

Supporting Information

Highly Asymmetric Cobalt-Catalyzed Aziridination of Alkenes with Trichloroethoxysulfonyl Azide (TcesN₃)

Velusamy Subbarayan, Joshua V. Ruppel, Shifa Zhu, Jason A. Perman and
X. Peter Zhang

Department of Chemistry, University of South Florida, Tampa, Florida 33620-5250

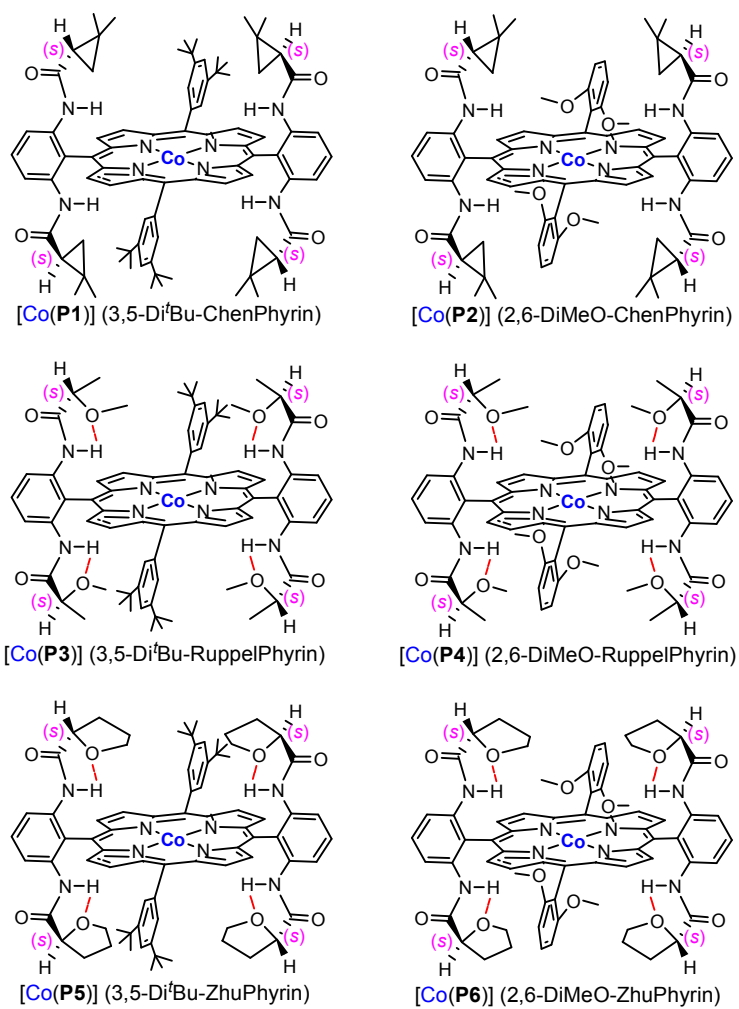
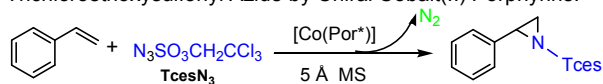


Figure S1. Structures of D_2 -Symmetric Chiral Cobalt(II) Porphyrins.

Table S1. Enantioselective Aziridination of Styrene with Trichloroethoxysulfonyl Azide by Chiral Cobalt(II) Porphyrins.^a



entry	[Co(Por*)] ^b	mol (%)	solvent	temp (°C)	yield (%) ^c	ee (%) ^d
1	[Co(P1)]	2.0	C ₆ H ₆	RT	78	21
2	[Co(P1)]	2.0	C ₆ H ₅ Cl	RT	80	25
3	[Co(P1)]	2.0	C ₂ H ₄ Cl ₂	RT	88	25
4	[Co(P2)]	2.0	C ₆ H ₅ Cl	RT	84	4
5	[Co(P3)]	2.0	C ₆ H ₅ Cl	RT	90	-39
6	[Co(P4)]	2.0	C ₆ H ₆	RT	78	-40
7	[Co(P4)]	2.0	C ₆ H ₅ Cl	RT	95	-51
8	[Co(P4)]	2.0	C ₂ H ₄ Cl ₂	RT	60	-39
9	[Co(P5)]	2.0	C ₆ H ₅ Cl	RT	85	52
10	[Co(P6)]	2.0	C ₆ H ₅ Cl	RT	58	86
11	[Co(P6)]	2.0	C ₆ H ₅ Cl	40	70	70
12	[Co(P6)]	3.0	C ₆ H ₅ Cl	RT	79	88
13	[Co(P6)]	3.0	C ₂ H ₄ Cl ₂	40	56	66
14	[Co(P6)]	5.0	C ₆ H ₅ Cl	RT	90	88
15	[Co(P6)]	5.0	C ₆ H ₅ Cl	40	84	76
16	[Co(P6)]	5.0	C ₆ H ₅ Cl	0	69	94
17 ^e	[Co(P6)]	5.0	C ₆ H ₅ Cl	0	91	94
18	[Co(P6)]	5.0	C ₆ H ₅ Cl	-10	15	96
19 ^e	[Co(P6)]	5.0	C ₆ H ₅ Cl	-10	59	96

^a Performed in chlorobenzene for 24 h under N₂ in the presence of 4 Å molecular sieves: alkene:TcesN₃ = 5.0:1.0; [alkene] = 0.25 M. ^b See Figure 1 for structures. ^c Isolated yields. ^d Determined by chiral HPLC. ^e In the presence of 5 mol % Pd(OAc)₂.

Table S2. [Co(P6)]-Catalyzed Enantioselective Aziridination of Different Alkenes with Trichloroethoxysulfonyl Azide (TcesN₃).^a

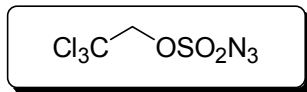
entry	olefin	aziridine	temp (°C)	yield (%) ^b	ee (%) ^c	[α] ^d
1			RT	90	88	
2			0	69	94	
3 ^f			0	91	94	(-)
4 ^{f,g}			0	60	94	
5 ^f			-10	59	96	
6			RT	84	79	
7			0	72	77	(-)
8 ^f			0	89	90	
9			RT	85	82	(-)
10			RT	86	84	(-)
11			RT	88	82	
12			0	65	85	(-)
13 ^f			0	89	85	
14			RT	90	84	(-)
15			0	71	91	(-)
16 ^f			0	93	91	(R) ^e
17			RT	90	83	
18			0	69	91	(-)
19 ^f			0	92	91	
20			RT	92	85	
21			0	72	90	(-)
22 ^f			0	90	90	
23			RT	94	80	
24			0	66	88	(-)
25 ^f			0	91	88	
26			RT	95	96	
27			0	68	99	(-)
28 ^f			0	92	99	
29			RT	82	71	
30			0	65	81	(-)
31 ^f			0	88	81	
32			RT	85	56	
33			0	62	80	(-)
34 ^f			0	82	80	
35			RT	90	70	
36			0	70	90	(-)
37 ^f			0	85	90	
38			RT	48	80	(-)
39			RT	43	80	(-)
40			40	87	--	--
41 ^h			40	26	90	(+)
42 ^{f,h}			40	42	91	(+)
43 ^{f,h}			40	30	90	(+)
44			0	26	94	(+)
45 ⁱ			RT	53	87	(-)
46			40	85	--	--
47			40	>50 ^j	--	--

^a Performed in C₆H₅Cl using 5 mol % [Co(P6)] for 24 h under N₂ with 4 Å MS; alkene:TcesN₃ = 5.0:1.0; [alkene] = 0.25 M. ^b Isolated yields. ^c By chiral HPLC. ^d Sign of optical rotation. ^e Determined by X-ray crystal structural analysis. ^f Added 5 mol % Pd(OAc)₂ for 48 h. ^g Styrene:TcesN₃ = 1.0:1.1. ^h Using [Co(P5)] as catalyst in CH₂Cl₂ for 48 h. ⁱ In CH₃CO₂C₂H₅. ^j Partial decomposition on silica gel.

General Considerations. All cross-coupling and aziridination reactions were performed under nitrogen in oven-dried glassware following standard Schlenk techniques. 4 Å molecular sieves were dried in a vacuum oven prior to use. Chlorobenzene, acetonitrile, and dichloromethane were dried over calcium hydride under nitrogen and freshly distilled before use. Toluene and tetrahydrofuran were distilled under nitrogen from sodium benzophenone ketyl prior to use. Co-Chiral Porphyrins were prepared from reported procedure¹. Thin layer chromatography was performed on Merck TLC plates (silica gel 60 F254). Flash column chromatography was performed with ICN silica gel (60 Å, 230-400 mesh, 32-63 µm). ¹H NMR and ¹³C NMR were recorded on a Varian Inova400 (400 MHz) instrument with chemical shifts reported relative to residual solvent. Infrared spectra were measured with a Nicolet Avatar 320 spectrometer with a Smart Miracle accessory. HPLC measurements were carried out on a Shimadzu HPLC system with a Whelk-O 1, Chiralcel OD-H, or Chiralcel OJ-H column. HRMS data was obtained on an Agilent 1100 LC/MS ESI/TOF mass spectrometer with electrospray ionization. Optical rotation was measured on a Rudolf Autopol IV Polarimeter.

Synthesis of Trichloroethoxysulfonyl Azide. The 2,2,2-trichloroethanol (1.91 ml, 20 mmol) was dissolved in DCM (20 mL). Pyridine (10 mL) was added in one portion at 0 °C, and the resulting solution was stirred for 15-20 minutes. Sulfuryl chloride (1.78 mL, 22 mmol in 20 mL DCM) was added dropwise over 20-30 minutes. The reaction mixture was allowed to warm up to room temperature and stirred overnight. After the reaction was complete, the flask underwent rotary evaporation until the DCM was removed. The residue was dissolved in 10 mL CH₃CN and the solution was stirred at 0 °C for 15-20 minutes. Sodium azide (1.95 g, 1.5 eq) was added in one portion to the sulfuryl chloride mixture and the reaction mixture was allowed to warm up to room temperature and stirred overnight. After the reaction was complete, the flask underwent rotary evaporation until the acetonitrile was removed. The crude product was extracted from the water using ethyl acetate (3 x 50 mL). It was then washed with brine (20 mL), dried over sodium sulfate, and concentrated by rotary evaporation. The resulting oil was then purified by flash

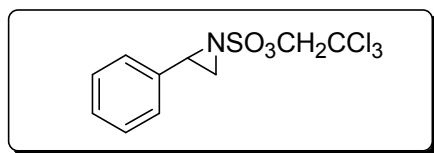
column chromatography. The fractions containing product were collected and concentrated by rotary evaporation to afford a colorless oily liquid (4.3 g, 84%).



Trichloroethoxysulfonyl Azide: ¹H NMR (400 MHz, CDCl₃): δ 4.74 (s, 2H). ¹³C NMR (100 MHz, CDCl₃): δ 92.3, 80.5. IR (neat, cm⁻¹): 2964, 2146, 1415, 1192, 1087, 995, 866, 784, 724, 622.

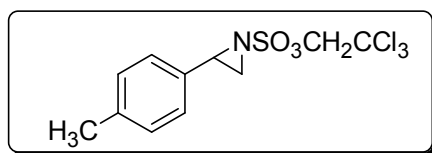
General Procedure for the Aziridination of Alkenes.

An oven dried Schlenk tube, that was previously evacuated and backfilled with nitrogen gas, was charged with catalyst (0.05 mmol), Pd(OAc)₂ (0.05 mmol), and 4Å MS (100 mg). The Schlenk tube was then evacuated and backfilled with nitrogen. The Teflon screw cap was replaced with a rubber septum and 0.5 ml of solvent was added followed by styrene (0.5 mmol) at room temperature, another portion of solvent at 0°C, then azide (0.1 mmol), and the remaining solvent (total 1 mL). The Schlenk tube was then purged with nitrogen for 1 minute and the rubber septum was replaced with the Teflon screw cap. The Schlenk tube was then placed at room temperature or 0°C for 24-48 h. Following the completion of the reaction, the reaction mixture was purified by flash chromatography. The fractions containing product were collected and concentrated by rotary evaporation to afford the compound.

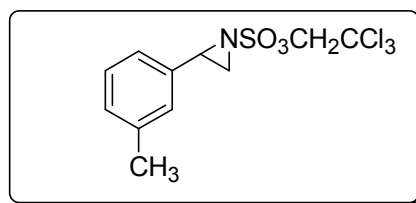


2-Phenyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:² [α]²⁰_D = -52.38 (*c* = 0.31, CHCl₃, ee = 94%). ¹H NMR (400 MHz, CDCl₃): δ 7.39-7.32 (m, 5H), 4.88 (d, 1H, *J* = 10.9 Hz), 4.81 (d, 1H, *J* = 10.9 Hz), 3.88 (dd, 1H, *J* = 7.2, 4.6 Hz), 3.09 (d, 1H, *J* = 7.2 Hz), 2.63 (d, 1H, *J* = 4.7 Hz). ¹³C NMR (100 MHz, CDCl₃): δ 133.8, 128.9, 128.8,

126.5, 92.8, 79.6, 42.7, 37.5. IR (neat, cm^{-1}): 2925, 1365, 1182, 1094, 1008, 908, 880, 785, 716, 695, 622. HRMS (ESI) Calcd. for $\text{C}_{10}\text{H}_{10}\text{Cl}_3\text{NO}_3\text{S}$: 328.9447, Found 182.0280 ($\text{M}^+ - \text{OCH}_2\text{CCl}_3$). HPLC analysis: ee = 96%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{\text{minor}} = 19.0$ min, $t_{\text{major}} = 23.4$ min.

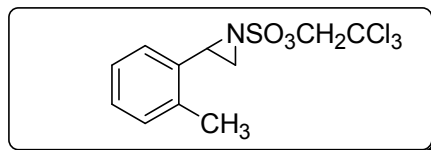


2-*p*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:² $[\alpha]^{20}\text{D} = -22.10$ ($c = 0.75$, CHCl_3 , ee = 90%). ^1H NMR (400 MHz, CDCl_3): δ 7.16 (s, 4H), 4.86 (d, 1H, $J = 10.8$ Hz), 4.79 (d, 1H, $J = 10.8$ Hz), 3.84 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.06 (d, 1H, $J = 6.8$ Hz), 2.60 (d, 1H, $J = 4.8$ Hz), 2.34 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3): δ 139.1, 130.9, 129.7, 126.7, 93.9, 79.9, 43.0, 37.6, 21.4. IR (neat, cm^{-1}): 2924, 2852, 1366, 1182, 1086, 1007, 917, 870, 788, 718. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_{11}\text{H}_{13}\text{Cl}_3\text{NO}_3\text{S}$: 343.9682, Found 343.9690. HPLC analysis: ee = 90%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{\text{minor}} = 19.1$ min, $t_{\text{major}} = 23.8$ min.

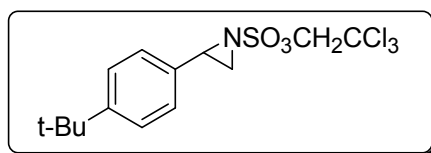


2-*m*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}\text{D} = -49.99$ ($c = 0.85$, CHCl_3 , ee = 82%). ^1H NMR (400 MHz, CDCl_3): δ 7.26 (s, 4H), 4.81 (d, 1H, $J = 10.8$ Hz), 3.83 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.06 (d, 1H, $J = 7.2$ Hz), 2.60 (d, 1H, $J = 4.4$ Hz), 2.34 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3): δ 138.8, 133.9, 129.9, 128.9, 127.4, 123.9, 93.1, 79.9, 43.0, 37.6, 21.6. IR (neat, cm^{-1}): 2921, 2851, 1463, 1378, 1186, 1090, 888, 721, 618. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_{11}\text{H}_{13}\text{Cl}_3\text{NO}_3\text{S}$: 343.9682, Found

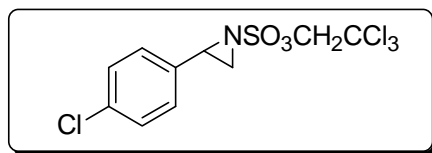
343.9694. HPLC analysis: ee = 82%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): t_{minor} = 18.7 min, t_{major} = 24.5 min.



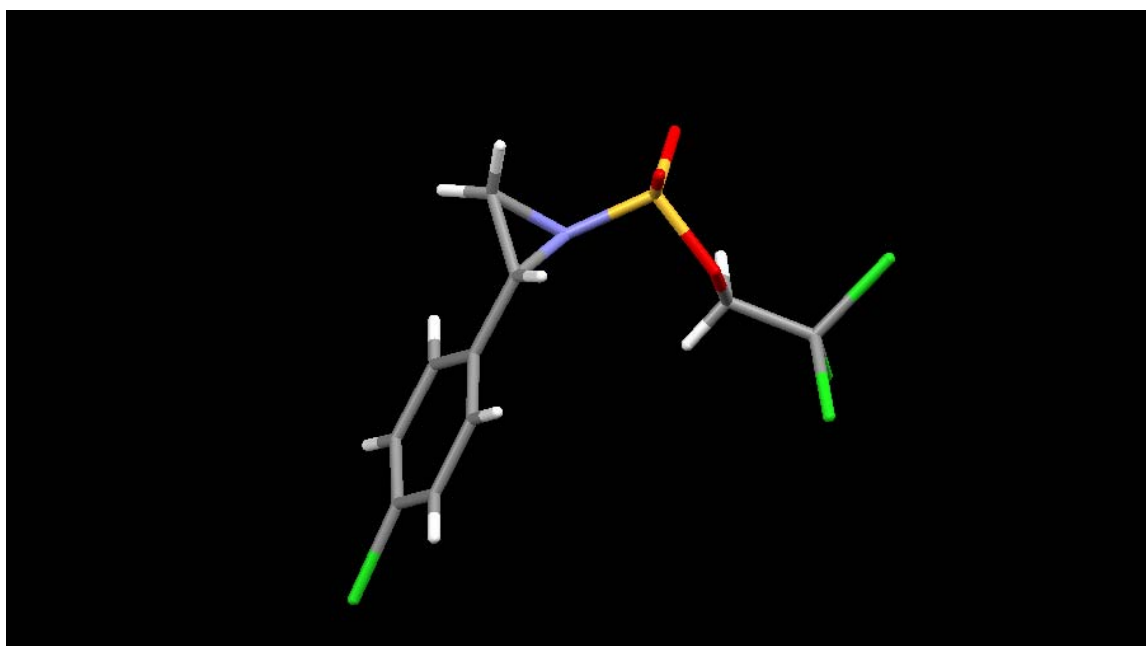
2-*o*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}_D = -24.81$ ($c = 0.66$, CHCl_3 , ee = 84%). $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.24-7.27 (m, 4H), 4.90 (d, 1H, $J = 10.8$ Hz), 4.84 (d, 1H, $J = 10.8$ Hz), 3.99 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.08 (d, 1H, $J = 6.8$ Hz), 2.57 (d, 1H, $J = 4.8$ Hz), 2.44 (s, 3H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ 137.3, 132.3, 130.6, 128.9, 126.5, 125.9, 93.1, 79.9, 41.5, 36.8, 19.3. IR (neat, cm^{-1}): 2926, 2854, 1364, 1180, 1095, 999, 921, 884, 846, 788, 723, 624. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_{11}\text{H}_{13}\text{Cl}_3\text{NO}_3\text{S}$: 343.9682, Found 343.9689. HPLC analysis: ee = 84%. Chiralcel OD-H (98% hexanes: 2%-isopropanol, 1.0mL/min): t_{minor} = 14.0 min, t_{major} = 15.3 min.



2-(4-*tert*-Butyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}_D = -17.08$ ($c = 1.51$, CHCl_3 , ee = 85%). $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.40 (d, 2H, $J = 8.4$ Hz), 7.25 (d, 2H, $J = 8.4$ Hz), 4.89 (d, 1H, $J = 10.8$ Hz), 4.82 (d, 1H, $J = 10.8$ Hz), 3.87 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.08 (d, 1H, $J = 7.2$ Hz), 2.63 (d, 1H, $J = 4.4$ Hz), 1.34 (s, 9H). $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ 152.4, 130.9, 126.6, 125.9, 93.1, 79.9, 42.9, 37.6, 34.9, 32.2, 31.5, 30.8. IR (neat, cm^{-1}): 2922, 2852, 1493, 1377, 1260, 1183, 1389, 1385, 1182, 1089, 1018, 801, 725. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_{14}\text{H}_{19}\text{Cl}_3\text{NO}_3\text{S}$: 386.0152, Found 386.0159. HPLC analysis: ee = 85%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): t_{minor} = 15.8 min, t_{major} = 18.5 min.



2-(4-Chloro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:² $[\alpha]^{20}_D = -56.13$ ($c = 0.46$, CHCl_3 , $ee = 91\%$). $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 (d, 2H, $J = 8.4$ Hz), 7.23 (d, 2H, $J = 8.4$ Hz), 4.86 (d, 1H, $J = 10.8$ Hz), 4.80 (d, 1H, $J = 10.8$ Hz), 3.83 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.08 (d, 1H, $J = 7.2$ Hz), 2.57 (d, 1H, $J = 4.8$ Hz). $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ 135.1, 132.6, 129.3, 128.1, 92.9, 79.9, 42.3, 37.8. IR (neat, cm^{-1}): 2922, 2851, 1366, 1182, 1085, 1007, 915, 868, 792, 716. HRMS (ESI) ($[\text{M}]^+$) Calcd. for $\text{C}_{10}\text{H}_9\text{Cl}_4\text{NO}_3\text{S}$: 362.9057, Found 362.9077. HPLC analysis: $ee = 91\%$. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{\text{minor}} = 20.4$ min, $t_{\text{major}} = 25.8$ min.



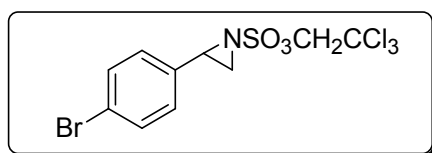
The X-ray intensities were measured using Bruker-AXS SMART APEX/CCD diffractometer ($\text{CuK}\alpha$, $\lambda = 0.71073$ Å). Indexing was performed using SMART v5.625. Frames were integrated with SaintPlus 6.01 software package. Absorption correction was performed by multi-scan method implemented in SADABS. The structure was solved

using SHELXS-97 and refined using SHELXL-97 contained in SHELXTL v6.10 and WinGX v1.70.01 program packages. All non-hydrogen atoms were refined anisotropically. Absolute configuration (and absolute structure) was established by anomalous-dispersion effects in diffraction measurements on the crystal. Crystal data and refinement conditions are shown in Table 1.

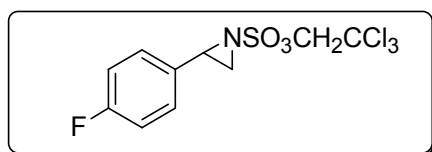
Table 1. Crystal data and structure refinement for (4-Chloro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

Empirical formula	C ₁₀ H ₉ Cl ₄ N O ₃ S	
Formula weight	365.04	
Temperature	100 K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P2(1)	
Unit cell dimensions	a = 10.4908(6) Å	α = 90°.
	b = 6.0700(4) Å	β = 104.370(3)°.
	c = 12.0008(7) Å	γ = 90°.
Volume	740.29(8) Å ³	
Z	2	
Density (calculated)	1.638 Mg/m ³	
Absorption coefficient	8.624 mm ⁻¹	
F(000)	368	
Crystal size	0.40 x 0.20 x 0.10 mm ³	
Theta range for data collection	3.80 to 68.13°.	
Index ranges	-12 ≤ h ≤ 12, -7 ≤ k ≤ 6, -14 ≤ l ≤ 13	
Reflections collected	6397	
Independent reflections	2367 [R(int) = 0.0384]	
Completeness to theta = 68.13°	96.6 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.4793 and 0.1299	
Refinement method	Full-matrix least-squares on F ₂	

Data / restraints / parameters	2367 / 1 / 172
Goodness-of-fit on F ₂	1.037
Final R indices [I>2sigma(I)]	R1 = 0.0347, wR2 = 0.0831
R indices (all data)	R1 = 0.0376, wR2 = 0.0851
Absolute structure parameter	0.04(2)
Largest diff. peak and hole	0.275 and -0.284 e.Å ⁻³

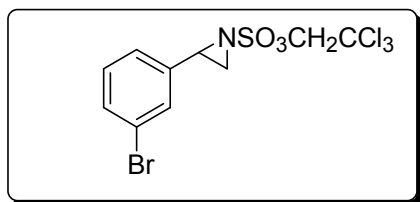


2-(4-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}_D = -51.64$ ($c = 0.57$, CHCl_3 , $ee = 91\%$). $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.49 (d, 2H, $J = 8.4$ Hz), 7.17 (d, 2H, $J = 8.4$ Hz), 4.86 (d, 1H, $J = 11.2$ Hz), 4.80 (d, 1H, $J = 11.2$ Hz), 3.82 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.08 (d, 1H, $J = 7.2$ Hz), 2.57 (d, 1H, $J = 4.4$ Hz). $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ 133.2, 132.2, 128.4, 123.2, 92.9, 79.9, 42.3, 37.7. IR (neat, cm^{-1}): 2926, 2853, 1365, 1179, 1090, 1008, 925, 889, 862, 789, 723. HRMS (ESI) ($[\text{M}]^+$) Calcd. for $\text{C}_{10}\text{H}_9\text{BrCl}_3\text{NO}_3\text{S}$: 406.8552, Found 406.8580. HPLC analysis: $ee = 91\%$. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{\text{minor}} = 22.6$ min, $t_{\text{major}} = 28.7$ min.

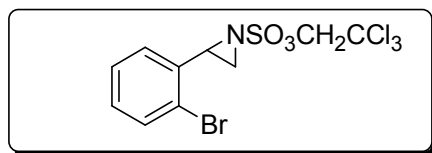


2-(4-Fluoro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}_D = -46.12$ ($c = 0.66$, CHCl_3 , $ee = 90\%$). $^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.28 (d, 2H, $J = 8.8$ Hz), 7.06 (d, 2H, $J = 8.4$ Hz), 4.86 (d, 1H, $J = 10.8$ Hz), 4.80 (d, 1H, $J = 10.8$ Hz), 3.85 (dd, 1H, $J = 7.2, 4.4$ Hz), 3.07 (d, 1H, $J = 7.2$ Hz), 2.57 (d, 1H, $J = 4.8$ Hz). $^{13}\text{C NMR}$ (100 MHz, CDCl_3): δ 164.5, 161.9, 129.8, 128.6, 128.5, 116.2, 115.9, 93.0, 79.9,

42.3, 37.7. IR (neat, cm^{-1}): 2925, 2854, 1516, 1367, 1182, 1086, 1008, 975, 919, 871, 837, 793, 717. HRMS (ESI) ($[\text{M}]^+$) Calcd. for $\text{C}_{10}\text{H}_9\text{Cl}_3\text{FNO}_3\text{S}$: 346.9353, Found 346.9370. HPLC analysis: ee = 90%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{\text{minor}} = 17.4$ min, $t_{\text{major}} = 21.0$ min.

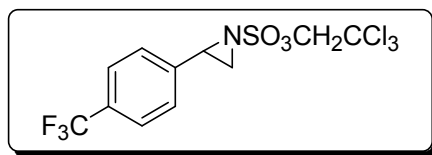


2-(3-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}\text{D} = -54.87$ ($c = 0.65$, CHCl_3 , ee = 88%). ^1H NMR (400 MHz, CDCl_3): δ 7.43-7.37 (m, 2H), 7.19-7.17 (m, 2H), 4.82 (d, 1H, $J = 10.8$ Hz), 4.66 (d, 1H, $J = 10.8$ Hz), 3.77 (dd, 1H, $J = 7.2, 4.4$ Hz), 3.02 (d, 1H, $J = 7.2$ Hz), 2.52 (d, 1H, $J = 4.8$ Hz). ^{13}C NMR (100 MHz, CDCl_3): δ 136.4, 132.3, 130.6, 129.7, 125.6, 123.1, 92.9, 79.9, 41.9, 37.7. IR (neat, cm^{-1}): 2925, 2853, 1464, 1369, 1181, 1088, 1009, 925, 854, 782, 725, 684. HRMS (ESI) ($[\text{M}]^+$) Calcd. for $\text{C}_{10}\text{H}_9\text{BrCl}_3\text{NO}_3\text{S}$: 407.8641, Found 407.8652. HPLC analysis: ee = 88%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{\text{minor}} = 20.2$ min, $t_{\text{major}} = 25.2$ min.

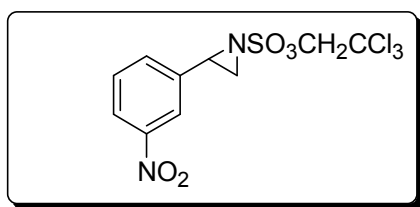


2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:² $[\alpha]^{20}\text{D} = -49.70$ ($c = 0.56$, CHCl_3 , ee = 99%). ^1H NMR (400 MHz, CDCl_3): δ 7.52 (d, 1H, $J = 8.0$ Hz), 7.28-7.12 (m, 3H), 4.85 (d, 1H, $J = 10.8$ Hz), 4.80 (d, 1H, $J = 10.8$ Hz), 4.08 (dd, 1H, $J = 7.2, 4.8$ Hz), 3.06 (d, 1H, $J = 7.2$ Hz), 2.43 (d, 1H, $J = 4.4$ Hz). ^{13}C NMR (100 MHz, CDCl_3): δ 133.9, 132.9, 130.3, 127.9, 127.8, 123.6, 93.1, 79.9, 43.0, 37.6. IR (neat, cm^{-1}): 2923, 2854, 1464, 1372, 1260, 1183, 1096, 1002, 917, 788, 755, 724, 623. HRMS

(ESI) ($[M]^+$) Calcd. for $C_{10}H_9BrCl_3NO_3S$: 406.8552, Found 406.8535. HPLC analysis: ee = 99%. Chiralcel OJ-H (95% hexanes: 5%-isopropanol, 1mL/min): t_{major} = 13.3 min, t_{minor} = 16.4 min.

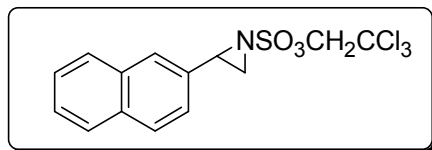


2-(4-Trifluoromethyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:
 $[\alpha]^{20}_D = -42.07$ ($c = 0.80$, $CHCl_3$, ee = 81%). 1H NMR (400 MHz, $CDCl_3$): δ 7.63 (d, 2H, $J = 8.0$ Hz), 7.40 (d, 2H, $J = 8.0$ Hz), 4.88 (d, 1H, $J = 10.8$ Hz), 4.82 (d, 1H, $J = 10.8$ Hz), 3.91 (dd, 1H, $J = 7.2, 4.4$ Hz), 3.12 (d, 1H, $J = 7.2$ Hz), 2.59 (d, 1H, $J = 4.4$ Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ 138.2, 131.5, 131.3, 127.2, 126.1, 126.0, 125.4, 92.9, 79.9, 42.0, 37.9. IR (neat, cm^{-1}): 2925, 2854, 1382, 1324, 1182, 1121, 1068, 1009, 920, 850, 783, 724. HRMS (ESI) ($[M+H]^+$) Calcd. for $C_{11}H_{10}Cl_3F_3NO_3S$: 397.9395, Found 397.9390. HPLC analysis: ee = 81%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): t_{minor} = 16.4 min, t_{major} = 19.5 min.

