Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supporting Information

Enantioselective organocatalytic amination of 2-perfluoroalkyl-oxazol-5(2*H*)-ones towards synthesis of chiral *N*,*O*-aminals with perfluoroalkyl and amino groups

Bo Zhu,* Tianxiao Yang, Yingxin Gu, Shuping Zhu, Gongming Zhu, Junbiao Chang*

NMPA Key Laboratory for Research and Evaluation of Innovative Drug, Henan Key Laboratory of Organic Functional Molecule and Drug Innovation, School of Chemistry and Chemical Engineering, Henan Normal University, Xinxiang, Henan, 453007, P. R. China

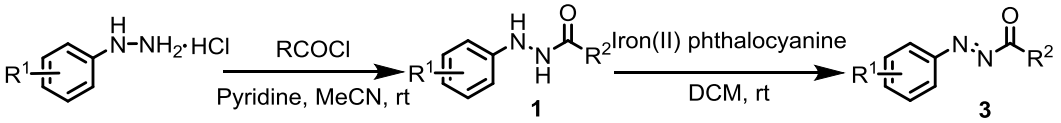
E-mail: zbtiantang@126.com; cjb@htu.edu.cn.

Content

1. General Information

All reactions were carried out under an atmosphere of air. All solvents and reagents were purchased from commercial sources and purified according to established procedures before use. Flash chromatography was carried out using silica gel (100-200 mesh). ^{1}H NMR spectra were recorded on Bruker Avance III HD 600 or Avance 400 MHz spectrometer. Chemical shifts are recorded in ppm relative to tetramethylsilane and with the solvent resonance as the internal standard. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, dd = doublet of doublets, t = triplet, q = quaternary, m = multiplet), coupling constants (Hz), integration. ^{13}C{1H} NMR data were collected on Bruker Avance III HD 150 or Avance 100 MHz spectrometer. HPLC analysis was performed on a Dionex UltiMate 3000, ThermoScientific. Chiral HPLC data for the products could be obtained using Chiralpak IA, Chiralpak IH, Chiralpak IF and NuAnalytical-FLM NZ_2 column. These chiral columns were purchased from Daicel Chemical Industries Ltd and FLM Scientific Instrument Co. Ltd. Optical rotations were measured on an Insmark polarimeter (IP-digi 300). HRMS was obtained by an ABI/Sciex QStar Mass Spectrometer (ESI). All melting points were conducted on a digital melting point apparatus and were uncorrected. TLC was performed on glass-backed silica plate.

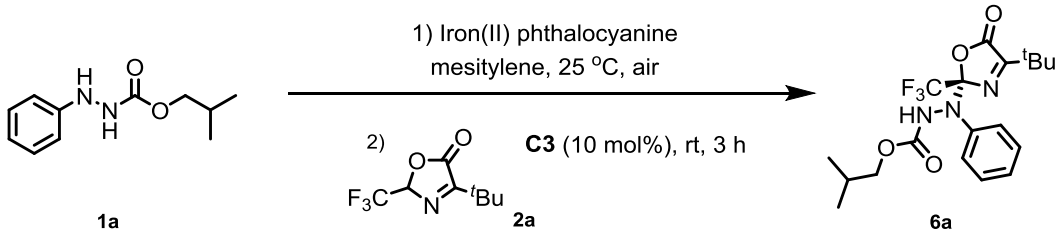
2. Preparation of Starting Materials[1, 2]



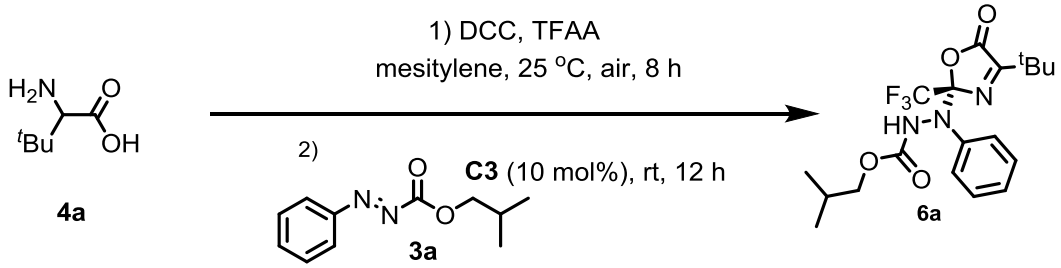
Phenylazocarboxylate **3a-3zc** were prepared following the literature procedure[3,4,5]. 20ml CH_3CN was added into 100ml round bottom flask. The solution was cooled to 0 ^oC and the corresponding hydrazine hydrochloride (10 mmol) was dissolved in it. Pyridine (1.71 mL, 21.2 mmol) was added. Then chloroformate (1.04 mL, 11 mmol) was added dropwise under stirring. The reaction mixture was stirred for 30 min at 0 ^{o} C and then for 4 h at room temperature. Water (20 mL) was added and the product was extracted with CH_2Cl_2 (50 mL). The combined organic layers were washed with saturated aq. $NaHCO_3$ (50 mL), brine (50 mL), dried over Na_2SO_4 and the solvent was evaporated to dryness. The crude products were purified by recrystallization with n−Hexane/DCM to afford the corresponding products **1a-1zc** in 60-85% yield.

Iron(II) phthalocyanine (568 mg, 1 mmol) was added to a solution of corresponding hydrazinecarboxylate (10 mmol) in 20 mL DCM. The reaction mixture was stirred for 4 h at room temperature and under an atmosphere of air. The solvent was evaporated to drynesspurified by chromatography on silica gel eluted with PE/EA (10/1-5/1) to afford the corresponding product **3a-3zc** in 75-98% yield.

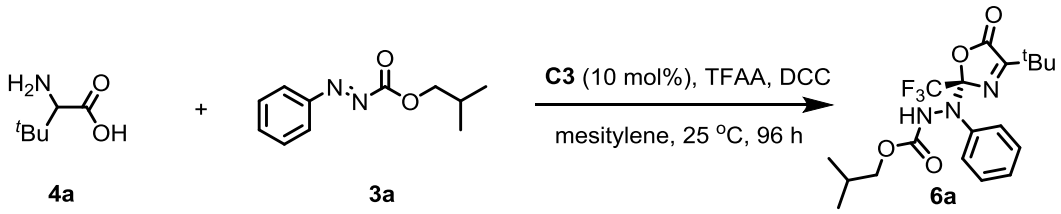
3. Four Ways to Synthesize 6a



Iron(II) phthalocyanine (0.015 mmol, 0.15 equiv) was added to a solution of isobutyl 2-hydrazinecarboxylate **1a** (0.15 mmol, 1.5 equiv) in 1 mL mesitylene. The reaction mixture was stirred for 8 h at room temperature and under an atmosphere of air. Catalyst **C3** (0.01 mmol, 0.1 equiv) and 4-(*tert*-butyl)-2-(trifluoromethyl)oxazol-5(2*H*)-one **2a** (0.10 mmol, 1 equiv) were added in the solvent. The reaction mixture was stirred for 3 h at room temperature. The resulting mixture was monitored by TLC and purified by silica gel column using eluent: PE/EA (10/1-5/1) to afford **6a**.

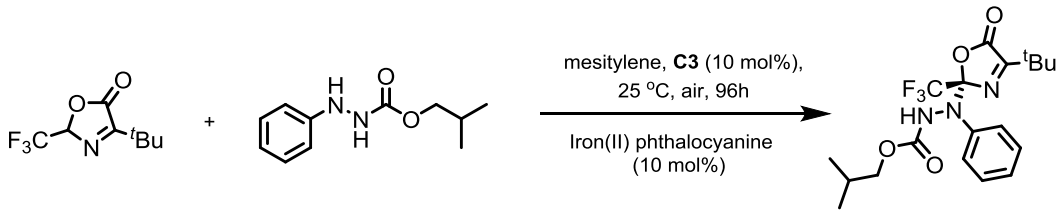


A mixture of tertiary leucine **4a** (0.2 mmol, 2 equiv), Trifluoroacetic anhydride (0.24 mmol, 2.4 equiv) and Dicyclohexylcarbodiimide (DCC) (0.8 mmol, 8 equiv) were dissolved in 1 mL mesitylene and stirred for 8 h at room temperature. Isobutyl 2-phenylazocarboxylate **3a** (0.1 mmol, 1 equiv) and Catalyst **C3** (0.01 mmol, 0.1 equiv) were added in the solvent. The reaction mixture was stirred for 12 h at room temperature. The resulting mixture was monitored by TLC. After suction filtration. Filtrate was evaporated to dryness and purified by silica gel column using eluent: PE/EA (10/1-5/1) to afford **6a**.



A mixture of tertiary leucine **4a** (0.2 mmol, 2 equiv), Trifluoroacetic anhydride (0.24

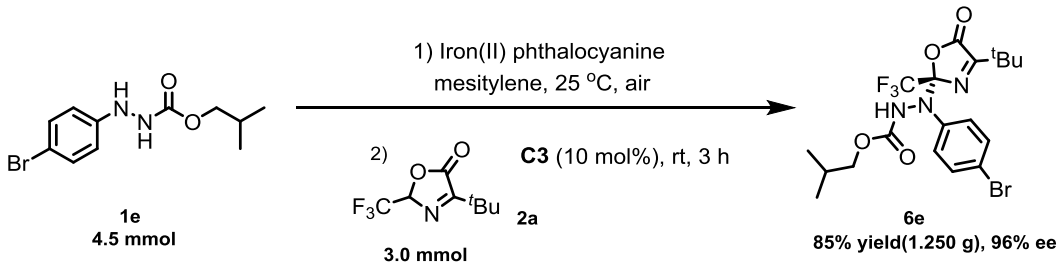
mmol, 2.4 equiv), Dicyclohexylcarbodiimide (DCC) (0.8 mmol, 8 equiv), Isobutyl 2-phenylazocarboxylate **3a** (0.1 mmol, 1 equiv) and Catalyst **C3** (0.01 mmol, 0.1 equiv) were dissolved in 1 mL mesitylene and stirred for 96 h at room temperature. The resulting mixture was monitored by TLC. After suction filtration. Filtrate was evaporated to dryness and purified by silica gel column using eluent: PE/EA (10/1-5/1) to afford **6a**.



2a **1a** **6a**

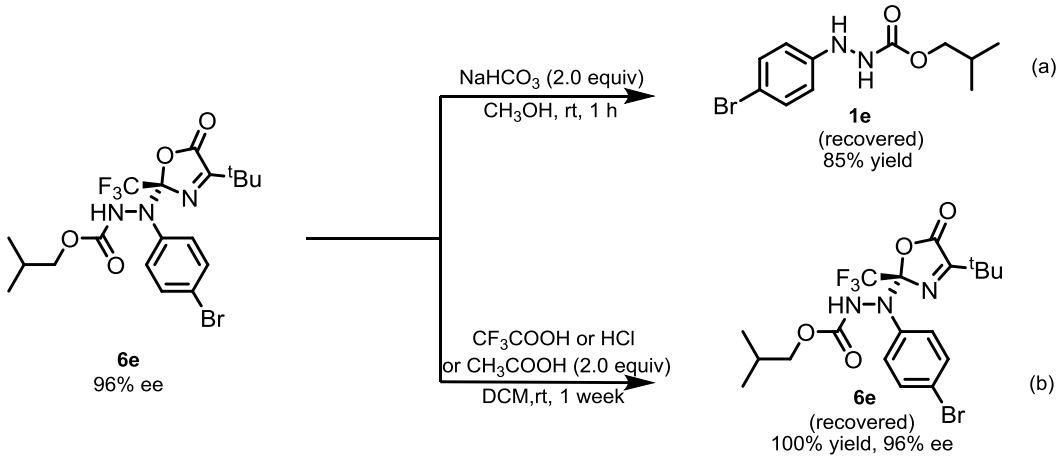
With the presence of Iron(II) phthalocyanine (0.015 mmol, 0.15 equiv), Catalyst **C3** (0.01 mmol, 0.1 equiv), 4-(*tert*-butyl)-2-(trifluoromethyl)oxazol-5(2*H*)-one **2a** (0.1 mmol, 1.0 equiv) and Isobutyl 2-hydrazinecarboxylate **1a** (0.15 mmol, 1.5 equiv) were dissolved in 1 mL mesitylene and stirred for 96 h under an atmosphere of air, at room temperature. The resulting mixture was monitored by TLC and purified by silica gel column using eluent: PE/EA (10/1-5/1) to afford **6a**.

4. Gram-Scale Synthesis of 6e



Iron(II) phthalocyanine (0.45 mmol, 0.15 equiv) was added to a solution of Isobutyl 2-(4-bromophenyl)hydrazinecarboxylate **1e** (4.5 mmol, 1.5 equiv) in 1 mL mesitylene. The reaction mixture was stirred for 16 h at room temperature and under an atmosphere of air. Catalyst **C3** (0.3 mmol, 0.1 equiv) and 4-(*tert*-butyl)-2-(trifluoromethyl)oxazol-5(2*H*)-one **2a** (3.0 mmol, 1 equiv) were added in the solvent. The reaction mixture was stirred for 10 h at room temperature. The resulting mixture was monitored by TLC and purified by silica gel column using eluent: PE/EA (10/1-5/1) to afford 1.250g **6e** in 85 % yield and 96% ee.

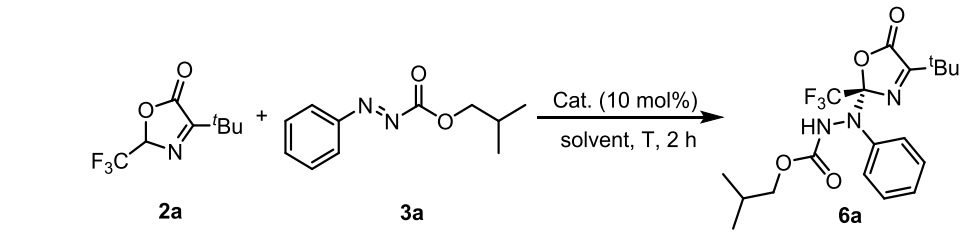
5. Experimental Procedures for Transformations of the Corresponding Products



(a) To a solution of **6e** (0.10 mmol, 1 equiv) in MeOH (1.0 mL), $NaHCO_3$ (0.20 mmol, 2 equiv) was added. The reaction mixture was stirred for 1 h at room temperature. The excess of solvent were removed under reduced pressure and **1e** was recovered by column chromatography (*silica gel*, PE/EA 5:1–3:1) as white solid in 85% yield. (b) To a solution of **6e** (0.10 mmol, 1 equiv) in CH_2Cl_2 (1.0 mL), HCl (0.50 mmol, 5 equiv) or CF_3COOH (0.50 mmol, 5 equiv) or CH_3COOH (0.50 mmol, 5 equiv) was added respectively. The reaction mixture was stirred for 1 week at room temperature. Structure and enantioselectivity were preserved.

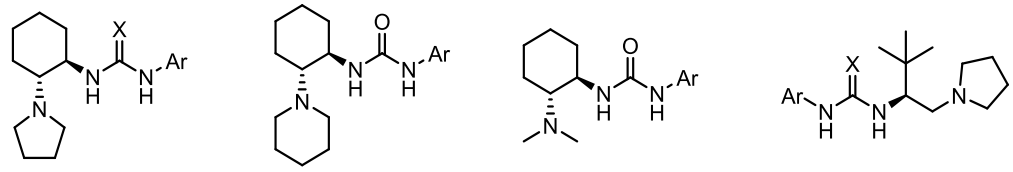
6. Optimization of Reaction Conditions

Table S1. The optimization of the enantioselective organocatalytic amination of 2-(trifluoromethyl)-oxazol-5(2*H*)-one with isobutyl 2-phenylazocarboxylate.



2a **3a** **6a**

Catalyst structures: Ar = 3,5-$(CF_3)_2C_6H_3$



C1: X = O
C2: X = S

C3

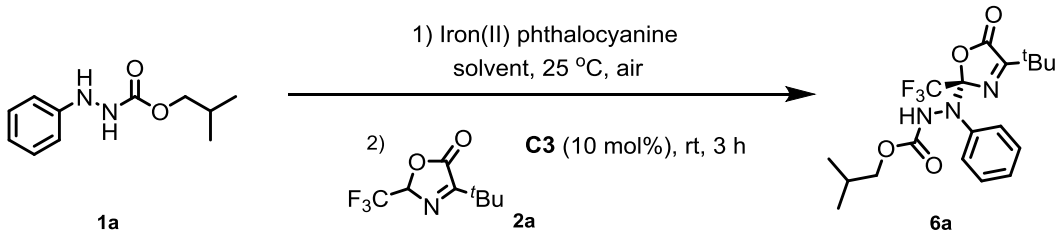
C4

C5: X = O
C6: X =S

Entry[a]	Cat.	Solvent	°C	Time (h)	Yield (%)[b]	Ee (%)[c]
1	**C1**	toluene	rt	2	91	91
2	**C2**	toluene	rt	2	81	87
3	**C3**	toluene	rt	2	92	95
4	**C4**	toluene	rt	2	90	87
5	**C5**	toluene	rt	2	73	-95
6	**C6**	toluene	rt	2	68	-88
7	**C3**	CH_2Cl_2	rt	2	83	89
8	**C3**	THF	rt	2	82	74
9	**C3**	MeCN	rt	2	91	24
10	**C3**	Et_2O	rt	2	86	92
11	**C3**	C_6HF_5	rt	2	87	95
12	**C3**	mesitylene	rt	2	94	96
13	**C3**	m-xylene	rt	2	91	95
14	**C3**	PhCl	rt	2	89	93
15	**C3**	$PhCF_3$	rt	2	93	93
16	**C3**	o-xylene	rt	2	85	93
17	**C3**	PhBr	rt	2	84	93
18	**C3**	mesitylene	0	2	62	96
19	**C3**	mesitylene	35	2	94	93

[a]Reaction conditions: 1a (0.075 mmol), Cat. (0.005 mmol), 2a (0.05 mmol), solvent (0.5 mL). [b]Yield of isolated product. [c]Determined by HPLC analysis on a chiral stationary phase.

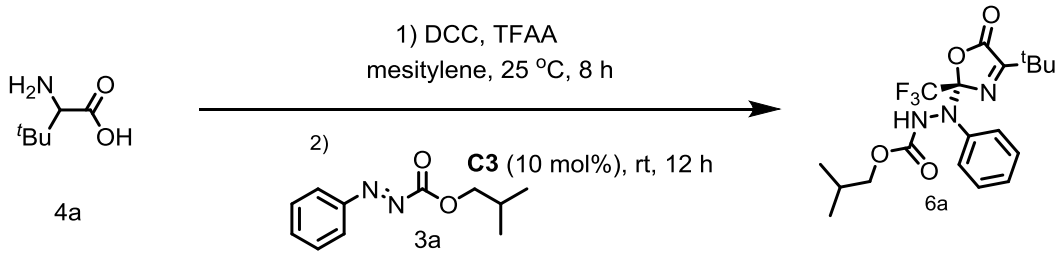
Table S2. The Optimization of the conditions A



Entry[a]	Cat.	Solvent	Time (h)[c]	Yield (%)[d]	Ee (%)[e]
1	Fe(Pc)	CH_2Cl_2	2	83	87
2	Fe(Pc)	THF	2	trance	-
3	Fe(Pc)	MeCN	2	trance	-
4	Fe(Pc)	toluence	2	29	93
5	Fe(Pc)	Et_2O	2	27	89
6	Fe(Pc)	mesitylene	2	34	95
7	Fe(Pc)	mesitylene	4	67	95
8	Fe(Pc)	mesitylene	6	78	95
9	Fe(Pc)	mesitylene	8	89	95
10	Fe(Pc)[b]	mesitylene	8	73	95

[a]Reaction conditions A: step 1) 1a (0.15 mmol), Iron(II) phthalocyanine (0.015 mmol), air, mesitylene (1.0 mL), 25 °C, step 2) 2a (0.10 mmol), C3 (0.01 mmol), 3 h at 25 °C. [b]Iron(II) phthalocyanine (0.0075 mmol). [c]Time of step one. [d]Yield of isolated product. [e]Determined by HPLC analysis on a chiral stationary phase. N.A. = not available.

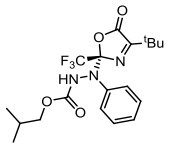
Table S3. The Optimization of the conditions B[a]



Entry[a]	**4a** (eq)	**5a** (eq)	DCC (eq)	Time (h)[b]	Yield (%)[c]	Ee (%)[d]
1	1.5	1.8	2	1	59	93
2	1.5	1.8	4	1	67	93
3	1.5	1.8	6	1	72	93
4	1.5	1.8	8	1	73	93
5	2	2.4	8	1	82	93
6	2	2.4	8	5	87	93
7	2	2.4	8	8	91	93

[a]Reaction conditions B: step 1) **4a**, **5a**, DCC, mesitylene (1.0 mL), 8 h at 25 °C, step 2) **C3** (0.01 mmol), **3** (0.10 mmol), 12 h at 25 °C. [b]Time of step one. [c]Isolated yield. [d]Determined by HPLC analysis on a chiral stationary phase.

7. Characterization of Adducts



6a

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (36.9 mg, 89% yield), 95% ee; Condition B: (37.7 mg, 91% yield), 93% ee; m.p.: 46.2−47.0 ^{o}C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 6.903 min (minor), 8.313 min (major); 6.990 min (minor), 8.417 min (major);

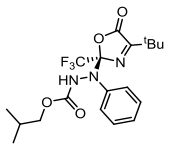
$[\alpha]_D^{18}$ = −79.2 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36–7.24 (m, 5H), 7.10 (s, 1H), 4.20–3.66 (m, 2H), 2.15–1.82 (m, 1H), 1.10 (s, 9H), 0.93 (d, *J* = 6.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.2, 161.2, 155.4, 142.5, 129.2, 128.4, 127.0, 120.2 (q, *J* =284.5 Hz), 108.0 (d, *J* =28.0 Hz), 72.3, 35.1, 28.0, 26.2, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.73.

HRMS (ESI) calcd. for $C_{19}H_{24}F_3N_3O_4Na$ ($[M+Na]^+$): 438.1611, found: 438.1607.



***ent*-6a**

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (27.8 mg 67% yield), 95% ee; 45.6−46.7 ^{o}C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 6.890 min (major), 8.433 min (minor);

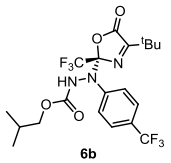
$[\alpha]_D^{20}$ = 75.4 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36–7.24 (m, 5H), 7.10 (s, 1H), 4.20–3.66 (m, 2H), 2.15–1.82 (m, 1H), 1.10 (s, 9H), 0.93 (d, *J* = 6.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.2, 161.2, 155.4, 142.5, 129.2, 128.4, 127.0, 120.2 (q, *J* =284.5 Hz), 108.0 (d, *J* =28.0 Hz), 72.3, 35.1, 28.0, 26.2, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.73.

HRMS (ESI) calcd. for $C_{19}H_{24}F_3N_3O_4Na$ ($[M+Na]^+$): 438.1611, found: 438.1607.



6b

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (38.6 mg 80% yield), 92% ee; Condition B: (39.6 mg 82% yield), 91% ee; m.p.: 52.2−53.4 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 254 nm, retention time: 5.160 min (minor), 6.043 min (major); 4.970 min (minor), 5.883 min (major);

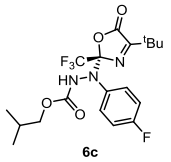
$[\alpha]_D^{21}$ = −19.5 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.5 Hz, 2H), 7.45 (d, *J* = 8.3 Hz, 2H), 7.08 (s, 1H), 4.23–3.60 (m, 2H), 2.15–1.75 (m, 1H), 1.17 (s, 9H), 0.90 (dd, *J* = 6.7, 2.3 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.5, 160.8, 155.1, 145.8, 130.0 (d, *J* =32.2 Hz), 126.2 (d, *J* = 3.8 Hz), 125.8, 123.8 (q, *J* = 270.3 Hz), 120.3 (q, *J* = 284.4 Hz), 107.2 (q, *J* = 32.0 Hz), 72.6, 35.4, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, CDCl3) δ -62.60, -77.01.

HRMS (ESI) calcd. for $C_{20}H_{23}F_6N_3O_4Na$ ($[M+Na]^+$): 506.1485, found: 506.1493.



6c

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (38.5 mg 89% yield), 95% ee; Condition B: (36.3 mg 84% yield), 92% ee; m.p.: 42.1−43.4 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 5.787 min (minor), 7.157 min (major); 5.950 min (minor), 7.450 min (major);

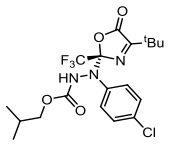
$[\alpha]_D^{21}$ = −60.0 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.31 (s, 2H), 7.14 (brs, 1H), 7.00 (t, *J* = 8.4 Hz, 2H), 4.24–3.60 (m, 2H), 1.92 (s, 1H), 1.14 (s, 9H), 0.91 (d, *J* = 6.8 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.5, 163.0, 161.2 (d, *J* =23.6 Hz), 155.4, 138.6 , 129.2, 120.2 (q, *J* =285.3 Hz), 116.0 (d, *J* =22.3 Hz), 108.0 (d, *J* =34.4 Hz), 72.4, 35.2, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.76, -112.37.

HRMS (ESI) calcd. for $C_{19}H_{23}F_4N_3O_4Na$ ($[M+Na]^+$): 456.1517, found: 456.1498.



6d

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (37.7 mg 84% yield), 95% ee; Condition B: (39.0 mg 87% yield), 92% ee; m.p.: 40.1−41.7 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 5.867 min (minor), 7.240 min (major); 5.933 min (minor), 7.310 min (major);

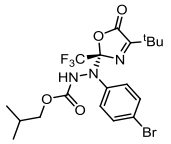
$[\alpha]_D^{22}$ = −12.6 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.33–7.26 (m, 3H), 7.25 (brs, 1H), 6.94 (s, 1H), 4.07–3.71 (m, 2H), 1.91 (s, 1H), 1.15 (s, 9H), 0.91 (dd, *J* = 6.9, 2.9 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.5, 161.0, 155.2, 141.1, 134.1, 129.3, 128.3, 120.2 (q, *J* =285.0 Hz), 107.7 (d, *J* =28.1 Hz),72.4, 35.3, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.80.

HRMS (ESI) calcd. for $C_{19}H_{23}ClF_3N_3O_4Na$ ($[M+Na]^+$): 472.1221, found: 472.1204.



6e

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (42.9 mg 87% yield), 94% ee; Condition B: (40.9 mg 83% yield), 91% ee; m.p.: 56.1−57.2 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 6.170 min (minor), 7.717 min (major); 6.403 min (minor), 8.043 min (major);

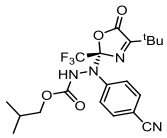
$[\alpha]_D^{22}$ = −6.3 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48–7.42 (m, 2H), 7.19 (d, *J* = 8.2 Hz, 2H), 6.89 (s, 1H), 4.20–3.47 (m, 2H), 2.08–1.81 (m, 1H), 1.16 (s, 9H), 0.91 (dd, *J* = 6.7, 1.8 Hz, 6H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.5, 161.0, 155.4, 141.7, 132.3, 128.5, 121.9, 120.2 (q, *J* =284.0 Hz), 107.6 (d, *J* =33.0 Hz), 72.5, 35.3, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.79.

HRMS (ESI) calcd. for $C_{19}H_{23}BrF_3N_3O_4Na$ ($[M+Na]^+$): 516.0716, found: 516.0702.



6f

Eluent: PE/EA (10/1-5/1); Pale yellow oil; Condition A: (38.7 mg 88% yield), 92% ee; Condition B: (36.1 mg 82% yield), 89% ee;

HPLC CHIRALPAK IF, n−Hexane/2−propanol = 90/10, flow rate = 1 mL/min, λ = 220 nm, retention time: 6.320 min (major), 6.790 min (minor); 6.297 min (major), 6.803 min (minor);

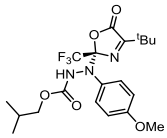
$[\alpha]_D^{19} = -63.1$ (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.6 Hz, 2H), 7.46 (d, *J* = 8.2 Hz, 2H), 7.37–7.07 (m, 1H), 3.88 (dd, *J* = 18.7, 5.6 Hz, 2H), 1.98–1.79 (m, 1H), 1.23 (s, 9H), 0.89 (s, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.5, 160.5, 155.5, 146.9, 133.0, 124.0, 120.4 (d, *J* =289.2 Hz), 118.4, 109.8, 106.6 (d, *J* =31.2 Hz), 72.7, 35.5, 28.0, 26.4, 19.0, 18.9.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -77.39.

HRMS (ESI) calcd. for $C_{20}H_{23}F_3N_4O_4Na$ ($[M+Na]^+$): 463.1564, found: 463.1547.



6g

Eluent: PE/EA (10/1-5/1); Pale yellow oil; Condition A: (23.6 mg 53% yield), 90% ee; Condition B: (27.6 mg 62% yield), 89% ee;

HPLC HPLC CHIRALPAK NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 10.710 min (minor), 13.727 min (major); 11.143 min (minor), 14.240 min (major);

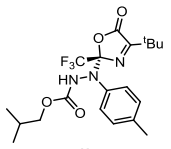
$[\alpha]_D^{22} = -21.2$ (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* =8.3 Hz, 2H), 6.89 (s, 1H), 6.86–6.75 (m, 2H), 4.01–3.81 (m, 2H), 3.77 (s, 3H), 2.04–1.82 (m, 1H), 1.13 (s, 9H), 0.92 (d, *J* = 6.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.2, 161.4, 159.5, 155.3, 135.4, 128.7, 120.2 (q, *J* =284.4 Hz), 108.4 (d, *J* =24.2 Hz), 72.2, 55.6, 35.1, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.55.

HRMS (ESI) calcd. for $C_{20}H_{26}F_3N_3O_5Na$ ($[M+Na]^+$): 468.1717, found: 468.1694.



6h

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (32.6 mg 76% yield), 94% ee; Condition B: (35.6 mg 83% yield), 91% ee; m.p.: 43.4−44.7 ^{o}C;

HPLC CHIRALPAK IG, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 7.900 min (minor), 9.183 min (major); 7.883 min (minor), 9.210 min (major);

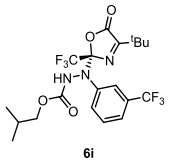
$[\alpha]_D^{21}$ = −14.4 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$）δ 7.16 (s, 2H), 7.11 (d, *J* = 7.8 Hz, 2H), 6.84 (s, 1H), 4.25–3.56 (m, 2H), 2.30 (s, 3H), 1.92 (s, 1H), 1.10 (s, 9H), 0.92 (d, *J* = 6.5 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.2, 161.3, 155.2, 140.0, 138.5, 129.7, 127.0, 120.2 (q, *J* =284.4 Hz), 108.2 (d, *J* =35.1 Hz), 72.3, 35.1, 28.0, 26.3, 21.1, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.61.

HRMS (ESI) calcd. for $C_{20}H_{26}F_3N_3O_4Na$ ($[M+Na]^+$): 452.1768, found: 452.1747.



6i

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (39.6 mg 82% yield), 95% ee; Condition B: (42.0 mg 87% yield), 93% ee;

HPLC CHIRALPAK IH, n−Hexane/2−propanol = 95/5, flow rate = 1 mL/min, λ = 220 nm, retention time: 4.513 min (minor), 5.610 min (major); 4.320 min (minor), 5.438 min (major);

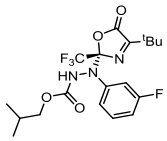
$[\alpha]_D^{23}$ = −62.8 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (s, 1H), 7.52 (d, *J* = 7.8 Hz, 2 H), 7.48–7.42 (m, 1H), 7.05 (s, 1H), 4.10–3.70 (m, 2H), 2.05–1.82 (m, 1H), 1.14 (s, 9H), 0.91 (dd, *J* = 6.7, 2.4 Hz, 6H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.7, 160.8, 155.8, 143.2, 131.7 (q, *J* = 33.0 Hz), 129.8, 129.5, 124.6 (d, *J* = 3.9 Hz), 123.8, 123.6 (d, *J* = 270.8 Hz), 120.2 (d, *J* = 285.0 Hz), 107.4 (d, *J* = 32.3 Hz), 72.6, 35.3, 28.0, 26.2, 19.0, 18.9.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -62.84, -76.92.

HRMS (ESI) calcd. for $C_{20}H_{23}F_6N_3O_4Na$ ($[M+Na]^+$): 506.1485, found: 506.1465.



6j

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (36.3 mg 84% yield), 95% ee; Condition B: (37.2 mg 86% yield), 91% ee; m.p.: 38.6−41.1 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 5.327 min (minor), 6.037 min (major); 5.407 min (minor), 6.163 min (major);

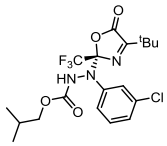
$[\alpha]_D^{19}$ = −37.5 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34–7.24 (m, 1H), 7.23–7.02 (m, 3H), 6.98 (td, *J* = 8.3, 2.5 Hz, 1H), 4.01–3.80 (m, 2H), 2.05–1.86 (m, 1H), 1.16 (s, 9H), 0.92 (dd, *J* = 6.7, 2.0 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.4, 163.5, 161.9, 161.0, 155.3, 144.1 (d, *J* = 9.2 Hz), 130.2 (d, *J* = 8.8 Hz), 122.0, 120.2 (q, *J* = 285.2 Hz), 115.1 (d, *J* = 20.8 Hz), 114.2 (d, *J* = 22.9 Hz), 107.5 (d, *J* = 32.3 Hz), 72.5, 35.3, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.99, -111.00.

HRMS (ESI) calcd. for $C_{19}H_{23}F_4N_3O_4Na$ ($[M+Na]^+$): 456.1517, found: 456.1506.



6k

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (38.1 mg 85% yield), 95% ee; Condition B: (36.8 mg 82% yield), 91% ee; m.p.: 65.1−66.2 °C;

HPLC CHIRALPAK IA, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 4.990 min (minor), 5.567 min (major); 4.833 min (minor), 5.397 min (major);

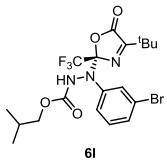
$[\alpha]_D^{20}$ = −79.4 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (s, 1H), 7.28–7.10 (m, 4H), 4.30–3.60 (m, 2H), 2.20–1.83 (m, 1H), 1.14 (s, 9H), 0.92 (d, *J* = 6.8 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.5, 161.0, 155.7, 143.7, 134.6, 130.1, 128.2, 127.2, 124.5, 120.2 (q, *J* =284.6 Hz), 108.0 (d, *J* =33.6 Hz), 72.5, 35.3, 28.0, 26.3, 19.0, 18.9.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.87.

HRMS (ESI) calcd. for $C_{19}H_{23}ClF_3N_3O_4Na$ ($[M+Na]^+$): 472.1221, found: 472.1208.



6l

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (40.9 mg 83% yield), 94% ee; Condition B: (41.9 mg 85% yield), 93% ee; m.p.: 49.3−52.5 °C;

HPLC CHIRALPAK IA, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 5.047 min (minor), 5.670 min (major); 4.967 min (minor), 5.583 min (major);

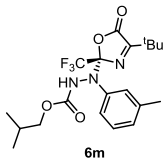
$[\alpha]_D^{22}$ = −47.8 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (s, 1H), 7.43–7.36 (m, 1H), 7.31–7.01 (m, 3H), 4.05–3.67 (m, 2H), 2.08–1.80 (m, 1H), 1.15 (s, 9H), 0.92 (d, *J* = 6.1 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.5, 161.0, 155.2, 143.8, 131.2, 130.4, 130.1, 125.0, 122.4, 120.2 (q, *J* =284.6 Hz), 107.5 (d, *J* =32.2 Hz), 72.5, 35.3, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.85.

HRMS (ESI) calcd. for $C_{19}H_{23}BrF_3N_3O_4Na$ ($[M+Na]^+$): 516.0716, found: 516.0711.



6m

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (31.3 mg 73% yield), 94% ee; Condition B: (34.3 mg 80% yield), 90% ee; m.p.: 45.7−46.7 °C;

HPLC CHIRALPAK IG, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 7.727 min (major), 8.920 min (minor); 7.160 min (major), 8.193 min (minor);

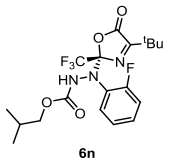
$[\alpha]_D^{22}$ = −15.0 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.18 (t, *J* = 7.7 Hz, 1H), 7.15–6.99 (m, 3H), 6.94 (s, 1H), 4.19–3.57 (m, 2H), 2.30 (s, 3H), 1.93 (s, 1H), 1.08 (s, 9H), 0.92 (d, *J* = 6.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.1, 161.3, 155.0, 142.4, 139.2, 129.1, 129.0, 127.8, 123.6, 120.2 (q, *J* = 284.4 Hz), 108.1 (d, *J* = 27.7 Hz), 72.3, 35.1, 28.0, 26.2, 21.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.69.

HRMS (ESI) calcd. for $C_{20}H_{26}F_3N_3O_4Na$ ([M+Na]+): 452.1768, found: 452.1762.



6n

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (34.2 mg 79% yield), 99% ee; Condition B: (37.2 mg 86% yield), 92% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 6.170 min (minor), 7.523 min (major); 6.447 min (minor), 7.957 min (major);

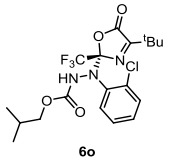
$[\alpha]_D^{20}$ = −44.0 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (s, 1H), 7.35–7.27 (m, 1H), 7.13 (td, *J* = 7.7, 1.4 Hz, 1H), 7.10–7.00 (m, 1H), 6.97 (brs, 1H), 4.02–3.73 (m, 2H), 1.93 (s, 1H), 1.14 (s, 9H), 0.93 (d, *J* = 6.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.2, 161.2, 159.0 (d, *J* =248.2 Hz), 155.3, 132.1, 130.6 (d, *J* =8.5 Hz), 129.9, 124.8, 120.3 (q, *J* =284.8 Hz), 116.3 (d, *J* =20.7 Hz), 107.1 (d, *J* =32.2 Hz), 72.3, 35.2, 28.0, 26.3, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -78.21, -120.04.

HRMS (ESI) calcd. for $C_{19}H_{23}F_4N_3O_4Na$ ($[M+Na]^+$): 456.1517, found: 456.1506.



6o

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (33.6 mg 75% yield), 98% ee; Condition B: (37.7 mg 84% yield), 95% ee;

HPLC CHIRALPAK NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 5.987 min (minor), 7.087 min (major); 6.073 min (minor), 7.187 min (major);

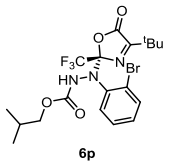
$[\alpha]_D^{17}$ = −81.6 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.72 (s, 1H), 7.41–7.31 (m, 1H), 7.30–7.26 (m, 1H), 7.12 (brs, 2H), 4.21–3.53 (m, 2H), 1.91 (s, 1H), 1.15 (s, 9H), 0.91 (s, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.0, 161.5, 155.6, 139.7, 133.0, 130.0, 127.6, 120.3 (q, *J* =285.2 Hz), 107.2 (d, *J* =33.9 Hz), 72.3, 35.2, 28.0, 26.4, 19.1, 19.0.

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -79.13.

HRMS (ESI) calcd. for $C_{19}H_{23}ClF_3N_3O_4Na$ ($[M+Na]^+$): 472.1221, found: 472.1206.



6p

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (41.4 mg 84% yield), 98% ee; Condition B: (42.4 mg 86% yield), 96% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 5.993 min (minor), 7.003 min (major); 6.170 min (minor), 7.263 min (major);

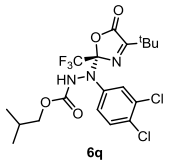
$[\alpha]_D^{21}$ = −55.6 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, CDCl3) δ 7.69 (s, 1H), 7.55 (d, *J* = 8.0 Hz, 1H), 7.37–7.28 (m, 1H), 7.25–7.06 (m, 2H), 4.05–3.71 (m, 2H), 1.92 (s, 1H), 1.17 (s, 9H), 0.91 (d, *J* = 6.8 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.1, 161.5, 155.6, 141.1, 133.3, 130.2, 128.2, 120.3 (q, *J* =285.3 Hz), 107.2 (d, *J* =31.2 Hz), 72.3, 35.2, 28.0, 26.4, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -78.89.

HRMS (ESI) calcd. for $C_{19}H_{23}BrF_3N_3O_4Na$ ($[M+Na]^+$): 516.0716, found: 516.0692.



6q

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (40.1 mg 83% yield), 95% ee; Condition B: (41.5 mg 86% yield), 94% ee;

HPLC CHIRALPAK IH, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 4.310 min (minor), 6.513 min (major); 4.337 min (minor), 6.533 min (major);

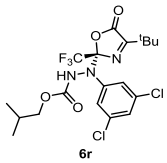
$[\alpha]_D^{21}$ = −30.3 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.46 (s, 1H), 7.39 (d, *J* = 8.7 Hz, 1H), 7.21 (s, 1H), 7.04 (s, 1H), 4.04–3.80 (m, 2H), 2.03–1.82 (m, 1H), 1.20 (s, 9H), 0.91 (dd, *J* = 6.8, 2.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.7, 160.8, 155.3, 142.0, 133.0, 132.1, 130.7, 128.6, 125.6, 120.2 (q, *J* = 285.2 Hz), 107.3 (d, *J* = 32.9 Hz), 72.6, 35.4, 28.0, 26.4, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.97.

HRMS (ESI) calcd. for $C_{19}H_{22}Cl_2F_3N_3O_4Na$ ($[M+Na]^+$): 506.0832, found: 506.0827.



6r

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (41.0 mg 85% yield), 94% ee; Condition B: (42.5 mg 88% yield), 94% ee;

HPLC CHIRALPAK IH, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 3.710 min (minor), 4.447 min (major); 3.733 min (minor), 4.513 min (major);

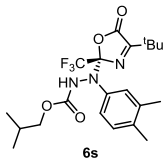
$[\alpha]_D^{23}$ = −17.7 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (s, 1H), 7.26 (s, 2H), 7.07 (s, 1H), 4.00–3.85 (m, 2H), 2.05–1.85 (m, 1H), 1.24 (s, 9H), 0.94 (dd, *J* = 6.8, 1.9 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.7, 160.7, 155.0, 144.5, 135.3, 127.7, 124.4, 120.2 (d, *J* = 283.9 Hz), 107.0 (d, *J* = 33.0 Hz), 72.7, 35.5, 28.0, 26.4, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -77.08.

HRMS (ESI) calcd. for $C_{19}H_{22}Cl_2F_3N_3O_4Na$ ($[M+Na]^+$): 506.0832, found: 506.0827.



6s

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (34.5 mg 78% yield), 96% ee; Condition B: (35.0 mg 79% yield), 94% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 6.247 min (minor), 7.213 min(major); 6.143 min (minor), 7.127 min(major);

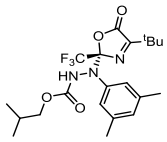
$[\alpha]_D^{21}$ = −23.1 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.05 (d, *J* = 8.0 Hz, 2H), 6.98 (s, 1H), 6.83 (s, 1H), 4.06–3.69 (m, 2H), 2.20 (s, 6H), 1.92 (s, 1H), 1.09 (s, 9H), 0.92 (d, *J* = 6.7 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.1, 161.4, 155.5, 140.1, 137.6, 137.1, 130.2, 128.3, 124.0, 120.2 (q, *J* = 284.4 Hz), 108.3 (d, *J* = 31.0 Hz), 72.2, 35.1, 28.0, 26.2, 19.8, 19.5, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.58.

HRMS (ESI) calcd. for $C_{21}H_{28}F_3N_3O_4Na$ ($[M+Na]^+$): 466.1924, found: 466.1915.



6t

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (33.7 mg 76% yield), 95% ee; Condition B: (35.9 mg 81% yield), 91% ee;

HPLC CHIRALPAK IH, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 4.063 min (minor), 5.247 min (major); 4.013 min (minor), 5.173 min (major);

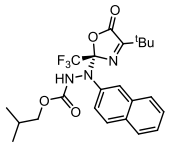
$[\alpha]_D^{23} = -11.8$ (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.02–6.60 (m, 4H), 4.05–3.74 (m, 2H), 2.26 (s, 6H), 2.02–1.85 (m, 1H), 1.09 (s, 9H), 0.92 (d, *J* = 5.8 Hz, 6H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.0, 161.4, 155.5, 142.3, 139.0, 129.9, 124.5, 120.3 (d, *J* = 284.5 Hz), 108.2 (d, *J* = 32.4 Hz), 72.2, 35.1, 28.0, 26.2, 21.2, 19.0 (two peaks).

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.71.

HRMS (ESI) calcd. for $C_{21}H_{28}F_3N_3O_4Na$ ($[M+Na]^+$): 466.1924, found: 466.1903.



6u

Eluent: PE/EA (10/1-5/1); Pale yellow oil; Condition A: (37.4 mg 82% yield), 96% ee; Condition B: (39.2 mg 86% yield), 93% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 7.807 min (minor), 9.443 min (major); 7.670 min (minor), 9.283 min (major);

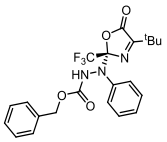
$[\alpha]_D^{18} = -14.0$ (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.00–7.63 (m, 4H), 7.55–7.47 (m, 2H), 7.38 (s, 1H), 6.96 (s, 1H), 4.17–3.62 (m, 2H), 1.93 (s, 1H), 1.02 (s, 9H), 0.92 (d, *J* = 6.4 Hz, 6H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.3, 161.2, 155.4, 139.8, 133.2, 132.7, 129.1, 128.2, 127.7, 126.9, 125.7, 124.6, 120.3 (q, *J* = 284.9 Hz), 108.1 (d, *J* = 34.4 Hz), 72.3, 35.1, 28.0, 26.2, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.73.

HRMS (ESI) calcd. for $C_{23}H_{26}F_3N_3O_4Na$ ($[M+Na]^+$): 488.1768, found: 488.1756.



6v

Eluent: PE/EA (5/1-3/1); Colorless oil; Condition A: (37.7 mg 84% yield), 95% ee; Condition B: (39.9 mg 89% yield), 91% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 210 nm, retention time: 10.557 min (minor), 12.090 min (major); 11.320 min (minor), 12.647 min (major);

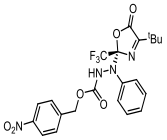
$[\alpha]_D^{24} = -75.1$ (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.23 (m, 10H), 7.13 (s, 1H), 5.15 (s, 2H), 1.09 (s, 9H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.3, 161.2, 155.0, 142.4, 135.8, 129.2, 128.6, 128.4, 128.2, 127.0, 120.3 (q, *J* =284.6 Hz), 108.0 (d, *J* =32.3 Hz), 67.9, 35.1, 26.2.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.64.

HRMS (ESI) calcd. for $C_{22}H_{22}F_3N_3O_4Na$ ($[M+Na]^+$): 472.1455, found: 472.1440.



6w

Eluent: PE/EA (5/1-2/1); Colorless oil; Condition A: (45.4 mg 92% yield), 97% ee; Condition B: (43.9 mg 89% yield), 93% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 80/20, flow rate = 1 mL/min, λ = 254 nm, retention time: 8.457 min (minor), 10.987 min (major); 8.148 min (minor), 10.515 min (major);

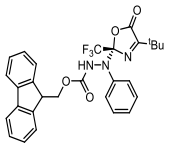
$[\alpha]_D^{18} = -66.8$ (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29–8.10 (m, 2H), 7.48 (d, *J* = 8.4 Hz, 2H), 7.36–7.23 (m, 6H), 7.15 (s, 1H), 5.60–4.81 (m, 2H), 1.07 (s, 9H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.5, 161.0, 154.7, 147.9, 143.1, 142.3, 129.3, 128.6, 128.3, 126.9, 123.9, 120.2 (q, *J* = 284.6 Hz), 107.7 (d, *J* = 30.7 Hz), 66.3, 35.2, 26.2.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.74.

HRMS (ESI) calcd. for $C_{22}H_{21}F_3N_4O_6Na$ ($[M+Na]^+$): 517.1305, found: 517.1300.



6x

Eluent: PE/EA (5/1-2/1); Colorless oil; Condition A: (46.7 mg 87% yield), 94% ee; Condition B: (45.6 mg 85% yield), 93% ee;

HPLC CHIRALPAK IH, n−Hexane/2−propanol = 80/20, flow rate = 1 mL/min, λ = 254 nm, retention time: 4.887 min (minor), 7.373 min (major); 4.787 min (minor), 7.220 min (major);

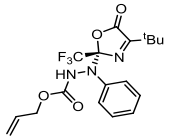
$[\alpha]_D^{20}$ = −53.8 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.6 Hz, 2H), 7.57 (d, *J* = 6.9 Hz, 2H), 7.39 (td, *J* = 7.5, 3.2 Hz, 2H), 7.36–7.27 (m, 6H), 6.96 (s, 1H), 4.60–4.29 (m, 2H), 4.22 (t, *J* = 7.0 Hz, 1H), 1.10 (s, 9H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.3, 161.1, 155.2, 143.7, 142.4, 141.5, 129.2, 128.4, 127.9, 127.2, 126.9, 125.2, 120.3 (q, *J* = 284.5 Hz), 120.1, 108.0 (d, *J* = 30.0 Hz), 68.0, 47.2, 35.2, 26.3.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.63.

HRMS (ESI) calcd. for $C_{29}H_{26}F_3N_3O_4Na$ ([M+Na]+): 560.1768, found: 560.1768.



6y

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (35.5 mg 89% yield), 95% ee; Condition B: (35.9 mg 90% yield), 95% ee; m.p.: 47.5−50.1 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 7.543 min (minor), 8.347 min (major); 7.577 min (minor), 8.270 min (major);

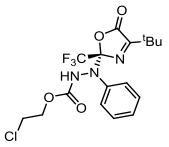
$[\alpha]_D^{21}$ = −21.8 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42–7.19 (m, 5H), 7.03 (s, 1H), 6.07–5.72 (m, 1H), 5.30 (d, *J* = 17.2 Hz, 1H), 5.22 (dd, *J* = 10.4, 1.5 Hz, 1H), 4.90–4.37 (m, 2H), 1.09 (s, 9H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.3, 161.2, 154.5, 142.4, 132.1, 129.2, 128.5, 127.0, 120.2 (q, *J* =285.1 Hz), 118.5, 108.0 (d, *J* =31.9Hz), 66.7, 35.2, 26.2.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.67.

HRMS (ESI) calcd. for $C_{18}H_{20}F_3N_3O_4Na$ ([M+Na]+): 422.1298, found: 422.1288.



6z

Eluent: PE/EA (10/1-5/1); Colorless oil; Condition A: (34.9 mg 83% yield), 94% ee; Condition B: (34.1 mg 81% yield), 90% ee;

HPLC NuAnalytical-FLM NZ_2 , n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 8.247 min (minor), 9.480 min (major); 8.047 min (minor), 9.340 min (major);

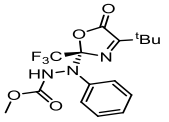
$[\alpha]_D^{22}$ = −62.4 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29–7.19 (m, 5H), 7.09 (s, 1H), 4.30 (s, 2H), 3.60 (t, *J* = 5.7 Hz, 2H), 1.03 (s, 9H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 176.4, 161.1, 154.5, 142.3, 129.3, 128.6, 127.1, 120.2 (q, *J* =284.6 Hz), 107.9 (q, *J* =32.2 Hz), 65.6, 41.7, 35.2, 26.2.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.67.

HRMS (ESI) calcd. for $C_{17}H_{19}F_3N_3O_4Na$ ([M+Na]+): 444.0908, found: 444.0888.



6za

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (32.4 mg 87% yield), 94% ee; Condition B: (28.3 mg 76% yield), 92% ee; m.p.: 50.1−52.2 °C;

HPLC CHIRALPAK IG , n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 9.320 min (major), 10.677 min (minor); 8.873 min (major), 10.157 min (minor);

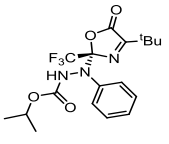
$[\alpha]_D^{19}$ = −65.8 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35–7.22 (m, 5H), 7.08 (s, 1H), 3.73 (s, 3H), 1.09 (s, 9H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.3, 161.2, 155.6, 142.4, 129.2, 128.4, 127.0, 120.2 (q, *J* =285.1 Hz), 108.0 (d, *J* =33.9 Hz), 53.2 , 35.1, 26.2.

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.72.

HRMS (ESI) calcd. for $C_{16}H_{18}F_3N_3O_4Na$ ($[M+Na]^+$): 396.1142, found: 396.1132.



6zb

Eluent: PE/EA (10/1-5/1); White solid; Conditions A: (30.4 mg 76% yield), 96% ee; Conditions B: (31.3 mg 78% yield), 94% ee; m.p.: 38.6−41.1 °C;

HPLC NuAnalytical-FLM NZ_2 , n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 7.660 min (minor), 9.893 min(major); 7.543 min (minor), 9.790 min(major);

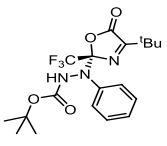
$[\alpha]_D^{22}$ = −9.6 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.34–7.23 (m, 5H), 6.84 (s, 1H), 5.04–4.80 (m, 1H), 1.23 (d, J = 6.3 Hz, 6H), 1.09 (s, 9H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.2, 161.3, 154.6, 142.6, 129.2, 128.3, 127.0, 120.2 (q, *J* =284.4 Hz), 108.1 (d, *J* =31.4 Hz), 70.0, 35.1, 26.2, 22.1, 22.0.

^{19}F{^{1}H} NMR (564 MHz, $CDCl_3$) δ -76.68.

HRMS (ESI) calcd. for $C_{18}H_{22}F_3N_3O_4Na$ ($[M+Na]^+$): 424.1455, found: 444.1442.



6zc

Eluent: PE/EA (10/1-5/1); White solid; Condition A: (14.5 mg 35% yield), 94% ee; Condition B: (19.5 mg 47% yield), 91% ee; m.p.: 46.1−48.1 °C;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 7.410 min (minor), 10.263 min (major); 7.547 min (minor), 10.543 min (major);

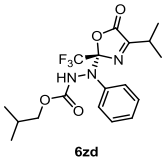
$[\alpha]_D^{22}$ = −21.3 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37–7.17 (m, 5H), 6.72 (s, 1H), 1.44 (s, 9H), 1.09 (s, 9H).

^{13}C{^{1}H} NMR (150 MHz, $CDCl_3$) δ 176.1, 161.3, 153.8, 142.7, 129.1, 128.2, 126.9, 120.3 (q, *J* = 284.9 Hz), 108.1 (d, *J* = 29.5Hz), 81.7, 35.1, 28.3, 26.3.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.69.

HRMS (ESI) calcd. for $C_{19}H_{24}F_3N_3O_4Na$ ($[M+Na]^+$): 438.1611, found: 438.1609.



6zd

Eluent: PE/EA (10/1-5/1); Pale yellow oil; (14.4 mg 36% yield), 90% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 8.727 min (minor), 10.347 min (major);

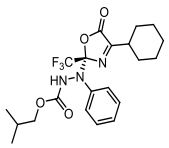
$[\alpha]_D^{18}$ = −64.5 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38–7.21 (m, 5H), 7.10 (s, 1H), 4.13–3.64 (m, 2H), 2.84 (s, 1H), 1.92 (s, 1H), 1.12 (d, *J* = 6.8 Hz, 3H), 0.91 (d, *J* = 6.8 Hz, 9H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 175.0, 162.3, 155.4, 142.5, 129.2, 128.4, 127.0, 120.2 (q, *J* = 284.6 Hz), 109.3 (d, *J* = 31.5 Hz), 72.3, 28.4, 28.0, 19.0 (two peaks), 18.5.

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.55.

HRMS (ESI) calcd. for $C_{18}H_{22}F_3N_3O_4Na$ ($[M+Na]^+$): 424.1455, found: 444.1447.



6ze

Eluent: PE/EA (10/1-5/1); Pale yellow oil; (18.0 mg 41% yield), 90% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 9.767 min (minor), 10.487 min (major);

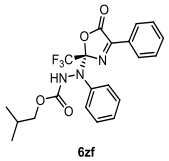
$[\alpha]_D^{19}$ = −60.4 (c 1.0, $CHCl_3$);

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47–6.97 (m, 6H), 4.13–3.56 (m, 2H), 2.78–3.60 (m, 1H), 2.00–1.05 (m, 11H), 0.91 (d, J = 6.8 Hz, 6H).

^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 173.9, 162.5, 155.8, 142.6, 129.2, 128.3, 127.0, 120.2 (q, *J* = 284.7 Hz), 109.4 (q, *J* = 32.7 Hz), 72.3, 37.3, 28.8, 28.7, 28.0, 25.5, 25.2, 25.1, 19.0 (two peaks).

^{19}F{^{1}H} NMR (376 MHz, $CDCl_3$) δ -76.56.

HRMS (ESI) calcd. for $C_{21}H_{26}F_3N_3O_4Na$ ($[M+Na]^+$): 464.1768, found: 464.1745.



6zf

Eluent: PE/EA (10/1-5/1); Pale yellow oil; (20.4 mg 47% yield), 20% ee;

HPLC NuAnalytical-FLM NZ_2, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 254 nm, retention time: 11.273 min (major), 12.020 min (minor);

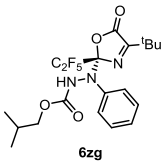
$[\alpha]_D^{21}$ = −37.5 (c 1.0, $CHCl_3$);

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.25 (s, 2H), 7.61 (t, *J* = 7.5 Hz, 1H), 7.47 (t, *J* = 7.8 Hz, 2H), 7.38 (s, 2H), 7.30 (t, *J* = 7.7 Hz, 2H), 7.21 (t, *J* = 7.4 Hz, 1H), 6.94 (s, 1H), 4.14–3.66 (m, 2H), 1.90 (s, 1H), 0.89 (d, *J* = 9.2 Hz, 6H).

$^{13}C\{^1H\}$ NMR (150 MHz, $CDCl_3$) δ 162.2, 162.0, 155.4, 142.7, 134.5, 129.6, 129.3, 129.1, 128.3, 127.0, 126.8, 120.4 (q, *J* = 285.5 Hz), 108.6 (d, *J* = 38.9 Hz), 72.3, 28.0, 19.0 (two peaks).

$^{19}F\{^1H\}$ NMR (376 MHz, $CDCl_3$) δ -76.21.

HRMS (ESI) calcd. for $C_{21}H_{20}F_3N_3O_4Na$ ($[M+Na]^+$): 458.1298, found: 458.1298.



6zg

Eluent: PE/EA (10/1-5/1); White solid; (40.4 mg 87% yield), 96% ee; m.p.: 44.9−46.8 ^oC;

HPLC CHIRALPAK IA, n−Hexane/2−propanol = 94/6, flow rate = 1 mL/min, λ = 220 nm, retention time: 4.817 min (minor), 7.733 min (major);

$[\alpha]_D^{23}$ = −26.8 (c 1.0, $CHCl_3$);

^1H NMR (600 MHz, $CDCl_3$) δ 7.35–7.23 (m, 5H), 6.97 (s, 1H), 4.26–3.63 (m, 2H), 1.92 (s, 1H), 1.08 (s, 9H), 0.92 (d, *J* = 6.6 Hz, 6H).

$^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 176.3, 161.2, 155.3, 142.5, 129.2, 128.7 (d, *J* = 87.4 Hz), 128.4, 127.0, 120.2 (q, *J* = 284.5 Hz), 108.0 (d, *J* = 31.4 Hz), 72.3, 35.2, 28.1, 26.3, 19.0 (two peaks).

$^{19}F\{^1H\}$ NMR (564 MHz, $CDCl_3$) δ -76.71, -79.33.

HRMS (ESI) calcd. for $C_{20}H_{24}F_5N_3O_4Na$ ($[M+Na]^+$): 488.1579, found: 488.1591.

8. References

1. L. Li, T. Yang, T. Zhang, B. Zhu and J. Chang, Organocatalytic asymmetric tandem cyclization/michael addition via oxazol-5(2*H*)-one formation: access to perfluoroalkyl-containing *N*,*O*-acetal derivatives. *J. Org. Chem*., 2020, **85**, 12294.
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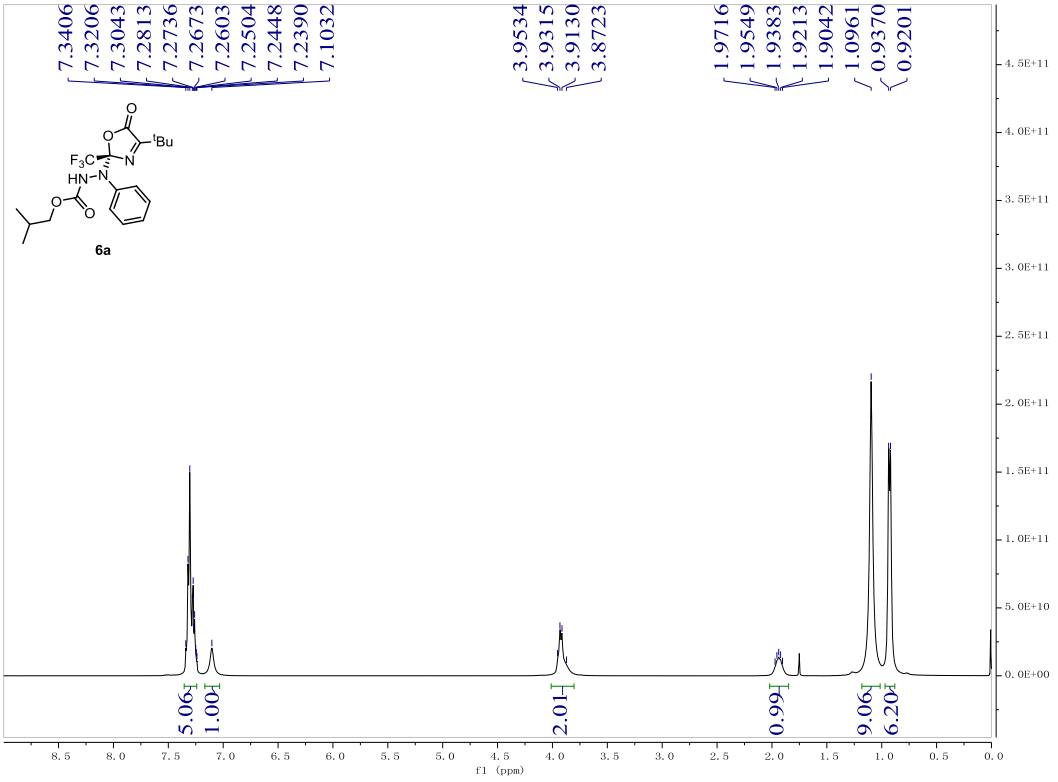
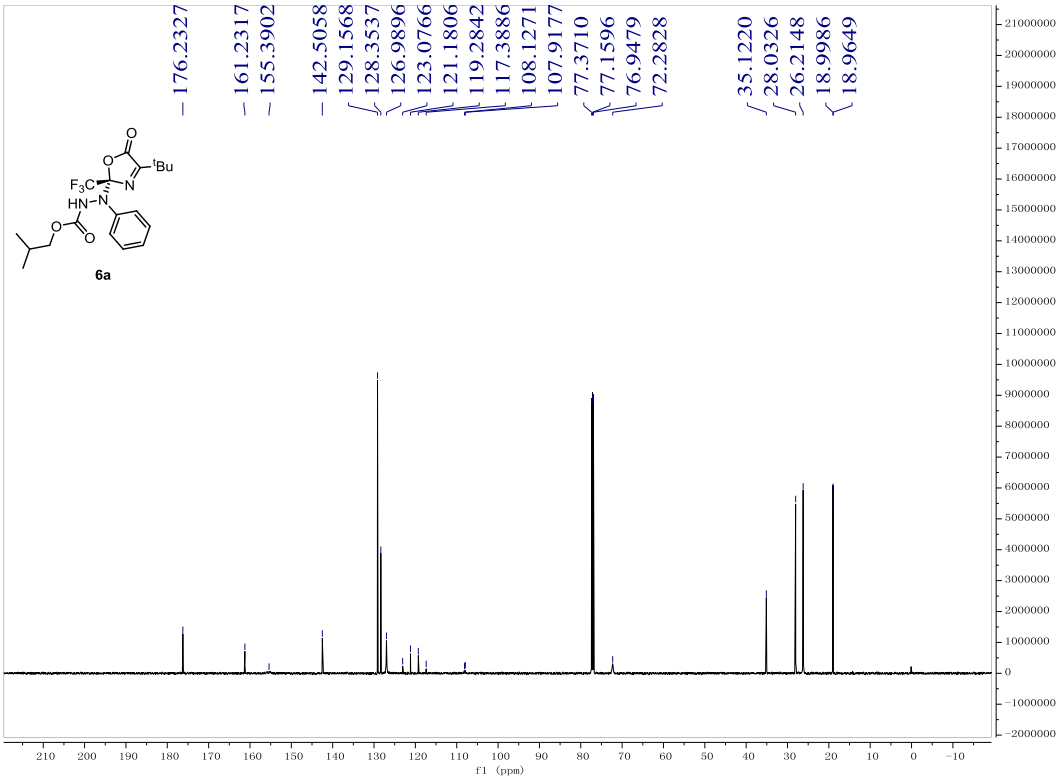
3. T. Hashimoto, D. Hirose and T. Taniguchi, Catalytic aerobic oxidation of arylhydrazides with Iron phthalocyanine. *Adv. Synth. Catal*., 2015, **357**, 14.
4. W. Li, H. Yuan, Y. Li and X. Li, Asymmetric synthesis of atropisomeric pyrazole via an enantioselective reaction of azonaphthalene with pyrazolone. *Chem. Commun*., 2019, **55**, 84.
5. L. W. Qi, J. H. Mao, Z. Jian and B. Tan, Organocatalytic asymmetric arylation of indoles enabled by azo groups. *Nat. Chem*., 2018, **10**, 58.

