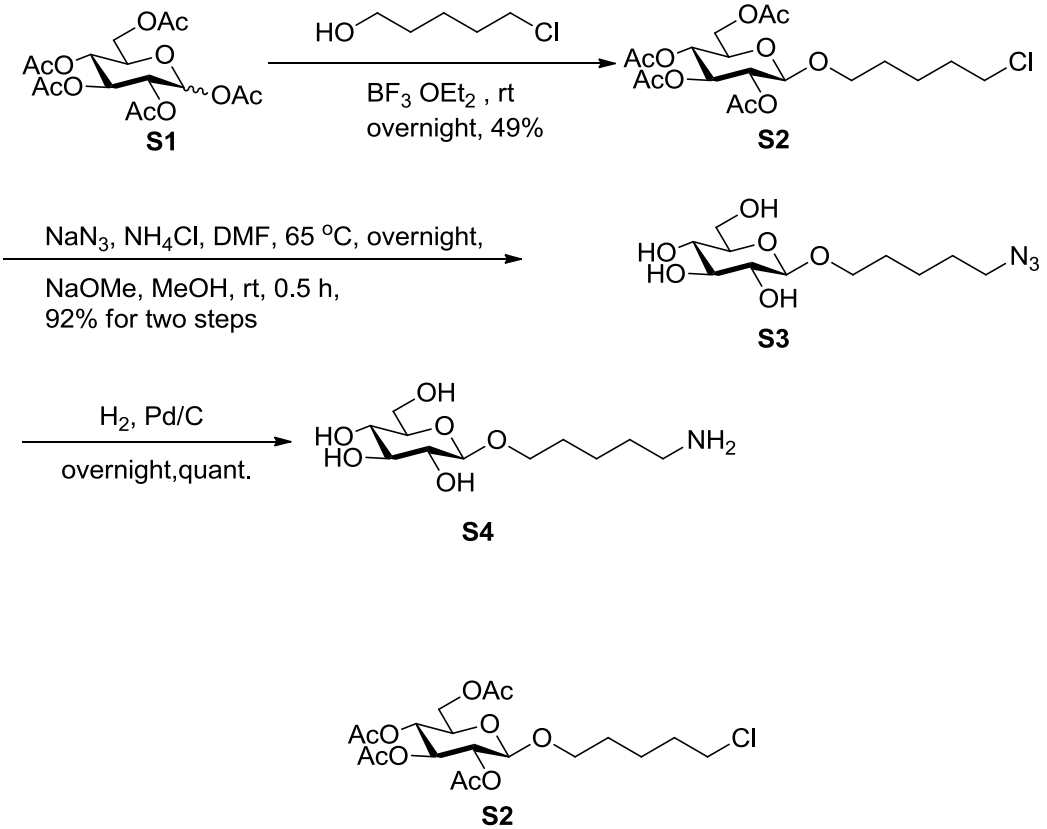
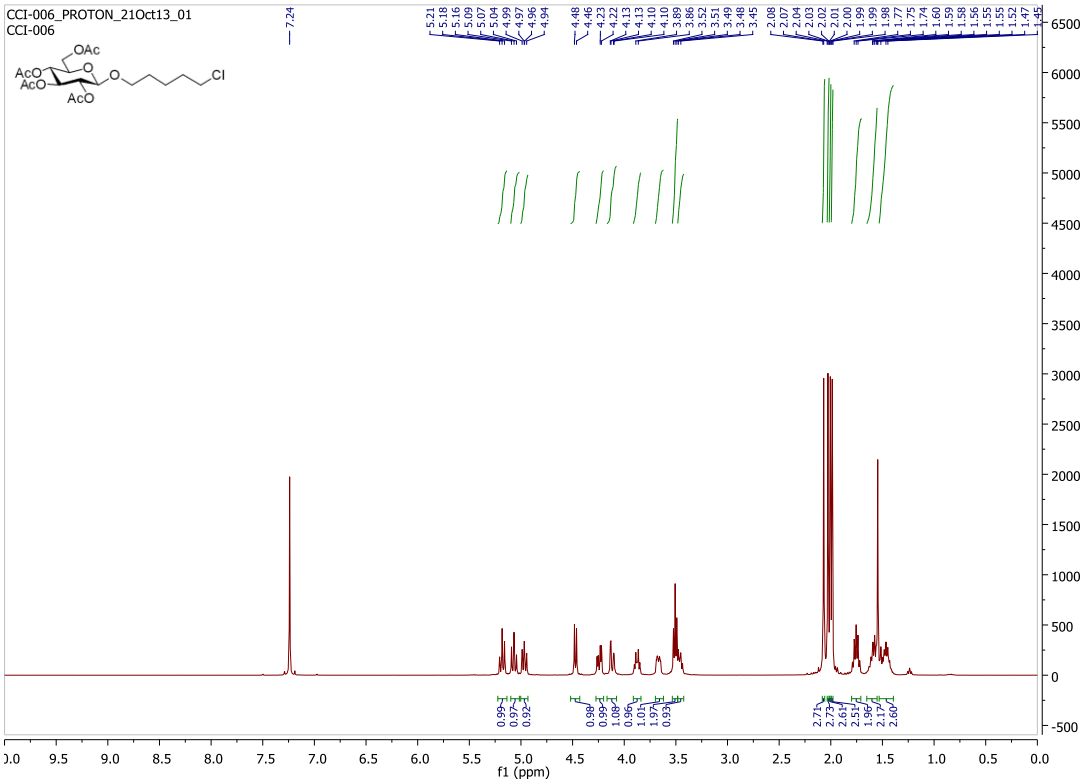
Scheme S1. Synthesis of glycose-amino ligand.



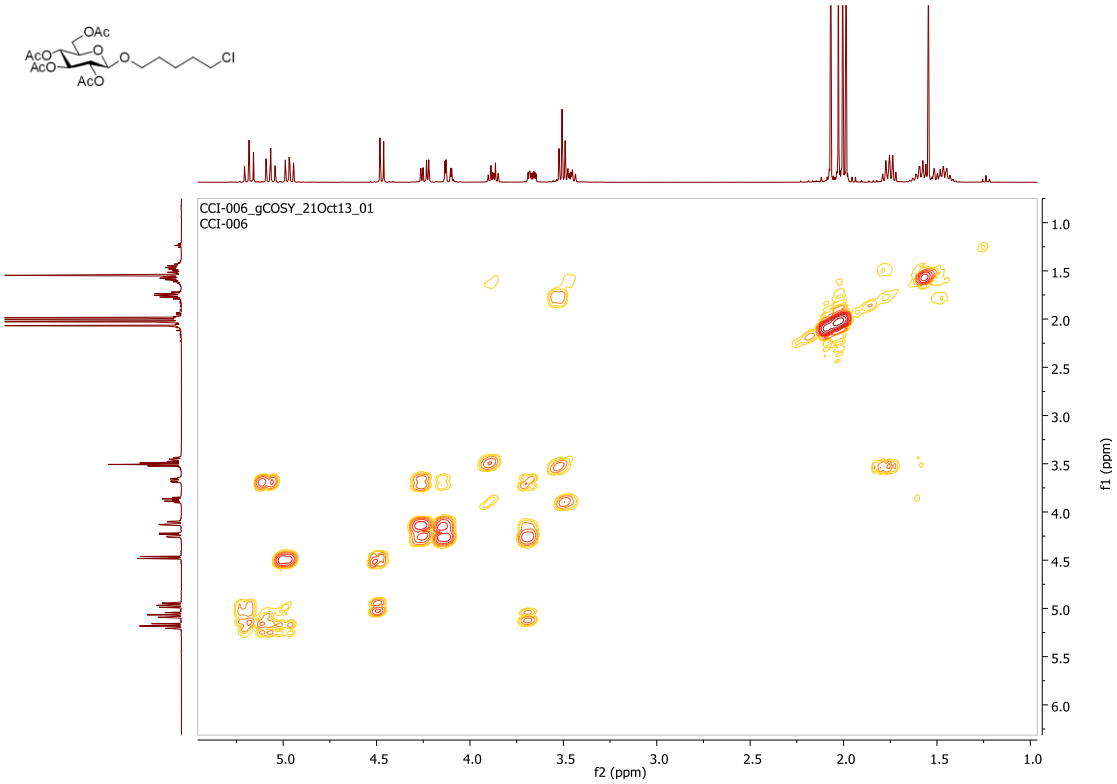
5-Chloro-1-pentyl-2,3,4,6-tetra-*O*-acetyl-ß-D-glucopyranoside S2

