Electronic Supplementary Material (ESI) for Analyst.

A glycan-based plasmonic sensor for the diagnostic of prostate cancer

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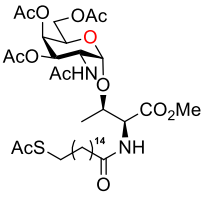
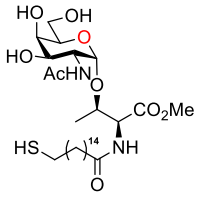
1. Experimental Section

A) Synthesis of Tn antigen



***S*-acetyl-mercaptohexadecanoyl-*O*-(2-acetamido-3,4,6-tri-*O*-acetyl-2-deoxy-α-D-galactopyranosyl)-L-threonine methyl ester (7).** To a solution of *S*-acetyl-mercaptohexadecanoic acid (194.3 mg, 0.588 mmol, 2 eq.) in DMF (1 mL) at room temperature, was added successively HATU (223.6 mg, 0.588 mmol, 2 eq.), HOAt (80.0 mg, 0.588 mmol, 2 eq.) and DIPEA (102 µL, 0.588 mmol, 2 eq.). The mixture was stirred at room temperature for 15 minutes. Then, a solution of *O*-(2-acetamido-3,4,6-tri-*O*-acetyl-2-deoxy-α-D-galactopyranosyl)-L-threonine methyl ester (136.0 mg, 0.294 mmol, 1 eq.) in DMF (1 mL) was added and the resulting mixture was stirred for 18 hours at room temperature. The mixture was then quenched with the addition of water (10 mL) and extracted with EtOAc (3 × 20 mL). The combined organic phases were washed with a saturated aqueous $NaHCO_3$ solution (30 mL) and a saturated aqueous NaCl solution (30 mL). The organic solution was dried over $MgSO_4$, filtered, and concentrated under reduced pressure. The obtained crude was purified by flash column chromatography (silica gel, EtOAc/Et_2O, 1:1 → 3:1) to give **7** as a colorless solid (217 mg, 0.280 mmol, 95% yield). R_f = 0.28 (silica, EtOAc/Et_2O, 3:1); $[\alpha]_D^{25}$ = 68.9 (*c* 0.4, $CHCl_3$); IR (ATR, NaCl) ν 3306, 2925, 2853, 1750, 1372, 1232, 1048 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 6.17 (d, *J* = 9.2 Hz, 1H, N*H*Thr), 5.80 (d, *J* = 9.4 Hz, 1H, N*H*Ac), 5.36 (d, *J* = 2.2 Hz, 1H, H4), 5.08 (dd, *J* = 11.4, 3.2 Hz, 1H, H3), 4.87 (d, *J* = 3.4 Hz, 1H, H1), 4.76 (dd, *J* = 9.2, 2.0 Hz, 1H, C*H*αThr), 4.55 (ddd, *J* = 11.2, 3.5 Hz, 1H, H2), 4.25 (qd, *J* = 6.3, 2.1 Hz, 1H, C*H*βThr), 4.19 (td, *J* = 6.9, 5.6, 0.8 Hz, 1H, H5), 4.10 (dd, *J* = 11.4, 5.5 Hz, 1H, H6a), 4.05 (dd, *J* = 11.4, 7.3 Hz, 1H, H6b), 3.73 (s, 3H, CO_2CH_3), 2.85 (t, *J* = 7.2 Hz, 2H, CH_2), 2.34 (t, *J* = 7.6 Hz, 2H, CH_2), 2.32 (s, 3H, $COCH_3$), 2.16 (s, 3H, $COCH_3$), 2.03 (s, 3H, $COCH_3$), 2.02 (s, 3H, $COCH_3$), 2.00 (s, 3H, $COCH_3$), 1.68 (p, *J* = 7.7 Hz, 2H, CH_2), 1.55 (p, *J* = 7.3 Hz, 2H, CH_2), 1.38 – 1.21 (m, 22H, 11 × CH_2), 1.28 (d, *J* = 6.4 Hz, 3H, CH_3γThr). ^{13}C NMR (126 MHz, $CDCl_3$) δ 196.3, 173.9, 171.7, 171.3, 170.7, 170.5, 170.5 (7C, 7 × *C*O), 100.2 (1C, C1), 77.8 (1C, *C*HβThr), 68.6 (1C, C3), 67.4 (2C, C4, C5), 62.3 (1C, C6), 56.3 (1C, *C*HαThr), 52.8 (1C, CO_2CH_3), 47.7 (1C, C2), 36.7 (1C, CH_2), 30.8 (1C, $COCH_3$), 29.8, 29.8, 29.7, 29.7, 29.6, 29.6, 29.5, 29.5, 29.3, 29.3, 29.0, 25.8 (14C, 14 × CH_2), 23.3, 20.93, 20.89, 20.8, (4C, 4 × $COCH_3$), 18.3 (1C, CH_3γThr) ppm. HRMS calcd for $C_{37}H_{63}N_2O_{13}S^+$ 775.4037, found 775.4045.