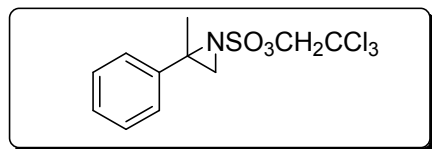


2-(3-Nitro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:² $[\alpha]^{20}_D = -101.66$ ($c = 0.32$, $CHCl_3$, ee = 80%). 1H NMR (400 MHz, $CDCl_3$): δ 8.22 (d, 1H, $J = 8.0$ Hz), 8.15 (s, 1H), 7.66 (d, 1H, $J = 8.0$ Hz), 7.58 (t, 1H, $J = 8.0$ Hz), 4.90 (d, 1H, $J = 10.8$ Hz), 4.84 (d, 1H, $J = 10.8$ Hz), 3.95 (dd, 1H, $J = 7.2, 4.4$ Hz), 3.15 (d, 1H, $J = 7.2$ Hz), 2.63 (d, 1H, $J = 4.8$ Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.8, 136.5, 122.9, 130.2, 124.1, 121.7, 92.9, 80.0, 41.6, 37.9. IR (neat, cm^{-1}): 2922, 2853, 1534, 1368, 1345, 1182, 1010, 939, 874, 787, 720, 648. calcd for $C_{10}H_9Cl_3N_2O_5S$ 373.9298. Found 227.0130

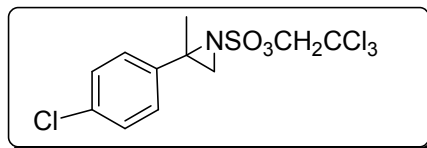
(M⁺-OCH₂CCl₃). HPLC analysis: ee = 80%. Welko-O 1 (98% hexanes: 2%-isopropanol, 1.0mL/min): t_{minor} = 29.8 min, t_{major} = 32.2 min.



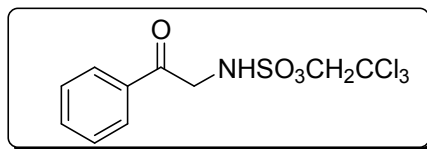
2-Naphthalene-2yl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}_D = -86.69$ ($c = 0.27$, CHCl₃, ee = 90%). ¹H NMR (400 MHz, CDCl₃): δ 7.85-7.81 (m, 4H), 7.52-7.50 (m, 2H), 7.33-7.31 (m, 1H), 4.90 (d, 1H, $J = 10.8$ Hz), 4.83 (d, 1H, $J = 10.8$ Hz), 4.04 (dd, 1H, $J = 7.2, 4.4$ Hz), 3.16 (d, 1H, $J = 7.2$ Hz), 2.72 (d, 1H, $J = 4.8$ Hz). ¹³C NMR (100 MHz, CDCl₃): δ 133.6, 122.2, 131.4, 129.0, 128.1, 128.0, 126.9, 126.9, 127.8, 123.5, 93.1, 79.9, 43.3, 37.7. IR (neat, cm⁻¹): 2922, 2852, 1364, 1260, 1180, 1090, 1003, 861, 788, 721, 643. HRMS (ESI) ($[M+H]^+$) Calcd. for C₁₄H₁₃Cl₃NO₃S: 379.9682, Found 379.9694. HPLC analysis: ee = 90%. Welko-O 1 (98% hexanes: 2%-isopropanol, 1.0mL/min): t_{minor} = 19.6 min, t_{major} = 28.1 min.



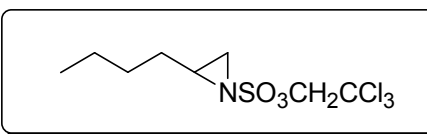
2-Phenyl-1-Methyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester: $[\alpha]^{20}_D = -1.68$ ($c = 0.26$, CHCl₃, ee = 80%). ¹H NMR (400 MHz, CDCl₃): δ 7.38-7.19 (m, 5H), 4.81 (s, 2H), 3.00 (s, 1H), 2.77 (s, 1H), 1.95 (s, 3H). IR (neat, cm⁻¹): 2922, 1365, 1182, 1094, 1008, 908, 880, 785, 716, 695, 622. HRMS (ESI) ($[M+H]^+$) Calcd. for C₁₁H₁₃Cl₃NO₃S: 343.9682, Found 343.9630. HPLC analysis: ee = 80%. Chiralcel OD-H (98.5% hexanes: 1.5%-isopropanol, 0.8mL/min): t_{minor} = 16.2 min, t_{major} = 17.3 min.



4-Chloro-2-Phenyl-1-Methyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester:
[α]²⁰_D = -1.92 (*c* = 0.16, CHCl₃, ee = 80%). ¹H NMR (400 MHz, CDCl₃): δ 7.29 (s, 4H), 4.77 (s, 2H), 2.97 (s, 1H), 2.71 (s, 1H), 1.89 (s, 3H). ¹³C NMR (100 MHz, CDCl₃): δ 138.22, 134.54, 129.94, 129.11, 128.13, 93.26, 79.71, 50.74, 43.42, 20.82. IR (neat, cm⁻¹): 2922, 1365, 1182, 1094, 1008, 908, 880, 785, 716, 695, 622. HRMS (ESI) ([M+H]⁺): Calcd. for C₁₁H₁₂Cl₄NO₃S: 377.9293, Found 377.9278. HPLC analysis: ee = 80%. Chiralcel OD-H (98.5% hexanes: 1.5%-isopropanol, 0.8mL/min): *t*_{minor} = 15.4 min, *t*_{major} = 19.6 min.

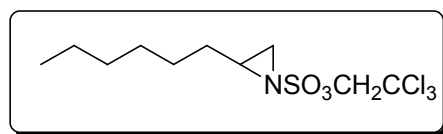


¹H NMR (400 MHz, CDCl₃): δ 7.94 (d, 2H, *J* = 7.28 Hz), 7.66 (t, 1H, *J* = 7.2 Hz), 7.51 (t, 2H, *J* = 7.6 Hz), 5.94 (bs, 1H), 4.70 (d, 1H, *J* = 4.0 Hz), 4.65 (s, 2H), 3.16 (d, 1H, *J* = 7.2 Hz), 2.72 (d, 1H, *J* = 4.8 Hz). ¹³C NMR (100 MHz, CDCl₃): δ 192.27, 135.05, 133.66, 129.39, 128.24, 93.49, 78.61, 49.47. IR (neat, cm⁻¹): 3280, 2958, 2922, 2852, 1686, 1448, 1409, 1371, 1313, 1234, 1178, 1079, 1014, 837, 747, 717, 620. HRMS (ESI) ([M+H]⁺): Calcd. for C₁₀H₁₁Cl₃NO₄S: 345.9679, Found 345.9694.

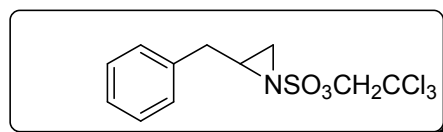


2-Butyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester³: [α]²⁰_D = +35.09 (*c* = 0.12, CHCl₃, ee = 91%). ¹H NMR (400 MHz, CDCl₃): δ 4.90 (d, 1H, *J* = 10.8 Hz), 4.83 (d, 1H,

$J = 10.8$ Hz), 2.87 (m, 1H), 2.72 (d, 1H, $J = 7.2$ Hz), 2.25 (d, 1H, $J = 4.8$ Hz), 1.62-1.33 (m, 6H), 0.92 (t, 3H). ^{13}C NMR (100 MHz, CDCl_3): δ 93.0, 79.6, 42.6, 35.7, 31.0, 28.8, 22.4, 14.2. IR (neat, cm^{-1}): 2958, 2852, 1364, 1260, 1180, 1090, 1013, 861, 788, 721, 643. HRMS (ESI) ($[\text{M}]^+$) Calcd. for $\text{C}_4\text{H}_{14}\text{Cl}_3\text{NO}_3\text{S}$: 308.9760, Found 308.9786. HPLC analysis: ee = 91%. Welko-O 1 (99% hexanes: 1%-isopropanol, 1.0mL/min): $t_{\text{major}} = 8.2$ min, $t_{\text{minor}} = 9.6$ min.

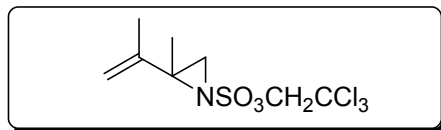


2-Hexyl-aziridine-1-sulfonic acid 2,2,2-trichloroethyl ester³: $[\alpha]^{20}\text{D} = +45.09$ ($c = 0.10$, CHCl_3 , ee = 90%). ^1H NMR (400 MHz, CDCl_3): δ 4.91 (d, 1H, $J = 10.8$ Hz), 4.84 (d, 1H, $J = 10.8$ Hz), 2.89 (m, 1H), 2.74 (d, 1H, $J = 7.2$ Hz), 2.26 (d, 1H, $J = 4.8$ Hz), 1.65-1.31 (m, 10H), 0.91 (t, 3H). ^{13}C NMR (100 MHz, CDCl_3): δ 93.0, 79.6, 42.6, 35.7, 31.0, 28.8, 22.4, 14.2. IR (neat, cm^{-1}): 2958, 2852, 1364, 1260, 1180, 1090, 1013, 861, 788, 721, 643. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_{10}\text{H}_{19}\text{Cl}_3\text{NO}_3\text{S}$: 338.0152, Found 338.0140. HPLC analysis: ee = 91%. Welko-O 1 (99% hexanes: 1%-isopropanol, 1.0mL/min): $t_{\text{major}} = 8.2$ min, $t_{\text{minor}} = 9.6$ min.

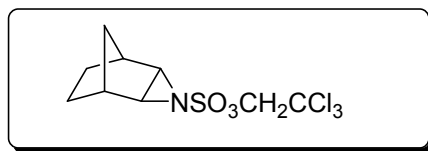


$[\alpha]^{20}\text{D} = +56.21$ ($c = 0.16$, CHCl_3 , ee = 94%). ^1H NMR (400 MHz, CDCl_3): δ 7.56-7.22 (m, 5H), 4.67 (d, 1H, $J = 10.8$ Hz), 4.54 (d, 1H, $J = 10.8$ Hz), 3.15-3.09 (m, 1H), 2.96-2.84 (m, 1H), 2.77 (d, 1H, $J = 7.2$ Hz), 2.33 (d, 1H, $J = 4.8$ Hz). ^{13}C NMR (100 MHz, CDCl_3): δ 136.1, 129.06, 129.01, 127.48, 92.6, 79.62, 42.55, 37.38, 35.23. IR (neat, cm^{-1}): 2958, 2852, 1364, 1260, 1180, 1090, 1013, 861, 788, 721, 643. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_{11}\text{H}_{13}\text{Cl}_3\text{NO}_3\text{S}$: 342.9603, Found 342.9615. HPLC analysis: ee =

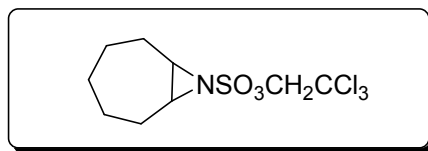
94%. Chiralcel OJ-H (95% hexanes: 5%-isopropanol, 0.8 mL/min): $t_{minor} = 34.6$ min, $t_{minor} = 42.6$ min.



$[\alpha]^{20}_D = -6.03$ ($c = 0.16$, CHCl₃, ee = 87%). ¹H NMR (400 MHz, CDCl₃): 5.04 (s, 1H), 4.98 (s, 1H), 4.78 (s, 2H), 2.79 (s, 1H), 2.63 (s, 1H), 1.80 (s, 3H), 1.73 (s, 3H). ¹³C NMR (100 MHz, CDCl₃): δ 143.3, 114.5, 93.1, 79.6, 52.8, 42.8, 19.1, 18.1. IR (neat, cm⁻¹): 2940, 2852, 1364, 1260, 1180, 1090, 1013, 861, 788, 721, 643. HRMS (ESI) ([M+H]⁺) Calcd. for C₈H₁₃Cl₃NO₃S: 307.9682, Found 307.9652. HPLC analysis: ee = 87%. Welko-O 1 (99.5% hexanes: 0.5%-isopropanol, 1.0mL/min): $t_{minor} = 9.5$ min, $t_{major} = 10.4$ min.



¹H NMR (400 MHz, CDCl₃): δ 4.75 (s, 2H), 3.03 (s, 2H), 2.54 (s, 2H), 1.53 (d, 2H, $J = 7.2$ Hz), 1.46 (d, 1H, $J = 10.0$ Hz), 1.28 (m, 2H), 0.84 (d, 2H, $J = 10.0$ Hz). ¹³C NMR (100 MHz, CDCl₃): δ 93.40, 79.60, 43.87, 36.04, 28.28, 28.24, 25.52. IR (neat, cm⁻¹): 2985, 2880, 1363, 1288, 1175, 1092, 1012, 979, 917, 870, 789, 723, 621. HRMS (ESI) ([M+H]⁺) Calcd. for C₉H₁₃Cl₃NO₃S: 319.9682, Found 319.9689.



N-(2, 2, 2-Trichloroethoxysulfonyl)-8-aza-bicyclo[5,1,0]octane:³ ¹H NMR (400 MHz, CDCl₃): δ 4.80 (s, 2H), 3.10 (m, 2H), 2.06-1.88 (m, 4H), 1.65-1.47 (m, 5H), 1.23 (m, 1H). ¹³C NMR (100 MHz, CDCl₃): δ 93.31, 79.56, 46.64, 31.06, 28.14, 25.40. IR (neat,

cm^{-1}): 2960, 2879, 1365, 1270, 1180, 1081, 1030, 869, 779, 709, 627. HRMS (ESI) ($[\text{M}+\text{H}]^+$) Calcd. for $\text{C}_9\text{H}_{15}\text{Cl}_3\text{NO}_3\text{S}$: 321.9839, Found 321.9850.

References:

- 1) a) Chen, Y.; Fields, K. B.; Zhang, X. P. *J. Am. Chem. Soc.* **2004**, *126*, 14718.
b) Zhu, S.; Ruppel, J. V.; Lu, H.; Wojtas, L.; Zhang, X. P. *J. Am. Chem. Soc.* **2008**, *130*, 5042.
- 2) Guthikonda, K.; Du Bois, J. *J. Am. Chem. Soc.* **2002**, *124*, 13672.
- 3) Xu, Q.; Appella, D. H. *Org. Lett.* **2008**, *10*, 1497.

Supporting Information

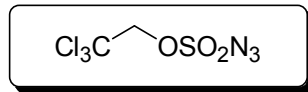
Highly Asymmetric Cobalt-Catalyzed Aziridination of Alkenes with Trichloroethoxysulfonyl Azide (TcesN₃)

Velusamy Subbarayan, Joshua V. Ruppel, Shifa Zhu,
Jason A. Permon and X. Peter Zhang
Department of Chemistry, University of South Florida,
Tampa, Florida 33620-5250

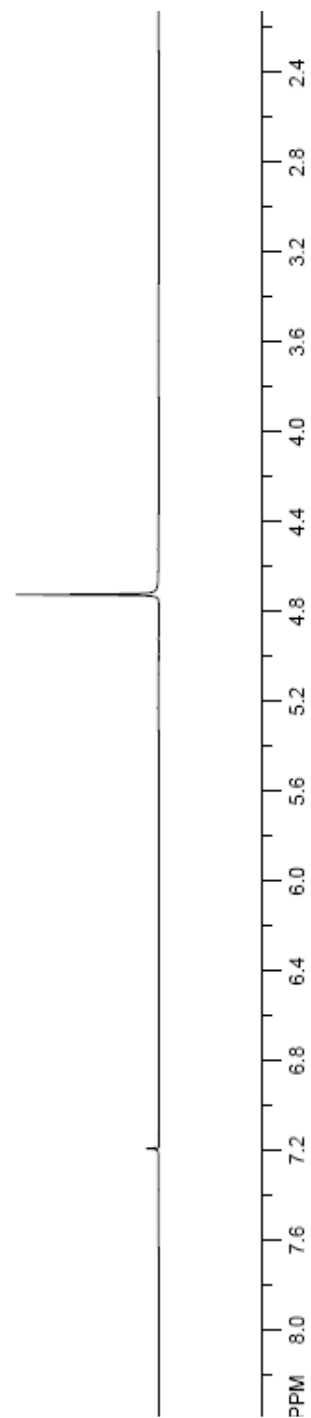
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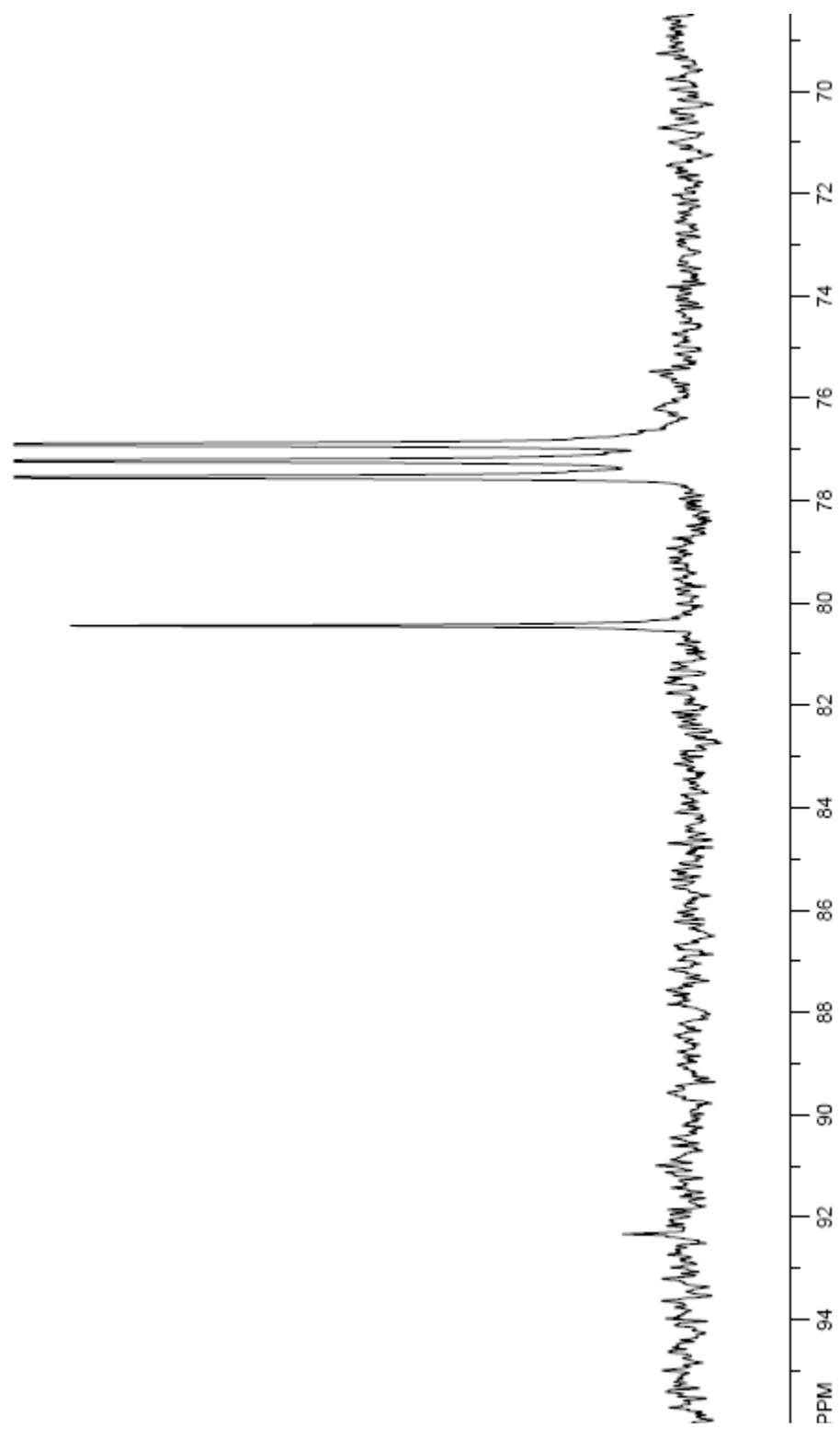
<u>NMR and IR spectral of Trichloroethoxy sulfonyl azide</u>	<u>SS-4-6</u>
<u>NMR spectral and HPLC data of 2-Phenyl-aziridine-1-sulfonic acid</u>	<u>SS-7-10</u>
<u>2,2,2-trichloro-ethylester</u>	
<u>NMR spectral and HPLC data of 2-<i>p</i>-Tolyl-2-aziridine-1-sulfonic acid</u>	
<u>2,2,2-trichloro-ethyl ester</u>	<u>SS-11-14</u>
<u>NMR spectral and HPLC data of 3-<i>m</i>-Tolyl-2-aziridine-1-sulfonic acid</u>	
<u>2,2,2-trichloro-ethyl ester</u>	<u>SS-15-18</u>
<u>NMR spectral and HPLC data of 3-<i>o</i>-Tolyl-2-aziridine-1-sulfonic acid</u>	
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<u>-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-27-31</u>
<u>NMR spectral and HPLC data of 2-(4-Bromo-phenyl)-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-32-35</u>
<u>NMR spectral and HPLC data of 2-(4-Fluoro-phenyl)-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-36-39</u>
<u>NMR spectral and HPLC data of 2-(3-Bromo-phenyl)-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-40-43</u>
<u>NMR spectral and HPLC data of 2-(2-Bromo-phenyl)-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-44-47</u>
<u>NMR spectral and HPLC data of 2-(4-Trifluoromethyl-phenyl)</u>	
<u>-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-48-51</u>
<u>NMR spectral and HPLC data of 2-(3-Nitro-phenyl)-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-52-55</u>
<u>NMR spectral and HPLC data of 2-Napthalene-2-yl-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-56-59</u>
<u>NMR spectral and HPLC data of 1-Methyl-2-Phenyl-aziridine</u>	

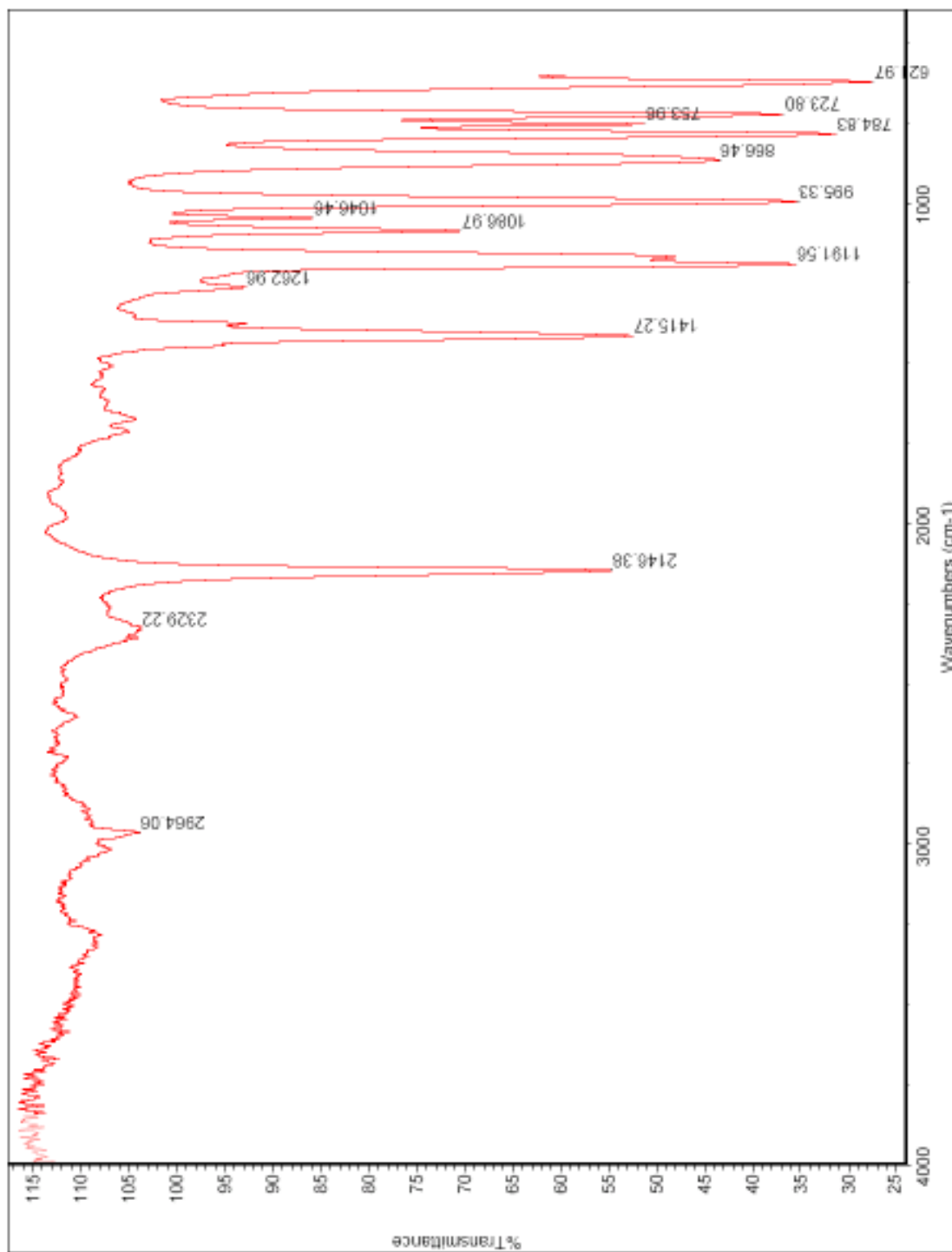
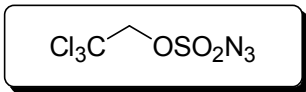
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<u>NMR spectral and HPLC data of 2,3-Dimethyl 1-butene aziridine-1-</u>	
<u>sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-76-79</u>
<u>NMR spectral of 2-Norbornenyl sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-80-81</u>
<u>Recyclability HPLC data of 2-(2-Bromo-phenyl)-aziridine</u>	
<u>-1-sulfonic acid 2,2,2-trichloro-ethyl ester</u>	<u>SS-83-84</u>
<u>UV-Vis Spectra of Recycled [Co(2,6-diMeOZhuPhyrin)]</u>	<u>SS-85</u>



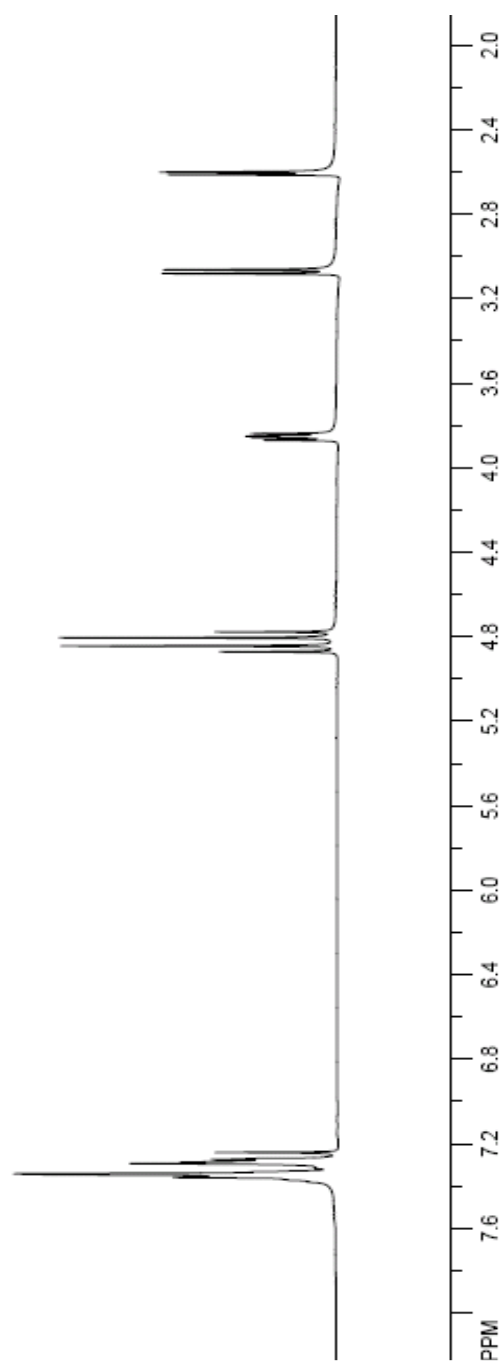
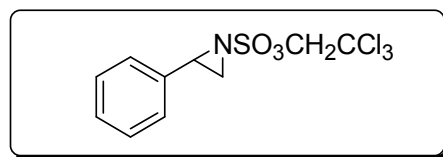
Trichloroethoxysulfonyl Azide (TcesN₃)



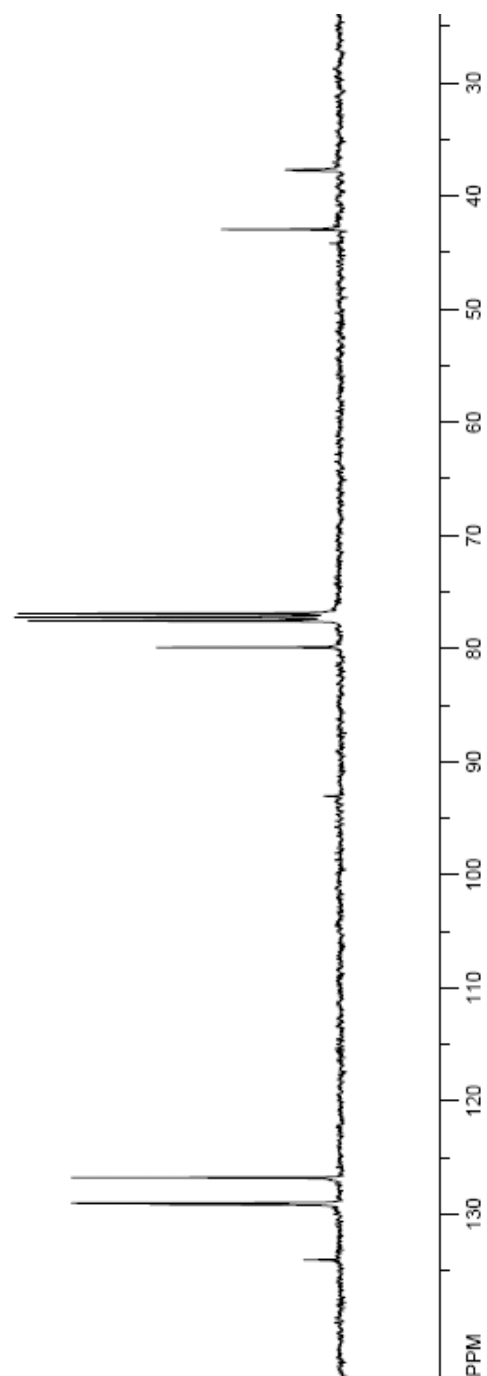
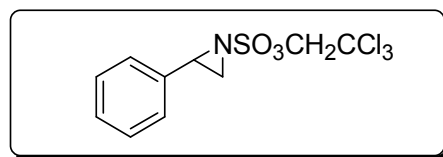


