RESEARCH NEWS

Silicon chip-integrated photonics: Photonic biosensors

The Fraunhofer Center MEOS in Erfurt develops silicon-based photonic devices and photonic integrated circuits PICs for sensors/biosensors with applications in biomedicine and environmental monitoring, as one of its research and development directions.

At the MEDICA trade fair (November 14–17, 2022) in Dusseldorf the Fraunhofer Center MEOS will present its photonic biosensor technology at the Fraunhofer booth #F74 in Hall 3. The photonic devices are fabricated on a proprietary silicon nitride-on-silicon (SiN-on-Si) integrated photonic circuit platform on 200 mm wafers. In particular, a biosensor system based on multiplexed silicon nitride microring resonator chip operating at 1550 nm has been developed and will be presented.

Features of the developed sensor systems

Expertise is provided in the development of all key subsystems of photonic biosensing systems – photonic devices, microfluidics, surface biofunctionalization, biocomponent development and system integration. This enables development of photonic sensor systems with the following features:

- Tailored PIC design and scaling up the number of sensor channels
- Customized microfluidics and multiplexed sensor schemes
- Development of analyte-specific bioprotocols for surface functionalization, detection and amplification
- Parallel detection of specific biomolecules from a broad range of biomolecules
- Quantification of multiple analytes in a single step
- Rapidly obtainable results
- System integration and miniaturization through photonic assembly
- Portable systems with results immediately available on-site

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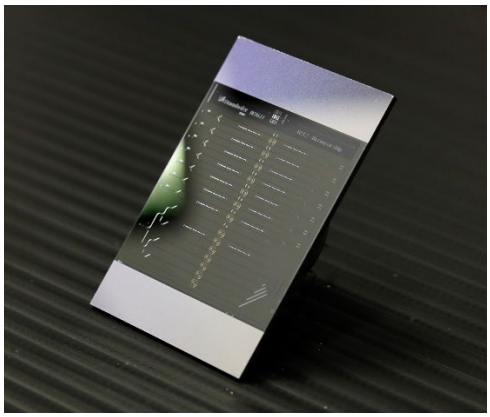
Promising biomarkers for early diagnosis of different diseases

An important application of photonic sensing is the detection of so-called micro-RNAs (miRNAs) biomarkers. These biomarkers are ideal for minimally invasive diagnoses due to their small size and traceability in the bloodstream. MiRNAs are considered promising biomarkers for early diagnosis of cancer or non-degenerative diseases such as Alzheimer's or Parkinson's disease, however disease diagnosis based on these biomarkers is specific for each individual patient (disease-indicating miRNA patterns need to be detected and analyzed). For existing mass screening technologies such as ELISA or PCR, this need for personalized diagnosis is time consuming and expensive. That is where the developed photonic sensing technology can help. The multichannel silicon nitride microring resonator biosensor system developed in MEOS demonstrates rapid and sensitive detection of multiple specific miRNA biomarkers in parallel.

Following the Fraunhofer standard, the core business model of Fraunhofer MEOS is customer and application specific research and development. The targeted application-oriented work includes technology development for the realization of Photonic Integrated Circuits (PICs) on 200 mm silicon wafers with the required performance and reliability, the development of specific surface functionalization and antigen-binding coatings as well as the development of the integrated system.



Picture 1 Integrated waveguides in silicon technology fabricated on 200-mm silicon wafers and used in combination with a functionalized surface as highly sensitive biosensors.

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