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High-Speed PIXE: Fast Elemental Analysis with a Colour X-Ray Camera

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A new PIXE-beamline equipped with a full-field energy dispersive X-ray camera [1,2] has recently been put into operation at HZDR. This so-called SLcam® comprises poly-capillary optics guiding the proton-induced X-ray fluorescence radiation towards a 264×264 pixel pnCCD-chip, each with an energy resolution of 156 eV (@Mn K α). Two X-ray optics are available, with a magnification of one and six, allowing a field of view of 12×12 mm² and 2×2 mm², respectively. Attached to a large sample analysis vacuum chamber containing a precision sample manipulator, high throughput of even large samples is feasible. Additionally, a beam broadening system ensures a homogeneous illumination of the detection area and an optical microscope allows correlative superimposition of the PIXE maps with optical images. The single CCD pixel size is 48×48 μ m² leading to a lateral resolution better than 100 μ m for the 1:1 optics. By using sub-pixel resolution algorithms imaging of single capillary channels (25 μ m) is expected.

The new setup is mainly developed for the investigation of geological samples for resource technology research which comprises the analysis of grain composition and intergrowths as well as the determination of rare earth element distributions. The simultaneous measurement of a huge array of pixel enables a fast overview over a large region of the sample with first results becoming visible almost immediately. Together with the PIGE implementation at the classical micro-beamline at HZDR this new approach allows analysis of most of the elements of interest in mineralogy.

First results concerning lateral resolution and detection limits on geological samples are encouraging. Due to the low background in the PIXE spectra investigation of trace elements with concentrations below 0.1 at.% is achievable.

[1] O. Scharf et al., Anal. Chem., Vol. 83, pp. 2532-2538 (2011).

[2] I. Ordavo et al., NIM A, Vol. 654, pp. 250-257 (2011).

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