SOLEIL SYNCHROTRON

FOR **BIOLOGISTS**

SMIS
beamline

MICRO

ORGANISMS

TISSUES

CELLS

ORGANELLES

COMPLEXES

PROTEINS

ATOMS

SAMPLES

TYPES

- **Cells** (fixed)**:** 2D cultures on infrared transparent windows (CaF2, ZnS...), primary cells, cell lines, yeast, bacteria, protozoa...
- **Tissues:** thin sections (2-10 µm thick , 20-30 µm for vegetal), 3D cell cultures, cryo-sectioned without embedding, deposited on IR transparent windows
- **Cells** (living)**:** require a microfluidic device with temperature control (available at the beamline)

ENVIRONMENTS

- **Transparent substrates:** compatible for cell growth, and/or with different spectral domains
- **Temperature stage:** -180 to 600°C, purged (Linkam FTIR600)
- **Microfluidic device:** CaF_2 windows, 2 intake and 2 exit ports, heating elements, temperature control
- **Stretching device:** with temperature control (Linkam TFT350), 2 and 20 N force transducers

OFFLINE INSTRUMENTS

- **Raman microscope:** TFS DXR, 532, 633 and 780 nm lasers, 50x and 100x objectives, 1 µm resolution

- **Imaging IR microscope:** Cary 620, 128x128 pixel Focal Plane Array detector to image large samples (mm^2 to cm^2 size) quickly with 20-30 µm resolution.

TECHNIQUE

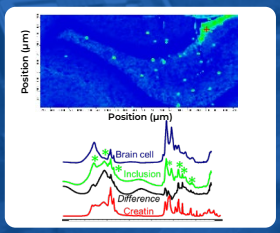
SMIS is an infrared microspectroscopy beamline that is organized in two branches: **SMIS Micro** and **SMIS Nano**. The SMIS Micro branch specializes in synchrotron infrared microspectroscopy and imaging for life science, cultural heritage, material under extreme conditions, polymers, astrophysics...

The **SMIS micro** branch operates two confocal infrared microscopes coupled to synchrotron to probe biological samples at the cellular and subcellular resolution (3-15 µm)

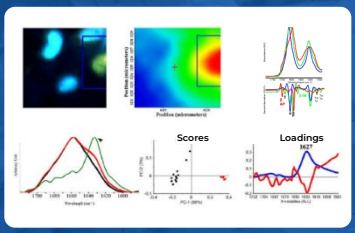
Infrared microspectroscopy can be used to:

- **Identify biomarkers** such as biomolecules or minerals within cells and tissues.
- **Quantify** the concentration of known biomarkers (polysaccharides, lipids, proteins, metabolites...).
- Estimate the **conformation** of proteins in cells and tissues, detect amyloids plaque and inclusions; lipid conformation...
- **Fingerprinting** cells and tissues to identify and delineate **cell types**, **metabolic** or **pathologic** states.

Identification and **quantification** of **creatin** in rat brain hippocampus



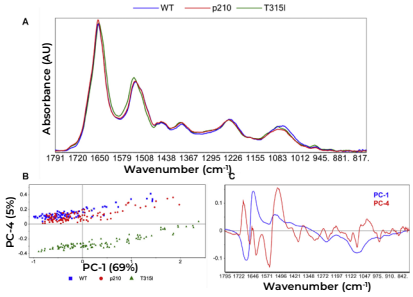
Conformation of proteins in **inclusions** in **Huntington Disease** patient brain



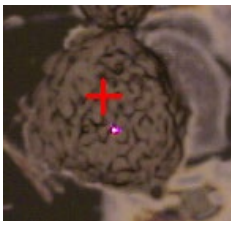
HIGHLIGHTS

Chronic Myeloid Leukemia (CML)can be treated efficiently by Tyrosine Kinase Inhibitors (TKI). Resistance to TKI therapies may develop during treatment due to mutations occurring in the ABL-kinase domain of the BCR-ABL oncogene. This has led to the development of a second and a third generation of TKI drugs. The T315I mutation in the bcr-abl gene renders leukemic cells resistant to all three generations of TKIs.

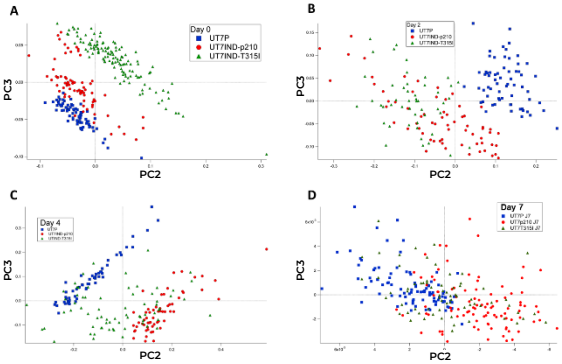
Synchrotron μFTIR can be used to measure the chemical composition of individual myeloid progenitor cells and extract a spectral signature of single cells expressing the T315I mutation.



GS2 colony.



Differentiation of murine embryonic stem cells expressing WT or T315I bcr-abl by SR-μFTIR and PCA. Peaks at 1242, 1122, 1088, 966 cm^{-1} are tentatively associated to RNA ribose-phosphate backbone.



Extinction of the T315I signature in the doxinducible UT7IND cell lines carrying WT or T315I bcr-abl.

Sandt et al. BBRC 2018 (503)

REFERENCES

- P. Dumas, et al. Synchrotron infrared microscopy at the French synchrotron facility SOLEIL Infrared Phys. Technol. 49(1–2), 152 (2006). 10.1016/j.infrared.2006.01.030
- P. Dumas, et al., Adding synchrotron radiation to infrared microspectroscopy: what's new in biomedical applications?, Trends Biotechnol. 25(1), 40 (2007). 10.1016/j.tibtech.2006.11.002.

More information on SMIS publications web page

COMPLEMENTARY BEAMLINES

ANATOMIX: obtain three-dimensional X-ray tomography images of bulk volume samples at microscopic resolution.

NANOSCOPIUM: micro to nano morphology, elemental composition and chemical speciation.

DISCO: chemical imaging using auto-fluorescence microspectroscopy.

LUCIA: X-ray microprobe (μ-XAS, μ-XRF).

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Health & Well-Being at SOLEIL

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SOLEIL's Health and Well-being Scientific Section is composed of 30 scientific experts from different fields. Through collaborative and science-driven approaches, the Section offers the community a coherent portfolio of state-of-the-art techniques to serve scientific and societal health-related challenges.

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