

Micro X-Ray Fluorescence

WITH FOCUSING POLYCAPILLARY OPTICS

Improved Performance with Polycapillary Optics:

A unique state-of-the-art optic design captures a large solid angle from an x-ray source and redirects the beam into a micron-sized focal spot.



FEATURES:

- Point to point focusing of x-rays
- Large capture angle from source
- Orders of magnitude flux gain from micron-sized spot
- Broad spectral bandwidth
- Integration with compact, low-power sources provides flux equivalent to rotating anode sources.

BENEFITS:

- Extremely high flux density
- Increased spatial resolution

Advantages over Electron Probe X-ray Analysis:

- Higher detection sensitivity
- No special sample preparation needed
- Operation in air

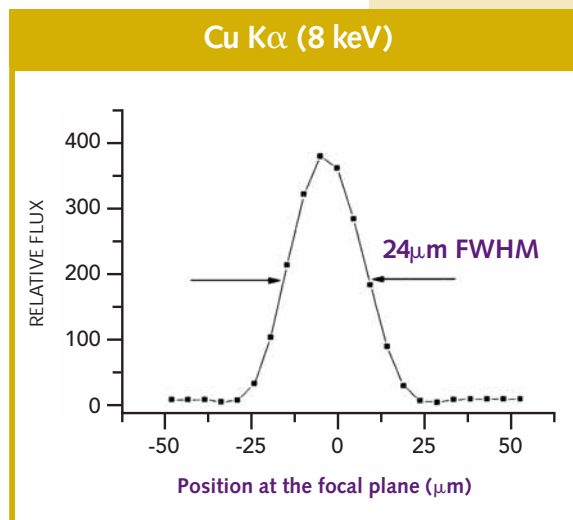
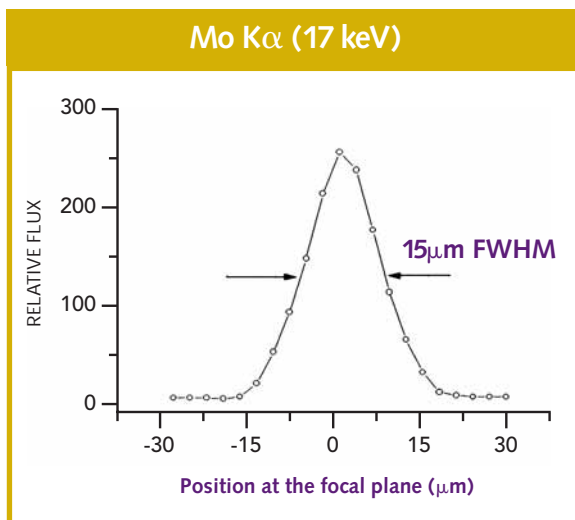
APPLICATIONS:

- Evaluation of small features
- Elemental mapping
- Film/plating thickness
- Detection of micro-contamination
- Multi-layered coatings for advanced circuit boards
- Small particle analysis
- Forensics

FIGURE 1

X-ray spot sizes at the focal plane for Mo K α and Cu K α

Spot sizes depend on x-ray energy. Small spot sizes range from: $\leq 20 \mu\text{m}$ for Mo K α (17keV) to $\leq 30 \mu\text{m}$ for Cu K α (8keV).



When characterizing small features and doing elemental mapping, focusing polycapillary optics deliver micron-sized focal spots and flux superior to conventional micro XRF. Several orders of magnitude flux gain are possible, depending on the experimental geometry.

FIGURE 2

Comparison of MXRF spectra generated using a focusing polycapillary optic and a pinhole aperture. The spectra were displayed by an air particulate sample ~ 50 μm in diameter. Mo excitation (40kV, 20W)

The polycapillary optic provides a large gain in flux density compared to a 50 μm pinhole. The greatly enhanced detection sensitivity offered by the polycapillary optic enables the compositional characterization of air particulates. The intensity of the pinhole spectrum was scaled from a 2 mm diameter aperture to a diameter equivalent to 50 μm.

