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Reduced Protein Adsorption Found on Plasma-Polymerized Vertical Chemical Gradient Films

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The wettability of a surface generally influences the way amphiphilic molecules adsorb onto it. Since amphiphilic molecules contain both hydrophilic and hydrophobic groups, a different interaction with hydrophilic or hydrophobic surfaces is anticipated. Using, for example, bovine serum albumin (BSA) as an amphiphilic probe molecule, a different amount of proteins is thus observed to adsorb on hydrophilic quartz-like and hydrophobic silicone-like surfaces. Additional interactions with regions below the surface significantly affect the adsorbed protein mass. This was uncovered in a study with plasma-polymerized siloxane films with low (hydrophilic) and high hydrcarbon content (hydrophobic) showing high and low BSA adsorption, respectively, in accordance with literature [1].
Then, both plasma polymer films were combined to form an ultrathin hydrophobic/hydrophilic vertical chemical gradient at the surface. Starting with the hydrophilic base layer (as deposited on a sensor), a nanometer thin adlayer of the hydrophobic film has been applied as a hydrophobic surface termination. As an unexpected result, the BSA adsorption on such vertical gradient structures was measured to be significantly reduced. The sub-surface region thus has an additional effect on protein adsorption, most likely due to water molecules that are able to penetrate the hydrophobic/hydrophilic structure. Similar effects were observed for gradient structures in the range of 2-8 nm thickness. Such sub-surface water, as confined in a vertical chemical gradient, might thus be exploited in future bio-medical and technical applications to obtain additional control over protein adsorption and energetics on resilient plasma polymer surfaces.
[1] D. Hegemann, N.E. Blanchard, M. Heuberger, Plasma Process. Polym. 2016; DOI:10.1002/ppap.201500228

Keywords
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wettability
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