SUPPORTING INFORMATION

New OligoEthylene Glycol Linkers for the Surface Modification of an Ultra-High Frequency Acoustic Wave Biosensor

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I. General remarks

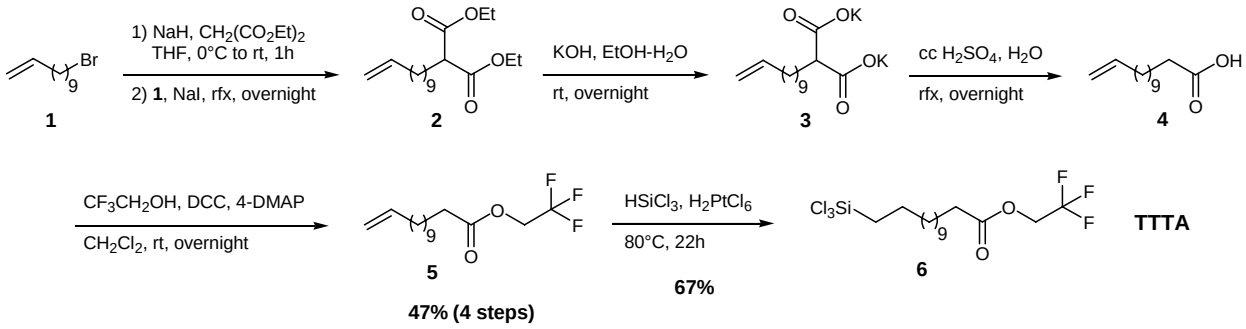
The following includes synthetic procedures and characterization data for linker, diluent and biotinthiol molecules as well as contact angle goniometry and X-ray photoelectron microscopy data for SAM characterization. $H_2PtCl_6 \bullet 6H_2O$ (99.9%) was purchased from Strem Chemicals Inc.®. Other chemicals were purchased from Sigma-Aldrich® and used as received unless otherwise noted. ^{1}H and ^{13}C NMR spectra were recorded at room temperature on Varian Mercury 300 or 400 MHz spectrometers using $CDCl_3$ or CD_3OD as the NMR solvents. ^{1}H and ^{13}C NMR spectra are referenced to the residual solvent peak ($CDCl_3$: 7.27 ppm (^{1}H) and 77.23 ppm (^{13}C), CD_3OD: 3.31 ppm (^{1}H)).

Supplementary Material (ESI) for Chemical Science

II. Chemical synthesis

II. A. TTTA synthesis

TTTA 6 was synthesized in five steps from 11-bromo-undec-1-ene **1** with a 31% overall yield (***Scheme S1***).



Scheme S1. TTTA synthesis.

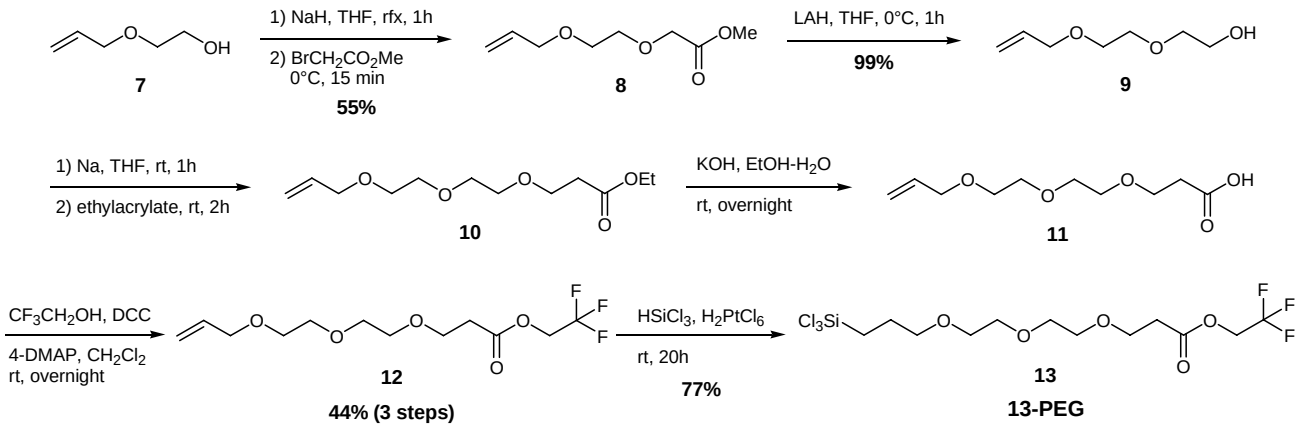
2,2,2-Trifluoroethyl tridec-12-enoate 5. To a stirred solution of NaH (60%, 484 mg, 12.1 mmol, 1.1 equiv.) in THF (50 mL) was added dropwise diethylmalonate (2.02 mL, 13.2 mmol, 1.2 equiv.) at 0ºC. After addition, the reaction was allowed to warm to room temperature then stirred for 1h. 11-bromo-undec-1-ene **1** (2.54 mL, 11.0 mmol, 1.0 equiv.) and anhydrous NaI (1.65 g, 11.0 mmol, 1.0 equiv.) were then successively added. After refluxing overnight, the reaction was quenched with brine then extracted with EtOAc. The combined organic layers were dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure to provide crude diethyl malonate **2**. The latter was diluted with a 1/1 (v/v) mixture of EtOH (20 mL) and 2.6 M KOH aqueous solution (20 mL). The reaction was vigorously stirred at room temperature overnight then the solvents were evaporated under reduced pressure to provide crude dipotassium malonate **3**. The residue was then submitted to a H_2O/CH_2Cl_2 extraction. The combined aqueous layers were concentrated under reduced pressure to about 100 mL then carefully acidified with concentrated H_2SO_4. The reaction was refluxed overnight then submitted to a CH_2Cl_2/H_2O extraction. The combined organic layers were dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure to provide crude acid **4**. The latter (2.06 g, 9.70 mmol, 1.0 equiv.) was dissolved in CH_2Cl_2 (70 mL) then DCC (2.22 g, 10.7 mmol, 1.1 equiv.), 2,2,2-trifluoroethanol (0.78 mL, 10.7 mmol, 1.1 equiv.) and 4-DMAP (0.12 g, 1.0 mmol, 0.1 equiv.) were successively added. The reaction was stirred at room temperature overnight then filtered through a short plug of Celite (CH_2Cl_2 washings). After evaporation of the filtrate under reduced pressure, the final purification was achieved by column chromatography on silica gel (Hexanes/EtOAc gradient) and provided 1.53 g (47%, 4 steps) of ester **5** as a pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.81 (m, 1H), 4.99 (m, 1H), 4.93 (m, 1H),

4.47 (q, J = 8.4 Hz, 2H), 2.41 (t, J = 7.5 Hz, 2H), 2.04 (m, 2H), 1.64 (m, 2H), 1.32 (m, 14H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 172.3, 139.4, 123.2 (q, J = 275.5 Hz), 114.3, 60.3 (q, J = 36.4 Hz), 34.0, 33.8, 29.8, 29.7, 29.6, 29.4, 29.3, 29.2, 29.1, 24.9; IR (neat) 1760 cm^{-1}; HRMS (EI, *m/z*) calcd. for $C_{15}H_{25}O_2F_3$ ($M^{+\bullet}$) 294.1807, found 294.1806.

