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Graduate Program in Forensic Science
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Forensic Analysis of Fiber Dyes via Surface-Enhanced Raman Spectroscopy

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Abstract

Improving fiber analysis methods has always been of great interest to forensic examiners, with special concentration in identifying not only the fiber's basic chemical makeup, but also fiber type, manufacturer, and ideally, establishing a strong association to the source object or person. Various methods have been employed to achieve these goals, including the use of FTIR for polymer identification, colorimetric UV-VIS, and the fluorescence spectrophotometric characterization of the native fiber and coloring agents. Morphological characteristics obtained via microscopy, when combined with the FTIR and UV-VIS analyses can give additional support to forensic association, but they do not provide a full picture of any fiber in question. Attempts in completing such analyses have been made, to the extent of using a combination of HPLC UV-Vis and MS methods for colorant analysis. This increase in the amount of resources and instrumentation required to perform all or most analyses may not be feasible either due to cost, training, time requirements, or simply because the weight added to the evidential value may not be substantial enough to justify the effort.

The focus of this study is to explore one aspect of forensic fiber analyses which has been historically weakly explored, and that is the analysis of very small amounts of the fiber dye. Where UV-Vis or fluorescence information may be obtained by microspectrophotometry pertaining to the electronic transitions of the fiber and dye system, the dye structural information and ultimately identification of the specific dye, which is of potential forensic interest, eludes criminalists, where samples are very small. The chemical structure may be obtained via Raman and surface-enhanced Raman spectroscopy (SERS), as well as mass spectrometry. The advantage of using SERS in forensic investigations is that it is a relatively simple technique that is complementary to existing methods. It provides information that can otherwise be missed, and which can prove important in discriminating between fibers or in providing more detail about the fiber-dye system. The technique can be used at microliter volumes and low concentrations, thereby requiring very little material for analysis. The purpose of this proposed research project is to analyze various fiber and dye systems in an attempt to produce a systematic approach for a more complete characterization of unknown fibers by vibrational spectrometry, with a focus on the SERS analysis of fiber dyes, by developing procedures that are appropriate for fiber dye extraction based on assumed fiber dyeing method.

Biograph

Mircea Comanescu is currently a PhD student in the Criminal Justice program at the CUNY Graduate Center, an adjunct instructor in the Department of Sciences at John Jay College, and conducting research exploring Surface Enhanced Raman Spectroscopy interferences in the Department of Scientific Research at the Metropolitan Museum of Art, and various projects involving graphite furnace atomic absorption, microspectrophotometry, and SEM in the Science Department at John Jay College. He is a John Jay College alumni, having graduated in 2013 with a Forensic Science - Criminalistics B.S., Summa Cum Laude.

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All are welcome
Science Conference or 5.67 Lecture Room
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