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Silicone Nanocarpets as Biointerfaces: from Superhydrophobicity to Selective Protein Enrichment

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INTRODUCTION: Surfaces with extreme wetting properties are receiving a lot of attention mainly in regards to fabricating superhydrophobic or superhydrophilic coatings for self cleaning, anti-fouling or anti-fogging applications.[1] The ability to create a wetting/non wetting contrast on a substrate has expanded the potential of such coatings to areas like liquid handling, micro array technology or open channel microfluidics devices.[2] We present a simple and versatile procedure to create surfaces with arbitrary superwetting/-nonwetting properties based on a novel, high surface area silicone nanofilament coating.[3] Additionally, the coating could be modified to mimic stable, high surface area anionic or cationic exchange resins with specific protein adsorption properties.

METHODS: Details on the preparation of the initial superhydrophobic silicone nanofilament coating can be found in a previous publication.[3] To create superhydrophilic/superhydrophobic surface patterns, areas on the coating were selectively activated in an oxygen plasma. The activated areas were chemically modified with 2-(carbomethoxy)ethyltrichlorosilane (CETS) and aminopropyltrichlorosilane (APTES) by standard SAM techniques.

Protein adsorption on the activated, CETS and APTES modified coatings was monitored by fluorescent techniques using dye labelled model proteins β-Lactoglobulin, α-Chymotrypsin, and Lysozyme.

RESULTS: Through plasma activation the initially superhydrophobic silicone nanofilament coating becomes superhydrophilic. In this way a wetting contrast of arbitrary shape and size can be created on a substrate (Figure 1). In a subsequent functionalization step only previously activated areas on the surface are susceptible to chemical modification. This enables a patterning of the surface both with a wetting contrast and a specific chemical functionality. On the charged APTES and CETS modified coating for instance, proteins specifically adsorb according to their electrostatic properties (Figure 2).

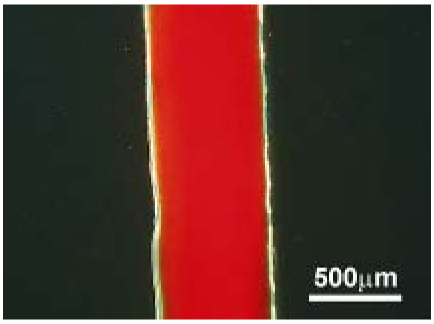

Fig. 1: A superhydrophilic stripe on a superhydrophobic background visualized by fluorescence microscopy.

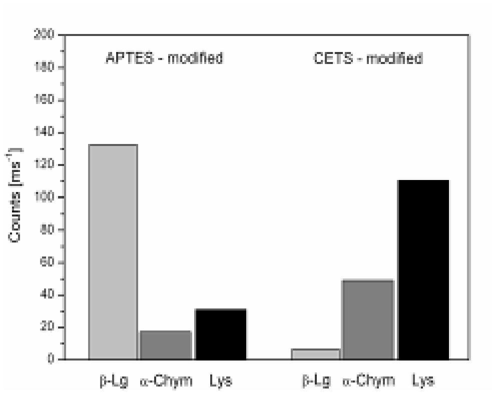

Fig. 2: Equilibrium coverage intensities of fluorescent dye labeled β-Lg, α-Chym and Lys on APTES and CETS modified silicone nanofilaments at pH 6.

DISCUSSION & CONCLUSIONS: The ability to create a diverse wetting and chemical contrast on a single, high surface area substrate will offer many new opportunities in the areas of micro array, micro channel and biosensor applications.

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