9. Copies of NMR Spectra of the Adducts

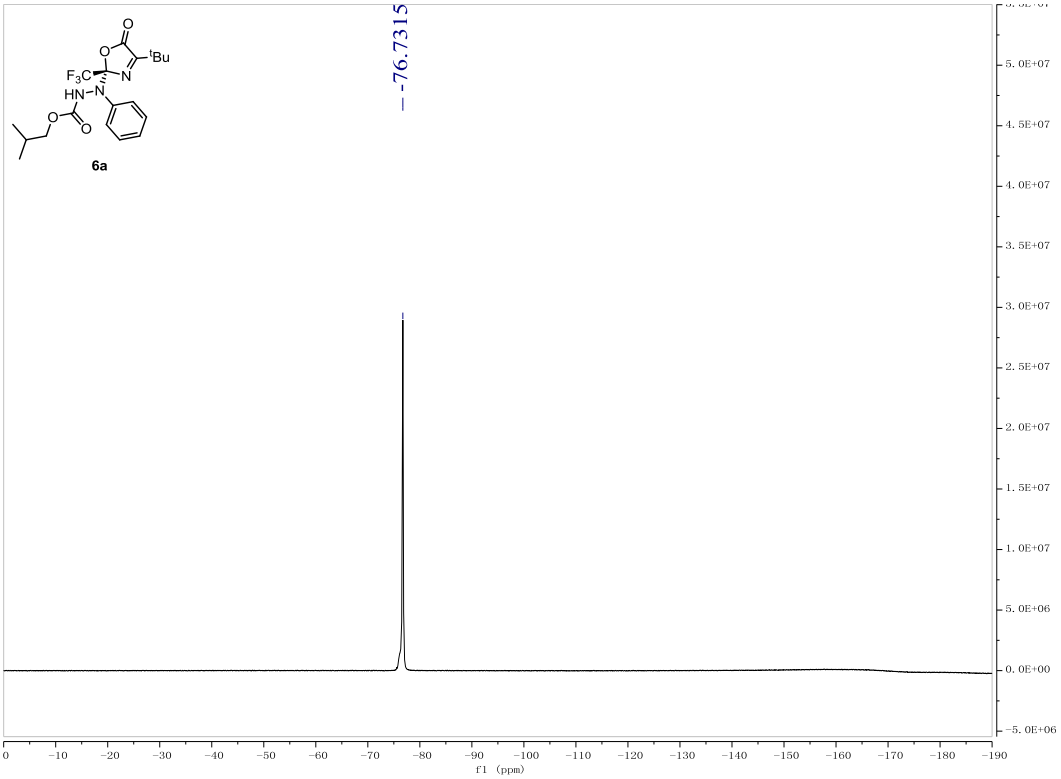
^{1}H NMR of 6a (400 MHz, $CDCl_3$)



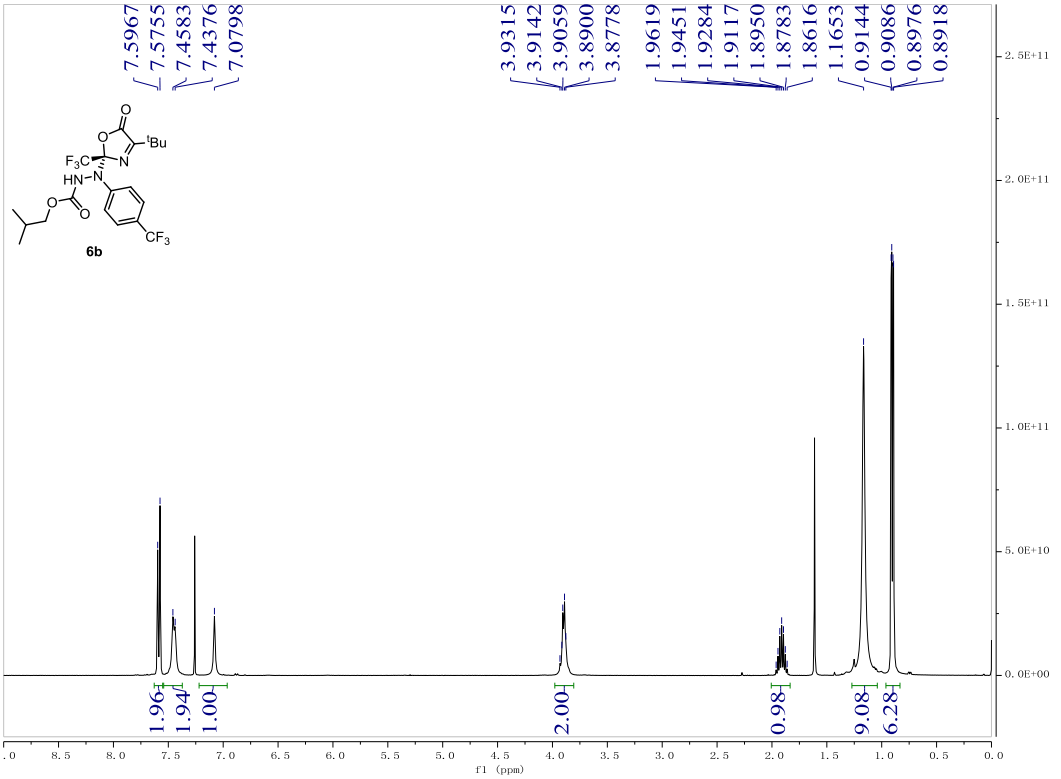
^{13}C{^{1}H} NMR of 6a (150 MHz, $CDCl_3$)



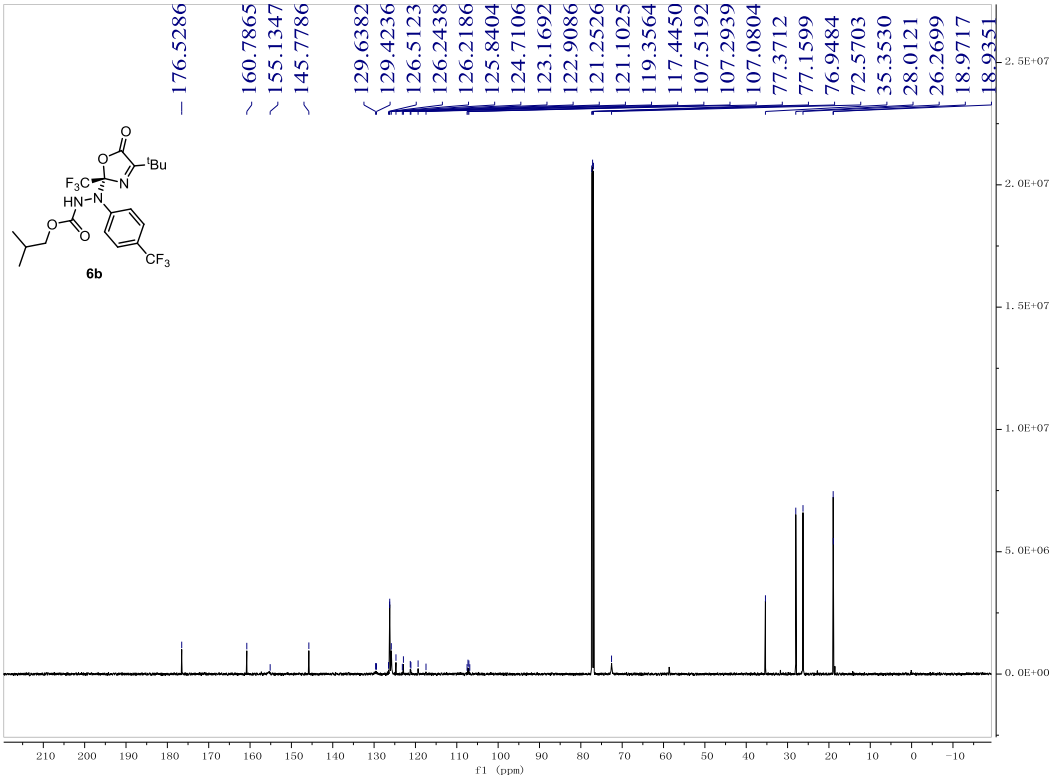
^{19}F{^{1}H} NMR of 6a (564 MHz, $CDCl_3$)



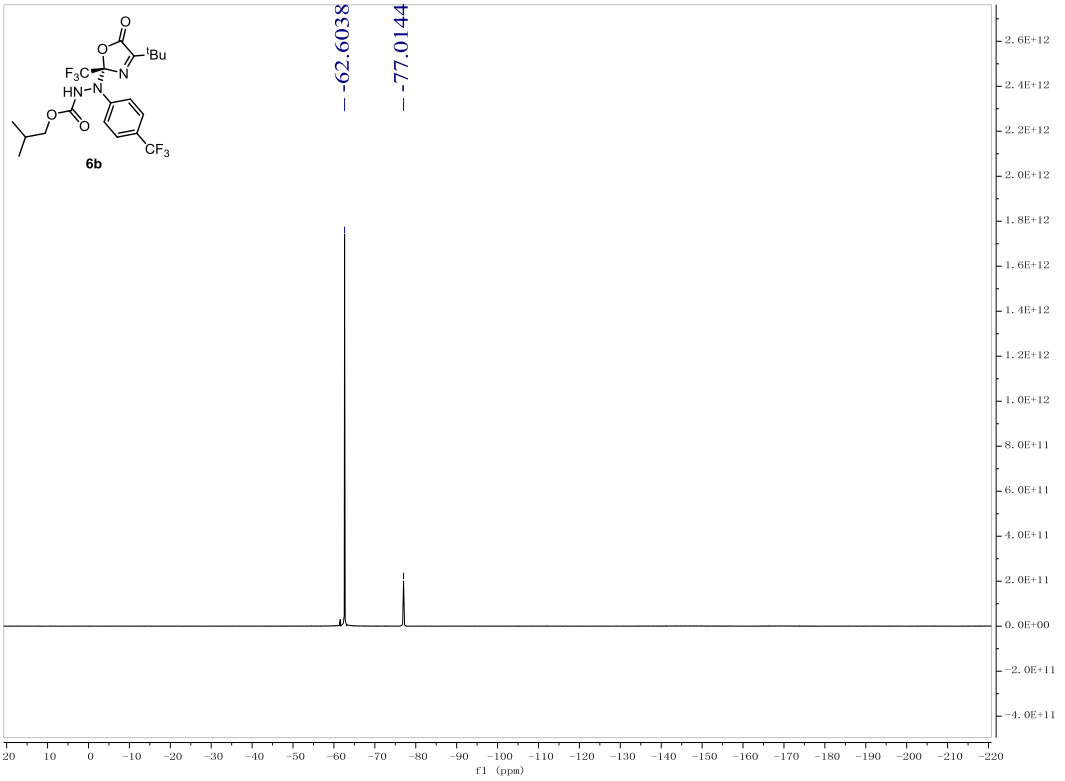
^{1}H NMR of 6b (400 MHz, $CDCl_3$)



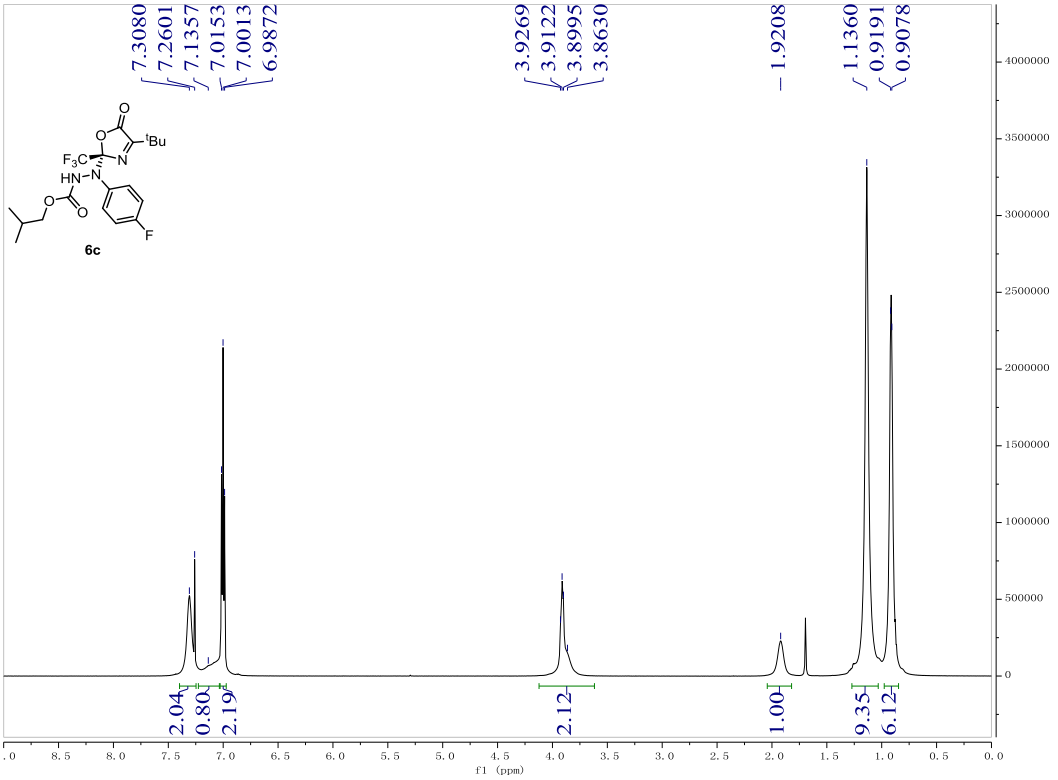
^{13}C{^{1}H} NMR of 6b (150 MHz, $CDCl_3$)



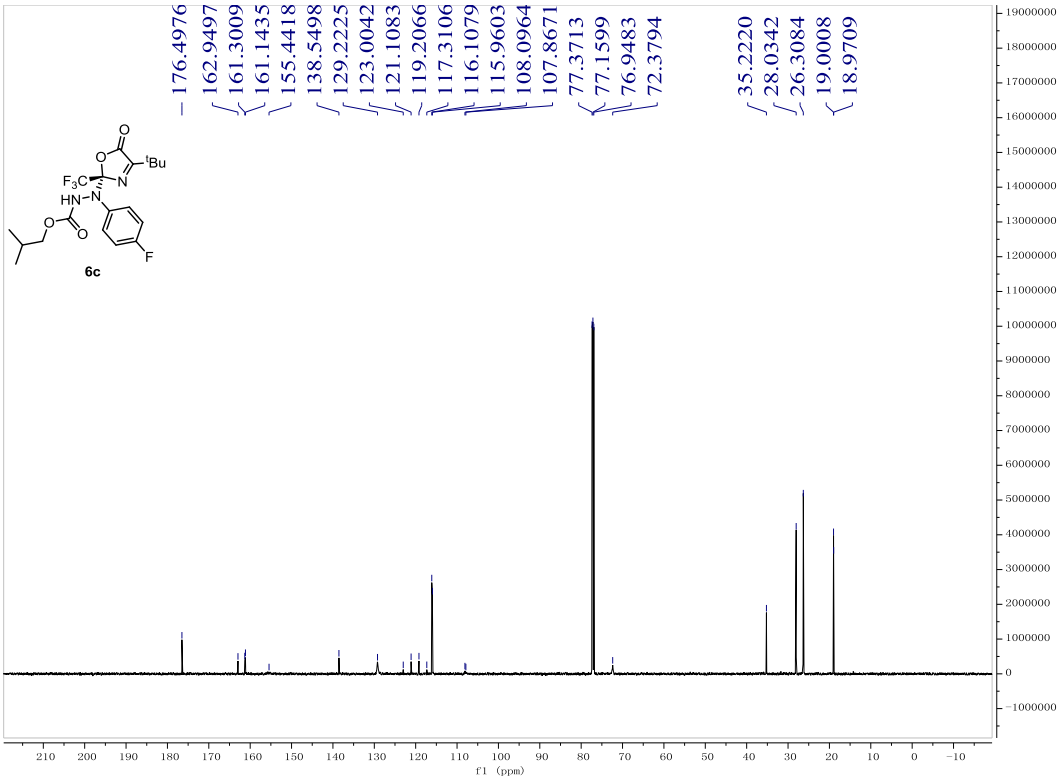
$^{19}F\{^{1}H\}$ NMR of 6b (376 MHz, $CDCl_3$)



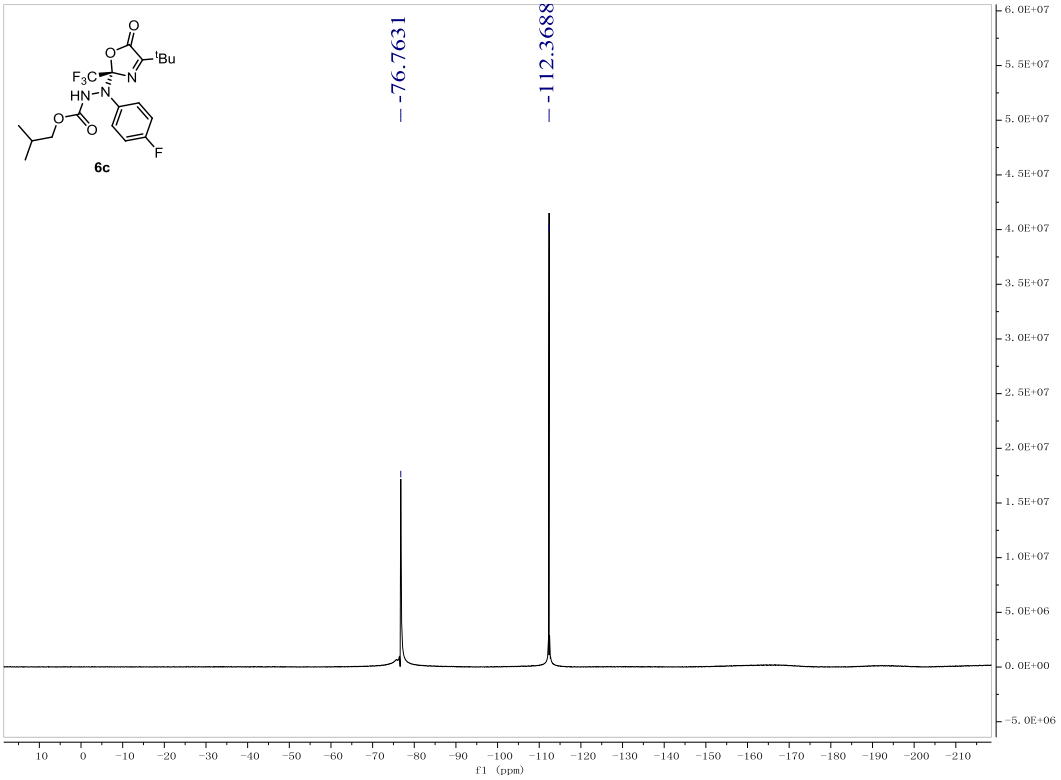
^{1}H NMR of 6c (600 MHz, $CDCl_3$)



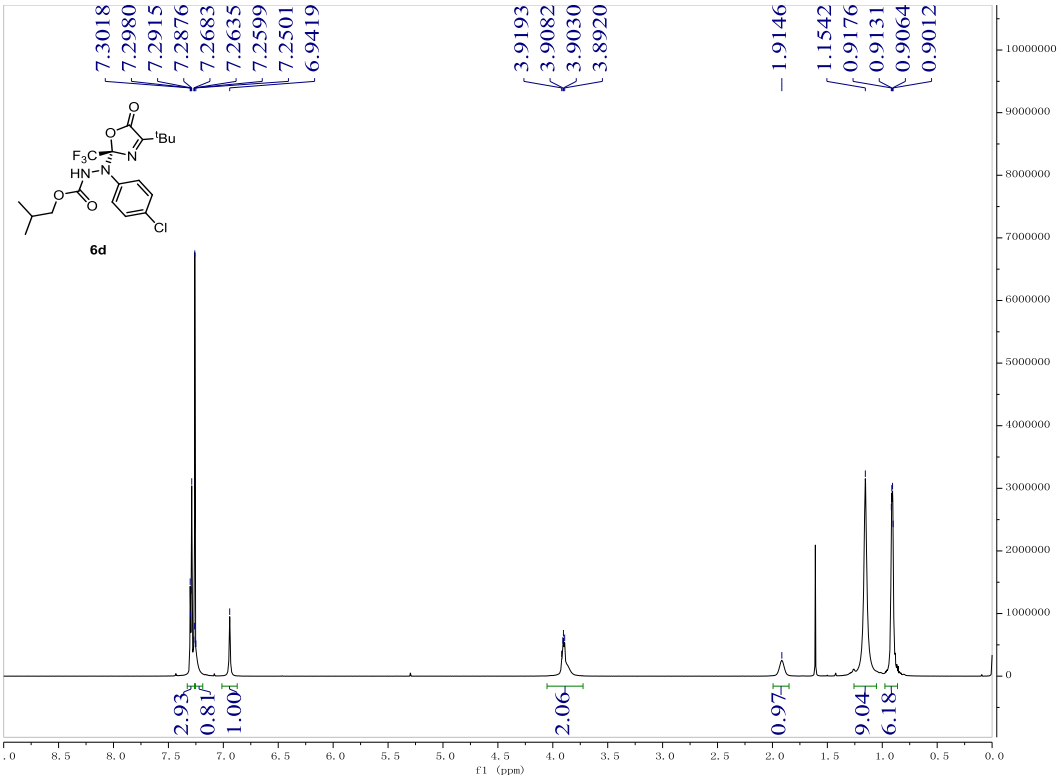
$^{13}C\{^{1}H\}$ NMR of 6c (150 MHz, $CDCl_3$)



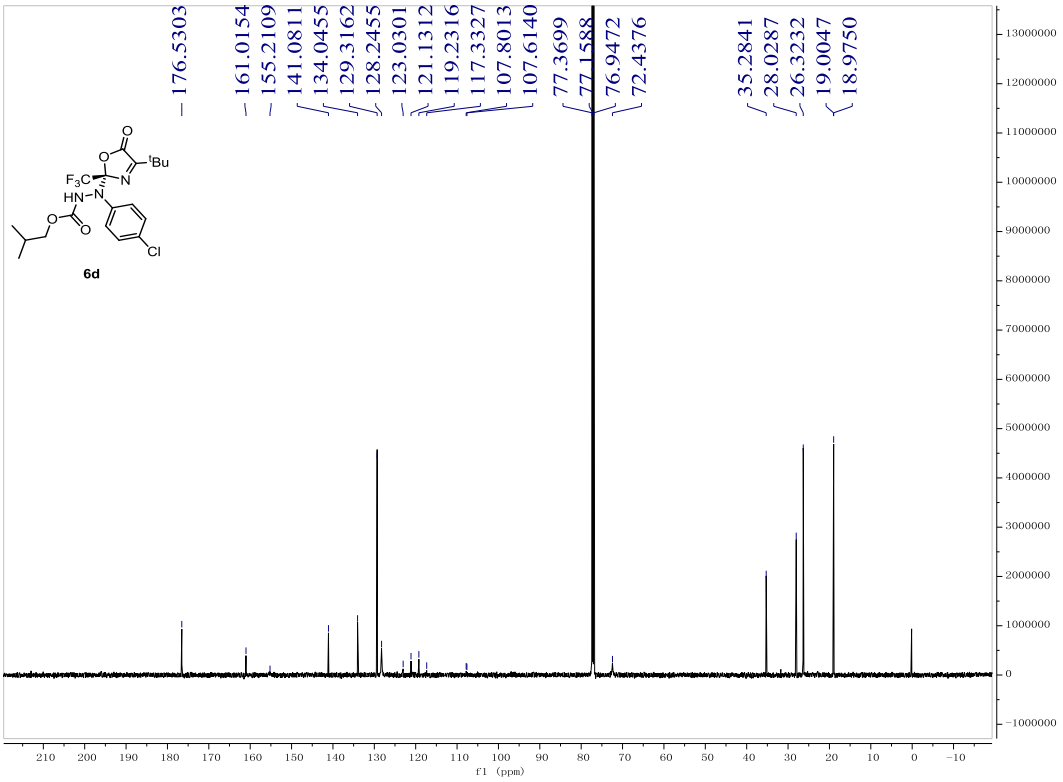
$^{19}F\{^{1}H\}$ NMR of 6c (564 MHz, $CDCl_3$)



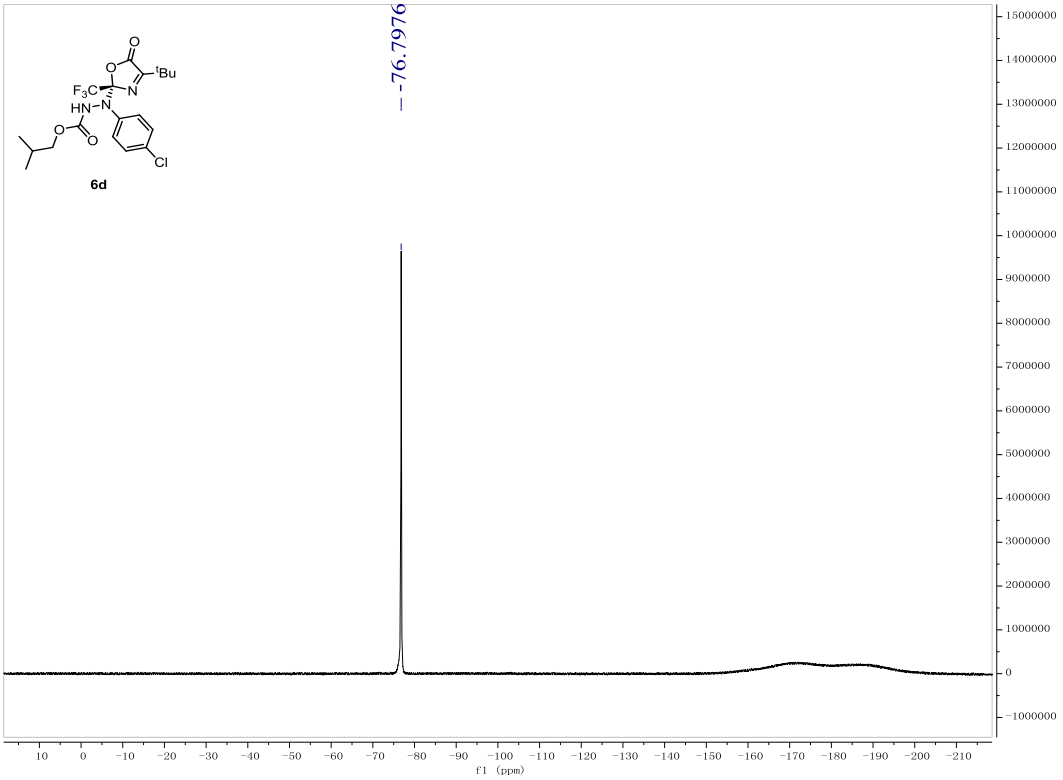
^{1}H NMR of 6d (600 MHz, $CDCl_3$)



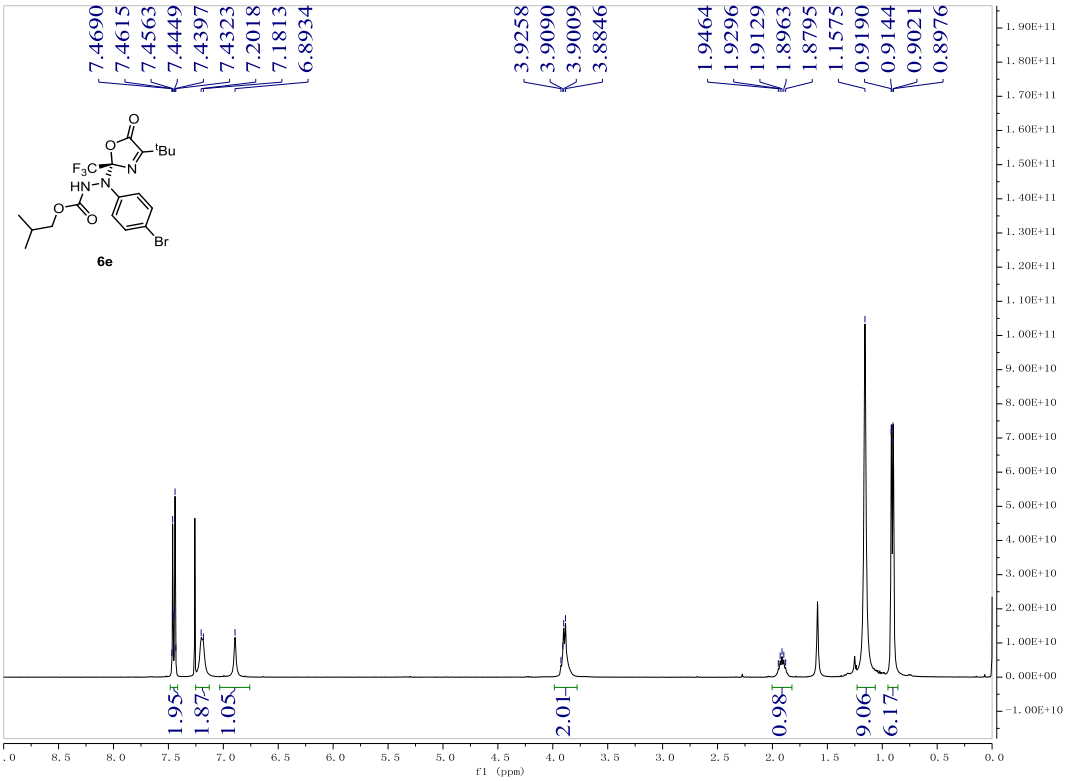
^{13}C{^{1}H} NMR of 6d (150 MHz, $CDCl_3$)



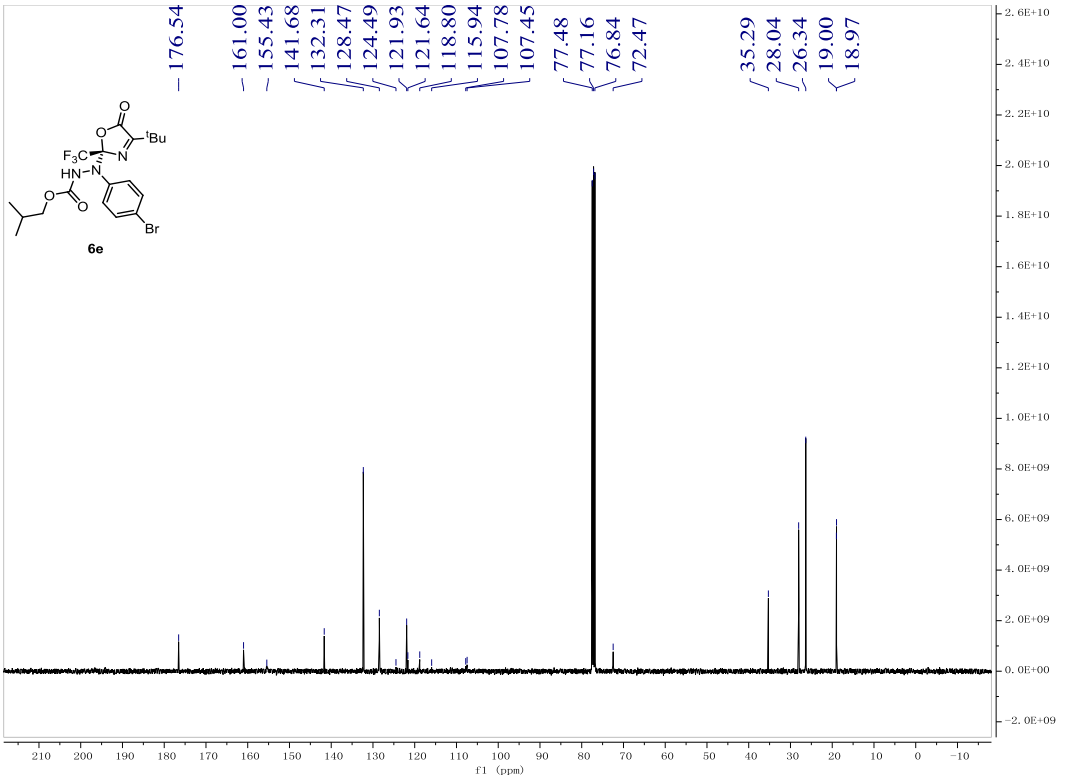
$^{19}F\{^{1}H\}$ NMR of 6d (564 MHz, $CDCl_3$)



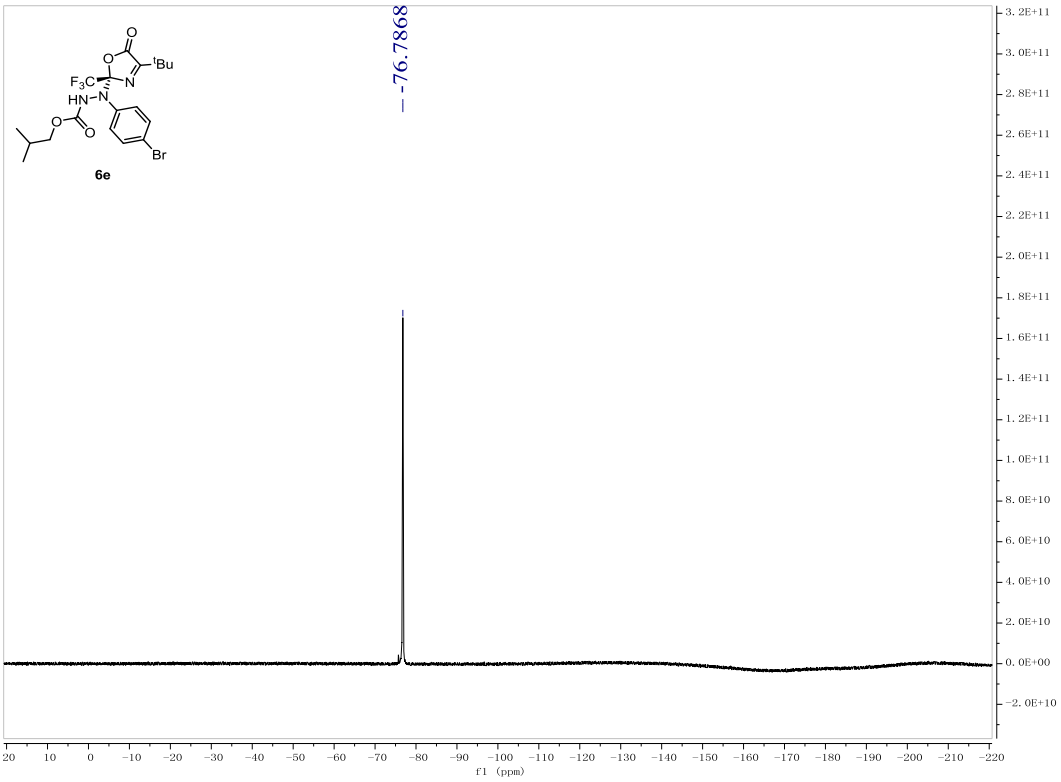
^{1}H NMR of 6e (400 MHz, $CDCl_3$)



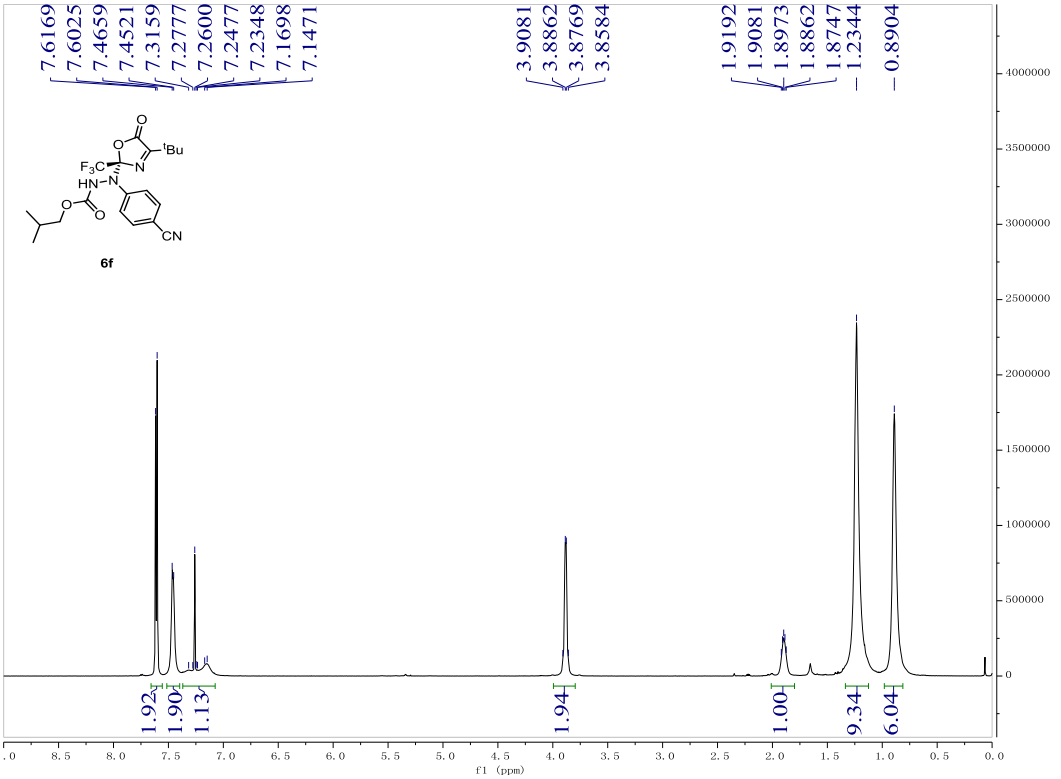
$^{13}C\{^{1}H\}$ NMR of 6e (100 MHz, $CDCl_3$)



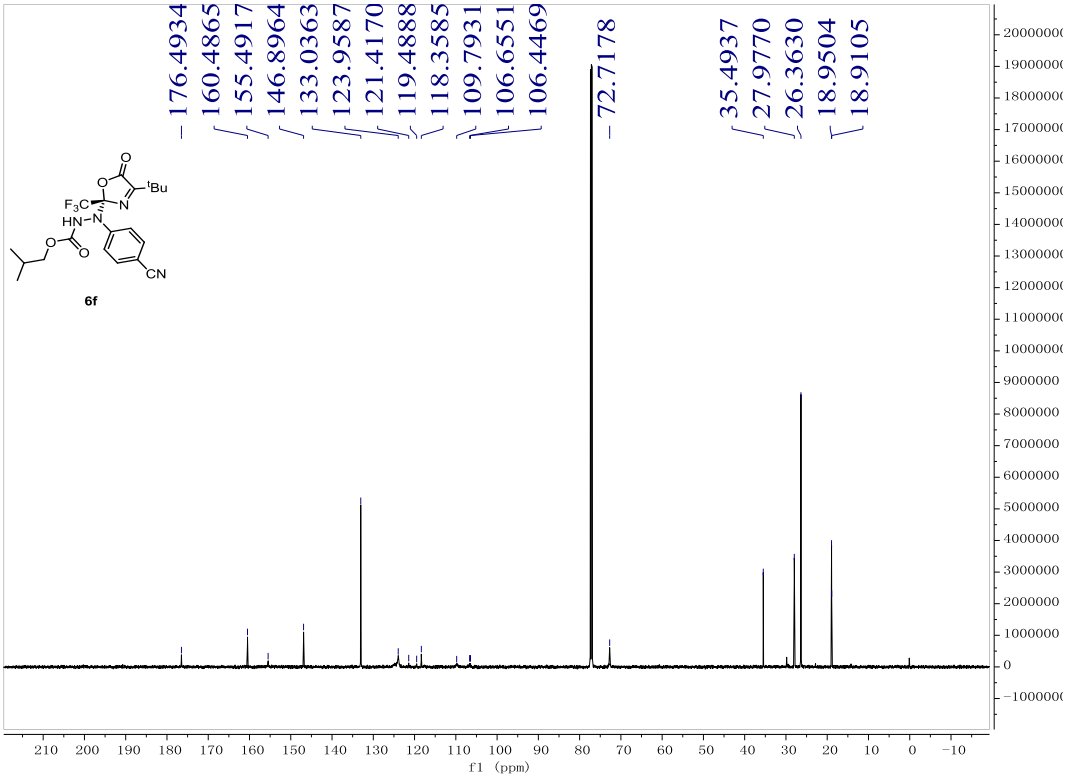
$^{19}F\{^{1}H\}$ NMR of 6e (376 MHz, $CDCl_3$)



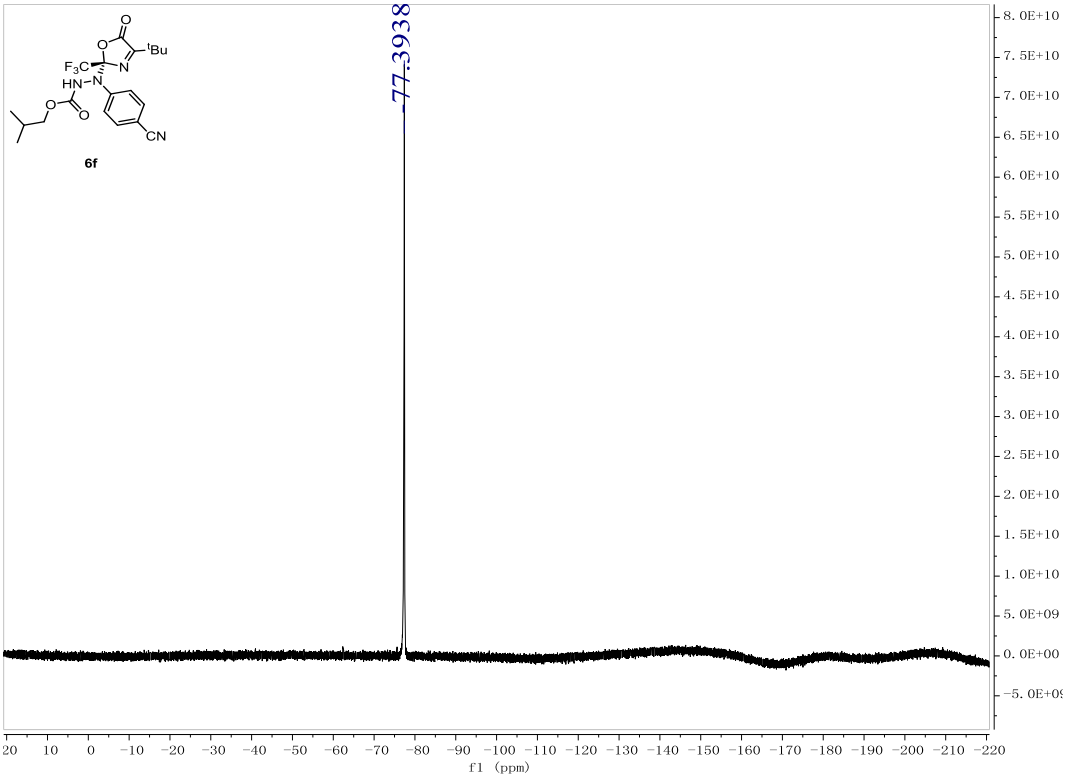
^{1}H NMR of 6f(600 MHz, $CDCl_3$)



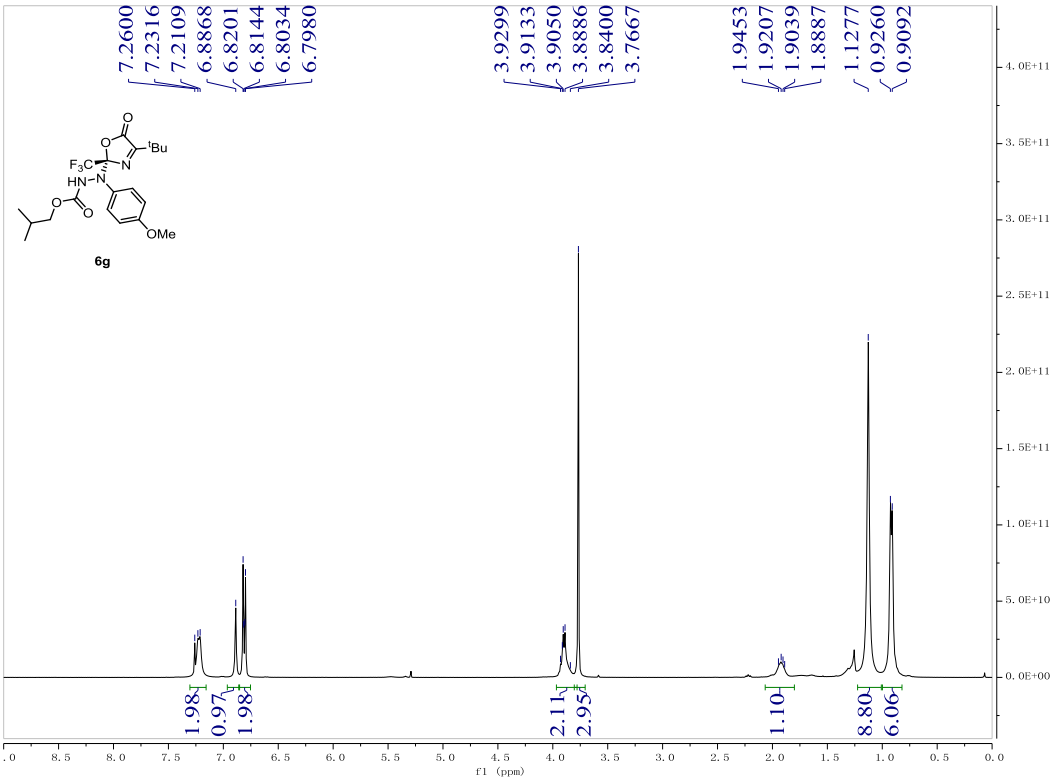
^{13}C{^{1}H} NMR of 6f (150 MHz, $CDCl_3$)



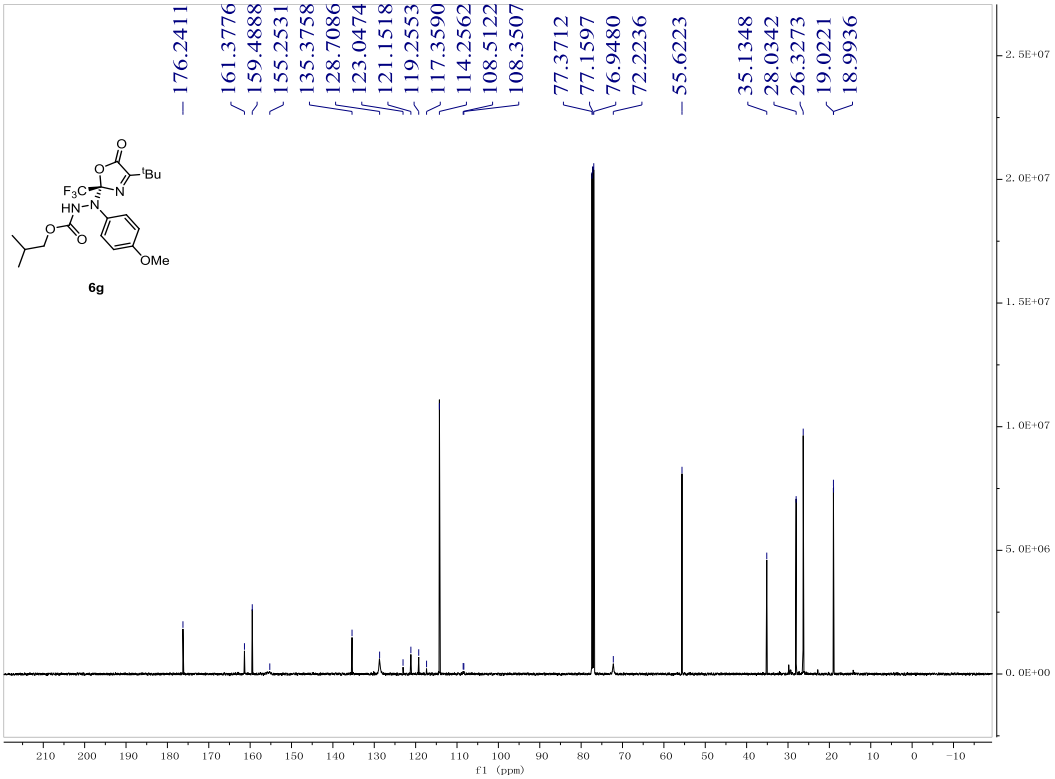
$^{19}F\{^{1}H\}$ NMR of 6f (376 MHz, $CDCl_3$)



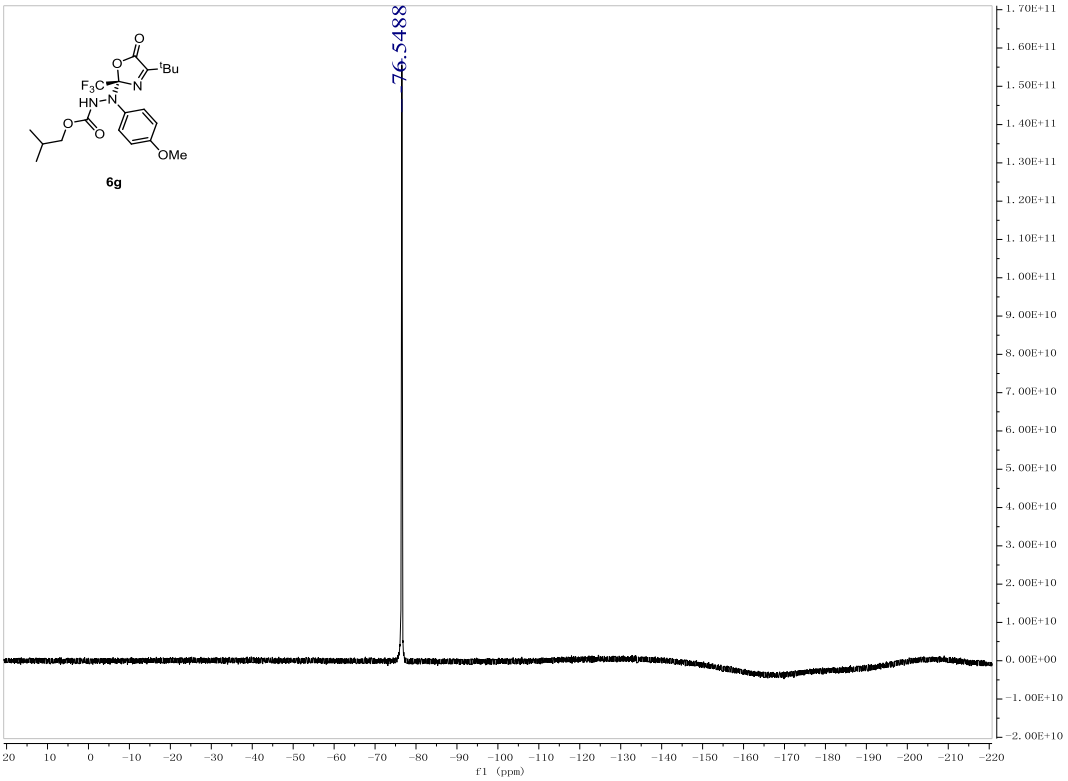
^{1}H NMR of 6g (400 MHz, $CDCl_3$)



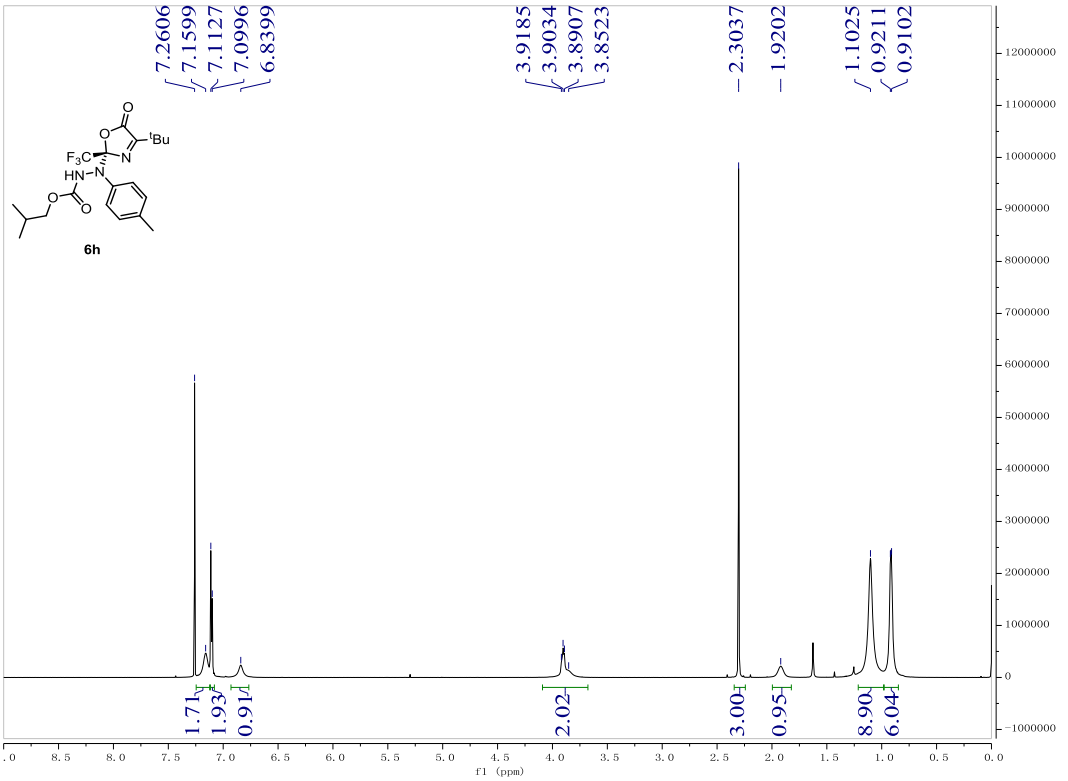
$^{13}C\{^{1}H\}$ NMR of 6g (150 MHz, $CDCl_3$)



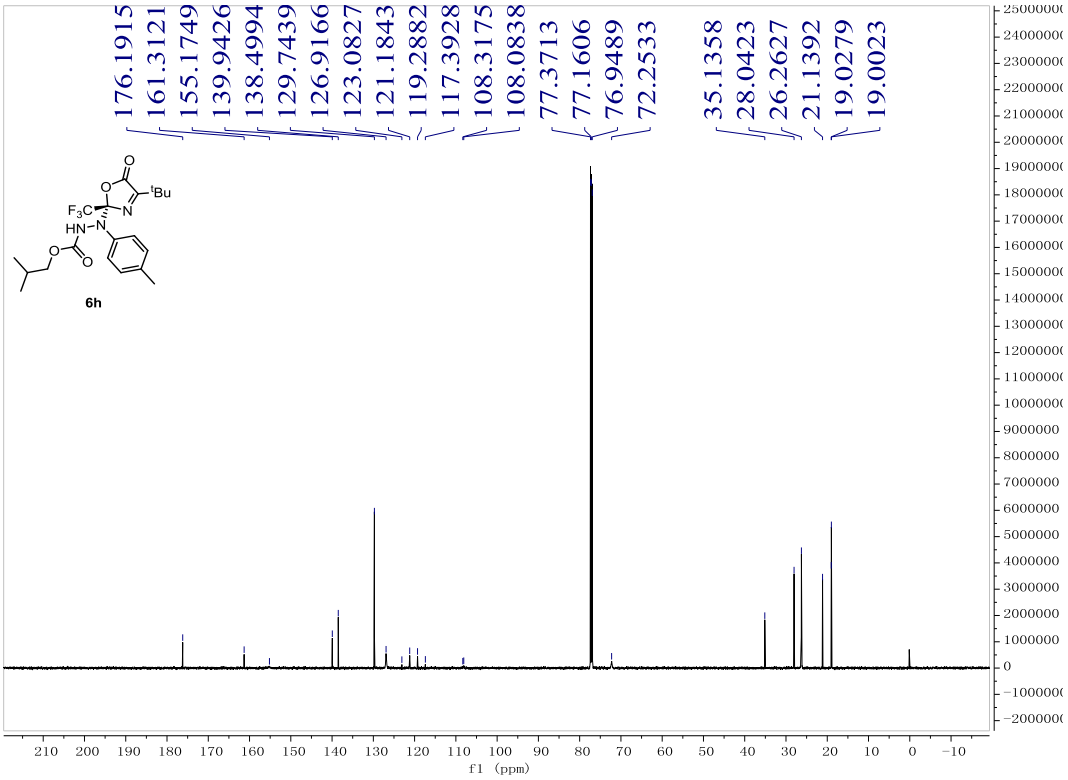
$^{19}F\{^{1}H\}$ NMR of 6g (376 MHz, $CDCl_3$)



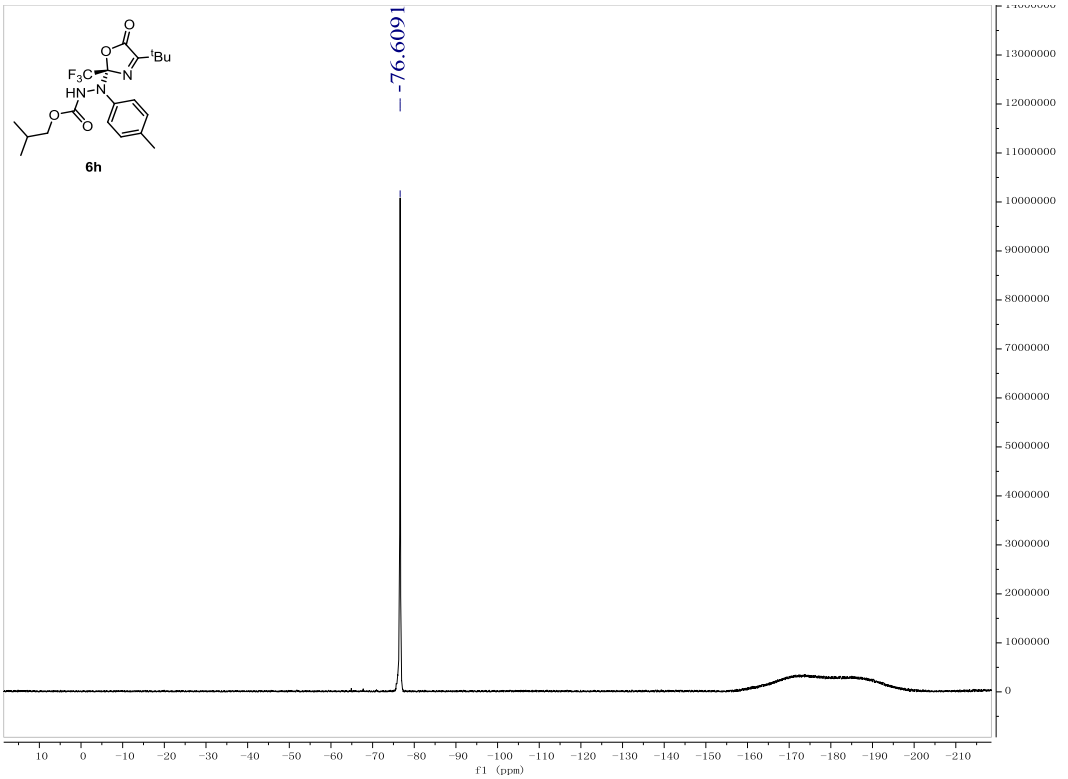
^{1}H NMR of 6h (600 MHz, $CDCl_3$)



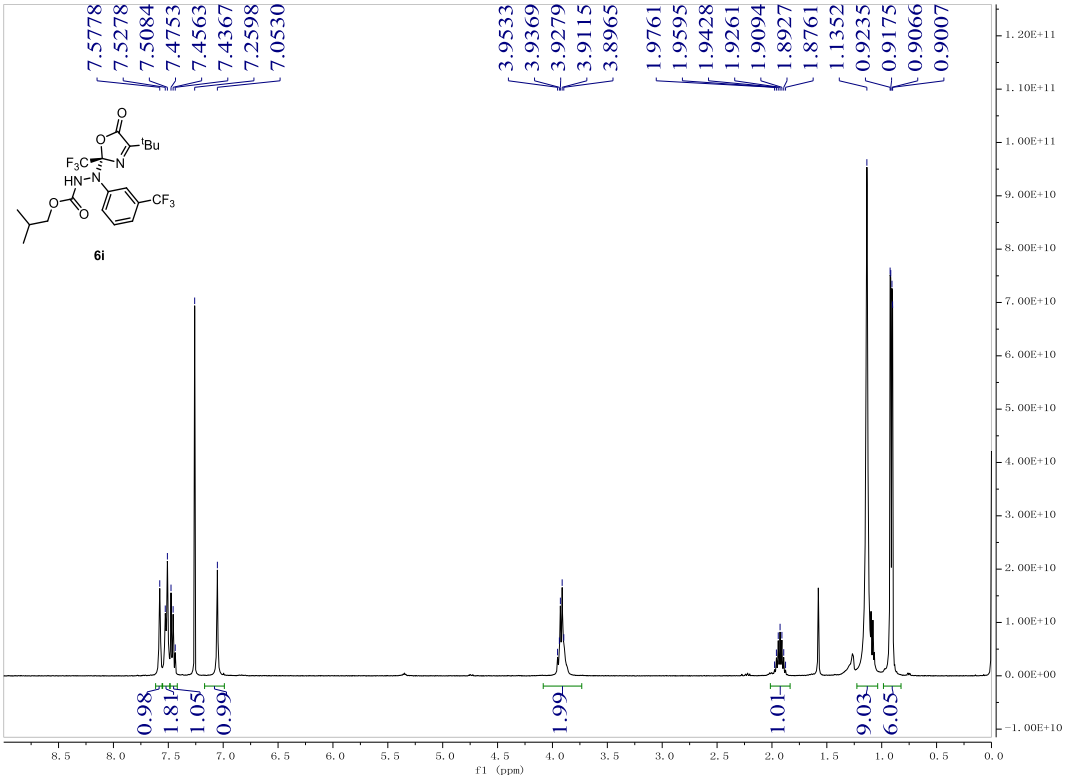
^{13}C{^{1}H} NMR of 6h (150 MHz, $CDCl_3$)



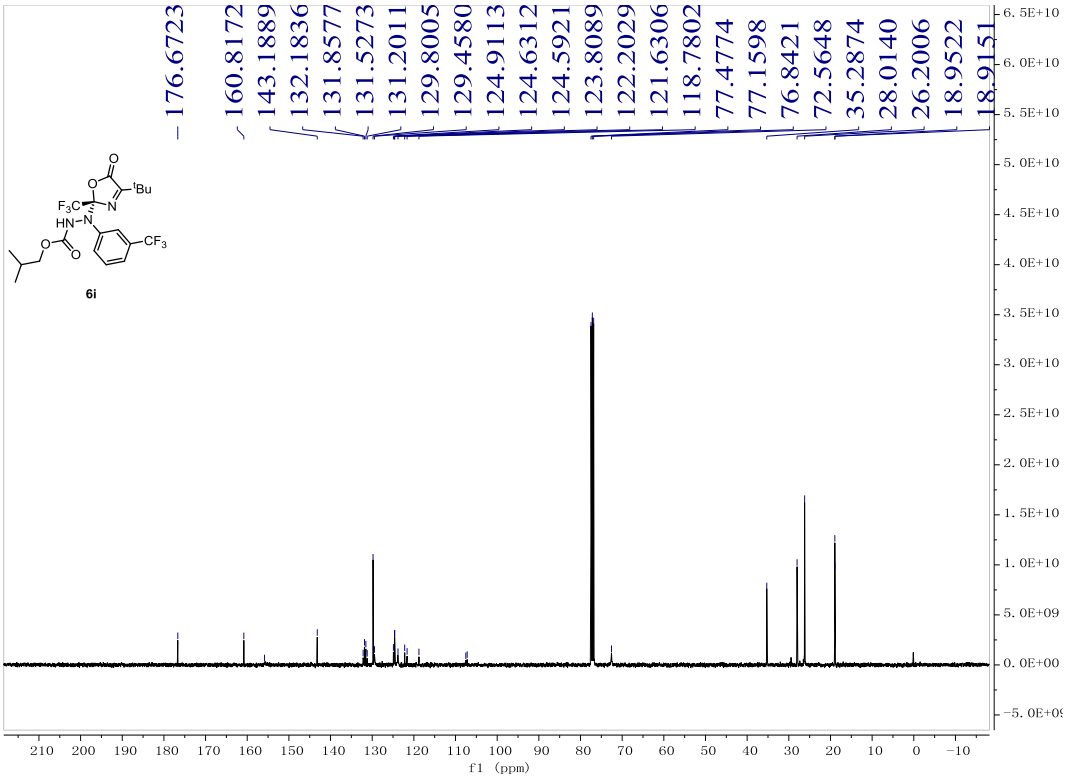
$^{19}F\{^{1}H\}$ NMR of 6h (564 MHz, $CDCl_3$)



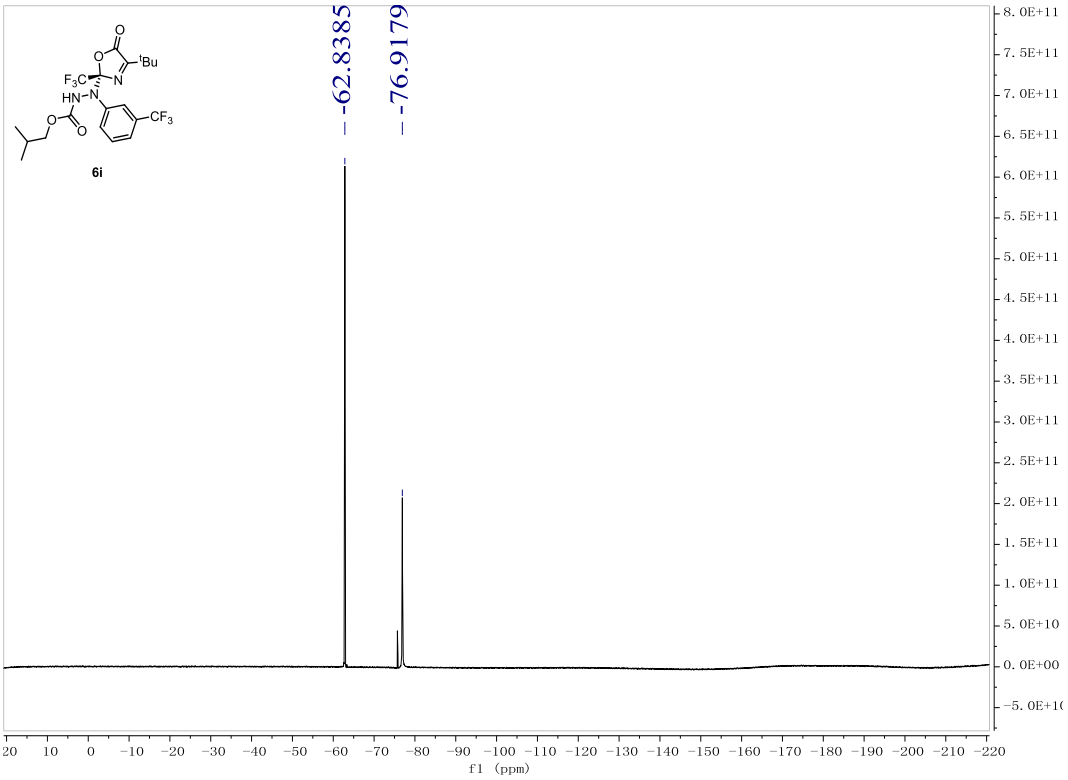
^{1}H NMR of 6i (400 MHz, $CDCl_3$)



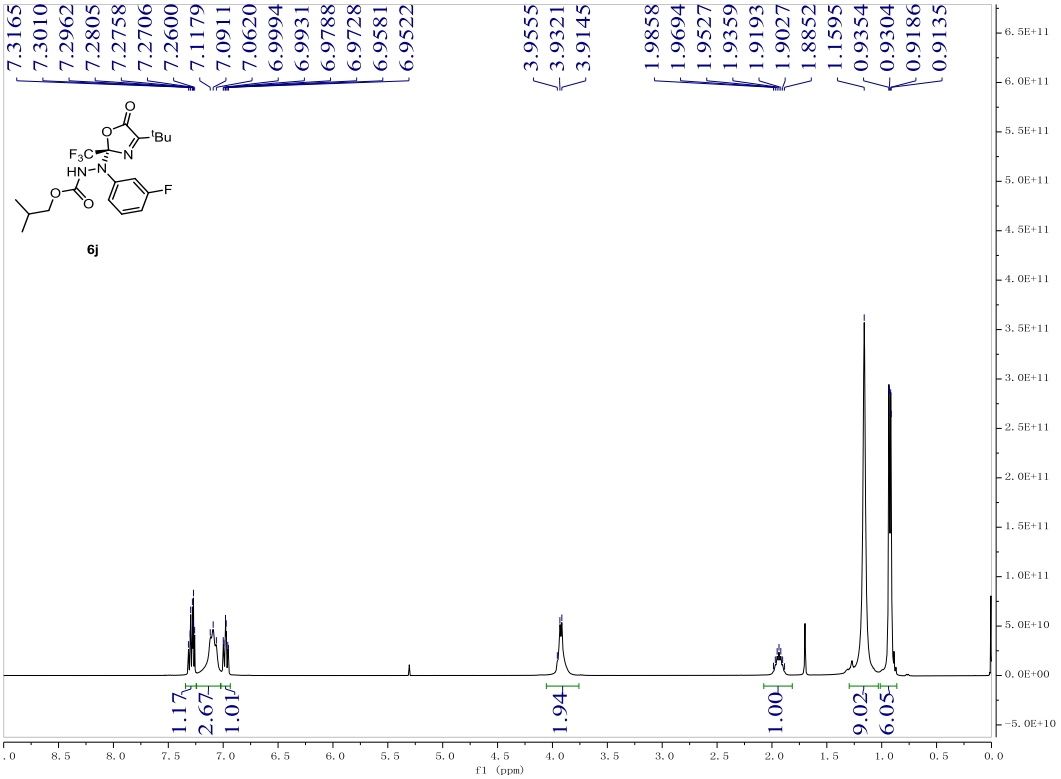
$^{13}C\{^{1}H\}$ NMR of 6i (100 MHz, $CDCl_3$)