To a solution of penta-*O*-acetyl-ß-D-glucopyranoside **S1** (3.0 g, 7.69 mmol) and 5-chloropentan-1-ol (1.413 g, 11.53 mmol) in CH_2Cl_2 (77 mL) at 0 °C, BF_3 . OEt_2 (1.948 mL, 15.37 mmol) was added under Ar. The reaction mixture was allowed slowly to rt and reacted for 18 h. After 18 h of stirring, the reaction mixture was quenched with $NaHCO_3$, diluted with CH_2Cl_2, then and then washed with brine, dried over $MgSO_4$, filtered and concentrated in vacuum to give a residue, which was then purified by a flash silica gel column chromatography (EA/Hex, form 1/10 to 1/3) to provide product 5-Chloro-1-pentyl-2,3,4,6-tetra-*O*-acetyl-ß-D-glucopyranoside **S2** (1.7 g, 3.75 mmol, 49 % yield) R_f = 0.19 (EA/Hex, 1/3); ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.18 (t, *J* = 9.6 Hz, 1H, H-3), 5.07 (t, *J* = 9.7 Hz, 1H, H-4), 4.97 (dd, *J* = 9.6, 8.0 Hz, 1H, H-2), 4.47 (d, *J* = 8.0 Hz, 1H, H-1), 4.24 (dd, *J* = 12.2, 4.7 Hz, 1H, H-6), 4.12 (dd, *J* = 12.2, 2.4 Hz, 1H, H-6'), 3.88 (dt, *J* = 9.6, 6.0 Hz, 1H, OC*H*$_2$), 3.67 (ddd, *J* = 9.7, 4.7, 2.4 Hz, 1H, H-5), 3.51 (t, *J* = 6.6 Hz, 2H, C*H*$_2$Cl), 3.48 – 3.43 (m, 1H, OC*H*$_2$), 2.07 (s, 3H), 2.03 (s, 3H), 2.00 (s, 3H), 1.99 (s, 3H), 1.75 (m, 2H), 1.65 – 1.55 (m, 2H), 1.53 – 1.40 (m, 2H); ESI-MS ($C_{20}H_{33}ClO_{10}$): calcd for [M+NH_4] 470.2; found 470.2

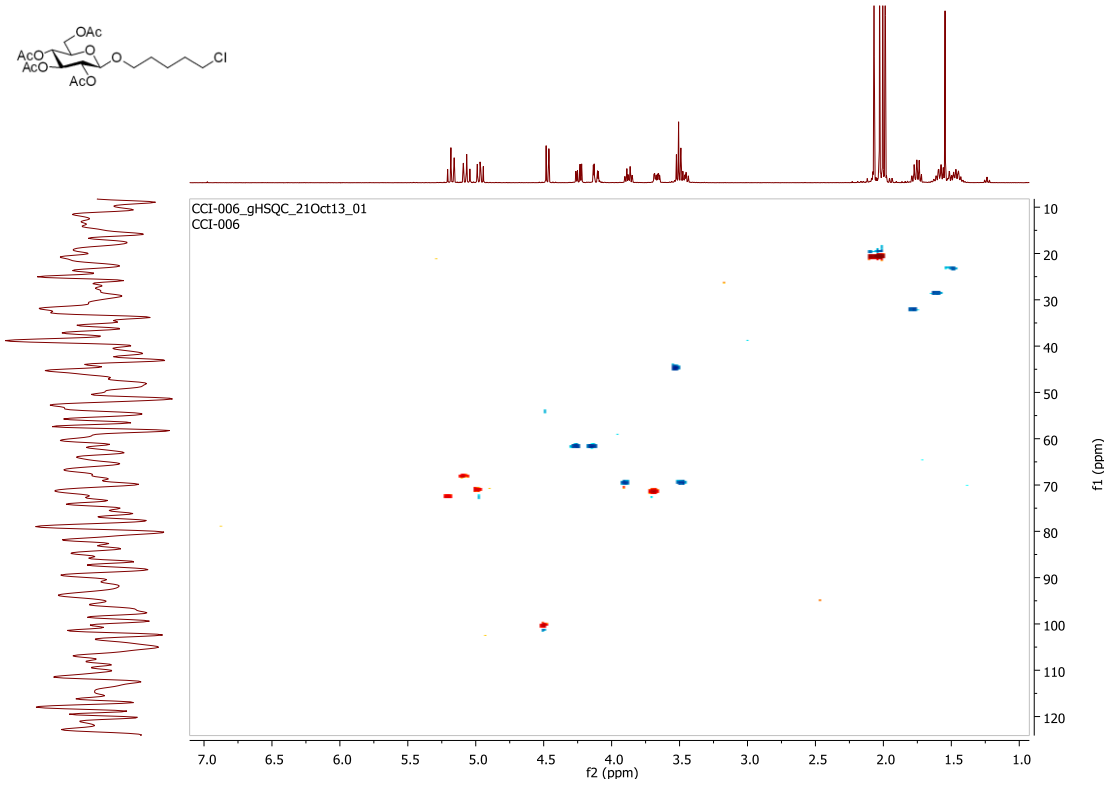
^{1}H NMR of S2 (400 MHz, $CDCl_3$)

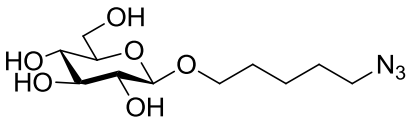


COSY NMR of S2 (400 MHz, $CDCl_3$)



HSQC NMR of S2 (400 MHz, $CDCl_3$)





