Supporting Information

Species-Dependent Aromatase Imaging in Rodents, Blood-Brain Barrier Permeability, and Tumor Visualization with a Novel ^{18}F-Labeled PET Tracer, [^{18}F]AromataPET-1

Xuan Ge[a‡], Xuebo Cheng[a‡], Hualong Chen[a], Jinghui Tong[a], Yongzhong Zhang[b], Yajing Liu[c*], Lin Ai[b] and Zehui Wu[a,d*]

a. Beijing Institute of Brain Disorders, Beijing Key Laboratory of Innovation and Translation of Central Nervous System Radiopharmaceuticals, Capital Medical University, Beijing, 100069, China; wzhhuey2012@ccmu.edu.cn (Z.W)

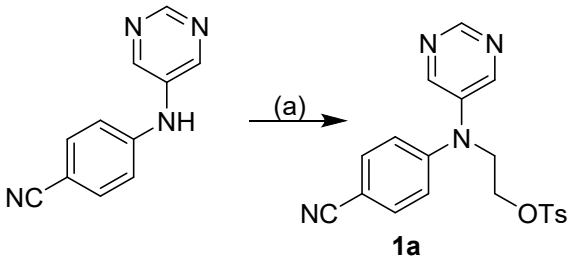
b. Department of Nuclear Medicine, Beijing Tiantan Hospital, Capital Medical University, Beijing 100071, China; ailin@bjtth.org (L. Ai)

c. School of Pharmaceutical Science, Capital Medical University, Beijing 100069, China; liuyj@ccmu.edu.cn (Y. Liu)

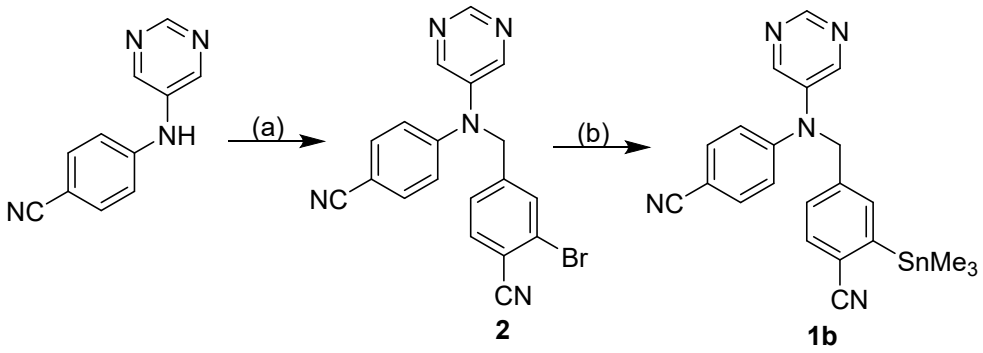
d. Department of Radiology and Nuclear Medicine, Xuanwu Hospital, Capital Medical University, No. 45 Changchun St, Xicheng District, Beijing 100053, China.

‡ Those two authors contribute equally

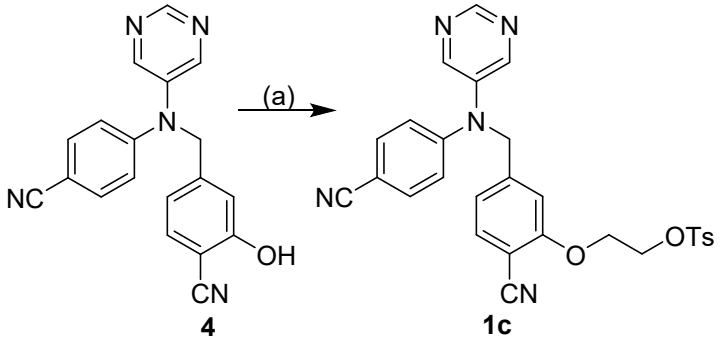
1. Synthesis of compound 1a, 1b and 1c



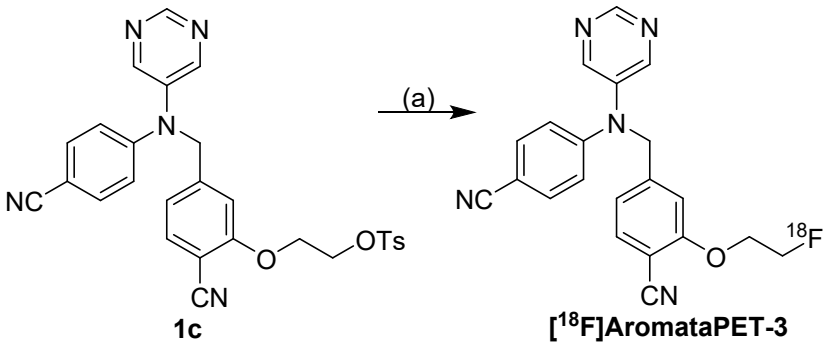
Scheme S1. Synthesis of **1a.** Reagents and conditions: (a) Cs_2CO_3, 1,2-dimethylmethoxyethane, 50 ℃, overnight.



Scheme S2. Synthesis of **1b.** Reagents and conditions: (a) K_2CO_3, DMF, 45 ℃, 7.5 h; (b) Hexamethyltin, $Pd(OAc)_2$, LiCl, 1,4-dioxane, 80 ℃, 2h.



Scheme S3. Synthesis of **1c.** Reagents and conditions: (a) Cs_2CO_3, 1,2-dimethylmethoxyethane, rt, 5h.



Scheme S4. Synthesis of **[^{18}F]AromataPET-3**. Reagents and conditions: (a)[^{18}F]fuoride with $K_{2.2.2}/K_2CO_3$:(220mg of $K_{2.2.2}$ in 18.6 mL of ACN/40 mg of K_2CO_3 in 3.4 mL of water), DMSO, 80 ℃, 10 min.

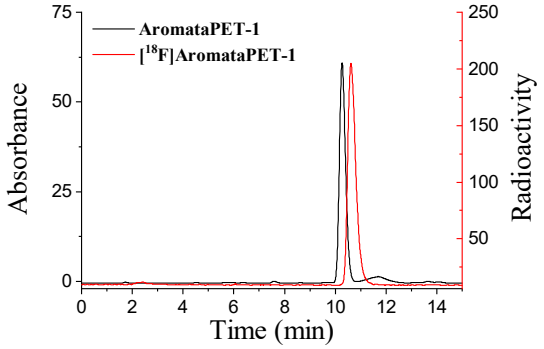


Figure S1. HPLC profiles of **AromataPET-1** and **[^{18}F]AromataPET-1** Using-HPLC System Column: (4.6 mm × 250 mm, 5 μm, ZORBAX SB-C18, Agilent). Mobile phase (Isocratic): ACN/·H_2O = 57/43 v/v.

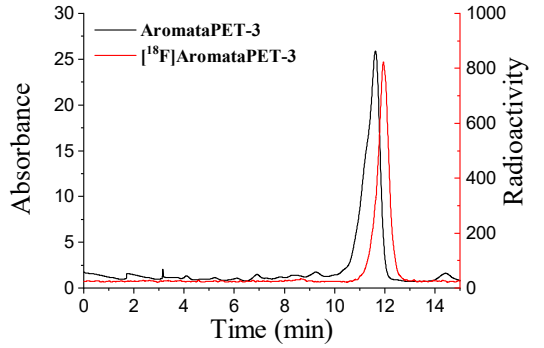


Figure S2. HPLC profiles of **AromataPET-3** and **[^{18}F]AromataPET-3** Using-HPLC System Column: (4.6 mm × 250 mm, 5 μm, ZORBAX SB-C18, Agilent). Mobile phase (Isocratic): ACN/·H_2O = 67/33 v/v.

2. MicroPET-CT imaging of mice.

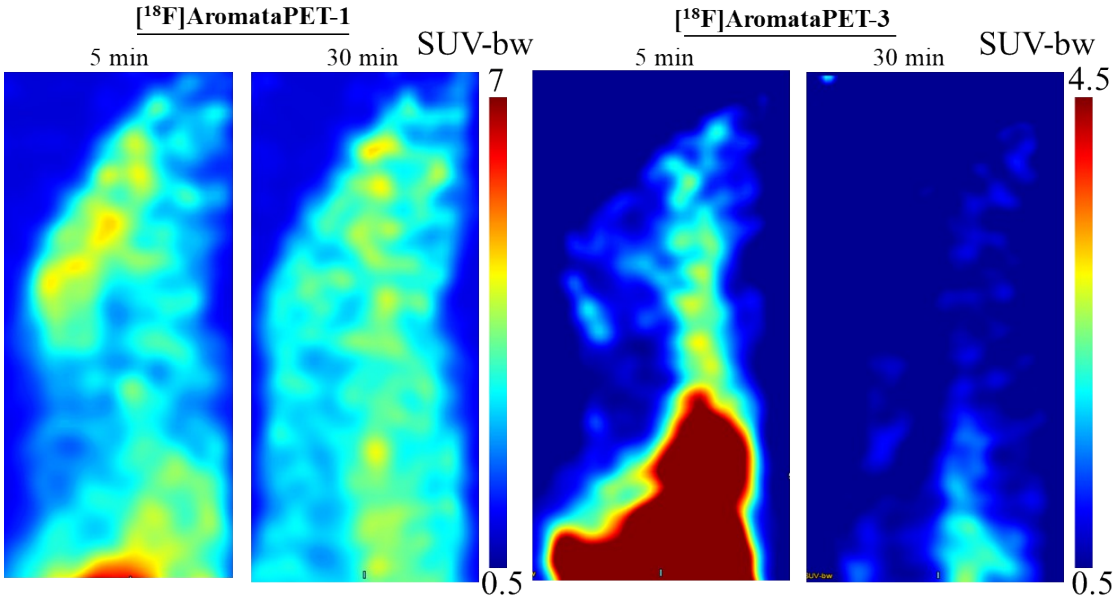


Figure S3. Representative brain PET images of **[^{18}F]AromataPET-1** and **[^{18}F]AromataPET-3** in mice at 5 min and 30 min post-injection.