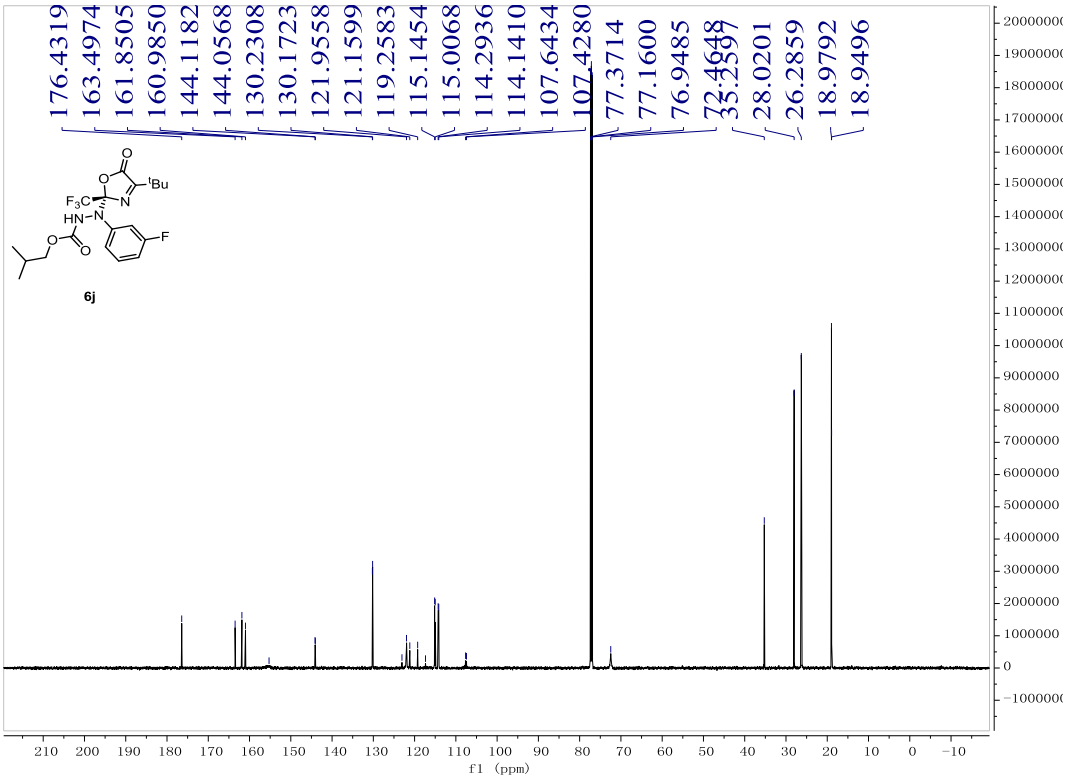
$^{19}F\{^{1}H\}$ NMR of 6i (376 MHz, $CDCl_3$)



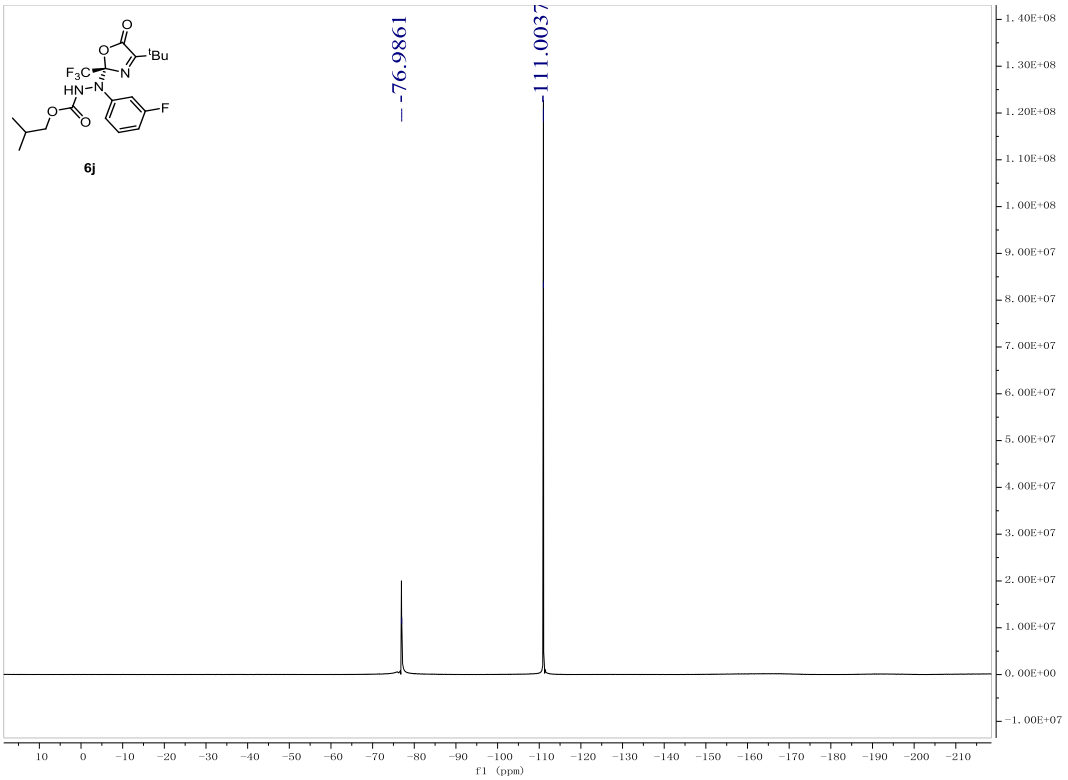
^{1}H NMR of 6j (400 MHz, $CDCl_3$)



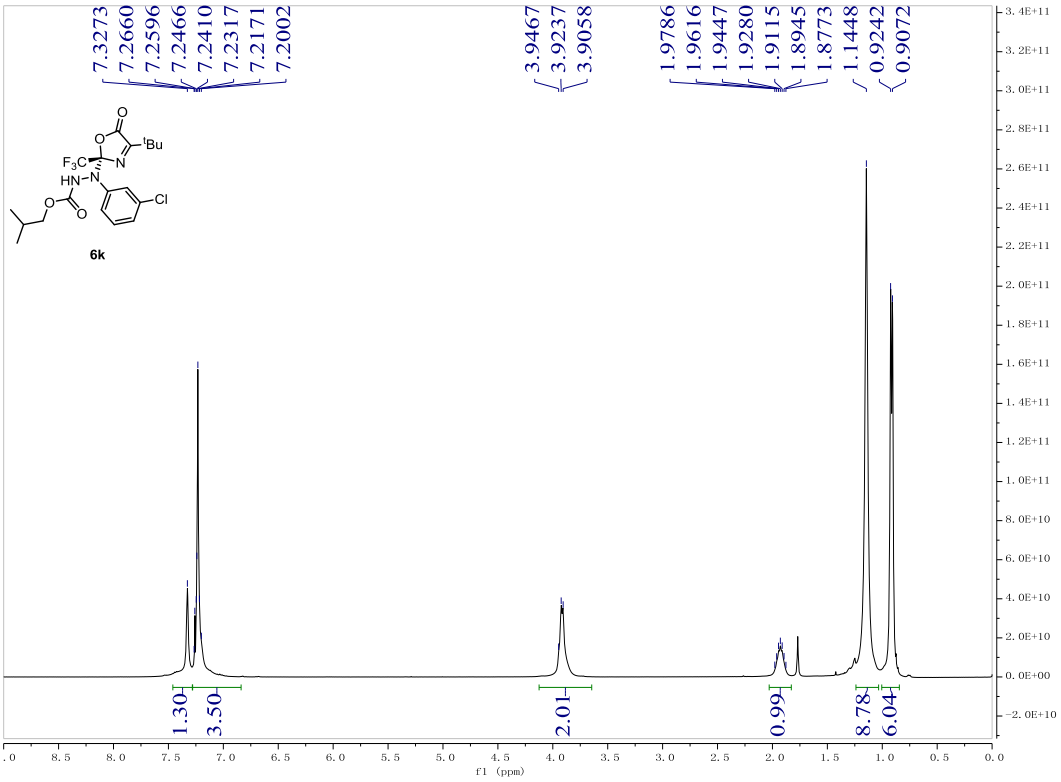
^{13}C{^{1}H} NMR of 6j (150 MHz, $CDCl_3$)



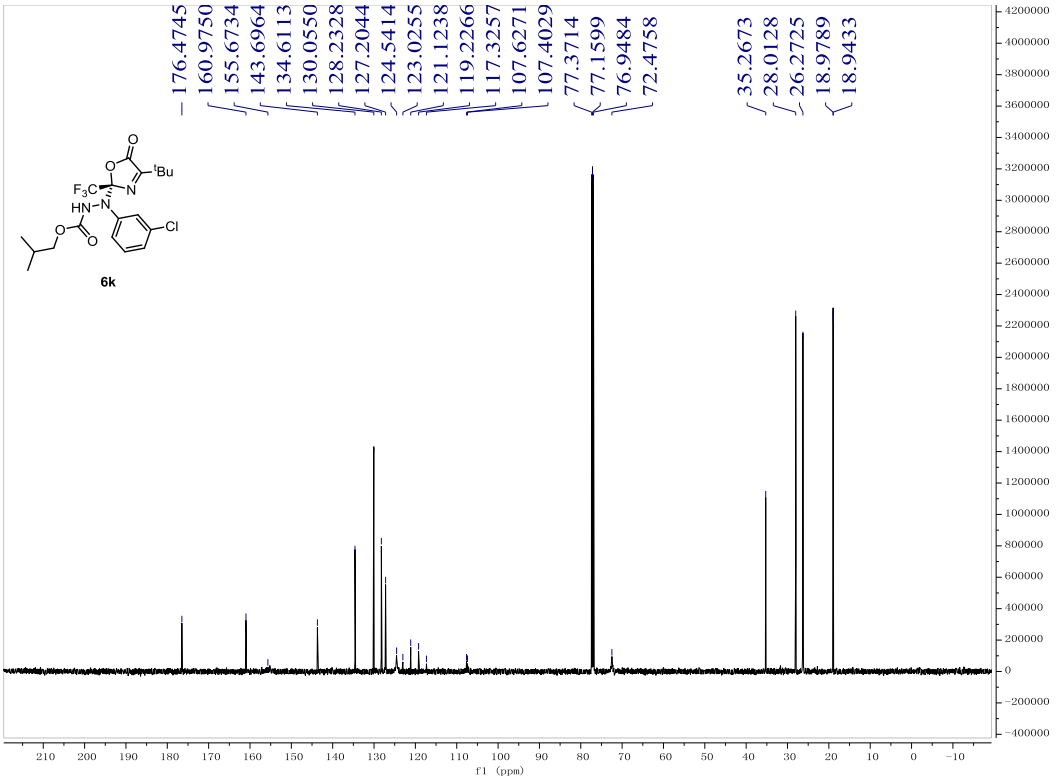
$^{19}F\{^{1}H\}$ NMR of 6j (564 MHz, $CDCl_3$)



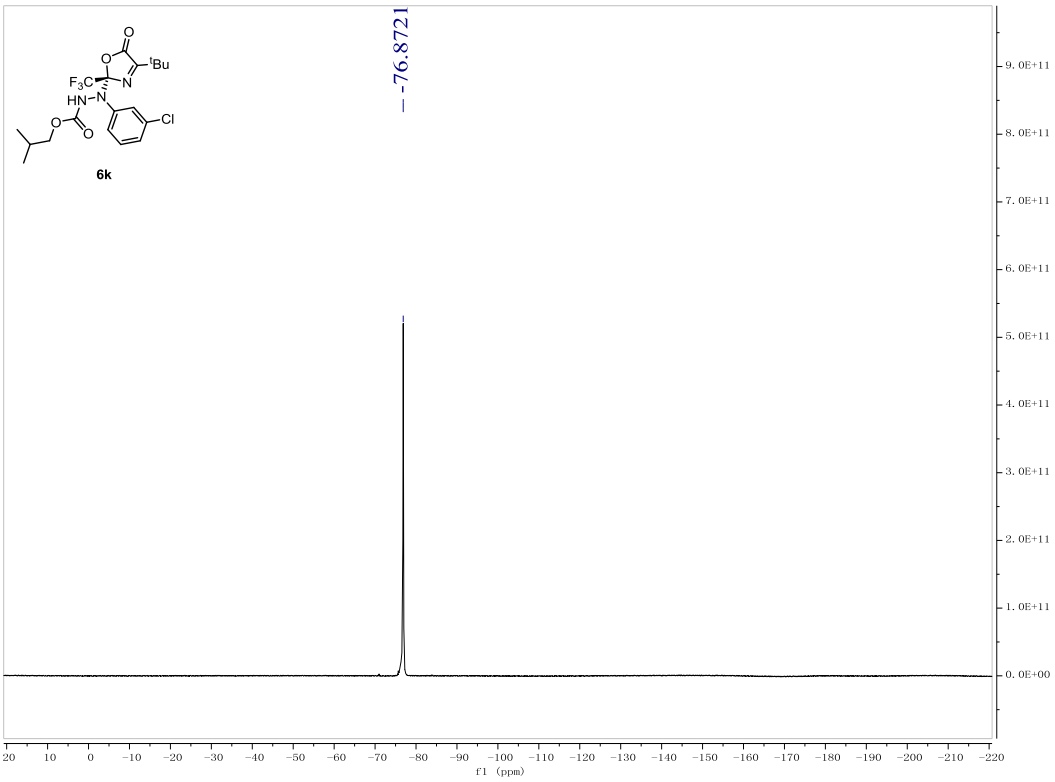
^{1}H NMR of 6k (400 MHz, $CDCl_3$)



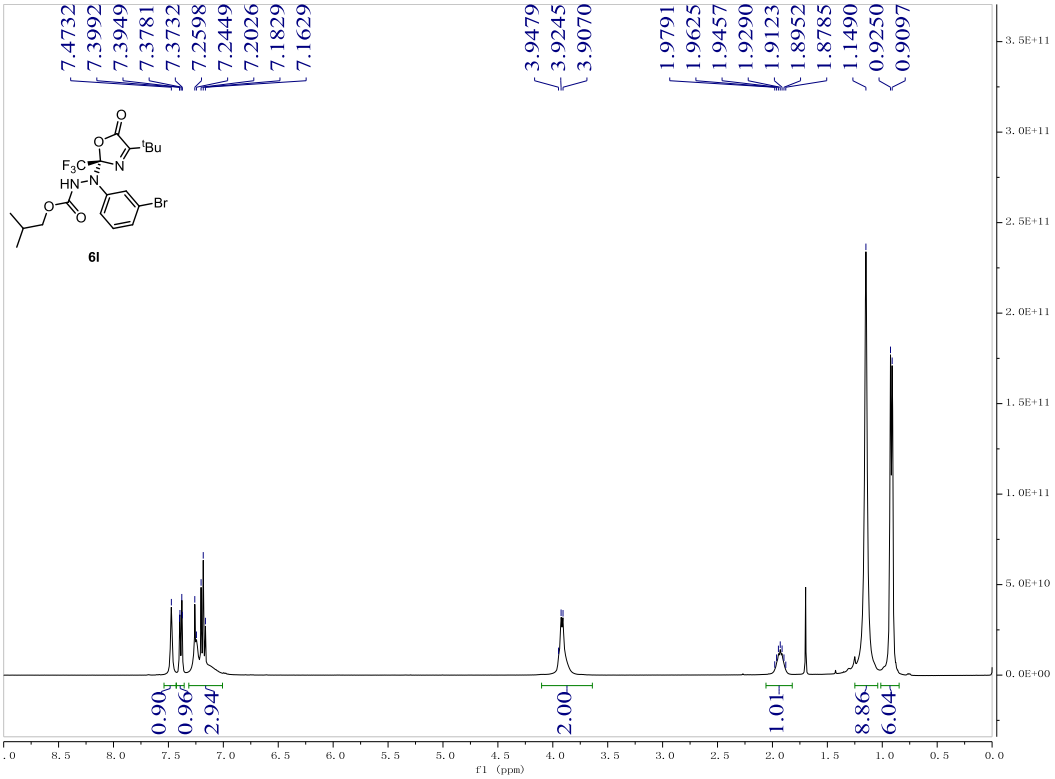
$^{13}C\{^{1}H\}$ NMR of 6k (150 MHz, $CDCl_3$)



$^{19}F\{^{1}H\}$ NMR of 6k (376 MHz, $CDCl_3$)



^{1}H NMR of 6l (400 MHz, $CDCl_3$)



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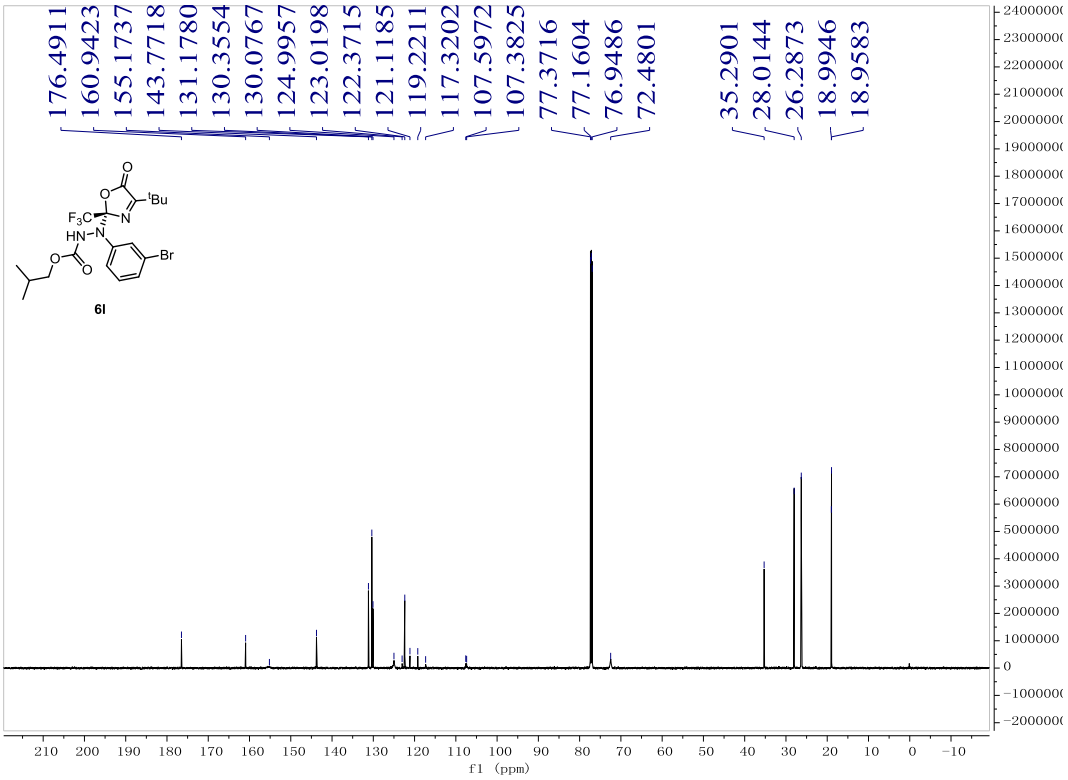
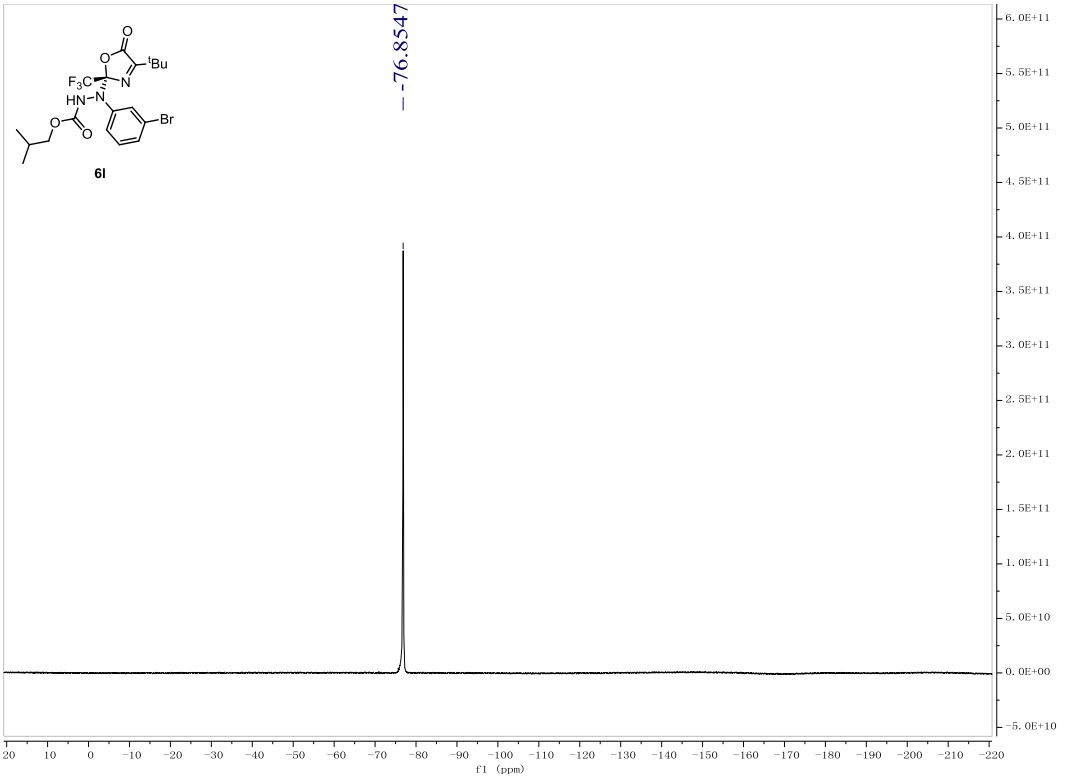
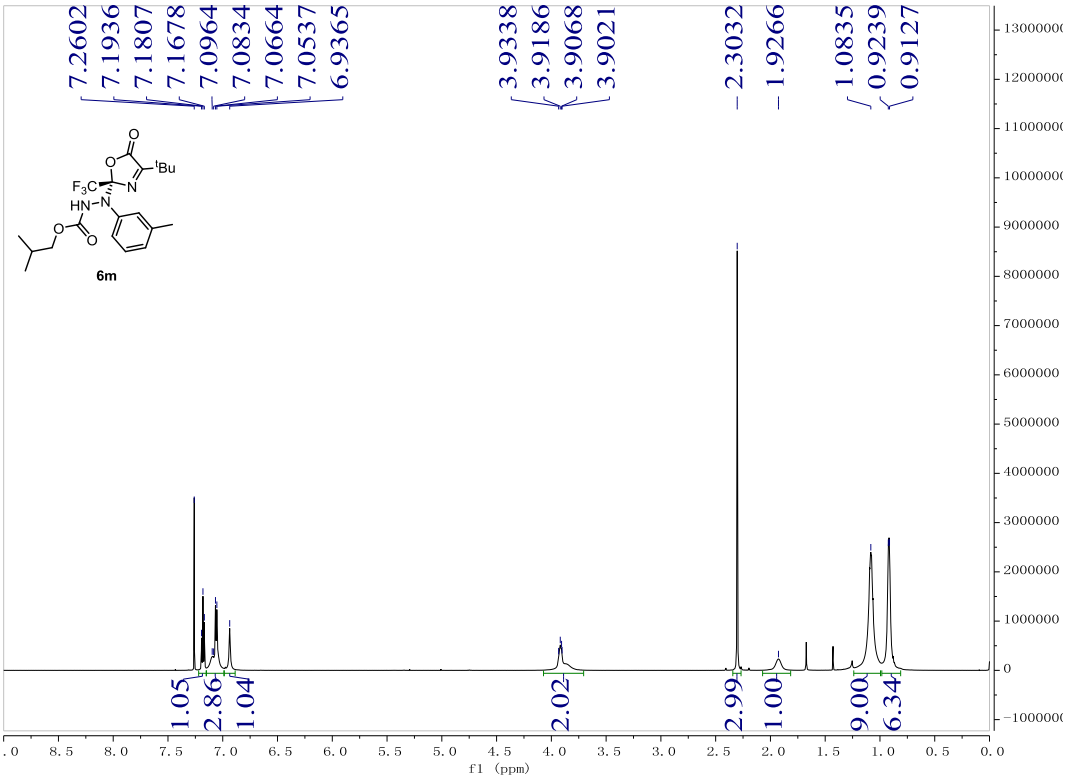


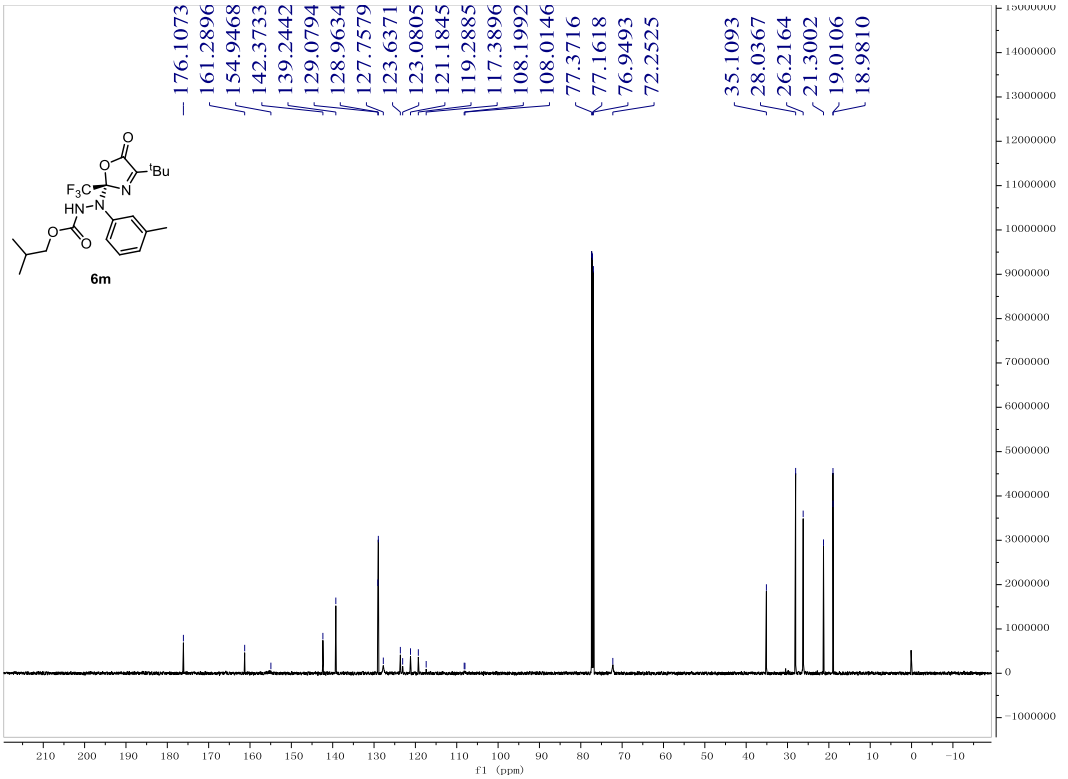
$^{19}F\{^{1}H\}$ NMR of 6l (376 MHz, $CDCl_3$)



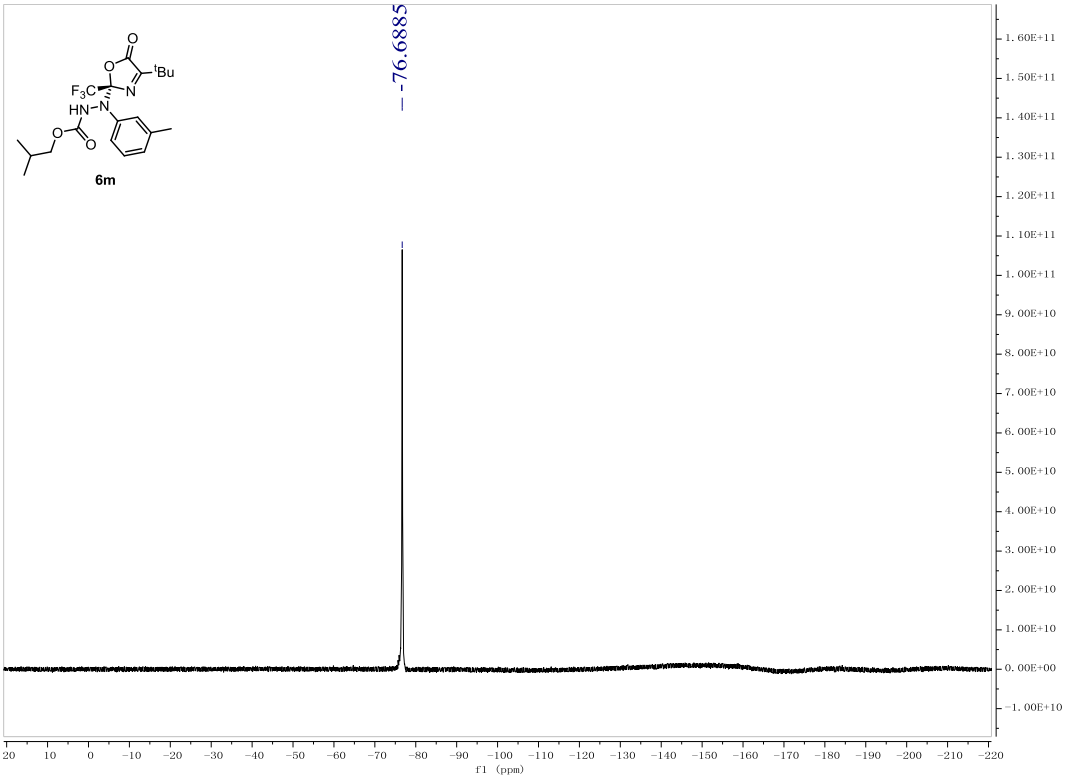
^{1}H NMR of 6m (600 MHz, $CDCl_3$)



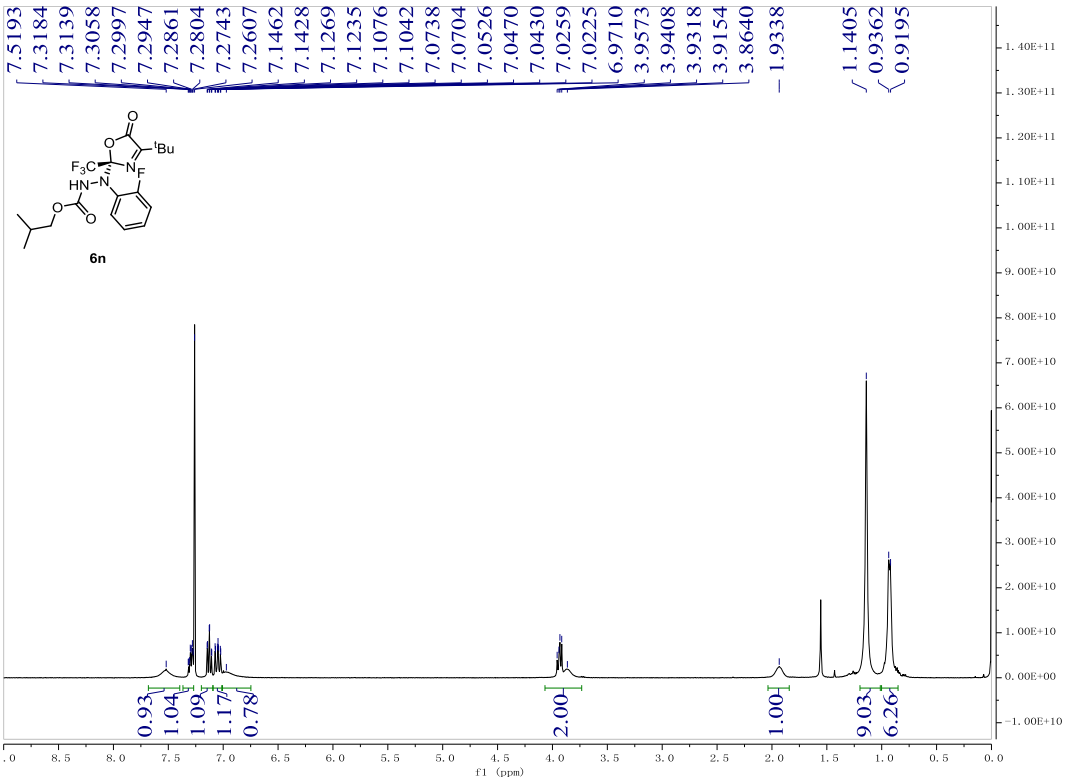
$^{13}C\{^{1}H\}$ NMR of 6m (150 MHz, $CDCl_3$)



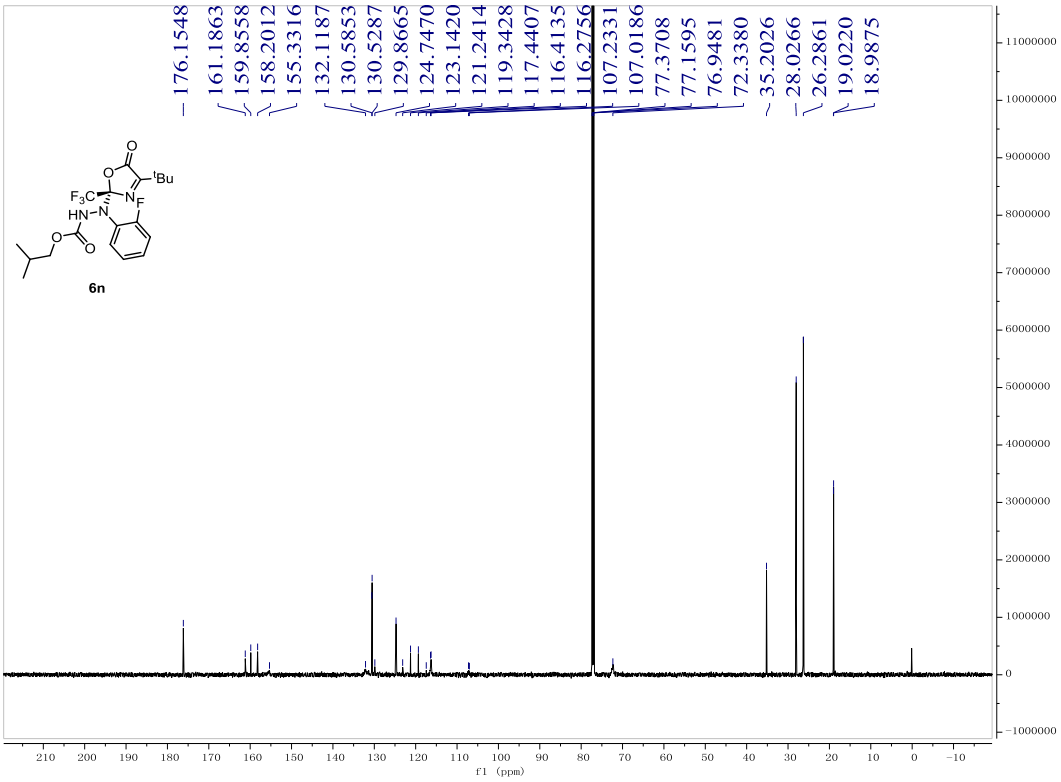
$^{19}F\{^{1}H\}$ NMR of 6m (376 MHz, $CDCl_3$)



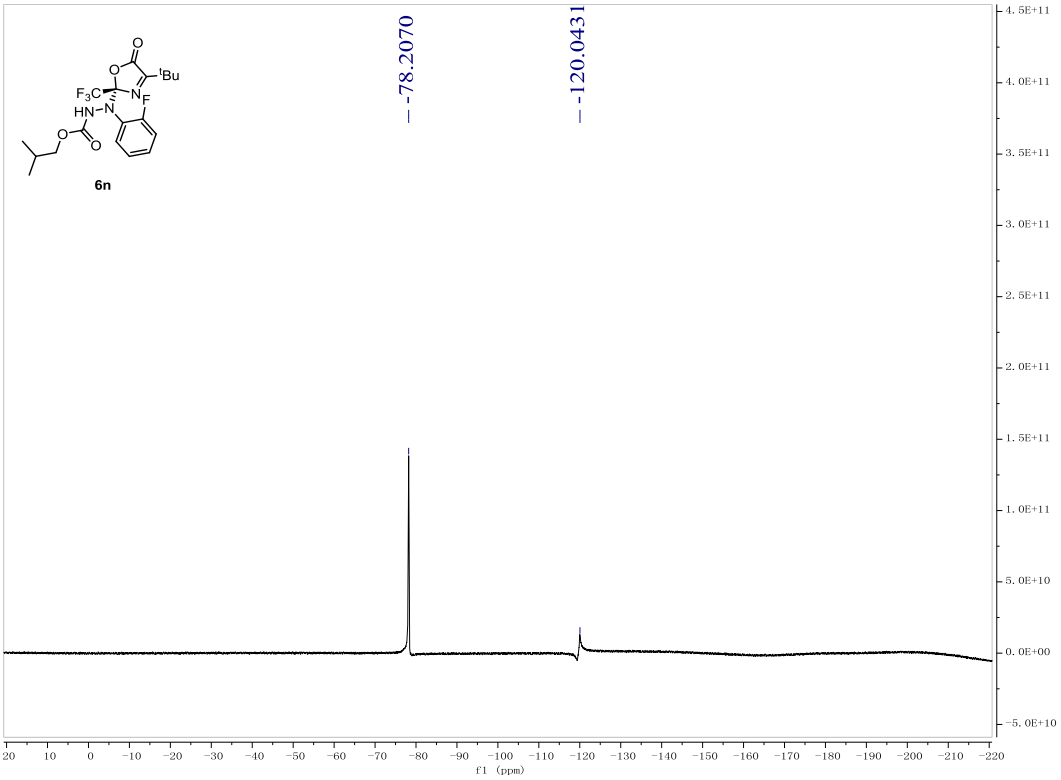
^{1}H NMR of 6n (400 MHz, $CDCl_3$)



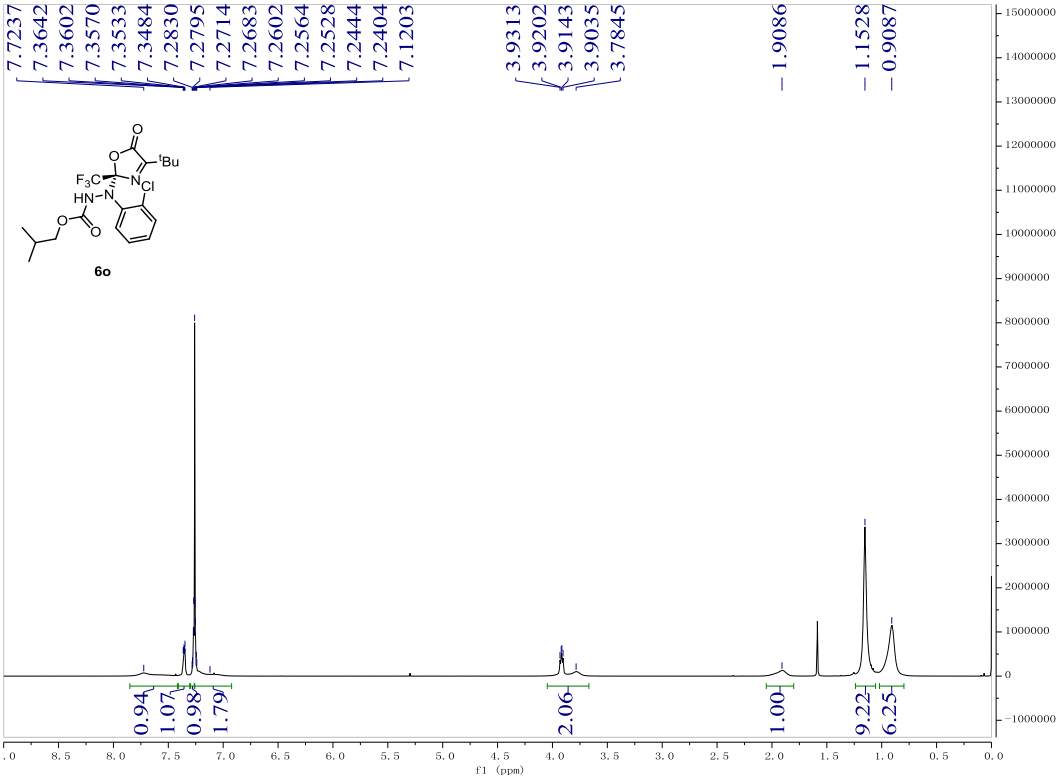
^{13}C{^{1}H} NMR of 6n (150 MHz, $CDCl_3$)



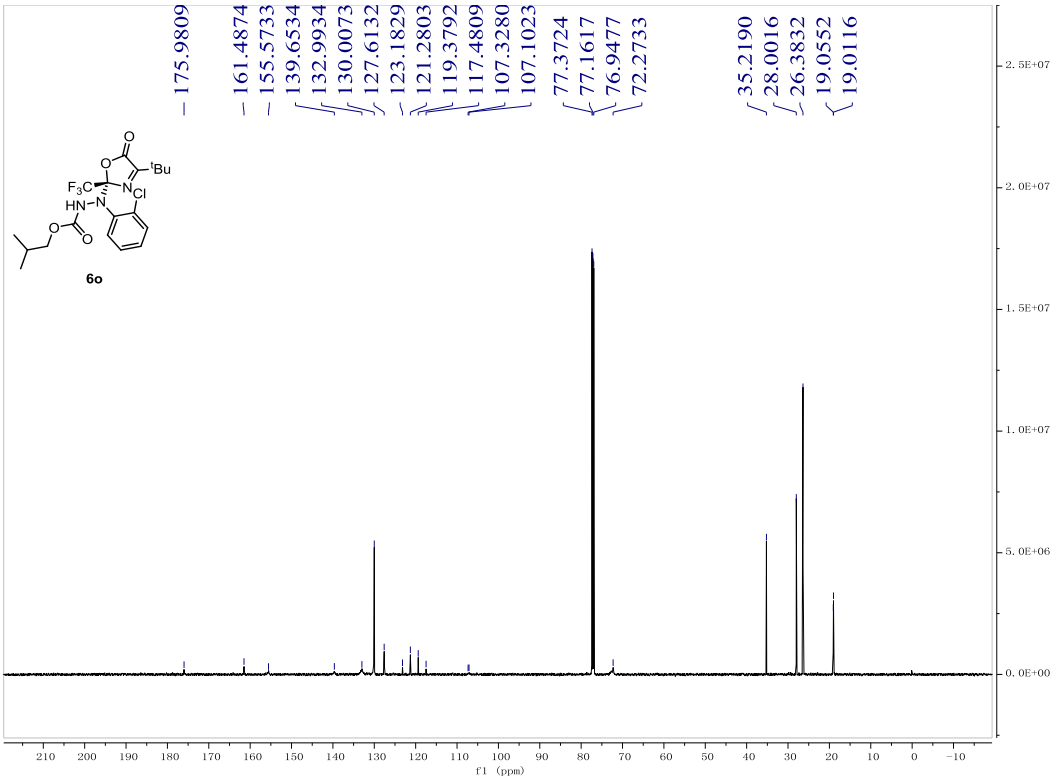
$^{19}F\{^{1}H\}$ NMR of 6n (376 MHz, $CDCl_3$)



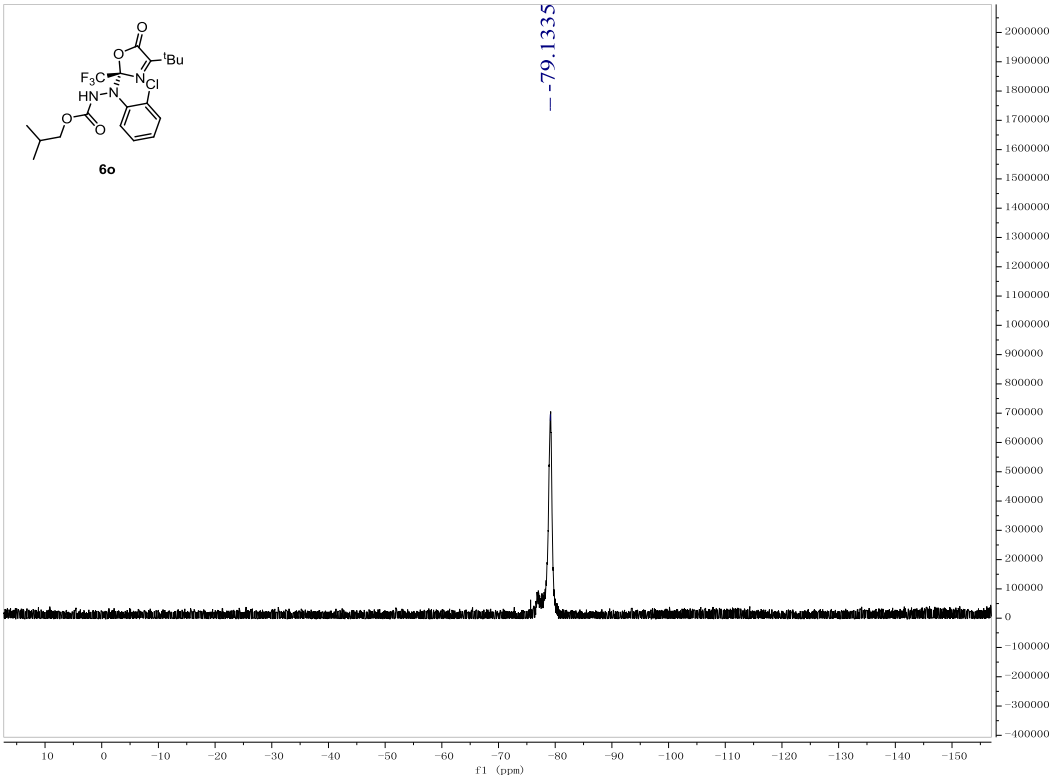
^{1}H NMR of 6o (600 MHz, $CDCl_3$)



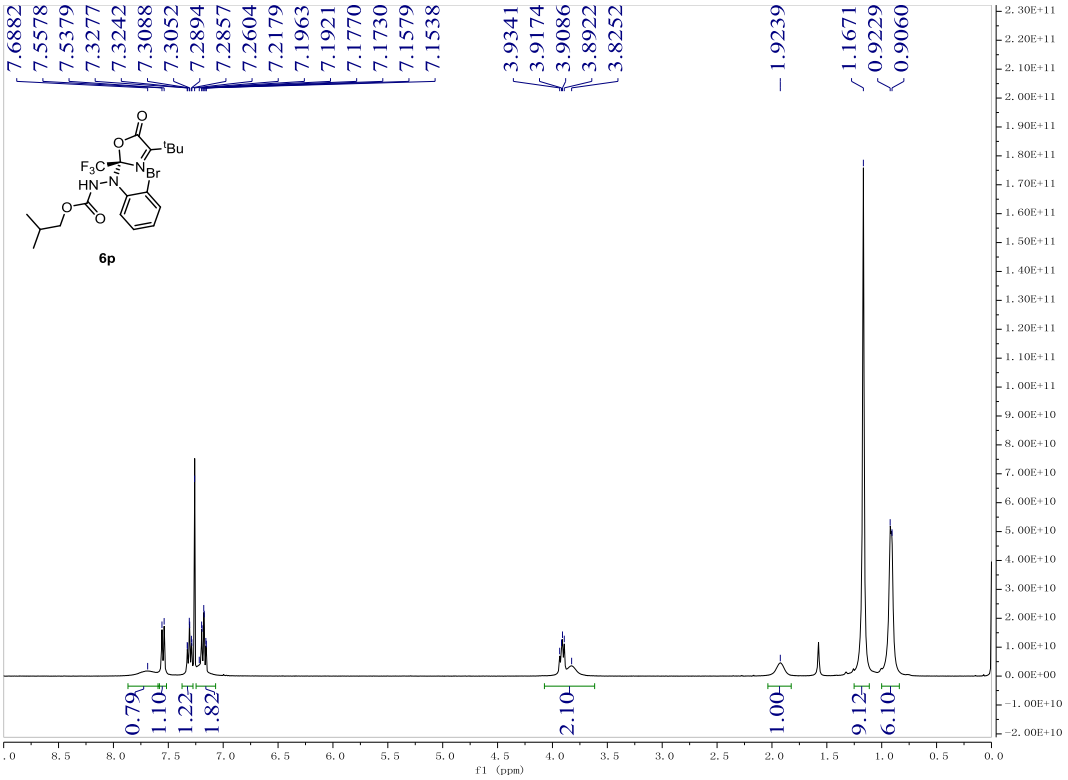
$^{13}C\{^{1}H\}$ NMR of 6o (150 MHz, $CDCl_3$)



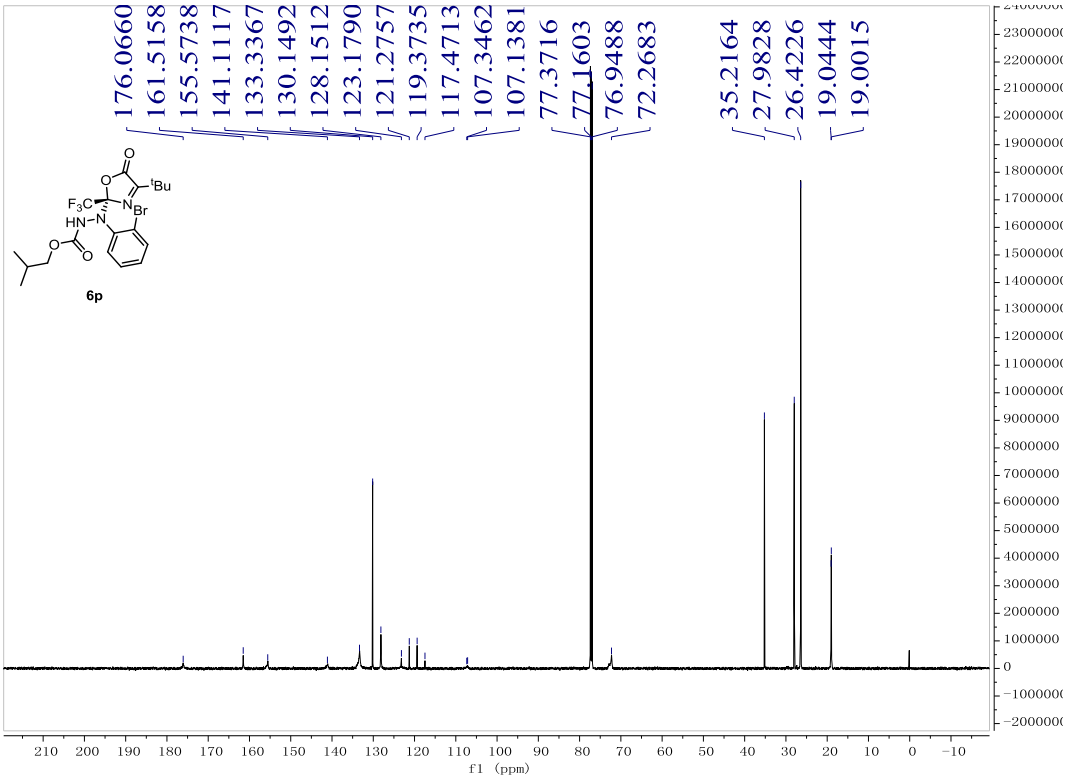
$^{19}F\{^{1}H\}$ NMR of 6o (564 MHz, $CDCl_3$)



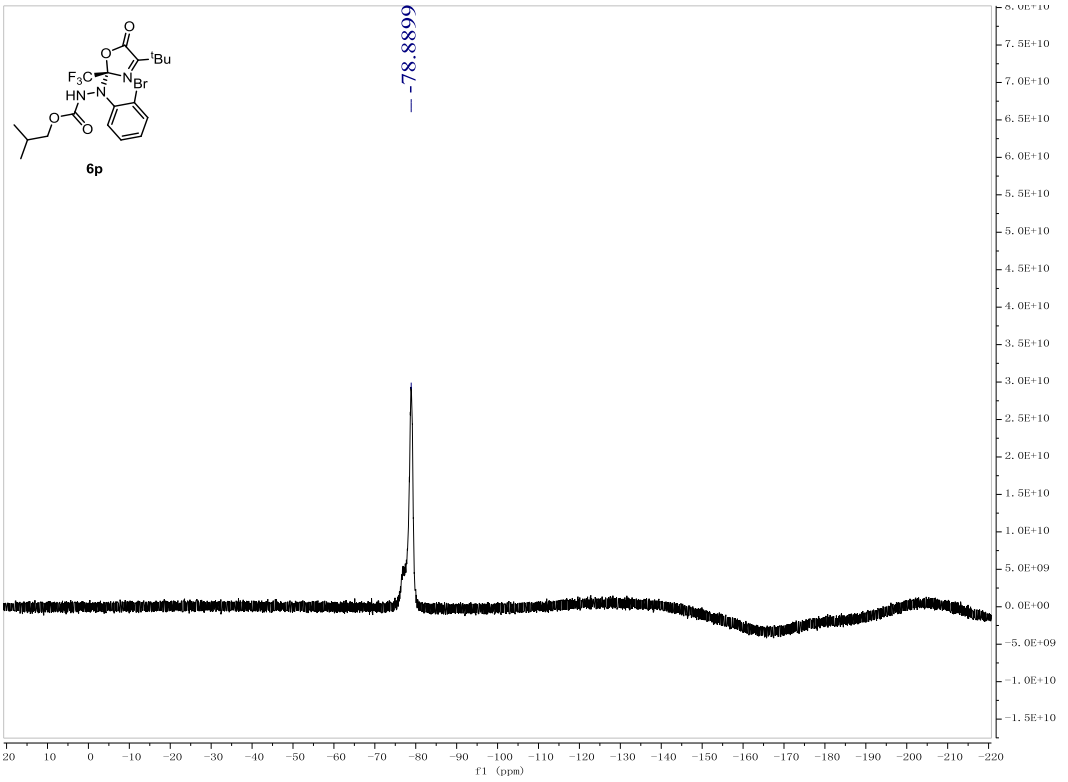
^{1}H NMR of 6p (400 MHz, $CDCl_3$)



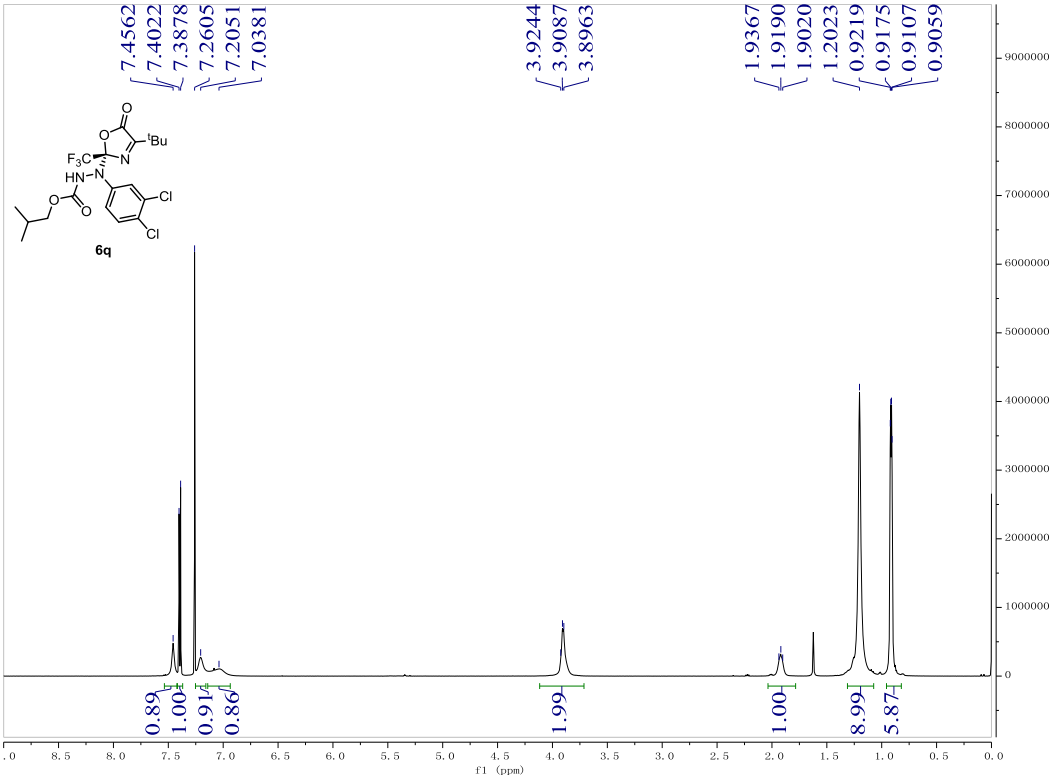
^{13}C{^{1}H} NMR of 6p (150 MHz, $CDCl_3$)



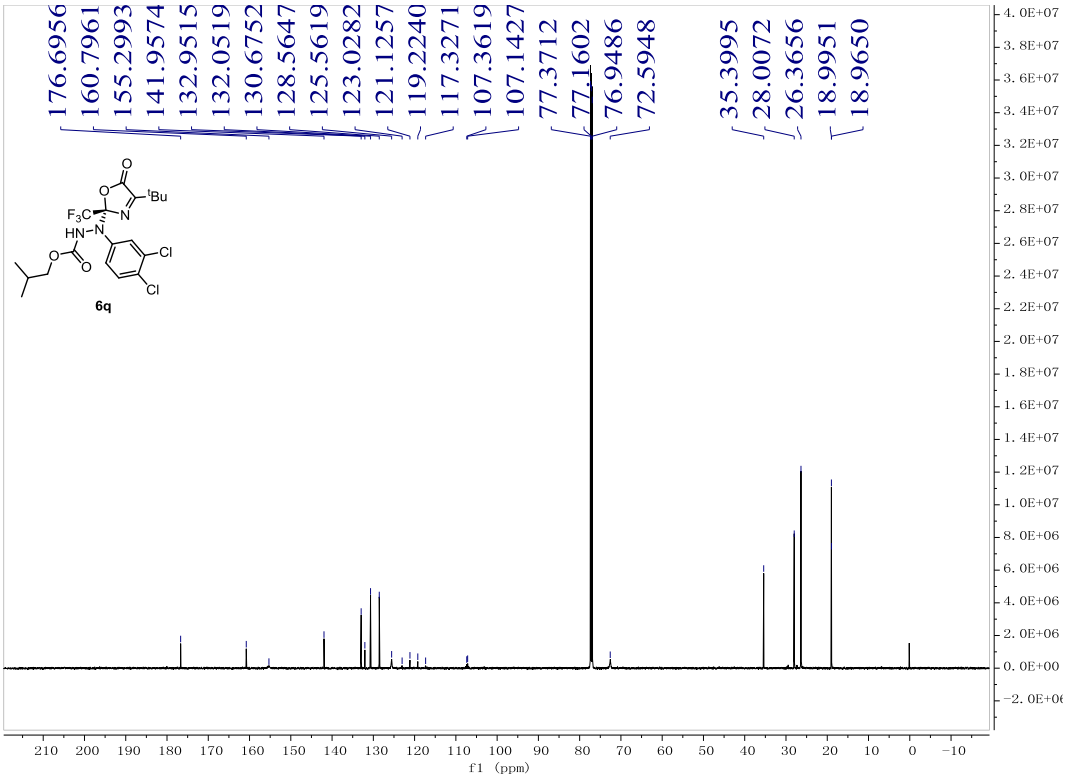
$^{19}F\{^{1}H\}$ NMR of 6p (376 MHz, $CDCl_3$)



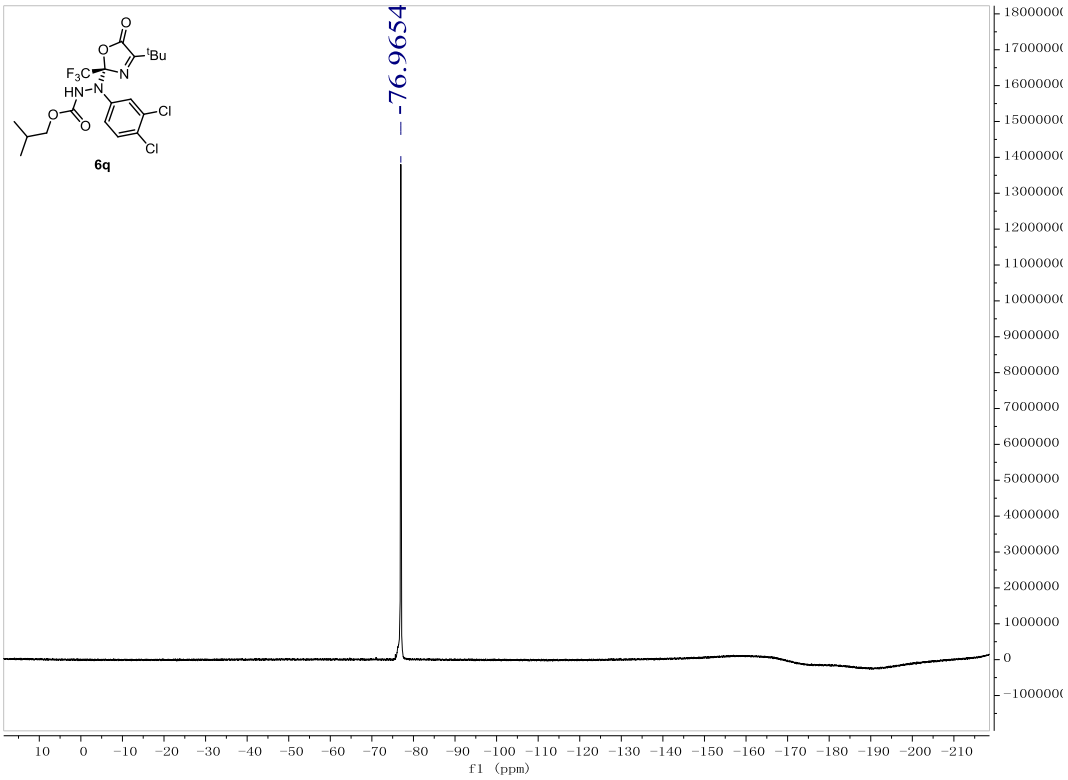
^{1}H NMR of 6q (600 MHz, $CDCl_3$)



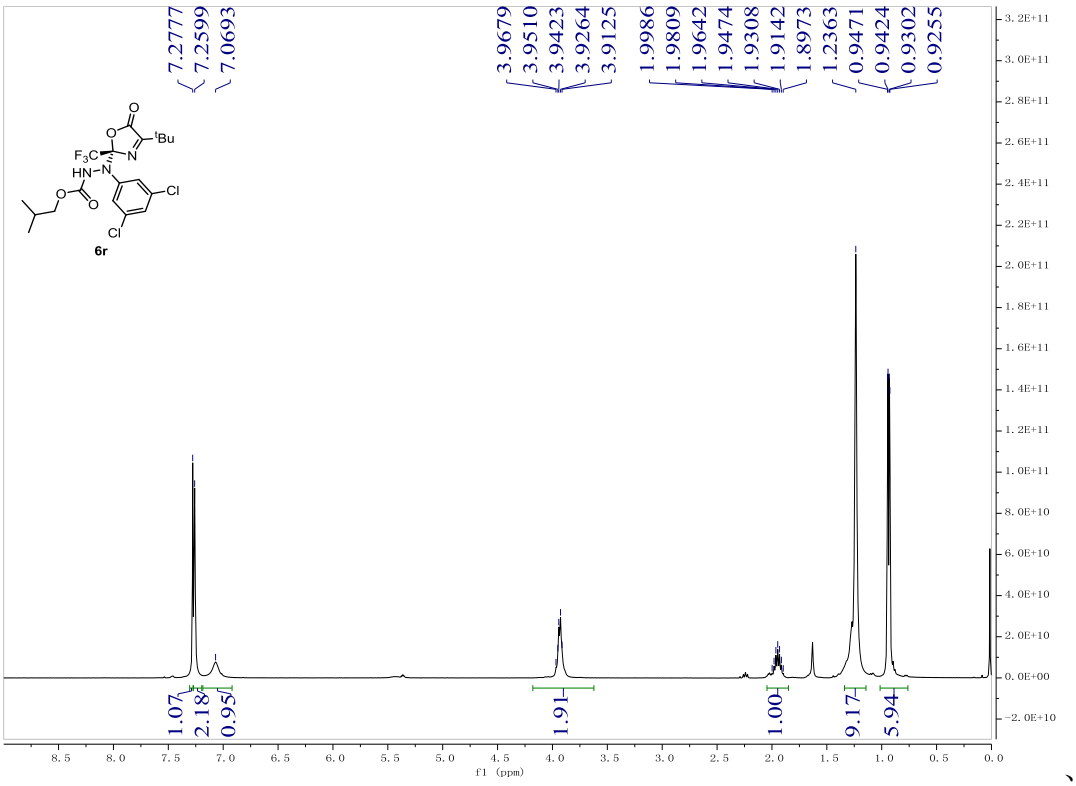
$^{13}C\{^{1}H\}$ NMR of 6q(150 MHz, $CDCl_3$)



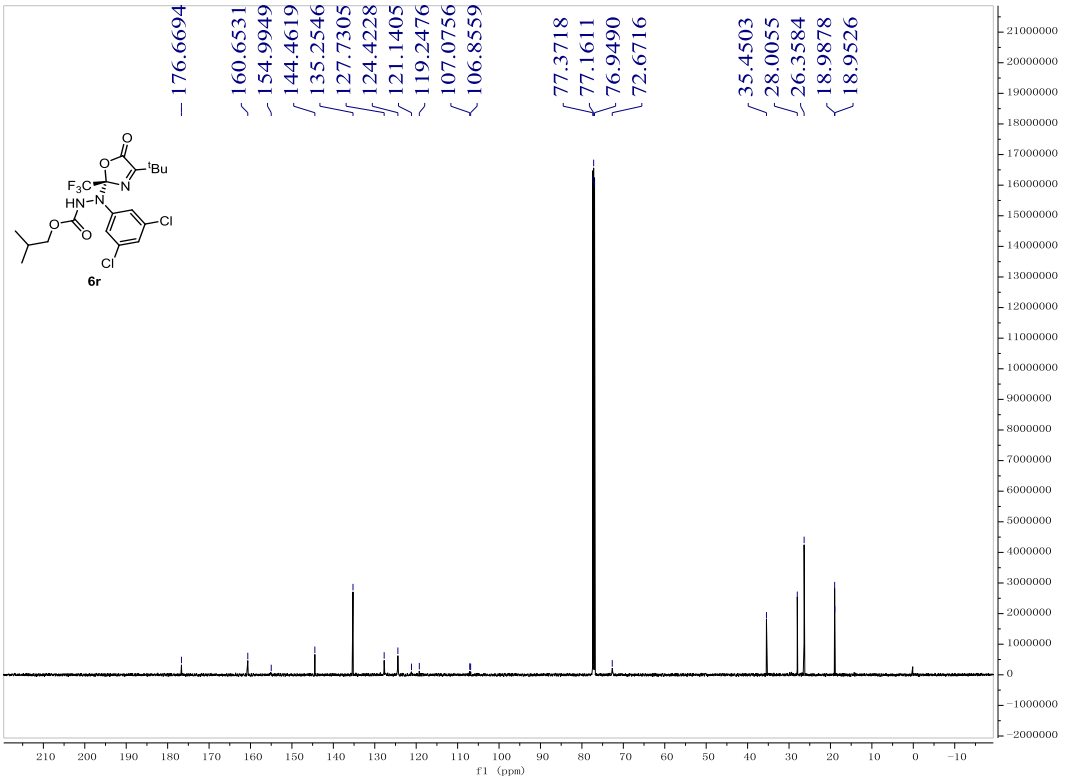
$^{19}F\{^{1}H\}$ NMR of 6q (564 MHz, $CDCl_3$)



