Interferometer Based biosensor (Ramot)

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An active integrated-optics device for biosensing applications based on an interferometric laser has been developed.

This device is an interferometric laser biosensor which combines the benefits of spectral interrogation of an emitting biosensor with the sensitivity of interferometric integrated optics devices. In order to maximize the sensitivity of the interferometric laser biosensor, and in order to have an integral and inherent biological reference within the sensor device to account for nonspecific binding, the sensor receptors are immobilized only on the sensing branch. A combined photolithographic-biochemical process was developed to enable the patterning of the sensor receptors on the branch.

The Need and Background

In recent years there has been an extensive effort to perform life-science assays at the single-chip level in order to enable fast, on-site, parallel and inexpensive diagnoses (i.e. Lab-on-a-chip). One of the main approaches is based on optical biochemical sensors, which are integrated optical devices with embedded biochemical receptors (antibodies or DNA oligonucleotides). Upon exposing the sensor to the target material to be sensed, the receptors bind specifically to the latter. The interaction of this bound layer with the evanescent optical fields gives rise to an optical readout.

Although optical biosensors are considered to be among the most sensitive detectors, their use is currently limited as a result of their high cost and the fact that they require a delicate coupling of laser source and detectors to the chip. This seversly restricts their use to small throughput research laboratories. E dge cleaving and polishing of the chip, needed for coupling light into the chip is an expensive process.

The sol-gel method is among the simplest and cheapest techniques for fabricating doped optical waveguides, since the liquid precursors are mixed and spin-coated onto a substrate.

Advantages

- New materials (thin Nd-doped sol-gel guiding layers)
- Robust (integrated-optics biosensor; output is encoded by the emission spectrum of the integrated device; delicate coupling of laser source and detectors to the chip is not required)
- High sensitivity (interferometric laser)
- Inexpensive & Disposable (sol-gel based; no chip edge polishing or processing is required).

Stage of Development

A prototype system was built and used to test the presence of CRP antibodies, which is an indicator for cardiovascular seizures. While clear specific binding occurred when the laser biosensor was exposed to CRP, there was only non-specific adsorption behavior on exposure to BSA, which was used as a biological control.

Patents

US granted patent 7,447,391

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