

Supplementary Information for

Chemiresistor Devices for Chemical Warfare Agent Detection Based on Polymer Wrapped Single-Walled Carbon Nanotubes

John F. Fennell Jr., Hitoshi Hamaguchi, Bora Yoon, Timothy M. Swager

Department of Chemistry, Massachusetts Institute of Technology

77 Massachusetts Avenue, Cambridge, Massachusetts 02139

tswager@mit.edu

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1. General

All air- and water-sensitive syntheses were performed in flame-dried flasks under an inert atmosphere with dry argon using standard Schlenk techniques. Diethyl ether, tetrahydrofuran, dichloromethane, and toluene were taken from an Innovative Technologies solvent purification system containing activated alumina columns and stored under argon over 3Å or 4Å molecular sieves. Reaction progress was monitored by thin layer chromatography (Merck silica gel 60 F254 plates), and column chromatography was performed using silica gel (60Å pore size, 230–500 mesh, Aldrich).

2. Synthesis of monomers



Figure S1. Compounds **3a** and **3b**

2,2-dimethyl-4-((octyloxy)methyl)-1,3-dioxolane, (**3a**) and 2,2-dimethyl-4-((oct-7-en-1-yloxy)methyl)-1,3-dioxolane (**3b**) were prepared in the same manner. A typical preparation for **3b** follows. To a flamed-dried 500 mL round bottom flask (RBF) containing 200 mL *N,N*-dimethyl formamide (DMF), 1,2-isopropylidenglycerol (**1**) (23.65 g, 179 mmol) and octenyl bromide (**2b**) (28.5 g, 149 mmol) were delivered. Sodium hydride (5.37 g, 224 mmol) was added over the course of one hour in six equal portions. The reaction was monitored with thin layer chromatography (TLC) using a solution of hexanes:ethyl acetate (90/10%) as the eluent. TLC plates were visualized with a KMnO₄ stain. The mixture was stirred at 40 °C under Ar(g) for 14 hours. The reaction was poured over 1.0 L of a saturated solution of ammonium chloride. The crude mixture was extracted three times with ethyl acetate, washed with brine and 10% solution of LiCl. After drying over MgSO₄, the solvent was evaporated under vacuum. The crude product was purified via vacuum distillation to yield 24.7 grams (68.3 % yield) of a clear, viscous liquid (**3b**).

3a characterization: ¹H NMR (400 MHz, CDCl₃): δ 5.76 (m, 1H), 4.97 (m, 1H), 4.90 (d, 1H), 4.24 (m, 1H), 4.03 (m, 1H), 3.70 (m, 1H), 3.44 (m, 4H), 2.02 (m, 2H), 1.55 (m, 2H), 1.40 (s, 3H), 1.34 (s, 3H). ¹³C NMR (125 MHz, CDCl₃) δ 109.5, 74.9, 72.0, 71.9, 67.0, 31.9, 29.7, 29.5, 29.4, 26.9, 26.2, 25.5, 22.8, 14.2 HR-MS (ESI) calc for C₁₄H₂₈O₃ [M+Na]⁺ 267.19, found 267.19. FT-IR (ATR, ν, cm⁻¹) 2991 (w), 2933 (m), 2860 (m), 1682 (w), 1468 (m), 1371 (m), 1216 (m), 1118 (m), 1058 (m), 979 (m), 849 (m), 823 (w), 728 (w)

3b characterization: ¹H NMR (500 MHz, CDCl₃): δ 7.52–7.42 (m, 6H), 2.03 (t, J = 6.8 Hz, 4H), 1.95 (m, 4H), 1.33–1.26 (m, 8H), 1.00–0.94 (m, 4H). ¹³C NMR (125 MHz, CDCl₃) δ 139.1, 114.3, 109.4, 74.8, 71.9, 67.0, 33.8, 29.6, 29.0, 28.9, 26.8, 26.0, 25.5. HR-MS (ESI) calc for C₁₄H₂₆O₃ [M+H]⁺ 243.1955, found 243.1927. FT-IR (ATR, ν, cm⁻¹) 3096 (w), 2992 (w), 2936 (m), 2864 (m), 1692 (w), 1643 (w), 1464 (w), 1261 (m), 1218 (m), 1056 (s), 912 (m), 849 (m), 823 (w), 735 (w).



Figure S2. Compounds **4a** and **4b**

3-(octyloxy)propane-1,2-diol, **4a**, and 3-(oct-7-en-1-yloxy)propane-1,2-diol, **4b**, were prepared in the same manner. A typical preparation for **4b** follows. To a 1000-mL RBF equipped a magnetic stir bar, **3b** (24.0 g, 99 mmol) and

400 mL of THF were added. Then, 280 mL of 1.0 M HCl_(aq) was delivered. The mixture was stirred for 12 hours at room temperature. The reaction was quenched with 280 mL de-ionized water. Then, the majority of the THF was evaporated under vacuum. The resulting mixture was extracted three times with methylene chloride and washed with brine, and then water. The extract was dried over MgSO₄ and then the solvent evaporated under vacuum to yield the product as a pale, yellow oil. The crude product was purified by silica gel column chromatography (100% ethyl acetate) to yield 13.8 g (69% yield) of a clear viscous liquid (**4b**).

4a characterization: ¹H NMR (400 MHz, CDCl₃): δ 3.88-3.82 (m, 1H), 3.72-3.58 (m, 2H), 3.53-3.40 (m, 4H), 2.76 (s, 2H), 1.61-1.52 (m, 2H), 1.36-1.19 (m, 10H), 0.91-0.82 (t, 3H). ¹³C NMR (125 MHz, CDCl₃) δ 72.4, 71.9, 70.8, 64.2, 31.9, 29.6, 29.5, 29.3, 26.2, 22.7, 14.2. HR-MS (ESI) calc for C₁₁H₂₄O₃ [M+H]⁺ 227.16, found 227.10. FT-IR (ATR, ν, cm⁻¹) 3415 (m, broad) 2931 (m), 2859 (m), 1469 (w), 1381 (w), 1107 (s), 1052 (s), 958 (w), 869 (w), 758 (w), 751 (w)

4b characterization: ¹H NMR (500 MHz, CDCl₃): δ 5.84-5.68 (m, 1H), 5.00-4.84 (m, 2H), 3.86-3.77 (m, 1H), 3.68-3.50 (m, 2H), 3.46-3.35 (m, 6H), 2.06-1.93 (m, 2H), 1.62-1.45 (m, 2H), 1.41-1.18 (m, 6H). ¹³C NMR (125 MHz, CDCl₃) δ 139.1, 114.4, 72.4, 71.8, 70.8, 64.2, 33.8, 29.6, 29.0, 28.9, 26.0. HR-MS (ESI) calc for C₁₁H₂₂O₃ [M+H]⁺ 203.1642, found 203.1638. FT-IR (ATR, ν, cm⁻¹) 3410 (m, broad), 3088 (w), 2932 (m), 2861 (m), 1745 (w), 1643 (w), 1467 (w), 1246 (w), 1107 (s), 1049 (s), 910 (s), 873 (w), 732 (w)

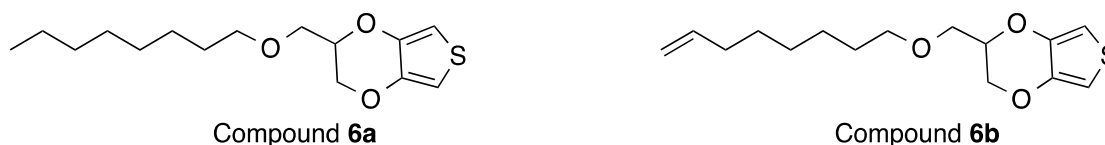


Figure S3. Compounds **6a** and **6b**

2-((octyloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine, **6a**, and 2-((oct-7-en-1-yloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine **6b**, were prepared in the same manner. A typical preparation for **6b** follows. To a flame-dried 200 mL round bottom flask equipped with a magnetic stir bar and a reflux condenser, *p*-toluenesulfonic acid monohydrate (PTSA) (338 mg, 1.96 mmol), 40 mL of toluene was added. While stirring under Ar atmosphere, **4b** (5.96 g, 29.5 mmol) and 3,4-dimethoxythiophene (2.83 g, 19.6 mmol) (**5**) was added. 30 μL of water was added. The mixture was refluxed for 72 h under Ar atmosphere. After cooling, 40 mL of de-ionized water was added to the mixture to separate phases. The mixture was separated extracted three times with ethyl acetate, dried with MgSO₄ and evaporated under reduced pressure. The crude black-green oil was purified by silica gel column chromatography (10% ethyl acetate in hexanes). The purified product still contains up to 10% contamination of starting material (**5**). Vacuum distillation via Kugelrohr was used to yield 3.26 g (58.7%) of **6b**.

6a characterization: ¹H NMR (400 MHz, CDCl₃): δ 6.36-6.29 (q, 2H), 4.33-4.27 (m, 1H), 4.27-4.22 (m, 1H), 4.09-4.01 (m, 1H), 3.71-3.56 (m, 2H), 3.52-3.44 (m, 2H), 1.63-1.53 (m, 2H), 1.38-1.20 (m, 10H), 0.96-0.82 (m, 3H). ¹³C NMR (125 MHz, CDCl₃) δ 139.8, 85.5, 73.3, 72.3, 68.6, 66.7, 31.9, 29.7, 29.5, 29.4, 26.2, 22.8, 14.3. HR-MS (ESI) calc for C₁₁H₂₄O₃S [M+H]⁺ 284.41, found 285.1971. FT-IR (ATR, ν, cm⁻¹) 3123 (m), 2927 (m), 2859 (m), 1586 (w), 1484 (s), 1454 (m), 1377 (m), 1185 (m), 1127 (m), 1022 (m), 949 (w), 939 (w), 859 (m), 754 (s)

6b characterization: ¹H NMR (500 MHz, CDCl₃): δ 6.40-6.25 (m, 2 H), 5.89-5.71 (m, 1H), 5.05-4.88 (m, 2H), 4.35-4.19 (m, 2H), 4.11-3.99 (m, 1H), 3.74-3.55 (m, 2H), 3.54-3.43 (m, 2H), 2.11-1.99 (m, 2H), 1.66-1.52 (m, 2H), 1.46-1.23 (m, 6H). ¹³C NMR (125 MHz, CDCl₃) δ 141.7, 139.2, 114.4, 99.8, 72.8, 72.2, 69.2, 66.4, 33.8, 29.6, 29.0, 28.9, 26.0. HR-MS (ESI) calc for C₁₅H₂₄O₃S [M+H]⁺ 283.162, found 283.1368. FT-IR (ATR, ν, cm⁻¹) 3122 (w), 3085 (w), 2931 (m), 2861 (m), 1756 (w), 1642 (w), 1585 (w), 1485 (w), 1428 (m), 1376 (m), 1313 (w), 1185 (s), 1127 (s), 1023 (s), 912 (m), 860 (m), 755 (s), 733 (w)

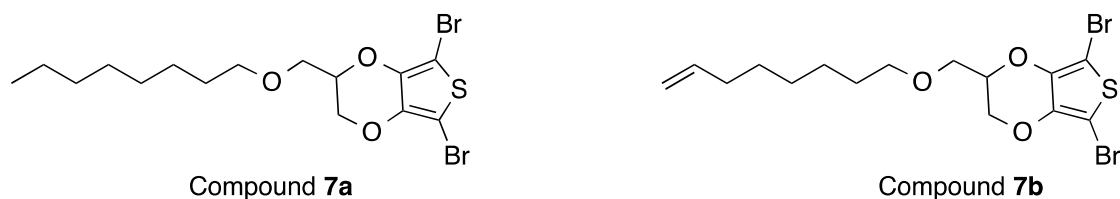


Figure S4. Compounds **7a** and **7b**

5,7-dibromo-2-((octyloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine, **7a**, and 5,7-dibromo-2-((oct-7-en-1-yloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine **7b**, were prepared in the same manner. A typical preparation for **7b** follows. A flame dried 100 mL Schlenk flask was flushed with Ar (g) and charged with **6b** (6.44 g, 22.8 mmol) and dry THF (100 mL). The reaction mixture was cooled down to 0 °C, and N-bromosuccinimide (NBS) (8.12 g, 45.6 mmol) was added in four aliquots over the course of a half an hour. The reaction mixture was allowed to reach room temperature and stirred overnight. Then, it was added to 100 mL of water and extracted three times with ethyl acetate (100 mL). The combined organic layer was washed with brine and then dried over anhydrous MgSO₄, filtered, and concentrated under vacuum. The crude compound was purified by silica gel column chromatography on silica gel using 33% methylene chloride in hexanes as an eluent. The compound was dried under vacuum to yield 91.3 g (90.9%) of a viscous yellow oil, **7b**.

7a characterization: ¹H NMR (400 MHz, CDCl₃): 4.37-4.27 (m, 2H), 4.16-4.06 (m, 1H), 3.77-3.57 (m, 2H), 3.53-3.43 (m, 2H), 1.66-1.48 (m, 2H), 1.38-1.17 (m, 10H), 0.95-0.80 (t, 3H). ¹³C NMR (125 MHz, CDCl₃) δ 139.7, 85.5, 72.3, 72.3, 68.6, 66.7, 31.9, 29.6, 29.5, 29.4, 26.2, 22.8, 14.3. -MS (ESI) calc for C₁₅H₂₂ Br₂O₃S [M+H]⁺ 442.97, found 440.97. FT-IR (ATR, ν, cm⁻¹) 2928 (m), 2858 (m), 1605 (w), 1507 (s), 1490 (w), 1415 (s), 1365 (s), 1221 (w), 1056 (s), 1017 (w), 965 (w), 916 (w), 916 (m), 759 (m), 669 (w)

7b characterization: ¹H NMR (500 MHz, CDCl₃): δ 5.86-5.74 (m, 1H), 5.02-4.89 (m, 2H), 4.38-4.27 (m, 2H), 4.18-4.06 (m, 1H), 3.78-3.57 (m, 2H), 3.53-3.43 (m, 2H), 2.09-1.97 (m, 2H), 1.64-1.51 (m, 2H), 1.45-1.24 (m, 6H). ¹³C NMR (125 MHz, CDCl₃) δ 139.7, 139.1, 114.4, 85.5, 73.2, 72.2, 68.6, 66.7, 33.8, 29.6, 29.0, 28.9, 26.0. HR-MS (ESI) calc for C₁₅H₂₀ Br₂O₃S [M+H]⁺ 440.96, found 440.95. FT-IR (ATR, ν, cm⁻¹) 3085 (w), 2931 (m), 2860 (m), 1642, (w), 1605 (w), 1507 (s), 1415 (s), 1366 (s), 1335 (w), 1056 (s), 996 (m), 984 (m), 914 (s), 765 (m).