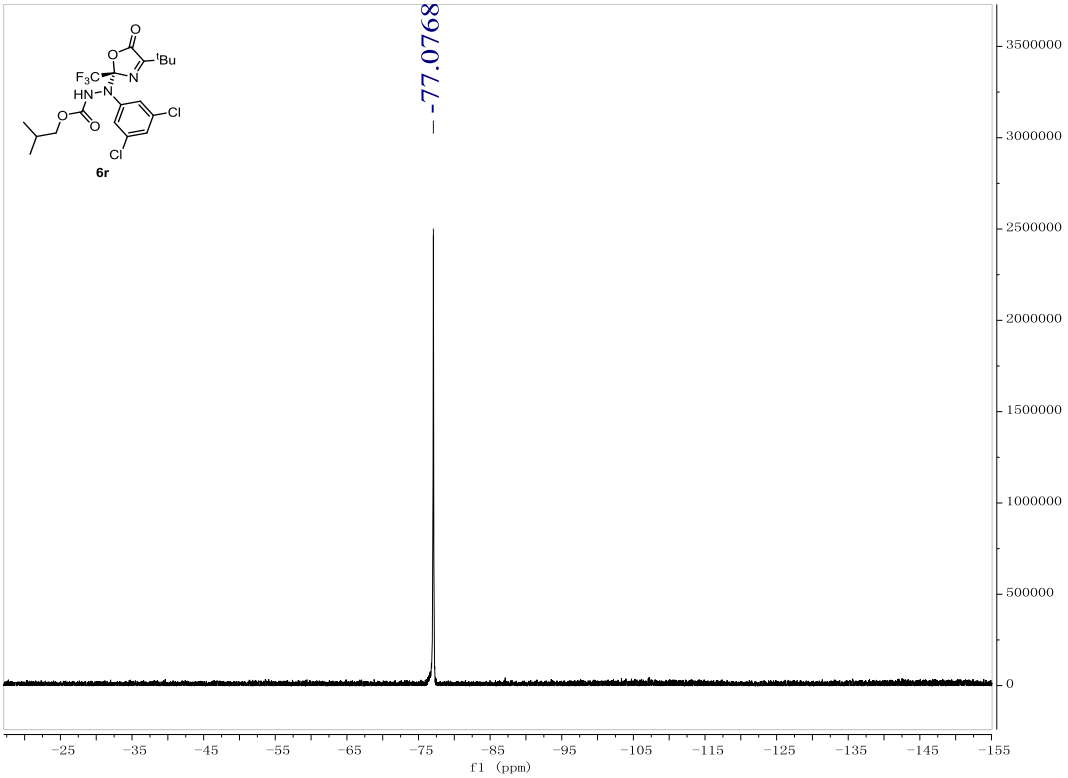
^{1}H NMR of 6r (400 MHz, $CDCl_3$)



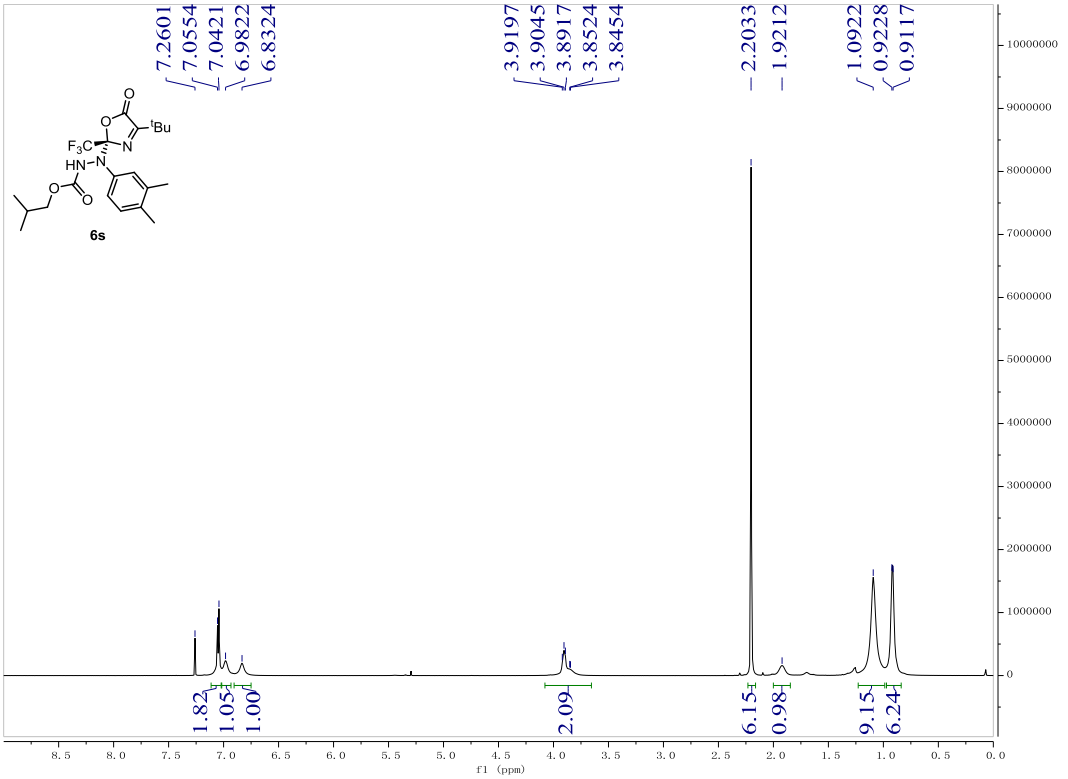
^{13}C{^{1}H} NMR of 6r (150 MHz, $CDCl_3$)



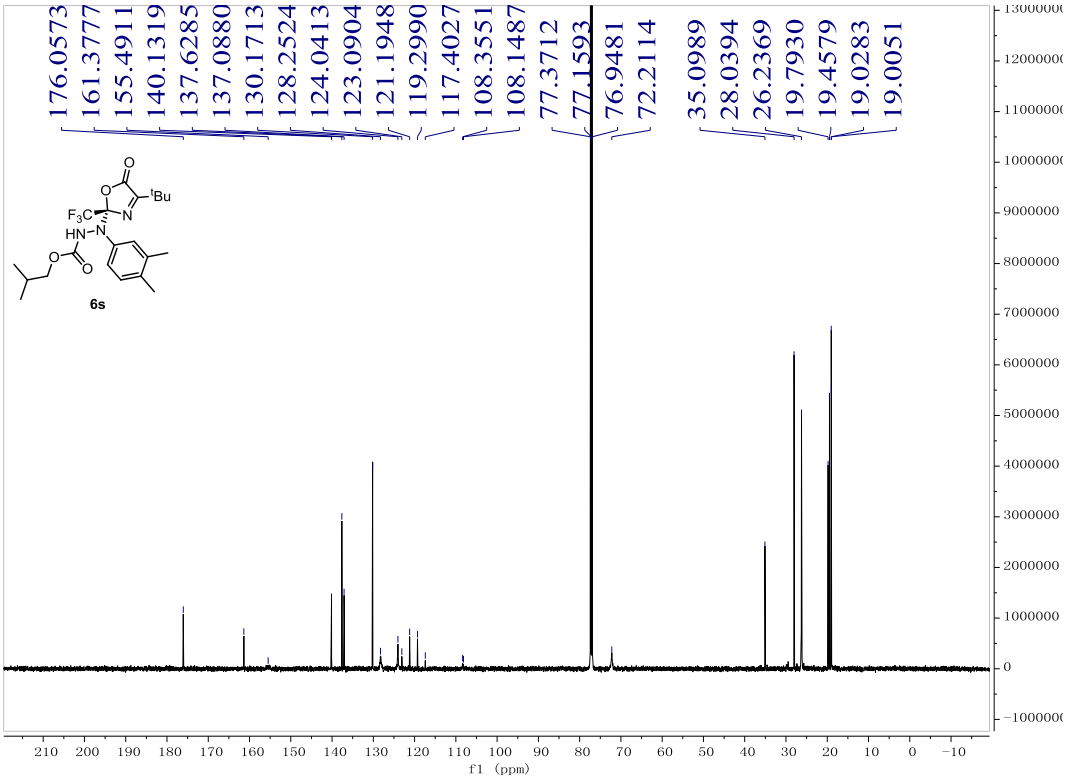
$^{19}F\{^{1}H\}$ NMR of 6r (564 MHz, $CDCl_3$)



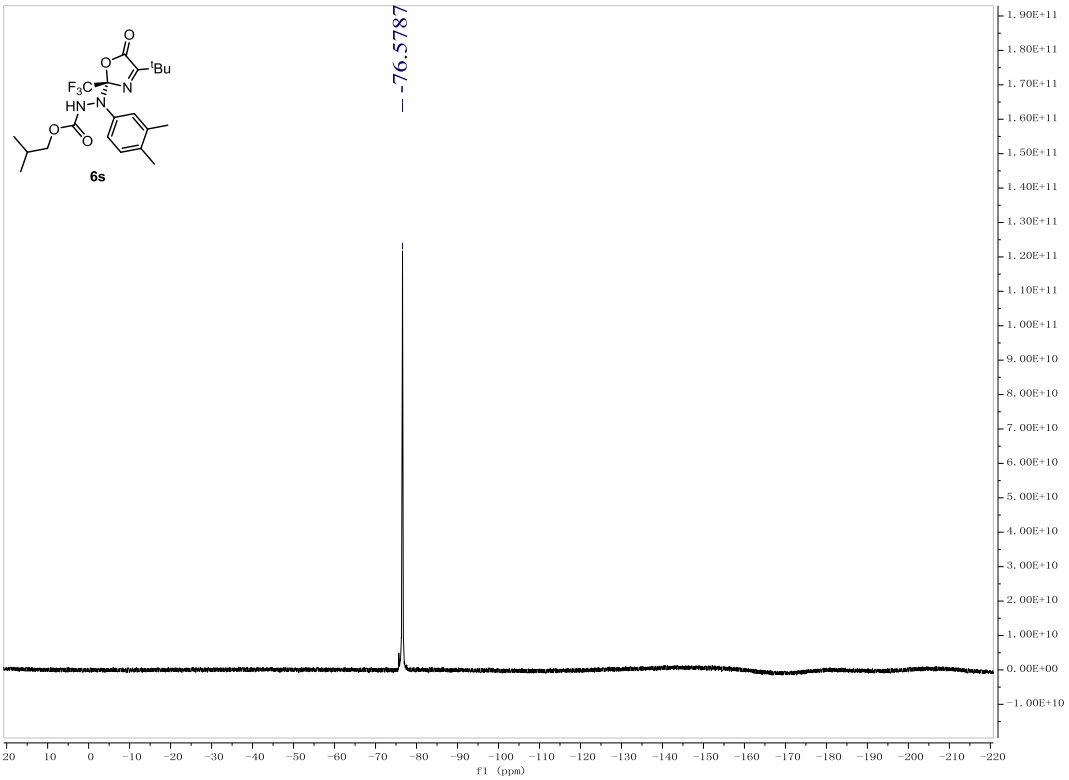
^{1}H NMR of 6s (600 MHz, $CDCl_3$)



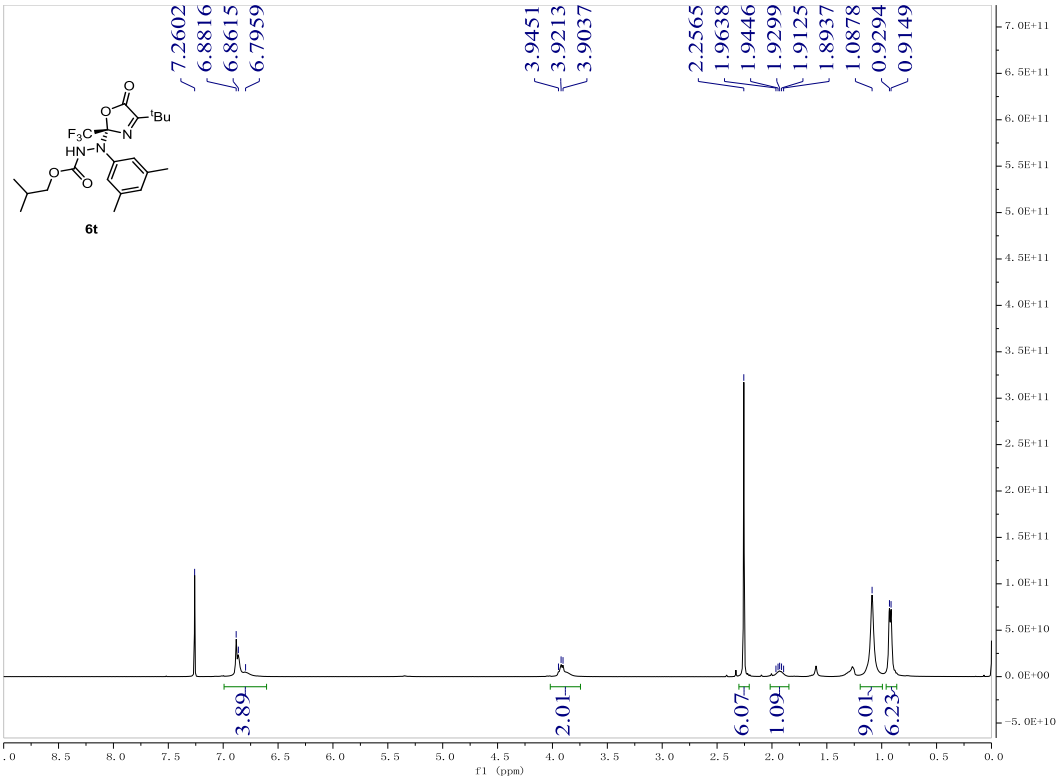
$^{13}C\{^{1}H\}$ NMR of 6s (150 MHz, $CDCl_3$)



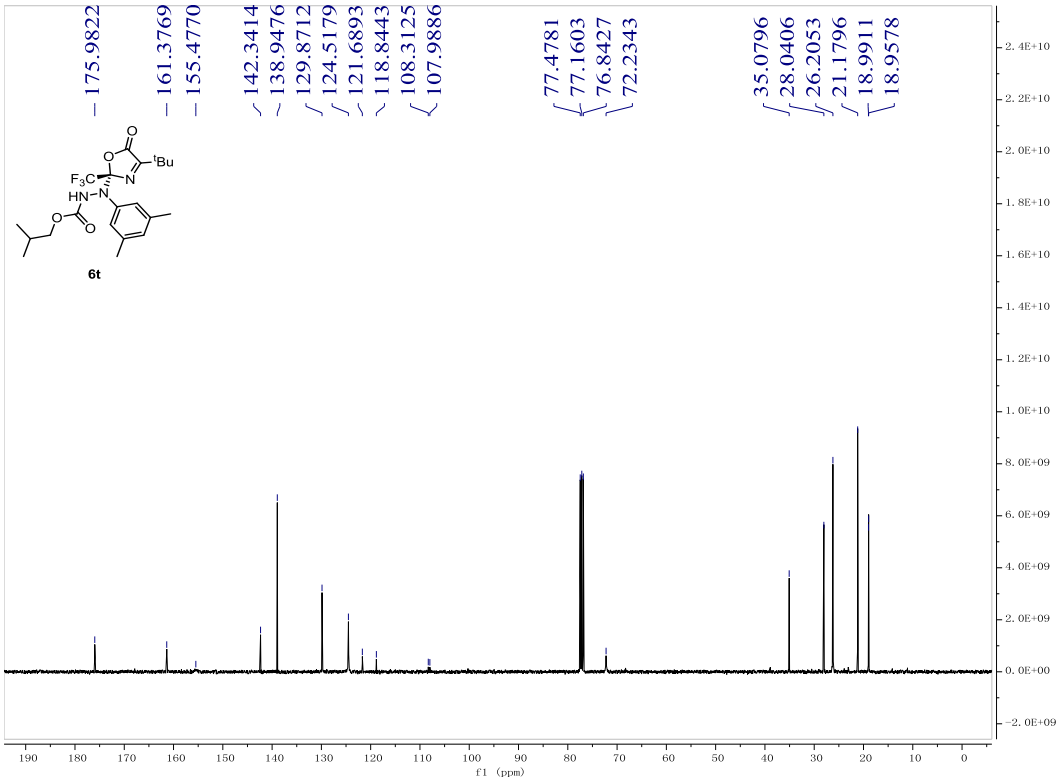
$^{19}F\{^{1}H\}$ NMR of 6s (376 MHz, $CDCl_3$)



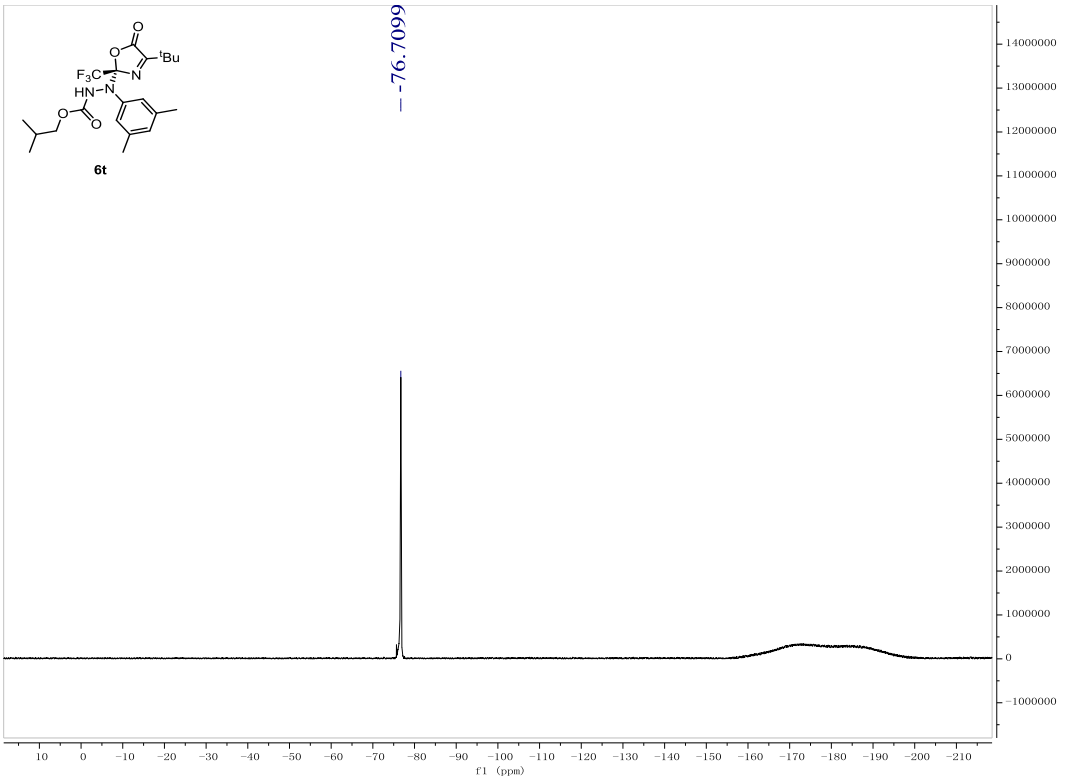
^{1}H NMR of 6t (400 MHz, $CDCl_3$)



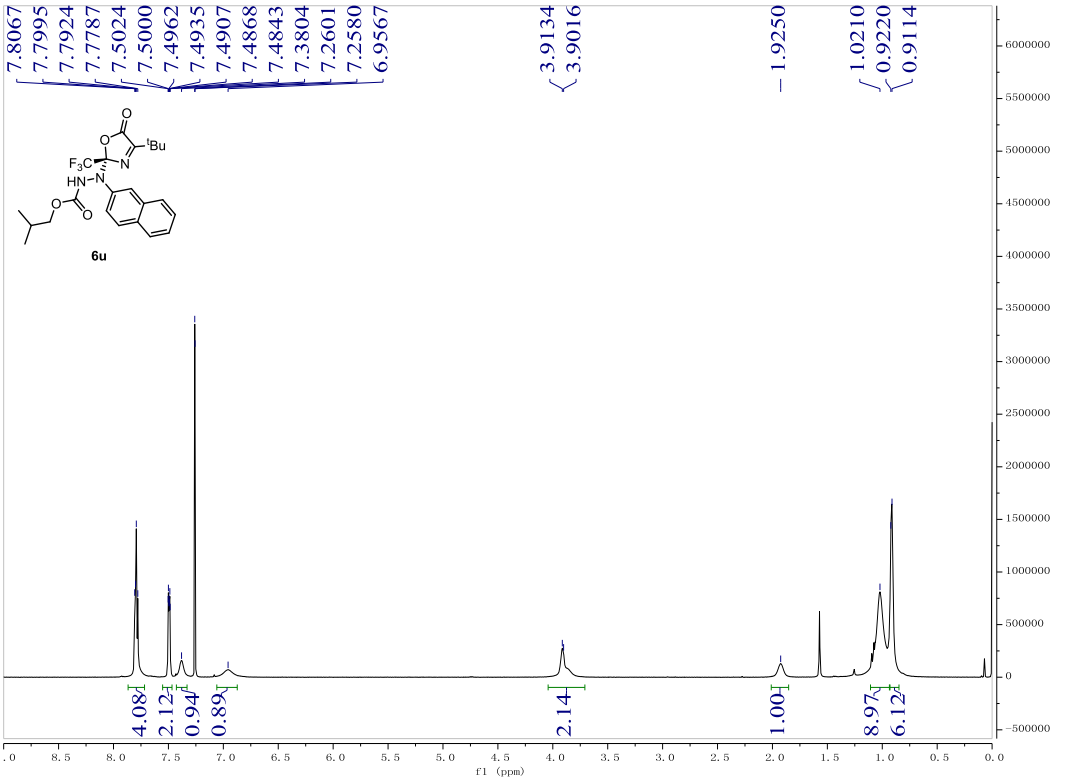
^{13}C{^{1}H} NMR of 6t (100 MHz, $CDCl_3$)



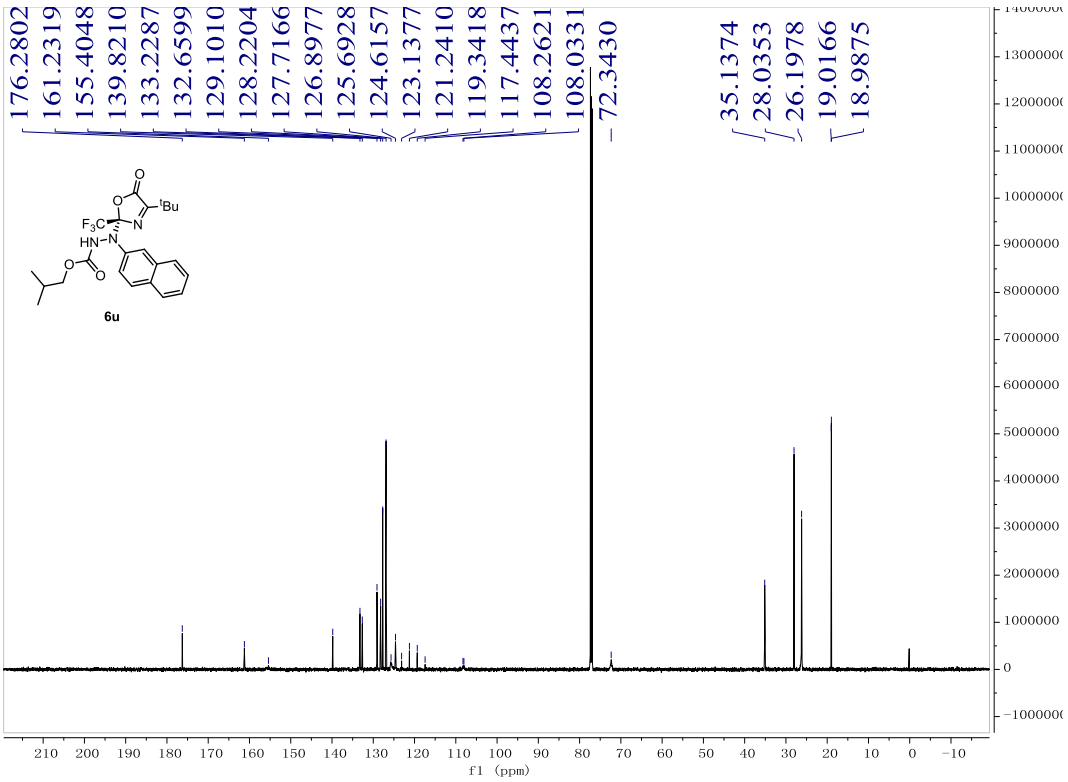
$^{19}F\{^{1}H\}$ NMR of 6t (564 MHz, $CDCl_3$)



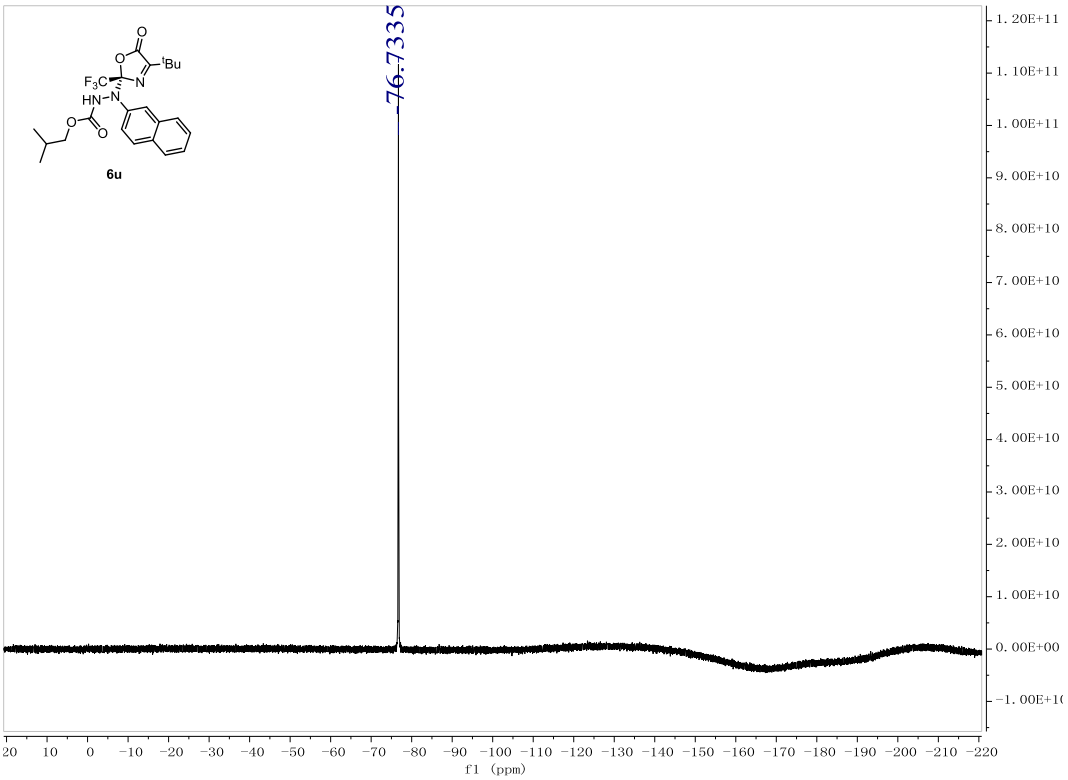
^{1}H NMR of 6u (600 MHz, $CDCl_3$)



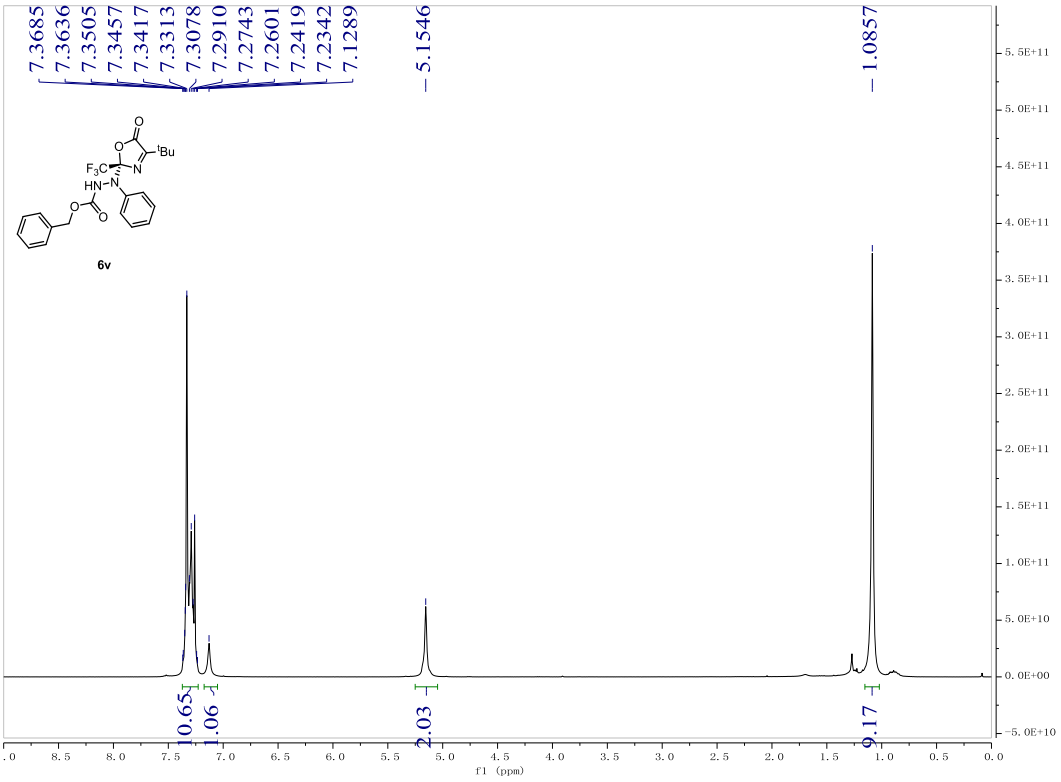
$^{13}C\{^{1}H\}$ NMR of 6u (150 MHz, $CDCl_3$)



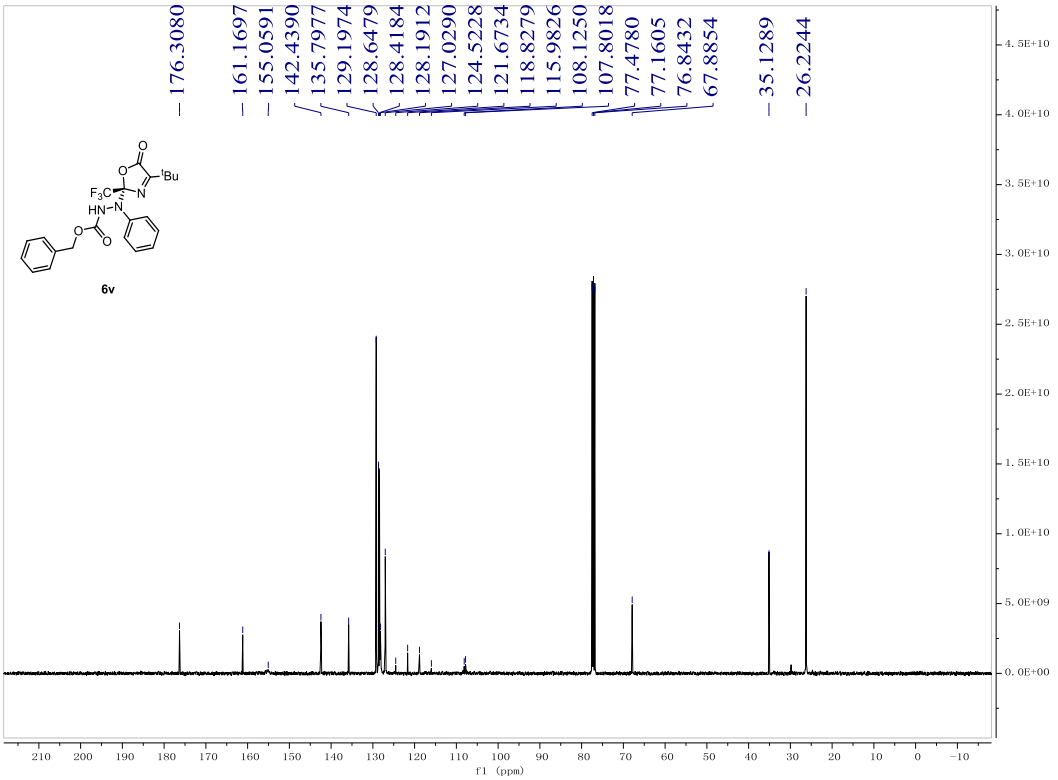
$^{19}F\{^{1}H\}$ NMR of 6u (376 MHz, $CDCl_3$)



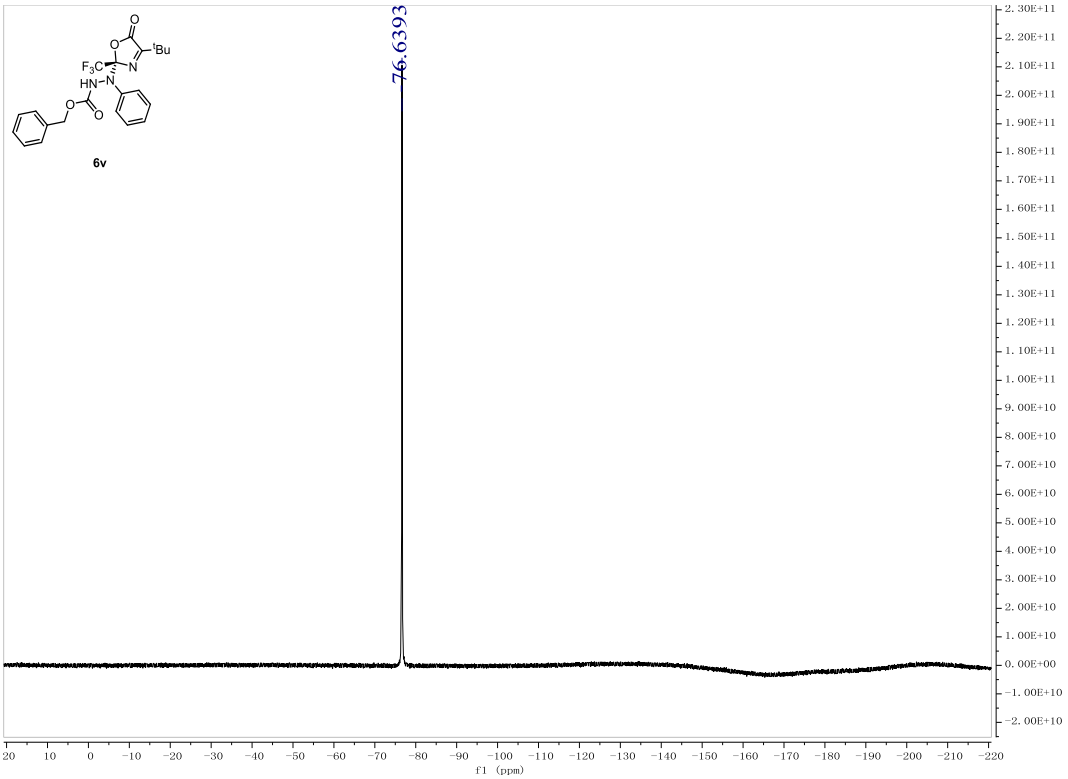
^{1}H NMR of 6v (400 MHz, $CDCl_3$)



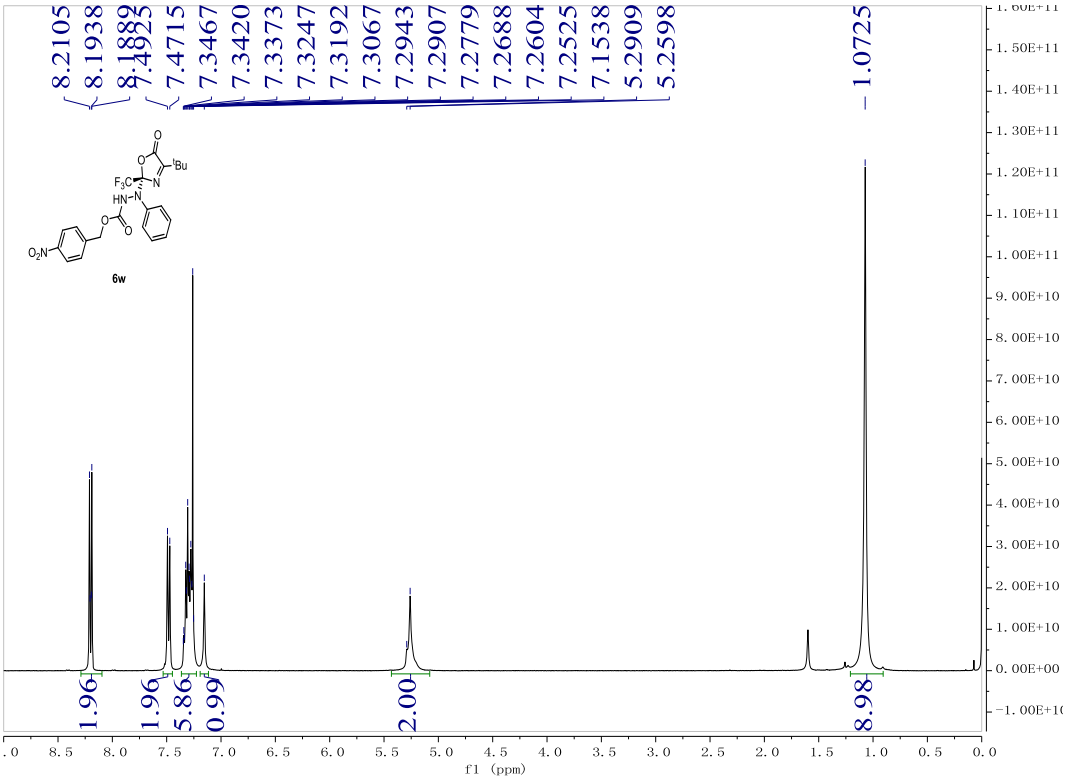
^{13}C{^{1}H} NMR of 6v (150 MHz, $CDCl_3$)



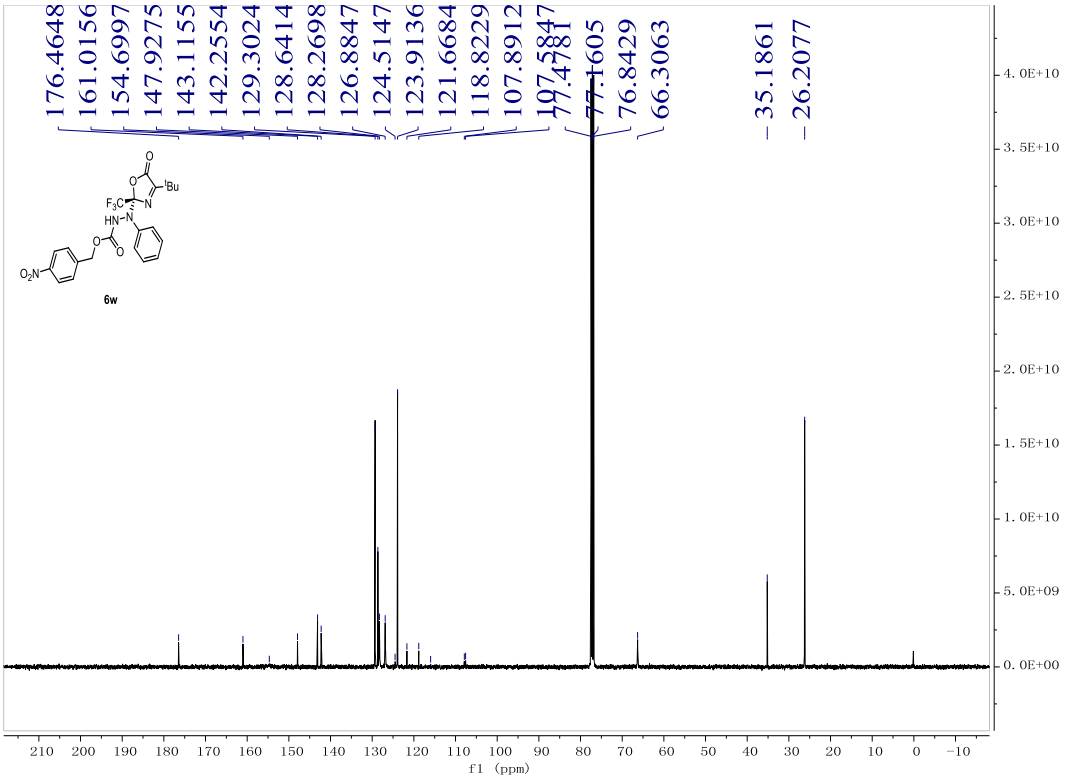
$^{19}F\{^{1}H\}$ NMR of 6v (376 MHz, $CDCl_3$)



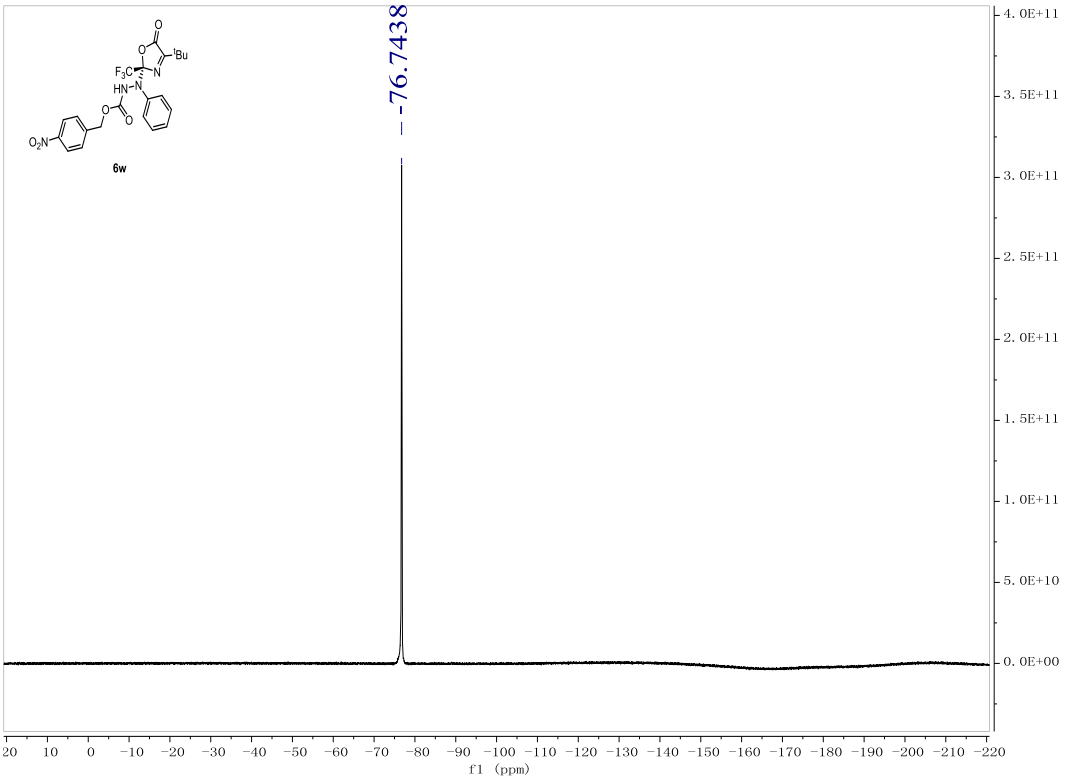
^{1}H NMR of 6w (400 MHz, $CDCl_3$)



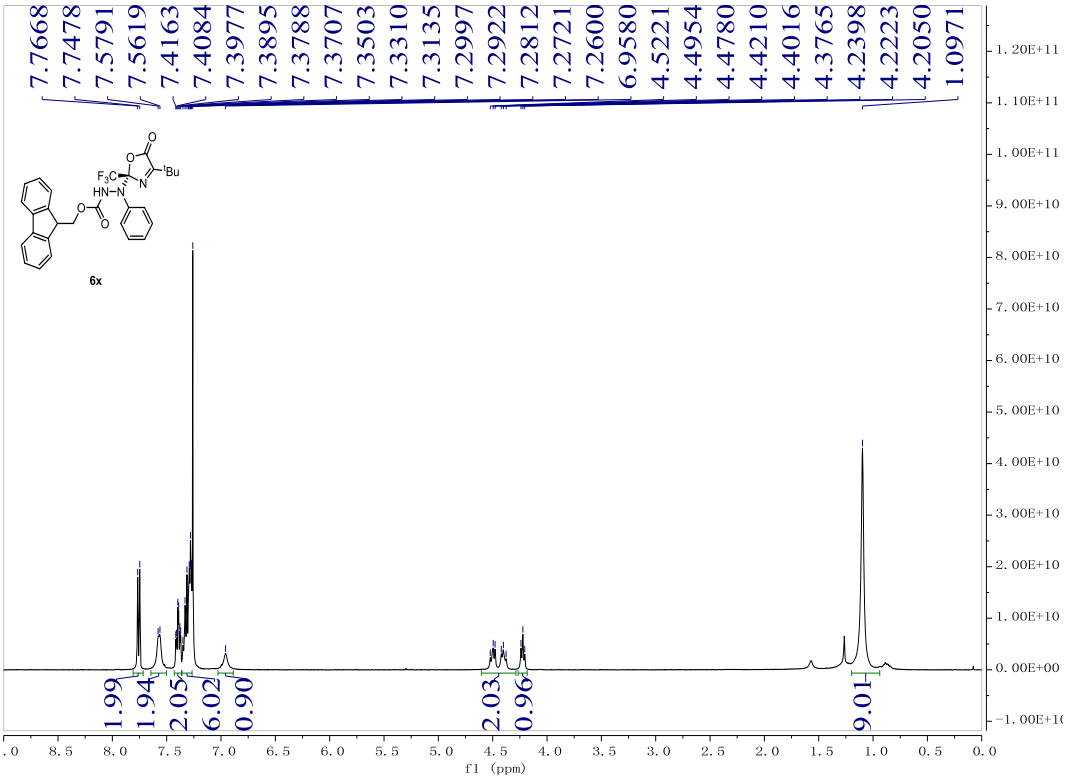
$^{13}C\{^{1}H\}$ NMR of 6w (100 MHz, $CDCl_3$)



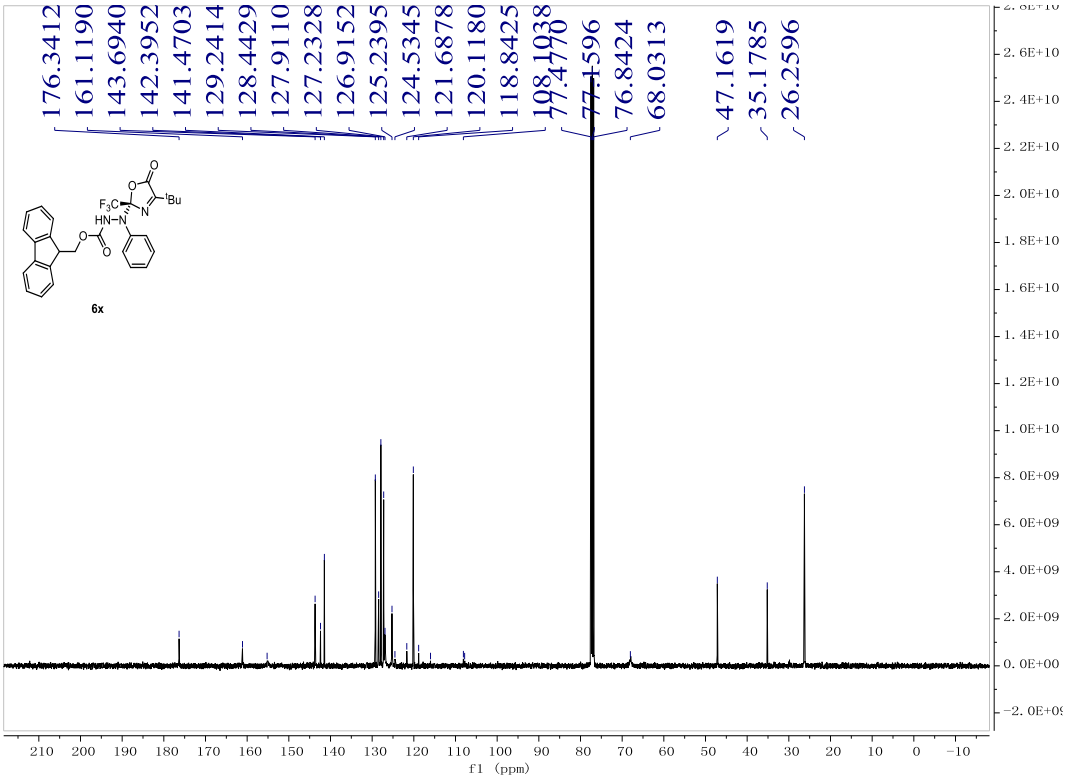
$^{19}F\{^{1}H\}$ NMR of 6w (376 MHz, $CDCl_3$)



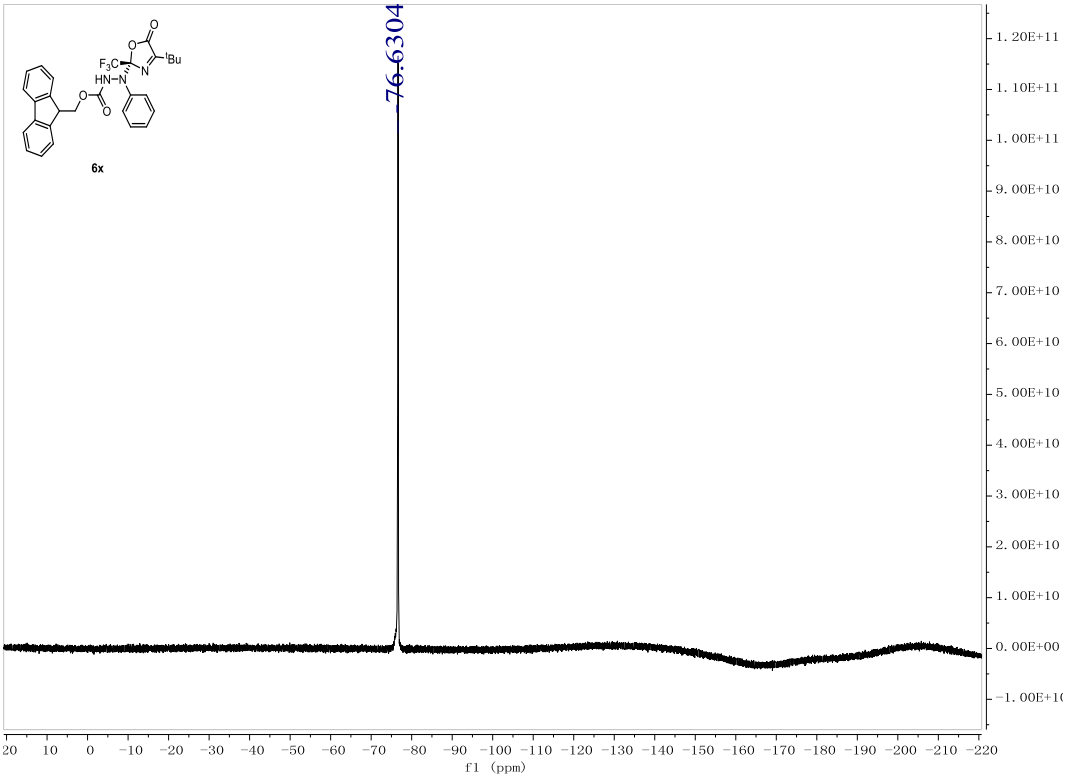
^{1}H NMR of 6x (400 MHz, $CDCl_3$)



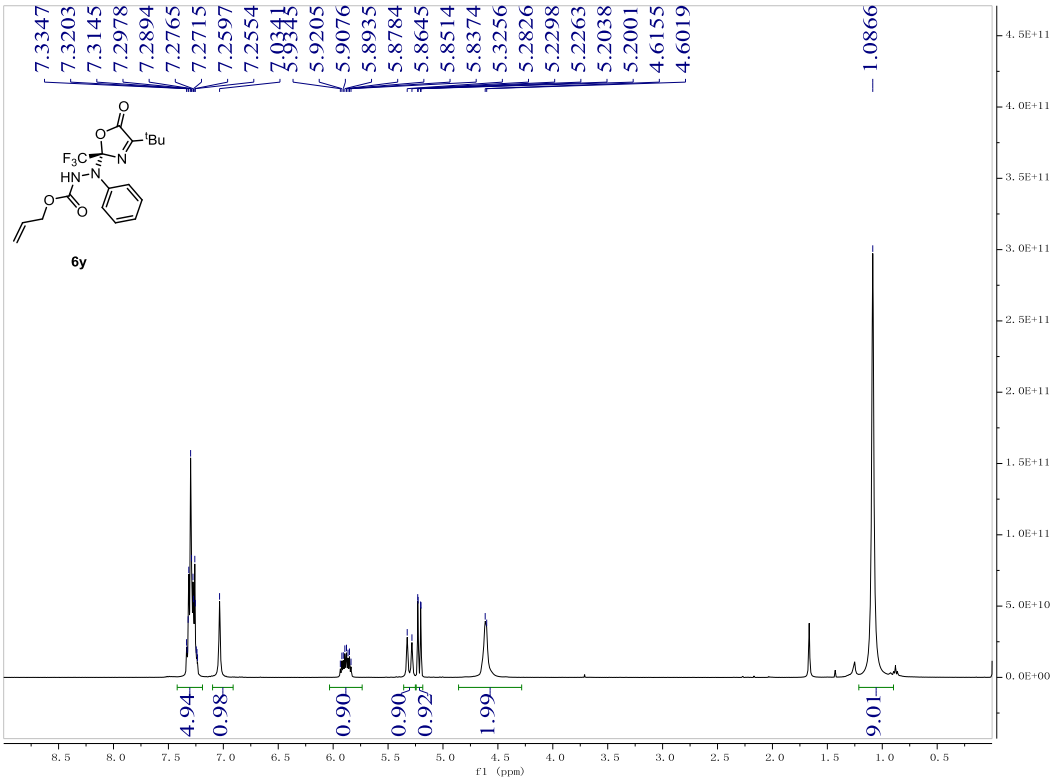
^{13}C{^{1}H} NMR of 6x (100 MHz, $CDCl_3$)



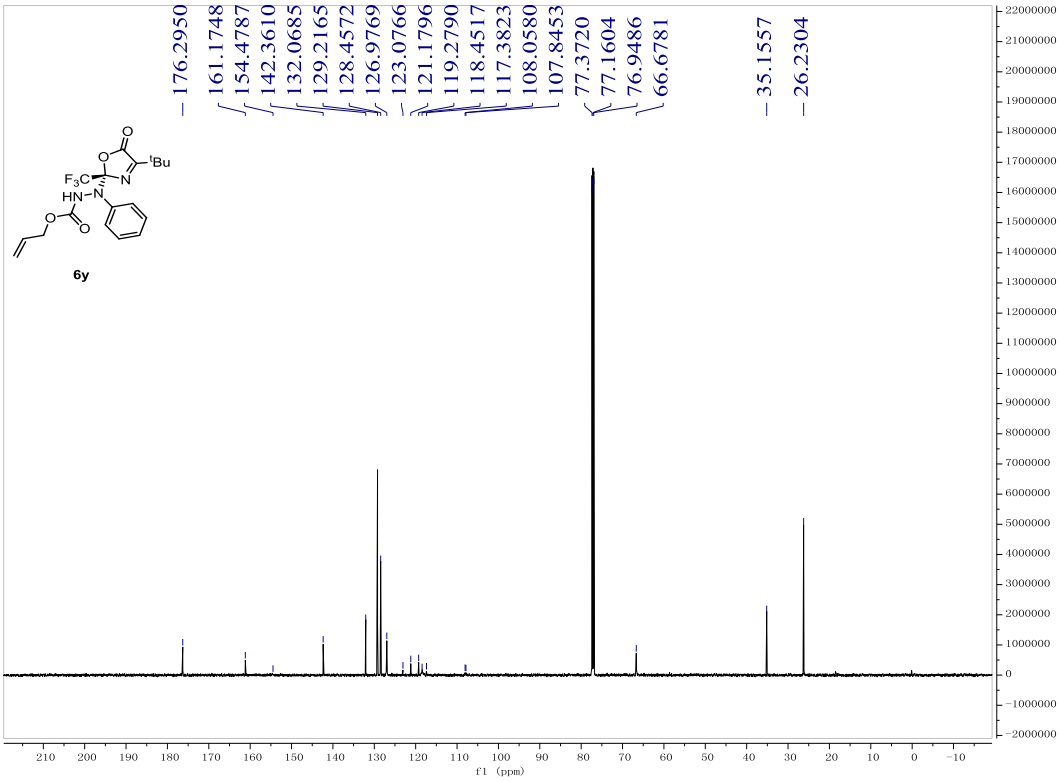
$^{19}F\{^{1}H\}$ NMR of 6x (376 MHz, $CDCl_3$)



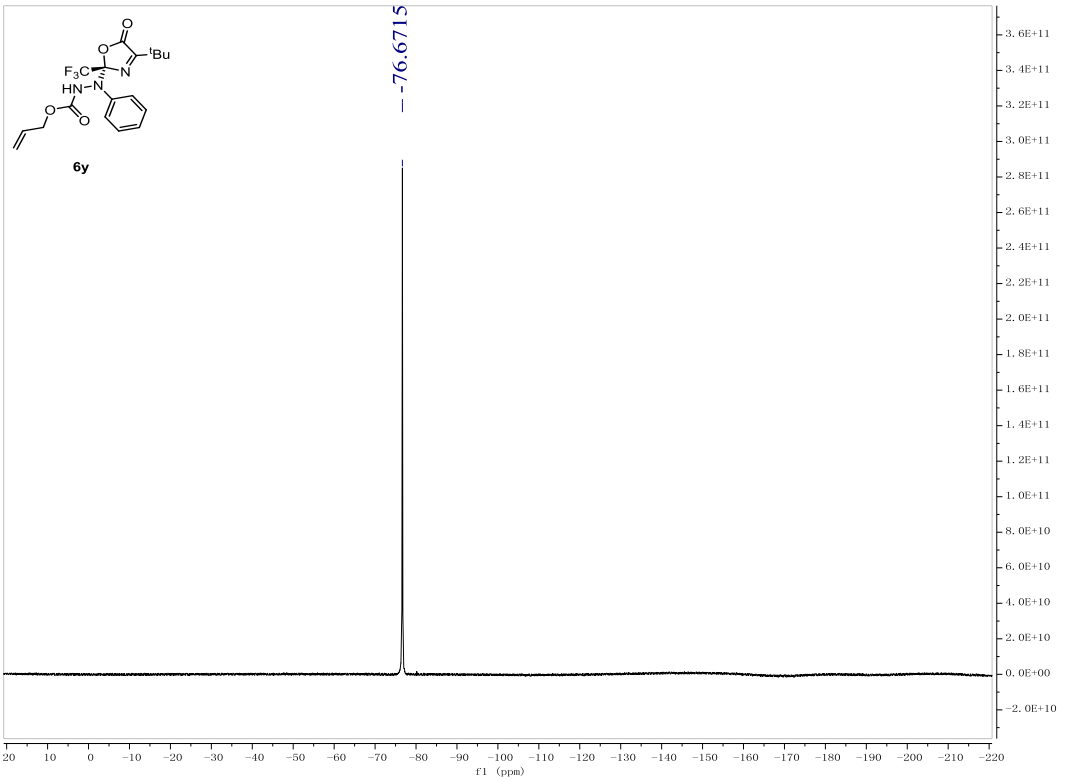
^{1}H NMR of 6y (400 MHz, $CDCl_3$)



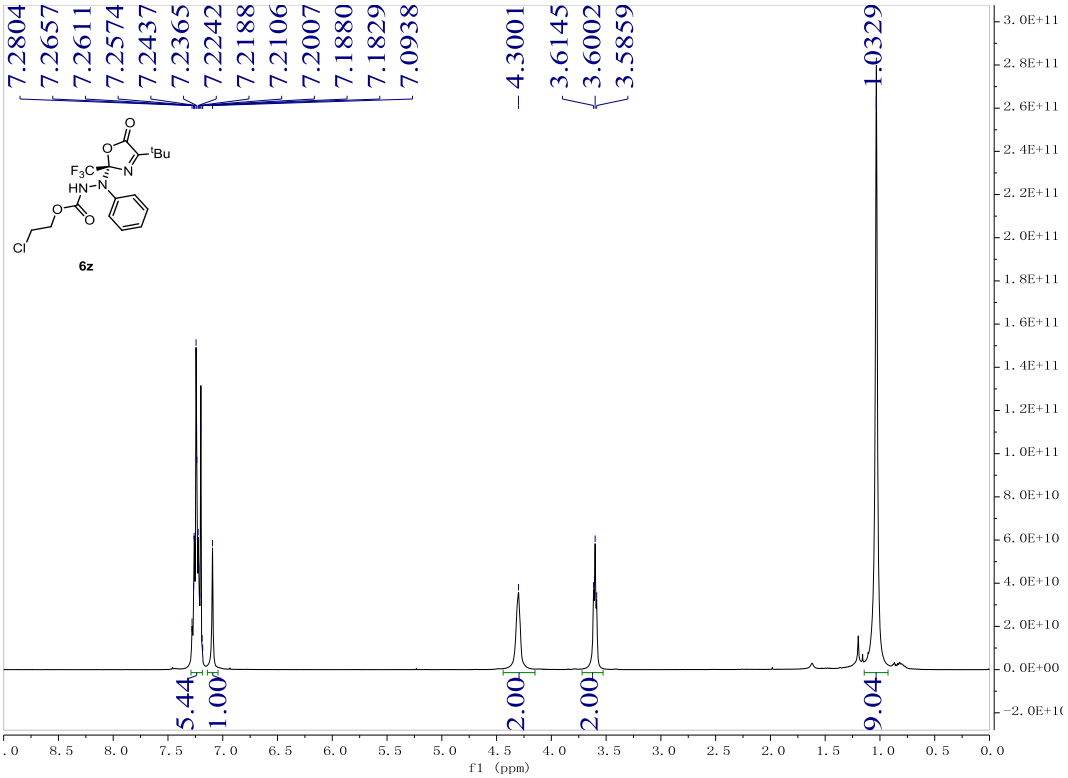
$^{13}C\{^{1}H\}$ NMR of 6y (150 MHz, $CDCl_3$)



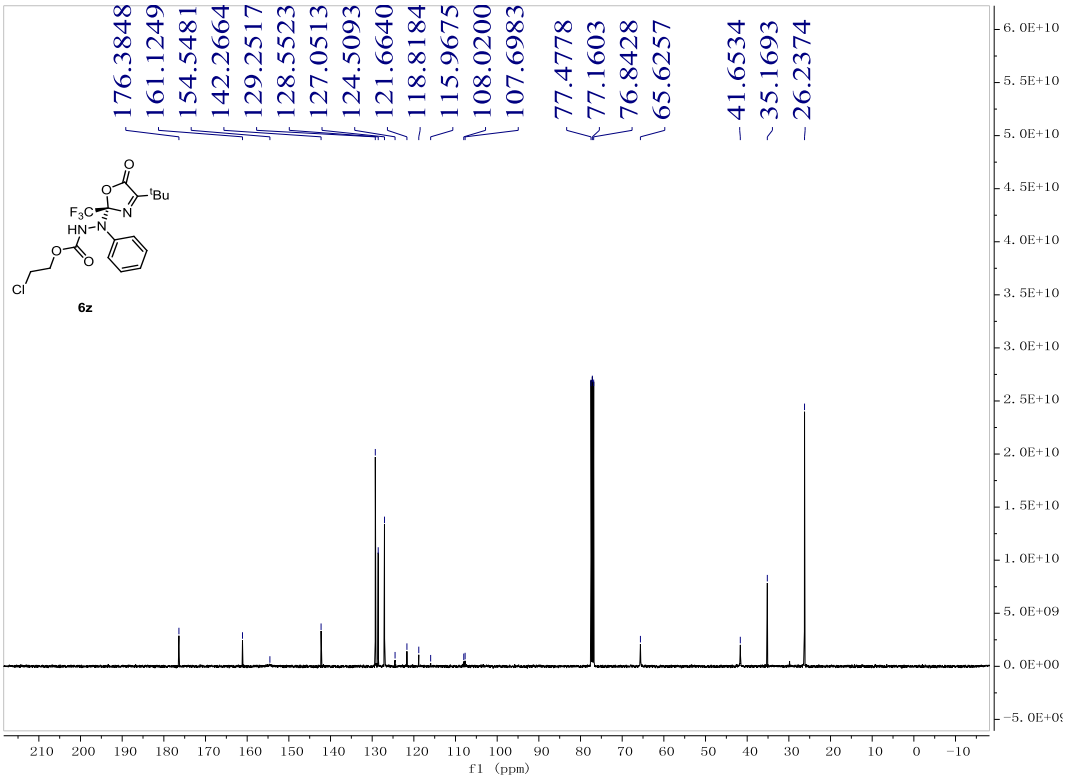
$^{19}F\{^{1}H\}$ NMR of 6y (376 MHz, $CDCl_3$)



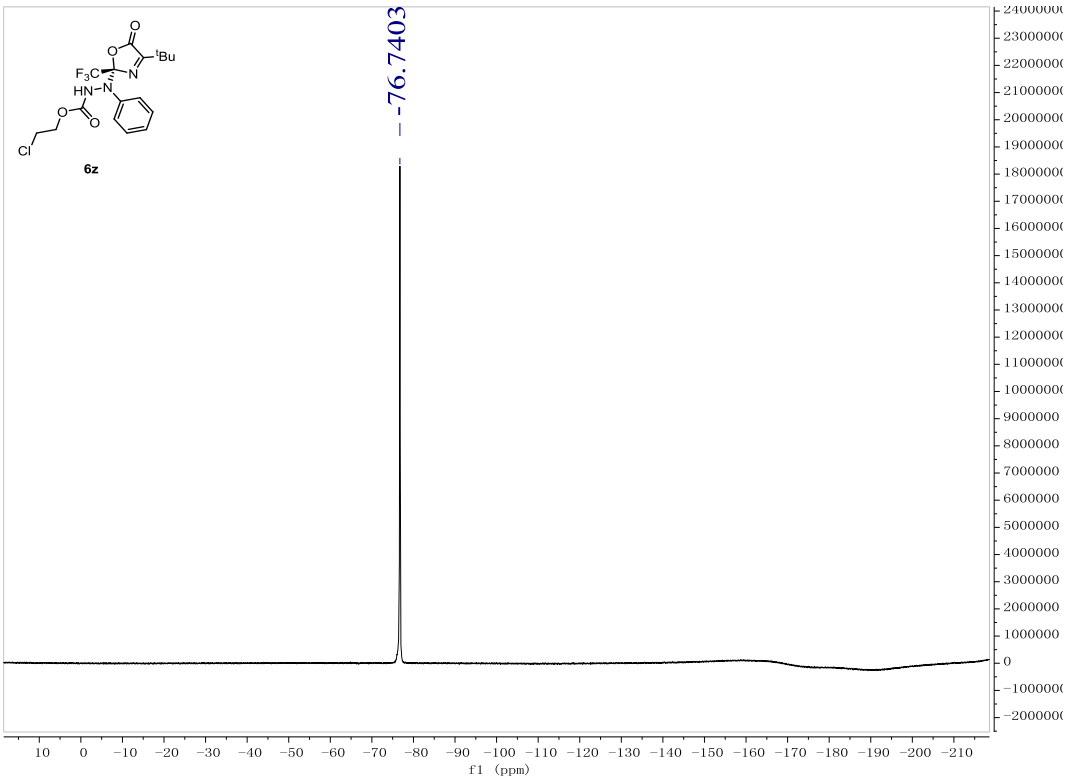
^{1}H NMR of 6z (400 MHz, $CDCl_3$)