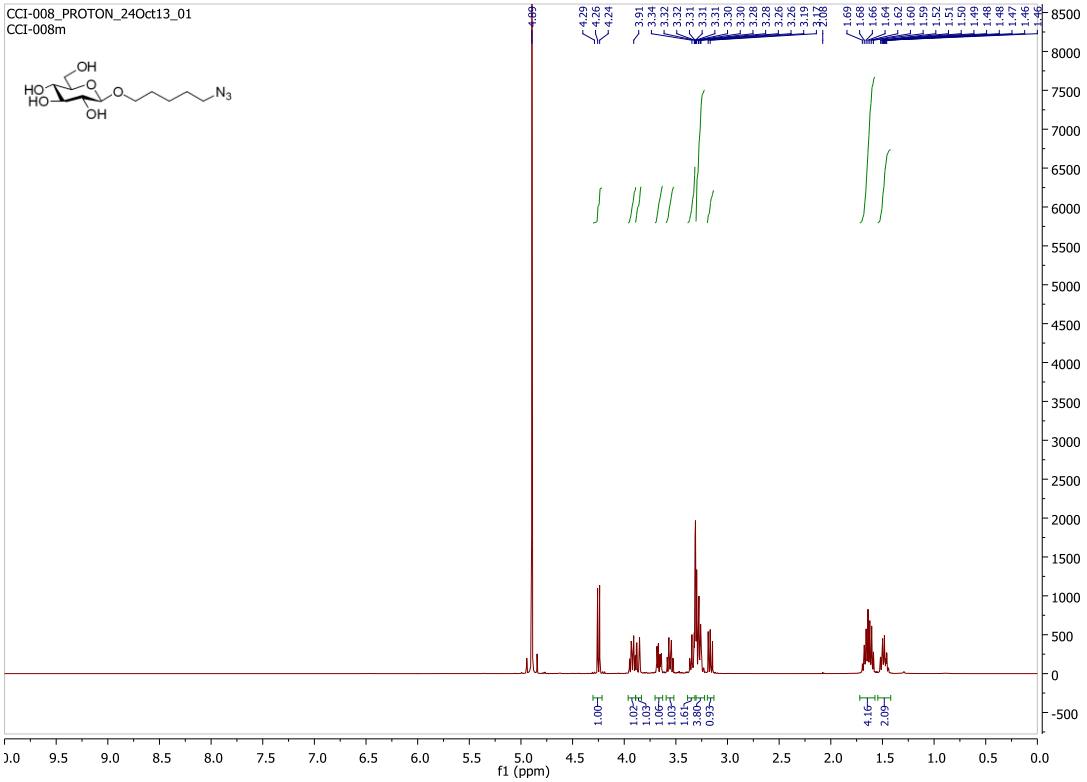
S3

5-Azido-1-pentyl-ß-D-glucopyranoside S3

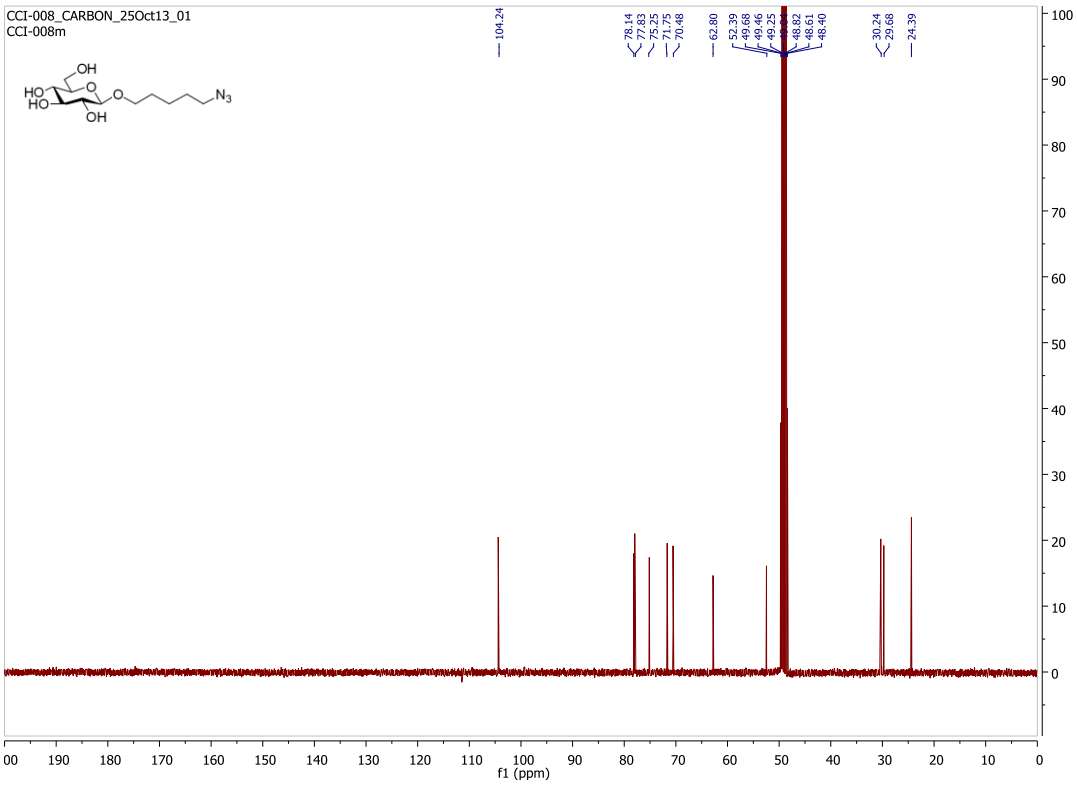
5-Chloro-1-pentyl-2,3,4,6-tetra-*O*-acetyl-ß-D-glucopyranoside **S2** (1.7 g, 3.75 mmol) , NaN_3 (2.440 g, 37.5 mmol) and NH_4Cl (0.402 g, 7.51 mmol) were dissolved in dry DMF (37.5 mL) at rt and allowed to stir for 18 h at 65 °C under Ar. After 18 h under stirring, the solvent was removed under vacuum. The reaction mixture was diluted with EA and then washed with H_2O twice and brine. The organic part was dried on $MgSO_4$. Without purification, R_f, 0.344 (EA/Hex, 1/2, same as SM). To a solution of 5-Azido-1-pentyl-2,3,4,6-tetra-O-acetyl-ß-D-glucopyranoside (1.7 g, 3.70 mmol) in dry MeOH (37,0 mL) at rt , NaOMe (0.20 g, 3.70 mmol) was added and allowed to stir for 1 h at rt under Ar. After the reaction was completed, the reaction mixture was neutralized with IR-120 (H^+). The residue was purified by silica gel column chromatography (EA/Hex 1/1 to EA/Hex/MeOH 1/1/0.15) to achieve the desired product 5-Azido-1-pentyl-ß-D-glucopyranoside **S3** (0.99 g, 3.40 mmol, 92 % yield); R_f,

0.375 (EA/Hex/MeOH, 1/1/0.2); $[\alpha]_D^{20}$ = -21.7 (c = 1.00, $CHCl_3$); IR (thin film) ν_{max} = 3476, 2936, 2872, 2098, 1455, 1077, 1035 cm^{-1}; ^1H NMR (400 MHz, CD_3OD) δ 4.25 (d, J = 7.8 Hz, 1H, H-1), 3.92 (dt, J = 9.8, 6.7 Hz, 1H, OC*H*$_2$), 3.89 – 3.83 (m, 1H, H-6), 3.66 (dd, J = 11.8, 5.4 Hz, 1H, H-6'), 3.56 (dt, J = 9.8, 6.7 Hz, 1H, OC*H*$_2$), 3.38-3.24 (m, 5H, H-3, H-4, H-5, C*H*$_2N_3$), 3.17 (dd, J = 9.0, 7.8 Hz, 1H, H-2), 1.74 – 1.53 (m, 4H), 1.54 – 1.40 (m, 2H); ^{13}C NMR (101 MHz, CD_3OD) δ 104.24 (C-1), 78.14, 77.83, 75.25 (C-2), 71.75 (O*C*H_2), 70.48 (C-6), 62.80 (*C*H_2N_3), 30.24, 29.68, 24.39; ESI-HRMS ($C_{11}H_{21}N_3O_6Na$): calcd for [M+Na] 314.1328; found 314.1317.

