Application Brief

SII

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Energy Dispersion X-ray Fluorescence Analyzer (Micro Element Monitor)

1. Overview

The minimum area of analysis by conventional fluorescent X-ray analysis methods (EDX, WDX) is at mm levels. Other analysis techniques, such as analytical electron microscopes (SEM-EDX or EPMA), Auger Electron Spectroscopy (AES), ion microanalysis (SIMS) are suitable for analyzing at microscopic regions below mm levels. Because these systems require sample pre-treatment and have highly technical operation and maintenance requirements, results are not easily produced. The micro element monitor introduced here requires no complicated pre-treatment, performs non-destructive, non-contact line and surface distribution analysis from particle analysis of micro areas, quantitative analysis, and multi-functional analysis of thin film and bulk samples. Furthermore, employment of the Windows OS environment makes operation simple.

This application brief introduces simple specifications and applications of the element monitor.

2. Analysis Conditions

An overview of the system is shown below in figure 1. One advantage of this system is accurate positioning ability with its coaxial excitation X-ray axis and sample observation beam axis. The detector employs a high performance semi-conductor detector that can detect elements from sodium to uranium. Employed in the excitation X-ray beam system is a micro focus X-ray tube that realizes a minimum beam size of 50 μm. A 50 μm particle can be selected and analyzed by adjusting the optical image at a magnification of 250X.

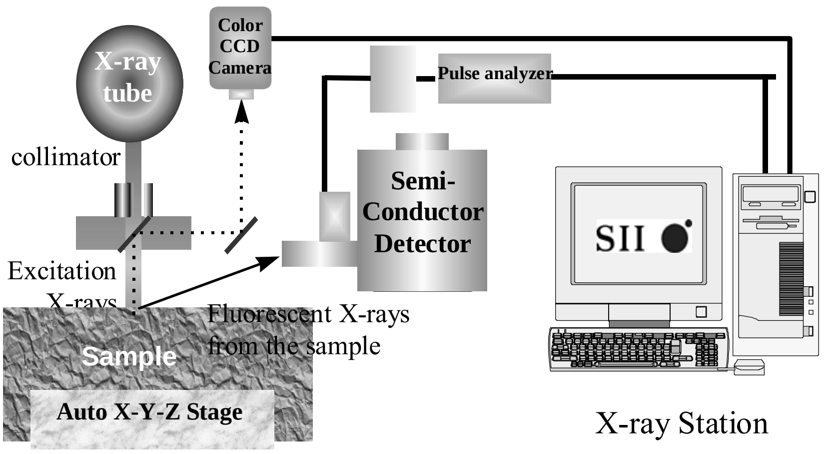
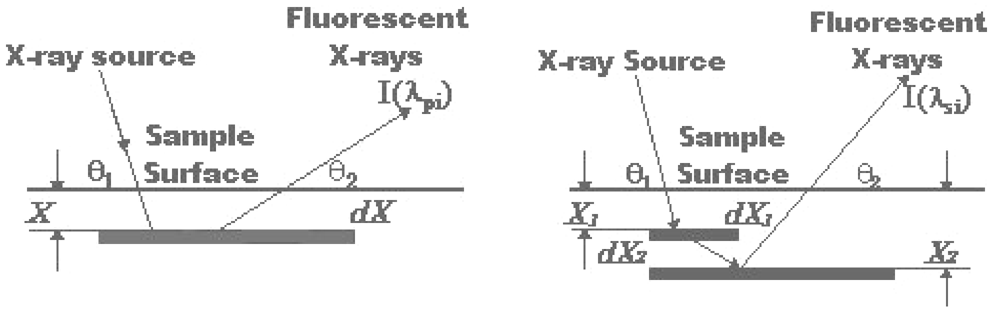


Figure 1 System Overview

3. Quantitative Method

Quantitative methods can be roughly classified into (1) measuring standard sample of known composition and thickness or the method of creating a calibration curve from the relationship of fluorescent X-ray intensities and thickness/composition, and (2) theoretical calculation method called the Fundamental Parameter (FP) Method. Explained here is the idea behind the FP method in which quantitative results can be easily obtained using fewer standard samples.