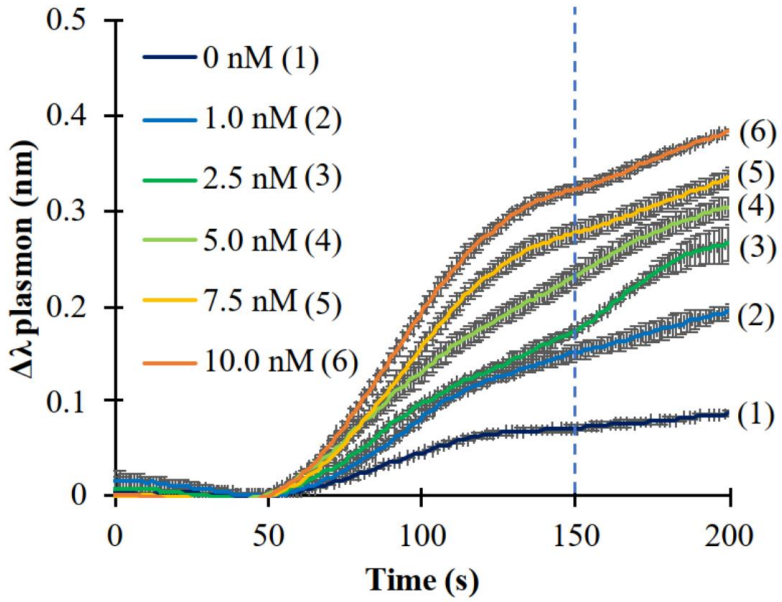


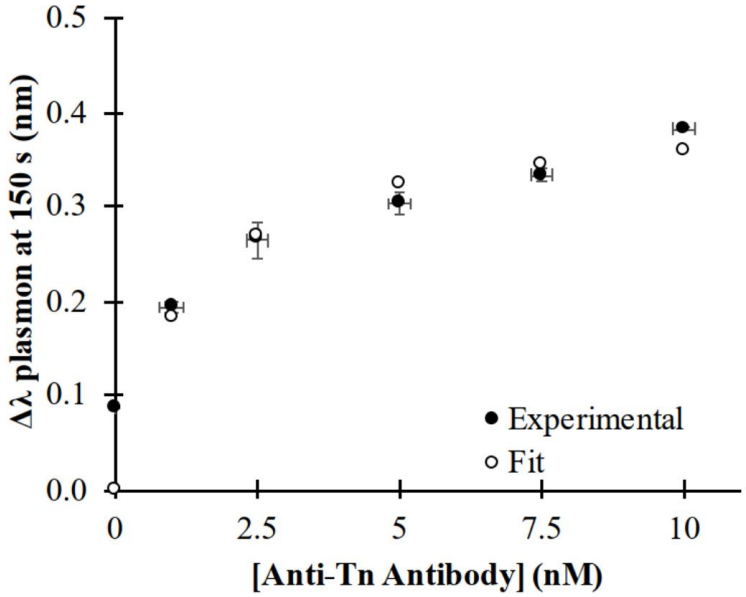
***S*-mercaptohexadecanoyl-*O*-(2-acetamido-2-deoxy-α-D-galactopyranosyl)-L-threonine methyl ester (8).** To a solution of **7** (60.4 mg, 0.078 mmol, 1 eq.) in methanol (0.78 mL) at room temperature, was added dropwise acetyl chloride (20 µL, 0.312 mmol, 4 eq.). The resulting mixture was stirred until the disappearance of starting material and intermediate products (~5h). The solvent was concentrated under pressure. The obtained crude was purified by flash column chromatography (silica gel, MeOH/CH_2Cl_2, 1:9 → 1:4) to give **8** as a white solid (33.9 mg, 0.056 mmol, 72% yield). R_f = 0.20 (silica, MeOH/CH_2Cl_2, 2:8); $[\alpha]_D^{25}$ = 38.6 (*c* 0.2, MeOH); IR (ATR, NaCl) ν 3284, 2923, 2853, 1743, 1651, 1462, 1025 cm^{-1}; ^{1}H NMR (500 MHz, CD_3OD) δ 4.77 (d, *J* = 4.0 Hz, 1H, H1), 4.63 (d, *J* = 1.9 Hz, 1H, C*H*αThr), 4.39 (qd, *J* = 6.3, 1.9 Hz, 1H, C*H*βThr), 4.24 (dd, *J* = 11.0, 3.9 Hz, 1H, H2), 3.88 (d, *J* = 3.2 Hz, 1H, H4), 3.86 (td, *J* = 6.9, 5.6, 0.8 Hz, 1H, H5), 3.73 (dd, *J* = 11.4, 6.8 Hz, 1H, H6a), 3.71 (dd, *J* = 11.0, 3.2 Hz, 1H, H3), 3.70 (s, 3H, CO_2CH_3), 3.68 (dd, *J* = 11.4, 5.3 