A150 A Standard Method for Collection of Dichroic Spectra of Dyed Fiber Evidence

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The goal of this presentation is to help attendees learn, retain, or implement a method for the collection of dichroic spectra of dyed fiber evidence that addresses several factors that are necessary in order to obtain reproducible and reliable absorption spectral data from microscopic fiber evidence.

This presentation will impact the forensic science community by showing attendees that observing dichroic behavior and measuring dichroic spectra are essential discriminating factors in dyed fiber comparisons. Dyed fibers are a common class of trace evidence and microspectrometry is used to obtain absorption spectra for comparison of a questioned fiber to a fiber from a known source. This study identifies factors that must be considered when making dichroic spectral measurements. Failure to make dichroic spectral measurements can lead to false exclusions or excessive spectral variations which can lead to either false inclusions or cause the analyst to believe the spectra are unreliable. This refined method for dichroic spectral measurements improves the reliability of spectral data and provides significant additional information for comparing dyed fiber evidence.

Polarization is a commonly ignored variable in micro-spectral analysis of dyed fiber evidence. Since all textile fibers are oriented molecular structures, measuring the spectra of dyed fibers requires the analyst to control the state of polarization when recording their absorption spectra. In recent studies, it has been shown that a majority of dyed textile fibers are dichroic.[1] The absorption spectrum of a dichroic fiber is dependent upon the orientation of the light's electric field vector relative to the fiber's principal axes. Spectra must be recorded with linearly polarized light. The absorption spectrum of the fiber must be recorded with the electric field vector parallel to the longitudinal fiber axis and perpendicular to this fiber axis.

Grating and prism-based dispersive spectrometers produce a degree of polarization. This intrinsic polarization can be detected by recording the change in intensity when a linear polarizer is rotated through 360°. If the spectrometer has no intrinsic polarization, then the intensity will be constant as the linear polarizer is rotated. Using a spectrometer without knowing its intrinsic polarization can lead to serious problems. Placing a single linear polarizer either before or after the sample provides the necessary control to orient the radiation's electric field to the principle directions of the fiber. Since most micro-spectrometers operate in a single-beam mode it is necessary to record a background for each orientation of the polarizer. The intrinsic polarization of several commercial micro-spectrometers and various dispersive elements will be presented to illustrate the magnitude of this problem. There is a mistaken belief that if a polarizer is not used, then there is no dichroic effect. The intrinsic polarization of the spectrometer is introducing an unseen variable when measuring the absorbance spectrum of a dyed fiber.

Reference:

[1]K. De Wael, T. Vanden Driessche, Dichroism measurements in forensic fibre examination Part 1 - Dyed polyester fibres, Science and Justice 51 (20l 1) 57-67

Microspectroscopy, Dichroism, Intrinsic Polarization

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