## A105 Qualitative and Quantitative X-Ray Diffraction in Forensic Analysis of Duct Tapes

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After attending this presentation, attendees will understand in which ways Qualitative and Quantitative XRD analysis can be used in the forensic analysis of duct tapes.

This presentation will impact the forensic science community by discussing how XRD analysis has the potential to offer a convenient, cost effective, and non-destructive method for further characterization of the tape backing layer. This research project investigates the usefulness of XRD analysis of duct tapes in distinguishing between tapes from different manufacturers and between tapes from different batches from the same manufacturer.

Duct tapes fall under the umbrella of pressure sensitive tapes (PST), which are an increasingly important class of forensic evidence. This study proposes the use of x-ray diffraction (XRD) technology to extend the ability of evidence examiners to gain additional information about a duct tape specimen. XRD data will support the commonly used microscopy, elemental, and spectral analyses for greater discrimination. XRD analysis has the potential to offer a convenient, cost effective, and non-destructive method for further characterization of the tape layers.

Forensic analysis of duct tapes has two main goals. Comparing physical and chemical characteristics can help determine how likely it is that two or more tape samples have the same origin. This can help in proving or disproving links between suspects and crimes or crimes to each other. In addition, comparing the characteristics of an unknown tape sample to a database of known tape samples can provide additional information for the investigative process.

A variety of physical investigations and instrumental analyses are used to gather information for discrimination of tapes. Efforts to further individualize tapes have centered on elemental analysis of the adhesive layer. The adhesive layers have more variation in composition than the backing layers, but they are also more sensitive to contamination and weathering effects. Many of the methods providing information about elemental composition involve analyses that destroy the sample, which is undesirable as the size of forensic tape samples is often very limited.

XRD analysis has the potential to offer a convenient, cost effective, and non-destructive method for further characterization of the tape layers. Although the composition of the polymer in the backing may not vary much between duct tapes, the different production methods and manufacturing machinery could result in different patterns of orientation of the components. The polymer used in the backing layer of duct tapes is polyethylene which is a semi-crystalline material. The crystalline component is influenced by many factors including microstructure, thermal history, processing, and average molecular weight. As a result, slight variations in the manufacturing process may produce significant and detectable differences in the crystallinity of the product.

This research project investigates the usefulness of XRD analysis of duct tapes in distinguishing between tapes from different manufacturers and between tapes from different batches from the same manufacturer. Limitations of specimen size will also be explored.

**Duct Tape, X-Ray Diffraction, Multivariate Statistics**

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