2,2,2-Trifluoroethyl 13-Trichlorosilyl-TridecAnoate (TTTA) 6. In a heavy-walled tube equipped with a magnetic stir bar, ester **5** (1.18 g, 4.00 mmol, 1.0 equiv.) and $H_2PtCl_6 \bullet 6H_2O$ (21 mg, 0.14 mmol, 1.0 mol. %) were loaded. The tube was transferred into a glovebox and $HSiCl_3$ (0.82 mL, 8.04 mmol, 2.0 equiv.) was added to the solution. The tube was tightly fastened then removed from the glovebox. The resulting solution was stirred at 80°C for 22h behind a protecting shield. Purification was achieved by Kugelrohr distillation under high vacuum and provided 1.16 g (67%) of **TTTA 6** as a colorless oil; bp = 170-180ºC (0.15 Torr); ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.45 (q, J = 8.5 Hz, 2H), 2.41 (t, J = 7.4 Hz, 2H), 1.72-1.55 (m, 4H), 1.45-1.22 (m, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.4, 123.3 (q, J = 275.8 Hz), 60.3 (q, J = 36.4 Hz), 33.9, 32.0, 29.8, 29.7, 29.6, 29.5, 29.4, 29.2, 29.1, 24.9, 24.5, 22.5.

II. B. OEG-TTTA synthesis

OEG-TTTA 13 was synthesized in six steps from 2-allyloxy-ethanol **7** with a 18% overall yield (***Scheme S2***).



Scheme S2. OEG-TTTA synthesis.

Methyl (2-allyloxy-ethoxy)-acetate 8. To a stirred solution of 2-allyloxy-ethanol **7** (10.9 mL, 100 mmol, 1.0 equiv.) in THF (200 mL) was carefully added NaH (60%, 4.8 g, 120 mmol, 1.2 equiv.) in small portions at room temperature. The reaction was then refluxed for 1h (until H_2 release ceased) then cooled to 0ºC. Methyl bromoacetate (11.4 mL, 120 mmol, 1.2 equiv.) was then added dropwise. After 15

min at 0ºC, the reaction was submitted to a EtOAc/H_2O extraction. The combined organic layers were washed with brine, dried over anhydrous $MgSO_4$, filtered then evaporated under reduced pressure. Purification was achieved by Kugelrohr distillation under reduced pressure and provided 9.77 g (55%) of ester **8** as a colorless oil; bp = 130-145ºC (water tap vacuum); ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.91 (m, 1H), 5.28 (m, 1H), 4.99 (m, 1H), 4.19 (s, 2H), 4.02 (m, 2H), 3.76 (s, 3H), 3.75 (m, 2H), 3.64 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.1, 134.8, 117.3, 72.4, 71.2, 69.7, 68.9, 51.9; IR (neat) 1755 cm^{-1}; HRMS (ESI, *m/z*) calcd. for $C_8H_{15}O_4$ (MH^+) 175.0964, found 175.0960.

2-(2-Allyloxy-ethoxy)-ethanol 9. To a stirred solution of ester **8** (9.77 g, 55.1 mmol, 1.0 equiv.) in THF (100 mL) was carefully added one portion of LAH (95%, 1.10 g, 27.5 mmol, 0.5 equiv.) at 0ºC. After 30 min, another portion of LAH was carefully added and the reaction was stirred for an additional 30 min. The reaction was then carefully quenched with a Na_2SO_4-saturated aqueous solution. The resulting white aluminum salts were then filtered off over a short plug of Celite (EtOAc washings) and the filtrate was evaporated under reduced pressure. Purification was achieved by Kugelrohr distillation under reduced pressure and provided 7.99 g (99%) of alcohol **9** as a colorless oil; bp > 200ºC (water tap vacuum). Spectroscopic data were consistent with those reported in the literature:[1] ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.92 (m, 1H), 5.28 (m, 1H), 5.19 (m, 1H), 4.04 (m, 2H), 3.73 (m, 2H), 3.68 (m, 2H), 3.62 (m, 4H), 2.36 (brs, 1H).

2,2,2-Trifluoroethyl 3-(2-(2-allyloxy-ethoxy)-ethoxy)-propanoate 12. To a stirred solution of alcohol **9** (8.77 g, 60.0 mmol, 2.2 equiv.) in THF (100 mL) was added freshly hexanes-degreased Na (0.2 g, 8.7 mmol, 0.3 equiv.) in small portions at room temperature. The reaction was then stirred at room temperature for 1h (until the Na chunks disappeared). A solution of ethyl acrylate (2.97 mL, 27.3 mmol, 1.0 equiv.) in THF (30 mL) was then added dropwise (30 min) through an addition funnel. After 2h at room temperature, the reaction was quenched with 10 drops of glacial acetic acid then submitted to a $CHCl_3$/H_2O extraction. The combined organic layers were dried over anhydrous $MgSO_4$, filtered then evaporated under reduced pressure to provide crude ester **10**. The latter was diluted with a 1/1 (v/v) mixture of MeOH (120 mL) and 2.5 M KOH aqueous solution (120 mL). The reaction was vigorously stirred at room temperature overnight then extracted with $CHCl_3$. The aqueous layer was carefully acidified with concentrated (38%) HCl then extracted with $CHCl_3$. The combined organic layers were dried over anhydrous $MgSO_4$, filtered then evaporated under reduced pressure to provide crude acid **11**. The latter (4.05 g, 18.6 mmol, 1.0 equiv.) was diluted with CH_2Cl_2 (120 mL) then DCC (4.25 g, 20.4 mmol, 1.1 equiv.), 2,2,2-trifluoroethanol (1.50 mL, 20.4 mmol, 1.1 equiv.) and 4-DMAP (0.23 g, 1.9

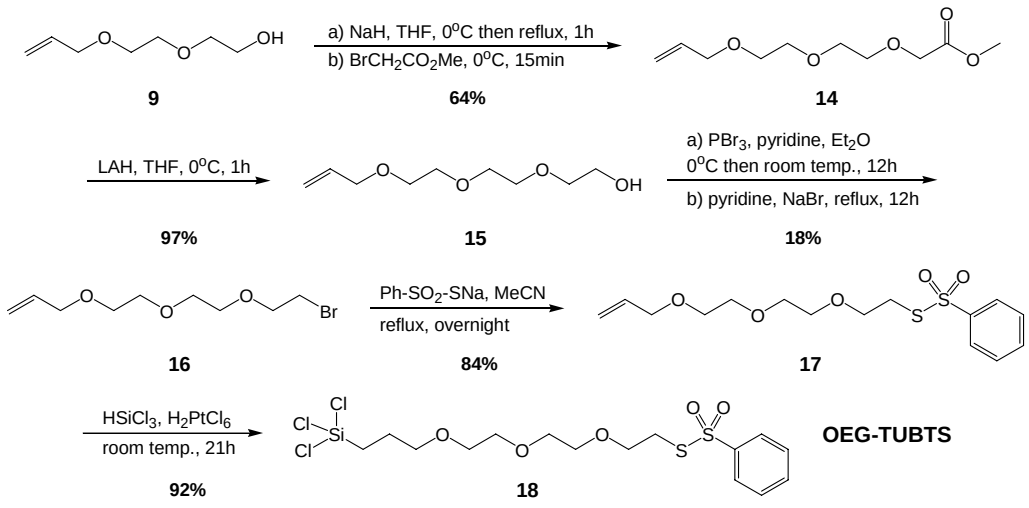
(1) a) Delgado, M.; Martin, J. D. *J. Org. Chem.* **1999**, *64(13)*, 4798-4816. b) Doyle, M. P.; Hu, W. *J. Org. Chem.* **2000**, *65(26)*, 8839-8847.

mmol, 0.1 equiv.) were successively added. The reaction was stirred at room temperature overnight then filtered through a short plug of Celite (CH_2Cl_2 washings). After evaporation of the filtrate under reduced pressure, the final purification was achieved by column chromatography on silica gel (Hexanes/EtOAc gradient) and provided 3.59 g (44%, 3 steps) of ester **12** as a pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.92 (m, 1H), 5.28 (m, 1H), 5.18 (m, 1H), 4.49 (q, *J* = 8.4 Hz, 2H), 4.03 (m, 2H), 3.79 (t, *J* = 6.4 Hz, 2H), 3.63 (m, 8H), 2.71 (t, *J* = 6.4 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.2, 134.9, 123.1 (q, *J* = 275.7 Hz), 117.2, 72.4, 70.9, 70.8, 70.7, 69.6, 66.3, 60.5 (q, *J* = 36.5 Hz), 34.8; IR (neat) 1760 cm^{-1}; HRMS (ESI, *m/z*) calcd. for $C_{12}H_{20}O_5F_3$ (MH^+) 301.1257, found 301.1258.

