



Criminalistics Section - 2016

B38 Characterization by Scanning Electron Microscopy With Energy-Dispersive X-Ray Spectroscopy (SEM/EDX) of Nail and Gel Polishes and Its Real-World Applications

*Audriana M. Wagner**, University of New Haven, 300 Boston Post Road, West Haven, CT 06516; *R. Christopher O'Brien, PhD*, University of New Haven, Dept of Forensic Science, 300 Boston Post Road, West Haven, CT 06516; *Elaine M. Pagliaro, JD*, University of New Haven, Lee Institute of Forensic Science, 300 Boston Post Road, West Haven, CT 06516; and *Brooke W. Kammrath, PhD*, University of New Haven, Forensic Science Dept, 300 Boston Post Road, West Haven, CT 06516

After attending this presentation, attendees will better understand the characterization and discrimination power of SEM/EDX for the forensic analysis of nail and gel polishes. In addition, real-world samples degraded in air, static freshwater, and dynamic freshwater environments were analyzed to assess changes in their elemental composition.

This presentation will impact the forensic science community by determining the characterizing and discriminating potential of SEM/EDX for the forensic analysis of nail and gel polishes as well as evaluating the effects of degradation on those results.

Because of their wide availability, popularity, and durability, nail polishes are an important type of cosmetic evidence. Although cosmetic evidence is not widely analyzed by forensic scientists, these types of evidence have proved to be incredibly valuable in a plethora of cases including the infamous “Wood Chipper Murder Case” in Connecticut. Traces of nail polish can be left at a location or transferred between individuals in a variety of ways, and the ability to associate a sample with the source (bottle and/or brand) is of the utmost importance.

SEM/EDX instrumentation is not only valuable for viewing powerful high-resolution microscopic images of samples but also for measuring their elemental composition. This instrumentation is commonly used to analyze trace paint evidence gathered from the scenes of hit-and-runs or burglaries for identification purposes. Nail and gel polish composition is complex and actually very similar to that of paint, which is the impetus for evaluating SEM/EDX performance in terms of nail and gel polish characterization and identification.

In this study, the effectiveness of SEM/EDX instrumentation was explored for the characterization of visually similar nail and gel polishes in red and pink hues. Seven different brands were chosen for each type of polish for a total of 14 brands. From each brand, seven colors of similar shades were selected as samples resulting in a total of 124 analyzed polishes including top and base coats from each brand. The brands used were a mix of salon quality polishes and polishes intended for at-home use. Additionally, painted nail clippings underwent extensive degradation studies in air, static freshwater, and dynamic freshwater environments, which were similarly analyzed by SEM/EDX to measure the degradation effects from each environment over a time period of one month. These degradation studies of painted human fingernails mimicked submissions of evidence to a forensic laboratory and offer real-world information on the decay of nail and gel polishes in the tested environments.

This study evaluated the forensic relevance of SEM/EDX instrumentation for the analysis of nail and gel polishes by comparing elemental compositions of the selected polishes. Multivariate statistical analysis methods, such as Principal Component Analysis/Canonical Variate Analysis (PCA/CVA), pair-wise comparisons, and standard deviation match criteria were used to assess the discrimination ability of the instrumental methods used for both characterization and degraded samples. Results indicate that although brands and bottles could not be uniquely identified because of similar elemental profiles, this technique would be useful for exclusion. This research provides valuable information to the field of forensic science, specifically for the analysis of cosmetic evidence, where a gap in the literature exists.

Cosmetic Evidence, Forensic Science, SEM/EDX