

# Chip-Integrated Optical Biosensors based on Ring Resonators



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Silicon-based optical biosensors integrated into a semiconductor chip technology can lead to major advances in point-of-care applications, food diagnostics, and environmental monitoring through the rapid and precise analysis of various substances. In recent years, there has been an increasing interest in sensors based on photonic integrated circuits (PIC) because they give rise to cost effective, scalable and reliable on-chip biosensors for a broad market.

The silicon-on-insulator (SOI)-technology is the most attractive technology for PICs from commercial point of view since it provides a scalable platform for mass production and the opportunity for monolithic integration of electronic and photonic devices, which is known as electronic photonic integrated circuits (EPIC). This allows the integration of sensors, detectors and read-out electronics in a single chip.

Once the photonic chip is fabricated, the silicon surface of the sensor can be coated with a covalently attached sensing layer. This layer determines the specific detection and, hence, the application. This step, however, is independent from the fabrication of the chip, making the PIC and EPIC technology attractive for both, science and industry. A further advantage of PIC-based biosensors is the possibility to realize sensor arrays. This allows for the detection of several substances in parallel (multiplexing).

This course provides a comprehensive introduction to chip-integrated optical biosensors based on silicon-on-insulator ring resonators. Ring resonators are widely used as sensor elements to enable a highly sensitive measurement of the refractive index change in the surrounding material.

The course is divided in the following sections:

1. Introduction to optical biosensor in a chip-technology
2. Fundamentals of chip-integrated optical waveguides
3. Fundamentals of chip-integrated optical ring resonators
4. Sensing mechanisms and detection limits of ring resonators
5. Future aspects and overview of ongoing research

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**Room B5**