Chemical Sensing by RIFTS-Reflective Interferometric Fourier-Transform Spectroscopy: A Robust, Self-Compensating Method for Label-Free Detection of Biomolecules

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BACKGROUND

Most optical transducers for label-free biosensing involve measurement of a change in the refractive index of a material induced upon analyte binding. While surface plasmon resonance (SPR) films, resonant and nonresonant diffraction gratings, reflectometric interference (RIFS) layers and Fabry-Perot interferometers show very sensitive responses to small changes in refractive index, these methods are all limited by zero-point-drift arising from changes in temperature, matrix composition, or nonspecific binding to the analytical surface.

A double-beam (Michelson-type) interferometer, in which one optical path acts as a reference channel, provides an excellent means of compensating for such effects. Various implementations of double-beam correction have been employed in micro-scale biosensor systems, generally involving two spatially distinct regions of a chip. However, because the sample and reference channels are separated in the X-Y plane, such designs pose significant alignment and manufacturability challenges, especially upon incorporation into high-throughput arrays.

TECHNOLOGY DESCRIPTION

This invention utilizes a novel self-compensating interferometric biosensor comprised of two layers of porous SiO 2, stacked one on top of the other. The reflectivity spectrum displays a complex interference pattern that arises from a combination of Fabry-Pérot interference from these layers. A ratio of the peak intensities in the fast Fourier transform (FFT) allows discrimination of target analyte from matrix effects arising from non-specific compositional changes in the analyte solution.

APPLICATIONS

Label-free biosensing, high-throughput molecular sensing, array-based sensing, drug lead discovery, diagnostics, and characterization of kinetic and thermodynamic binding constants in biomolecular binding assays.

ADVANTAGES

The approach is very general. For example, the methodology should also work with other label-free transduction modalities in materials other than porous SiO 2 or porous Si that utilize refractive index changes, such as surface plasmon resonance or microcavity resonance. The built-in reference channel and Fourier method of analysis provides a general means to compensate for changes in sample matrix, non-specific binding, temperature, and other experimental variables.

STATE OF DEVELOPMENT

The concept has been demonstrated with a Protein A capture probe and Human Immunoglobulin G as the target analyte. The system response is shown to be insensitive to the addition of 4000-fold excess sucrose or 80-fold excess bovine serum albumin.

RELATED MATERIALS

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OTHER INFORMATION

KEYWORDS
porous silicon, biosensor, photonic crystal, optical biosensor, interferometric biosensor, chemical sensor

CATEGORIZED AS
- **Biotechnology**
  - Genomics
  - Proteomics
- **Medical**
  - Diagnostics
  - Other
  - Research Tools
- **Nanotechnology**
  - NanoBio
- **Research Tools**
  - Nucleic Acids/DNA/RNA
  - Screening Assays

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INTELLECTUAL PROPERTY INFO

A patent application is pending.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,909,985	03/06/2018	2005-179

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