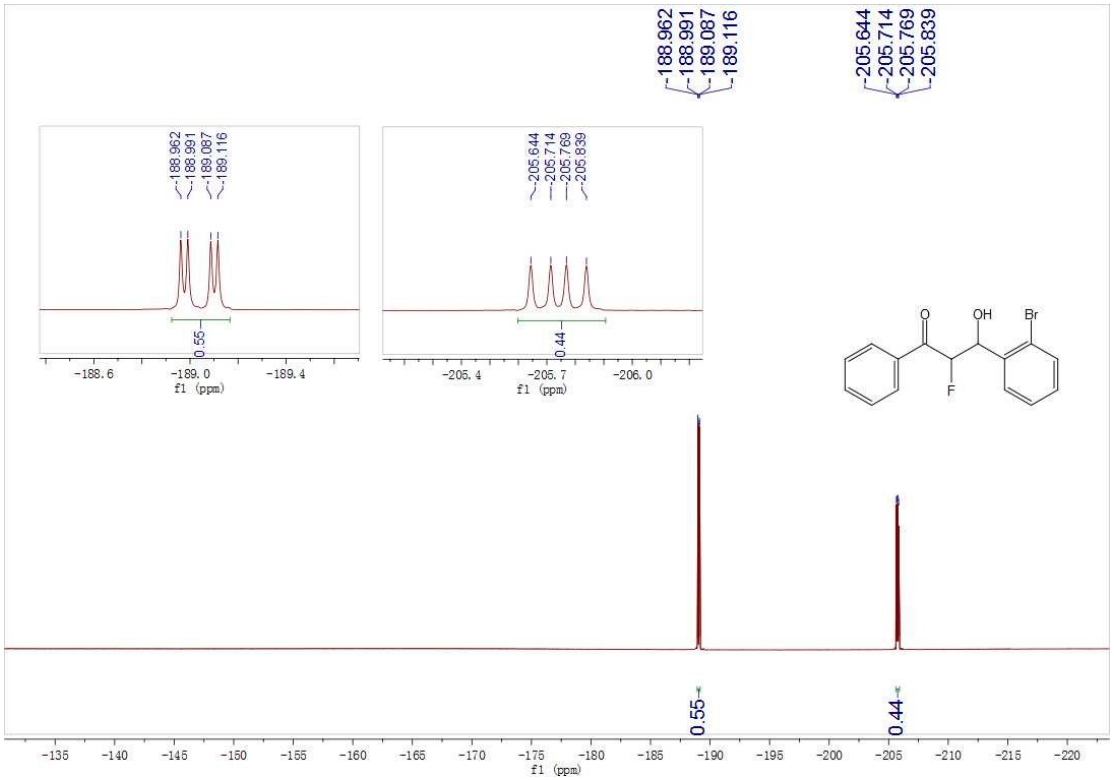

195.589
195.412
195.387
195.217
134.110
133.923
129.505
129.481
129.347
129.333
129.109
129.072
129.050
129.039
128.906
128.872
128.752
128.505
128.483
127.216
127.060
93.906
93.185
91.998
91.307
70.802
70.562
70.520
70.330
O
OH
Cl
F
f1 (ppm)


189.099
189.127
189.223
189.252
205.518
205.587
205.643
205.712
0.54
0.46
O
OH
Cl
F
f1 (ppm)

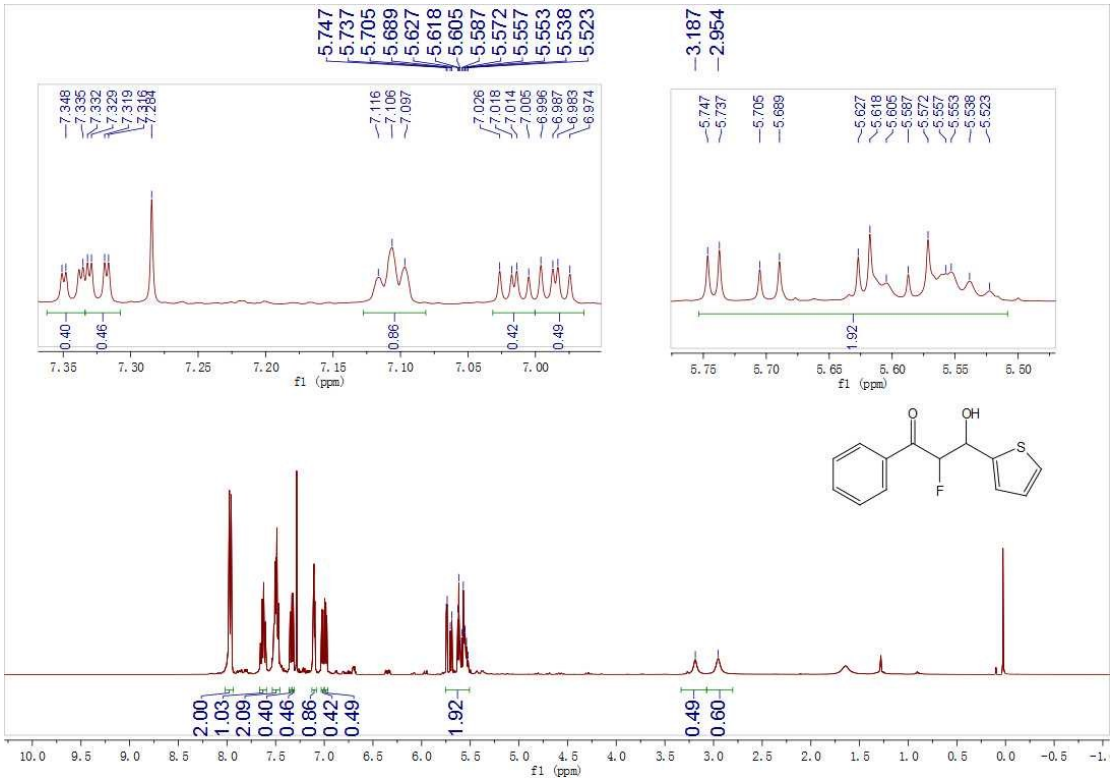
3-(2-bromophenyl)-2-fluoro-3-hydroxy-1-phenylpropan-1-one (2k)

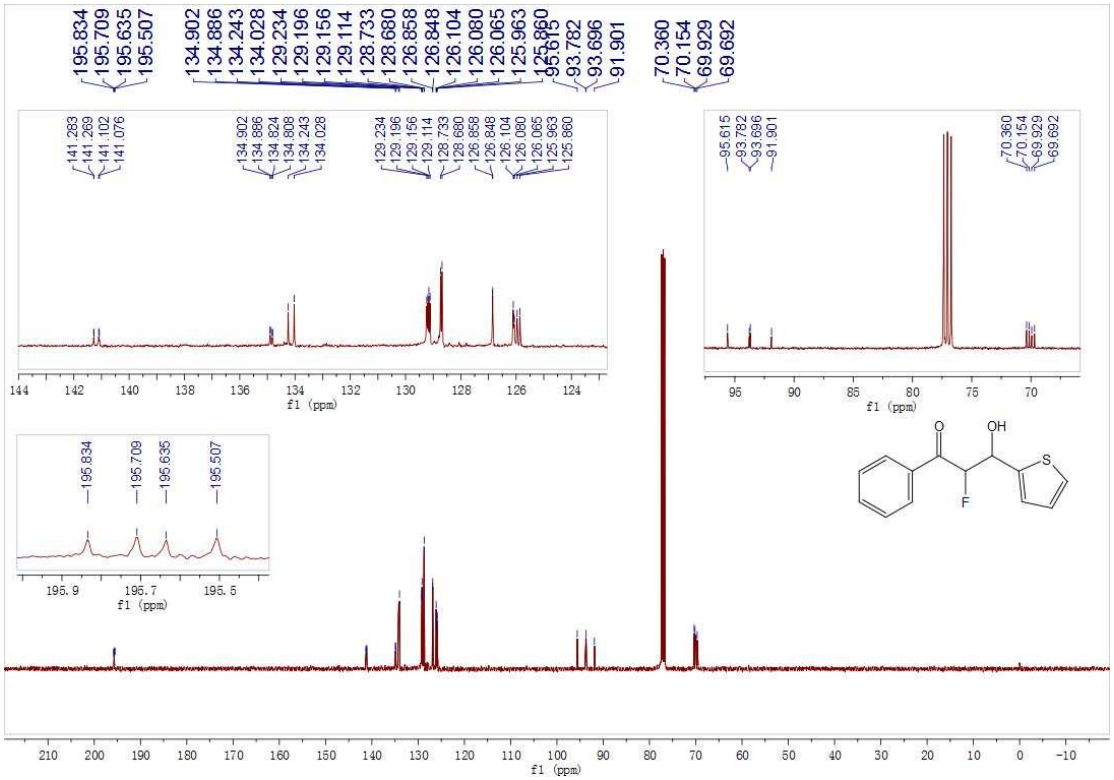


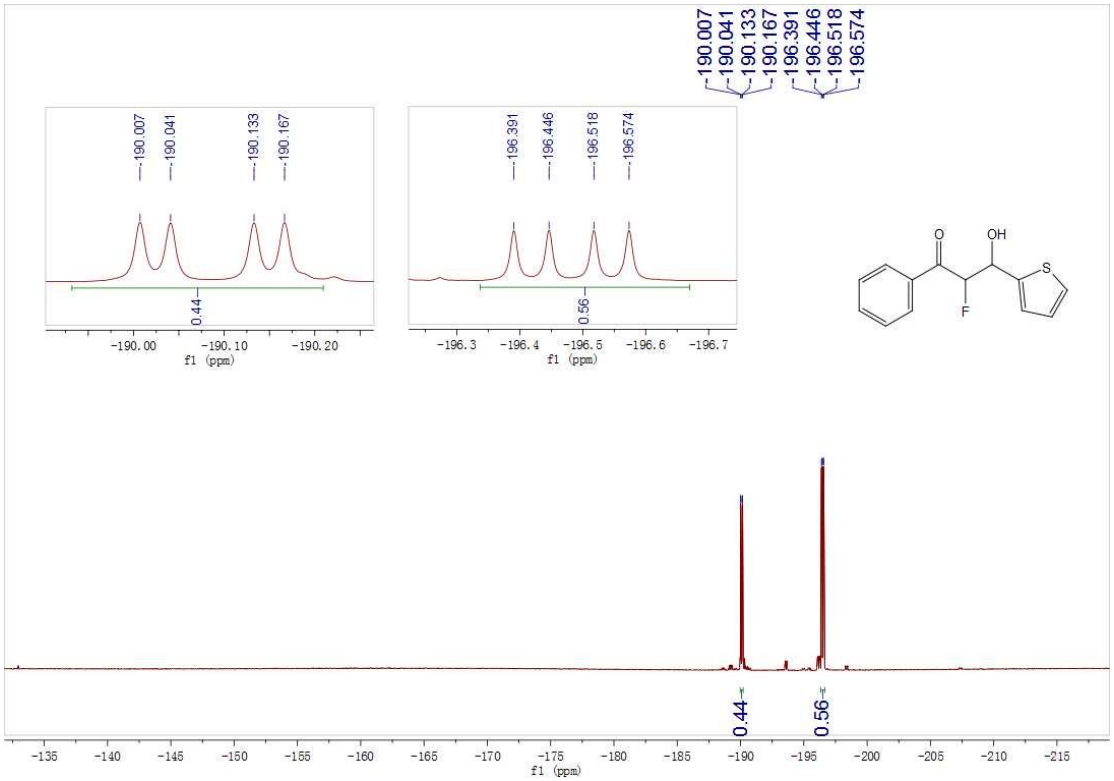




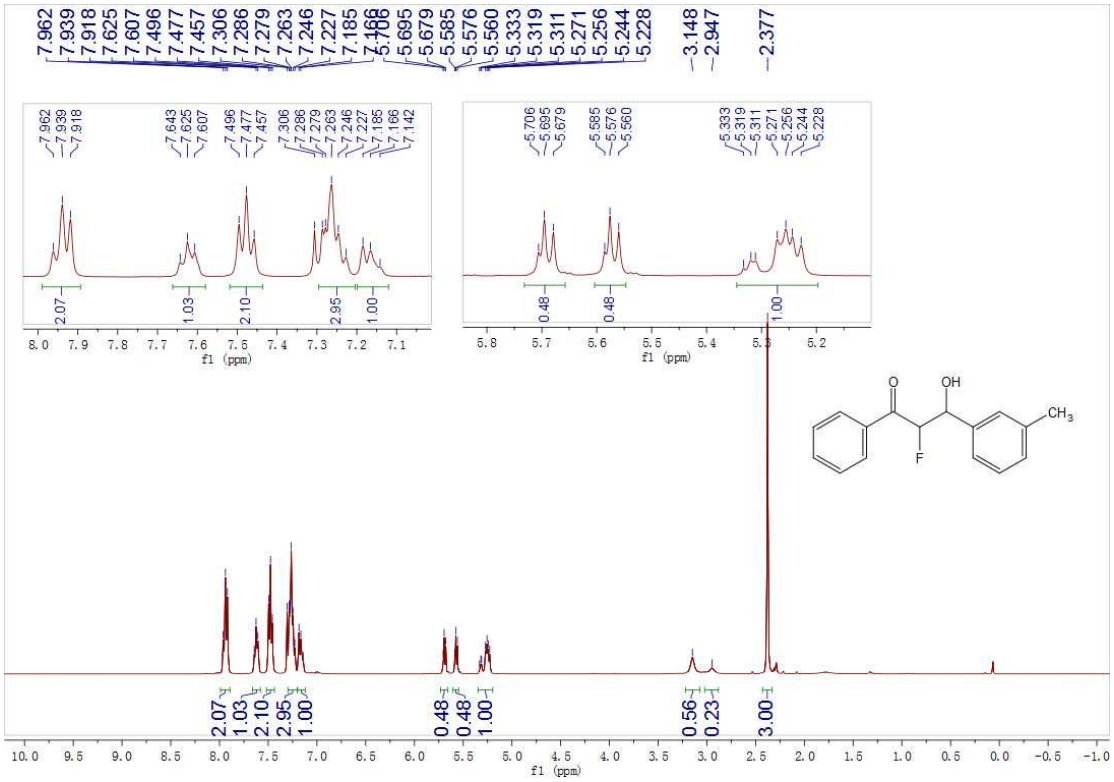
2-fluoro-3-hydroxy-1-phenyl-3-(thiophen-2-yl)propan-1-one (2l)

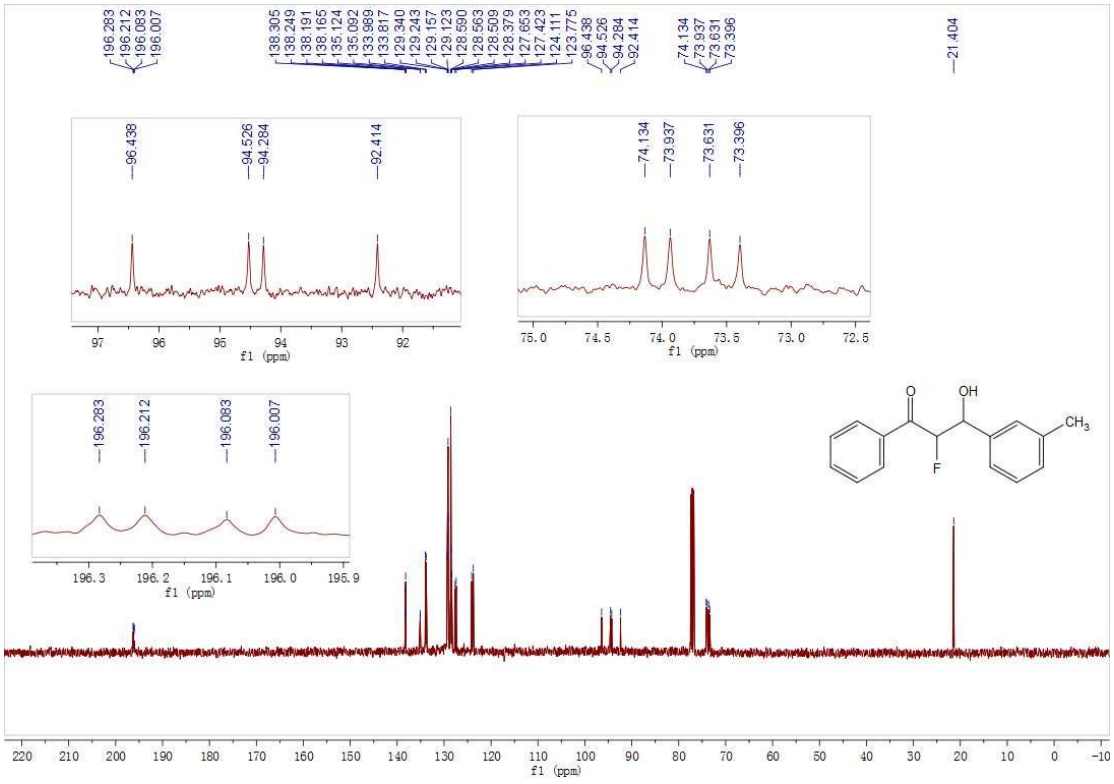


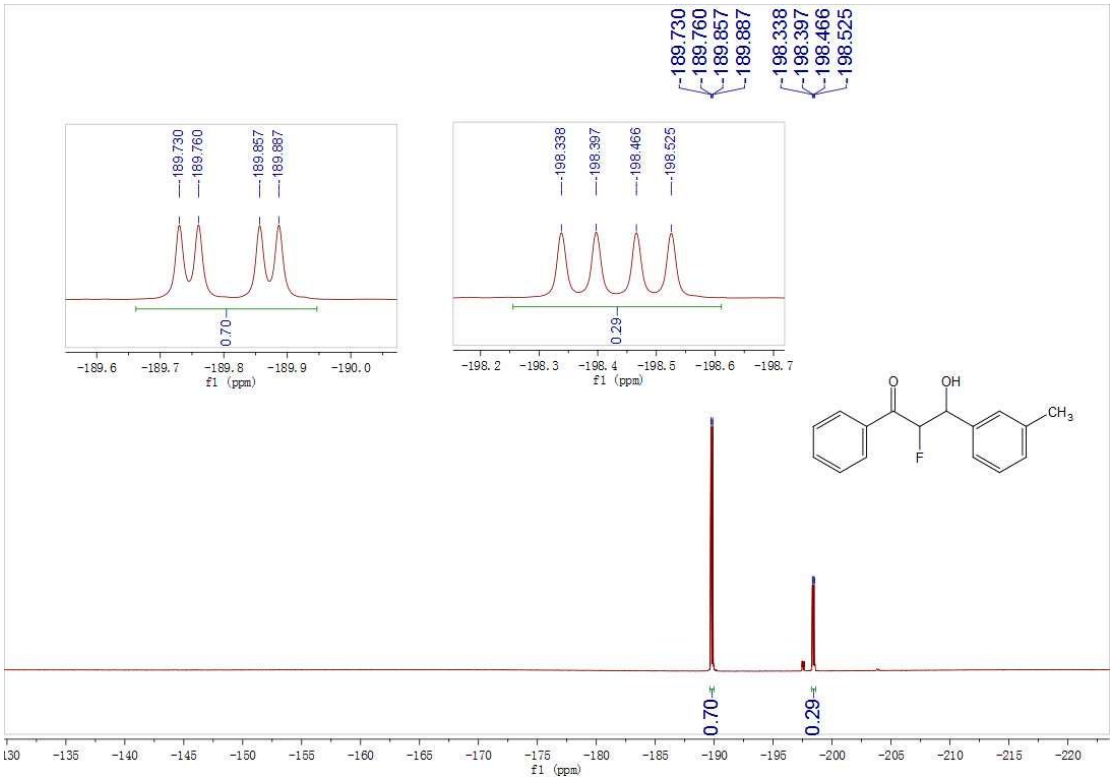

195.834
195.709
195.635
195.507
134.902
134.886
134.243
134.028
129.234
129.196
129.156
129.114
128.733
128.680
126.858
126.848
126.104
126.080
126.065
125.963
125.860
95.615
93.782
93.696
91.901
70.360
70.154
69.929
69.692
O
OH
S
F
f1 (ppm)


