Polycapillary based confocal detection schemes for XRF micro and nano-spectroscopy

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Polycapillary based confocal XRF imaging is being used to perform non-destructive multi-element analysis by directly recording three-dimensional (3D) XRF information from the samples under investigation.

This is done by restricting the detector's view on the irradiated intersection of the incoming microscopic/nanoscopic X-ray beam and the sample by applying a polycapillary half-lens on the detection side. In this way, the induced fluorescent radiation from the (sub)microscopic volume, selected within the sample, is guided through the polycapillary half-lens towards the energy-dispersive detector. The obtained XRF information is therefore in principle three-dimensional in nature, so that 3D XRF analysis can be performed directly, simply by XYZ scanning of the sample. Because of the known advantages of (sub)micron XRF analysis (non-destructive, multi-element, trace-level), it is a favoured method to investigate precious samples.

This work describes various applications of the confocal XRF technique for elemental imaging at various synchrotron radiation facilities (HASYLAB beamline L in Hamburg - Germany, ESRF ID13-ID18F-ID22NI in Grenoble - France) in order to obtain microscopic/nanoscopic information on exceptional, extremely rare and unique samples, such as inclusions within natural diamonds providing information of deep Earth, or cometary and interstellar dust samples from NASA's Stardust project. Also illustrated is the combination of laboratory and synchrotron 3D elemental imaging for the study of delicate biological model organisms.