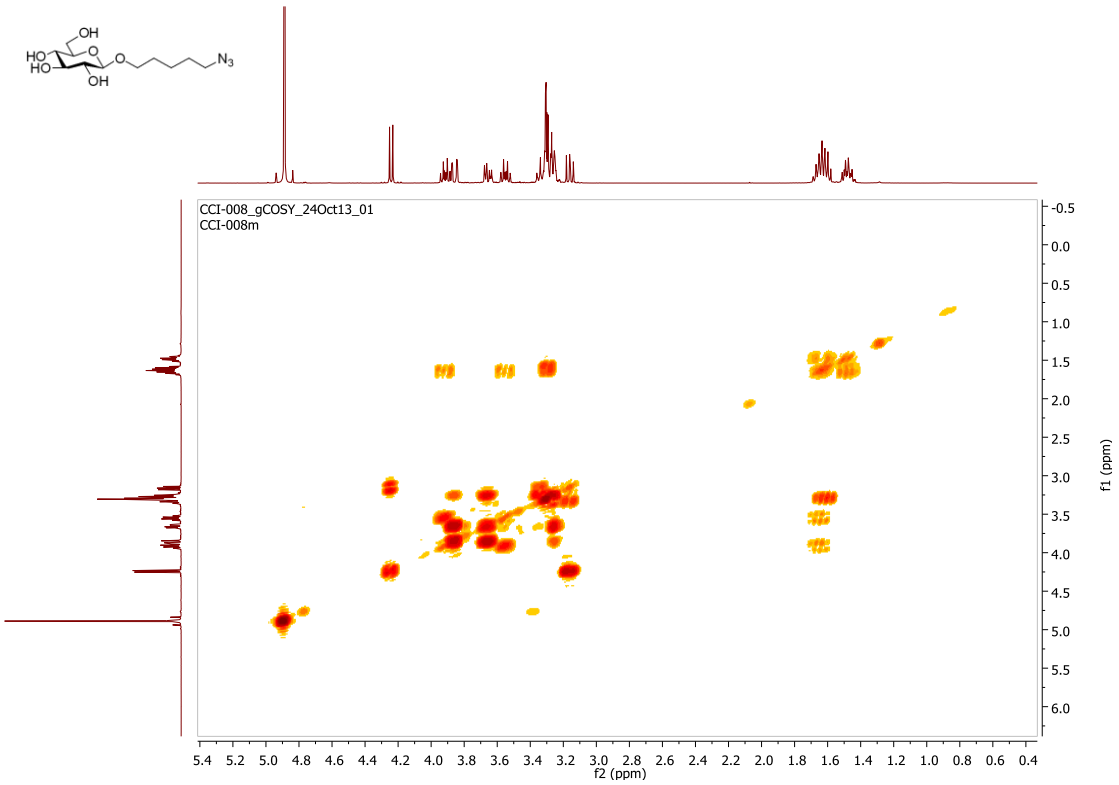
^1H NMR of S3 (400 MHz, $CDCl_3$)



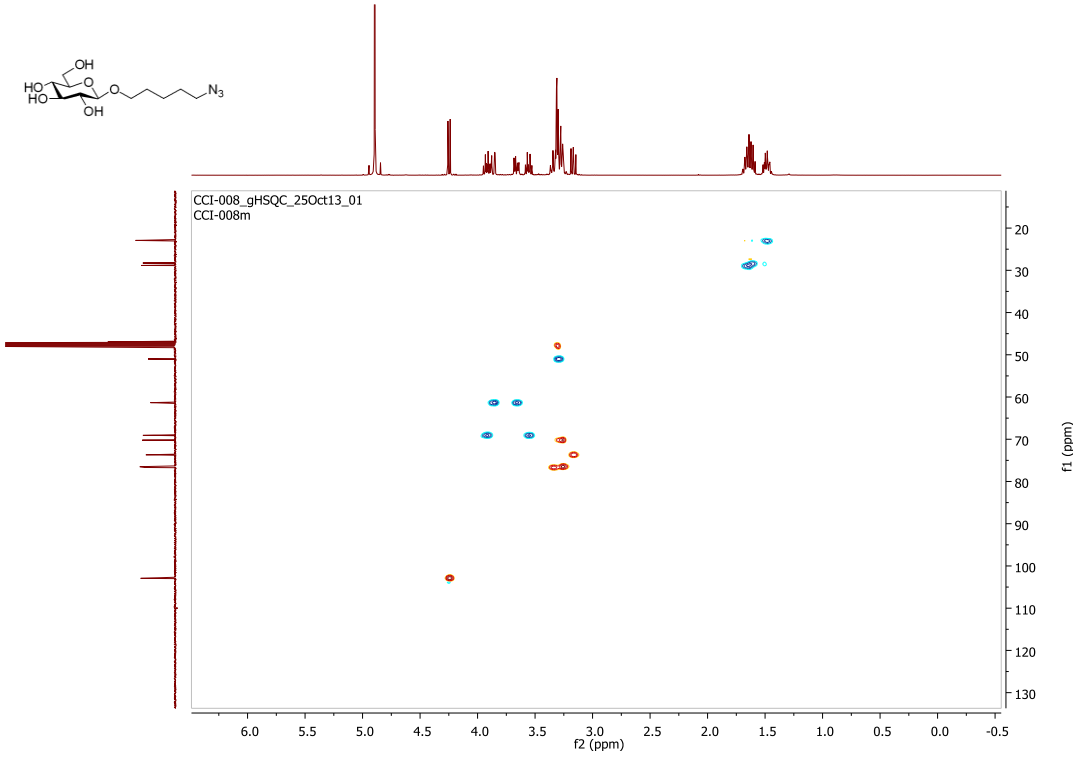
^{13}C NMR of S3 (101 MHz, $CDCl_3$)

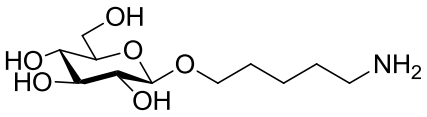


COSY NMR of S3 (400 MHz, $CDCl_3$)



HSQC NMR of S3 (400 MHz, $CDCl_3$)