Hz, 1H, H6b), 2.49 (t, *J* = 7.2 Hz, 2H, CH_2), 2.36 (t, *J* = 7.5 Hz, 2H, CH_2), 2.04 (s, 3H, $COCH_3$), 1.67 (p, *J* = 7.4 Hz, 2H, CH_2), 1.59 (p, *J* = 7.3 Hz, 2H, CH_2), 1.43 – 1.28 (m, 22H, 11 × CH_2), 1.26 (d, *J* = 6.4 Hz, 3H, CH_3γThr) ppm; ^{13}C NMR (126 MHz, CD_3OD) δ 176.7, 173.9, 172.2 (3C, 3 × *C*O), 100.7 (1C, C1), 76.6 (1C, *C*HβThr), 72.9 (1C, C5), 70.3 (1C, C4), 69.7 (1C, C3), 62.8 (1C, C6), 57.8 (1C, *C*HαThr), 52.8 (1C, CO_2CH_3), 51.2 (1C, C2), 36.8, 35.3, 30.79, 30.78, 30.76, 30.74, 30.72, 30.69, 30.5, 30.4, 30.2, 29.4, 27.1, 25.0 (14C, 14 × CH_2), 23.2 (1C, $COCH_3$), 19.3 (1C, CH_3γThr) ppm. HRMS calcd for $C_{29}H_{55}N_2O_9S^+$ 607.3623, found 607.3618.

B) Determination of apparent dissociation constant K_d

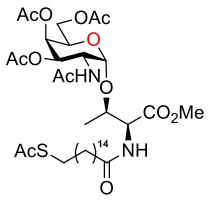
The value of K_d for anti-Tn IgM antibodies on the PDA@Tn@PEO and PDA@PEO surfaces was calculated from the Langmuir isotherm (eqn (1)) fitted to the experimental SPR data, where $\Delta\lambda_{SPR}$ is the plasmon shift measured at 150 s for different ligand concentrations (see example below) and where $K = 1/K_d$.[5,6]

$$\Delta\lambda_{SPR} = \frac{K[\text{ligand}]\Delta\lambda_{max}}{1+K[\text{ligand}]} \quad (1)$$