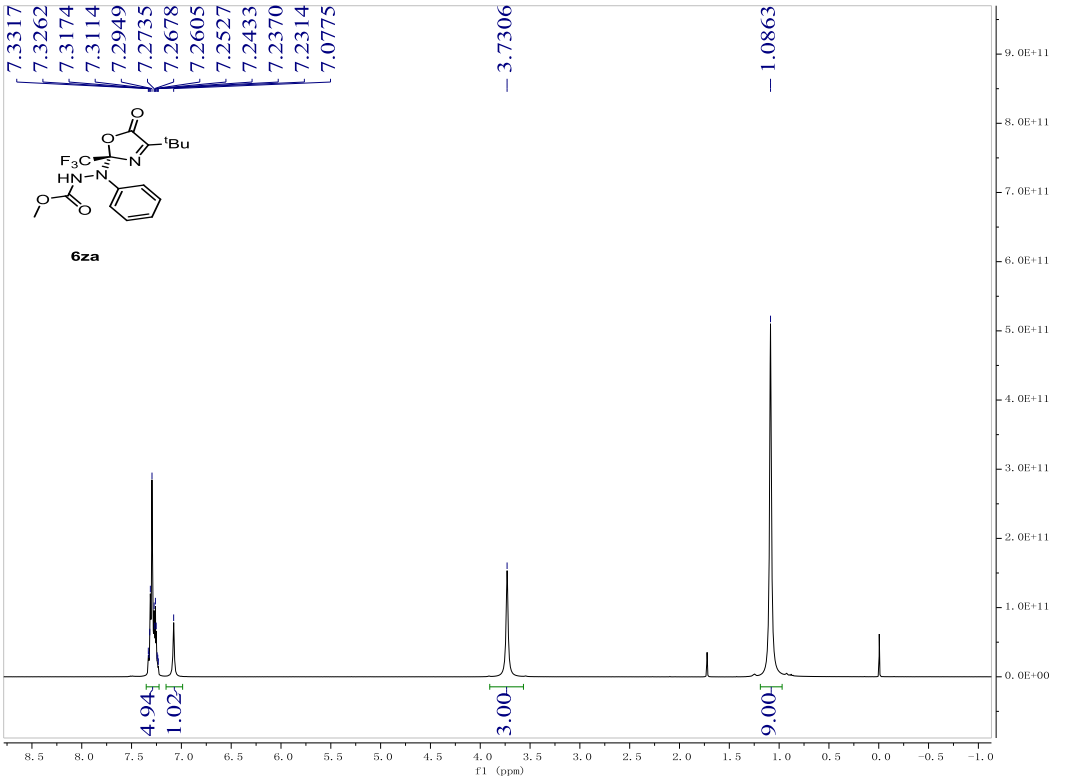
^{13}C{^{1}H} NMR of 6z (100 MHz, $CDCl_3$)



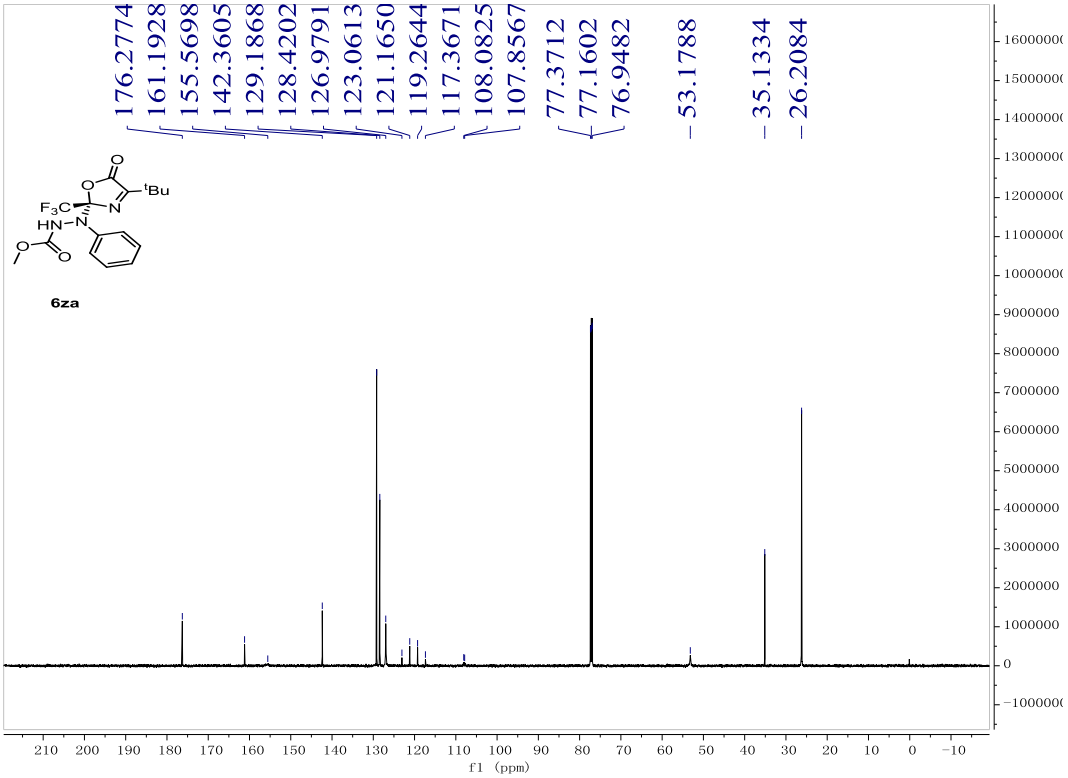
$^{19}F\{^{1}H\}$ NMR of 6z (564 MHz, $CDCl_3$)



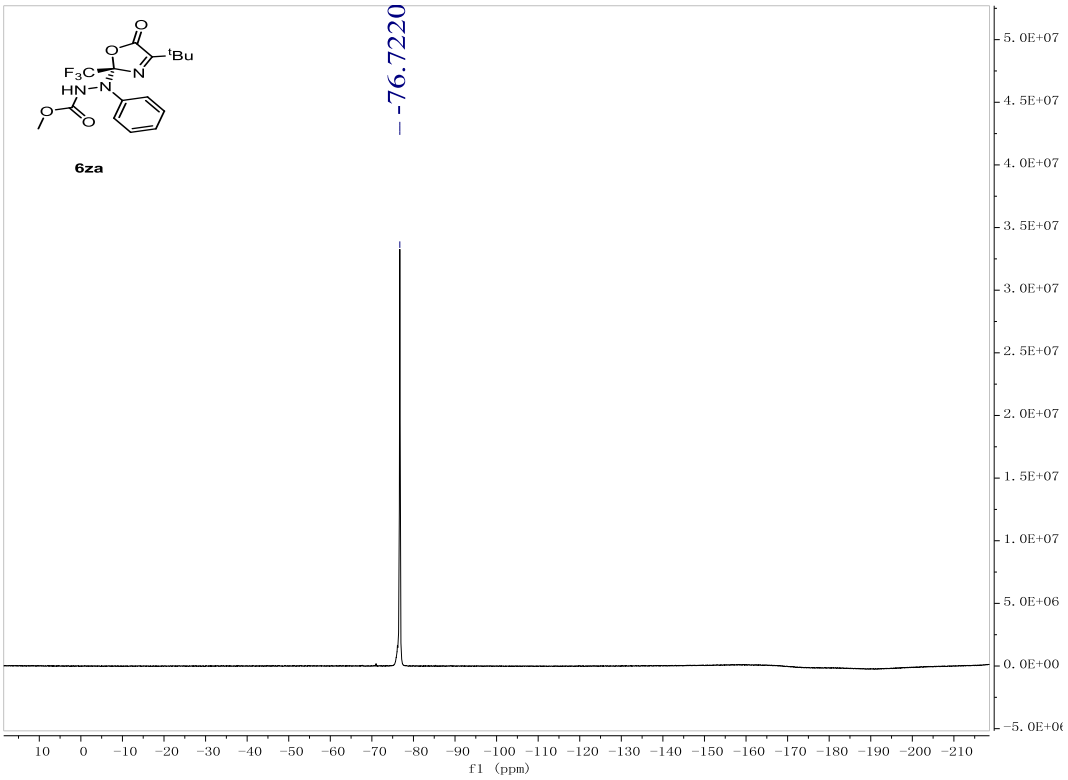
^{1}H NMR of 6za (400 MHz, $CDCl_3$)



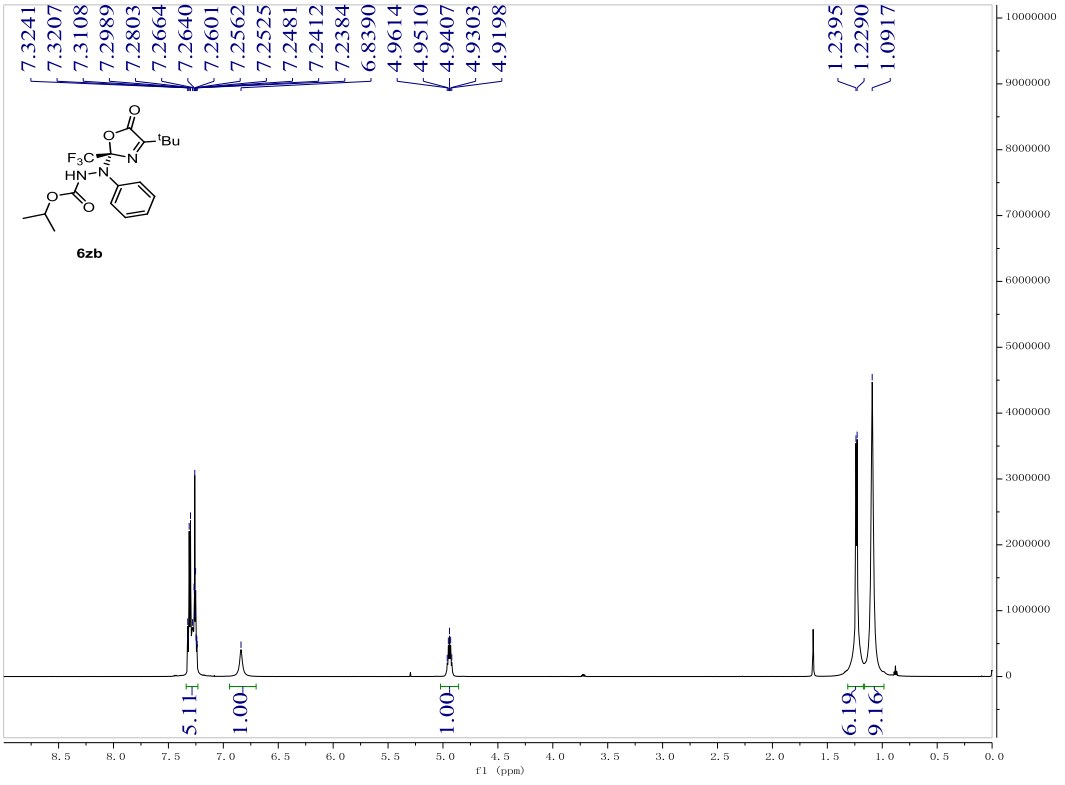
$^{13}C\{^{1}H\}$ NMR of 6za (150 MHz, $CDCl_3$)



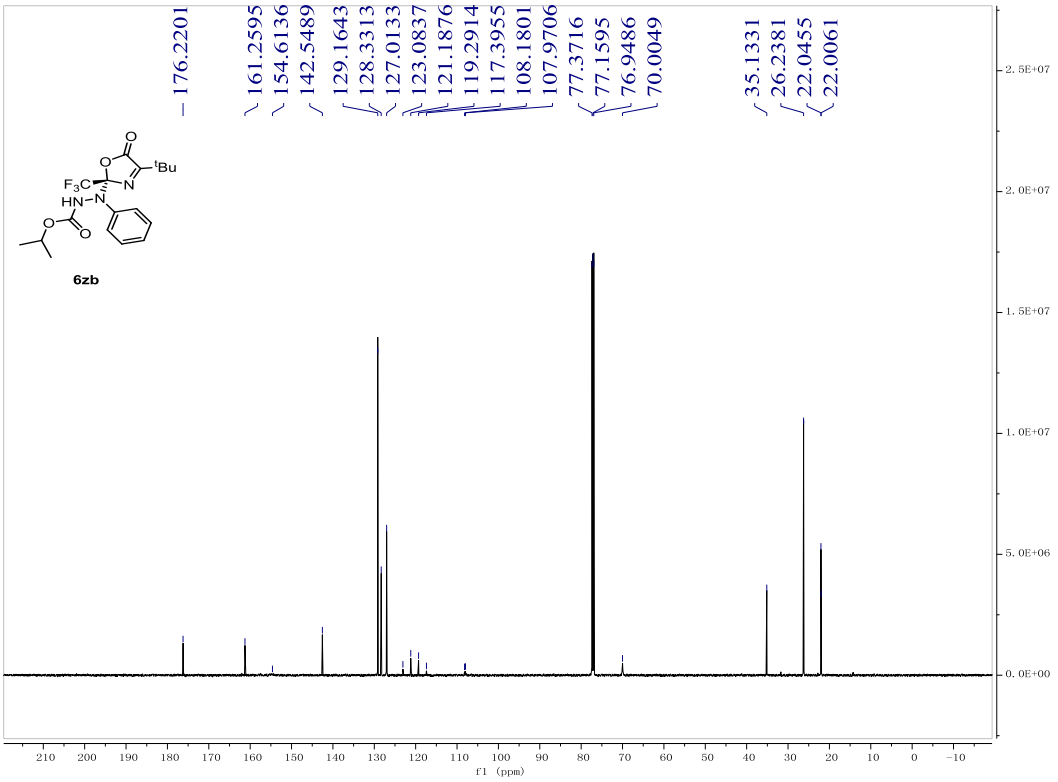
$^{19}F\{^{1}H\}$ NMR of 6za (564 MHz, $CDCl_3$)



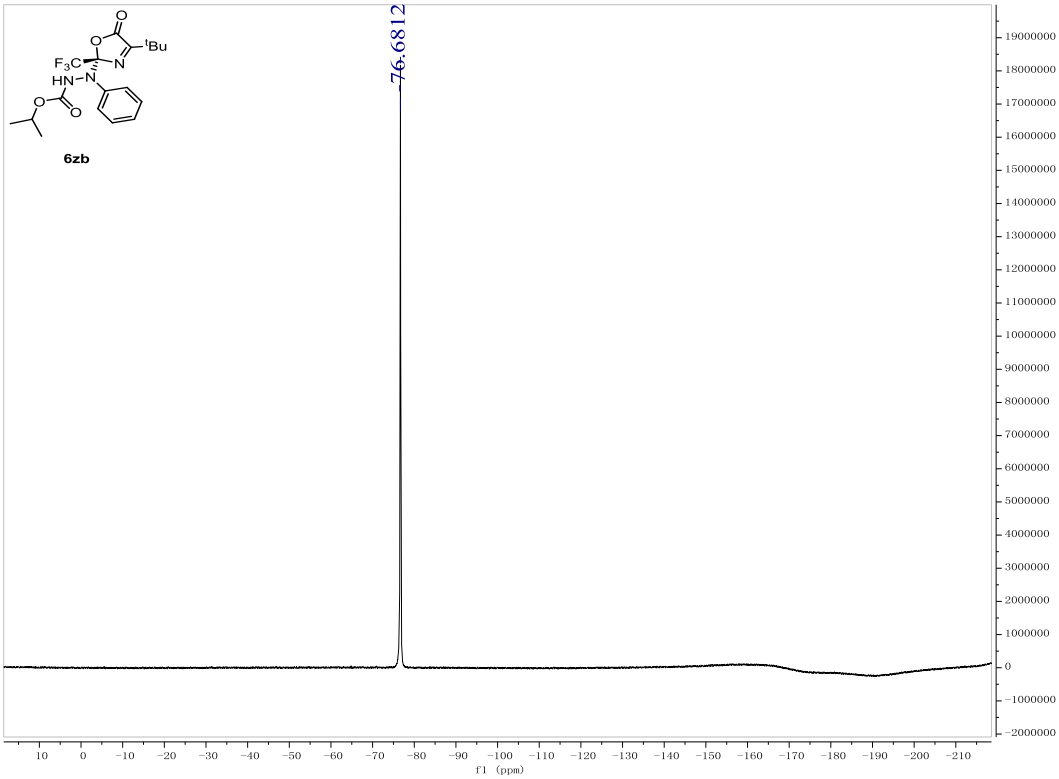
^{1}H NMR of 6zb (600 MHz, $CDCl_3$)



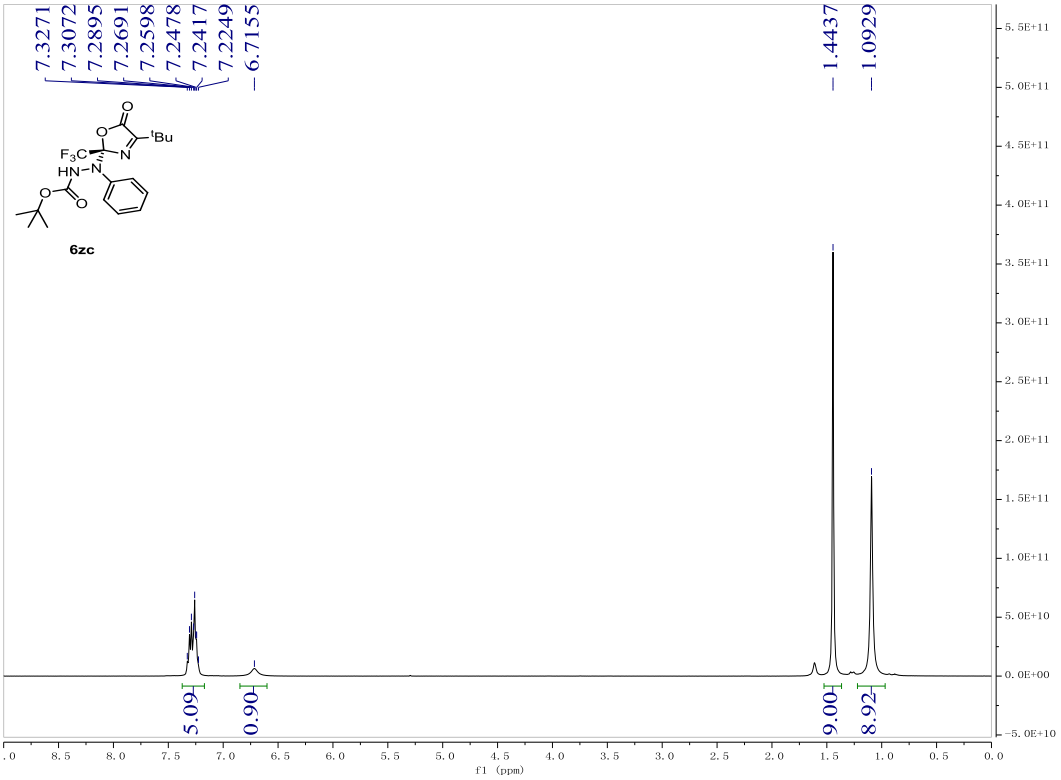
^{13}C{^{1}H} NMR of 6zb (150 MHz, $CDCl_3$)



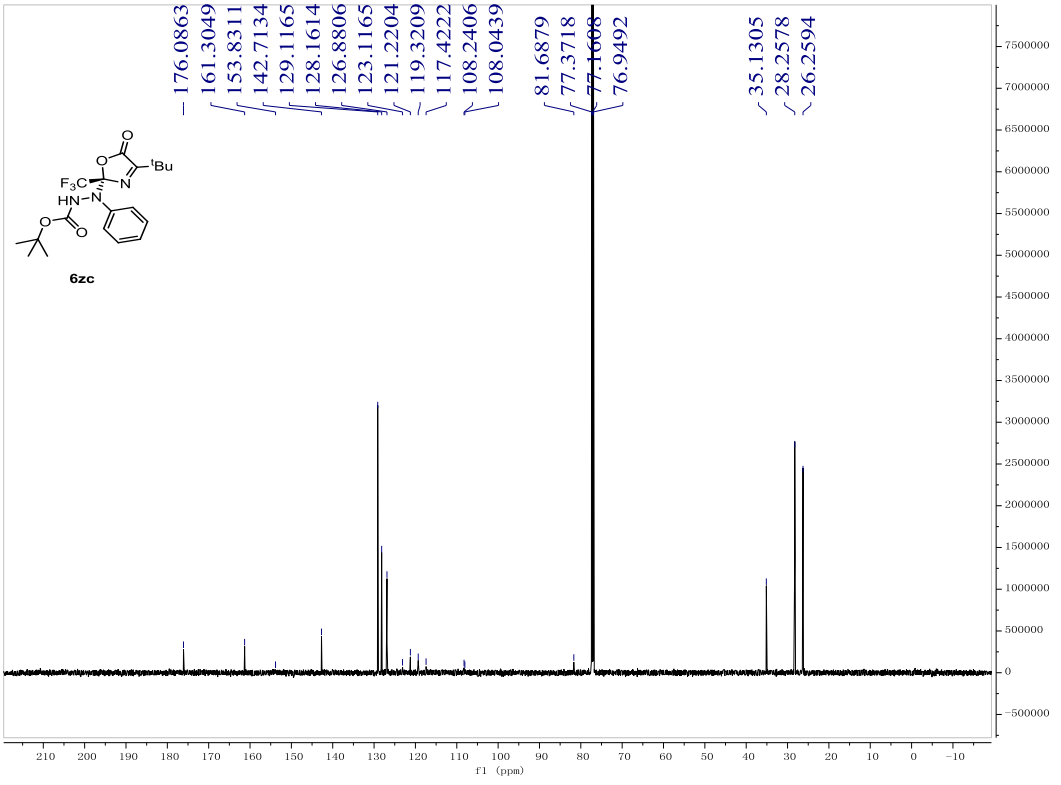
$^{19}F\{^{1}H\}$ NMR of 6zb (564 MHz, $CDCl_3$)



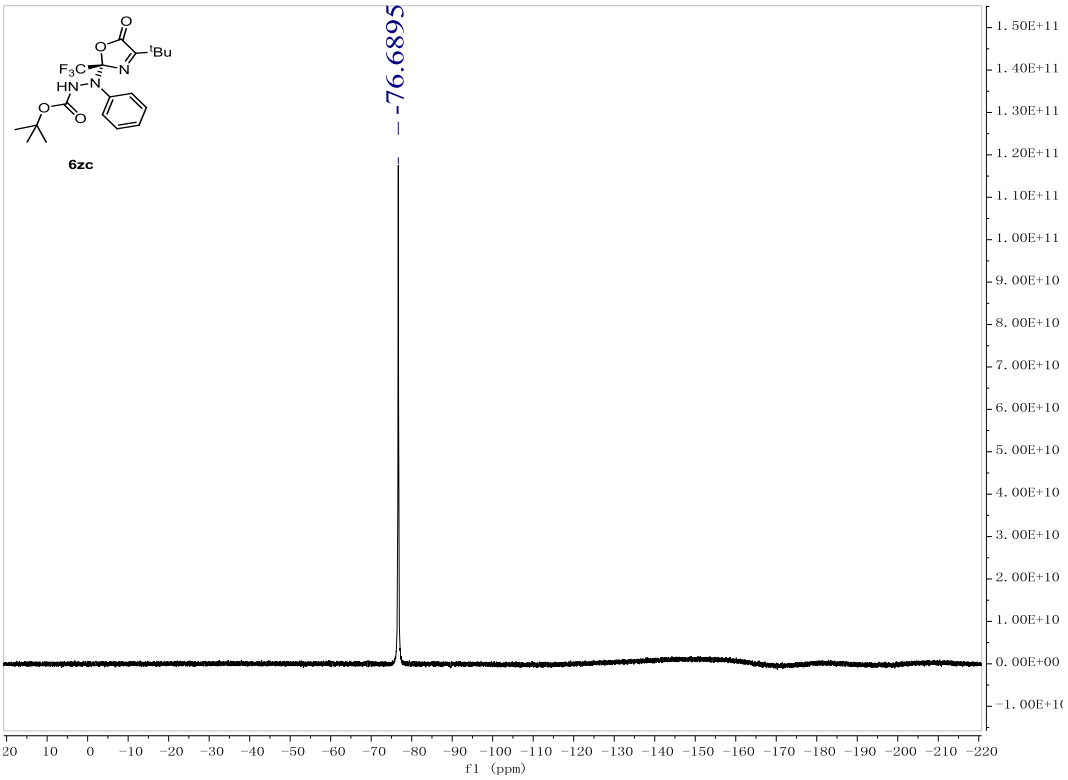
^{1}H NMR of 6zc (400 MHz, $CDCl_3$)



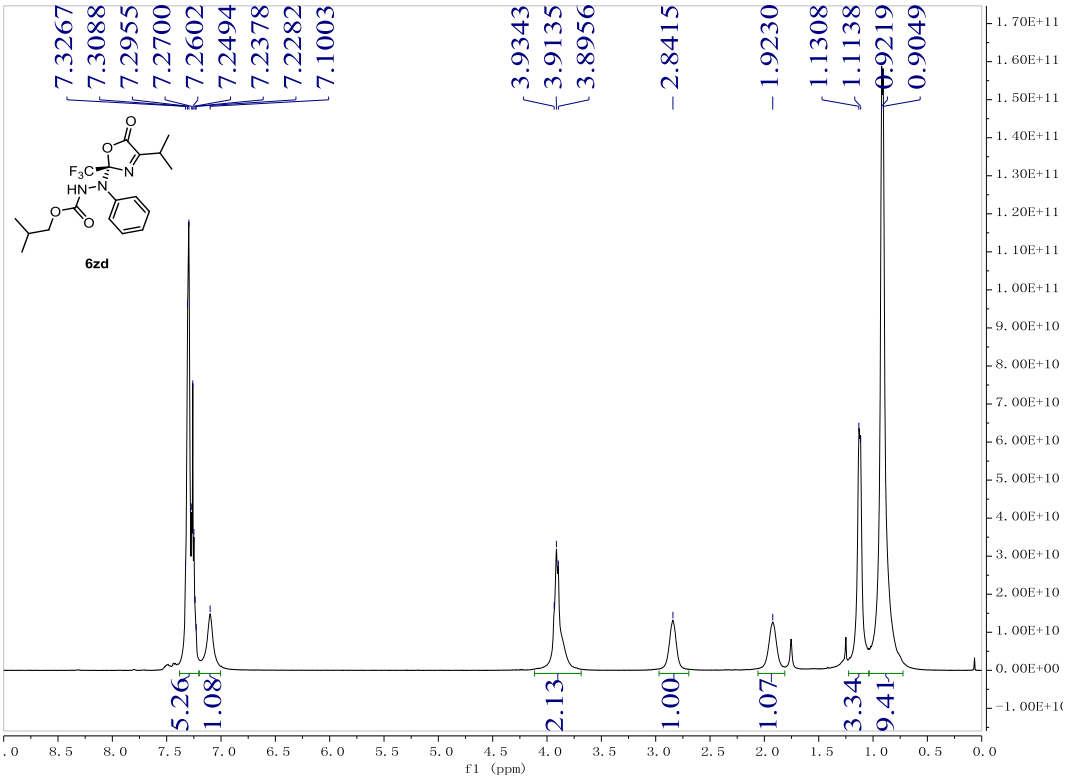
$^{13}C\{^{1}H\}$ NMR of 6zc (150 MHz, $CDCl_3$)



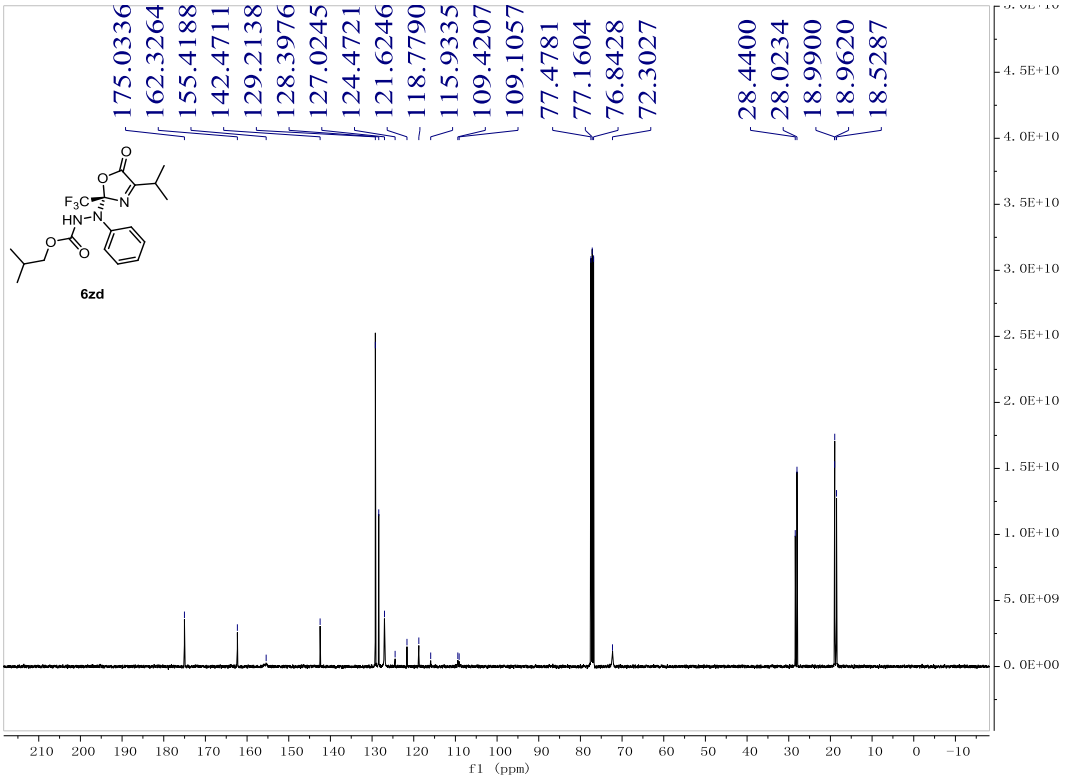
$^{19}F\{^{1}H\}$ NMR of 6zc (376 MHz, $CDCl_3$)



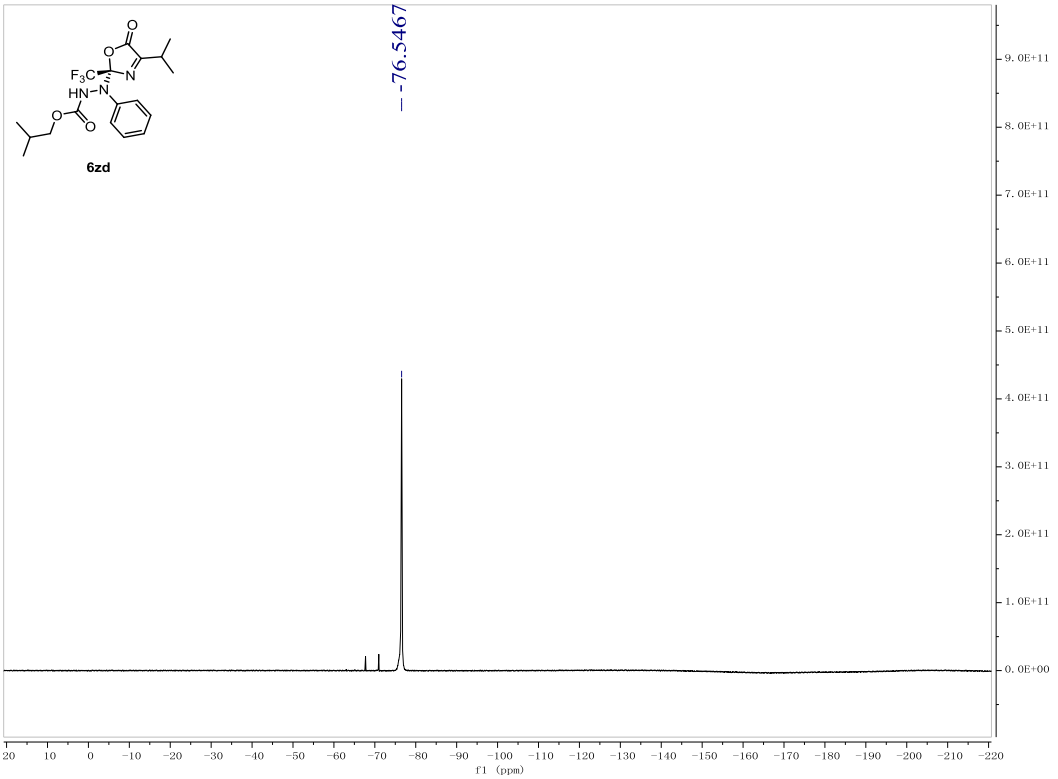
^{1}H NMR of 6zd (400 MHz, $CDCl_3$)



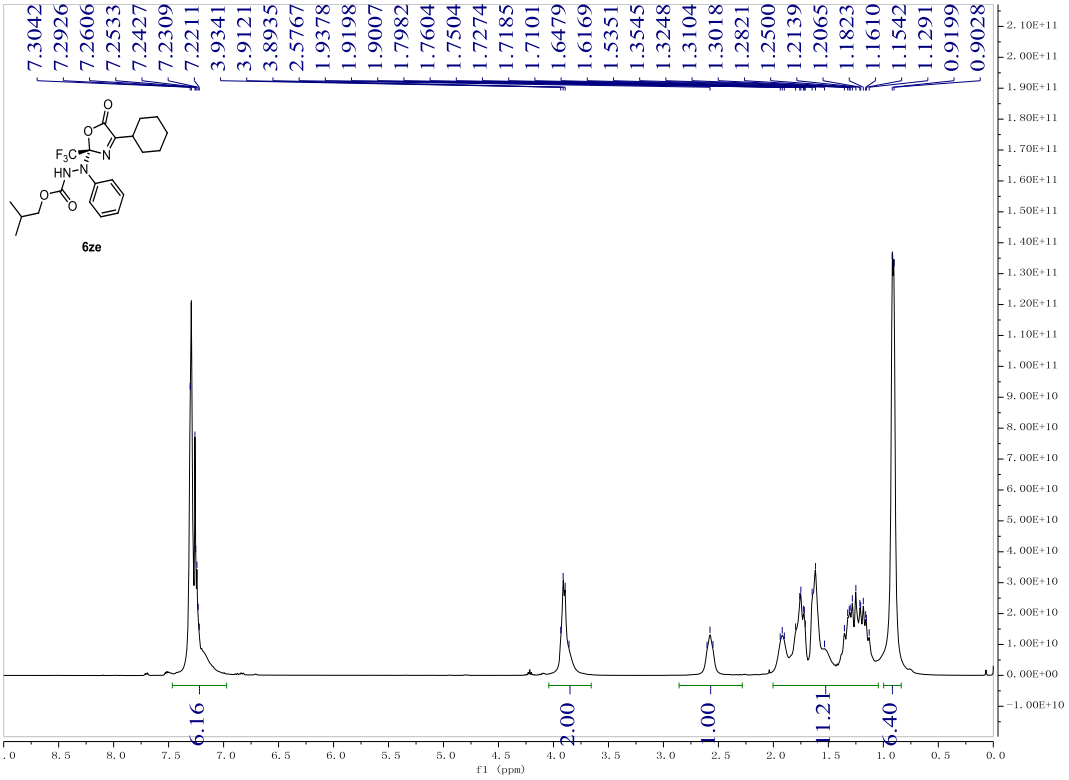
^{13}C{^{1}H} NMR of 6zd (100 MHz, $CDCl_3$)



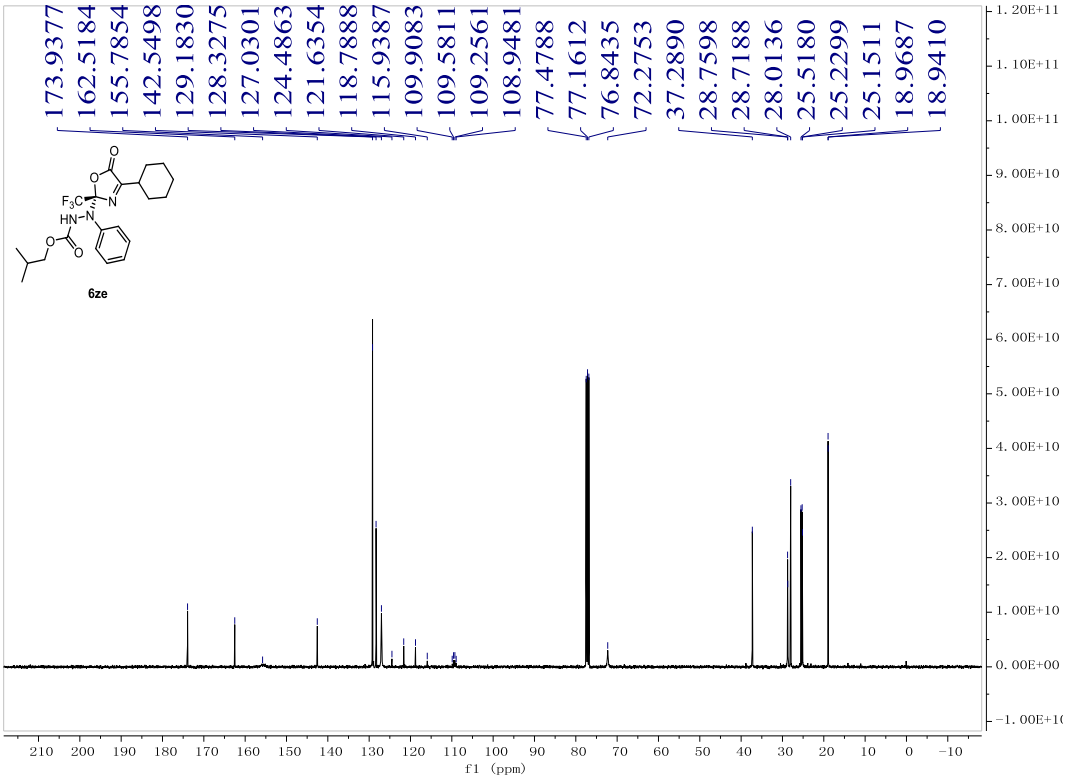
$^{19}F\{^{1}H\}$ NMR of 6zd (376 MHz, $CDCl_3$)



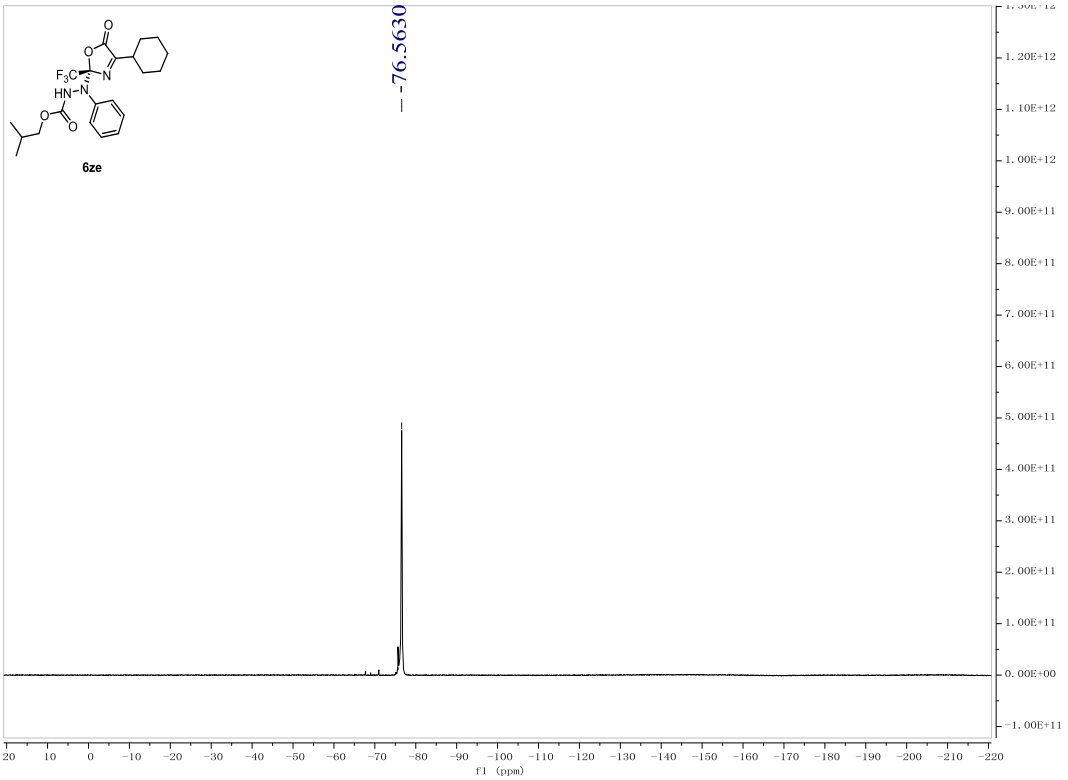
^{1}H NMR of 6ze (400 MHz, $CDCl_3$)



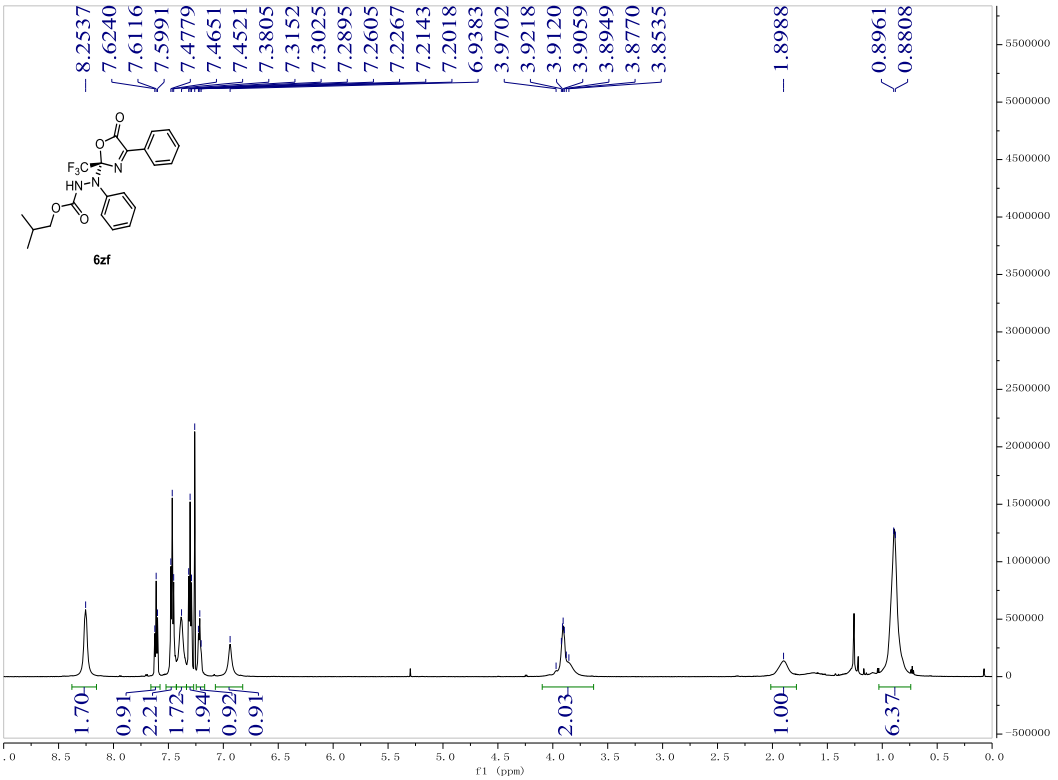
$^{13}C\{^{1}H\}$ NMR of 6ze (100 MHz, $CDCl_3$)



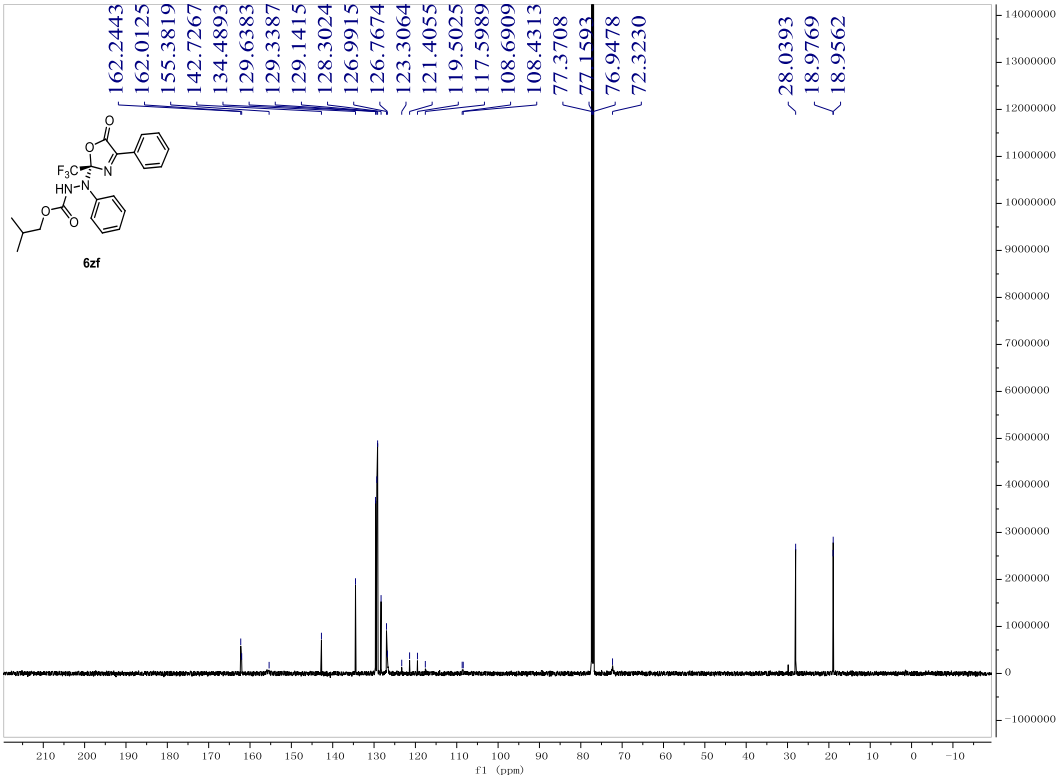
$^{19}F\{^{1}H\}$ NMR of 6ze (376 MHz, $CDCl_3$)



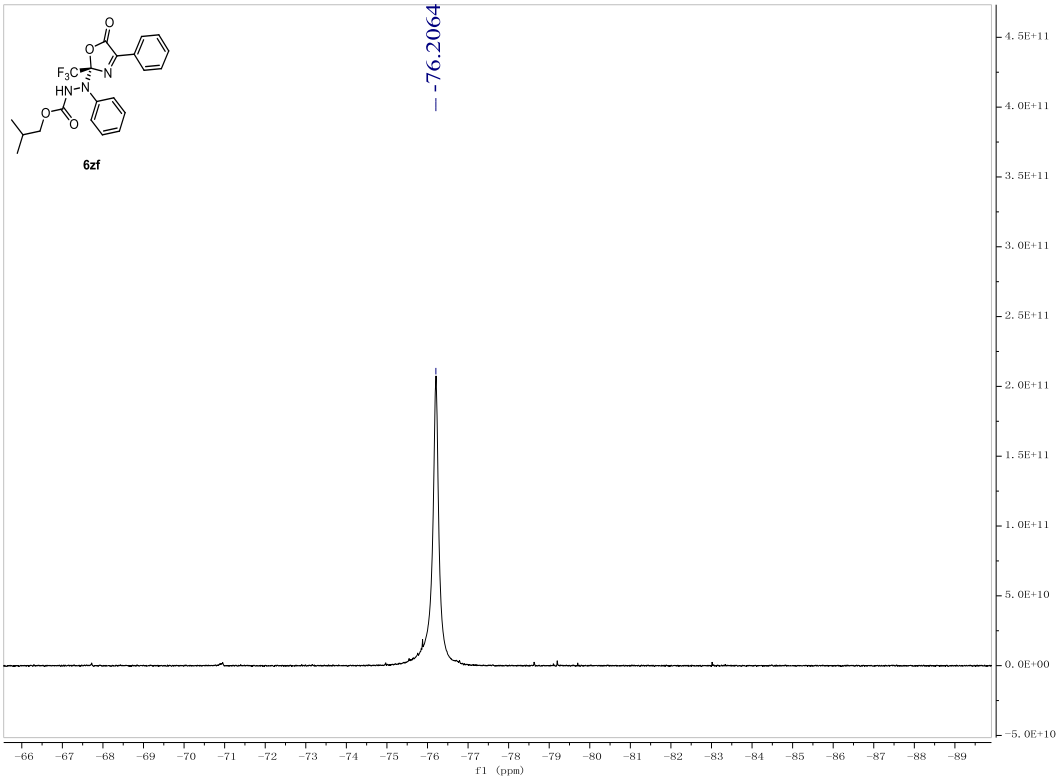
^{1}H NMR of 6zf (600 MHz, $CDCl_3$)



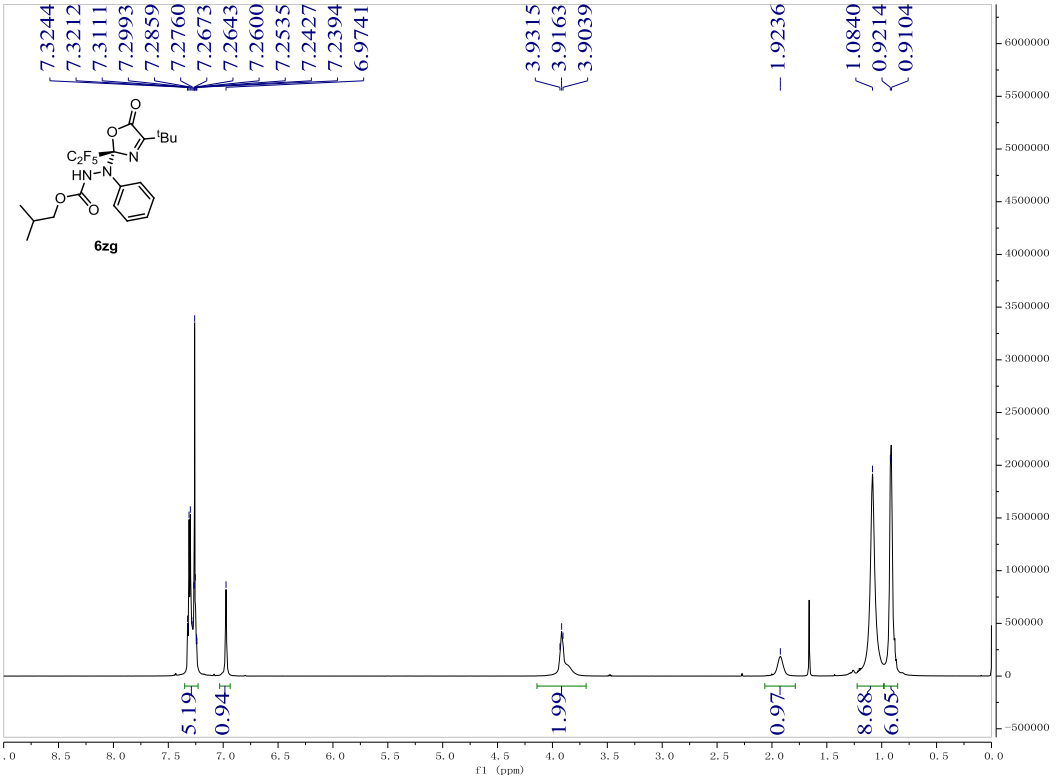
^{13}C{^{1}H} NMR of 6zf (150 MHz, $CDCl_3$)



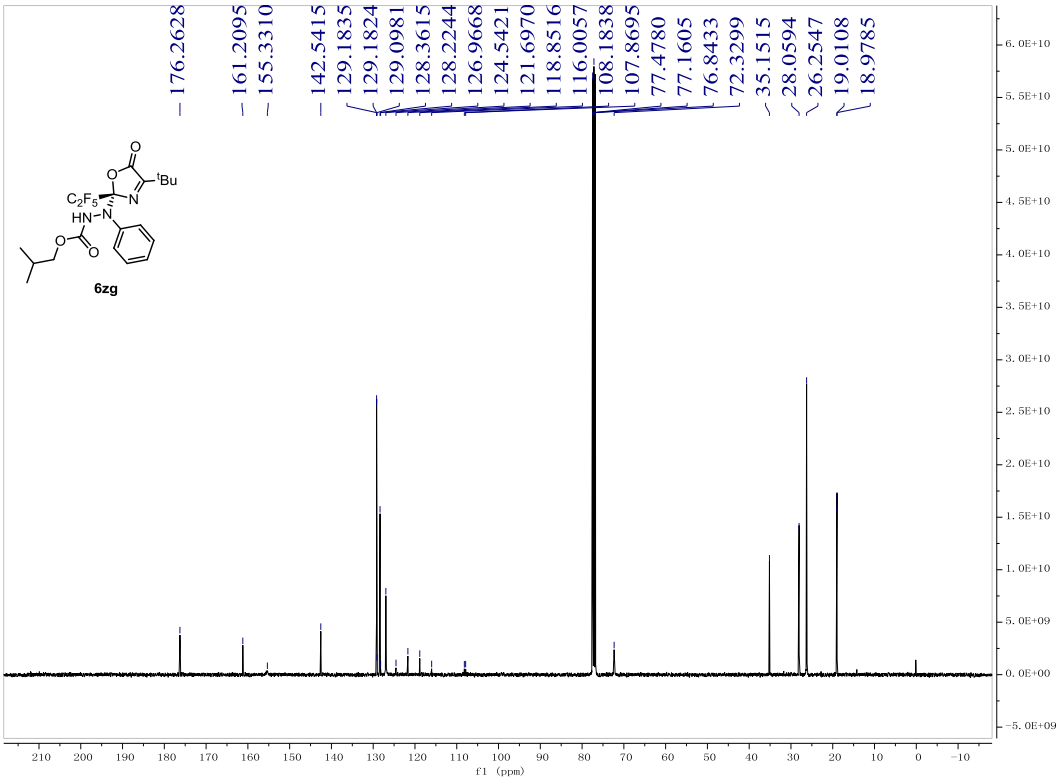
$^{19}F\{^{1}H\}$ NMR of 6zf (376 MHz, $CDCl_3$)



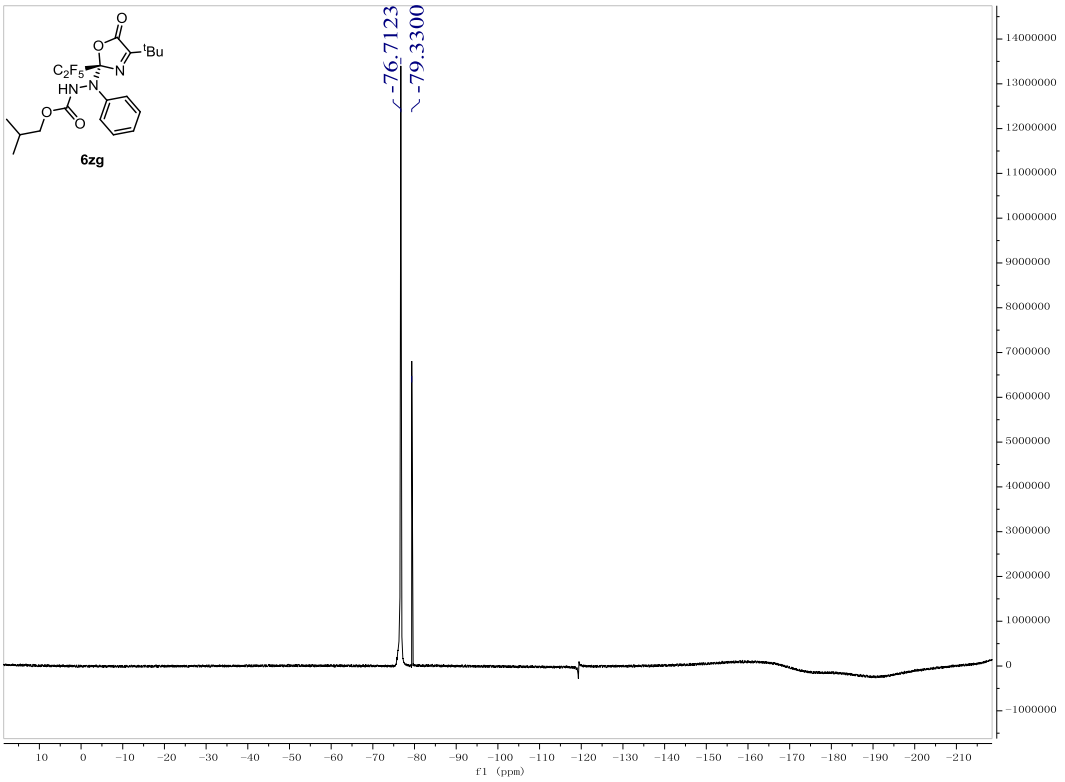
^{1}H NMR of 6zg (600 MHz, $CDCl_3$)



$^{13}C\{^{1}H\}$ NMR of 6zg (100 MHz, $CDCl_3$)

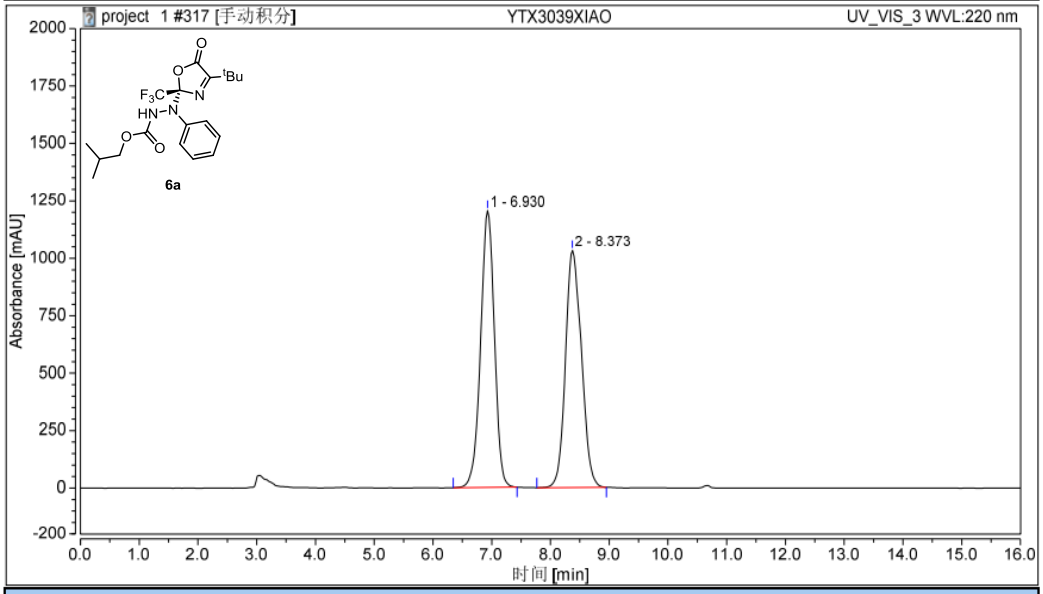


$^{19}F\{^{1}H\}$ NMR of 6zg (564 MHz, $CDCl_3$)


6zg
-76.7123
-79.3300
14000000
13000000
12000000
11000000
10000000
9000000
8000000
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
-1000000
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)

10. Copies of HPLC Spectra for Racemic and Chiral Adducts

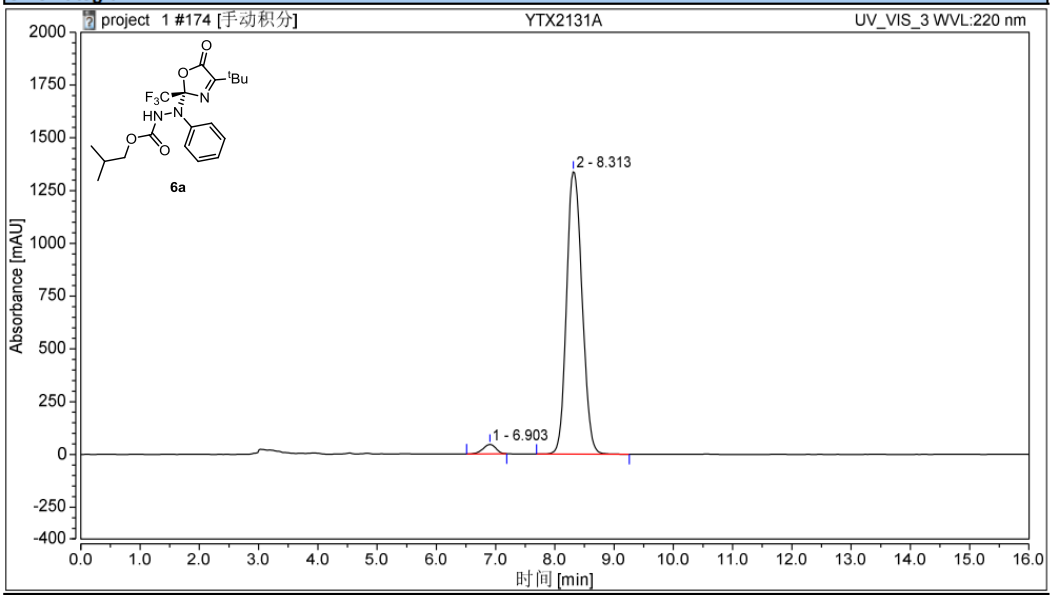
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.930	326.526	1205.073	50.09	53.87	n.a.
2		8.373	325.351	1031.898	49.91	46.13	n.a.
Total:			**651.877**	**2236.972**	**100.00**	**100.00**	

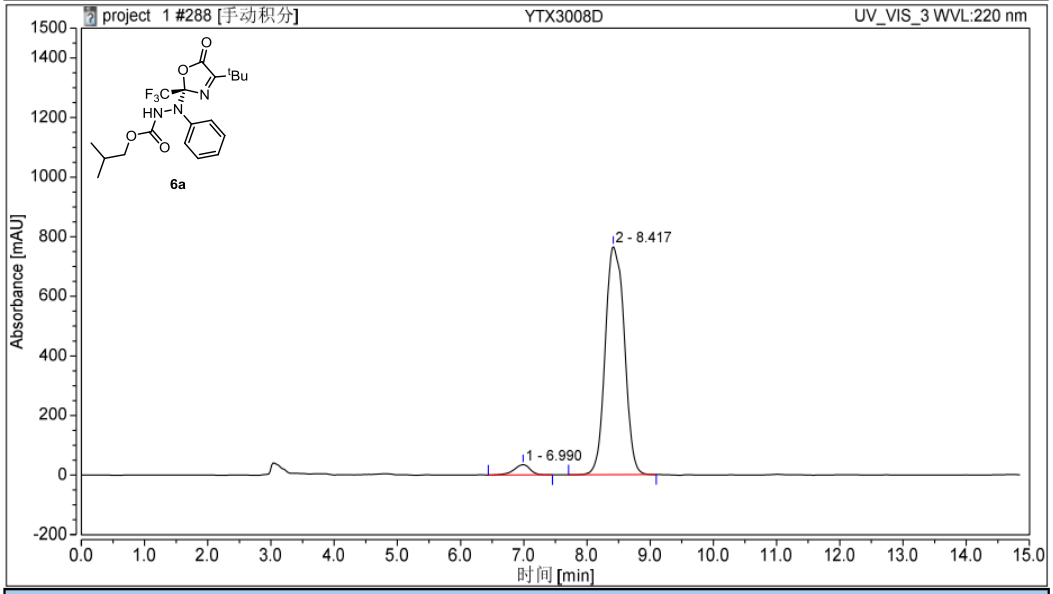
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.903	11.129	44.608	2.67	3.22	n.a.
2		8.313	406.001	1340.068	97.33	96.78	n.a.
Total:			**417.130**	**1384.676**	**100.00**	**100.00**	

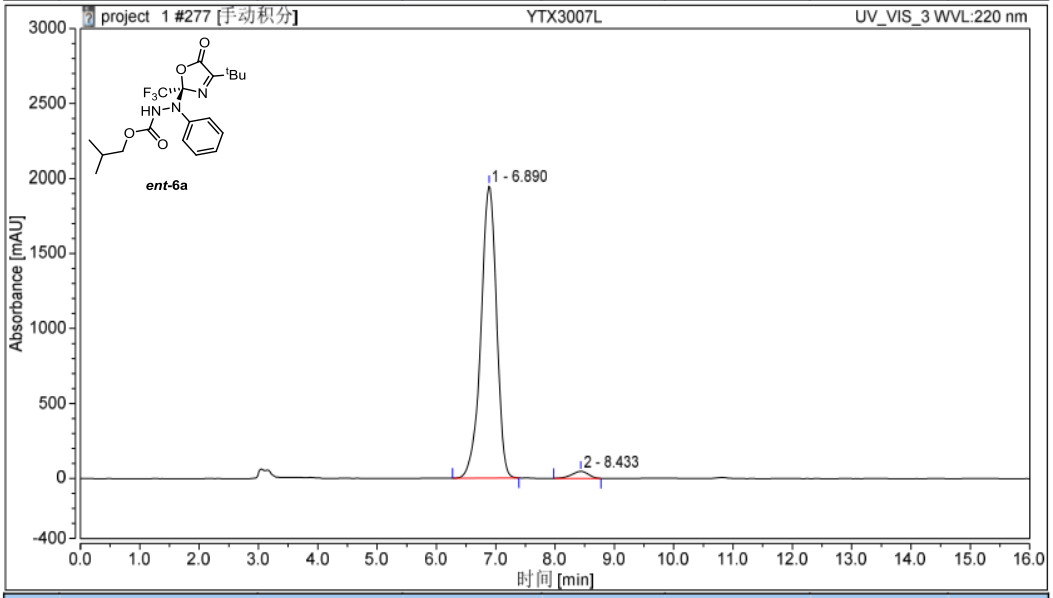
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.990	10.118	34.383	3.63	4.29	n.a.
2		8.417	268.411	766.347	96.37	95.71	n.a.
Total:			**278.529**	**800.730**	**100.00**	**100.00**	