2,2,2-Trifluoroethyl 3-(2-(2-(3-trichlorosilyl-propyloxy)ethoxy)ethoxy)-propanoate 13 (OEG-TTTA). In a heavy-walled tube equipped with a magnetic stir bar, ester **12** (1.65 g, 5.50 mmol, 1.0 equiv.) and H_2PtCl_6 • $6H_2O$ (28 mg, 0.06 mmol, 1.0 mol. %) were loaded. The tube was transferred into a glovebox and $HSiCl_3$ (1.12 mL, 11.00 mmol, 2.0 equiv.) was added to the solution. The tube was tightly fastened then removed from the glovebox. The resulting solution was stirred at room temperature for 20h behind a protecting shield. Purification was achieved by Kugelrohr distillation under high vacuum and provided 1.85 g (77%) of **OEG-TTTA 13** as a colourless oil; bp = 175-185ºC (0.19 Torr); ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.47 (q, *J* = 8.4 Hz, 2H), 3.78 (t, *J* = 6.4 Hz, 2H), 3.61 (m, 8H), 3.51 (t, *J* = 6.4 Hz, 2H), 2.70 (t, *J* = 6.4 Hz, 2H), 1.85 (m, 2H), 1.48 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.1, 123.1 (q, *J* = 275.7 Hz), 71.7, 70.8, 70.7, 70.6, 70.3, 66.3, 60.4 (q, *J* = 36.6 Hz), 34.7, 22.7, 21.1.

II. C. OEG-TUBTS synthesis

OEG-TUBTS 18 was synthesized in five steps from alcohol **9** with a 9% overall yield (***Scheme S3***).



Scheme S3. OEG-TUBTS synthesis.

Methyl (2-(2-allyloxy-ethoxy)-ethoxy)-acetate 14. To a stirred solution of alcohol **9** (4.86 g, 33.2 mmol, 1.0 equiv.) in THF (70 mL) was carefully added NaH (60%, 1.60 g, 40.0 mmol, 1.2 equiv.) in small portions at room temperature. The reaction was then refluxed for 1h (until H_2 release ceased) then cooled to 0ºC. Methyl bromoacetate (3.8 mL, 40.1 mmol, 1.2 equiv.) was then added dropwise. After 15 min at 0ºC, the reaction was submitted to a EtOAc/H_2O extraction. The combined organic phases were washed with brine, dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure. Purification was achieved by distillation under high vacuum and provided 4.68 g (64%) of ester **14** as a colourless oil; bp = 130-140 0ºC (0.09 Torr); ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.91 (m, 1H), 5.28 (m, 1H), 5.18 (m, 1H), 4.17 (s, 2H), 4.02 (m, 2H), 3.75 (s, 3H), 3.75-3.58 (m, 8H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.0, 134.8, 117.1, 72.3, 71.0, 70.8, 70.7, 69.5, 68.7, 51.8; IR (neat) 1754 cm^{-1}; HRMS (ESI, *m/z*) calcd. for $C_{10}H_{19}O_5$ (MH^+) 219.1236, found 219.1227.

2-(2-(2-Allyloxy-ethoxy)-ethoxy)-ethanol 15. To a stirred solution of ester **14** (4.60 g, 21.1 mmol, 1.0 equiv.) in THF (60 mL) was carefully added one portion of LAH (0.50 g, 12.5 mmol, 0.5 equiv.) at 0ºC. After 30 min, another portion of LAH was carefully added and the reaction was stirred for an additional 30 min. The reaction was then carefully quenched with a Na_2SO_4-saturated aqueous solution. The resulting white aluminum salts were then filtered off over a short plug of Celite (EtOAc washings) and the filtrate was finally evaporated under reduced pressure to afford pure alcohol **15** (no purification required) as a pale yellow oil (3.89 g, 97%). Spectroscopic data were consistent with those reported in the literature:[1a] ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.93 (ddt, *J* = 17.2, 10.3, 5.7 Hz, 1H), 5.28 (dq, *J* = 17.2, 1.5 Hz, 1H), 5.19 (dq, *J* = 10.3, 1.5 Hz, 1H), 4.04 (dt, *J* = 5.7, 1.5 Hz, 2H), 3.78-3.58 (m, 12H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 134.8, 117.3, 72.7, 72.4, 70.8, 70.7, 70.5, 69.5, 61.8.

2-(2-(2-Allyloxy-ethoxy)-ethoxy)-1-bromo-ethane 16. To a stirred solution of alcohol **15** (3.83 g, 20.1 mmol, 1.0 equiv.) and pyridine (0.16 mL, 2.00 mmol, 0.1 equiv.) in Et_2O (20 mL) was added dropwise phosphorus tribromide (0.74 mL, 7.60 mmol, 0.36 equiv.) at 0ºC. After 30 min, the reaction was allowed to warm to room temperature. As the reaction was not completed after 12h, pyridine (1.60 mL, 20.0 mmol, 1.0 equiv.) and sodium bromide (4.14 g, 40.2 mmol, 2.0 equiv.) were successively added. After 12h of reflux, the resulting solution was submitted to a EtOAc/NH_4Cl-saturated aqueous solution extraction. The combined organic phases were dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure. Purification was achieved by column chromatography (Hexanes/EtOAc gradient) to afford bromide **16** (0.90 g, 18%) as a yellow oil; ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.93 (ddt, *J* = 17.3, 10.5, 5.7 Hz, 1H), 5.28 (dq, *J* = 17.3, 1.5 Hz, 1H), 5.19 (dq, *J* = 10.5, 1.5 Hz, 1H), 4.03 (dt, *J* =

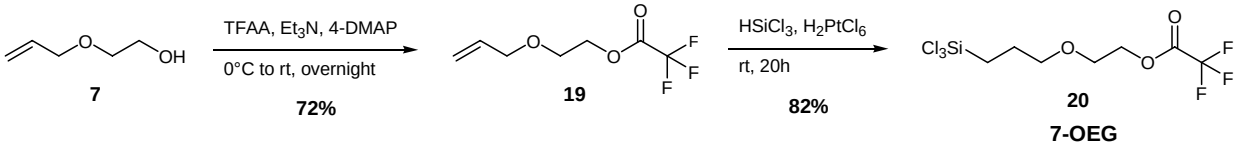
5.7, 1.5 Hz, 2H), 3.82 (t, *J* = 6.3 Hz, 2H), 3.71-3.65 (m, 6H), 3.64-3.59 (m, 2H), 3.48 (t, *J* = 6.3 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 134.9, 117.4, 72.5, 71.4, 70.9, 70.8, 70.7, 69.6, 30.5.

