Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Highly Effective Copper-Mediated *gem*-Difluoromethylenation of Arylboronic Acids

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Content:

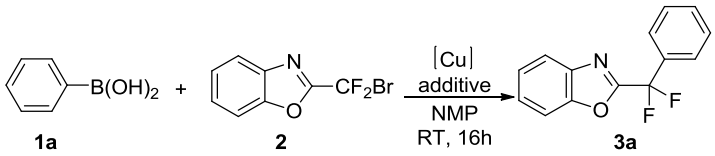
1. General Information

General Information： ^{1}H-, ^{13}C- and ^{19}F-NMR spectra were recorded in $CDCl_3$ on 500 spectrometers. Chemical shifts for ^{1}H NMR spectra are reported in ppm relative to residual $CHCl_3$ as internal reference (δ 7.26 ppm for ^{1}H) downfield from TMS, chemical shifts for ^{13}C NMR spectra are reported in ppm relative to internal chloroform (δ 77.10 ppm for ^{13}C), and chemical shifts for ^{19}F NMR spectra are reported in ppm downfield from internal fluorotrichloromethane ($CFCl_3$). Coupling constants (*J*) are given in Hertz (Hz). The terms m, s, d, t, q refer to multiplet, singlet, doublet, triplet, quartlet respectively; br refers to a broad signal. High resolution mass spectra (HRMS) and Mass spectra (MS) were recorded using an Electron impact (EI) or Electrospray ionization (ESI) techniques. Elemental analyses were carried out on an elemental analyzer. Infrared spectra (IR) were recorded on FT-IR spectrometer, absorbance frequencies are given at maximum of intensity in cm^{-1}. Melting points were obtained on a X-4 digital melting point apparatus without correction. Reactions were monitored by ^{19}F NMR or TLC carried out on commercial silica gel plates (GF254) using UV light as a visualizing agent. Flash column chromatograph was carried out using 300-400 mesh silica gel at medium pressure.

All reagents were used as received from commercial sources, unless specified otherwise, or prepared as described in the literature. NMP was distilled under reduced pressure from CaH_2 and stored with 4 Å molecular sieves.

2. Optimization of the Reaction Condition

Table S1. *gem*-Difluoromethylenation of Phenylboronic Acids with Additives



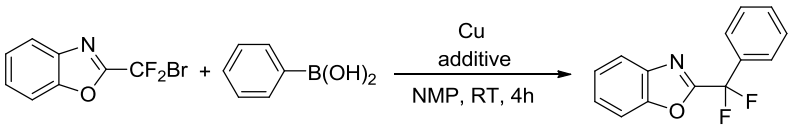
1a 2 3a

Entry[a]	[Cu]	Additive	**1a**:**2**:[Cu]: Additive	Yield(%)[a]
1	Cu	bipy	1:3:3:1	31
2	Cu	phen	1:3:3:1	47
3	Cu	Ph_3P	1:3:3:1	0
4	Cu	DPPP	1:3:3:1	0
5	Cu	DPPF	1:3:3:1	0
6	Cu	KOAc	1:3:3:1	0
7	Cu	Na_2CO_3	1:3:3:1	0
8	Cu	$CsCO_3$	1:3:3:1	0
9	Cu	*t*-BuOK	1:3:3:1	3

[a]Yields determined by ^{19}F NMR analysis with $PhCF_3$ as the internal standard

3. Preliminary mechanistic study

Table S2. Effects of Additives on *gem*-Difluoromethylenation of Phenylboronic acid



1a 2 3

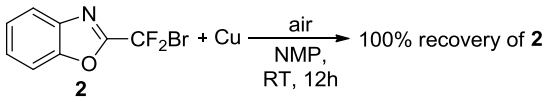
Entry	Additive	Yield (%)[a]
1	ambient light	86
2	dark	81
3	50mol% 1,4-dinitrobenzene	78
4	50mol% hydroquinone	81
5	100mol% TEMPO	trace

[a] Yields determined by ^{19}F NMR spectroscopy with $PhCF_3$ as internal standard.

Control reactions to probe for the possible mechanism.

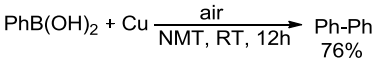
A 10 mL Schlenk tube was charged with copper (96 mg, 1.5 mmol), 2 (1.5 mmol, 3 equiv) and solvent (NMP, 3 mL). After stirred at room temperature for 12 h, the resulting mixture was analyzed by 19F NMR and GC-MS, respectively (Scheme 1). The new signals were not detected

by ^{19}FNMR, and the reactant **2** was recovery almost completely.



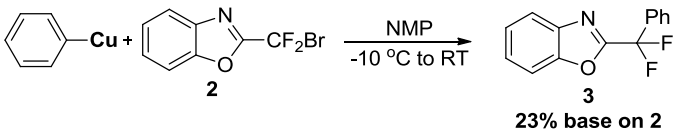
Scheme 1

A 10 mL Schlenk tube was charged with copper (96 mg, 1.5 mmol), Phenylboronic acid (0.5 mmol, 1 equiv) and solvent (NMP, 3 mL). The mixture was stirred under air at room temperature for 12 h. The solution was poured into water and filtered through a pad of Celite, washed with ether. The combined filtrates were washed with brine (10 mL×3), and the organic phase was dried over Na_2SO_4. After filtration and evaporation of the solvent, the crude mixture was purified by flash silica gel column chromatography to afford the 1,1'-biphenyl product as a white soild in 76% yield (Scheme 2).



Scheme 2

Phenyl lithium (1.5 M in ether, 0.5mL, 0.75mmol, 1.0 equiv) were added dropwise to the mixture of cuprous bromide (113mg, 0.8mmol, 1.05 equiv) in Et_2O at -10℃. After standing under -10℃ to -5℃ for 30 min, the upper phase was removed carefully using a syringe. The remaining ether was removed by evaporation under vacuum to give a solid of phenylcopper mixed with cuprous bromide (CuBr) and lithium bromide (LiBr). The mixture was used directly without further purification. To the solid obtained from previous step was added a solution of 2-(bromodifluoromethyl)benzoxazole **2** (555mg, 2.25 mmol) in NMP at -10℃. The mixture was allowed to warm to room temperature and stirred under N_2 for 5 h. (Trifluoromethyl) benzene (329 mg, 2.25 mmol) was added as an internal standard. The desired product **3** was observed in 23% yield based on **2** added as determined by ^{19}F NMR spectrum. ^{19}F NMR spectroscopic analysis of the crude reaction mixture did not show the presence of transmetallation active species ($ArCF_2Cu$) (Scheme 3).



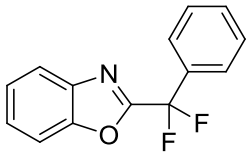
Scheme 3

4. Typical procedure for the *gem*-Difluoromethylenation of arylboronic acids

A 10 mL Schlenk tube was charged with copper (96 mg, 1.5 mmol, 1.5 equiv) and aryl boronic acid (0.5 mmol, 1.0 equiv), 2 (1.5 mmol, 3 equiv) and solvent (NMP, 3 mL). The mixture was stirred at room temperature. After the completion of the reaction, the solution was poured into cold water and filtered through a pad of Celite, washed with ether. The combined filtrates were washed with brine (10 mL×3), and the organic phase was dried over Na_2SO_4. After filtration and evaporation of the solvent, the crude mixture was purified by flash silica gel column chromatography to afford the desired products **3a-3z** .

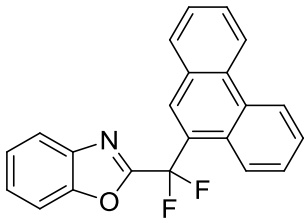
5. Compounds Characterization

2-(difluoro(phenyl)methyl)benzo[d]oxazole (3a):



White solid (petroleum ether/EtOAc = 40/1, 104.4 mg, 85% yield), mp: 35-37℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.82 (d, *J* = 7.5 Hz, 1H), 7.74 (d, *J* = 7.0 Hz, 2H), 7.58 (d, *J* = 7.5 Hz, 1H), 7.54-7.48 (m, 3H), 7.46 - 7.38 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.5 (t, *J* = 37.1Hz), 150.8, 140.1, 133.6 (t, *J* = 25.7 Hz), 131.2, 128.8, 126.8 125.7 (t, *J* = 5.5 Hz), 125.3, 121.4, 114.5 (t, *J* = 243.7 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.28 (s); IR (KBr, cm^{-1}): ν_{max} = 3067, 1616, 1573, 1451, 1261, 914, 774, 748; LC-MS (ESI): *m/z* 246 $[M+1]^+$; HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_{10}F_2NO^+$: 246.0725, found: 246.0729.

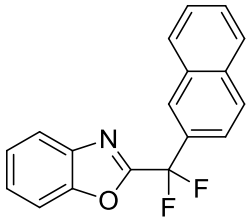
2-(difluoro(phenanthren-9-yl)methyl)benzo[d]oxazole (3b):



White solid (petroleum ether/EtOAc = 40/1, 125.4 mg, 73% yield); mp: 120-122℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.71 (d, *J* = 8.1Hz, 1H), 8.64 (d, *J* = 8.3 Hz, 1H), 8.39 (s, 1H), 8.27 (d, *J* = 8.1 Hz, 1H), 8.00 (d, *J* = 7.8 Hz, 1H), 7.87-7.83 (m, 1H), 7.72 (t, *J* = 7.6 Hz, 1H), 7.66-7.61 (m, 2H), 7.60-7.53 (m, 2H), 7.41-7.36 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.7 (t, *J* = 35.7 Hz), 150.7, 140.1, 131.7, 131.0, 129.9, 129.8, 128.7, 127.5, 127.4, 127.3, 127.22, 127.20, 127.0, 126.8, 125.3, 125.1, 123.3, 122.6, 121.4, 115.1 (t, *J* = 243 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): -92.35 (s); IR (KBr, cm^{-1}): ν_{max} = 3064, 3044, 1616, 1531, 1453, 1239, 1137, 1053, 896, 749; MS (EI): *m/z* 345 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{22}H_{14}F_2NO^+$: 346.1038, found: 346.1045.

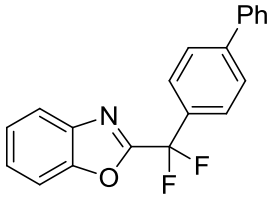
2-(difluoro(naphthalen-2-yl)methyl)benzo[d]oxazole (3c):

White solid (petroleum ether/EtOAc = 40/1, 122.5 mg, 83% yield); mp: 64-66℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.30 (s, 1H,), 7.99-7.90 (m, 2H,), 7.90-7.80 (m, 3H), 7.64-7.51 (m, 3H), 7.45-7.35 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.5 (t, *J* = 36.8 Hz), 150.7, 140.1, 134.3,



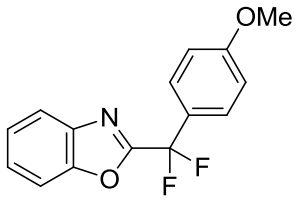
132.4, 130.7 (t, *J* = 26.5 Hz), 128.9, 128.8, 127.8, 127.0, 126.8, 125.9 (t, *J* = 6.8 Hz), 125.2, 122.1 (t, *J* = 4.8 Hz), 121.3, 114.7 (t, J = 245.0 Hz), 111.3; ^{19}F NMR (470 MHz, $CDCl_3$): δ -94.73 (s). IR (KBr, cm^{-1}): ν_{max} = 3061, 1616, 1573, 1450, 1277, 1104, 1077, 1009, 828, 748; MS (EI): *m/z* 295 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{18}H_{12}F_2NO^+$: 296.0881, found: 296.0887.

2-([1,1'-biphenyl]-4-yldifluoromethyl)benzo[d]oxazole (3d):



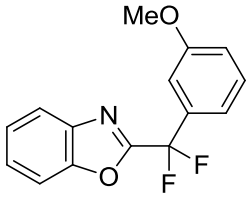
White solid (petroleum ether/EtOAc = 20/1, 99.1 mg, 62% yield); mp: 70-72℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.87-7.83 (m, 3H), 7.73 (d, *J* = 7.0 Hz, 2H), 7.63 (d, *J* = 7.5 Hz, 3H), 7.49-7.39 (m, 5H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.5 (t, *J* = 36.8 Hz), 150.8, 144.1, 140.1, 139.9, 132.4 (t, *J* = 25.5 Hz), 129.0, 128.1, 127.5, 127.3, 126.8, 126.2 (t, *J* = 5.5 Hz), 125.4, 121.5, 114.6(t, *J* = 243.2 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -94.80 (s); IR (KBr, cm^{-1}): ν_{max} = 3075, 1611, 1489, 1452, 1257, 1082, 978, 839, 753, 692; MS (EI): *m/z* 321 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{20}H_{14}F_2NO^+$: 322.1038, found: 322.1041.

2-(difluoro(4-methoxyphenyl)methyl)benzo[d]oxazole (3e):



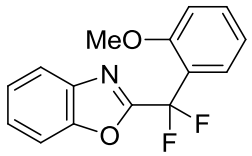
White solid (petroleum ether/EtOAc = 20/1, 104.8 mg, 76% yield); mp: 75-76℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.81 (d, *J* = 7.9 Hz, 1H), 7.66 (d, *J* = 8.9 Hz, 2H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.43-7.36 (m, 2H), 6.99 (d, *J* = 8.9 Hz, 2H), 3.82 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 161.7, 158.8 (t, *J* = 37.7 Hz), 150.8, 140.1, 127.3 (t, *J* =5.5 Hz), 126.7, 125.7 (t, *J* = 26.3 Hz), 125.2, 121.4, 114.7 (t, *J* = 245.0 Hz), 114.1, 111.3, 55.3; ^{19}F NMR (470 MHz, $CDCl_3$): δ -93.49 (s); IR (KBr, cm^{-1}): ν_{max} = 3074, 2948 1615, 1519, 1492, 1454, 1255, 1081, 980, 921, 753; MS (EI): *m/z* 275 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_{12}F_2NO_2^+$: 276.0831, found: 276.0835.

2-(difluoro(3-methoxyphenyl)methyl)benzo[d]oxazole (3f):



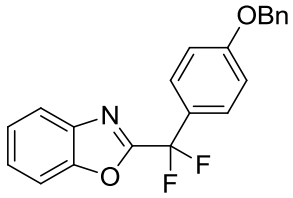
White solid (petroleum ether/EtOAc = 20/1, 87.2 mg, 63% yield); mp: 42-43℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.81 (d, *J* = 8.1 Hz, 1H), 7.41 (d, *J* = 7.8 Hz, 1H), 7.40-7.37 (m, 3H), 7.32 (d, *J* = 7.9 Hz, 1H), 7.28 (s, 1H), 7.04 (d, *J* = 7.8 Hz, 1H), 3.81 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 159.7, 158.4 (t, *J* = 36.8 Hz), 150.7, 140.0, 134.8 (t, *J* =26.7 Hz), 130.0, 126.7, 125.2, 121.3, 117.8 (t, *J* = 36.8 Hz), 116.8, 114.3 (t, *J* = 245.0 Hz), 111.3, 111.1 (t, *J* = 6.4 Hz), 55.3; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.26 (s); IR (KBr, cm^{-1}): ν_{max} = 3071, 2962, 1607, 1492, 1453, 1274, 1089, 1008, 836, 749, 696; MS (EI): *m/z* 275 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_{12}F_2NO_2^+$: 276.0831, found: 276.0834.

2-(difluoro(2-methoxyphenyl)methyl)benzo[d]oxazole (3g):



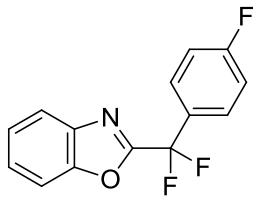
White solid (petroleum ether/EtOAc = 20/1, 121.5 mg, 88% yield); mp: 116-117℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.81 (d, *J* = 7.8 Hz, 2H), 7.60 (d, *J* = 8.0 Hz, 1H), 7.52 (t, *J* = 8.0 Hz, 1H), 7.46 - 7.36 (m, 2H), 7.13 (t, *J* = 7.5 Hz, 1H), 6.97 (d, *J* = 8.3 Hz, 1H), 3.61 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 159.4 (t, *J* = 34.9 Hz), 157.5 (t, *J* = 4.9 Hz), 150.5, 140.5, 133.0, 126.8 (t, *J* =7.3 Hz), 126.4, 125.1, 121.9 (t, *J* = 24.6 Hz), 121.3, 120.6, 113.4 (t, *J* = 241.7 Hz), 112.0, 111.3, 56.0; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.13 (s); IR (KBr, cm^{-1}): ν_{max} = 3084, 2974, 1604, 1491, 1443, 1298, 1092, 973, 914, 753, 674; MS (EI): *m/z* 275 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_{12}F_2NO_2^+$: 276.0831, found: 276.0838.

2-((4-(benzyloxy)phenyl)difluoromethyl)benzo[d]oxazole (3h):



White solid (petroleum ether/EtOAc = 20/1, 131.2 mg, 75% yield); mp: 81-83℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.83 (d, *J* = 7.7 Hz, 1H), 7.67 (d, *J* = 8.6 Hz, 2H), 7.59 (d, *J* = 8.2 Hz, 1H), 7.45-7.40 (m, 6H), 7.35 (t, *J* = 7.0 Hz, 1H), 7.08 (d, *J* = 8.6 Hz, 2H), 5.11 (s, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 160.8, 158.7 (t, *J* = 35.7 Hz), 150.7, 140.1, 136.3, 128.7, 128.2, 127.5, 127.4 (t, *J* = 5.5 Hz), 126.7, 125.9 (t, *J* = 26.5 Hz), 125.2, 121.4, 115.0, 114.6 (t, *J* = 243.3 Hz), 111.4, 70.1; ^{19}F NMR (470 MHz, $CDCl_3$): δ -93.54 (s); IR (KBr, cm^{-1}): ν_{max} = 3038, 2946, 1609, 1512, 1451, 1246, 1081, 980, 836, 745, 697; MS (EI): *m/z* 351 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{21}H_{16}F_2NO_2^+$: 352.1144, found: 352.1142.

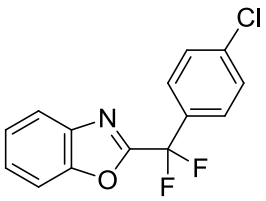
2-(difluoro(4-fluorophenyl)methyl)benzo[d]oxazole (3i):



White solid (petroleum ether/EtOAc = 20/1, 113.8 mg, 87% yield); mp: 47-48℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.80 (d, *J* = 8.0 Hz, 1H), 7.73-7.69 (m, 2H) , 7.56 (d, *J* = 7.9 Hz, 1H), , 7.44-7.34 (m, 2H), 7.15 (t, *J* = 8.3 Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 164.3 (d, *J* = 251.1 Hz), 158.2 (t, *J* = 37.7 Hz), 150.7, 140.0, 129.6 (td, *J* =26.5, 3.3 Hz), 128.1 (dt, *J* =8.9, 5.5 Hz), 126.9, 125.3, 121.4, 115.9 (d, *J* = 22.1 Hz), 114.2 (t, *J* =245.0 Hz), 111.3; ^{19}F NMR (470 MHz, $CDCl_3$): δ -94.02 (s), -108.6 – -108.7 (m, *J* = 10.3 Hz); IR (KBr, cm^{-1}): ν_{max} = 3079, 1605, 1511, 1453, 1261, 1079, 984, 843, 749, 556; MS (EI): *m/z* 263 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_9F_3NO^+$: 264.0631, found: 264.0630.

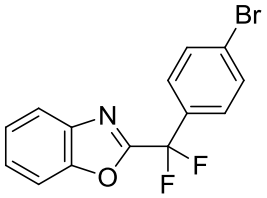
2-((4-chlorophenyl)difluoromethyl)benzo[d]oxazole (3j):

White solid (petroleum ether/EtOAc = 20/1, 122.1 mg, 87% yield); mp: 59-61℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.80 (d, *J* =7.6 Hz, 1H), 7.66 (d, *J* =8.7 Hz, 2H), 7.59 (d, *J* = 7.8 Hz, 1H), 7.47 (d, *J* = 8.7 Hz, 2H), 7.45-7.37 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.1 (t, *J* = 36.2 Hz), 150.8,



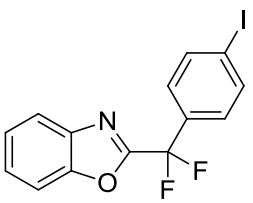
140.0, 137.5 (t, *J* = 1.8 Hz), 132.1 (t, *J* = 26.6 Hz), 129.1, 127.3(t, *J* = 5.6 Hz), 127.0, 125.4, 121.5, 114.1 (t, *J* = 244.7 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.03 (s); IR (KBr, cm^{-1}): ν_{max} = 3095, 1617, 1450, 1260, 1077, 983, 828, 750, 736; MS (EI): *m/z* 279 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_9ClF_2NO^+$: 280.0335, found: 280.0336

2-((4-bromophenyl)difluoromethyl)benzo[d]oxazole (3k):



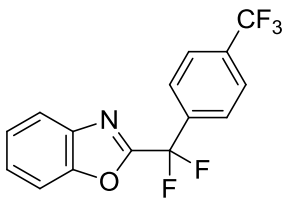
White solid (petroleum ether/EtOAc = 20/1, 113.3 mg, 70% yield); mp: 74-75℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.81 (d, *J* =7.8 Hz, 1H), 7.63-7.57 (m, 5H), 7.43 (t, *J* = 7.4 Hz, 1H), 7.38 (t, *J* = 7.4 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.9 (t, *J* = 36 Hz), 150.7, 140.0, 132.5 (t, *J* = 26.3 Hz), 132.0, 127.4 (t, *J* = 5.9 Hz), 127.0, 125.9, 125.4, 121.4, 114.1 (t, *J* = 245.0 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.18 (s); IR (KBr, cm^{-1}): ν_{max} = 3093, 1617, 1595, 1451, 1260, 1081, 982, 824, 750; MS (EI): *m/z* 323 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_9BrF_2NO^+$: 323.9830, found: 323.9837. Anal. Calcd. for $C_{14}H_8BrF_2NO$: C, 51.88; H, 2.49; N, 4.32; Found:C, 51.81; H, 2.53; N, 4.28.

2-(difluoro(4-iodophenyl)methyl)benzo[d]oxazole (3l)：



White solid (petroleum ether/EtOAc = 20/1, 152.0 mg, 82% yield); mp: 83-84℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.88 - 7.78 (m, 3H), 7.58 (d, *J* = 8.1 Hz, 1H), 7.50 - 7.36 (m, 4H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.9 (t, *J* = 36.7 Hz), 150.8, 140.0, 138.0, 133.2 (t, *J* =26.1 Hz), 127.4 (t, *J* = 5.8 Hz), 127.0, 125.4, 121.4, 114.2 (t, *J* = 243.8 Hz), 111.4, 98.1; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.54 (s); IR (KBr, cm^{-1}): ν_{max} = 3089, 1615, 1589, 1452, 1346, 1256, 1094, 1080, 917, 814, 741; MS (EI): *m/z* 371 (M^+); MS (EI): 371 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_9F_2INO^+$: 371.9691, found: 371.9695.

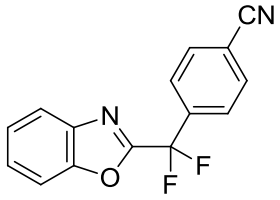
2-(difluoro(4-(trifluoromethyl)phenyl)methyl)benzo[d]oxazole (3m):



White solid (petroleum ether/EtOAc = 12/1, 99.2 mg, 63% yield); mp: 76-78℃;^{1}H NMR (500 MHz, $CDCl_3$): δ 7.88 (d, *J* = 8.1 Hz, 2H), 7.81 (d, *J* = 7.8 Hz, 1H), 7.76 (d, *J* = 8.2 Hz, 2H), 7.59 (d, *J* = 8.2 Hz, 1H), 7.44 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.8 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.8 (t, *J* = 36.7 Hz), 150.9, 140.0, 137.2 (t, *J* = 27.8 Hz), 133.3 (q, *J* = 33.0 Hz), 127.1, 126.5 (t, *J* = 5.6 Hz), 125.8 (q, *J* = 3.7 Hz), 125.5, 124.7 (q, *J* = 272.8 Hz), 121.5, 113.9 (t, *J* = 243.8 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ-63.13 (CF_3, s), -95.82 (CF_2, s); IR (KBr, cm^{-1}): ν_{max} = 3082, 1619, 1453, 1323, 1259, 1177, 1086, 986, 850, 744, 693; MS (EI): *m/z* 313 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_9F_5NO^+$:

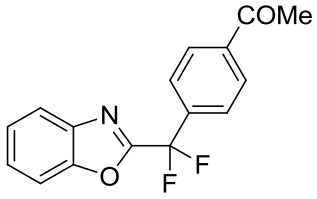
314.0599, found: 314.0598.

4-(benzo[d]oxazol-2-yldifluoromethyl)benzonitrile (3n):



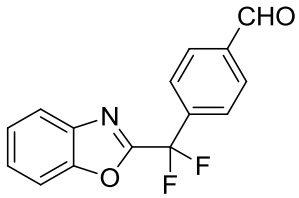
Yellow solid (petroleum ether/EtOAc = 8/1, 95.1 mg, 70% yield); mp: 101-103℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (t, *J* = 7.9 Hz, 2H), 7.78 (t, *J* =7.0 Hz, 3H), 7.58 (t, *J* = 7.6 Hz, 1H), 7.44 (t, *J* = 6.7 Hz, 1H), 7.39 (t, *J* = 7.4 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.2 (t, *J* = 34.8 Hz), 150.7, 139.8, 137.7 (t, *J* = 25.2 Hz), 132.5, 127.2, 126.7 (t, *J* = 5.6 Hz), 125.5, 121.4, 117.7, 115.2, 113.5 (t, *J* = 245.0 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -96.07 (s); IR (KBr, cm^{-1}): ν_{max} = 3101, 3049, 2235, 1616, 1452, 1261, 1111, 1075, 985, 920, 847, 741; MS (EI): 270 *m/z* (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_9F_2N_2O^+$: 271.0677, found: 271.0674.

1-(4-(benzo[d]oxazol-2-yldifluoromethyl)phenyl)ethanone (3o):



White solid (petroleum ether/EtOAc = 12/1, 81.3 mg, 57% yield); mp: 90-92℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.04 (d, *J* = 8.2 Hz, 2H), 7.80 (d, *J* = 8.2 Hz, 2H), 7.60 (d, *J* = 7.5 Hz, 1H), 7.55 (d, *J* = 8.1 Hz, 1H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.36 (t, *J* = 7.6 Hz, 1H), 2.60 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 197.0, 157.7 (t, *J* = 38.1 Hz), 150.7, 139.9, 139.1, 137.5 (t, *J* = 26.9 Hz), 128.6, 127.0, 126.1 (t, *J* = 5.0 Hz), 125.4, 121.4, 114.0 (t, *J* = 245.0 Hz), 111.3, 26.7; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.84 (s); IR (KBr, cm^{-1}): ν_{max} = 3100, 3071, 1690, 1612, 1265, 1078, 986, 833, 745; MS (EI): *m/z* 287 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{16}H_{12}F_2NO_2^+$: 288.0831, found: 288.0826. Anal. Calcd. for $C_{16}H_{11}F_2NO_3$: C, 63.37; H, 3.66; N, 4.62; Found:C, 63.33; H, 3.61; N, 4.65.

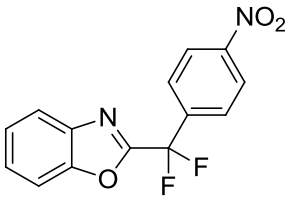
4-(benzo[d]oxazol-2-yldifluoromethyl)benzaldehyde (3p):



White solid (petroleum ether/EtOAc = 12/1, 63.1 mg, 46% yield); mp: 116-118℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 10.07 (s, 1H), 7.99 (d, *J* = 8.1 Hz, 2H), 7.89 (d, *J* = 8.1 Hz, 2H), 7.77 (d, *J* = 7.8 Hz, 1H), 7.57 (d, *J* = 7.9 Hz, 1H), 7.43 (t, *J* = 7.8 Hz, 1H), 7.38 (t, *J* = 7.4 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 191.2, 157.6 (t, *J* = 36.4 Hz), 150.7, 139.9, 138.9 (t, *J* =26.0 Hz), 138.2, 129.9, 127.1, 126.6 (t, *J* = 5.6 Hz), 125.5, 121.4, 113.9 (t, *J* = 244.8 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.90 (s); IR (KBr, cm^{-1}): ν_{max} = 3100, 2864, 1705, 1612, 1451, 1261, 1096, 1076, 831, 750; MS (EI): *m/z* 273 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_{10}F_2NO_2^+$: 274.0674, found: 274.0677.

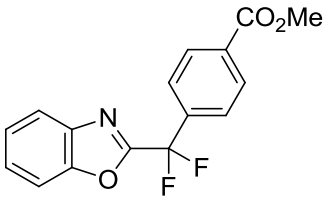
2-(difluoro(4-nitrophenyl)methyl)benzo[d]oxazole (3q):

Yellow solid (petroleum ether/EtOAc = 6/1, 83.3 mg, 57% yield); mp: 133-135℃; ^{1}H NMR (500



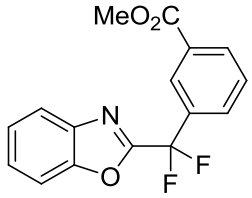
MHz, $CDCl_3$): δ 8.33 (d, *J* = 8.7 Hz, 2H), 7.92 (d, *J* =8.9 Hz, 2H), 7.78 (d, *J* = 7.9 Hz, 1H), 7.60 (d, *J* = 7.9 Hz 1H), 7.46 (t, *J* = 7.3 Hz, 1H), 7.40 (t, *J* = 7.60 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.2 (t, *J* = 33.0 Hz), 150.8, 149.6, 139.9, 139.4 (t, *J* = 26.0 Hz), 127.34 (t, *J* = 5.6 Hz), 127.29, 126.7, 125.6, 124.0, 121.5, 113.5 (t, *J* = 245.0 Hz), 111.5; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.80 (s); IR (KBr, cm^{-1}): ν_{max} = 3077, 1615, 1533, 1452, 1258, 1071, 954, 854, 752; MS (EI): *m/z* 290 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_9F_2N_2O_3^+$: 291.0576, found: 291.0581.

Methyl 4-(benzo[d]oxazol-2-yldifluoromethyl)benzoate (3r):



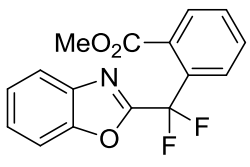
White solid (petroleum ether/EtOAc = 6/1, 106.3 mg, 70% yield); mp: 107-109℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.14 (d, *J* = 8.1 Hz, 2H), 7.78 (t, *J* = 8.6 Hz, 3H), 7.56 (d, *J* = 7.8 Hz, 1H), 7.40 (d, *J* = 7.3 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 1H), 3.92 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$): δ 166.0, 157.8 (t, *J* = 36.8 Hz), 150.7, 140.0, 137.6 (t, *J* =25.50 Hz), 132.7, 129.9, 127.0, 125.9 (t, *J* = 5.7 Hz), 125.4, 121.4, 114.0 (t, *J* = 245.0 Hz), 111.4, 52.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.87 (s); IR (KBr, cm^{-1}): ν_{max} = 3067, 2957, 1715, 1609, 1453, 1283, 1071, 982, 824, 785, 742, 725; MS (EI): *m/z* 303 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{16}H_{12}F_2NO_3^+$: 304.0780, found: 304.0782.

Methyl 3-(benzo[d]oxazol-2-yldifluoromethyl)benzoate (3s):



White solid (petroleum ether/EtOAc = 6/1, 118.6 mg, 78% yield); mp: 93-95℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.40 (s, 1H), 8.17 (d, *J* = 8.1 Hz, 1H), 7.90 (d, *J* = 7.6 Hz, 1H), 7.77 (d, *J* = 7.6 Hz, 1H), 7.56 (t, *J* = 7.5 Hz, 2H), 7.41 (t, *J* = 8.9 Hz, 1H), 7.34 (t, *J* = 7.3 Hz, 1H), 3.91 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 165.9, 157.9 (t, *J* = 36.3 Hz), 150.7, 140.0, 134.0 (t, *J* = 26.50 Hz), 132.2, 130.9, 130.0 (t, *J* = 5.6 Hz), 129.0, 126.94 (t, *J* = 6.5 Hz), 126.92, 125.3, 121.4, 114.0 (t, *J* = 245.0 Hz), 111.4, 52.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.27 (s); IR (KBr, cm^{-1}): ν_{max} = 3070, 2959, 1722, 1614, 1450, 1294, 1235, 1078, 966, 764, 746, 723; MS (EI): *m/z* 303 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{16}H_{12}F_2NO_3^+$: 304.0780, found: 304.0781.

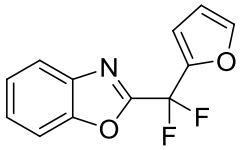
Methyl 2-(benzo[d]oxazol-2-yldifluoromethyl)benzoate (3t):



White solid (petroleum ether/EtOAc = 4/1, 144.7 mg, 95% yield); mp: 98-100℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.02 (d, *J* = 7.6 Hz, 1H), 7.98 (d, *J* = 7.6 Hz, 1H), 7.75 (d, *J* = 7.7 Hz, 1H), 7.70 (t, *J* = 7.3 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 2H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.36 (t, *J* = 6.6 Hz, 1H), 3.64 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 166.5, 159.3 (t, *J* = 34.3 Hz), 150.2, 140.2, 133.0 (t,

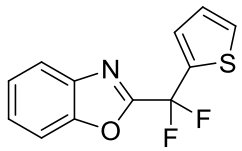
J = 24.50 Hz), 132.1, 131.2, 131.1, 129.9 (t, *J* = 3.5 Hz), 127.1 (t, *J* = 9.0 Hz), 126.5, 125.1, 121.1, 113.9 (t, *J* = 245.0 Hz), 111.3, 52.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -90.60 (s); IR (KBr, cm^{-1}): ν_{max} = 3075, 2954, 1719, 1600, 1452, 1272, 1090, 916, 829, 753; MS (EI): *m/z* 303 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{16}H_{12}F_2NO_3^+$: 304.0780, found: 304.0785.

2-(difluoro(furan-2-yl)methyl)benzo[d]oxazole (3u):



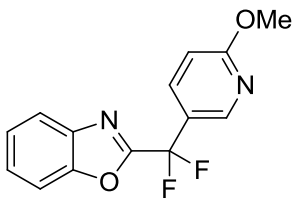
Colorless oil (petroleum ether/EtOAc = 20/1, 80.3 mg, 68% yield); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.85 (d, *J* = 7.6 Hz, 1H), 7.62 (d, *J* = 7.9 Hz, 1H), 7.56 (s, 1H), 7.45 (t, *J* = 7.5 Hz, 1H), 7.41 (t, *J* = 7.9 Hz, 1H), 6.89 (s, 1H), 6.49 (s, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 156.7 (t, *J* = 37 Hz), 150.8, 145.2, 145.0 (t, *J* = 34 Hz), 140.0, 127.1, 125.4, 121.5, 112.2 (t, *J* = 4 Hz), 111.5, 110.8, 109.6 (t, *J* = 240 Hz); ^{19}F NMR (470 MHz, $CDCl_3$): δ -94.28 (s); IR (KBr, cm^{-1}): ν_{max} = 3143, 3092, 1614, 1498, 1452, 1267, 1162, 1087, 1010, 881, 762, 749; MS (EI): *m/z* 235 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{12}H_8F_2NO_2^+$: 236.0518, found: 236.0525.

2-(difluoro(thiophen-2-yl)methyl)benzo[d]oxazole (3v):



Colorless oil (petroleum ether/EtOAc = 20/1, 63.7 mg, 51% yield); ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.84 (d, *J* = 7.6 Hz, 1H), 7.60 (d, *J* = 7.6 Hz, 1H), 7.50-7.48 (m, 2H), 7.44-7.38 (m, 2H), 7.08 (d, *J* = 5.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.6 (t, *J* = 37 Hz), 150.7, 139.9, 134.9 (t, *J* = 31 Hz), 129.1, 128.9 (t, *J* = 6 Hz), 127.1, 126.9, 125.3, 121.4, 112.8 (t, *J* = 241 Hz), 111.3; ^{19}F NMR (470 MHz, $CDCl_3$): δ -83.18 (s); IR (KBr, cm^{-1}): ν_{max} = 3110, 1688, 1616, 1550, 1462, 1080, 843, 748, 718; MS (EI): *m/z* 251 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{12}H_8F_2NOS^+$: 252.0289, found: 252.0296.

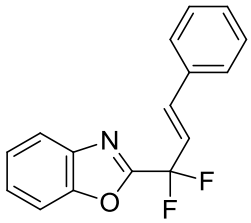
2-(difluoro(6-methoxypyridin-3-yl)methyl)benzo[d]oxazole (3w):



White solid (petroleum ether/EtOAc = 5/1, 76.2 mg, 55% yield); mp: 60-62℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.51 (s, 1H), 7.86 (d, *J* = 8.4 Hz, 1H), 7.78 (d, *J* = 8.4 Hz, 1H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.44-7.34 (m, 2H), 6.81 (d, *J* = 8.7 Hz, 1H), 3.95 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 165.8, 158.0 (t, *J* = 36.9 Hz), 150.8, 145.3 (t, *J* = 6.5 Hz), 140.0, 136.2 (t, *J* = 4.7 Hz), 127.0, 125.4, 122.6 (t, *J* = 26.4 Hz), 121.4, 114.1 (t, *J* = 244.5 Hz), 111.4, 111.1, 53.9; ^{19}F NMR (470 MHz, $CDCl_3$): δ -94.05 (s); IR (KBr, cm^{-1}): ν_{max} = 3085, 2945, 1608, 1493, 1387, 1259, 1079, 919, 841, 749; MS (EI): *m/z* 276 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{14}H_{11}F_2N_2O_2^+$: 277.0783, found: 277.0780.