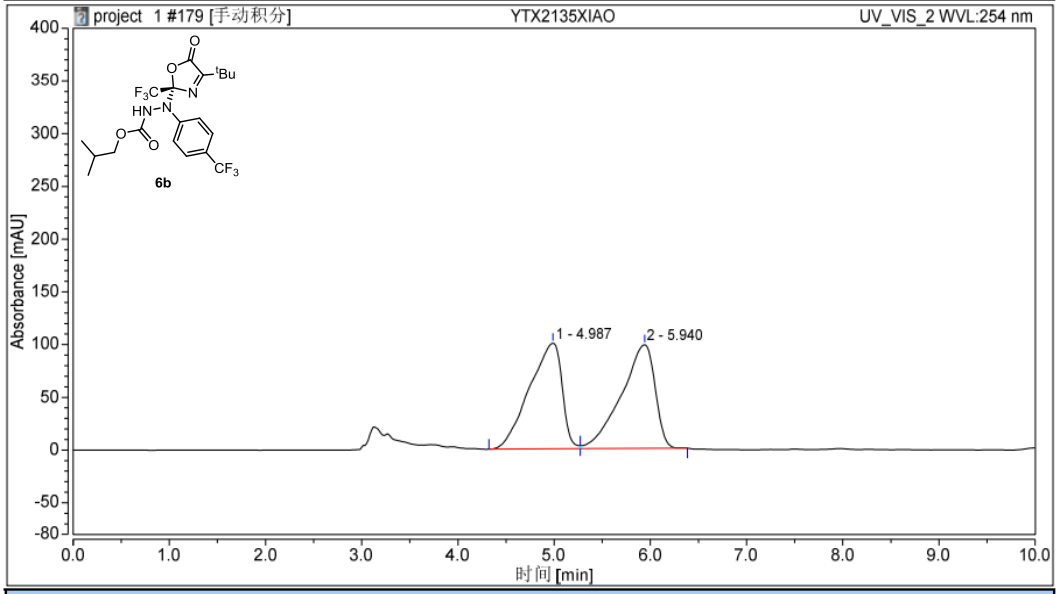
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.890	590.167	1951.043	97.46	97.64	n.a.
2		8.433	15.411	47.213	2.54	2.36	n.a.
Total:			**605.578**	**1998.256**	**100.00**	**100.00**	

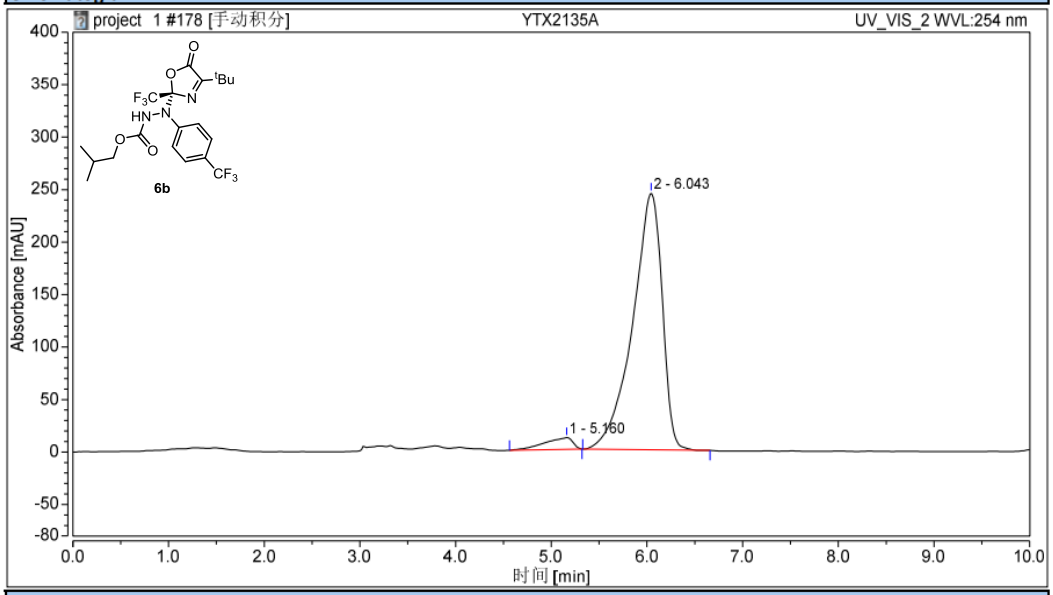
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.987	39.627	100.249	49.74	50.50	n.a.
2		5.940	40.043	98.283	50.26	49.50	n.a.
Total:			**79.670**	**198.532**	**100.00**	**100.00**	

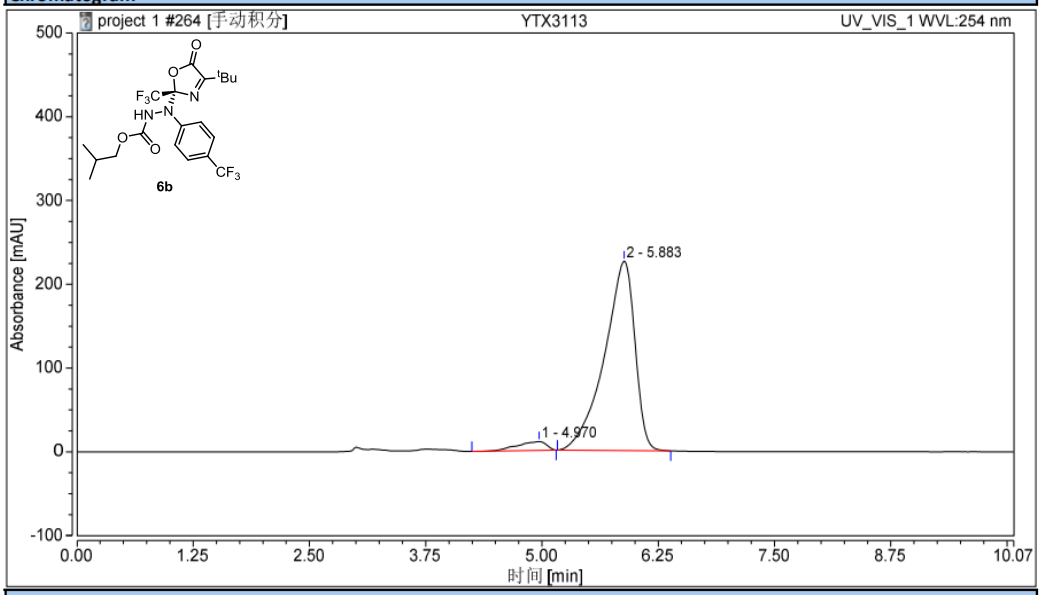
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.160	3.848	11.205	4.21	4.38	n.a.
2		6.043	87.640	244.626	95.79	95.62	n.a.
Total:			**91.488**	**255.831**	**100.00**	**100.00**	

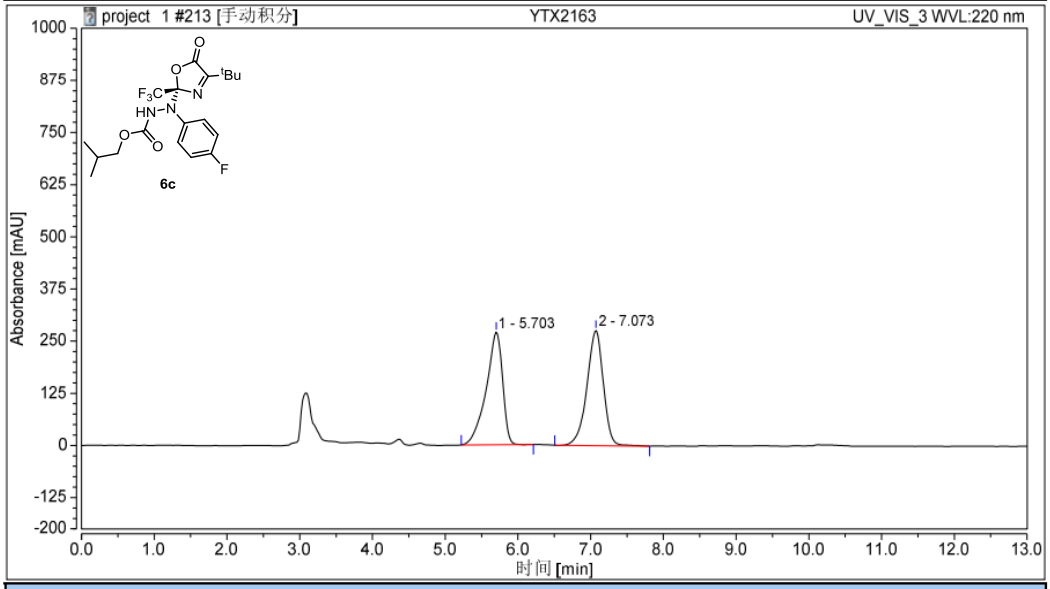
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.970	3.844	10.456	4.28	4.42	n.a.
2		5.883	86.065	226.240	95.72	95.58	n.a.
Total:			**89.909**	**236.697**	**100.00**	**100.00**	

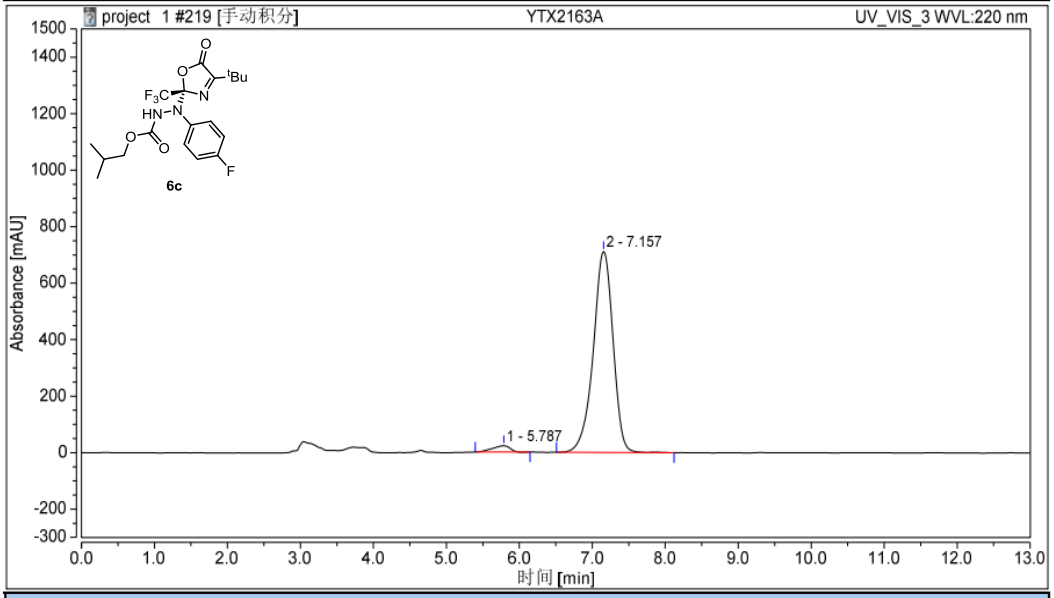
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.703	70.055	269.923	49.20	49.39	n.a.
2		7.073	72.326	276.543	50.80	50.61	n.a.
Total:			**142.381**	**546.465**	**100.00**	**100.00**	

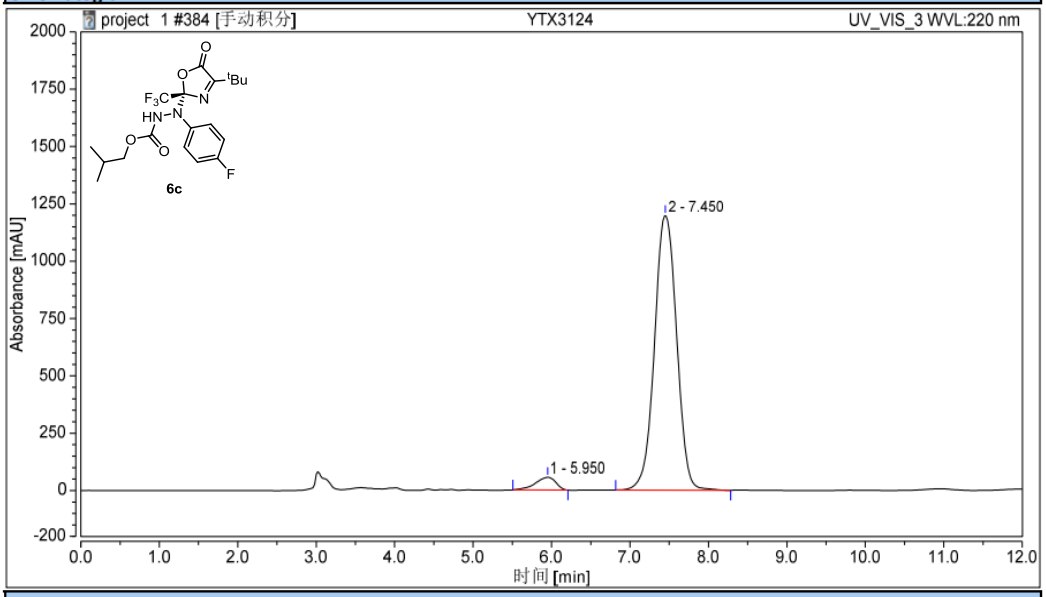
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.787	6.135	22.427	2.68	3.06	n.a.
2		7.157	222.971	711.573	97.32	96.94	n.a.
Total:			**229.106**	**734.001**	**100.00**	**100.00**	

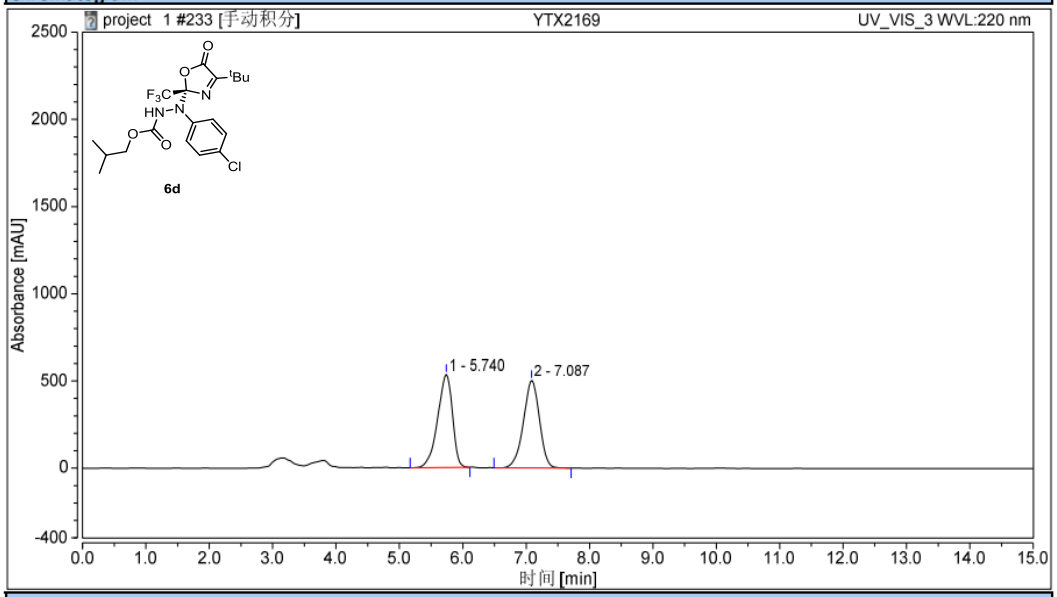
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.950	16.749	55.794	4.10	4.45	n.a.
2		7.450	391.422	1197.987	95.90	95.55	n.a.
Total:			**408.171**	**1253.782**	**100.00**	**100.00**	

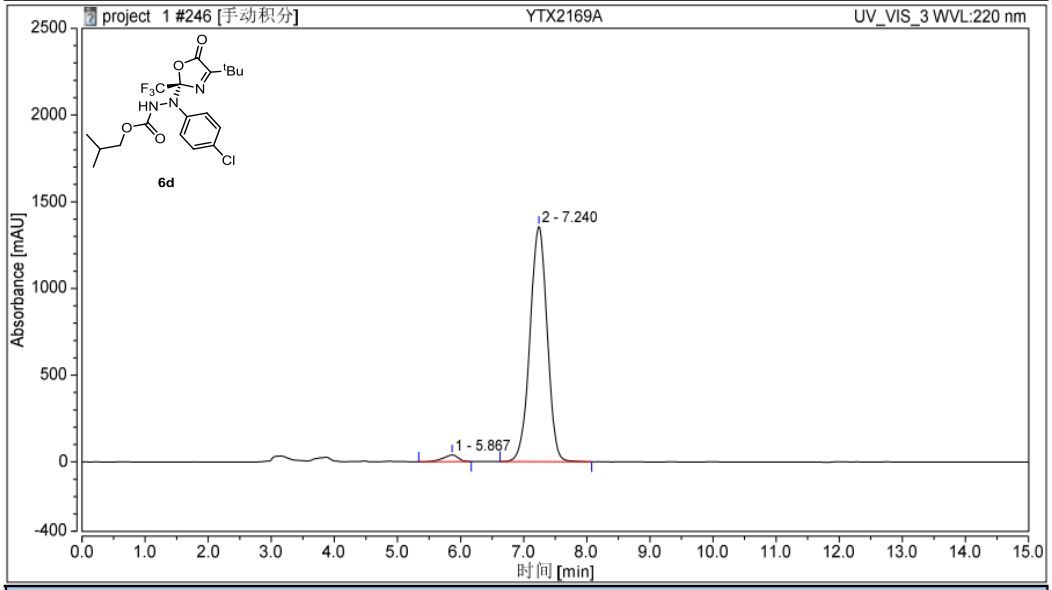
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.740	143.868	532.848	49.53	51.49	n.a.
2		7.087	146.601	501.949	50.47	48.51	n.a.
Total:			**290.469**	**1034.797**	**100.00**	**100.00**	

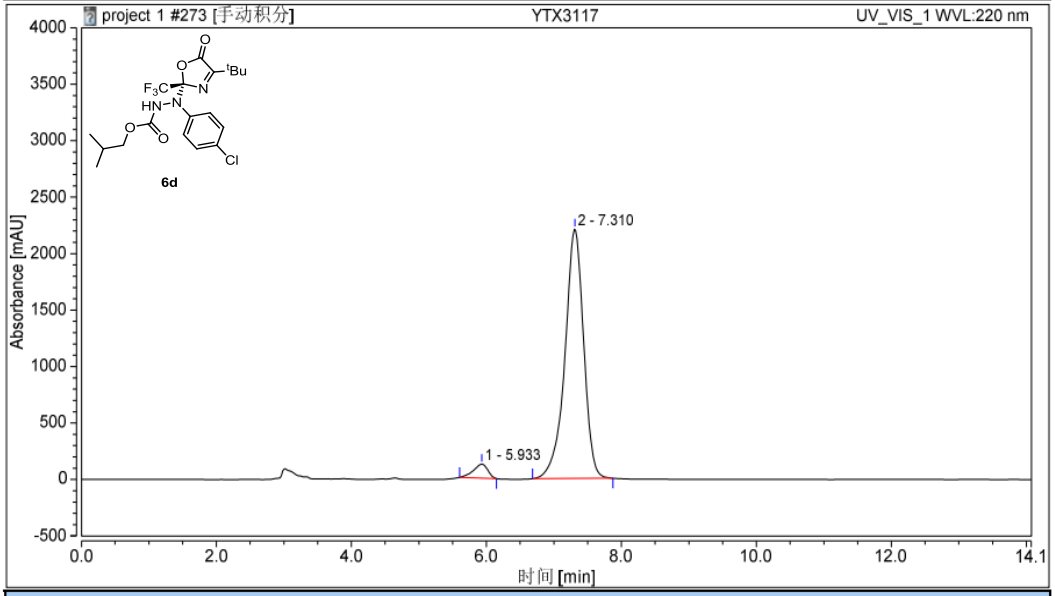
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.867	10.947	39.329	2.49	2.81	n.a.
2		7.240	428.033	1358.703	97.51	97.19	n.a.
Total:			**438.980**	**1398.032**	**100.00**	**100.00**	

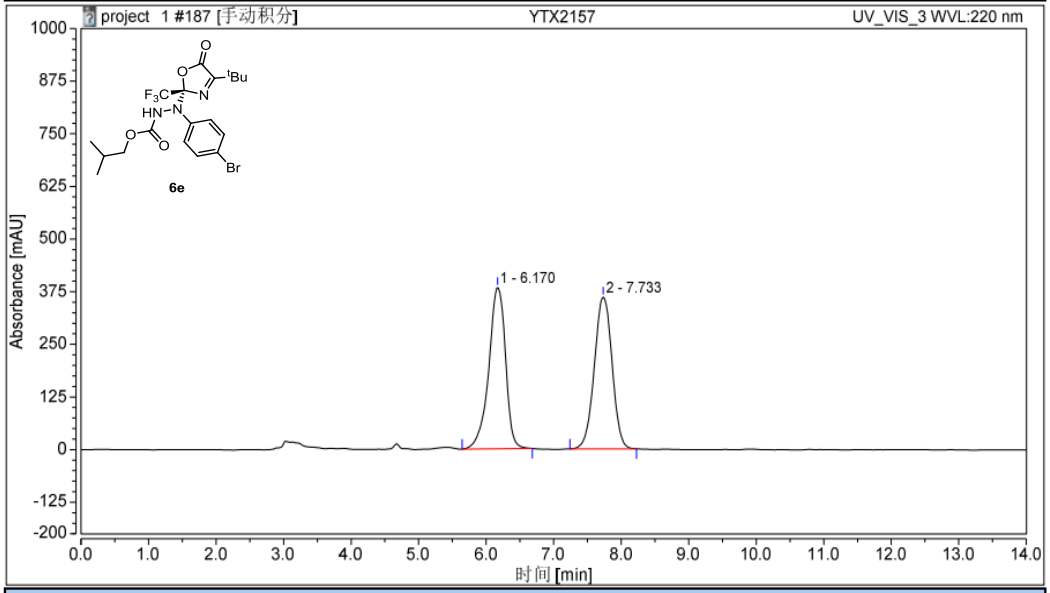
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.933	30.353	123.461	4.11	5.29	n.a.
2		7.310	707.912	2209.847	95.89	94.71	n.a.
Total:			**738.265**	**2333.308**	**100.00**	**100.00**	

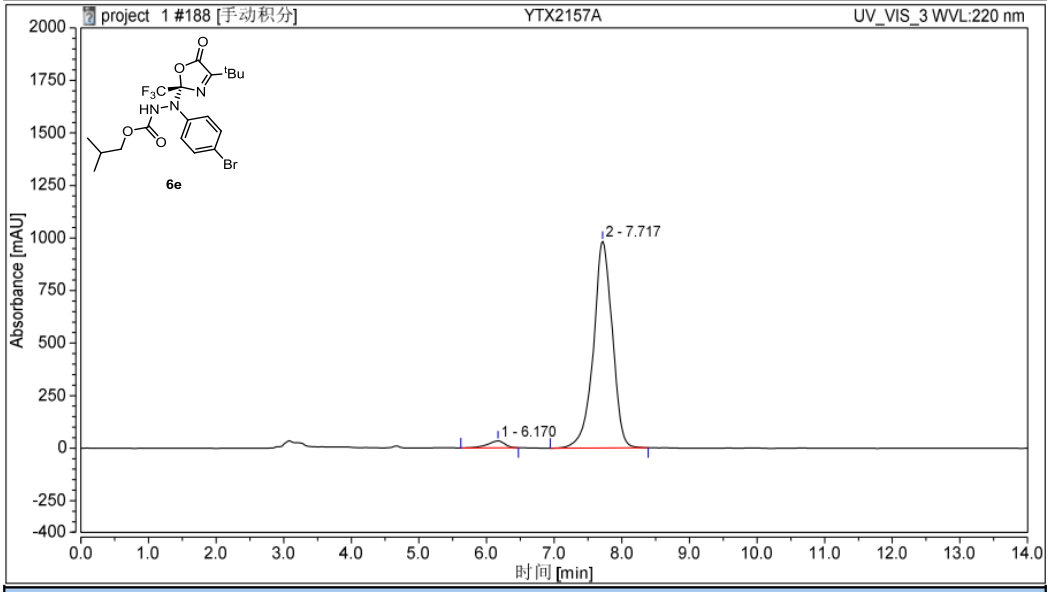
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.170	110.028	383.555	50.06	51.55	n.a.
2		7.733	109.764	360.419	49.94	48.45	n.a.
Total:			**219.792**	**743.974**	**100.00**	**100.00**	

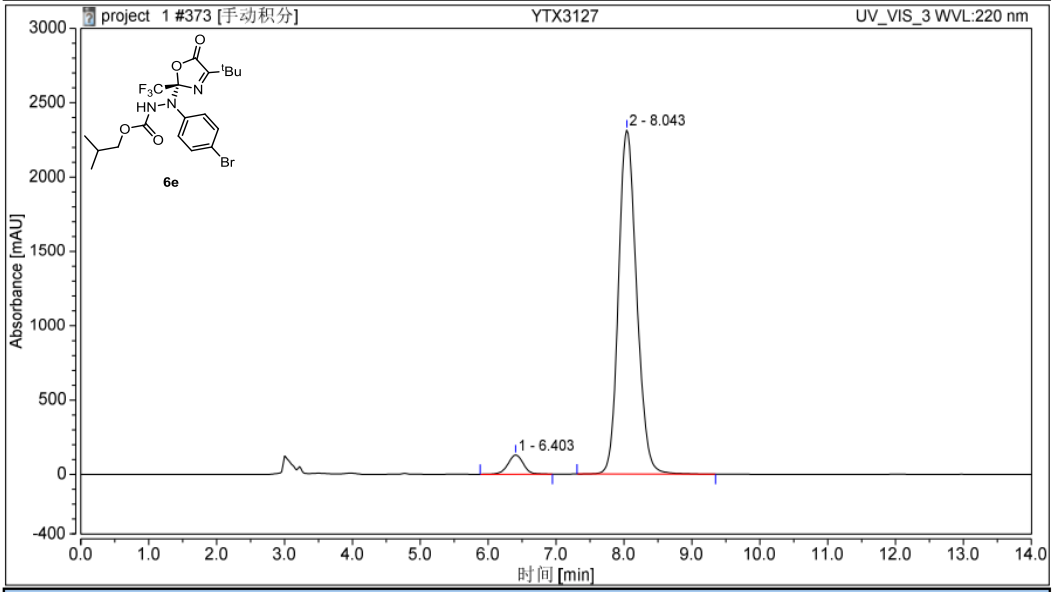
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.170	9.571	32.277	2.91	3.18	n.a.
2		7.717	318.897	983.431	97.09	96.82	n.a.
Total:			**328.469**	**1015.708**	**100.00**	**100.00**	

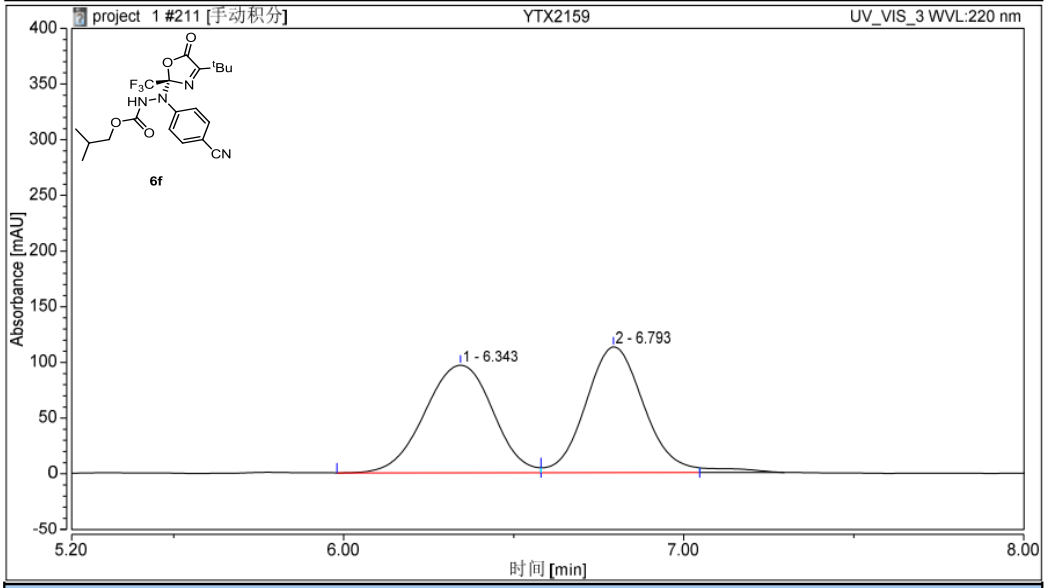
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.403	34.252	129.464	4.56	5.30	n.a.
2		8.043	717.497	2314.079	95.44	94.70	n.a.
Total:			**751.749**	**2443.543**	**100.00**	**100.00**	

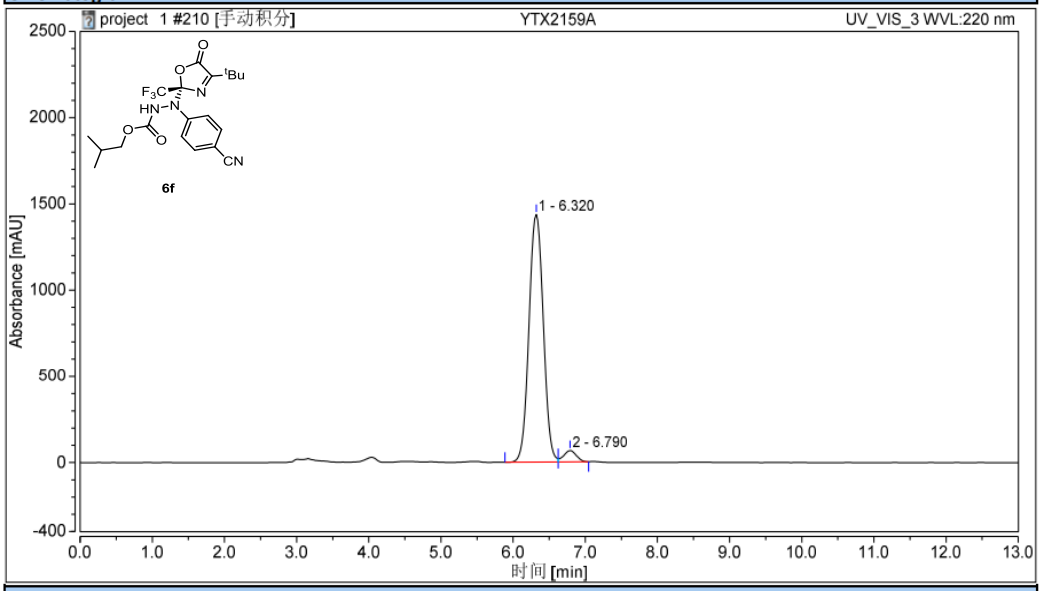
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.343	22.365	96.518	50.19	46.09	n.a.
2		6.793	22.199	112.908	49.81	53.91	n.a.
Total:			**44.564**	**209.425**	**100.00**	**100.00**	

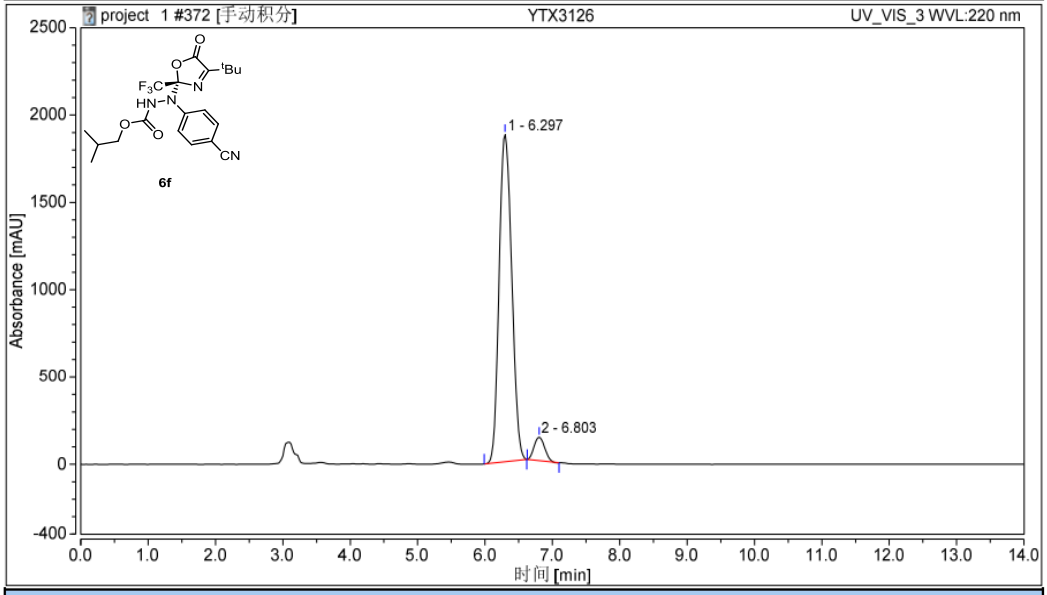
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.320	328.465	1435.586	96.11	95.64	n.a.
2		6.790	13.297	65.396	3.89	4.36	n.a.
Total:			**341.762**	**1500.982**	**100.00**	**100.00**	

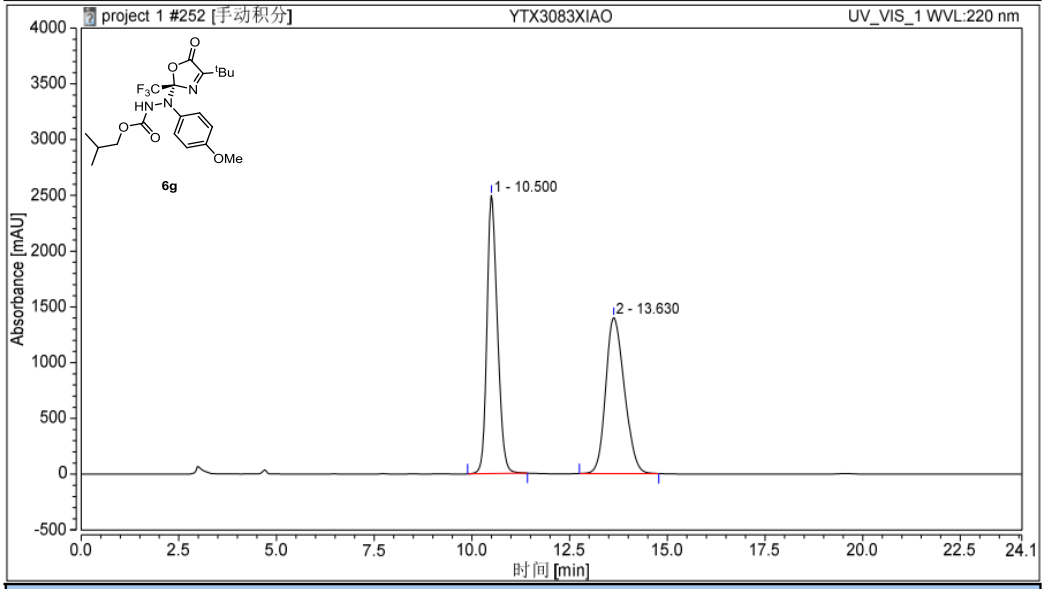
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.297	406.792	1875.403	94.33	93.32	n.a.
2		6.803	24.462	134.289	5.67	6.68	n.a.
Total:			**431.254**	**2009.692**	**100.00**	**100.00**	

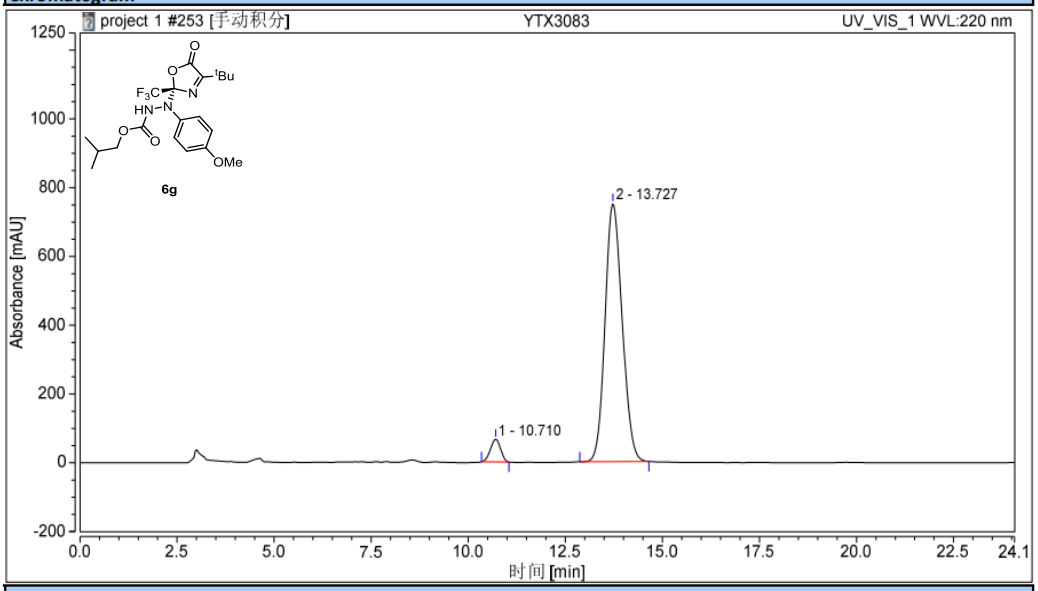
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		10.500	774.100	2495.373	49.97	64.08	n.a.
2		13.630	774.996	1399.020	50.03	35.92	n.a.
Total:			**1549.096**	**3894.393**	**100.00**	**100.00**	

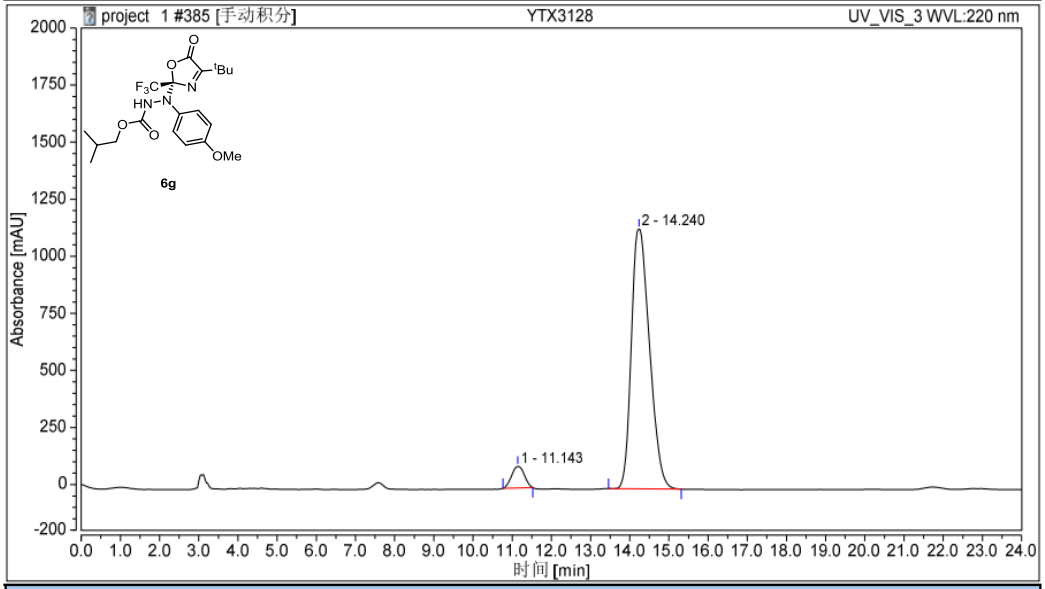
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		10.710	19.878	66.351	4.94	8.12	n.a.
2		13.727	382.423	750.303	95.06	91.88	n.a.
Total:			**402.301**	**816.654**	**100.00**	**100.00**	

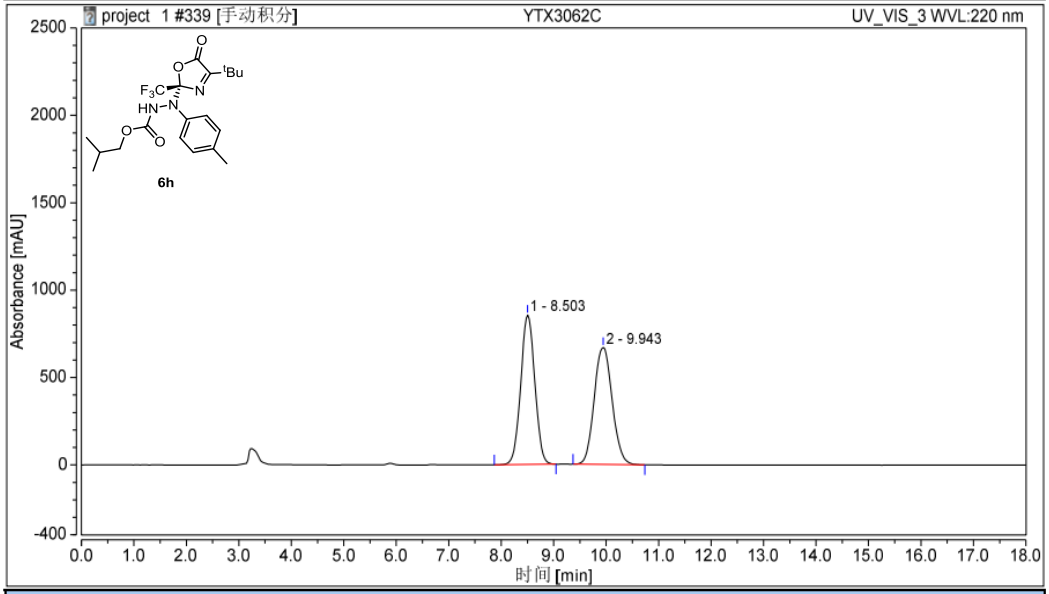
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.143	35.342	94.214	5.47	7.64	n.a.
2		14.240	610.581	1138.438	94.53	92.36	n.a.
Total:			**645.923**	**1232.652**	**100.00**	**100.00**	

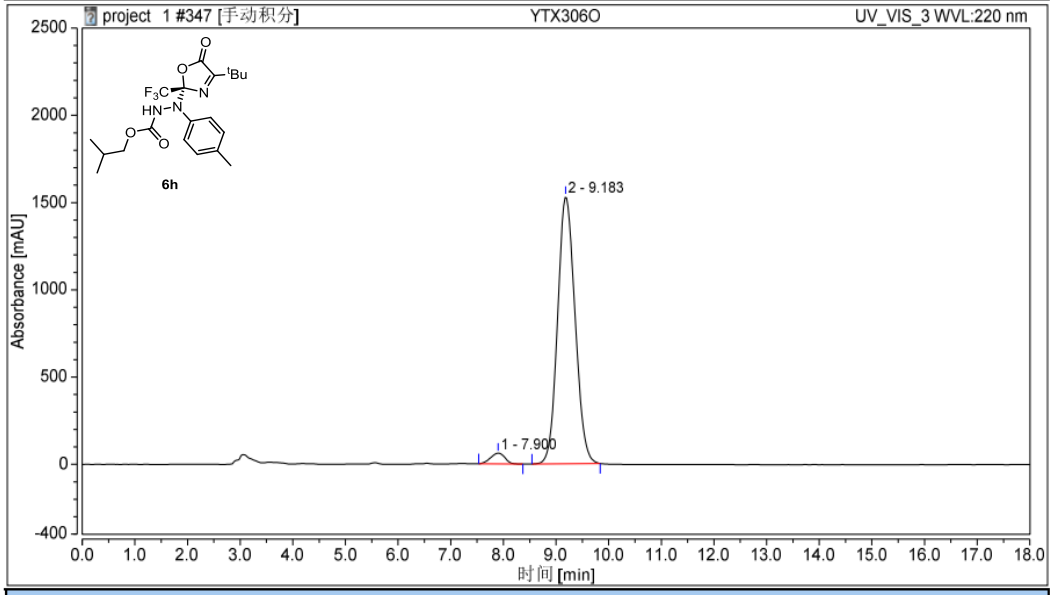
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.503	265.849	854.143	50.00	56.10	n.a.
2		9.943	265.798	668.502	50.00	43.90	n.a.
Total:			**531.647**	**1522.646**	**100.00**	**100.00**	

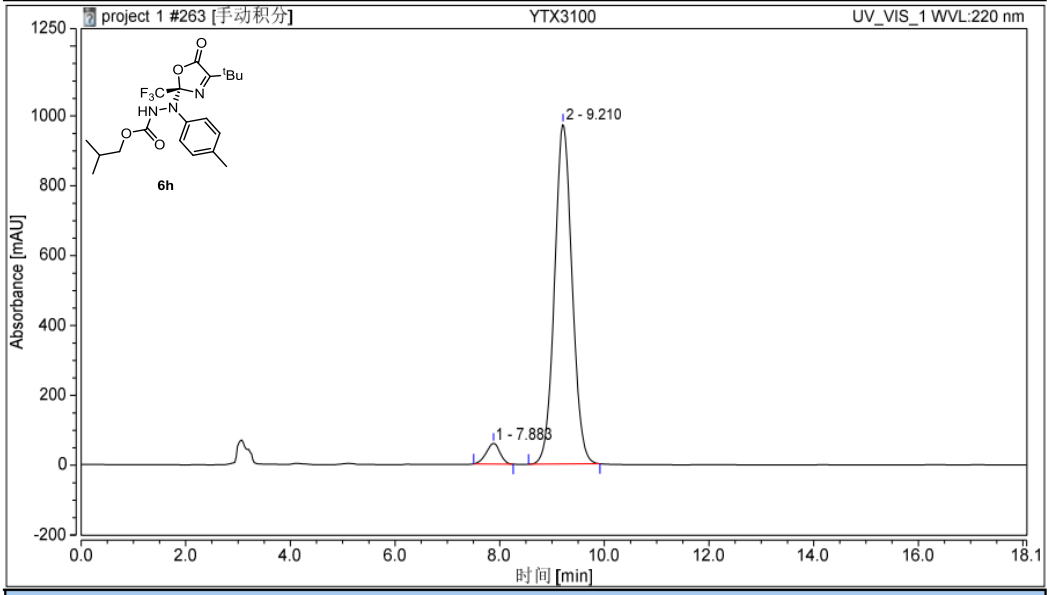
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.900	19.396	62.091	3.20	3.90	n.a.
2		9.183	587.164	1531.127	96.80	96.10	n.a.
Total:			**606.559**	**1593.218**	**100.00**	**100.00**	

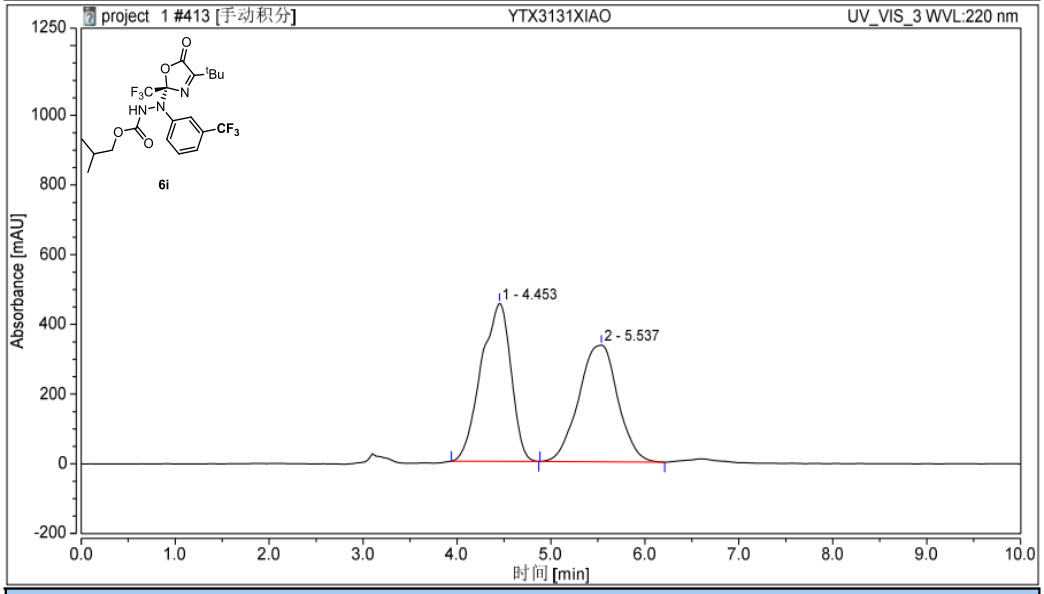
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.883	17.893	59.201	4.51	5.73	n.a.
2		9.210	378.505	973.408	95.49	94.27	n.a.
Total:			**396.398**	**1032.609**	**100.00**	**100.00**	

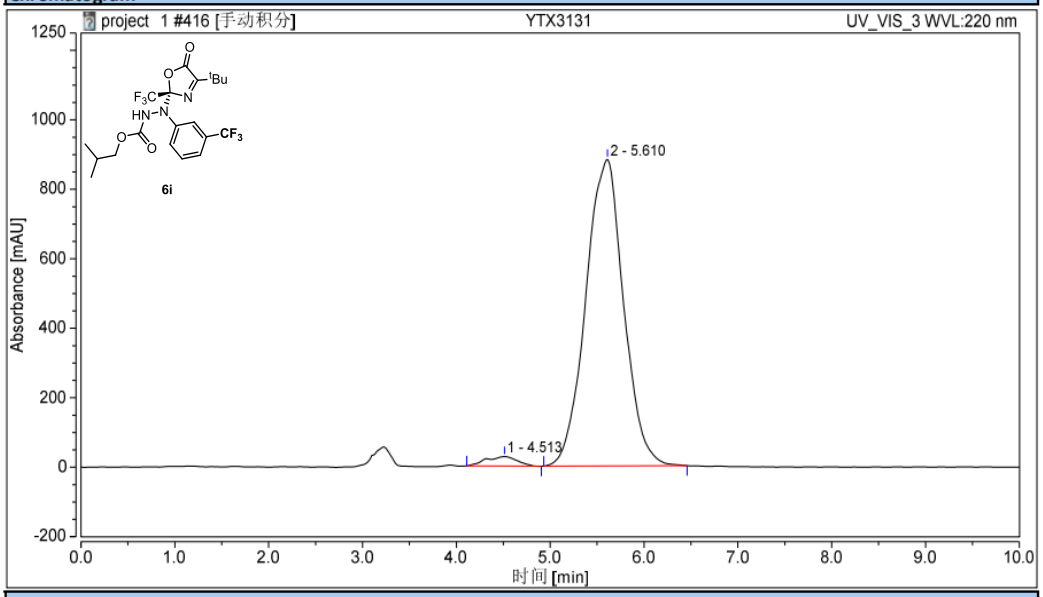
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.453	167.057	452.909	50.88	57.53	n.a.
2		5.537	161.277	334.387	49.12	42.47	n.a.
Total:			**328.333**	**787.296**	**100.00**	**100.00**	

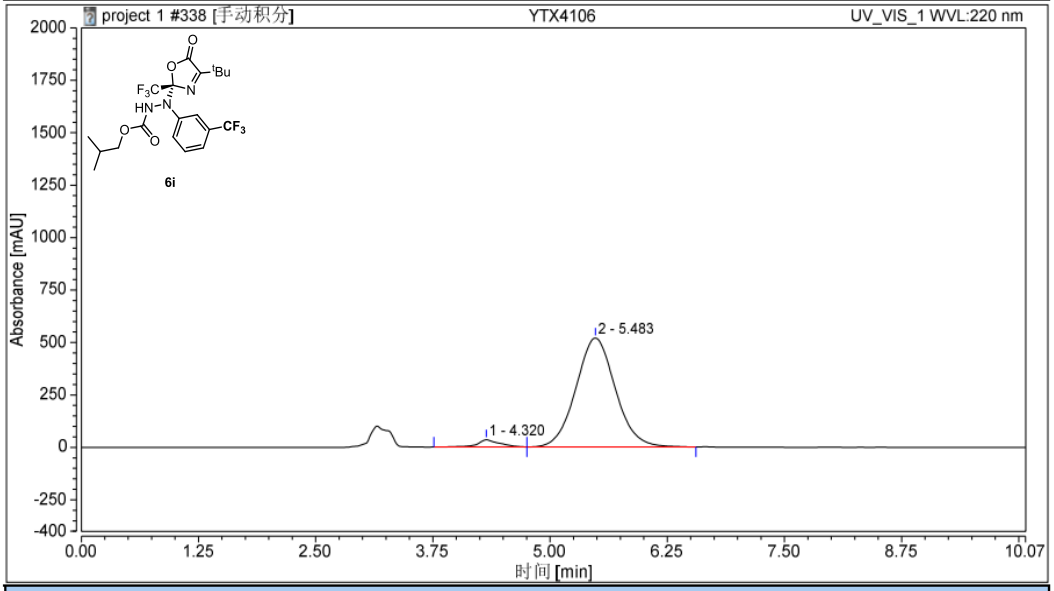
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.513	10.570	27.323	2.51	3.00	n.a.
2		5.610	411.212	882.613	97.49	97.00	n.a.
Total:			**421.782**	**909.936**	**100.00**	**100.00**	

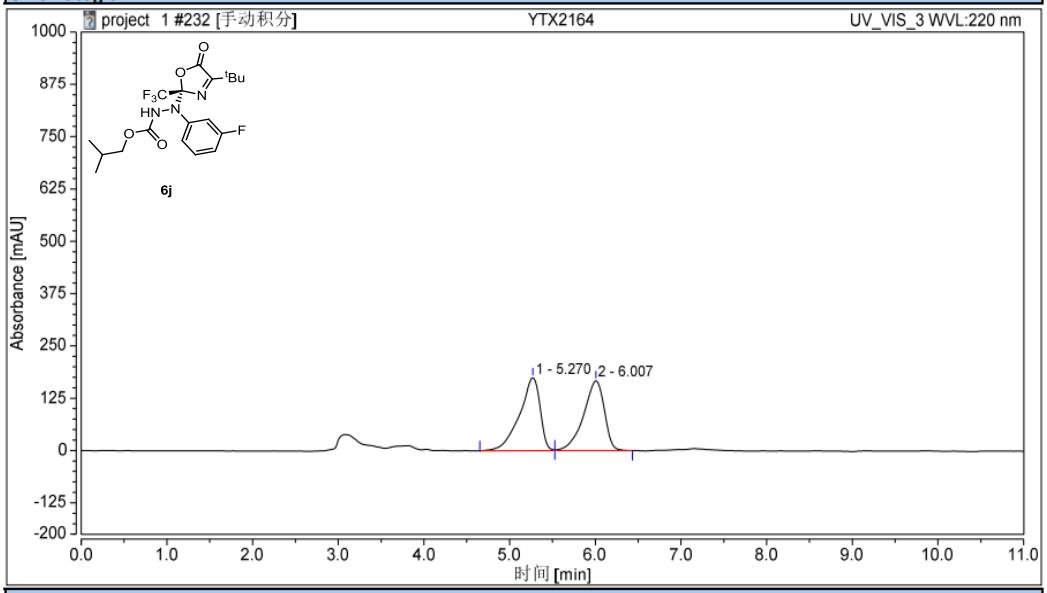
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.320	9.213	34.598	3.51	6.25	n.a.
2		5.483	253.172	519.387	96.49	93.75	n.a.
Total:			**262.385**	**553.985**	**100.00**	**100.00**	

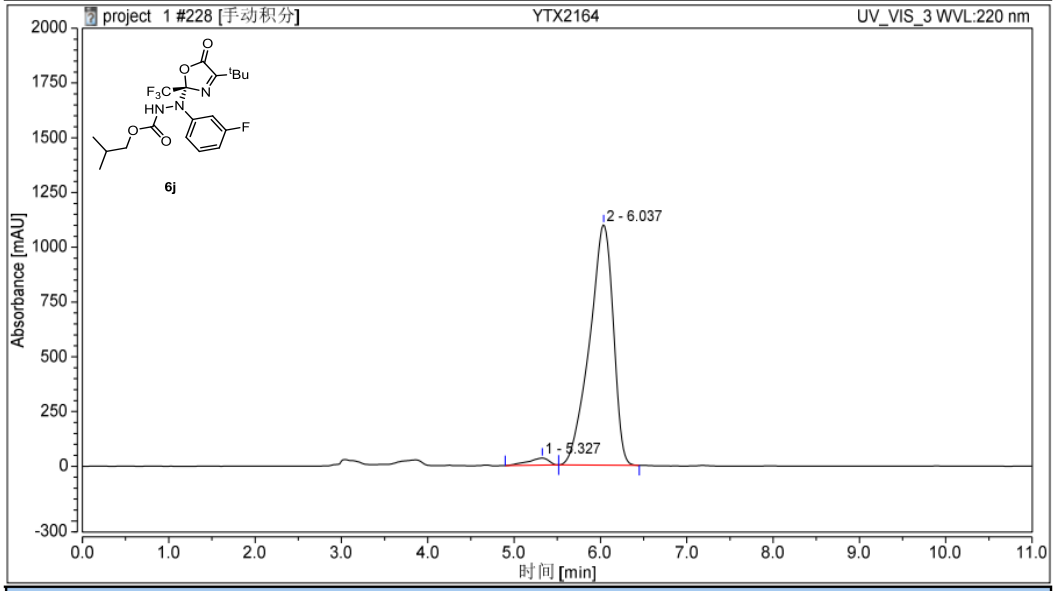
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.270	48.712	174.427	50.72	51.08	n.a.
2		6.007	47.338	167.078	49.28	48.92	n.a.
Total:			**96.050**	**341.505**	**100.00**	**100.00**	

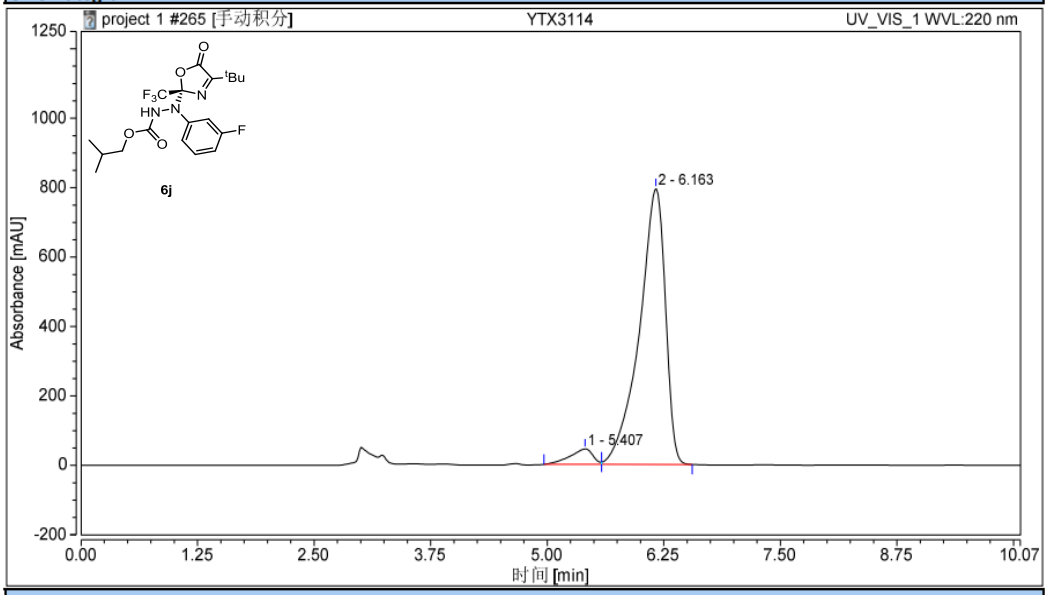
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.327	9.140	32.502	2.54	2.88	n.a.
2		6.037	351.062	1097.965	97.46	97.12	n.a.
Total:			**360.203**	**1130.467**	**100.00**	**100.00**	

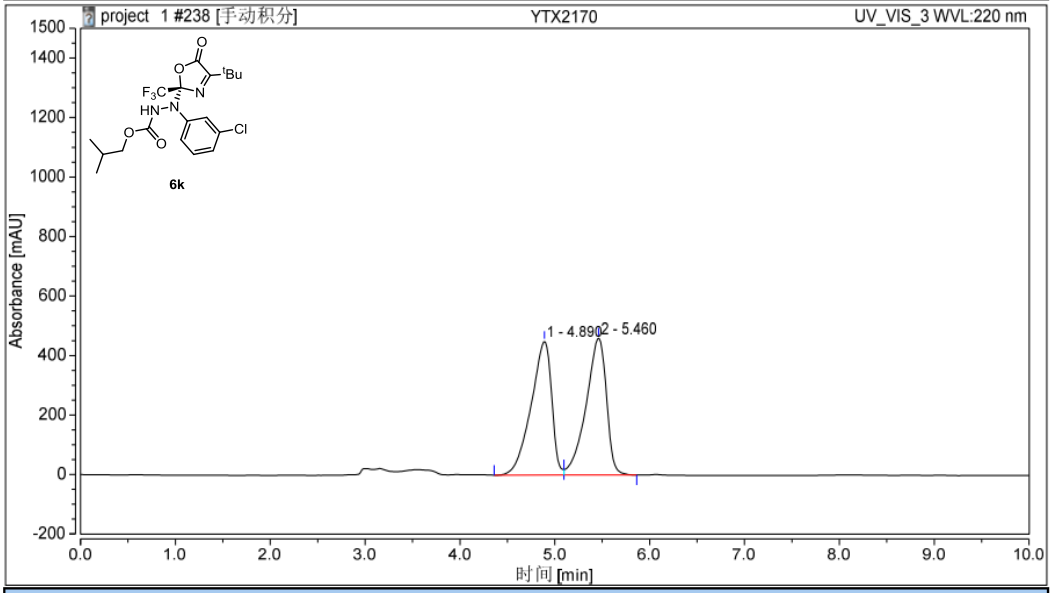
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.407	12.694	44.489	4.72	5.30	n.a.
2		6.163	256.488	794.758	95.28	94.70	n.a.
Total:			**269.183**	**839.248**	**100.00**	**100.00**	

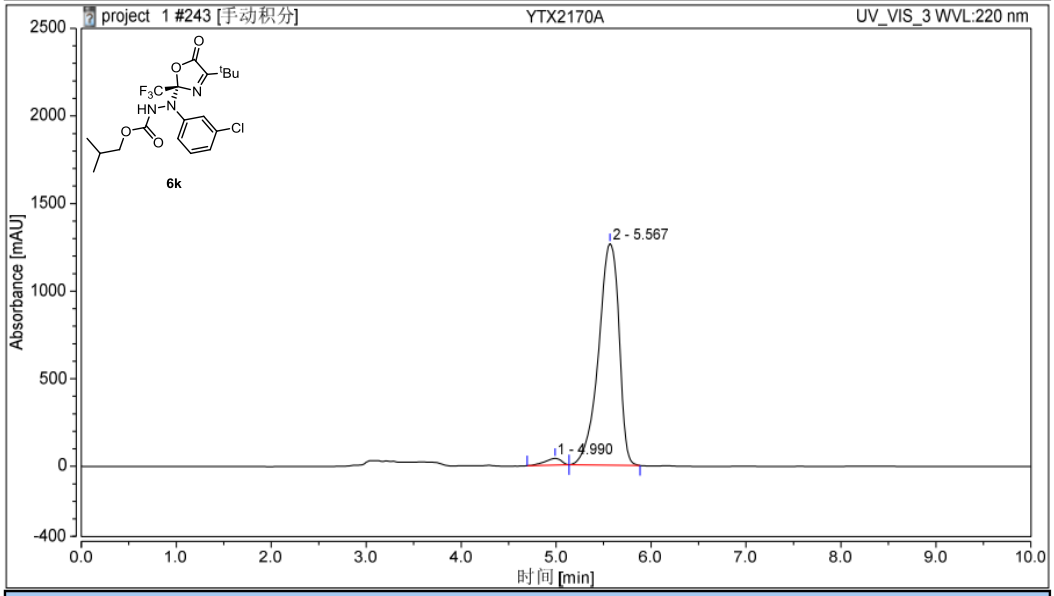
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.890	113.302	449.777	49.69	49.39	n.a.
2		5.460	114.709	460.880	50.31	50.61	n.a.
Total:			**228.010**	**910.657**	**100.00**	**100.00**	

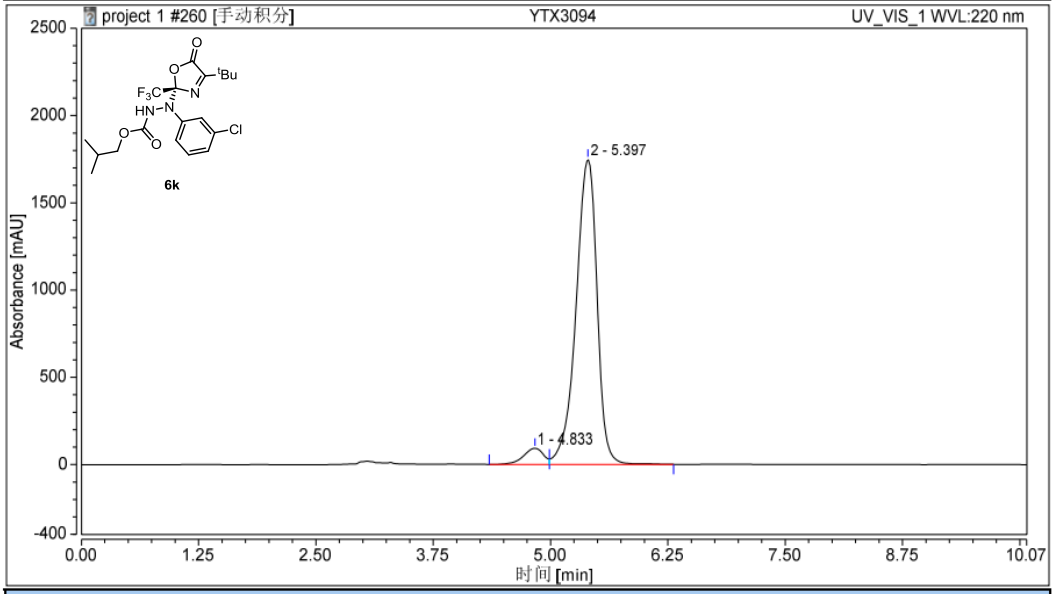
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.990	7.635	37.940	2.36	2.91	n.a.
2		5.567	315.596	1264.121	97.64	97.09	n.a.
Total:			**323.231**	**1302.061**	**100.00**	**100.00**	

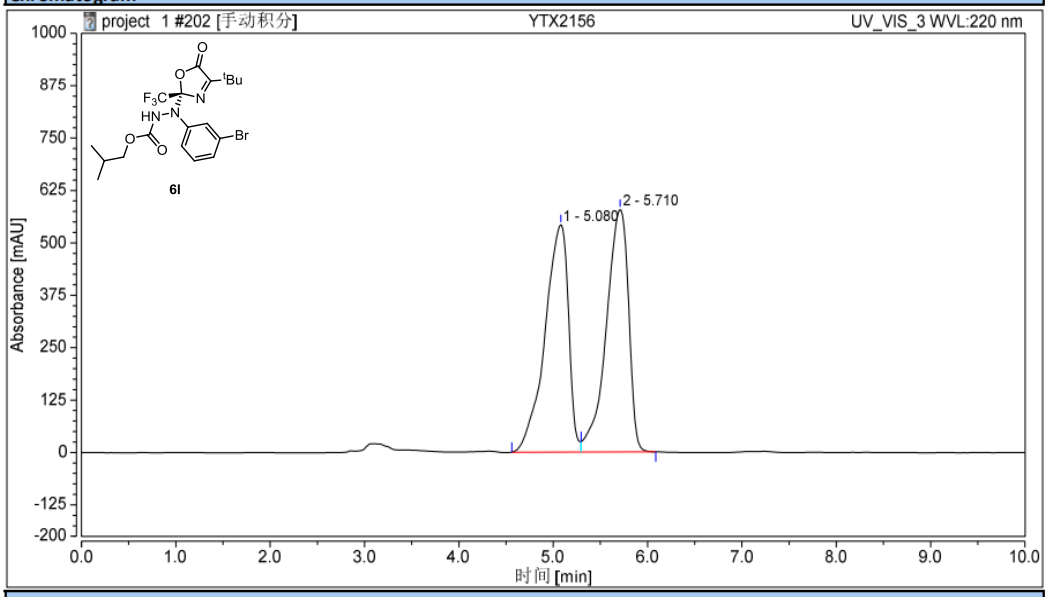
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.833	22.643	92.071	4.74	5.01	n.a.
2		5.397	454.859	1747.294	95.26	94.99	n.a.
Total:			**477.503**	**1839.365**	**100.00**	**100.00**	

