

### **Position description**

Development of an innovative microfluidic device for the screening of bioengineered micro-organisms.

### **Academic partnership**

ESPCI (<http://www.lcmd.espci.fr>) and LISBP (<http://www.lisbp.fr/>).

In the **Laboratoire de Colloïdes et Matériaux Divisés** at **ESPCI** we develop microfluidics tools for the control of droplets dispersed in an oil phase (water/oil emulsion) inside glass and PDMS chips. Each microorganism is randomly encapsulated within a growth medium droplet that acts as an individual micro-bioreactor.

In this project, subpopulations of growing cells will be differentially submitted to metabolic perturbations resulting either from light or temperature-induced recombinant gene expression, changes in oxygen or carbon dioxide concentrations, or chemical stresses and their physiological response dynamically analyzed. Based on real time windowed multi-parametric analysis, individual droplets will be selected and recovered to allow complementary genomic and transcriptomic analyses down to single cell level.

### **Goals of the project**

Project aims to develop a microfluidic device allowing real time and clonal evaluation of metabolic and energetic balance shifts in engineered microbes within controllable and adjustable microenvironments.

The main objectives will be to develop:

1. A culture microfluidic chamber for bioengineered micro-organisms, in order to evaluate in real-time growth and metabolism as a function of perturbations.
2. A collection device to select for individual clones to be sent for metabolomics and genomics analysis

### **Role of the candidate**

The candidate will take part in various steps of the development of a microfluidics system dedicated to the screening of bioengineered micro-organisms, in collaboration with the members of the laboratory already involved in the project and members of LISBP who will engineer the strains. The candidate will develop three sets of chips.

1. Chip1 for generation of droplet embedding tunable number (from single) microorganism cell(s) using flow focusing methodology.
2. A disposable Chip2 for incubation and monitoring of microorganisms. Materials on one side of the incubation chamber will be adapted to facilitate diffusion of external gas (O<sub>2</sub>, CO<sub>2</sub>) within incubation chamber. Secondly, a thermal coating will be used on one side of the chamber to be able to create local thermal stimuli inside the chamber.
3. Chip 3 for sorting of droplet into microtiter plates using dielectrophoretic fields. Two options for the sorting trigger will be tested: the use of photomultipliers and multiparametric laser detection signal, or the use of real time image processing
4. Final step will be to install the platform in Toulouse inside LISBP lab to test industrially relevant strains.

### **Desired skills and qualifications**

The candidate should hold a PhD with expertise in one or more of the following fields: droplet microfluidics, microfabrication, and engineering. The project is highly multidisciplinary so the candidate should be ready to work and interact with chemists and biologists from both academia and industry. Additional experience or interest in programming, instrument development, or microbiology would be advantageous but not essential.

### **About LCMD**

The Laboratory of Colloids and Divided Materials (LCMD) possess a deep experience in designing and developing novel colloidal particles as well as being one of the lab leaders in colloidal science. Digital Microfluidics and High-throughput Screening has become one of the most challenging topics throughout these last 5 years. We are currently exploring questions related to diversity in biology and biochemistry. The ability of water droplets to be treated as independent reservoirs allows following millions of independent micro-organism cultures and to identify for each of them their growth curve and their relative difference. Colloidal Materials and novel colloids have been for long one of the major source of innovation of LCMD.

This includes monodisperse Brownian droplets, magnetic iridescent emulsion, double wax emulsion and magnetic dumbbells.

**Start date and duration of contract**

The expected start date is 5<sup>th</sup> of January 2014. The salary will be up to 2,500 Eur/month depending on experience. The project will be for 12<sup>^</sup> months.

**Application procedure**

Applications, including a CV and the names of at least 2 referees, should be sent to Dr. Laurent Boitard [[laurent.boitard@espci.fr](mailto:laurent.boitard@espci.fr)]