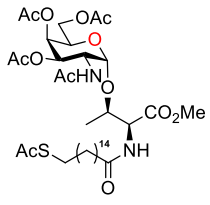


2. NMR spectra of compounds



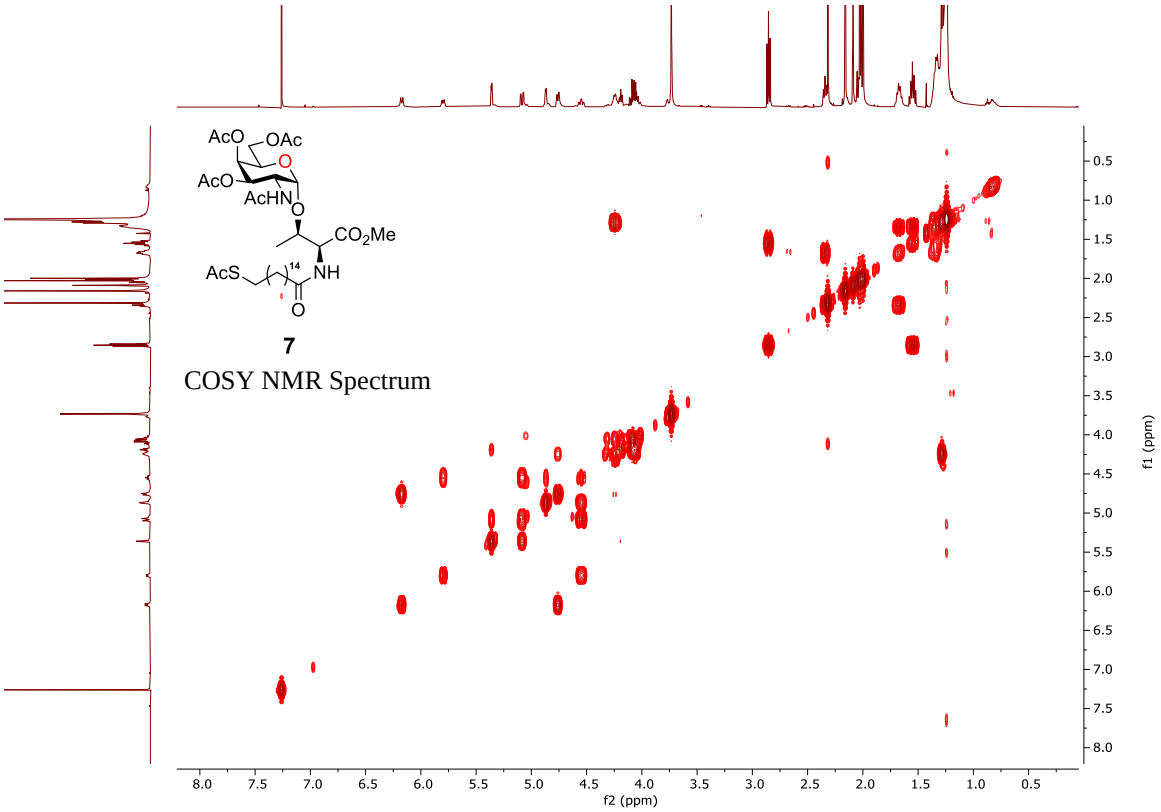
7

^{1}H NMR Spectrum
($CDCl_3$, 500 MHz)



7

^{13}C NMR Spectrum
($CDCl_3$, 126 MHz)


