POLYCAPILLARY-BASED MICRO-XRF AND MICRO-XANES BY MEANS OF CONVENTIONAL AND SYNCHROTRON RADIATION

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In the last five years, the field of X-ray fluorescence is subject to an important technological evolution in the sense that more powerful X-ray sources (synchrotrons and micro-focus tubes), X-ray optics (lenses and concentrators of various nature) and X-ray detectors (compact energy-dispersive devices with good energy resolution) have become available. This evolution has benefitted more specifically the field of microscopic X-ray fluorescence analysis (micro-XRF) where next to highly performant trace-level microanalytical instruments which are installed at synchrotron source beamlines, also easily transportable, compact analysis devices are now available.

Polycapillary lenses are monolithic X-ray optics that allow to capture radiation within a large solid angle and focus it into spots of 20-100 µm diameter. Whereas full lenses are suitable for efficient focussing of radiation produced in (low power micro-focus) X-ray tubes, half-lenses can be employed for efficiently focussing synchrotron radiation.

Full polycapillary lenses have been employed by us for the construction of compact and portable micro-XRF equipment. Such spectrometers are useful for quantitative trace/minor element-level micro-analysis (above the 10 ppm level) of various materials (glass and other alumino-silicate materials, metal alloys, …) in the framework of fingerprinting studies as encountered in forensic and cultural heritage investigations. The considerations taken into account during the construction of these spectrometers will be outlined and a few applications discussed.

When polycapillary half-lenses are combined with a simple channel-cut monochromators at sychrotron beamlines, the resulting monochromatic focussed microbeam does not change position when the monochromatic energy/angle is scanned in a narrow range. Also, the high focussing efficiency of the half-lenses permits the formation of a very intense microbeam, with which micro-XANES (X-ray absorption near-edge spectroscopy) profiles of trace constituents (50 ppm level) can be recorded, even at bending magnet beamlines. The possibilities of this solid-state speciation method and its applications in the environmental sector will be discussed.