B215 Parameter Optimization and Validation for Qualitative Elemental Analysis of Electrical Tape Backings by X-Ray Fluorescence (XRF)

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Learning Overview: After attending this presentation, attendees will have learned of the benefit of implementing XRF in the analysis of electrical tape backings due to the rapid and non-destructive nature of the method. Attendees will gain an understanding of the key factors and potential interferences to assess when attempting to adapt this method for use in their respective laboratories while learning of the relevant figures of merit reported for the method on an XRF instrument.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing insight into the validation process of a rapid and non-destructive method for increased sample discrimination of electrical tape backings beyond traditional Scanning Electron Microscopy with Energy-Dispersive X-ray Spectroscopy (SEM/EDS) analysis.

Electrical tape becomes relevant forensic evidence in high-profile casework involving homicides or explosive devices. As such, it is critical that practitioners have access to rapid, minimally invasive techniques of analysis to best support these investigations. The characterization of electrical tape backings through XRF spectroscopy has been shown to be a highly discriminatory, non-destructive method of analysis requiring limited sample preparation. In a previous study by Prusinowski et al., XRF analysis of electrical tape backings exhibited increased discrimination from traditional SEM/EDS methodology from 78.8% up to 91.0%, making the method desirable for implementation in a forensic laboratory.[1]

This study describes the process of parameter optimization and validation of the method on an XRF spectrometer for casework use. This work expands upon the previous discrimination study by broadening the total sample set of characterized tapes from 40 to 90 samples. Replicate measurements on different locations of the tape sample were analyzed (n=3) to assess the within-sample variability. XRF provided superior discrimination to SEM/EDS on the expanded dataset and a more comprehensive elemental characterization (17 elements by XRF vs. 8 by SEM/EDS). Duplicate controls and tape fragments from the same roll were also analyzed to assess inter-day, intra-day, and intra-roll variability. Parameter optimization included comparison of atmospheric conditions, collection times, and instrumental filters. A study of the effects of adhesive and backing thickness on spectrum collection revealed key implications to the method that required modification to the sample substrate. As an electrical tape standard reference material does not currently exist, the National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1831, a standard soda-lime glass, was found to be an adequate reference material for tuning the instrument.

In addition to the parameter optimization, figures of merit assessed during the validation portion of this study included accuracy, precision, sensitivity, selectivity, and processed sample stability. By optimizing this technique for use on an XRF instrument, a new tool for rapid, highly informative elemental analysis of electrical tape backings was provided to expand examiners' casework capabilities.

Reference(s):

1. Meghan Prusinowski et al. Assessment of the utility of X-ray Fluorescence for the chemical characterization and comparison of black electrical tape backings. *Forensic Chemistry* 13 (February 2019): 1-11, https://doi.org/10.1016/j.forc.2019.100146.

X-Ray Fluorescence, Elemental Analysis, Electrical Tape

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