AcO
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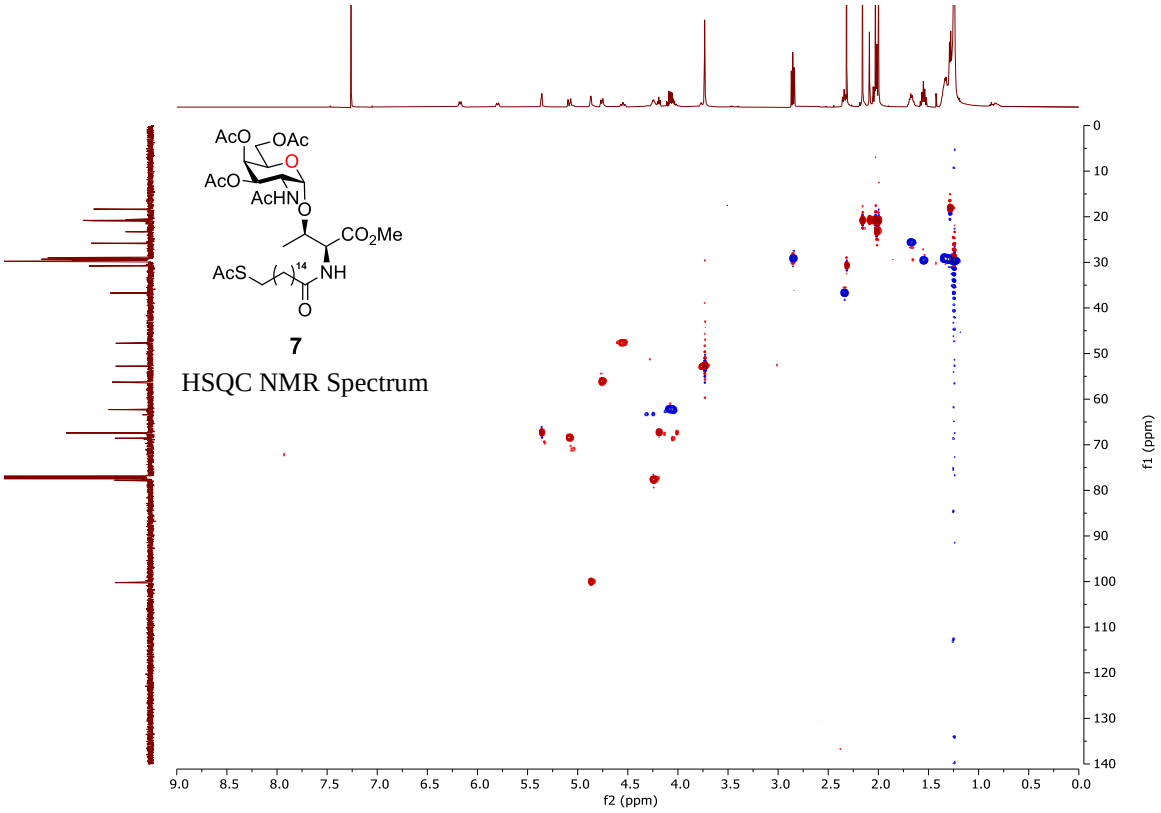
O
AcO
AcHN
O
CO2Me
AcS
14
NH
O
7
COSY NMR Spectrum
f2 (ppm)
f1 (ppm)


