HORIBA Scientific

Application Note

Forensics

XGT

XGT6

Fingerprint imaging with micro-XRF

The fast and non-destructive elemental analysis provided by x-ray fluorescence (XRF), has long been known as a useful tool for forensic science. As microscopic capabilities in the technique have advanced, so its suitability to forensic analysis has increased, now allowing accurate analysis of minute material fragments (see Figure 1) such as paint chips, metals, glasses, and gun shot residues.

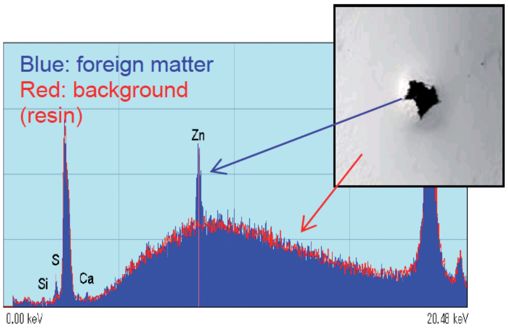


Figure 1: Fast identification of a microscopic fragment embedded in a polymer resin using the XG T-5000.

Fingerprint analysis

In this note a slightly less usual forensic application for micro-XRF has been investigated – fingerprint imaging. Whilst there is a wide range of fingerprinting techniques available (both chemical and optical), there nonetheless remains certain cases where analysis of the latent is difficult. Examples of these include prints left on shiny colour surfaces (for example, glossy magazines) and finely woven fabrics.

Since many prints are routinely treated with chemical agents (for example, physical developer and vacuum metal deposition), the use of a micro-XRF elemental imaging system is an interesting extension of existing techniques for forensic scientists.

The award winning XGT-5000 XRF microscope instrument allows convenient access to beam sizes as small as 10 µm, ensuring that fine detail of the prints can be accurately extracted. Spacious sample chambers allow even large samples to be accommodated without the need for cutting, and areas up to 10 cm x 10 cm can be routinely mapped.

Experiment results

A fingerprint located on an inside page of a typical glossy magazine was initially treated with physical developer to give a silver deposit, and then toned with potassium iodide to give a silver iodide deposit. The physical developer reacts with fatty deposits within the fingerprint, and so the whole process provides clear chemical distinction between the print and the background material.

Mapping experiments over a ~20 x 20 mm^2 area allow this elemental distribution to be easily distinguished using micro-XRF, as illustrated in Figure 2. The unique capabilities of the XGT-5000 in fact provide two methods for providing the necessary contrast – XRF imaging to examine distribution of silver and iodine atoms, and transmitted x-ray imaging which distinguishes regions of high and low x-ray absorption. In the case of the fingerprint, strong absorption is presented by the silver and iodine atoms located on the grease ridges, whereas the background paper substrate has much reduced absorption.

With elemental images such as this, it is then a simple matter to have the fingerprint ‘marked up’ for distinguishing features, and in a criminal case, hopefully matched to a known suspect.

JOBIN YVON Technology

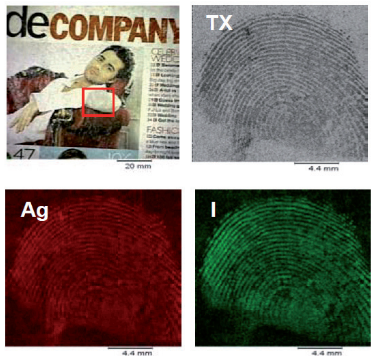


Figure 2: Optical image of magazine page, transmitted x-ray image (TX) and iodine (I) and silver (Ag) XRF images of fingerprint. The analysis was made in the area highlighted in the optical image.

In a second experiment, a finely woven silk material was coated sequentially with gold (thin layer) and zinc (thicker layer) by vacuum metal deposition.

In many traditional techniques, the weave of the fabric makes analysis of the print difficult. Mapping experiments for zinc distribution over the fabric clearly shows the fingerprint image – in addition, the fine weave can also be distinguished in the scattered x-ray image, illustrating the high spatial resolution of the XGT instruments (Figure 3).

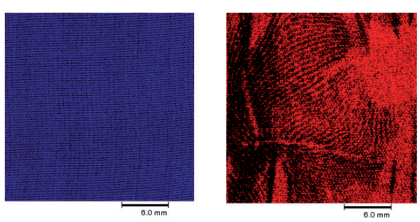
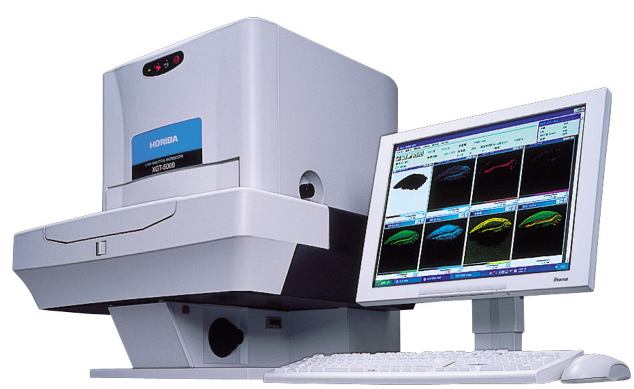


Figure 3: Scattered x-ray image (left) and zinc XRF image (right) acquired over fin gerprint on fabric

Summary

The XGT-5000 has been successfully used to analyse and image fingerprints on what are traditionally difficult substrates. Whilst there are many routine techniques available to allow fingerprints to be imaged, the XGT technology highlights a more specialised method for one-off critical prints in high priority cases.

In addition, the fast elemental characterisation possible with spatial resolution down to 10 µm means that micro-XRF analysis with the XGT-5000 is ideally suited to many other forensic applications. In particular, the method is non-destructive, ensuring vital trails of evidence can be maintained.



XGT-5000

info.sci@horiba.com
www.horiba.com/scientific

HORIBA Scientific

USA: +1 732 494 8660 **France:** +33 (0)1 64 54 13 00 **Germany:** +49 (0)89 4623 17-0
UK: +44 (0)20 8204 8142 **Italy:** +39 0 2 5760 3050 **Japan:** +81 (0)3 38618231
Spain: +34 91 490 23 34 **China:** +86 (0)10 8567 9966 **Brazil :** +55 11 5545 1540
Other Countries: +33 (0)1 64 54 13 00