3. Synthesis of polymers

A. Kumada catalyst polycondensation polymerization.

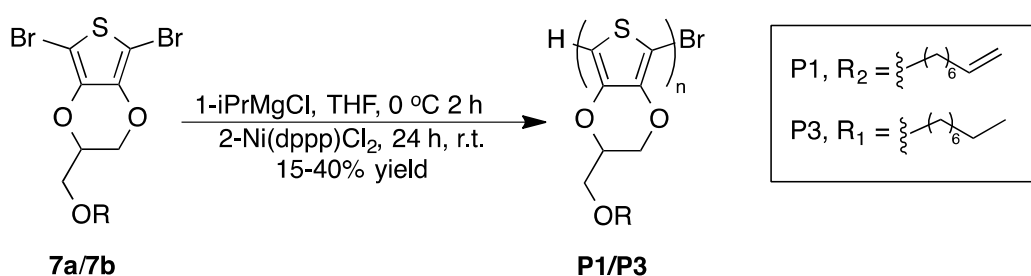


Figure S5. Synthesis of **P1** and **P3**

P1 and **P3** were prepared in the same manner. A typical preparation for **P1** follows. A solution of **7b** (1.00 g, 2.27 mmol) and 15 mL of dry, degassed THF in a 50 mL Schlenk tube was cooled to 0 °C. Then, *i*PrMgCl•LiCl (329.9 mg, 2.27 mmol) was delivered dropwise via syringe. After 2 h, the reaction mixture was transferred via cannula to another 25 mL Schlenk tube containing 5 mL dry, degassed THF and Ni(dppp)Cl₂ (12.31 mg, 22.72 μmol) and allowed to react at room temperature for 24 h. The reaction was quenched with 0.50 mL of degassed 6.0 M HCl_(aq). The crude mixture was precipitated in 200 mL cold methanol containing 5.0 mL hydrazine hydrate. The resulting suspension of polymer was filtered to afford a black solid. This solid was placed in a Soxhlet thimble and extracted

with methanol, hexanes and THF. The solvent was removed under vacuum and the remaining polymer was placed in a vacuum oven overnight to yield 441 mg (44%) of a purple and copper colored solid, **P1**.

P1 characterization: ^1H NMR (500 MHz, CDCl_3): 6.626 (m, 0.05 H, end group), 5.94-5.53 (m, 1H), 5.13-4.69 (m, 2H), 4.62-3.99 (m, 3H), 3.94-3.07 (m, 4H), 2.04 (m, 2H), 1.59 (m, 2H), 1.36 (m, 2H). FT-IR (ATR, ν , cm^{-1}) 2939 (broad, weak), 2872 (broad, weak), 1666 (broad, weak), 1519 (broad, weak), 1465 (sharp, medium), 14315 (sharp, medium), 1316 (broad, medium), 1208 (sharp, medium), 1107 (sharp, medium), 1045 (sharp, medium), 976 (sharp, medium),

P3 characterization: ^1H NMR (400 MHz, CDCl_3): δ 6.27 (0.06, m, end group) 4.47 (m, 2H), 4.22 (m, 1H), 3.94-3.69 (m, 2H), 3.57 (m, 2H), 1.57 (m, 2H), 1.38-1.27 (m, 10H), 0.87 (t, 3H). FT-IR (ATR, ν , cm^{-1}) 2927 (sharp, med), 2860 (sharp, med), 1518 (broad, weak), 1465 (sharp, med), 1435 (sharp, strong), 1380 (sharp, med), 1310 (sharp, med), 1200 (broad, med), 1107 (sharp, strong), 1079 (sharp, strong), 1043 (sharp, strong), 989 (broad, med), 723 (sharp, weak), 639 (sharp, medium)

B. Post-polymerization modification via alkene cross metathesis.

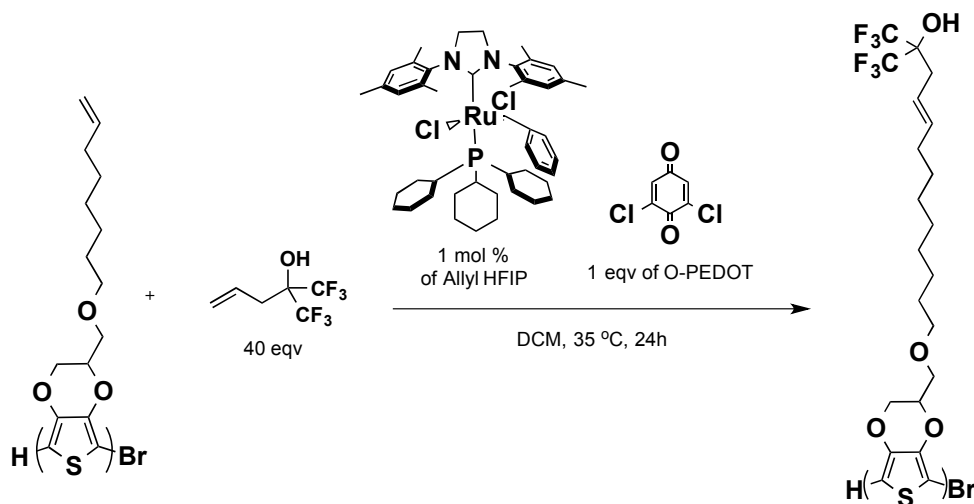


Figure S6. Synthesis of **P2**

To a 50 mL round bottom flask equipped with a magnetic stir bar and a reflux condenser, 20 mL degassed methylene chloride was added. Then, allyl-hexafluoroisopropanol (4.5 g, 21.6 mmol), 2,5-dichlorobenzoquinone (76.0 mg, 0.432 mmol) and **P1** (121 mg, 0.432 mmol) were delivered to the flask and sparged for 10 minutes with $\text{Ar}_{(\text{g})}$. Grubbs' II catalyst (184 mg, 0.216 mmol) was added and the reaction was heated to 35 °C and was allowed to react for 24 hours. The reaction was quenched with the addition of 0.10 mL of ethyl vinyl ether and the mixture was precipitated in 175 ml cold acetonitrile containing 5.0 mL hydrazine hydrate. The resulting suspension of polymer was filtered to afford a black solid. This solid was placed in a Soxhlet thimble and extracted with methanol and hexanes. Then, the crude polymer was dissolved in THF and placed in a 2000 MWCO dialysis bag. The dissolved polymer in was placed in a beaker of stirring THF and allowed to remain for 24 hours. The THF was then evaporated and the solid was placed in a vacuum oven over night to yield 166 mg (78%) of a dark navy blue powdered solid, **P2**.

P2 characterization: ^1H NMR (500 MHz, THF-d_8): 6.31 (m, 0.16 H, end group), 5.88-5.35 (m, 2H), 4.49 (m, 2H), 4.24 (m, 2H), 3.85, 2.67, 2.08, 1.91. FT-IR (ATR, ν , cm^{-1}) 3518-3121 (broad, weak), 2932 (broad, weak), 2861 (broad, weak), 1519 (sharp, med), 1344 (broad, strong) 1204 (sharp, strong), 1053 (broad, strong), 978 (sharp, med)

Figure S7: Gel Permeation Chromatogram (GPC) of P1-P3 (THF fractions)

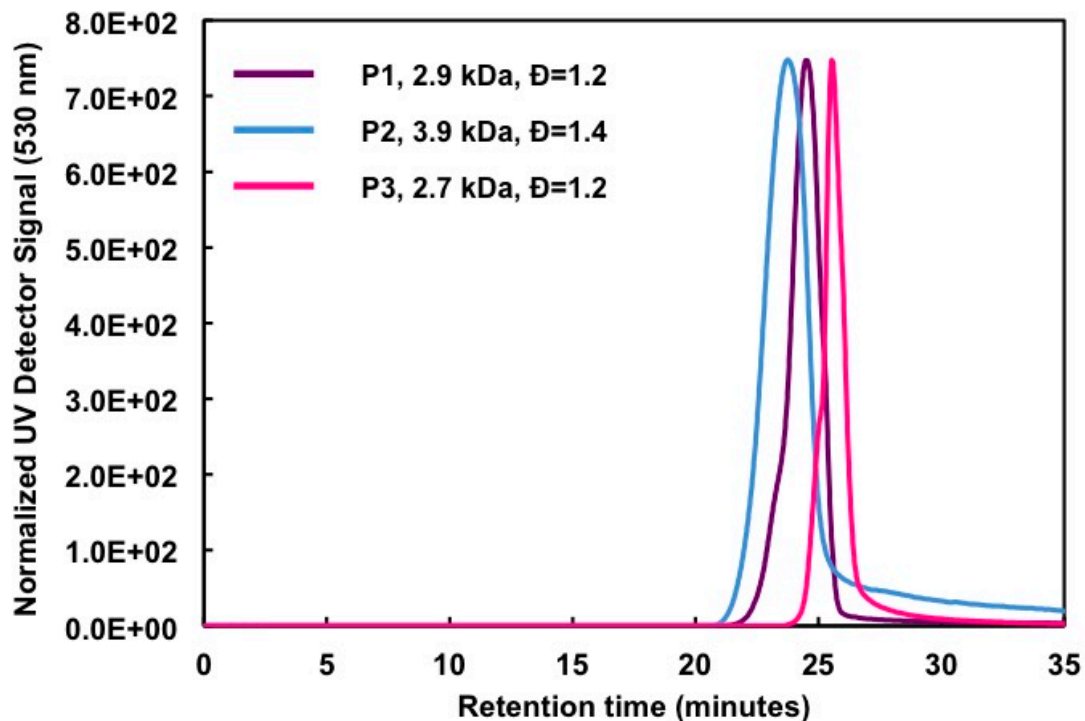


Table S1: Molecular Weight Analysis

Analytical Technique	P1 MW (repeat units)	P2 MW (repeat units)	P3 MW (repeat units)
GPC	2,900 g/mol Đ=1.2 (10)	3,900 g/mol Đ=1.2 (8)	2,700 g/mol Đ=1.2 (9)
¹ H NMR (end group analysis)	5,800 g/mol (20)	6,600 g/mol (13)	9,300 g/mol (33)
MALDI-TOF MS	2,245 g/mol (8)	1322 g/mol (3)	3,395 g/mol (12)

Figure S8: MALDI-TOF MS of Compound P1- poly(octenyleDOT), high molecular weight, sparingly soluble fraction

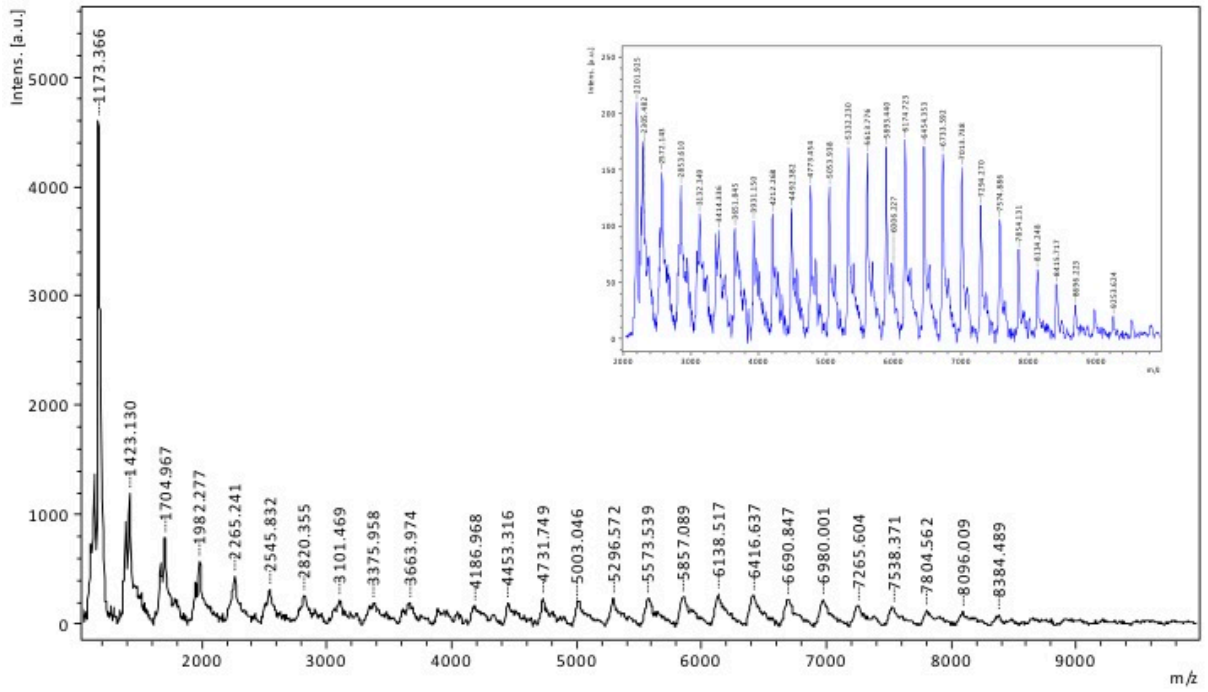


Figure S9: MALDI-TOF MS of Compound P1- poly(octenyleDOT)

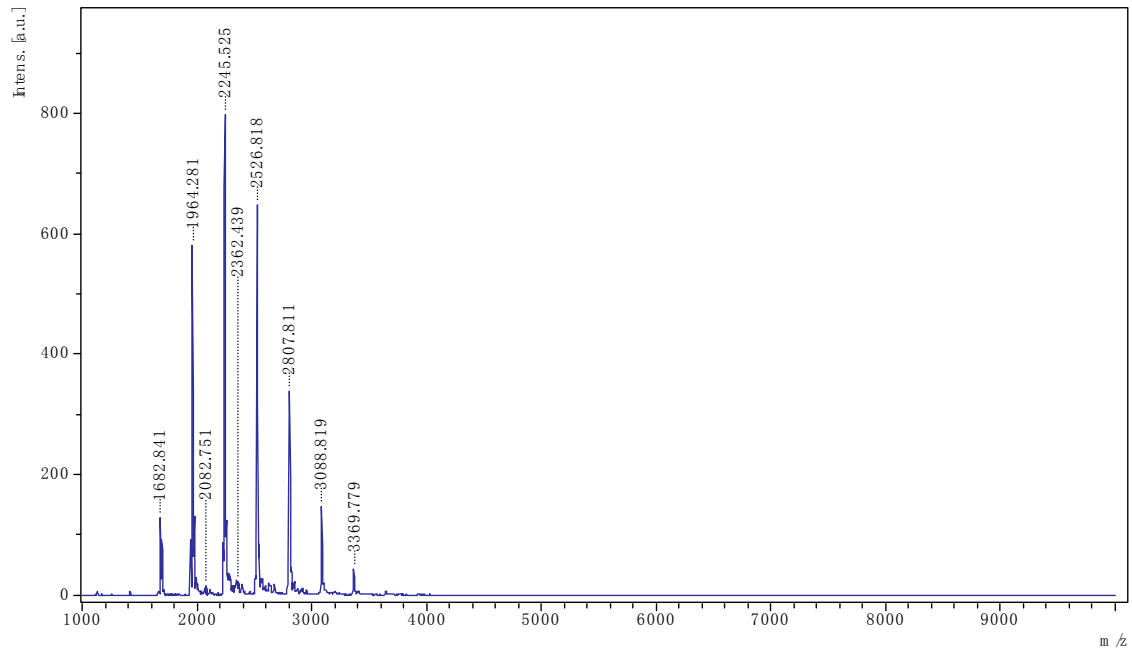


Figure S10: MALDI-TOF MS Compound P2- Poly(octenyl-HFIP-PEDOT)