AcO
OAc
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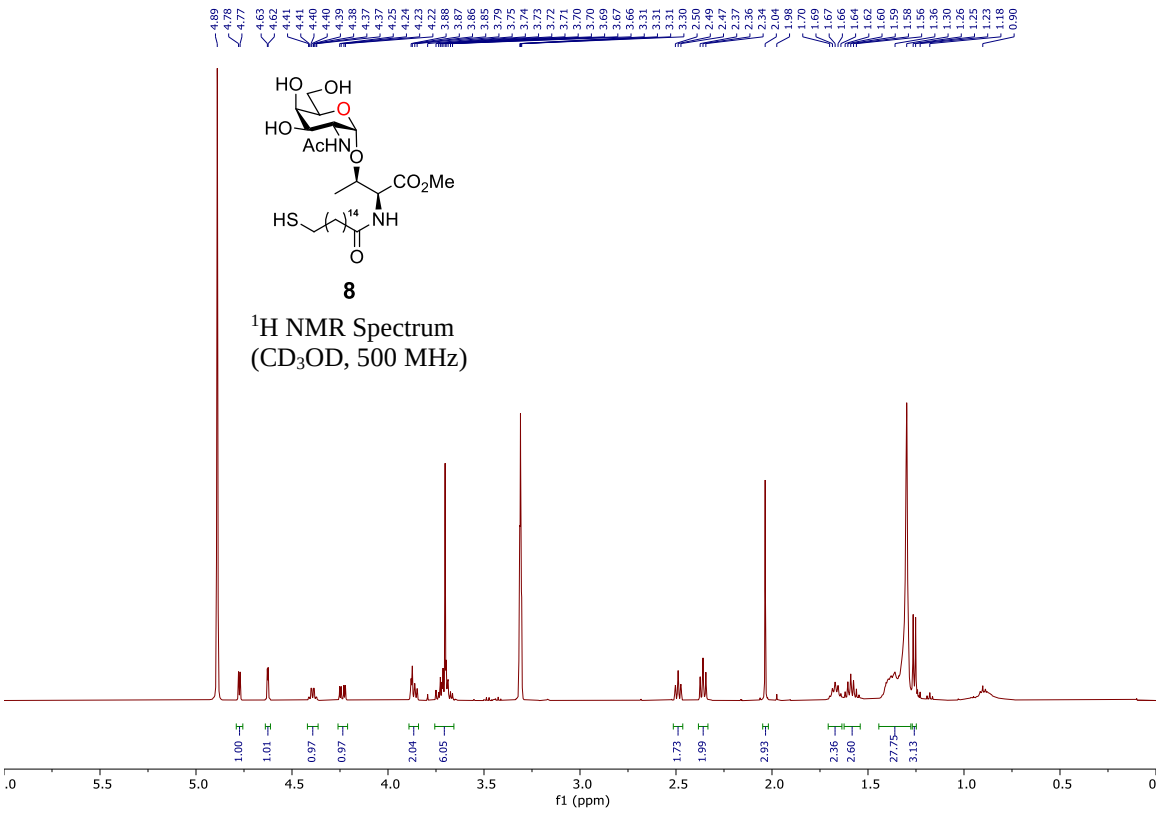
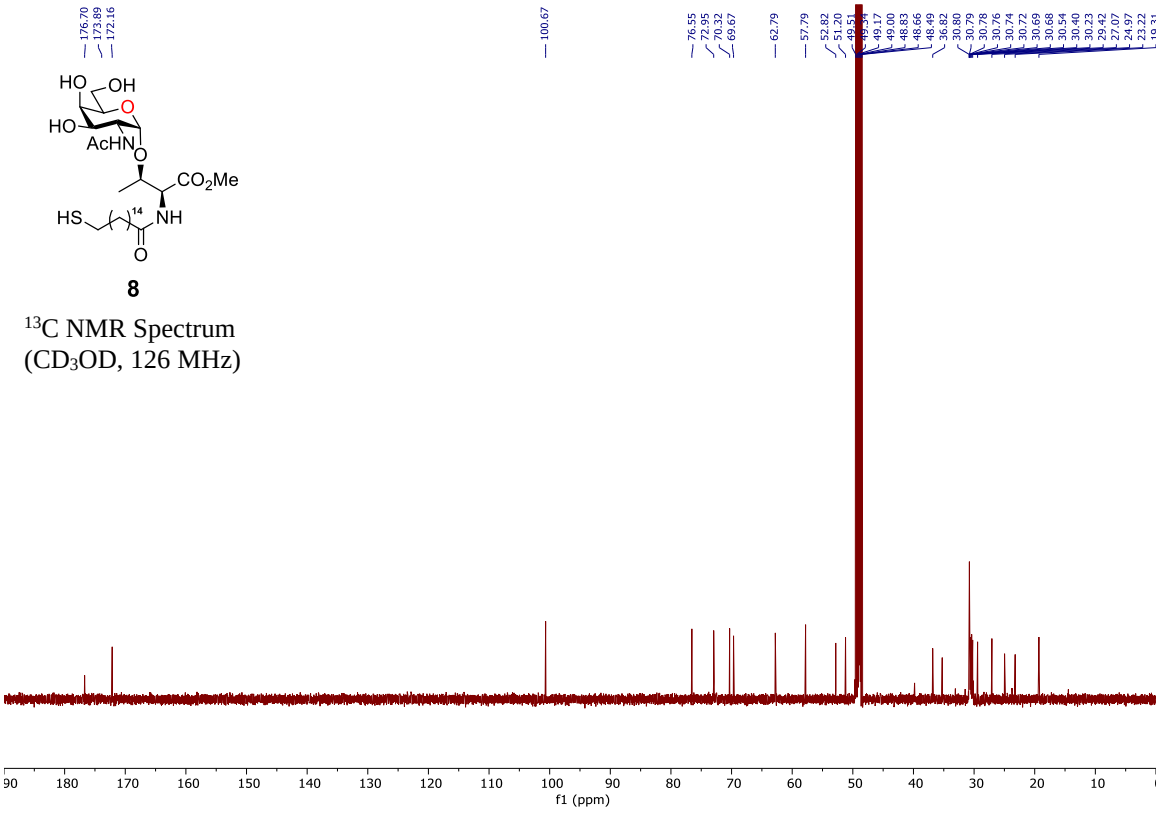
AcO
AcHN
O
CO2Me
AcS
14
NH
O
7
HSQC NMR Spectrum
f2 (ppm)
f1 (ppm)



