



Experiment title: X-ray fluorescence microtomography

Experiment number: MI-367

Beamline:

Date of experiment:

Date of report:

ID22

from: 25.09.99

to:30.09.99

11.02.2000

Shifts:

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Report:

Aim the experiment *MI-367* performed at the ESRF on the beamline ID22 during September 1999 was to collect experimentally measured X-ray fluorescence set of projections from inhomogeneous sample to realise a computer tomography with sub-micron resolution. This experiment was a continuation of an experiment performed on ID22 (see the report 20.02.99) where the standard homogeneous sample was analysed with 5 microns resolution and the first testing of the steps involved in processing tomographic data was made [1].

During the experiment *MI-367* the set of X-ray fluorescence projections for the unhomogeneous sample was collected (1), two techniques for the tomographic data processing was used and detailed comparison of these techniques was made (2), the X-ray tomography experiment for the geological sample (titanit with the black heads from the Khibina alkaline massif, Russia) was carry out (3).

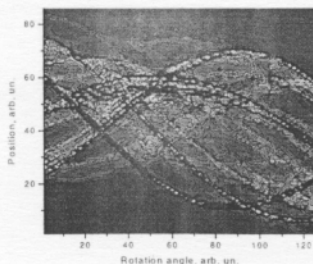


Fig.1.

1. The sample is a glass capillary about $100 \mu\text{m}$ in diameter with the components mixture (glass dust + $\text{K}_2\text{Fe}(\text{CN})_6$, glass dust + $\text{YO}_2 + \text{HCl}$, glass dust + CuSO_4). The data were collected using monochromatic 20 keV X-rays. Refractive X-ray lens was used to focus X-ray beam. Beam spot size is $.6 \mu\text{m}$. Parallel scanning scheme was used. The fluorescence projections

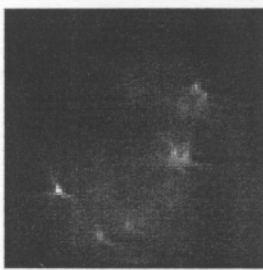


Fig.2.

were collecting using a Si drift diode placed in the vertical plane at 90^0 with respect to the incident beam to minimise the scattering contribution. Projections for the following elements were registered: *K, Fe, Cu, As, Y, Zr* (see the set of the $Y_{K\alpha}$ projections in Fig.1.).

2. Two parallel techniques were used to reconstruct the images from registered fluorescence projections. Furrier back-projection technique and modified algebraic technique were written in codes by applicants. Comparison of the reconstruction

results was made [2] from the artefacts and noise points of view. Reconstruction result by ART for $Y_{K\alpha}$ is presented in Fig.2. Results of this experiment confirm that the concentration estimates of the trace elements distribution is possible using intense synchrotron source with micro-focused beam.

3. Unusual crystals of titanite with the black heads from a natrolite vein in rischorrite of the Khibina alkaline massif was investigate by X-ray tomography (one of the reconstructed slices is presented in Fig.3). Highly absorbing inclusion is clearly seen on the Centre right part as well as voids or fluid inclusions on the upper and down right of the titanite. However, it does not allow to explain unusual facets colour of the crystal and to find out the reasons of the colour. The work has been done allows to get more specific tasks of the investigation, potentialities and limits of the technique and requests to sample preparation for the planed X-ray fluorescence tomography.

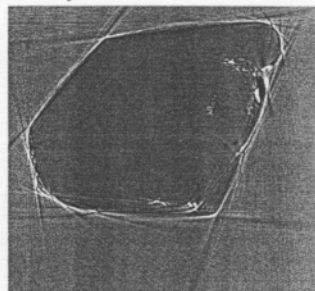


Fig.3.

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