



B&W Tek Raman Solution Suite for Forensics Applications

Introduction

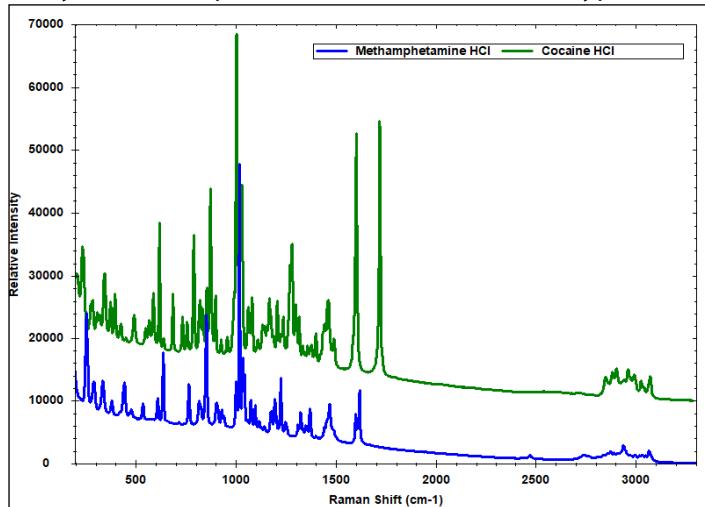
Law enforcement personnel, laboratory technicians, crime scene investigators and many others face a significant challenge for identification of materials in a forensic investigation. During an investigation, technicians must routinely examine materials such as gun powder residue, drugs of abuse, hair sampling, chemical precursors and more. Traditionally, technicians used multiple forms of identification in order to collect results from various forms of forensic samples. Although certain technologies are ideal for precise laboratory identification, many technologies, such as Raman spectroscopy, can be successfully used for identification of multiple forensic sample types either directly in the field or in the lab. Raman spectroscopy is classified as a Category A analytical method by the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG; Version 7.1, 2016).



Raman Spectroscopy Overview

Raman spectroscopy is a well-established, highly sensitive analytical technique that can be used to analyze solids, liquids, and slurries. Raman is a type of vibrational spectroscopy, a technique that is

sensitive to the vibrations of atoms in molecules which can be used for identification of a compound. Infrared (IR) spectroscopy is another vibrational spectroscopy technique. Both Raman and IR have been used in forensic laboratories for decades due to their high specificity and low false alarm rates. Raman spectroscopy is specific to the chemical structure of a material and can consequently be used to nondestructively identify a sample, providing a significant





advantage compared to other methods. Organically-based chemical compounds, such as drugs of abuse, have molecules that vibrate at discrete frequencies. The number and frequency of these vibrations depend primarily on the number of atoms in the chemical compound and how these atoms are connected via specific chemical bonds. Since the types of atoms, the number of each type of atom, and the connectivity between the atoms differ between chemical compounds (such as cocaine versus methamphetamine as shown in the plot above), the vibrational frequencies will be different. Raman spectroscopy utilizes this difference in each compound's vibrational frequencies to differentiate compounds. A Raman spectrum acts as a graphical representation of the vibrational frequencies observed from a measurement.

Raman spectrometers operate with a laser incident on a sample to generate the spectrum of the scattered Raman signal. The most widely used laser for Raman is the 785 nm excitation system as it offers the best balance of signal strength, sensitivity to fluorescence, cost and overall performance, and can be used for to collect the Raman spectrum of most organic materials quickly. When samples are dark or highly colored, a longer excitation wavelength of 1064 nm is beneficial for identification by Raman spectroscopy.

Handheld and portable Raman spectrometers provide analysis options for field testing and rapid screening, and for more extensive testing and analysis in a controlled laboratory environment. Systems with different laser excitation are available so that a system best-suited to analyze many samples can be selected.

TacticID® Handheld Raman System

Ideal for bulk sampling of narcotics, pharmaceutical drugs, explosives, hazardous materials, cutting agent, precursors and more

The TacticID is a handheld, field-based sample identification system that rapidly identifies numerous narcotics, explosives, and more in mere seconds per test.



Leveraging Raman spectroscopy, the TacticID provides the high chemical specificity of Raman along with non-destructive and non-contact analysis. This minimizes exposure of law enforcement officers to unknown materials while maintaining the original state of the evidence. Most narcotic samples can be quickly identified in their original packaging by simply pressing the sample within a container, such as a plastic bag, against the sampling tip of the analyzer and pressing the scan button.

The TacticID provides a clear, definitive result, with no user interpretation required. All scans are time and date stamped and stored automatically in the analyzer. Many samples are not a single pure



substance, and with the mixture analysis function of the TacticID, the major components of the mixture can be identified. The intuitive user interface allows the unit to easily transfer data from the handheld unit to a computer for automated, secure data storage and reporting. The analyzer includes a diagnostic self-check system to verify that the instrument is working properly at the time of use and can support chain of custody for prosecution with permanent, printable records.

