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Supporting Information

Heptylmannose-functionalized cellulose for the binding and specific detection of E.coli pathogen.

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General Methods. All reagents were purchased from Acros Organics or Aldrich and were used without further purification. Whatman grade 6 filter paper (42.5 mm Ø) with a grammage of *ca*. 100 g/m^2 was used as cellulose source. All compounds were fully characterized by ^{1}H (400.133 or 300.135 MHz), ^{13}C (125.773 or 75.480 MHz) NMR spectroscopy (Bruker Avance 300 Ultra Shield or Bruker Avance III 400 spectrometer). When needed, ^{13}C heteronuclear HMQC and HMBC were used to unambiguously establish structures. High-resolution mass spectra (HRMS) were recorded with a Thermofisher hybrid LTQ-orbitrap spectrometer (ESI +) and a Bruker Autoflex III SmartBeam spectrometer (MALDI). FT-IR spectra were recorded on a Bruker Tensor 27 spectrometer with ATR technic and KBr tablet method. Elemental analyses were performed on a Thermo Fisher Scientific Flash 2000 CHNS organic elemental analyzer. Centrifugations were performed on a Sigma 3-16 Centrifuge. Dialysis were performed with Spectra/Por dialysis membrane MWCO 3500 K.

1- Chemical synthesis of compounds **3**, **4**

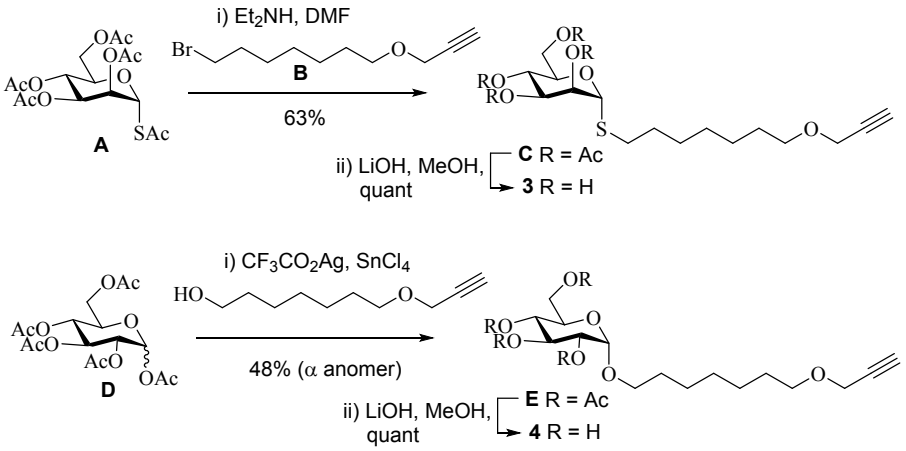
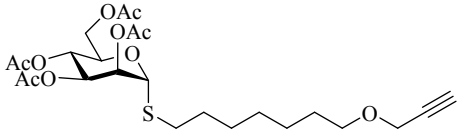


Figure S1. Chemical synthesis of compound **3** and **4**.

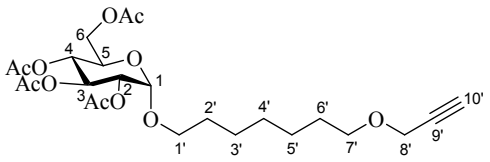
7-Propargyloxyheptyl 1-thio-2,3,4,6-tetra-O-acetyl-α-D-mannopyranoside (C)



To a solution of **A**[1] (402 mg, 0.995 mmol) and **B**[2] (277 mg, 1.194 mmol) in DMF (41 mL), diethylamine (1.1 mL, 10.8 mmol) was added and the mixture was stirred overnight at room temperature under argon atmosphere. The mixture was evaporated under reduced pressure. The residue was purified by column chromatography (80/20 EP - EtOAc) to give **C** as a colorless oil (321 mg, 63%). The analysis data is consistent with literature.[1]

1 D. Alvarez Dorta, A. Sivignon, T. Chalopin, T. I. Dumych, G. Roos, R. O. Bilyy, D. Deniaud, E.-M. Krammer, J. de Ruyck, M. F. Lensink, J. Bouckaert, N. Barnich and S. G. Gouin, *ChemBioChem*, 2016, **17**, 936–952.
2 P. A. Procopiou, V. J. Barrett, N. J. Bevan, K. Biggadike, P. R. Butchers, D. M. Coe, R. Conroy, D. D. Edney, R. N. Field, A. J. Ford, S. B. Guntrip, B. E. Looker, I. M. McLay, M. J. Monteith, V. S. Morrison, P. J. Mutch, S. A. Richards, R. Sasse and C. E. Smith, *J. Med. Chem.*, 2009, **52**, 2280–2288.

8-Oxaundec-10-ynyl 2,3,4,6-tetra-O-acetyl-α-D-glucopyranoside (E)



Glucosyl pentaacetate **D** (200 mg, 0.51 mmol), 8-oxaundec-10-yn-1-ol (131 mg, 0.77 mmol) and silver trifluoroacetate (169 mg, 0.77 mmol) were dissolved in dry dichloromethane (3 mL). A solution of $SnCl_4$ 1M in dichloromethane (1.53 mL) was added and the mixture was stirred at room temperature for 3 h under argon atmosphere. The solution was diluted with 10 mL of $NaHCO_3$ (aq) sat. and 10 mL of dichloromethane and the mixture was stirred for 15 min. The mixture was filtrered through a pad of celite, the organic layer was separated and washed with $NaHCO_3$ (aq) sat. (2×10 ml). The organic layer was dried over $MgSO_4$ and concentrated under reduced pressure. The residue was purified by column chromatography (8/2 petroleum spirits–ethyl acetate) to give **E** (90 mg, 36%) as a yellowish oil. This procedure allows the formation of the α-anomer.

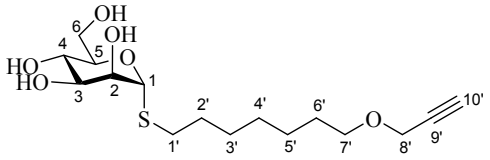
$[\alpha]^{26}_D$ +100 (c 1 ; CH_2Cl_2); ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm): 5.46 (t, J = 9.7 Hz, 1H, H-3), 5.04 (d, J = 3.8 Hz, 1H, H-1), 5.03 (t, 1H, H-4), 4.83 (dd, $J_{2,1}$ = 3.8 Hz, 1H, H-2), 4.24 (dd, $J_{6a,6b}$ = 12.3 Hz, $J_{6a,5}$ = 4.6 Hz, 1H, H-6a), 4.11 (d, J = 2.4 Hz, 2H, H-8'), 4.07 (dd, $J_{6b,5}$ = 2.3 Hz, 1H, H-6b), 3.99 (m, 1H, H-5), 3.65 (m, 1H, H-7'a), 3.50 (t, J = 6.7 Hz, 2H, H-1'), 3.40 (m, 1H, H-7'b), 2.40 (t, J = 2.4 Hz, 1H, H-10'), 2.07, 2.04, 2.01, 1.99 (four s, 12H, -CH_3), 1.63-1.54 (m, 4H, H-2', H-4'), 1.40-1.30 (m, 6H, H-3', H-5', H-6'); ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm): 170.73, 170.28, 170.21, 169.73 (-C=O), 95.79 (C-1), 80.17 (C-9'), 74.18 (C-10'), 71.10 (C-2), 70.42 (C-3), 70.25 (C-1'), 68.83 (C-4, C-7'), 67.30 (C-5), 62.11 (C-6), 58.13 (C-8'), 29.56, 29.31, 29.21 (C-2',C-4', C-6'), 26.17, 26.08 (C-3',C-5'), 20.08, 20.77, 20.73 (-CH_3); HRMS: m/z calcd for $C_{24}H_{40}NO_{11}$ $[M+NH_4]^+$calc : 518.2601, found 518.2608.

General procedure for deacetylation

Acetylated compound was placed in MeOH (10 mL for 1 mmol) with lithium hydroxide (0.5 eq) and the solution was stirred for 1 hour. Water (3 mL for 1 mmol) was added and the mixture stirred for another 30 minutes. Dowex-50 resin was added until pH reached 7. The mixture was filtered through a fritted funnel and concentrated under reduced pressure to yield the deacetylated compound in quantitative yield.

7-Propargyloxyheptyl 1-thio-α-D-mannopyranoside (3)

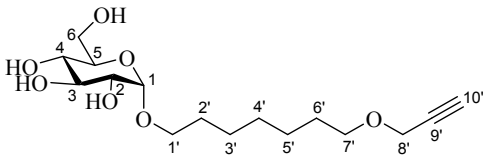
Compound **11** was obtained in quantitative yield (338 mg) by deacetylation of **7** (500 mg, 0.969 mmol) following general procedure for deacetylation.



$[\alpha]^{26}_D$ +151 (c=1, CH_3OH); ^1H NMR (300 MHz, $CDCl_3$): δ (ppm): 5.21 (d, $J_{1,2}$ = 1.3 Hz, 1H, H-1), 4.12 (d, $J_{8',10'}$ = 2.4 Hz, 2H, H-8'), 3.93-3.86 (m, 2H, H-2, H-5), 3.82 (dd, $J_{6a,6b}$ = 11.9 Hz, $J_{6a,5}$ = 2.6 Hz, 1H, H-6a), 3.73 (dd, 1H, H-6b), 3.67-3.63 (m, 2H, H-3, H-4), 3.52 (t, $J_{7',6'}$ = 6.5 Hz, 2H, H-7'), 2.80 (t, $J_{10',8'}$ = 2.4 Hz, 1H, H-10'), 2.74-2.53 (m, 2H, H-1'), 1.70-1.52 (m, 4H, H-2', H-4'), 1.48-1.33 (m, 6H, H-3', H-5', H-6'); ^{13}C NMR (75 MHz, $CDCl_3$): δ (ppm): 86.41 (C-1), 75.53 (C-9'), 74.86, 73.79 (C-2, C-5), 73.19 (C-3), 72.63 (C-10'), 70.94 (C-7'), 68.84 (C-4), 62.74 (C-6), 58.69 (C-8'), 31.81 (C-1'), 30.62, 30.45 (C-2', C-4'), 30.00, 29.78, 27.08 (C-3', C-5', C-6'); HRMS: m/z calcd for $C_{16}H_{28}O_6S$ $[M-H]^-$ calc : 347.1528, found 347.1531.