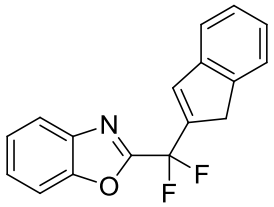
(E)-2-(1,1-difluoro-3-phenylallyl)benzo[d]oxazole (3x):

White solid (petroleum ether/EtOAc = 20/1, 69.6 mg, 51% yield); mp: 57-59℃; ^{1}H NMR (500



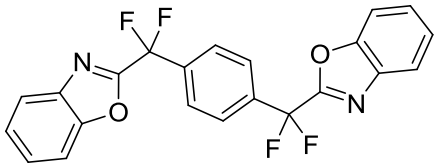
MHz, $CDCl_3$): δ 7.85 (d, *J* =7.9 Hz, 1H), 7.63 (d, *J* =7.9 Hz, 1H), 7.50 (d, *J* = 6.7 Hz, 2H), 7.48-7.42 (m, 2H), 7.41-7.36 (m, 3H), 7.22 (d, *J* = 16.2 Hz, 1H), 6.71-6.62 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 158.1 (t, *J* = 35.8 Hz), 150.7, 140.1, 136.8 (t, *J* = 8.8 Hz), 134.1, 129.7, 128.9, 127.6, 126.9, 125.4, 121.4, 119.5 (t, *J* = 24.4 Hz), 113.5 (t, *J* = 240.3 Hz), 111.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -94.45 (d, *J* = 10.0 Hz); IR (KBr, cm^{-1}): ν_{max}= 3033, 1656, 1615, 1595, 1451, 1224, 979, 763, 750; MS (EI): *m/z* 271 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{16}H_{12}F_2NO^+$: 272.0881, found: 272.0886.

2-(difluoro(1H-inden-2-yl)methyl)benzo[d]oxazole (3y):



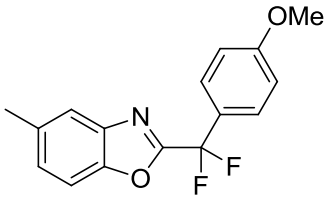
White solid (petroleum ether/EtOAc = 20/1, 74.2 mg, 52% yield); mp: 67-69℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.86 (d, *J* =7.8 Hz, 1H), 7.64 (d, *J* =7.8 Hz, 1H), 7.51 (d, *J* = 6.8 Hz, 1H), 7.49-7.41 (m, 3H), 7.35-7.29 (m, 3H), 3.80 (s, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.9 (t, *J* = 36.2 Hz), 150.7, 143.5, 142.3, 140.1, 138.5 (t, *J* = 26.4 Hz), 134.7 (t, *J* = 7.6 Hz), 126.9, 126.89, 126.8, 125.4, 124.1, 122.8, 121.4, 113.5 (t, *J* = 239.2 Hz), 111.4, 37.5; ^{19}F NMR (470 MHz, $CDCl_3$): δ -91.97 (s); IR (KBr, cm^{-1}): ν_{max} = 3076, 2923, 1616, 1451, 1293, 1185, 1070, 1021, 981, 887, 749, 716; MS (EI): *m/z* 283 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{17}H_{12}F_2NO^+$: 284.0881, found: 284.0887.

1,4-bis(benzo[d]oxazol-2-yldifluoromethyl)benzene (3z):



White solid (petroleum ether/EtOAc = 20/1, 87.4 mg, 42% yield); mp: 90-92℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.88 (s, 4H), 7.81 (d, *J* = 7.8 Hz, 2H), 7.60 (d, *J* = 8.3 Hz, 2H), 7.46 (t, *J* = 7.3 Hz, 2H), 7.41 (t, *J* = 8.0 Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.9 (t, *J* = 36.3 Hz), 150.9, 140.0, 136.5 (t, *J* =27.2 Hz), 127.1, 126.5 (t, *J* = 5.5 Hz), 125.5, 121.5, 114.0 (t, *J* = 245.0 Hz), 111.5; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.92 (s); IR (KBr, cm^{-1}): ν_{max} = 3103, 3058, 1616, 1451, 1264, 1076, 983, 919, 842, 761, 747; MS (EI): *m/z* 412 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{22}H_{13}F_4N_2O_2^+$: 413.0908, found: 413.0912.

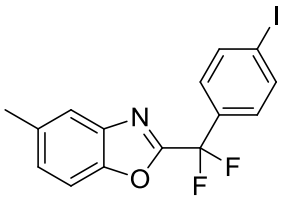
2-(difluoro(4-methoxyphenyl)methyl)-5-methylbenzo[d]oxazole (7a):



White solid (petroleum ether/EtOAc = 20/1, 110.4mg, 76% yield); mp: 90-92℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.64 (d, *J* = 8.7 Hz, 2H), 7.58 (s, 1H), 7.43 (d, *J* = 8.4 Hz, 1H), 7.21 (d, *J* =8.5 Hz, 1H), 6.97 (d, *J* = 8.8 Hz, 2H), 3.81 (s, 3H), 2.45 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 161.6 (t, *J* = 1.7 Hz), 158.8 (t, *J* = 38.7 Hz), 149.0, 140.3, 135.2, 127.9, 127.3 (t, *J* =6.5 Hz), 125.7 (t, *J* = 27.3 Hz), 121.0, 114.7 (t, *J*

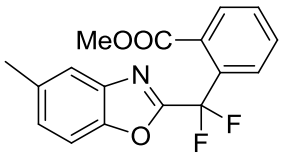
= 245.0 Hz), 114.0, 110.6, 55.3, 21.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -93.39 (s); IR (KBr, cm^{-1}): ν_{max} = 2968, 2964, 1616, 1518, 1246, 1048, 980, 838, 812; MS (EI): *m/z* 289 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{16}H_{14}F_2NO_2^+$: 290.0987, found: 290.0988.

2-(difluoro(4-iodophenyl)methyl)-5-methylbenzo[d]oxazole (7b):



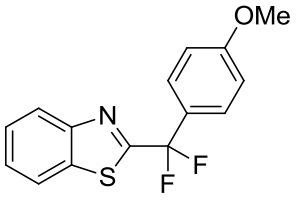
White solid (petroleum ether/EtOAc = 20/1, 143.7 mg, 75% yield); mp: 97-99℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.82 (d, *J* = 7.9 Hz, 2H), 7.57 (s, 1H), 7.44 (d, *J* = 8.4 Hz, 3H), 7.23 (d, *J* = 8.3 Hz, 1H), 2.46 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 157.9 (t, *J* = 36.8 Hz), 149.0, 140.2, 137.9, 135.4, 133.2 (t, *J* =26.2 Hz), 128.1, 127.4 (t, *J* = 5.6 Hz), 121.1, 114.2 (t, *J* = 244.9 Hz), 110.7, 98.0, 21.5; ^{19}F NMR (470 MHz, $CDCl_3$): δ -95.42 (s); IR (KBr, cm^{-1}): ν_{max} = 3091, 1625, 1588, 1393, 1259, 1097, 1078, 986, 829, 801; MS (EI): *m/z* 385 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_{11}F_2INO^+$: 385.9848, found: 385.9853.

Methyl 2-(difluoro(5-methylbenzo[d]oxazol-2-yl)methyl)benzoate (7c):



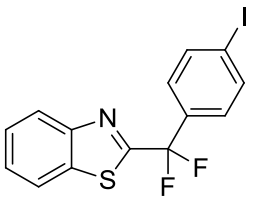
White solid (petroleum ether/EtOAc = 4/1, method A: 151.0 mg, 95% yield); mp: 101-103℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.00 (d, *J* = 7.9 Hz, 1H), 7.97 (d, *J* = 7.5 Hz, 1H), 7.70 (t, *J* = 7.8 Hz, 1H), 7.61 (t, *J* = 7.8 Hz, 1H), 7.53 (s, 1H), 7.48 (d, *J* = 8.1 Hz, 1H), 7.22 (d, *J* = 8.5Hz, 1H), 3.64 (s, 3H), 2.44 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 166.6, 159.3 (t, *J* = 32.3 Hz), 148.5, 140.4, 135.0, 133.1 (t, *J* =24.1 Hz), 132.0, 131.1, 130.0, 127.7, 127.1 (t, *J* = 8.7 Hz), 120.9, 113.9 (t, *J* = 245.0 Hz), 110.7, 52.4, 21.4; ^{19}F NMR (470 MHz, $CDCl_3$): δ -90.51 (s); IR (KBr, cm^{-1}): ν_{max} = 3001, 2953, 1721, 1612, 1283, 1038, 981, 806, 770, 718; MS (EI): *m/z* 317 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{17}H_{14}F_2NO_3^+$: 318.0936, found: 318.0944.

2-(difluoro(4-methoxyphenyl)methyl)benzo[d]thiazole (8a):



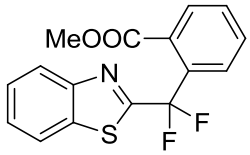
Yellow solid (petroleum ether/EtOAc = 20/1, 111.3 mg, 76% yield); mp: 82-84℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.12 (d, *J* = 8.1 Hz, 1H), 7.90 (d, *J* = 8.1 Hz, 1H), 7.68 (d, *J* = 8.7 Hz, 2H), 7.51 (t, *J* = 7.9 Hz, 1H), 7.43 (t, *J* = 7.3 Hz, 1H), 6.97 (d, *J* = 8.9 Hz, 2H), 3.80 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): 165.3 (t, *J* = 36.8 Hz), 161.3 (t, *J* = 1..9 Hz), 152.8, 127.4 (t, *J* = 5.6 Hz), 126.9 (t, *J* = 27.5 Hz), 126.6, 126.4, 124.3, 121.8, 117.6 (t, *J* = 242.5 Hz), 113.9, 55.2; ^{19}F NMR (470 MHz, $CDCl_3$): δ -84.84 (s); IR (KBr, cm^{-1}): ν_{max} = 3065, 2961, 1614, 1516, 1311, 1256, 1178, 1029, 907, 831, 760, 730; MS (EI): *m/z* 291 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_{12}F_2NOS^+$: 292.0602, found: 292.0607.

2-(difluoro(4-iodophenyl)methyl)benzo[d]thiazole (8b):



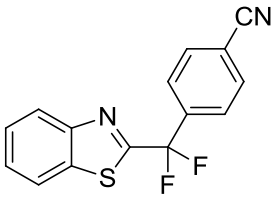
Yellow solid (petroleum ether/EtOAc = 20/1, 142.1 mg, 73% yield); mp: 105-106℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.10 (d, *J* = 8.1 Hz, 1H), 7.93 (d, *J* =8.0 Hz, 1H), 7.81 (d, *J* = 8.2 Hz, 2H), 7.53 (t, *J* = 7.9 Hz, 1H), 7.50 - 7.44 (m, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 164.4 (t, *J* = 36.6 Hz), 152.8, 137.8, 135.0, 134.5 (t, *J* = 27.3 Hz), 127.6 (t, *J* = 5.7 Hz), 126.8, 126.6, 124.5, 121.9, 117.2 (t, *J* = 245.0 Hz), 97.6; ^{19}F NMR (470 MHz, $CDCl_3$): δ -87.03 (s); IR (KBr, cm^{-1}): ν_{max} = 2965, 2928, 1615, 1588, 1452, 1346, 1256, 1080, 977, 917, 814, 741; MS (EI): *m/z* 387 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+ C_{14}H_9F_2INS^+$: 387.9463, found: 387.9469.

Methyl 2-(benzo[d]thiazol-2-yldifluoromethyl)benzoate (8c):



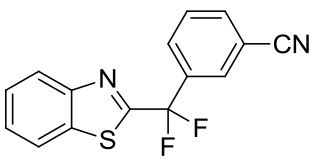
Yellow solid (petroleum ether/EtOAc = 6/1, 135.9 mg, 85% yield); mp: 65-67℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.03 (d, *J* = 7.9 Hz, 2H), 7.93 (d, *J* = 7.52 Hz, 1H), 7.87 (d, *J* = 7.8 Hz, 1H), 7.67 (t, *J* = 7. 8 Hz, 1H), 7.58 (t, *J* = 7. 8 Hz, 1H), 7.47 (t, *J* = 7. 6 Hz, 1H), 7.43 (t, *J* = 7. 6 Hz, 1H), 3.66 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 167.2, 165.8 (t, *J* = 35.5 Hz), 152.2, 135.1, 133.4 (t, *J* =25.3 Hz), 131.5, 130.7, 130.5, 130.4, 127.6 (t, *J* = 8.8 Hz), 126.4, 126.3, 124.3, 121.9, 117.2 (t, *J* = 241.1 Hz), 52.2; ^{19}F NMR (470 MHz, $CDCl_3$): δ -81.45 (s); IR (KBr, cm^{-1}): ν_{max} = 3069, 2958, 1730, 1512, 1490, 1434, 1272, 1190, 1099, 1018, 904, 763, 715; MS (EI): *m/z* 319 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+ C_{16}H_{12}F_2NO_2S^+$: 320.0551, found: 320.0556.

4-(benzo[d]thiazol-2-yldifluoromethyl)benzonitrile (8d):



Yellow solid (petroleum ether/EtOAc = 8/1, 95.5 mg, 67% yield); mp: 104-106℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.05 (d, *J* = 8.2 Hz, 1H), 7.93 (d, *J* = 7.8 Hz, 1H), 7.84 (d, *J* = 8.4 Hz, 2H), 7.74 (d, *J* = 8.4 Hz, 2H), 7.52 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.6Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 163.5 (t, *J* = 35.5 Hz), 152.6, 139.0 (t, *J* = 28.6 Hz), 134.8, 132.3, 126.9, 126.8, 126.7 (t, *J* = 5.6 Hz), 124.4, 121.9, 117.8, 116.5 (t, *J* = 245.0 Hz), 114.7; ^{19}F NMR (470 MHz, $CDCl_3$): δ -87.69 (s); IR (KBr, cm^{-1}): ν_{max} = 3101, 3058, 2234, 1516, 1261, 1229, 1095, 1046, 925, 831, 758, 724; MS (EI): *m/z* 286 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+ C_{15}H_9F_2N_2S^+$: 287.0449, found: 287.0448.

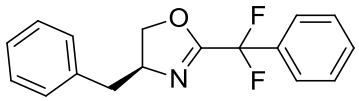
3-(benzo[d]thiazol-2-yldifluoromethyl)benzonitrile (8e):



Yellow solid (petroleum ether/EtOAc = 8/1, 106.2 mg, 74% yield); mp: 85-87℃; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.06 (d, *J* = 8.0 Hz, 1H), 8.03 (s, 1H), 7.98 - 7.92 (m, 2H), 7.76 (d, *J* = 7.7 Hz, 1H), 7.58 (t, *J* = 8.0 Hz, 1H), 7.52 (t, *J* = 8.2 Hz, 1H), 7.47 (t, *J* = 7.6 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$): δ 163.5 (t, *J* = 36.8 Hz), 152.6, 136.2 (t, *J* = 27.6 Hz), 134.9, 134.1, 130.2 (t, *J* = 5.4 Hz), 129.7 (t, *J* = 6.1 Hz), 129.6, 126.9, 126.8, 124.4, 122.0, 117.8, 116.3 (t,

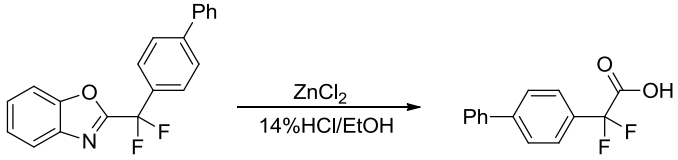
J = 244.1 Hz), 113.0; ^{19}F NMR (470 MHz, $CDCl_3$): δ -86.98 (s). IR (KBr, cm^{-1}): ν_{max} = 3082, 3059, 2234, 1518, 1429, 1229, 1090, 1054, 951, 813, 792, 757, 698; MS (EI): *m/z* 286 (M^+); HRMS (ESI-TOF) calcd for $[M+H]^+$ $C_{15}H_9F_2N_2S^+$: 287.0449, found: 287.0448.

(S)-4-benzyl-2-(difluoro(phenyl)methyl)-4,5-dihydrooxazole (9)



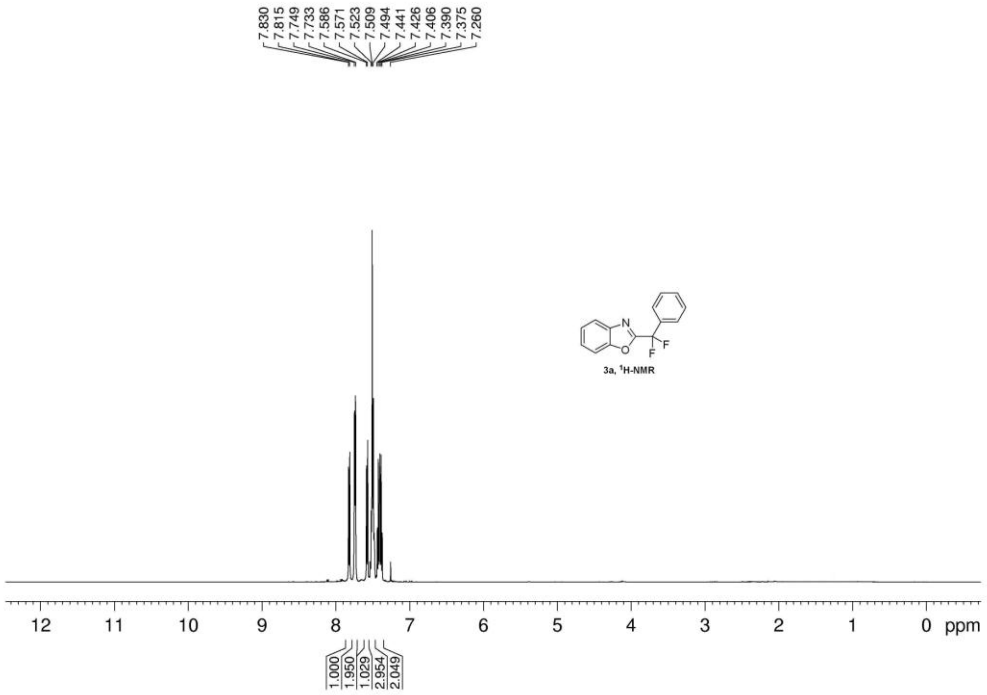
A 10 mL Schlenk tube was charged with copper (96 mg, 1.5 mmol, 3 equiv), phenylboronic acid (0.5 mmol, 1.0 equiv), 6 (1.5 mmol, 3 equiv) and solvent (NMP, 3 mL). The mixture was stirred at 50 ^oC under N_2. After the completion of the reaction, the solution was poured into cold water and filtered through a pad of Celite, washed with ether. The combined filtrates were washed with brine (10 mL×3), and the organic phase was dried over Na_2SO_4. After filtration and evaporation of the solvent, the crude mixture was purified by flash silica gel column chromatography to afford the desired products **9**. Clear oil; 66.1 mg, 46%; ^{1}H NMR (500 MHz, $CDCl_3$): δ 7.60 (d, *J* = 7.3 Hz, 2H), 7.53-7.43 (m, 3H), 7.31-7.20 (m, 3H), 7.17 (d, *J* = 7.0 Hz, 2H), 4.61-4.53 (m, 1H), 4.34 (t, *J* = 9.0 Hz, 1H), 4.15 (t, *J* = 8.1 Hz, 1H), 3.17 (dd, *J* = 13.9, 4.9 Hz, 1H), 2.75 (dd, *J* = 13.9, 4.9 Hz, 1H); ^{19}F NMR (470 MHz, $CDCl_3$): δ -99.48 (dd, *J* = 41.4 Hz,); ^{13}C NMR (125 MHz, $CDCl_3$): δ 161.3 (t, *J* = 33.7 Hz), 136.9, 133.7 (t, *J* = 25.5 Hz), 131.0, 129.4, 128.7, 128.6, 126.9, 125.6 (t, *J* = 6.2 Hz), 114.0 (t, *J* = 242.8 Hz), 73.2, 67.5, 40.8； HRMS (ESI FT) calcd for $[M+H]^+$ $C_{17}H_{16}F_2NO^+$: 288.1200, found: 288.1211.

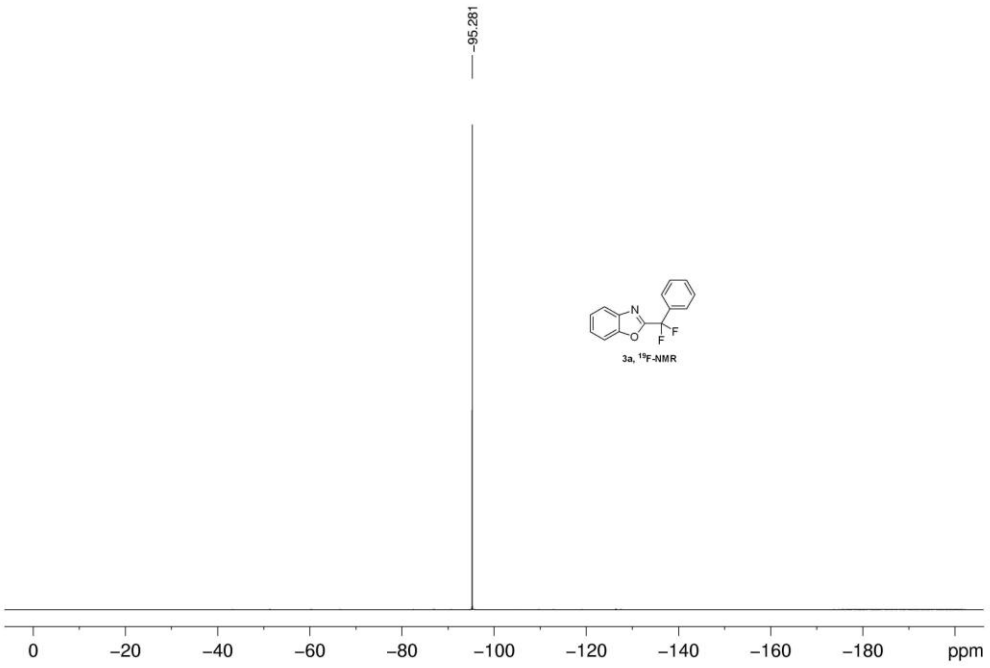
Biphenyl-4-yl(difluoro)acetic acid:

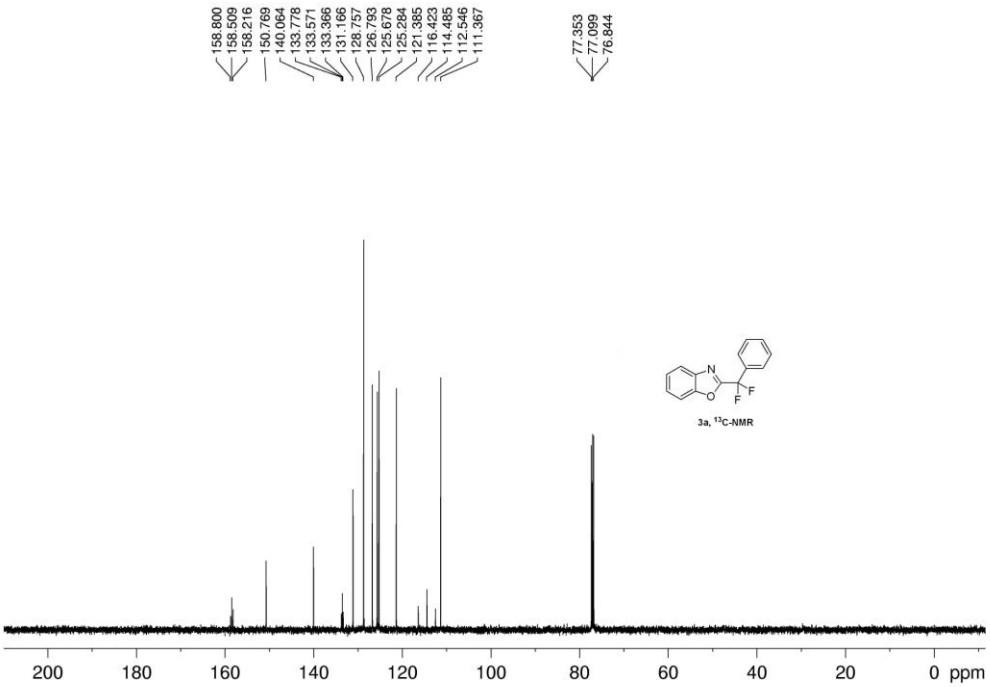


The decarbonylation of Biphenyl-4-yl(difluoro)acetic acid obtained from the reaction of **3d** (65 mg, 0.2 mmol) was hydrolyzed upon treatment with $ZnCl_2$ (55 mg, 0.4 mmol) and a 14% HCl aqueous solution (2.0 mL) in EtOH (4.0 mL) at 80 ℃ for 12h. The NaOH was added at room temperature with continuous stirring for 2h. After evaporation of the solvent, the aqueous layer was washed with CH_2Cl_2 (3×5 mL). The aqueous layer was acidified with a concentrated HCl aqueous solution and then extracted with EtOAc (10 mL x 5). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated in vacuo to give the corresponding carboxylic acid as a off-white solid; (32.3 mg, 65% yield); ^{1}H NMR (500 MHz, $CDCl_3$) δ 10.50 (s, 1H), 7.75-7.69 (m, 4H), 7.62 (d, *J* = 7.8 Hz, 2H), 7.49 (t, *J* = 7.4 Hz, 2H), 7.42 (t, *J* = 7.3 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.4 (t, *J* = 37.5 Hz), 144.5, 139.9, 130.7 (t, *J* = 25.7 Hz), 129.0, 128.2, 127.6, 127.3, 126.1 (t, *J* = 5.5 Hz), 113.2 (t, *J* = 257.3 Hz); ^{19}F NMR (470 MHz, $CDCl_3$) δ −104.99 (s).

6. Copies of ^{1}H NMR, ^{19}F NMR and ^{13}C NMR spectra



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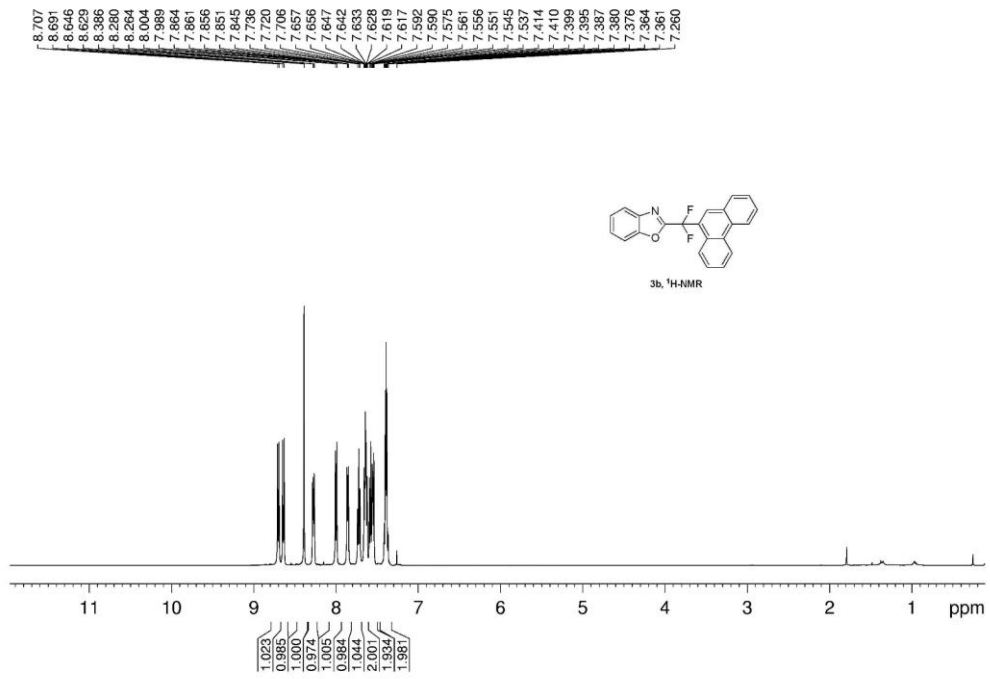
158.509
158.216
150.769
140.064
133.778
133.571
133.366
131.166
128.757
126.793
125.678
125.284
121.385
116.423
114.485
112.546
111.367
77.353
77.099
76.844
3a, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0 ppm


8.707
8.691
8.646
8.629
8.386
8.280
8.264
8.004
7.989
7.864
7.861
7.856
7.851
7.845
7.736
7.720
7.706
7.657
7.656
7.647
7.642
7.633
7.628
7.619
7.617
7.592
7.590
7.575
7.561
7.556
7.551
7.545
7.537
7.414
7.410
7.399
7.395
7.387
7.380
7.376
7.364
7.361
7.260
3b, 1H-NMR
11
10
9
8
7
6
5
4
3
2
1
ppm
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1.000
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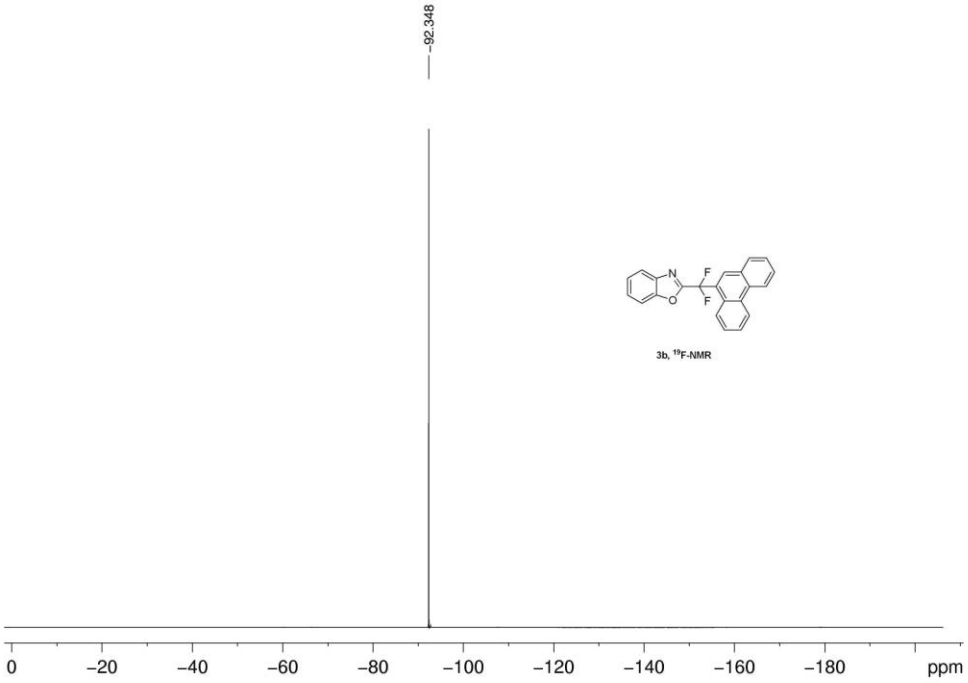
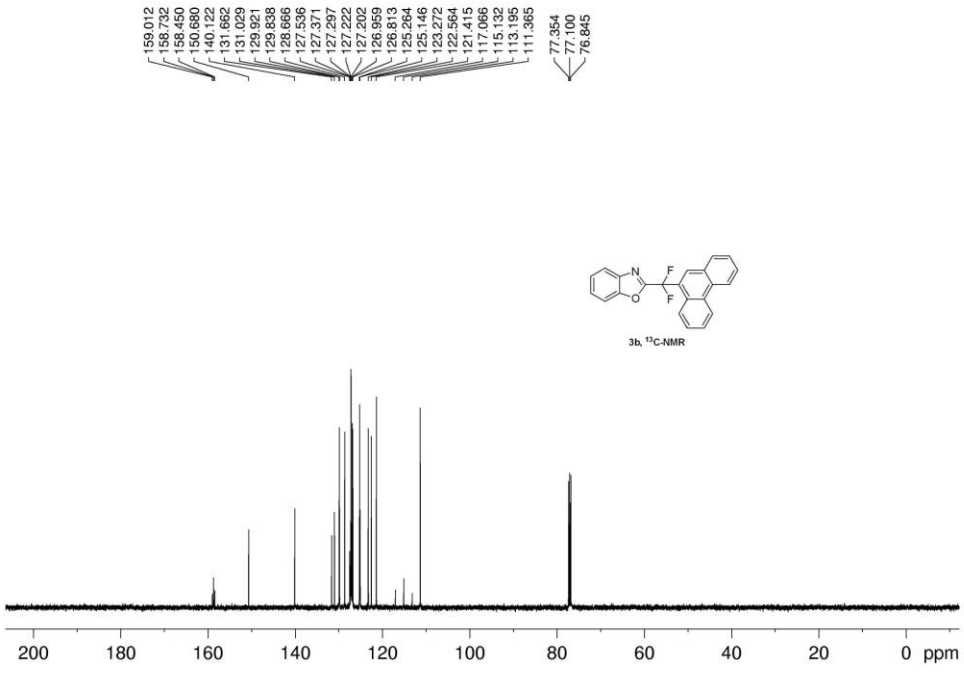
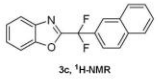
1.005
0.984
1.044
2.001
1.934
1.981