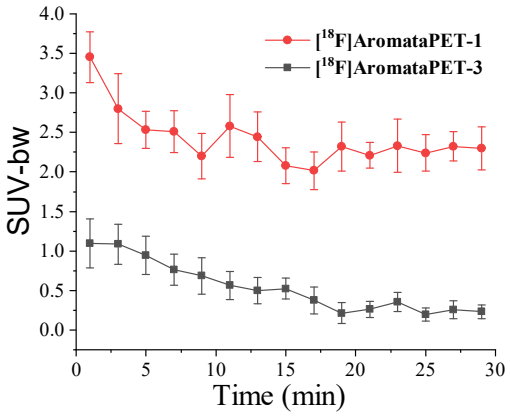


Figure S4. The uptake time curves of **[^{18}F]AromataPET-1** and **[^{18}F]AromataPET-3** in mice brain.

3. Biodistribution.

Table S1. In Vivo Biodistribution of **[^{18}F]AromataPET-1** in ICR Mice (% ID/g)

ICR Mice	Female			Male
Organ	2 min	30 min	60 min	30 min
Blood	3.26±0.15	3.59±0.7	3.65±0.34	3.43±0.30
Brain	3.10±0.15	2.12±0.25	1.99±0.13	2.06±0.31
Heart	3.92±0.19	3.69±0.17	3.89±0.26	3.28±0.21
Liver	11.54±3.95	3.29±0.48	3.33±0.45	3.79±0.49
Spleen	2.57±0.39	2.59±0.26	3.20±0.58	2.27±0.20
Lung	5.64±0.36	3.45±0.30	3.49±0.25	3.00±0.28
Kidney	4.96±0.11	2.99±0.21	3.08±0.31	2.73±0.17
Stomach	2.24±0.24	2.34±0.27	2.48±0.20	2.28±0.12
Small intestine	4.74±0.56	4.25±0.34	3.86±0.41	3.98±0.39
Large intestine	3.68±0.62	4.05±0.61	4.18±0.34	4.12±0.96
Ovary/Testis	3.85±0.51	3.15±0.14	2.94±0.63	2.06±0.28
Pancreas	3.96±0.25	2.66±0.36	2.14±0.17	1.90±0.41
Adrenal gland	13.87±2.48	1.79±1.04	2.90±0.57	2.97±0.47
Skin	2.08±0.33	2.74±0.53	2.69±0.33	2.49±0.27

Muscle	2.68±0.16	2.64±0.34	2.84±0.25	2.13±0.08
Bone	1.08±0.20	2.35±0.56	3.37±0.25	2.07±0.33
Bladder	1.62±0.42	4.20±0.43	4.01±0.27	4.04±0.98

4. In vivo stability

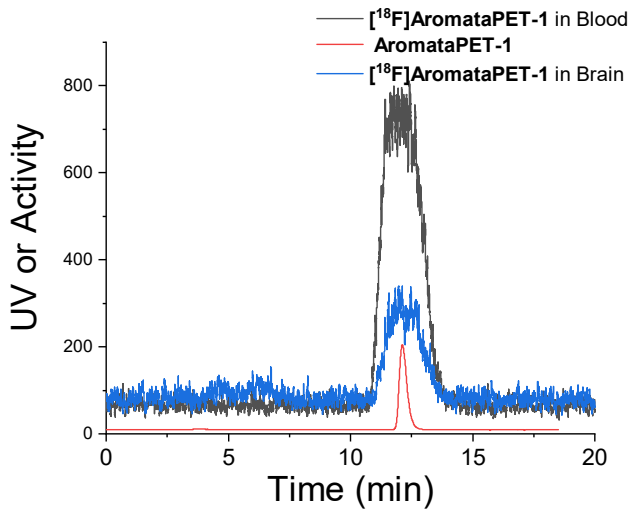


Figure S5. In vivo stability of **[^{18}F]AromataPET-1** at 30 min post-injection.

5. Single crystal analysis and Molecular docking

Crystal structure determination of AromataPET-1

Crystal Data for **AromataPET-1** (M =241.25 g/mol): triclinic, space group P-1 (no. 2), a = 8.3490(2) Å, b = 9.2715(2) Å, c = 15.5660(3) Å, α = 95.7270(10)°, β = 95.7710(10)°, γ = 90.4700(10)°, V = 1192.64(4) Å^3, Z = 4, T = 295.00 K, μ(CuKα) = 0.793 mm^{-1}, *Dcalc* = 1.344 g/cm^3, 11963 reflections measured (5.736° ≤ 2Θ ≤ 136.646°), 4220 unique (R_{int} = 0.0467, R_{sigma} = 0.0452) which were used in all calculations. The final R_1 was 0.0601 (I > 2σ(I)) and wR_2 was 0.1907 (all data).

Table S2. Crystal data and structure refinement for AromataPET-1.

Identification code	**AromataPET-1**
Empirical formula	$C_{13}H_{10}FN_4$
Formula weight	241.25
Temperature/K	295.00
Crystal system	triclinic
Space group	P-1
a/Å	8.3490(2)
b/Å	9.2715(2)
c/Å	15.5660(3)
α/°	95.7270(10)
β/°	95.7710(10)
γ/°	90.4700(10)
Volume/Å^3	1192.64(4)
Z	4
ρ_{calc}g/cm^3	1.344
μ/mm^{-1}	0.793
F(000)	500.0
Crystal size/mm3	0.20×0.18×0.26

Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	5.736 to 136.646
Index ranges	$-7 \leq h \leq 10$, $-11 \leq k \leq 11$, $-18 \leq l \leq 18$
Reflections collected	11963
Independent reflections	4220 [R_{int} = 0.0467, R_{sigma} = 0.0452]
Data/restraints/parameters	4220/0/325
Goodness-of-fit on F^2	1.075
Final R indexes [I>=2σ (I)]	R_1 = 0.0601, wR_2 = 0.1759
Final R indexes [all data]	R_1 = 0.0860, wR_2 = 0.1907
Largest diff. peak/hole / e $Å^{-3}$	0.47/-0.38

Table S3. Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for AromataPET-1. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
F1	816(2)	-1801(2)	4105.2(13)	95.2(6)
N1	1413(4)	3057(2)	4473.9(14)	80.8(8)
N2	259(4)	4048(2)	3237.7(14)	83.6(8)
N3	225(2)	87.4(18)	2779.5(11)	49.2(4)
N4	3051(3)	-1278(3)	-1137.2(15)	80.9(7)
C1	930(3)	4141(2)	4036.8(15)	59.6(6)
C2	1197(4)	1735(3)	4052.8(16)	74.2(8)
C3	505(3)	1496(2)	3223.8(13)	45.4(5)
C4	67(4)	2716(3)	2835.1(16)	76.0(9)
C5	-1011(3)	-812(2)	3081.0(16)	56.7(5)
C6	-369(3)	-2158(3)	3422(2)	71.7(7)
C7	818(2)	-257(2)	1985.2(13)	42.2(4)
C8	2146(3)	506(2)	1769.1(14)	51.5(5)
C9	2729(3)	233(2)	976.4(15)	53.7(5)
C10	2005(3)	-839(2)	365.0(13)	47.3(5)
C11	738(3)	-1645(3)	588.5(16)	59.0(6)
C12	162(3)	-1370(2)	1379.4(15)	56.6(6)
C13	2573(3)	-1091(3)	-472.5(15)	58.1(6)
F2	4289(2)	1473.4(18)	5972.7(11)	81.2(5)
N5	4560(4)	7835(2)	6685.4(14)	87.2(9)
N6	3601(3)	6288(2)	5437.4(13)	67.7(6)

Table S3. Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Parameters ($Å^2 \times 10^3$) for AromataPET-1. U_{eq} is defined as 1/3 of of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
N7	4757(2)	4055.1(18)	7211.8(11)	48.1(4)
N8	1950(3)	4135(3)	11148.9(15)	80.2(7)
C14	3984(4)	7565(3)	5864.5(16)	69.4(7)
C15	4784(4)	6678(3)	7121.3(16)	73.3(8)
C16	4449(3)	5287(2)	6747.2(13)	45.4(5)
C17	3835(3)	5148(2)	5892.1(14)	56.5(6)
C18	6009(3)	3076(2)	6926.9(15)	54.1(5)
C19	5433(3)	1543(3)	6687.7(17)	62.1(6)
C20	4173(2)	4006(2)	8014.3(13)	42.1(4)
C21	2792(3)	4776(2)	8205.7(14)	49.3(5)
C22	2222(3)	4791(2)	8999.5(14)	51.7(5)
C23	2995(3)	4013(2)	9638.6(13)	47.6(5)
C24	4313(3)	3197(3)	9442.8(15)	56.0(6)
C25	4891(3)	3175(3)	8647.1(15)	54.3(5)
C26	2425(3)	4077(3)	10481.6(15)	56.6(6)