190.007
190.041
190.133
190.167
196.391
196.446
196.518
196.574
0.44
0.56
O
OH
S
F
f1 (ppm)

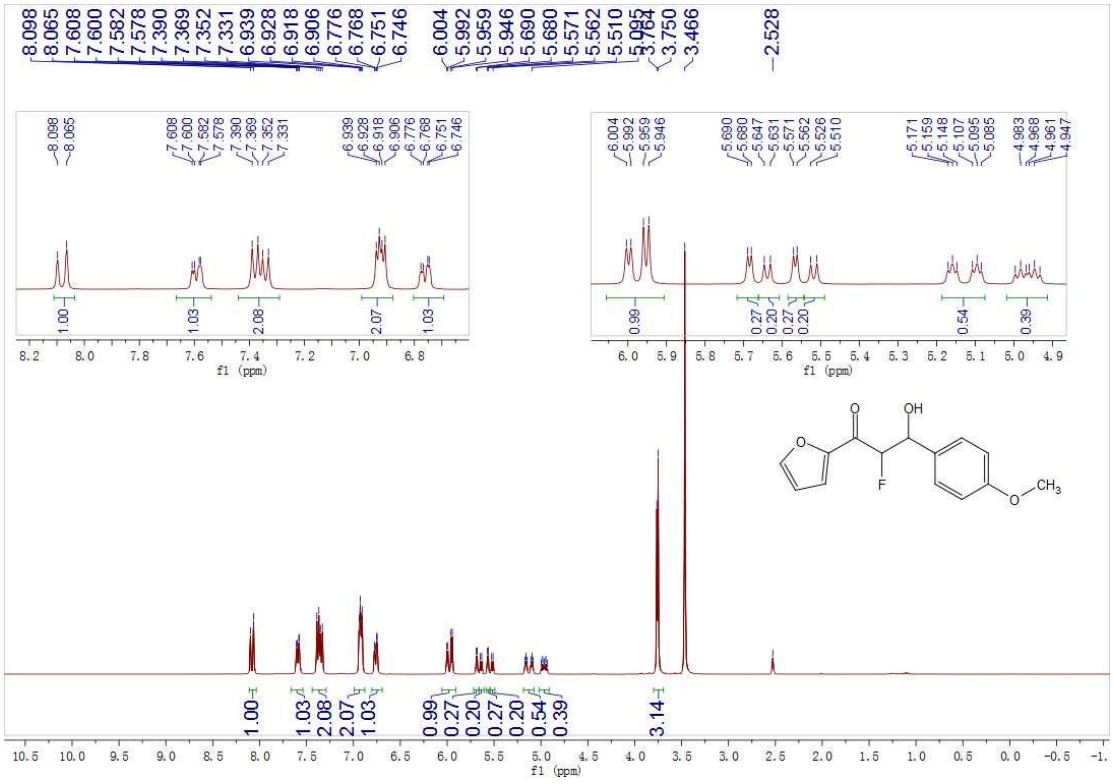
2-fluoro-3-hydroxy-3-phenyl-1-(m-tolyl)propan-1-one (2m)

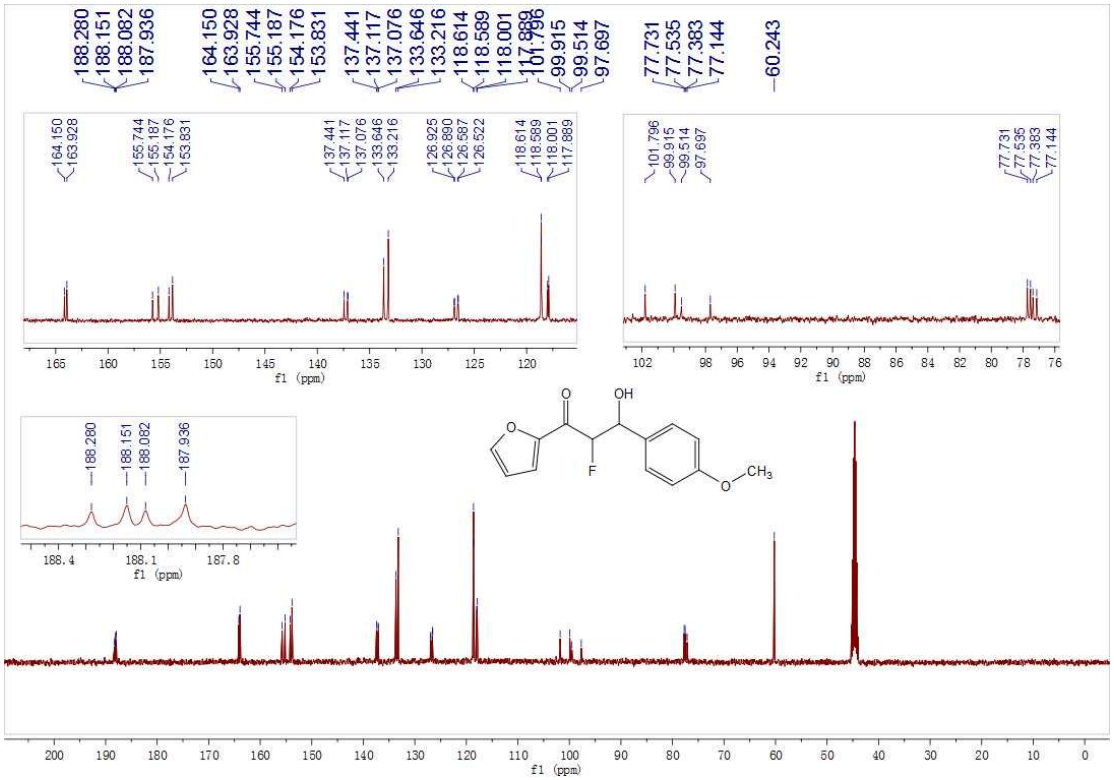


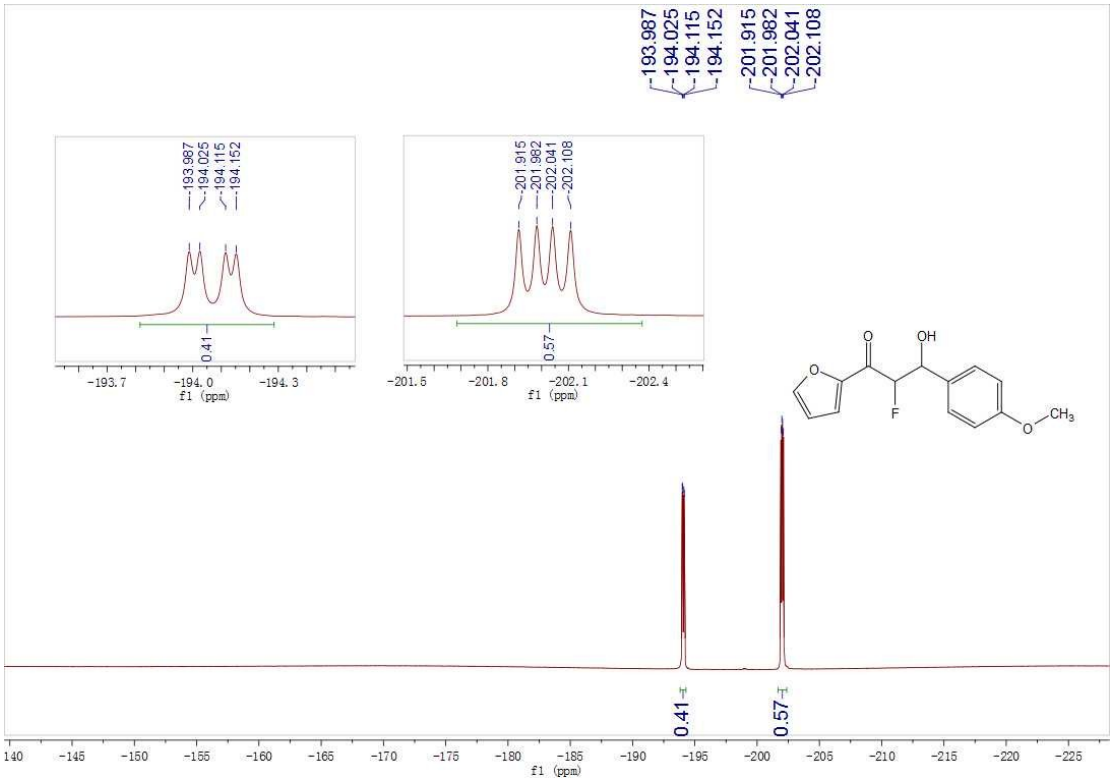




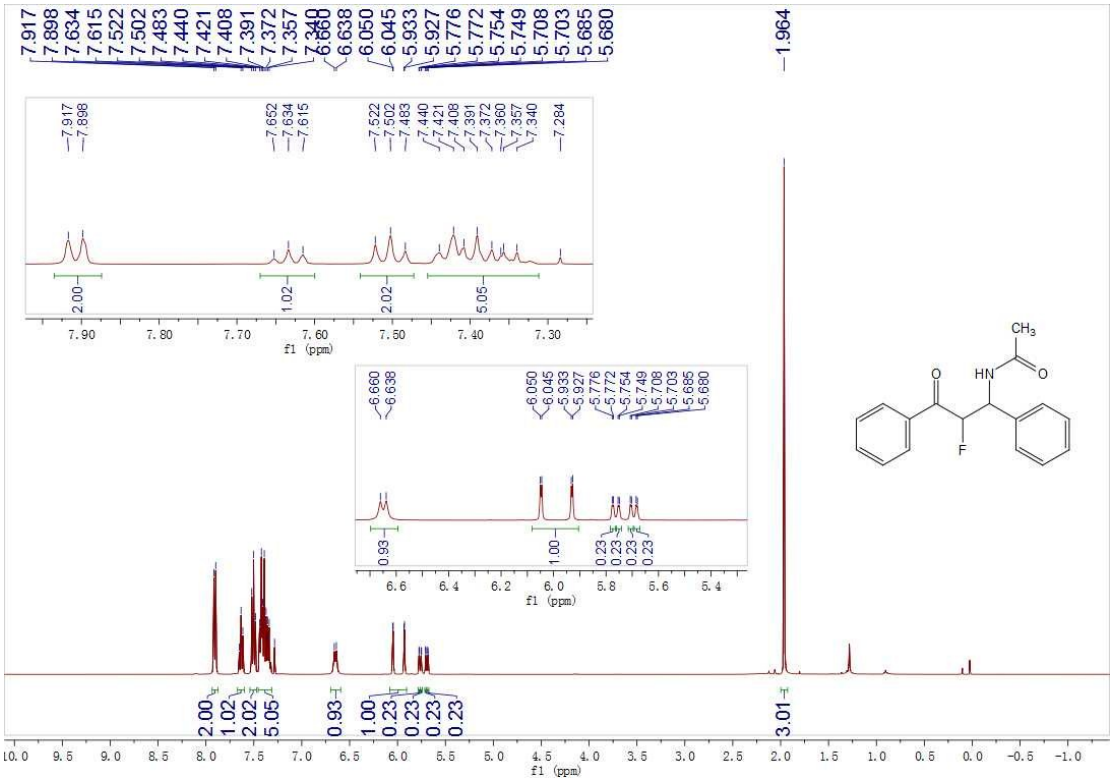
2-fluoro-1-(furan-2-yl)-3-hydroxy-3-(4-methoxyphenyl)propan-1-one (2n)

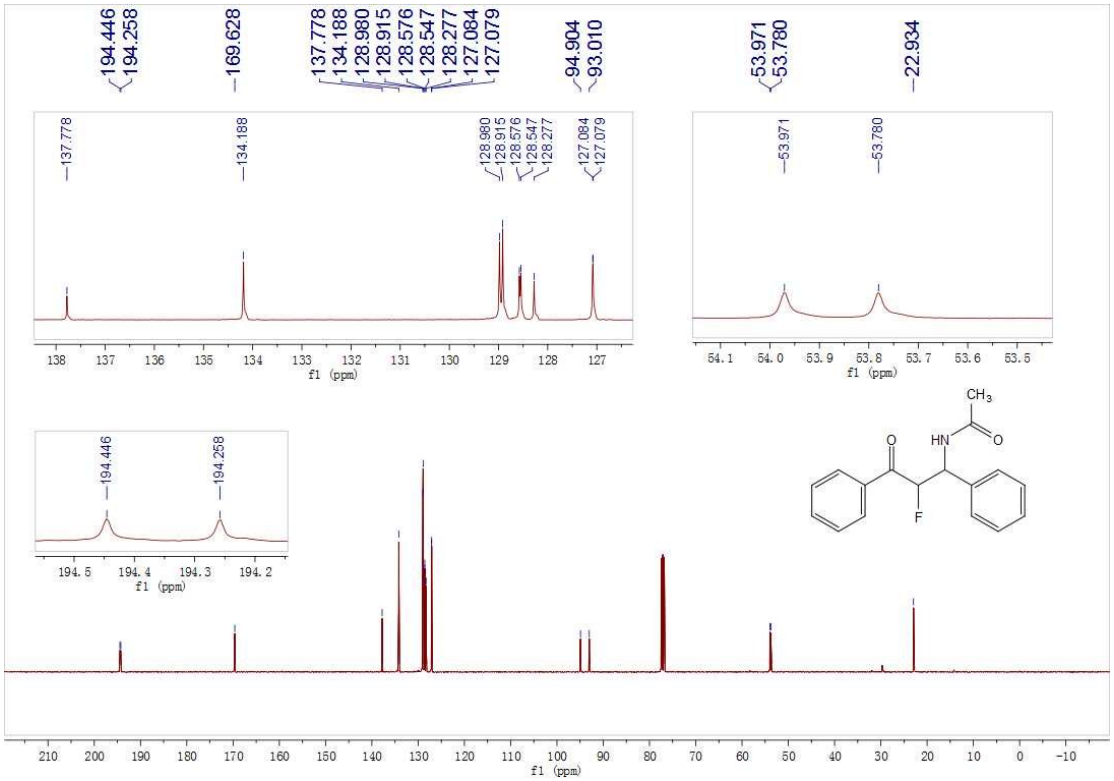


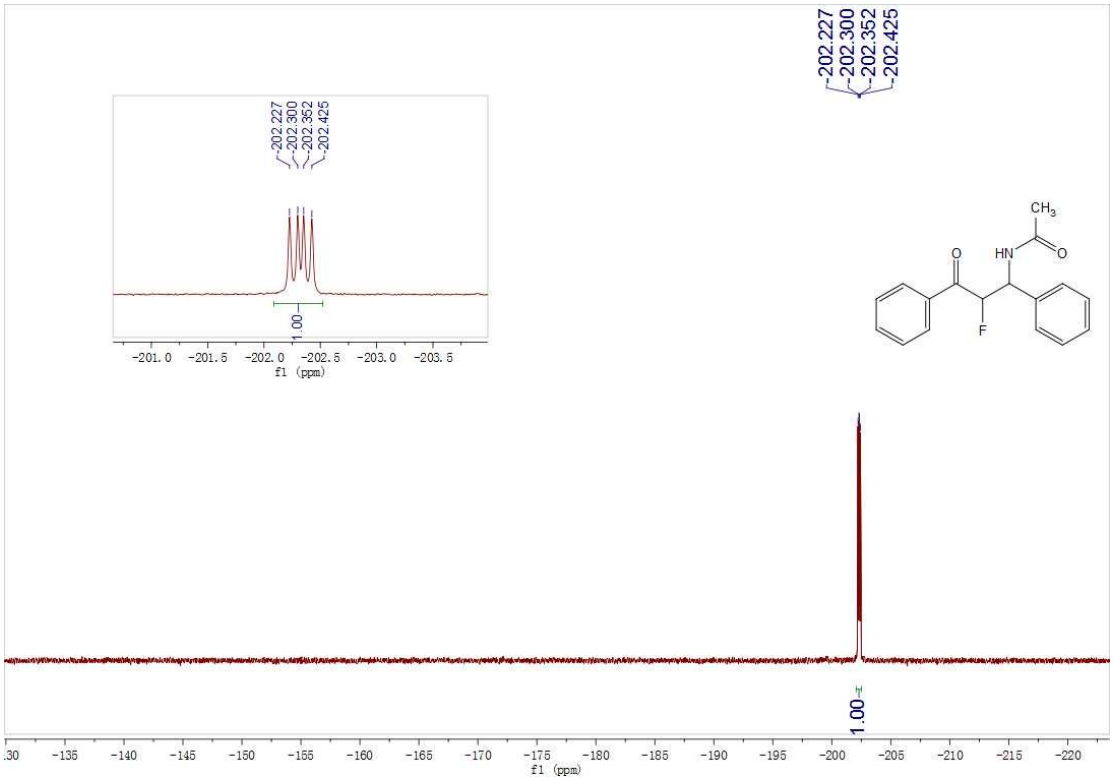

188.280
188.151
188.082
187.936
164.150
163.928
155.744
155.187
154.176
153.831
137.441
137.117
137.076
133.646
133.216
118.614
118.589
118.001
117.889
101.796
99.915
99.514
97.697
77.731
77.535
77.383
77.144
60.243
f1 (ppm)


193.987
194.025
194.115
194.152
201.915
201.982
202.041
202.108
0.41
0.57
f1 (ppm)

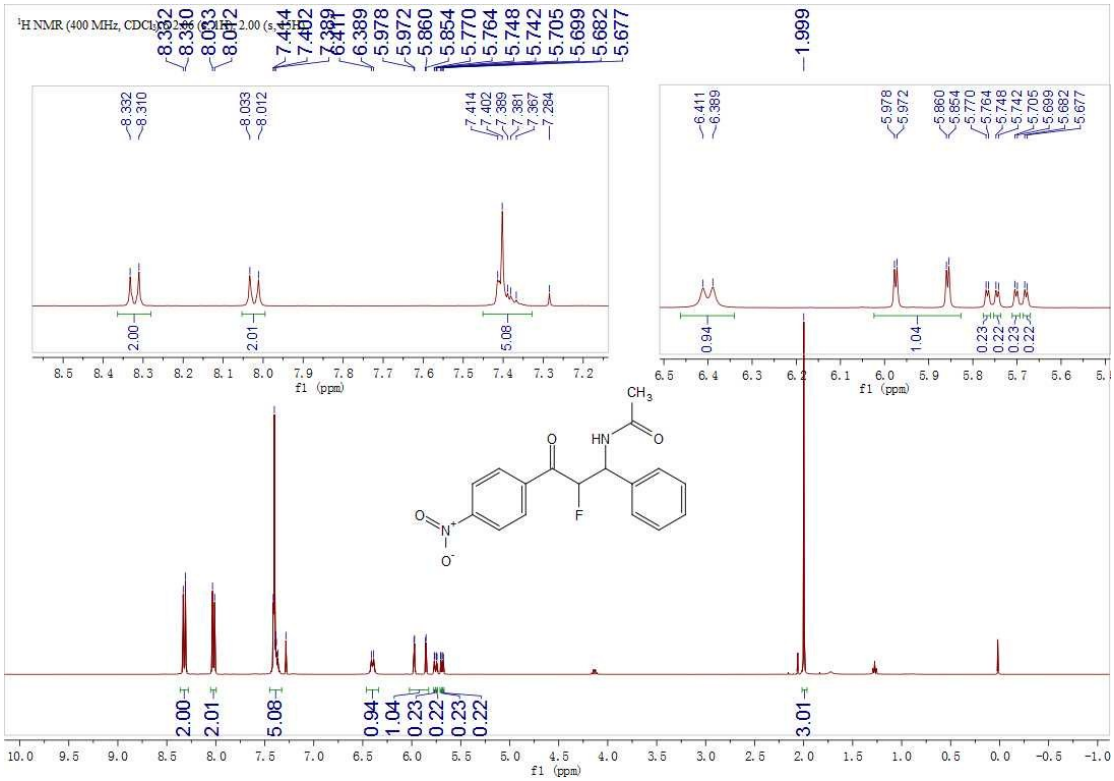
2-fluoro-3-acetamido-1,3-diphenylpropan-1-one (3a)

