Master Thesis 2011-2012

Electro Wetting On Dielectric (EWOD) microfluidic chip design and evaluation

Background

Microfluidics can be defined as the study of fluids flows at the microscale. This field has gained a huge attention through the years, thanks to its scientific and industrial potential. Nevertheless, there is currently only a few successful applications regardind its promising potential. One of the key for microfluidic system is the integration of sensors, which are usually external systems not adapted to miniaturization [1].

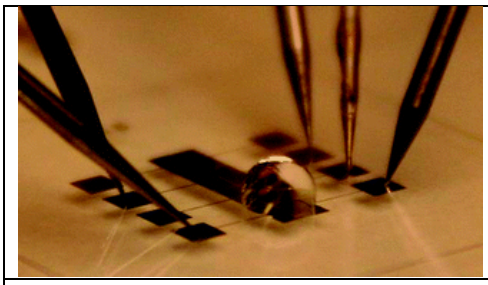

Fig.1 – Exemple de puce EWOD ouverte. [V. Schaller et al. - ***Lab Chip***, 2009, **9**, 3433-3436].

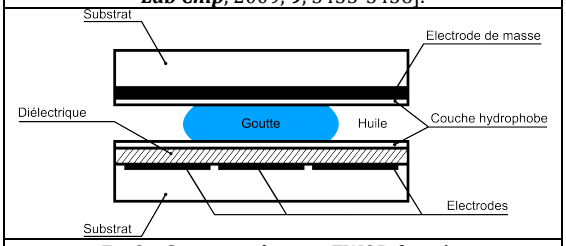

Fig.2 – Structure de puce EWOD fermée.

Problem statement

The purpose of this work is to design and evaluate a digital microfluidic system based on the Electro Wetting On Dielectric technology [2]. This technique allows the manipulation of nanovolumes (< 100nL) on top of an electrode matrix, as shown in Fig.1. Applying appropriate electrical potentials can displace, merge or separate these nanovolumes. Each droplet become an independent liquid volume that is controlled by an electronic system, without moving parts like in a typical pressure-based microfluidic system, thus offering a very versatile architecture.

One of the major drawbacks of such a system is the durability: electrical potentials can be as high as several hundreds of Volts, implying high constraints on the dielectric layer (see Fig.2) which is usually less than 10µm thick. The associated electronic circuitry has to be able to supply such high potentials, which are usually not compatible with a miniaturization approach.

Tasks and tools

The MSc student will be in charge of creating the first EWOD chips at the IMS lab, working in team with a CNRS research fellow. She/he will be active in all the steps, from design to characterization of the EWOD chips. She/he will have the opportunity to work in a clean room environment, using various MEMS fabrication techniques such as spin-coating, thermal evaporation, soft lithography or photolithography. Physical, electrical and optical characterization will also be part of the Master's Thesis.

Depending on his/her skills, the student will also have the opportunity to contribute to simulation and computations of EWOD (through the use of Matlab and Comsol Multiphysics tools) and instrumentation design for the EWOD driver.

After the Master Thesis

This digital microfluidic platform will be used as the starting point for a more ambitious project of a true Lab on a Chip, using various integrated sensors technologies. At the end of the Master's thesis, a PhD position will be available at the IMS laboratory, financed by University Bordeaux 1.

Bibliography

[1] Fair, R. (2007). Digital microfluidics: is a true lab-on-a-chip possible? *Microfluidics and Nanofluidics*, 3 (3), 245-281.
[2] Mugele, F., & Baret, J. (2005). Electrowetting: from basics to applications. *Journal of Physics: Condensed Matter*, 17, 705-774.

Requirements

Candidates are expected to be very motivated by this multidisciplinary topic, implying design, microfabrication in a clean-room environment, and characterization techniques. Rigorous and open-minded applicants are expected. A background on micro technologies will be a plus.

Practical information

Duration from 5 to 8 months. 400€ per month gratification.

Contact: Vincent Raimbault – CNRS research fellow
vincent.raimbault@ims-bordeaux.fr
Phone +33 (0) 540 006 166

IMS Bordeaux – UMR5218
Microsystems group – Acoustic Detection Microsystems (MDA) team
Bâtiment A31
351 cours de la Libération
33405 TALENCE - CEDEX
http://www.ims-bordeaux.fr/

About our team:

Our approach is to work at the interface of scientific fields, in order to provide original and effective solutions to various topics, such as thin-film characterization, complex fluids behavior study, chemical or biological species detection in gaseous or aqueous medium. During the last years, the team has focused on biosensing applications, with currently hot topics like real time detection of living bacteria or heavy metal ion traces detection in liquid environments. The team relies on a wide spectrum of skills, from electronics to surface chemistry, biology, microfabrication or microfluidics, thanks to our national and international collaborations.

We're looking for motivated, open-minded and rigorous candidates to address these scientific challenges.