Table S4. Anisotropic Displacement Parameters ($Å^2 \times 10^3$) for AromataPET-1. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
F1	94.5(13)	95.2(13)	100.4(13)	40.4(10)	1.7(11)	0.2(10)
N1	123(2)	60.1(12)	51.0(11)	-0.1(9)	-24.0(13)	-6.0(13)
N2	135(2)	48.1(11)	59.1(12)	-4.9(9)	-23.4(14)	23.6(13)
N3	54.9(10)	41.3(9)	51.3(9)	1.1(7)	8.9(8)	-7.9(7)
N4	79.7(16)	101.8(19)	59.5(13)	-4.7(12)	9.8(12)	11.5(14)
C1	79.0(16)	47.8(11)	49.0(12)	-4.9(9)	2.0(11)	-1.3(11)
C2	115(2)	50.1(12)	52.2(13)	8.8(10)	-20.0(14)	-0.3(14)
C3	48.4(11)	44.5(10)	42.0(10)	1.8(8)	1.3(8)	-1.5(8)
C4	115(2)	52.2(13)	51.4(13)	-5.5(10)	-28.6(14)	24.4(14)
C5	49.1(12)	51.9(12)	69.9(14)	1.0(10)	16.7(11)	-7.0(9)
C6	68.5(16)	56.9(14)	93.9(19)	20.4(13)	16.1(15)	-9.9(12)
C7	42.8(10)	35.2(9)	47.2(10)	3.6(7)	-1.1(8)	-0.6(7)
C8	56.8(12)	43.7(10)	51.5(11)	-4.5(8)	4.3(10)	-15.4(9)
C9	56.0(12)	48.6(11)	56.7(12)	2.5(9)	10.6(10)	-9.7(9)
C10	47.3(11)	45.7(10)	47.1(11)	1.9(8)	-1.4(9)	10.6(8)
C11	53.8(12)	56.1(12)	61.3(13)	-16.4(10)	-0.3(10)	-9.6(10)
C12	49.9(12)	51.1(11)	65.7(13)	-8.9(10)	6.1(10)	-16.2(9)
C13	57.5(13)	61.8(13)	52.5(13)	-2.2(10)	-0.3(10)	12.9(11)
F2	92.3(12)	68.4(9)	80.2(10)	0.5(8)	2.9(9)	-6.8(8)
N5	160(3)	44.6(11)	55.3(12)	8.3(9)	2.9(14)	-21.7(14)
N6	93.4(16)	58.1(11)	49.8(11)	12.4(9)	-7.8(11)	-2.6(11)

Table S4. Anisotropic Displacement Parameters ($Å^2×10^3$) for AromataPET-1. The Anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U_{11}+2hka^*b^*U_{12}+\ldots]$.

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
N7	51.1(10)	44.7(9)	50.0(9)	11.9(7)	5.1(8)	5.6(7)
N8	82.0(16)	99.2(18)	62.3(13)	16.3(12)	15.0(12)	-10.5(14)
C14	107(2)	45.6(12)	58.3(14)	16.9(10)	8.8(14)	0.5(13)
C15	119(2)	50.3(12)	46.7(12)	7.9(10)	-11.8(13)	-27.7(14)
C16	51.3(11)	41.5(10)	43.0(10)	6.8(8)	0.6(8)	-5.2(8)
C17	73.3(15)	44.1(11)	49.2(12)	3.7(9)	-6.8(11)	-5.0(10)
C18	44.6(11)	58.3(12)	62.2(13)	13.1(10)	12.2(10)	6.3(9)
C19	62.2(14)	51.0(12)	75.0(15)	10.8(11)	10.9(12)	12.1(11)
C20	41.3(10)	37.6(9)	46.9(10)	8.2(7)	-1.8(8)	-4.1(7)
C21	54.1(12)	44.1(10)	50.8(11)	14.0(8)	0.6(9)	10.1(9)
C22	52.4(12)	44.6(10)	58.6(12)	7.2(9)	6.2(10)	6.3(9)
C23	47.5(11)	45.9(10)	48.7(11)	8.0(8)	-0.2(9)	-10.1(8)
C24	50.9(12)	63.2(13)	56.1(12)	25.0(10)	-2.7(10)	4.1(10)
C25	45.2(11)	58.0(12)	62.0(13)	20.0(10)	1.5(10)	9.7(9)
C26	55.7(13)	61.5(13)	52.7(12)	11.3(10)	1.7(10)	-10.4(10)

Table S5. Bond Lengths for AromataPET-1.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
F1	C6	1.390(4)	F2	C19	1.388(3)
N1	C1	1.313(3)	N5	C14	1.318(3)
N1	C2	1.333(3)	N5	C15	1.330(3)

Table S5. Bond Lengths for AromataPET-1.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
N2	C1	1.306(3)	N6	C14	1.319(3)
N2	C4	1.329(3)	N6	C17	1.335(3)
N3	C3	1.422(3)	N7	C16	1.423(2)
N3	C5	1.463(3)	N7	C18	1.464(3)
N3	C7	1.387(3)	N7	C20	1.391(3)
N4	C13	1.144(3)	N8	C26	1.145(3)
C2	C3	1.356(3)	C15	C16	1.375(3)
C3	C4	1.370(3)	C16	C17	1.370(3)
C5	C6	1.488(4)	C18	C19	1.496(3)
C7	C8	1.397(3)	C20	C21	1.403(3)
C7	C12	1.396(3)	C20	C25	1.401(3)
C8	C9	1.373(3)	C21	C22	1.367(3)
C9	C10	1.394(3)	C22	C23	1.395(3)
C10	C11	1.383(3)	C23	C24	1.383(3)
C10	C13	1.430(3)	C23	C26	1.436(3)
C11	C12	1.367(3)	C24	C25	1.372(3)

Table S6. Bond Angles for AromataPET-1

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C1	N1	C2	116.2(2)	C14	N5	C15	115.5(2)
C1	N2	C4	115.8(2)	C14	N6	C17	115.8(2)
C3	N3	C5	116.73(17)	C16	N7	C18	117.05(17)
C7	N3	C3	119.91(16)	C20	N7	C16	119.48(16)
C7	N3	C5	121.64(17)	C20	N7	C18	121.64(16)
N2	C1	N1	126.5(2)	N5	C14	N6	127.3(2)
N1	C2	C3	122.9(2)	N5	C15	C16	122.8(2)
C2	C3	N3	123.20(19)	C15	C16	N7	122.15(19)
C2	C3	C4	115.4(2)	C17	C16	N7	121.62(18)
C4	C3	N3	121.42(19)	C17	C16	C15	116.22(19)
N2	C4	C3	123.2(2)	N6	C17	C16	122.4(2)
N3	C5	C6	113.4(2)	N7	C18	C19	113.76(19)
F1	C6	C5	109.6(2)	F2	C19	C18	109.84(18)
N3	C7	C8	120.07(17)	N7	C20	C21	120.02(17)
N3	C7	C12	122.80(19)	N7	C20	C25	122.39(19)
C12	C7	C8	117.11(19)	C25	C20	C21	117.56(19)
C9	C8	C7	121.73(19)	C22	C21	C20	121.39(18)
C8	C9	C10	120.1(2)	C21	C22	C23	120.4(2)
C9	C10	C13	120.2(2)	C22	C23	C26	120.1(2)
C11	C10	C9	118.6(2)	C24	C23	C22	118.7(2)
C11	C10	C13	121.2(2)	C24	C23	C26	121.27(19)
C12	C11	C10	121.11(19)	C25	C24	C23	121.29(18)

Table S6. Bond Angles for AromataPET-1

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
C11	C12	C7	121.3(2)	C24	C25	C20	120.6(2)
N4	C13	C10	178.8(3)	N8	C26	C23	179.0(3)

Table S7. Torsion Angles for AromataPET-1.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
N1	C2	C3	N3	-178.0(3)	N5	C15	C16	N7	177.3(3)
N1	C2	C3	C4	1.4(5)	N5	C15	C16	C17	-1.1(5)
N3	C3	C4	N2	177.7(3)	N7	C16	C17	N6	-177.2(2)
N3	C5	C6	F1	58.3(3)	N7	C18	C19	F2	64.3(3)
N3	C7	C8	C9	-177.5(2)	N7	C20	C21	C22	-177.63(19)
N3	C7	C12	C11	177.4(2)	N7	C20	C25	C24	177.6(2)
C1	N1	C2	C3	-0.8(5)	C14	N5	C15	C16	0.3(5)
C1	N2	C4	C3	1.3(5)	C14	N6	C17	C16	-0.5(4)
C2	N1	C1	N2	0.4(5)	C15	N5	C14	N6	0.5(6)
C2	C3	C4	N2	-1.7(5)	C15	C16	C17	N6	1.2(4)
C3	N3	C5	C6	-117.4(2)	C16	N7	C18	C19	-122.9(2)
C3	N3	C7	C8	24.2(3)	C16	N7	C20	C21	26.9(3)
C3	N3	C7	C12	-157.0(2)	C16	N7	C20	C25	-154.8(2)
C4	N2	C1	N1	-0.6(5)	C17	N6	C14	N5	-0.4(5)
C5	N3	C3	C2	69.4(3)	C18	N7	C16	C15	-113.1(3)
C5	N3	C3	C4	-110.0(3)	C18	N7	C16	C17	65.2(3)
C5	N3	C7	C8	-171.24(19)	C18	N7	C20	C21	-169.0(2)