8-Oxaundec-10-ynyl α-D-glucopyranoside (4)

Compound **10** was obtained in quantitative yield (332 mg) by deacetylation of **4** (501 mg, 1 mmol) following the general procedure for deacetylation.



$[\alpha]^{26}_D$ +65 (c 1 ; CH_3OH); ^1H NMR (300 MHz, $CDCl_3$): δ (ppm): 4.77 (d, $J_{1,2}$ = 3.8 Hz, 1H, H-1), 4.12 (d, $J_{8',10'}$ = 2.4 Hz, 2H, H-8'), 3.80 (dd, $J_{6a,6b}$ = 11.9 Hz, $J_{6a,5}$ = 2.5 Hz, 1H, H-6a), 3.77-3.70 (m, 1H, H-7'a), 3.70-3.60 (m, 2H, H-6b, H3), 3.60-3.54 (m, 1H, H-5), 3.52 (t, $J_{1',2'}$ = 6.5 Hz, 2H, H-1'), 3.48-3.41 (m, 1H, H-7'b), 3.38 (dd, $J_{2,3}$ = 9.8 Hz, $J_{2,1}$ = 3.8 Hz, 1H, H-2), 3.29-3.25 (m, 1H, H-4), 2.80 (t, $J_{10',8'}$ = 2.4 Hz, 1H, H-10'), 1.70-1.53 (m, 4H, H-2', H-4'), 1.48-1.33 (m, 6H, H-3', H-5', H-6'); ^{13}C NMR (75 MHz, $CDCl_3$): δ (ppm): 100.11 (C-1), 80.87 (C-9'), 75.48 (C-10'), 75.17 (C-3), 73.66 (C-5, C-2), 71.91 (C-4), 71.01 (C-1'), 69.12 (C-7'), 62.74 (C-6), 58.70 (C-8'), 30.55, 30.48, 30.30 (C-2', C-4', C-6'), 27.25, 27.13 (C-3', C-5'); HRMS: m/z calcd for $C_{16}H_{28}O_7$ $[M+Na]^+$calc : 355.1733, found 355.1724.

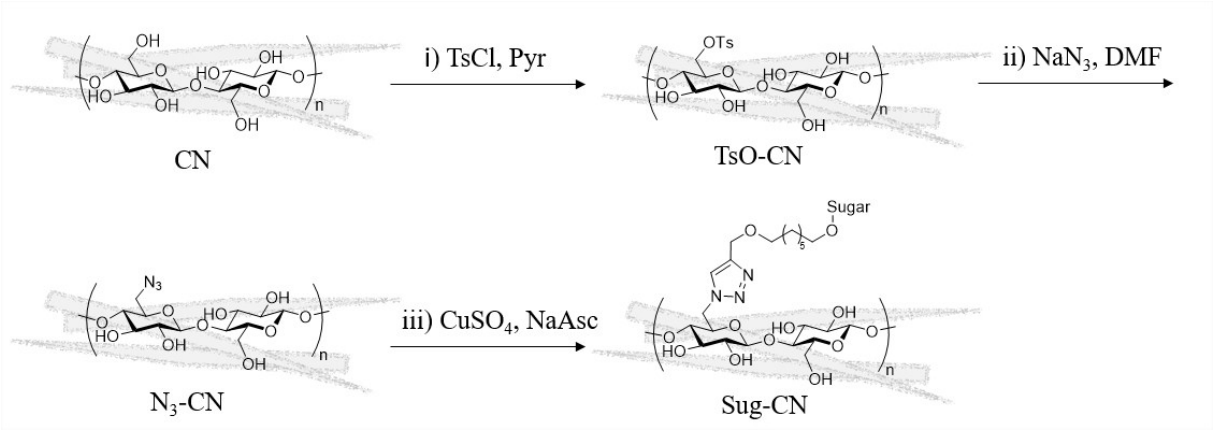


Figure S2. General scheme for the chemical synthesis of **Man-CN**, **HMan-CN**, **HSMan-CN**, **HGlc-CN**.

N_3-CN. In a first step the primary hydroxyl groups of the glucose units from cellulose nanofibers (CN) are activated with a tosyl group according to method 1 or 2.
To a mixture of CN (178 mg, 1 mmol U/Glc) in pyridine (10 mL), *p*-toluenesulfonyl chloride (1.144 g, 6 mmol) was added and the mixture was stirred for 40 hours at room temperature under argon atmosphere. The mixture is filtered through Millipore paper and the CN was washed with ethyl acetate and with DCM to give TsO-CN (270 mg, grafting ratio of 50%) as a white solid.

TsO-CN. Elemental analysis: C: 46.04%, H: 5.08%, N: 0.77%, S: 7.24%; Infra-red analysis (KBr tablet) cm^{-1}: 3377 (ν(OH)), 2924 (ν(C-H)), 1542 (ν(C=C)), 1363 ($\nu_{as}(SO_2)$), 1177 ($\nu_s(SO_2)$), 1059 (ν(C-O-C)).

Then sodium azide (585 mg, 9 mmol) was added to **TsO-CN** (270 mg, 1 mmol U/Glc) in DMF (10 mL), and the mixture was stirred for 22 hours at 60 °C and then 4 hours at 120°C. The mixture was filtered through Millipore paper and CN washed with water, ethyl actetate and DCM to give **N_3-CN** (197 mg, grafting ratio of 30-40%).
Additional washing was required to remove sodium azide trapped in the CN (Figure S3). **N_3-CN** was suspended in water and heated at 80°C under ultrasounds for 20 min. After filtration through Millipore, **N_3-CN** was rinced with acetone and dichloromethane.

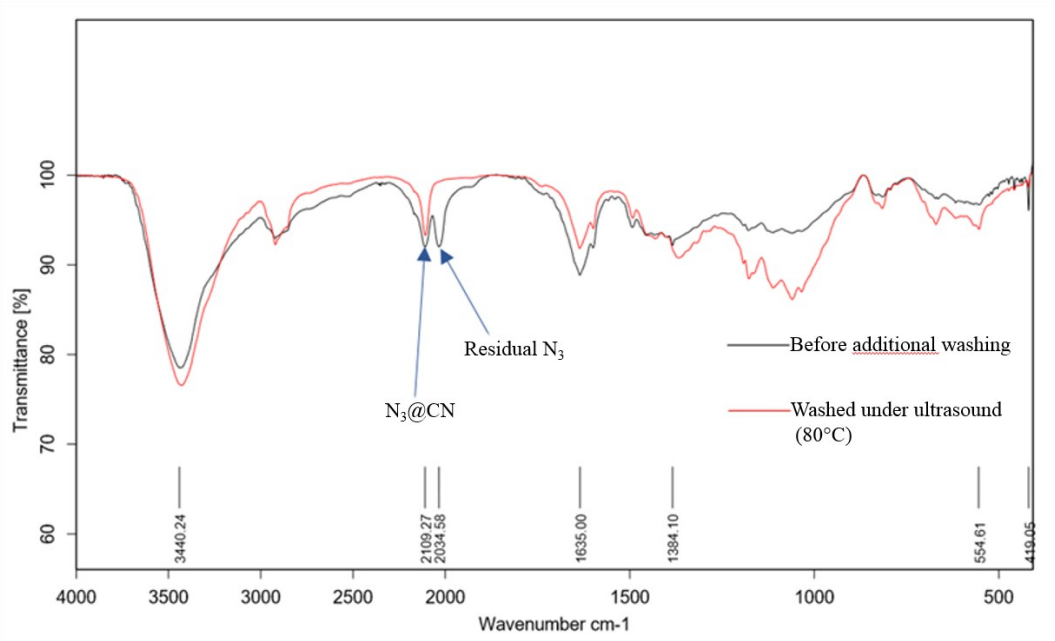


Figure S3. FT-IR showing the efficiency of washing under ultrasounds to remove excess of N_3.

N_3-CN Elemental analysis: C: 37.55%, H: 4.97%, N: 8.27%, S: 0.00% (SD ~30-40%) ; Infra-red analysis (KBr tablet) cm^{-1}: 3377 (ν(OH)), 2924 (ν(C-H)), 2108 ($\nu_{as}(N_3)$), 1059 (ν(C-O-C)).

General procedure for CuAAC

Sodium ascorbate (0.4 eq) and copper sulfate pentahydrate (0.2 eq) was added to a mixture of glycoside (3 eq) and **N_3-CN** (1 eq N_3) in dioxane/water 2/1. The mixture was stirred at 60 °C for 16 hours. The solvent was removed under reduced pressure, water was added (2 mL) with ethylenediaminetetraacetic acid (EDTA) (2 eq) and the mixture was stirred for 20 minutes to remove the residual copper. The mixture was dialyzed for 24 hours.

Man-CN was obtained in quantitative yield (IR analysis) by CuAAC of **N_3-CN** (19 mg, 0.031 mmol of N_3) and propargyl-α-D-mannoside[3] (20 mg, 0.092 mmol) following the general procedure. Elemental analysis: C: 40.23%, H: 5.44%, N: 5.49%, S: 0.00%; Infra-red analysis (KBr tablet method) cm^{-1}: 3385 (ν(OH)), 2921 (ν(C-H)), 1059 (ν(C-O-C)). Substitution degree (SD) 20-30%.

3 P. van der Peet, C. T. Gannon, I. Walker, Z. Dinev, M. Angelin, S. Tam, J. E. Ralton, M. J. McConville and S. J. Williams, *ChemBioChem*, 2006, **7**, 1384–1391.

HMan-CN was obtained in quantitative yield (FT-IR) by CuAAC of **N_3-CN** (25 mg, 0.040 mmol of N_3) and **2** (40 mg, 0.119 mmol) following the general procedure. Elemental analysis: C: 41.31%, H: 5.88%, N: 4.34%, S: 0.00%; IR analysis (KBr tablet method) cm^{-1}: 3396 (ν(OH)), 2925 (ν(C-H)), 1059 (ν(C-O-C)). SD ~30%.

