Master program: Pharmaceutical sciences

Master 2 Course: Development of Drugs and Health Products

Firm/Laboratory/public body: Institut de Chimie-Physique

Address: Université Paris-Saclay, Campus d’Orsay, batiment 350

& Normal and Pathological Lymphoid Differentiation Lab

Institut Necker-Enfants Malades | INSERM U1151, Paris

*Trainee supervision:*

Tutor’s name: Dr Deniset-Besseau

Position: Physical chemist Researcher

Email: ariane.deniset@université-paris-saclay.fr

Phone:

Internship period: mid-January/mid-July

**Title of the project: Nanoscale studies of ferroptosis-induced phospholipid peroxidation in membranes of T-cell.**

T-cell acute leukaemia (T-ALL) is a haematological cancer disease. In the last decade survival rates significantly improved, but still cancer cells resistant to treatment pose serious problems leading to drastically reduced overall survival rates under 25%. Novel treatment options are therefore essential. The research institute of hospital Necker is working on a novel approach to reach resistant cells. They propose to increase the production of reactive oxygen species inside the resistant cancer cells to induce a specific cell death called ferroptosis. This regulated, non-apoptotic cell death is initiated by iron-mediated phospholipid peroxidation through increased reactive oxygen radical production, via various cell metabolism pathways. By artificially increasing the ROS production in those T-cells via exogenous initiator molecules, the utilization of this mechanism to eliminate refractory cancer cells could represent a new generation of cancer therapeutics. This strategy is promising but yet not well understood.

The introduction of atomic force microscopy coupled with infrared spectroscopy (AFM-IR) allows the chemical identification of these treatment-dependent membrane changes in mid-IR spectral at the nanoscale. In previous work, a protocol for the optimization of the sample preparation, the acquisition of global IR signatures of the peroxidation process by O-PTIR, and the investigation of membrane degradation via AFM-IR was established. During this initial exploratory study, we detected extracellular vesicles and nano patches of peroxidized lipids on the cell membrane following treatment with two exogenous initiator molecules. The next step will involve determining the composition of these vesicles and nano patches, as well as assessing the impact of varying doses and exposure times for the two initiator molecules.

**Missions**

To explore this system, the student will study two model cell lines incubated with two different ferroptosis inducers using the following characterization tools:

* Optical microscopy at Necker Hospital
* Micro and nanoscale photothermal infrared spectroscopies

Depending on the course of the internship and collaborations, analyses with super-resolved fluorescence microscopy might be performed.

The internship will include:

• A bibliographic review.

• Sample preparation and their multiscale-multimodal analysis

• The intern will also work on data processing using Orange, SPM software and Python.

**Profiles:**

Master 2 student in physics/physical-chemistry/chemistry. Desirable knowledge in spectroscopy. Aptitude for data processing, taste for experimentation. Initiative, curiosity, autonomy.

**The topic can be adapted for M1 students**

**Language:** French & English.

**Duration:** 5-6 months

**Location:**

AFMIR Lab, ICP, Building 350 - Faculty of Sciences of Orsay, University of Paris Saclay

15, avenue Jean Perrin 91405 Orsay, FRANCE.

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**Contact:**

Please send your CV, course transcript and cover letter to Ariane DENISET-BESSEAU (ariane.deniset@universite-paris-saclay.fr) with the subject: InternAFMIR2025immunology - Last name.