For detection of low levels of a substance in a sample, surface-enhanced Raman spectroscopy (SERS) is used to enhance the signal of the material of interest so that it can be detected. This requires a minimal sample preparation to dissolve the sample in solvent and then apply it to the SERS substrate. The SERS sample can be measured directly with the TacticID with the specialized TacPac™ adaptor. The identity of low levels of substances with SERS such as controlled substances, or active ingredients in pharmaceutical drugs is a valuable tool to detect counterfeits.

i-Raman® EX 1064nm Fiber Optic Portable Raman System



Ideal for forensic analysis, bioscience/biomedical diagnostics, pharmaceutical material analysis, explosive detection, petroleum analysis, food/agriculture and more

The i-Raman EX portable Raman system is ideal for forensic analysis, including narcotics, pharmaceutical material analysis, biological samples and natural products, especially those that may be dark or colored.

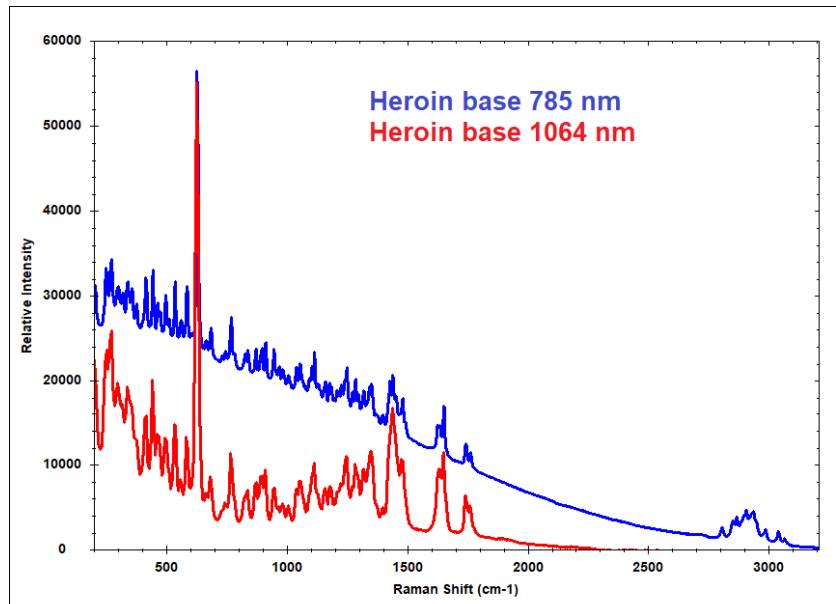
The i-Raman EX uses a 1064nm excitation laser and a high sensitivity InGaAs array detector with deep TE cooling and high dynamic range. It has high signal-to-noise ratio without inducing auto-fluorescence. The user has full flexibility in setting all the measurement parameters, and can use data for identification against a library or developing quantitative analysis methods. The fiber-optically coupled system can be used for measurement of solids, liquids, fibers, and slurries. The i-Raman EX gives high precision qualitative and quantitative forensic solutions.

For micro sampling and precision of testing on a specific part of a sample, the i-Raman EX can also be coupled with a Raman video microscope. The microscope accessory is designed to offer the highest level of flexibility in facilitating Raman sampling for forensic applications. The microscope and integrated camera allow for precision Raman sampling through camera monitoring of the laser beam and imaging details. When coupled with the i-Raman EX, it provides the advantages of a Raman microscope at a fraction of the cost of most research instruments.





i-Raman EX and TacticID-1064 for Heroin Identification



Heroin is a major drug of concern in nearly every part of the world and is gaining in popularity among various social classes. While the most commonly used laser wavelength in Raman instruments is 785nm, it is often unable to identify common street heroin and other dark samples due to the natural high fluorescence and impurity from excessive material cutting. Using the

longer 1064nm wavelength, the i-Raman EX is not limited by the fluorescence issue generally associated with heroin identification using Raman spectroscopy with 785 nm laser excitation. The i-Raman EX and TacticID-1064 are ideal for highly accurate, specific identification of heroin and other street samples,

Conclusion

B&W Tek offers a full solution for identification of a wide variety of substances commonly found during forensic investigations. Utilizing this forensic suite, users can perform laboratory-proven forensic identification anywhere they need to, resulting in increased productivity without compromising the quality of the techniques or the equipment. Handheld TacticID models for the majority of samples using 785 nm, and for more challenging fluorescing samples with 1064 nm are available. For detection of low levels of samples, the TacPac using SERS technology gives the increased sensitivity for identification. Portable i-Raman EX with a microscope accessory provides research quality Raman spectroscopy in a compact design. Previously, Raman spectrometers of this caliber were typically confined to large form factors within laboratories. Today B&W Tek's TacticID and i-Raman series systems provide equally clear results in the field or in the lab in a lightweight, easy to use form factor. For thermally sensitive samples to be measured please check with the factory for our STRaman™ technology solutions for handheld and/or portable systems.



Additional Resources:

[TacticID-GP datasheet](#)

[TacticID-1064 datasheet](#)

[i-Raman EX datasheet](#)

Further Reading:

[Fundamentals of Raman Spectroscopy](#)

[B&W Tek TacticID for Narcotics Identification](#)

[Choosing the Most Suitable Laser Wavelength For Your Raman Application](#)

[Portable Raman Spectroscopy in Forensics: Explosive Residues and Inflammable Liquids](#)

[Rapid Detection of the Low Dose API in Xanax Using Surface-Enhanced Raman Spectroscopy for Anti-Counterfeiting Purposes](#)

If you have any questions about the application or would like to know how Raman would work for your application, please contact us at appnote@bwtek.com or call us at +1 (855) 297-2626 to speak with an expert.