B152 Forensic Discrimination of Dyed Textile Fibers Using UV-Vis and Fluorescence Microspectrophotometry

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The goal of this presentation is to evaluate the relative discriminating power of visible, UV/visible, and UV/fluorescence spectrophotometry for the characterization of dyed textile fibers.

This presentation will impact the forensic community and/or humanity by demonstrating how UV/Vis and fluorescence microspectrophotometry are valuable tools for the discrimination of fibers, in particular for discrimination of fibers of similar color but different dye composition. The fibers and associated spectra in the database are a useful tool for fiber comparisons in casework and in quality control and training of analysts.

Fibers are ubiquitously found as trace evidence in crimes of personal contact, such as homicide, assault, sexual offenses, and hit-and-run accidents. Ultraviolet-visible (UV-VIS), and fluorescence microspectrophotometry (MSP) offers direct, relatively inexpensive, and informative means of characterizing dyed textile fibers. Research in the use of UV-VIS and fluorescence MSP has multiple objectives: improving the forensic discrimination of fibers by defining protocols for the most discriminating approaches, validating data analysis methods, and providing a tested database of spectra from dyed and undyed textile fibers.

Fiber samples for forensic microspectrophotometry are typically mounted in a mounting medium (or mountant). The mountant must not chemically react with the dyed fiber, be relatively easy to use, adhere and harden rapidly for permanent storage (if desired), have high optical clarity with no formation of bubbles or crystals, have a refractive index near 1.5 for performing polarized light microscopy (PLM), be soluble in a non-toxic solvent to facilitate recovery of the fiber from the medium, be colorless, be non-fluorescent, not yellow or shrink with age, and be inexpensive. While no mountant possesses all of these ideal properties, a suitable mountant must have most of these characteristics, and of particular importance is that it must not react with the textile fiber. The authors have evaluated three different mounting media (glycerin, Norland Optical Adhesive 65, and Permount®) for the forensic discrimination of fibers by UV-VIS and UV/fluorescence. Subject to a few working recommendations, it has been found that Permount to be a suitable mountant for analyses.

A physical database containing over 500 dyed and undyed textile fibers has been developed with contributions from textile companies in the southeastern United States. All fibers have been characterized by polarized light microscopy, UV/Visible, and fluorescence microspectroscopy. A total of 25,000 UV-vis and fluorescence spectra have been acquired. Visual comparisons among the fiber spectra from the database have been supplemented by multivariate statistical analysis to confirm the statistical validity of discrimination observed.

Overall, UV/Vis and fluorescence microspectrophotometry are valuable tools for the discrimination of fibers, in particular for discrimination of fibers of similar color but different dye composition. The fibers and associated spectra in the database are a useful tool for fiber comparisons in casework and in quality control and training of analysts. Recommendations will be made for approaches which produce the most discriminating data to ensure that the limited time and resources available in forensic laboratories are most efficiently applied.

Fibers, UV-Visible Microspectrophotometry, Fluorescence

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