S-(2-(2-(2-Allyloxy-ethoxy)-ethoxy)-ethyl) benzenethiosulfonate 17. To a stirred solution of bromide **16** (0.90 g, 3.6 mmol, 1.0 equiv.) in MeCN (18 mL) was added benzenethionosulfonic acid sodium salt (85%, 1.64 g, 7.1 mmol, 2.0 equiv.) at room temperature. The reaction was refluxed overnight then submitted to a EtOAc/brine extraction. The combined organic phases were dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure. Purification was achieved by column chromatography (Hexanes/EtOAc gradient) to afford benzenethiosulfonate **17** (1.04 g, 84%, > 95% purity) as a pale yellow oil. An additional careful column chromatography afforded pure **17** as a pale yellow oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.95 (m, 2H), 7.65 (m, 1H), 7.56 (m, 2H), 5.91 (m, 1H), 5.29 (m, 1H), 5.19 (m, 1H), 4.01 (m, 2H), 3.74-3.56 (m, 10H), 3.20 (t, *J* = 6.3 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.0, 134.9, 133.9, 129.5, 127.2, 117.3, 72.4, 70.8, 70.7, 70.6, 69.6, 69.2, 35.9; IR (neat) 3068, 1647, 1324, 1142 cm^{-1}; HRMS (ESI, *m/z*) calcd. for $C_{15}H_{23}S_2O_5$ (MH^+) 347.0971, found 347.0981.

S-(2-(2-(2-(3-Trichlorosilyl-propyloxy)-ethoxy)-ethoxy)-ethyl) benzenethiosulfonate 18 (OEG-TUBTS). In a heavy-walled tube equipped with a magnetic stirring bar, benzenethiosulfonate **17** (347 mg, 1.00 mmol, 1.0 equiv.) and $H_2PtCl_6 \cdot 6H_2O$ (5.2 mg, 0.010 mmol, 1.0 mol. %) were loaded. The tube was transferred into a glovebox and $HSiCl_3$ (0.30 mL, 2.94 mmol, 3.0 equiv.) was added to the solution. The tube was tightly fastened then removed from the glovebox. The resulting solution was stirred at room temperature for 21 hours behind a protecting shield. $HSiCl_3$ excess was then removed under high vacuum to afford **OEG-TUBTS 18** as a viscous yellow-orange cloudy oil (444 mg, 92%): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.94 (m, 1H), 7.62 (m, 1H), 7.58 (m, 1H), 7.46 (m, 1H), 7.32 (m, 1H), 3.85-3.55 (m, 16H), 3.20 (t, *J* = 6.2 Hz, 1H), 2.80 (t, *J* = 6.2 Hz, 1H).

II. D. 7-OEG synthesis

7-OEG 20 was synthesized in two steps from 2-allyloxy-ethanol **7** with a 59% overall yield (***Scheme S4***).



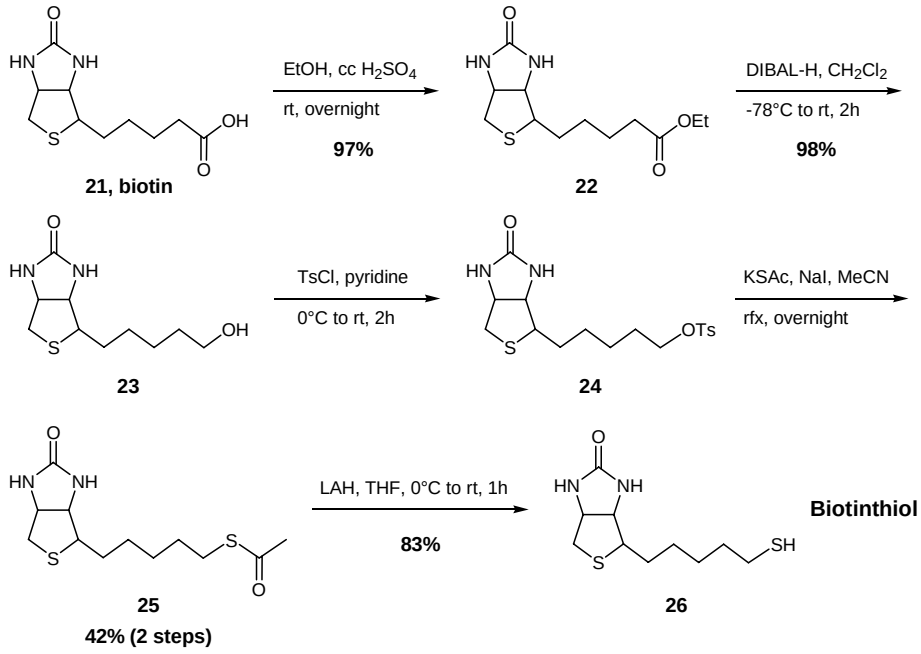
Scheme S4. 7-OEG synthesis.

2-Allyloxy-ethyl trifluoroacetate 19. To a stirred solution of 2-allyloxy-ethanol **7** (4.36 mL, 40.0 mmol, 1.0 equiv.), Et_3N (11.2 mL, 80.0 mmol, 2.0 equiv.) and 4-DMAP (0.49 g, 4.0 mmol, 0.1 equiv.) in CH_2Cl_2 (80 mL) was added dropwise trifluoroacetic anhydride (6.74 mL, 48.0 mmol, 1.2 equiv.) at 0ºC. After addition, the reaction was allowed to warm to room temperature then stirred overnight. The reaction was then submitted to a CH_2Cl_2/NH_4Cl-saturated aqueous solution extraction. The combined organic layers were dried over anhydrous $MgSO_4$, filtered then evaporated under reduced pressure. Purification was achieved by distillation under reduced pressure and provided 5.76 g (72%) of ester **19** as a colourless oil; bp = 72-74ºC (water tap vacuum); ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.88 (m, 1H), 5.29 (m, 1H), 5.21 (m, 1H), 4.52 (t, *J* = 4.8 Hz, 2H), 4.03 (m, 2H), 3.76 (t, *J* = 4.8 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 157.7 (q, *J* = 42.1 Hz), 134.2, 117.8, 114.7 (q, *J* = 283.9 Hz), 72.4, 67.2, 67.0.

2-(3-Trichlorosilyl-propyloxy)-ethyl trifluoroacetate (7-OEG) 20. In a heavy-walled tube equipped with a magnetic stir bar, ester **19** (3.97 g, 20.0 mmol, 1.0 equiv.) and $H_2PtCl_6 \bullet 6H_2O$ (104 mg, 0.20 mmol, 1.0 mol. %) were loaded. The tube was transferred into a glovebox and $HSiCl_3$ (4.10 mL, 40.2 mmol, 2.0 equiv.) was added to the solution. The tube was tightly fastened then removed from the glovebox. The resulting solution was stirred at room temperature for 20h behind a protecting shield. Purification was achieved by Kugelrohr distillation under high vacuum and provided 5.46 g (82%) of **7-OEG 20** as a colourless oil; bp = 115-120ºC (0.09 Torr); ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.52 (m, 2H), 3.76 (m, 2H), 3.56 (t, *J* = 6.2 Hz, 2H), 1.85 (m, 2H), 1.48 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.7 (q, *J* = 42.3 Hz), 114.7 (q, *J* = 284.1 Hz), 71.8, 67.9, 67.0, 22.8, 21.0.

II. E. Biotinthiol synthesis

Biotinthiol **26** was synthesized in five steps from biotin **21** with a 33% overall yield (***Scheme S5***).



Scheme S5. Biotinthiol synthesis.