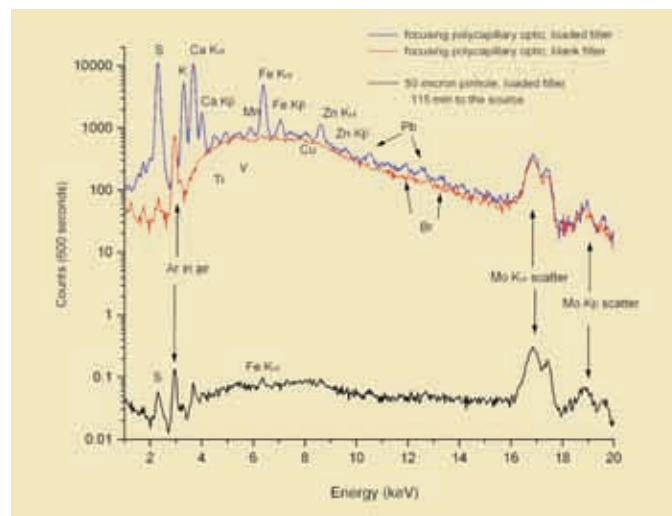


FIGURE 3

Spectrum of NIST SRM 1832 standard XRF sample using a polycapillary optic. Mo excitation (40kV, 12W)

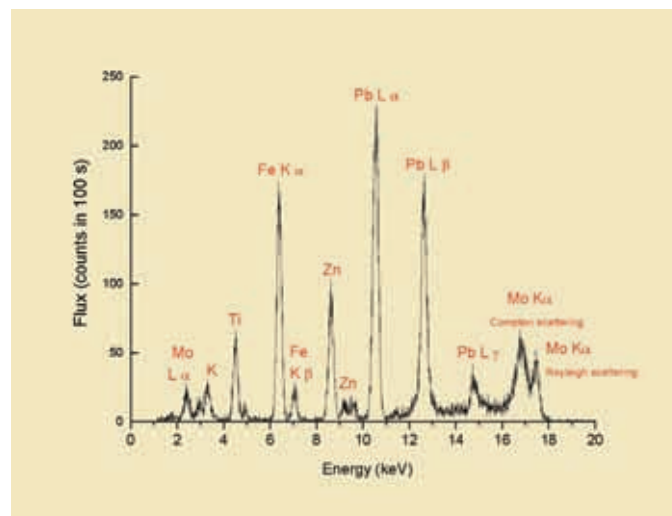


TABLE 1

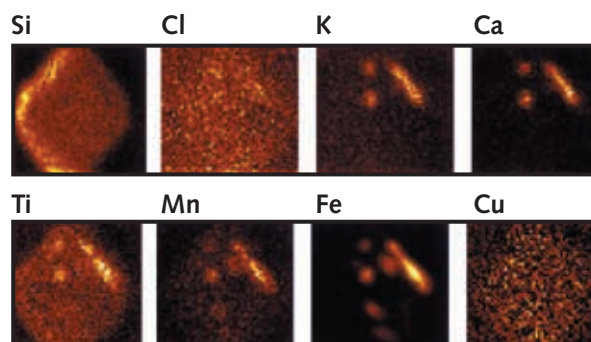
Picogram detection limits are possible using the polycapillary optic for this thin film SRM sample.

| Element | K | Ti | Fe | Zn | Pb |
|-------------------------|-----|-----|------|------|------|
| Limit of Detection (pg) | 4.1 | 1.5 | 0.57 | 0.28 | 0.52 |

FIGURE 4

Elemental mapping of the composition of a volcanic glass reveals the spatial distribution of inclusions within quartz phenocrysts. Mo excitation (40kV, 12W)

Excellent spatial resolution of 40 μm for a wide range of elements was achieved in 14 seconds for each 10 μm step.



200μm

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