Contents:

1. Lectin titration

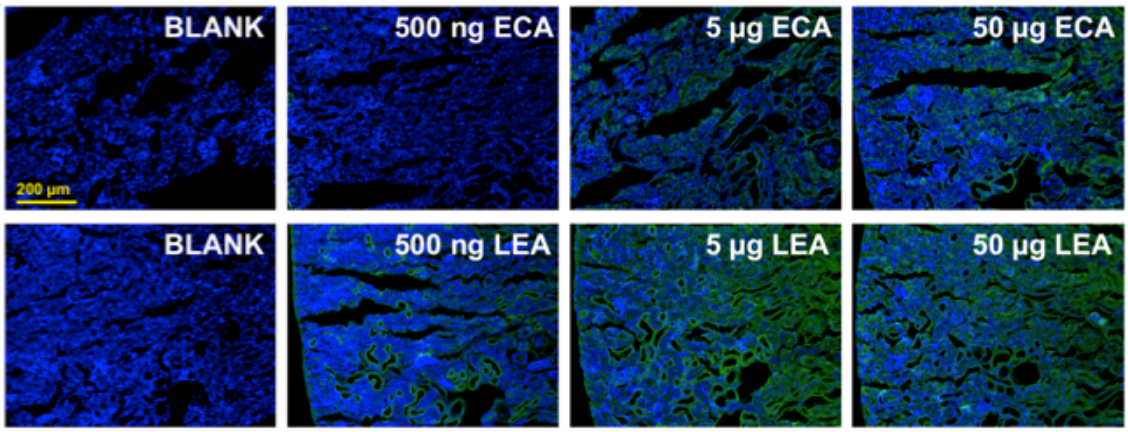

Figure S1. Photomicrographs of 5 µm, FFPE, serial mouse kidney tissues with lectin titration. (Top row, from left) 0, 500 ng, 5 µg and 50 µg of ECA respectively. (Bottom row, from left) 0, 500 ng, 5 µg, and 50 µg of LEA respectively.

2. ECA and LEA lectin labeling on kidney sections

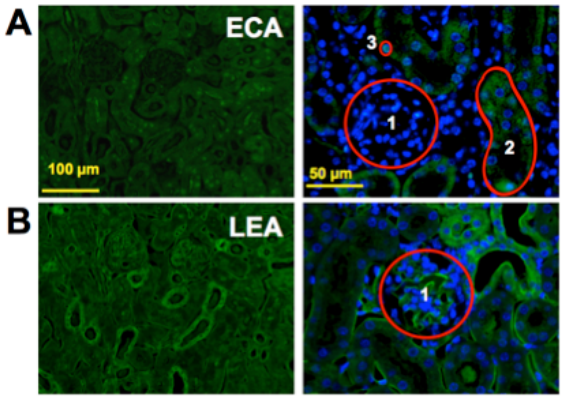

Figure S2. Commercially available LacNAc binding lectins ECA and LEA show distinct labeling patterns on FFPE mouse kidney tissues. **A)** ECA (green) lightly stains the distal tubules (2) and the nuclei of the distal tubules (3). **B)** LEA (green) stains the basement membrane of the glomeruli (1), the distal tubules (2) and connective tissues. DAPI nuclear stain shown in blue.

