

HIGH-DEFINITION XRF – MULTIPLE MONOCHROMATIC BEAMS EDXRF – FOR CONSUMER PRODUCT ANALYSIS

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Toxic elements, such as Pb, Cd and Sb, in consumer goods or children products are a significant safety concern for public recently. Both US and EU has strict regulations that set maximum allowable limits for Pb, As, Hg, Ba, Cr, Se, Cd and Sb in surface coatings of children products. Traditional Energy dispersive x-ray fluorescence (EDXRF) based on a polychromatic beam has historically been a powerful tool for quantitative analysis of these elements in bulks. However, quantitative analysis of the mass fraction of toxic elements in a paint layer directly is thus far difficult by traditional EDXRF. There are three major issues for traditional EDXRF for the analysis of thin coatings on toys or other goods. The first issue is that signals are often buried in the background noise for thin coating with low ppm toxins. The background is mainly comes from the substrate scattering of bremsstrahlung portion of the beam. The second issue is a small beam is often needed for small coating feature or irregular surface analysis. The third issue is the quantification of a coating layer in mass fraction is very difficult because the thickness and density of the layer are often unknown.

To overcome these issues, a multiple monochromatic beams EDXRF analyzer, called high-definition XRF (HDXRF) analyzer, has been developed. The physical base for this HDXRF analyze is a focused beam monochromatic excitation EDXRF technique based on a point focusing doubly curved crystal (DCC) optics. With the use of monochromatic excitation, the S/B ratio is improved significantly because of the elimination of the bremsstrahlung scattering underneath the signals. With the point focusing nature of the DCC optic, the HDXRF analyzer provides small spot beam to address small feature analysis and irregular surface. More importantly, quantitative analysis of a surface layer can be achieved by using multiple monochromatic beams.

A new HDXRF analyzer consists of three monochromatic beams which focus to a spot of 1mm in diameter on a sample. This analyzer provides rapid screening and quantification of toxic elements in both uncoated samples and coated samples. The lower limit of detection (LOD) for the toxins in low Z matrix is in the sub-ppm range for bulk samples. The LOD for toxic metals in a 25 μm paint layer is in the single digit ppm range. For some traditional difficult elements for EDXRF, such as Cd, unprecedented LOD in a surface layer and bulk metal has been achieved.

In this paper, analytical capability, software aspects, and application data will be presented and discussed.