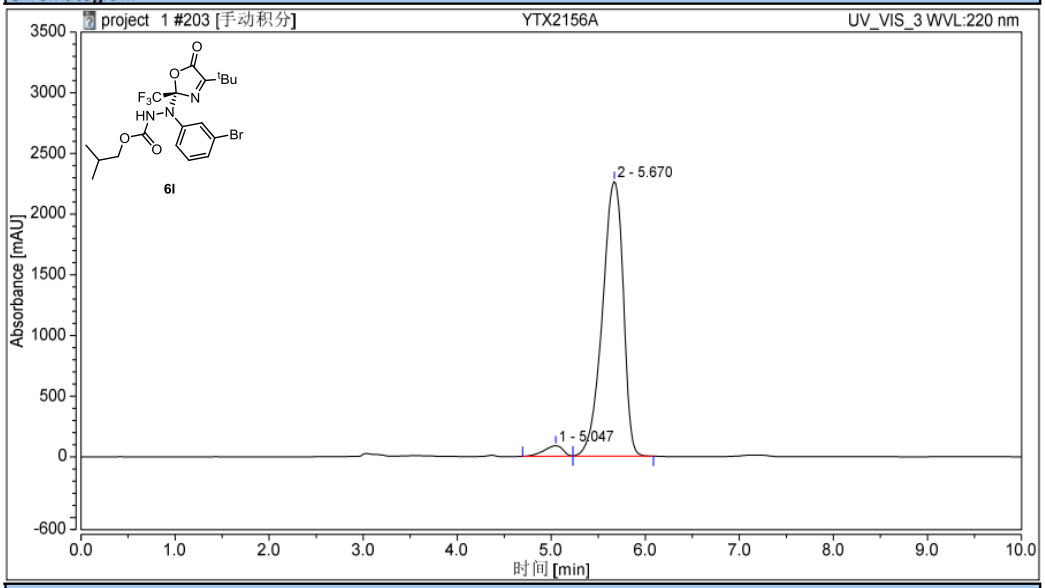
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.080	157.064	542.327	49.90	48.39	n.a.
2		5.710	157.714	578.420	50.10	51.61	n.a.
Total:			**314.777**	**1120.747**	**100.00**	**100.00**	

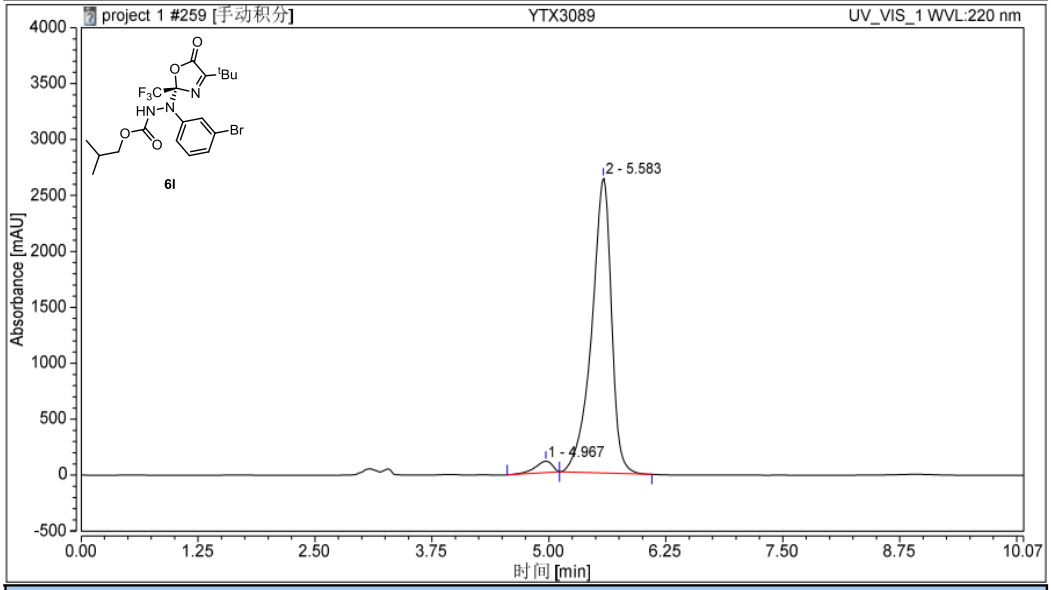
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.047	20.470	86.729	3.40	3.69	n.a.
2		5.670	580.886	2263.719	96.60	96.31	n.a.
Total:			**601.356**	**2350.448**	**100.00**	**100.00**	

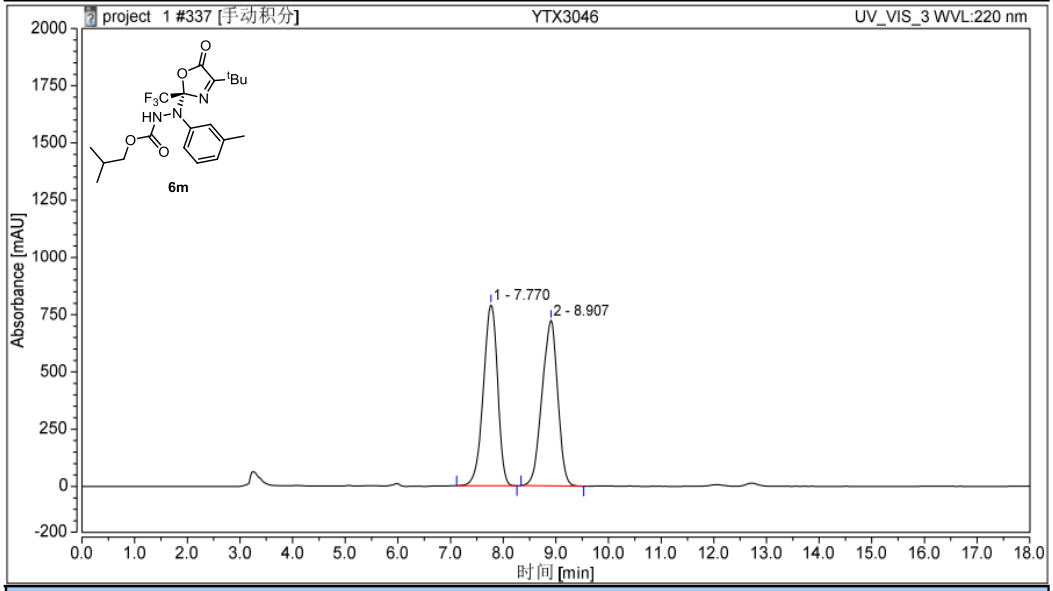
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.967	21.428	101.281	3.21	3.70	n.a.
2		5.583	645.177	2636.907	96.79	96.30	n.a.
Total:			**666.605**	**2738.188**	**100.00**	**100.00**	

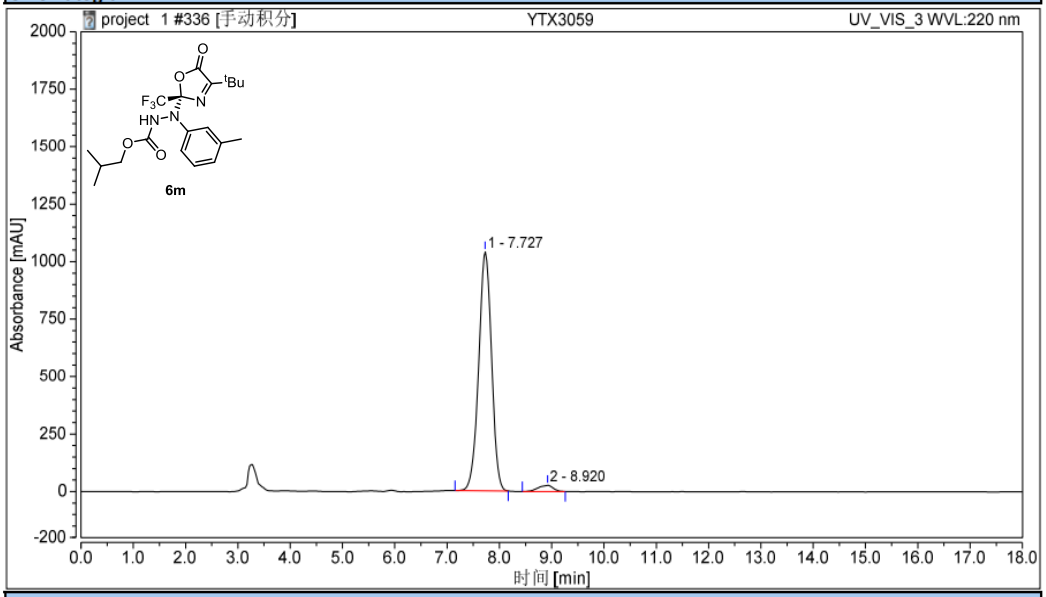
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.770	249.041	791.035	49.94	52.22	n.a.
2		8.907	249.657	723.855	50.06	47.78	n.a.
Total:			**498.698**	**1514.889**	**100.00**	**100.00**	

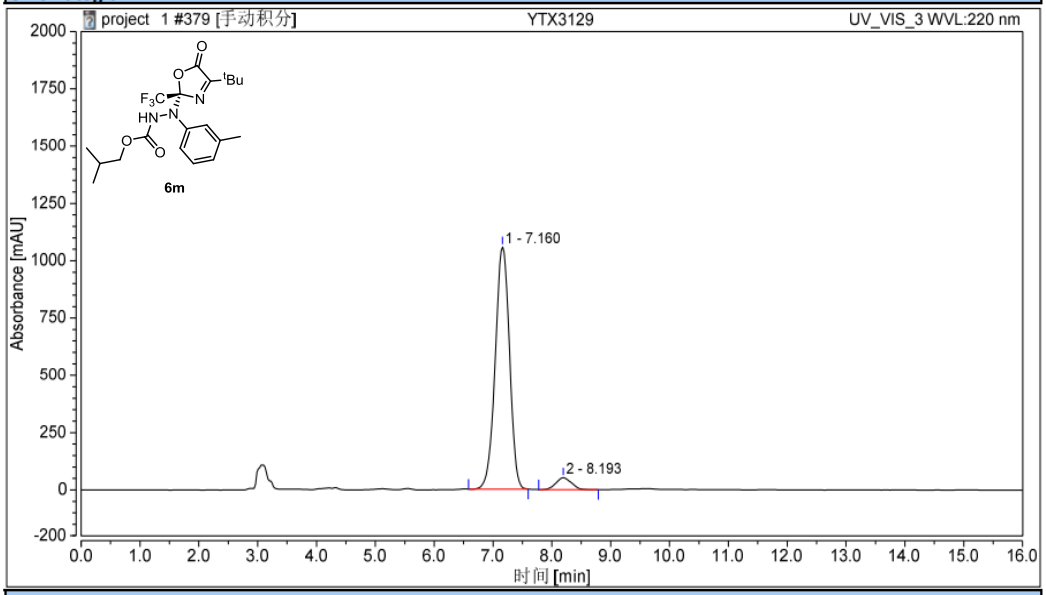
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.727	295.745	1041.054	97.04	97.45	n.a.
2		8.920	9.030	27.221	2.96	2.55	n.a.
Total:			**304.775**	**1068.275**	**100.00**	**100.00**	

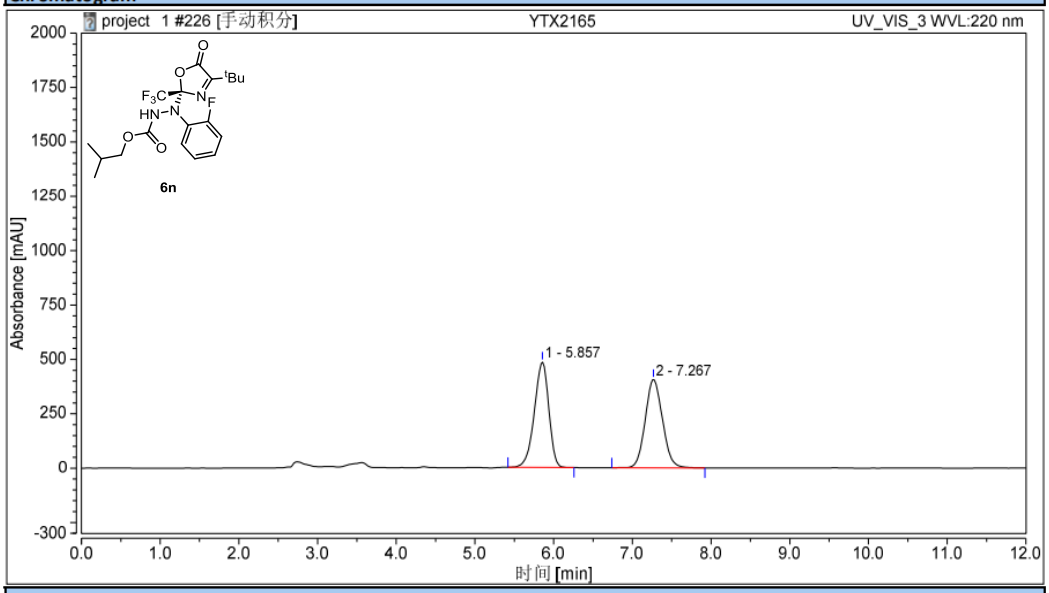
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.160	296.718	1057.472	95.00	95.35	n.a.
2		8.193	15.612	51.629	5.00	4.65	n.a.
Total:			**312.330**	**1109.101**	**100.00**	**100.00**	

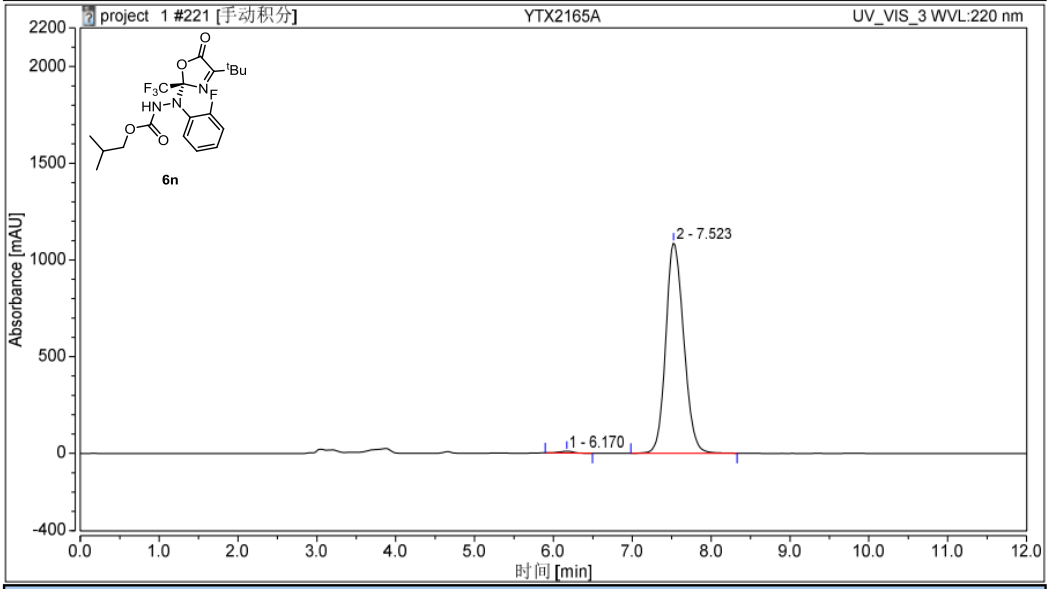
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.857	102.951	484.625	49.88	54.33	n.a.
2		7.267	103.454	407.352	50.12	45.67	n.a.
Total:			**206.405**	**891.977**	**100.00**	**100.00**	

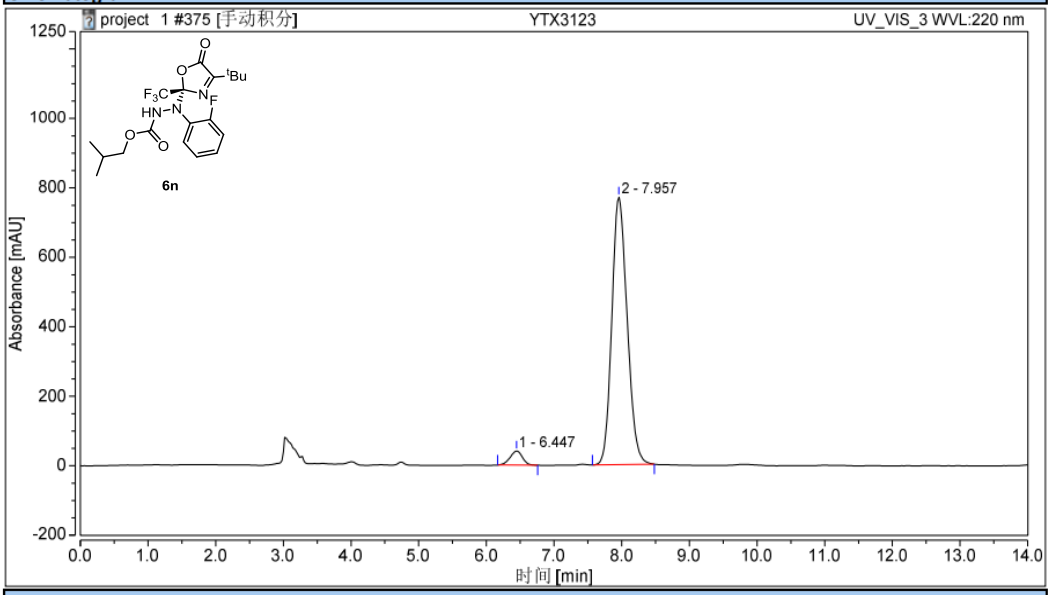
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.170	1.733	9.460	0.60	0.86	n.a.
2		7.523	288.323	1087.691	99.40	99.14	n.a.
Total:			**290.055**	**1097.151**	**100.00**	**100.00**	

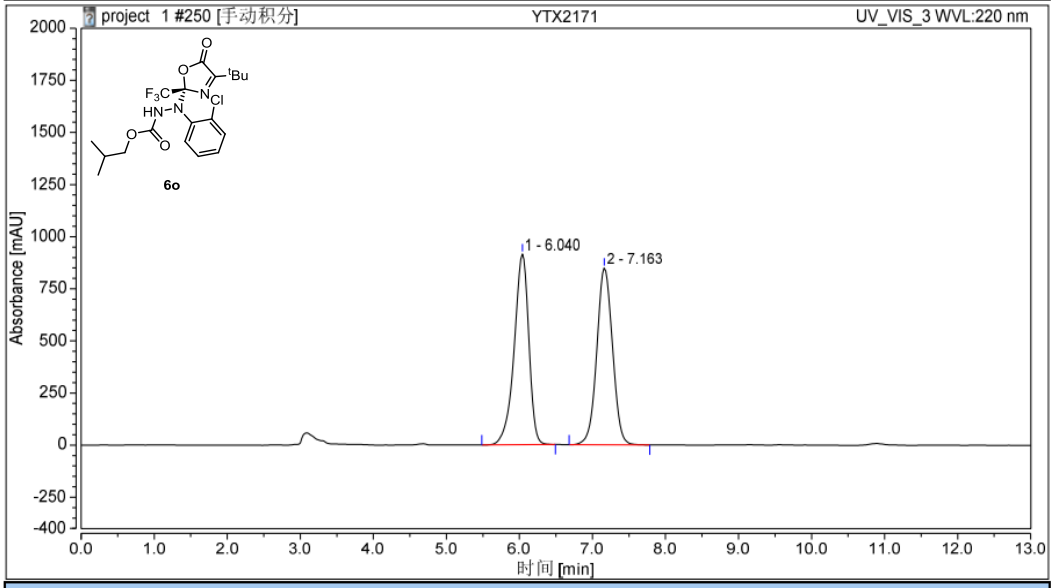
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.447	8.554	40.729	4.05	5.02	n.a.
2		7.957	202.541	770.772	95.95	94.98	n.a.
Total:			**211.096**	**811.501**	**100.00**	**100.00**	

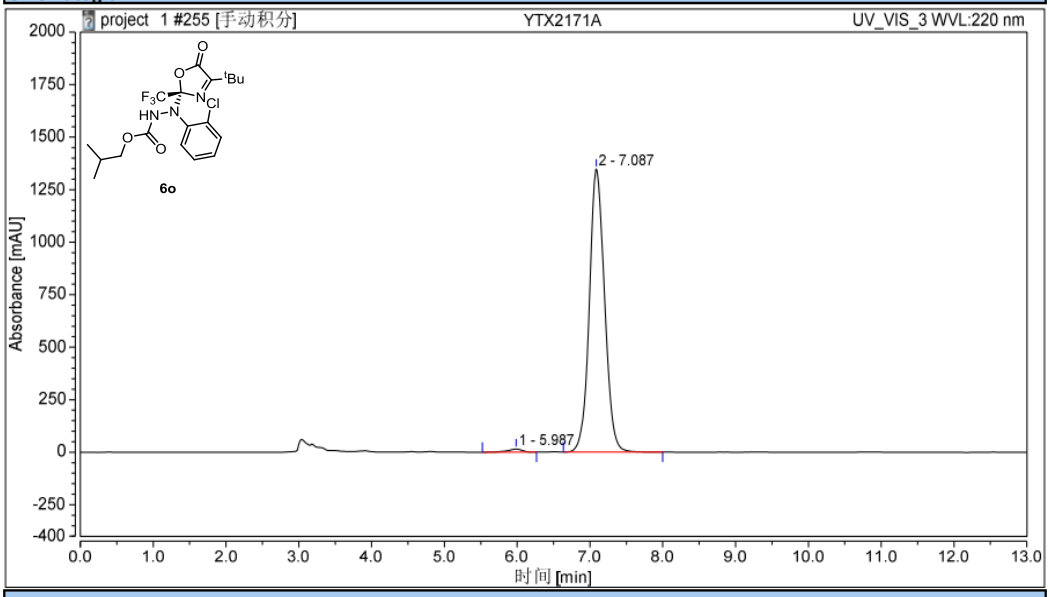
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.040	211.771	915.009	50.02	51.90	n.a.
2		7.163	211.583	847.891	49.98	48.10	n.a.
Total:			**423.354**	**1762.900**	**100.00**	**100.00**	

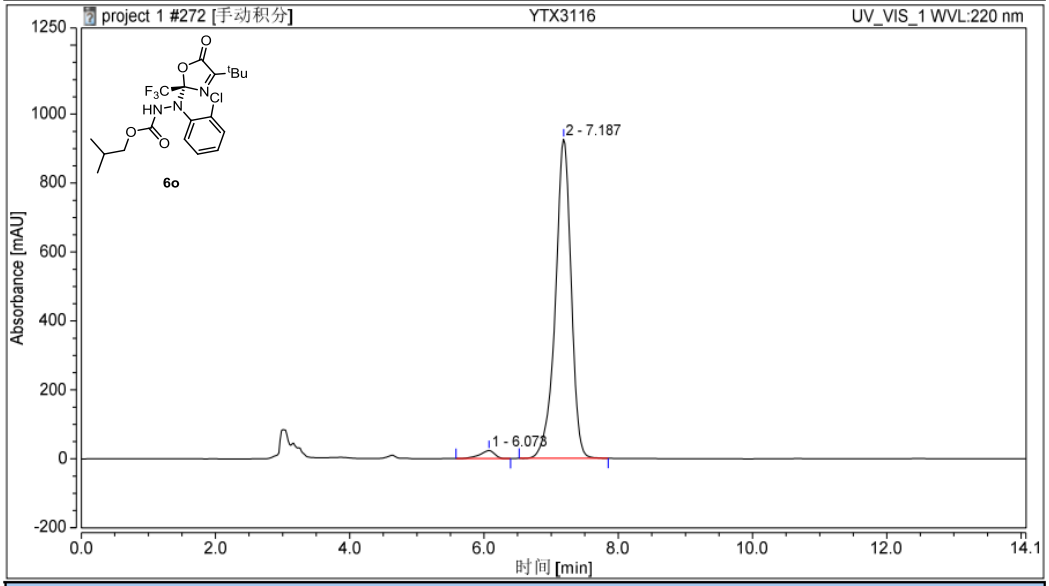
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.987	3.402	14.514	1.03	1.07	n.a.
2		7.087	327.213	1347.659	98.97	98.93	n.a.
Total:			**330.615**	**1362.173**	**100.00**	**100.00**	

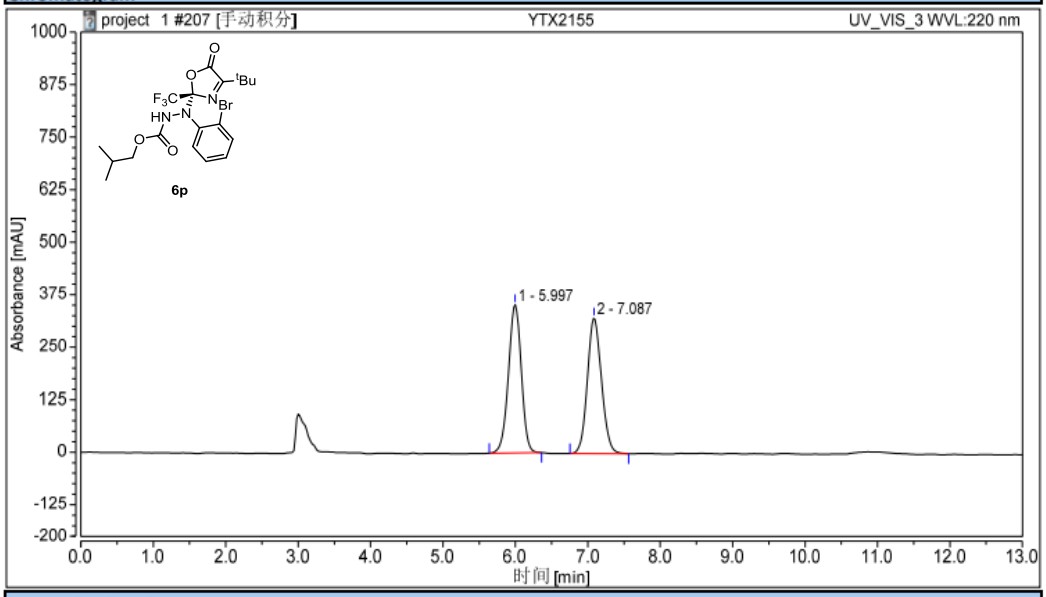
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.073	5.888	23.281	2.28	2.45	n.a.
2		7.187	251.905	926.382	97.72	97.55	n.a.
Total:			**257.793**	**949.663**	**100.00**	**100.00**	

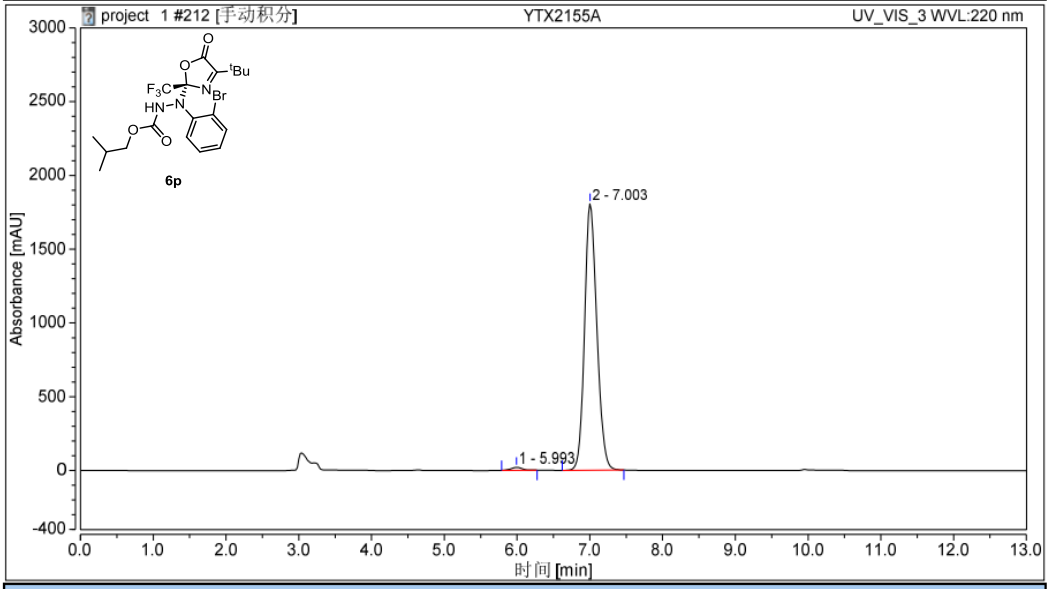
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.997	72.471	353.182	49.83	52.23	n.a.
2		7.087	72.957	323.084	50.17	47.77	n.a.
Total:			**145.428**	**676.265**	**100.00**	**100.00**	

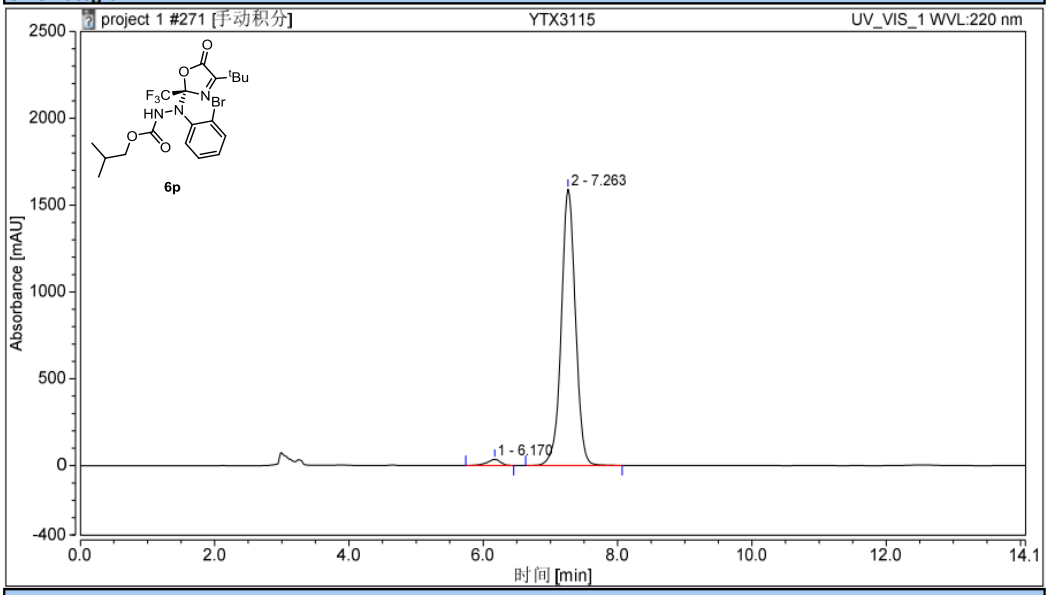
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		5.993	3.463	19.982	0.97	1.09	n.a.
2		7.003	355.200	1807.594	99.03	98.91	n.a.
Total:			**358.663**	**1827.575**	**100.00**	**100.00**	

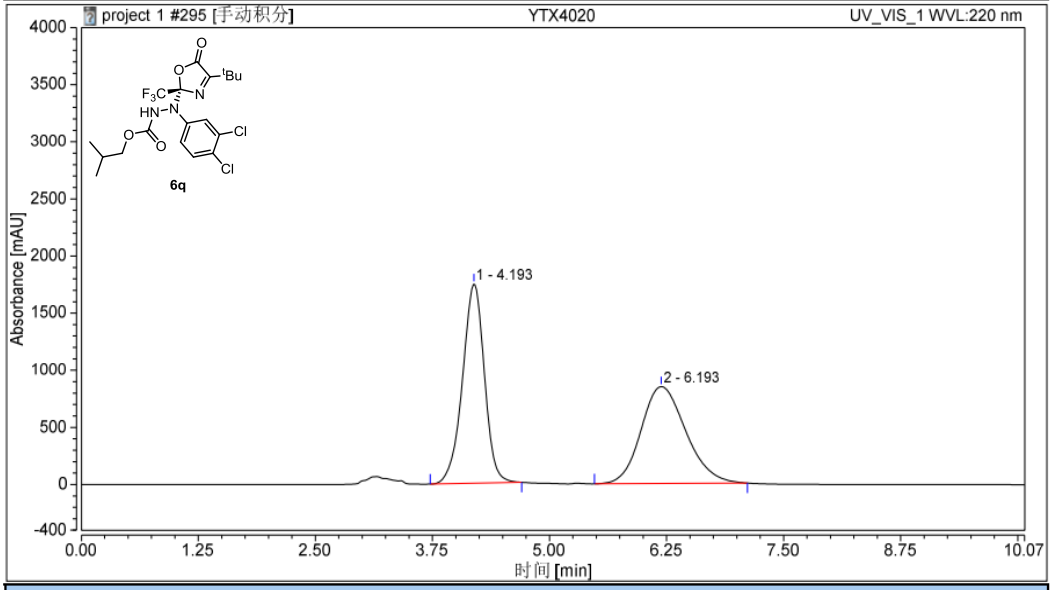
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.170	8.045	35.343	2.03	2.17	n.a.
2		7.263	389.142	1591.050	97.97	97.83	n.a.
Total:			**397.186**	**1626.393**	**100.00**	**100.00**	

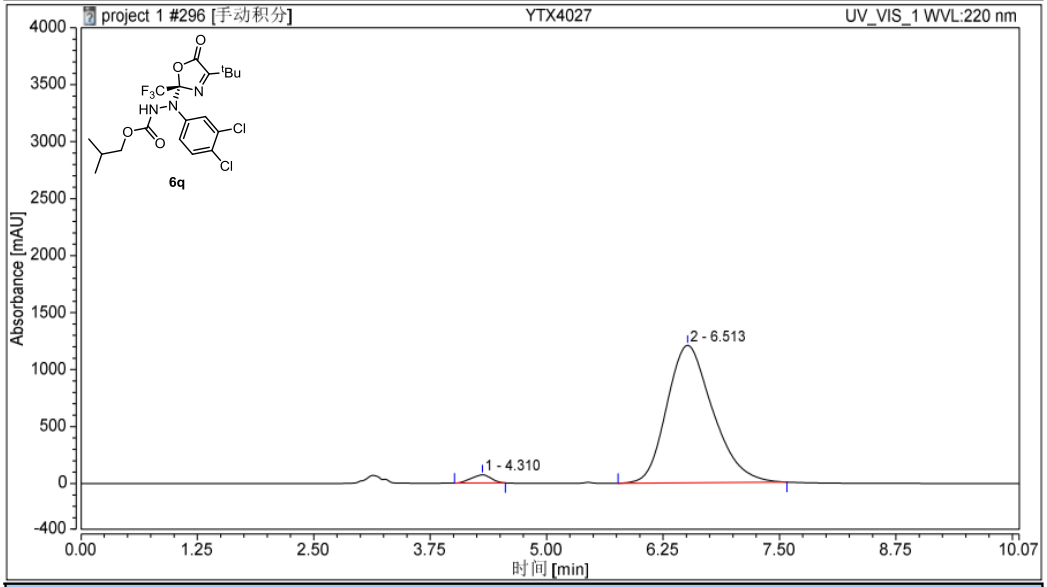
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.193	473.841	1745.345	50.19	67.29	n.a.
2		6.193	470.337	848.296	49.81	32.71	n.a.
Total:			**944.178**	**2593.641**	**100.00**	**100.00**	

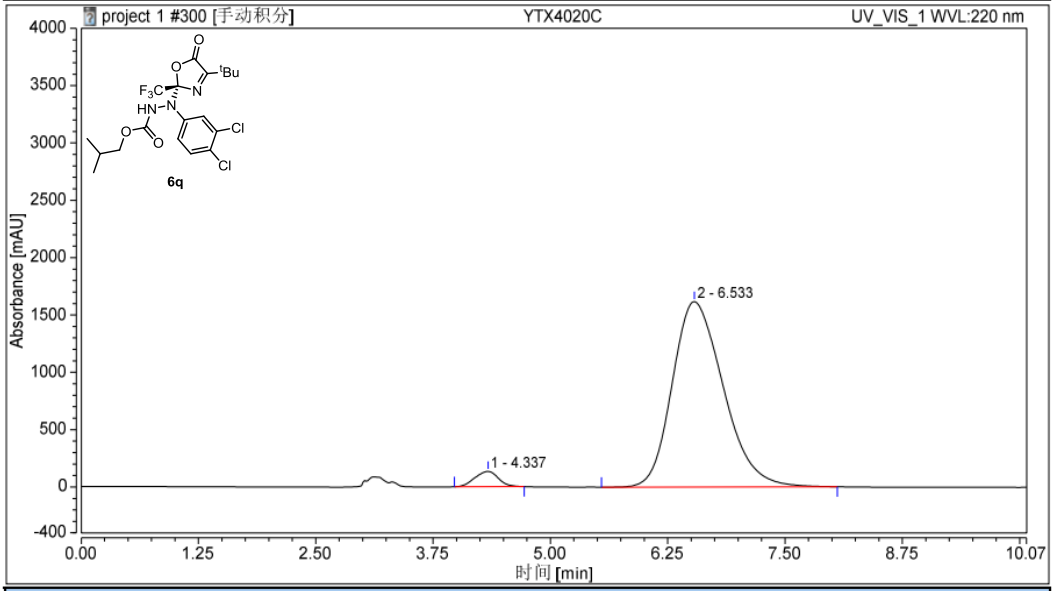
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.310	17.765	71.555	2.51	5.60	n.a.
2		6.513	690.457	1206.834	97.49	94.40	n.a.
Total:			**708.222**	**1278.389**	**100.00**	**100.00**	

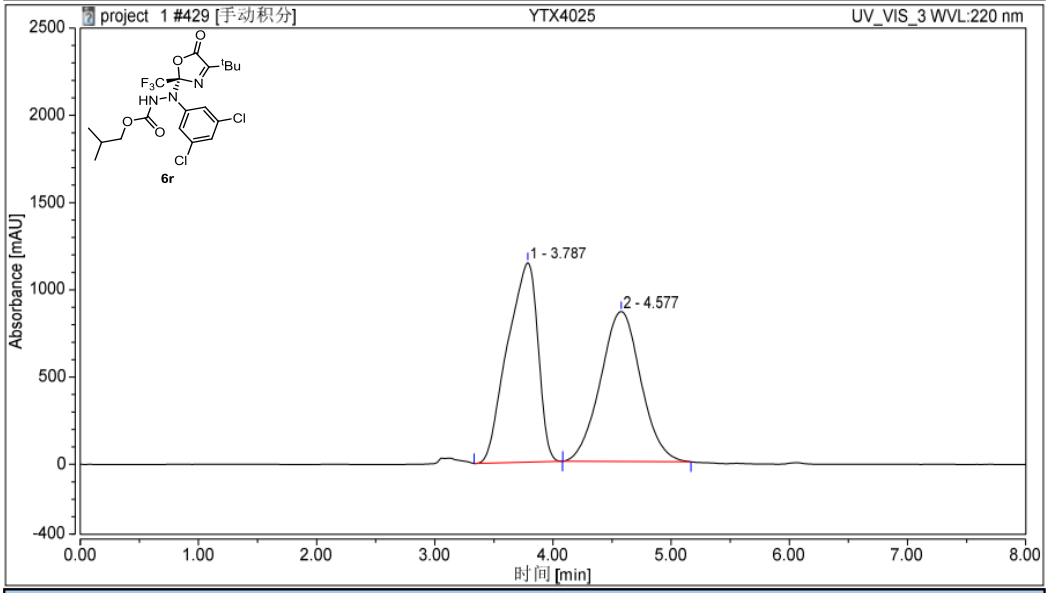
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.337	38.713	133.323	3.65	7.61	n.a.
2		6.533	1020.630	1617.614	96.35	92.39	n.a.
Total:			**1059.343**	**1750.937**	**100.00**	**100.00**	

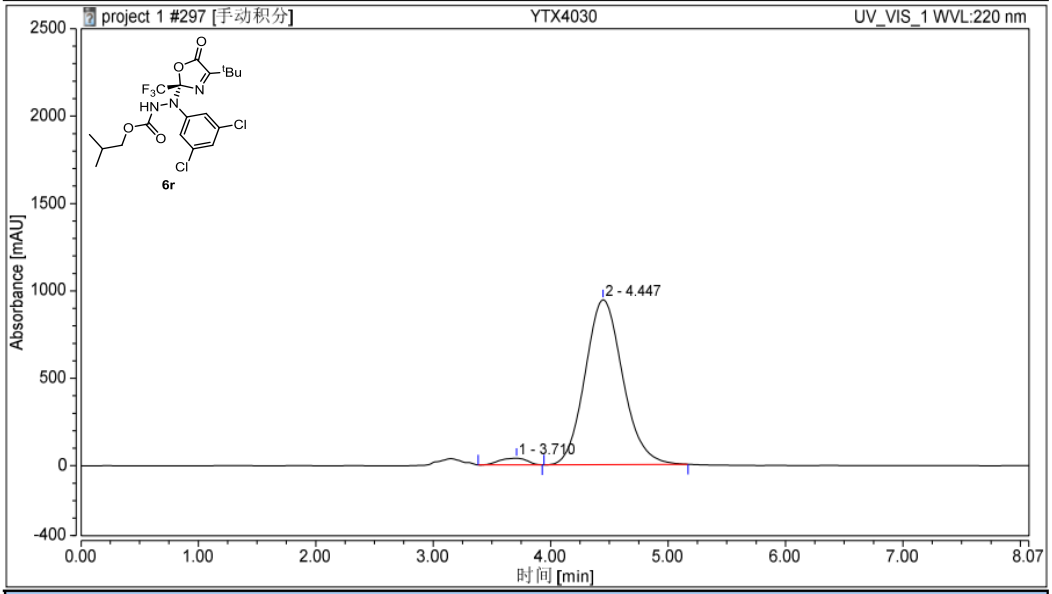
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		3.787	341.058	1142.989	50.06	57.09	n.a.
2		4.577	340.194	858.954	49.94	42.91	n.a.
Total:			**681.252**	**2001.943**	**100.00**	**100.00**	

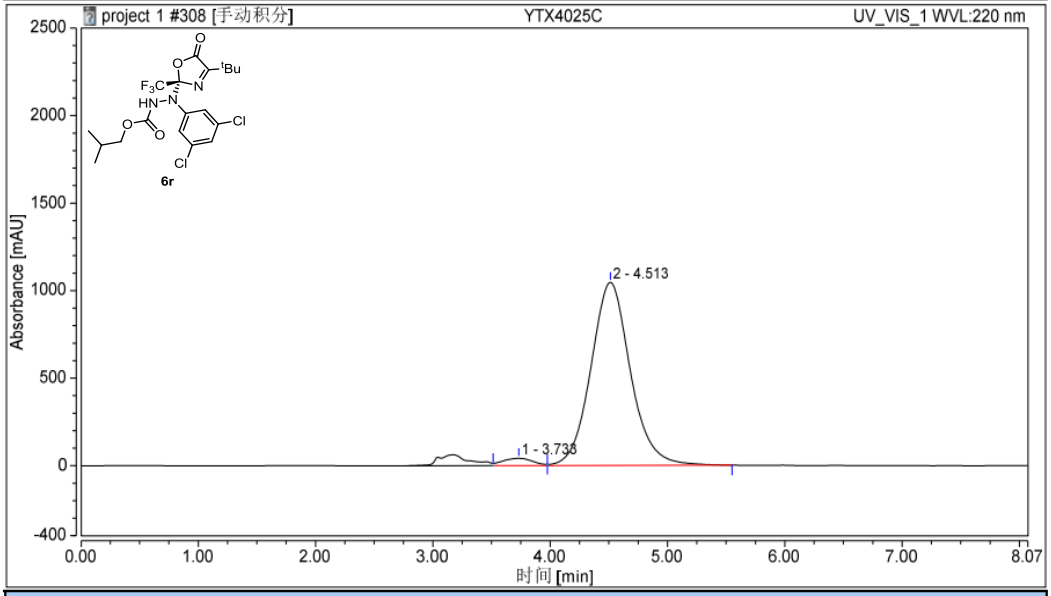
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		3.710	10.295	37.711	2.85	3.85	n.a.
2		4.447	350.593	942.839	97.15	96.15	n.a.
Total:			**360.887**	**980.550**	**100.00**	**100.00**	

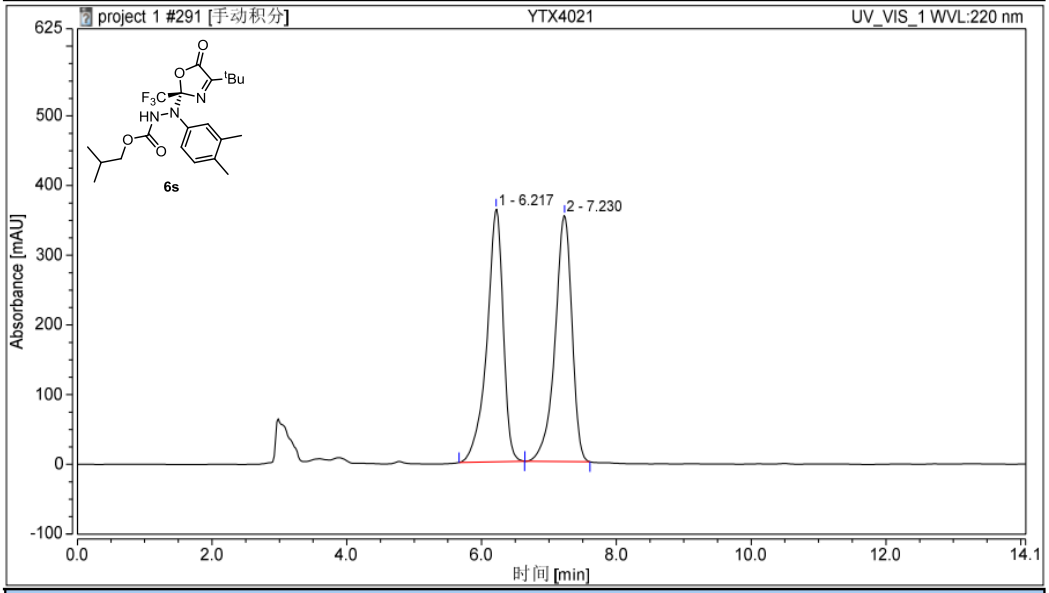
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		3.733	12.168	41.102	2.90	3.78	n.a.
2		4.513	407.983	1046.053	97.10	96.22	n.a.
Total:			**420.151**	**1087.156**	**100.00**	**100.00**	

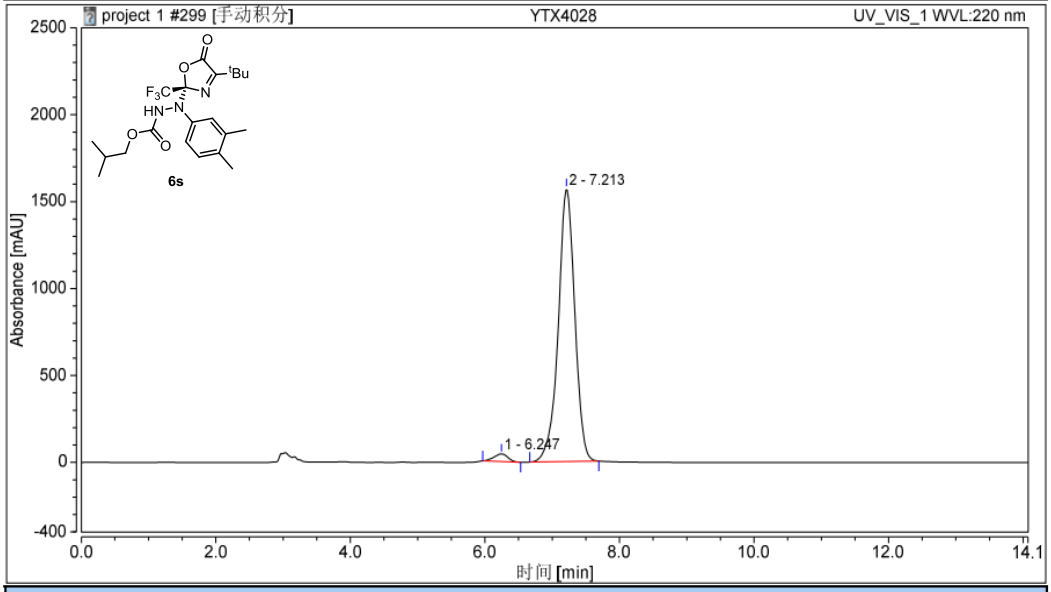
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.217	101.517	362.871	49.75	50.66	n.a.
2		7.230	102.519	353.472	50.25	49.34	n.a.
Total:			**204.036**	**716.344**	**100.00**	**100.00**	

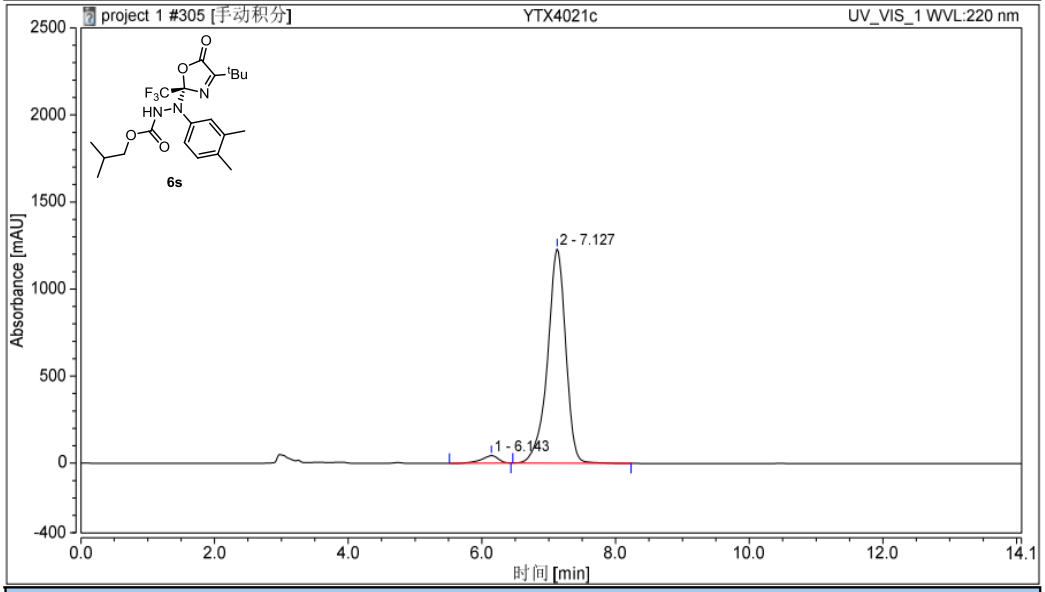
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.247	10.329	43.729	2.26	2.71	n.a.
2		7.213	446.038	1569.262	97.74	97.29	n.a.
Total:			**456.368**	**1612.992**	**100.00**	**100.00**	

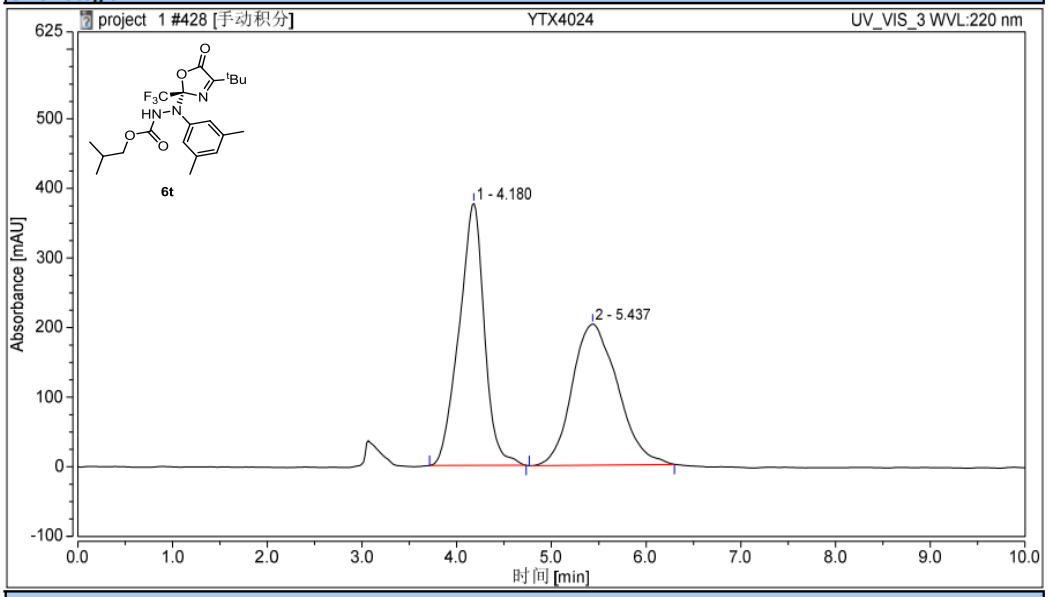
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		6.143	12.409	43.000	3.11	3.38	n.a.
2		7.127	387.189	1230.085	96.89	96.62	n.a.
Total:			**399.598**	**1273.085**	**100.00**	**100.00**	

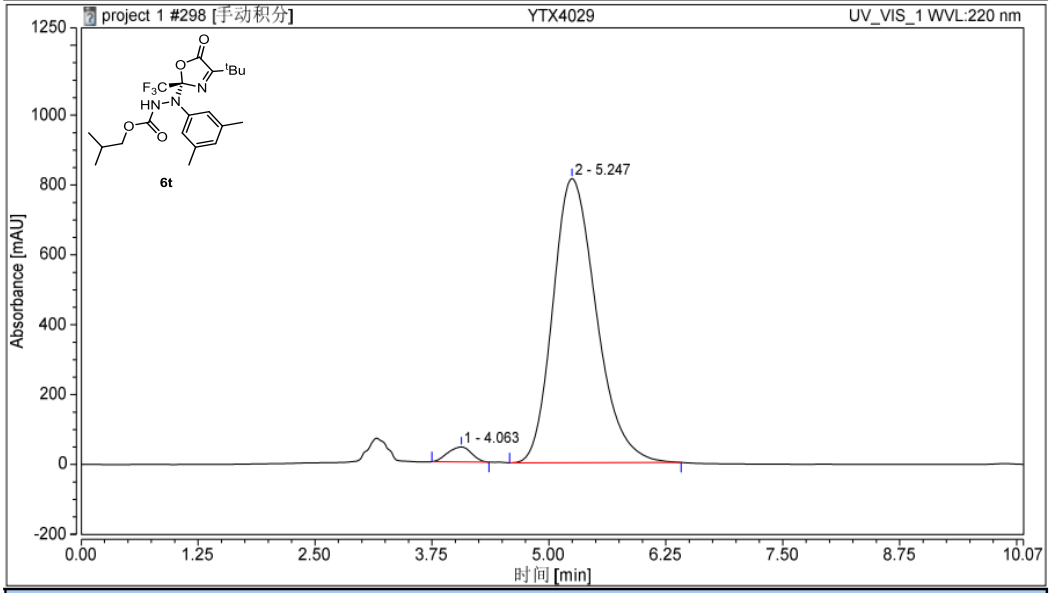
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.180	116.425	376.728	50.78	65.02	n.a.
2		5.437	112.832	202.702	49.22	34.98	n.a.
Total:			**229.256**	**579.431**	**100.00**	**100.00**	

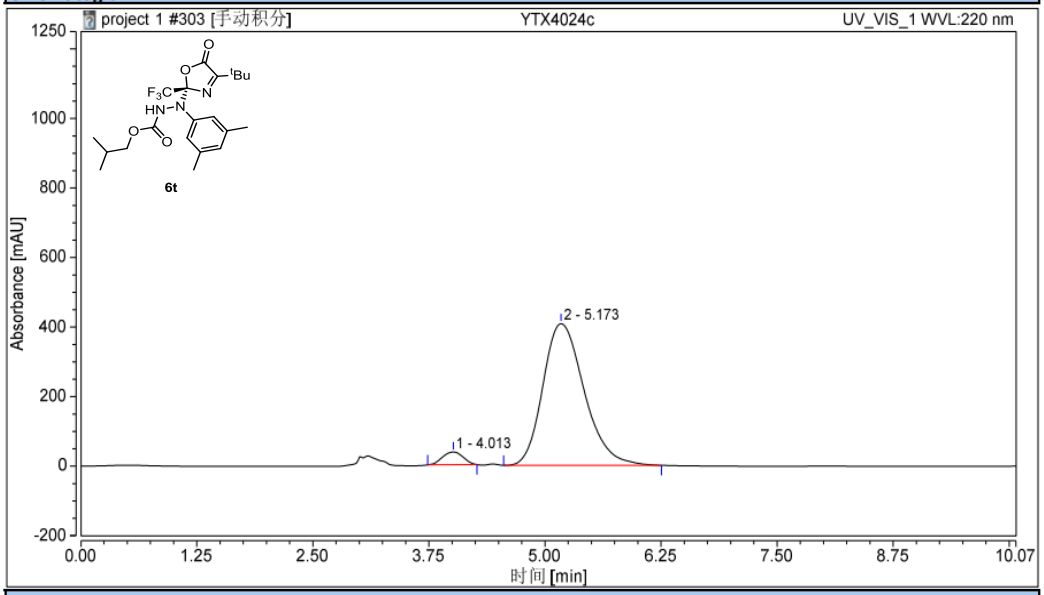
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.063	12.463	42.452	2.77	4.96	n.a.
2		5.247	438.018	813.190	97.23	95.04	n.a.
Total:			**450.480**	**855.642**	**100.00**	**100.00**	

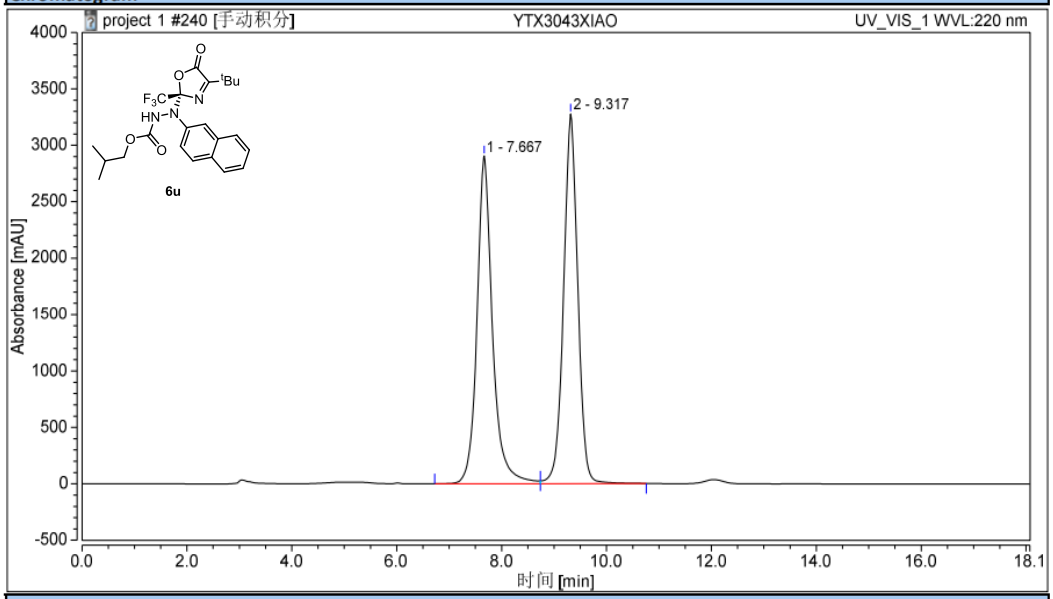
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.013	9.489	36.459	4.32	8.21	n.a.
2		5.173	210.023	407.561	95.68	91.79	n.a.
Total:			**219.512**	**444.020**	**100.00**	**100.00**	

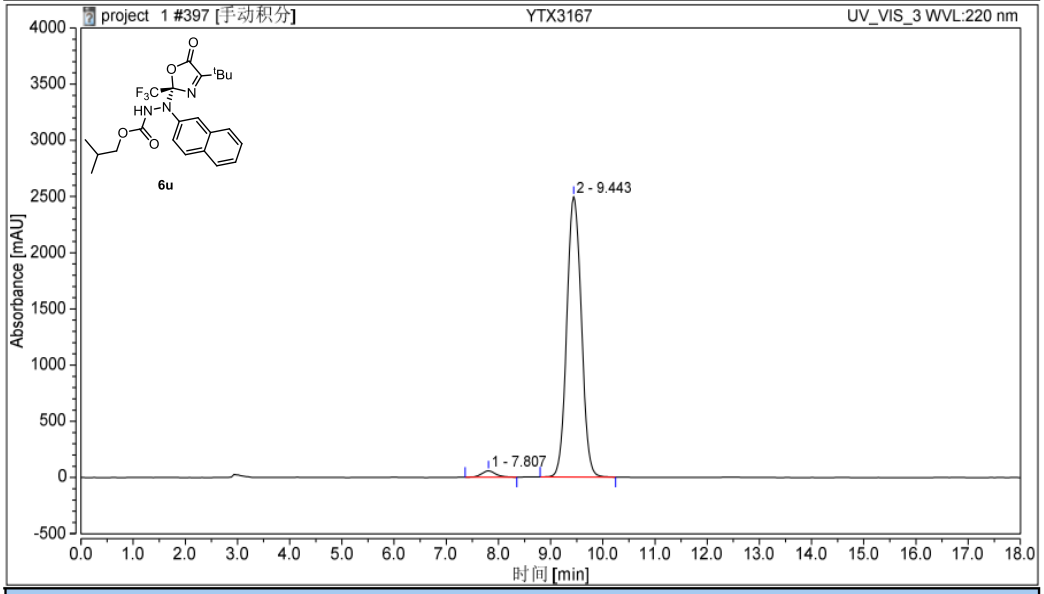
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.667	995.671	2904.743	49.29	46.98	n.a.
2		9.317	1024.308	3277.584	50.71	53.02	n.a.
Total:			**2019.979**	**6182.327**	**100.00**	**100.00**	

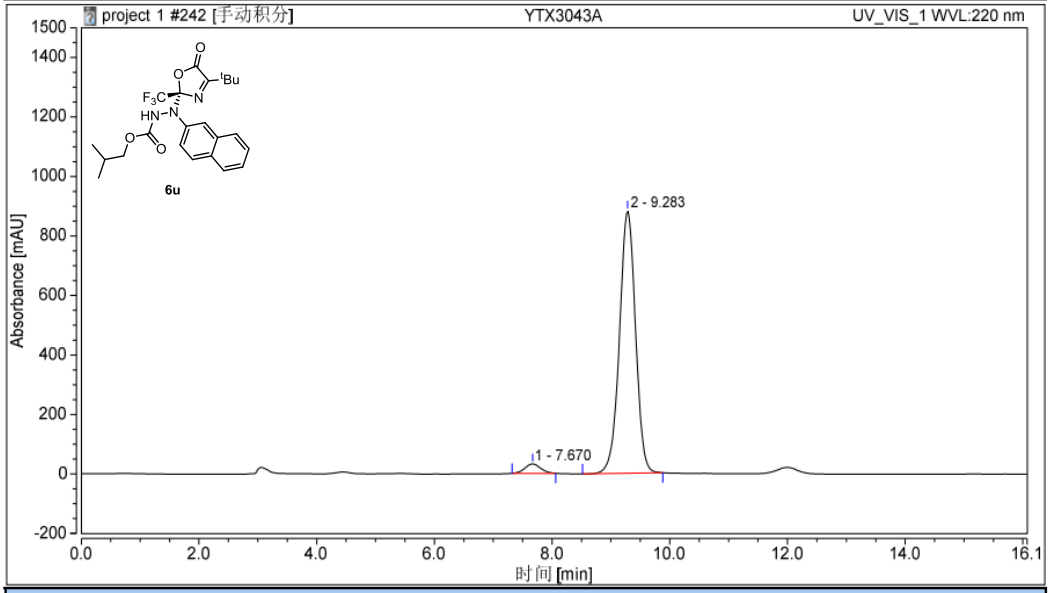
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.807	17.122	55.890	2.08	2.19	n.a.
2		9.443	804.887	2496.273	97.92	97.81	n.a.
Total:			**822.009**	**2552.163**	**100.00**	**100.00**	

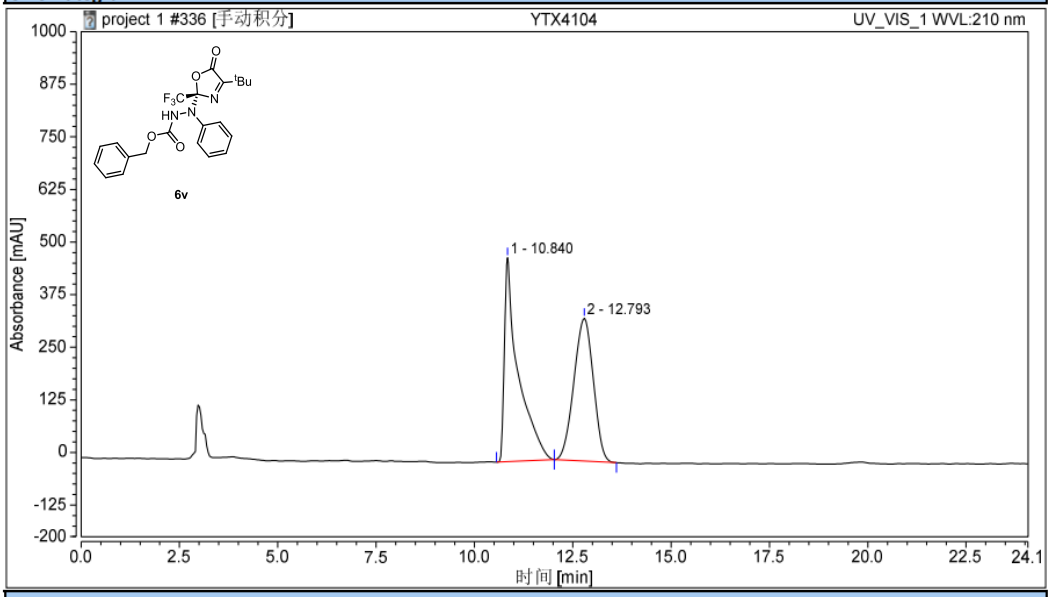
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.670	9.689	31.603	3.37	3.46	n.a.
2		9.283	278.191	881.936	96.63	96.54	n.a.
Total:			**287.879**	**913.539**	**100.00**	**100.00**	