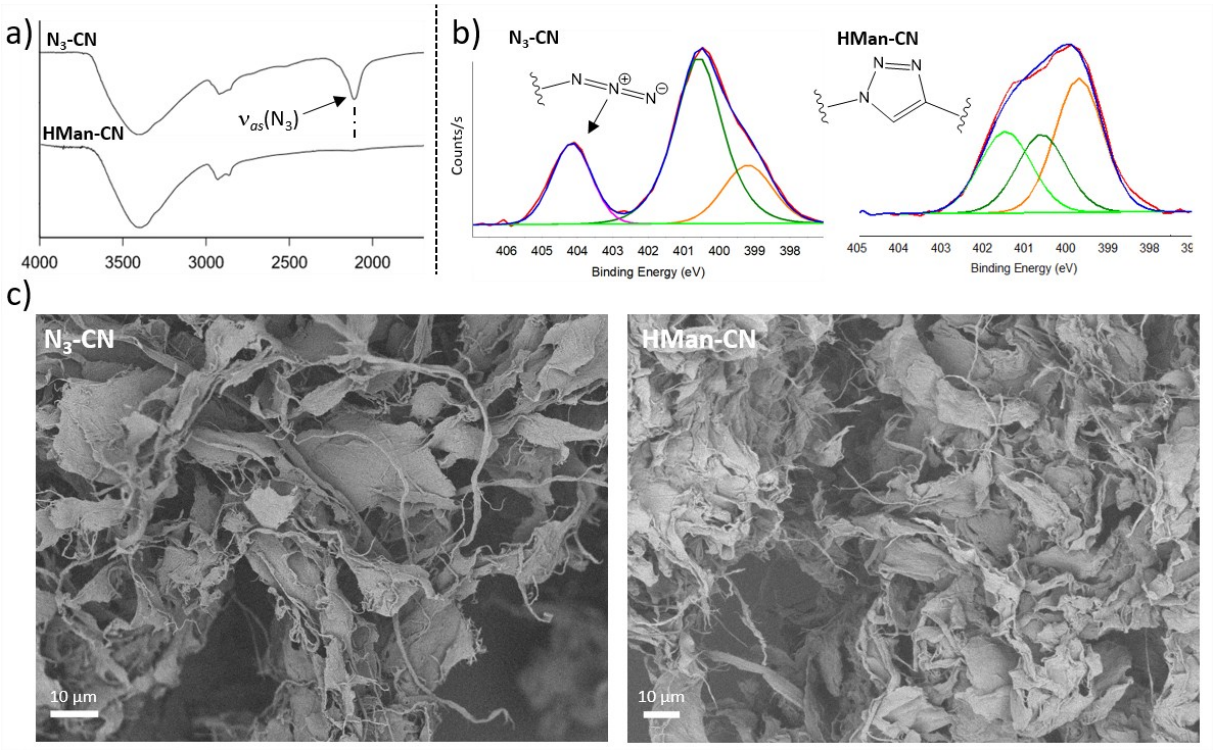


Figure S4. a) FTIR of N_3-CN and HMan-CN showing disappearance of the characteristic $\nu_{as}(N_3)$ band at 2110 cm^{-1}. b) High resolution N1s spectrum (XPS) of N_3-CN and HMan-CN showing the disappearance of the components assigned to electropositive nitrogen atoms. C) SEM images of N_3-CN and HMan-CN showing a conserved structure of the cellulosic material after CuAAC.

HSMan-CN was obtained in quantitative yield (IR analysis) by CuAAC of **N_3-CN** (42 mg, 0.067 mmol of N_3) and **3** (70 mg, 0.200 mmol) following the general procedure. Elemental analysis: C: 42.21%, H: 6.08%, N: 4.34%, S: 2.57%; Infra-red analysis (KBr tablet method) cm^{-1}: 3384 (ν(OH)), 2924 (ν(C-H)), 1059 (ν(C-O-C)). SD ~30%

HGlc-CN was obtained in quantitative yield (FT-IR) by CuAAC of **N_3-CN** (40 mg, 0.063 mmol of N_3) and **3** (63 mg, 0.189 mmol) following the general procedure. Elemental analysis: C: 45.18%, H: 6.33%, N: 4.80%, S: 0.00%; Infra-red analysis (KBr tablet method) cm^{-1}: 3377 (ν(OH)), 2924 (ν(C-H)), 1059 (ν(C-O-C)). SD ~30%.

Procedures for the modification of cellulose paper (CP)

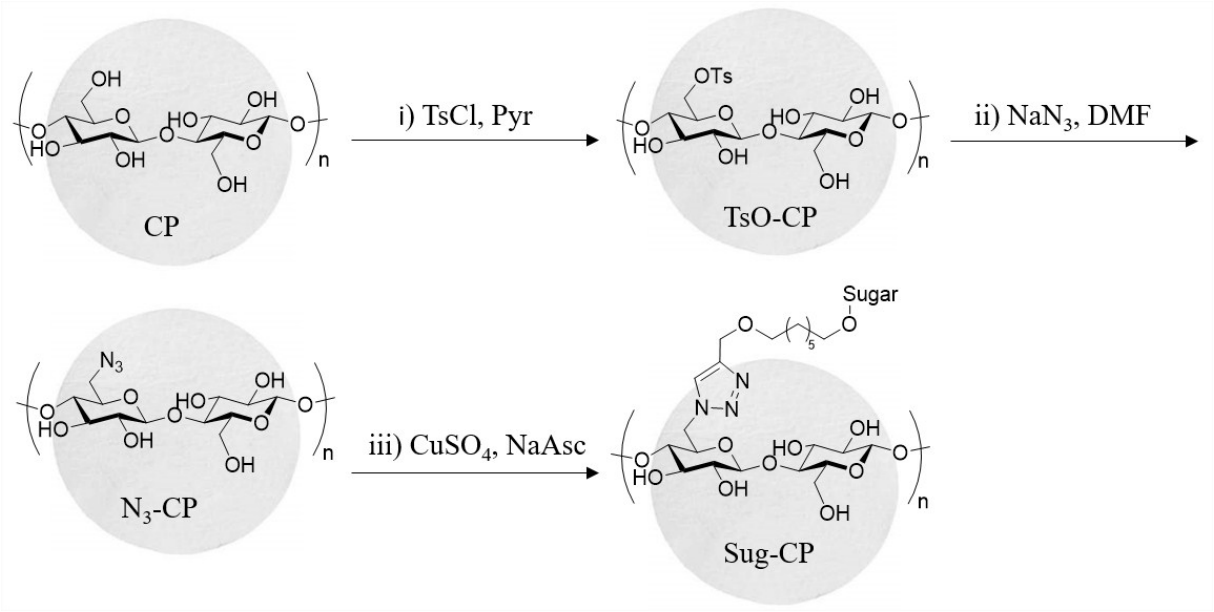


Figure S5. General scheme for the chemical synthesis of **Sug-CP**.

Procedure for the pre-treatment of CP. Five pieces of cellulose filter papers (approximately 750 mg) were dispersed in 250 mL of a freshly prepared 10% (w/w) NaOH aqueous solution. This mixture was shaken 24 h on an orbital agitator. The cellulose samples were washed 6 times with 50 mL of EtOH and stored under EtOH.

Synthesis of TsO-CP. A piece of cellulose paper (145 mg, 0.81 mmol Glc) was immersed in pyridine (10 mL) and treated with *p*-toluenesulfonyl chloride (464 mg, 2.44 mmol). The mixture was shaken for 20 h at 40°C on an orbital agitator. The paper was sonicated three times with 20 mL of DMF and stored in DMF for the next step. For analytical purposes only, **TsO-CP** was isolated and dried under vacuum. **TsO-CP** is stored in DMF after three successive washings to remove pyridine and unreacted p-toluenesulfonyl chloride. Elemental analysis: C: 46.11%, H: 4.99%, N: 0.13%, S: 6.18%; IR analysis (ATR) cm^{-1}: 3377 (ν(OH)), 2924 (ν(C-H)), 1542 (ν(C=C)), 1363 ($\nu_{as}(SO_2)$), 1177 ($\nu_{s}(SO_2)$), 1059 (ν(C-O-C)).

Synthesis of N_3-CP. A piece of **TsO-CP** (0.81 mmol Glc) was immersed in DMF (10 mL) and treated with NaN_3 (526 mg, 8.10 mmol). The resulting mixture was shaken for 40 h at 60 °C on an orbital agitator. The **N_3-CP** paper was sonicated with 20 mL of H_2O, acetone, EtOH and DCM and dried under vacuum. Elemental analysis: C: 41.25%, H: 4.86%, N: 6.65%, S: 0.98%; IR analysis (ATR) cm^{-1}: 3377 (ν(OH)), 2924 (ν(C-H)), 2108 ($\nu_{as}(N_3)$), 1059 (ν(C-O-C)). SD ~30-40%.

Synthesis of **HMan-CP**. To a mixture of **7** (640 mg, 1.93 mmol) and **N_3-CP** (0.81 mmol Glc) in dioxane/water 3/1 were added sodium ascorbate (1 eq) and copper sulfate pentahydrate (0.1 eq). The mixture was stirred at 60 °C for 24 hours, filtered through a fritted funnel and washed with methanol. The paper was put into water with EDTA (2 eq) and was sonicated. The resultant paper was successively sonicated with 20 mL of H_2O, acetone, EtOH and DCM and dried under vacuum. Elemental analysis: C: 44.63%, H: 6.18%, N: 4.60%, S: 0.95%; IR analysis (ATR) cm^{-1}: 3377 (ν(OH)), 2924 (ν(C-H)), 2108 ($\nu_{as}(N_3)$), 1059 (ν(C-O-C)).SD ~30%.

Inhibition assay on FimH lectin

The inhibition profile of five **N_3-CN, Glc-CN, Man-CN, HMan-CN, HSMan-CN** on FimH lectin were performed by using FimH LEct-PROFILE kit available from GLYcoDiag. The principle of the analysis is b**ased on a competition assay bet**ween a FimH tracer (known to have good affinity for FimH and labelled with bio**tin) and the CN derivatives** Firstly, a mix of FimH tracer (fixed concentration) and the corresponding **CN** (range of concentrations) prepared in PBS supplemented with 1 mM CaCl2 and 0.5 mM MgCl2 is deposed in each well (50 µL each) in duplicates and incubated two hours at room temperature. After washing with PBS buffer, the conjugate streptavidin-DTAF is added (50 µL) and incubated 30 min more. The plate was washed again with PBS buffer and the readout is performed with a fluorescence reader (Fluostar, BMG labtech, Of-fenburg, Germany). The signal intensity is inversely correlated with the capac**ity of the inhibitor to be reco**gnized by the lectin and expressed as inhibition percentage with comparison with the corresponding tracer alone (FimH tracer).