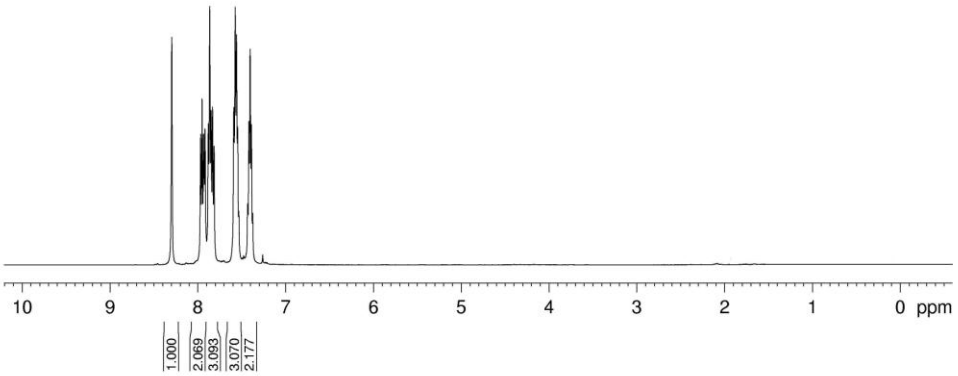
3b, ^{19}F-NMR

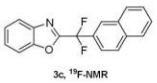


3b, ^{13}C-NMR

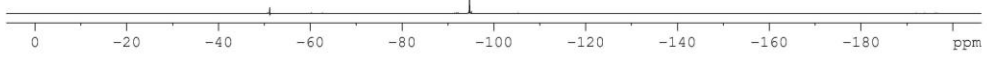


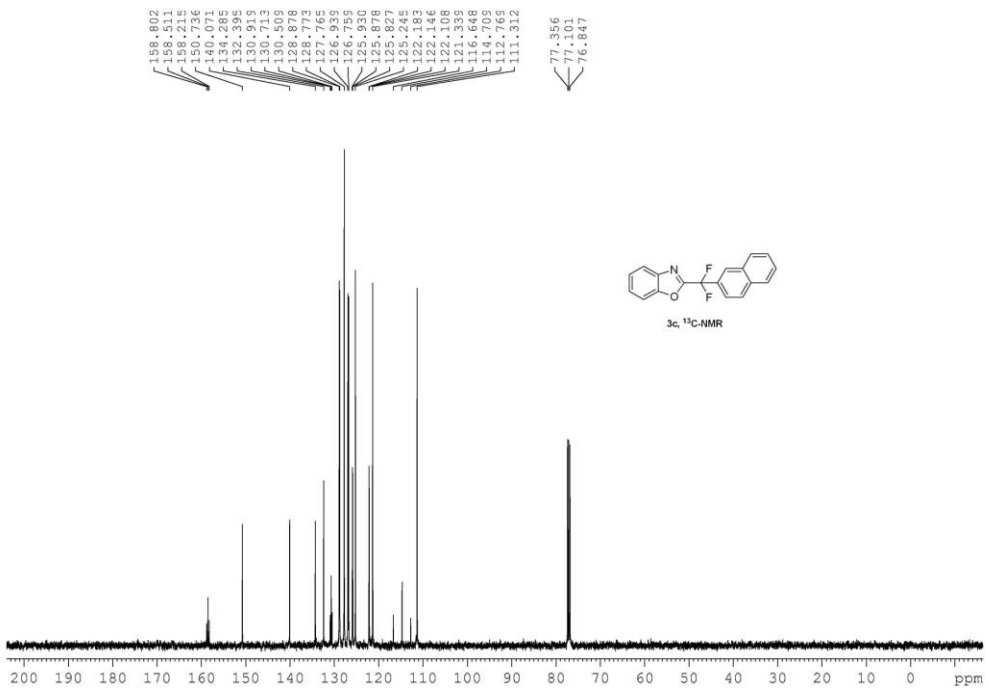
3c, ^{1}H-NMR

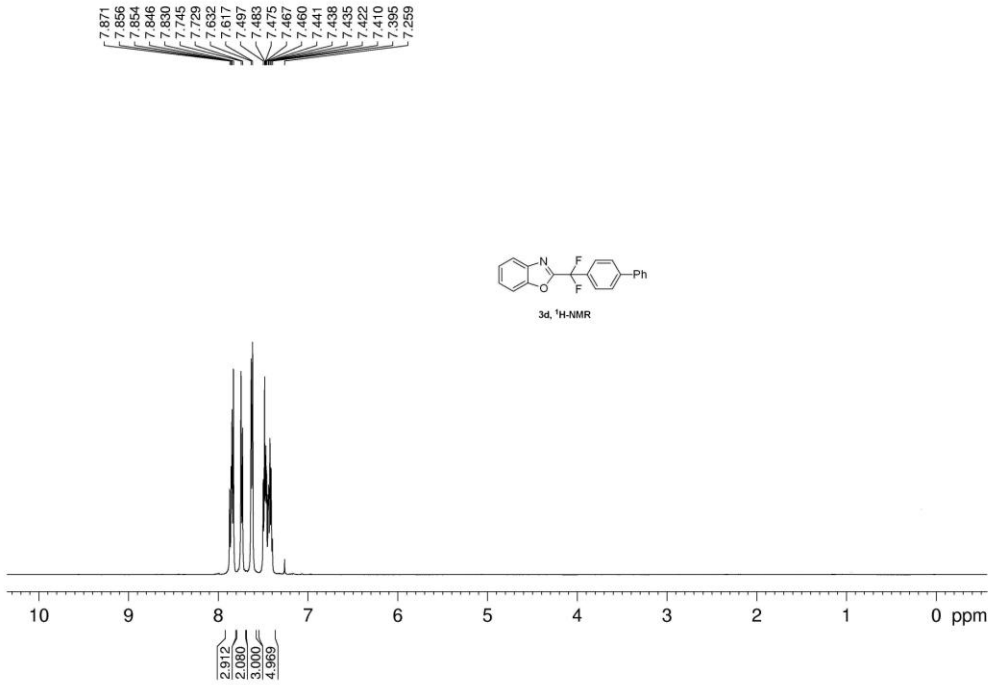


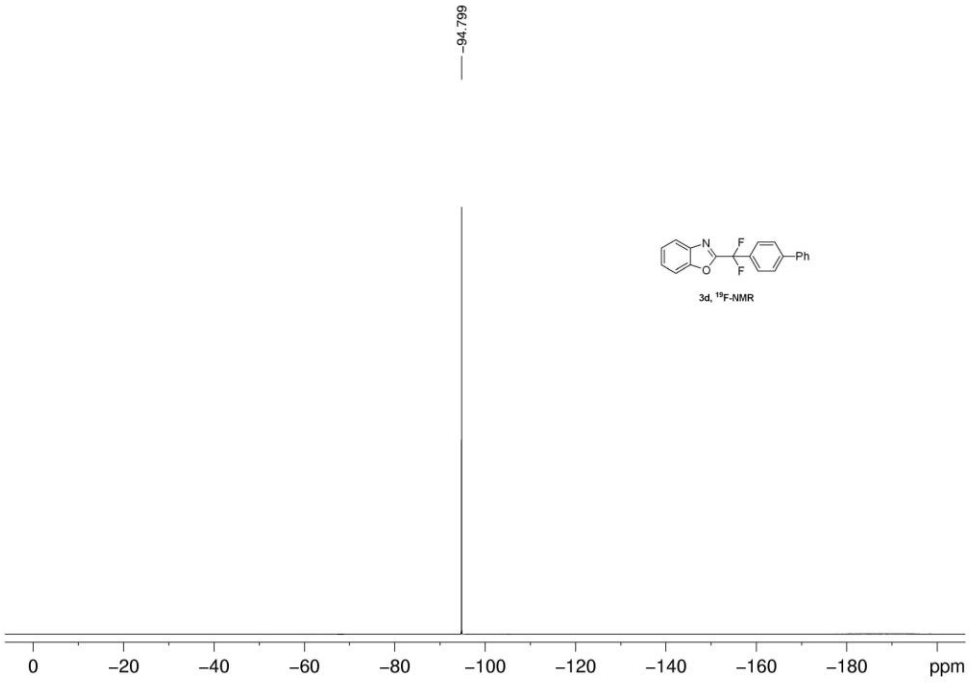


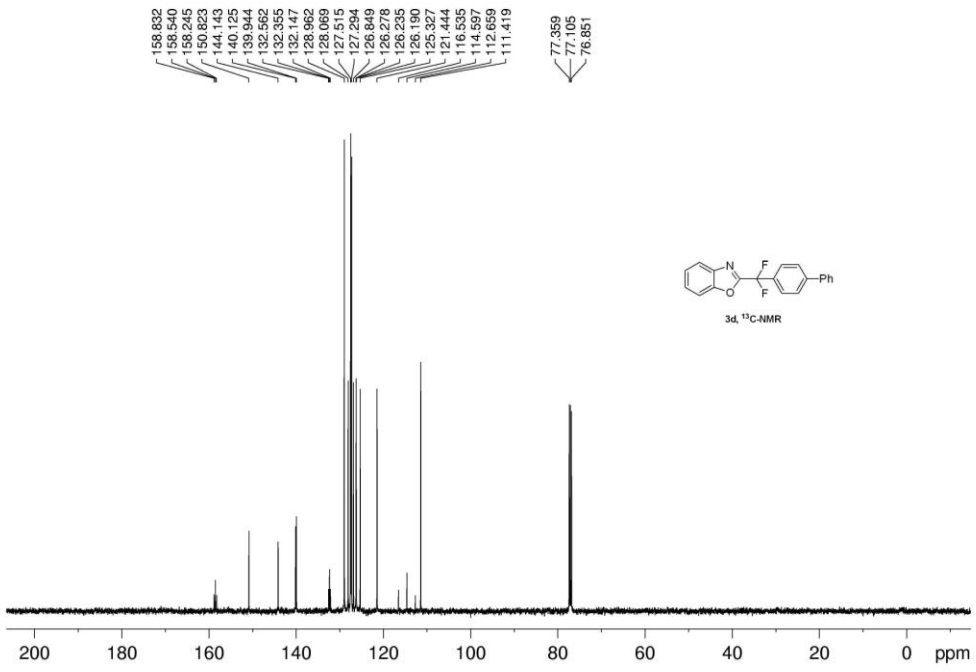
3c, ^{19}F-NMR

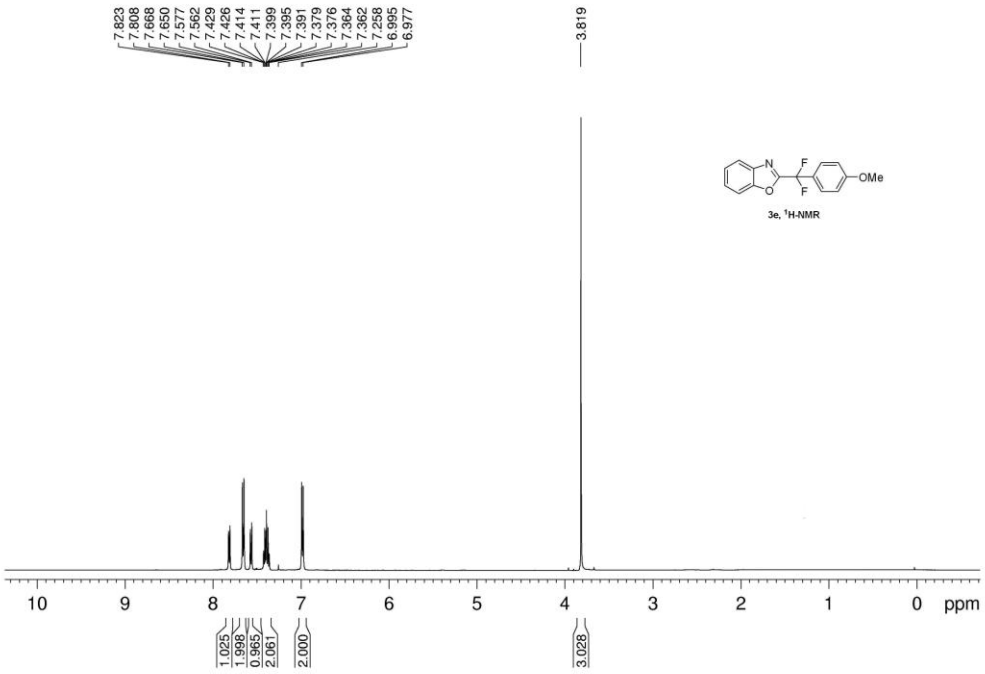


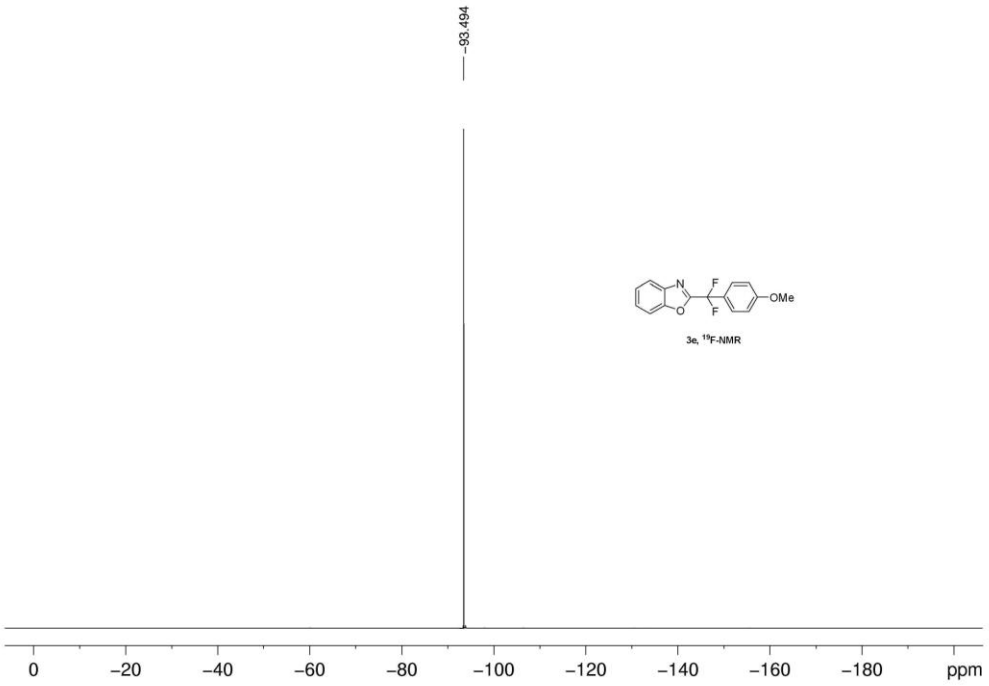

158.802
158.511
158.215
150.736
140.071
134.285
132.395
130.919
130.713
130.509
128.878
128.773
127.765
126.939
126.759
125.930
125.878
125.827
125.245
122.183
122.146
122.108
121.339
116.648
114.709
112.769
111.312
77.356
77.101
76.847
3c, 13C-NMR
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

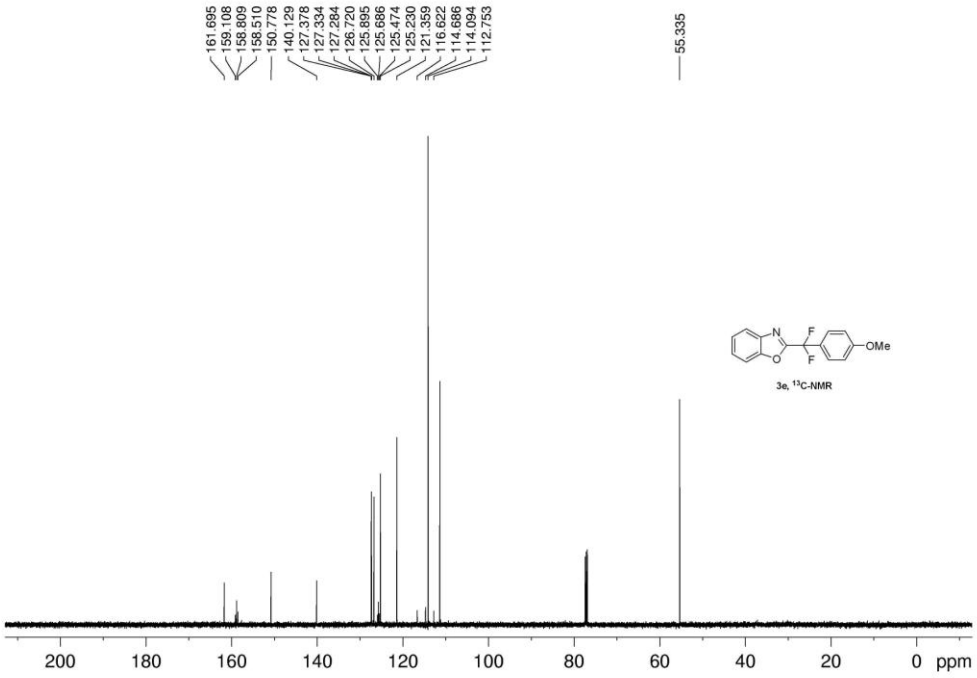

7.871
7.856
7.854
7.846
7.830
7.745
7.729
7.632
7.617
7.497
7.483
7.475
7.467
7.460
7.441
7.438
7.435
7.422
7.410
7.395
7.259
Ph
3d, 1H-NMR
10 9 8 7 6 5 4 3 2 1 0 ppm
2.912
2.080
3.000
4.969

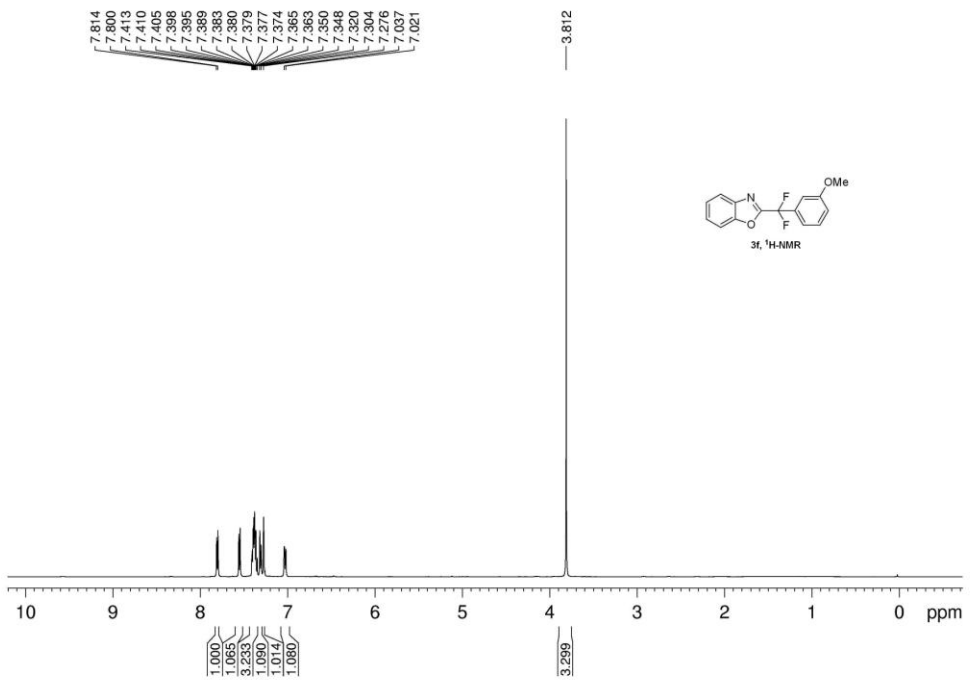

-94.799
3d, 19F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm

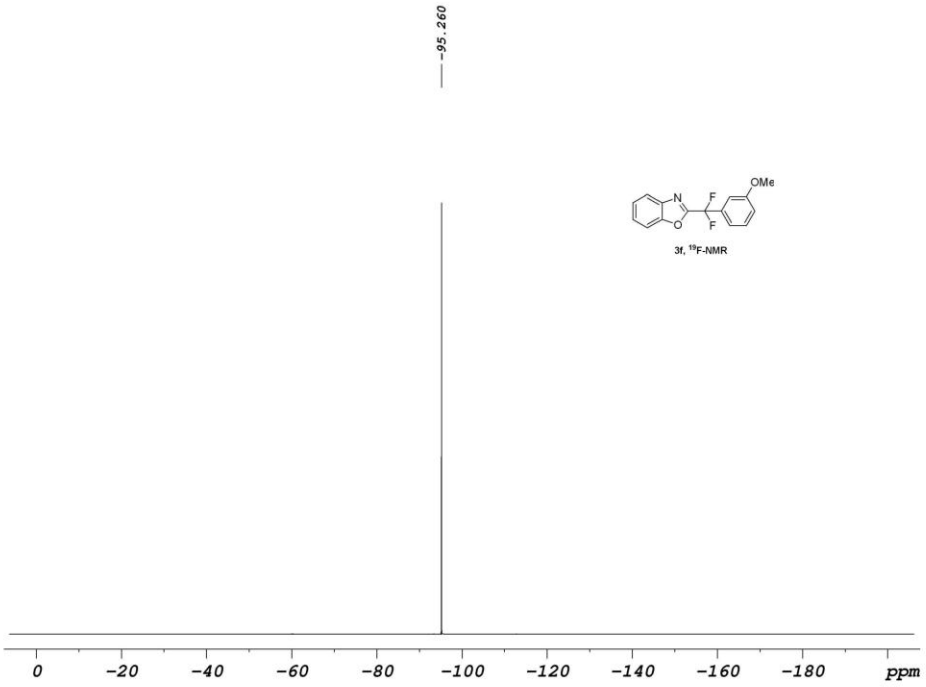

158.832
156.540
156.245
150.823
144.143
140.125
139.944
132.562
132.355
132.147
128.962
128.069
127.515
127.294
126.849
126.278
126.235
126.190
125.327
121.444
116.535
114.597
112.659
111.419
77.359
77.105
76.851
3d, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm

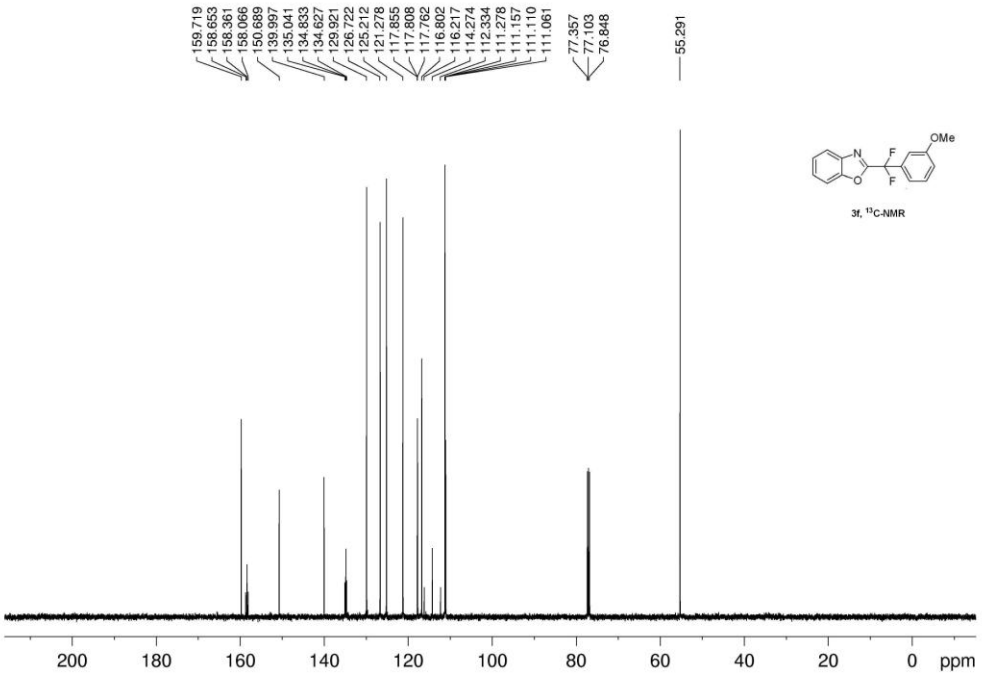

7.823
7.808
7.668
7.650
7.577
7.562
7.429
7.426
7.414
7.411
7.399
7.395
7.391
7.379
7.376
7.364
7.362
7.258
6.995
6.977
3.819
3e, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
1.025
1.998
0.965
2.061
2.000
3.028

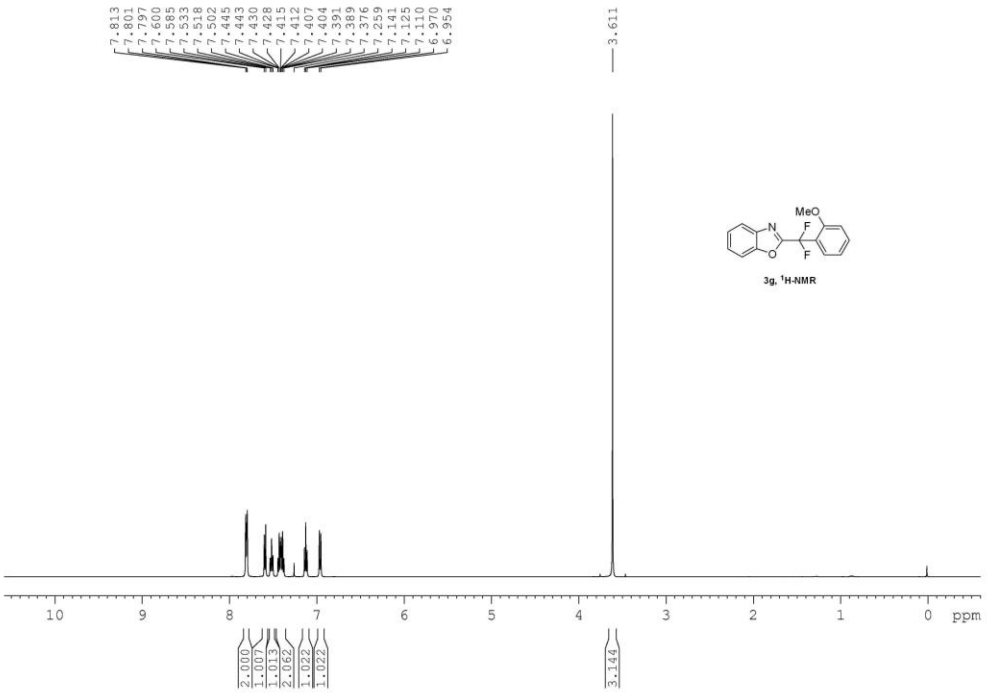

-93.494
3e, ^{19}F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm


161.695
159.108
158.809
158.510
150.778
140.129
127.378
127.334
127.284
126.720
125.895
125.686
125.474
125.230
121.359
116.622
114.886
114.094
112.753
55.335
N
O
F
F
OMe
3e, ^{13}C-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm

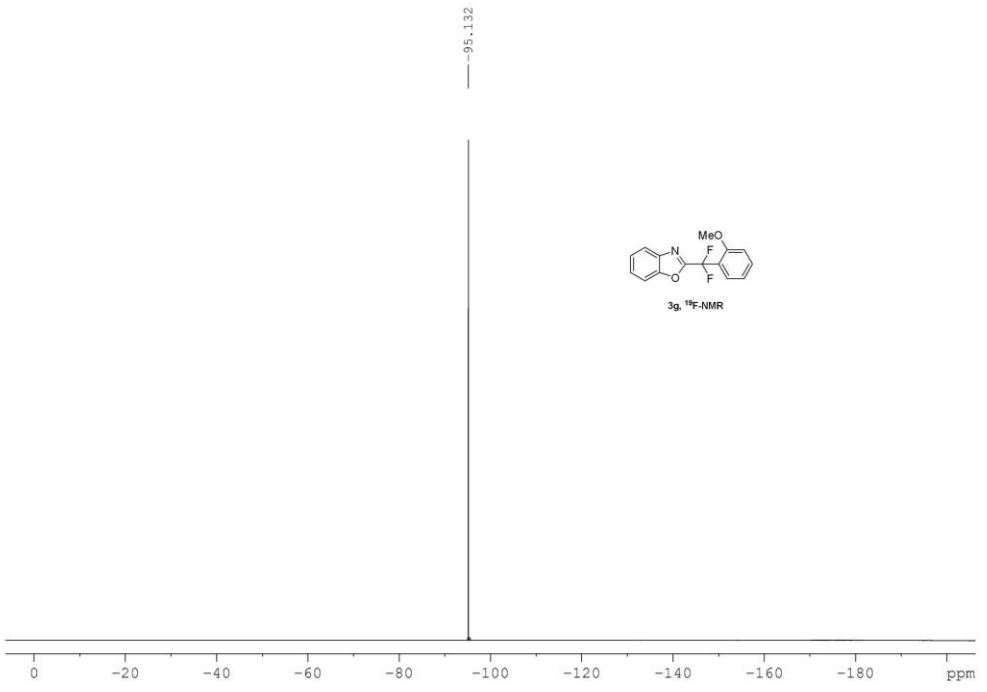

7.814
7.800
7.413
7.410
7.405
7.398
7.395
7.389
7.383
7.380
7.379
7.377
7.374
7.365
7.363
7.350
7.348
7.320
7.304
7.276
7.037
7.021
3.812
N
O
F
F
OMe
3f, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
1.000
1.065
3.233
1.090
1.014
1.080
3.299


-95.260
OMe
N
O
F
F
3f, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

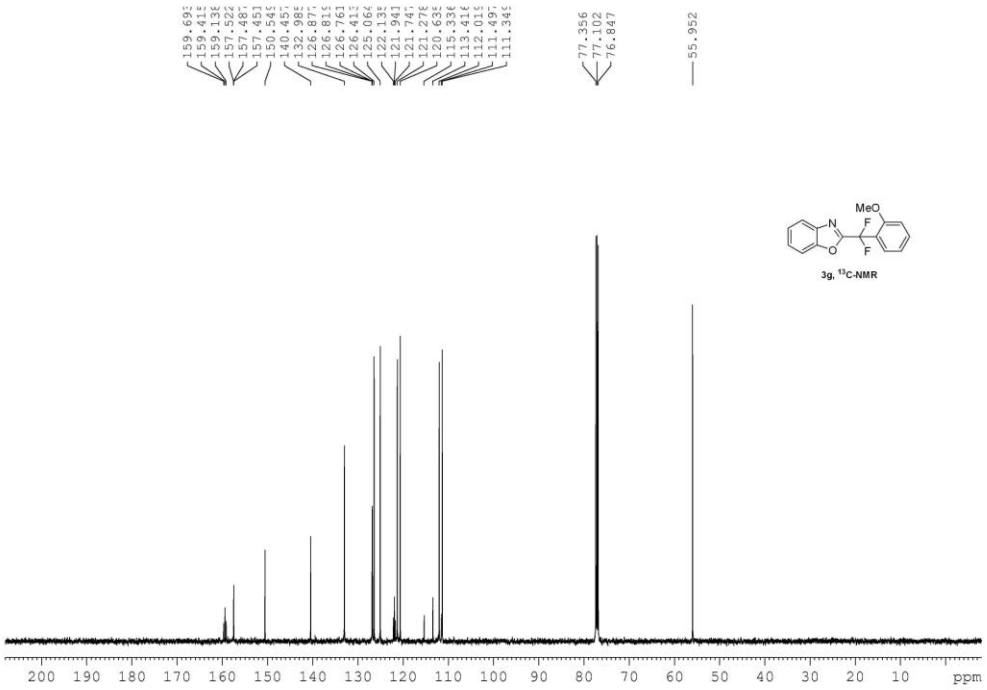

159.719
158.653
158.361
158.066
150.689
139.997
135.041
134.833
134.627
129.921
126.722
125.212
121.278
117.855
117.808
117.782
116.802
116.217
114.274
112.334
111.278
111.157
111.110
111.061
77.357
77.103
76.848
55.291
OMe
N
O
F
F
3f, ^{13}C-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm



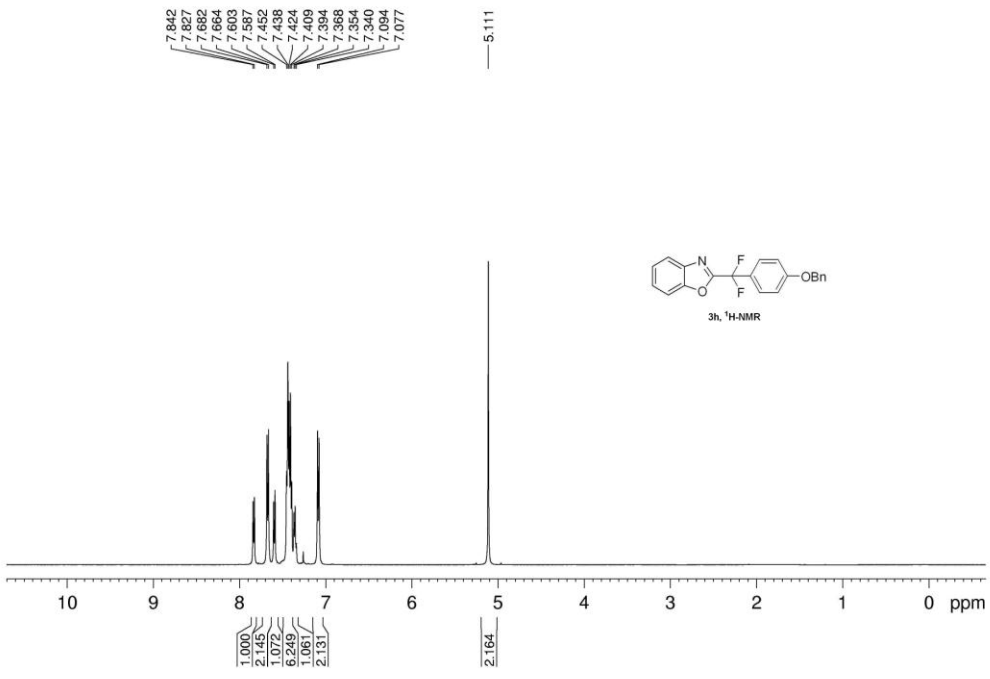
3g, ^{1}H-NMR



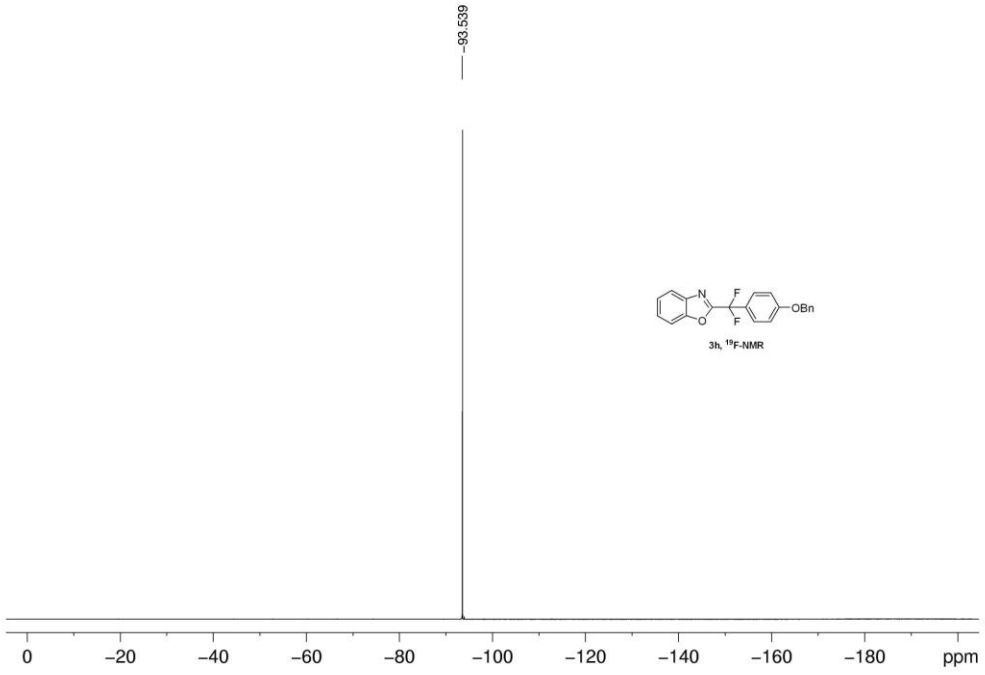
3g, ^{19}F-NMR

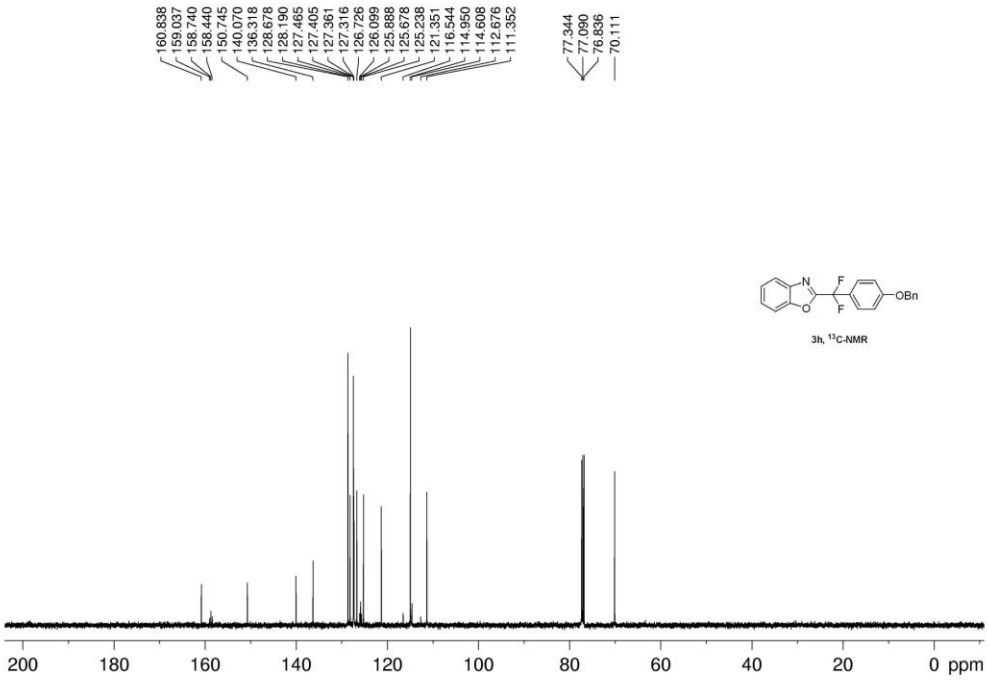


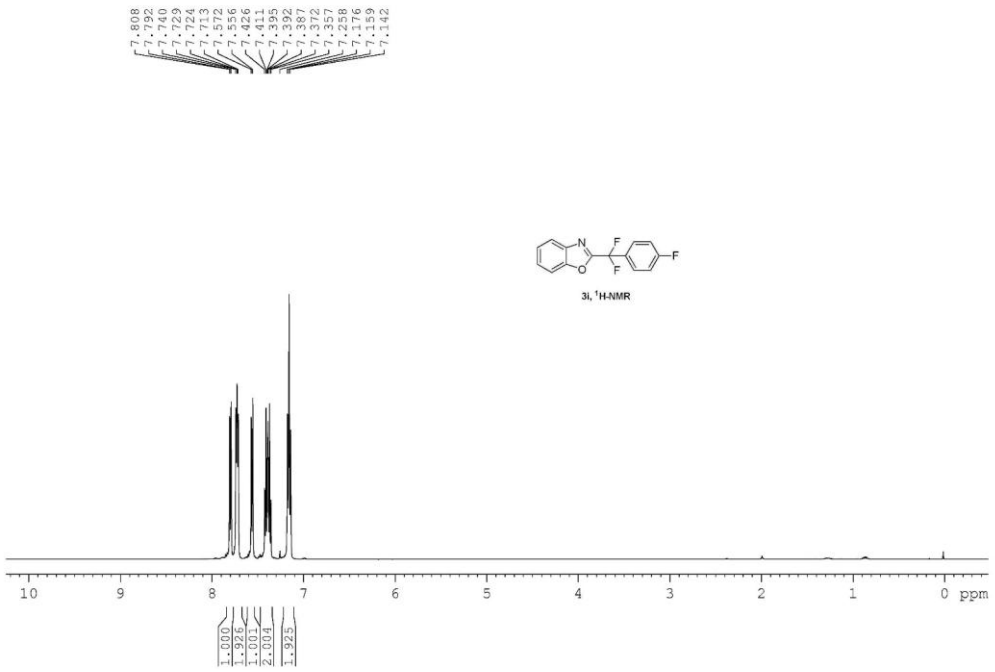
3g, ^{13}C-NMR

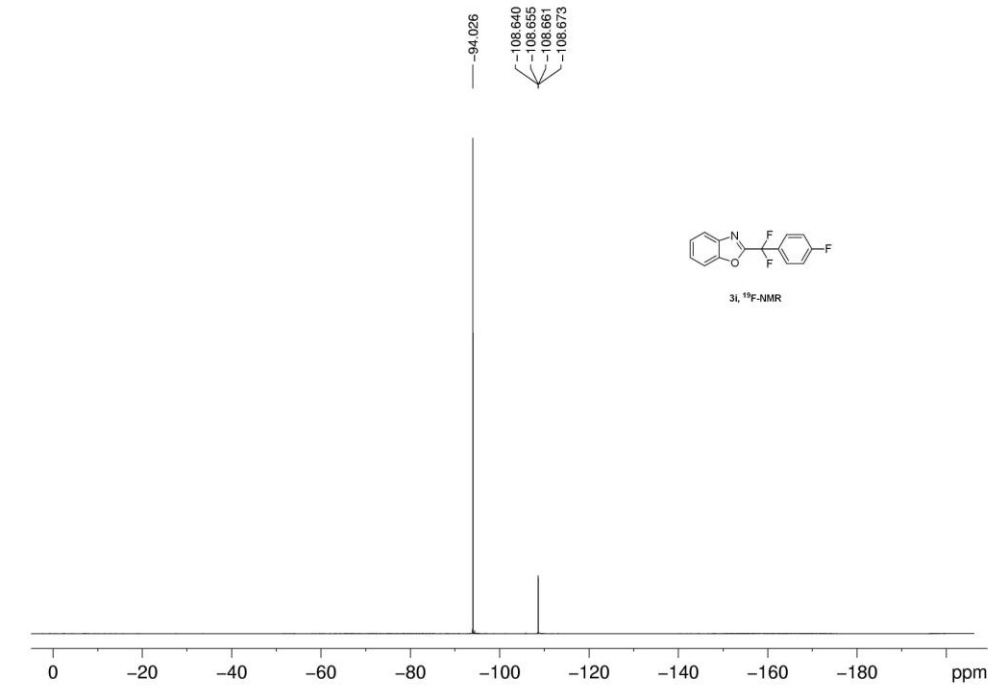


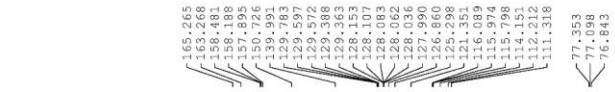
3h, ^{1}H-NMR

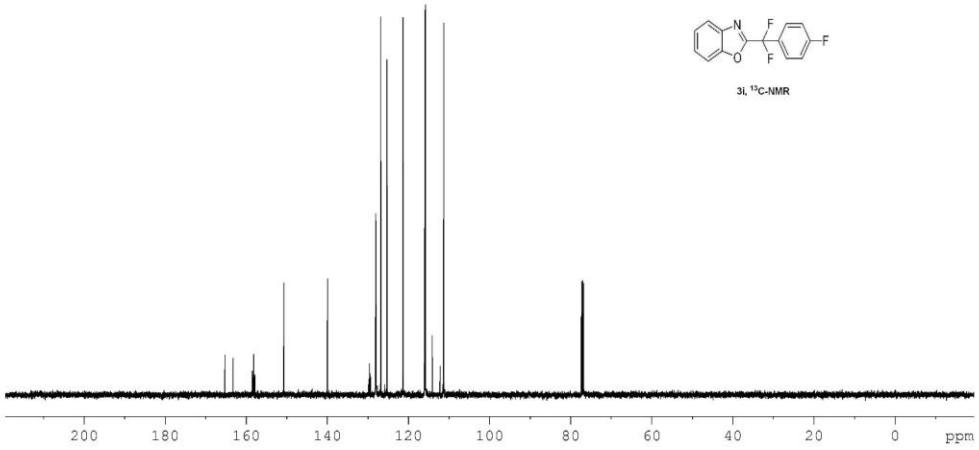

-93.539
N
O
F
F
OBn
3h, 19F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm