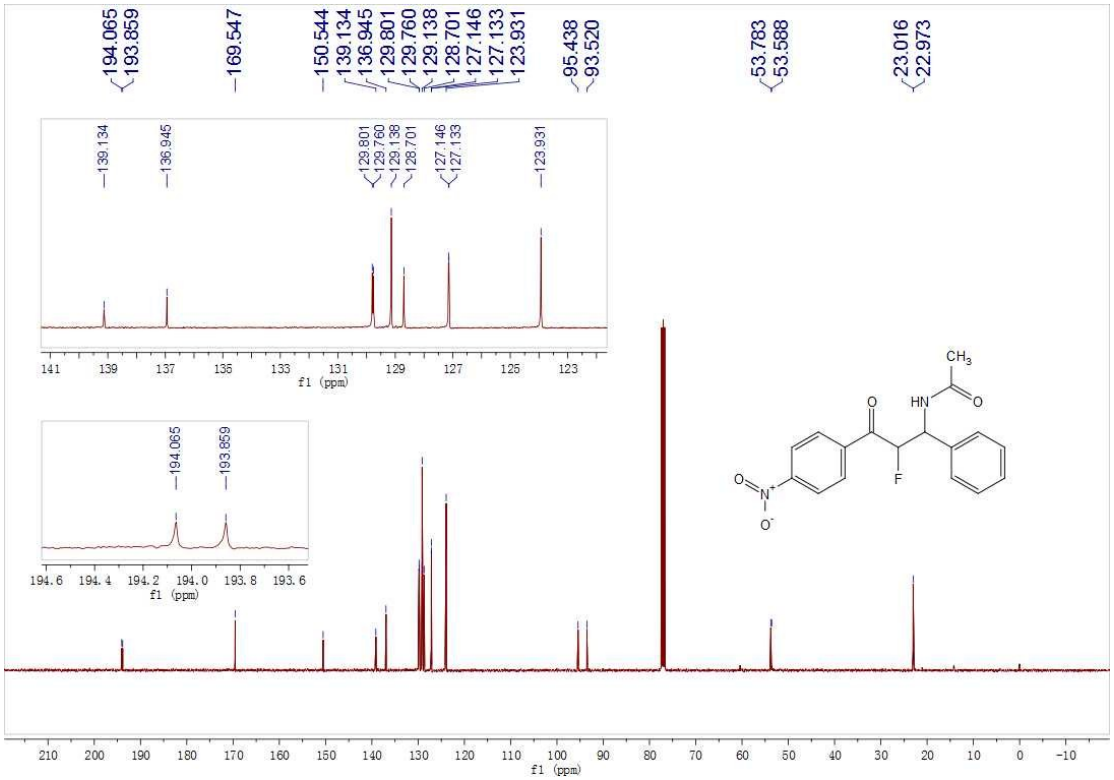


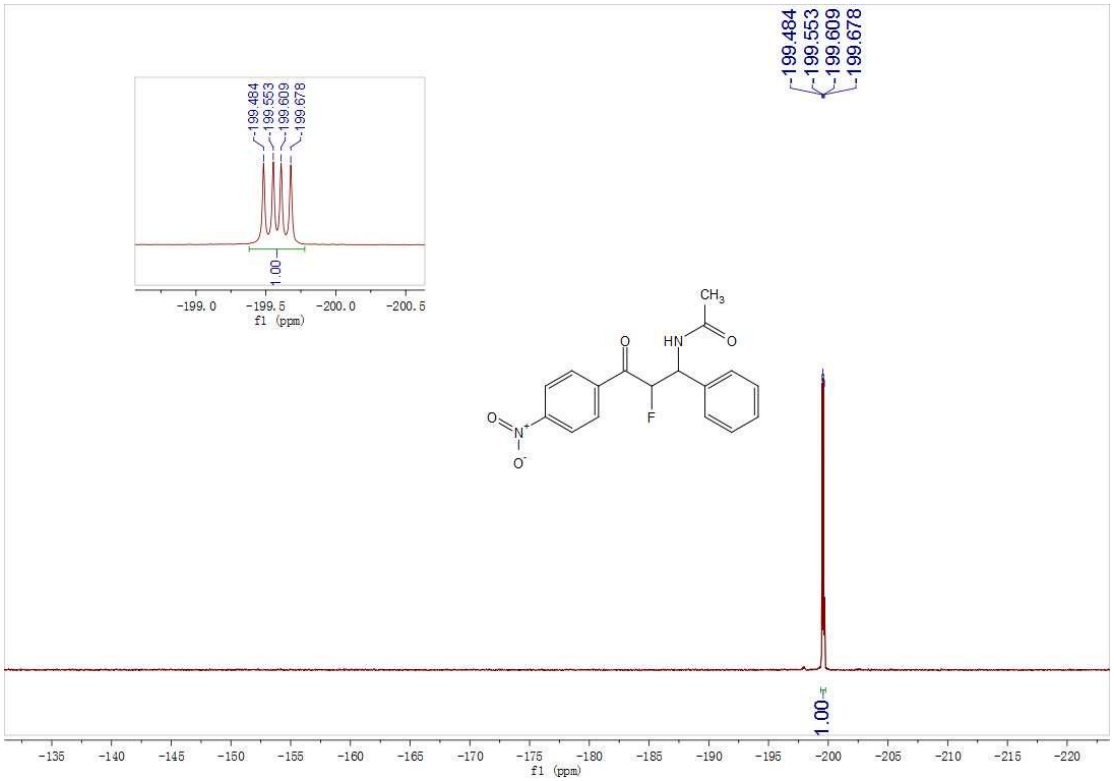




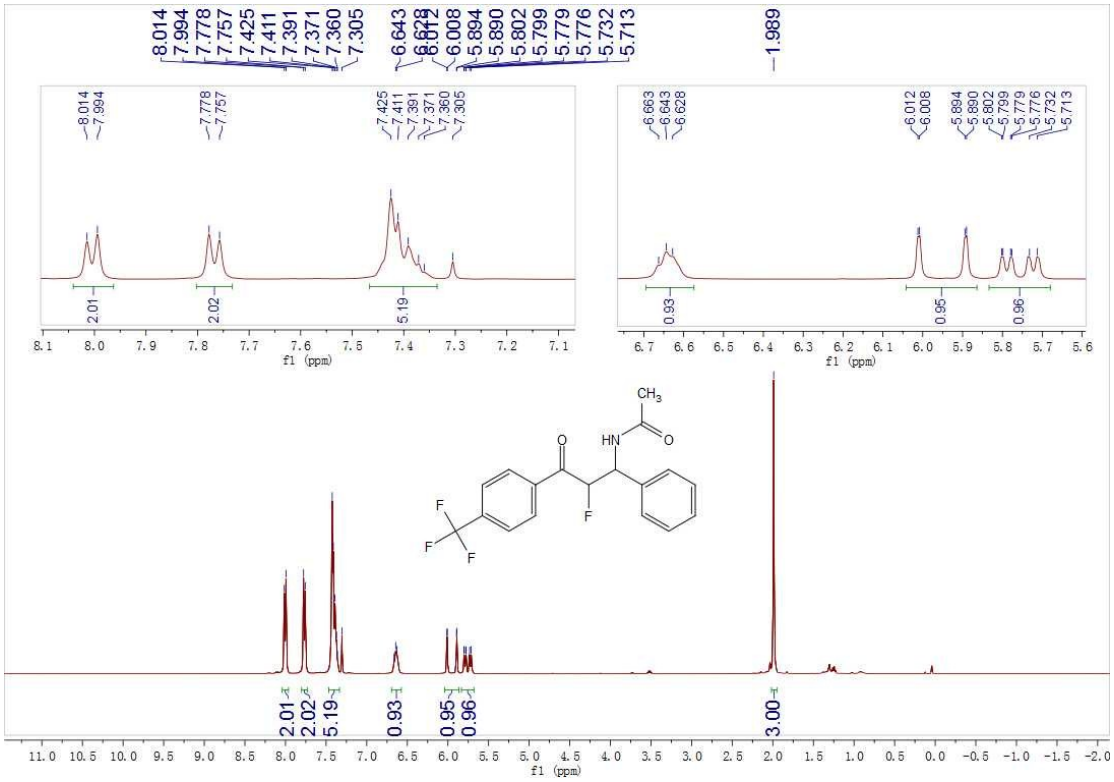
2-fluoro-3-acetamido-1-(4-nitrophenyl) -3-phenylpropan-1-one (3b)

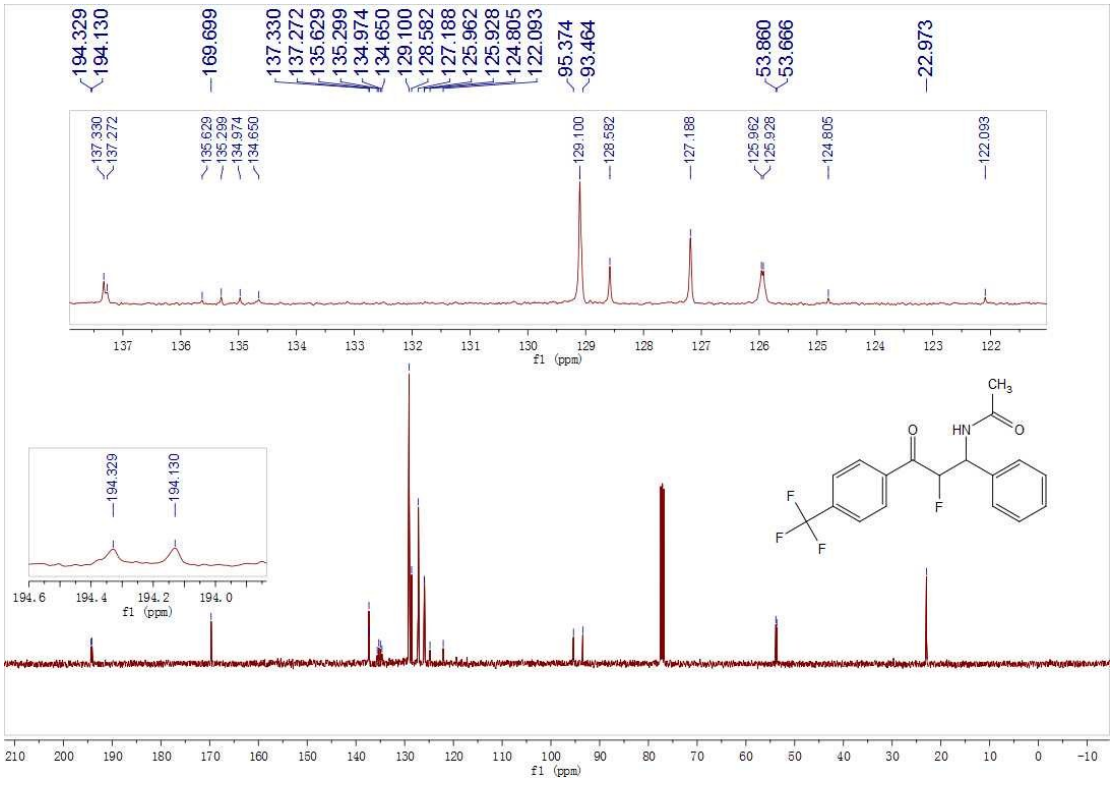


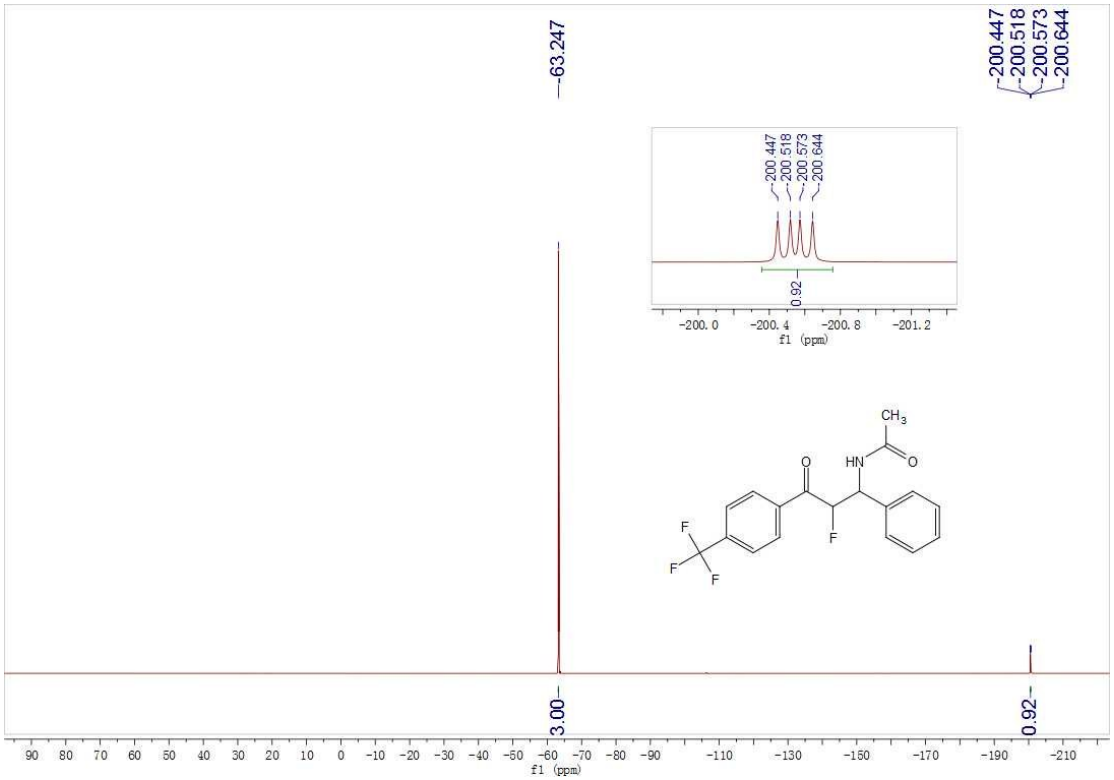

194.065
193.859
169.547
150.544
139.134
136.945
129.801
129.760
129.138
128.701
127.146
127.133
123.931
95.438
93.520
53.783
53.588
23.016
22.973
f1 (ppm)


199.484
199.553
199.609
199.678
1.00
f1 (ppm)

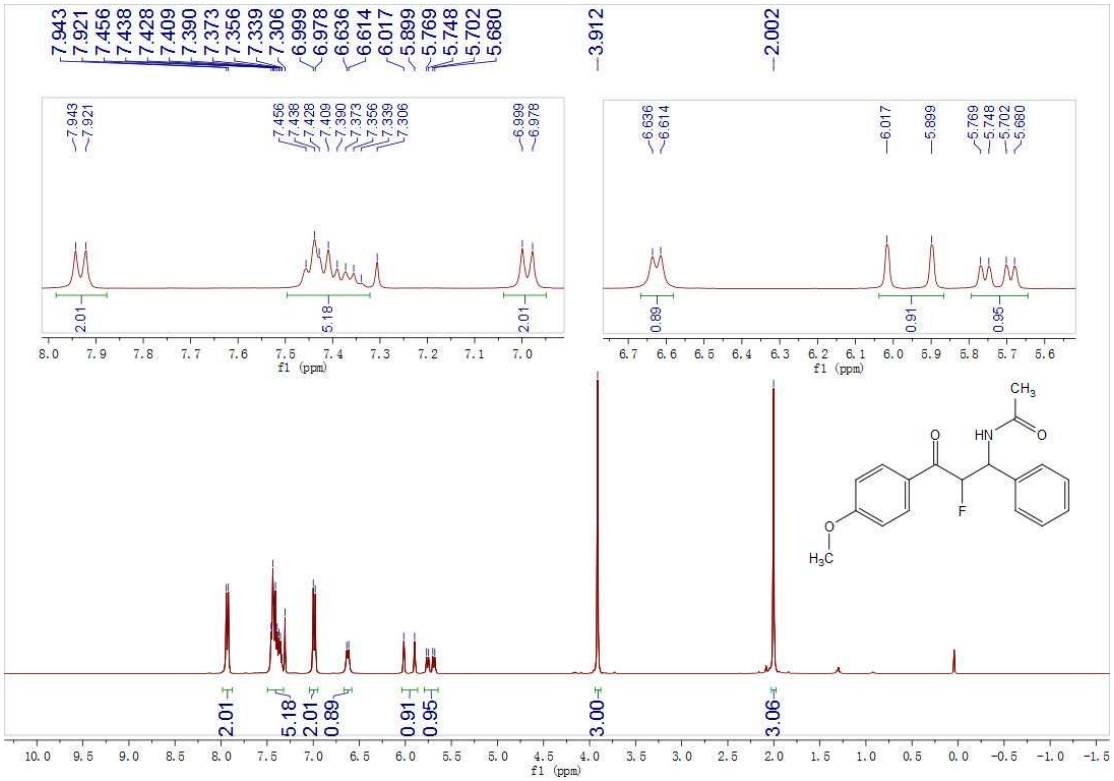
2-fluoro-3-acetamido-1-(4-trifluoromethylphenyl) -3-phenylpropan-1-one (3c)

