Biomechanics of cancer cells

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Partners or collaborations : *Indicate the references of other researchers or labs involved in the project supervision.*

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Collaborations are underway with the Institut de Sciences des Materiaux in Mulhouse and from the Institut Curie in Paris

Describe the team that the student will join for the project.

The intern will join a group of 6 researchers, composed of 1 PhD (Fanny Mousseau), 2 postdocs (Leticia Vitorazi, one to be hired) and 3 permanent positions. The permanent positions are an ANR awarded "Chaire d'excellence" (Emek Seyrek), a biology engineer (Carine Vias) and a CNRS scientist (Jean-François Berret).

Our research group develops novel functional nanostructures with stimuli-responsive features and biocompatibility. The particles, proteins and other biomacromolecules are elementary bricks of colloidal scaffolds designed for applications. Based on techniques of assembly using non-covalent interactions, this approach offers versatility and simplicity for the fabrication of novel nanomaterials with enhanced functionalities. A second objective of our research deals with the applications of these nanomaterials in medicine, biology and in environment. It includes their use as tools for imaging and therapy in living cells and tissues, as well as the study of their cyto- and genotoxicity. In this research, emphasis is put on key features such as interactions, localization and titration of nanomaterials in biological and natural environments.

Project description :

Cancerous metastatic cells can escape a solid tumor, reach a distant location and erupt into a secondary tumor. This feature has led biologists to propose the hypothesis that cancerous cells have specific mechanical properties, very different indeed from healthy cells. This hypothesis was verified recently using osteosarcoma cells from bone cancer. It was found that the cytoplasm and the nuclei deform considerably when deposited on patterned substrates (Figure 1). In contrast, healthy cells do not deform and remain at the top of the pillars [1].

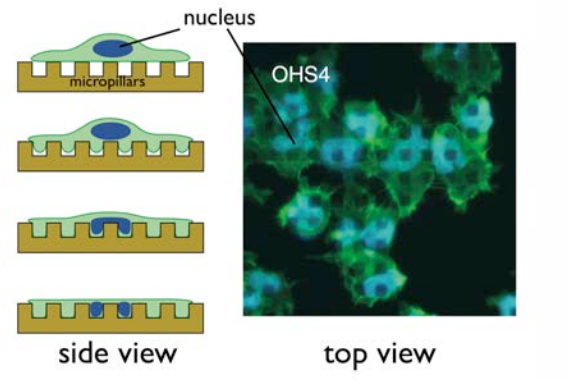

Figure 1*: Osteosarcoma cells deform to adapt their environment, here patterned micropillars [1].*

The goal of this internship is to measure the viscosity of cell interiors using magnetic nanowires and optical microscopy. These wires are in the micron range and were found to be easily internalized by cells. They are also excellent probes for the measure of viscosity [2]. Magnetic nanowires are interesting because they can also be remotely actuated by the application of an external magnetic field (Figure 2).

The objectives of the internship are:

- The synthesis of magnetic nanowires
- The culture of an osteosarcoma cell line, the internalization and the tracking of wires by optical microscopy.
- The measure of the viscosity of the interior of cells, cancerous and healthy.
- The confirmation or rebuttal of the model proposed by the biologists for the specific mechanical properties of cancer cells.

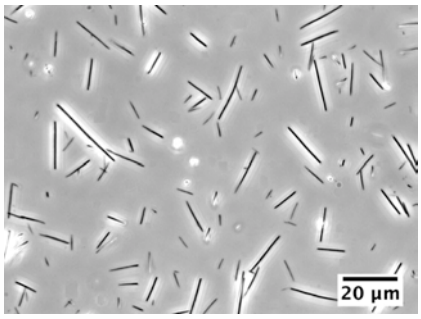

Figure 2 *: Optical microscopy image of magnetic nanowires [2]*

During the internship, the student (M1, M2) will have the opportunity to learn different techniques of physical-chemistry and biophysics, including the manipulation of nano/bio materials, optical microscopy, cell culture and magnetism.

Recent References on this work

[1] F. Badique, D. R. Stamov, P. M. Davidson, M. Veuillet, G. Reiter, J.-N. Freund, C. M. Franz, K. Anselme, *Directing nuclear deformation on micropillared surfaces by substrate geometry and cytoskeleton organization, Biomaterials 34 (2013) 2991e3001*

[2] R. Colin, L. Chevry, B. Abou and J.-F. Berret, *Intracellular microrheology probed by micron-sized wires*, Biomaterials 34 (2013) 6299 - 6305