160.838
159.037
158.740
158.440
150.745
140.070
136.318
128.678
128.190
127.465
127.405
127.361
127.316
126.726
126.099
125.888
125.678
125.238
121.351
116.544
114.950
114.608
112.676
111.352
77.344
77.090
76.836
70.111
N
O
F
F
OBn
3h, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0 ppm

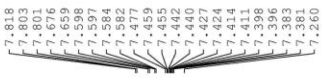

7.808
7.792
7.740
7.729
7.724
7.713
7.572
7.556
7.426
7.411
7.395
7.392
7.387
7.372
7.357
7.258
7.176
7.159
7.142
3i, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0 ppm
1.000
1.926
1.001
2.004
1.925

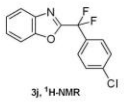

−94.026
−108.640
−108.655
−108.661
−108.673
3i, ^{19}F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm



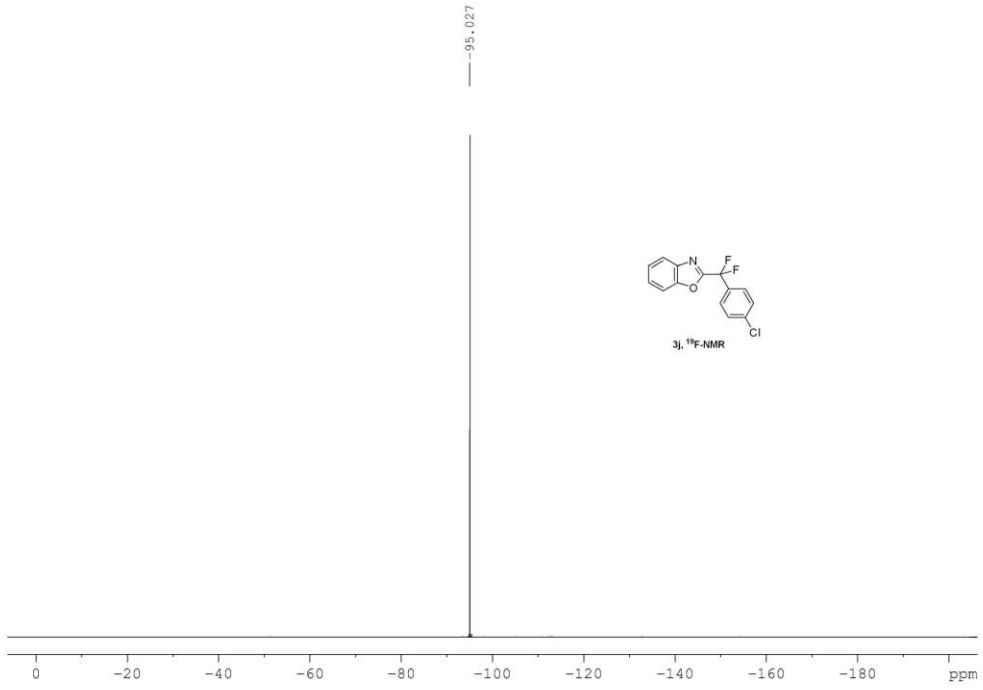


3i, ^{13}C-NMR

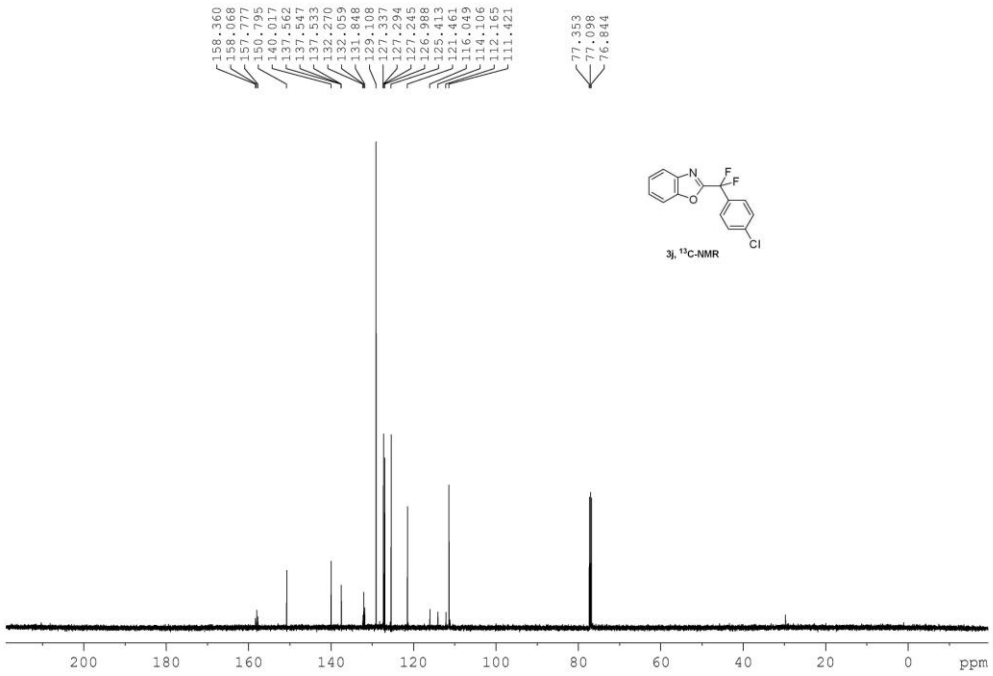




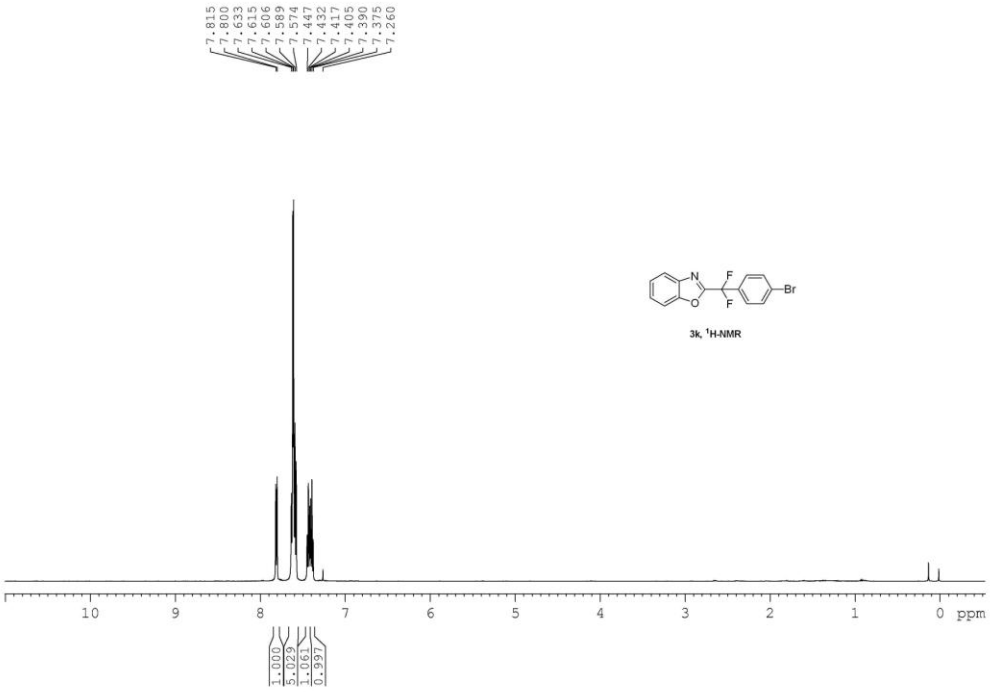
3j, ^{1}H-NMR



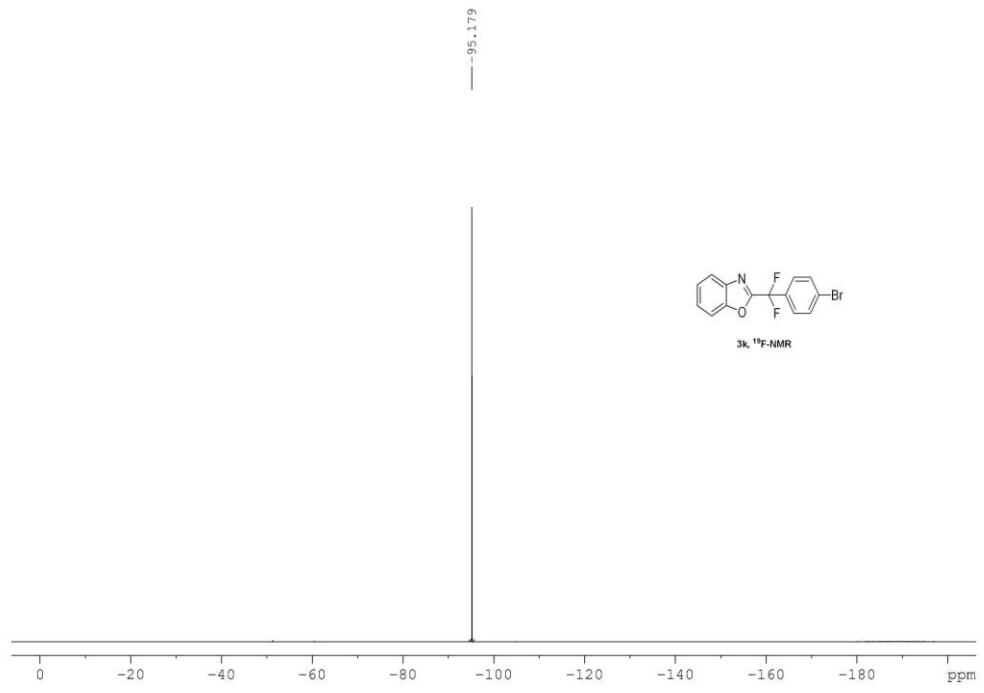
3j. ^{19}F-NMR



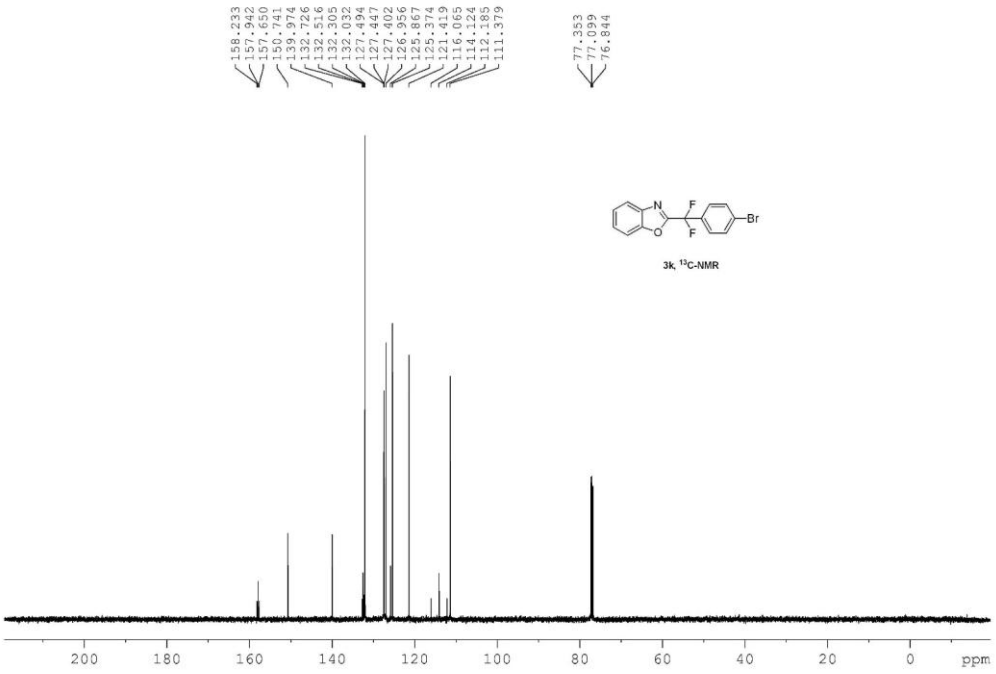
3j. ^{13}C-NMR



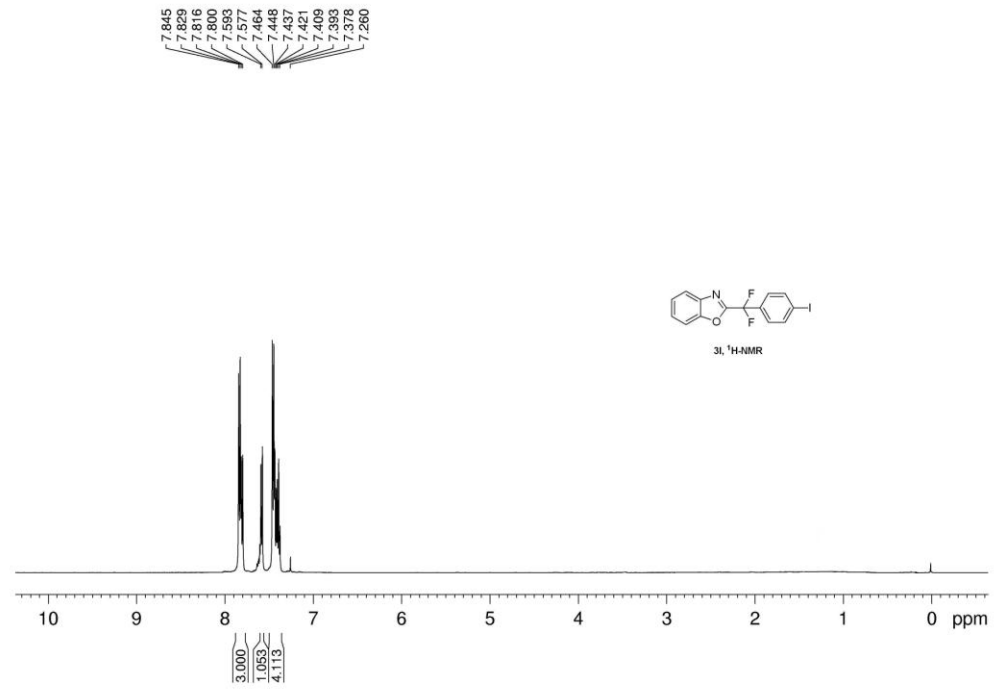
3k, ^{1}H-NMR



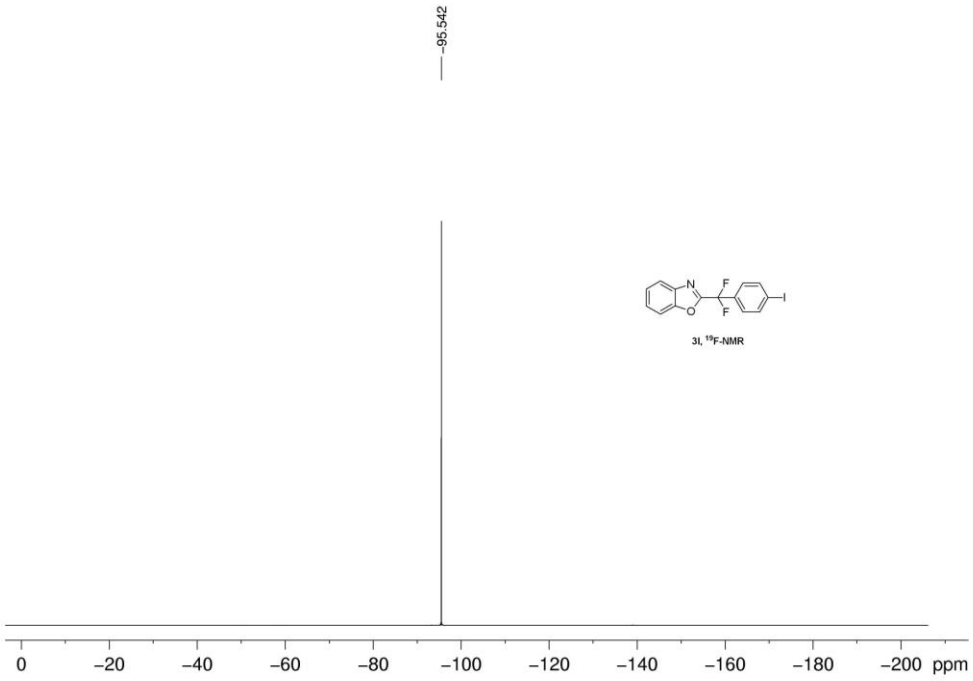
3k, ^{19}F-NMR

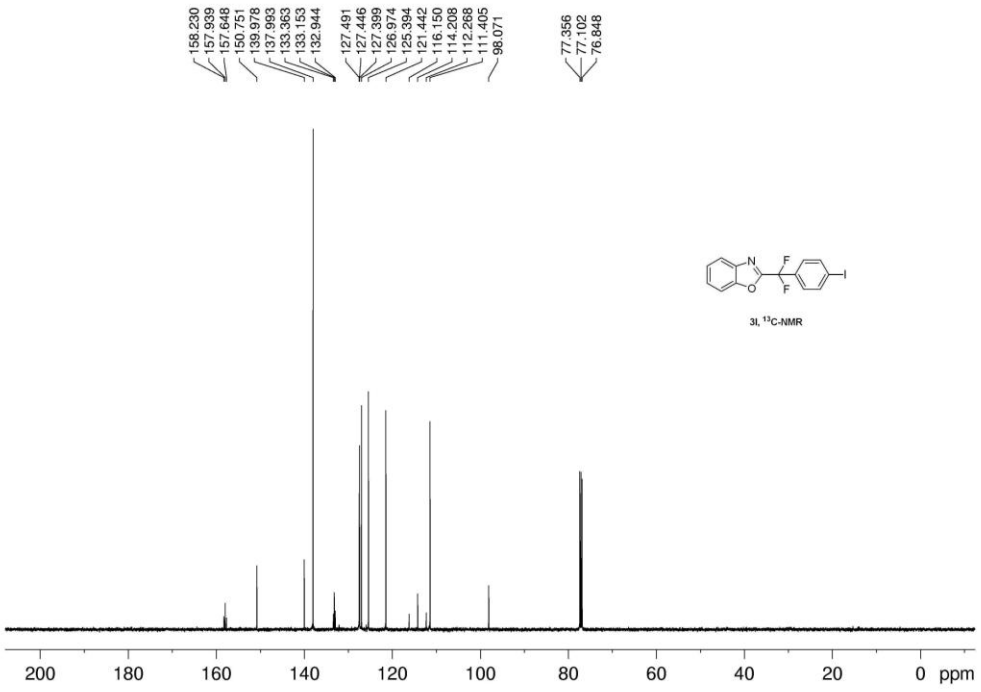


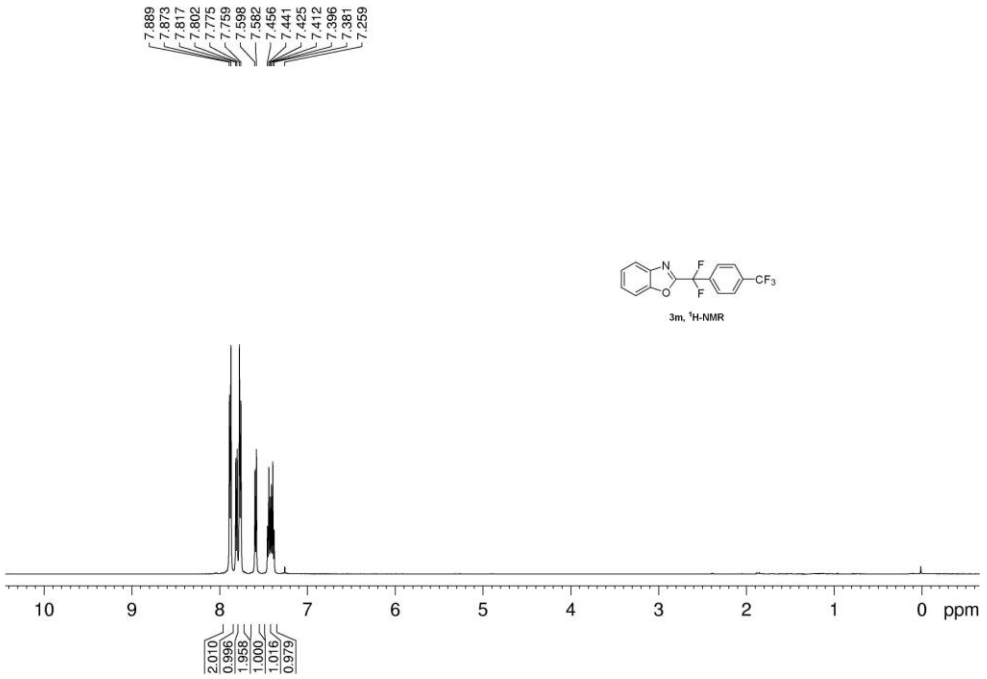
3k, ^{13}C-NMR

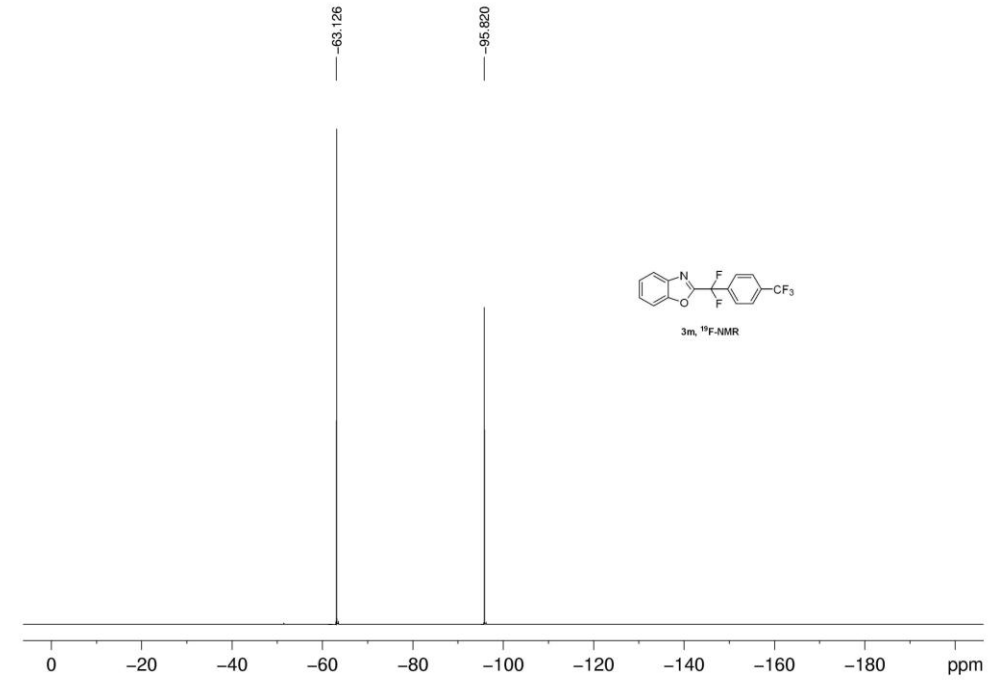


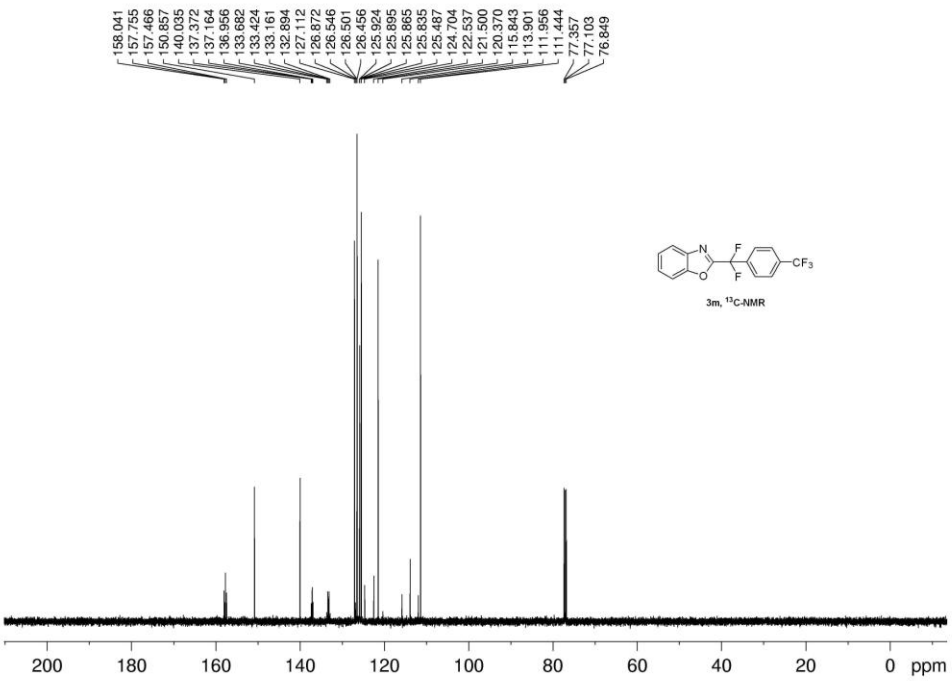
3l, ^{1}H-NMR

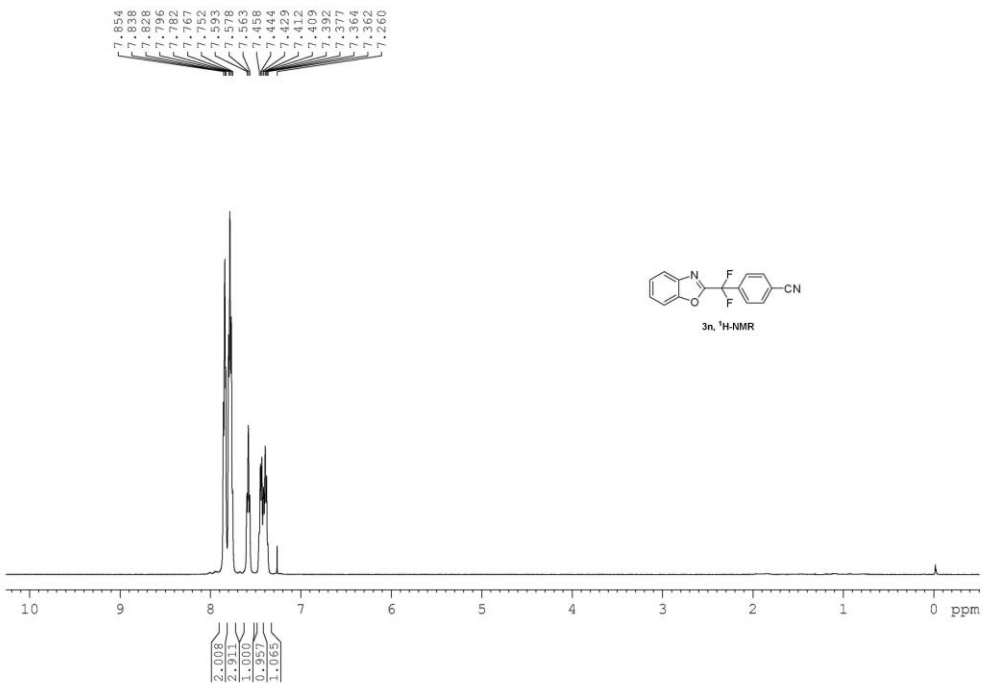

-95.542
3l, 19F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
−200 ppm

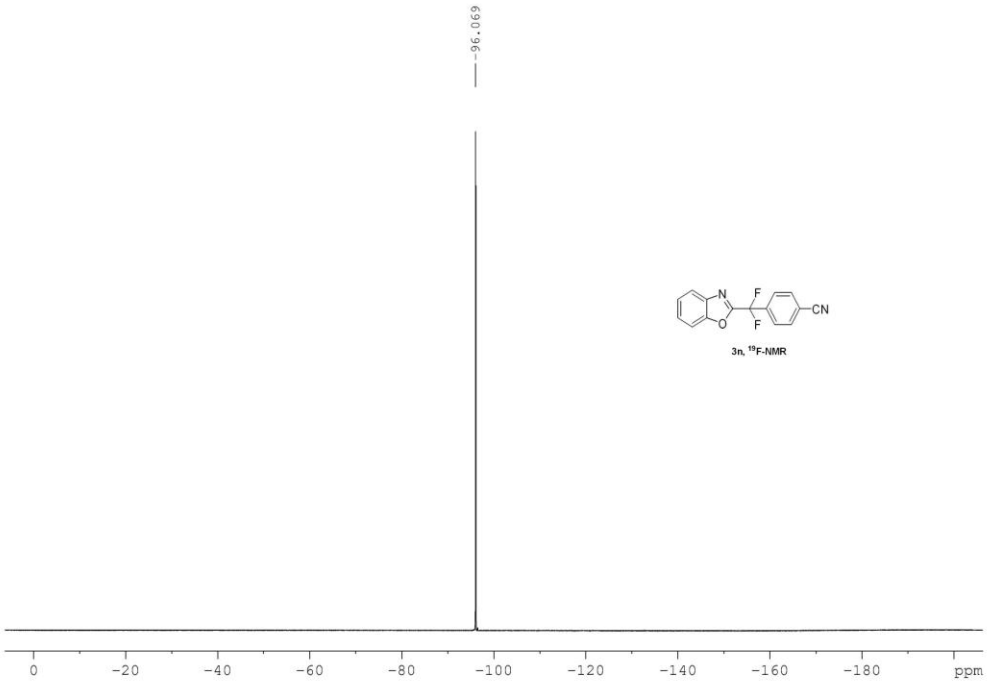

158.230
157.939
157.648
150.751
139.978
137.993
133.363
133.153
132.944
127.491
127.446
127.399
126.974
125.394
121.442
116.150
114.208
112.268
111.405
98.071
77.356
77.102
76.848
3l, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0 ppm


7.889
7.873
7.817
7.802
7.775
7.759
7.598
7.582
7.456
7.441
7.425
7.412
7.396
7.381
7.259
3m, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
2.010
0.996
1.958
1.000
1.016
0.979

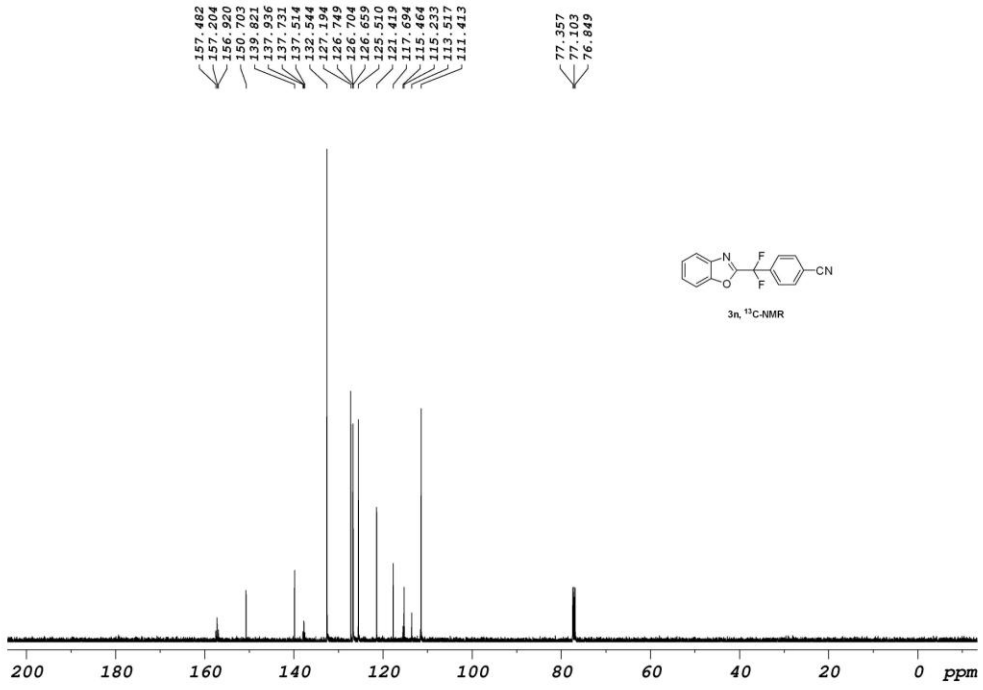

−63.126
−95.820
3m, ^{19}F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm


158.041
157.755
157.466
150.857
140.035
137.372
137.164
136.956
133.682
133.424
133.161
132.894
127.112
126.872
126.546
126.501
126.456
125.924
125.895
125.865
125.835
125.487
124.704
122.537
121.500
120.370
115.843
113.901
111.956
111.444
77.357
77.103
76.849
N
O
F
F
CF3
3m, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0 ppm

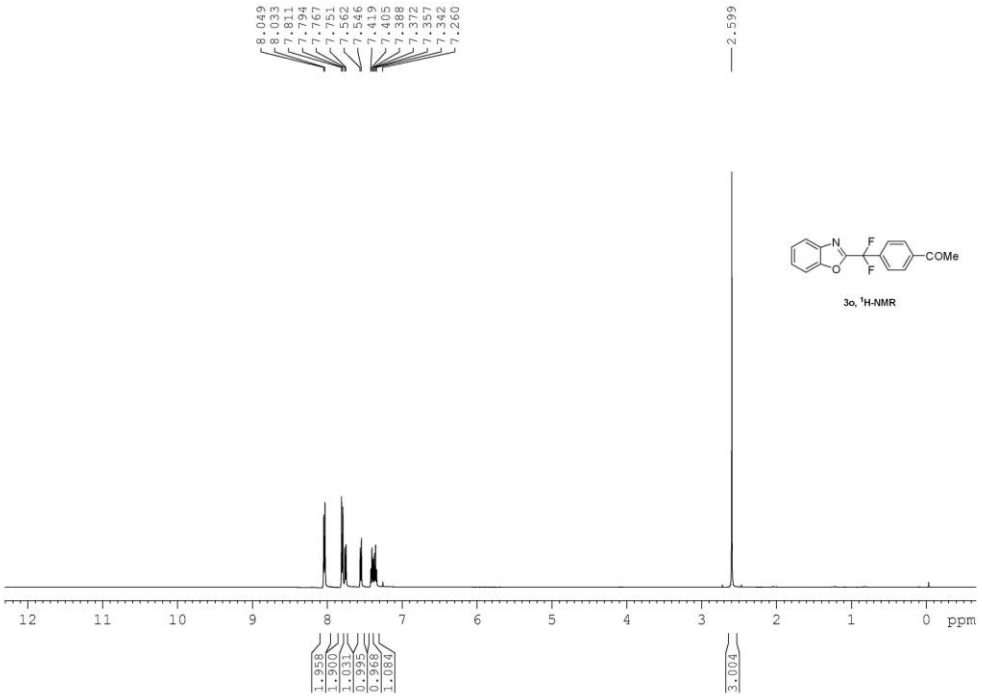

7.854
7.838
7.828
7.796
7.782
7.767
7.752
7.593
7.578
7.563
7.458
7.444
7.429
7.412
7.409
7.392
7.377
7.364
7.362
7.260
N
O
F
F
CN
3n, 1H-NMR
10
9
8
7
6
5
4
3
2
1
0 ppm
2.008
2.911
1.000
0.957
1.065