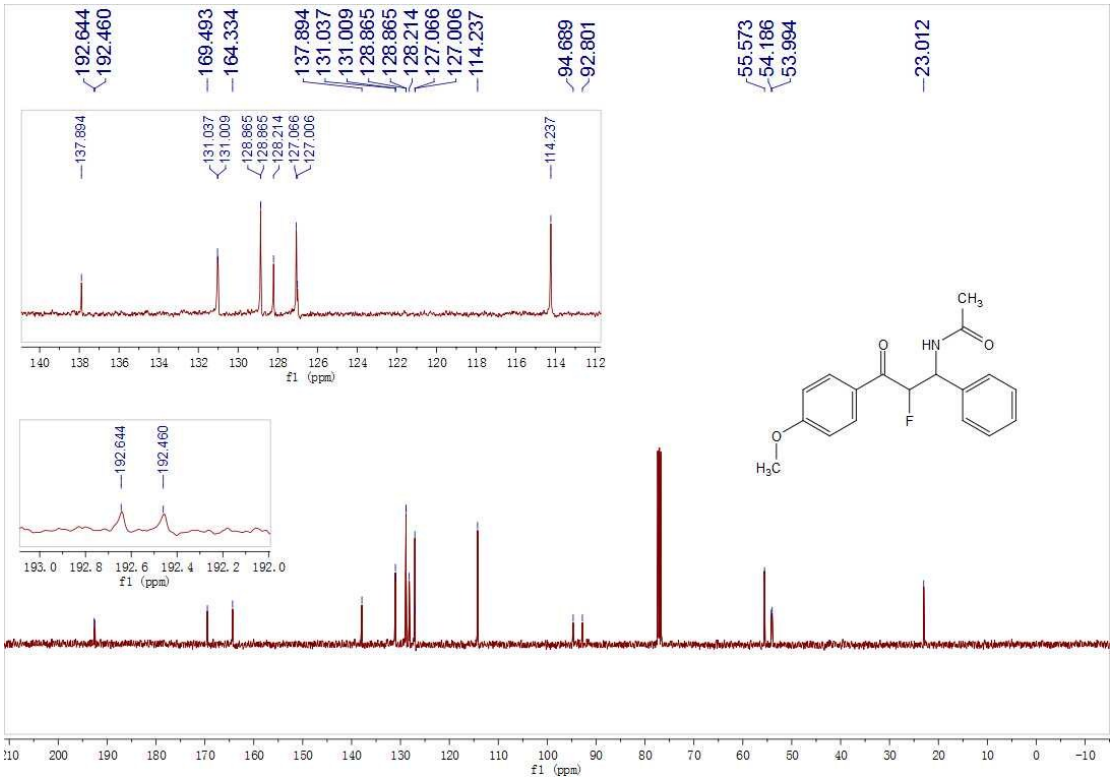


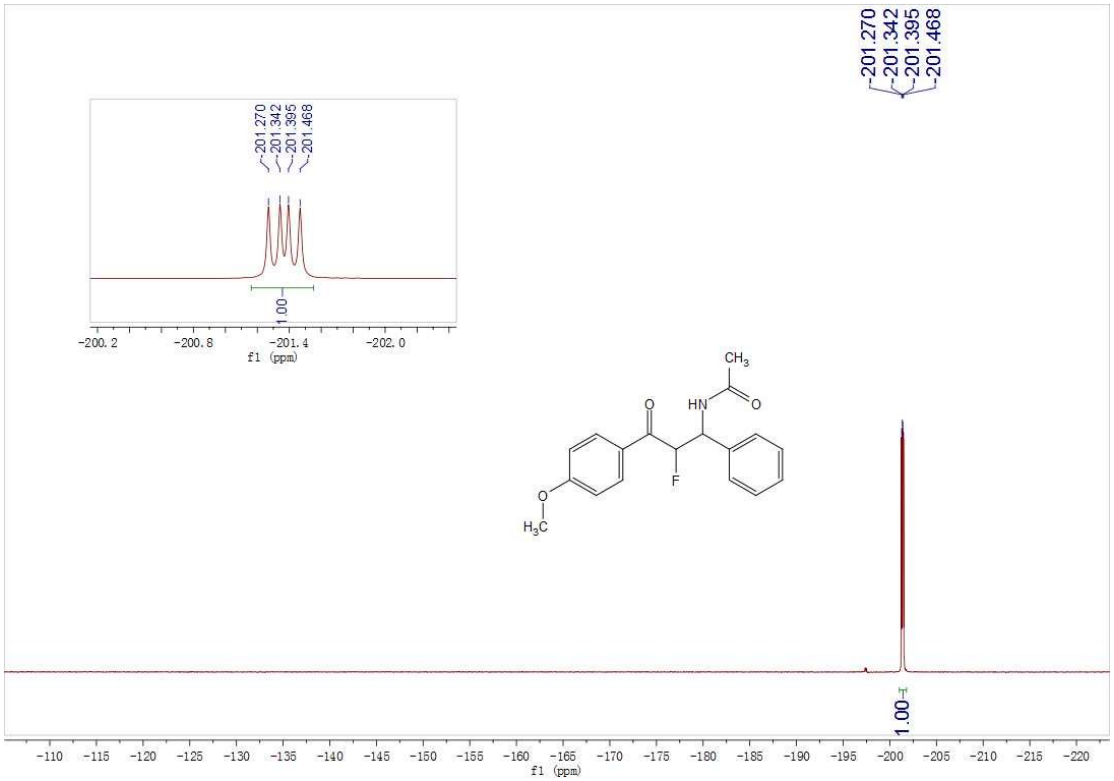




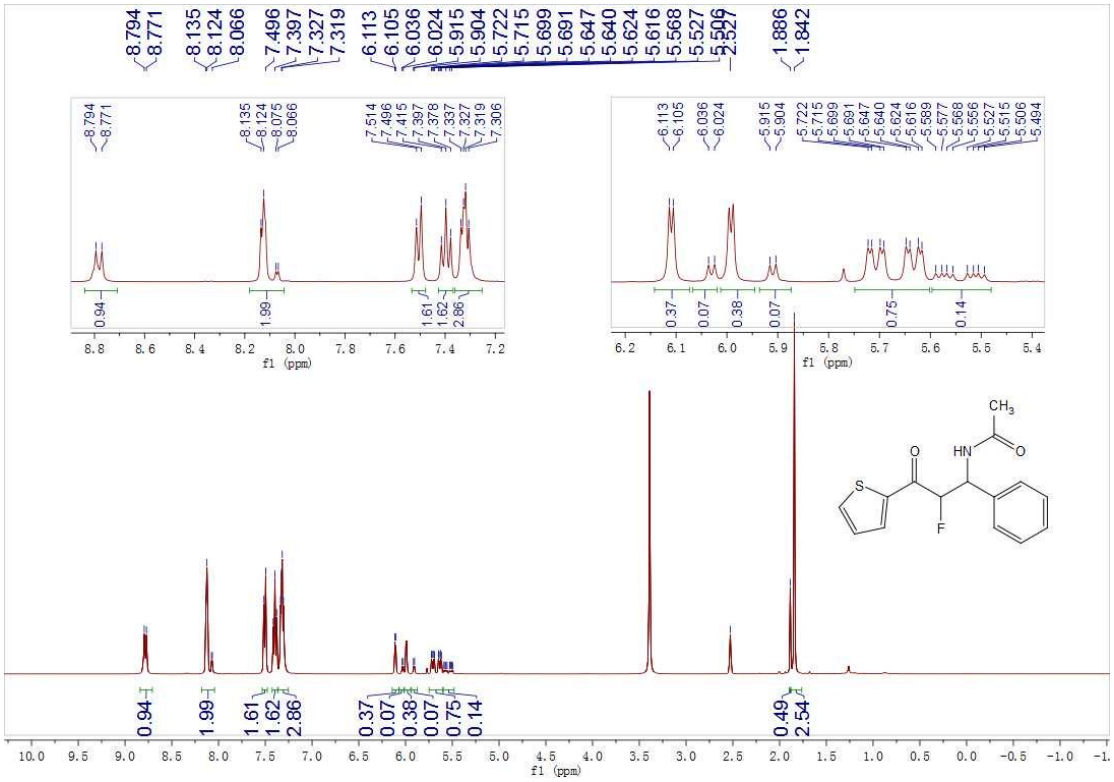
2-fluoro-3-acetamido-1-(4-methoxyphenyl) -3-phenylpropan-1-one (3d)

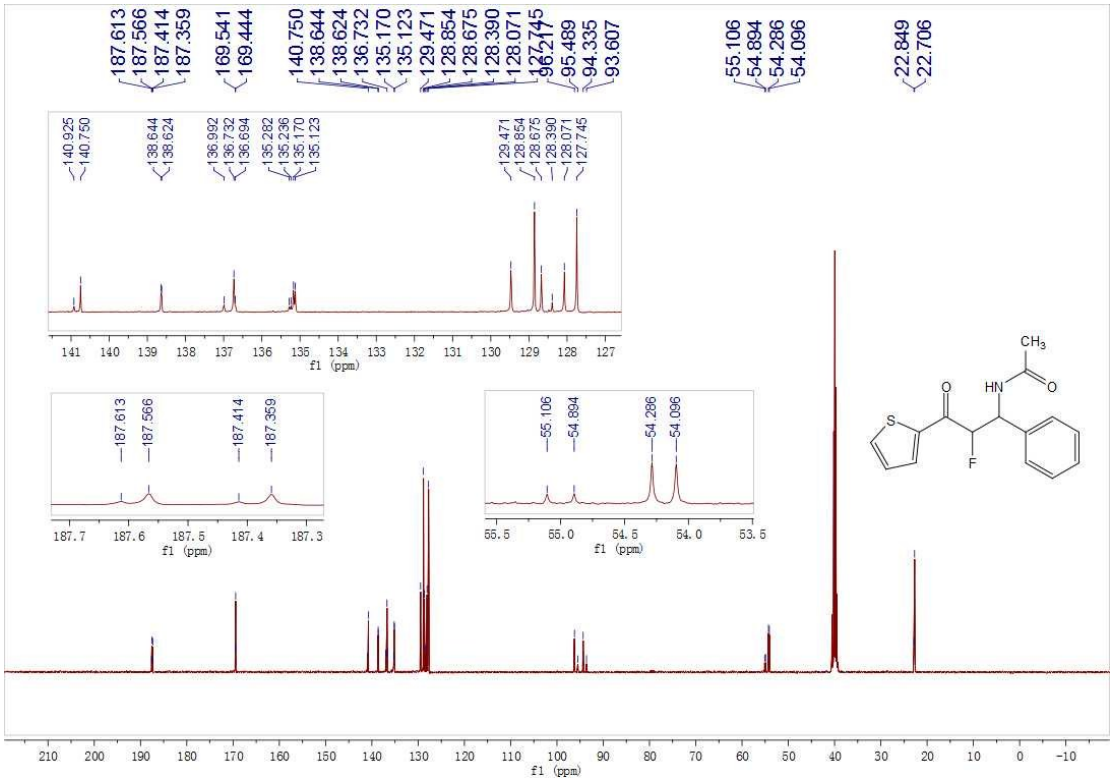


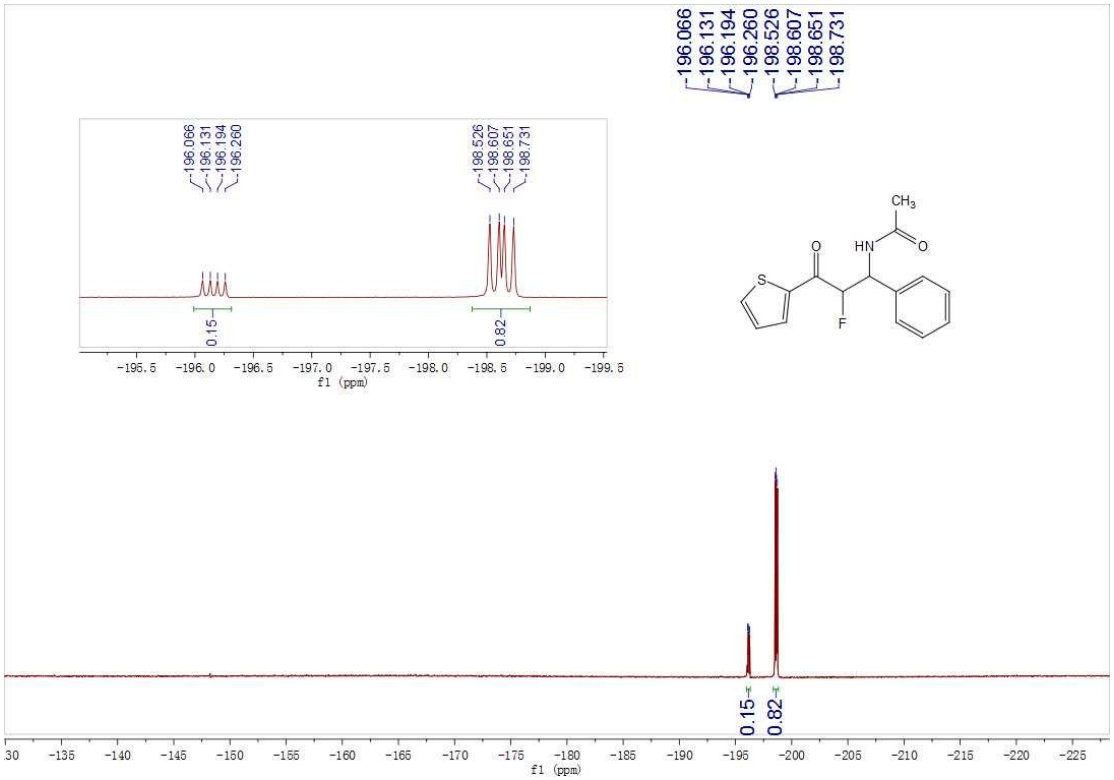

192.644
192.460
169.493
164.334
137.894
131.037
131.009
128.865
128.865
128.214
127.066
127.006
114.237
94.689
92.801
55.573
54.186
53.994
23.012
f1 (ppm)


201.270
201.342
201.395
201.468
1.00
f1 (ppm)

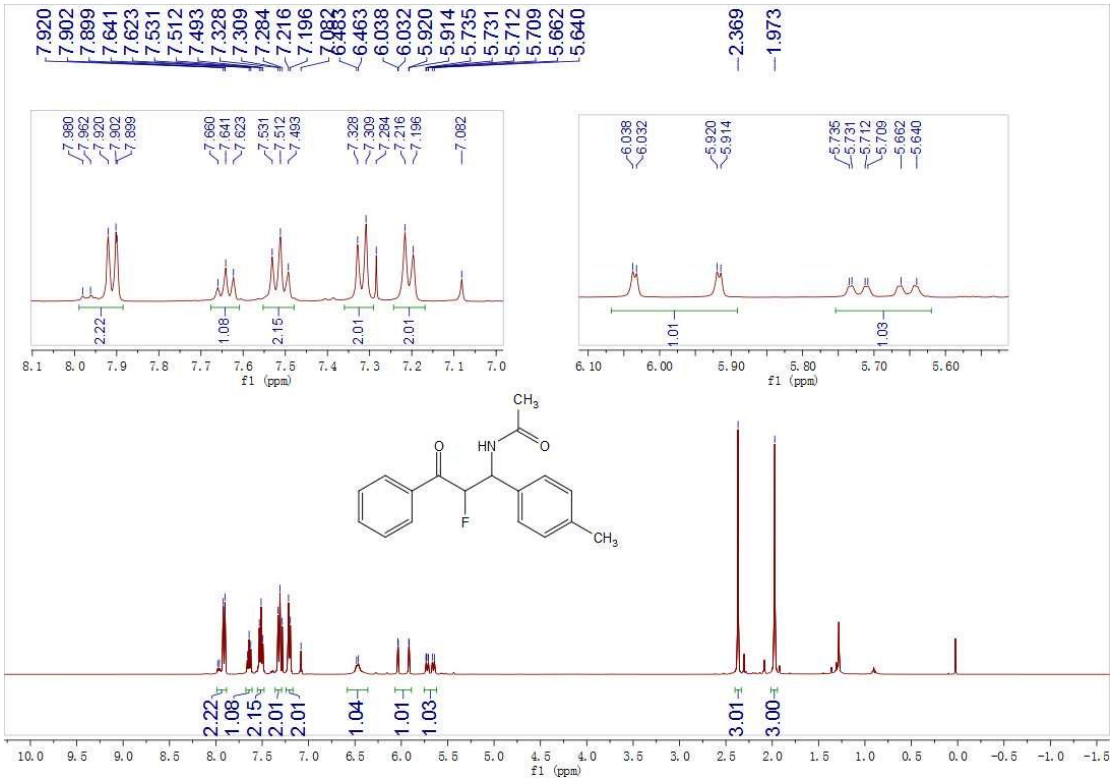
2-fluoro-3-acetamido-3-phenyl-1-(thiophen-2-yl)propan-1-one (3e)

