

NON-SPECIFIC PROTEIN ADSORPTION ON THIN FILM COATINGS

M.Rankl, T.Ruckstuhl & S.Seeger

Institute for physical chemistry, University of Zürich, Zürich, Switzerland.

INTRODUCTION: Chemical composition and topology of a surface determine its physical properties and thus the non-specific interaction with biomolecules. In the present study the surface tension parameters of thin film coatings commonly used in biological assays are determined by contact angle measurements. With this data the relation between chemical composition of the surface films, their energetic properties and the nonspecific adsorption properties is investigated¹. Therefore coatings with different functional groups and backbone structures are used. Poly-L-lysine (PLL), aminopropyltriethoxysilane (APTES), aminopropyltrimethylsilyl ether cellulose (ATMSC), cinnamatrimethylsilyl ether cellulose (CTMSC) and trimethylsilyl ether cellulose (TMSC) (see figure 1) provide a suitable variance in chemical composition, as either the backbone or the side chain remains unchanged. To study the biomolecule surface interactions a highly sensitive biosensor was developed to detect surface bound molecules exclusively².

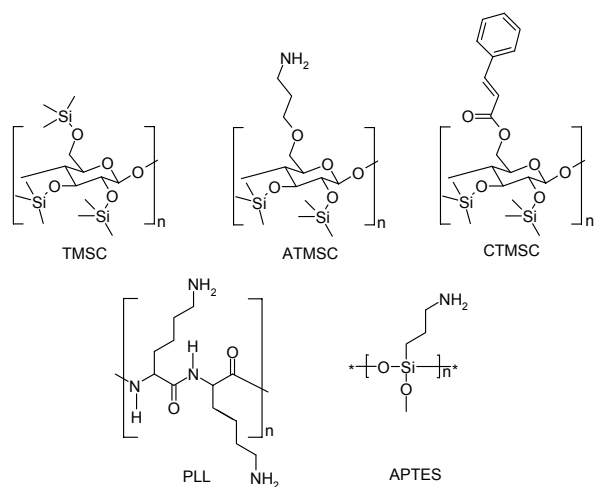


Fig. 1: Chemical structure of the substances used for coating of glass cover slips.

METHODS: The cellulose polymers can easily be coated on common cover slips with the Langmuir-Blodgett-technique yielding very flat and homogeneous films. APTES and PLL are deposited wet chemically on the glass cover slips. The surface tension components are determined by contact angle measurements. Roughness and topology of the surface films are determined by AFM-microscopy. The proteins are labelled with the fluorescent dye Cy5 and adsorption studies are carried out with a supercritical angle fluorescence (SAF) biosensor, which was designed for the selective detection of surface bound molecules. This is achieved by collecting supercritical angle fluorescence emission of the surface bound dipole emitter. Thus the

penetration depth of the detection volume into the aqueous medium is reduced to about 100 nm and bulk fluorescence from the solution is rejected successfully.

RESULTS: All films reduce the surface tension of the bare glass cover slip and in particular the biological cellulose LB-films and PLL can be considered to be low tension surfaces. The predominant Lewis-base properties of the cellulose derivatives as well as their electron-acceptor properties coincide with the degree of substitution. While the polarity of the films varies with the covalent attachment of functional groups to the cellulose backbone, there is only a minor effect within the amino-functional films.

AFM-measurements reveal a roughness for all coatings at a nm-scale. The influence of surface roughness on adsorption is found to be rather small.

By SAF-measurements the kinetics and equilibrium density of adsorbed proteins are measured. Celluloses show an extremely weak tendency to adsorb proteins nonspecifically.

DISCUSSION & CONCLUSIONS: Kinetics and yield of the adsorption process are strongly dependent on the surface properties. The adsorption tends to be mainly driven by the backbone properties of the polymer and only to a minor degree by the substituent. Thus cellulose provides an excellent substrate for use in analytics. Different functional groups to bind receptor molecules covalently can be introduced without weakening its low-adsorptive qualities.

REFERENCES: ¹M. Rankl, S. Laib, S. Seeger (2003) *Colloids and Surfaces B: Biointerfaces* (2003) 30(3) 177-86. ²T. Ruckstuhl, M. Rankl, S. Seeger (2003) *Biosensors&Bioelectronics* 18(9) 1193-99.

ACKNOWLEDGEMENTS: This work was supported by Schweizerischer Nationalfonds (SNF), Grant 21-63839.00 and the European Union, Grant 02.0001.