

Carbohydrate functionalized surfaces for Glycomic applications

[K. Barth](#), [G. Coullerez](#), [M. Textor](#)

BioInterfaceGroup, Laboratory for Surface Science and Technology, ETH Zurich, Zurich, Switzerland.

INTRODUCTION: Glycomics became a field of growing interest in the recent years due to the important role of carbohydrates in many important biological processes like cell-cell and cell-pathogen recognition.[1] Because of missing analytical tools and the difficulties to synthesize or purely isolate complex carbohydrates, there is until now little known about the exact role of carbohydrates in these processes. Therefore, the goal of our work is to contribute to the development of systems that allow a high throughput screening of specific carbohydrate interactions.

METHODS: We have newly developed a method to graft mono- and oligomannosides to the polycationic copolymer poly(L-lysine)-graft-poly(ethylene glycol) (PLL-[g]-PEG), which adsorbs spontaneously on negative charged oxide surfaces (Nb_2O_5 , TiO_2). With our system it is possible to control the density and distribution of the mannosides on the polymer backbone by changing on one hand the proportion between sugar terminating and non-functionalized PEG chains or on the other hand the ratio of PEG chains per Lysine unit. We use the label free bio-sensing method Optical Lightmode Waveguide Spectroscopy (OWLS) to study the specific adsorption of the well-known D-mannose specific lectin Concanavalin A (Con A) on our functionalized surfaces. Furthermore the interactions of mannose functionalized surfaces with the mannose specific strain K12 of the bacteria Escherichia coli (E. coli) are tested.

Patterns of the carbohydrate functionalized polymers with a non-fouling background are formed with the photolithographic patterning method MAPL (Molecular Assembly Patterning by Lift-off).[2]

RESULTS: The OWLS results show that the carbohydrate functionalized PLL-[g]-PEG are resistant against non-specific serum adsorption while the amount of adsorbed Con A depends on the mannose surface density. As we can determine the mass of adsorbed polymer qualitatively with a sensitivity around 2 ng/cm^2 , we are able to define binding constants for the interaction strength between the lectin and our system as well as IC_{50} values with the inhibitor α -methyl-mannose.

The absence of non-specific interaction and the mannose surface density dependence can be also

seen for the adhesion of the E. coli strain K12 via the mannose specific lectin FimH on the functionalized surfaces.

The specific interaction with the biological targets Con A and E. coli can be clearly shown with the patterns of carbohydrate functionalized PLL-[g]-PEGs formed by the MAPL technique as shown in Fig. 1.

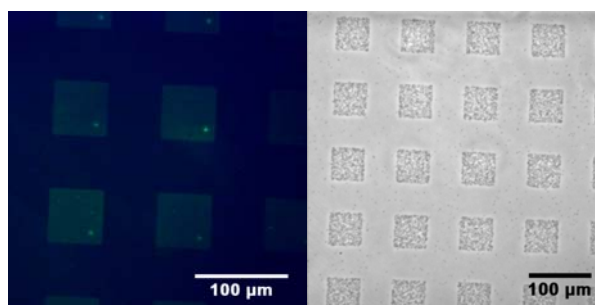


Fig. 1: FITC labelled Con A (left) and E. coli (right) adsorbed on patterns of Mannose functionalized PLL-[g]-PEG formed by the MAPL technique.

DISCUSSION & CONCLUSIONS: Mannose functionalized PLL-[g]-PEG is a simple method to immobilize carbohydrates in a controlled manner on surfaces for the detection of specific carbohydrate interactions. With the well known model systems Con A and E. coli we proof that mannosides immobilized on surfaces are still available for specific interactions while the non-specific interaction is prevented by the ethylenglycol moieties in the polymer. With the possibility to extend this approach to complex oligosaccharides it is a versatile tool for the study of the role of carbohydrates in biological systems.

REFERENCES: ¹ N. Shanon, H. Lis (1993) *Sci Am* **268**, 82-89. ² D. Falconnet, A. Koenig, F. Assi, M. Textor (2004) *Adv Func Mat* **14**, 749-756.

ACKNOWLEDGEMENTS: ETH Research Grant TH-38/04-2: "Carbohydrate-functionalized surfaces for Glycomics"