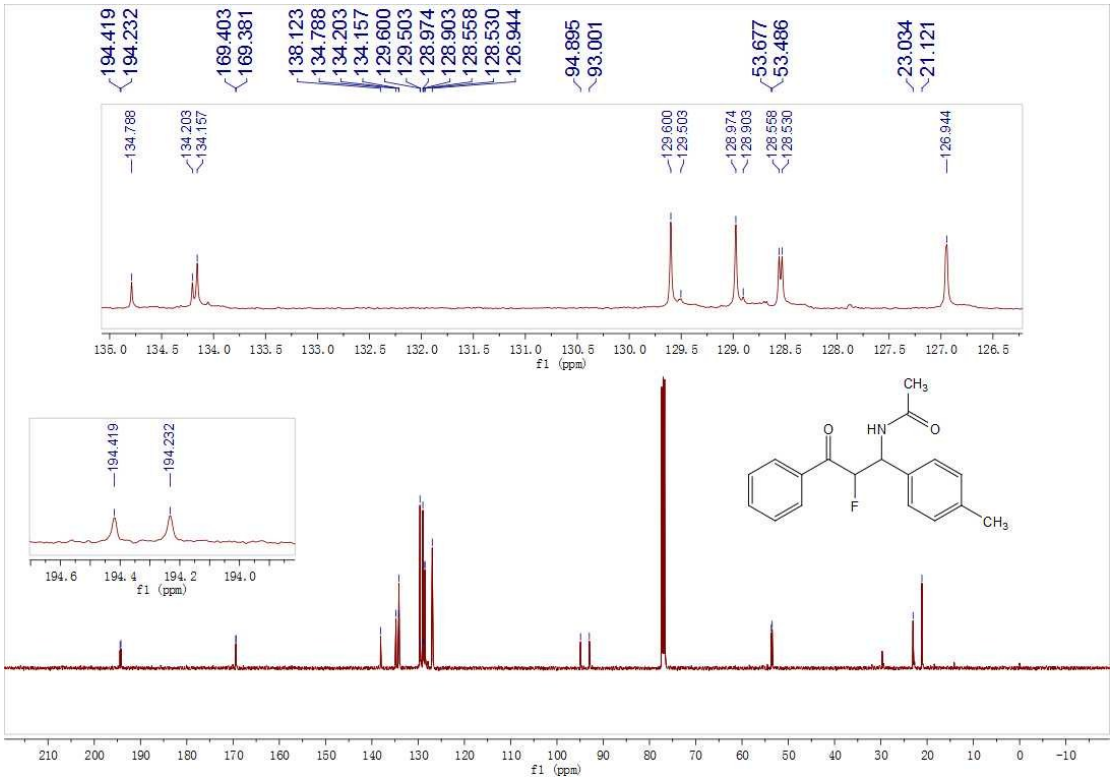


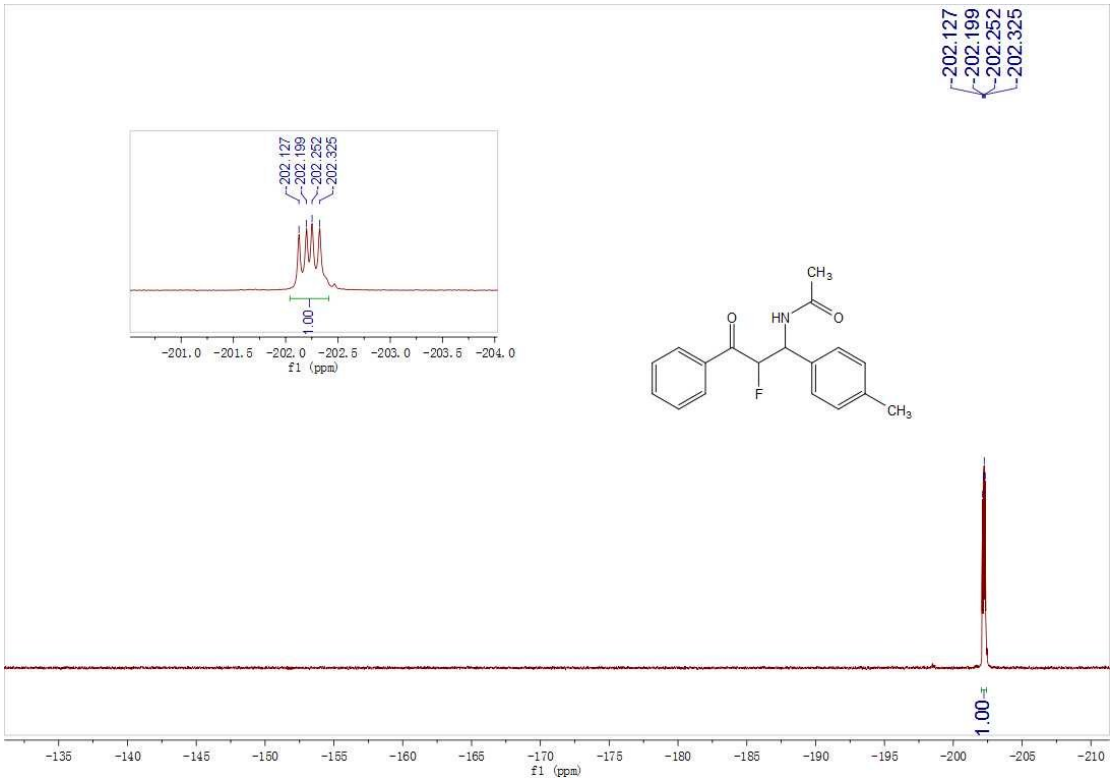




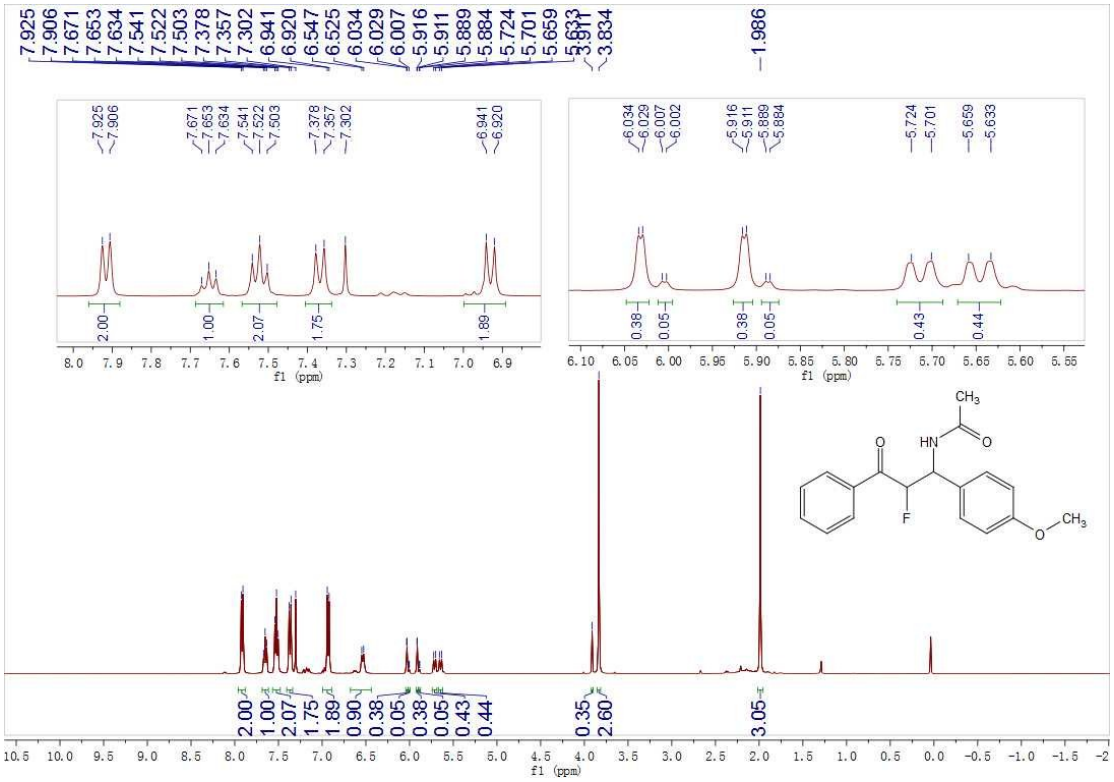
2-fluoro-3-acetamido-1-phenyl-3-*p*-tolylpropan-1-one (3f)

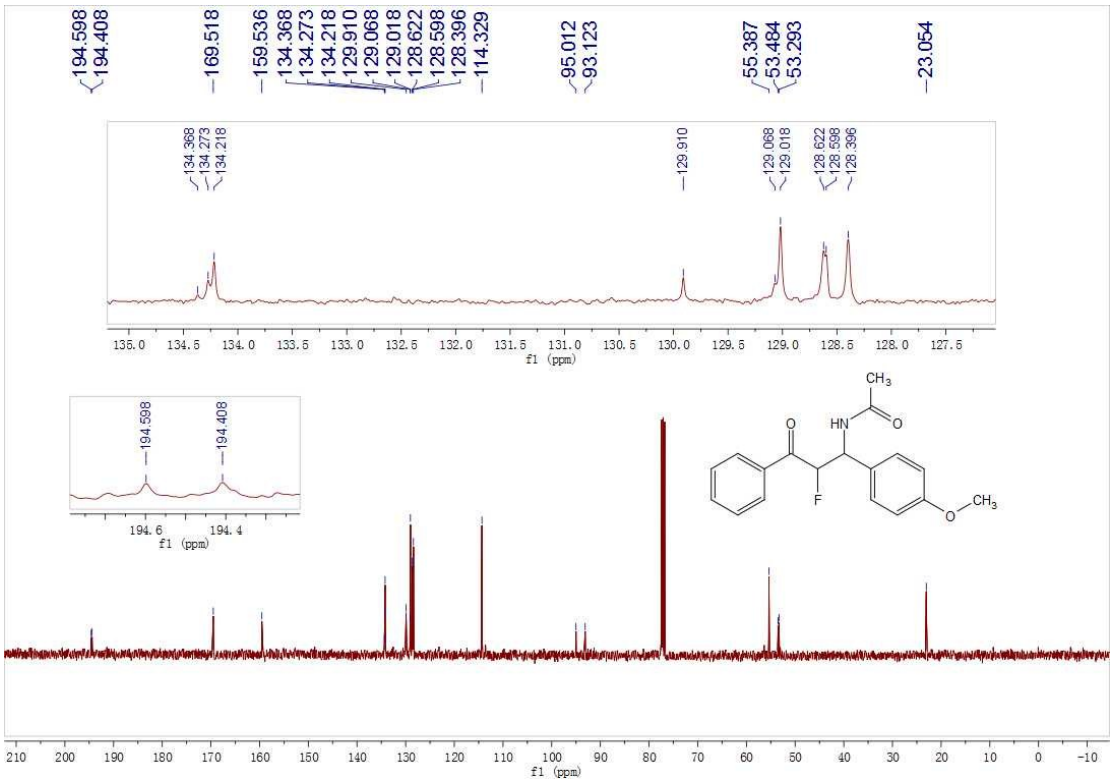


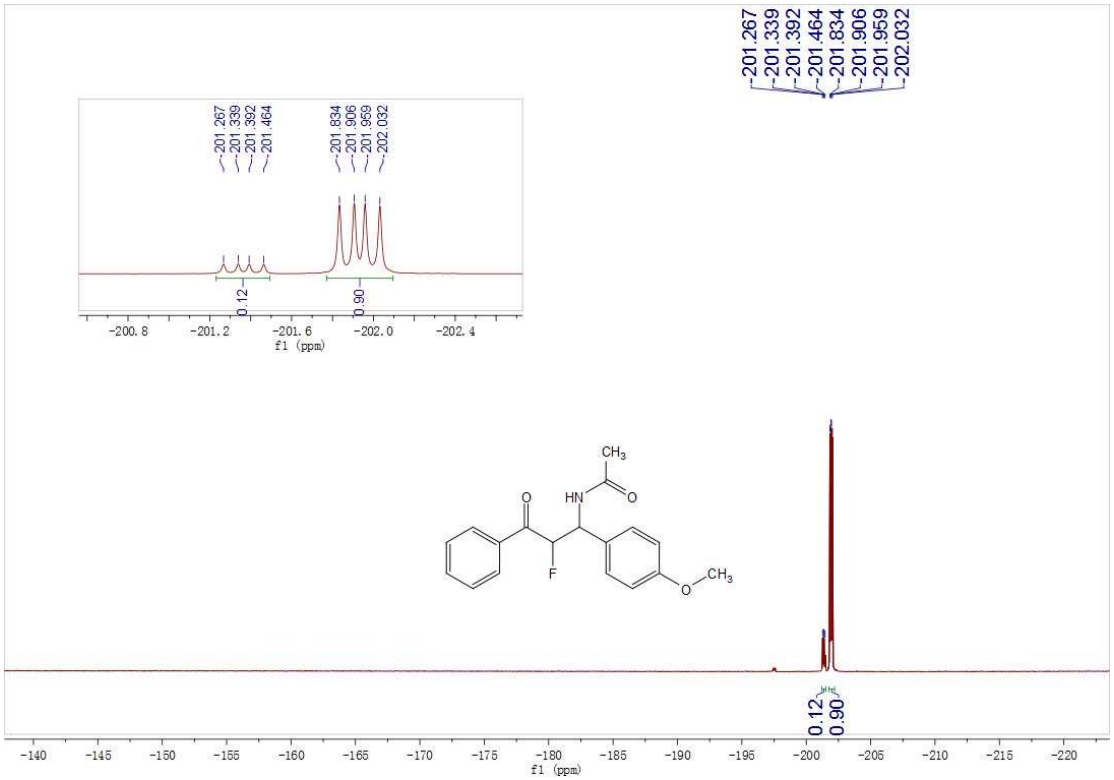

194.419
194.232
169.403
169.381
138.123
134.788
134.203
134.157
129.600
129.503
128.974
128.903
128.558
128.530
126.944
94.895
93.001
53.677
53.486
23.034
21.121
f1 (ppm)
CH3
HN
O
F


202.127
202.199
202.252
202.325
1.00
f1 (ppm)
CH3
HN
O
F

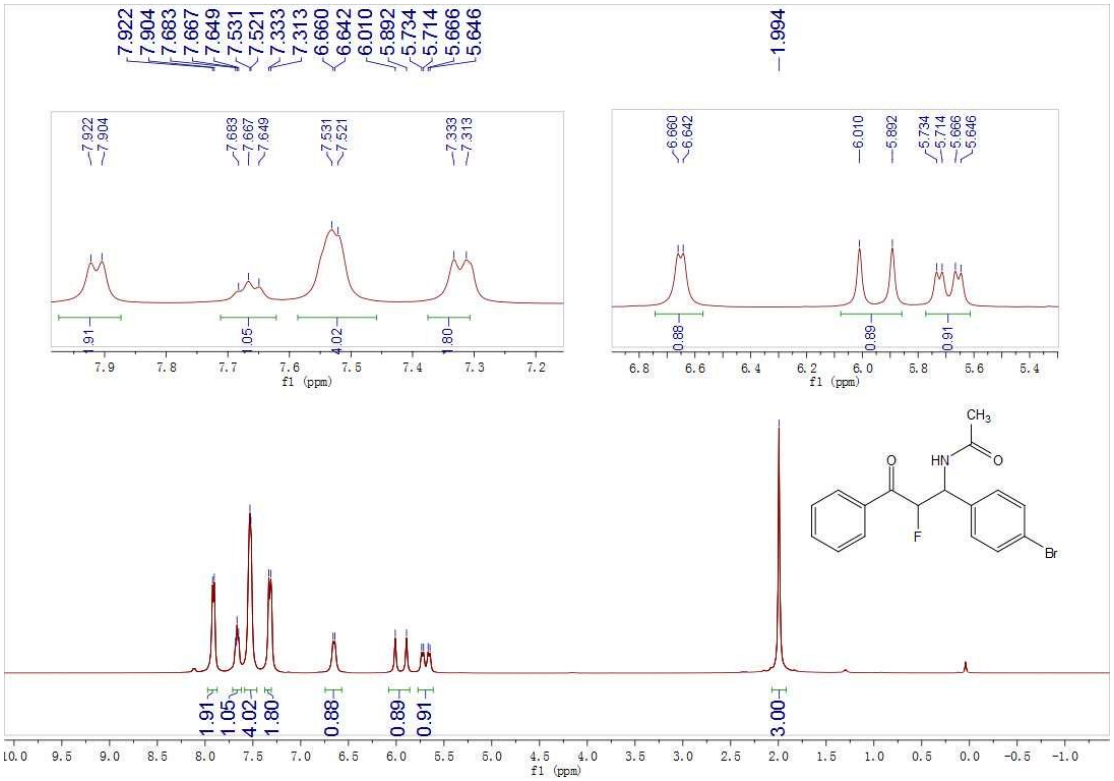
2-fluoro-3-acetamido-1-phenyl-3-*p*- methoxyphenyl propan-1-one (3g)

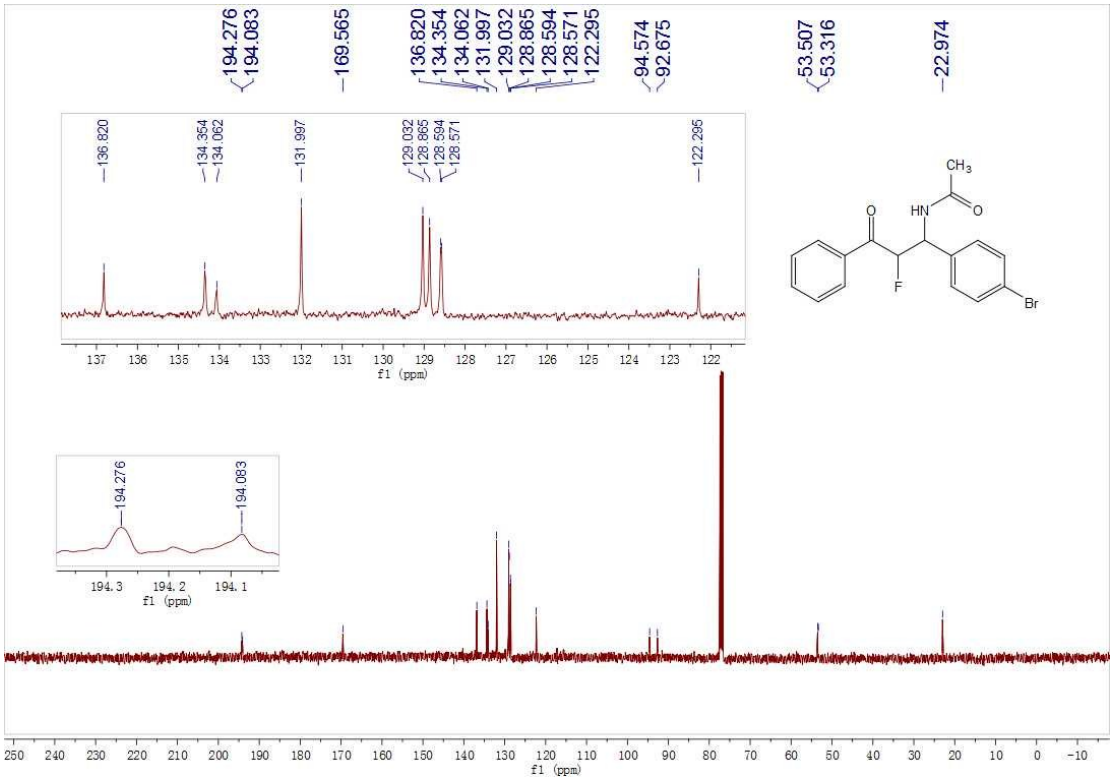


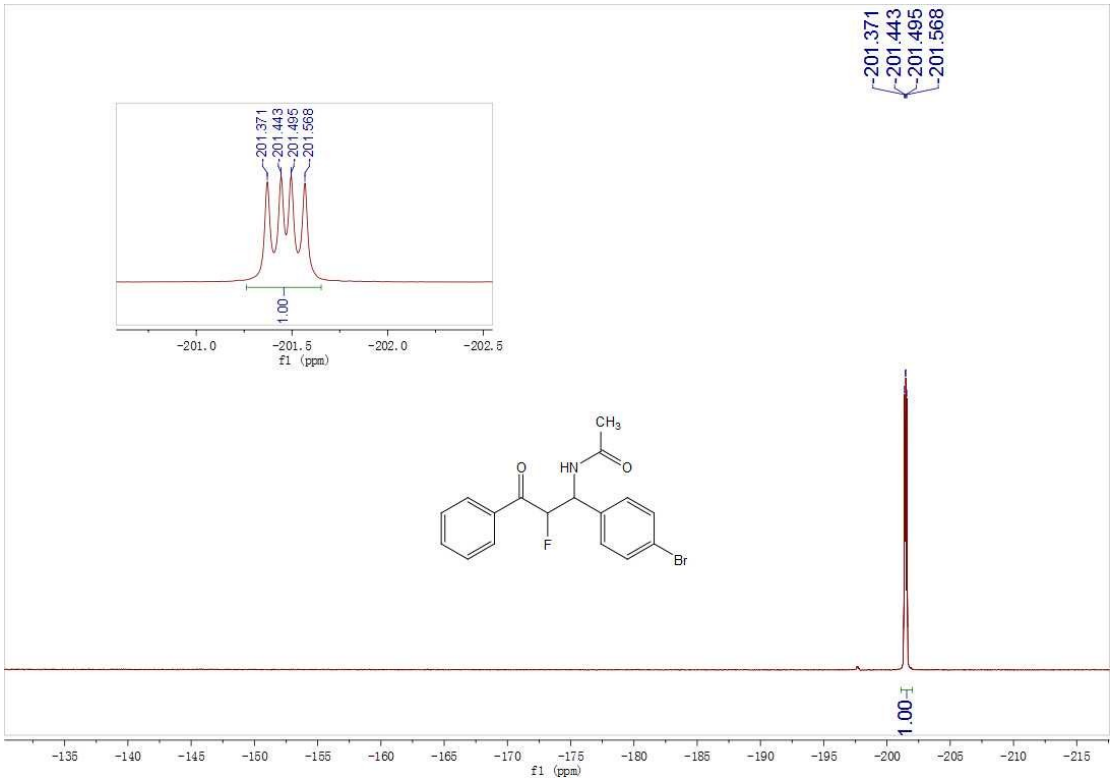




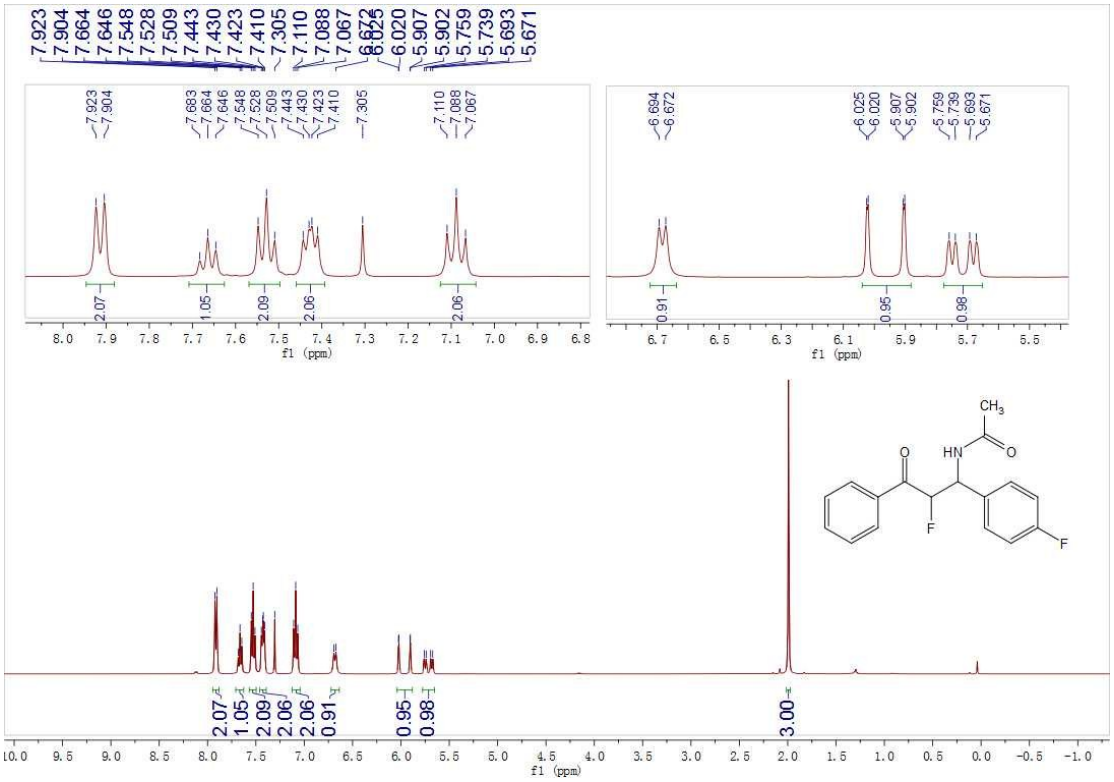
2- fluoro -3-(4-bromophenyl)-3-acetamido-1-phenylpropan-1-one (3h)