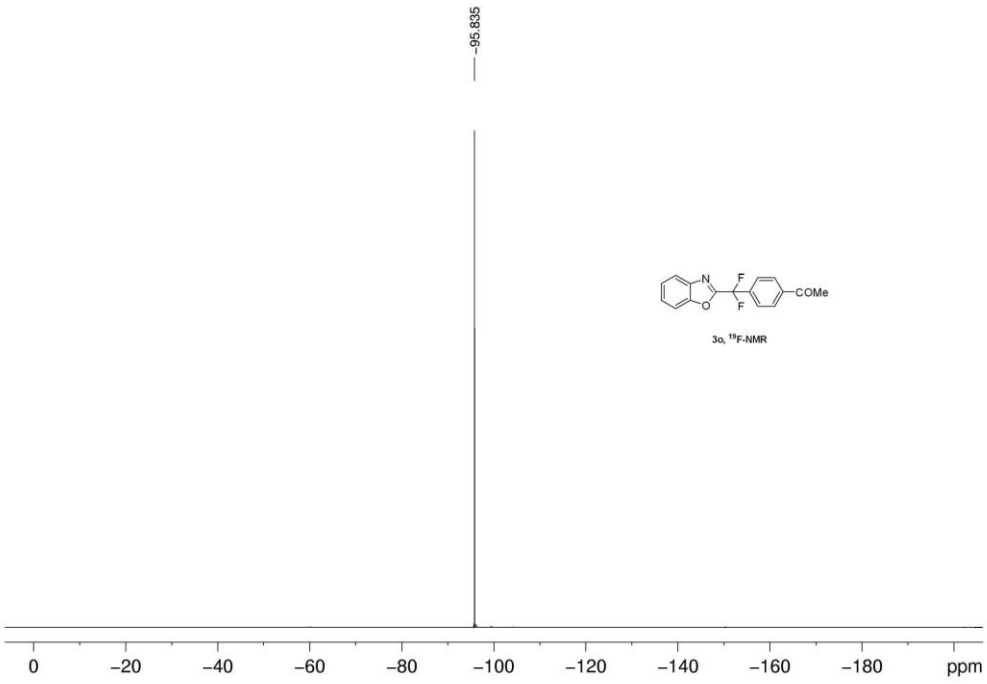


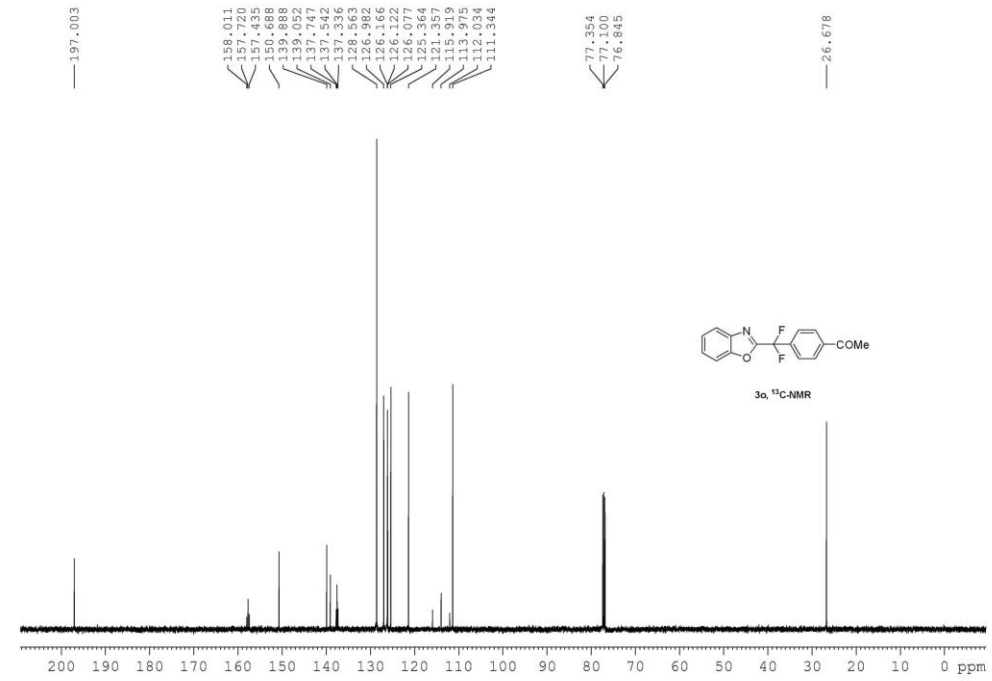
3n, ^{19}F-NMR



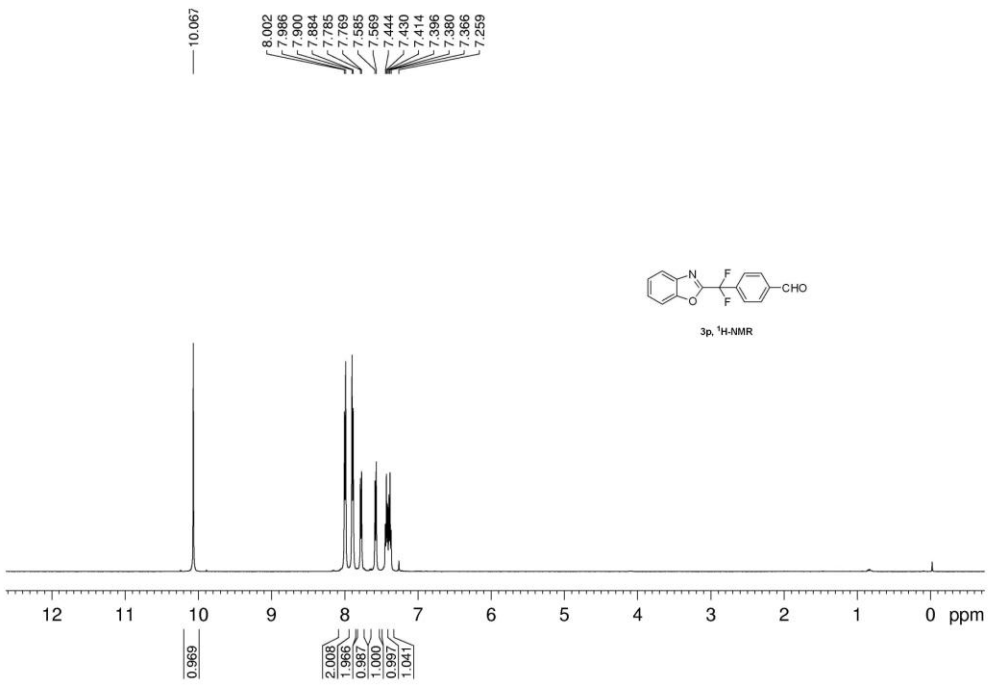
3n, ^{13}C-NMR


8.049
8.033
7.811
7.794
7.767
7.751
7.562
7.546
7.419
7.405
7.388
7.372
7.357
7.342
7.260
2.599
COMe
3o, ^{1}H-NMR
12
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.958
1.900
1.031
0.995
0.968
1.084
3.004

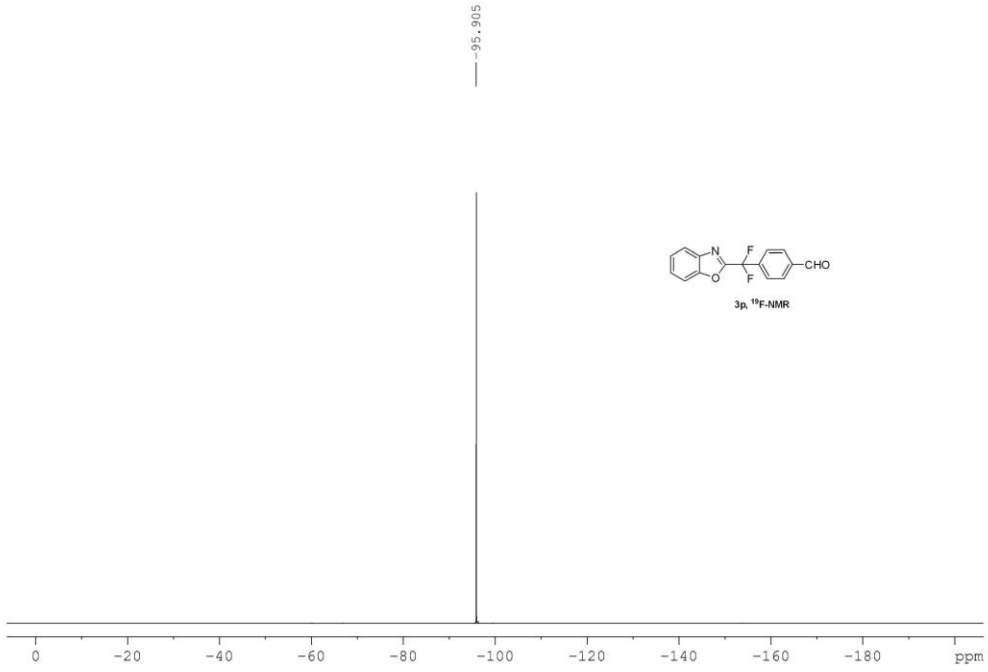

-95.835
COMe
3o, ^{19}F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm

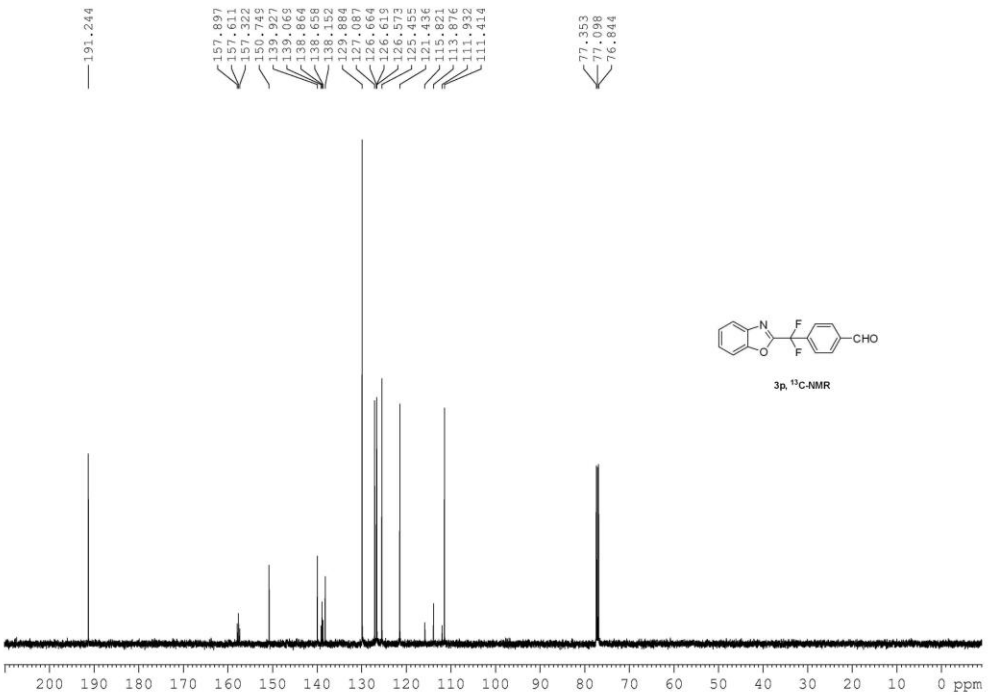


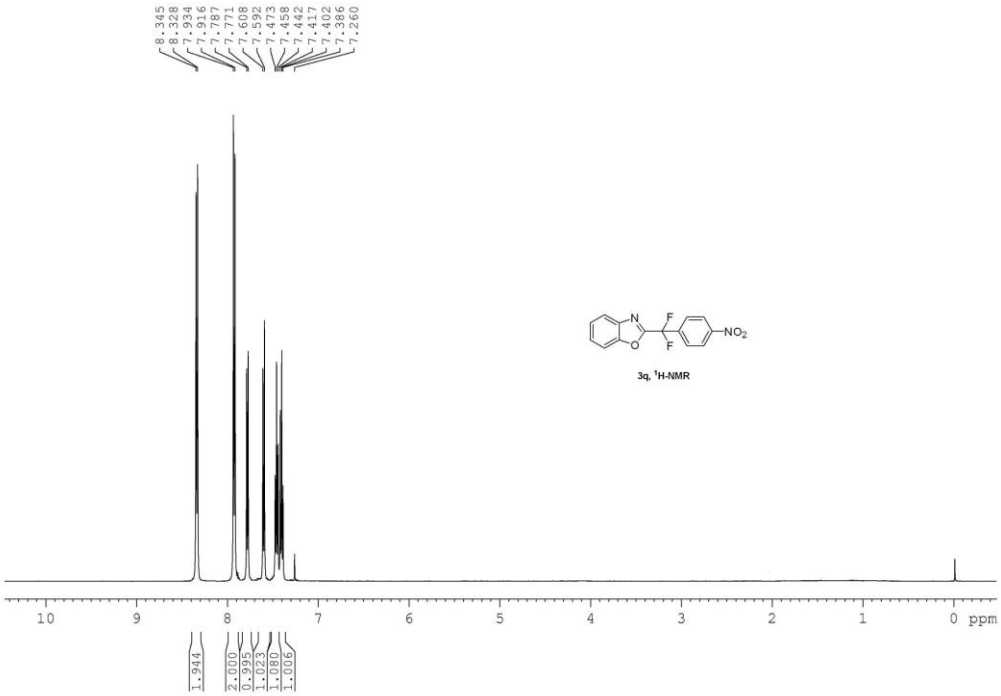
3o, ^{13}C-NMR



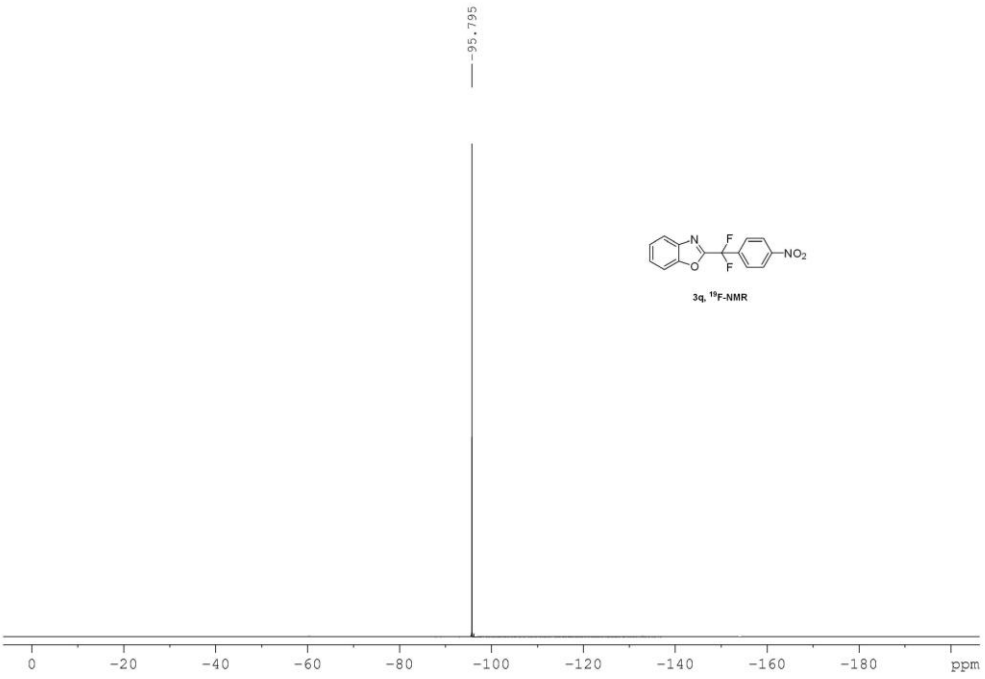
3p, ^{1}H-NMR


-95.905
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm
3p, ^{19}F-NMR

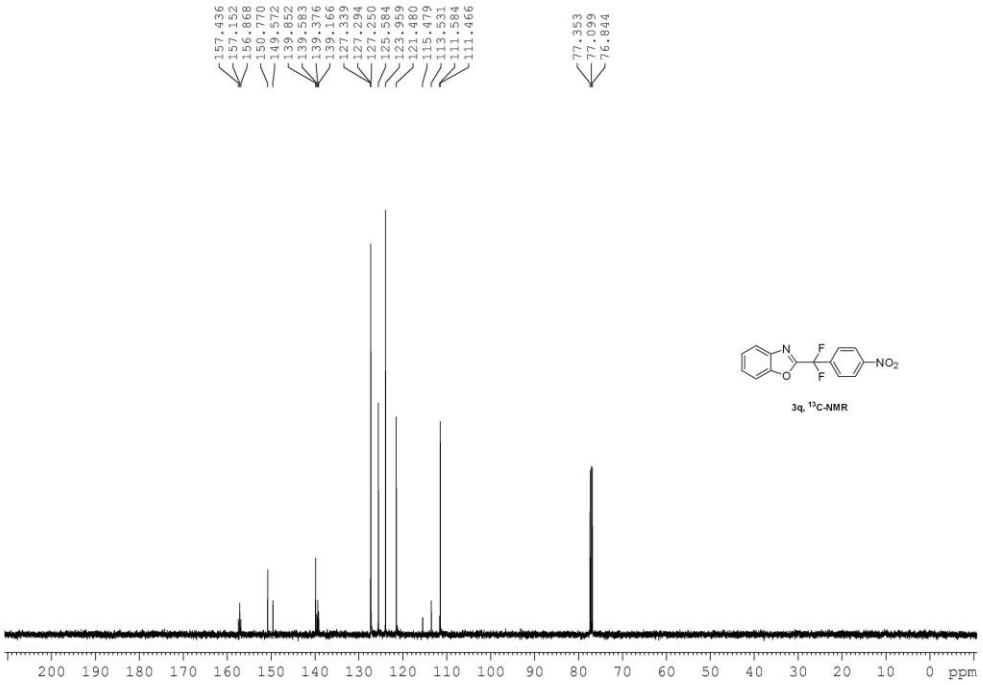

191.244
157.897
157.611
157.322
150.749
139.927
139.069
138.864
138.658
138.152
129.884
127.087
126.664
126.619
126.573
125.455
121.436
115.821
113.876
111.932
111.414
77.353
77.098
76.844
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm
3p, ^{13}C-NMR



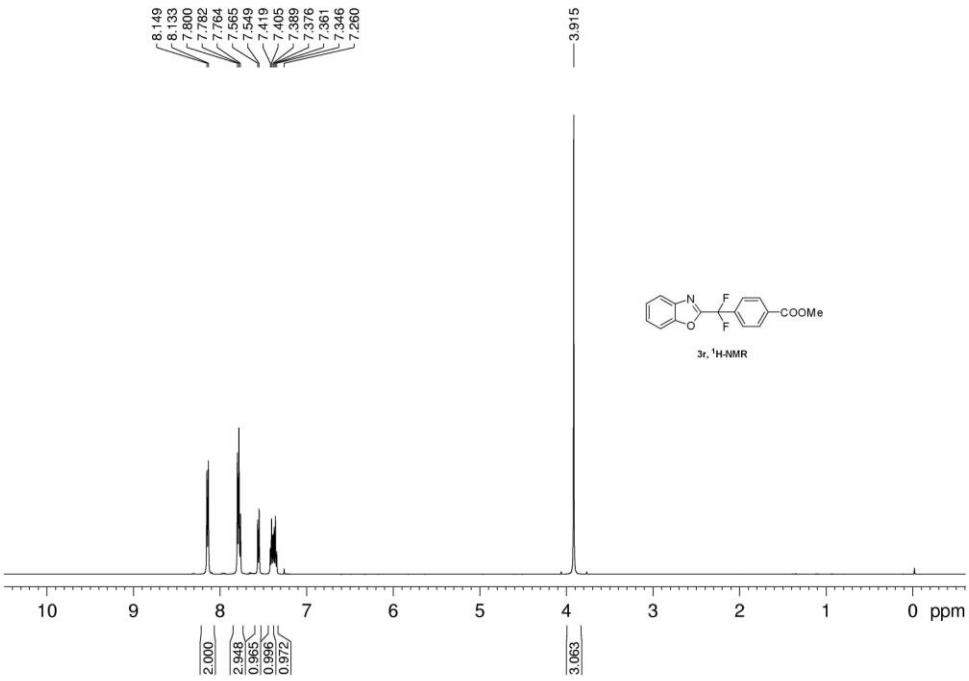
3q, ^{1}H-NMR



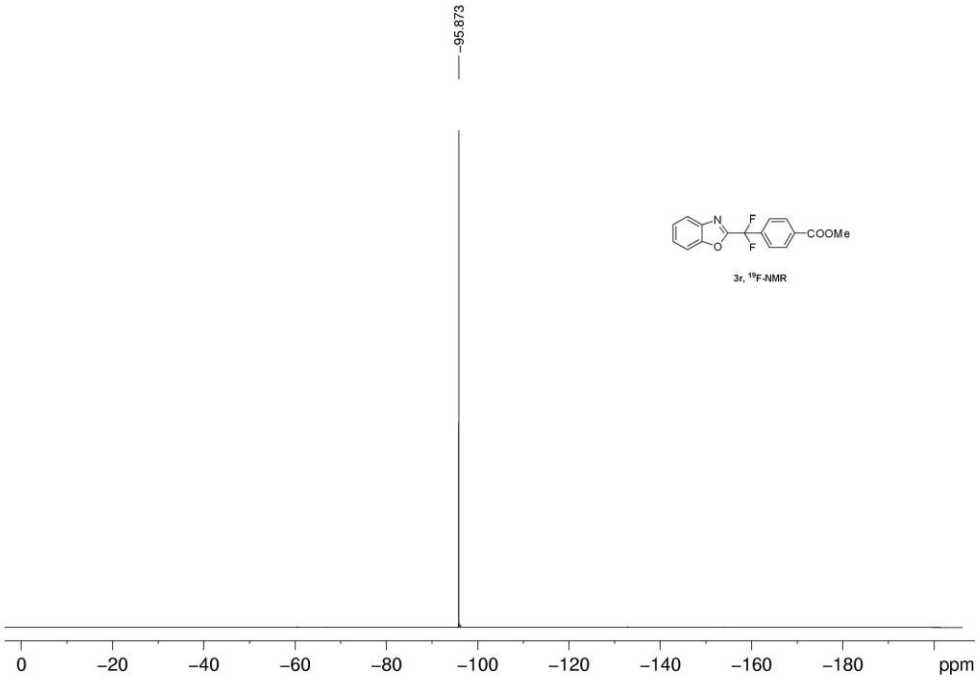
3q, ^{19}F-NMR

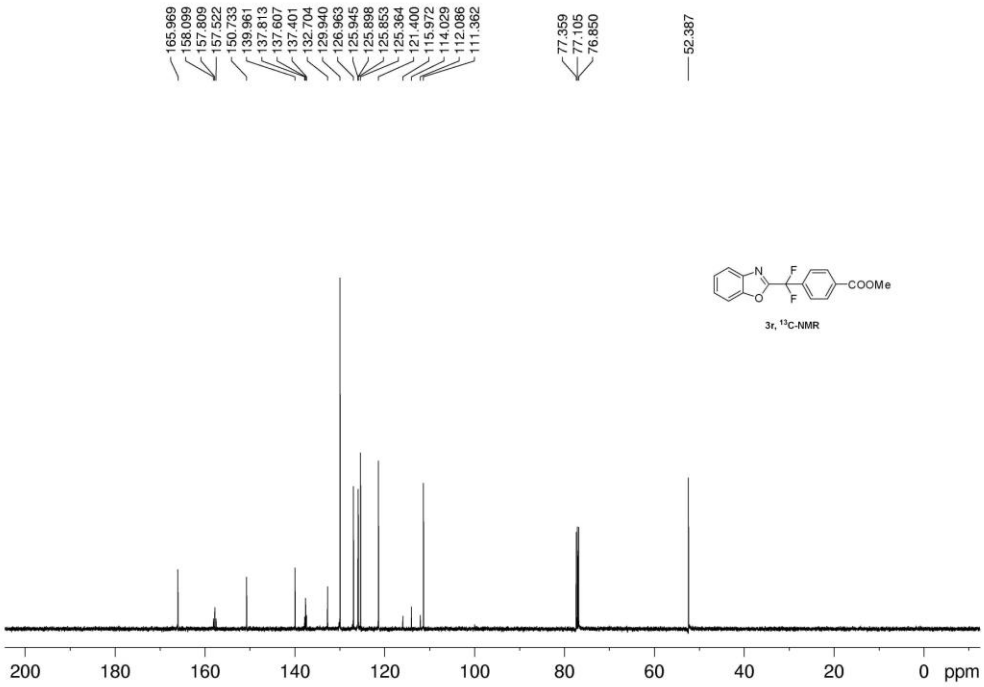


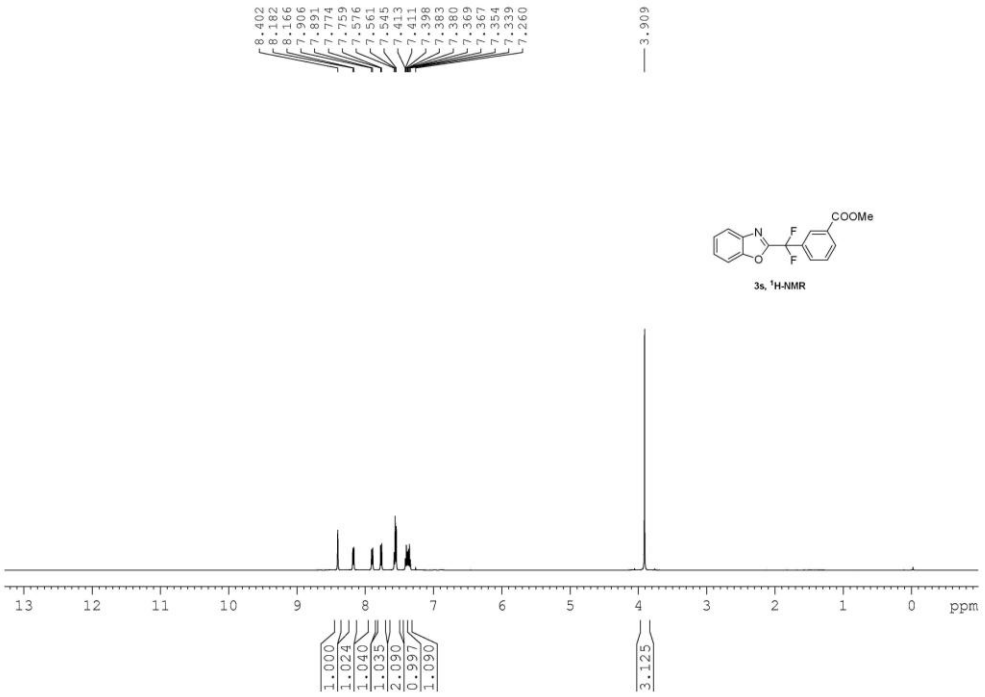
3q, ^{13}C-NMR

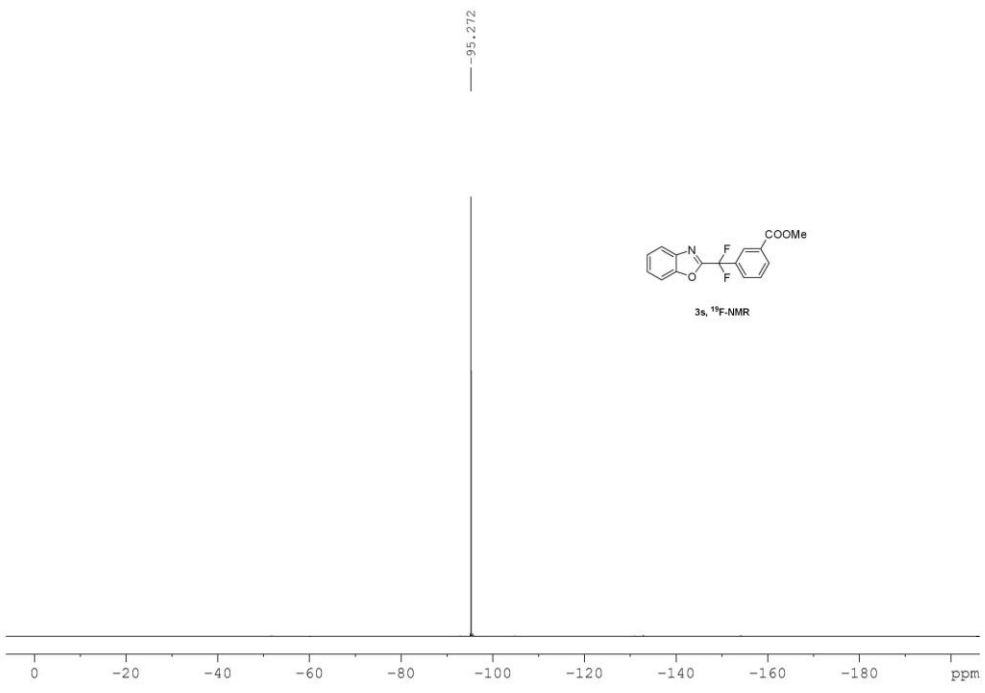


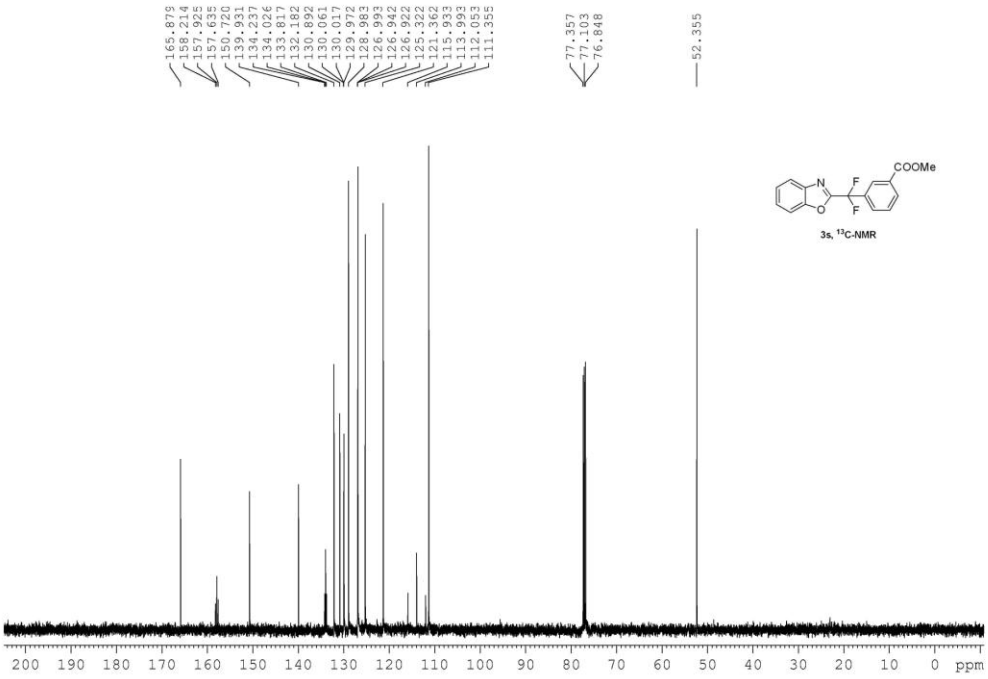
3r, ^{1}H-NMR

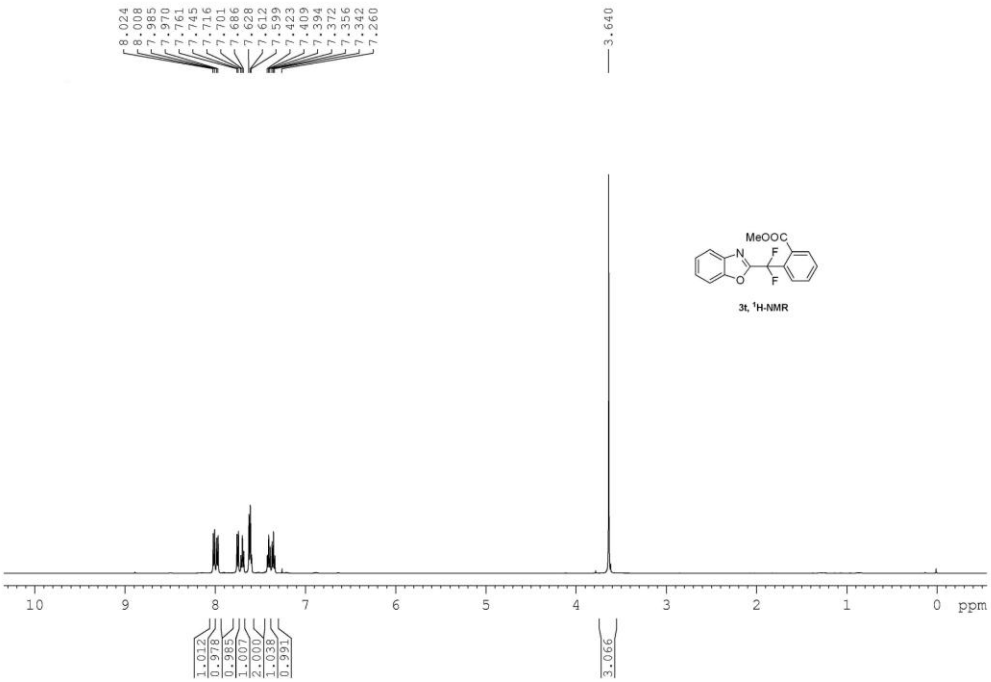

-95.873
COOMe
3r, 19F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm

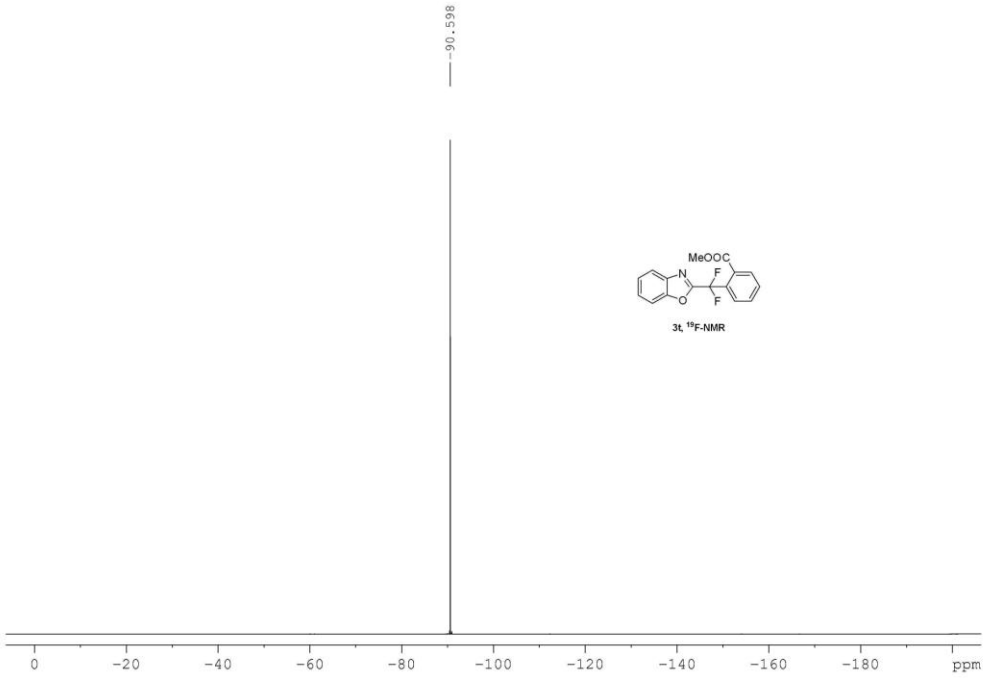

165.969
158.099
157.809
157.522
150.733
139.961
137.813
137.607
137.401
132.704
129.940
126.963
125.945
125.898
125.853
125.364
121.400
115.972
114.029
112.086
111.362
77.359
77.105
76.850
52.387
COOMe
3r, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm