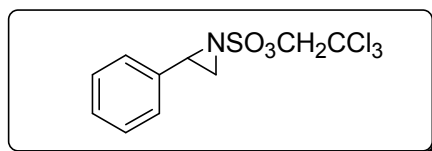


2-Phenyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

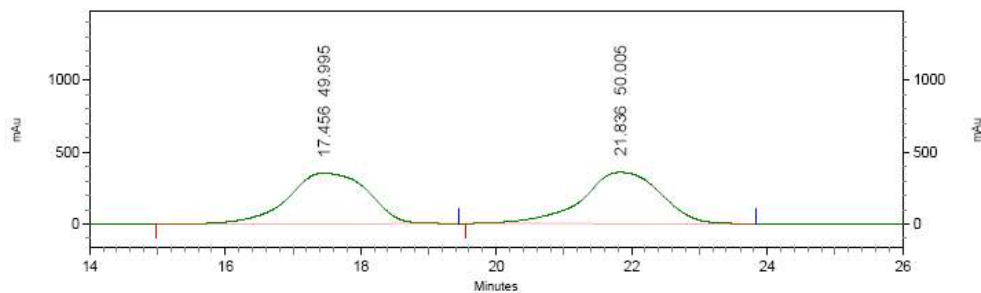
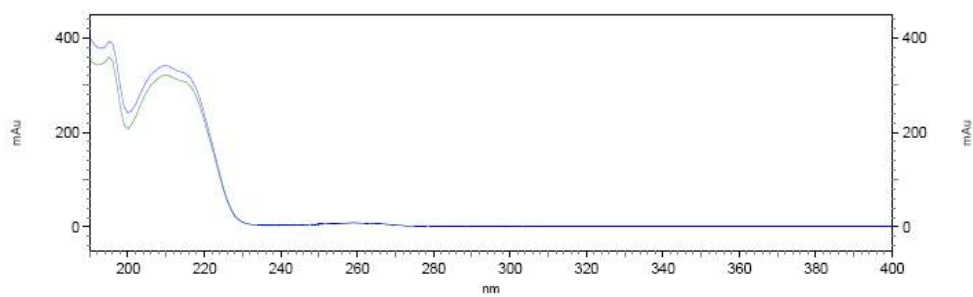


2-Phenyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester





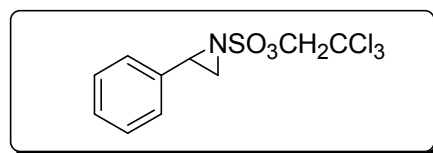
2-Phenyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



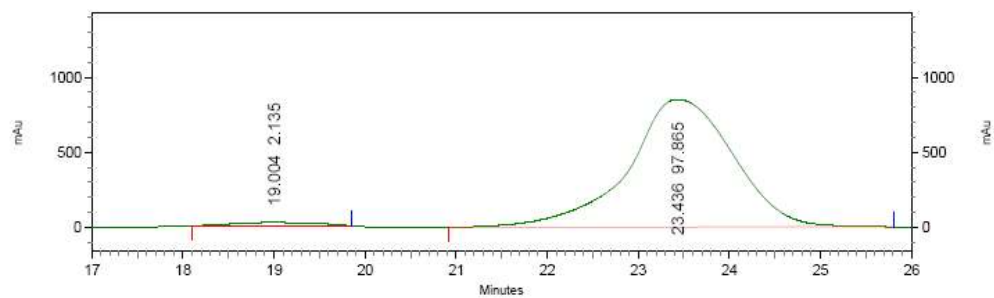
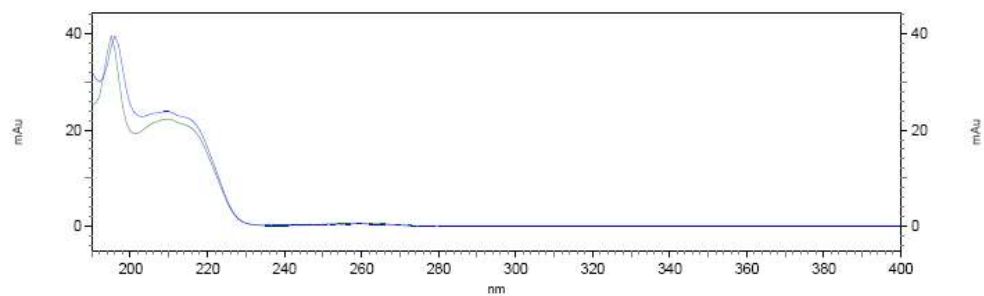
1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	17.456	49.995
2	21.836	50.005

Totals	100.000
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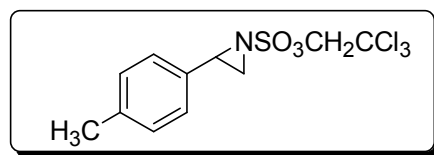
2-Phenyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



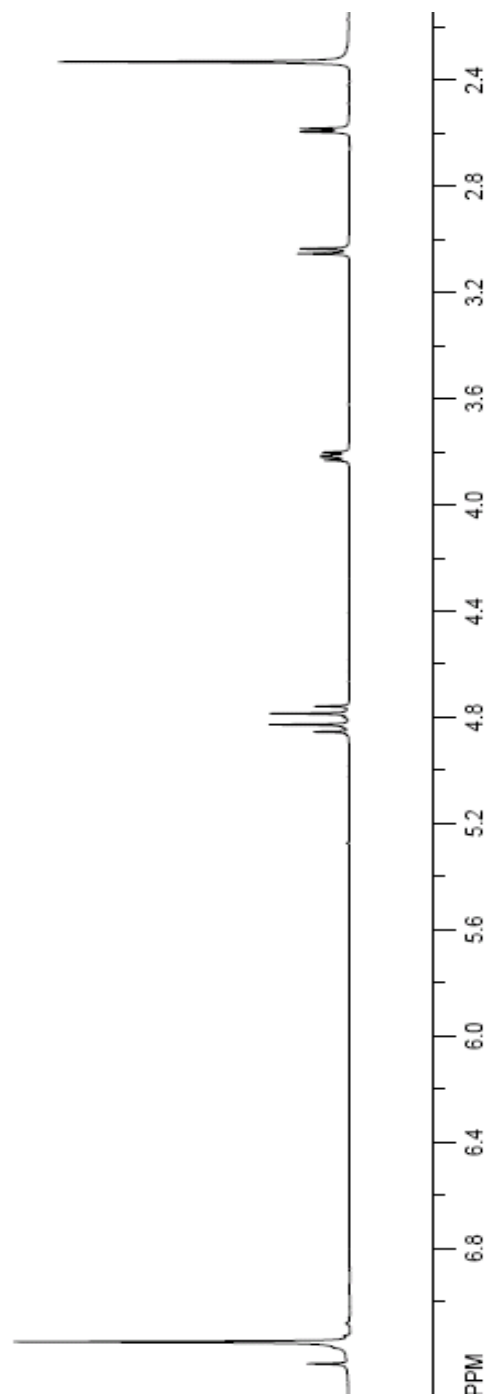
1: 225 nm, 4 nm Results

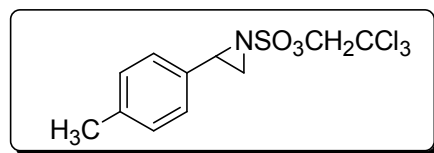
Pk #	Retention Time	Area Percent
1	19.004	2.135
2	23.436	97.865

Totals	100.000
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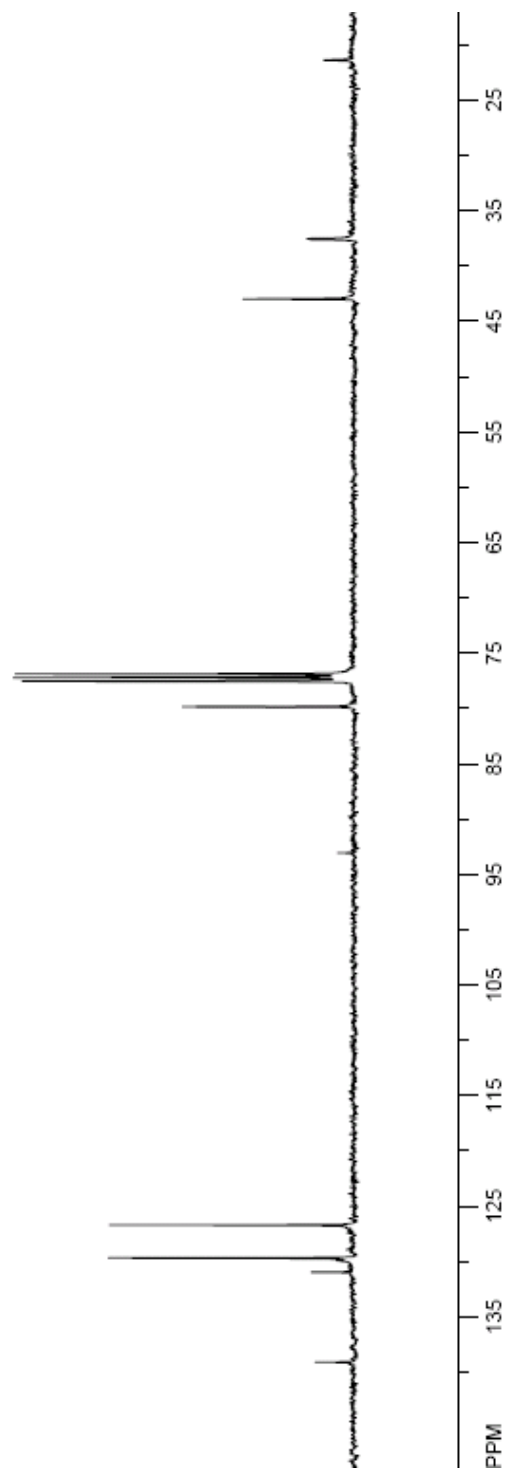


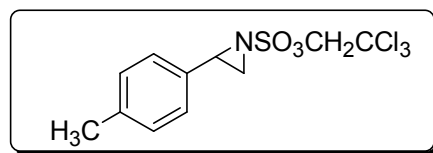
2-*p*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



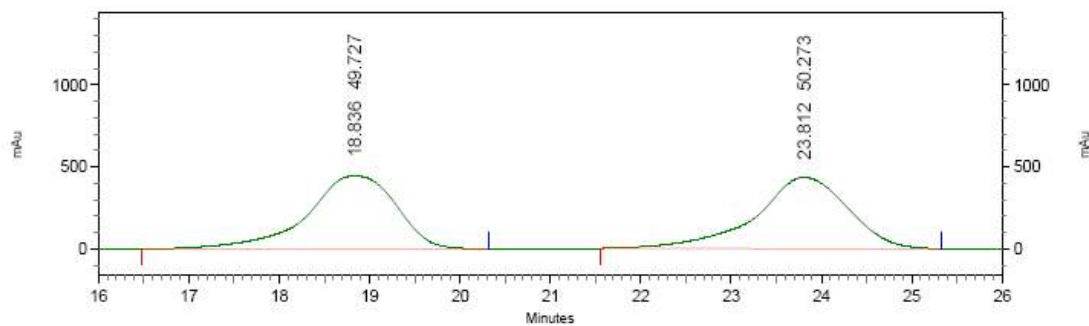
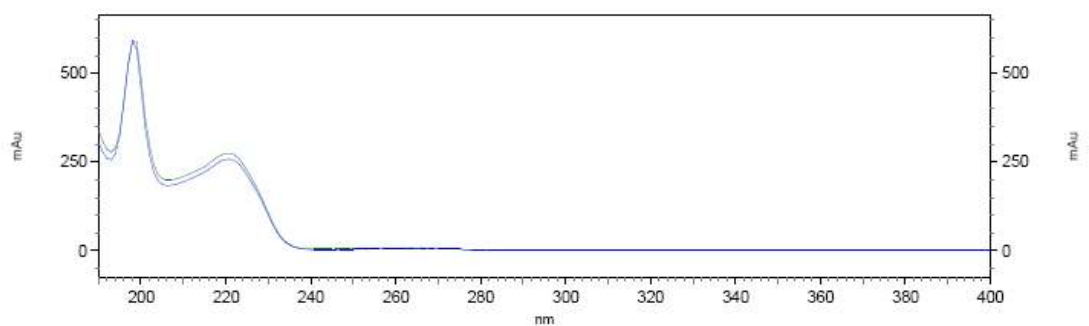


2-*p*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



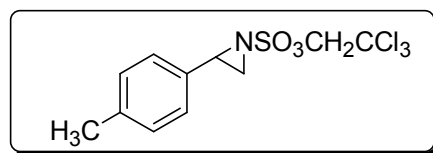


2-*p*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

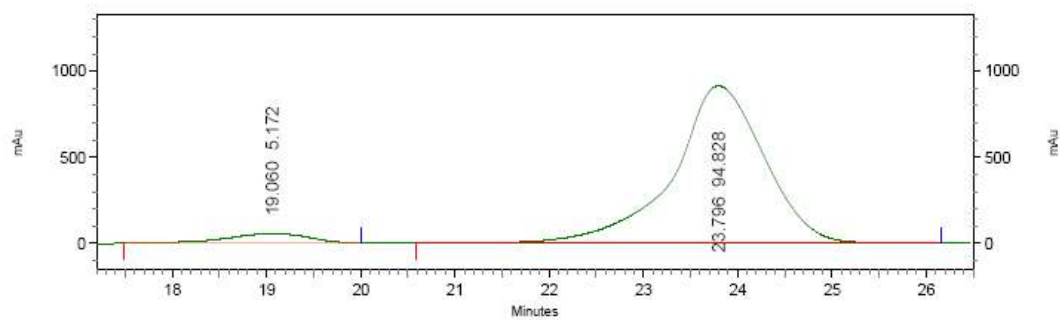
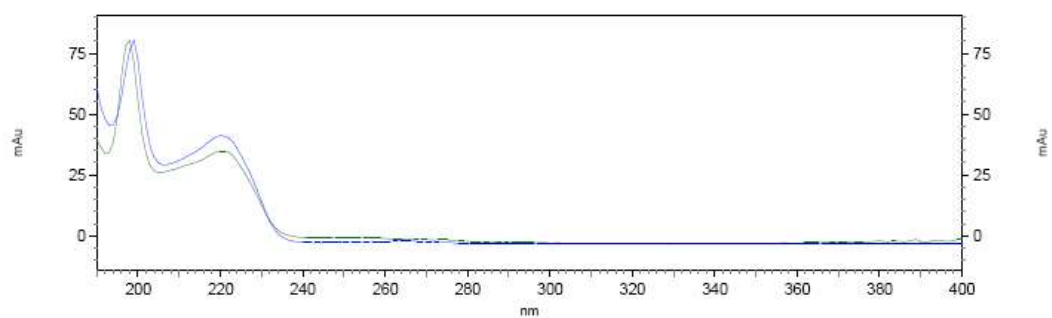


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	18.836	49.727
2	23.812	50.273
Totals		100.000



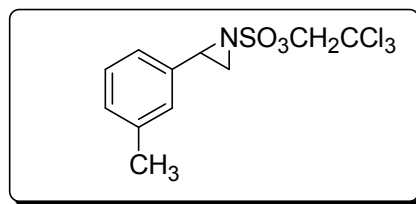
2-*p*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



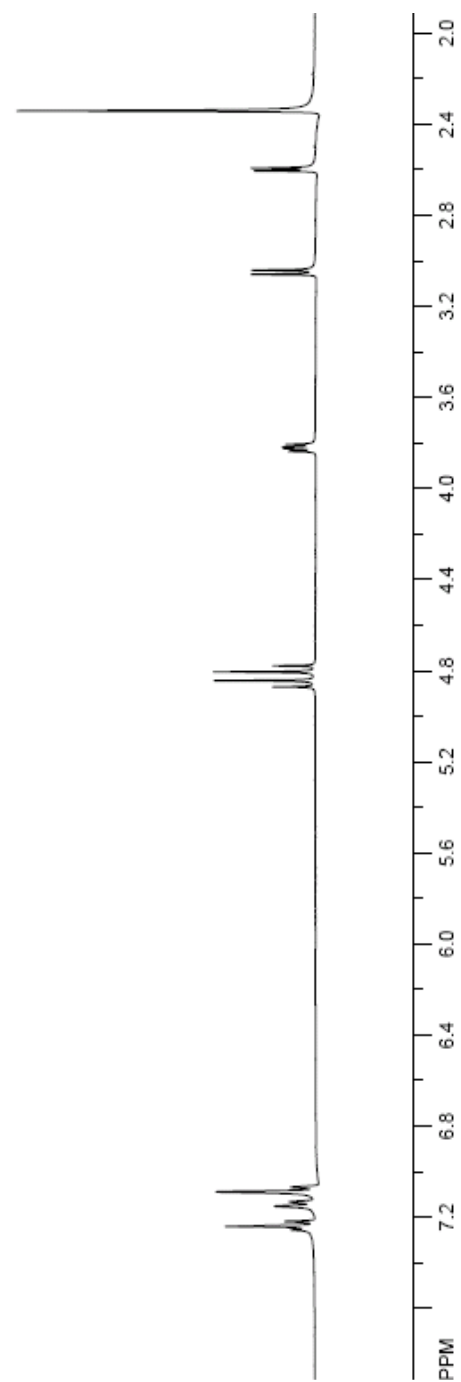
1: 225 nm, 4 nm Results

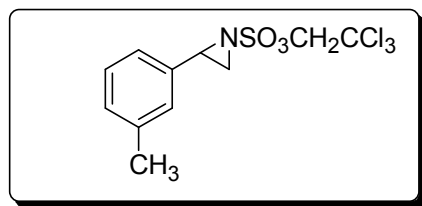
Pk #	Retention Time	Area Percent
1	19.060	5.172
2	23.796	94.828

Totals	100.000
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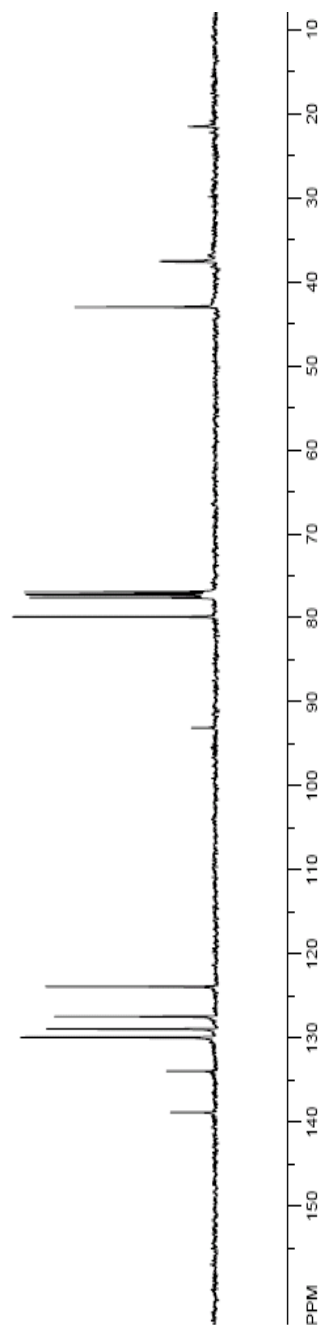


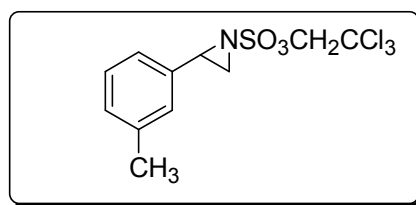
2-*m*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



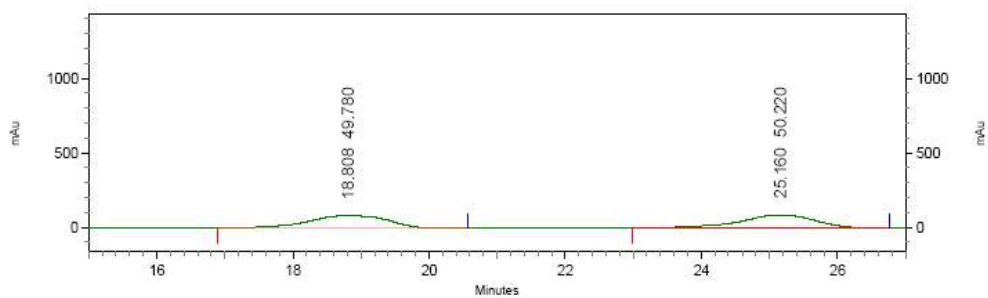
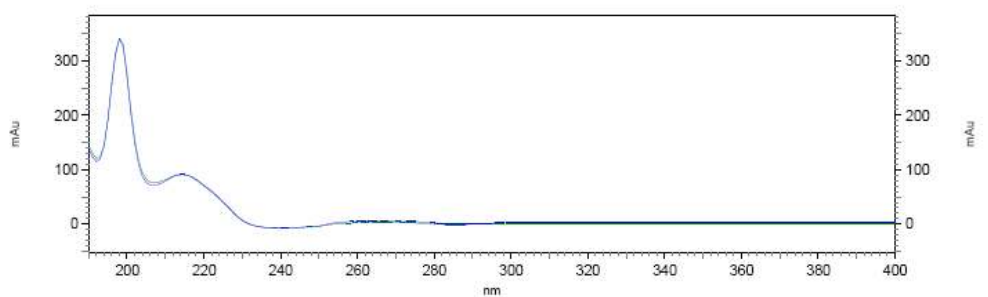


2-*m*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



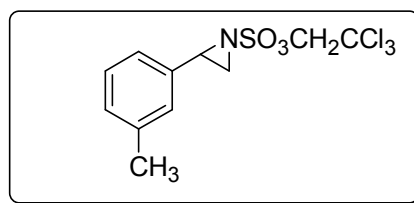


2-*m*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

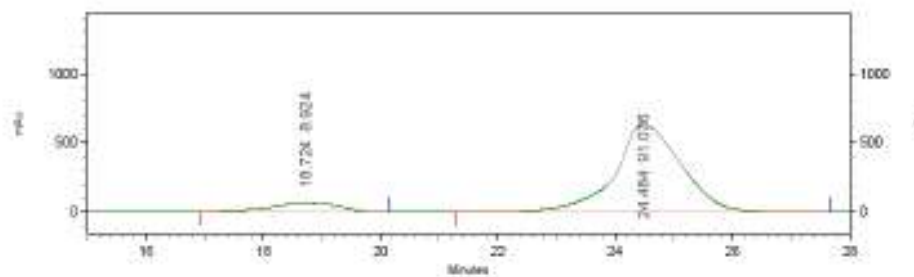
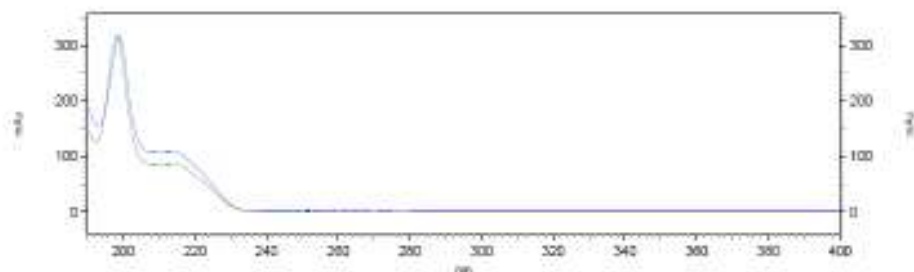


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	18.808	49.780
2	25.160	50.220
Totals		100.000

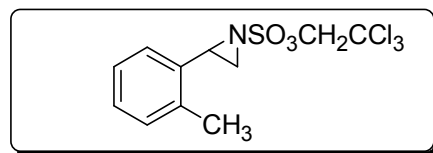


2-*m*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

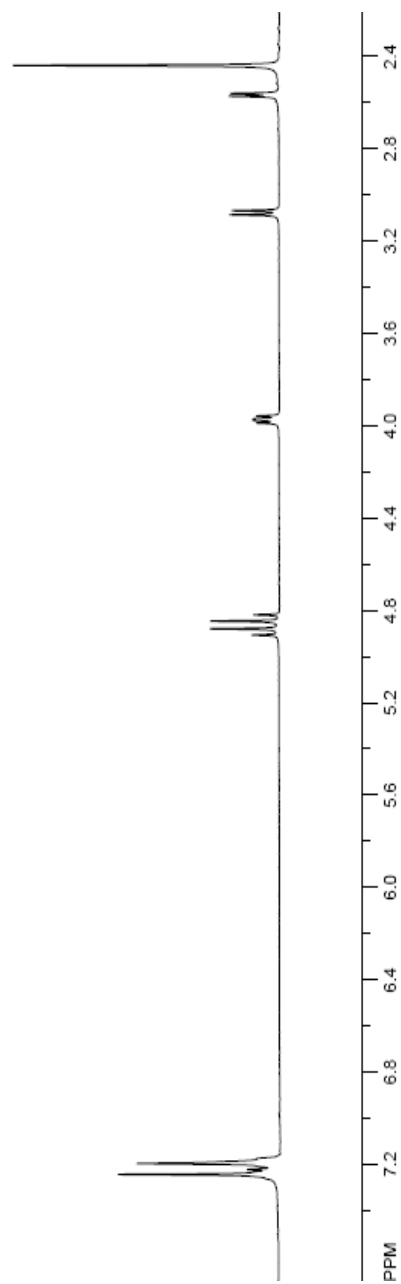


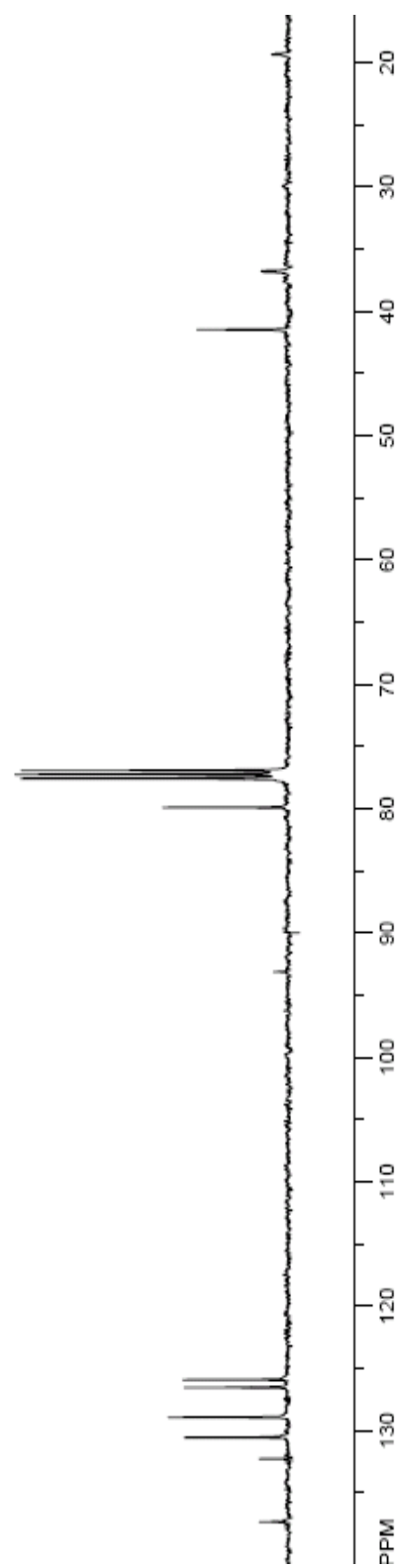
i: 225 nm, 4 nm Results

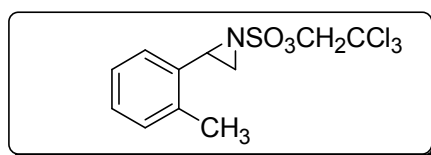
pk #	Retention Time	Area Percent
1	10.724	8.924
2	24.484	91.076
Totals		100.000



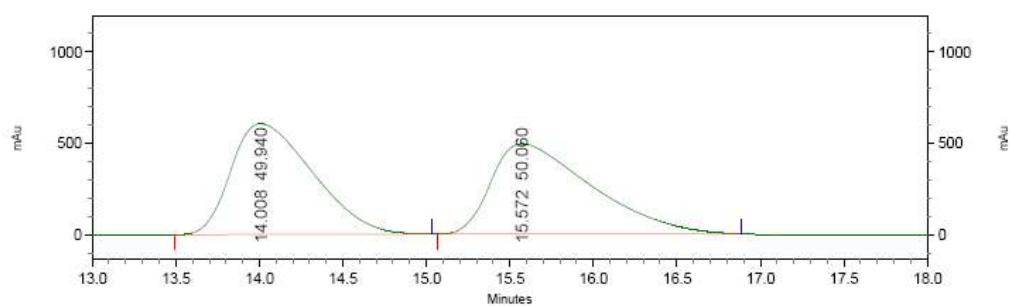
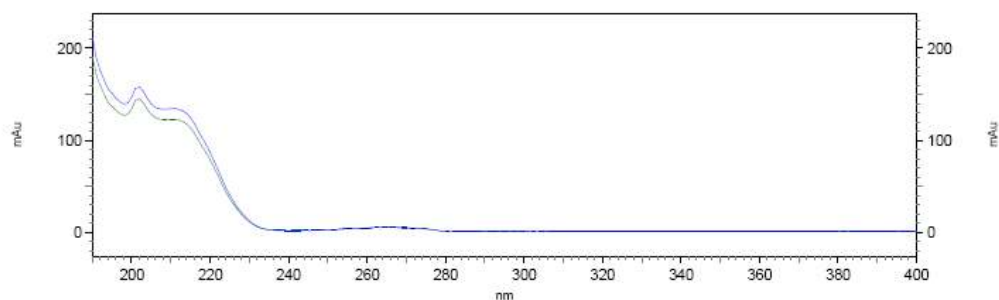
2-*o*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester