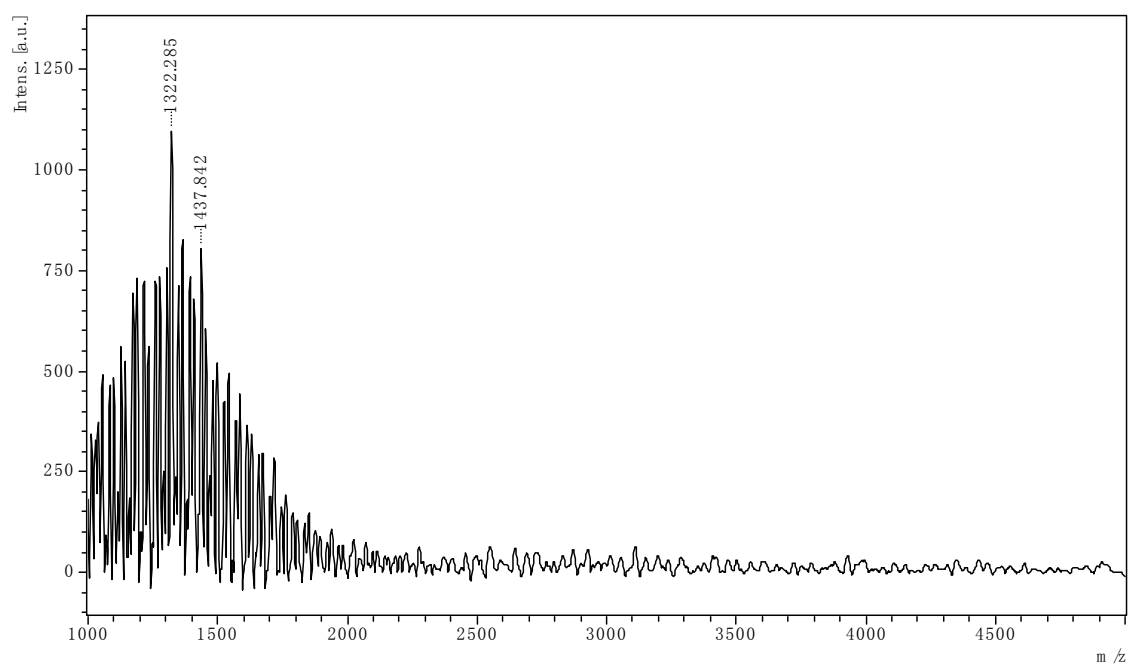


Figure S11: MALDI-TOF MS Compound P3- poly(octylPEDOT)

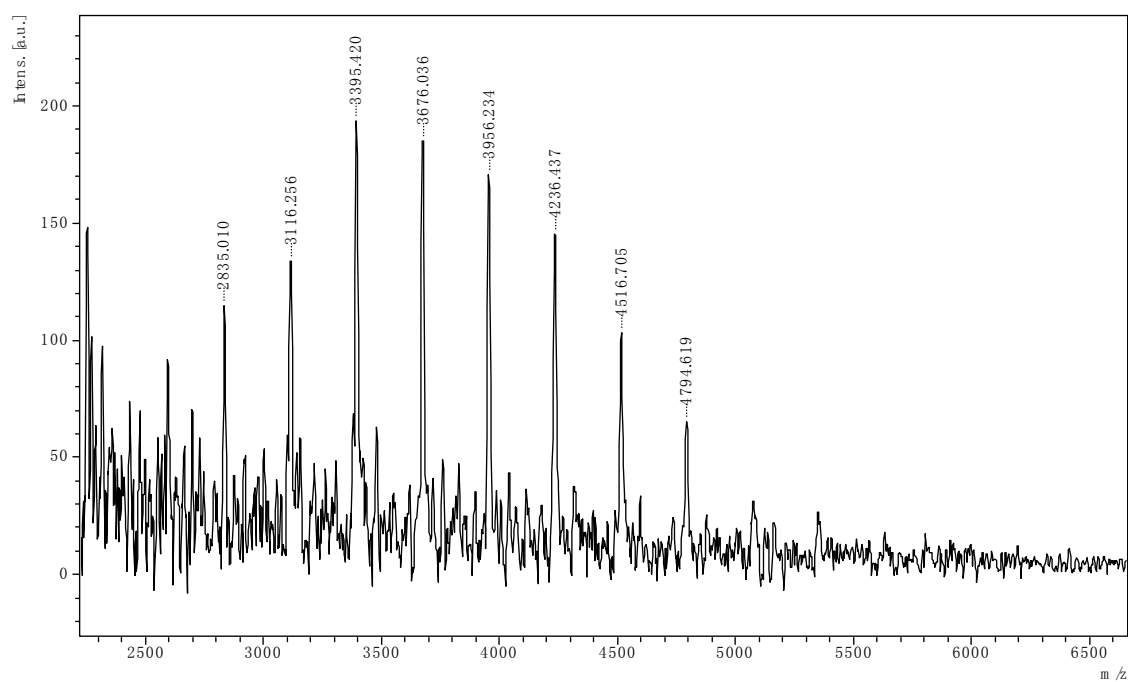


Figure S12: ^1H NMR of Compound P1- poly(octenylEDOT)

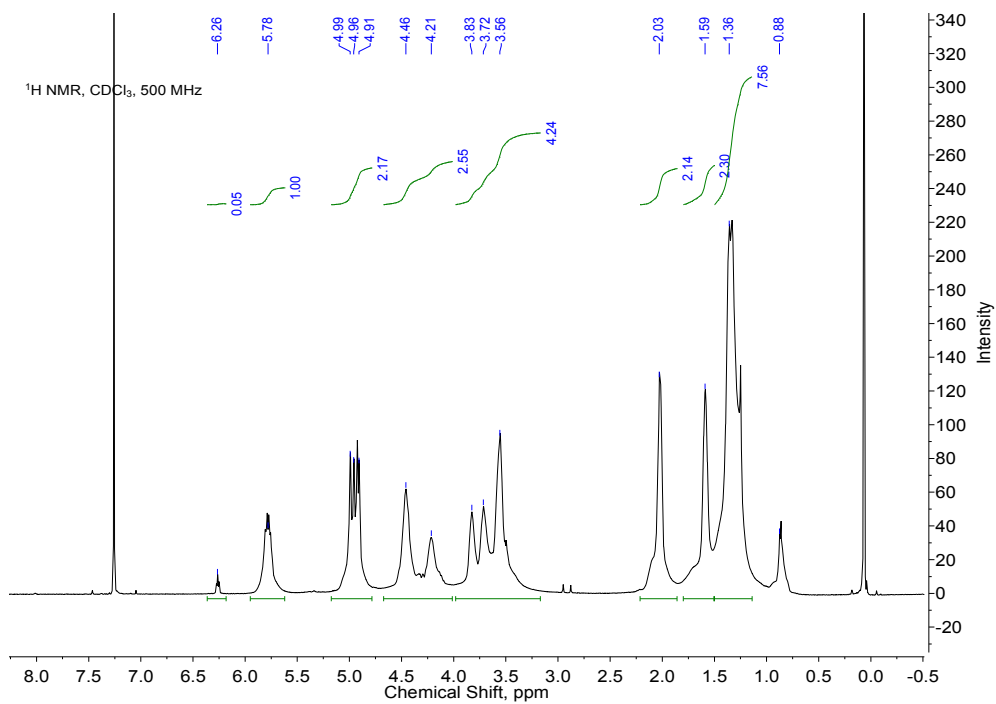


Figure S13: ^1H NMR of Compound P2- Poly(octenyl-HFIP-PEDOT)

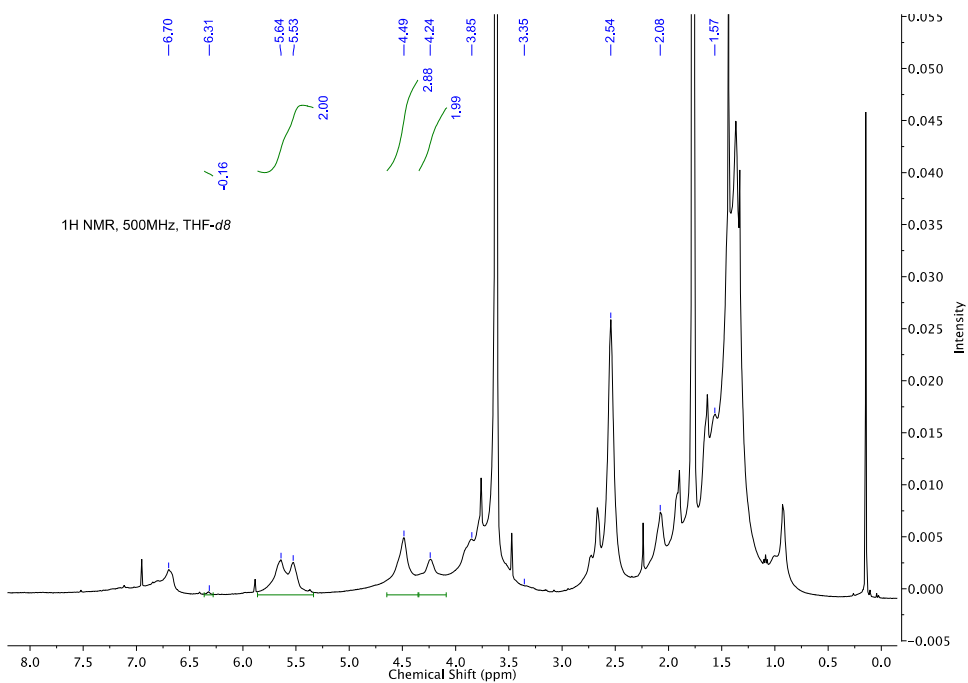


Figure S14: ^{19}F NMR of Compound P2- Poly(octenyl-HFIP-PEDOT)

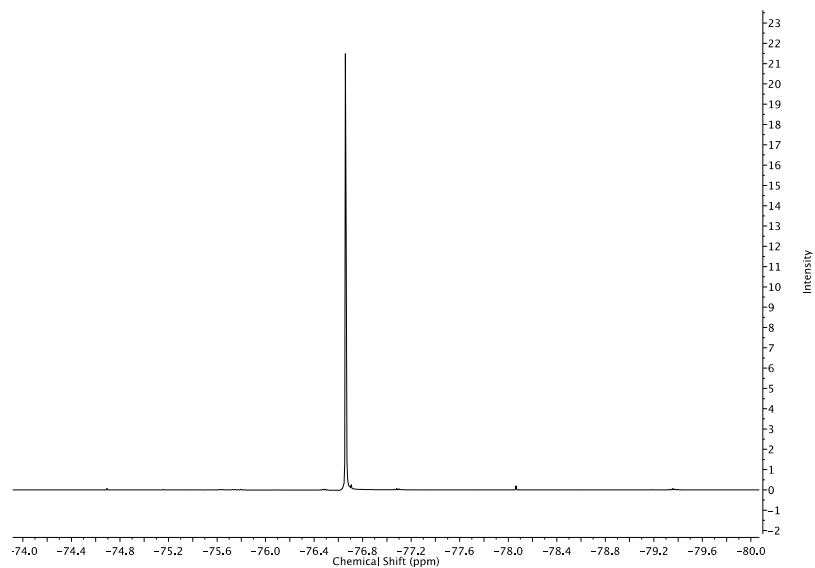


Figure S15: Compound P3- poly(octylEDOT)

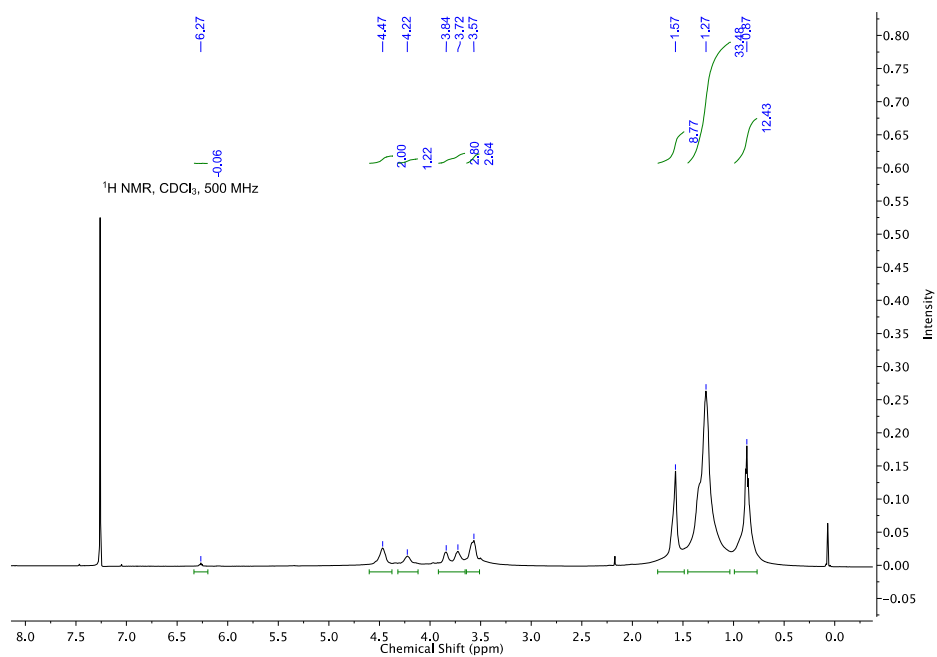


Figure S16: Response of three devices with three ratios of P2/SWCNT to 2.0 ppm DMMP for a 60 second exposure with N₂ as a diluent gas.

