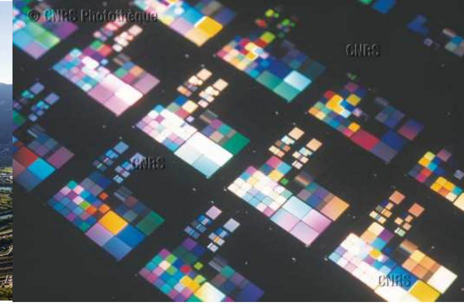


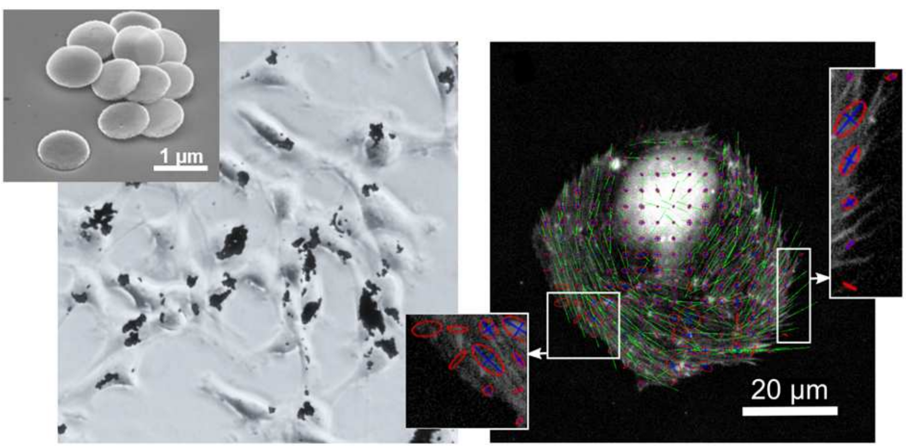
Offre de Stage de Master 2

Mechanical response of cells under local magneto-mechanical vibrations (LTM/CEA SPINTEC)

Keywords: Mechanobiology, Cell biology, Magnetic nanoparticles

Summary :

The proposed internship aims to study the mechanical response of cells subjected to magnetic stimulation. The aim is to analyze the impact of the duration of exposure and the frequency of magnetic stimulation on cell contractility. Preliminary results obtained at the SPINTEC laboratory show that certain combinations of frequencies and amplitude direct cells towards apoptosis, which should lead to a rapid decrease in their contractility. During the internship, the evolution of cell contractility will be linked to the parameters of magnetic stimulation and the degree of apoptosis obtained by biochemical labeling. Moreover, since the particles are internalized by cells, the effect of their surface chemistry (metal, PEG, protein) on the cellular response will be analyzed.



Left: Glioblastoma brain cancer cells incubated with magnetic nanoparticles.

Right: Intracellular stress tensor in human umbilical vein endothelial cell, represented as a set of ellipses, aligned with actin filaments (stained in green).

Description :

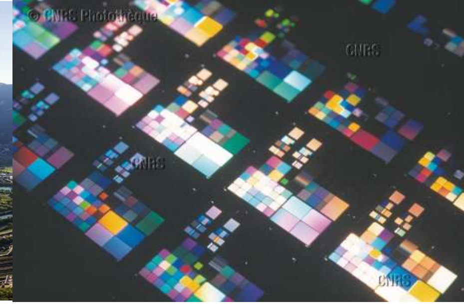
The SPINTEC laboratory has been pursuing for several years research on the development and implementation of magnetic nanoparticles for biomedical applications. The interest for these particles lies in the possibility of setting them in motion, or in vibration, by the remote application of a magnetic field. When the particles are in close contact with a cell this generates a localized mechanical force or torque on the cell membrane or in the cytoplasm, depending on whether the particle is internalized or not. In particular, it has been observed in previous in vitro experiment

Host laboratory:
Laboratoire des Technologies de la Microélectronique (LTM/CNRS)
17 avenue des martyrs
38054 GRENOBLE cedex 9

- ✓ **Required Training: M2**
- ✓ **Duration: 6 months**
- ✓ **Beginning: March 2021**

HOW TO APPLY

Send your applicationwith CV to : alice.nicolas@cea.fr robert.morel@cea.fr



that after a few minutes the magneto-mechanical vibration leads to the death of cancer cells, with a significant increase in apoptosis.[1] These observations pave the way for the development of innovative therapeutic approaches. However, the understanding of the mechanisms involved in mechanical stimulation and the signaling pathways leading to apoptosis remain largely misunderstood.

For its part, the LTM Micro & Nano Technologies for Health research team is developing analytical and technological tools for the study of cell mechanics. This theme includes the study of the effect of the rigidity of the cellular environment on cellular behavior and the development of tools for quantifying cellular forces. For this purpose, a methodology has been implemented which makes it possible to dynamically measure the contractility of cells with a micrometric resolution.[2] Cellular contractility is indeed a marker of cellular activity. Many signaling pathways are directly linked to it, such as mitosis, differentiation of stem cells or cancerous phenotypes, migration, apoptosis, etc. The proposed technique is based on a mechanical analysis of the interaction of cells and their substrate, without any hypothesis on the signaling pathways involved. Thus, when a cell goes into apoptosis, its contractility decreases significantly over a period of time and this can be detected with mechanical measurement.

[1] C. Naud, C. Thébault, M. Carrière, Y. Hou, R. Morel, F. Berger, B. Diény, and H. Joisten, *"Cancer treatment by magneto-mechanical effect of particles, a review"*, Nanoscale Adv., https://doi.org/10.1039/D0NA00187B.
[2] M. Moussus, C. der Loughian, D. Fuard, M. Courçon, D. Gulino-Debrac, H. Delanoë-Ayari, and A. Nicolas, *"Intracellular stresses in patterned cell assemblies"*, Soft Matter 10, 2014 (2014).

Request skills :

Master 2 in Nanophysics with a strong interest in cell biology.

Possibility to follow with a PhD: Yes

Contacts

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