5-Binding assays with the Adherent-Invasive *E. coli* (AIEC) strain LF82 and *in vivo* experiment

Bacterial strains, intestinal epithelial cell line, mouse infection experiment and ethics statement

Ampicillin-erythromycin-resistant *E. coli* strain LF82, isolated from a chronic ileal lesion of a CD patient, was used as the AIEC reference strain (Darfeuille-Michaud et al., 1998). A non-piliated isogenic mutant AIEC LF82 deleted for *fimH* and the *E. coli* K-12 C600 strain were also used in this study. Bacteria were grown overnight statically at 37 °C in Luria-Bertani (LB) broth medium.

The human intestinal cell line T84, purchased from American Type Culture Collection (ATCC, CCL-248), was maintained in an atmosphere containing 5% CO_2 at 37 °C in the culture medium recommended by ATCC. T84 cells were seeded in 48-well tissue culture plates at a density of 1.5 x 10^5 cells/well and incubated at 37 °C for 48 h.

Mice were housed in specific-pathogen-free conditions in the animal care facility of the University Clermont Auvergne (Clermont-Ferrand, France). FVB/N wildtype mice, provided by Charles Rivers Laboratories France, and FVB/N CEABAC10 transgenic mice (heterozygous for h*ceacam6*) were coupled in our animal care facility. The animal protocol used in this study were approved by the CEMEA Auvergne committee for ethical issues (00730.02).

Adhesion assays with AIEC LF82 in the presence of grafted CN.

A bacterial suspension of the AIEC LF82 strain was prepared at a final concentration of 3×10^6 bacteria/mL in DMEM/F12 (50:50) medium supplemented with 10% (v/v) of heat-inactivated fetal calf serum (FCS). Bacteria were pre-incubated for 1 hour at room temperature with N3-CN, HMan-CN, HSMan-CN, HGlc-CN, Man-CN or Hman at concentrations of 100, 10, 1, or 0.1 µM. Mixes (500 µL) were added onto the T84 cells at a multiplicity of infection (MOI) of 10 bacteria per cell. After a 3 hours-period of incubation at 37 °C, monolayers were washed four time with phosphate-buffered saline (PBS). The epithelial cells were then lysed with 1% Triton X-100 (Sigma) in deionized water. Samples were diluted and plated onto LB agar plates to determine the number of colony-forming units (CFU) par well. Adhesion level of AIEC LF82 in absence of any treatment was normalized at 100% of adhesion and effect of the treatments on adhesion was expressed in percentages of residual adhesion.

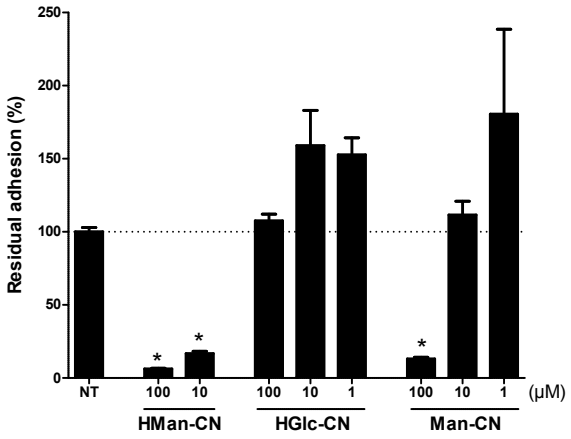


Figure S6. Effects of the compounds on the adhesion ability of AIEC bacteria to T84 intestinal cells. Results are expressed as percentages residual adhesion (n=6 experiments, means±SEMs; *p<0.05). LF82 infection in the absence of treatment (non-treated, NT) was normalized to 100 %.

Effect of HMan-CN in AIEC LF82-infected CEABAC10 mice

Seven to 8-week-old FVB/N CEABAC10 transgenic male mice were given dextran sulfate sodium (DSS) (molecular mass of 36,000 to 50,000 Da; MP Biomedicals) at 0.5% in drinking water, starting 3 days before infection. Twenty-four hours before infection, mice were orally given 5 mg of the broad-spectrum antibiotic streptomycin (Euromedex) to disrupt normal resident intestinal microbiota. The mice were orally challenged with 5×10^9 AIEC LF82 bacteria (day 0 of the experiment), immediately after an oral administration of 0.1 mL of sodium bicarbonate at 0.2 M. HMan-CN was orally administered in a volume of 0.2 ml of PBS, 2 h and 24 h after LF82 infection at a dose of 30 mg/kg. For non-treated mice (NT), 0.2 mL of PBS was administered. Colonization was assessed on fresh fecal samples collected at days 1 and 2 post-

infection and suspended in sterile saline solution (NaCl [9‰]). Samples were diluted and plated onto LB agar containing 100 µg/ml ampicillin and 20µg/ml erythromycin to quantify LF82 bacteria. The bacterial colonization was expressed in the number of CFU per gram of feces.

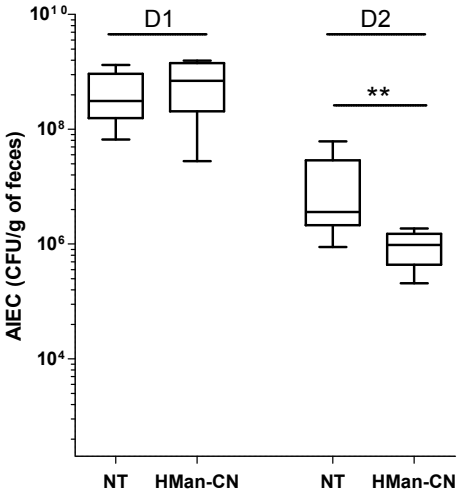
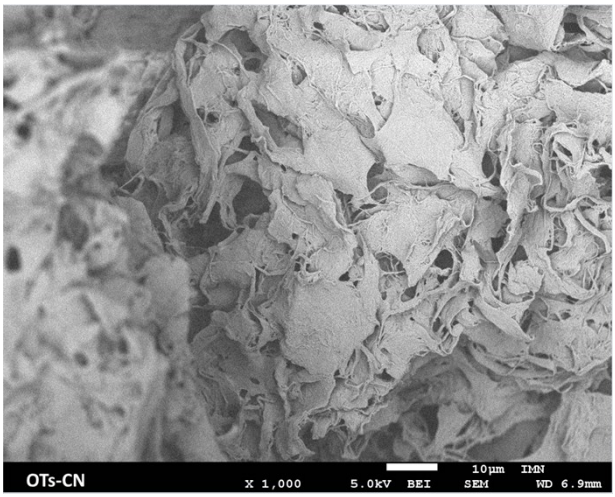


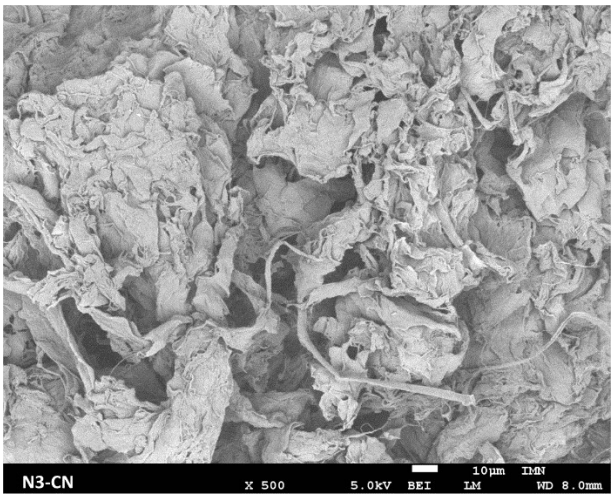
Figure S7. Effect of a HMan-CN treatment on the AIEC bacterial load in the feces of AIEC-infected CEABAC10 mice (n=9 mice/ group) at days 1 (D1) and 2 post-infection (D2). Two doses of 30 mg/kg were orally administered to mice 2 and 24 hours after the bacterial challenge. Results are expressed numbers of AIEC bacteria per gram of feces (box and whiskers, min to max ;**$p<0.01$). NT: non-treated.

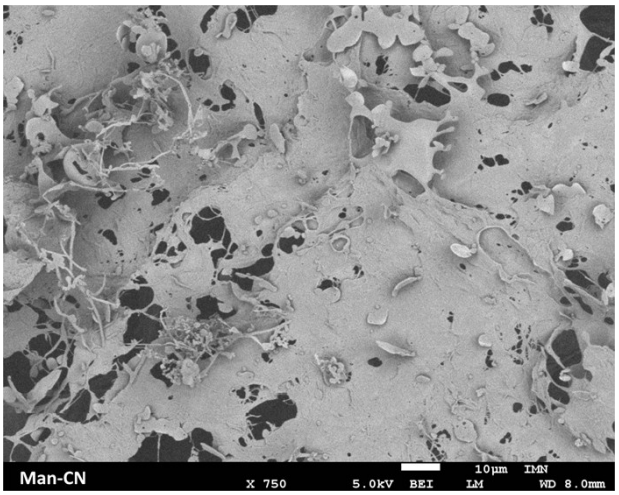
Detection by paper sensors of AIEC bacteria

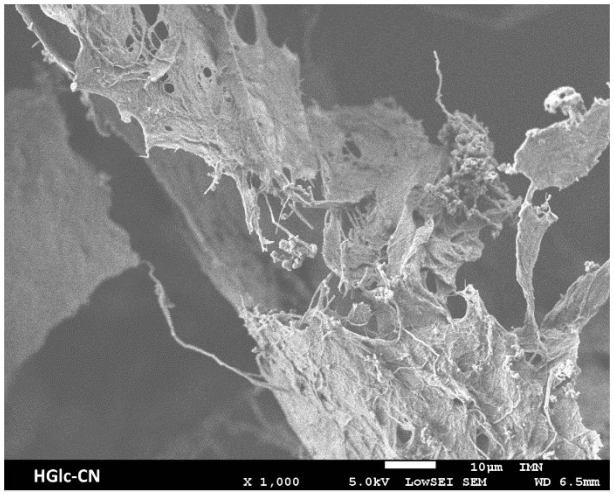
HMan-CP or N3-CP fibers (disc of 6 mm diameter) were pre-incubated in 24-well plates in phosphate buffered saline (PBS) at room temperature for 15 minutes with gentle shaking. Fibers were then incubated at room temperature with bacterial suspensions calibrated at 10^8 bacteria/mL in PBS for one hour. AIEC LF82 reference strain, the non-piliated LF82-Δ*fimH* mutant and *E. coli* K12 C600 were tested for their abilities to bind HMan-CP or N3-CP fibers. Fibers were washed 6 times in PBS and homogenized (Ultra Turrax) in 1 mL of PBS. Appropriate dilutions of homogenized fibers were plated onto LB agar in order to quantified bacteria trapped into the fibers. After culturing at 37°C overnight, bacterial counts were recorded. Percentages of trapped bacteria were determined according to the total number of bacteria in the presence of fibers.