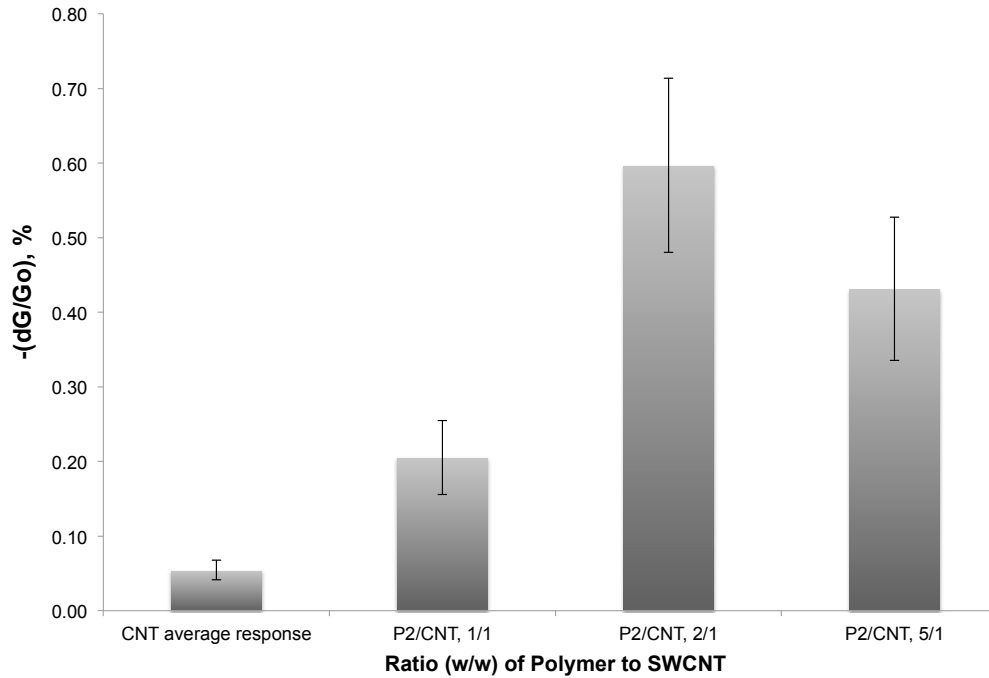


Figure S17: Full Raman Spectra of pristine SWCNT, P1/SWCNT, P2/SWCNT, P3/SWCNT taken at an excitation wavelength of 633 nm

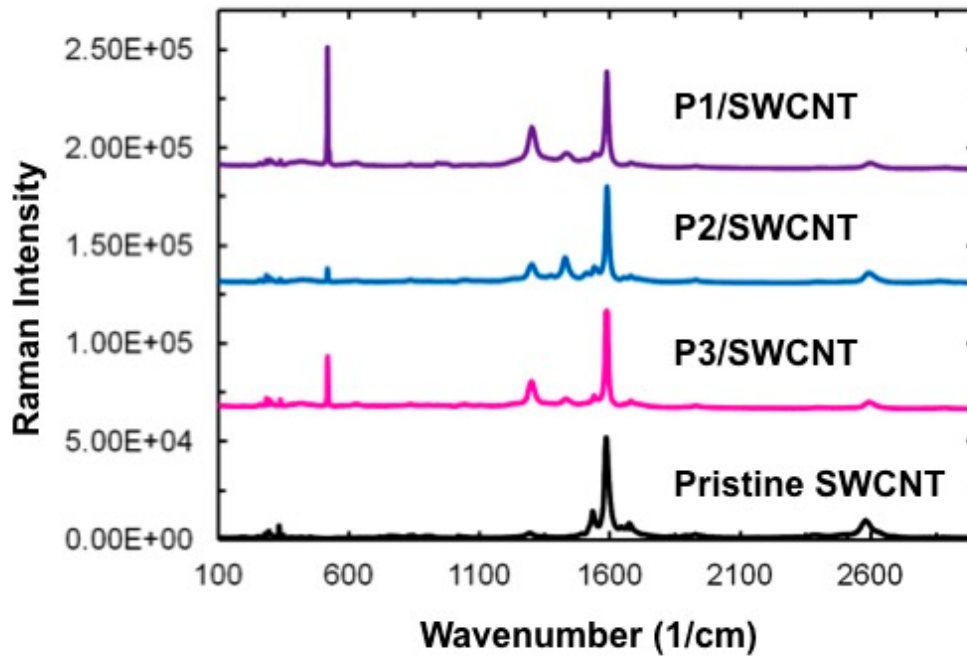


Figure S18: Full Raman Spectra of P1-P3 and Pristine SWCNTs taken at an excitation wavelength of 633 nm

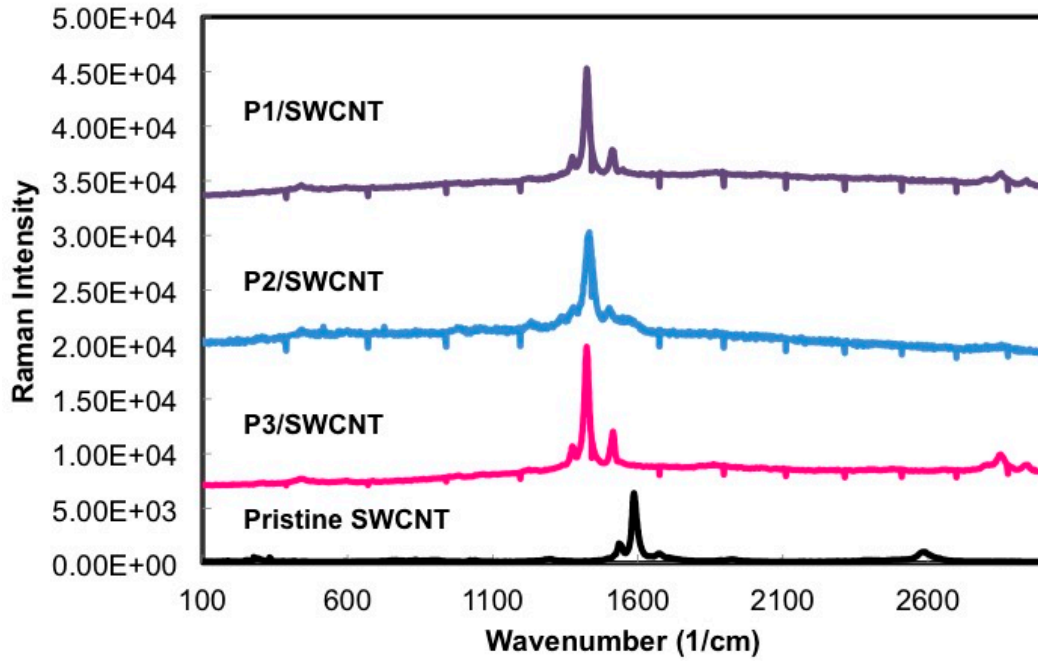


Figure S19: Combined sensing traces of a pristine SWCNT device (black trace) and P2/SWCNT (blue trace) and P3/SWCNT devices (pink trace) to 60 s exposures followed by of VOCs at a flow rate of 200 mL/min. The traces are offset for clarity.

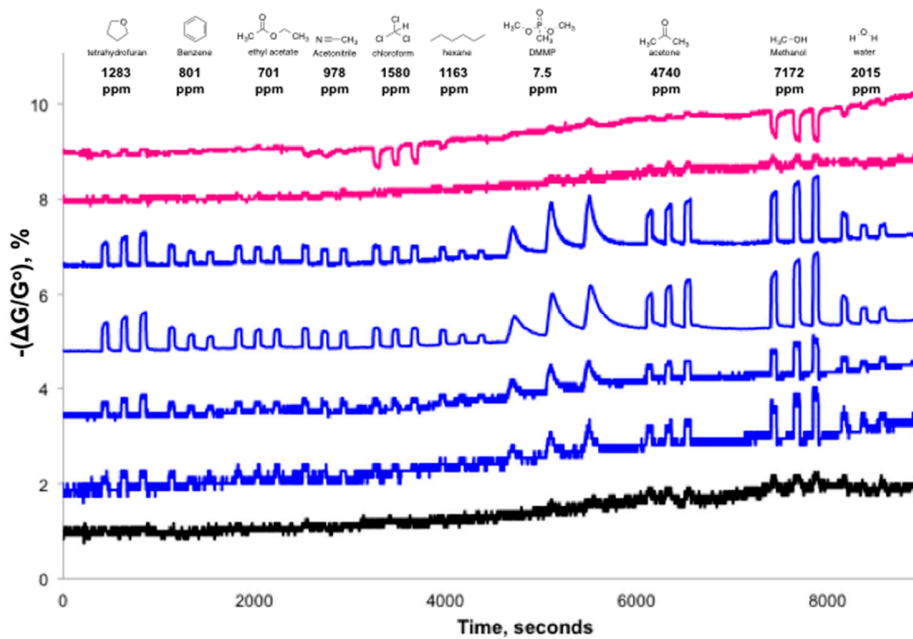


Figure S19a: Sensing trace of a pristine SWCNT device resulting from 60 s exposures followed by of VOCs at a flow rate of 200 mL/min.

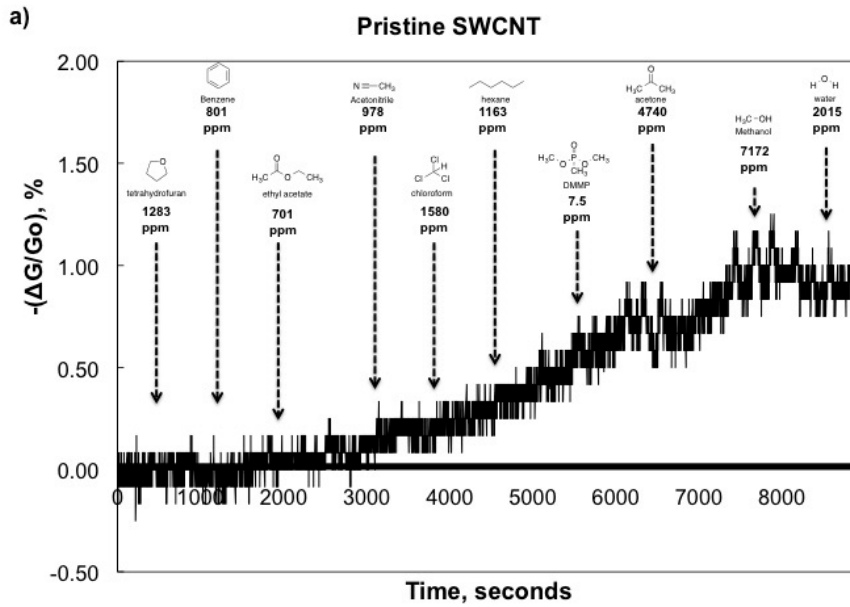


Figure S19b: Sensing trace of a P2/SWCNT device resulting from 60 s exposures followed by of VOCs at a flow rate of 200 mL/min.

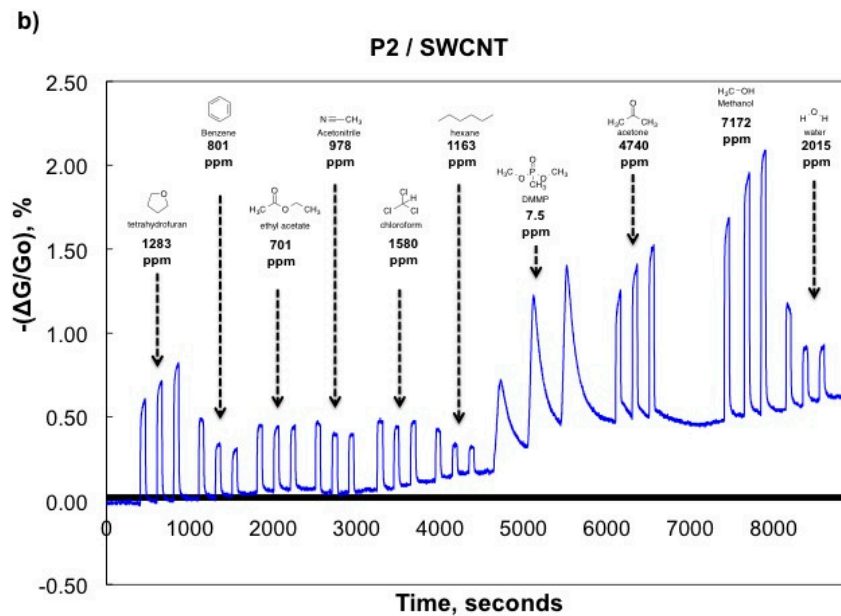


Figure S19c: Sensing trace of a P3 / SWCNT device resulting from 60 s exposures followed by of VOCs at a flow rate of 200 mL/min.

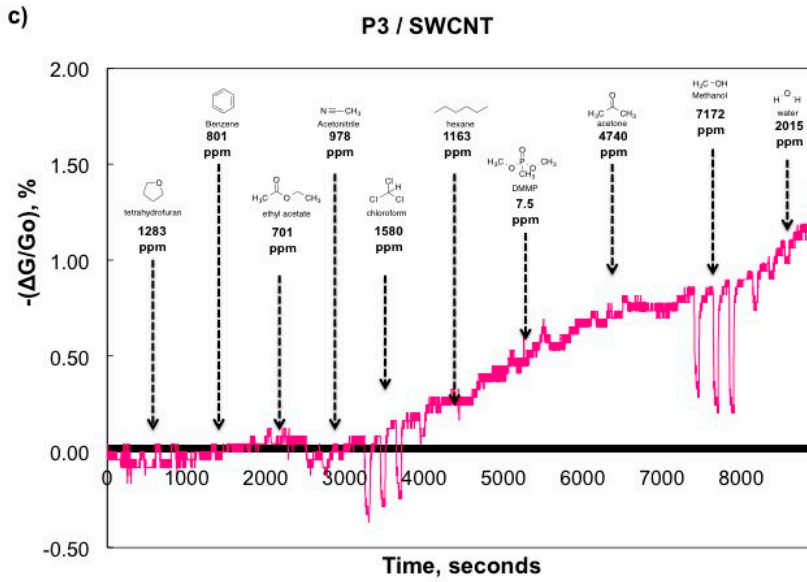
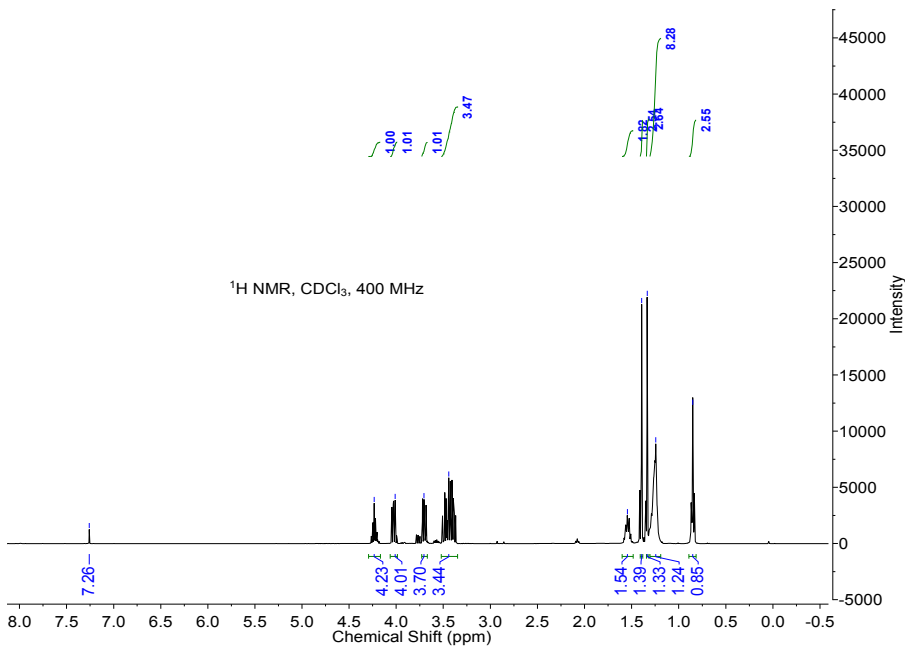


