

Forensic Application Note

Micro X-ray Fluorescence Spectrometer

Micro-X-ray fluorescence – a versatile tool for forensic studies

Non-destructive chemical fingerprinting is a powerful technique for the characterization of inorganic materials in the field of forensic sciences. Analytical requirements are small spot size, low detection limits as well as elemental mapping capabilities.

The system which can meet all these requirements is the Eagle-III μ -Probe.



Micro X-ray Fluorescence Spectrometer with beam concentration by capillary optics

- No sample preparation needed.
- Works with powders, pastes, liquids, bulk material etc.
- X-ray μ -spot focussing
- Optimized spectral energy resolution
- Variable sample chamber sizes
- Mapping functions
- ppm-level detection limits and only a few 100 mg needed
- Measurement time below 1 minute



Fig 1
Glass particles on plastic foil

1. Glass particle analysis:

Often the sources of glass fragments need to be determined. Refractive index values are in many cases not indicative enough in order to unambiguously clarify the relationship of secured glass shards e.g. from a burglary case. Here micro-XRF is a fast way to determine the chemistry of small glass particles:.

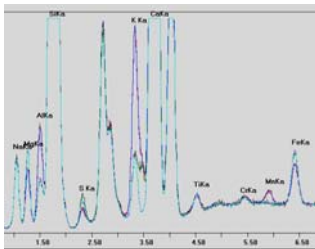


Fig 2
Spectra of glass particles

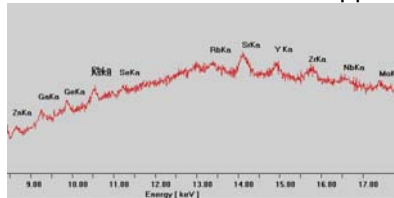
Fig. 1 shows glass particles roughly 50-100 μ m in size. The red circle represents the diameter of the x-ray beam. In Fig. 2 two types of glasses are compared. With micro-XRF even glasses with almost identical composition can be differentiated. As can be seen in the spectra, Mn-contents of 200 ppm versus < 25 ppm can be easily distinguished.

2. Verification of low detection limits

Detection limits (in ppm) for glasses:
Ti 50, V 40, Cr 30, Mn 25, Fe 20, Ni 20, Cu 20,
Zn 15, Ga 10, Pb 30, Rb 15, Sr 15, Zr 15, Mo 20

These values were obtained without primary filter. With filters these limits can be improved.

Fig 3
Spectra of glass NIST 612
all elements are at the 30 - 40 ppm level



Forensic Application Note

3. Gun-shot residue distribution

After shooting incidences the court needs to know the distance of the gun from the victim. The distribution of the gun powder on the victims clothes can be a valuable tool to determine the distance and direction of the shot. With our micro-XRF system and its precise x-y-z scanning stage maps of the elemental distribution of the gun powder on any surfaces can be obtained.

Fig. 4 Example of the distribution of Potassium, Sulfur, Copper and Zinc around the bullet hole in a piece of cloth. In this case the scanned area comprises about 15 x 12 mm, but up to 300 x 300 mm are possible. . In Fig. 5 the relationship between Zn-intensity and shooting distance are displayed.

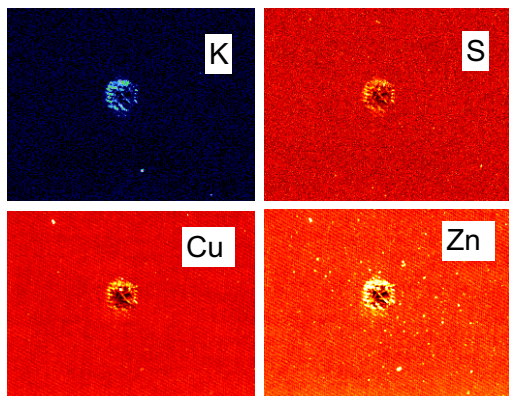


Fig 4
Elemental maps of gun-shot residue

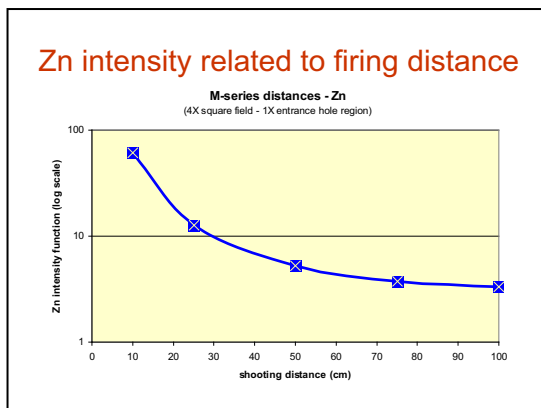


Fig 5
Shooting distance determination

4. Rapid detection of P and I chemicals to characterize illegal drug residues

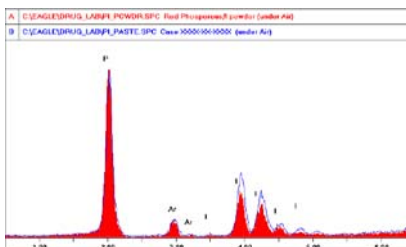
The use of methamphetamines is becoming a problem of epidemic proportions. The simplicity of methamphetamine production, for example matches and "over-the-counter" cold remedies, aid the spread of methamphetamine use. An ordinary kitchen can be readily converted into an illegal methamphetamine lab in no time at all.

In some manufacturing processes, iodine (i.e. I₂) and red phosphorous are combined during the production process. Identification of suspected drug lab residues containing both phosphorous and iodine is one step toward successful prosecution of a suspected methamphetamine manufacturer.

Therefore, a fast analytical technique to check for P and I is desired, which does not require vacuum atmosphere to minimize contamination of the measuring instrument.

In Fig. 6 a spectra of drug residue confirms the presence of Phosphorus and Iodine.

Fig 6



The Eagle micro-XRF elemental analyzer has been demonstrated for rapid confirmation of the presence of P and I in suspected drug lab residues in a variety of forms. In addition it was shown that highly accurate analysis of glass particles and mapping results of gun shot residue distribution can be an important help for all forensic scientists during their routine tasks.

Non-destructive analysis results can be obtained in as little as 30 seconds. The small analytical spot size of the Eagle allows the user to minimize the amount of sample needed for analysis while quick sample positioning with video cameras eliminates the need for a special sample holder. In conclusion, the Eagle Micro-XRF analyzer is the ideal tool for quick and non-destructive analysis in the forensic science laboratory.