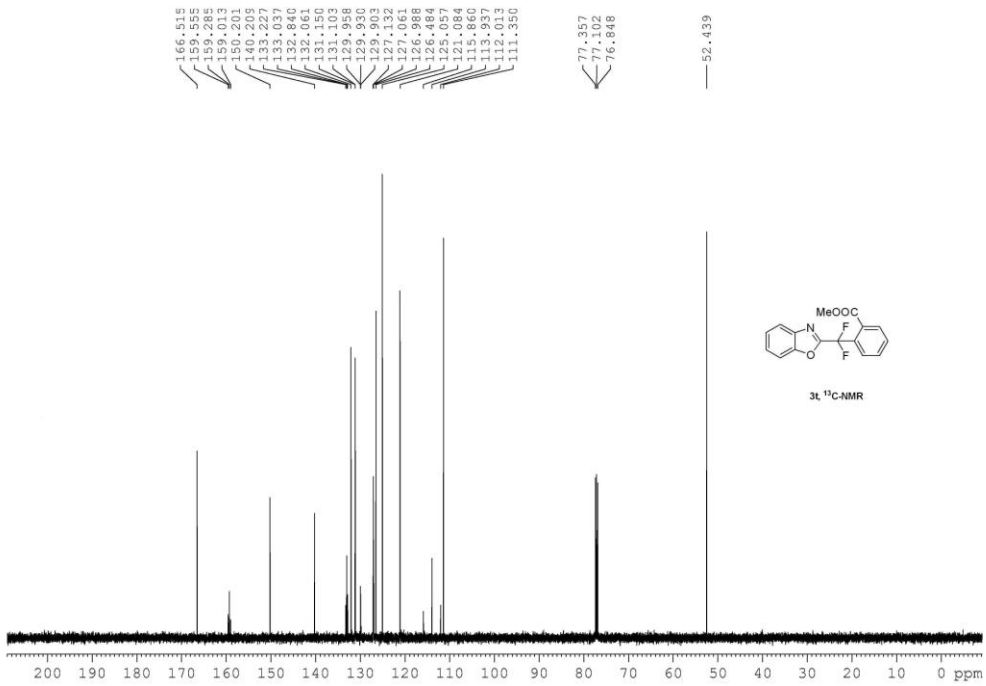

8.402
8.182
8.166
7.906
7.891
7.774
7.759
7.576
7.561
7.545
7.413
7.411
7.398
7.383
7.380
7.369
7.367
7.354
7.339
7.260
3.909
COOMe
N
O
F
F
3s, ^{1}H-NMR
13
12
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.000
1.024
1.040
1.035
2.090
0.997
1.090
3.125

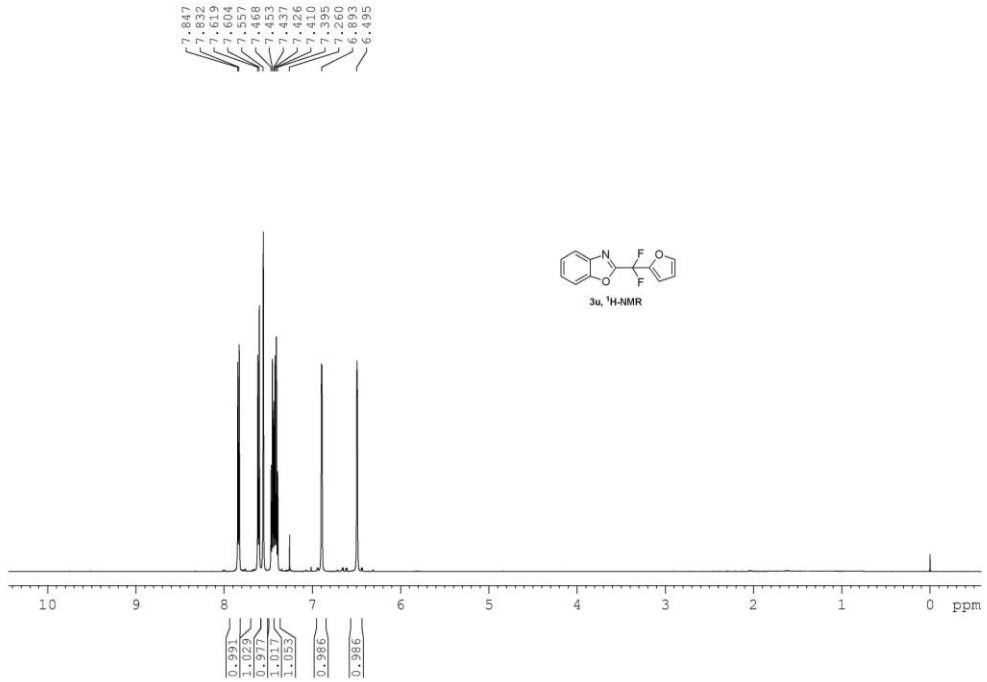

-95.272
COOMe
N
O
F
F
3s, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

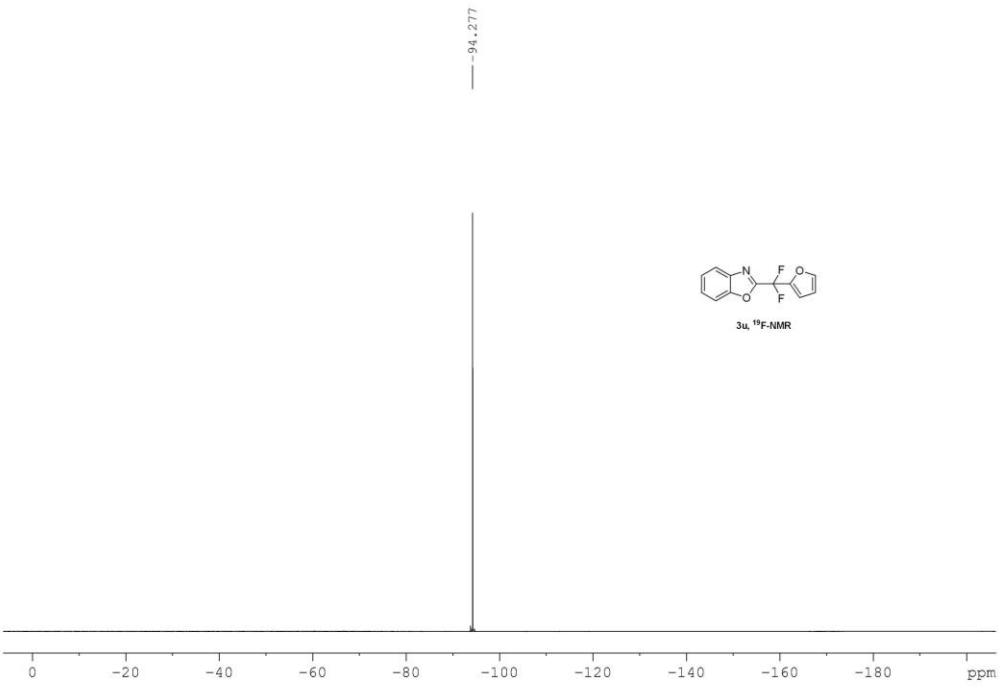

165.879
159.214
157.925
150.780
139.931
134.237
134.026
133.817
132.182
130.892
130.061
130.017
129.972
128.983
126.993
126.942
126.922
125.322
121.362
115.933
113.993
112.053
111.355
77.357
77.103
76.848
52.355
COOMe
F
F
N
O
3s, 13C-NMR
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

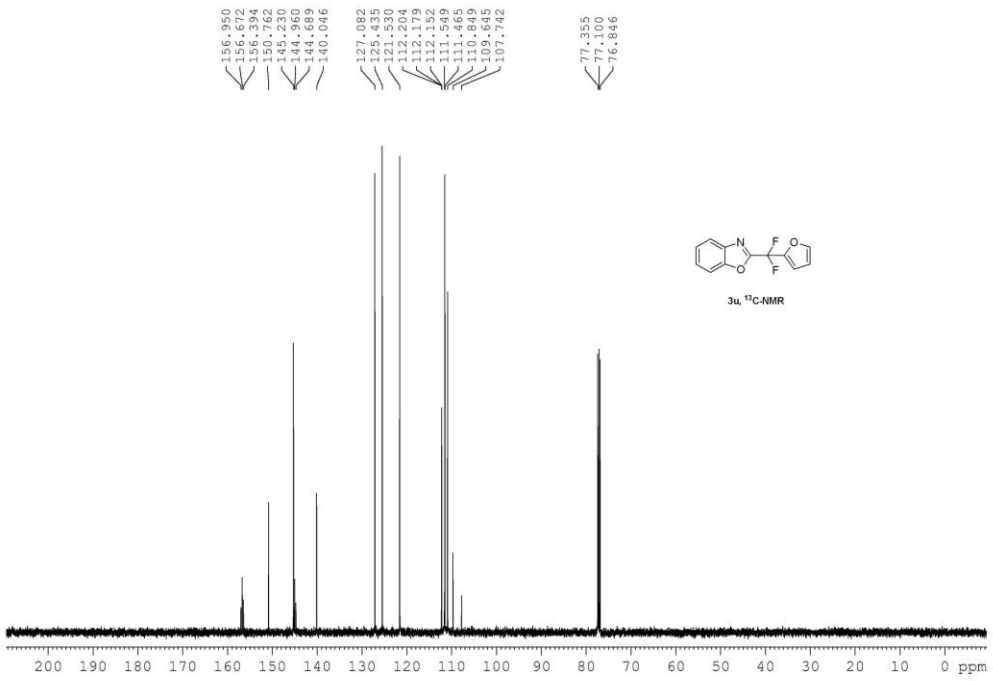

8.024
8.008
7.985
7.970
7.761
7.745
7.716
7.701
7.686
7.628
7.612
7.599
7.423
7.409
7.394
7.372
7.356
7.342
7.260
3.640
MeOOC
F
F
N
O
3t, 1H-NMR
10 9 8 7 6 5 4 3 2 1 0 ppm
1.012
0.978
0.985
1.007
2.000
1.038
0.991
3.066


-90.598
MeOOC
F
F
3t, 19F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

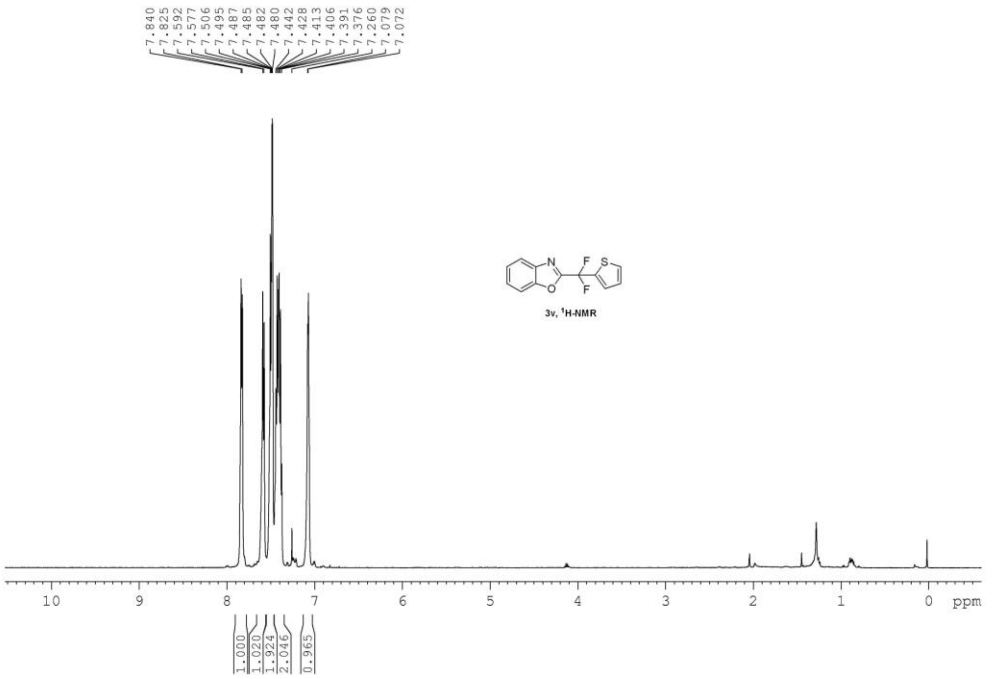

166.515
159.555
159.285
150.013
150.201
140.205
133.227
133.037
132.840
132.061
131.150
131.103
129.958
129.930
129.903
127.132
127.061
126.988
126.484
125.057
121.084
115.860
113.937
112.013
111.350
77.357
77.102
76.848
52.439
MeOOC
F
F
3t, 13C-NMR
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm


7.847
7.832
7.619
7.604
7.557
7.468
7.453
7.437
7.426
7.410
7.395
7.260
6.893
6.495
3u, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
0.991
1.029
0.977
1.017
1.053
0.986
0.986

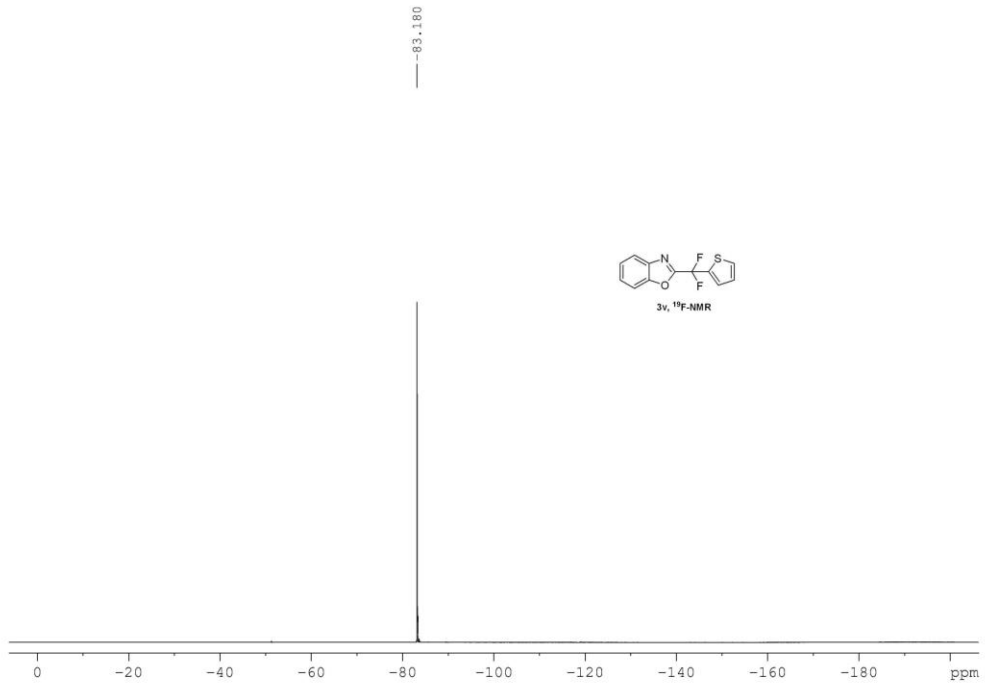

-94.277
3u, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

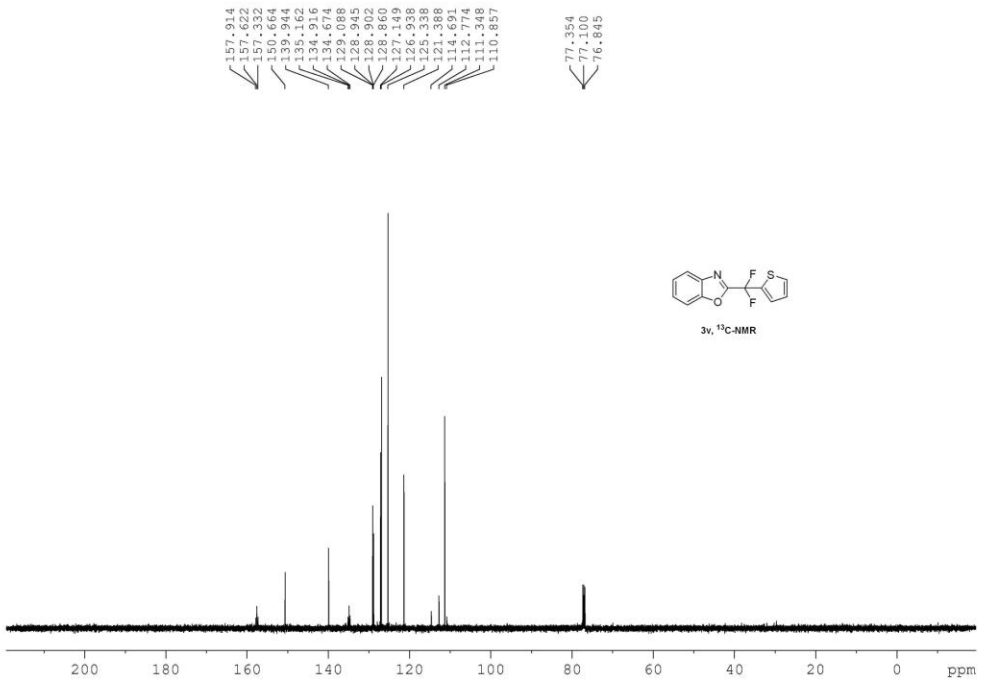


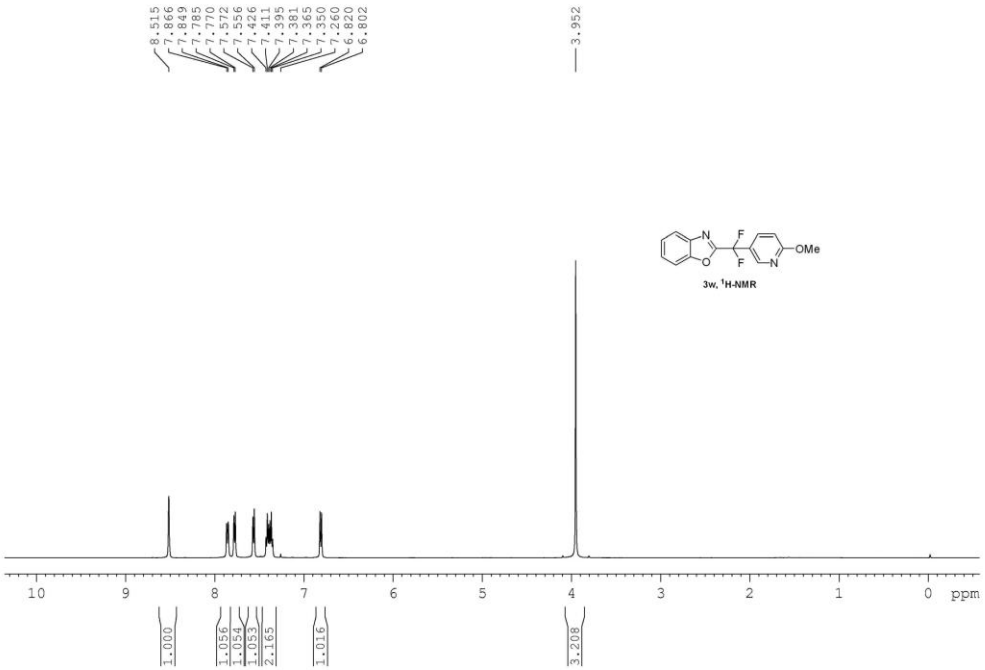
3u, ^{13}C-NMR

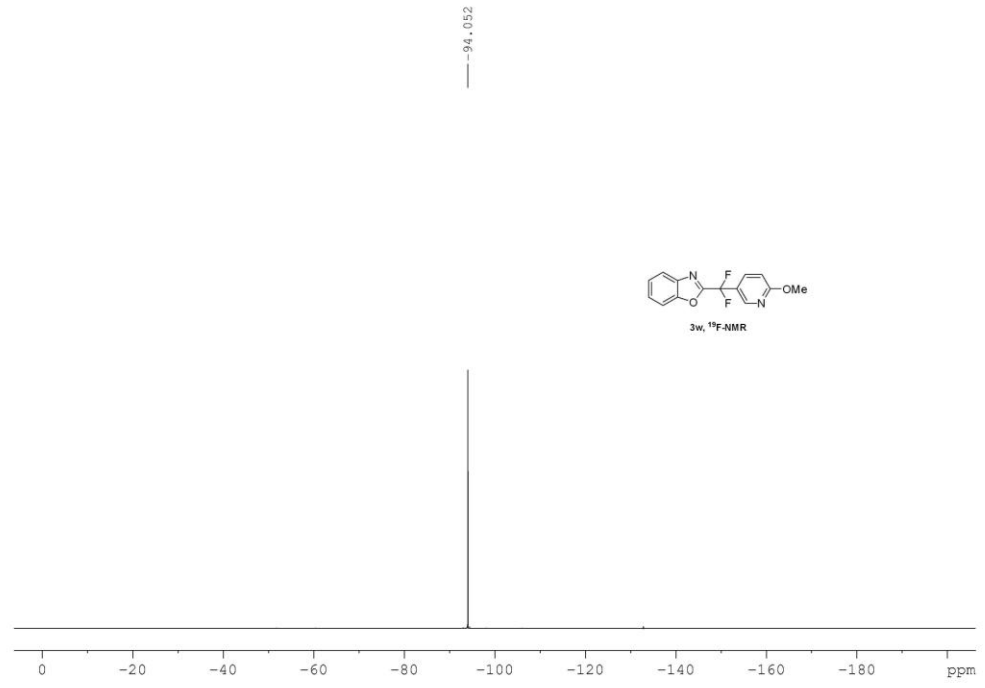


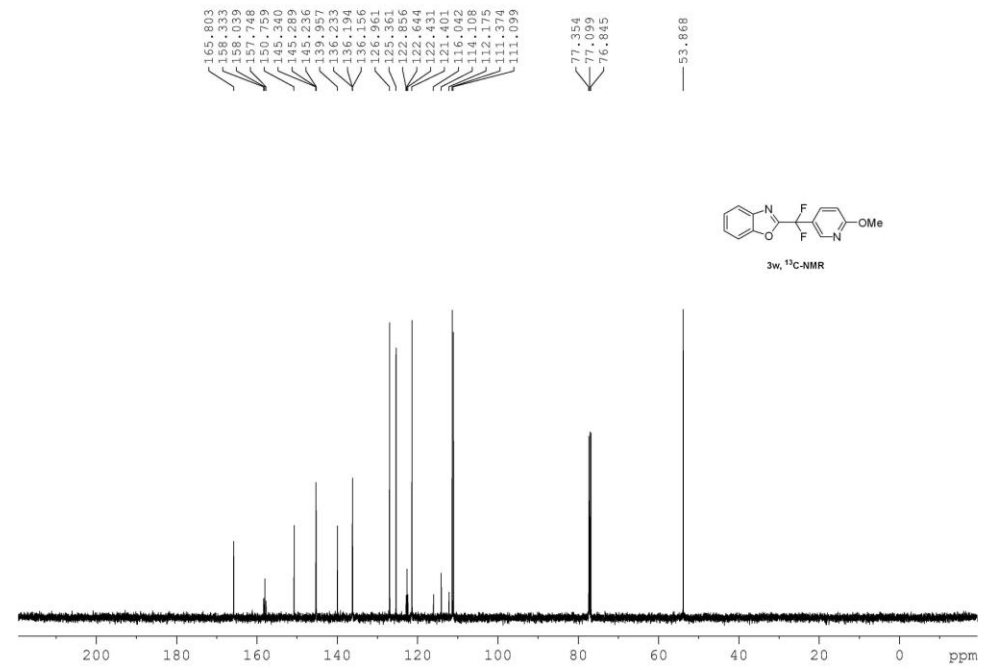
3v, ^{1}H-NMR


-83.180
3v, 19F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

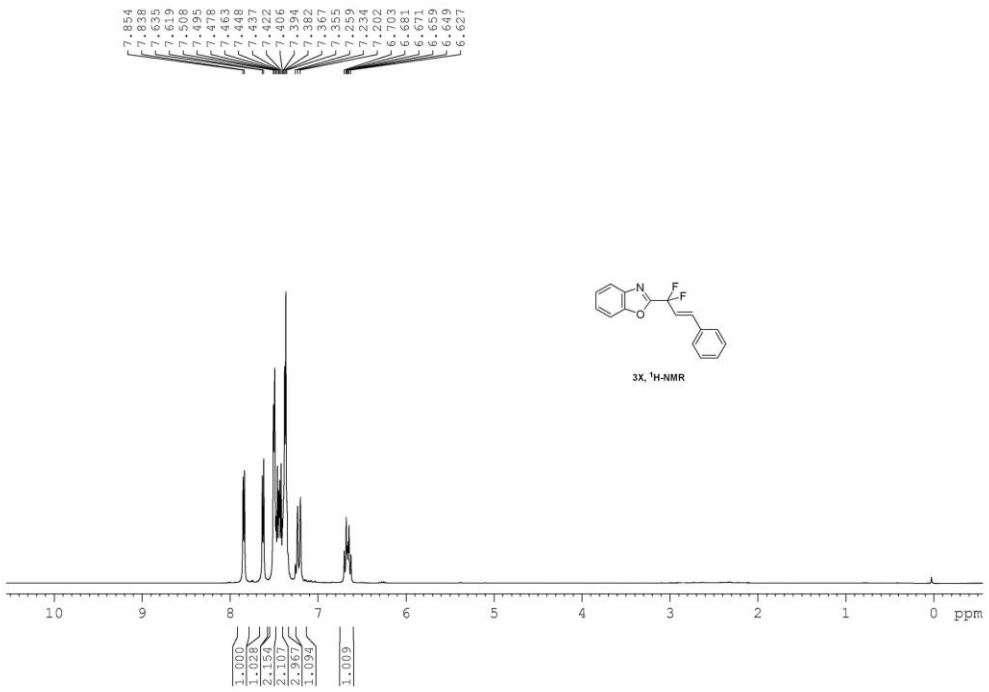

157.914
157.622
157.332
150.664
139.944
135.162
134.916
134.674
129.088
128.945
128.902
128.860
127.149
126.938
125.338
121.388
114.691
112.774
111.348
110.857
77.354
77.100
76.845
3v, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm


8.515
7.866
7.849
7.785
7.770
7.572
7.556
7.426
7.411
7.395
7.381
7.365
7.350
7.260
6.820
6.802
3.952
OMe
3w, 1H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
1.000
1.056
1.054
1.053
2.165
1.016
3.208

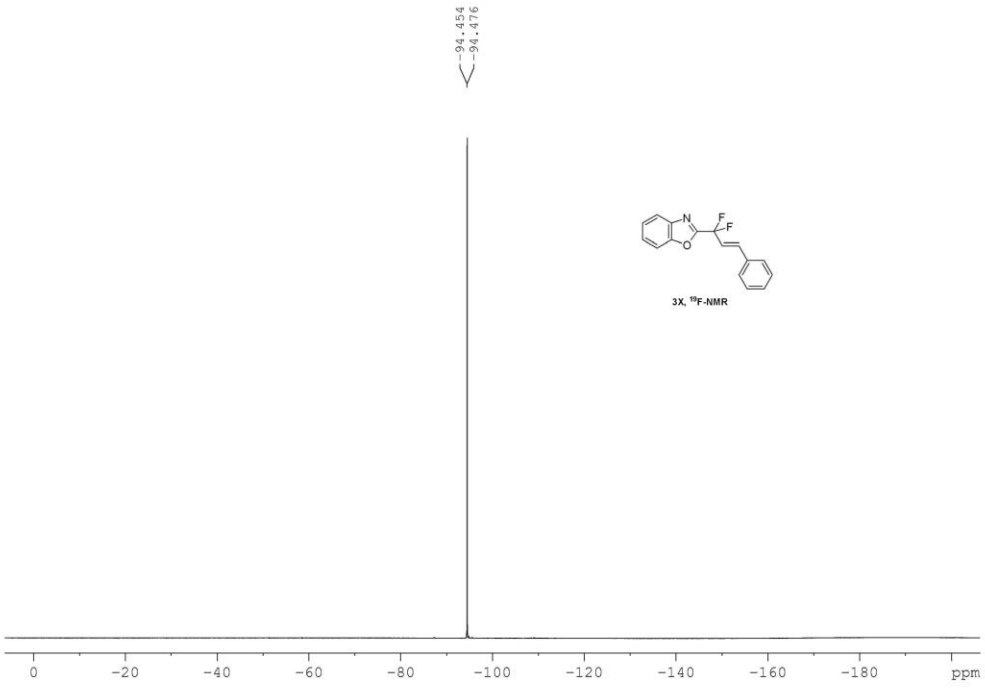

-94.052
OMe
3w, 19F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

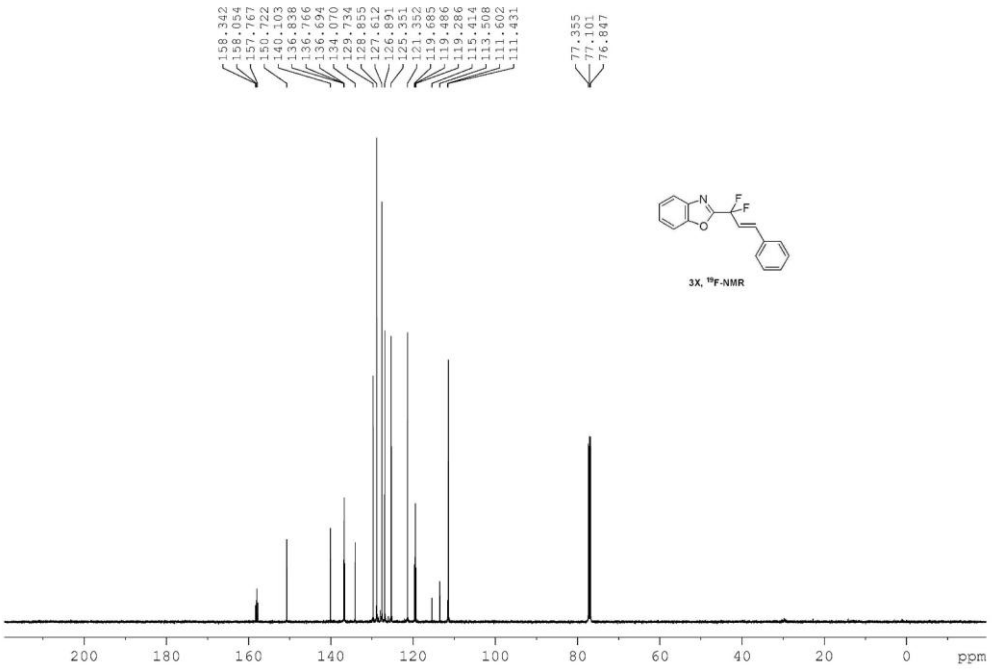


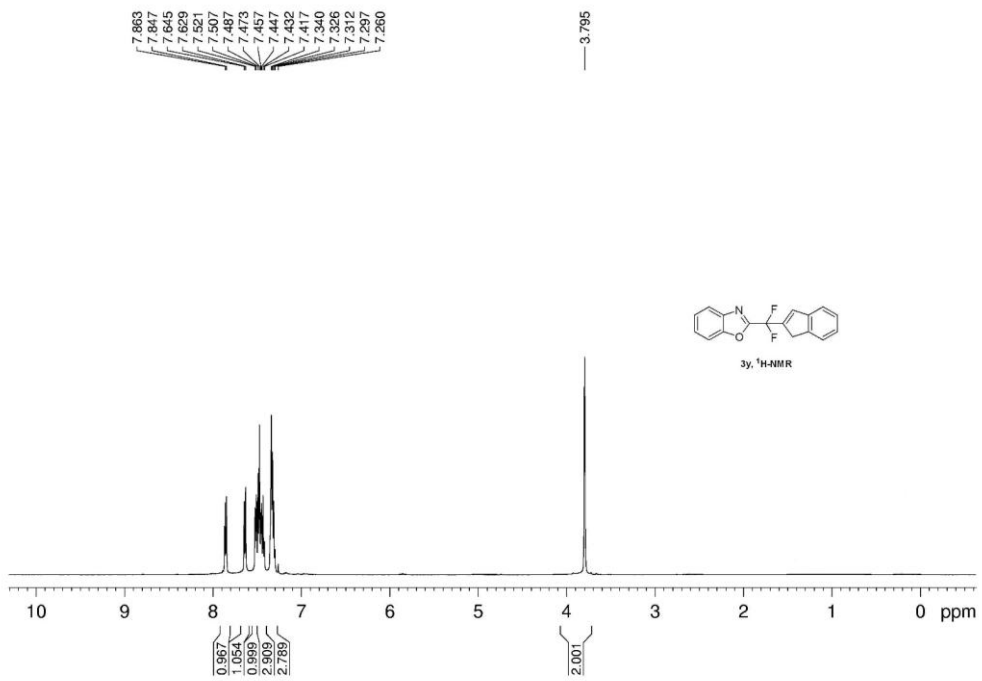
3w, ^{13}C-NMR

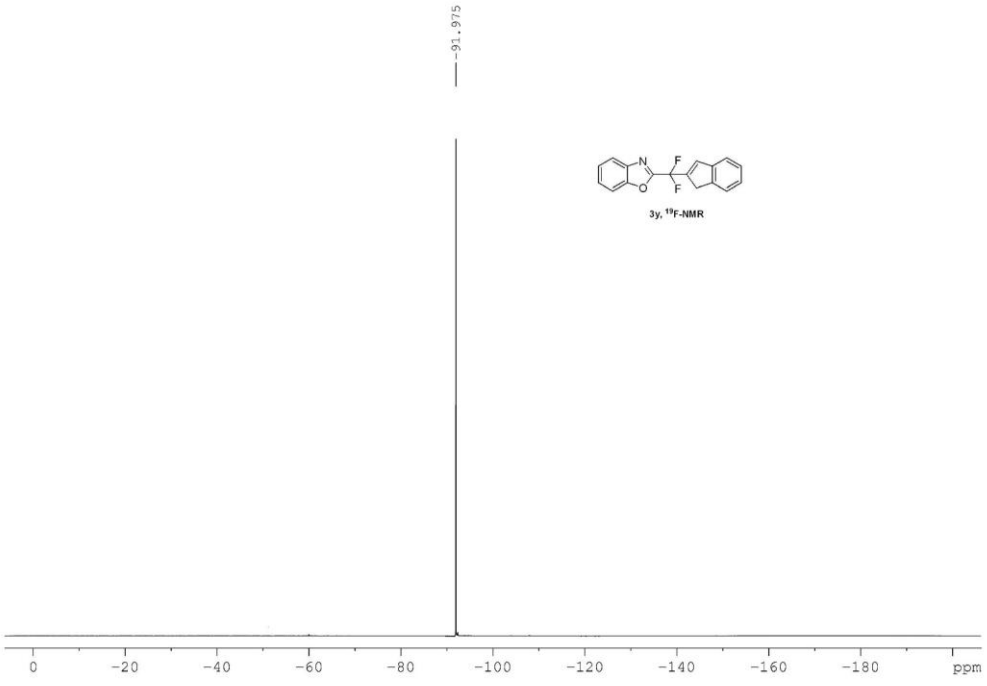


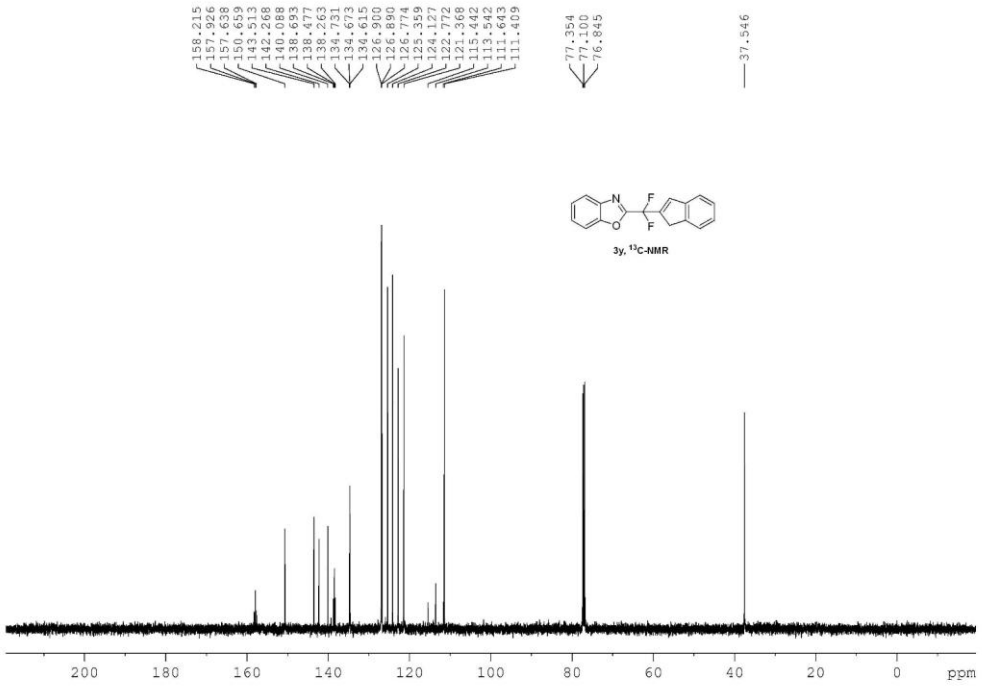
3X, ^{1}H-NMR

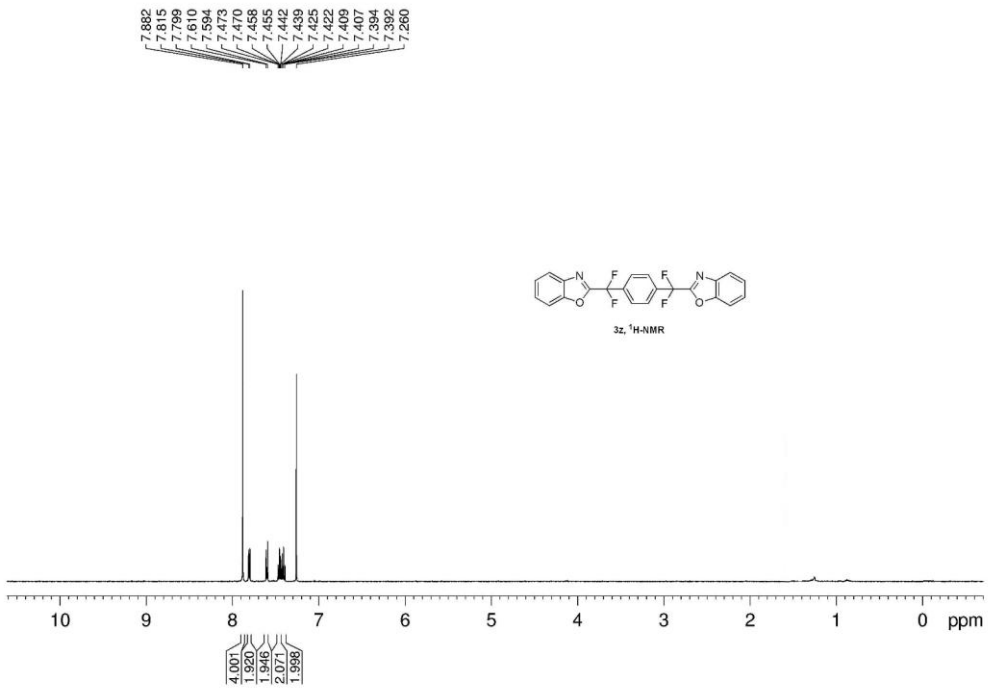

-94.454
-94.476
3X, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

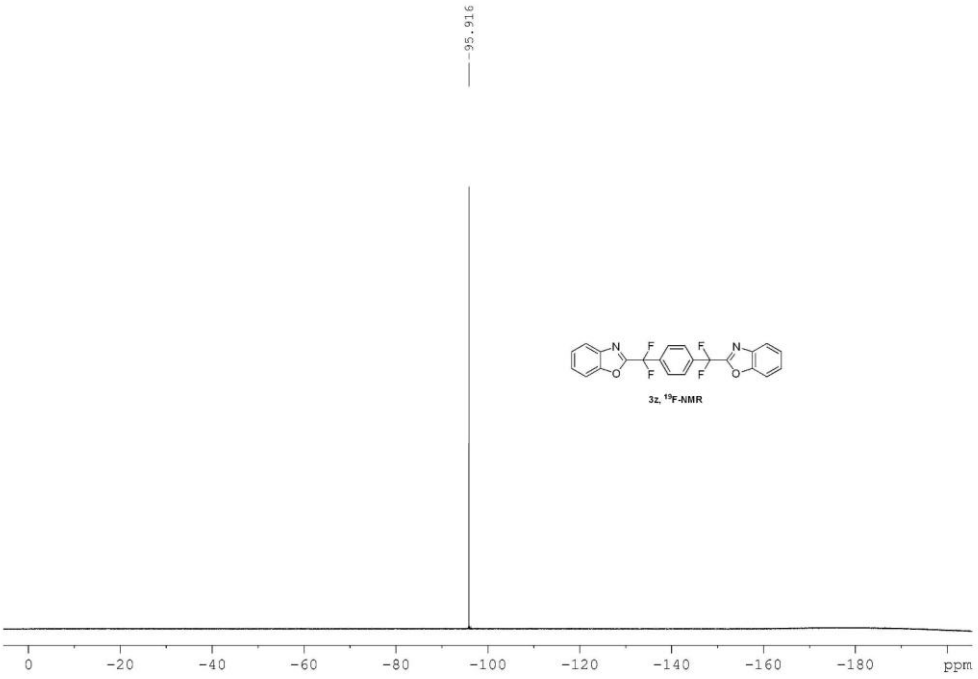

158.342
158.054
157.767
150.722
140.103
136.838
136.766
136.694
134.070
129.734
128.855
127.612
126.891
125.351
121.352
119.685
119.486
119.286
115.414
113.508
111.602
111.431
77.355
77.101
76.847
3X, ^{19}F-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm


