Modulating Protein Adsorption on Oxygen Plasma Modified Polysiloxane Surfaces

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The adsorption behaviour of proteins onto synthetic surfaces is one of the main issues in view of biocompatible surfaces and biosensing applications.

In the present paper we report the study on the adsorption behaviour of three model globular proteins, Human Serum Albumin, Lactoferrin and Egg Chicken Lysozyme onto both unmodified surfaces of a silicon-based polymer and the corresponding plasma treated surfaces. In particular, thin films of hydrophobic polysiloxane (about 90° of static water contact angle, WCA) were converted by oxygen plasma treatment at reduced pressure into very hydrophilic phases of SiO_x (WCA less than 5°). The kinetics of protein adsorption processes were investigated by QCM-D technique, while the chemical structure and topography of the protein adlayer have been studied by Angular resolved-XPS and AFM respectively. It turned out that Albumin and Lysozyme exhibited the opposite preferential adsorption respectively onto the hydrophobic and hydrophilic surfaces, while Lactoferrin did not exhibit significant differences. The observed protein behaviour are discussed both in terms of surface-dependent parameters, including surface free energy and chemical structure, and in terms of protein-dependent parameters, including charge as well as the average molecular orientation in the adlayers. Finally, some examples of differential adsorption behaviour of the investigated proteins are reported onto nanopatterned polysiloxane surfaces consisting of hydrophobic nanopores surrounded by hydrophilic (plasma-treated) matrix and the reverse.