B44 Analysis of Glass by Cathodoluminescence

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After attending this presentation, attendees will be familiar with the application of cathodoluminescence (CL) detection to forensic glass analysis. This presentation will cover the spectroscopy of cathodoluminescence and discuss the reproducibility of CL emission when applied to National Institute of Standards and Technology (NIST) standard glass samples.

The impact of cathodoluminescence to the analysis of glass samples will impact the forensic community and/or humanity by providing the forensic community with a new instrumental technique to analyze glass samples and provide a means to link glass from a suspect to glass found at the scene of the crime.

Glass is a common piece of evidence submitted to forensic laboratories for analysis because it can be found virtually anywhere: automotive headlights, windows, mirrors, and eyeglasses. Automobile accidents, theft, and burglary are crimes in which glass can be the most important piece of evidence. Glass is very stable and does not degrade over time, making it easy to handle, analyze, and store. Previous work in glass analysis has been principally elemental, using laser ablation inductively coupled plasma mass spectrometry, scanning electron microscopy equipped with energy dispersive spectrometry, refractive index measurements, and X-Ray fluorescence spectrometry. This study focused on the application of the technique of cathodoluminescence to forensic glass analysis. CL detection is a technique used by geologists to investigate the internal structure of minerals. Because CL detection can provide information about the quality and composition of glass, it will enhance the information available to forensic scientists. Cathodoluminescence is a phenomenon occurring when a production of a beam of high energy electrons impacts a material, such as glass, causing it to emit visible light. CL detection is a sensitive technique that is non-destructive and does not require a high power laser. The electrons generated in a scanning electron microscope (SEM) provide sufficient conditions for CL detection. The coupling of SEM and CL detection aids in minimizing sample preparation. Sample preparation for the SEM is relatively simple and no matrix substitution is needed. SEM and CL detection are both non-destructive techniques, so the sample's integrity is maintained. For this study, a SEM equipped with a cathodoluminescence detector was used. This method of analysis, which is very popular for semiconductor analysis, has not yet been applied to forensic glass samples.

In this study, the compositions of NIST standard glass samples were analyzed. Samples of different sizes were mounted in various orientations and analyzed to assess the reproducibility of CL emission. The NIST samples analyzed were soda-lime float glass, which is the type of glass found in automotive and security windows, and multicomponent glass. Preliminary work investigating the spectroscopy of cathodoluminescence was also performed and will be discussed. Future work in this study will involve the creation of a database that is capable of comparing and matching glass fragments based on their CL emission. This will be of tremendous value to the forensic community.

Cathodoluminescence, Glass, Scanning Electron Microscopy