Biosensing platform for the monitoring of a small population of cells

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Keywords: Microfluidics, cantilevers, biosensor.

Context

The objective of this work is the design, fabrication, characterization and packaging of a biosensing chip aimed to the dynamical characterization of the activity of a small population pancreatic Beta-Cells, responsible for the production of insulin. This project is part of a wider collaboration involving several universities in Japan (CREST project) bringing experience in pancreatic Beta Cell culture on chip.

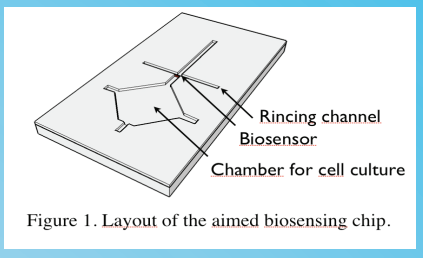


Figure 1. Layout of the aimed biosensing chip.

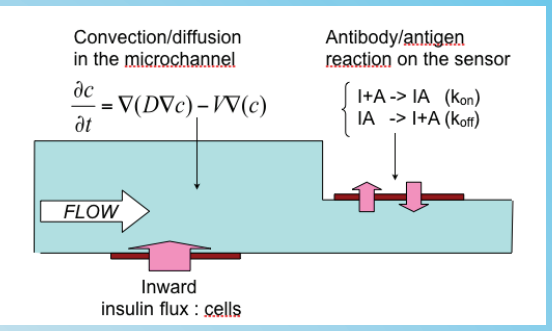
Layout of the biosensing chip.

Objectives

The activity of the targeted cells can be monitored by several direct or indirect means. In our case, we focus on the direct and dynamic characterization of the produced insulin using integrated on chip biosensing solution.

Methods

A numerical model was first setup to optimize the channel dimensions in regards to mass transport. This multiphysic model consists in two separate domains : a 2D domain in which convection and diffusion equations are solved, and a 1D domain in which the antibody/antigen reaction is modeled [1,2].



Simulated geometry, divided into a culture chamber and a microchannel bearing the biosensing element..

A biosensing technique based on functionalized resonating cantilevers is set up. Torsion mode is chosen in order to limit the hydrodynamic effects on the quality factor of the resonating element. Moreover, an original integrated actuation/detection method based on magnetostrictive films is set up in collaboration with LEMAC/IEMN [3].

References and Publications

[1] M. Sigurdson, D. Wang, C. D. Meinhart, Lab Chip, 5, pp. 1366-1373 (2005).
[2] G. Hu, Y. Gao, D. Li, Biosensors and Bioelectronics 22, pp. 1403-1409 (2007).
[4] S. Li, L. Orona, Z. Li, Z.Y. Cheng, Applied Physics Letters, 88, 073507 (2006)