Towards a flexible microfluidic test strip for IL-8 detection

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Abstract— **This paper proposes a polyester (PET) based flexible microfluidic test strip with an integrated immuno-sensor for interleukin-8 (IL-8) detection. Clinically, IL-8 has been associated with various clinical conditions including urinary bladder cancer, prostatitis, bacterial infections and others. The fabrication process of the sensor and the optical detection of IL-8 on a functionalized gold electrode are discussed. The functionalized gold sensors can detect IL-8 between 10^0 to 10^6 pg/mL, which spans the clinically relevant reference intervals of serum IL-8 and urine IL-8 [1].**

I. Introduction

With the increasing popularity of health monitoring, a low-cost, disposable solution for routine biomarker monitoring is of great interest. Passive microfluidics for bio-sensing can enable low-cost and non-invasive health monitoring using various bodily fluids. Current at-home monitoring tests include lateral-flow assays which are low cost and easy to use, but the results are mostly qualitative, with limited control of capillary flow through the test strip [2].

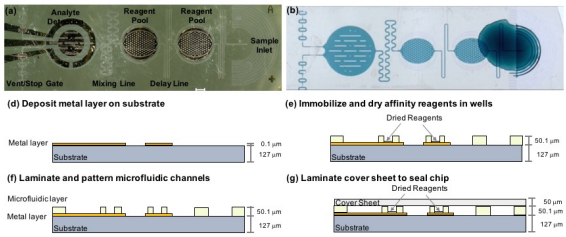

Figure 1. (a) Example of a flexible test strip with integrated optical sensor. (b) Example of a blue dye flowing through the microfluidic network of the test strip. (d)-(g) Process flow for test strip fabrication.

II. Main Results

The proposed microfluidic test strip is fabricated on a flexible PET film by first depositing and patterning the metal electrode via shadow mask deposition, Figure 1(d), and then an epoxy based dry film resist is laminated and patterned to form the microfluidic channels [3], Figure 1(e). Affinity reagents are immobilized and dried in the microfluidic wells, and the sensor surface is functionalized with antibodies specific to IL-8, Figure 1(f). Lastly, a cover sheet is laminated to seal the channels, allowing passive liquid flow, Figure 1(g).

The sensor was functionalized with an IL-8 specific capture antibody using standard thiol-based self-assembly monolayer and EDC/NHS coupling chemistry on gold [4]. Following standard ELISA protocol and wash steps, a biotinylated secondary antibody is used to sandwich the IL-8 antigen, followed by binding of streptavidin-bound horseradish peroxidase (HRP) enzyme. Detection is observed spectrophotometrically at 450 nm in the presence of 3,3',5,5'-tetramethylbenzidine (TMB), which forms a colored product in a 1:1 ratio to the concentration of HRP present.

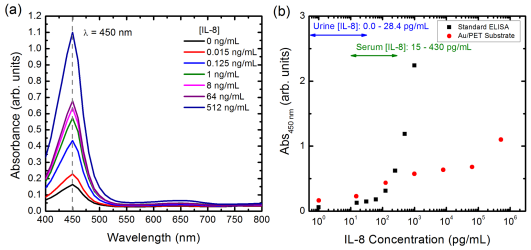

Figure 2. (a) Absorption spectra of collected TMB solutions at varying IL-8 concentrations. (b) Absorption at 450nm of the collected TMB solutions vs. standard ELISA.

To verify the successful binding of IL-8, varying concentrations of IL-8 was exposed to the functionalized gold sensors, and the final TMB solution was collected and measured spectrophotometrically. Figure 2(a) shows the absorption spectra of the collected TMB solutions. Figure 2(b) compares the absorbance at 450 nm of the collected TMB solutions to a standard ELISA using the same capture/detector antibodies in a 96-well plate. The functionalized gold sensor detected IL-8 from 10^0 to 10^6 pg/mL, spanning the clinically relevant reference intervals for serum and urine IL-8. Further optimization of antibody concentrations is required to improve the signal range of IL-8 detection.

III. Conclusions

In this work, we demonstrated the successful detection of IL-8 using flexible gold sensors. Next steps include full integration of the IL-8 sensor with the passive microfluidic elements to form a low-cost, quantitative bio-sensing test strip for at-home routine health monitoring.

Acknowledgment

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References

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