D30 Comparison of XRF, SEM-EDS, ICP-MS, and LA-ICP-MS in Forensic Glass Fragment Analysis

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After attending this presentation, attendees will learn the strengths and weaknesses of the techniques adopted in differentiating glass samples and the compounds which are useful in differentiation of glass.

This presentation will impact the forensic science community by the variety of techniques used to analyze glass fragments.

Glass is one of the most tangible pieces of evidence found in forensic cases, as it appears everywhere in our daily lives, and, because of its physical, chemical, mechanical, and optical properties, it presents the kind of evidence that can be analyzed using many different methods. For this reason, much research has been conducted on these methods. This research has generally consisted of the determination of the glass refractive index and elemental analysis. Improvements in analytical technology have made possible the development of new methods in elemental analysis leading to an increase in the ability to distinguish between glass fragments. Because of its nature, glass consists of different oxides. When elemental analysis methods are applied, the oxide components in the glass vary proportionately. While some oxides make up a large bulk of the composition, others are found in very low quantities. The oxide composition of the glass is a very important factor in comparing different samples in terms of their relative oxide quantitative distribution.

The goal of this study is to establish the definition and differentiation of glass samples by looking at their elemental composition, particularly when the evidential glass is of unknown origin. In this study, glass samples encountered in many criminal cases are examined using X-Ray Fluorescence (XRF) spectrometer, Scanning Electron Microscope with Energy Dispersive X-ray Spectroscopy (SEM-EDS), Inductively Coupled Plasma Mass Spectrometry (ICP/MS), and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP/MS). These four techniques provide high resolution of the elemental analysis of glass materials, while based on different principles.

A total of 50 uncolored glass samples were divided into two groups, window and headlight. As a result of some analysis that had been done during the research, it became clear that the quantification of only one oxide is insufficient to differentiate between the various types of glass. When several of the oxides are analyzed together, the results obtained can help in the recognition of and differentiation between glass fragments. Also, more precise results can enable determination of which oxide is useful in defining and differentiating the glass. This can be achieved by normalizing the elemental analysis of the oxide composition, selecting an appropriate oxide, and then carrying out a critical evaluation of the results.

In conclusion, this study will be performed in order to ascertain whether spectroscopic analytical methods are beneficial in distinguishing between glass samples and, thus, in defining the origin of unclassified glass.

Glass Comparisons, Elemental Analysis, Trace Evidence

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