

SILICON NANOPHOTONICS SENSORS INTEGRATED IN REACTION TUBES

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An enormous amount of immunoassays are performed every day in hospitals and laboratories. An enzyme-linked immunosorbent assay (ELISA) is the most popular immunoassay technique and it is used as a diagnostic tool in medicine and plant pathology, as well as a quality-control check in various industries. [1]

However, ELISA tests have their drawbacks and limitations. Complex labeling techniques are required to be able to perform the assay and non-specific binding and endpoint timing are difficult to optimize. These issues could be solved by label free techniques such as silicon nanophotonic microring resonator sensors we studied earlier [2], but the disadvantage of that platform is that it requires microfluidics, which is still very much removed from the daily practice in e.g. hospital labs, which still relies to a large degree on platforms like 96-well microtiter plates, or reaction tubes

To address these issues, here, we propose the combination of a simple and compatible reaction tube platform with label free silicon-on-insulator (SOI) photonic biosensors.

The device (Figure 1) consists of a reaction tube in which bottom a silicon photonic chip has been integrated. This chip contains an array of well-known microring resonators sensors [2] which will be in contact with the fluid under analysis.

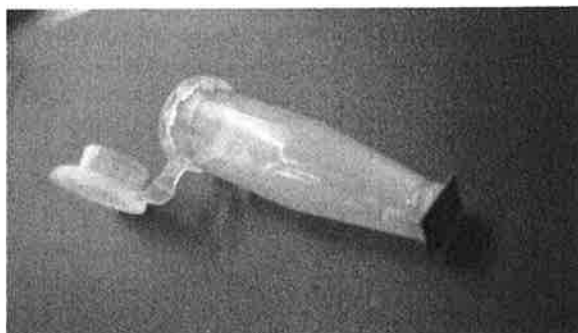


Figure 1. Silicon-on-insulator photonic chip integrated at the bottom of a reaction tube.

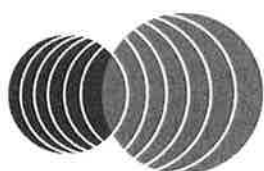
The main difference with our previous work which involved microfluidic packaging is that now light from a tunable laser is coupled into the microring resonator through the chip substrate, i.e. from below, instead of from the top of the sample as. To avoid the scattering of the rough substrate surface and to optimize the coupling few simple processing steps must be done in advance, like the thinning and polishing of the chip substrate. A shift in the resonance wavelength of the ring is measured when the binding of the specific antibody to the antigen (previously coated on the sensor surface) is produced. This shift is monitored by an infrared CCD camera that reads out the chip also through its substrate.

This device allows real time detection and analysis. Its great flexibility and small footprint make it ideal for an easy handling in any laboratory.

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[1] J. R. Crowther "Methods in molecular biology, the ELISA guidebook" Biomedical and life science, 2009.

[2] K. De Vos, "Multiplexed antibody detection with an array of silicon-on-insulator microring resonators" IEEE Photonics Journal, 2009, vol. 1(4), pp. 225-235.



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