3. Comparison of CuAAC and copper free click chemistry enabled CHoMP (Direct labelling

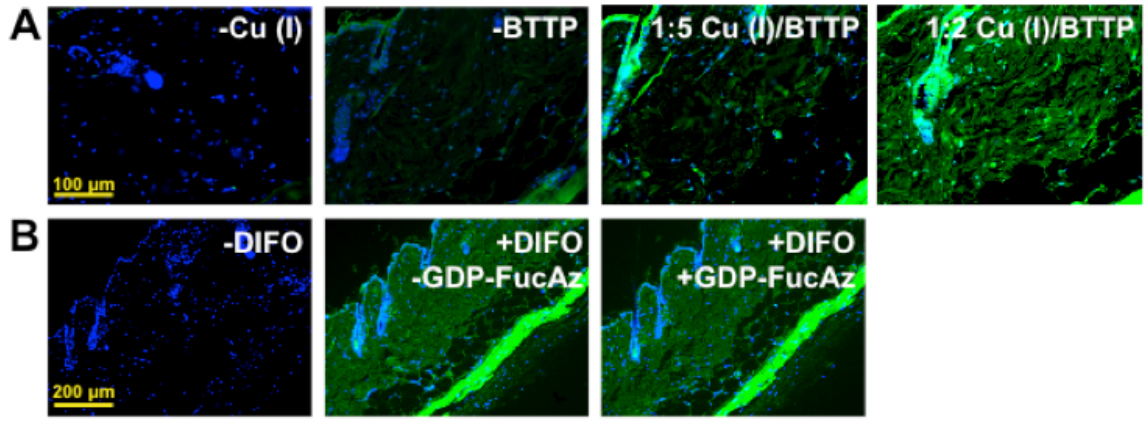

Figure S3. Comparison of CuAAC and copper free click chemistry enabled CHoMP (Direct labeling) on serial, FFPE mouse skin sections using GDP-FucAz. **A**) CuAAC "click" chemistry (From left) Direct labeling without Cu(I) catalyst in CuAAC reaction; Direct labeling without BTTP ligand in CuAAC reaction; Direct labeling with 1:5 ratio of Cu(I):BTTP in CuAAC reaction; Direct labeling with 1:2 ratio of Cu(I) to BTTP in CuAAC reaction. A specific pattern of labeling is shown in the stem cells of the hair follicle, adipose, keratinocytes and fibroblasts. **B**) Copper-free "click" chemistry. (From left) No treatment with DIFO-488; No GDP-FucAz in enzymatic reaction prior to treatment with DIFO-488; Presence of GDP-FucAz in enzymatic reaction prior to treatment with DIFO-488.

4. Direct CHoMP labeling—organ screen

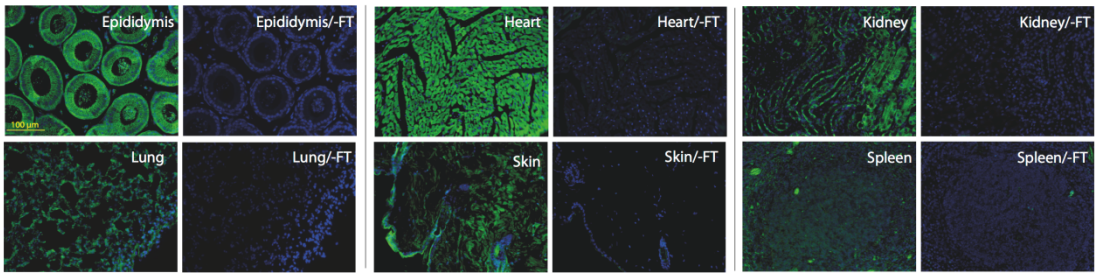

Figure S4. Screening LacNAc expression in FFPE mouse tissue samples using CHoMP (direct labeling with Alexa Fluor 488 N_3). Slides were incubated for 1 h at 37°C in the labeling solution containing 400 μg/mL FT, 350 μM GDP-FucAl, 5 mM $MgCl_2$ in TBST. After the FucAl incorporation, the slides were washed, reacted with 12.5 μM Alexa Fluor 488 N_3, 75 μM $CuSO_4$ premixed with 150 μM BTTP, 2.5 mM sodium ascorbate at RT for 30 min. Green: LacNAc. staining; Blue: DAPI nuclear staining.

5. Direct CHoMP labeling vs. ABC/TSA CHoMP method

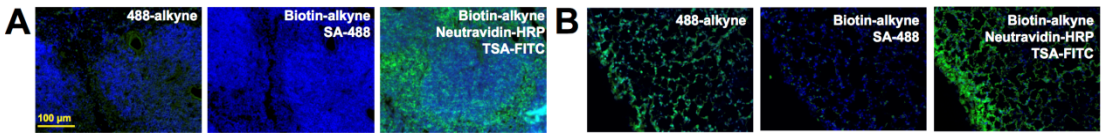

Figure S5. Comparison of the efficiency of CHoMP based on direct labeling and signal amplification using Streptavidin-488 or TSA, respectively, in FFPE sections of **A**) spleen and **B**) lung sections. Slides were incubated for 1 h at 37°C to enzymatically transfer FucAz to cell-surface LacNAc. After the azide incorporation, the slides were washed, reacted with 100 µM Alexa Fluor 488 alkyne or biotin alkyne, 75 µM $CuSO_4$ premixed with 150 µM BTTP, 2.5 mM sodium ascorbate at RT for 30 min. Slides treated with biotin alkyne were either labeled with streptavidin 488 or Neutravidin-HRP followed by TSA-FITC treatment and imaged using a fluorescence microscope. Green: LacNAc staining; Blue: DAPI nuclear staining.

