

Optical (Bio-) Sensor

Optical (bio-) sensors have significant advantages with respect to non-optical detection methods. They feature higher sensitivity, a larger dynamic range and are immune against electrical interference. Organic electronics provide the chance to monolithically integrate different active optoelectronic components together with a microfluidic chip into a lab-on-a-chip (LOC). One example developed at CSEM is a fully organic mini-spectrometer compatible with monolithical integration. Such mini-spectrometers represent an important building block for disposable low-cost bio- and chemical sensors.

The Concept

At its simplest an optical (bio-)sensor consists of a light source, a light-guiding structure such as a waveguide and either a single photodetector or a detector array.

The evanescent field of the waveguide mode overlaps with the sensing region where the analyte is located. The probe photons are either simply absorbed or absorbed and reemitted at a longer wavelength and coupled back into the waveguide. In either case the light intensity or the spectral distribution of the light inside the waveguide is modified.

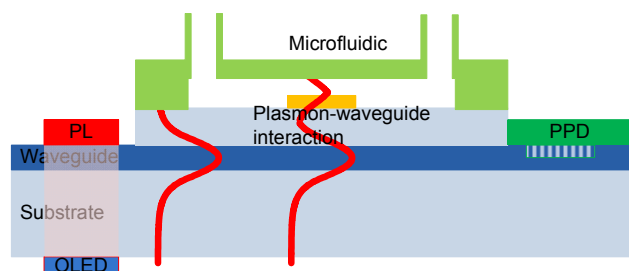


Figure 1 Biochip developed at CSEM: Light is coupled into single mode waveguide and interacts with the analyte inside the fluidic channel. Changes in the spectrum of the guided light are detected by an array of PPDs.

The Technology

The Thin Film Optics Division in Basel owns some IP in the domain of light-coupling from OLEDs into single mode waveguides. CSEM also has experience with highly integrated spectrometers based on an array of polymer photodiodes (PPD).

The Thin Film Optics Division also has the capability to define diffractive grating structures by means of embossing, a technology compatible with mass-production.

In collaboration with other divisions, CSEM can offer a complete solution including the optoelectronic chip and microfluidics. A particularly robust technology consists of microdrilling of plastic and laser-cut adhesive tapes in order to fix the microfluidics on the chip.

Applications

The past few years have seen great advances in lab-on-a-chip (LOC) technologies for genomic, proteomic and enzymatic analysis. The need for low-cost and disposable medical devices has driven the development of these LOC systems. The requirements for future systems can be summarized as follows: systems that are able to process multi-parameter measurements from small volumes of complex fluids with efficiency and speed, without the need for an expert operator. These systems should be inexpensive, but still accurate, reliable and portable. By integrating different functional units for reaction, detection, and separation into a microfluidic channel network, it could become feasible to realize one microchip comprising all features of a complete lab, which could be used to perform complex reactions and analyses.

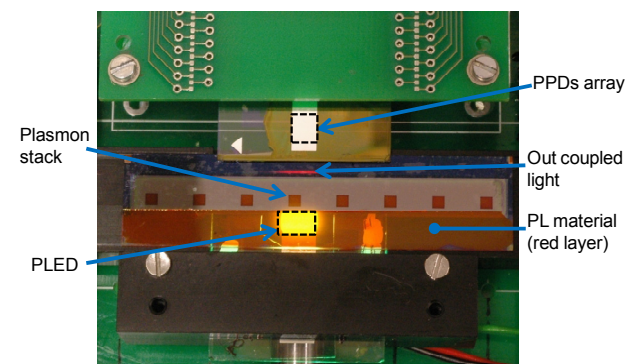


Figure 2 Picture of the biochip with organic optical components.

Organic optoelectronic devices – due to their potential ease, especially in regard to production processes - make them highly attractive for integrated, low-cost and niche LOC applications. A major strength of organic optoelectronics, particularly polymer optoelectronics based on solution processing, is the possibility to deposit such semi-conducting inks by additive print processes in defined patterns and areas forming the desired integrated systems.