Tunable Fabry-Perot Optical Filter with a Resonant Cavity Based on a Piezoelectric Polymer

B. Silva, J.G. Rocha*, A. J. Ferreira**, S.Lanceros-Mendez** and G.Minas**
**Universidade do Minho, Dept. de Electrónica Industrial, 4800-058 Guimarães, Portugal*
***Universidade do Minho, Dept de Física, Campus de Gualtar, 4710-057 Braga, Portugal*

gerardo@dei.uminho.pt

This article describes a tunable Fabry-Perot optical filter with its resonant cavity based on a piezoelectric polymer, for application in the biochemical analysis of biologic fluids. The filter is composed by two thin-films of silver -mirrors- located parallel one to the other and separated by a nanometer size thin polymer film of poly(vinilidene fluoride), PVDF, in its β-phase. When applying an electrical voltage to the mirrors, the thickness of the polymer changes, changing the distance between the mirrors and thus modifying the response of the filter. The lack of parallelism in conventional Fabry-Perot filters is solved with this approach, once the changes in polymer, reflecting variations at a molecular level, are uniform in the whole area. Therefore, this filter provides the selection of a wide range of wavelengths allowing the use of a conventional white light as source, and avoiding the use of monochromatic sources that increase substantially the price of the analysis devices and consequently the cost of the analysis.

The analysis of biological fluids has shown to be a very important factor in the detection and/or treatment of illnesses. For that reason, it is usual a doctor to prescribe, periodically, clinical analysis to the patients for routine diagnosis. Normally the analyses are performed in central laboratories dislocated from the doctor's office, being their results available only some hours or even days later. Due to this situation, the doctor cannot make a reliable diagnosis to the patient in useful time and, moreover, the analysis system becomes expensive and uncomfortable [1, 2]. In order to avoid the drawbacks existing in conventional analysis devices, it has been developed small portable and easy of use devices that provide higher comfort to the patient.

The filter that is presented here constitutes one of the three parts of a clinical analysis microlaboratory, whose working principle is based on the spectrophotometric analysis of biological fluids for measuring the concentration of several biomolecules that are present in those fluids. Each biomolecule presents a maximum value of absorbance when excited by a light at a specific wavelength. The concentration of each biomolecule in the biological fluid is directly related with the value of the absorbance [3, 4].

The referred microlaboratory is composed by three parts. The first one is a microchannel system in which the samples and reagents are placed, and includes microreservoirs where each sample is tested (Fig. 1a). The second part contains optical detectors and their readout electronics, which are usually manufactured in CMOS (Fig. 1b). The third part contains the optical filtering system, which selects the wavelength that corresponds to the biomolecule into analysis (Fig. 1c). The tunable optical filter presented in this article has the main goal of simplifying the third part of the microlaboratory, replacing the array of non-tunable optical filters already implemented by our group (Fig.1c) [5].

The fabrication of the filter is based on thermal evaporation and spin coating techniques. In a first step, a silver mirror was deposited on a glass substrate, whose only function here is to serve as physical support to the filter. In the next step a nonometer size thin polymer film was spin-coated on top of the silver thin-film already deposited and poled. Finally, the second thin-film of silver was deposited on the polymer film. Fig. 2 shows a picture of the filter.

Acknowledgements:

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References:

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Figures:

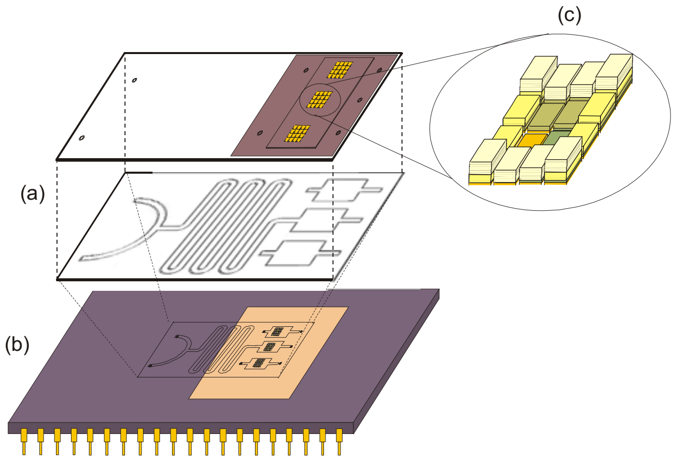

Fig.1: Schematic representation of the lab-on-a-chip structure; a) microchannel system, b) optical detectors and their readout electronics; c) optical filter array.

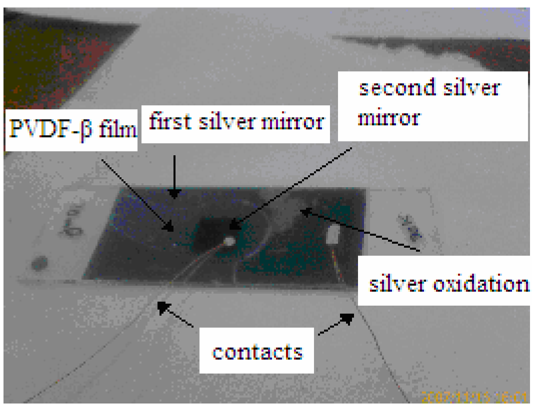

Fig.2: Tunable Fabry-Perot Optical filter prototype.