Biotin methyl ester 22.[2] To a stirred solution of biotin **21** (900 mg, 3.65 mmol, 1.0 equiv.) in absolute EtOH (30 mL) were added few drops of concentrated H_2SO_4 at room temperature. After stirring at room temperature overnight, the reaction was submitted to a CH_2Cl_2/Na_2CO_3-aqueous solution extraction. The combined organic layers were dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure to provide 961 mg (97%) of ester **22** as a white solid. Spectroscopic data were consistent with those reported in the literature:[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.55 (brs, 1H), 5.17 (brs, 1H), 4.54 (m, 1H), 4.34 (m, 1H), 4.15 (q, *J* = 7.2 Hz, 2H), 3.18 (m, 1H), 2.93 (dd, *J* = 12.8, 4.8 Hz, 1H), 2.75 (d, *J* = 12.8 Hz, 1H), 2.36 (t, *J* = 7.6 Hz, 2H), 1.69 (m, 4H), 1.45 (m, 2H), 1.24 (t, *J* = 7.2 Hz, 3H).

Biotinol 23.[2] To a stirred solution of biotin methyl ester **22** (961 mg, 3.53 mmol, 1.0 equiv.) in CH_2Cl_2 (10 mL) was added dropwise DIBAL-H (1.0 M in hexanes, 12.4 mL, 12.4 mmol, 3.5 equiv.) at -78°C. After addition, the reaction was allowed to warm to room temperature then stirred for 2h. The reaction was then carefully quenched, at -78°C, by dropwise addition of MeOH then H_2O. After evaporation of the solvents under reduced pressure, the purification was achieved by Soxhlett extraction (EtOH) and provided 796 mg (98%) of biotinol **23** as a white solid; ^{1}H NMR (400 MHz, CD_3OD) δ 4.49 (dd, *J* = 7.8, 4.8 Hz, 1H), 4.30 (dd, *J* = 7.8, 4.8 Hz, 1H), 3.55 (t, *J* = 6.6 Hz, 2H), 3.21 (m, 1H), 2.93 (dd, *J* = 12.6, 4.8 Hz, 1H), 2.71 (d, *J* = 12.6 Hz, 1H), 2.16 (s, 1H), 1.74 (m, 1H), 1.57 (m, 3H), 1.45 (m, 4H).

(2) Corona, C.; Bryant, B. K.; Arterburn, J. B. *Org. Lett.* **2006**, *8(9)*, 1883-1886.

Biotin tosylate[3] **24 and biotin thiocetate 25**. To a stirred solution of biotinol **23** (796 mg, 3.46 mmol, 1.0 equiv.) in pyridine (20 mL) was added tosyl chloride (1.75 g, 9.09 mmol, 2.6 equiv.) at 0°C. After addition, the reaction was allowed to warm to room temperature then stirred for 2h. The reaction was then submitted to a CH_2Cl_2/1 M H_2SO_4 aqueous solution extraction. The combined organic layers were dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure. The residue was rapidly purified by column chromatography on silica gel (EtOAc/MeOH gradient) to provide 697 mg of an off-white solid. The latter was immediately dissolved in anhydrous MeCN (30 mL) then anhydrous NaI (2.65 g, 17.7 mmol) and KSAc (2.06 g, 17.7 mmol) were successively added at room temperature. The reaction was refluxed overnight then submitted to a CH_2Cl_2/H_2O extraction. The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure. Purification was achieved by column chromatography on silica gel (CH_2Cl_2/MeOH gradient) and provided 417 mg (42%, 2 steps) of biotin thioacetate **25** as a beige solid. Spectroscopic data were consistent with those reported in the literature:[4] ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.22 (brs, 1H), 4.86 (brs, 1H), 4.55 (m, 1H), 4.34 (m, 1H), 3.17 (m, 1H), 2.94 (dd, *J* = 12.8, 5.2 Hz, 1H), 2.87 (t, *J* = 7.4 Hz, 2H), 2.76 (d, *J* = 12.8 Hz, 1H), 2.36 (s, 3H), 1.64-1.57 (m, 4H), 1.42 (m, 4H).

Biotinthiol 26.[4] To a stirred solution of biotin thioacetate **25** (410 mg, 1.42 mmol, 1.0 equiv.) in THF (40 mL) was added LAH (95%, 454 mg, 11.36 mmol, 8.0 equiv.) in small portions at 0°C. After addition, the reaction was allowed to warm to room temperature then stirred for 1h. The reaction was diluted with EtOAc then carefully quenched with a 1 M HCl aqueous solution. The resulting aqueous layer was extracted with EtOAc. The combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, filtered then evaporated under reduced pressure. Purification was achieved by column chromatography on silica gel (EtOAc/MeOH gradient) and provided 291 mg (83%) of biotinthiol **26** as a white solid. Spectroscopic data were consistent with those reported in the literature:[4] ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.00 (brs, 1H), 4.84 (brs, 1H), 4.55 (m, 1H), 4.35 (m, 1H), 3.20 (m, 1H), 2.95 (dd, *J* = 12.8, 5.2 Hz, 1H), 2.76 (d, *J* = 12.8 Hz, 1H), 2.56 (q, *J* = 7.3 Hz, 2H), 1.76-1.59 (m, 4H), 1.53-1.40 (m, 4H), 1.37 (t, *J* = 7.3 Hz, 1H).

III. Surface analyses

III. A. Contact angle measurement (CAM)

Contact angle measurements (static) were performed in the Department of Chemistry, University of Toronto, Toronto, ON, Canada. The surfaces were analyzed with the KSV contact angle measurement

(3) DeLaLuz, P. J.; Golinski, M.; Watt, D. S.; Vanaman, T. C. *Bioconjugate Chem.* **1995**, *6(5)*, 558-566.
(4) Galonić, D.; Ide, N. D.; van der Donk, W. A.; Gin, D. Y. *J. Am. Chem. Soc.* **2005**, *127(20)*, 7359-7369.

instrument (KSV Instruments Ltd.) and ultrapure water as the test liquid. Contact angle values were generated using the CAM101 software (***Table S1***).

Surface	Contact angle
TTTA/OTS SAM	77°
OEG-TTTA/7-OEG SAM	69°
OEG-TUBTS/7-OEG SAM	75°
Cleaned quartz disc	12°

Table S1. Static contact angle measurements for TTTA/OTS, OEG-TTTA/7-OEG and OEG-TUBTS/7-OEG mixed SAMs recorded with ultrapure water.

III. B. X-ray photoelectron spectroscopy (XPS)

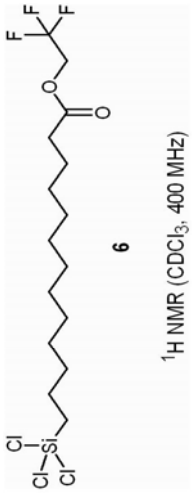
Angle-resolved XPS analysis was performed with a Theta probe ThermoFisher Scientific Instrument (East Grinstead, UK) located at *Surface Interface Ontario*, University of Toronto, Toronto, ON, Canada. The samples were analyzed with monochromated Al Kα X-rays (elliptical spots of 400 μm along the long axis), with take-off angles of 72.5˚ and 27.5˚ relative to the surface. The binding energy scale was calibrated to the main C1s signal at 285 eV. Peak fitting and data analysis were performed using *Avantage* software provided with the instrument (***Table S2***).