Figure S20: ^1H and ^{13}C NMR of Compound 3a - 2,2-dimethyl-4-((octyloxy)methyl)-1,3-dioxolane



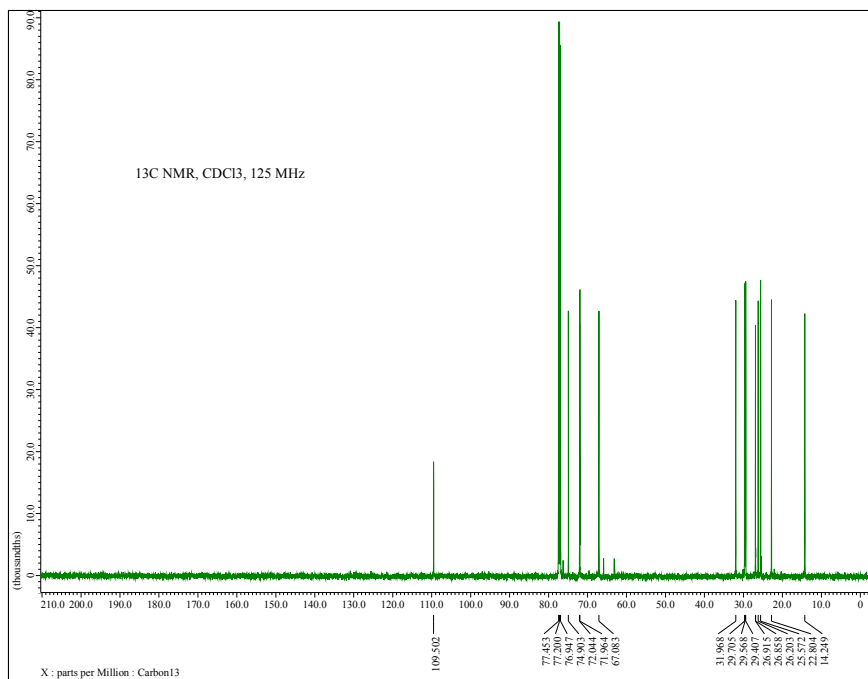


Figure S21: ^1H and ^{13}C NMR of Compound **3b** - 2,2-dimethyl-4-((oct-7-en-1-yloxy)methyl)-1,3-dioxolane

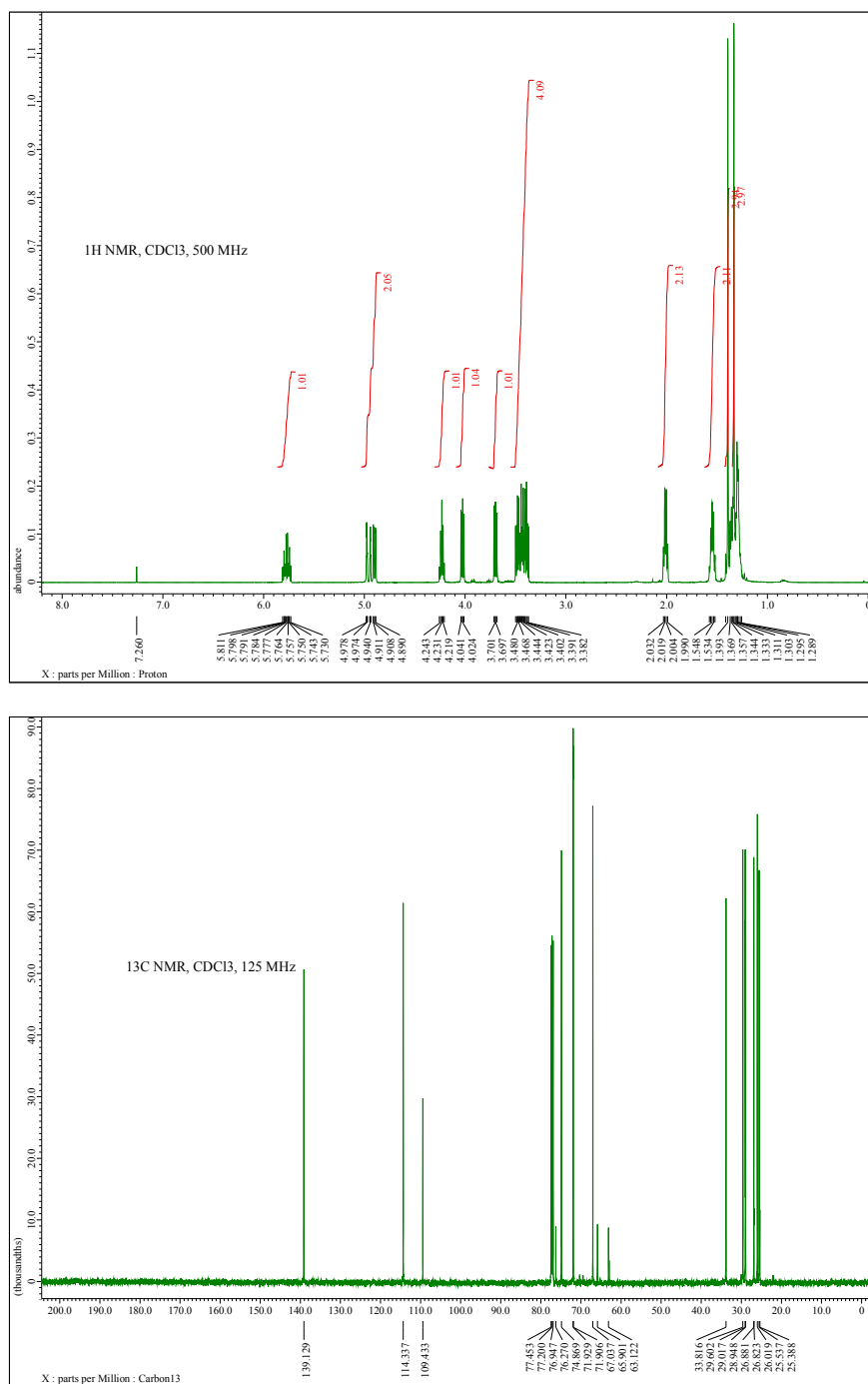


Figure S22: ^1H and ^{13}C NMR of Compound **4a** 3-(octyloxy)propane-1,2-diol

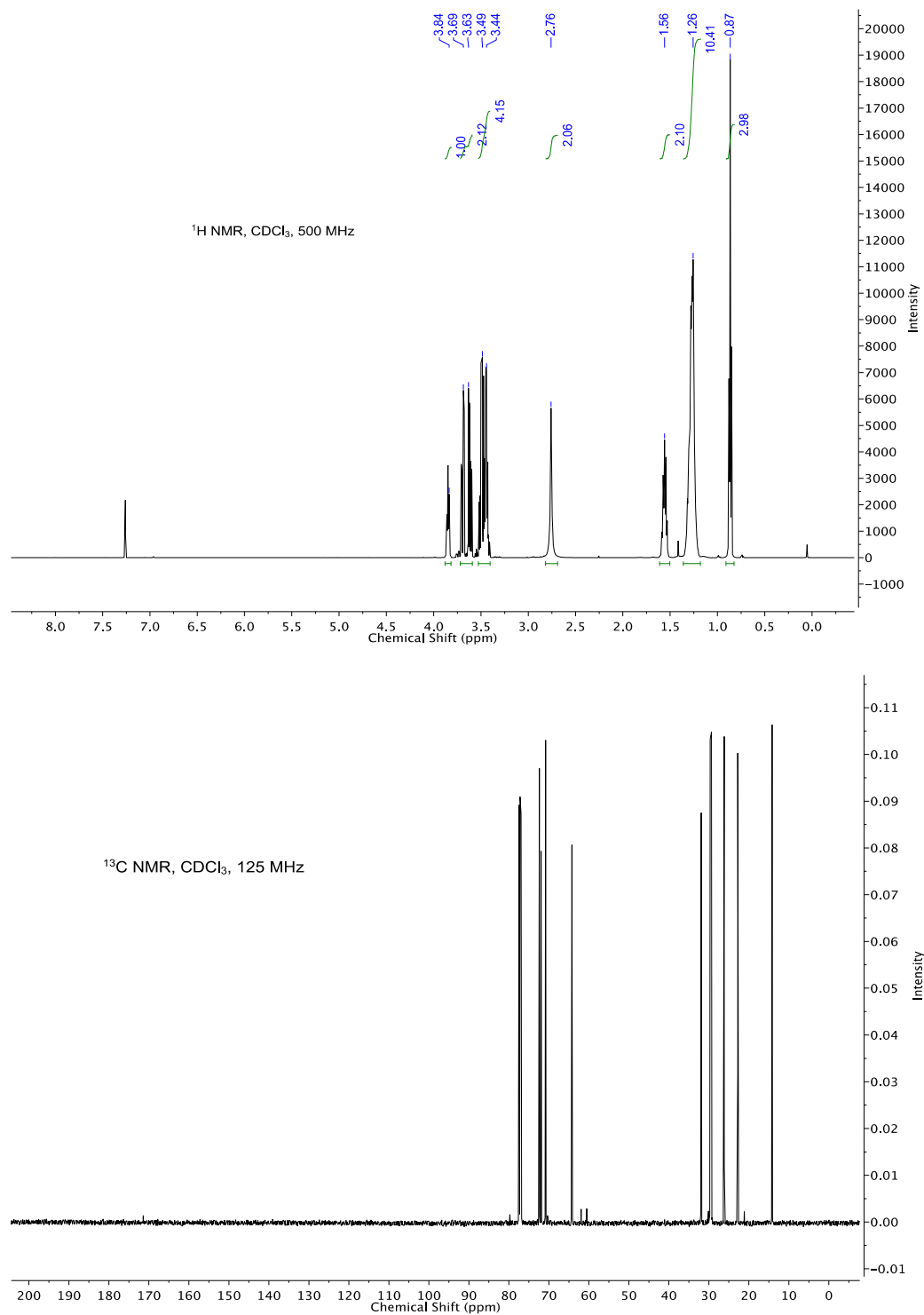


Figure S23: ^1H and ^{13}C NMR of Compound **4b** - 3-(oct-7-en-1-yloxy)propane-1,2-diol

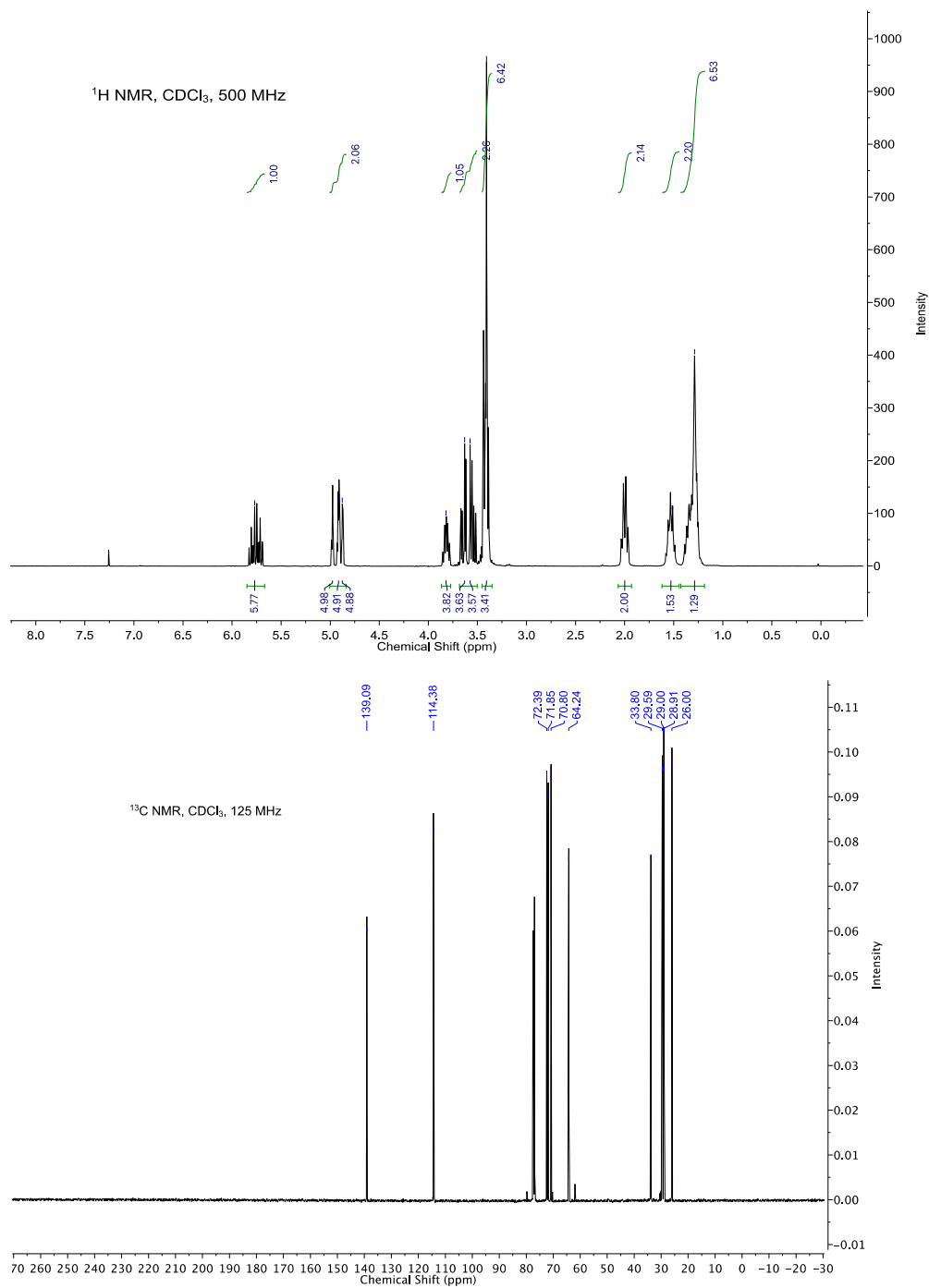


Figure S24: ^1H and ^{13}C NMR of Compound **6a** - 2-((octyloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

