Efficient nanophotonic biosensing for low cost real-time bioassays

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Polarimetry has previously been used to demonstrate that free standing 200 nm pore AAO membranes, when functionalized with an epoxysilane, allow analytes to flow-through less than 100 nm from the assay surface, breaking mass transport limitations and effectively targeting their delivery[1]. Here, we report coating the membranes instead with a functional copolymer using a novel procedure, that has demonstrated less non-specific binding, and therefore greater selectivity, and more stability over time for immobilized allergens than epoxysilane[2]. A series of bulk refractive index experiments, with immobilized allergens on the pore walls, yielded a detection limit of 5×10^{-6} RIU, with a standard deviation <5%. Both the stability and the functionality of the coating and spotting procedures were then evaluated, with the response produced by the binding between the allergen protein and its cognate antibodies acquired in real-time. With the aid of streptavidin conjugated CdSe quantum dot (SA-QD) signal enhancers, a noise floor for individual measurements of 3.7 ng/ml (25 pM) was obtained, in a total assay time of under one hour. In comparison, for protein binding recognition, within the FP6 project SABIO a surface LoD of 0.9 pg/mm2 for anti-BSA on a gluteraldehyde-covered surface was recorded, corresponding to a 125ng/ml anti-BSA solution, whilst in InTopSens 5pg/mm^2 and 10ng/ml for biotin on a streptavidin coated surface was seen. Volumetric limits of detection (LoD) of 5×10^{-6} RIU and $8.3\text{x}10^{-6}$ RIU (refractive index units) for sensitivities of 246nm/RIU and 2169nm/RIU were reported from ring resonator biosensor based prior projects FP6 SABIO (at 1.31μm) and FP7 InTopSens (at 1.55μm) respectively.

References

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