Table S7. Torsion Angles for AromataPET-1.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
C5	N3	C7	C12	7.6(3)	C18	N7	C20	C25	9.3(3)
C7	N3	C3	C2	-125.4(3)	C20	N7	C16	C15	51.7(3)
C7	N3	C3	C4	55.3(3)	C20	N7	C16	C17	-130.0(2)
C7	N3	C5	C6	77.6(3)	C20	N7	C18	C19	72.6(3)
C7	C8	C9	C10	-0.7(3)	C20	C21	C22	C23	-1.1(3)
C8	C7	C12	C11	-3.7(3)	C21	C20	C25	C24	-4.1(3)
C8	C9	C10	C11	-2.3(3)	C21	C22	C23	C24	-1.9(3)
C8	C9	C10	C13	177.8(2)	C21	C22	C23	C26	177.7(2)
C9	C10	C11	C12	2.2(3)	C22	C23	C24	C25	1.8(3)
C10	C11	C12	C7	0.9(4)	C23	C24	C25	C20	1.2(4)
C12	C7	C8	C9	3.6(3)	C25	C20	C21	C22	4.0(3)
C13	C10	C11	C12	-177.8(2)	C26	C23	C24	C25	-177.7(2)

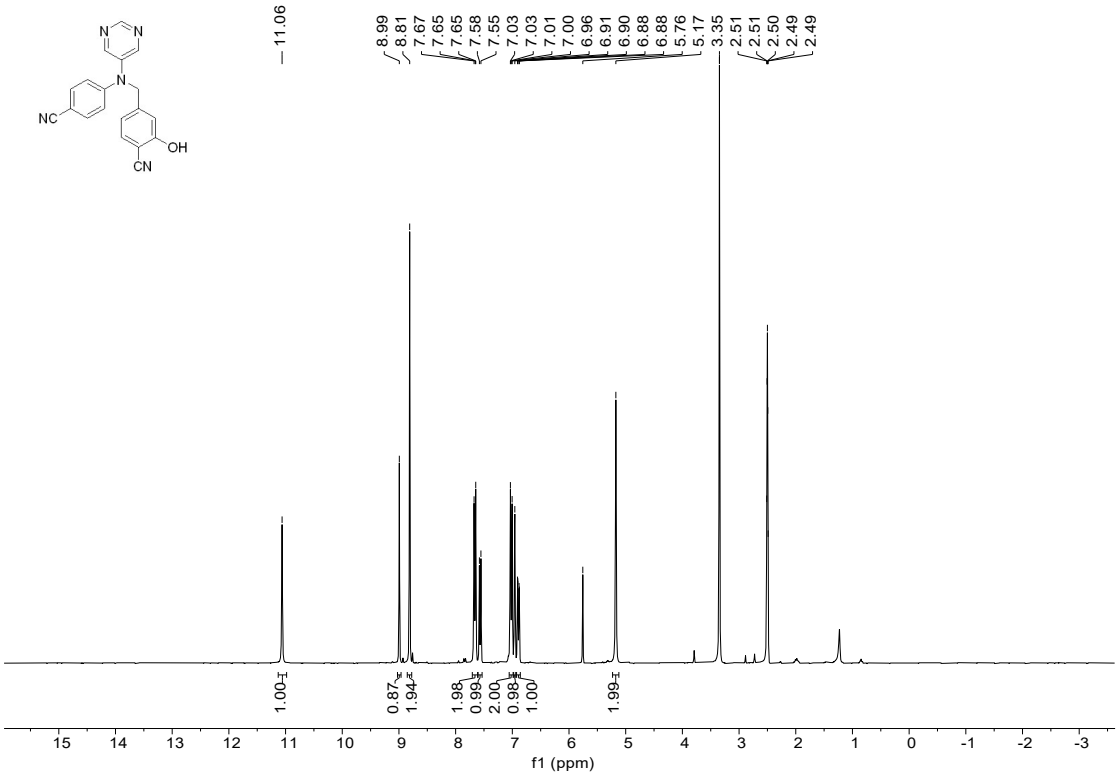
Table S8. Hydrogen Atom Coordinates (Å×10^4) and Isotropic Displacement Parameters (Å^2×10^3) for AromataPET-1.

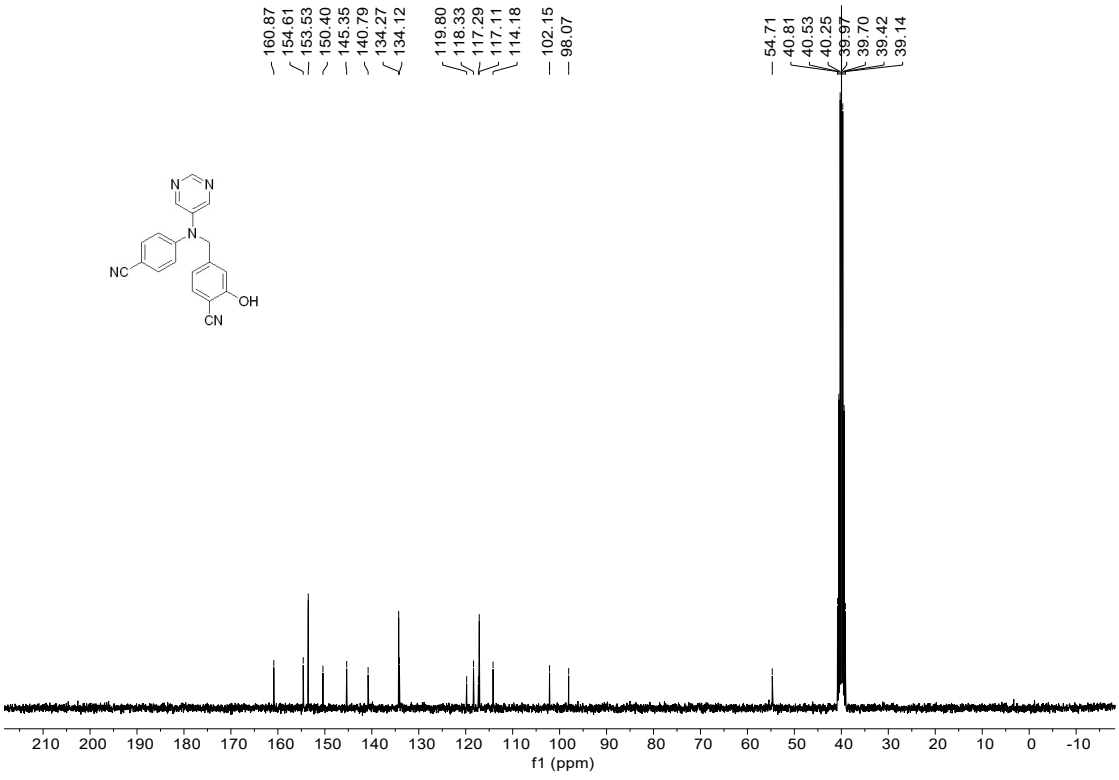
Atom	*x*	*y*	*z*	U(eq)
H1	1081.9	5067.37	4324.81	72
H2	1536.85	941.36	4339.98	89
H4	-385.8	2605.82	2261.15	91
H5A	-1832.47	-1074.1	2603.51	68
H5B	-1517.49	-246.7	3534.24	68
H6	-709.58	-3096.27	3211.21	86
H8	2647.39	1216.58	2172.84	62
H9	3608.05	763.64	846.99	64
H11	268.36	-2385.21	194.2	71
H12	-682.08	-1936.98	1516.26	68
H14	3830.67	8364.43	5551.32	83
H15	5185.08	6814.95	7703.52	88
H17	3573.52	4226.23	5618.73	68
H18A	6883.21	3093.09	7388.45	65
H18B	6435.2	3431.84	6428.78	65
H19	5788.56	754.54	6975.21	75
H21	2252.82	5286.42	7783.57	59
H22	1314.43	5322.2	9114.35	62
H24	4818.46	2653.18	9858.61	67
H25	5767.26	2602.95	8526.65	65