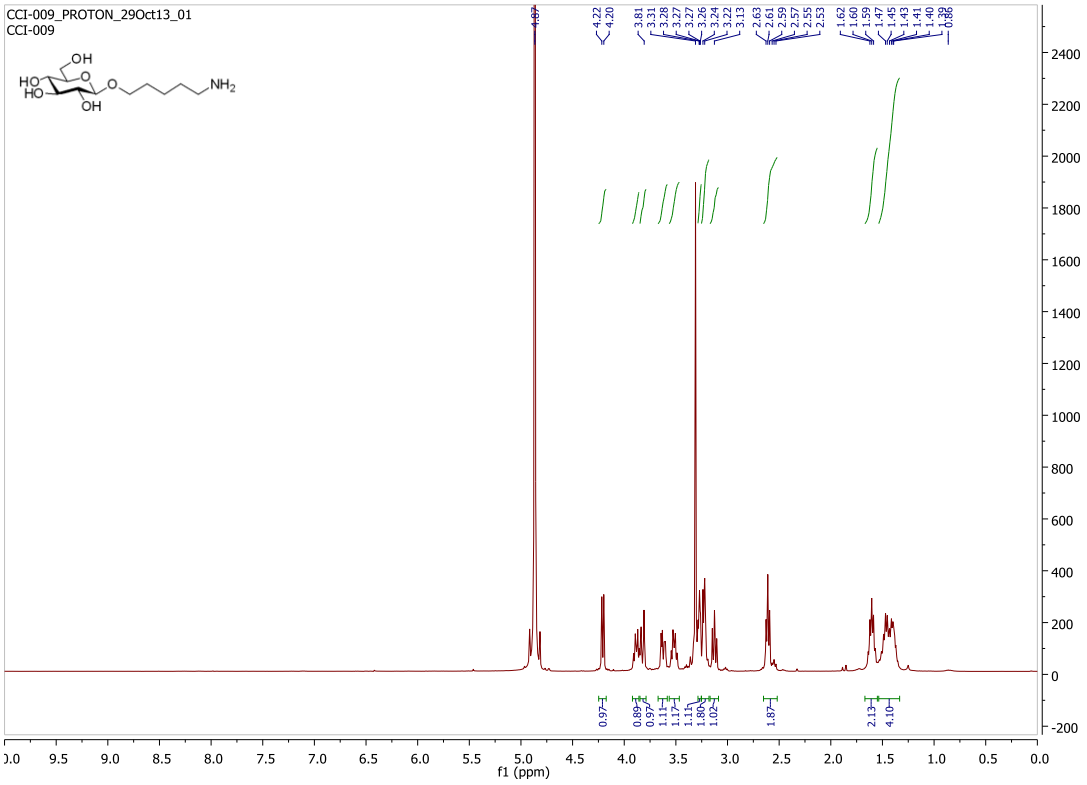


S4

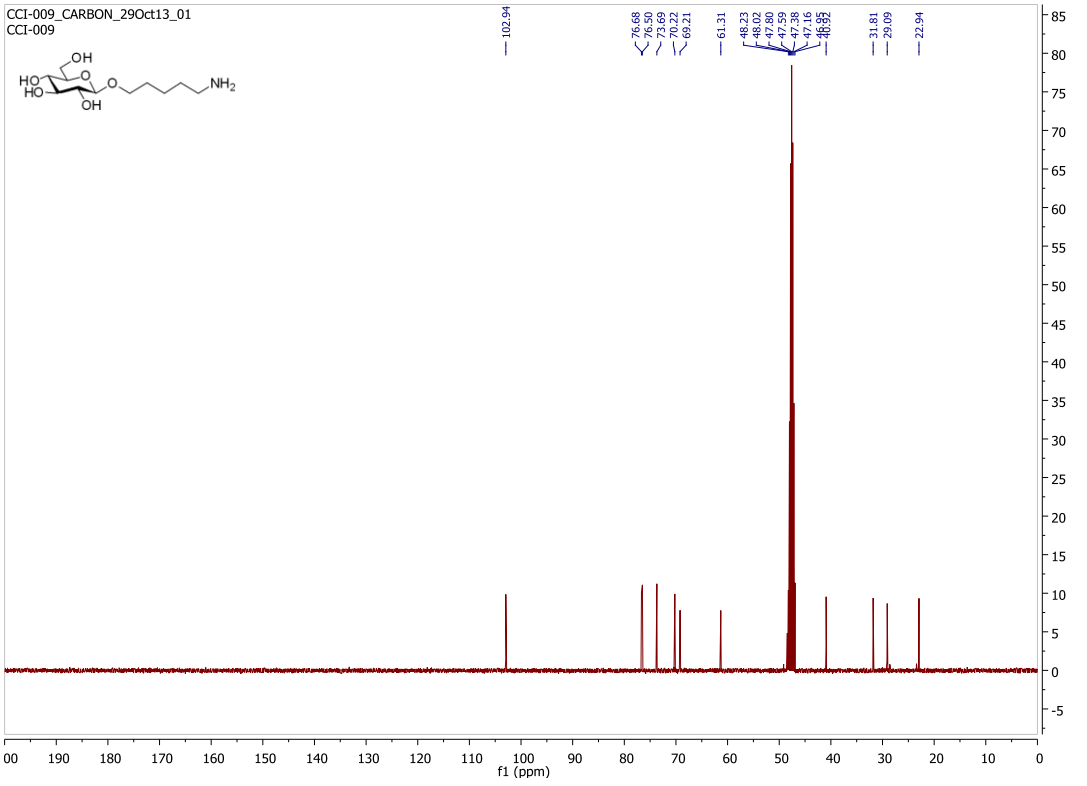
5-Amino-1-pentyl-ß-D-glucopyranoside S4

Methanol (10 mL) was added in a ground flask with 5-Azido-1-pentyl-ß-D-glucopyranoside **S3** (440 mg, 1,510 mmol) and 10% Pd/C (48 mg). The reaction mixture was purged with H_2 and allowed for overnight. The catalyst was removed by filtration through a pad of celite. The filtrate was concentrated to give 5-Amino-1-pentyl-ß-D-glucopyranoside **S4** (400 mg, 1.508 mmol, quant). $[\alpha]_D^{20}$ = -26.3 (c = 1.00, CH_3OH); IR (thin film) ν_{max} = 3362, 2924, 2861, 1568, 1459, 1078, 1037 cm^{-1}; ^1H NMR (400 MHz, CD_3OD) δ 4.21 (d, J = 7.8 Hz, 1H, H-1), 3.88 (dt, J = 9.6, 6.6 Hz, 1H, OC*H*$_2$), 3.82 (dd, J = 11.7, 1.8 Hz, 1H, H-6), 3.62 (dd, J = 11.7, 5.4 Hz, 1H, H-6'), 3.52 (dt, J = 9.6, 6.6 Hz, 1H, OC*H*$_2$), 3.29 – 3.25 (m, 1H, H-4), 3.25 – 3.20 (m, 2H, H5, H-3), 3.13 (t, J = 8.5 Hz, 1H, H-2), 2.61 (t, J = 6.9 Hz, 2H, C*H*$_2$$NH_2$), 1.66 – 1.54 (m, 2H), 1.53 – 1.34 (m, 4H); ^{13}C NMR (101 MHz, CD_3OD) δ 102.94 (C-1), 76.68, 76.50, 73.69 (C-2), 70.22, 69.21 (O*C*H_2), 61.31(C-6), 40.92 (*C*H_2NH_2), 31.81, 29.09, 22.94; ESI-HRMS ($C_{11}H_{24}NO_6$): calcd for [M+H] 266.1604; found 266.1608.