Analytical intensity is able to describe the sample composition and fundamental constant (fundamental parameter) as a function if the sample is analytically uniform. In other words, the intensity produced from a sample of any composition can be calculated from this fundamental constant.



Primary Fluorescent X-rays　　**Secondary Fluorescent X-rays (Excitation Effect)**

Figure 2　Analytical rays generating mechanism by excitation effect

Figure 2 displays the model for generating fluorescent X-rays. We know that the fluorescent X-ray intensity analyzed and obtained theoretically from this type of model closely agrees with actual sample values. The FP method of quantitative analysis is based on this fact.

If the depth at which fluorescent X-rays are generated is infinite in terms of X-rays, then the FP method is suitable for bulk samples, and if depth is a small value (less than the critical thickness) then the FP method is suitable for thin film samples. A major characteristic of the FP method is the ability to simultaneously measure composition and thickness of thin film samples from composition analysis of bulk samples. This method requires a very complex process of calculations, but recent speed gains in the processing ability of personal computers has made the FP method practical to use.

4. Analysis Results

Because X-rays are the excitation source there are basically no restrictions to what type of sample can be measured. A solid sample can be analyzed without pre-treatments such as pulverizing the sample or dissolving the sample in solution. One example shown here is analysis of red seal-ink stamped on paper.

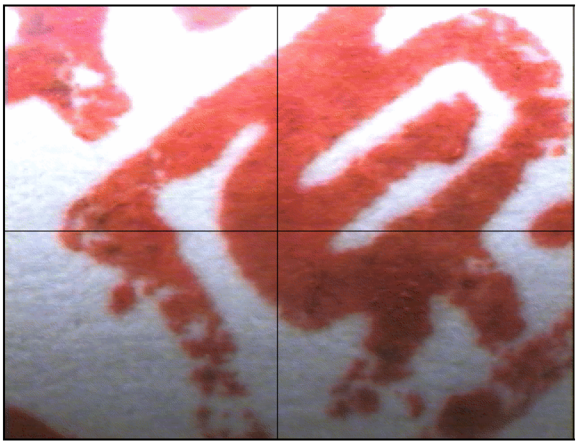


Figure 3 Sample Image

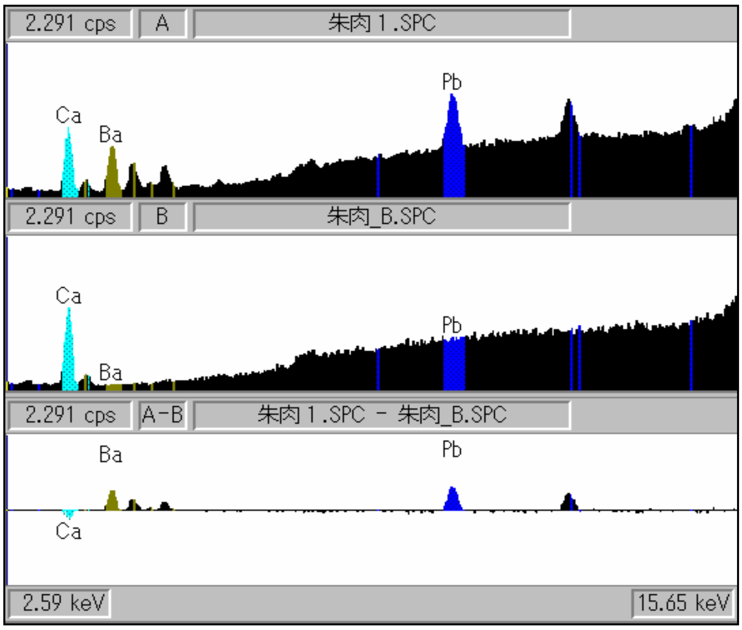


Figure 4 Fluorescent X-ray Spectrum

In Figure 3, measurement positioning was done from the CCD image and analysis performed. Qualitative and quantitative analysis can be performed from fluorescent X-ray spectrum, such as that in Figure 4, and the seal-ink components identified.