B89 The Use of Scanning Electron Microscopy With Energy-Dispersive X-Ray Spectroscopy (SEM/EDS) for Quantitative Forensic Comparisons of Blue Glass

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After attending this presentation, attendees will understand the problems encountered during the quantitative analysis of SEM/EDS spectra of blue glass samples and how to overcome them.

This presentation will impact the forensic science community by instructing attendees on how to overcome problems of black-box software while using SEM/EDS for the quantitative analysis of blue glass samples.

EDS, especially when employing an SEM as an excitation source, is a core elemental characterization technique for micro and ultra-micro samples. This technique has long been used to add to the evidential value of micro-transfer trace evidence by microscopical forensic examinations. Glass chips are one specific class of transfer evidence for which this technique has been employed. As a strategy for comparing glass samples by EDS, criminalists often normalize the data and compare ratios of peak heights or peak areas to one common major element, such as silicon. Courts today often require data regarding the frequency of occurrence of similar spectra to assist the trier of fact concerning the weight of this comparative evidence. This research hopes to add insight into this matter.

In this presentation, X-ray spectra obtained from 46 blue glass samples will be compared. Previous work has been completed that looked at the Ultraviolet/Visible (UV/VIS) spectra of these blue glass samples using a fiber optic micro-spectrophotometer in which few spectral differences led to possible differentiation among certain samples in this set. As color is the first logical step in comparing glass samples for analysis, it could sometimes be subjective to the observer. This research allowed for the comparisons to be instrumentally supported. The UV/VIS spectra will be compared with the SEM/EDS spectra to determine if differentiation among these glass samples is possible using these two techniques alone or in conjunction with one another. Sample preparation will be discussed as often how the sample is prepared for analysis will define any further analysis.

Being mindful of the caveat given by Dr. Peter Zoon of the Netherlands Forensic Institute (to be careful about how we generate and use data obtained with computerized black box software), the quantitative data generated from the blue glass samples and a pair of standard reference materials (620 and 621) from the National Bureau of Standards (NBS) were evaluated by a commercial software package utilizing both standardless and with-standard algorithms. In addition, the raw data was processed using the National Institute of Standards and Technology's (NIST's) Desk Top Spectrum Analyzer II (DTSA II). By use of the NBS standard reference materials, the advantages of both DTSA II and the commercial software package can be assessed. Statistical treatment of the data in the form of principal component analysis allows determination of the discrete characteristics of elemental composition to classify and discriminate between these glass samples. The results of these investigations, as well as some topics to be mindful of, will be presented.

SEM/EDS, Glass, Quantitative