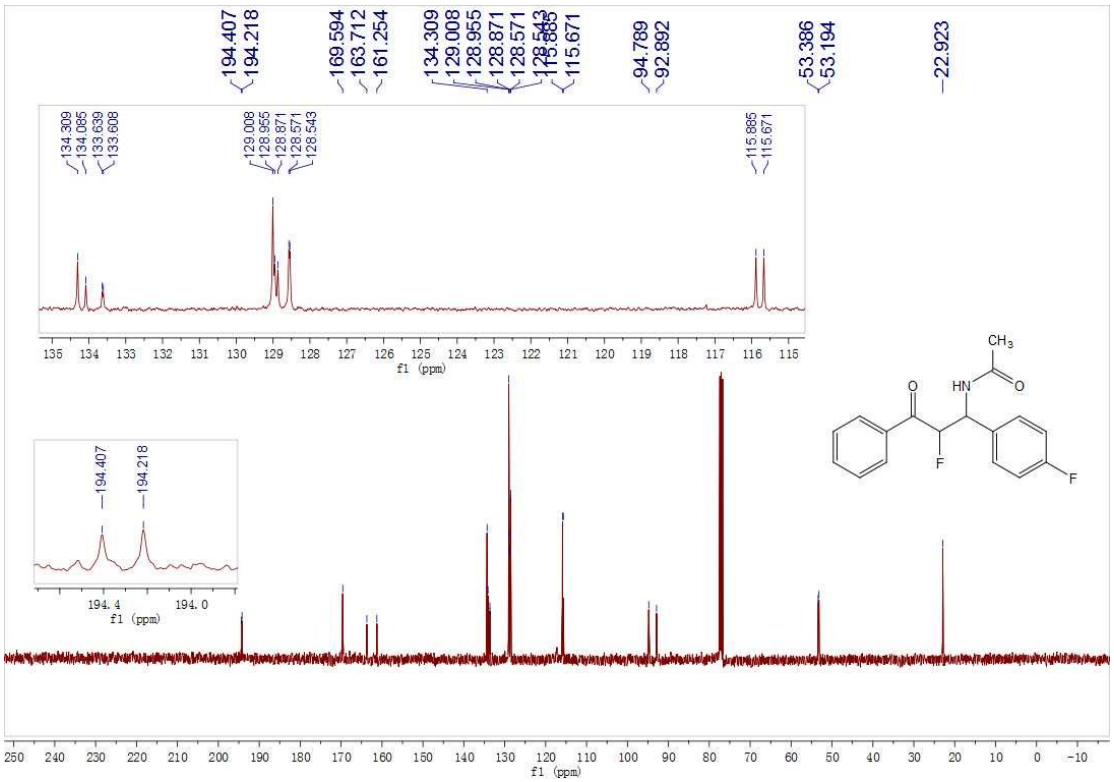


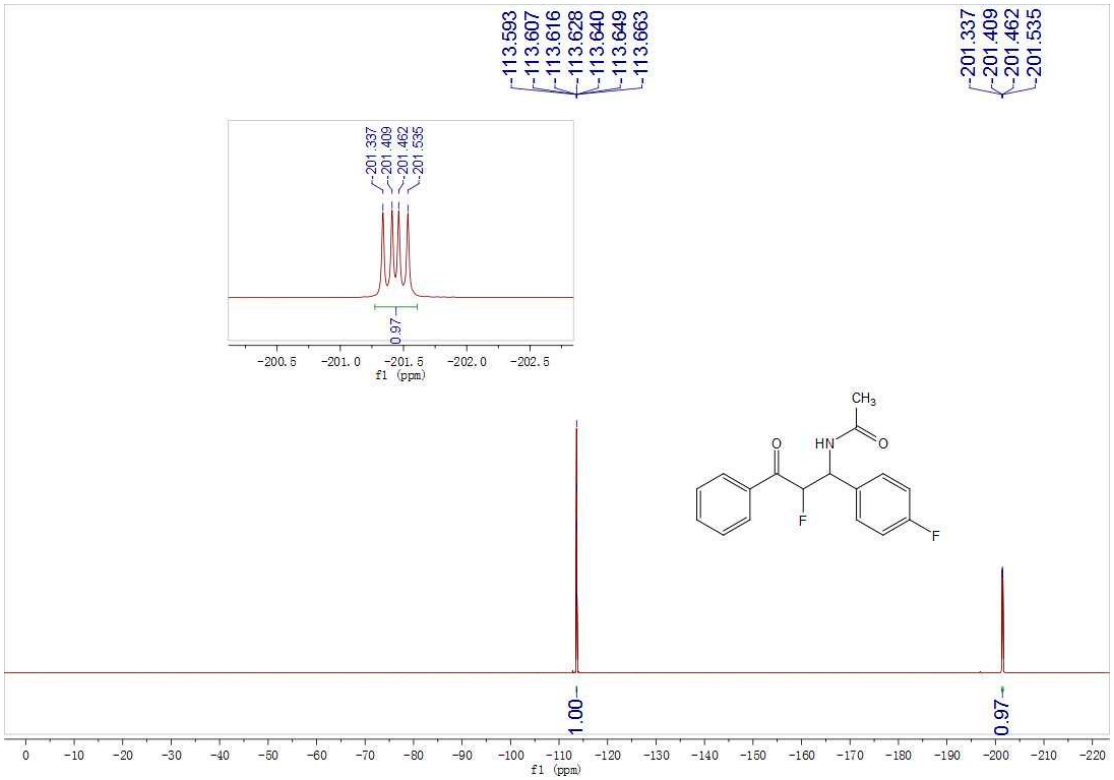

194.276
194.083
169.565
136.820
134.354
134.062
131.997
129.032
128.865
128.594
128.571
122.295
94.574
92.675
53.507
53.316
22.974
f1 (ppm)


201.371
201.443
201.495
201.568
1.00
f1 (ppm)

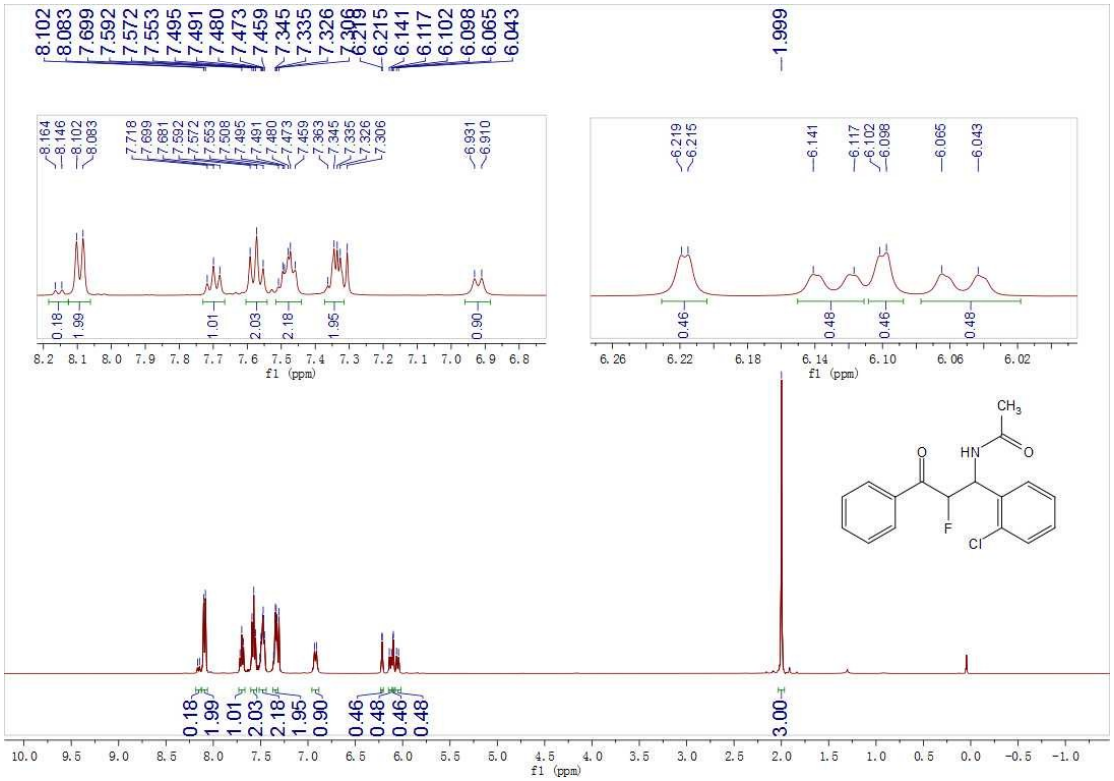
2- fluoro-3-(4- fluorophenyl)-3-acetamido-1-phenylpropan-1-one (3i)

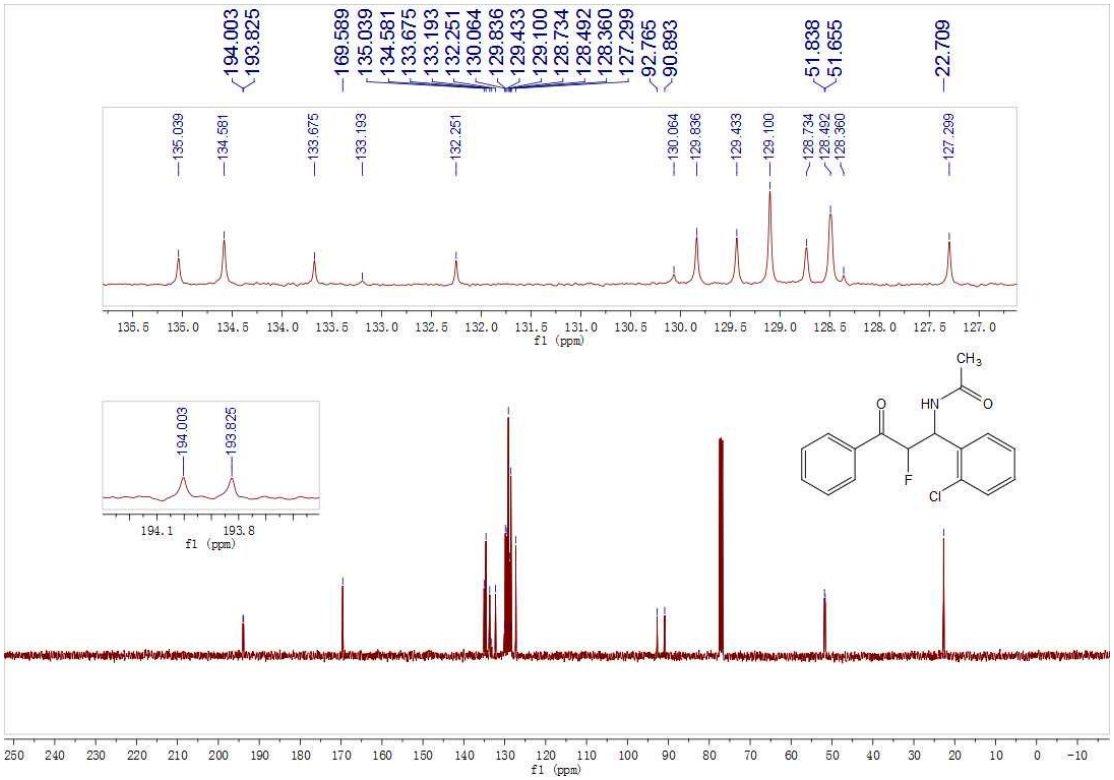


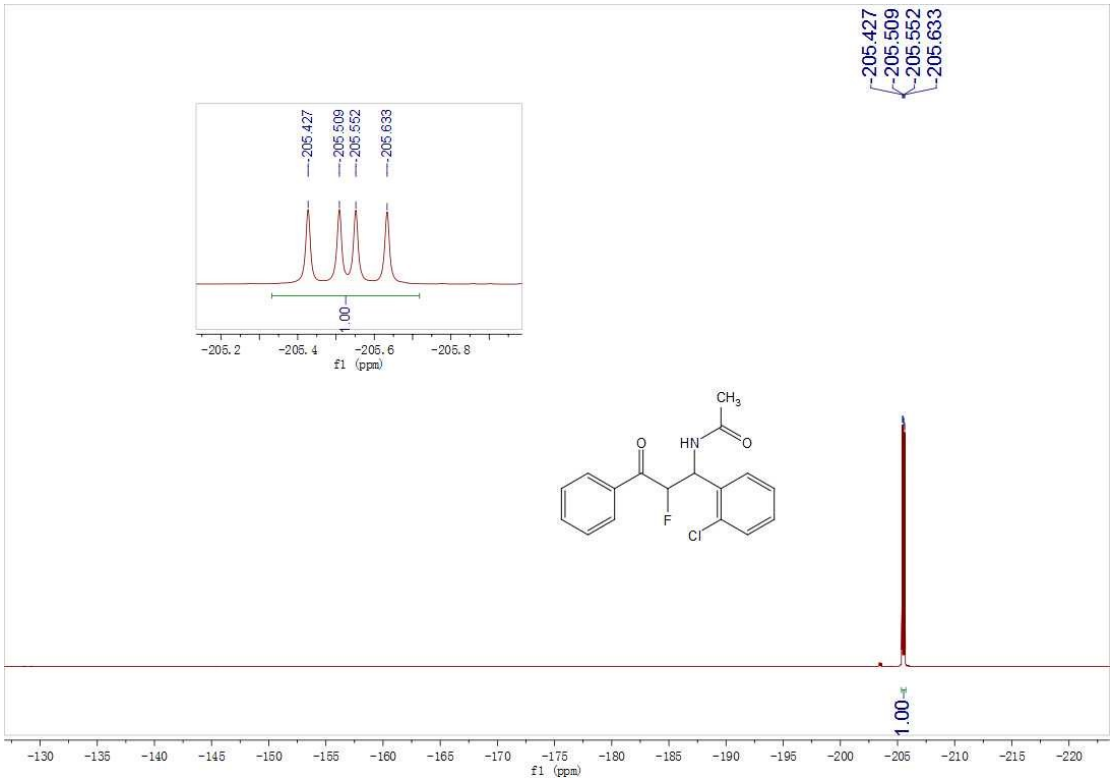




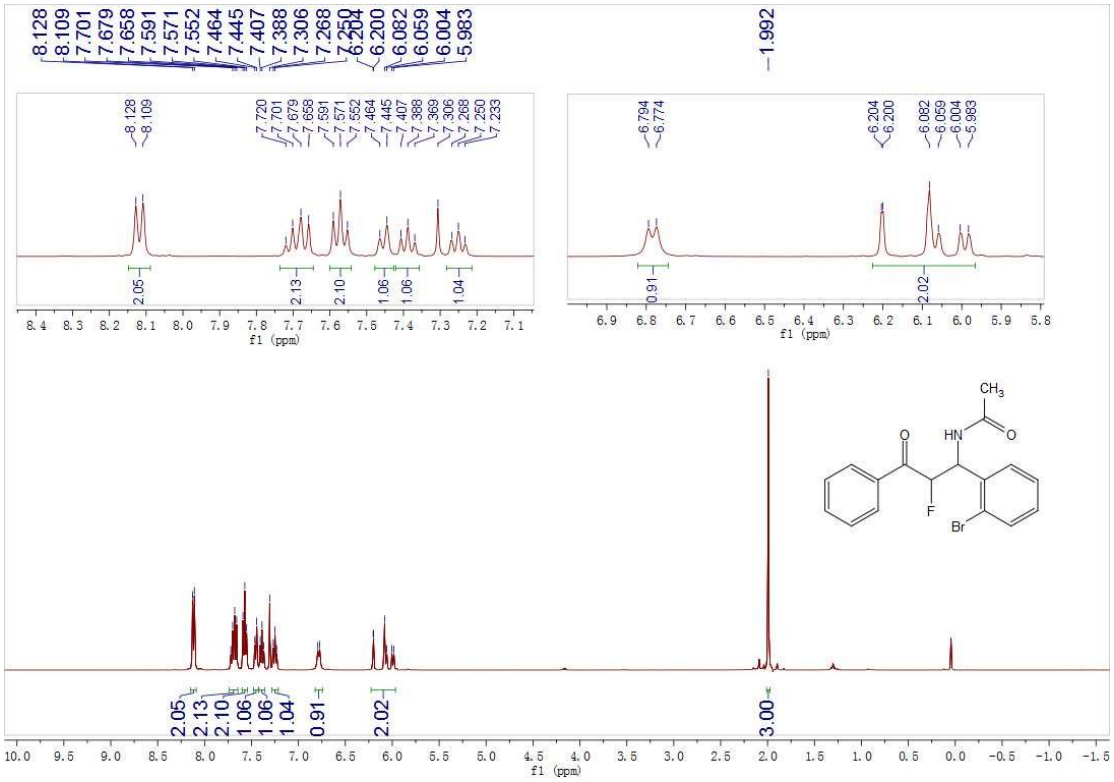
2- fluoro-3-(2-chlorophenyl)-3- acetamido-1-phenylpropan-1-one (3j)