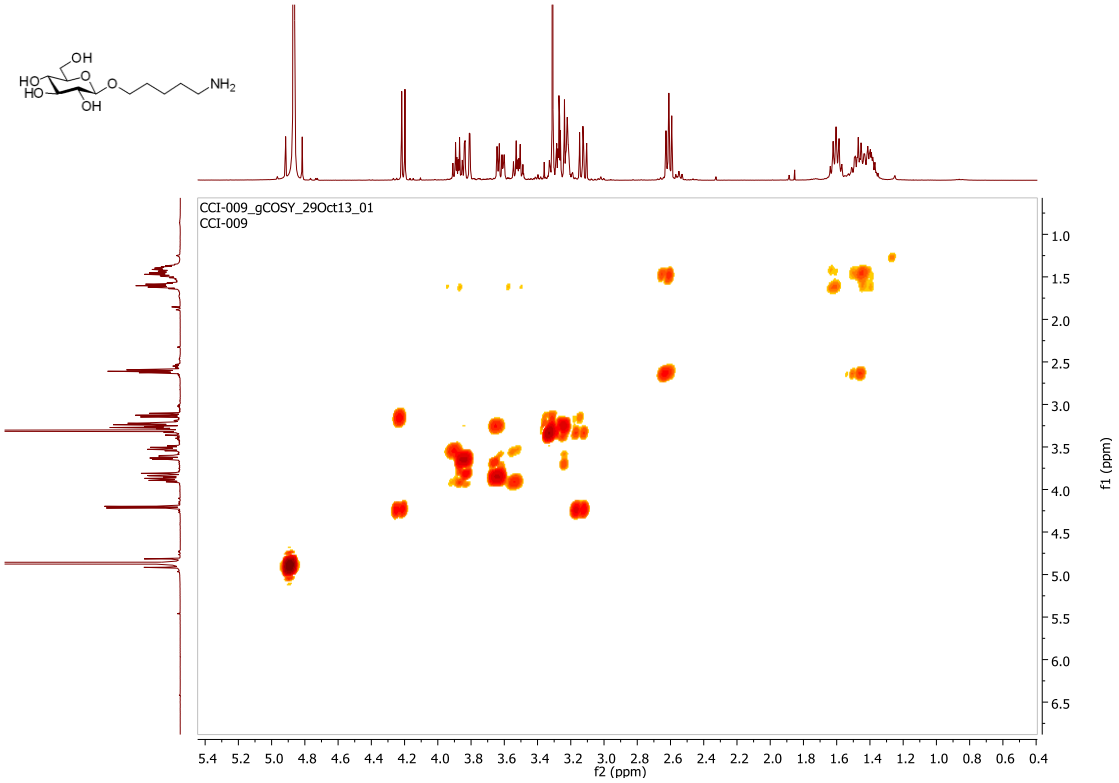
^{1}H NMR of S4 (400 MHz, $CDCl_3$)



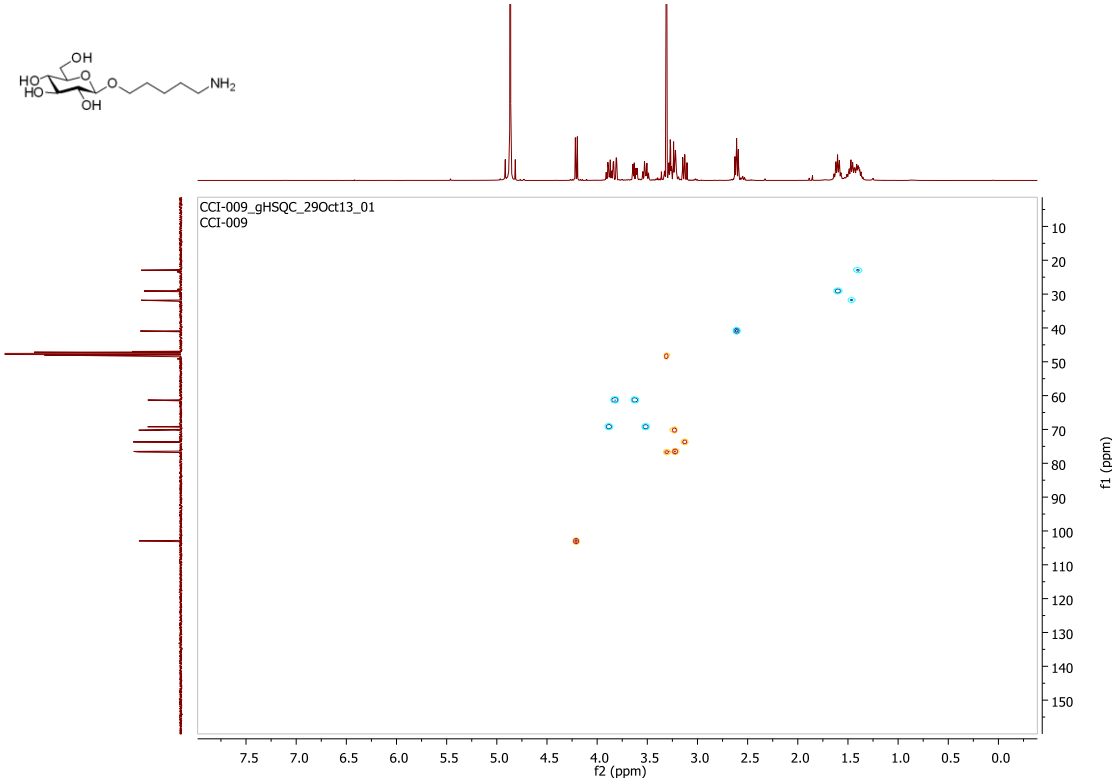
^{13}C NMR of S4 (101 MHz, $CDCl_3$)



COSY NMR of S4 (400 MHz, $CDCl_3$)



HSQC NMR of S4 (400 MHz, $CDCl_3$)



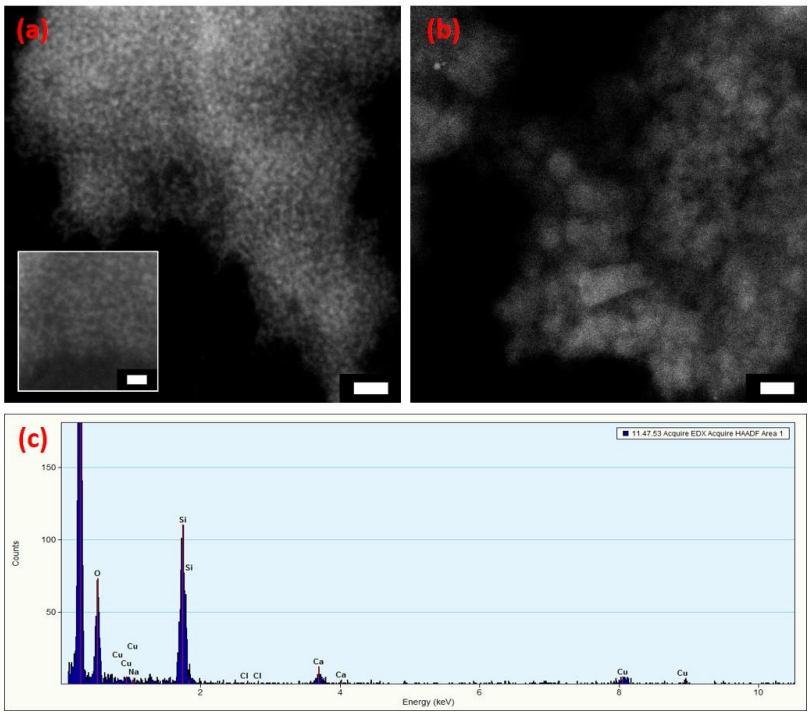


Figure S1. (a) STEM imaging of Si-COOH NPs. (b) STEM imaging of Si-Glc NPs. (c) EDX analysis of Si-Glc NPs. Scale bar: 20 nm. Inset scale bar: 10 nm.