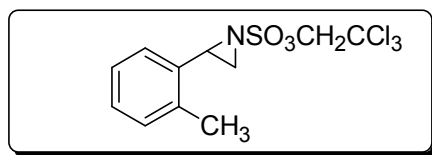


2-*o*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

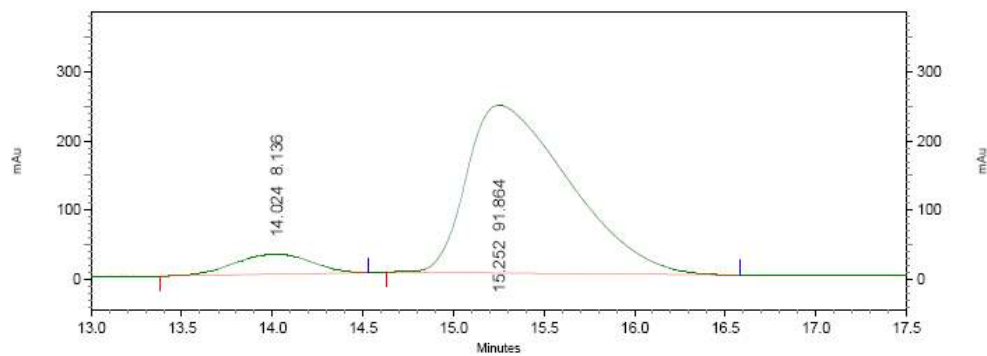
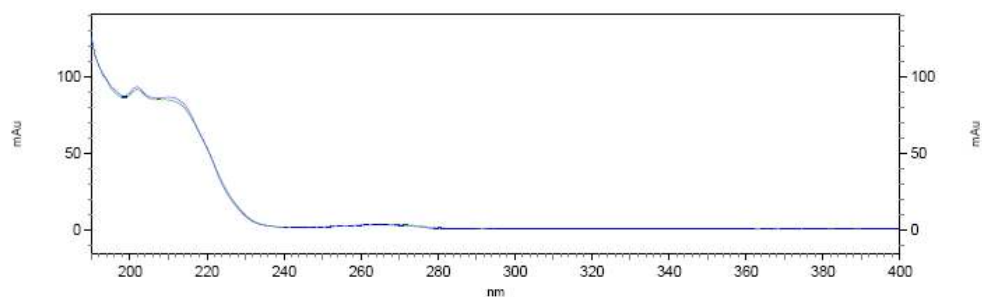


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	14.008	49.940
2	15.572	50.060
Totals		100.000



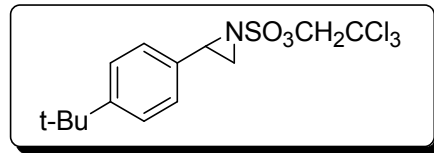
2-*o*-Tolyl-2-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



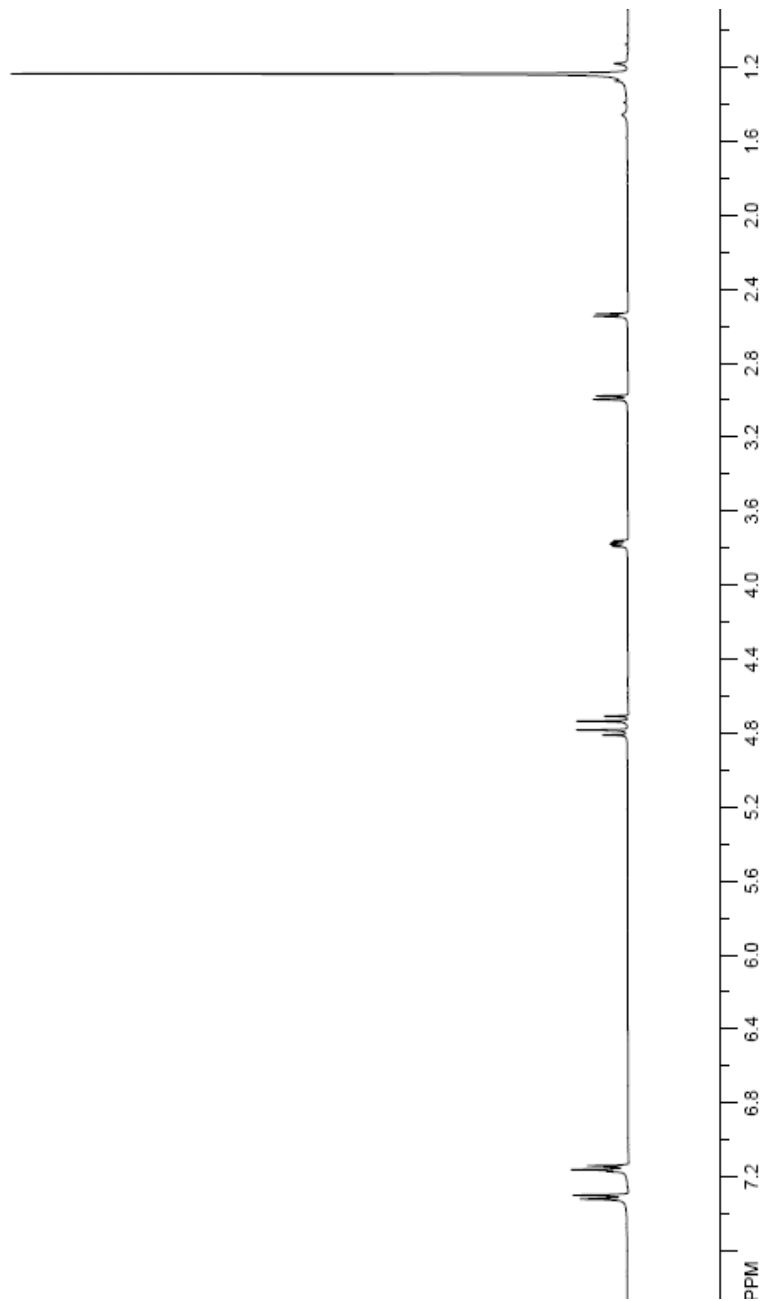
1: 232 nm, 4 nm Results

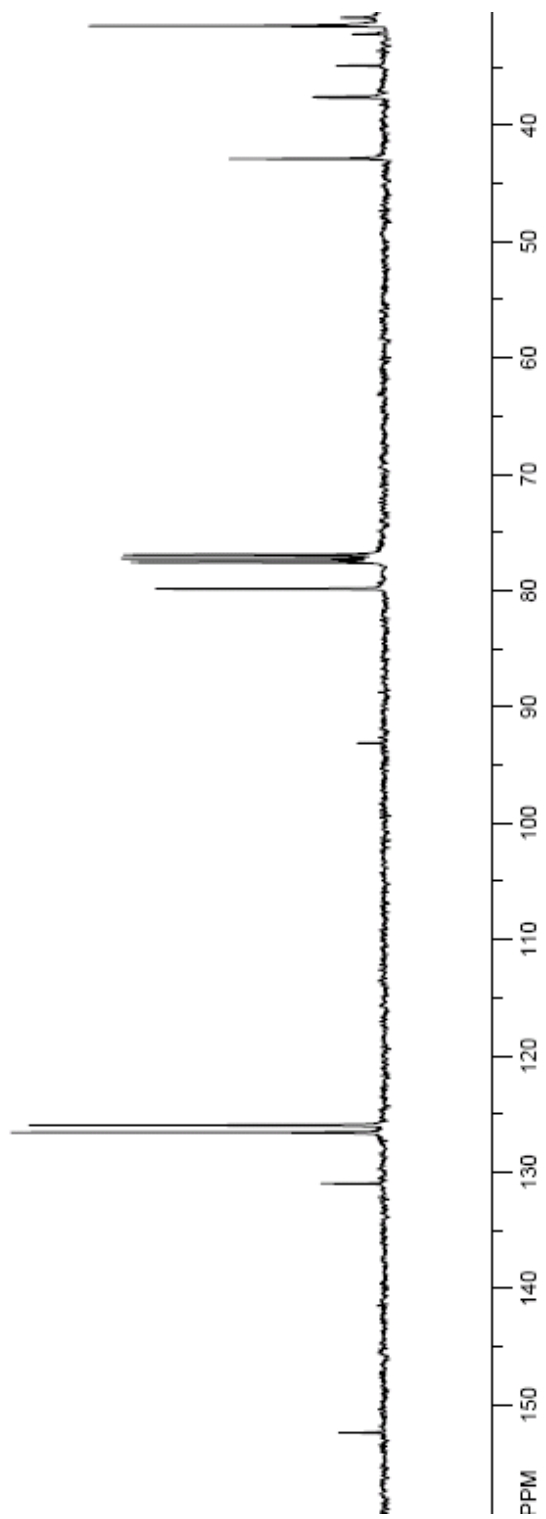
PK #	Retention Time	Area Percent
1	14.024	8.136
2	15.252	91.864

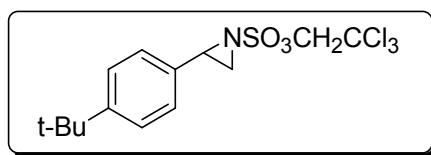
Totals	100.000
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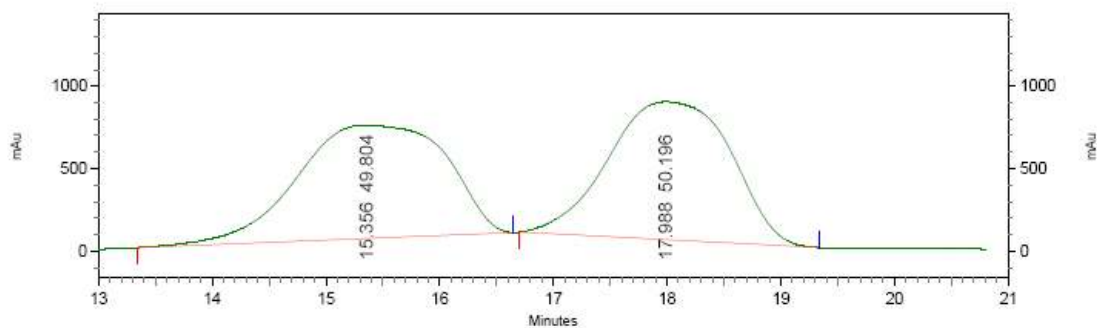
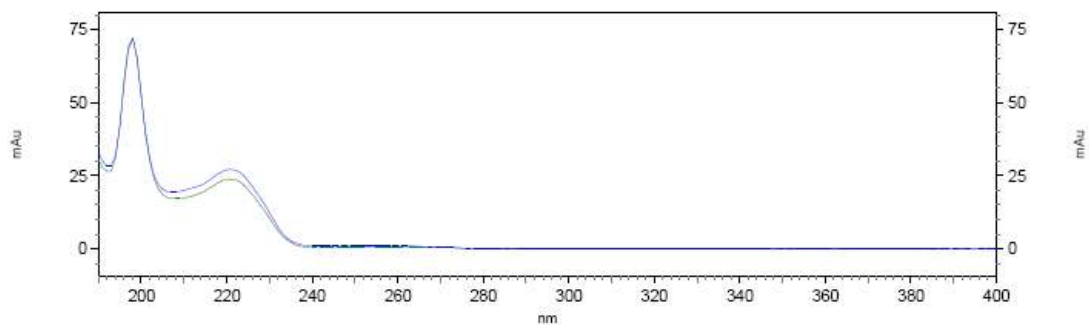
2-(4-*tert*-Butyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester





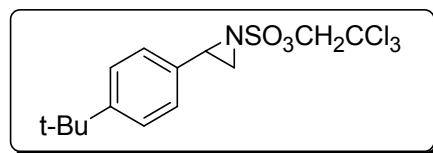


2-(4-*tert*-Butyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

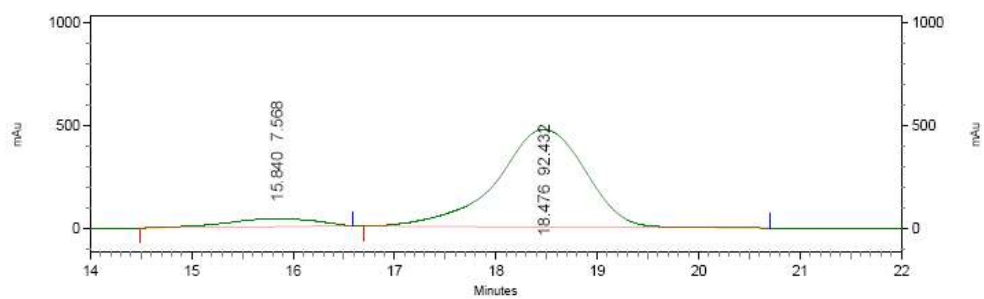
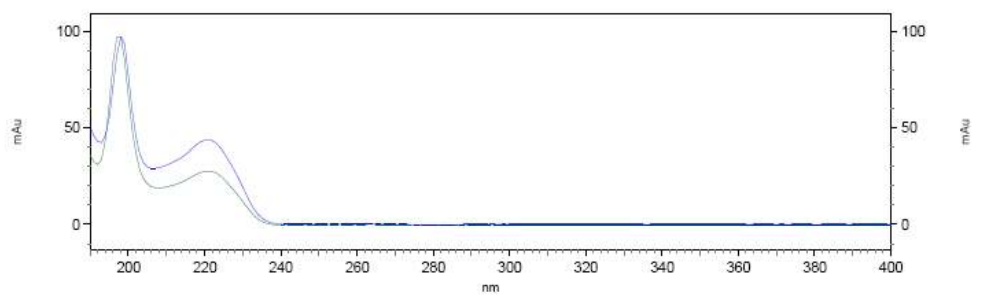


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	15.356	49.804
2	17.988	50.196
Totals		100.000



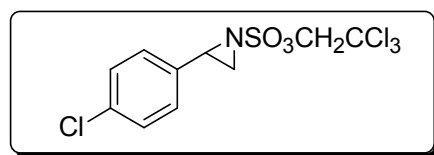
2-(4-*tert*-Butyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



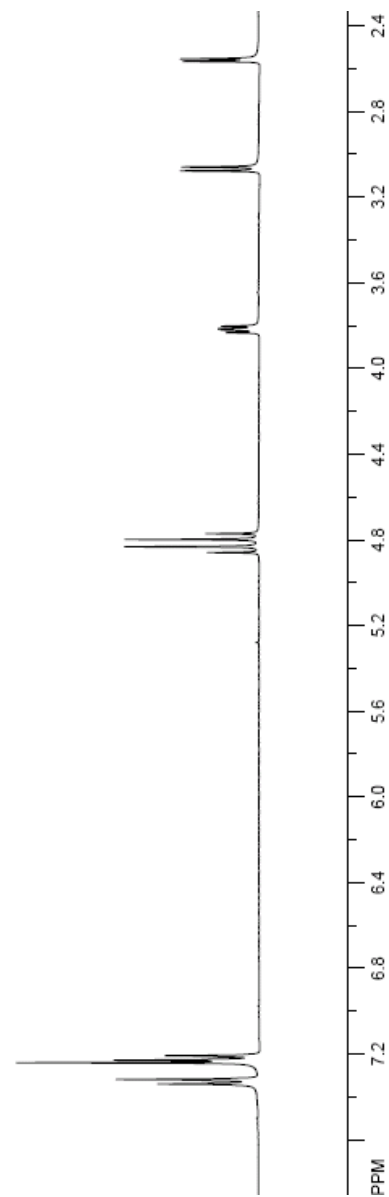
1: 225 nm, 4 nm Results

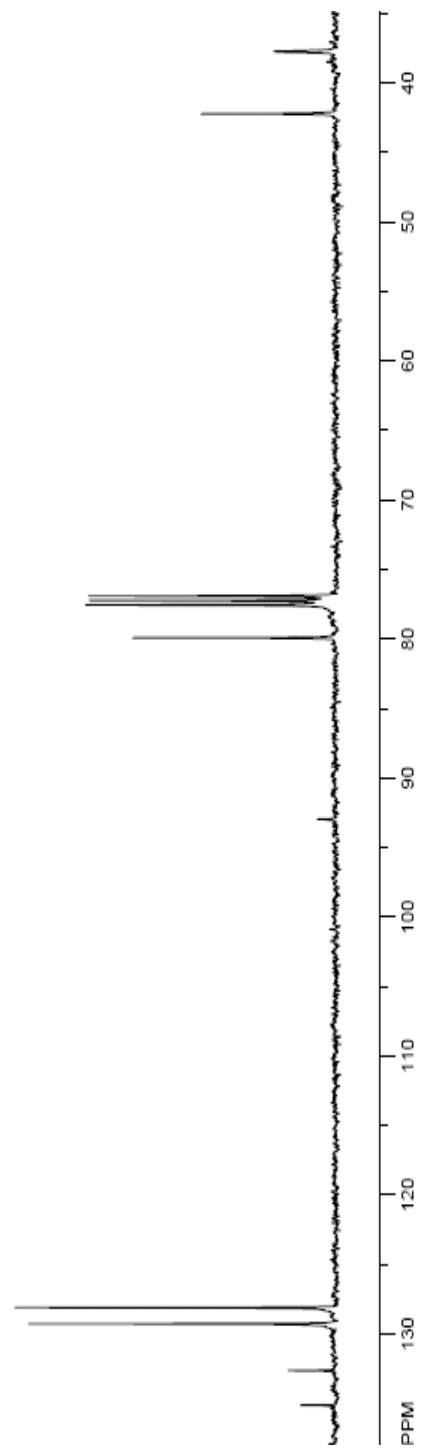
Pk #	Retention Time	Area Percent
1	15.840	7.568
2	18.476	92.432

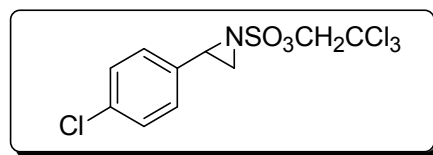
Totals		100.000
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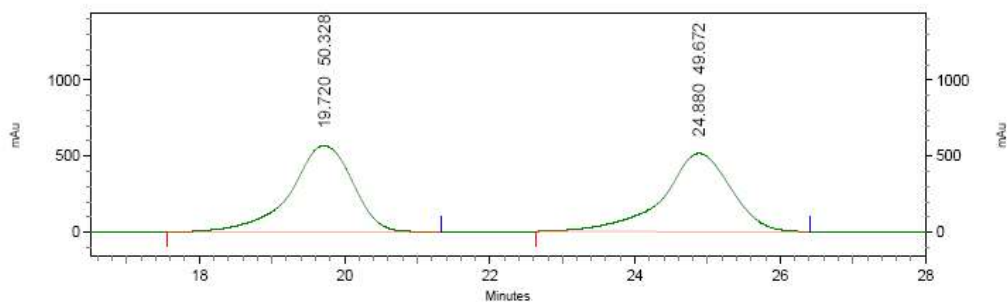
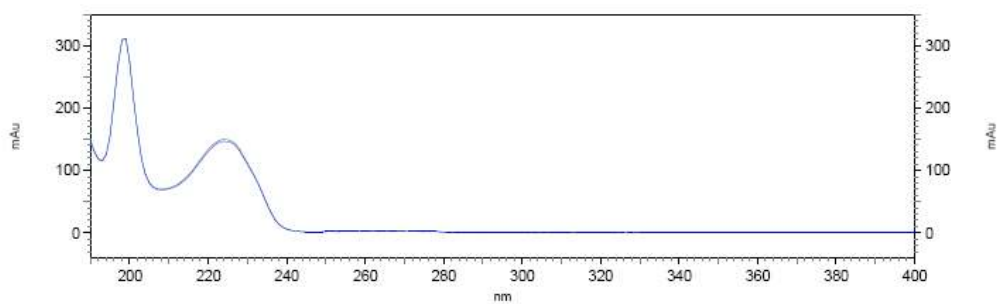
2-(4-Chloro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester





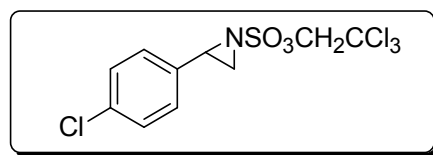


2-(4-Chloro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

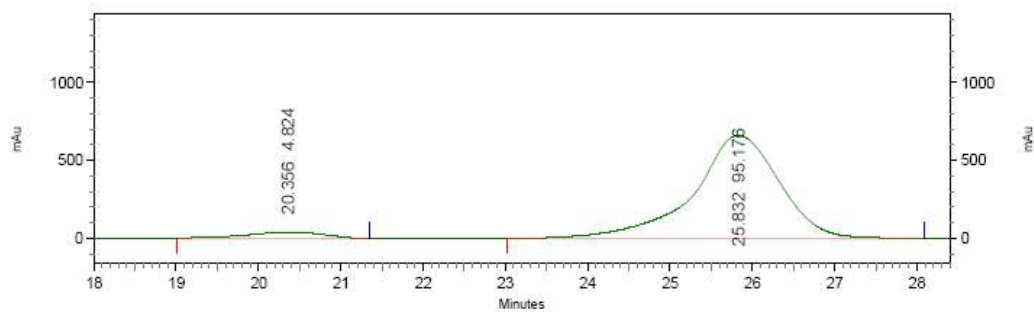
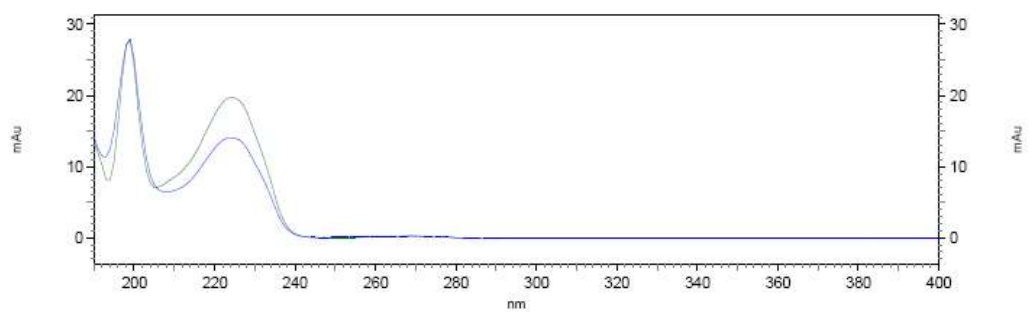


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	19.720	50.328
2	24.880	49.672
Totals		100.000



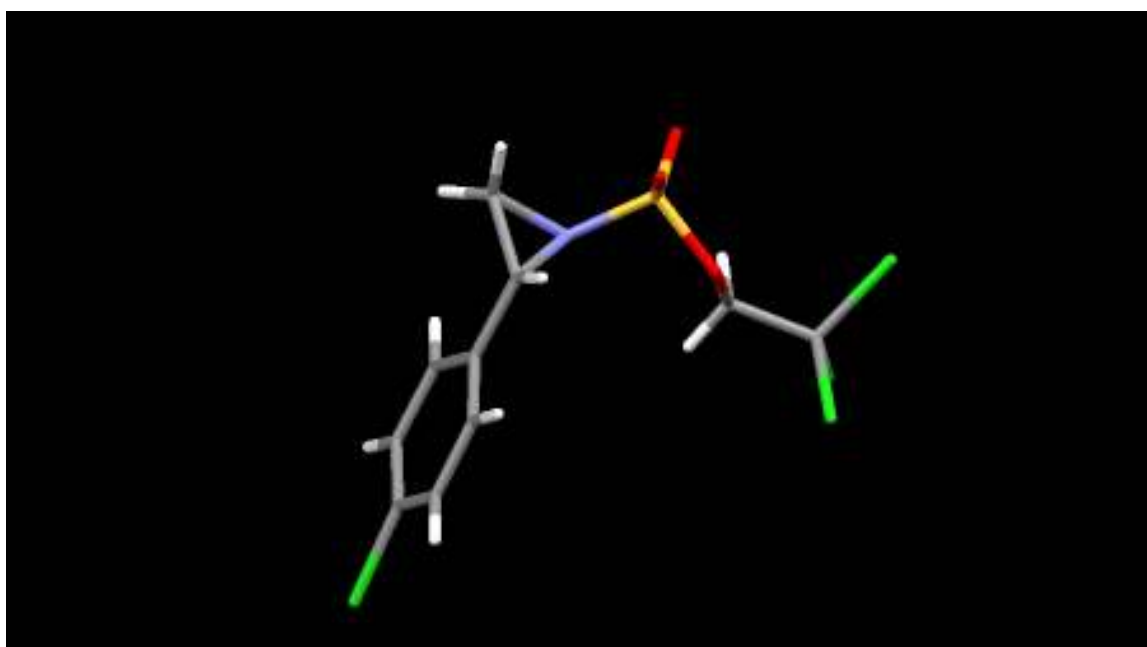
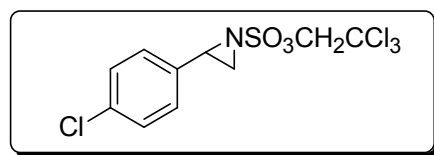
2-(4-Chloro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



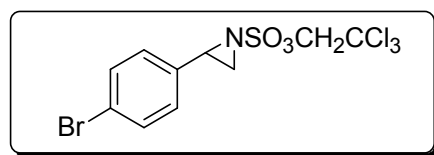
1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	20.356	4.824
2	25.832	95.176

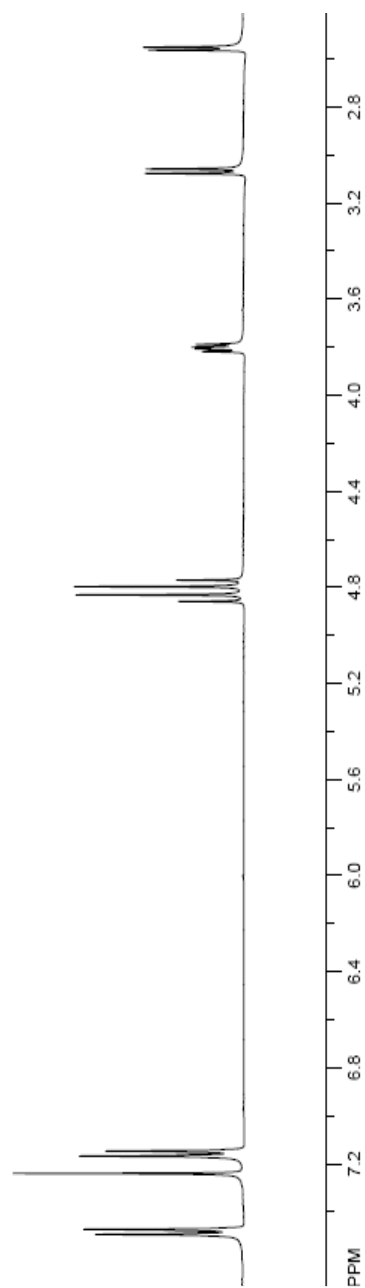
Totals	100.000
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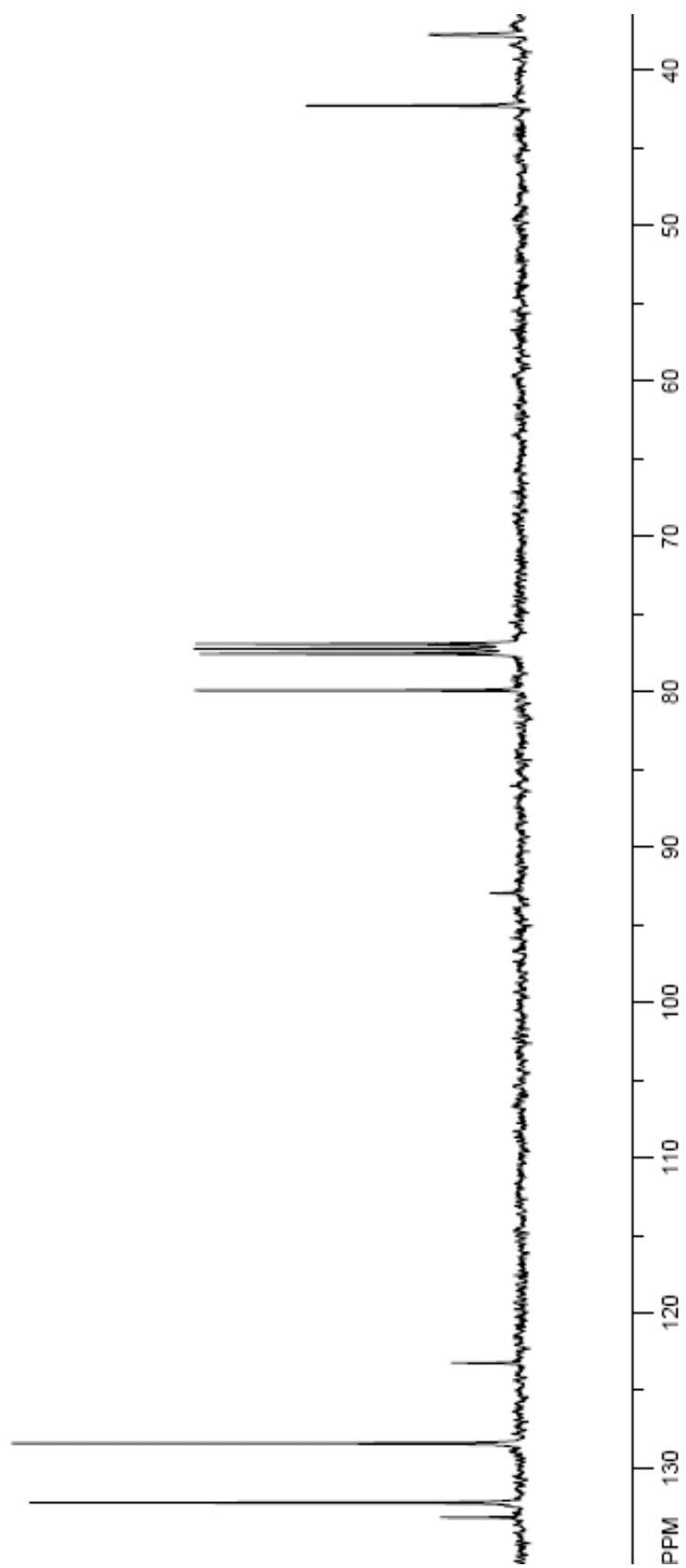


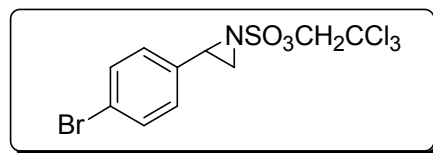
X-Ray structural of 2-(4-Chloro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



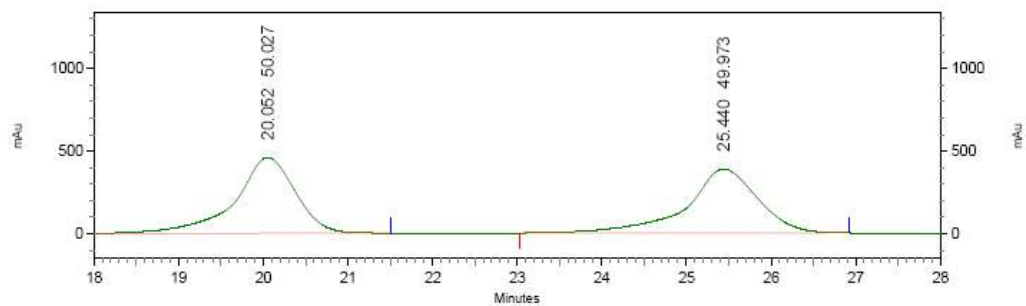
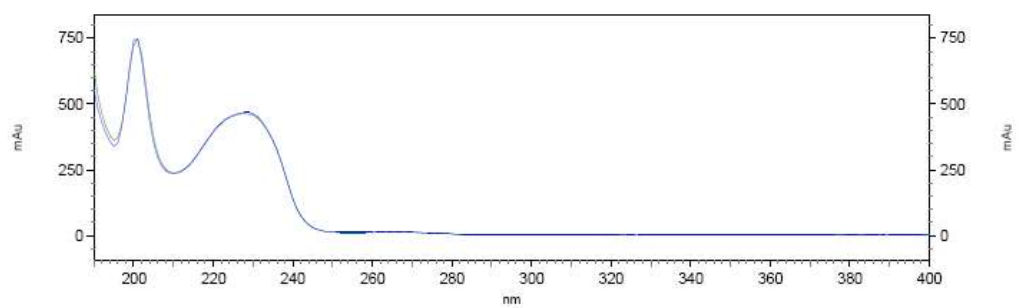
2-(4-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester







