

ENHANCING XRD² MICRODIFFRACTION WITH FOCUSING X-RAY MICROLENSSES

Christoph Berthold⁽¹⁾, Jens Brechbuehl⁽²⁾, Lutz Bruegemann⁽²⁾, Aniouar Bjeoumikhov⁽³⁾

⁽¹⁾ Institute of Geoscience, University of Tübingen, Germany

⁽²⁾ Bruker AXS GmbH, Karlsruhe, Germany

⁽³⁾ IfG - Institute for Scientific Instruments GmbH, Berlin, Germany

Microdiffractometers equipped with standard pinhole collimators to define a several 10 microns small analysis spot on the sample surface suffer from one fact: the intensity of the X-ray beam on the sample dramatically decreases and results in long measurement times. Different attempts were made to avoid this drawback. High-power rotating anode X-ray sources were applied to increase the primary intensity of the X-ray beam. The use of mono-capillary X-ray wave guides replacing the pinhole collimators in order to focus the X-ray beam was another attempt to increase the X-ray intensity on the sample. However, typical measurement times are up to 30 minutes for collecting a reasonable pattern if using a microdiffractometer equipped with a standard X-ray tube, a mono-capillary with 50 μ m beam diameter, and even if using a 2-dimensional detector with a huge 2-theta and psi coverage.

For many applications of locally resolved X-ray diffraction, measurement time is an important factor. Typical examples are phase content mapping of heterogeneous samples such as sediments or laminated ceramics, or locally resolved stress determination of mechanically exposed materials, or the phase analysis of samples smaller than 10 μ g.

The only way to reduce the measurement time without massive changes of the technical setup of typical microdiffractometers is the application of a focusing X-ray microlens.

Compared to a typically used 50 μ m mono-capillary the use of a focusing X-ray microlens with similar spot size leads to an increase of the primary beam flux between a factor of approximately 10 to larger than 100 depending on an additional pinhole used at the exit of the lens (Fig.1). This additional pinhole can be used to optimize the beam geometry for a better peak profile.

In the case of having a D8 DISCOVER with GADDS microdiffractometer, the focusing X-ray microlens fits in the standard collimator support enabling switching between collimators, mono-capillaries and the microlens without realignment. No time consuming modification of the microdiffractometer is needed.

Using a focusing X-ray microlens instead of a mono-capillary reduces the measurement time by at least a factor of 10. A factor of up to 100 is possible by simply changing the diameter of the exit pinhole - for the price of a wider peak profile.

The presentation will give an overview about locally resolved stress-measurement, phase identification in small scale heterogeneous materials, and phase analysis of small samples (<10 μ g) using different types of mono-capillaries and focusing X-ray microlenses with a D8 DISCOVER with GADDS.

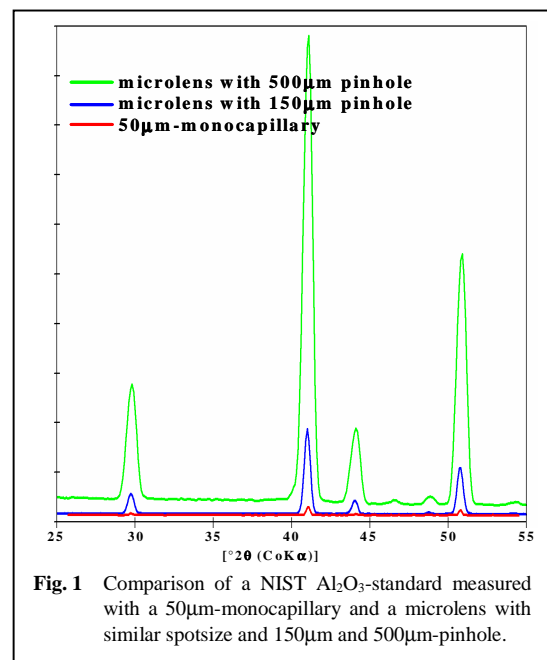


Fig. 1 Comparison of a NIST Al₂O₃-standard measured with a 50 μ m-monocapillary and a microlens with similar spotsizes and 150 μ m and 500 μ m-pinhole.