Surface	XPS angle	% C1s 285 eV	% F1s 685 eV	% O1s 531 eV	% Si2p 100 eV	% S2p 163 eV
Cleaned quartz disc	72.5°	20.1[a]	0.0	52.0	27.9	0.0
	27.5°	6.5[a]	0.0	56.4	37.1	0.0
TTTA/OTS SAM	72.5°	26.6	2.1	48.0	23.4	0.0
	27.5°	9.0	0.9	55.6	34.5	0.0
OEG-TTTA/7-OEG SAM	72.5°	19.8	3.2	54.6	22.4	0.0
	27.5°	6.7	1.2	56.9	35.2	0.0
OEG-TUBTS/7-OEG SAM	72.5°	31.4	6.5	44.2	16.5	1.4
	27.5°	25.7	5.8	45.7	21.3	1.5

Table S2. Angle-resolved XPS analysis (72.5° (surface) and 27.5° (bulk)) for cleaned disc as well as TTTA/OTS, OEG-TTTA/7-OEG and OEG-TUBTS/7-OEG mixed SAMs. [a] This signal is due to unavoidable surface contamination by adventitious carbon.

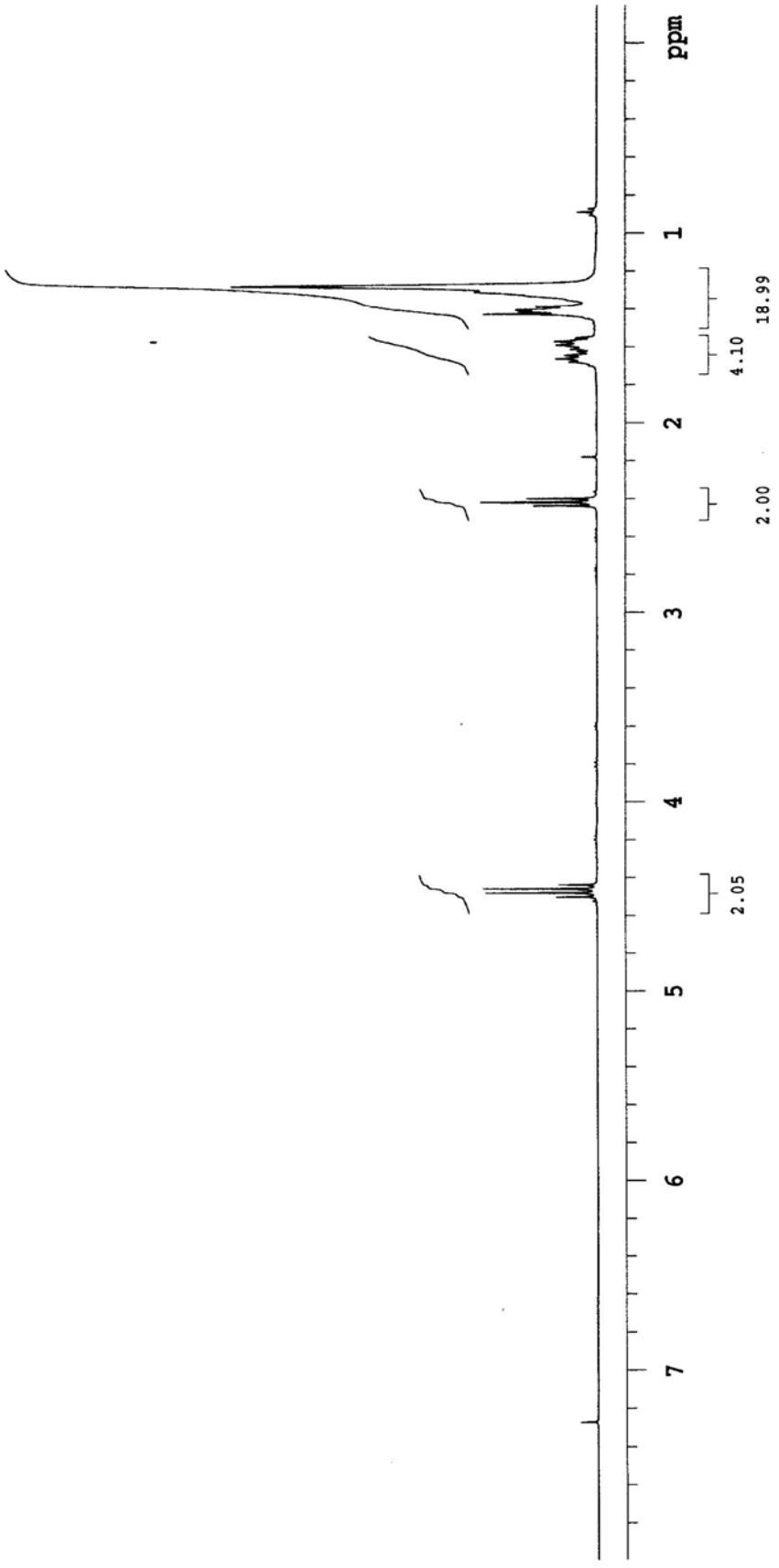
Angle-resolved XPS data (along with CAMs in table 1) were used to determine whether the linker and diluent molecules had deposited from solution onto the quartz slides. Atomic percentages for characteristic elements of the linker/diluent molecules (fluorine and sulfur) along with those for elements (mainly) present in quartz (silicon and oxygen) were calculated and compared before (clean quartz crystal) and after linker/diluent deposition. As expected, clean quartz crystals only showed Si and O as well as unavoidable adventitious carbon. Upon deposition of TTTA/OTS molecules, XPS data were as expected: F signal appeared (and was higher at the surface) and the signals of the underlying buried O and Si decreased. The same was true for the OEG-TTTA/7-OEG system except for the O surface signal, which slightly increased because both OEG-TTTA and 7-OEG molecules possess a non-neglectable amount of O that was reflected in the total amount of O. As expected as well for the OEG-TUBTS/7-OEG system, F and S signals appeared (showing that both molecules deposited) and the signals of the underlying buried O and Si decreased.

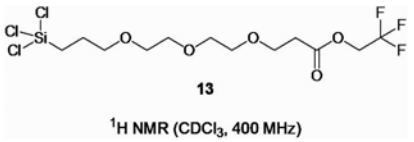
IV. ^{1}H NMR spectra



6

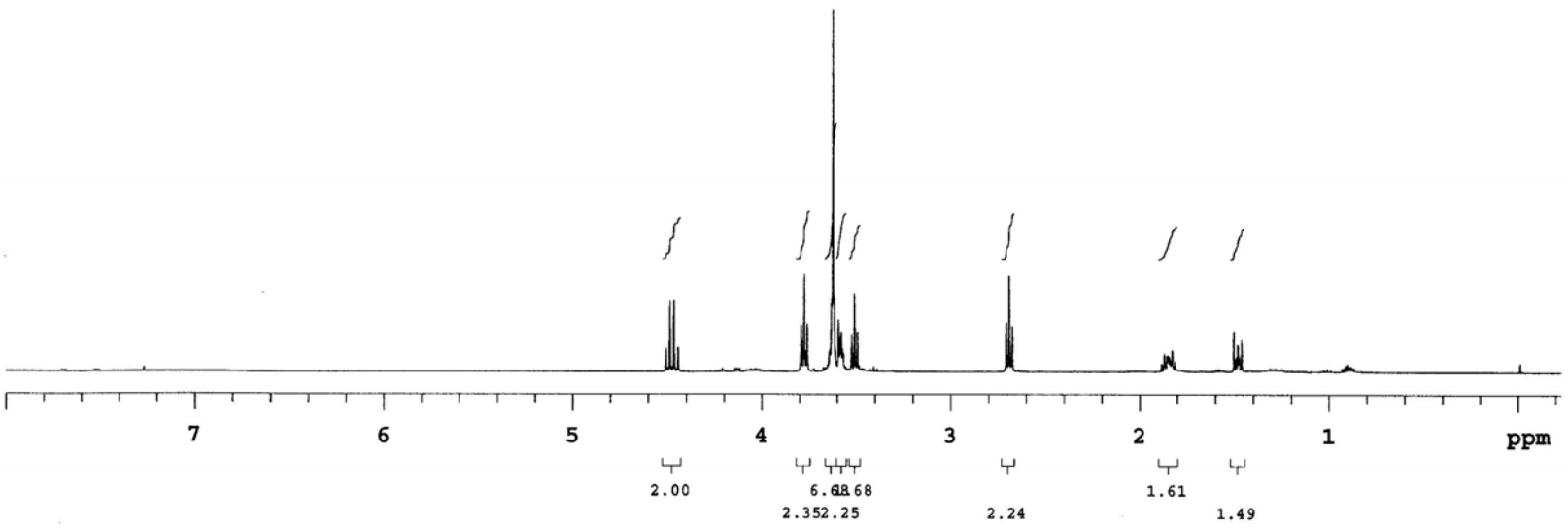
^{1}H NMR ($CDCl_3$, 400 MHz)