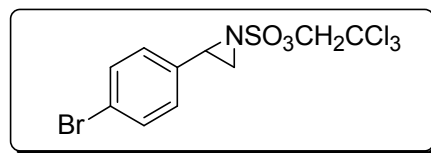
2-(4-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



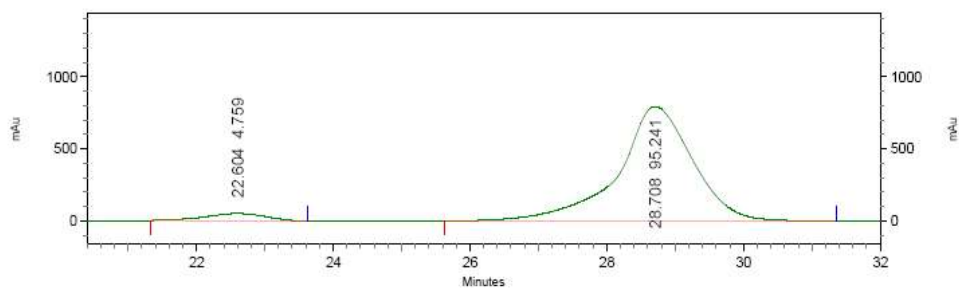
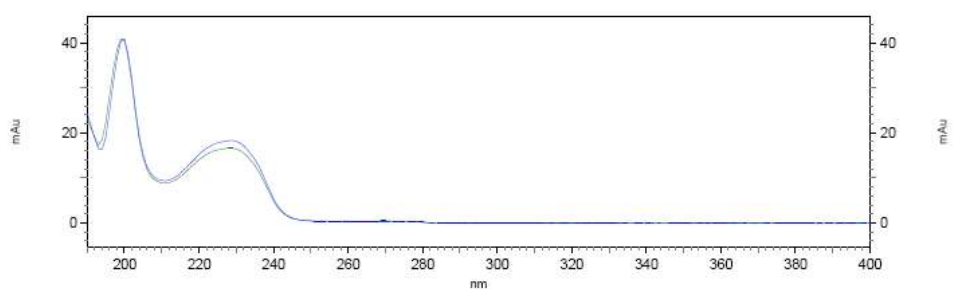
1: 225 nm, 4 nm Results

PK #	Retention Time	Area Percent
1	20.052	50.027
2	25.440	49.973

Totals	Area Percent
	100.000



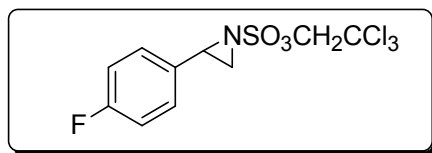
2-(4-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



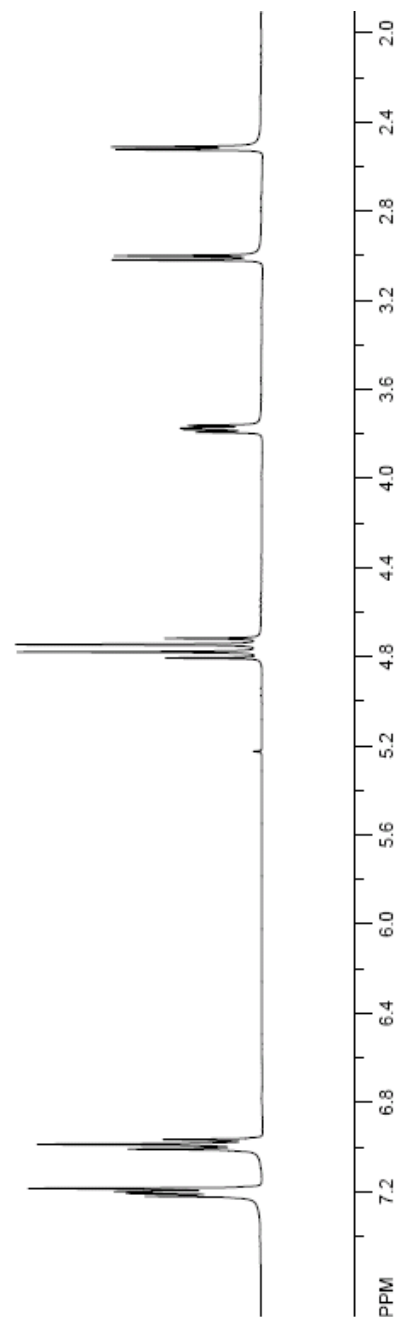
1: 225 nm, 4 nm Results

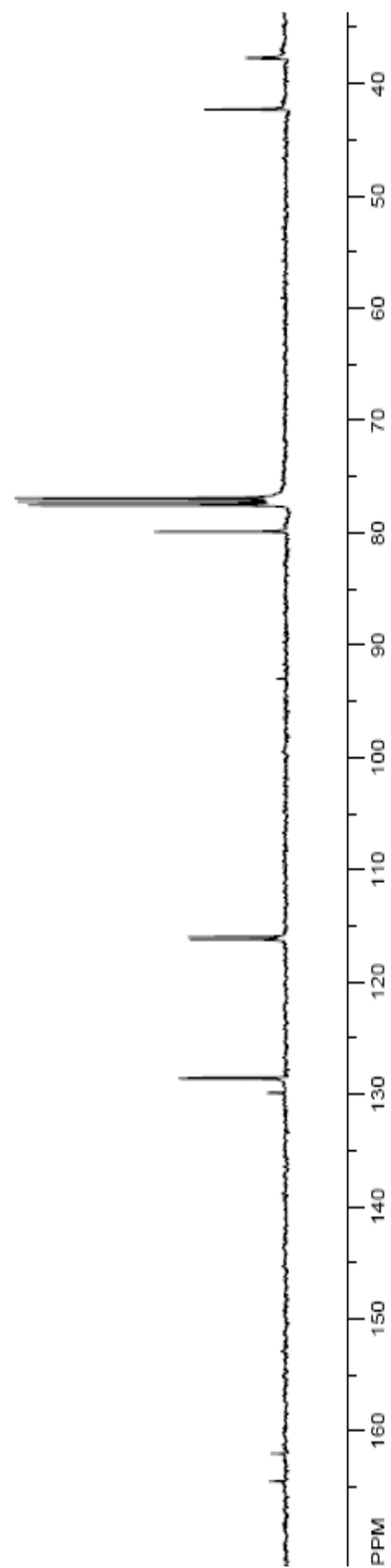
Pk #	Retention Time	Area Percent
1	22.604	4.759
2	28.708	95.241

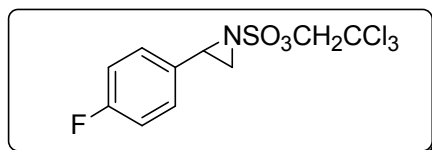
Totals		100.000
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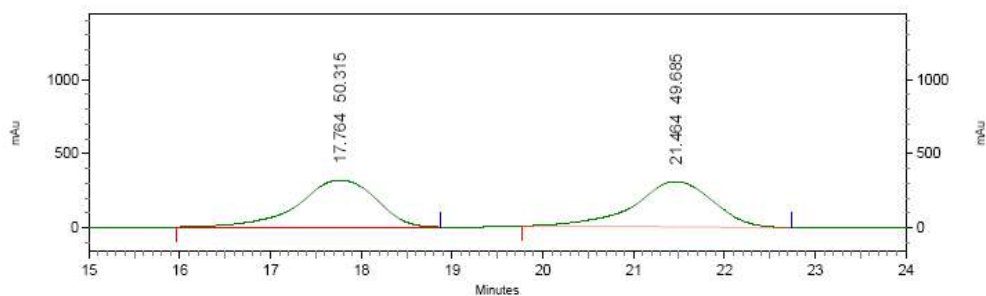
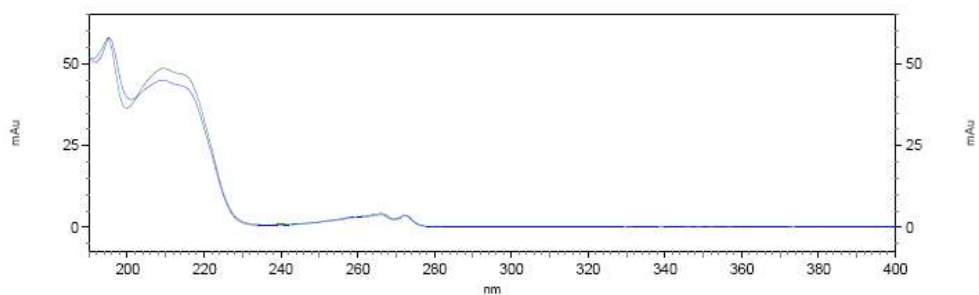
2-(4-Fluoro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester







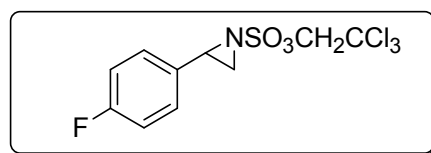
2-(4-Fluoro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



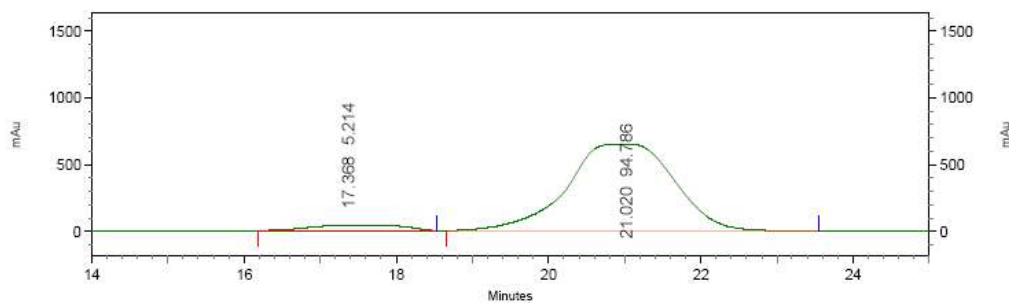
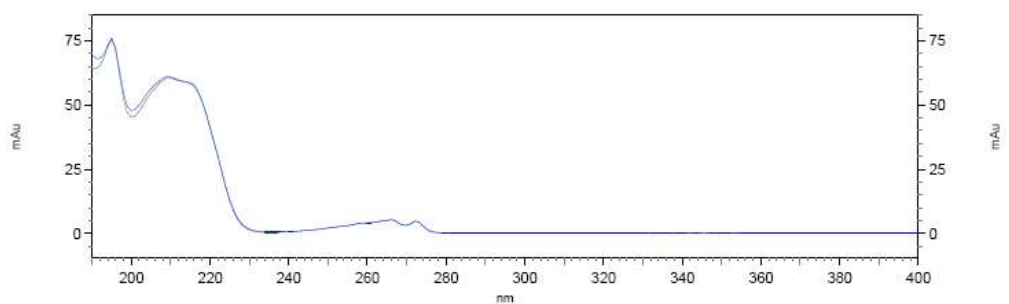
1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	17.764	50.315
2	21.464	49.685

Totals	Area Percent
	100.000



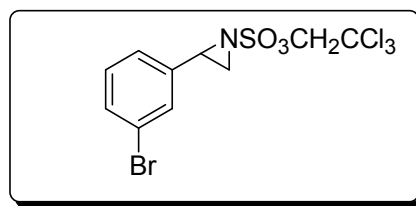
2-(4-Fluoro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



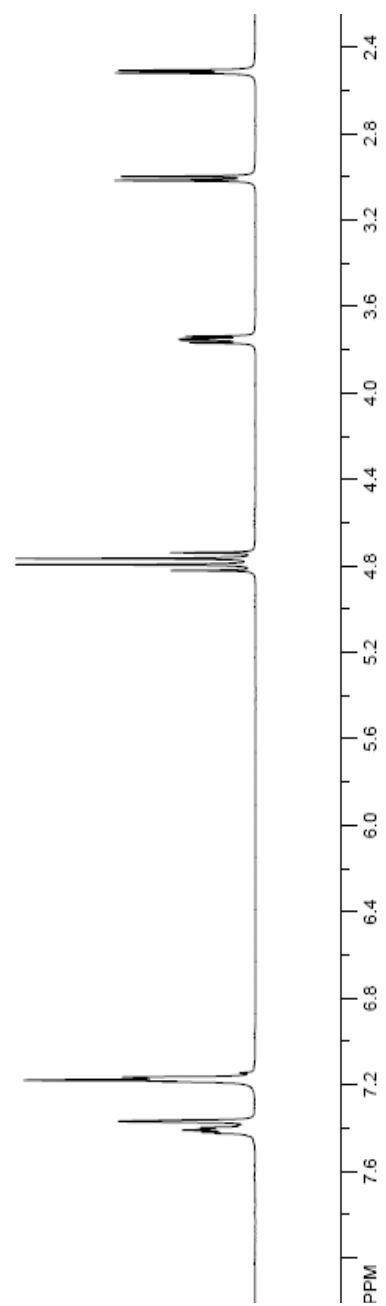
1: 225 nm, 4 nm Results

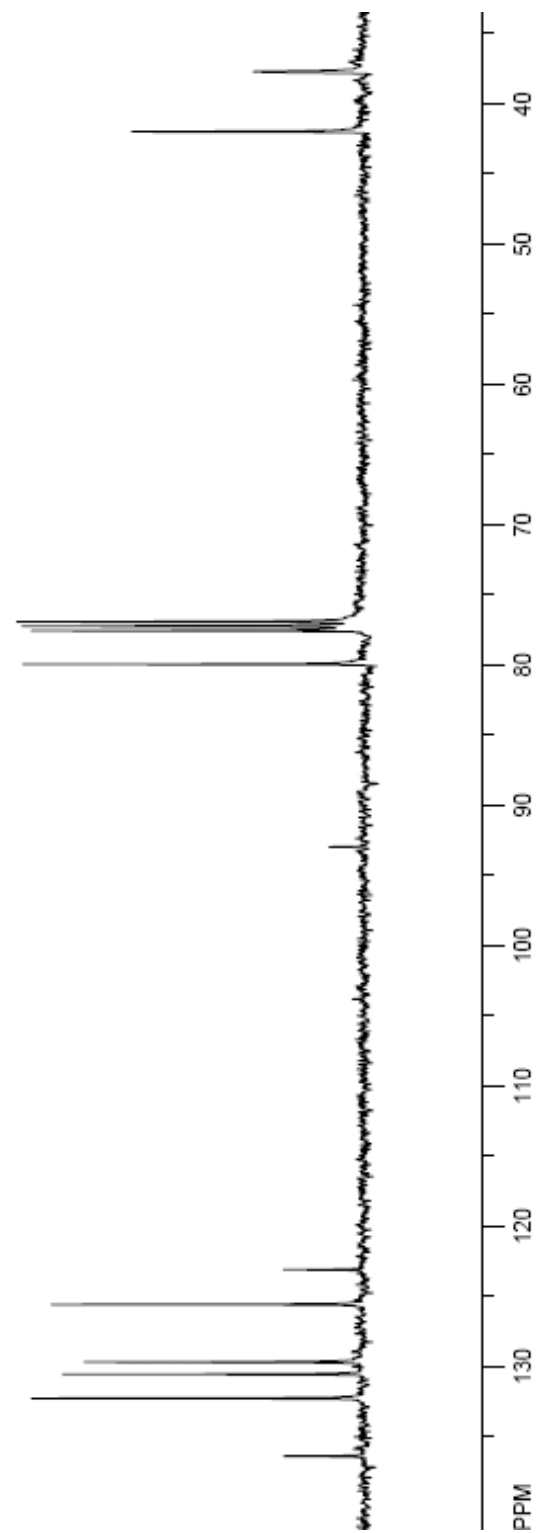
Pk #	Retention Time	Area Percent
1	17.368	5.214
2	21.020	94.786

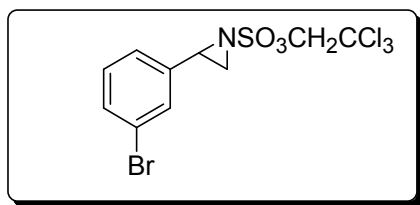
Totals		100.000
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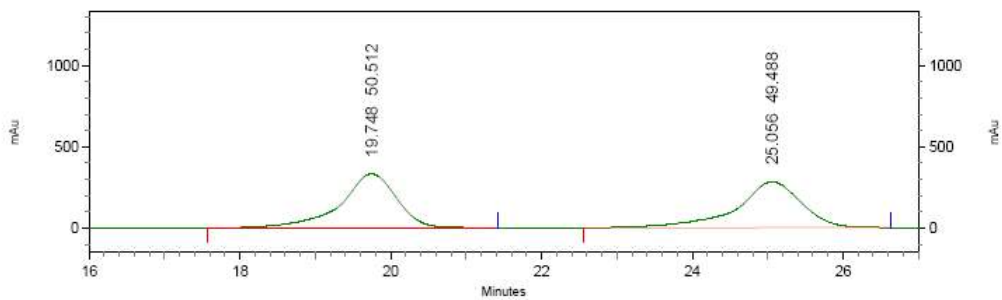
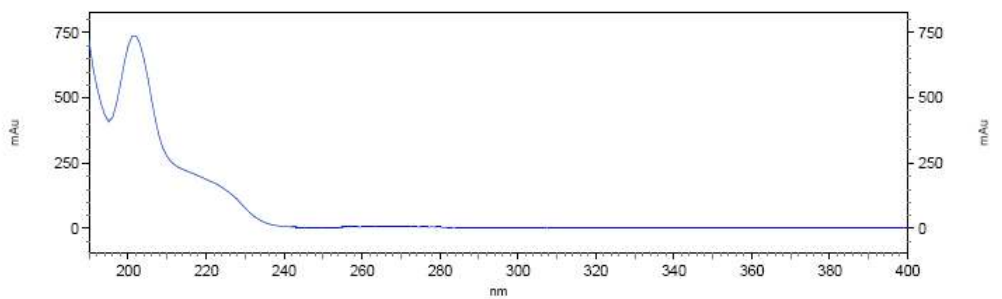
2-(3-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester





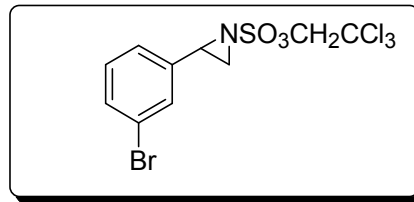


2-(3-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

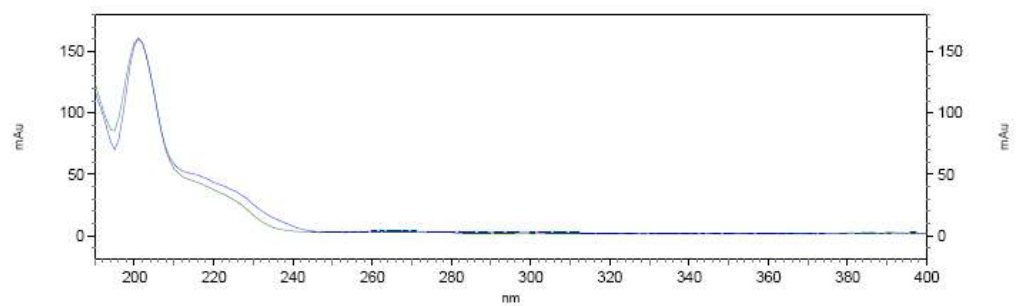


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	19.748	50.512
2	25.056	49.488
Totals		100.000



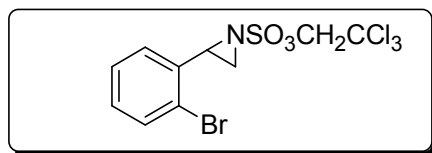
2-(3-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



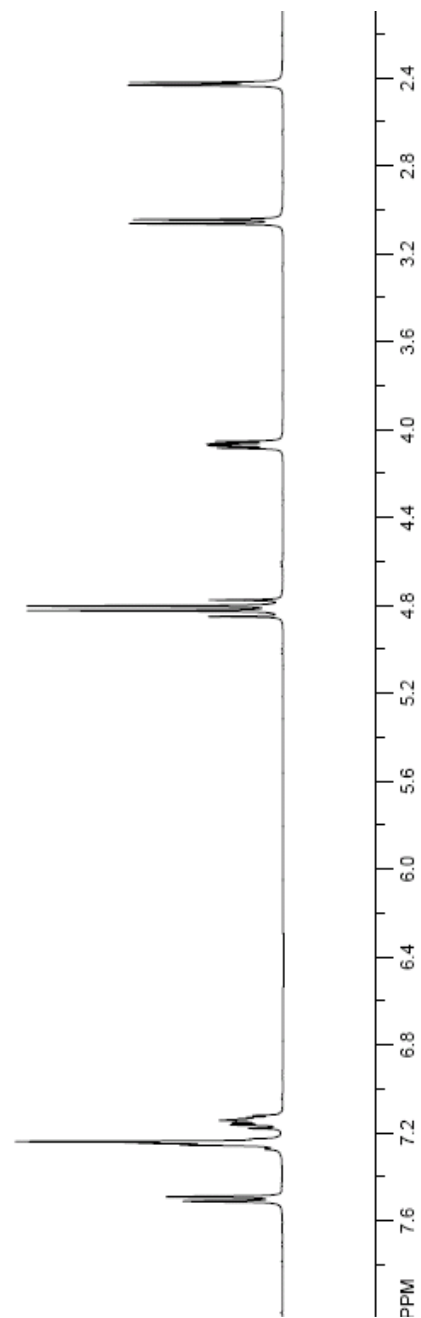
1: 225 nm, 4 nm Results

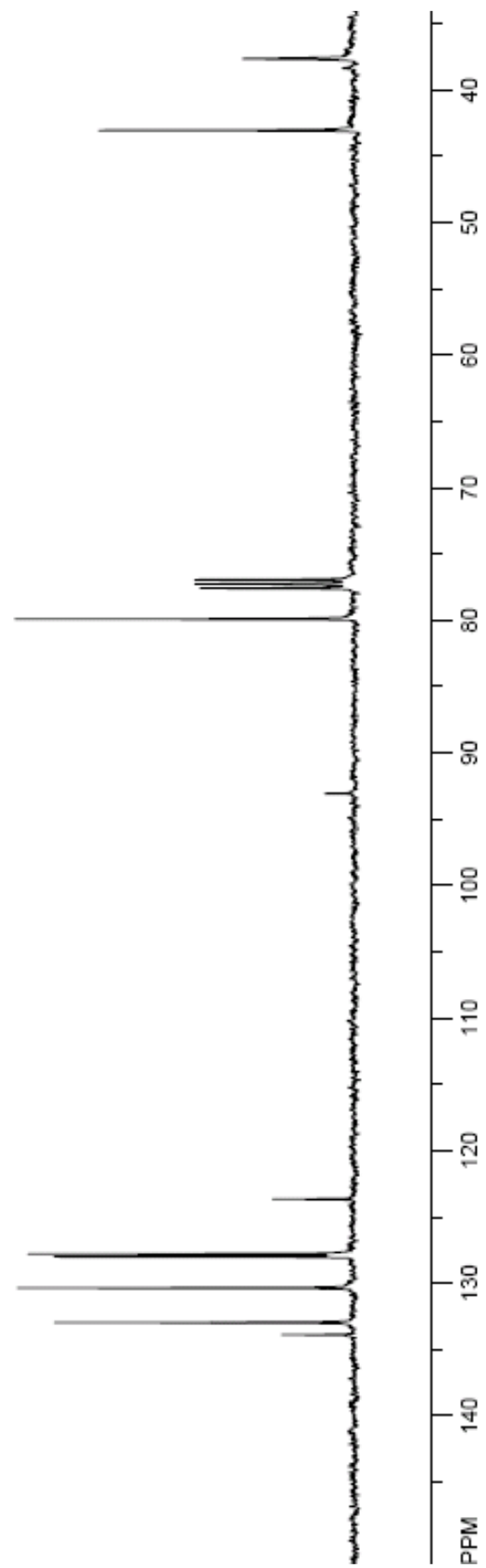
Pk #	Retention Time	Area Percent
1	20.216	5.920
2	25.192	94.080

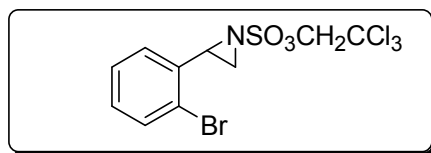
Totals		100.000
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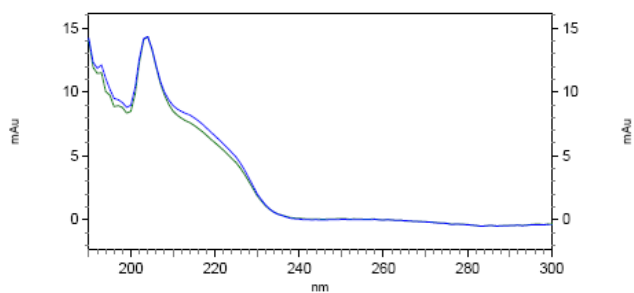
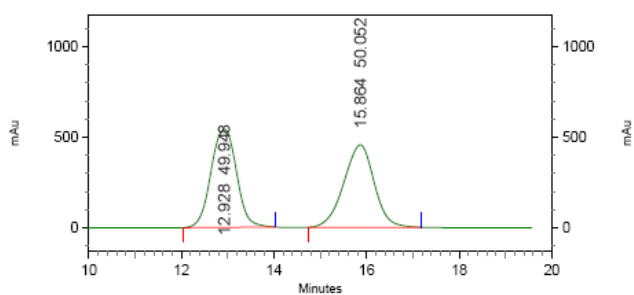
2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester







2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

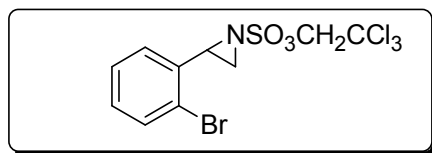


2: 225 nm, 4 nm

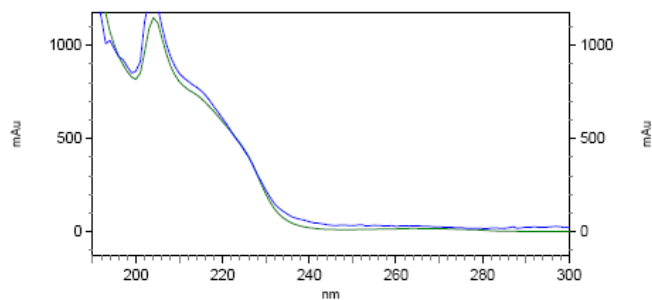
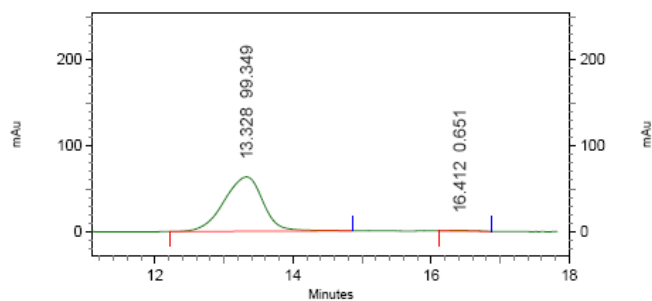
Results

Name	Retention Time	Area Percent	Pk #
	12.928	49.948	1
	15.864	50.052	2

Totals		100.000	
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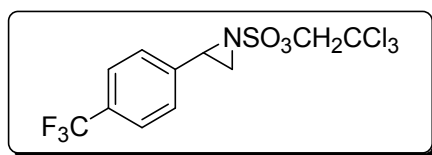
2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



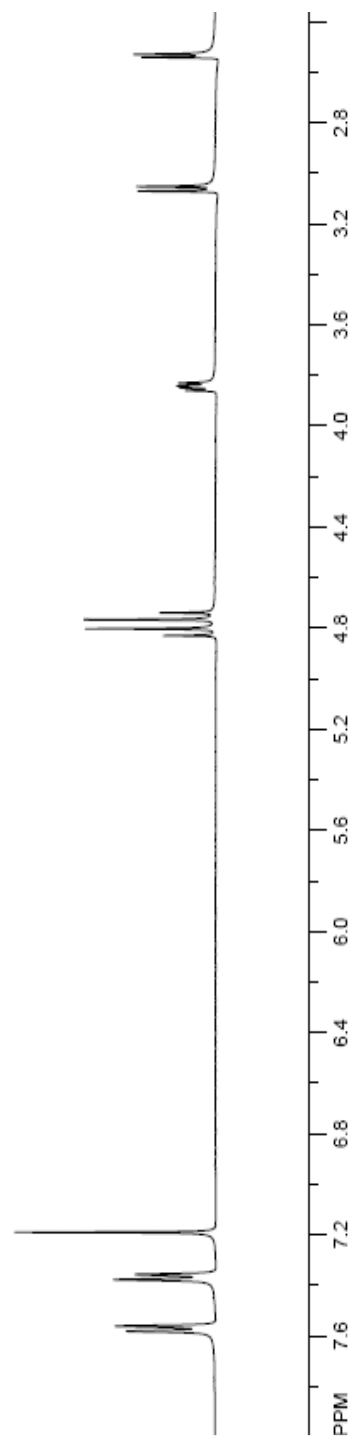
1: 234 nm, 4 nm

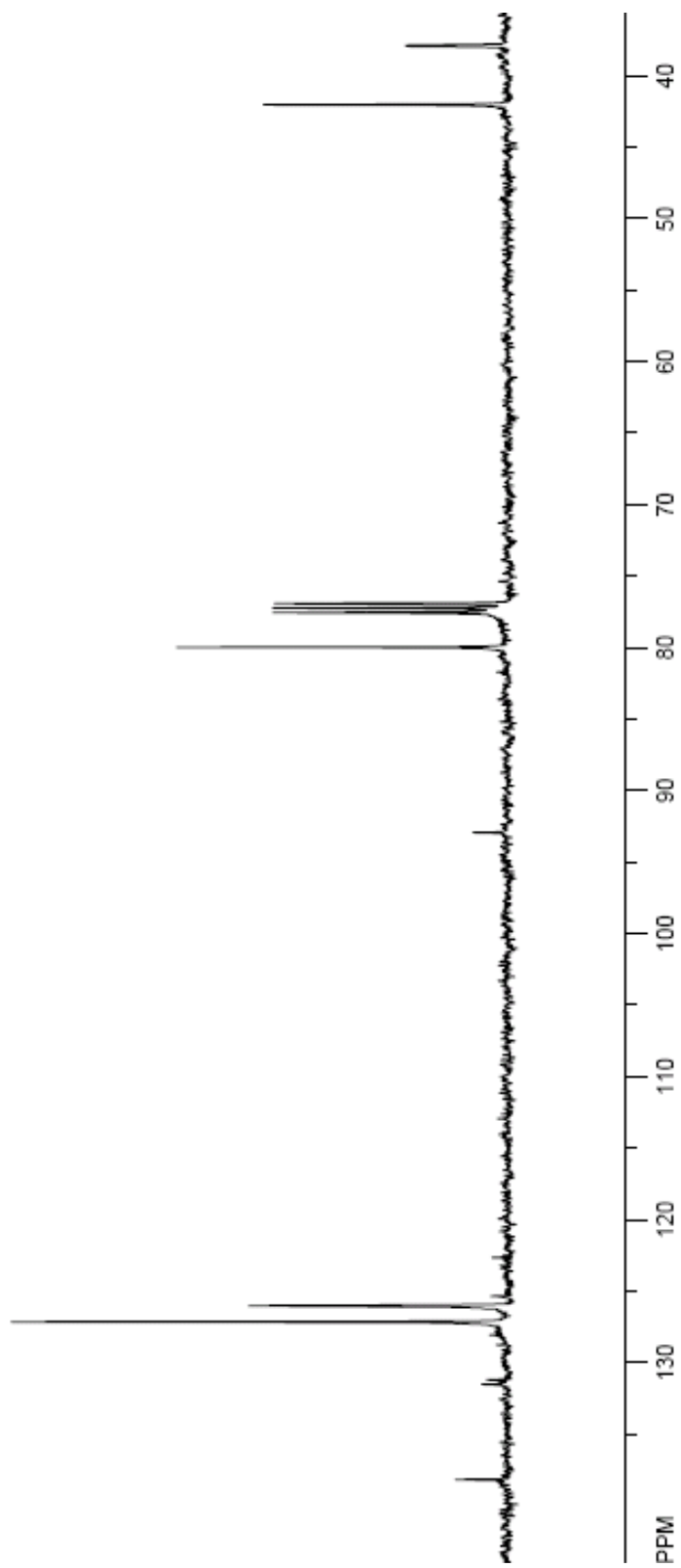
Results

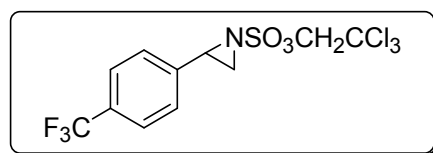
Name	Retention Time	Area Percent	Pk #
	13.328	99.349	1
	16.412	0.651	2
Totals		100.000	



