A94 Application of Raman Spectroscopy to the Forensic Analysis of Drugs, Controlled Substances, and Fibers

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After attending this presentation, attendees will learn of the application of Raman microscopy to drugs and fiber analysis.

This presentation will impact the forensic science community by providing methodology and technical details of using micro-Raman analysis of drugs, controlled substances, and fibers.

Raman spectroscopy and infrared spectroscopy are complementary techniques often used for the identification of compounds. Raman spectroscopy; however, offers several advantages over infrared spectroscopy. Raman spectroscopy is a light-scattering technique whereby light from a laser interacts with a sample producing scattered light of different wavelengths. The scattered light which is specific to a particular compound is funneled to a detector enabling chemical identification.

Raman analysis has been recognized to have potential for solving a wide variety of problems associated with forensic science. Early motivation was to identify substances/contaminants that appeared in crime scene evidence and manufactured products; however, it was quickly applied to all types of materials analysis.

Raman spectroscopy is very applicable in the field of forensic science. It uses a technique that offers a non-destructive and non-contact method of analysis. Only a small amount of sample is required and little or no sample preparation is necessary. It allows for trace analysis, and sampling can be done directly through transparent evidence bags and packaging such as glass and plastics. It covers a wide spectral range, from $1000cm^{-1}$ to $4000cm^{-1}$ making the technique ideal for the identification of both organic and inorganic substances, which includes drugs, pharmaceuticals, explosives, fibres, inks, paint, etc. Bulk analysis and screening of opaque materials such as powders is also possible. Raman spectroscopy also allows for the identification of the components of non-homogeneous samples and automated high-definition Raman mapped images can be obtained.

The purpose of this paper is to demonstrate some of the forensic applications of Raman spectroscopy. In particular, the capability of Raman spectroscopy to differentiate between drugs of similar structure will be demonstrated. That is, Raman spectroscopy has the capability of detecting even slight differences in the chemical composition of a drug and, therefore, plays a vital role in helping to determine when drugs have been illegally manufactured. In order to illustrate the abovementioned, spectra of the two main forms of cocaine (hydrochloride and base) will be highlighted in this paper as well as the ability to identify drugs in plastic bags/containers.

In an effort to aid law enforcement personnel and the public at large, investigations have been geared toward the ability of Raman spectroscopy to identify a variety of polymers used in fibers. This is very important as the presence of fibers at a crime scene has often been instrumental in the process of solving crime. “Fingerprints” of nylon 6, Kevlar, poly-styrene, PET, poly-propylene, and some others, along with different types of nylon (nylon 6, nylon 66, nylon 12, and others) will be presented.

Data will be collected using both a 633nm and a 785nm lasers. Comparison of the drugs and fibers will be done using similar wavelength lasers.

Raman spectra will be presented and method development including statistical analysis will be described. It will be shown that a search can provide quick identification of materials whose spectra have been collected in a library, or just matched to suspect material samples.

Drugs, Fibers, Raman