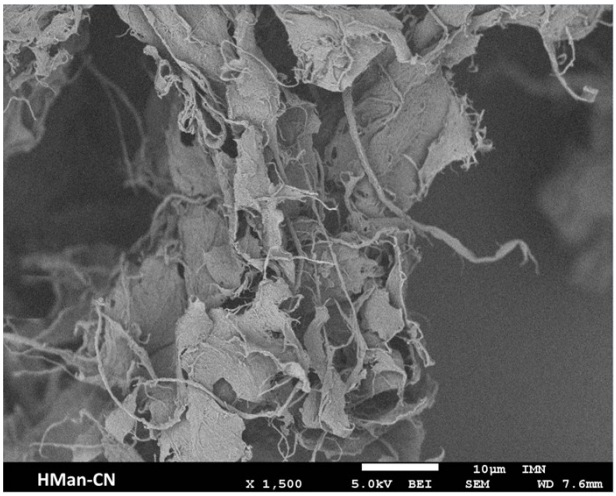
4- SEM images of functionalized celluloses

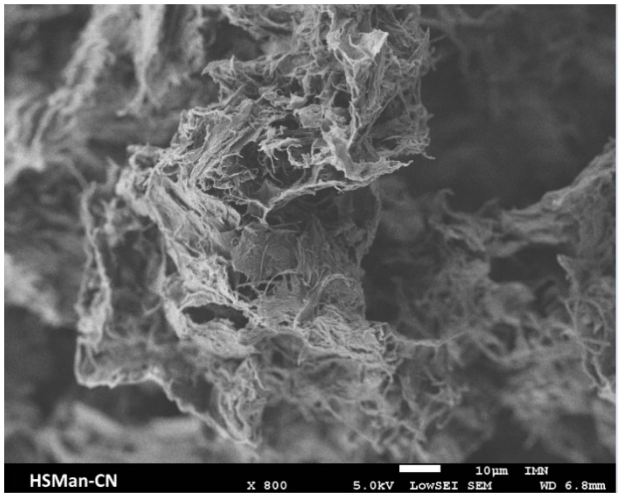












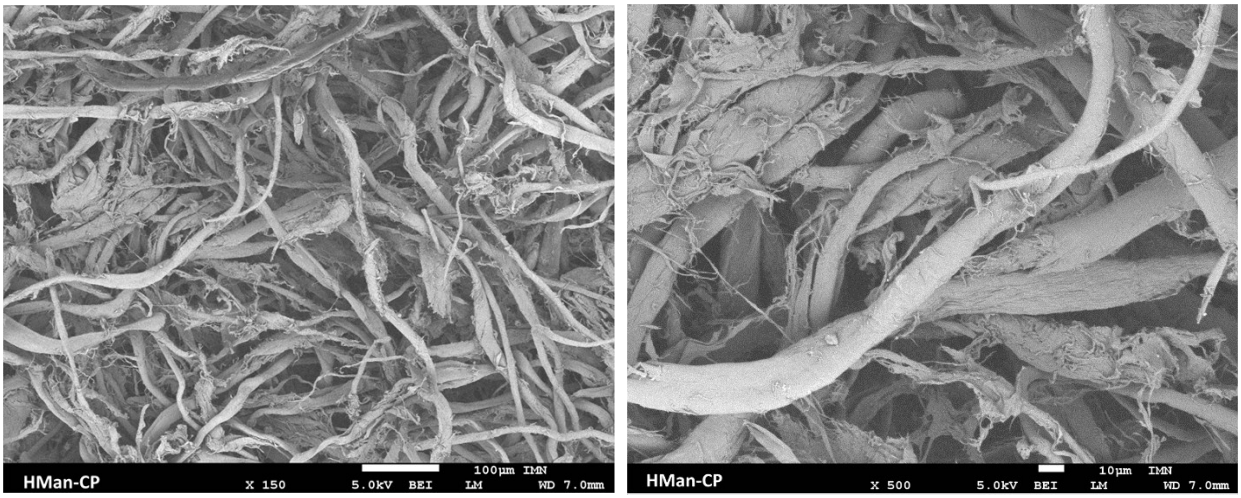
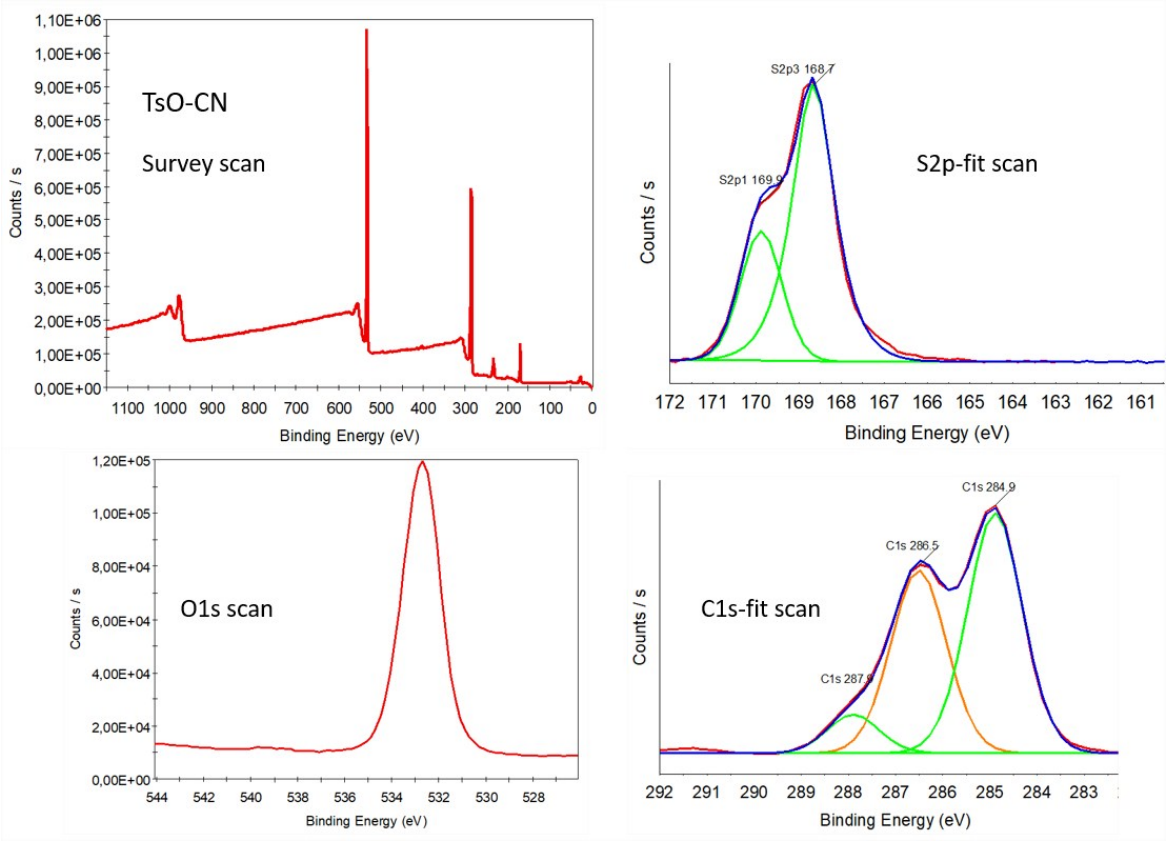
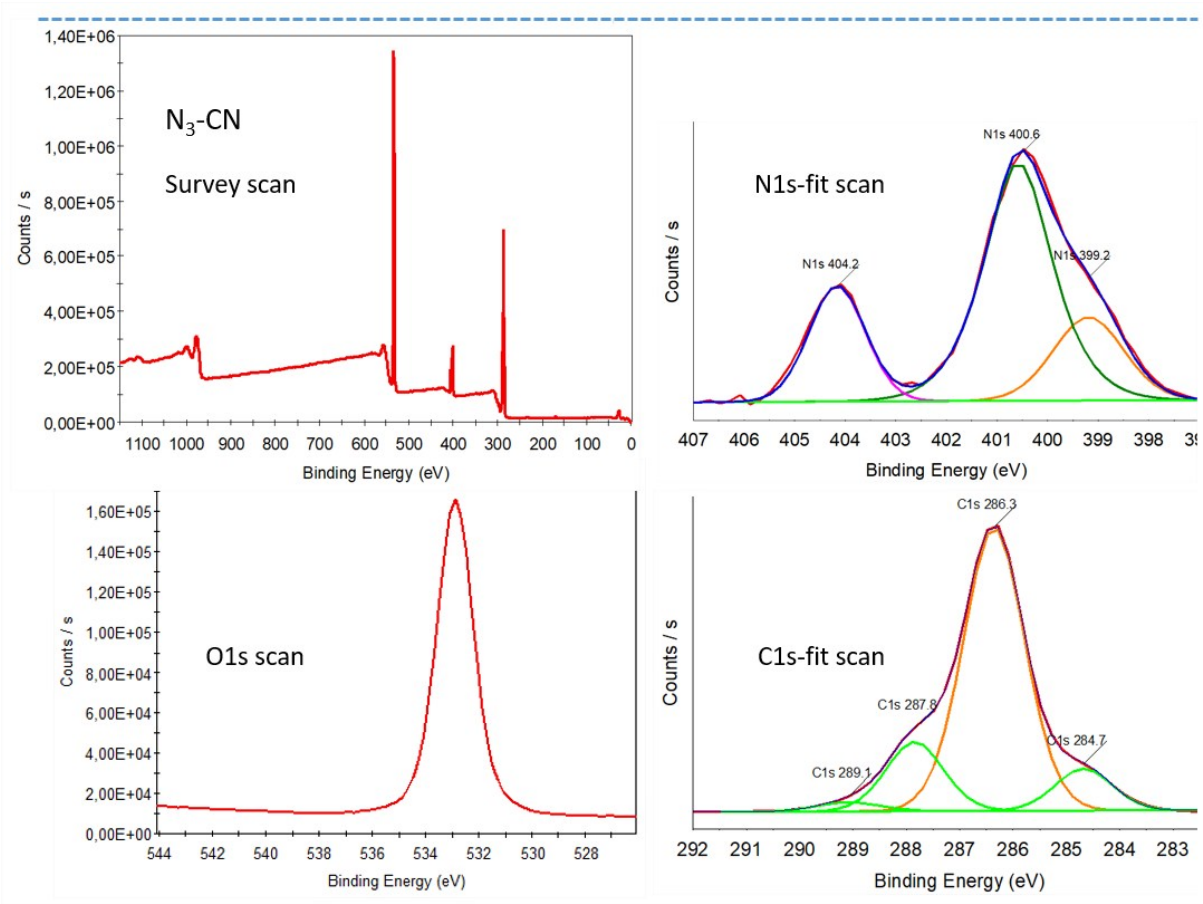
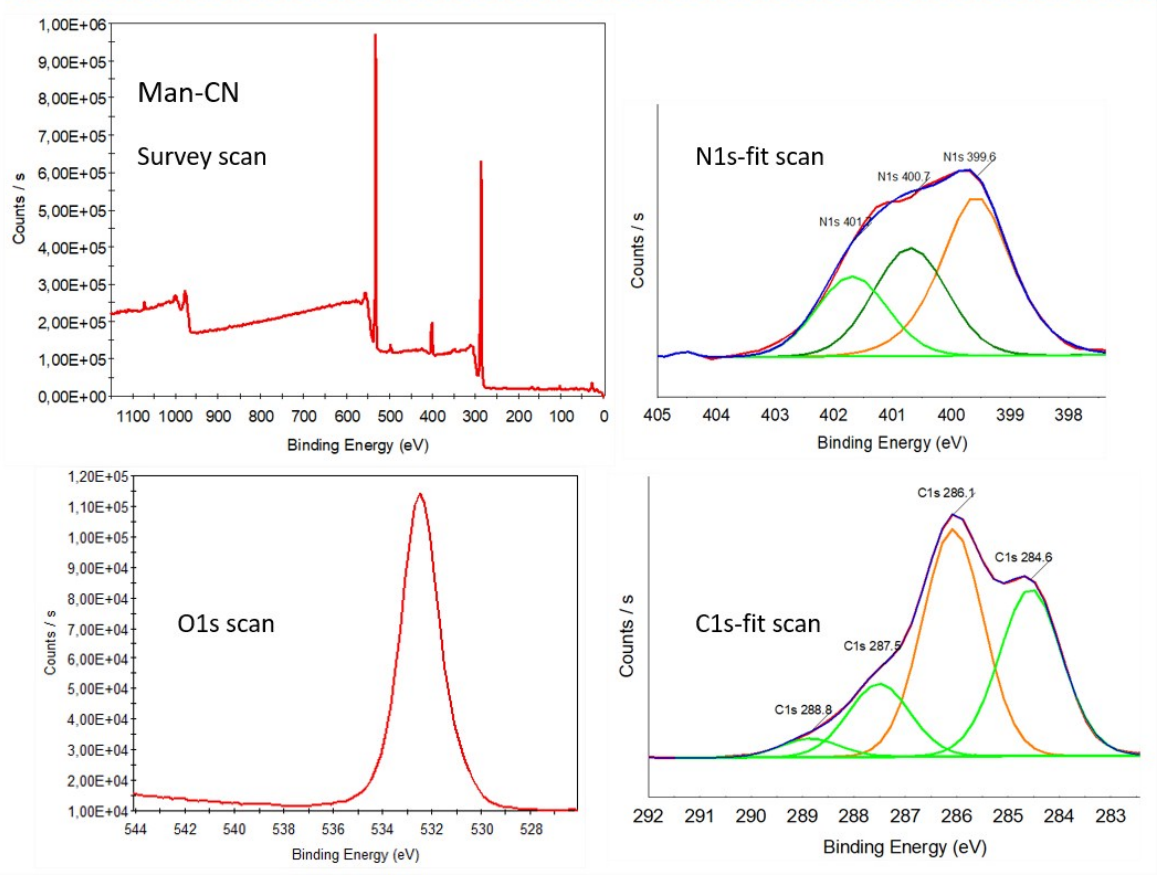