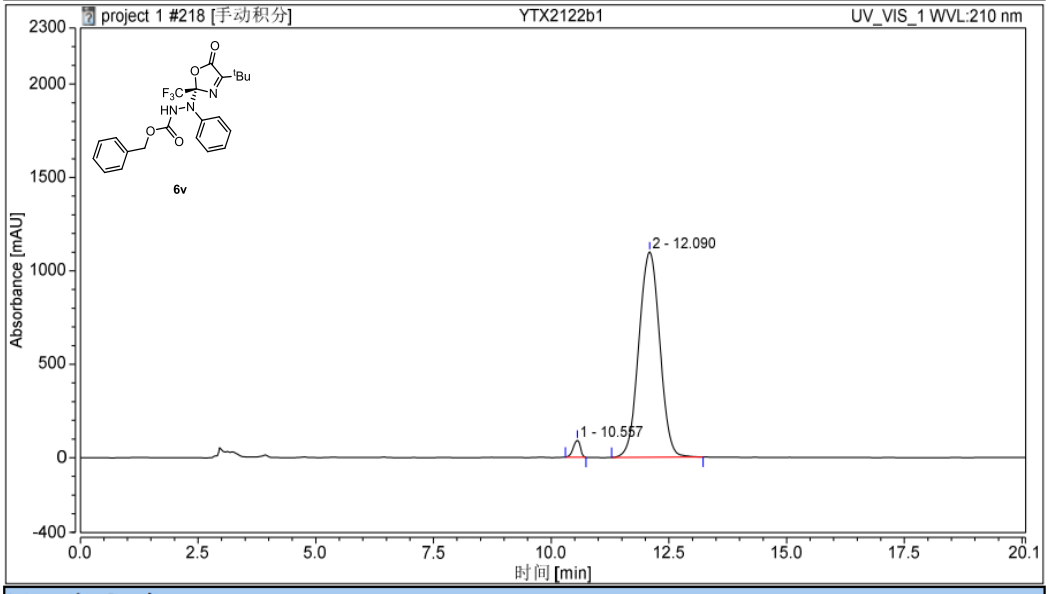
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		10.840	194.959	484.918	50.00	58.81	n.a.
2		12.793	194.971	339.573	50.00	41.19	n.a.
Total:			**389.930**	**824.491**	**100.00**	**100.00**	

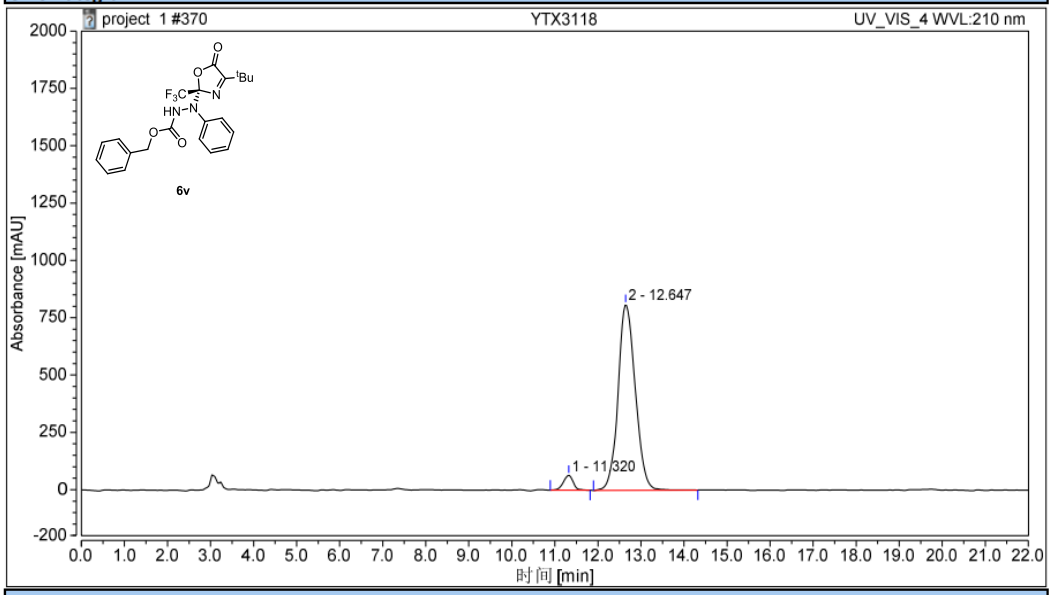
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		10.557	16.023	89.774	2.76	7.55	n.a.
2		12.090	564.373	1098.880	97.24	92.45	n.a.
Total:			**580.397**	**1188.655**	**100.00**	**100.00**	

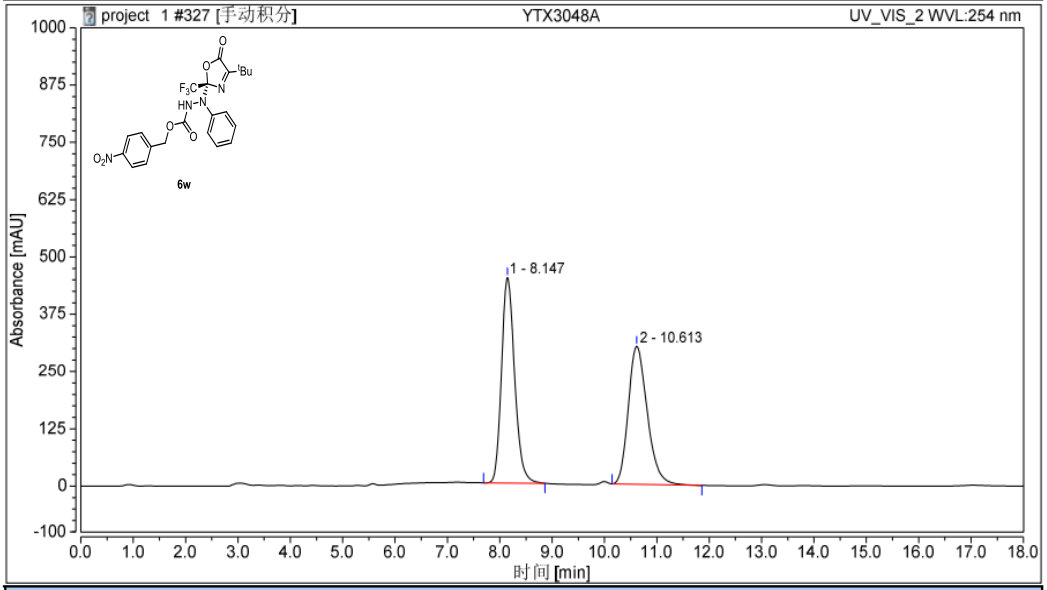
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.320	17.556	65.296	4.47	7.46	n.a.
2		12.647	374.993	810.299	95.53	92.54	n.a.
Total:			**392.549**	**875.595**	**100.00**	**100.00**	

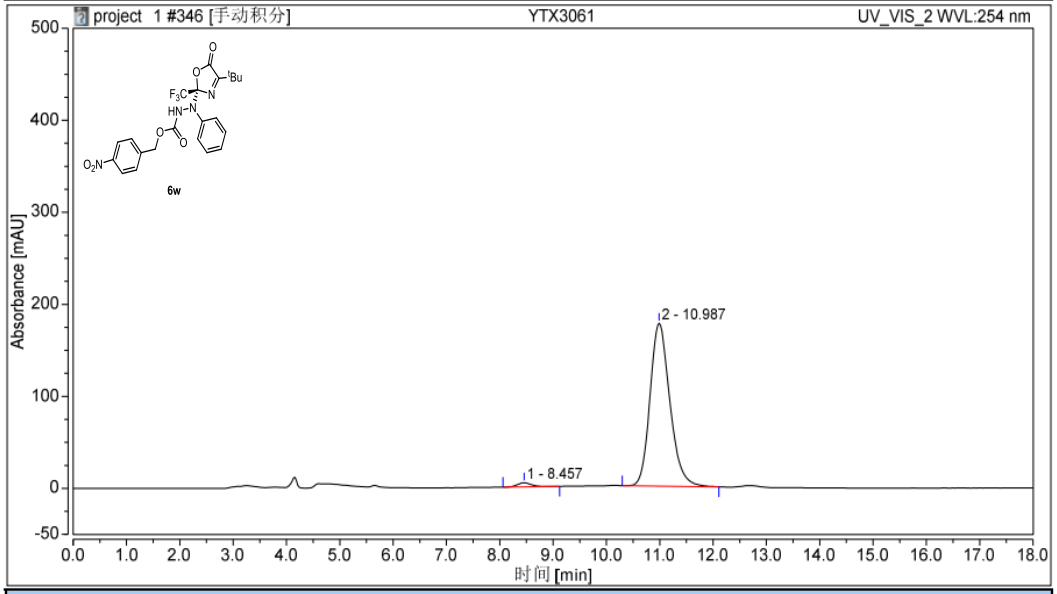
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.147	130.069	448.270	50.70	59.78	n.a.
2		10.613	126.468	301.659	49.30	40.22	n.a.
Total:			**256.536**	**749.929**	**100.00**	**100.00**	

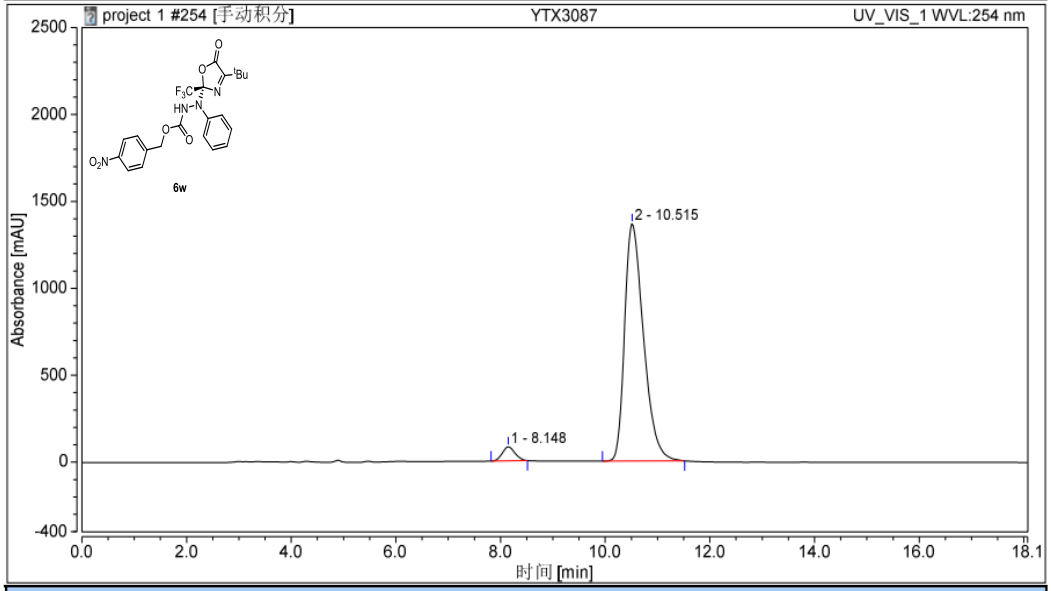
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.457	1.330	4.471	1.72	2.46	n.a.
2		10.987	76.191	177.128	98.28	97.54	n.a.
Total:			**77.522**	**181.599**	**100.00**	**100.00**	

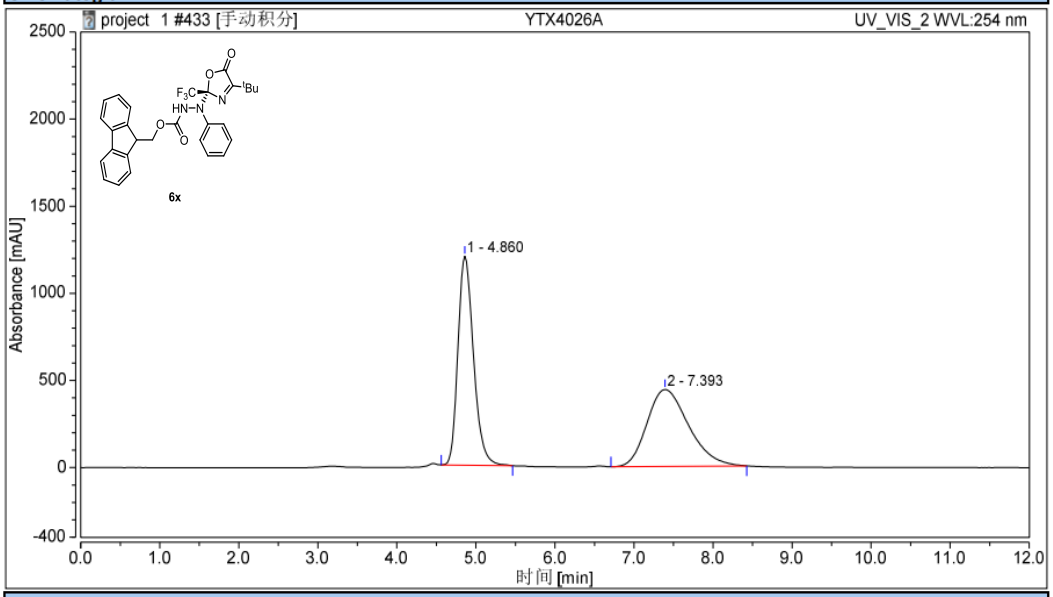
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.148	22.456	79.913	3.79	5.53	n.a.
2		10.515	570.487	1364.783	96.21	94.47	n.a.
Total:			**592.943**	**1444.696**	**100.00**	**100.00**	

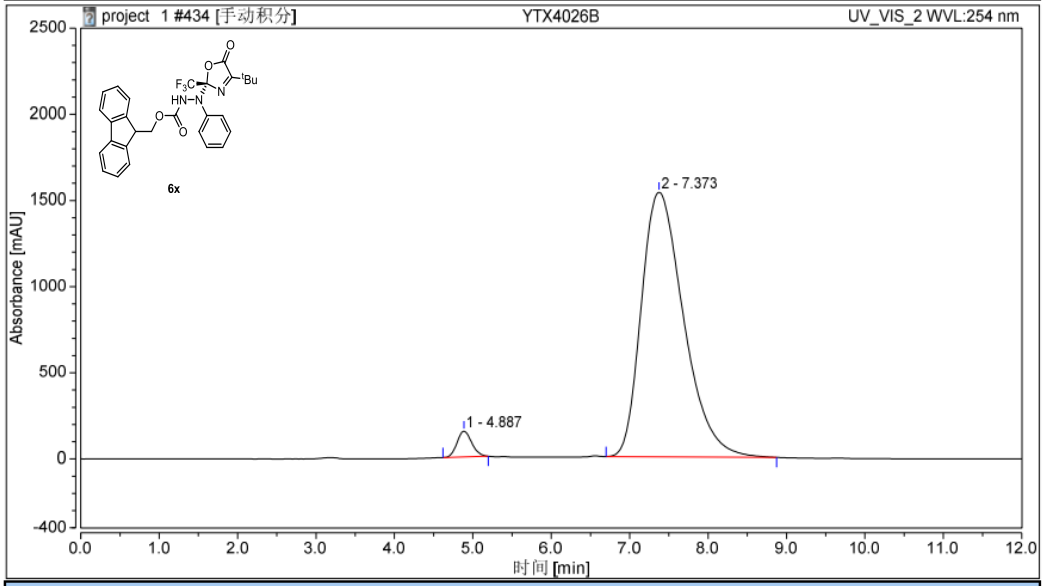
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.860	273.486	1199.168	50.42	73.10	n.a.
2		7.393	268.901	441.365	49.58	26.90	n.a.
Total:			**542.387**	**1640.533**	**100.00**	**100.00**	

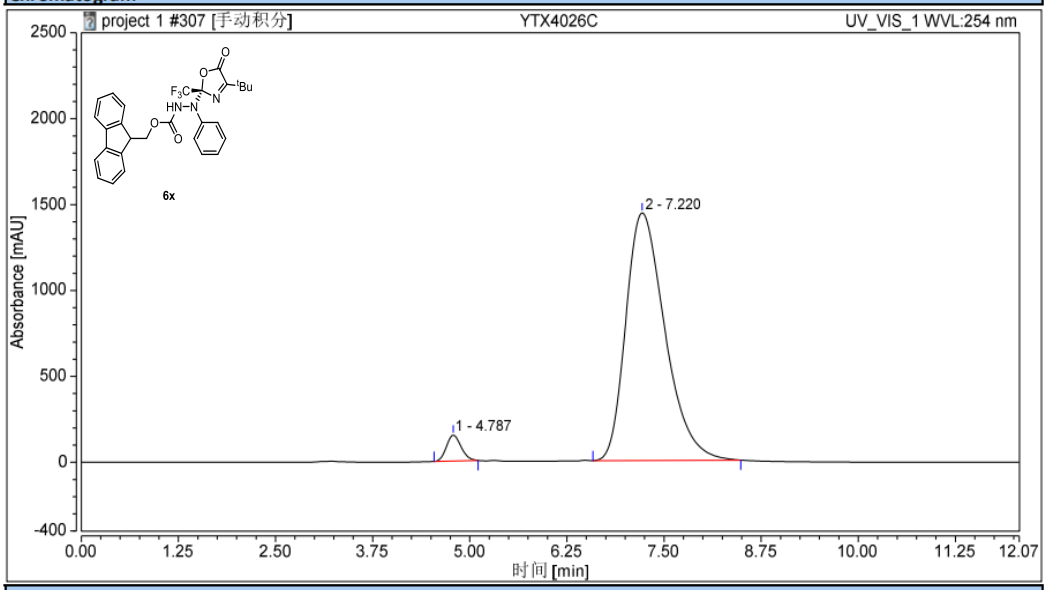
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.887	32.567	150.107	3.28	8.91	n.a.
2		7.373	959.542	1535.328	96.72	91.09	n.a.
Total:			**992.109**	**1685.436**	**100.00**	**100.00**	

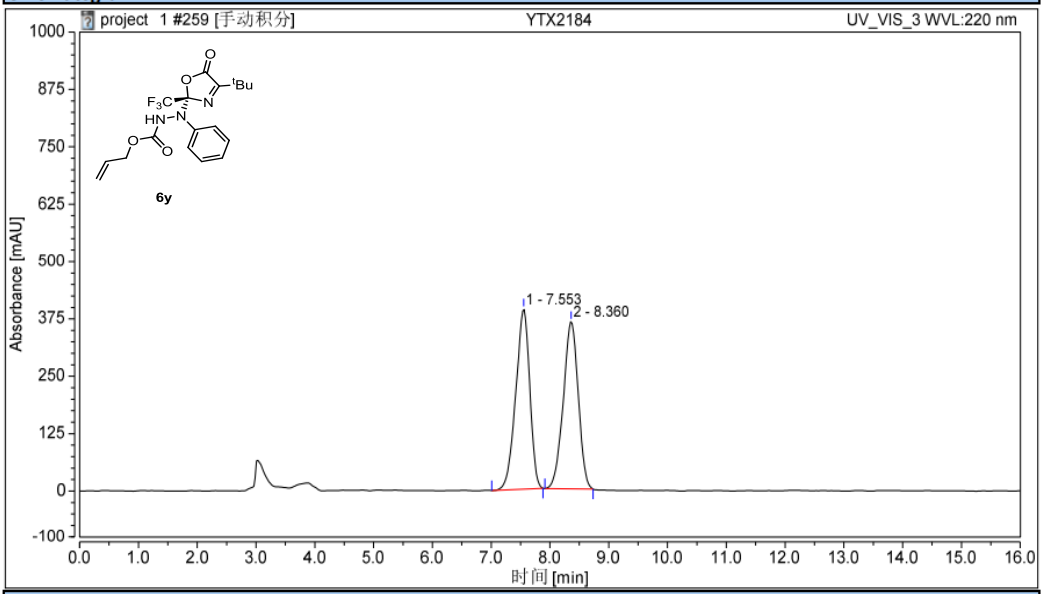
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.787	32.745	150.818	3.74	9.47	n.a.
2		7.220	841.668	1441.166	96.26	90.53	n.a.
Total:			**874.413**	**1591.983**	**100.00**	**100.00**	

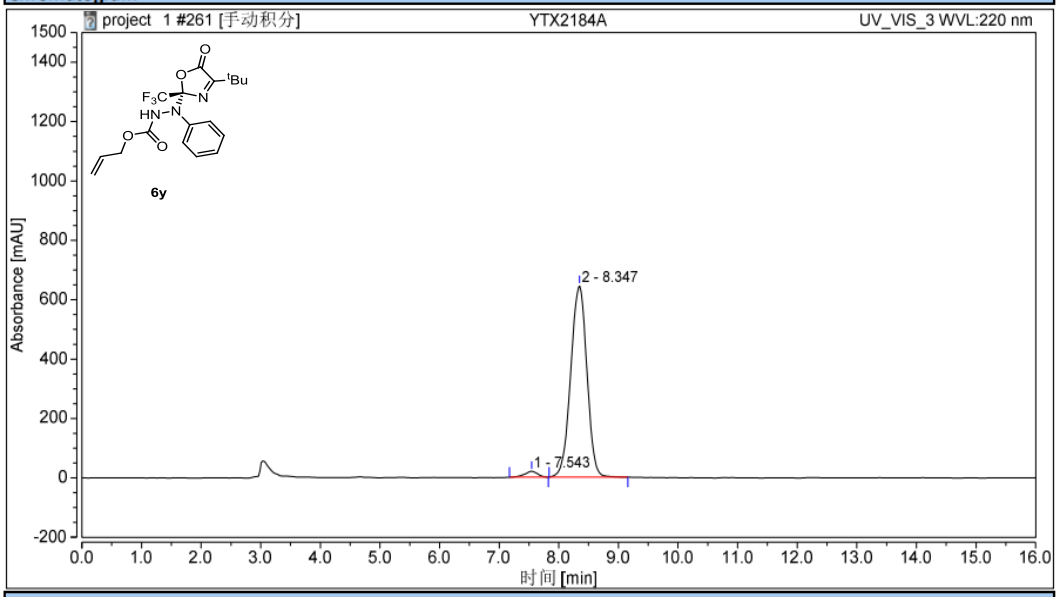
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.553	108.503	392.632	50.27	51.84	n.a.
2		8.360	107.347	364.811	49.73	48.16	n.a.
Total:			**215.850**	**757.442**	**100.00**	**100.00**	

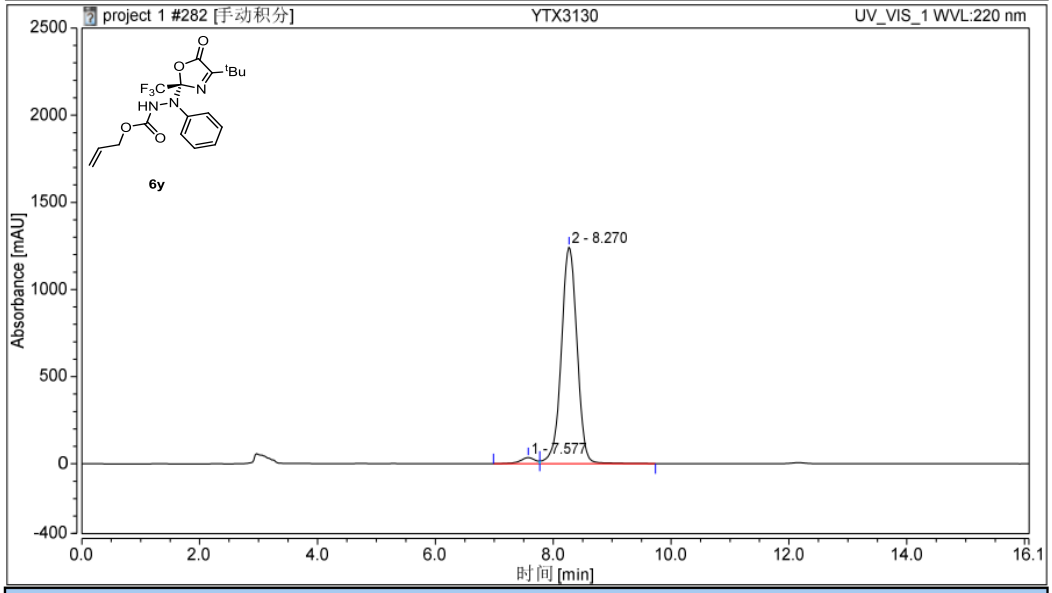
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.543	4.908	19.877	2.37	2.99	n.a.
2		8.347	202.296	644.699	97.63	97.01	n.a.
Total:			**207.205**	**664.576**	**100.00**	**100.00**	

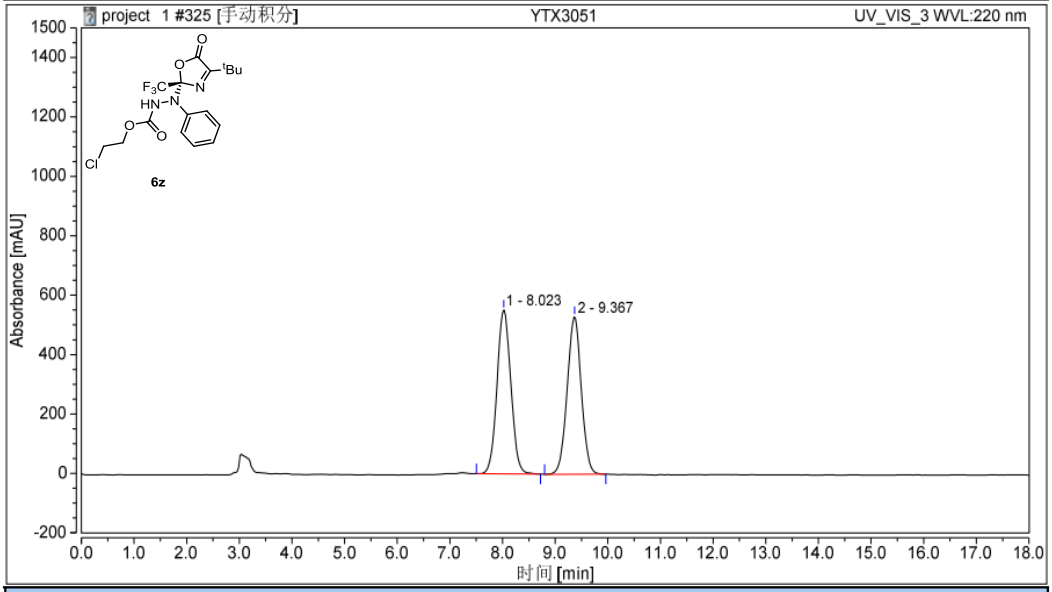
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.577	10.110	34.273	2.56	2.68	n.a.
2		8.270	384.757	1243.592	97.44	97.32	n.a.
Total:			**394.867**	**1277.865**	**100.00**	**100.00**	

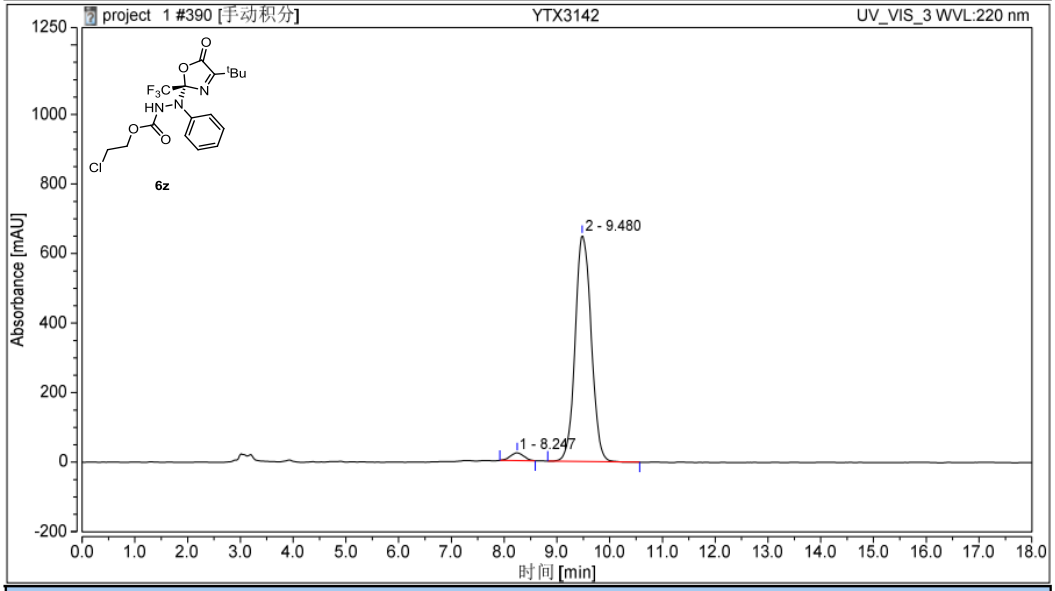
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.023	168.243	552.030	50.58	50.97	n.a.
2		9.367	164.408	530.951	49.42	49.03	n.a.
Total:			**332.651**	**1082.981**	**100.00**	**100.00**	

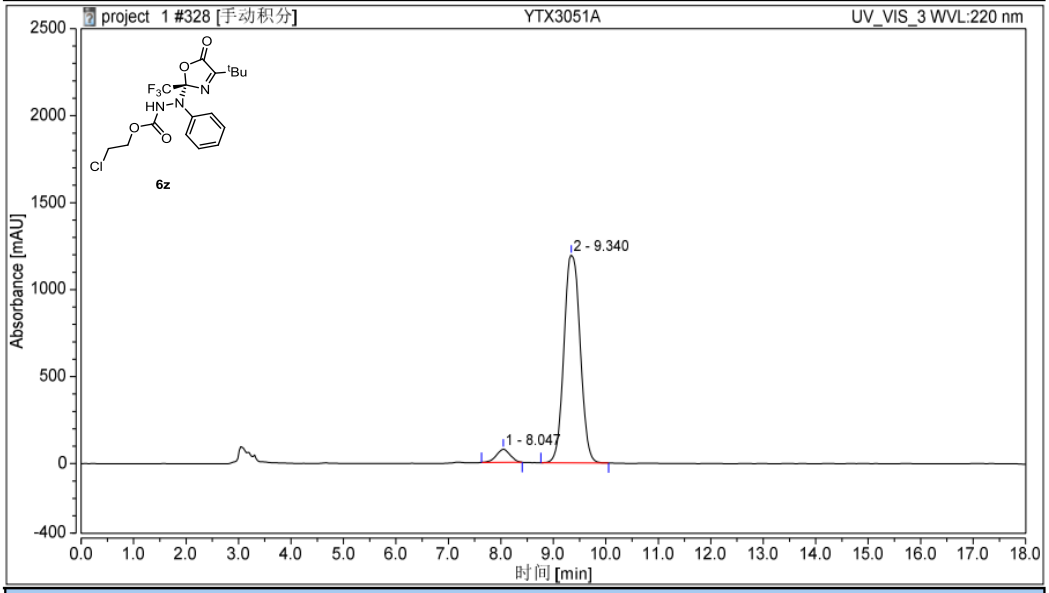
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.247	6.461	22.001	2.74	3.27	n.a.
2		9.480	229.084	650.200	97.26	96.73	n.a.
Total:			**235.545**	**672.201**	**100.00**	**100.00**	

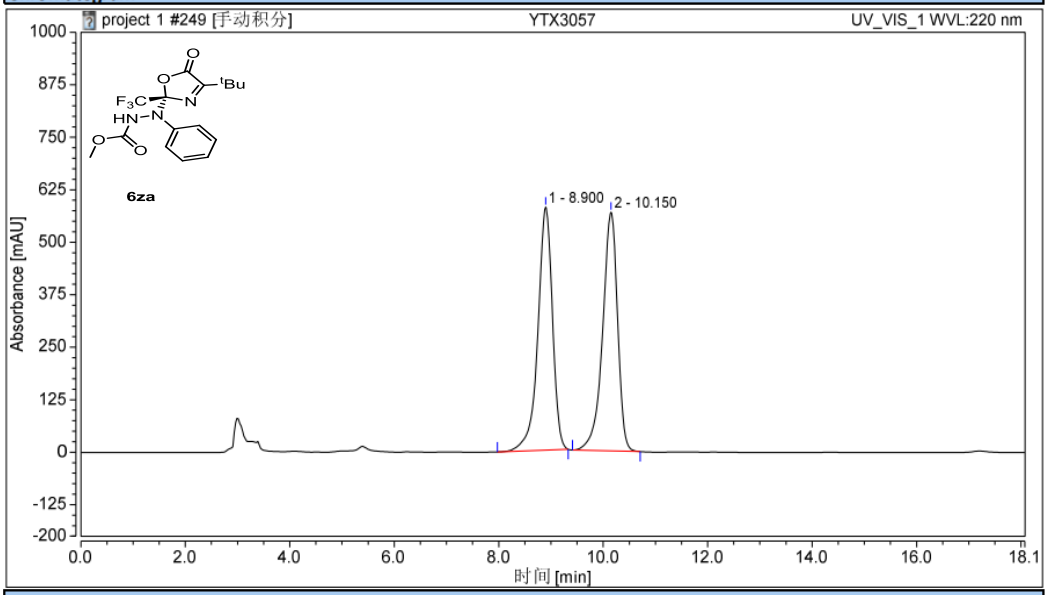
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.047	23.310	75.552	5.15	5.95	n.a.
2		9.340	428.943	1193.213	94.85	94.05	n.a.
Total:			**452.254**	**1268.765**	**100.00**	**100.00**	

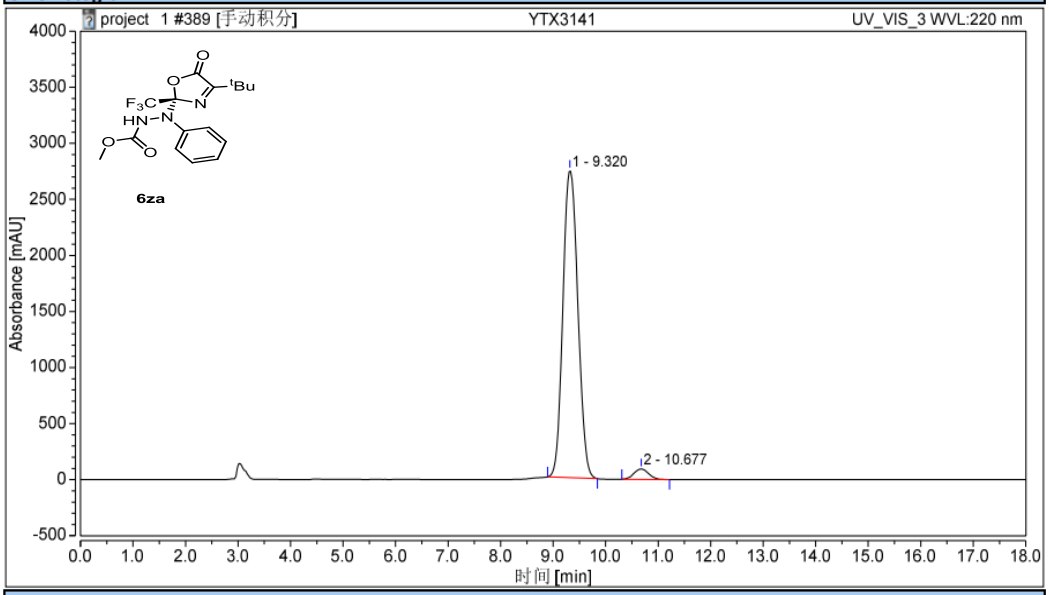
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.900	186.598	578.999	49.76	50.46	n.a.
2		10.150	188.361	568.490	50.24	49.54	n.a.
Total:			**374.959**	**1147.489**	**100.00**	**100.00**	

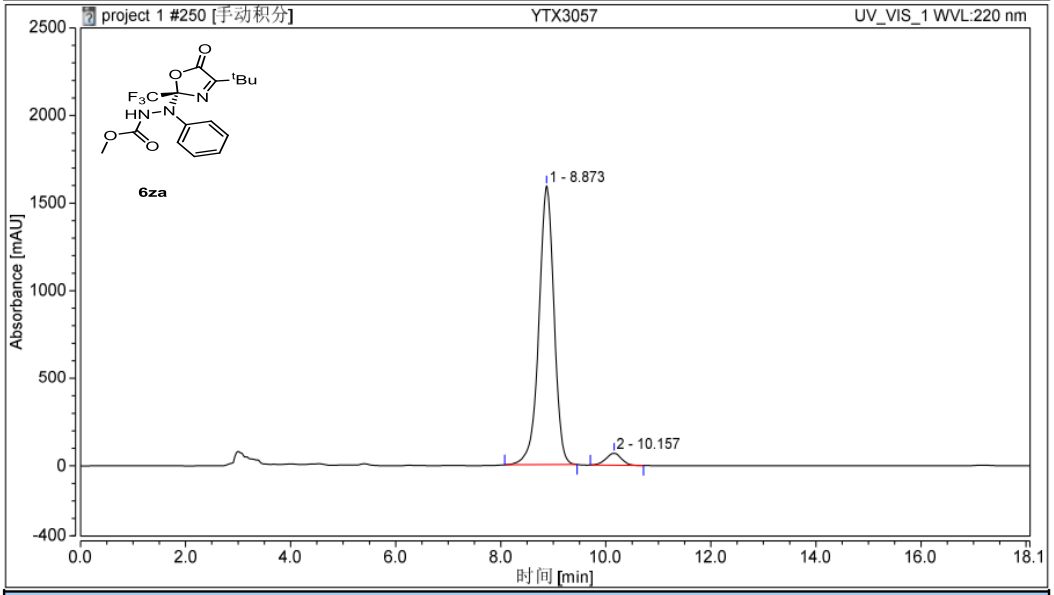
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		9.320	903.007	2742.487	96.78	96.71	n.a.
2		10.677	30.036	93.442	3.22	3.29	n.a.
Total:			**933.043**	**2835.929**	**100.00**	**100.00**	

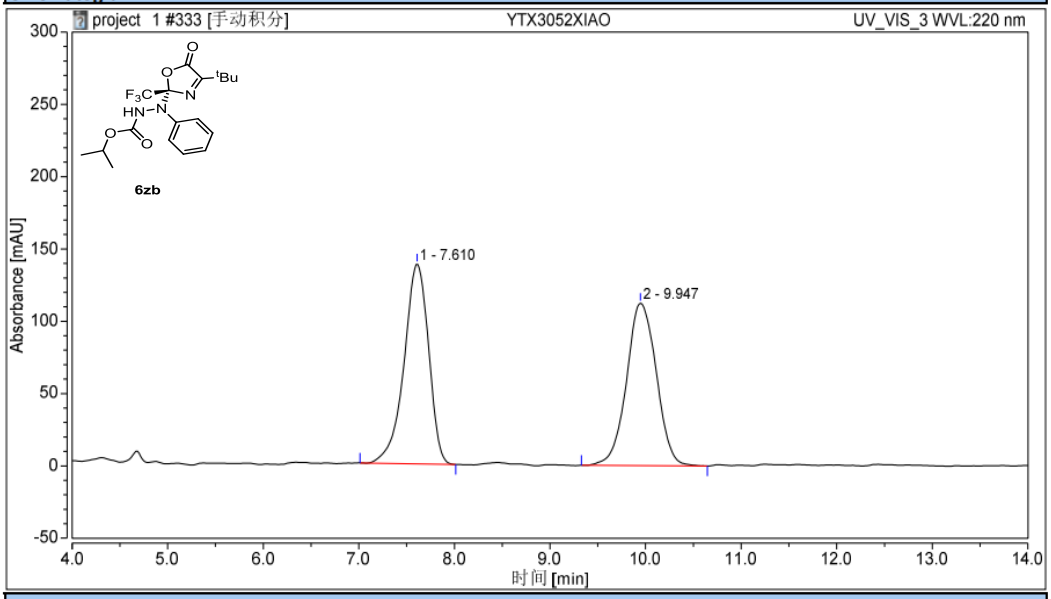
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.873	529.680	1592.168	95.79	95.87	n.a.
2		10.157	23.269	68.524	4.21	4.13	n.a.
Total:			**552.950**	**1660.691**	**100.00**	**100.00**	

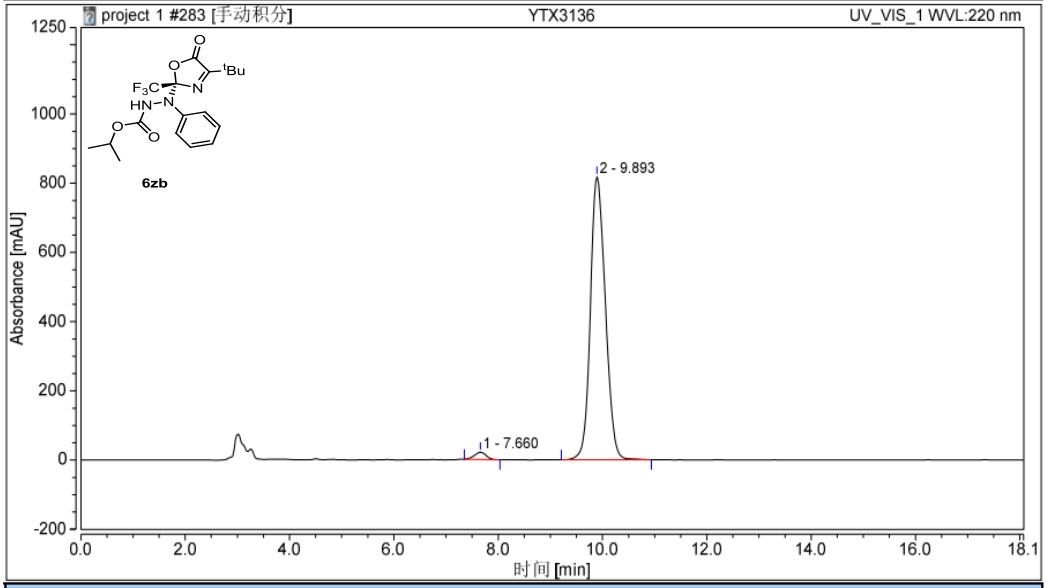
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.610	41.148	138.295	50.31	55.17	n.a.
2		9.947	40.647	112.383	49.69	44.83	n.a.
Total:			**81.796**	**250.678**	**100.00**	**100.00**	

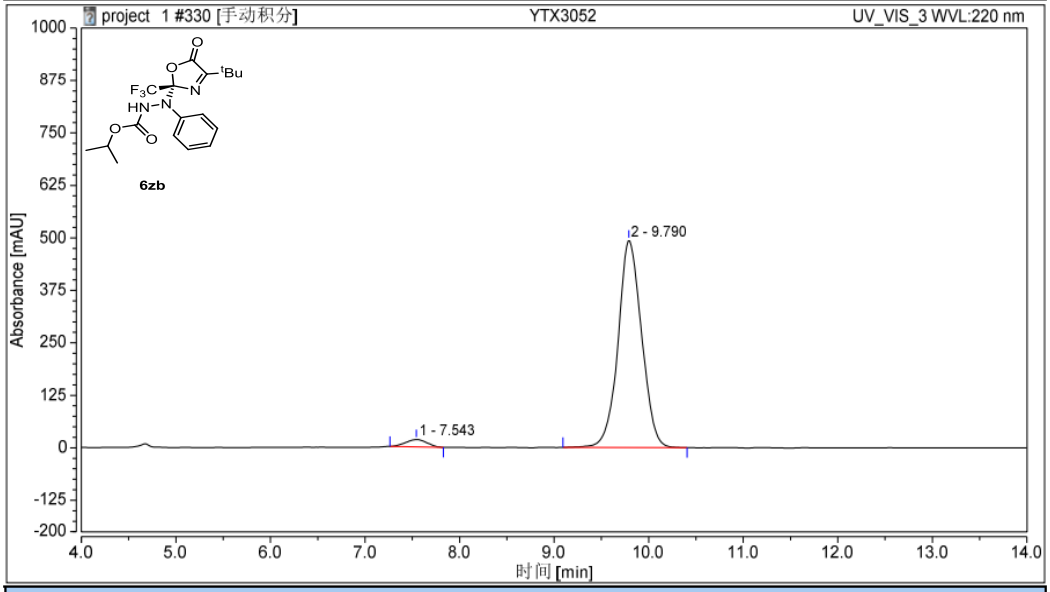
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.660	5.358	20.819	1.93	2.48	n.a.
2		9.893	272.043	818.563	98.07	97.52	n.a.
Total:			**277.401**	**839.382**	**100.00**	**100.00**	

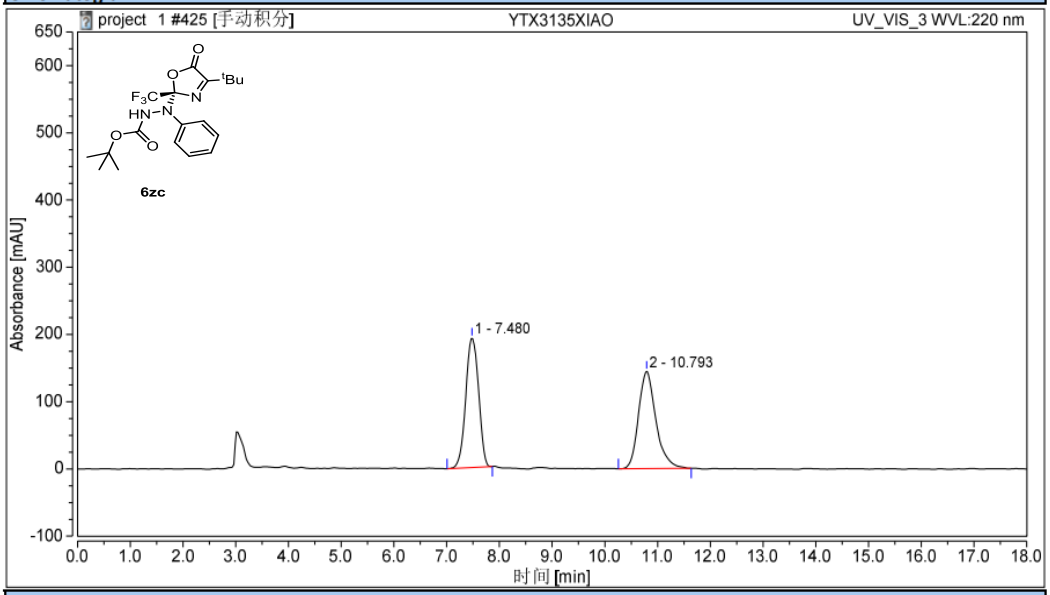
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.543	4.450	17.360	3.03	3.40	n.a.
2		9.790	142.214	493.533	96.97	96.60	n.a.
Total:			**146.664**	**510.893**	**100.00**	**100.00**	

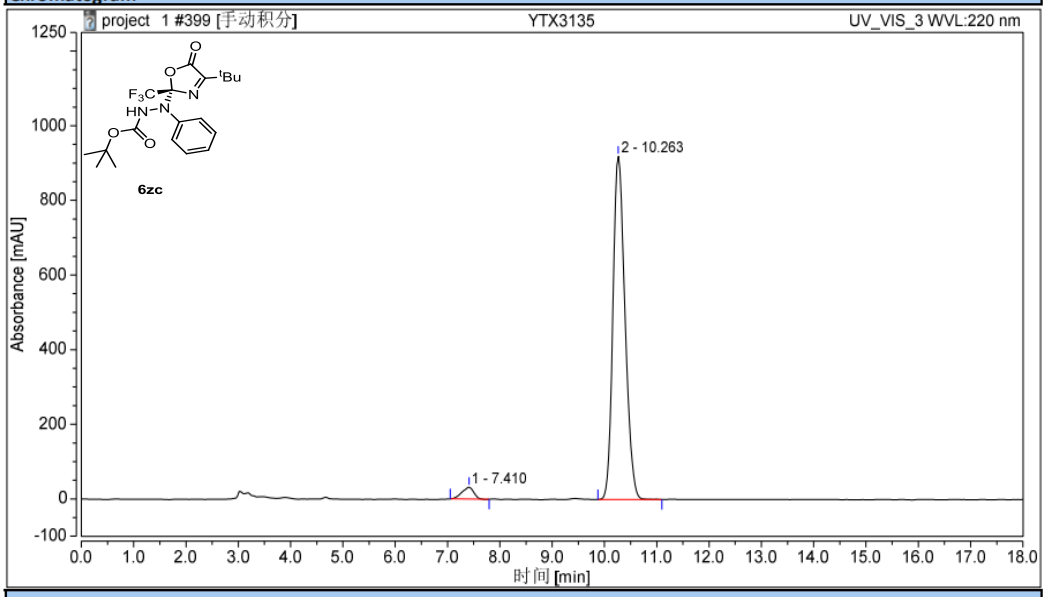
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.480	54.514	192.813	49.60	57.07	n.a.
2		10.793	55.401	145.036	50.40	42.93	n.a.
Total:			**109.914**	**337.848**	**100.00**	**100.00**	

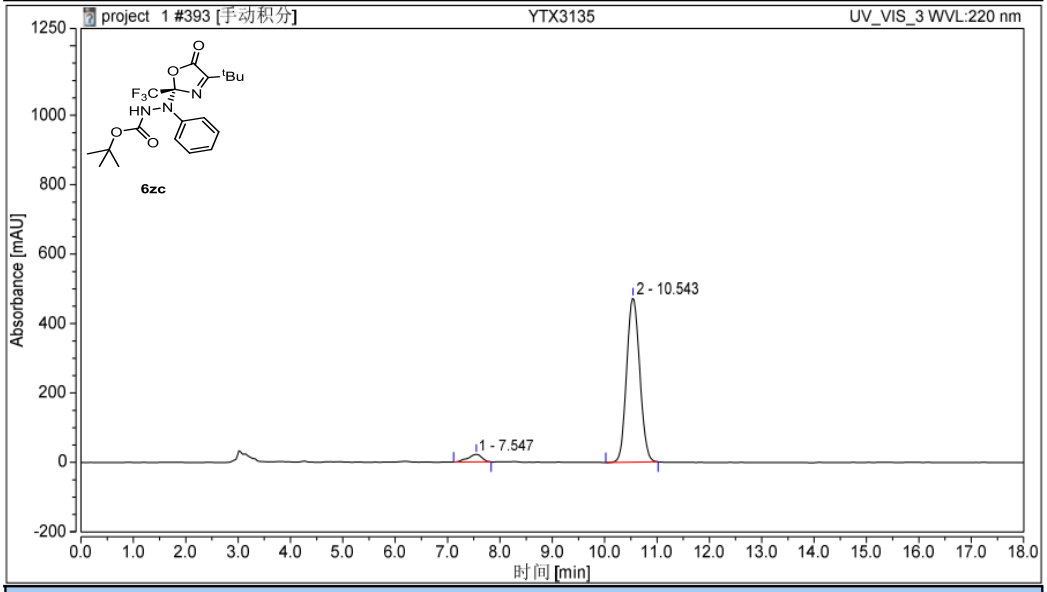
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.410	8.220	31.722	3.23	3.33	n.a.
2		10.263	246.095	920.393	96.77	96.67	n.a.
Total:			**254.315**	**952.115**	**100.00**	**100.00**	

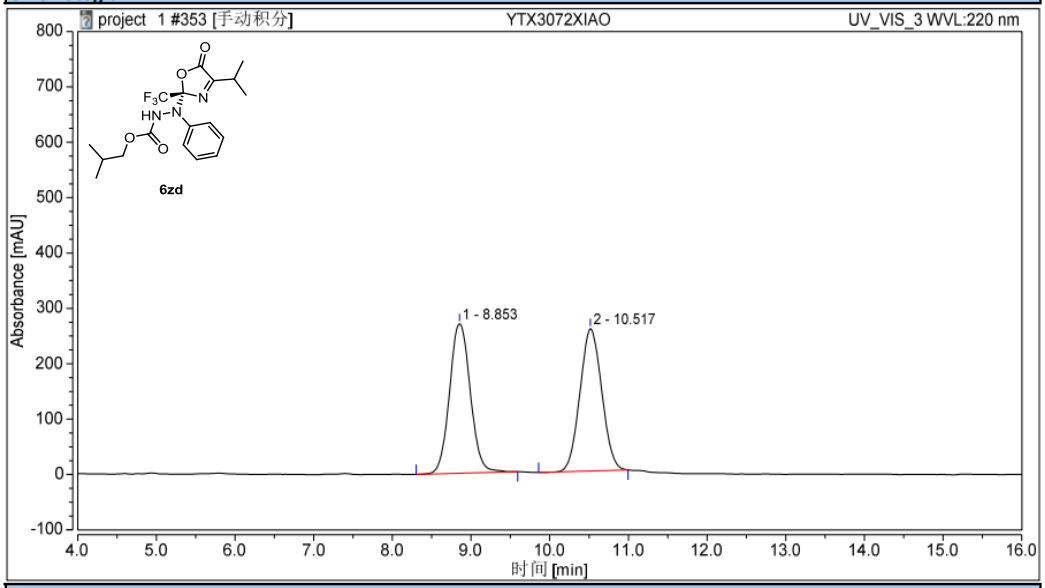
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		7.547	6.704	22.060	4.66	4.45	n.a.
2		10.543	137.109	473.187	95.34	95.55	n.a.
Total:			**143.813**	**495.247**	**100.00**	**100.00**	

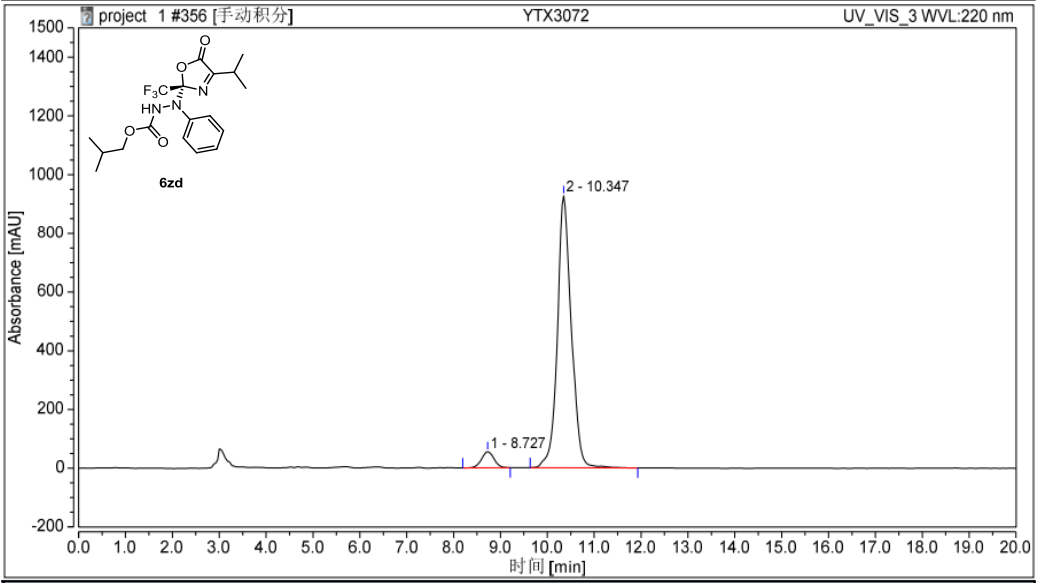
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.853	82.582	270.333	50.07	51.23	n.a.
2		10.517	82.339	257.346	49.93	48.77	n.a.
Total:			**164.921**	**527.679**	**100.00**	**100.00**	

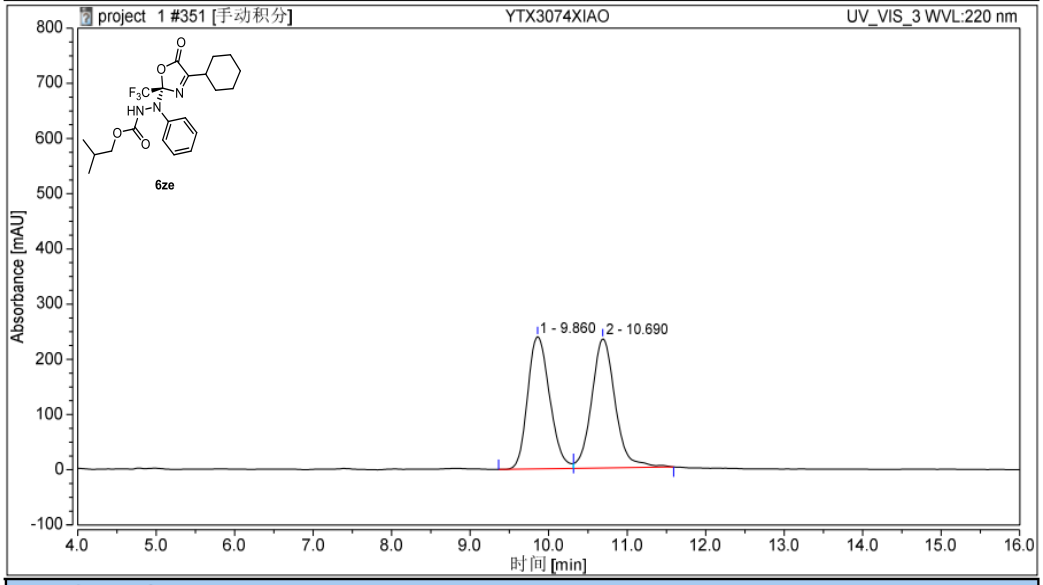
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		8.727	16.803	54.852	5.00	5.59	n.a.
2		10.347	318.941	926.536	95.00	94.41	n.a.
Total:			**335.744**	**981.388**	**100.00**	**100.00**	

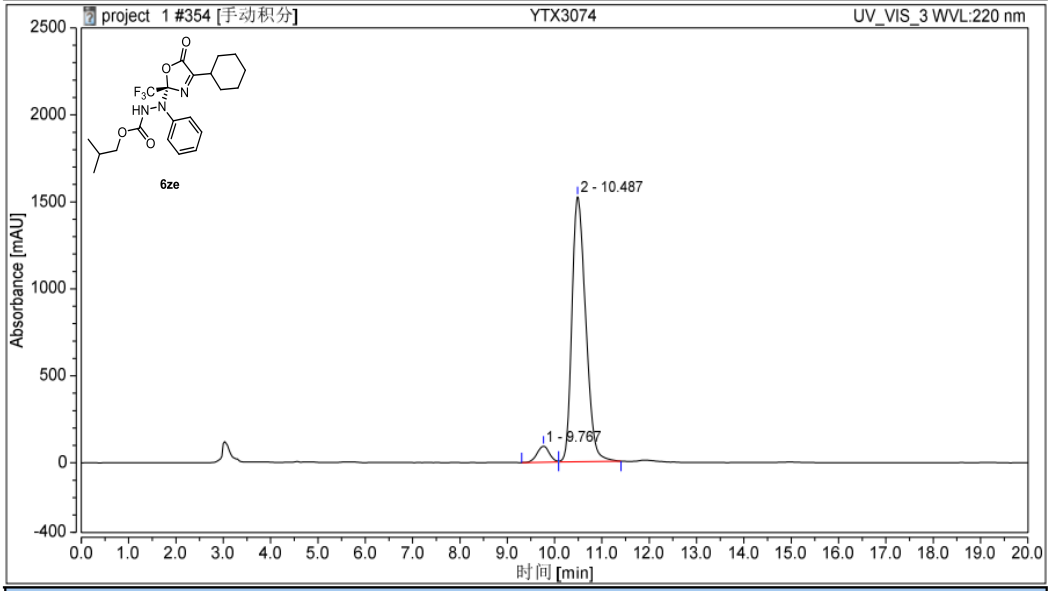
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		9.860	77.952	239.495	48.93	50.58	n.a.
2		10.690	81.348	234.043	51.07	49.42	n.a.
Total:			**159.300**	**473.539**	**100.00**	**100.00**	

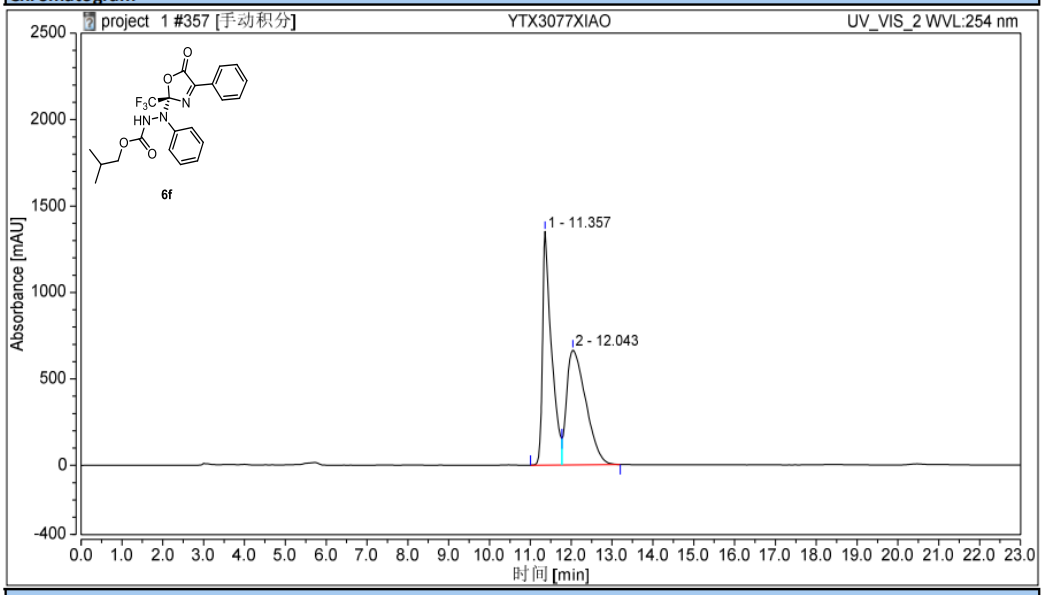
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		9.767	28.038	92.371	5.19	5.72	n.a.
2		10.487	512.598	1523.900	94.81	94.28	n.a.
Total:			**540.636**	**1616.272**	**100.00**	**100.00**	

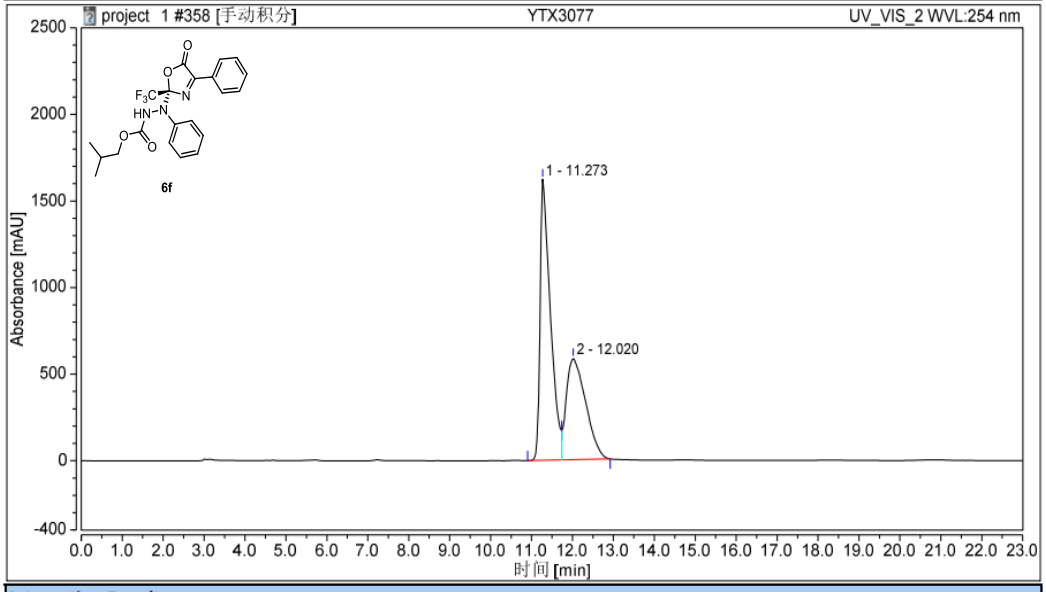
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.357	342.076	1351.175	48.60	67.03	n.a.
2		12.043	361.718	664.481	51.40	32.97	n.a.
Total:			**703.793**	**2015.657**	**100.00**	**100.00**	

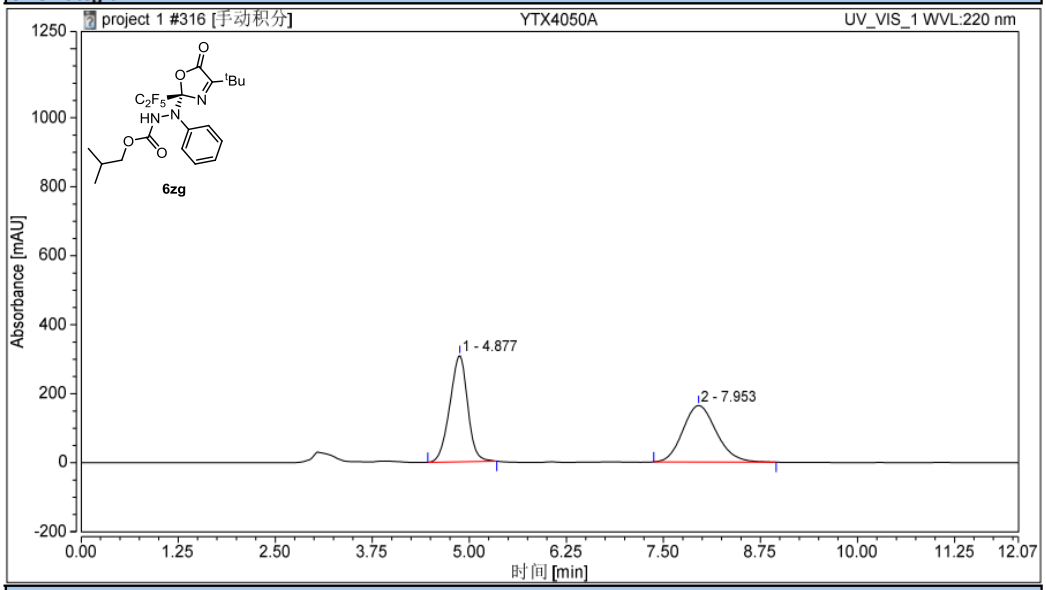
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.273	471.839	1624.802	59.54	73.52	n.a.
2		12.020	320.670	585.088	40.46	26.48	n.a.
Total:			**792.510**	**2209.890**	**100.00**	**100.00**	

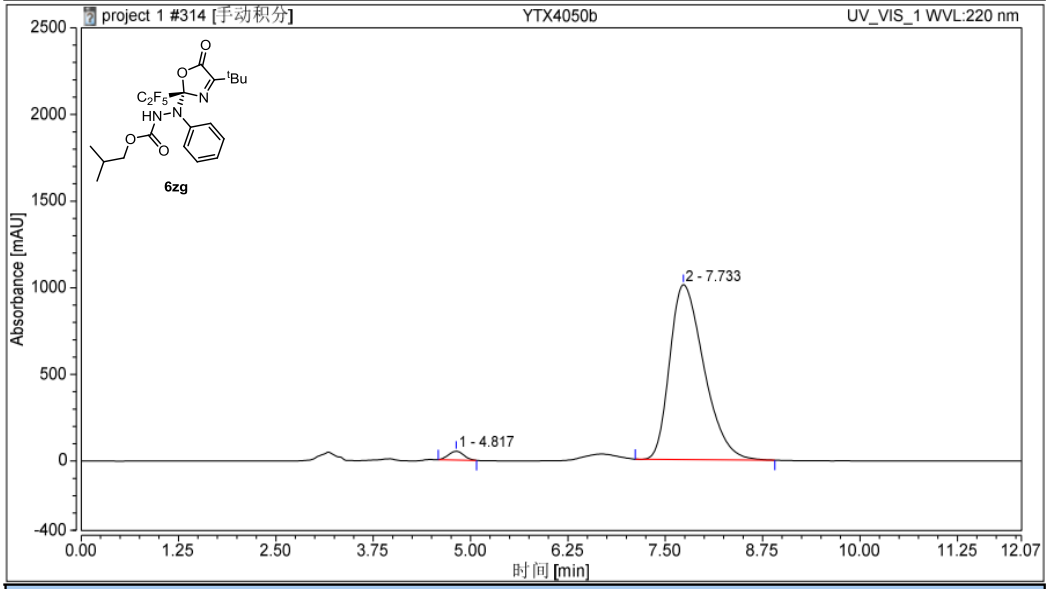
Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.877	81.705	308.218	49.87	65.30	n.a.
2		7.953	82.141	163.821	50.13	34.70	n.a.
Total:			**163.846**	**472.039**	**100.00**	**100.00**	

Chromatogram



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		4.817	11.408	50.493	2.17	4.77	n.a.
2		7.733	513.200	1009.086	97.83	95.23	n.a.
Total:			**524.608**	**1059.580**	**100.00**	**100.00**	