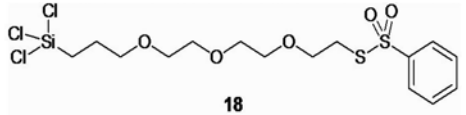




13

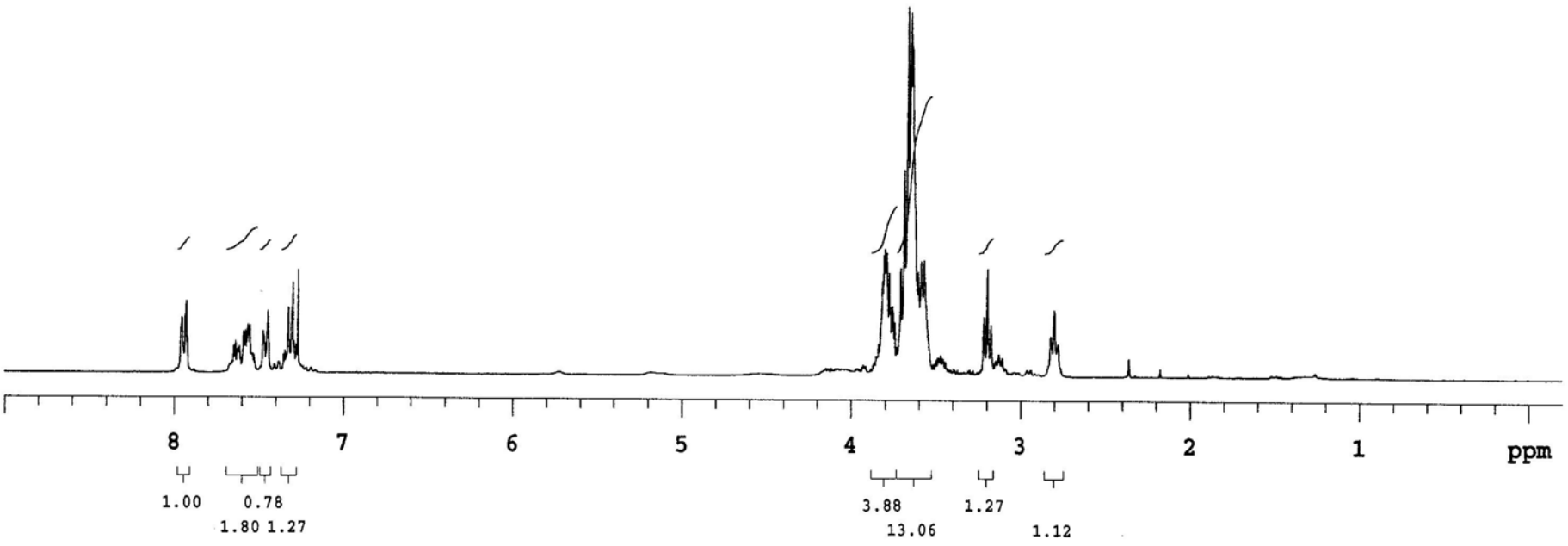
^{1}H NMR ($CDCl_3$, 400 MHz)

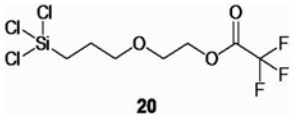




18

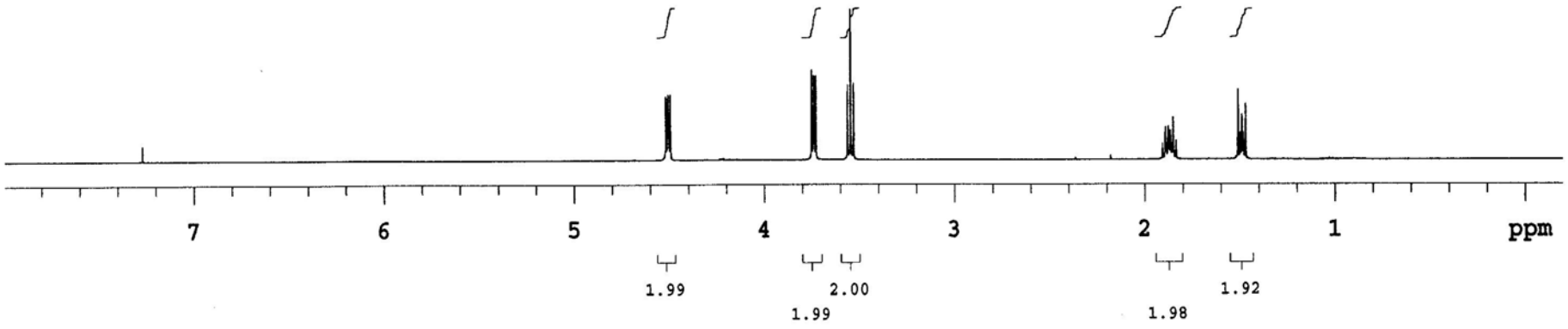
^{1}H NMR ($CDCl_3$, 300 MHz)