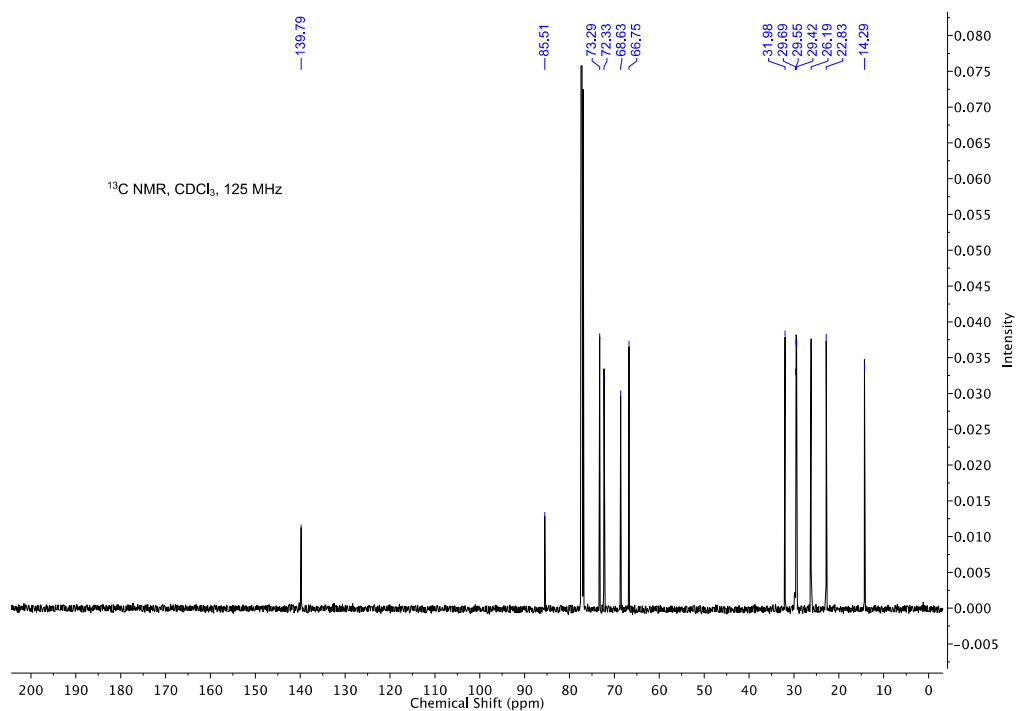
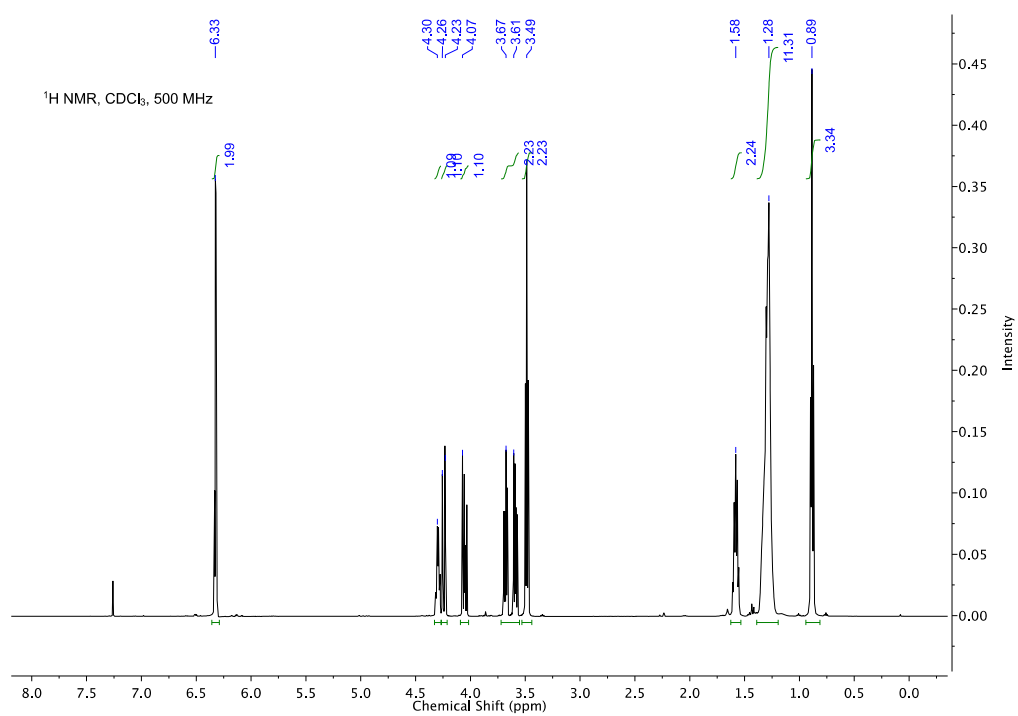


Figure S25: ^1H and ^{13}C NMR of Compound **6b** - 2-((oct-7-en-1-yloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

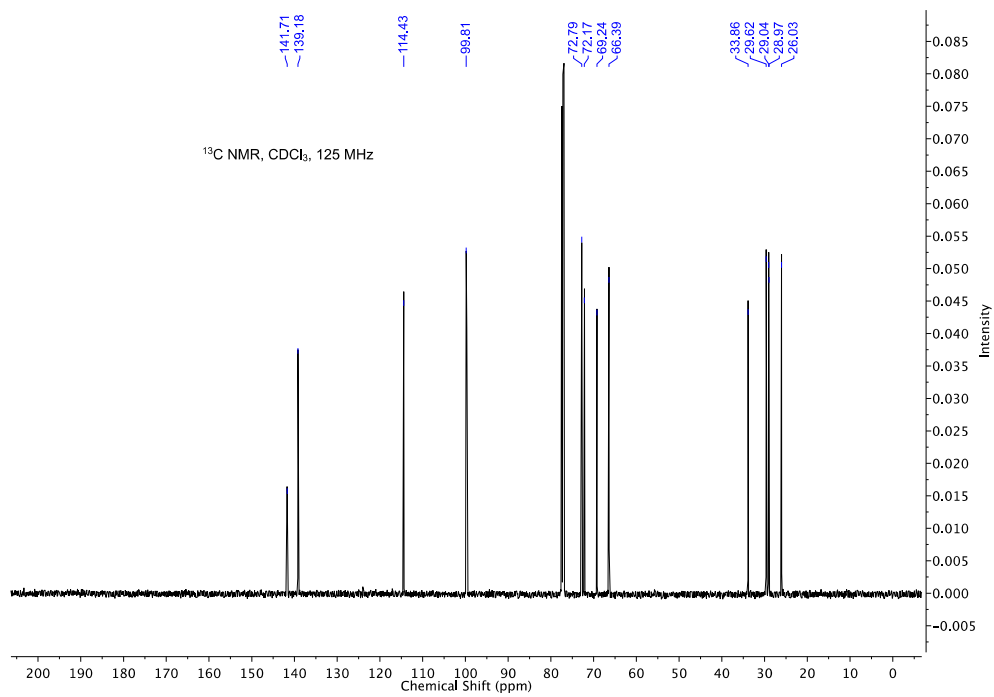
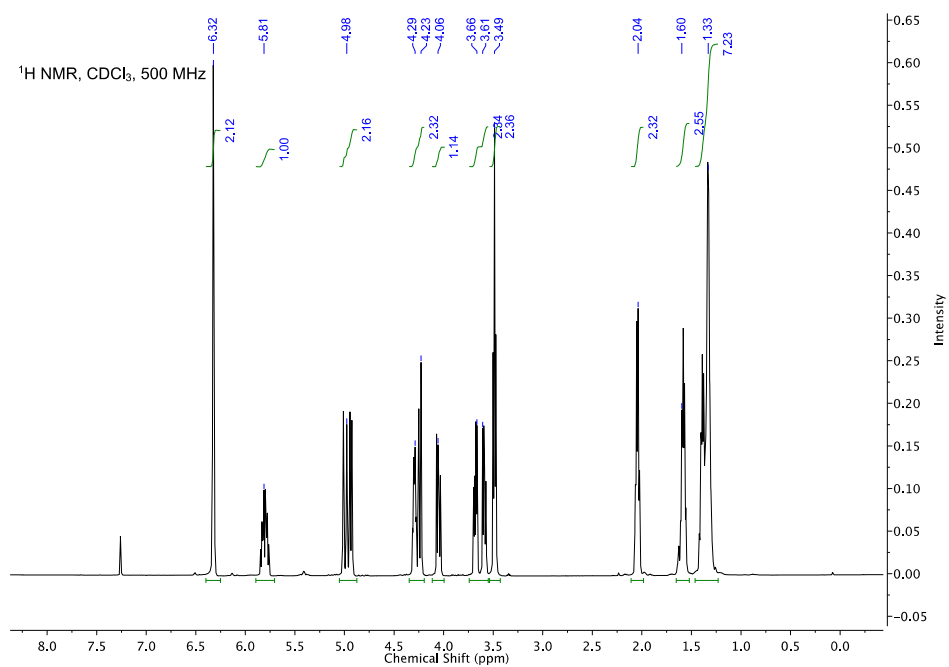


Figure S26: ^1H and ^{13}C NMR of Compound **7a** - 5,7-dibromo-2-((octyloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

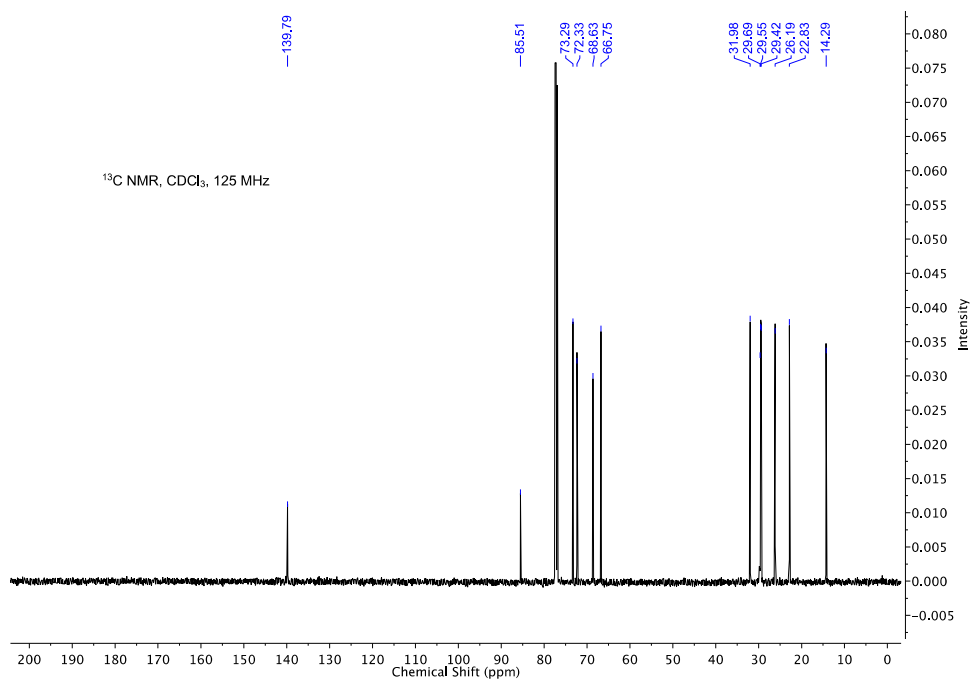
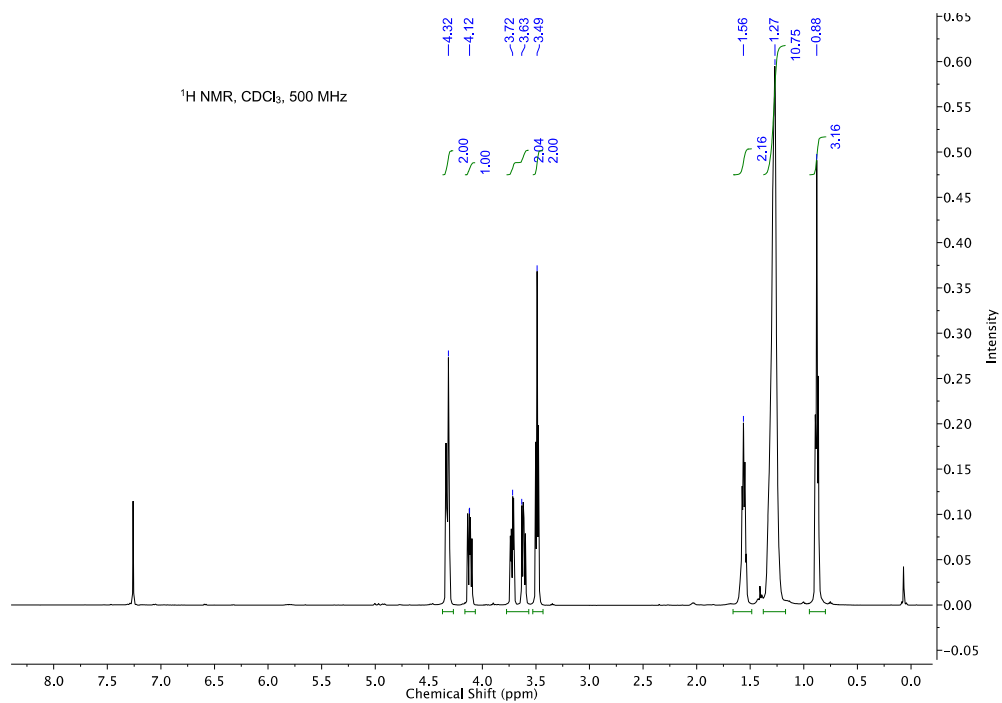


Figure S27: ^1H and ^{13}C NMR of Compound **7b** - 5,7-dibromo-2-((oct-7-en-1-yloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