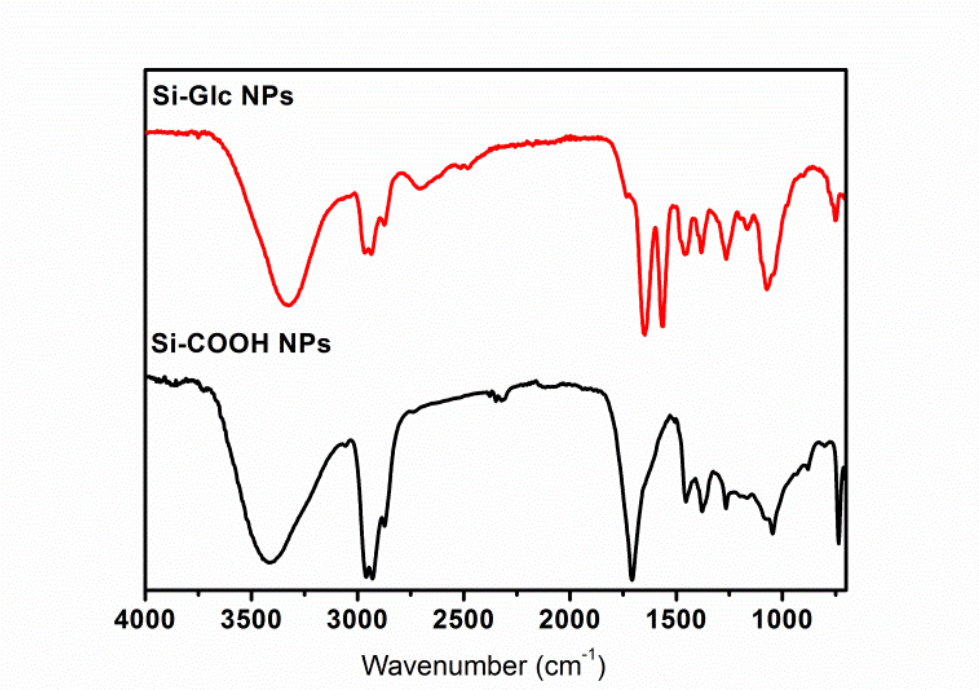


Figure S2. FT-IR spectra of Si-COOH and Si-Glc NPs.

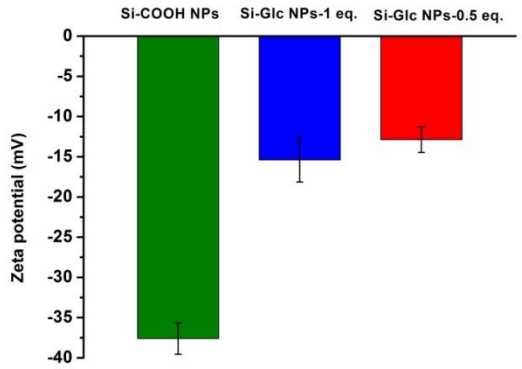


Figure S3. Zeta potential of Si-COOH NPs (-37.6±1.9 mV), Si-Glc NPs-1 eq. (-15.4±2.8 mV), and Si-Glc NPs-0.5eq. (-12.9±1.6 mV).

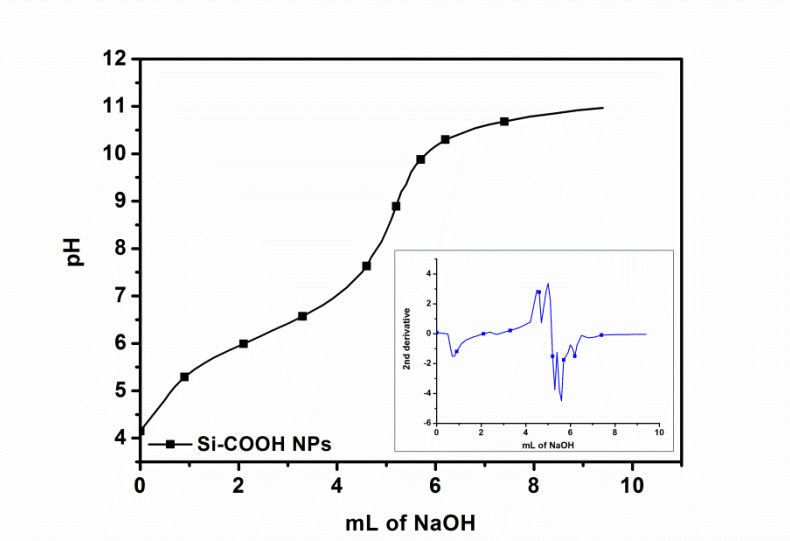


Figure S4. Acid-base titration of Si-COOH NPs. (inset: 2nd derivative vs V_{NaOH})

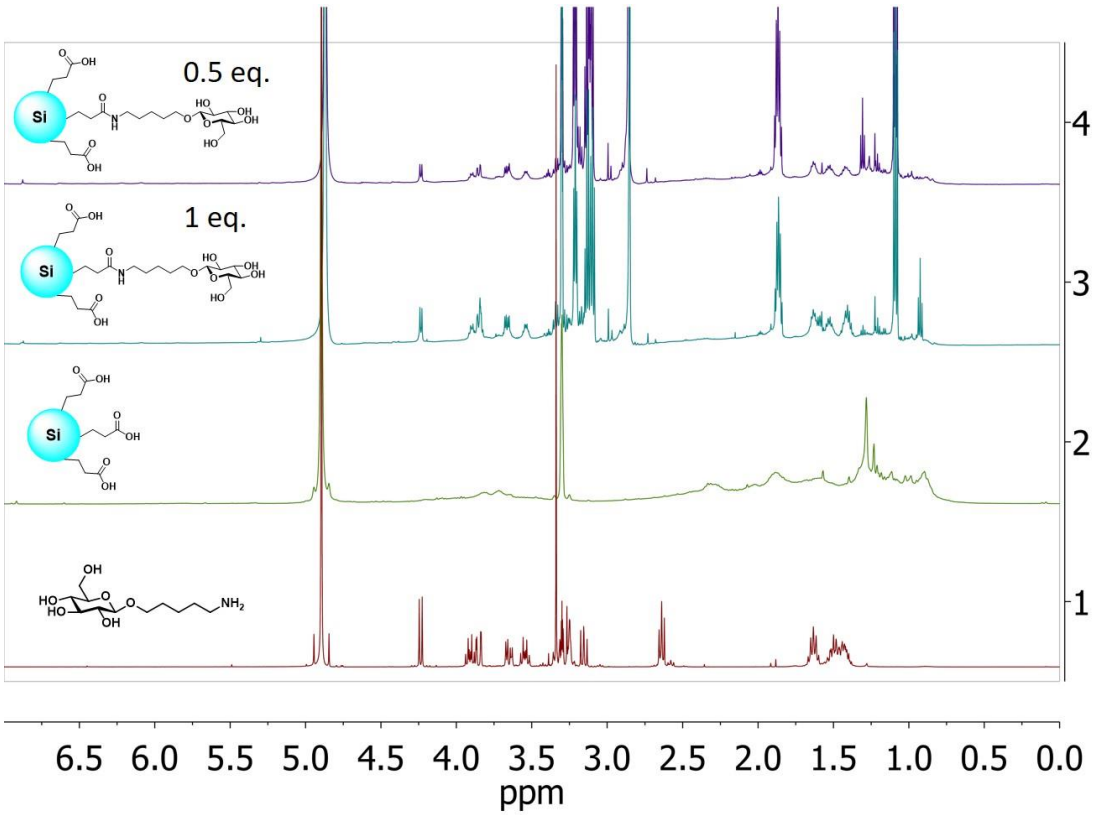


Figure S5. ^{1}H NMR spectra of sugar ligand (S4), Si-COOH NPs, Si-Glc NPs (1 eq. and 0.5 eq. of sugar).

