Silicon Nanophotonics On-chip Sensing

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Abstract— Silicon nanophotonics is a very promising platform for integrated biosensing due to its high index contrast and mass fabrication potential. Ring resonators are particularly attractive because they allow very accurate determination of refractive index.

In this paper, several advances in silicon ring resonator biosensors are presented. First, we address the problem that due to the high index contrast, small deviations from perfect symmetry lift the degeneracy of the normal resonator mode. This severely deteriorates the quality of the output signal. To address this, we discuss an integrated interferometric approach to give access to the unsplit, high-quality normal modes of the microring resonator.

Second, we also demonstrate how we can integrate ring-resonator based sensing chips in a plastic reaction tube while at the same time still allowing for sample flow. This is achieved by using laser ablation to create holes through the chip.

We also show a different scheme with through-chip fluidics which can lead to improved analyte delivery and show an improvement of at least a factor of 3 in delivery time.

In addition, we present a multimodal sensing technique which simultaneously allows us to measure thicknees and refractive index of biolayers. This opens the door towards high-throughput study of conformational changes in biomolecules, which is very promising for drug discovery research.