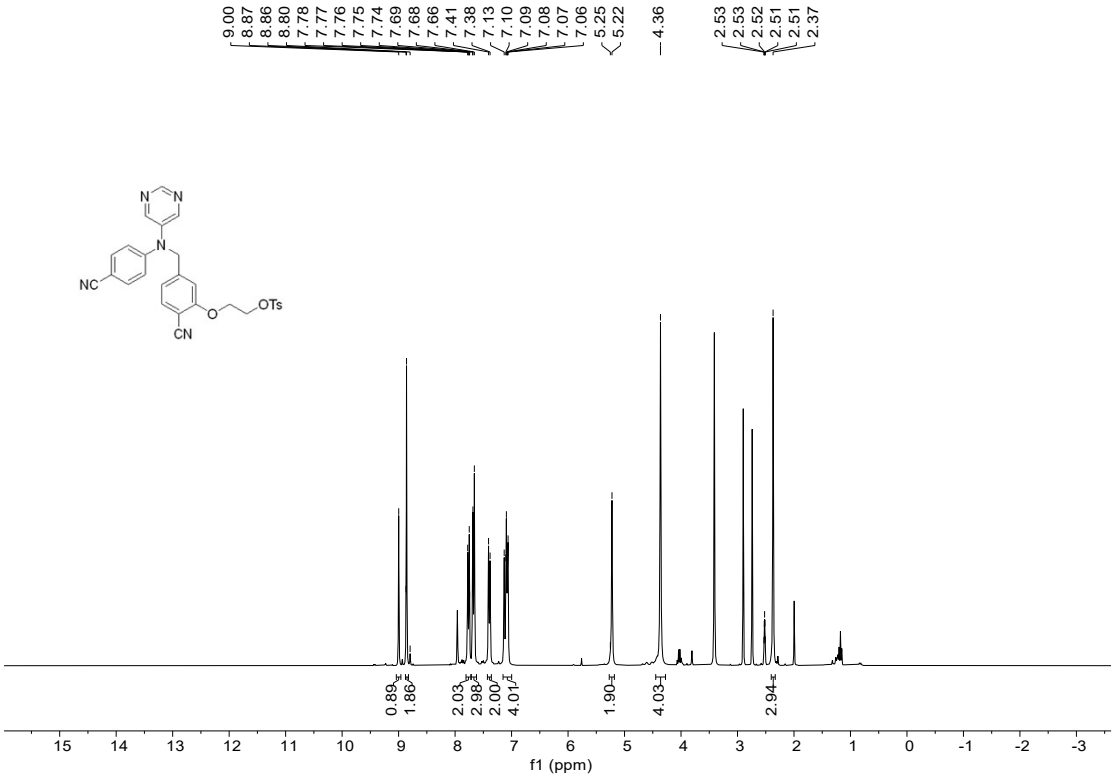
Table S9. Docking results for **AromataPET-1** with the Aromatase

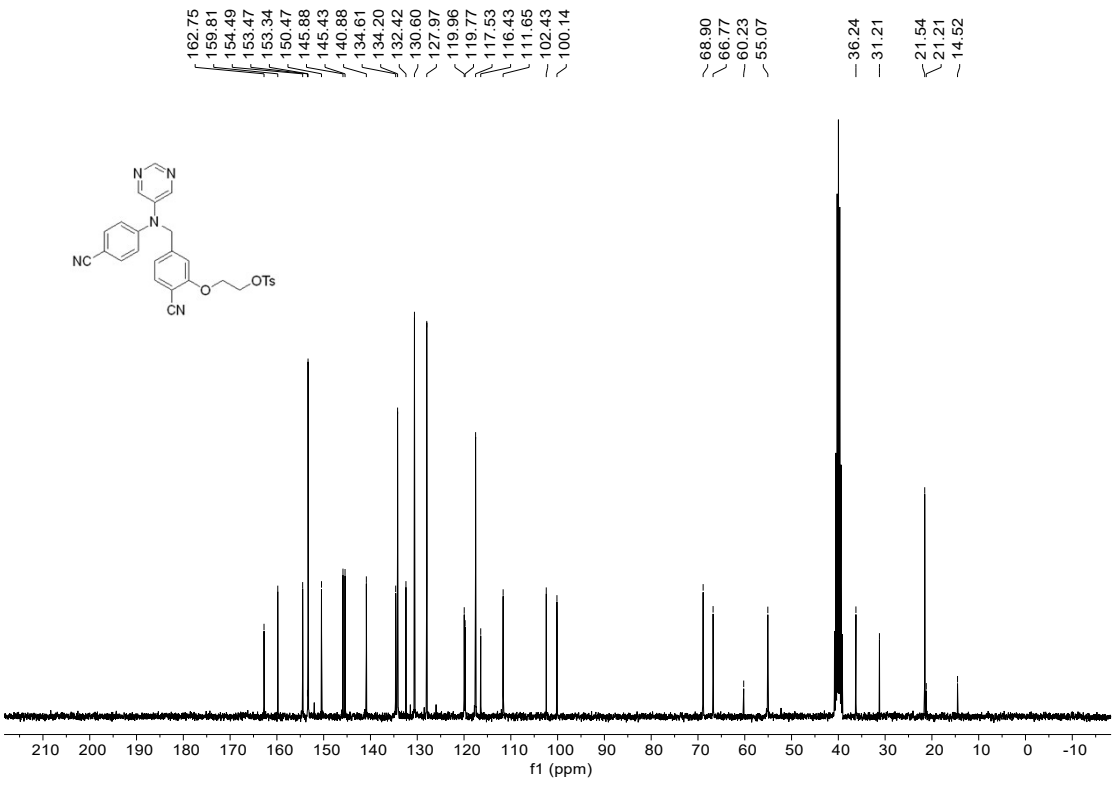
Mode	Affinity (kcal/mol)	Distance from best mode	
		rmsd l.b.	**rmsd u.b.**
1	-8.6	0.000	0.000
2	-8.6	0.042	1.070
3	-8.3	1.090	1.158
4	-7.3	1.308	5.645
5	-7.2	1.931	2.520
6	-6.8	2.044	2.510
7	-6.7	1.809	5.504
8	-6.4	2.668	6.081
9	-6.3	2.643	6.263
10	-6.1	13.962	15.944

