# Confocal µXRF spectrometer for low to high Z element analysis

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Confocal µXRF is a powerful tool for analyzing the spatial distribution of major, minor and trace elements in 3 dimensions. Being a non-destructive analyzing technique, confocal µXRF is suited for measuring a wide spectrum of samples (biological, geological, cultural heritage, etc.).

## Components

The ATI's µXRF spectrometer [1] uses a low power tube with Rh anode (20 W) as excitation source. In order to focus the primary beam onto the sample, a polycapillary full-lense (XOS) with a nominal spot-size of 32µm for Mo Ka is installed between tube and sample stage.

For confocal measuring, a polycapillary half-lense (XOS) can be mounted between sample and detector. Both polycapillary lenses are mounted on piezo positioner xyz-stacks (Attocube) to make for a convenient adjustment procedure. Fluorescence radiation is detected by a 30mm² LN2 cooled Si(Li) detector with an ultra-thin polymer window to minimize absorption of low Z element fluorescence lines. Additionally, the whole setup is situated in a vacuum chamber (~1 mbar), making it perfectly suited for measuring low Z elements.

The sample is mounted on a motorized xyz stage and for precise positioning of the sample, an optical video microscope is focused on the z-position of the confocal volume, while the xy- position is marked by an adjustable ellipse on the microscope screen.

## Operating Modes

The µXRF spectrometer can be operated in non-confocal (with only one lens in the excitation channel, i.e. conventional µXRF) or confocal (with a second lens between tube and sample) mode.

In confocal µXRF, two focussing optics are adjusted such, that their beam paths are intersecting. Consequently, the detected fluorescence radiation is coming solely from this confocal volume, allowing the determination of the spatial distribution of elements in a sample in 3 dimensions. For the confocal setup a voxel size of 50µmx50µmx50µm for Cu-Ka was determined.

Line-, area- and volume-scans can be programmed using the in-house µXRF-software package. Line-scans can be utilized for depth scans, while area-scans provide elemental maps of a sample. Here, the confocal setup has the advantage over elemental maps created by conventional µXRF, with better spatial resolution and higher surface sensitivity. Furthermore, volume scans enable the user to measure 3-dimensional element distributions.

## Example Measurements

Example measurements of non-confocal and confocal 2D-scans of a chicken-finger cut as well as a rat femur implanted with WZ21-alloy (2 wt% Y, 1 wt% Zn, 0.25 wt% Ca, 0.15 wt% Mn and 96.4 wt% Mg) pins will be presented.

Furthermore, an example of a 3D scan of a Cu wire cross will be included.

[1] S. Smolek, B. Pemmer, M. Fölser, C. Streli, P. Wobrauschek, Rev. Sci. Instrum. 83 (2012) 083703.