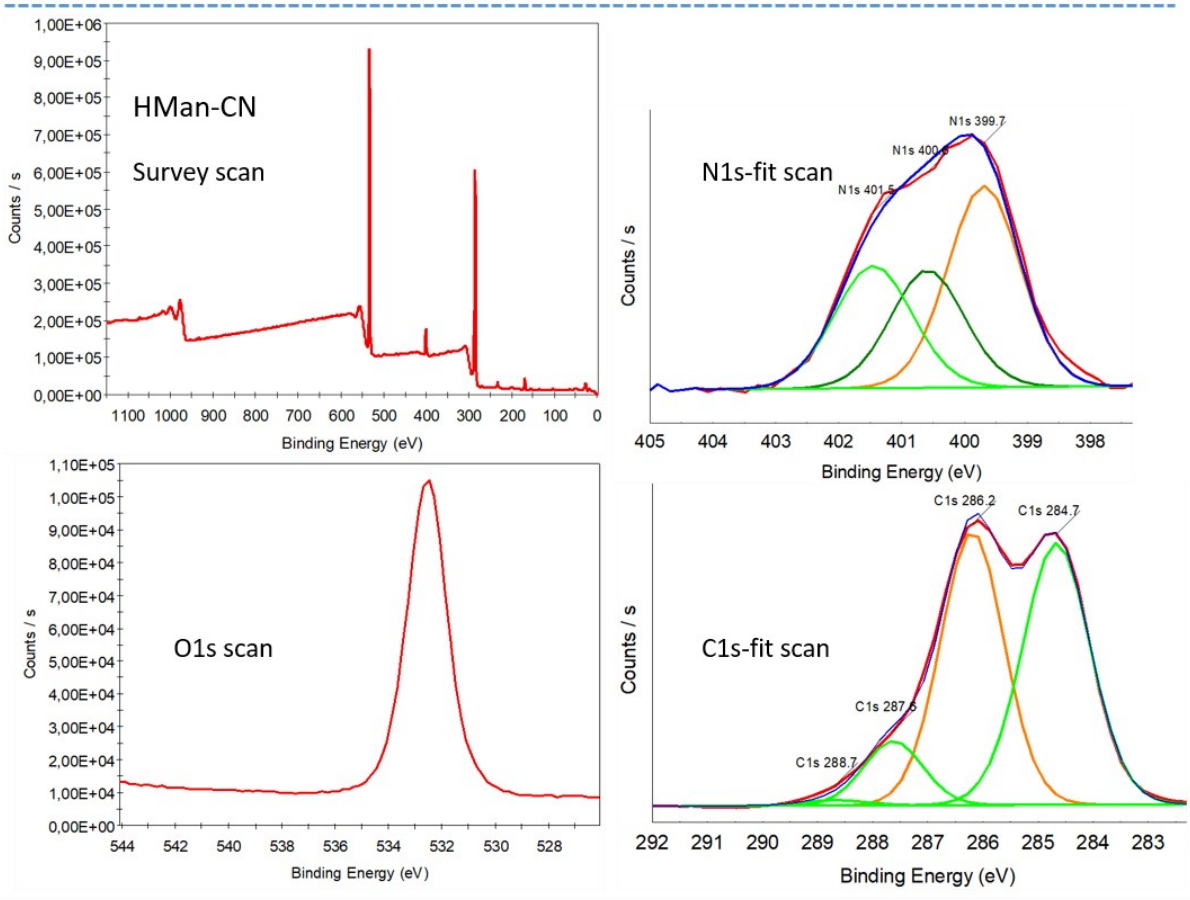
Figure S8. SEM images of the modified CN and CP

5- XPS analysis of functionalized celluloses






Man-CN
Survey scan
Counts / s
Binding Energy (eV)
N1s-fit scan
N1s 399.6
N1s 400.7
N1s 401.9
O1s scan
C1s-fit scan
C1s 286.1
C1s 284.6
C1s 287.5
C1s 288.8


HMan-CN
Survey scan
Counts / s
Binding Energy (eV)
N1s-fit scan
N1s 399.7
N1s 400.8
N1s 401.5
O1s scan
C1s-fit scan
C1s 286.2
C1s 284.7
C1s 287.6
C1s 288.7

