Novel Integrated Optic Sensors

H.J.W.M. Hoekstra, P.V. Lambeck, G. Altena, M. Dijkstra, J. van Lith and R. Wijn

Integrated Optical Microsystems group

MESA+ Research Institute, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands

Abstract

A few

- novel integrated optics sensor principles, and
- a presently studied sensor-array, for multisensing,

are presented and discussed.

Introduction

There is a strong need for cheap, compact sensing systems, with a low detection limit and high resolution for applications in the chemical domain, in e.g. food processing, and the detection of moving mechanical parts. Integrated optics (IO) sensors are excellent candidates to fulfill these needs and they have shown already to be commerciable. The IO sensor research of the IOMS group focuses on improving the sensor performance in novel devices, as well as to apply these sensors in arrays for multi-sensing purposes.

Technology

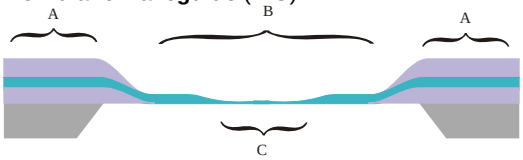
IO sensing devices are fabricated using

- SiON technology (offering an index range of 1.45-2)
- as well as functional materials, like ZnO (EO modulation) and interfacial materials.

Structuring of optimized waveguiding structures takes place with photo-lithographical processes.

Novel IO Sensing Principles

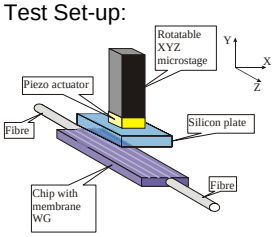
Membrane waveguide (WG)



A: couple sections; B: Membrane WG; C: Sensing section

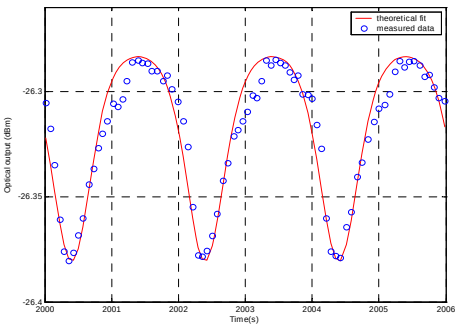
Principle: the presence of material influences loss/phase

Test Set-up:

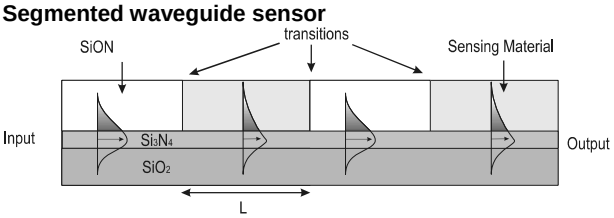


The thin WG (100nm) ensures a wide sensing range (~10µm), detection limit ~1nm

Result of experiments:

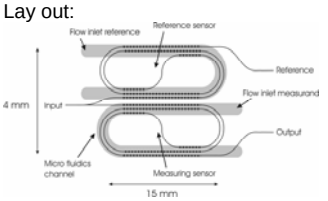


Segmented waveguide sensor

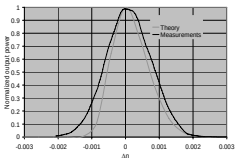


Principle: Losses, at transitions are index dependent.

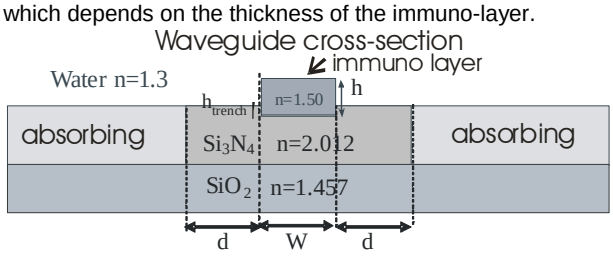
Lay out:



Result:

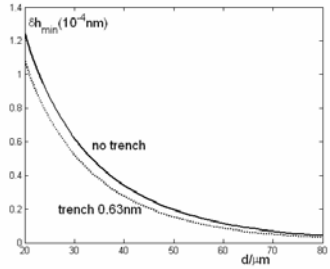


Immuno-sensor, using concentration dependent absorption: *Principle*, the modal absorption depends on the field shape, which depends on the thickness of the immuno-layer.

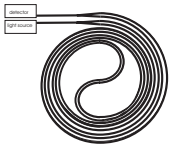


A resolution of $\delta h \sim 10^{-4} nm$ is feasible.

The sensor is almost insensitive to temperature fluctuations.

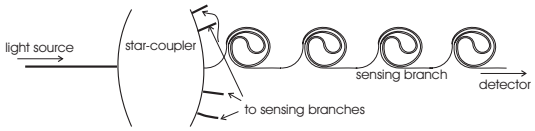


Mach-Zehnder based sensor array



Basic element: Sensing windows and EO modulation are applied.

Due to the lay-out, the sensor is quite insensitive for temperature fluctuations.



Multi-sensing array, each sensor is EO-modulated with a different frequency

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