

ALL A

SMIS beamline



ORGANISMS

TISSUES





PROTEINS

ATOMS





93

F

B

RUNNE



SAMPLES

TYPES

O Cells (fixed): 2D cultures, primary cells, cell lines, yeast, bacteria, microalgae, protozoa...

Tissue sections
Living Cells: in O-PTIR (Optical Photothermal IR)
Virus
Protein fibrils and complexes, fibers
Organelles, vesicles
Nanoparticles

- Nanoparticles

ENVIRONMENTS

O-PTIR:

- Compatible with glass, metals and IR transparent substrates
- Compatible with microfluidic devices made of glass and IR transparent window

NanolR:

 \odot

Flat, ultrasmooth gold substrates

OFFLINE INSTRUMENTS

\odot Raman microscope:

TFS DXR, 532, 633 and 780 nm lasers, 50x and 100x objectives, 1 µm resolution

Imaging IR microscope: \odot

Cary 620, 128x128 pixel Focal Plane Arrav detector to image large samples (mm² to cm² 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 Nano** branch gives spatial resolutions well below the diffraction limit of mid-IR. The **O-PTIR** technique (Optical Photothermal IR) gives 500 nm resolution and the **nanoIR** spectroscopy reaches 10-50 nm spatial resolution. The **NanoIR** instrument can be coupled to a laser source (900-1800 cm⁻¹) or to the synchrotron (700-1800 cm-1) and can use sSNOM or AFM-IR modes.



Both techniques can be used in combination with infrared microspectroscopy for:

 Quickly image samples at single wavenumber to locate molecules at sub-diffraction resolution

Spectral Identification of molecules



Mapping photosensitive lipids in human hair medulla with OPTIR



Amyloid conformation in Alzheimer disease primary neurons in OPTIR



HIGHLIGHTS

Alzheimer's disease (AD) is a fatal neurodegenerative disorder associated with neuronal loss caused by the aggregation of amyloid proteins into neurotoxic β sheet enriched structures. the amyloid plaque. However, the mechanism amvloid of protein aggregation in cells is still not well understood especially its first steps. Many challenges arise when studying the endogenous amyloid structures in neurons or in brain tissue: small size, complexity of the cell medium...

AD-related amyloid protein aggregation can be measured directly in neuron by OPTIR superresolution microspectroscopy at submicrometer resolution.



Schematic of experimental setup and sample geometry. a) Illustration of hyperspectral O-PTIR superresolution infrared imaging.

Measuring primary neurons with O-PTIR.



a) O-PTIR image of the neuron acquired at 1650 cm⁻¹ (proteins) (b) OPTIR spectra. Scalebar 20 μ m. c) AFM image of the same primary neuron. D) OPTIR signal from the neuron cell body to the cell neurite

REFERENCES

Nano-Infrared Imaging of Primary Neurons Raul O. Freitas, Adrian Cernescu, Anders Engdahl, Agnes Paulus, João E. Levandoski, et al. (2021) Cells, 10

Super-Resolution Infrared Imaging of Polymorphic Amyloid Aggregates Directly in Neurons Oxana Klementieva, Christophe Sandt, Isak Martinsson, Mustafa Kansiz, Gunnar Keppler Gouras, et al. (2020) Advanced Science



 \odot

ര

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).



CONTACT

Ferenc Borondics

Beamline manager S ferenc.borondics@synchrotron-soleil.fr S +33 (0)1 69 35 81 92

Christophe Sandt

Beamline scientist, life sciences Christophe.sandt@synchrotron-soleil.fr Chief (0)1 69 35 81 07

Health & — Well-Being at SOLEIL



Link to the web page

🎦 @HelioBio_SOLEIL

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.





L'Orme des Merisiers - Départementale 128 91190 Saint-Aubin - FRANCE www.synchrotron-soleil.fr

