Nanosized hydrogel dots for biomarker detection

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Hydrogels are interesting materials for biosensing applications. Their tridimensional nature and high water content make them an appropriate matrix for protein immobilization, while their inertness minimizes non-specific protein binding[1]. Hydrogels also offer the possibility to produce protein microarrays on non-functionalized substrates, in a cost-efficient way[2].

Here in this study we present a model for a biomarker sensor based on spotted picoliter-volume hydrogel drops with a thickness of few nanometers. The polymer contains photoreactive moieties, allowing for UV crosslinking after deposition of the dots on the subtrate. In the same reaction, the polymer network was crosslinked and adhered to the substrate. When streptavidin was mixed with the polymer, the protein was immobilized in the matrix upon UV-crosslinking. In the first stages, the optimal crosslinking parameters were studied, and dot morphology was characterized with AFM and SEM.

For the proof of concept of the biosensing application, the streptavidin-biotin interaction was used to model an antibody-antigen interaction, and fluorescence was used for protein detection. In a first approach, the immobilization of streptavidin in the hydrogel matrix was studied using fluorochrome-tagged streptavidin. Then, regular streptavidin was immobilized and the functionalized dots were incubated with fluorescent biotin. The detection of fluorescence indicates that the streptavidin-biotin interaction has taken place. An analysis algorithm was developed which allows to discriminate fluorescence coming from the hydrogel dot and from the polymeric substrate, eliminating non-specific fluorescence from the analysis.

References

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2) Stumpf A, Brandstetter T, Hübner J, Rühe J. Hydrogel based protein biochip for parallel detection of biomarkers for diagnosis of a Systemic Inflammatory Response Syndrome (SIRS) in human serum. PLoS One. 2019 Dec 2;14(12):e0225525. doi: 10.1371/journal.pone.0225525. PMID: 31790441; PMCID: PMC6886838.

Figures

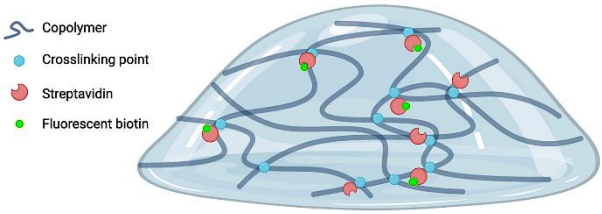

Figure 1: Representation of the experimental design. The hydrogel dots contain immobilized streptavidin, which is detected by binding of fluorescent biotin.