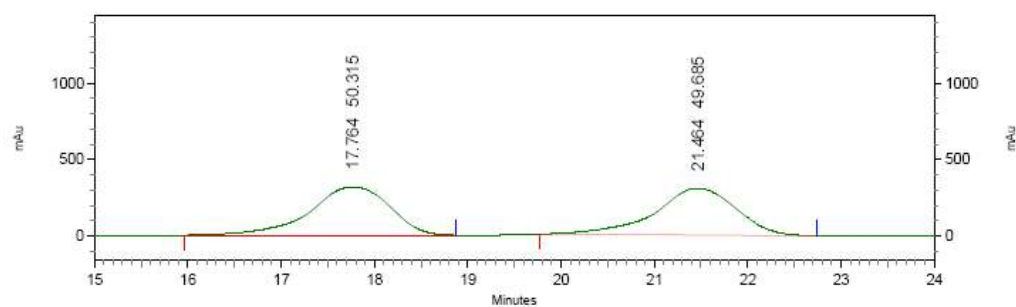
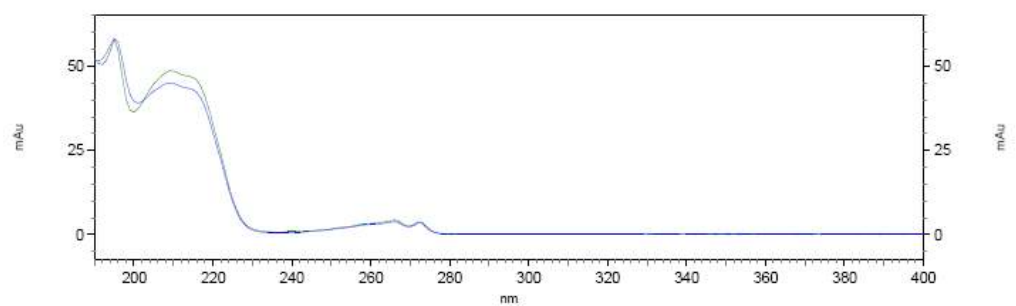
2-(4-Trifluoromethyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester





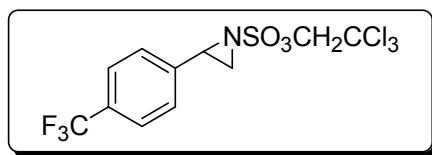


2-(4-Trifluoromethyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

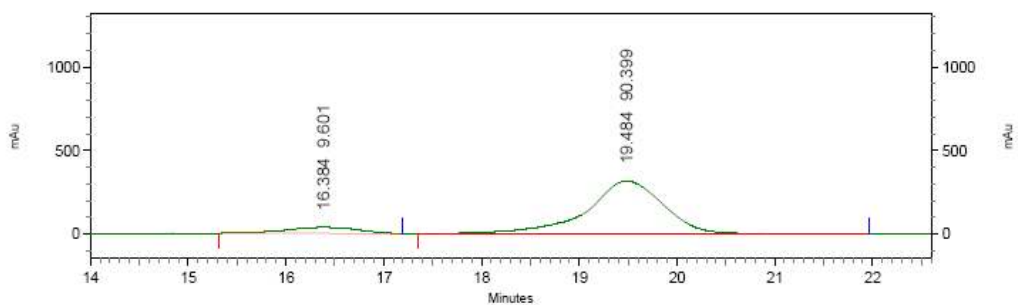
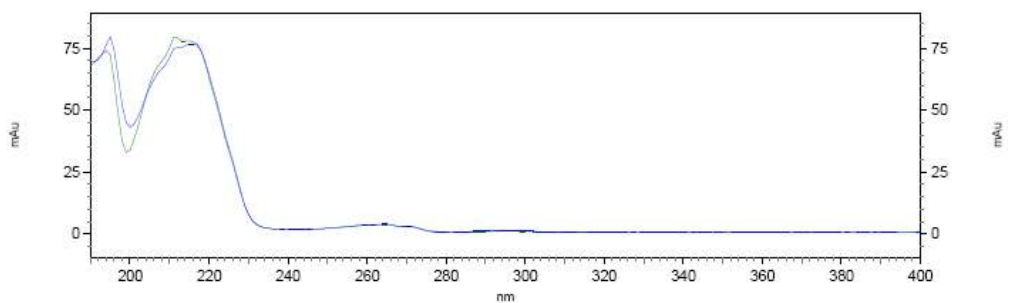


1: 225 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	17.764	50.315
2	21.464	49.685
Totals		100.000



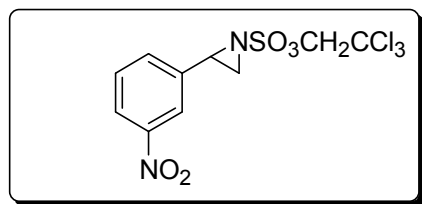
2-(4-Trifluoromethyl-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



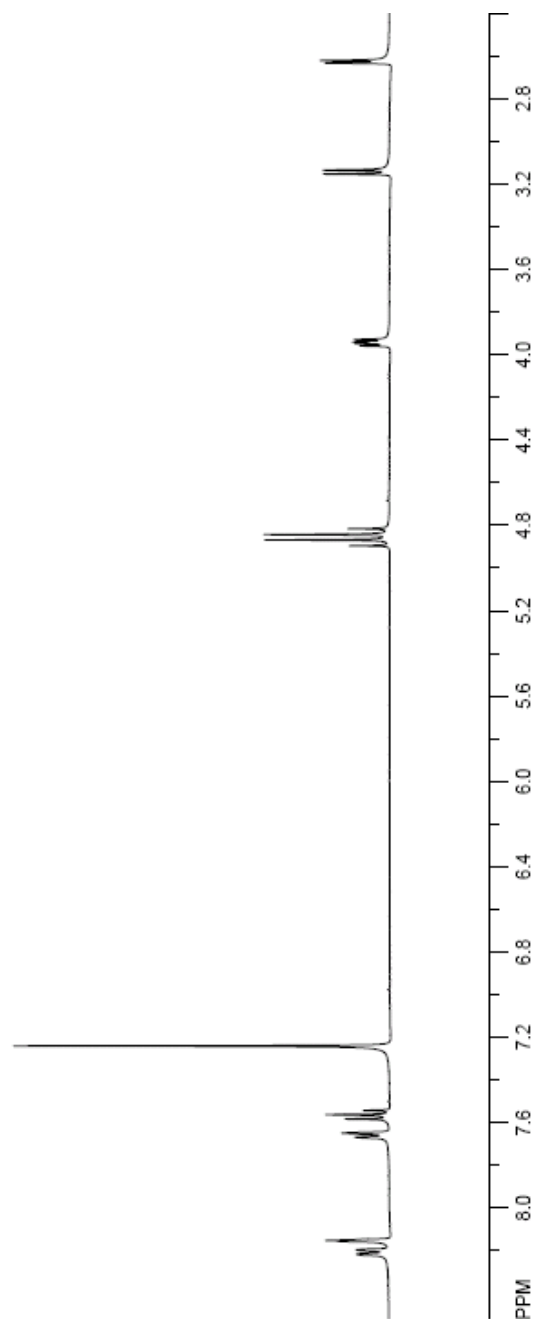
1: 225 nm, 4 nm Results

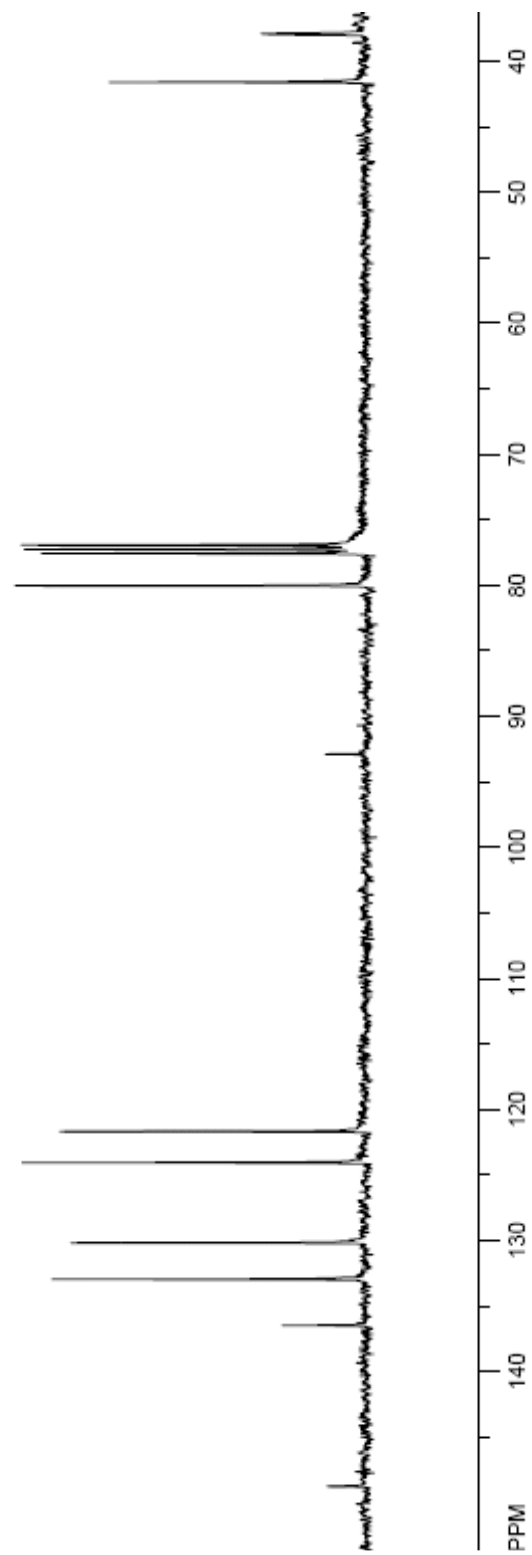
Pk #	Retention Time	Area Percent
1	16.384	9.601
2	19.484	90.399

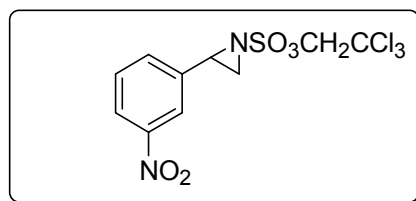
Totals	100.000
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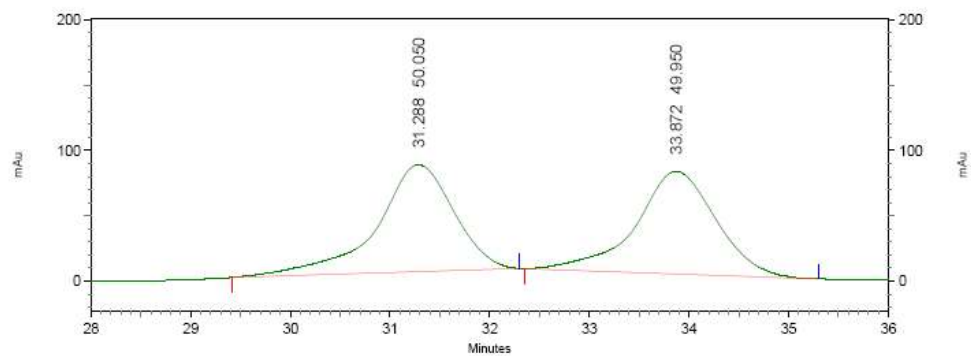
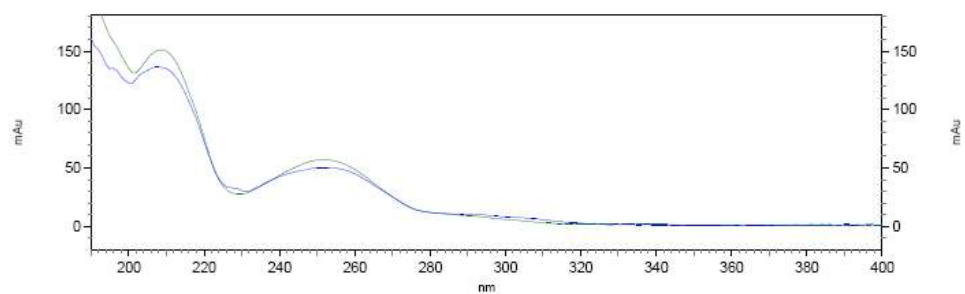
2-(3-Nitro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester







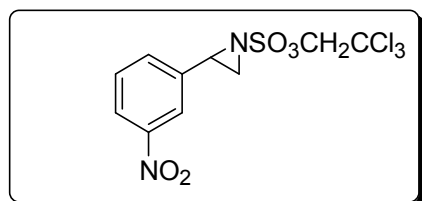
2-(3-Nitro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



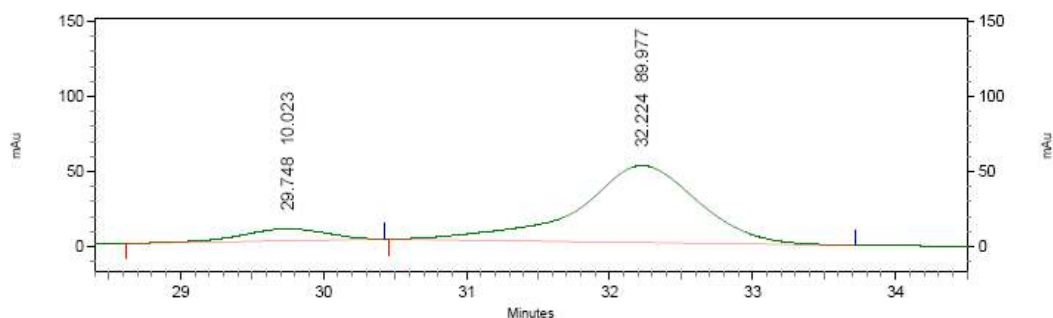
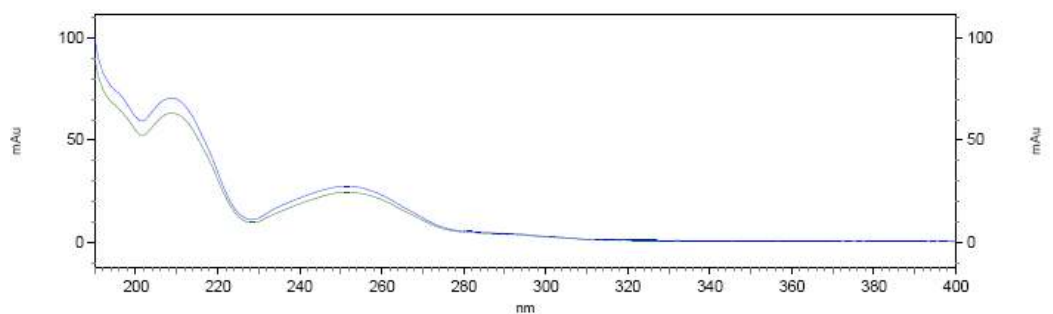
1: 260 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	31.288	50.050
2	33.872	49.950

Totals		100.000
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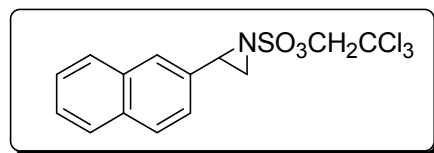
2-(3-Nitro-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



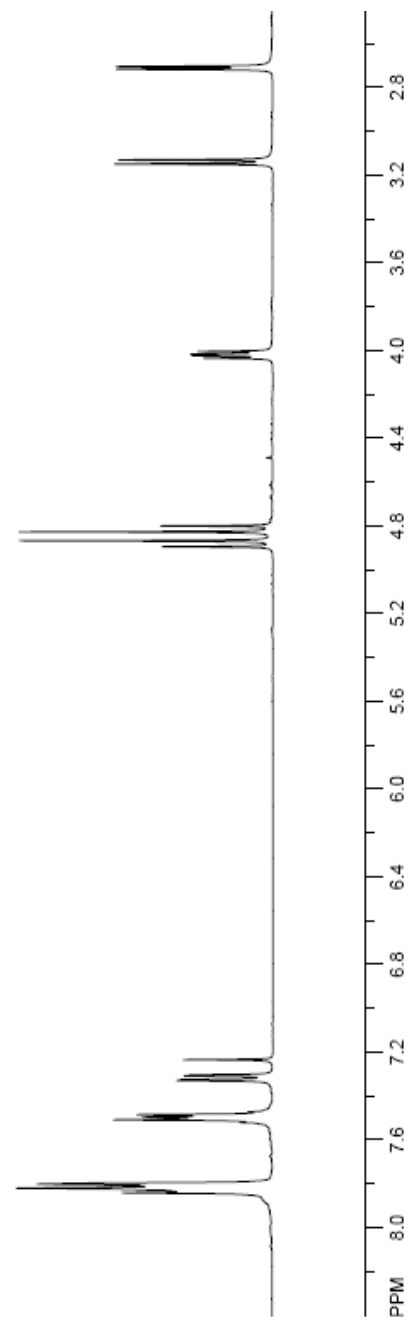
1: 260 nm, 4 nm Results

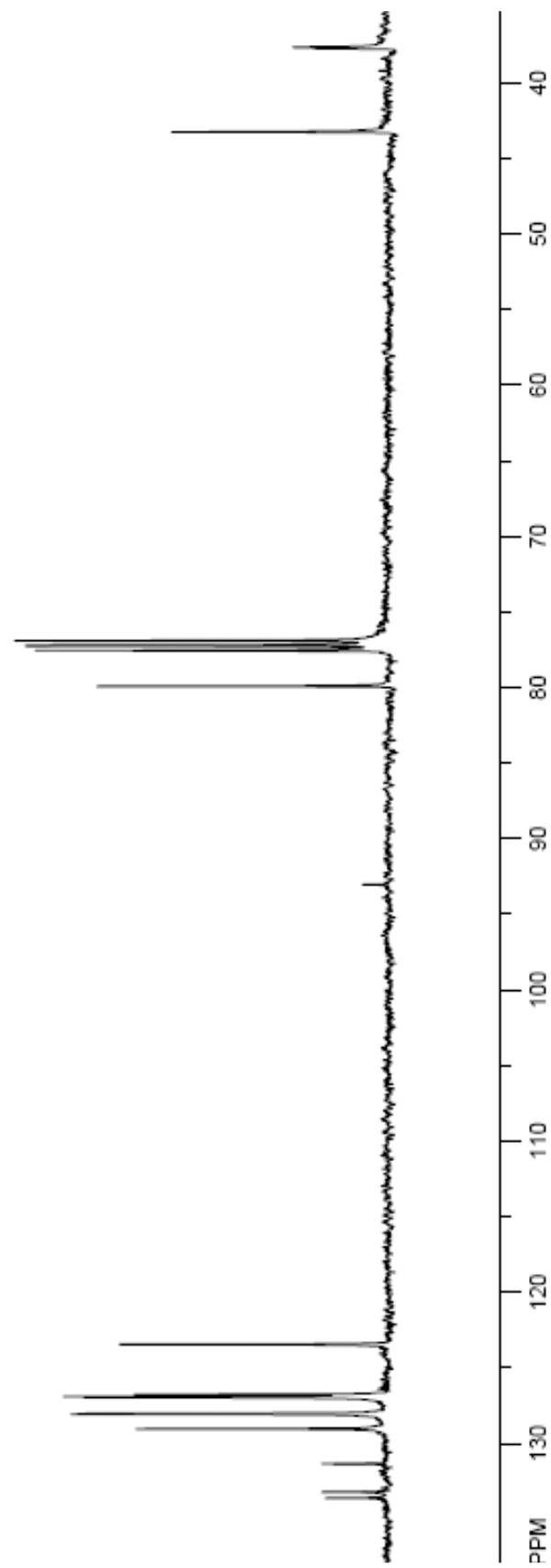
Pk #	Retention Time	Area Percent
1	29.748	10.023
2	32.224	89.977

Totals	100.000
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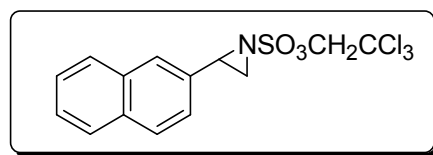


2-Naphthalene-2yl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

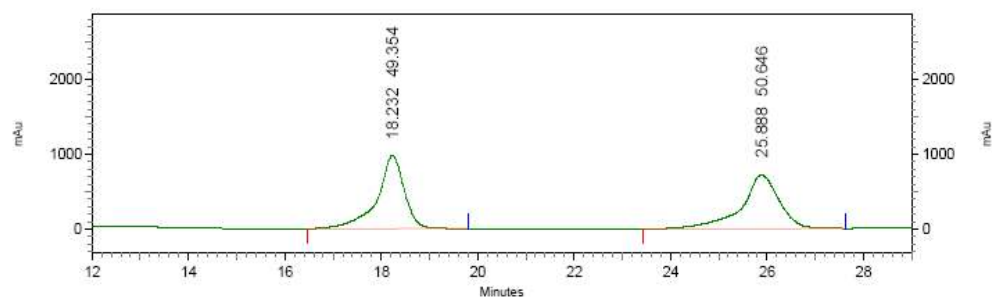
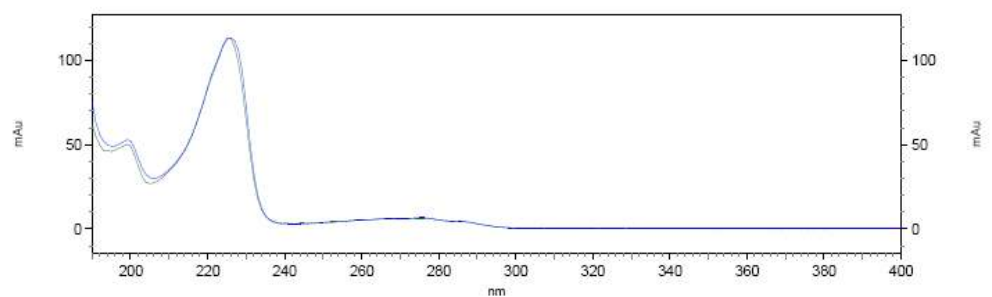




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2-Napthalene-2-yl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



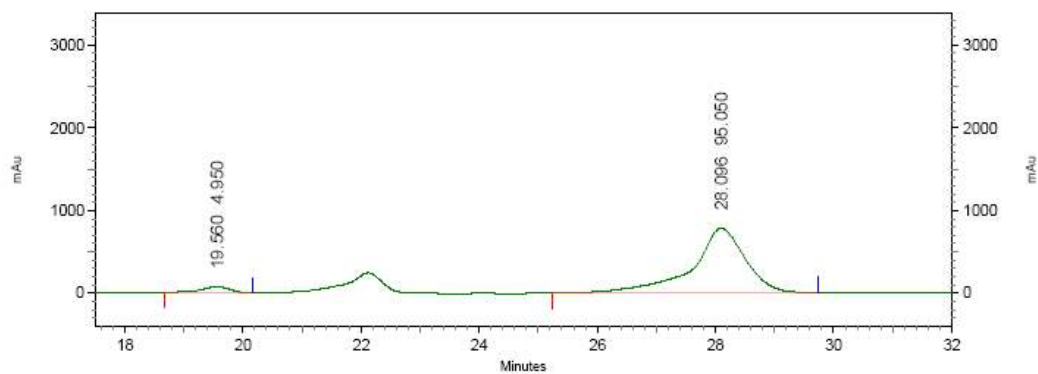
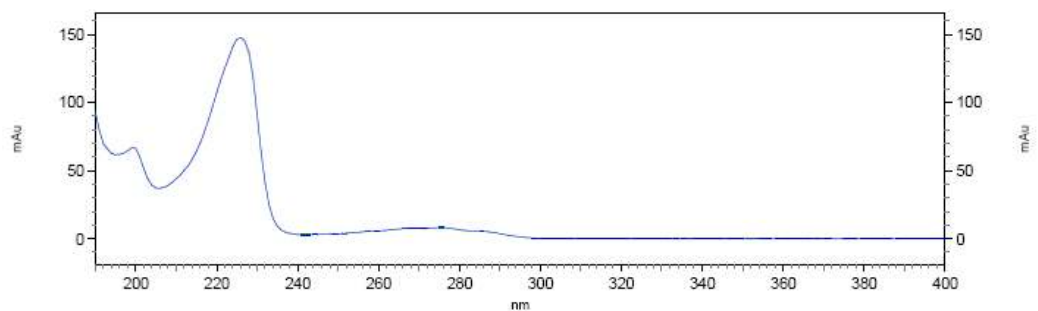
1: 210 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	18.232	49.354
2	25.888	50.646

Totals	100.000
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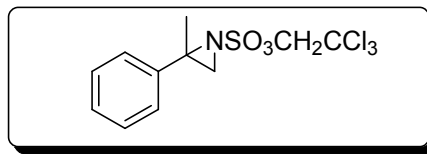


2-Naphthalene-2yl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

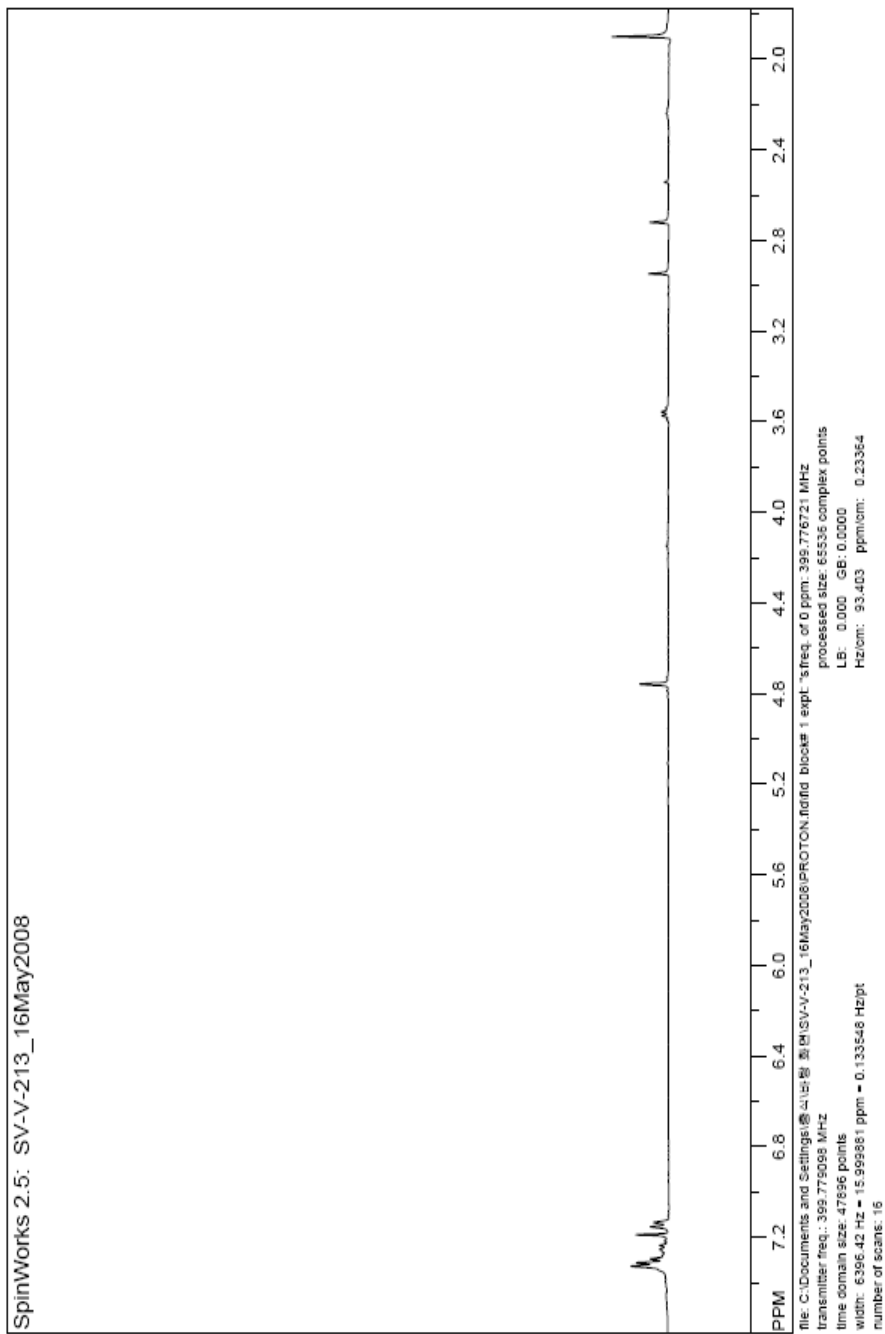


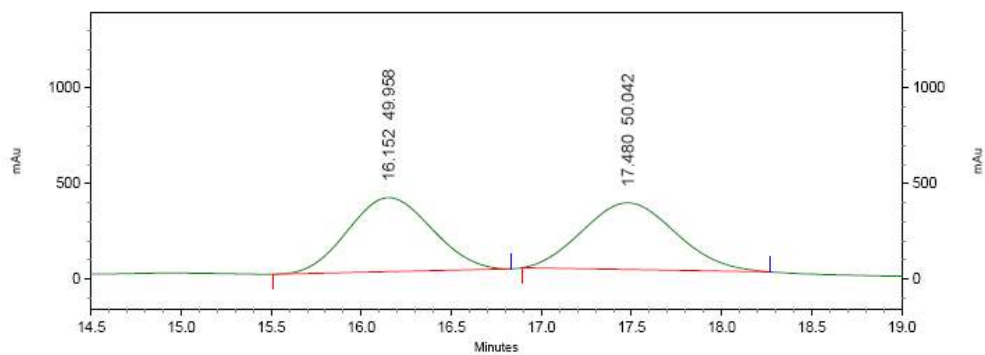
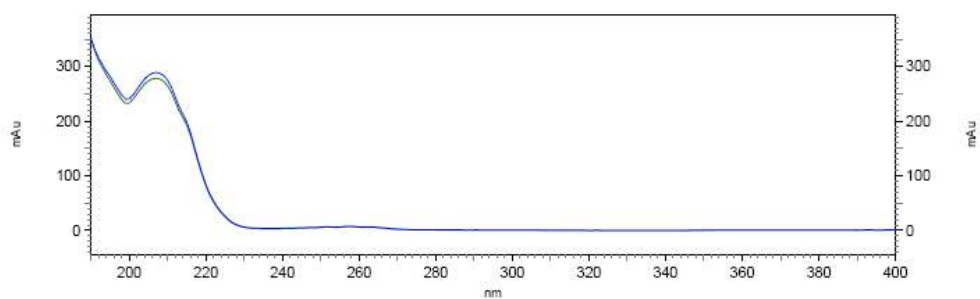
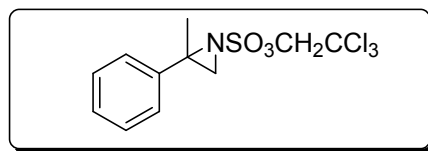
1: 207 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	19.560	4.950
2	28.096	95.050
Totals		100.000