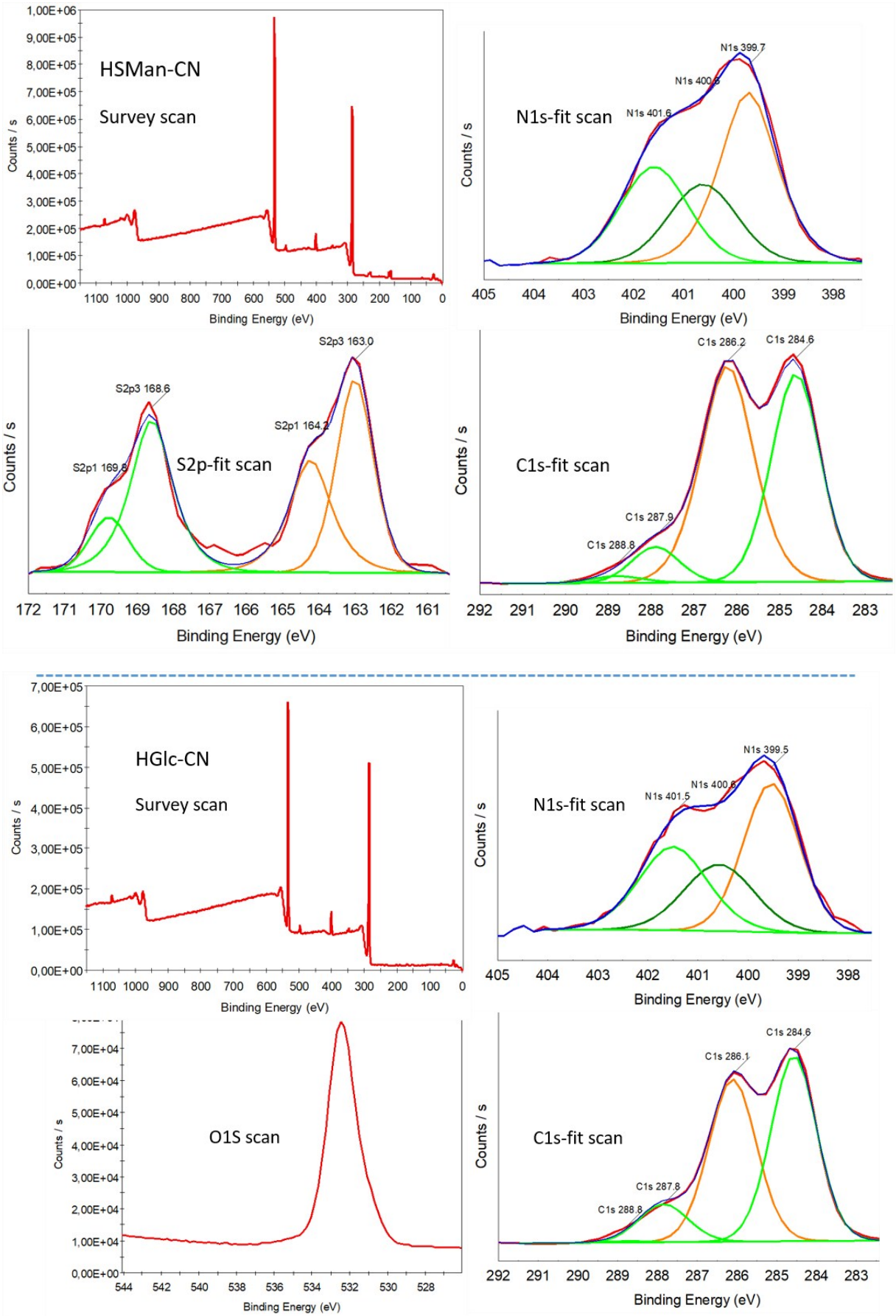
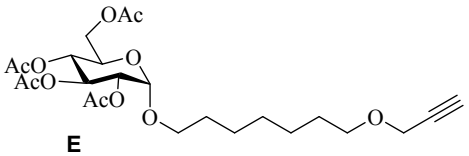
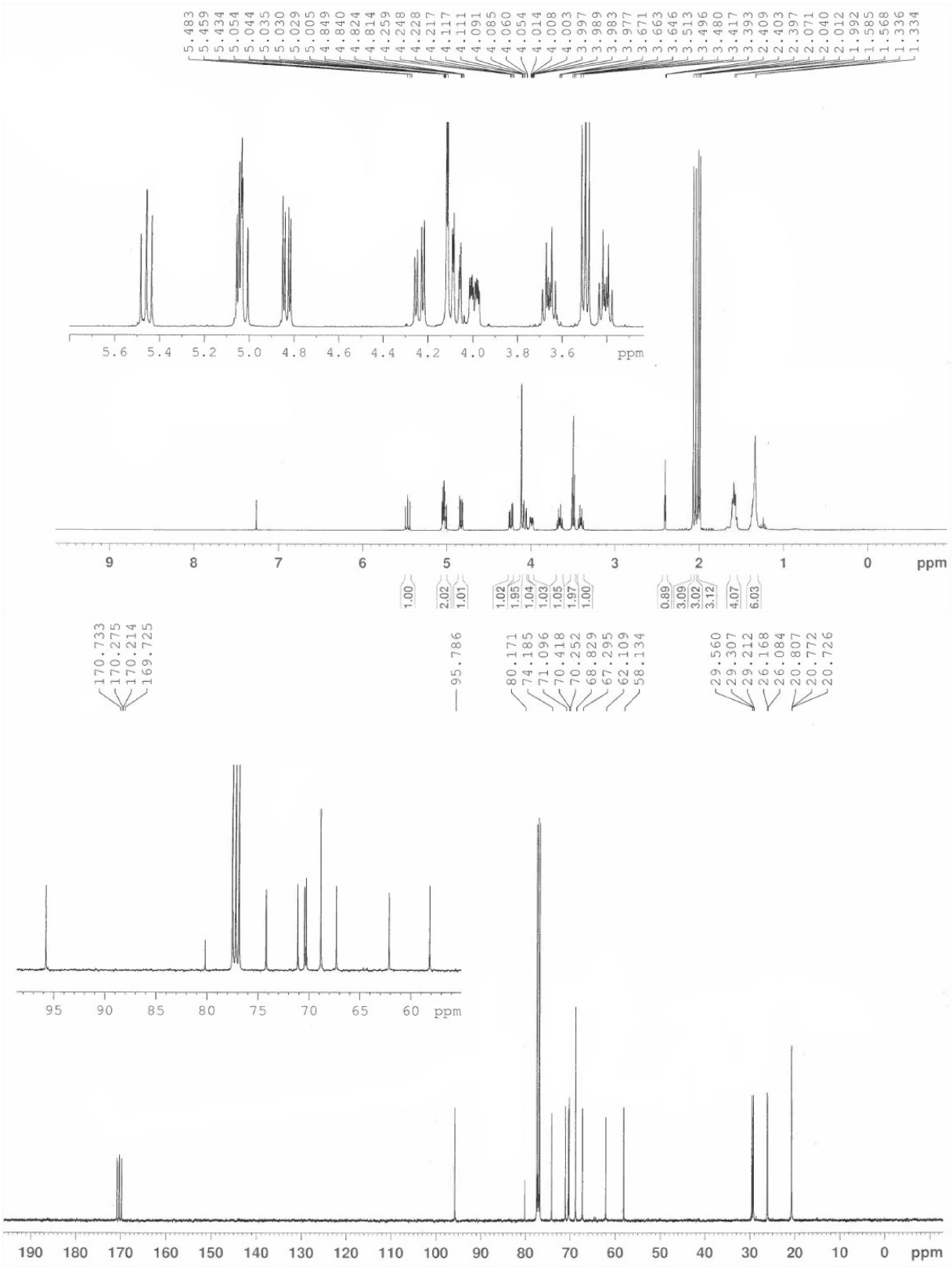


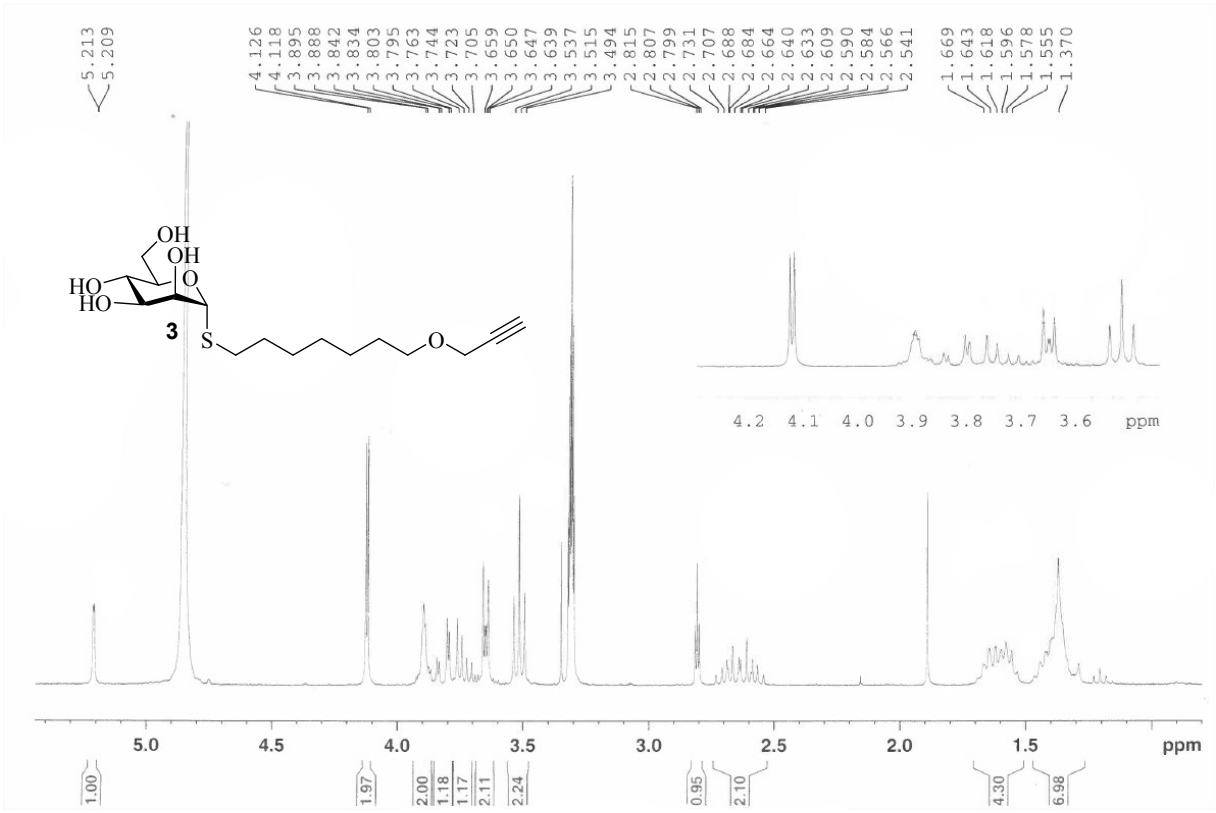
Figure S9. XPS analysis of the modified CN

