PhD proposal in Cell biophysics

Development of microstructures with magnetic-actuation to mimic intestinal villi

Laboratory: Lyon Institute of Nanotechnology (Institut des Nanotechnologies de Lyon, INL)
6 rue Ada Byron, 69622 Villeurbanne, France
Team: Devices for Health & Environment Group: Lab-On-a-Chip & Instrumentation
Funding: Doctoral contract – Electronics, Electrical engineering, Automatics (EEA) Doctoral school
Speciality: Engineering for life
Keywords: Microfabrication, Hydrogels, Magnetic traps, Image analysis, Intestinal cells, Organ-on-chip.

Context: *In vitro* microsystems for health allow the study of cellular behaviour in controlled and reproducible environments. On the one hand, this gives the possibility to achieve quantitative results and to reveal causal relationships between properties of the cellular environment and biological processes. On the other hand, it allows the development of organs-on-chip for medical diagnosis and treatment. It is therefore essential to increase the complexity of these microsystems in order to mimic *in vivo* systems and reproduce the physiological and pathological states of organs.
Among different organs, the tissue barrier in the gut is particularly heterogeneous along its topography[1]: on the top (the villi), it mainly contains enterocytes cells, whereas on the bottom (the crypts), it represents a reservoir of stem cells. Despite extensive studies have been carried out to understand the biochemical pathways ruling the separation of these two important cell domains in the gut, very little is known about how physical parameters contribute to tissue functionality.
Objectives: The objective of this PhD project is to take inspiration from intestinal villi to develop curved structures that can be actuated in a controlled and reversible manner, in order to mimic the movements of the digestive tract. The use of magnetic composite materials allows these microstructures to be shaped and actuated.
These *in vitro* microsystems will give access to simple models to better understand cell growth in heterogeneous tissues, which are, however, still poorly reproduced in controlled devices.

Candidate background: We are seeking a highly motivated candidate, strongly interested in interdisciplinary and experimental projects, going from microtechnologies to mechanics, surface chemistry and cell biology. Experience or knowledge in microfluidics, magnetism and bio-imaging would be appreciated.

The duration of the PhD is of **3 years**, starting from **October 2021**.

Local environment & collaborative network: The student will benefit from the technological infrastructures of the Nanolyon facility at the INL with 100m² of clean room and 40m² of cell culture and from the expertise in magnetic microsystems at the ILM (Institut Lumière Matière, Lyon – D. Le Roy) and in intestinal models at the Jacques Monod Institute (Paris – D. Delacour).

To apply, please **send by e-mail a CV with cover letter, with the transcript of marks and the names of referees familiar with your work.**
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Deadline: 10/05/2021
Interview at the EEA Doctoral school: between end of May and mid-June

1. Barker, Nick. "Adult intestinal stem cells: critical drivers of epithelial homeostasis and regeneration." *Nature reviews Molecular cell biology* 15.1 (2014): 19-33.
2. Dempsey, N. M., et al. "Micro-magnetic imprinting of high field gradient magnetic flux sources." *Applied Physics Letters* 104.26 (2014): 262401.
3. Faivre, Magalie, et al. "Magnetophoretic manipulation in microsystem using carbonyl iron-polydimethylsiloxane microstructures." *Biomicrofluidics* 8.5 (2014): 054103.