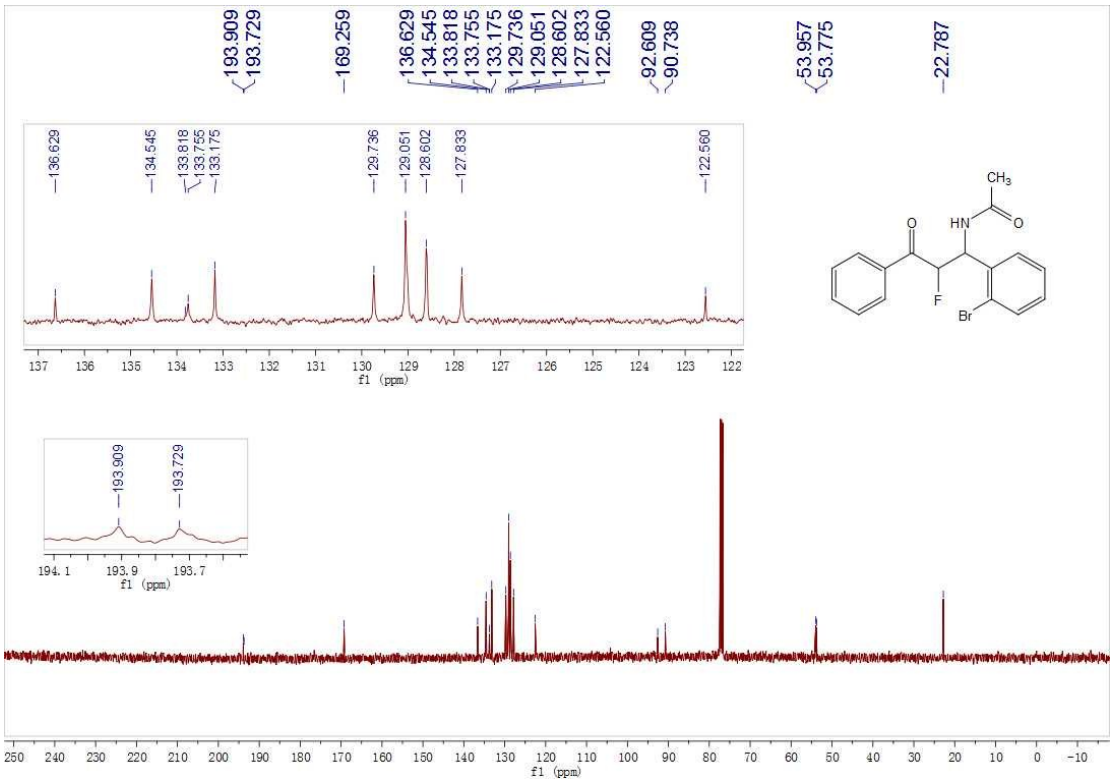


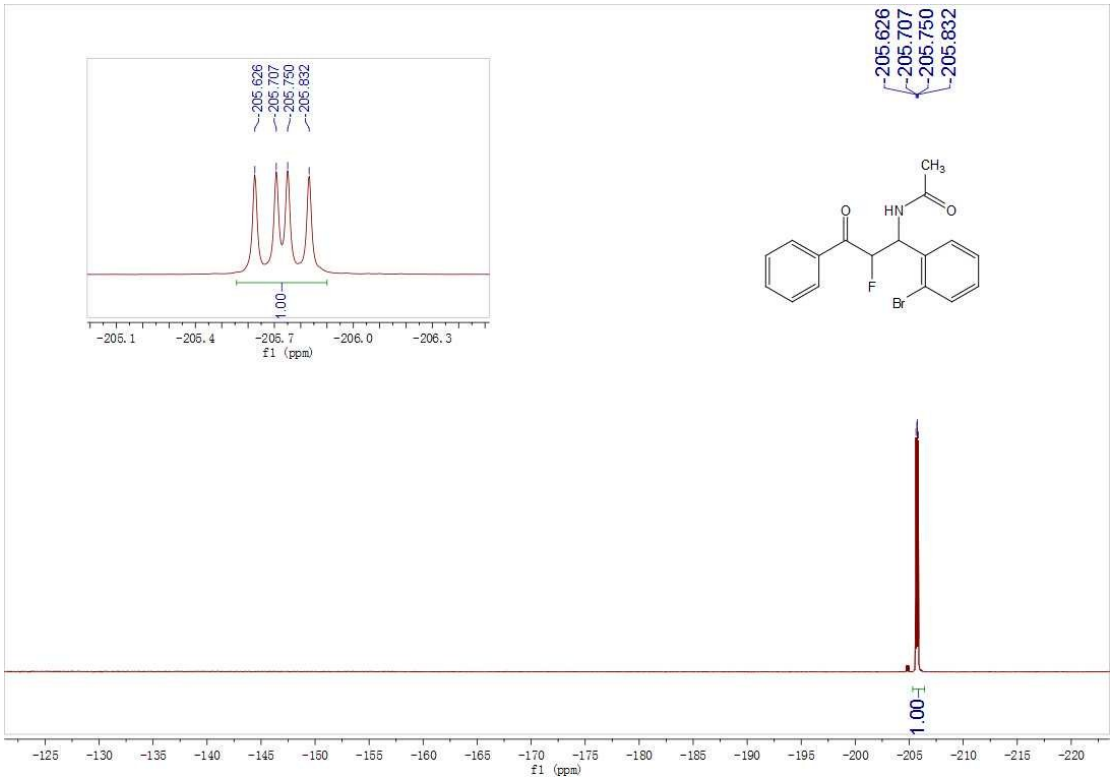

194.003
193.825
169.589
135.039
134.581
133.675
133.193
132.251
130.064
129.836
129.433
129.100
128.734
128.492
128.360
127.299
92.765
90.893
51.838
51.655
22.709
f1 (ppm)


205.427
205.509
205.552
205.633
1.00
f1 (ppm)

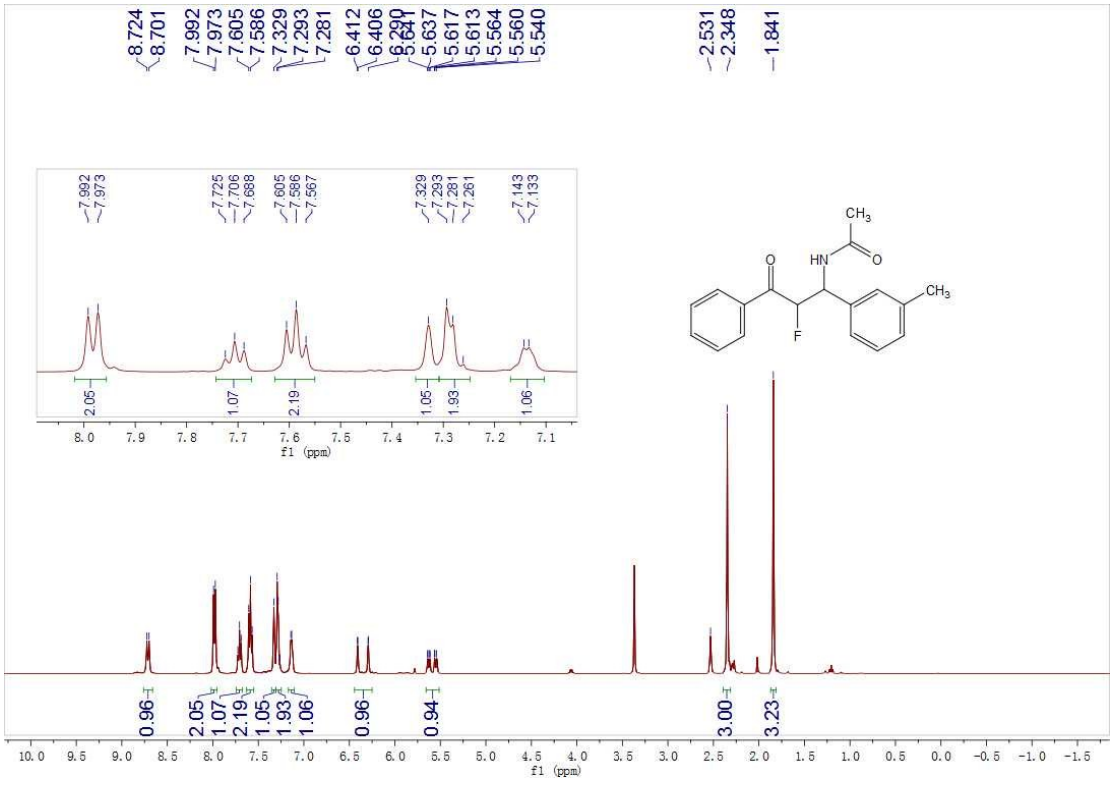
2- fluoro-3-(2-bromophenyl)-3-acetamido-1-phenylpropan-1-one (3k)

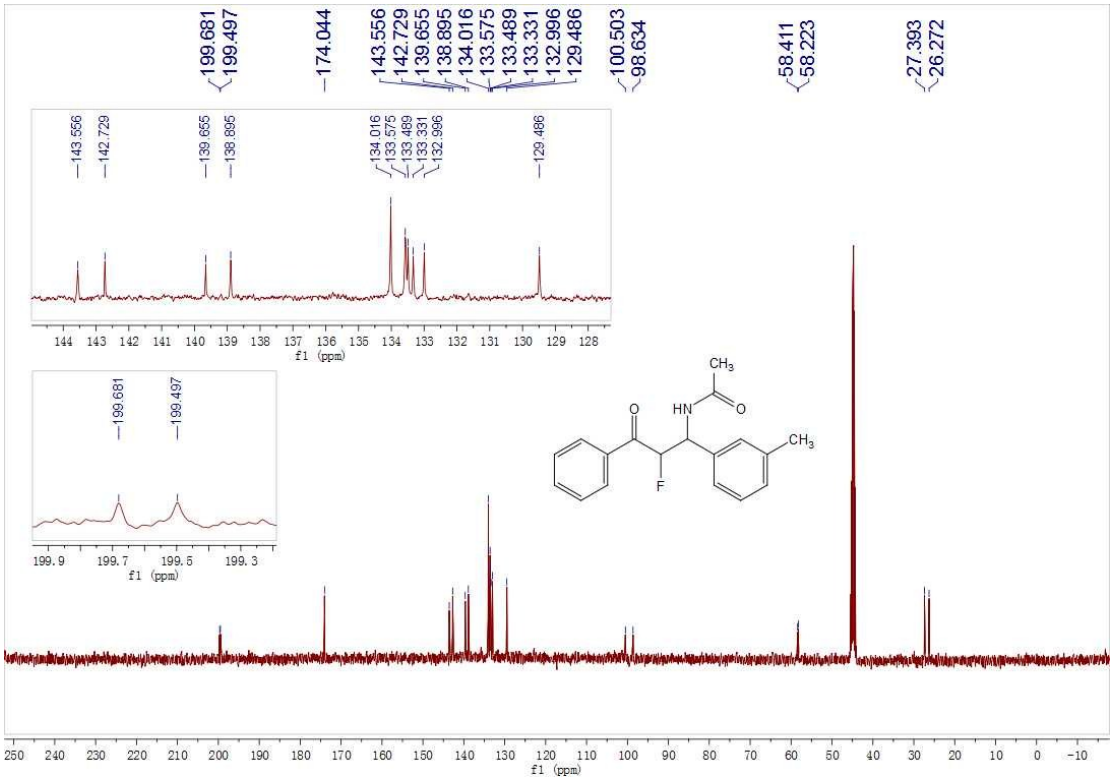


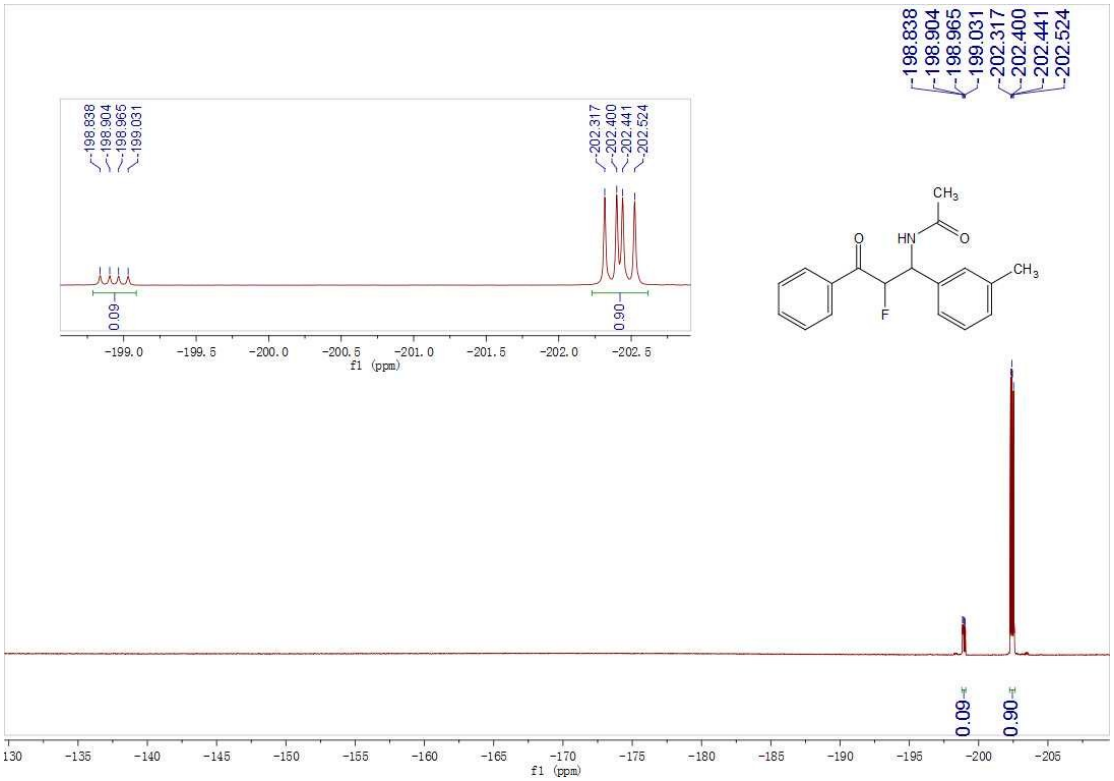




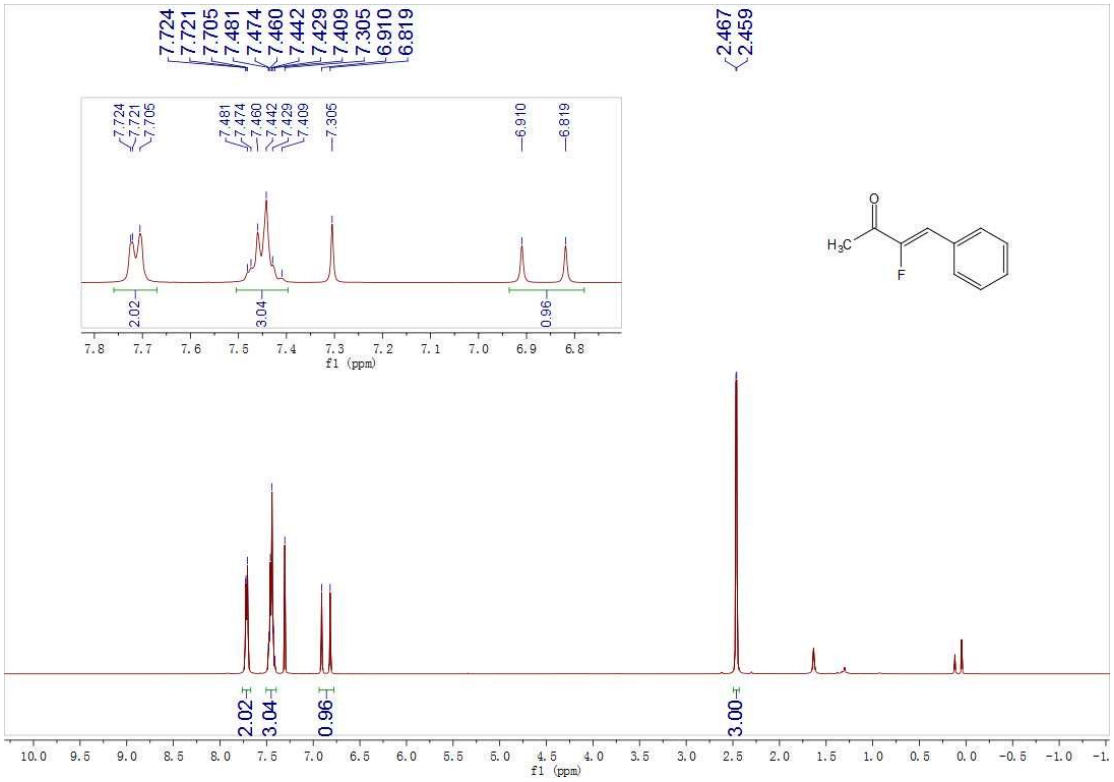
2- fluoro-3-acetamido-1-phenyl-3-m-tolylpropan-1-one (3m)

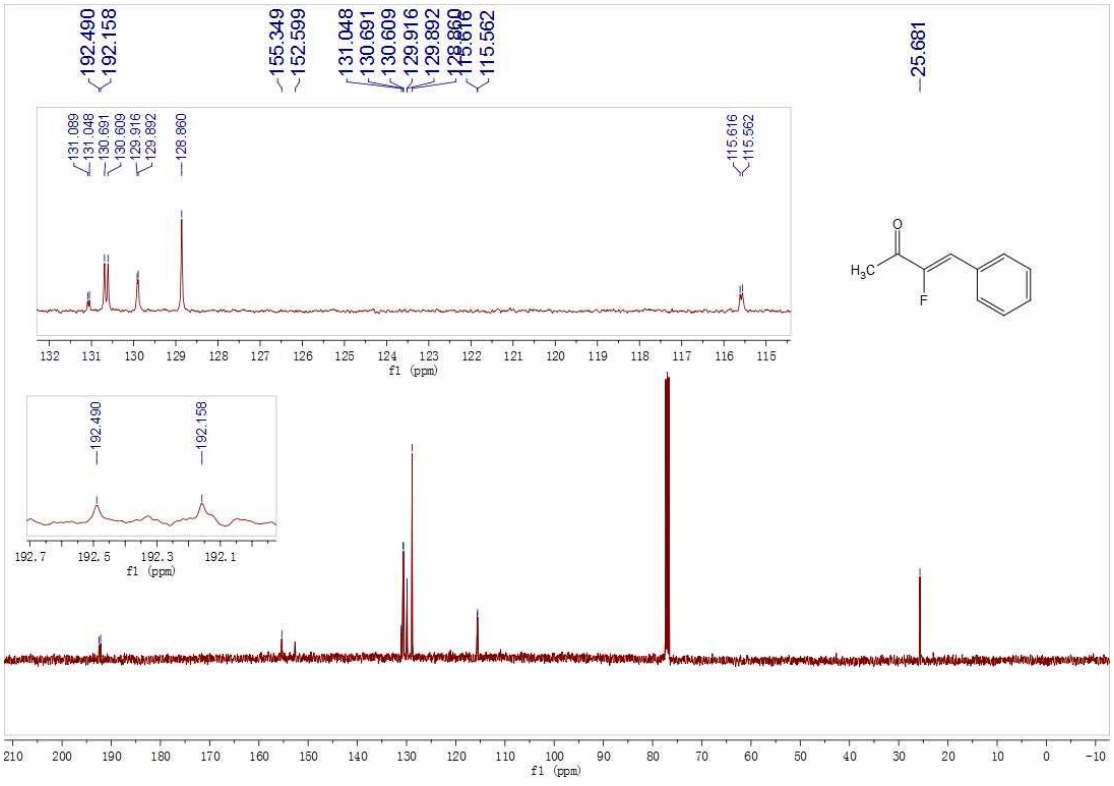


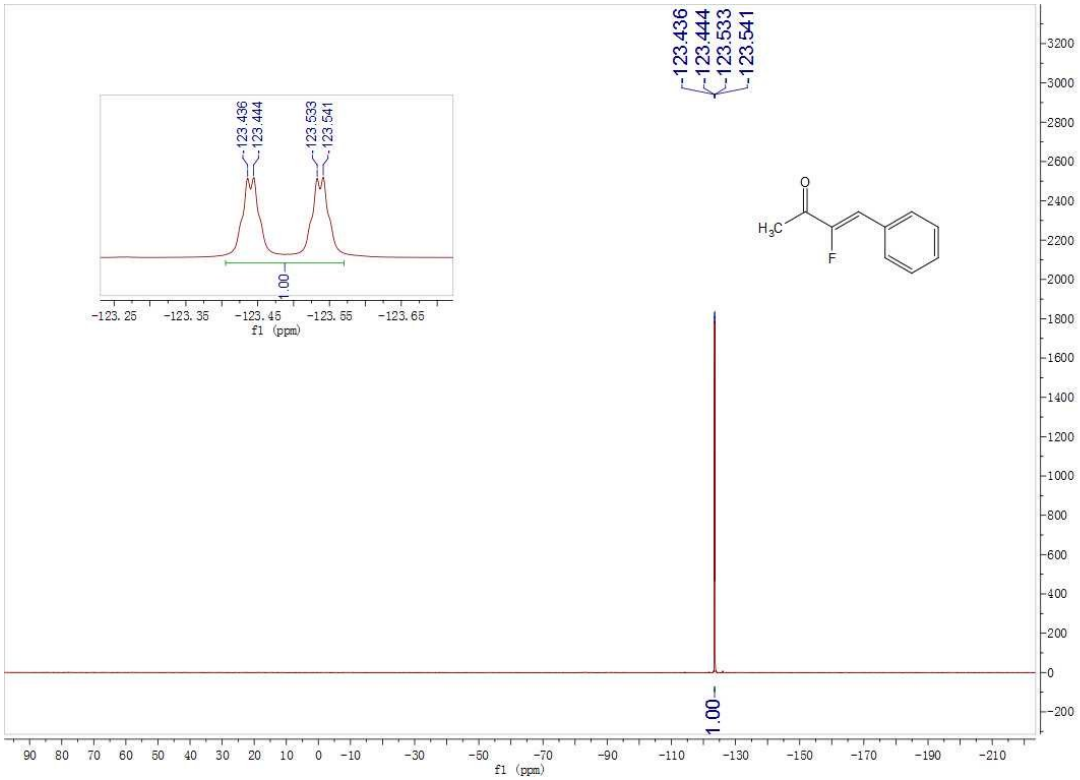

199.681
199.497
174.044
143.556
142.729
139.655
138.895
134.016
133.575
133.489
133.331
132.996
129.486
100.503
98.634
58.411
58.223
27.393
26.272
f1 (ppm)
CH3
HN
O
F