NMR Spectra



E

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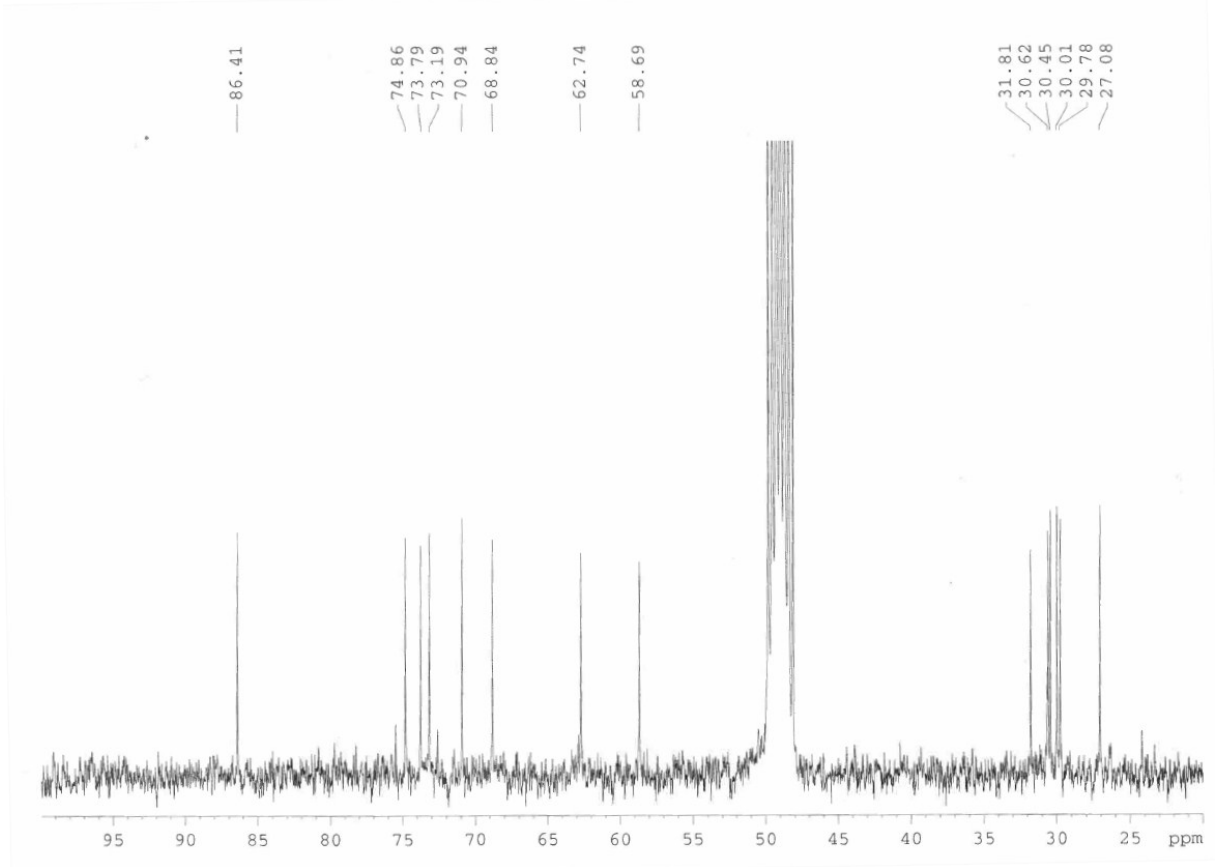
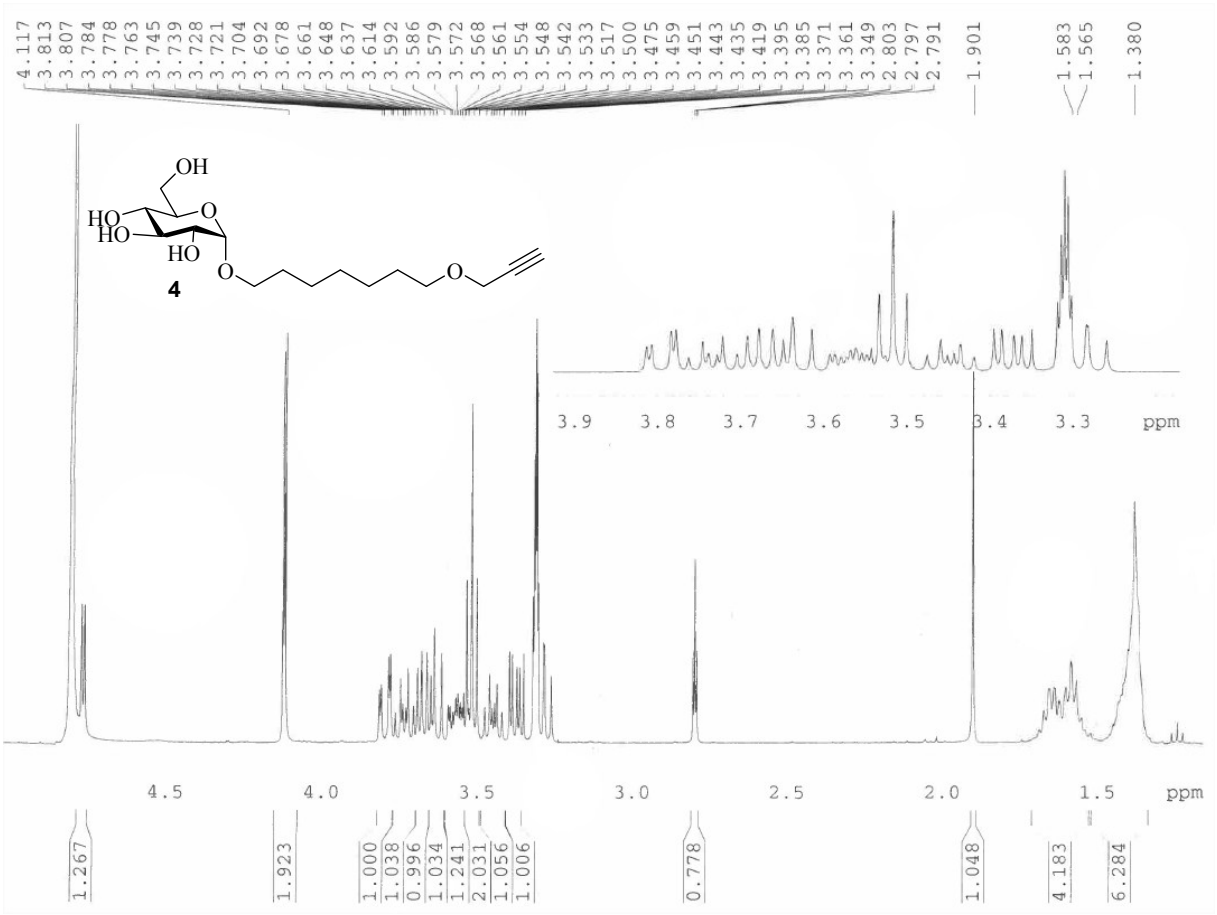
5.209
4.126
4.118
3.895
3.888
3.842
3.834
3.803
3.795
3.763
3.744
3.723
3.705
3.659
3.650
3.647
3.639
3.537
3.515
3.494
2.815
2.807
2.799
2.731
2.707
2.688
2.684
2.664
2.640
2.633
2.609
2.590
2.584
2.566
2.541
1.669
1.643
1.618
1.596
1.578
1.555
1.370
OH
OH
HO
HO
O
3
S
O
4.2 4.1 4.0 3.9 3.8 3.7 3.6 ppm
5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 ppm
1.00
1.97
2.00
1.18
1.17
2.11
2.24
0.95
2.10
4.30
6.98


86.41
74.86
73.79
73.19
70.94
68.84
62.74
58.69
31.81
30.62
30.45
30.01
29.78
27.08
95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 ppm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3.813
3.807
3.784
3.778
3.763
3.745
3.739
3.728
3.721
3.704
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3.678
3.661
3.648
3.637
3.614
3.592
3.586
3.579
3.572
3.568
3.561
3.554
3.548
3.542
3.533
3.517
3.500
3.475
3.459
3.451
3.443
3.435
3.419
3.395
3.385
3.371
3.361
3.349
2.803
2.797
2.791
1.901
1.583
1.565
1.380
OH
HO
HO
HO
O
O
O
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm
4.5
4.0
3.5
3.0
2.5
2.0
1.5
ppm
1.267
1.923
1.000
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1.034
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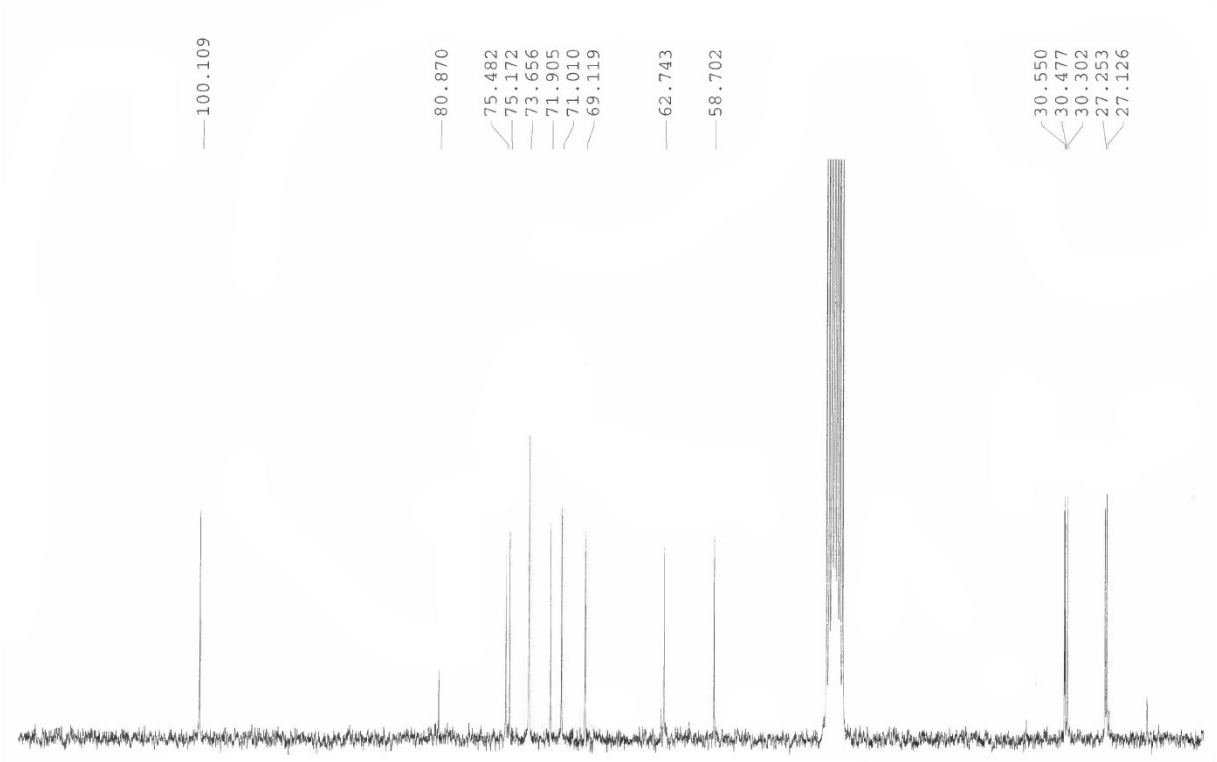
2.031
1.056
1.006
0.778
1.048
4.183
6.284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73.656
71.905
71.010
69.119
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58.702
30.550
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30.302
27.253
27.126