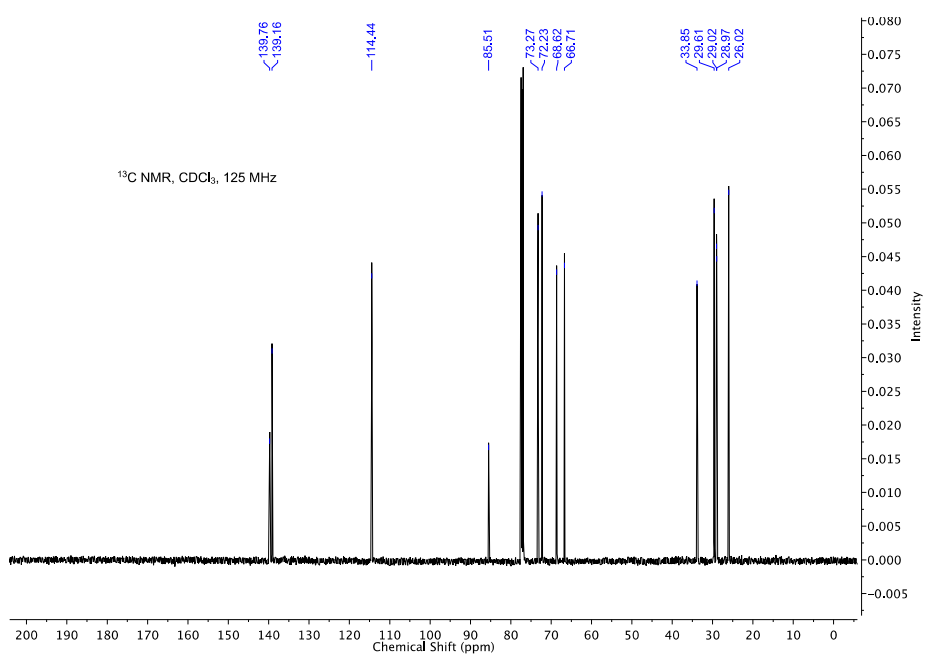
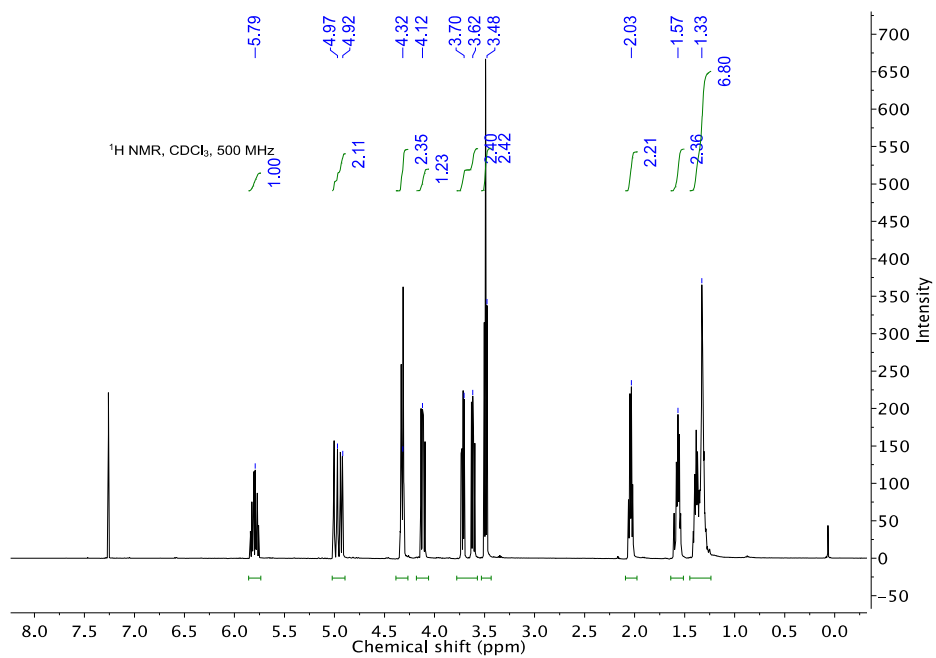


Figure S28: FTIR-ATR of Compound **3a** - 2,2-dimethyl-4-((octyloxy)methyl)-1,3-dioxolane

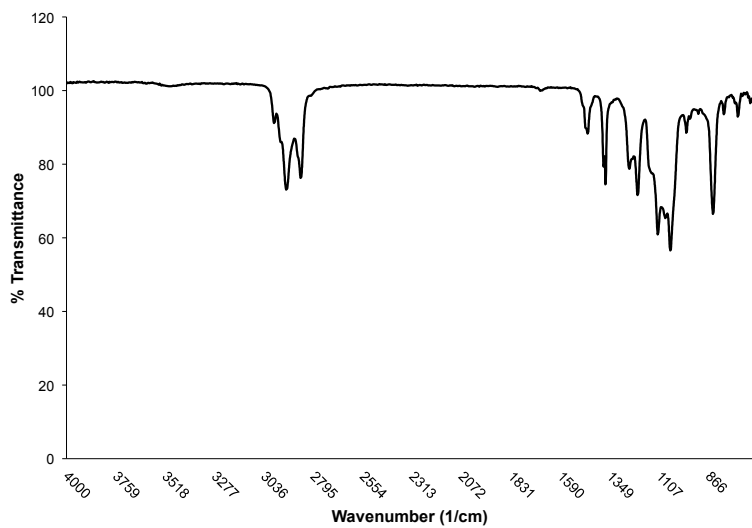


Figure S29: FTIR-ATR of Compound **3b** - 2,2-dimethyl-4-((oct-7-en-1-yloxy)methyl)-1,3-dioxolane

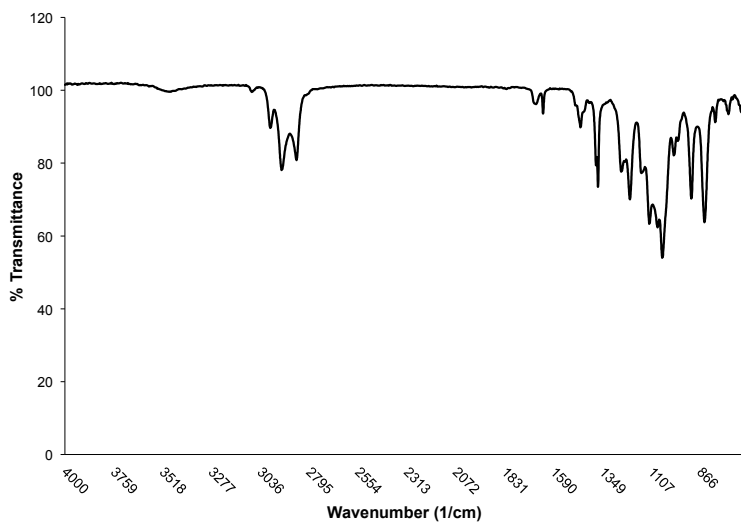


Figure S30: FTIR-ATR of Compound **4a** 3-(octyloxy)propane-1,2-diol

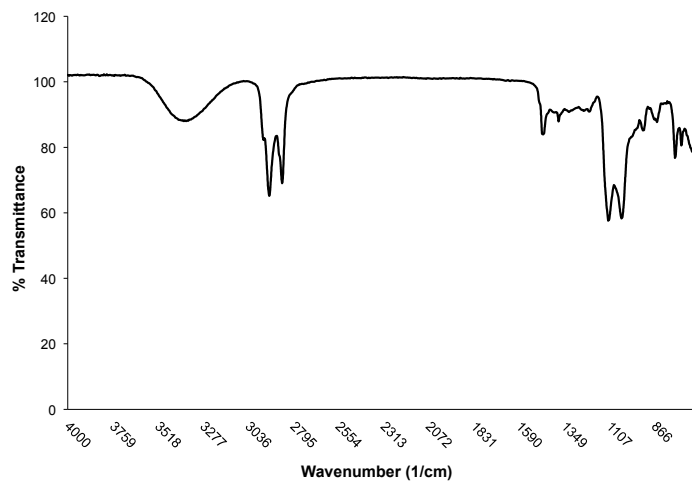


Figure S31: FTIR-ATR of Compound **4b** - 3-(oct-7-en-1-yloxy)propane-1,2-diol

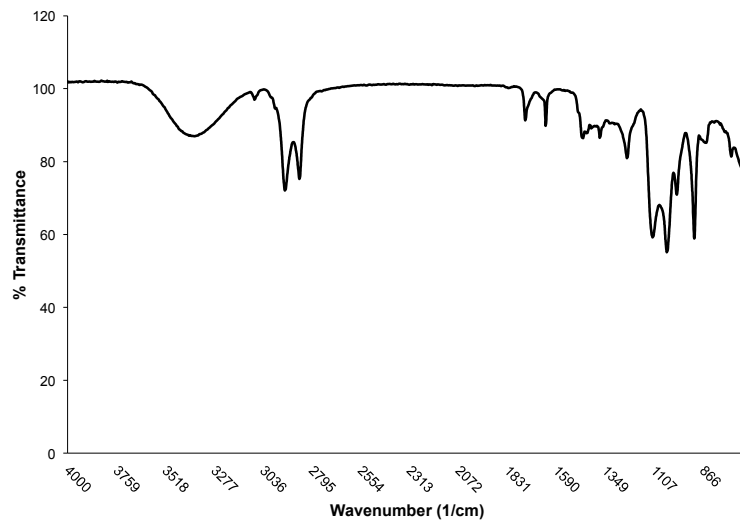


Figure S32: FTIR-ATR of Compound **6a** - 2-((octyloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

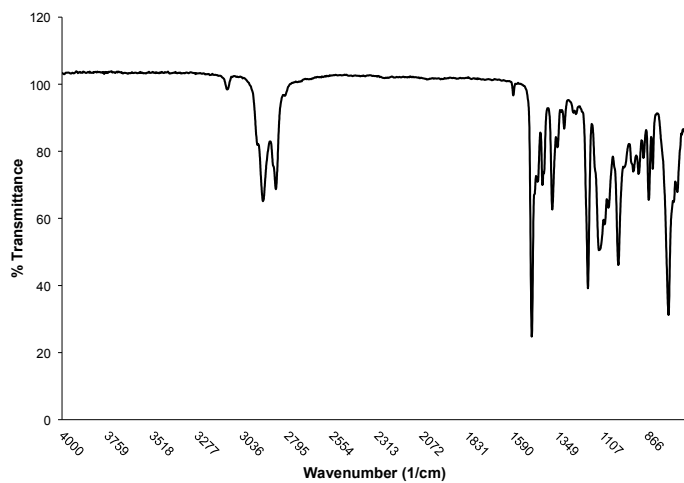


Figure S33: FTIR-ATR of Compound **6b** - 2-((oct-7-en-1-yloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

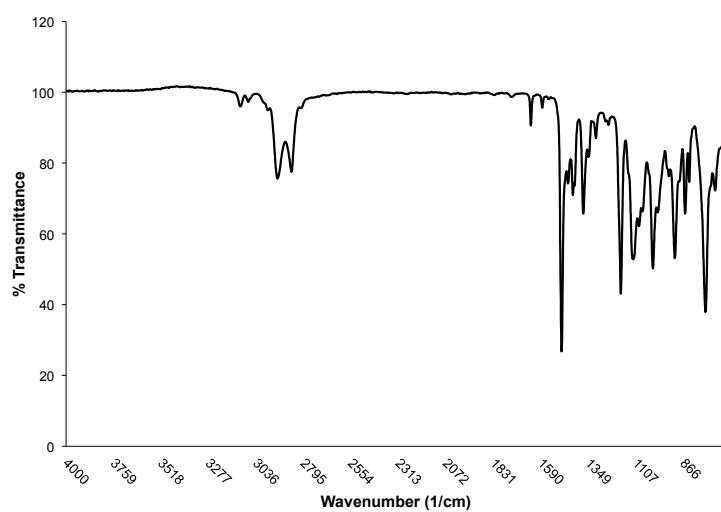


Figure S34: FTIR-ATR of Compound **7a** - 5,7-dibromo-2-((octyloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

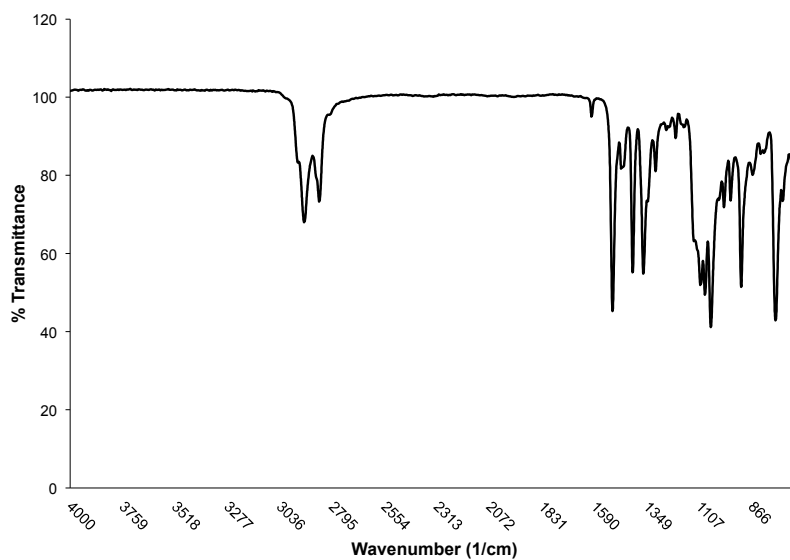


Figure S35: FTIR-ATR of Compound **7b** - 5,7-dibromo-2-((oct-7-en-1-yloxy)methyl)-2,3-dihydrothieno[3,4-*b*][1,4]dioxine

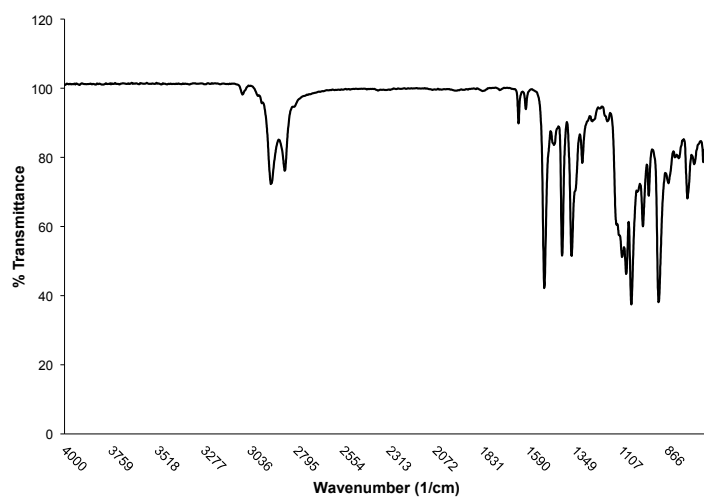


Figure S36: FTIR-ATR of Compound P1- poly(octenylEDOT)

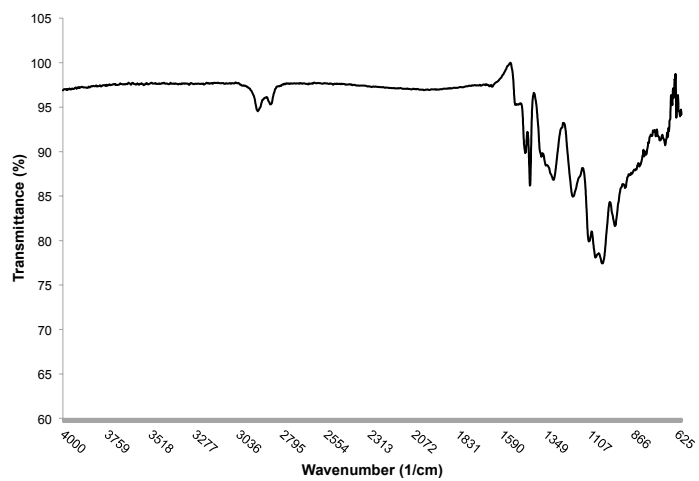


Figure S37: FTIR-ATR of Compound P2- Poly(octenyl-HFIP-PEDOT)