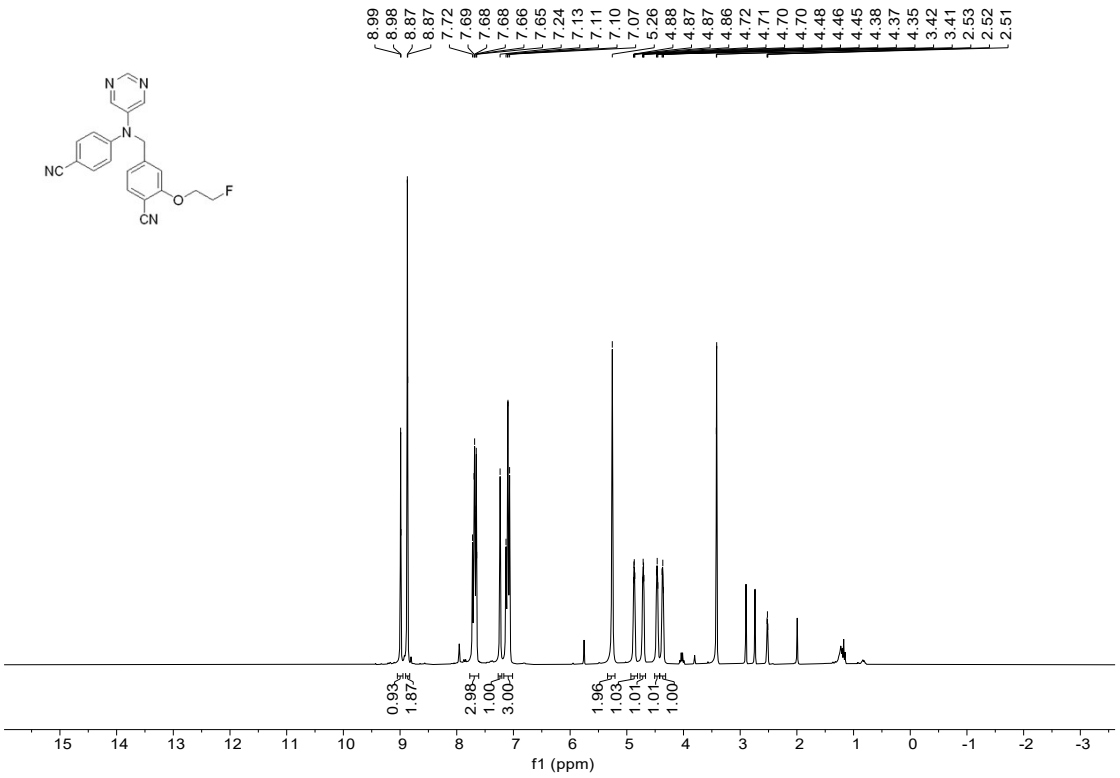
6. NMR of compounds

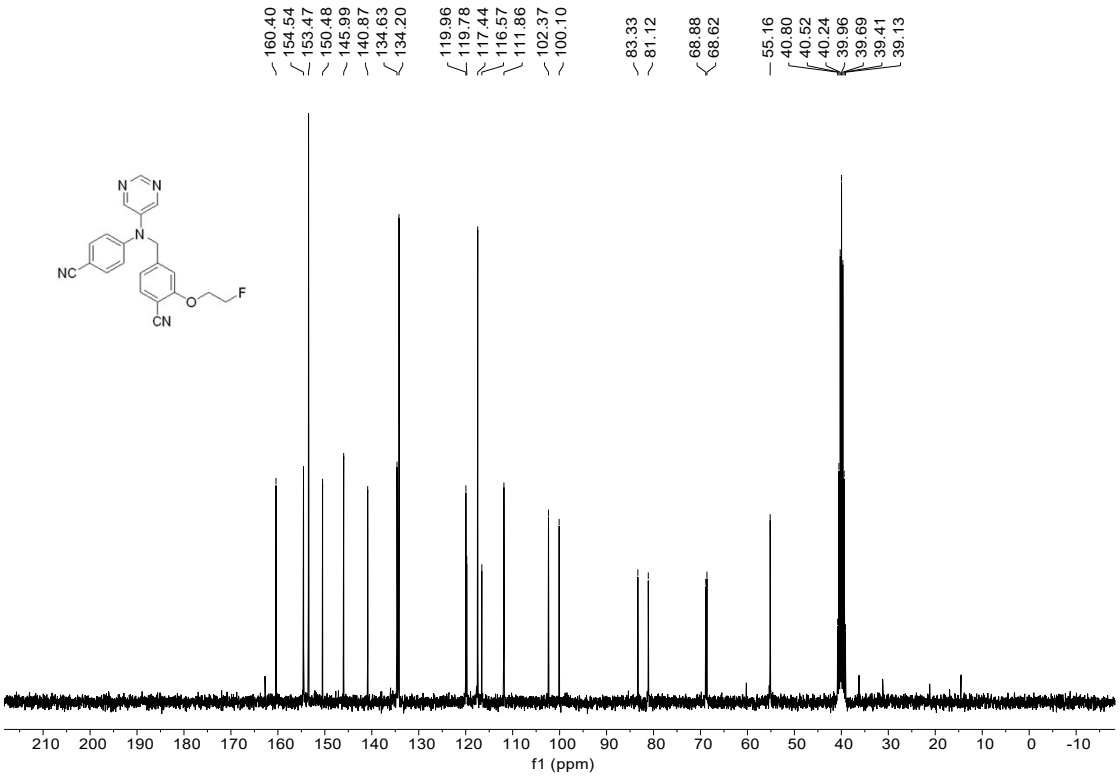


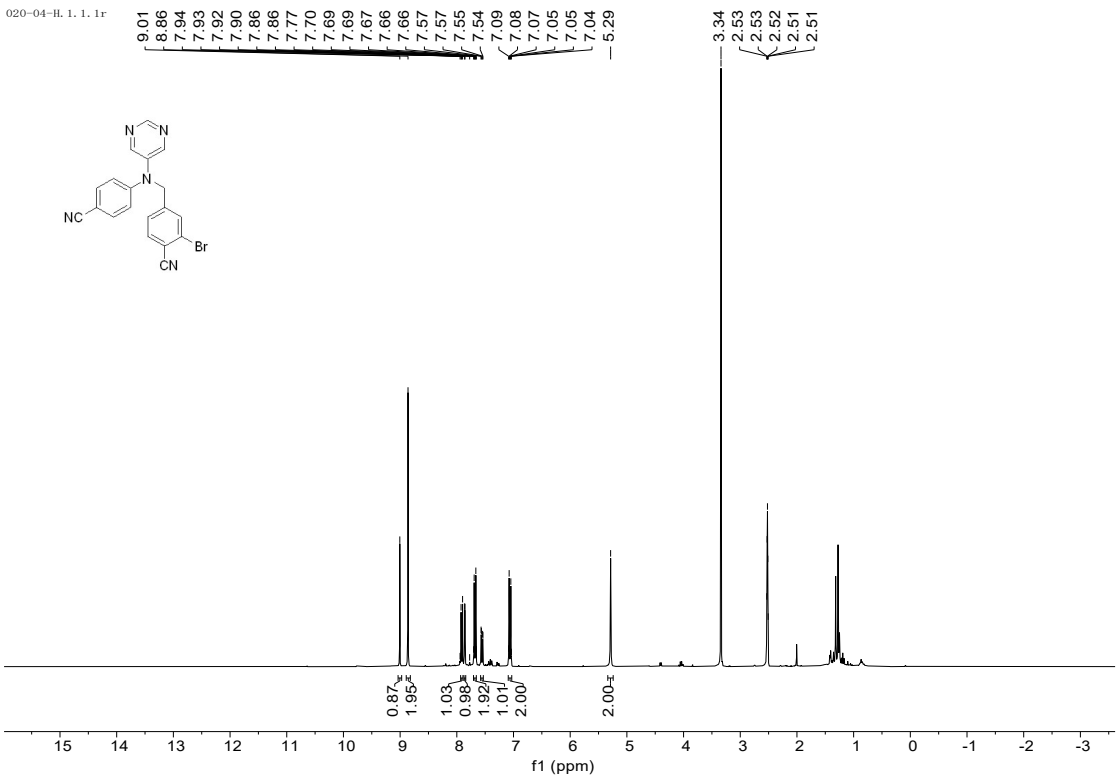


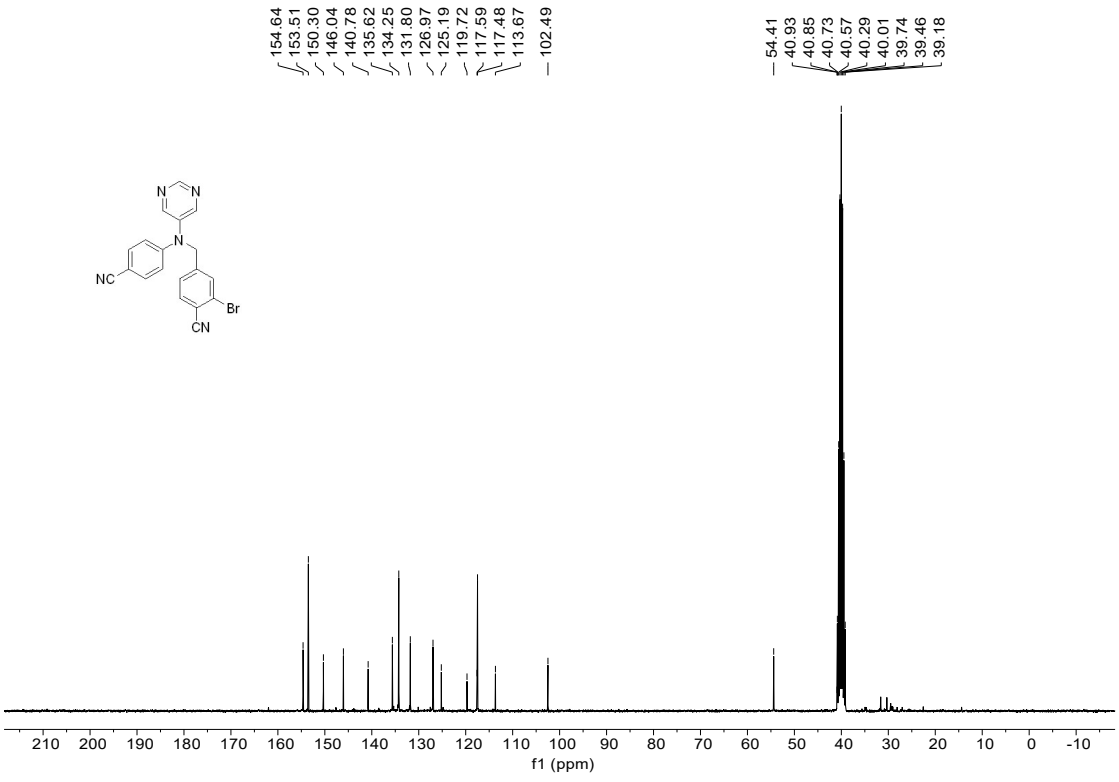

9.00
8.87
8.86
8.80
8.78
7.77
7.76
7.75
7.74
7.69
7.68
7.66
7.41
7.38
7.13
7.10
7.09
7.08
7.07
7.06
5.25
5.22
4.36
2.53
2.53
2.52
2.51
2.51
2.37
NC
OTs
CN
0.89
1.86
2.03
2.98
2.00
4.01
1.90
4.03
2.94
f1 (ppm)

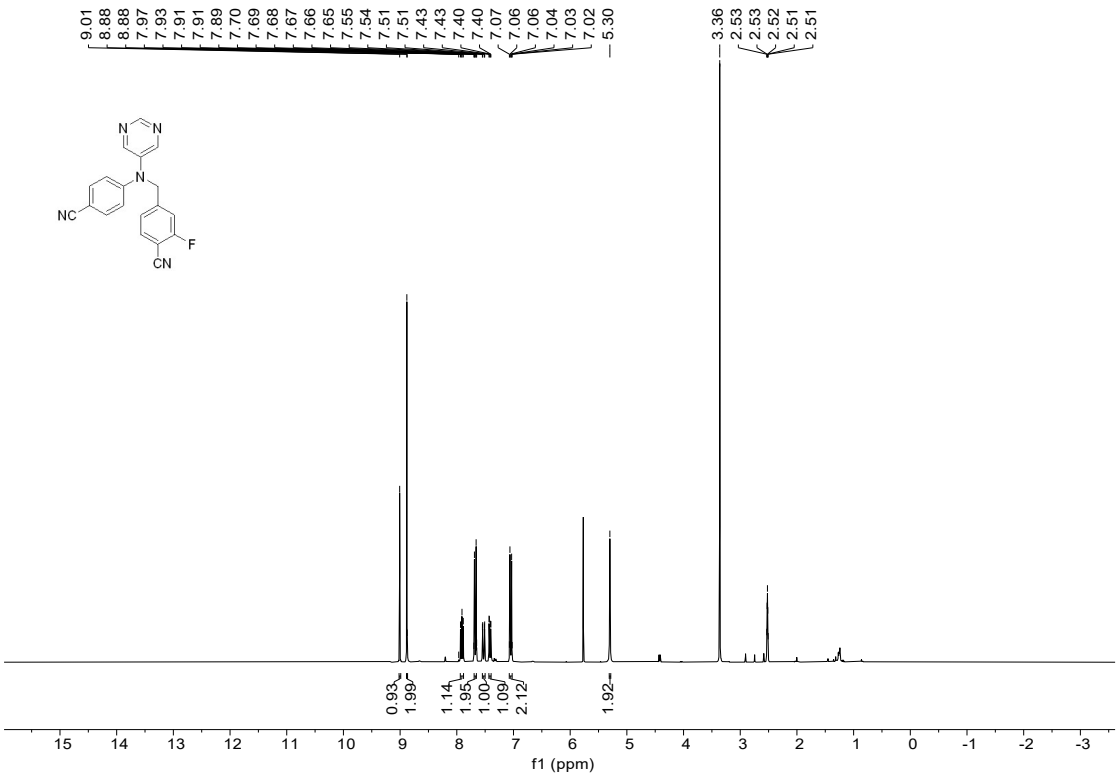

162.75
159.81
154.49
153.47
153.34
150.47
145.88
145.43
140.88
134.61
134.20
132.42
130.60
127.97
119.96
119.77
117.53
116.43
111.65
102.43
100.14
68.90
66.77
60.23
55.07
36.24
31.21
21.54
21.21
14.52
NC
OTs
CN
f1 (ppm)