The calculation of amount of glucose on Si NPs

We used $CDCl_3$ as internal standard for calculating the amount of glucose on the Si NPs. 100 μL $CDCl_3$ (99.8% D atom) was added into Si-Glc NPs samples and the integration value of ^{1}H NMR showed the ratio between $CHCl_3$ and H_{C1} from glucose. According to this ratio, we can quantify the amount of glucose and also calculate the coverage on Si NPs. As a result, 71.8% of glucose attached when we used 1 eq. of glucose, and 32.6% cover when using 0.5 eq. of glucose.[1]

Table S1. The amount of glucose on Si NPs

	μmol of Glc/mg of Si NPs	% of glucose on Si NPs
Si-Glc NPs-1 eq.	0.840	71.8%
Si-Glc NPs-0.5 eq.	0.381	32.6%

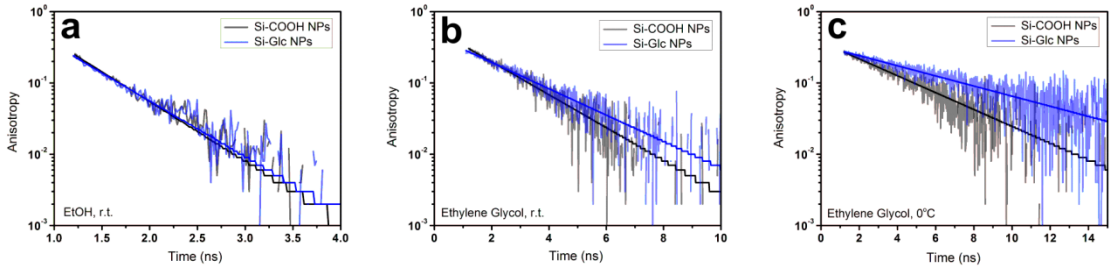


Figure S6. Comparison of the anisotropy decay of Si-Glc NPs in (a) MeOH, rt, (b) ethylene glycol, rt, (c) ethylene glycol, 0°C.

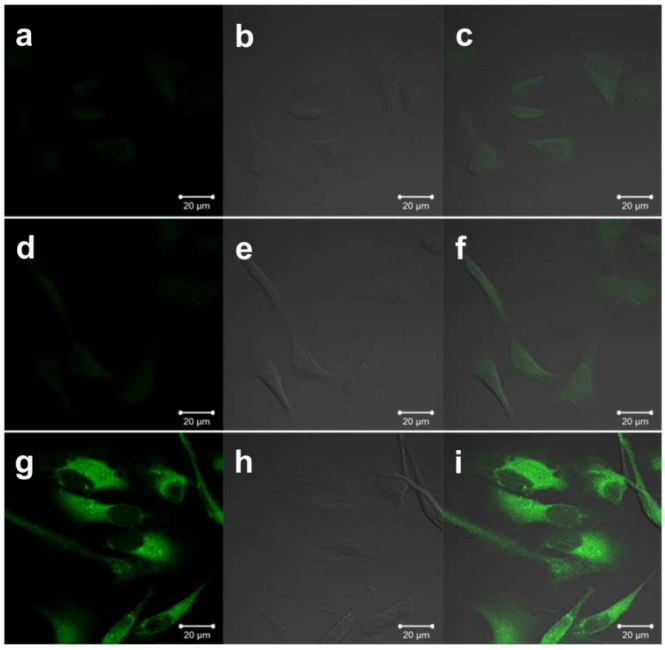


Figure S7. Confocal imaging of 100 µg/ mL Si-COOH NPs incubated with HeLa cells for (a) 1 hour (d) 4 hours (g) 24 hours. Scale bar : 20 µm, false colors.

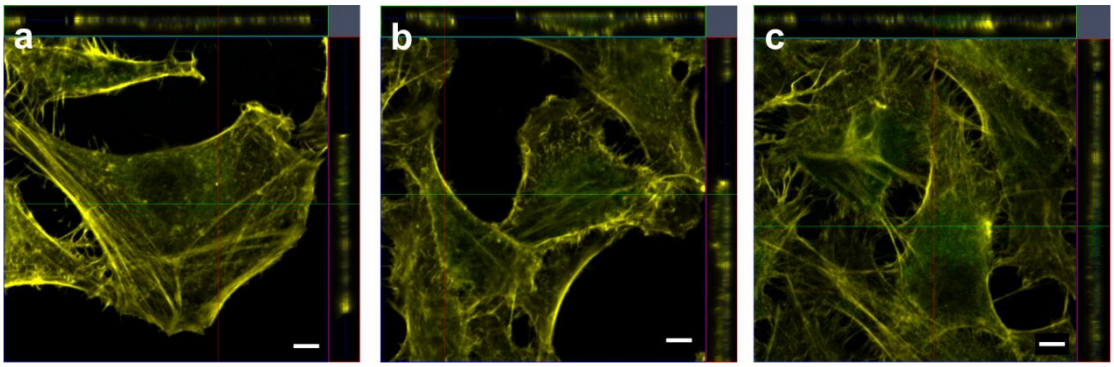


Figure S8. Z-stack of Si-COOH NPs after: (a) 1 hour, (b) 4 hours, (c) 24 hours incubation. Scale bar: 5 µm, false color.

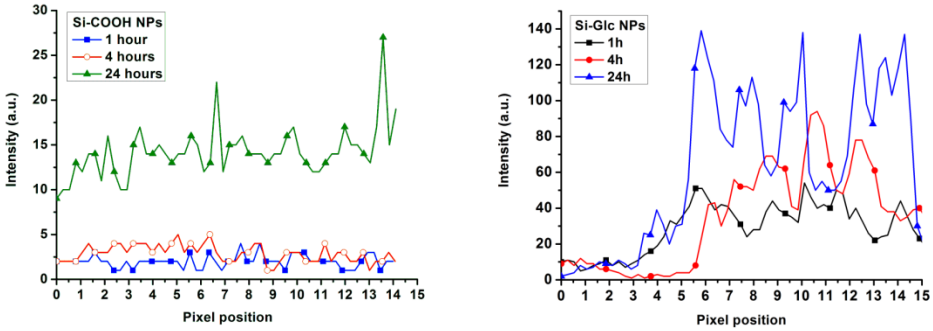


Figure S9. Intensity profile of Si NPs incubated with HeLa cells for 1, 4 and 24 hours. (left) Si-COOH NPs, (right) Si-Glc NPs.

Reference

[1] Correspond to ref [12f] in the manuscript: Chian-Hui Lai, Julia Hütter, Chien-Wei Hsu, Hidenori Tanaka, Luisa De Cola, Bernd Lepenies, Peter H. Seeberger *Nano Letters*, **2016**, *16*, 807-811