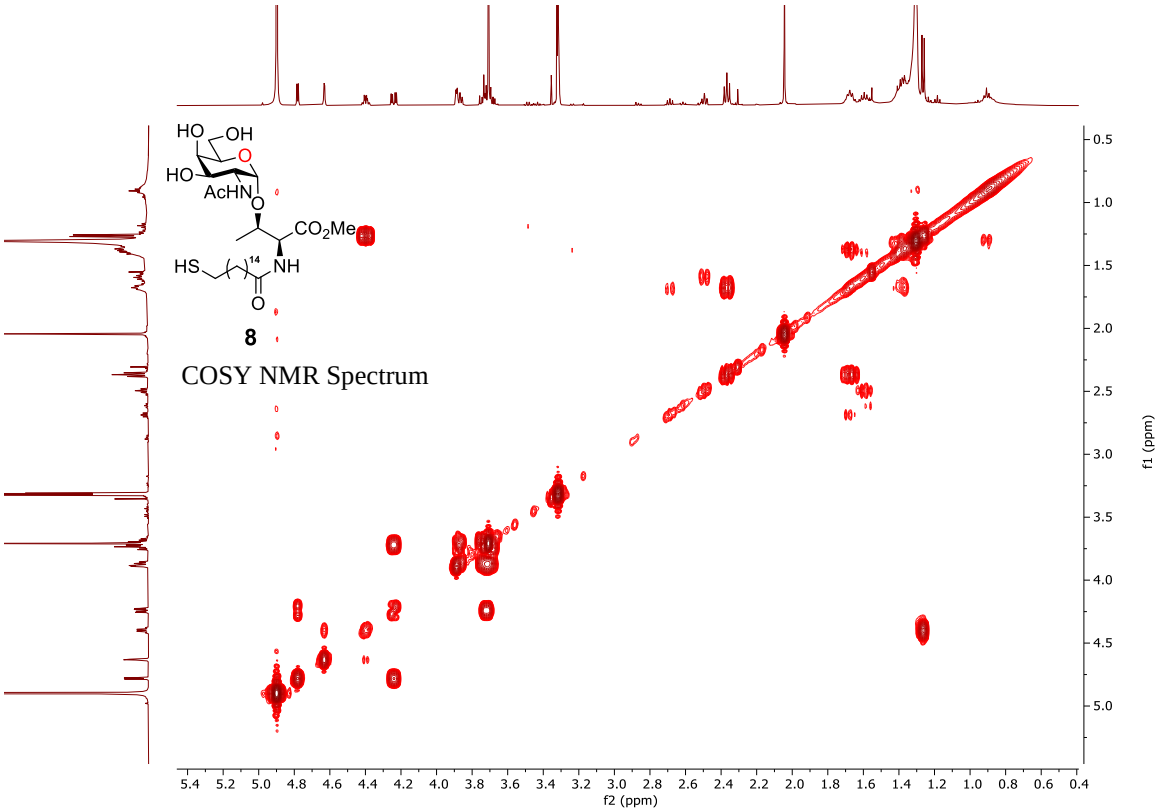
8

^{1}H NMR Spectrum
(CD_3OD, 500 MHz)