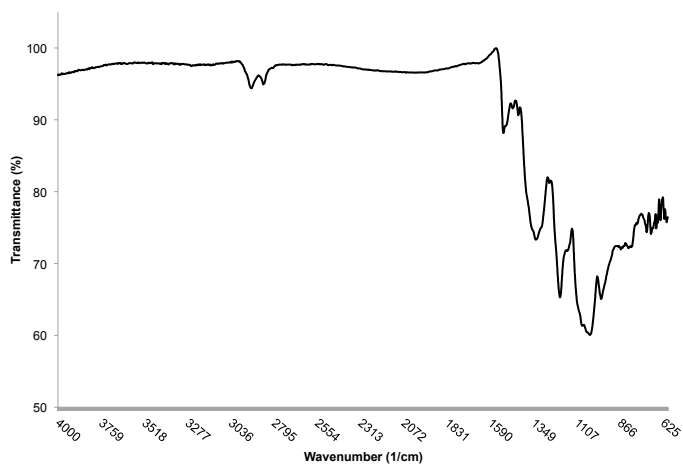


Figure S38: FTIR-ATR of Compound P3- poly(octyl-PEDOT)

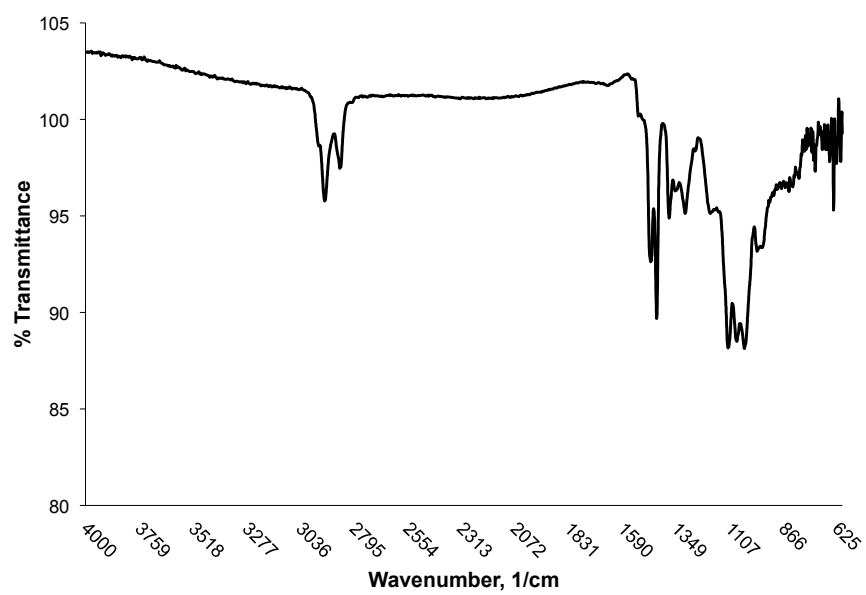


Figure S39: Schematic/cartoon of sensing experimental set up

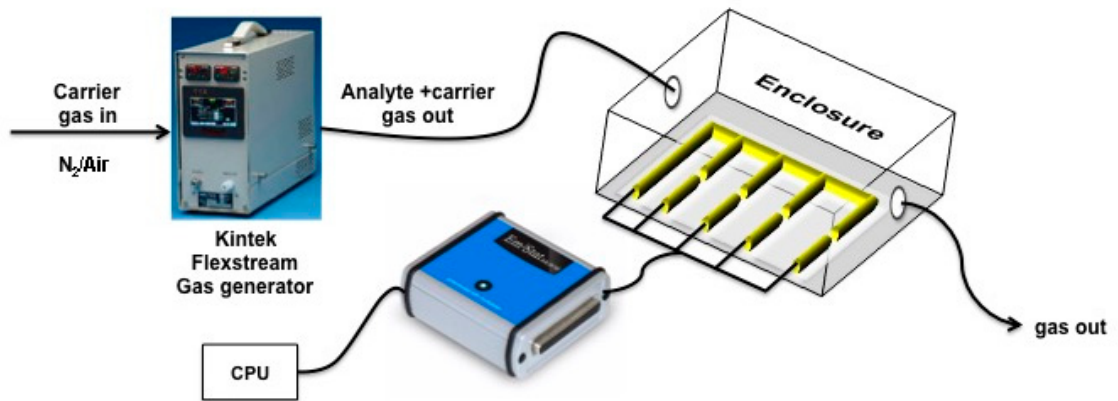


Figure S40: Photograph of sensing experimental set up

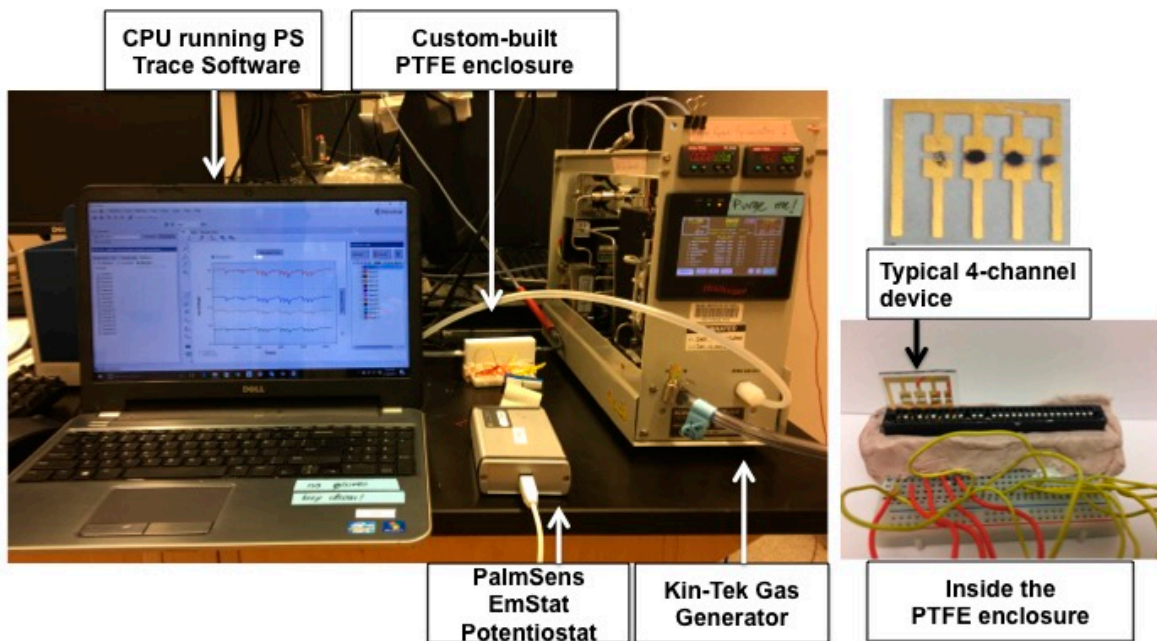


Figure S41: Schematic/cartoon of sensing experimental set up for sensing in humidified carrier gas (air)

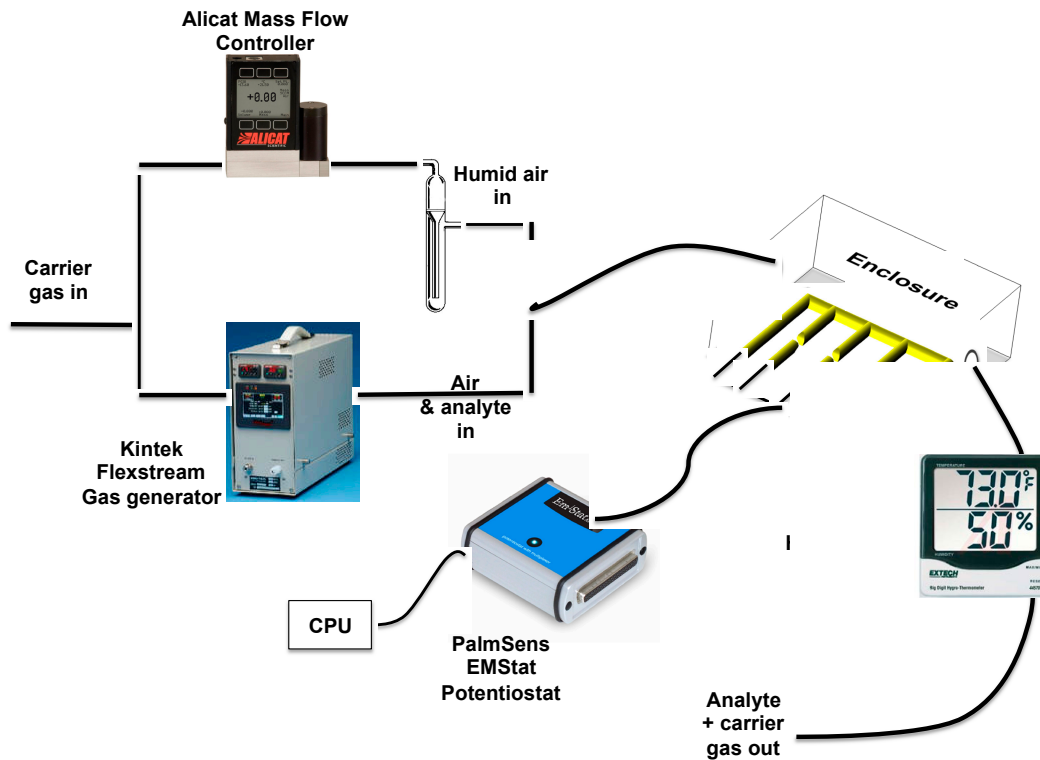


Figure S42. Chemiresistive response saturation times for P2/SWCNT in N₂ (blue triangles) and air (24% RH) (red diamonds) to increasing concentrations of DMMP (The legend for air data here is a square not a diamond)

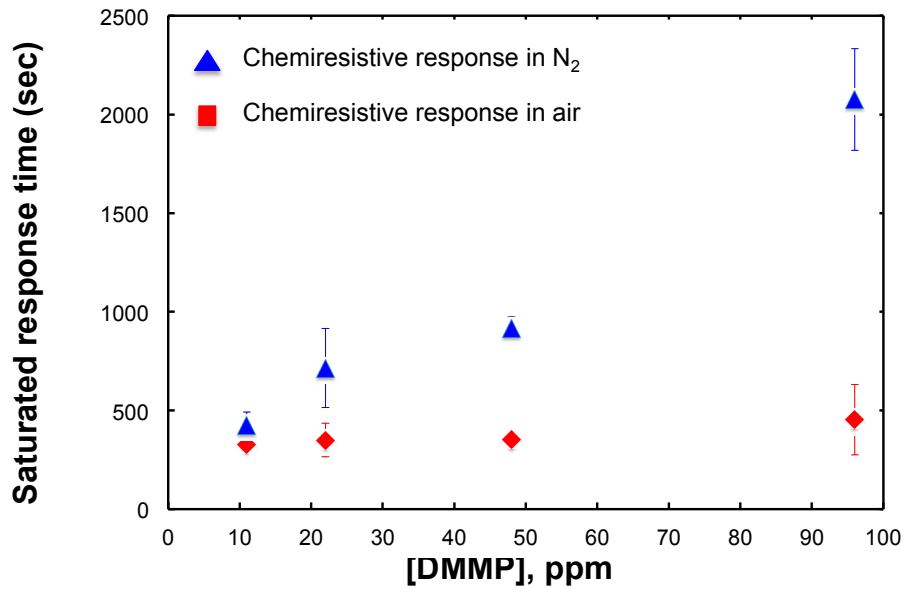


Figure S43. Linear response curves for P2/SWCNT in N₂ (blue triangles) and air (24% RH) (red diamonds) to increasing concentrations of DMMP

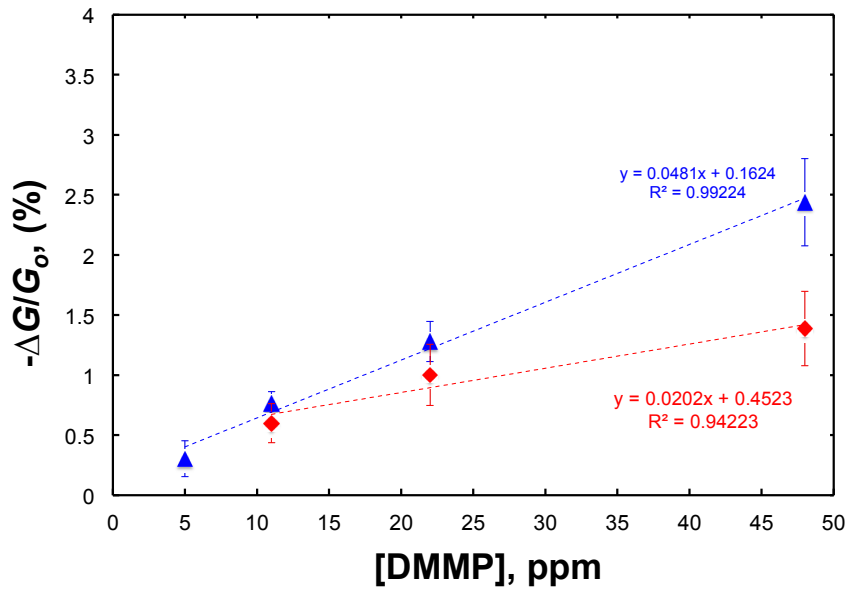


Figure S44. Chemiresistive response versus P2/SWCNT device age, in days. Devices were exposed to 11 ppm DMMP diluted with N₂ until saturation was reached, then stored under ambient conditions.

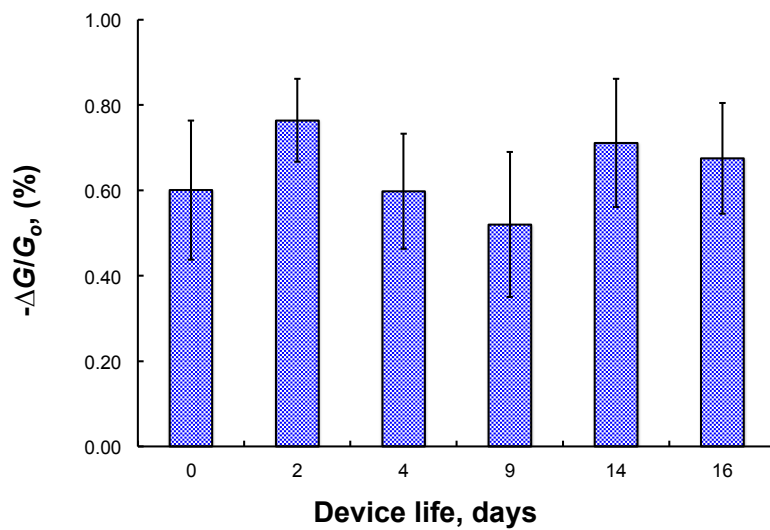


Figure S45. Conductance traces of three P2/SWCNT chemiresistors to 11 ppm DMMP in humid air (50% RH)