6. CHoMP - ABC/TSA method optimization

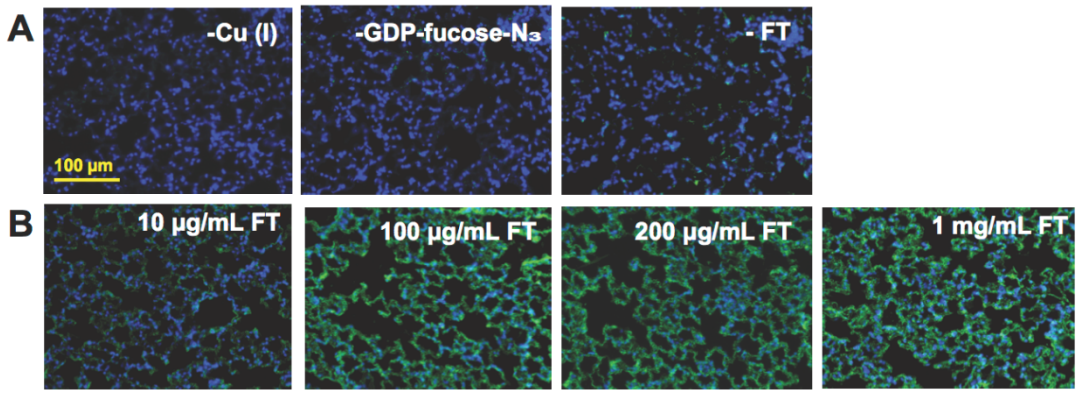

Figure S6. Optimization of 'click reaction' for CHoMP - ABC/TSA in FFPE lung serial sections using GDP-FucAZ. **A**) From left to right: Without the presence of Cu(I) catalyst in the CuAAC reaction; Without the presence of GDP-fucAz in the enzymatic reaction; Without the presence of α1,3FucT in the enzymatic reaction. **B**) α1,3FucT titration.

7. Organ screen with CHoMP- ABC/TSA.

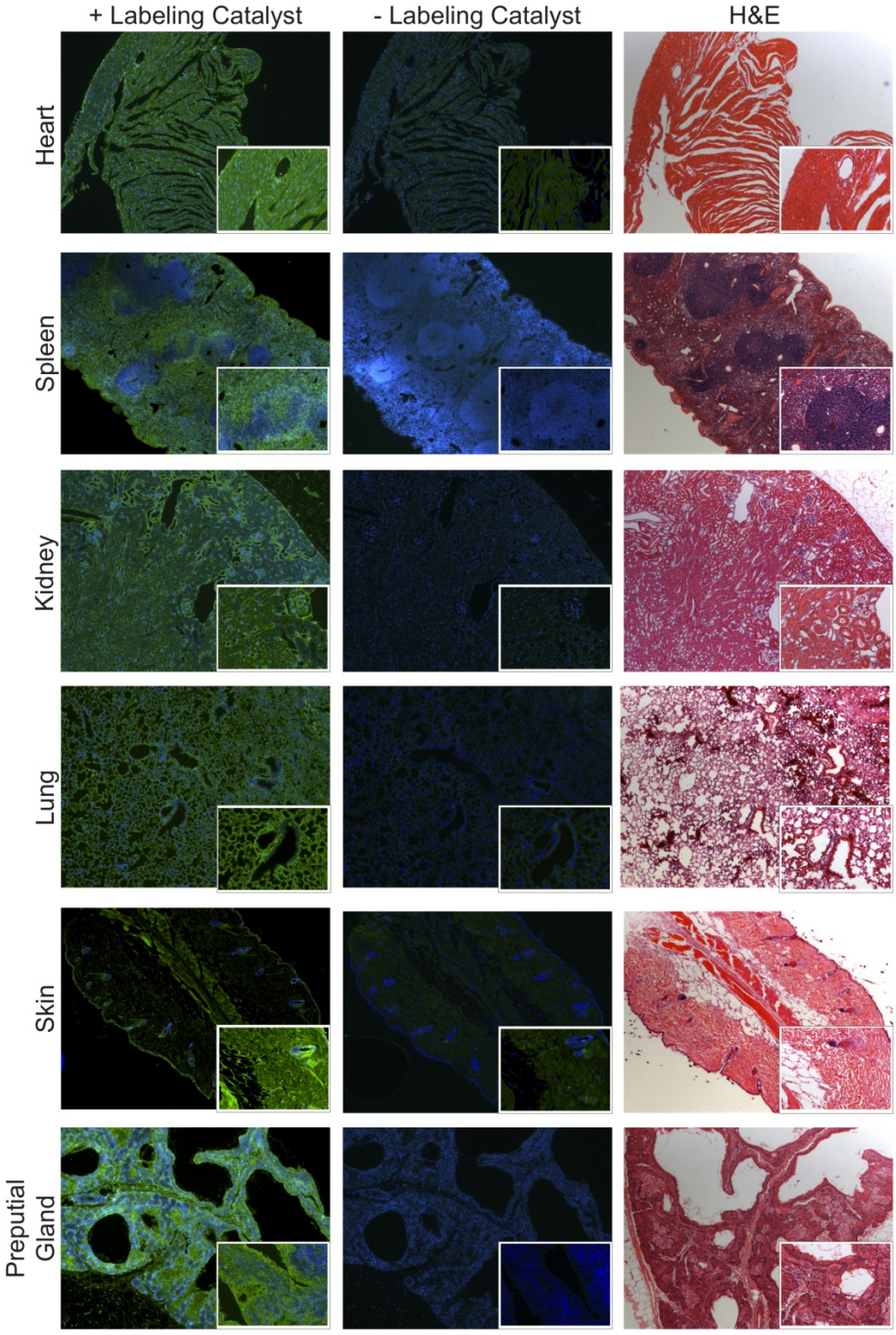

Figure S7. CHoMP labeling on paraffin embedded mouse heart, spleen, kidney, lung, skin and preputial gland tissues. LacNAc (green), DAPI stain (blue), and serial H&E. Center panel depicts CHoMP labeling without the presence of Cu(I) in the "Click" reaction