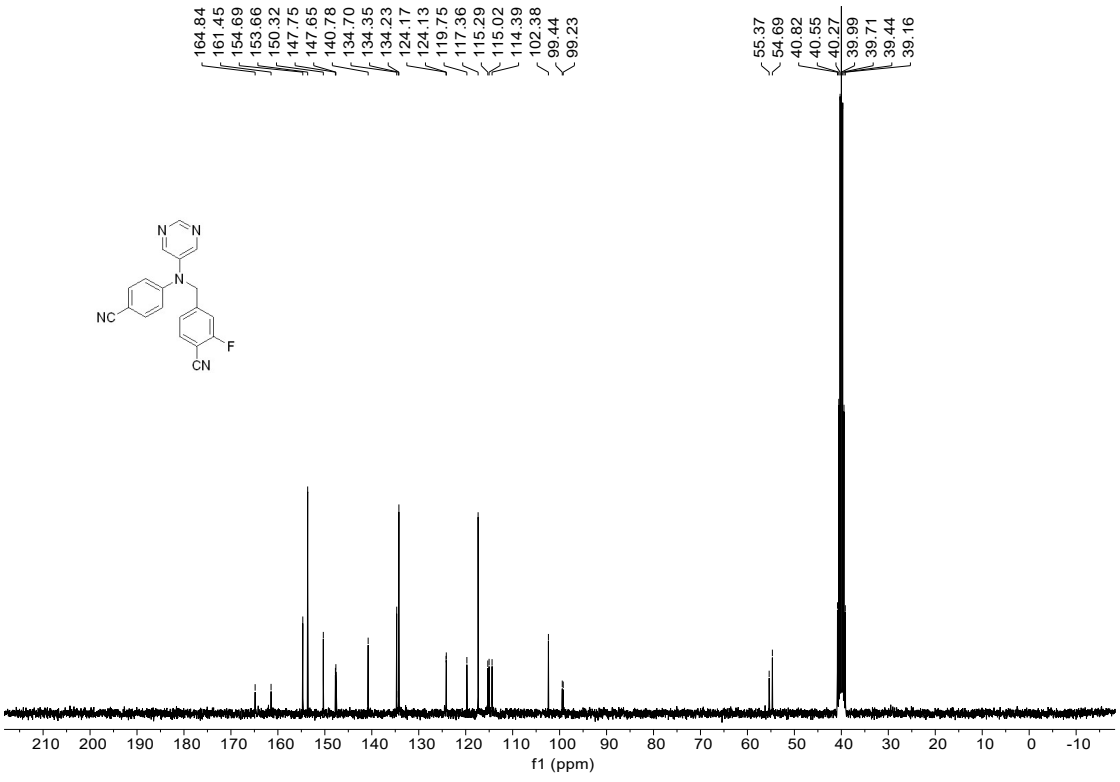

8.99
8.98
8.87
8.87
7.72
7.69
7.68
7.68
7.66
7.65
7.24
7.13
7.11
7.10
7.07
5.26
4.88
4.87
4.87
4.86
4.72
4.71
4.70
4.70
4.48
4.46
4.45
4.38
4.37
4.35
3.42
3.41
2.53
2.52
2.51
N
N
N
NC
O
F
CN
0.93
1.87
2.98
1.00
3.00
1.96
1.03
1.01
1.01
1.00
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3
f1 (ppm)

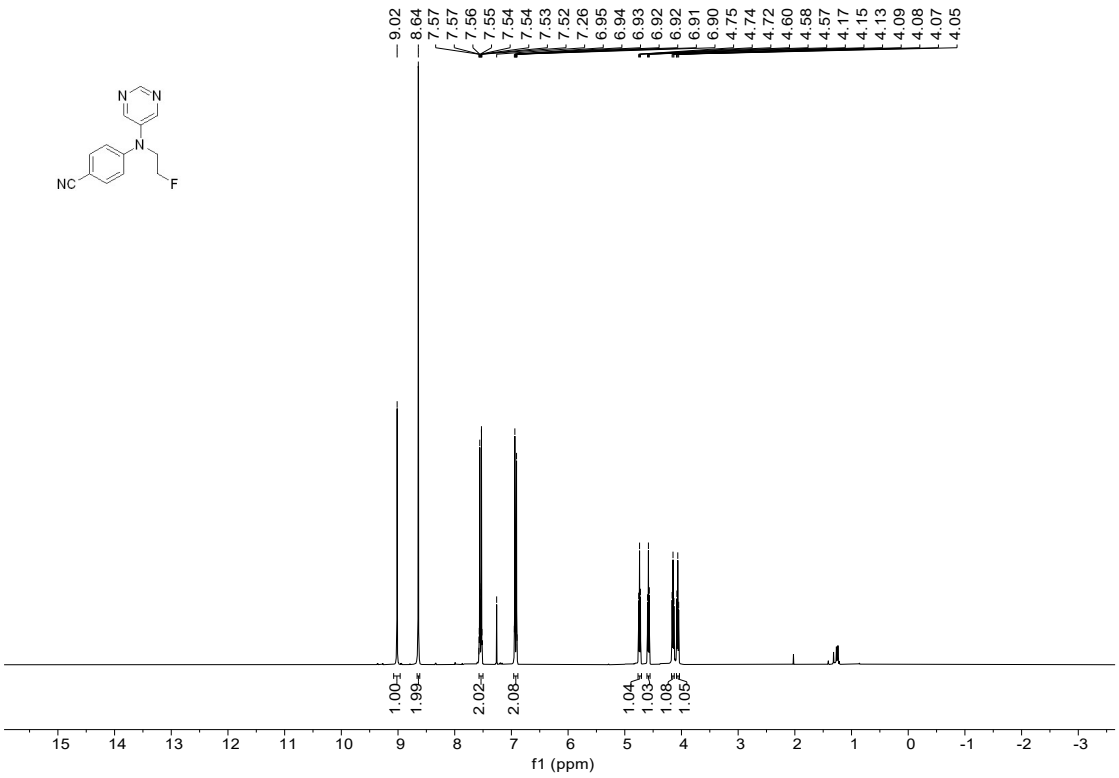

160.40
154.54
153.47
150.48
145.99
140.87
134.63
134.20
119.96
119.78
117.44
116.57
111.86
102.37
100.10
83.33
81.12
68.88
68.62
55.16
40.80
40.52
40.24
39.96
39.69
39.41
39.13
N
N
N
NC
O
F
CN
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

