



## Micro-XRF analysis for the Electronics Industry

The combination of the XGT-5000's ground breaking spatial resolution and sensitivity means it is the instrument of choice for fast analysis of electronic components, whether for analysis of restricted harmful elements (the WEEE/RoHS 'lead free' legislation), trouble shooting, or R&D.

With a beam size of 10  $\mu\text{m}$  even the smallest features on a populated circuit board can be accurately analysed, allowing microscopic contaminants to be identified, wiring/soldering defects to be located, and elemental composition of parts and components to be checked. In addition, the capability for simultaneous XRF and transmission x-ray mapping allows information to be obtained on parts not visible to the eye, for example, circuitry encased in plastic.

### Troubleshooting the Manufacturing Process

The XGT-5000 was used to observe the internal structure of a lead free solder used on a malfunctioning board. A large portion of the circuit board was initially imaged via x-ray transmission, and was used to locate a 1 mm<sup>2</sup> area for more detailed analysis (Figure 1). Voids within the solder were quickly identified in the transmission image, and their size was shown to be in the order of 25-70  $\mu\text{m}$ .

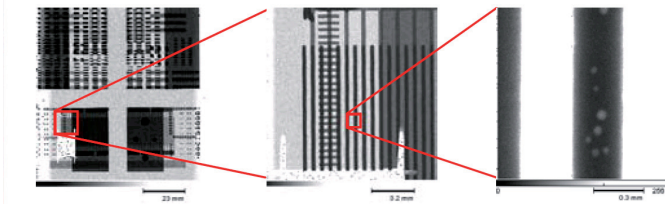


Figure 1: Transmission x-ray images of circuit board, with consecutive zoom to illustrate mapping region discussed in text

Elemental mapping with the 10  $\mu\text{m}$  guide tube clearly illustrates the distribution of the tin and copper constituents in the solder. It is clear from the results (Figure 2) that there is copper ion migration beyond the flux of the solder, and it is this which contributes to the board malfunctioning.

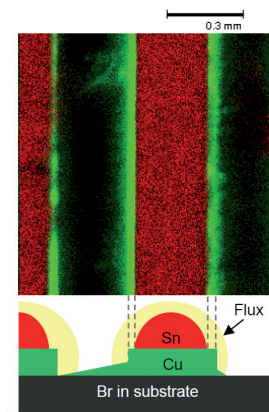


Figure 2: Composite XRF image (Sn + Cu) with schematic showing copper ion migration from solder lines

### Restriction of Hazard Substances within Electronics

The electronics industry is widely affected by the forthcoming European legislation on the Restriction of the Use of Certain Hazardous Substances (RoHS), which limits the use of Cadmium (Cd), Lead (Pb), Mercury (Hg), hexavalent Chromium (Cr<sup>VI</sup>), polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE). The RoHS directive is far reaching, for it applies to every individual component within electronic appliances (for example, videos, televisions, computers, televisions, fridges, telephones). Similar "lead-free" legislation for the automotive industry is already in place – the End of Life Vehicles (ELV) directive.

In order to prove compliance to these directives, manufacturers of parts and components must test all individual parts for presence of the restricted species. XRF provides a fast, non-destructive way to analyse for Cadmium, Lead, Mercury, total Chromium and total Bromine. With a unique primary x-ray clean up filter and integrated RoHS/ELV software, the XGT-5000 instrument can be used for fast analysis of both large and small parts (Figure 3) for concentrations down to just 2 ppm.

Whether the analysis is for a power cord, on-off switch, resistor, solder, cable tie, screw and washer, LCD display etc, the XGT technology has the answer.

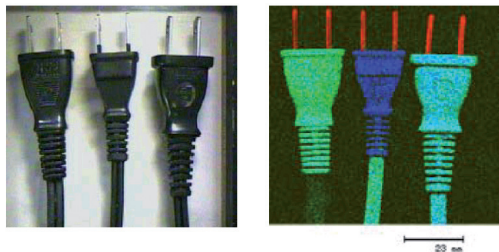


Figure 3: (Left) Optical image, (Right) composite image Ni+Pb+Cl

### «Lead-free» manufacturing

The requirement to stop the use of the five RoHS/ELV restricted elements in electronic appliances necessitates amended manufacturing processes. The most important of these is the move from lead containing solder to lead-free solder. In this example, a circuit board used in a HORIBA pH meter (Figure 4) is tested before and after a new manufacturing process is initiated.

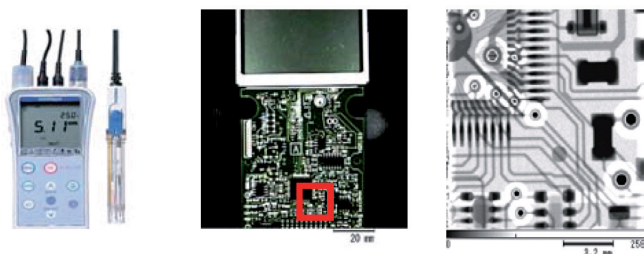


Figure 4: A HORIBA pH meter (left), optical image of circuit board (center), and transmitted x-ray image of highlighted region (right)

Figure 5 clearly illustrates how the revised manufacturing with new solder has removed most of the lead from the circuit board. The remaining Lead is present only in the three integrated chips, which have since undergone their own revised manufacture so that the pH meter can fully comply with the RoHS directive.

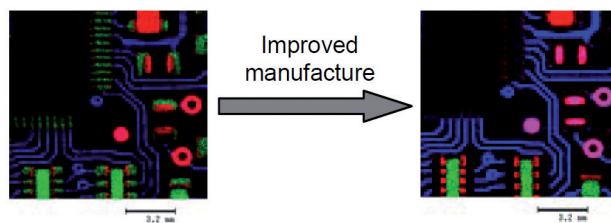


Figure 5: Composite image of circuit board, before and after implementation of lead-free soldering. Ni+Pb+Cl

### Conclusions

The fast non-destructive elemental mapping capability of the XGT-5000 is ideally suited to probing intricate features within electronic components. With the narrow, high intensity beam delivered by the unique HORIBA x-ray guide tube (diameters down to 10 µm) even the smallest detail can be observed.

Additional quantitative information on elemental composition is proving vital for manufacturers across the world to ensure their products comply with the forthcoming RoHS and ELV directives, which restrict the use of specific harmful elements such as Lead and Cadmium.

### Acknowledgements

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XGT-5000

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