A34 Identification of Body Fluid Traces Using Raman Spectroscopy: Toward Practical Application

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The goal of this presentation is to describe the development of a novel method for non-destructive, confirmatory identification of body fluid traces on the crime scene and in the laboratory. Attention will be focused on the most recent development of the method for characterization of contaminated samples, mixtures of body fluids, and possible substrate interferences. The attendees will also have a better understanding of the recent advancement of this application of Raman spectroscopy. The implementation of advanced statistics for automatic analysis of spectroscopic data and the evaluation of the accuracy and reliability of the conclusions made will be discussed.

This presentation will impact the forensic science community by offering the potential to greatly impact the accuracy and effectiveness of biological stain analysis for forensic purposes.

The identification of traces of body fluids discovered at a crime scene is a major part of forensic investigation today.[1] The three most common fluids found are blood, semen, and saliva, and there are several methods used currently to distinguish one from another. Blood can be presumptively tested by using different color spot tests, but these tests are destructive to the sample and can also produce false positives. Semen is similar in that there are destructive presumptive tests as well as confirmatory tests. Saliva; however, has no confirmatory tests. Most presumptive tests can be performed in the field, but some sample preparation such as extraction is often necessary. Most confirmatory tests must be done in the laboratory. The main problem with these tests is the destruction of the sample. The forensic science community is in great need of a reliable, non-destructive, on-field method for identification of all common body fluids.

Raman spectroscopy is a technique that is increasing in popularity among the different disciplines of forensic science. Some examples of its use today involve the identification of drugs, lipsticks, and fibers, as well as paint and ink analysis. The theory behind Raman spectroscopy is based on the inelastic scattering of low-intensity, non-destructive laser light by a solid, liquid, or gas sample. Very little or no sample preparation is needed, and the required amount of material tested with a Raman microscope can be as low as several picograms or femtoliters. A typical Raman spectrum consists of several narrow bands and provides a unique vibrational signature of the material. Typically, non-resonance Raman spectroscopic measurements do not damage the sample. The stain could be tested in the field and still be available for further use in the laboratory for DNA analysis. A portable Raman spectrometer is a reality now that should allow for use at the crime scene.

Reported here is the latest development of a new method for identification of body fluid traces using Raman spectroscopy combined with advanced statistics. Multidimensional Raman spectroscopic signatures of dry traces of sweat and vaginal fluid were developed in addition to the signatures of semen, saliva, and blood reported earlier.[2-4] Combined software was developed for the identification of all major body fluids and the evaluation of the accuracy and reliability of the conclusions made. The method was expanded for the application to blood and semen samples contaminated heavily with sand, dust, and soil.[5] The ability of the method to detect and identify small amounts of semen and blood in their mixed samples will be reported.[6] Potential interferences from common substrates will be discussed.

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