A108 Raman Spectroscopy: A Solution for the Analysis of Light Colored Fibers?

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After attending this presentation, attendees will understand the principles of raman spectroscopy, the challenges presented when analyzing light colored fibers, the utility of raman spectroscopy for forensic analysis of light blue cotton fibers, and the advantages of raman spectroscopy over current analysis methods for of light colored fibers, specifically microspectrophotometry.

This presentation will impact the forensic science community by proposing a more discriminative method for forensic analysis of light blue cotton fibers and potentially other light colored fiber types, which could result in the successful analysis of fiber evidence that while frequently encountered, remains problematic for current analysis techniques.

Light colored fibers are commonly encountered in forensic case work, but have little probative value due to the difficulties encountered when analyzing them with current fiber color analysis methods, such as microspectrophotometry or thin layer chromatography. Raman spectroscopy may present an alternative technique for the forensic analysis of light colored fibers.

Raman analysis provides spectral information of fiber colorants based on the inelastic electron scattering that results from the molecular vibrations and rotations when the sample surface is exposed to a laser. It is a non-destructive technique that requires little sample preparation and can be performed in-situ, all of which are advantages when working with forensic evidence samples. Previous research has successfully applied raman spectroscopy to the analysis of colorants in fibers and to differentiate fibers within color blocks, however research has been limited to dark colored fibers. In this research, raman spectroscopy was applied to the analysis of light blue cotton fibers. Light blue cotton fibers were chosen because blue fibers and cotton fibers are commonly encountered in forensic casework. 22 samples were collected from a variety of clothing types and brands, with only the fiber type known. The samples were analyzed using Raman spectroscopy and microspectrophotometry. Two lasers (514 nm and 785 nm) were used for Raman analysis to determine if two different wavelengths elicited additional spectral information. The samples were classified into groups based on the spectra obtained for each method and the more discriminative method was determined based on a comparison of the resulting groups. A blind test using four fibers selected from the sample group was also performed.

Raman analysis of the samples resulted in the individualization of 14 out of 22 samples, with three small groups of fibers remaining undifferentiated. Combining the microspectrophotometry results with those obtained with raman spectroscopy individualized two additional fibers, but microspectrophotometry alone resulted in fewer groups and no individual fibers could be isolated. The results of the blind test confirmed the utility of raman spectroscopy, which identified two of the unknowns, while none were identified with microspectrophotometry.

Based upon the results obtained, raman spectroscopy was more discriminative than microspectrophotometry for the analysis of light blue cotton fibers. While analysis with only one laser was more selective than microspectrophotometry, the use of two lasers permitted a higher degree of fiber discrimination. Overall, raman spectroscopy presents a suitable lternative to microspectrophotometry that conforms to the needs and demands of forensic science and that could be easily incorporated into the current forensic fiber analysis techniques when analyzing light blue cotton fibers. With further experimentation it could also be applied to light colored fibers of other types. As raman spectroscopy was more discriminative for light blue cotton fibers, it would be most beneficial as a replacement or precursor to microspectrophotometry.

Raman Spectroscopy, Cotton Fiber, Light Colored