7.863
7.847
7.645
7.629
7.521
7.507
7.487
7.473
7.457
7.447
7.432
7.417
7.340
7.326
7.312
7.297
7.260
3.795
3y, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0 ppm
0.967
1.054
0.999
2.909
2.789
2.001

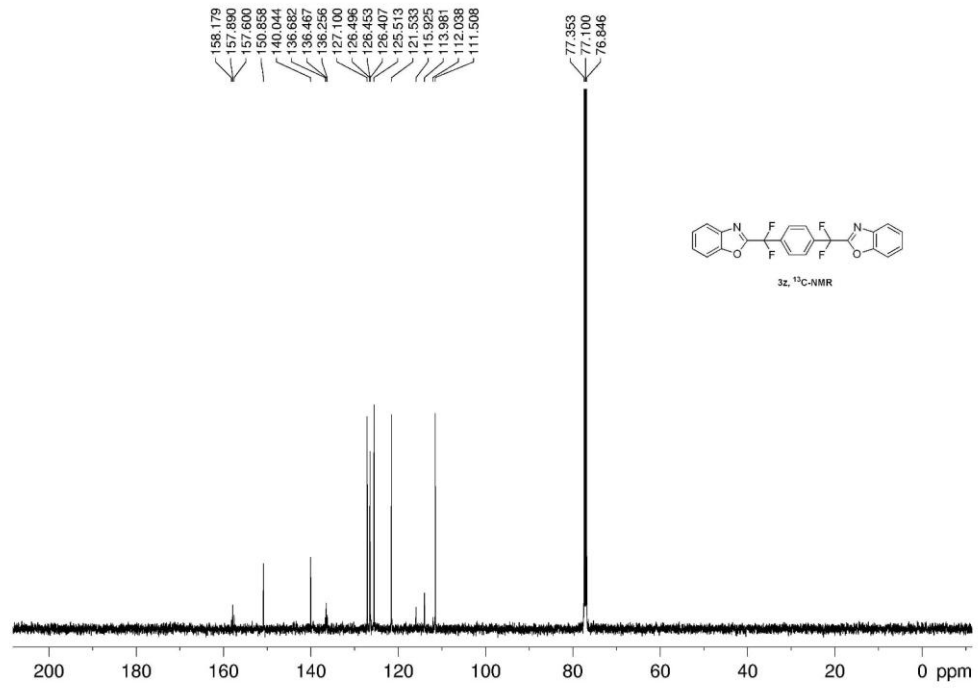

-91.975
3y, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


158.215
157.926
157.638
150.659
143.513
142.268
140.088
138.693
138.477
138.263
134.731
134.673
134.615
126.900
126.790
126.774
125.359
124.127
122.772
122.368
113.442
113.242
111.643
111.409
77.354
77.100
76.845
37.546
3y, 13C-NMR
200
180
160
140
120
100
80
60
40
20
0
ppm

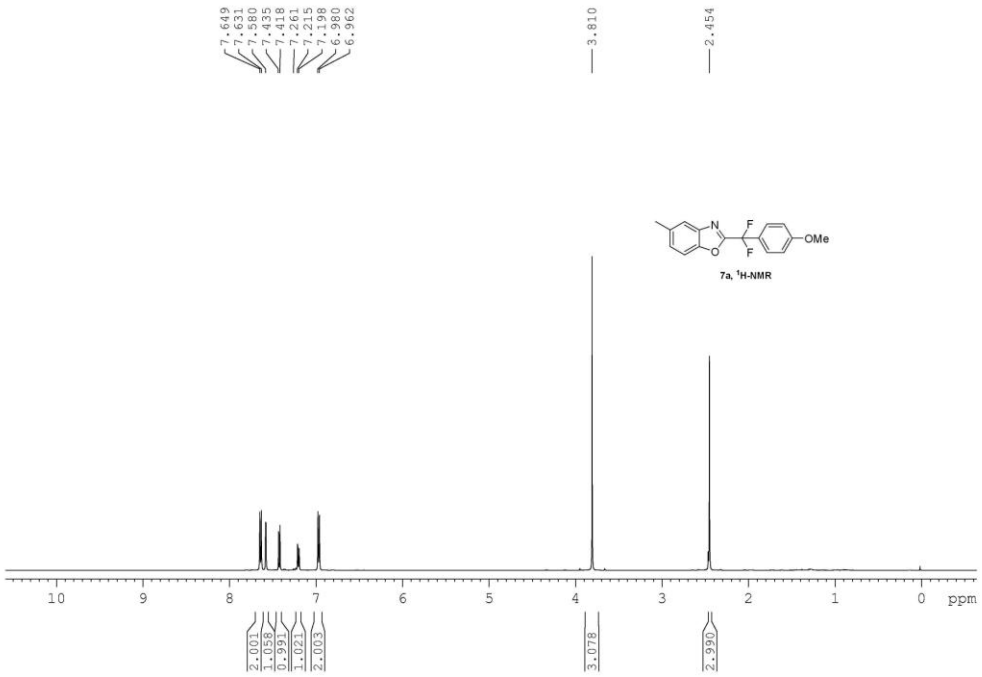

7.882
7.815
7.799
7.610
7.594
7.473
7.470
7.458
7.455
7.442
7.439
7.425
7.422
7.409
7.407
7.394
7.392
7.260
3z, 1H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
4.001
1.920
1.946
2.071
1.998

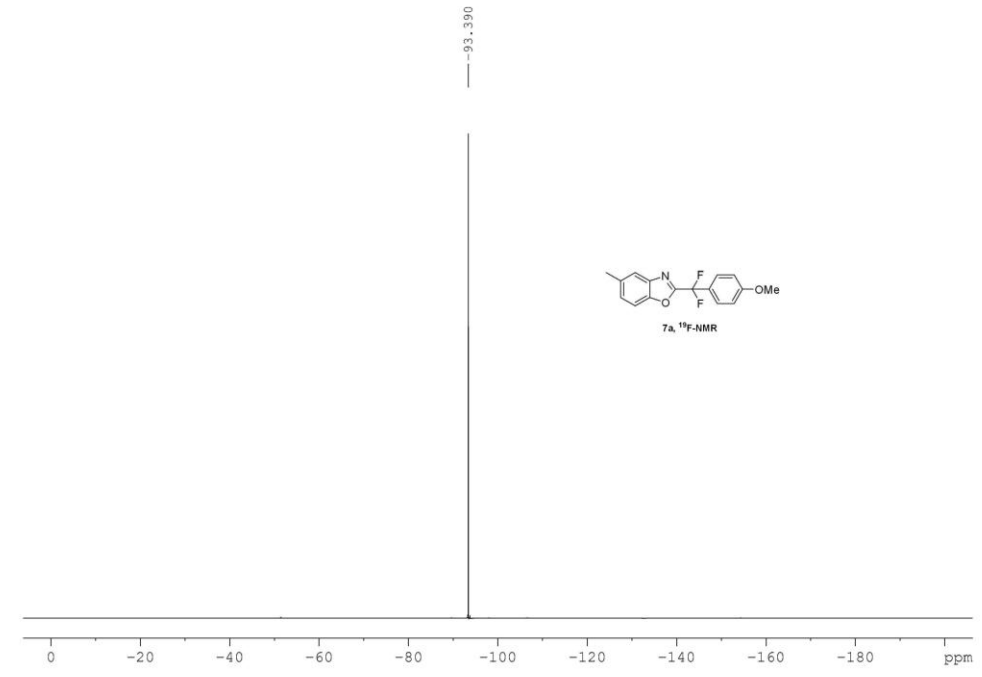


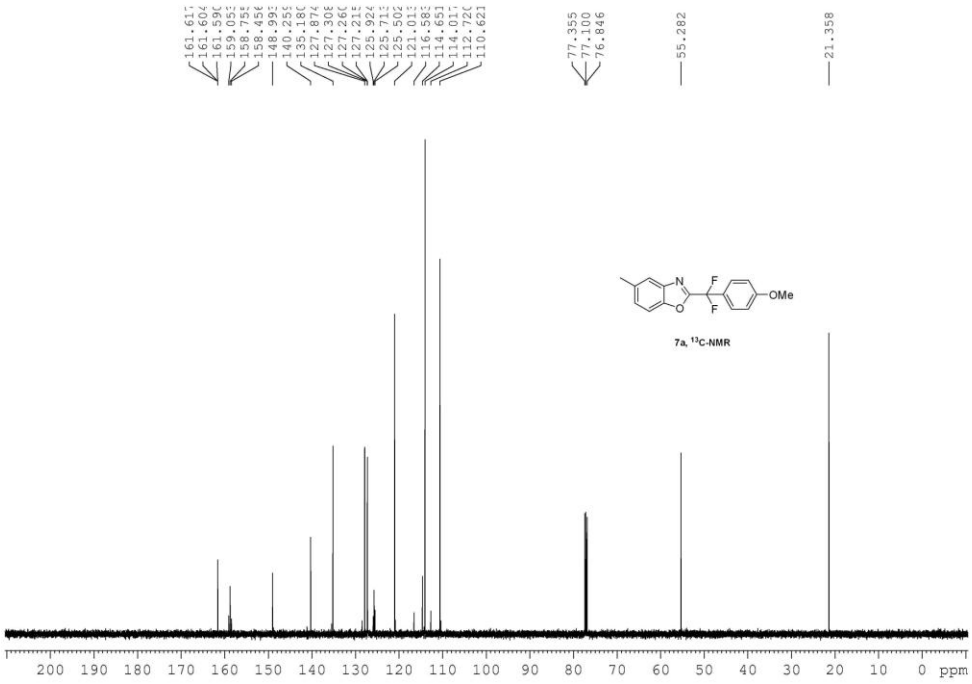
3z, ^{19}F-NMR



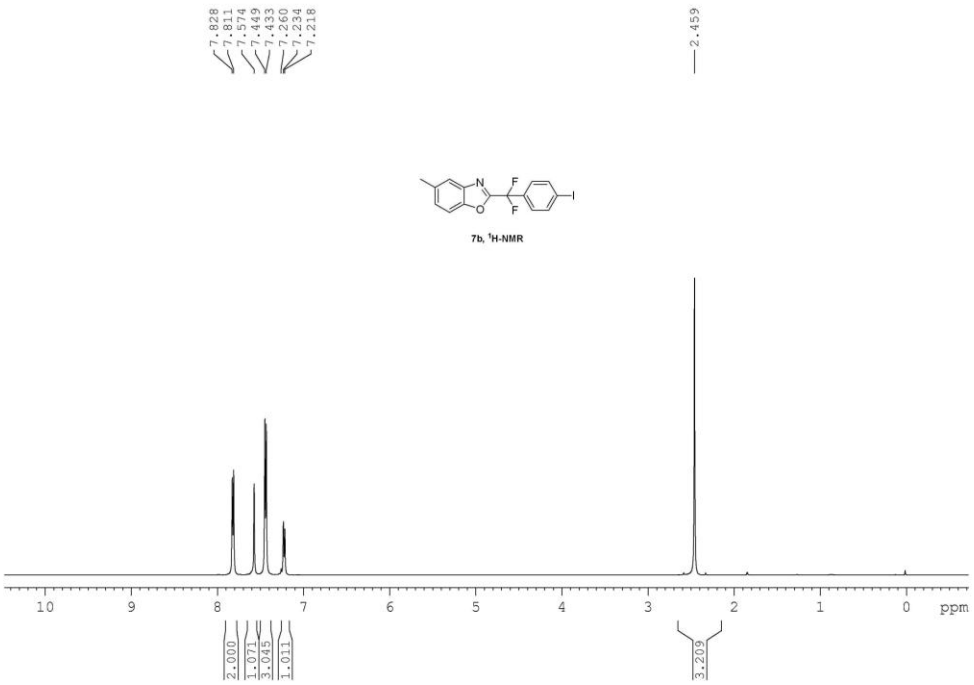
3z, ^{13}C-NMR


7.649
7.631
7.580
7.435
7.418
7.261
7.215
7.198
6.980
6.962
3.810
2.454
7a, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0
ppm
2.001
1.058
0.991
1.021
2.003
3.078
2.990

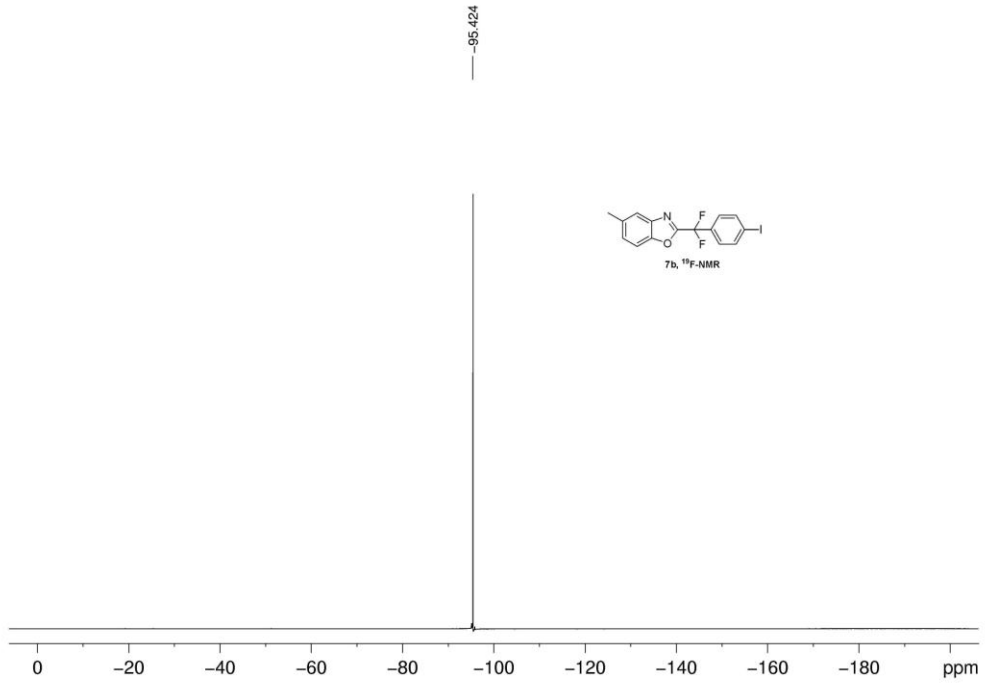

-93.390
7a, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

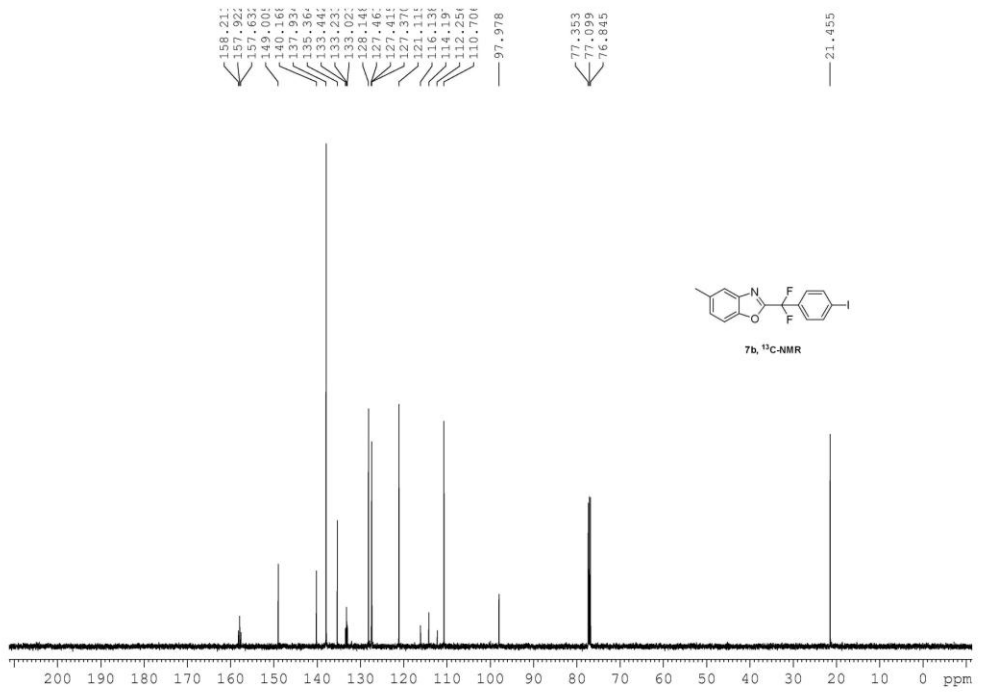


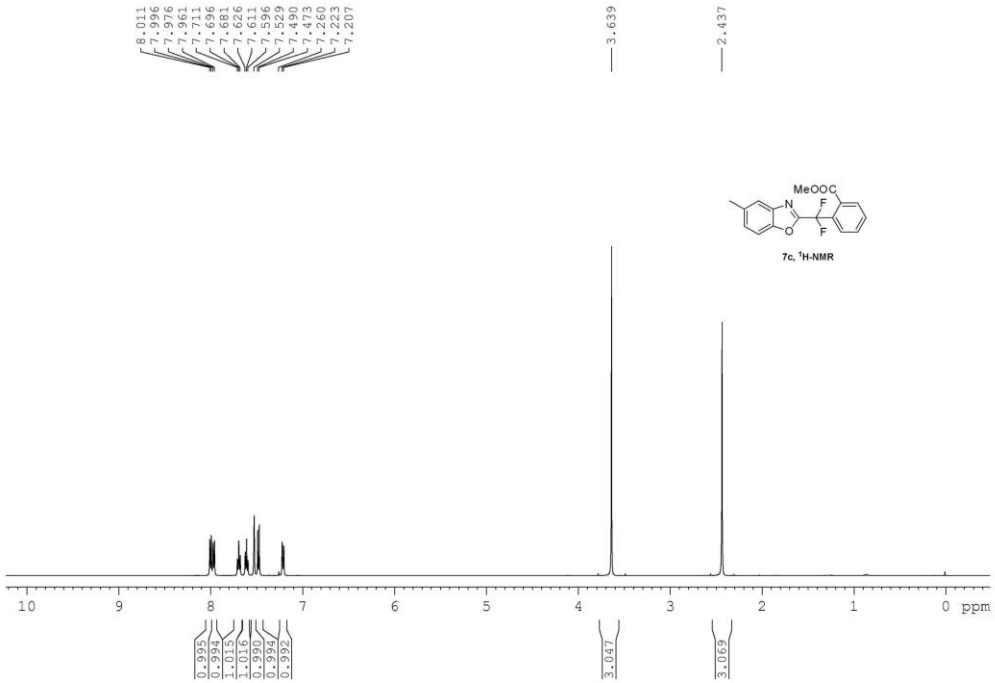
7a, ^{13}C-NMR



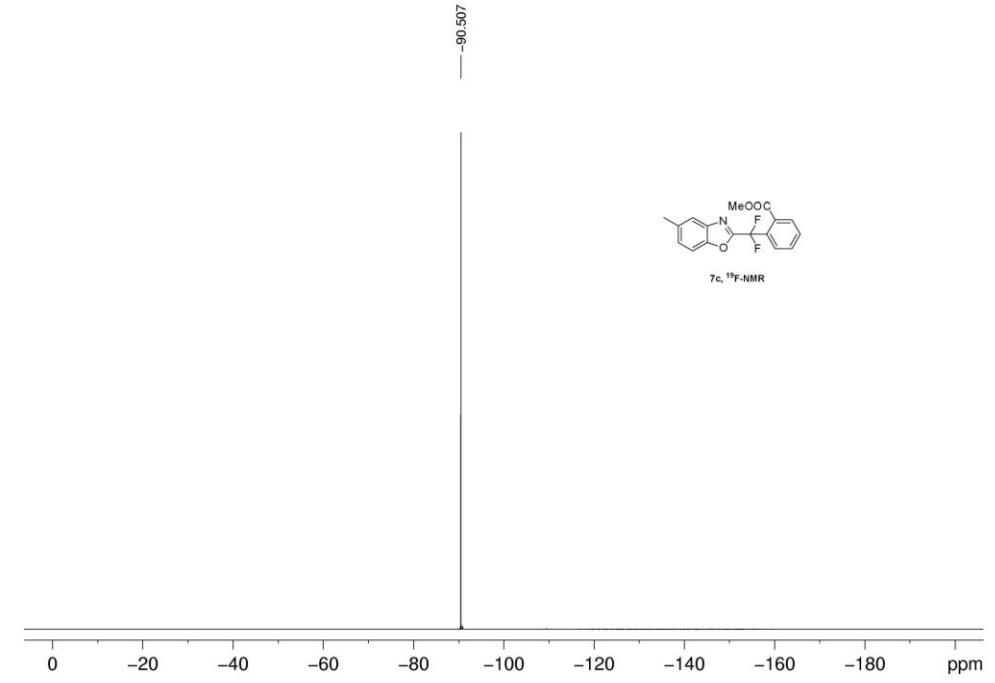
7b, ^{1}H-NMR


-95.424
7b, ^{19}F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm

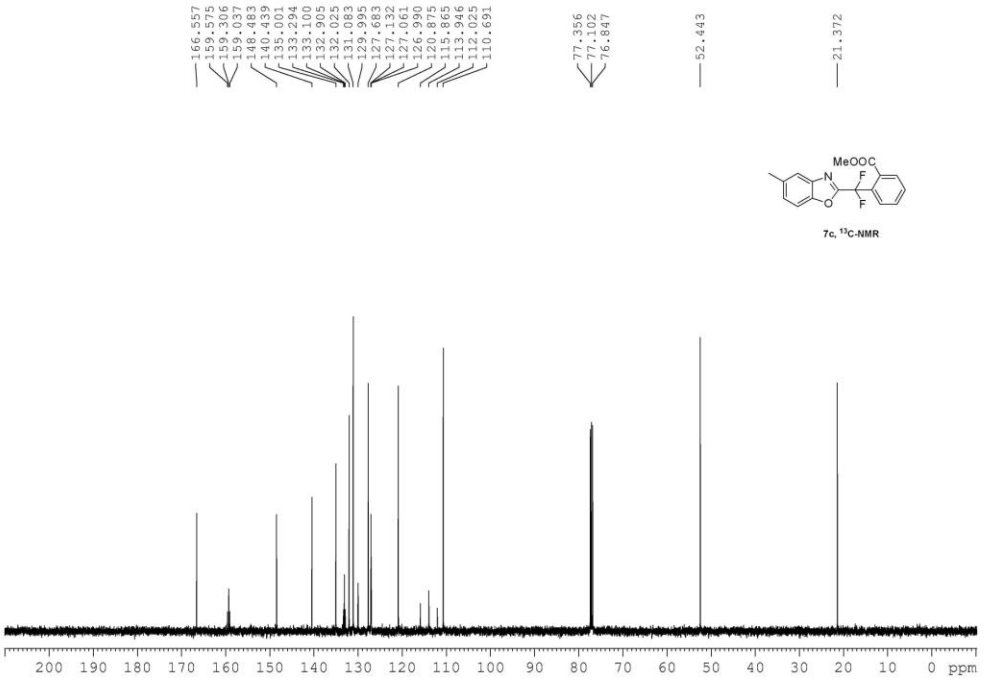

158.21
157.92
157.63
149.00
140.16
137.93
135.36
133.44
133.23
133.02
128.14
127.46
127.41
127.37
121.11
116.13
114.19
112.25
110.70
97.978
77.353
77.099
76.845
21.455
7b, ^{13}C-NMR
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

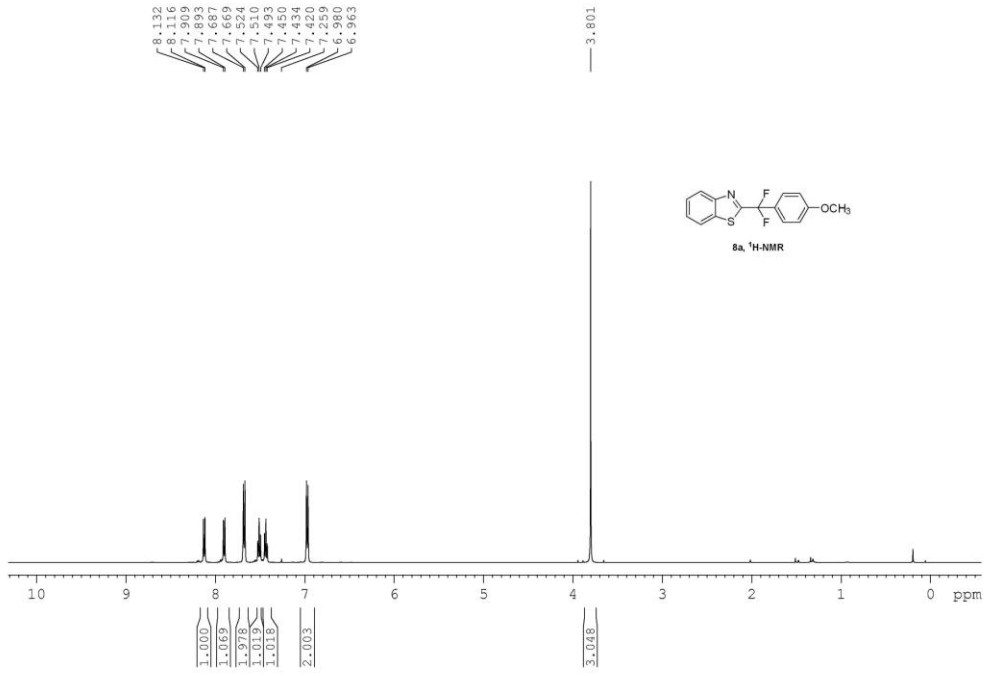


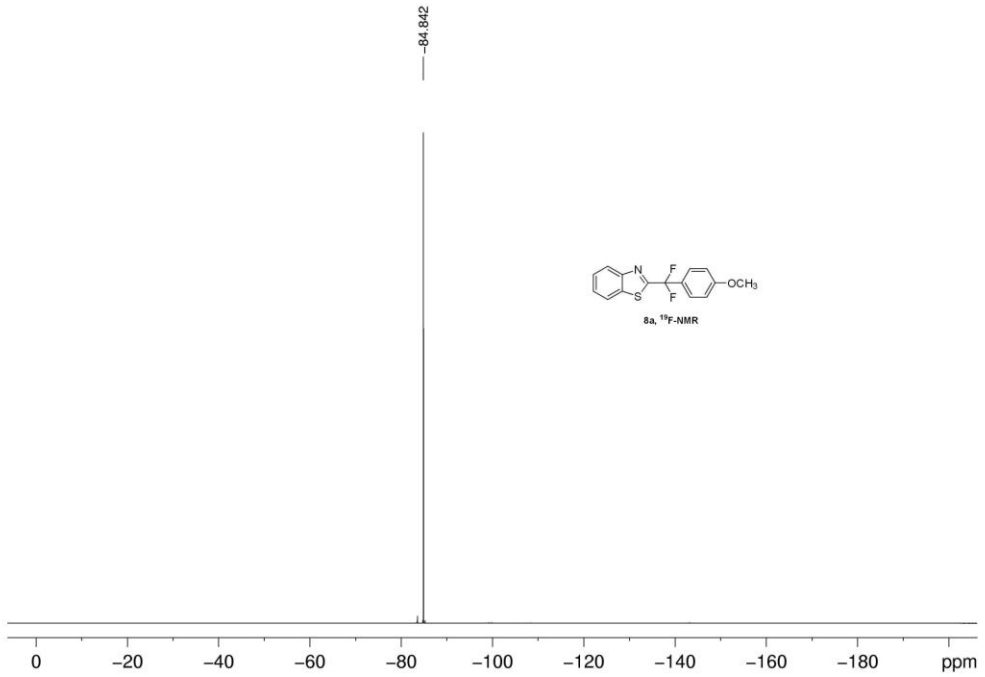
7c, ^{1}H-NMR



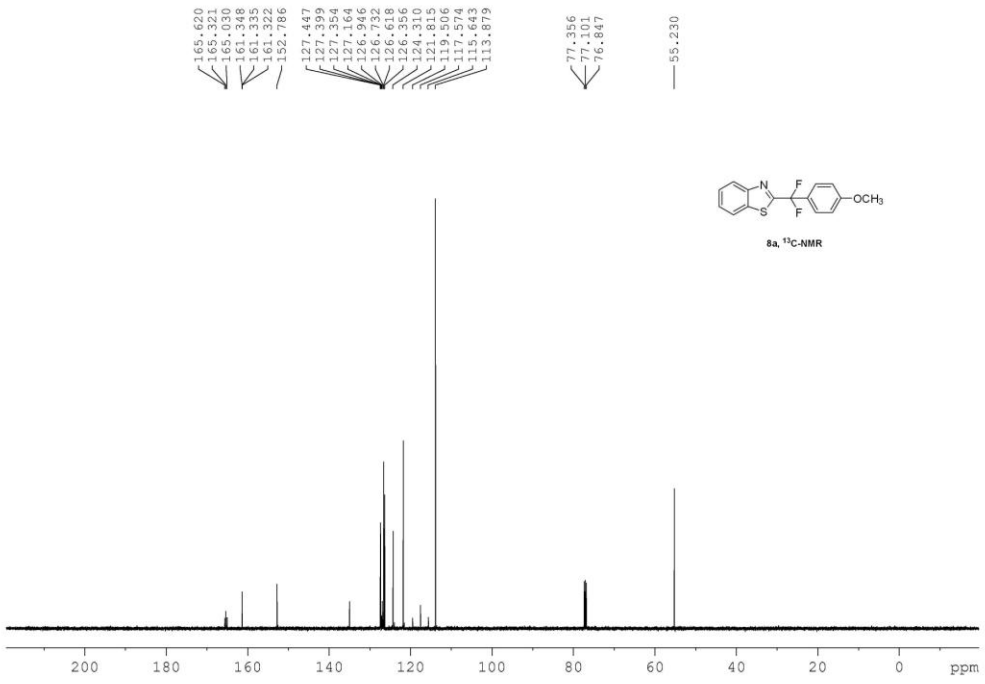
7c, ^{19}F-NMR


166.557
159.575
159.306
159.037
148.483
140.439
135.001
133.204
133.100
132.025
131.063
129.995
127.683
127.132
127.061
126.990
120.875
115.865
113.946
112.025
110.691
77.356
77.102
76.847
52.443
21.372
MeOOC
F
F
7c, ^{13}C-NMR
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

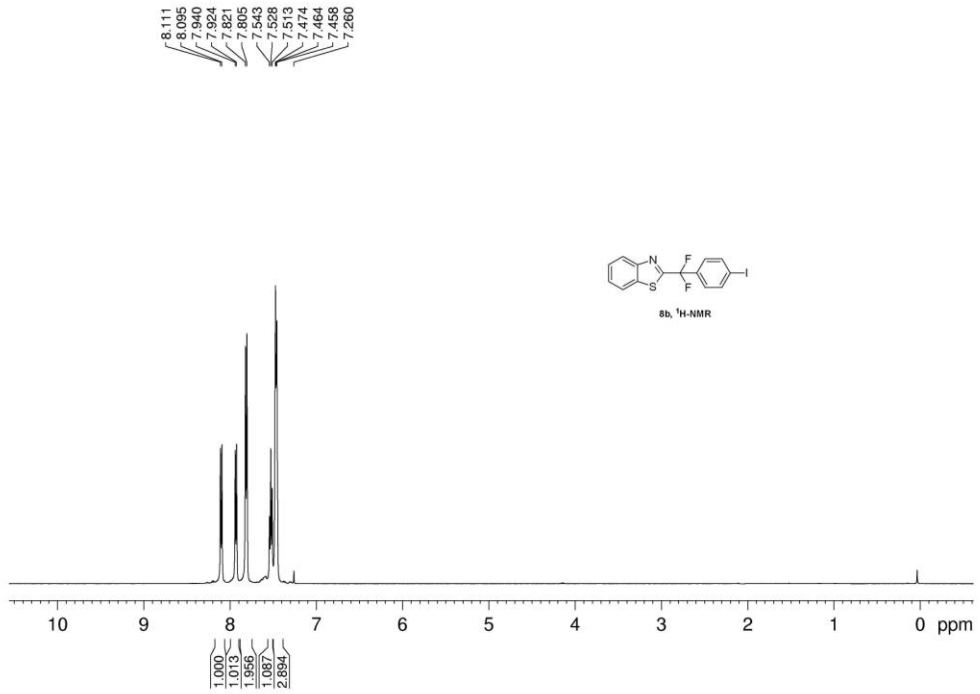

8.132
8.116
7.909
7.893
7.687
7.669
7.524
7.510
7.493
7.450
7.434
7.420
7.259
6.980
6.963
3.801
F
F
OCH3
8a, ^{1}H-NMR
10 9 8 7 6 5 4 3 2 1 0 ppm
1.000
1.069
1.978
1.019
1.018
2.003
3.048

