Label-free optical biosensor based on active and passive resonant cavities.

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Integrated optical devices offer an enormous potential for miniaturized, compact and highly sensitive biosensors. Sensing of biomolecules is gaining interest due to its applications in many research areas; bacterial and virus detection, medical diagnostics, drug development, food and environmental control. We are developing micro- and nanophotonic biosensors in both active and passive material platforms for label-free detection of biomolecular interactions.

The use of optical semi-conductor cavities for sensing purposes is based on a measurement of the resonance wavelength shift caused by a refractive index change when a biomolecule binds to receptor molecule fixed on the cavity's surface. The use of high index contrast materials allows making micron- and submicron sized cavities with extremely sharp resonance peaks. They can be used for quantitative and real-time detection of very small amounts of analyte.
We are currently investigating passive SOI microrings, fabricated with DUV lithography. Figure 1 shows the shift of the resonance peak for a microring of diameter 1µm for liquids with different refractive indices. The resonance wavelength shift per refractive index unit (RUI) is measured to be 85 nm. Given the peak width of 0.15 nm, we estimate that the smallest change of refractive index that can be measured with these rings is $1*10^{-4}$.

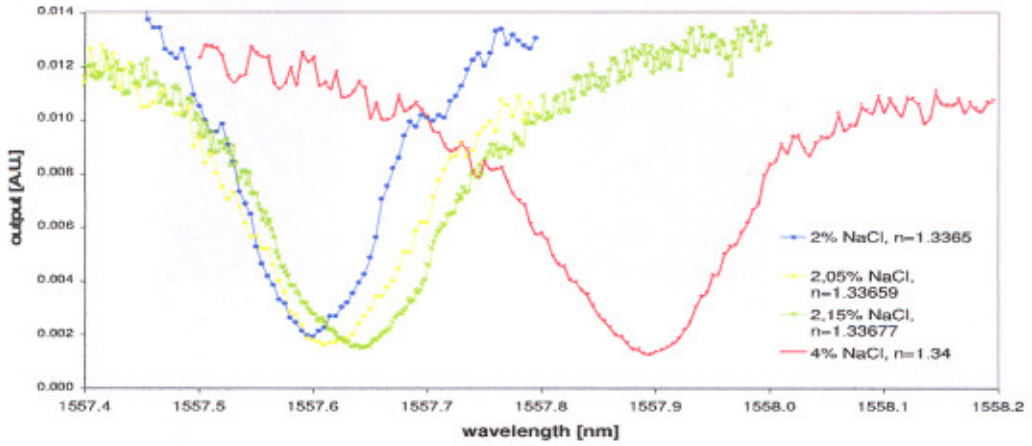

Figure 1: *Measured pass-spectra of an SOI ring, immersed in liquids with different refractive indices.*

By means of a microfluidic flow cell biological samples can be flown over the sensor in a controlled manner. The first tests sensing an avidin-biotin binding are accomplished. We plan to line up different microrings in arrays for a proof-of-principle biosensor for multiparameter analyses.

Furthermore we investigate active membrane InP microcavities (both microdisks and photonic crystal cavities). Their sharper emission peaks will enhance the sensor's sensitivity, so smaller amounts of analyte will be measurable, where single molecule detection is the ultimate aim.

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