Synchrotron X-ray microdiffraction (SR-µXRD)

Data sheet

Type of samples : all
Pixel size: 50 nm to 1 mm
Sample size: from 10 µm to 10 cm
Sensitivity: high, submicrometer objects can be analyzed individually
Typical acquisition time: 0.1 s per 2D pattern
Sample preparation: none
Available sample environment: temperature, humidity, gas, mechanical stresses,

Why X-ray micro-diffraction ?

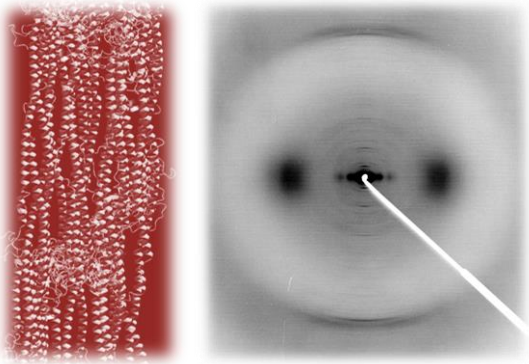
The X-ray diffraction is used to study the molecular and supramolecular structures of any kind of material, whether fully crystallized or not. This technique becomes a micro-analytical technique using a micrometer size "synchrotron" X-ray beam , and even an imaging technique in 2D scan mode.

Principle

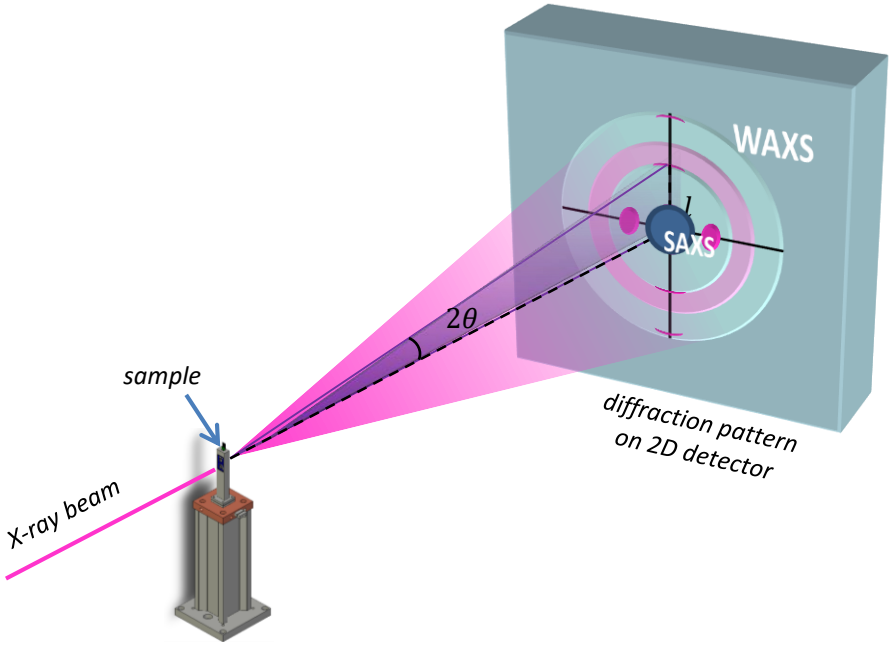
The diffraction/scattering phenomenon is due to the interaction between the X-ray photons of the incident beam and the electrons of atoms. The scattered waves interfere with each other, leading to intensity modulation in space. The analysis of the "diffraction pattern" can be traced back to the material structure at the atomic and molecular scales, all the more so precisely that the order is well defined.

Imaging mode The high flux and low divergence of synchrotron beams can be exploited by reducing the size of the analytical beam through focusing devices in the sub-micrometer scale, paving the way for structural imaging; by scanning the sample to the micro-beam and collecting diffraction patterns at each point it is possible to visualize the molecular structures along profiles (1D) or maps (2D) with a pixel size as small as 50 nm.

Real-time monitoring The assays can be performed while varying the environment of the samples in temperature, humidity, pressure or by applying a mechanical stress such as stretching, compression or shear. It is also possible to monitor structural changes over time to a resolution of one millisecond.



Supramolecular organization of keratin molecules in hair (left) inferred from its X-ray scattering pattern (right)



Case studies

- Identification of phases and nanoparticules
- Crystalline polymorphism of AI and ingredients
- Structural changes versus T, RH, mechanical stress…
- Orientation and crystallinty grade of polymers
- Stability of cosmetic creams
- Effect of treatments in hair and skin
- Characterization of thin surface layers
- Stresses in plastic and metallic pieces