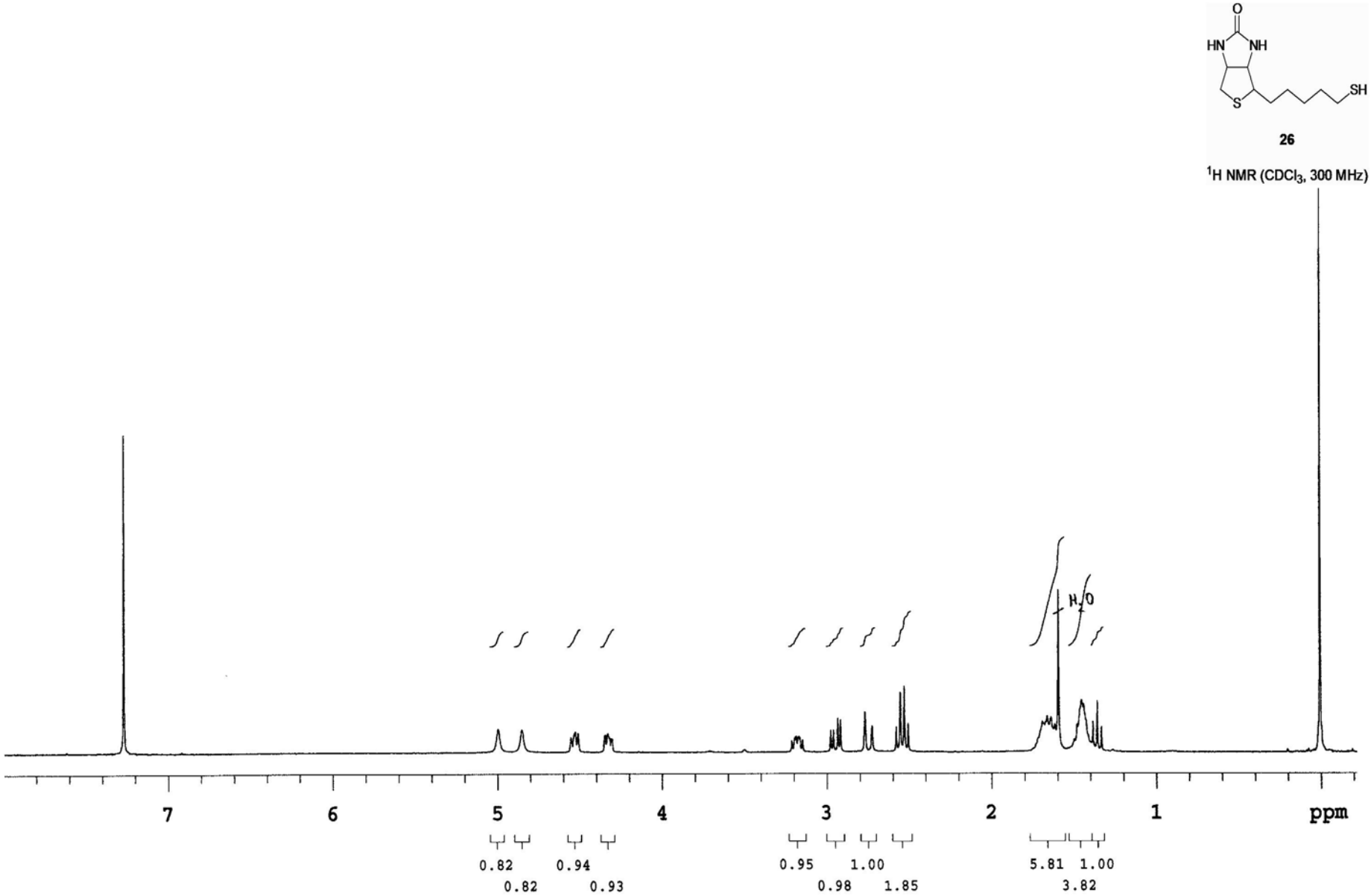




20

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





V. Example of an EMPAS profile: OEG-TUBTS/7-OEG (7 mm disc)

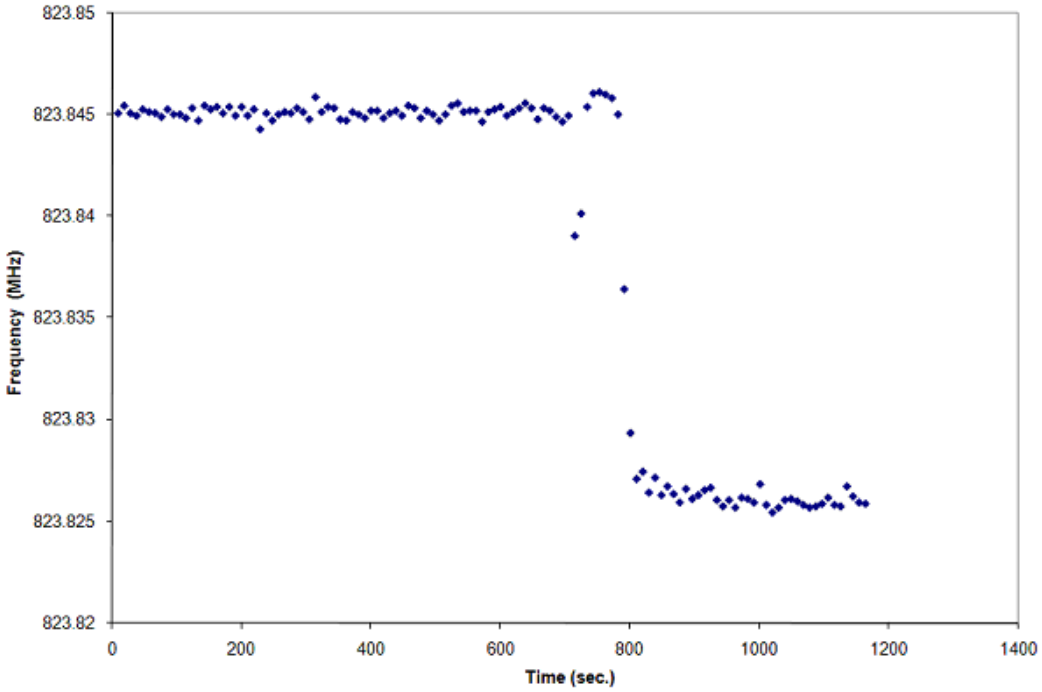


Figure S1. EMPAS specific avidin adsorption profile for a biotinylated OEG-TUBTS/7-OEG mixed SAM formed on a 7 mm quartz disc.

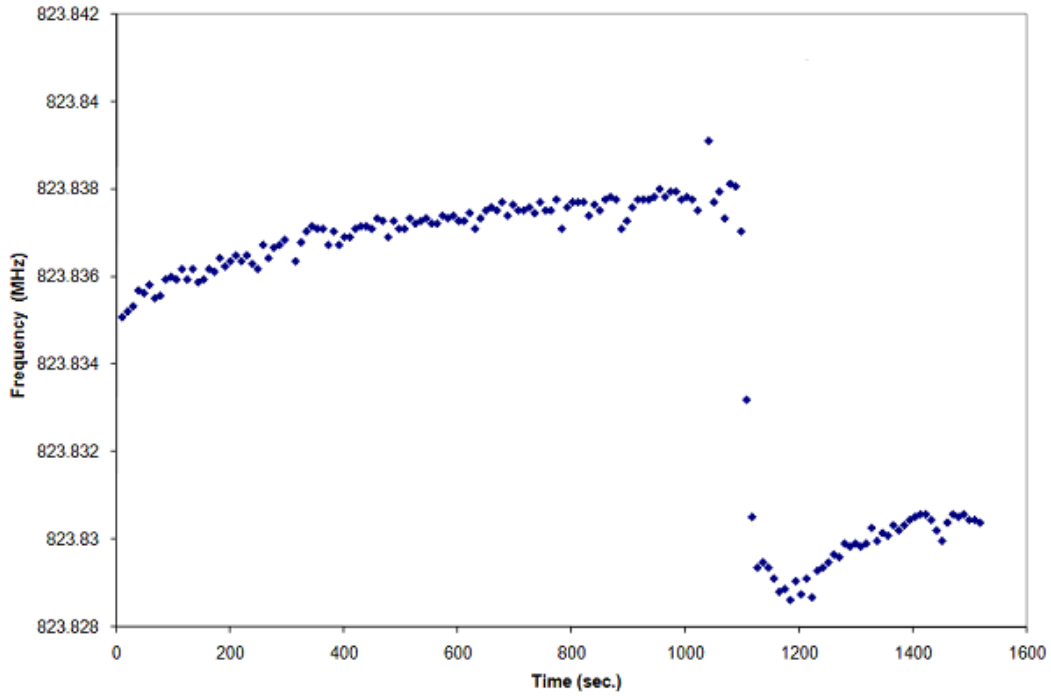


Figure S2. EMPAS non-specific avidin adsorption profile for an unbiotinylated OEG-TUBTS/7-OEG mixed SAM formed on a 7 mm quartz disc.