B172 Discrimination of Automobile Side Windows by micro-XRF

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After attending this presentation, attendees will learn about the effects of recent improvements in the design X-ray fluorescence spectrometers on their use for the comparative analysis of glass fragments, including the factors which affect the ability to discriminate between samples of lass using X-ray fluorescence techniques. Specifically, this presentation will offer insight into the capabilities of a polycapillary, micro-XRF instrument for the source discrimination of similar glass fragment samples, the limits of accuracy and precision of the results obtained, and the rates at which comparison errors occur.

This presentation will impact the forensic community and/or humanity by demonstrating This research provides a basis for the analysis of glass samples utilizing X-ray fluorescence (XRF) techniques.

Differences in surface geometries and thicknesses of small glass frag- ments result in inaccuracies in the results of comparative XRF measure- ments, including loss of signal from elements with larger excitation depths. Furthermore, difficulties in spectral interpretation result from variations in detector sensitivity for different x-ray energies and interferences from other X-ray phenomena such as diffraction.

X-ray fluorescence measurements were made using an Eagle II (EDAX) spectrometer with a Rh tube. Samples selected for this study are tempered automobile glasses with similar refractive indices (n_D=1.5186 ± 0.0002). Semi-quantitative comparisons, based upon the ratios of the net intensities of the silicon (Si), potassium (K), manganese (Mn), and iron (Fe) emissions to the calcium (Ca) emission and the strontium (Sr) to zirconium (Zr) net intensity ratio, were used for this study.

Statistically-based tests can be used to test the hypothesis that the means of measurements from two samples are equal. For this study, three forms of the Student's t test were utilized. One form, which uses pooled standard deviations from the samples, is based on the assumption that the sample variances are equal. The second test, Welch's modification to the t test, assumes that the sample variances are unequal. Finally, in the third variant of the t test, the equality of variances for each variable was tested using the F-test and the appropriate form of the t test was applied to the data set. That is, those comparisons showing unequal variances were compared using Welch's modified t test, while those with equal variances used the pooled standard deviation t test.

A Type I error, or false exclusion, is made when the conclusion reached is that the two samples are distinct when in fact they are from the same source. A Type II error, or false inclusion, is a failure to distinguish between two samples that are from different sources.

The first portion of this study investigated the ability of replicate mea- surements on a single fragment to adequately account for the effects of changing surface geometries and the limits of thickness tolerances. The second portion of the study focused on the ability to discriminate between similar sources of glass, the ability to identify the correct source of a single fragment, and the rates of Type I and Type II errors associated with these comparisons.

Although the accuracy and precision of results obtained by µXRF analysis of glass fragments is limited to some extent by the size and shape of the fragments and by the x-ray source energy range of the instrument, this study has demonstrated that µXRF may be used to differentiate some glass sources that are indistinguishable by refractive index. A semi-quanti- tative approach involving multiple measurements of the ratios of x-ray peak intensities for selected elements in each fragment is optimal for using µXRF for glass source discrimination.

Micro-X-Ray Fluorescence, Trace Evidence, Glass