SpinWorks 2.5: SV-V-213_16May2008

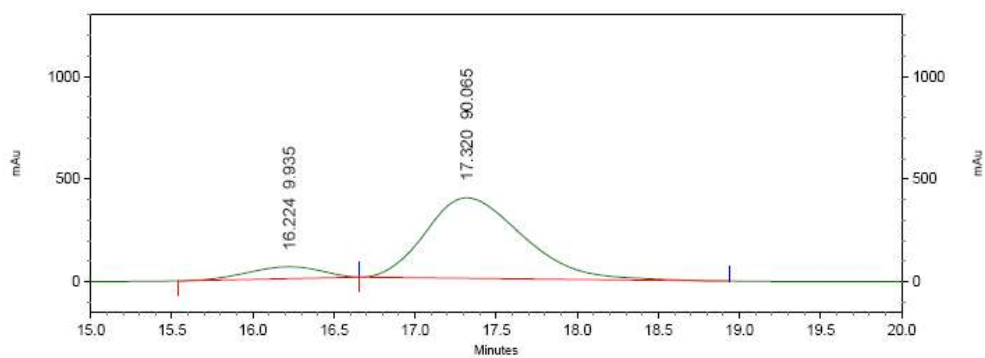
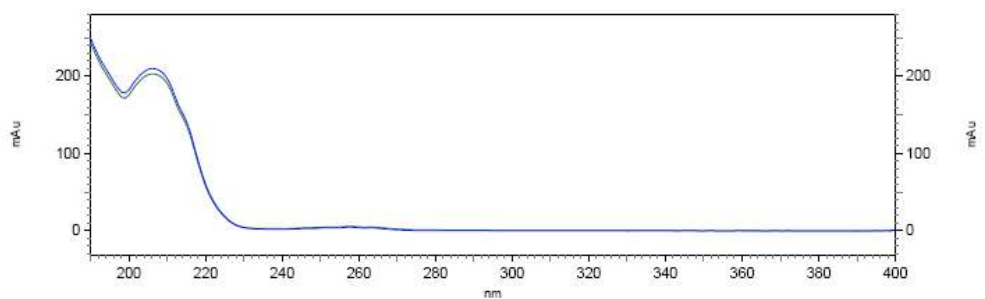
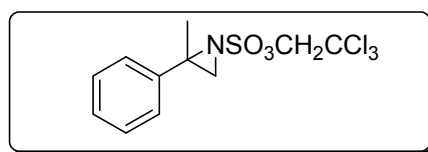




1: 224 nm, 4 nm Results

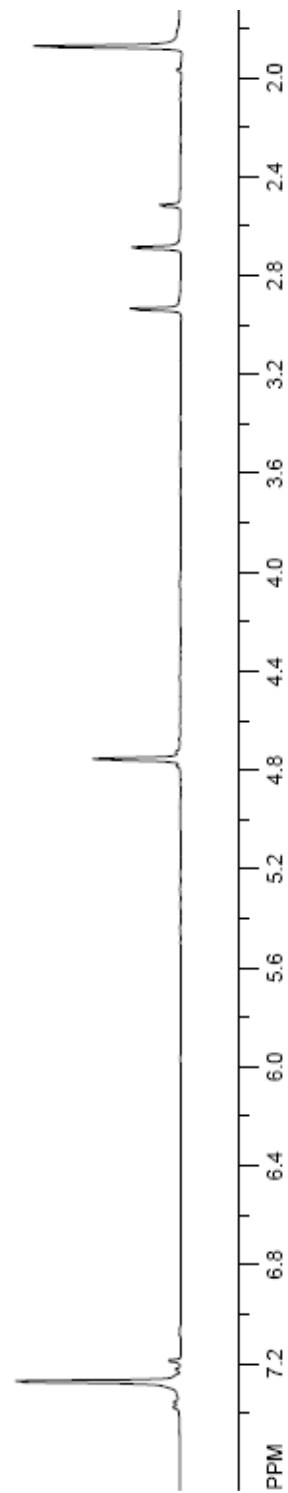
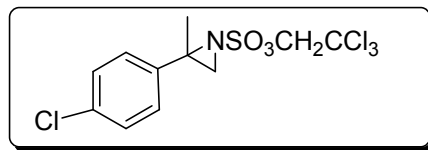
Pk #	Retention Time	Area Percent
1	16.152	49.958
2	17.480	50.042

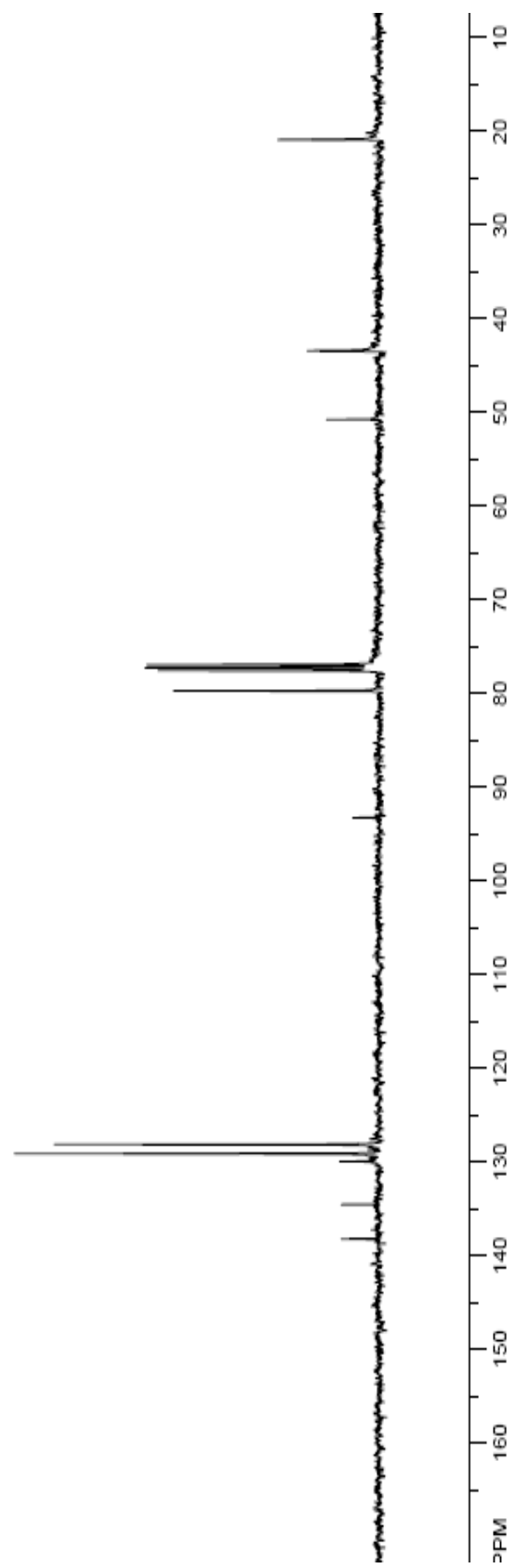
Totals		100.000
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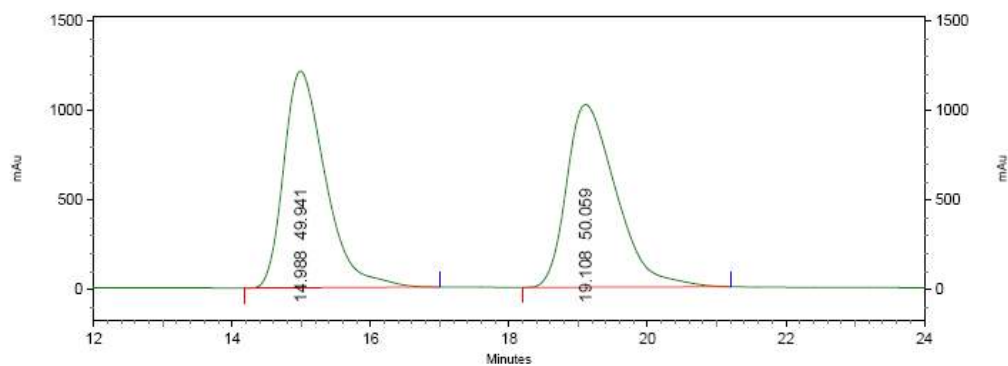
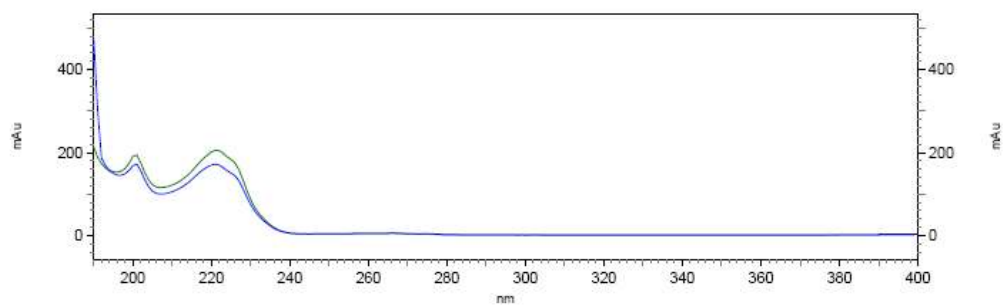
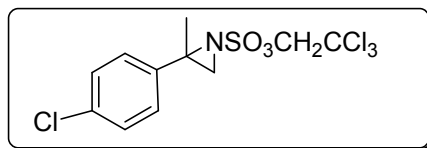


1: 224 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	16.224	9.935
2	17.320	90.065
Totals		100.000

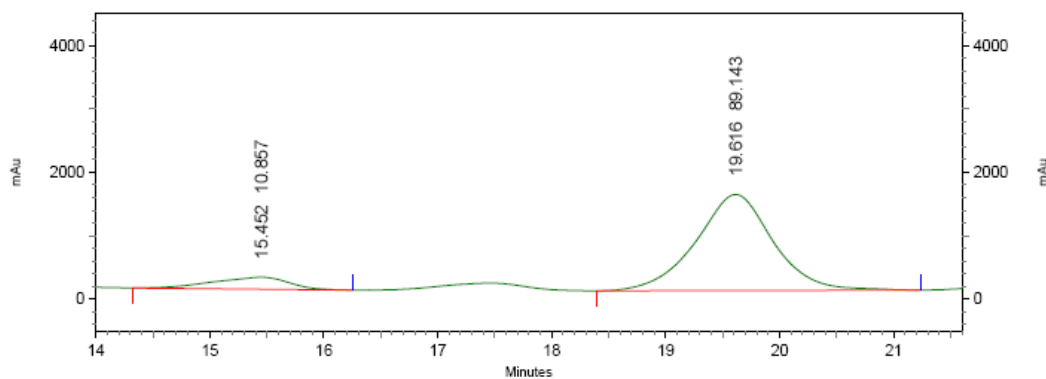
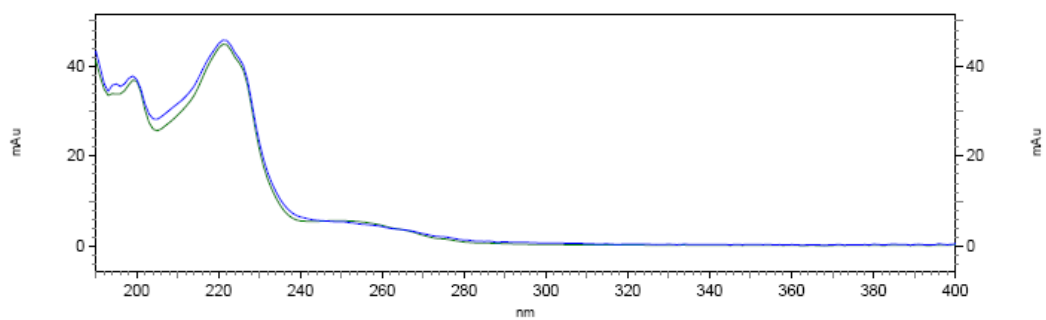
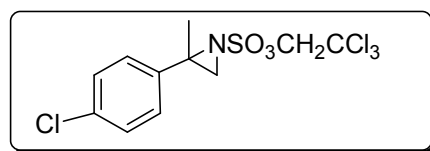






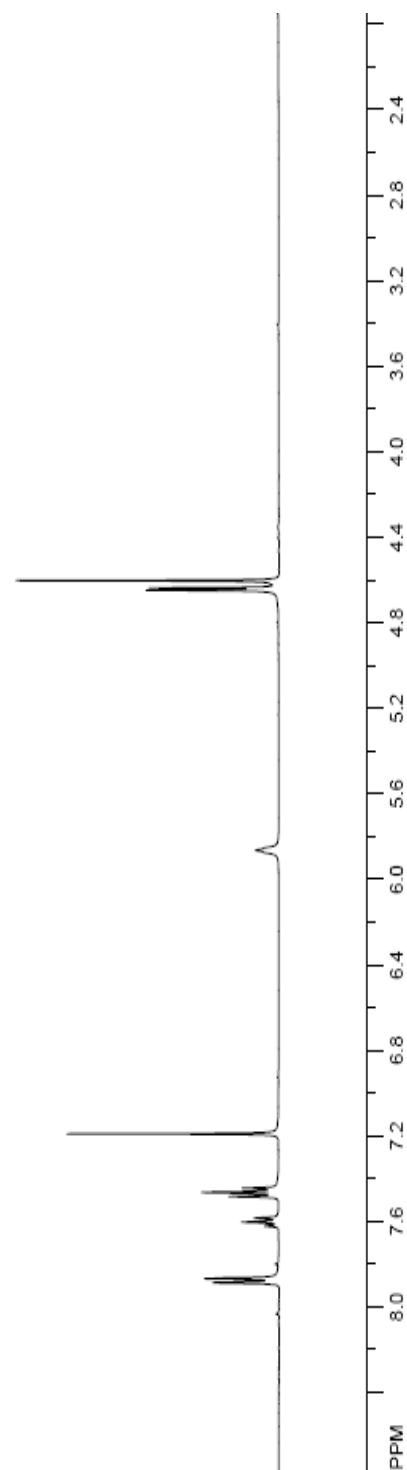
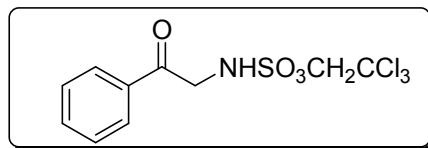
1: 234 nm, 4 nm Results

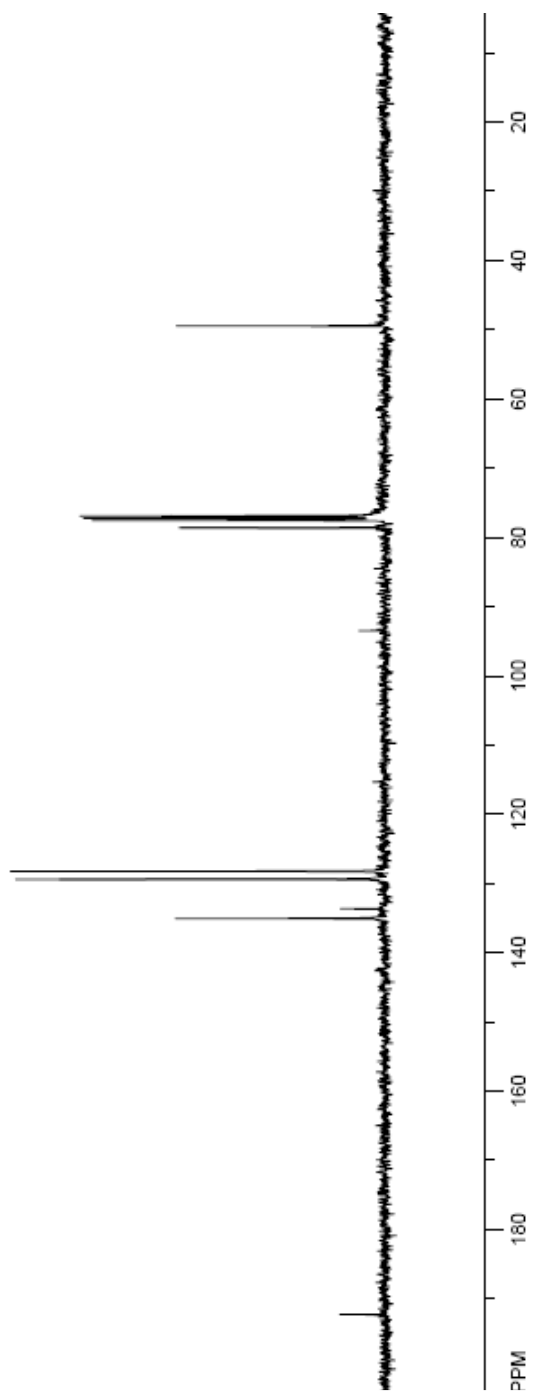
Pk #	Retention Time	Area Percent
1	14.988	49.941
2	19.108	50.059
Totals		100.000

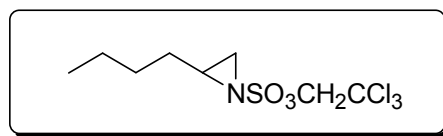


1: 234 nm, 4 nm Results

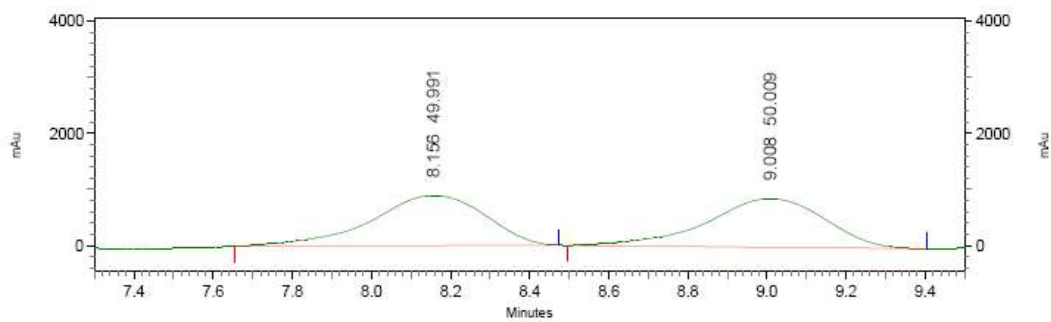
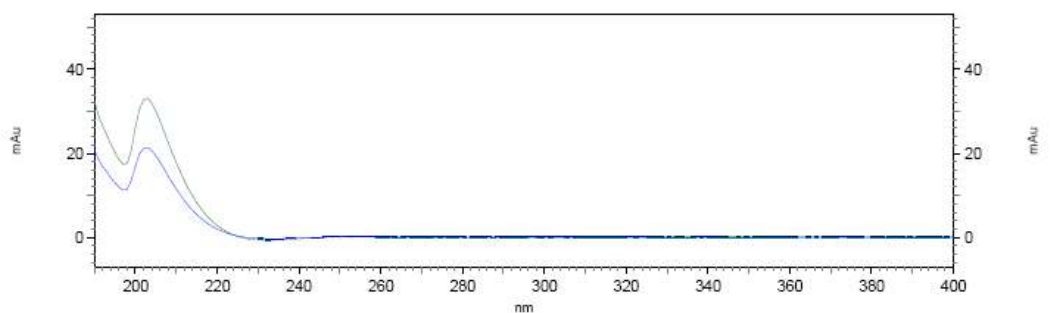
Pk #	Retention Time	Area Percent
1	15.452	10.857
2	19.616	89.143
Totals		100.000





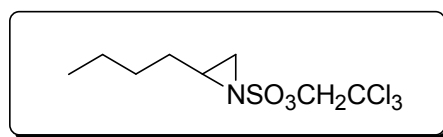


2-Butyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

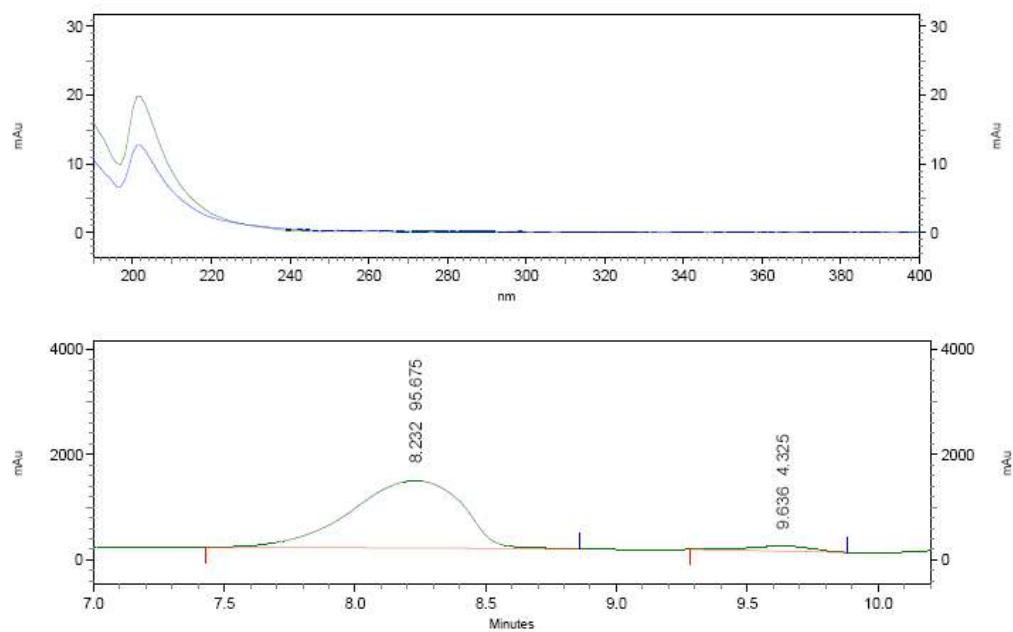


1: 204 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	8.156	49.991
2	9.008	50.009
Totals		100.000



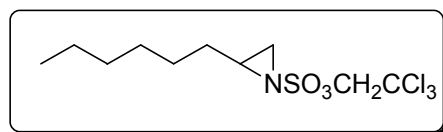
2-Butyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



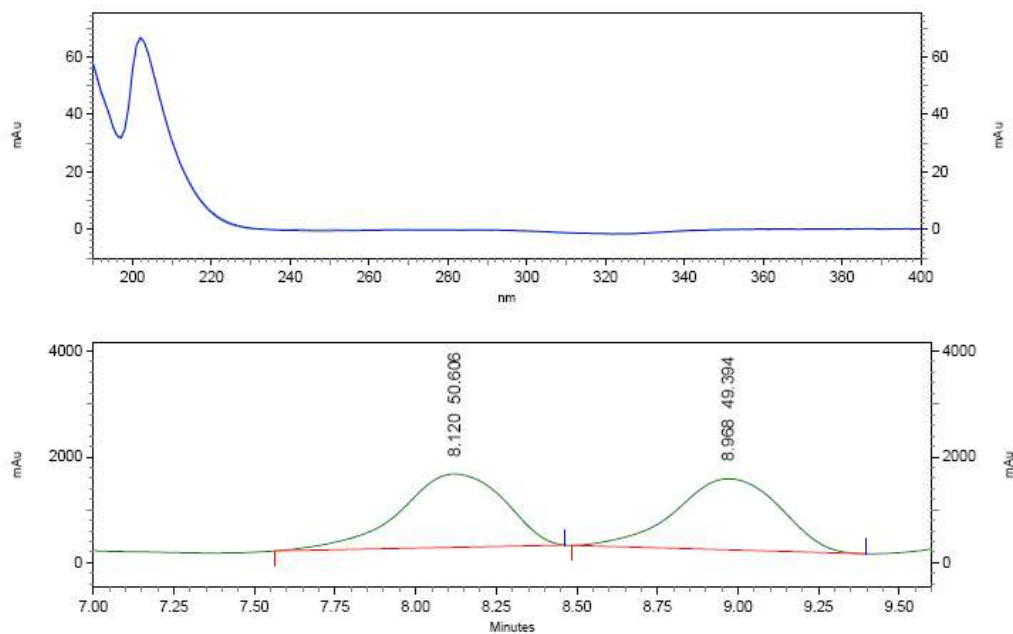
1: 204 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	8.232	95.675
2	9.636	4.325

Totals		100.000
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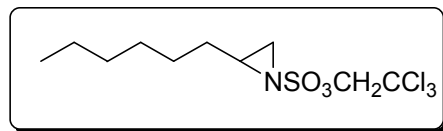
2-hexyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



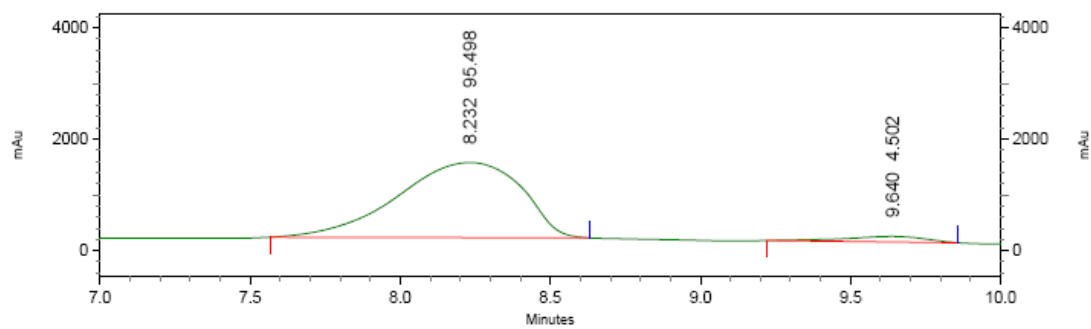
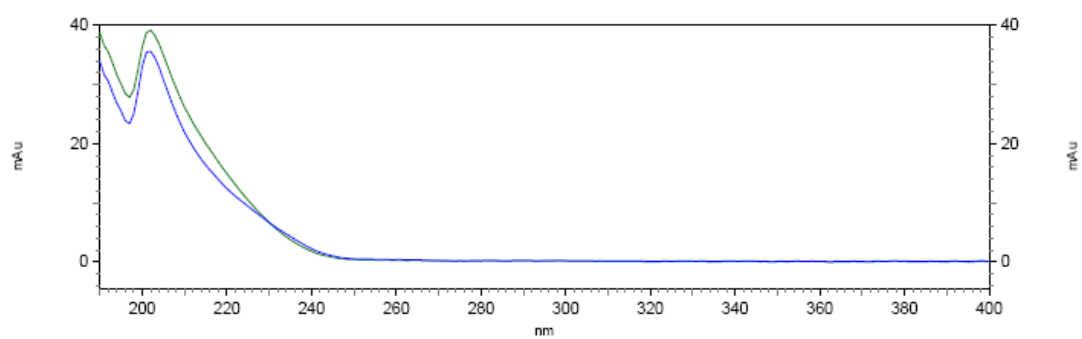
1: 205 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	8.120	50.606
2	8.968	49.394

Totals		100.000
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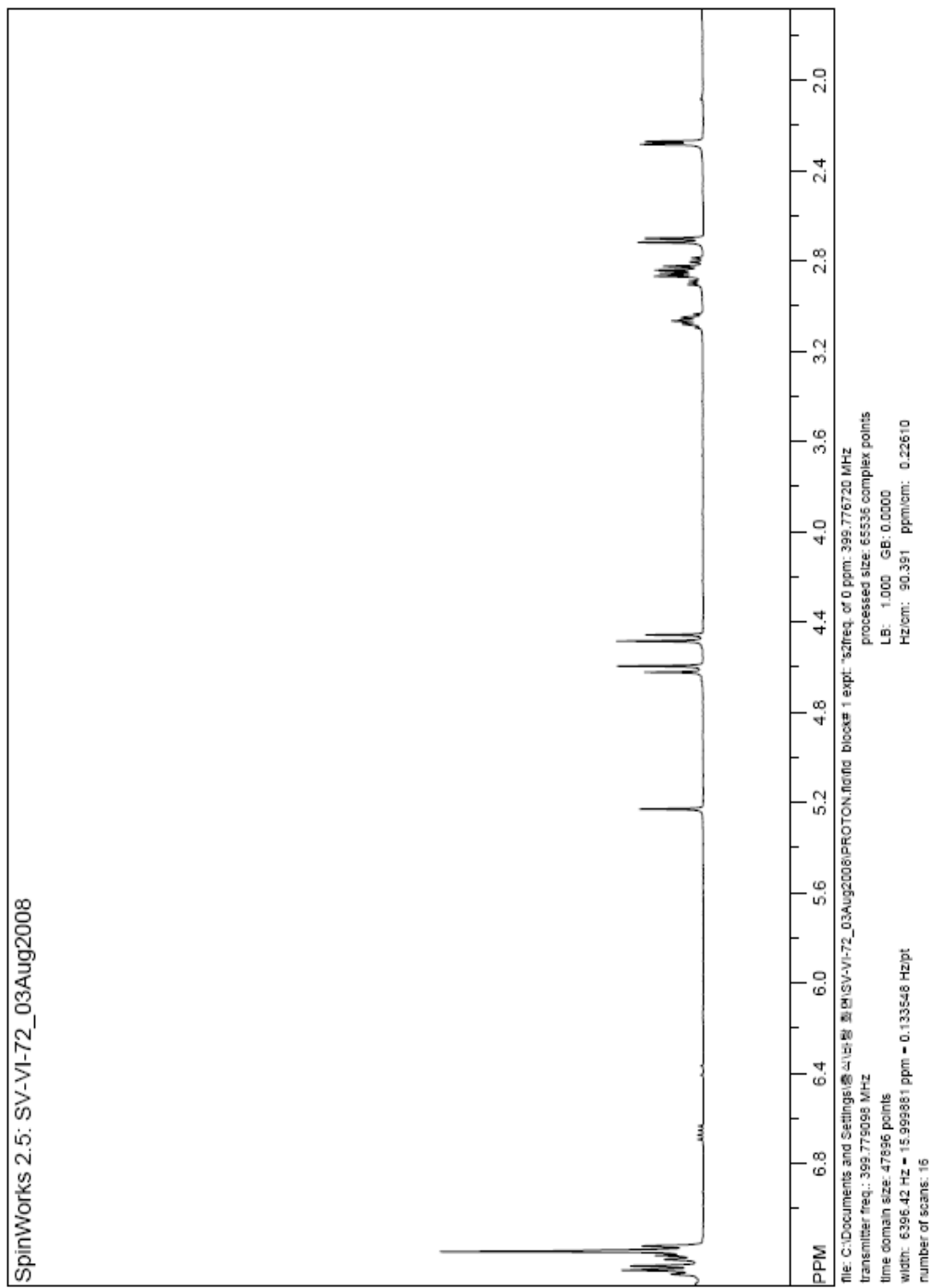
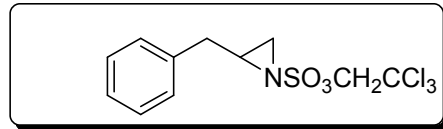