8

^{13}C NMR Spectrum
(CD_3OD, 126 MHz)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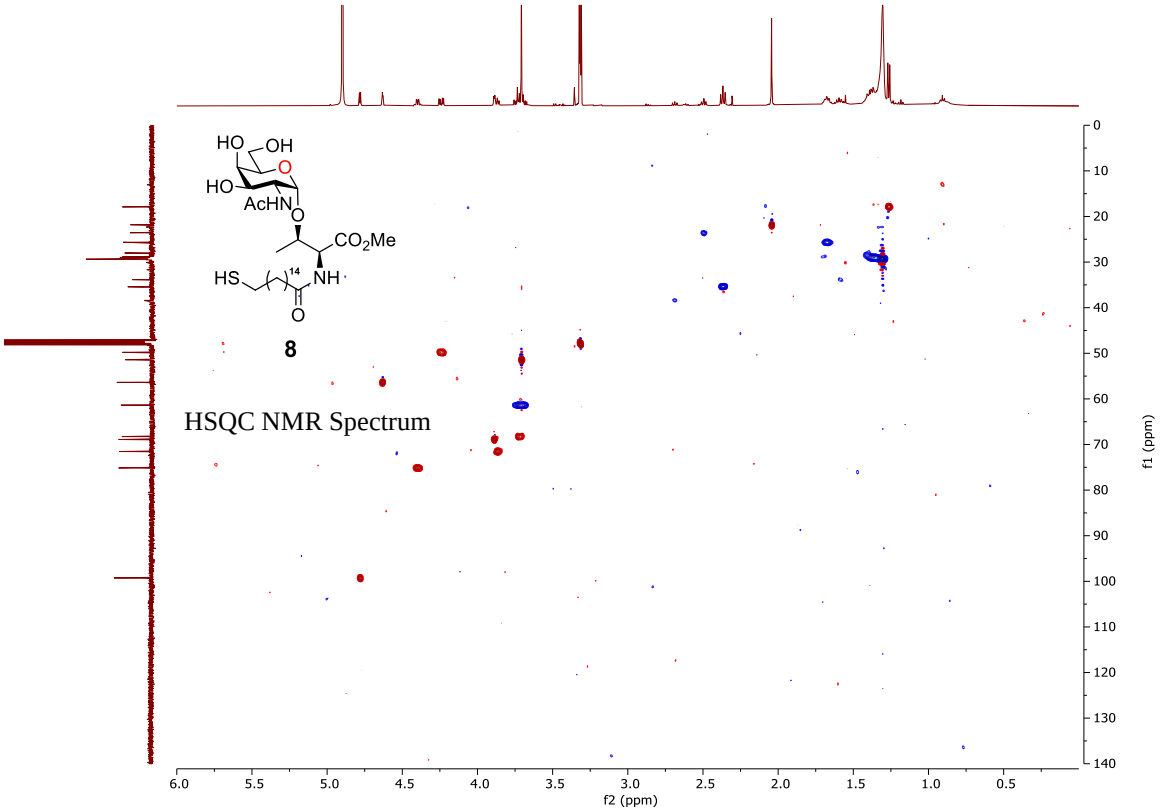
OH
O
HO
AcHN
O
CO2Me
HS
14
NH
O
8
COSY NMR Spectrum
f2 (ppm)
f1 (ppm)


HO
OH
O
HO
AcHN
O
CO2Me
HS
14
NH
O
8
HSQC NMR Spectrum
f2 (ppm)
f1 (ppm)

3. References

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