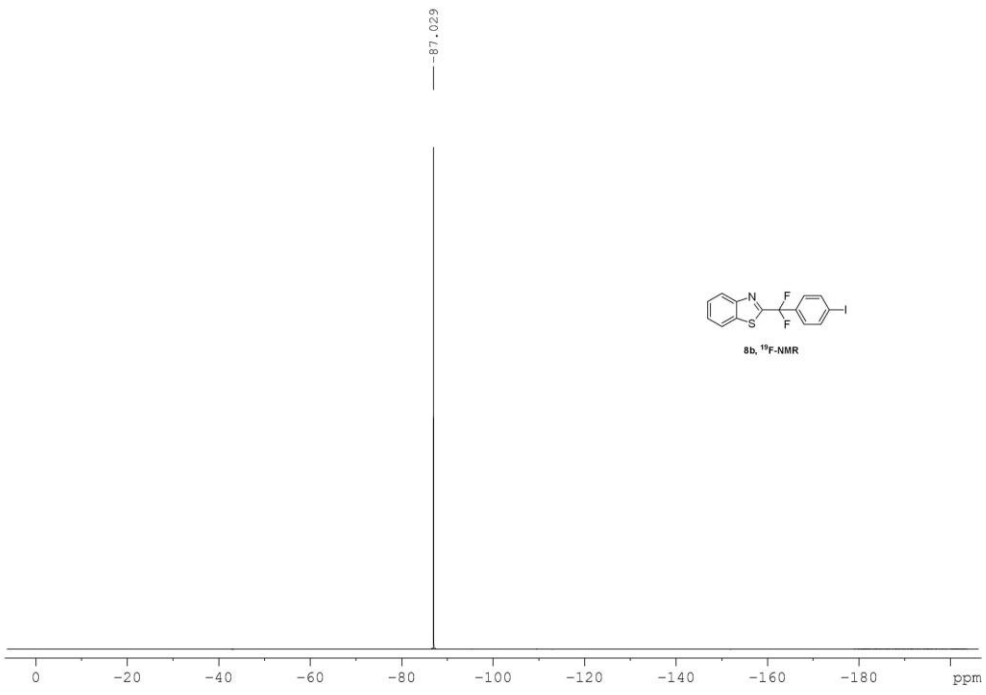


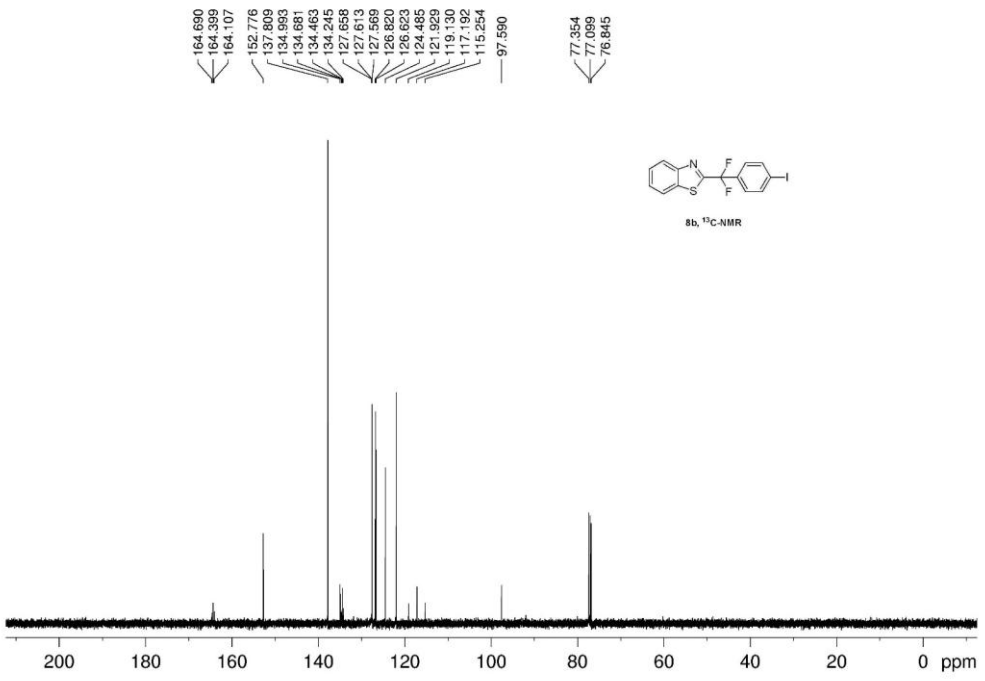
8a, ^{19}F-NMR



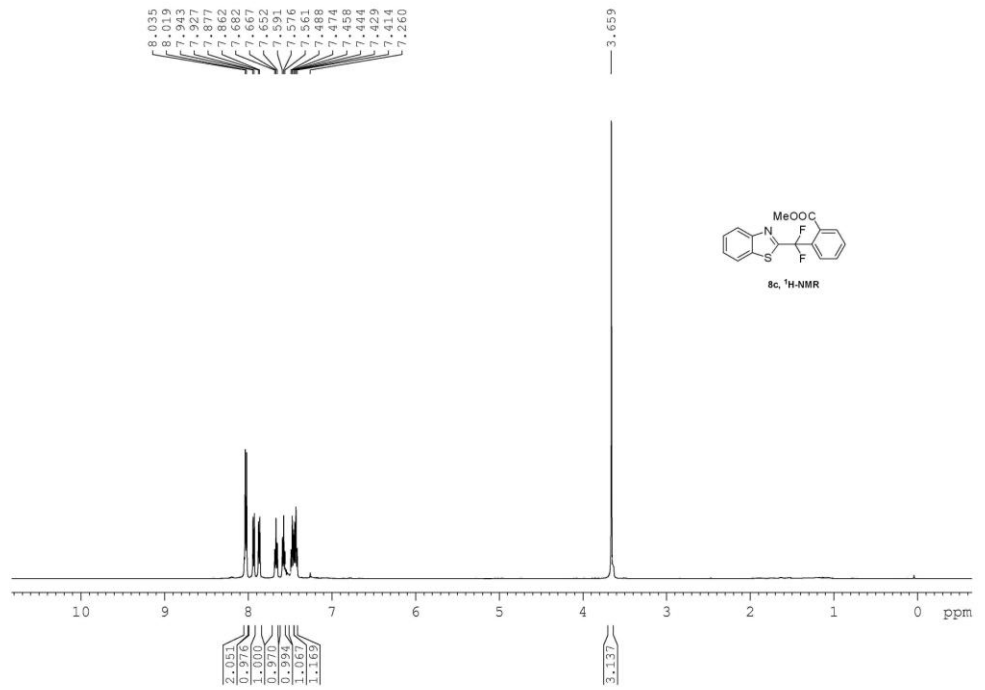
8a, ^{13}C-NMR


8.111
8.095
7.940
7.924
7.821
7.805
7.543
7.528
7.513
7.474
7.464
7.458
7.260
8b, ^{1}H-NMR
10
9
8
7
6
5
4
3
2
1
0 ppm
1.000
1.013
1.956
1.087
2.894

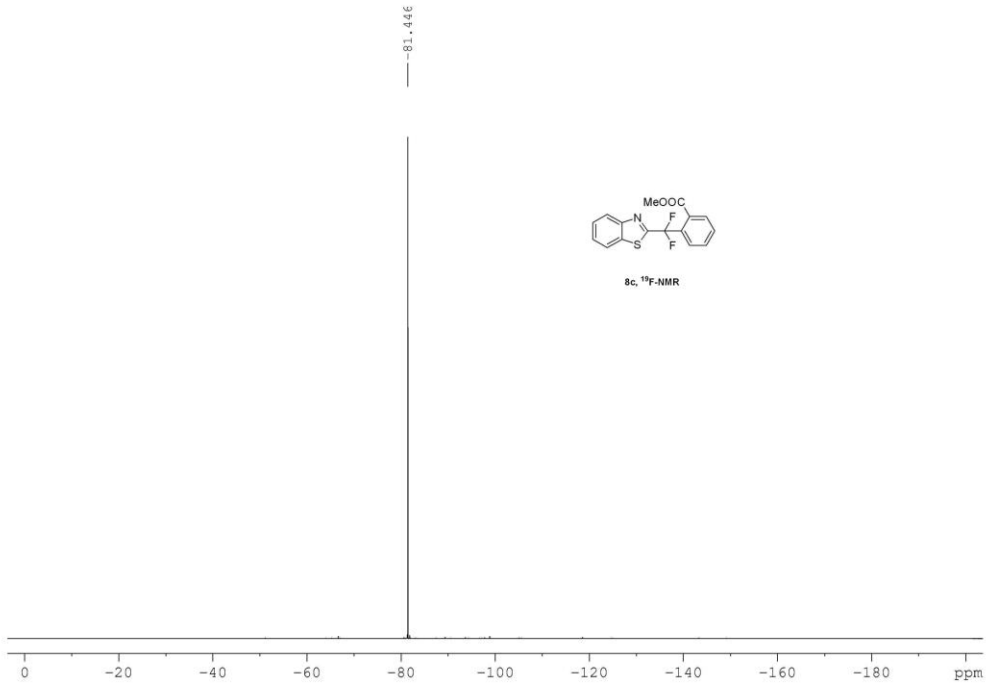

-87.029
8b, ^{19}F-NMR
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm



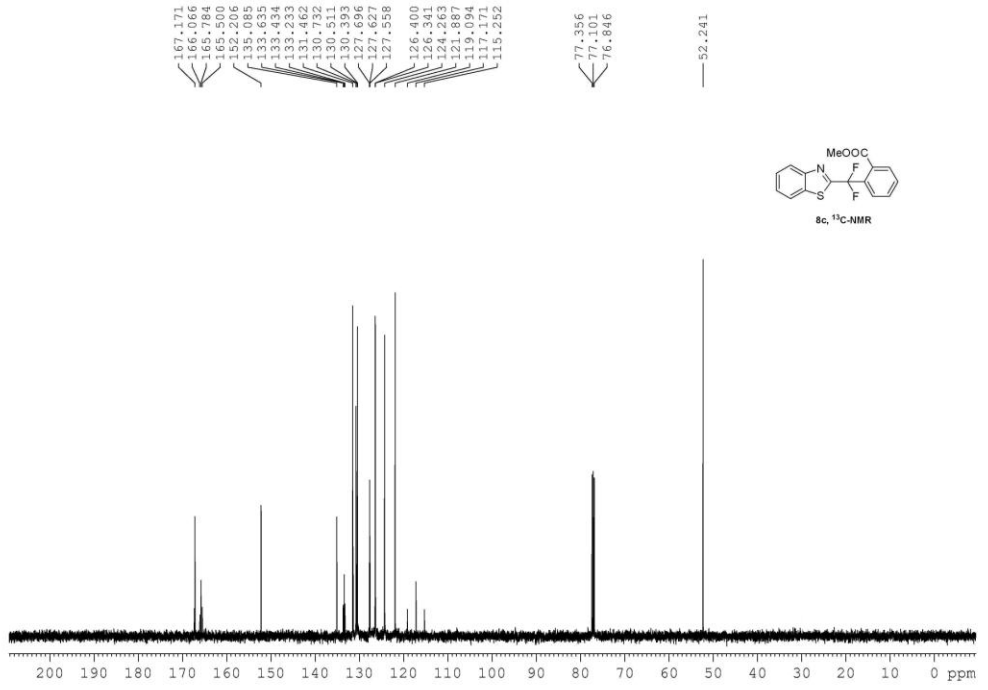
8b, ^{13}C-NMR



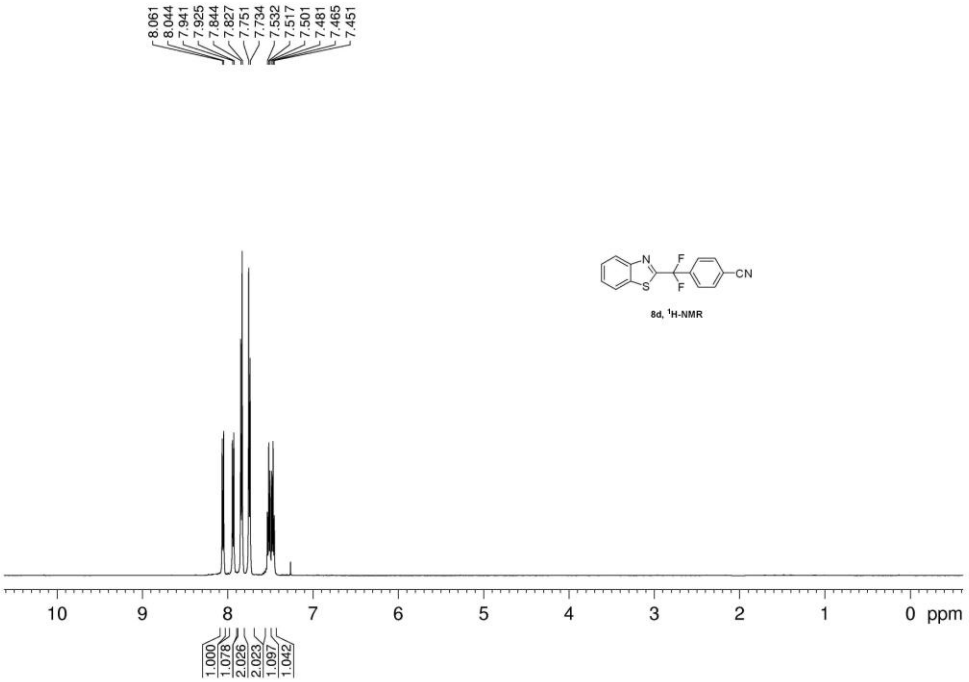
8c, ^{1}H-NMR

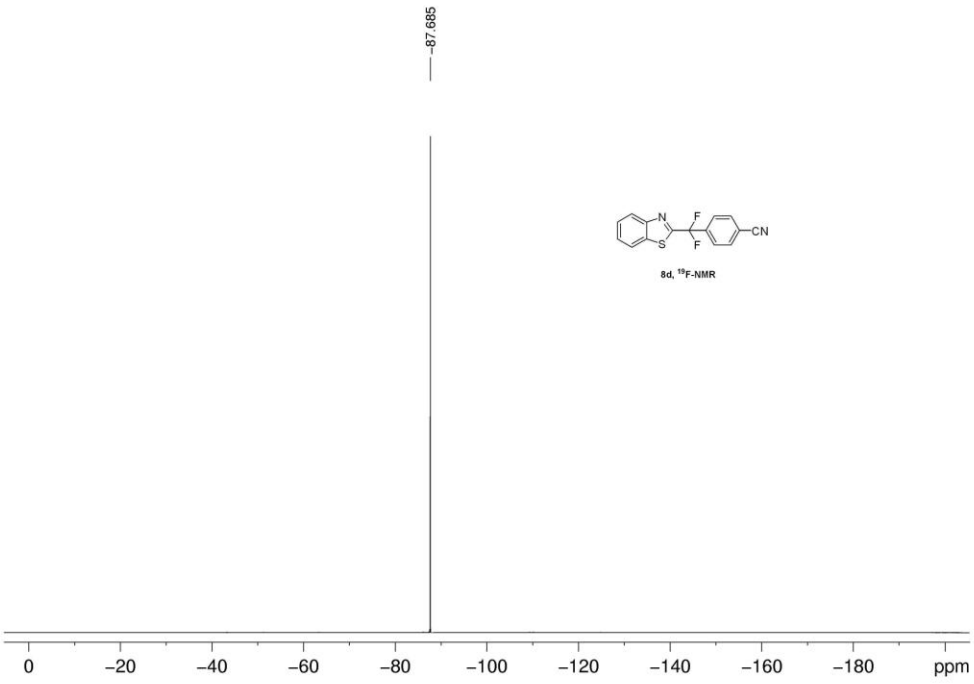


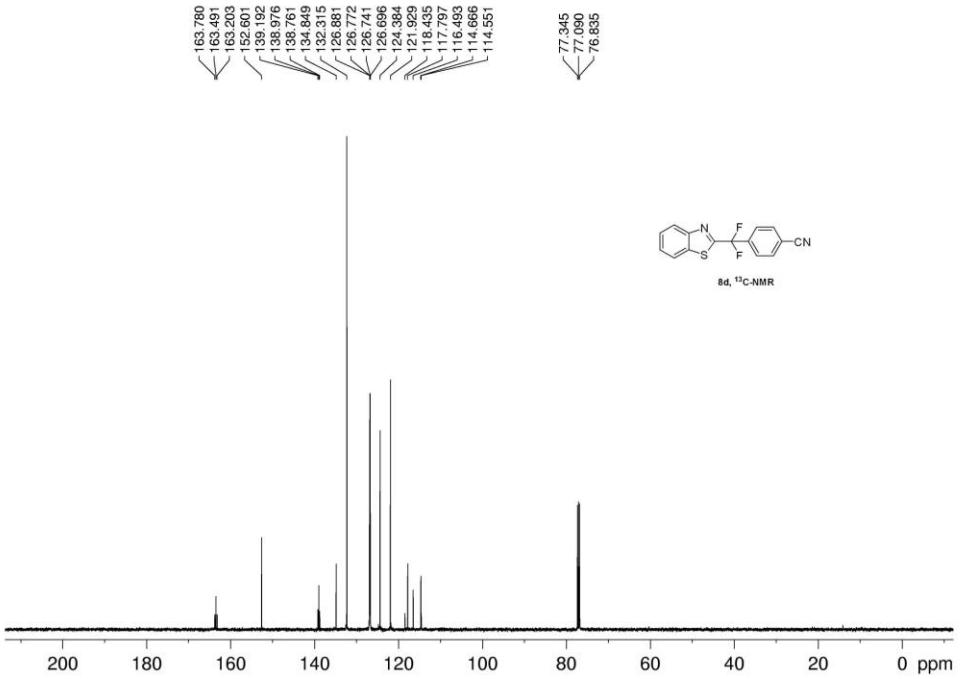
8c, ^{19}F-NMR



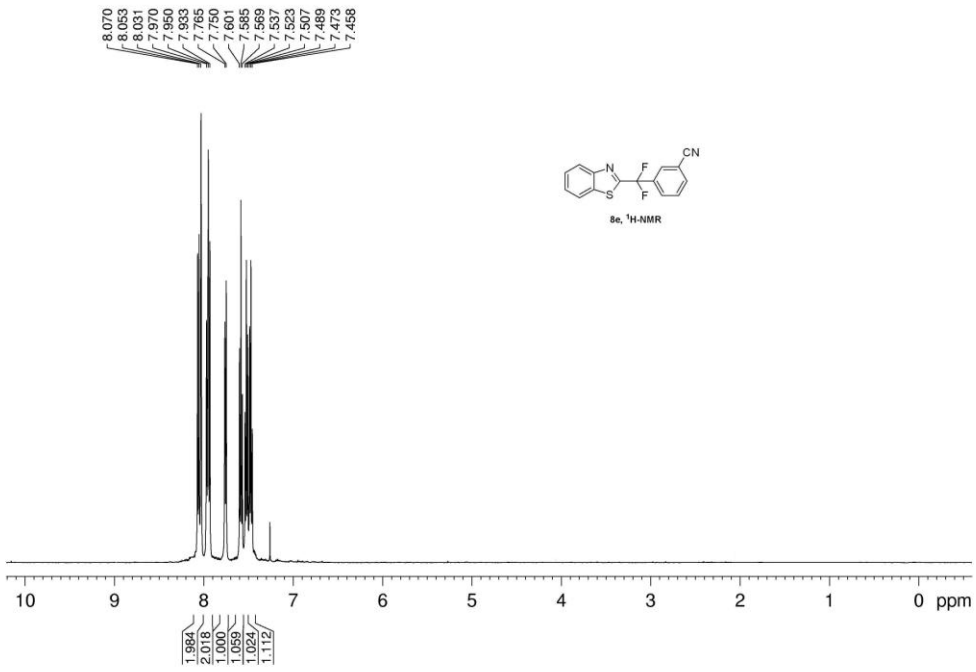
8c, ^{13}C-NMR


8.061
8.044
7.941
7.925
7.844
7.827
7.751
7.734
7.532
7.517
7.501
7.481
7.465
7.451
8d, 1H-NMR
10
9
8
7
6
5
4
3
2
1
0 ppm
1.000
1.078
2.026
2.023
1.097
1.042

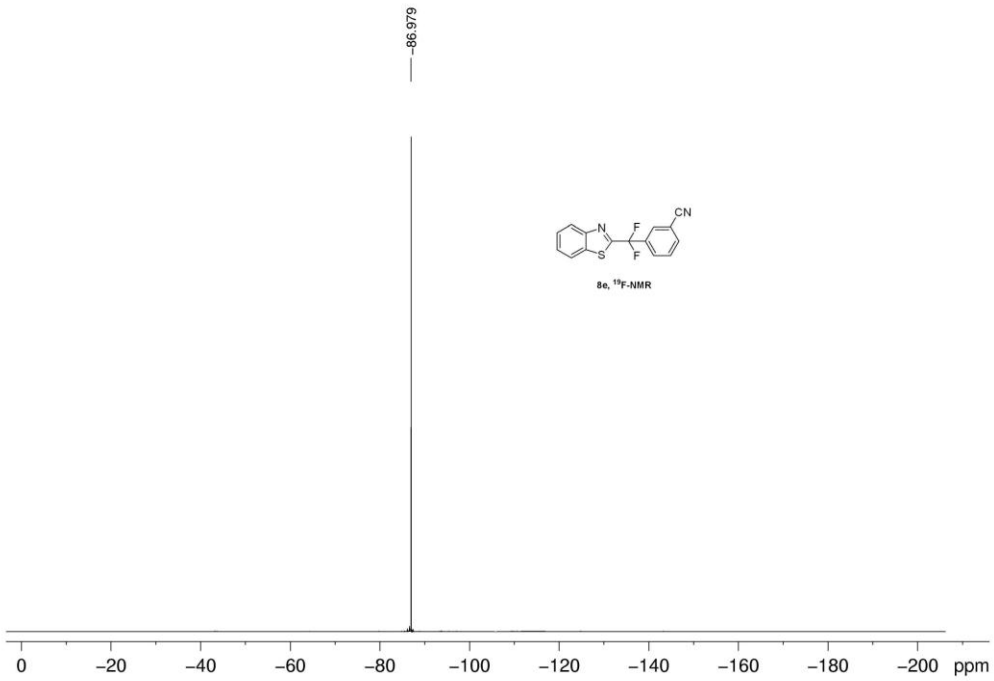

-87.685
8d, 19F-NMR
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm



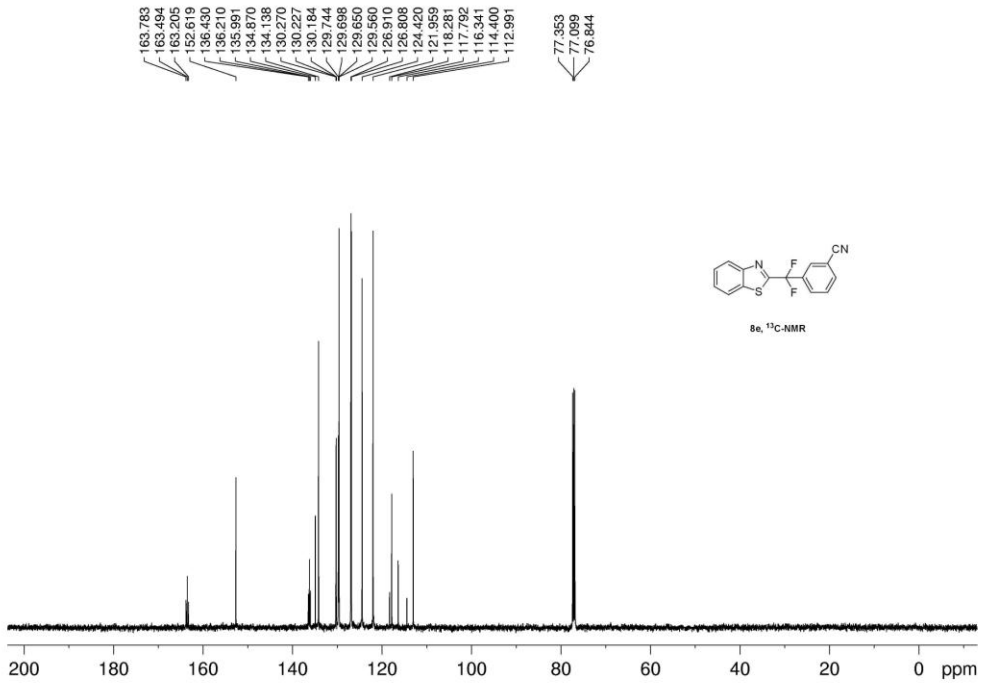
8d, ^{13}C-NMR



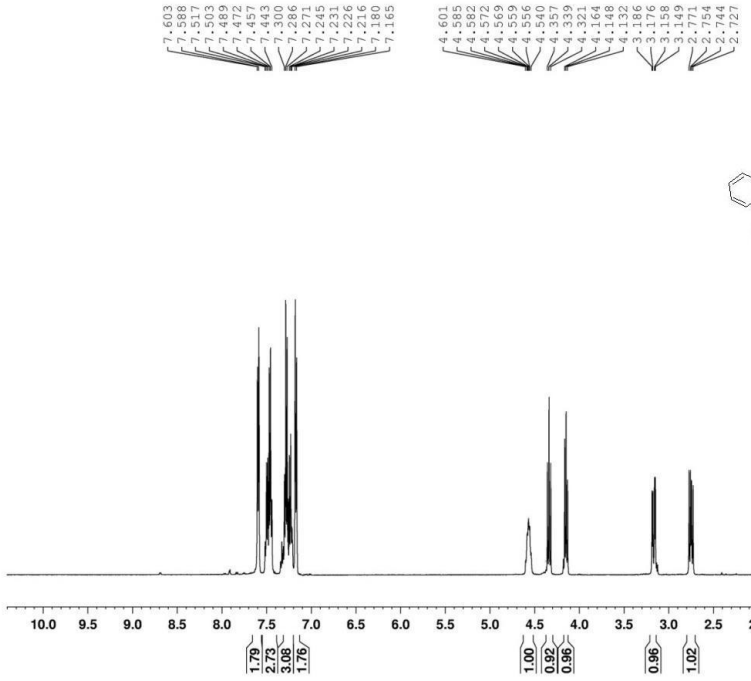
8e, ^{1}H-NMR

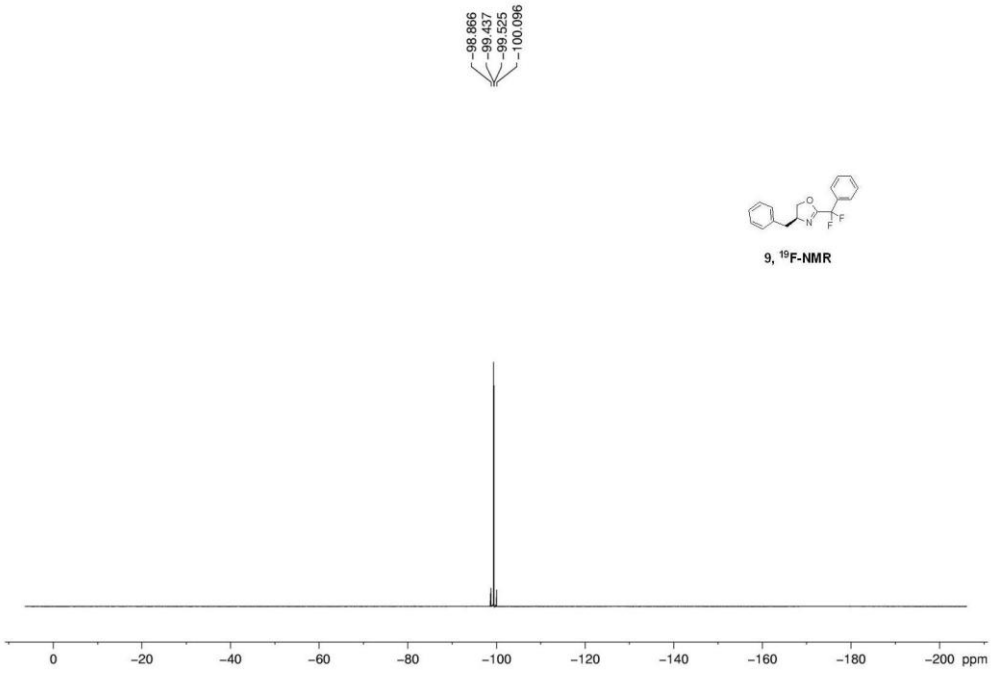


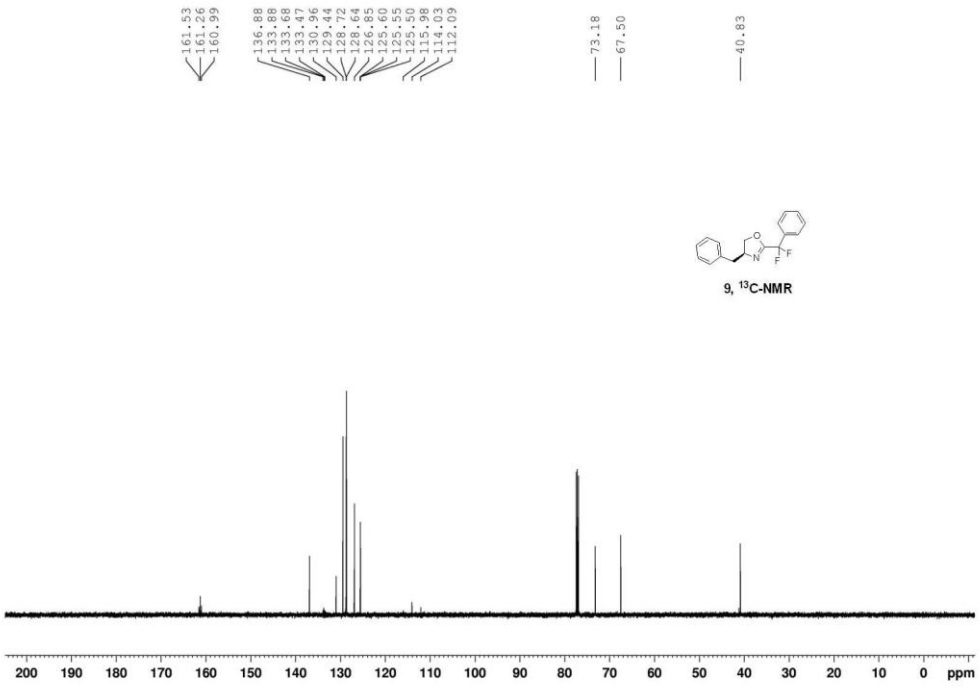
8e, ^{19}F-NMR

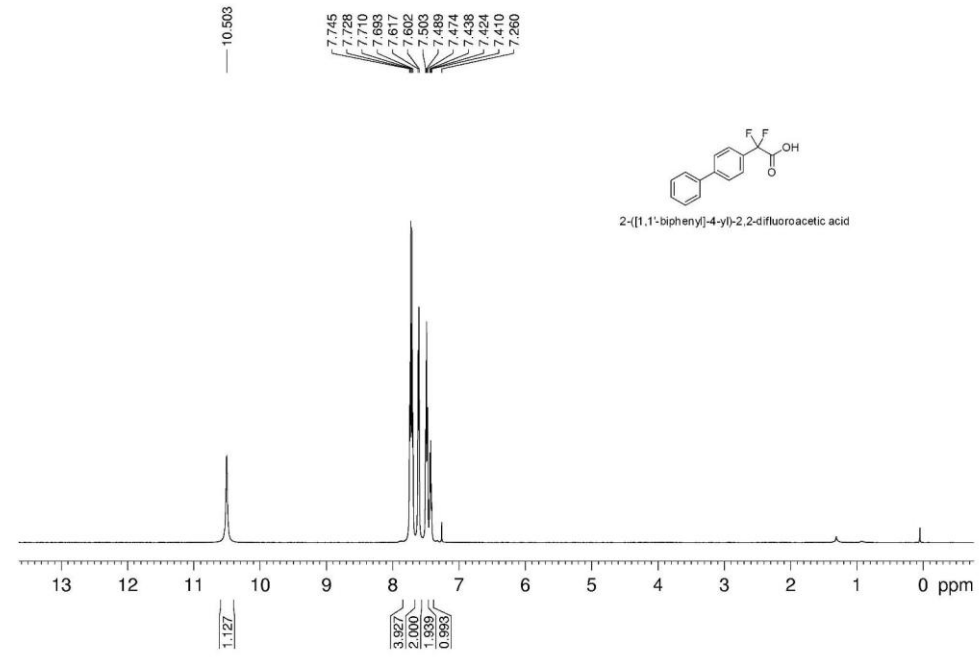


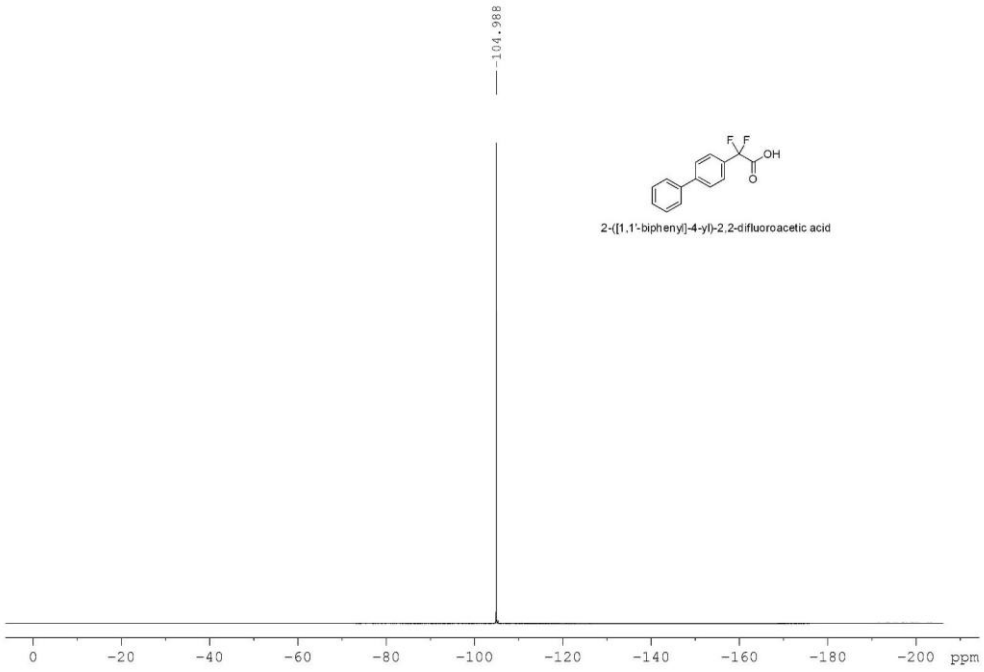
8e, ^{13}C-NMR

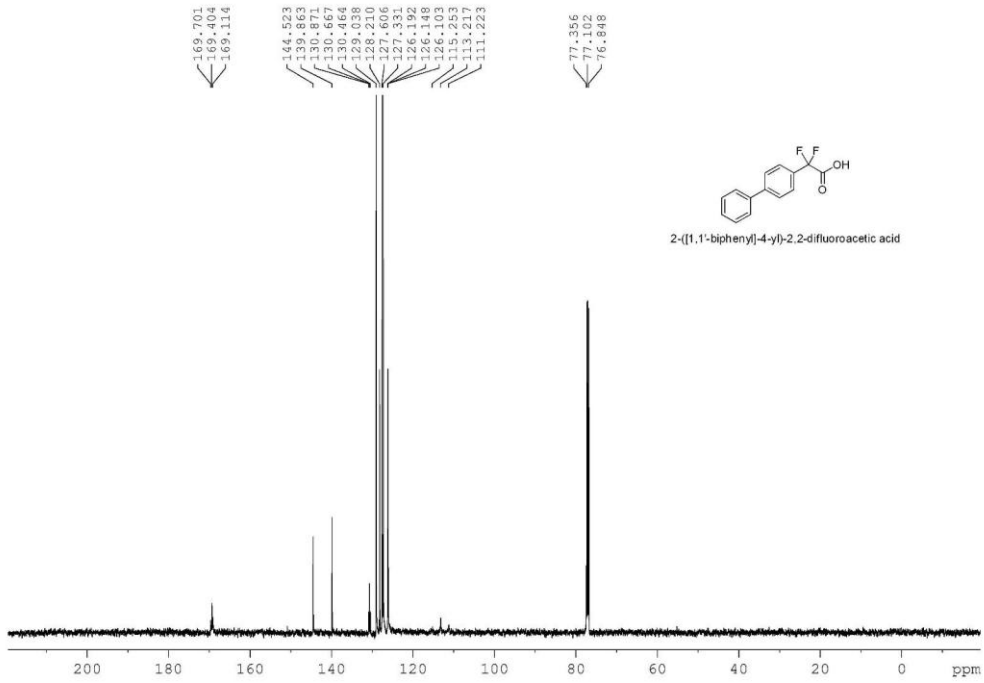

7.603
7.588
7.517
7.503
7.489
7.472
7.457
7.443
7.300
7.286
7.271
7.245
7.231
7.226
7.216
7.180
7.165
4.601
4.585
4.582
4.572
4.569
4.559
4.556
4.540
4.337
4.339
4.321
4.164
4.138
4.132
3.176
3.158
3.149
2.771
2.754
2.744
2.727
O
N
F
F
9, ^{1}H-NMR
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.79
2.73
3.08
1.76
1.00
0.92
0.96
0.96
1.02


-98.866
-99.437
-99.525
-100.096
O
N
F
F
9, ^{19}F-NMR
0 −20 −40 −60 −80 −100 −120 −140 −160 −180 −200 ppm


161.53
161.26
160.99
136.88
133.88
133.68
133.47
130.96
129.44
128.72
128.64
126.85
125.60
125.55
125.50
115.98
114.03
112.09
73.18
67.50
40.83
9, ^{13}C-NMR
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


10.503
7.745
7.728
7.710
7.693
7.617
7.602
7.503
7.489
7.474
7.438
7.424
7.410
7.260
2-([1,1'-biphenyl]-4-yl)-2,2-difluoroacetic acid
13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.127
3.927
2.000
1.999
0.993


-104.988
F F
OH
O
2-([1,1'-biphenyl]-4-yl)-2,2-difluoroacetic acid
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 ppm


169.701
169.404
169.114
144.523
139.863
130.871
130.667
130.464
129.038
128.210
127.606
127.331
126.192
126.148
126.103
115.253
113.217
111.223
77.356
77.102
76.848
F F
OH
O
2-([1,1'-biphenyl]-4-yl)-2,2-difluoroacetic acid
200 180 160 140 120 100 80 60 40 20 0 ppm