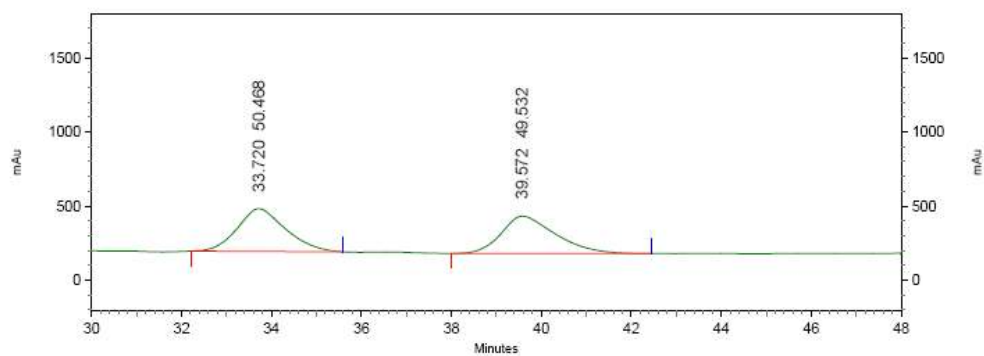
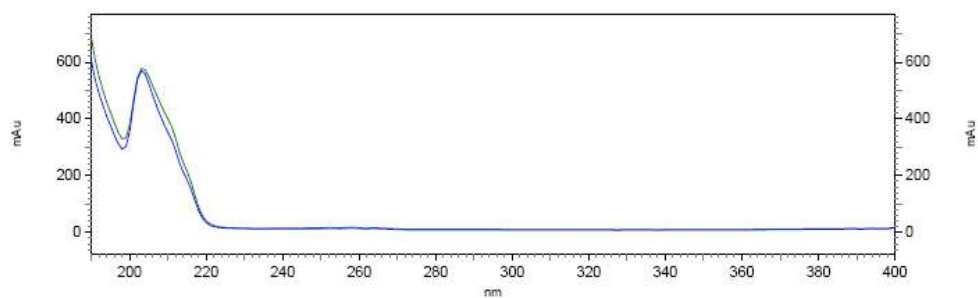
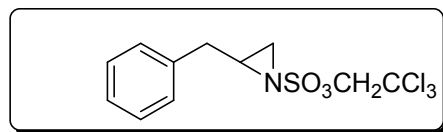
2-hexyl-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



1: 205 nm, 4 nm Results

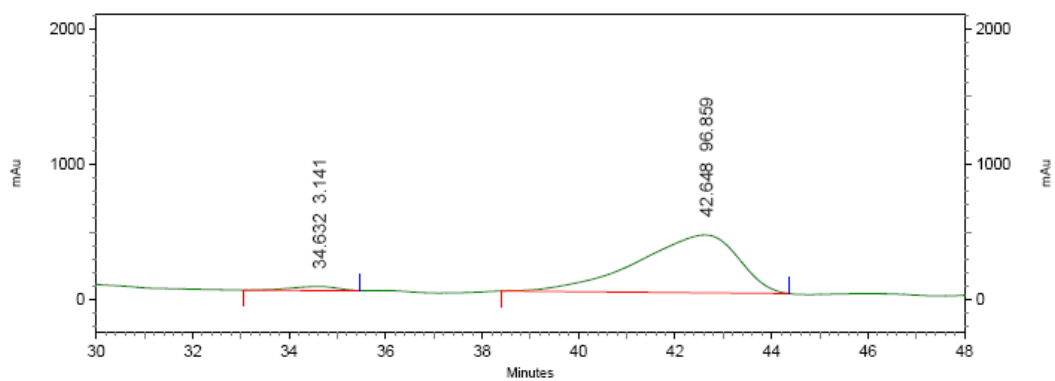
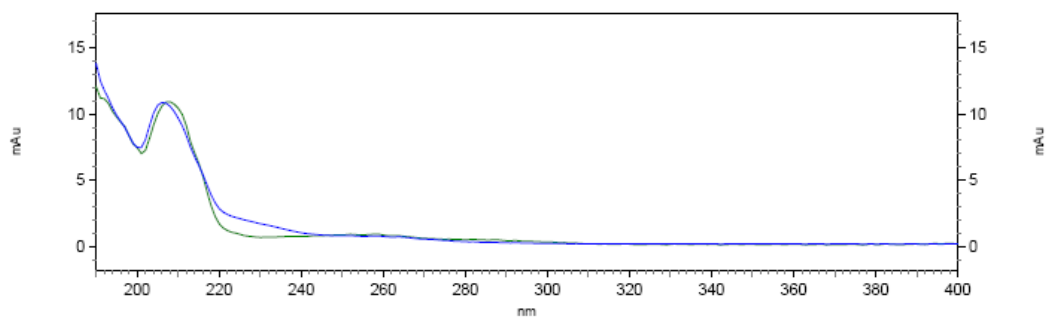
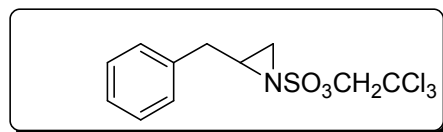
Pk #	Retention Time	Area Percent
1	8.232	95.498
2	9.640	4.502
Totals		100.000





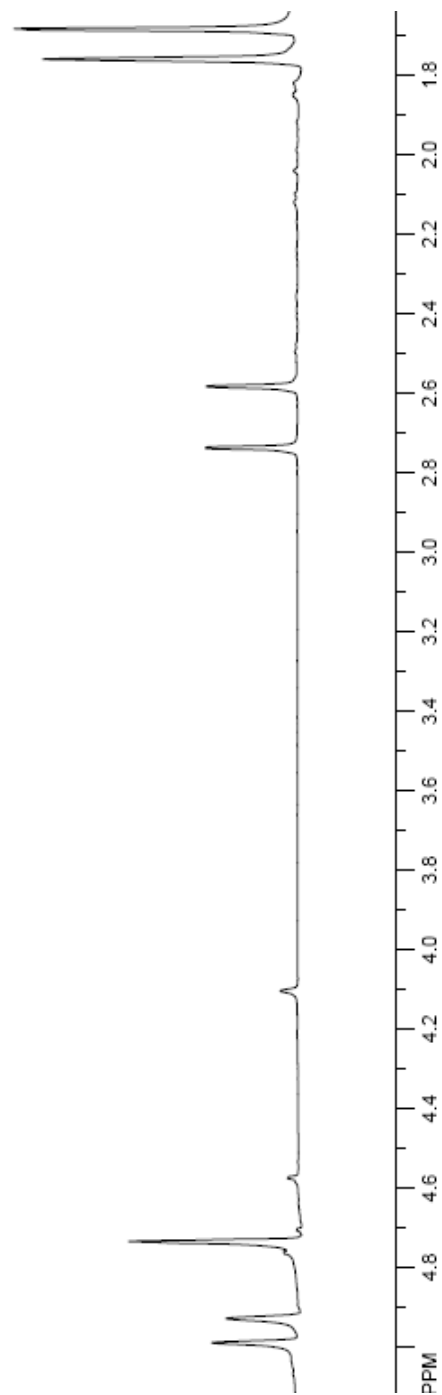
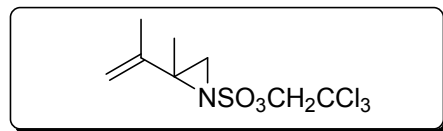
1: 220 nm, 4 nm Results

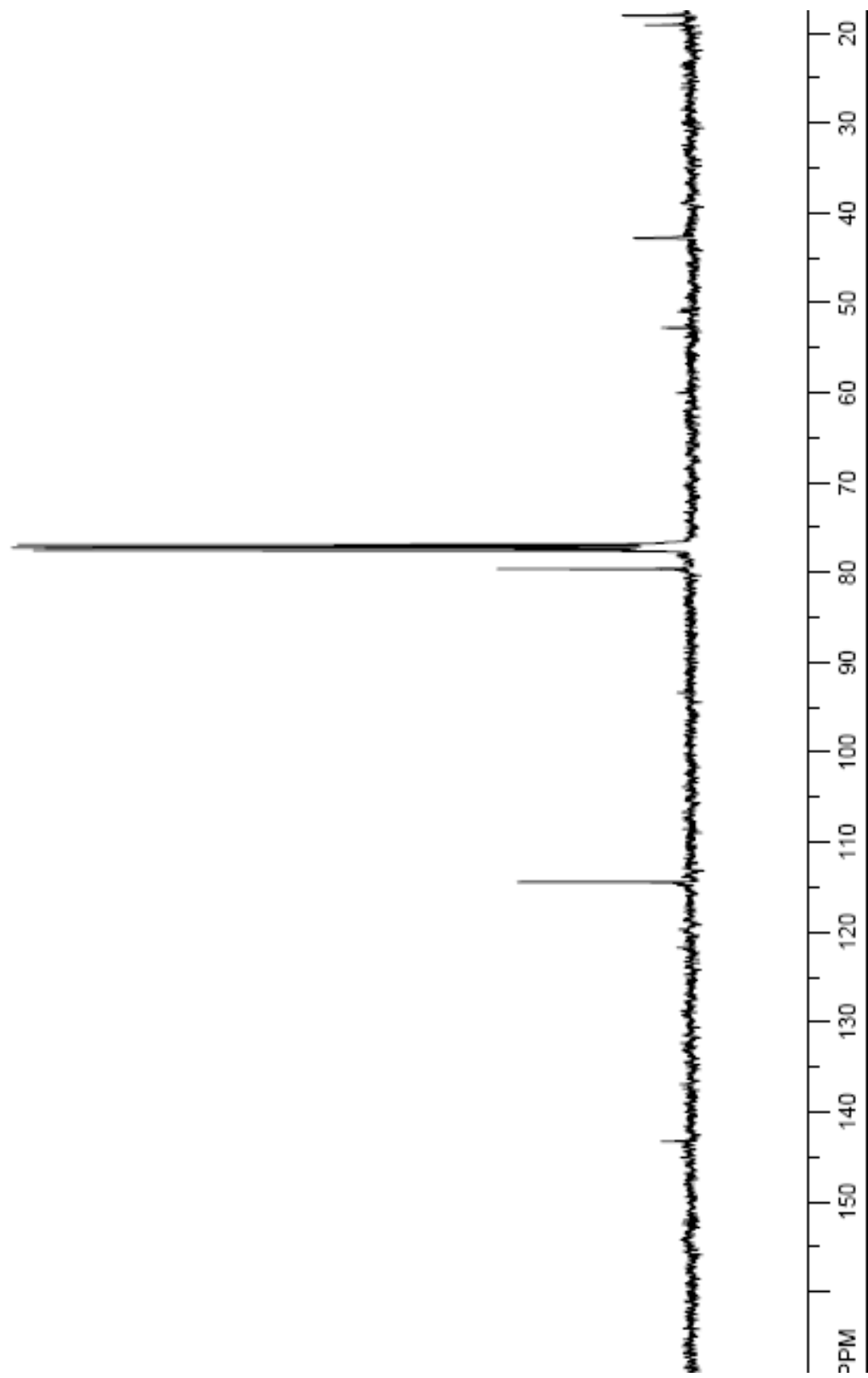
Pk #	Retention Time	Area Percent
1	33.720	50.468
2	39.572	49.532
Totals		100.000

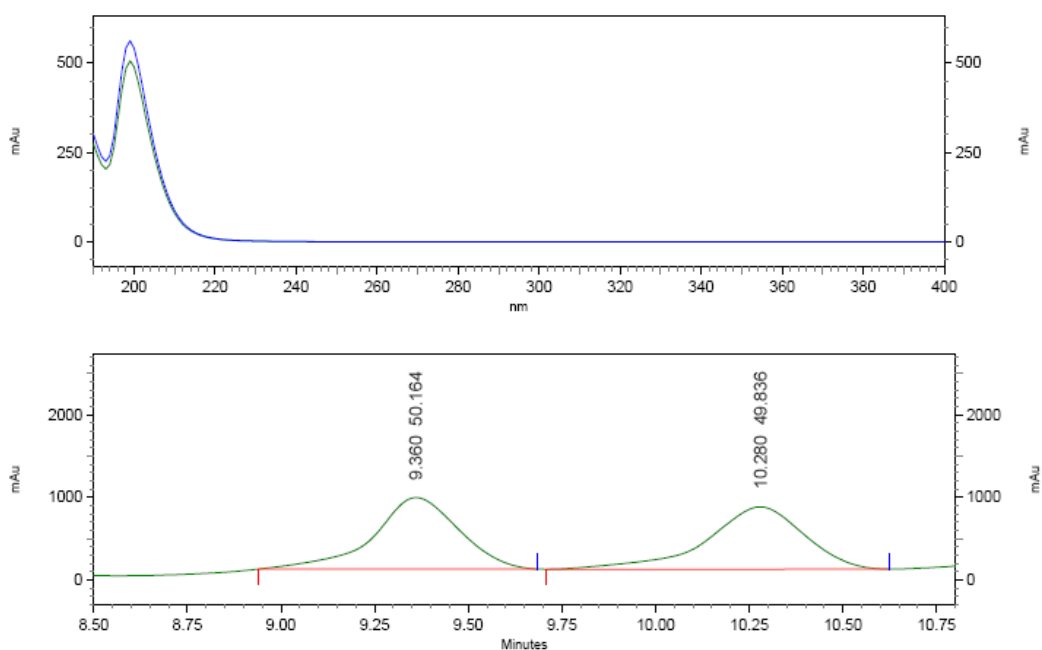
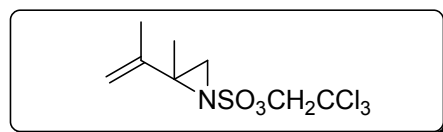


1: 221 nm, 4 nm Results

Pk #	Retention Time	Area Percent
1	34.632	3.141
2	42.648	96.859
Totals		100.000

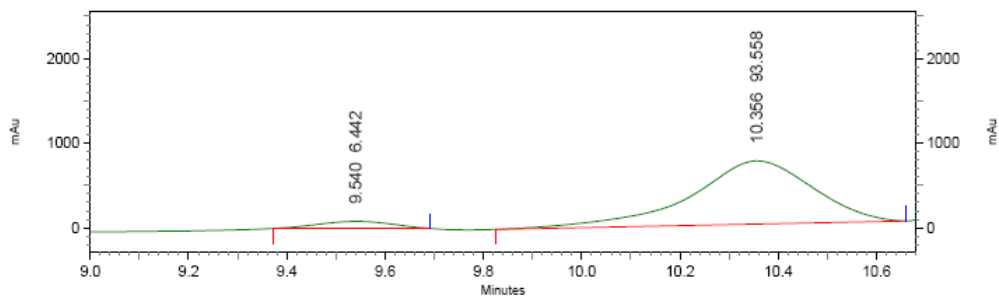
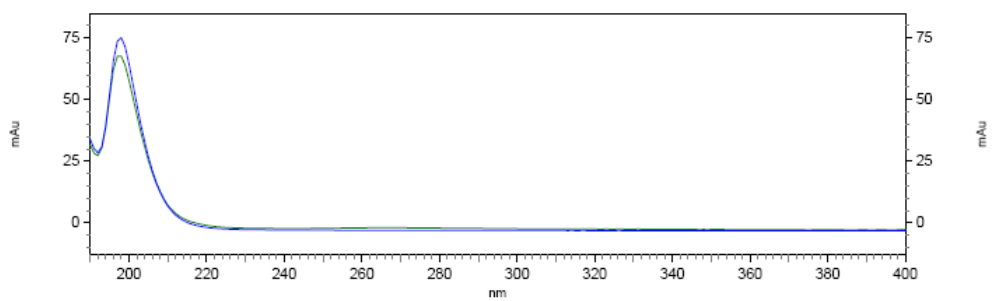
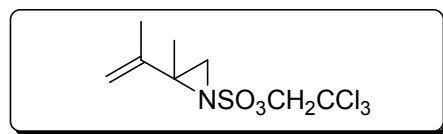






1: 213 nm, 4 nm Results

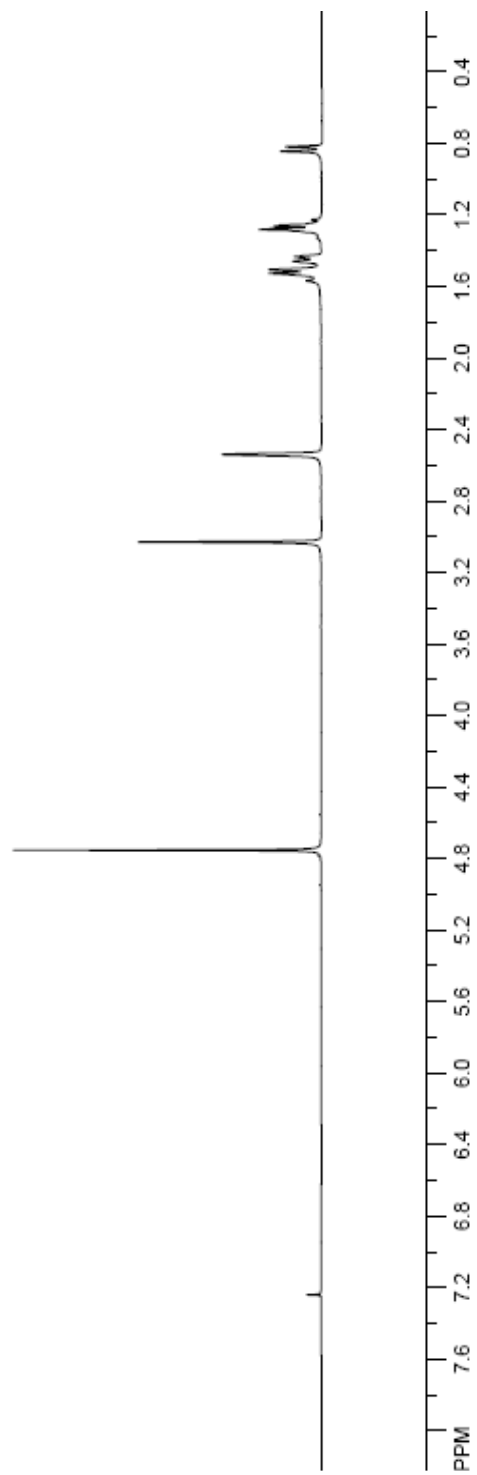
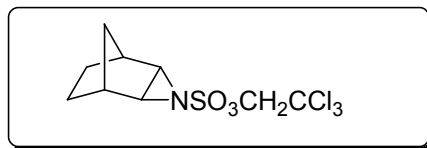
Pk #	Retention Time	Area Percent
1	9.360	50.164
2	10.280	49.836
Totals		100.000

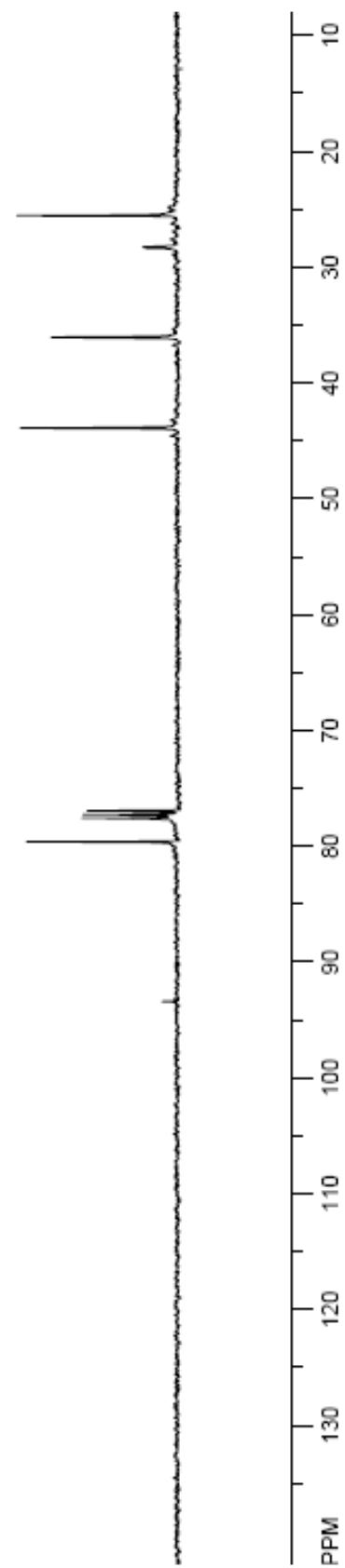


1: 214 nm, 4 nm Results

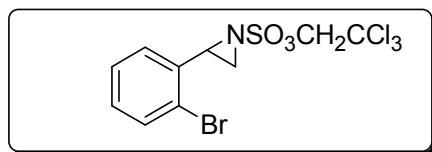
Pk #	Retention Time	Area Percent
1	9.540	6.442
2	10.356	93.558

Totals		100.000
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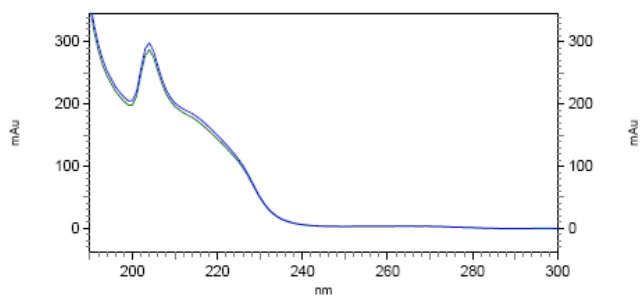
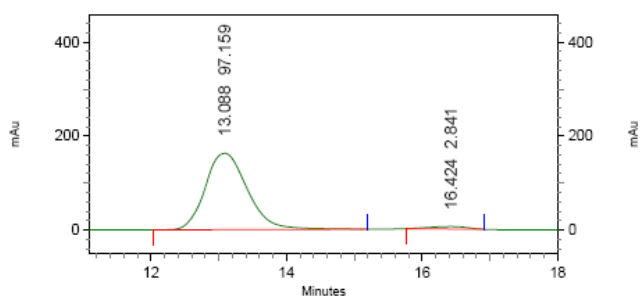




Recyclability1



2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester

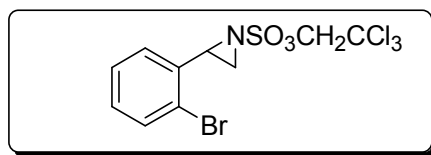


1: 234 nm, 4 nm

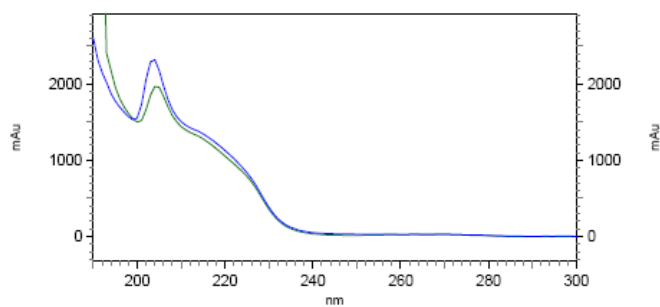
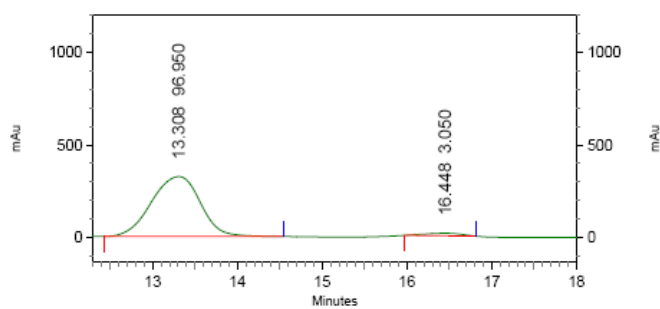
Results

Name	Retention Time	Area Percent	Pk #
	13.088	97.159	1
	16.424	2.841	2
Totals		100.000	

Recyclability 2



2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



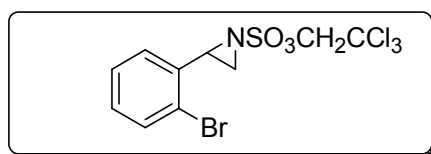
2: 225 nm, 4 nm

Results

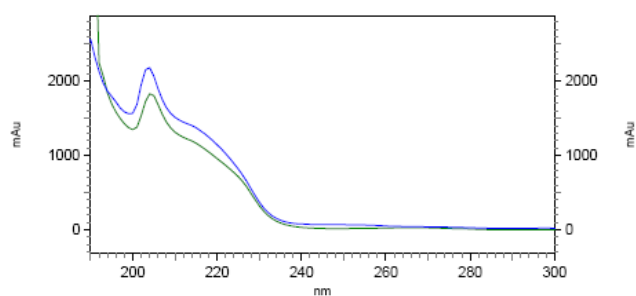
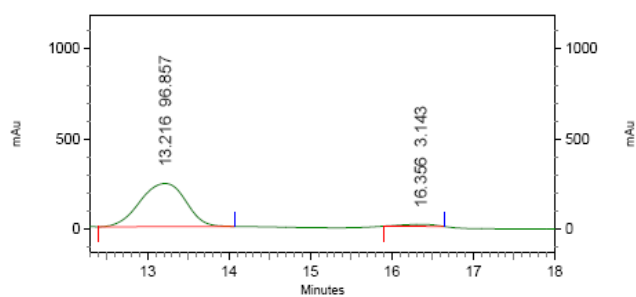
Name	Retention Time	Area Percent	Pk #
	13.308	96.950	1
	16.448	3.050	2

Totals		100.000	
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Recyclability 3



2-(2-Bromo-phenyl)-aziridine-1-sulfonic acid 2,2,2-trichloro-ethyl ester



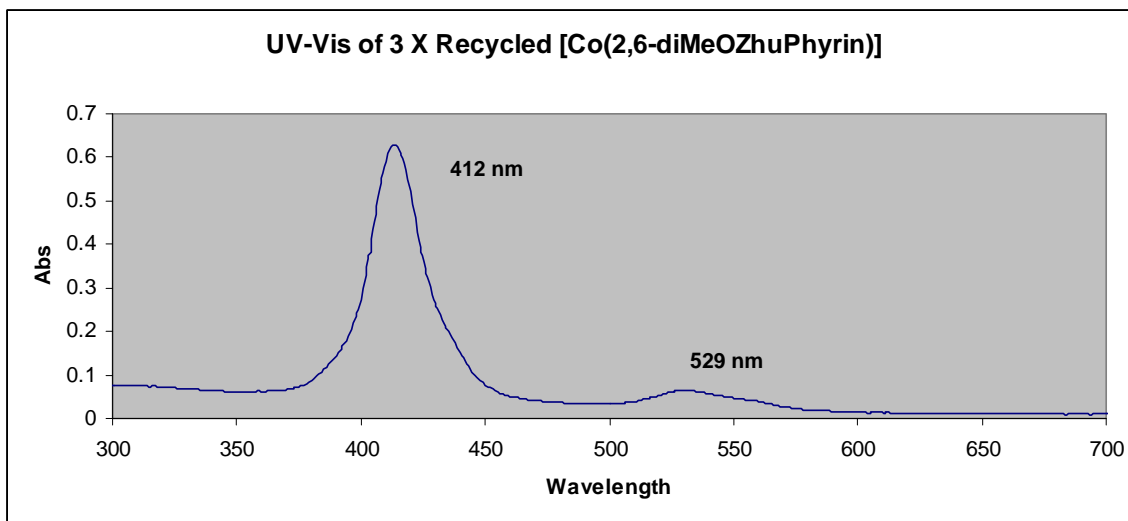
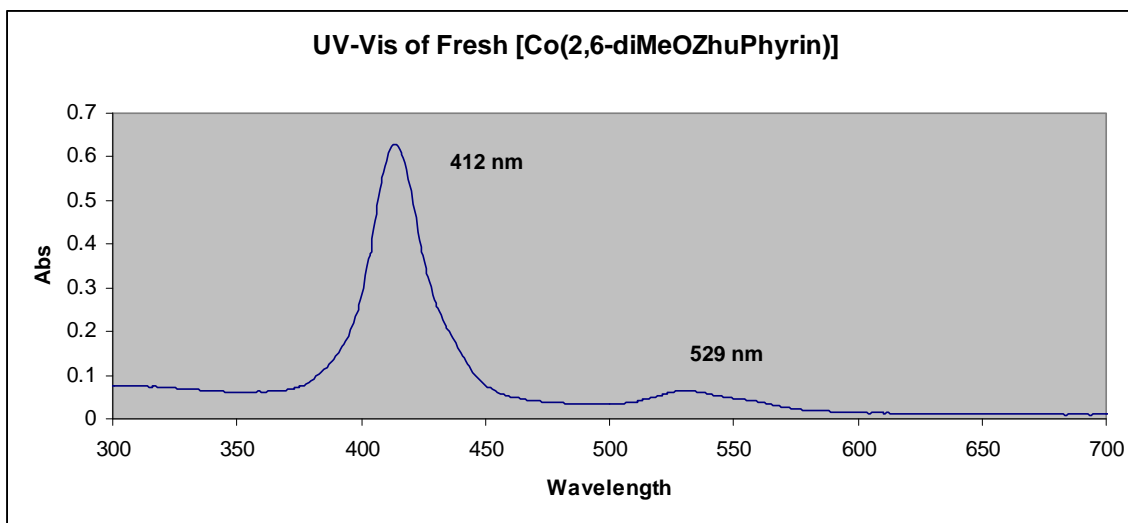
2: 225 nm, 4 nm

Results

Name	Retention Time	Area Percent	Pk #
	13.216	96.857	1
	16.356	3.143	2

Totals	100.000
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Recyclability of [Co(2,6-diMeOZhuPhyrin)]



The above UV-Vis spectra demonstrate that the nature of [Co(2,6-diMeOZhuPhyrin)] catalyst is unchanged after recycling the catalyst 3 times through the simple filtration and drying protocol developed for this catalytic process.