198.838
198.904
198.965
199.031
202.317
202.400
202.441
202.524
0.09
0.90
f1 (ppm)
CH3
HN
O
F

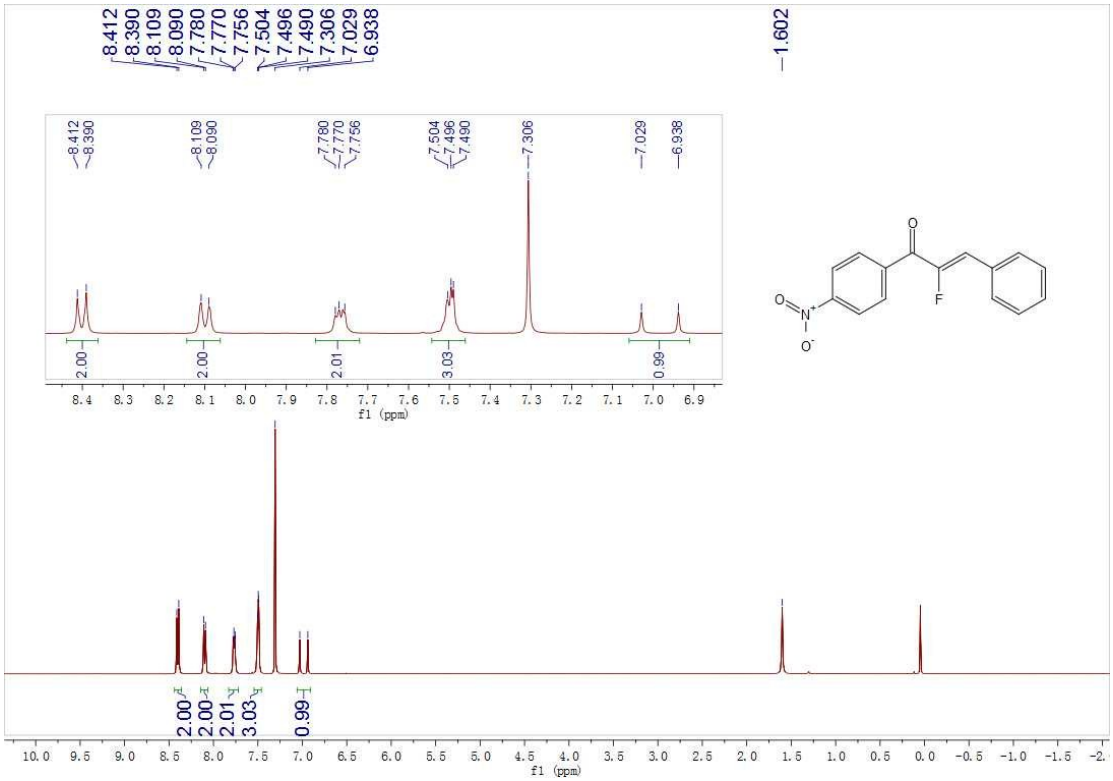
(*Z*)-3-fluoro-4-phenylbut-3-en-2-one (5p)

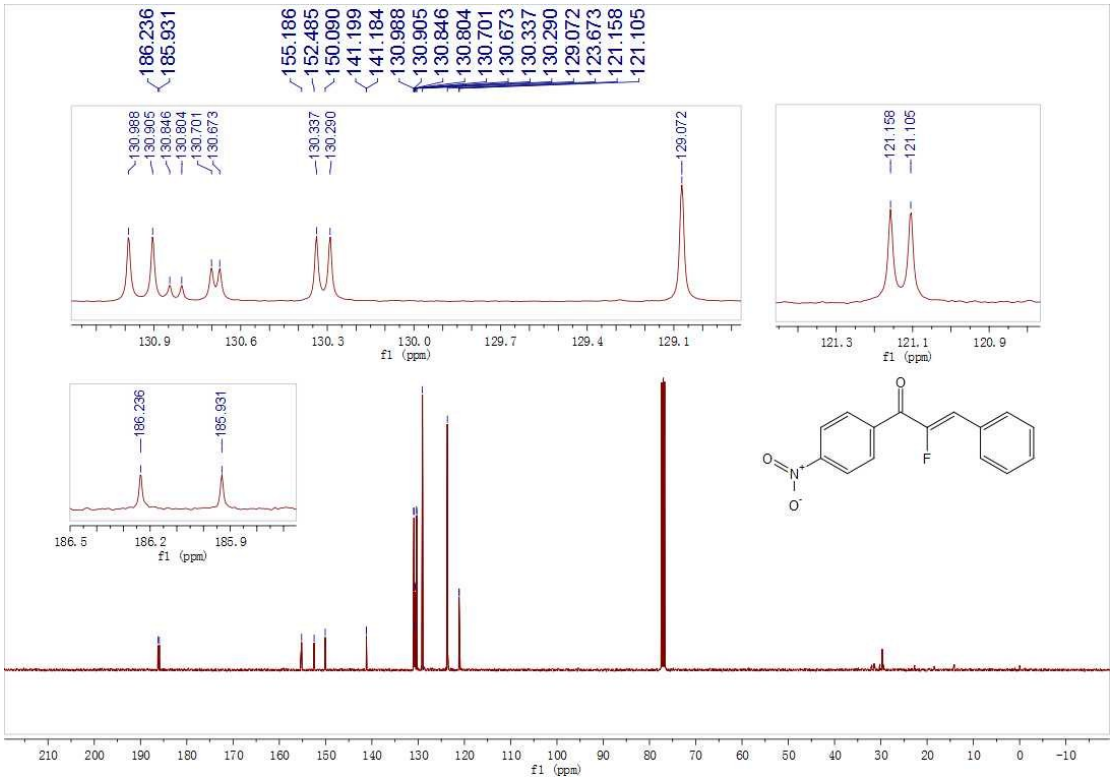


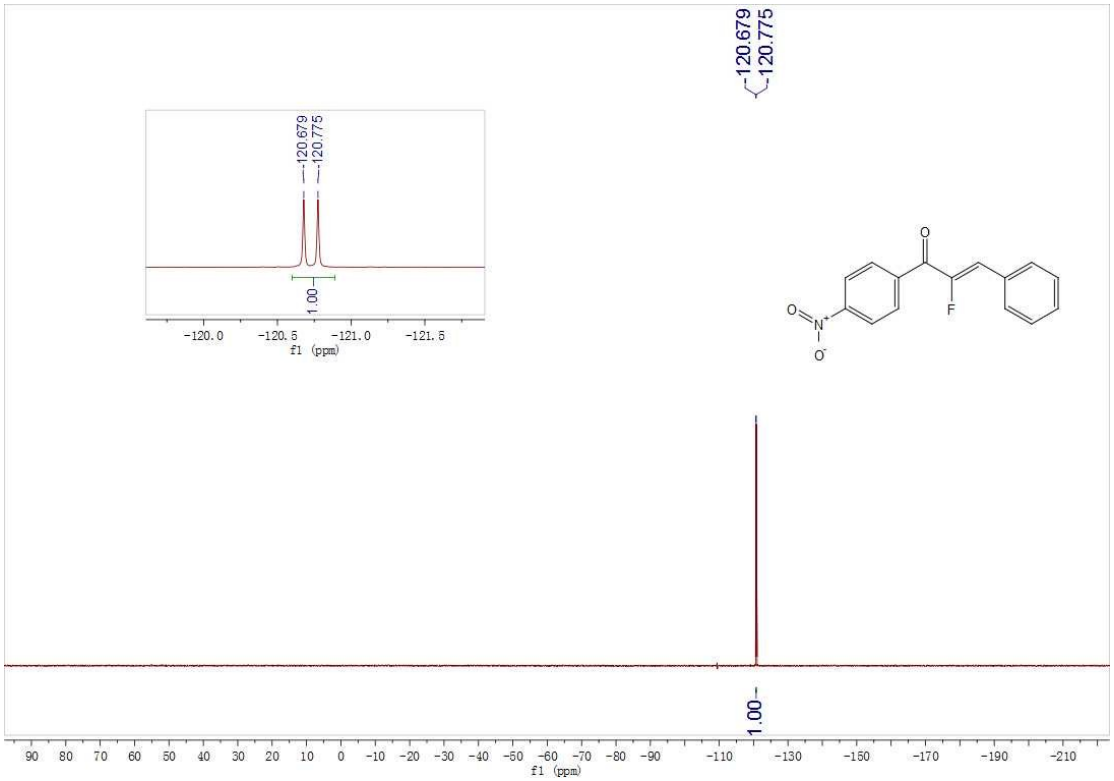




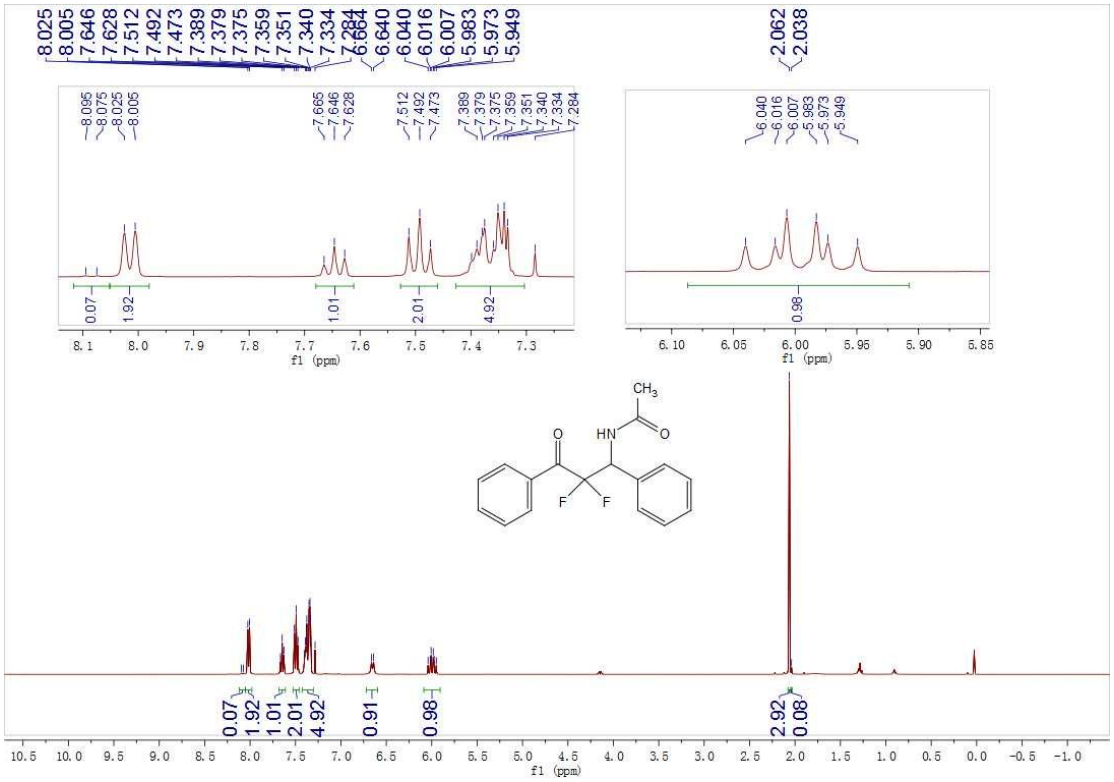
(*Z*)-2-fluoro-1-(4-nitrophenyl)-3-phenylprop-2-en-1-one (5b)

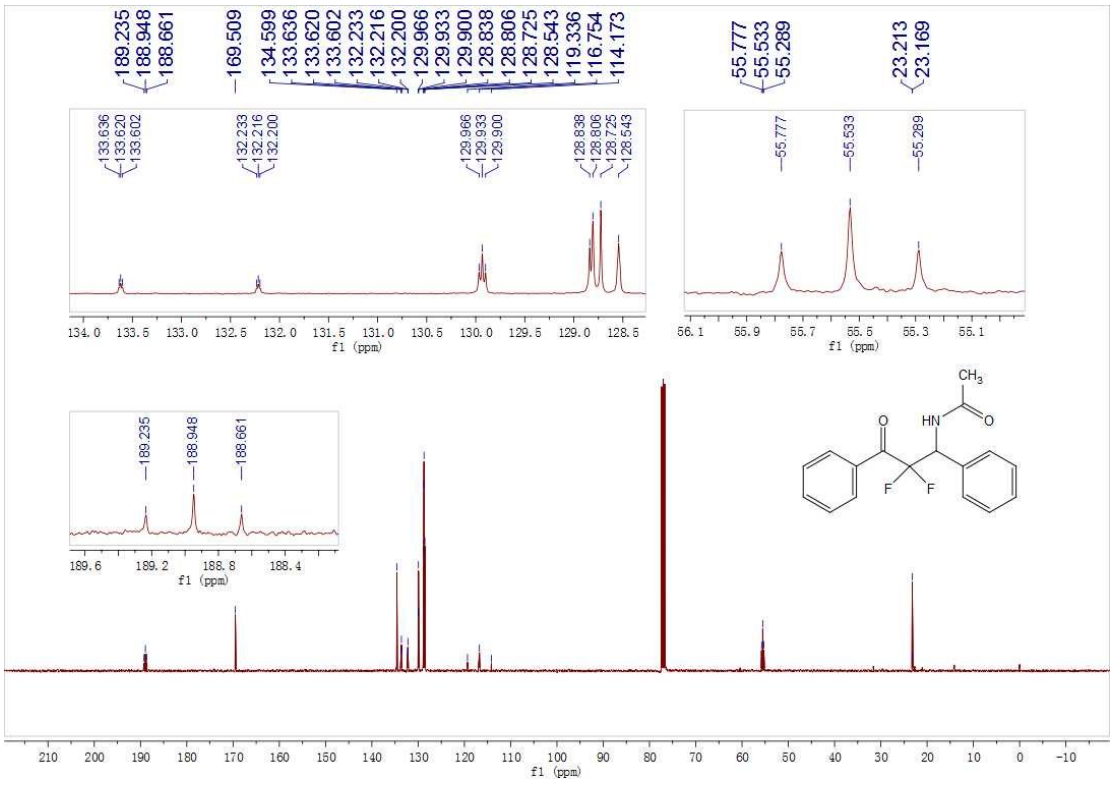


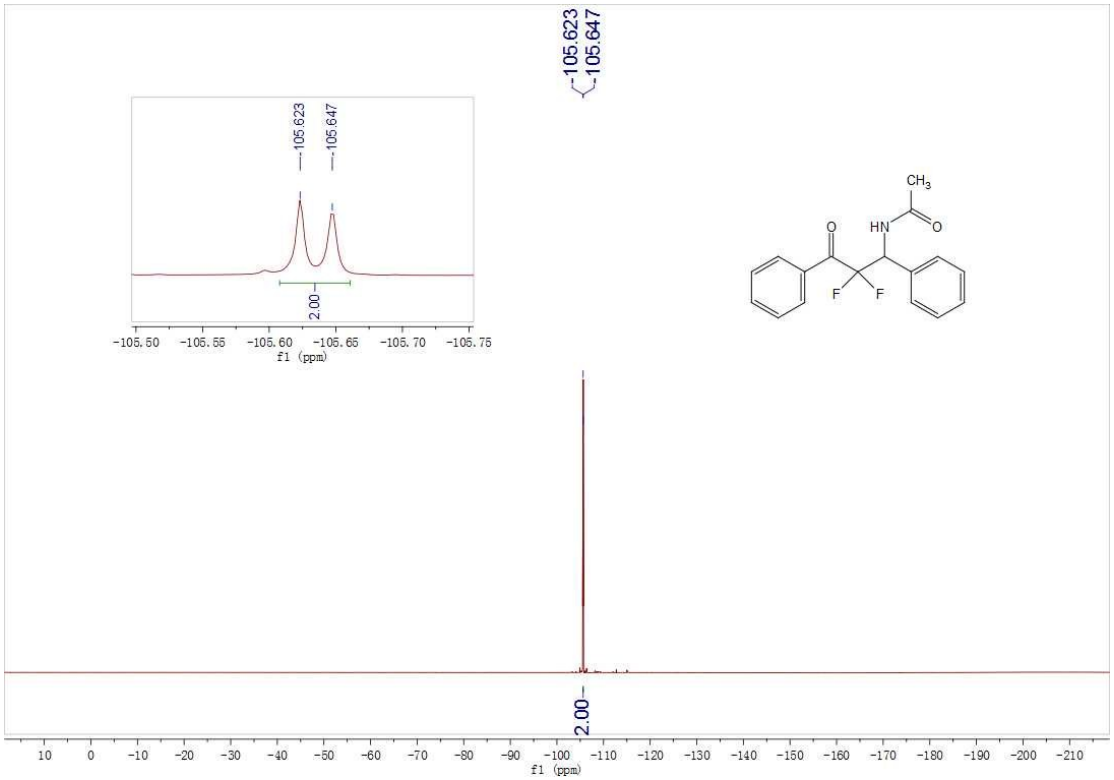

186.236
185.931
155.186
152.485
150.090
141.199
141.184
130.988
130.905
130.846
130.804
130.701
130.673
130.337
130.290
129.072
123.673
121.158
121.105
f1 (ppm)


120.679
120.775
1.00
f1 (ppm)

2,2-difluoro-3-acetamido-1,3-diphenylpropan-1-one (4a)






105.623
105.647
105.623
105.647
2.00
-105.50 -105.55 -105.60 -105.65 -105.70 -105.75
f1 (ppm)
CH3
HN
O
O
F
F
2.00
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)