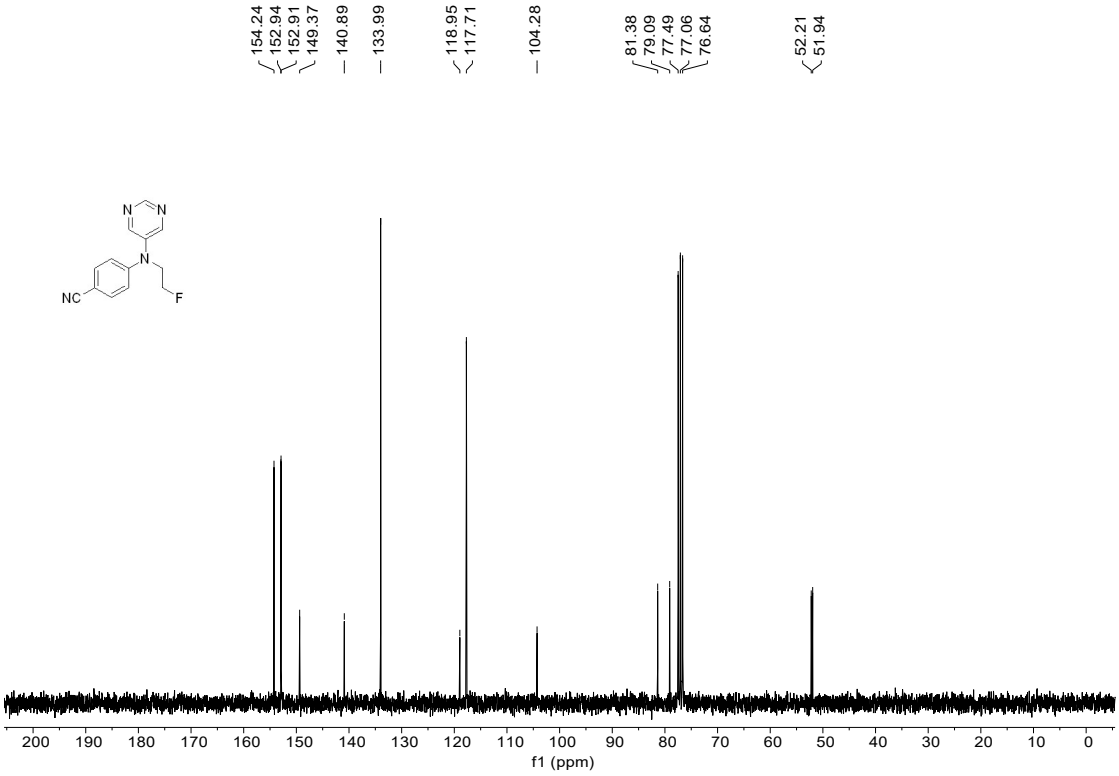

020-04-H. 1. 1. 1r
9.01
8.86
7.94
7.93
7.92
7.90
7.86
7.86
7.77
7.70
7.69
7.69
7.67
7.66
7.66
7.57
7.57
7.55
7.54
7.09
7.08
7.07
7.05
7.05
7.04
5.29
3.34
2.53
2.53
2.52
2.51
2.51
N
N
N
NC
Br
CN
0.87
1.95
1.03
0.98
1.92
1.01
2.00
2.00
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3
f1 (ppm)

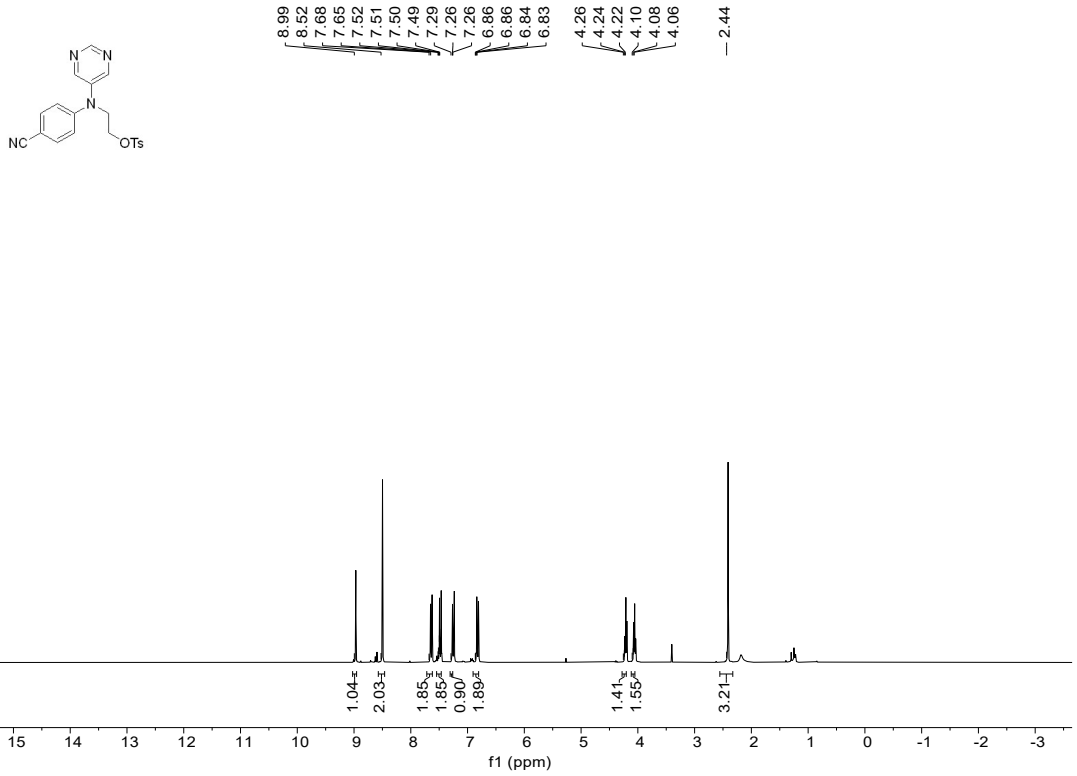

154.64
153.51
150.30
146.04
140.78
135.62
134.25
131.80
126.97
125.19
119.72
117.59
117.48
113.67
102.49
54.41
40.93
40.85
40.73
40.57
40.29
40.01
39.74
39.46
39.18
N
N
N
NC
Br
CN
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

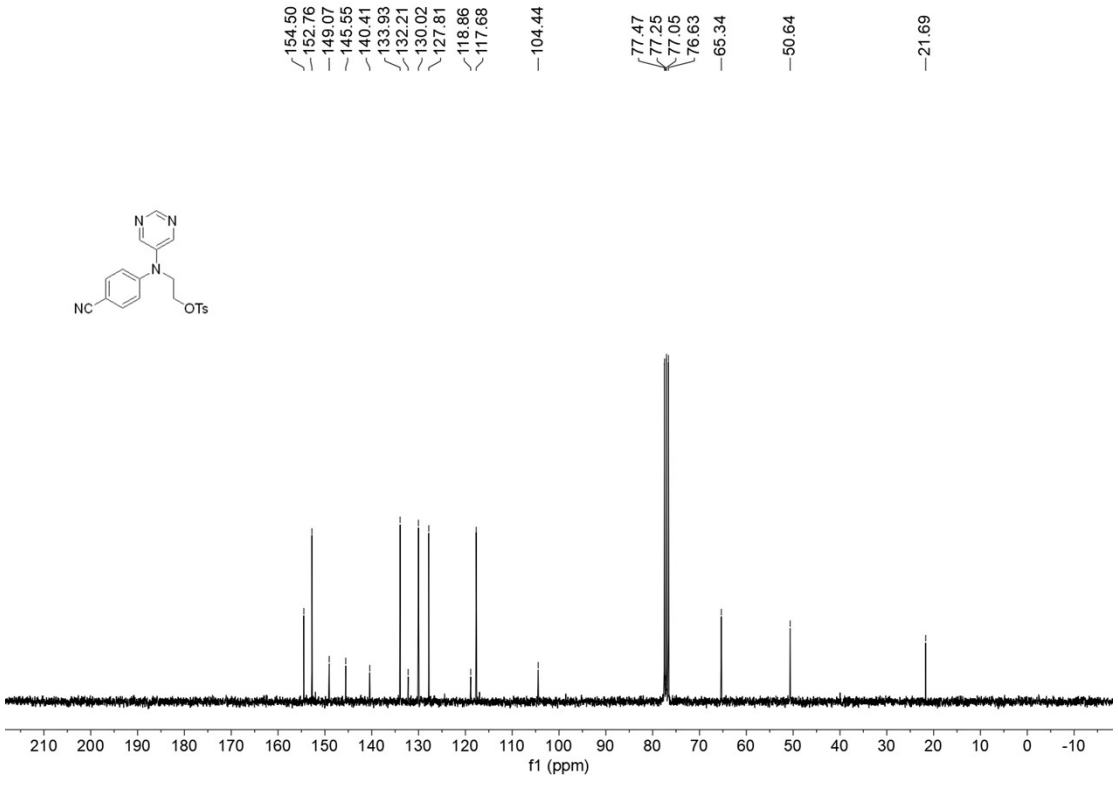

9.01
8.88
8.88
7.97
7.93
7.91
7.91
7.89
7.70
7.69
7.68
7.67
7.66
7.65
7.55
7.54
7.51
7.51
7.43
7.43
7.40
7.40
7.07
7.06
7.06
7.04
7.03
7.02
5.30
3.36
2.53
2.53
2.52
2.51
2.51
0.93
1.99
1.14
1.95
1.00
1.09
2.12
1.92
f1 (ppm)


164.84
161.45
154.69
153.66
150.32
147.75
147.65
140.78
134.70
134.35
134.23
124.17
124.13
119.75
117.36
115.29
115.02
114.39
102.38
99.44
99.23
55.37
54.69
40.82
40.55
40.27
39.99
39.71
39.44
39.16
f1 (ppm)


9.02
8.64
7.57
7.57
7.56
7.55
7.54
7.54
7.53
7.52
7.26
6.95
6.94
6.93
6.92
6.92
6.91
6.90
4.75
4.74
4.72
4.60
4.58
4.57
4.17
4.15
4.13
4.09
4.08
4.07
4.05
1.00
1.99
2.02
2.08
1.04
1.03
1.08
1.05
f1 (ppm)


154.24
152.94
152.91
149.37
140.89
133.99
118.95
117.71
104.28
81.38
79.09
77.49
77.06
76.64
52.21
51.94
f1 (ppm)


8.99
8.52
7.68
7.65
7.52
7.51
7.50
7.49
7.29
7.26
7.26
6.86
6.86
6.84
6.83
4.26
4.24
4.22
4.10
4.08
4.06
2.44
NC
OTs
1.04
2.03
1.85
1.85
0.90
1.89
1.41
1.55
3.21
f1 (ppm)


154.50
152.76
149.07
145.55
140.41
133.93
132.21
130.02
127.81
118.86
117.68
104.44
77.47
77.25
77.05
76.63
65.34
50.64
21.69
NC
OTs
f1 (ppm)